The Electromagnetic Radiation Spectrum

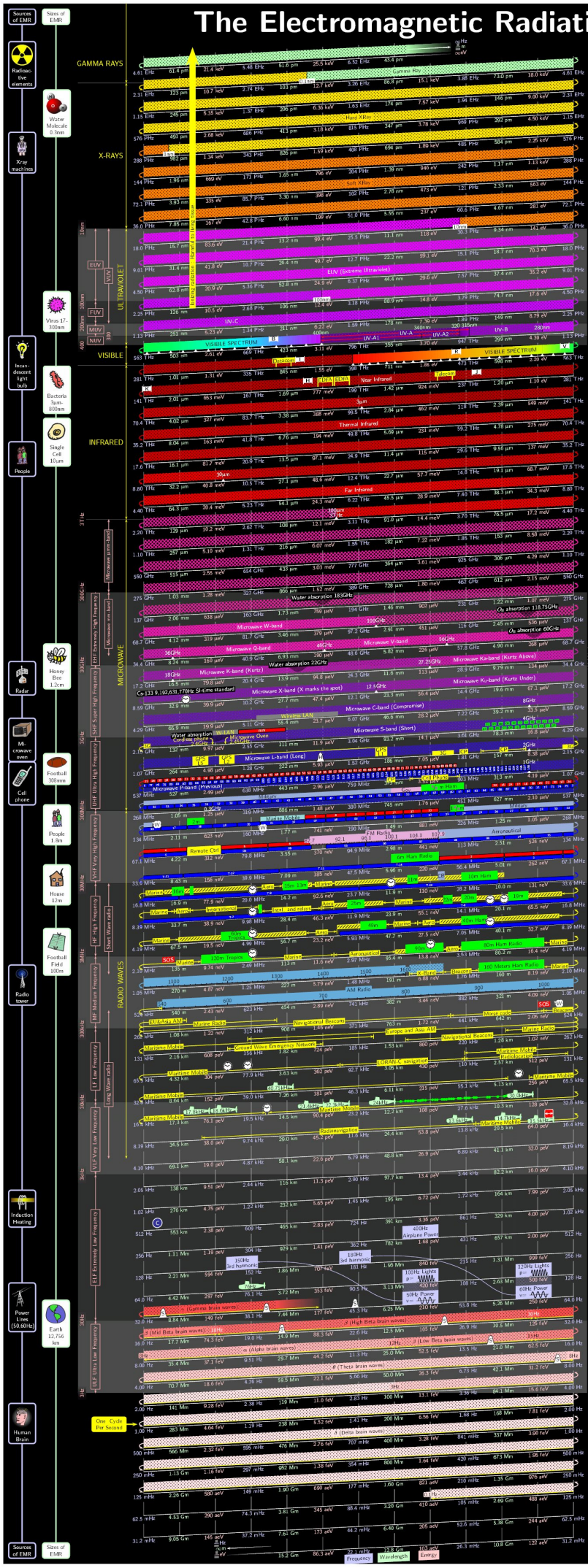

How to read this chart

- This chart is organized in octaves (frequency doubling/halving) starting at 1Hz and going higher (2,4,8, etc) and lower (1/2, 1/4, etc). The octave is a natural way to represent frequency.
- Frequency increases on the vertical scale in the upward direction.
- The horizontal bars wrap around from far right to far left as the frequency increases upwards.
- There is no limit to either end of this chart, however, due to limited space, only the "known" items have been shown here. A frequency of 0Hz is the lowest possible frequency but the method of depicting waves used here does not allow for ever reaching 0Hz, only approaching it. Also, by the definition of frequency (Cycles per second), there is no such thing as negative frequency.
- Values on the chart have been labeled with the following colours: Frequency measured in Hertz, Wavelength measured in meters, Energy measured in electronVolts.

Ultraviolet Light

- Ultraviolet light is beyond the range of human vision.
- Physicists have divided ultraviolet light ranges into Vacuum Ultraviolet (VUV), Extreme Ultraviolet (EUV), Far Ultraviolet (FUV), Medium Ultraviolet (MUV), and Near Ultraviolet (NUV).
- UV-A, UV-B and UV-C were introduced in the 1930's by the Commission Internationale de l'Eclairage (CIE, International Commission on Illumination) for photobiological spectral bands.
- Short-term UV-A exposure causes sun-tanning which helps to protect against sunburn. Exposure to UV-B is beneficial to humans by helping the skin produce vitamin D. Excessive UV exposure causes skin damage. UV-C is harmful to humans but is used as a germicide.
- The CIE originally divided UVA and UVB at 315nm, later some photo-dermatologists divided it at 320nm.
- UVA is subdivided into UVA1 and UVA2 for DNA altering effects at 340nm.
- The sun produces a wide range of frequencies including all the ultraviolet light, however, UVB is partially filtered by the ozone layer and UVC is totally filtered out by the earth's atmosphere.
- A bumblebee can see light in the UVA range which helps them identify certain flowers.

Emission and Absorption

- As EMR passes through elements, certain wavelength bands get absorbed and some new ones get emitted. This absorption and emission produces characteristic spectral lines for each element which are useful in determining the makeup of distant stars. These lines are used to prove the red-shift amount of distant stars.
- When a photon hits an atom it may be absorbed if the energy is just right. The energy level of the electron is raised – essentially holding the radiation. A new photon of specific wavelength is created when the energy is released. The jump in energy is a discrete step and many possible levels of energy exist in an atom.
- Johann Balmer created this formula defining the photon emission wavelength (λ): where m is the initial electron energy level and n is the final electron energy level:

$$\lambda = 364.56\mathrm{nm}\left(\frac{m^2}{m^2-n^2}\right)$$

- Much of the interstellar matter is made of the simplest atom hydrogen. The hydrogen visible-spectrum emission and absorption lines are shown below:

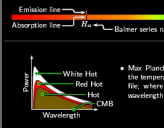

- Max Planck determined the relationship between the temperature of an object and its radiation profile, where B_λ is the radiation power, λ is the wavelength, T is the temperature:

$$B_\lambda = \frac{37418}{\lambda^5\left(e^{\frac{14388}{\lambda T}}-1\right)}$$

Cosmic Microwave Background Radiation

- CMB radiation is the leftover heat from the hot early universe, which last scattered about 400,000 years after the Big Bang.
- CMB permeates the entire universe at a temperature of 2.725 ± 0.001K.
- CMB was predicted in the 1940's by Ralph Alpher, George Gamow and Robert Herman.
- Arno Penzias and Robert Wilson accidentally discovered CMB while working for Bell Telephone Laboratories in 1965.
- The intensity is measured in Mega Jansky (Jy) per steradian. $1Jy = 10^{-26}W/m^2/Hz$

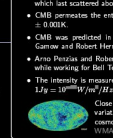

Close examination of slight CMB intensity variations in different parts of the sky help cosmologists study the formation of galaxies. WMAP photo by NASA

Television

- Television is transmitted in the VHF and UHF ranges (30MHz - 3GHz).
- TV channels transmitted over the air are shown as TV.
- TV channels transmitted through cable (CATV) are shown as TV. CATV channels starting with "T-" are channels fed back to the cable TV station (like news feeds).
- Air and cable TV stations are broadcast with the separate video, colour, and audio frequency carriers grouped together in a channel band as follows:

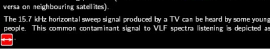

- Satellite channels broadcast in the C-Band are depicted as TV. These stations are broadcast in alternating polarities (Ex. Ch 1 is vertical and 2 is horizontal and vice versa on neighbouring satellites)
- The 15.7 kHz horizontal sweep signal produced by a TV can be heard by some young people. This common contaminant signal to VLF spectra listening is depicted as

Radio Bands

- The radio spectrum (ELF to EHF) is populated by many more items than can be shown on this chart, only a small sampling of bands used around the world have been shown.
- Communication using EMR is done using either:
  - Amplitude Modulation (AM)

    OR
  - Frequency Modulation (FM)

- Each country has its own rules and regulations for allotting bands in this region. For more information, look up the radio communications authority in your area (Ex. FCC in the US, DOC in Canada).
- Not all references agree on the ULF band range, the HAARP range is used here.
- RAdio Detecting And Ranging (RADAR) uses EMR in the microwave range to detect the distance and speed of objects.
- Citizens Band Radio (CB) contains 40 stations between 26.965-27.405MHz.
- Schumann resonance is produced in the cavity between the Earth and the ionosphere. The resonant peaks are depicted as
- Hydrogen gas emits radio band EMR at 21cm
- Some individual frequencies are represented as icons:
  - Submarine communications
  - Time and frequency standards
  - Ham radio and international meteor bands
  - Miscellaneous short wave radio
  - Weather stations
  - Cellular and PCS Phones (including; FDMA, TDMA, CDMA ranges)

Sound

- Although sound, ocean waves, and heartbeats are not electromagnetic, they are included on this chart as a frequency reference. Other properties of electromagnetic waves are different from sound waves.
- Sound waves are caused by an oscillating compression of molecules. Sound cannot travel in a vacuum such as outer space.
- The speed of sound in air is 1240kph (770mph).
- Humans can only hear sound between ≈20Hz to ≈20kHz.
- Infrasound (below 20Hz) can be sensed by internal organs and touch. Frequencies in the 0.2Hz range are often the cause of motion sickness.
- Bats can hear sound up to ≈50kHz.
- The 88 piano keys of the Equal Temperament scale are accurately located on the frequency chart.
- Over the ages people have striven to divide the continuous audio frequency spectrum into individual musical notes that have harmonious relationships. Microtonal musicians study various scales. One recent count lists 4700 different musical scales.
- Middle C is depicted on the chart as C

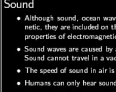

This image depicts air being compressed as sound waves in a tube from a speaker and then travelling through the tube towards the ear.

Gravity Waves

- Gravity is the mysterious force that holds large objects together and binds our planets, stars and galaxies together. Many people have unsuccessfully theorized about the details of gravity and its relationship to other forces. There have been no links between gravity waves and electromagnetic radiation.
- Gravity is theorized to warp space and time. In fact, gravity is responsible for bending light as observed by the gravity-lens example of distant galaxies.
- "Gravity waves" would appear as ripples in space-time formed by large objects moving through space that might possibly be detected in the future by very sensitive instruments.
- The speed that gravity propagates through space has been theorized to be the same as the speed of light.

Brain Waves

- By connecting electrodes from the human head to an electroencephalograph (EEG), it is possible to measure very small cyclic electrical signals.
- There has been much study on this topic, but like all effects on humans, the science is not as exact as the science of materials.
- Generally, lower brain wave frequencies relate to sleep, and the higher frequencies relate to alertness.
- Devices have been made for measuring and stimulating brain waves to achieve a desired state.

Electromagnetic Radiation (EMR)

- EMR is emitted in discrete units called photons but has properties of waves as seen by the images below. EMR can be created by the oscillation or acceleration of electrical charge or magnetic field. EMR travels through space at the speed of light (2.997 924 58 $\times 10^8$ m/s). EMR consists of an oscillating electrical and magnetic field which are at right angles to eachother and spaced at a particular wavelength. There is some controversy about the phase relationship between the electrical and magnetic fields of EMR, one of the theoretical representations is shown here:

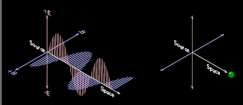

E = Electric Field Strength
B = Magnetic Field Strength
Wave Nature
Particle Nature

- The particle nature of EMR is exhibited when a solar cell emits individual electrons when struck with very dim light.
- The wave nature of EMR is demonstrated by the famous double slit experiment that shows cancelling and addition of waves.
- Much of the EMR properties are based on theories since we can only see the effects of EMR and not the actual photon or wave itself.
- Albert Einstein theorized that the speed of light is the fastest that anything can travel. So far he has not been proven wrong.
- EMR can have its wavelength changed if the source is receding or approaching as in the red-shift example of distant galaxies and stars that are moving away from us at very high speeds. The emitted spectral light from these receding bodies appears more red than it would be if the object was not moving away from us.
- We only have full electronic control over frequencies in the microwave range and lower. Higher frequencies must be created by waiting for the energy to be released from elements as photons. We can either pump energy into the elements (ex. heating a rock with visible EMR and letting it release infrared EMR) or let it naturally escape (ex. uranium decay).
- We can only see the visible spectrum. All other bands of the spectrum are depicted as hatched colours

System International d'unité prefixes (SI unit prefixes)			
Symbol	Name	Exp.	Multiplier
Y	yotta	10^{24}	1,000,000,000,000,000,000,000,000
Z	zetta	10^{21}	1,000,000,000,000,000,000,000
E	exa	10^{18}	1,000,000,000,000,000,000
P	peta	10^{15}	1,000,000,000,000,000
T	tera	10^{12}	1,000,000,000,000
G	giga	10^{9}	1,000,000,000
M	mega	10^{6}	1,000,000
k	kilo	10^{3}	1,000
		10^{0}	1
m	milli	10^{-3}	0.001
μ	micro	10^{-6}	0.000 001
n	nano	10^{-9}	0.000 000 001
p	pico	10^{-12}	0.000 000 000 001
f	femto	10^{-15}	0.000 000 000 000 001
a	atto	10^{-18}	0.000 000 000 000 000 001
z	zepto	10^{-21}	0.000 000 000 000 000 000 001
y	yocto	10^{-24}	0.000 000 000 000 000 000 000 001

Measurements on this chart		
Symbol	Name	Value
c	Speed of Light	$2.997\,924\,58 \times 10^8$ m/s
h	Planck's Constant	$6.626\,1 \times 10^{-34}$ J·s
$\hbar$	Planck's Constant (freq)	$1.054\,592 \times 10^{-34}$ J·s
f	Frequency (cycles / second)	Hz
λ	Wavelength (meters)	m
E	Energy (Joules)	J

Conversions

$E = h \cdot f$

$\lambda = \frac{c}{f}$

$1\mathring{A} = 0.1\mathrm{nm}$

$1\mathrm{nm} = 10\mathring{A}$

$1\mathrm{Joule} = 6.24 \times 10^{18}$ eV

Gamma Rays

- Gamma radiation is the highest energy radiation (up to ≈ 10^{20} eV) that has been measured. At this energy, the radiation could be from gamma-rays, protons, electrons, or something else.
- Alpha, beta, and delta radiation do not electromagnetic but are actually parts of the atom being released from a radioactive atom. In some cases this can cause gamma radiation. These are not to be confused with brain waves of similar names.

Visible Spectrum

- The range of EMR visible to humans is also called "Light". The visible spectrum also closely resembles the range of EMR that filters through our atmosphere from the sun.
- Other creatures see different ranges of visible light, for example bumble-bees can see ultraviolet light and dogs have a different response to colours than do humans.
- The sky is blue because our atmosphere scatters light and the shorter wavelength blue gets scattered the most. It appears that the entire sky is illuminated by a blue light but in fact that light is scattered from the sun. The longer wavelengths like red and orange move straight through the atmosphere which makes the sun look like a bright white ball containing all the colours of the visible spectrum.
- Interestingly, the visible spectrum covers approximately one octave.
- Astronomers use filters to capture specific wavelengths and reject unwanted wavelengths, the major astronomical (visual) filter bands are depicted as

Infrared Radiation

- Infrared radiation (IR) is sensed by humans as heat and is below the range of human vision. Humans (and anything at room temperature) are emitters of IR.
- IR remote control signals are invisible to the human eye but can be detected by most camcorders.
- Night vision scopes/goggles use a special camera that senses IR and converts the image to visible light. Some IR cameras employ an IR lamp to help illuminate the view.
- IR LASERs are used for burning objects.
- A demonstration of IR is to hold a metal bowl in front of your face. The IR emitted by your body will be reflected back using the parabolic shape of the bowl and you will feel the heat.
- Fiber-optic based infrared communication signals are sometimes amplified with Erbium-Doped Fiber Amplifiers

LASER

- LASER is an acronym for Light Amplification by Stimulated Emission of Radiation.
- A LASER is a device that produces monochromatic EMR of high intensity.
- With proper equipment, any EMR can be made to operate like a LASER. For example, microwaves are used to create a MASER.

Polarization

- As a photon (light particle) travels through space, its axis of electrical and magnetic fluctuations does not rotate. Therefore, each photon has a fixed linear polarity of somewhere between 0° to 360°. Light can also be circularly and elliptically polarized.
- Some crystals can cause the photon to rotate its polarization.
- Receivers that expect polarized photons will not accept photons that are in other polarities. (ex. satellite dish receivers have horizontal and vertical polarity positions).
- A polarized filter (like Polaroid™ sunglasses) can be used to demonstrate polarized light. One filter will only let photons that have one polarity through. Two overlapping filters at right angles will almost totally block the light that exits, however, a third filter inserted between the first two at a 45°angle will rotate the polarized light and allow some light to come out the end of all three filters.
- Light that reflects off an electrical insulator becomes polarized. Conductive reflectors do not polarize light.
- Perhaps the most reliably polarized light is a rainbow.
- Moonlight is also slightly polarized. You can test this by viewing the moonlight through a Polaroid™ sunglass lens, then rotate that lens, the moonlight will dim and brighten slightly.

Refraction

- Refraction of EMR is dependent on wavelength as can be seen by the prism example below.

By using a glass prism, white light can be spread by refraction into a spectrum of its composite colours. All wavelengths of EMR can be refracted by using the proper materials.

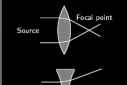

Convex lenses make objects appear closer and are used to correct far-sitedness.

Concave lenses make objects appear farther away and are used to correct near-sitedness.

Photo by STScI

Heavy objects like dense galaxies and large planets cause light to bend due to gravitational lensing.

Reflection

- Reflection of EMR is dependent on wavelength as demonstrated when visible light and radio waves bounce off objects that X-Rays would pass through. Microwaves, which have a large wavelength compared to visible light, will bounce off metal mesh in a microwave oven whereas visible light will pass through.

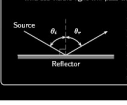

EMR of any wavelength can be reflected, however, the reflectivity of a material depends on many factors including the wavelength of the incident beam.

The angle of incidence (θ_i) and angle of reflection (θ_r) are the same.

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Min/Max:
Beeps when a new min/max observed while calculating running average
AC Voltage
Shift: Frequency Counter
DC Current
AC Current
Shift: Frequency Counter
Shift Key:
Use to access the yellow labeled features
Screen Backlight:
Auto-off in 40 sec.
DC Voltage
Millivolts for AC
Shift: Millivolts for DC
Ohmmeter Setting
Continuity Beeper
Diode Test
Shift: Capacitometer
Ammeter Terminal
Common Ground (COM)
Everything but Ammeter Terminal
FLUKE
115
600.0
HOLD
MIN/MAX
RANGE
OFF
COM
10 A FUSED
CAT III 600 V

electricity from radiowaves 3

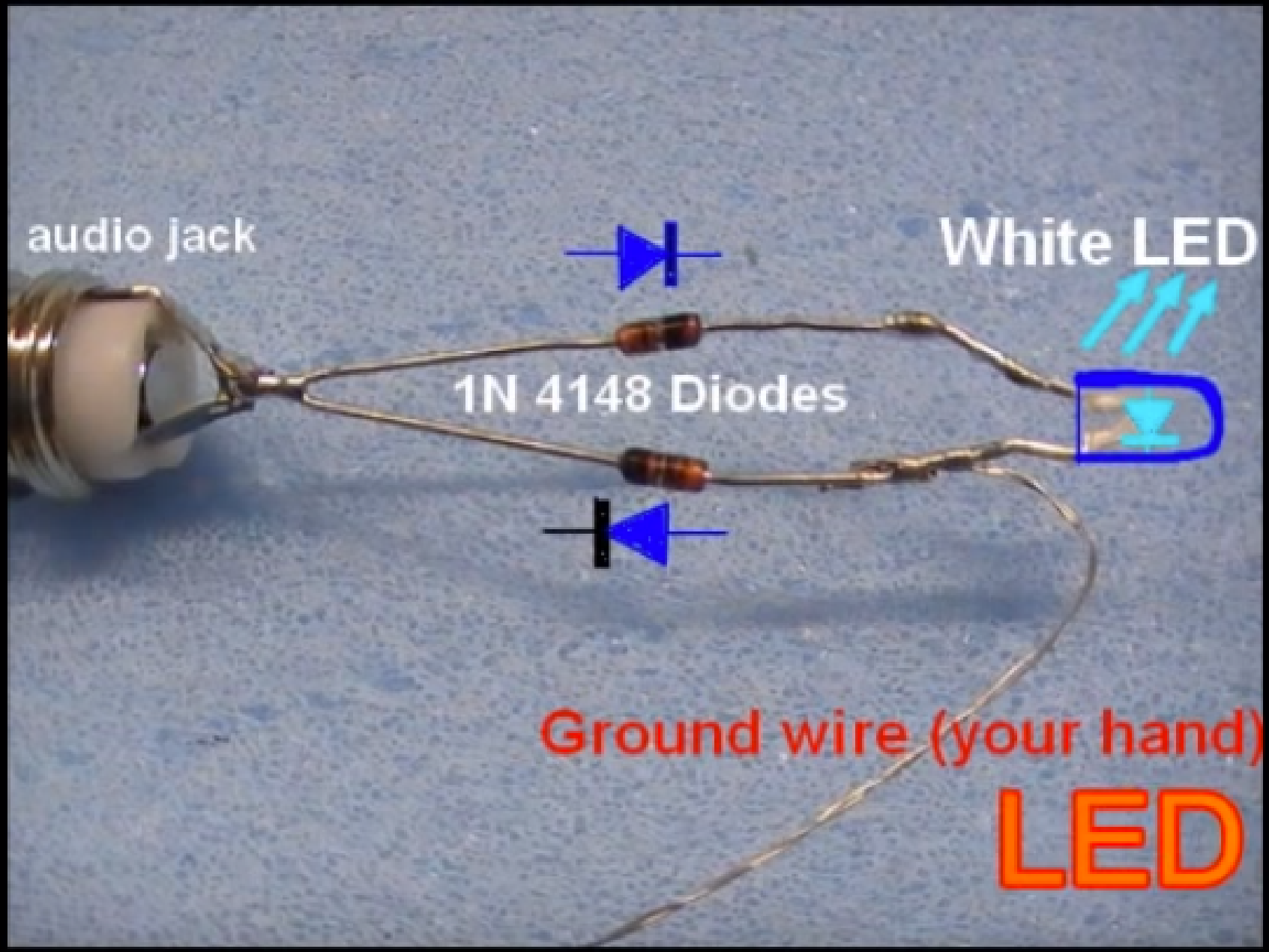

LED HF

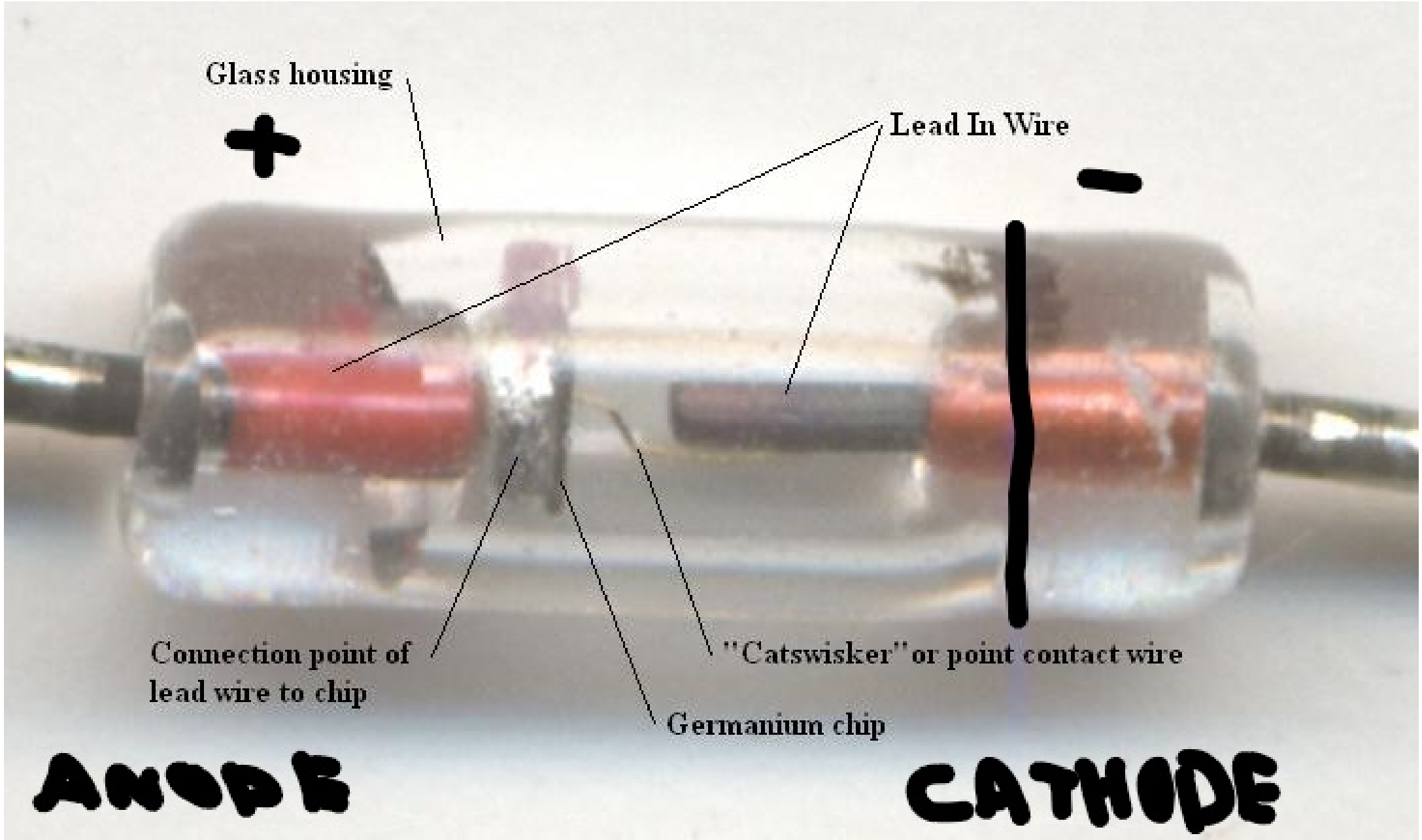
Glass housing
+
Lead In Wire
-
Connection point of
lead wire to chip
"Catswisker" or point contact wire
Germanium chip
ANODE
CATHODE

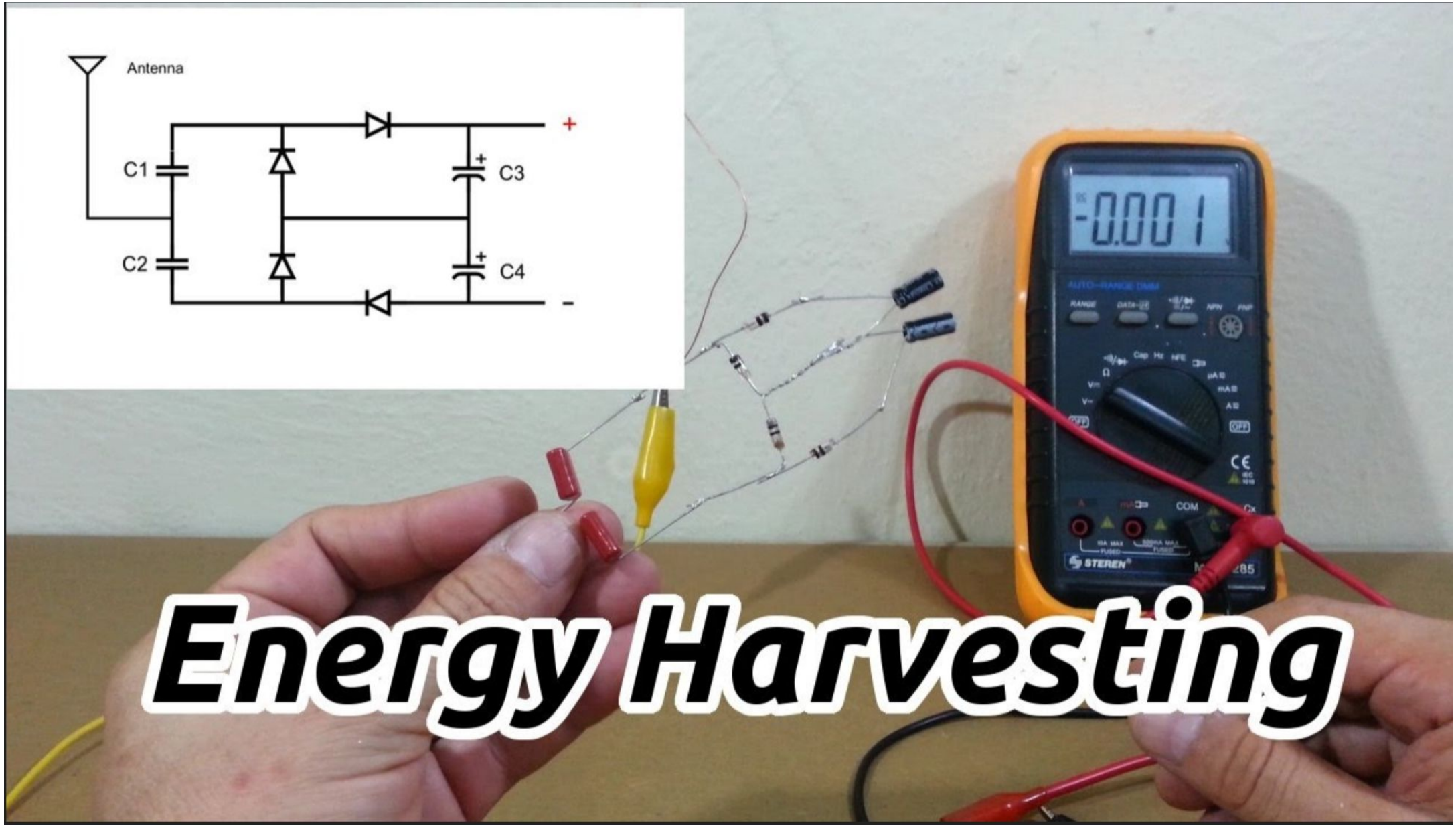
Antenna
C1
C2
C3
C4
+
-
-0.001
COM
STEREN
Energy Harvesting

feluri (fig. III.9), schemele fiind echivalente cu reprezentarea de bază din fig. III.8. Diodele sînt legate în serie, în formă de patrulater, două avînd comun anodul (punctul *2*), iar celelalte două catodul (punctul *4*). Tensiunea alternativă de intrare se aplică pe diagonala *1—3*, iar consumatorul se conectează pe diagonala *2—4*.

Pentru a urmări funcționarea punții, să presupunem că prima alternanță sosită în nodul *1* este pozitivă. Ea blochează dioda D_2 și o deschide pe D_1, debitînd prin R_S un curent I_1 (săgețile pline), care se întoarce la

tice sau cu parametri cît mai apro-

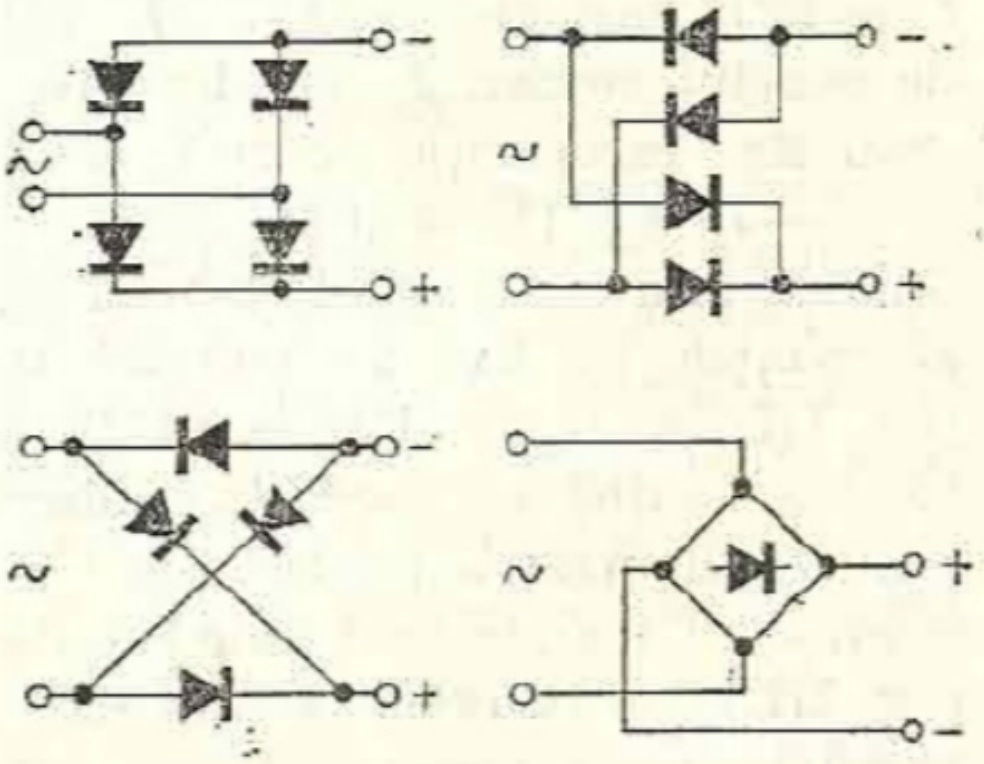

III.9. Puntea redresoare în diferite reprezentări.

circuits used on LC "RadioWaves"

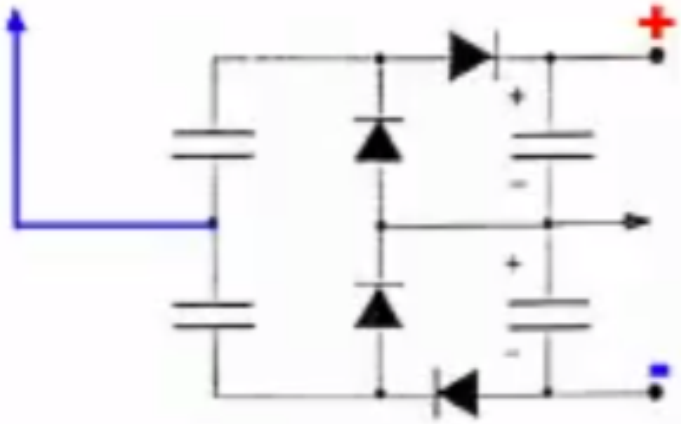

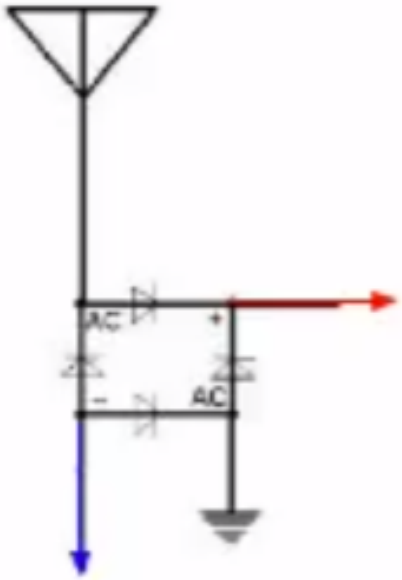

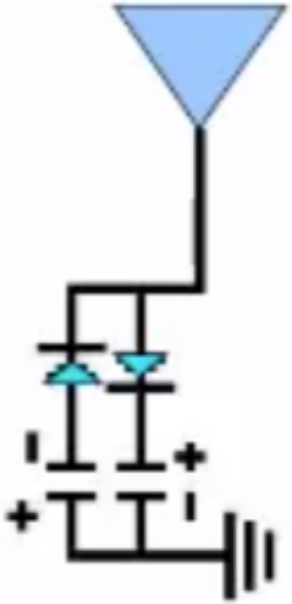

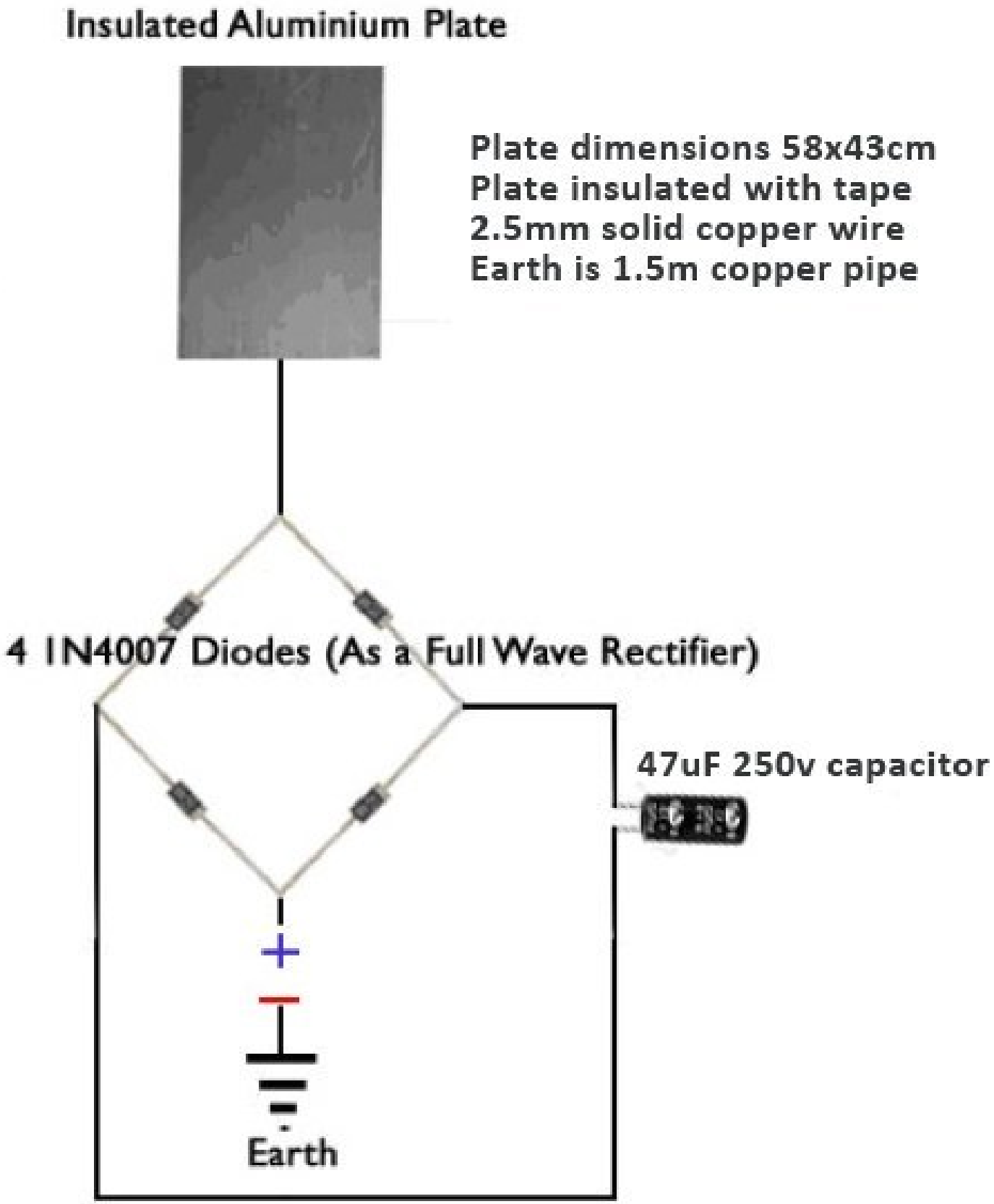
Insulated Aluminium Plate
Plate dimensions 58x43cm
Plate insulated with tape
2.5mm solid copper wire
Earth is 1.5m copper pipe
4 1N4007 Diodes (As a Full Wave Rectifier)
47uF 250v capacitor
+
-
Earth

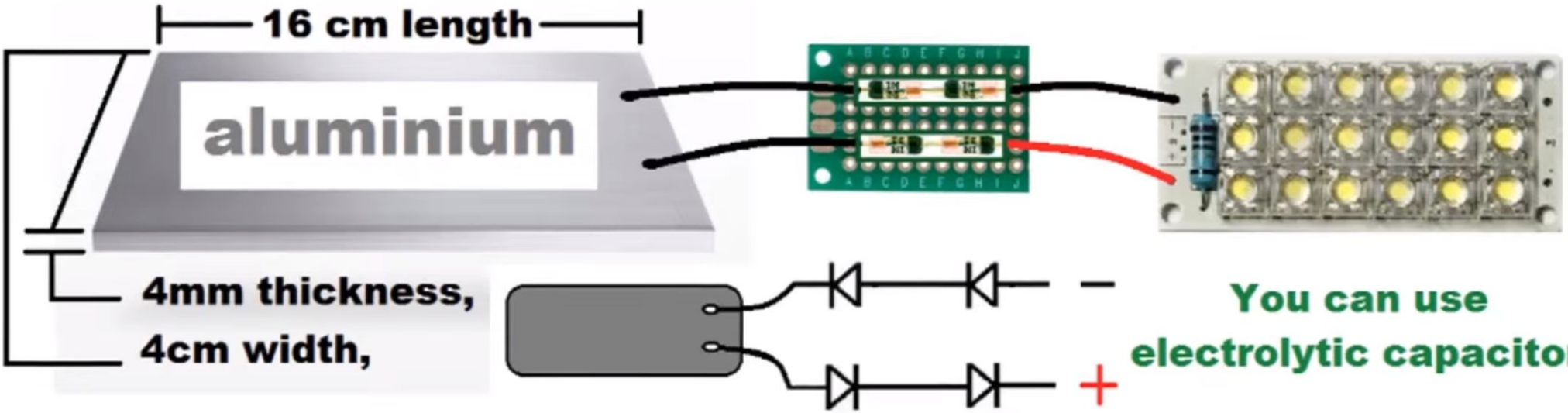

You can use electrolytic capacitor!

Germanium Diode

IN34 or IN34A

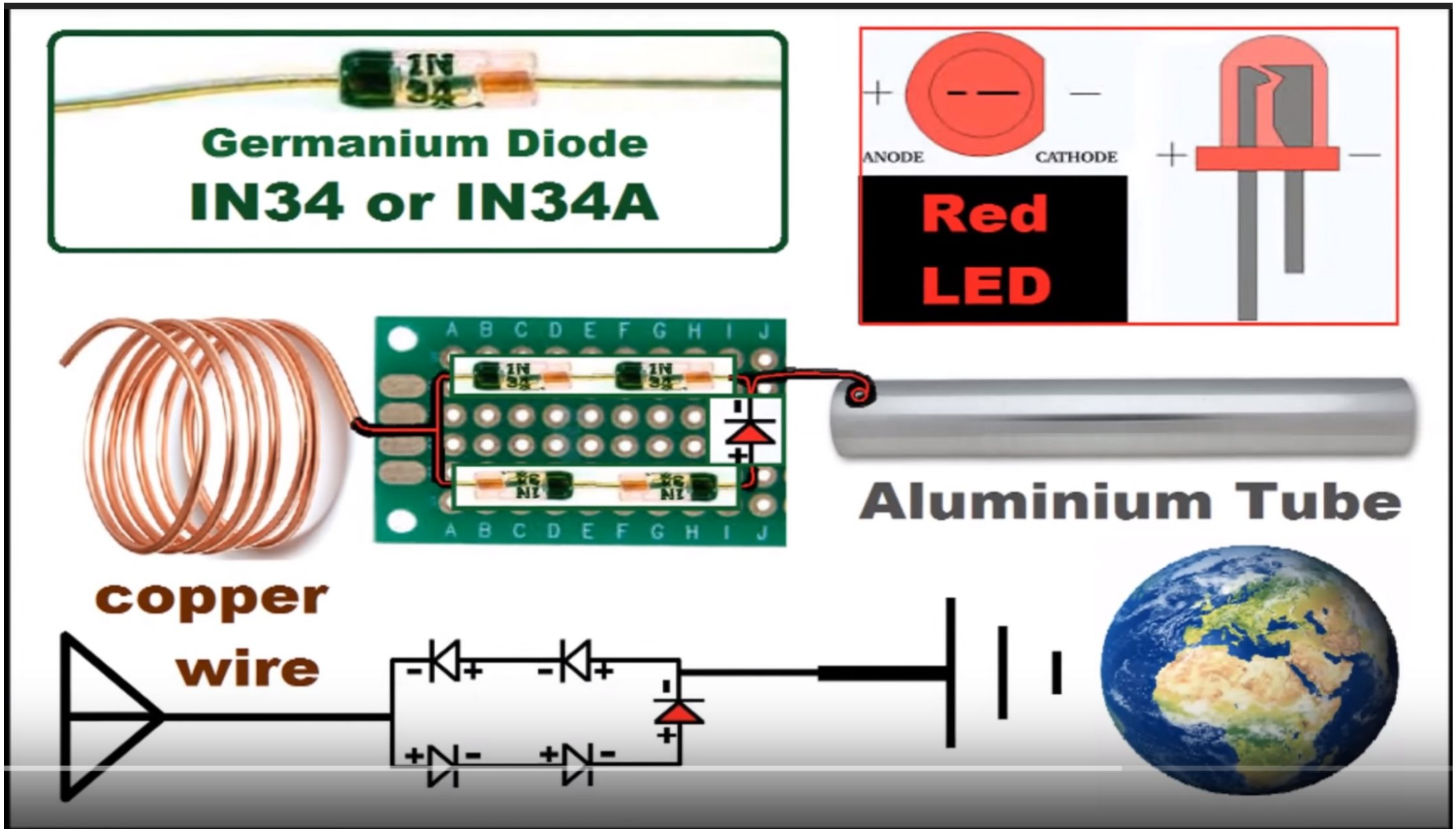
Germanium Diode
IN34 or IN34A
ANODE
CATHODE
Red
LED
Aluminium Tube
copper
wire

.01
10NF
.1
100NF

Ceramic Disc Capacitor

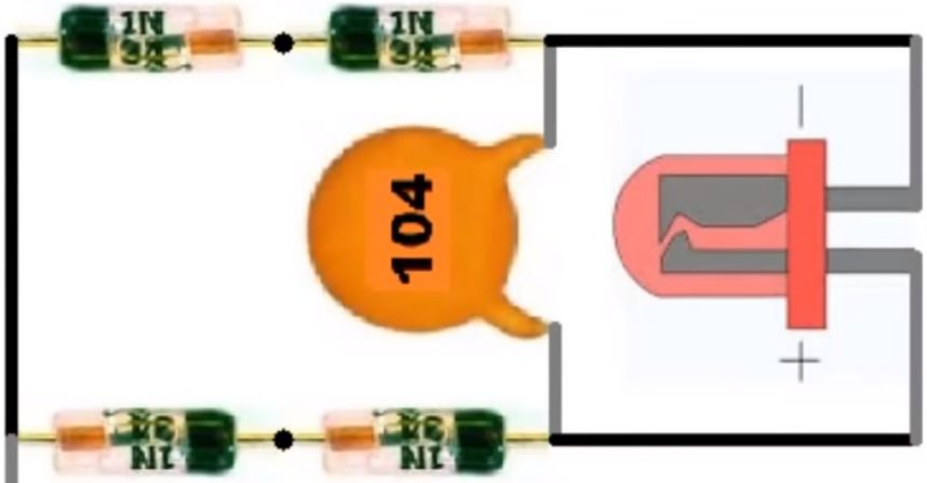

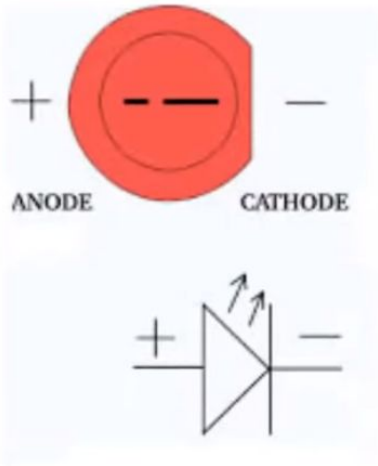

Germanium Diode

IN34 or IN34A

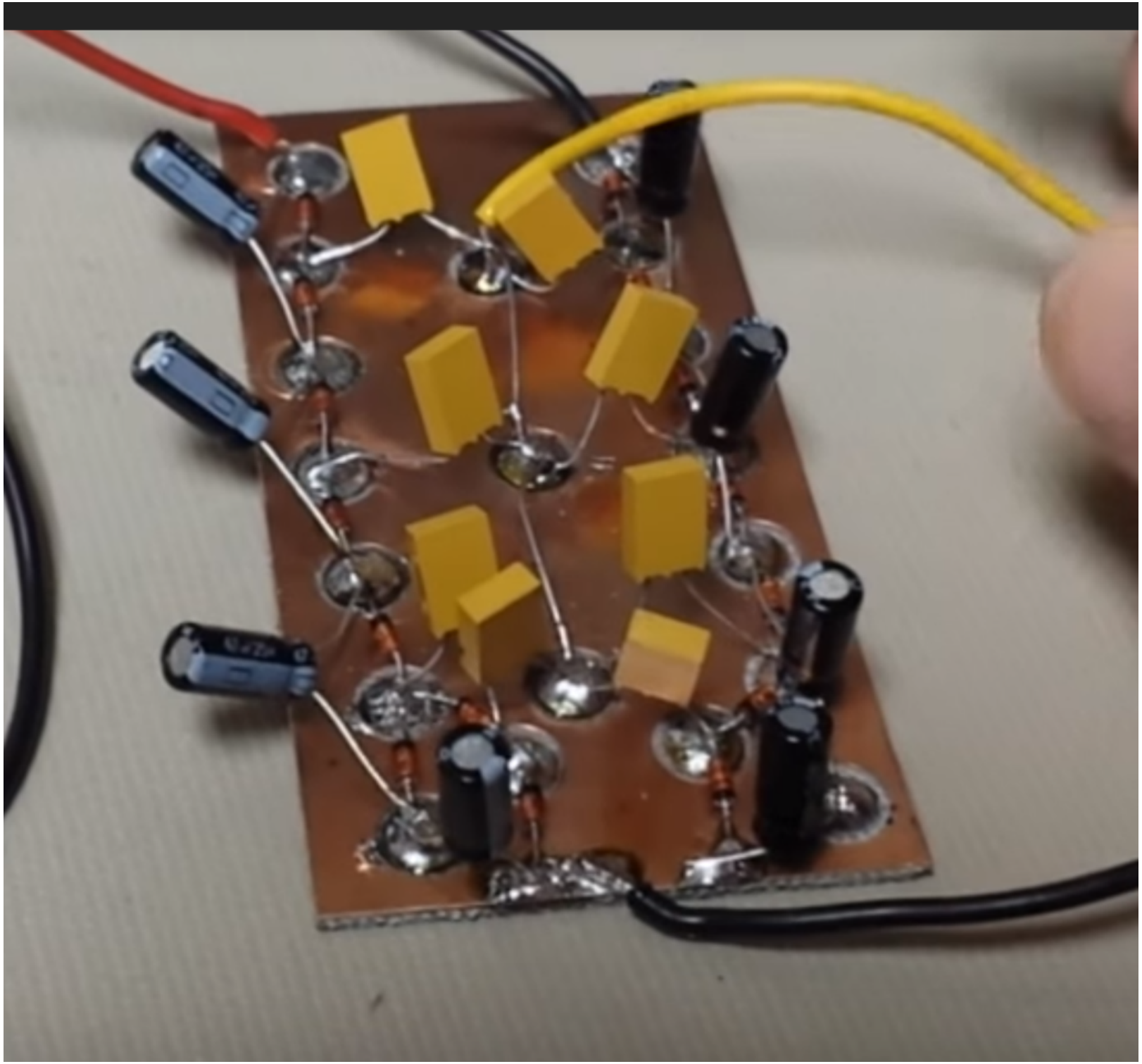

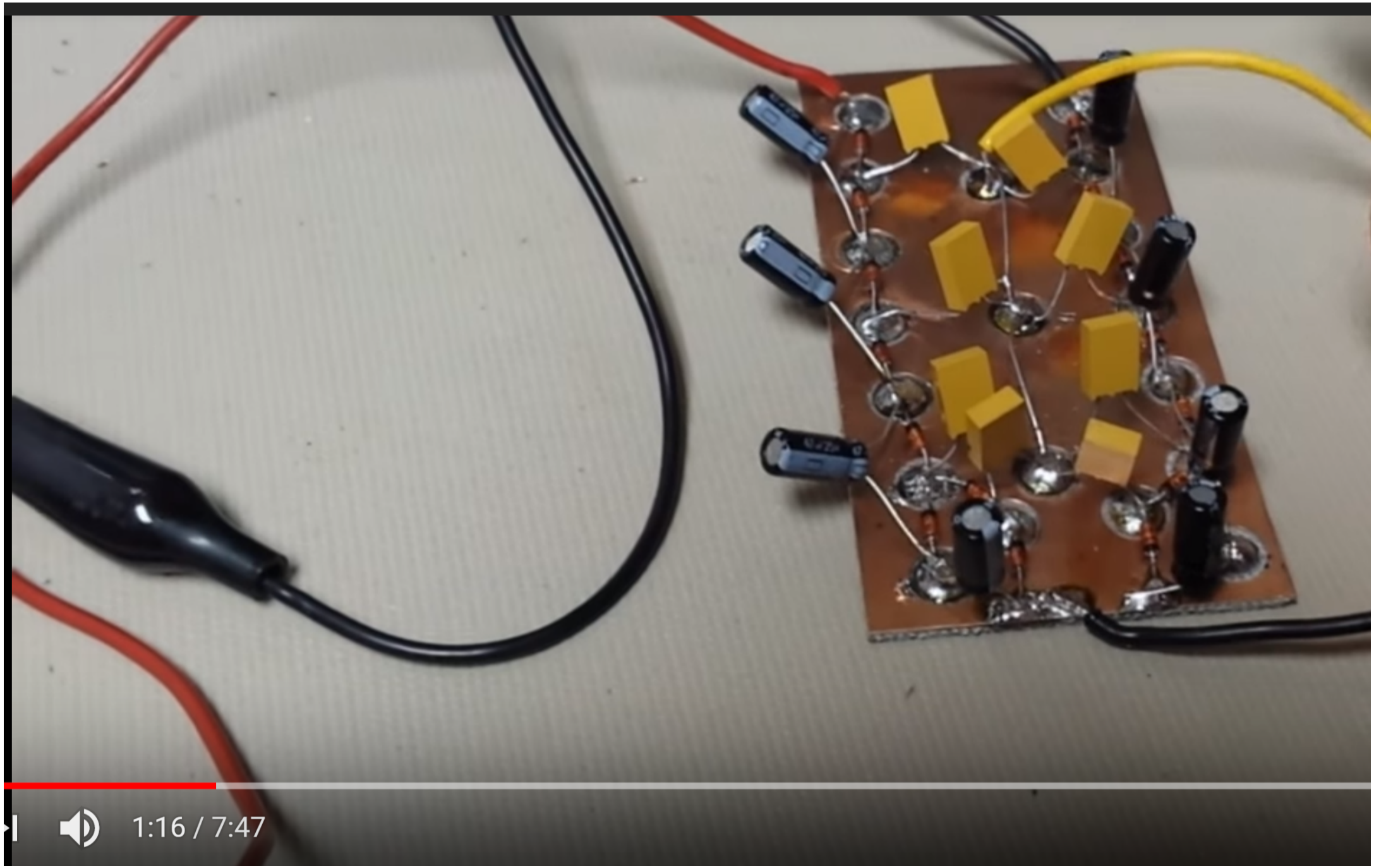
1:16 / 7:47

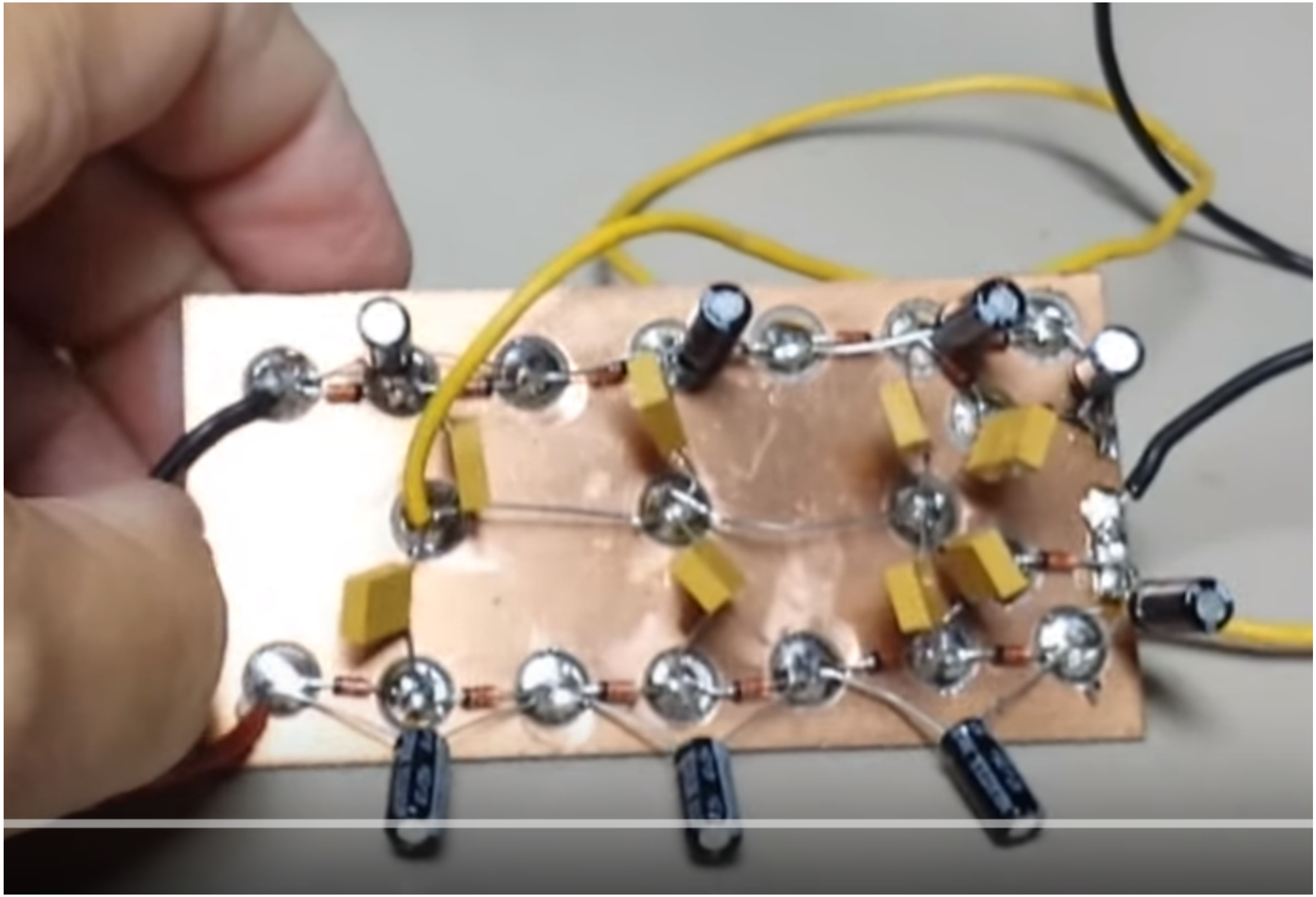

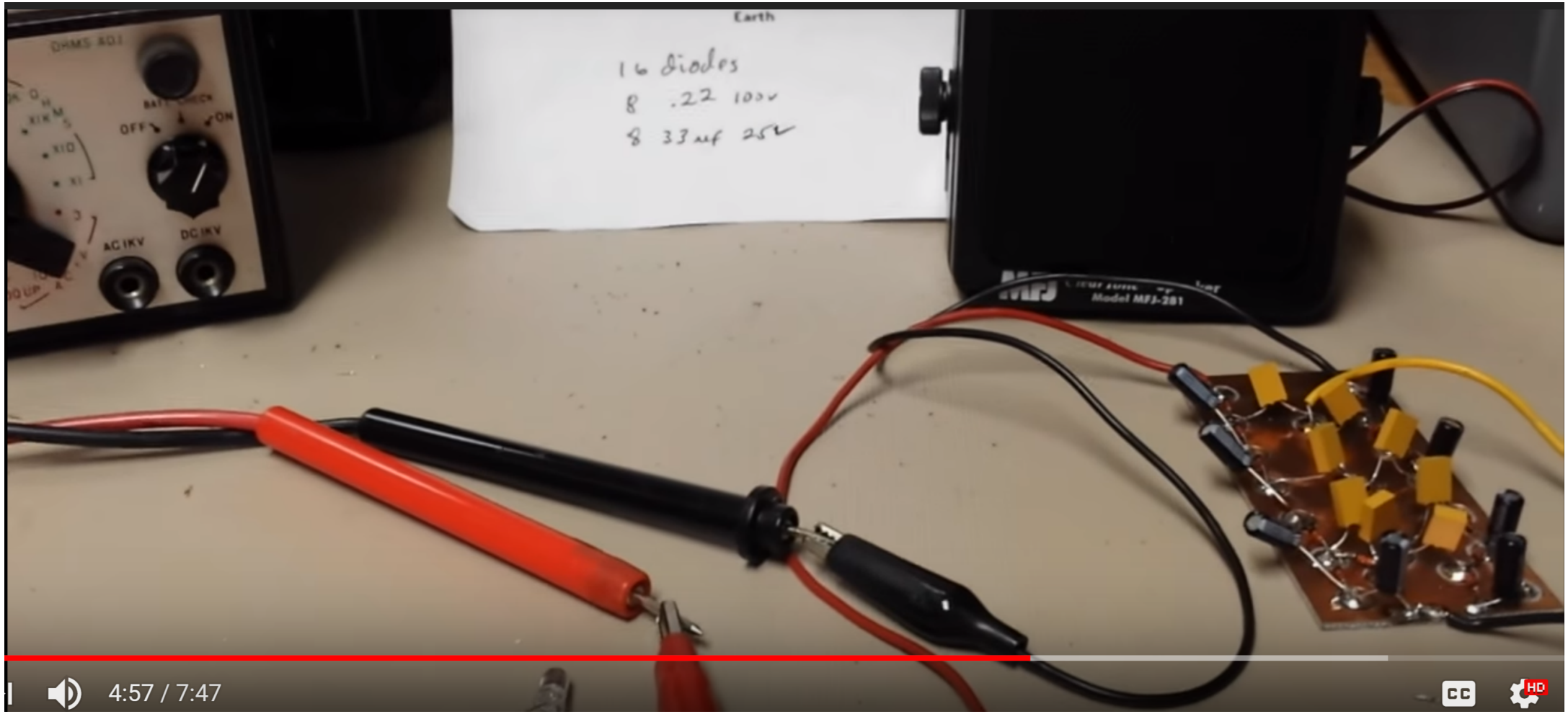
Earth
16 diodes
8 .22 100v
8 33uf 25v
OHMS ADJ
OFF
ON
AC 1KV
DC 1KV
Model MFJ-281
4:57 / 7:47

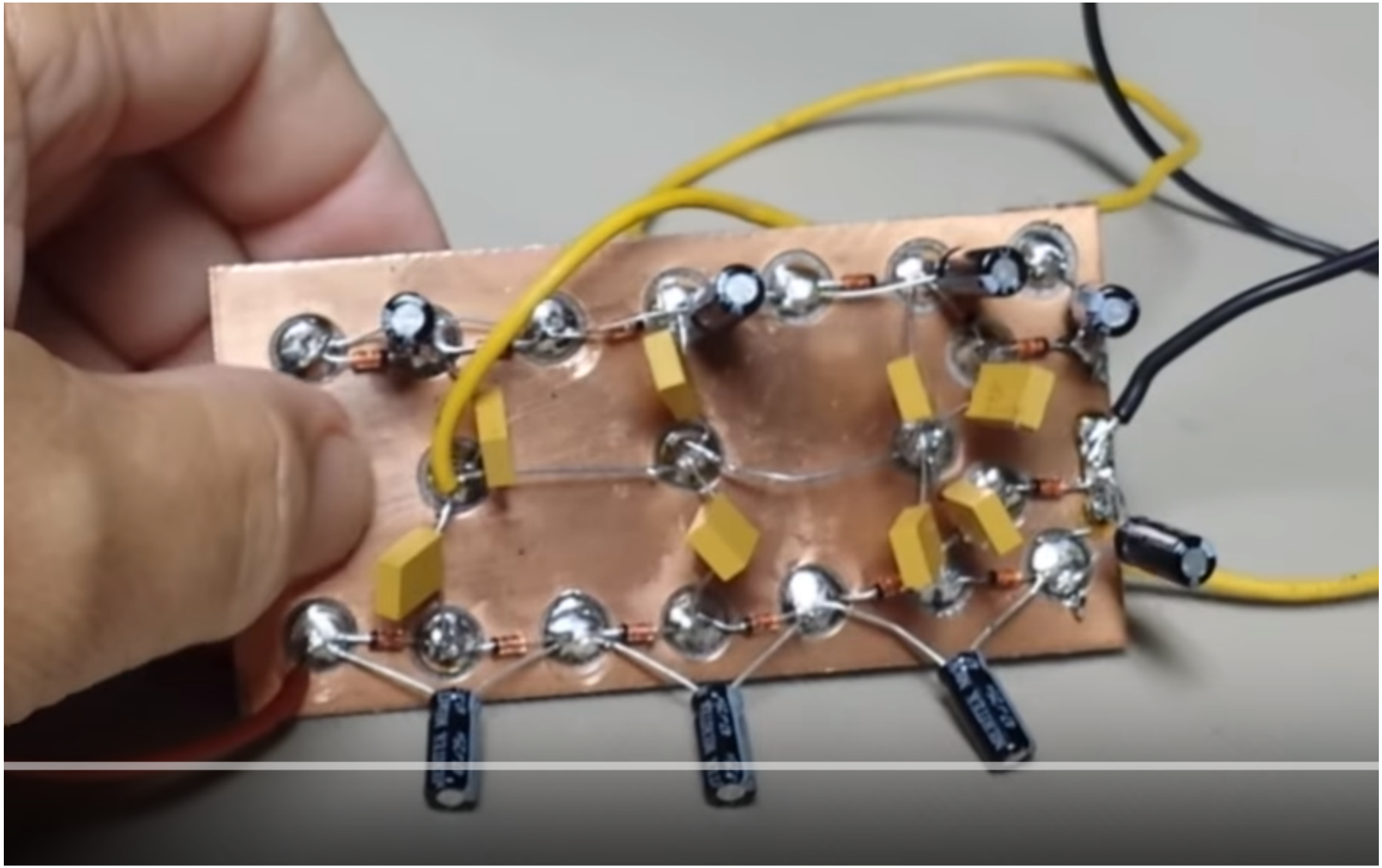

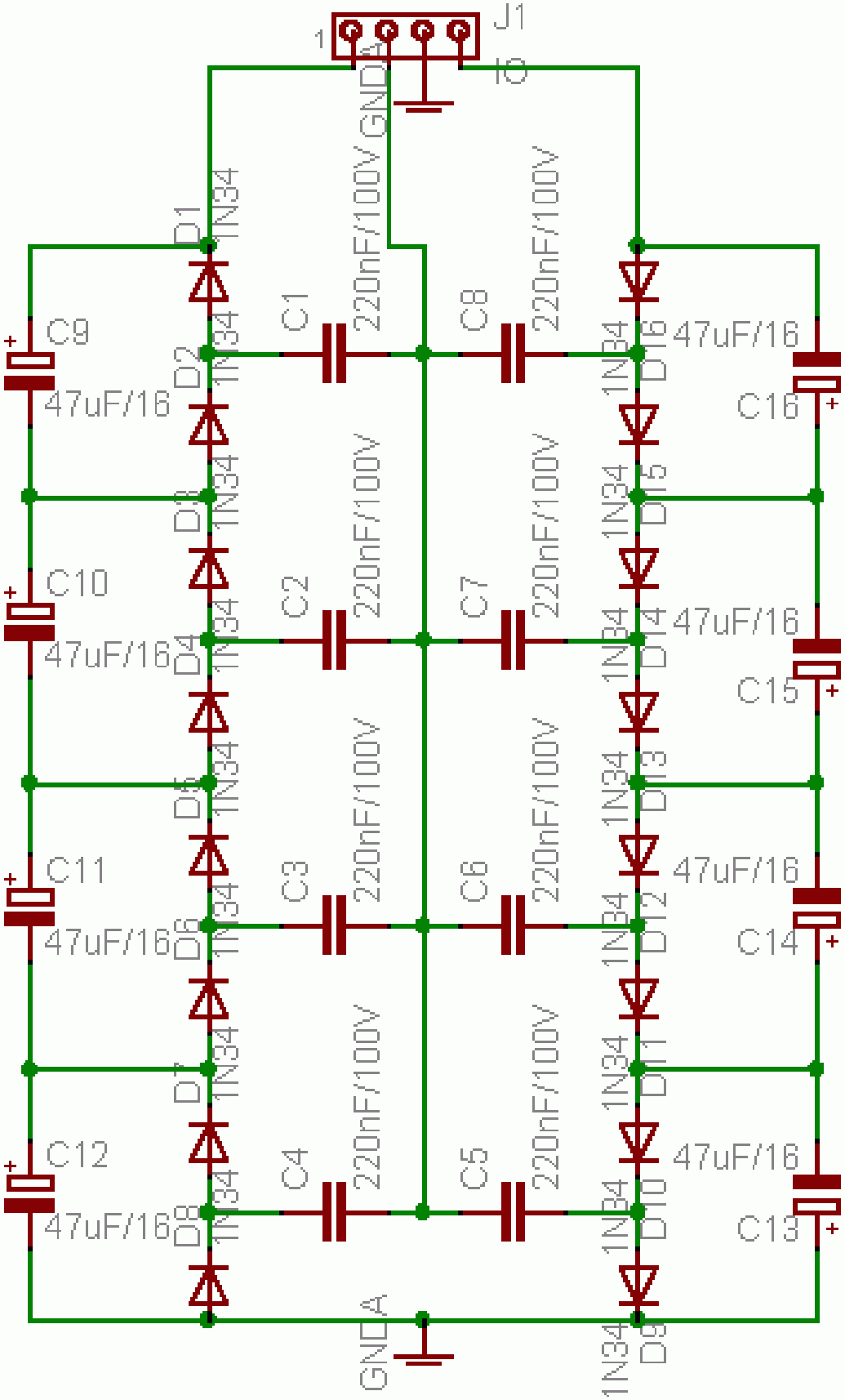

AMBIENT POWER MODULE

(C) - GROUNDLOOP 2012

Circuit Diagram

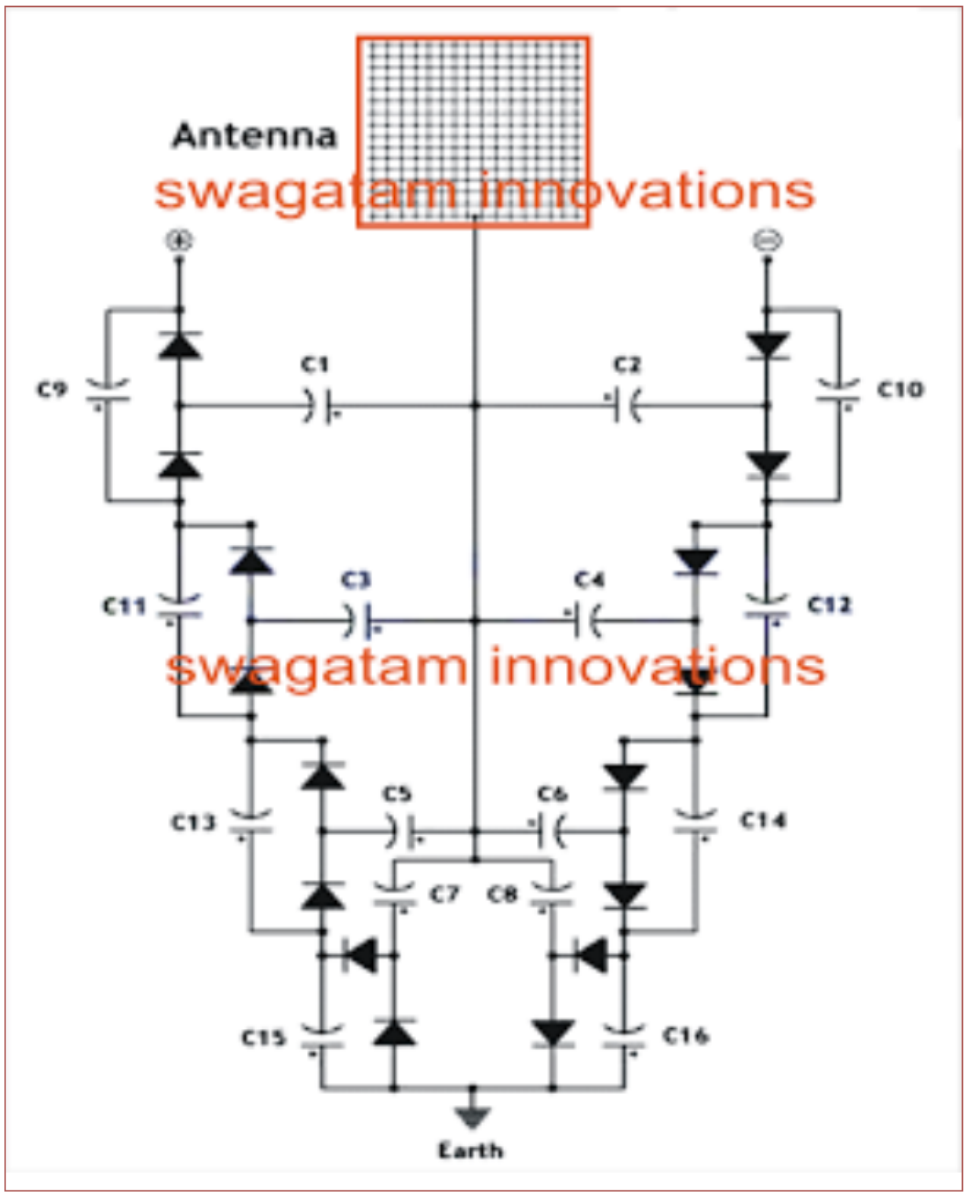

Parts List

All Diodes are 1N4148

C1---C8 = 0.22uF/100V mylar

C9----C16 = 33uF/25V electrolytic

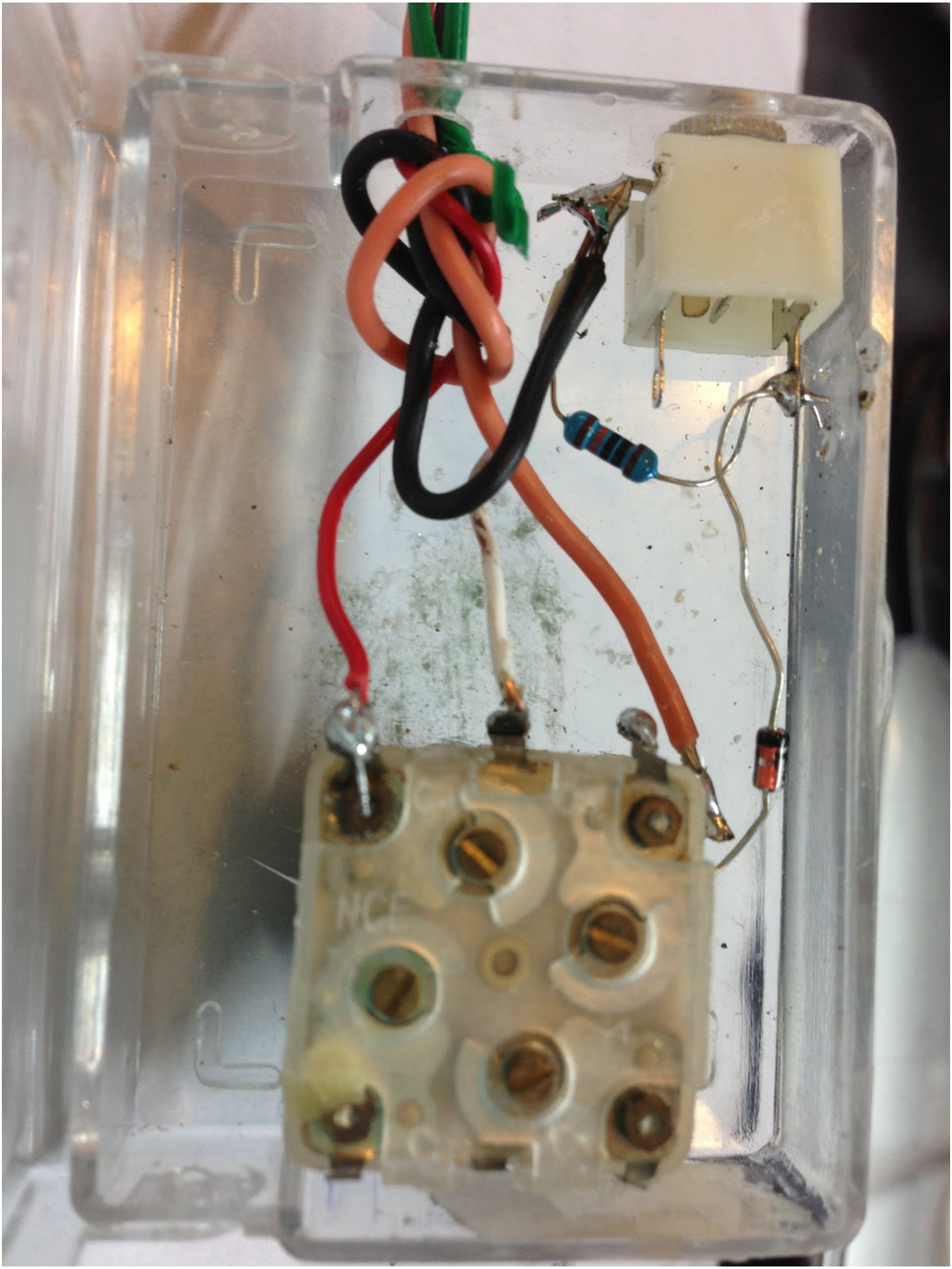
NC

Matrix Board

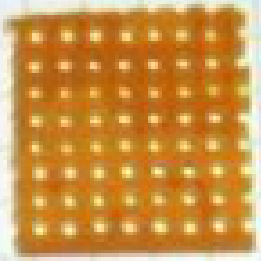

Resistor

Capacitor

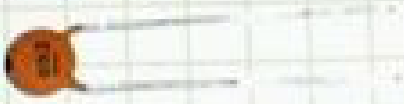

Inductor

Diode

Crystal Earphone

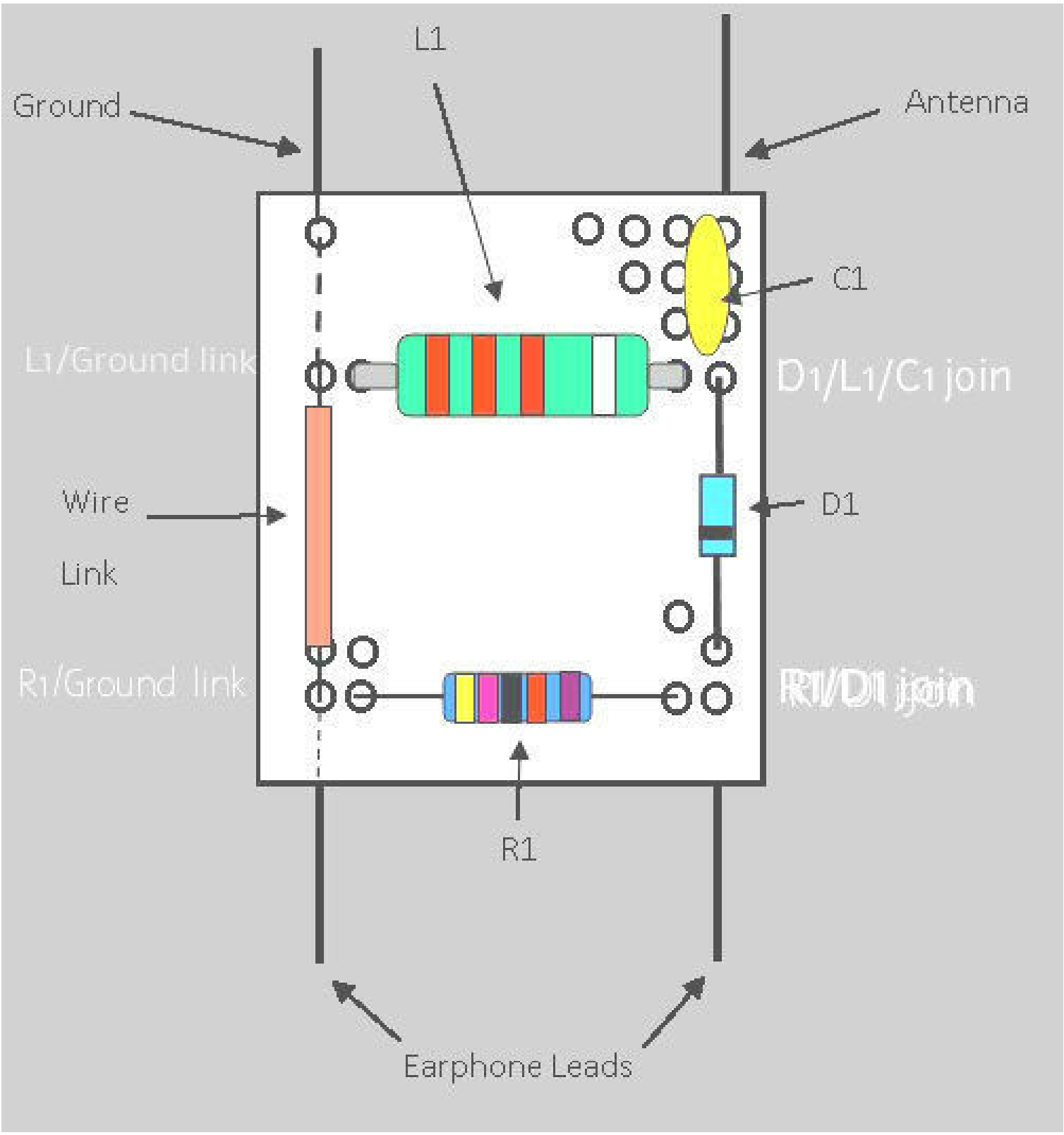
L1
Ground
Antenna
C1
L1/Ground link
D1/L1/C1 join
Wire
Link
D1
R1/Ground link
R1/D1 join
R1
Earphone Leads

24g NET
FRESHNESS IN 2 CALORIES
tic tac
Strawberry Fields

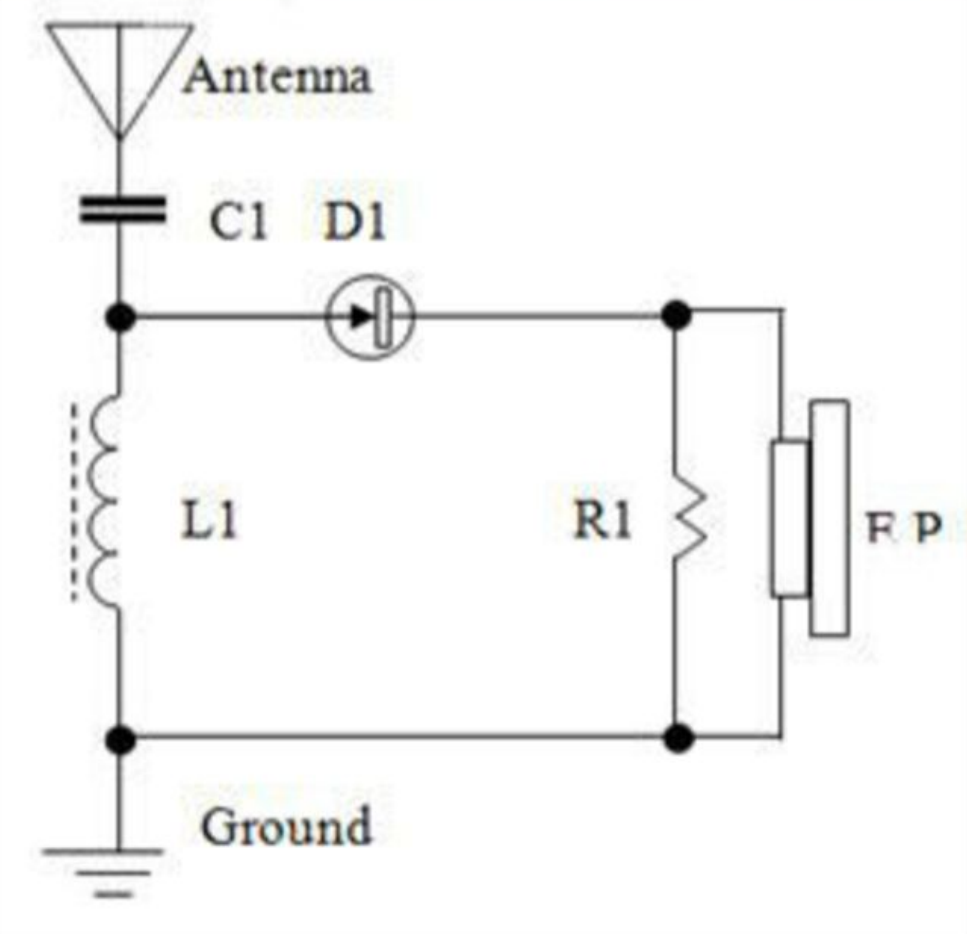
Antenna
C1
D1
L1
R1
E P
Ground

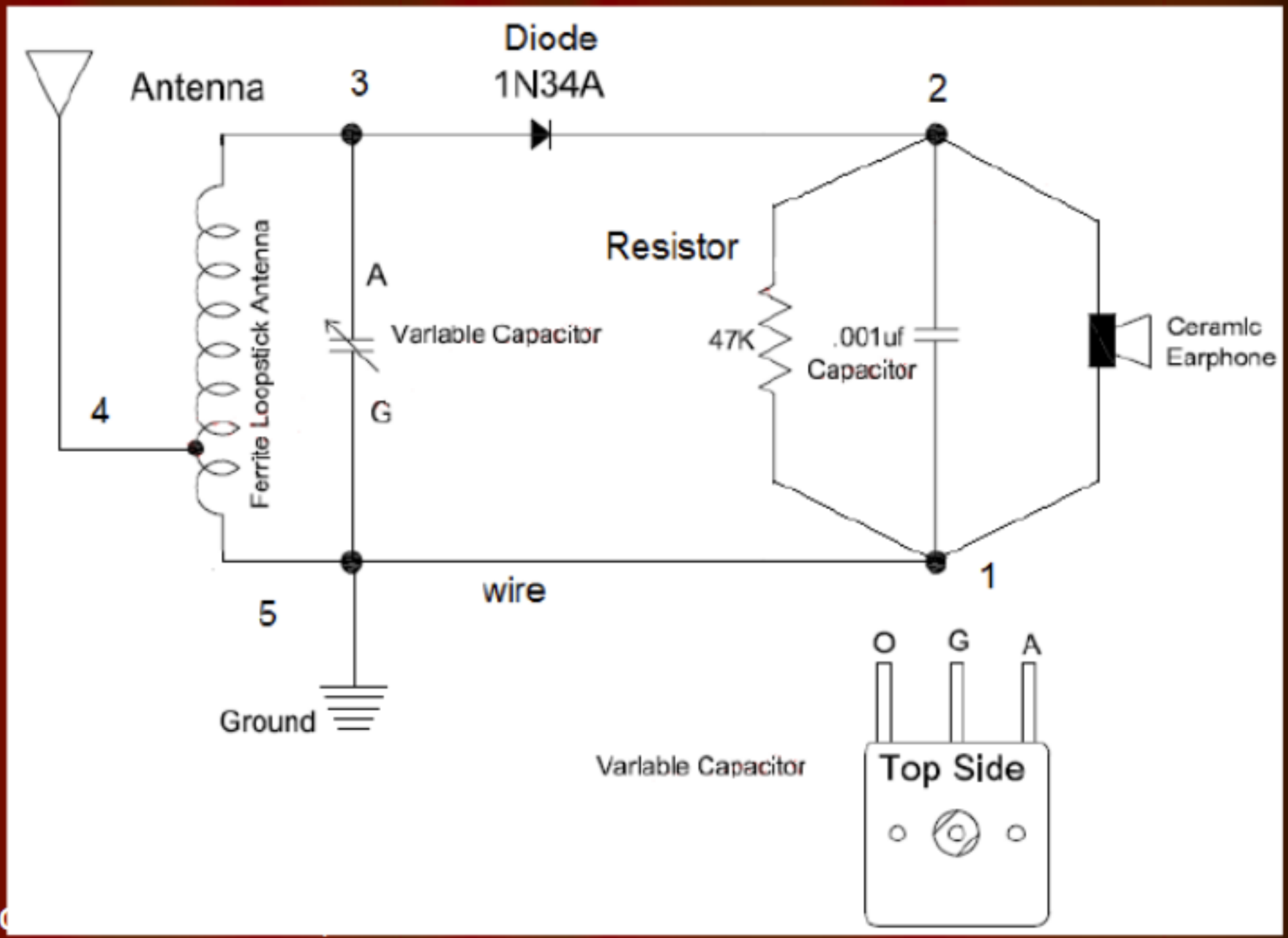

[Sc

http://www.angelfire.com/electronic2/index1/DmCrystalSet.html]

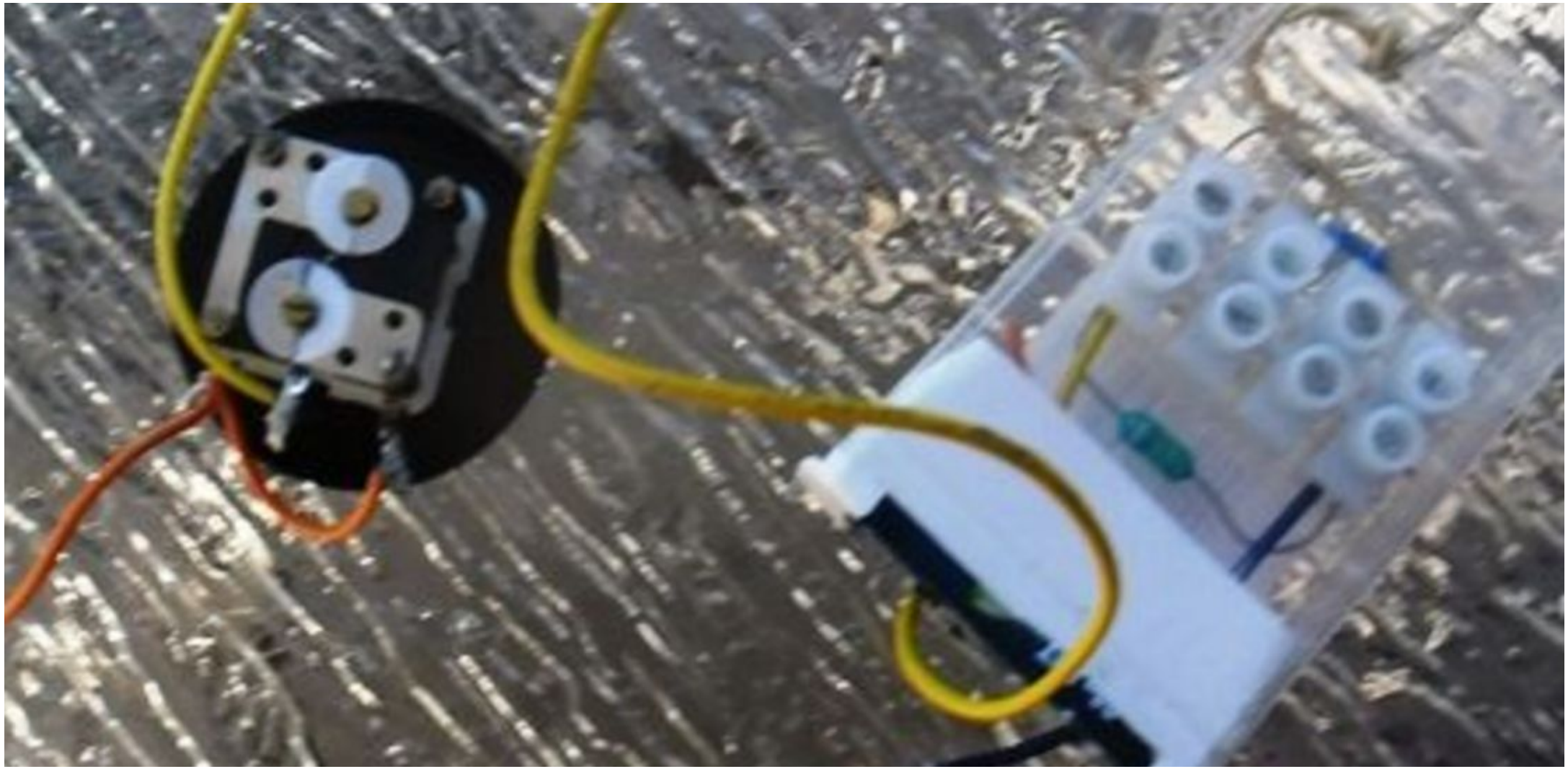

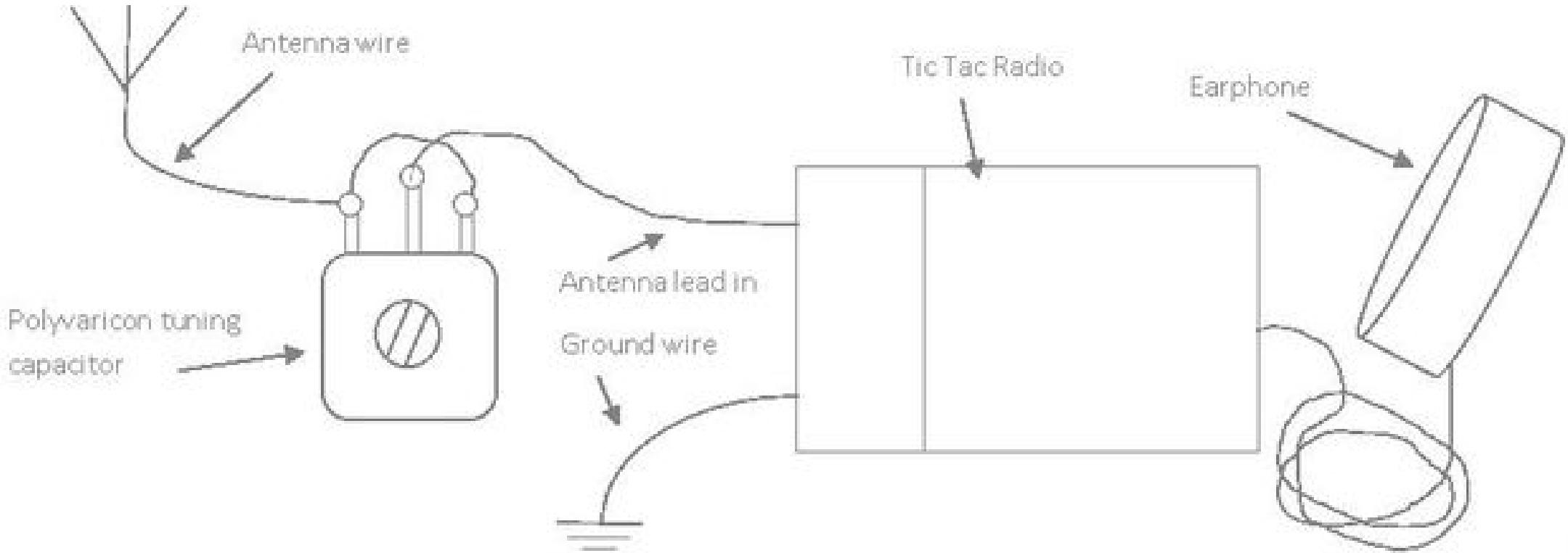
Antenna wire
Tic Tac Radio
Earphone
Antenna lead in
Polyvaricon tuning
capacitor
Ground wire

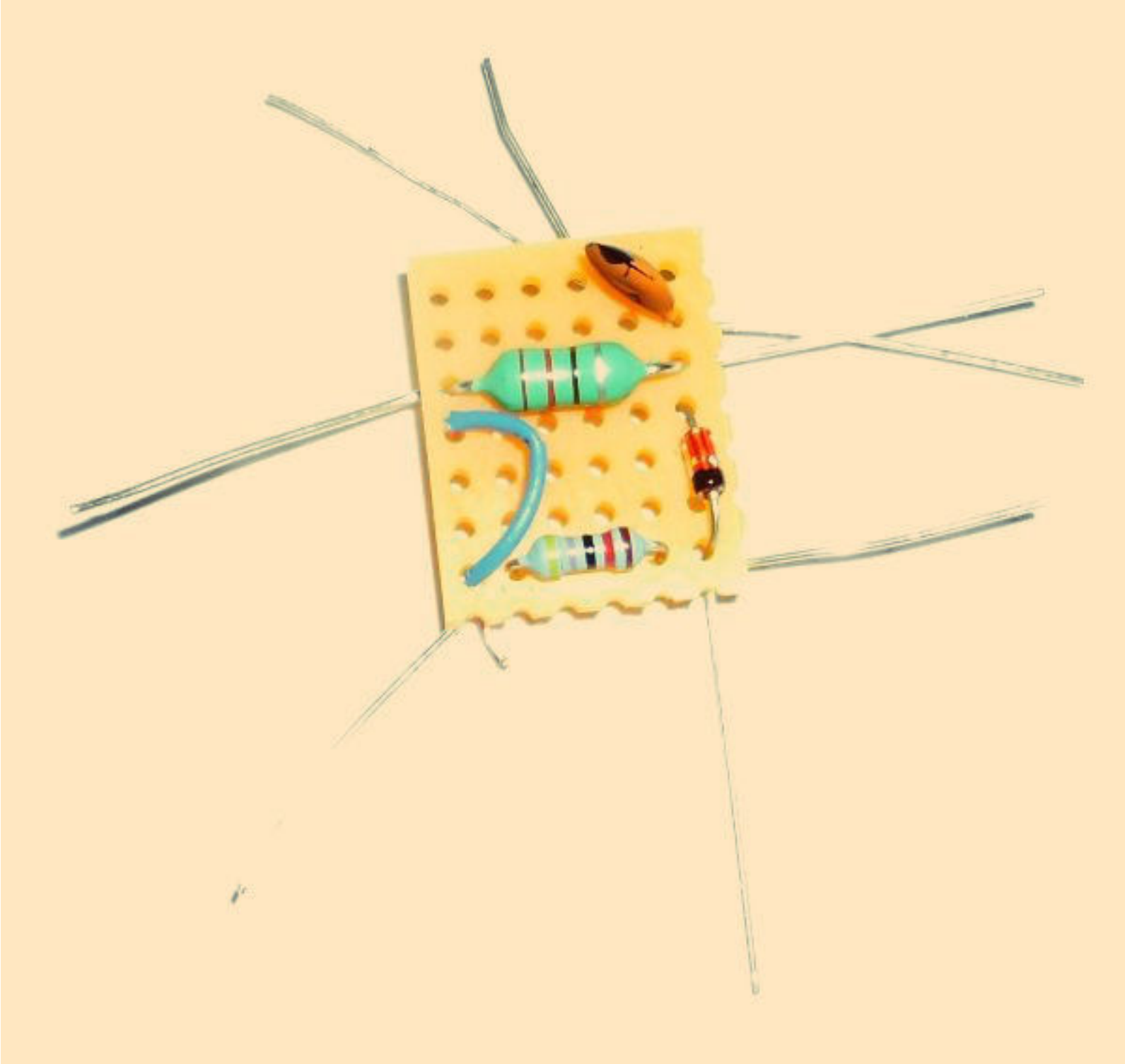

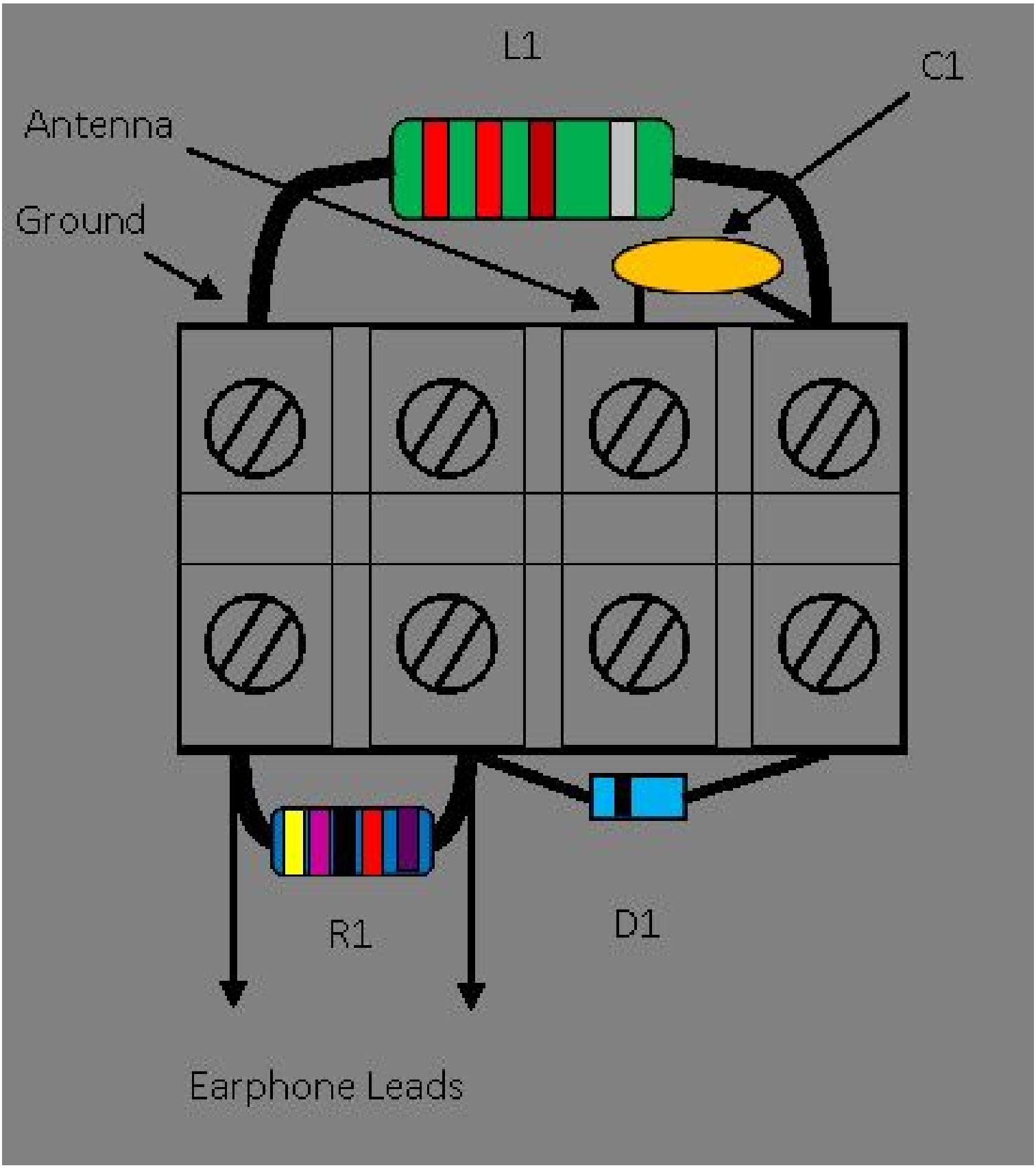
L1
C1
Antenna
Ground
R1
D1
Earphone Leads

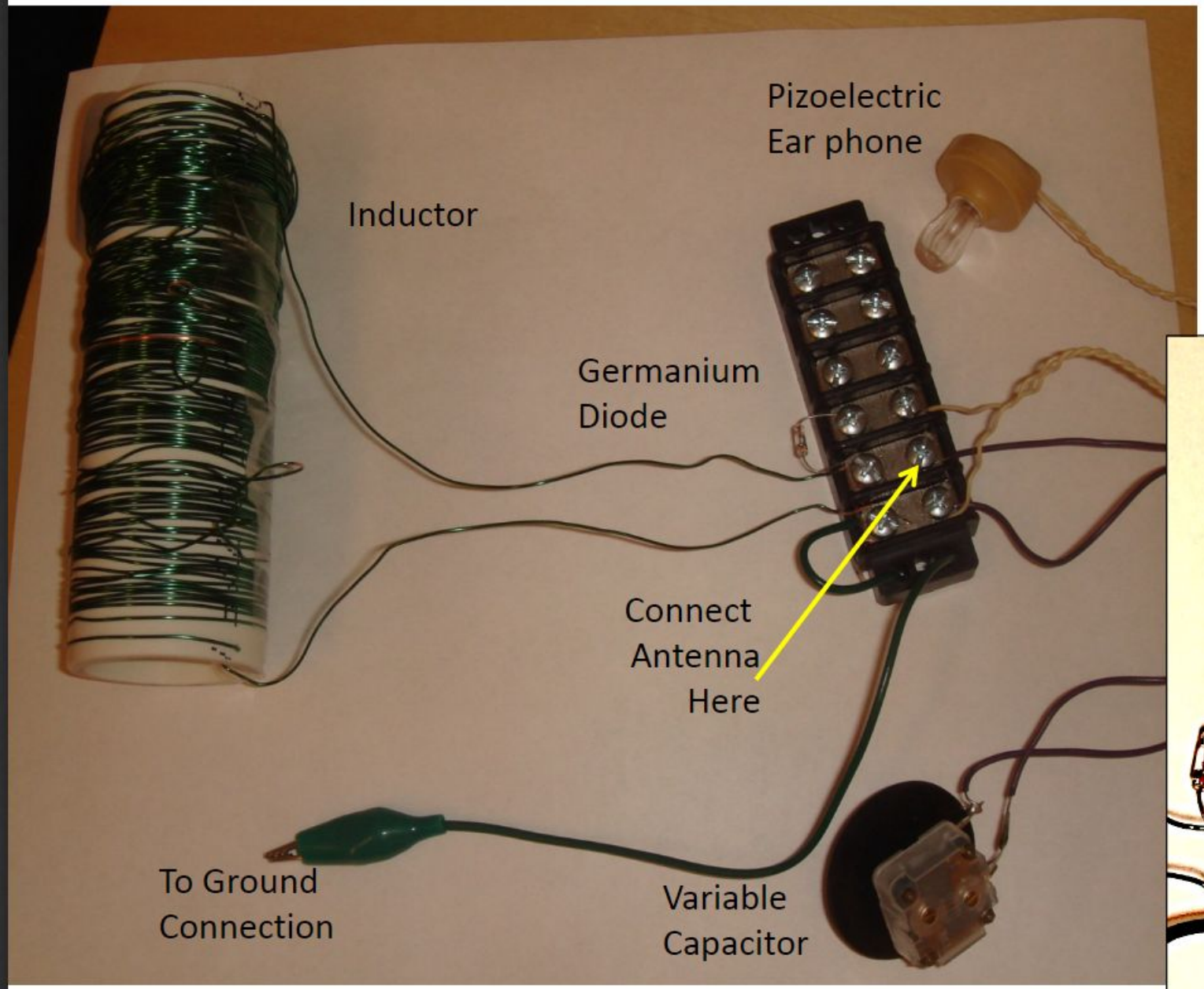
Pizoelectric
Ear phone
Inductor
Germanium
Diode
Connect
Antenna
Here
To Ground
Connection
Variable
Capacitor

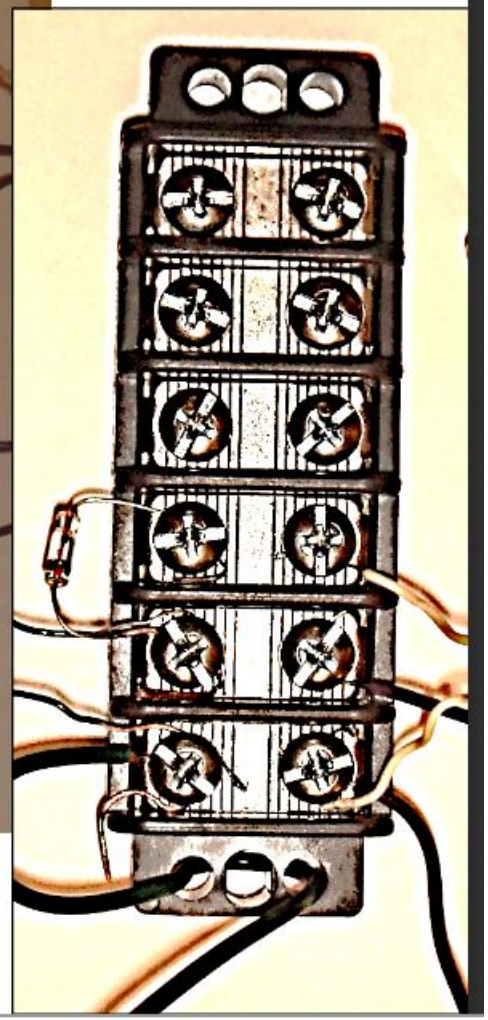

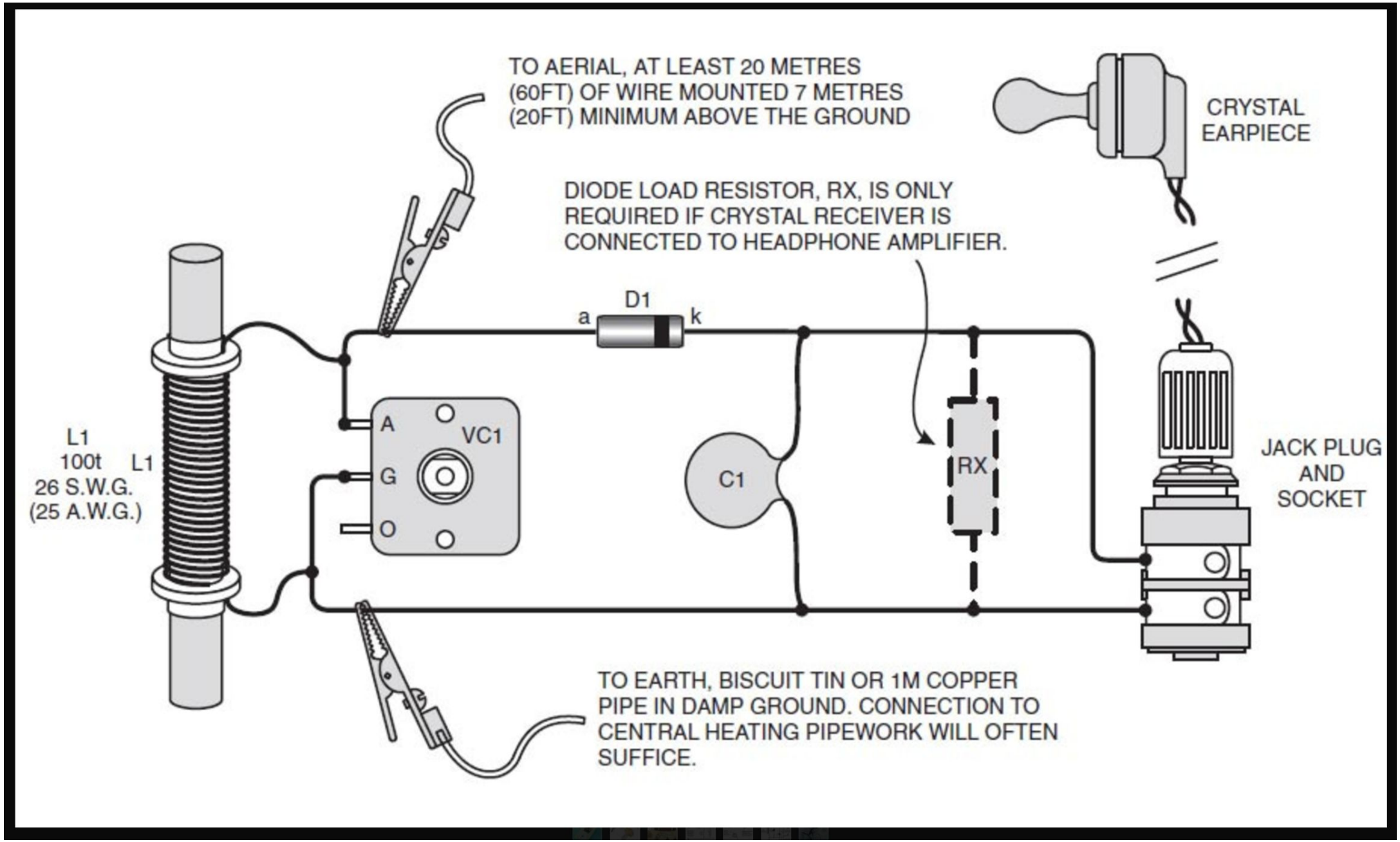
TO AERIAL, AT LEAST 20 METRES
(60FT) OF WIRE MOUNTED 7 METRES
(20FT) MINIMUM ABOVE THE GROUND
CRYSTAL
EARPIECE
DIODE LOAD RESISTOR, RX, IS ONLY
REQUIRED IF CRYSTAL RECEIVER IS
CONNECTED TO HEADPHONE AMPLIFIER.
D1
a
k
L1
100t
26 S.W.G.
(25 A.W.G.)
L1
A
G
O
VC1
C1
RX
JACK PLUG
AND
SOCKET
TO EARTH, BISCUIT TIN OR 1M COPPER
PIPE IN DAMP GROUND. CONNECTION TO
CENTRAL HEATING PIPEWORK WILL OFTEN
SUFFICE.

ANTENNA
-
+
392J
GROUND

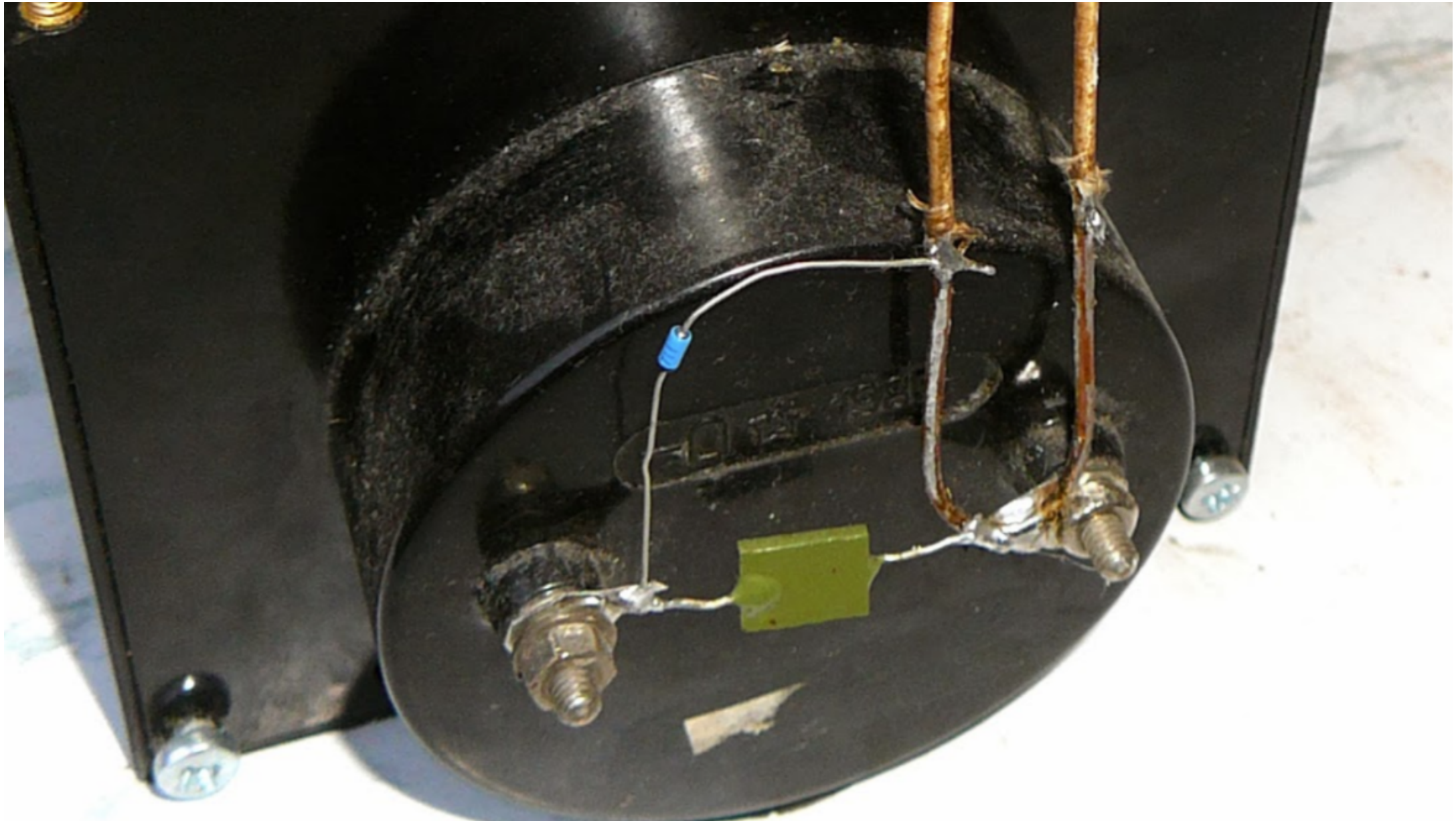

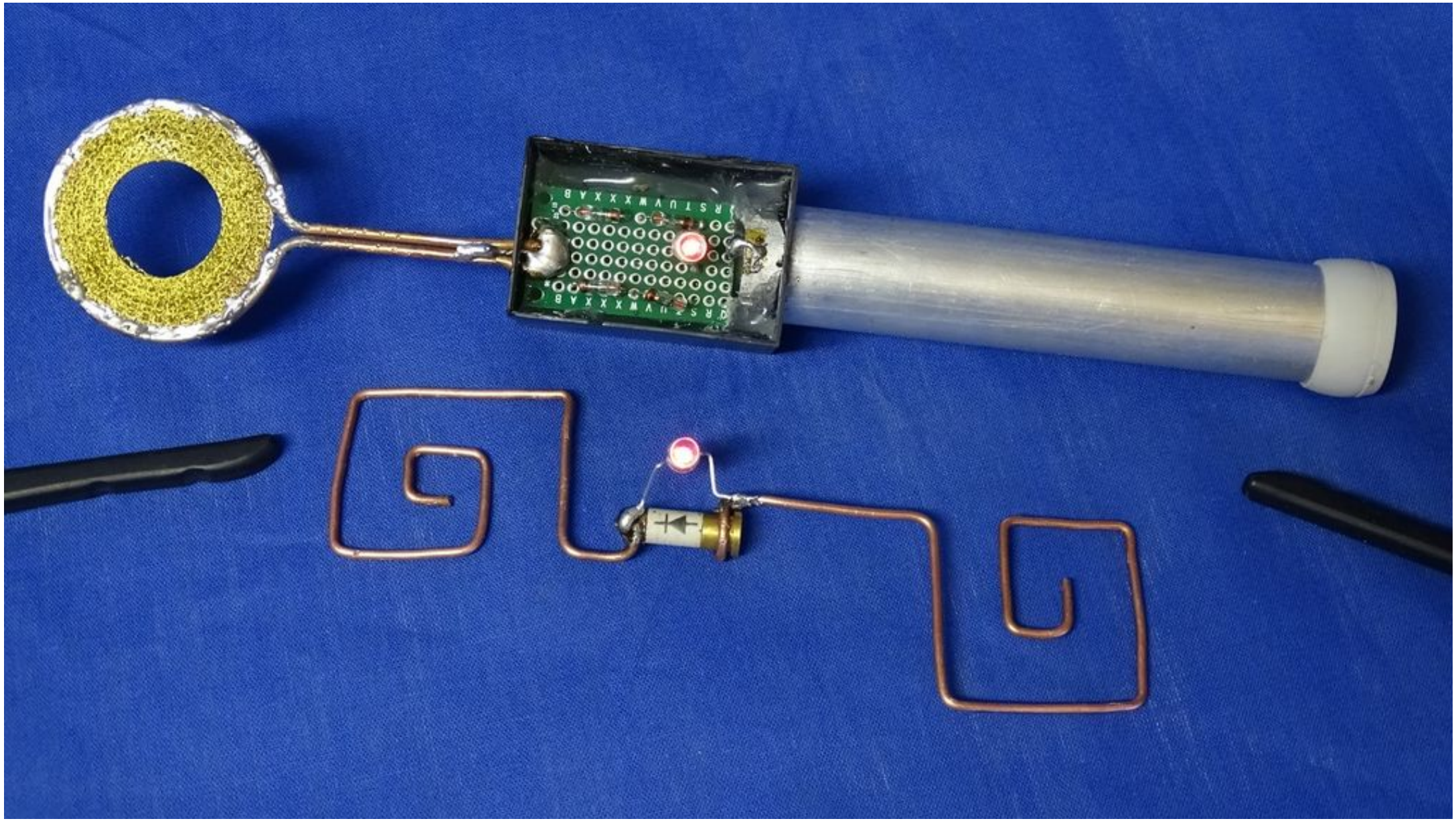

Step 1: LED+RF Diode

First Solder the led parallel to the Rf diode

Add Tip Ask Question Comment Download

Step 2: RF Diode+ LED+ Wires

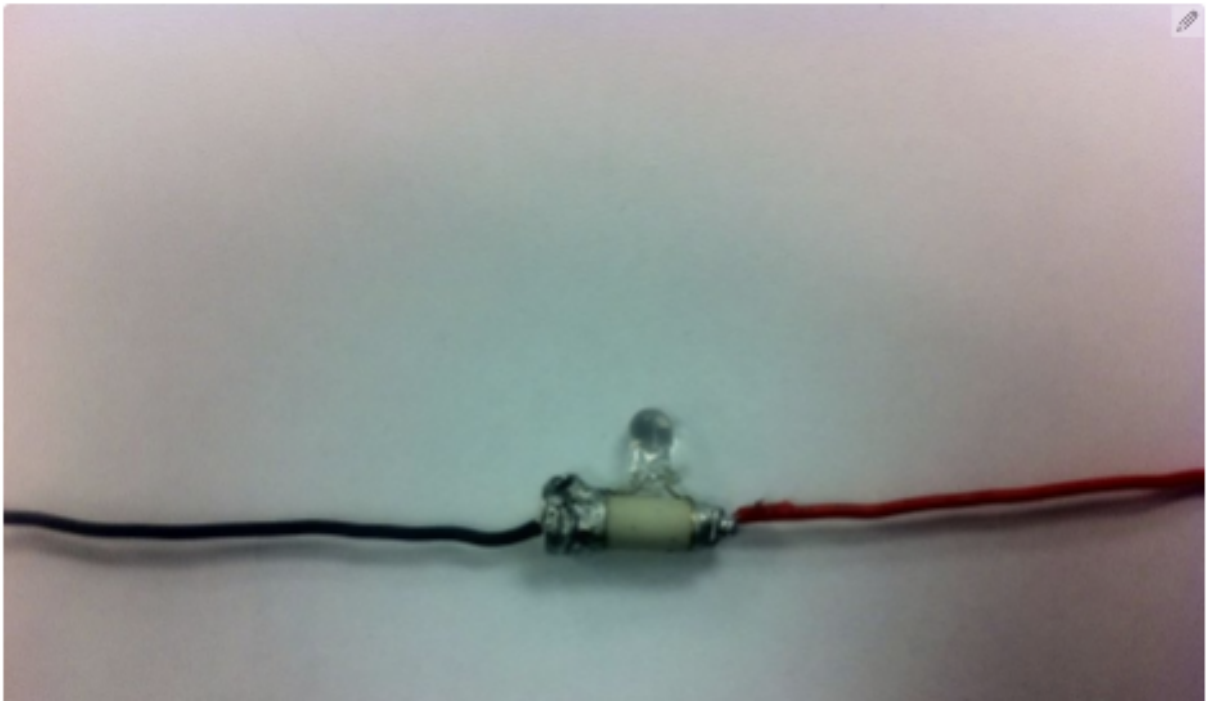

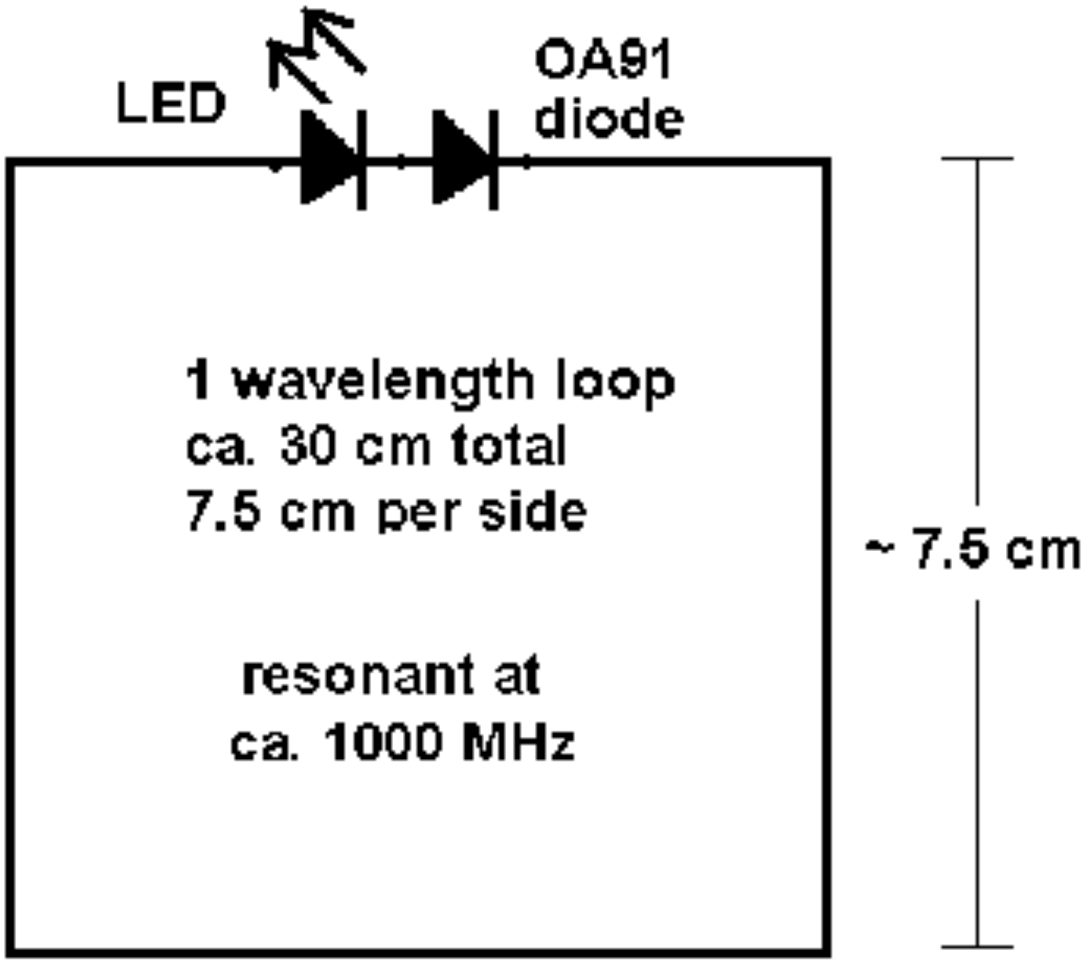
LED
OA91
diode
1 wavelength loop
ca. 30 cm total
7.5 cm per side
resonant at
ca. 1000 MHz
~ 7.5 cm

1N238
0:56 / 1:49

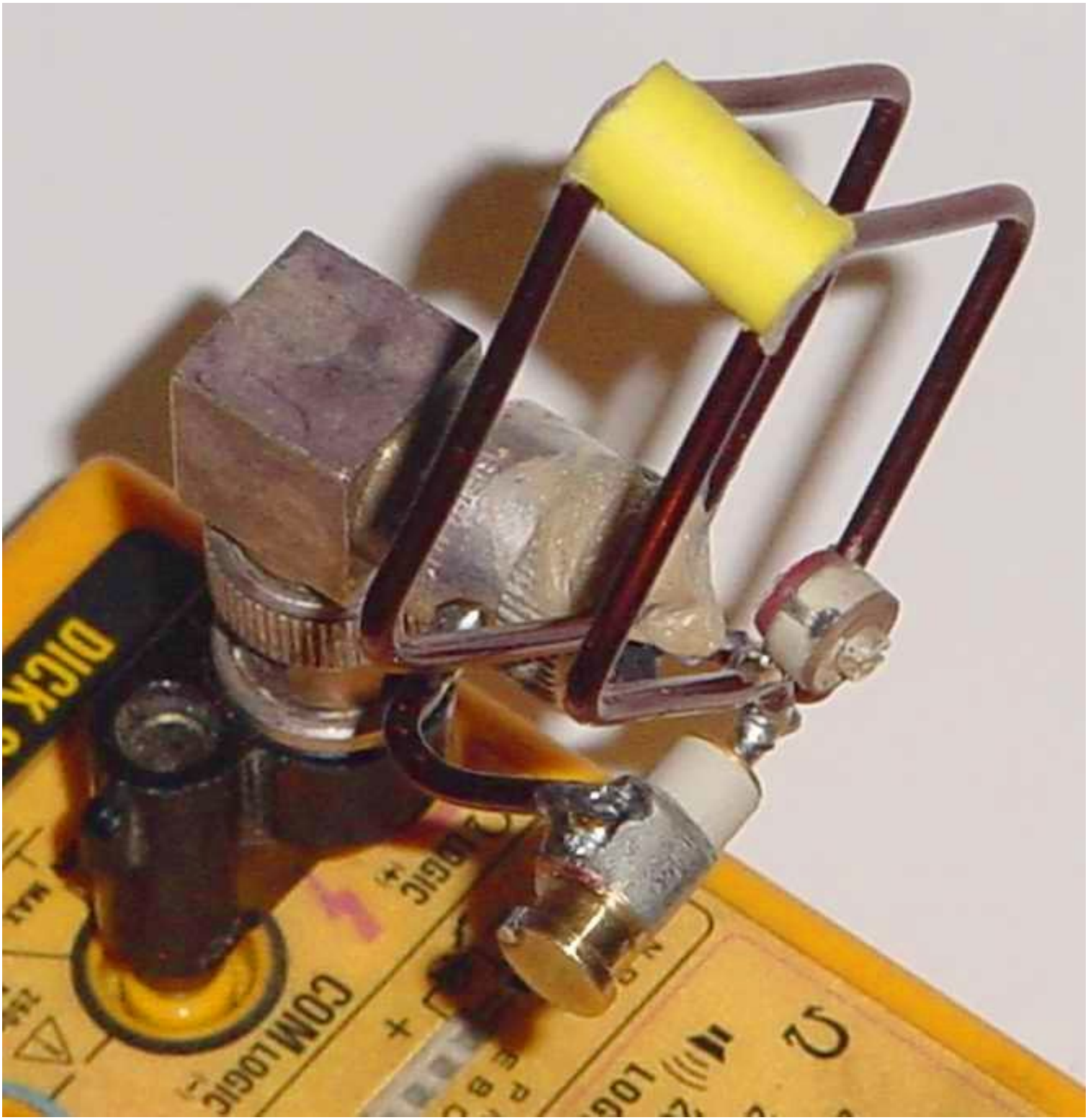
COM
LOGIC

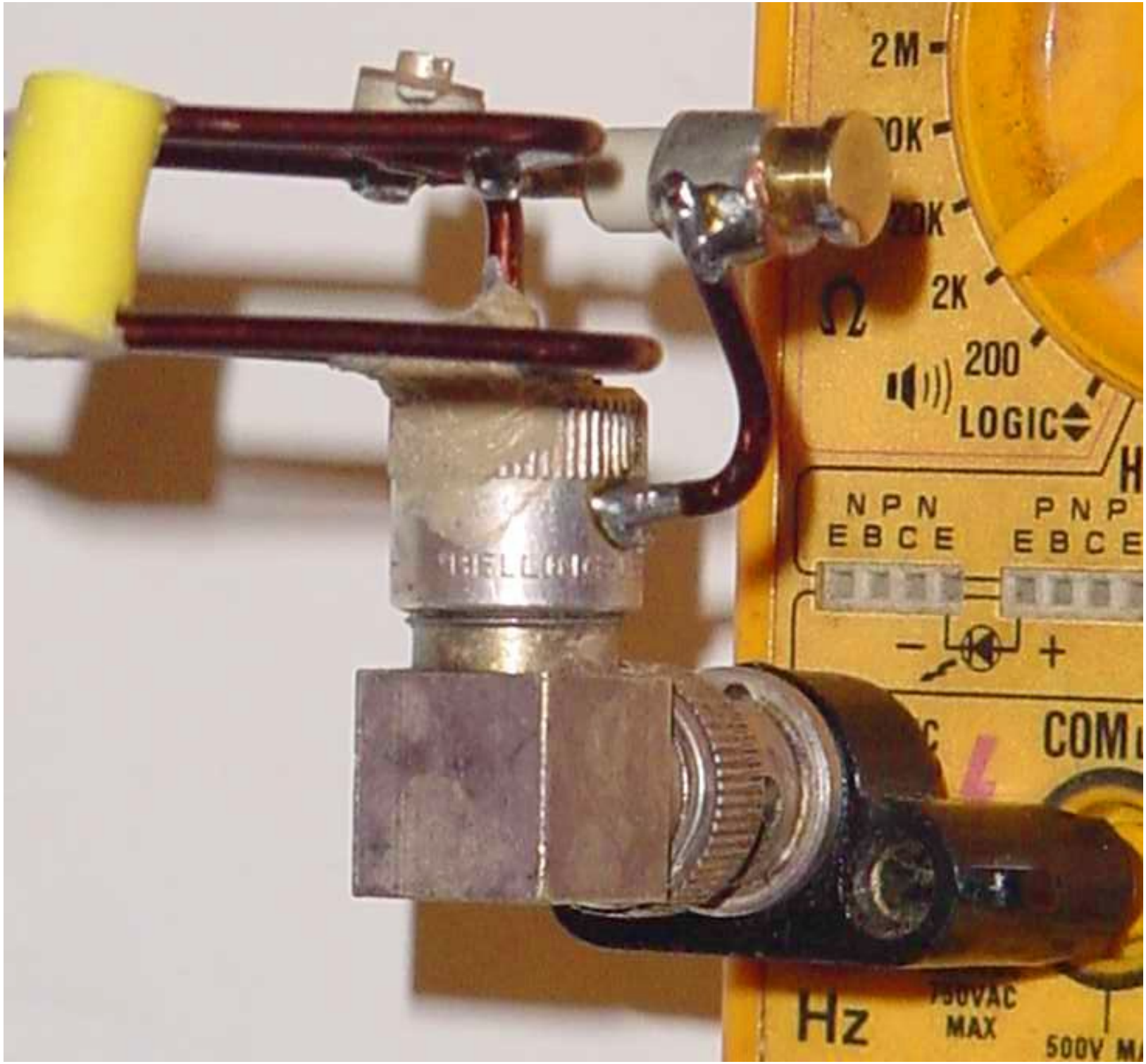
2M
2K
200
LOGIC
NPN
EBCE
PNP
EBCE
COM
Hz
MAX

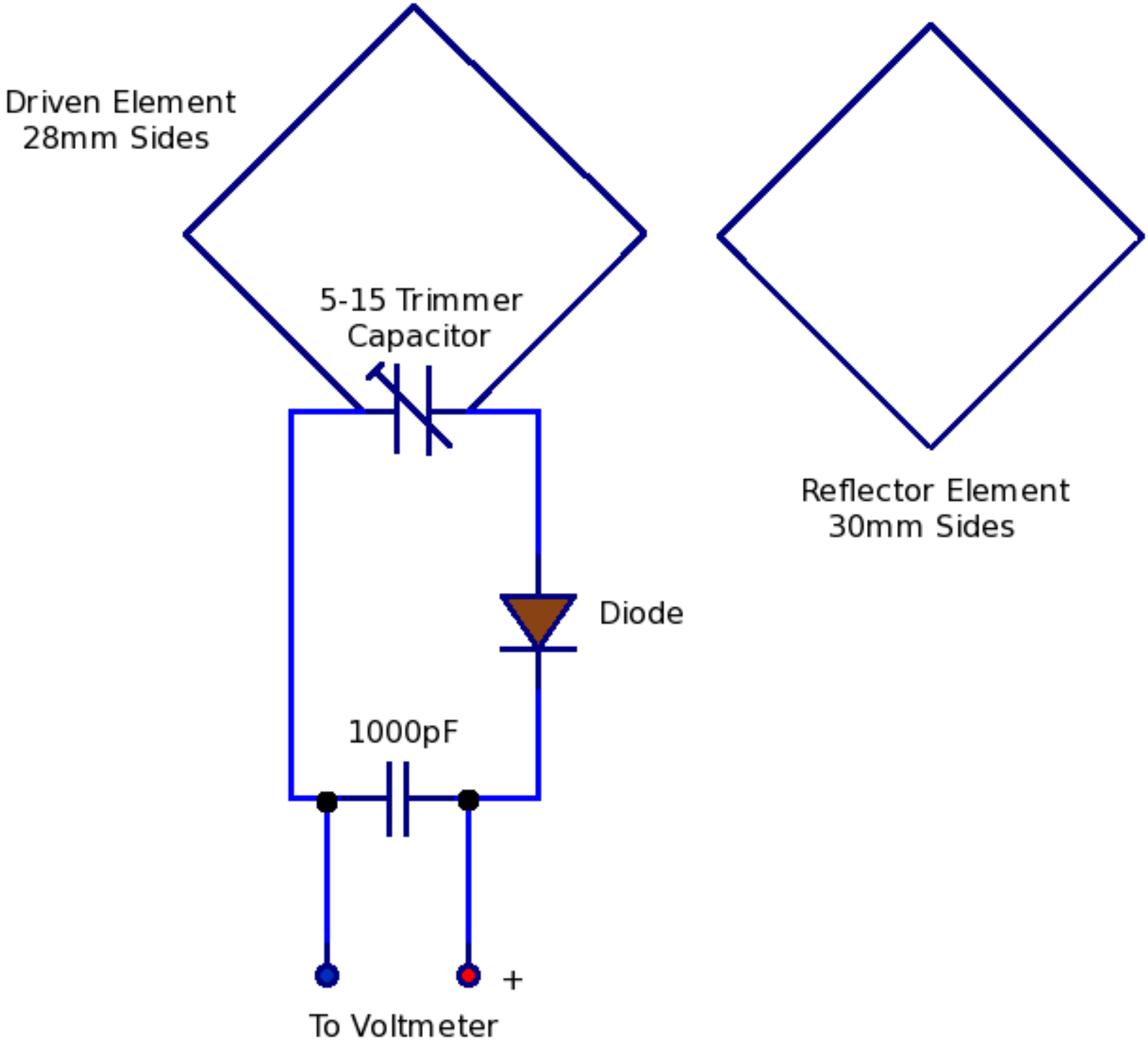
Driven Element
28mm Sides
5-15 Trimmer
Capacitor
Diode
1000pF
+
To Voltmeter
Reflector Element
30mm Sides

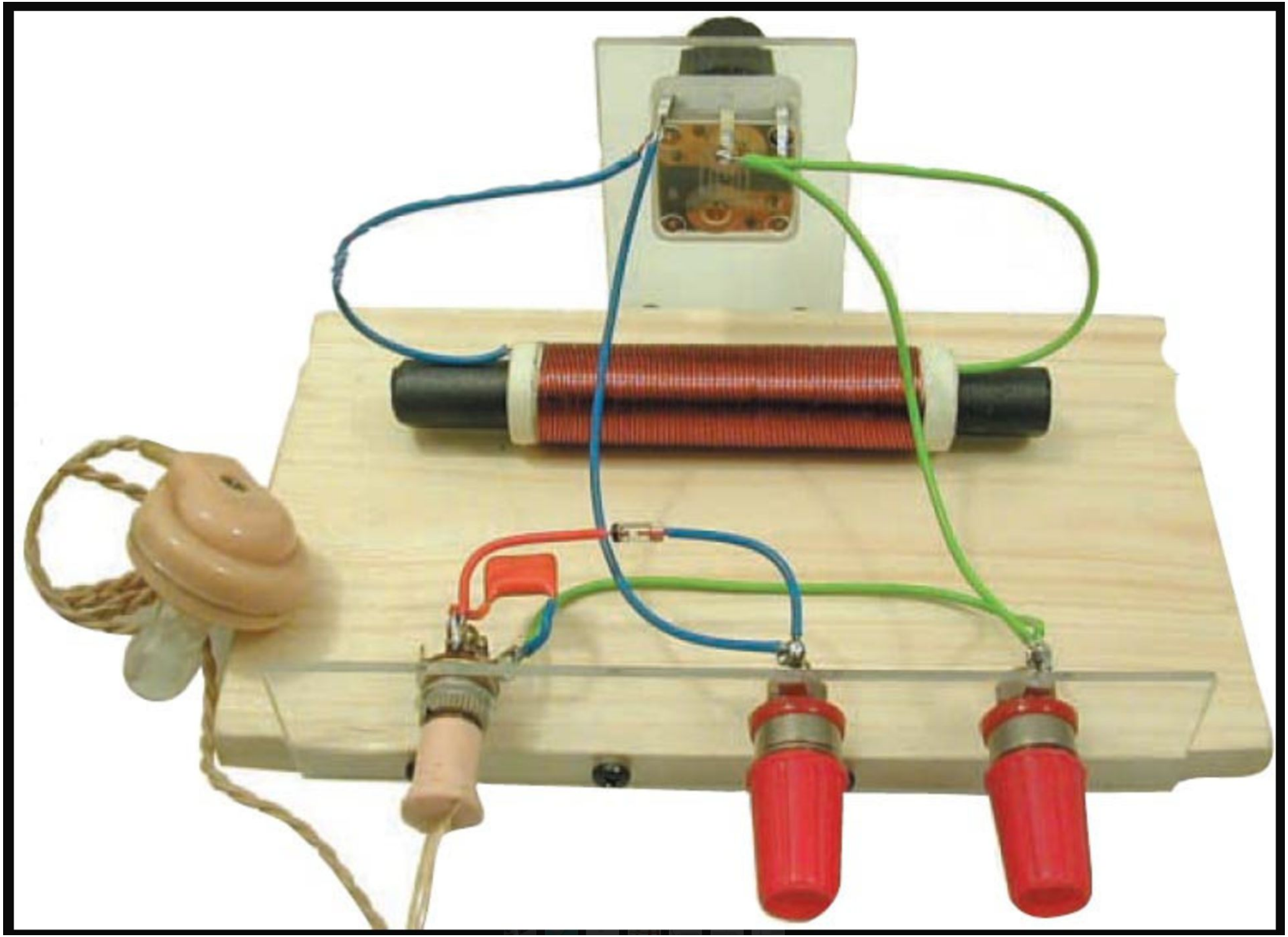

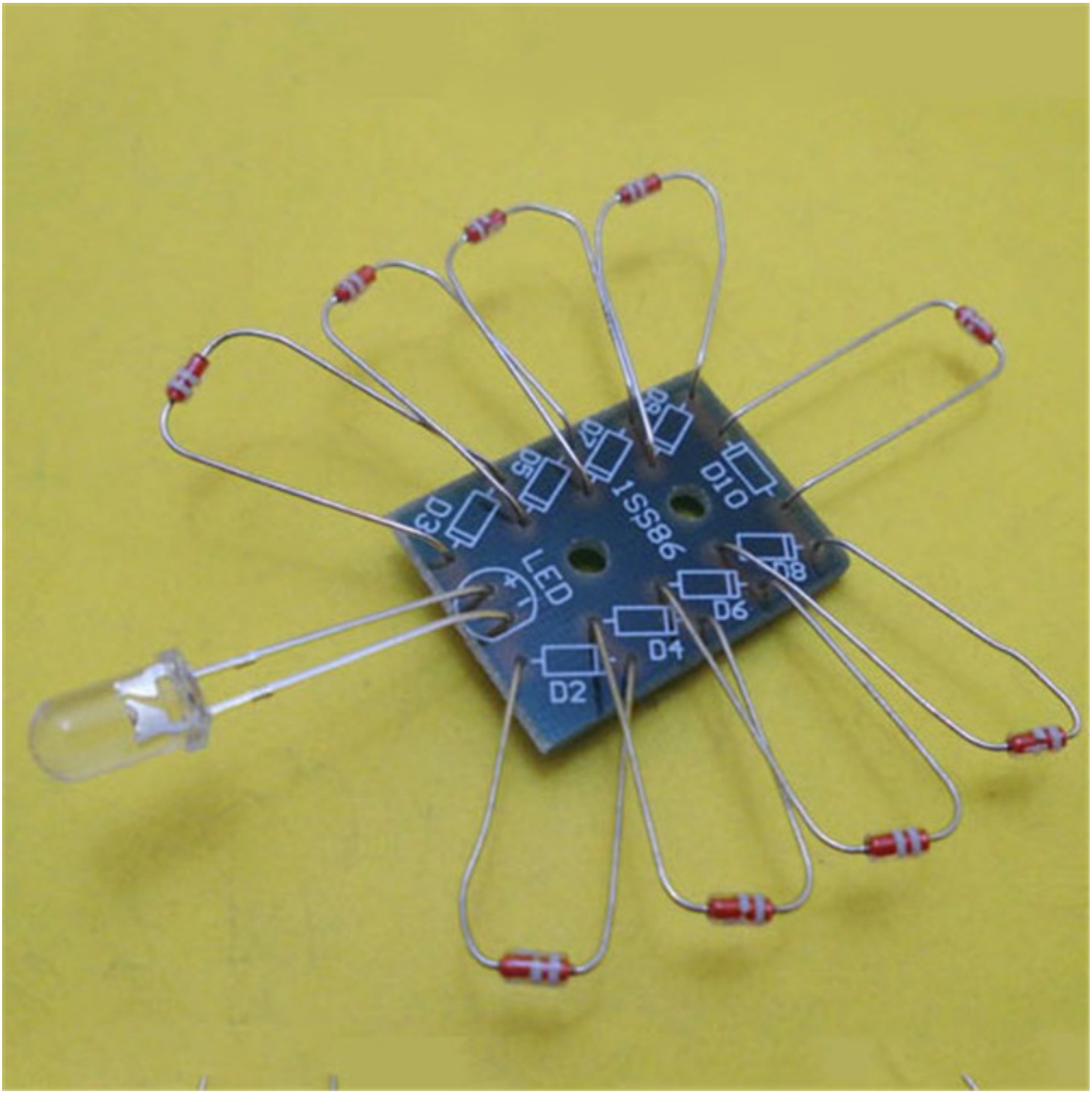
D3
D5
D7
D9
D10
1SS86
LED
D8
D6
D4
D2

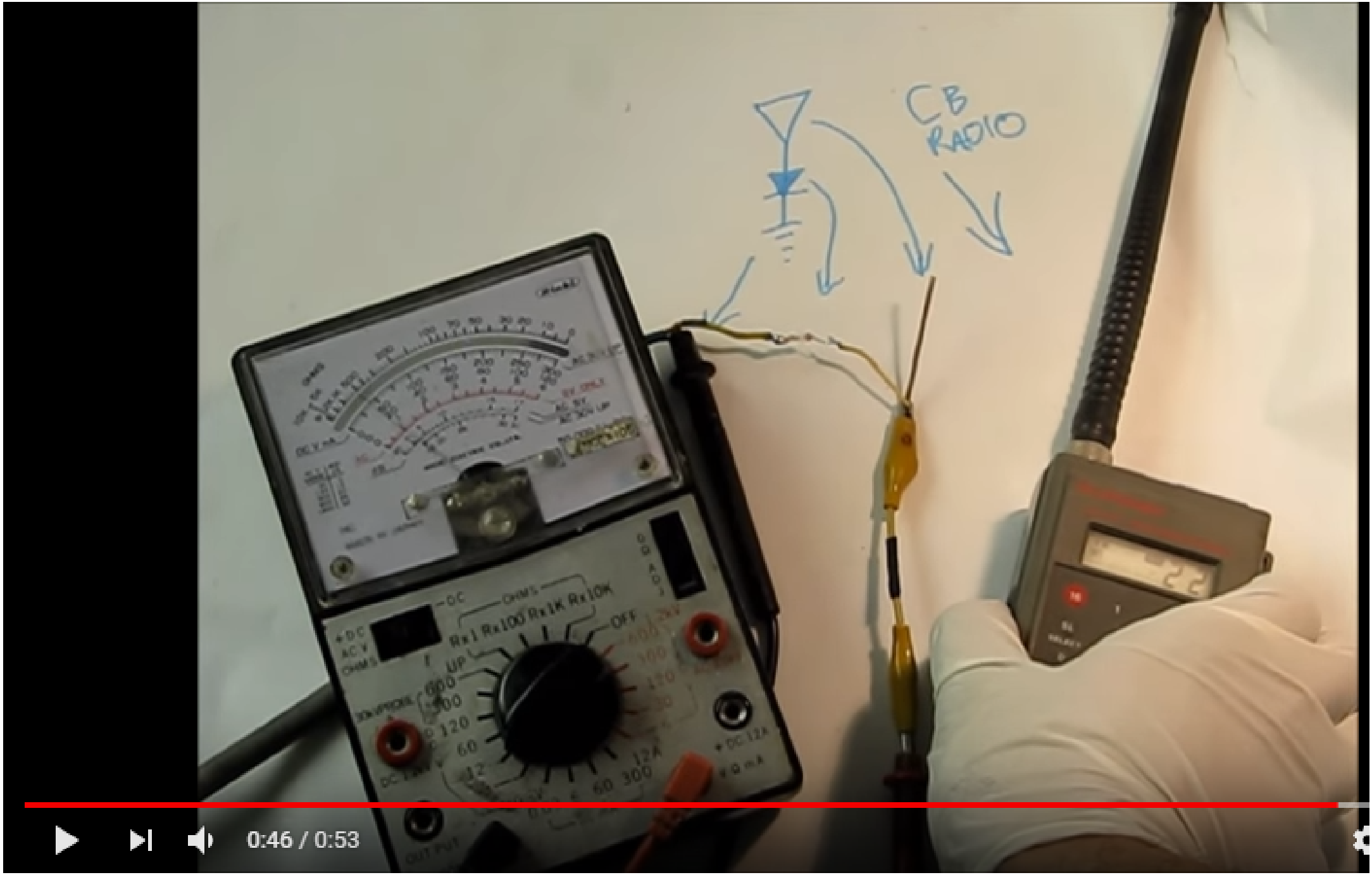

DIY Wireless Power - Part 2: Simple Wireless Power Transmission! (CB)

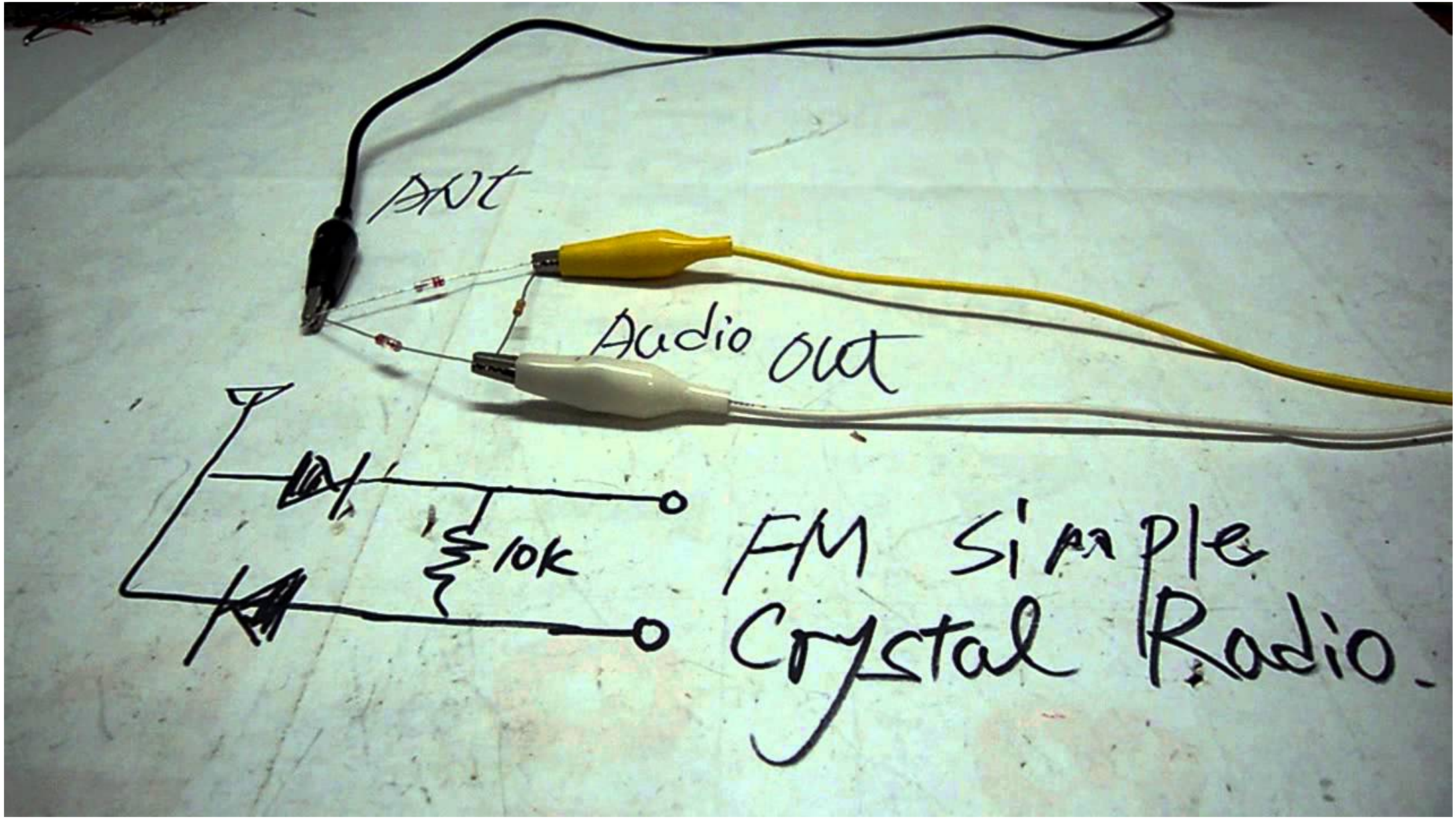
ANT
Audio out
10K
FM Simple
Crystal Radio.

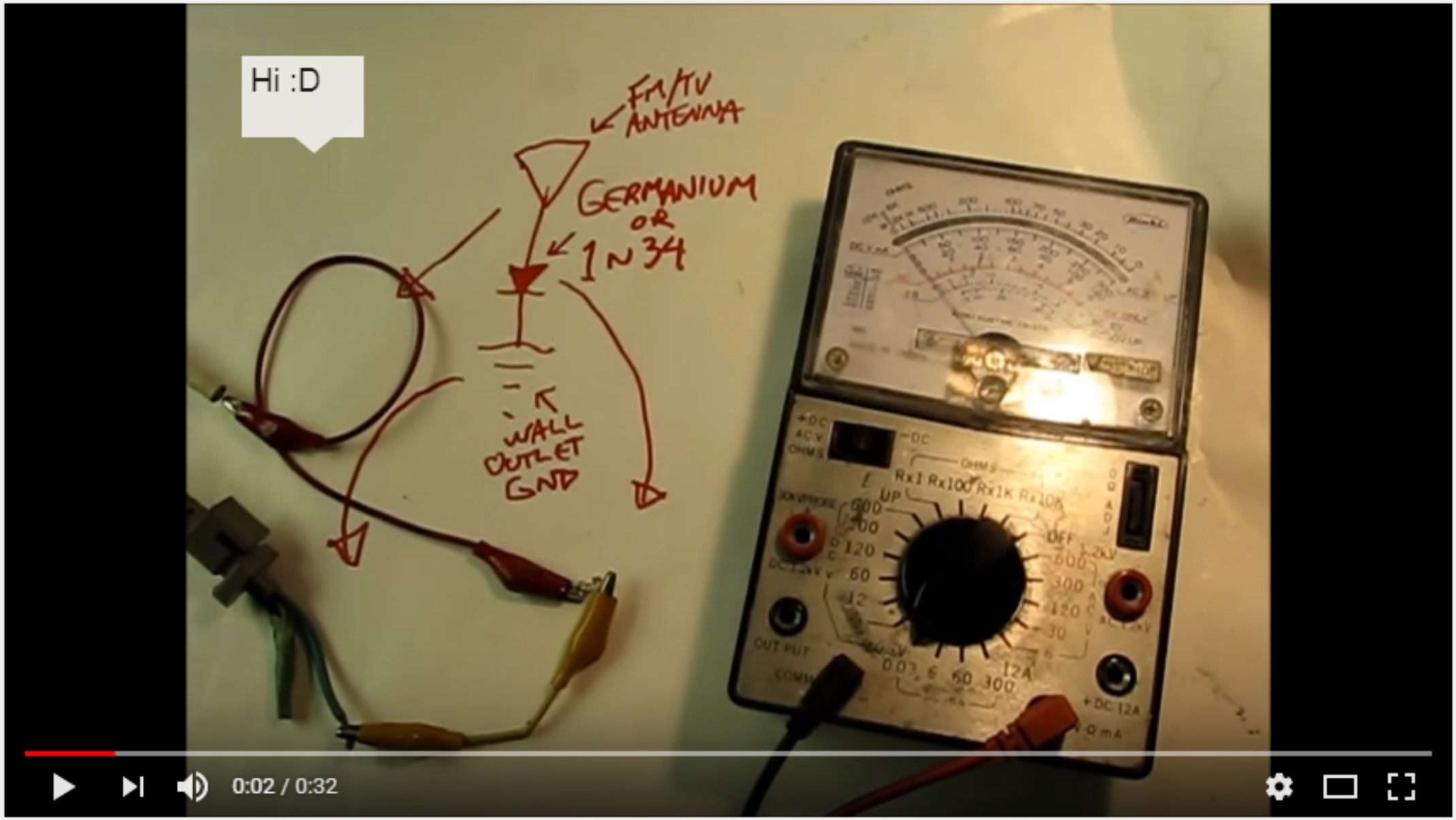

DIY Wireless Power - Part 1: TV/FM Antenna,1N34/Germanium Diode

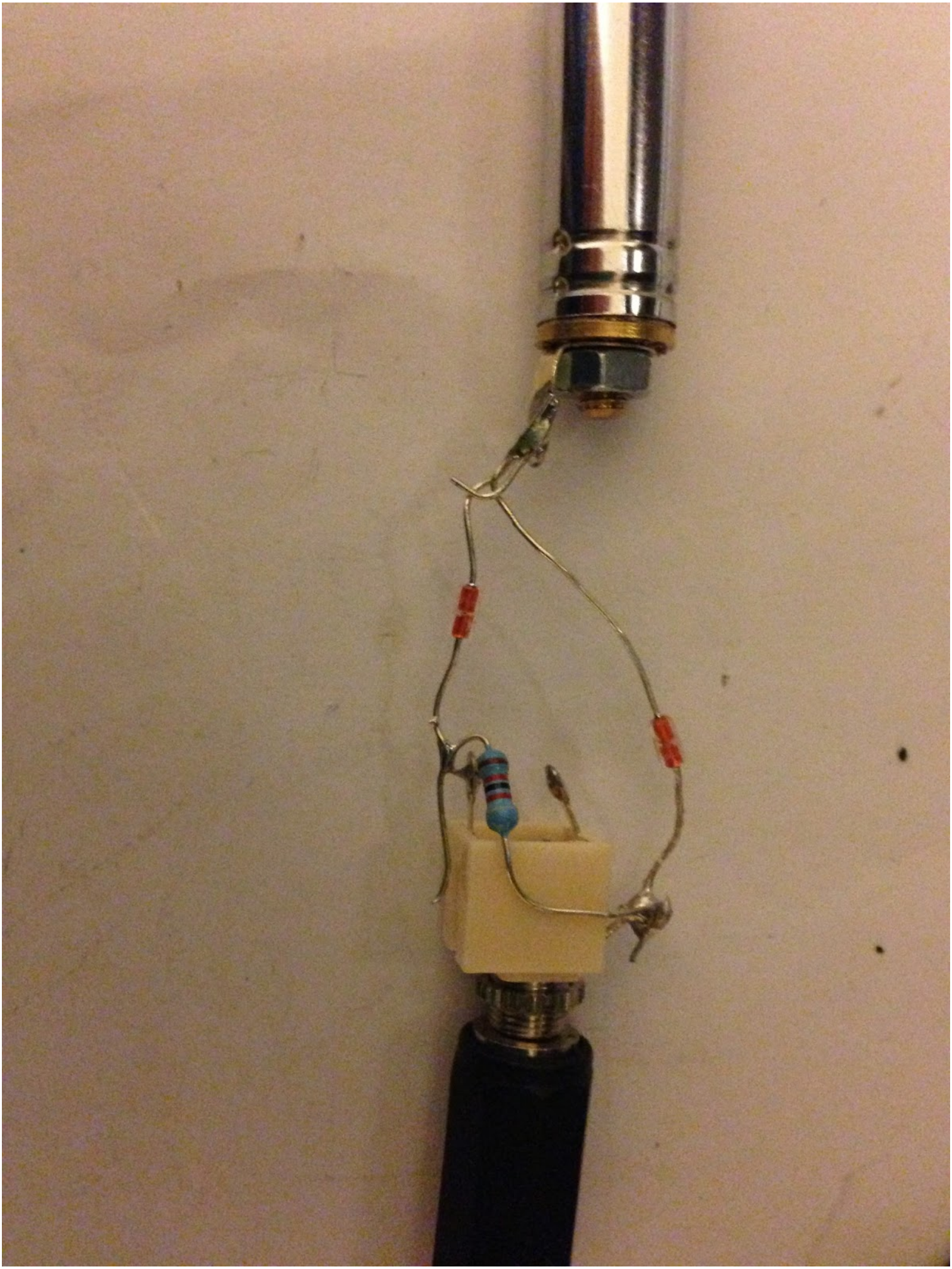

The simplest FM Crystal Radio Circuit - http://billydiy.blogspot.hk

Antenna - Extendable Radio 1.8 meter. That also serves as tuning

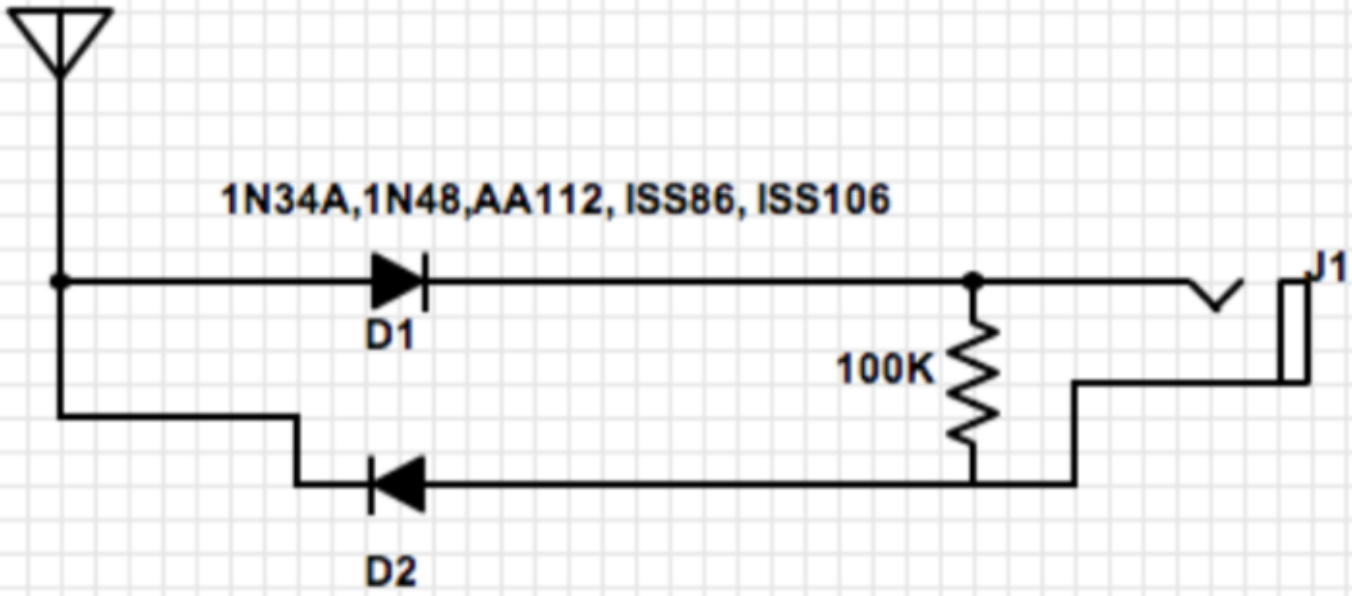

3.5mm Mono earphone Jack for Crystal earphone

Simple crystal receiver for FM

Carlo Bramanti

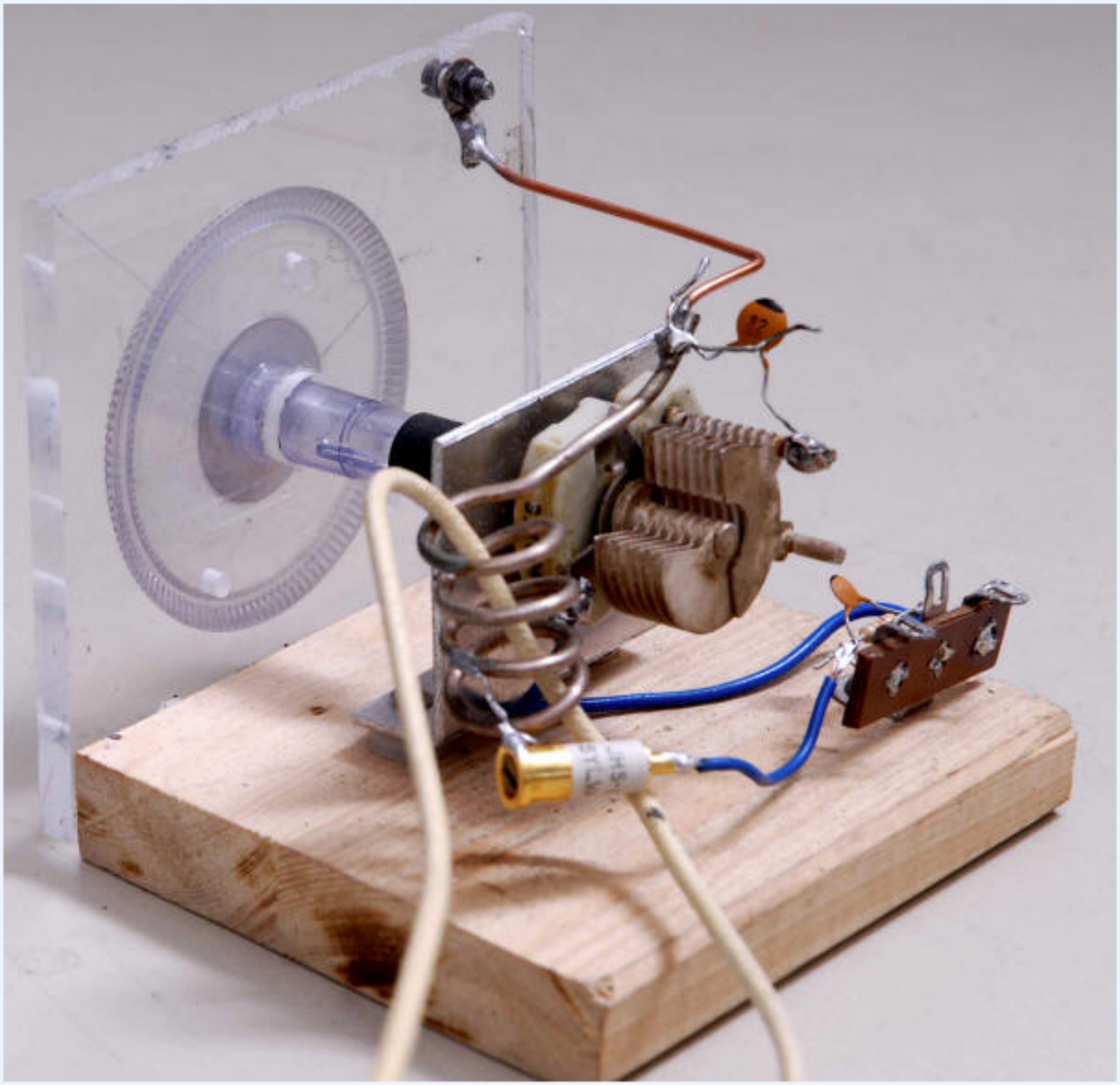

FM Crystal Radio Circuit

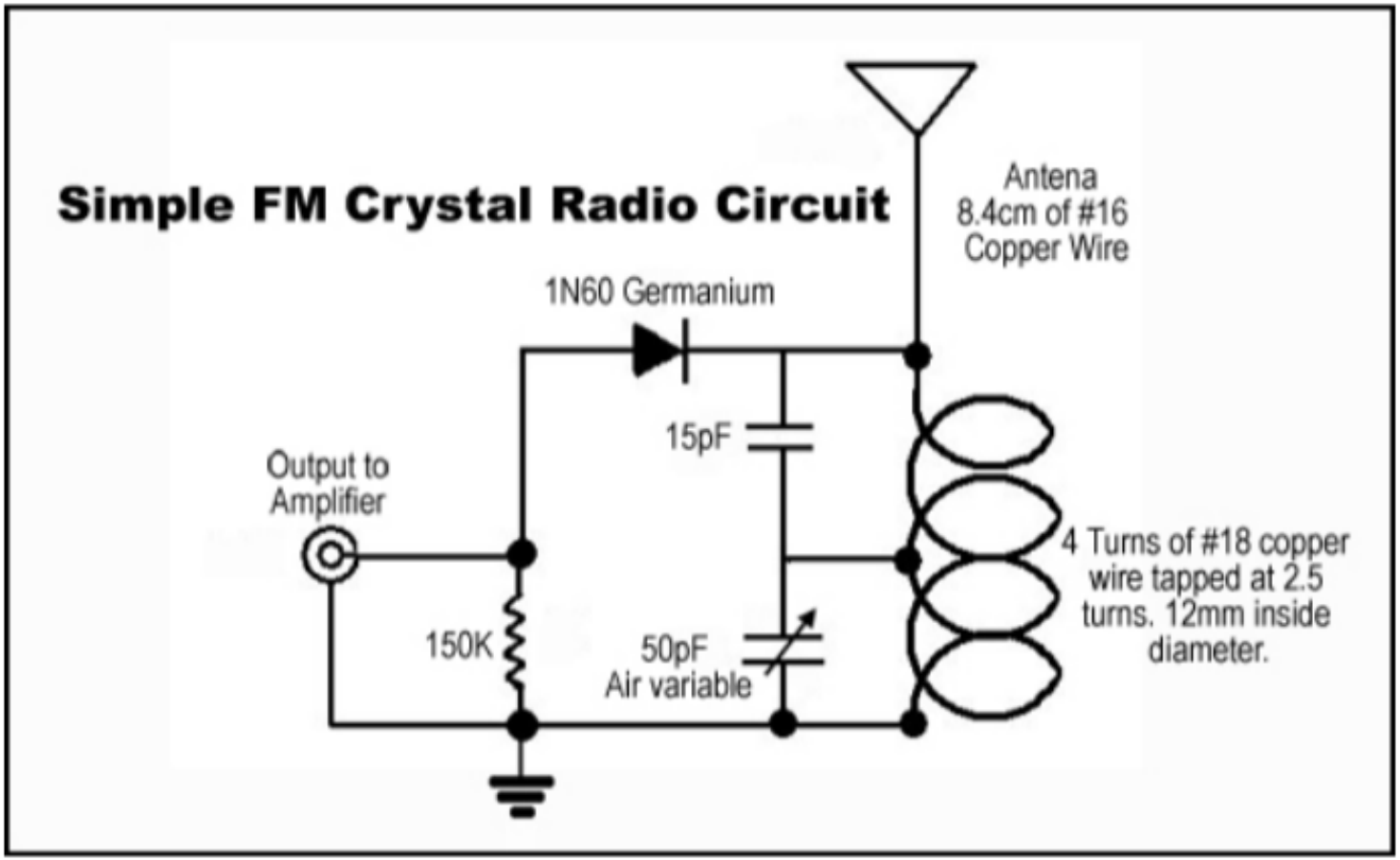

Parts List (some of these parts you can buy from our online store):

- 1N60 Germanium Diode
- 15pF Ceramic Capacitor
- 50pF Variable Capacitor
- 150K Ohm Resistor
- #16 & #18 Copper wires

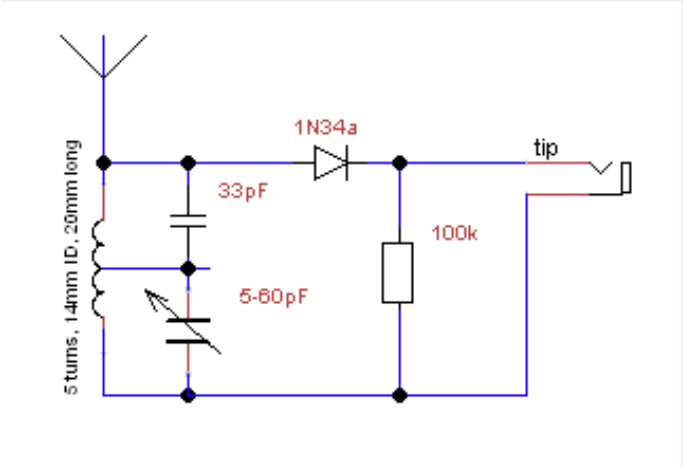
5 turns, 14mm ID, 20mm long
33pF
5-60pF
1N34a
100k
tip

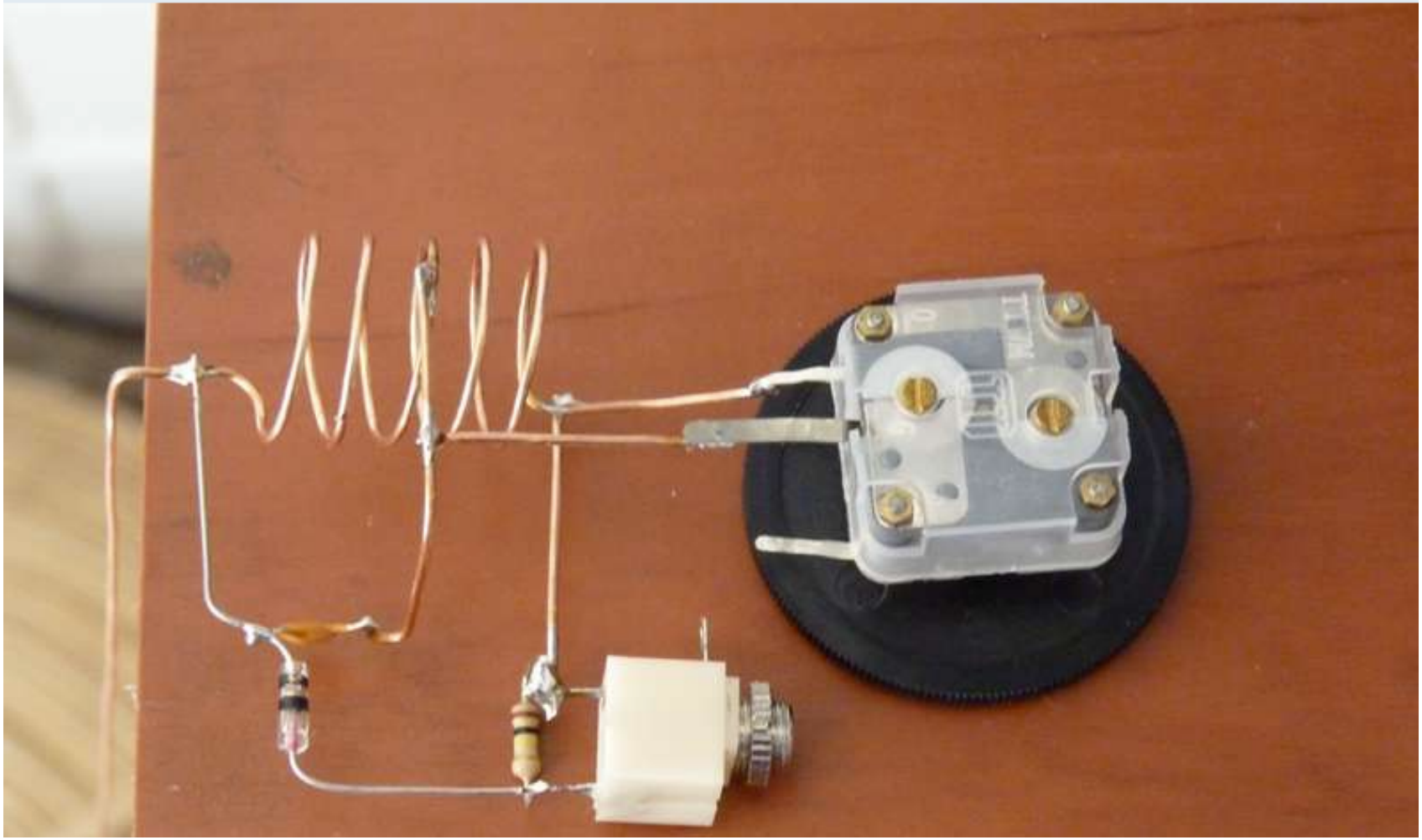

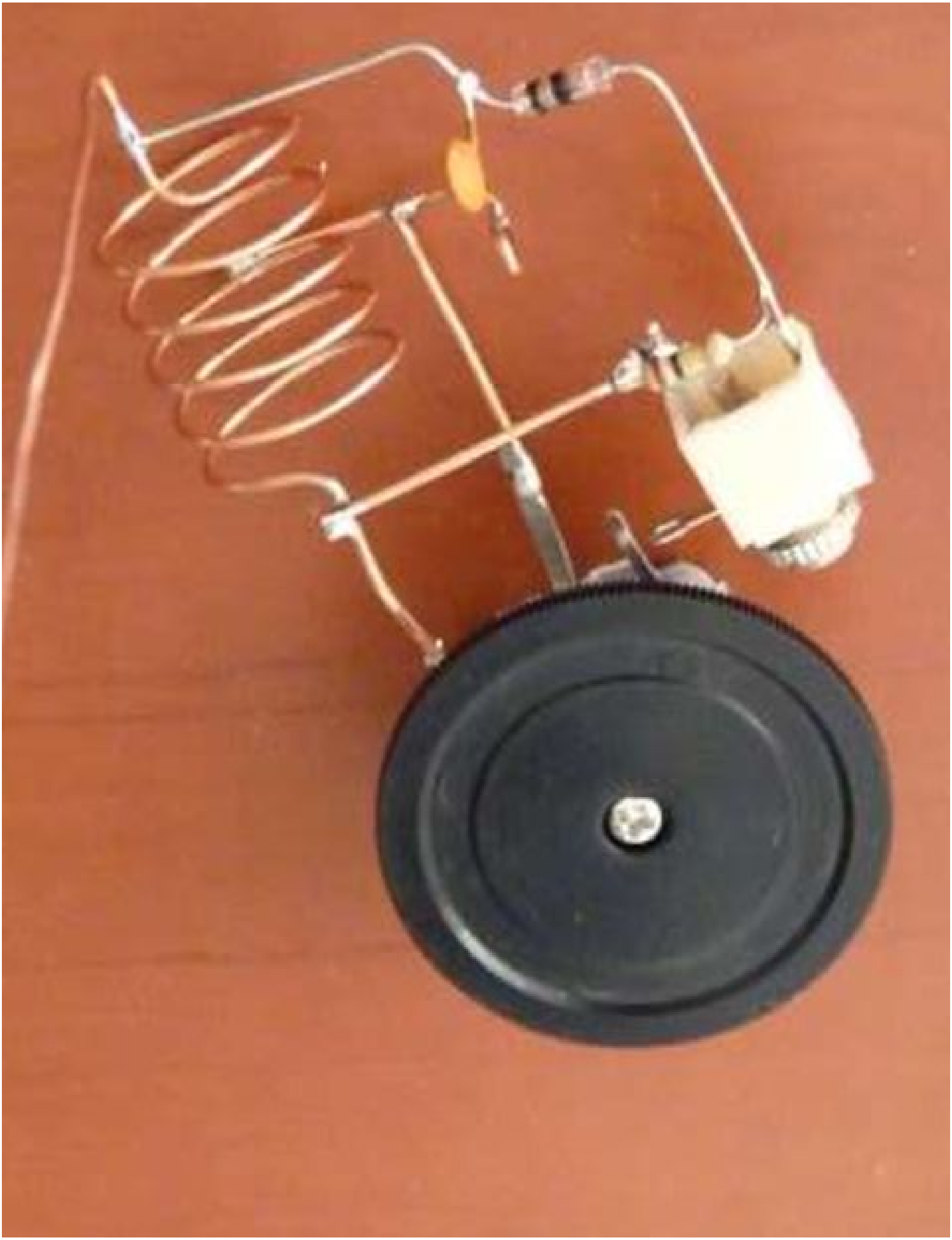

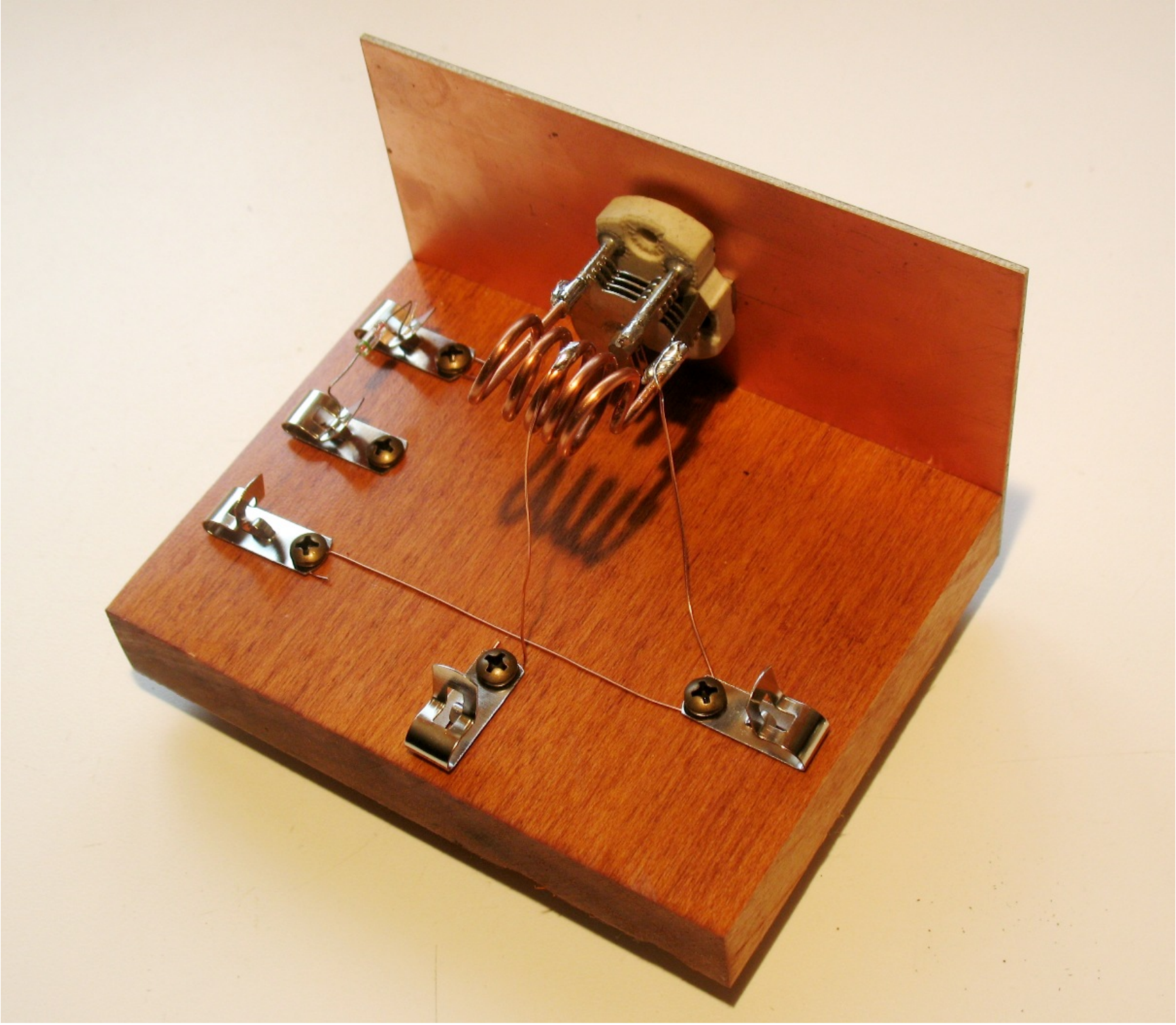

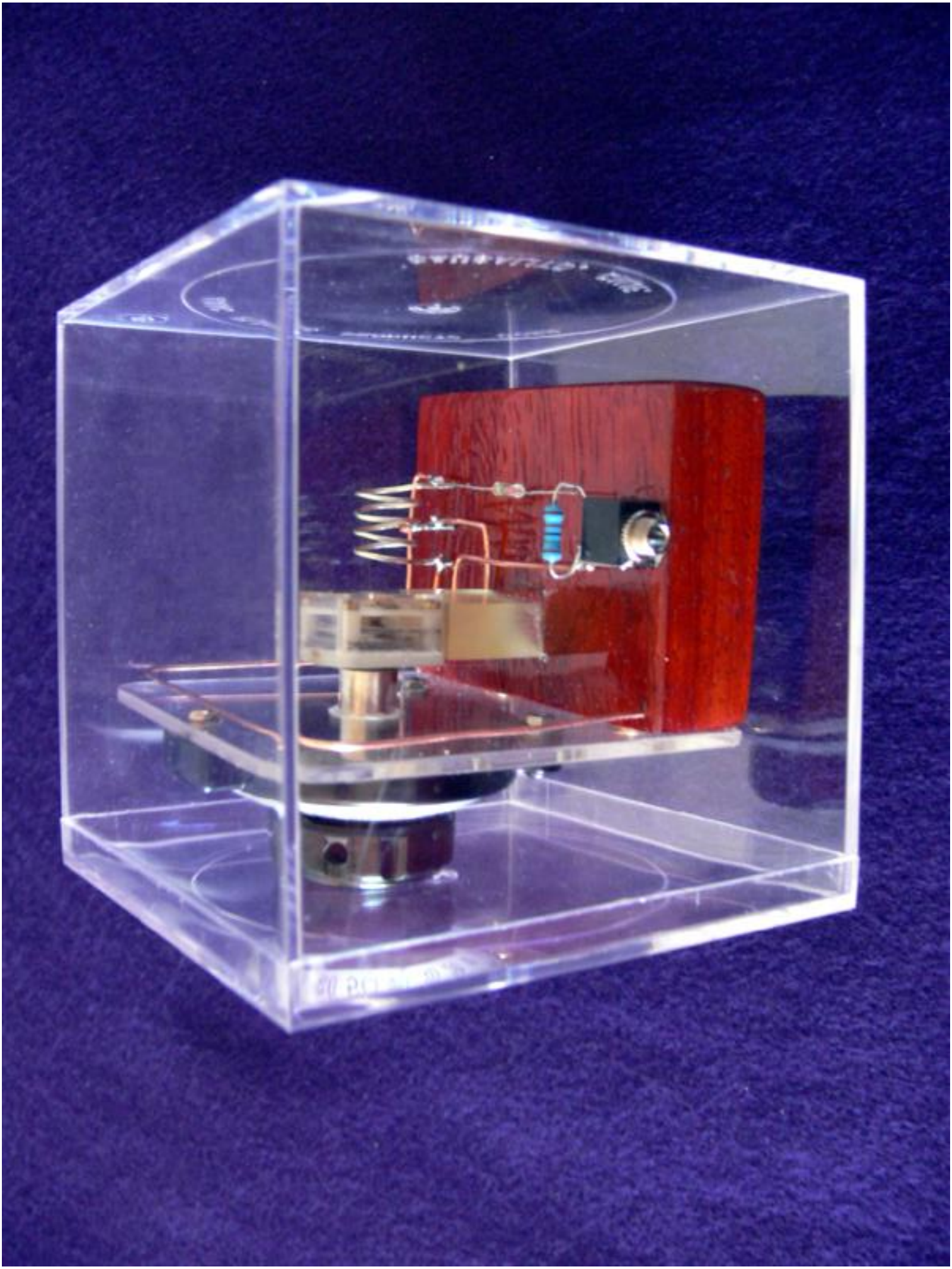

L - 4 turns #18 copper or silver wire, 12mm inside diameter, tapped at 2.5 turns
Ant - 7 inches of #18 bare copper wire
C1 - 18 pf ceramic capacitor
C2 - 50 pf air variable capacitor
D - 1N34 diode or rock crystal
R - 150K resistor

All passive components

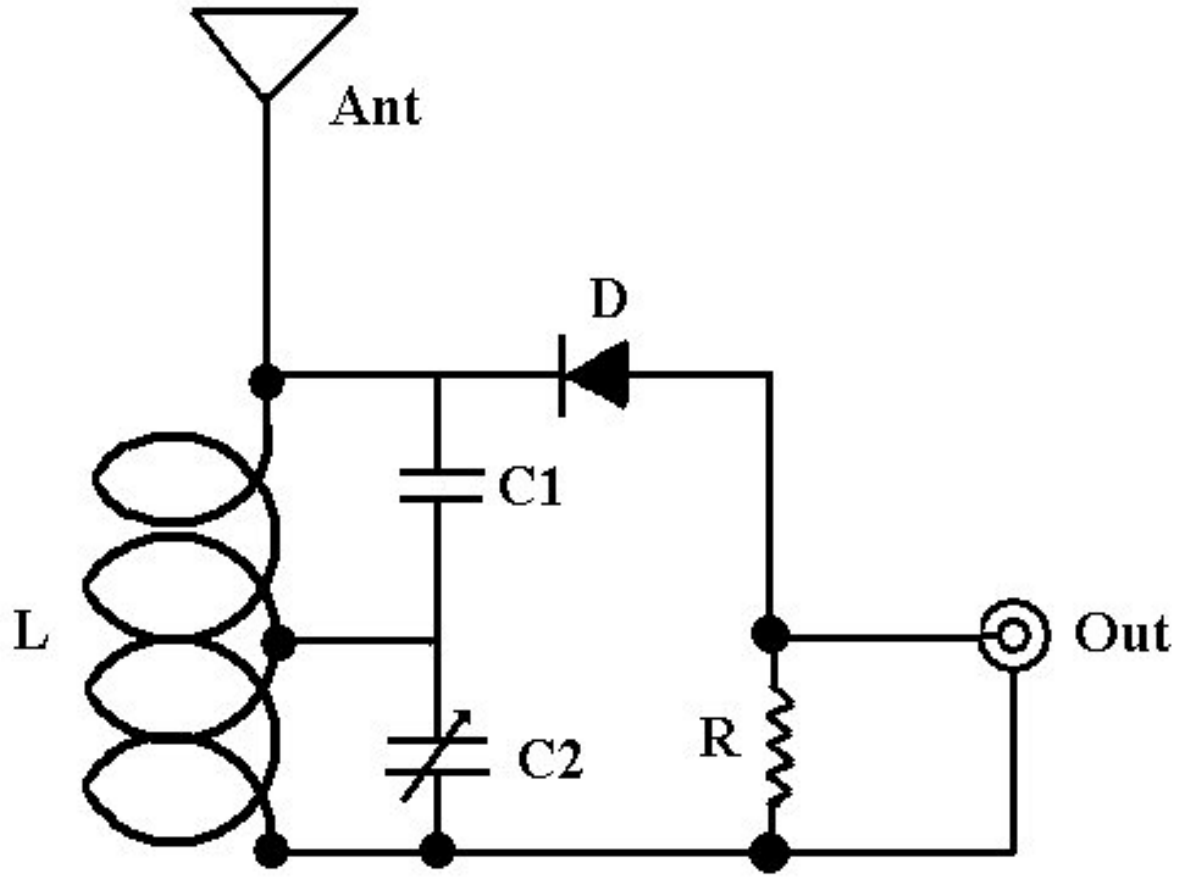

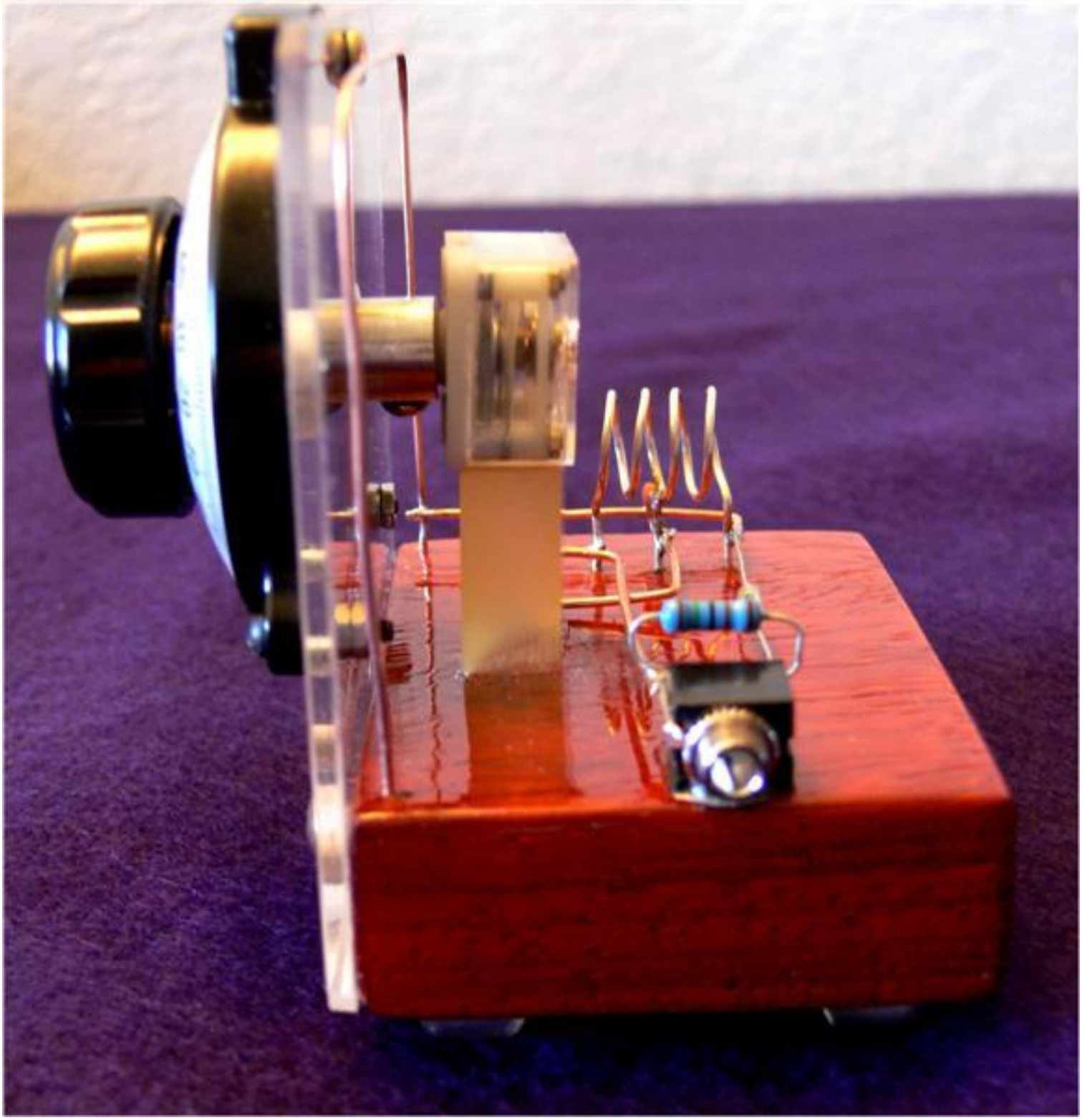

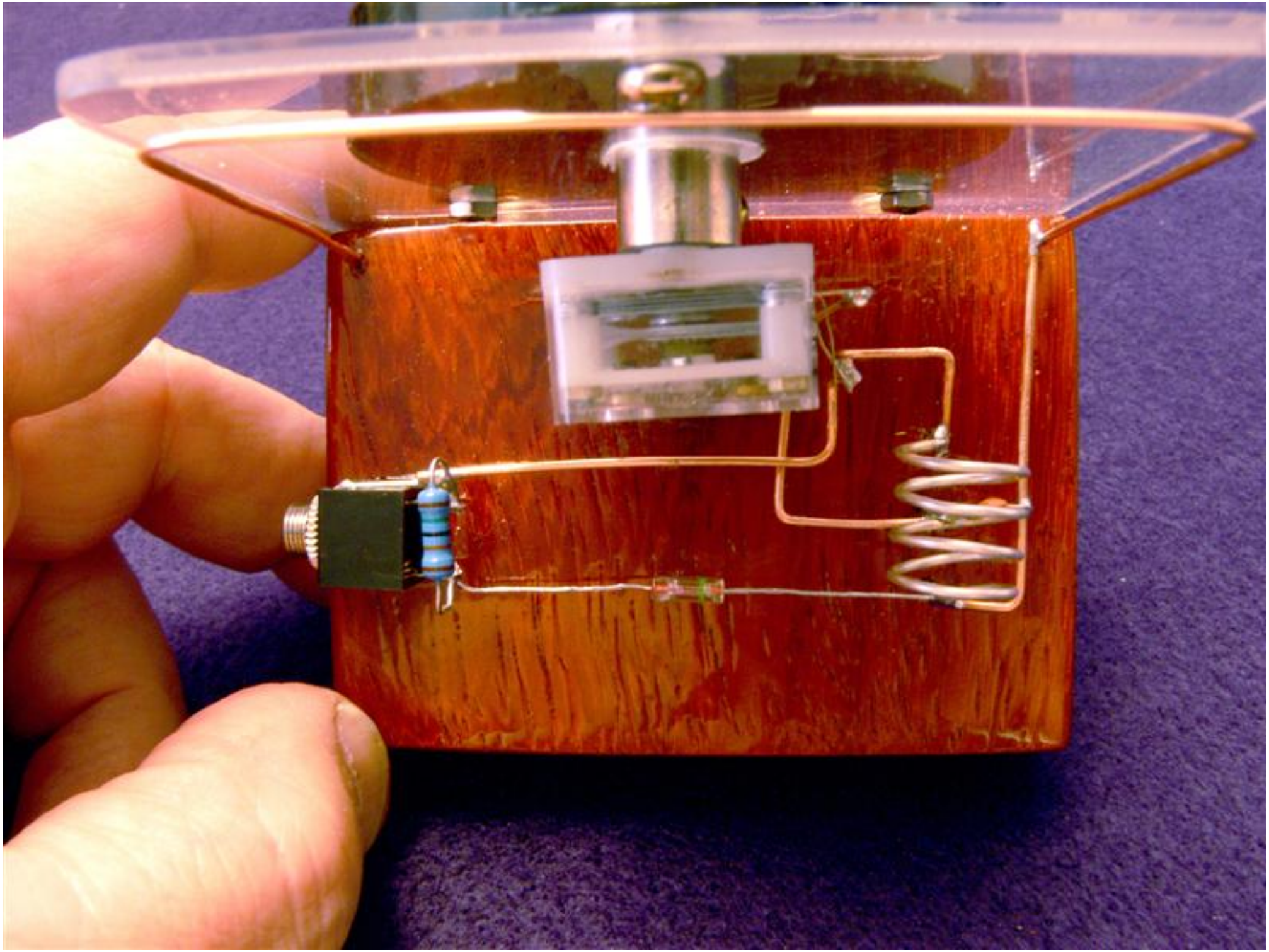

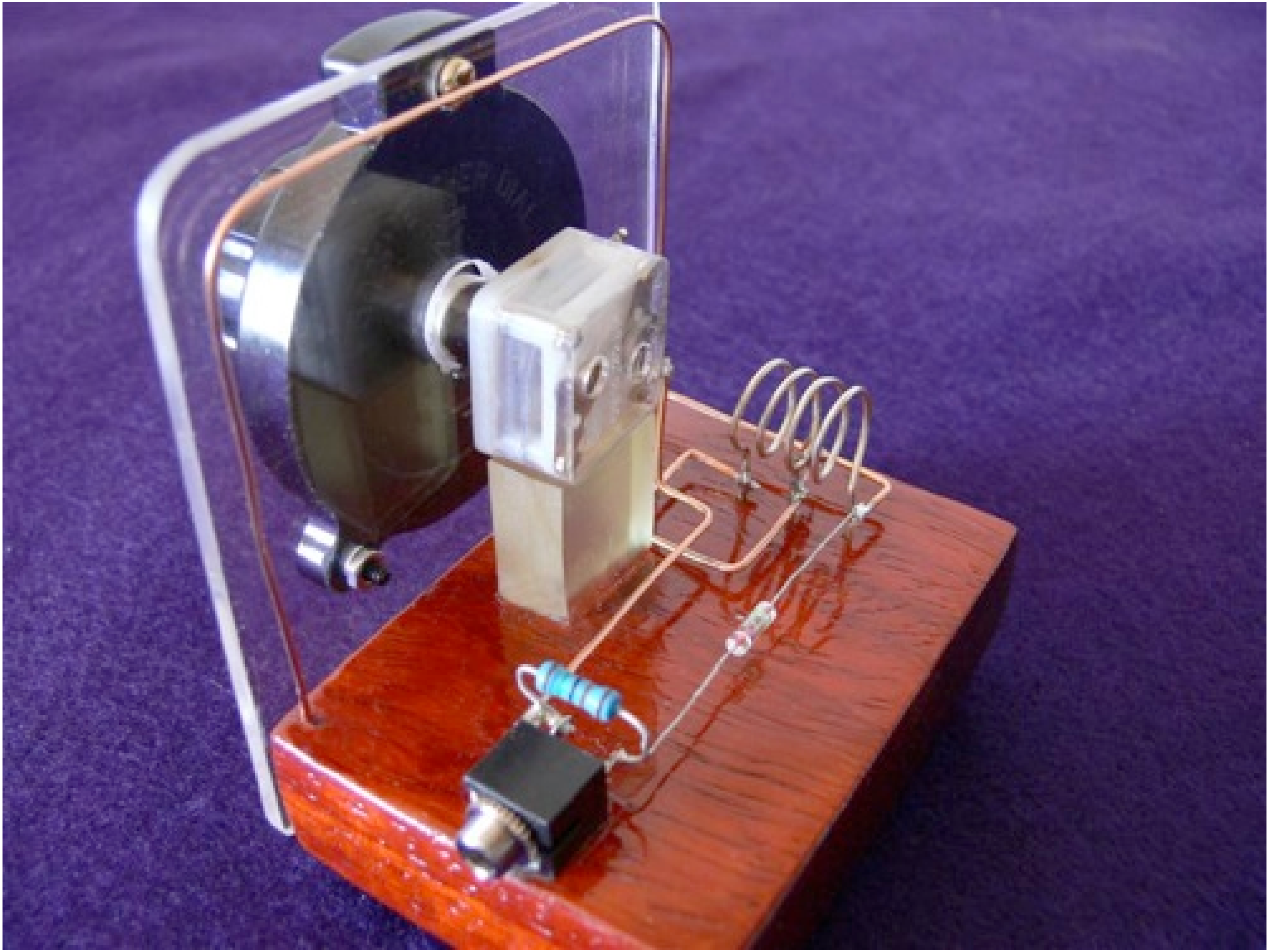

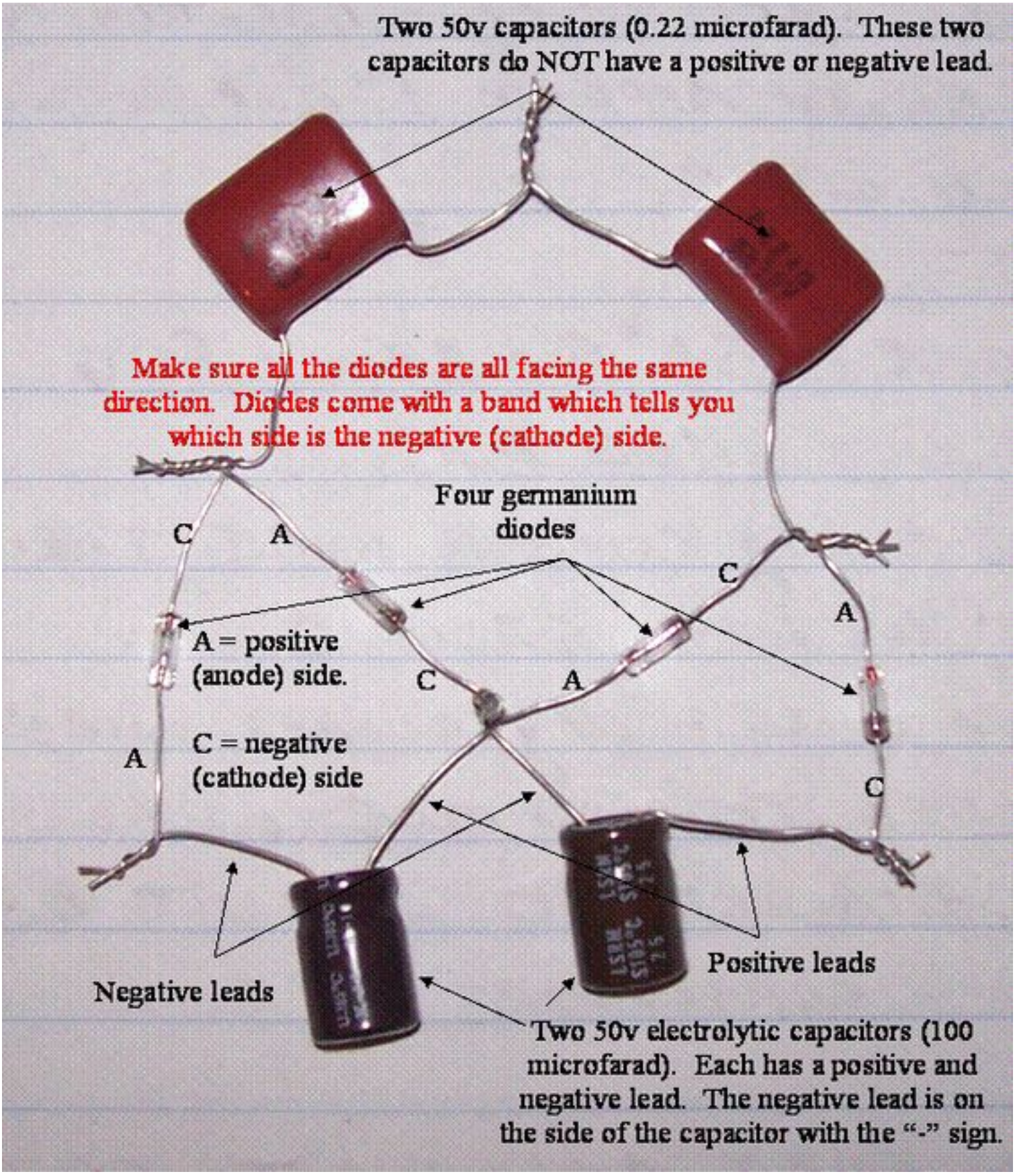
Two 50v capacitors (0.22 microfarad). These two capacitors do NOT have a positive or negative lead.
Make sure all the diodes are all facing the same direction. Diodes come with a band which tells you which side is the negative (cathode) side.
Four germanium diodes
C
A
C
A
A = positive (anode) side.
C
A
C = negative (cathode) side
A
C
Negative leads
Positive leads
Two 50v electrolytic capacitors (100 microfarad). Each has a positive and negative lead. The negative lead is on the side of the capacitor with the "-" sign.

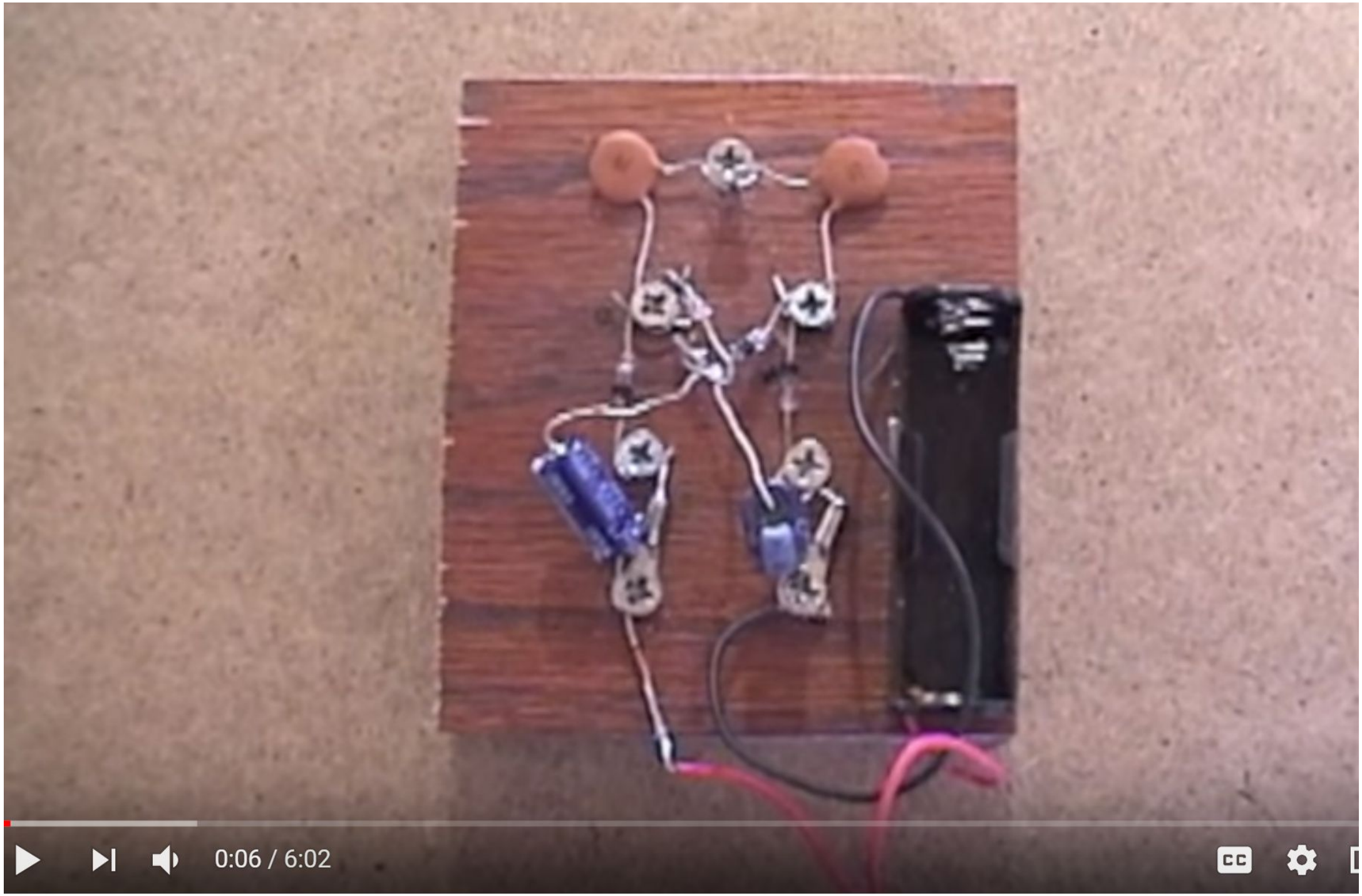
0:06 / 6:02

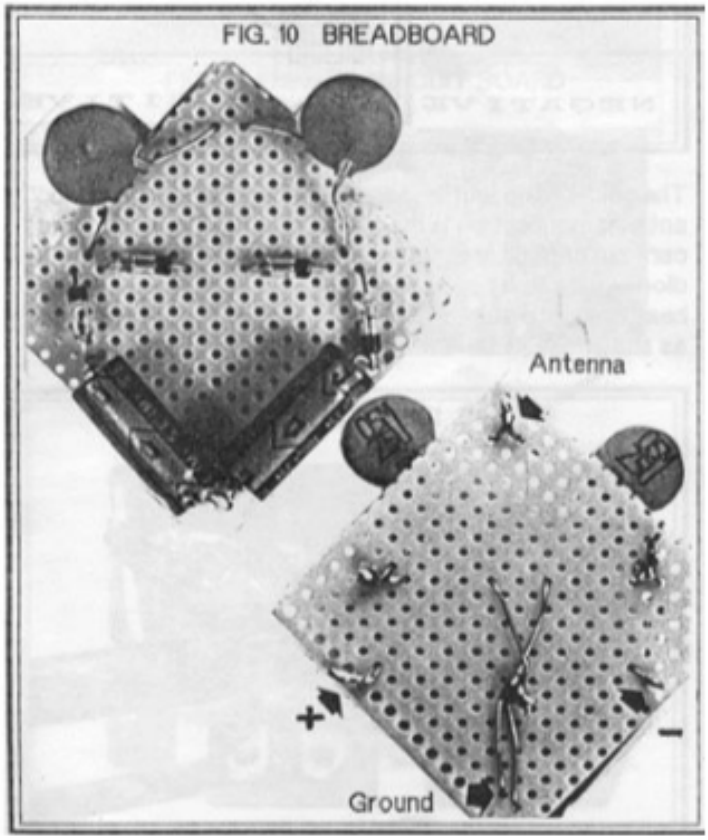

FIG. 10 BREADBOARD

the board as shown in Figure 11. This unit is powering a small red LED indicated by the arrow.

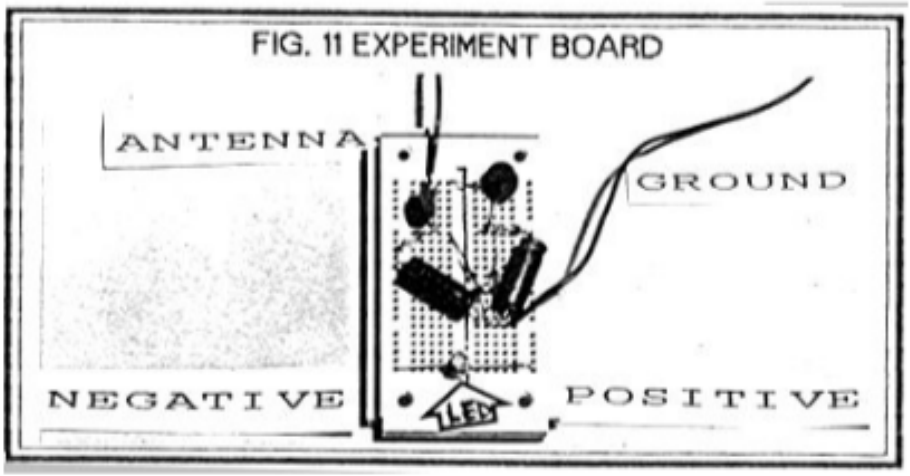

FIG. 11 EXPERIMENT BOARD

made to the twisted ends of the ceramic capacitors. When soldering the leads of the 1N34 diodes, care must be taken to

FIG. 9 TERMINAL STRIP

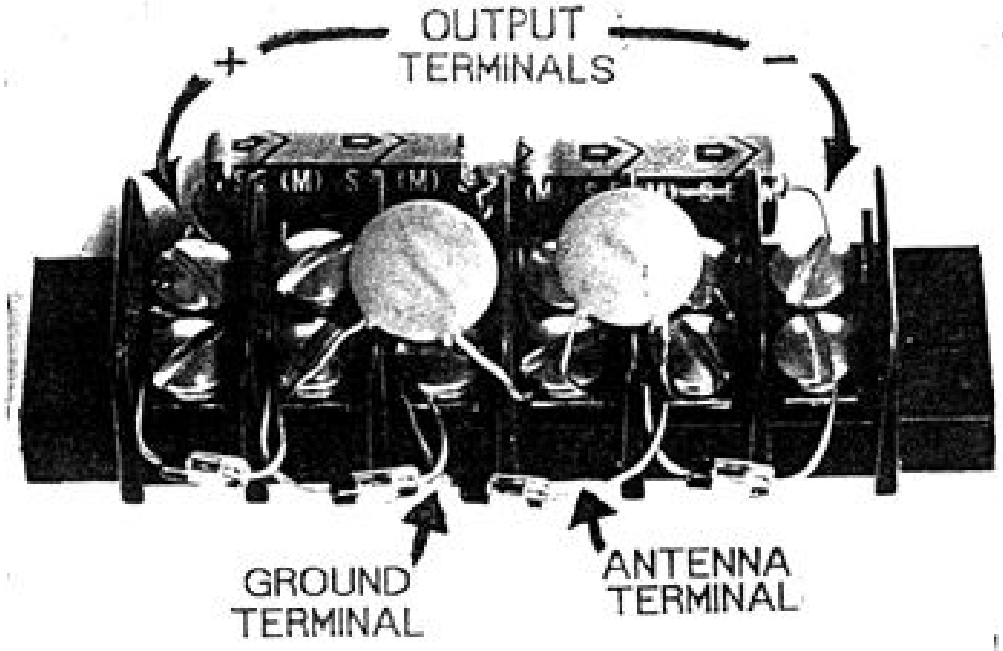

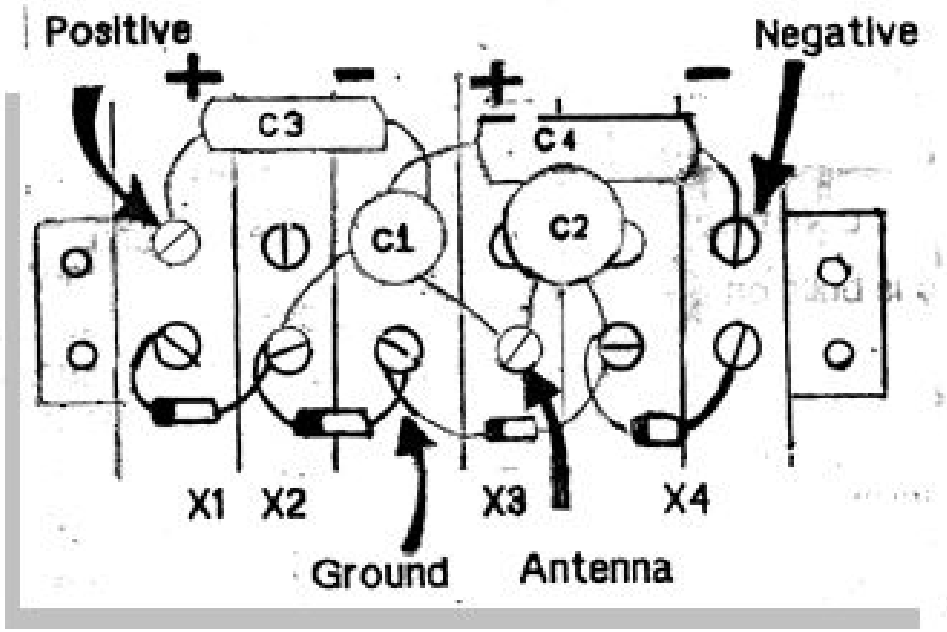

Amplifier circuit. The crystal radio used for example purposes is the crystal radio made from scraps here.

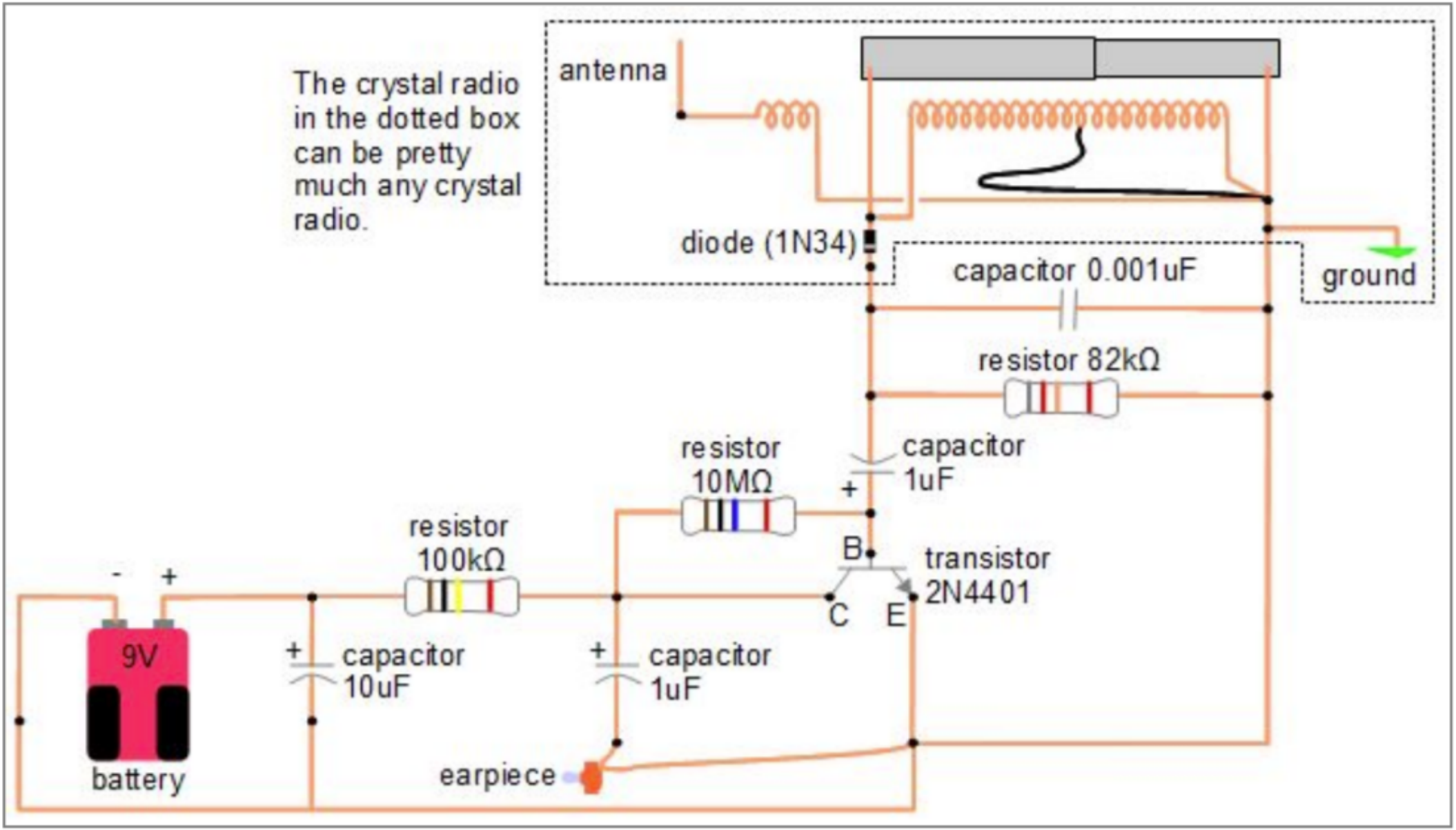

SATURDAY, NOVEMBER 13, 2010

SIMPLE FIELD STRENGTH METER

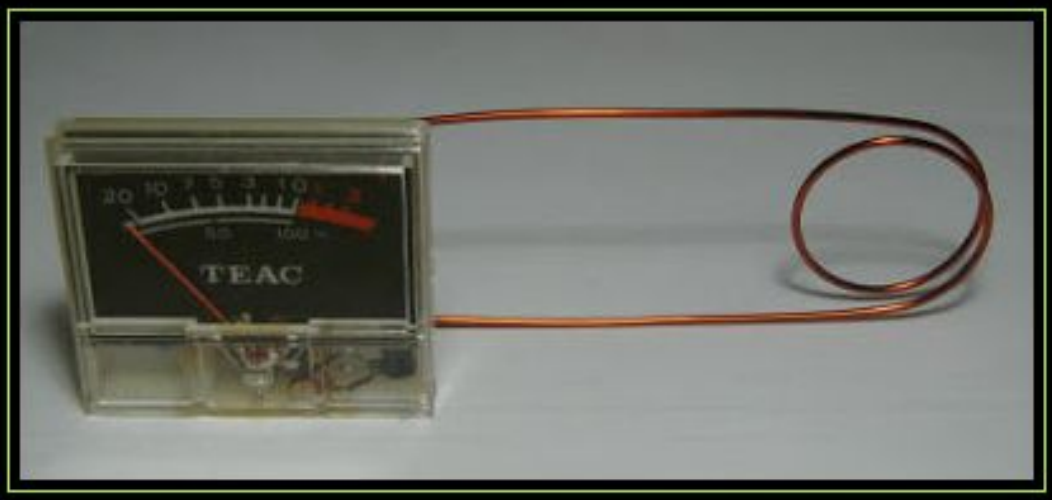

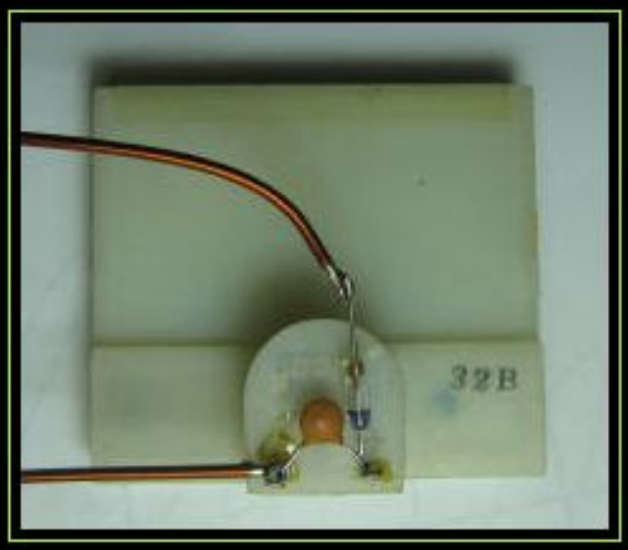

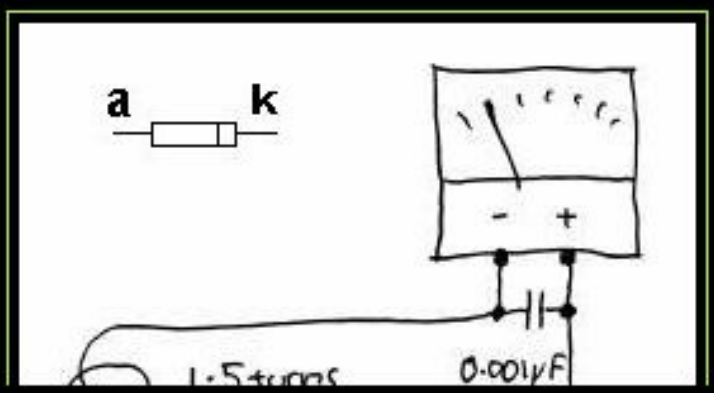

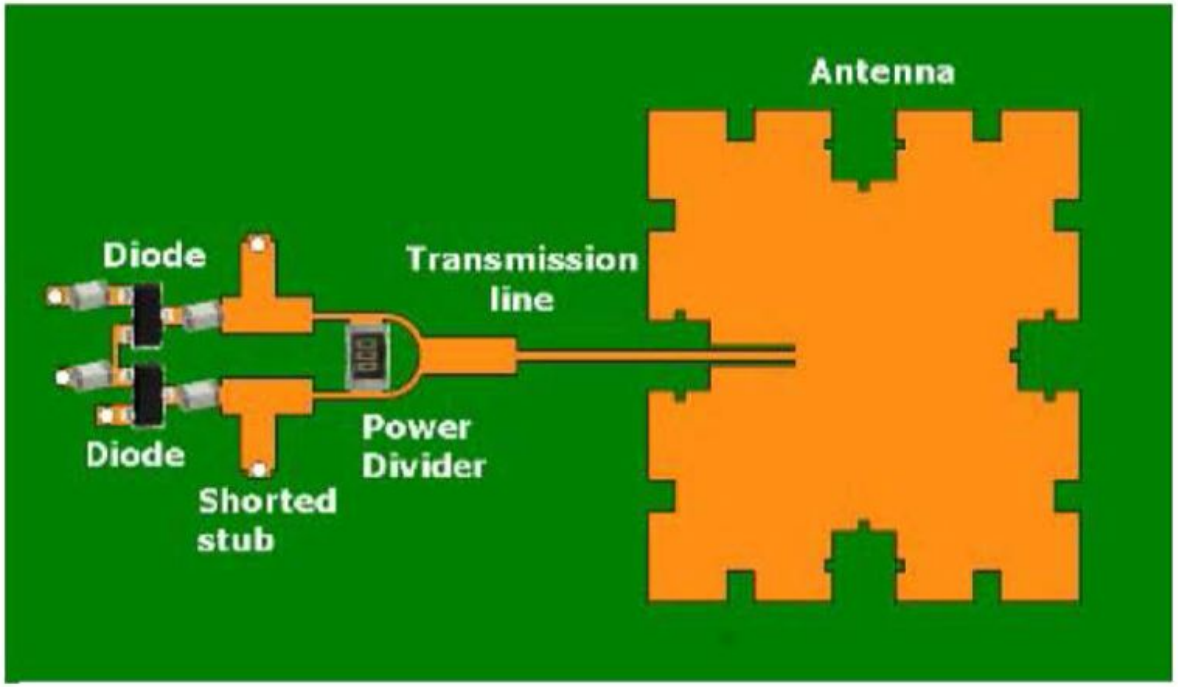
Antenna
Diode
Transmission line
Diode
Power Divider
Shorted stub

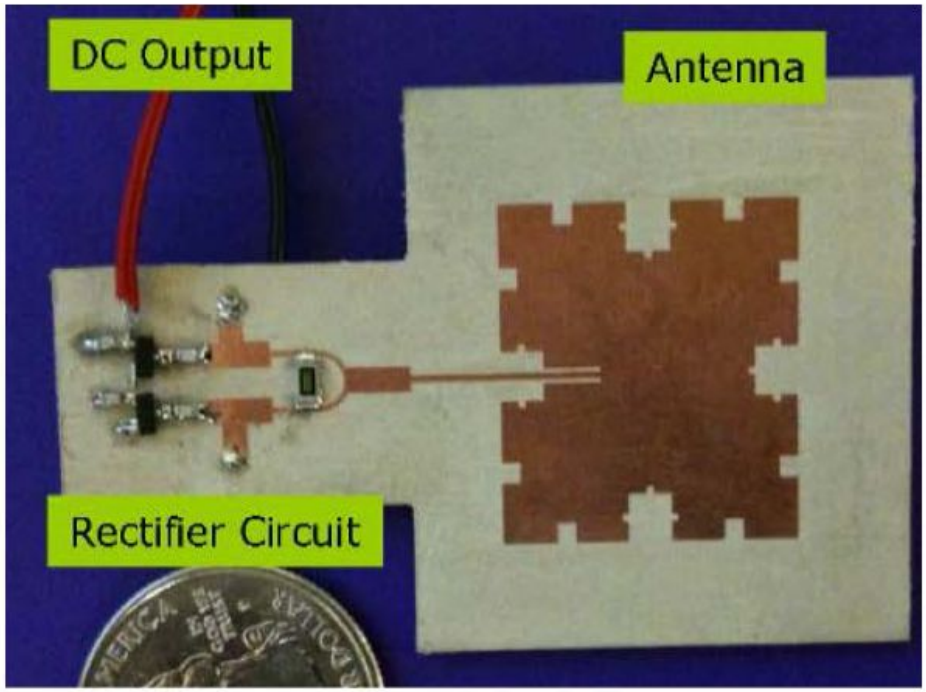
DC Output
Antenna
Rectifier Circuit

4. Results and Analysis

The simulated and measured results at the output voltage of voltage multiplier circuit are shown graphically in **Figure 8**. From the graph analysis, the simulated and the measured results agree considerably with each other. The measured results are shown to be better than the simulation results. The reason behind this may be due to the uncertainty in series resistance value of the diode obtained from SPICE parameters in modeling as explained in Equation (5). This resistance vale of diodes in practical circuit may be lower than in the model, which provides fast discharge path, in turn rise in voltage as passes through the stages and reaches to final output. In this work, the DC output voltages obtained through simulation and measurement at 0 dBm re 2.12 V and 5.0 V respectively. These results are comparatively much better than in ref. [9], where in at 0 dBm, 900 MHz they achieved 0.5 V and 0.8 V through simulation and measurement increasing to 1.4 V, 1.67 V, 1.87 V and 2.12 V for 4, 5, 6 and 7 stages respectively compared to 2 mS as shown in [10]. **Figure 12** shows that the conversion ratio of 22 is achieved at 0 dBm input power and drops to 2.5 at –40 dBm. The highest value at 0 dBm is due to the innate characteristics of the zero bias Schottky diodes which conduct fairly well at higher input voltages.

5. Conclusion

From the experimental results, it is found that the pro-

Table 2. Component used in 7 stage voltage multiplier.

Name of component	Label	Value
Stage capacitors	C_1 - C_{14}	3.3 nF
Stage diodes	D_1 - D_{14}	HSMS 2850
Filter capacitor	C_L	100 nF
Load resister	R_L	100 kΩ

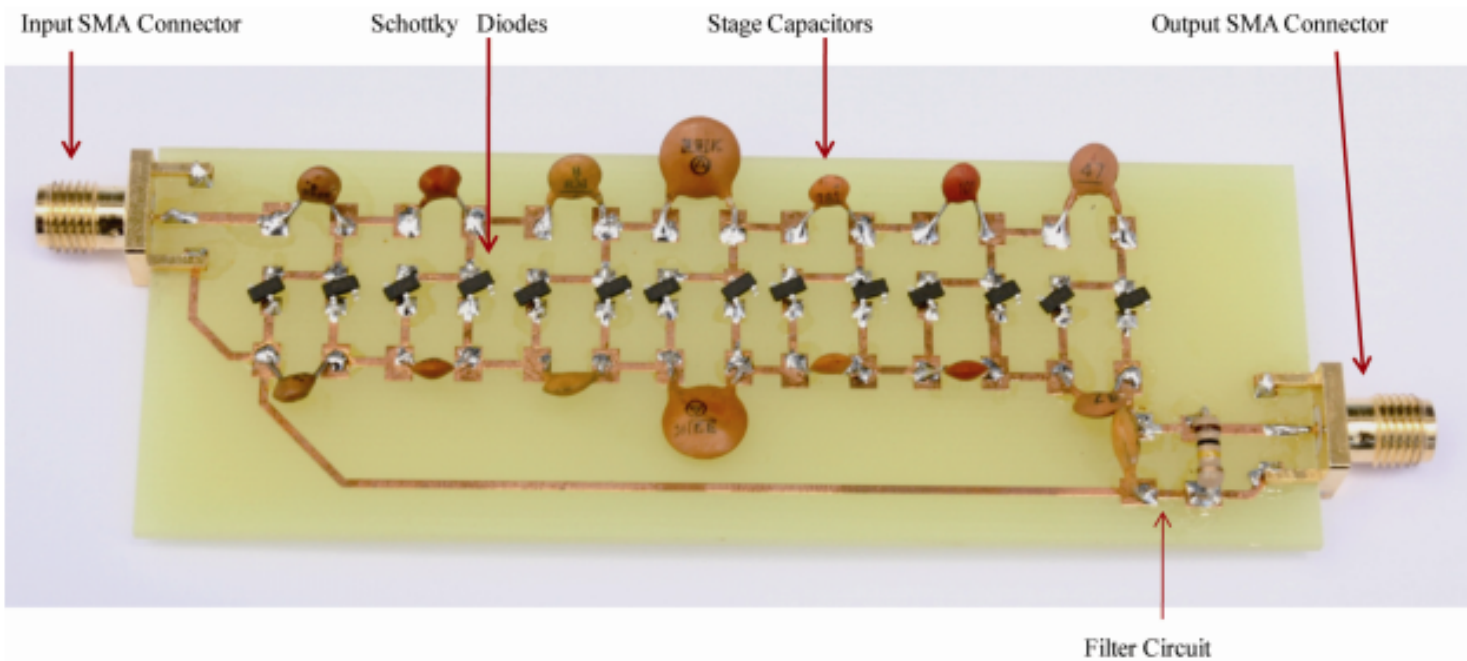

Figure 7. Photograph of assembled circuit board.

sign in this paper uses a capacitor across the load to store and provide DC leveling of the output voltage and its value only affects the speed of the transient response. Without a capacitor across the load, the output is not a good DC signal, but more of an offset AC signal.

In addition to the above, an equivalent load resistor is connected at the final node. The output voltage across the load decreases during the negative half cycle of the AC input signal. The voltage decreases is inversely proportional to the product of resistance and capacitance across the first stage was 3.3 nF, the second stage was 1.65 nF, third stage was 825 pF, fourth stage was 415 pF and so on. But keeping in view of testing, the capacitance values were chosen to have a close match with the standard available values in the market.

Simulation was carried out through 4 to 9 voltage doubler stages. Based on results obtained a 7 stage doubler is best to implemented for this application.

The design of the printed circuit board (PCB) was carried out using DipTrace software. The material used to

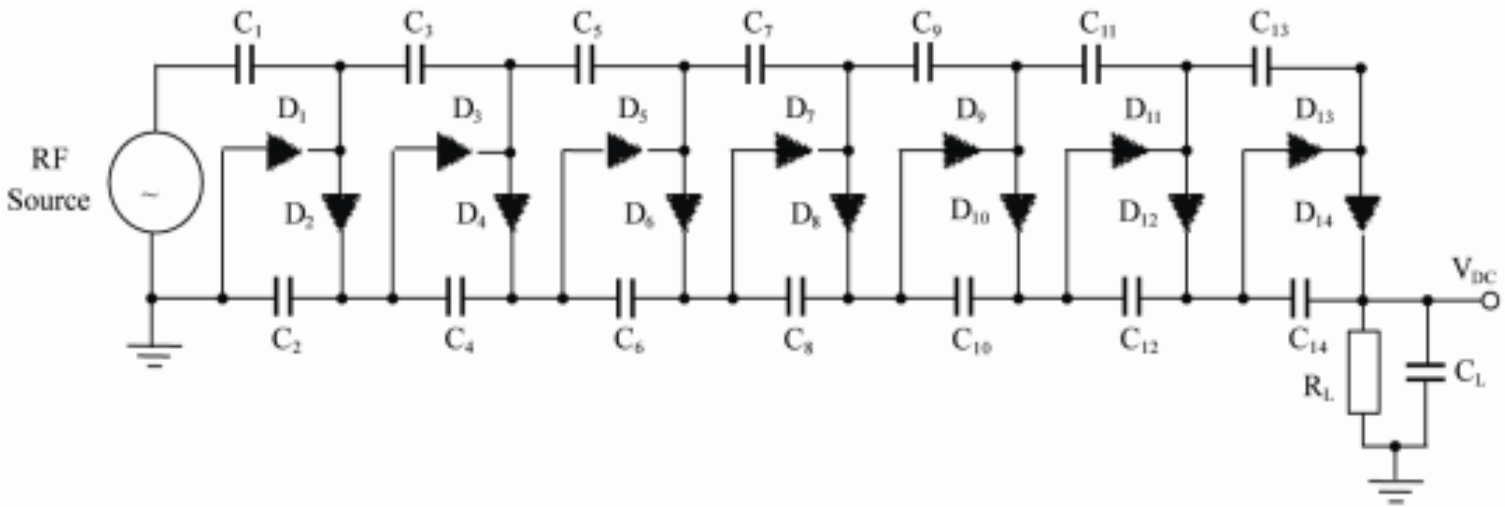

Figure 6. Schematic of 7 stage voltage multiplier.

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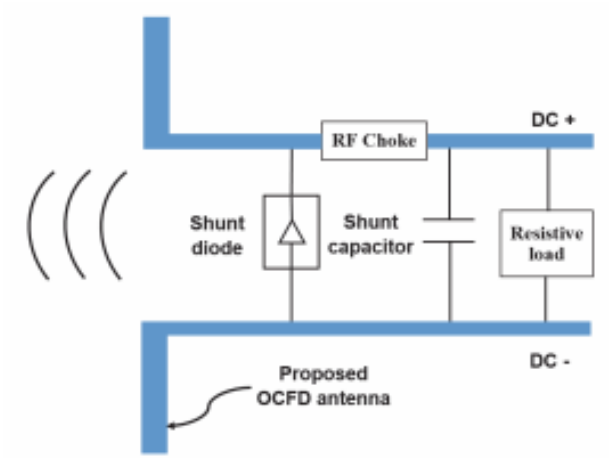

Fig. 9. Configuration of a single shunt diode (Class F) rectifier with a dipole antenna.

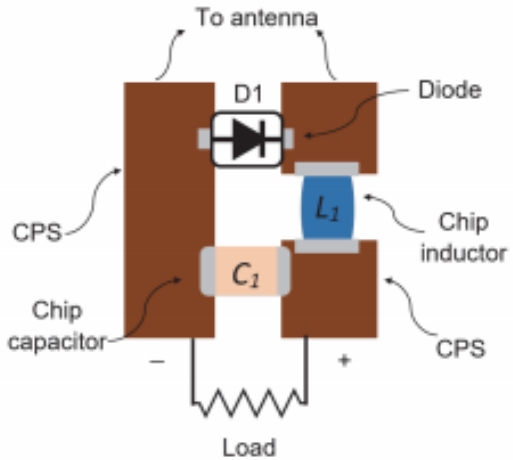

Fig. 10. Configuration of the proposed rectifier on coplanar striplines (CPS).

TABLE III
CIRCUIT COMPONENTS USED IN THE DESIGN

Component name	Nominal Value	Part number and supplier
D1	Schottky diode	SMS7630-079LF, Skyworks
L1	47 nH chip inductor	0603HP47N, Coilcraft
C1	100 nF chip capacitor	GRM188R71H104JA93D, Murata

antenna have a radius of 50 mm and a circumference angle of

respectively. While the imaginary part of the proposed OCFD is around 0 Ω at resonant frequencies 0.6 GHz, 1.2 GHz and 2.4 GHz, which are f_0, $2f_0$, and $4f_0$ respectively. These results have demonstrated that the simulated results agree with the OCFD theory as discussed in Section III–A. Furthermore, the imaginary part of the impedance of the antenna over the resonant frequency band from 1.4 to 2 GHz turns from negative values (for the reference antenna) to positive values (for the proposed antenna). As shown in Fig. 7(b), the value of the imaginary part of the proposed antenna impedance varies between 0 and 300 Ω over the desired frequency band. This feature could help the proposed antenna to produce a better conjugate matching with the rectifier, since the imaginary part of the impedance of the rectifier normally varies between -700 and 0 Ω as we discussed earlier. The simulated 3D radiation patterns of the proposed antenna at the frequencies of interest are depicted in Fig. 8. The 2D polar plots of antenna patterns in *E-plane* and *H-plane* are shown as well. Here we have only showed the directivity (maximum gain) of the antenna (without taking the mismatch loss into account). From Fig. 8, it can be seen that the antenna has symmetrical patterns about YOZ plane with a maximum directivity of 1.8 dBi at 0.9 GHz, 3.5 dBi at 1.8 GHz and 3.3 dBi at 2.4 GHz. The antenna is more directive towards the long arm direction at 1.8 GHz and 2.4 GHz with the half-power beam-widths (HPBW) of around 174° and 185° respectively. The HPBW is about 96° at 0.9 GHz.

Therefore, the proposed broadband OCFD antenna has obtained high impedance over a wide frequency range. The proposed design is just an example to illustrate the proposed new method. The details of the dipole could be modified according to the frequency of interest.

IV. RECTENNA INTEGRATION

A. Rectifier Configuration

The proposed high impedance OCFD antenna may directly conjugate match with the input impedance of a rectifier over a wide frequency band. The rectifier should only consist of few circuit components for rectification, DC storage and output. A single shunt diode rectifier is selected due to its very simple structure and high conversion efficiency [33]. The configuration of the single shunt diode rectifier with a dipole

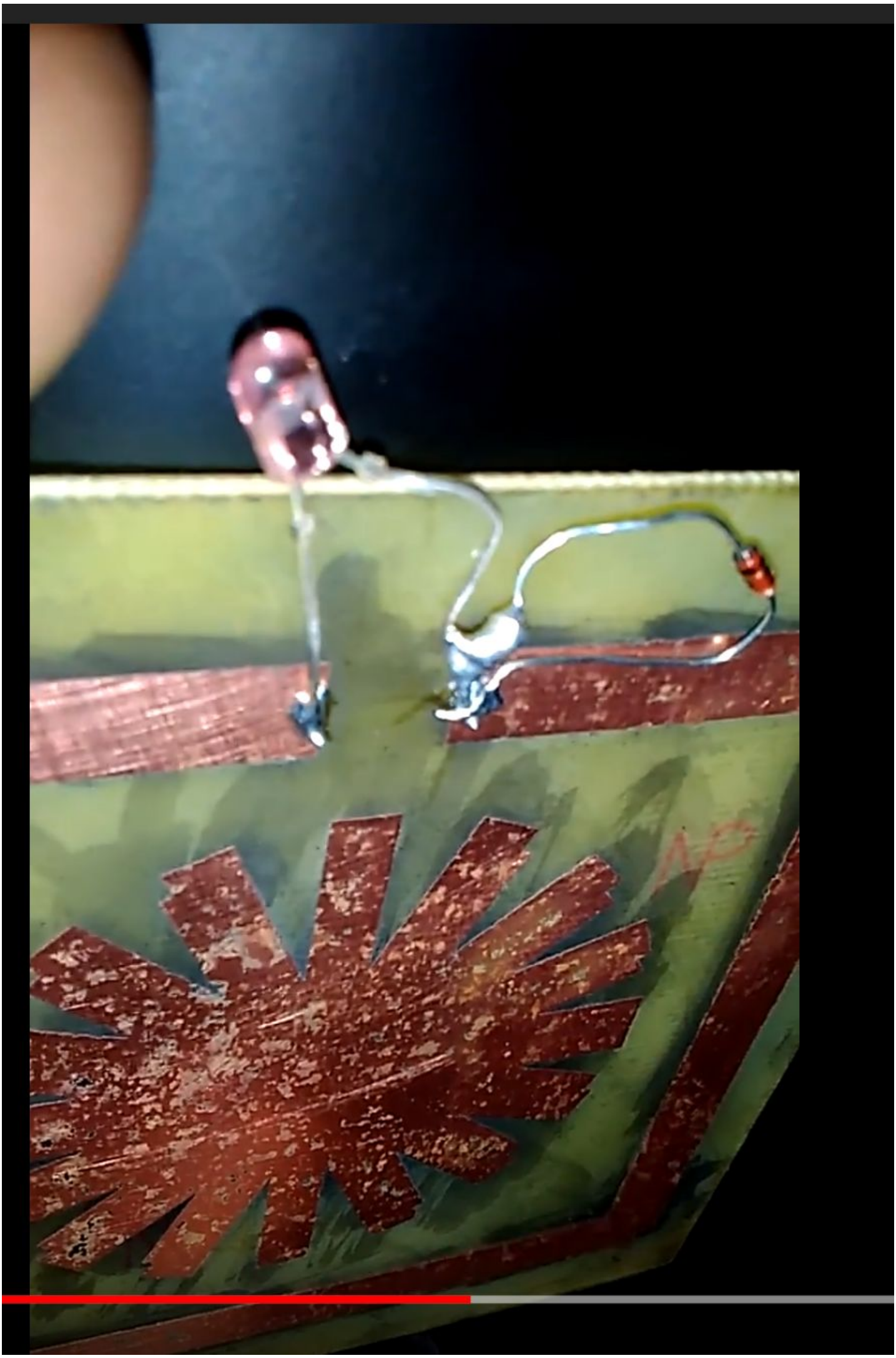

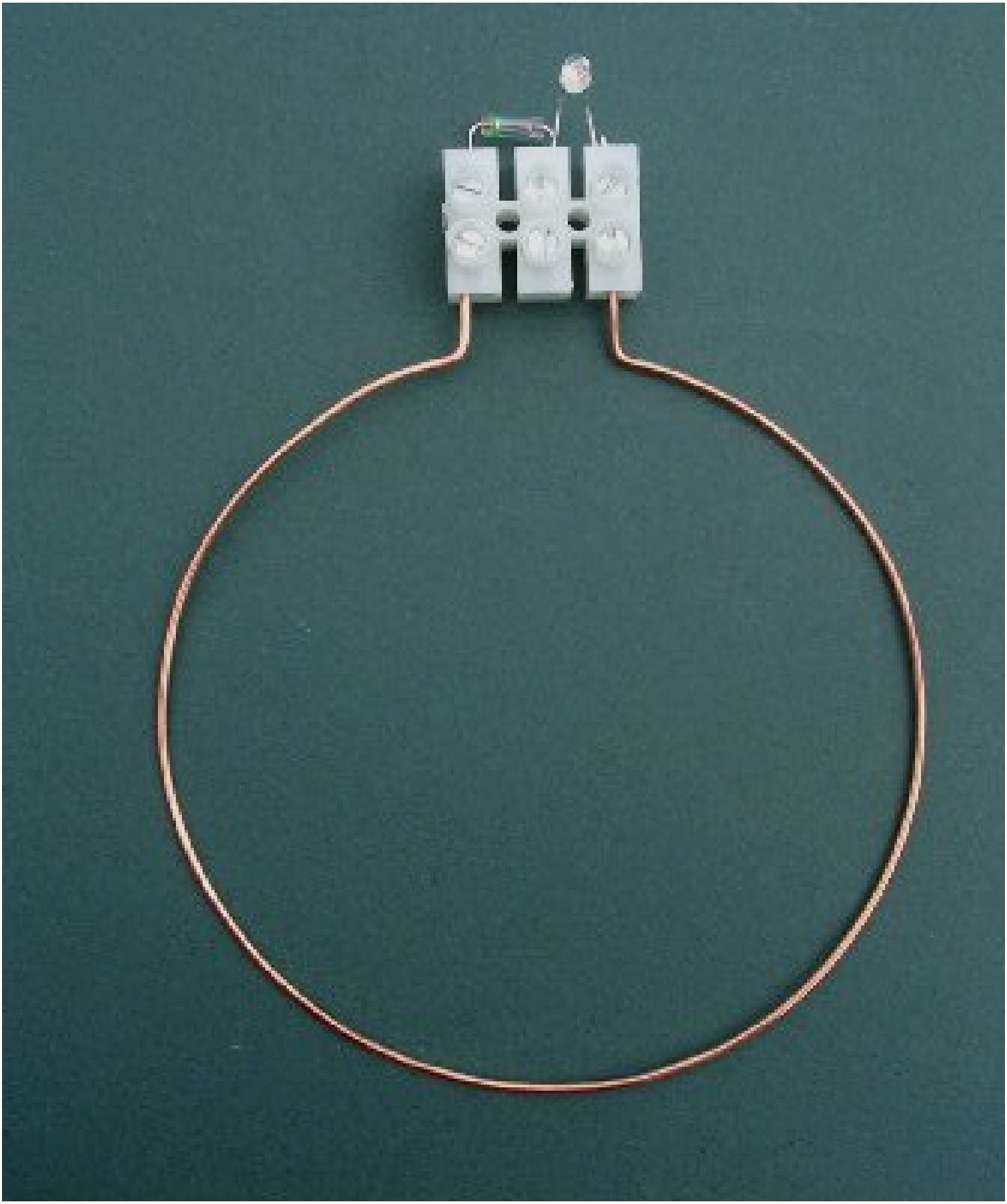

Sony Ericsson

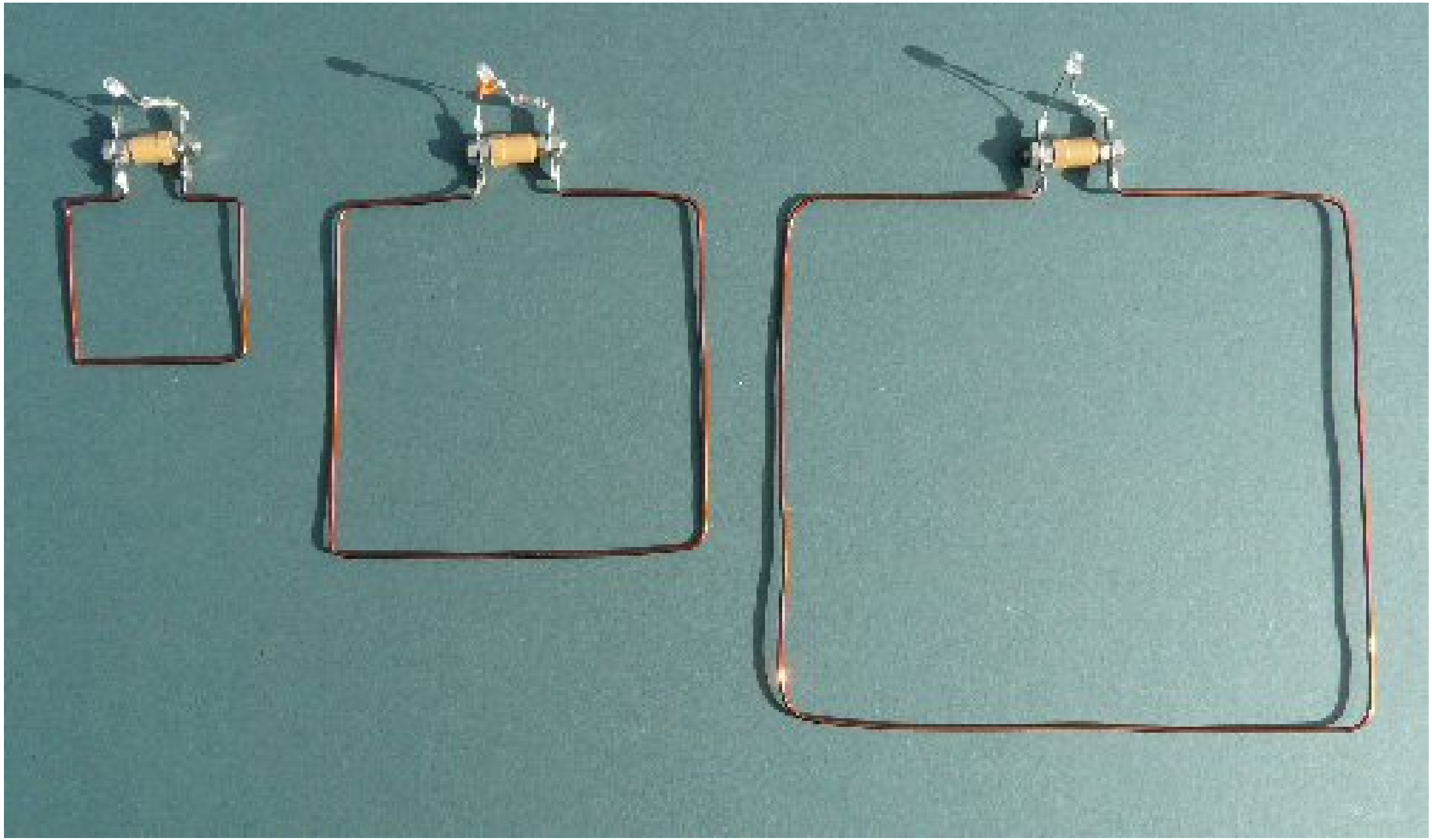

ake and it can be sent in an envelope. I made tens of them and sent them to politicians, newspapers, universities... I gave some to local people, together with a user
later version, that can be rolled up in an envelope that fits the conditions to be sent with only one stamp.

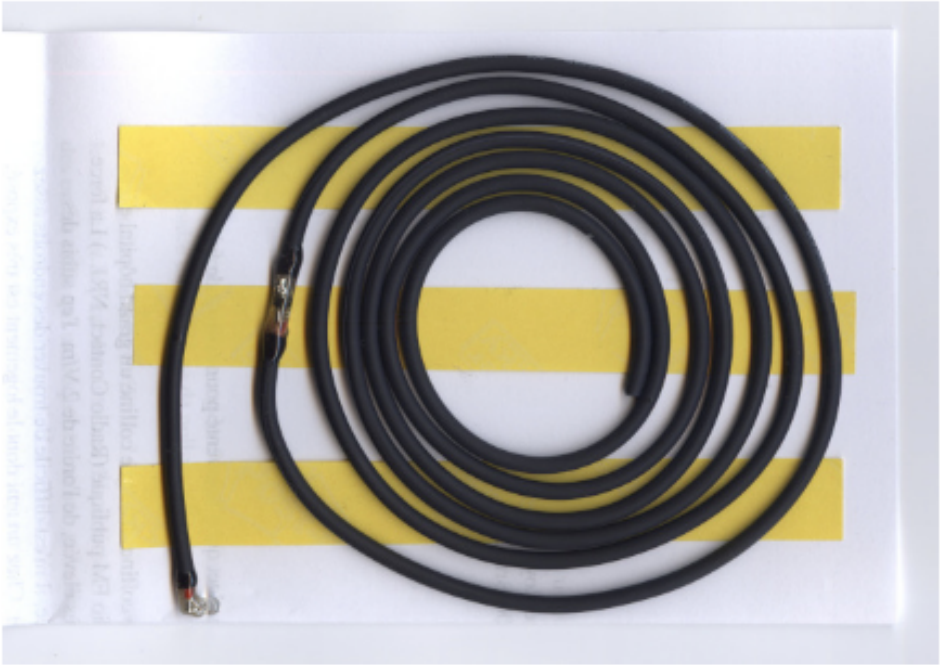

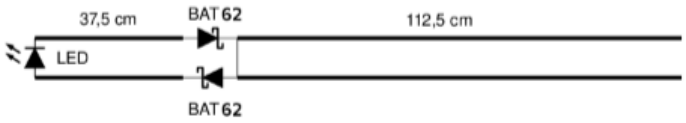

BAT62 detection diodes are no more produced. **BAT15** diodes work fine but they wear out; after a few months they stop functioning. **SMS7630** diodes are great but very little and mechanically fragile. **MMSD701T1G** diodes are sturdy and powerful; an excellent choice for a beginner. Such SMD diodes do also work for cell phone frequencies, which allows to test out a snake with a calling cell phone pushed against it. But any detection diodes that can manage 100 MHz will do.

The LED I'm currently using is the **L-7113SEC-H** . It lights up with a low tension and a very low current (the bluer a LED, the more tension it needs). Its color is red yet close to orange hence it is easily seen by the human eye (the eye is most sensitive to green, yellow and orange). The beam is quite narrow so when the LED is directed towards somebody's eyes it will appear quite bright.

For the lengths of 37.5 and 112.5 centimeters, any electric wire with two copper conductors will do. Audio signal wire is a practical solution. Use the shielding as one of the two conductors. The lengths of the two segments must not be precise. What matters is that the total length of the snake be 1.5 meters. Do not hesitate to try out if a little longer or shorter snake gives better results.

A schematic of my current probes, that I connect to a standard multimeter, measuring Volts DC. The measure displayed by the multimeter must be multiplied by 10. When using a 200.0 mV scale, just read while forgetting the dot:

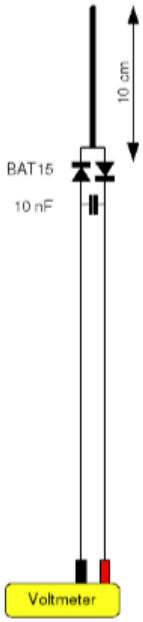

Lead Free Status	Lead Free
RoHS Status	RoHS Compliant

Features, Applications

The MMSD301T1, and MMSD701T1 devices are spin-offs of our popular MMBD301LT1, and MMBD701LT1 SOT-23 devices. They are designed for high-efficiency UHF and VHF detector applications. Readily available to many other fast switching RF and digital applications.

Extremely Low Minority Carrier Lifetime Very Low Capacitance Low Reverse Leakage AEC Qualified and PPAP Capable S Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant*

XXX G = Specific Device Code SMMSD701T1G = Date Code = Pb-Free Package
Rating Reverse Voltage MMSD701T1G, SMMSD701T1G Forward Current (DC) Continous Forward Power Dissipation = 25C Junction Temperature Storage Temperature Range Symbol VR Value to +150 Unit Vdc M G

152

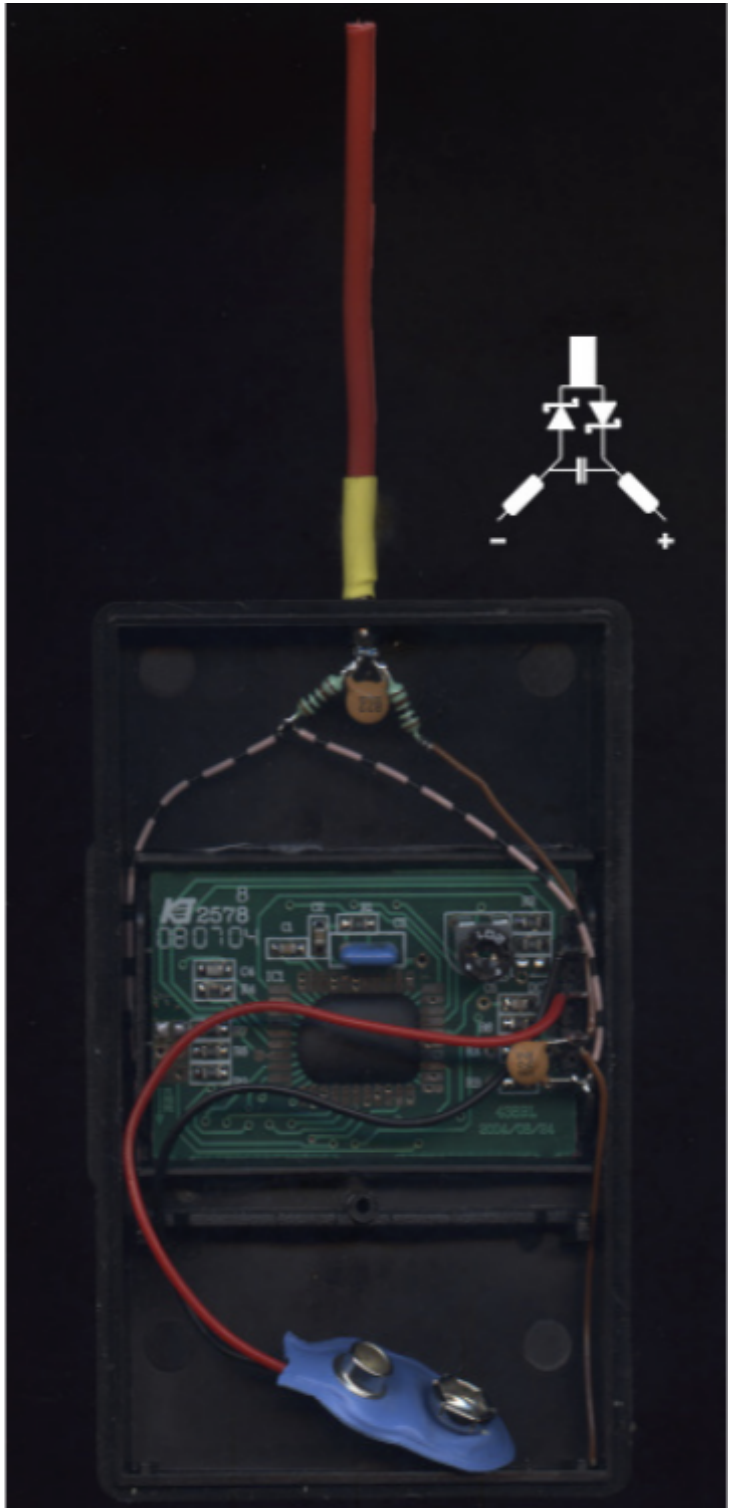
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Parts Required:

1. 100nF & 100pF
2. n4148 Diode x(2)
3. A bright good quality LED

Circuit Diagram:

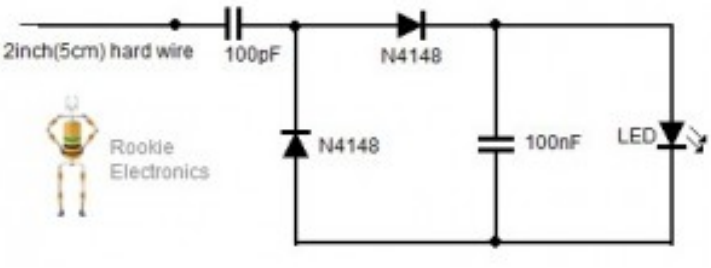

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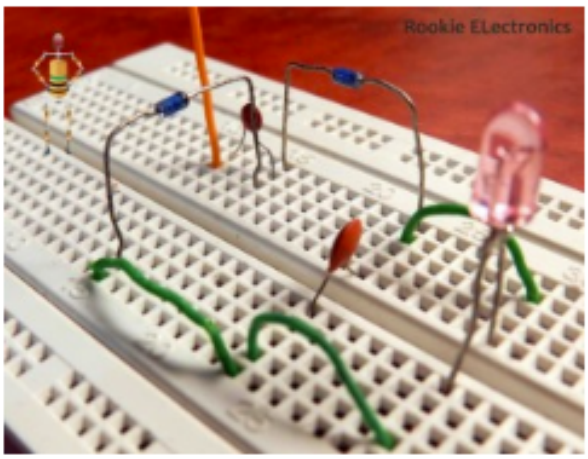

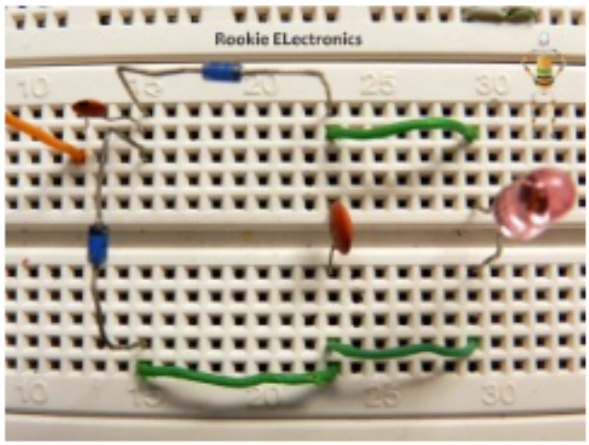

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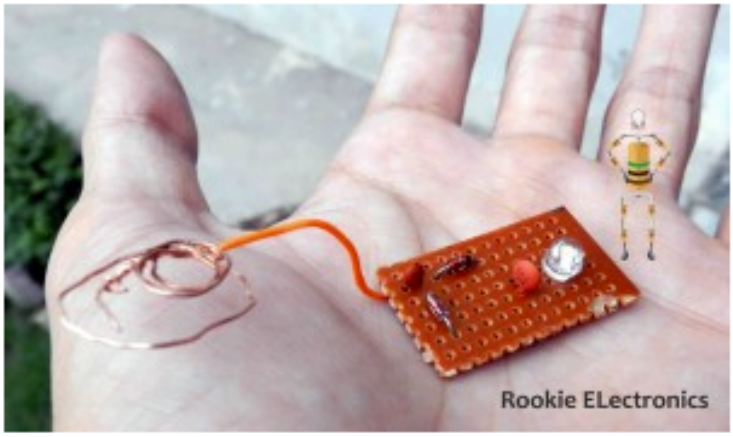

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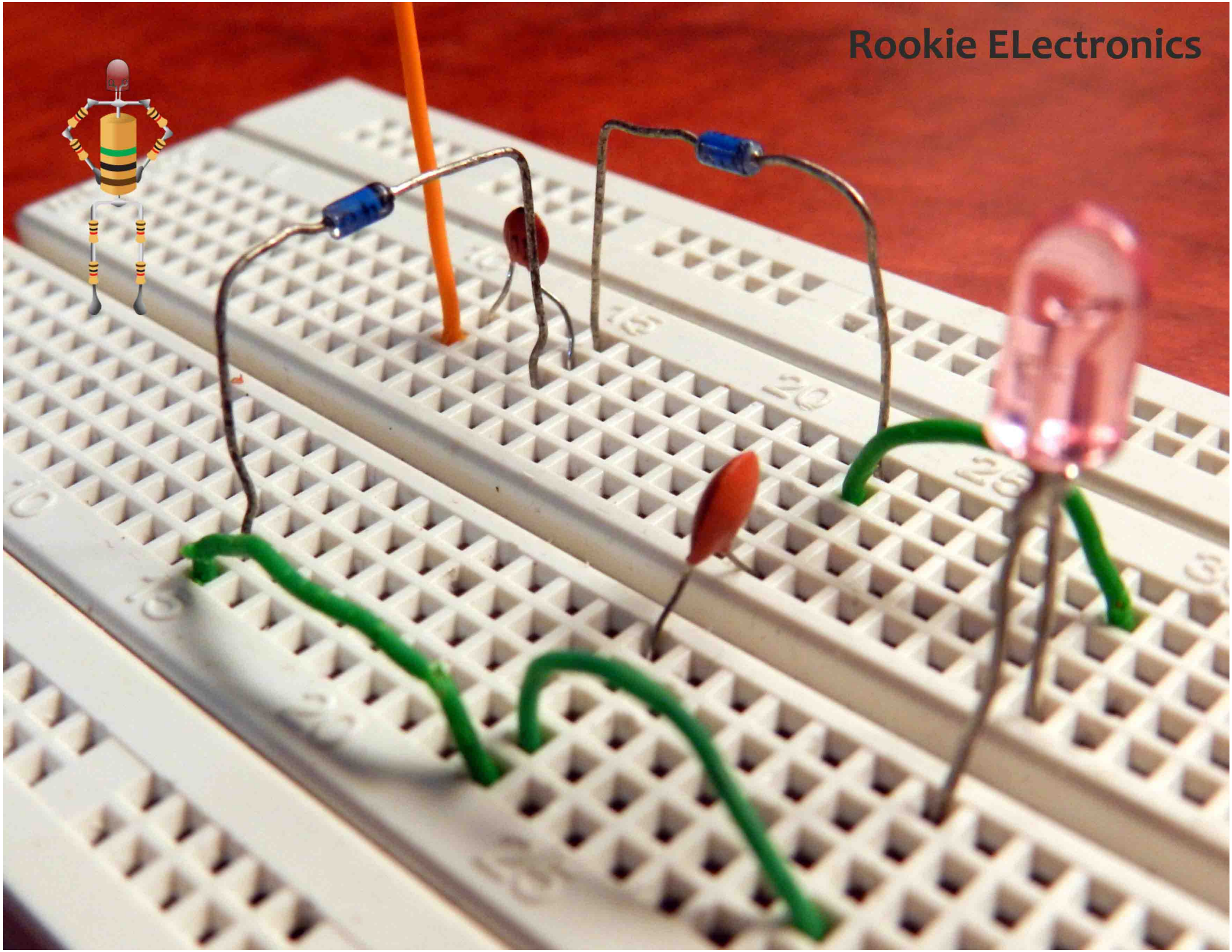

Rookie Electronics

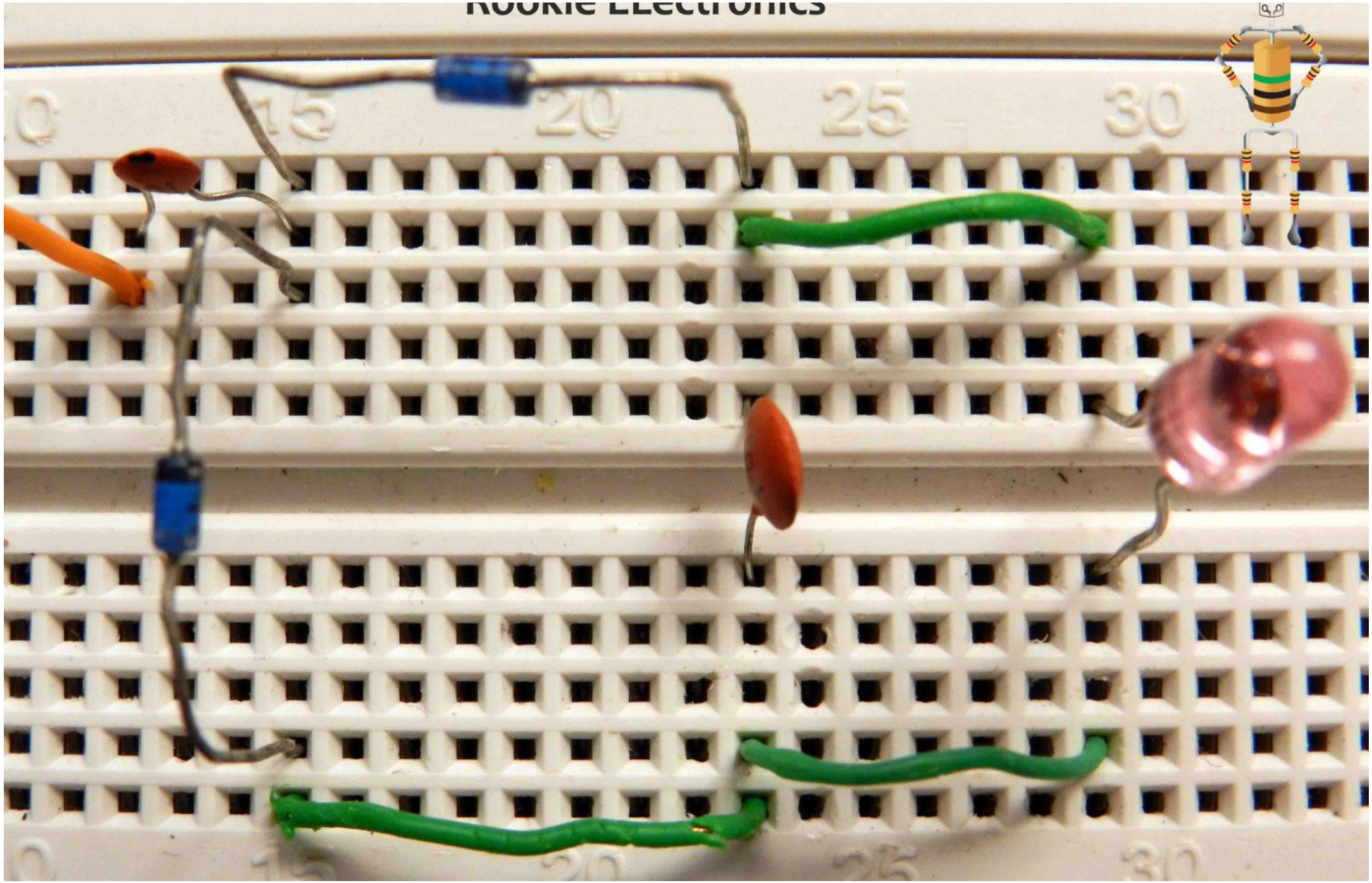

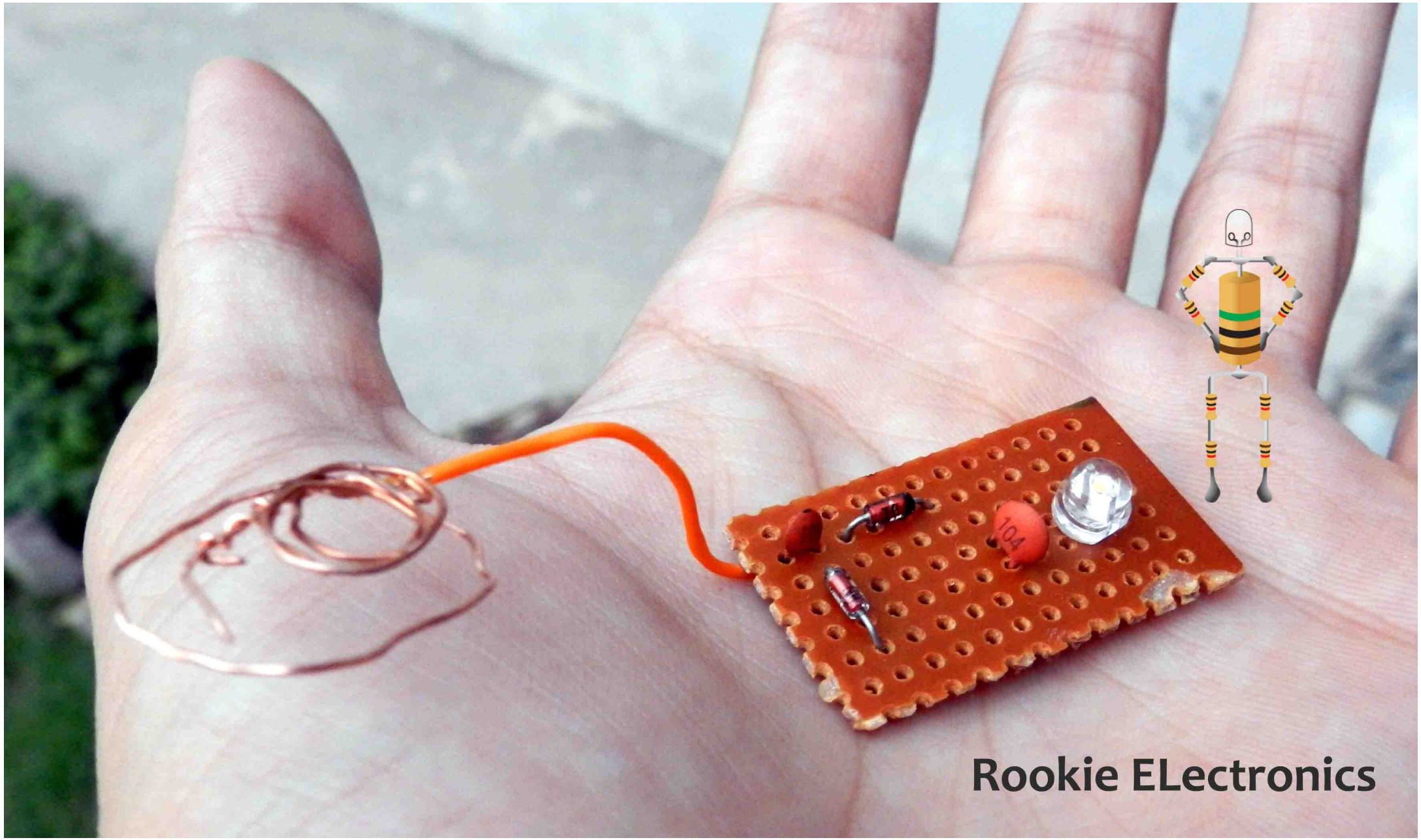

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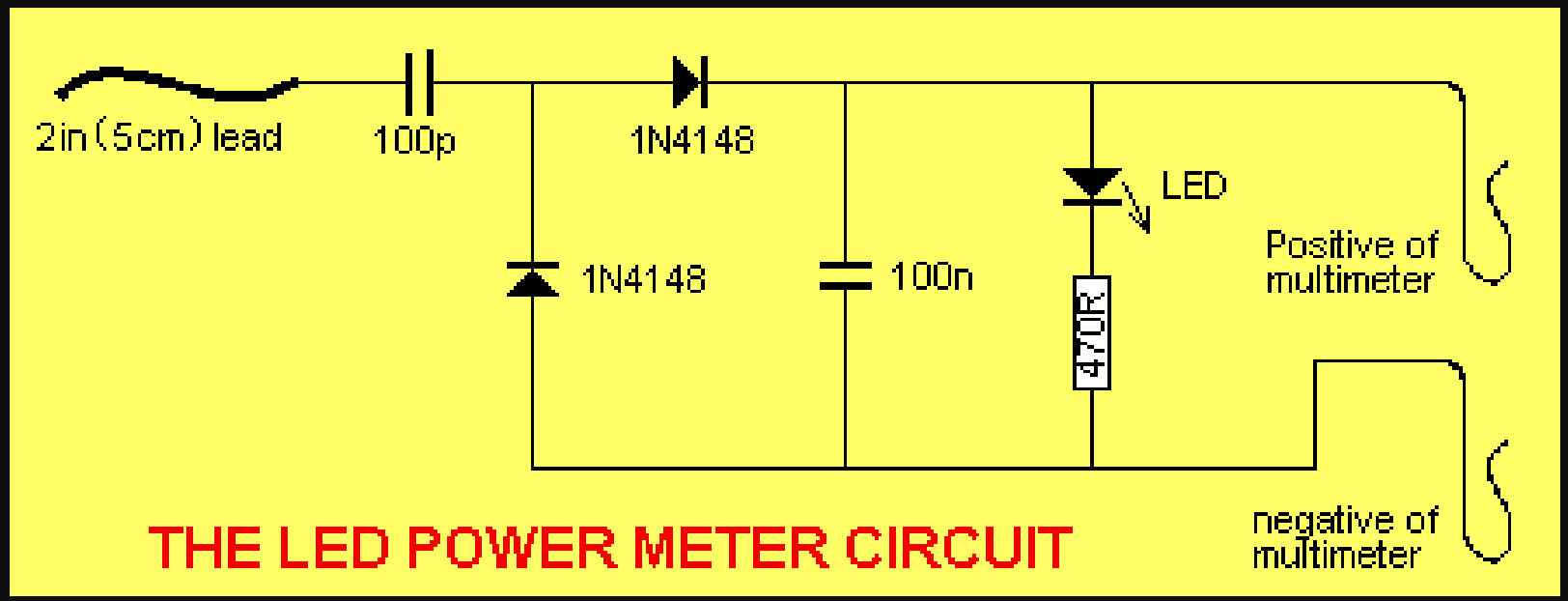
2in (5cm) lead
100p
1N4148
1N4148
100n
LED
470R
Positive of multimeter
negative of multimeter
THE LED POWER METER CIRCUIT

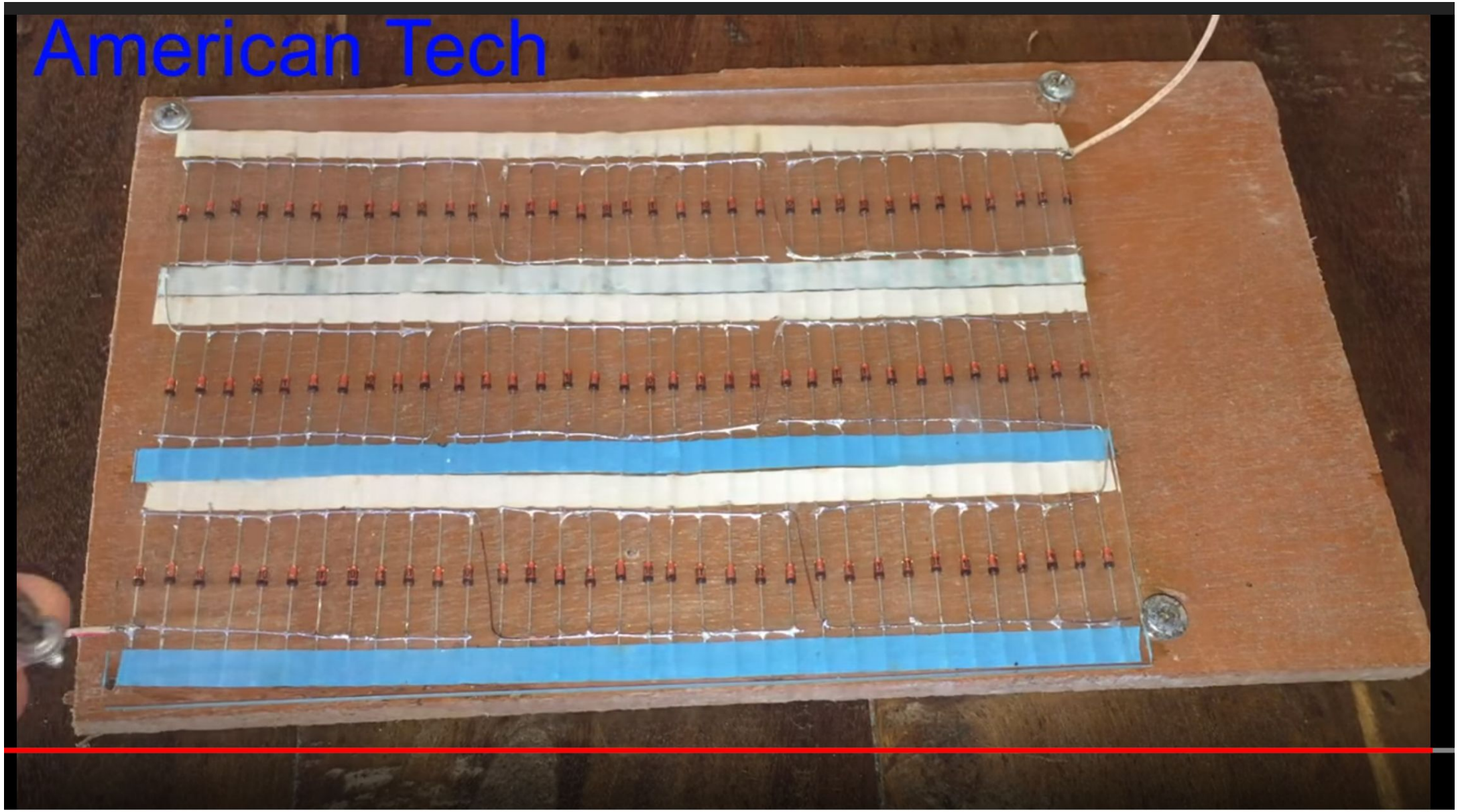
American Tech

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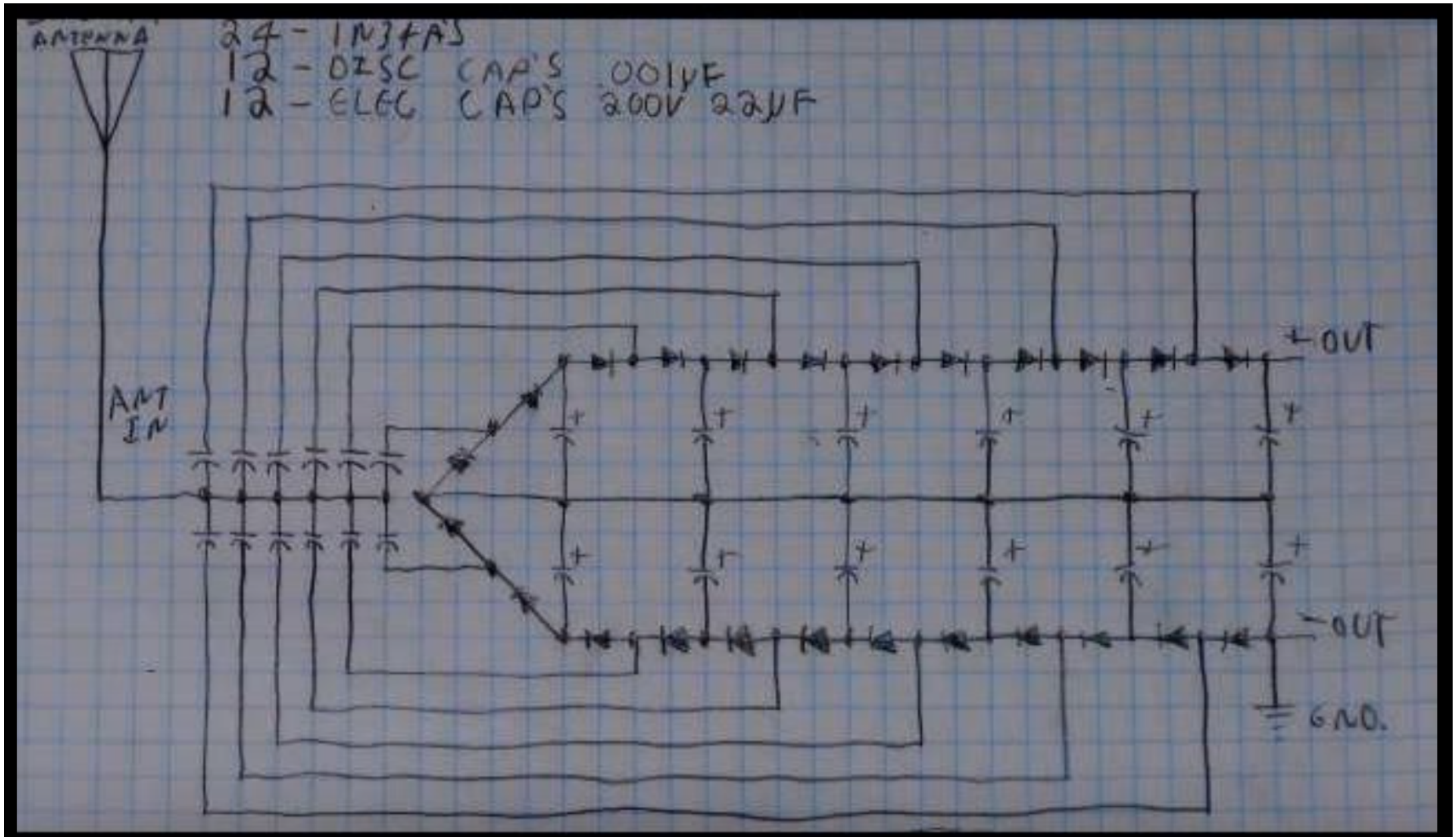
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24 - 1N34A'S
12 - DISC CAP'S .001UF
12 - ELEC CAP'S 200V 22UF
ANT IN
+ OUT
- OUT
GND.

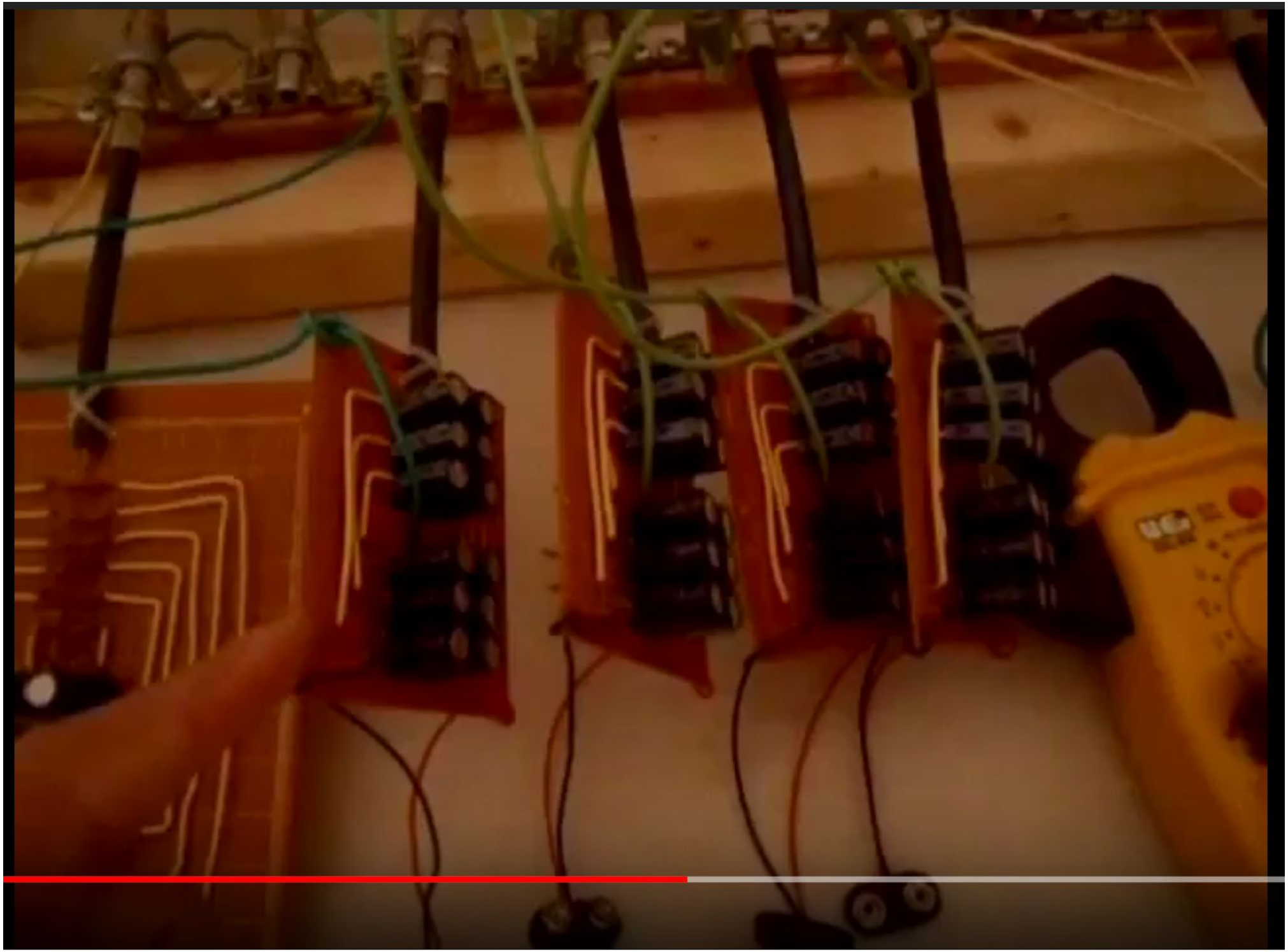

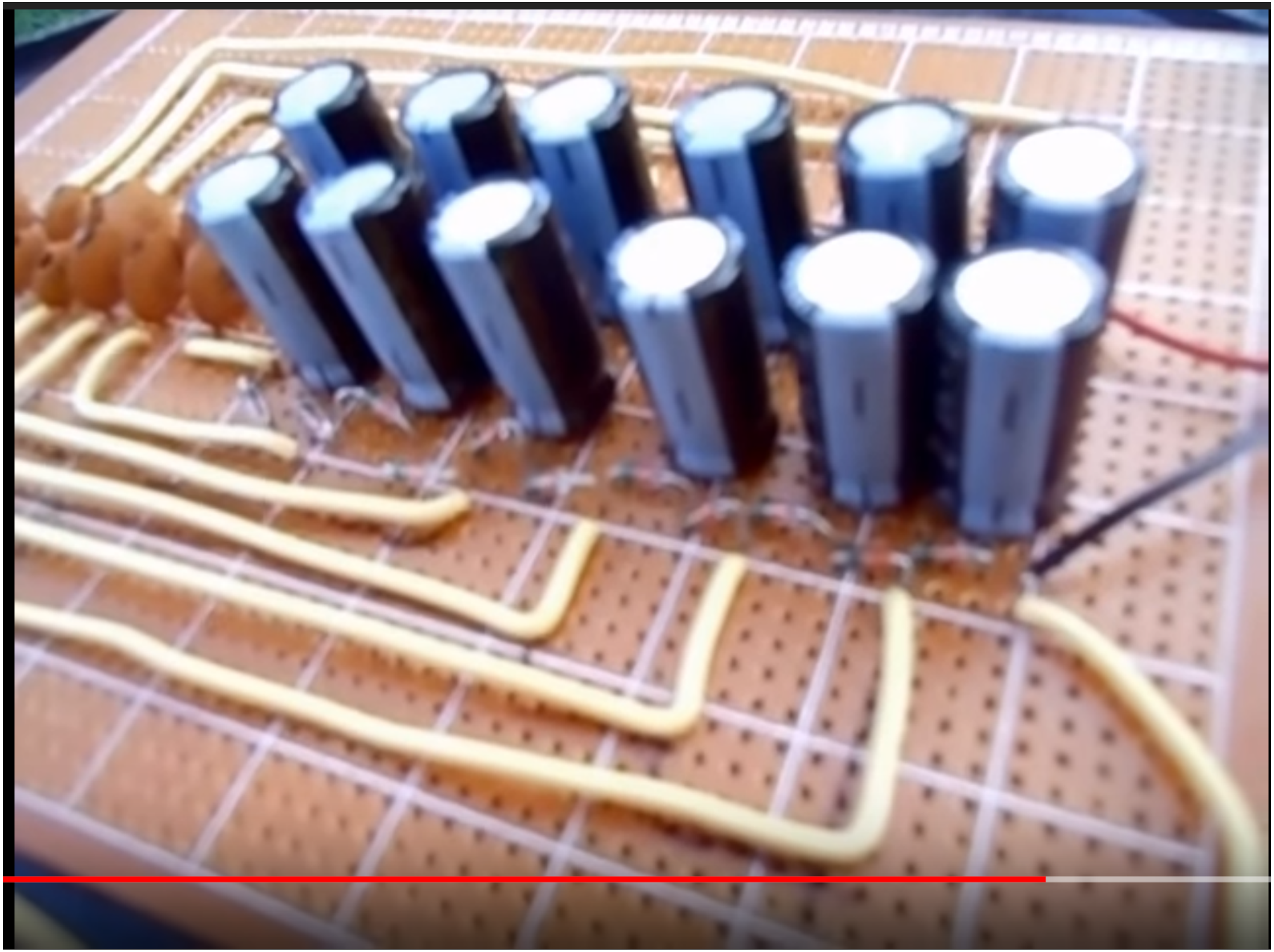

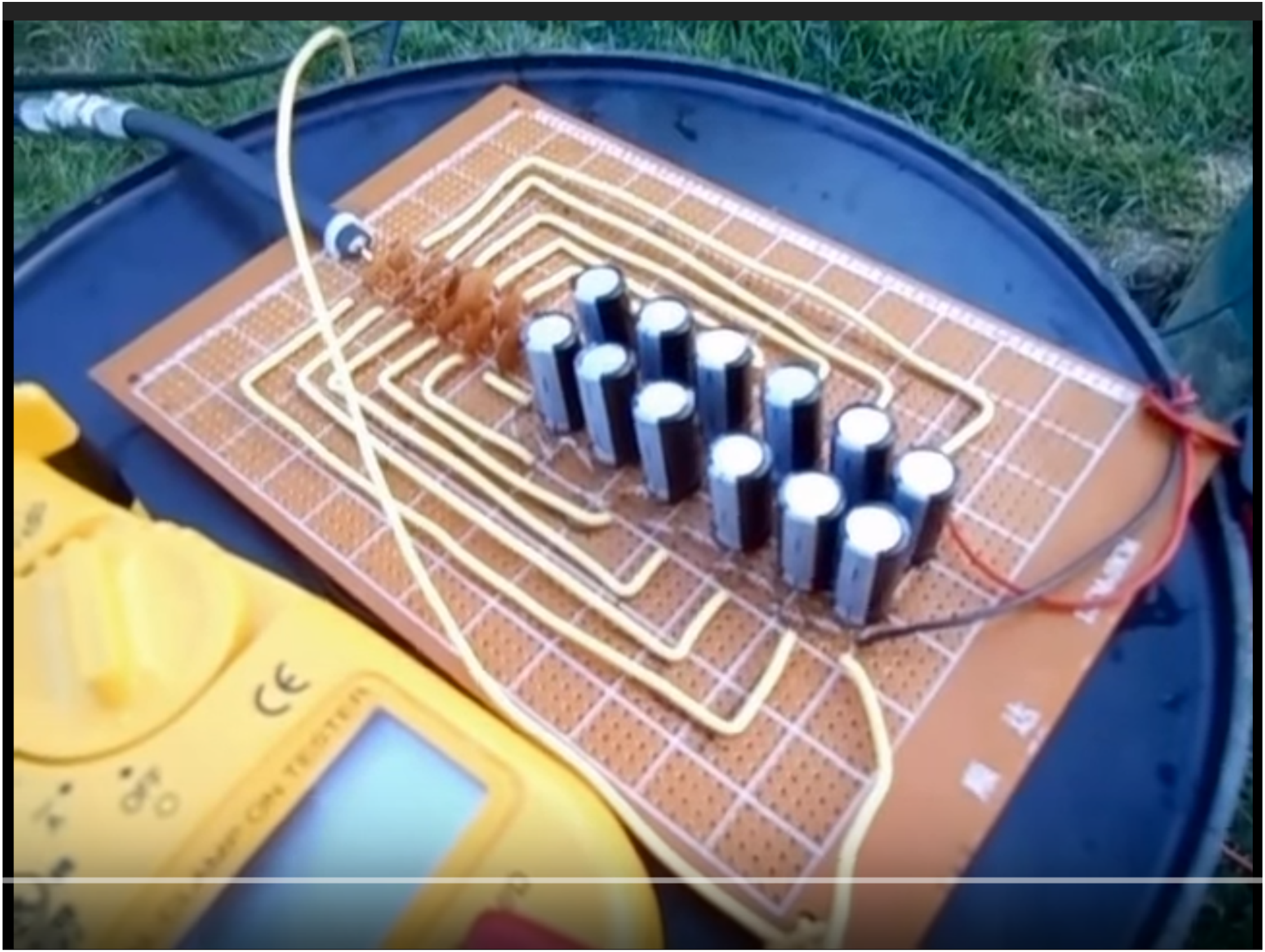

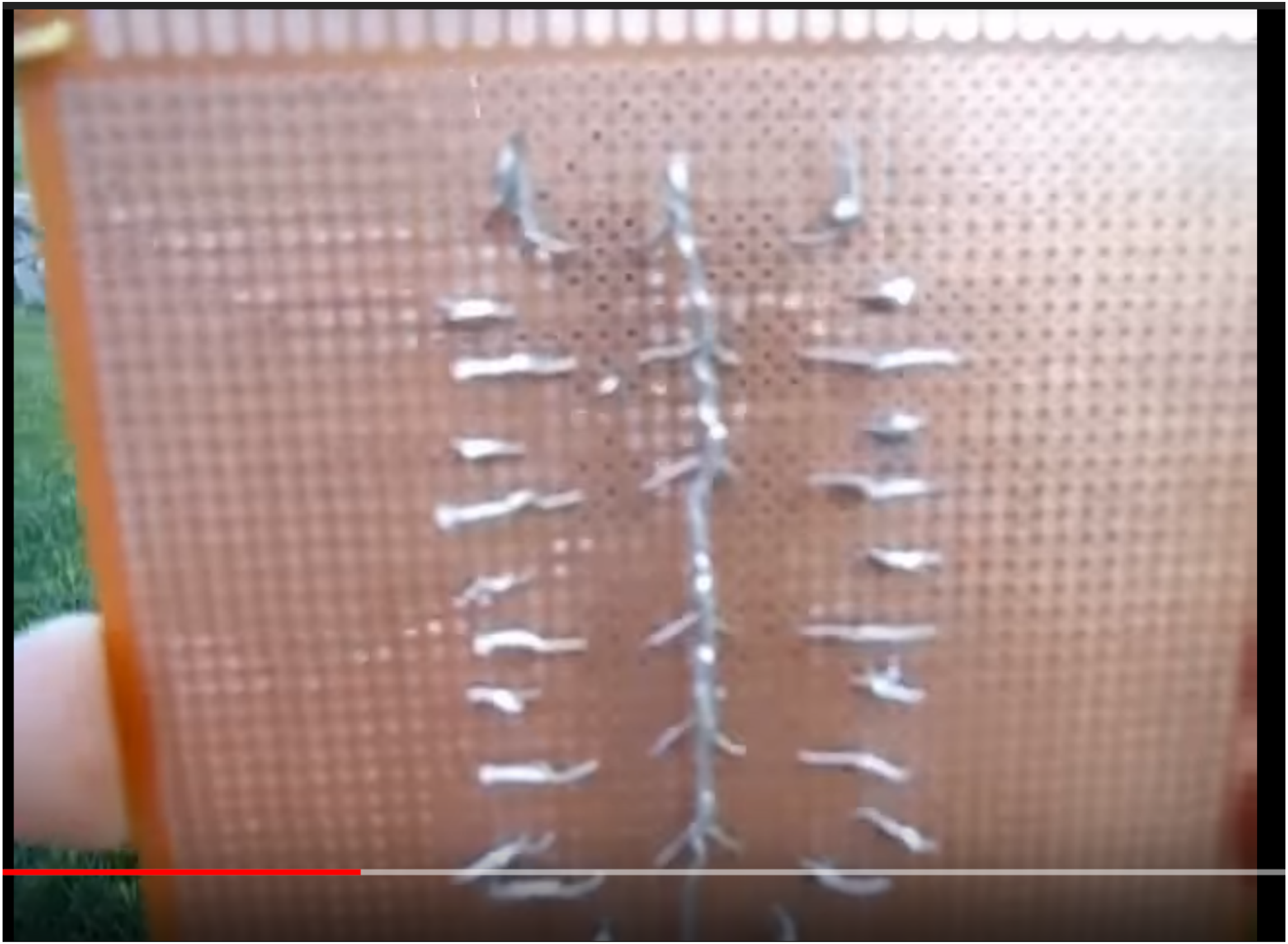

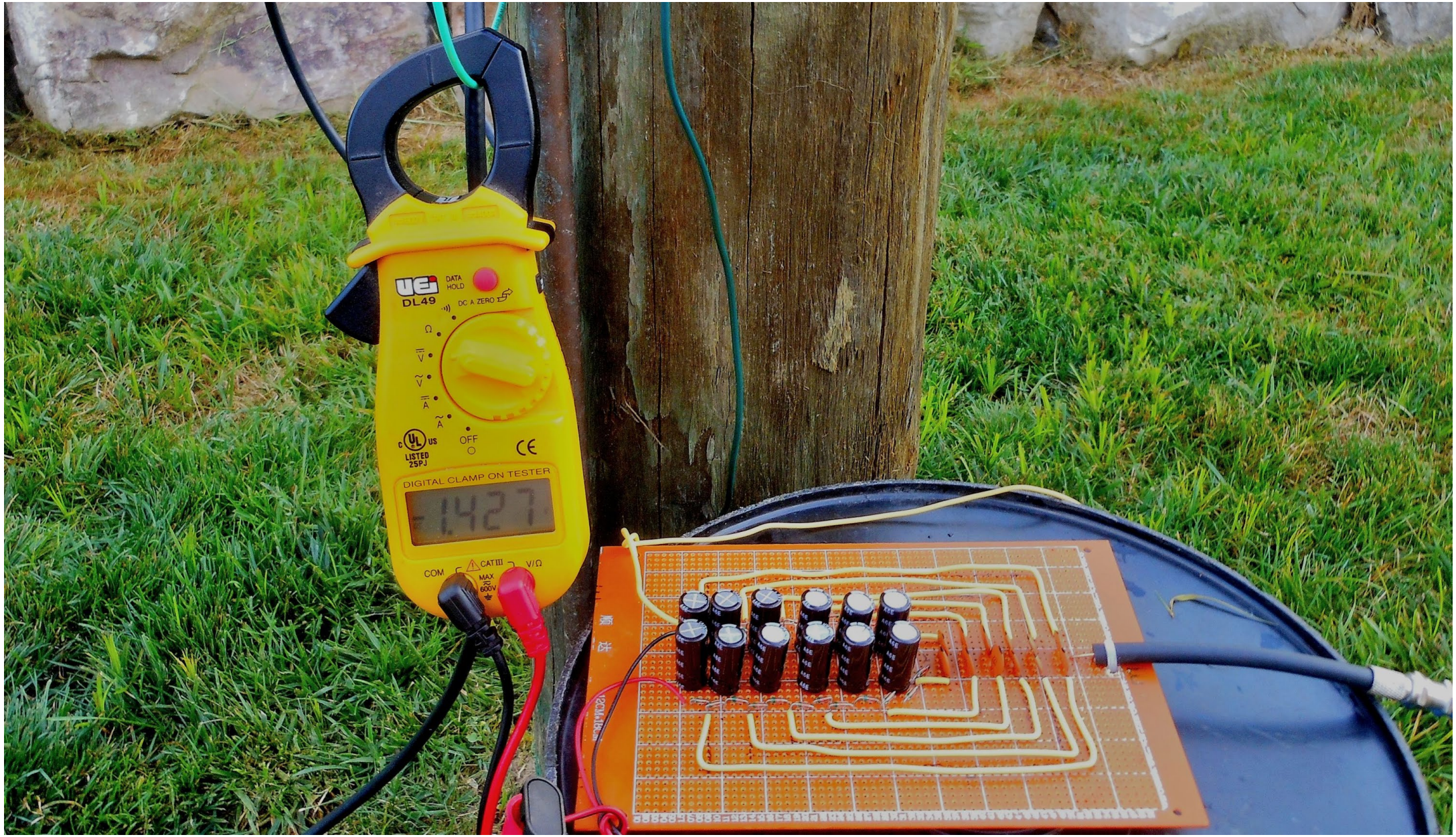
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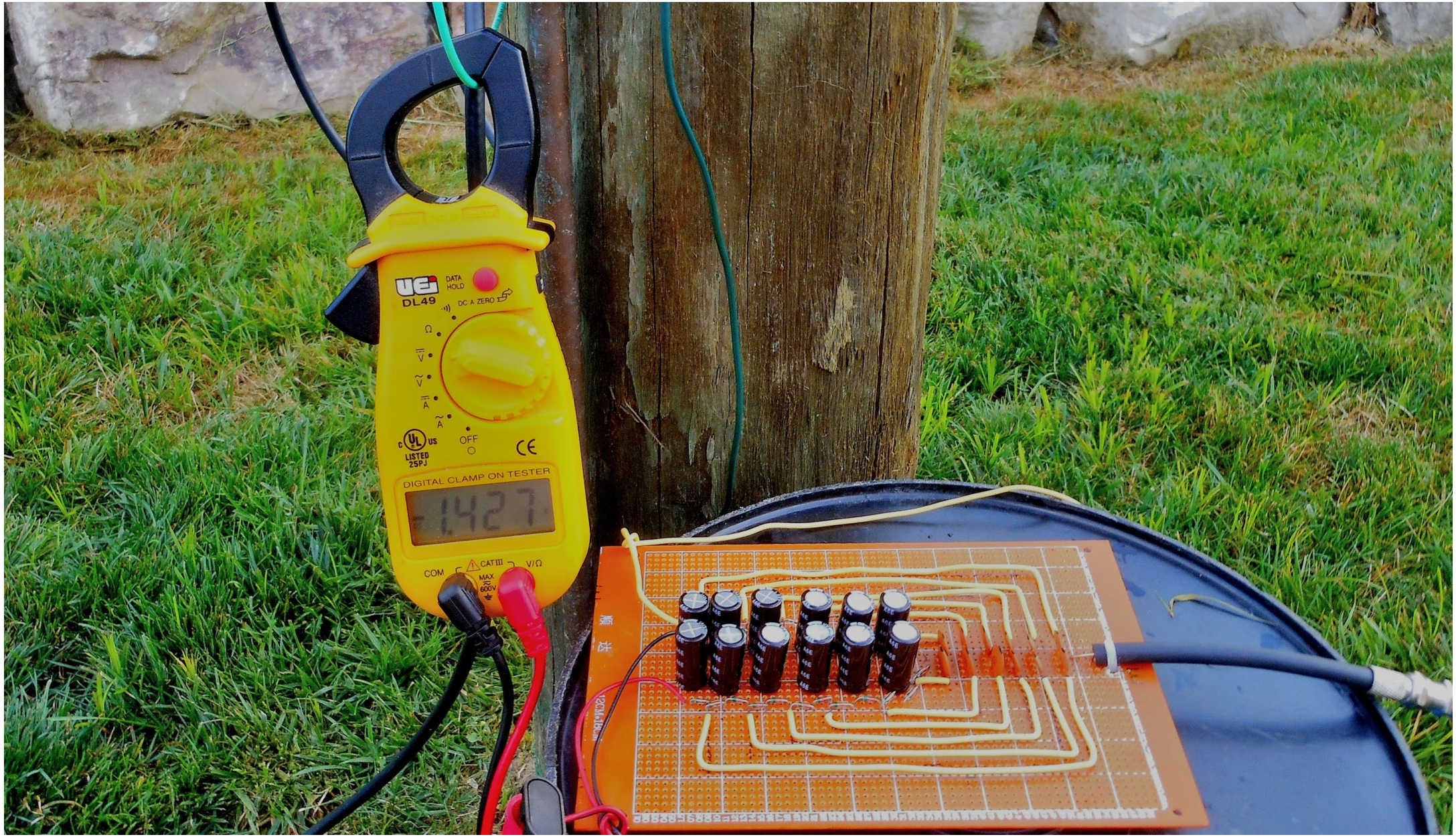
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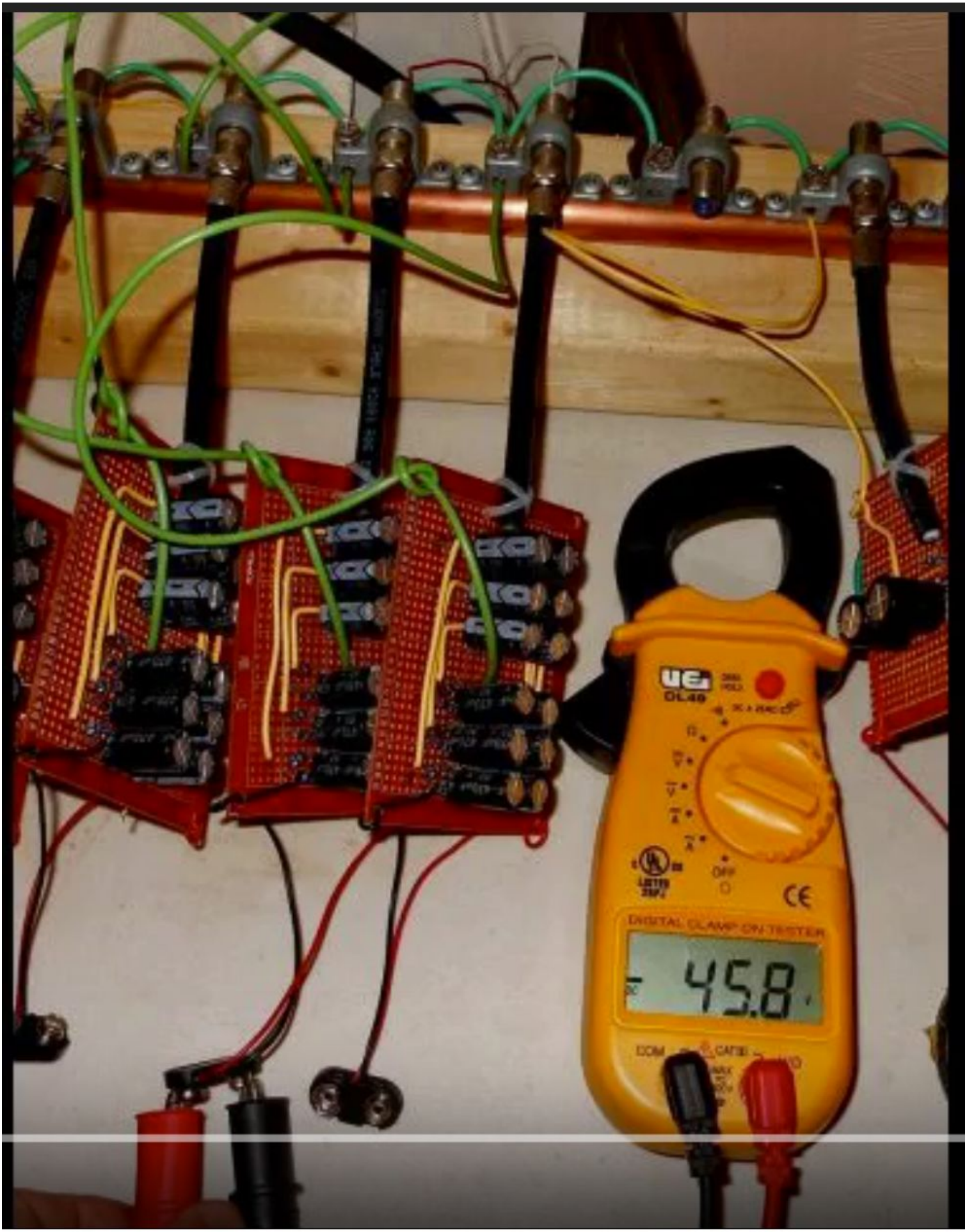
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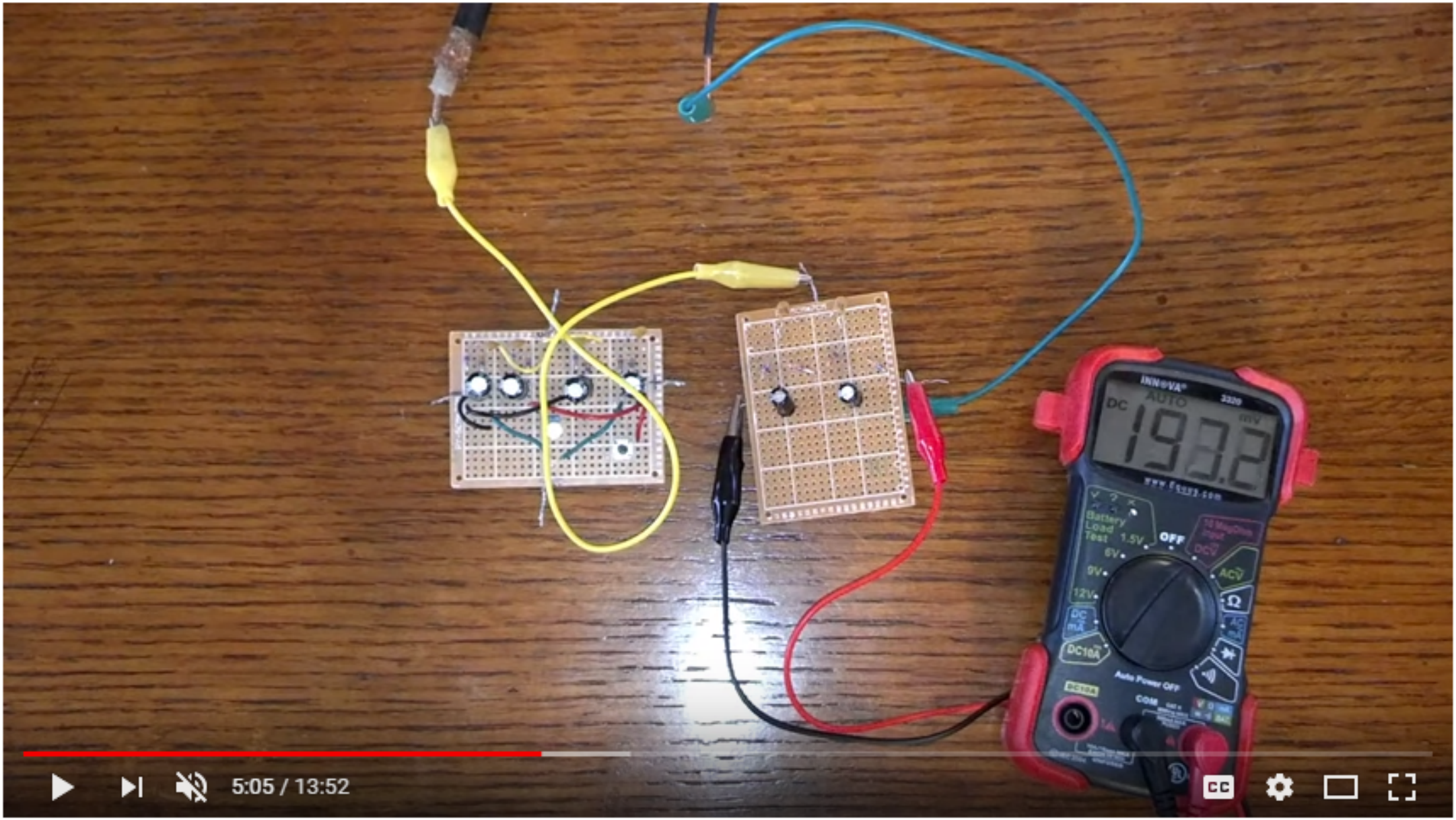

Tesla Free Energy Air Circuit

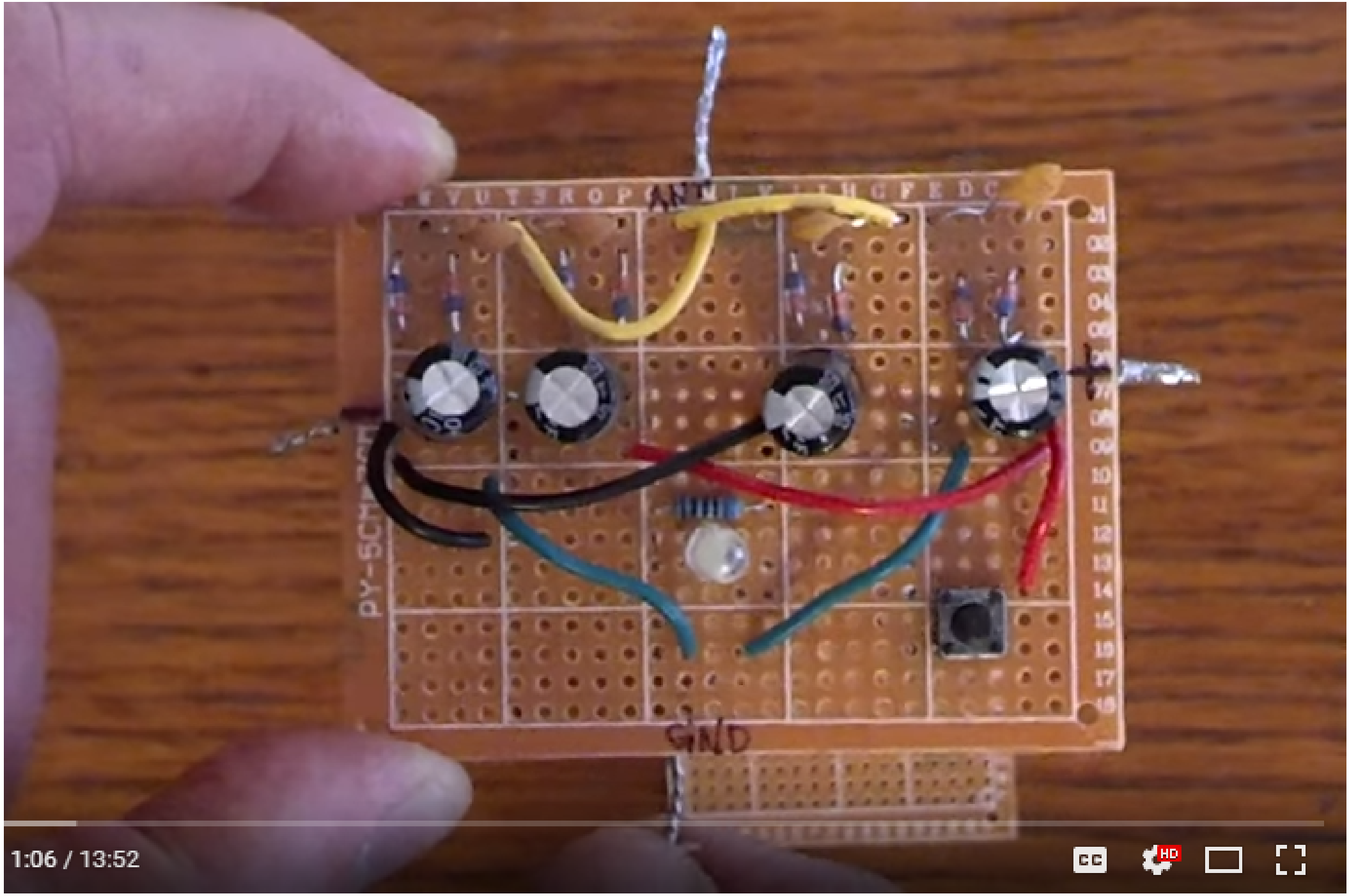
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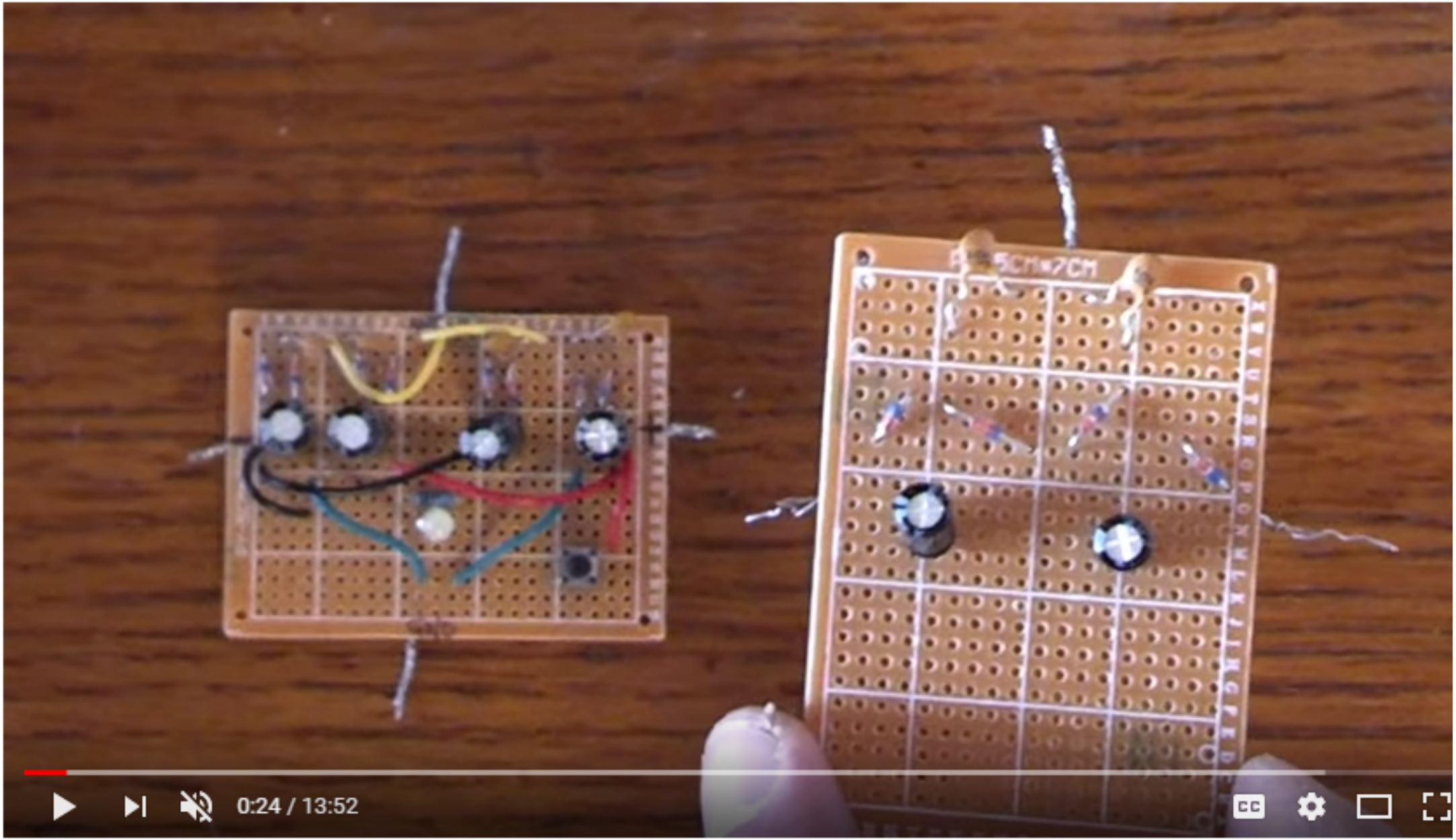

Tesla Free Energy Air Circuit

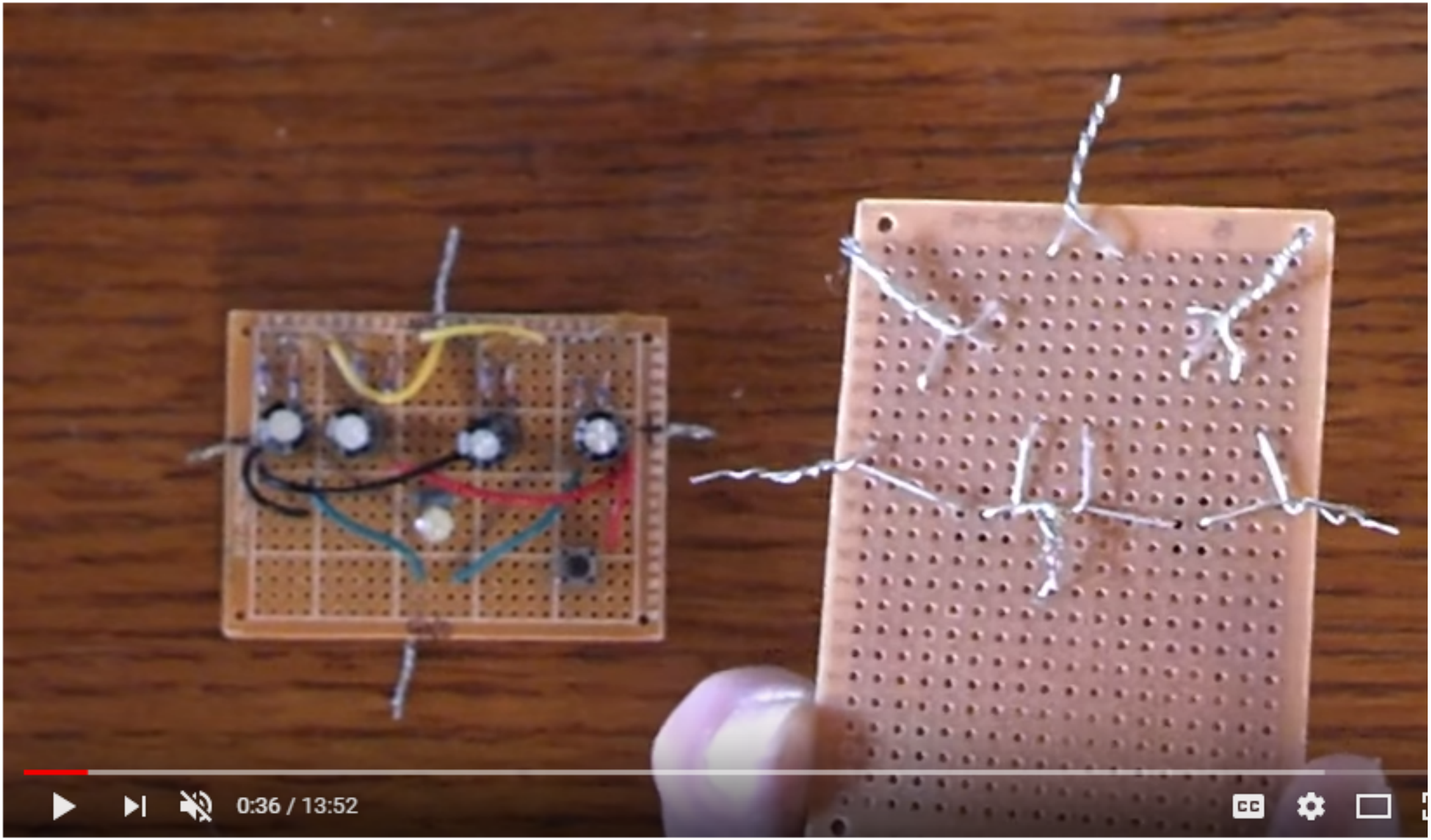

Tesla Free Energy Air Circuit

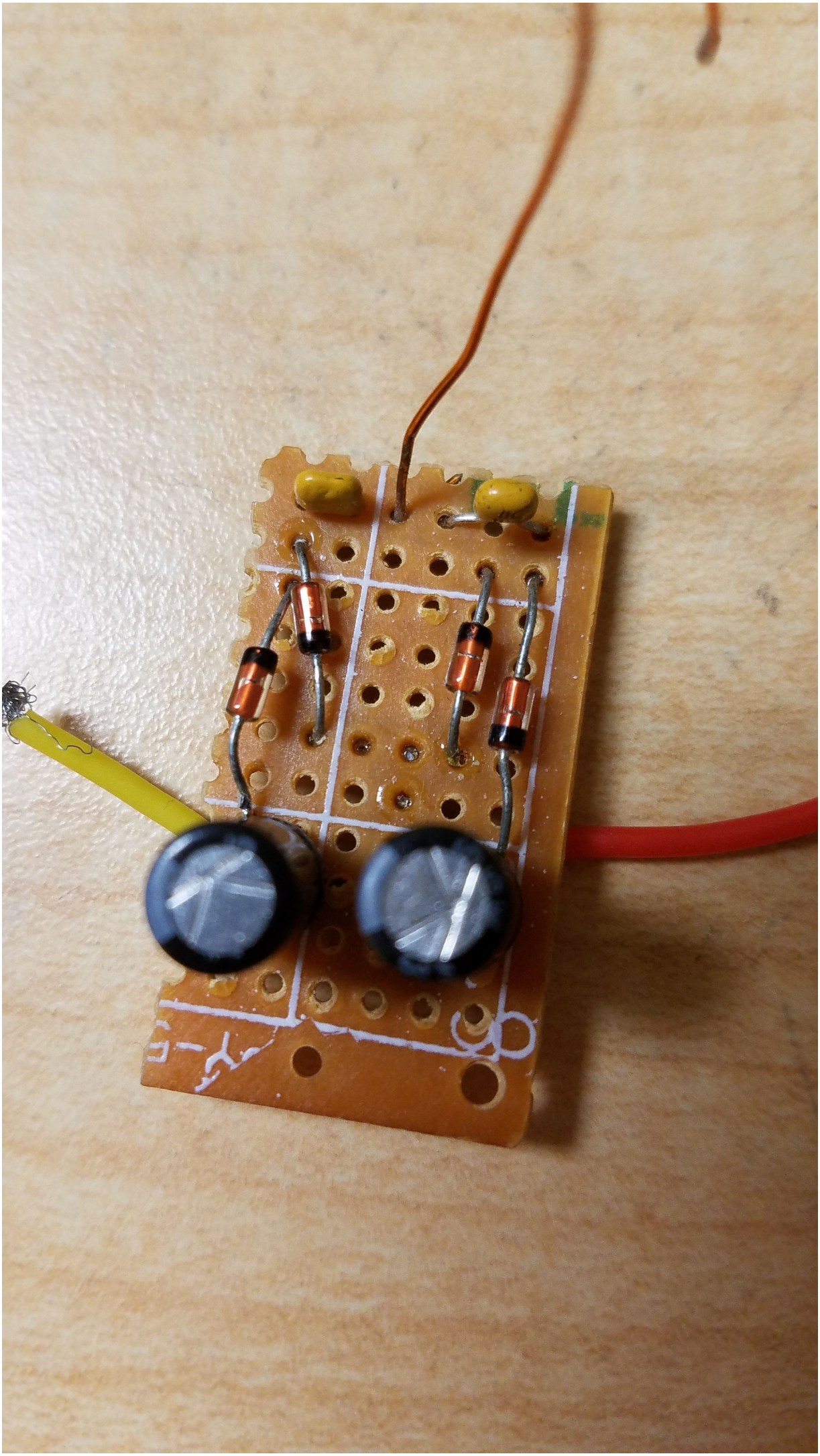

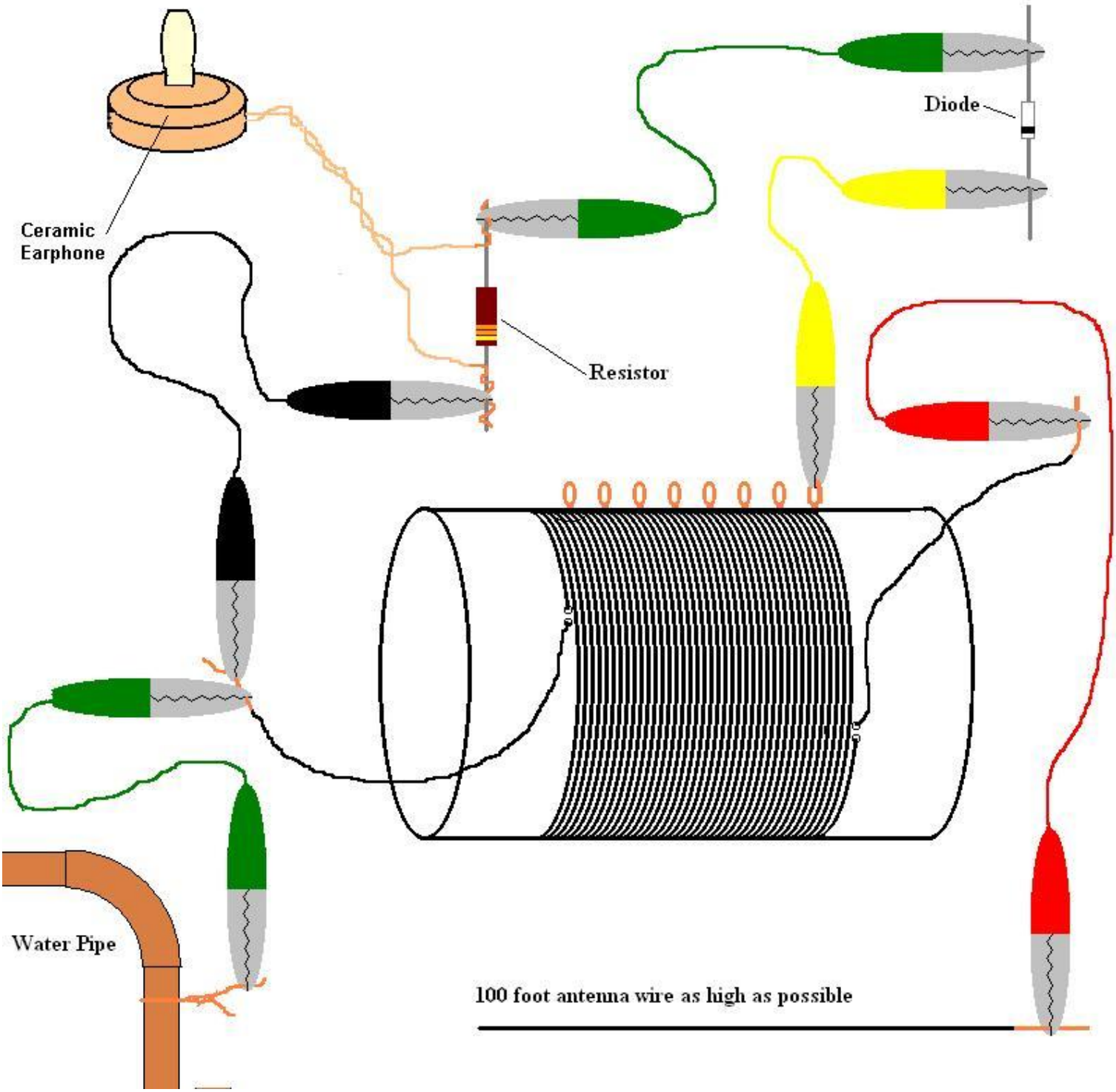
Ceramic
Earphone
Diode
Resistor
Water Pipe
100 foot antenna wire as high as possible

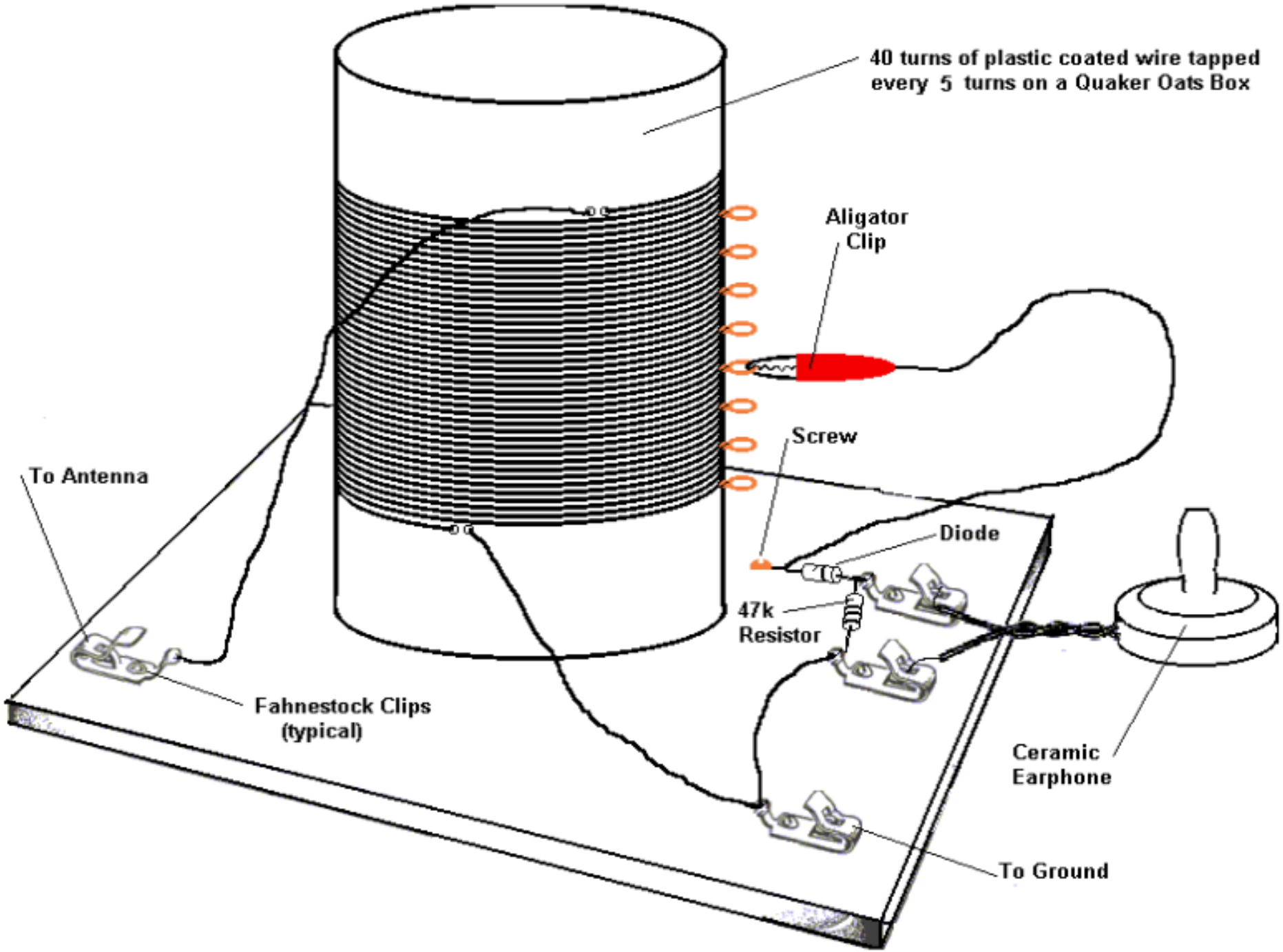
40 turns of plastic coated wire tapped every 5 turns on a Quaker Oats Box
Aligator Clip
Screw
Diode
47k Resistor
To Antenna
Fahnestock Clips (typical)
Ceramic Earphone
To Ground

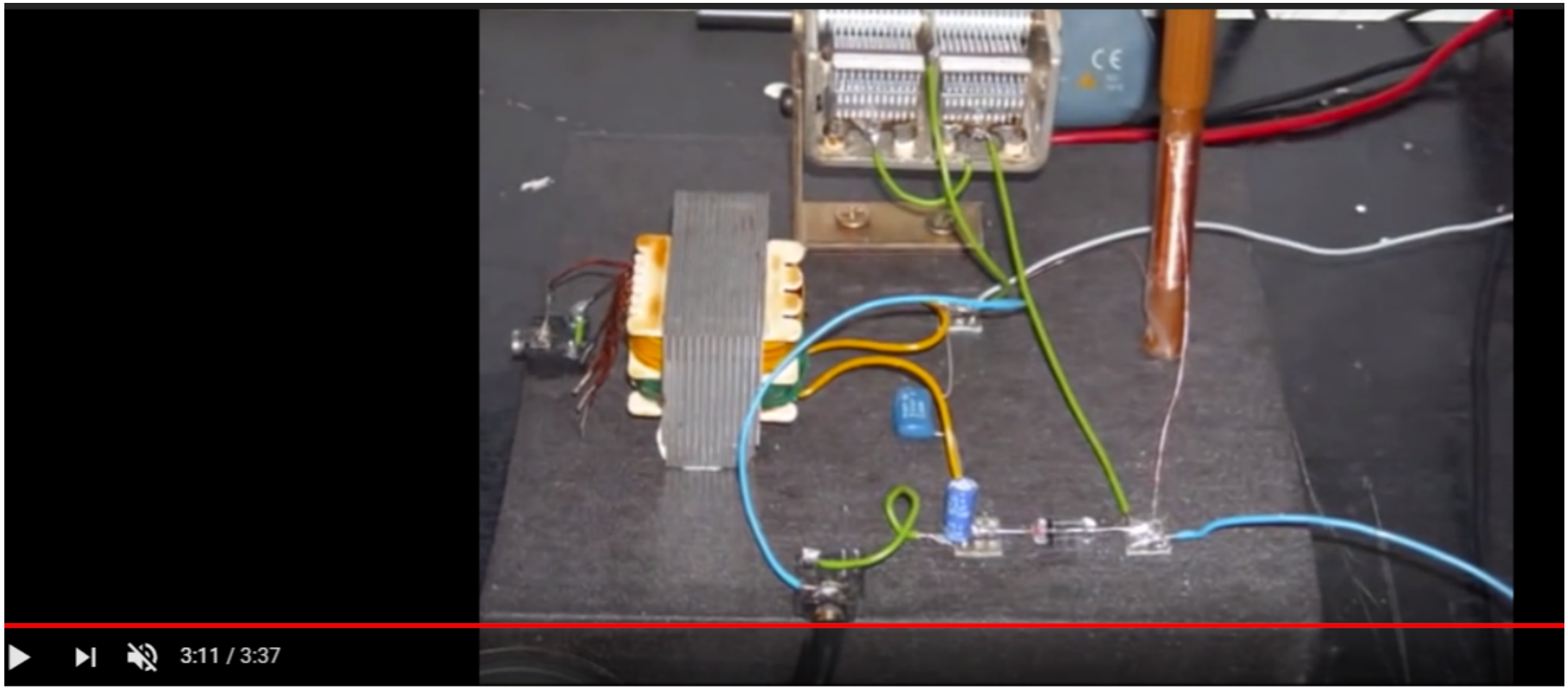

Radio Galena

Up next

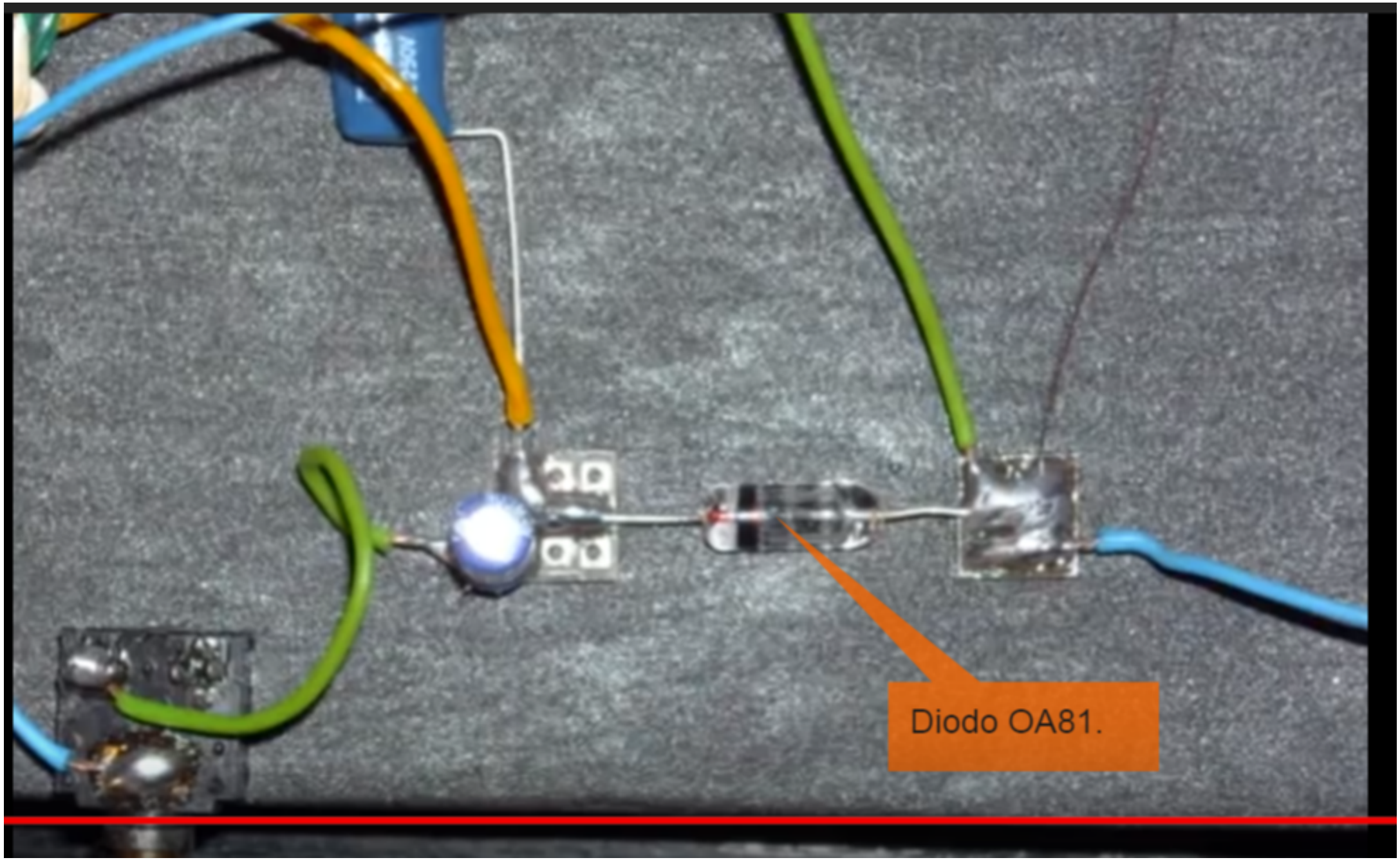
Diodo OA81.

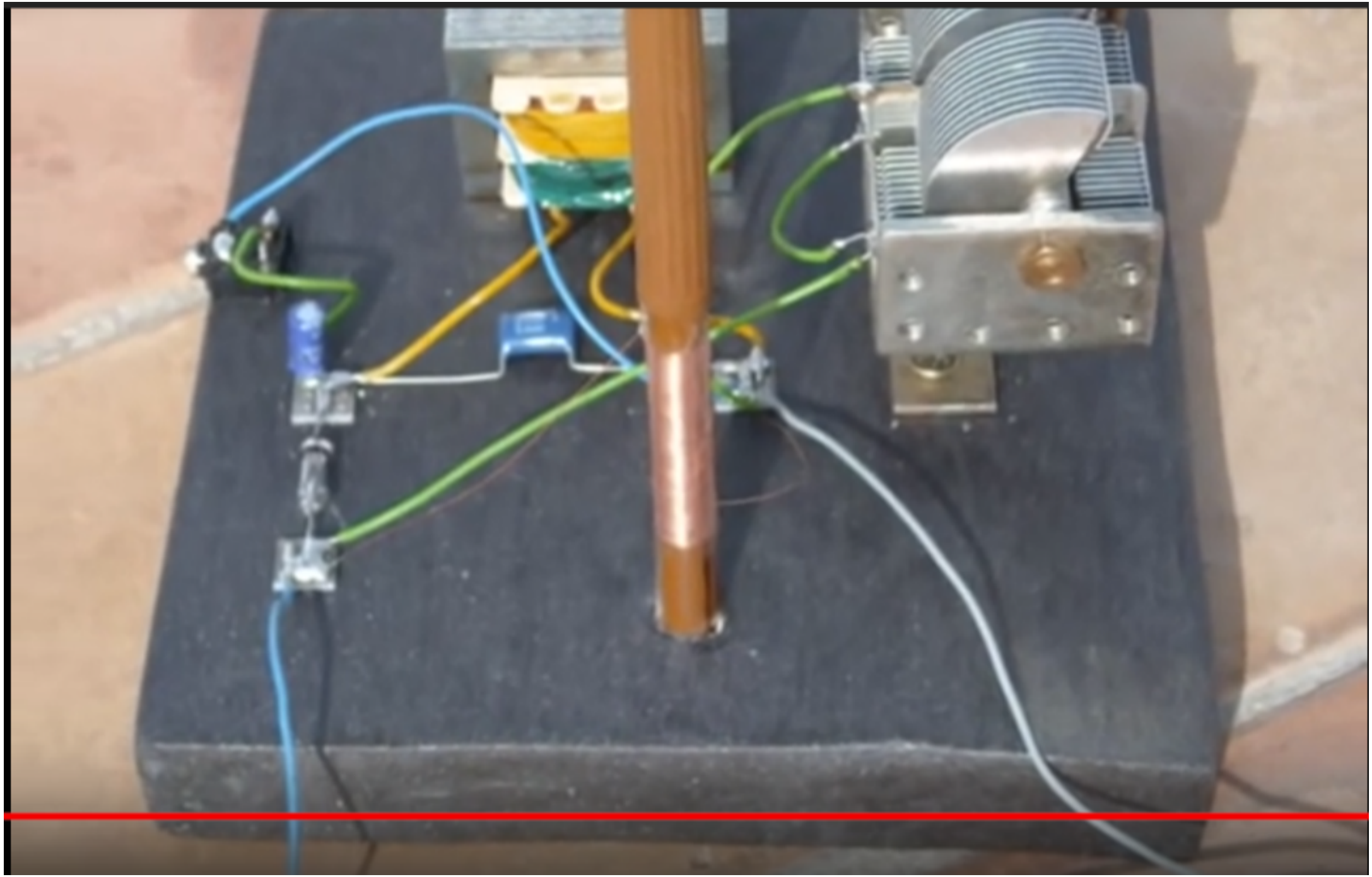

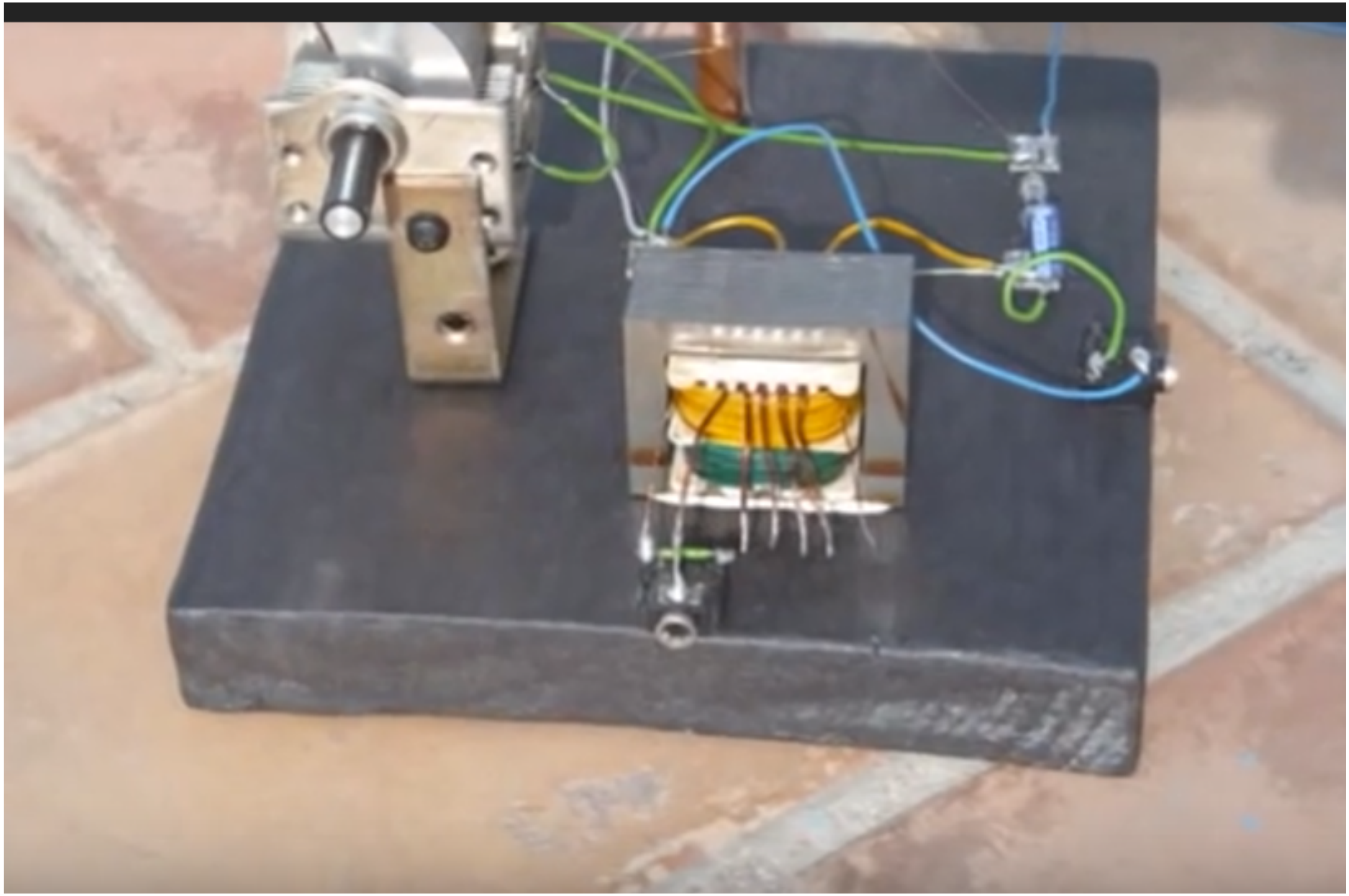

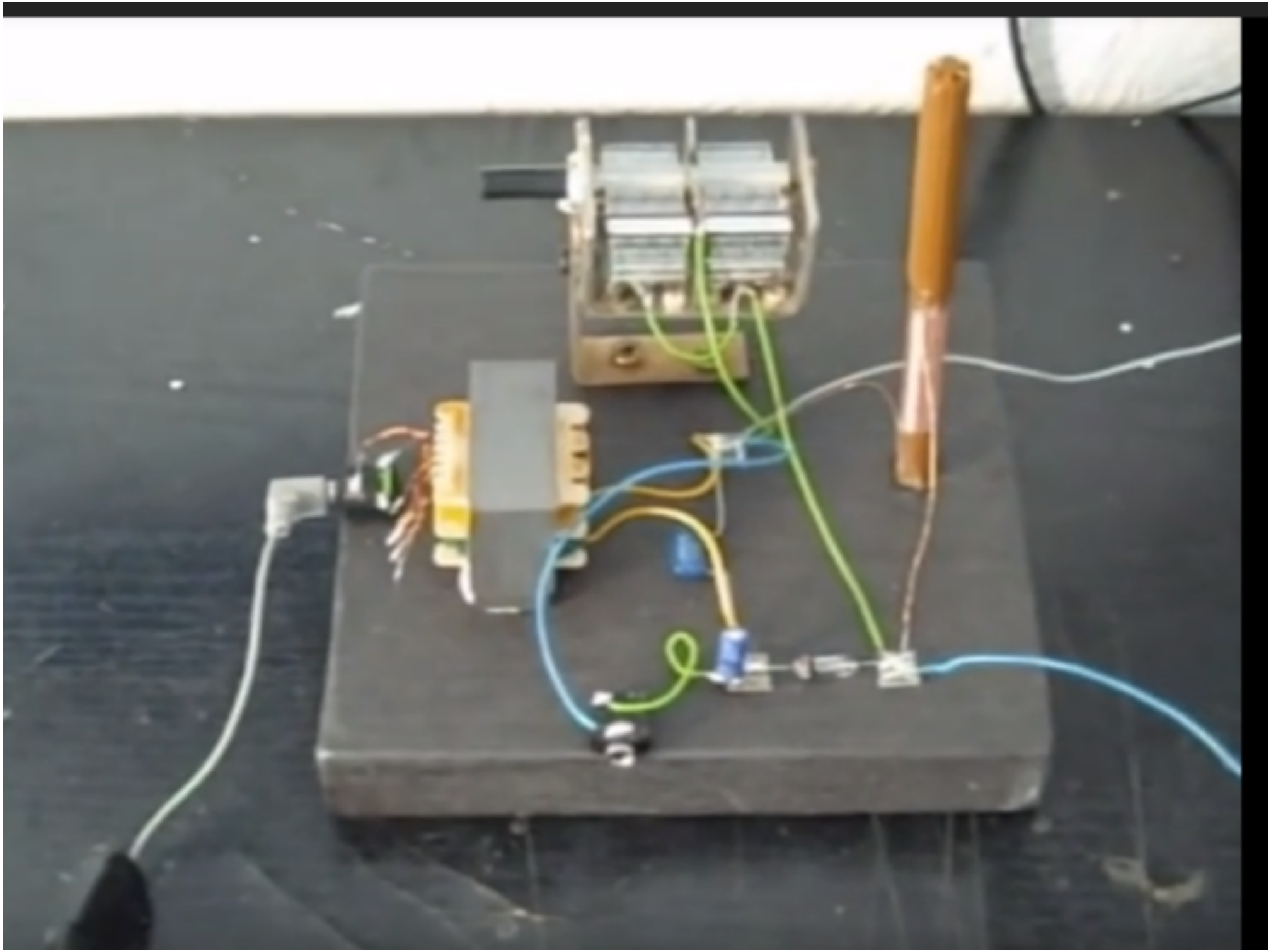

GND

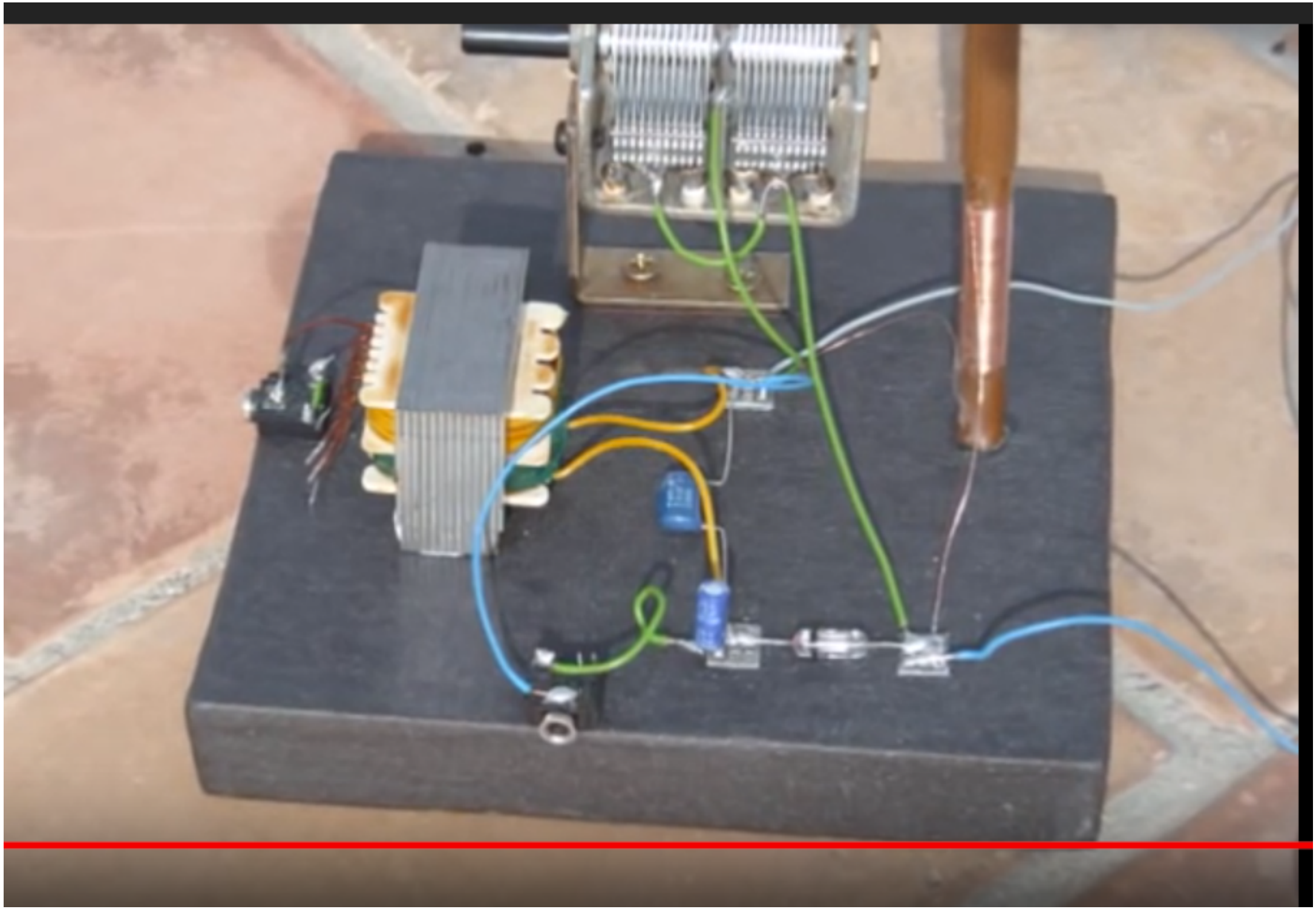

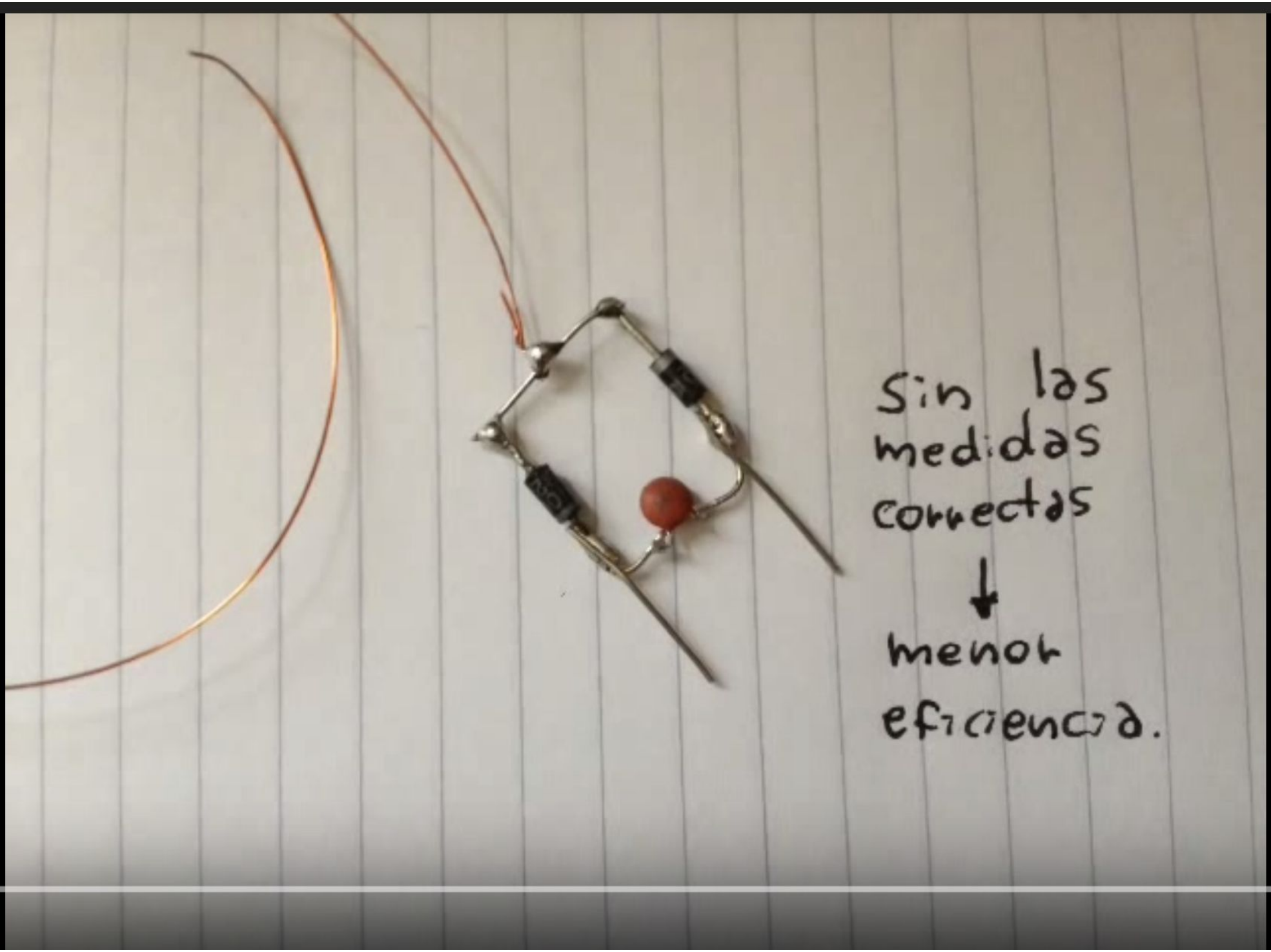
sin las
medidas
correctas
↓
menor
eficiencia.

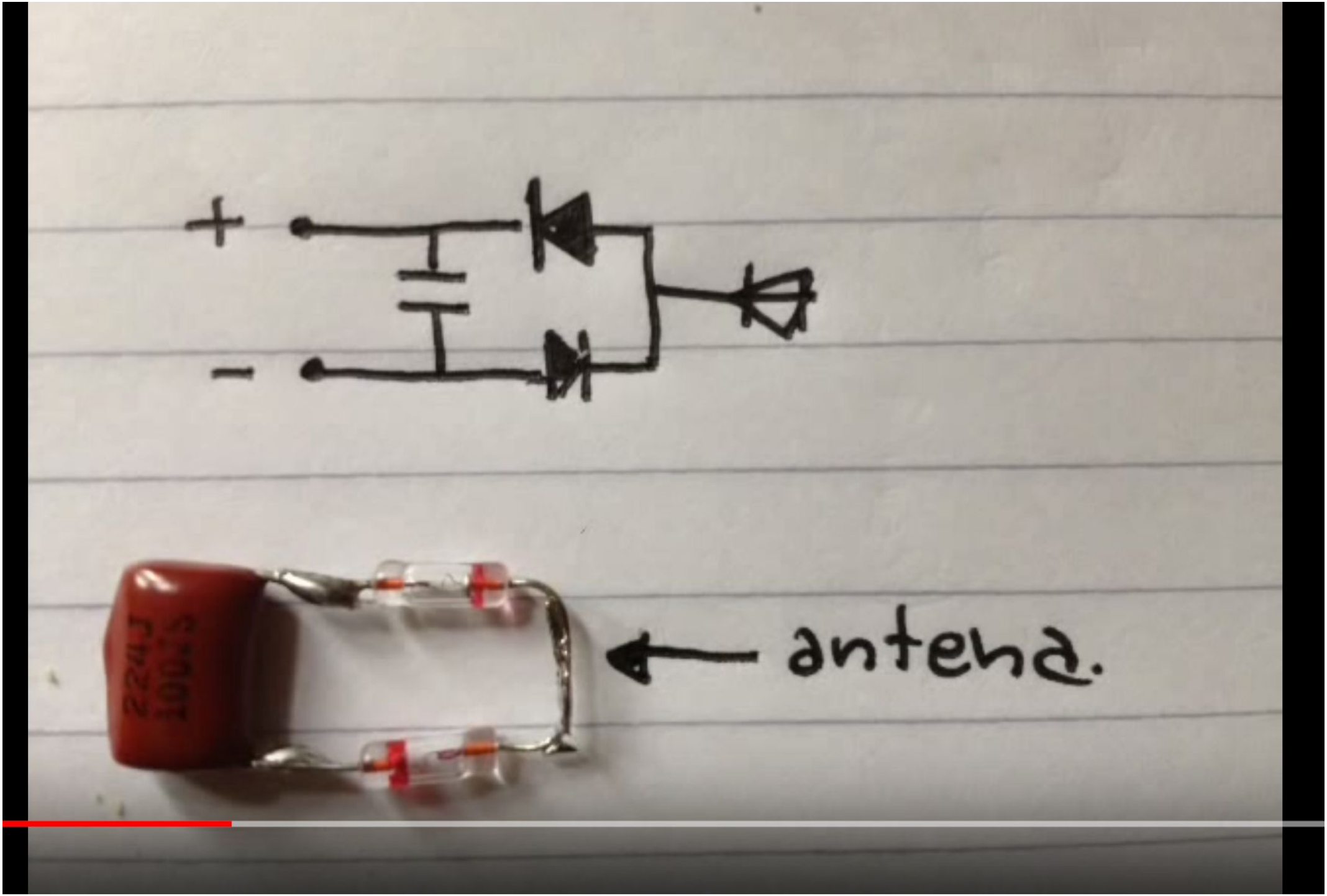
+
-
antena.

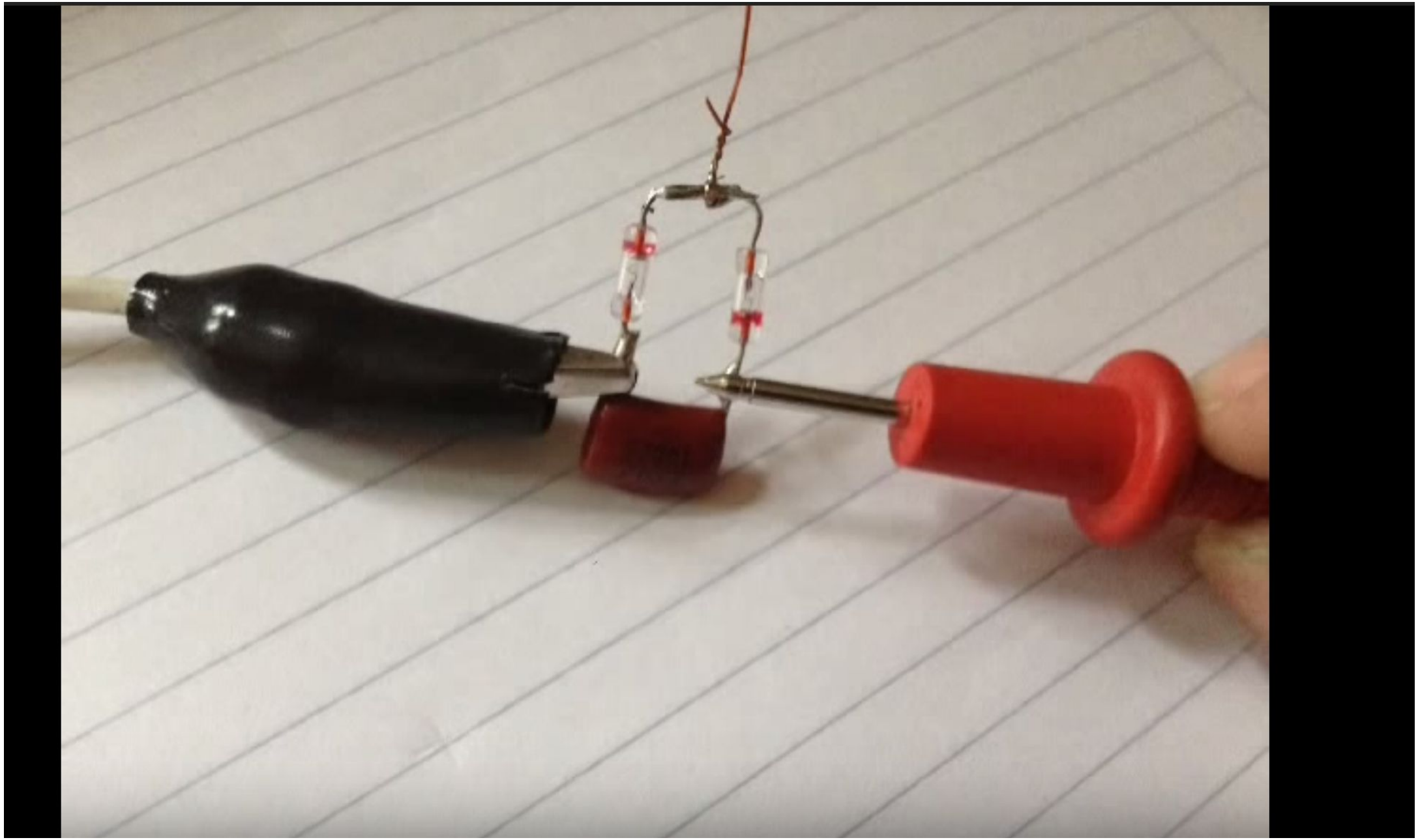

Ricevitore a cristallo per FM

Un progetto di Giacomo Cavuoti

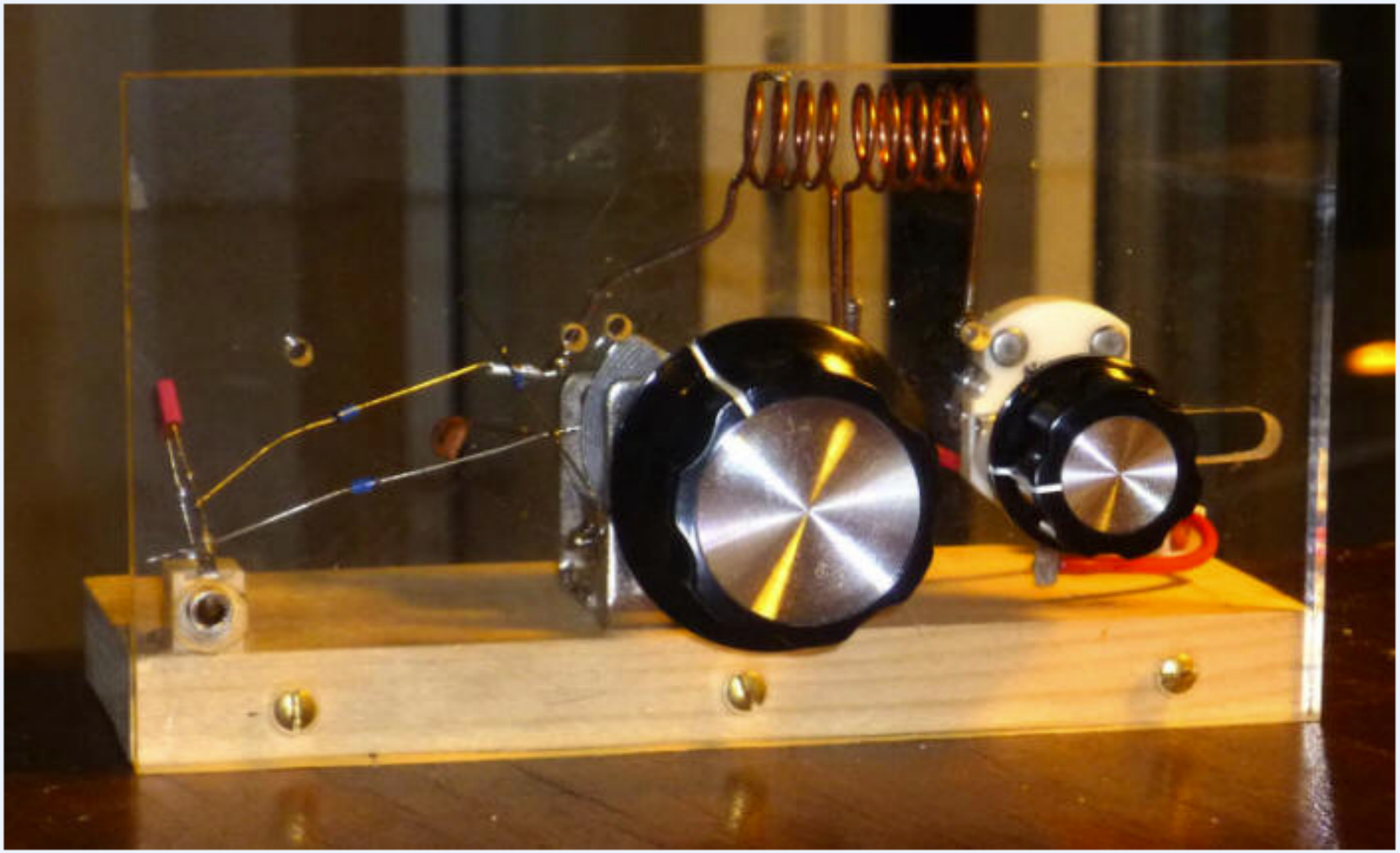

Seguendo l'invito di Leonardo ho realizzato questo semplice ricevitore a cristallo per FM (fare clic sullo schema qua sotto per vederlo ingrandito).

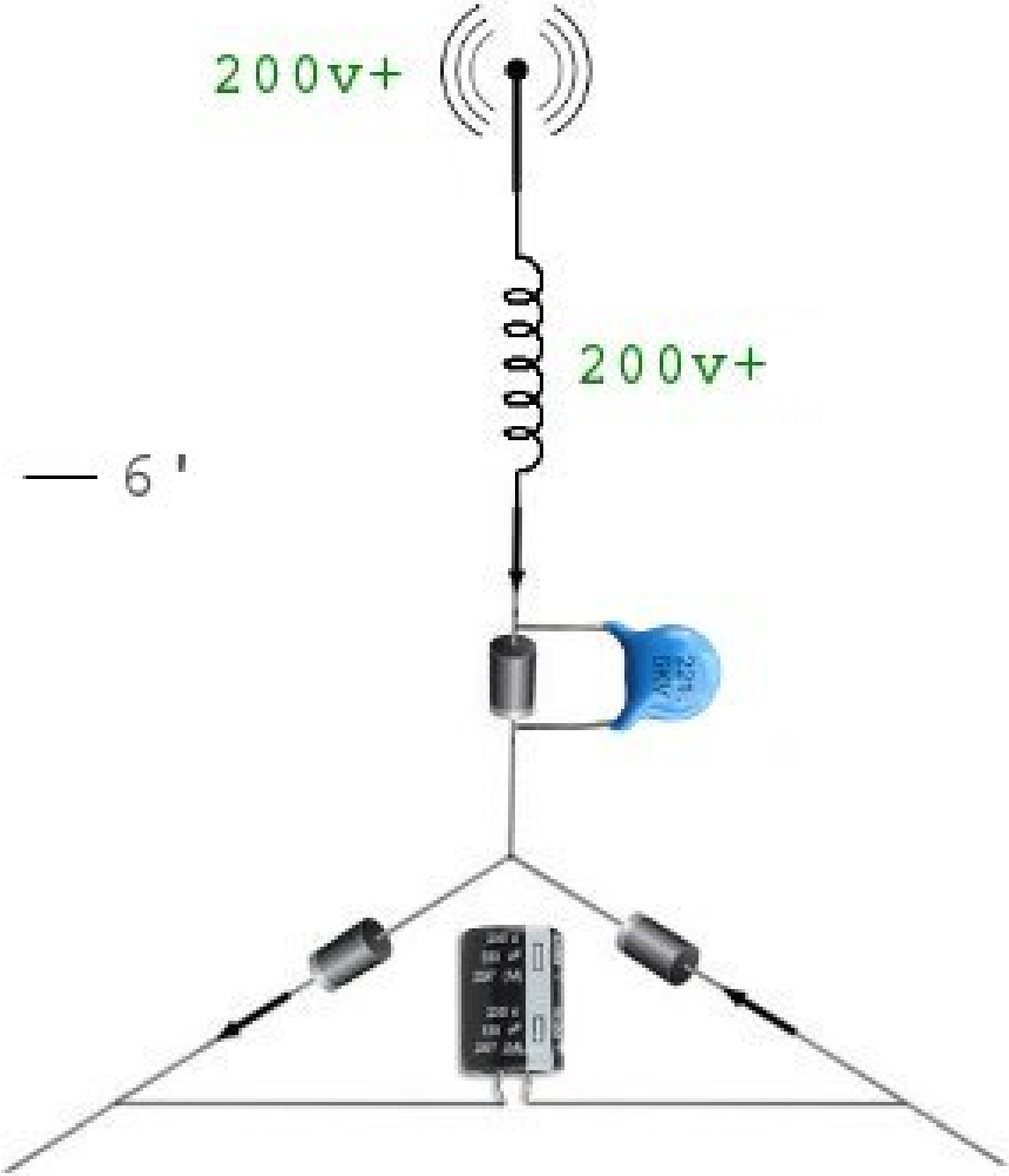
200v+
200v+
6'

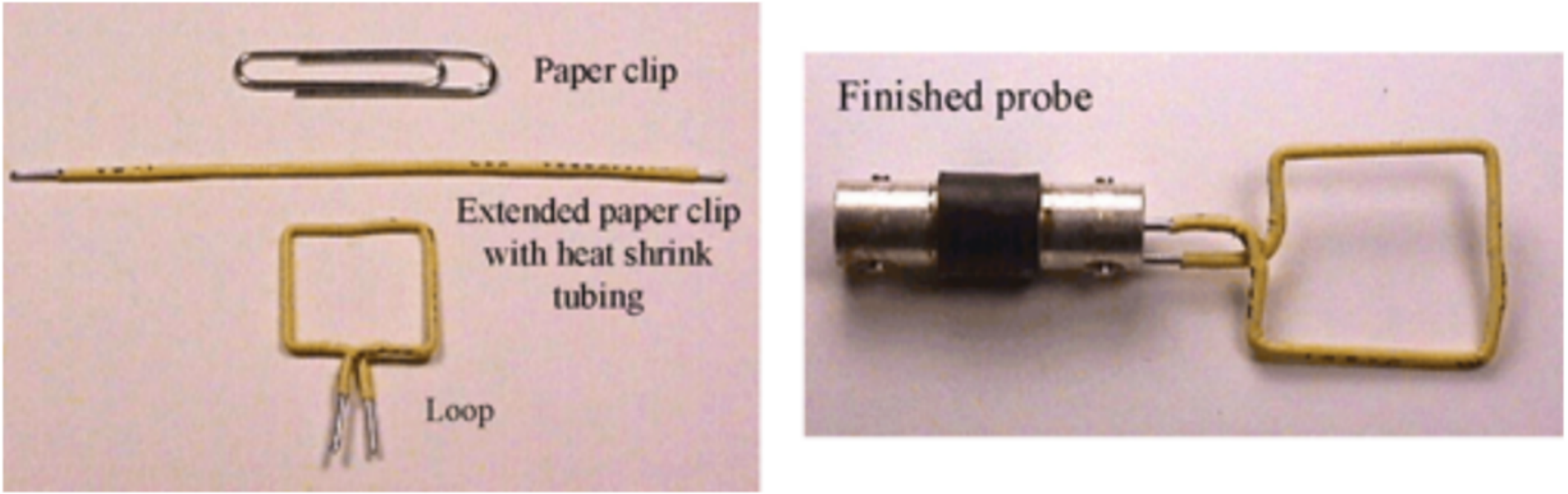

Figure 1: Magnetic field probe build from a paper clip.

YAESU
HOME
SEL
CLAR
VFOa CW
14.054.00 R
SW
A
B
C
V/M
LOCK
PWR
AF SQL/RF
C-POISE
1:54 / 2:18

Simple SWR Indicator for QRP
0:01 / 2:18

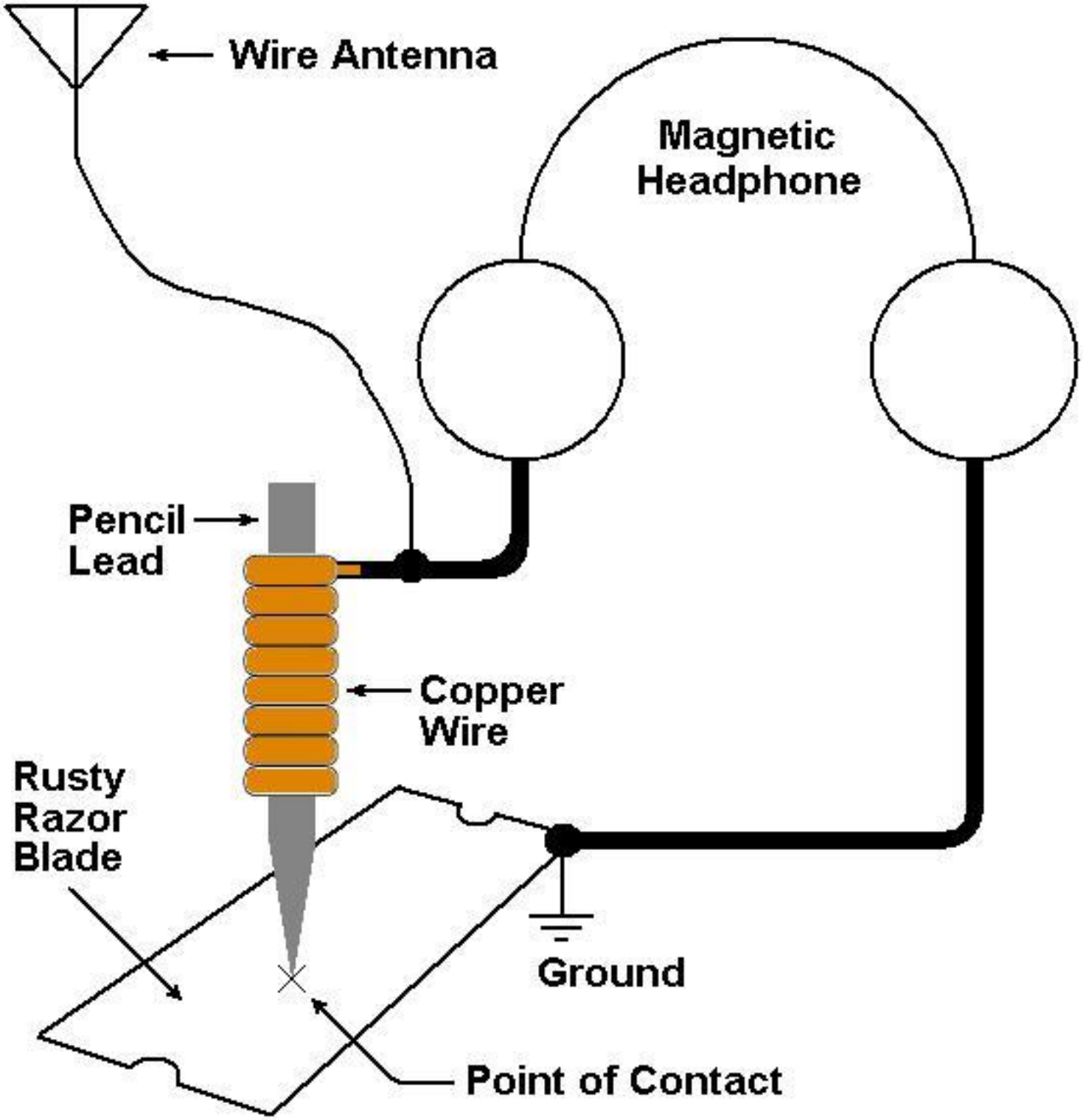
Wire Antenna
Magnetic Headphone
Pencil Lead
Copper Wire
Rusty Razor Blade
Ground
Point of Contact

Bogen T725 Transmatch
MARX 2013

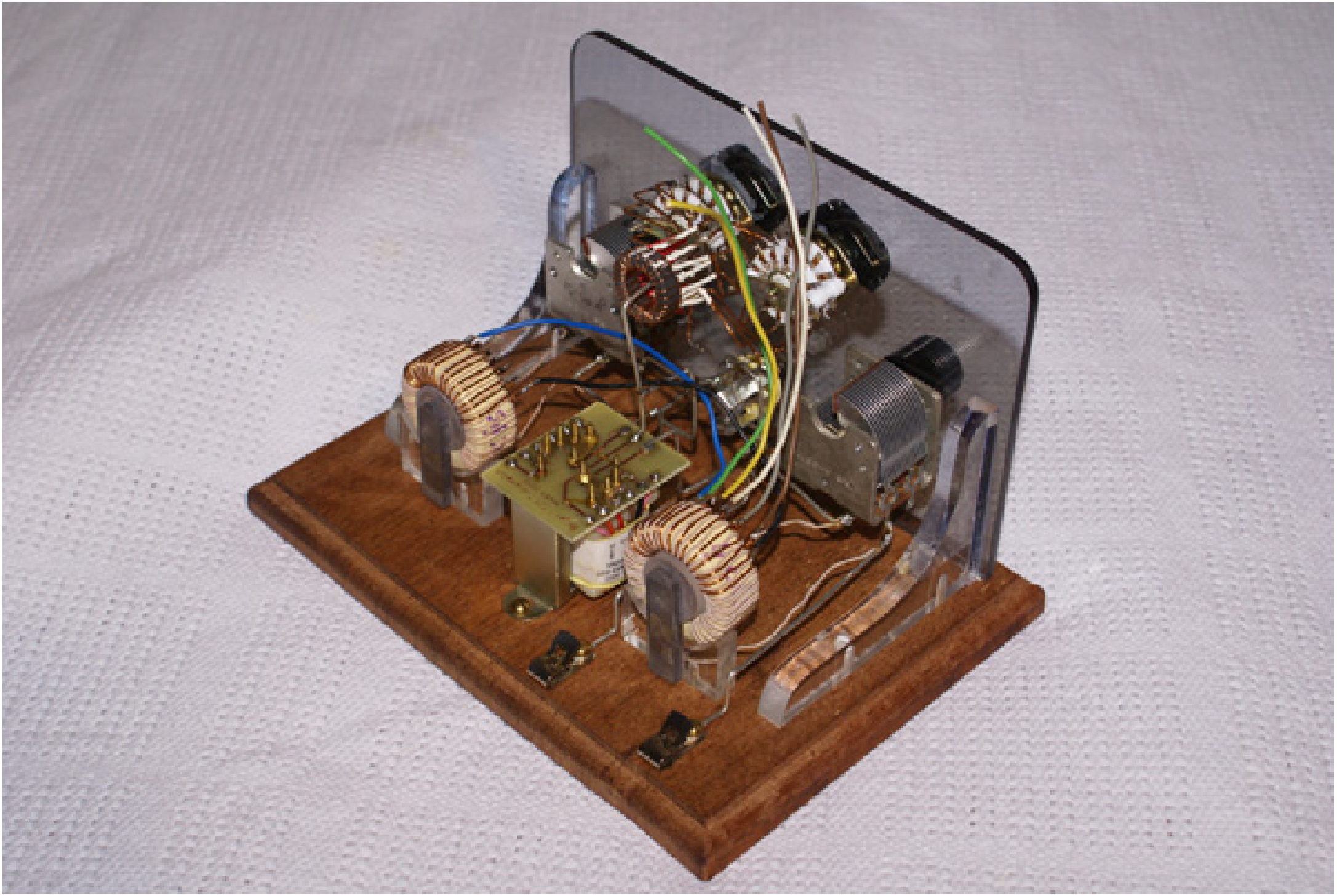

SWJ.
DRQ.

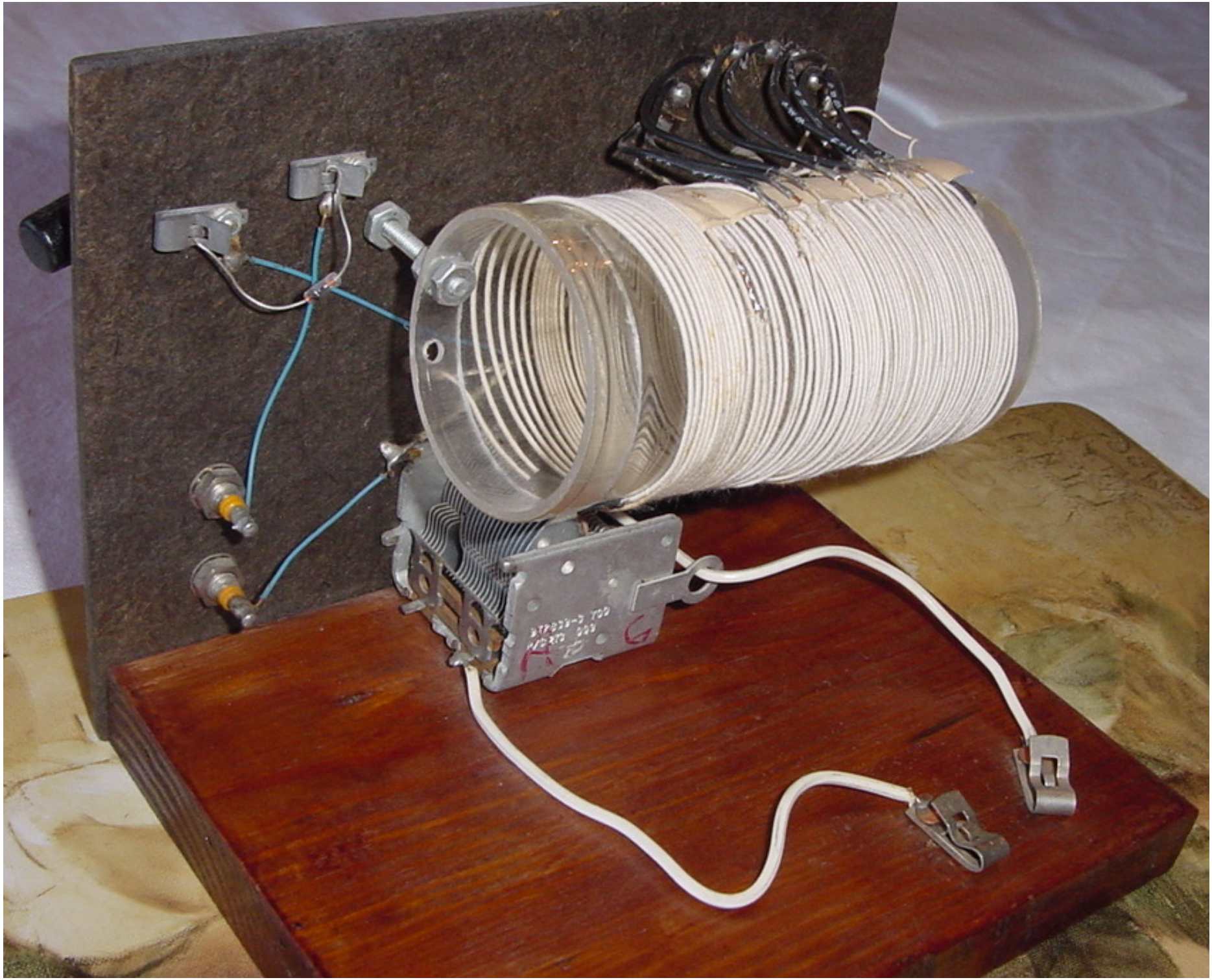

Another Prototype similar to the Heathkit using toroid coil

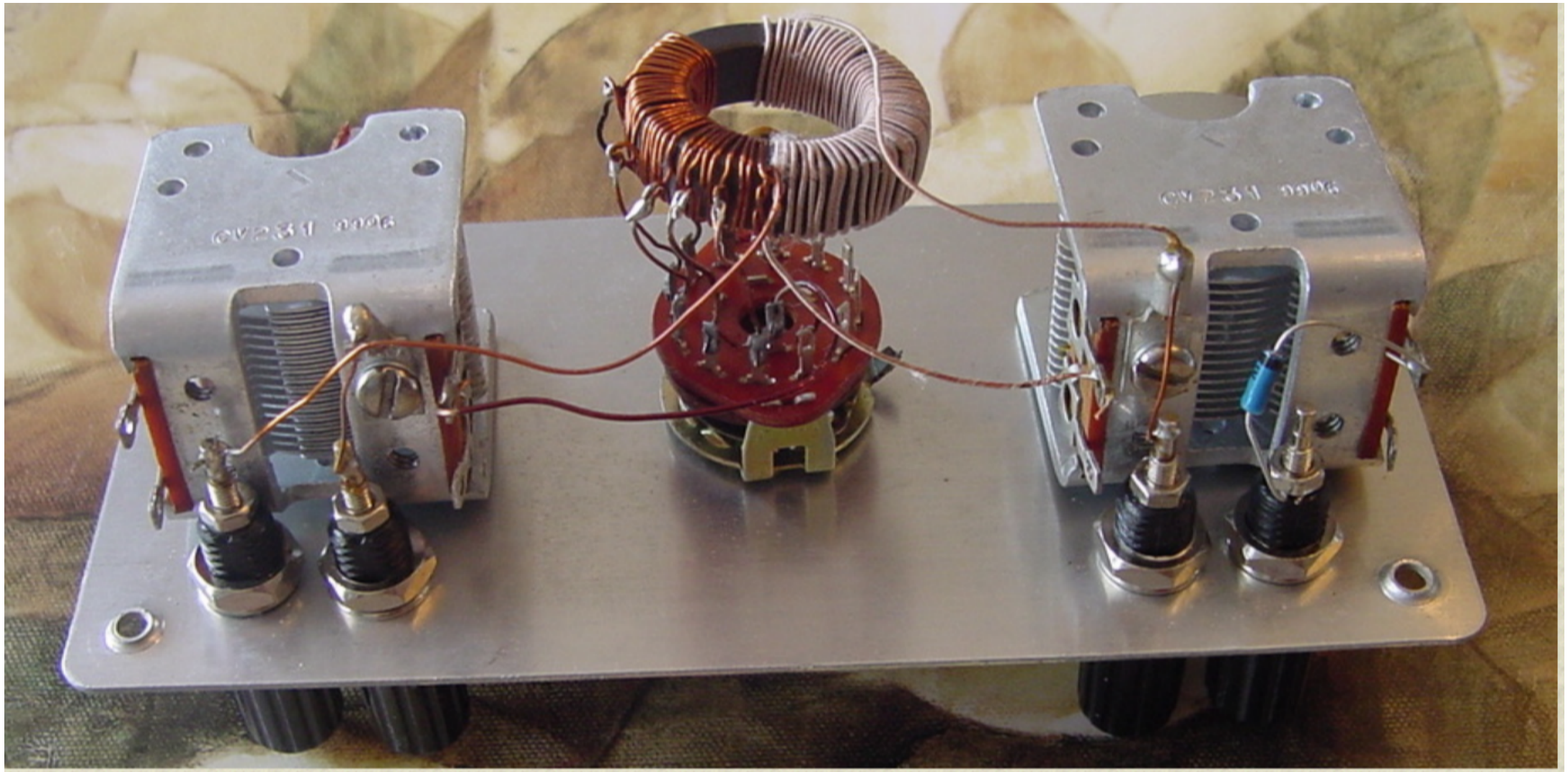

This is a dual tuned crystal set made in a box like the CR-1, just a fun prototype I made a few years back. It pulls in AM stations loud and clear.

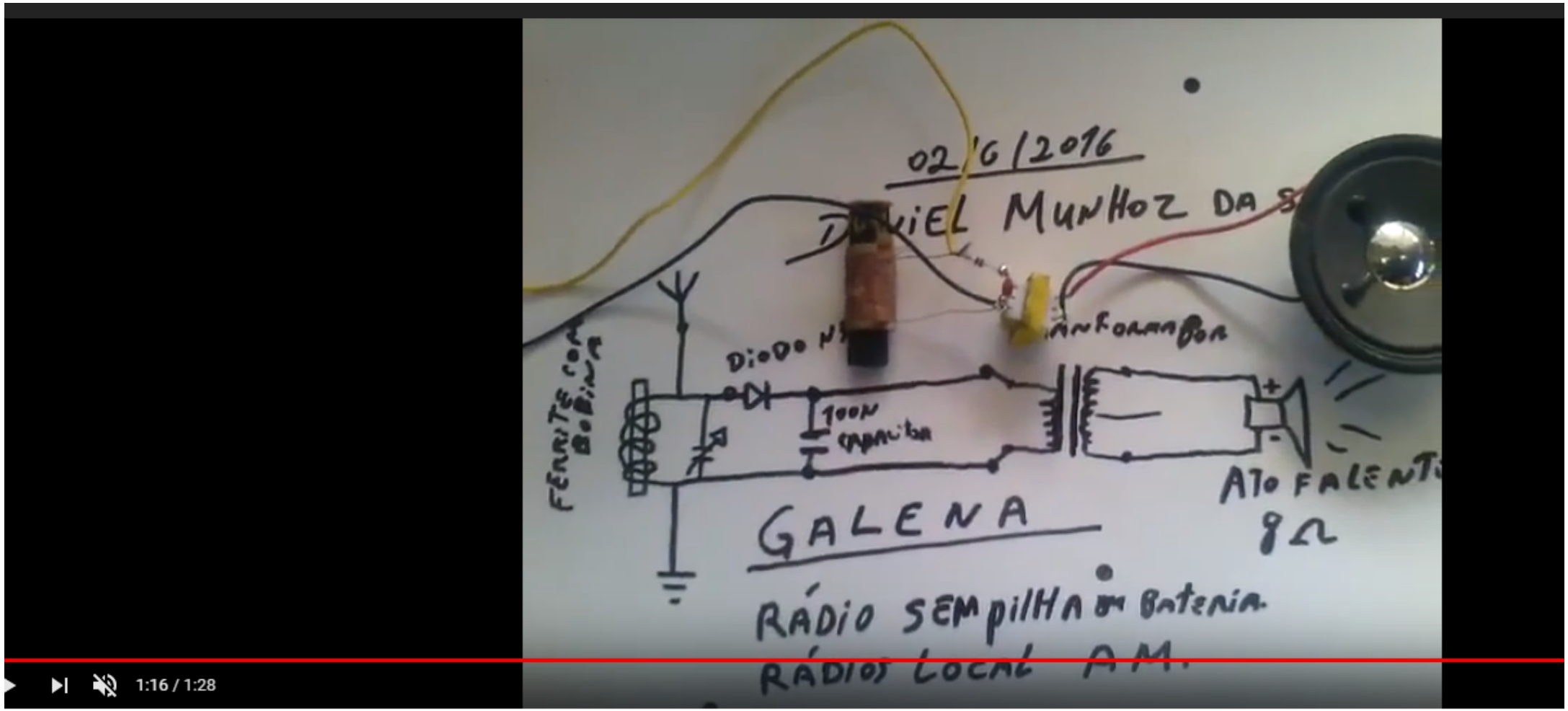

GALENA , Rádio AM ,sem pilha.

Up next

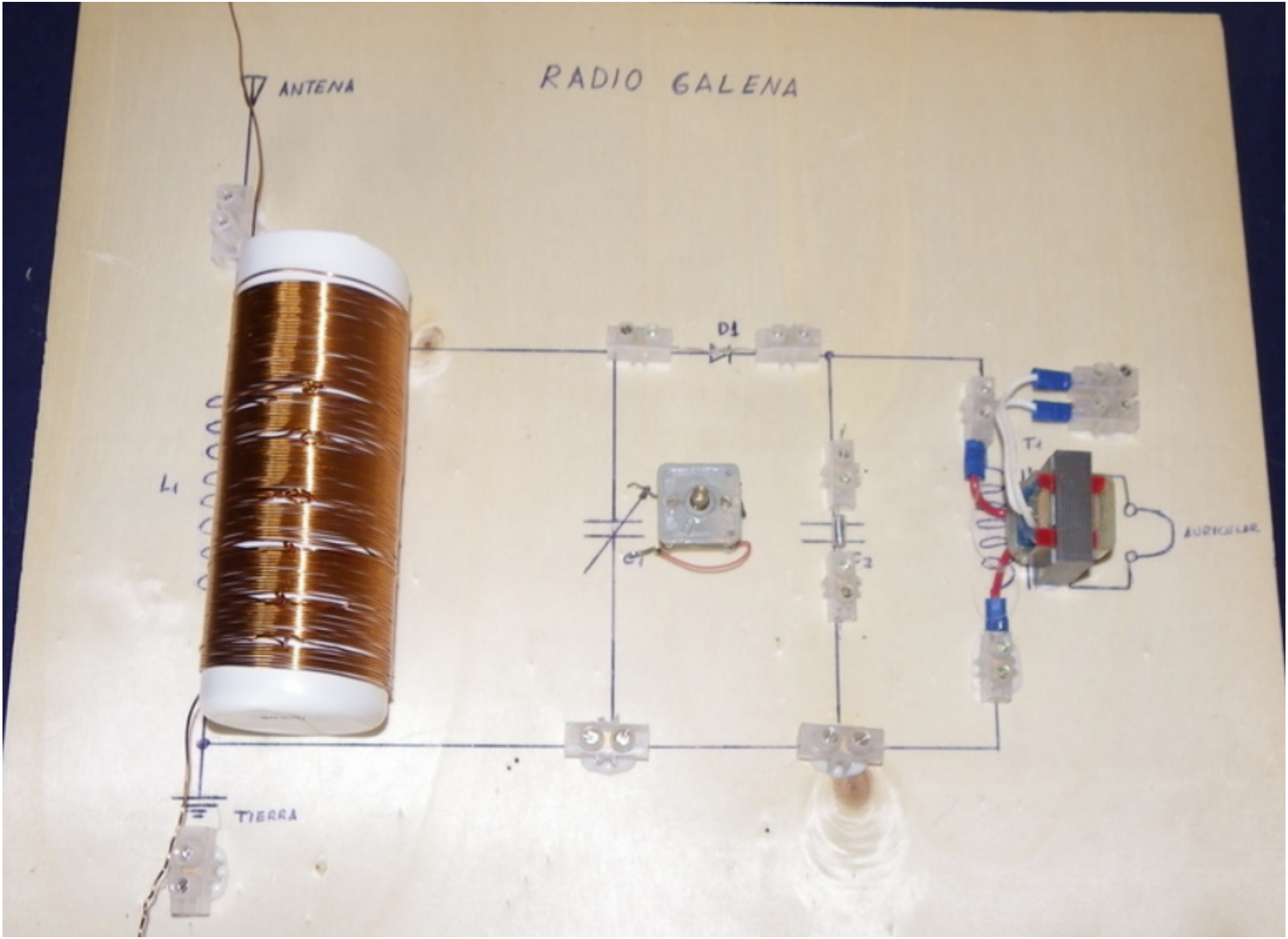
RADIO GALENA
ANTENA
L1
D1
C1
C2
T1
AURICULAR
TIERRA

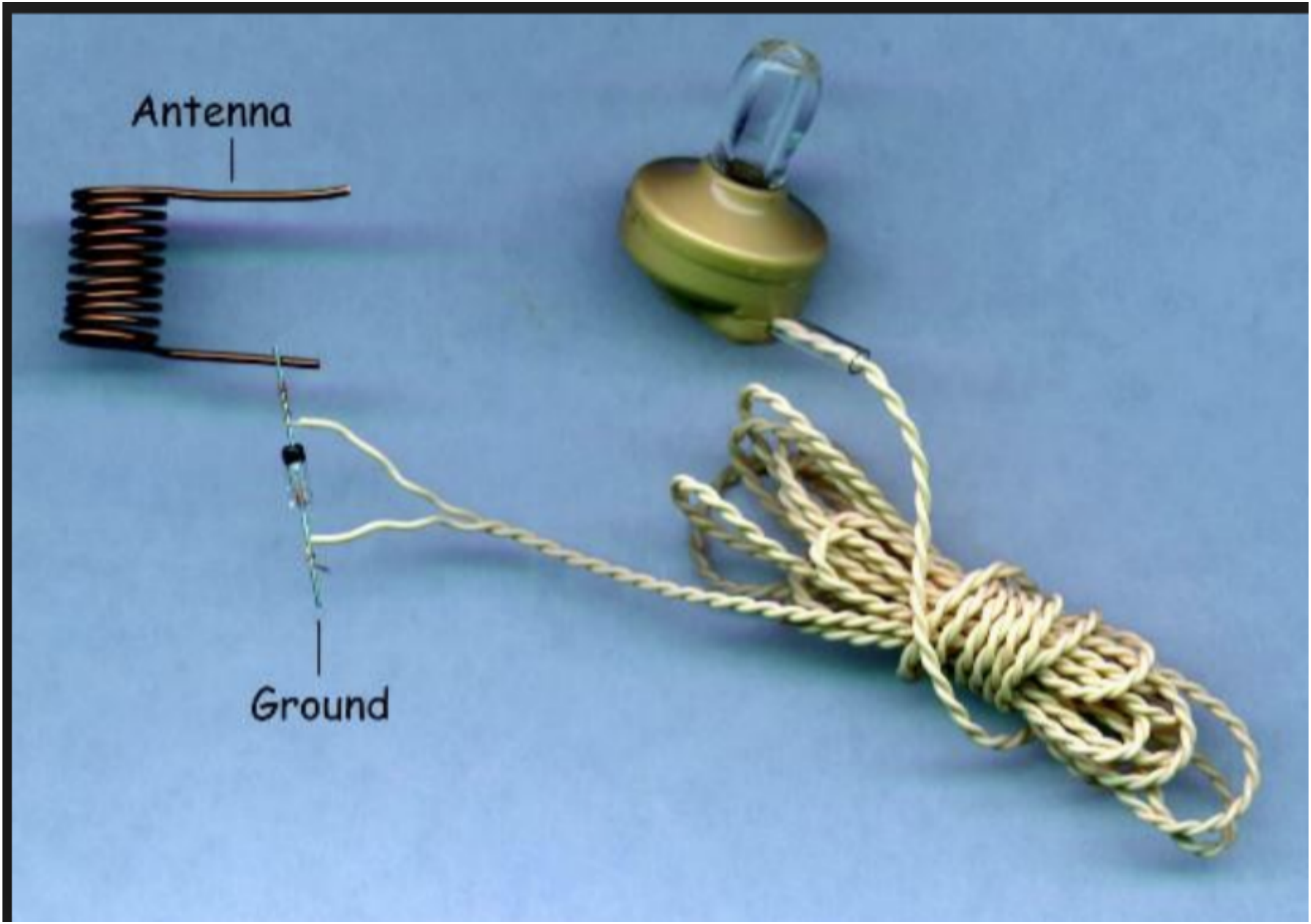
Antenna
Ground

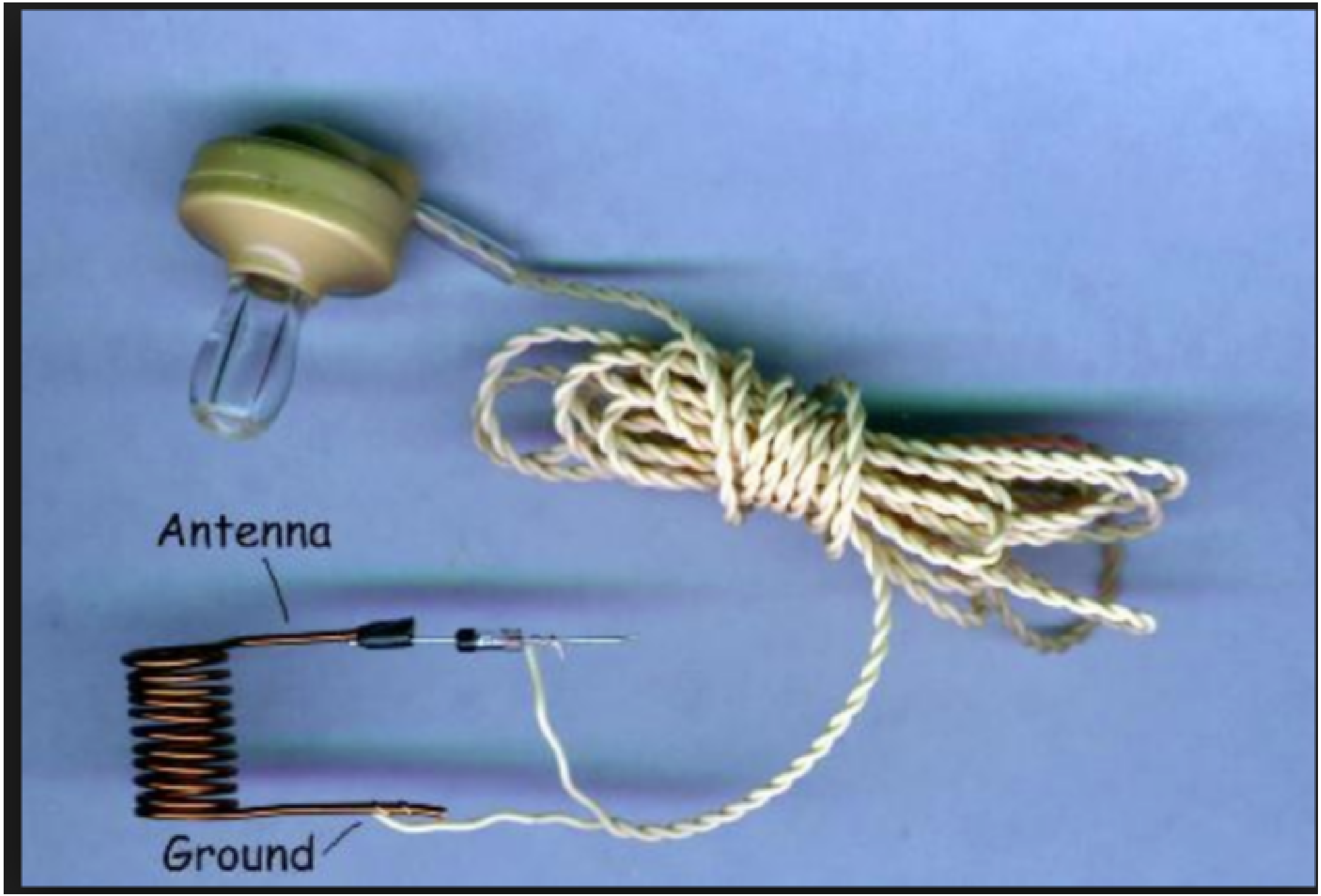
Antenna
Ground

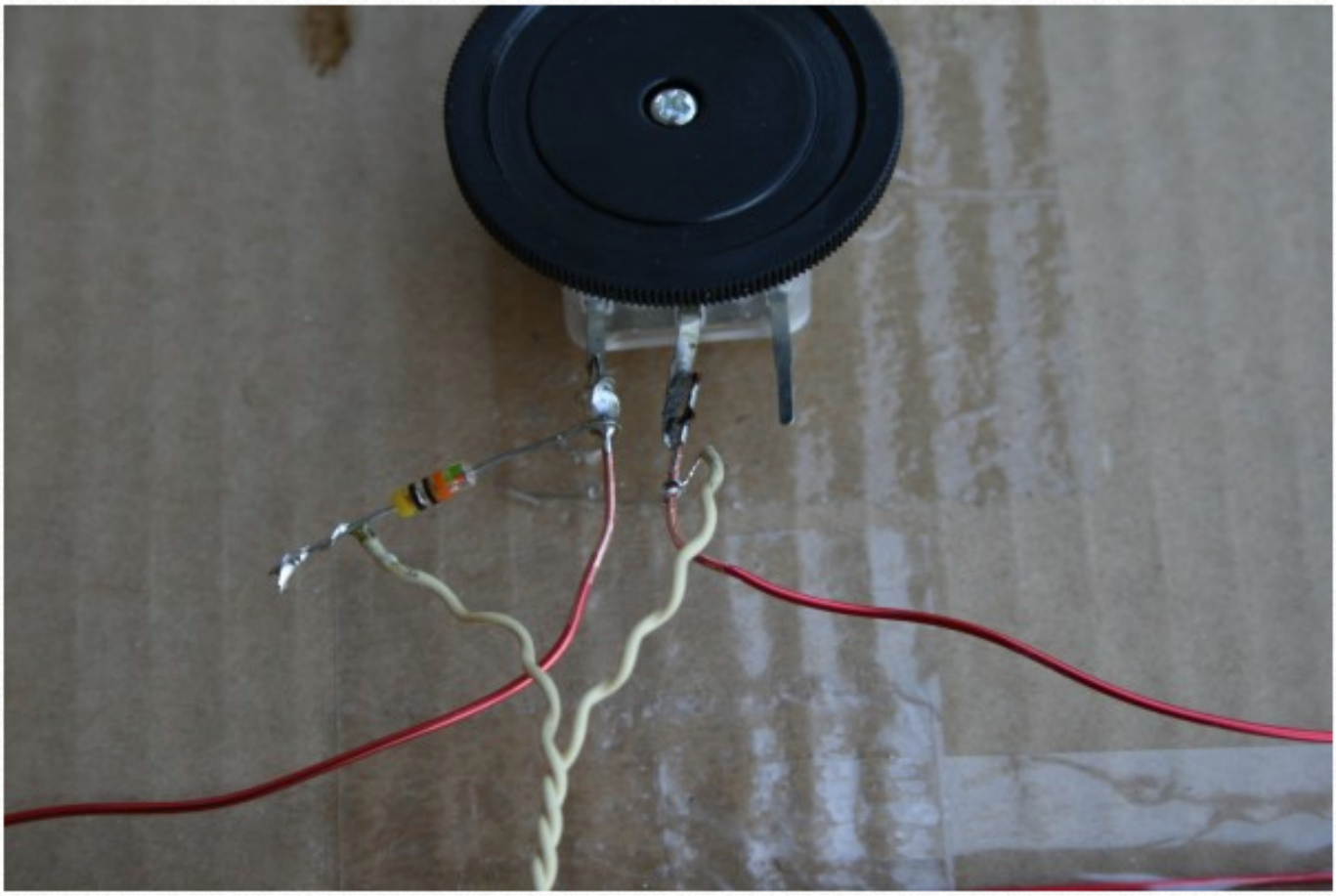

Click on photo for a larger picture

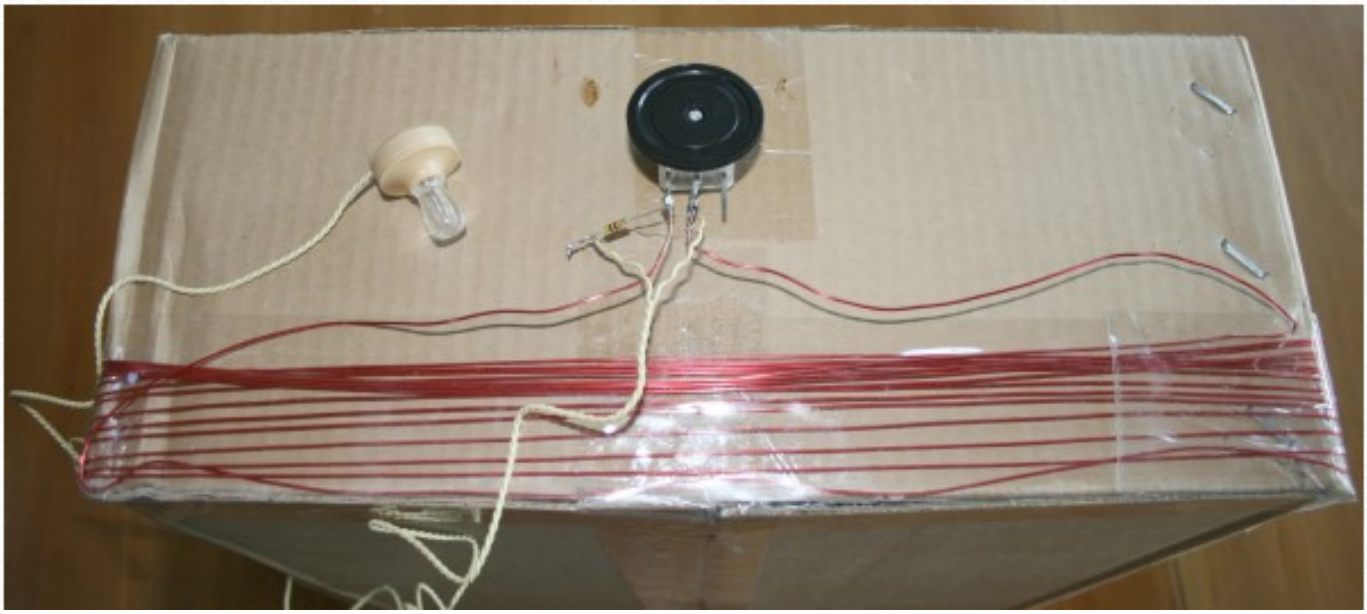

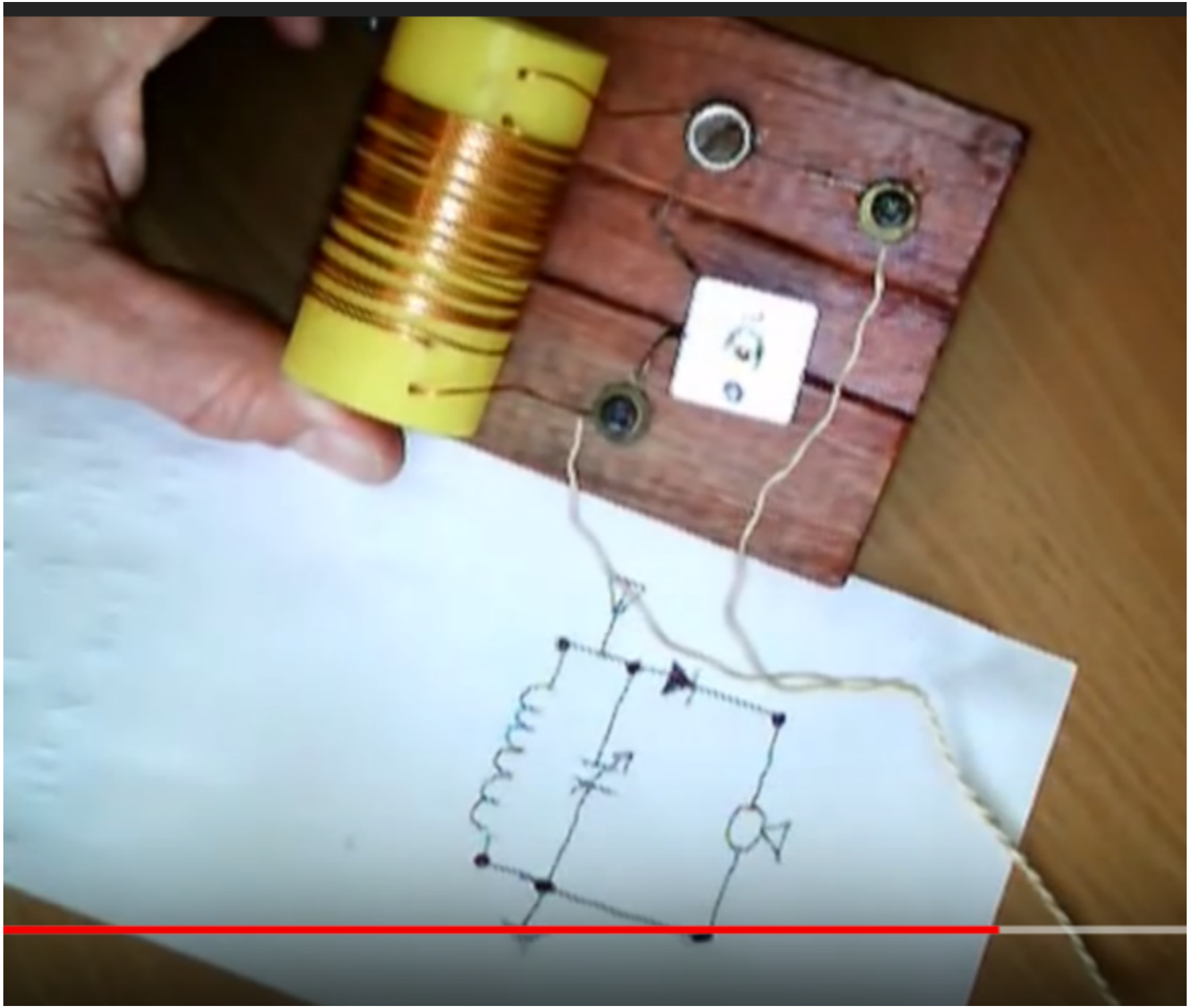

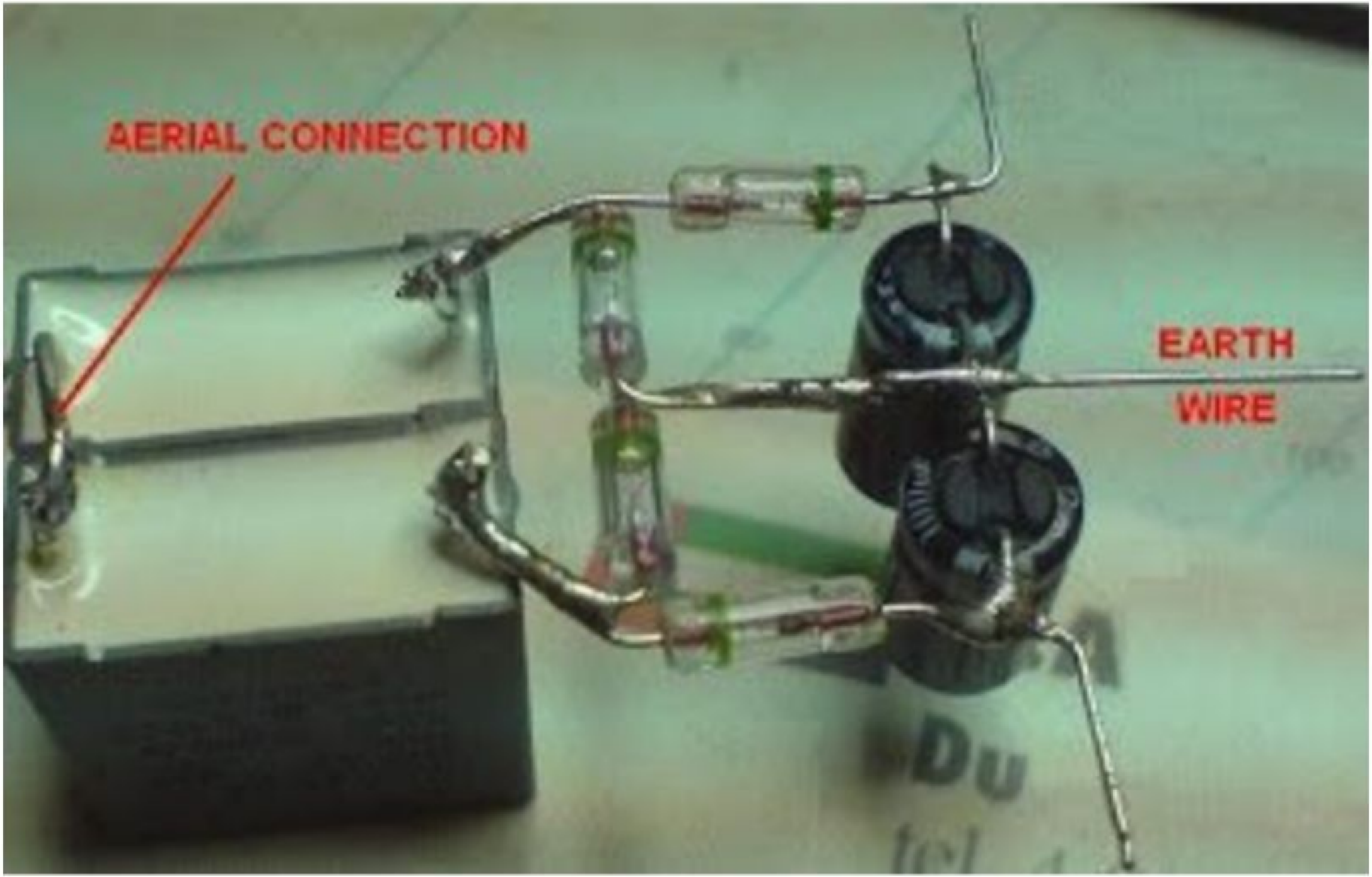
AERIAL CONNECTION
EARTH
WIRE

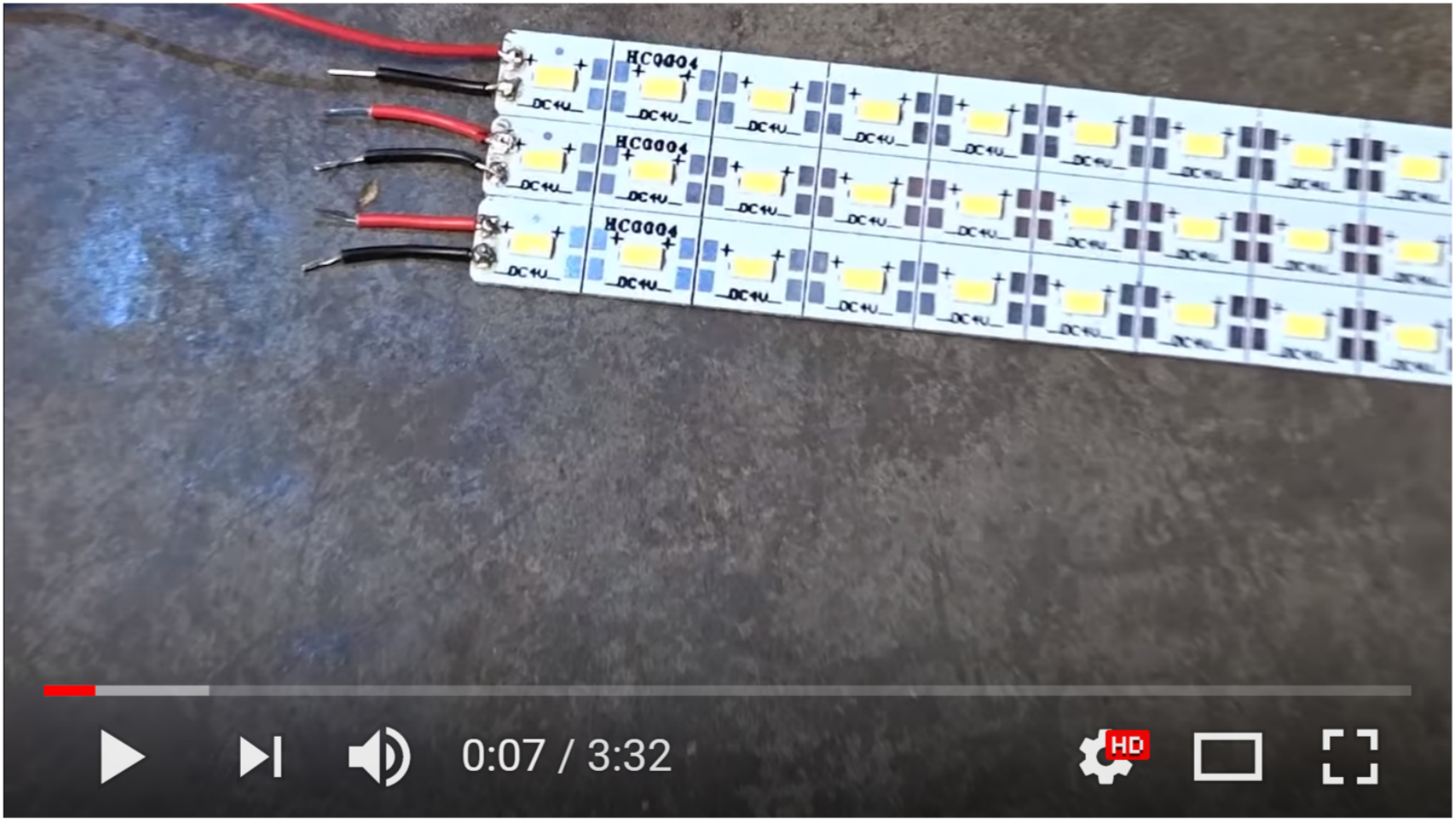

New idea - You can make Solar Cell from LED (Free Energy)

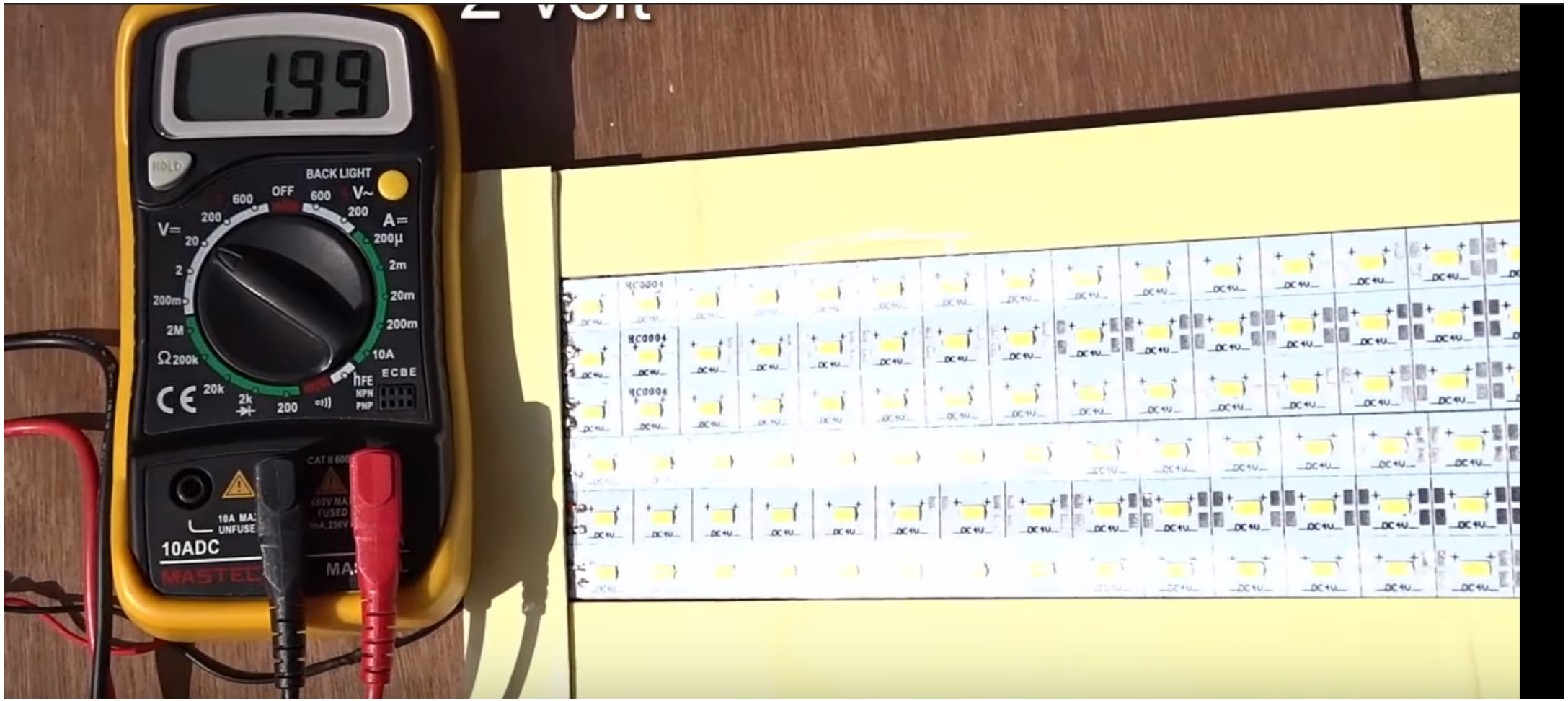
1.99
HOLD
BACK LIGHT
OFF
V~
V=
A=
200µ
2m
20m
200m
10A
ECBE
hFE
NPN
PNP
Ω200k
20k
2k
200
2M
200m
2
20
200
600
10A MAX
UNFUSE
10ADC

Instructions for using
Philmore Crystal Radio Detector

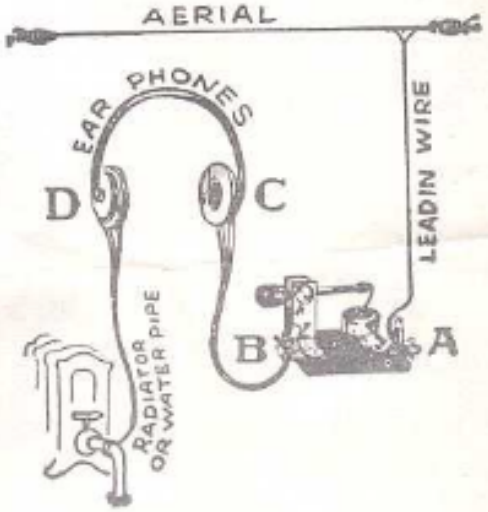

This Detector is a radio in itself, as it is possible to get reception with it alone, provided you are within 25 miles of a broadcasting station. Under very favorable conditions reception is sometimes possible at much greater distances.

In order to get reception, you need an aerial kit and headphones. The AERIAL may consist of 100 to 125 feet of copper wire and two insulators. Attach insulators to each end of the wire. Stretch the wire allowing as little sag as possible. No part of this wire should touch any portion of the building or any other obstruction.

The LEAD-IN may consist of any desired length of covered wire which will reach from the aerial to the set. Scrape each end of the lead-in so that the wire is absolutely clean. Wind one end securely around the aerial wire. Place the other end in the clip marked "A".

There are two cords leading from the headphones. Connect the cord "C" as illustrated, from the earphone to clip "B" or the clip under the detector arm. The other wire from the earphone marked "D" is to be connected to water pipe, radiator or any other suitable connection to be used for the ground.

You are now ready to receive broadcast. Find a sensitive spot on the crystal by means of the cats-whisker. You may find it necessary to "hunt" for live spots on the crystal as only some parts of a crystal are sensitive, and unless you find these sensitive spots you will not hear anything.

If you do not at first get results, do not blame the detector, as every set is tested before being shipped and will positively get results under the proper conditions. Do not write in and ask what the trouble is for a personal examination of your entire hook-up will be necessary. Go over your aerial, ground, various connections, etc., and if necessary get someone who thoroughly understands radios to help you.

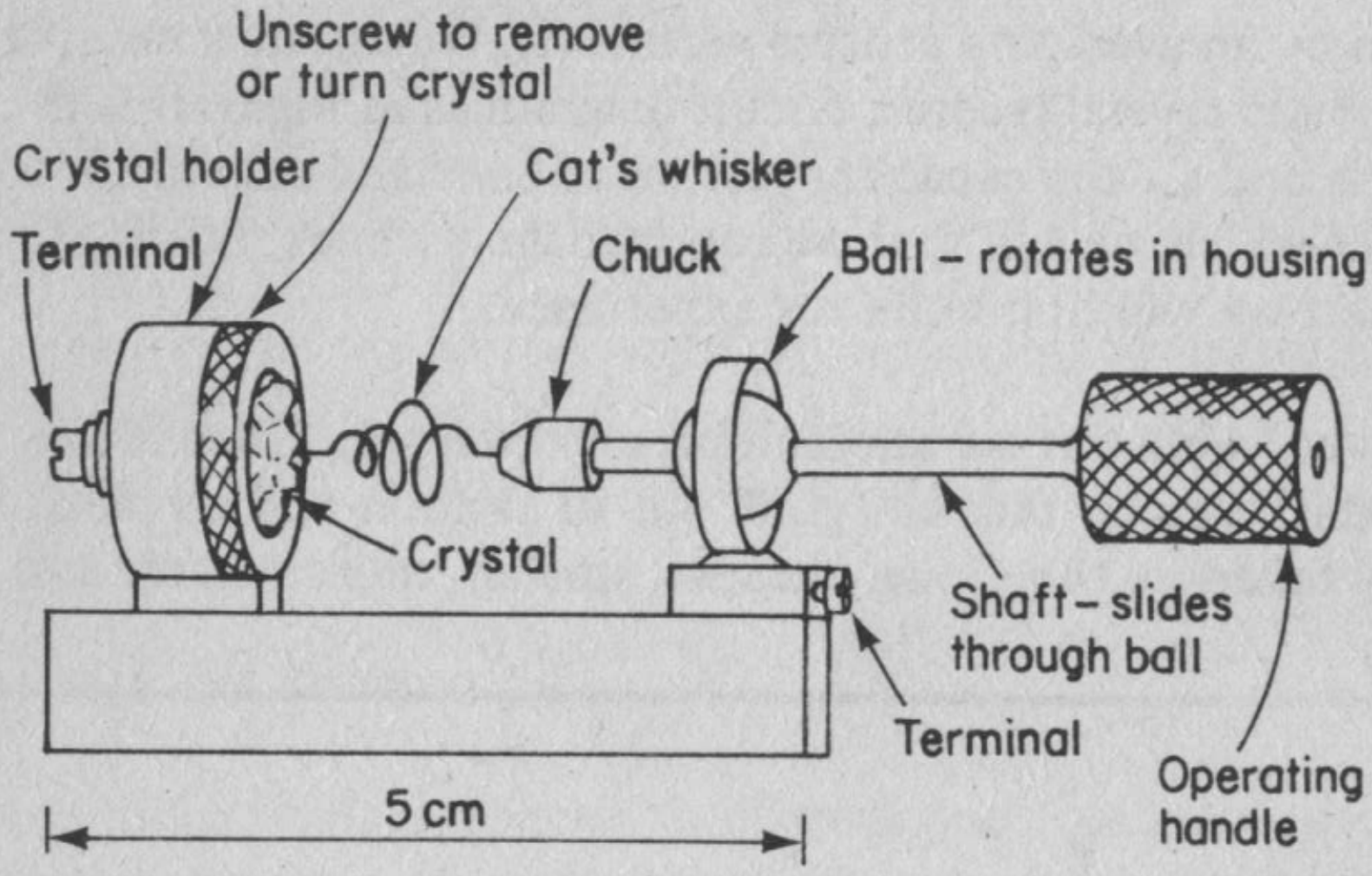

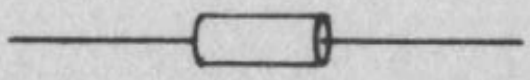

Modern diode (7·5 X 2·5 mm)

Majoritatea componentelor active folosite în circuitele electronice moderne sînt dispozitivele bazate pe semiconductoare.

Cel mai simplu dispozitiv este *dioda* punctiformă cu germaniu. Ea are proprietatea de bază de a se comporta ca şi cum este conectată direct la o sursă electrică de curent continuu (plusul sursei la plusul diodei) şi ca un izolator, cînd este conectată invers la aceeaşi sursă (plusul sursei la minusul diodei), ca în figura 2.9.

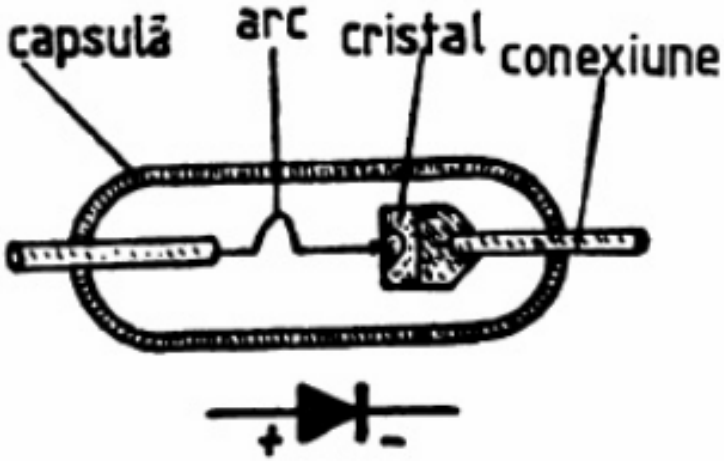

FIG. 2.9.

Dioda punctiformă cu germaniu

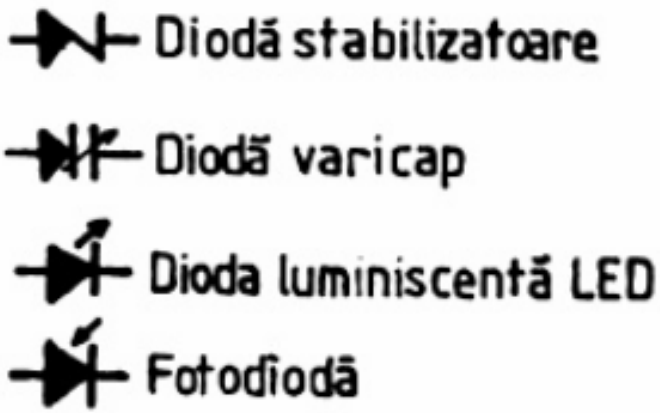

FIG. 2.10.

Tipuri de diode semiconductoare

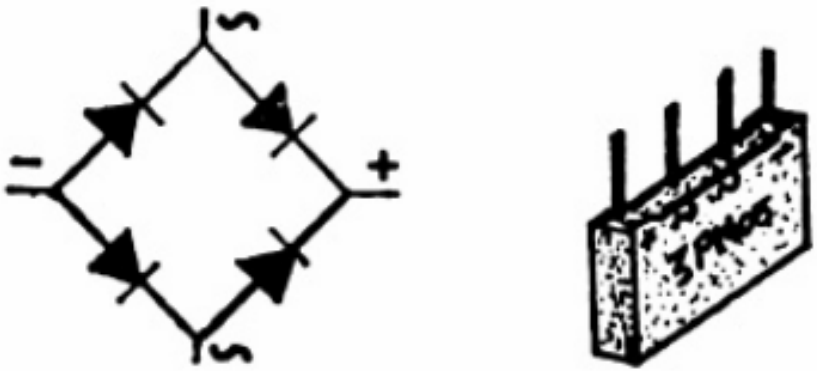

FIG. 2.11.

Puntea redresoare

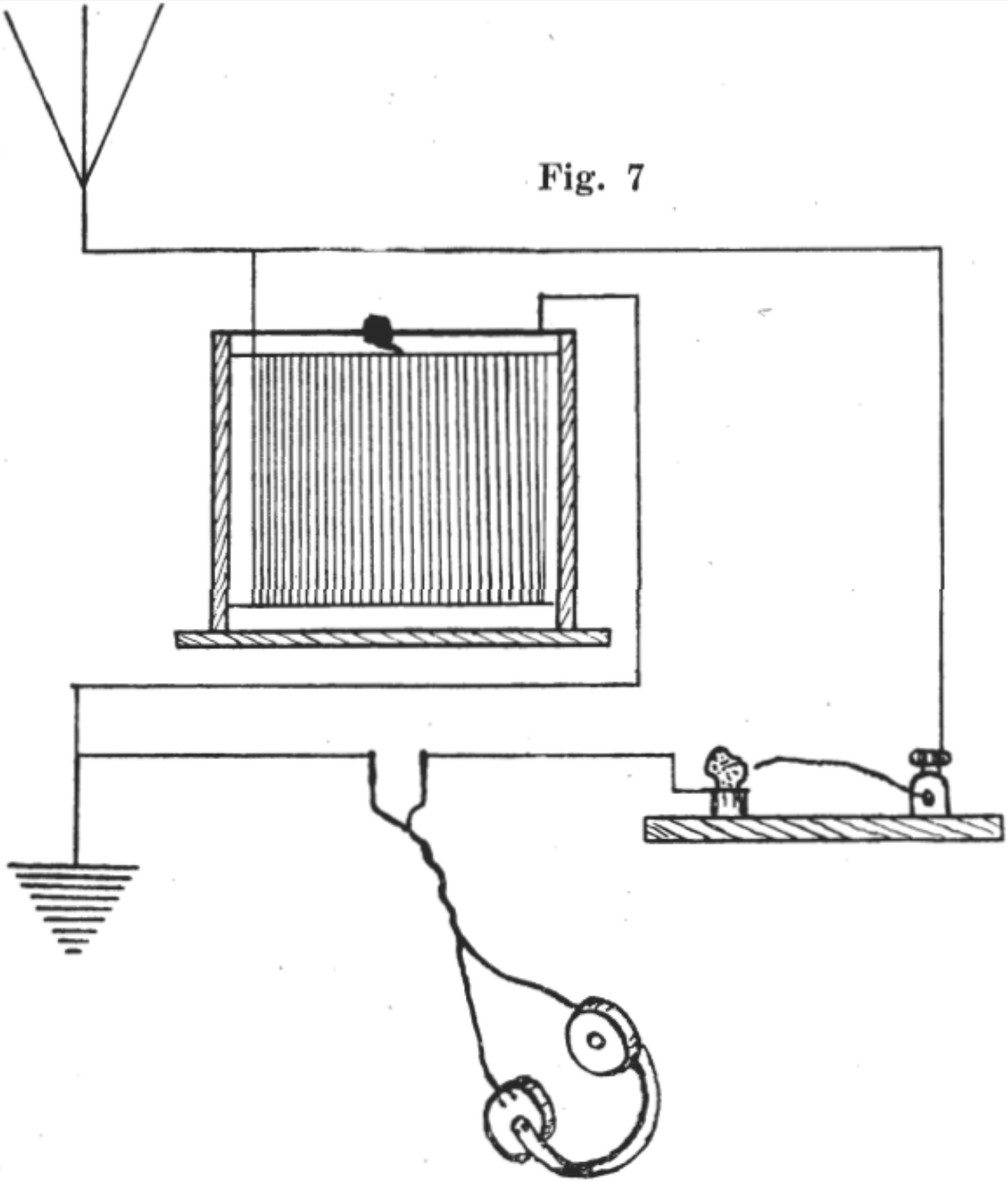

Fig. 7

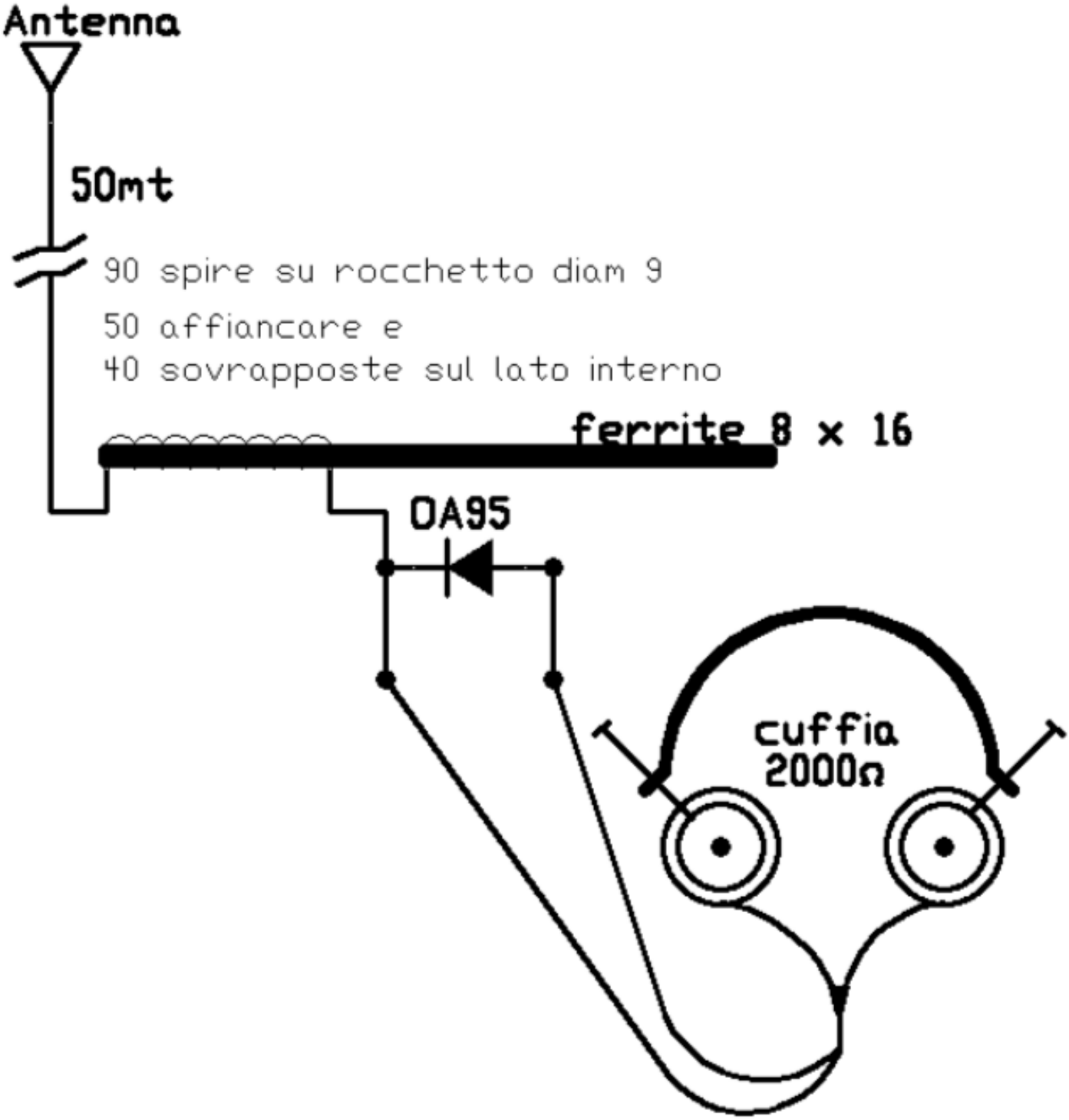
Antenna
50mt
90 spire su rocchetto diam 9
50 affiancare e
40 sovrapposte sul lato interno
ferrite 8 x 16
OA95
cuffia
2000Ω

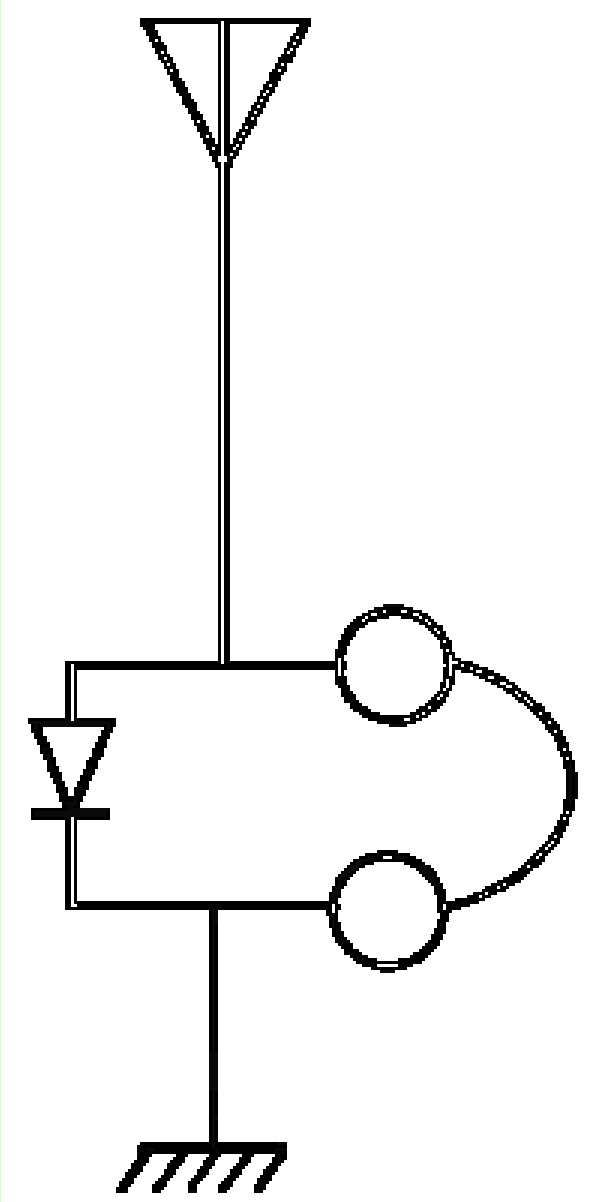

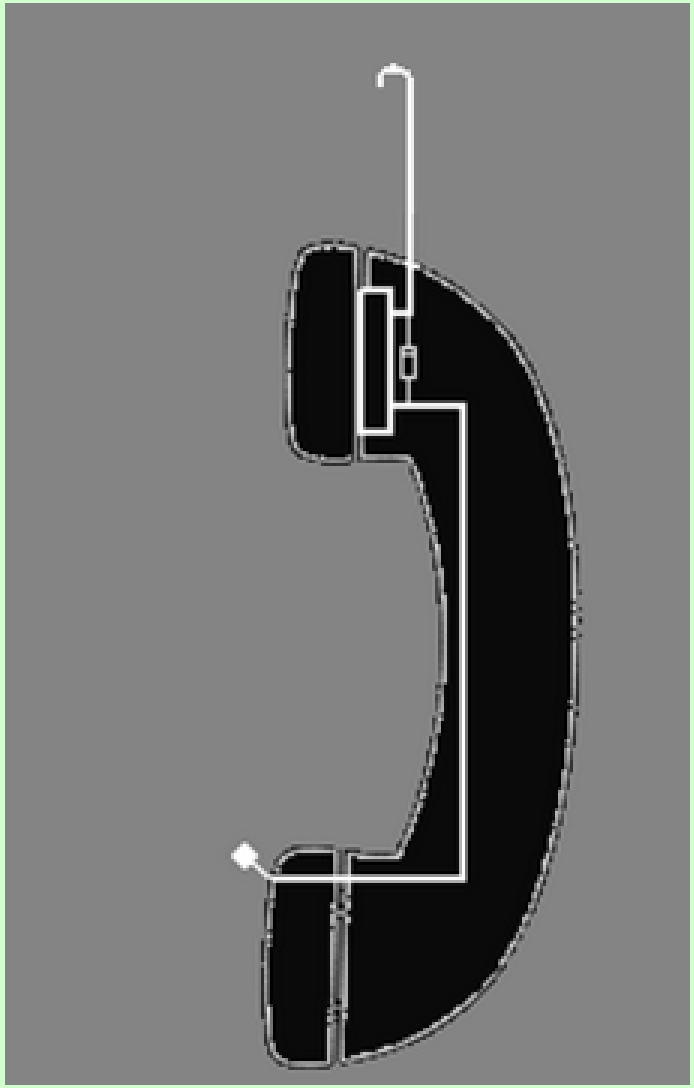

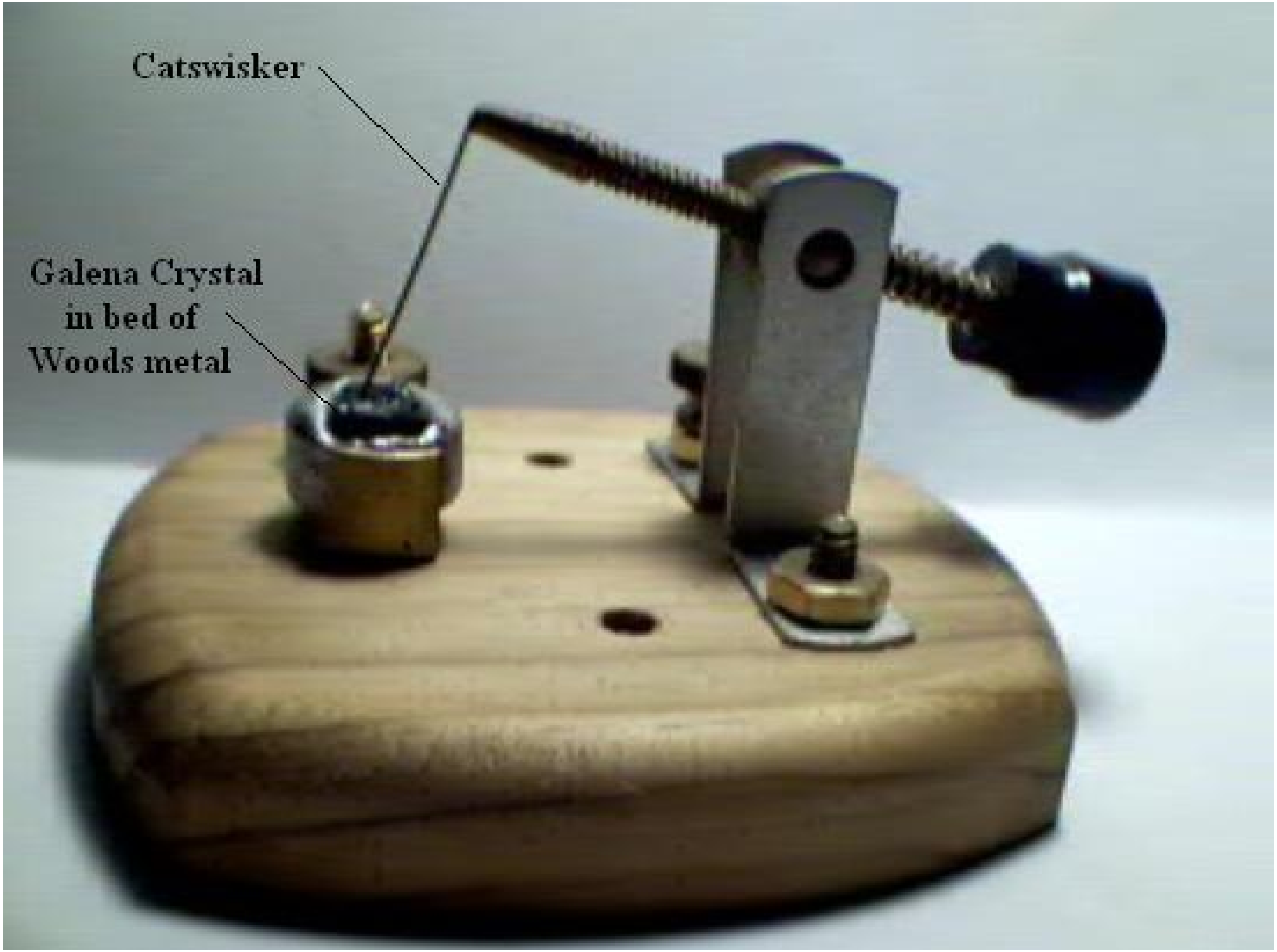
Catswisker
Galena Crystal
in bed of
Woods metal

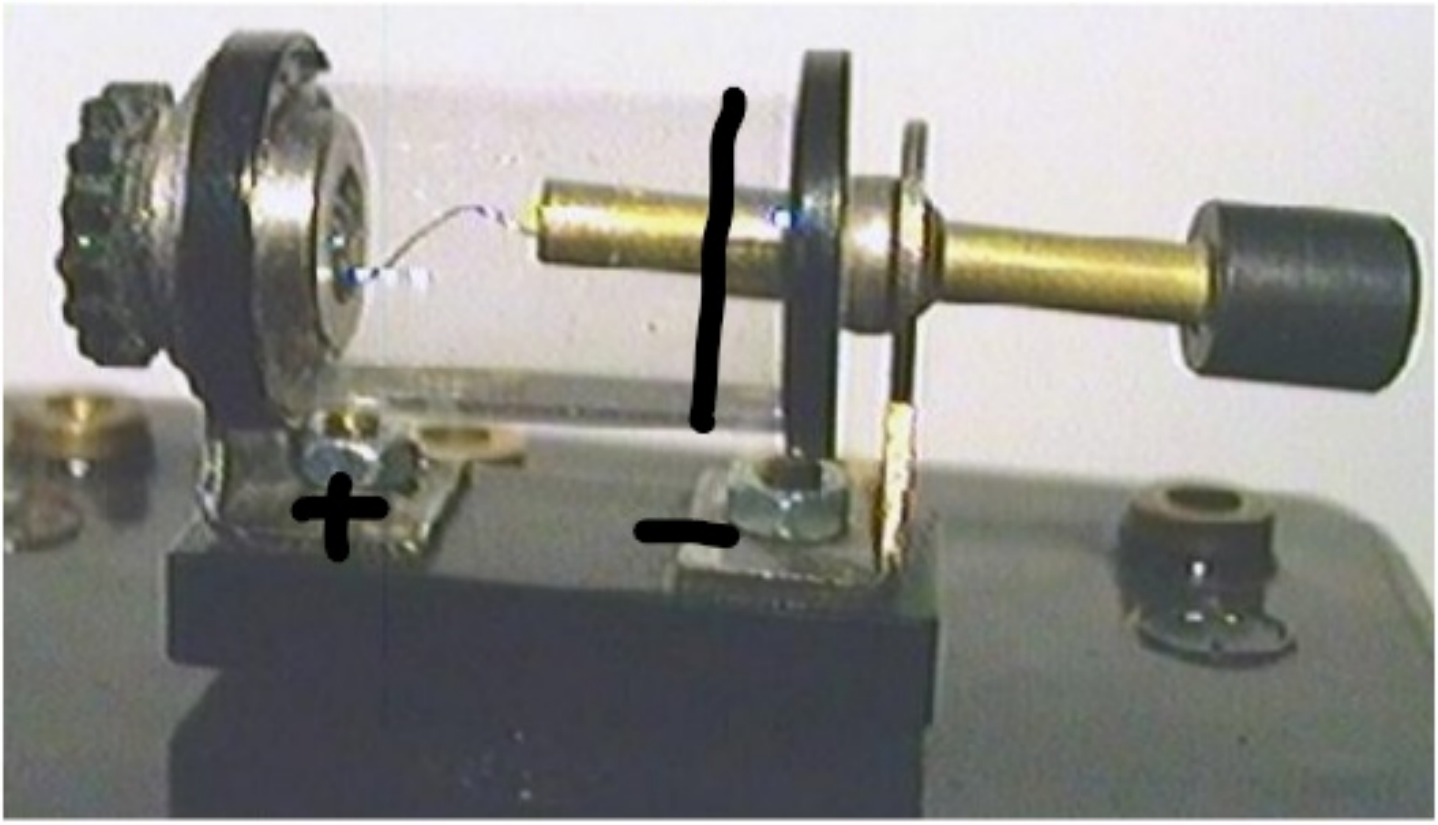
+
−

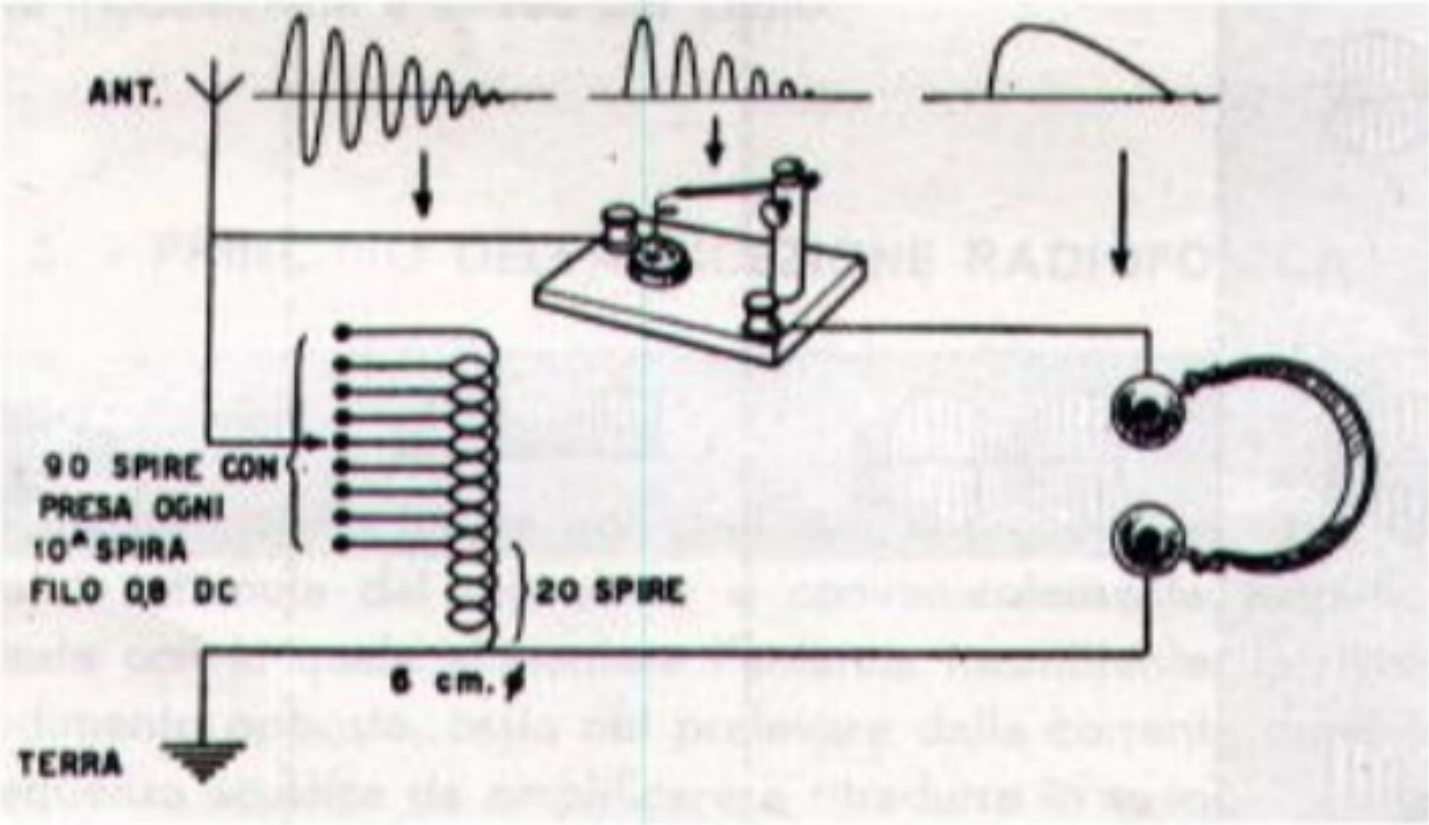
ANT.
90 SPIRE CON
PRESA OGNI
10ª SPIRA
FILO 0,8 DC
20 SPIRE
6 cm. ϕ
TERRA

Lead sulfide crystals, also called "galena"

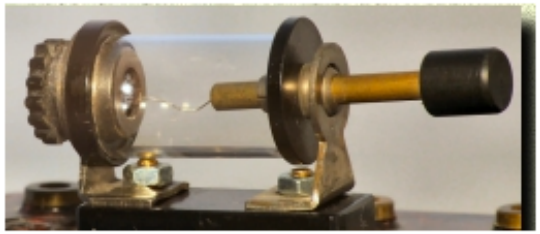

Crystal detector, the lever was used to position the spring contact on a crystal face capable of performing the radio signal detection.

Yeah , but how does a galena radio work? Here is the constructive scheme of a receiver of this kind, obtained from a book of popular radio commu
to the knowledge of the radio, ed.Hepep 1943):

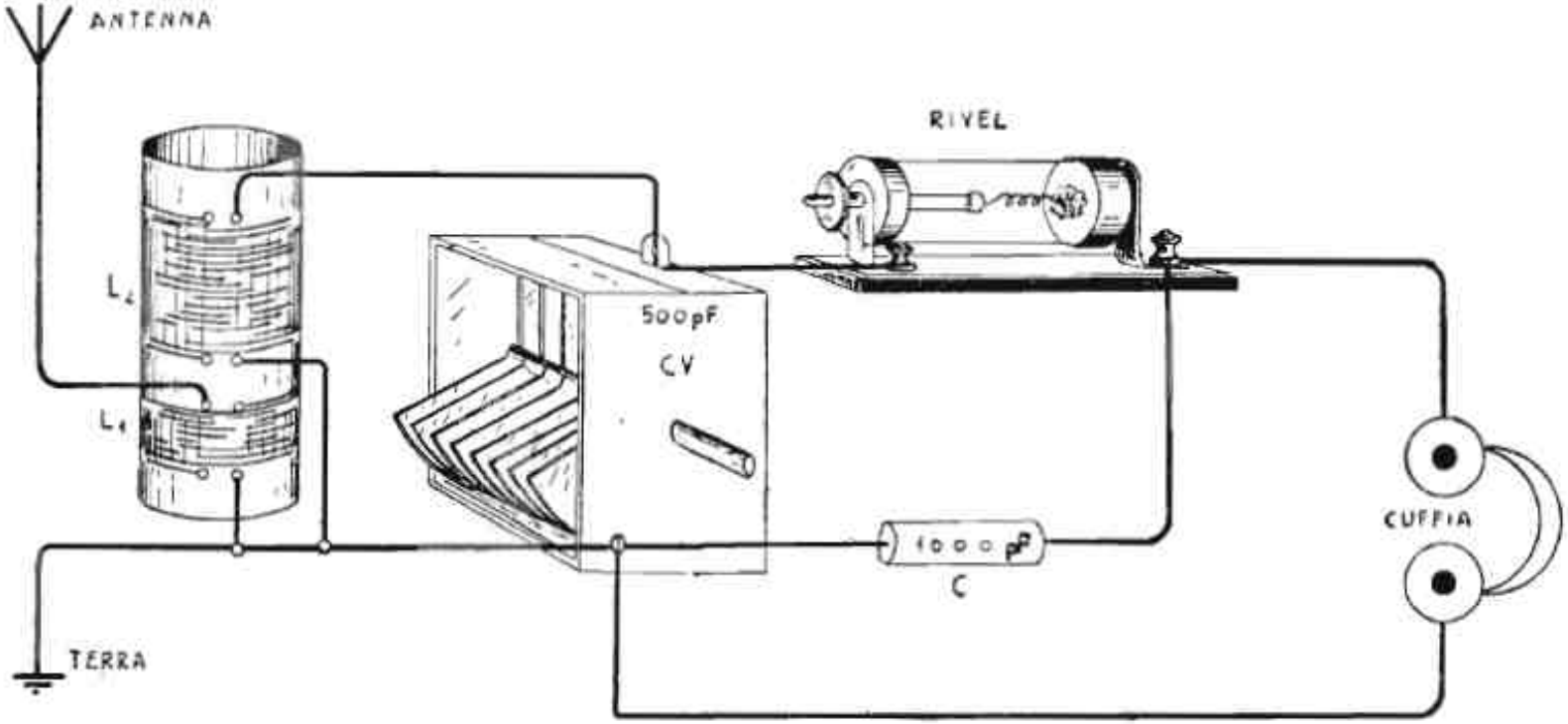

Fig. 13.5. – Realizzazione pratica dello schema di fig. 13.3 con aggiunta della bobina d'antenna.

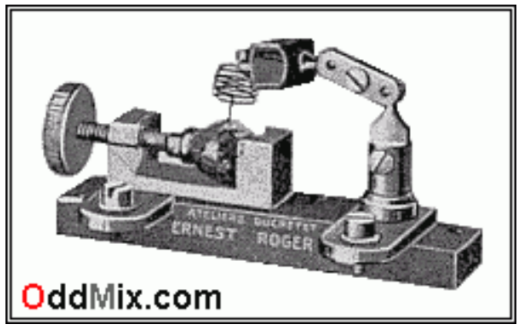

Picture 1. "Ernest Roger" Crystal detector from 1920

Many of the **younger generation** never had the pleasure to have, or to even see a real beautiful crystal detector as shown on **Picture 1**. A detector like that was the product of the early 1920's, and it was an expensive, quality, well made product. They were usually hands assembled with machine made components.

This particular "**Ernest Roger**" detector device is built on an insulated base, either wood or most likely of Bakelite, the most widely used and only available plastic material at the times.

Many of the younger generation never had the pleasure to have, or to even see a real beautiful crystal detector as shown on **Picture 1**. The new generations are much too involved with technology and playing on their computers or going to an **online University**. This excellent detector holder used copper, brass and bronze generously for the crystal holder and for all of the **electrodes**.

The most often used crystal in this and similar detectors - then and now - was **pyrite** or galena as shown in the 1925 listing in a table in the **"American Mineralogist"** publication, that has a listing of thirty three minerals catalogued with rectifying detector properties.

Among the very first commercially produced diodes is the 1N21B shown on **Picture 2**. It is more than curious, that this "diode" is enclosed in a case on which there is a slotted screw-head is just visible on the wide side (lower right). That screw is connected to a fine "cats whisker" steel wire, a few turns of a spring-like device, terminating in a point that is in touch of the germanium semiconductor material connected to the top left diode terminal.

Picture 2. Early point contact diode with adjustable srew

The arrangement is much smaller, and more diode like, then the detector on **Picture 1**., but it made in a very similar arrangement, which has became known as the point contact diode. From these and similar germanium diodes, evolutionary progress leads us to current PN junction Silicon, Gallium Arsenide or other more exotic semiconductor materials which are the achievement of the latest scientific age and many years of steady experimentation, research and development.

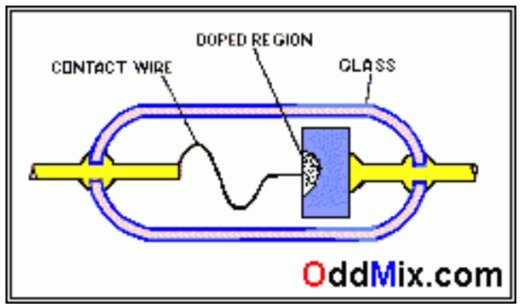

Picture 3. Point contact diode

Picture 3 shows the cross section of a hermetically glass enclosed, point contact diode. If the left side, point contact terminal would be attached to a screw and a short spring, and the glass envelope would have a threaded metal part in it, the **Picture 2** and **Picture 3** devices would be nearly identical.

These point contact "cat's whisker" devices, are still made occasionally because of their very small capacitance. As it was discovered early on, they are highly useful in high frequency electronics. All the way up to microwave frequencies they useable. The simplest radar detectors usually made with a simple horn **antenna**, a diode similar to **Picture 2** and **Picture 3** and a transistor amplifier. If the designer keeps it simple, and don't use a local oscillator, such radar detectors

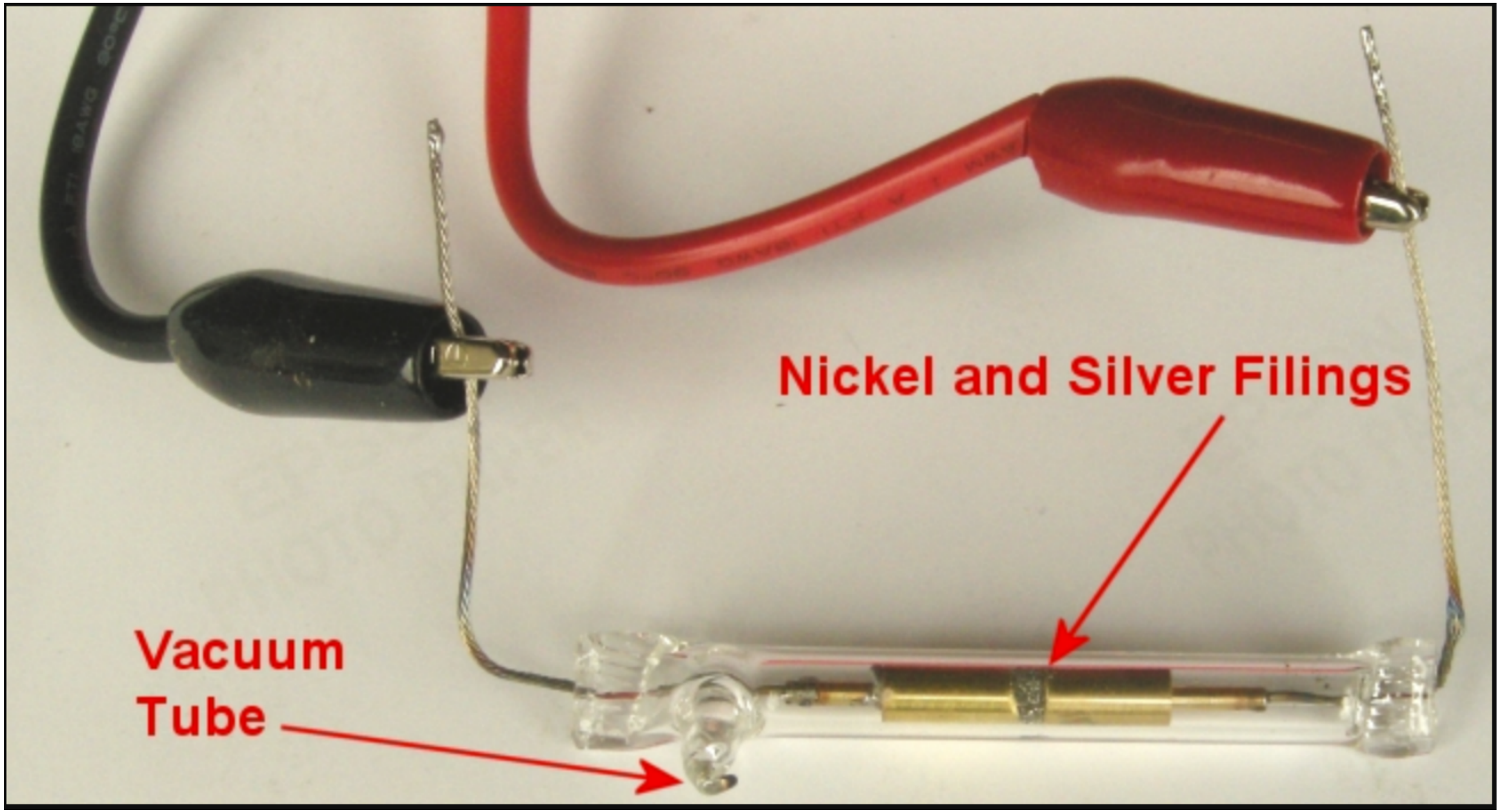
Nickel and Silver Filings
Vacuum
Tube

Meter on 200 Ohm Range
Display Indicates Activation = 11.2 Ohms
Coherer Detector
Press to Spark
Spark Gap
11.2
CEN-TECH
DIGITAL MULTIMETER
OFF
ON
10ADC
COM

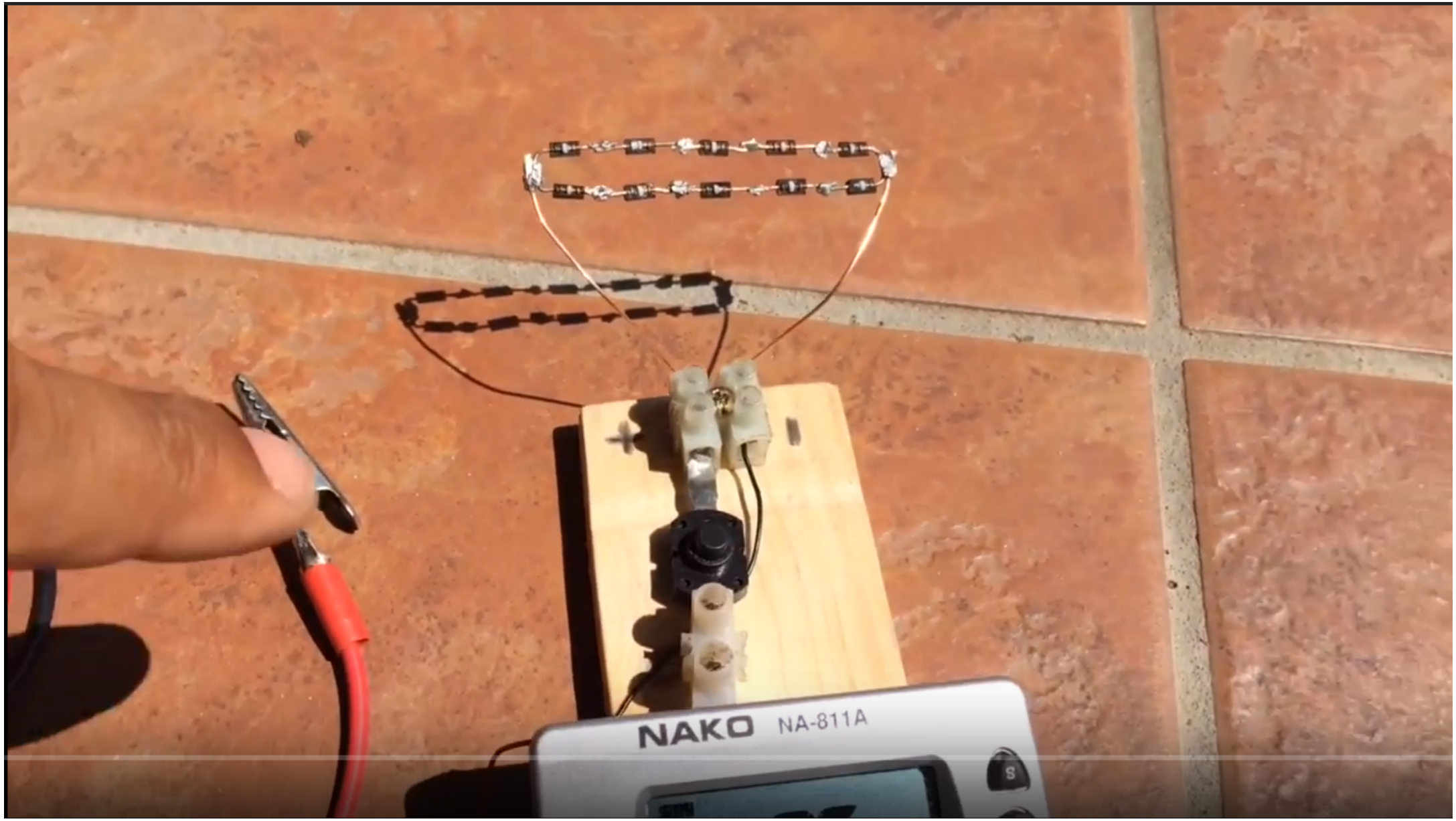
NAKO
NA-811A
S

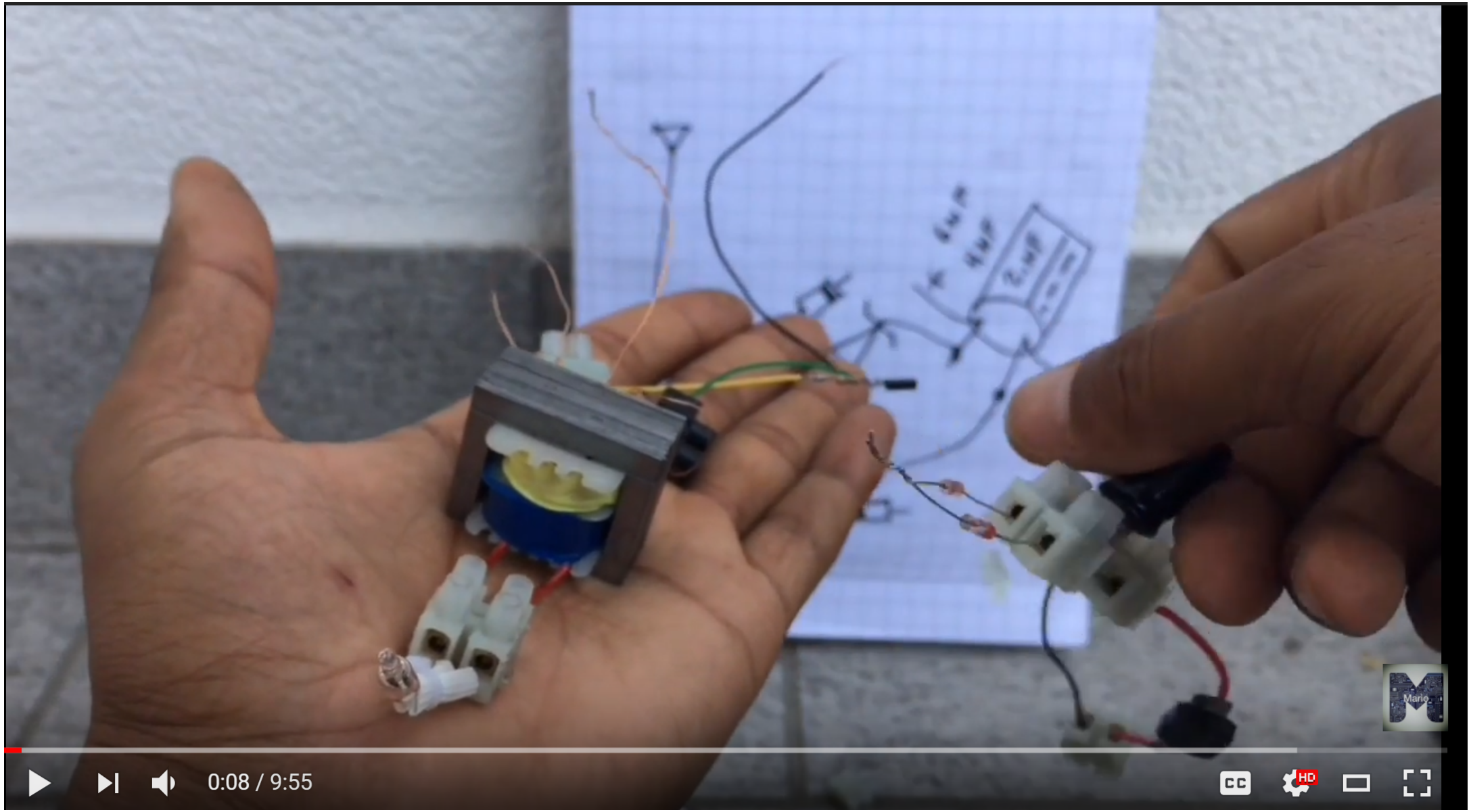
0:08 / 9:55

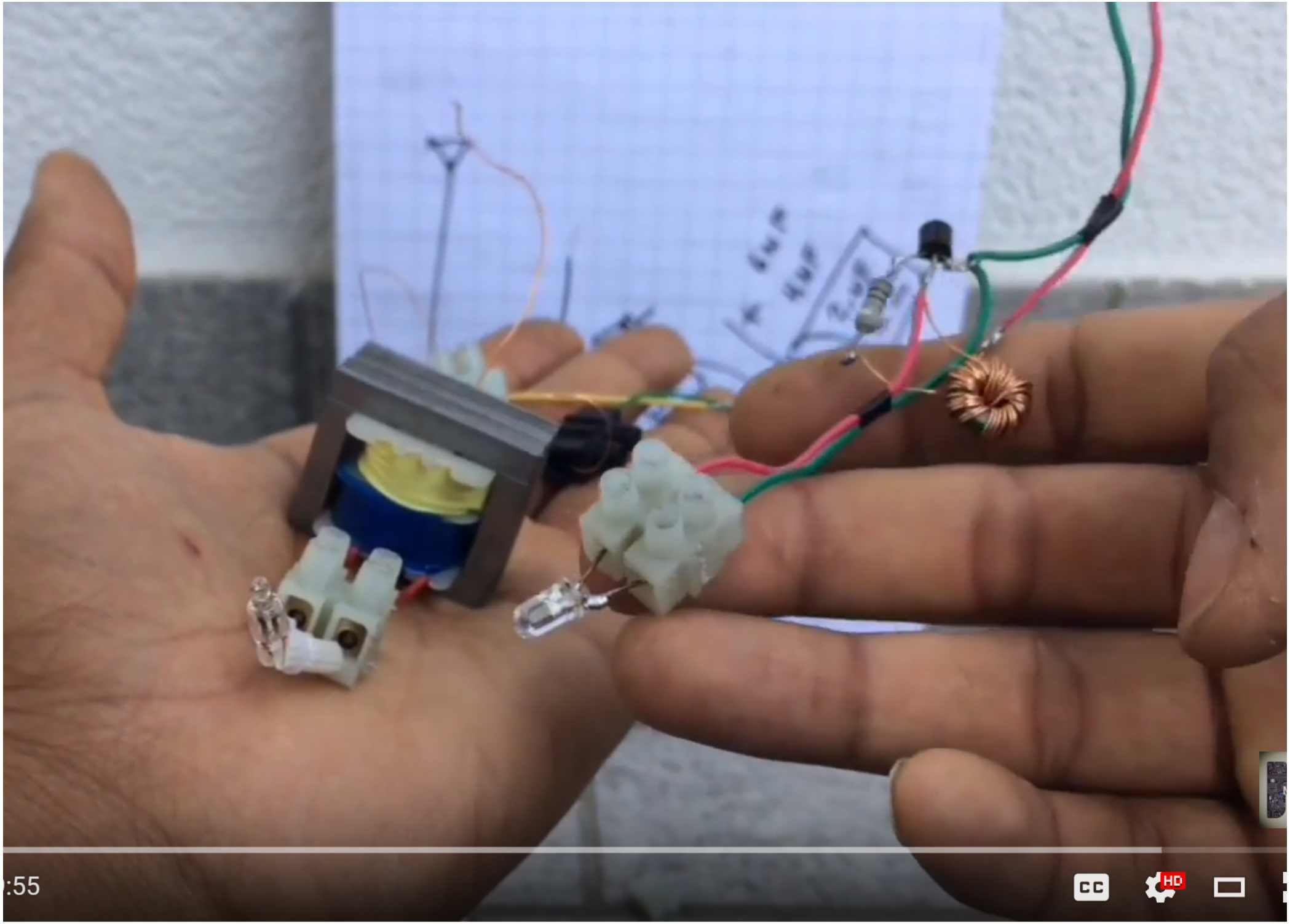
:55
HD

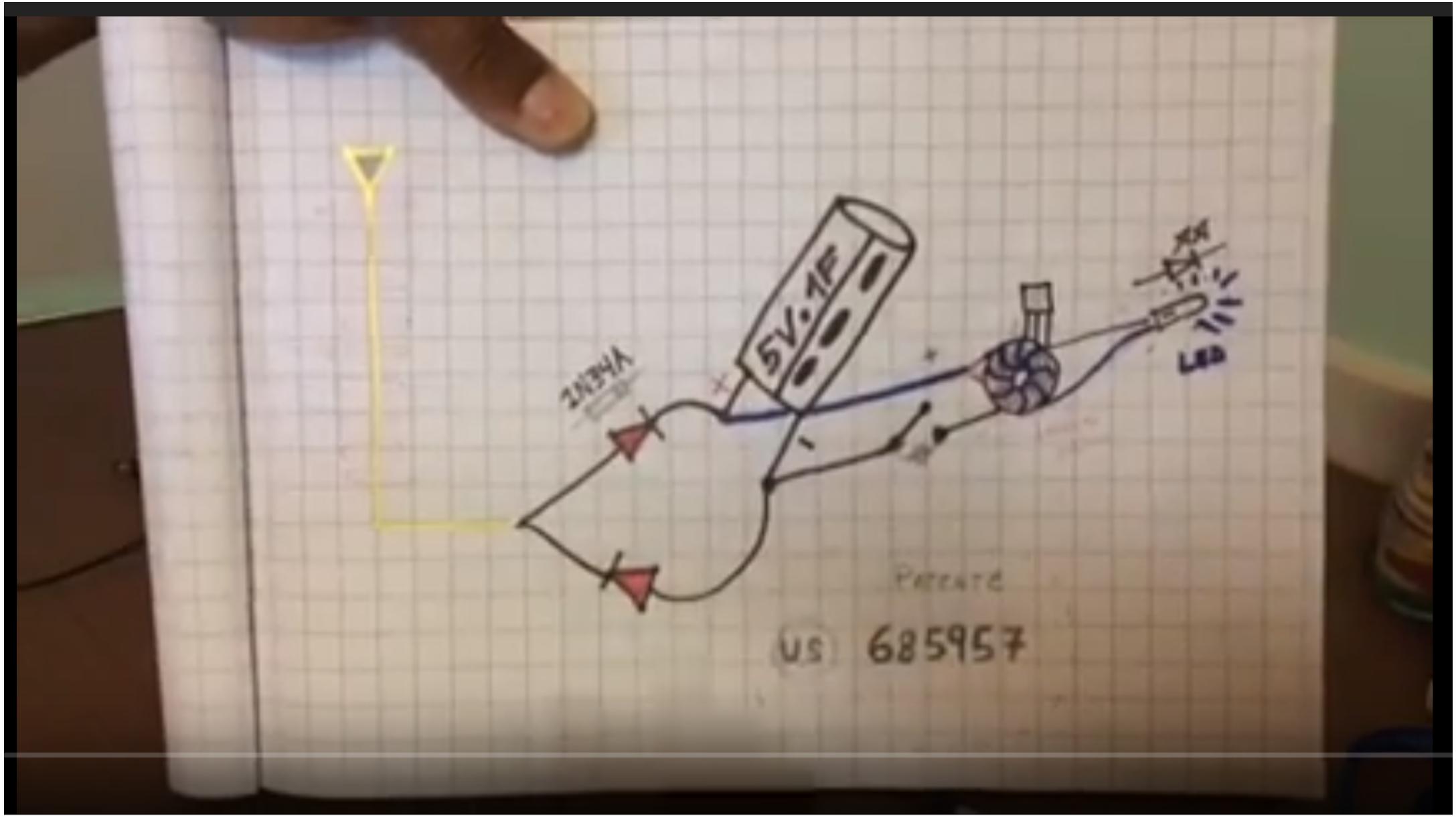
5V.1F
LED
PATENTE
US 685957

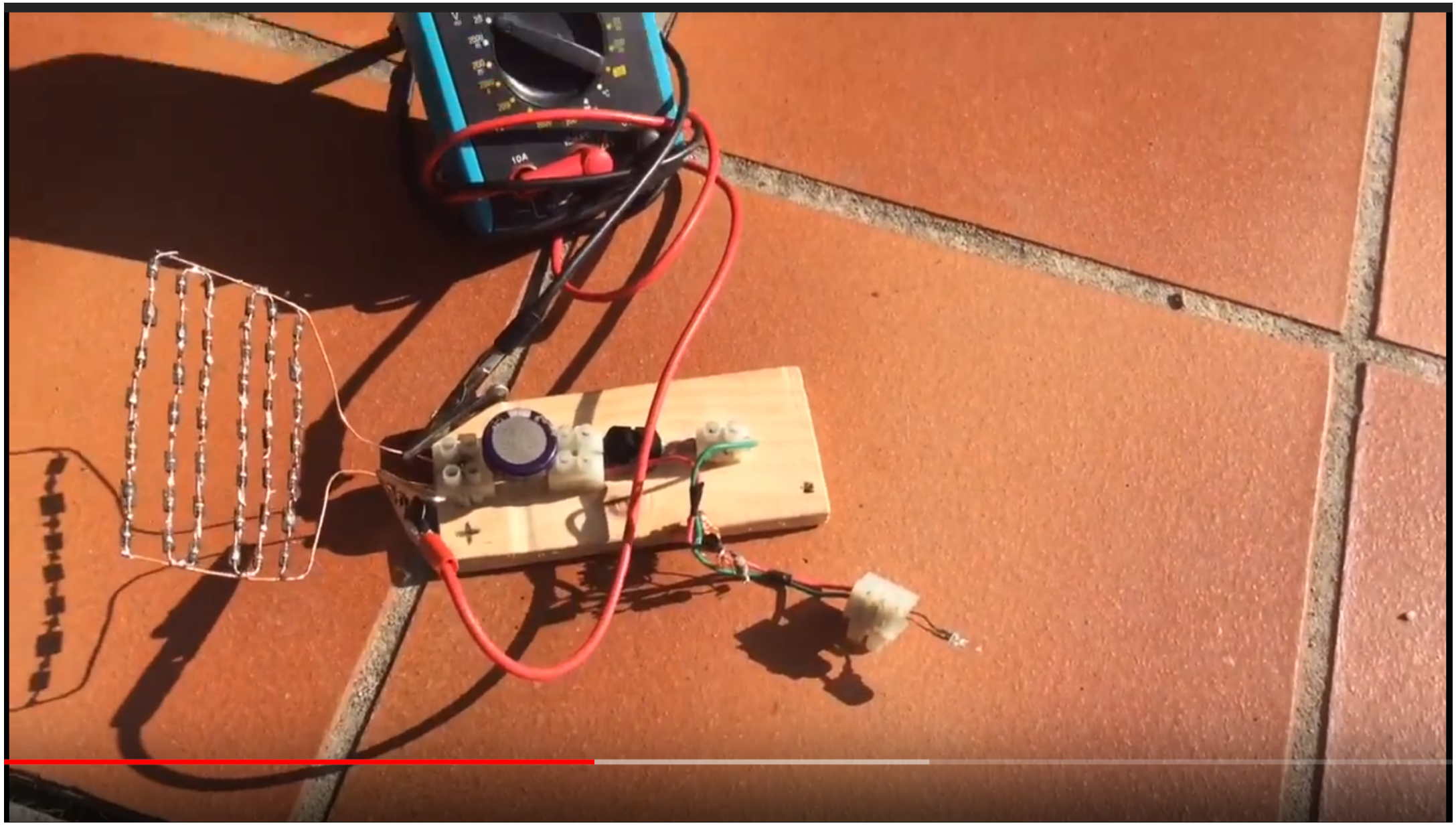
10A

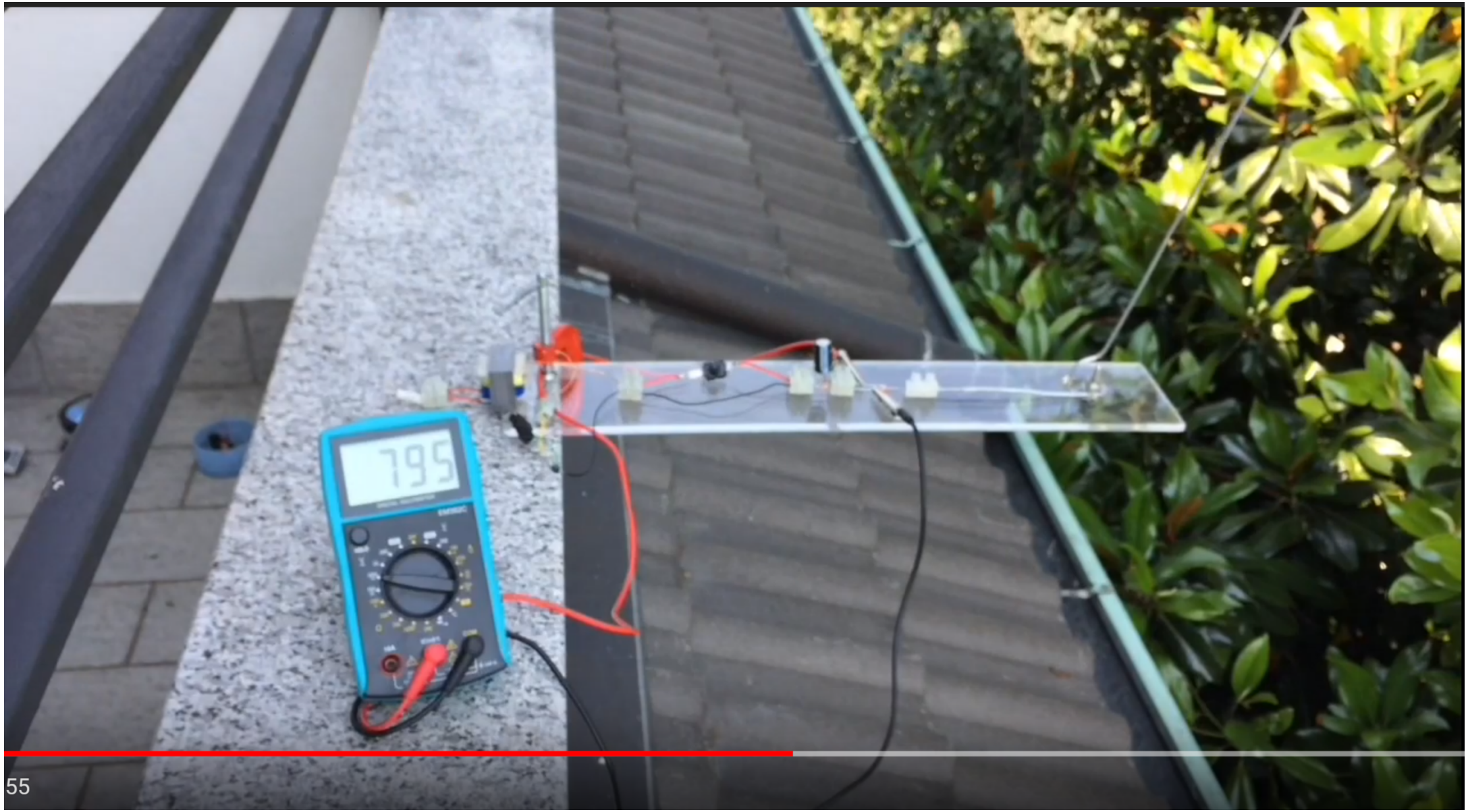
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55

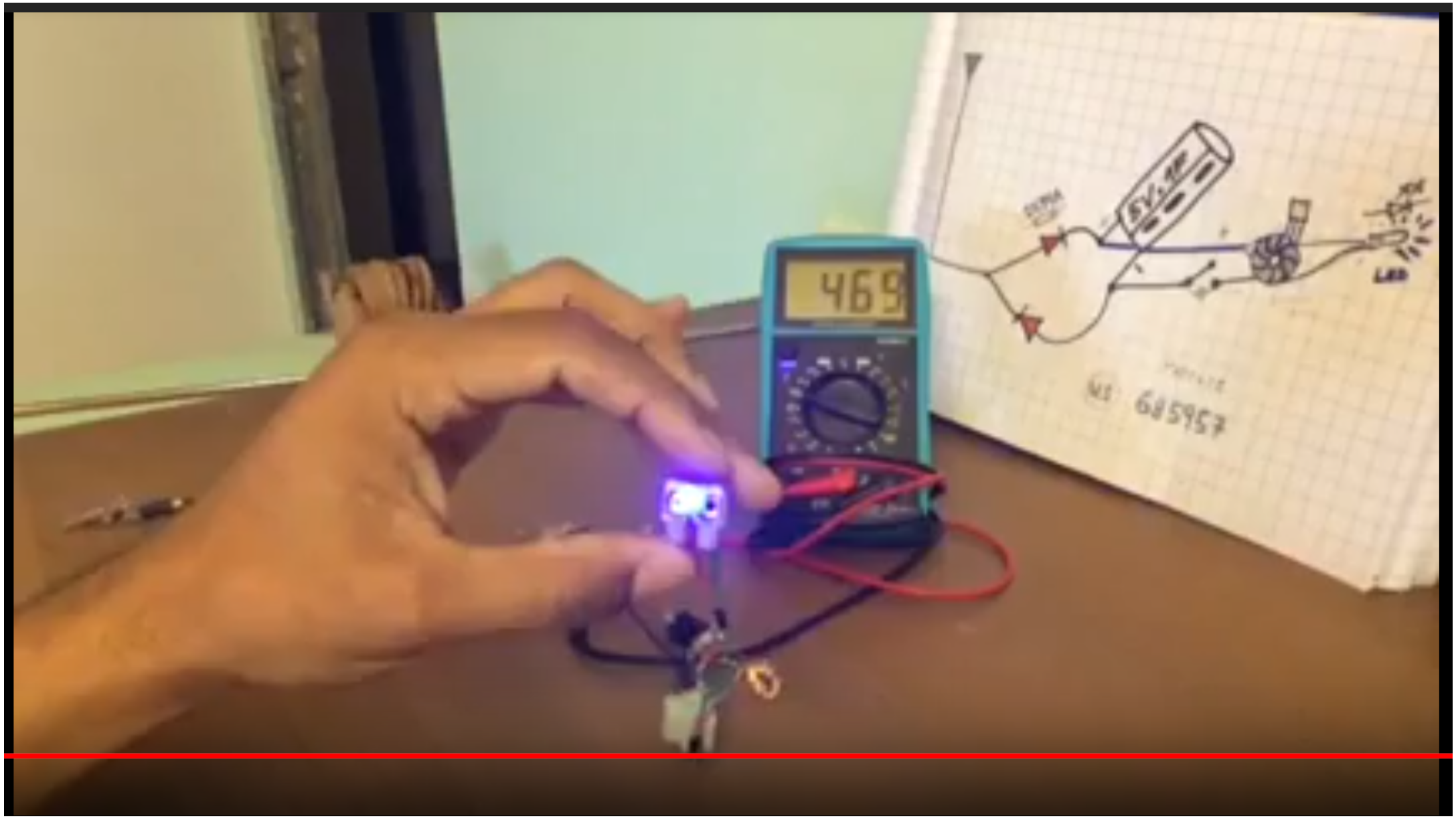
469
685957

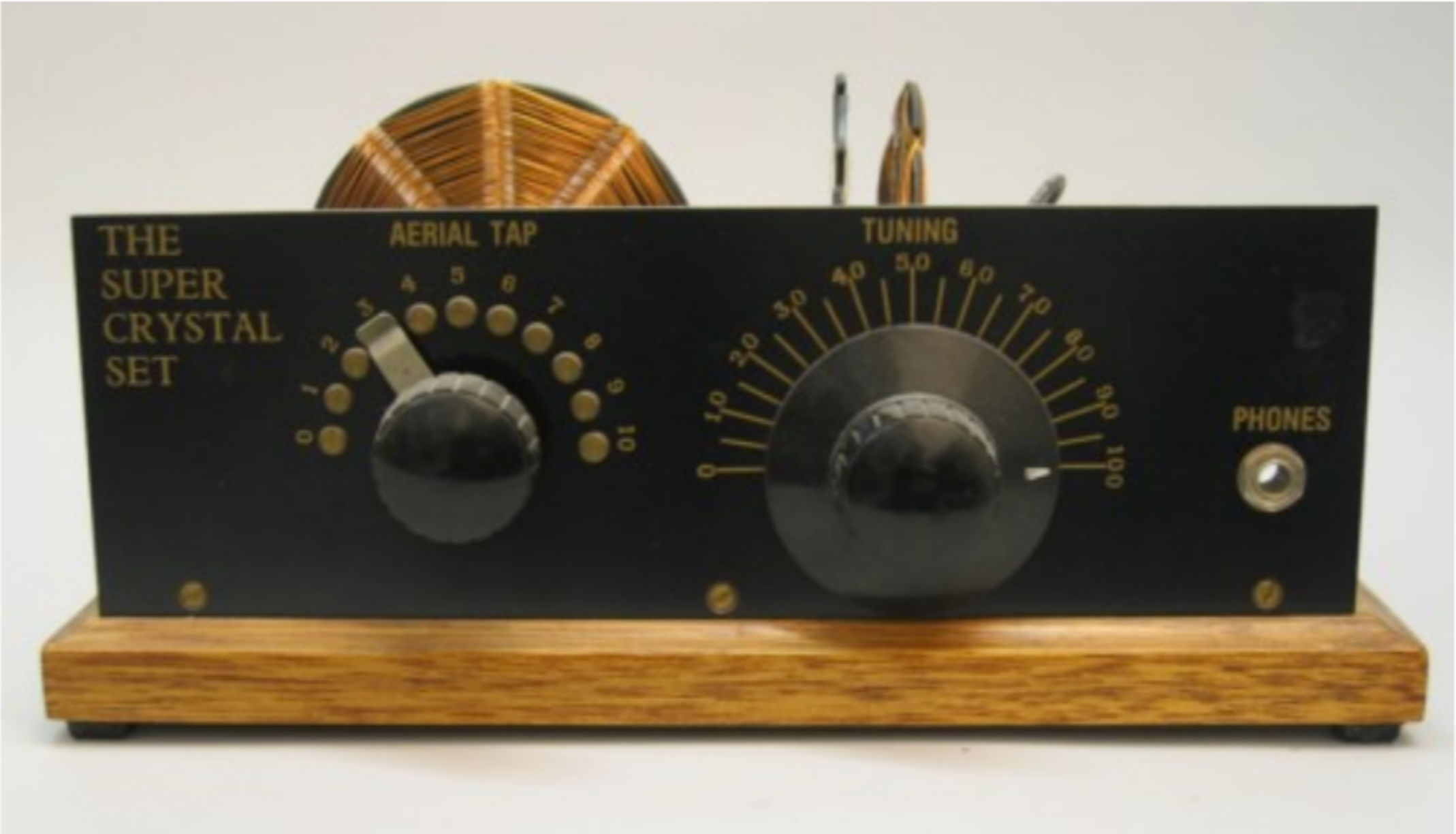
THE
SUPER
CRYSTAL
SET
AERIAL TAP
0 1 2 3 4 5 6 7 8 9 10
TUNING
0 10 20 30 40 50 60 70 80 90 100
PHONES

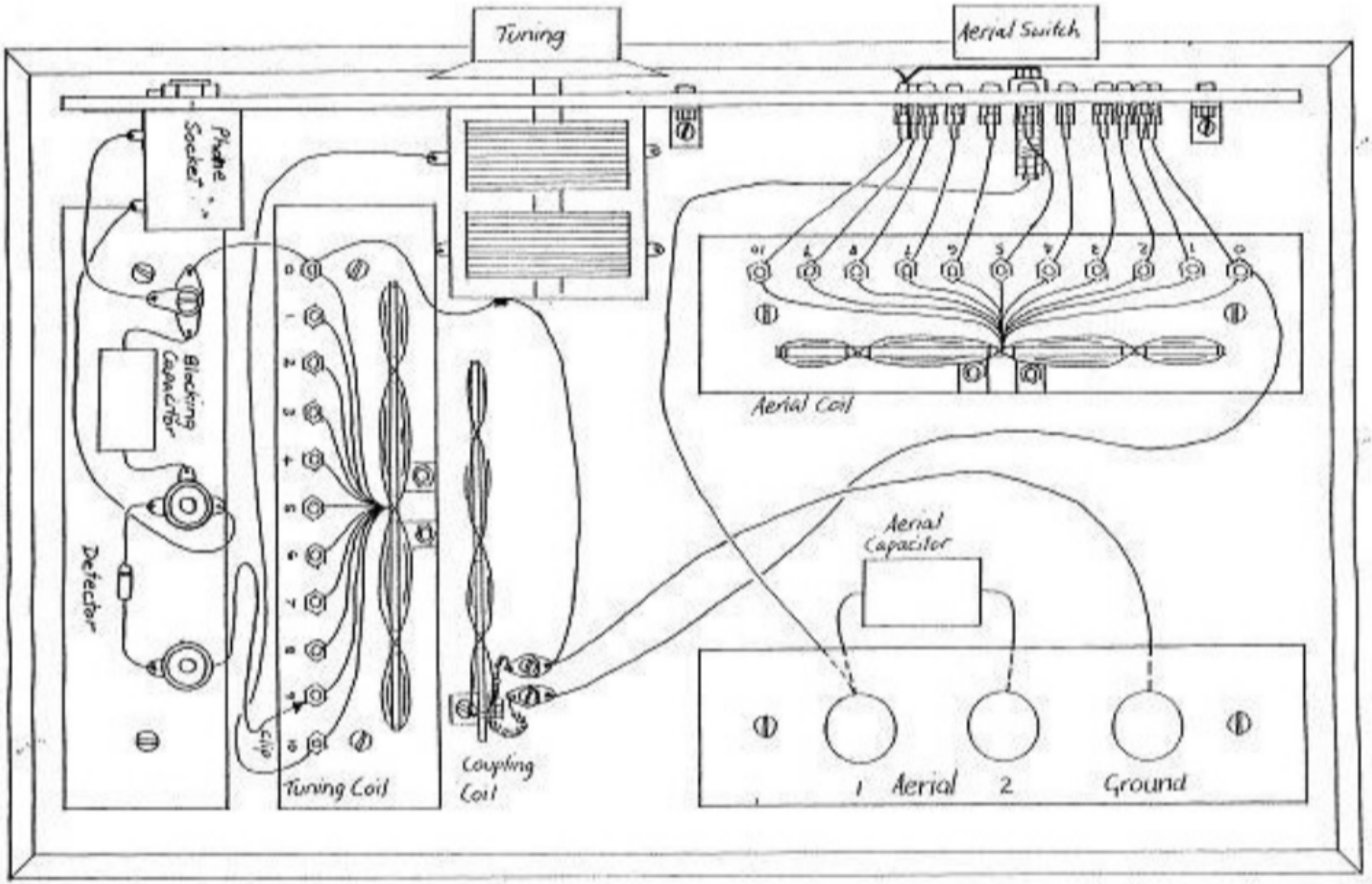
Tuning
Aerial Switch
Phone Socket
Blocking Capacitor
Detector
Clip
Tuning Coil
Coupling Coil
Aerial Coil
Aerial Capacitor
1 Aerial 2
Ground

KB8TAD

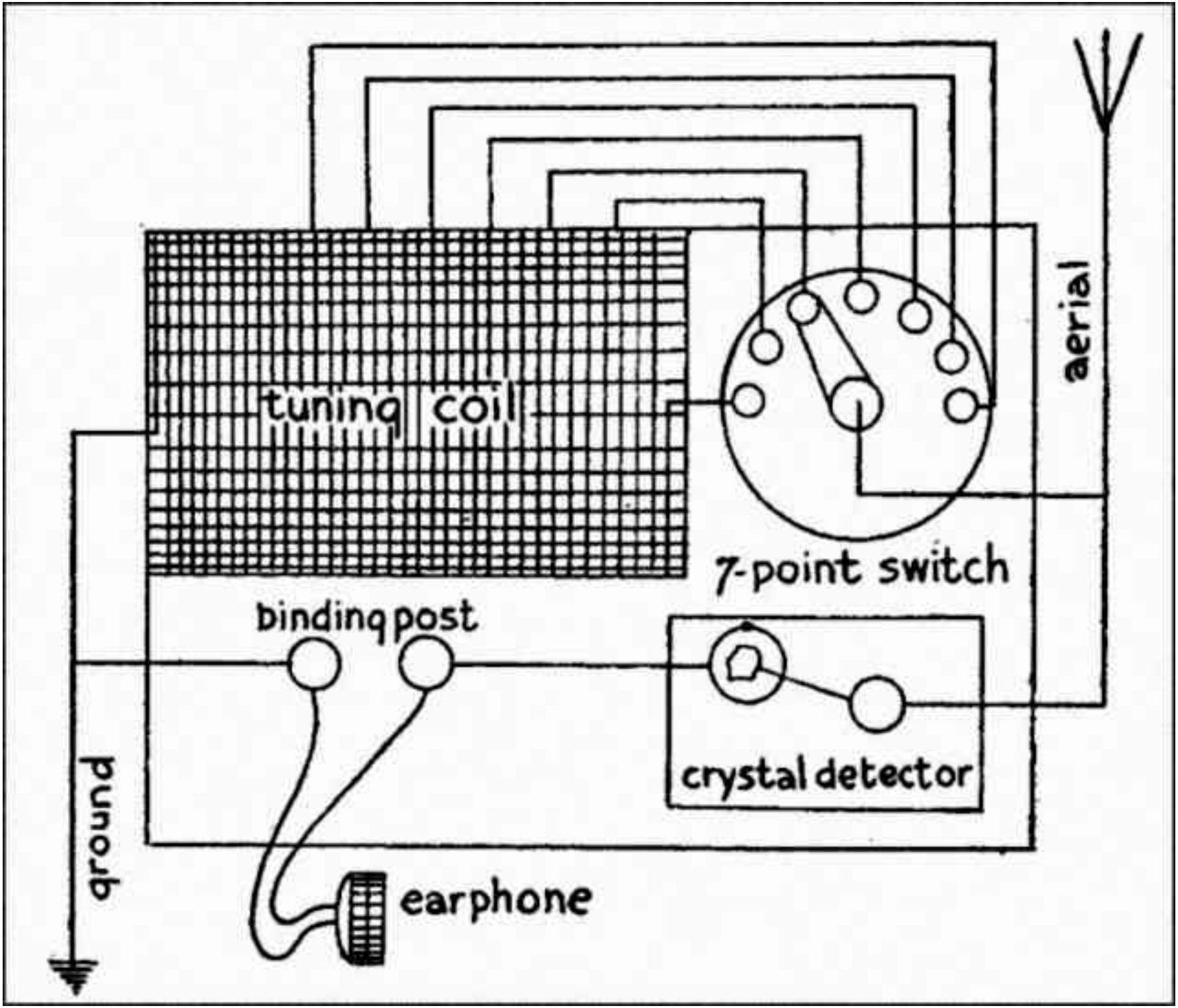
tuning coil
7-point switch
aerial
binding post
crystal detector
ground
earphone

KB8TAD

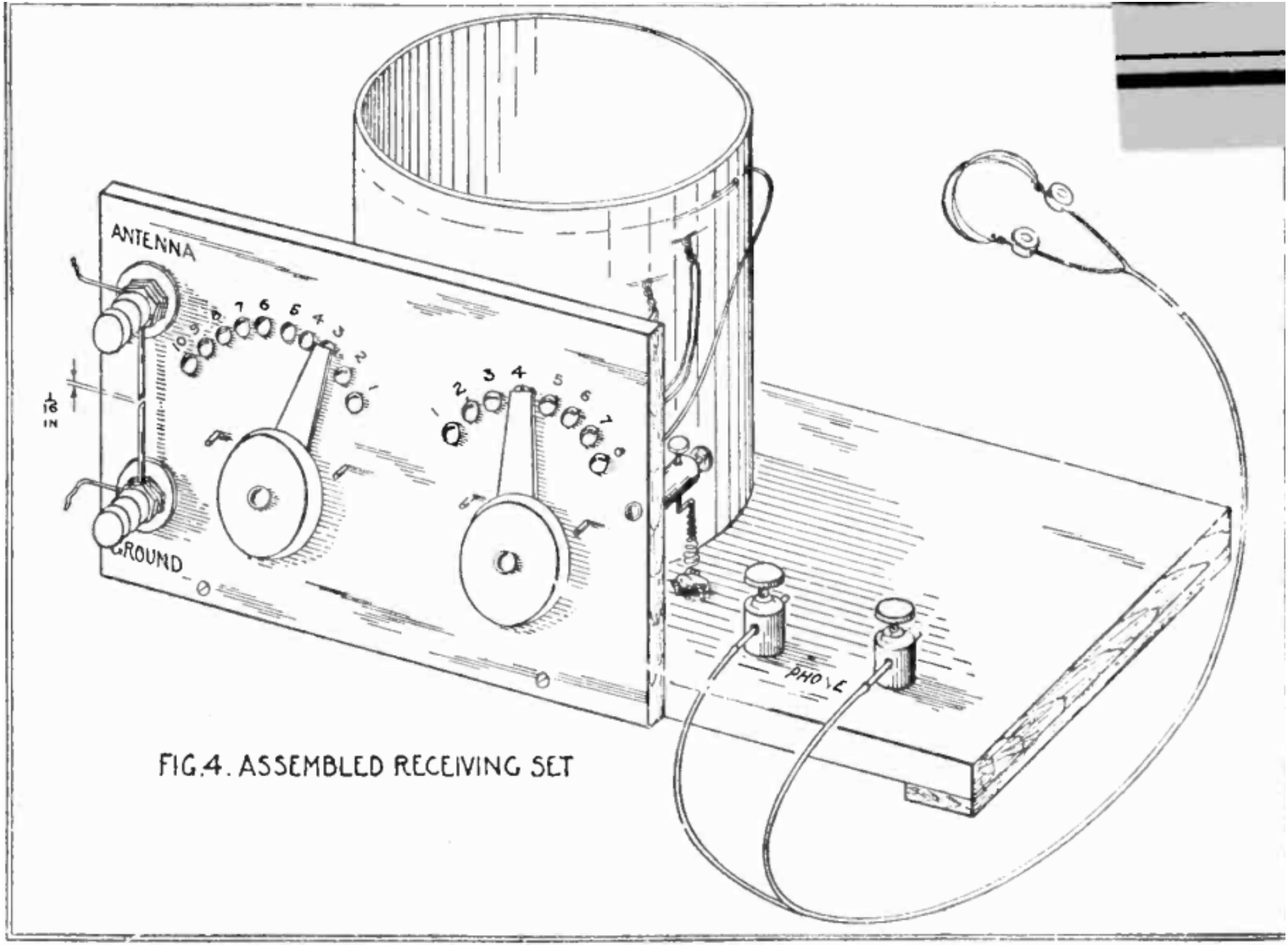

FIG.4. ASSEMBLED RECEIVING SET

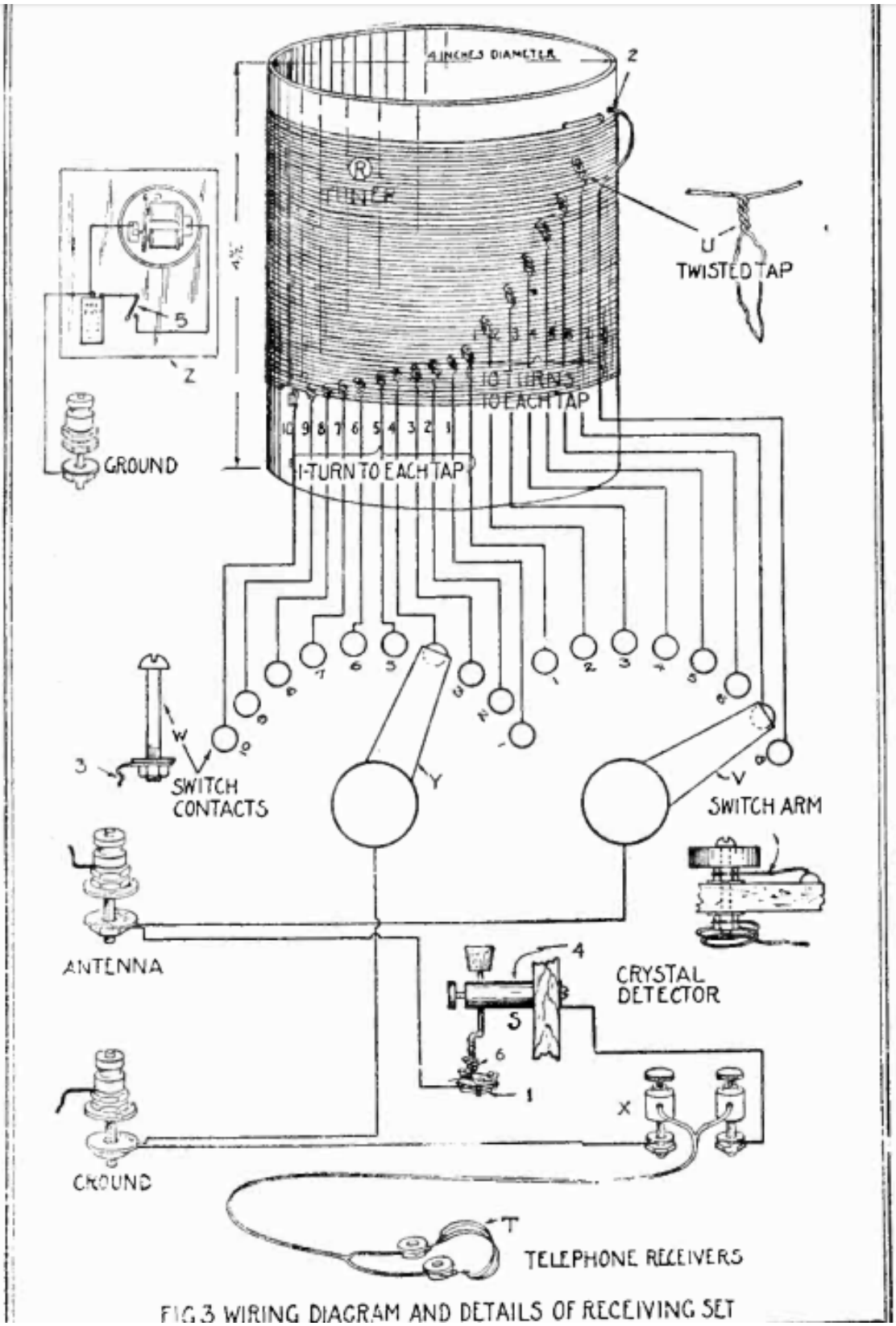

FIG.3 WIRING DIAGRAM AND DETAILS OF RECEIVING SET

FIG 2. RECEIVING SET, WITH ANTENNA AND GROUND CONNECTIONS

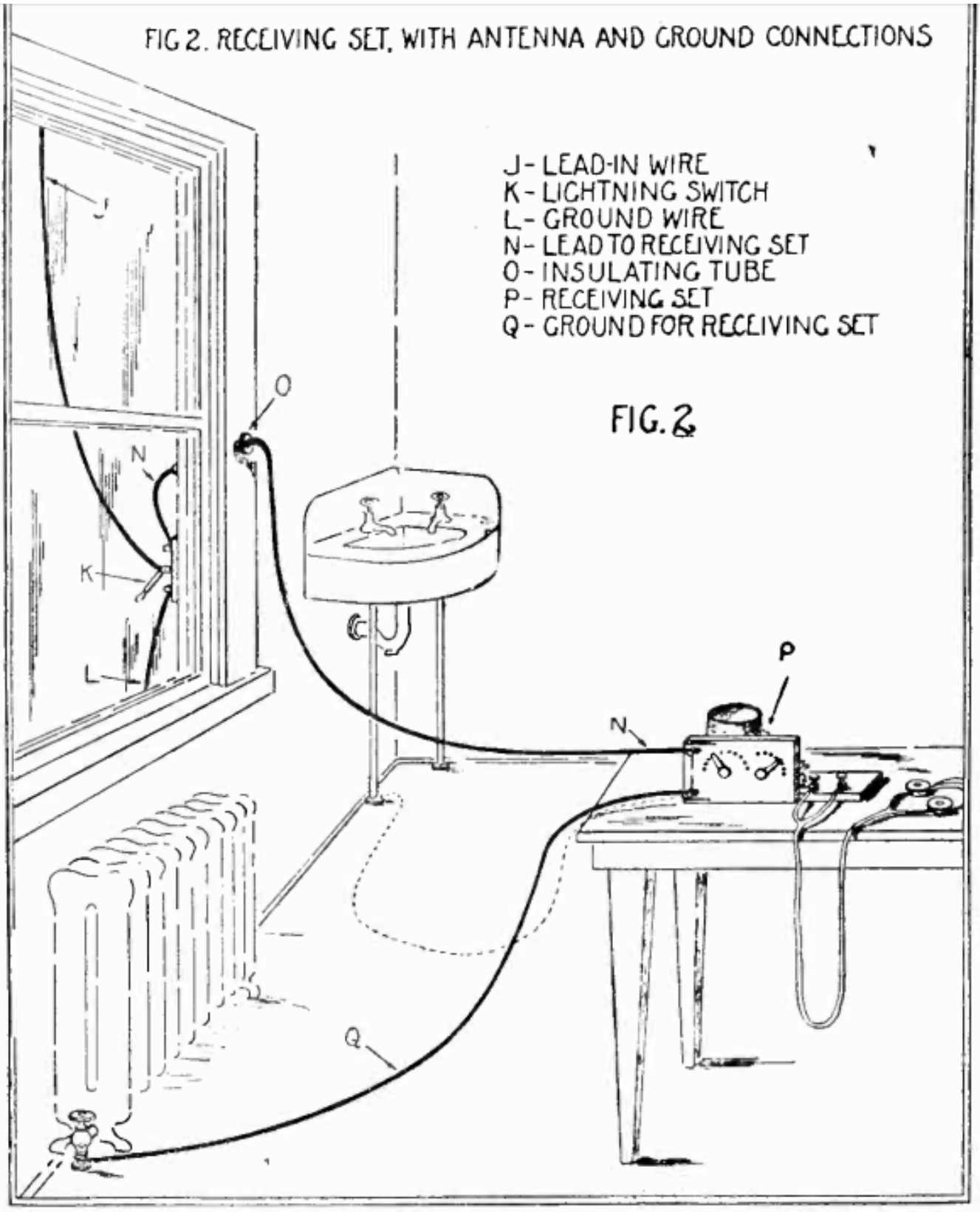

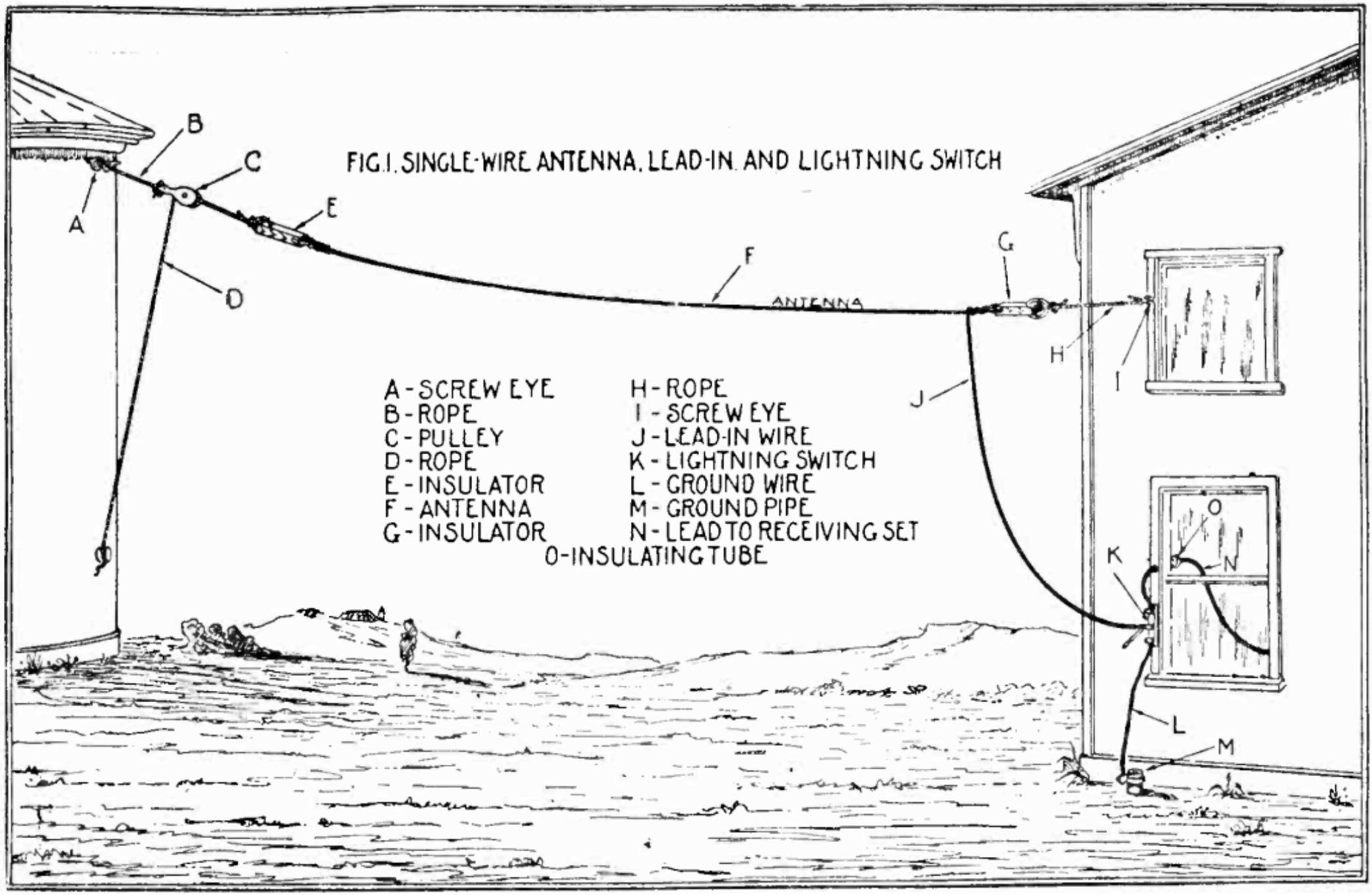
FIG. I. SINGLE-WIRE ANTENNA, LEAD-IN AND LIGHTNING SWITCH
A - SCREW EYE
B - ROPE
C - PULLEY
D - ROPE
E - INSULATOR
F - ANTENNA
G - INSULATOR
H - ROPE
I - SCREW EYE
J - LEAD-IN WIRE
K - LIGHTNING SWITCH
L - GROUND WIRE
M - GROUND PIPE
N - LEAD TO RECEIVING SET
O - INSULATING TUBE
ANTENNA
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O

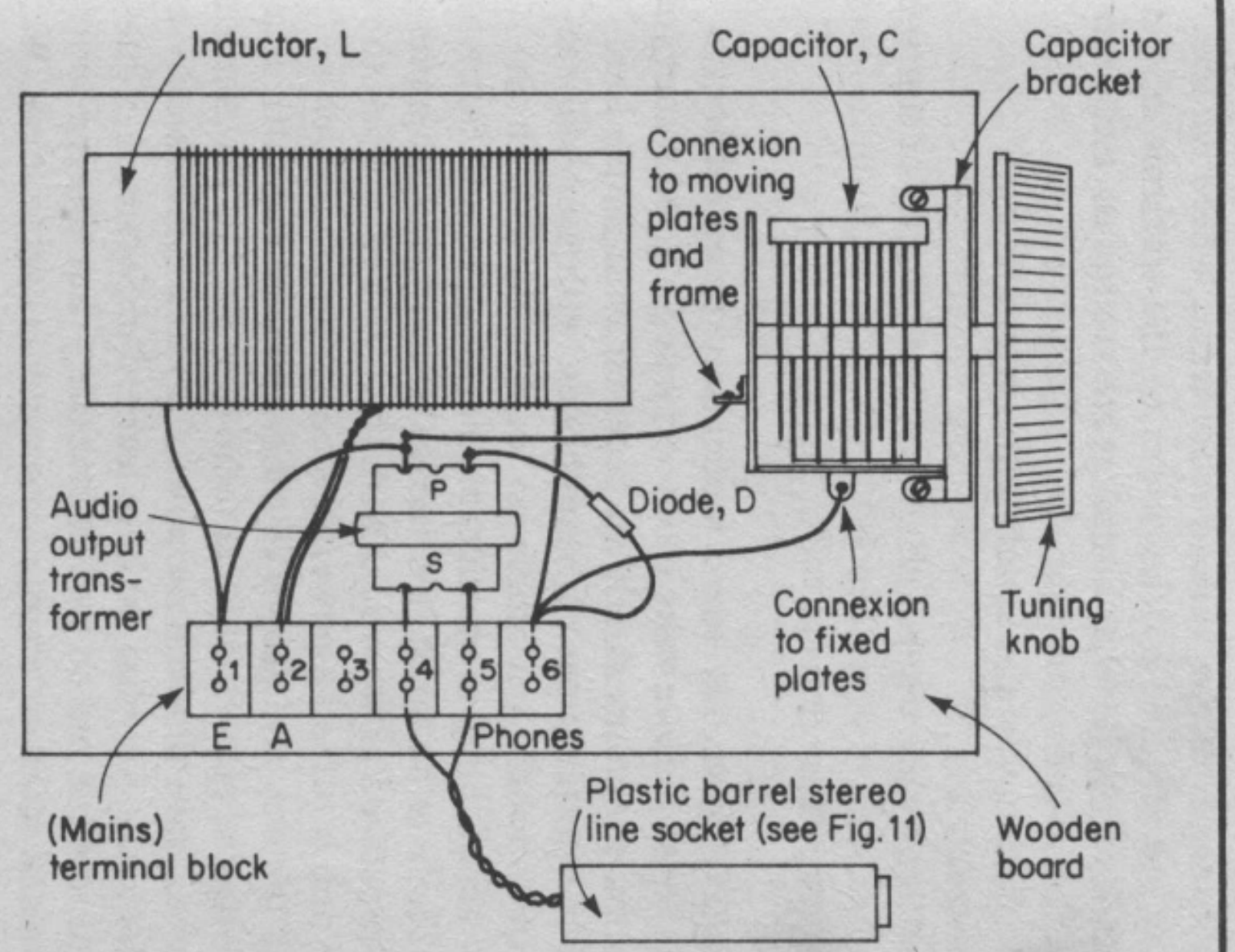

Fig. 14 Suggested component arrangement for elementary crystal set

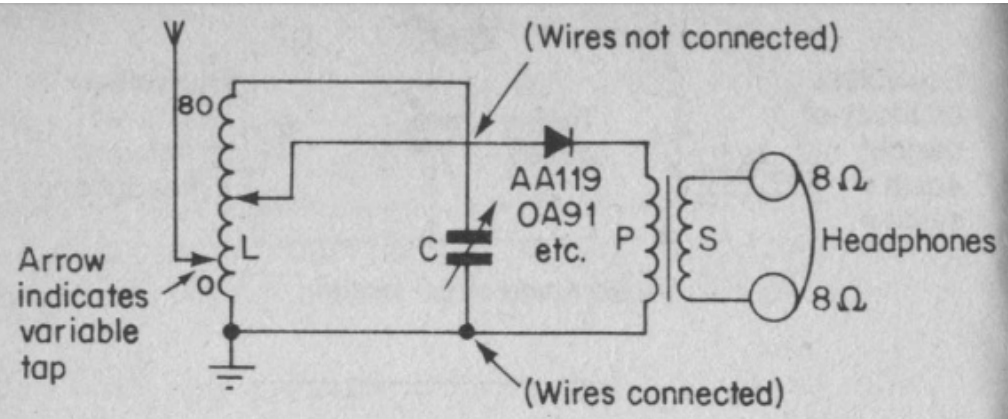

(i) Circuit

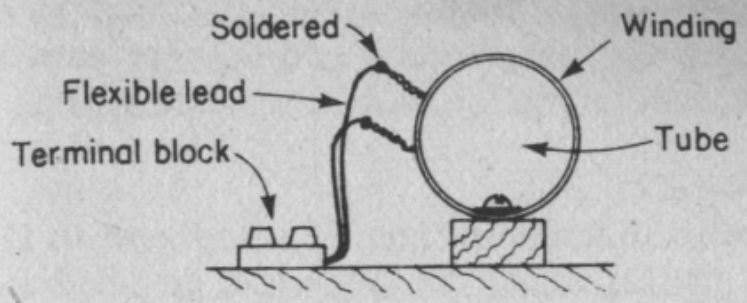

(iii) Alternative mounting

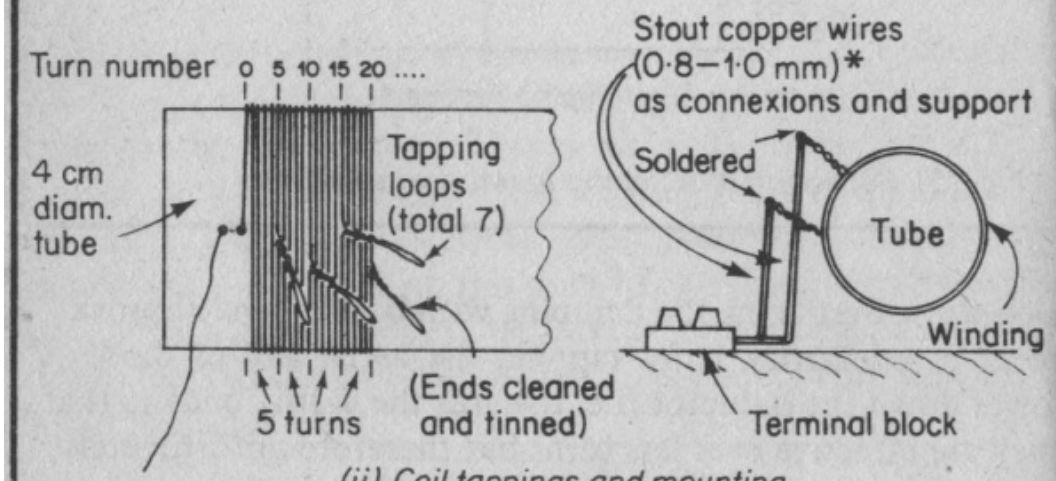

(ii) Coil tappings and mounting

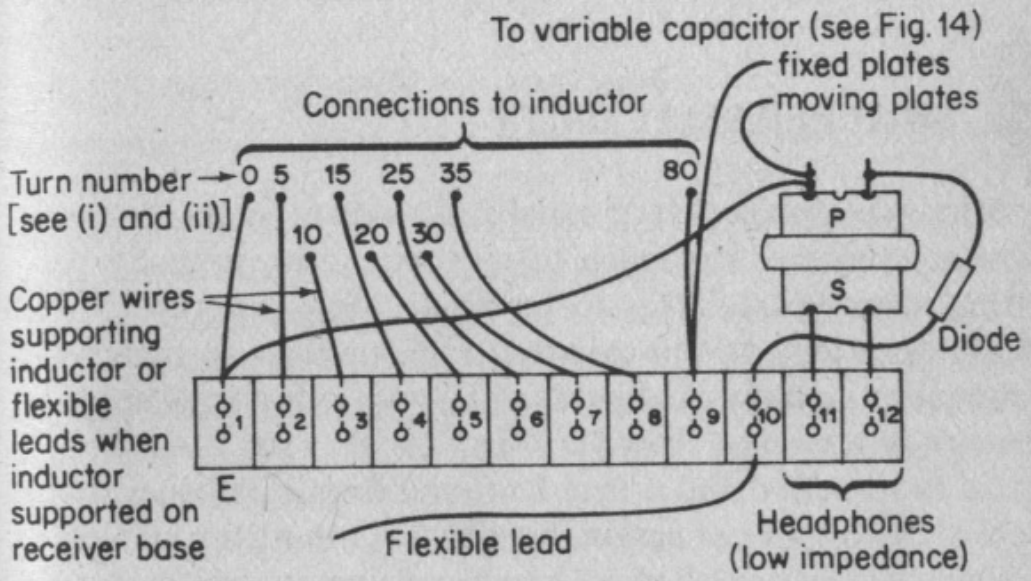

(iv) Suggested component arrangement

Fig. 16 Circuit with tapped inductor

* 21–19 SWG, 20–18 AWG

required) and a *flying lead* for the diode, these components are shown in Fig.16(iv). This is doing the job properly, there is no reason however (except for unreliability of contact) why both aerial and diode flying leads should not terminate on *crocodile clips* and be clipped onto the chosen taps as required.

Earth is connected to terminal 1 and the headphones to 11 and 12. Both the aerial and the diode lead are tried at terminals 2 – 9, a game of "poke and hope" but one which can be rewarding. Remember that generally but not always, the tappings with the lower numbers reduce loudness but increase selectivity. Aerial to terminal 8, diode to 9 brings us back to Fig.13(i) of course.

5.2 SWITCHED SELECTIVITY

A technique of selection of aerial and diode tappings by means of rotary switches has much to recommend it especially if setting changes are likely to be needed for reception of different stations. In this case two single-pole 8-way switches are required, usually obtainable as 12-way so leaving 4 spare. The drawing symbol shown in Fig.17 speaks for itself with regard to its action and it may be found from catalogues that there are two types of *action*, by which is meant the manner in which the switch changes over from one contact to the adjoining one. *Break before make* switches disconnect one circuit before the next is connected and *make before break* have a change-over period during which both circuits are connected at once for a short time. Either type is suitable for us. A knob to rotate each switch is also required, a small one, say 2 cm diameter or less is ample, if with an indicator line or pointer, so much the better. The modifications to Fig.16 for switching are given in Fig.17.

With such rotary switches a search for the optimum arrange-

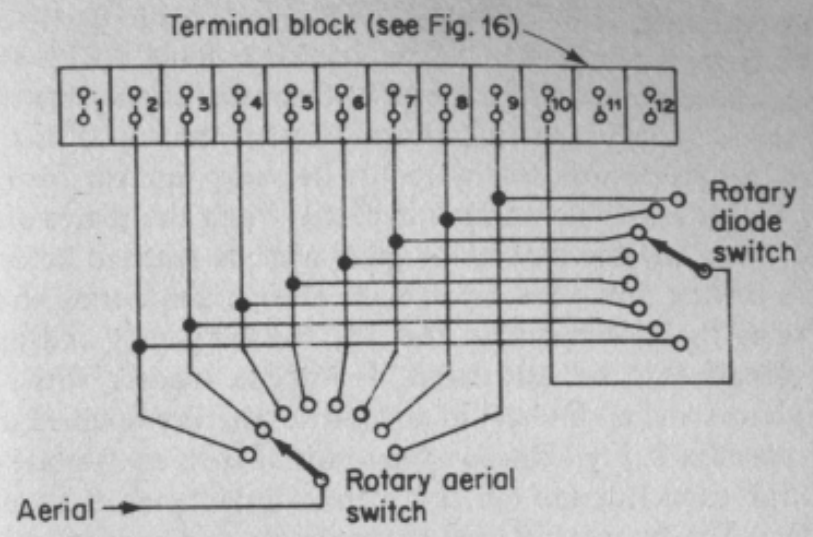

Fig. 17 - Switching aerial and diode leads

variable capacitor, the two switches and the headphone socket, the latter must then be of the chassis type. A pair of terminals for aerial and earth completes the receiver. On the panel the two rotary switches are easily labelled 1 – 8 but we are still uncertain about a tuning dial because we may not have the right variable capacitor for the inductor, this is the subject of the next section.

5.3 GETTING THE RANGE RIGHT

This is where we pause in receiver construction to remove some of the confusion which may still exist with regard to the tuning ingredients, wavelength, frequency, inductance and capacity, each of which has some bearing on the others, to fit together these four pieces of the puzzle, so to speak. For most crystal sets the inductance is fixed according to the variable capacitor available and we tune the receiver over the range by rotating the variable capacitor knob over half a

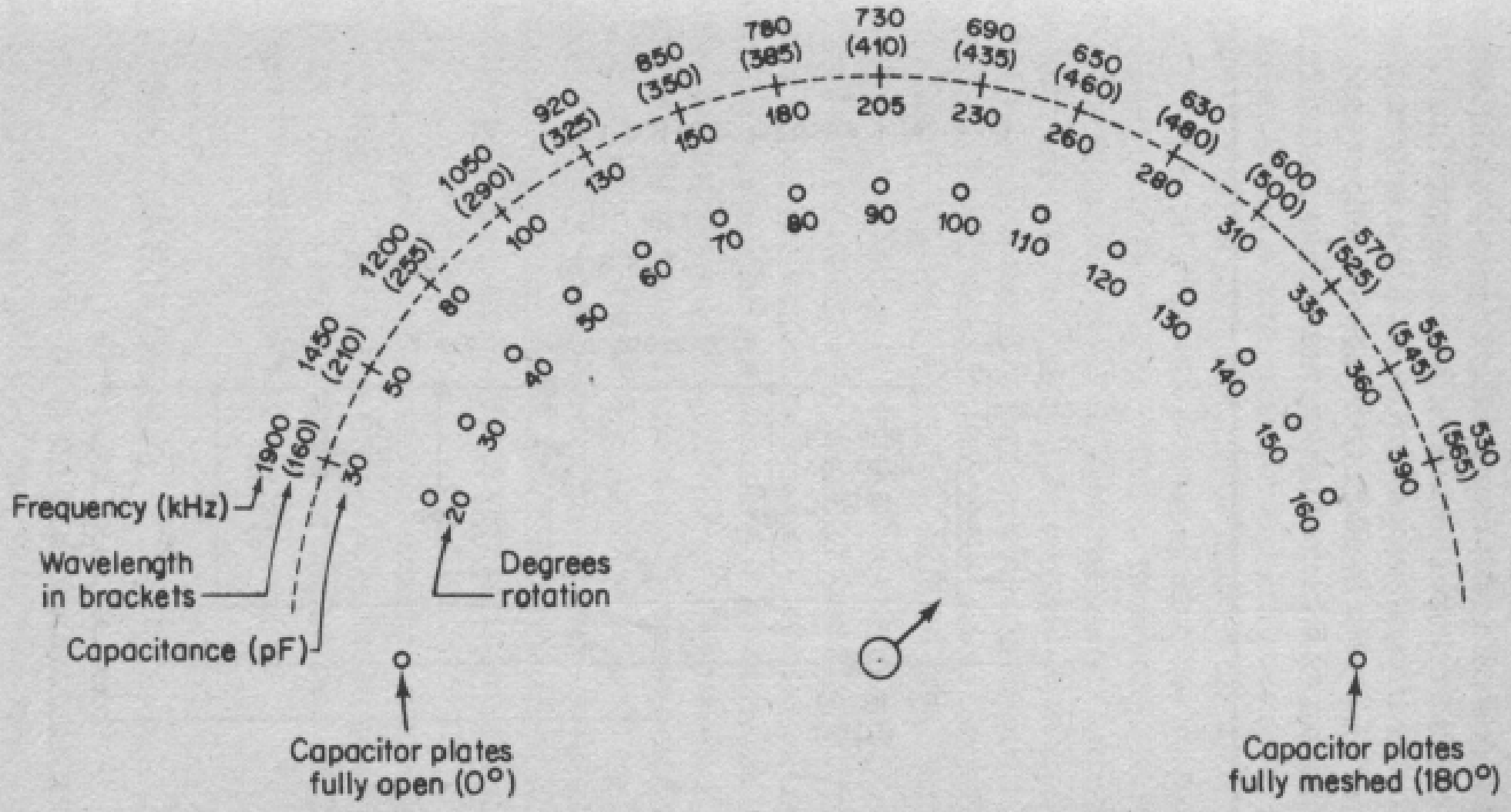

Fig. 18 Approximate capacitance and frequency values for 365 pF variable capacitor and 230 µH coil

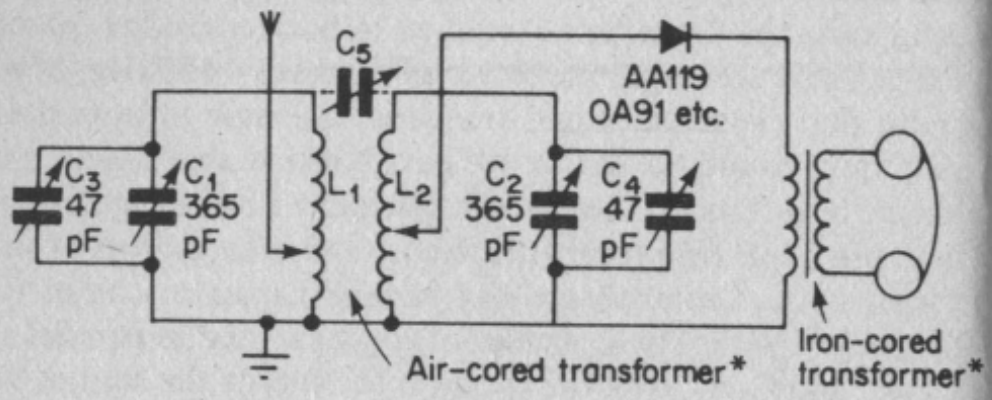

(i) Circuit

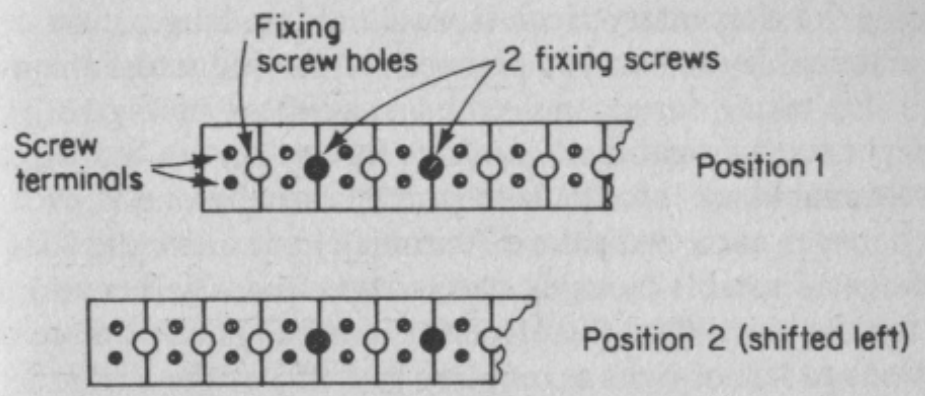

(iii) Moving inductor L_1

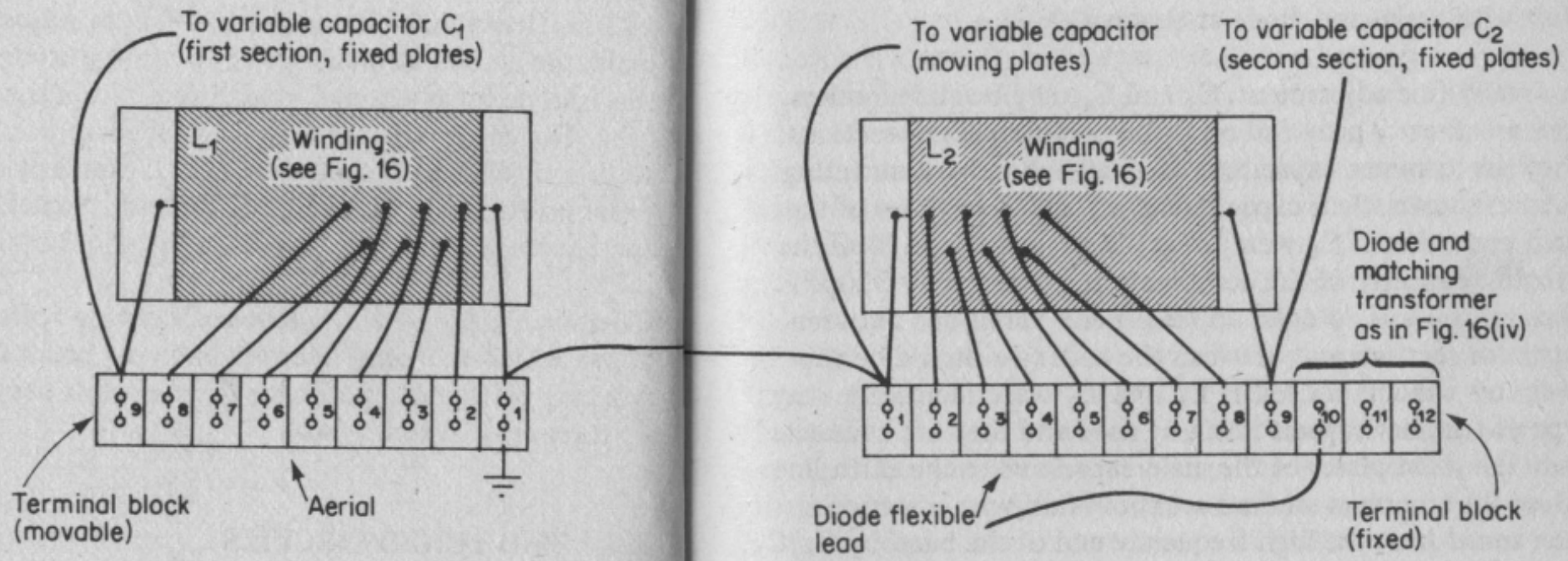

(ii) Arrangement of inductors

Fig. 21 A double-tuned crystal receiver

* See Section 2.4

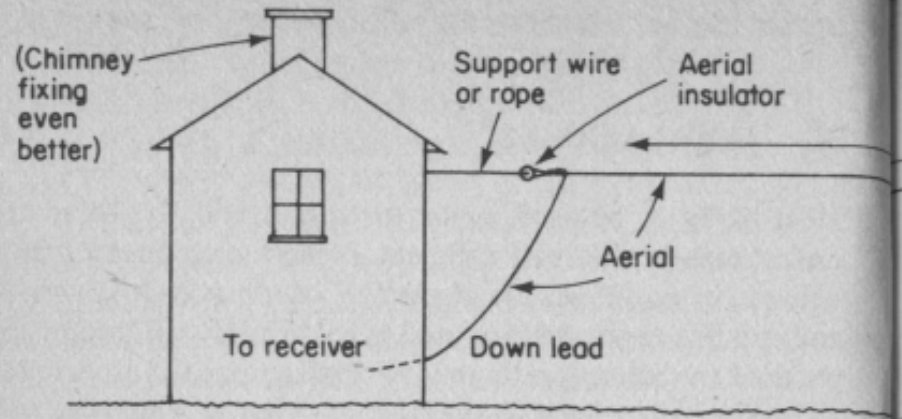

(i) Outdoor Aerial

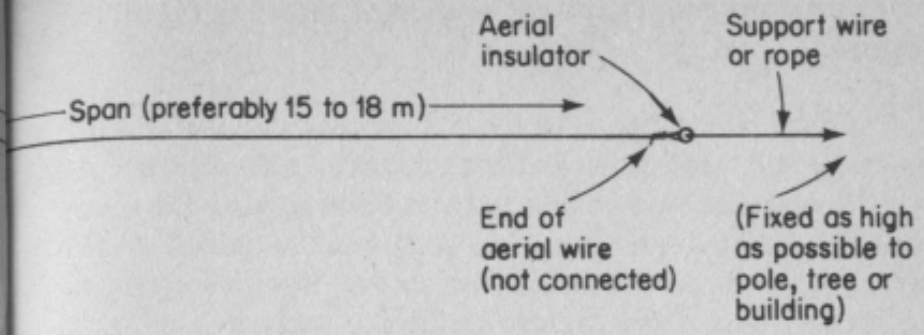

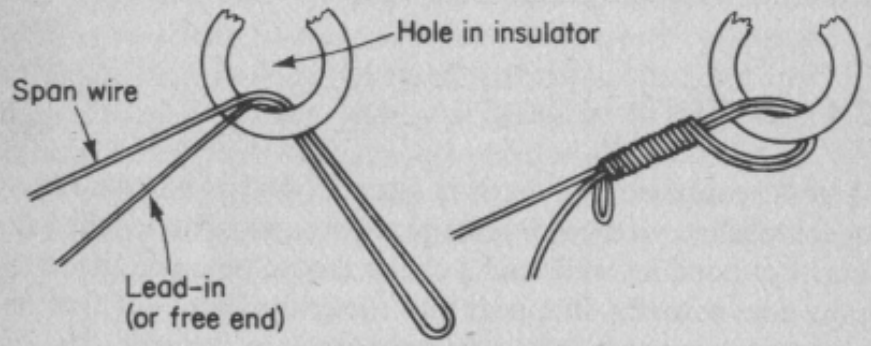

(ii) Attaching aerial to insulator

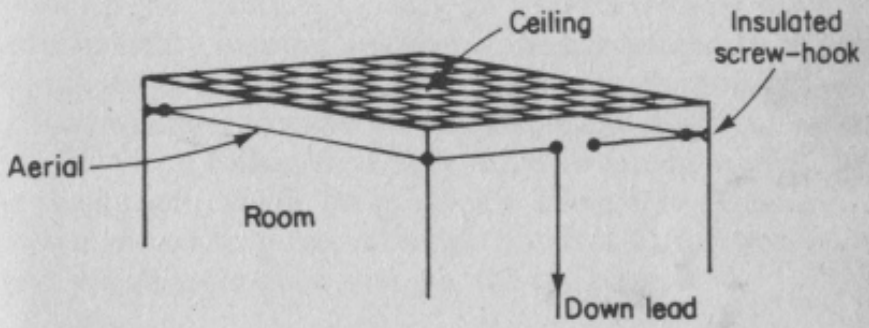

(iii) Room aerial

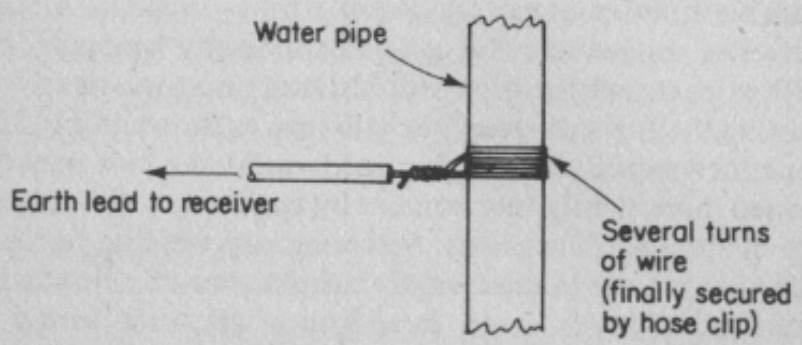

(iv) Earth connection to water pipe

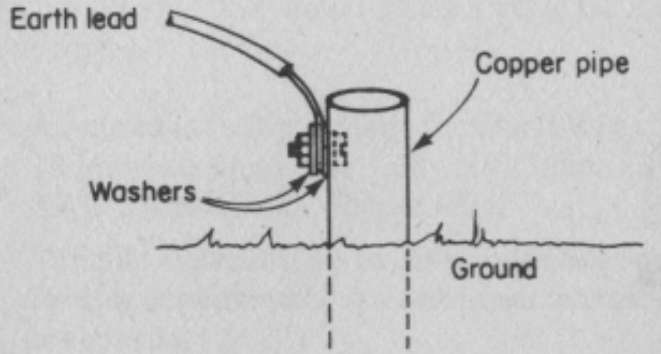

(v) Lead bolted to earth spike

Fig. 12 Aerial/earth systems

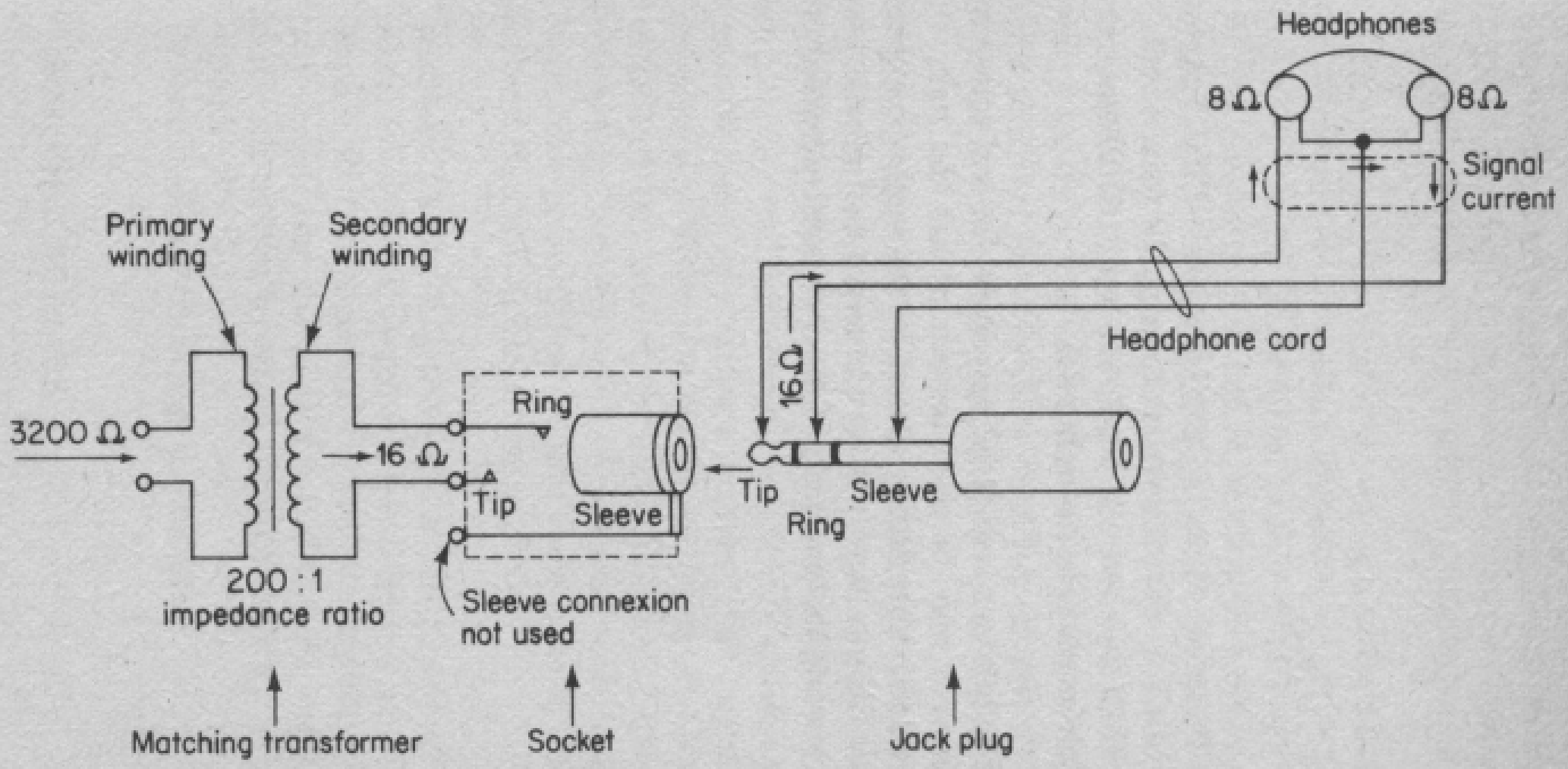

Fig. 11 Matching a high impedance receiver to low impedance headphones

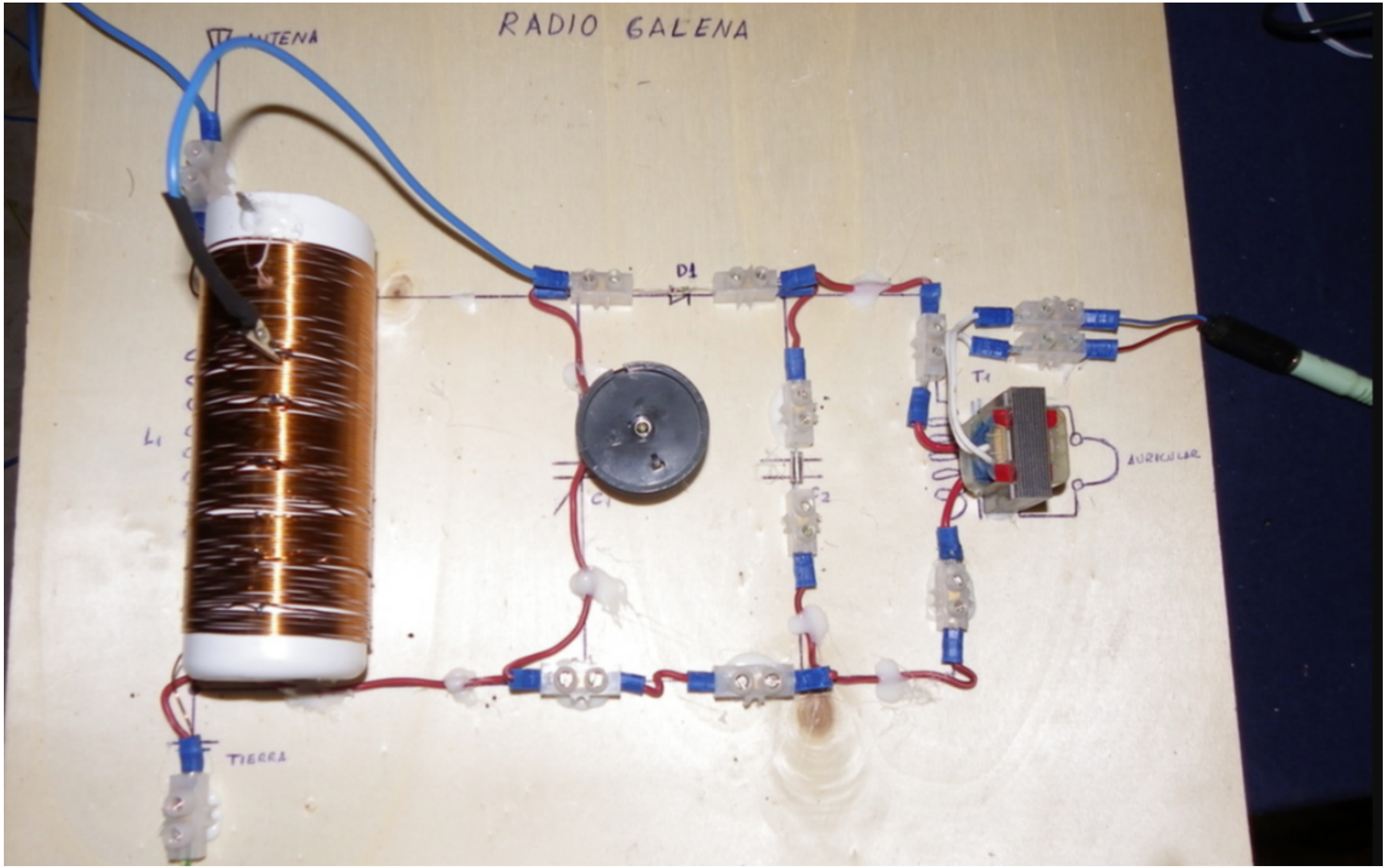
RADIO GALENA
ANTENA
D1
L1
C1
C2
T1
AURICULAR
TIERRA

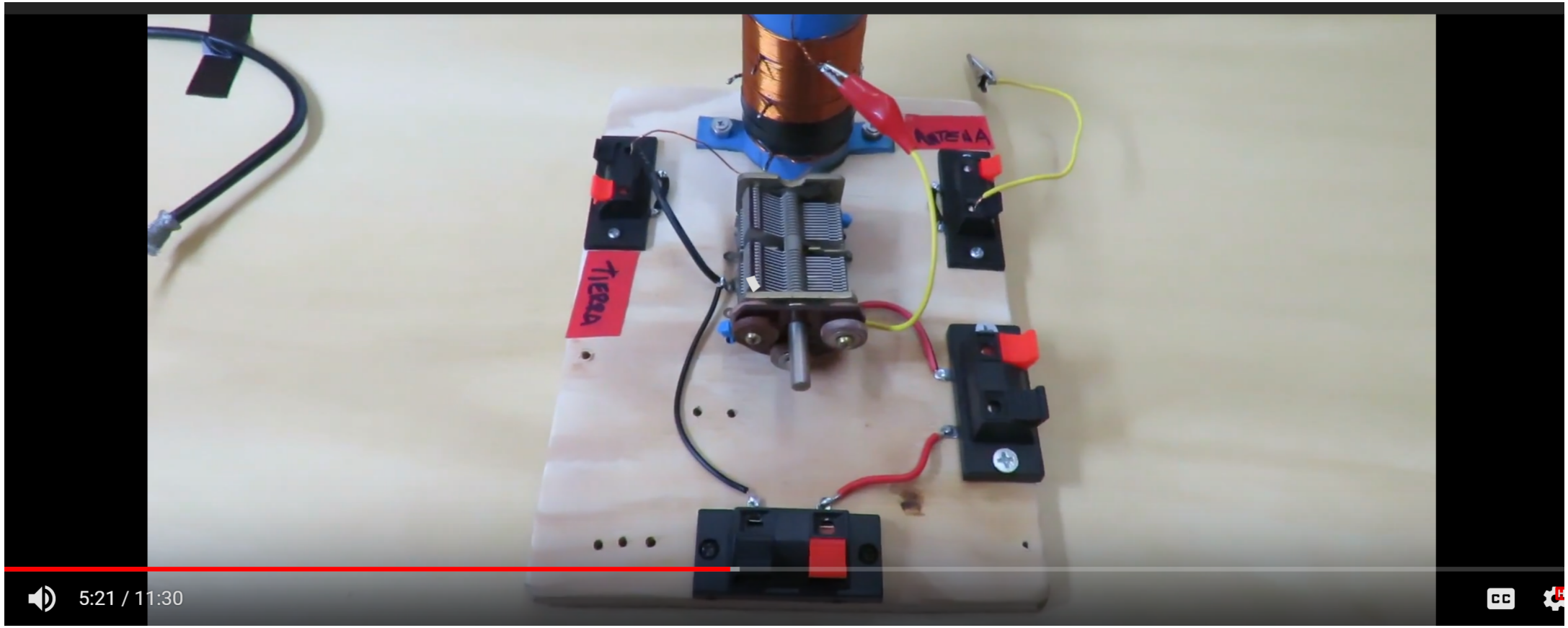

Radio Galena en la practica (con diodo detector)

Up next

AUTOPLA

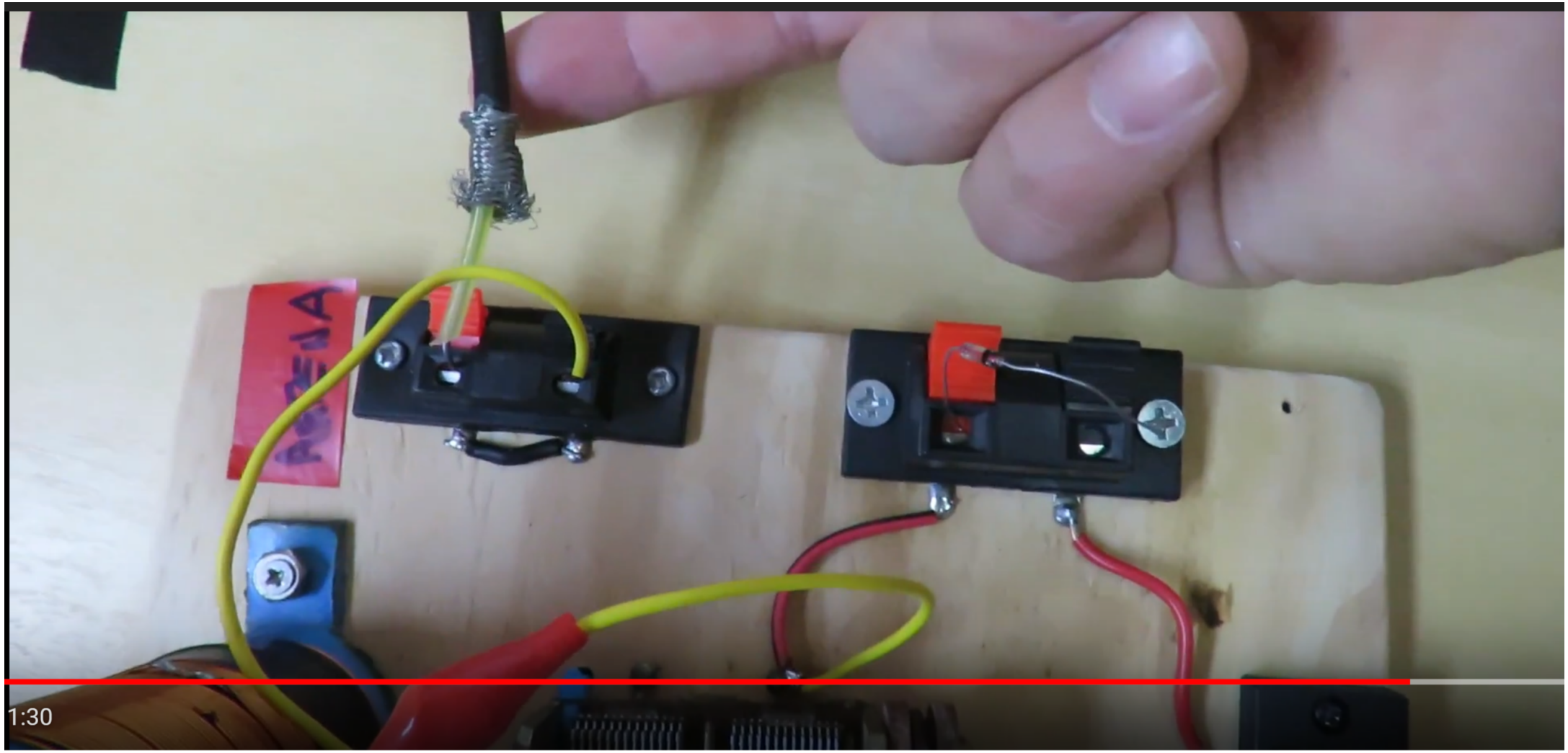
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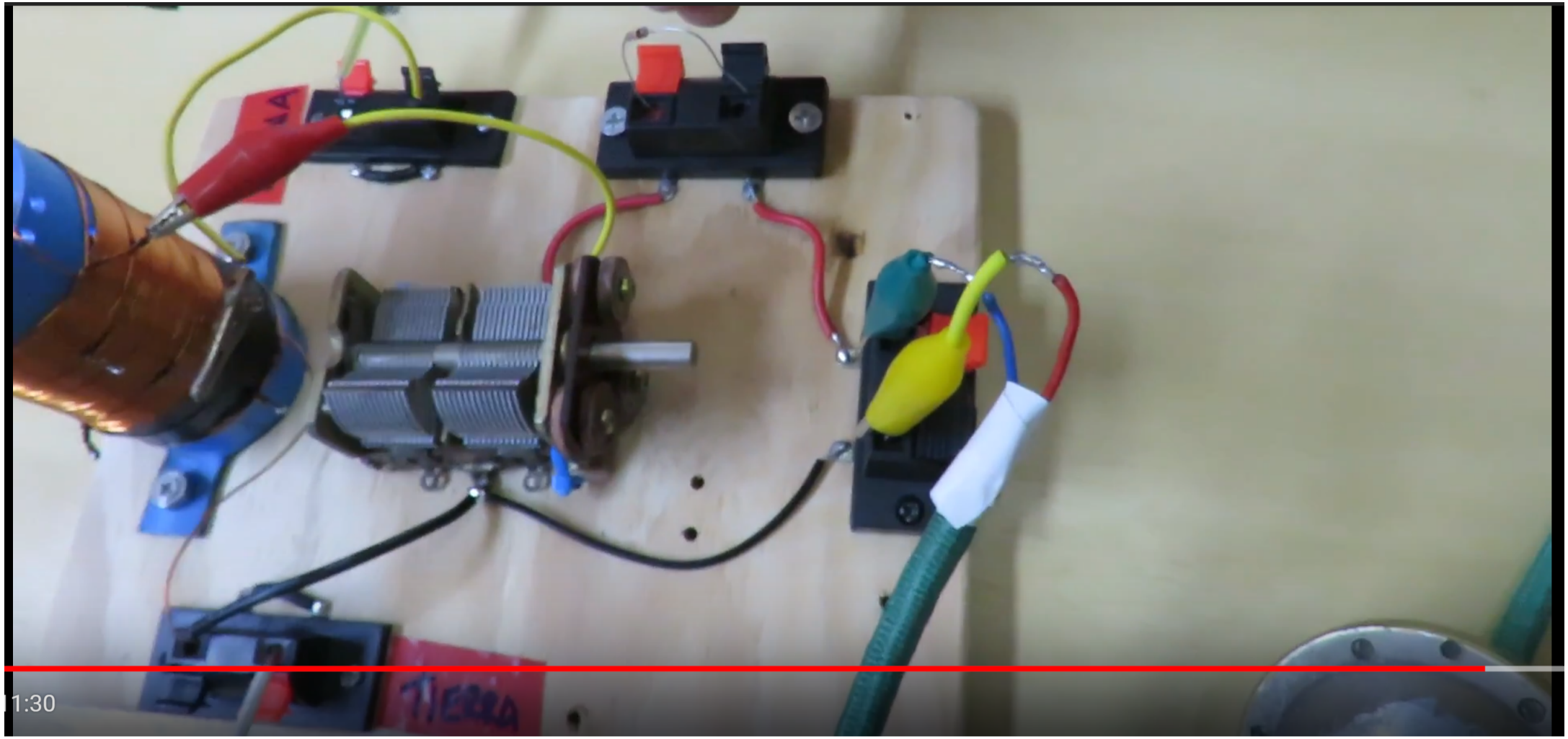
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11:30

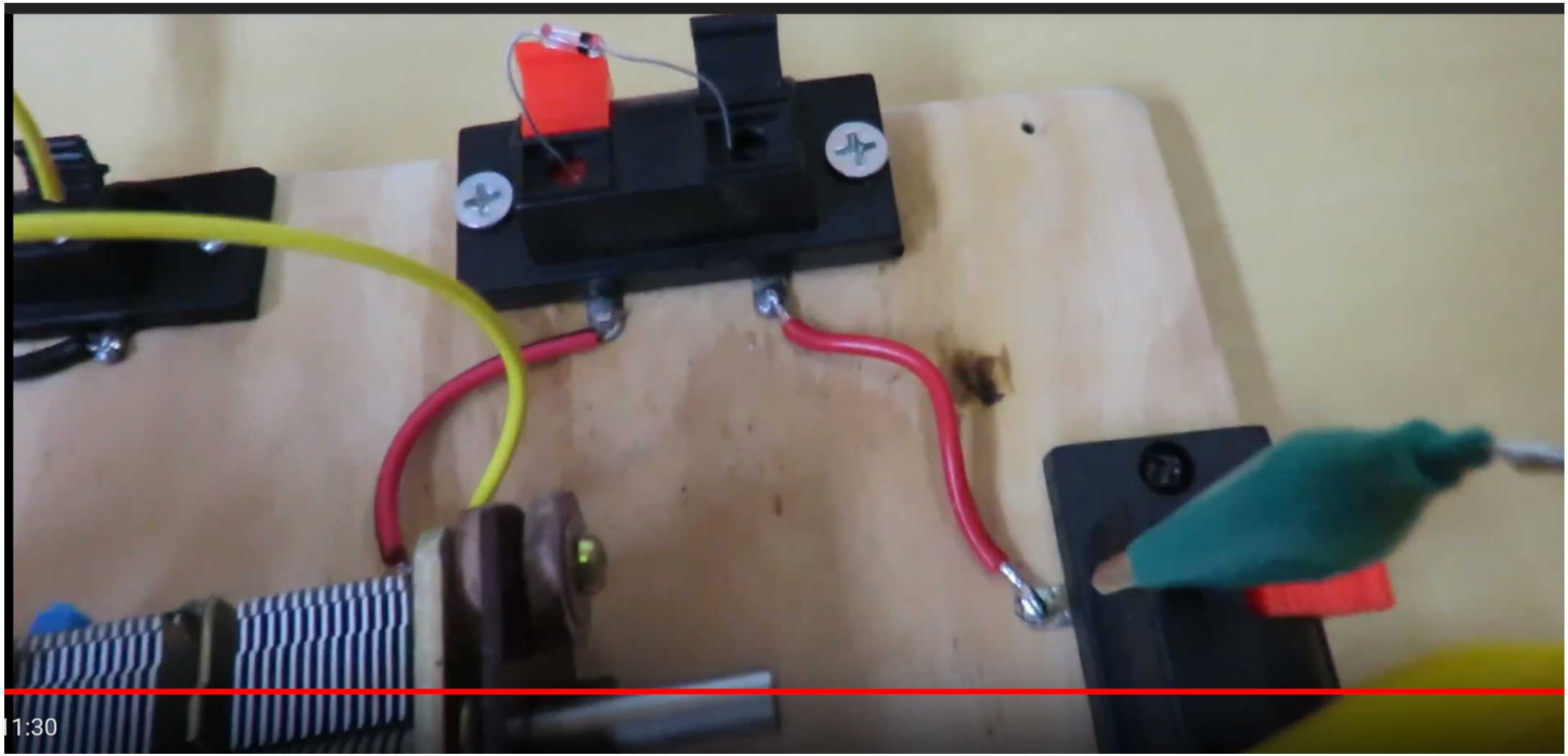
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TIERRA
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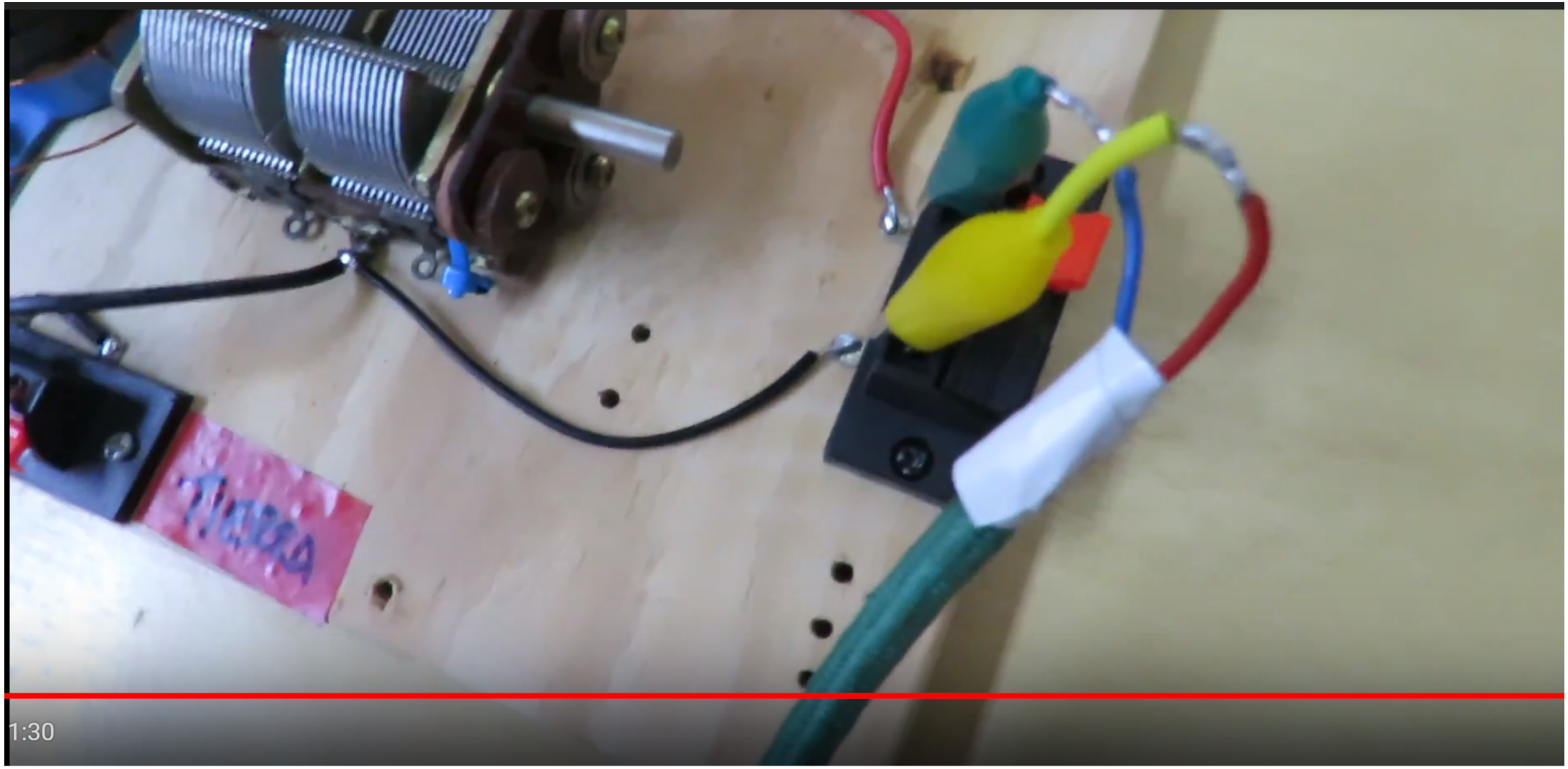
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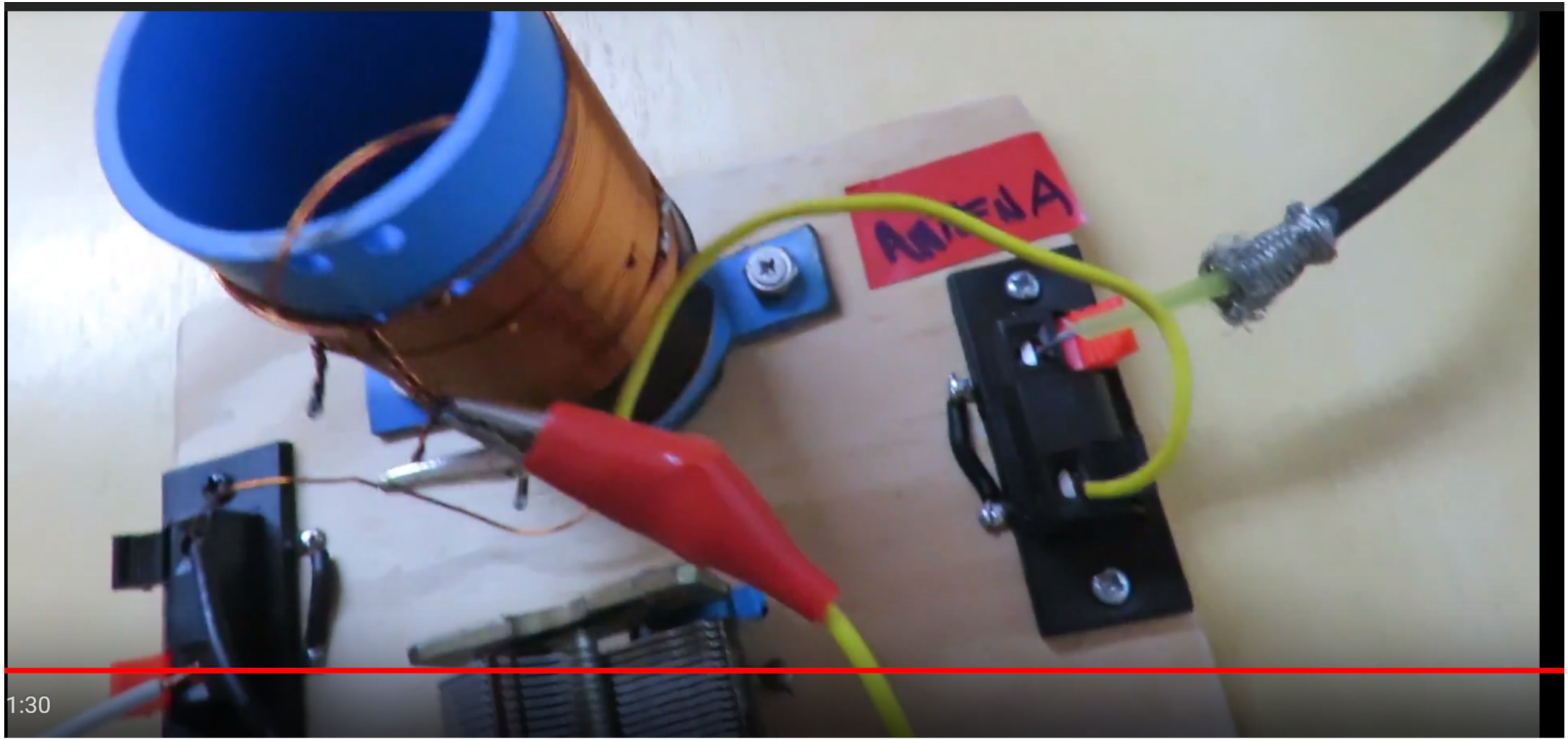
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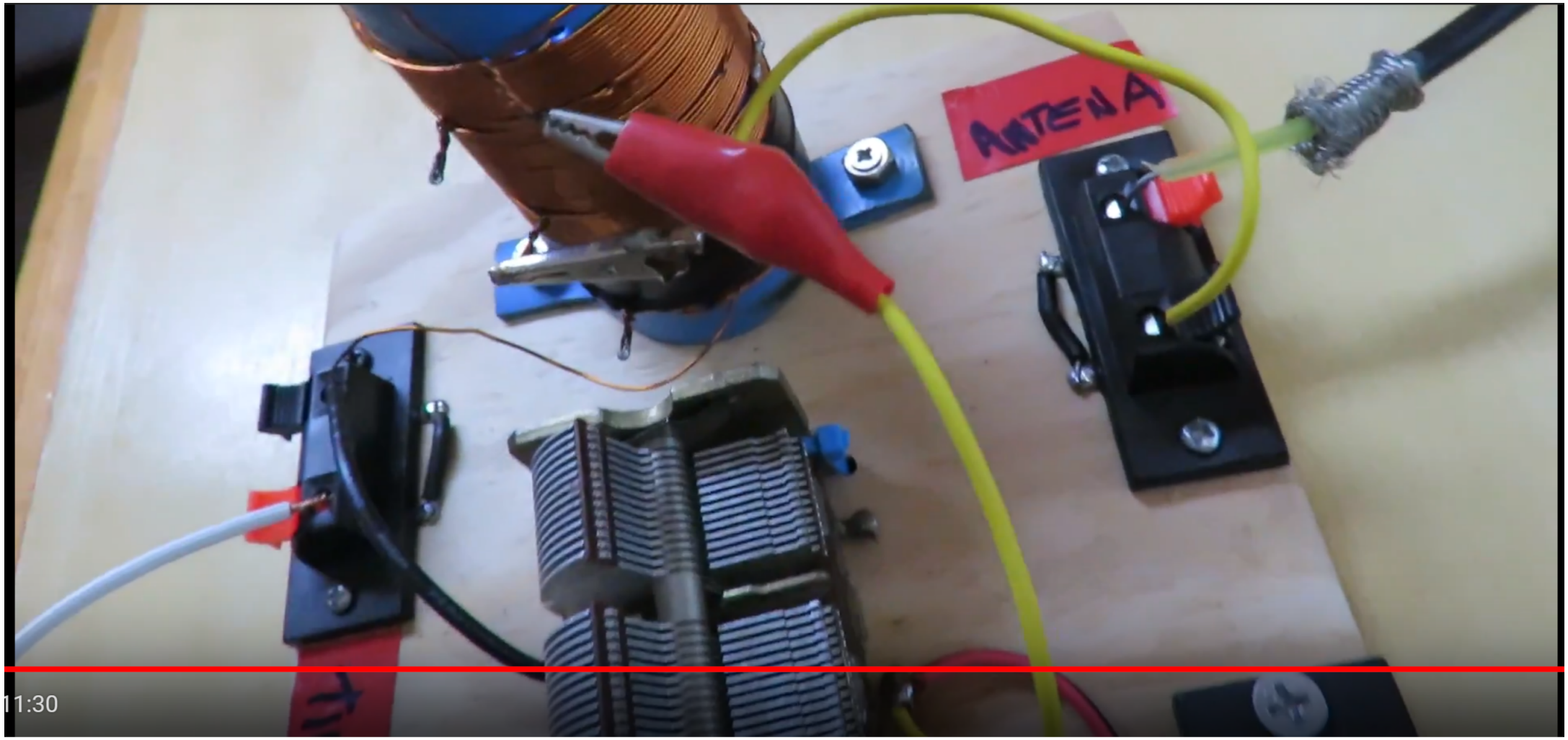
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11:30

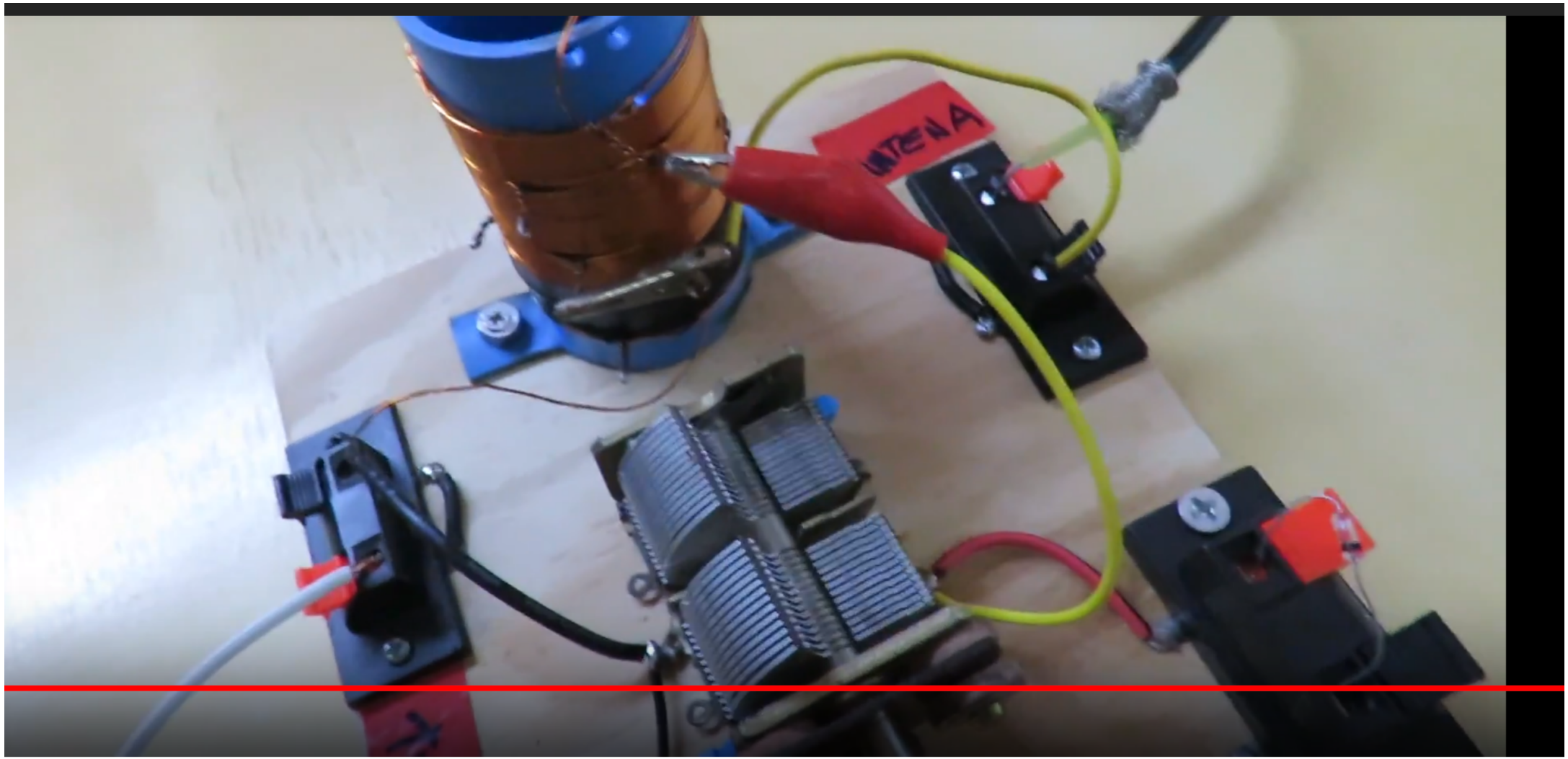
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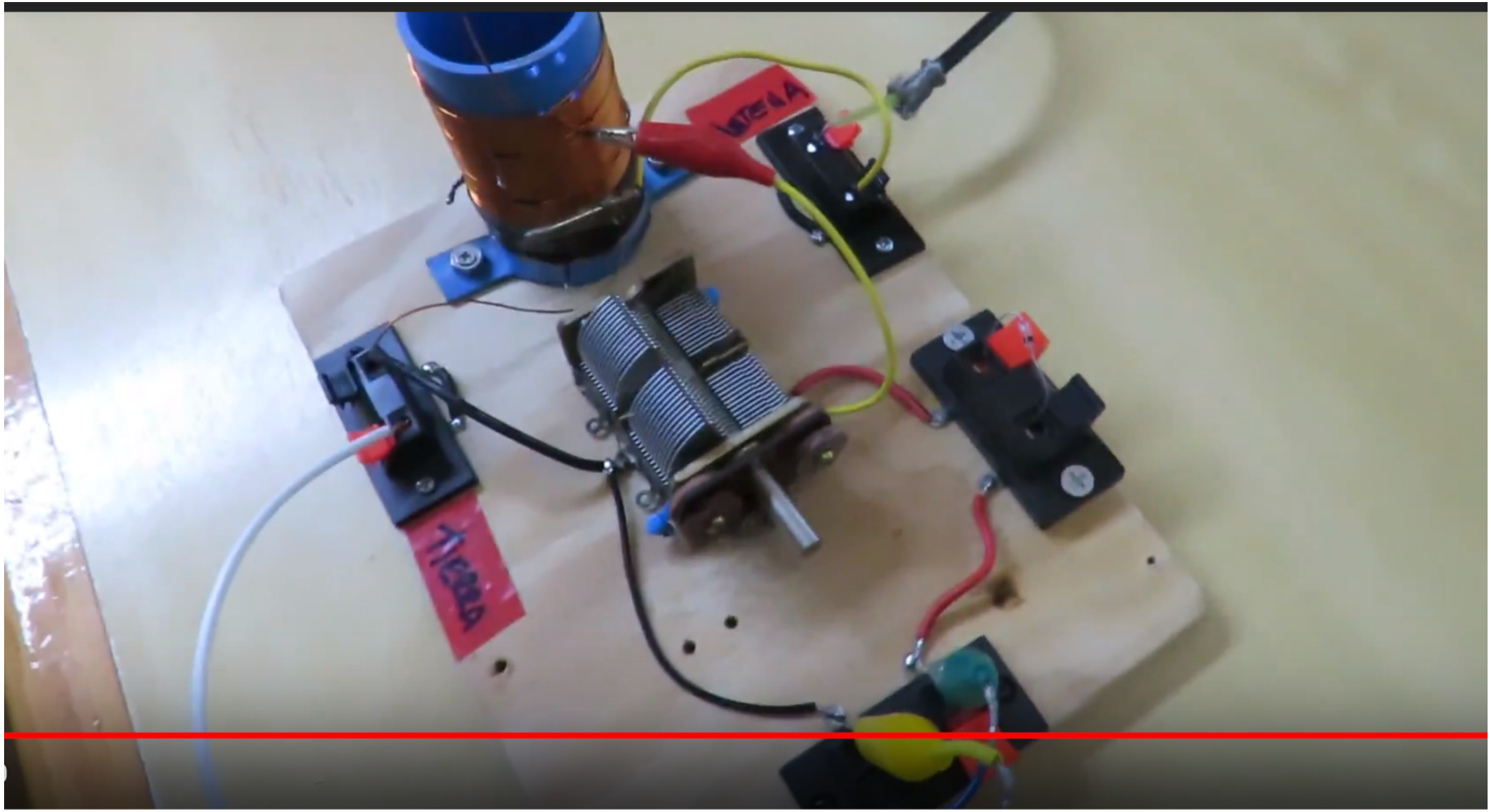

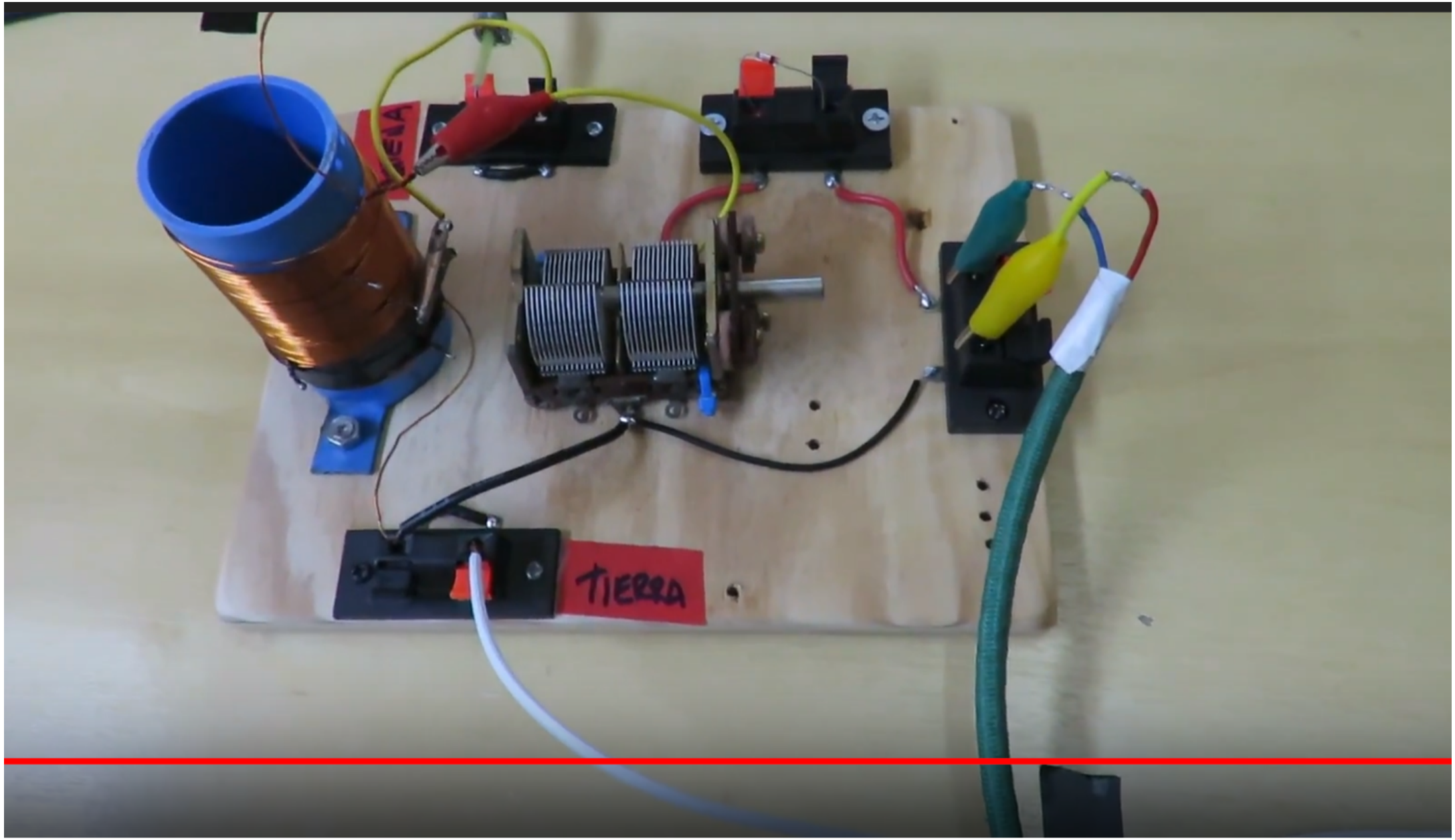
TIERRA

Tubo de PVC de 40 mm de diámetro,
y 12 cm de largo

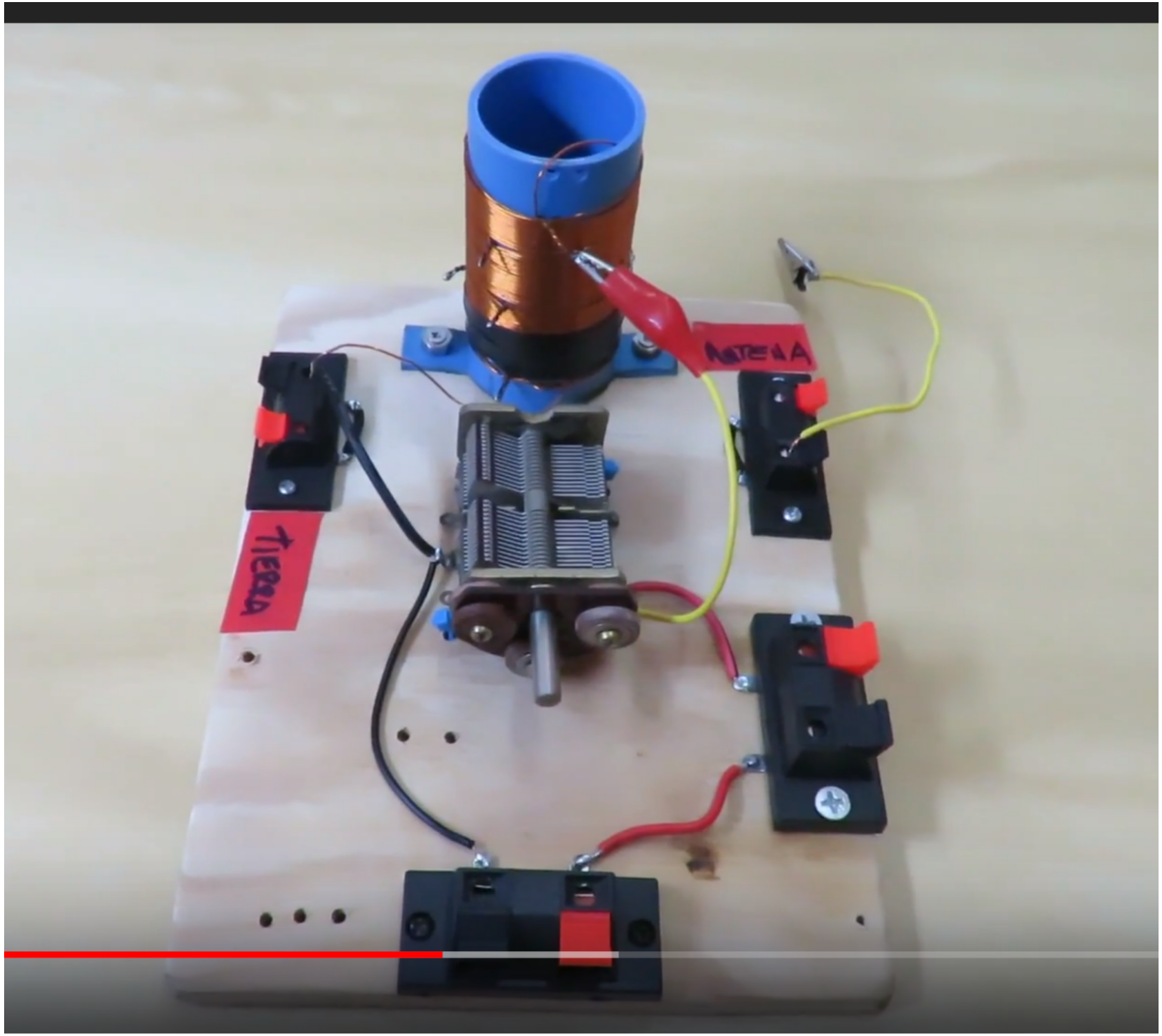
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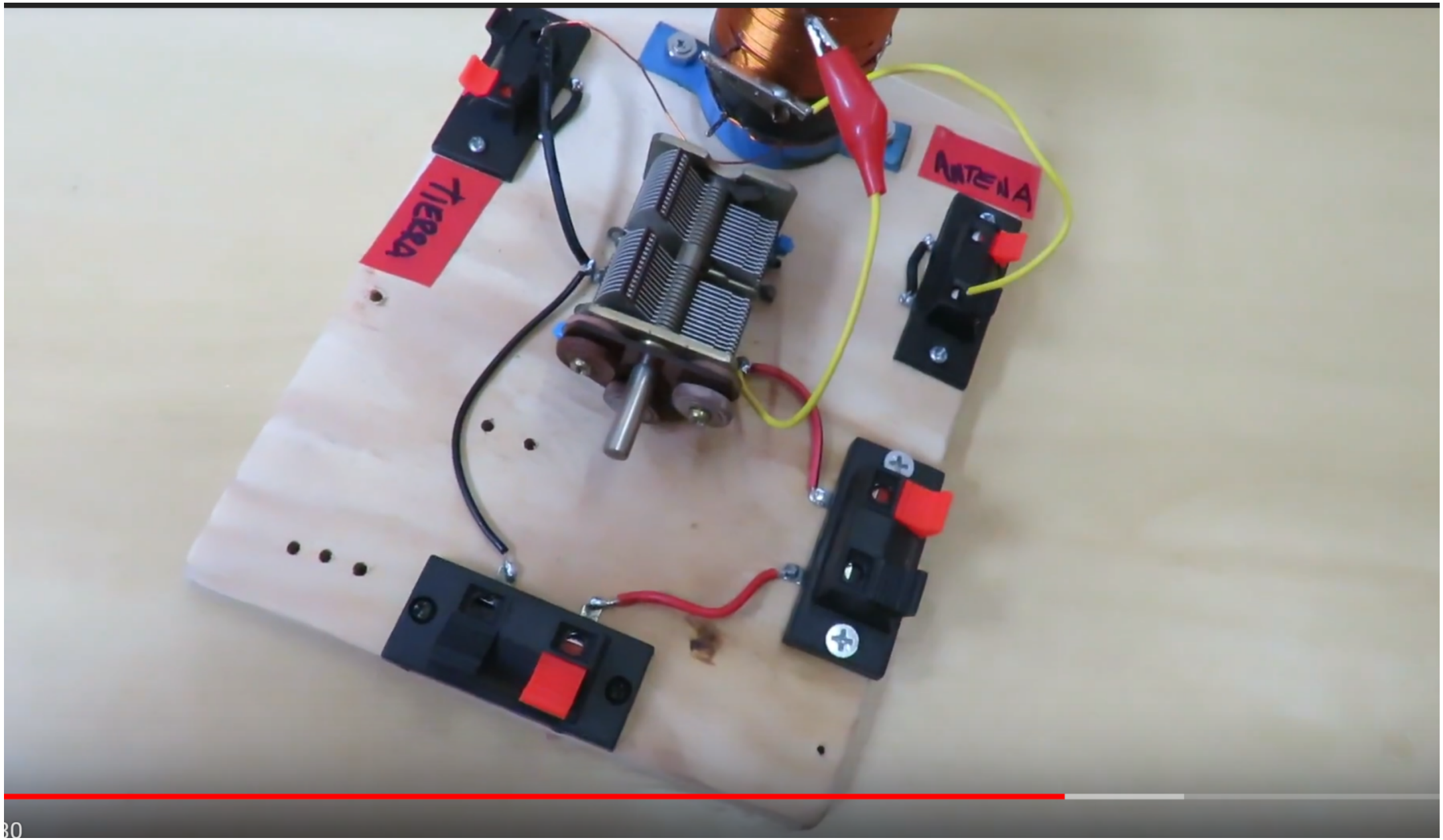
TIERRA
ANTENA

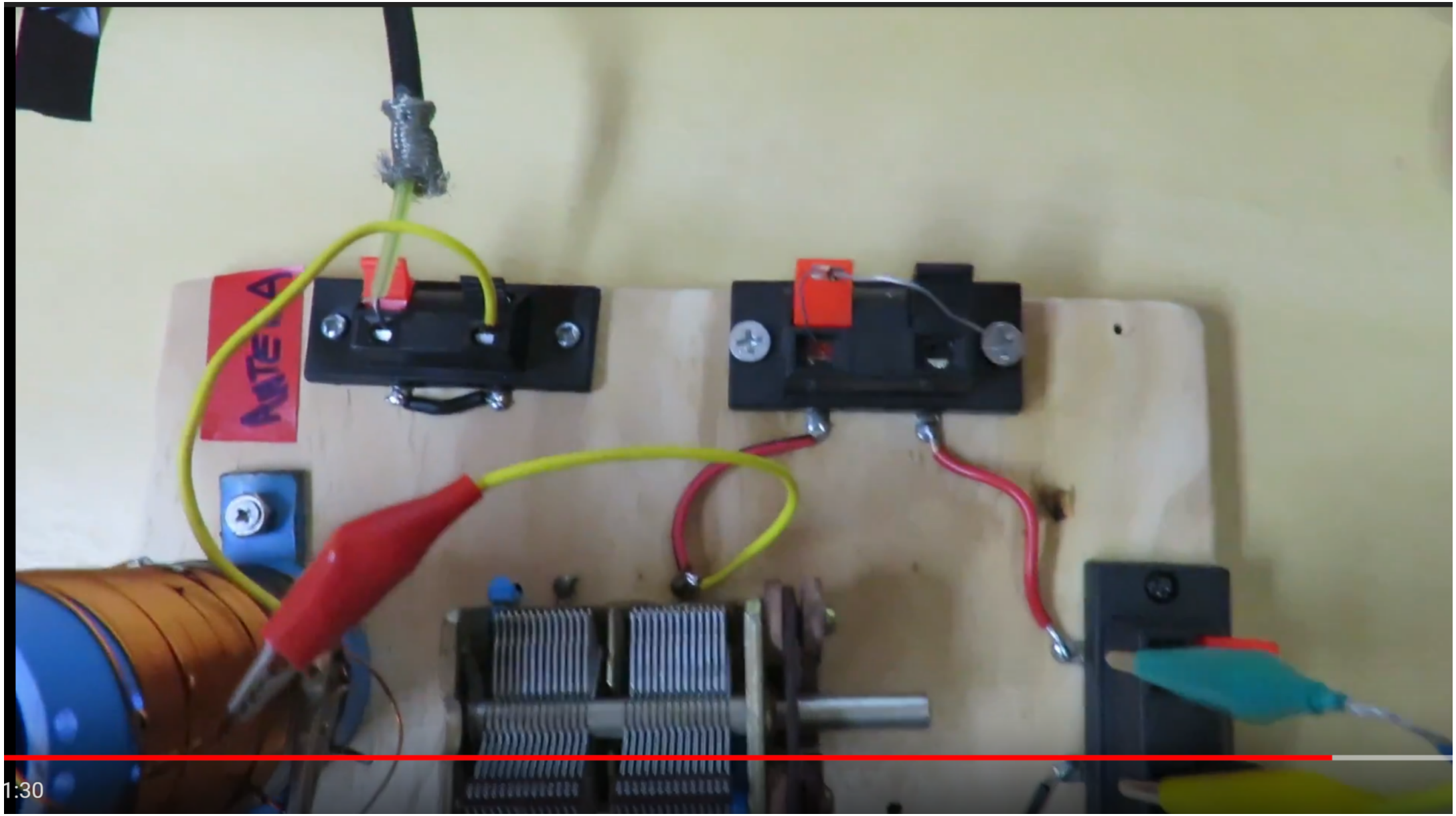
ANTENA
1:30

Rádio de Galena com Antena de Quadro - UTFPR - TD

Up next

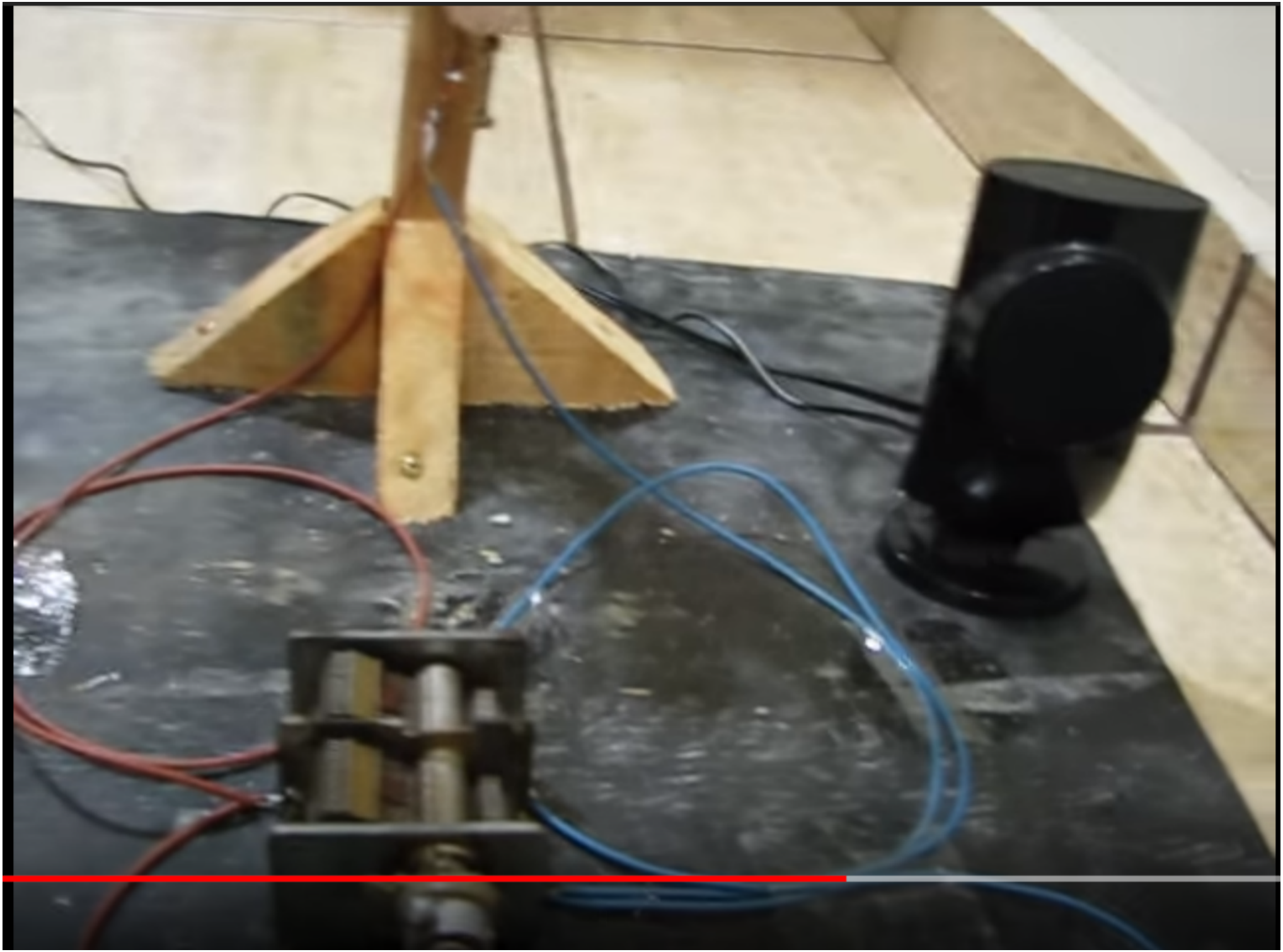

BINER R
BRiel T

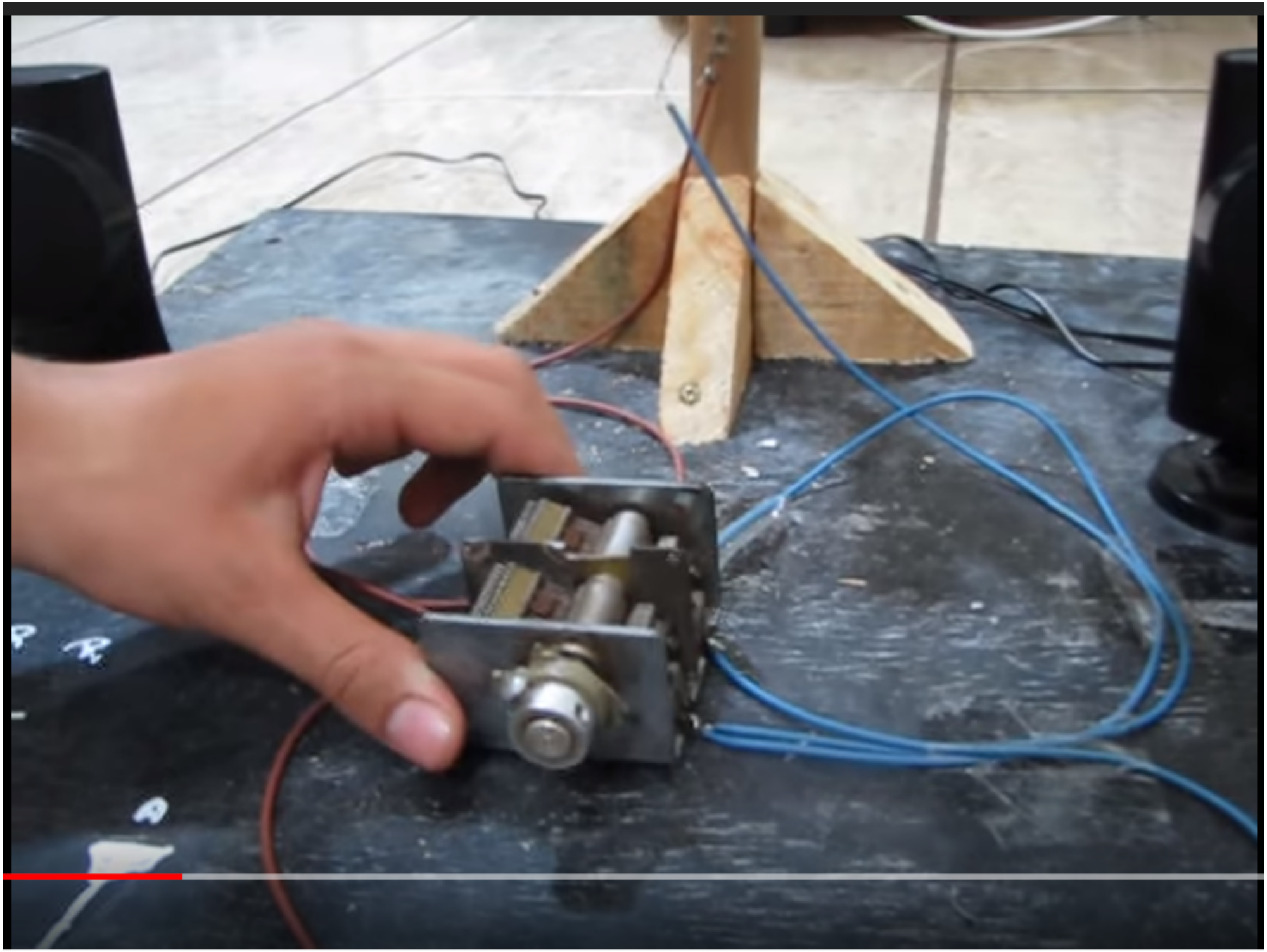

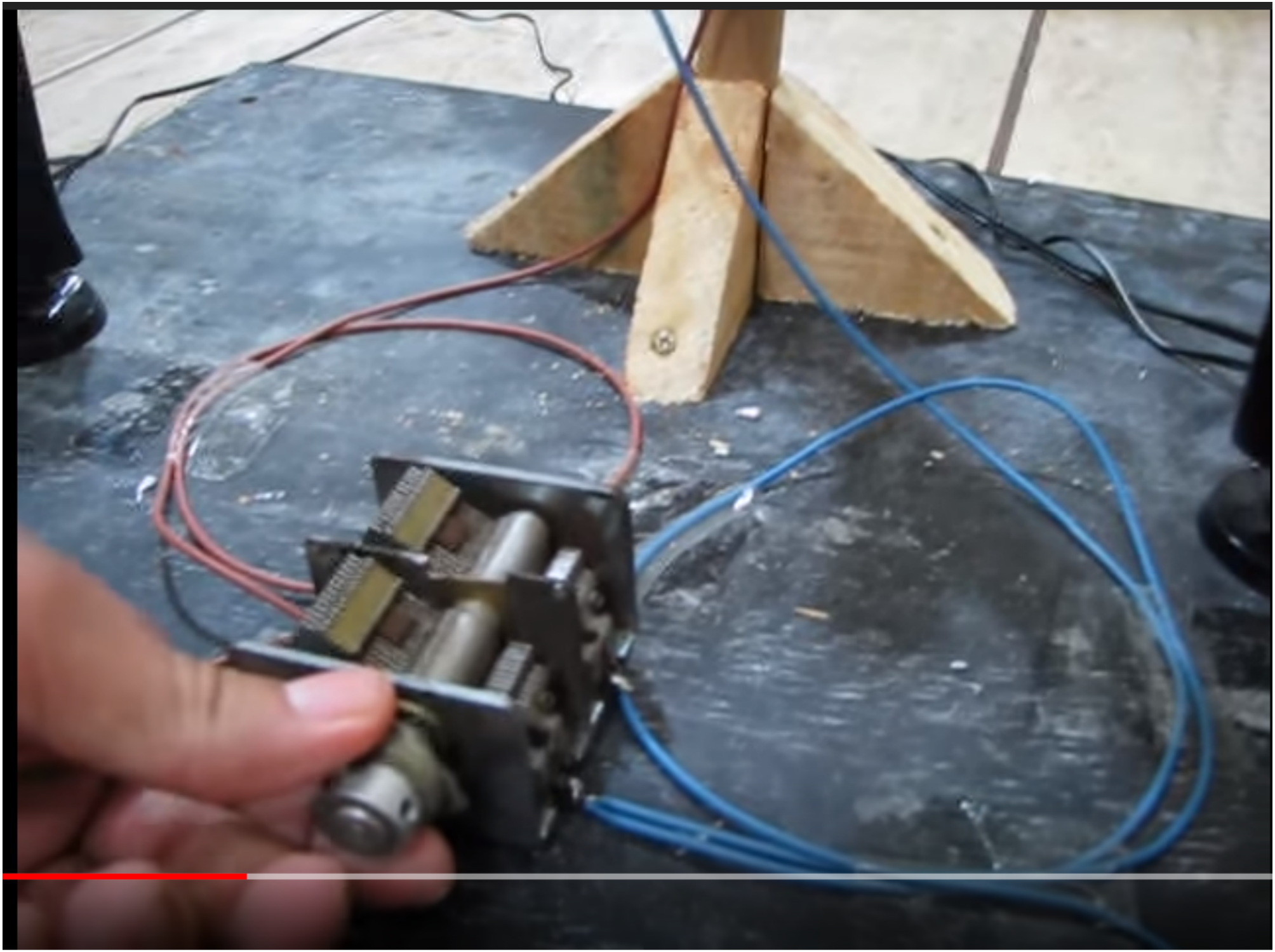

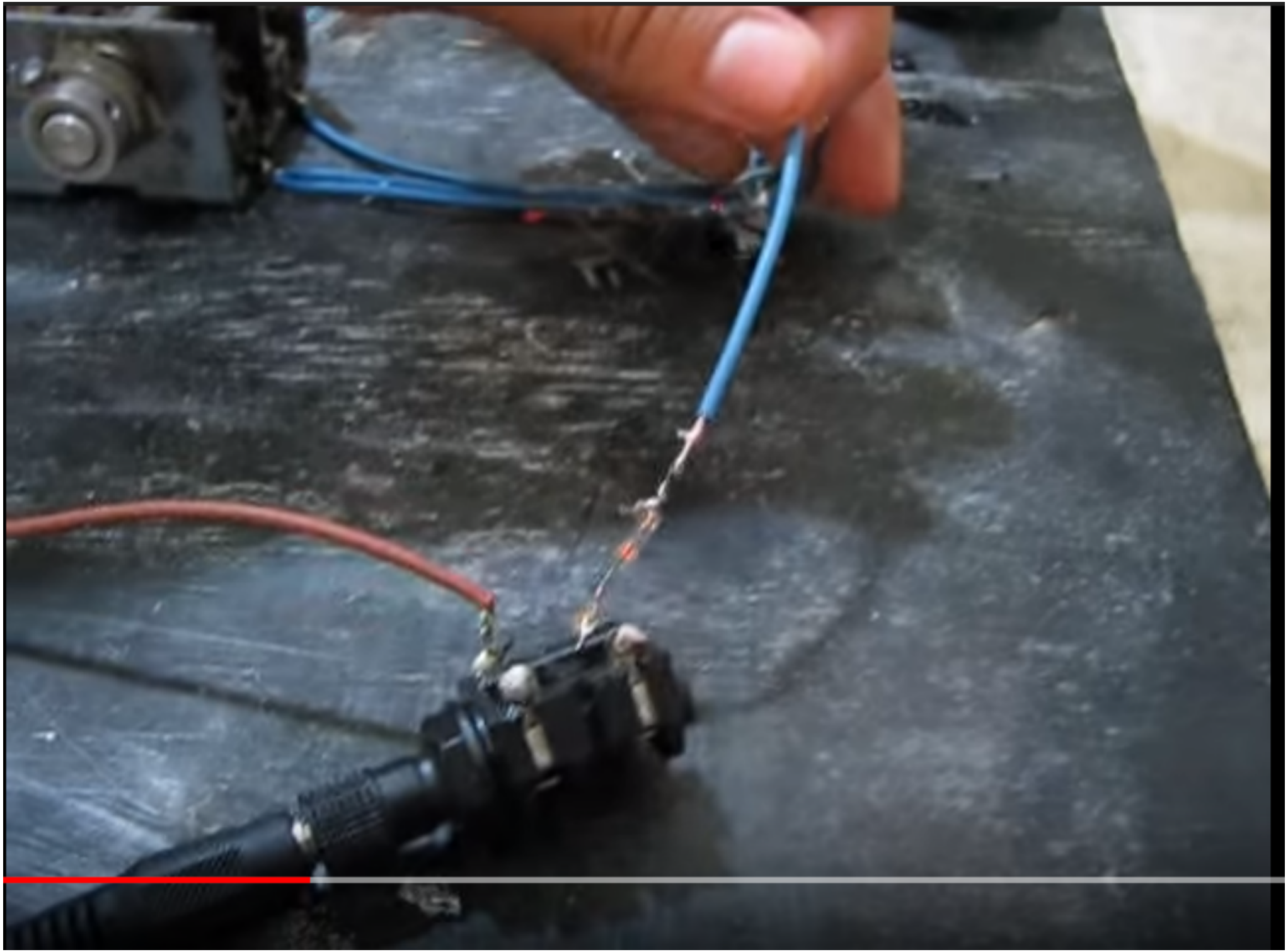

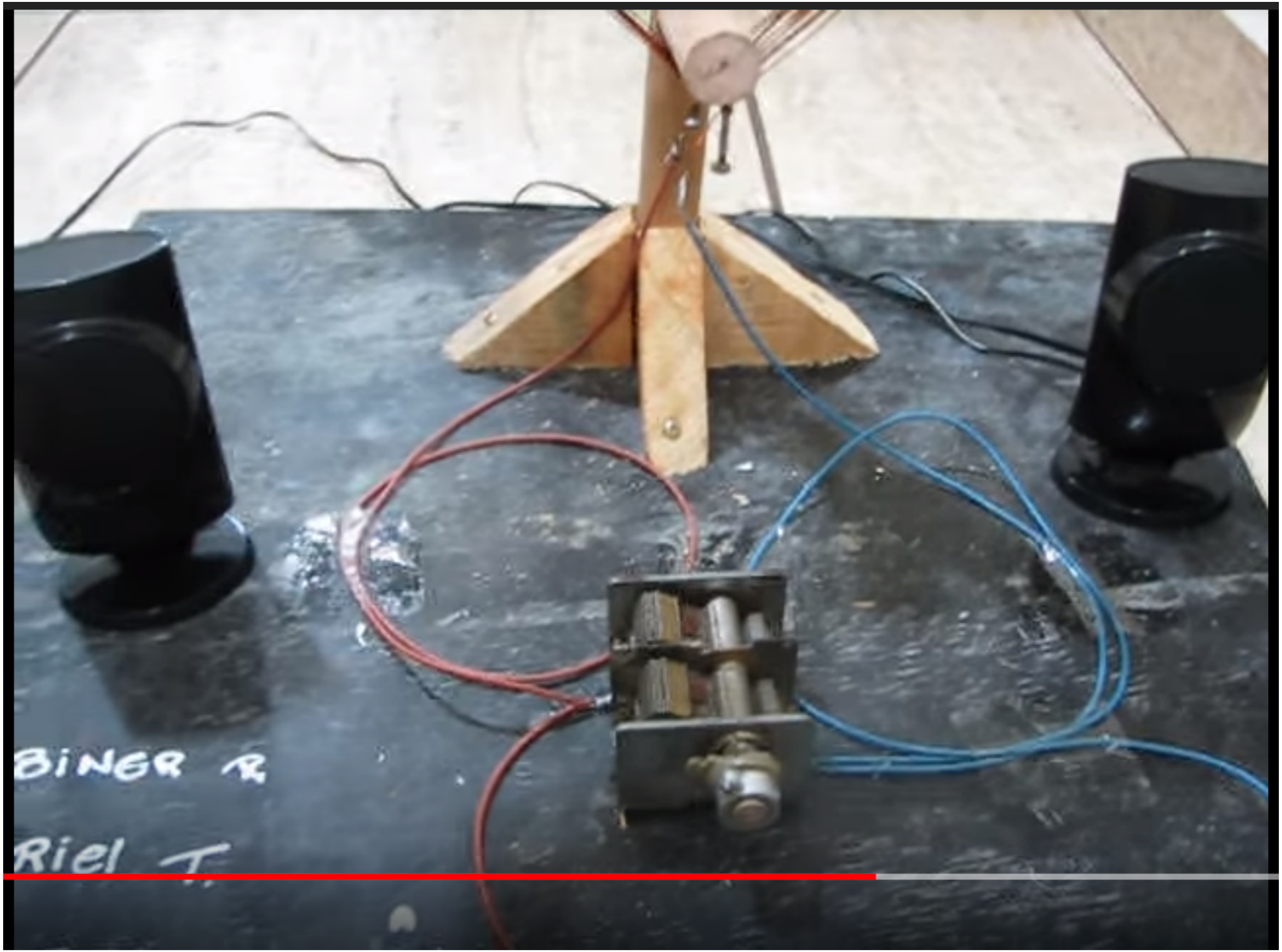
BINER R
Riel T.

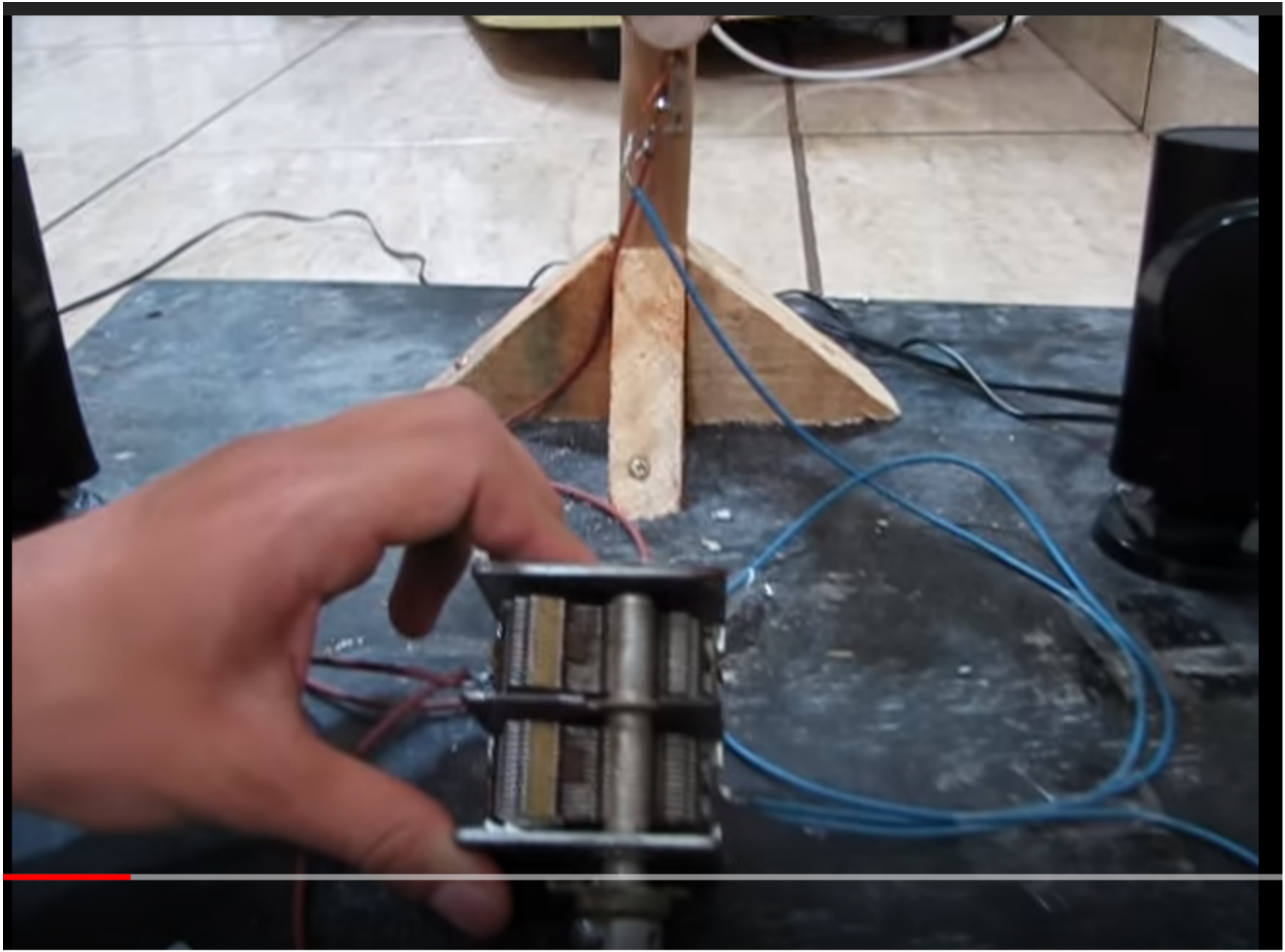

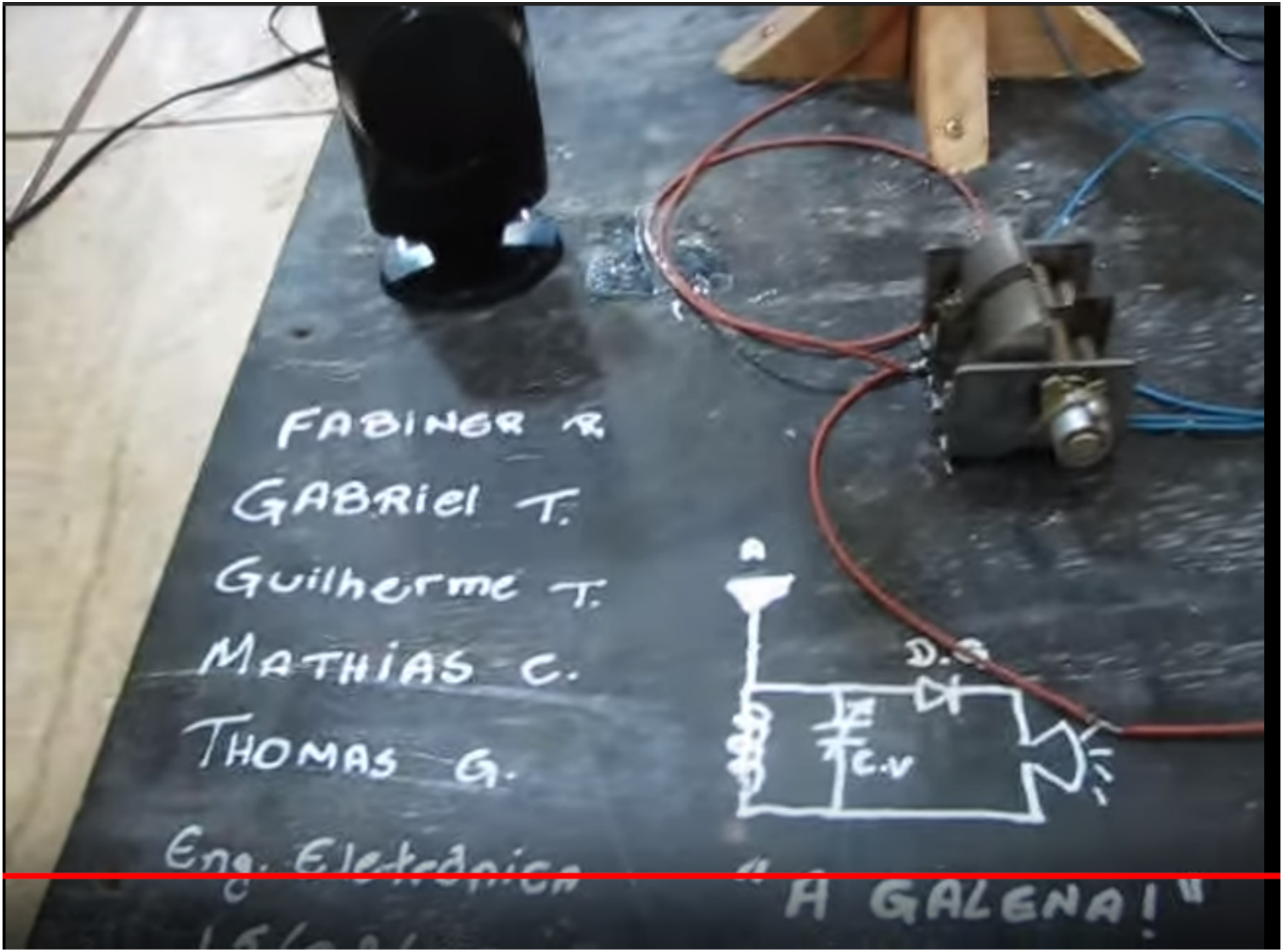
FABINER R.
GABRIEL T.
Guilherme T.
MATHIAS C.
THOMAS G.
Eng. Eletrônica
A
D.
C.V
"A GALENA!"

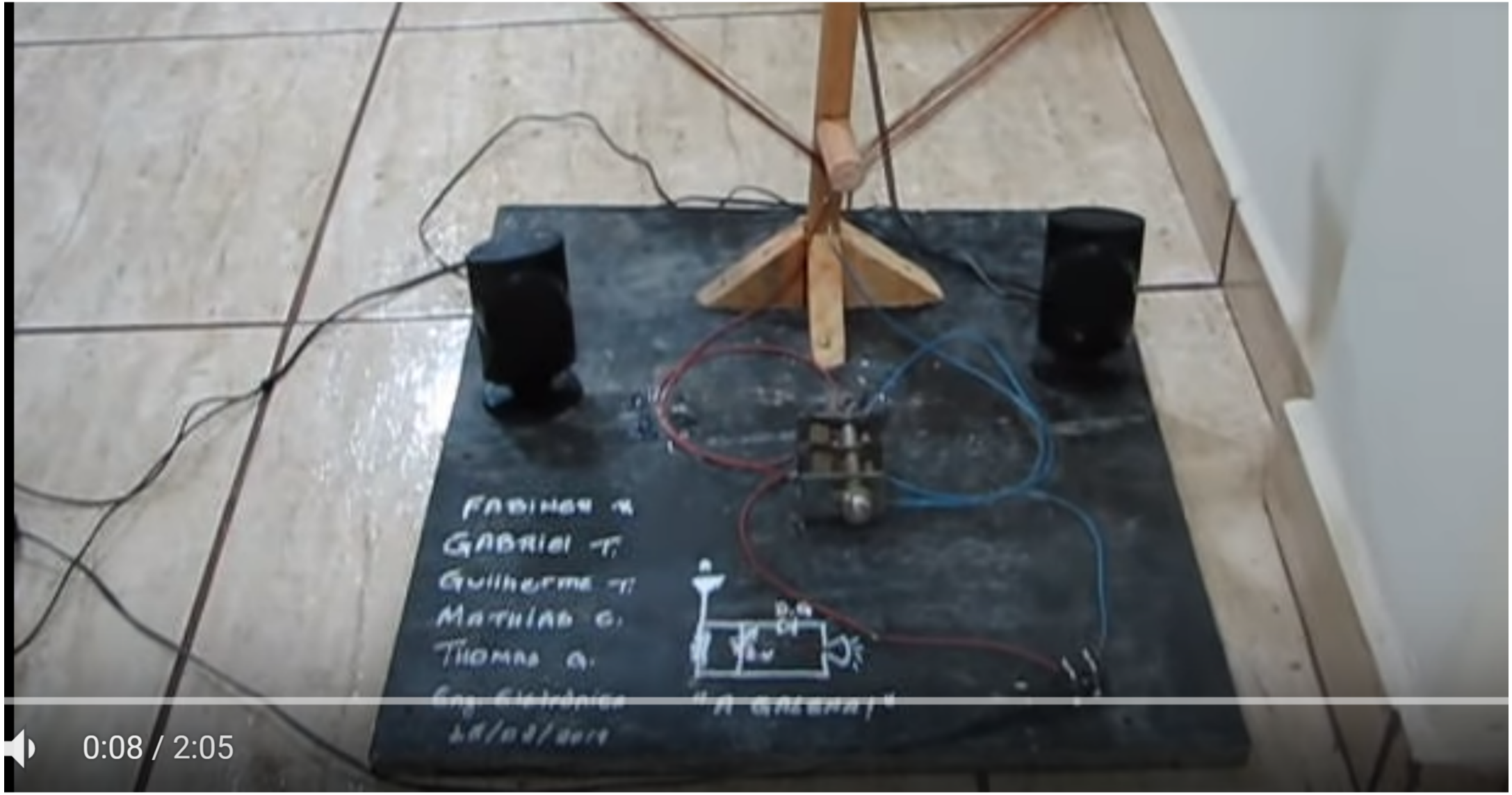
0:08 / 2:05

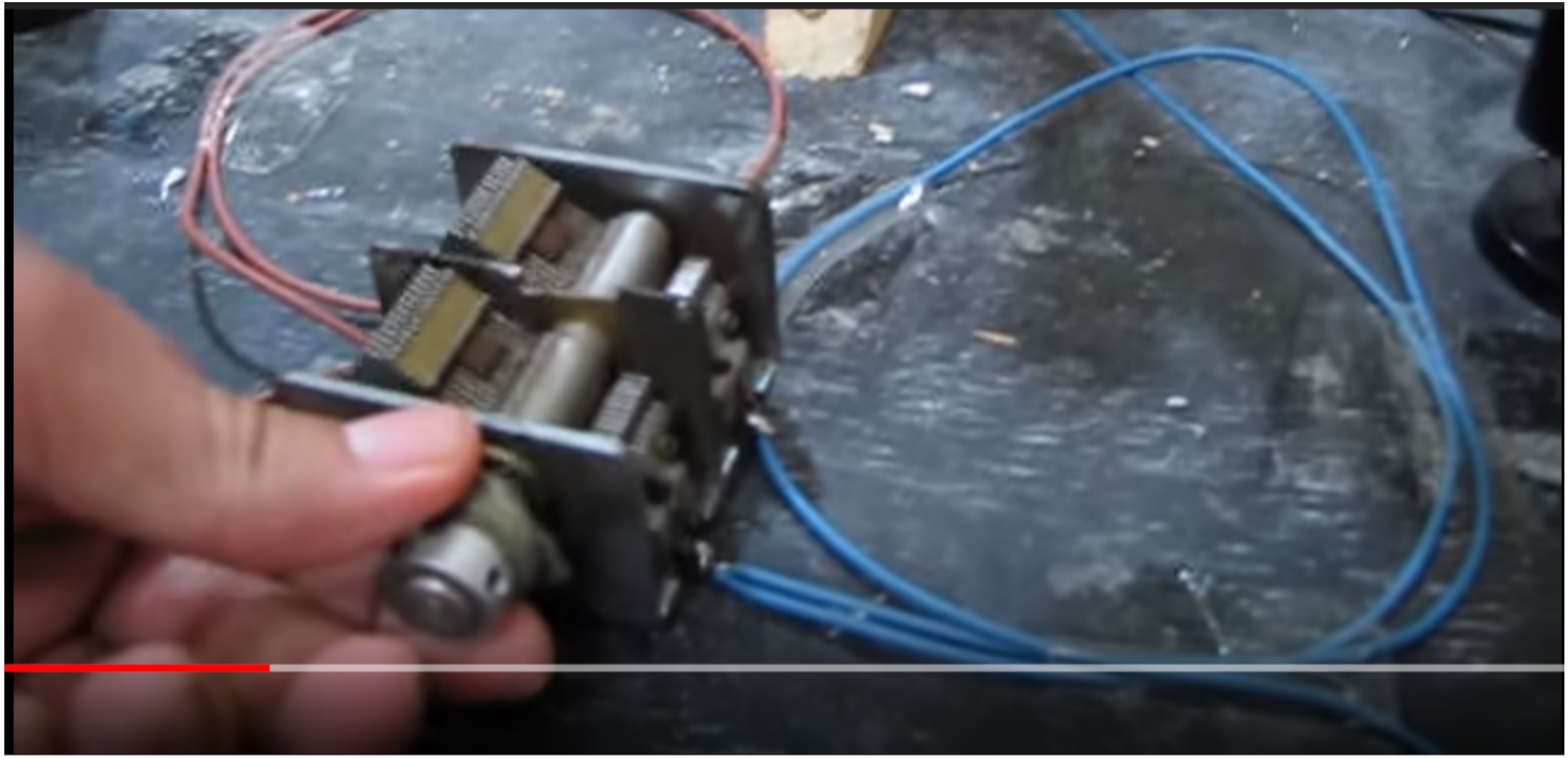

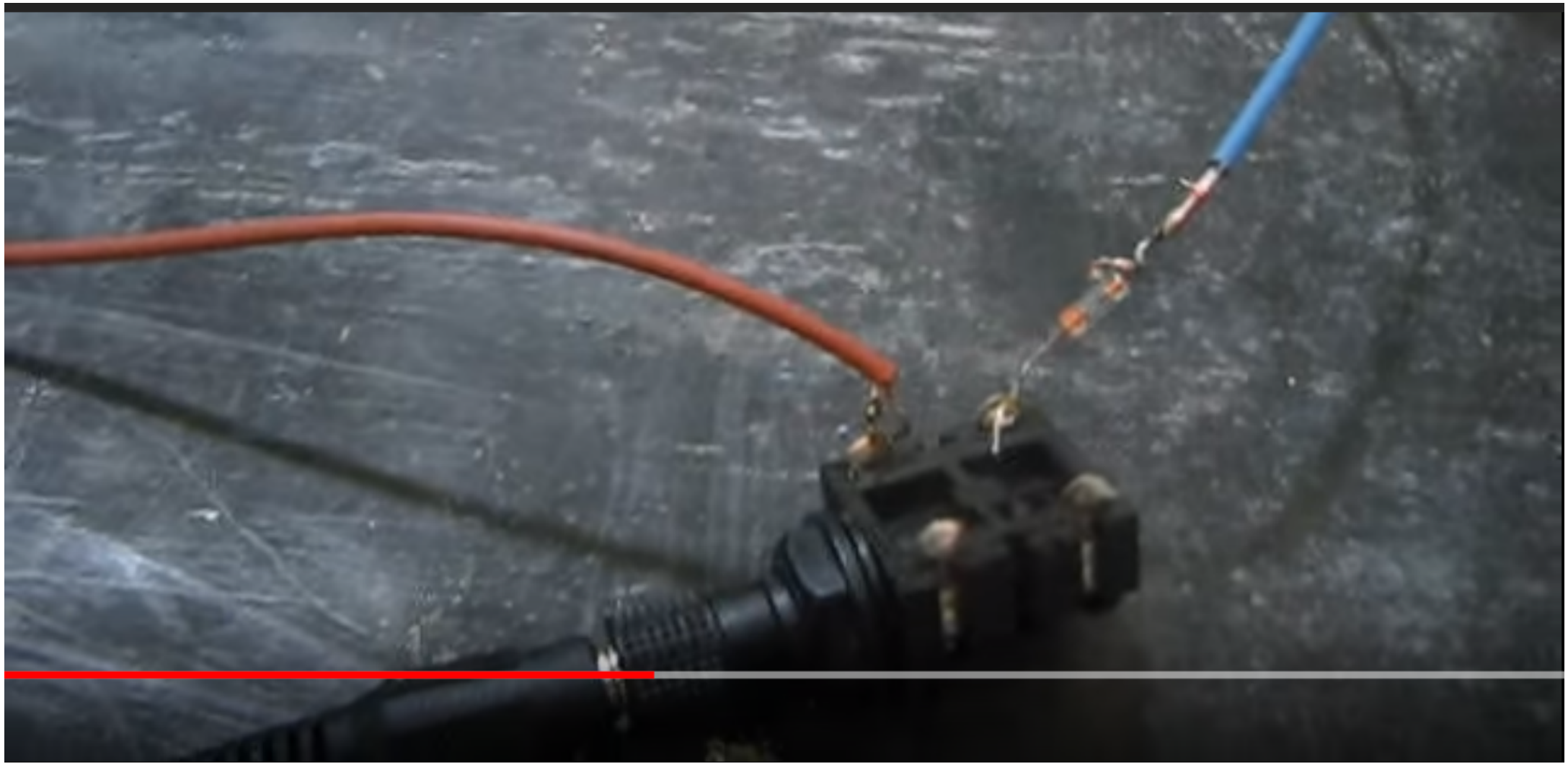

1 Watt Nuclear Generator - Free Energy

Gadget Addict

Subscribed 53K

138,050 views

Add to Share More

905 555

Shop "tritium battery"

Sponsored

Betalux Tritium Exit

Lithonia EXR LED EL

DQG Fairy Brass XP-

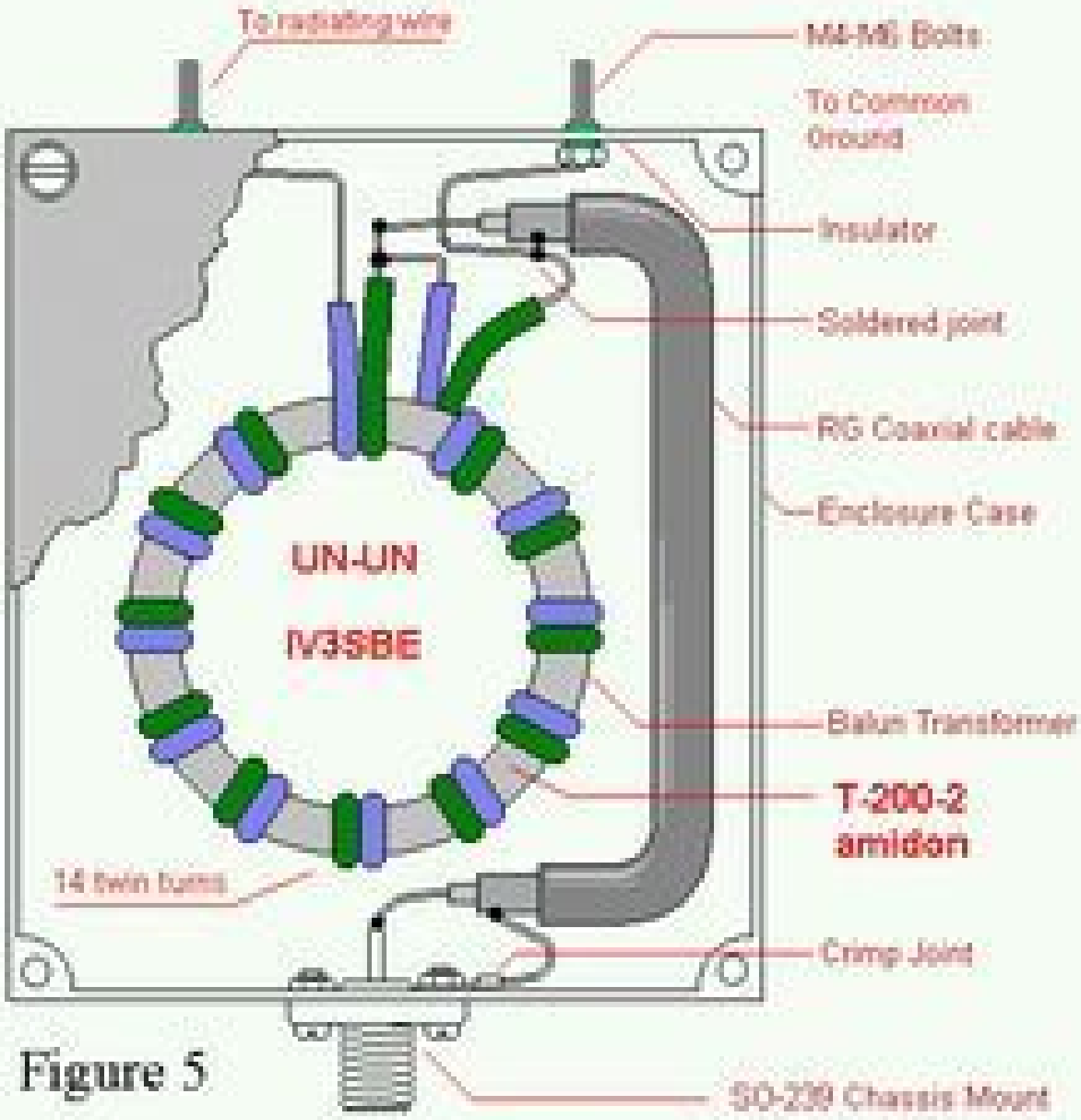
To radiating wire
M4-M6 Bolts
To Common Ground
Insulator
Soldered joint
RG Coaxial cable
Enclosure Case
UN-UN
IV3SBE
Balun Transformer
T-200-2
amidon
14 twin turns
Crimp Joint
SO-239 Chassis Mount

Figure 5

Voltage Balun / "Magnetic Balun"

From GW0VMR's plan

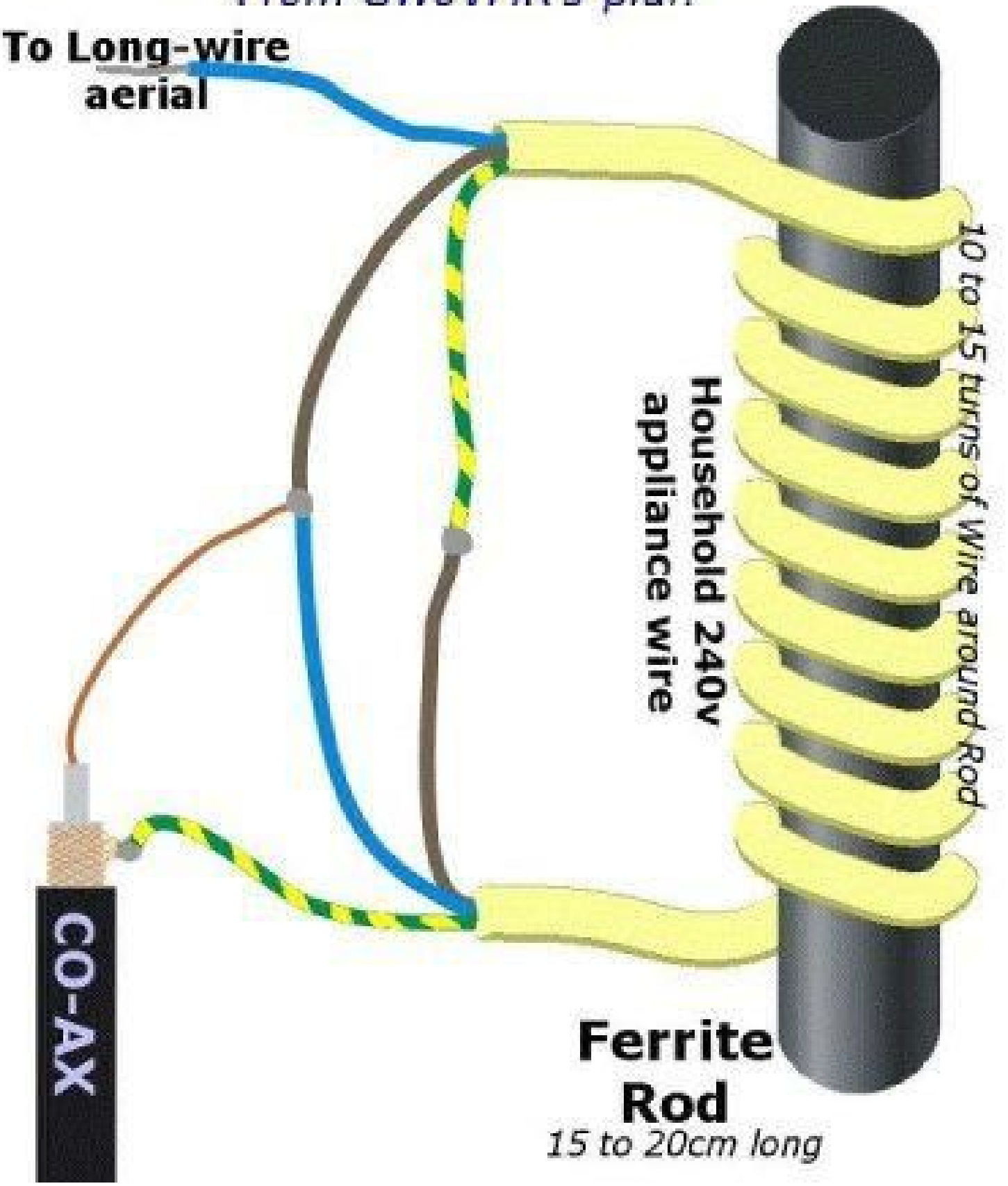

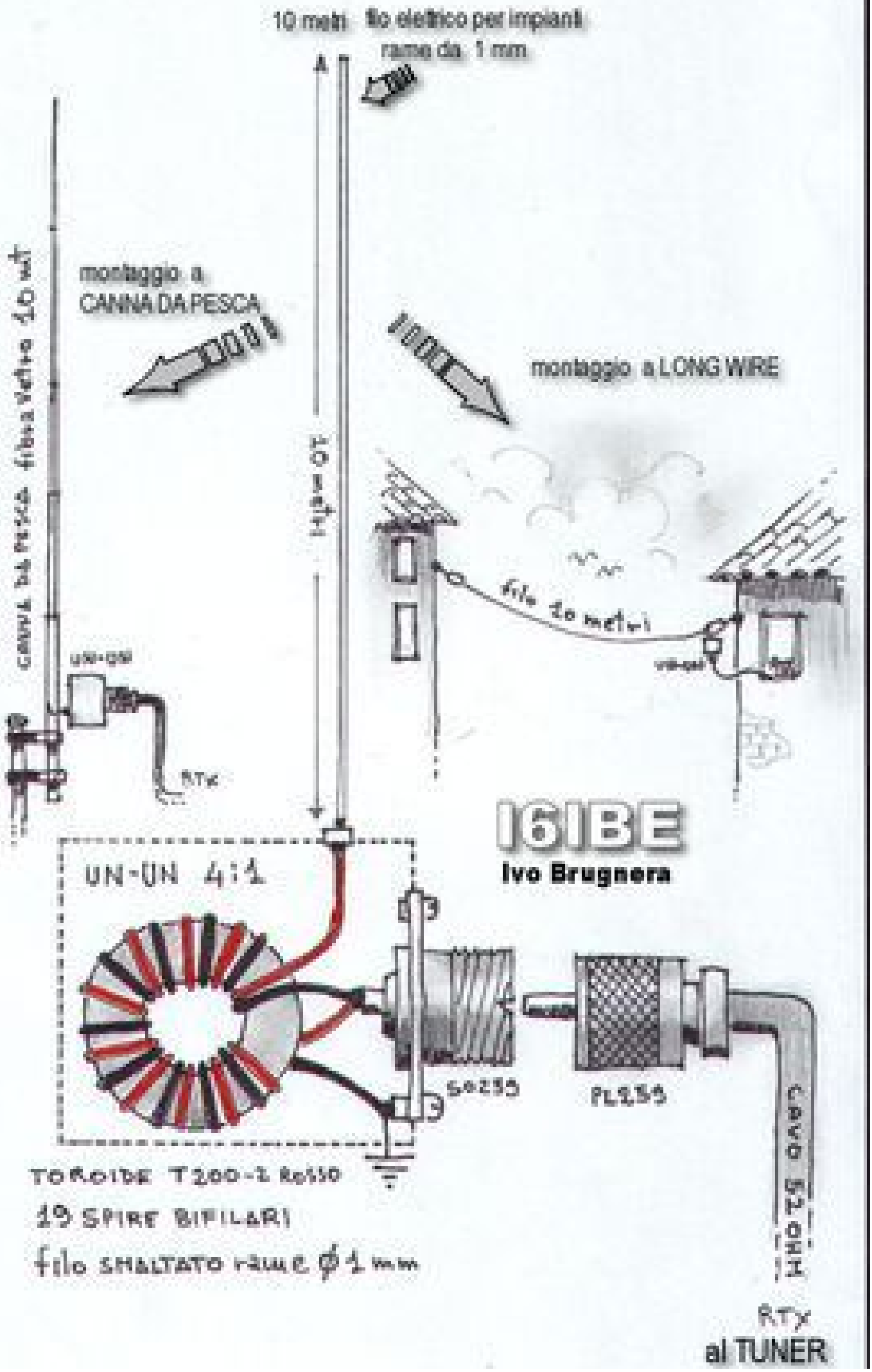
10 metri
filo elettrico per impianti
rame da 1 mm
montaggio a
CANNA DA PESCA
montaggio a LONG WIRE
canna da pesca fibra vetro 10 mt
10 metri
filo 10 metri
UN-UN
RTX
I6IBE
Ivo Brugnera
UN-UN 4:1
SO239
PL259
CAVO 52 OHM
TOROIDE T200-2 Rosso
19 SPIRE BIFILARI
filo SMALTATO rame ϕ 1 mm
RTX
al TUNER

BALUN 9:1 Antenna Long Wire

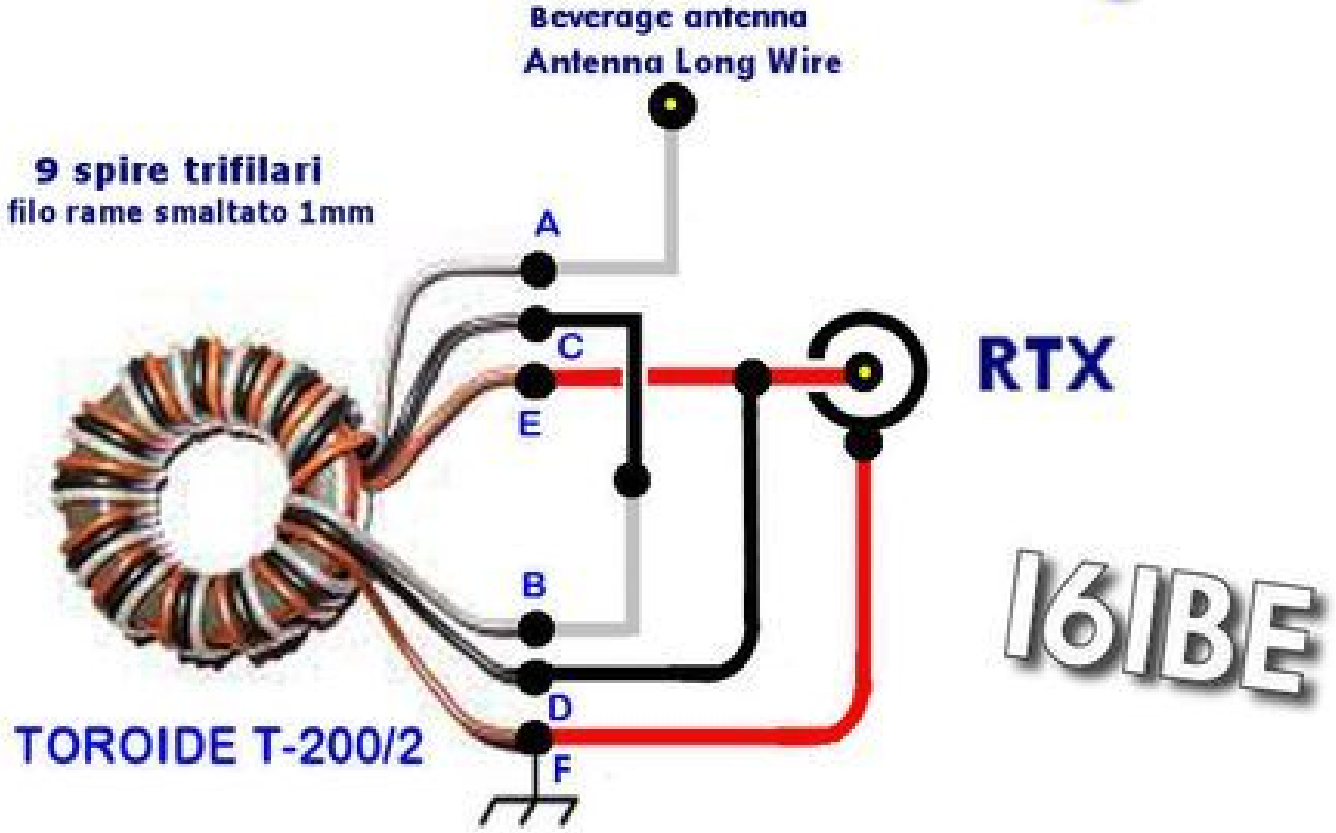

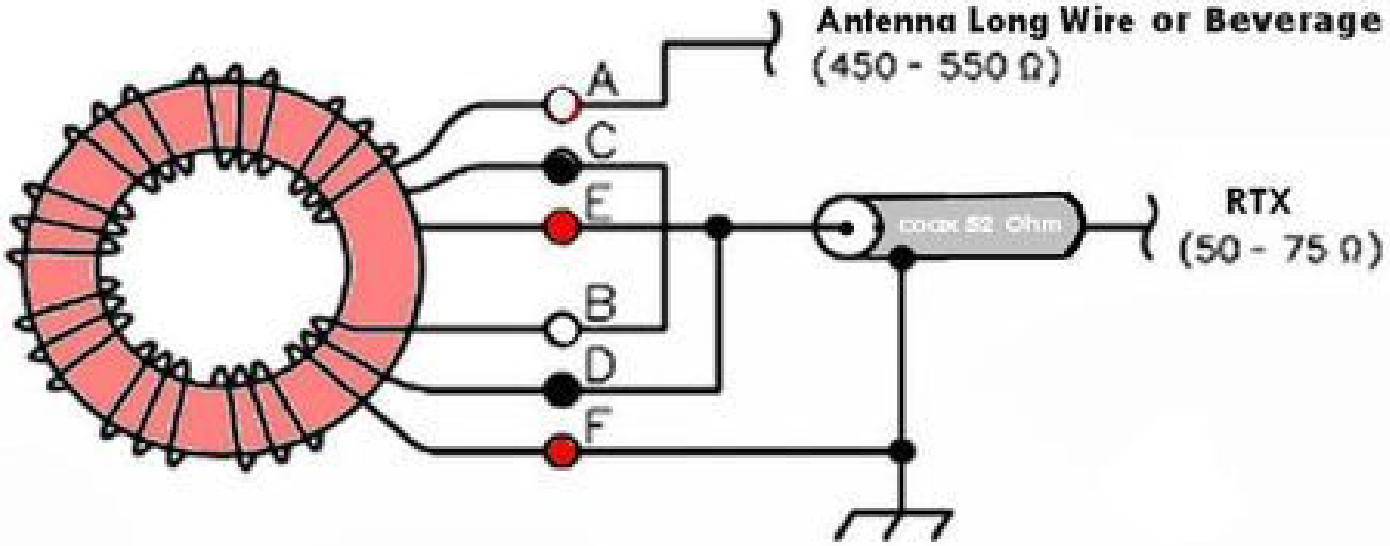

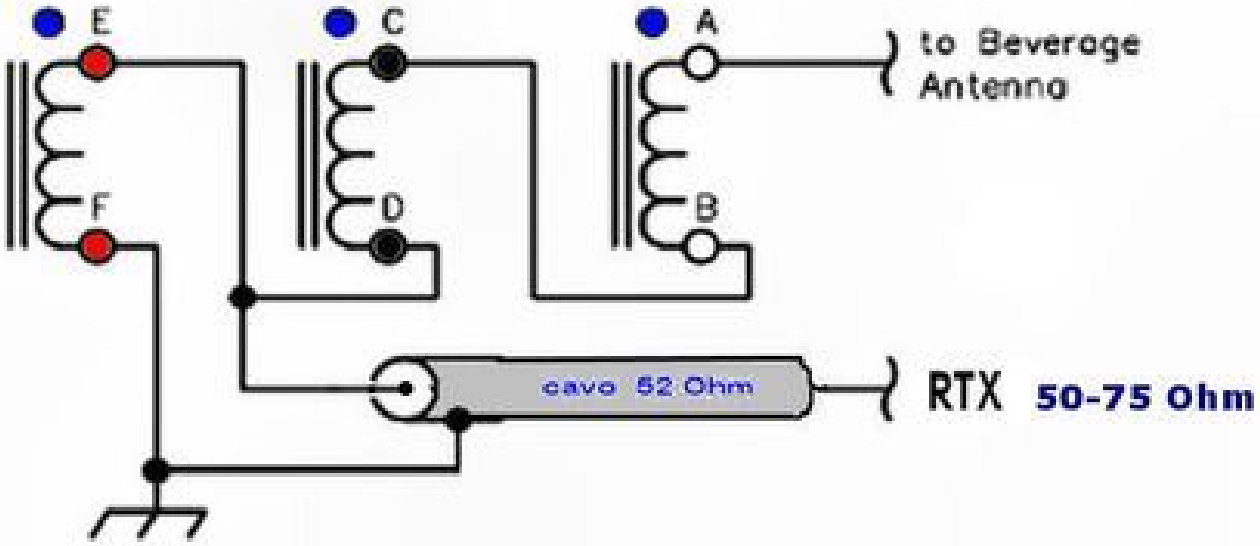

Bal-Un 2:1 per antenna DELTA-LOOP

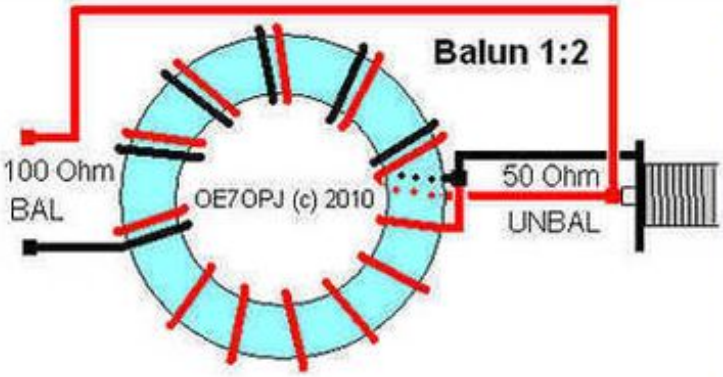

by OE7OPJ

Toroide	Numero di Spire	Potenza Supportata
T80-2	25	60 Watts
T106-2	16	100 Watts
T130-2	18	150 Watts
T157-2	16	250 Watts
T200-2	17	400 Watts
T200A-2	13	400 Watts
T400-2	14	1000 Watts

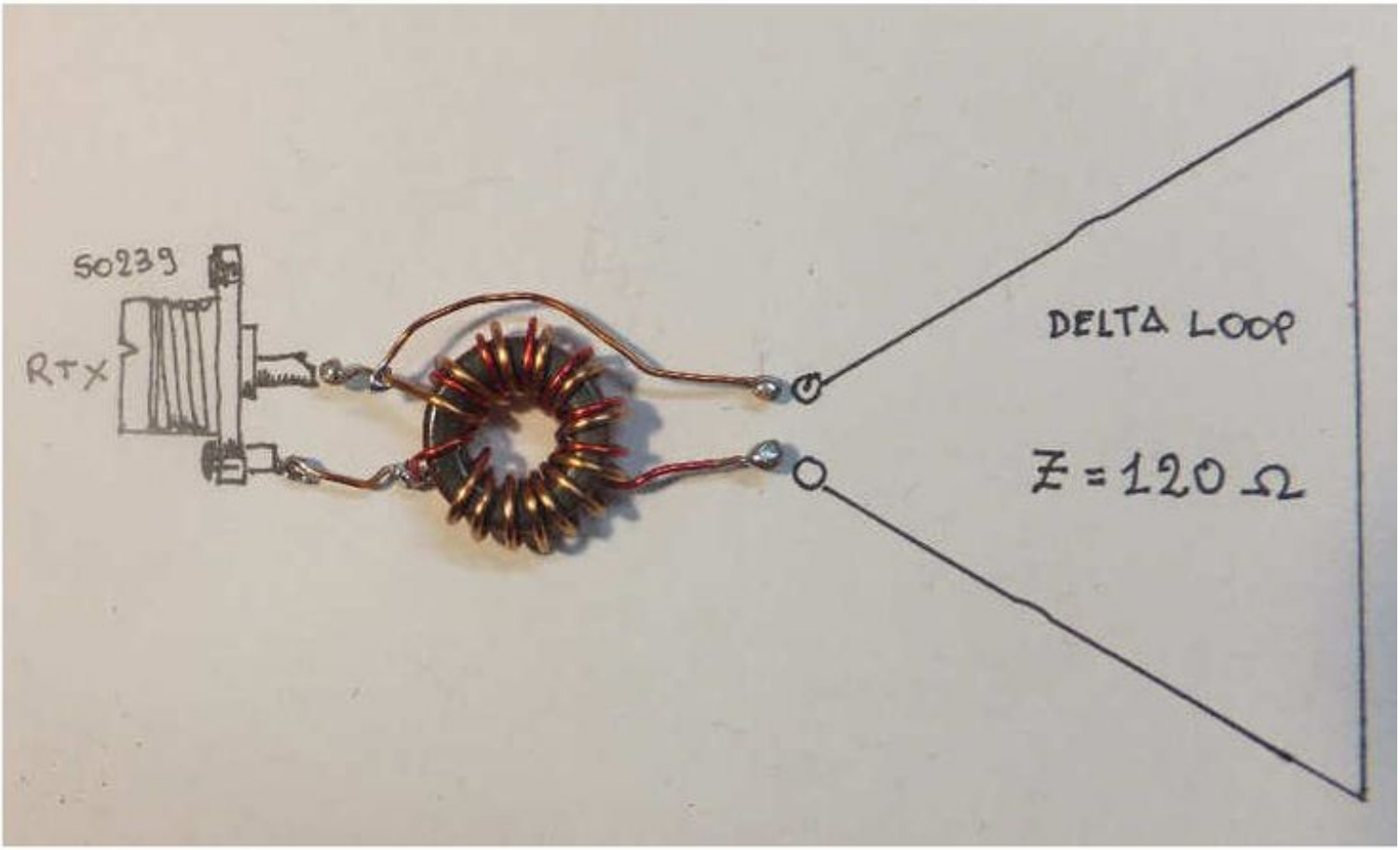

Autoformer, not a parallel transmission line – Ruthroff balun (voltage)

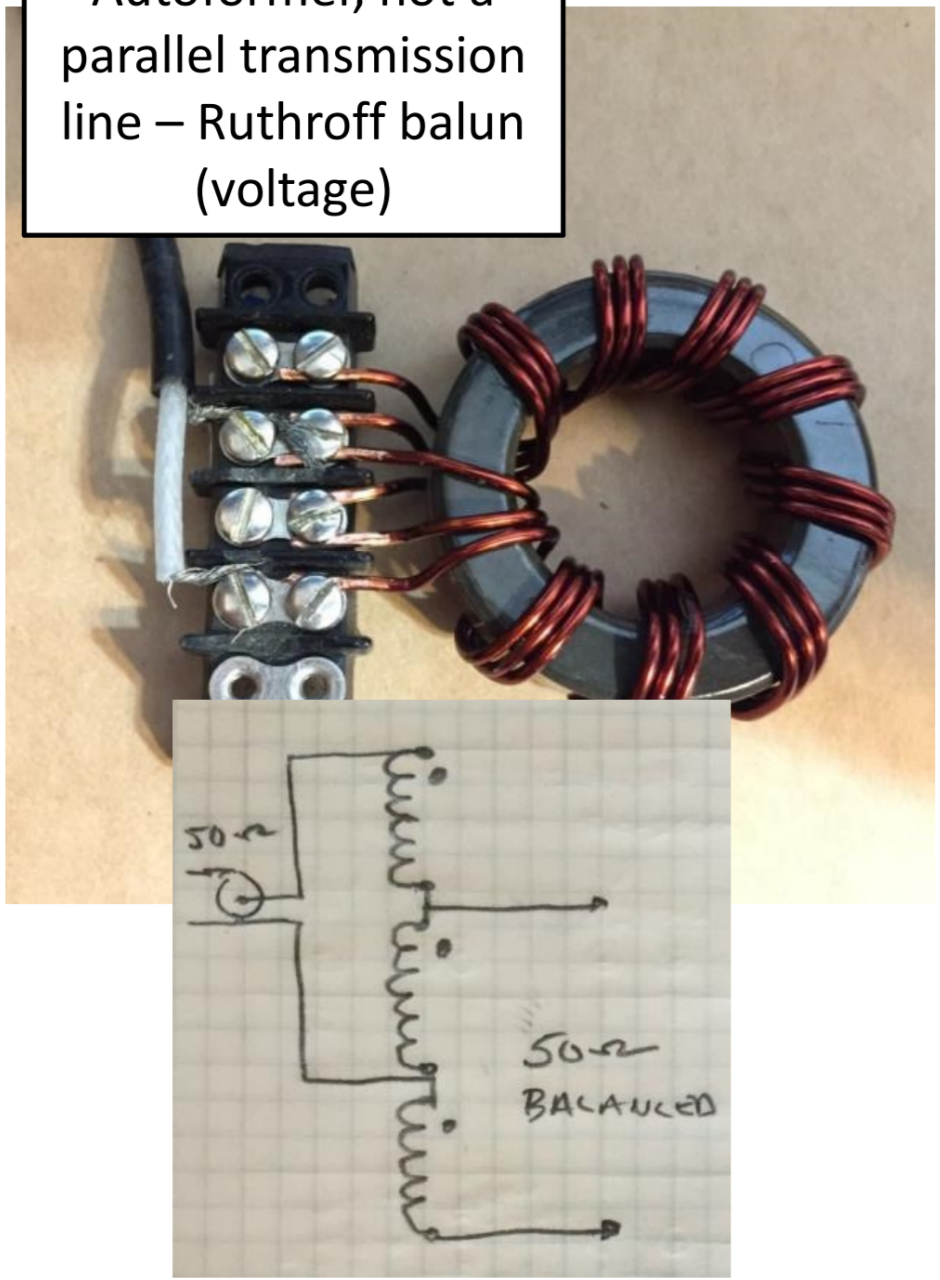

One or more parallel transmission lines, connected various ways – Guanella balun (current) – core is used solely for choking action

F/B: 0.00 dB; Rear: Azim. 120 deg, Elev. 60 deg

Coax is unbalanced …..

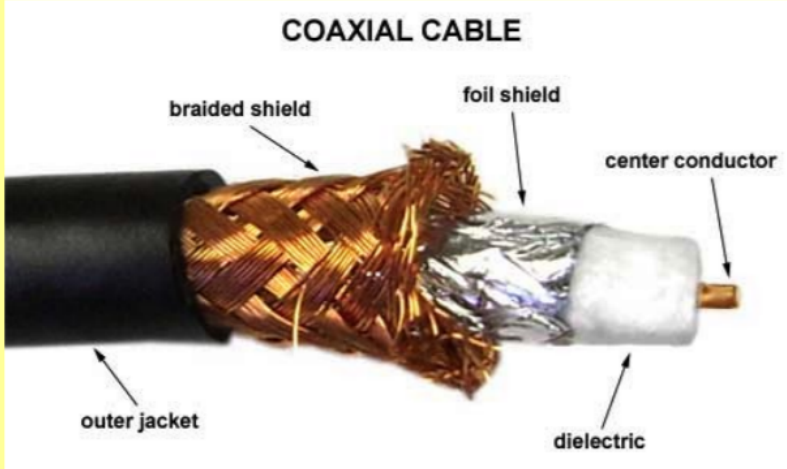

… Ladder line is balanced

Coax is unbalanced, while ladder line and open wire feeder is balanced, as long as it is used properly and is kept away from metal and "earthy" materials

Convert parallel feedline to coax

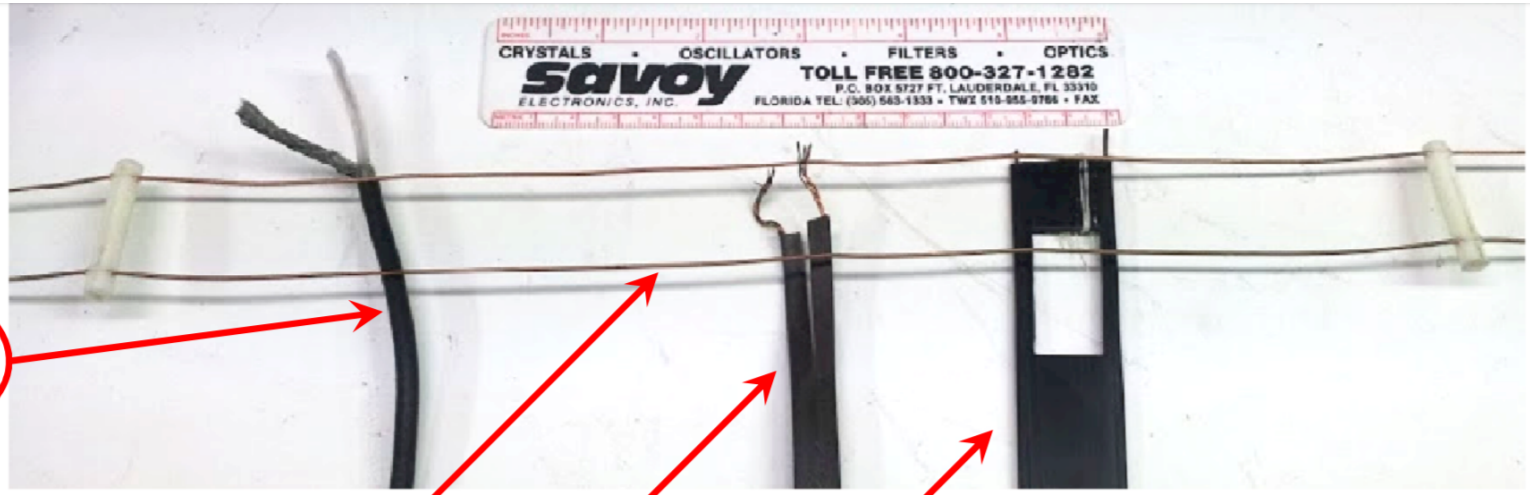

Types of Parallel Line

- **Open Feeder** or **Ladder line**
  - Typ 450 and 600 ohm
- **Twin Lead**
  - Common for (old) outdoor TV antennas
- **Window line**
  - Commonly available today

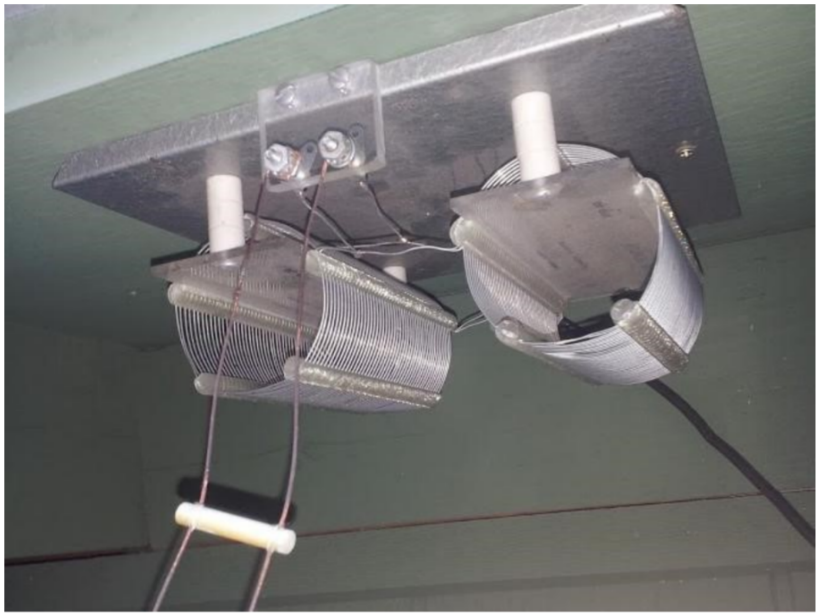

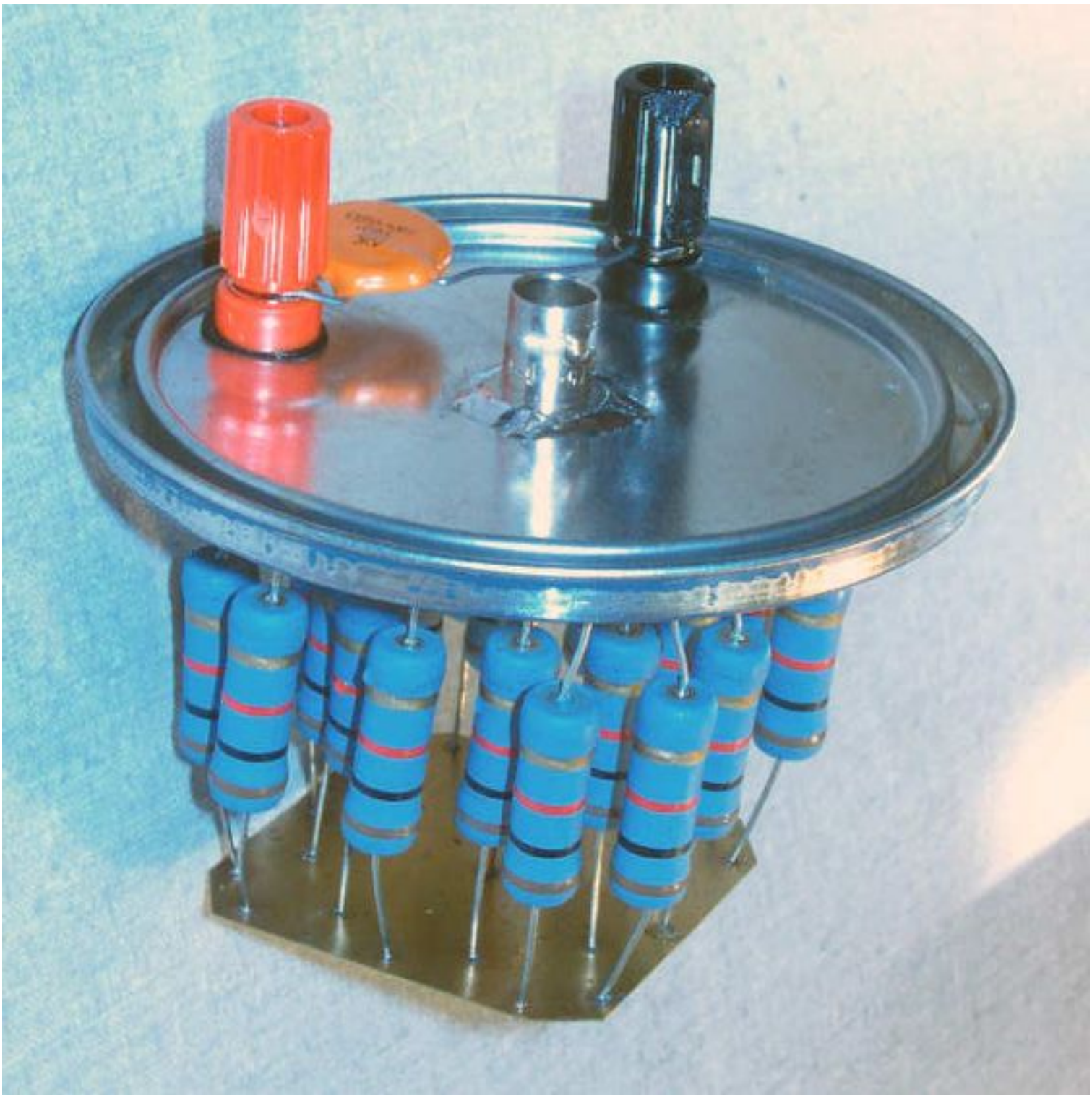

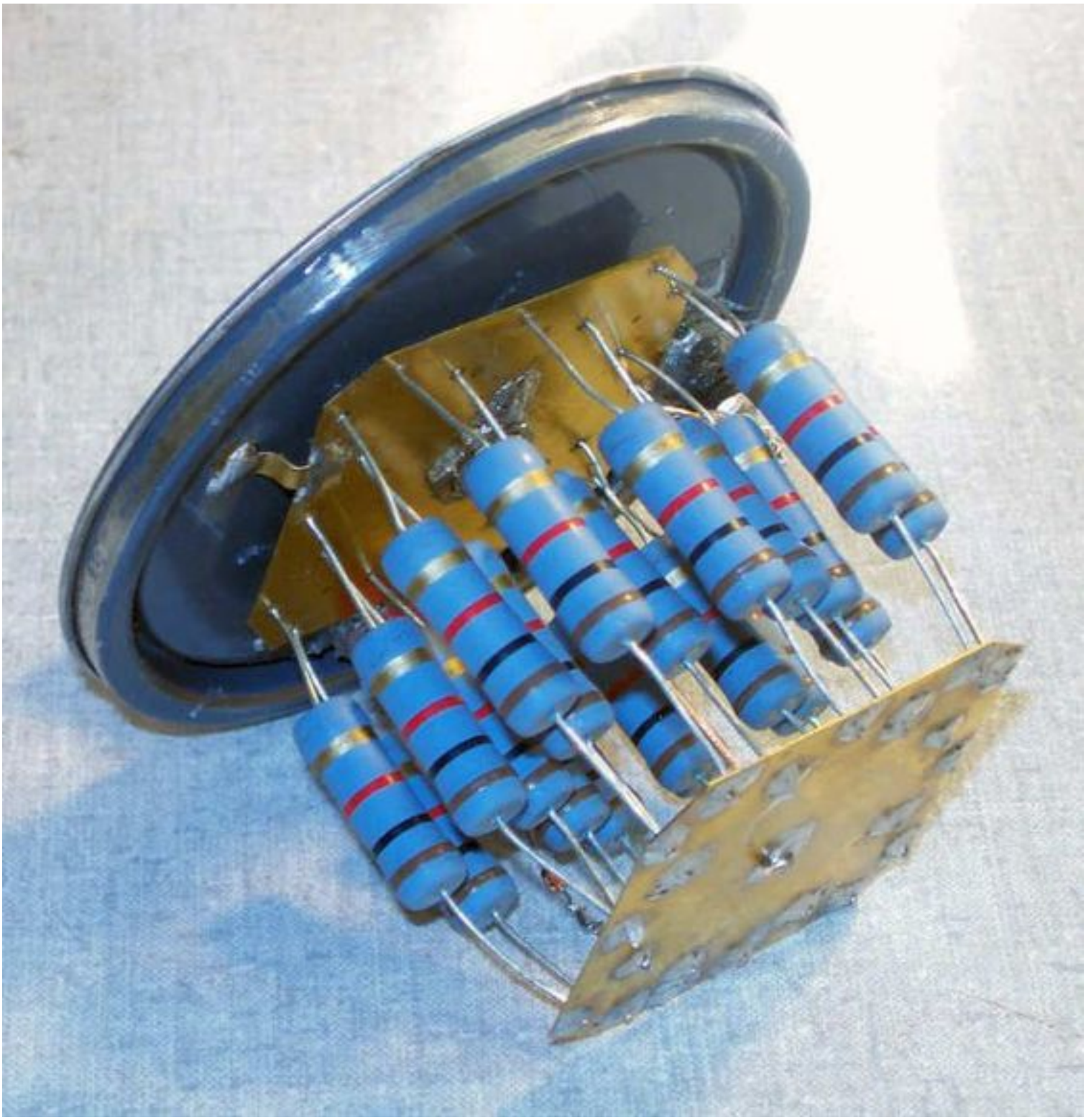

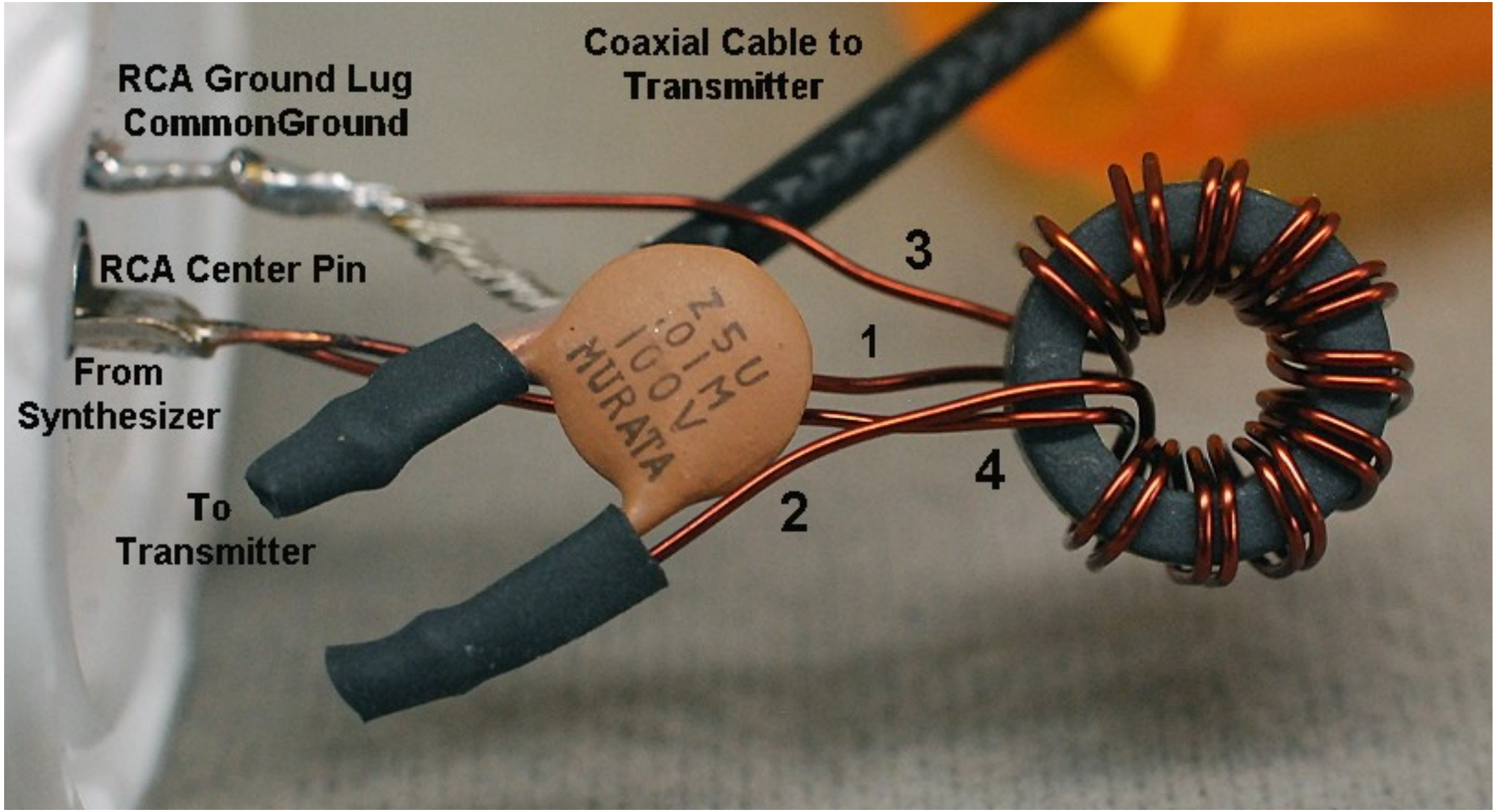
RCA Ground Lug
CommonGround
Coaxial Cable to
Transmitter
RCA Center Pin
From
Synthesizer
To
Transmitter
3
1
4
2
Z5U
101
100V
MURATA

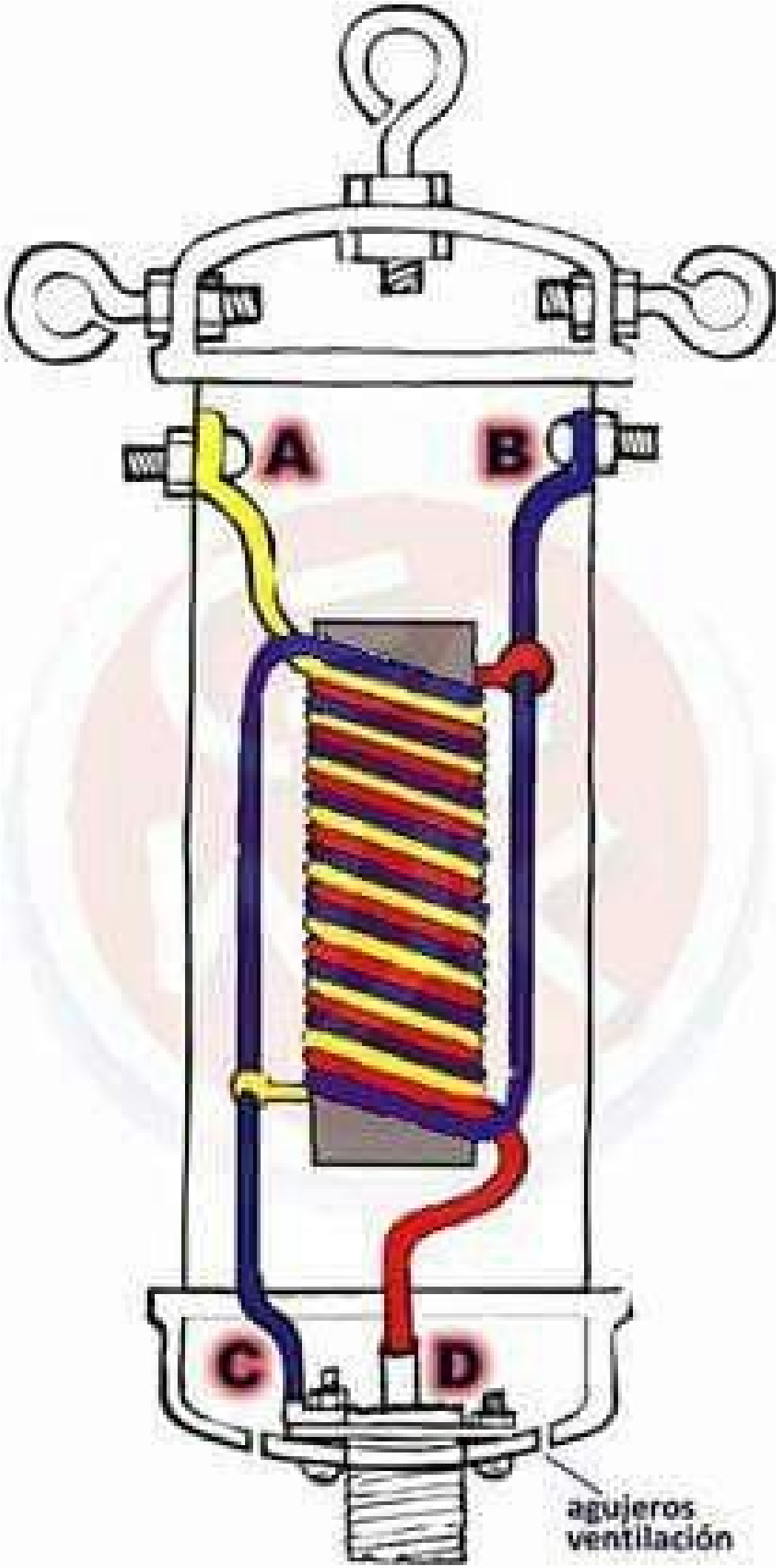
A
B
C
D
agujeros
ventilación

Formula LUNGHEZZA DELTA LOOP	Esempio 14.00 MHz (20 metri)	Lunghezza TOTALE del LOOP
Velocita' Luce : Freq MHz x 0.97= L	**299.8** VL : **14.100** MHz x **0,97**	**20.624** metri totale loop
$L = \frac{300.000}{MHz} \times 0.97$	I6IBE	
Formula LUNGHEZZA Stub coax 75 Ohm	Esempio 14.00 MHz (20 metri)	Lunghezza TOTALE cavo 75 Ohm
Lunghezza LOOP x 0.66 : 4	**20.624** x **0.66 : 4**	**3.402** Metri coax RG-59

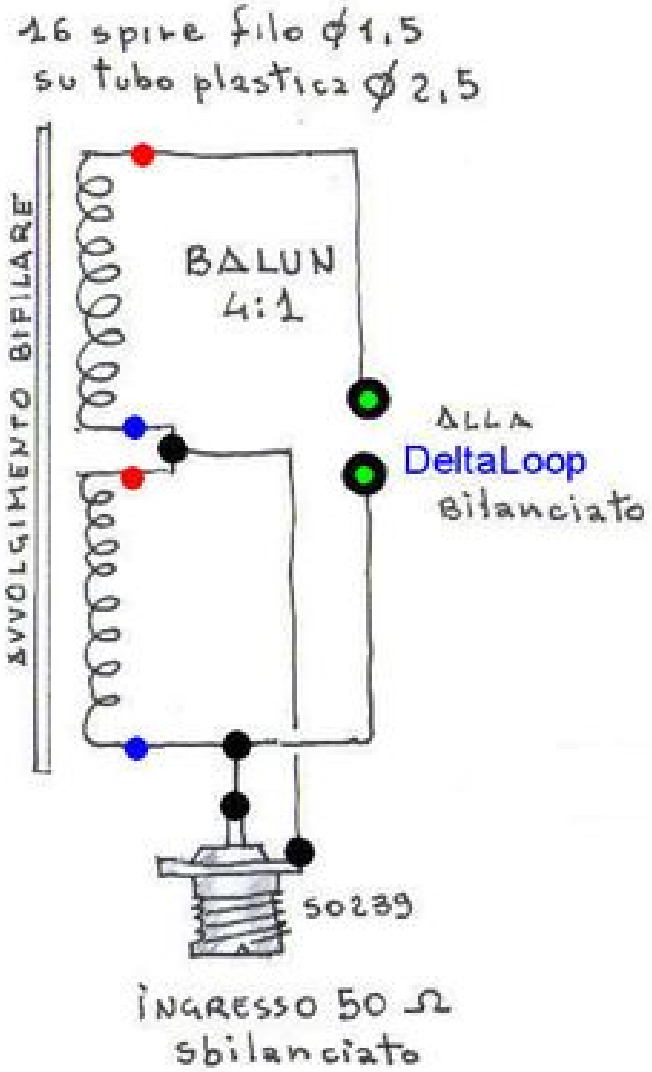

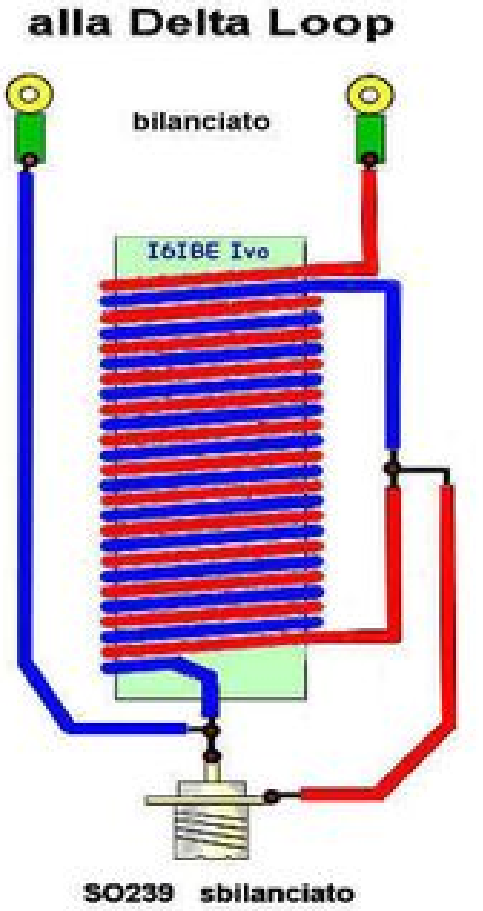

BALUN 4:1

I6IBE

Choke RFI

toroide

cavo RG-58

5+5 spire

controfase

BOCCHETTONE
INGRESSO ANTENNA
SO-239

2. Insert metal electrodes and attach multimeter leads [copper (+), aluminum (-)] For measuring direct current voltage: set multimeter function switch to "DCV: 20" take a reading in volts DC. for measuring direct current: set multimeter function switch to "DCA: 20m" take a reading in milliamps (mA) DC.

Lawn battery (summer). INSET: Marsh mud battery. (Circles show position of electrodes.)

Calculating Earth Battery Power (W = I * V)

EXAMPLE: A lawn battery in late summer (little rain) produces a 0.65V, 0.2mA current. A battery power calculation of 0.00013W (0.13mW).

Powered by: PIXEL ink LLC

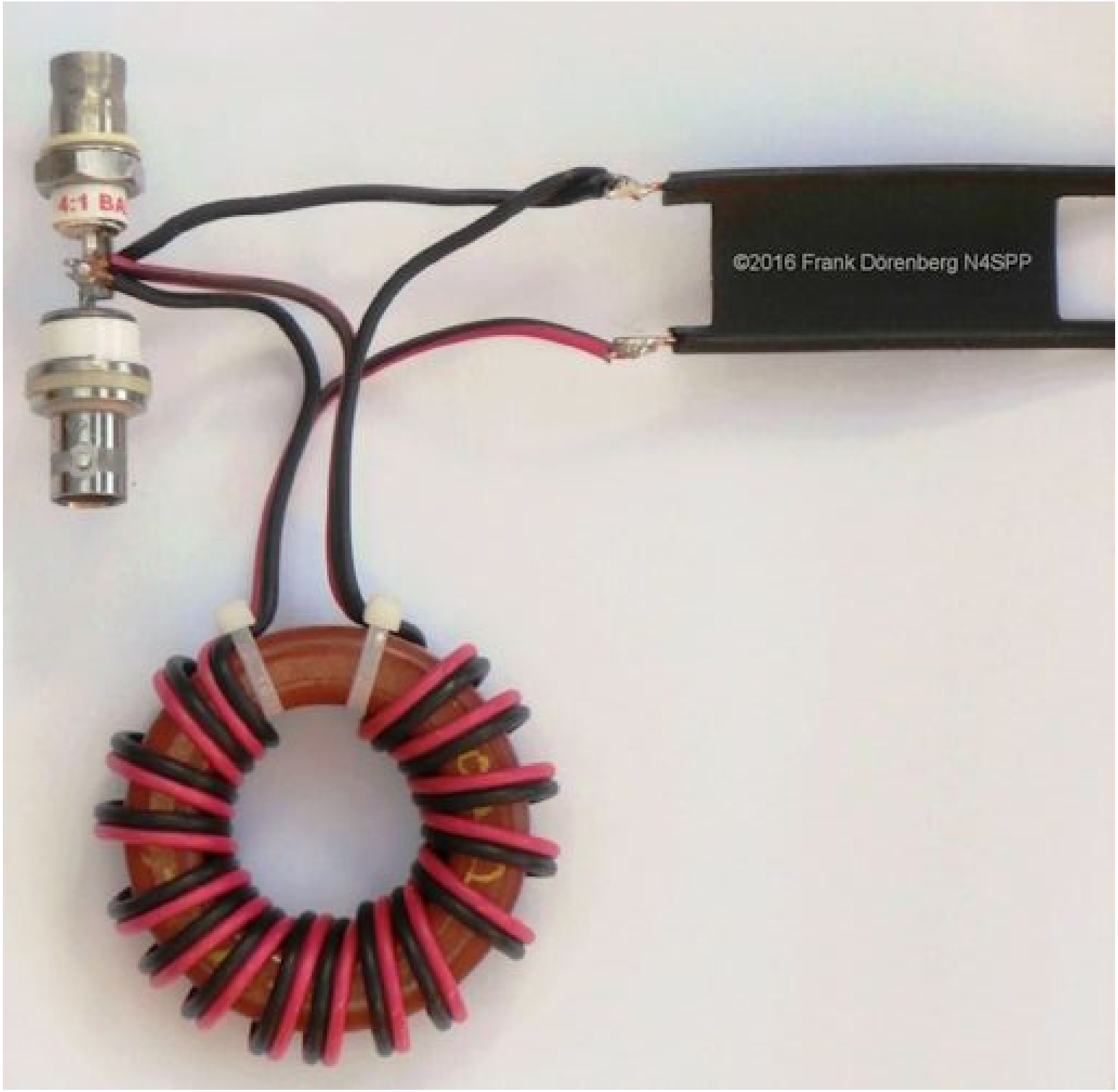
4:1 BA
©2016 Frank Dorenberg N4SPP

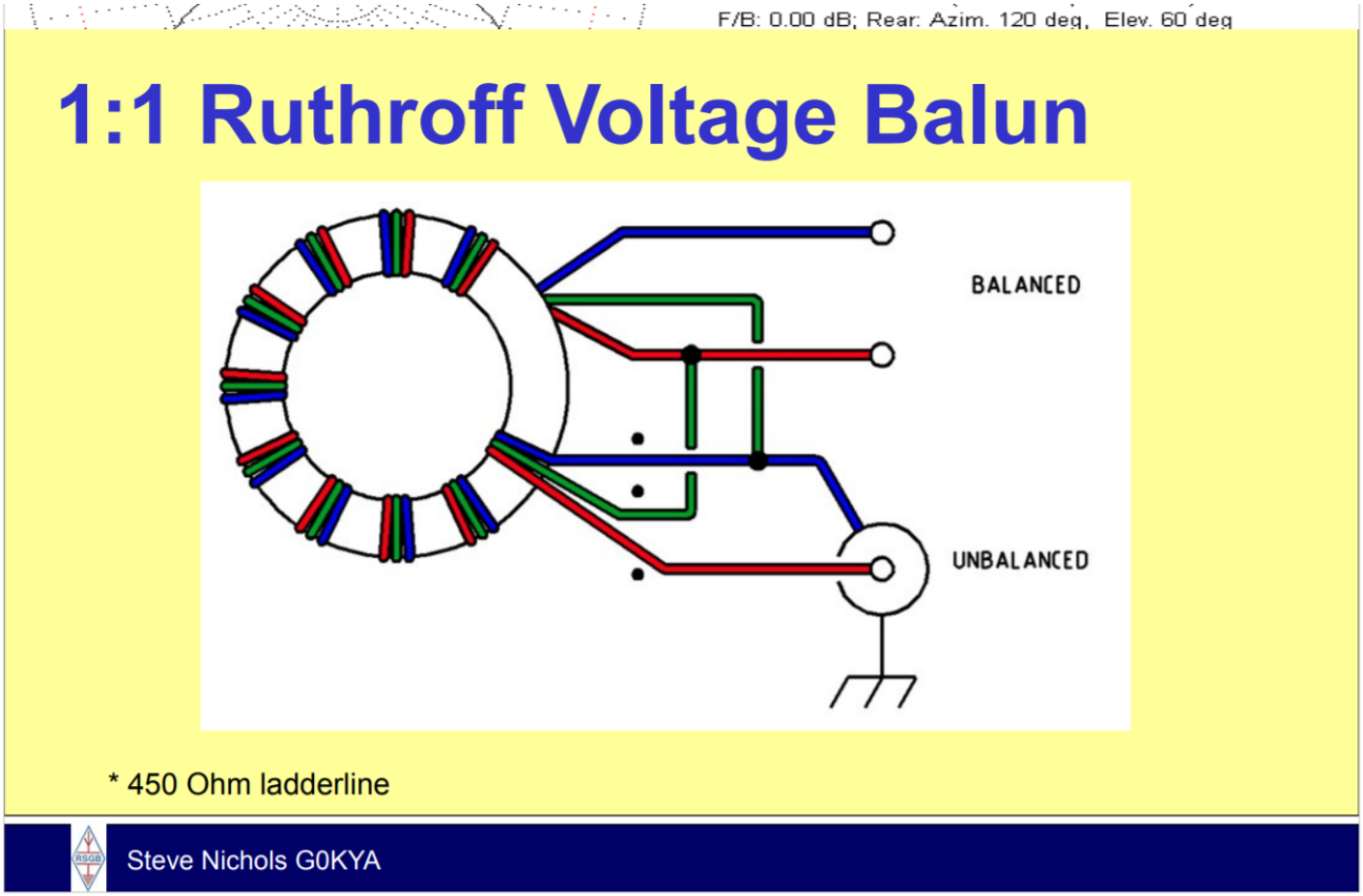

The Ruthroff or voltage balun is another type. Voltage baluns balance the voltages. Current balance is considered to be superior to voltage balance. Voltage baluns should not be used in lines with high SWR. They have the narrowest impedance and frequency range of any balun type. Properly designed voltage baluns have low common mode impedance. Properly designed current baluns have high common mode impedance, and provide better balance. If you want to stop common mode currents flowing on your coax a current balun is a better choice. But in the Carolina Windom, which uses the vertical coax as a radiator you WANT common mode currents, so a Ruthroff voltage balun is better.

F/B: 0.00 dB; Rear: Azim. 120 deg, Elev. 60 deg

1:1 Guanella current balun

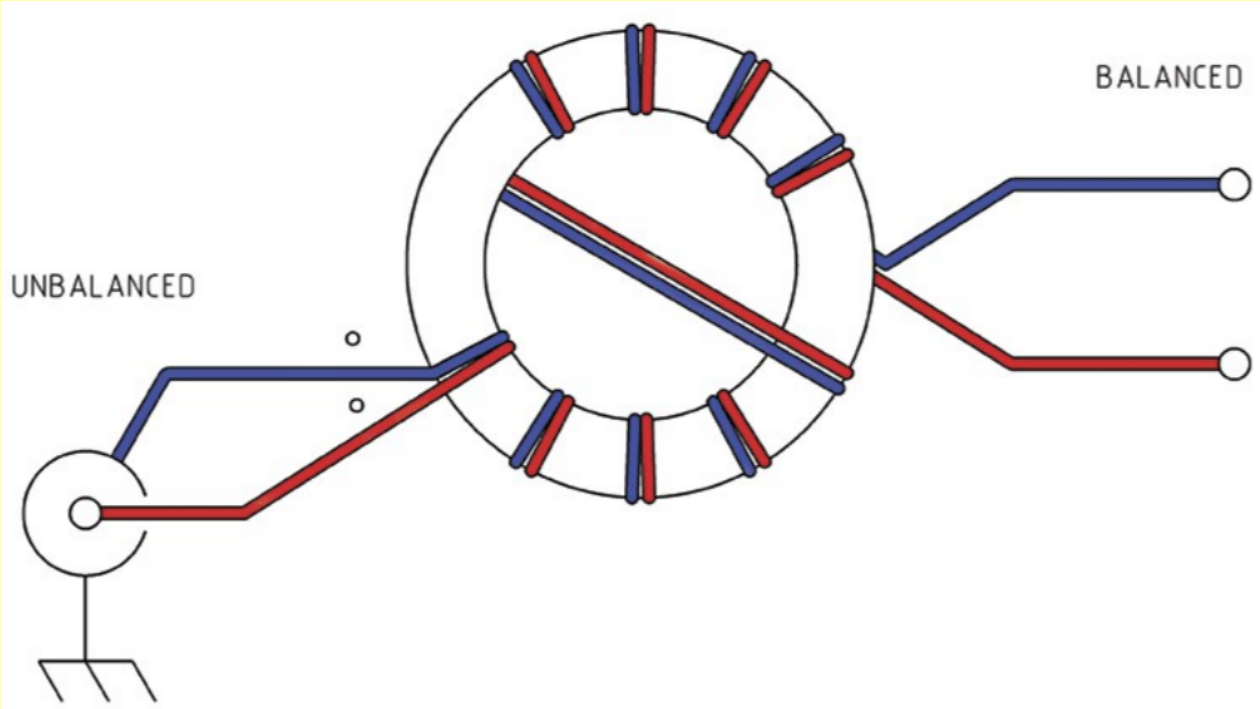

* 450 Ohm ladderline

A Guanella or current balun is very common. Current baluns stop RF from coming back down the outside of the coax shield, and are so called that because they "force equal currents in each side of a dipole"

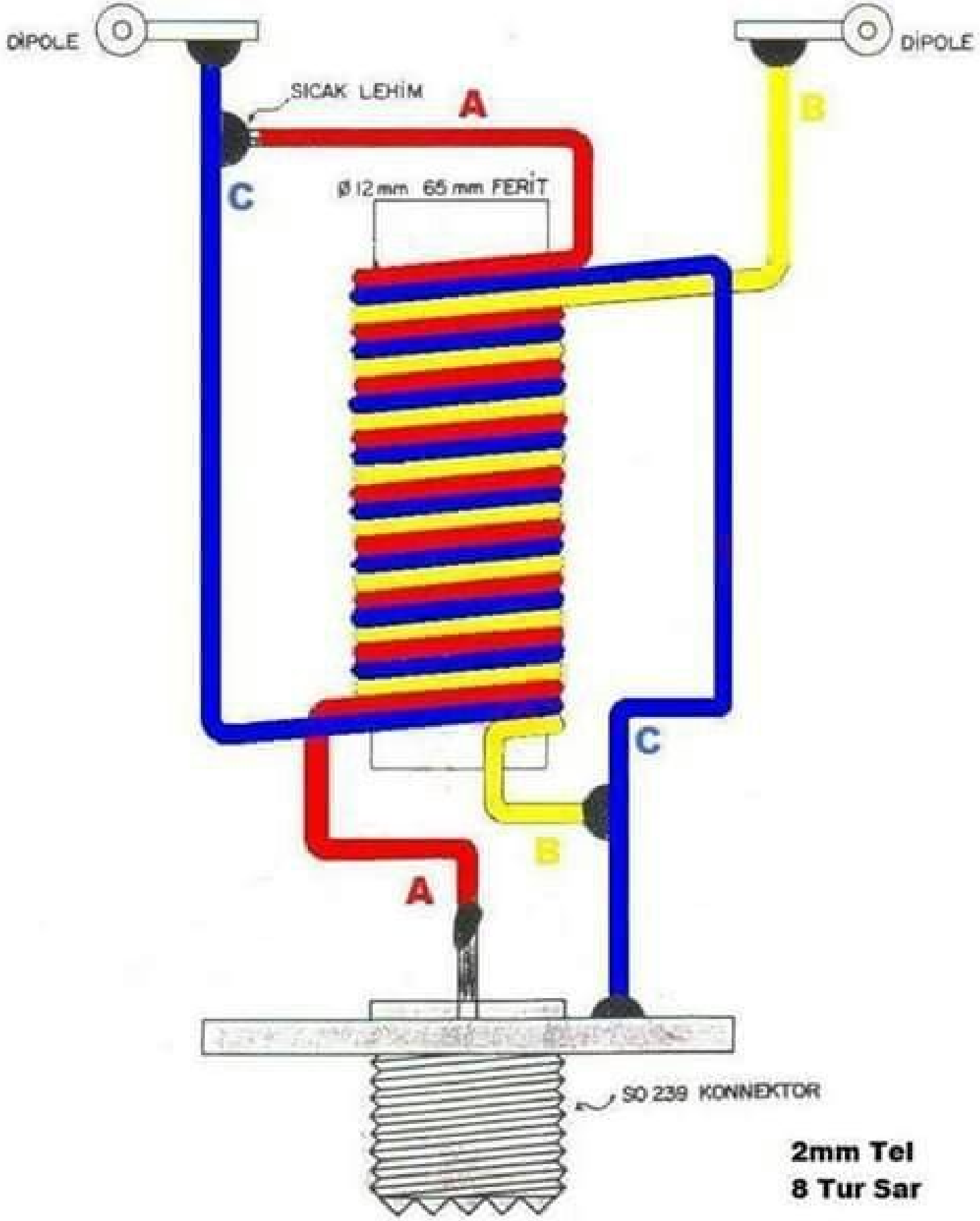
DİPOLE
DİPOLE
SICAK LEHİM
A
B
C
Ø 12 mm 65 mm FERİT
C
B
A
SO 239 KONNEKTOR
2mm Tel
8 Tur Sar

© Azega.com

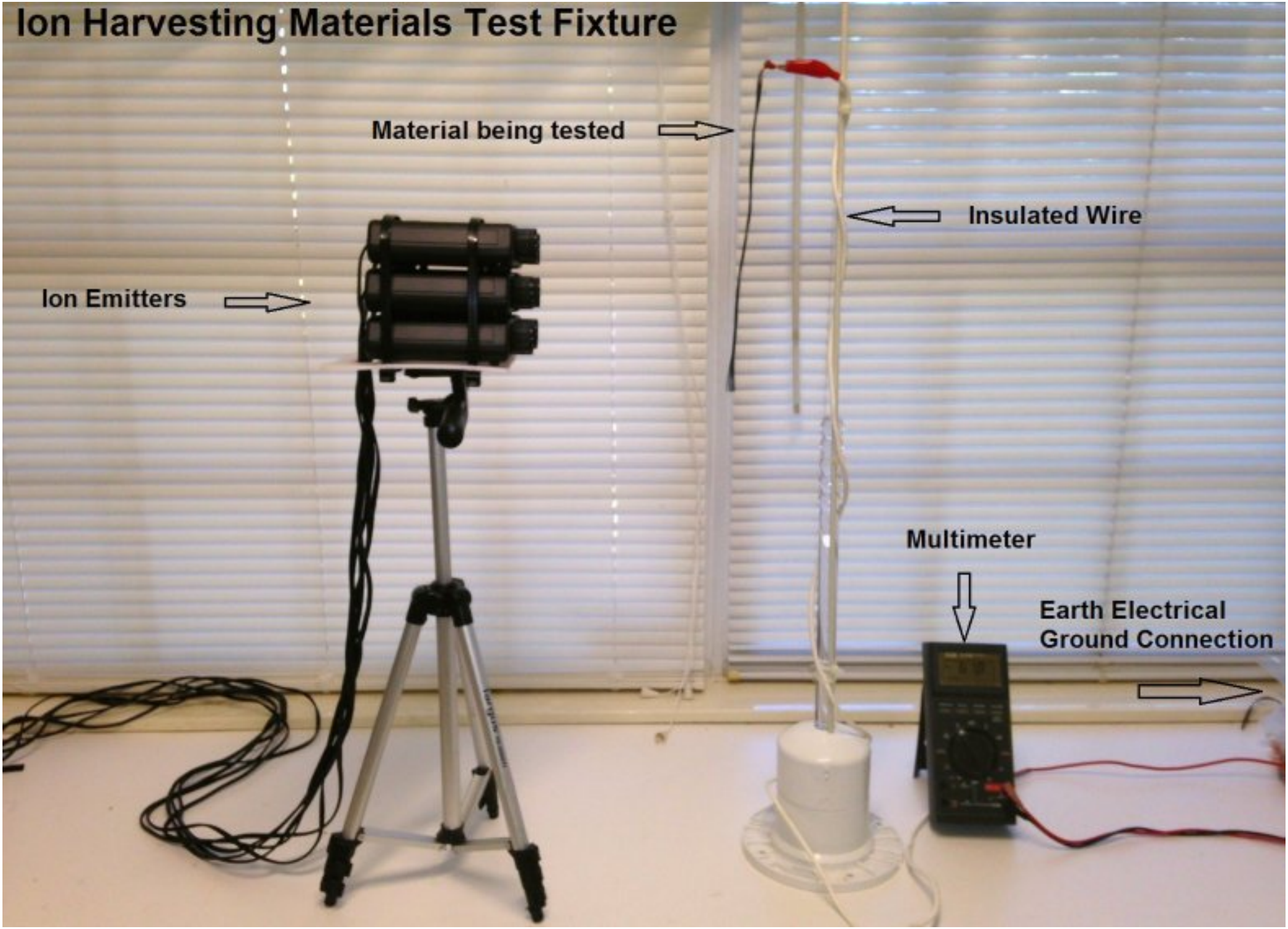
Ion Harvesting Materials Test Fixture
Material being tested
Insulated Wire
Ion Emitters
Multimeter
Earth Electrical
Ground Connection

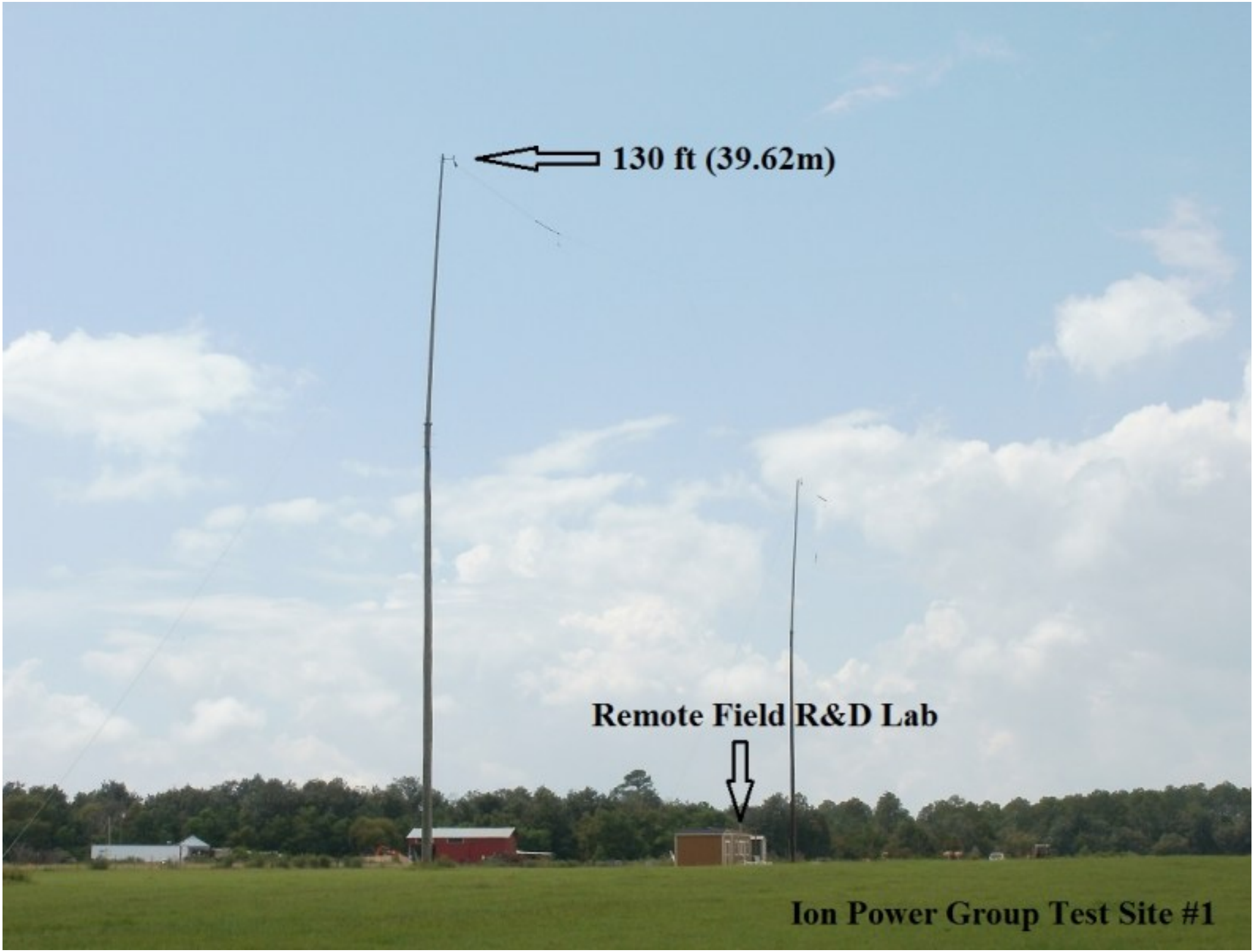
130 ft (39.62m)
Remote Field R&D Lab
Ion Power Group Test Site #1

DANGER
HIGH VOLTAGE
KEEP AWAY
1
2
3
4
5
6
7
8
9
10

DANGER
HIGH VOLTAGE
KEEP AWAY
1
2
3
4
5
6
7
8
9
10
Ion Harvesting Electrical Storage
(10) General Electric capacitors in parallel
rated at 41.kV totaling 75.uf capacity

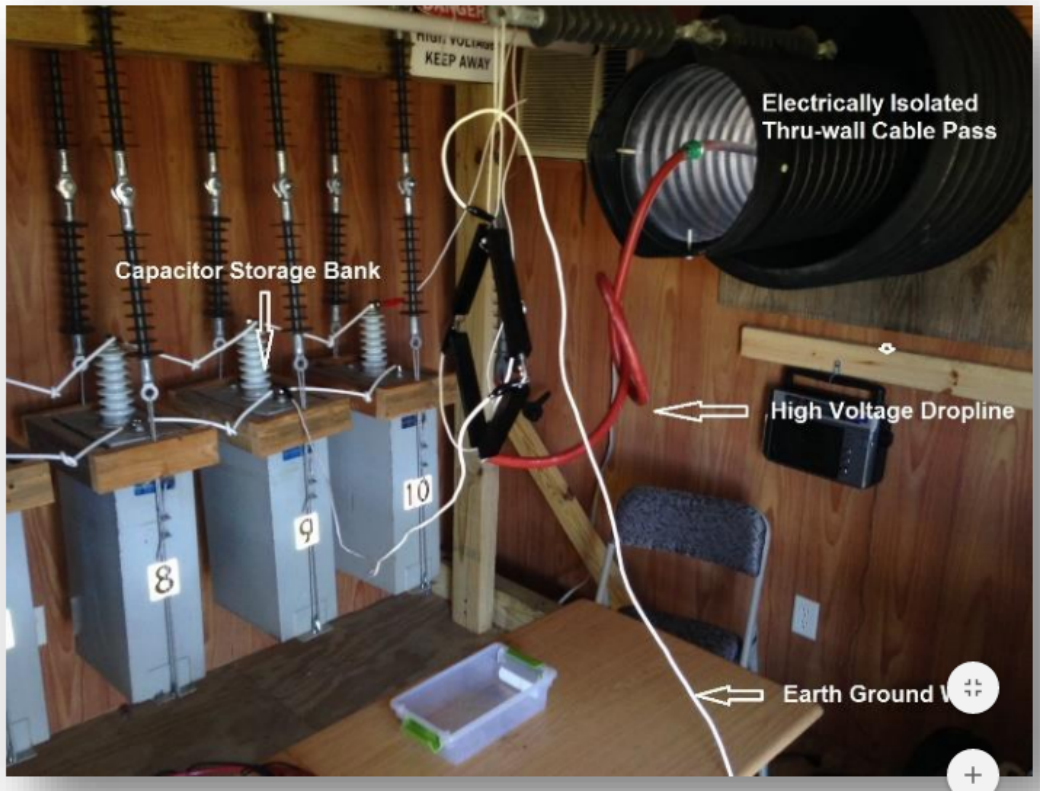
KEEP AWAY
Electrically Isolated
Thru-wall Cable Pass
Capacitor Storage Bank
High Voltage Dropline
Earth Ground
8
9
10

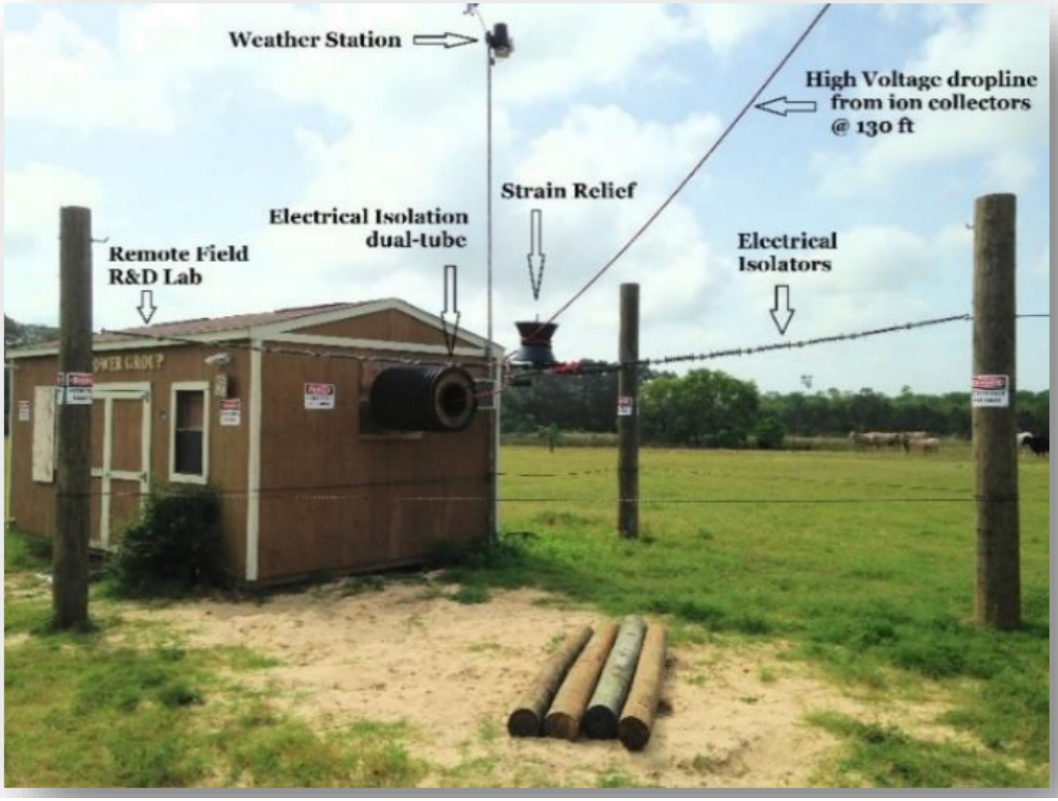

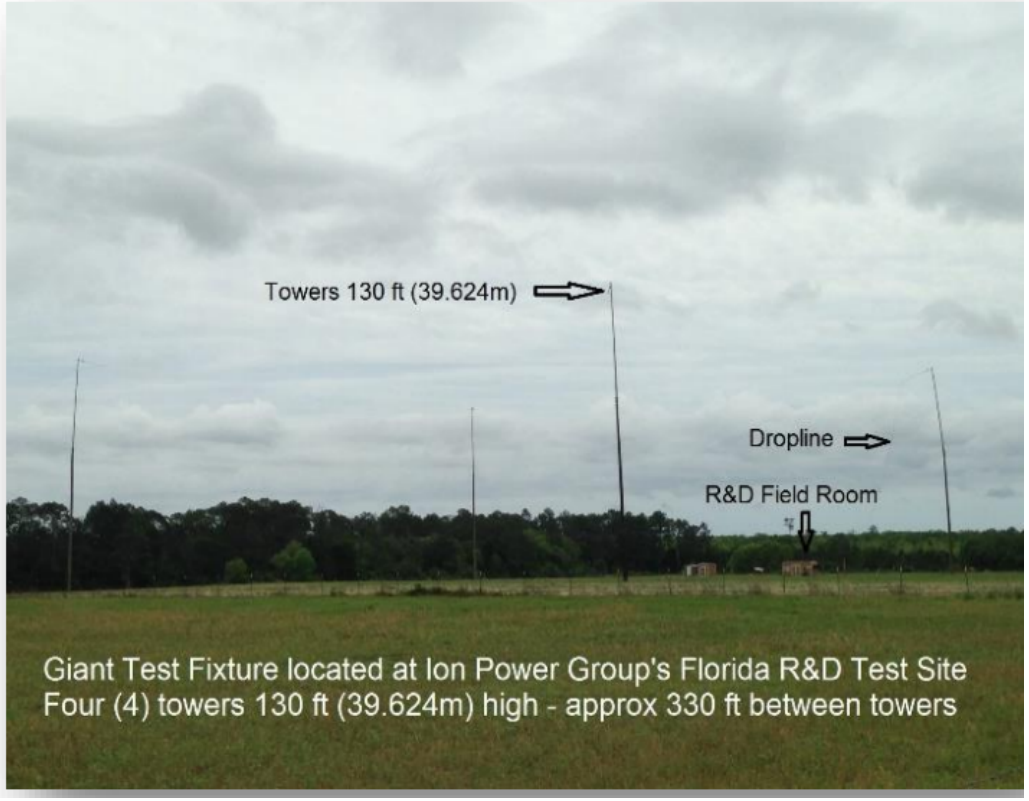

Giant Test Fixture located at Ion Power Group's Florida R&D Test Site
Four (4) towers 130 ft (39.624m) high - approx 330 ft between towers

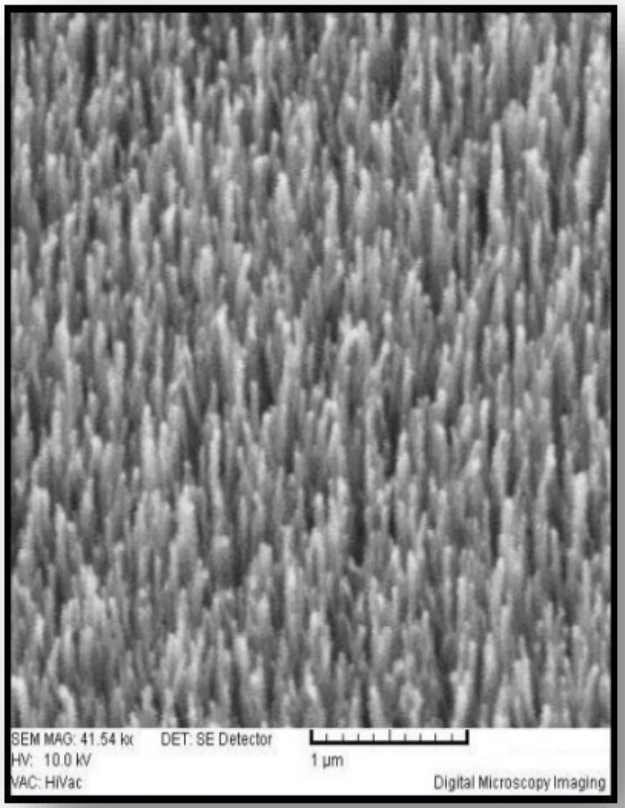

Ion Power Group's new method of coupling to atmospheric electricity is vastly different from all previous techniques by virtue of our patented breakthrough revealing that carbon nanomaterials such as **Graphite (and Graphene) microscopic shown at left, macroscopic shown at right are significantly more effective at coupling to airborne charge carriers (ions) than metal.** The use of carbon based nanomaterials distinguishes Ion Power Group from all other researchers.

I cut a hole in the side of the balun then cut the end off a piece of coax cable I had and soldered it to the contacts of the coax connection.

EXAMPLE: W1JR (Reisert) Cross-Winding Method

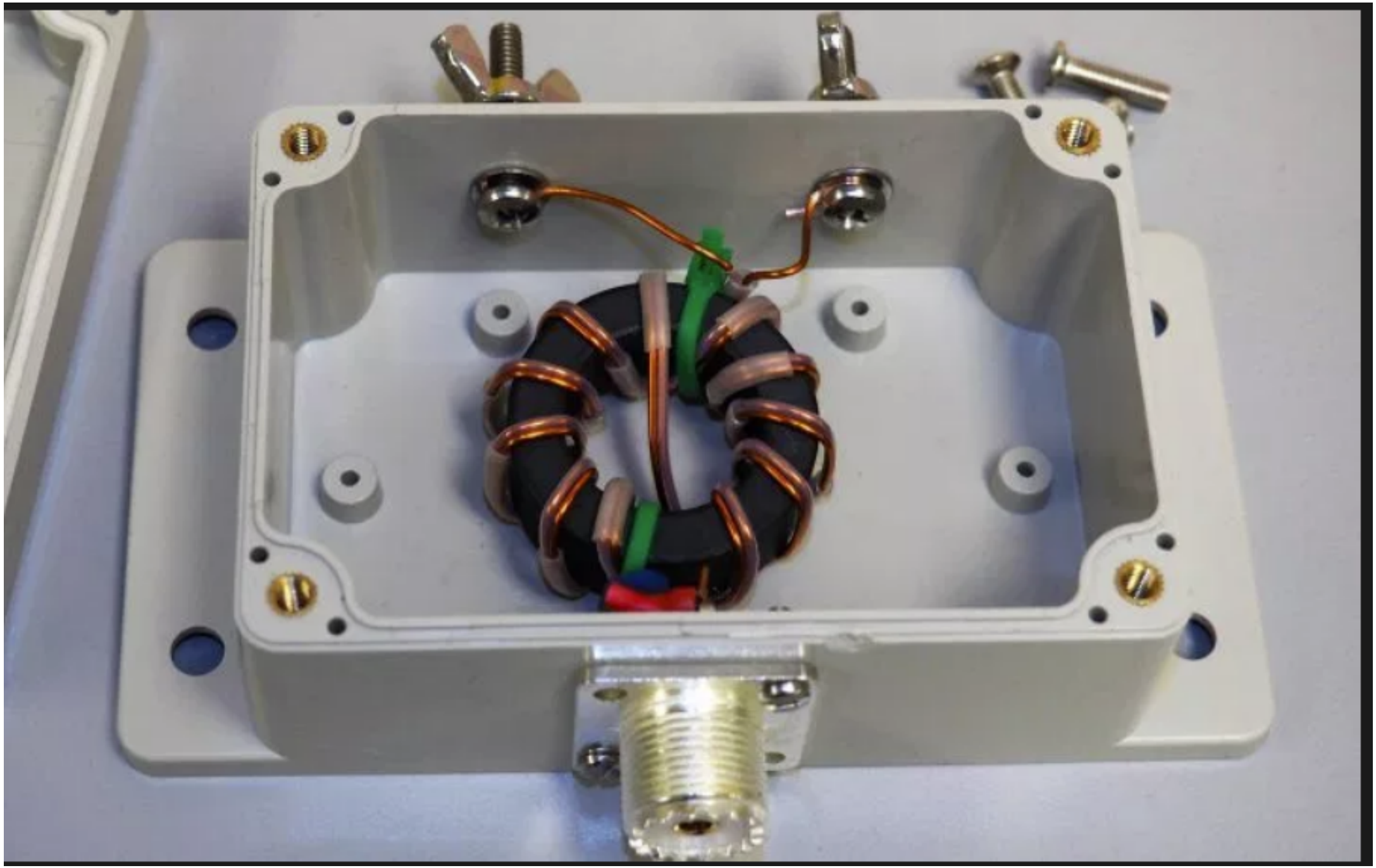

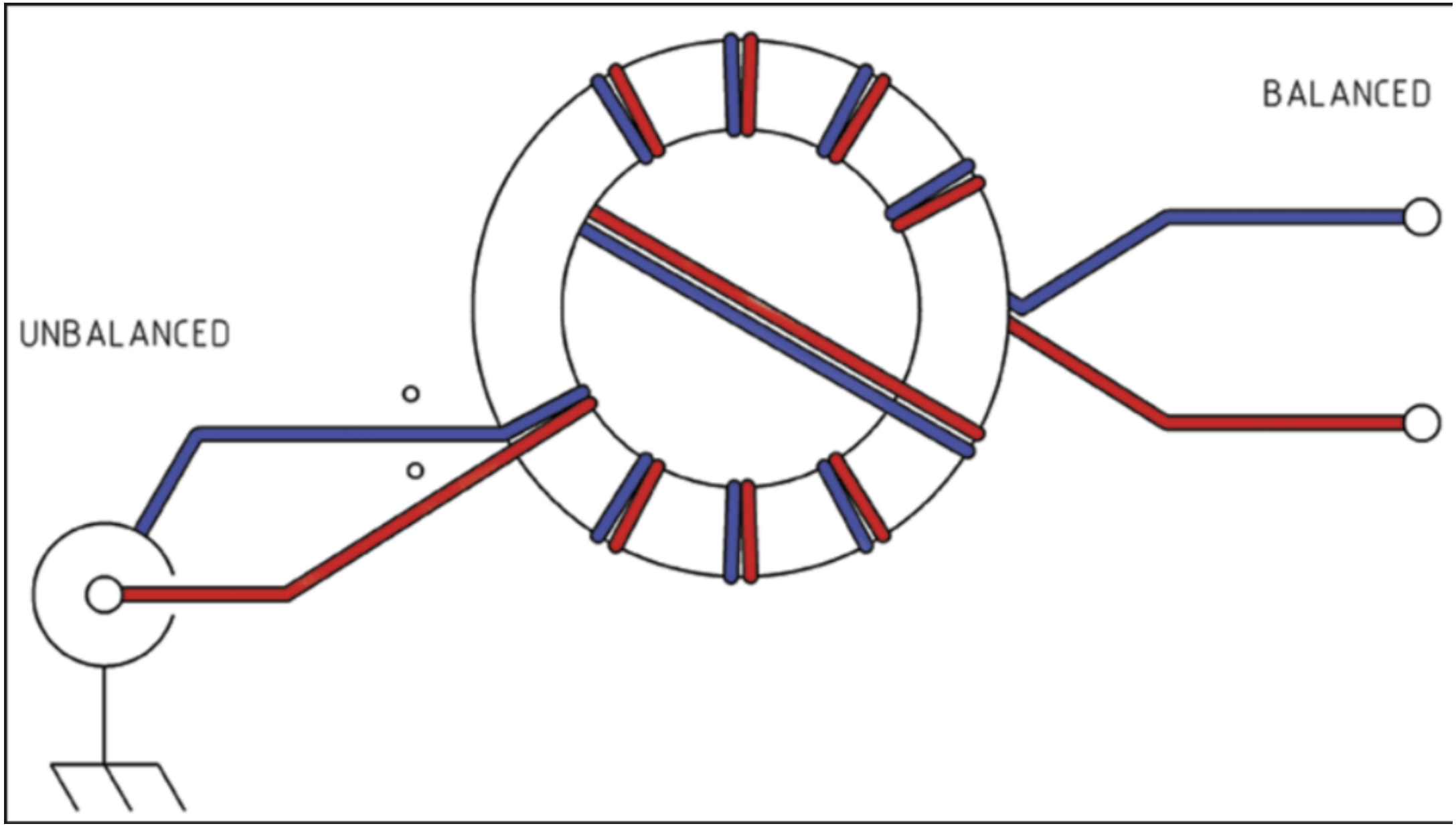
BALANCED
UNBALANCED

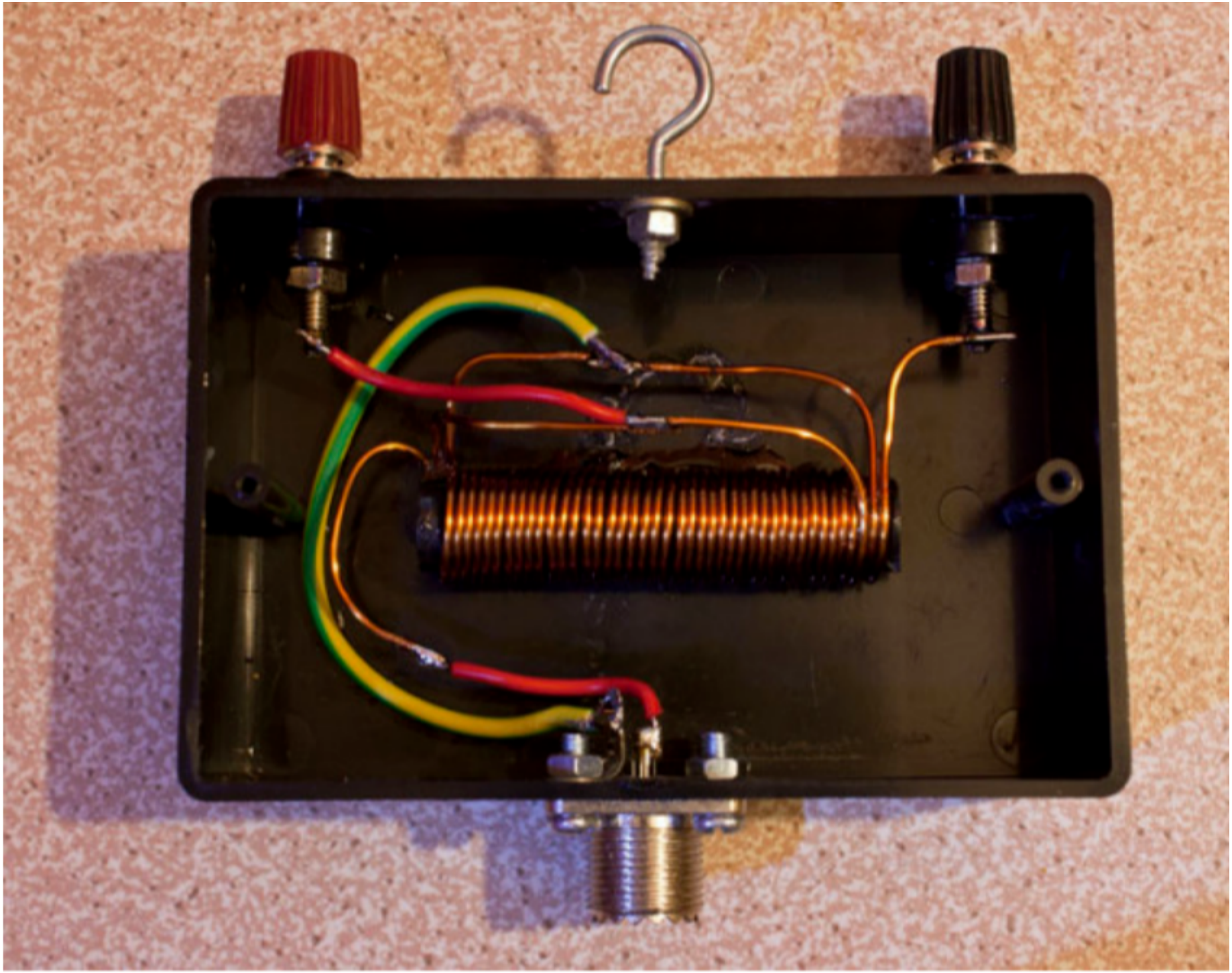

Balun 1: 1 for HF

1:1 Voltage balun ("Ruthroff")

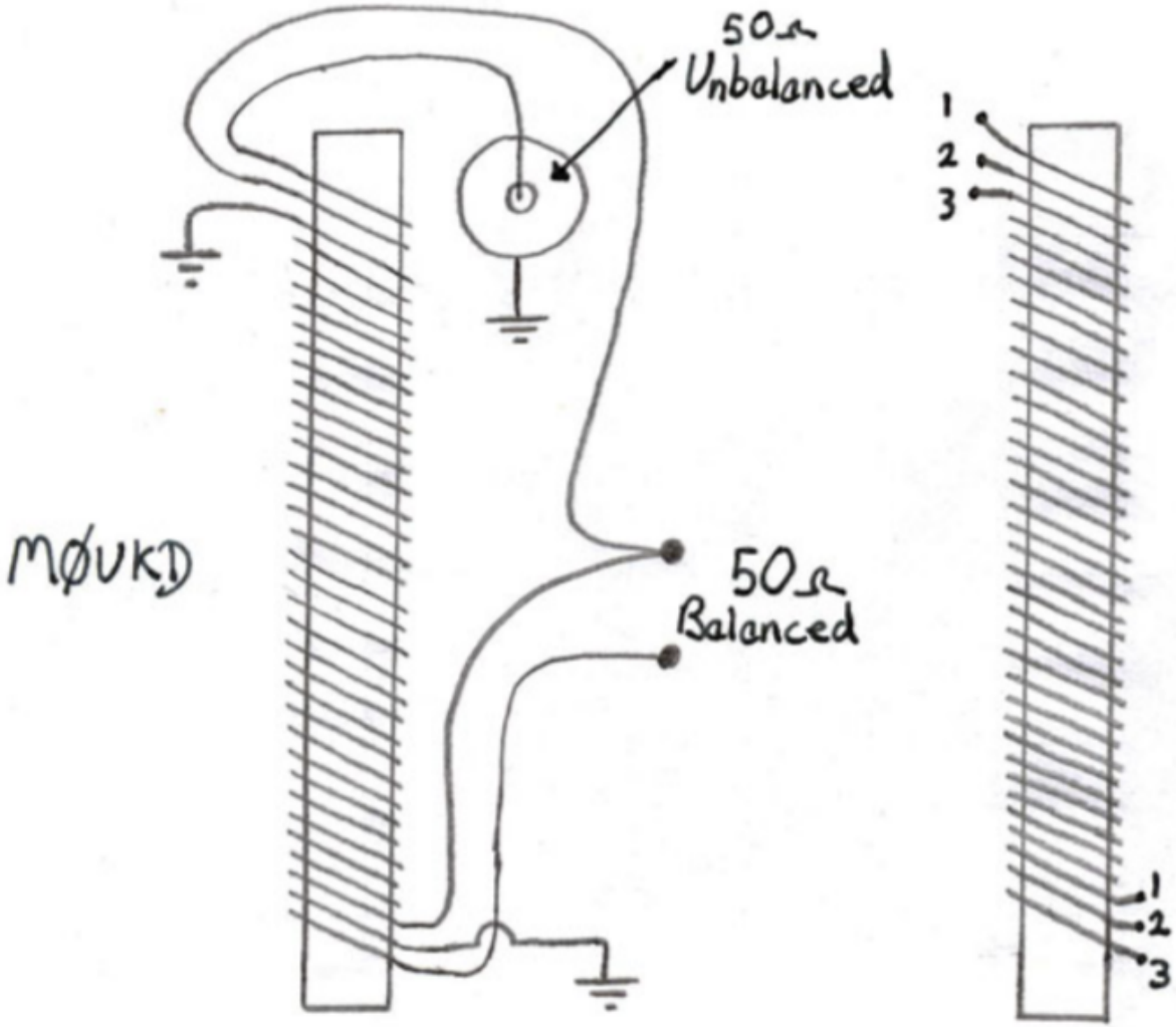

10 - 15 trifilar turns on ferrite rod.

1:1 ferrite rod voltage balun

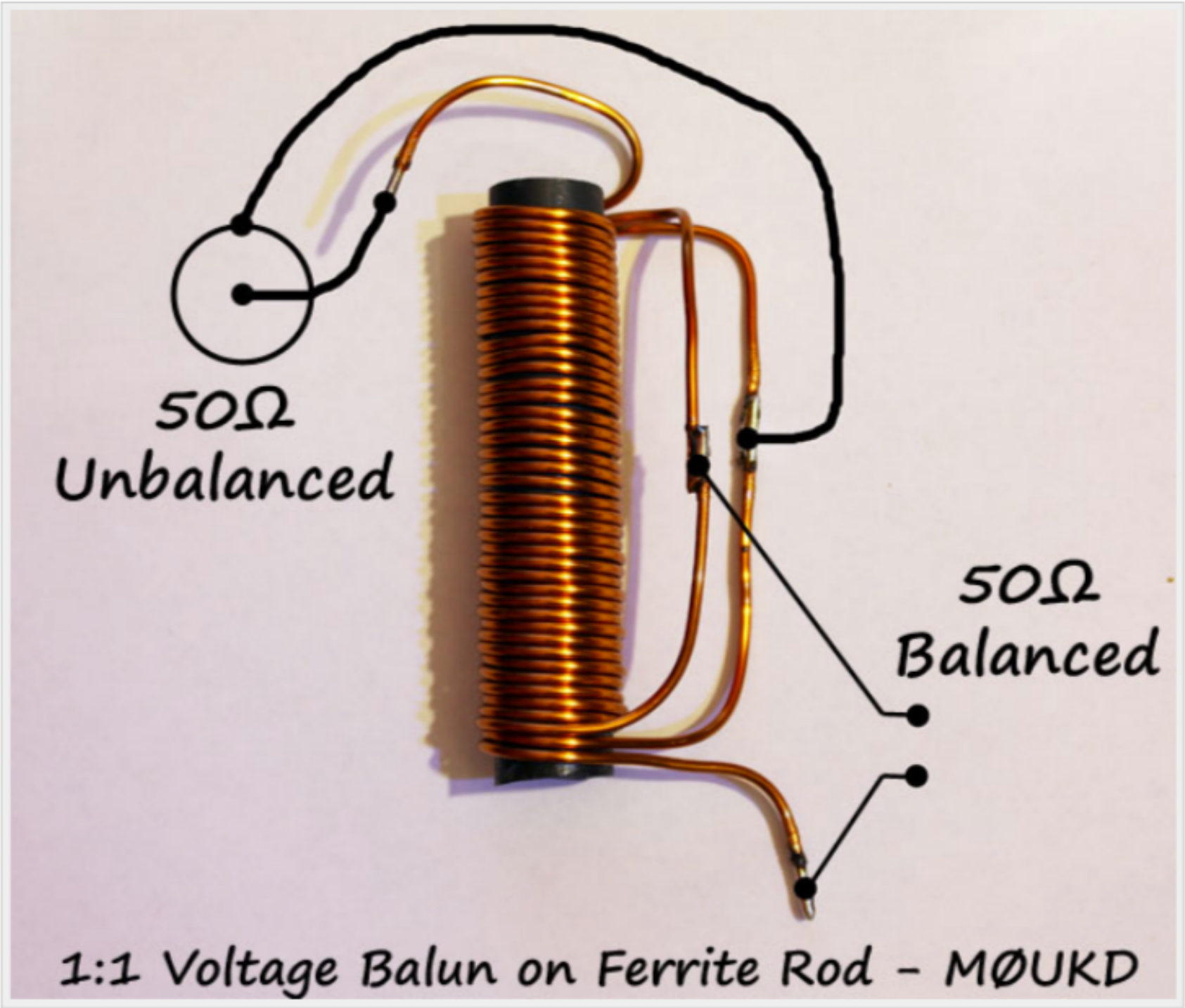

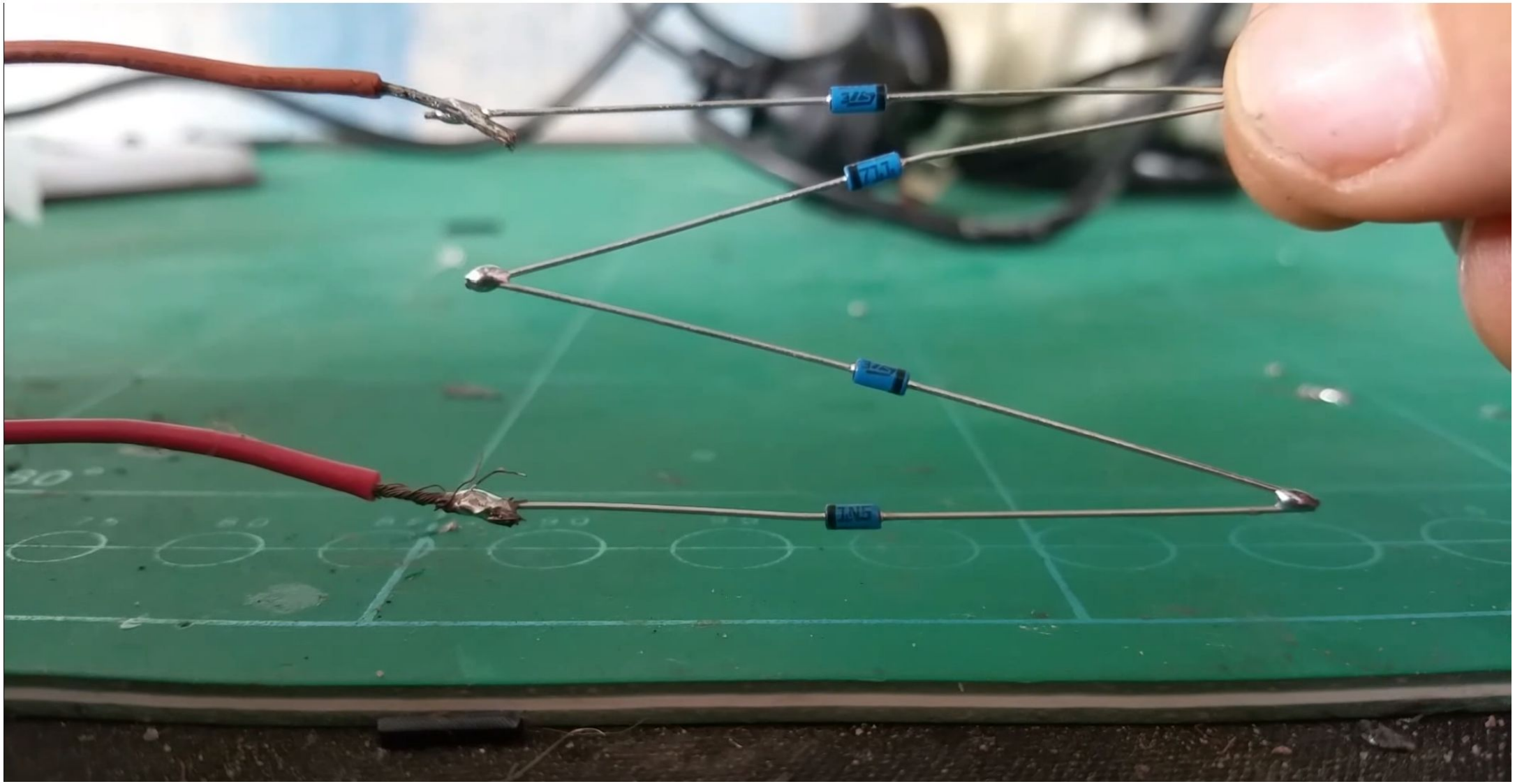

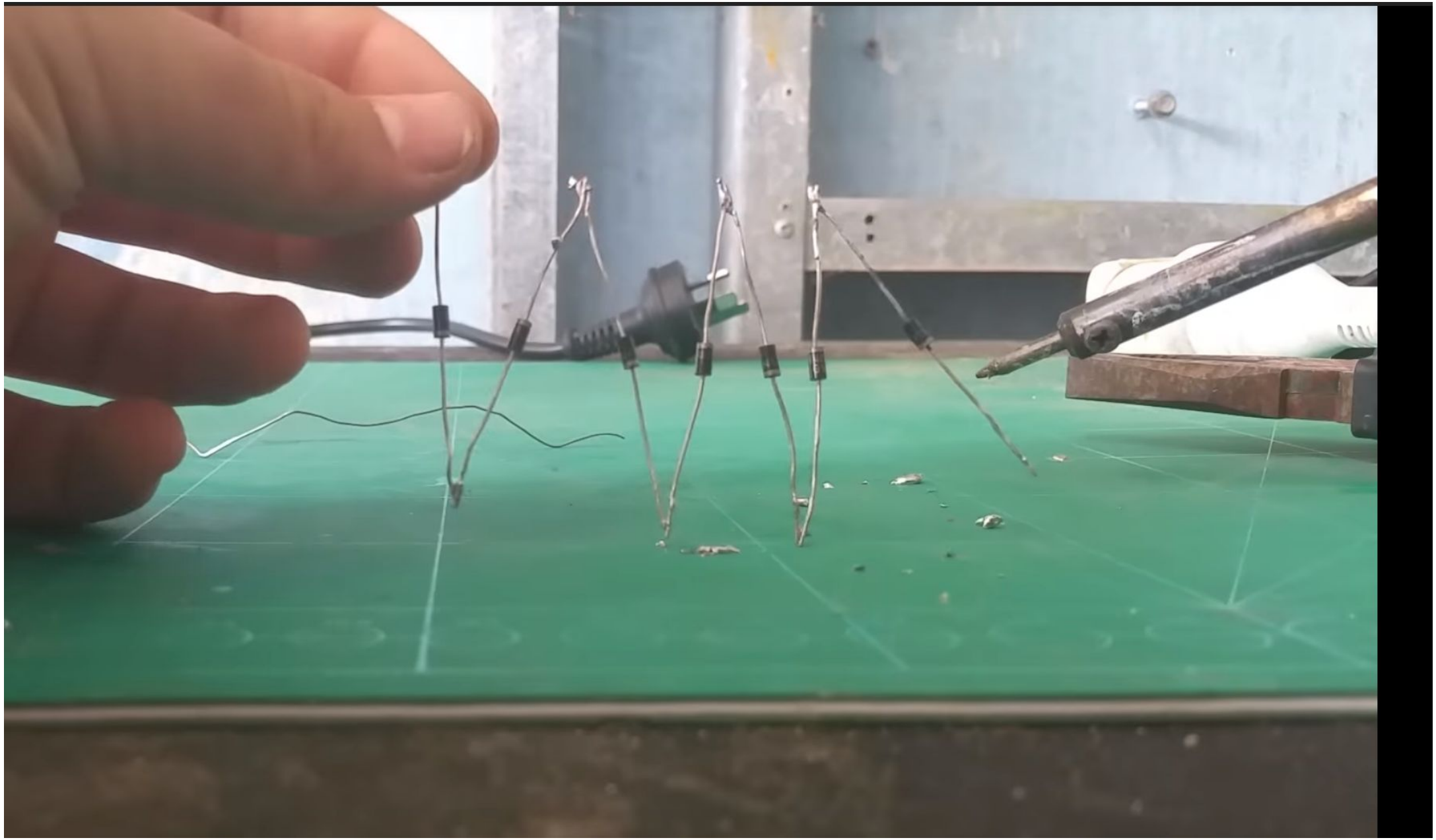

How to convert seawater into drinking water [Class 6, Chapter 14, ...

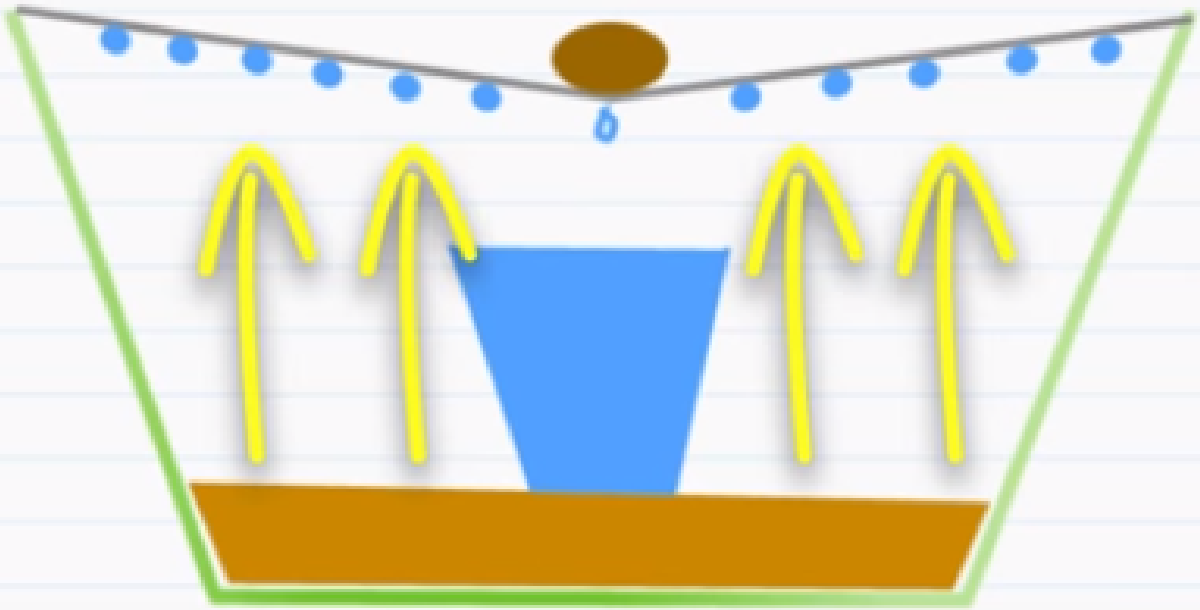

SUBSCRIBE

2:14 / 2:49

How to convert seawater into drinking water [Class 6, Chapter 14, ...
SUBSCRIBE
1:09 / 2:49
YouTube

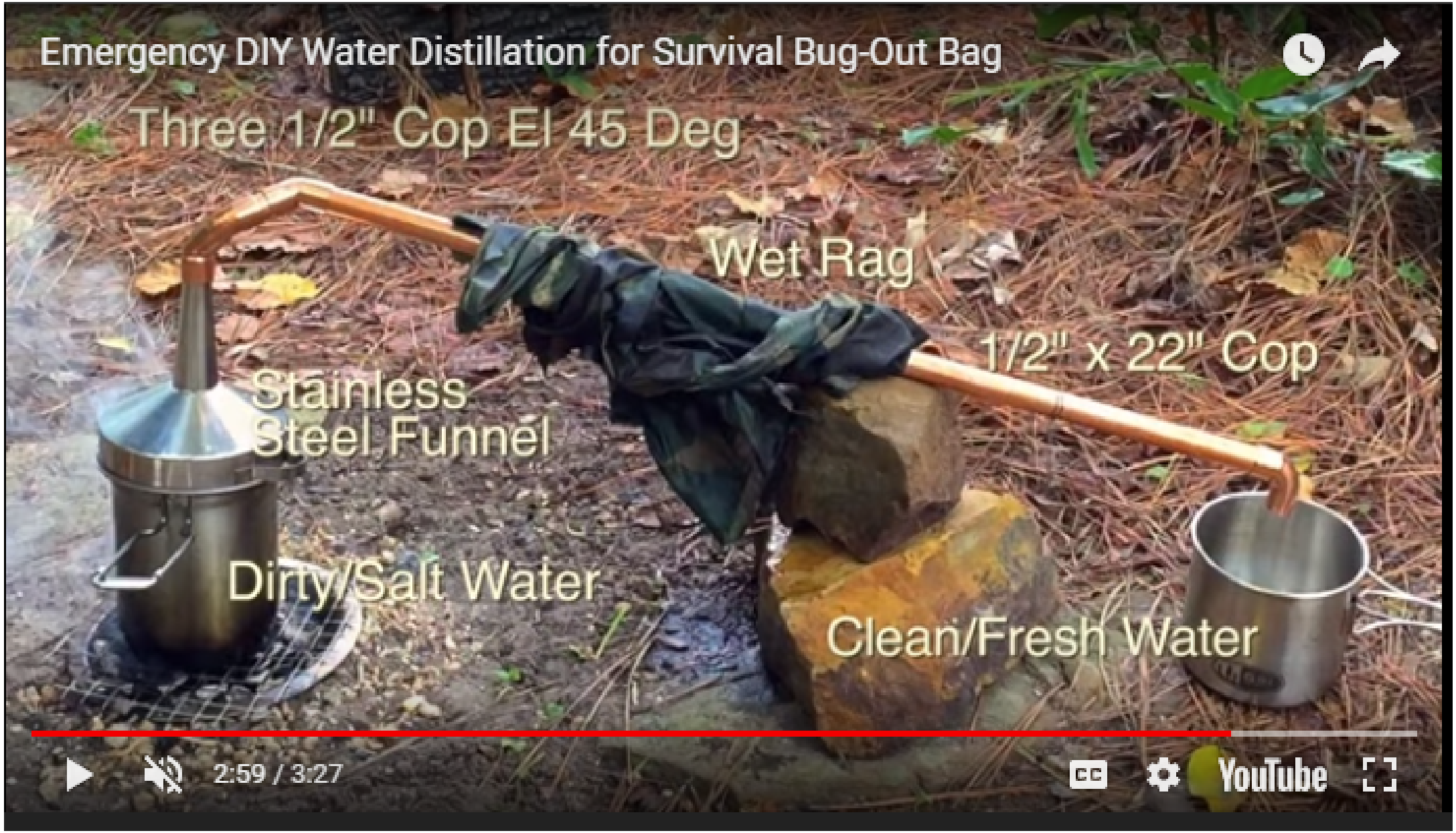
Emergency DIY Water Distillation for Survival Bug-Out Bag
Three 1/2" Cop El 45 Deg
Wet Rag
1/2" x 22" Cop
Stainless
Steel Funnel
Dirty/Salt Water
Clean/Fresh Water
2:59 / 3:27
YouTube

Solar Water Distilling

Simple Survival Water Distilling

How to Make
A Solar Water Distiller

Aquamate Solar Still

Turns Sea Water Into Fresh (Potable) Water

Inflatable & Re-useable

Solar Still

Turns sea water or impure water into drinking water

1 Remove from pack and retain pack to top up salt water in still.

2 Lay out Solar Still and inflate valve (A) on floatation ring by mouth or by liferaft or dinghy pump.

3 Inflate clear dome to obtain shape using valve (E) in base. Do not over inflate. It may be necessary to manually regulate dome pressure during high temperatures.

4 Attach tapered bag (B) and attachment cord (C) to boat or liferaft.

5 Pour 5 litres of sea water into tapered bag (B) using pack which holds 5 litres (approx). Close valve (F) after filling.

6 Ensure both valves (G) are open in reservoir feed tube and drinkable water will start to collect in reservoir (D). Air may need to be squeezed out to assist collection of water.

7 Ensure the Solar Still is kept in direct sunlight whenever possible.

8 Re-fill Solar Still and inflate/deflate dome as required.

9 Daily – Agitate Solar Still to dampen fabric.

10 To drain unwanted water open valve (E) in base.

11 Shelter Solar Still during bad weather.

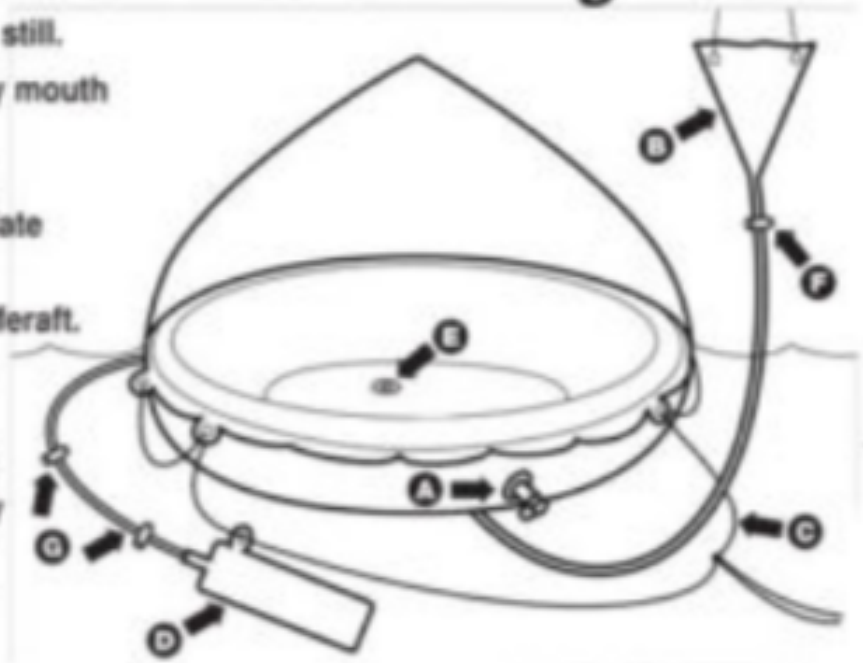

IMPORTANT

IF INNER BLACK MATERIAL SALTS UP FILL WITH SEA WATER AND AGITATE TO CLEAR SALT CRYSTALS AND DRAIN AWAY. PROCESS DRINKING WATER AS INSTRUCTIONS UNTIL SALT IS NO LONGER PRESENT. IN NO CIRCUMSTANCES DRINK WATER THAT TASTES OF SALT.

5 060259 930188 >

AQUAMATE PRODUCTS

NATO Stock No. 4610-66-144-2646

P.O. Box 6032 Dunmow CM6 3AS U.K. Tel: +44 (0)1371 830 216 Fax: 831 733 e-mail: aquamatesales@aol.com

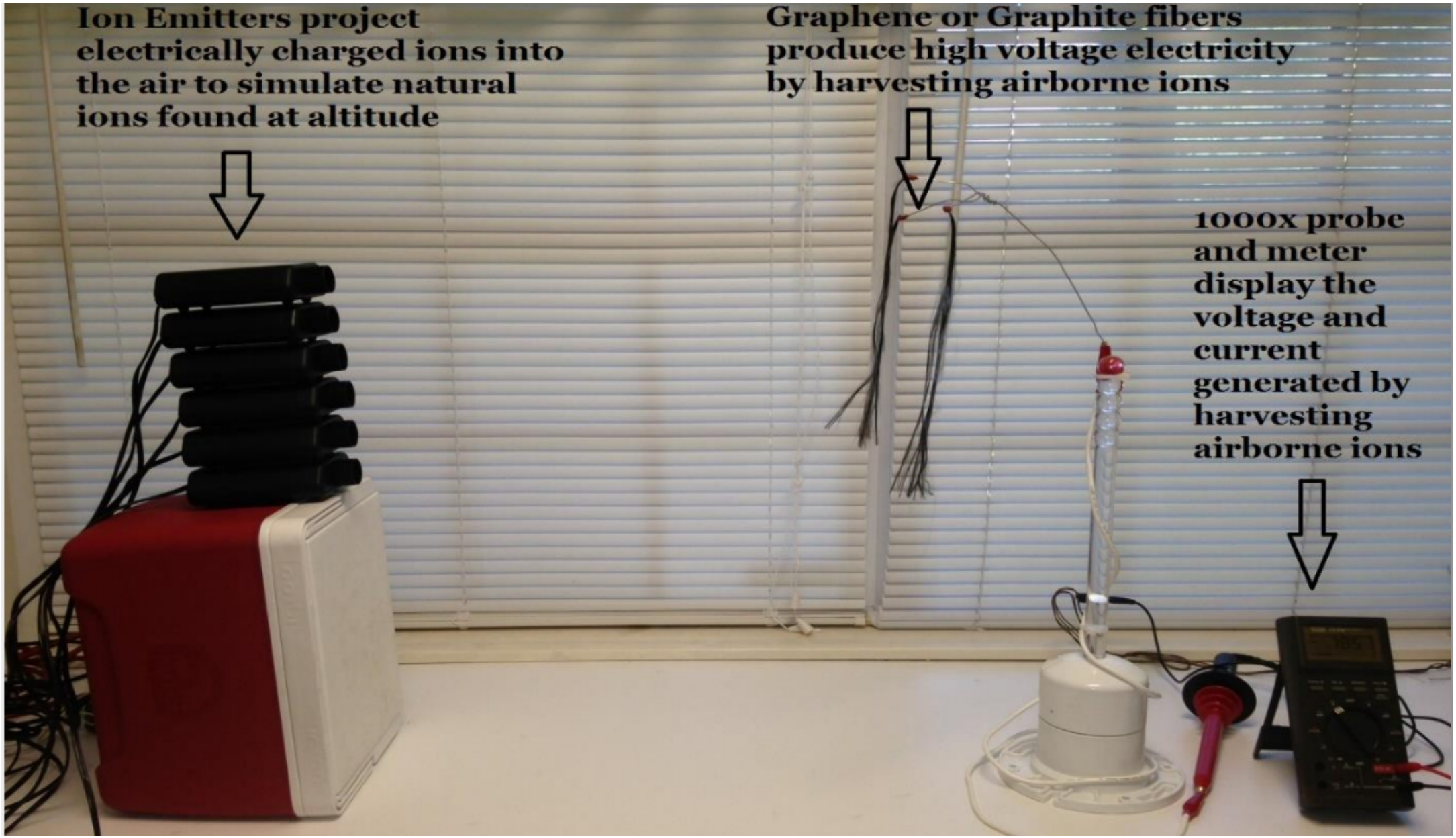
Ion Emitters project electrically charged ions into the air to simulate natural ions found at altitude
Graphene or Graphite fibers produce high voltage electricity by harvesting airborne ions
1000x probe and meter display the voltage and current generated by harvesting airborne ions

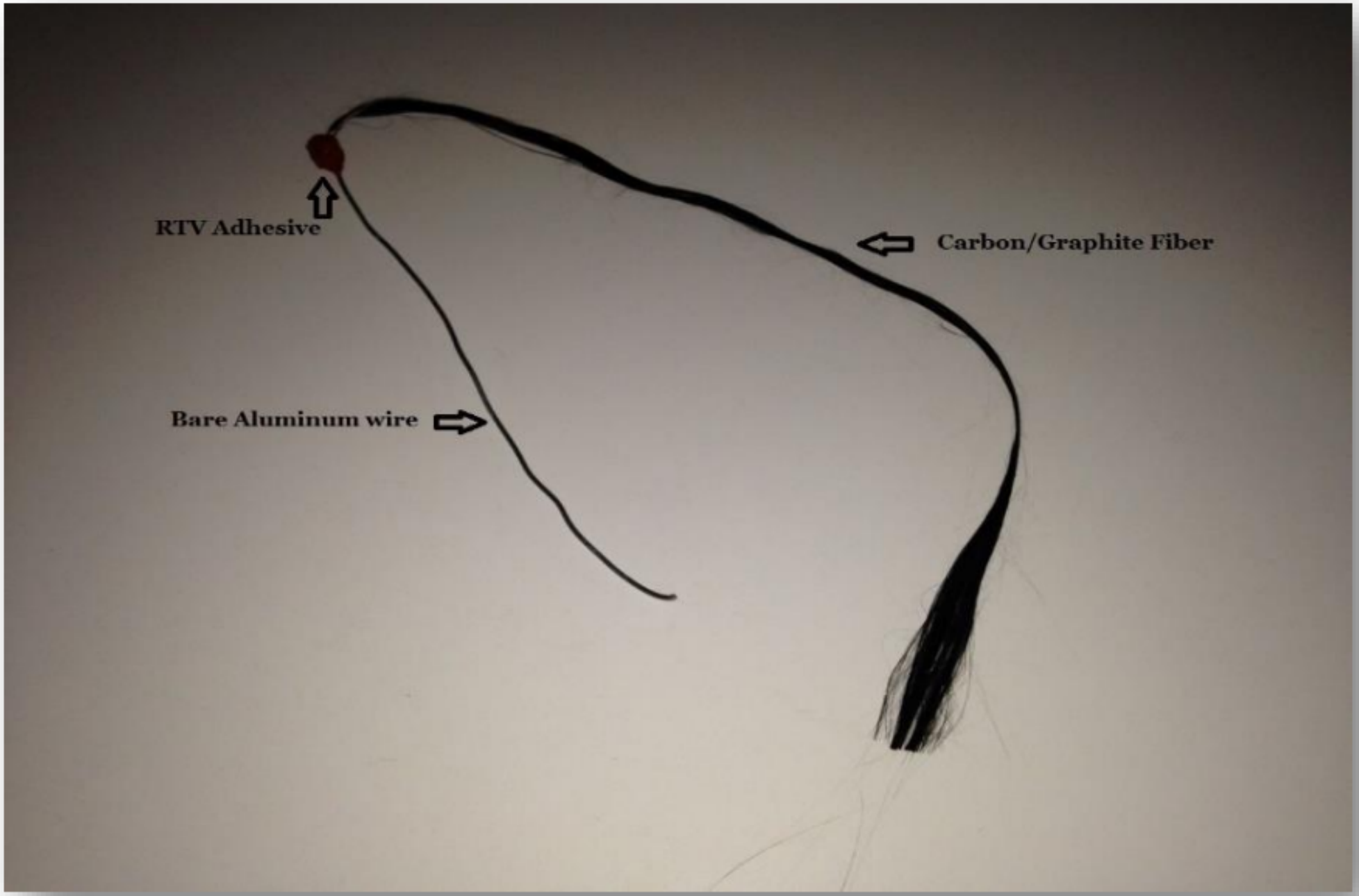

Image of a patented Ion Collector made of carbon/graphite weighing approximately 1 ounce.

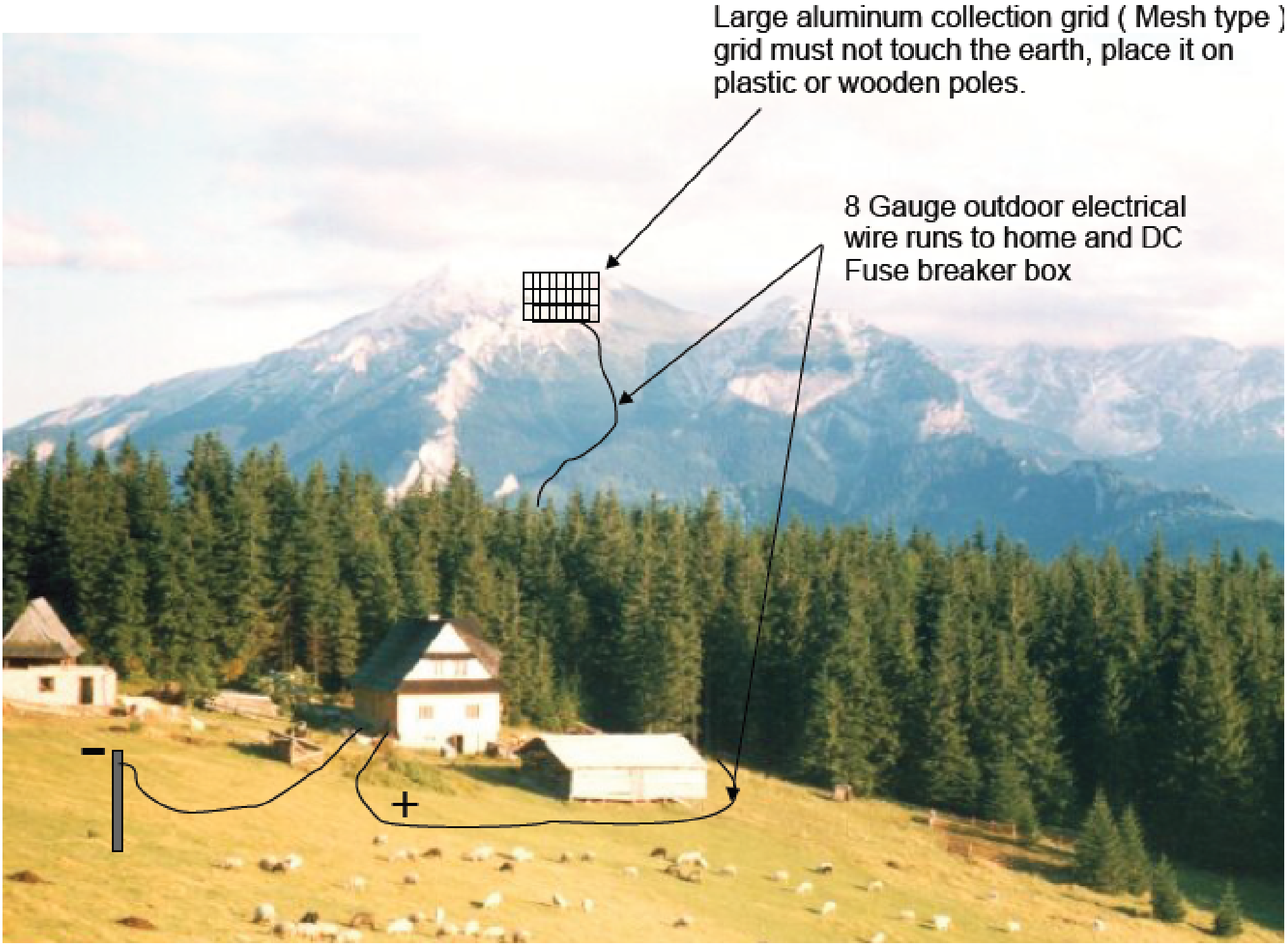
Large aluminum collection grid (Mesh type)
grid must not touch the earth, place it on
plastic or wooden poles.
8 Gauge outdoor electrical
wire runs to home and DC
Fuse breaker box
-
+

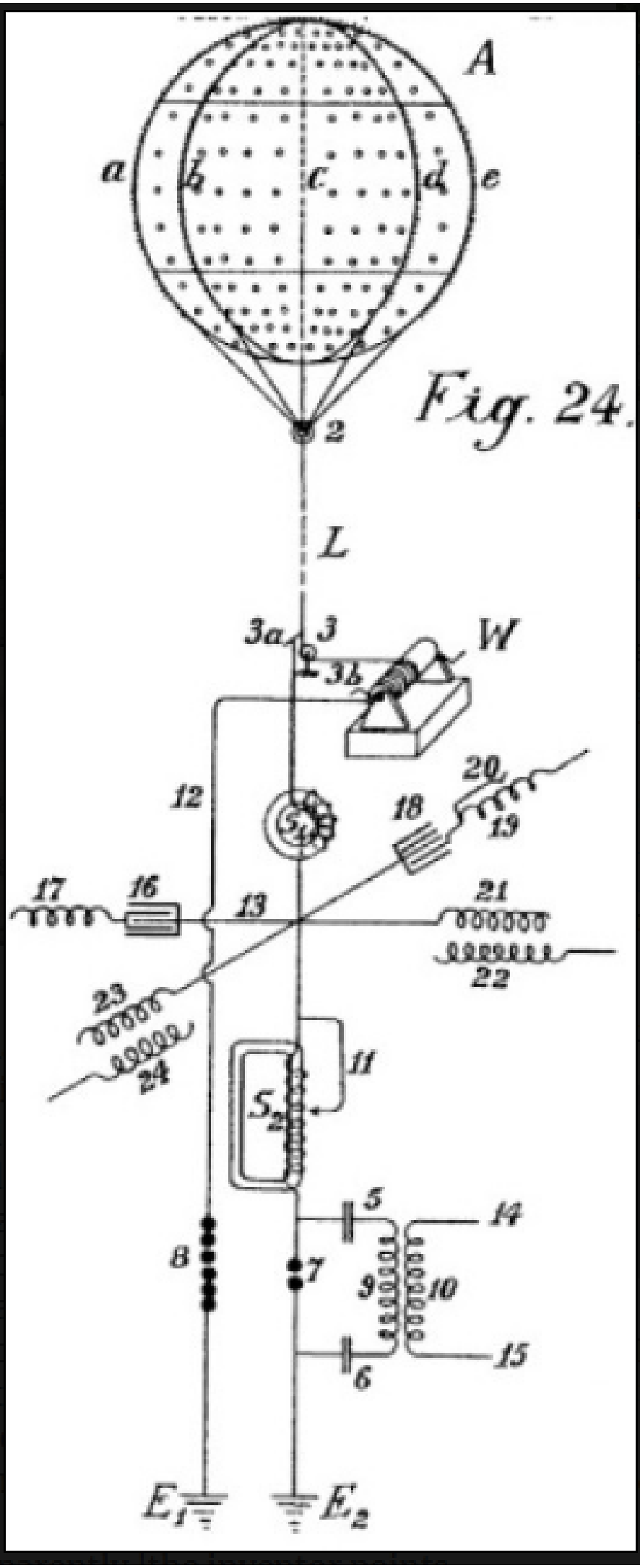
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E_1
E_2

Fig. 24.

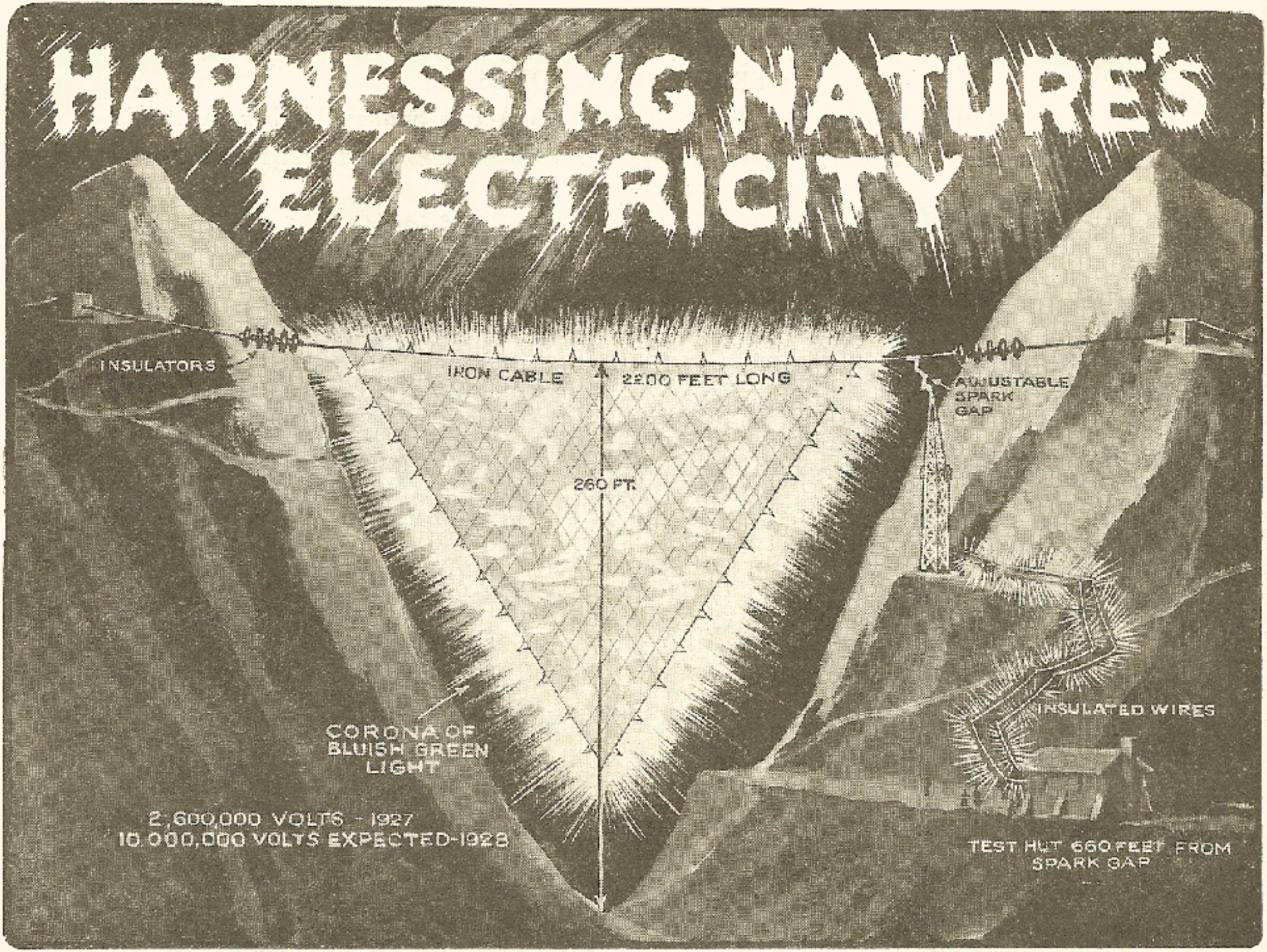
HARNESSING NATURE'S ELECTRICITY
INSULATORS
IRON CABLE
2200 FEET LONG
ADJUSTABLE SPARK GAP
260 FT.
CORONA OF BLUISH GREEN LIGHT
INSULATED WIRES
2,600,000 VOLTS - 1927
10,000,000 VOLTS EXPECTED-1928
TEST HUT 660 FEET FROM SPARK GAP

Remarkable European Experiments with Atmospheric Electrical Discharges with Potentials as High as 3,000,000 Volts

By HENRY TOWNSEND

elevation of 350 ft., and these students of natural electrical phenomena have found a very desirable location in the Alps, where they can suspend between one mountain and an adjacent one, a strong iron cable having a length of about 2,000 ft. This cable is about 250 feet above the intervening valley, and from it these daring engineers have suspended a coarsely woven wire net, which serves as an electrical capacity to gather the electricity from the atmosphere. As shown in the pictures, the wire net is supplied with numerous sharp points to aid in collecting the current from the air.

As the accompanying photographs of the actual apparatus and wire cable used last year clearly show, an adjustable spark gap of considerable length is provided. By adjusting this spark gap to various lengths, it is possible to judge the voltage of the discharge which leaps the gap at any moment. Mr. F. W. Peek, Jr., the well-known American worker in the realm of high voltage measurements, together with other engineers, have provided tabulated data and curves for various lengths of both needle and sphere type spark gaps. As one of the accompanying diagrams shows, it is a simple matter to calculate the voltage when a certain length of gap is used. The engineer first checks the length of the gap on the chart; he then follows a line horizontally from the gap length, to where it intersects with the angular line on the chart; and from the point of intersection he looks in a visual line downward to a place where the voltage is given. For needle spark gap measurements, the characteristic curve on the chart is practically a straight line, while for sphere gaps the characteristic curve on the voltage versus gap length, is a curved line. Those interested in high voltage measurements by means of the spark gap method can find the voltage-gap tables and charts in the *Standardization Rules* of the American Institute of Electrical Engineers. According to Mr. Peek's researches, the voltage per foot of atmospheric electrical discharges is about 100,000, while in laboratory measurements with A.C., transformer high potential discharges, the average voltage per foot of spark was found to be about 150,000 volts. The voltage of a lightning flash may

(*Continued on page* 156)

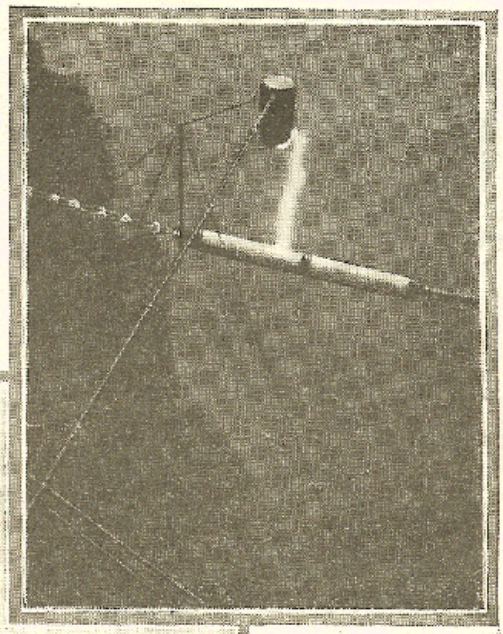

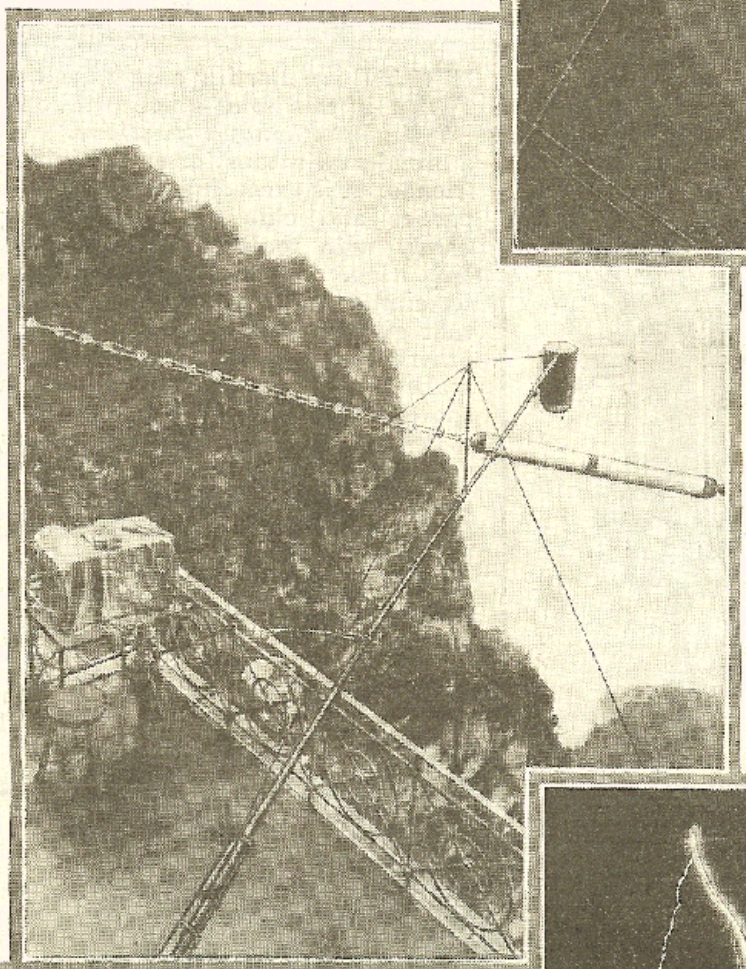

Actual photo above shows 13 ft., heavy spark obtained from the collecting net in the Alps by the German scientists. The voltage is about 2,000,000. The spark occurred once per second for 30 minutes.

Photo, left, shows the adjustable spark gap used in the Alps. Notice the heavy electrode on the end of the adjustable arm to which the spark jumps.

Below we see 3,000,000-volt artificial lightning stroke produced in G. E. Laboratory at Pittsfield, Mass. Note man.

Actual photograph of the experimental "kite" used by the German experimenters in the Alps Mountains, for the purpose of accumulating high potential electrical discharges from the atmosphere. Note the size of the insulators.

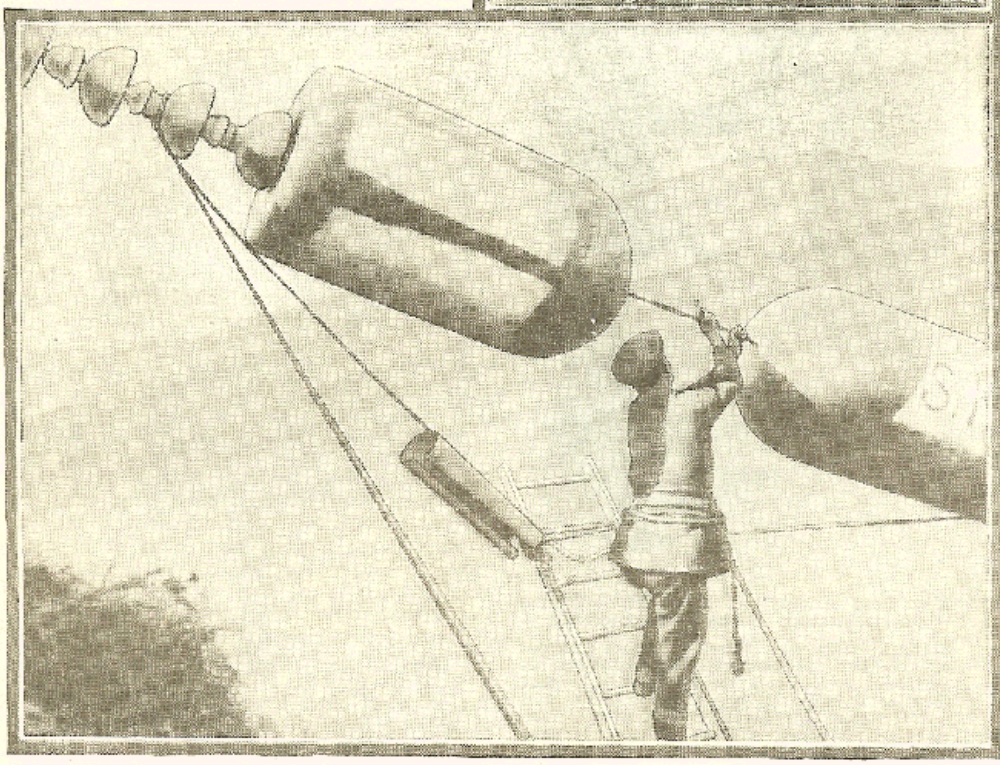

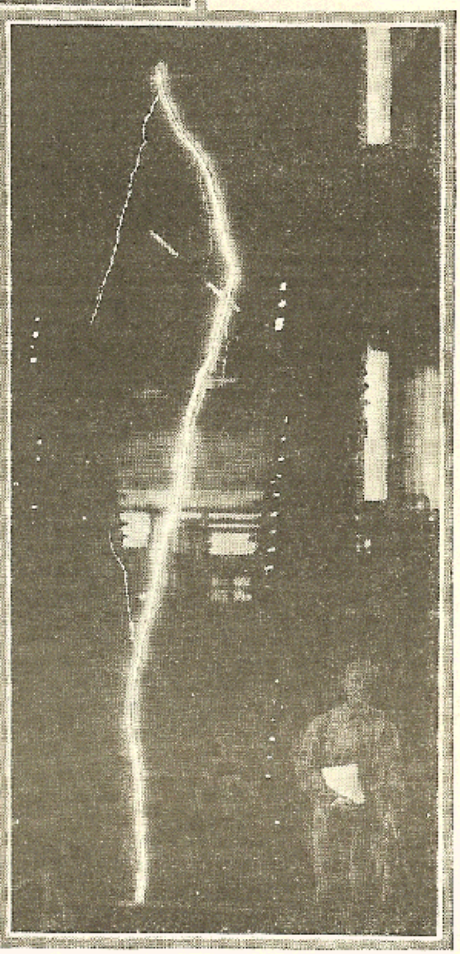

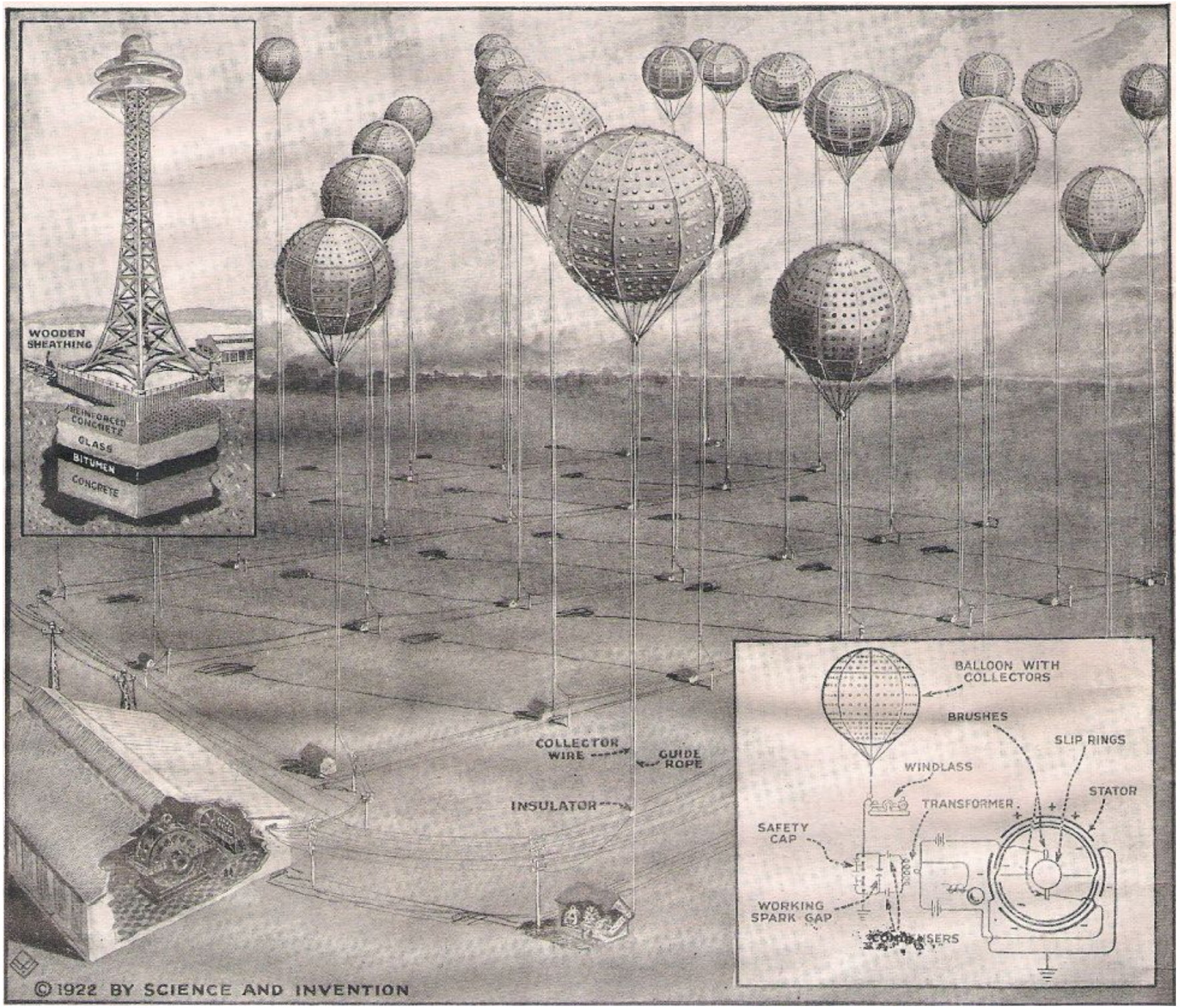
WOODEN SHEATHING
REINFORCED CONCRETE
GLASS
BITUMEN
CONCRETE
COLLECTOR WIRE
GUIDE ROPE
INSULATOR
BALLOON WITH COLLECTORS
BRUSHES
SLIP RINGS
WINDLASS
STATOR
TRANSFORMER
SAFETY CAP
WORKING SPARK GAP
CONDENSERS
© 1922 BY SCIENCE AND INVENTION

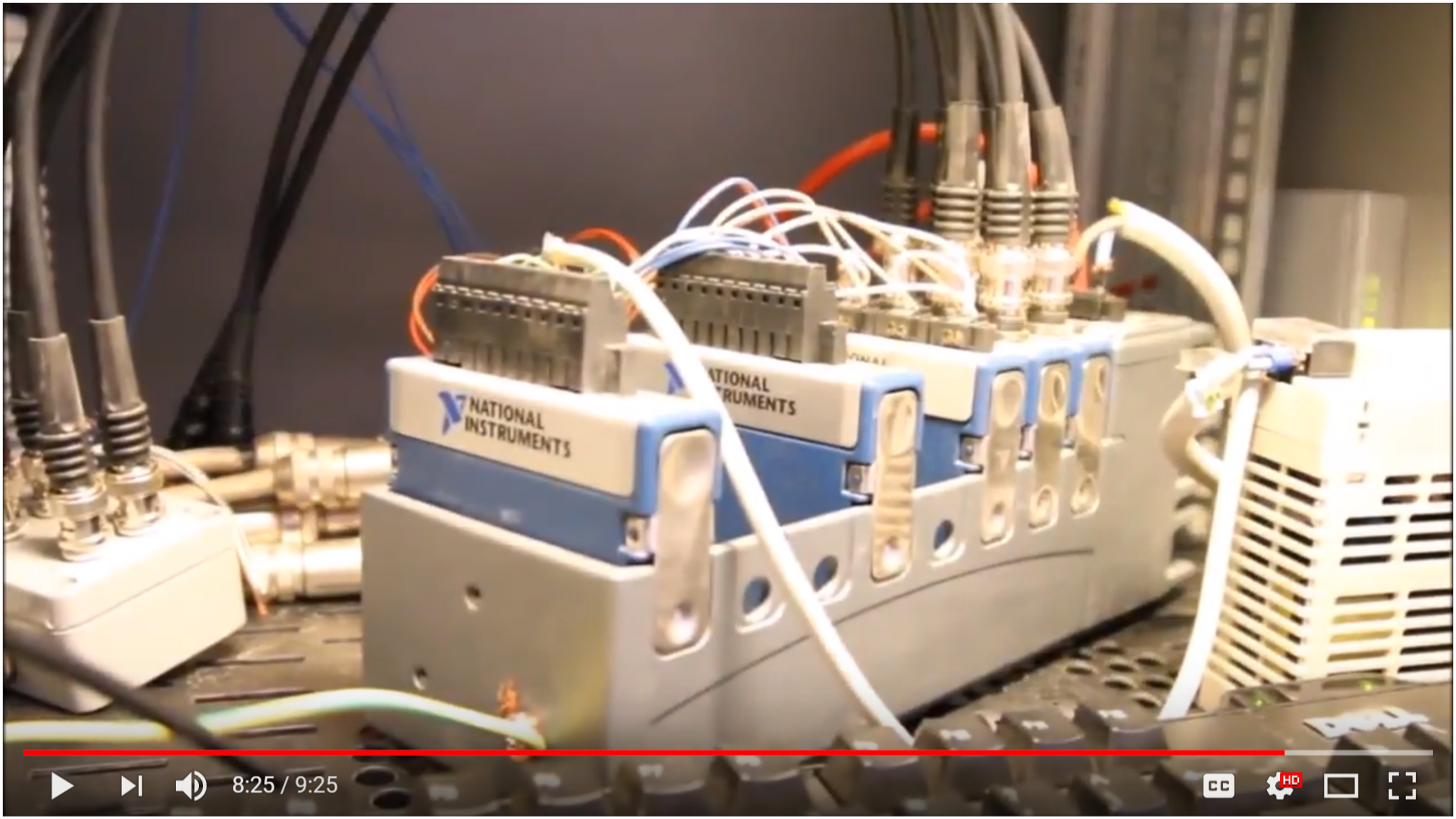

Flat Earth CON SPIRES! Cathedral Spires Are Secretly Atmospheric Electricity Ma

NOT FOR BROADCAST
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STORMHIGHWAY.COM

1:45 / 9:25
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HD

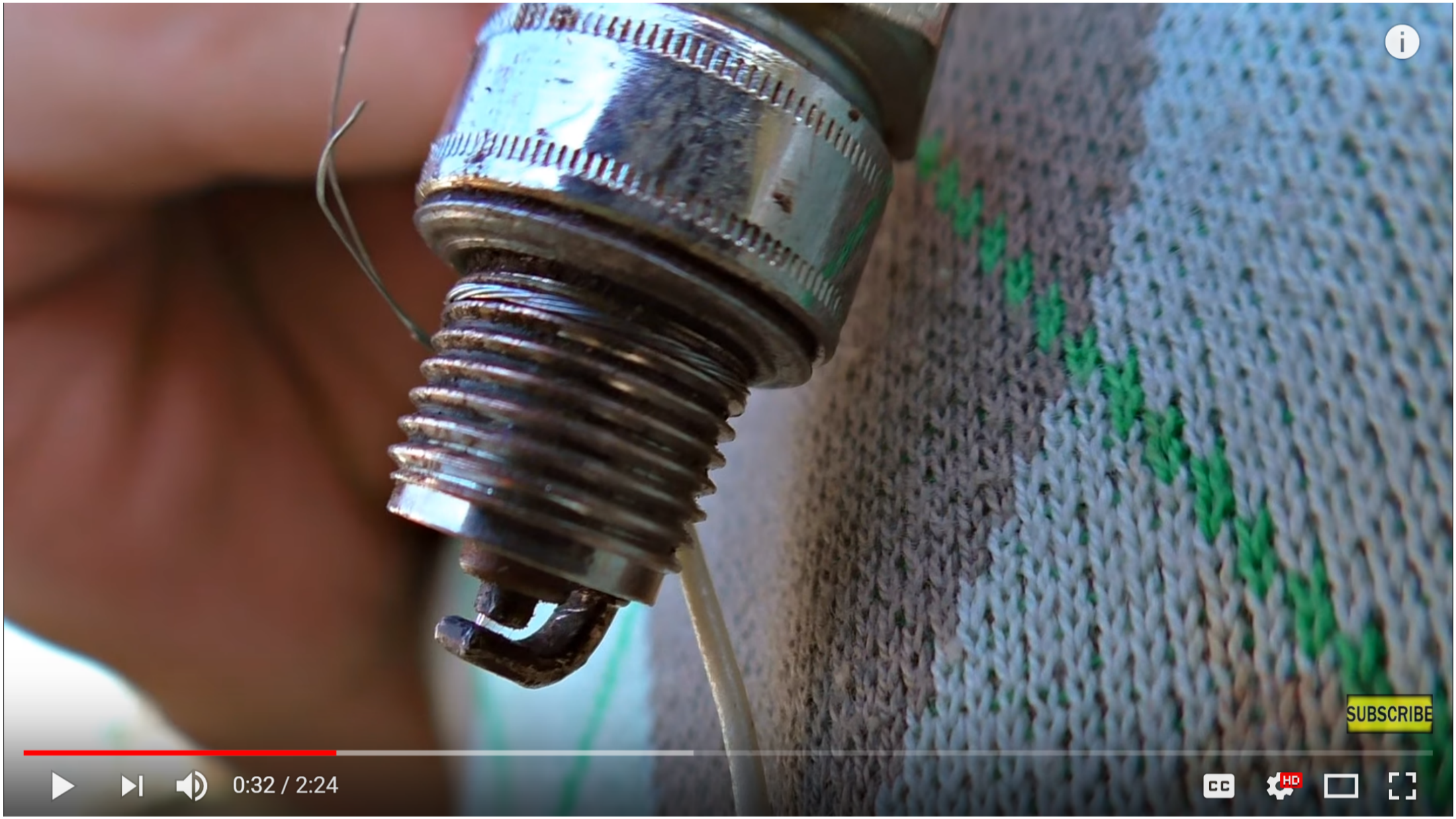

Charging from the power lines.

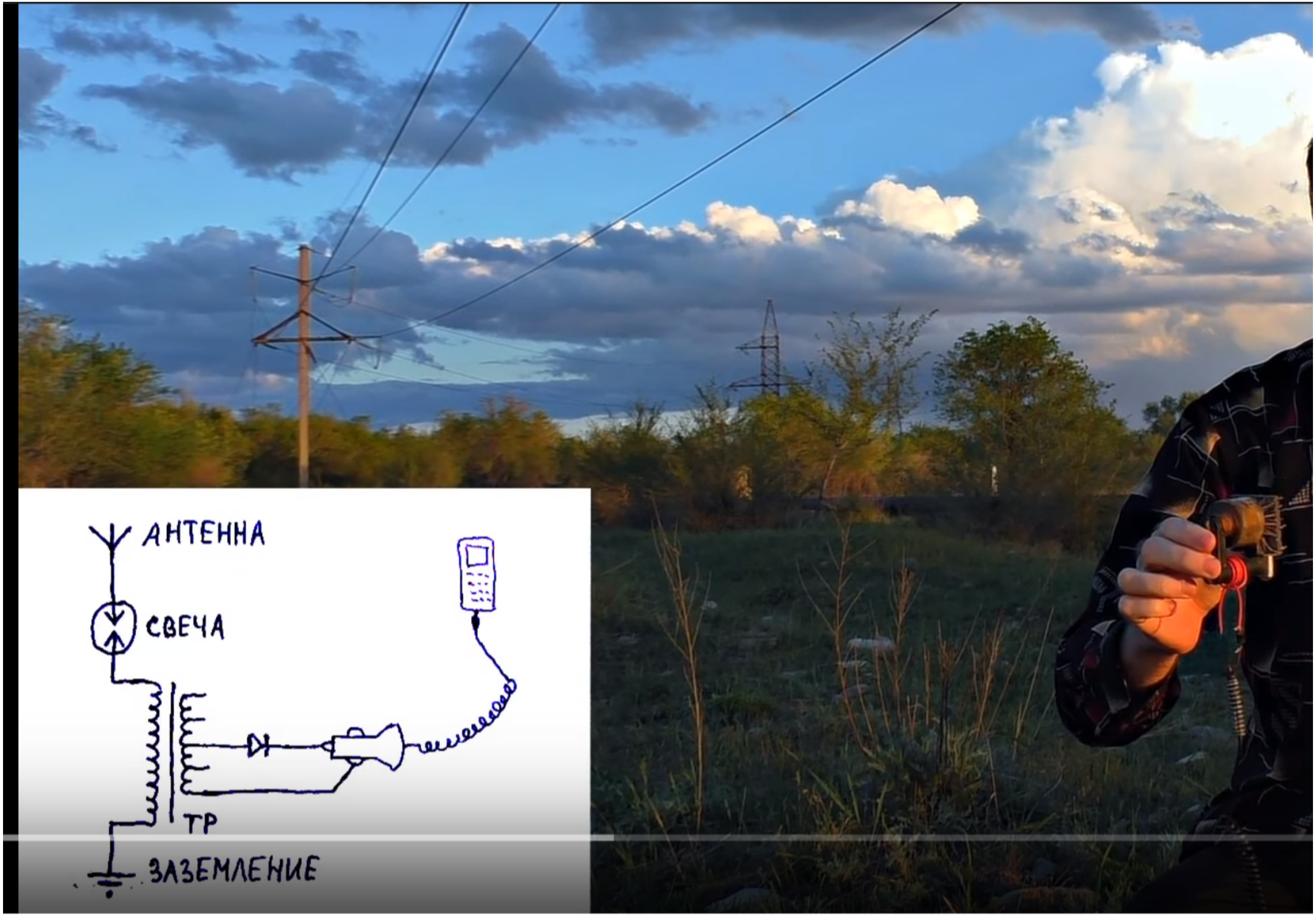
АНТЕННА
СВЕЧА
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ЗАЗЕМЛЕНИЕ

E8

MULTI DISPLAY DMM
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SPARK PLUG DIODE CAR CHARGER FLYBACK TRANSFORMER TV ANTENNA
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POWER
COM
DT-92

must depend on the area occupied by the building; for instance, a church of ordinary design and size would require four "down" rods, that is, one from the spire, one on both sides of the nave, and one at the extreme end. It is advantageous to run two conductors from the top of the spire or tower, one on each side.

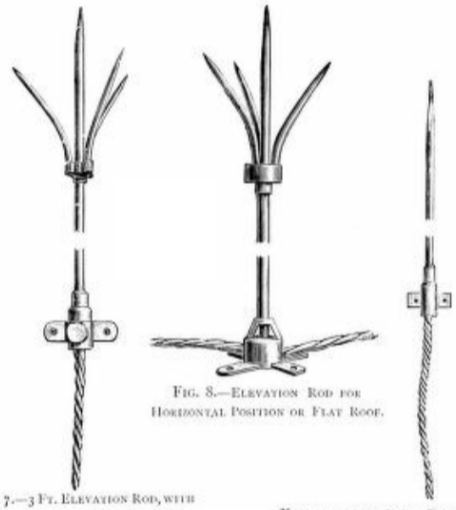

FIG. 7.—3 FT. ELEVATION ROD, WITH POINTS BRAZED TOGETHER, USED WHERE EXPOSED TO MUCH HEAT.

FIG. 8.—ELEVATION ROD FOR HORIZONTAL POSITION OR FLAT ROOF.

FIG. 9.—PLAIN POINT ELEVATION ROD.

Horizontal Conductors (see L.R.C. Suggestion 2, page 15). To complete the system, all the down conductors should be intersected by at least one horizontal rod, with the object of having a path for any side flash or portion of the main stroke which may not be carried away harmlessly by the main rod. Where there is a considerable length of roof, aigrettes (Fig. 11) should be fixed as shown by Fig. 10, which is taken from a model of the roof of Westminster Abbey. The down conductros on their way to earth should be connected to any metal work in the neighbourhood, also to rain-water gutters,

pipes, etc.; the number of these subsidiary down conductors depends on the length of the roof.

At a conference held on behalf of the L.R.C., in April, 1904, Sir Oliver Lodge suggested that these down conductors should, in the case of a church, be run between each of the windows.

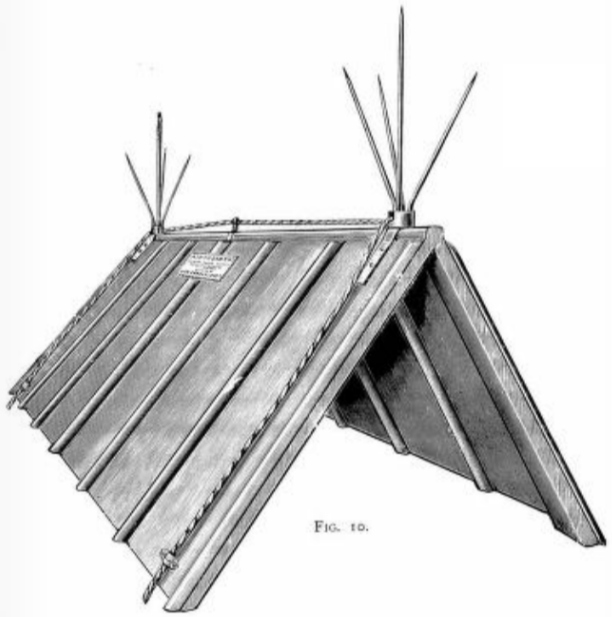

FIG. 10.

Method of running Conductors. These, whether vertical or horizontal, should be kept away from the structure (L.R.C. Rule 10) so as to avoid all sharp bends, and facilitate straining, and secondly, to prevent the corrosion which may take place where the metal is in contact with the brick or stone work. It is found advisable

Modern lightning conductors: an illustrated

surface of the joint need not necessarily exceed that of the cross section of the conductors. The joint should be put together previously by screws or rivets, and the soldered joint, especially if used in underground work, should be carefully protected from local electrical action by tarred rope. Stranded iron conductors can be connected (as previously described) by use of a box joint; the box, Fig. 28, must be of the same metal as the conductors.

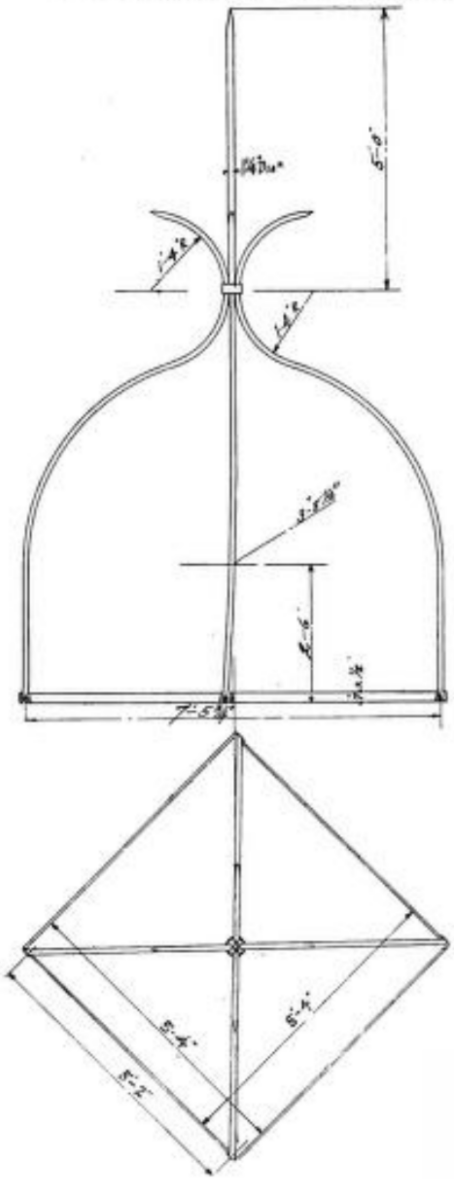

FIG. 27.—TERMINALS IN FORM OF AN ARCH FOR CHIMNEY STACK.

Vanes.—Particular attention must be paid to the necessity of making a permanent joint to the spindle. A clamp is prepared of the same material as the spindle, and is furnished with two bolts to tighten; if iron is used it is well to line the clamp with a piece of sheet lead. The conductor is sweated into a socket which is fitted with an eye, through which one of the tightening bolts passes. In the

FIG. 28.

case of the vanes of churches and those fixed in inaccessible positions, two separate clamps should be used.

Internal Masses of Metal.—Roof trusses fitted with longitudinal iron tie rods will, as a rule, be found to be electrically connected, but should this not be the case each truss must be joined to the conductors. All large and long masses of metal, such as beams, girders, roof trusses, tie rods, hot water systems, traveller ways, hoisting crabs, engines, boilers, large machines, and ventilators fixed in the interiors of buildings, should be connected to all conductors that pass near them, and as far as possible with one another. The discontinuous parts of traveller rails should be connected by straps, or in some cases tramway bonds might be used. If electric light wires are run in tubes, such as the "SIMPLEX," this should be earthed. Metallic contact between lead or zinc sheeting and flashings should be carefully studied, and for special work strips of sufficient size should be either burnt on to lead or soldered in such a way that the joint will stand rough usage, and allow for expansion or contraction.

Earth Connection.—"*It is essential that the lower extremity of the conductor be buried in permanently damp soil; hence proximity to rain-water pipes, and to drains, is desirable. It is a very good plan to make the conductor bifurcate close below the surface of the ground, and adopt two of the following methods for securing the escape of the lightning into the earth. A strip of copper tape may be led from the bottom of the rod to the nearest gas or water* main—*not merely to a lead pipe—and be soldered to it; or a tape may be soldered to a sheet of copper* 3 *feet by* 3 *feet and* $\frac{1}{16}$ *inch thick, buried in permanently wet earth, and surrounded by cinders or coke; or many yards of the tape may be laid in a trench filled with coke, taking care that the surfaces of copper are, as in the previous cases, not less than* 18 *square feet. Where iron is used for the rod, a galvanised iron plate of similar dimensions should be employed.*

"The use of cinders or coke appears to be questionable owing to the chemical or electrolytic effect on copper or iron. Charcoal or pulverised carbon (such as ends of arc-light rods) is better. **A tubular earth** consisting of a perforated steel spike driven tightly into moist ground and lengthened up to the surface, the conductor reaching to the bottom and being packed with granulated charcoal, gives as much **effective area** as a plate of larger surface, and can easily be kept moist by connecting it to the nearest rain-water pipe. The resistance of a tubular earth on this plan should be very low and practically constant."—*Lightning Research Committee, 1905.*

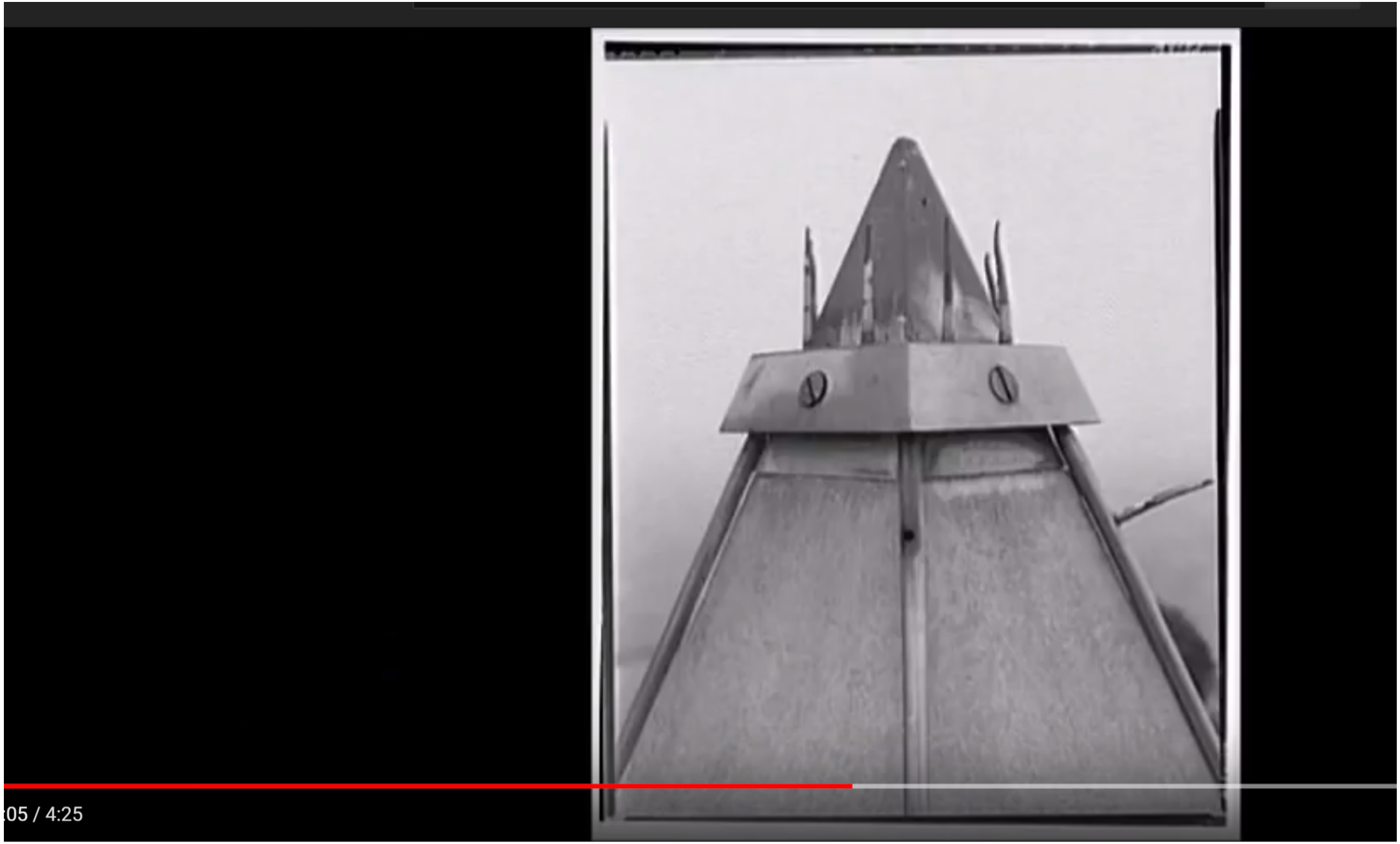

Washington Monument is an Atmospheric Electricity Mast

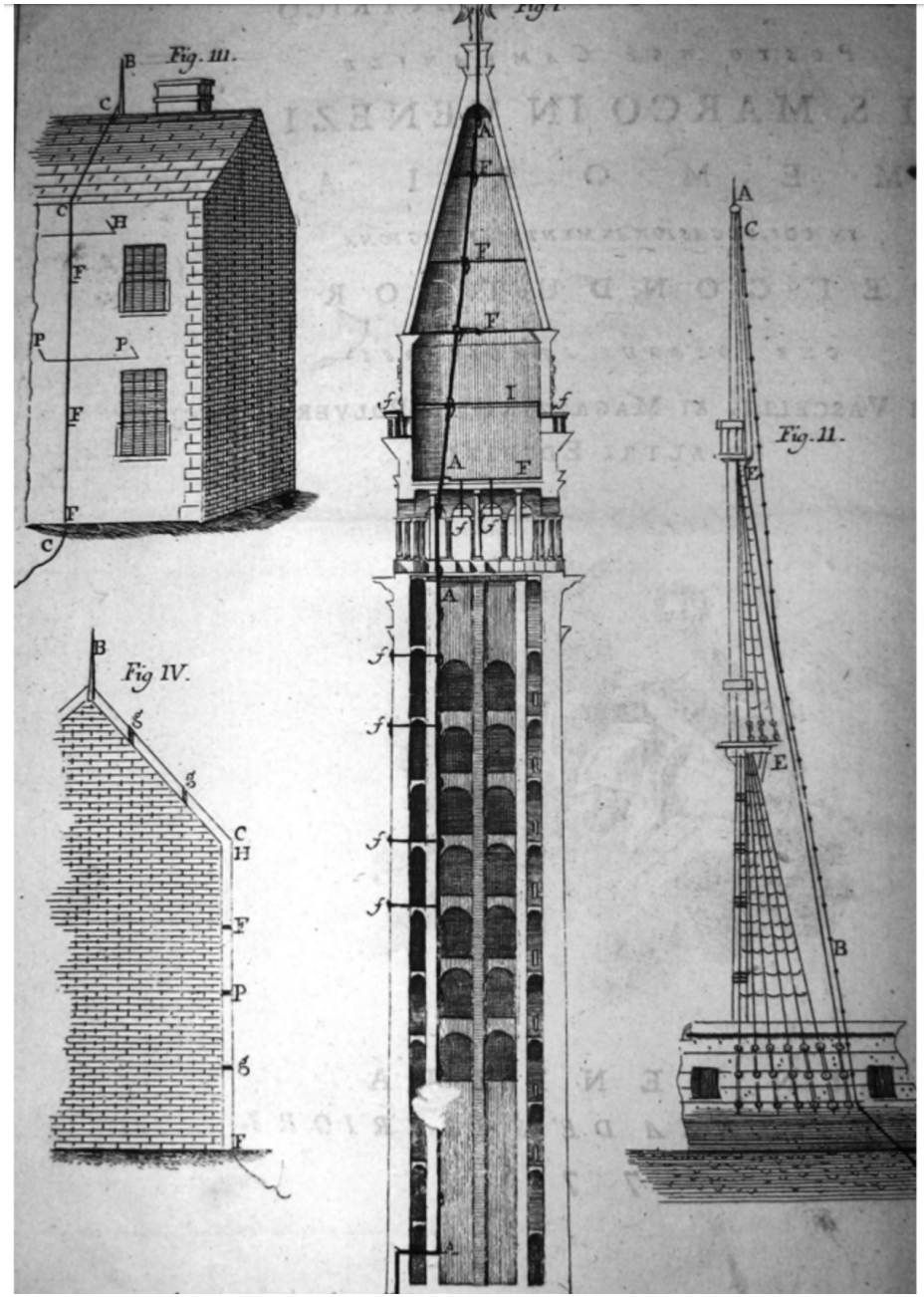

Figure 2.3. The lightning rod that Toaldo designed for the church of San Marco in Venice. GiuseppeToaldo, "Del conduttore elettrico posto nel campanile" (Padua, 1776). Franklin Collec-

Gilded Temples Are Secretly Atmospheric Electricity Masts

How To Find S-W Stations Quickly

~ EUROPEAN STATIONS ~

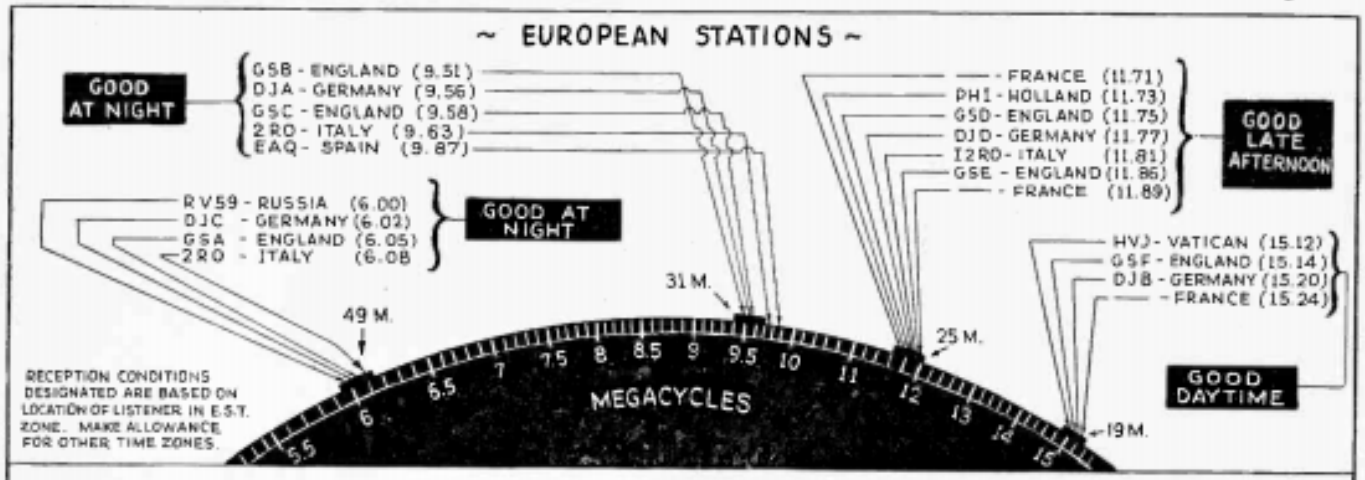

~ CANADIAN SHORT-WAVE STATIONS ~

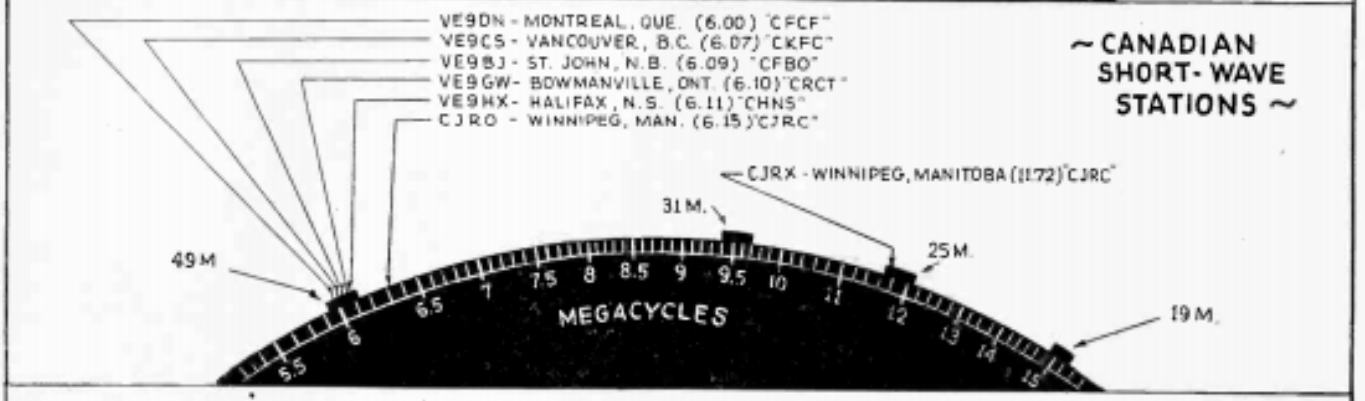

~ UNITED STATES SHORT-WAVE STATIONS ~

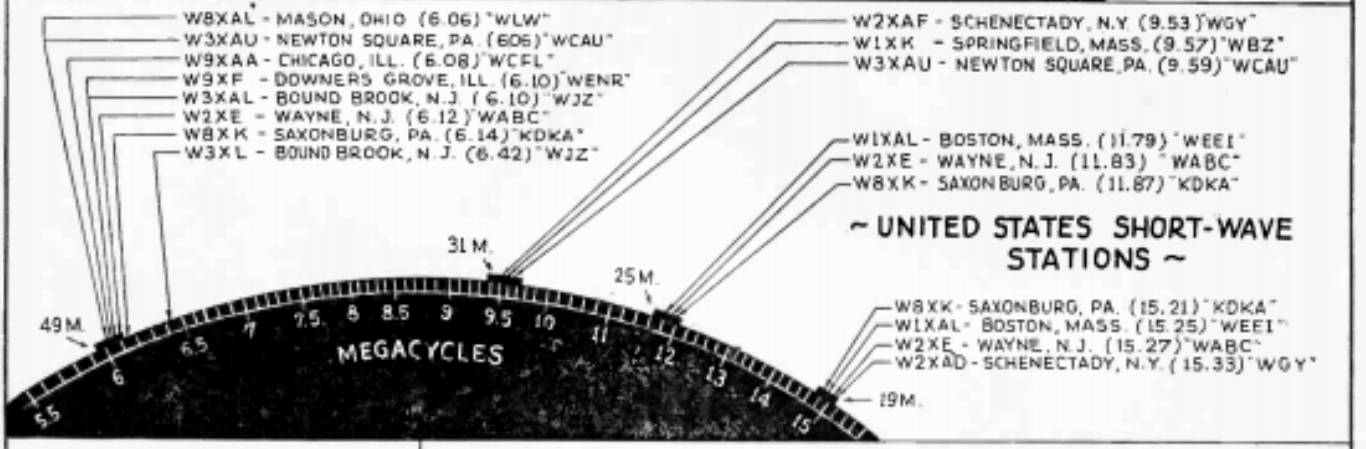

When To Tune and Where

● Until you have had considerable experience in short wave tuning, it is well to confine your efforts to the four bands indicated on the dial. These may look small, compared to the total length of the dial, but they contain the best "plums" among the foreign stations and many faint ones which, at first, you will probably pass unnoticed until you learn to tune slowly and carefully, intent upon identifying each slight "swish", which may be a station.

U.S. STATIONS BROADCASTING PROGRAMS ON SHORT-WAVE CHANNELS

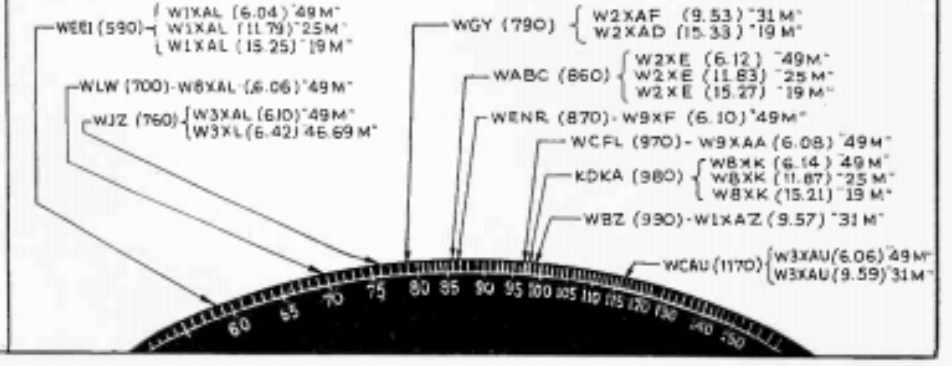

Copyright 1935 by H. Gernsback.

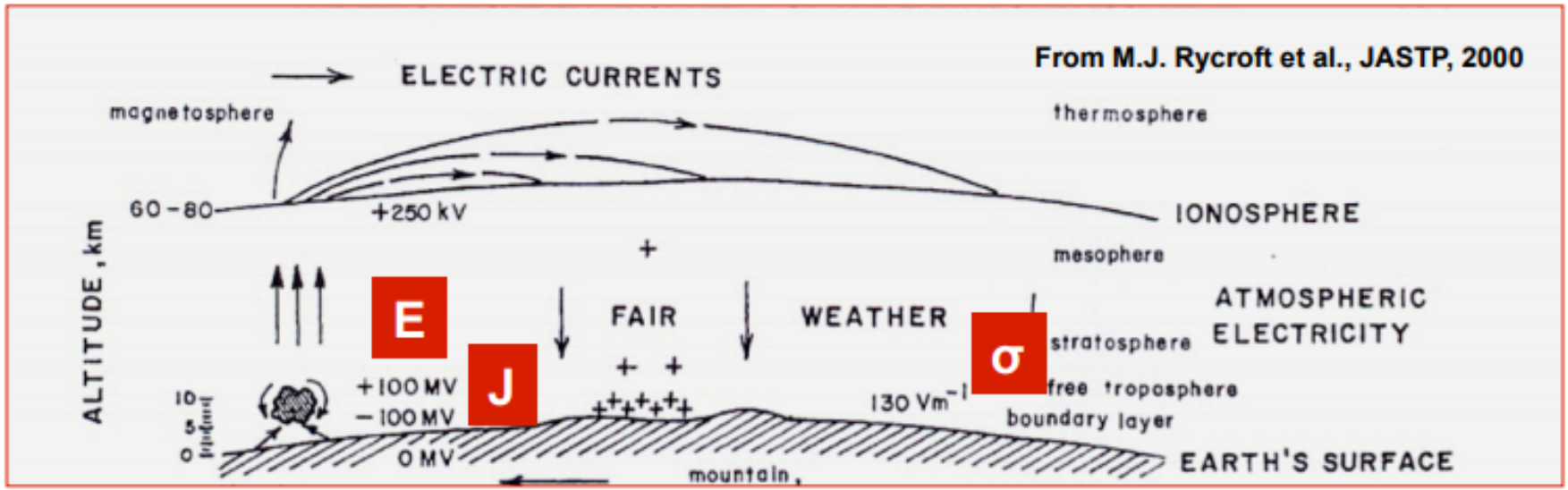
From M.J. Rycroft et al., JASTP, 2000
ELECTRIC CURRENTS
magnetosphere
thermosphere
60 – 80
+250 kV
IONOSPHERE
mesophere
ALTITUDE, km
E
FAIR
WEATHER
ATMOSPHERIC
ELECTRICITY
stratosphere
σ
J
+100 MV
– 100 MV
0 MV
130 Vm⁻¹
free troposphere
boundary layer
EARTH'S SURFACE
mountain

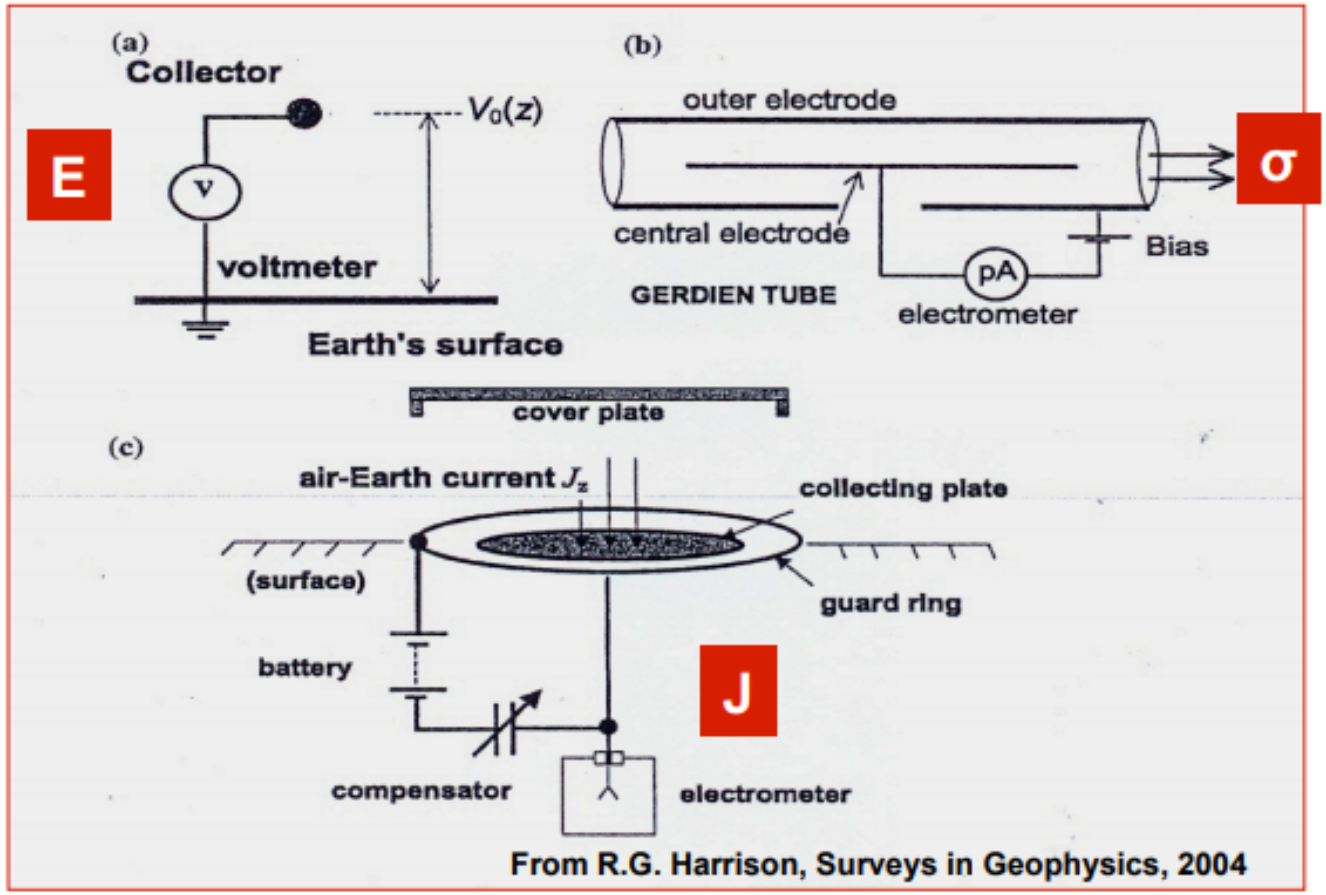
(a)
Collector
E
V
voltmeter
$V_0(z)$
Earth's surface
(b)
outer electrode
σ
central electrode
Bias
pA
GERDIEN TUBE
electrometer
cover plate
(c)
air-Earth current J_z
collecting plate
(surface)
guard ring
battery
J
compensator
electrometer
From R.G. Harrison, Surveys in Geophysics, 2004

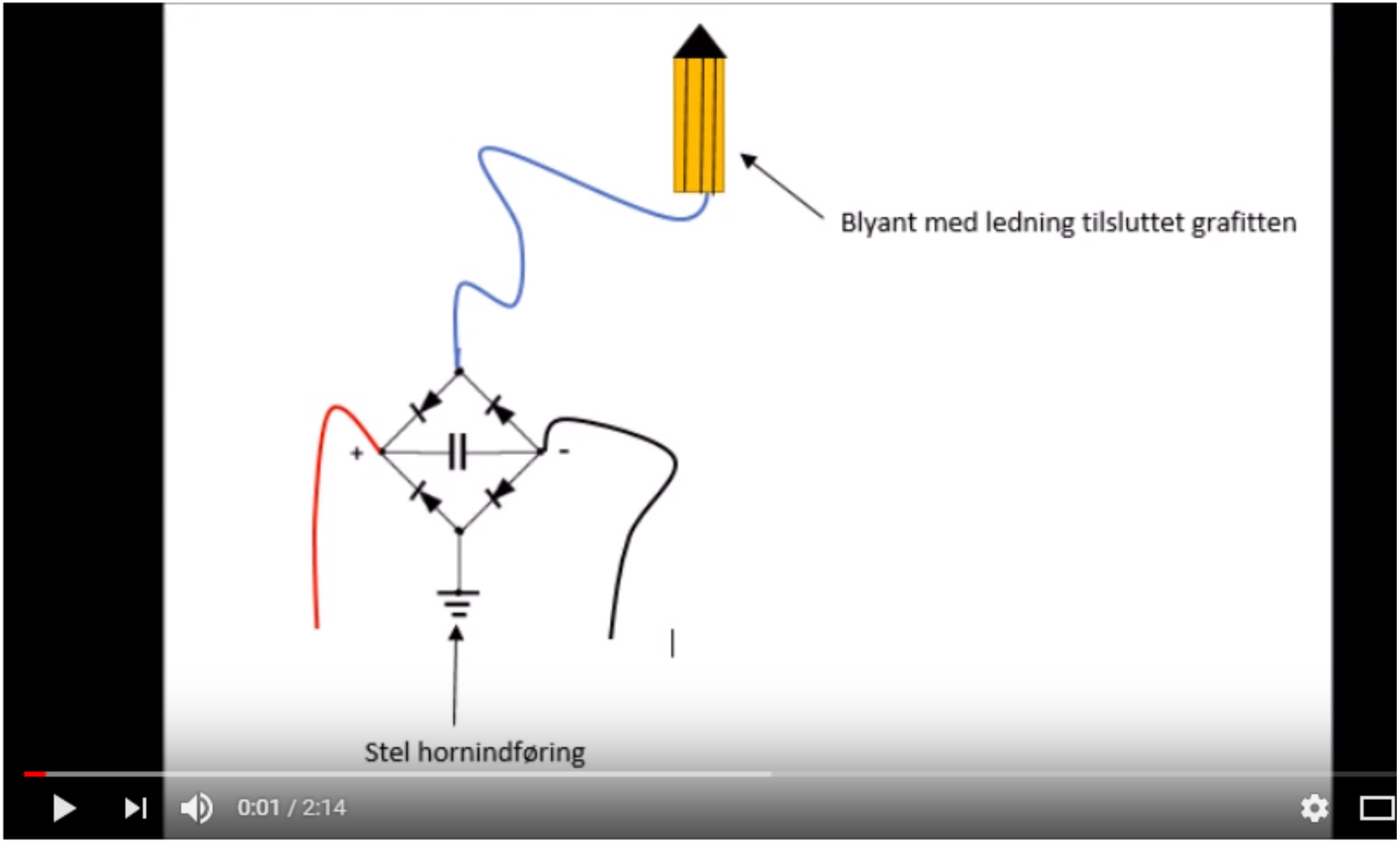

tesla radiant collector/ion collector with pencil

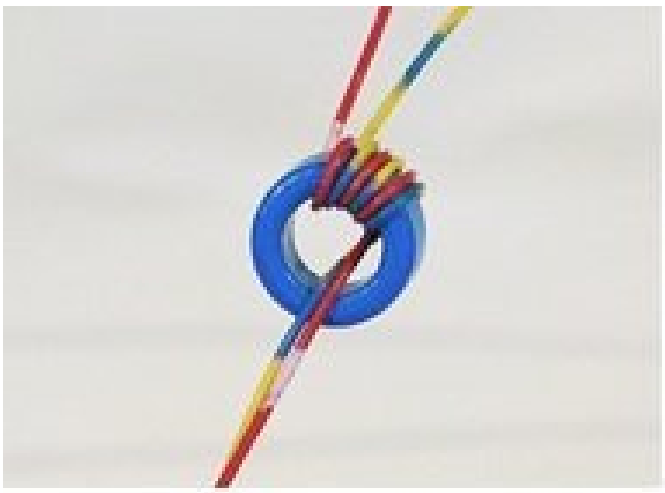

Keeping the two wires together, make a few more turns through the center.

Keep winding until you fit as many turns as will fit in a single layer around the toroid, typically 7-10 turns with thin insulated wire.

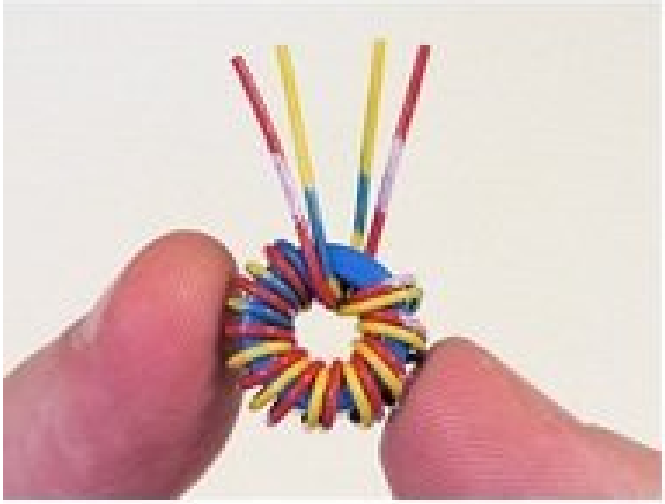

Clip the wire leads down. Note that we have two pairs of wires: one coming out the front, and one coming out the back.

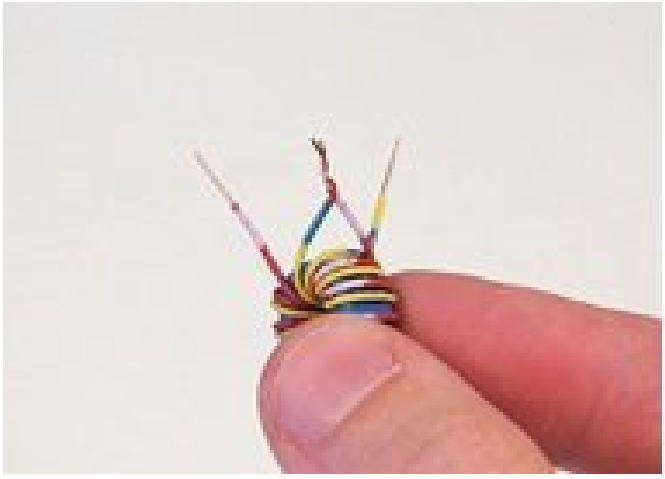

Strip the wire ends. Take one wire from each pair *of different color* and attach them together.

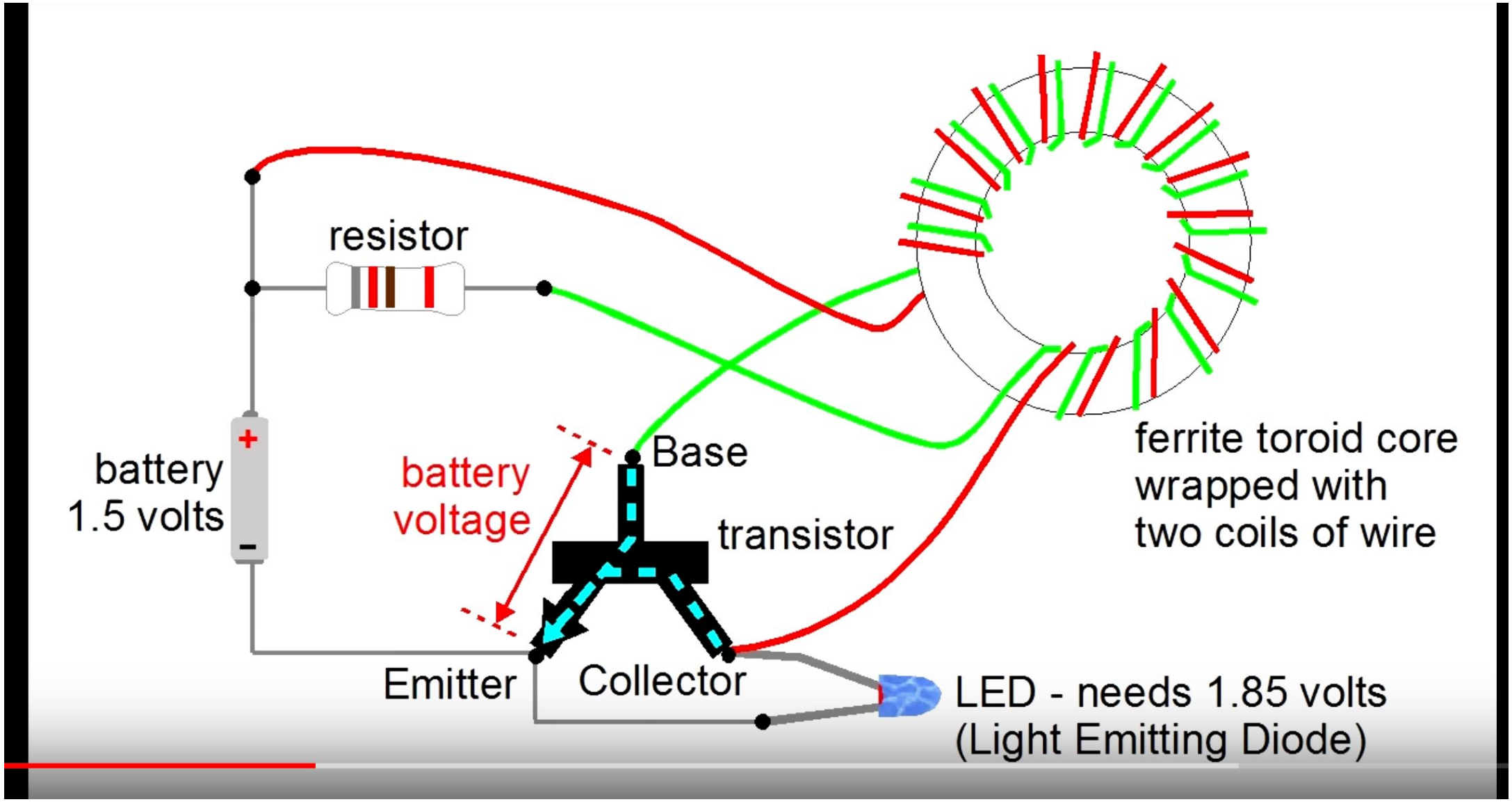
resistor
battery
1.5 volts
+
-
battery
voltage
Base
transistor
Emitter
Collector
ferrite toroid core
wrapped with
two coils of wire
LED - needs 1.85 volts
(Light Emitting Diode)

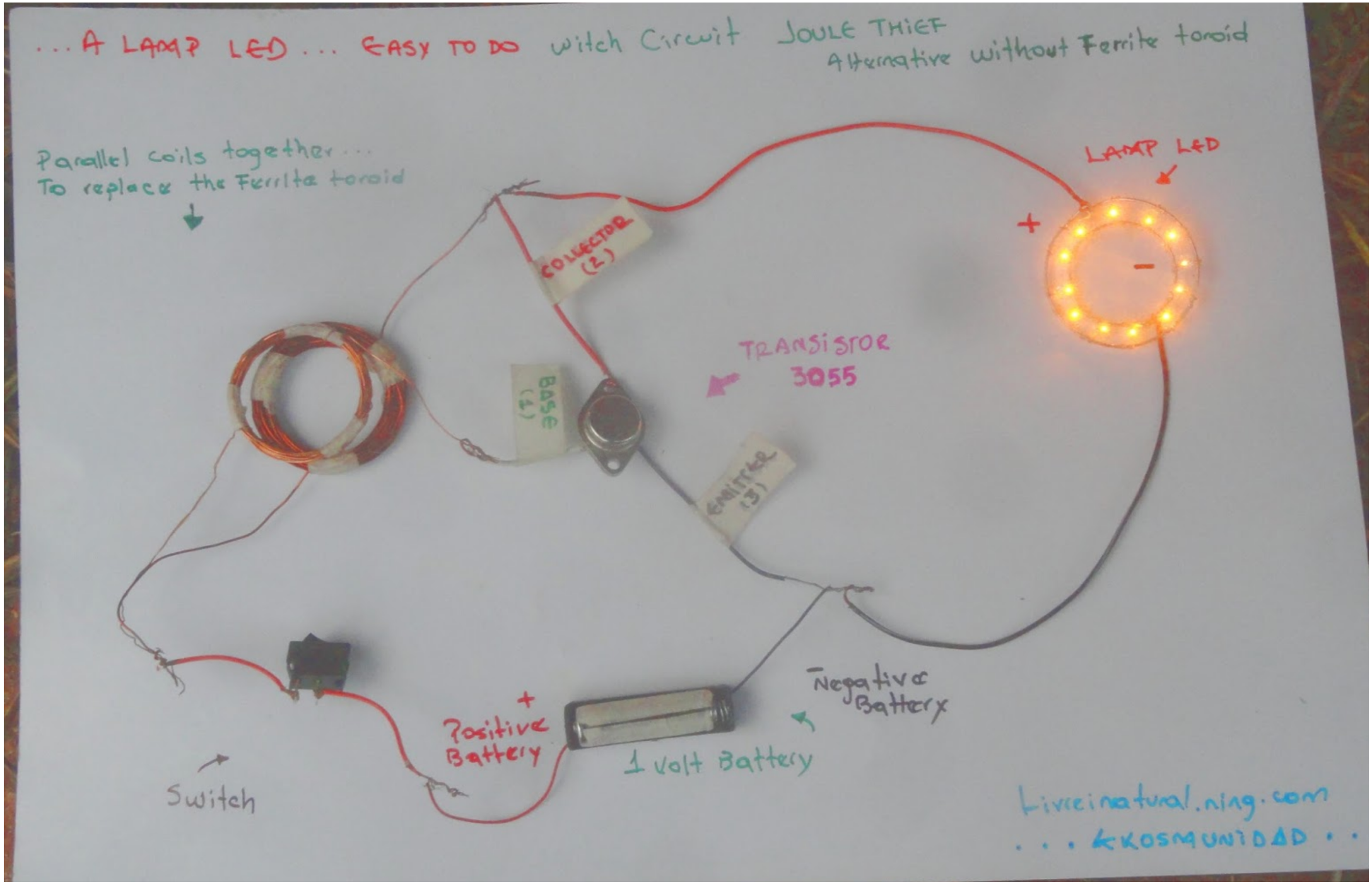
... A LAMP LED ... EASY TO DO witch Circuit JOULE THIEF
Alternative without Ferrite toroid
Parallel coils together ...
To replace the Ferrite toroid
LAMP LED
+
-
COLLECTOR (2)
BASE (1)
EMITTER (3)
TRANSISTOR 3055
Negative Battery
+
Positive Battery
1 volt Battery
Switch
Livecinatural.ning.com
... KOSMUNIDAD ..

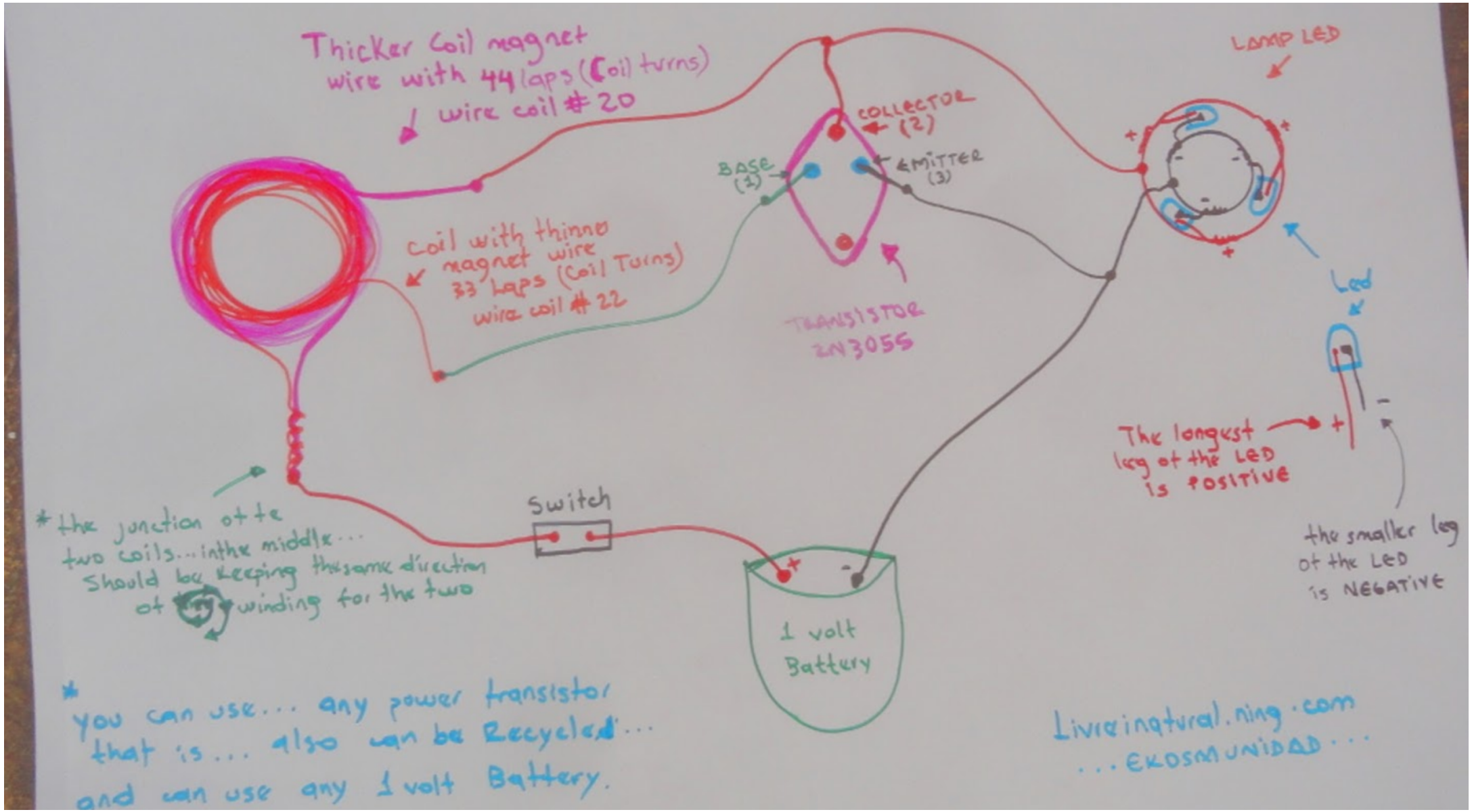
Thicker Coil magnet wire with 44 laps (Coil turns) wire coil # 20
LAMP LED
COLLECTOR (2)
BASE (1)
EMITTER (3)
Coil with thinner magnet wire 33 laps (Coil Turns) wire coil # 22
TRANSISTOR 2N3055
Led
The longest leg of the LED is POSITIVE
the smaller leg of the LED is NEGATIVE
* the junction of te two coils... in the middle... Should be keeping the same direction of winding for the two
Switch
1 volt Battery
* you can use... any power transistor that is... also can be Recycled... and can use any 1 volt Battery.
livreinatural.ning.com
...EKOSMUNIDAD...

...000... 0 ...000...

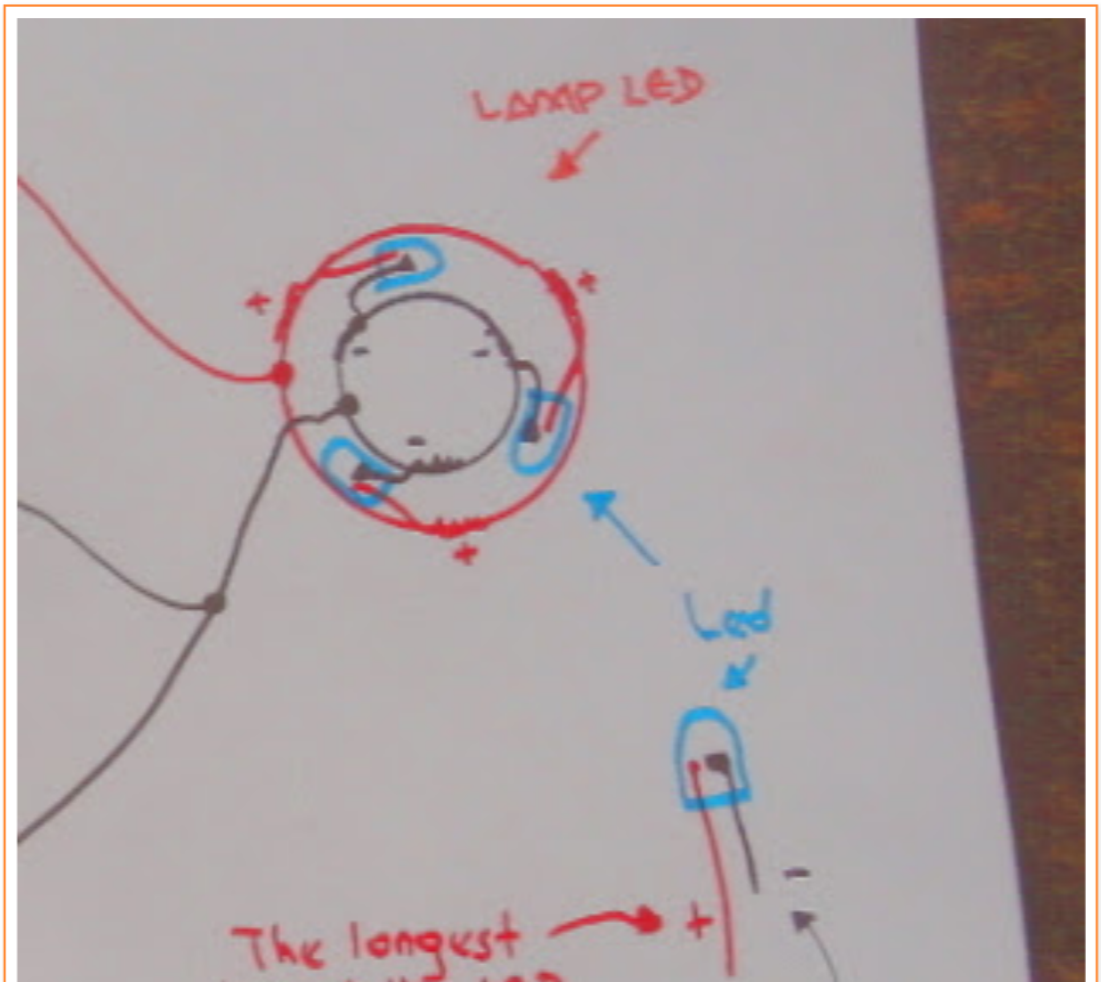
LAMP LED
Led
The longest

...Livreinatural.ning.com...
... EkosOphia ...O...

...Livreinatural.ning.com...

... TRANSISTORES ...
3055

Vista trasera
2N3055

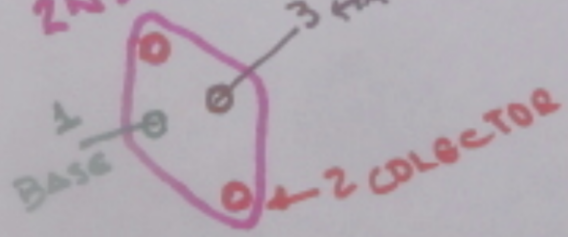

Vista frontal

1 → BASE
2 → COLECTOR
3 → EMISOR

... Livre ingatural ...
... EKOSMUNIDAD ...

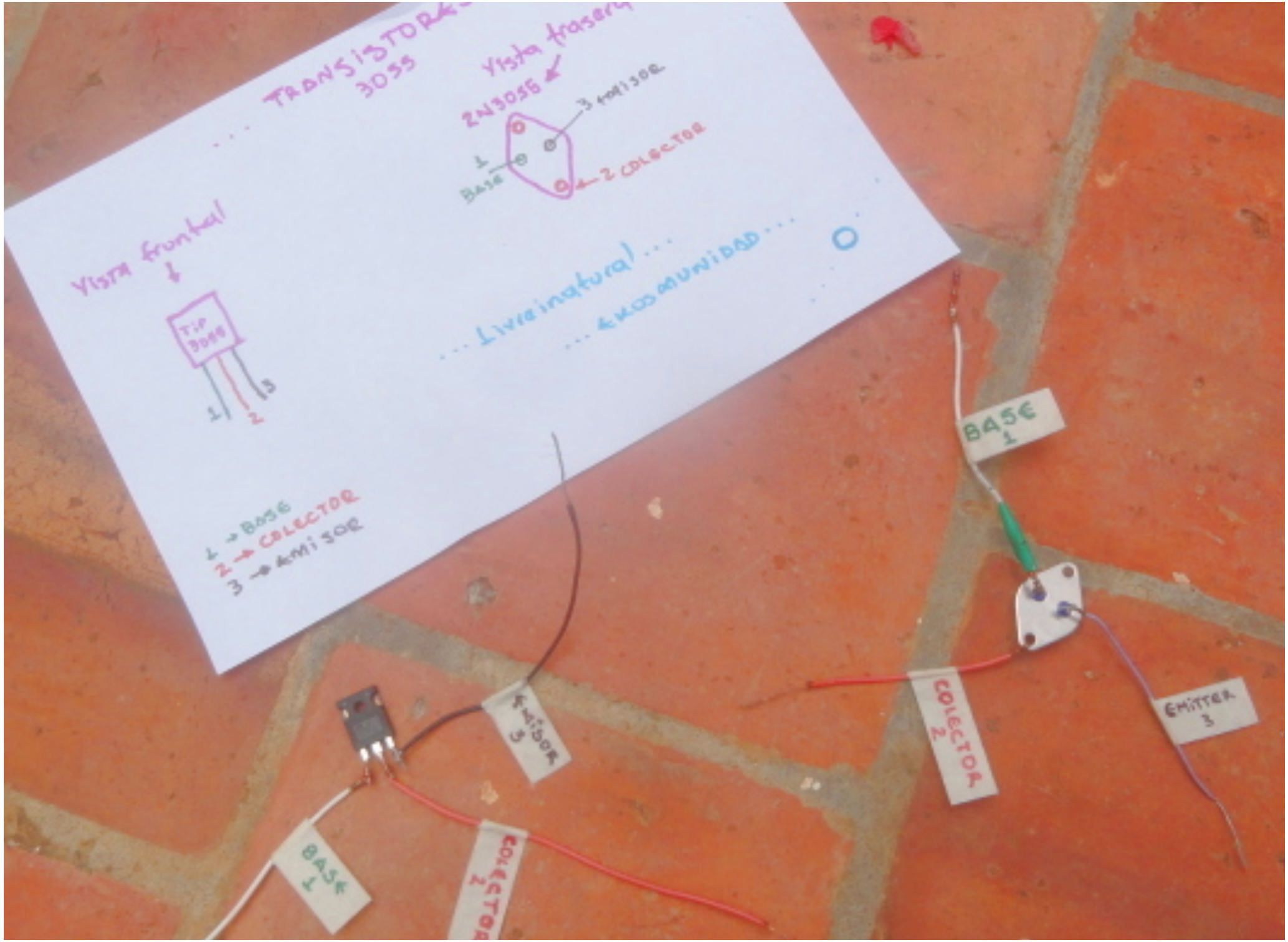
TRANSISTOR
3055
Vista trasera
2N3055
3 emisor
1
Base
2 colector
Vista frontal
TIP 3055
1
2
3
1 → Base
2 → Colector
3 → emisor
BASE
1
COLECTOR
2
EMITTER
3
BASE
1
COLECTOR
2
EMISOR
3

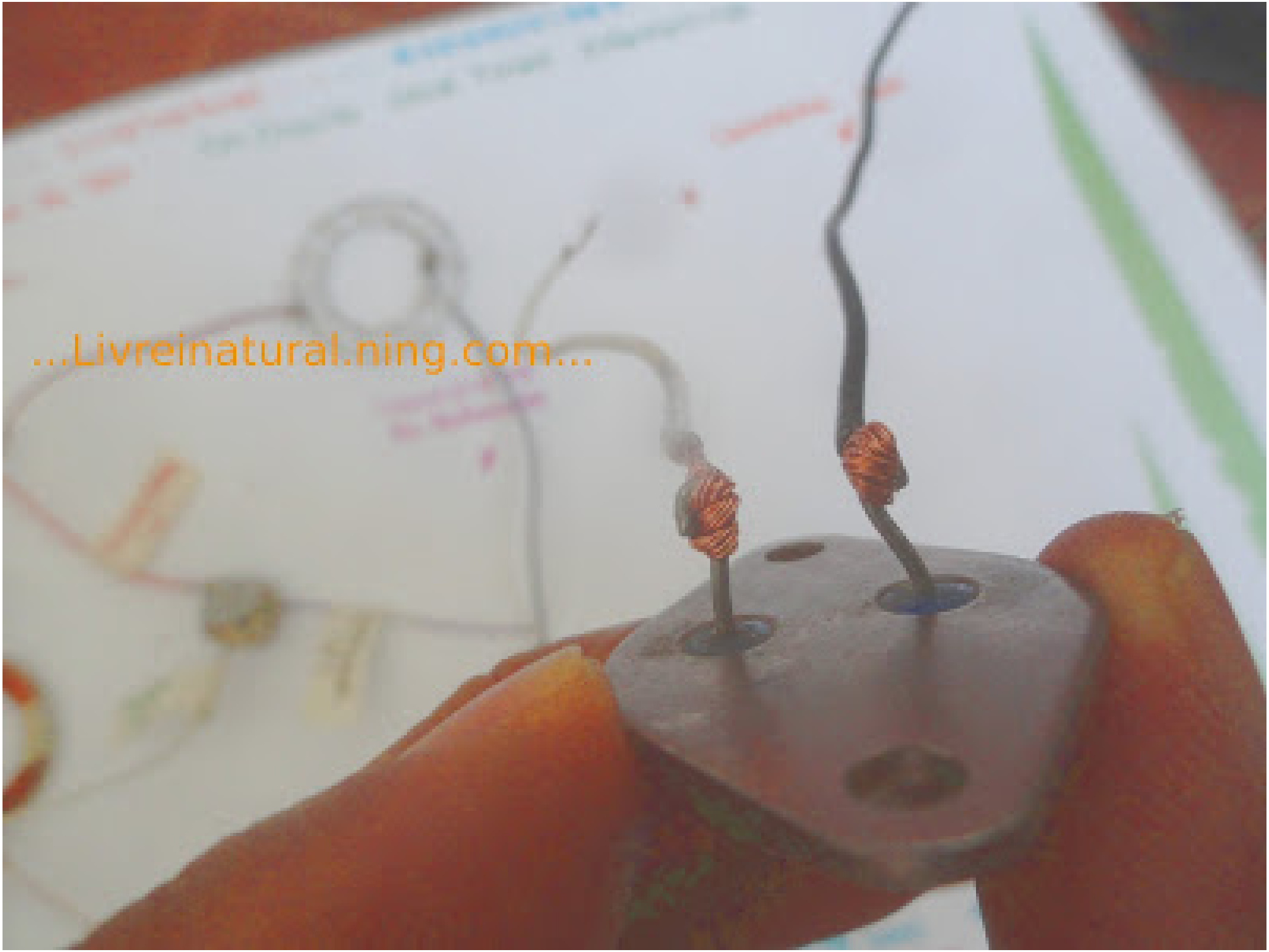
...Livreinatural.ning.com...

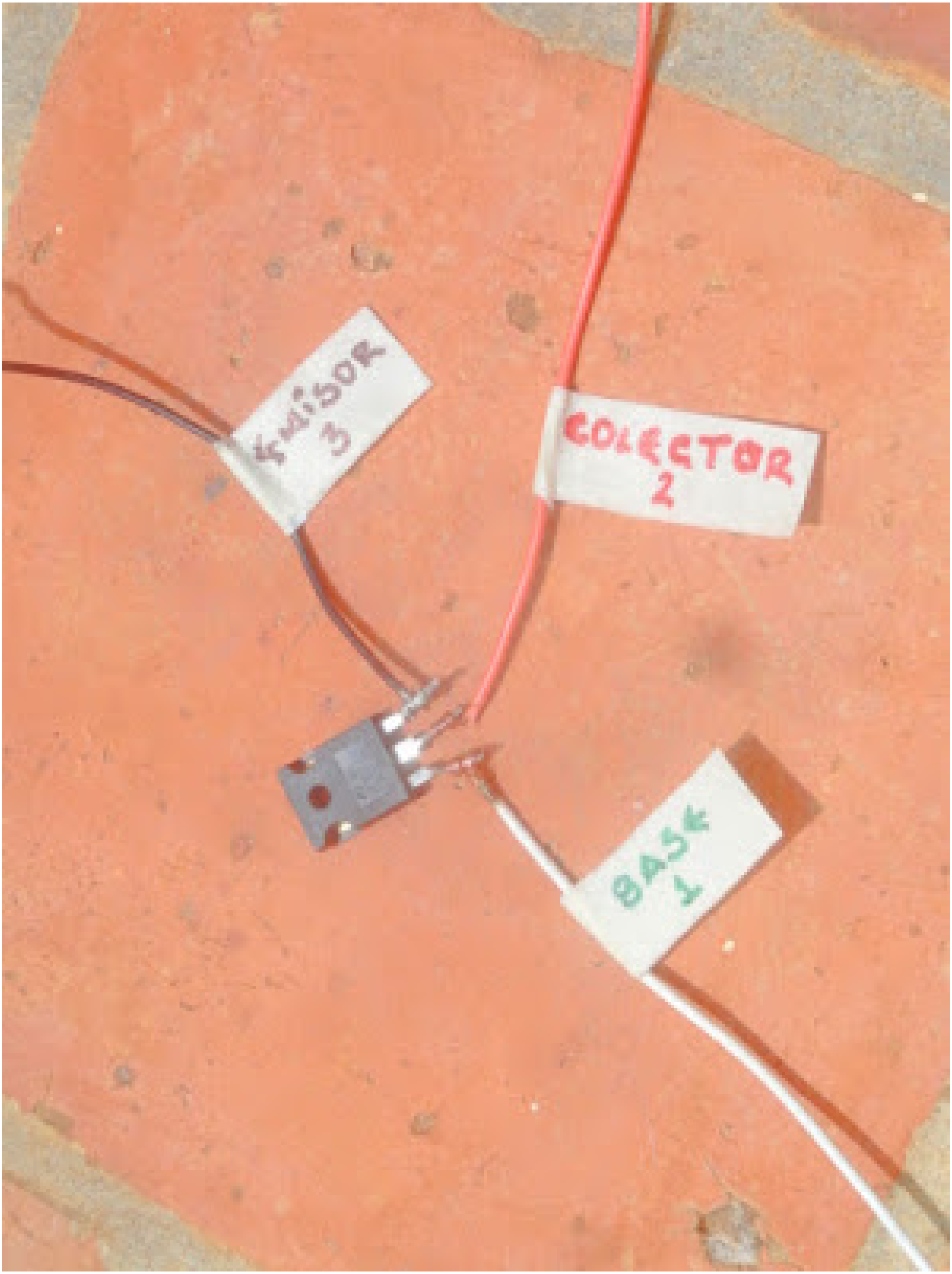
EMISOR
3
COLECTOR
2
BASE
1

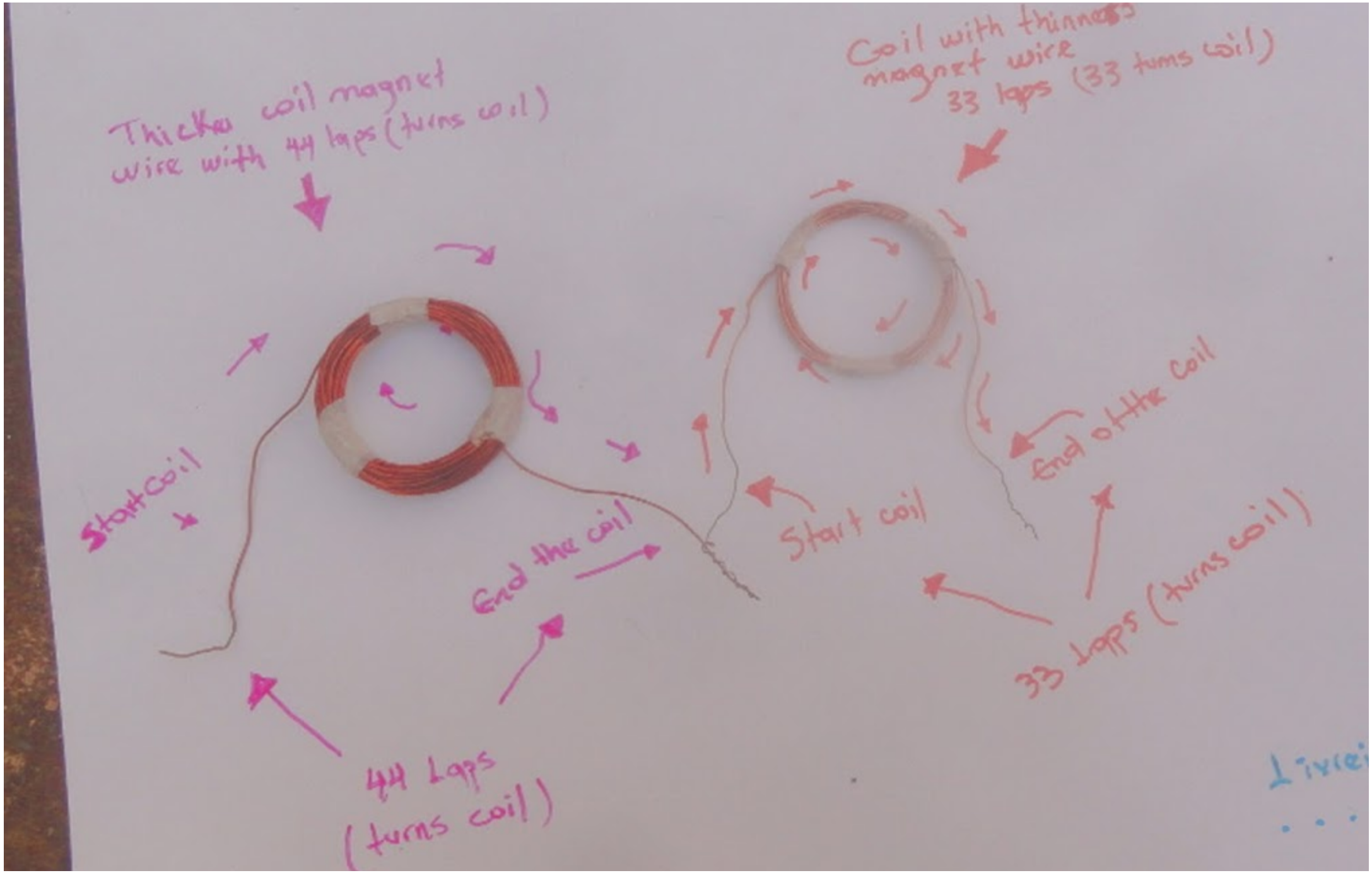
Thicker coil magnet wire with 44 laps (turns coil)
Coil with thinner magnet wire 33 laps (33 turns coil)
Start coil
End the coil
Start coil
End of the coil
33 laps (turns coil)
44 Laps (turns coil)

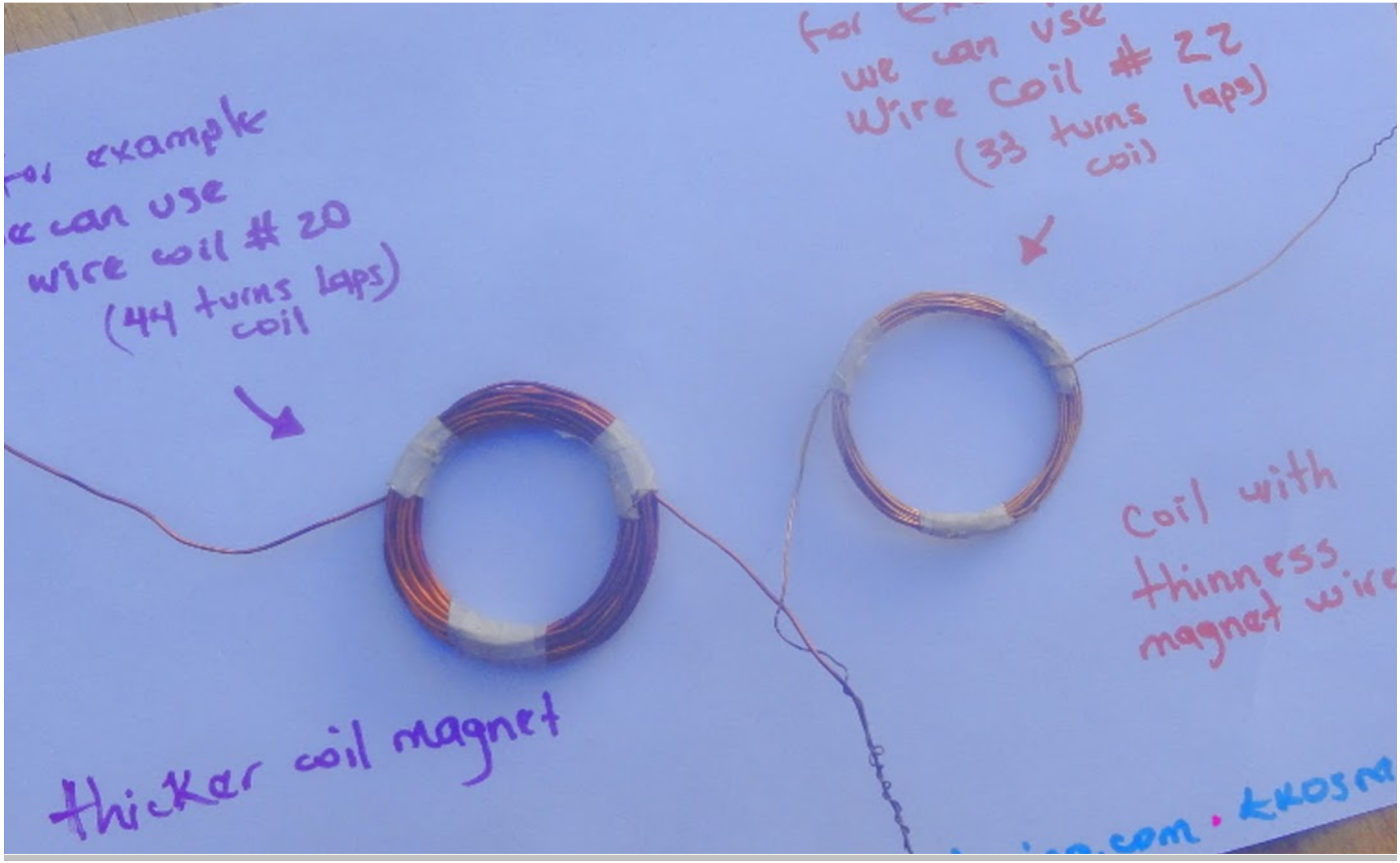
for example
we can use
wire coil # 20
(44 turns laps)
coil
for
we can use
Wire Coil # 22
(33 turns laps)
coil
Coil with
thinness
magnet wire
thicker coil magnet

This provision replaces the use of the ferrite toroid in the Joule Thief

thicker coil magnet wire with 44 laps (coil turns)
For example we can use wire coil # 20

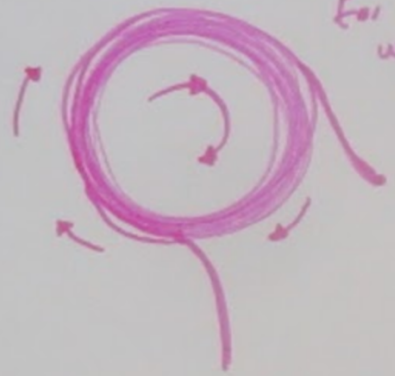

The junction of the two coils... in the middle should be keeping the same direction of winding for the two

For example

Coil with thinness magnet wire 33 laps (coil turns)
for example we can use wire coil # 22

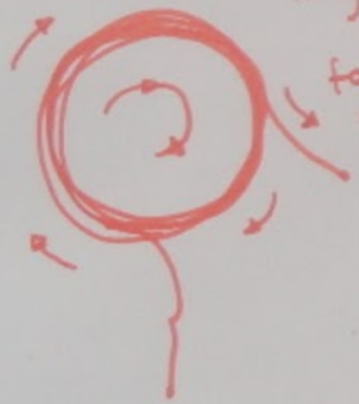

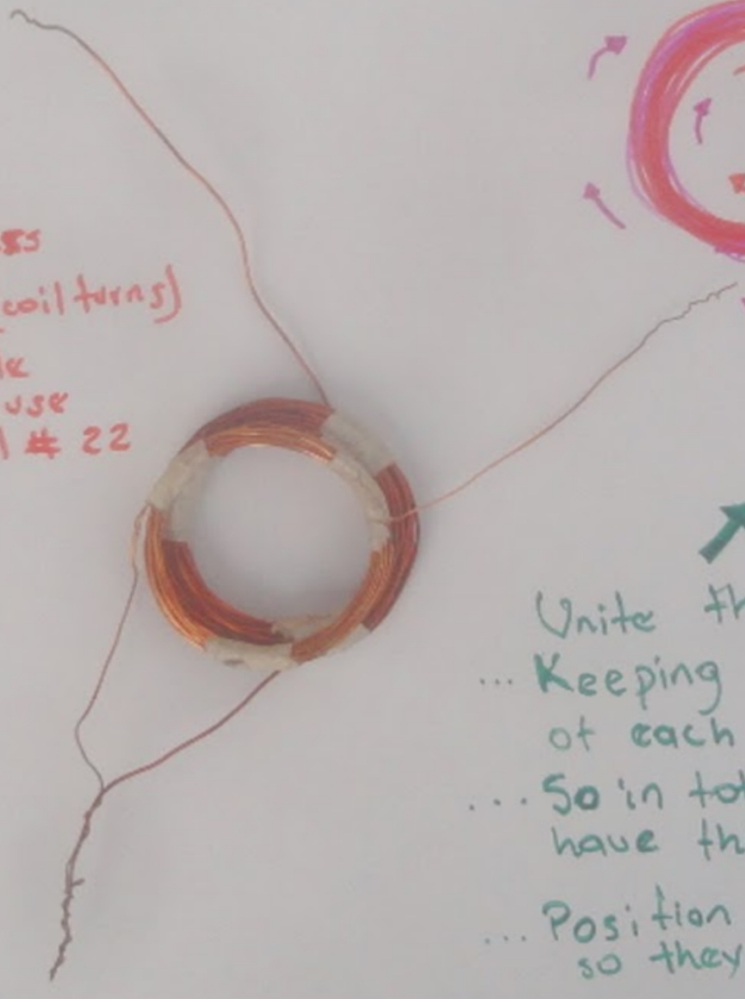

Unite these two coils...
... Keeping the same rotation direction of each coil...
... So in total the union of the two coils have the same rotational.
... Position a coil above the other so they are parallel

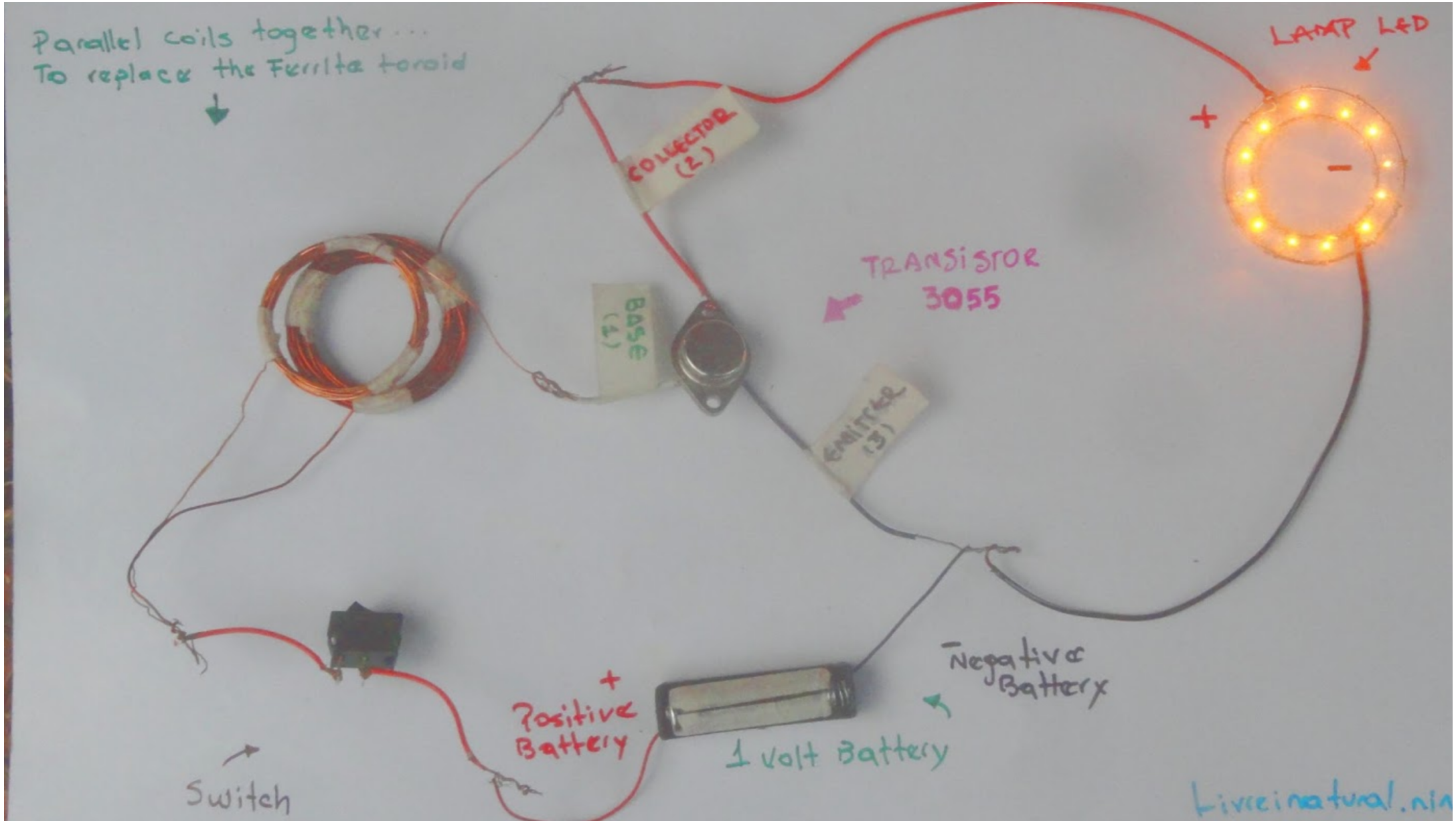
Parallel coils together...
To replace the Ferrite toroid
LAMP LED
+
-
COLLECTOR (2)
BASE (1)
EMMITTER (3)
TRANSISTOR 3055
+
Positive Battery
Negative Battery
1 volt Battery
Switch
Livreinatural.nin

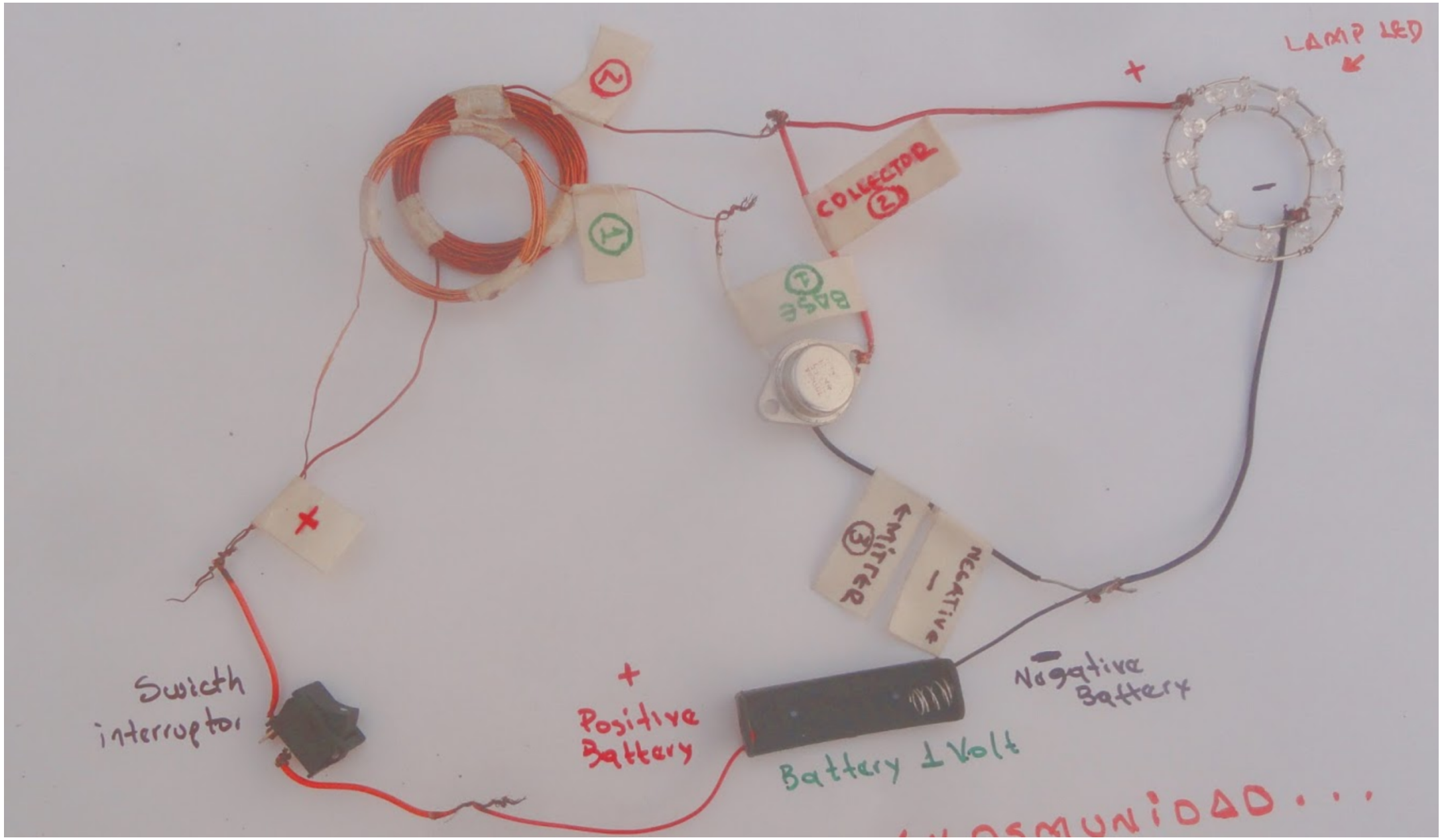
LAMP LED
+
COLLECTOR
2
BASE
3
EMITTER
3
NEGATIVE
-
+
Switch
interruptor
+
Positive
Battery
Battery 1 Volt
-
Negative
Battery

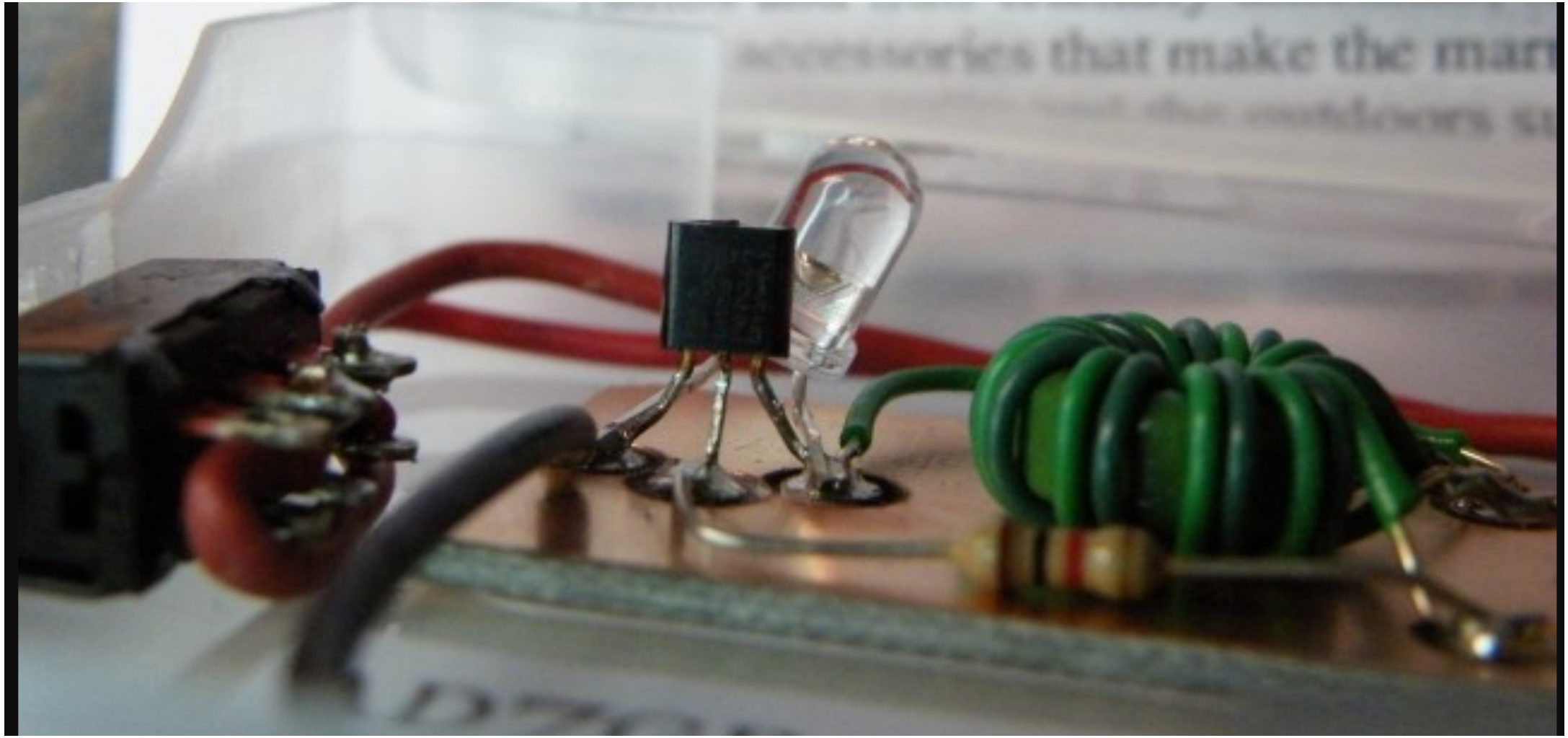
accessories that make the mar

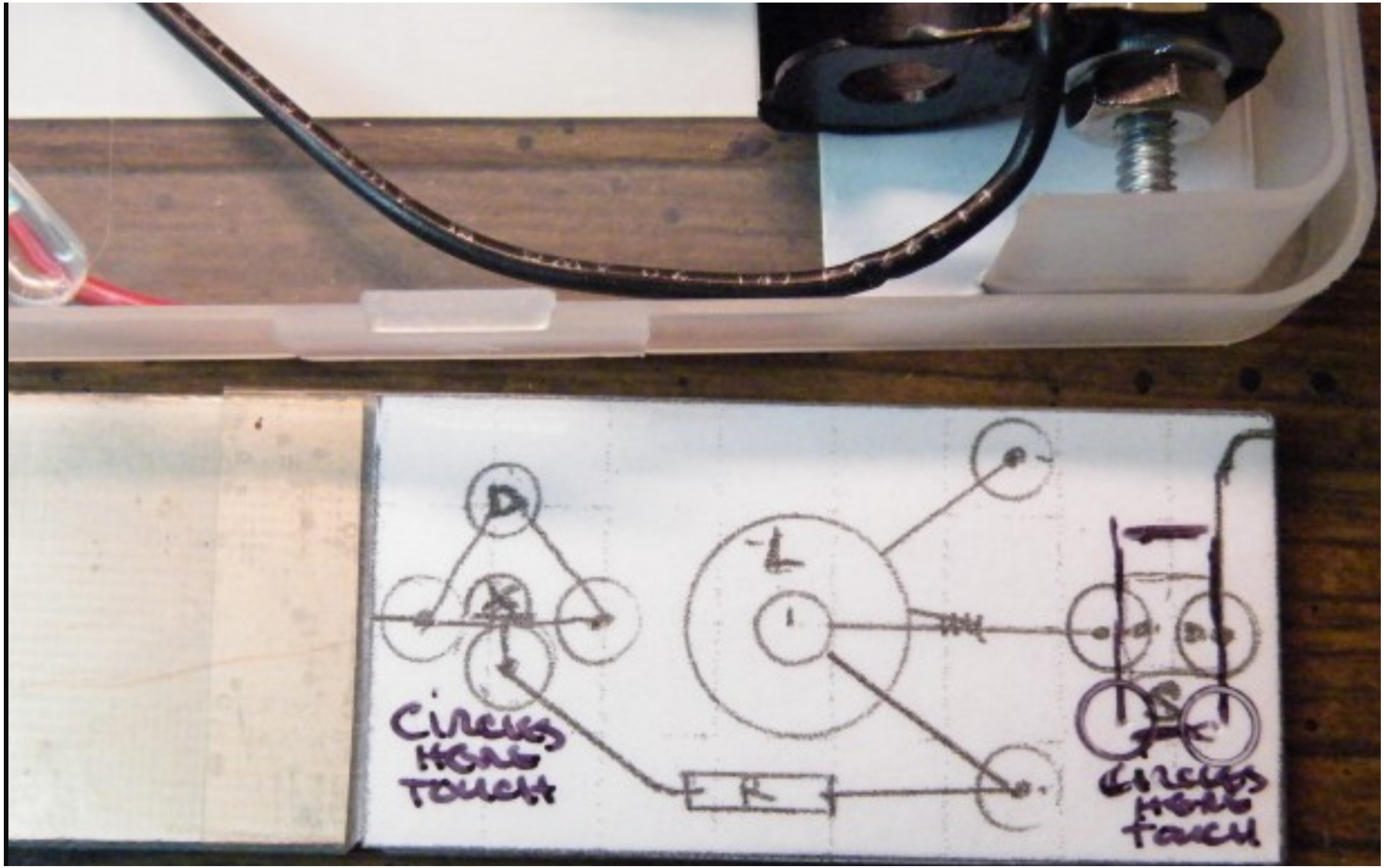
D
L
R
CIRCUIT HOME TOUCH
CIRCUIT HOME TOUCH

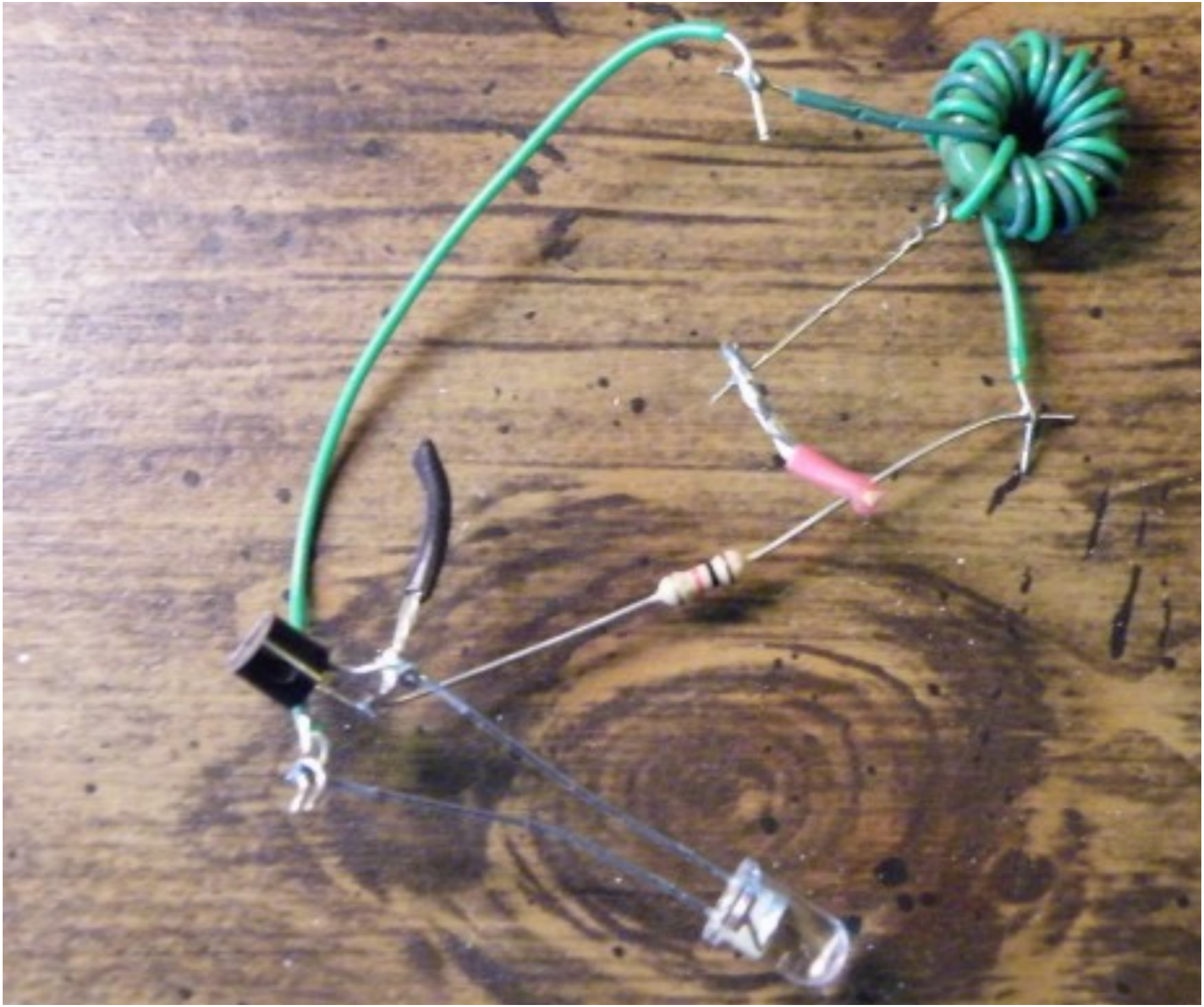

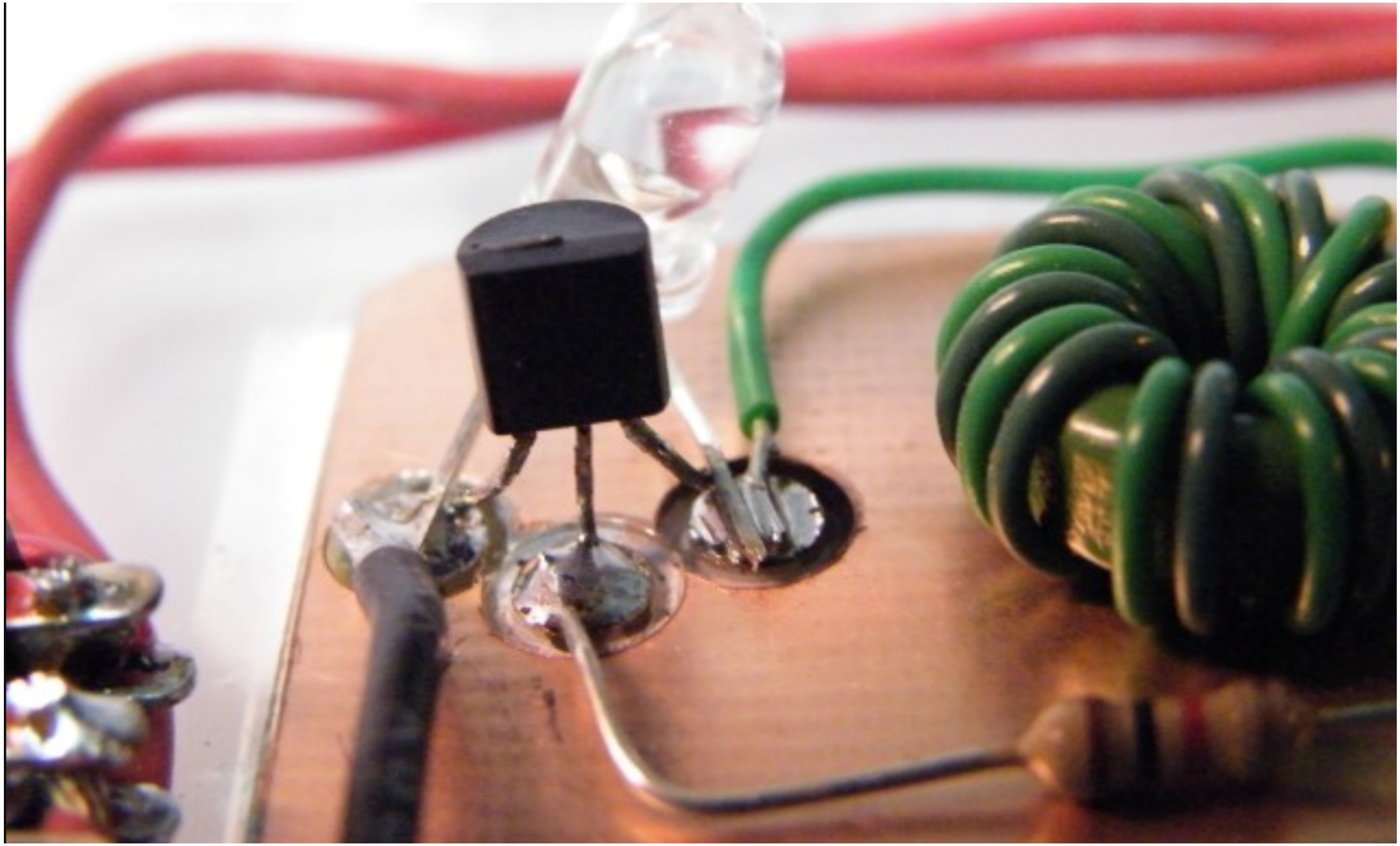

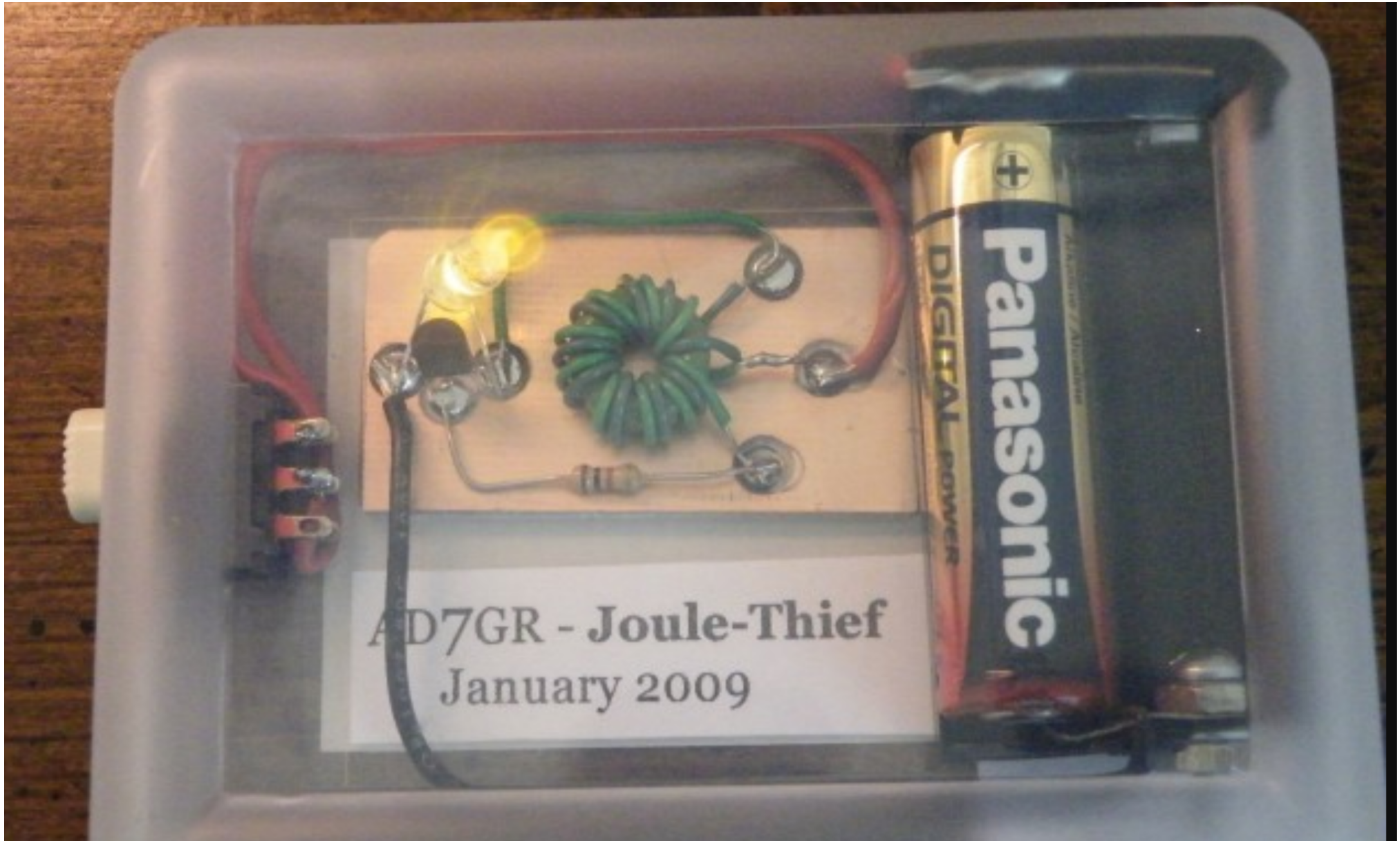
AD7GR - Joule-Thief
January 2009
Panasonic
DIGITAL POWER

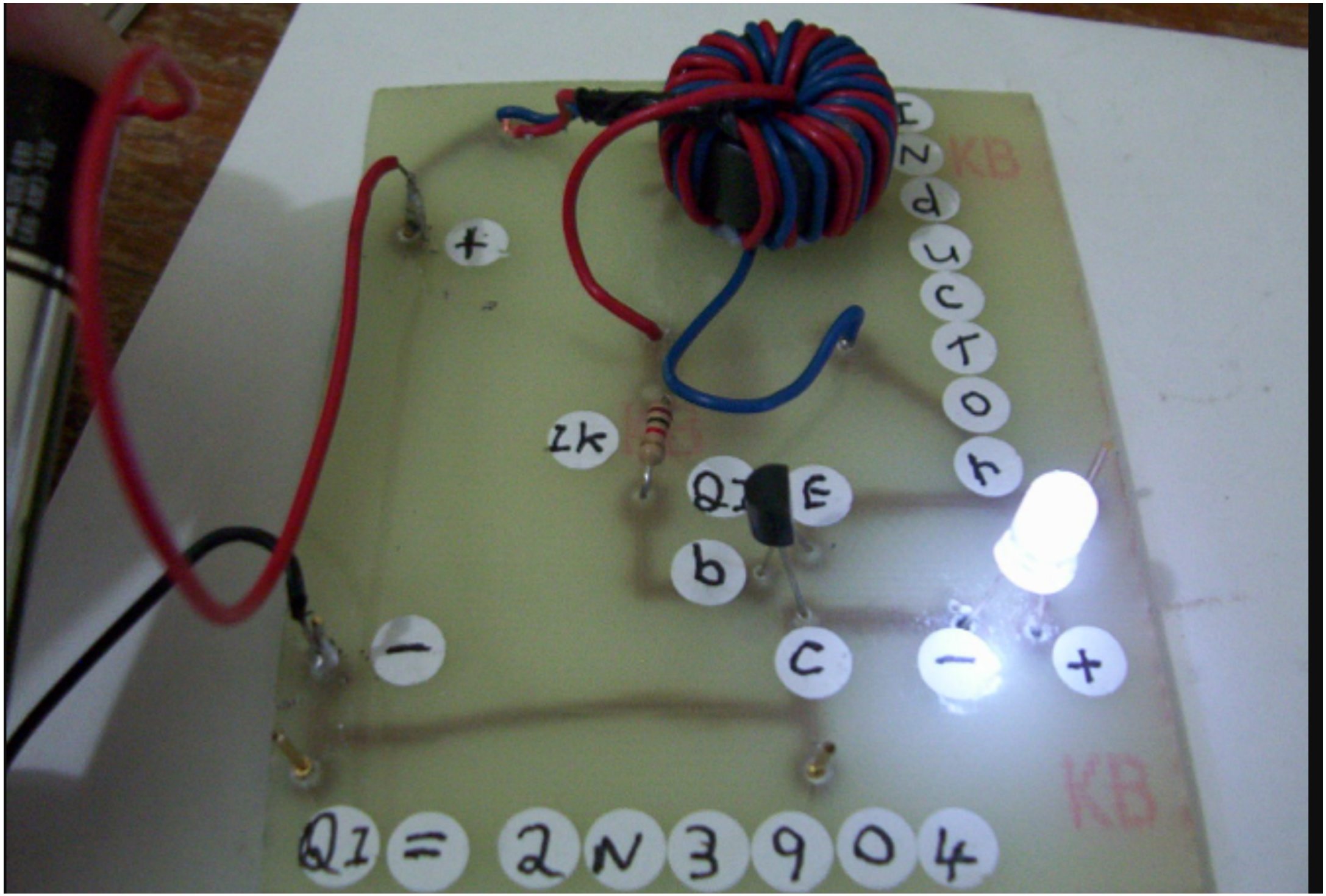
+
1k
Q1
E
b
C
−
+
−
Inductor
Q1 = 2N3904

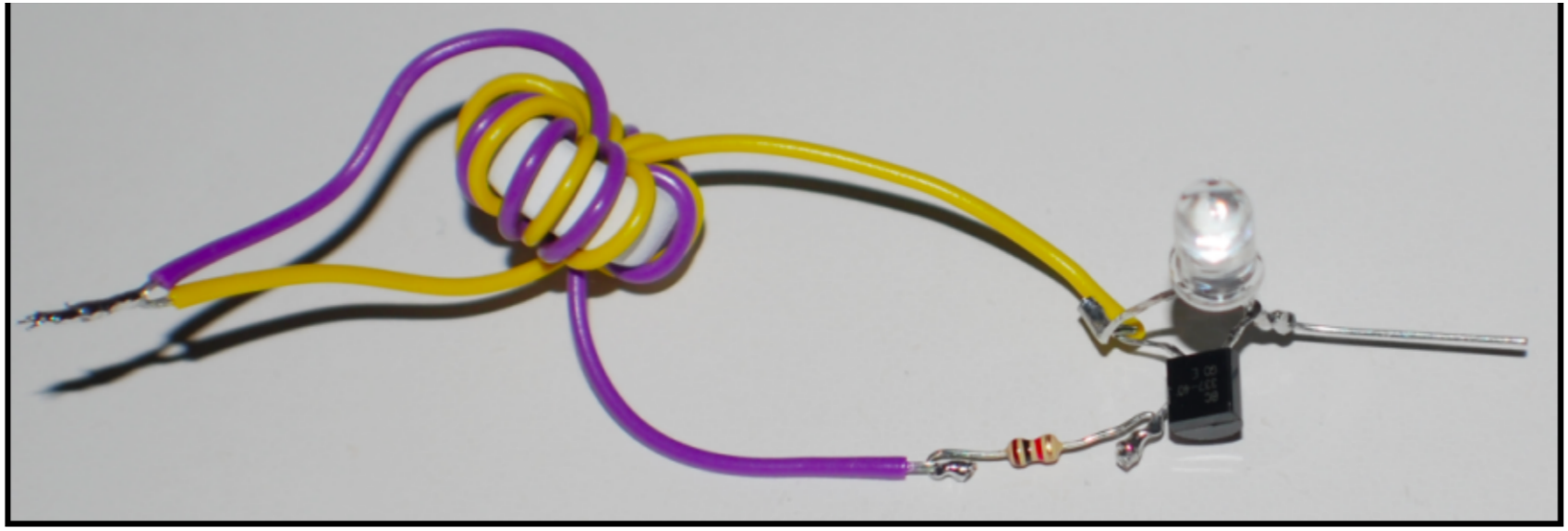

... and these are the components you need:

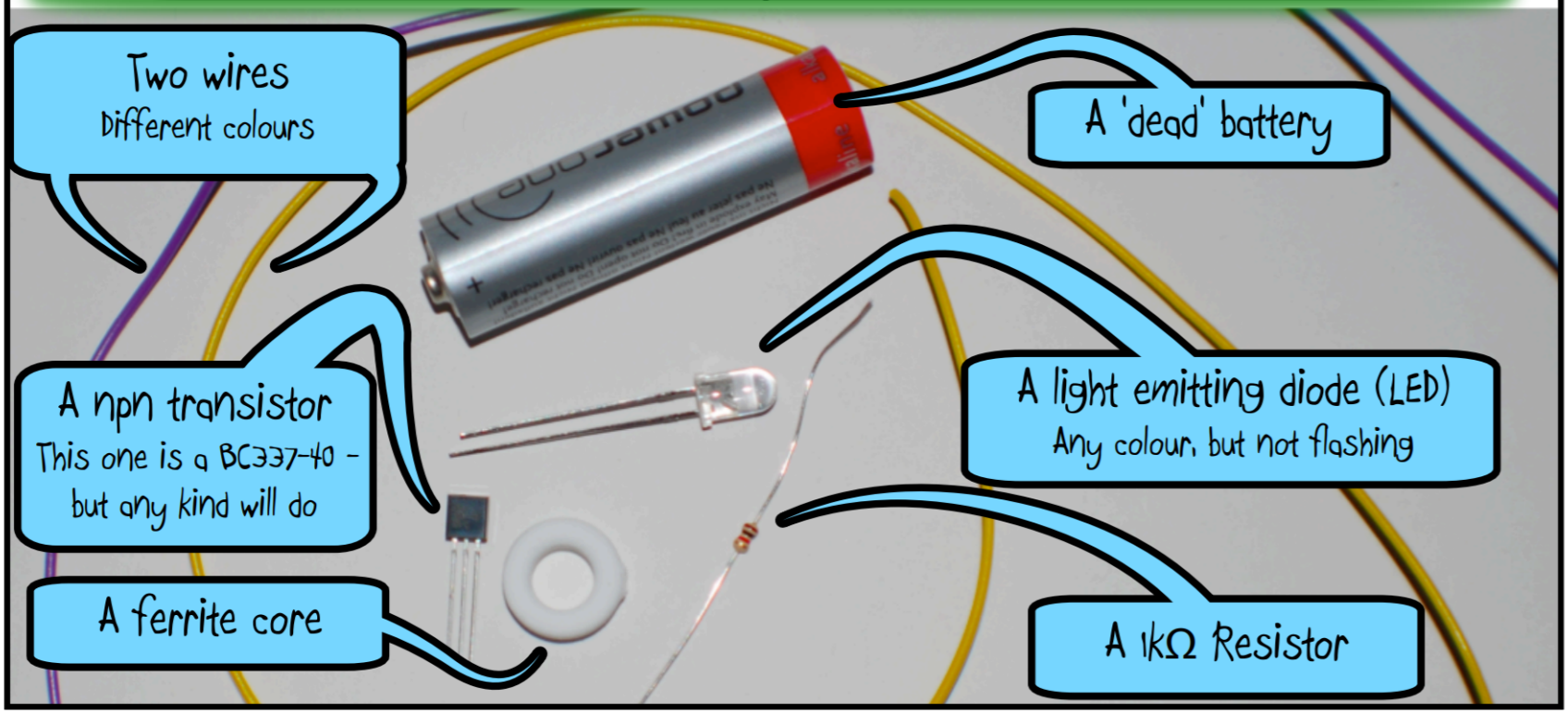

Solder the 1kΩ Resistor to either of the unsoldered wires coming from the inductor.

Solder the other end of the resistor to the base lead of the transistor.
On the transistor used here, that is the middle lead.
Cut off the spare ends of leads.

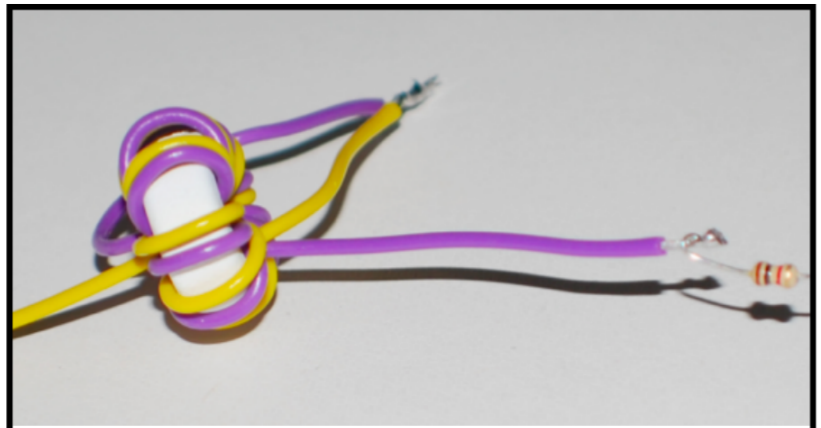

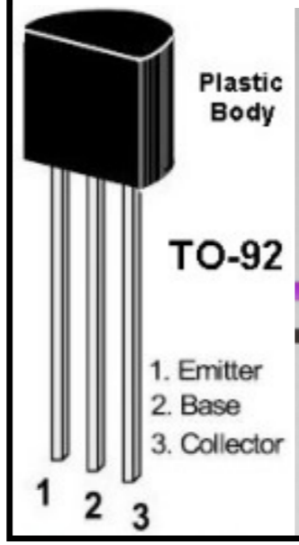

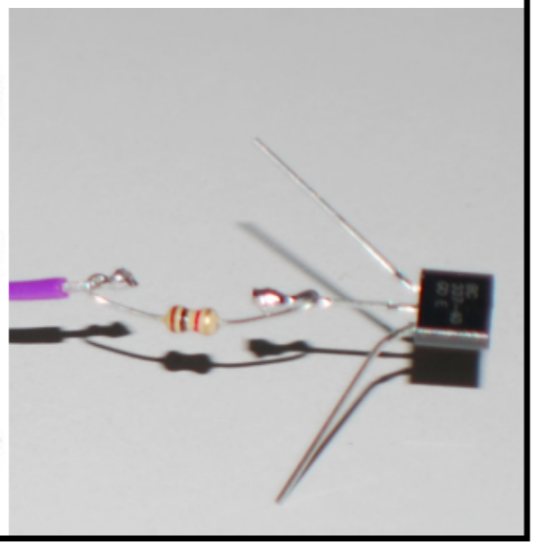

Solder the anode of the LED (the longer leg) to the collector lead of the transistor AND the remaining wire from the inductor.
Cut off the ends of the leads.

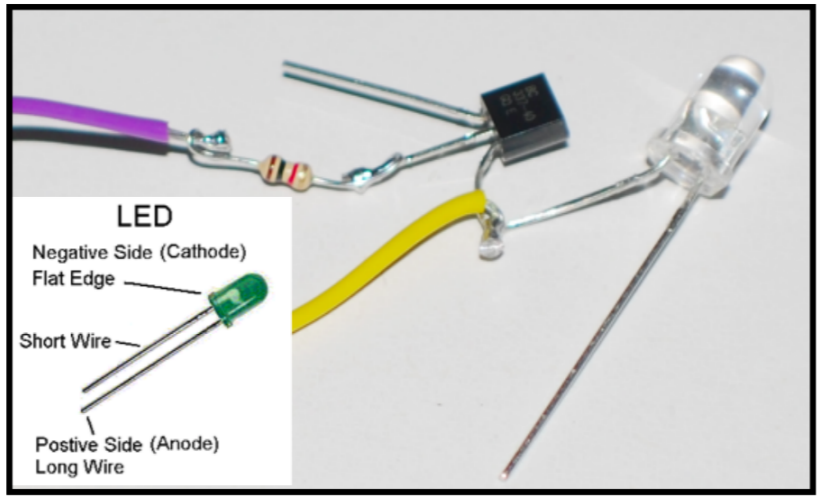

Solder the other leg of the LED (the cathode) to the emitter lead of the transistor.
Do NOT cut off the LED leg.
(Don't wory if you have cut it off - you'll just need to solder another wire to this leg so that you can connect it to the battery.)

That's the circuit finished. Now use it.

First you need a 'dead' battery - that means one where the voltage is less than 1.3V.
You can see that the battery used here has a Voltage of just over 1V.

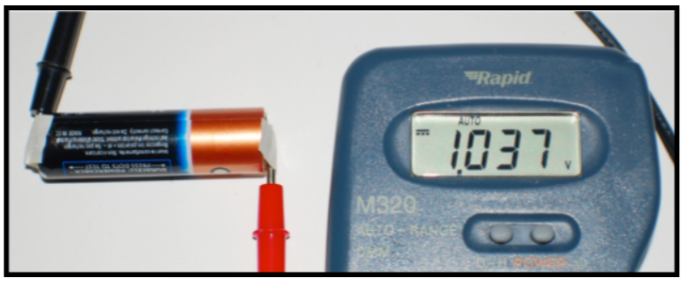

Connect the two soldered wires coming from the inductor to the positive (+) side of the battery.
Connect the uncut LED leg (the athode) to the negative (-) side of the battery.

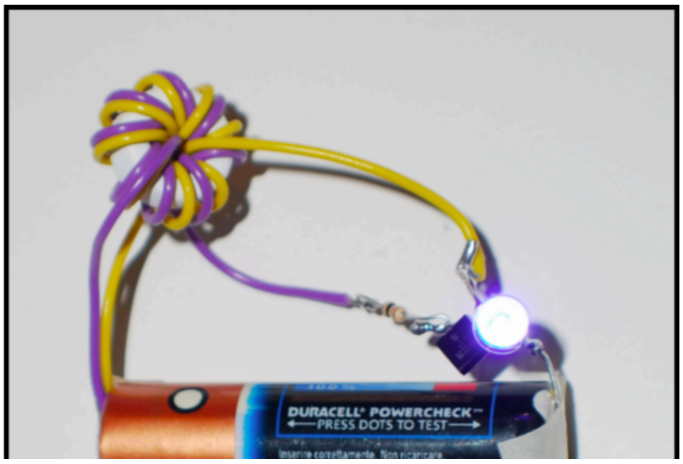

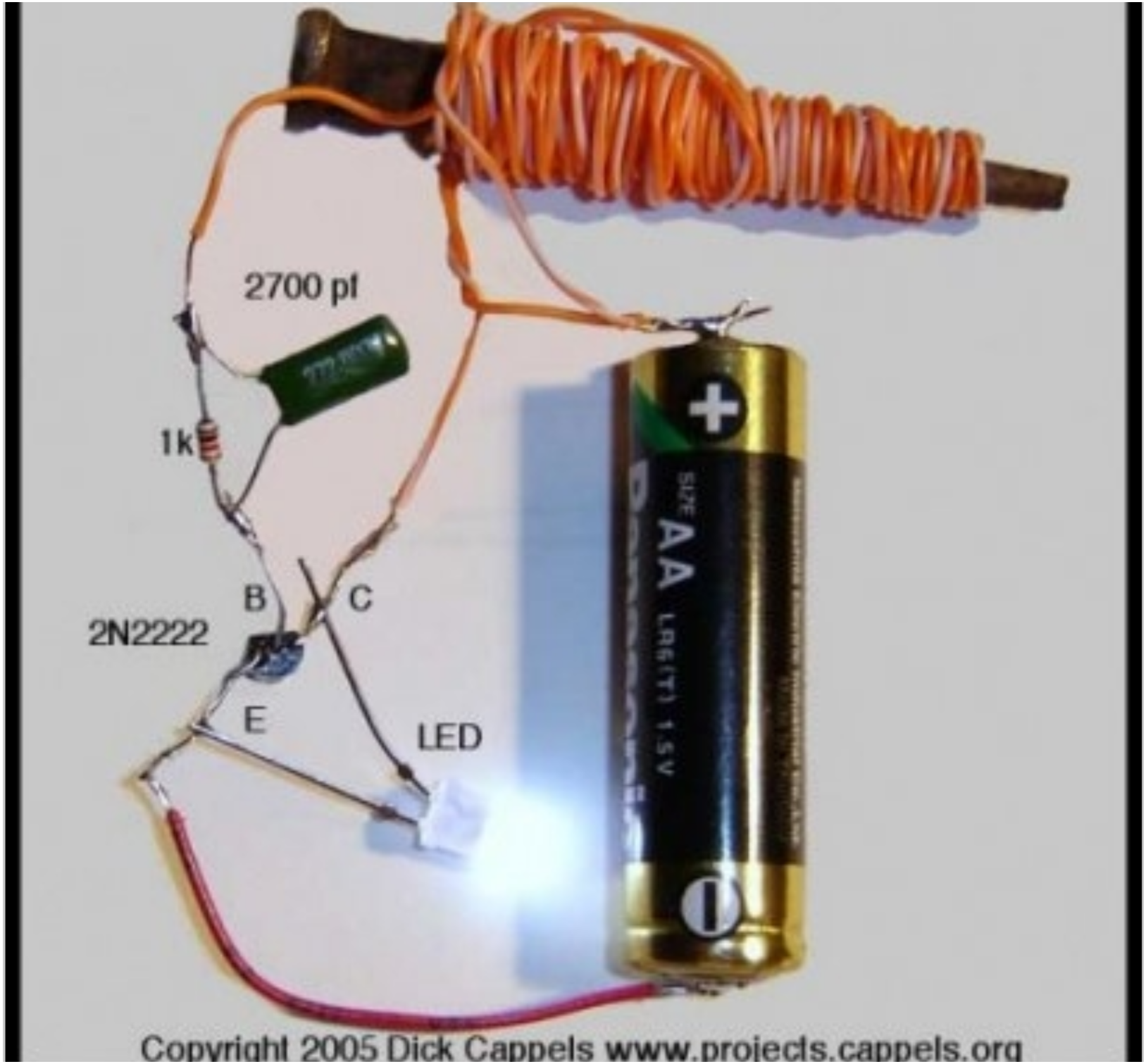
2700 pf
1k
B
C
2N2222
E
LED
SIZE
AA
LR6(T) 1.5V
Copyright 2005 Dick Cappels www.projects.cappels.org

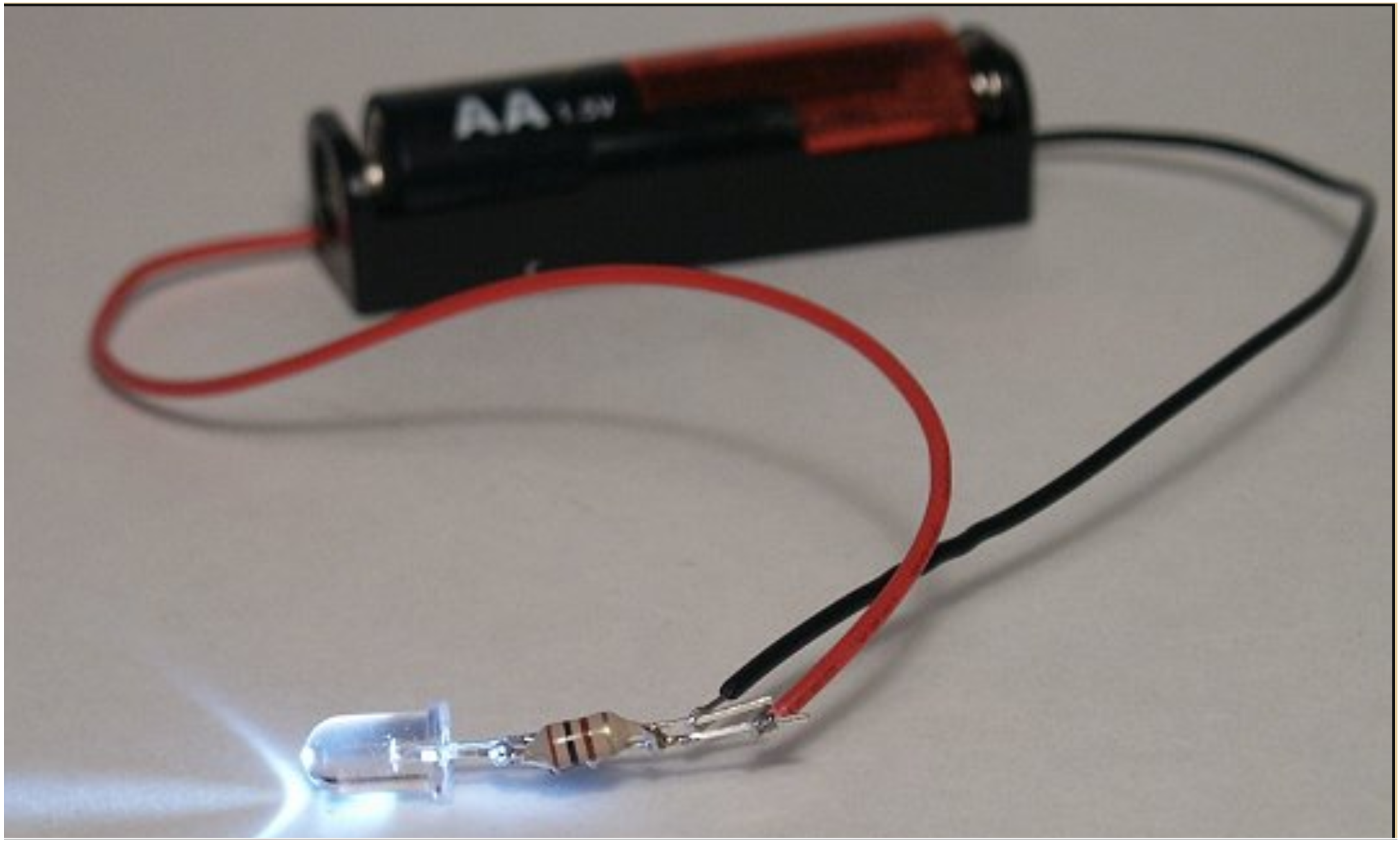
AA 1.5V

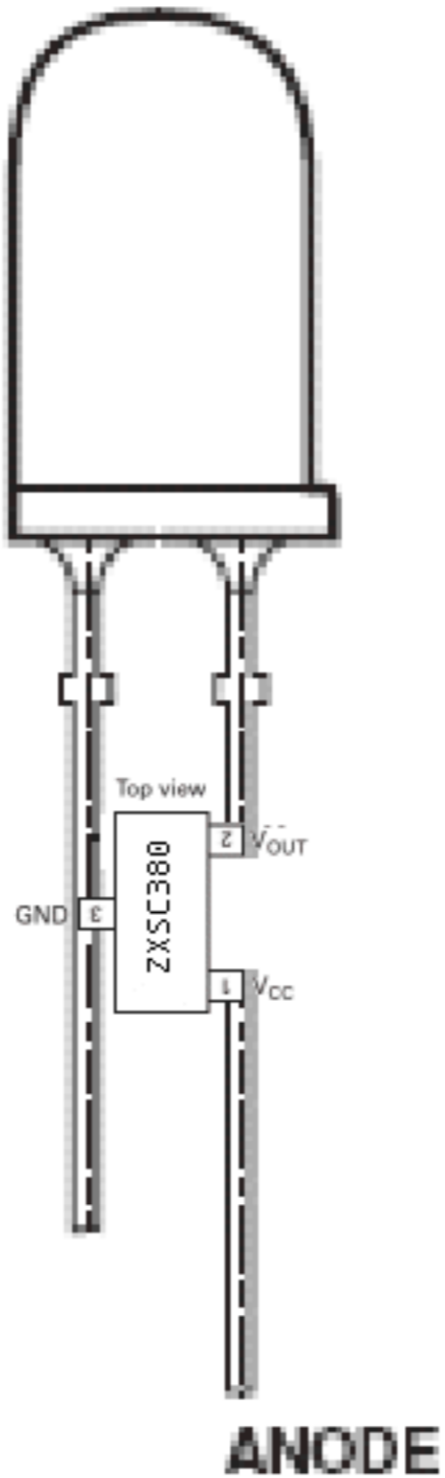

The chip is soldered onto the legs of the LED and then the wire between pins 1 and 2 is cut out so there is no connection. The inductor is then soldered so as to bridge pins 1 and 2. I soldered the inductor on before cutting out the wire but it might be easier to try some other method.

As I said previously, this is a tedious solder job, and the SOT23 IC is easily damaged (ask me how I know!) It takes patience and a steady hand to assemble these few parts.

This circuit would work for the LED indicator in the 1.5v boosters and would most likely be a better choice than the Joule Thief that I posted previously.

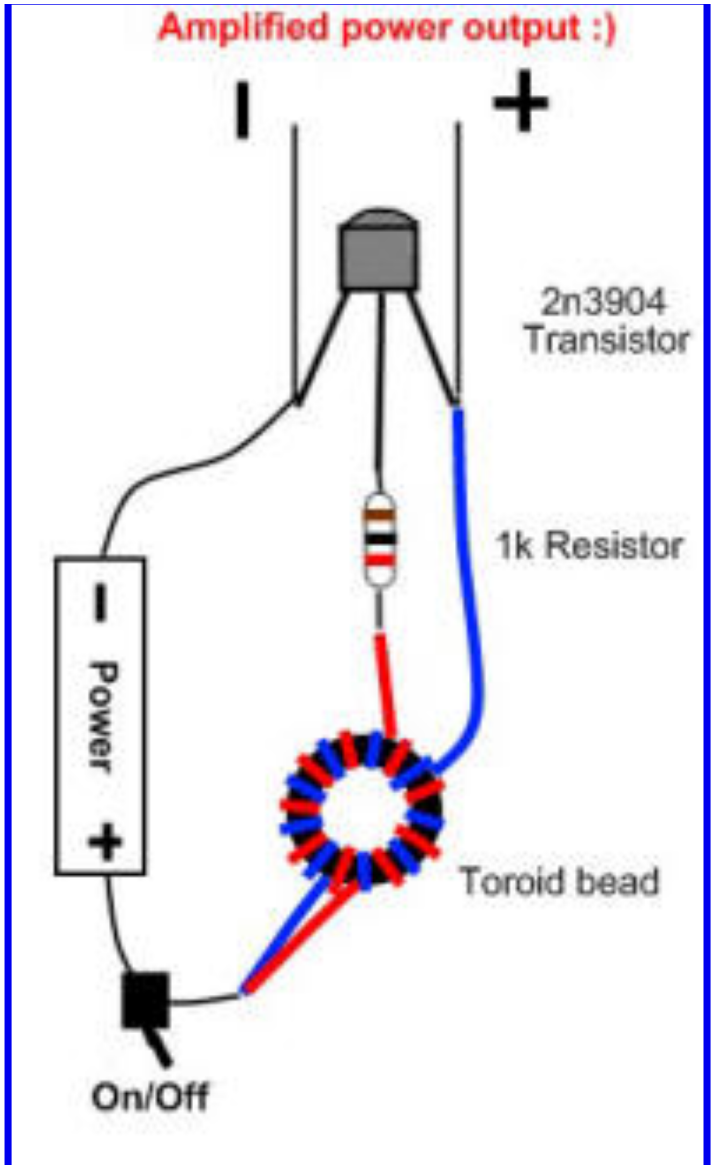
Amplified power output :)
I
+
2n3904
Transistor
1k Resistor
I
Power
+
Toroid bead
On/Off

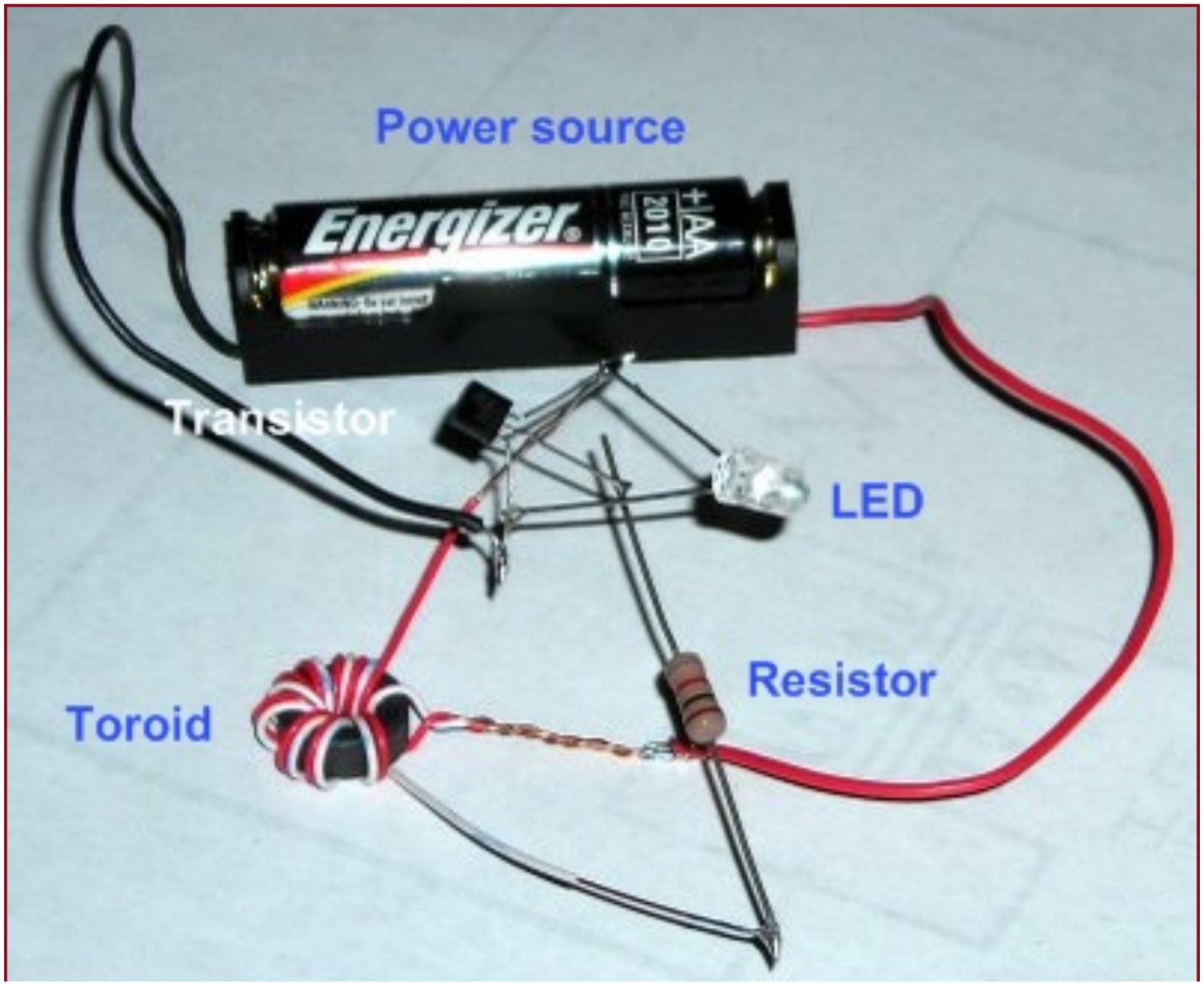
Power source
Energizer
Transistor
LED
Resistor
Toroid

The CIRCUIT

The circuit is very simple. All the work is done by the 5252F chip.
It contains an oscillator, a high speed diode and a power transistor. All these components inside the "IC" that looks like a 4-leaded transistor!
This IC is smaller and cheaper than all the parts individually and is less expensive than the competition (that costs 70 cents).
We can produce a complete project for a few dollars and it has two "test features."
You can place a LED across one of the LEDs on the board and find out the colour as many LEDs come in a "clear-as-glass" package and you cannot tell the colour until they are illuminated.
The other feature is INDUCTOR TESTING.
The current taken by the circuit changes according to the value of the inductor.
You just need a few reference values and you can work out the value of an inductor within the range of the inductors you have used as samples, or slightly higher or lower values.

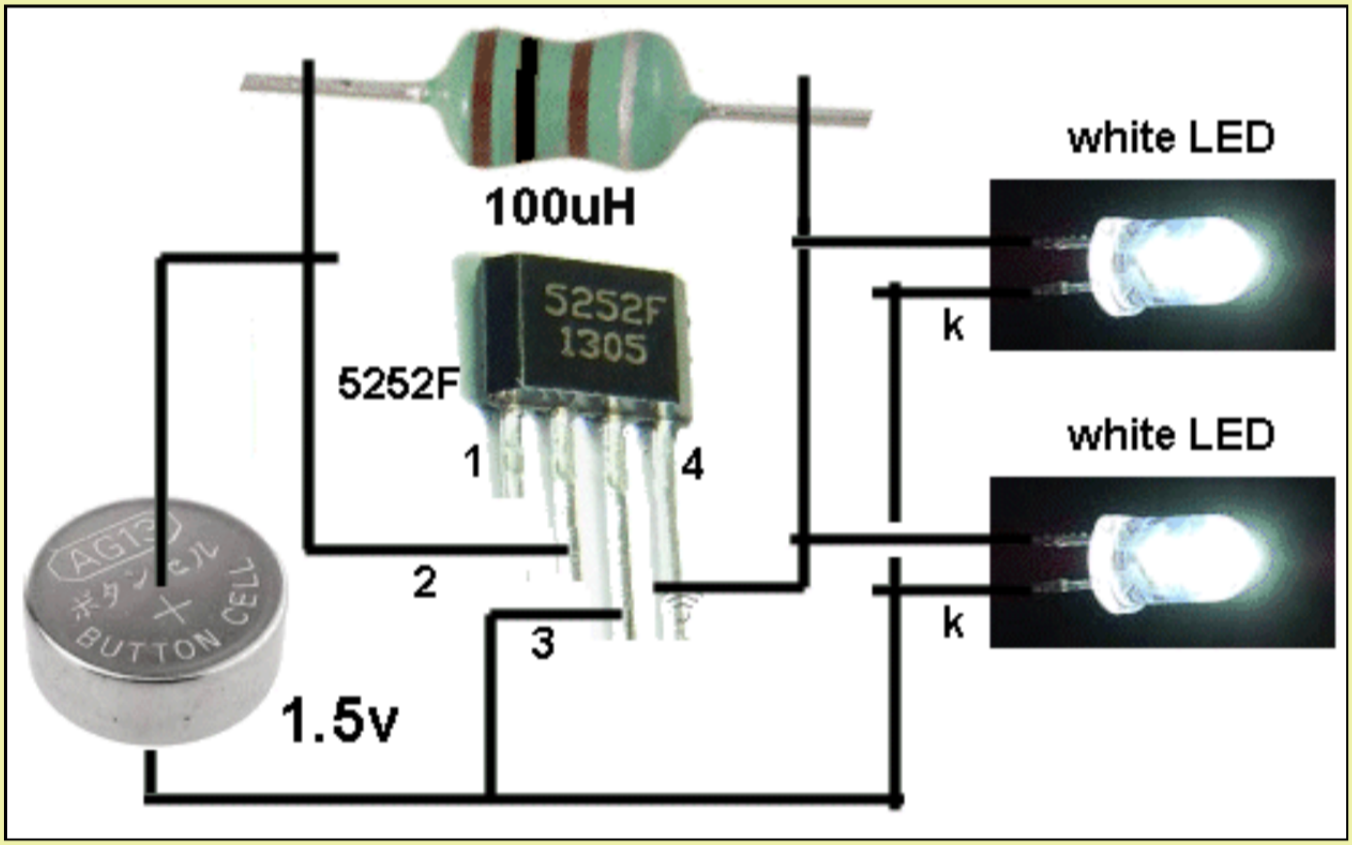

The layout using component pictures.

Using a 220uH, the circuit takes 13mA and illuminates 2 white LEDs very brightly.
Using 100uH the circuit takes 30mA and the LEDs are really the same brightness.
Using 33uH the circuit takes 80mA and the LEDs are just about the same brightness.
Obviously the 220uH creates the most efficient circuit.
The QX5252F is capable of delivering more than 100mA to the LEDs but we only need

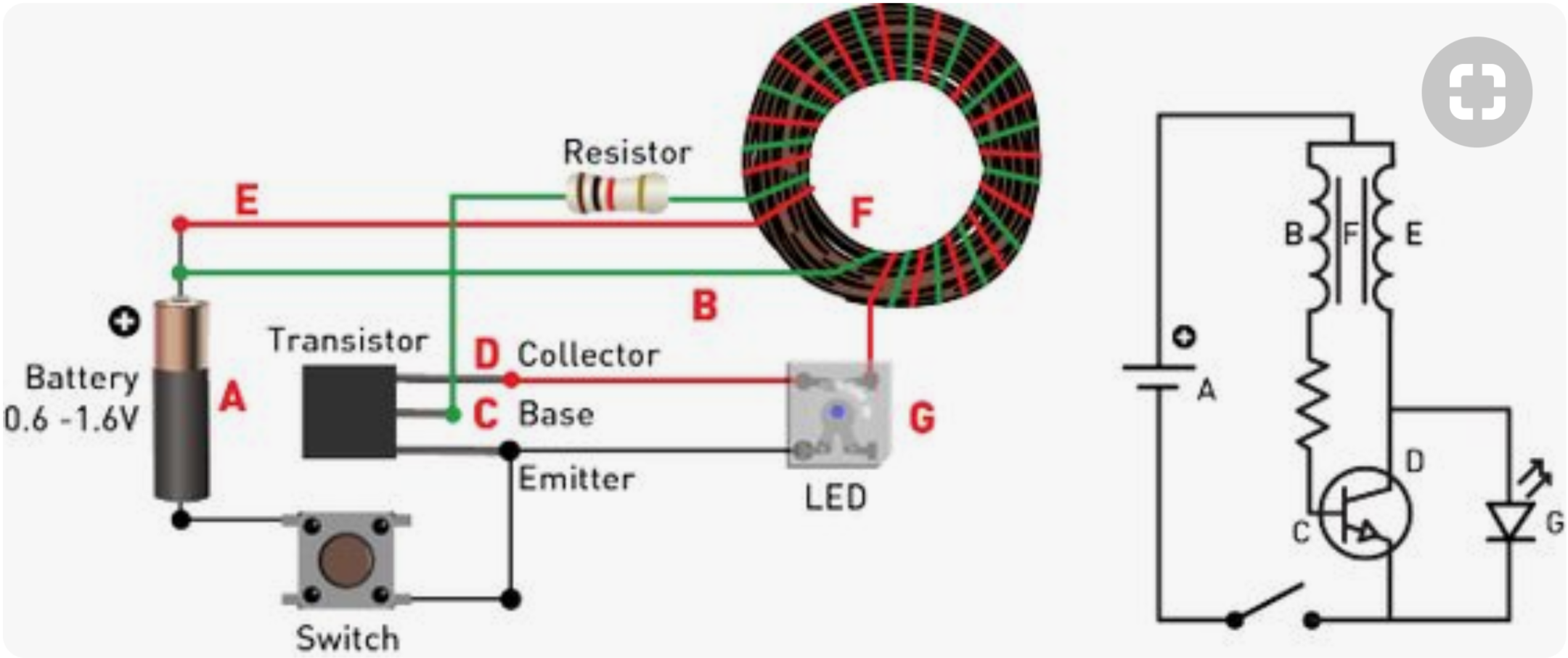
Resistor
E
F
B
Transistor
D Collector
Battery
0.6 -1.6V
A
C Base
G
Emitter
LED
Switch
B
F
E
A
D
C
G

Watson's 2 Transistor "Joule Thief" V. Booster

Uses 2N3904 for output. Coil is 180 microhenry, 2.5 ohm RF choke (green blob)

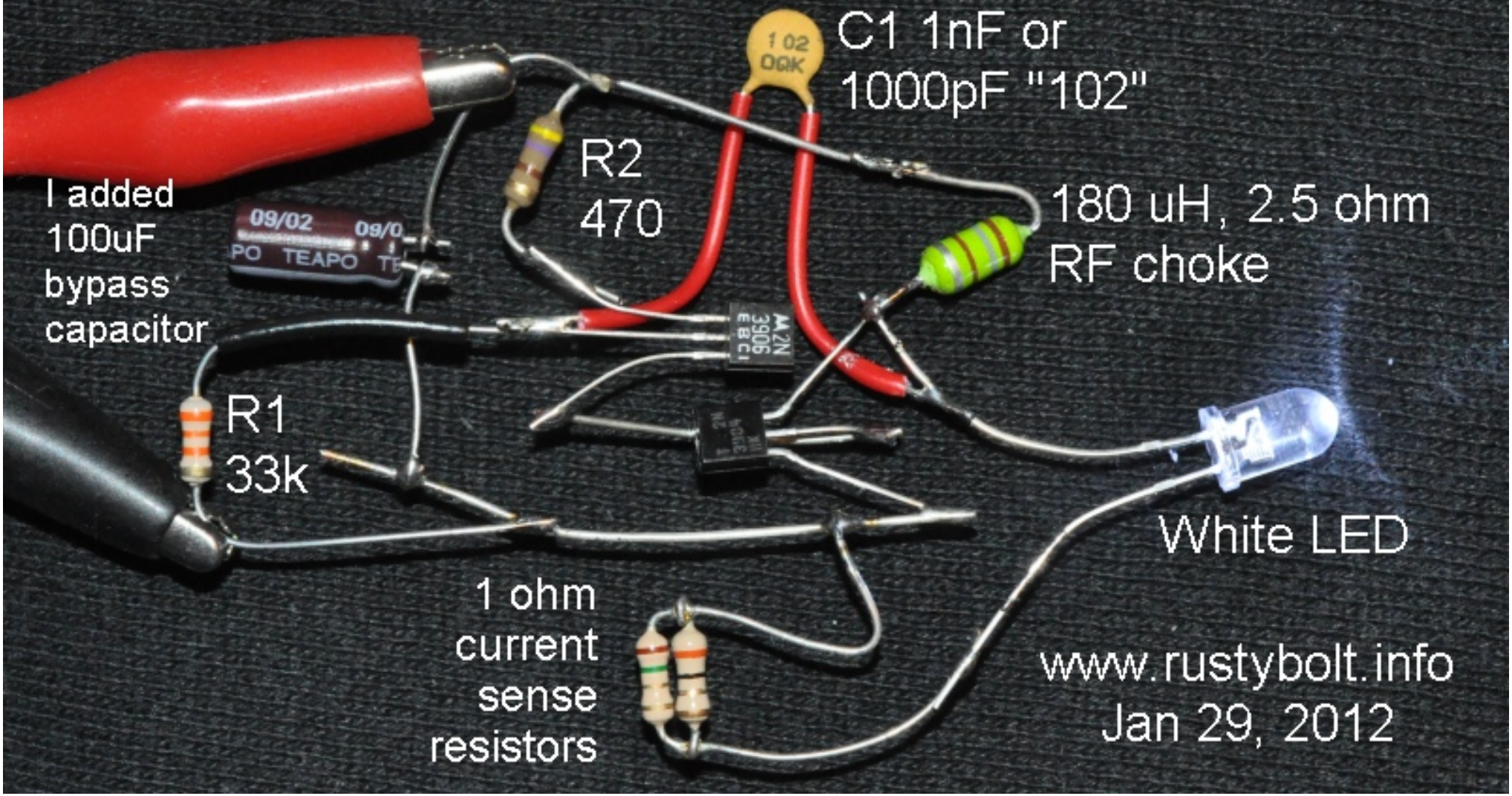

www.rustybolt.info
Jan 29, 2012

Watson's Version of "1.5v Joule Thief -Blinks Led"

Taken from http://www.youtube.com/watch?v=GVP2QGpk5KE Nov 14, 2012

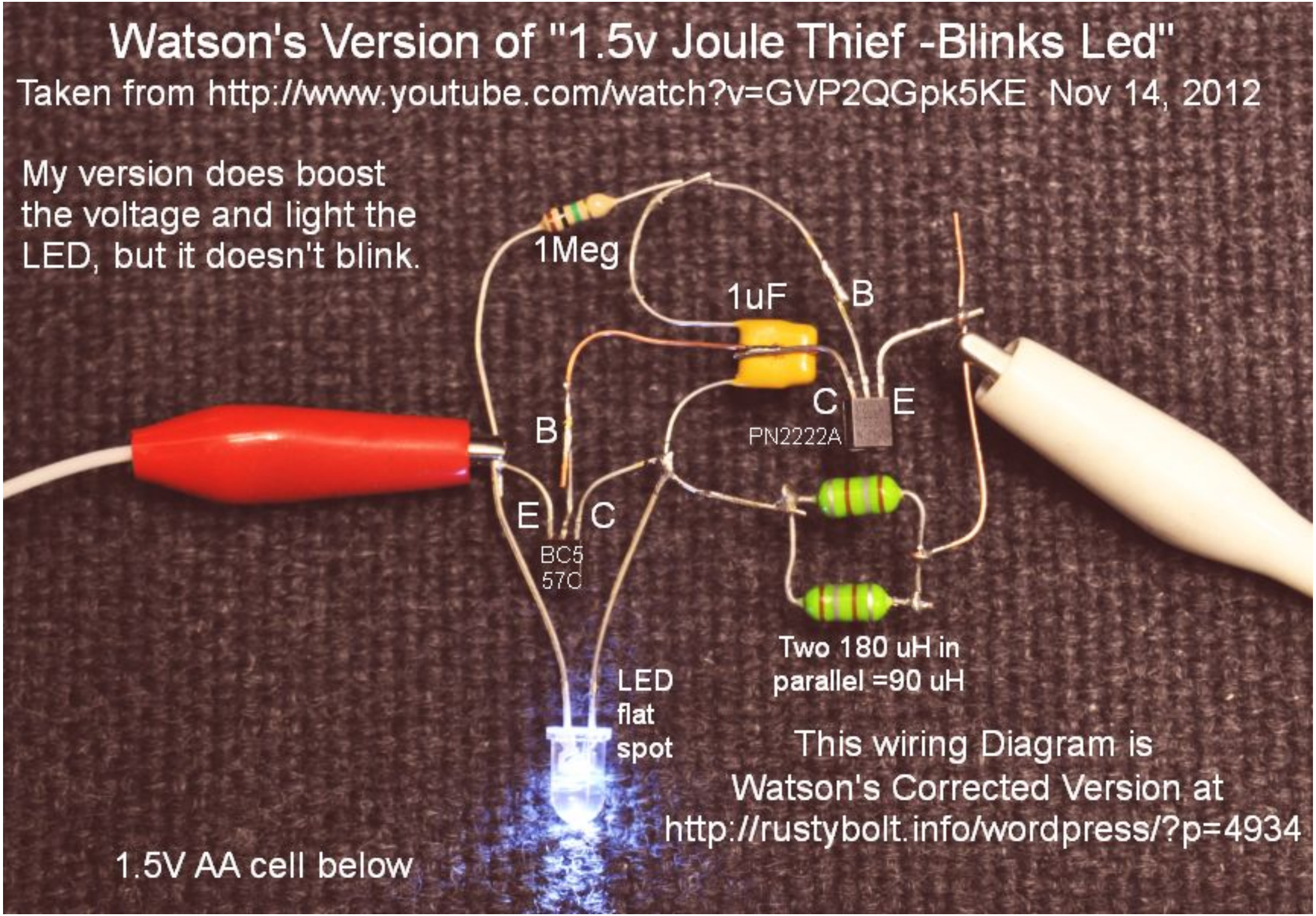

Watson's Joule Thief Pictorial Diagram

http://rustybolt.info/wordpress/?p=128 2011 Dec 07

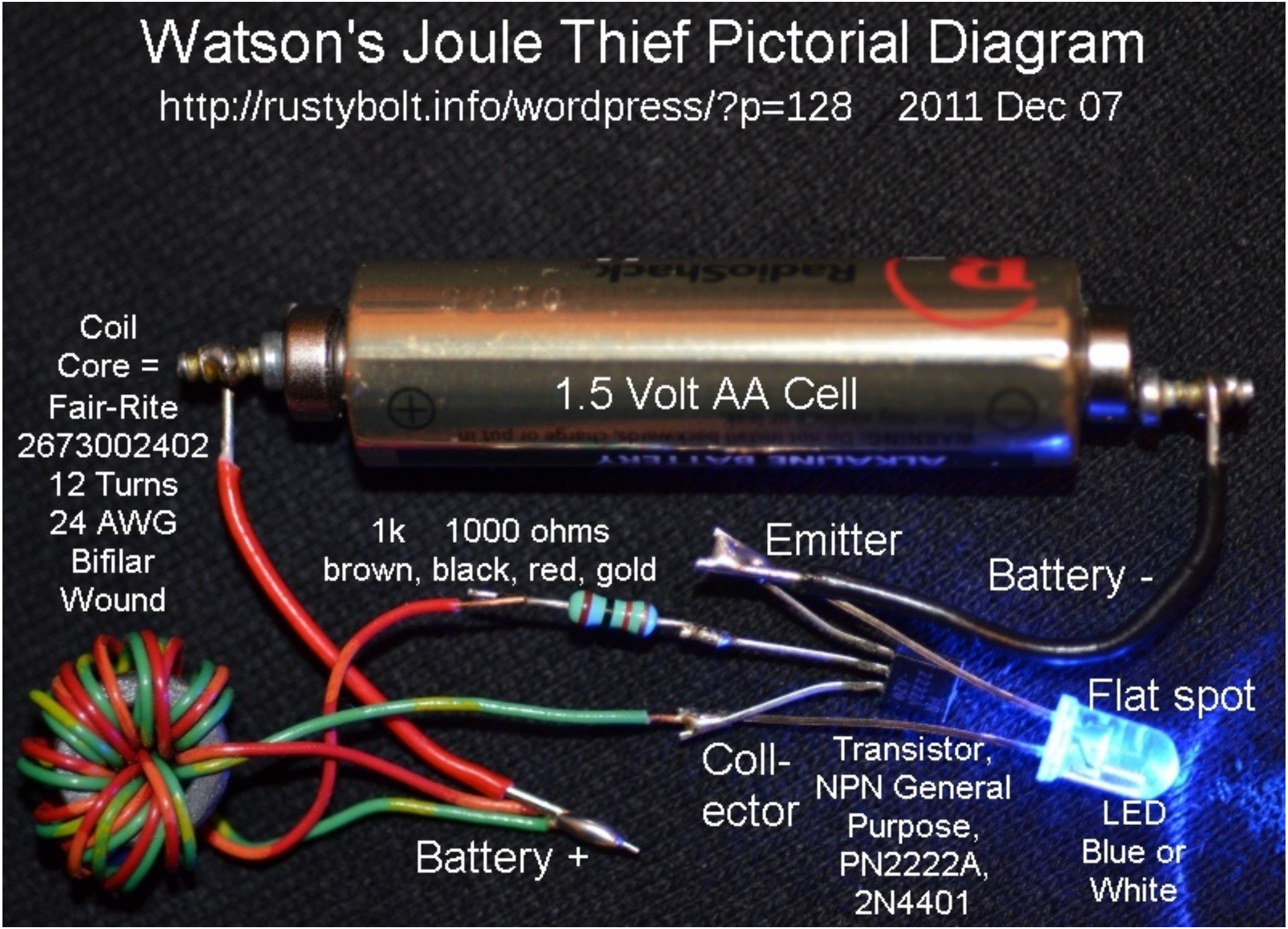

Joule Thief

Pictorial Wiring Diagram Dec 11, 2009

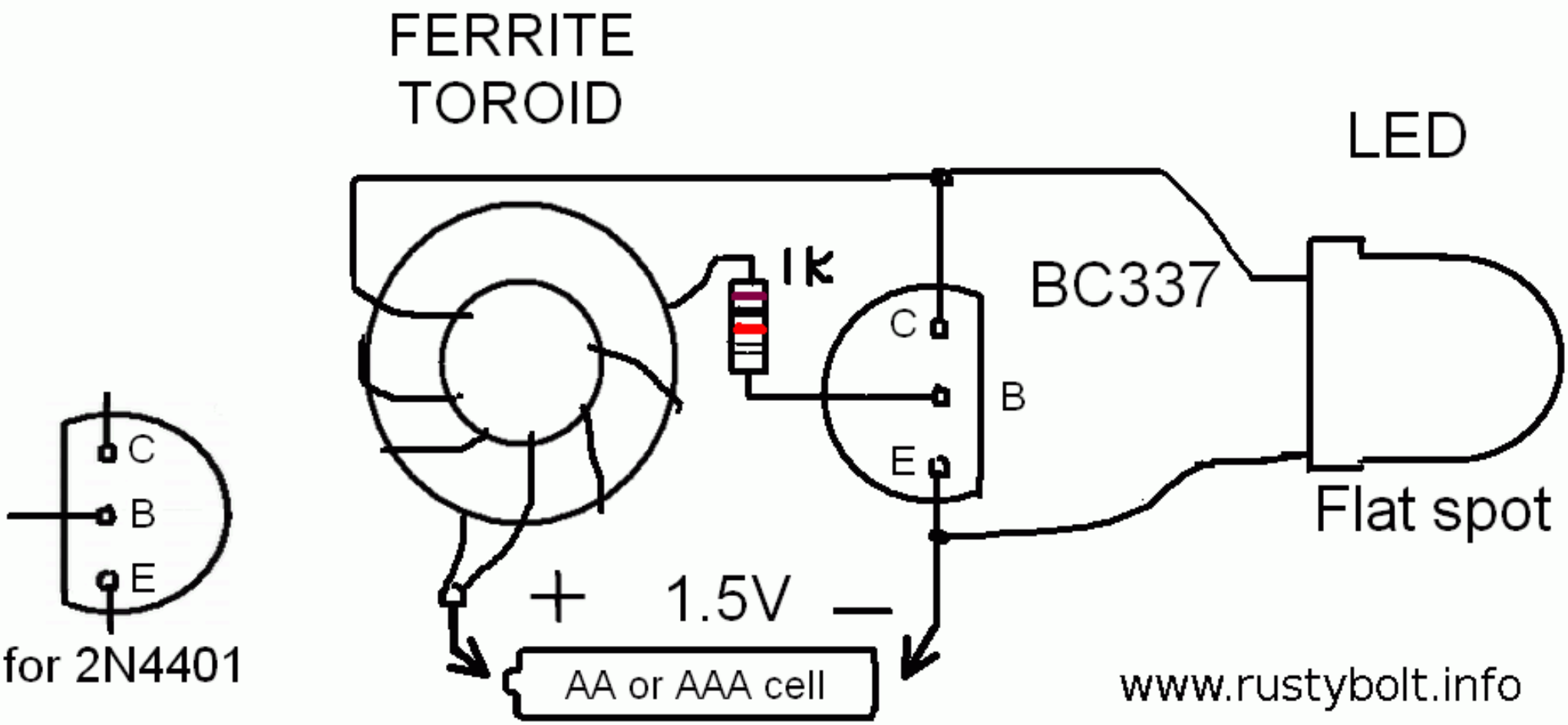

www.rustybolt.info

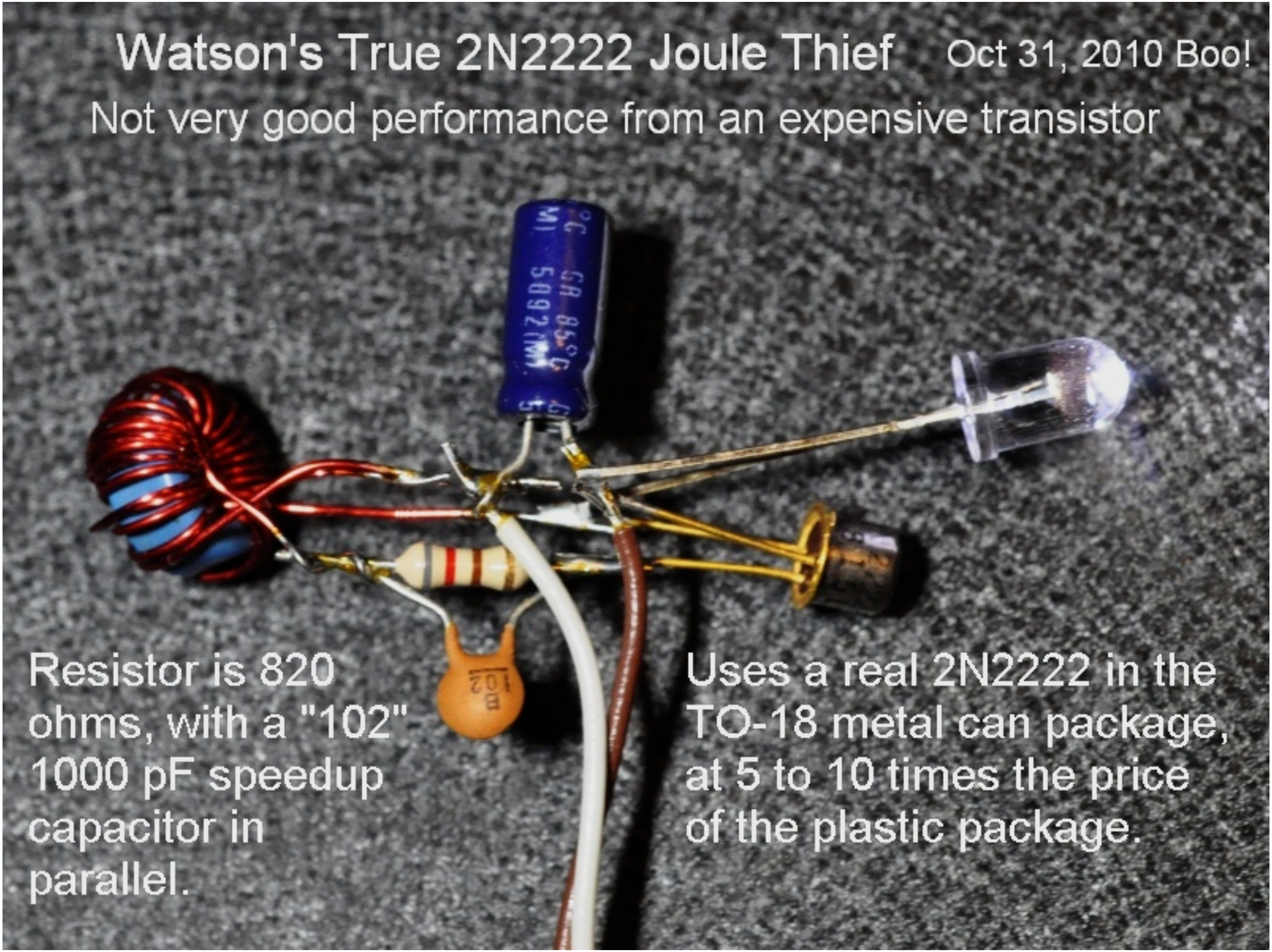
Watson's True 2N2222 Joule Thief
Oct 31, 2010 Boo!
Not very good performance from an expensive transistor
Resistor is 820 ohms, with a "102" 1000 pF speedup capacitor in parallel.
Uses a real 2N2222 in the TO-18 metal can package, at 5 to 10 times the price of the plastic package.

Watson's Tiny Toroid Conventional Joule Thief - Nov 18, 2009

Not much bigger than the transistor!

www.rustybolt.info

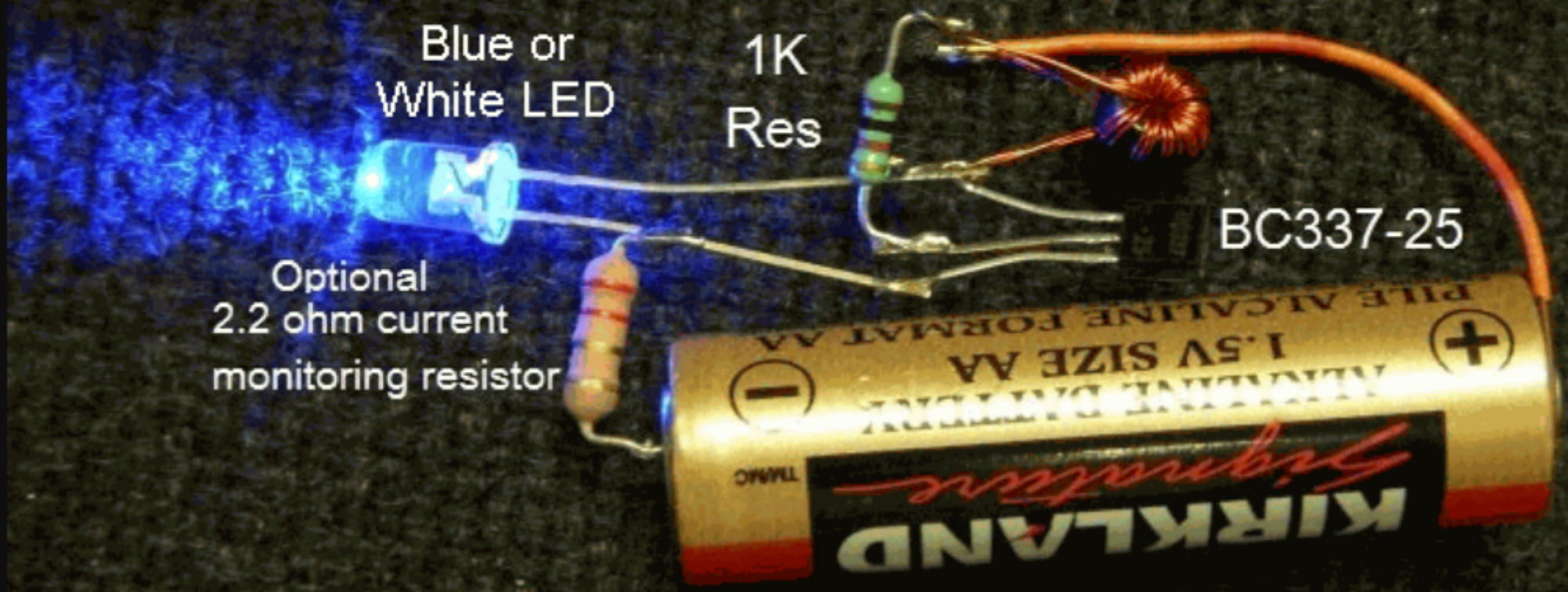

Three windings 30 AWG, each about 6 inches long, trifilar wound on 0.229 inch O.D. toroid, 2 in parallel for main winding.

I took this photo just before Halloween back in 2010, after I made this Joule Thief without solder and without a toroid. It shows that you don't have to know how to solder and you don't have to have a toroid to make a working Joule Thief – all you need is a screwdriver. So do your thing and experiment a bit, and see what you can come up with.

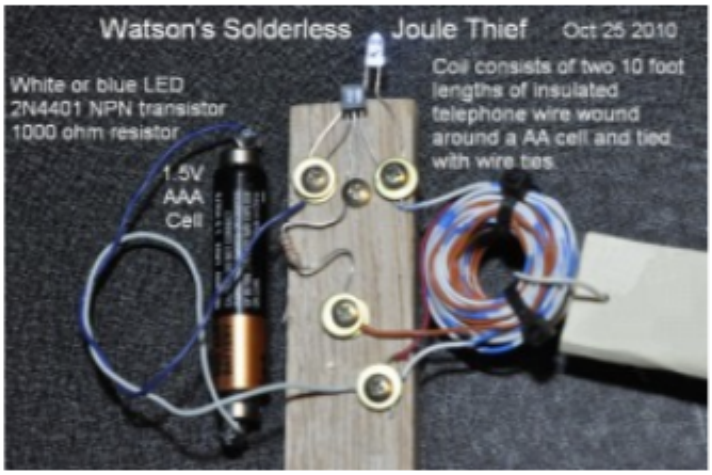

Each screw (except for one) has two washers to hold the wires. Putting two or more wires under the screw head without the washers will be difficult and the wires will try to come loose. Two or three washers makes it easier and the wires are held much firmer. The wood block is a piece of solid oak that is about a half inch (12mm) thick. The oak is very hard and the screw holes have to be drilled out before the screws are put in. This also makes it possible to use small screws with a flat end which were used for holding plastic parts together. The screw size is about #3 by 3/8 inch long, with coarse threads like a sheet metal screw.

The LED is not very bright because it's a cheap 3 mm white LED I got from an eBay seller, and it has been used a bit so it has dimmed. Use a decent LED and this circuit will be as bright as a toroid JT.

Another Joule Thief I put together is shown in the second photo. This uses the bare wires to wrap around the joints in place of solder. The joints are not as mechanically strong as solder but for a quick experiment they should work okay. If the JT is going to be used, the wire joints may become intermittent or loose. The solder joints are a much better connection.

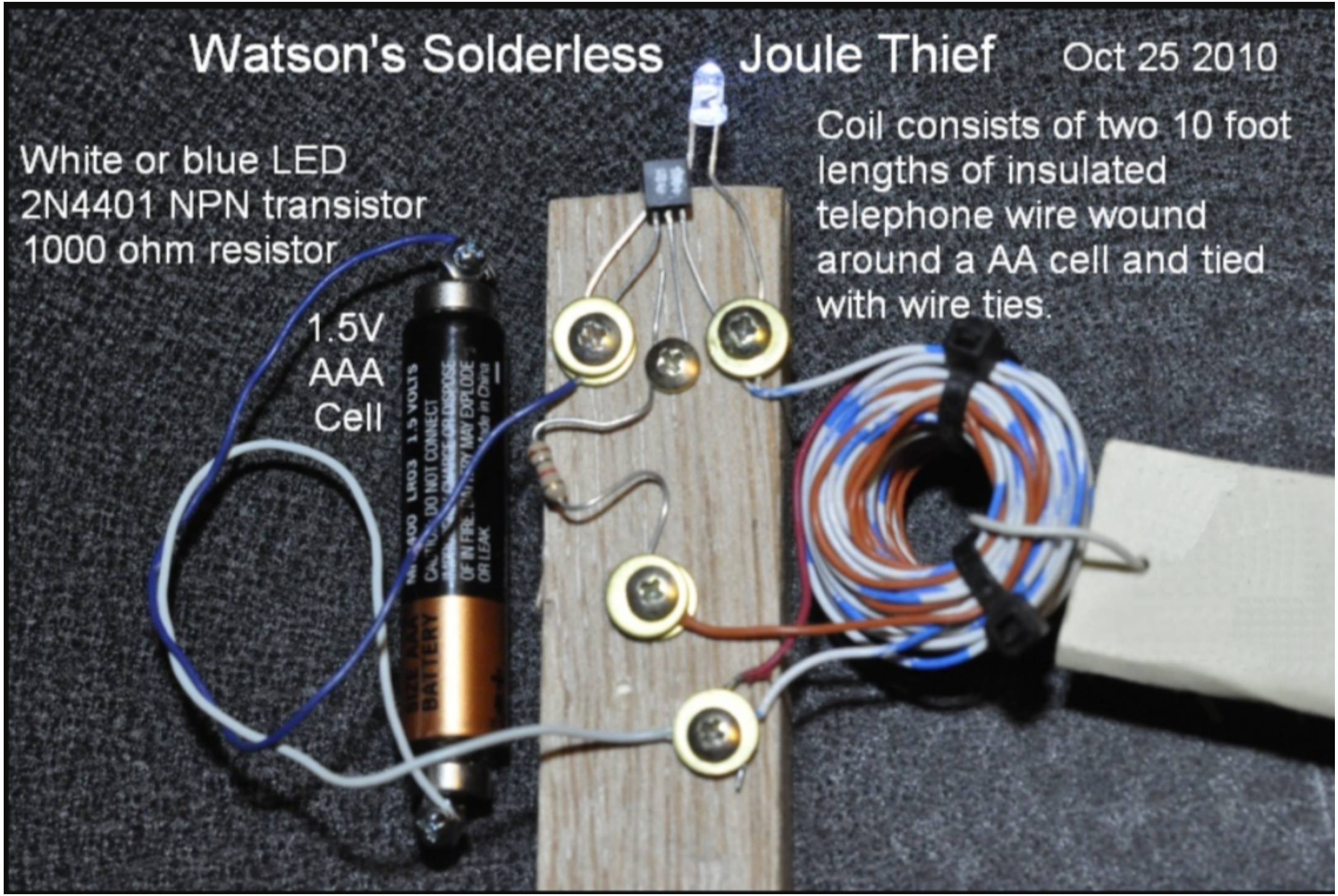
Watson's Solderless Joule Thief
Oct 25 2010
White or blue LED
2N4401 NPN transistor
1000 ohm resistor
1.5V
AAA
Cell
Coil consists of two 10 foot lengths of insulated telephone wire wound around a AA cell and tied with wire ties.

Watson's 'Toroid Free' Air Core Joule Thief
2.2k Red, Red, Red, Gold
rustybolt.info/wordpress/?p=2872 May 21, 2012

Watson's Nearly Disposable Joule Thief Light

rustybolt.info/wordpress/?p=2133 Fri. Apr 13 2012

Completed circuit ready for coating of silicone sealant.
Transistor is a BC337. If it was a PN2222A or 2N4401,
the flat side would be facing up.

2222A

Watson's Solderless Joule Thief
http://rustybolt.info/wordpress/?p=5210

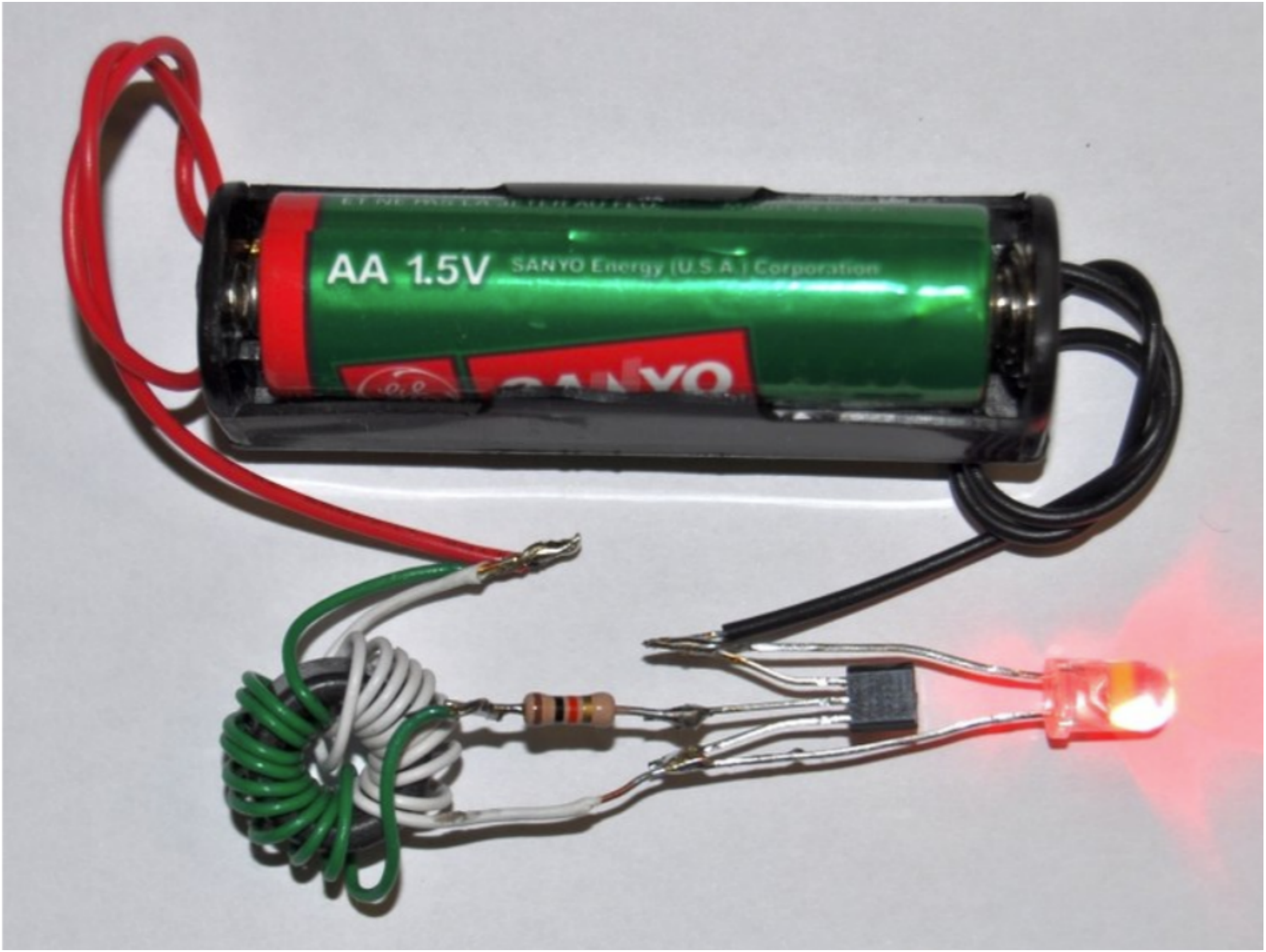
AA 1.5V
SANYO Energy (U.S.A.) Corporation
SANYO

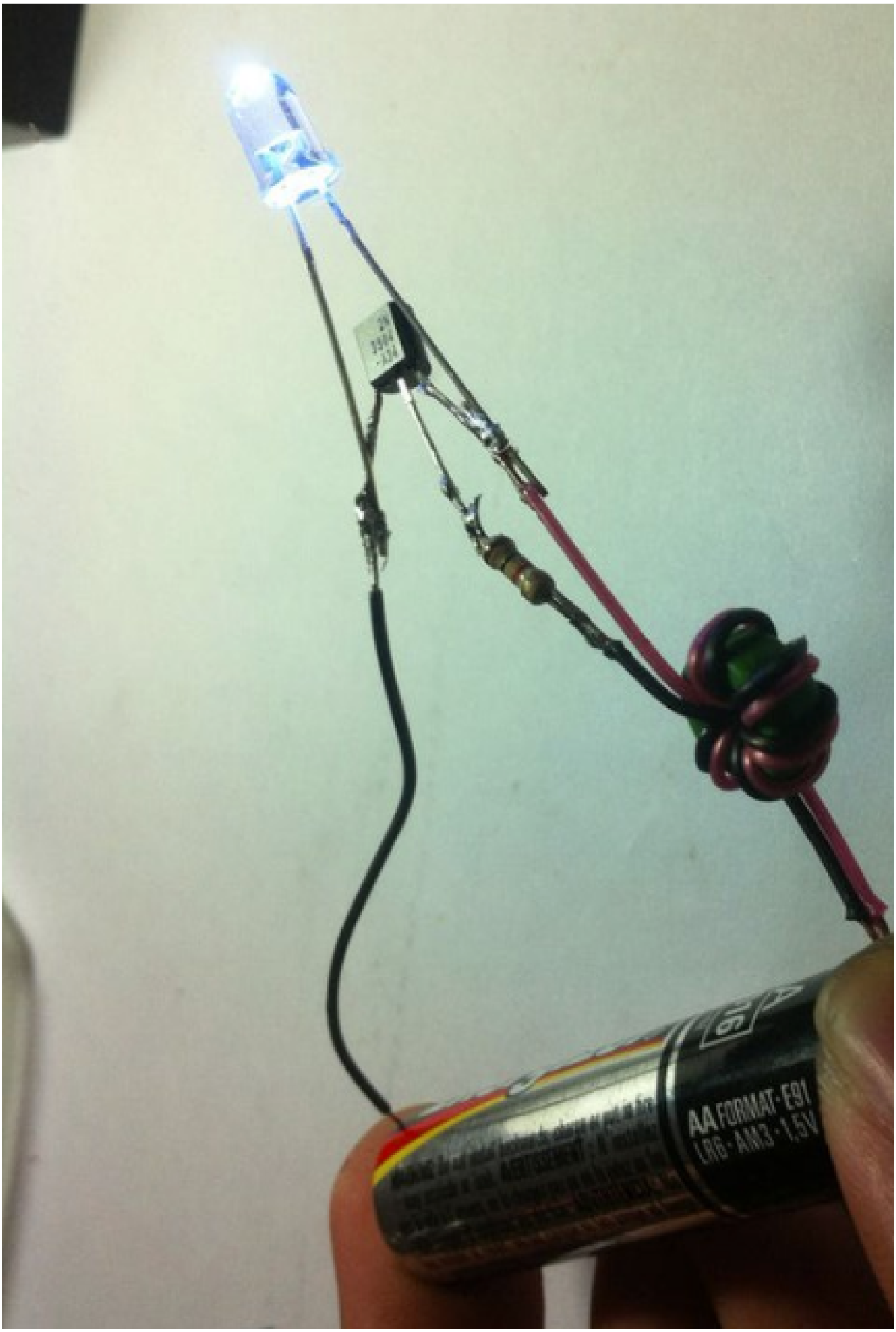
AA FORMAT · E91
LR6 · AM3 · 1.5V

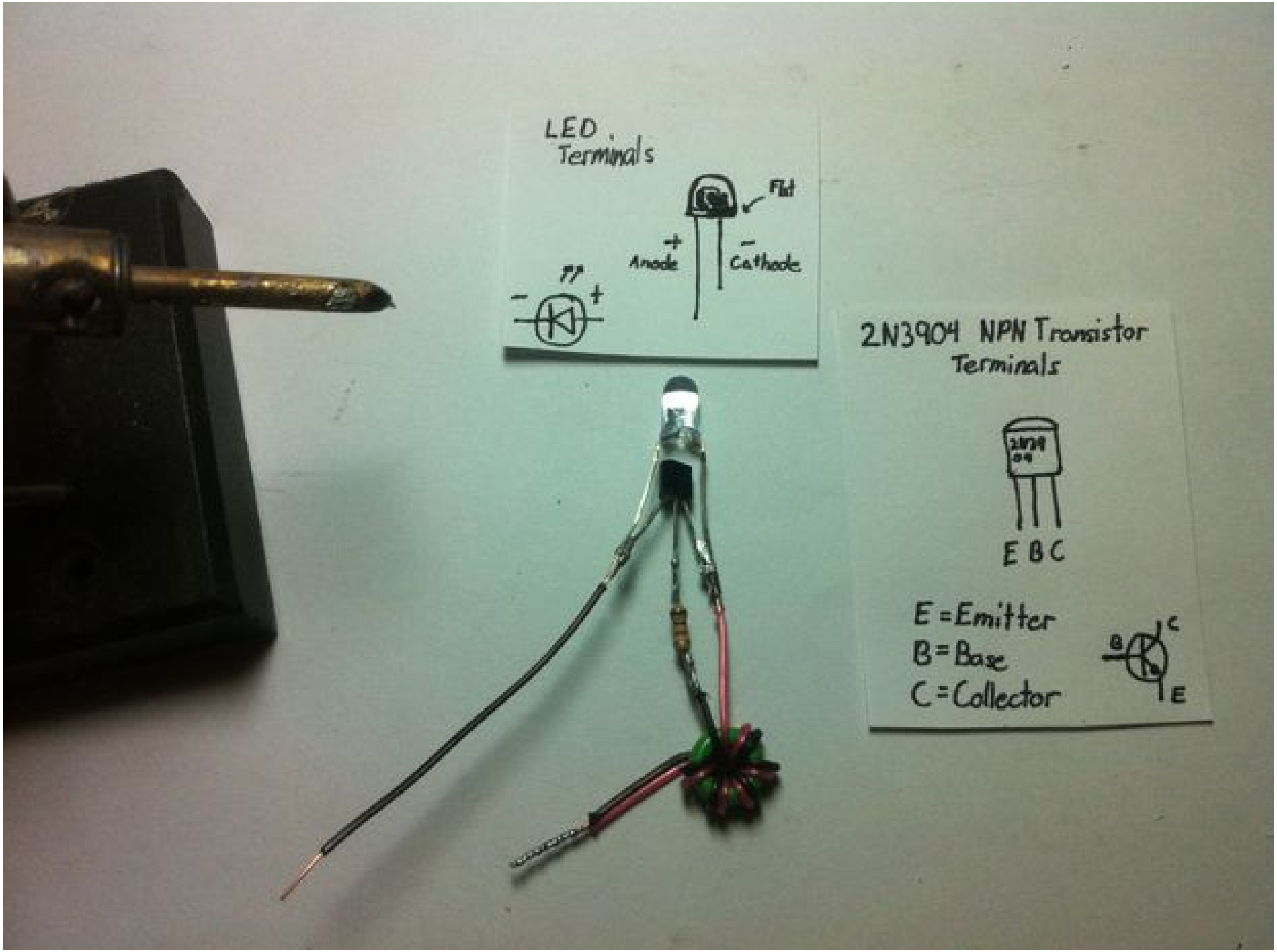
LED
Terminals
Flat
+
Anode
−
Cathode
−
+
2N3904 NPN Transistor
Terminals
E B C
E = Emitter
B = Base
C = Collector
B
C
E

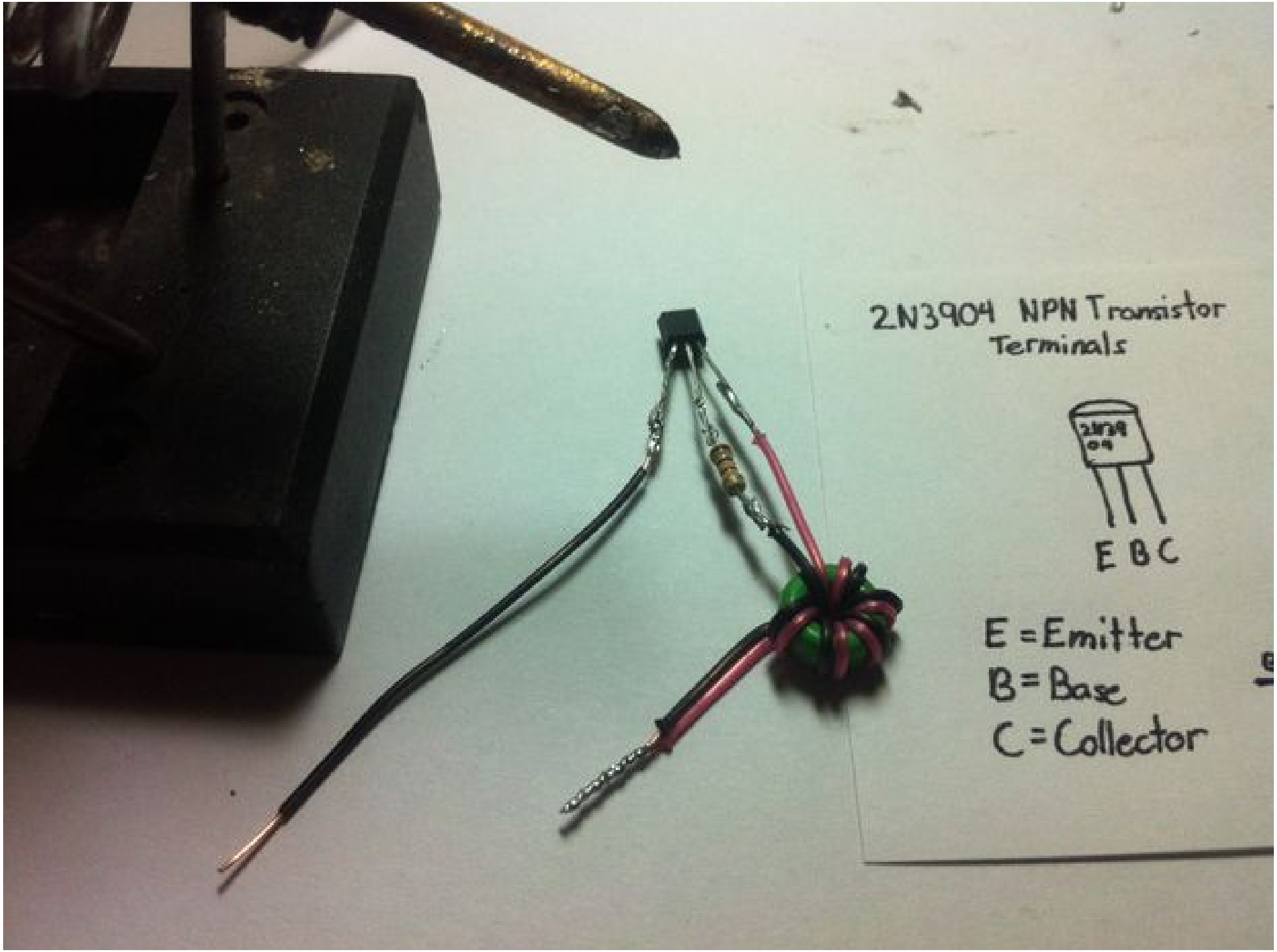
2N3904 NPN Transistor
Terminals
E B C
E = Emitter
B = Base
C = Collector

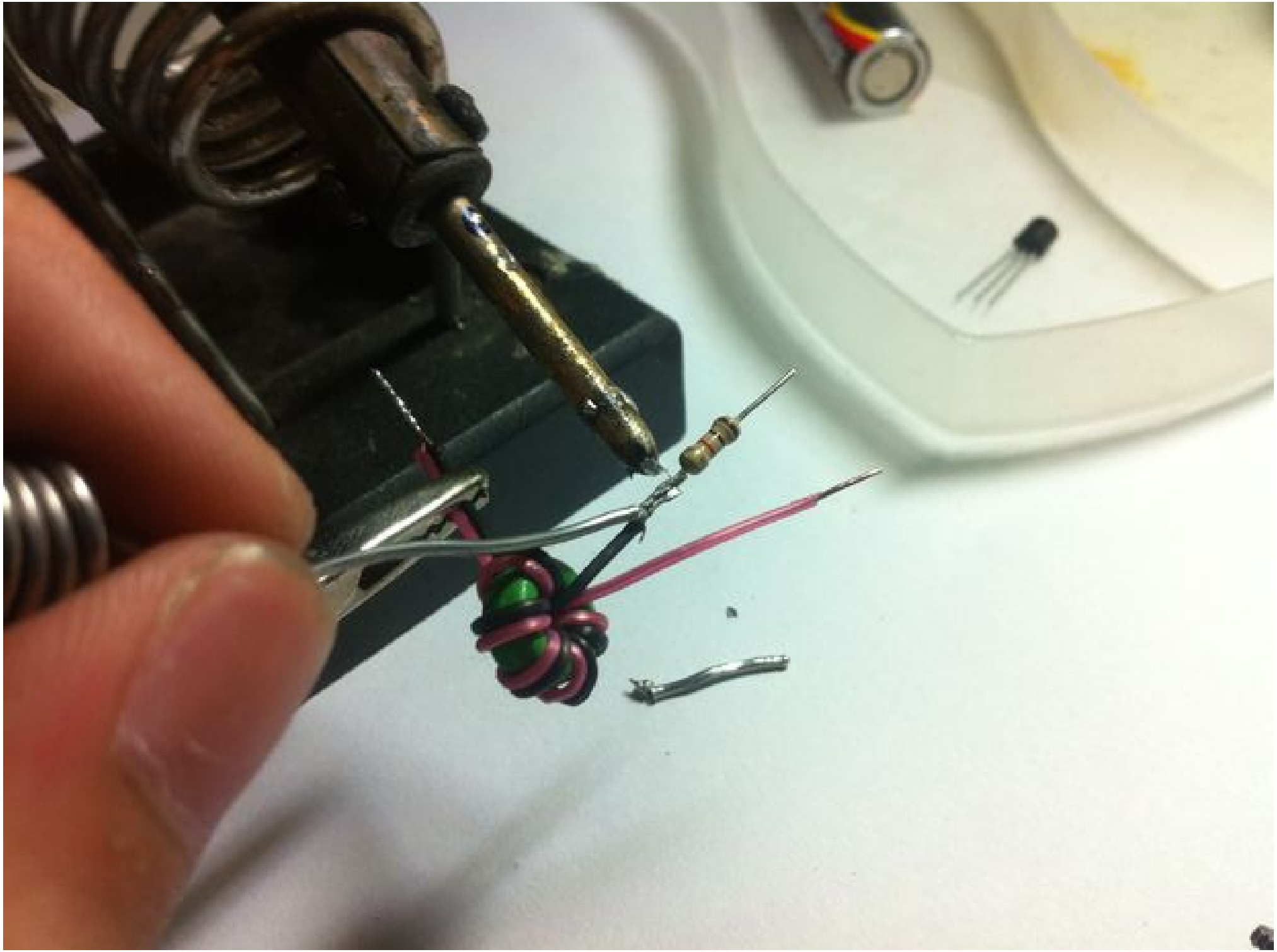

Transistor Terminals

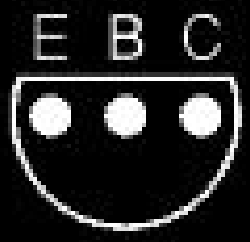

2N3904
(NPN Transistor)

LED Terminals

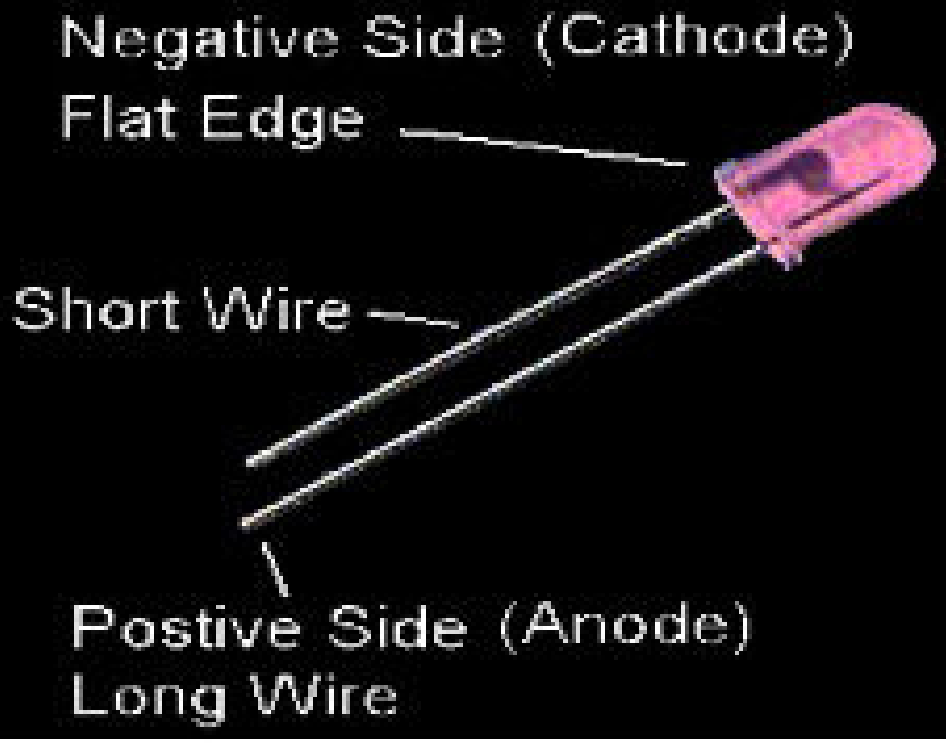

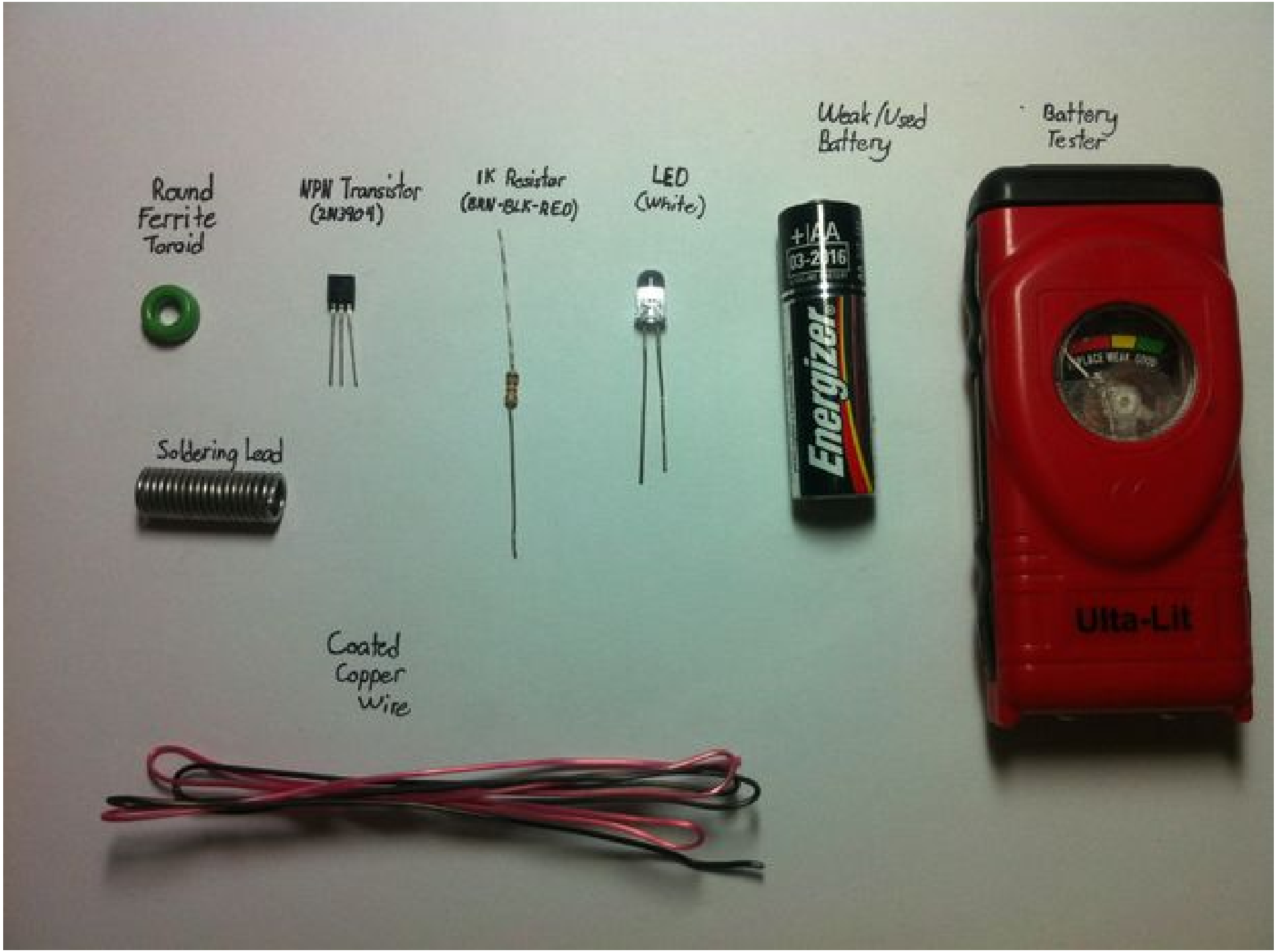
Round Ferrite Toroid
NPN Transistor (2N3904)
1K Resistor (BRN-BLK-RED)
LED (White)
Weak/Used Battery
Battery Tester
Soldering Lead
Coated Copper Wire
+1AA
Energizer
Ulta-Lit

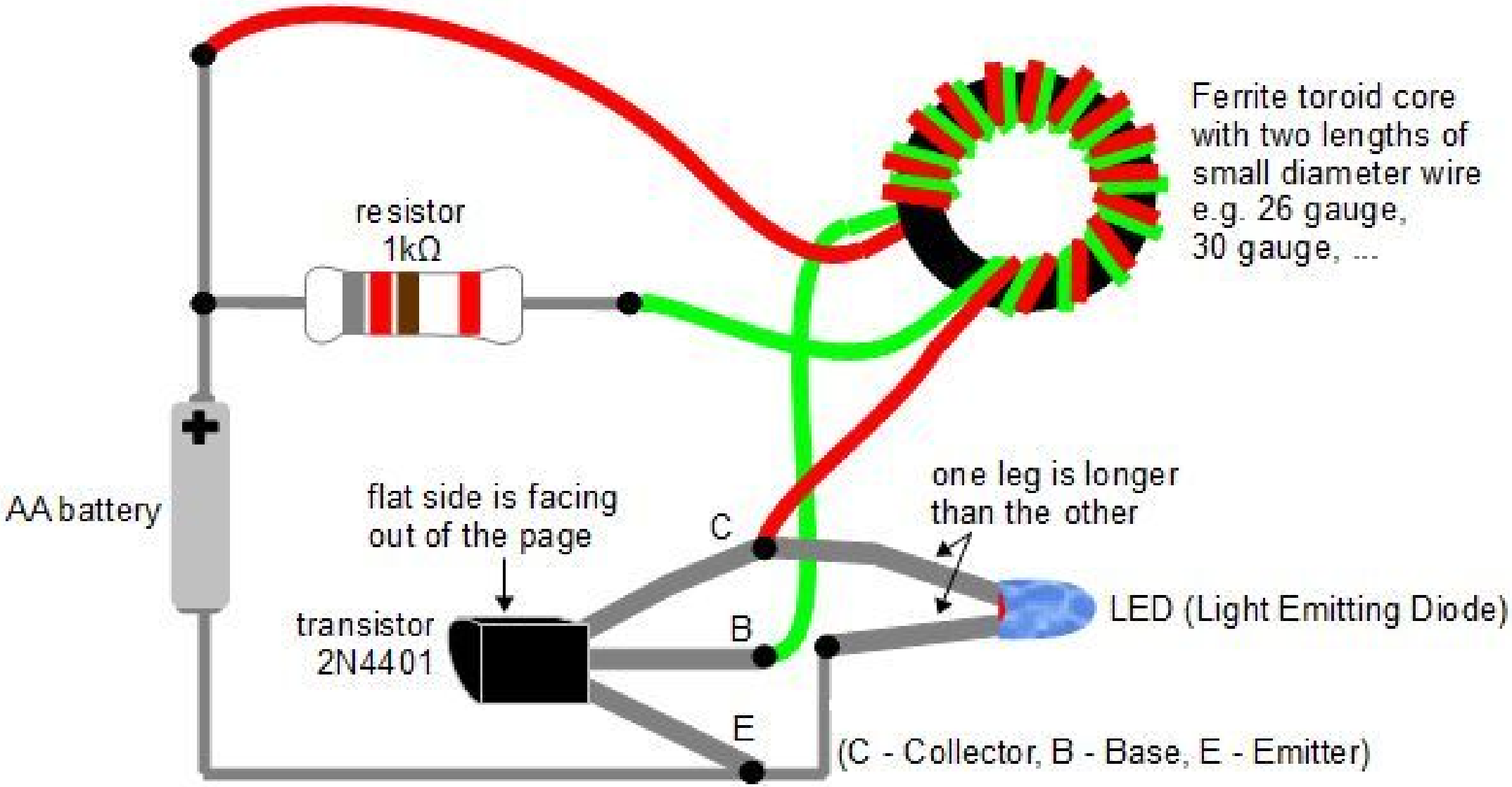
Ferrite toroid core
with two lengths of
small diameter wire
e.g. 26 gauge,
30 gauge, ...
resistor
1kΩ
AA battery
flat side is facing
out of the page
C
one leg is longer
than the other
transistor
2N4401
B
LED (Light Emitting Diode)
E
(C - Collector, B - Base, E - Emitter)

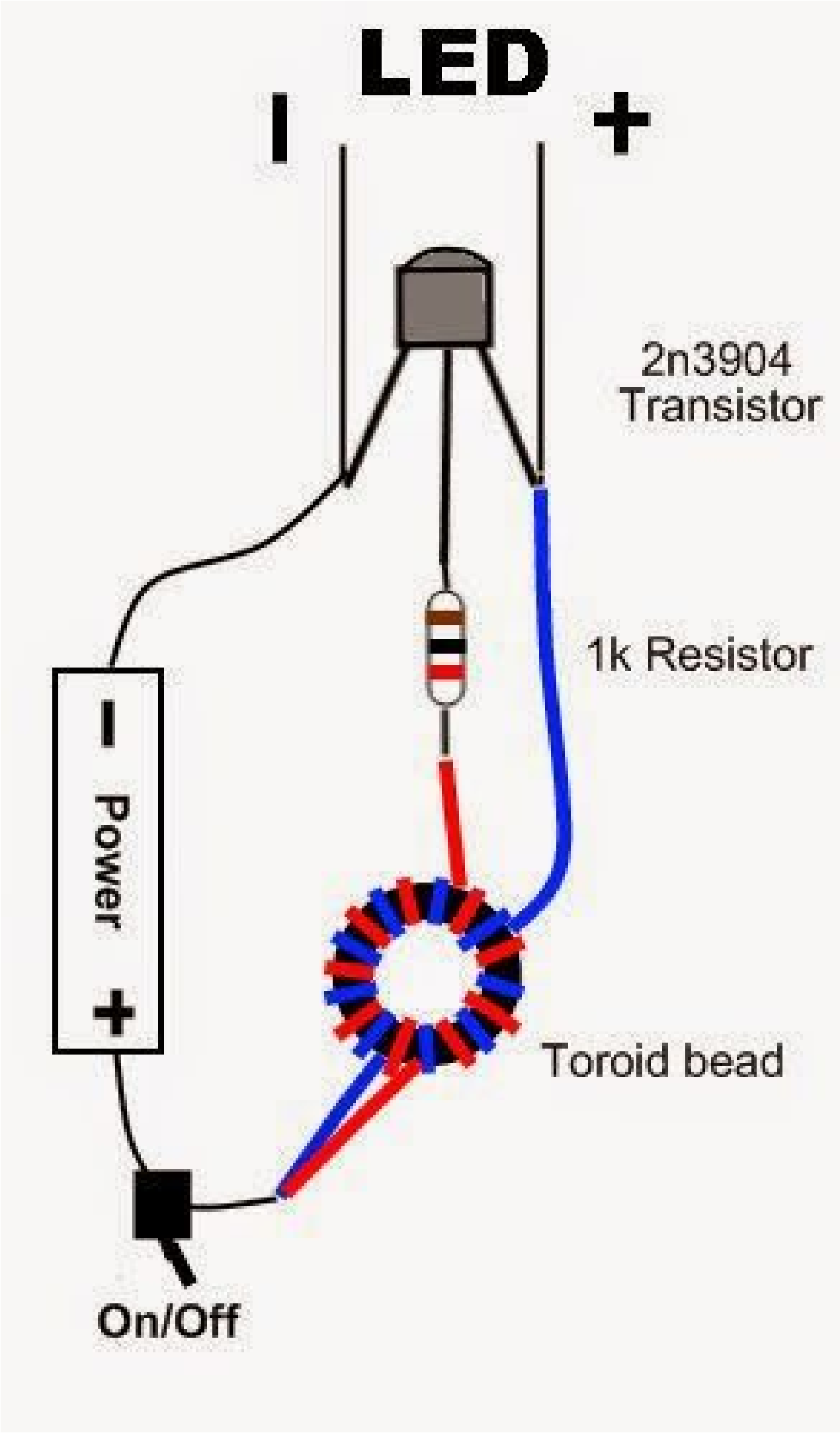
LED
-
+
2n3904
Transistor
1k Resistor
-
Power
+
Toroid bead
On/Off

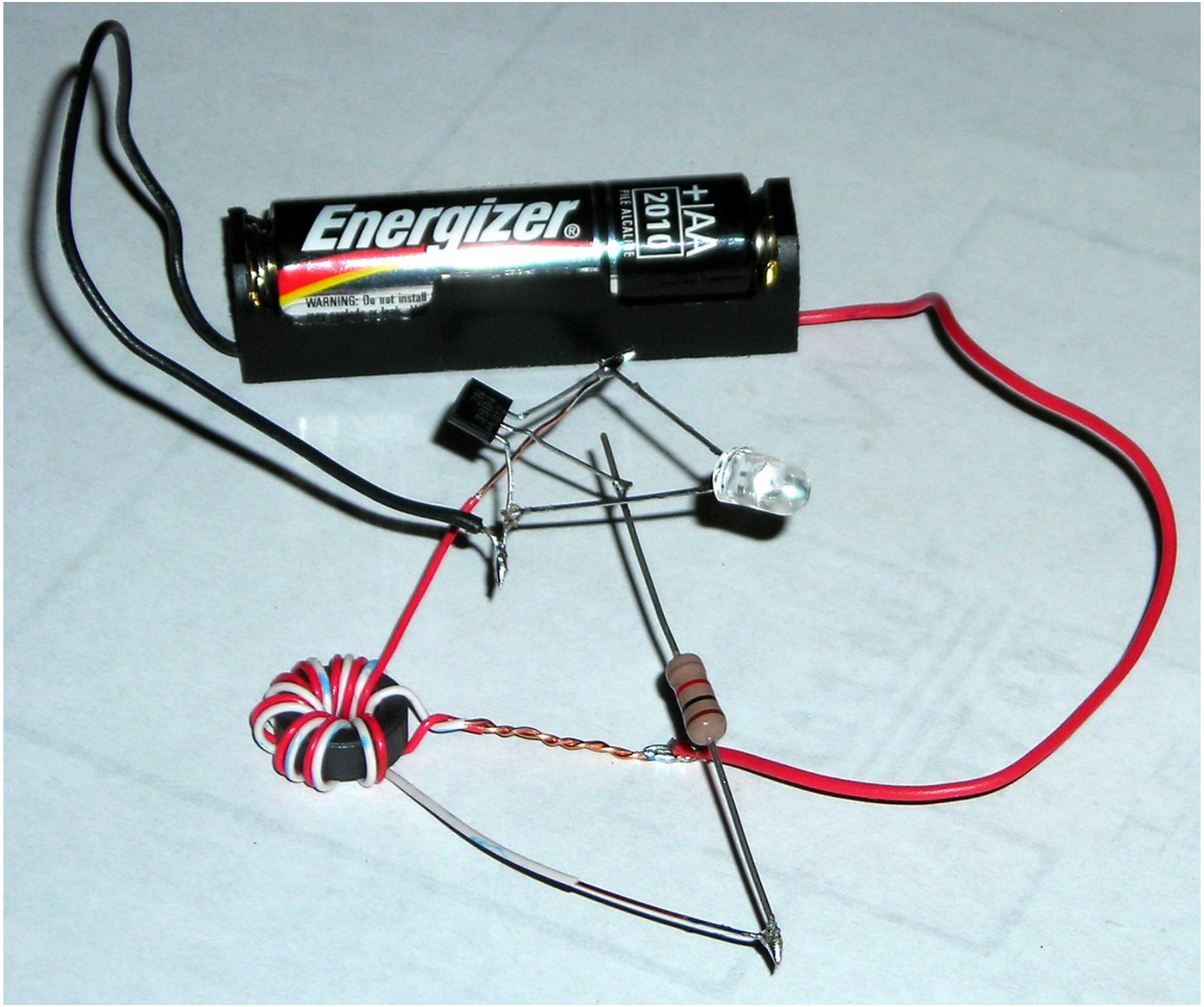
Energizer
+ AA
2010
PILE ALCALINE
WARNING: Do not install

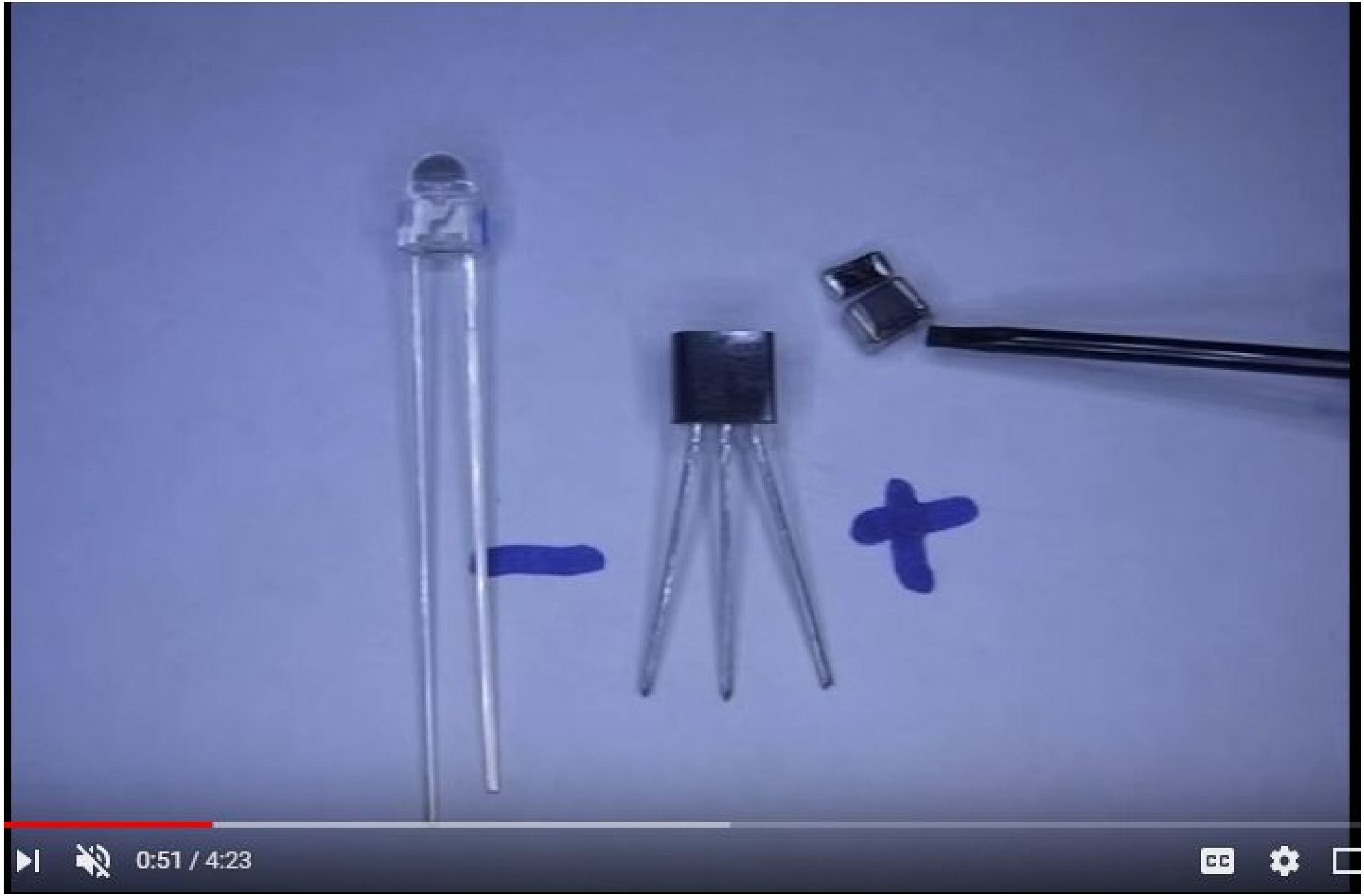
0:51 / 4:23

3:25 / 4:23

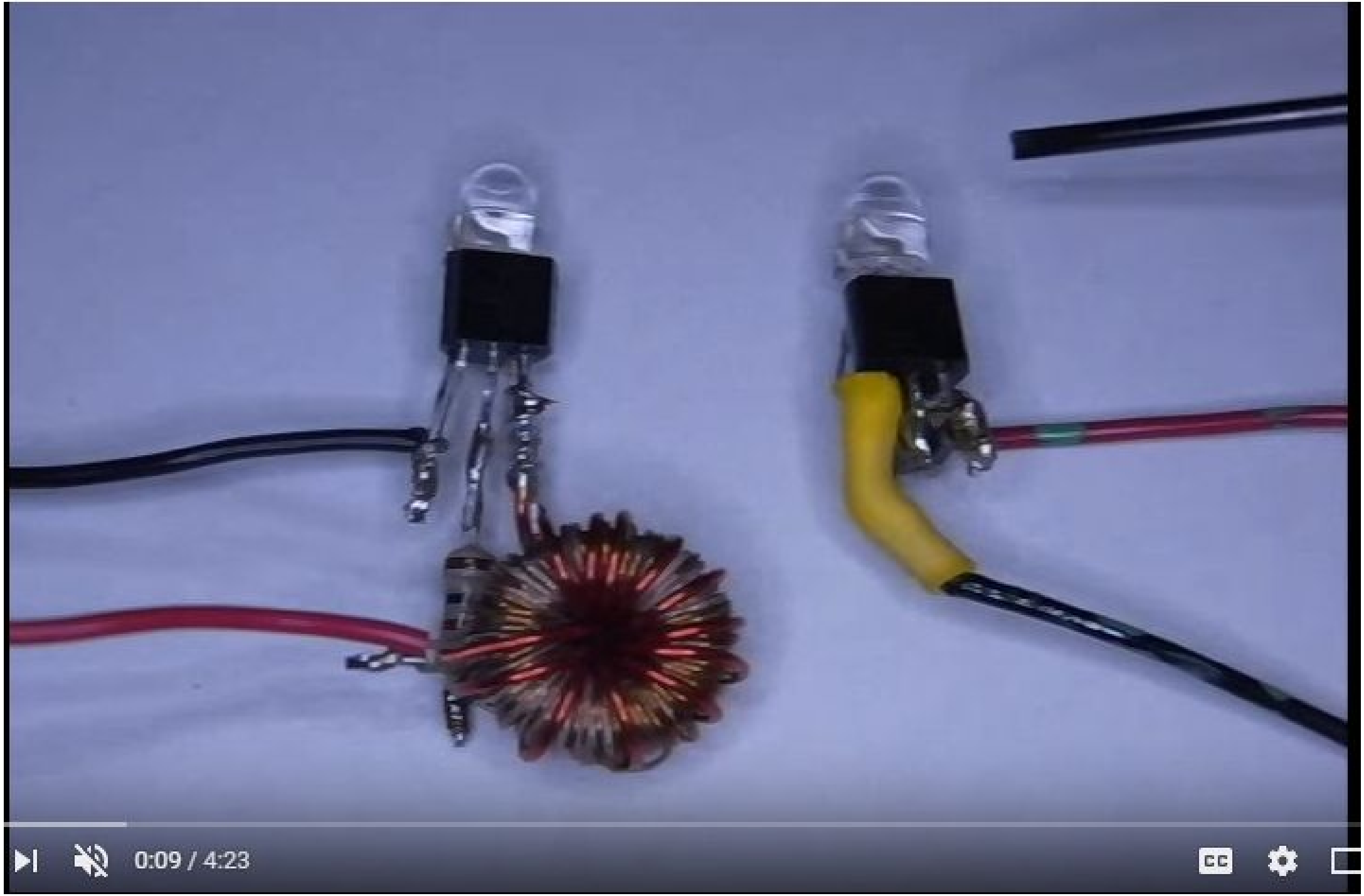
0:09 / 4:23

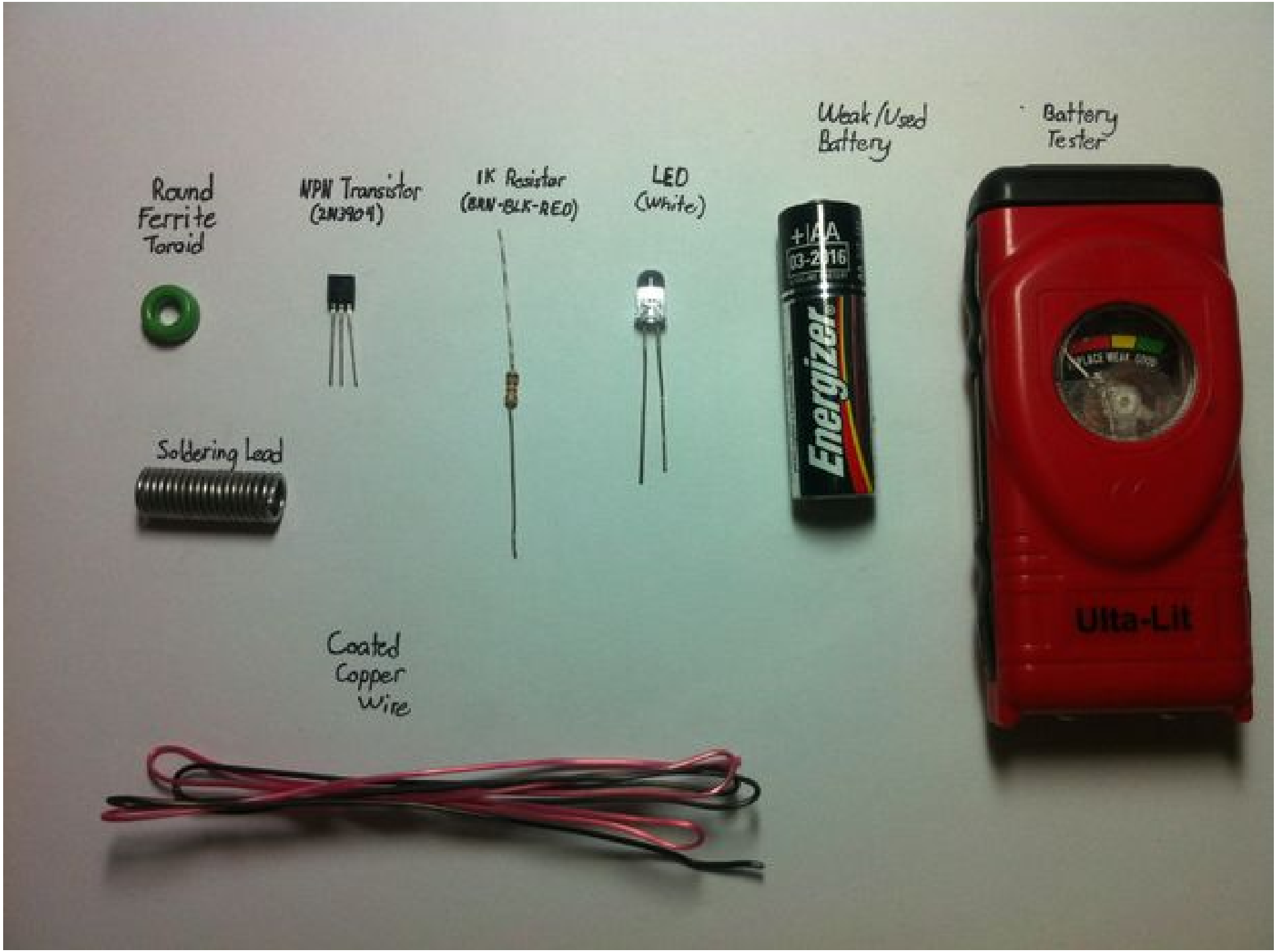
Round Ferrite Toroid
NPN Transistor (2N3904)
1K Resistor (BRN-BLK-RED)
LED (White)
Weak/Used Battery
Battery Tester
Soldering Lead
Coated Copper Wire
+1AA
Energizer
Ulta-Lit

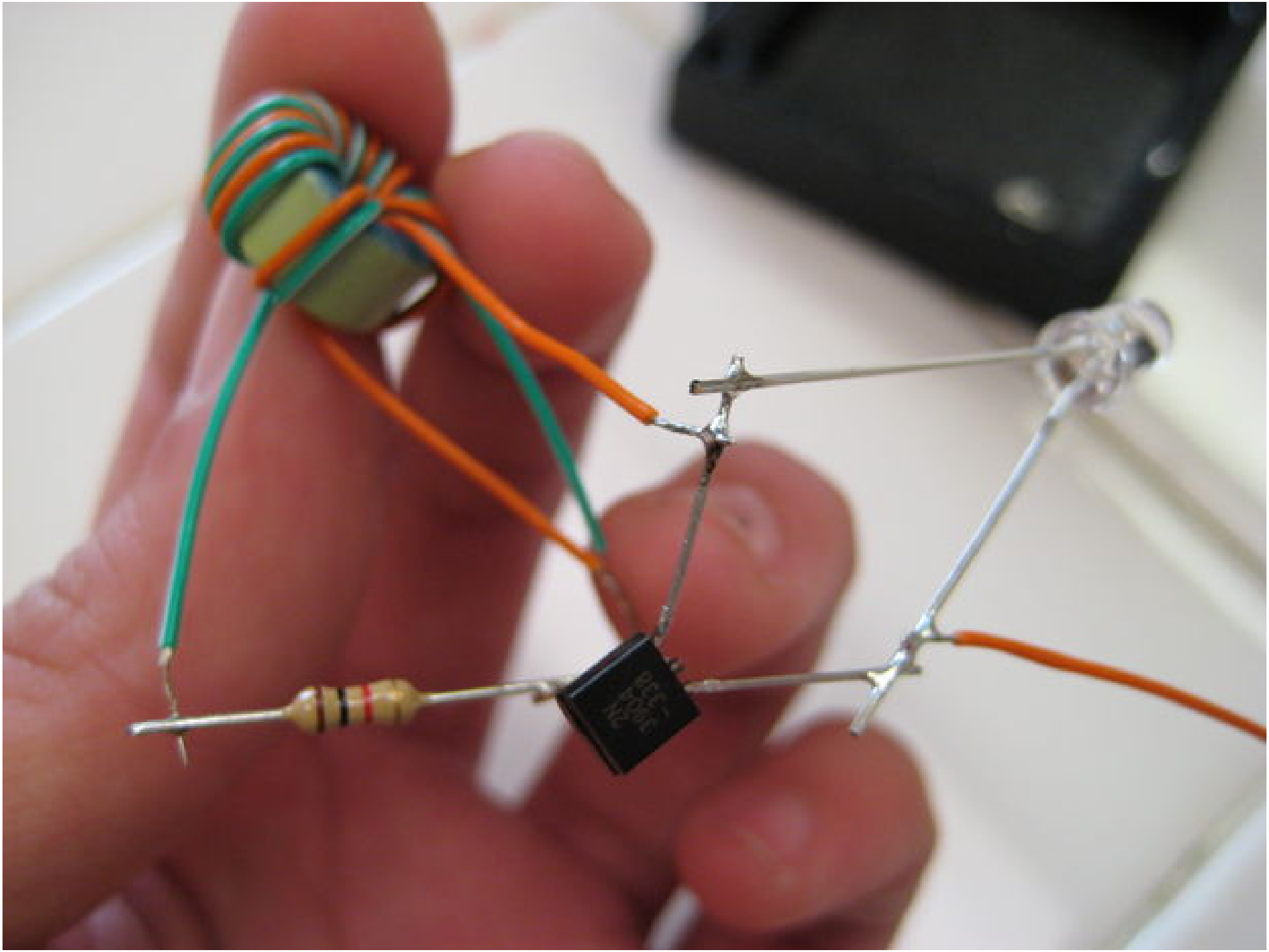

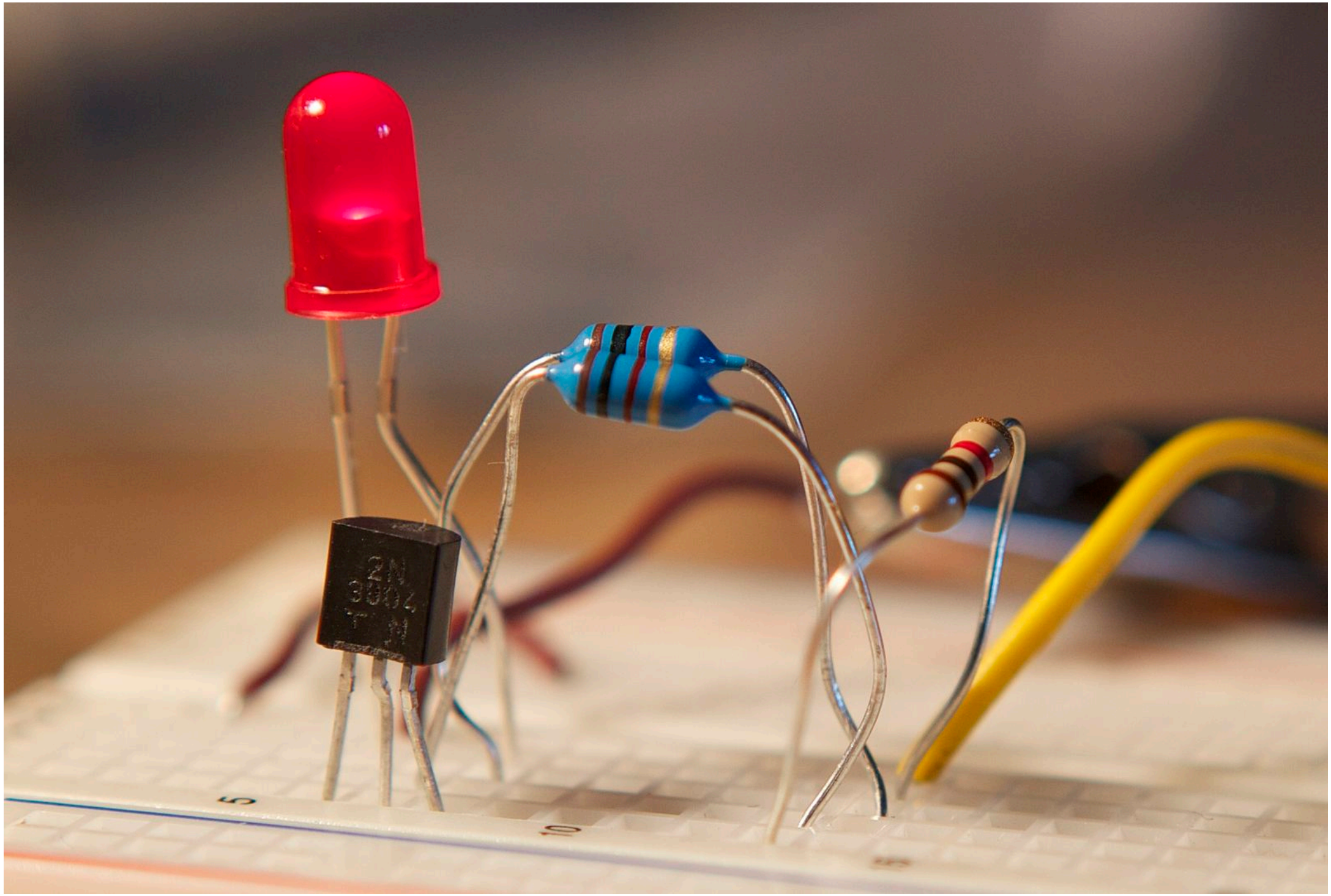
2N
3904
T M

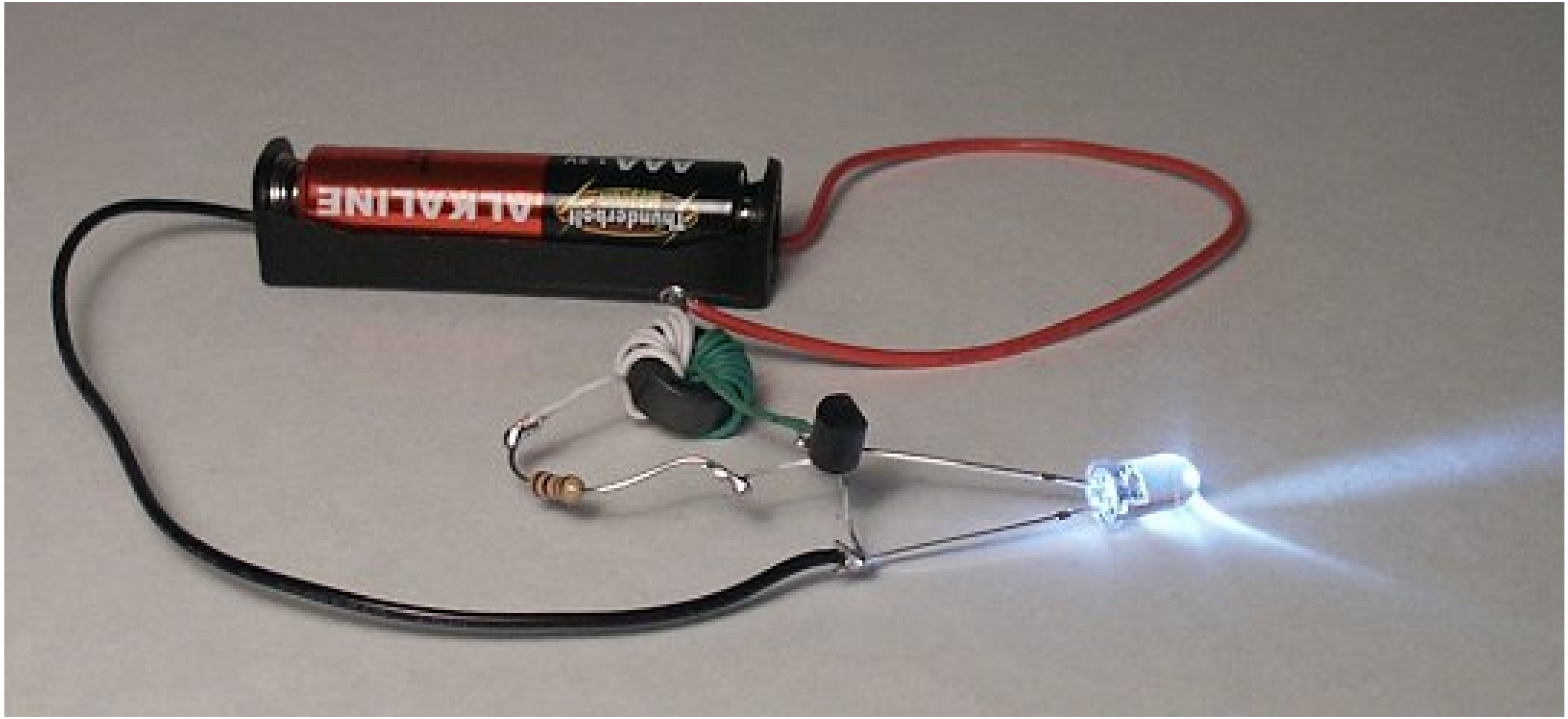
ALKALINE

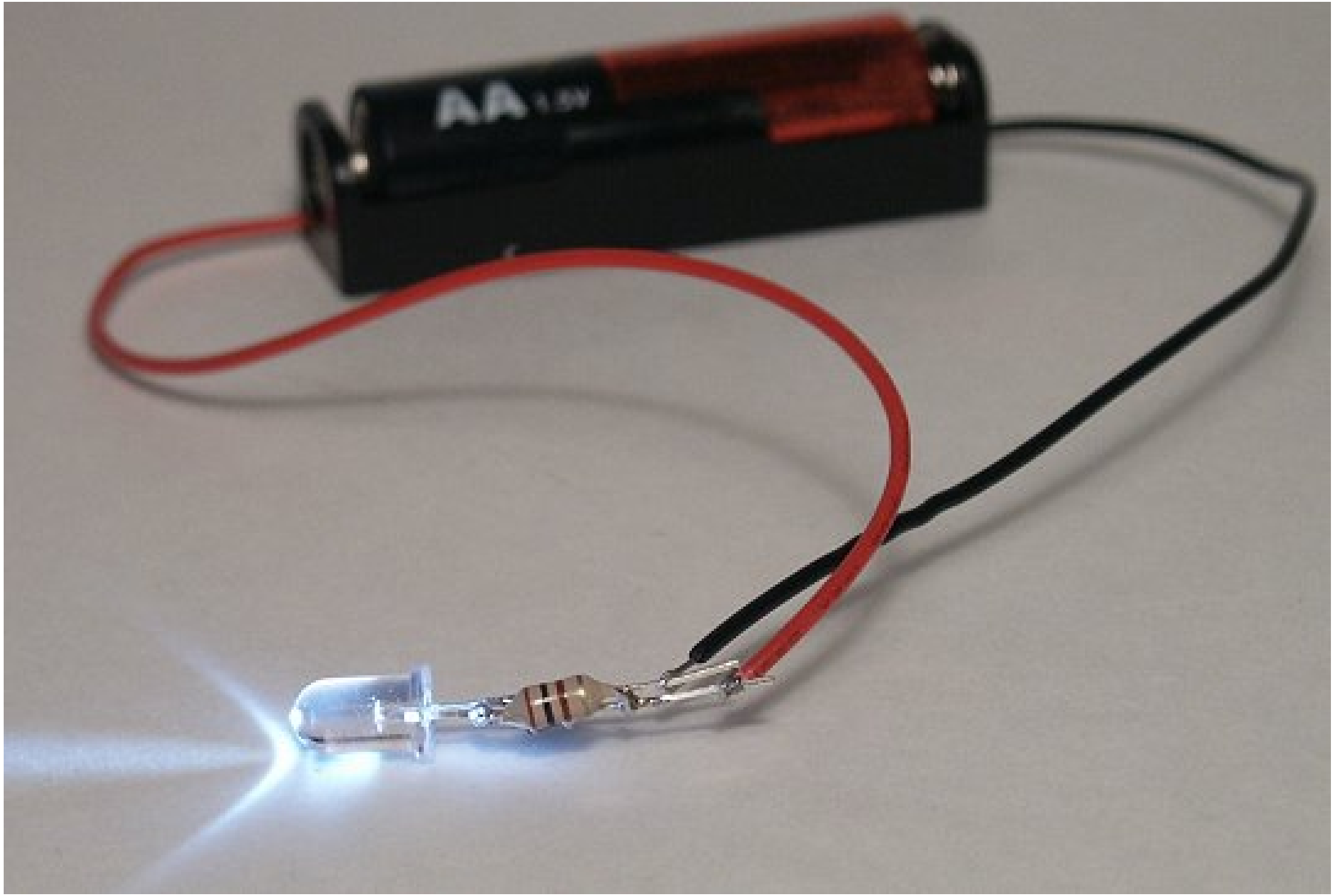
AA

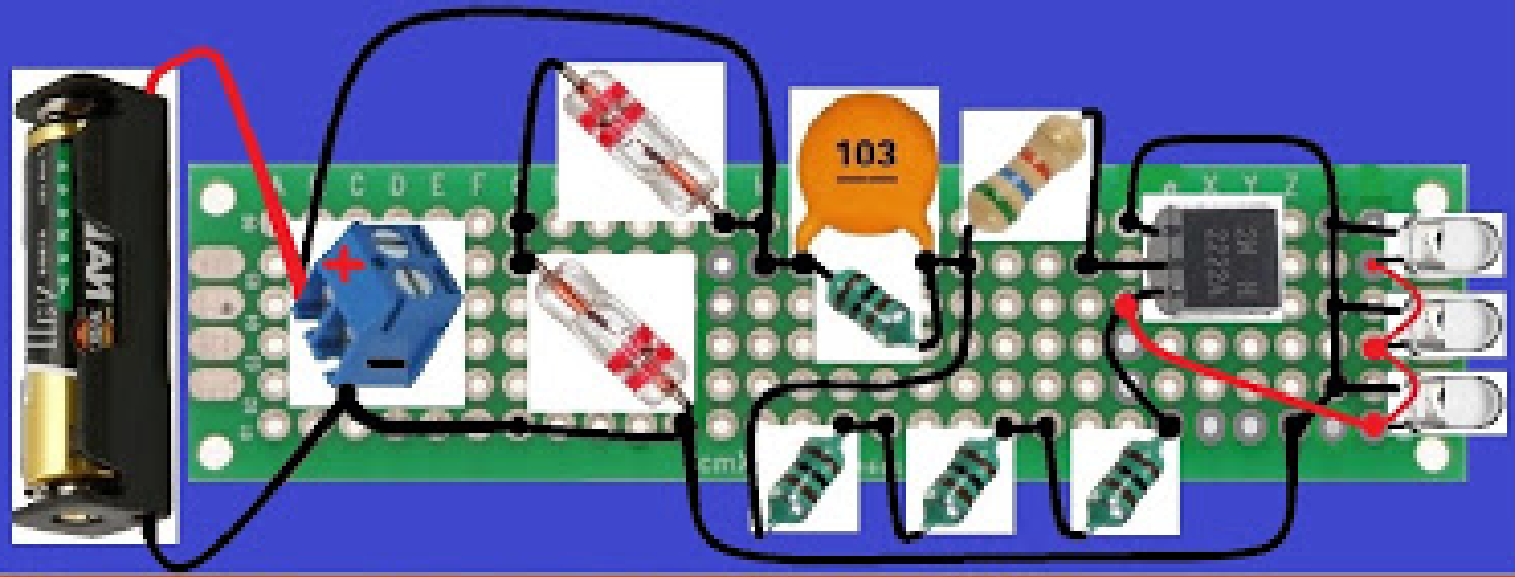

3* Axial lead inductor 82uH 1/4W

1* 10nf ceramic capacitor 103

2* AO90 Germanium signal diode

1* 2N2222 NPN Transistor bipolar 0.6A 40V

1* RESISTOR 5.6K Ohm 1/4W

3* 5mm white Emitting led Diode 20 mA 3.2 V

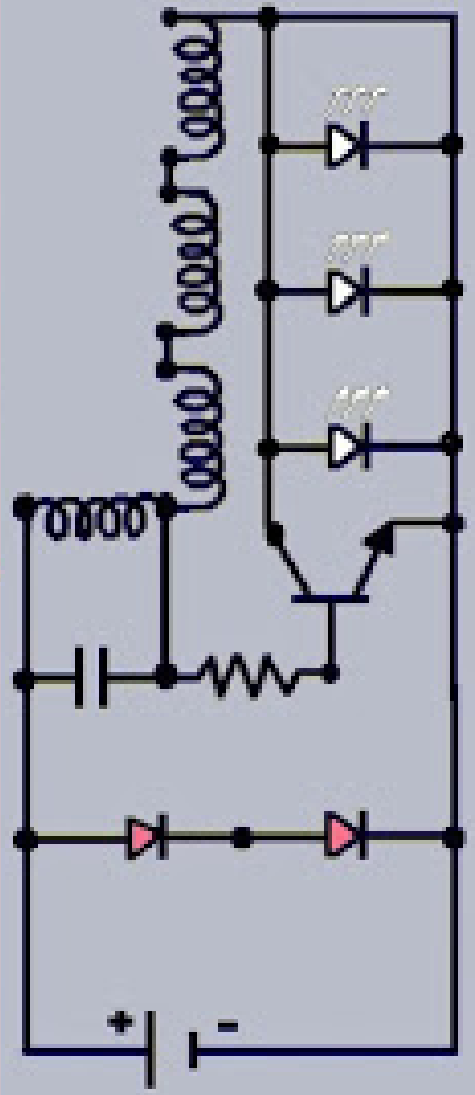

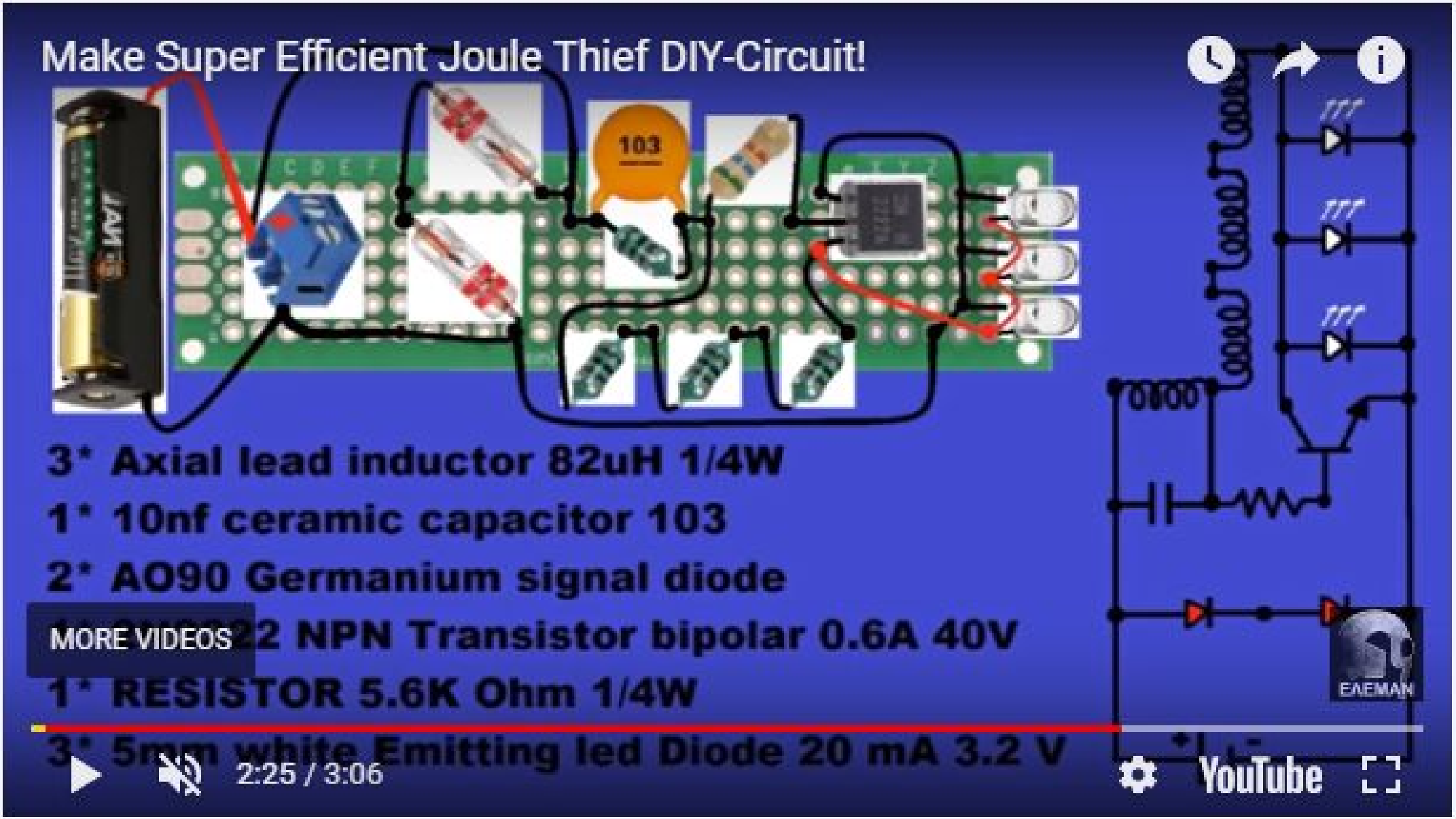
Make Super Efficient Joule Thief DIY-Circuit!
103
3* Axial lead inductor 82uH 1/4W
1* 10nf ceramic capacitor 103
2* AO90 Germanium signal diode
MORE VIDEOS
1* RESISTOR 5.6K Ohm 1/4W
2:25 / 3:06
YouTube
ΕΛΕΜΑΝ

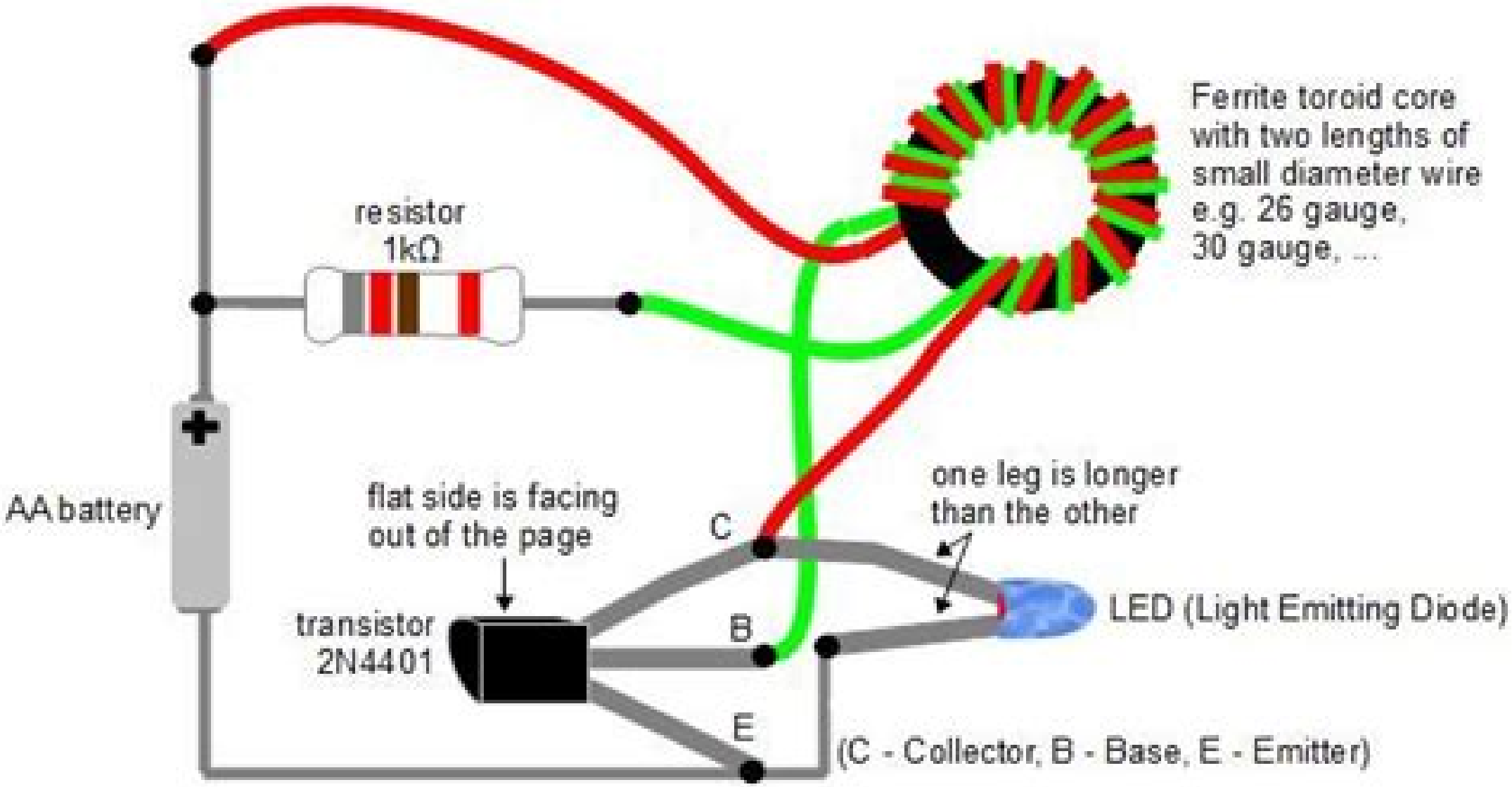
Ferrite toroid core
with two lengths of
small diameter wire
e.g. 26 gauge,
30 gauge, ...
resistor
1kΩ
AA battery
flat side is facing
out of the page
one leg is longer
than the other
C
B
E
transistor
2N4401
LED (Light Emitting Diode)
(C - Collector, B - Base, E - Emitter)

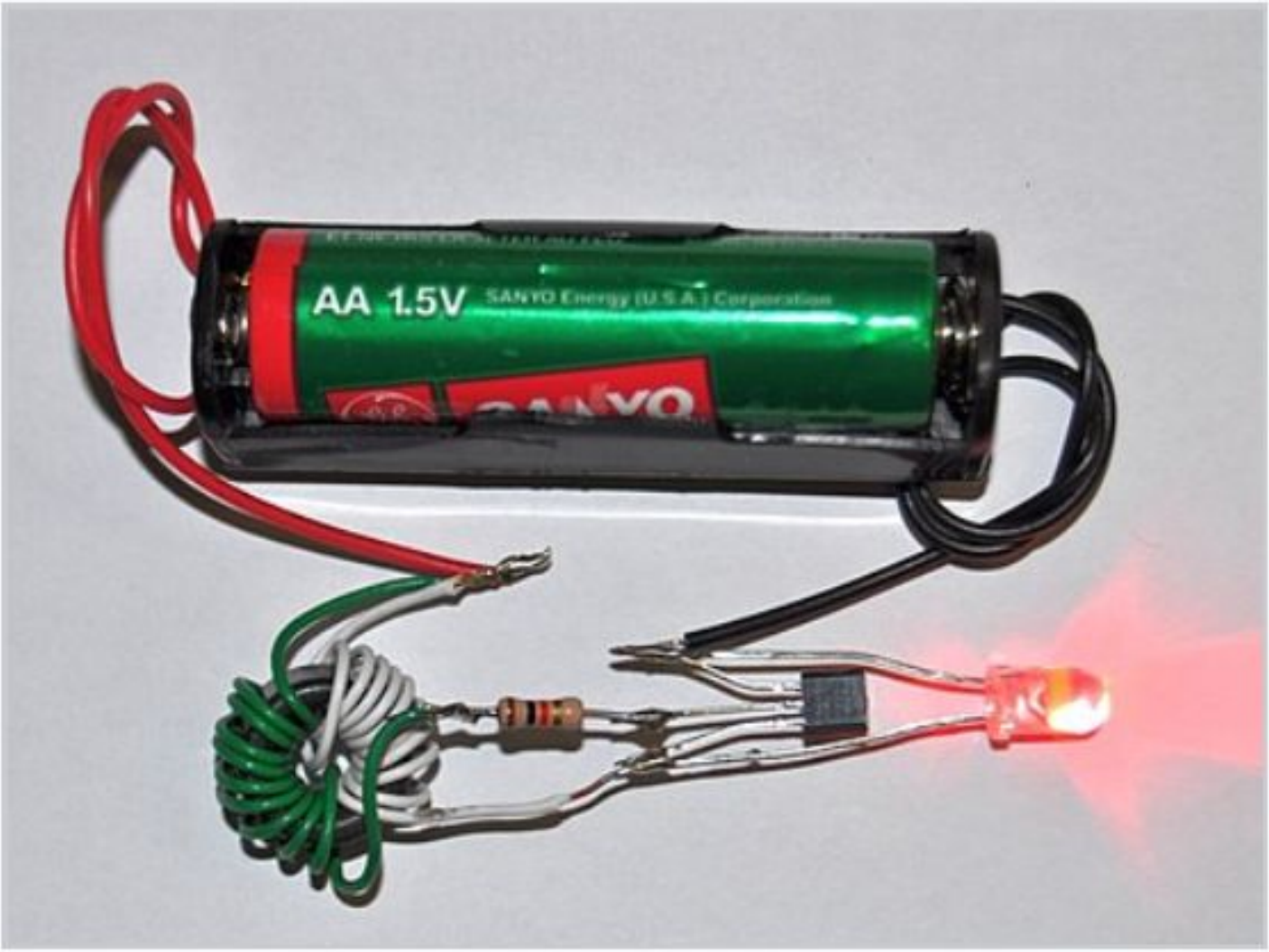

A conventional joule thief, shows components and how they are connected. This example uses a red LED. A ferrite toroid is wound to form a coil with primary (white) and feedback (green) windings. A 2N2222A transistor and 1000 ohm resistor are used.

The Joule Thief

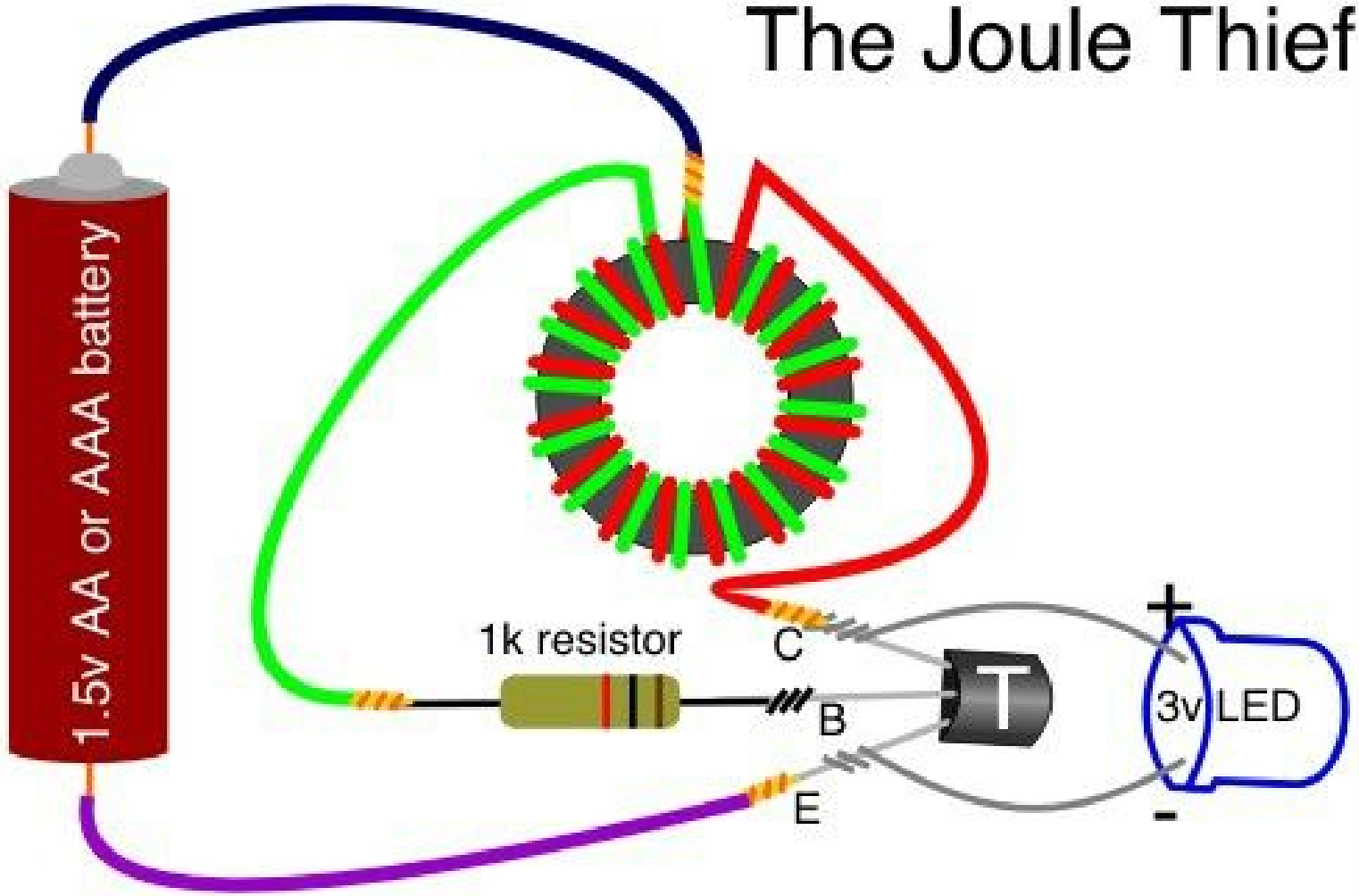

Transistor shown (T) is 2N3904 (can also use 2N2222).

Note LED pins - negative is shorter and has flat on bulb edge.

2 wires round ferrite ring are wound together, then start of one joined to end of other.

Try adding more and more LEDs…

Joule Thief

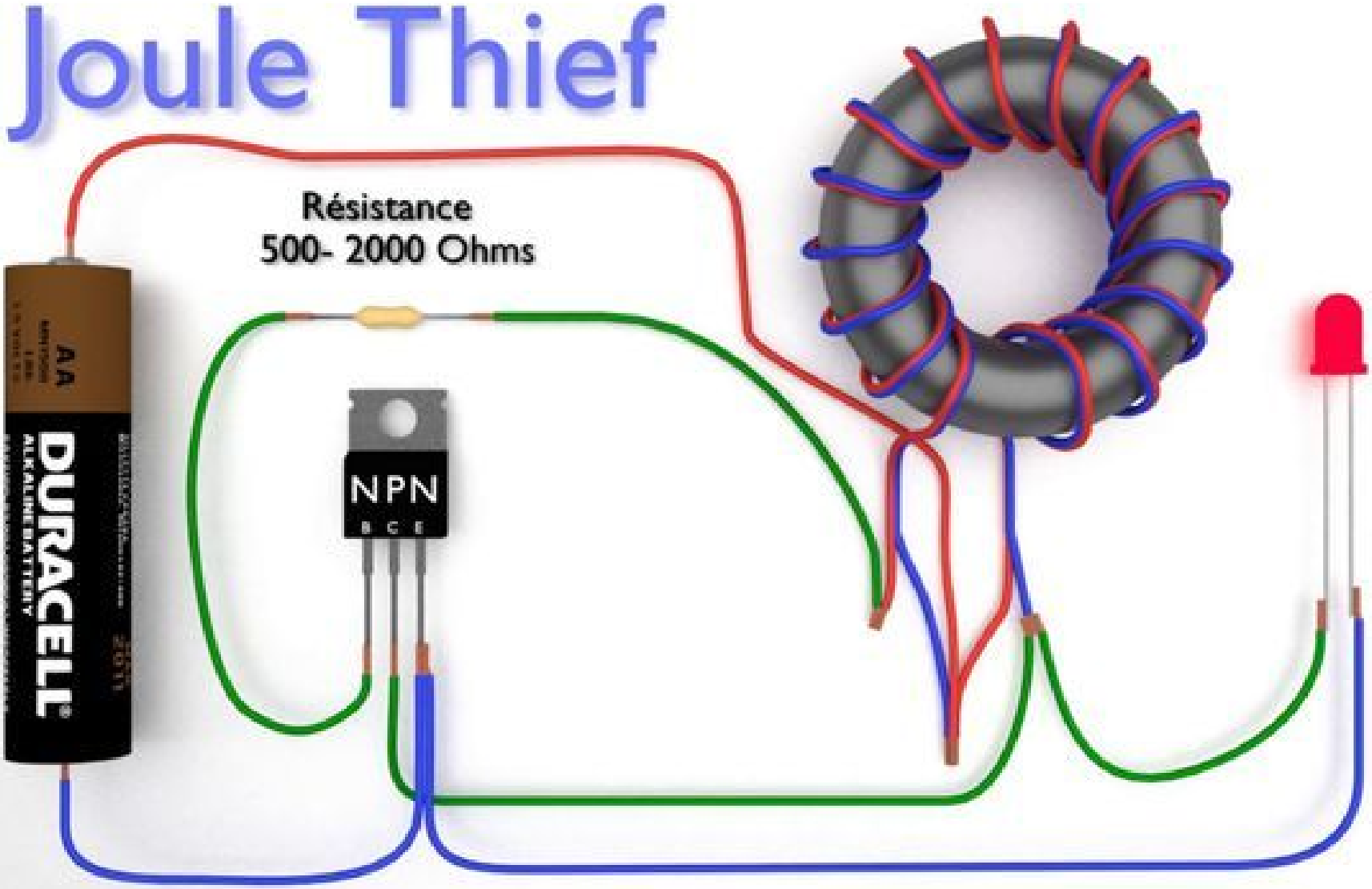
Résistance
500- 2000 Ohms
NPN
B C E
AA
DURACELL
ALKALINE BATTERY

Its a Rubbish Challenge
Dog Light

Joule Thief
electronics circuit

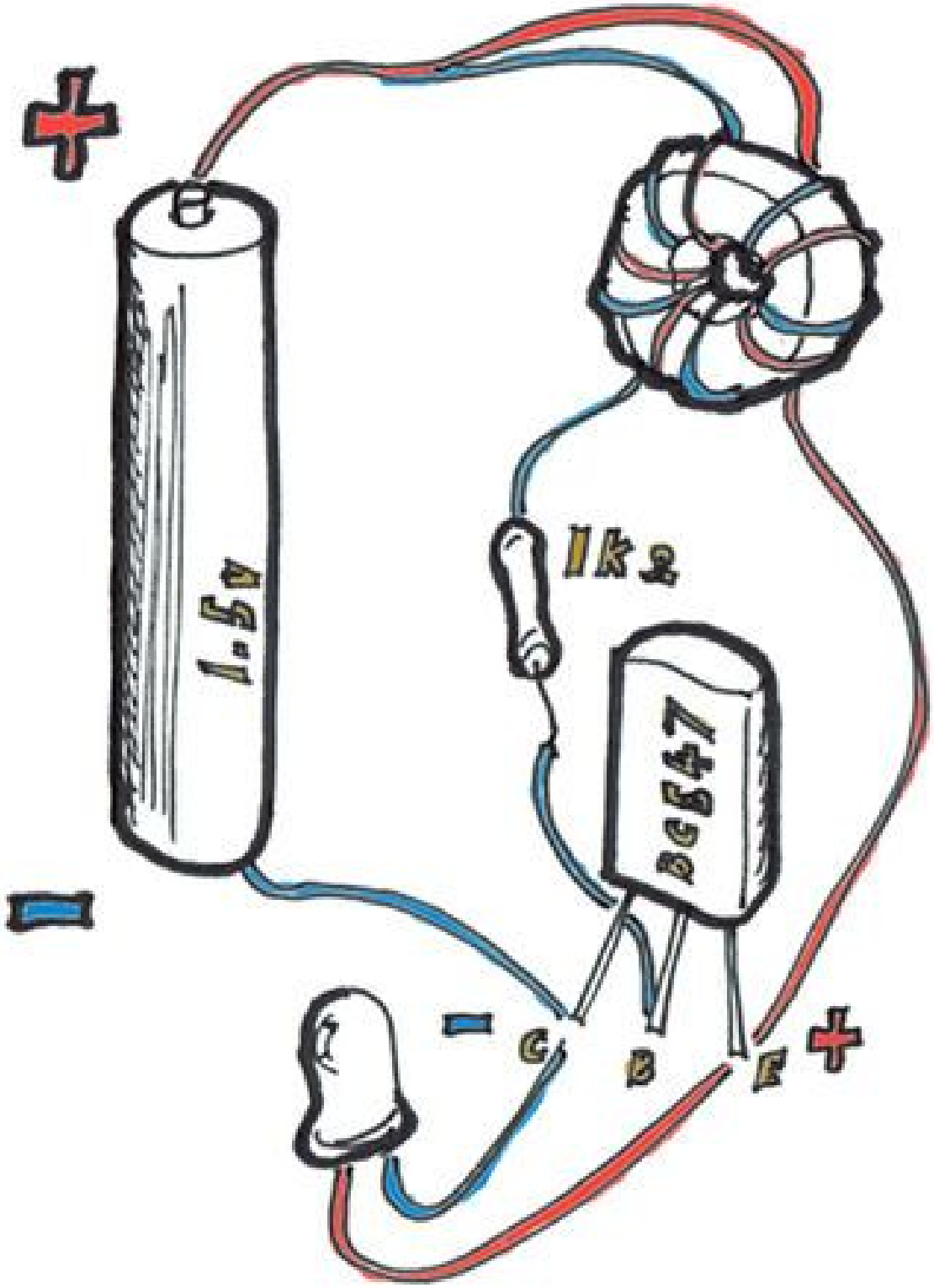

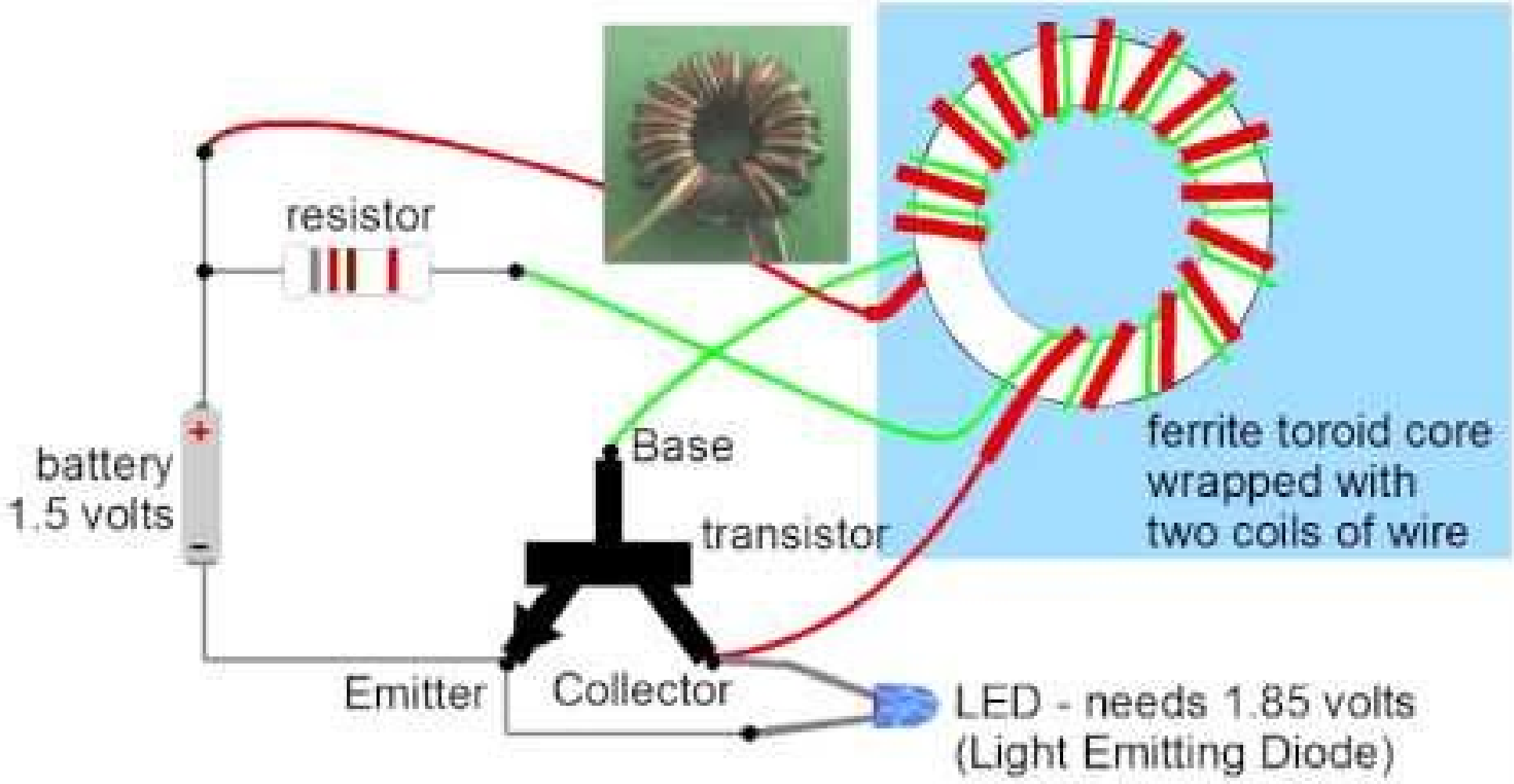
resistor
battery
1.5 volts
+
-
Base
transistor
Emitter
Collector
LED - needs 1.85 volts
(Light Emitting Diode)
ferrite toroid core
wrapped with
two coils of wire

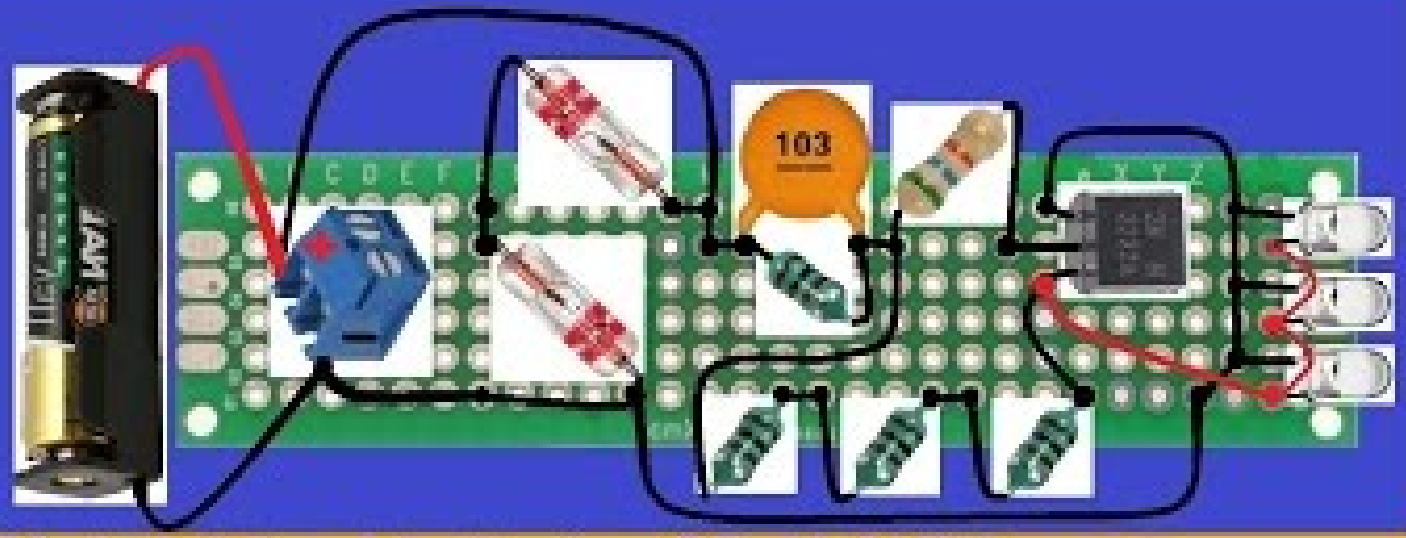

3* Axial lead inductor 82uH 1/4W

1* 10nf ceramic capacitor 103

2* AO90 Germanium signal diode

1* 2N2222 NPN Transistor bipolar 0.6A 40V

1* RESISTOR 5.6K Ohm 1/4W

3* 5mm white Emitting led Diode 20 mA 3.2 V

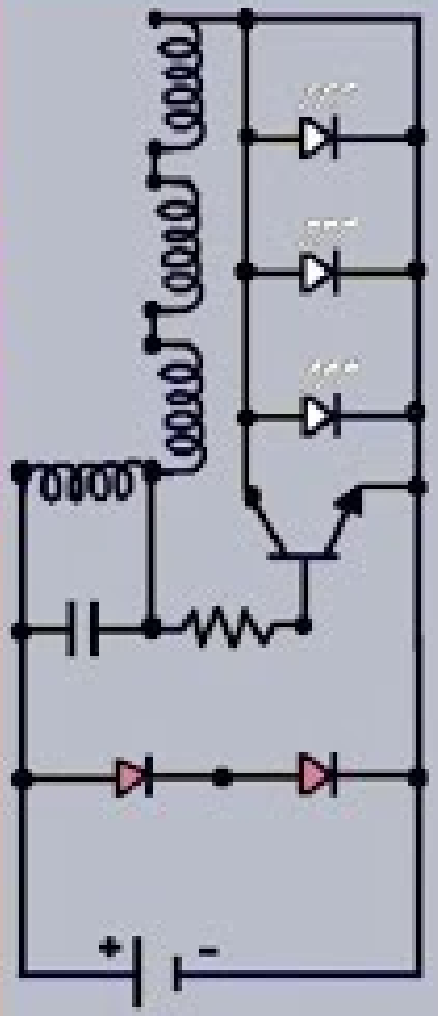

AA 1.5V
SANYO Energy (U.S.A.) Corporation
SANYO

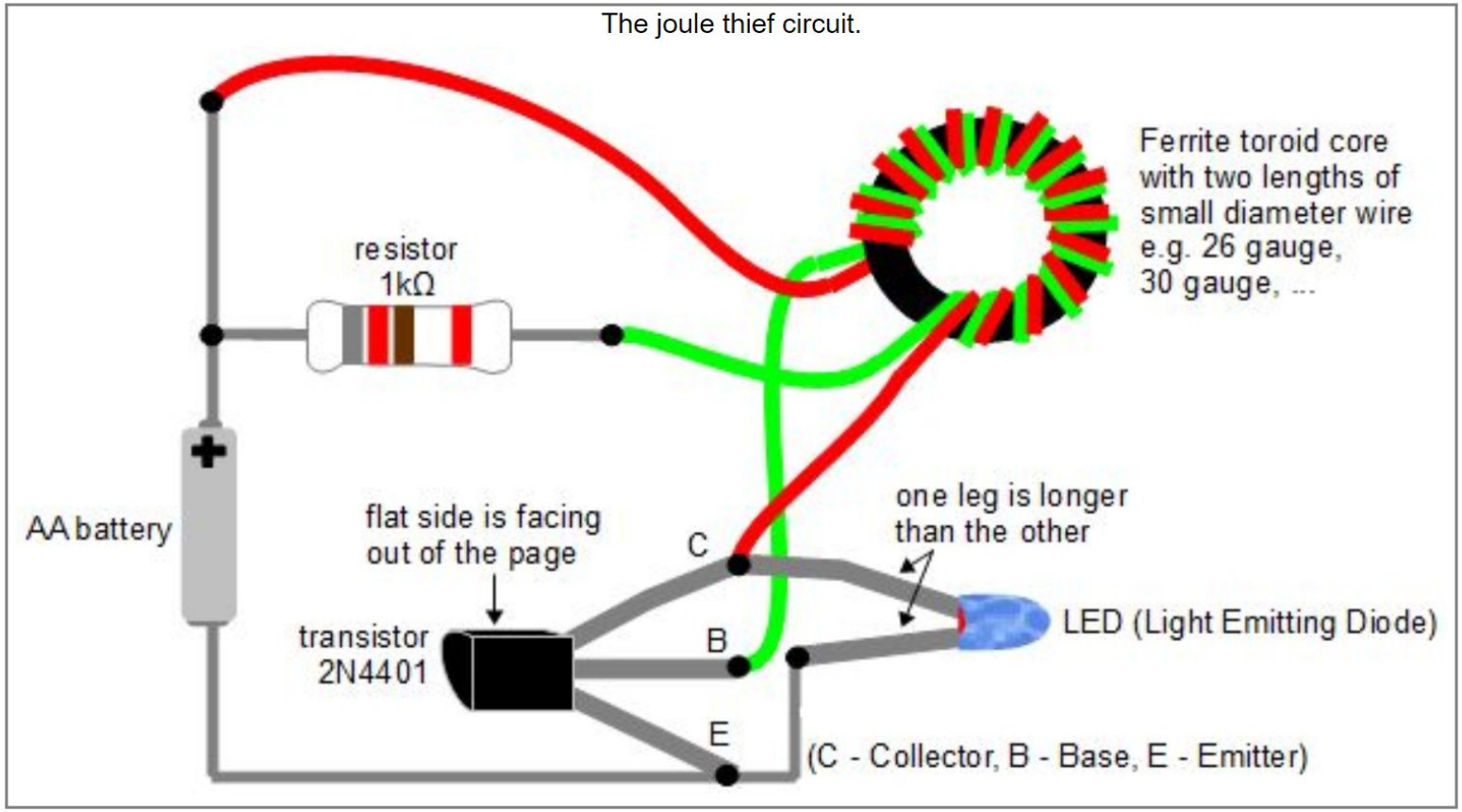

Transistor - The legs of the transistor can be determined by noticing that there's a flat side to the transistor case. See the diagram above. A large number of transistors have been reported to work: 2N4401, NET123AP, BC547B, 2SC2500, BC337, PN2222, to name just a few.

LED - One leg of the LED is longer than the other leg. Use this to determine which one goes where. See the diagram above.

Resistor - The diagram says use a 1 kilo ohm resistor but I've used an 820 ohm one just fine. I've also seen a 2 kilo ohm one in use. Use whatever works for you. You can also use a potentiometer (a variable resistor) so that you can easily adjust it to select the resistance that gives the best light.

Toroid ferrite core - Some people have gotten these by opening up compact fluorescent lightbulbs (CFLs). I took mine out of some device whose original function I don't know. To get it working, my first one had just 13 turns for each wire and I used a 30 gauge wire and a 26 gauge wire. The wire must be insulated. A variety of number of turns will work. This is something you can play with. Look at the diagram carefully to determine where the wires connect to.

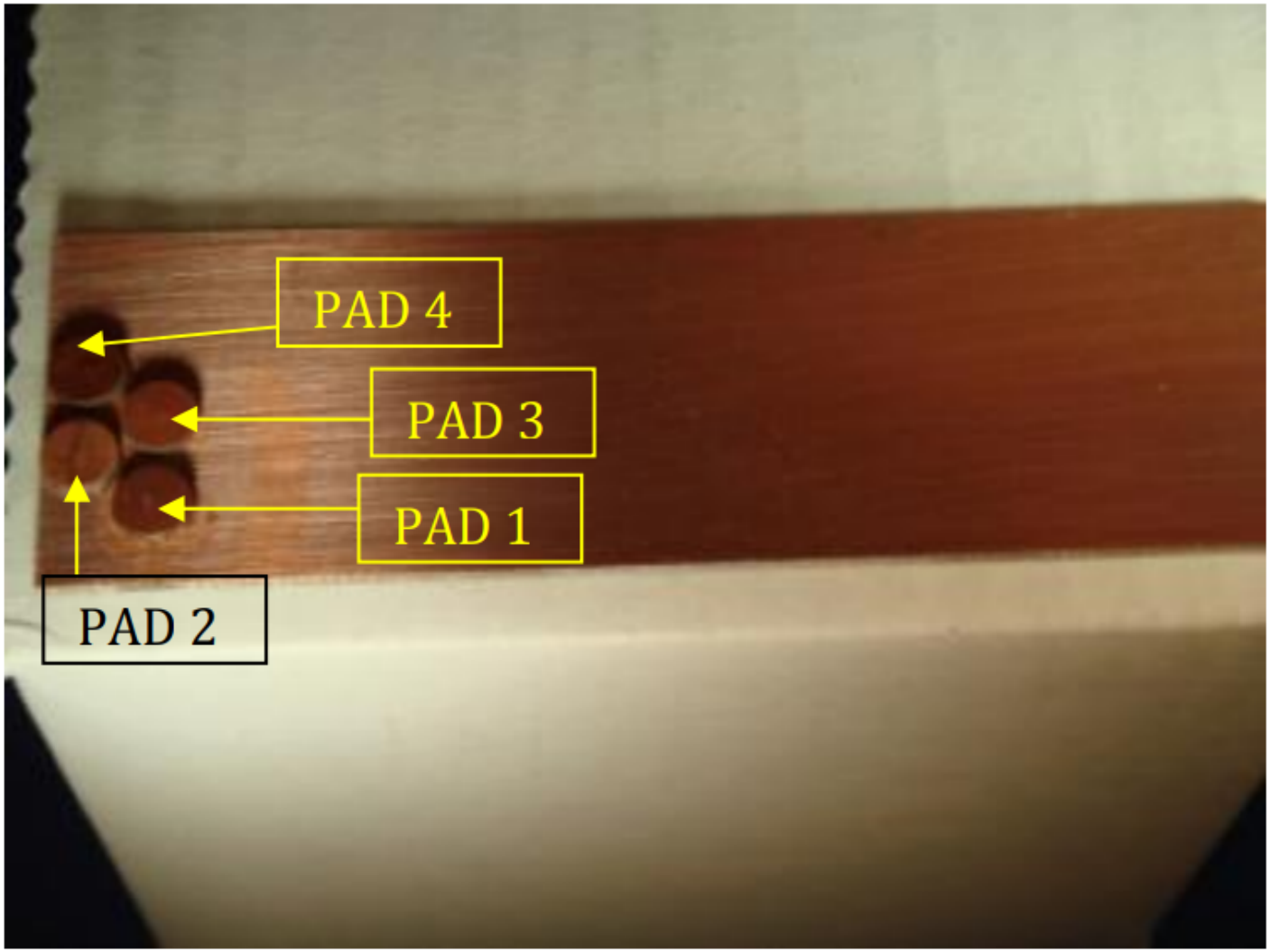

Superglue four pads to the PC board. Make sure they are not touching each other. You should have roughly 1/8 inch between the pads. Apply a small drop of superglue on the board and press the pad onto the board with the small dimple up. Use a small screwdriver to hold pressure on the pad until the glue dries (about 10 seconds).

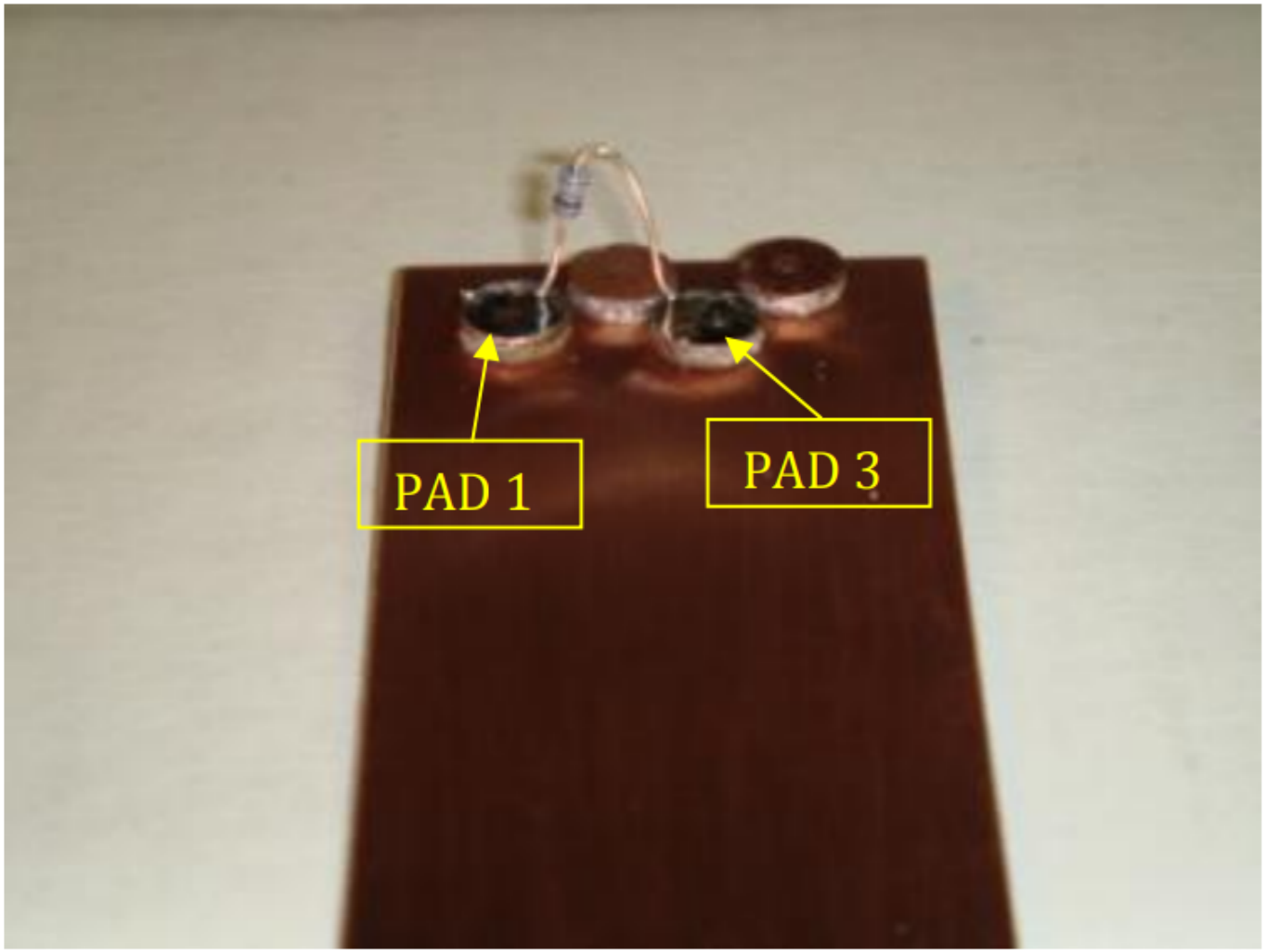

Solder the 1,000 ohm resistor onto pads 1 and 3. When soldering all components, place a 90-degree bend on the ends of the component where they touch the pad to allow better soldering. There is no polarity on a resistor.

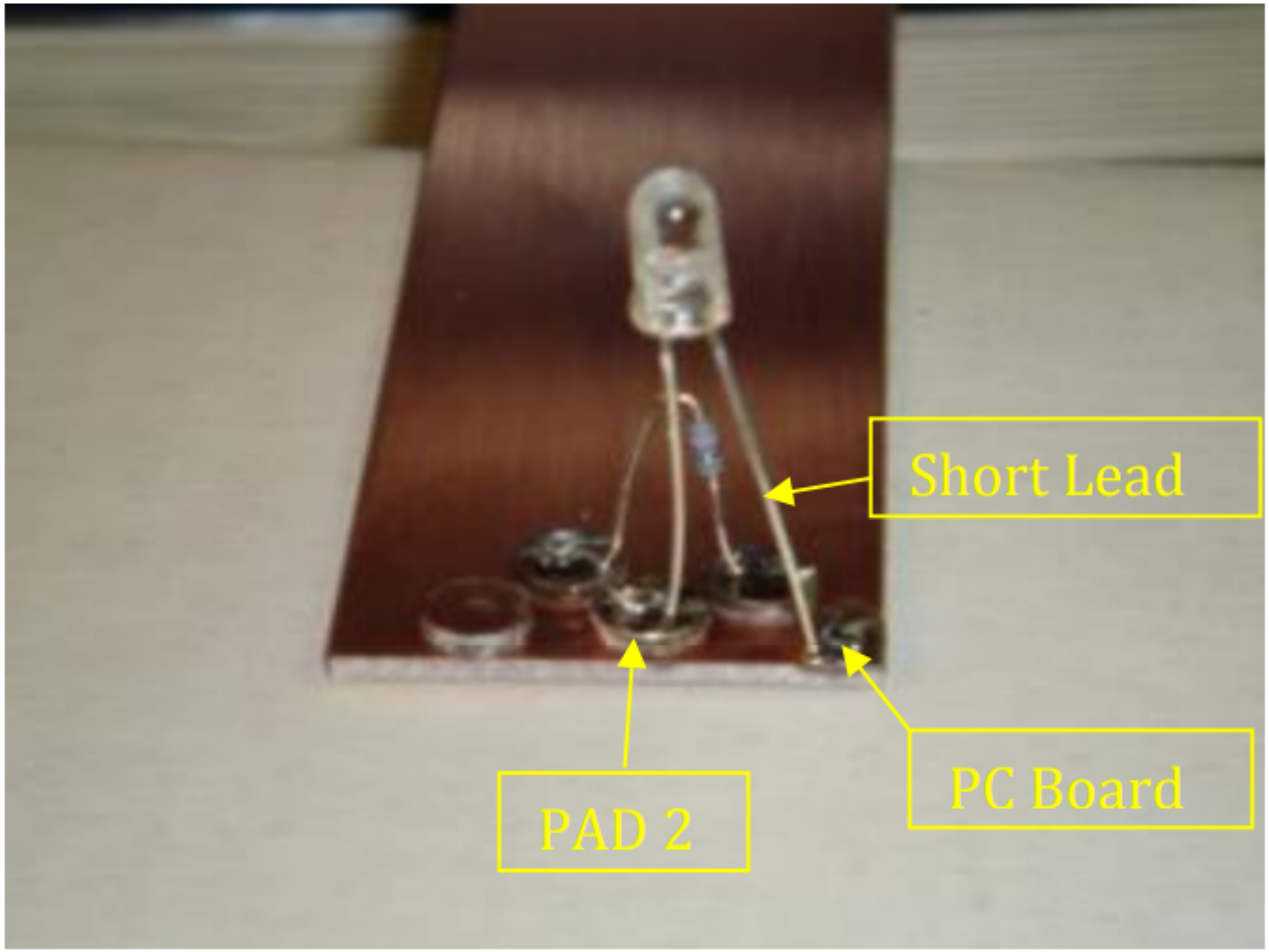

Solder the LED to the board. **VERY IMPORTANT**: Solder the **long lead** to pad 2 and the **short lead** directly to the PC board. The LED will not illuminate of you put it in backwards. If you look into the LED, the anvil shaped part is the lead that gets soldered to the PC board.

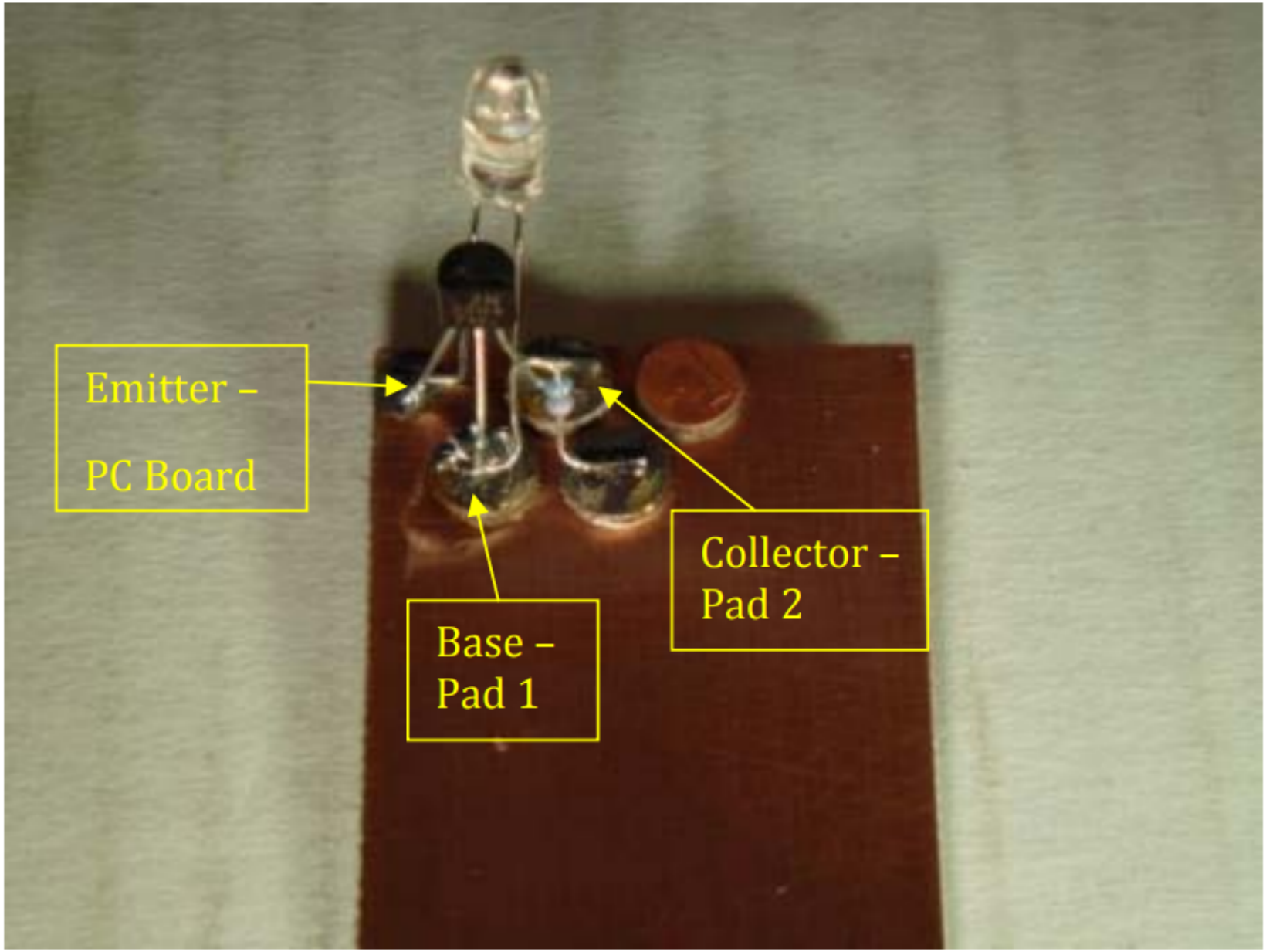

Solder the transistor to the board. With the flat part facing you the left lead (emitter) is soldered directly to the PC board. The center lead (base) is soldered to pad 1. The right lead (collector) is soldered to pad 2. Failure to install this part correctly will prevent the Joule Thief from working.

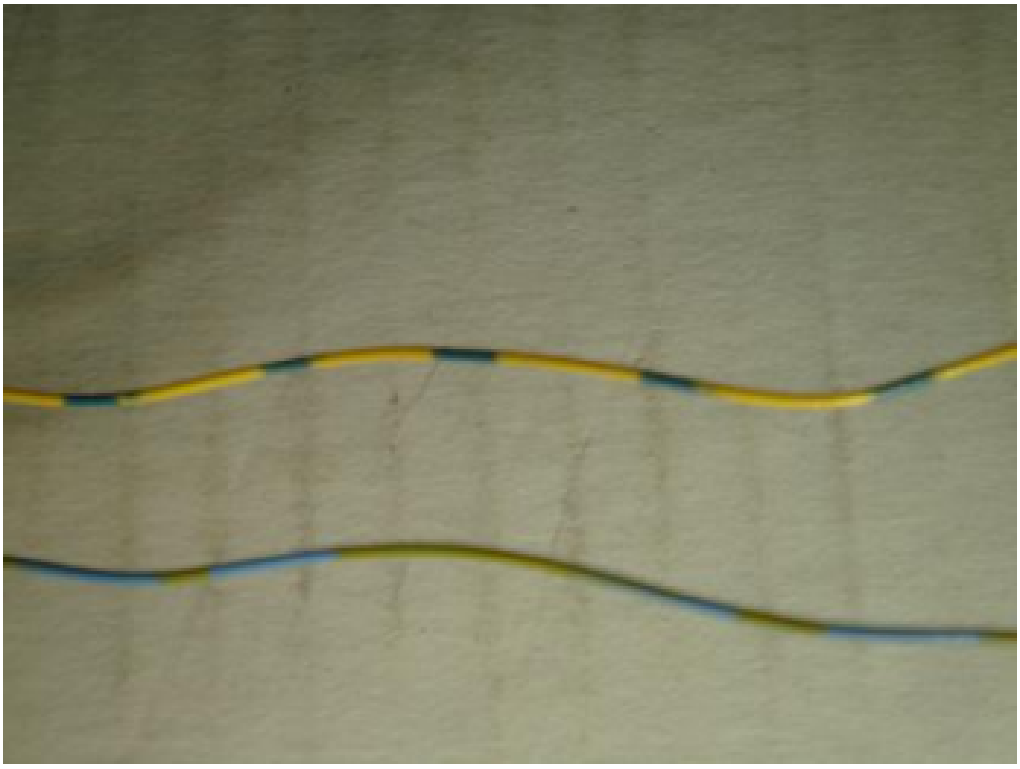

Take the two pieces of wire and **untwist** them if they are twisted. The toroid requires 12 inches of wire. You will wind the toroid with this pair of wires side by side.

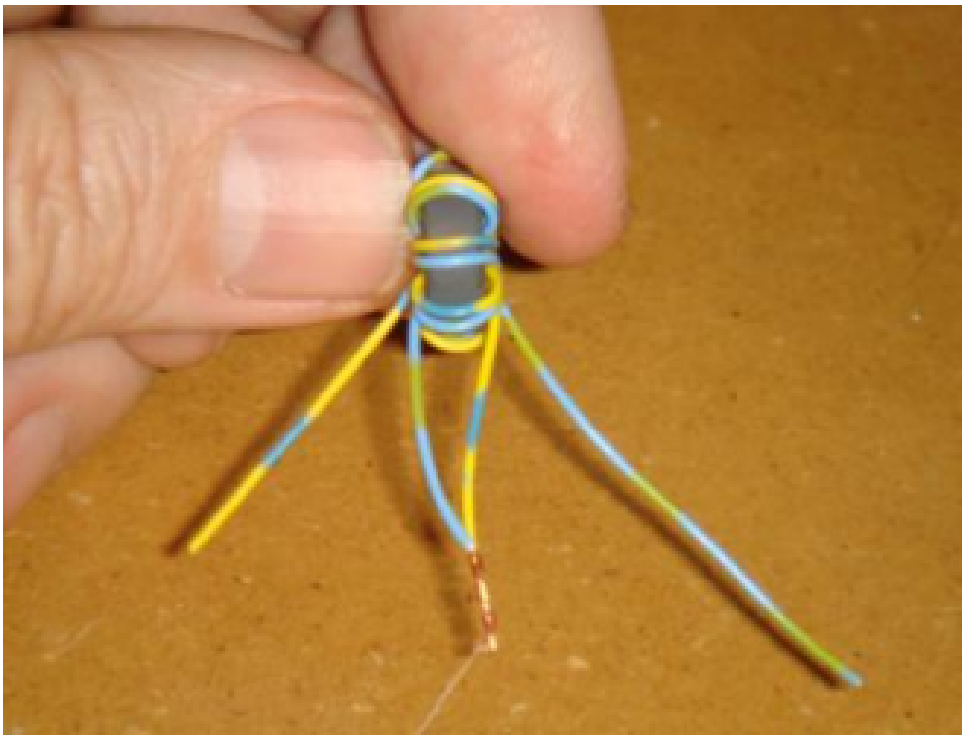

Wind the toroid with **9 turns** of the wire. Each turn through the hole in the center counts as one turn. **VERY IMPORTANT:** You must take one wire **from each side of the winding** and twist them together. This makes the transformer windings out of phase. This is critical to operation. Connect one wire of each color.

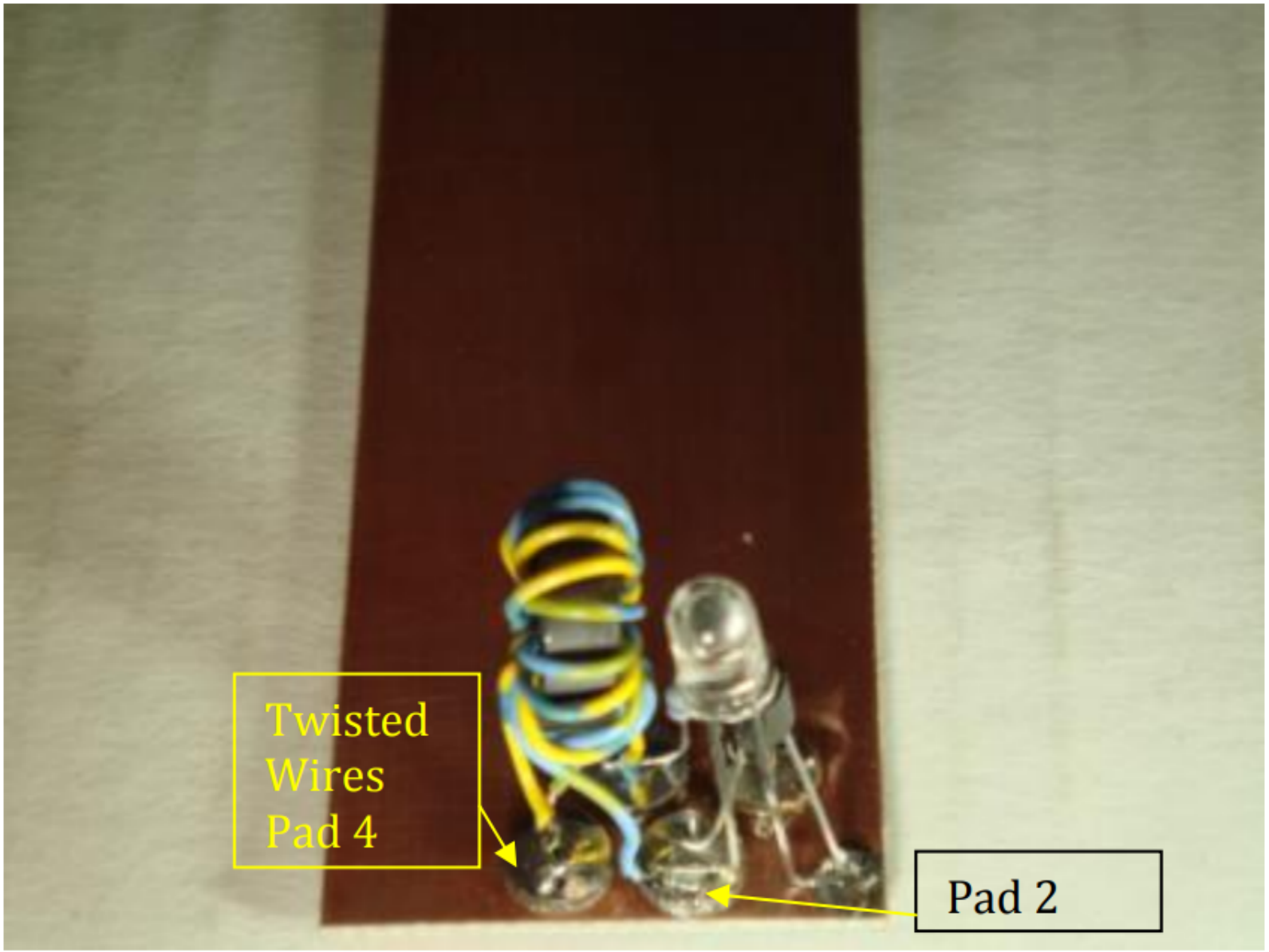

Solder the twisted wires on the toroid to pad 4. Solder one of the other toroid wires (doesn't matter which one) to pad 2.

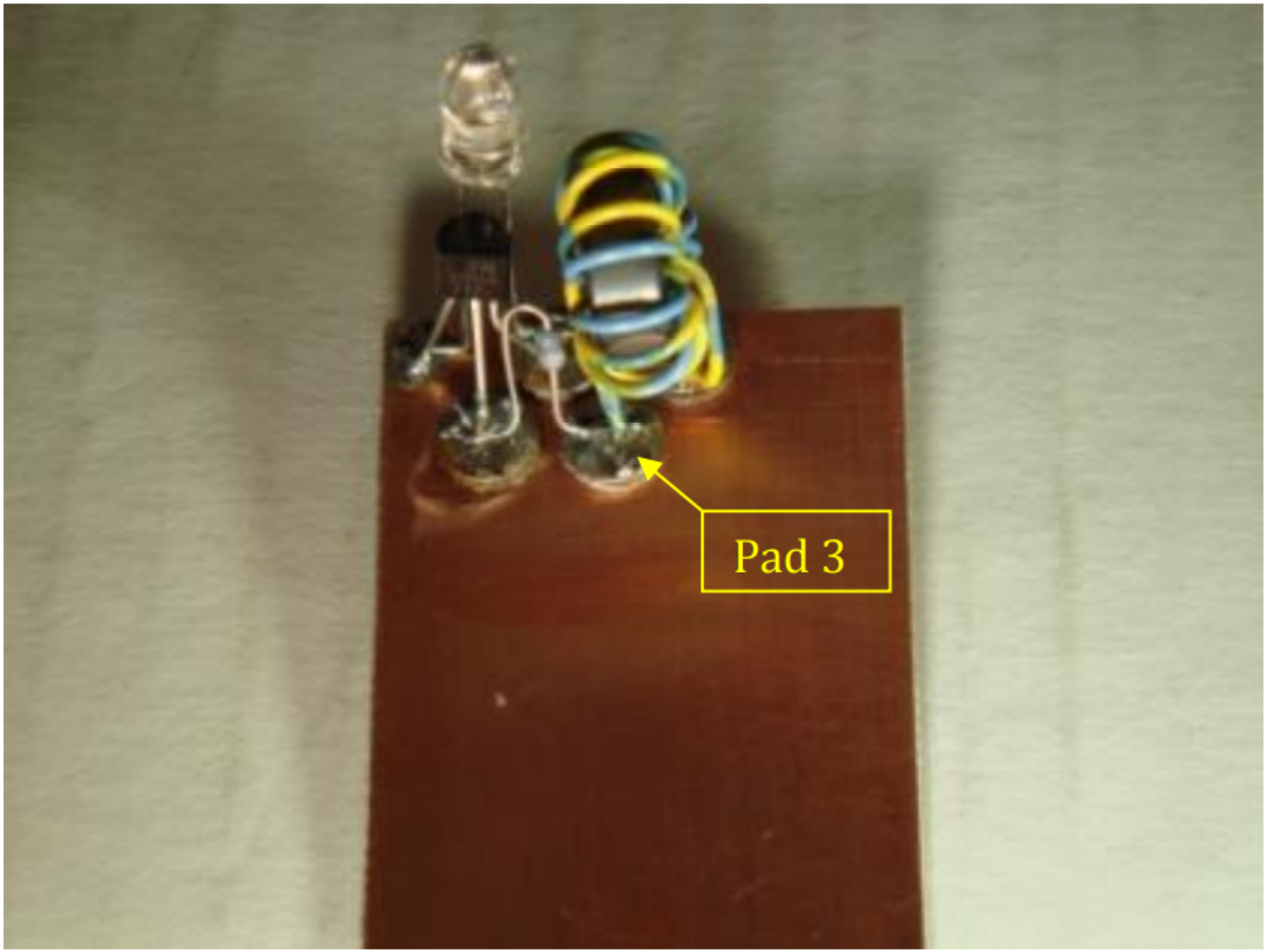

Solder the other wire on the toroid to pad 3.

Solder the battery holder. Connect a short piece of wire from the positive terminal (the one without the spring) to pad 4. Solder the negative terminal (the one with the spring) directly to the PC board using a short piece of wire. Use hot glue or some other glue to secure the battery holder to the PC

Step 1 – Wound the Toroid

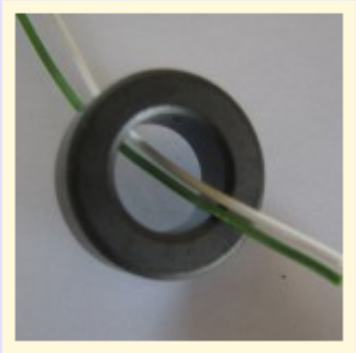

Take the two strands of plastic insulated wire and hold them together. Start off by sticking then through the middle of the toroid until you have 2 cm of wire left to make a connection with later. Keep the two wires together and wrap them around the toroid until you have covered the whole toroid. If you have wire left you can continue until you have about 2 cm of wire free on either side. Remove about a 0.5 cm of the plastic insulation on all four of the wires as in the photo. You have now wound your toroid and we are ready to continue.

Step 2 – Join the two coils of Toroid

The next step is to join the two coils or windings of the toroid. You may have noticed the two dots next to the toroid windings in the circuit diagram. These two dots indicate the polarity of the transformer and as you can see the two windings are opposite to each other. To make sure that the polarity of our toroid windings are correct we must do the following:

- If we look at the toroid we noticed that we have two wires of different colours sticking out at both ends of the toroid.
- Take one wire of a specific colour (green in the example) on the one side of the toroid and one wire of the other colour (white in the example) on the other side of the toroid and connect (or solder) them together. These two wires forms the top pole of the toroid as in the circuit diagram and is connected to the positive terminal of the battery.

A conventional joule thief, shows components and how they are connected. This example uses a red LED. A ferrite toroid is wound to form a coil with primary (white) and feedback (green) windings. A 2N2222A transistor and 1000 ohm resistor are used.

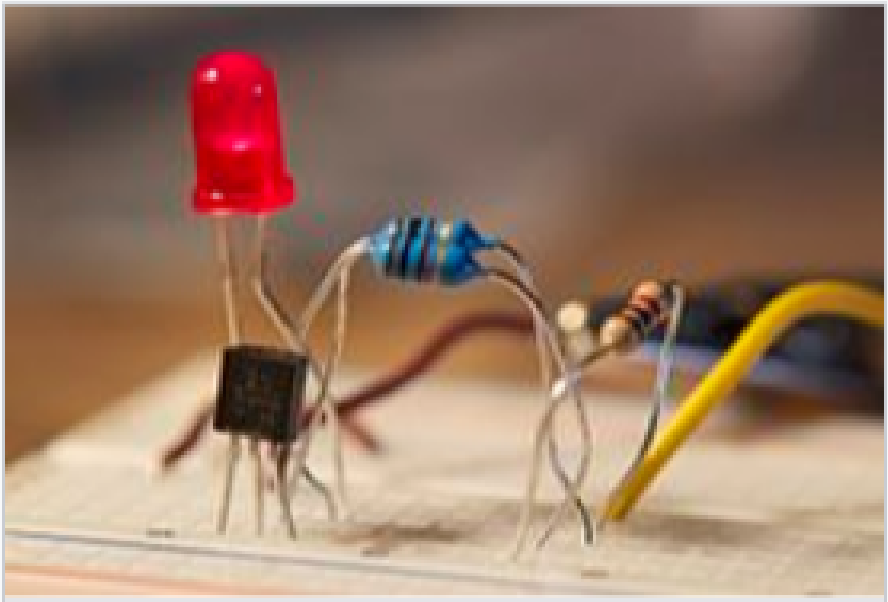

A joule thief with two axial inductors replacing the ferrite toroid, shown on a solderless breadboard

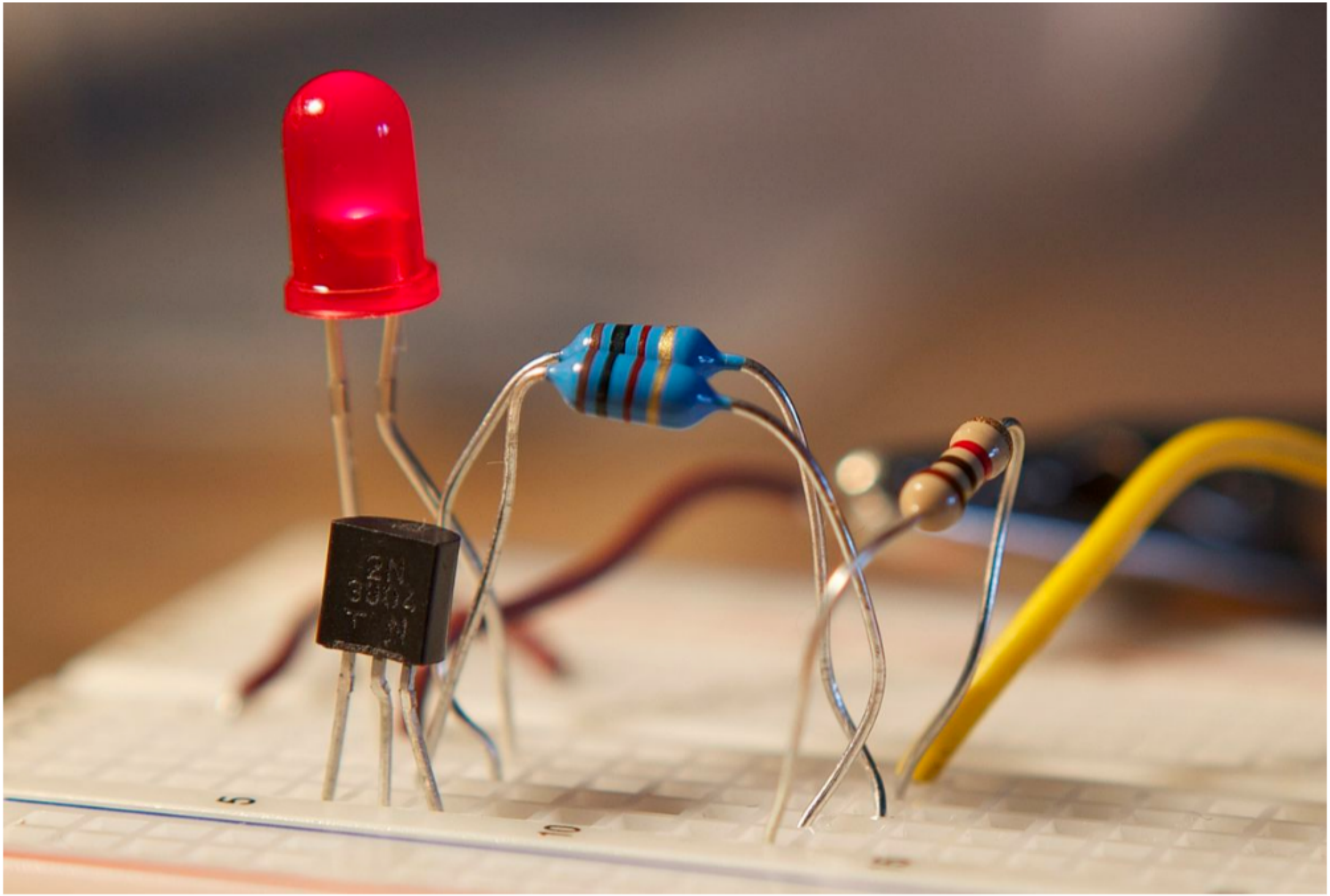
2N
3904
5
10
15

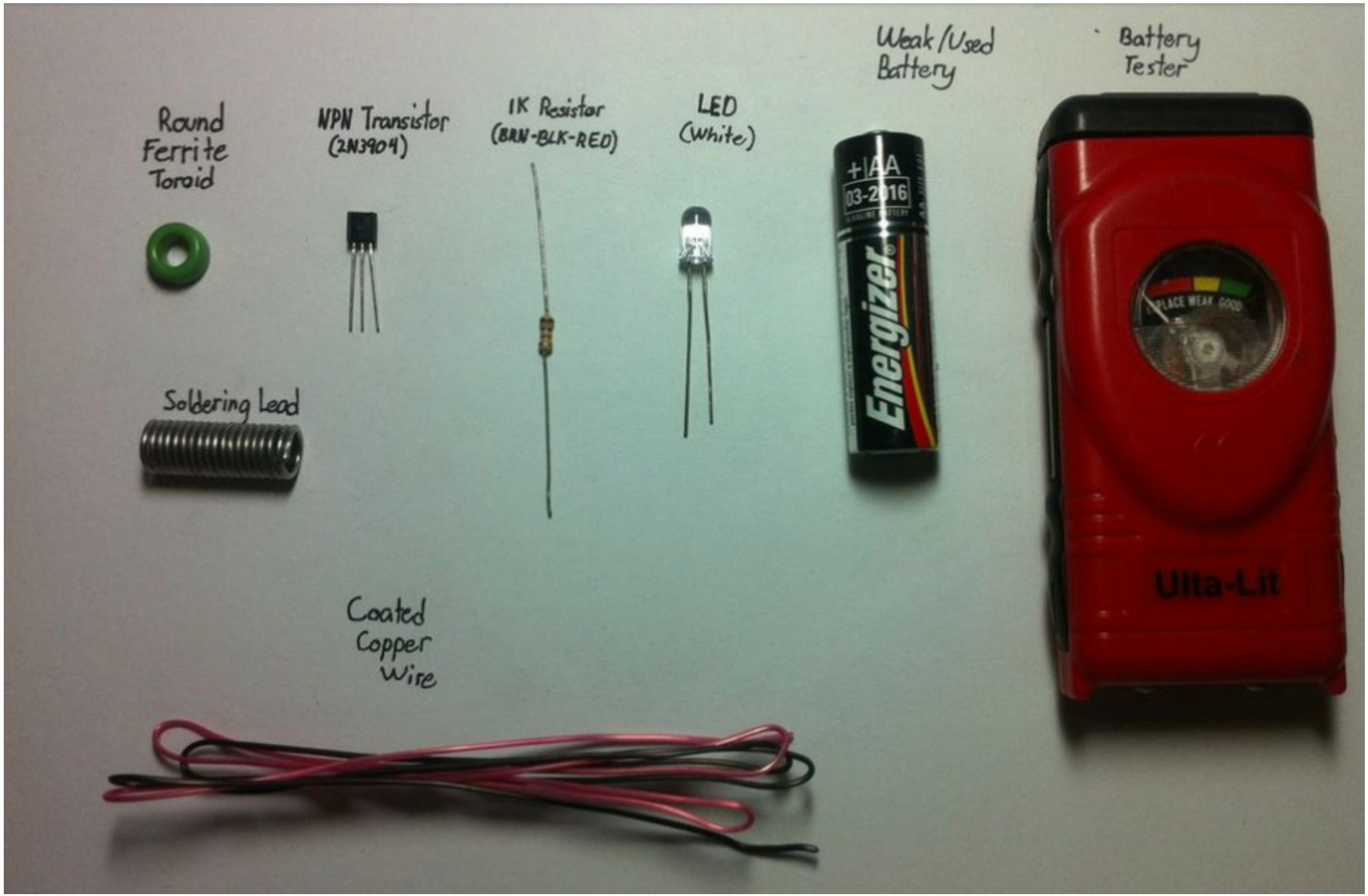
Round Ferrite Toroid
NPN Transistor (2N3904)
1K Resistor (BRN-BLK-RED)
LED (White)
Weak/Used Battery
Battery Tester
Soldering Lead
Coated Copper Wire
+ AA
03-2016
Energizer
PLACE WEAK GOOD
Ulta-Lit

Step 2: Schematic Diagrams

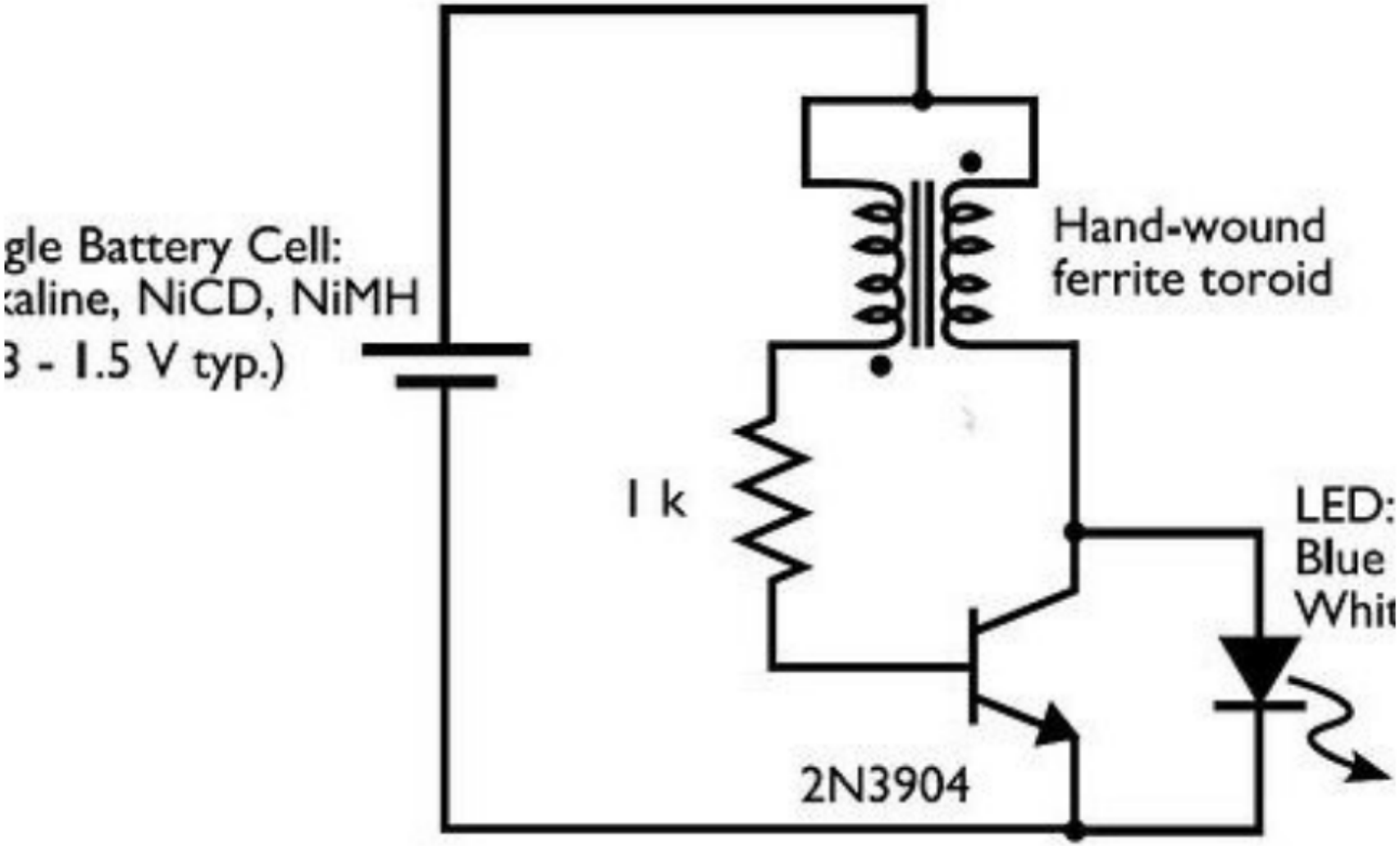

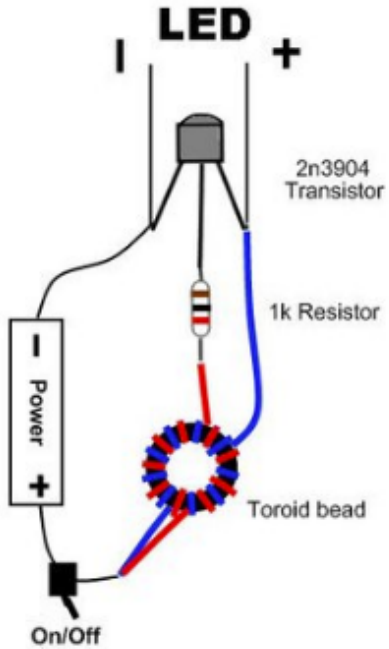

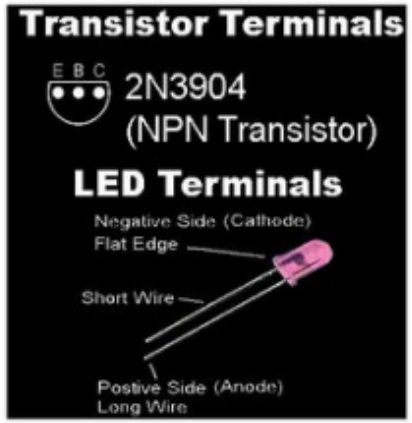

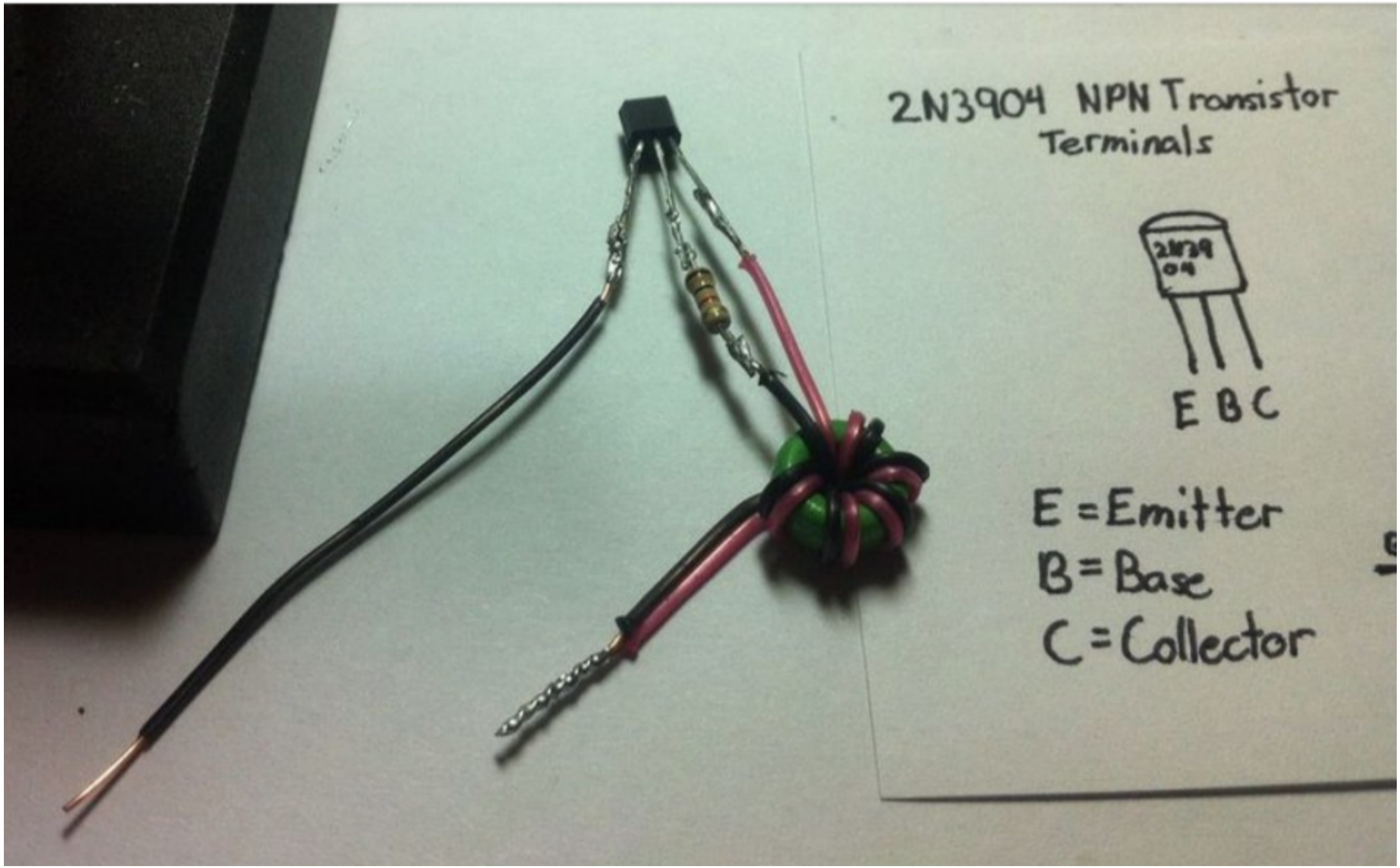
2N3904 NPN Transistor
Terminals
2N39
04
E B C
E = Emitter
B = Base
C = Collector

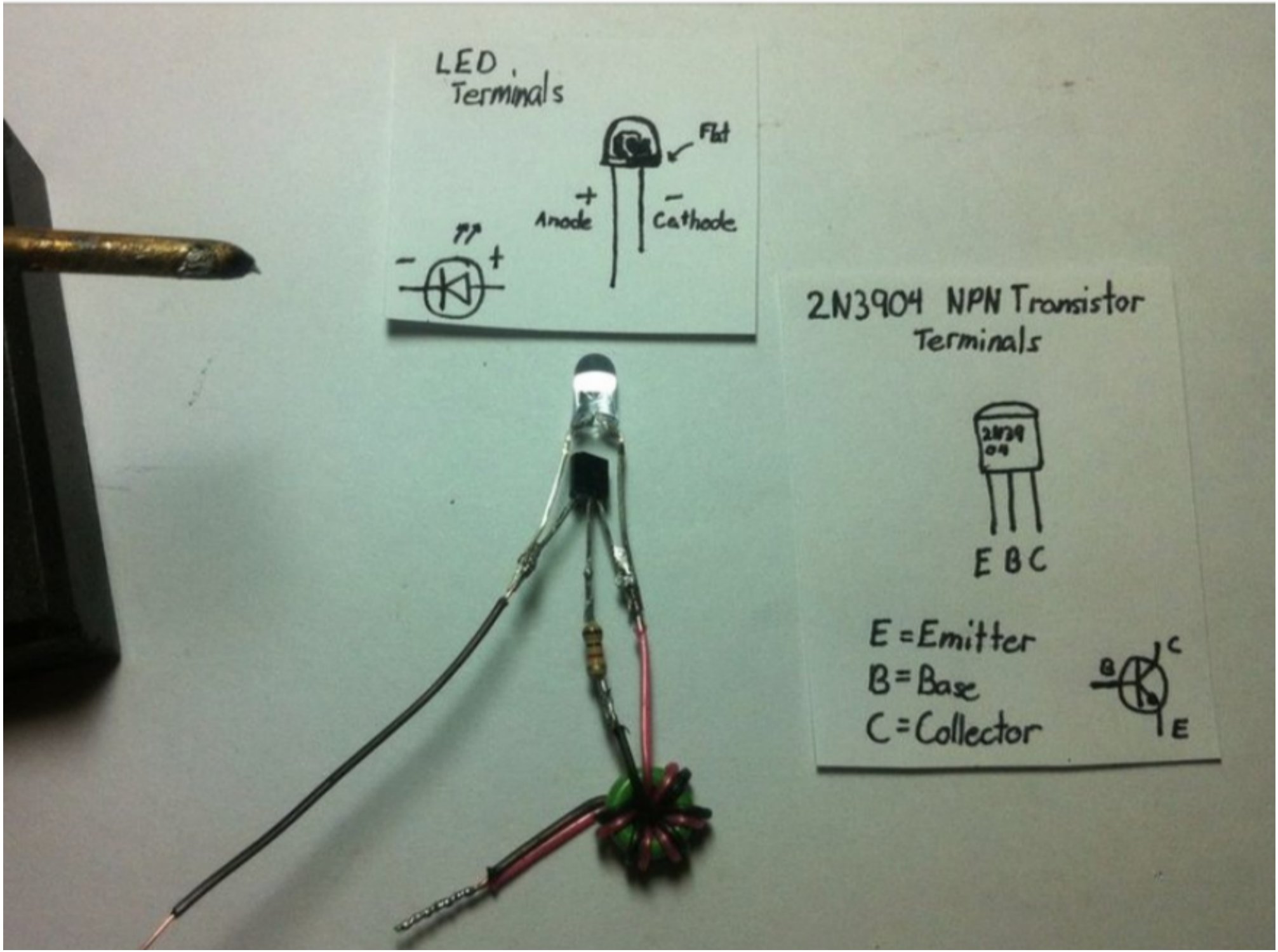
LED
Terminals
Flat
+
Anode
−
Cathode
−
+
2N3904 NPN Transistor
Terminals
2N39
04
E B C
E = Emitter
B = Base
C = Collector
B
C
E

These tiny T231212T toroids from Surplussales.com are high permeability so it doesn't take much wire to make a good Joule Thief coil. The core is less than a quarter inch diameter (here is a data sheet in .PDF.). Six inches of 30 AWG magnet wire trifilar wound, with two of the windings connected in parallel for the primary winding.

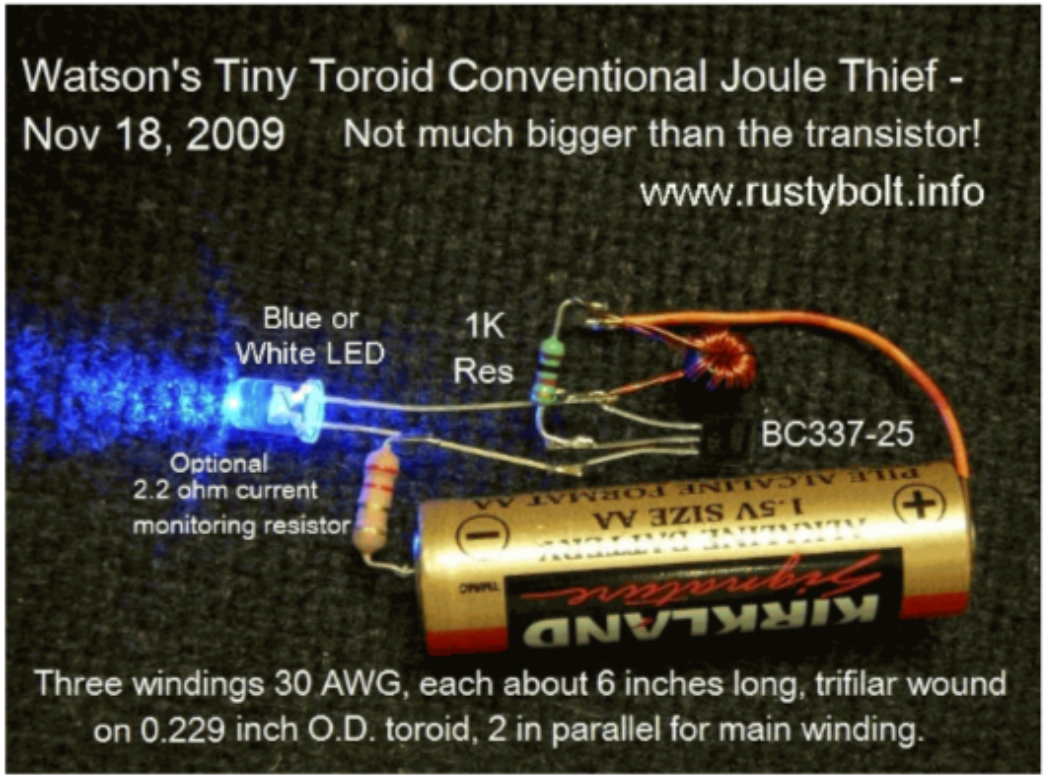

The transistor is a BC337-25. I put a 2.2 ohm resistor in series with the circuit to measure the battery current. It can be put there temporarily and removed when the LED current is what you want. How do you change the LED current? Change the 1k resistor to a different value. Higher values will reduce the LED current. With the BC337-25 and 1k resistor, the LED current should be close to 20 milliamps so it's probably not wise to go much below 1k. If you use another transistor, especially the pipsqueak 2N3904, you may have a hard time getting it to put out 20 milliamps.

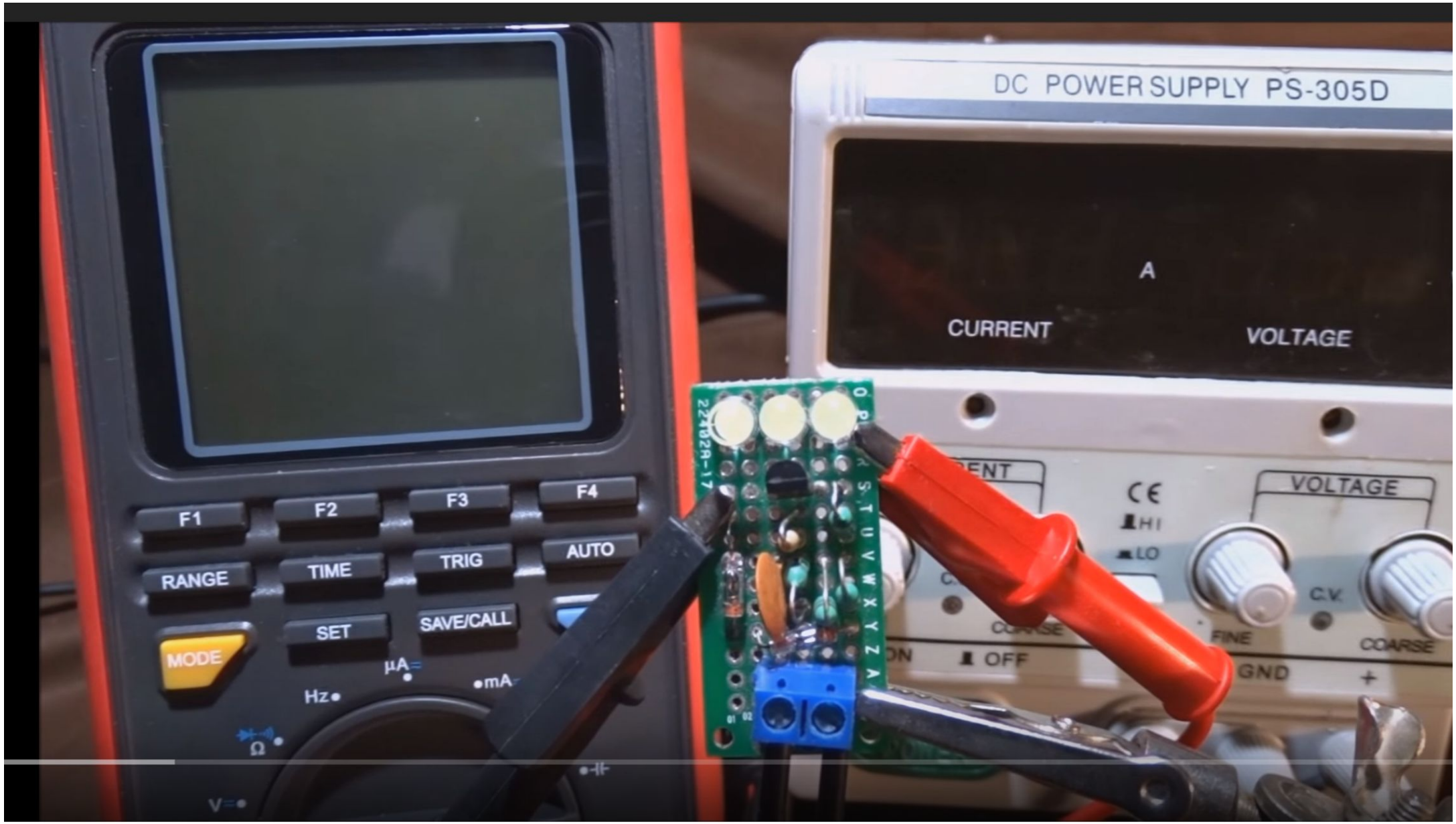
DC POWER SUPPLY PS-305D
A
CURRENT
VOLTAGE
F1
F2
F3
F4
RANGE
TIME
TRIG
AUTO
MODE
SET
SAVE/CALL
µA
Hz
mA
Ω
V
HI
LO
OFF
VOLTAGE
C.V.
FINE
COARSE
GND
+

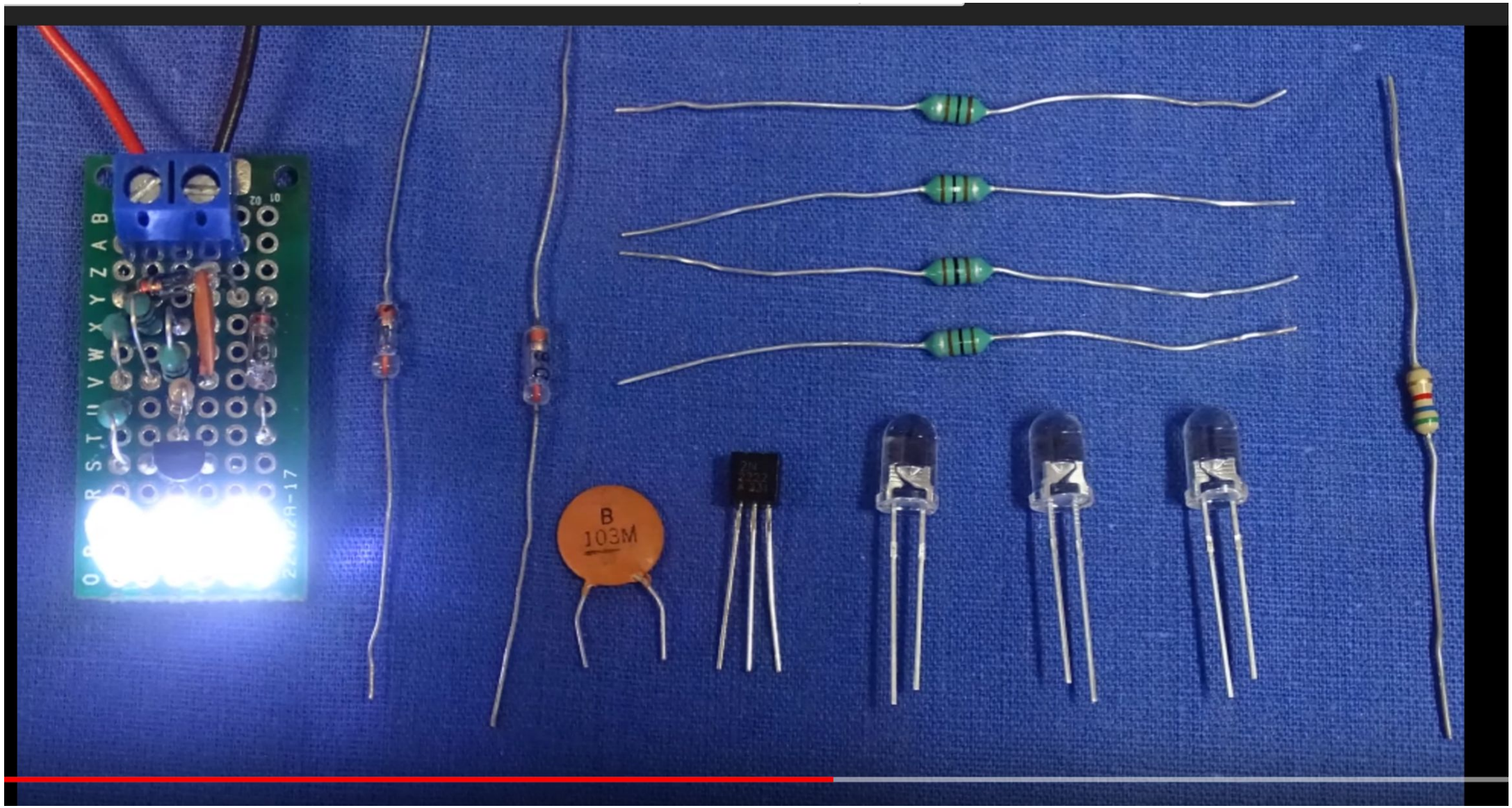
B
103M

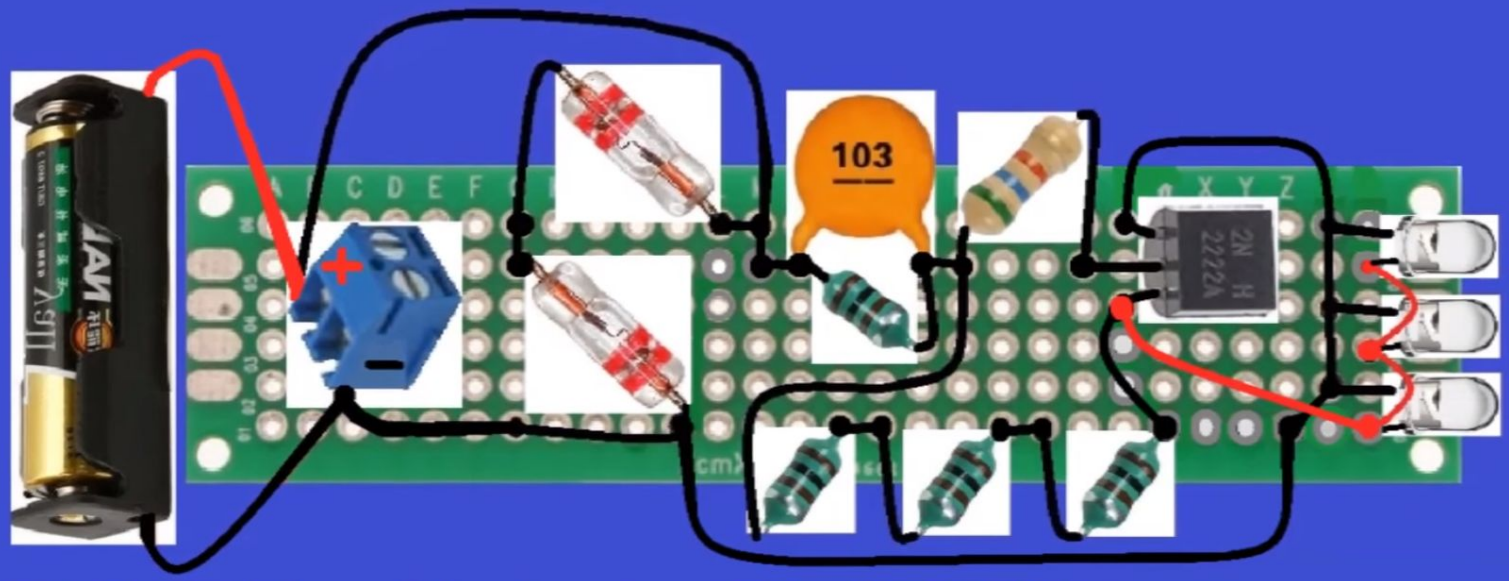

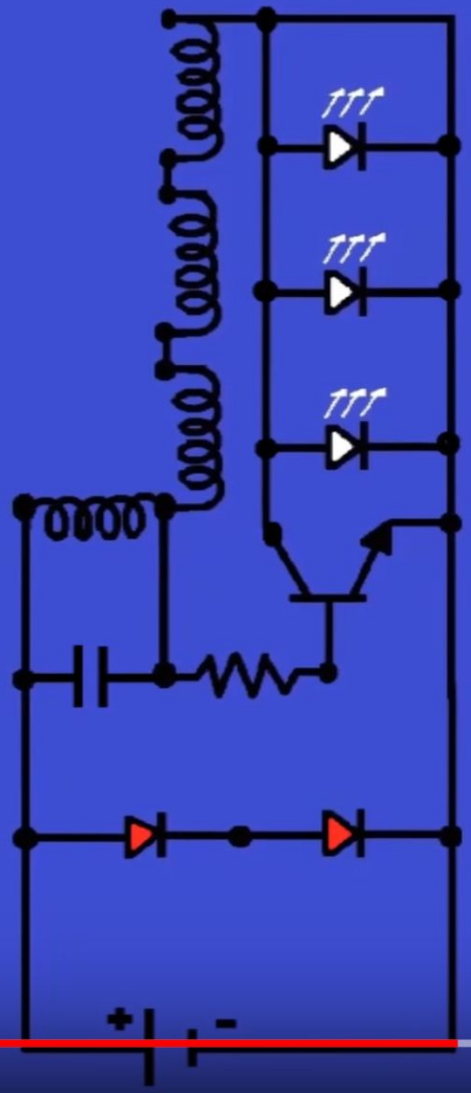

3* Axial lead inductor 82uH 1/4W

1* 10nf ceramic capacitor 103

2* AO90 Germanium signal diode

1* 2N2222 NPN Transistor bipolar 0.6A 40V

1* RESISTOR 5.6K Ohm 1/4W

3* 5mm white Emitting led Diode 20 mA 3.2 V

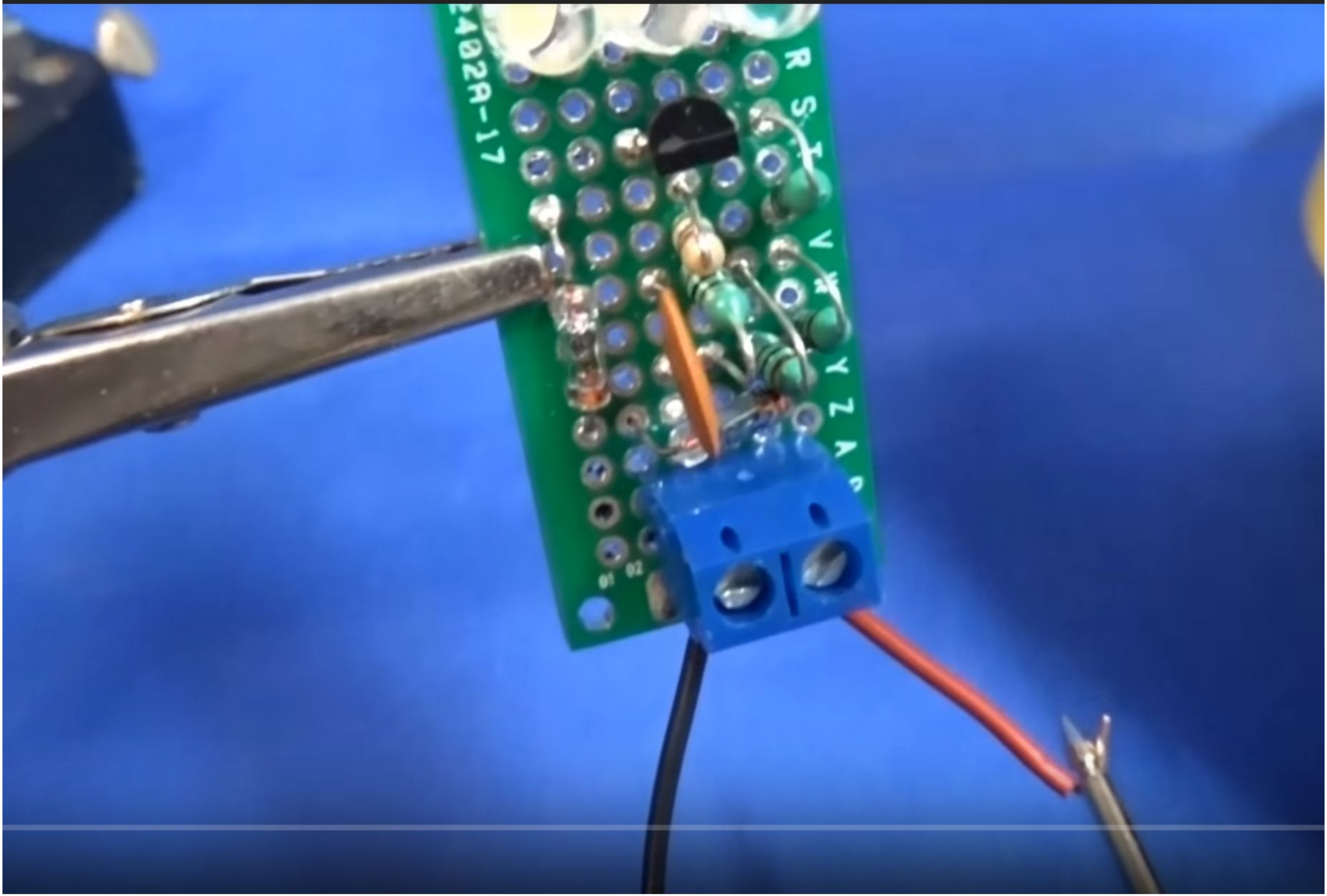
2402A-17
R
S
T
V
Y
Z
01
02

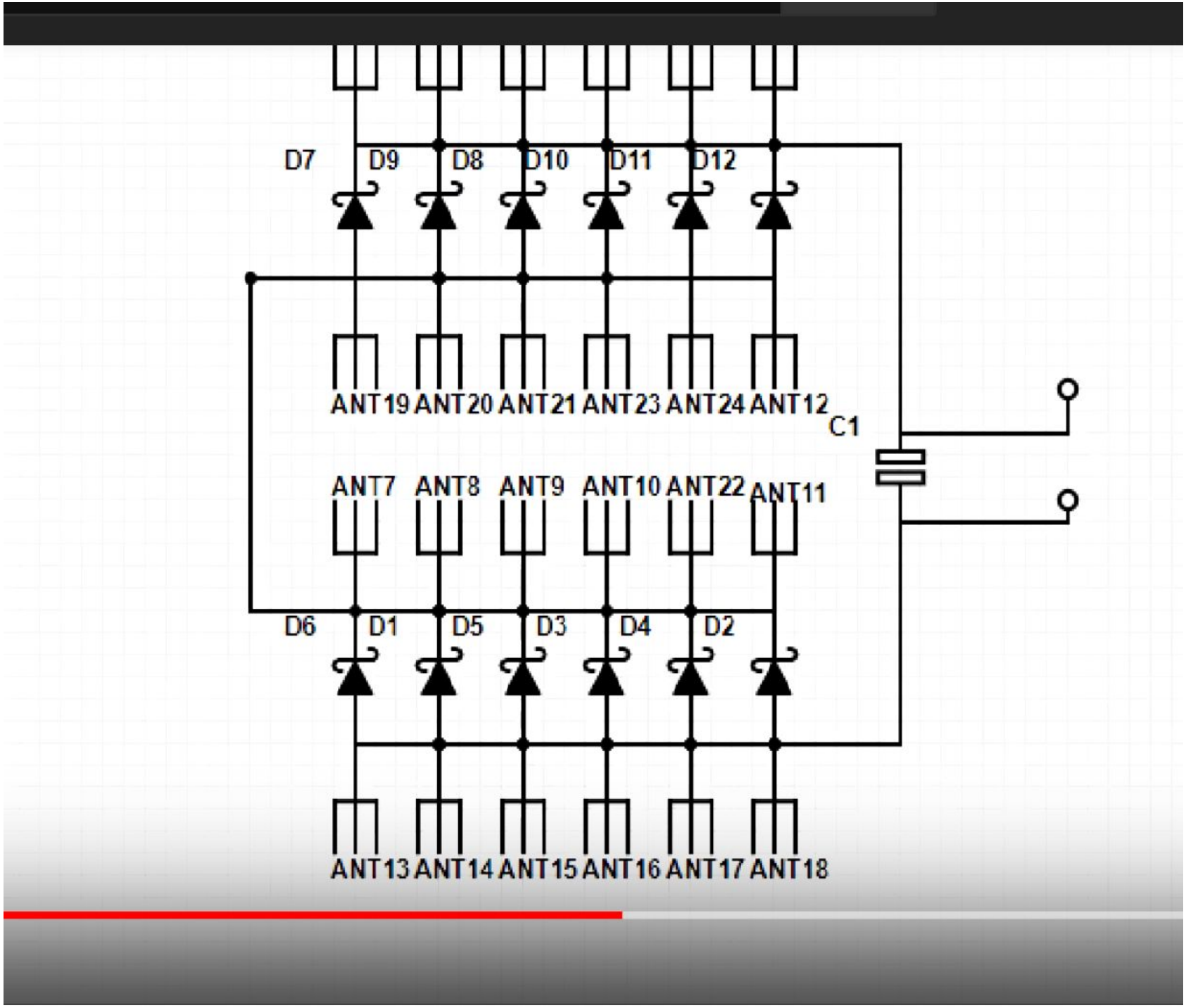
D7
D9
D8
D10
D11
D12
ANT19
ANT20
ANT21
ANT23
ANT24
ANT12
C1
ANT7
ANT8
ANT9
ANT10
ANT22
ANT11
D6
D1
D5
D3
D4
D2
ANT13
ANT14
ANT15
ANT16
ANT17
ANT18

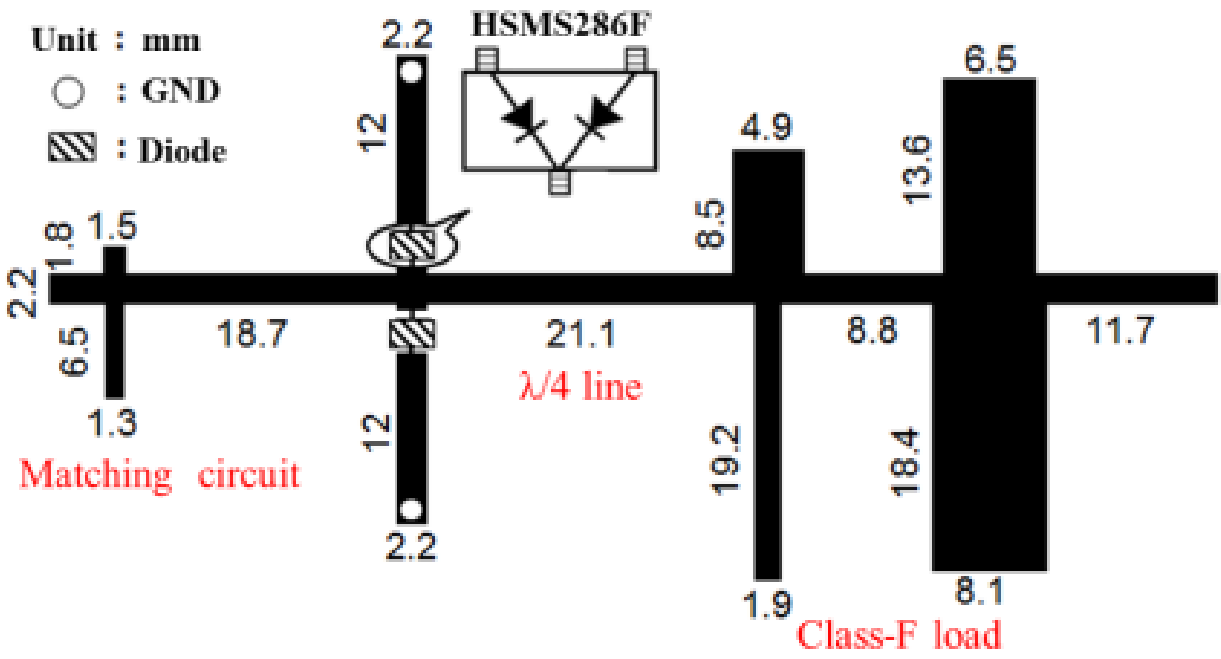

(a)

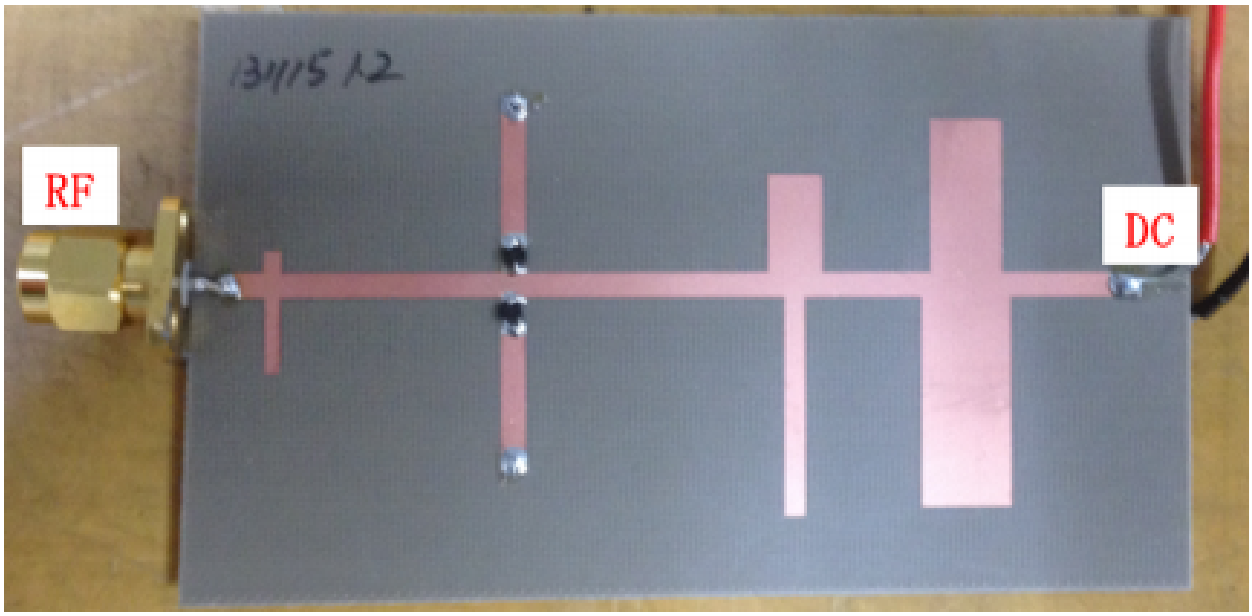

(b)

Figure 4.1: Proposed positive output voltage rectifier. (a) Structure and size. (b) Photograph.

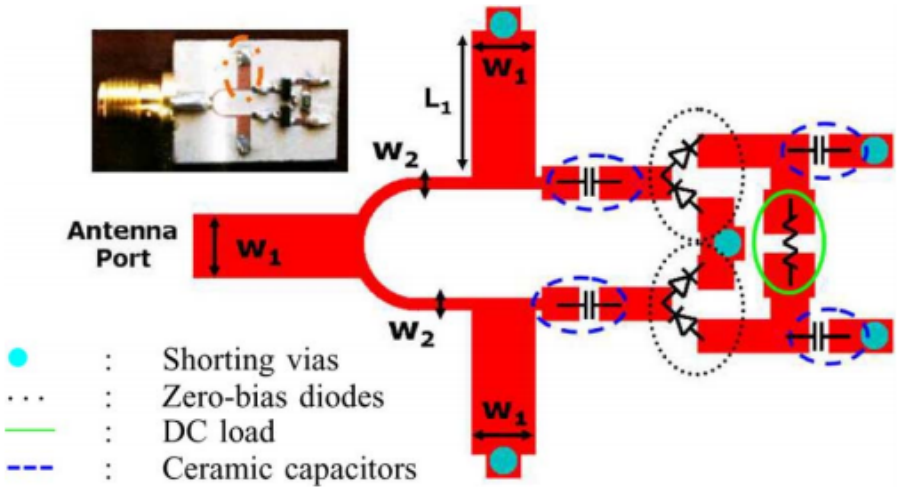

Fig. 3. Layout of the rectifier prototype, printed on RO3206. $w_1 = 72$ mil, $w_2 = 15$ mil, and $L_1 = 171$ mil. Fabricated sample is shown in top left, and the impedance matching stub is encircled.

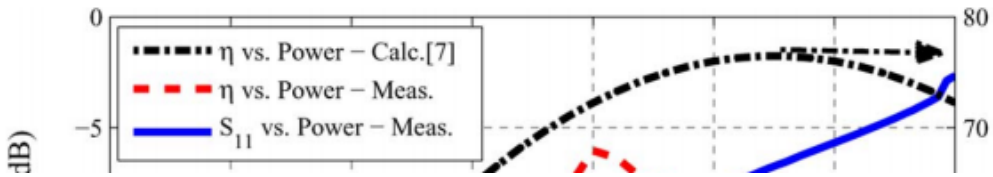

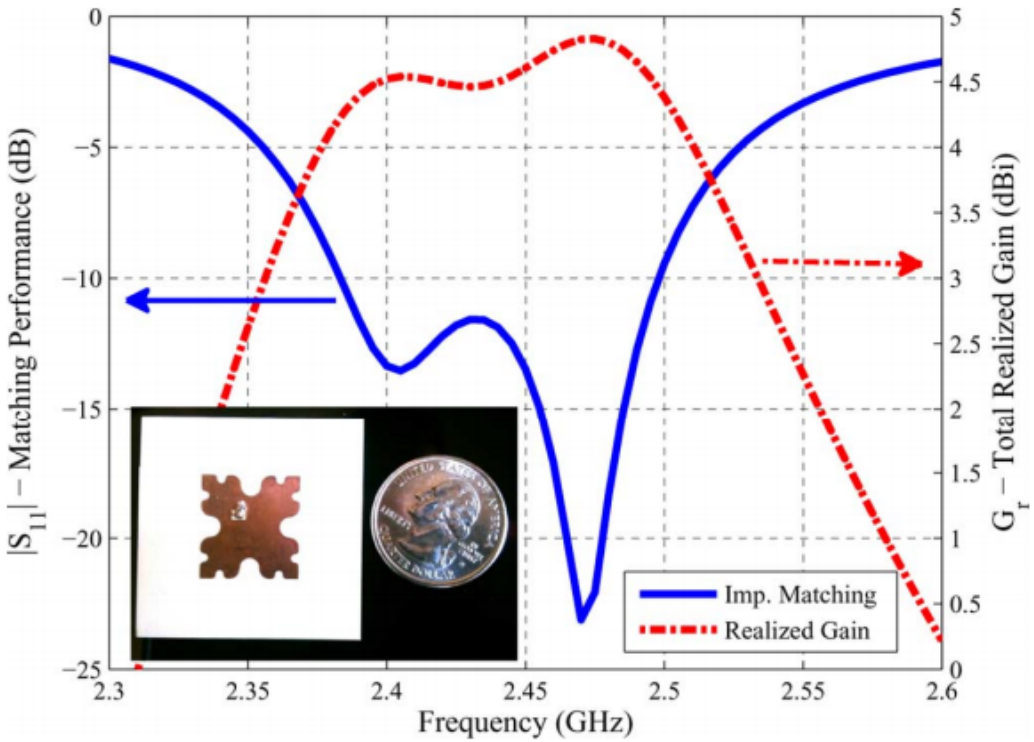

Fig. 5. Measured $|S_{11}|$ performance and total realized gain (at boresight) of the proposed antenna. Fabricated sample is shown in bottom left.

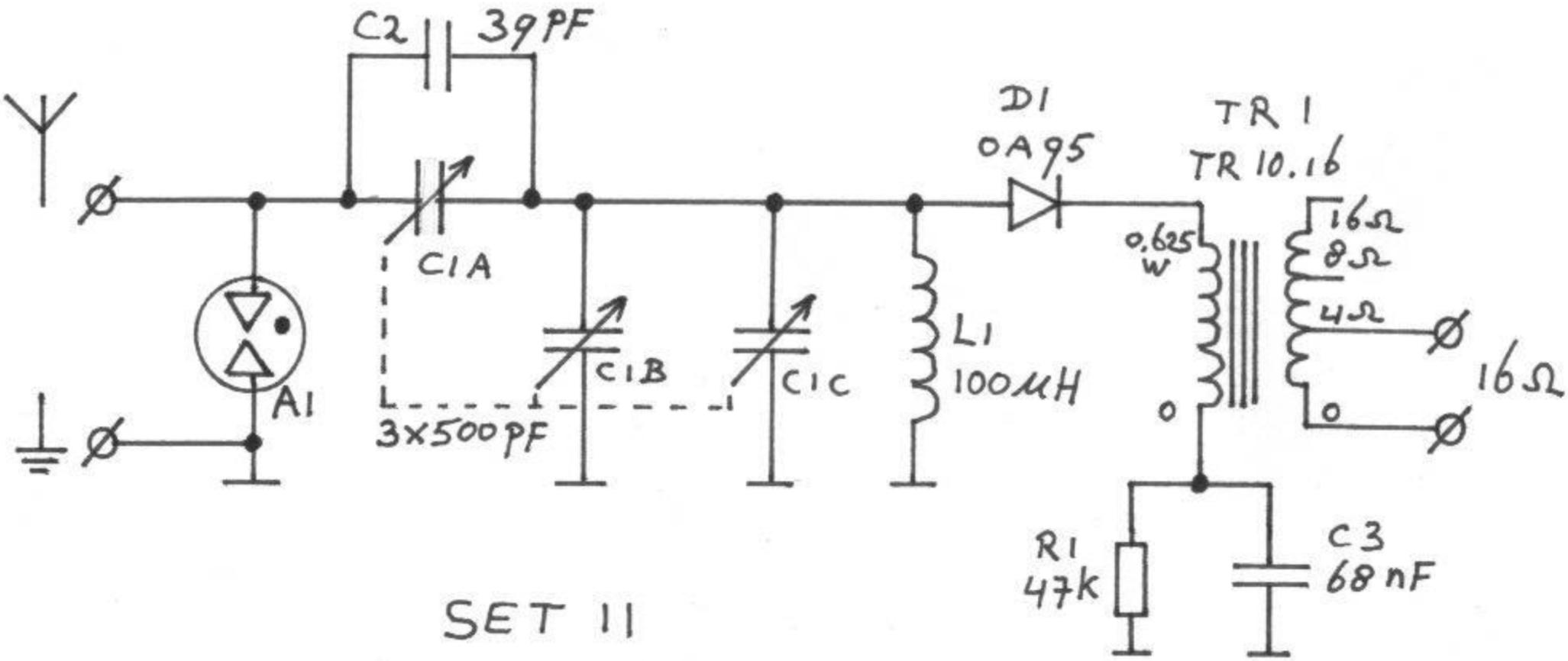
C2
39PF
D1
OA95
TR 1
TR 10.16
C1A
C1B
C1C
L1
100µH
A1
3x500pF
0.625
W
16Ω
8Ω
4Ω
16Ω
R1
47k
C3
68nF

SET 11

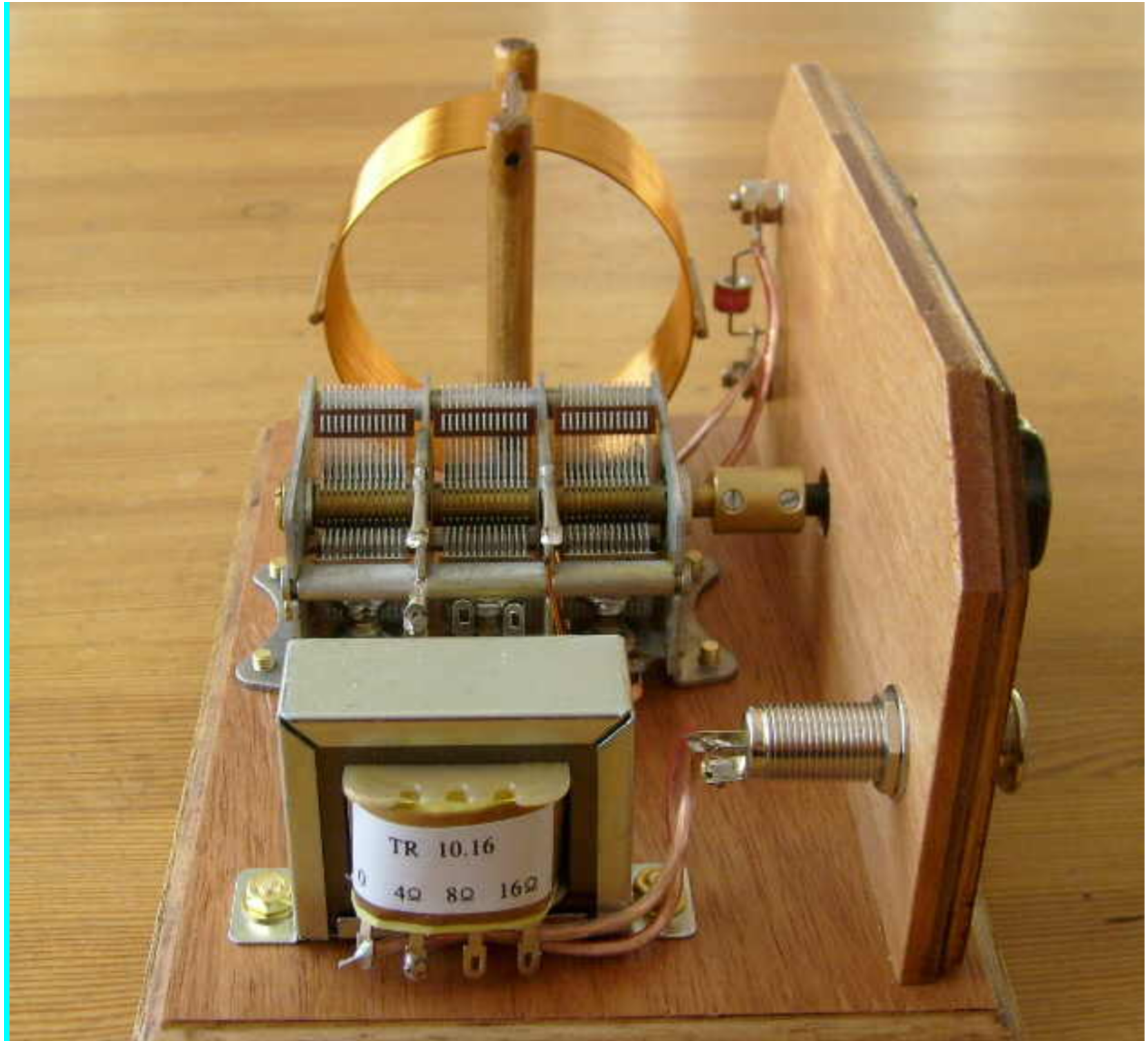
TR 10.16
4Ω 8Ω 16Ω

Preparation of the tuning capacitor

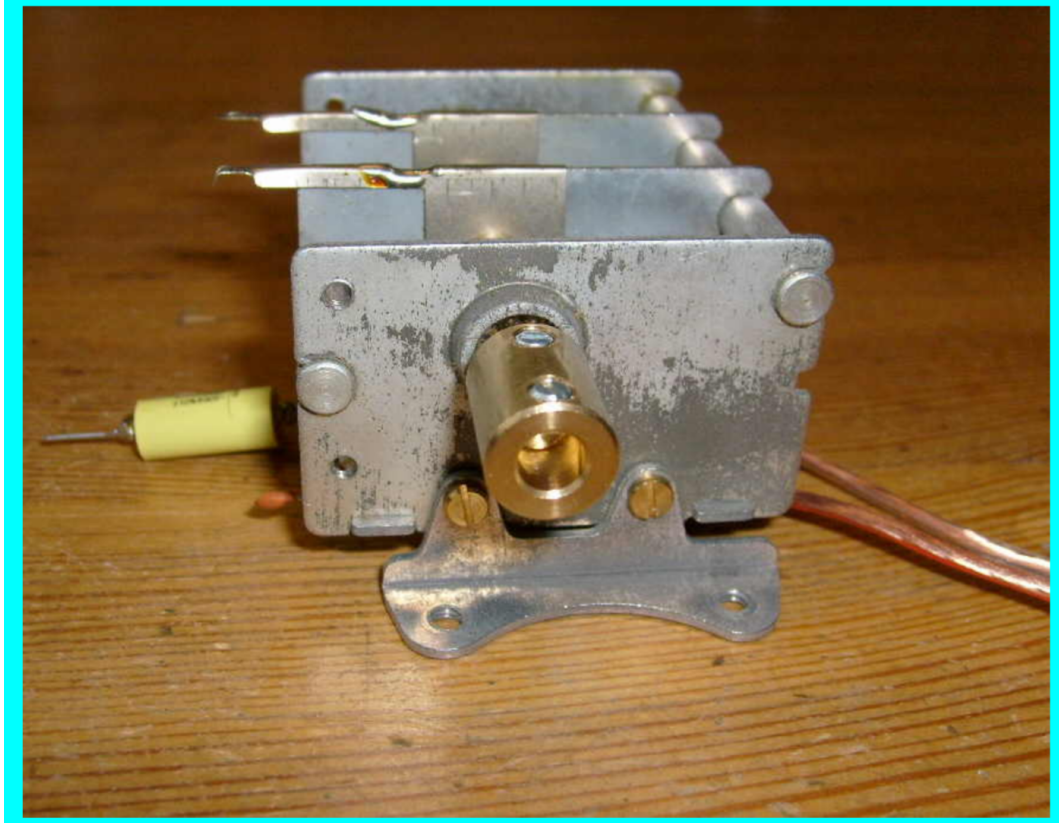

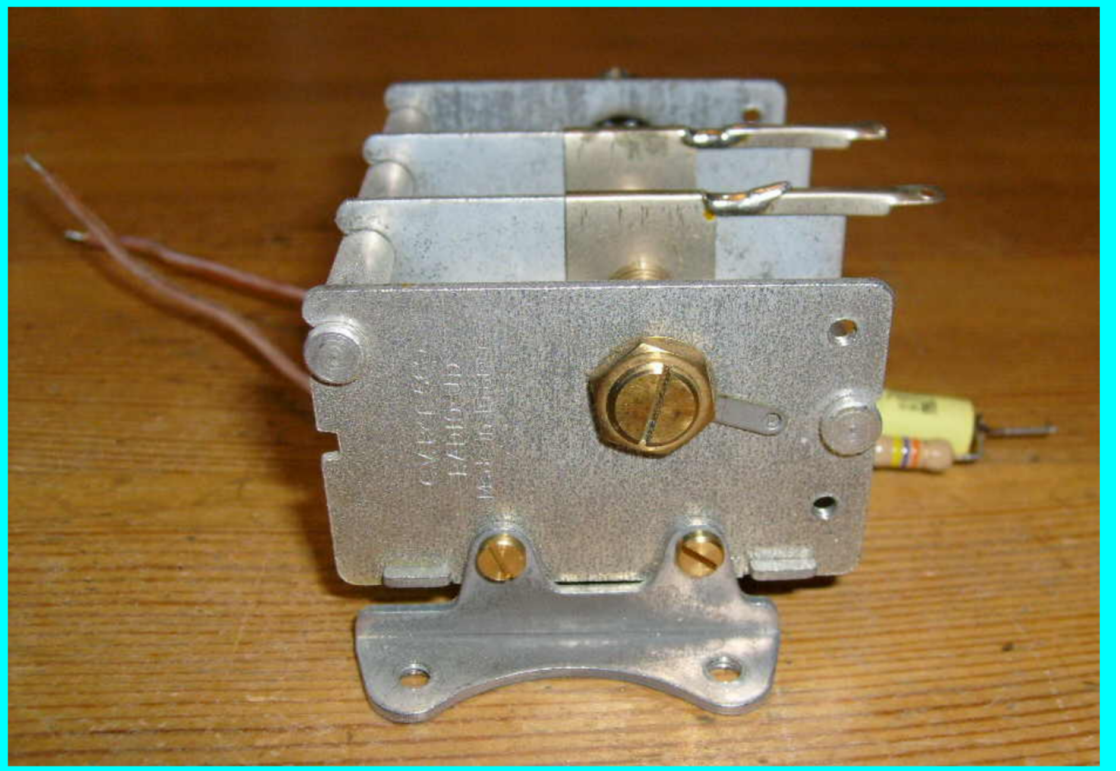

Mount the mounting supports on the tuning capacitor (they are delivered with the tuning capacitor).
Place the shaft coupler on the shaft of the tuning capacitor.

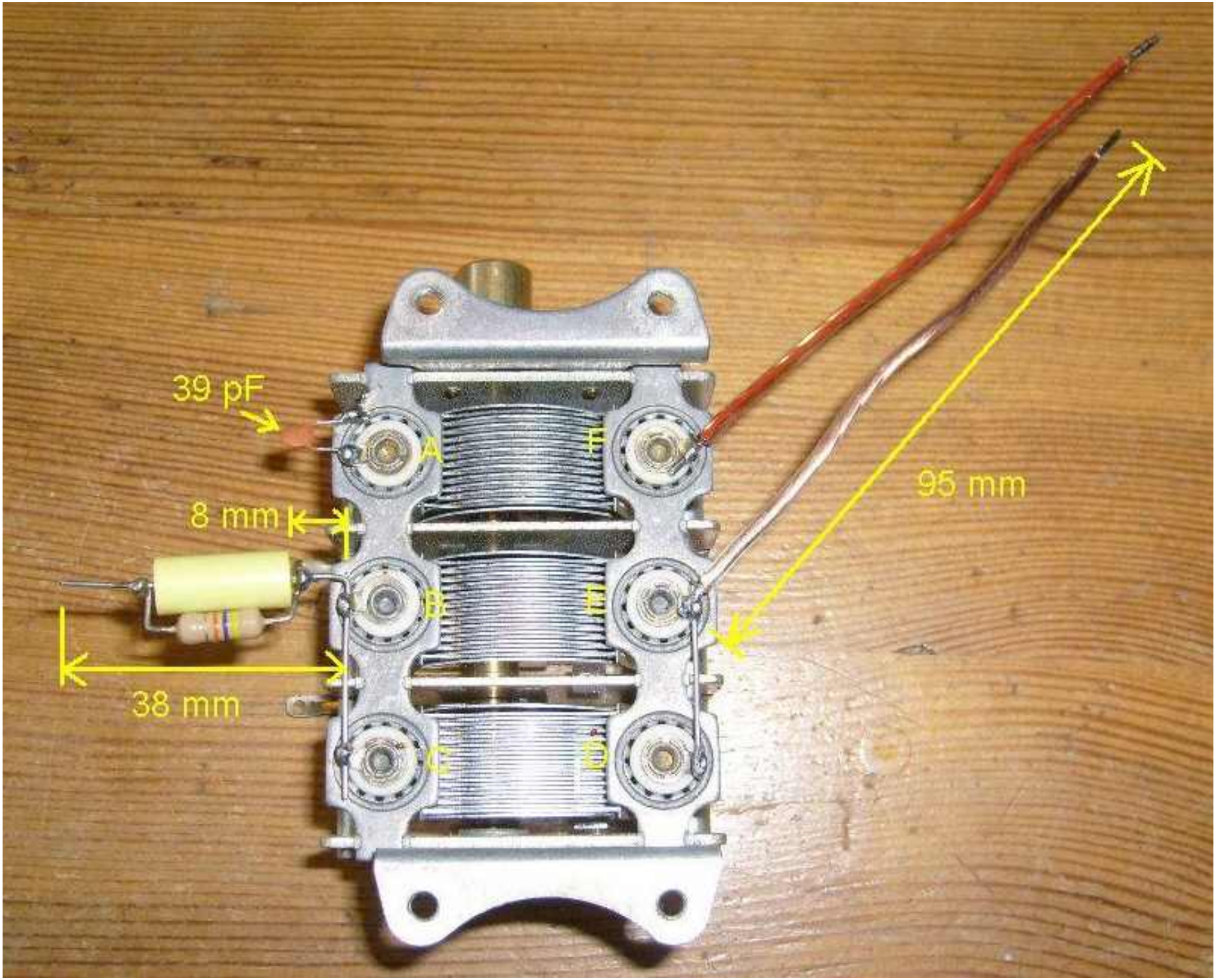
39 pF
8 mm
38 mm
95 mm
A
B
C
D

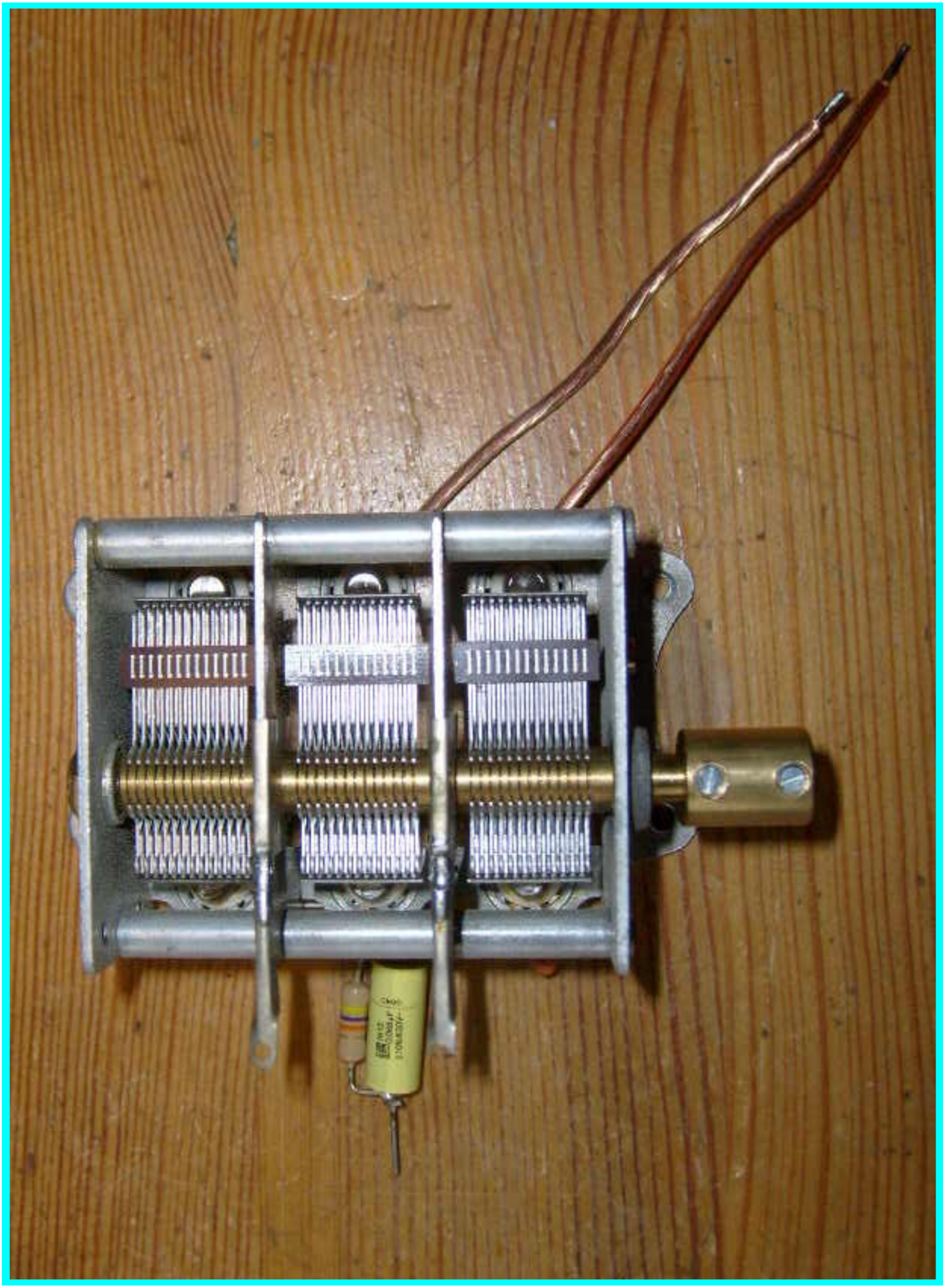

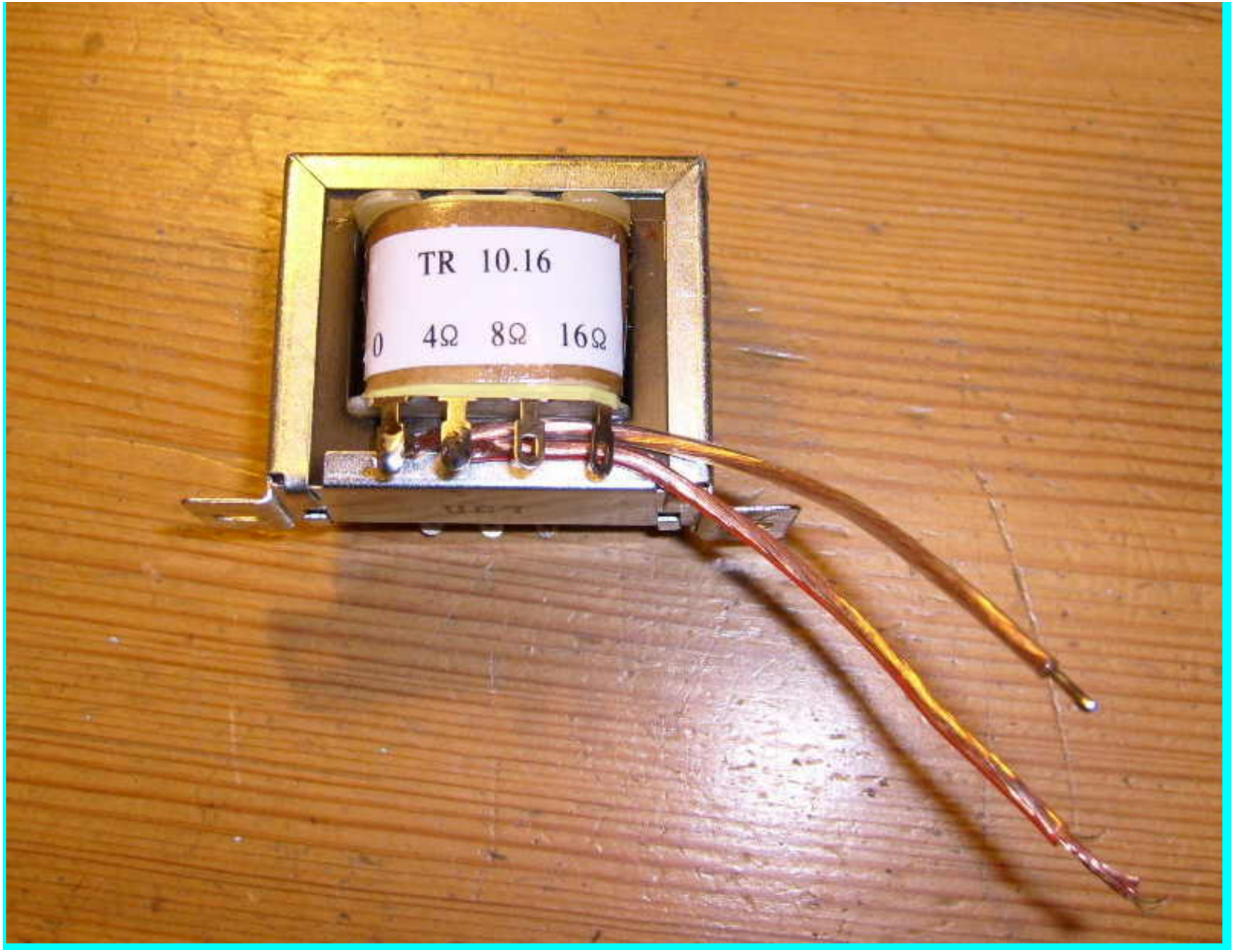
TR 10.16
0 4Ω 8Ω 16Ω

Screw the front on the bottom plate with four screws 3x45 mm.
Place the headphone socket.
Place the two terminal posts and the gas discharge tube.

Make a paper strip with 4 sections of 40x55 mm on it.
Do the strip around the tube, and fix it with a piece of tape.
Don't tape the strip onto the tube on places where later the coil is wound.

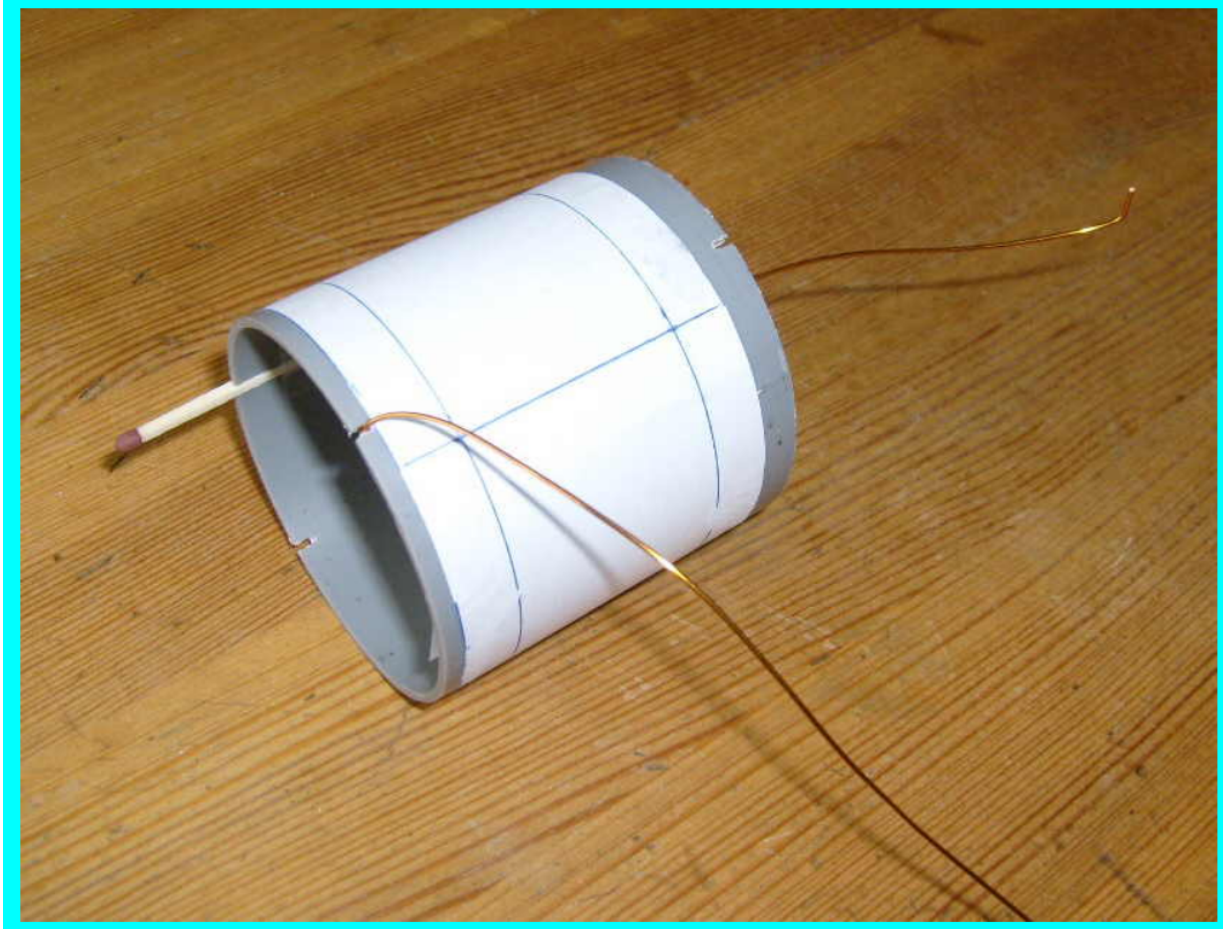

For the coil we need 8.6 meter enamelled copper wire with 0.8 mm thickness.
Hook the begin of the coilwire onto the slot in the tube.
Also fix the begin of the wire on the inside of the tube with some tape.

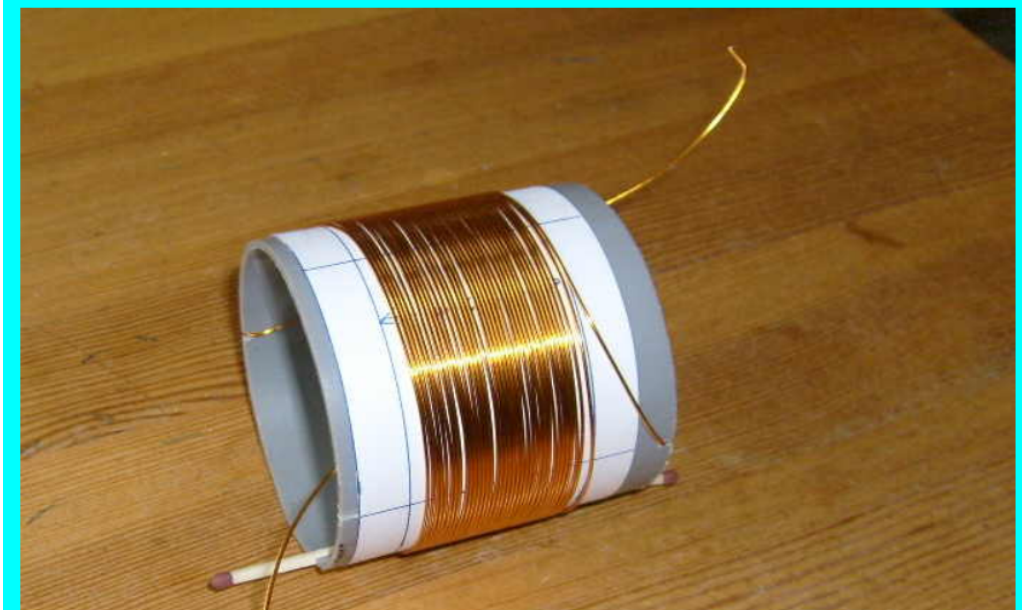

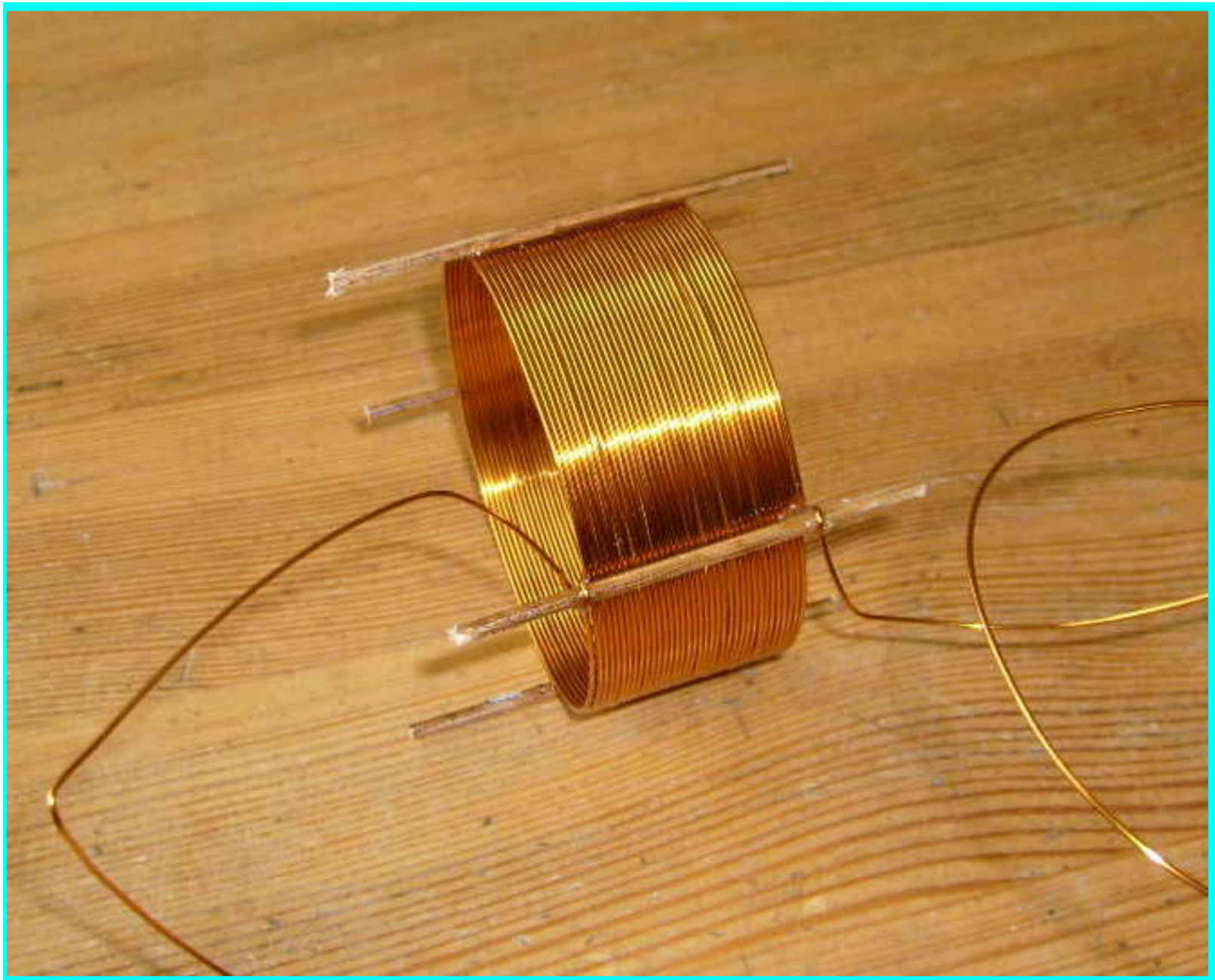

Wait until the glue is hardened.
Remove the rubber bands, the tape and the matches.
Shift the tube out of the coil, and remove the paper out of the coil.
Turn the both ends of the wire one time around the stick at the bottom side of the coil, and apply some extra glue here.

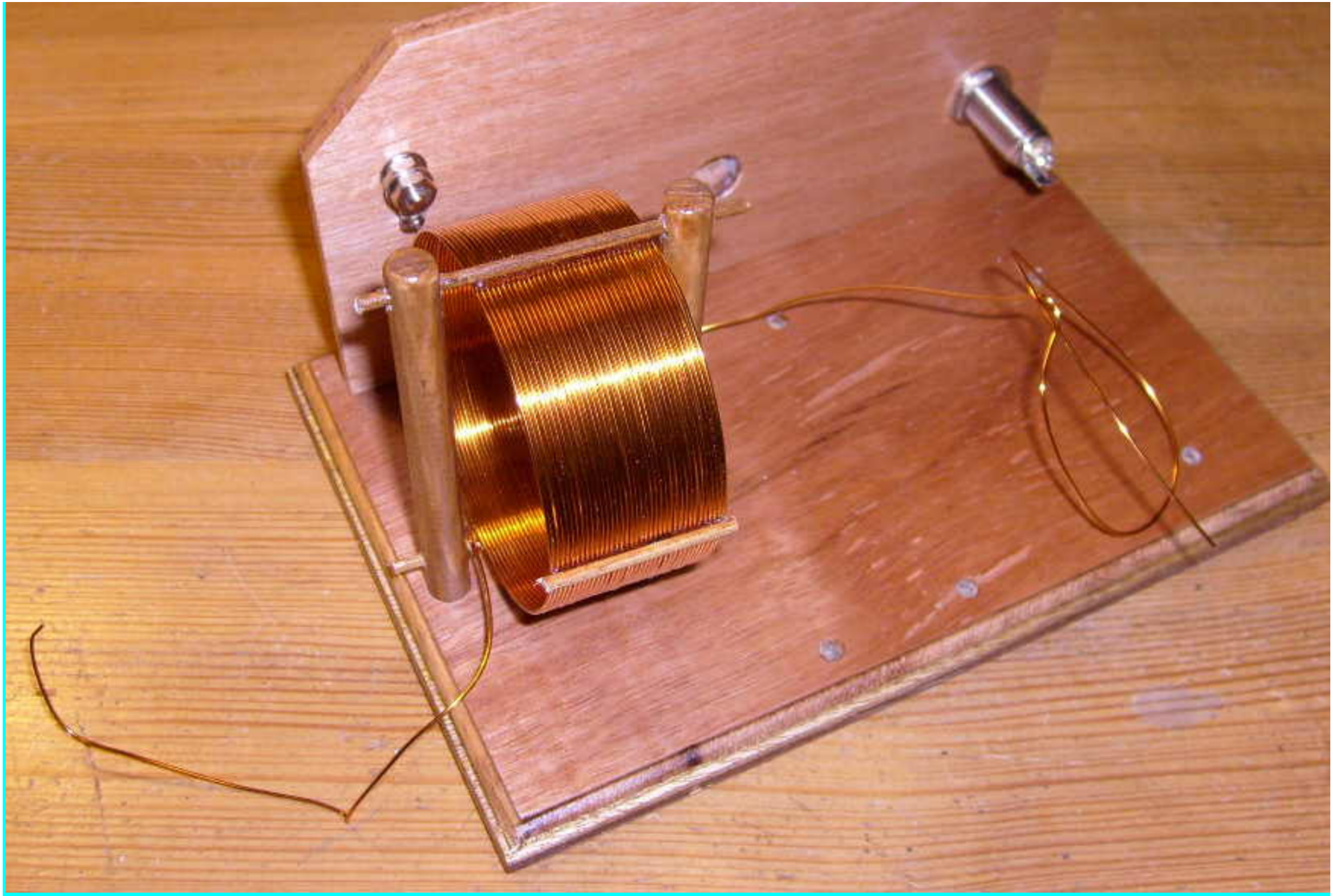

Apply some glue in the holes in the 9 mm sticks
Also apply some glue in the 9 mm holes in the bottom plate.
Place the coil as shown in this picture.
Wait until the glue is dry.

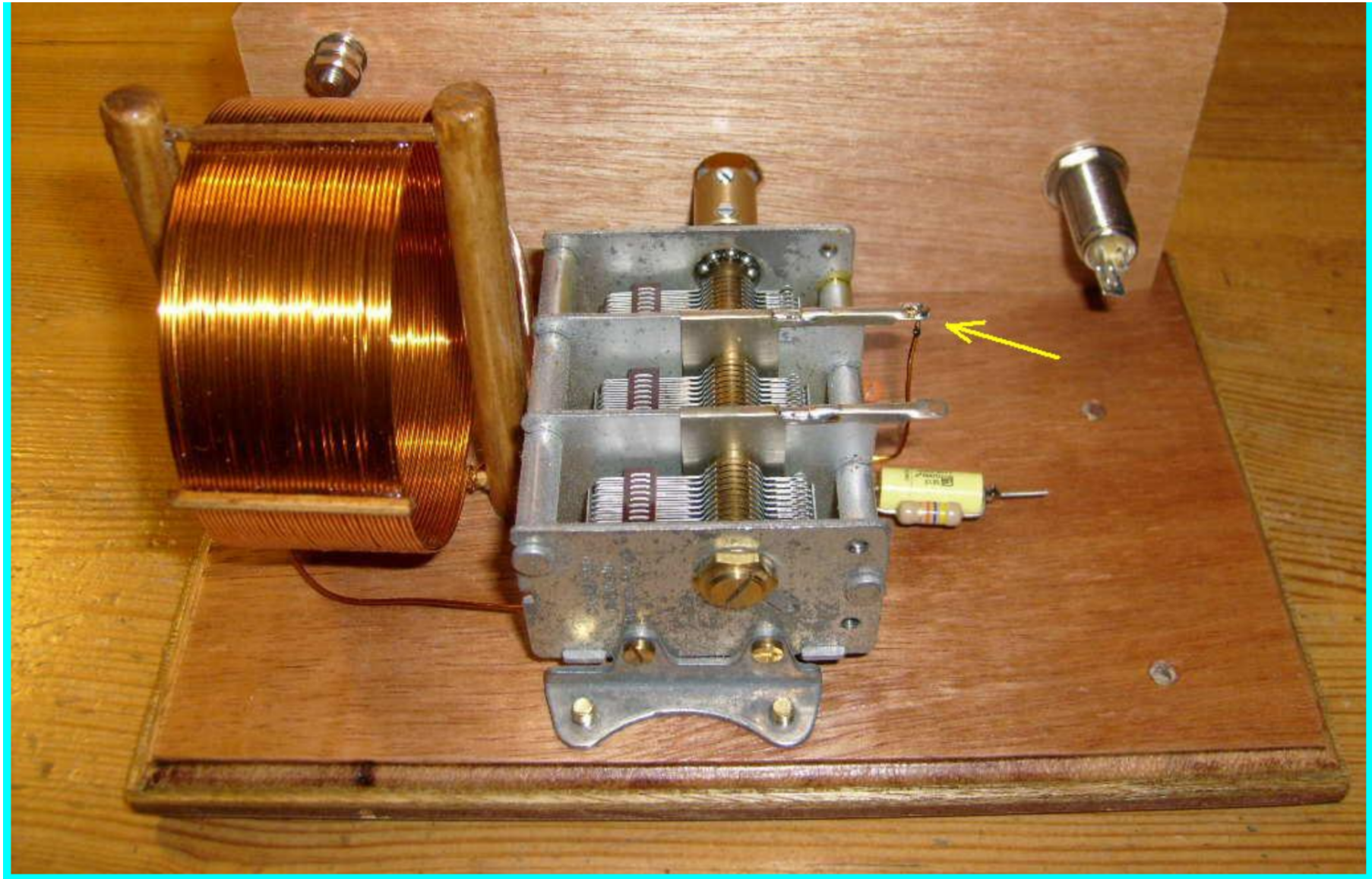

Place the tuning capacitor on the frame.
Fix it with four screws M4x16
One coilwire runs underneath the tuning capacitor, is then bend upwards and cut to length.
Solder this wire to the tuning capacitor (indicated with the arrow in the above picture).
Scrap of the lacquer from the wire, before soldering.

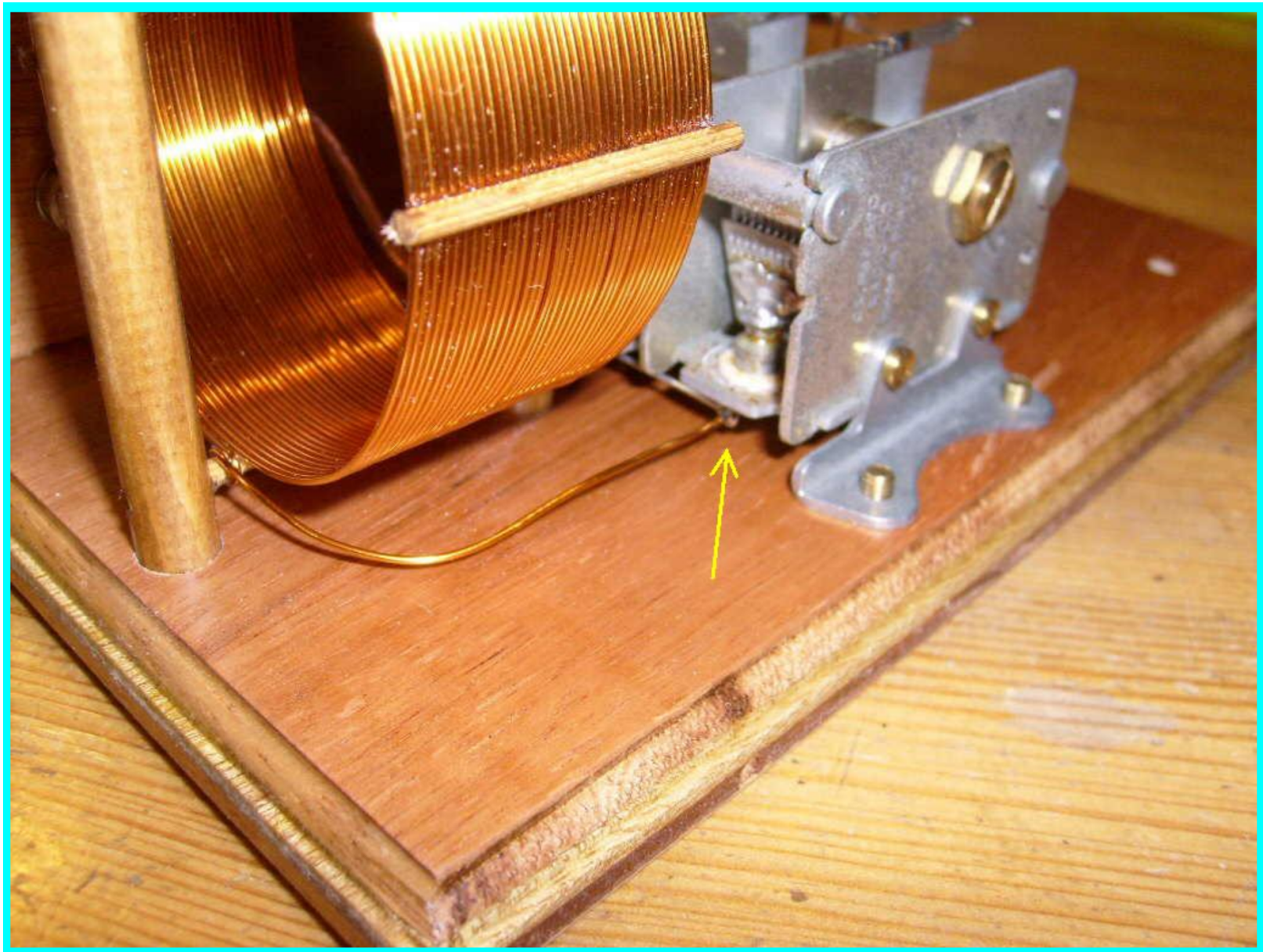

The other wire is cut to length, and soldered to the solder tag of the tuning capacitor (indicated with arrow).

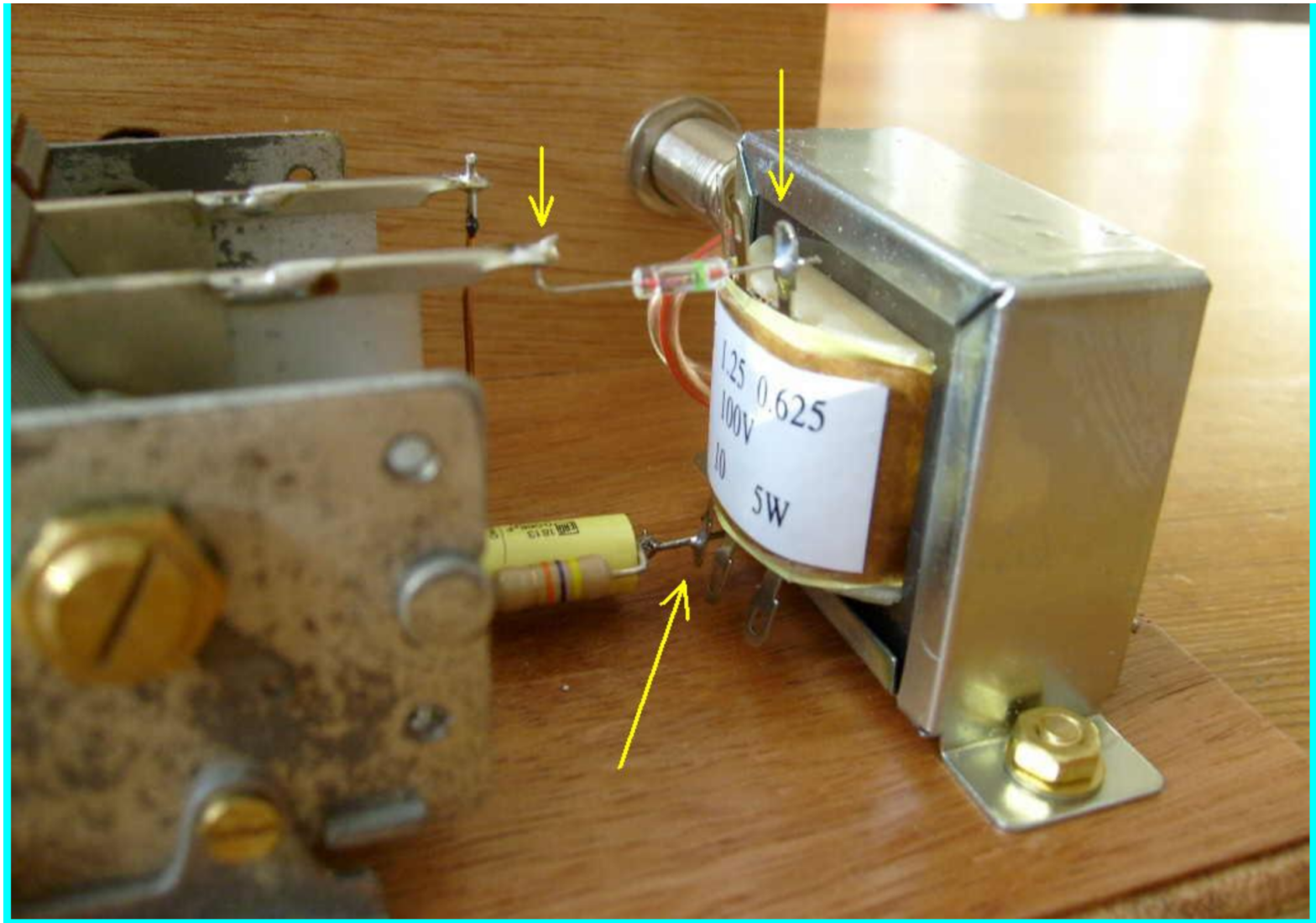

Place the transformer on the frame, fix it with two M4x16 screws, 2 rings and 2 nuts
The wire of the 68 nF capacitor must stick through the "0" connection of the transformer, and is then soldered.
Solder the OA95 diode between tuning capacitor and the "0.625W" connection of the transformer.
The green band on the diode must point towards the transformer.

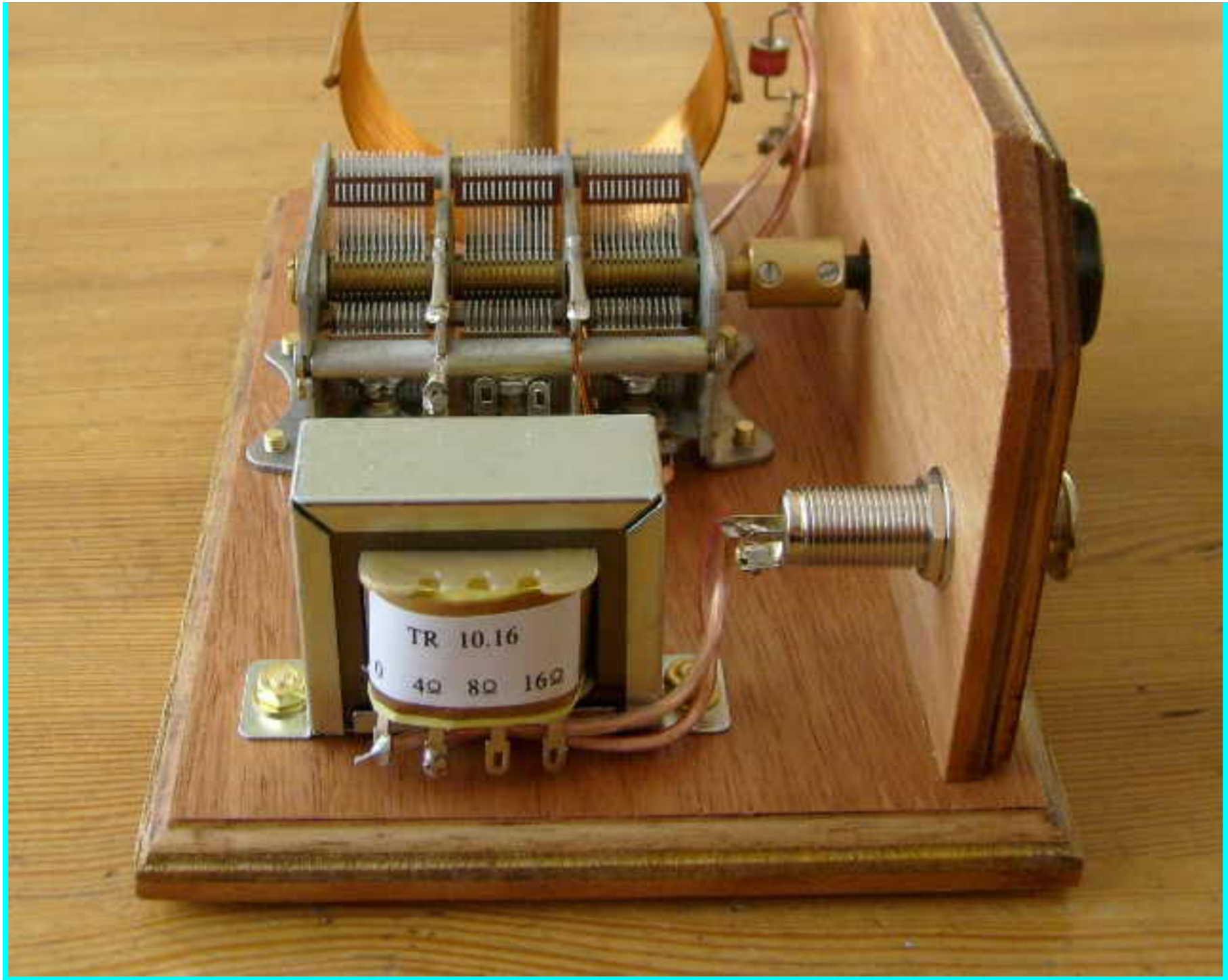

Solder the two wires from the transformer to the headphone socket (see for detail: next picture).

Solder the two wires from the tuning capacitor to the terminal posts.
The wire with the red line on it, comes on the upper (antenna) connection.
The wire without red line, comes on the lower (ground) connection.

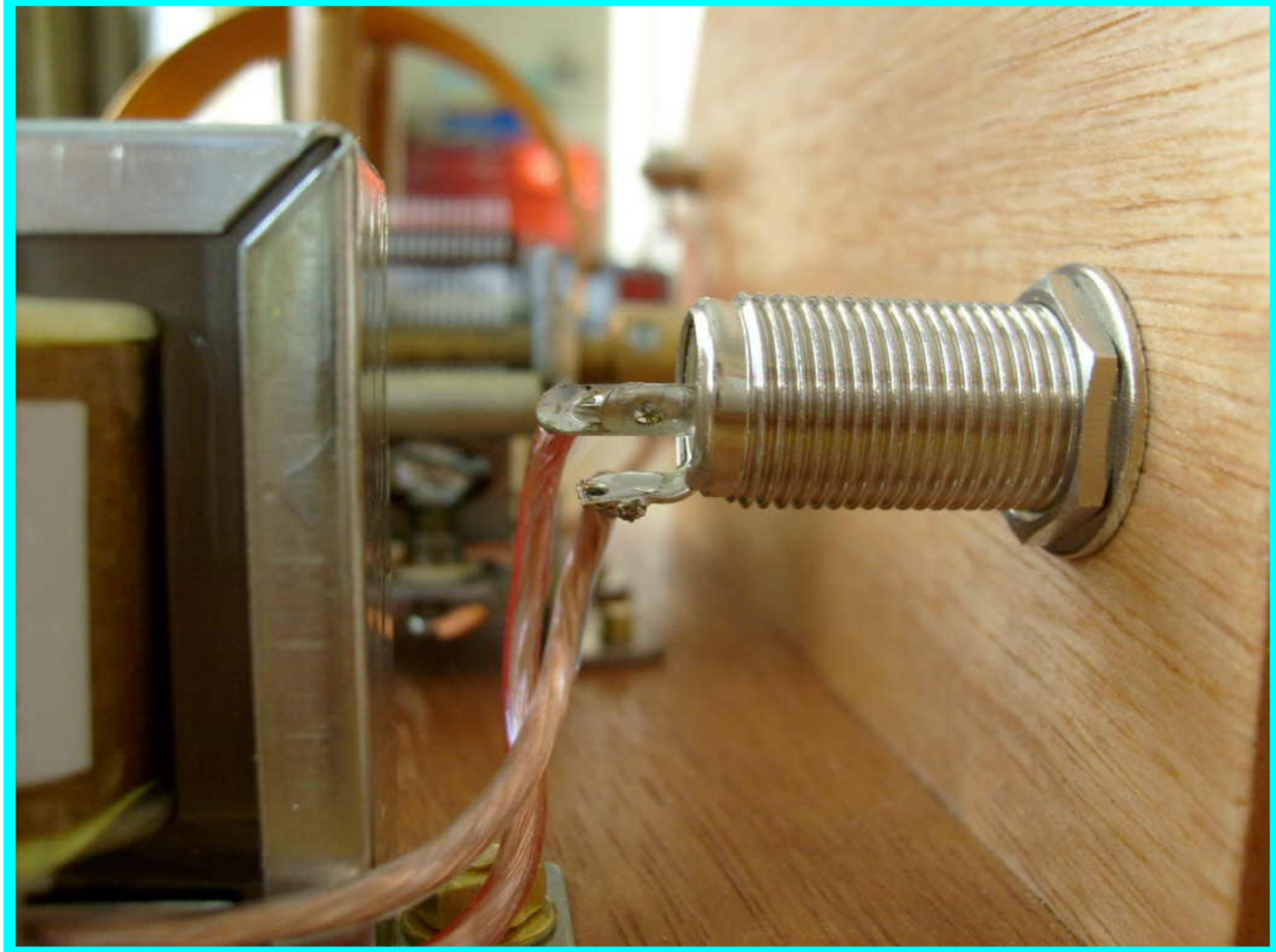

Detail of the wires on the headphone socket.
The wire without red line comes on the ground connection.
The wire with the red line comes on the two signal pins, so these two signal pins are connected together.

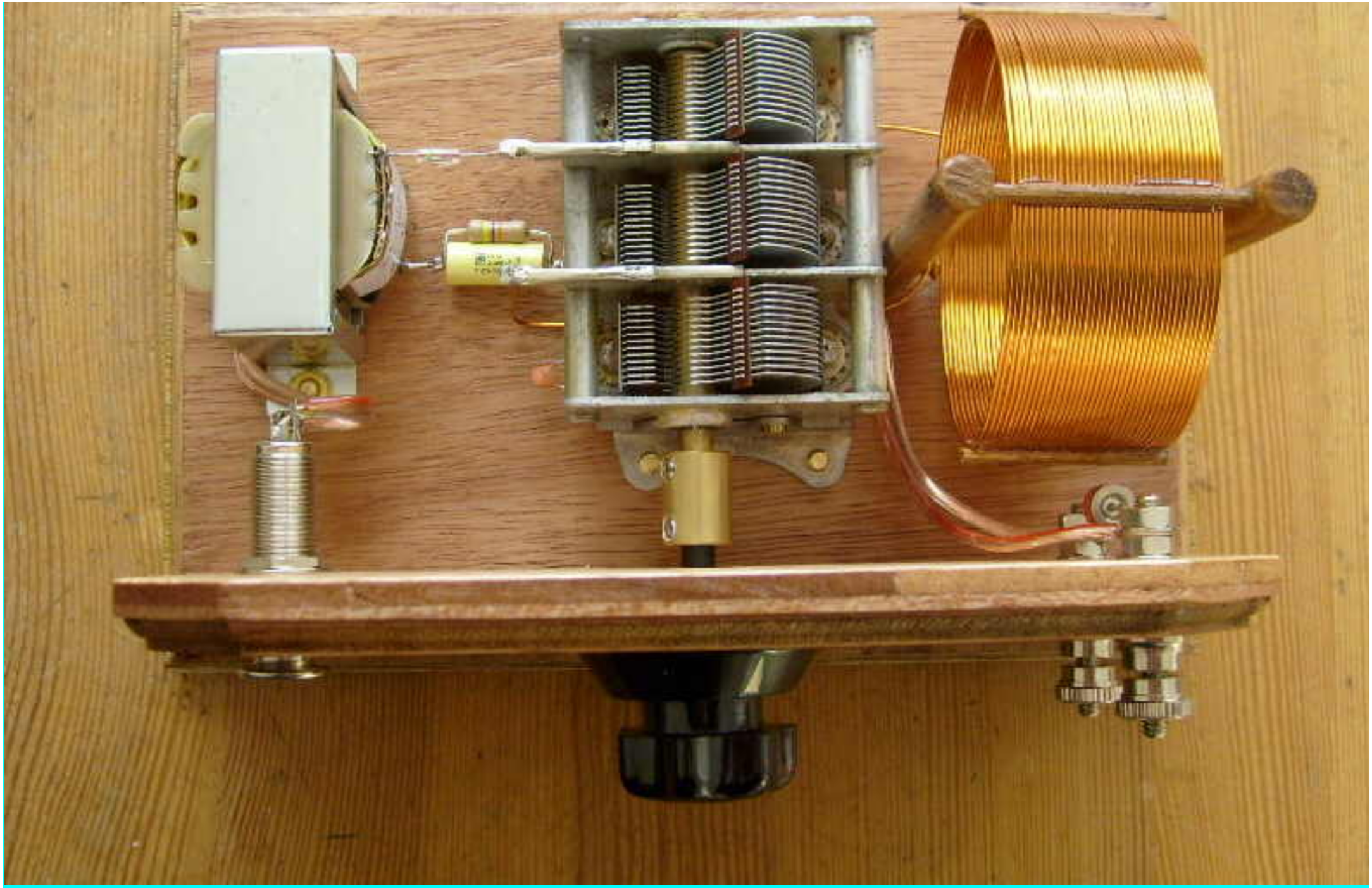

Mount the extension shaft and the knob on the tuning capacitor.
In the middle position, the pointer on the knob must point upwards.

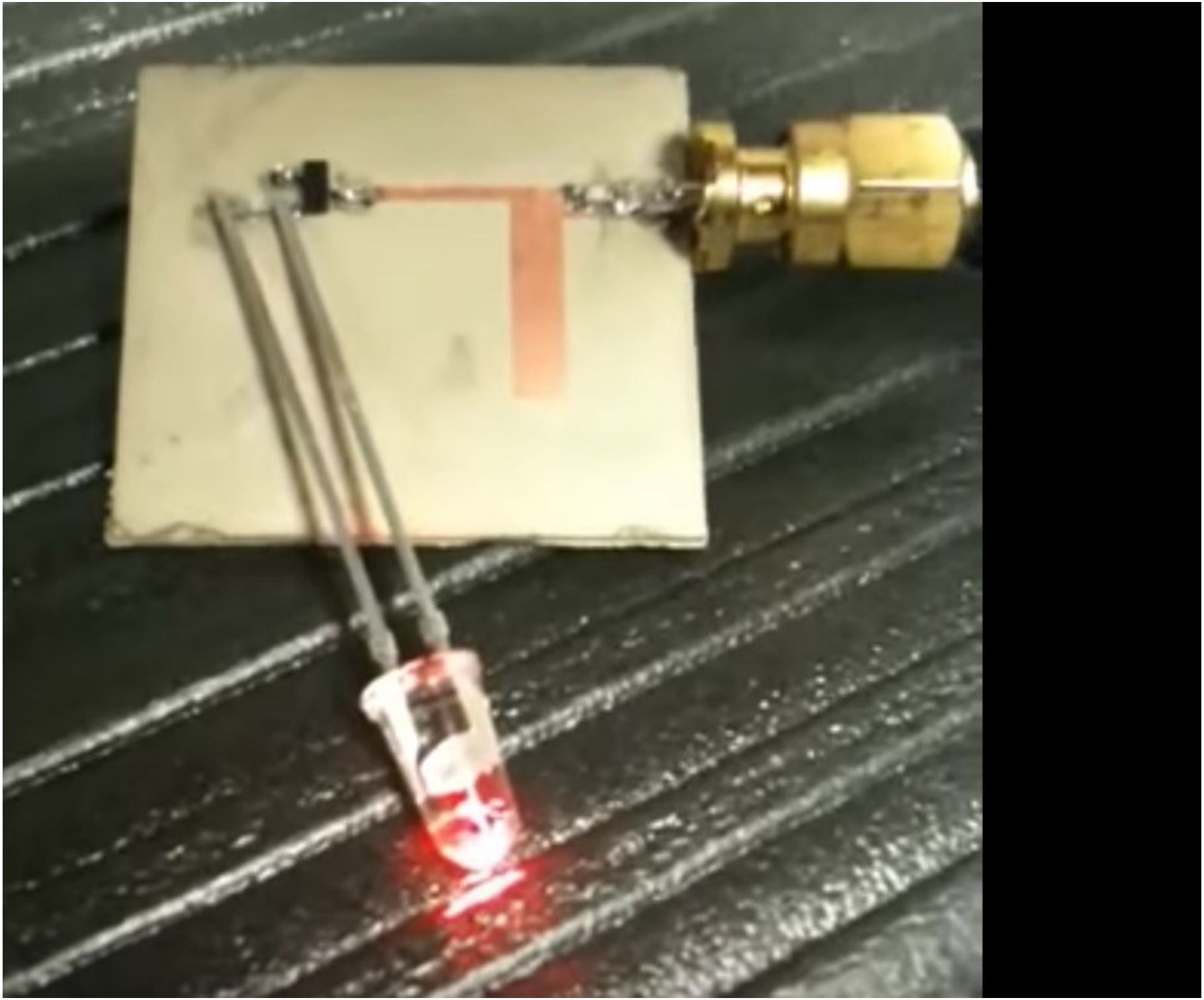

$10,000
in $100 bills

$1,000,000
in $100 bills

$100 Million
in $100 bills

$1 Billion
in $100 bills

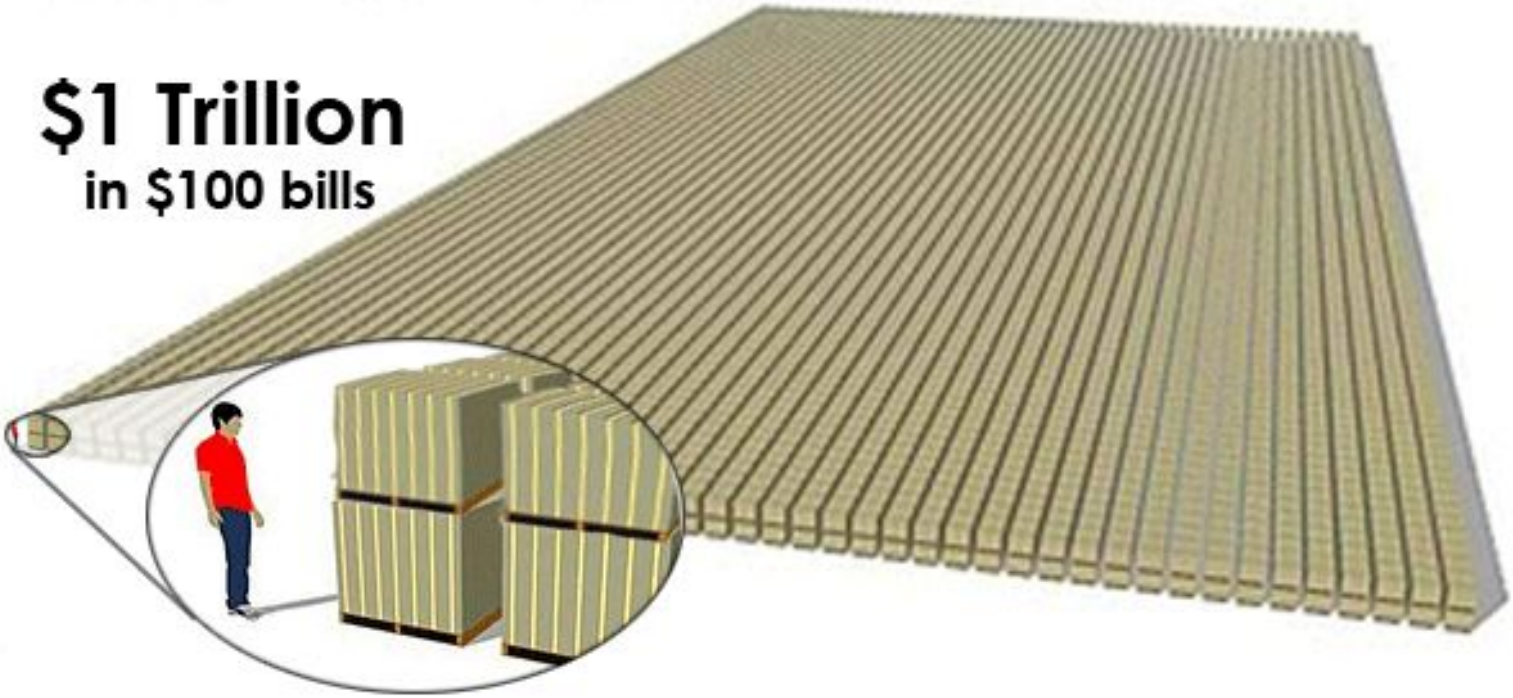
$1 Trillion
in $100 bills

USB Type A Female Field Termination Connector

Roll over image to zoom in

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MATHEMATICS — A LEARNING MAP

WHY STUDY MATHEMATICS?
WHAT IS MATHEMATICS?
LEARNING MATHEMATICS
HISTORY OF MATHEMATICS
Resources

COUNTING
one Wati; two Wati; many Wati — TARZAN

ARITHMETIC: NUMBERS + NUMBER SYSTEMS
CONTINUED FRACTIONS
DIOPHANTINE EQUATIONS
NUMBER THEORY
"THEORY OF EQUATIONS"
SOLUTION OF CUBIC + QUARTIC EQUATIONS

ALGEBRA: SYMBOLIC REPRESENTATIONS + SYMBOLIC CALCULATION

POWER SERIES
REAL NUMBERS

GEOMETRY: MODELING SPATIAL CONFIGURATIONS
COMPUTATIONAL GEOMETRY
SURREAL NUMBERS
SET THEORY
LOGIC
"KRIPKE THEORY"
"CHOMSKY THEORY"
BOOLEAN ALGEBRA
MATHEMATICAL LINGUISTICS
"NEURAL NETS"
MATHEMATICAL NEUROLOGY

SETS + FUNCTIONS
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ALGORITHMS
COMPLEXITY THEORY
THEORY OF COMPUTATION
LISP
PROLOG
FORMAL LANGUAGES, GRAMMARS + AUTOMATA
NATURAL LANGUAGE PROCESSING
ARTIFICIAL INTELLIGENCE

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COMBINATORIAL OPTIMIZATION
MATROIDS
PROGRAMMING LANGUAGES
TRANSLATORS
COMPILERS
PARSING
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ABSTRACT ALGEBRA: THE STUDY OF ALGEBRAIC SYSTEMS
GROUPS
FIELDS
GALOIS THEORY
MODULES
ALGEBRAIC NUMBER THEORY
ALGEBRAIC K-THEORY
GROUP REPRESENTATIONS
ALGEBRAIC GROUPS
LIE ALGEBRAS
CATEGORY THEORY
ALGEBRAIC GEOMETRY

SMALE SET THEORY
DESCRIPTIVE SET THEORY
FRACTALS
MEASURE THEORY
PROBABILITY
STATISTICS
INFORMATION THEORY

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NON-EUCLIDEAN GEOMETRY
HYPERBOLIC
RIEMANNIAN
"GRAPHING"
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"the key discovery of modern mathematics"
ANALYTIC GEOMETRY

COMPLEX NUMBERS
COMPLEX GEOMETRY
TRIGONOMETRY
POLAR COORDINATES
POLAR GRAPHING
VECTOR GEOMETRY
LINEAR ALGEBRA
LIE GROUPS
COHOMOLOGY OF GROUPS
HOMOLOGICAL

CALCULUS
NUMERICAL ANALYSIS
TOPOLOGICAL GROUPS

VECTOR CALCULUS
DIFFERENTIAL GEOMETRY
TOPOLOGY
SPECTRAL SEQUENCES

REAL VARIABLES
LIMITS
VERGENCE
CONTINUITY
DIFFERENTIABILITY
INTEGRATION

DIFFERENTIAL EQUATIONS
ORTHOGONAL POLYNOMIALS
CALCULUS OF VARIATIONS
METRIC SPACES
CONVEX ANALYSIS
FOURIER ANALYSIS
WAVELETS
FUNCTIONAL ANALYSIS
BANACH SPACES
HILBERT SPACE

CLASSICAL MECHANICS
SYMPLECTIC MANIFOLDS
"WITTEN THEORY"
DIFFERENTIAL TOPOLOGY
ALGEBRAIC TOPOLOGY
MORSE THEORY
COBORDISM
RIEMANN SURFACES
COMPLEX MANIFOLDS
RIEMANNIAN MANIFOLDS
MATHEMATICAL PHYSICS
GENERAL RELATIVITY
QUANTUM MECHANICS
QUANTUM ELECTRODYNAMICS
QUANTUM FIELD THEORY
STRING THEORY

COMPLEX VARIABLES
THE COMPLEX INTEGRAL
CAUCHY'S INTEGRAL THEOREM
RESIDUES

ANALYTIC NUMBER THEORY

= high-powered/advanced
symmetric, involving groups
= geometry
= algebra
= numbers
— patterns, order
analysis, smoothness
topology, continuity
= measure/integration
= linearity
= approximation
= optimization

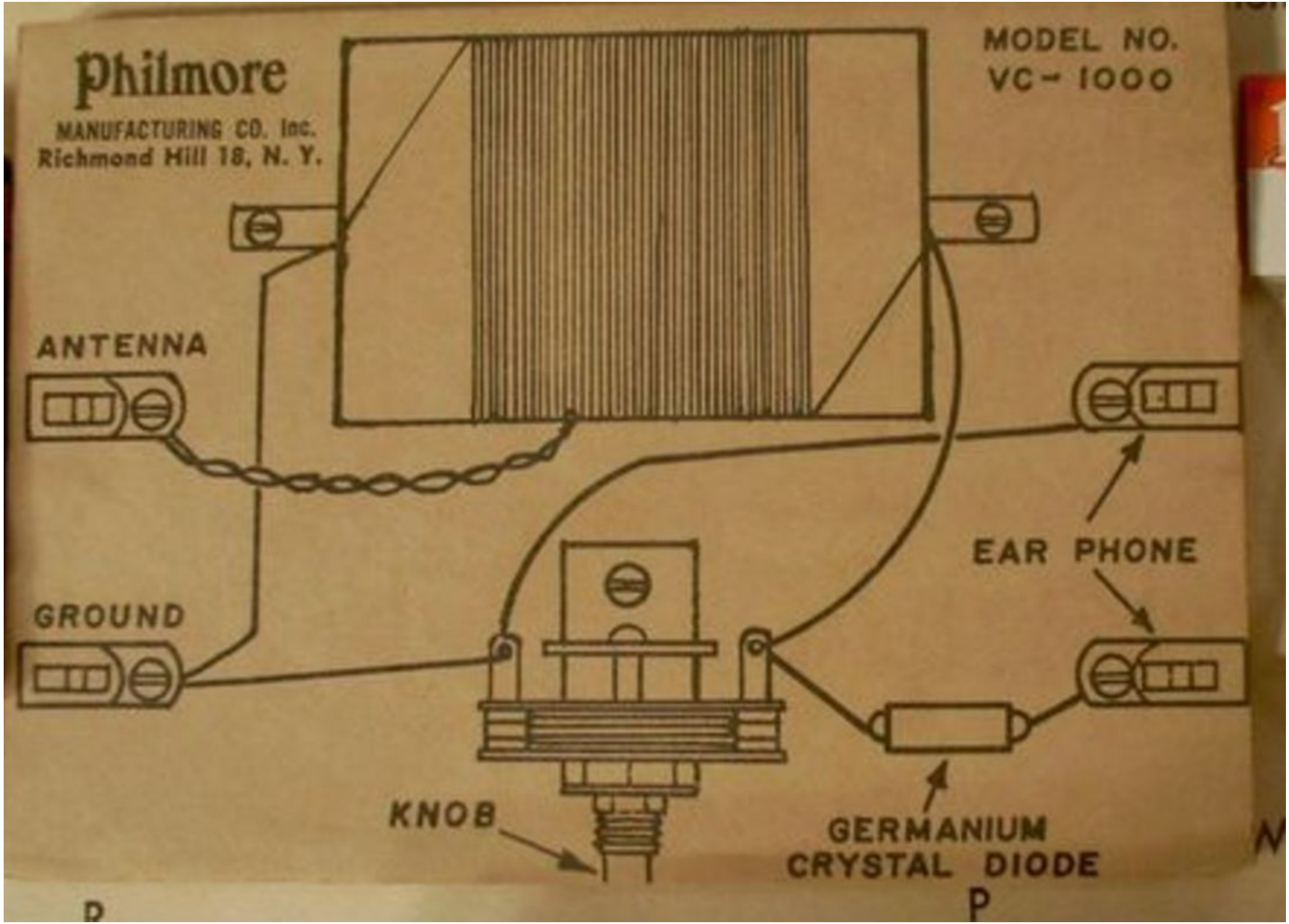
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EAR PHONE
KNOB
GERMANIUM
CRYSTAL DIODE

1 LED azul
(con tensión entre 3V y 3,6V)

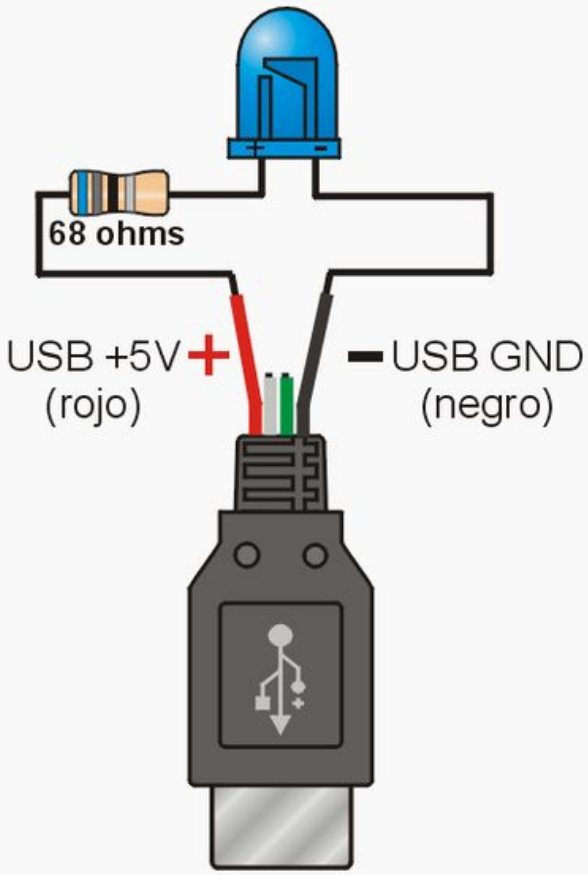

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1 LED rojo
(con tensión entre 1,8V y 2,1V)

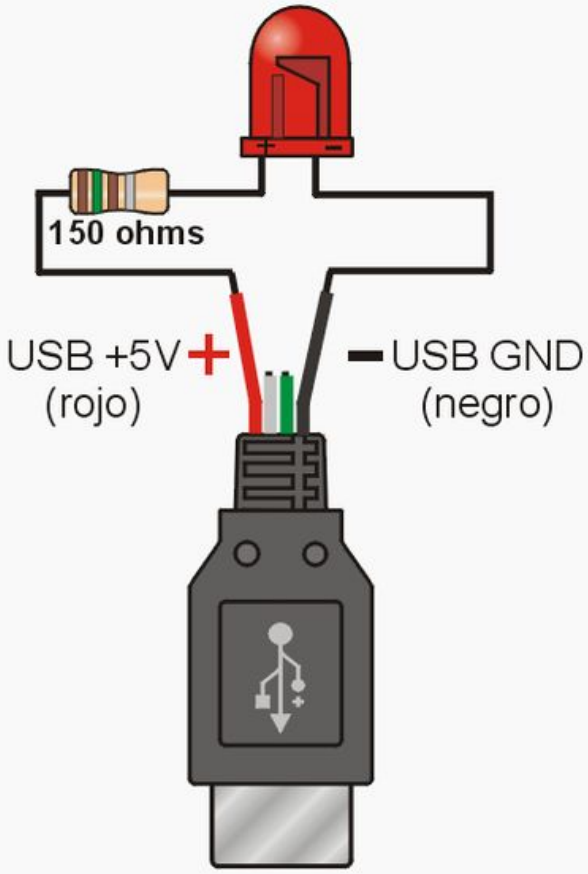

The Tesla Experiment

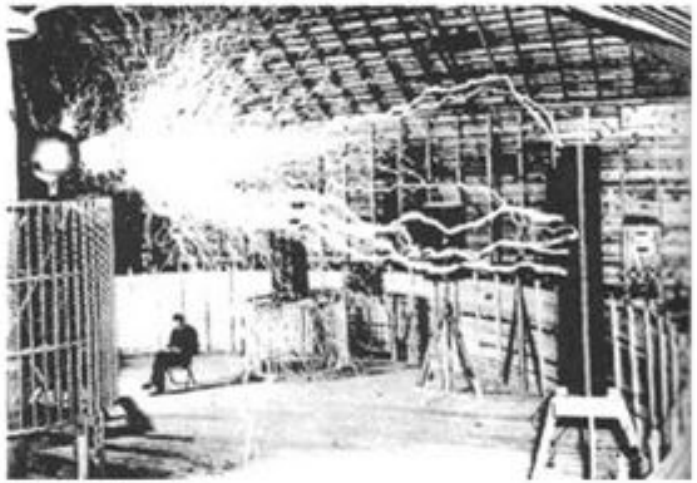

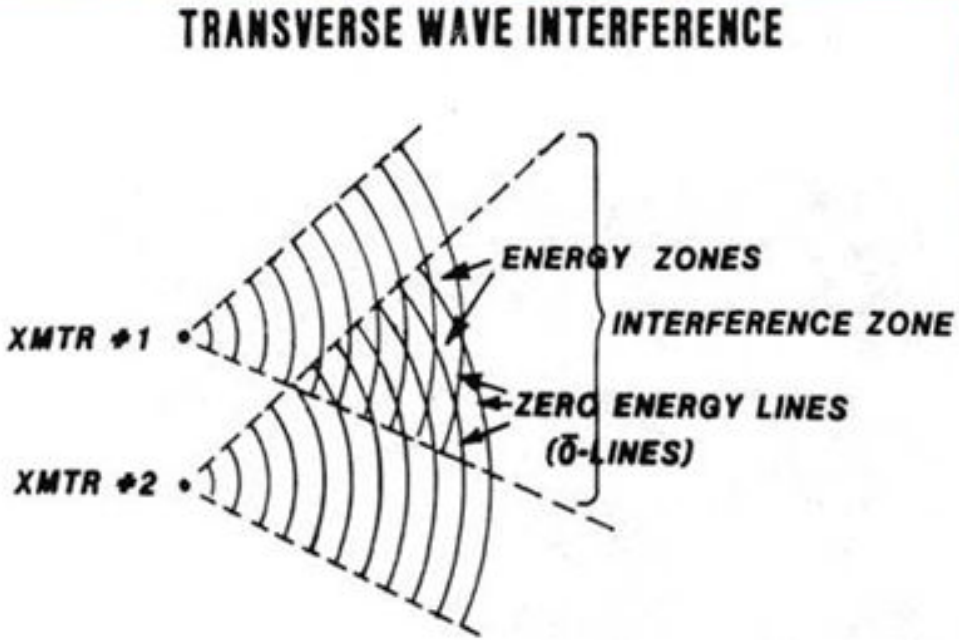

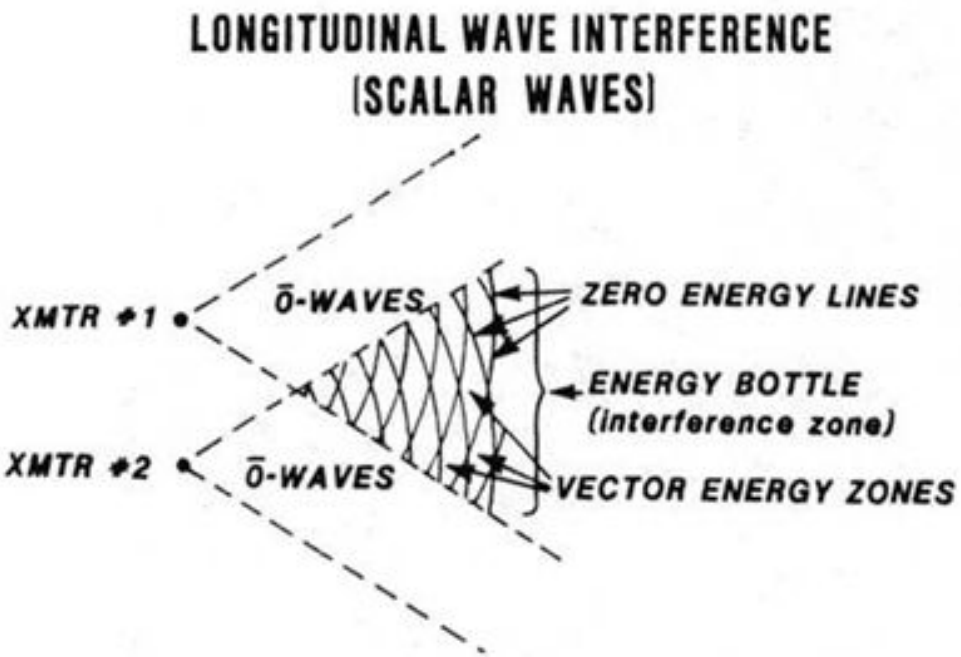

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About this book

Lost Dwgs & Tech, Ancient India, & "Four"

THE LOST HAMEL DRAWINGS:

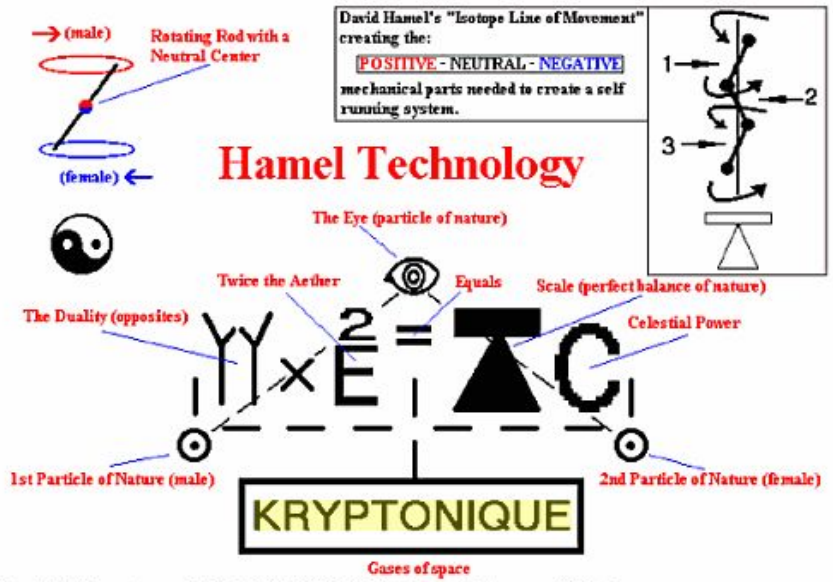

Particle Structure. [The MOST IMPORTANT Hamel Diagram of All.]

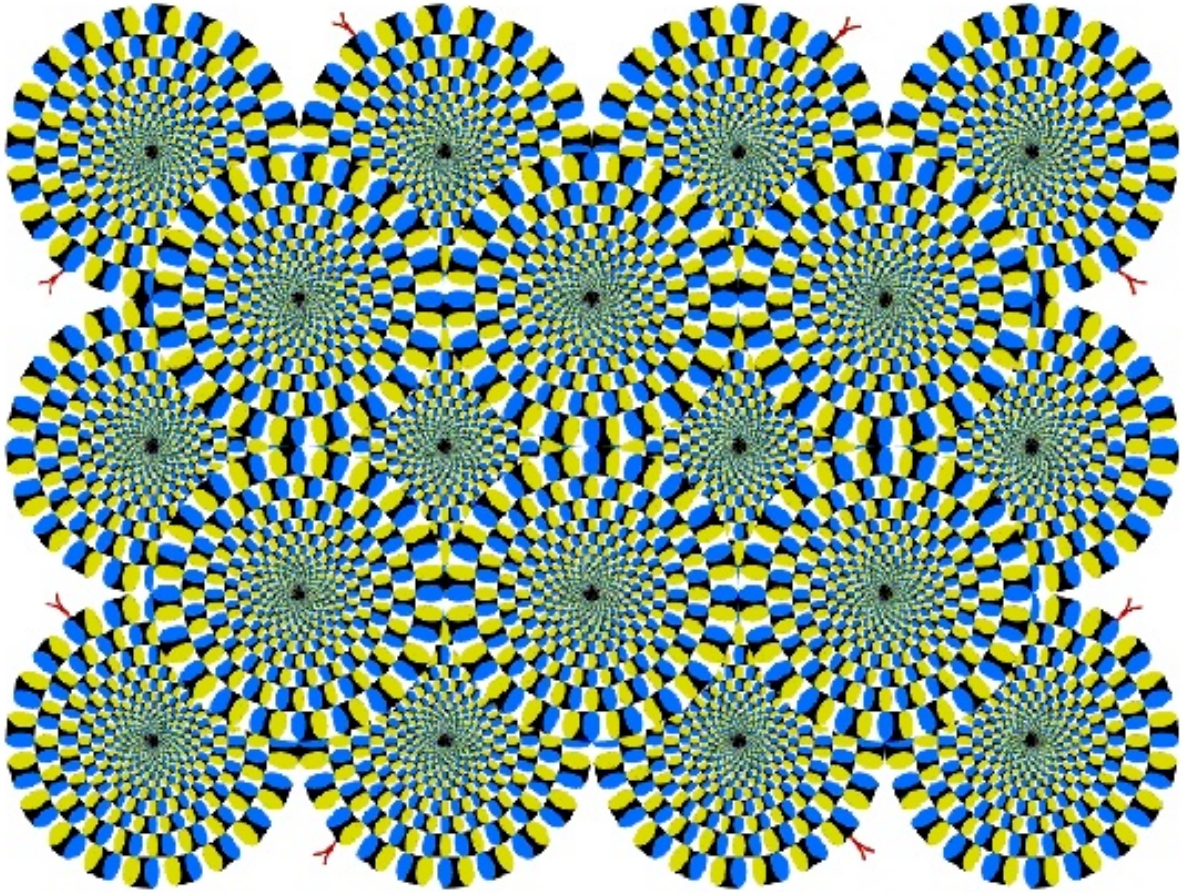

Addie's super foxhole radio schematic

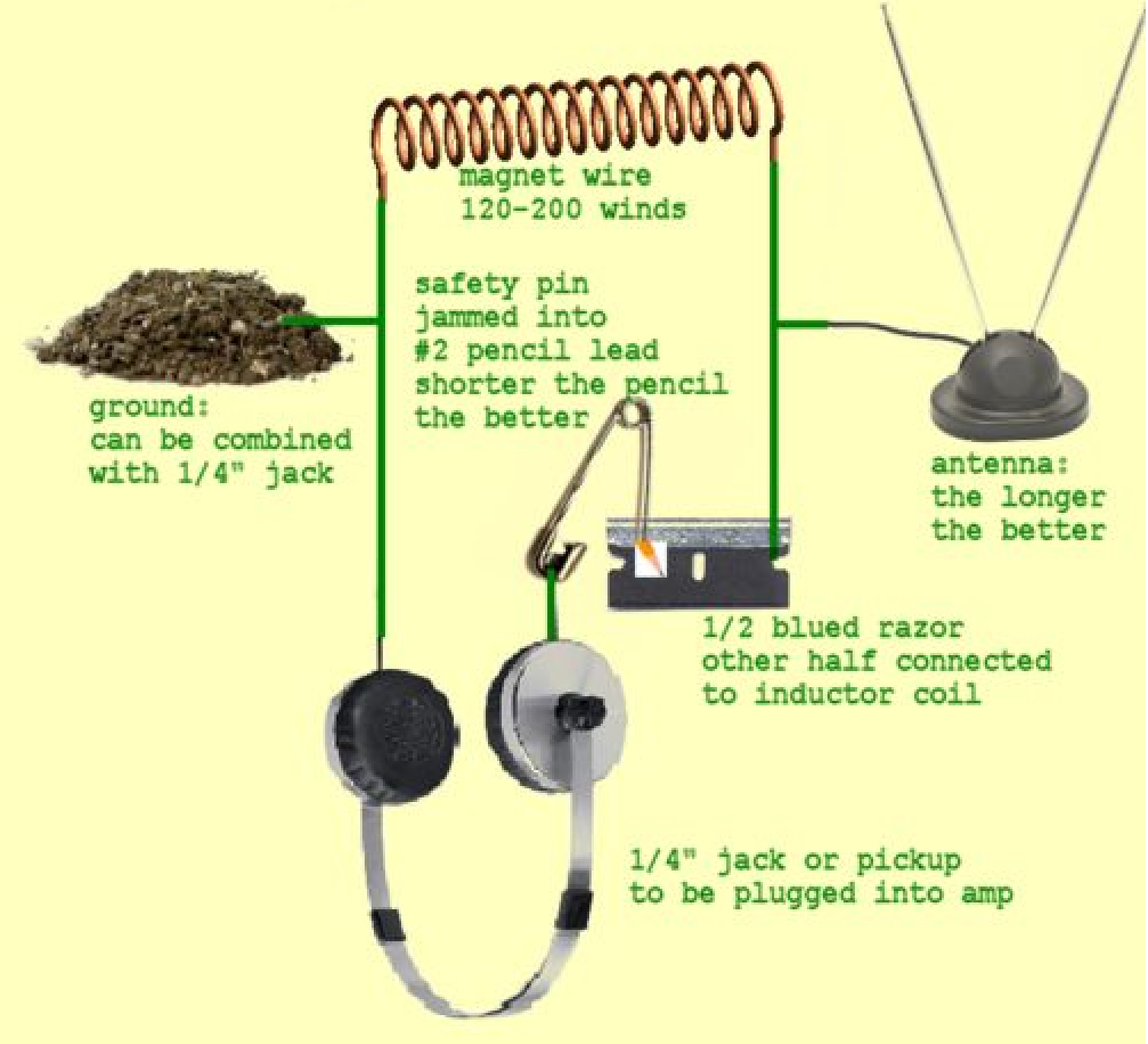

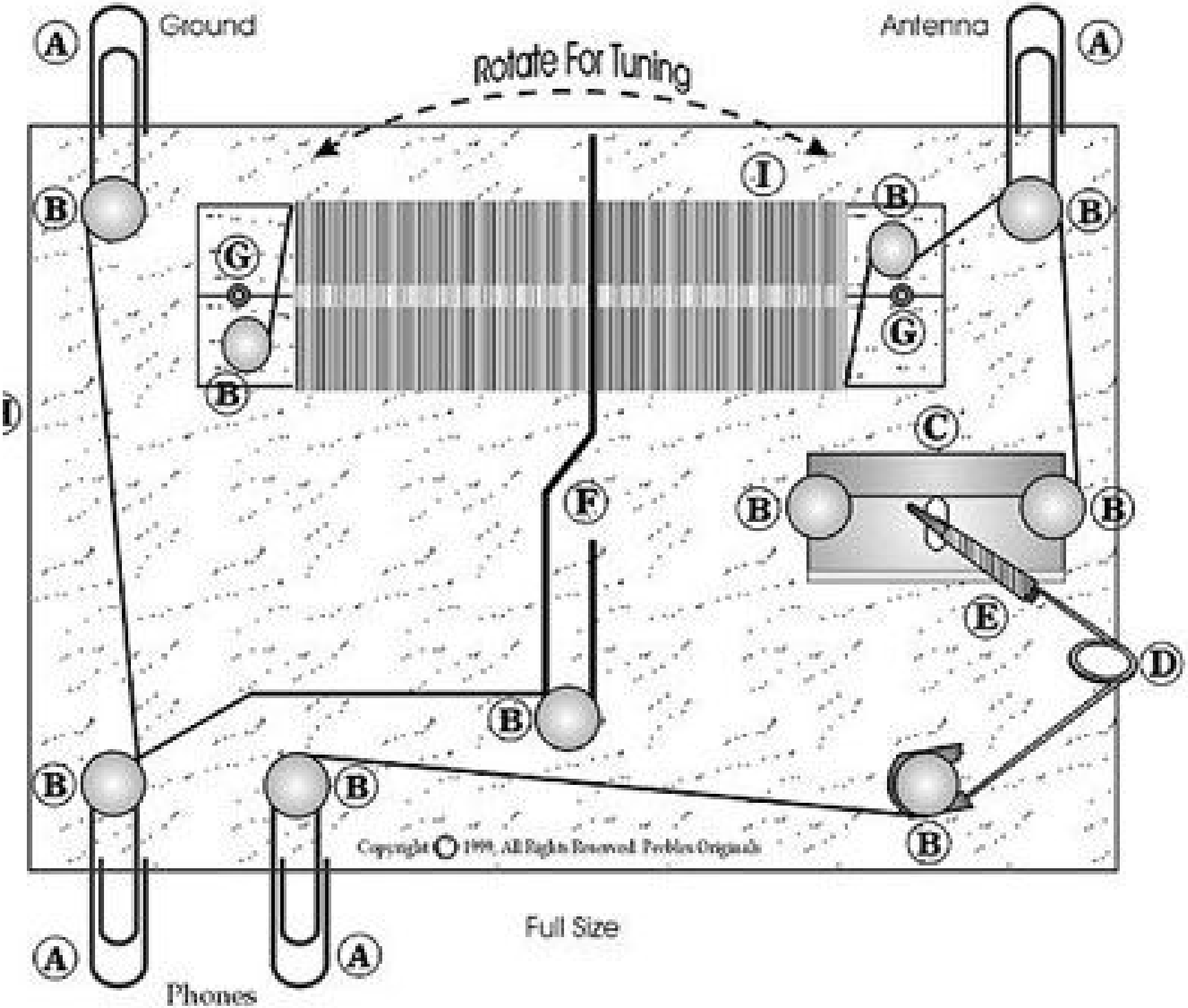
Ground
Antenna
Rotate For Tuning
A
B
C
D
E
F
G
I
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Full Size
Phones

The PO-102, Crystal Radio Kit, w/Slider-Tuning!

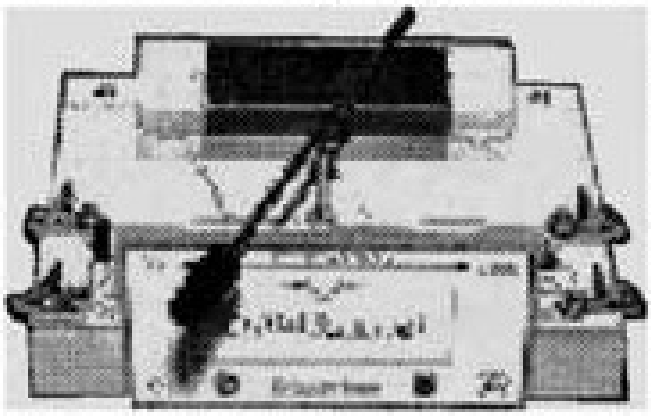

Perfect for parents, grandparents, and teachers to build with kids! Also a super starter kit for the beginning adult builder! Includes small coil form, wire, slider assembly, capacitors, and diode. Easy parts layout guide provided for kids. Excellent performance for such a simple but elegant classic slider. Earplug included.

PO-102, w/Crystal Earphone

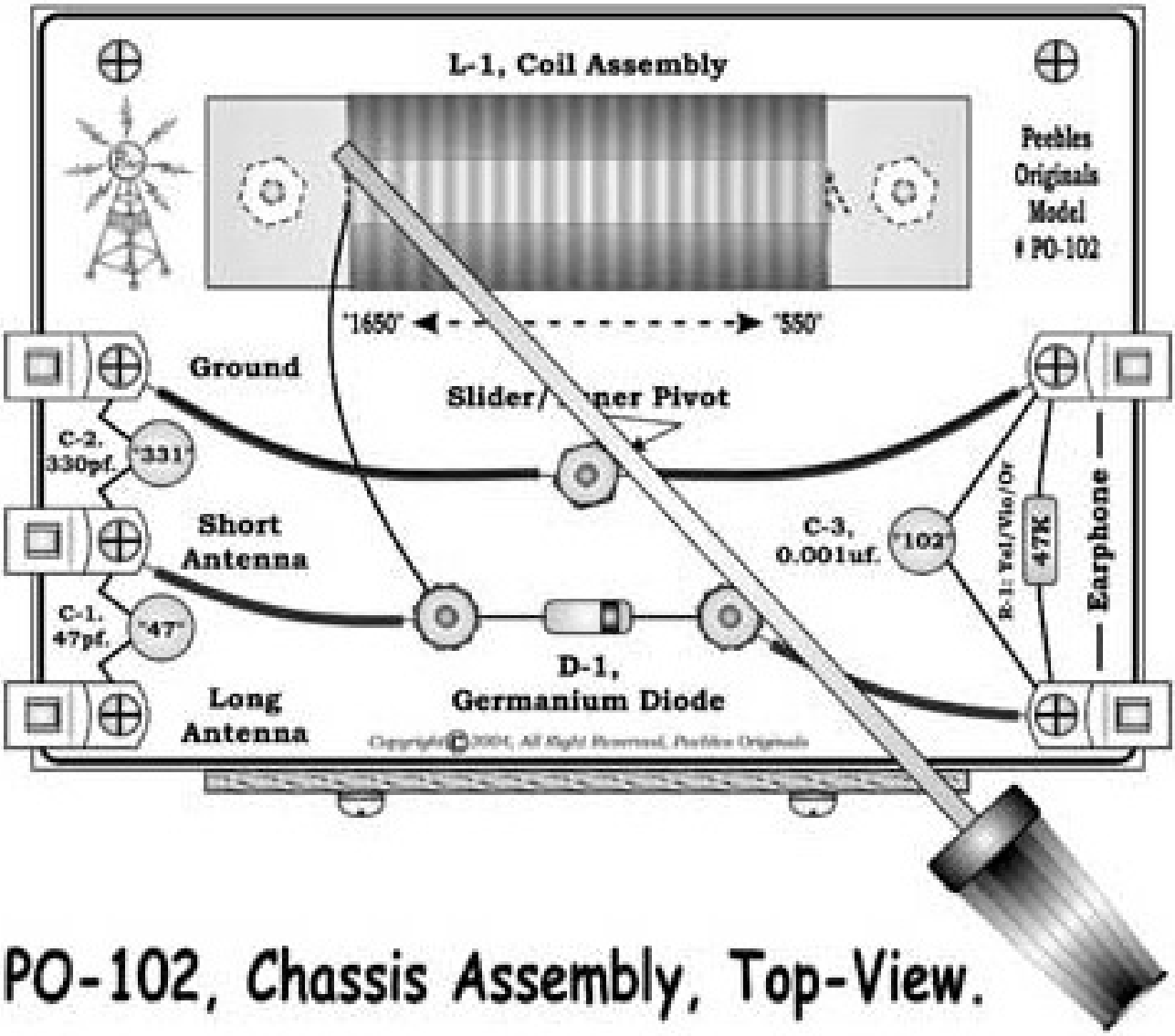

PO-102, Chassis Assembly, Top-View.

Fire Kit Example

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11. Highlander Survival Bag
12. Highlander Solid Fuel Cooker
13. Highlander Trekker Hammock
14. Highlander Folding Saw
15. Kombat UK W/proof Matches
16. Kombat UK 40l Molle Bag
17. Kombat UK Fire Starting Kit
18. Kombat UK Compass
19. Kombat UK Throwing Axe
20. Oasis Water Purification Tablets
21. Pro Force Survival Saw
22. Sawyer Mini Water Filter
23. Sharpening Stone
24. Survival Mirror
25. Turboflame Lighter
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27. Wateproof Rucksack Liner
28. Wind Up Solar Torch
29. Wooden Deluxe Knife w/ Case
30. 100ft Paracord
31. 24hr Ration Pack

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Maine Military Supply's 72 Hr Bug-Out-Bag

Item Description	SKU:	Org.Price:
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#10: Spork OD	020362	$3.99
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#13: Wise Emergency Food Kit 72hr	017279	$29.99
#14: Medium Transport Pack Black	020355	$48.99
#15: Adventurer Knife Kit	020363	$24.99
#16: Trip Wire: Yellow & Green	019917	$2.99
#17: Waterproof Storage Box	019152	$1.99
#18: 10hr Hand and Body Warmers (x3)	08016	$4.47
#19: Coin Towels 4pk Tubes (x3)	019415	$1.47
#20: 3-IN-1 Compass Whistle	019133	$2.99
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-20%

Total Bug Out Bag Weight: 12.4lbs

Your Price: $258.15

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HOW TO SURVIVE THE END OF THE WORLD ON A BUDGET
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Bug out Bag
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Aquamira Tablets
Handwarmers
Cotton Balls
Fire Starter
Knife
Matches
70 oz Camelbak Bladder in bag
TP
BG Parang
Fenix Flashlight w/
CR123 Batteries
6 MRE's
Fuel Stove Kit
Spare Contcats
First Aid Kit w/ Quikclot
Israeli Bandage
Walther P99 w/ 130 rds
of 9mm
Pampers
Baby Wipes

6 EMERGENCY USES FOR PARACORD

1. Snare Trap

2. Fishing Line

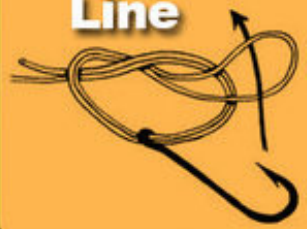

3. Shelter

Did you know?

A single length of paracord has been tested to handle 550 lbs of weight.

Did you know?

There are seven internal strands, each of which comes apart into two, so there's 14 thin lines.

4. Fishing Net

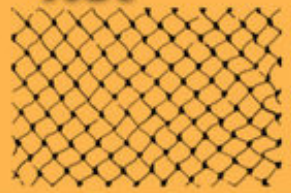

5. Fire

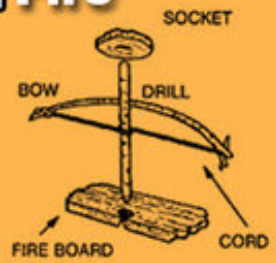

6. Bear Bag

AFTER 1 HOUR
© BRIGHTSIDE

5 WAY TAG STRIP

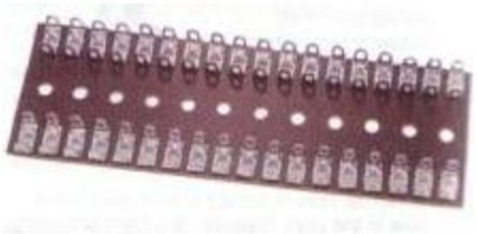

36 WAY TAG STRIP - TWO ROWS

e wired together ,with a little ingenuity, with the component wires being held together in the grip of solderless crocodile clips, whereby the conne
older.

ex circuits a plastic Terminal Block (sometimes referred to as a choc' or chocolate block) can be utilised very effectively indeed. These are used
15 Amp and 30 Amp. The 5 and 15 Amp Terminal Blocks I have found to be the most suitable. The various component wires can be trappec
makes it easy to change the components around when experiment with different circuits. See The EXPERMENTAL CRYSTAL SET for more det

'CHOCOLATE' TERMINAL BLOCK

Where to connect to the earbud jack.

For connecting to one earbud only.

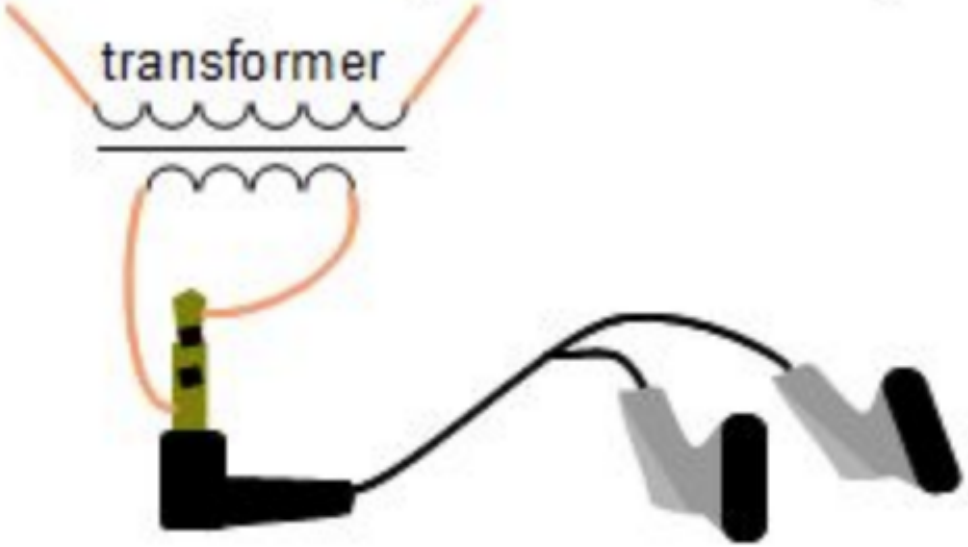

For connecting to both earbuds.

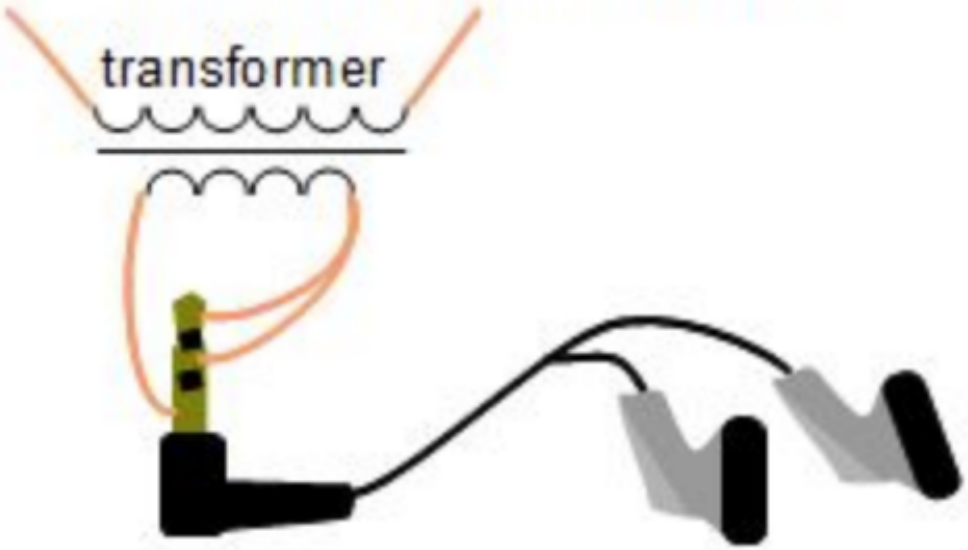

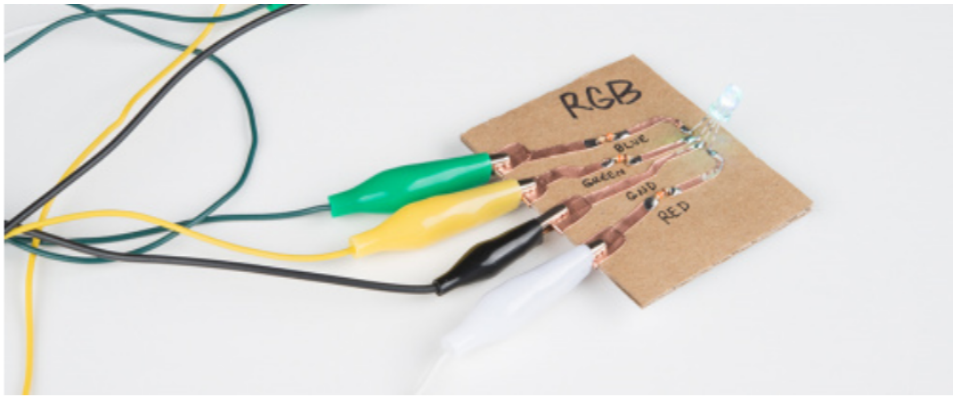

The current-limiting resistors are part of the cardboard circuit. The black spots are where I used the Bare Conductive paint

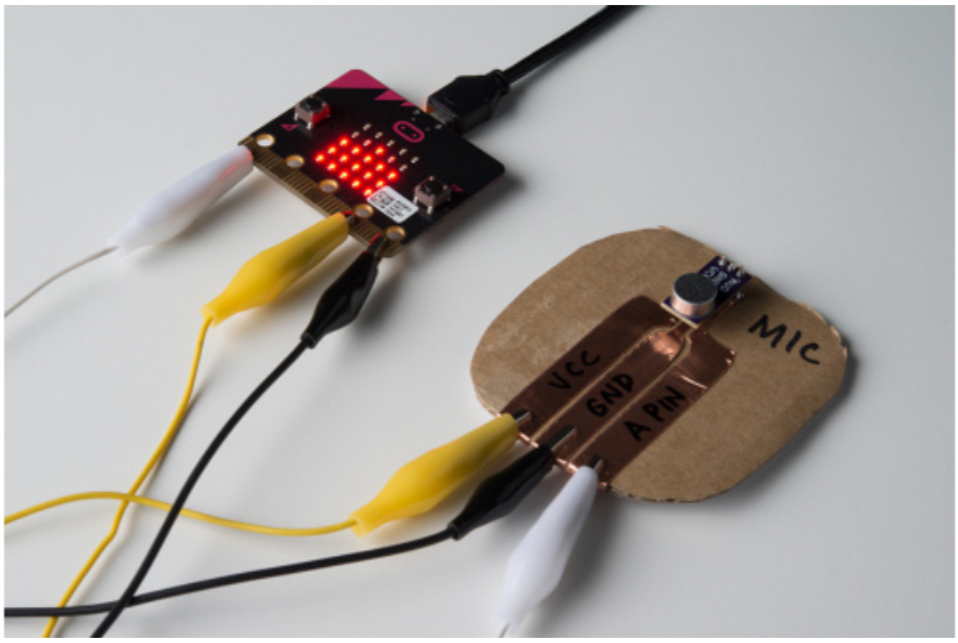

The micro:bit is plotting the analog values on the 5x5 LED matrix, which represent the noise level in the room.

All you need to get started is a roll of copper tape, a few components and conductive paint. One roll of tape and tube of paint can make about 200 circuits.

COSMIC VIBRATIONS

Octave	Manifestation	Vibrations per second	Gaps
1	TOUCH	2	
2		4	
3		8	
4		16	
5	SOUND	32	
6		64	
7		128	
8		256	
9		512	
10		1,024	
11		2,048	
12		4,096	
13		8,192	
14		16,384	
15		32,768	
16	ELECTROMAGNETIC (Longer Radio Waves)	65,536	
17		131,072	
18		262,144	
19		524,288	
20		1,048,576	
21		2,097,152	
22		4,194,304	
23		8,388,608	
24		16,777,216	
25		33,554,432	
26		67,108,864	
27		134,217,728	
28		268,435,456	
29	ELECTROMAGNETIC (Increasing)	536,870,912	
30		1,073,741,824	
31		2,147,483,648	
32		4,294,967,296	
33		8,589,934,592	
34		17,179,869,184	
35		34,359,738,368	
36		68,719,476,736	
37		137,438,953,472	
38		274,877,906,944	
39	HEAT OR INFRARED	549,755,813,888	
40		1,099,511,627,776	
41		2,199,023,255,552	
42		4,398,046,511,104	
43		8,796,093,022,208	
44		17,592,186,044,416	
45		35,184,372,088,832	
46		70,368,744,177,664	
47		140,737,488,355,328	
48	VISIBLE LIGHT	281,474,976,710,656	
49		562,949,953,421,312	
50		1,125,899,906,842,624	
51	ULTRAVIOLET	2,251,799,813,685,248	SPIRIT ELECTRONS
52		4,503,599,627,370,496	
53		9,007,199,254,740,992	
54		18,014,398,509,481,984	
55		36,028,797,018,963,968	
56		72,057,594,037,927,936	
57	X-RAY	144,115,188,075,855,872	
58		288,230,376,151,711,744	
59		576,460,752,303,423,488	
60	GAMMA AND COSMIC RAYS		
61			
62		4,611,686,018,427,387,904	
63			
64		*The Vibrations in these octaves increase to an incomprehensible number per second.*	PSYCHIC PROJECTIONS
65			
66			
67			
68			
69			
70		*The phenomena of psychic projections and soul essence occur in octaves considerably beyond those of any known material manifestations. Consequently, they must not be considered as immediately following any manifestations which we have shown on this chart.*	
71			
72			
73			SOUL ESSENCE
74			
75			
76			
77			
78			
79			
80			

(THESE INTERVALS AND FIGURES ARE APPROXIMATE AND NOT EXACT)

NOTICE

This chart was carefully compiled by the Editorial and Research Departments of AMORC College after consulting the most eminent scientific authorities on the subjects of physics and chemistry and comparing their observations and notations with the reports from the Rosicrucian laboratories in foreign countries.

There is a slight disagreement in regard to the rates of vibrations for the various keys of the musical keyboard, due to different standards of pitch in various countries, and there is some disagreement among scientific authorities in regard to the colors associated with various musical notes. This chart represents not only the consensus of most of these authorities but also adheres strictly to what the Rosicrucians have been able to demonstrate as truth in our own laboratories and in the experiments of thousands of members in various parts of the world. Regardless, therefore, of any disagreement with authorities outside the organization, this chart is the authentic presentation of the Rosicrucian knowledge.

This chart is to be used by the members of the Rosicrucian Order in connection with their studies and experiments and is not to be used for any other purpose or in any other way. Like the lessons themselves, this chart and the facts contained on it are reserved and restricted in use under the rules and regulations of the organization.

INTERNATIONAL SEAL OF THE SUPREME LODGE of the Rosicrucian Order

THE SOLAR SPECTRUM

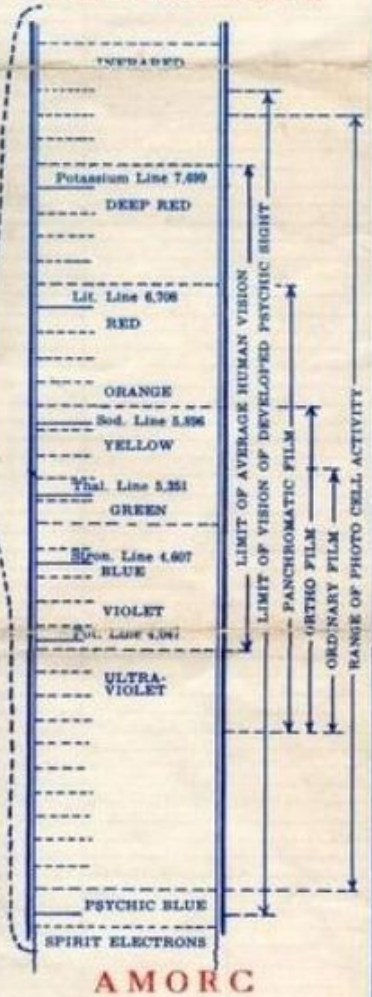

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THE
Rosicrucian Order
San Jose, California

LITHO. IN U. S. A.

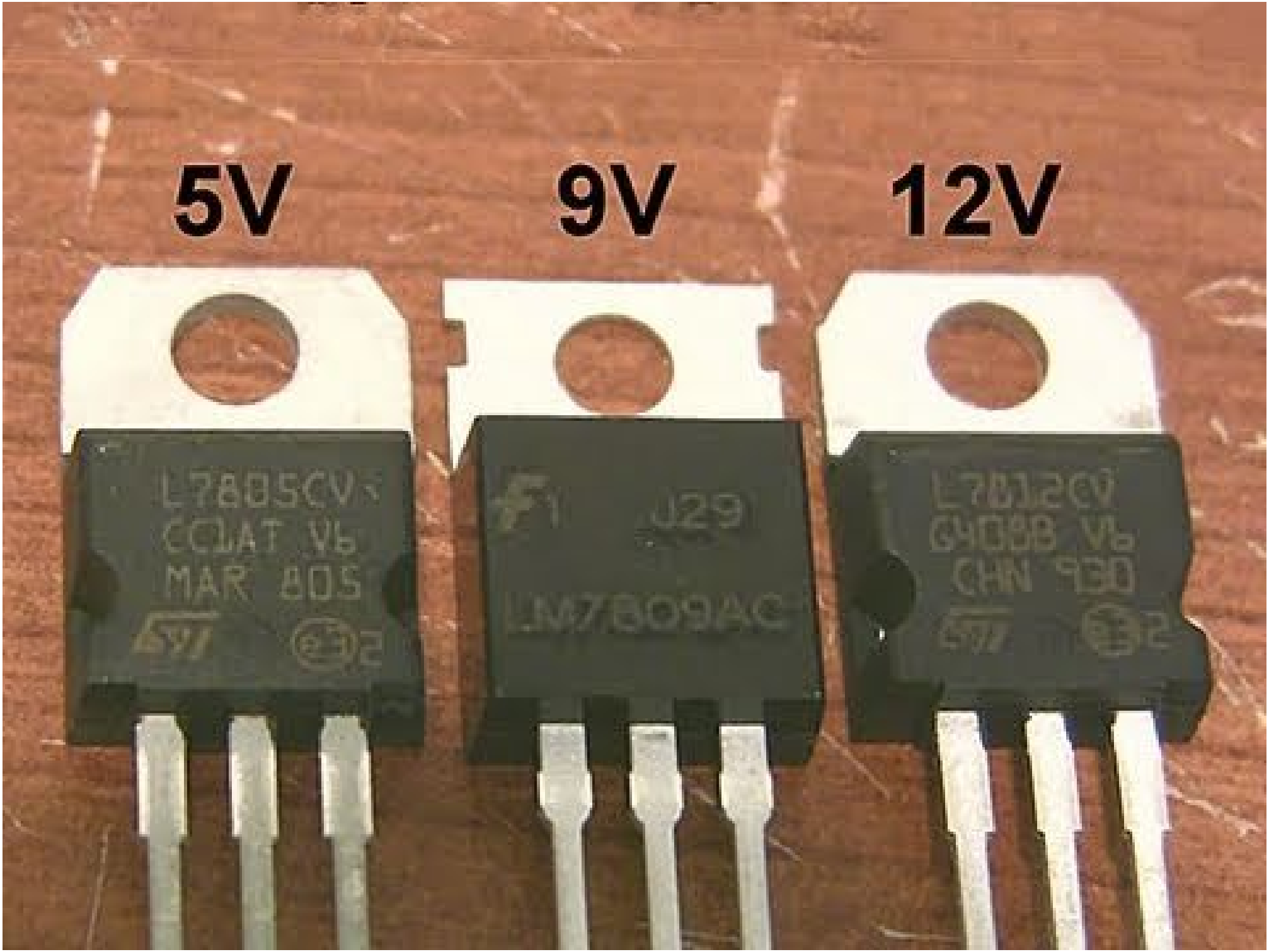
5V
9V
12V
L7805CV
MAR 805
J29
LM7809AC
L7812CV
CHN 930

7 LOGIC GATES & 4 USEFUL COMBINATIONS

Standard Logic Gates

NOT

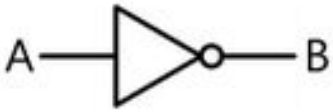

A	B
1	0
0	1

AND

A	B	C
1	1	1
1	0	0
0	1	0
0	0	0

NAND

A	B	C
1	1	0
1	0	1
0	1	1
0	0	1

OR

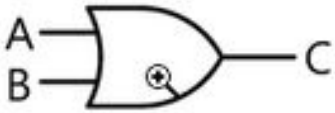

A	B	C
1	1	1
1	0	1
0	1	1
0	0	0

NOR

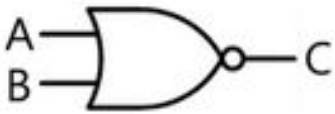

A	B	C
1	1	0
1	0	0
0	1	0
0	0	1

XOR

A	B	C
1	1	0
1	0	1
0	1	1
0	0	0

XNOR

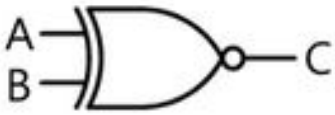

A	B	C
1	1	1
1	0	0
0	1	0
0	0	1

Preceding NOT Gate on One Input for AND, NAND, OR, NOR Gates

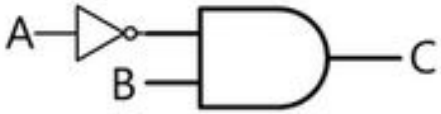

A	B	C
1	1	0
1	0	0
0	1	1
0	0	0

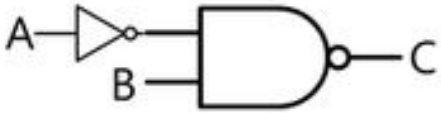

A	B	C
1	1	1
1	0	1
0	1	0
0	0	1

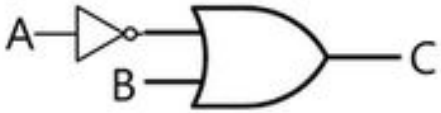

A	B	C
1	1	1
1	0	0
0	1	1
0	0	1

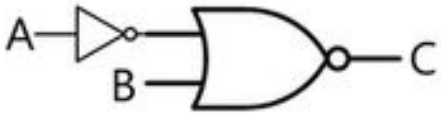

A	B	C
1	1	0
1	0	1
0	1	0
0	0	0

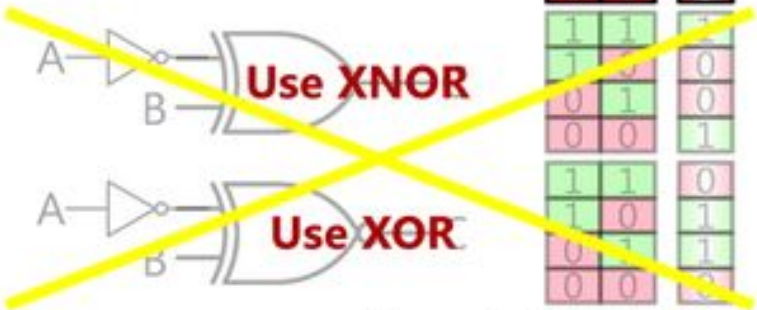

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TYPE N F

SMA M

PAL/BELLING LEE F

UHF F

MCX MALE
(OTHER END)

TYPE F F

BNC F

SMA F

TYPE N F

SMA M

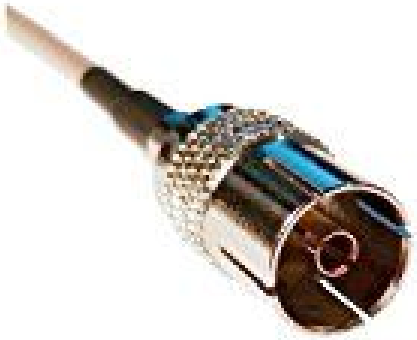

PAL/BELLING LEE F

UHF F

MCX MALE
(OTHER END)

TYPE F F

BNC F

SMA F

DIODE

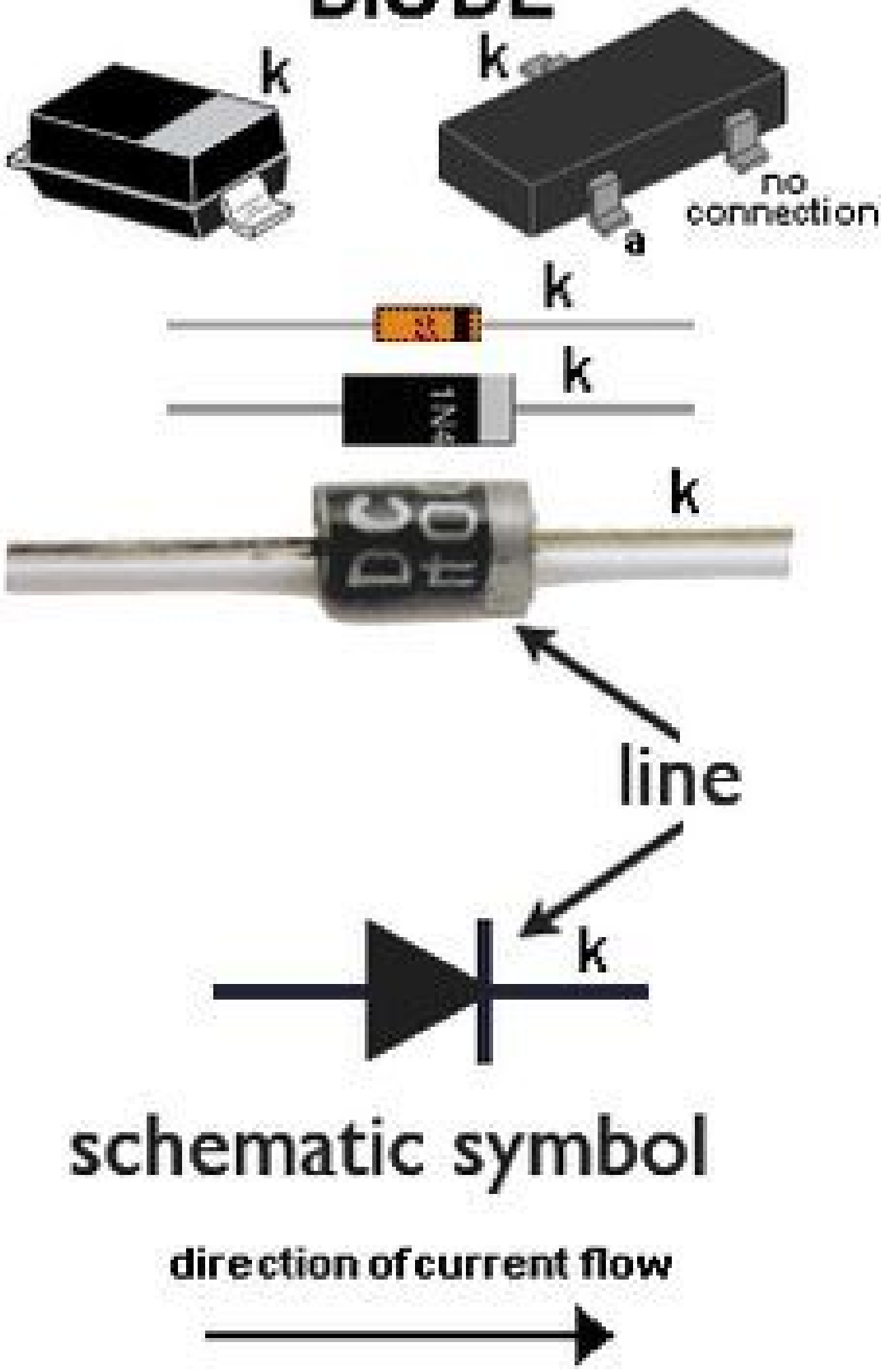
k
k
no connection
a
k
k
k
line
k
schematic symbol
direction of current flow

7. 555 Timer Projects

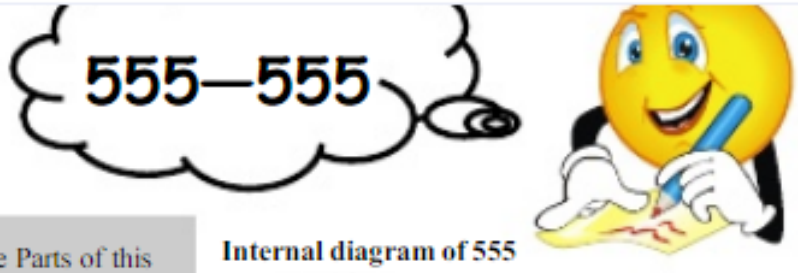

In this section we will make :

7.1 4 Key Piano
7.2 Light sensitive music circuit
7.3 Light controlled Police Siren
7.4 Touch Switch
7.5 Timer
7.6 Continuity Tester
7.7 Knight Rider
7.8 Cricket Game
7.9 Multipurpose circuit
7.10 Johnson counter

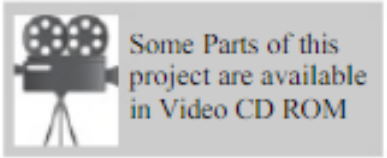
Some Parts of this project are available in Video CD ROM

What is it about ?

555 timer integrated circuit (IC) is a very popular chip used in variety of applications like timer, pulse generation and oscillators. This is a low cost, stable and widely available chip which makes it favorite for hobbyists. The internal components of 555 as shown in figure consists of 2 comparators and a flip flop. All of these components contain 25 transistors and 15 resistors packed in the IC.

The three highlighted 5k resistors shown in figure are the reason why this IC is named as 555.

Internal diagram of 555

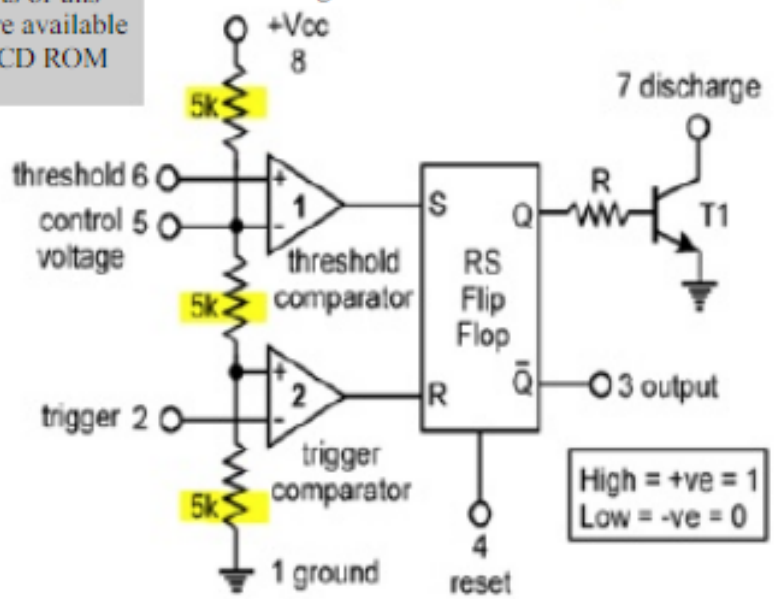

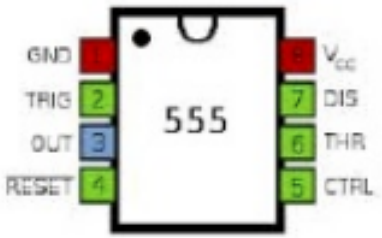

Please note the notch near first pin. This is made to indentify the first pin of IC.

Pin	Name	Purpose
1	GND	Ground reference voltage, low level (0 V)
2	TRIG	The OUT pin goes high and a timing interval starts when this input falls below 1/2 of CTRL voltage (which is typically 1/3 of V_{CC}, when CTRL is open).
3	OUT	This output is driven to approximately 1.7V below $+V_{CC}$ or GND.
4	RESET	A timing interval may be reset by driving this input to GND, but the timing does not begin again until RESET rises above approximately 0.7 volts. Overrides TRIG which overrides THR.
5	CTRL	Provides "control" access to the internal voltage divider (by default, 2/3 V_{CC}).
6	THR	The timing (OUT high) interval ends when the voltage at THR is greater than that at CTRL.
7	DIS	Open collector output which may discharge a capacitor between intervals. In phase with output.
8	V_{cc}	Positive supply voltage, which is usually between 3 and 15 V depending on the variation.

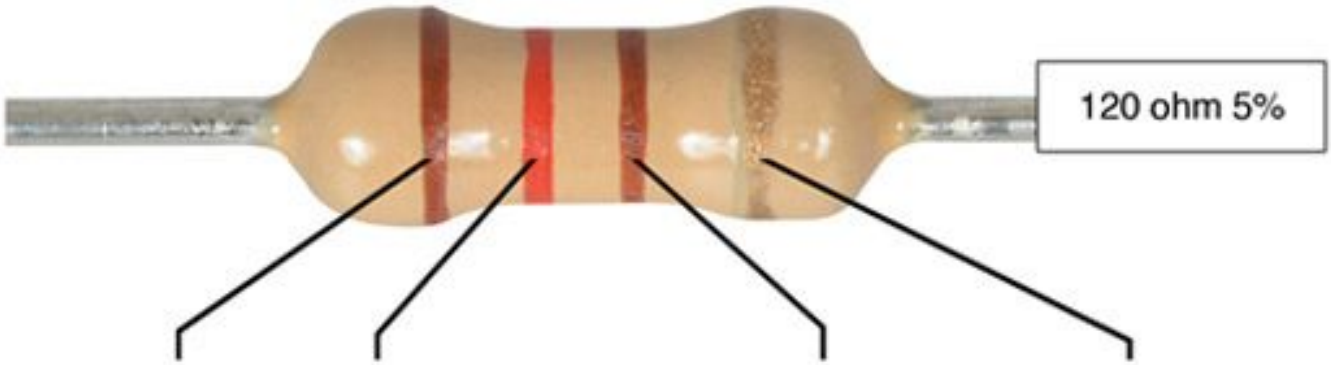

120 ohm 5%

	1st	2nd	3rd	Multiplier		Tolerance	
0	Black	Black	Black	Black	1		
1	Brown	Brown	Brown	Brown	10^1	Brown	1%
2	Red	Red	Red	Red	10^2	Red	2%
3	Orange	Orange	Orange	Orange	10^3		
4	Yellow	Yellow	Yellow	Yellow	10^4		
5	Green	Green	Green	Green	10^5		
6	Blue	Blue	Blue	Blue	10^6		
7	Violet	Violet	Violet	Violet	10^7		
8	Grey	Grey	Grey	Grey	10^8		
9	White	White	White	White	10^9		
				Gold	0.1	Gold	5%
				Silver	0.01	Silver	10%

1st 2nd 3rd Multiplier Tolerance

4.7k ohm 1%

ELECTROMAGNETIC RADIATION SPECTRUM

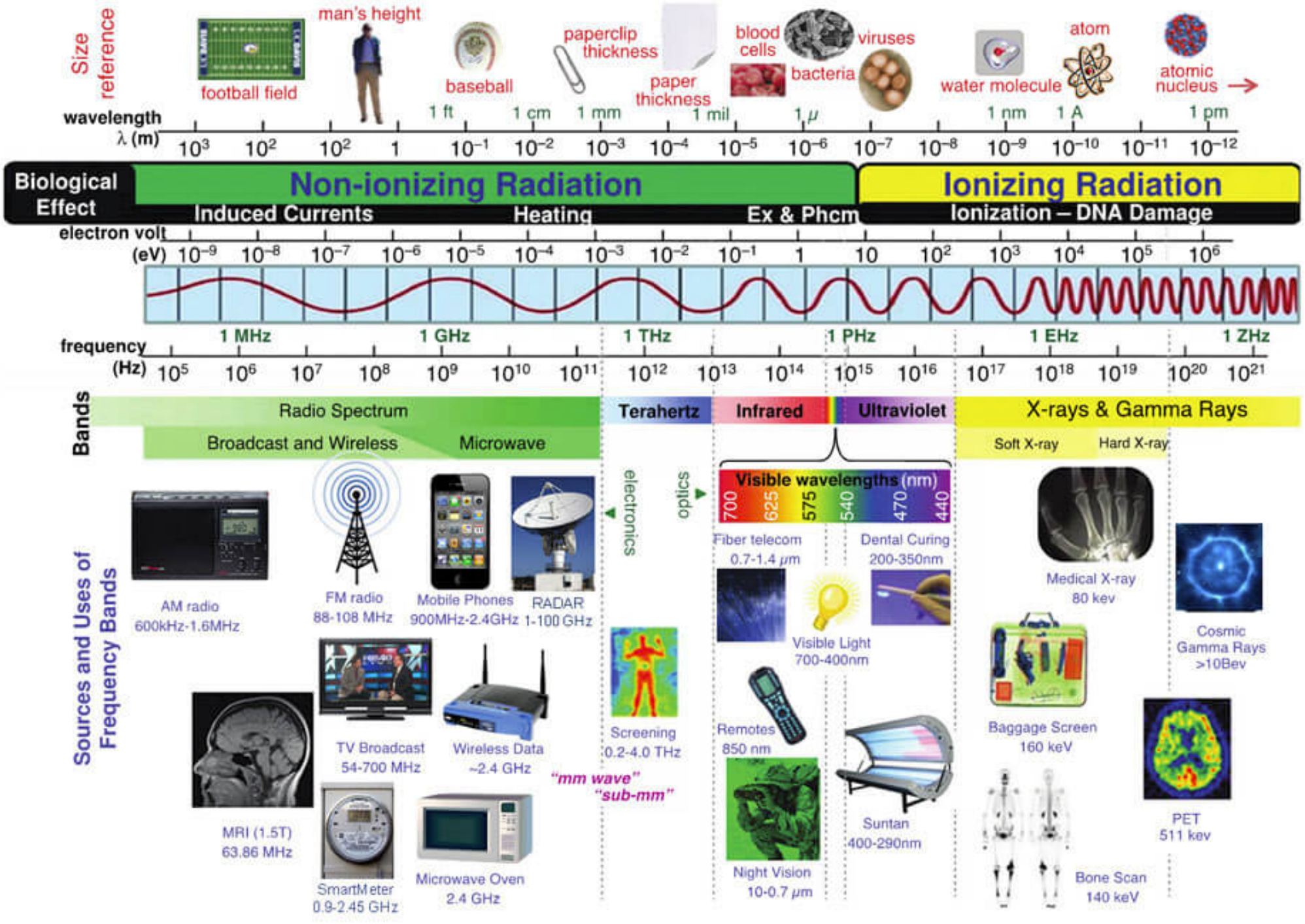

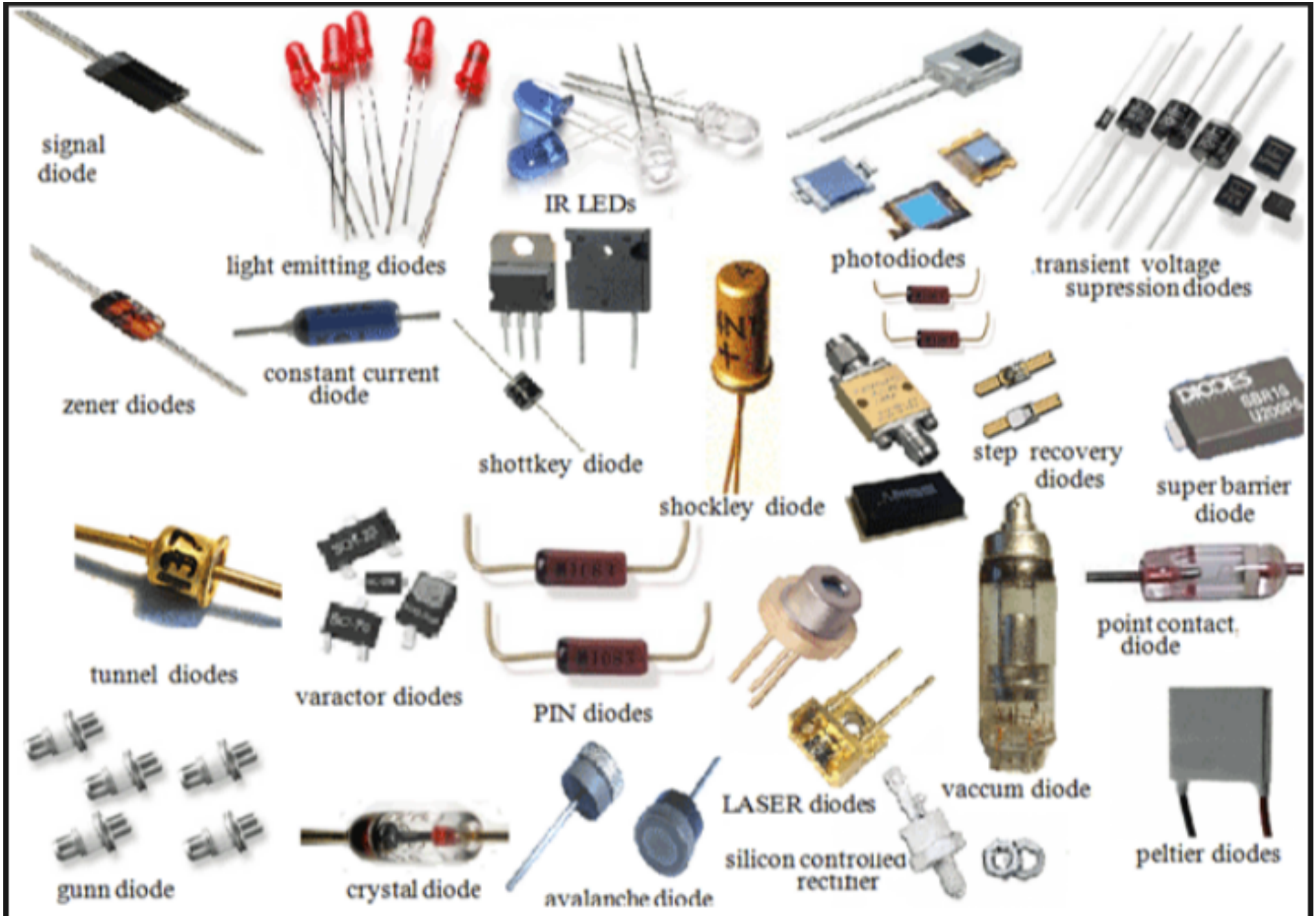

Types of Diode

X2 capacitor
called "mains capacitor"

electrolytic
called "can electrolytic"

the line is
negative !!!

tantalum

the line is positive !!!

surface mount electrolytic

black mark negative

surface mount capacitor

green cap

+

+ "pig tail" electro
double-ended electro

single-ended electro

+

air trimmer

"green cap"
but RED !!!

high voltage ceramic

high voltage ceramic

monolythic
capacitor
(ceramic)

"bead"
capacitor
(ceramic)

tantalum capacitors can
"go up in smoke"

"bead" tantalum

Electronics
Reference Sheet v1.1b

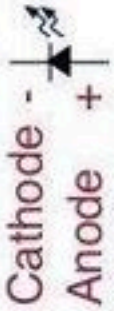

LED

CAPACITOR

REGULATOR (e.g. LM78xx)

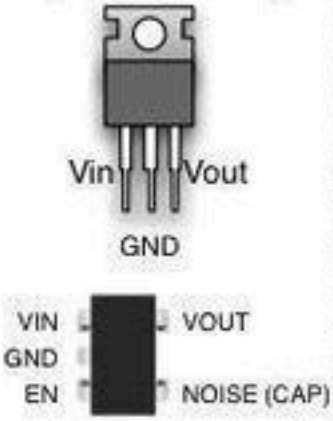

Resistor

	Digit	Multiplier	Tolerance
Silver	-	0.01	±10%
Gold	-	0.1	±5%
Black	0	1	-
Brown	1	10	±1%
Red	2	100	±2%
Orange	3	1k	-
Yellow	4	10k	-
Green	5	100k	±0.5%
Blue	6	1M	±0.25%
Violet	7	10M	±0.1%
Gray	8	-	-
White	9	-	-

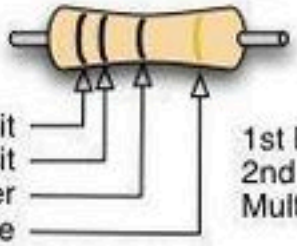

DIODE

NPN transistor (Current sink) (e.g. PN2222)

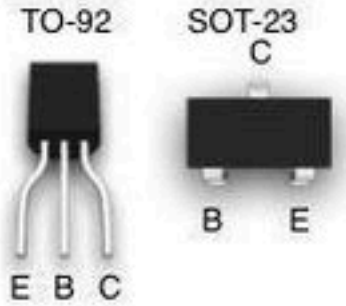

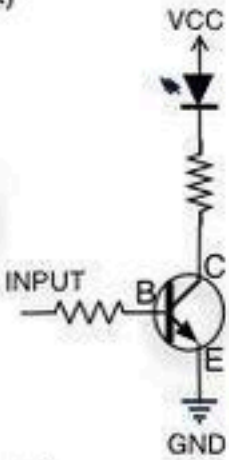

N-channel MOSFET

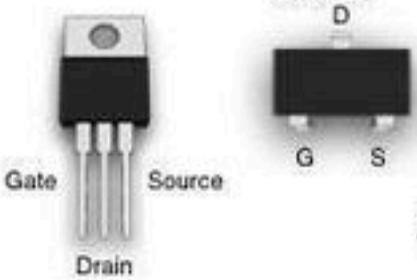

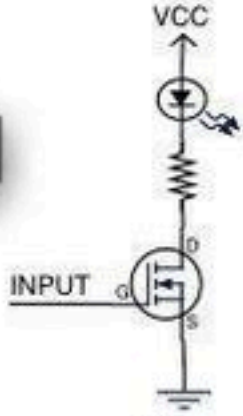

PNP transistor (Current source) (e.g. PN2907)

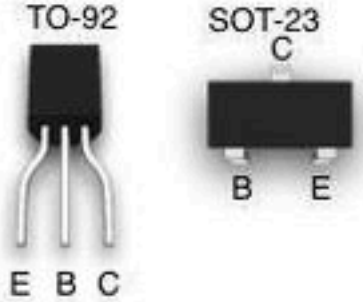

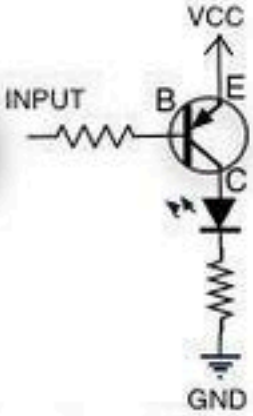

P-channel MOSFET

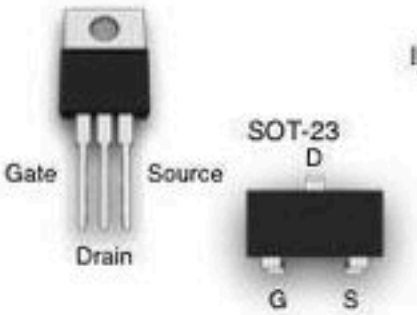

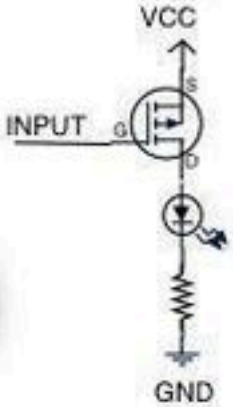

* Please note that some components may have a different pinout than the one showed above, you should always check the data sheet before using a new component.

Reich's Orgone Accumulator Box

Cutaway View of Box Layers

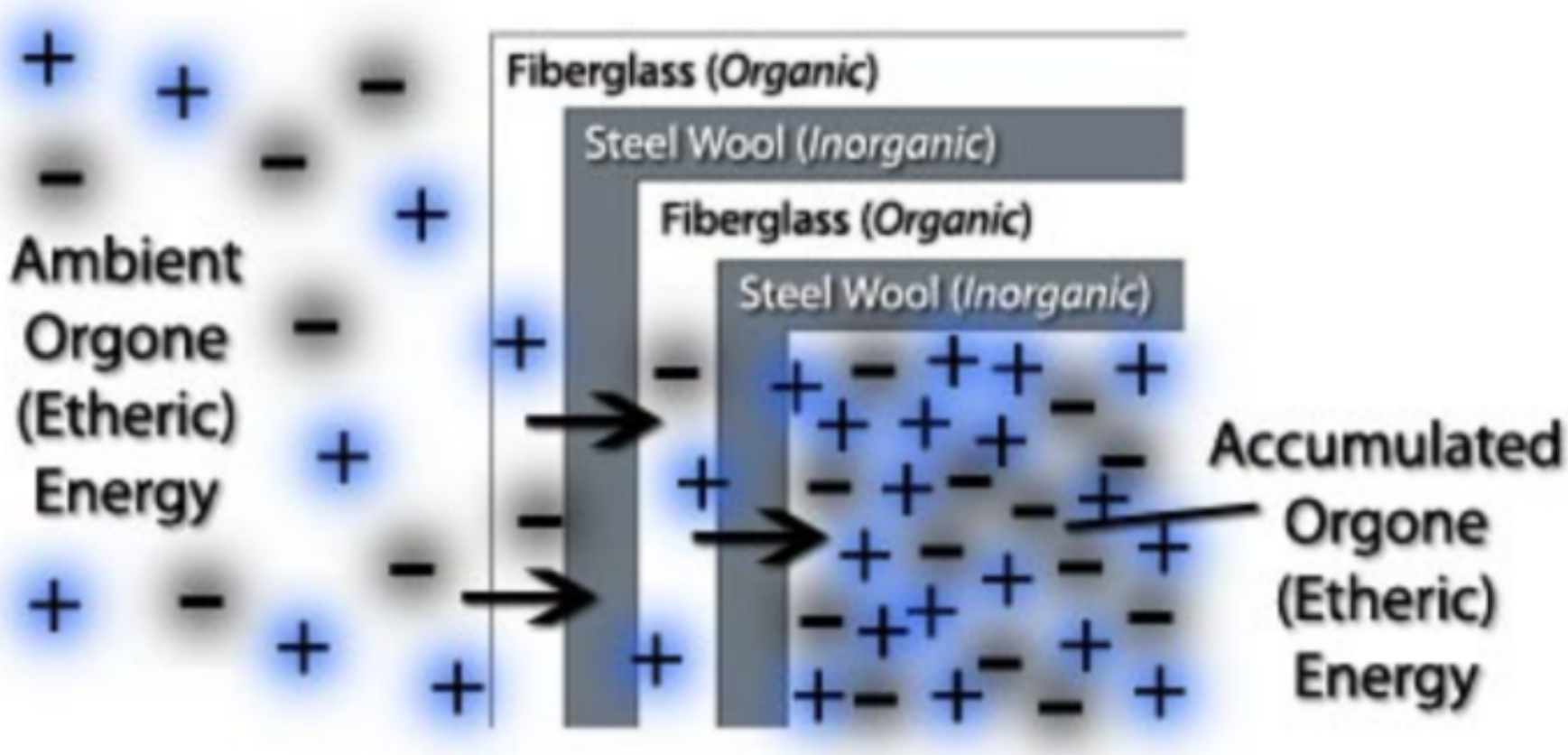

Key:

+ Positive Orgone (Etheric) Energy (a.k.a., "OR" / "POR")

− Deadly Orgone (Negative Etheric) Energy (a.k.a., "DOR")

rgonite.info

How to build a Don Croft ORGONITE CLOUD BUSTER

Materials List:

Wear safety gear as necessary
- respirator, gloves when pouring resin.
- gloves & goggles when cutting wood - with a respirator if cutting MDF etc.

4 x 10' lengths of copper (or other) pipe (cut 3 lengths in half, and one length into six 1' pieces)

6 pipe endcaps and 6 pipe connectors

2 gallon bucket (polypropylene if possible)

10 double terminated quartz (6 of these must fit into garden hose for insertion into base of pipes)

6 pieces of garden hose (3/4" - 1" long)

Resin and metal suitable for orgonite

A roll of tape (duct tape etc)

Glue (silicone glue will work)

Stick for mixing metal into resin when pouring layers

Top, middle (temporary) and bottom spacers cut and drilled out of wood. If not buying readymade, use templates or measure with copmass, ruler, pencil.
Drill the holes with 1 1/8" and 1 1/4" wood drill bits, and cut into shape with a Jigsaw.

Refer to (Part 1 - 2) How to Make an Orgonite CloudBuster:
http://www.youtube.com/watch?v=cCn1DO2Rj6k

Third - The temporary spacer is removed and the pipe-tops are taped up to stop resin or metal getting into them.
Further layers are poured, allowing resin to cure and cool between pouring.
More crystals or other components may be added with the basic orgonite mixture.
When done, the tape is removed from the pipe ends.

Second poured layer (the temporary spacer is fixed in place while this layer is curing, and then removed)

First poured layer (1" - 1 1/2" high) Include four double-terminated crystals at compass points

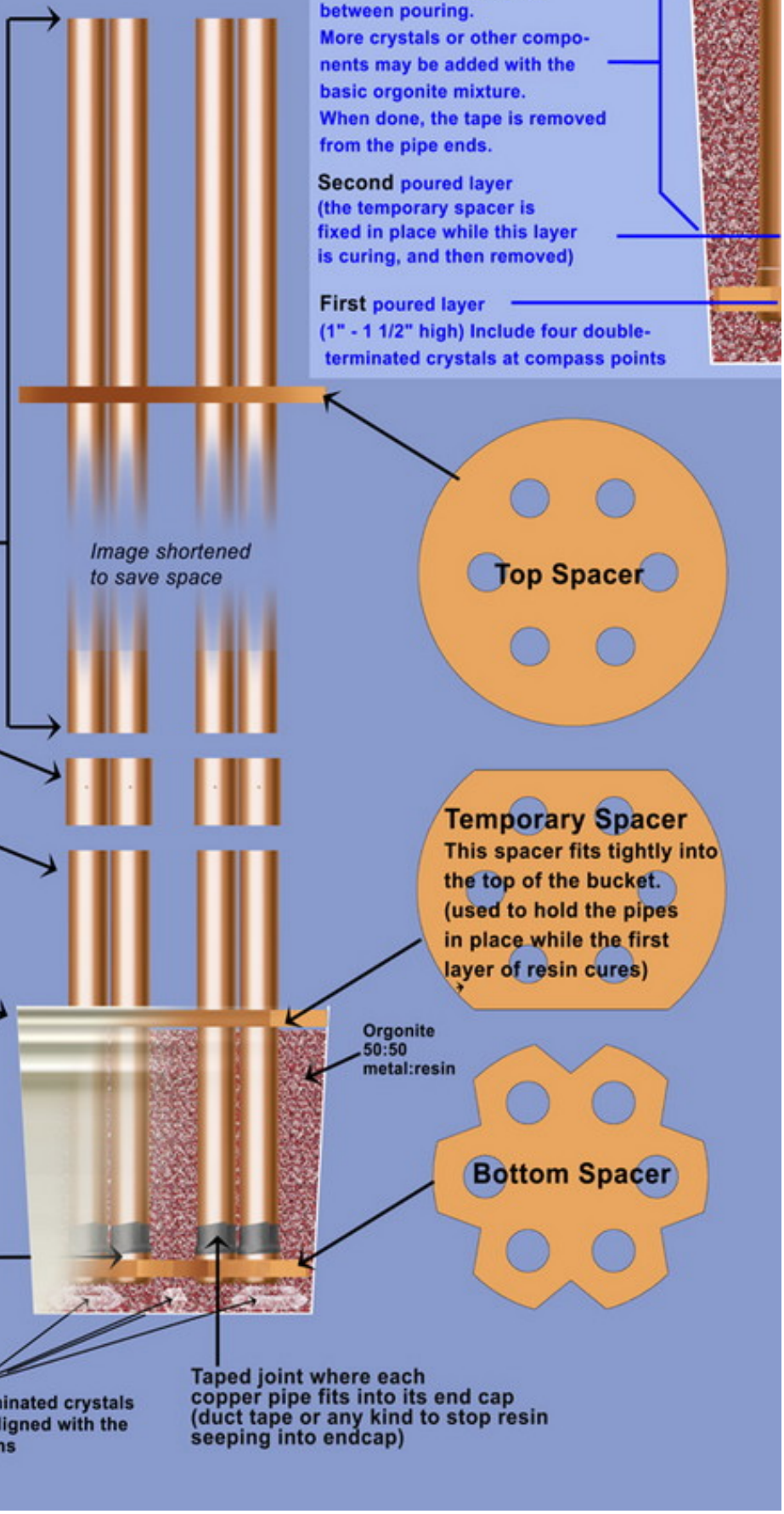

BOAT
BOAT
GOOP

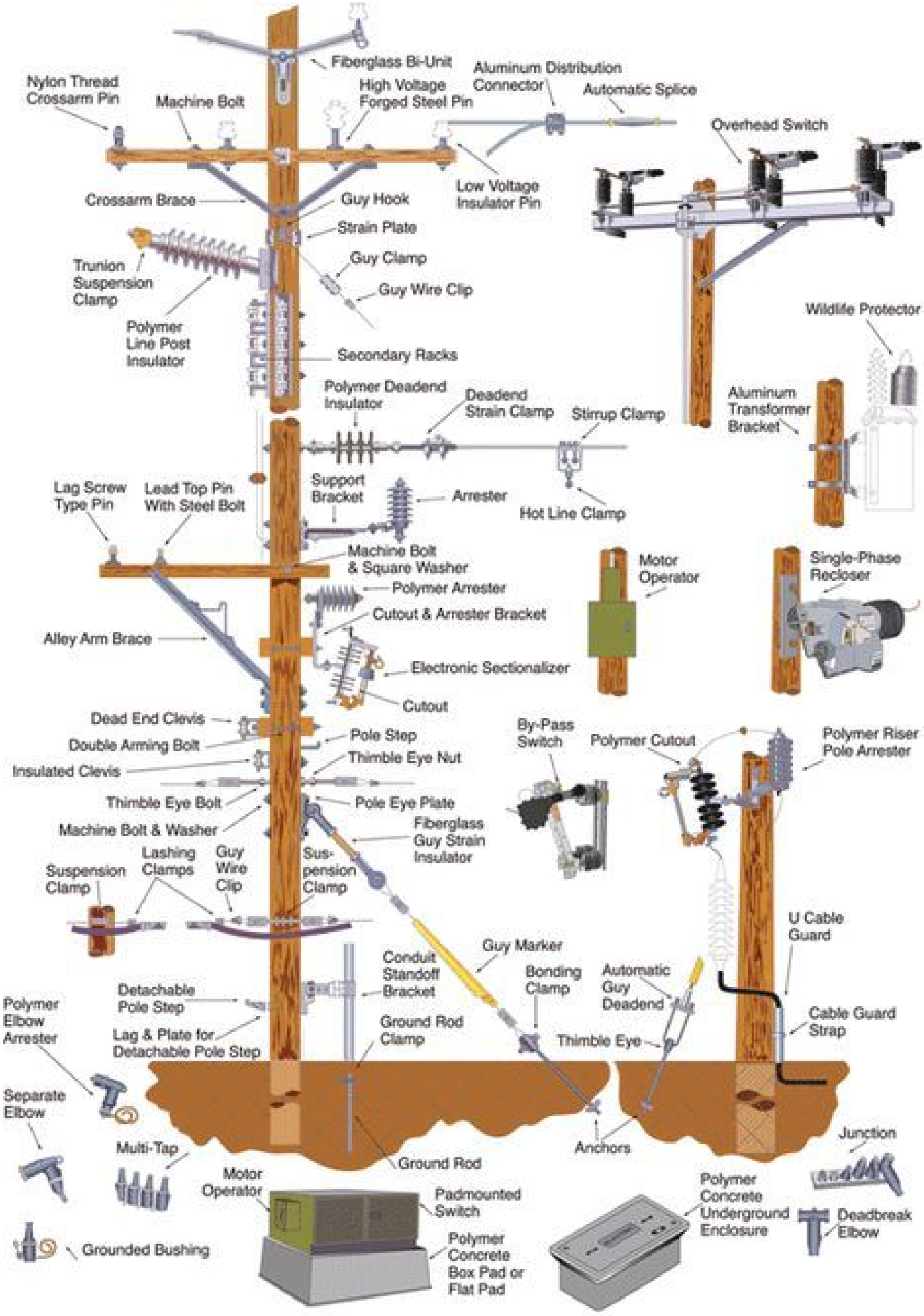
Fiberglass Bi-Unit
Aluminum Distribution Connector
Automatic Splice
Nylon Thread Crossarm Pin
Machine Bolt
High Voltage Forged Steel Pin
Overhead Switch
Low Voltage Insulator Pin
Crossarm Brace
Guy Hook
Strain Plate
Guy Clamp
Trunion Suspension Clamp
Guy Wire Clip
Wildlife Protector
Polymer Line Post Insulator
Secondary Racks
Polymer Deadend Insulator
Deadend Strain Clamp
Stirrup Clamp
Aluminum Transformer Bracket
Support Bracket
Arrester
Lag Screw Type Pin
Lead Top Pin With Steel Bolt
Hot Line Clamp
Machine Bolt & Square Washer
Motor Operator
Single-Phase Recloser
Polymer Arrester
Cutout & Arrester Bracket
Alley Arm Brace
Electronic Sectionalizer
Cutout
Dead End Clevis
Pole Step
By-Pass Switch
Polymer Cutout
Polymer Riser Pole Arrester
Double Arming Bolt
Thimble Eye Nut
Insulated Clevis
Thimble Eye Bolt
Pole Eye Plate
Machine Bolt & Washer
Fiberglass Guy Strain Insulator
Lashing Clamps
Guy Wire Clip
Suspension Clamp
Sus-pension Clamp
U Cable Guard
Guy Marker
Conduit Standoff Bracket
Bonding Clamp
Automatic Guy Deadend
Detachable Pole Step
Polymer Elbow Arrester
Ground Rod Clamp
Cable Guard Strap
Lag & Plate for Detachable Pole Step
Thimble Eye
Separate Elbow
Anchors
Junction
Multi-Tap
Ground Rod
Motor Operator
Padmounted Switch
Polymer Concrete Underground Enclosure
Deadbreak Elbow
Grounded Bushing
Polymer Concrete Box Pad or Flat Pad

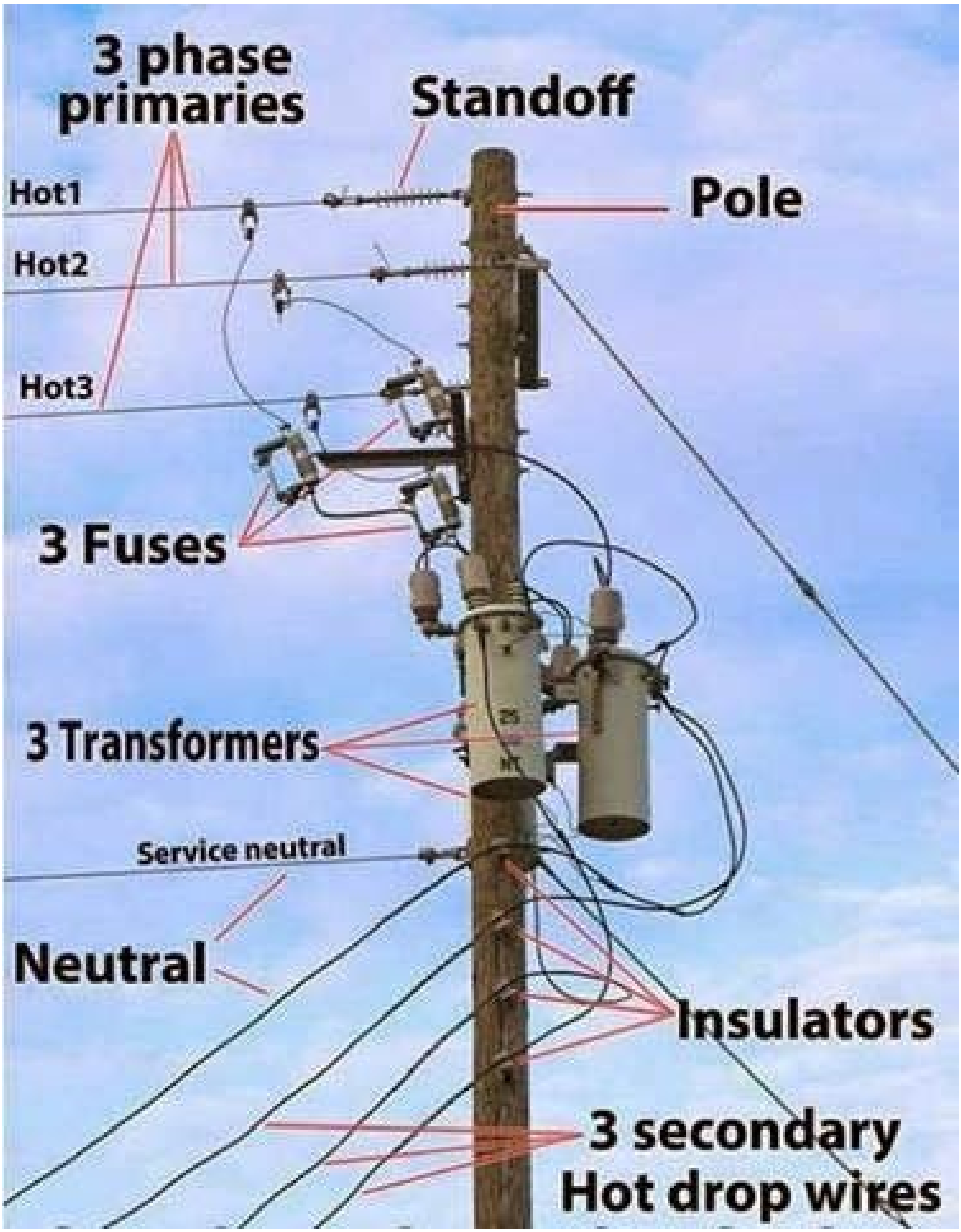
3 phase primaries
Standoff
Hot1
Pole
Hot2
Hot3
3 Fuses
3 Transformers
Service neutral
Neutral
Insulators
3 secondary Hot drop wires

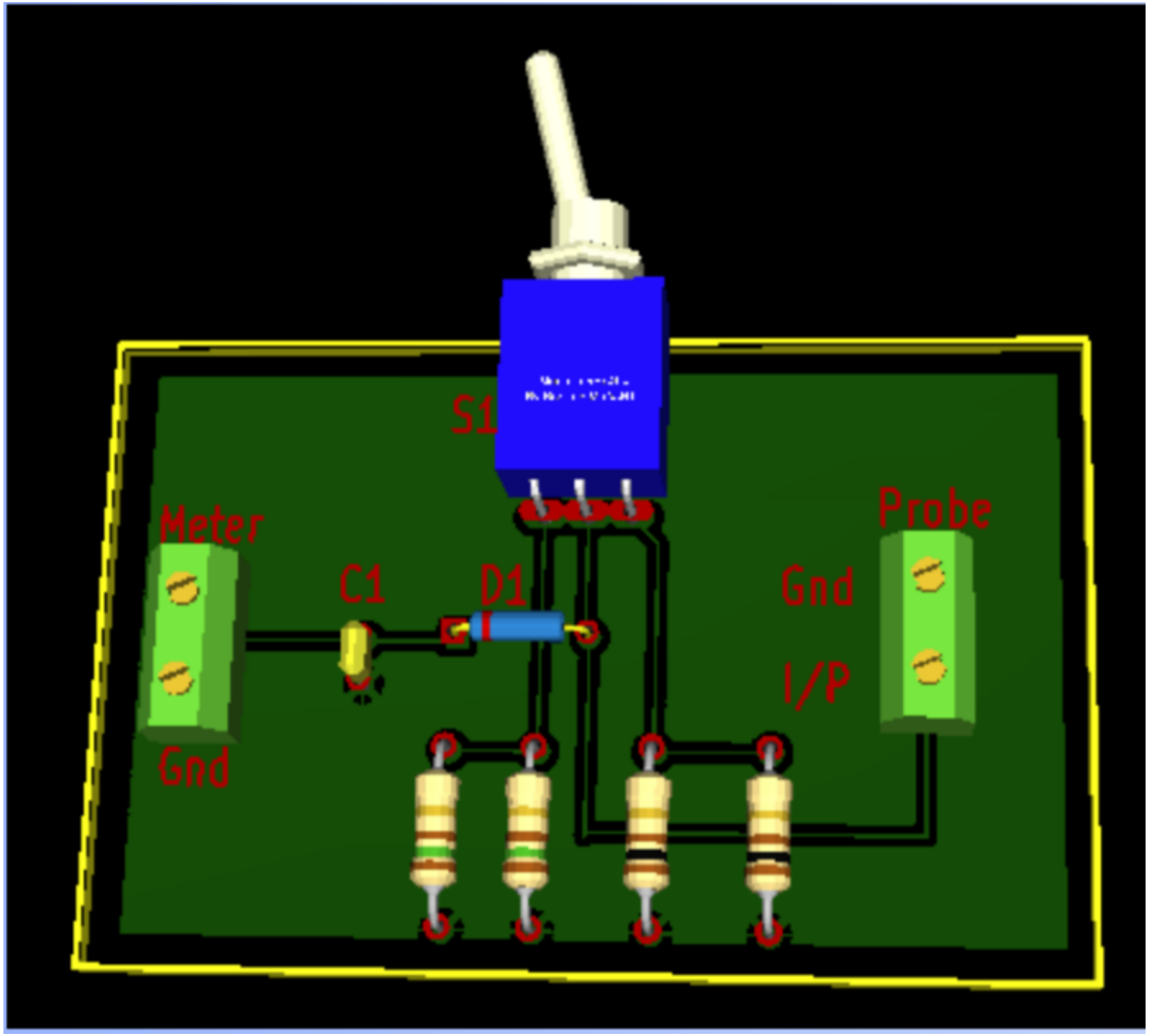
S1
Meter
C1
D1
Probe
Gnd
I/P
Gnd

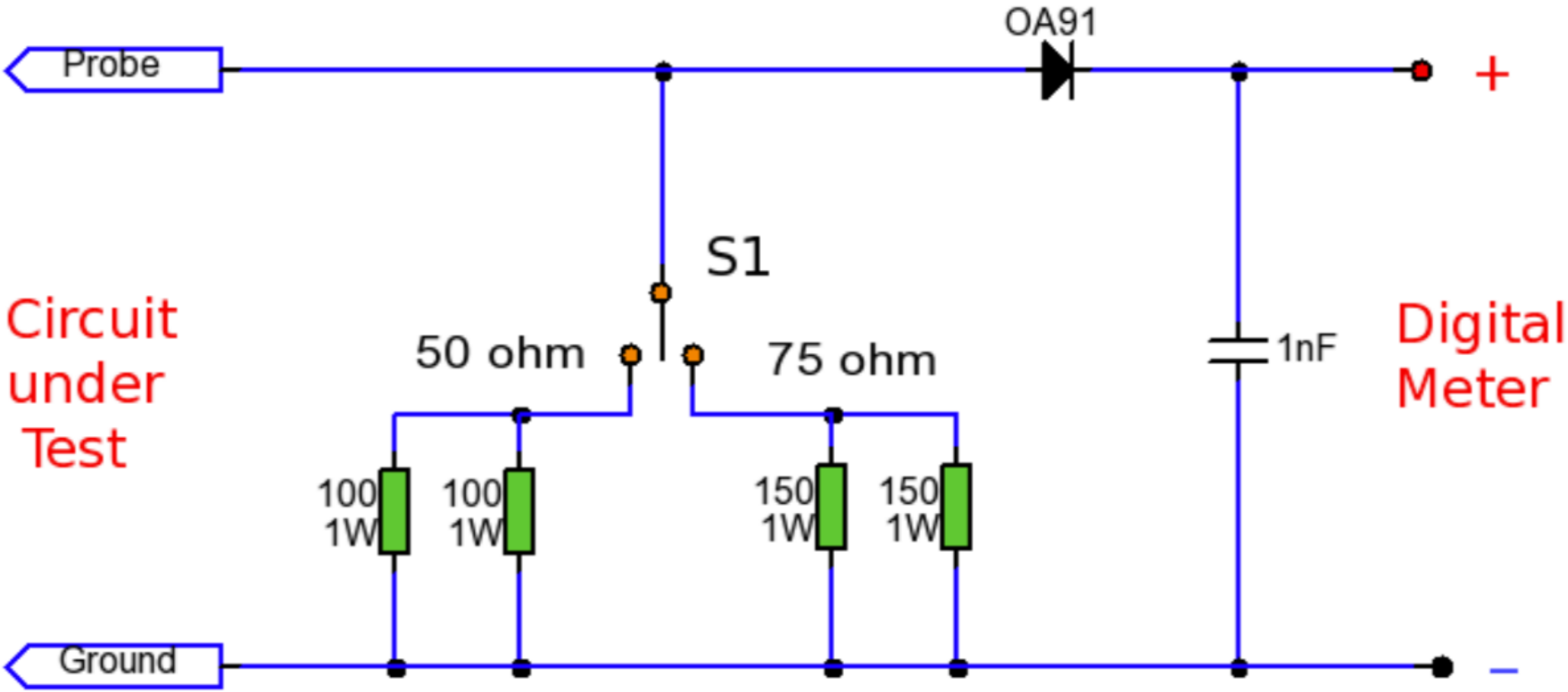
Probe
OA91
+
S1
Circuit
under
Test
50 ohm
75 ohm
1nF
Digital
Meter
100
1W
100
1W
150
1W
150
1W
Ground
–

N. TESLA.

APPARATUS FOR TRANSMITTING ELECTRICAL ENERGY.

APPLICATION FILED JAN. 18, 1902. RENEWED MAY 4, 1907.

1,119,732. Patented Dec. 1, 1914.

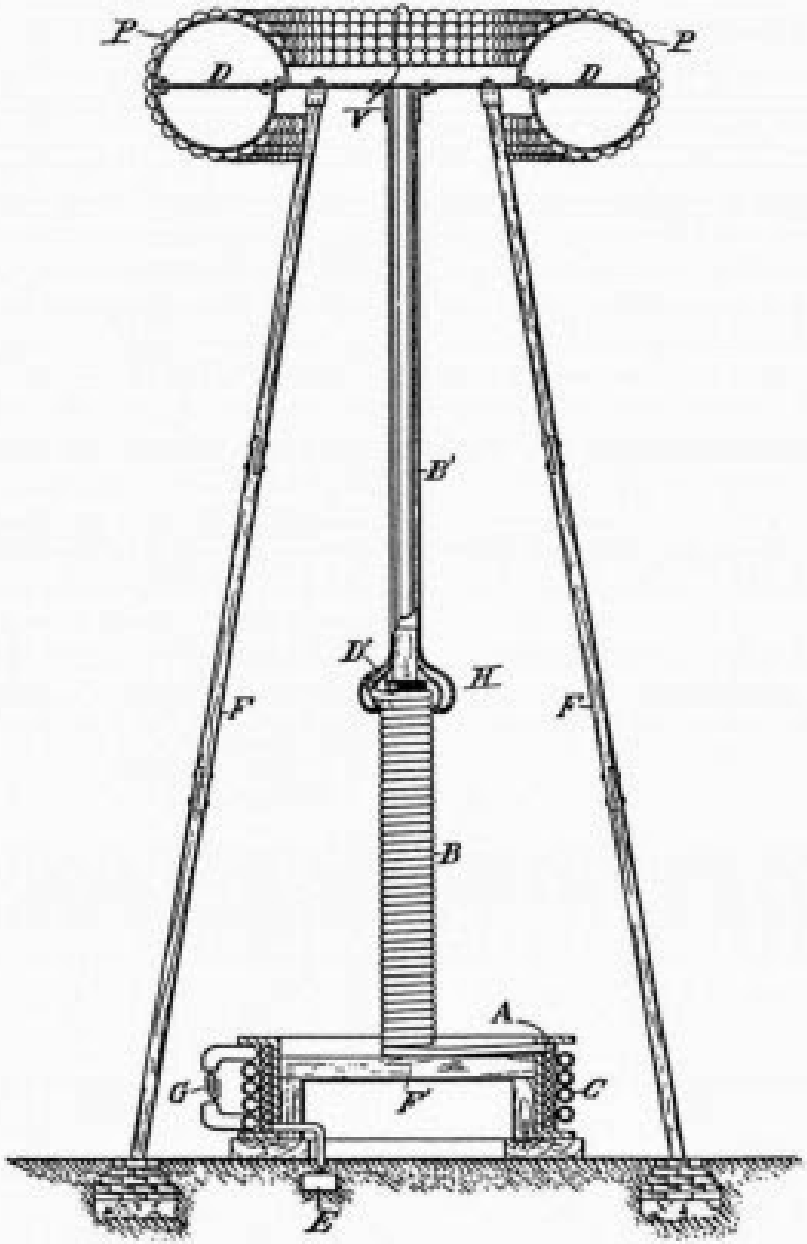

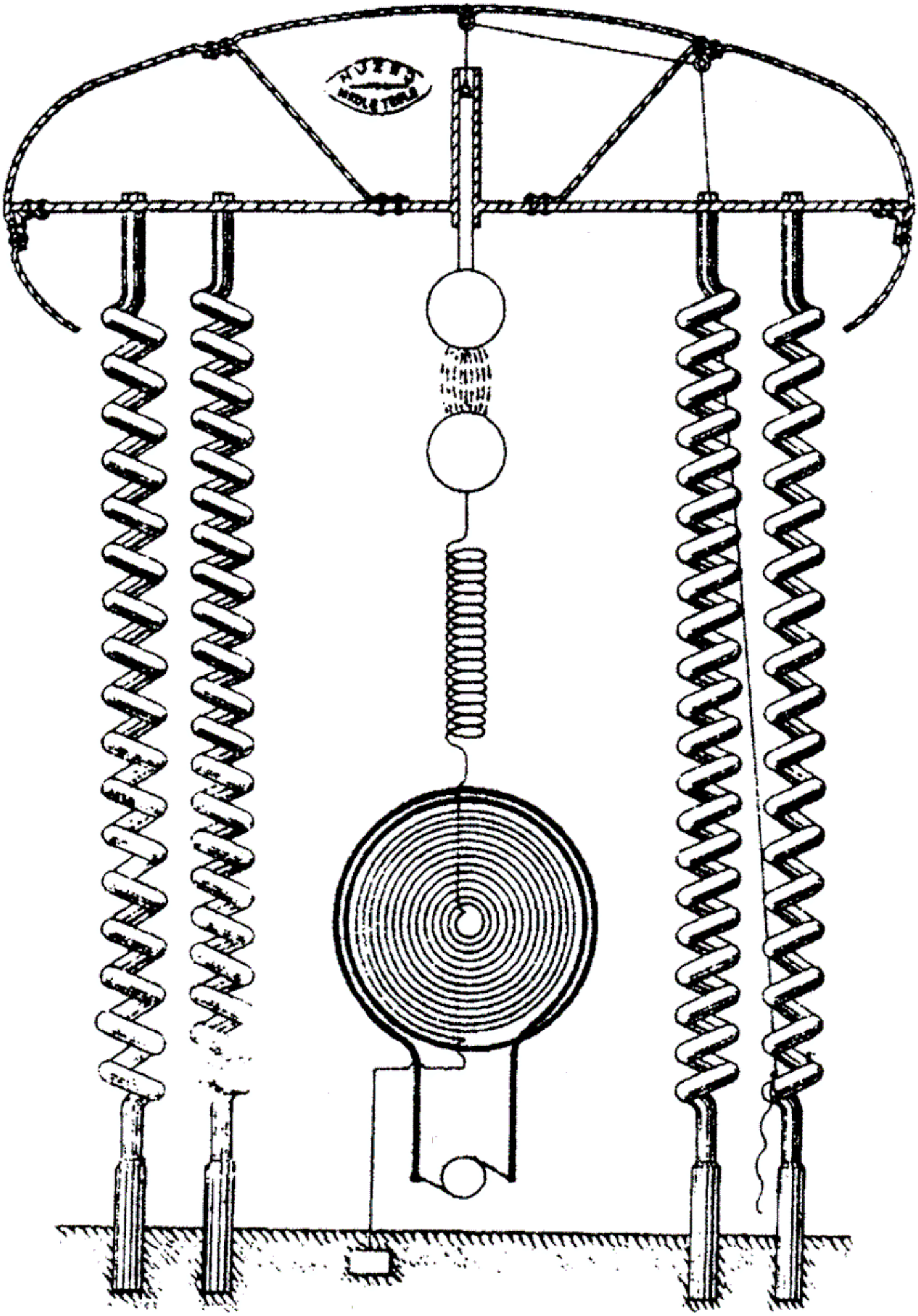

New York, Aug. 30th, 1901
46 & 48 East Houston Str.

Mr. Stanford White
160 Fifth Ave.
New York City

My Dear Stanford:
Many thanks for your suggestions. I am writing to Mr. Powell today. Perhaps he will be able to clear the land altogether.

I want you to understand that I went to the American Bridge Company simply because of my anxiety to have the work pushed through as fast as practicable. I am only too glad to follow your advice and beg you to consider yourself absolutely free in your choice and arrangements regarding this work.

Yours very sincerely,
N. Tesla

New York, Sep. 12th, 1901
46 & 48 East Houston Str.

Babcock & Wilcox Co.
85 Liberty Street
New York City

Gentlemen:
Under enclosure I forward sketch showing your two boilers as they will be placed in my building and their position relative to and exact distance from the chimney. The scale is ½ inch to a foot.

You will greatly oblige me by furnishing the drawings of the flues leading to the chimney and the position of the breech, as the builder cannot proceed without this information.

Yours very truly,
Encl.

Anyone familiar with the Wardenclyffe Tower knows it to have been a colossal structure. Yet, few realize that it was supposed to have been even larger. Although the exact figures are not revealed, Tesla must have drastically underestimated the cost of building his structure as is evidenced by the following response to White.

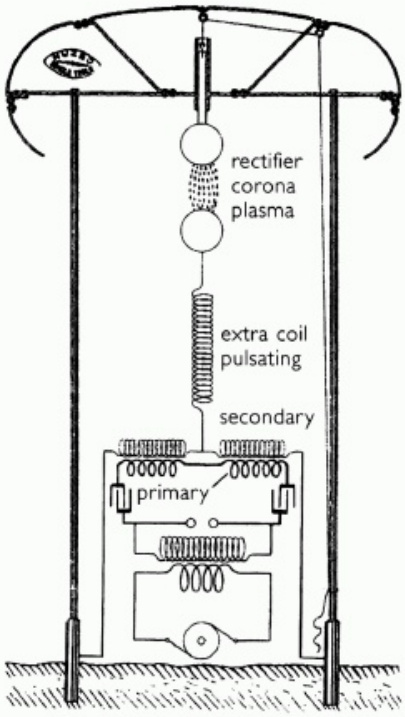

Fig. 5 Oscillating statically charged terminal.

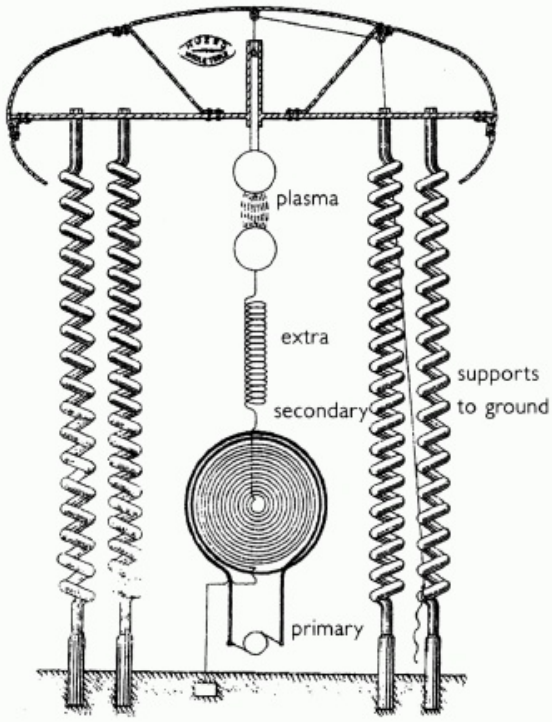

Fig. 6 Oscillating electrostatically charged dome.

N. TESLA

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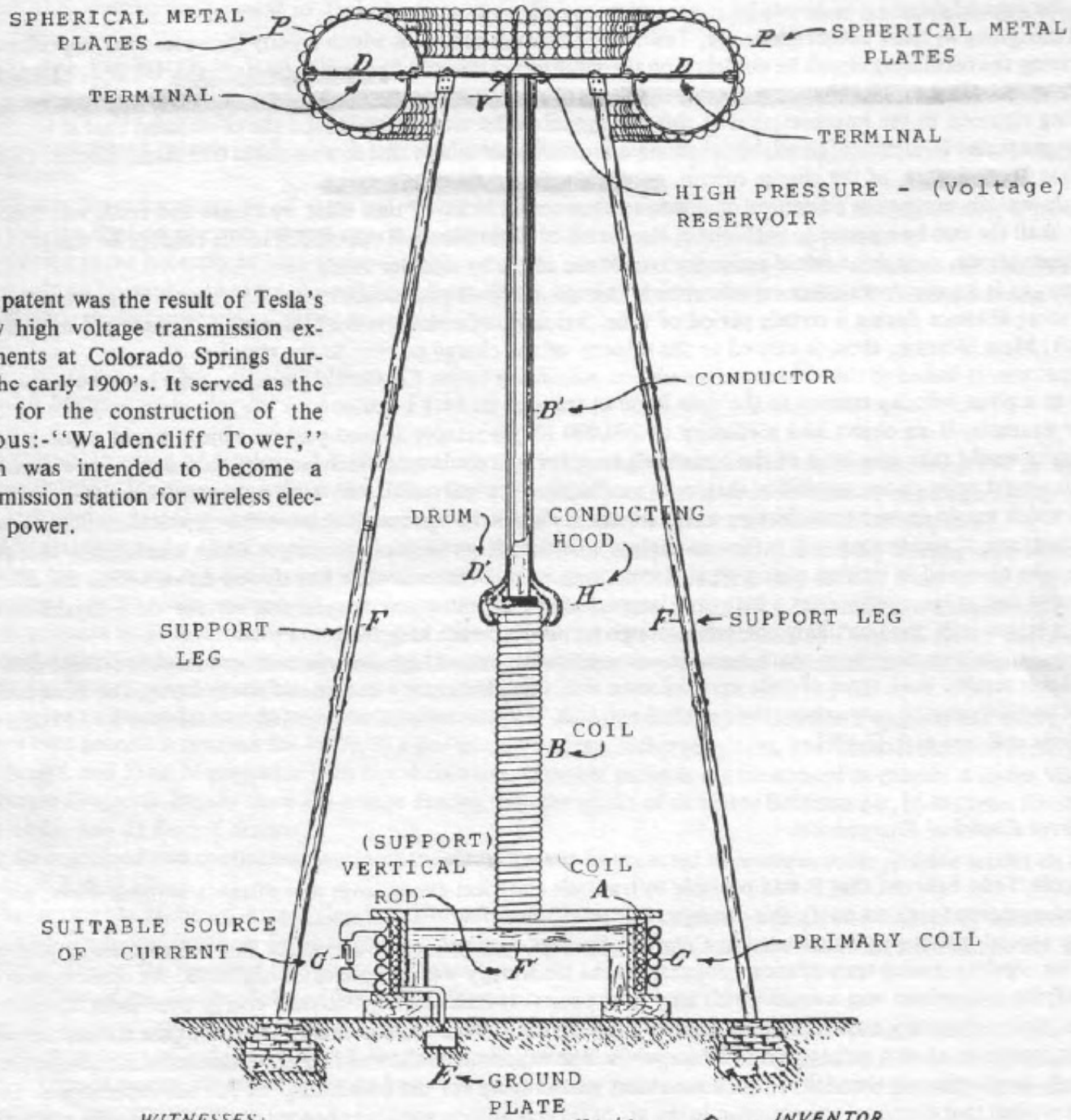

This patent was the result of Tesla's many high voltage transmission experiments at Colorado Springs during the early 1900's. It served as the basis for the construction of the famous:-"Waldencliff Tower," which was intended to become a transmission station for wireless electrical power.

WITNESSES:
H. Lawson Dyer
Benjamin Miller.

Nikola Tesla, INVENTOR,
BY Kerr, Page & Cooper,
his ATTORNEYS.

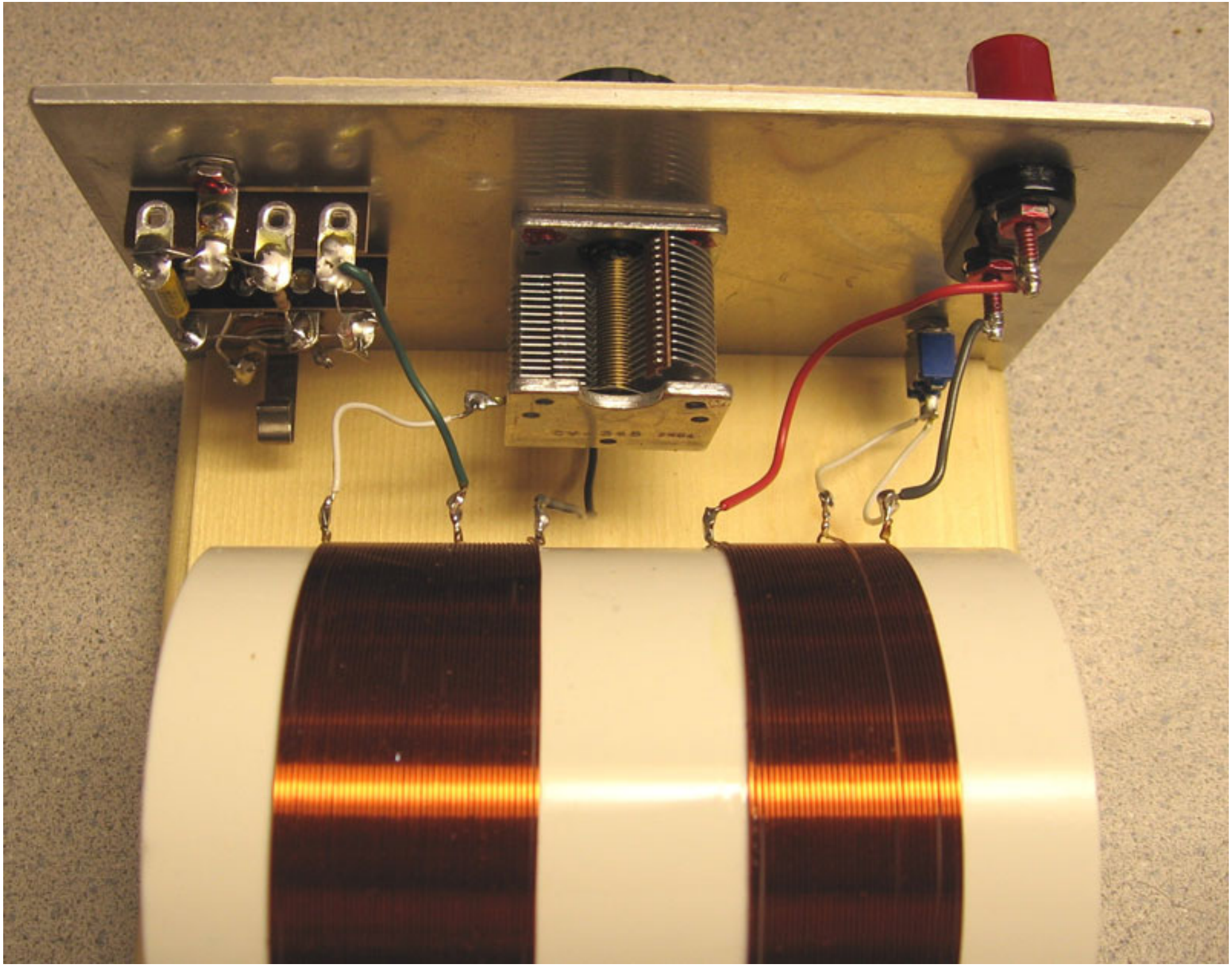

"HIGH SELECTIVITY CRYSTAL RADIO"
[WITH SHORT WAVE]

RGK. 2007

570KHZ → 2.5MHZ

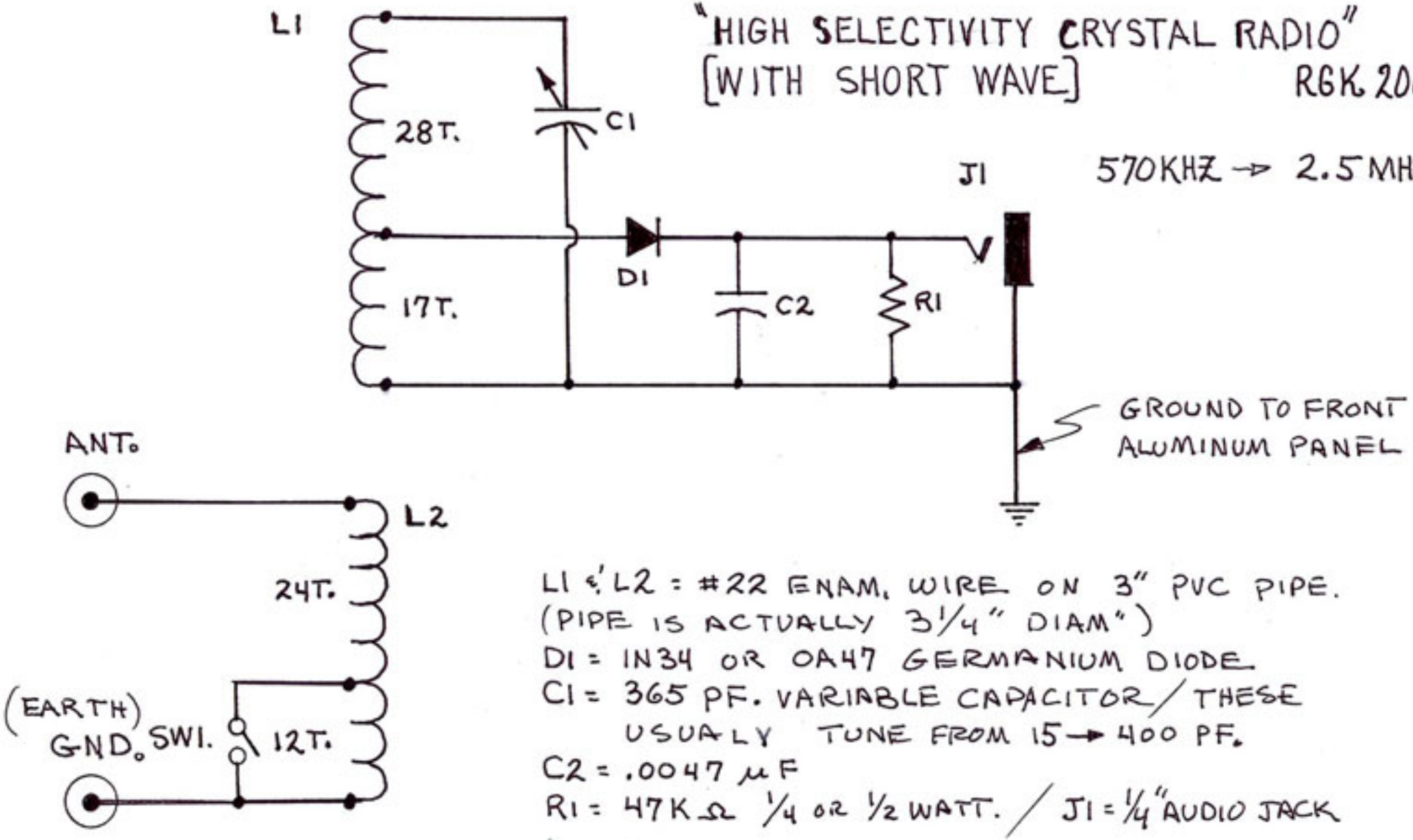

L1 & L2 = #22 ENAM. WIRE ON 3" PVC PIPE.
(PIPE IS ACTUALLY 3 1/4" DIAM")
D1 = 1N34 OR OA47 GERMANIUM DIODE
C1 = 365 PF. VARIABLE CAPACITOR / THESE USUALY TUNE FROM 15 → 400 PF.
C2 = .0047 μF
R1 = 47K Ω 1/4 OR 1/2 WATT. / J1 = 1/4" AUDIO JACK

[L1/L2 NOTES: L1 = 45 TURNS TOTAL & L2 = 36 TURNS TOTAL. THE SPACE BETWEEN L1 & L2 IS 1 1/16".]

SW1 = SPST. SWITCH / FOR ANTENNA MATCHING

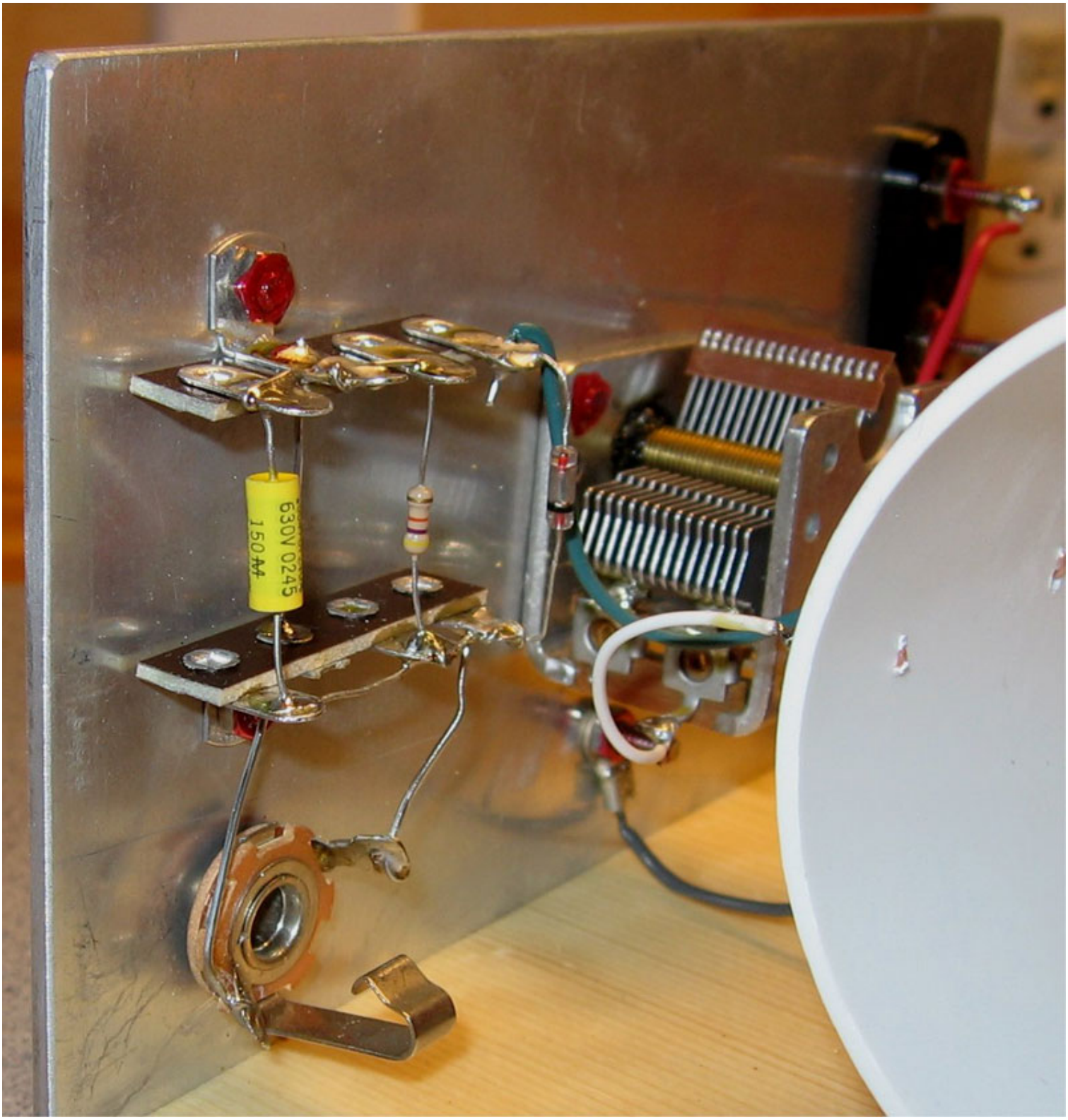
630V 0245
150 44

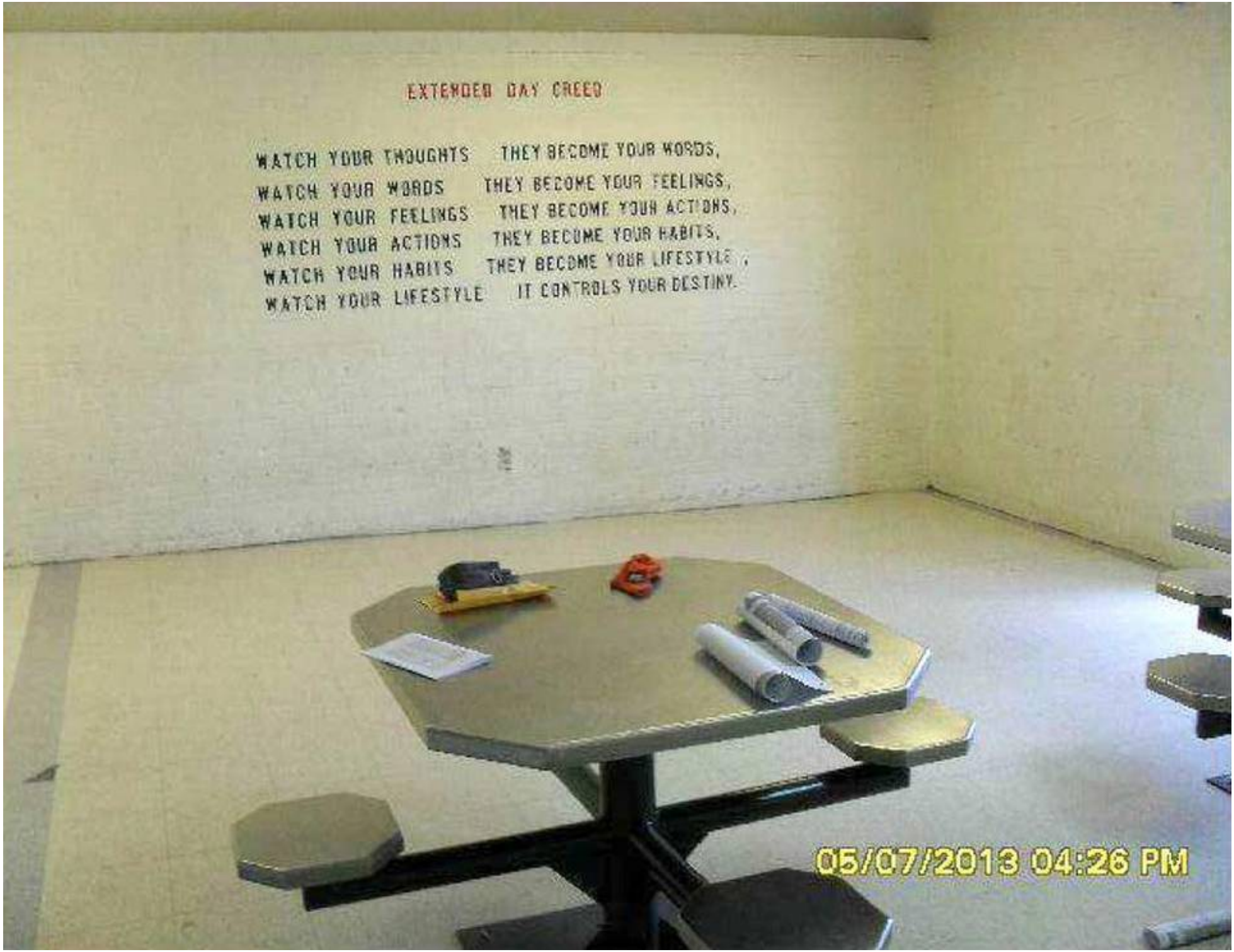
EXTENDED DAY CREED
WATCH YOUR THOUGHTS THEY BECOME YOUR WORDS,
WATCH YOUR WORDS THEY BECOME YOUR FEELINGS,
WATCH YOUR FEELINGS THEY BECOME YOUR ACTIONS,
WATCH YOUR ACTIONS THEY BECOME YOUR HABITS,
WATCH YOUR HABITS THEY BECOME YOUR LIFESTYLE,
WATCH YOUR LIFESTYLE IT CONTROLS YOUR DESTINY.
05/07/2013 04:26 PM

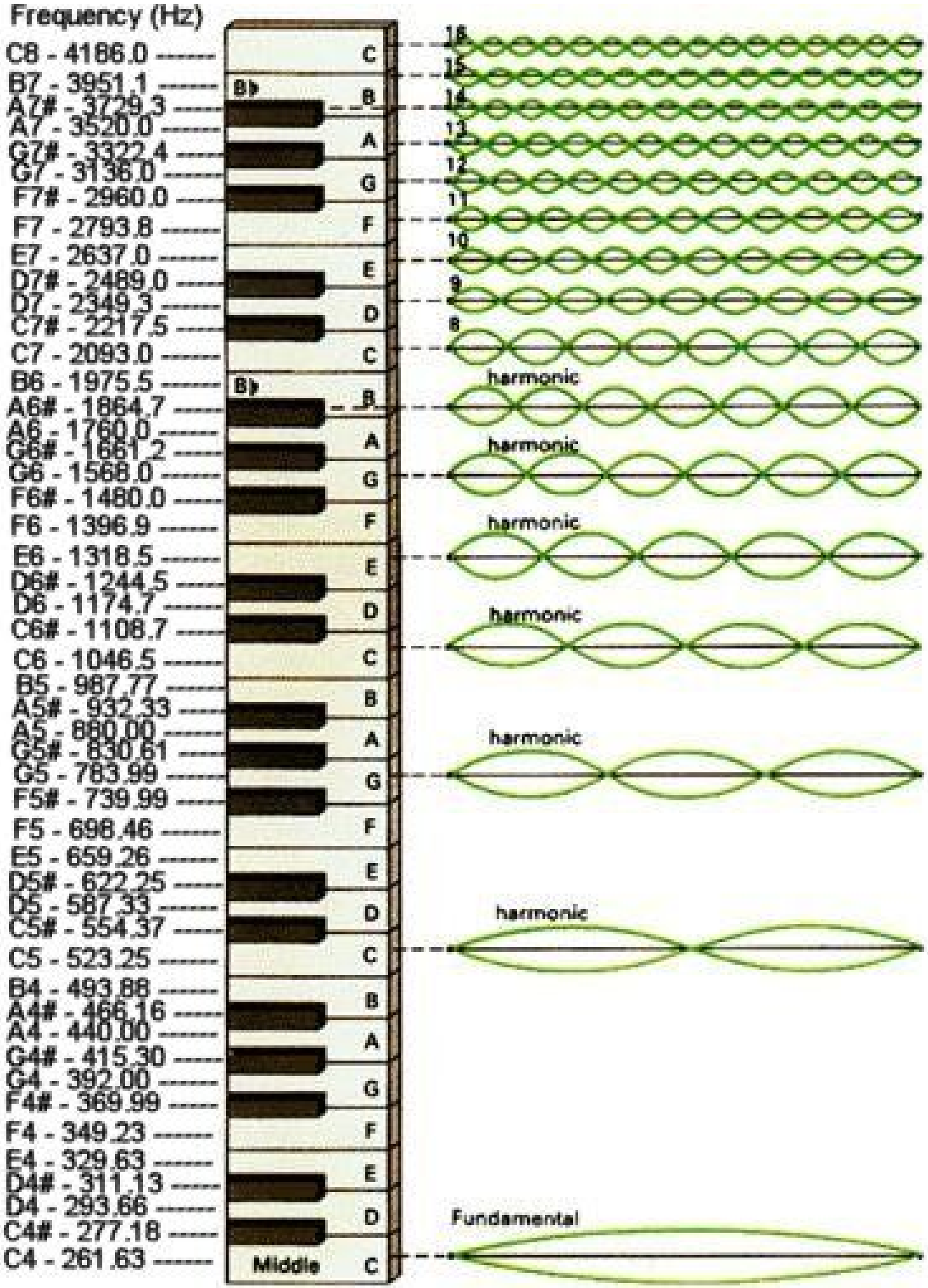
Frequency (Hz)
C8 - 4186.0
B7 - 3951.1
A7# - 3729.3
A7 - 3520.0
G7# - 3322.4
G7 - 3136.0
F7# - 2960.0
F7 - 2793.8
E7 - 2637.0
D7# - 2489.0
D7 - 2349.3
C7# - 2217.5
C7 - 2093.0
B6 - 1975.5
A6# - 1864.7
A6 - 1760.0
G6# - 1661.2
G6 - 1568.0
F6# - 1480.0
F6 - 1396.9
E6 - 1318.5
D6# - 1244.5
D6 - 1174.7
C6# - 1108.7
C6 - 1046.5
B5 - 987.77
A5# - 932.33
A5 - 880.00
G5# - 830.61
G5 - 783.99
F5# - 739.99
F5 - 698.46
E5 - 659.26
D5# - 622.25
D5 - 587.33
C5# - 554.37
C5 - 523.25
B4 - 493.88
A4# - 466.16
A4 - 440.00
G4# - 415.30
G4 - 392.00
F4# - 369.99
F4 - 349.23
E4 - 329.63
D4# - 311.13
D4 - 293.66
C4# - 277.18
C4 - 261.63
B♭
B♭
Middle
C
B
A
G
F
E
D
C
B
A
G
F
E
D
C
B
A
G
F
E
D
C
B
A
G
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E
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8
harmonic
harmonic
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harmonic
harmonic
Fundamental

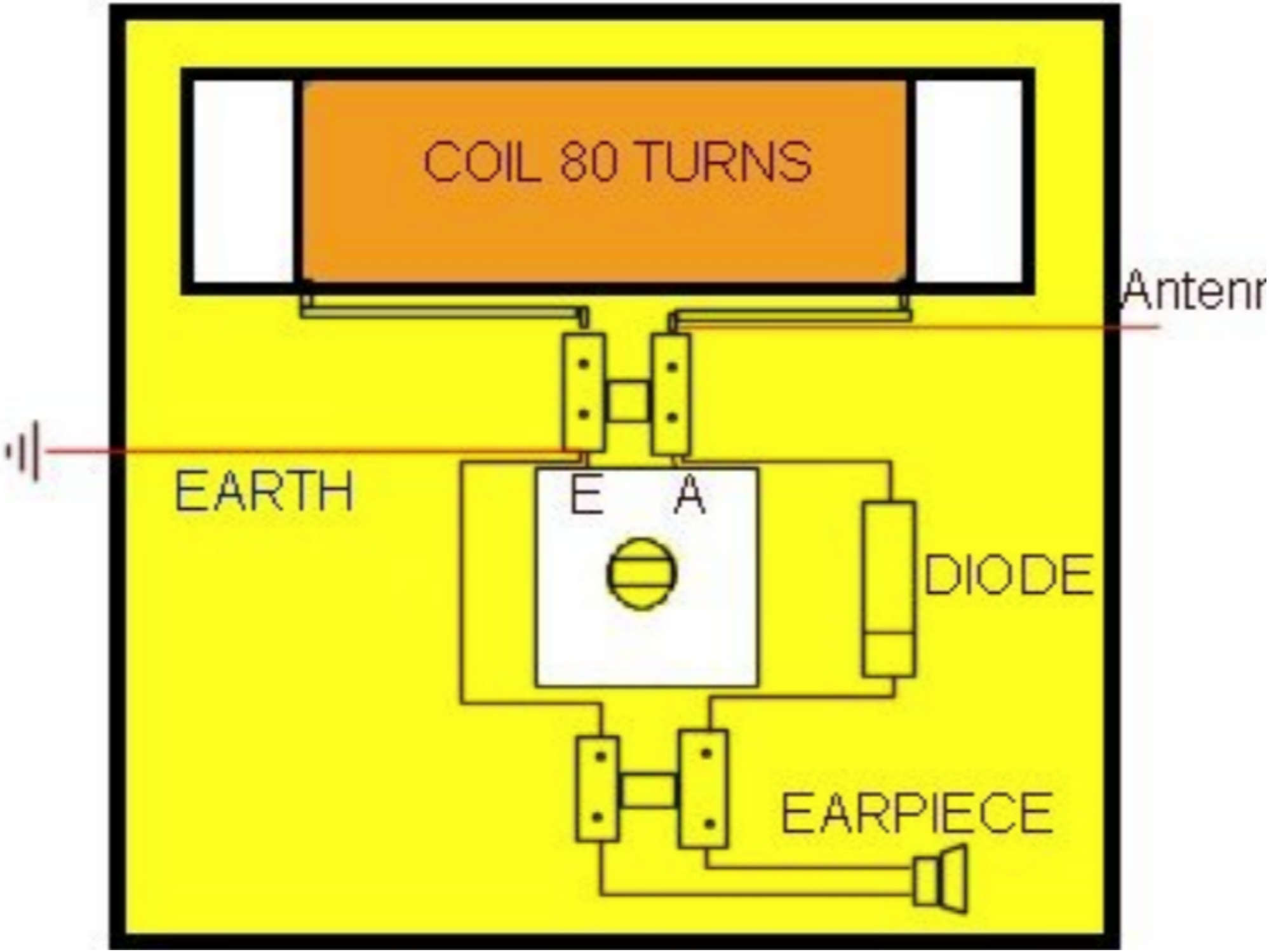
COIL 80 TURNS
Antenn
EARTH
E
A
DIODE
EARPIECE

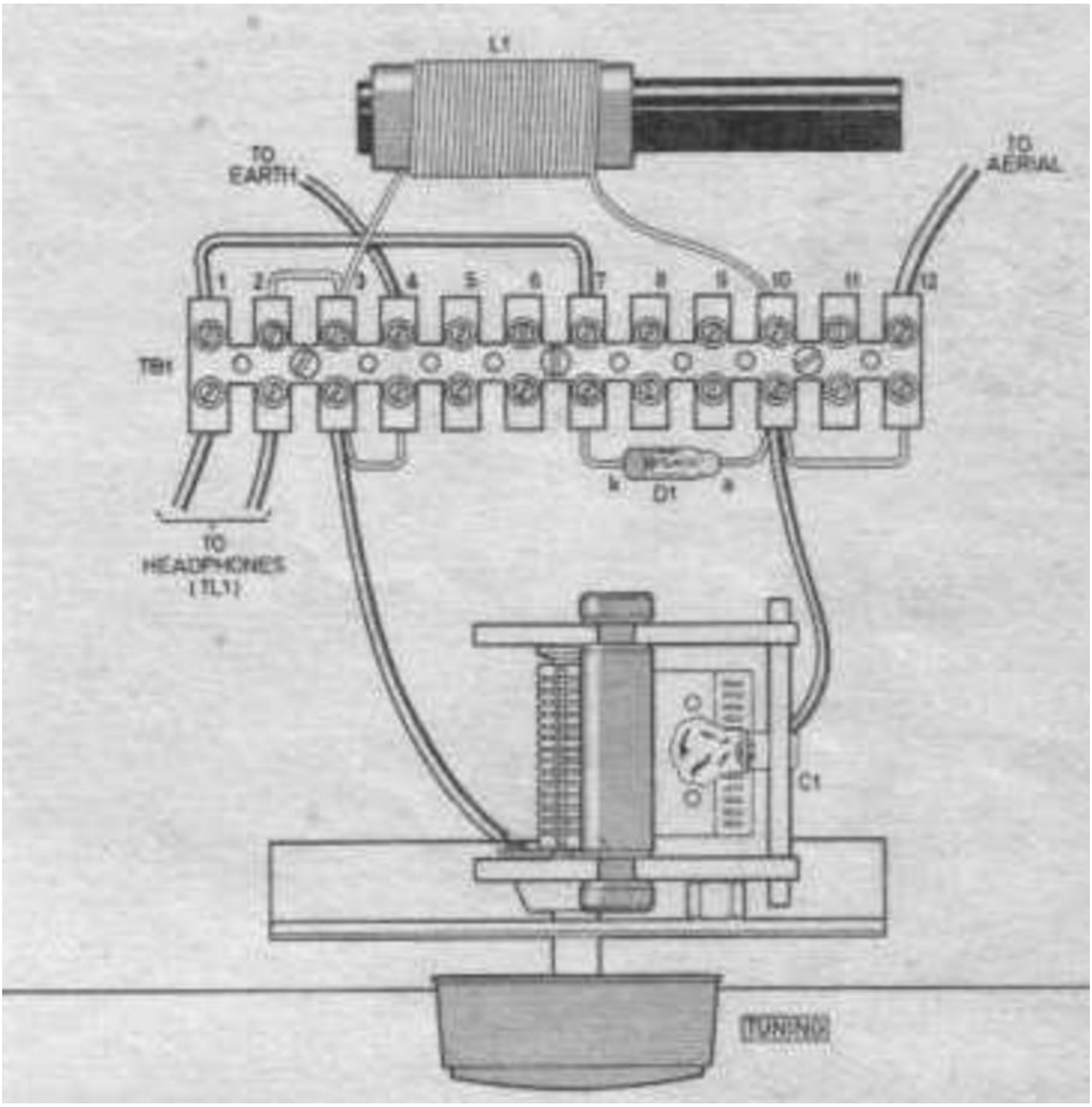
L1
TO EARTH
TO AERIAL
1
2
3
4
5
6
7
8
9
10
11
12
TB1
k
D1
a
TO HEADPHONES (TL1)
C1
TUNING

RF Energy Harvesting for INTERNET OF THINGS

K.J. Vinoy

ECE Dept
Indian Institute of Science
Bangalore 560012

ECE Dept, Indian Institute of Science

- **Vision Statement:** Excellence in Theoretical and Experimental Research in Communications, Signal Processing, Microelectronics and RF/Photonics.
- **Faculty: 24;** Fellows of IEEE: 4; Fellows of INAE: 8
- Active in Publications: Books, Book Chapters, Journal & Conference Papers; Patents; Standardization etc
- Collaborative research

People
Masters Students
[ME, MSc→ Mtech, Mtech(Res)]
PhD Students
Project Staff

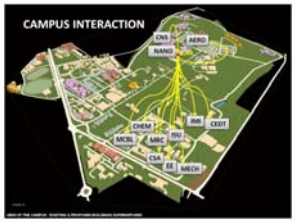

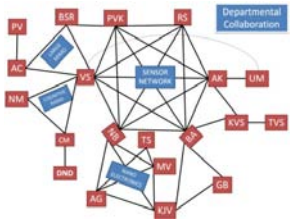

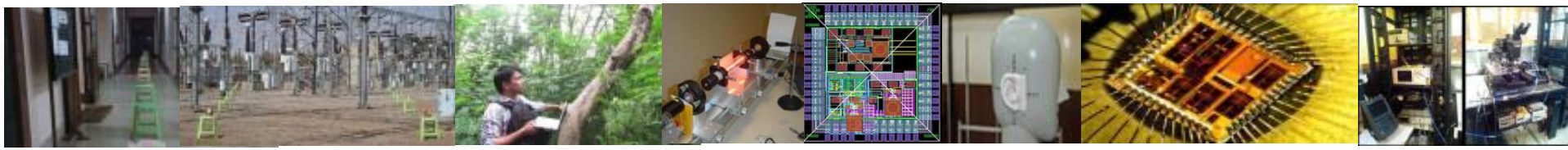

ECE: Microwave Engineering

K.J. Vinoy

- Low-Actuation Voltage Capacitive RF MEMS Switch (<10V)
  - Low-complexity fabrication process to enhance process yield
  - High reliability: no failure even up to 10 million cycles of operation tested
- Meso-scale Electrostatic Phase Shifter on microwave Laminate (MEPL)
  - Utilizes modern printed circuit board fabrication technology.
  - X-band monolithic antenna array system on the microwave laminate board demonstrated.

- Wideband group delay engineering in RF circuits for radar, medical imaging, and spectrum sensing.
  - Demonstration uses two stage All – Pass Networks; can be extended over multiple stages to obtain a higher bandwidth and/or higher group delay slope.
- RF energy harvesting circuits
  - Integrated with RF transmitters and sensors for practical IoT nodes
  - High efficiency RF-DC converter which can operate at input power of -20dBm (10µW) at 2.4GHz using UMC 130nm process MOSFETs.
- FEM based algorithms for Electromagnetic circuits & components (periodic structures such as metamaterials)
  - Fast computation of electromagnetic propagation characteristics
  - Especially suited for evaluation of processes uncertainties

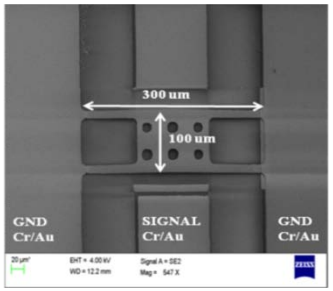

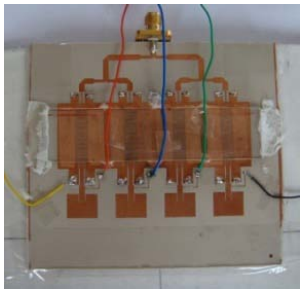

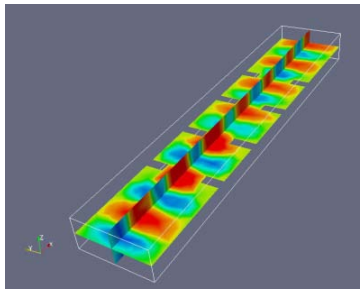

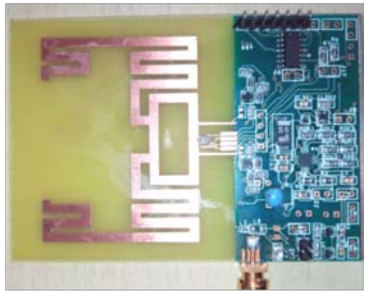

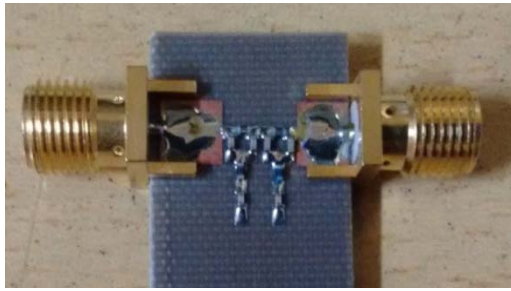

Setting the stage….

- **Introduction**
  - **Wireless Power Transfer**
    - **Energy Harvesting**
  - **Internet of Things**
- Highlights of Recent Development (Hardware)
  - Powering wireless terminals
  - RFID with integrated sensors

Ongoing Research Challenges

Wireless Power Transfer (WPT)

- Indicates transfer of electric energy remotely

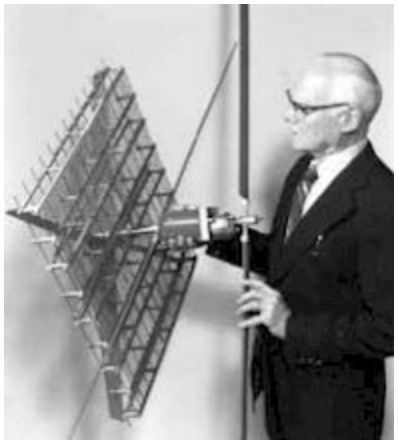

- WPT has a long history!!
  - Tesla demonstrated it in 1899 by wirelessly powering fluorescent lamps 40 kms away from the power source.
  - Had multiple patents in early 1900s.

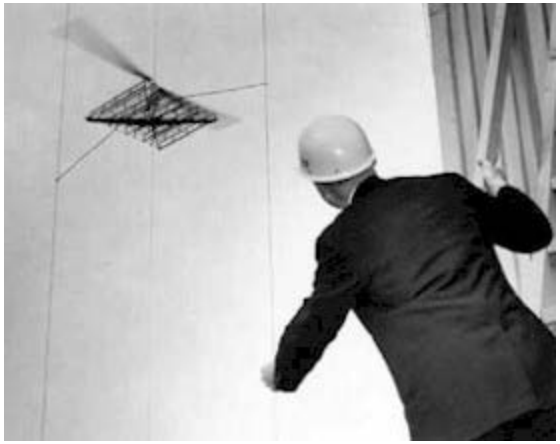

- In 1960s W.C. Brown coined the term Rectenna, which he used to directly converts incoming microwaves to DC.
  - He demonstrated its ability to power a helicopter solely through microwaves for 10 hours continuously.

- These demonstrations involved dedicated sources with **large power to transmit over long distances**.

http://mainland.cctt.org/istf2008/brown.asp

SSPS

- Space Solar Power Satellites

- WPT is widely investigated for putting **solar power generating satellites** into space and transmitting power to Earth stations. (Mainly in Japan)

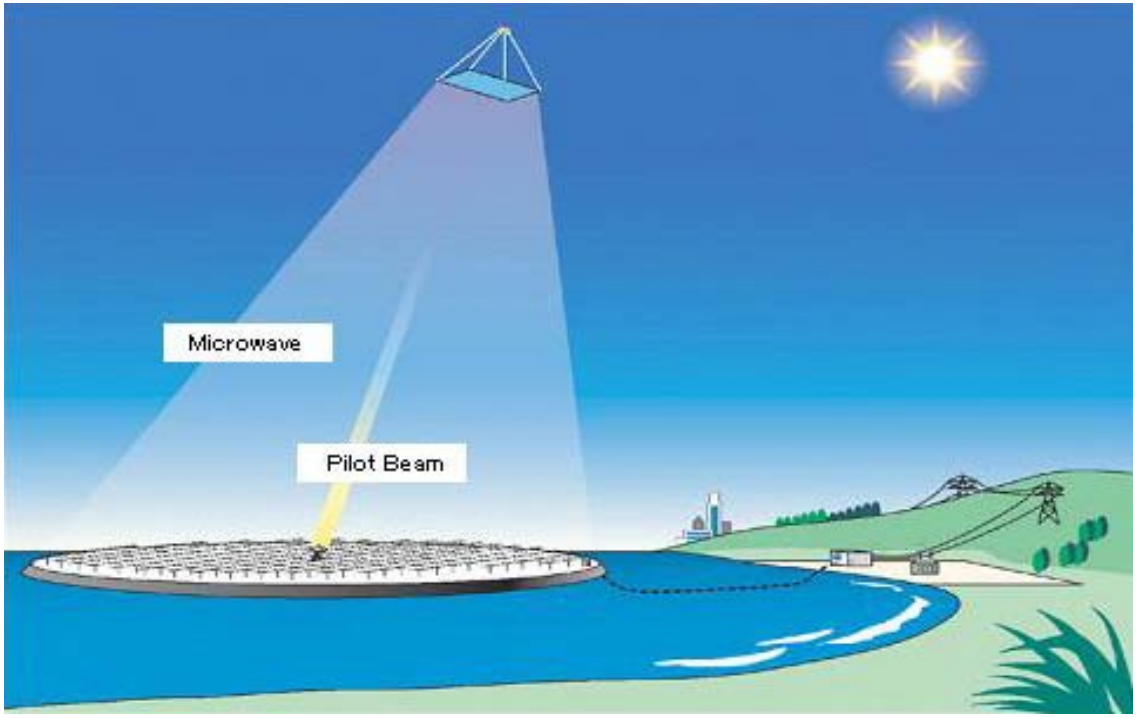

http://www.jspacesystems.or.jp/en_project_ssps/

Near field Wireless Power Transfer

- Recent demonstration by MIT to transfer high RF power (Watts) transferred across meters.
- Resonant coils are used
- Typically at 100 kHz to 10's of MHz
- Many new applications emerged

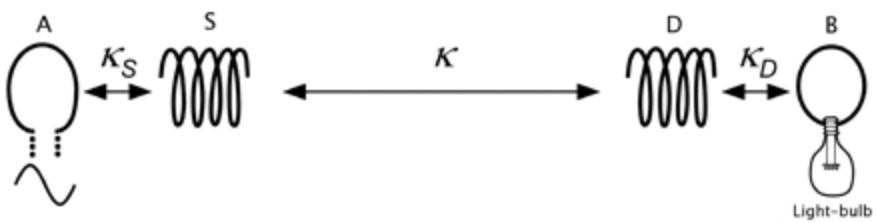

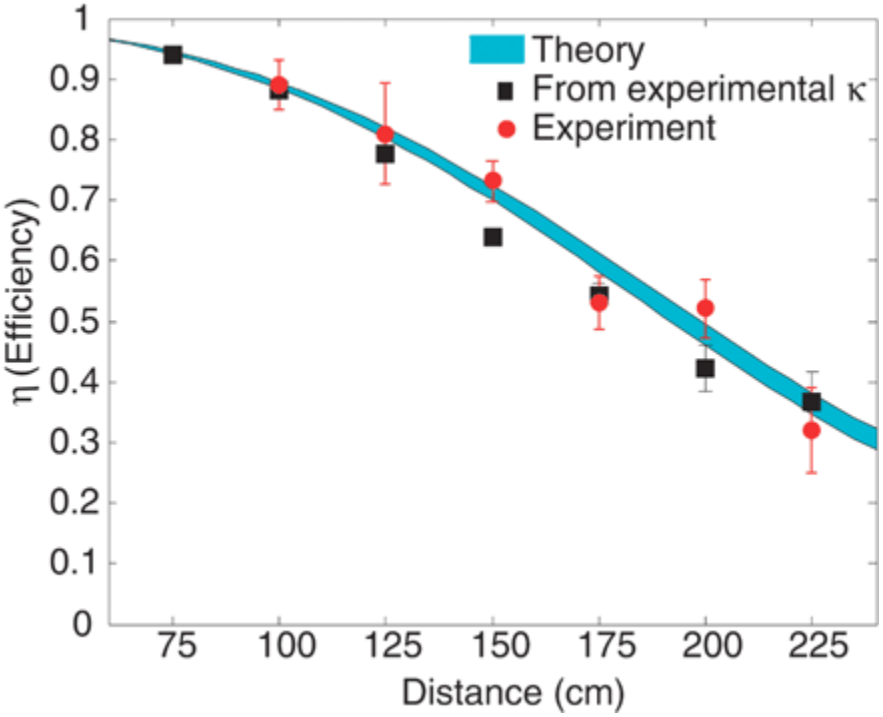

André Kurs et al, Wireless Power Transfer via Strongly Coupled Magnetic Resonances , Science, Vol. 317 no. 5834 pp. 83-86. 6 July 2007.

System Schematic Qi

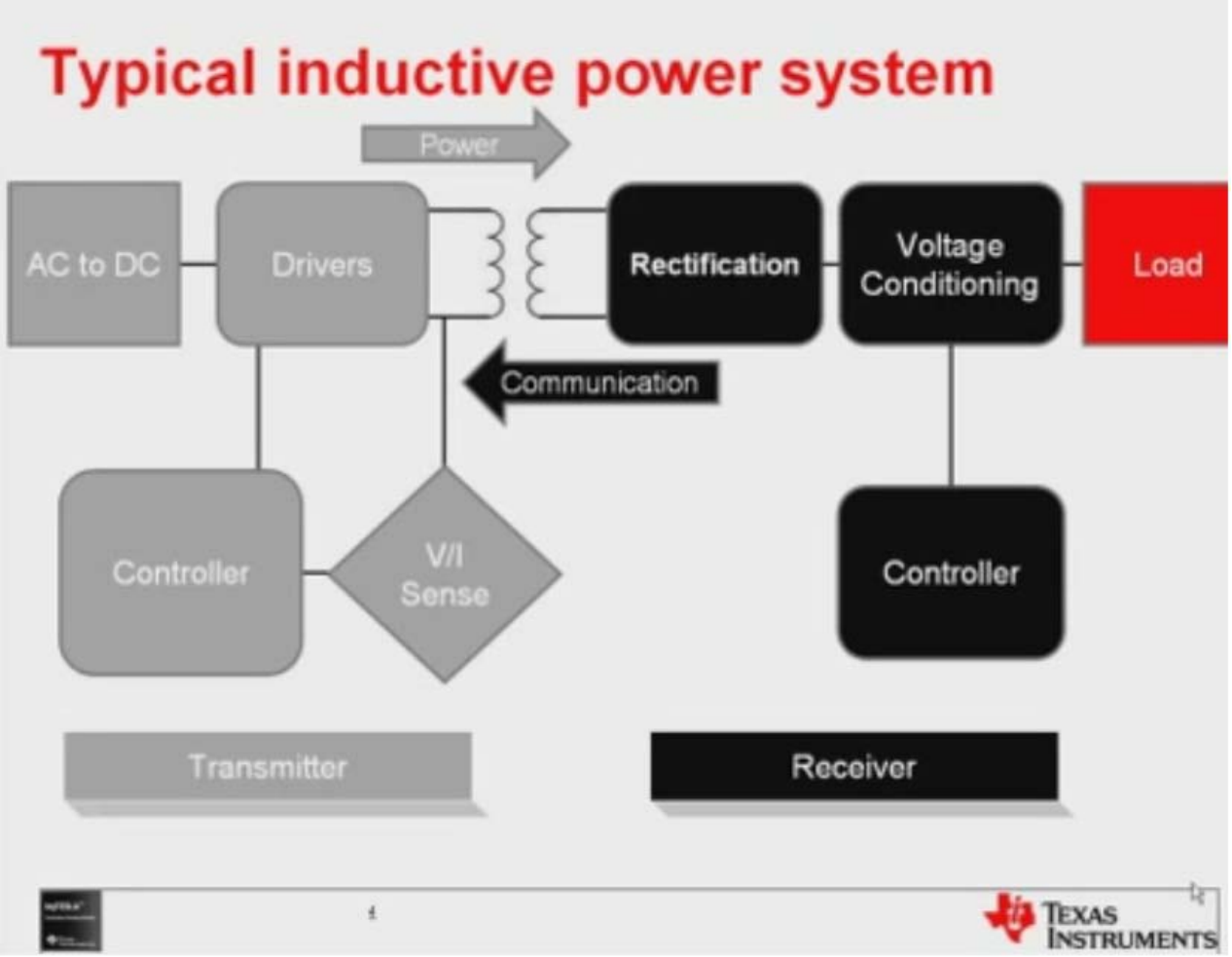

Source: Texas Instruments Qi Development kit

Far → Near in WPT

- Free space loss factor is a major bottleneck for power transfer at large distances

- Short distance/ Near field options
  - MIT demonstration (2007)
  - Qi Standard
  - Phone charging solutions
  - Vehicles running on wireless power

- Two extremes in WPT
  - mW ← → MW
  - mm ← → 1000s km
  - 100kHz ← → 2.4/5.8GHz
  - 10cm x 10cm ← → km x km
  - Commercial vs bluesky

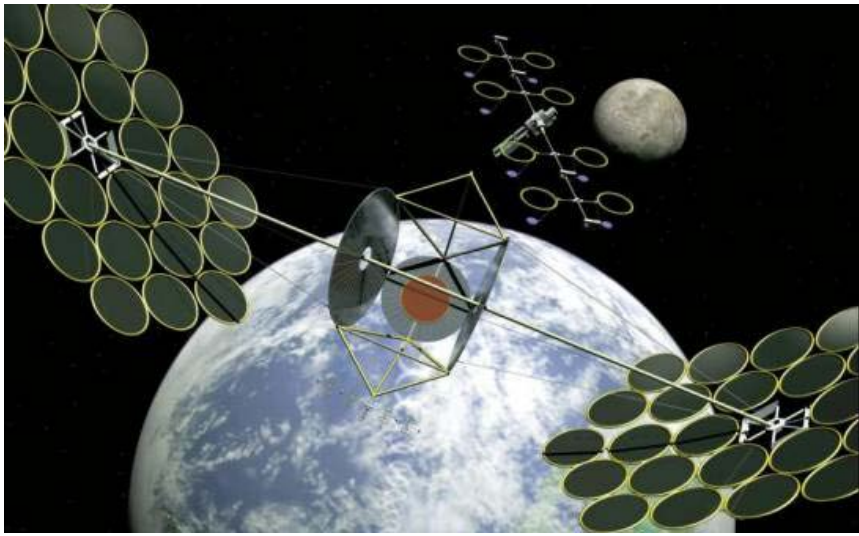

Far Field Transfer of RF Energy

- Focus of this talk
- Applications: RFID tags, Wireless Sensor Network nodes, biomedical equipment, home automation and structural monitoring can benefit from RF energy harvesting.
- Block diagram and a design example:

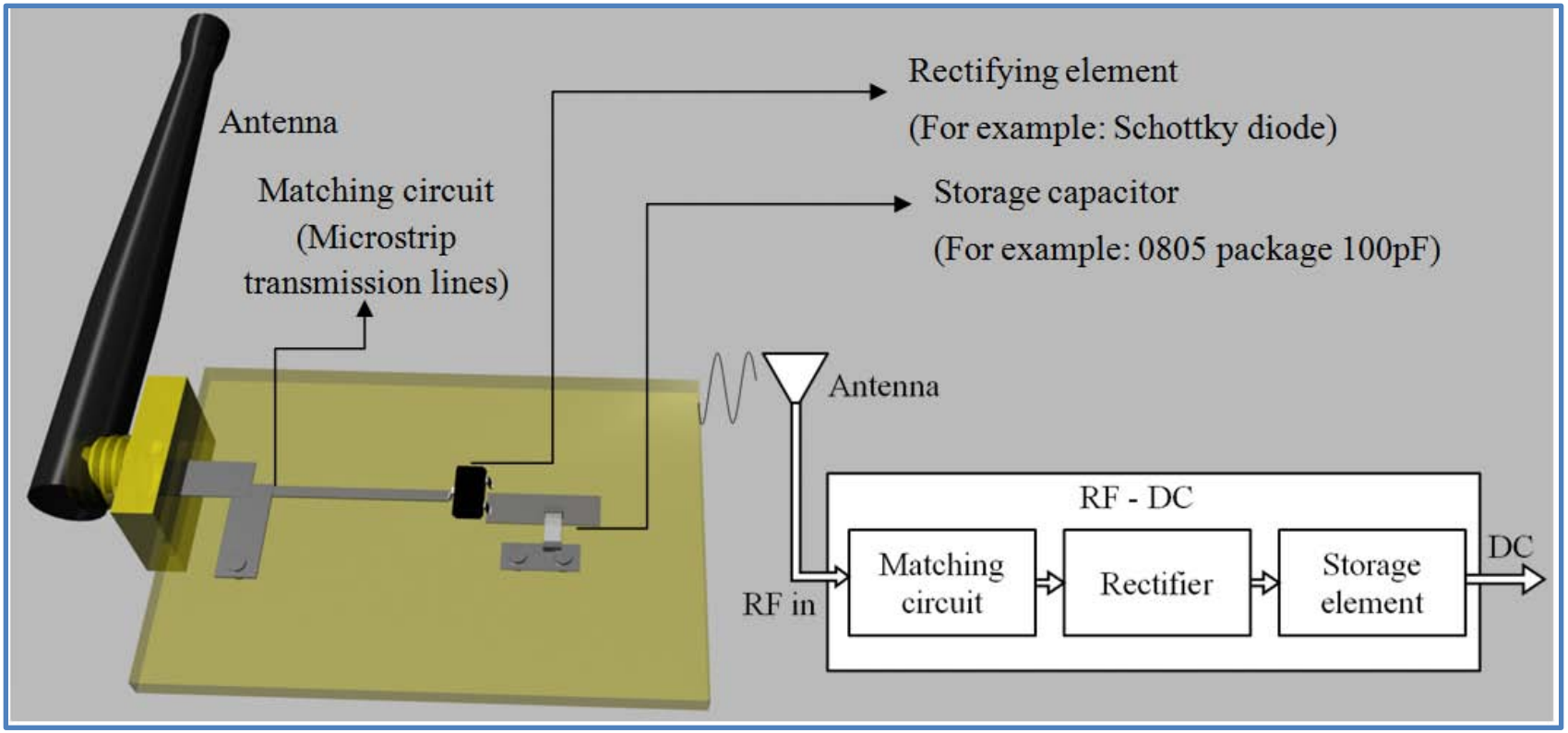

A New Paradigm: Internet of Things (IoT)

- IoT refers to uniquely identifiable objects and their virtual representations in an Internet-like structure.

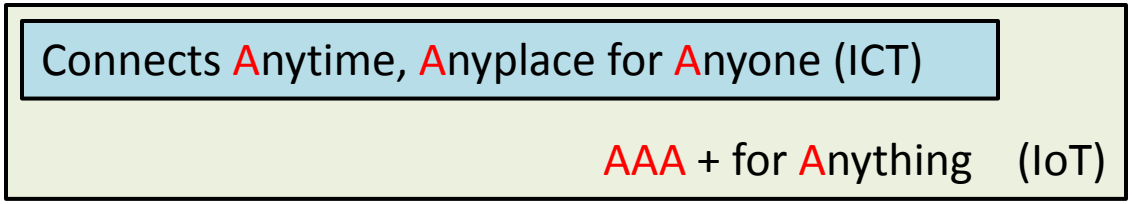

- IoT is a scheme for connecting things: sensors, actuators, and other smart technologies, thus enabling person-to-object and object-to-object communications.

- **Continuous availability of power is crucial for their deployment**

IoT Applications

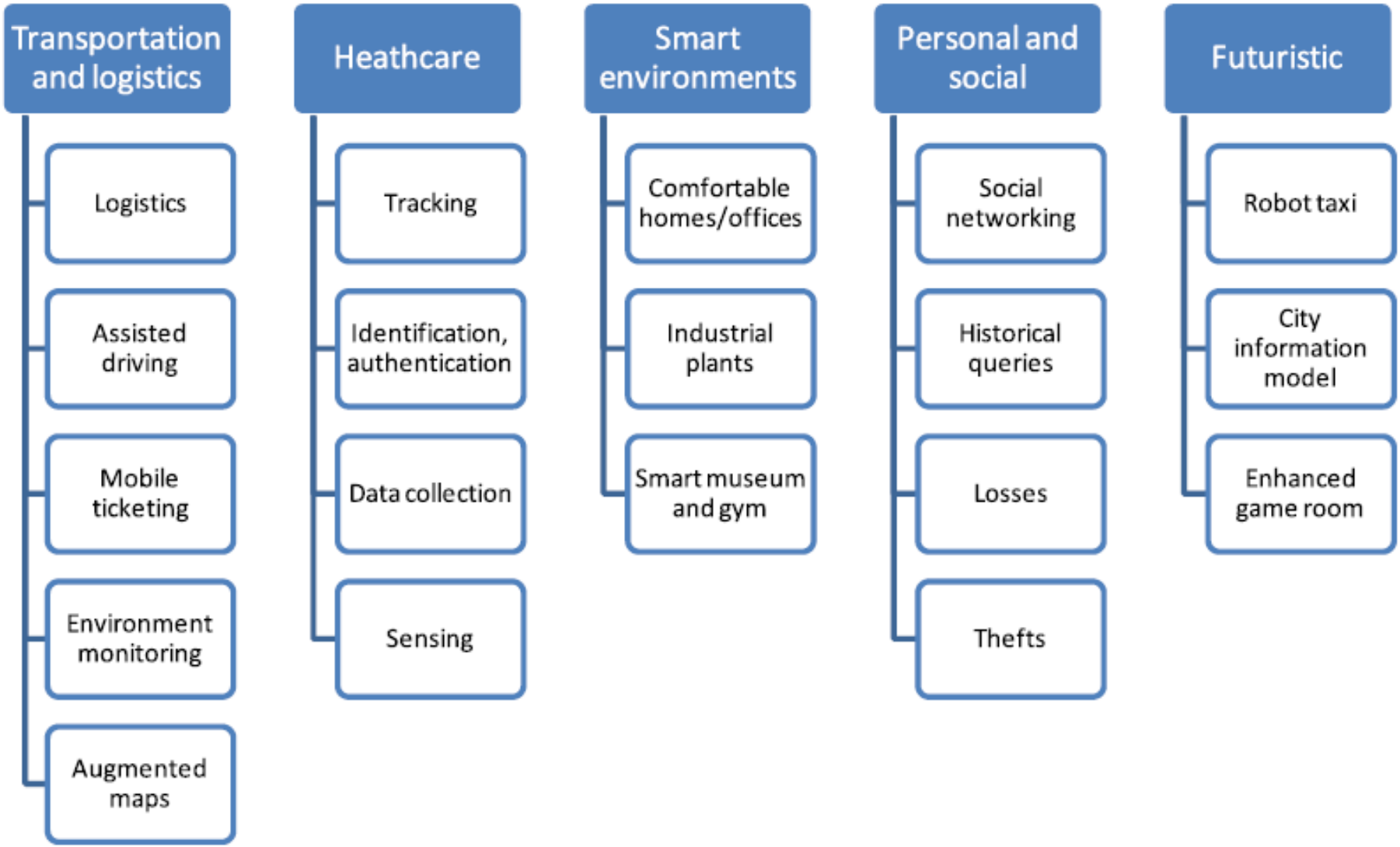

L. Atzori , A. Iera, G. Morabito, The Internet of Things: A survey Computer Networks 54 (2010) 2787–2805

Comparison of different wireless protocols

Today, a lot can be done at low power!!

Characteristics of key 2.4GHz ISM Band Radios studied :

	BLE	ANT	Zigbee	WLAN
Topologies	P2P , Star	P2P , Star, tree, mesh	P2P , Star, mesh	P2P , Star
Modulation	GFSK	GFSK	OQPSK	DSSS (802.11b)
Max data rate	1Mbps	12.8-60 Kbps	250Kbs (@2.4Ghz)	1- 11Mbps (802.11b)
Throughput	305 kbps	20Kbps	100Kbps	6Mbps (802.11b)
Range (in m)	10-100(0-10dBm)	30 (@ 0dBm)	10-100 (0-20dBm)	100+(20dBm)
Max nodes in piconet	7	65533	Star-65536	32-64
Battery life	1-2 years (coin cell)	1-2years (coin cell)	100-1000 days	0.5-5days

Key Aspects :

BLE is robust and has lowest power consumption but cannot natively form mesh networks,

Zigbee can support large mesh networks, power consumption is higher than BLE and throughput is lower: It is suitable for low data rate, low power, large size networks.

WLAN is primarily suitable for transferring bulk data at high speeds, Not suitable for low power applications.

Power Requirements in Common WSN

	Crossbow MICAz	Intel IMote2	Jennic JN5139
Radio standard	IEEE802.15.4/ZigBee	IEEE802.15.4	IEEE802.15.4/ZigBee
Typical range	100m (outdoor), 30m (indoor)	30m	1 km
Data rate (kbps)	250 kbps	250 kbps	250 kbps
Sleep mode (deep sleep)	15 μA	390 μA	2.8 μA (1.6μA)
Processor only	8mA active mode	31–53mA*	2.7+0.325mA/MHz
RX	19.7mA	44mA	34mA
TX	17.4mA (+0dbm)	44mA	34mA (+3 dBm)
Supply voltage (minimum)	2.7V	3.2V	2.7V
Average	2.8mW	12mW	3mW

JM. Gilbert* F. Balouchi, Comparison of Energy Harvesting Systems for Wireless Sensor Networks, International Journal of Automation and Computing 05(4), October 2008, 334-347

	Jennic JN5148	TI- CC430	BLE	Zarlink ZL70250
Active mode current at 16MHz [mA]	6	4	6.7	3.2
Deep sleep current [nA]	100	1000	400	20
Transmission current [mA]@Tx-power [dBm]	15@2.5	18@0	36@2	2@-10
Transmit frequency	2.4 GHz	2.4 GHz	2.4 GHz	868 MHz
Wakeup time [ms]	1	3	0.12	0.16
Energy consumption for a transmission cycle of 2ms [µJ]	183	300	196	32
Power supply voltage [V]	2.2 – 3.6	1.8 -3.6	2-3.6	1.2 – 1.8

In perspective

- Energy requirements in different devices/systems
- 6 orders of magnitude variation!!!

- Energy requirements in WSN
  - Depends on the complexity/ standard/ range
  - eg 90 μW to power a pulse oxymeter sensor, to process data and to transmit them at intervals of 15 s

Device type	Power consumption
Smartphone	1W
MP3 decoder chip	58 mW
Hearing aid	1 mW
Wireless sensor node	100 μW*
RF receiver chip	24 mW
GPS receiver chip	15 mW
6D motion sensor	14.4 mW
Cell phone (standby)	8.1 mW
PPG sensor	1.473 mW
Humidity	1 mW
Pressure	0.5 mW
3D accelerometer	0.324 mW
Temperature	27 μW
Cardiac pacemaker	50 μW
Wristwatch	7 μW
Memory R/W	2.17 μW
A-D conversion	1 μW

J Yun, S. Patel, M.Reynolds, G. Abowd "A Quantitative Investigation of Inertial Power Harvesting for Human-powered Devices," UbiComp'08, September 21-24, 2008, Seoul, Korea.

R.J.M. Vullers, et.al, Micropower energy harvesting, Solid-State Electronics 53 (2009) 684–693

Power Density from Various Harvesters

Ambient RF	< 1 μW/cm^2
Ambient light	100 mW/cm^2 (directed toward bright sun)
	100 μW/cm^2 (illuminated office)
Thermoelectric	60 μW/cm^2
Vibrational	4 μW/cm^3 (human motion ~Hz)
microgenerators	800 μW/cm^3 (machines ~kHz)
Ambient airflow	1 mW/cm^2
Push buttons	50 μJ/N
Hand generators	30 W/kg
Heel strike	Up tp 7 W for 1 cm deflection

Power requirements in conventional sensor network nodes may not be met by harvesting alone!

J Yun, S. Patel, M.Reynolds, G. Abowd "A Quantitative Investigation of Inertial Power Harvesting for Human-powered Devices," UbiComp'08, September 21-24, 2008, Seoul, Korea.

Electromagnetic: Solar → RF

- PV is a good source of energy. Recall,

Ambient light	100 mW/cm^2 (directed toward bright sun)
	100 μW/cm^2 (illuminated office)

- However, it light is not always available.
  - At night
  - Specific scenarios: in a closed chamber, or mine.

- RF is an alternative
  - Unlike others, RF sources may be ambient or intentional.
  - Ambient sources such as base stations or broadcast stations
  - Special sources: RF ID reader, Phone charger, special beacons

Demand and Supply

- The peak currents needed during transmit and receive operation is not achievable using the harvester alone.
- Buffering is also needed to ensure continuous operation during times without power generation.
- The combination of an energy harvester with a small-sized storage is the best approach to enable energy autonomy of the network over the entire lifetime.
  - Rechargeable battery
  - Thin film batteries
    - can be integrated directly in Integrated Circuit (IC) packages in any shape or size,
    - Flexible when fabricated on thin plastics
    - Thin film batteries have high impedance;
    - Low discharge efficiency compared to Li-ion batteries
  - super capacitor
    - Leakage in super capcitors depends on the voltage. Low at low voltage

Internet of Things (IoT)

Embedding short-range mobile transceivers into a wide array of gadgets and everyday items, enabling new forms of communication between people and things, and between things themselves.

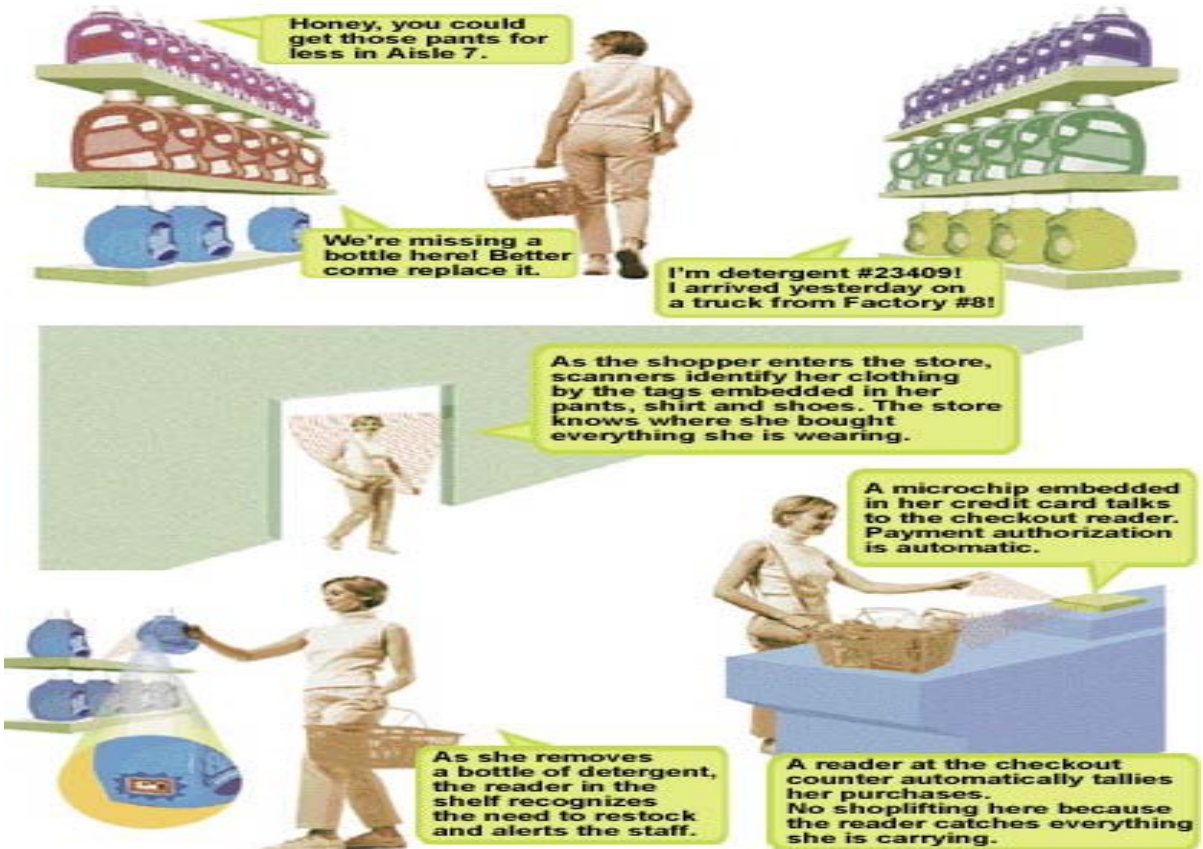

When shopping in the market, the goods will introduce themselves.

When entering the doors, scanners will identify the tags on clothing.

When paying for the goods, the microchip of the credit card will communicate with checkout reader.

When moving the goods, the reader will tell the staff to put a new one.

Introduction to RFID

- The reader converts incident field and returns useful data
- In passive RFID systems reader transmits EM energy that "wakes up“ the tag and provides power for the tag to respond to the reader.

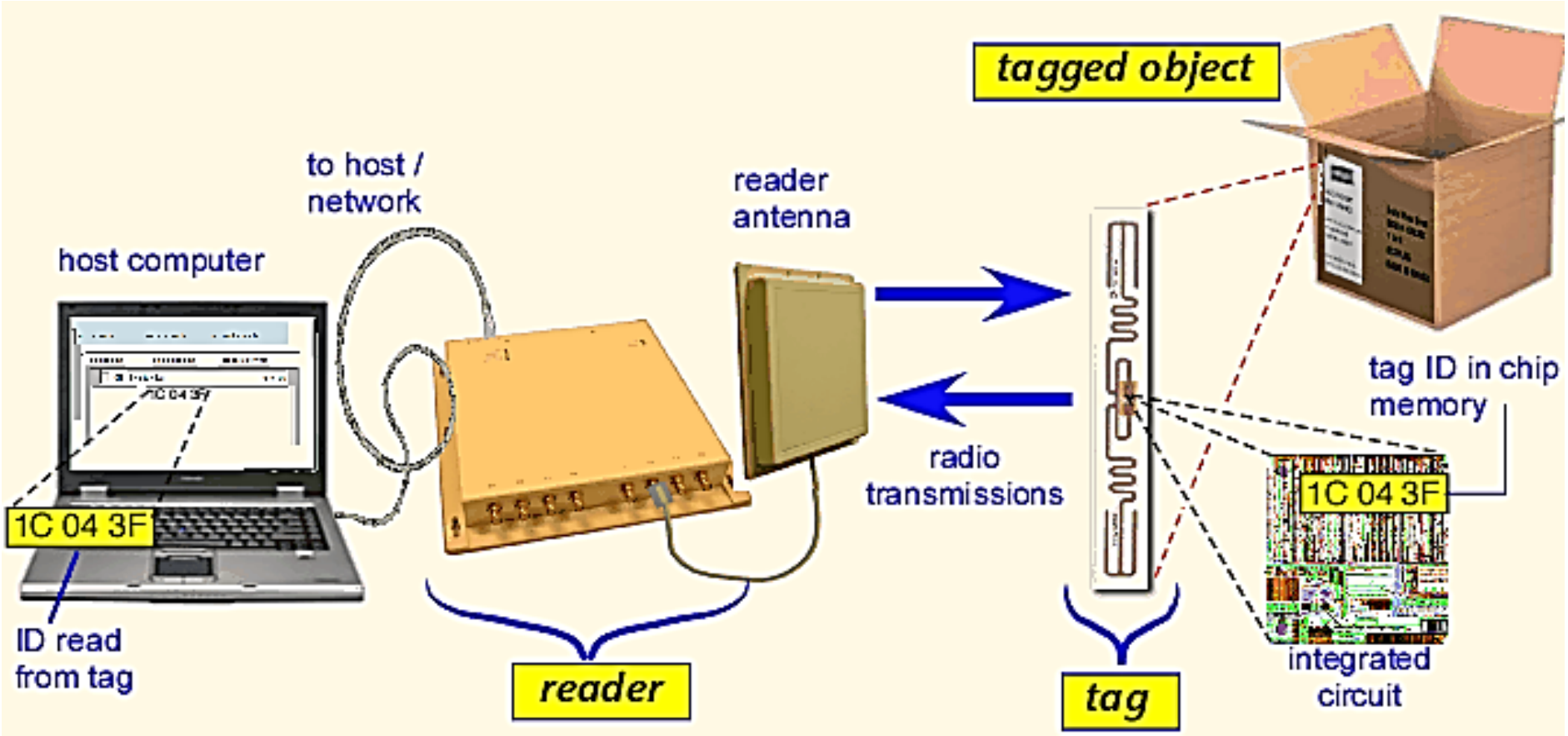

Backscatter Communication

- **Backscatter** is the reflection of signals back towards their source.
  - In this scheme, two devices communicate using incident (or ambient) RF as the source of power.
  - Backscattering is achieved by changing the impedance of a receiver in the presence of an incident signal.
  - When waves encounter a new media that have different impedances, a part of the wave is reflected.
  - The reflection depends on the difference in the impedances.
- By modulating the impedance at the receiver port, one can control the scattered RF energy, hence enabling information transmission.

abc.cs.washington.edu/files/comm153-liu.pdf

RFID → IoT

- RFID
  - Uses radio waves for identifying or tracking the object.
  - Proven to be a simple and cost effective system
  - Tags are very cheap and is possible to be attached to everyday objects.

- RFID is considered a prerequisite of **Internet of Things.**

- **Example: RFID tags can be integrated with sensors**
  - When a reader reads a tag, the sensor information will be sent to the reader along with the identity of the object.

Some Examples

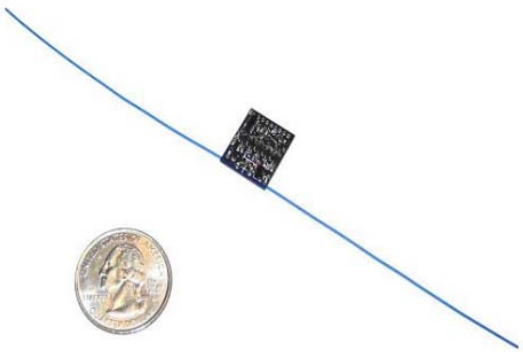

Discrete Element Based
WISP (Wireless Identification Sensing Platform)

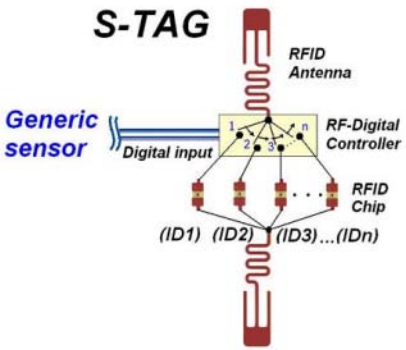

Multi-Chip Based S-tag

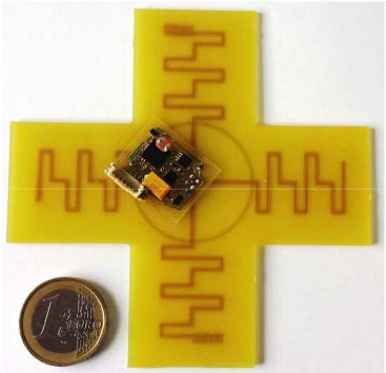

Chips with I2C / SPI
SPARTACUS / RAMSES (Self-Powered Augmented RFID Tag for Autonomous Computing and Ubiquitous Sensing / RFID Augmented Module for Smart Environmental Sensing)

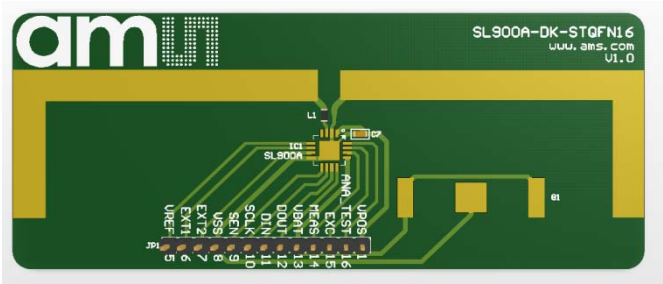

Single IC Based Sensing Tags

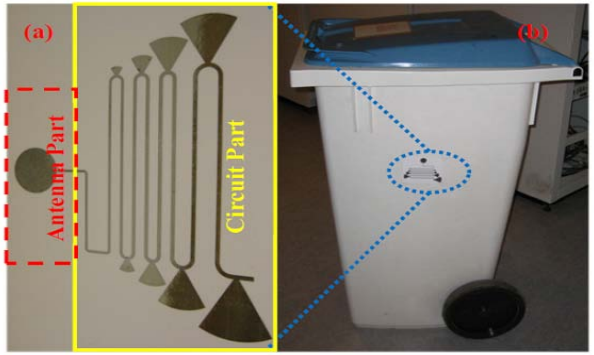

Printed Chipless RFID Tag

WISP

- Wireless Identification Sensor Platform (2009)
  - WISPs are a wireless, battery-free sensing and computation platform, powered by harvested energy from off-the-shelf UHF RFID readers.
  - To a RFID reader, a WISP is a EPC gen1 or gen2 tag; but inside the WISP, the harvested energy is operating a 16-bit general purpose microcontroller.
  - The microcontroller can perform computing tasks, including sampling sensors, and communicate to the RFID reader.
  - WISPs have been built with various sensors, WISPs can write to flash and perform cryptographic computations.

A collaboration between Intel Research Seattle and the University of Washington.

http://wisp.wikispaces.com/Wisp+4.1+DL

RFID Sensors (Products)

- ID operation is passive; yet most sensors require power sources

- Powercast has a wireless sensor that is battery-less. Uses RF energy harvesting.
- Harvesting schemes works at power as low as -12dBm. (RF-DC conversion efficiency above 40% only above -8dBm)
- Harvested power >0.4mW for RF in of >-1dBm.
- Multiple custom ICs and discretes

- Other suppliers include
  - Phase IV
  - RFID sensor systems
  - etc

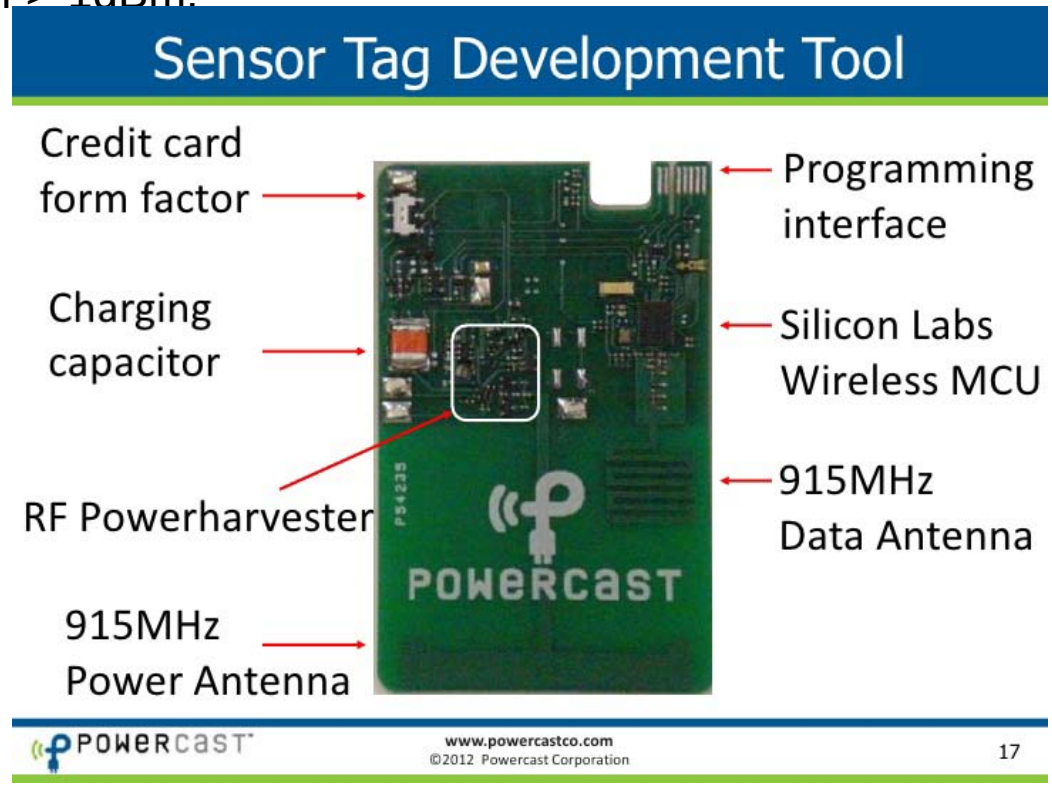

http://www.powercastco.com/uhf-rfid-sensing-passive-rfid-wireless-sensor-tags/

Battery-less Wireless Terminals

- Most of our work in this direction was towards battery-less terminals
- Long life terminals without wiring
- These are useful when
  - Terminals are embedded within structures (or body)
  - Devices to be deployed in hostile environments
  - Use of battery is not allowed (potential cause for explosion)
- Other factors
  - Cost, weight, etc.
- Primary focus: use of radio frequencies (ambient/intentional)

Ambient RF Sources

- Several sources:
  - WiFi Access points (mW) [2.4/.6GHz]
  - Cellular Tower (W) [900/1800 MHz]
  - TV Broadcast (MW) [150-450MHz]
  - FM broadcast (kW) [90-108MHz]
  - AM Radio broadcast (kW) [<1MHz]

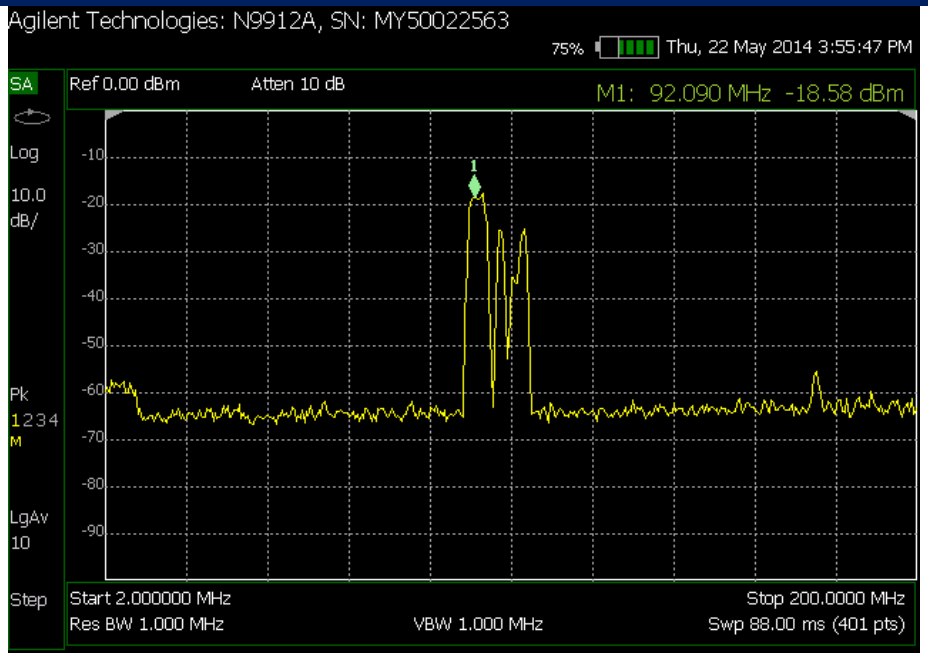

- In general
  - Lower frequencies help non-line-of sight propagation
  - Power availability from ambient sources is limited and varies from place to place.

- Note
  - Unlike other sources, most practical RF harvesters (eg in RF ID) depend on **intentionally generated energy**.
  - This is called **wireless power transfer (WPT)** in the conventional RF/Microwave parlance.

Wireless Communication System

- Power transfer scheme is no different!!

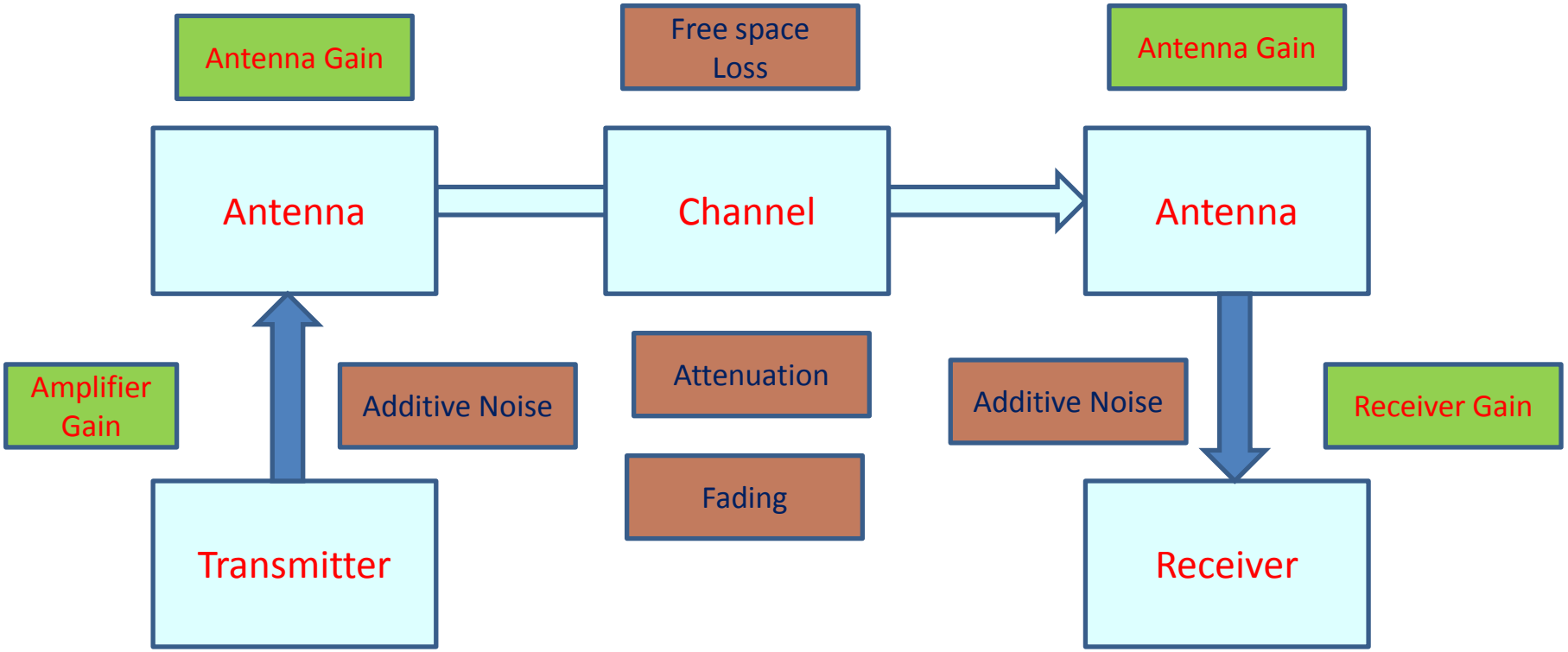

Antenna Fundamentals: Directivity

This is the ratio of the radiation intensity in a given direction to the radiation intensity averaged over all direction

Average radiation intensity, $U_0 = \dfrac{P_{rad}}{4\pi}$

Directivity,

$$D(\theta,\phi) = \frac{U(\theta,\phi)}{U_0} = \frac{4\pi U(\theta,\phi)}{P_{rad}}$$

- If direction is not specified, it implies the direction of maximum radiation intensity

$$D_{\max} = \frac{4\pi U_{\max}}{P_{rad}} \qquad D_{dB} = 10\log D$$

Maximum directivity and Maximum effective area

The radiated power density by a transmitter at a distance R

$$W_t = \frac{P_t D_t}{4\pi R^2}$$

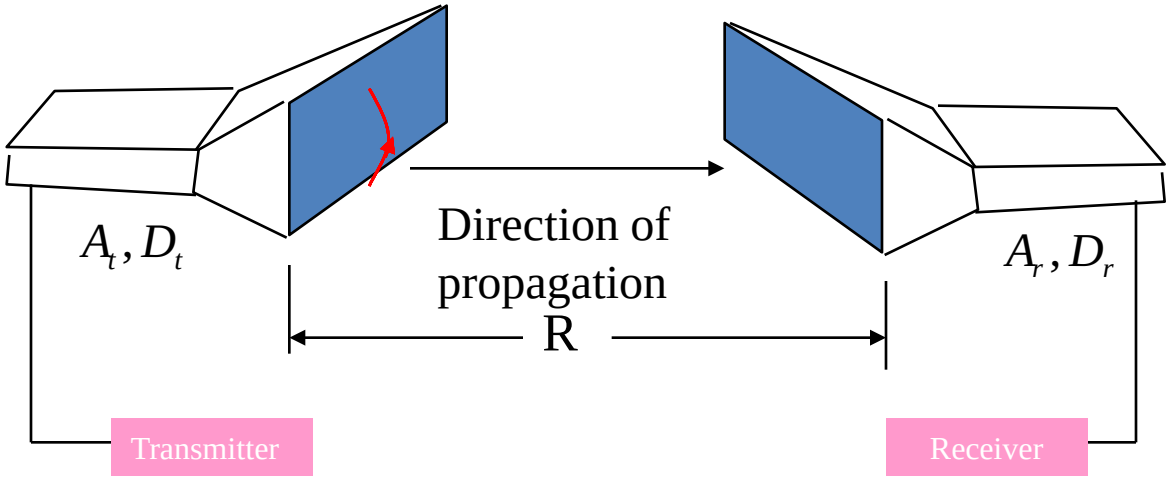

Power received

$$P_r = W_t . A_r = \frac{P_t D_t A_r}{4\pi R^2}$$

$$or,\ D_t . A_r = \frac{P_r}{P_t} . 4\pi R^2$$

$$\therefore \frac{D_t}{A_t} = \frac{D_r}{A_r}$$

$$if,\ D_0 = \text{max. directivity}$$

$$A_{em} = \text{max. effective area}$$

By reversing the transmission direction

$$D_r A_t = \frac{P_r}{P_t} \cdot 4\pi R^2$$

this can be generalized by

$$\frac{D_1}{A_1} = \frac{D_2}{A_2} = k = \frac{4\pi}{\lambda^2}$$

$$D = \frac{4\pi A_{em}}{\lambda^2}$$

Frii's Transmission Equation

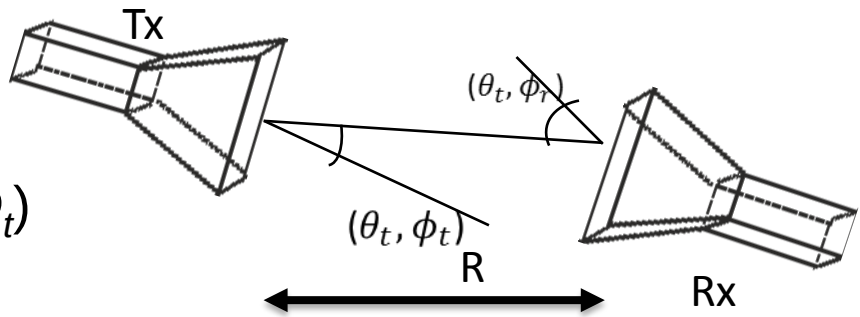

- The radiation intensity for an isotropic radiator is $W_0 = \frac{P_t}{4\pi R^2}$
- For an antenna of gain G_t (or directivity D_t)

$$W_t = \frac{P_t G_t(\theta_t,\phi_t)}{4\pi R^2} = e_t \frac{P_t D_t(\theta_t,\phi_t)}{4\pi R^2}$$

- The effective aperture of a receiving antenna is given by $A_r = e_r D_r(\theta_r, \phi_r)\frac{\lambda^2}{4\pi}$
- Therefore,

$$P_r = e_r D_r(\theta_r, \phi_r)\frac{\lambda^2}{4\pi} W_t = e_t\, e_r D_t(\theta_t, \phi_t) D_r(\theta_r, \phi_r)\frac{\lambda^2}{(4\pi R)^2}|\hat{\boldsymbol{\rho}}_t \cdot \hat{\boldsymbol{\rho}}_r|^2$$

$$\frac{P_r}{P_t} = e_t e_r D_t(\theta_t, \phi_t) D_r(\theta_r, \phi_r)\frac{\lambda^2}{(4\pi R)^2}|\hat{\boldsymbol{\rho}}_t \cdot \hat{\boldsymbol{\rho}}_r|^2$$

$$\frac{P_r}{P_t} = e_{cdt} e_{cdr}(1 - |\Gamma_t|^2)(1 - |\Gamma_r|^2) D_t(\theta_t, \phi_t) D_r(\theta_r, \phi_r)\frac{\lambda^2}{(4\pi R)^2}|\hat{\boldsymbol{\rho}}_t \cdot \hat{\boldsymbol{\rho}}_r|^2$$

- When the antennas are pointing towards each others' peak radiation direction,

$$\frac{P_r}{P_t} = G_{0t} G_{0r}\left(\frac{\lambda}{4\pi R}\right)^2$$

Note that includes a loss factor (usually called **Free space Loss factor)**
Does not include dissipation/attenuation in medium; caused by spreading

Some numbers on Radiative form of WPT…

- Practical systems will have
  - Operational frequencies in ISM bands.
  - Most terminals are compact.
  - Antenna efficiency is compromised.
  - Nearly isotropic radiations expected.

- Main bottleneck is the physical limits in transmission.

$$P_r = P_t * G_t * G_r * (\lambda / 4\pi r)^2$$

  - At 1 GHz (λ=30cm) r=1m; Antenna gain @0dBm, free space loss factor is about **0.06%**
  - Even with a moderate gain transmitter antenna (6dBi) power received @1m for 1W transmission, is just 2mW.
    - Drops to 23μW at 10m !!
    - **The voltage of the signal is low!!**

- In radiative power transfer, Distance from transmitter is a major concern.

Some questions addressed in our work

- **Harvesting of ambient radiations or Radiative transfer of energy addressed**
  - Is it possible to harvest the RF energy from base stations
  - Are there other viable sources of RF energy

- Can low power communication systems be designed to operate entirely from harvested energy
  - Integrate sensors, control, etc

- Can we use RF EH/ WPT to increase the range of backscatter communication (RFID scenario)

Design of Rectifiers

Required for converting incoming RF into DC power.

The challenge lies in maximizing the power conversion efficiency for low input power and minimizing the dimensions.

- RF to DC conversion by rectification of the incident RF signal by a ***Schottky diode***
  - Most diodes have a finite cut-in voltage
  - Diode is a non-linear device (performance depends on current or load)
  - Impedance matching required between antenna and diode
  - In most cases, the input voltage needs to be boosted

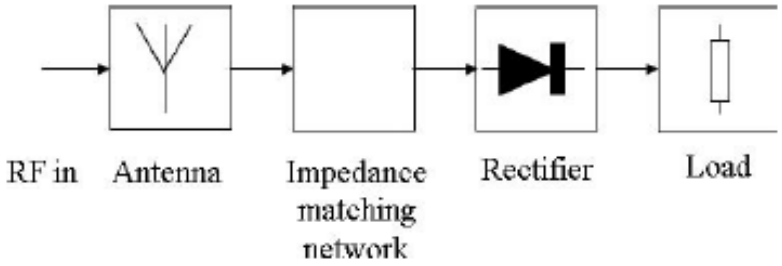

Conceptual diode based Rectenna

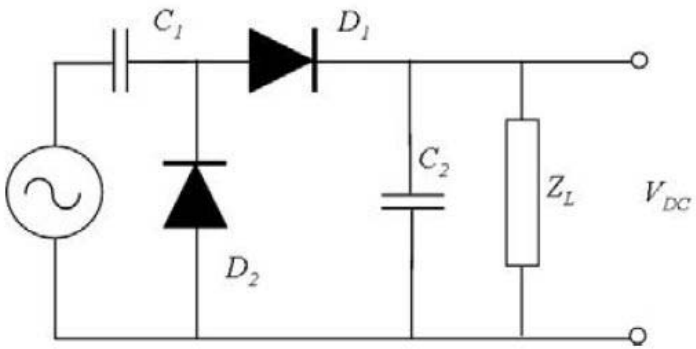

Voltage doubler

Voltage magnification in Matching circuit

- Matching circuit is required to provide impedance match between antennas (50Ω typical) to diode terminated with high impedance load (capacitor and/or high R in parallel).
  - LC matching networks provide voltage magnification.
  - This helps the diode conduct a good fraction of half cycle.
- The higher the voltage across the diodes, the more efficient the rectifier gets.
  - In practice Q is limited
  - Applications requiring higher voltages, a voltage multiplier configuration is used.

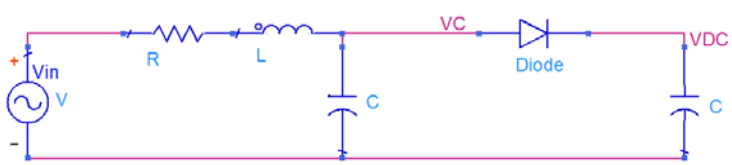

$$V_C = V_{in} \times \frac{\frac{1}{j\omega C}}{R + j\omega L + \frac{1}{j\omega C}}$$

At resonance,

$$V_C = V_{in} \times \frac{1}{j\omega_0 CR} = -jQV_{in}$$

Tuned Rectifier at RF

- A tuned rectifier implemented using discrete components

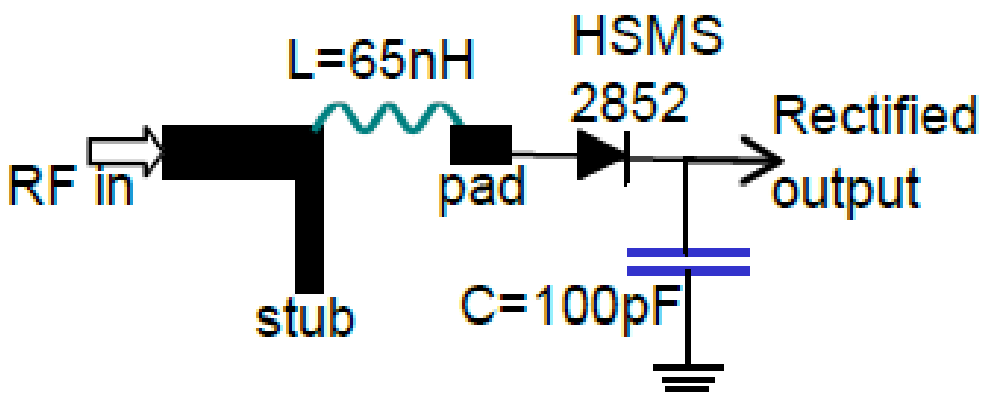

P_in→	-10dBm	-13dBm	-16dBm	-20dBm	-25dBm
Freq.↓					
930MHz	917mV	664mV	469mV	281mV	131mV
945MHz	1016mV	736mV	515mV	300mV	132mV
955MHz	1038mV	747mV	513mV	289mV	122mV
960MHz	1032mV	736mV	499mV	276mV	114mV
Peak efficiency	51%	47%	39%	33%	20%

K. J. Vinoy, T. V. Prabhakar, A Universal Energy Harvesting Scheme for Operating Low-Power Wireless Sensor Nodes Using Multiple Energy Resources, pp. 453-466, Micro and Smart Devices and Systems, Springer 2014.

Typical Performance of Rectifier

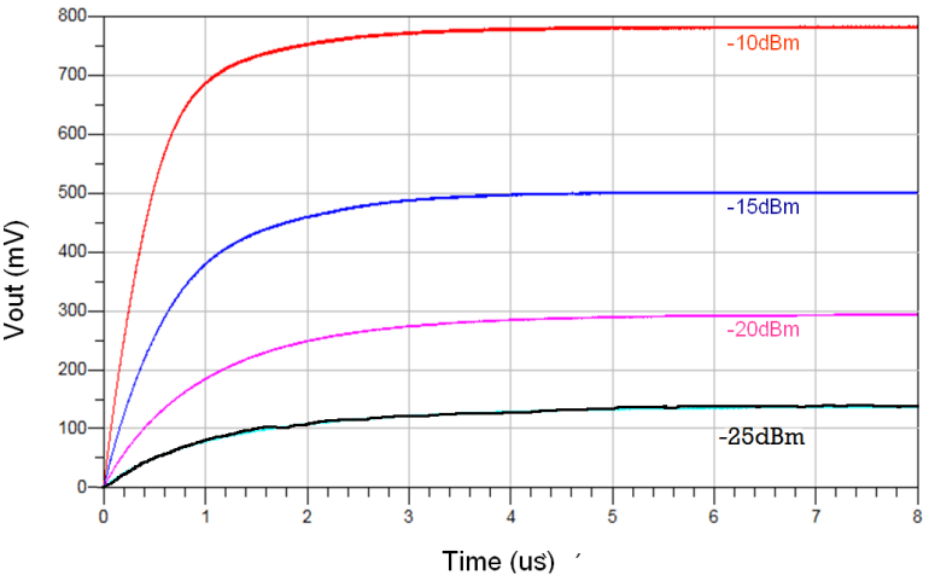

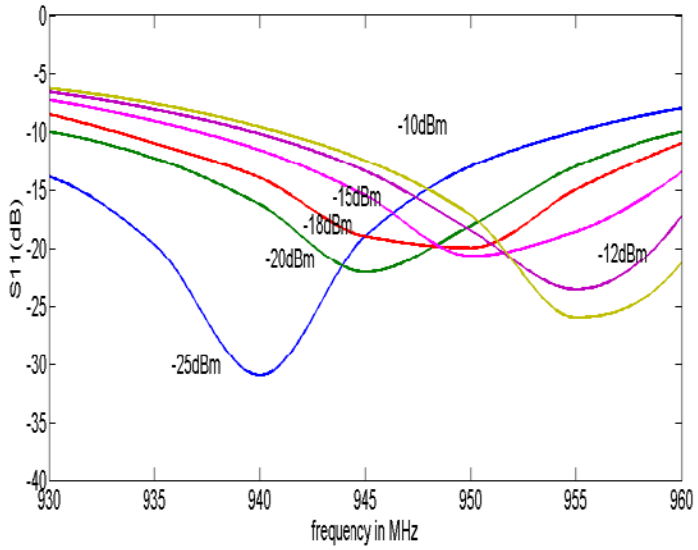

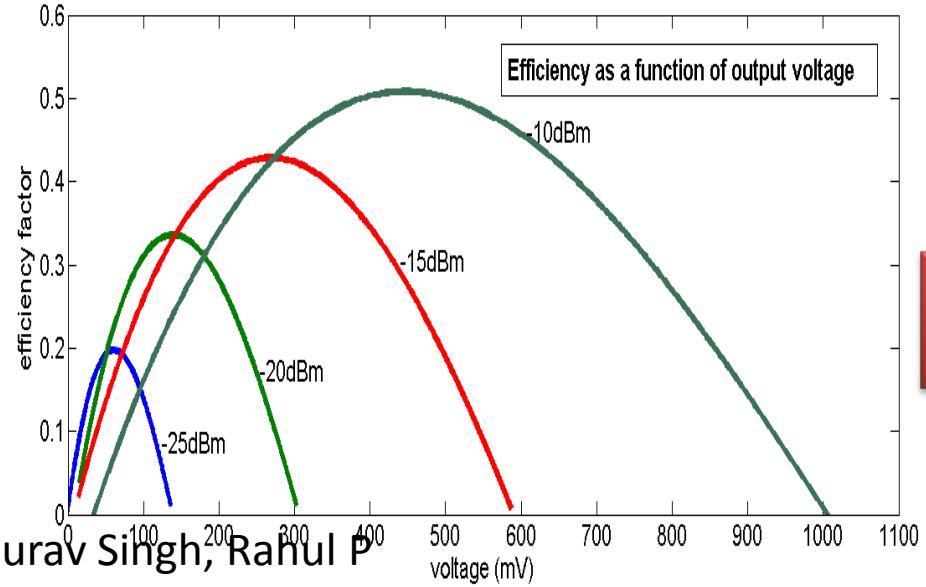

RF-DC Conversion efficiency depends on various conditions

Rectifier Circuit using 4 diodes

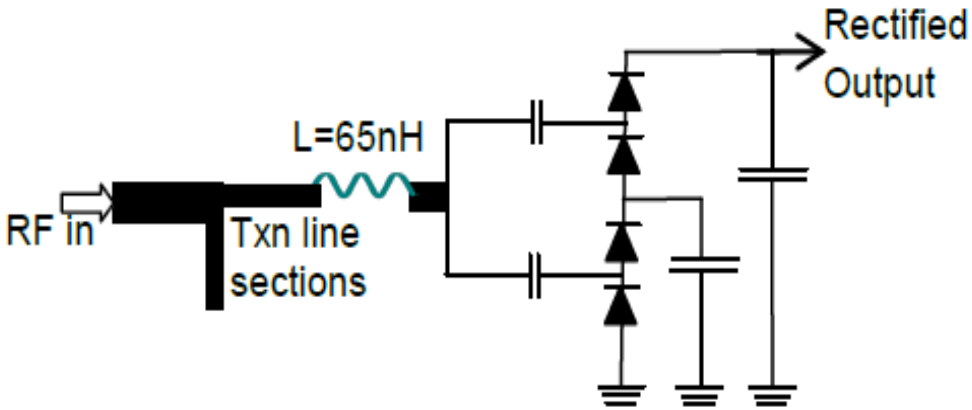

Power level (dBm)	Charging time (ms)	Efficiency (%)
0	40	64.11
-2	55	63.77
-3	67.5	63.5
-5	90	63
-7	230	59.89
-10	370	56.78
-12	500	53.89
-15	900	45
-18	2000	20.56

K. J. Vinoy, T. V. Prabhakar, A Universal Energy Harvesting Scheme for Operating Low-Power Wireless Sensor Nodes Using Multiple Energy Resources, pp. 453-466, Micro and Smart Devices and Systems, Springer 2014.

1: Scavenging Mobile Tower Radiations

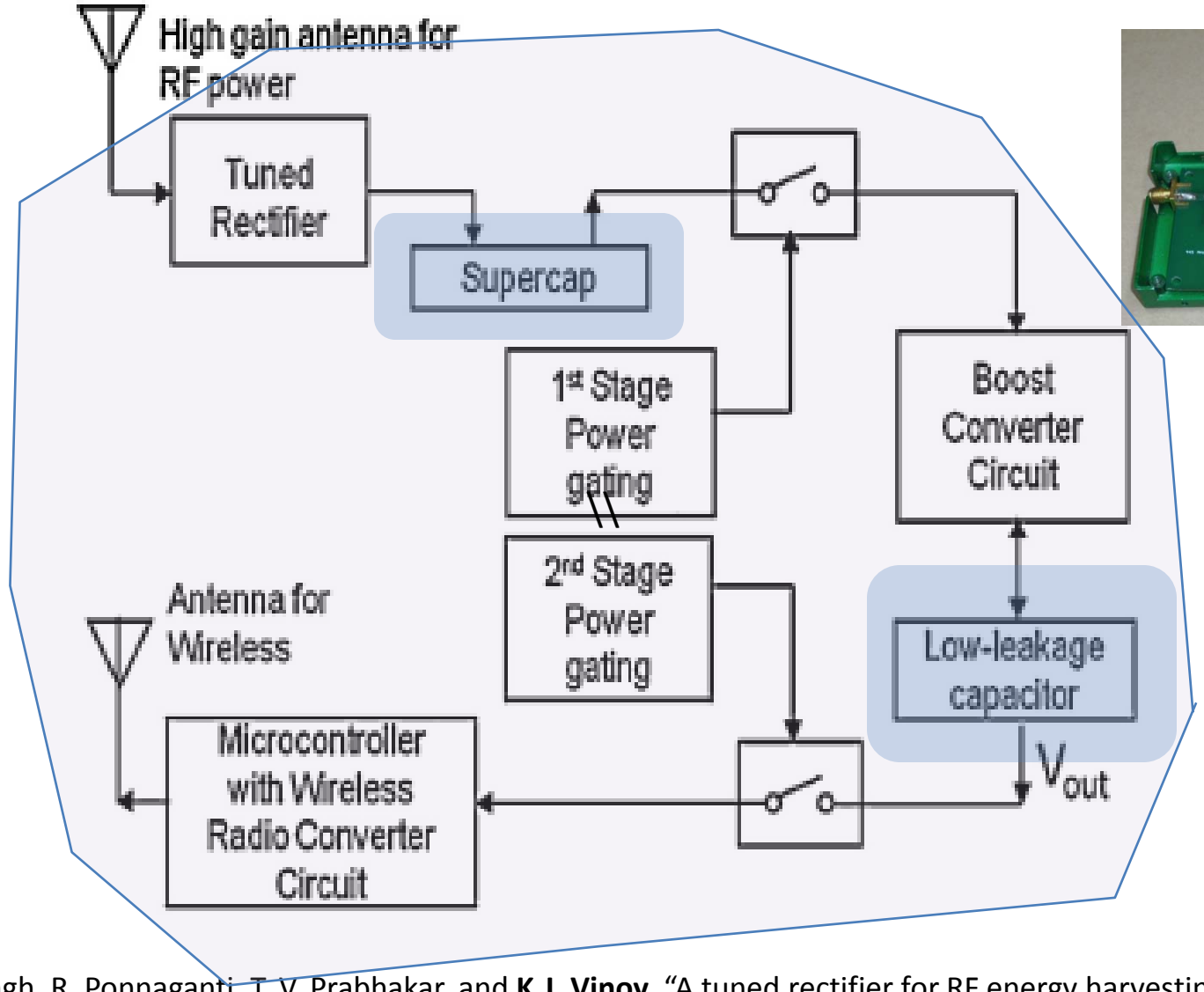

G. Singh, R. Ponnaganti, T. V. Prabhakar, and **K.J. Vinoy**, "A tuned rectifier for RF energy harvesting from ambient radiations," Int. J. Electronics & Communications, vol. 67, no. 7, pp. 564-569, July 2013

Gaurav Singh, Rahul P (2010-11)

Gaurav Singh, Rahul P (2010-11)

Characterization in Lab

- Using various antennas

Distance from Transmitter [m]	1.5	2	2.5	3
Power received by dipole antenna [dBm]	-20.5	-22.1	-23.9	-25.2
Calculated power density [uW/cm^2]	0.078	0.055	0.035	0.03
Power received by patch antenna [dBm]	-15.1	-16.1	-17.6	-19.2
Transmit interval [mm:ss]	07:26	12:13	25:00	never
Power received by biquad antenna [dBm]	-11.8	-13.2	-14.9	-15.9
Transmit interval [mm:ss]	02:20	03:25	7:10	10:33

G. Singh, R. Ponnaganti, T. V. Prabhakar, and **K.J. Vinoy**, "A tuned rectifier for RF energy harvesting from ambient radiations," Int. J. Electronics & Communications, vol. 67, no. 7, pp. 564-569, July 2013

Gaurav Singh, Rahul P (2010-11)

Incident power above -18dBm required for operation

2. Universal Energy Harvesting Platform

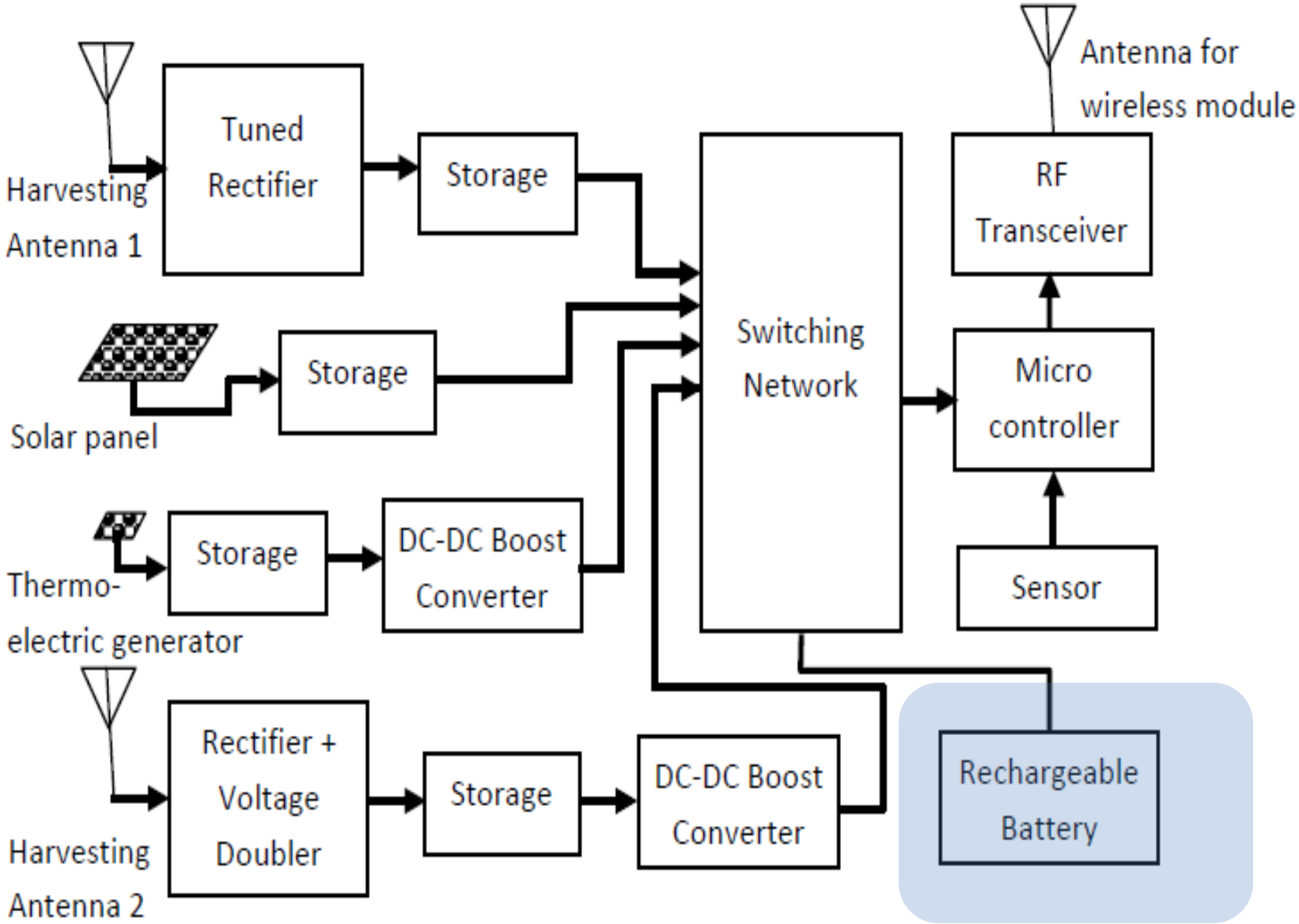

Only a small thin film battery is used

UEHP: Performance with different sources

Solar		RF		TEG	
Light Intensity (Lux)	Duty Cycle of operation (s)	Power Level (dBm)	Duty Cycle of Operation (s)	Temperature Differential (°C)	Duty Cycle of Operation (s)
1000	7	0	3	55	9
300	11	-5	6	45	13
200	**20**	**-7**	20	35	240
100	42	-10	50	-	-
-	-	-12	240	-	-

An incident RF power of -7dBm (~0.2mW) performs similarly as at low light PV.

An appropriately oriented 20mW source with a high gain antenna (~10dB) can reach this RF power at a low gain rectenna (eg using PIFA) at 1 m distance.
Power levels within emission guidelines…

K. J. Vinoy, T. V. Prabhakar, A Universal Energy Harvesting Scheme for Operating Low-Power Wireless Sensor Nodes Using Multiple Energy Resources, pp. 453-466, Micro and Smart Devices and Systems, Springer 2014.

Other Possibilities using Wireless Power Transfer

- Power transfer by radiation is not efficient
- Waveguiding systems can ensure better transmission of power
  - Loss in waveguide is a small fraction of a dB/m (~0.2dB/m)
  - Metal ducts may carry higher order modes with higher losses
  - Extended to conducting ducts, Tunnels, mine shafts etc with some compromise
- Other possibilities
  - Surface wave
  - Focusing of fields
- Empty enclosures with metallic walls
  - Containers, tanks, airplane cabin, trains, etc
  - Other objects in the path may reduce the efficiency!

3: Antenna for RFID sensors

- Work involved design of antenna for RF harvesting sensors
  - These fuel level sensors to be deployed in a fuel tank of aircrft.
  - Optimization of design should focus on efficiency
  - High gain or directivity is not required.

- EH platform to be used with RFID sensors deployed inside fuel tank

- Requirements/Assumptions:
  - Incident energy is of random polarity and direction.
  - Operating frequency is 902MHz-928MHz.
  - Antenna must operate in air (relative permittivity = 1) and fluid (relative permittivity = 2.1)
  - Dimensions of planar antenna board:
    - Target dimensions: 3 in. x 2 in.
    - Maximum dimensions: 6 in. x 4 in.

Antenna Design dimensions

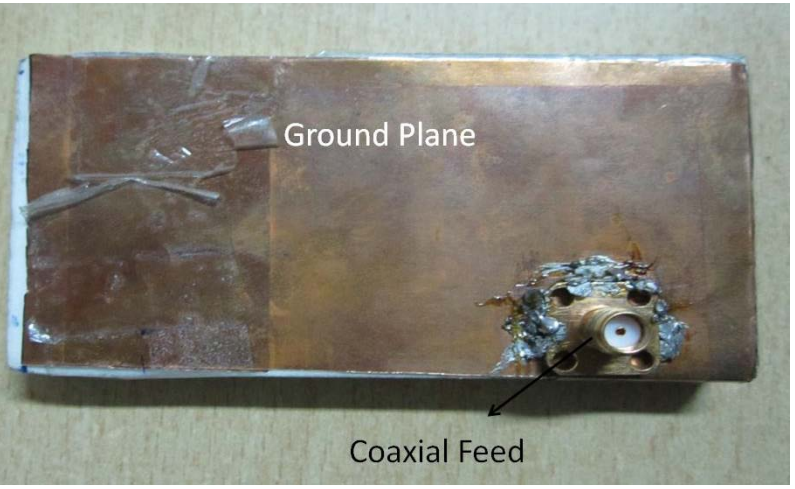

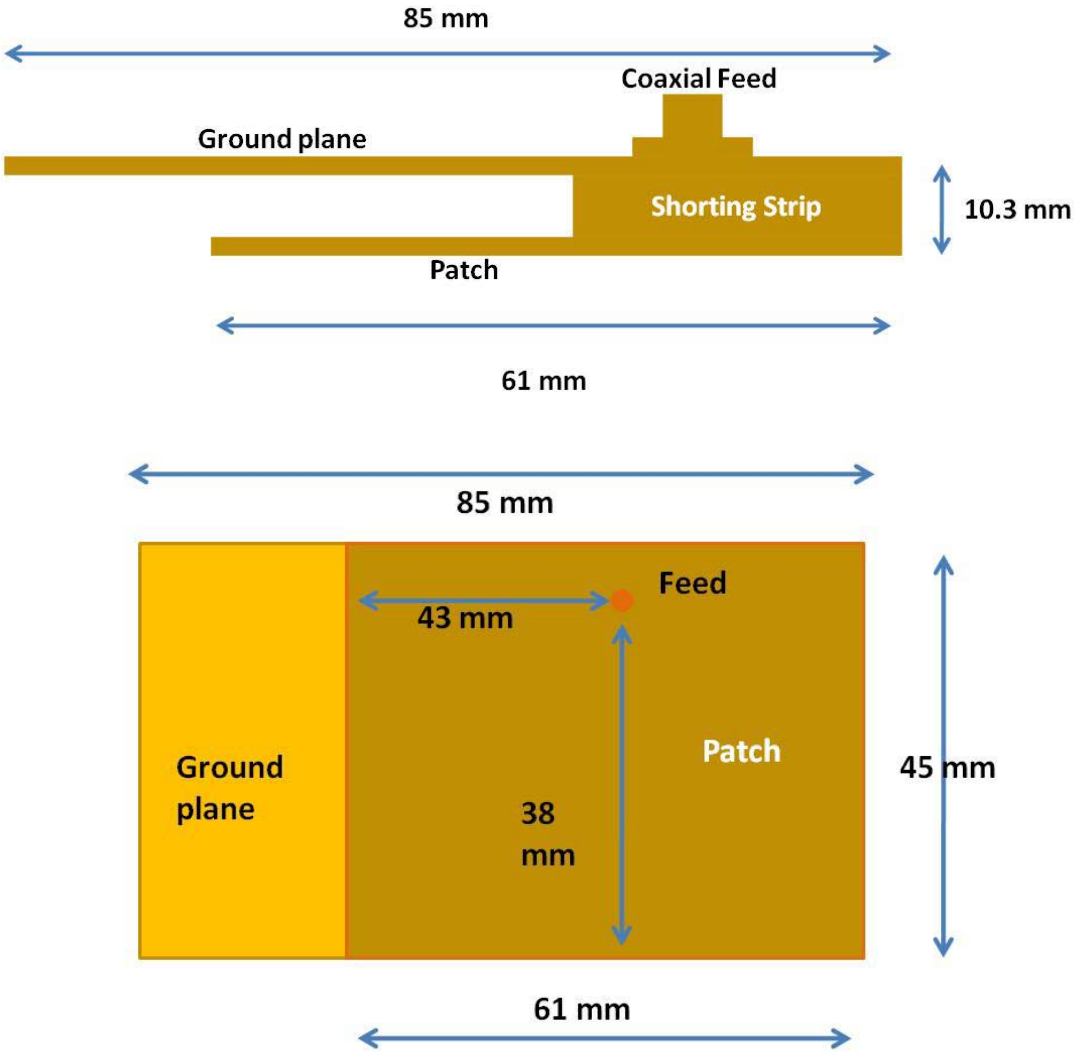

Vivekanand M, Harikiran M

Measurements at Boeing (Nov 2013)

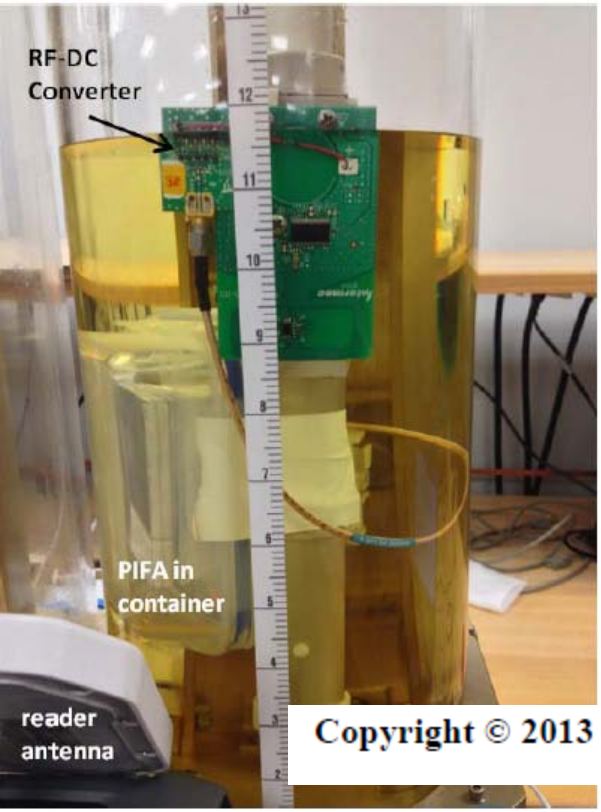

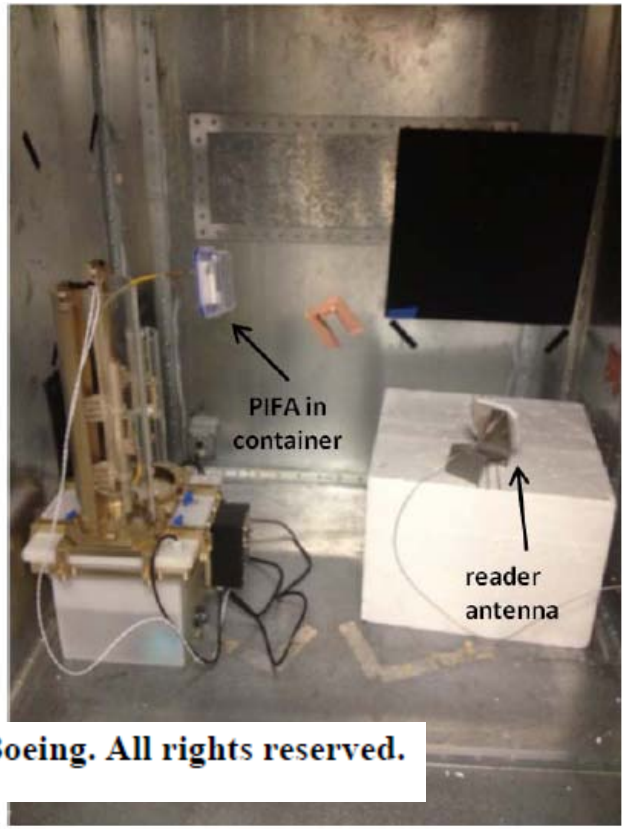

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After Integrating with Sensor and RFID board;

Measured in a room and reverberation chamber

Resolution of fluid height measurement to within 0.25”.
1W maximum transmit power.
Uses a modified reader protocol.

A. Robb, J. Bommer, R. Martinez, J. Harrigan, S. Ramamurthy , H. Muniganti, V. Mannangi, and KJ Vinoy, “Wireless Aircraft Fuel Quantity Indication System,” 2014 IEEE Sensors Applications Symposium - , Feb 18-20, 2014, Queenstown, Newzealand.

4. RFID Integrated with Sensor

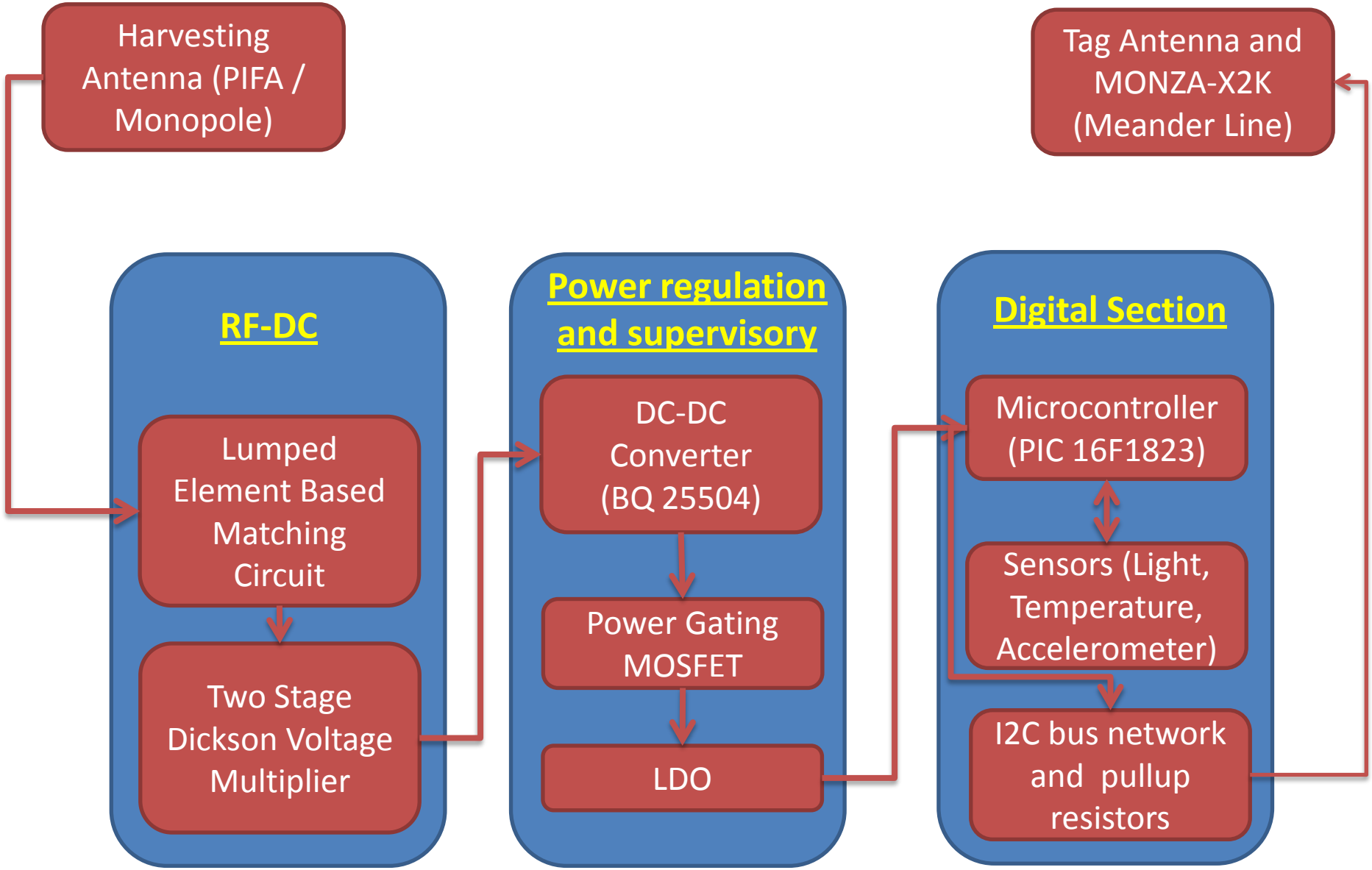

Parts of Fabricated System

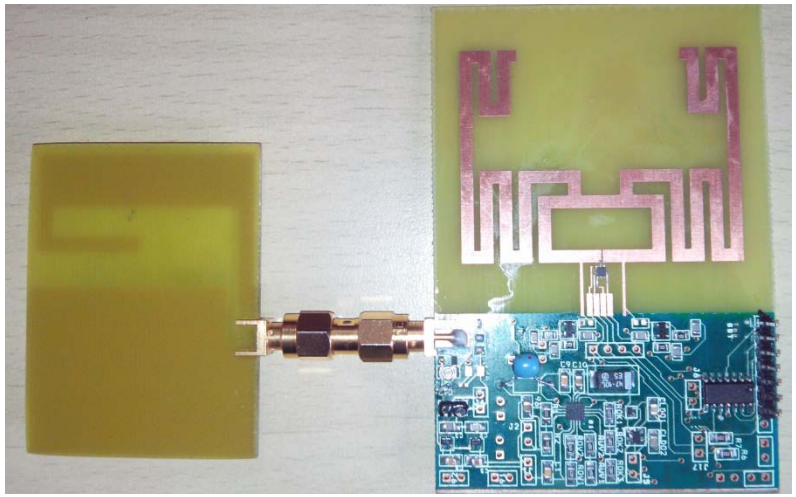

PIFA CONNECTED SENSING TAG

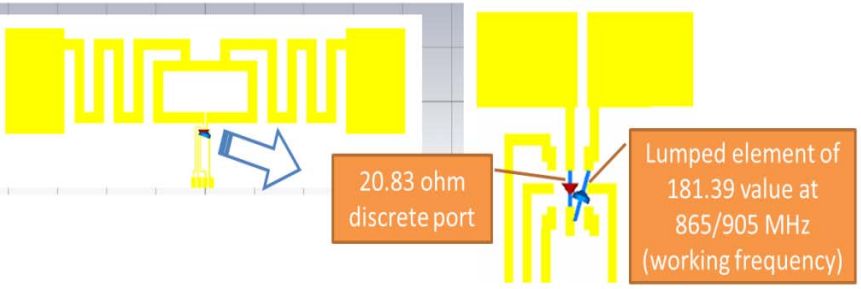

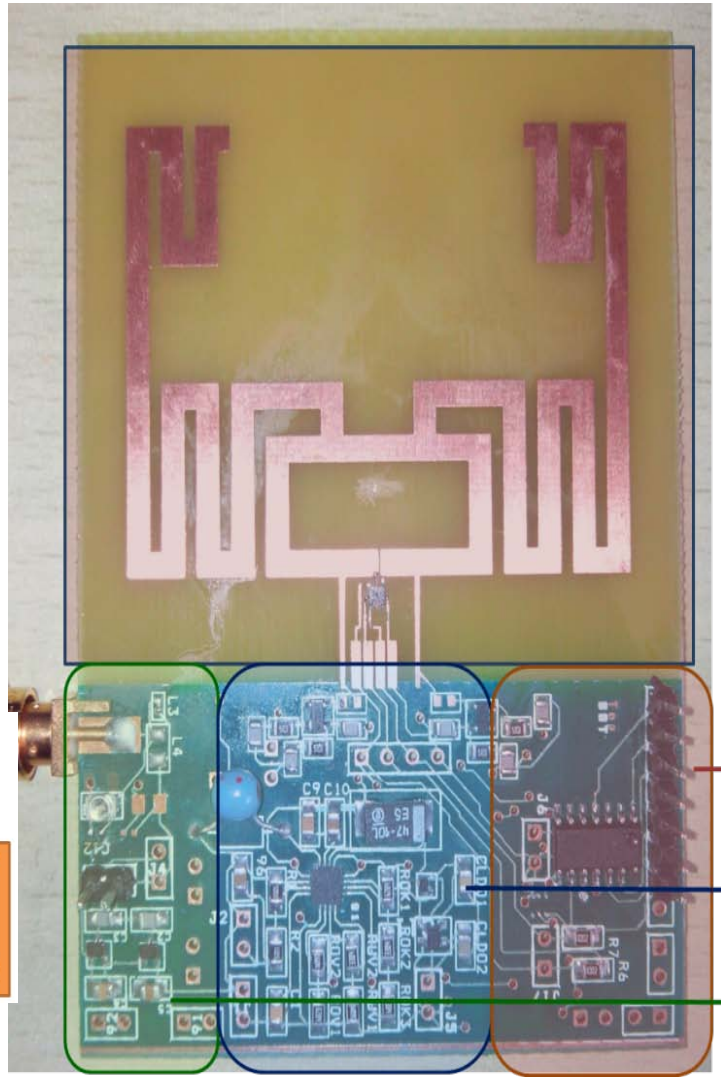

Sandeep Rana 2014-15

Sandeep Rana, TV Prabhakar, KJ Vinoy, An Efficient Architecture for Battery-less Terminals for Internet of Things, Applied Computational Electromagnetic Conference, Guwahati, Dec 28-21, 2015

Characterization of Performance

Source	Power
RFID Reader	30 dbm
Circularly polarized antenna	8 dbi
Polarization loss	3 dbi
Monopole Antenna	5 dbi
PIFA antenna	1 dbi
Meander Antenna	0.4 dbi

Tag Antenna	EIRP (dbm) + Gr	Rg Expected (-10 dbm) and 50 % overall efficiency	Range Achieved
Monopole	40	7.5 mtr	7 mtr
PIFA	36	5 mtr	5.5 mtr
Meander Line	35.4	4.5 mtr	4.5 mtr

$\lambda = 34.5\ cm$ $\qquad$ $\text{Prx} = \text{EIRP} * \text{Gr} * \left(\frac{\lambda}{4*\pi*r}\right)^2$

Efficiency worked out for -10 dbm
RF-DC efficiency – 20 % and DC-DC efficiency – 80%
Overall efficiency – 16%

Sandeep Rana 2014-15

5. Harvesting at 2.4GHz

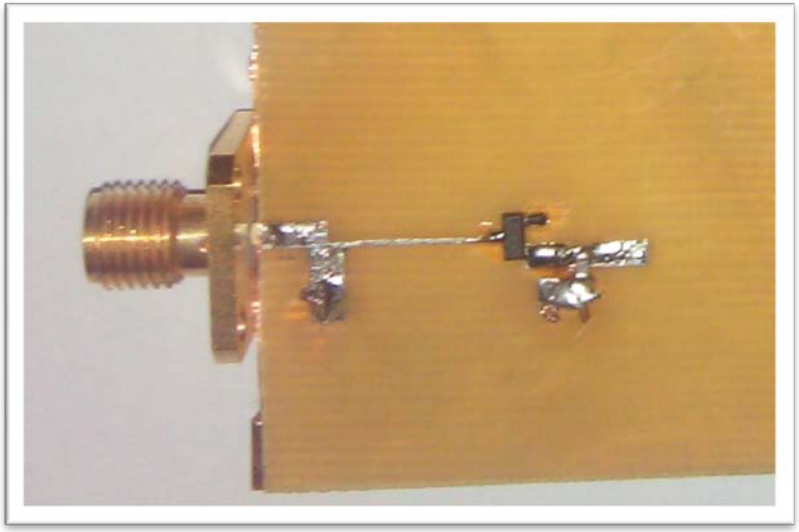

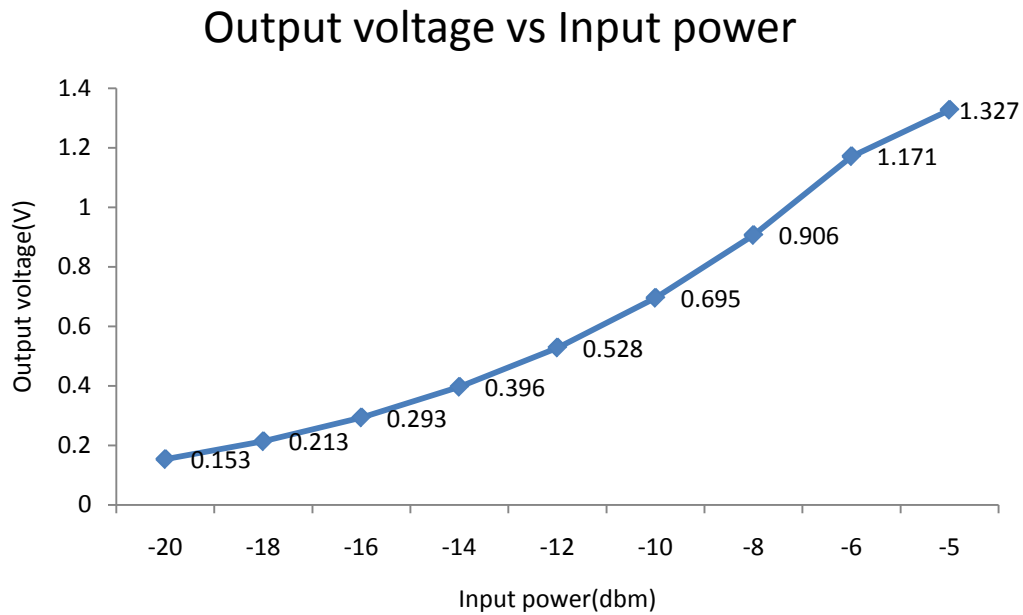

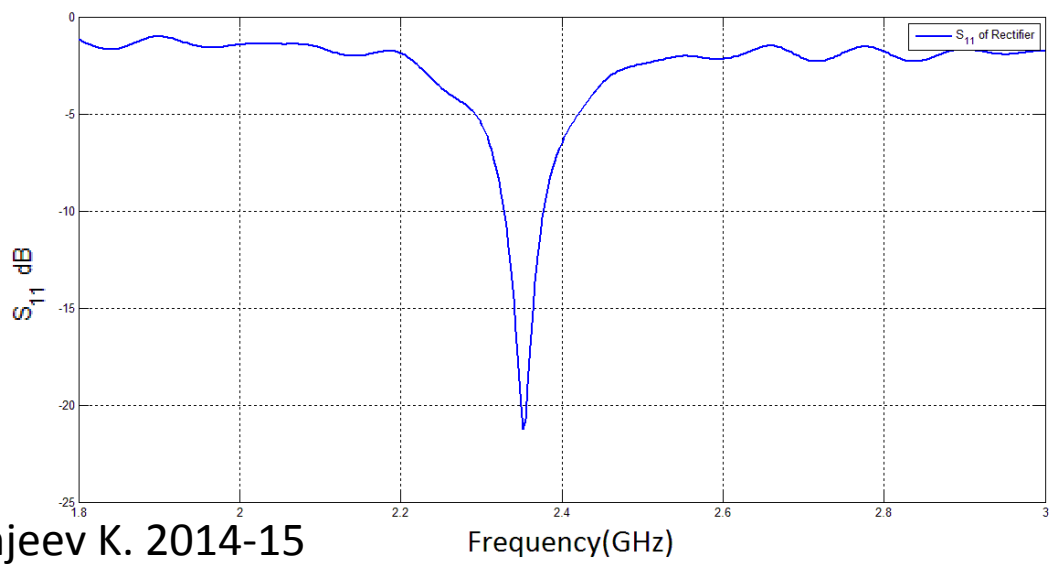

Sanjeev K. 2014-15

RICOH imagine. change.

Comparison of Efficiencies

Schottky diode

	900MHz	2400MHz
-15dbm	Efficiency=47% Output voltage=0.29V Load resistor=6K	Efficiency =17% Output voltage=0.2V Load resistor=6K
-20dbm	Efficiency=31% Output voltage=0.15V Load resistor=6K	Efficiency=5% Output voltage=0.1V (0.153V unloaded) Load resistor=6K
	Used HSMS 2852	Used HSMS 2862

Diode connected MOS with high Q matching

	900MHz	2400MHz
-14dbm	Efficiency=6.2% Output voltage=1.1V Load resistor=500K	Efficiency=2% Output voltage=0.632V Load resistor=500K
-20dbm	Efficiency=1.8% Output voltage=0.3V Load resistor=500K	Efficiency=0.2% Output voltage=0.118V Load resistor=500K

Zero V_{TH} CMOS

	900MHz	2400MHz
-15dbm	Efficiency=4.6% Output voltage=0.86V Load resistor=500K	Efficiency=3.79% Output voltage=0.774V Load resistor=500K
-25dbm	Efficiency=2.4% Output voltage=0.198V Load resistor=500K	Efficiency=1.7% Output voltage=0.165V Load resistor=500K

← Power

← Technologies

Frequencies →

Cross-coupled Rectifiers for Low Power

- CMoS integration requires diodes using MoSFETs.
- Simple diode connected configurations are not effective at low power/voltage levels
- In Cross Coupled Rectifiers
  - Biasing of MOSFETs by charge stored in capacitors. This is a way of threshold compensation.
  - Low ON resistance due to high overdrive voltage.
  - In both cycles of input, output capacitor is charged. Although DCP uses both cycles, only alternate cycles charges the output capacitor and the other cycle charges the input capacitor.

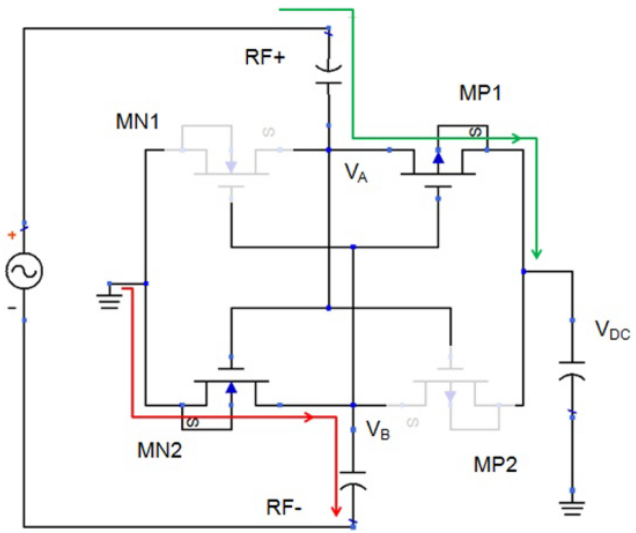

DC-DC converter

- Low loss switched capacitor DC-DC converter:

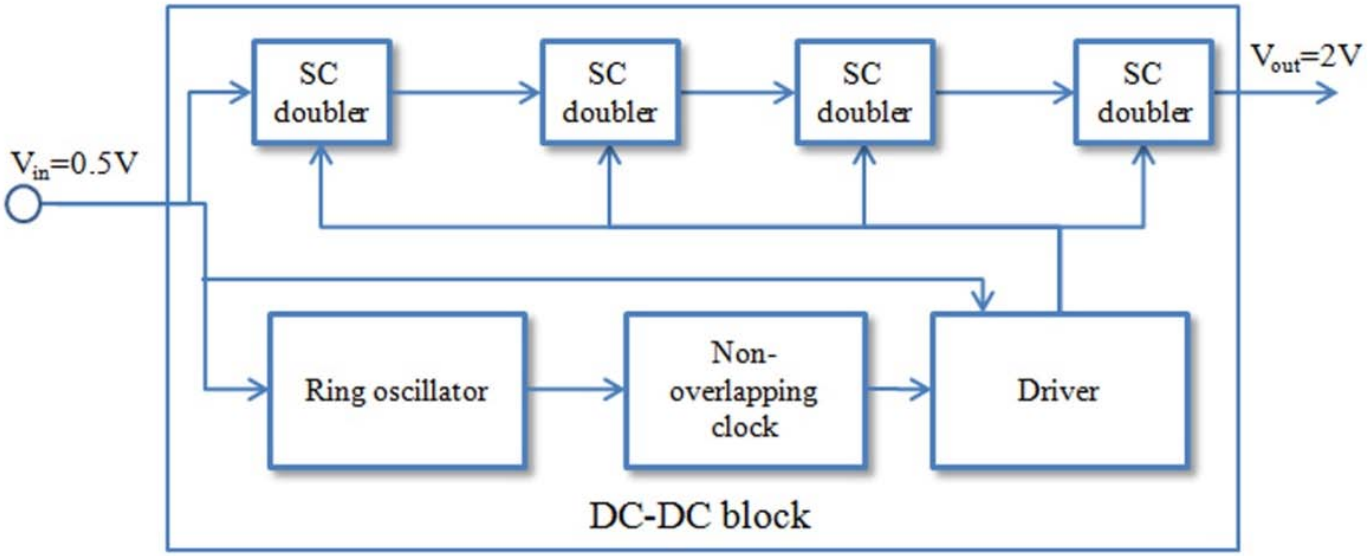

Full system block diagram

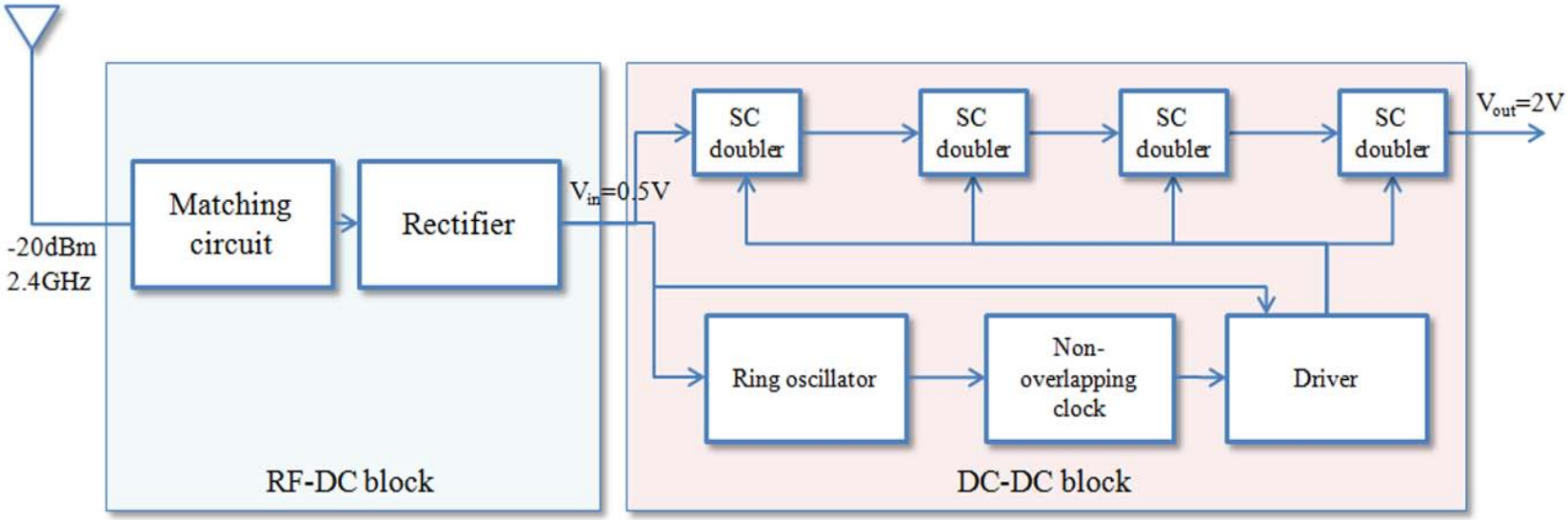

1. Output capacitor of RF-DC supplies DC-DC
2. Enable generator logic constructed using back to back inverters
3. 5 MOSFETs added to limit supply voltage to ring oscillator

RICOH
imagine. change.

Sanjeev K, Manjunath M, TV Prabhakar, KJ Vinoy, Some Practical Considerations of RF to DC Converter using Low Vth CMOS Rectifier, Applied Computational Electromagnetic Conference, Guwahati, Dec 28-21, 2015

Full system simulations

- Output capacitor of RF-DC loaded heavily when clocks transition, so ripples exist in RF-DC output.
- Below 0.5V at clock transitions, above 0.5V between clock transitions
- Time step is 8ps for RF-DC simulation and DC-DC has to run for hundreds of µs or few ms, so simulations times are large.

Output voltage=2V across a load of 1.6MΩ, which gives

$$Efficiency = \frac{2^2/1.6\times10^6}{10^{-5}} = 25\%$$

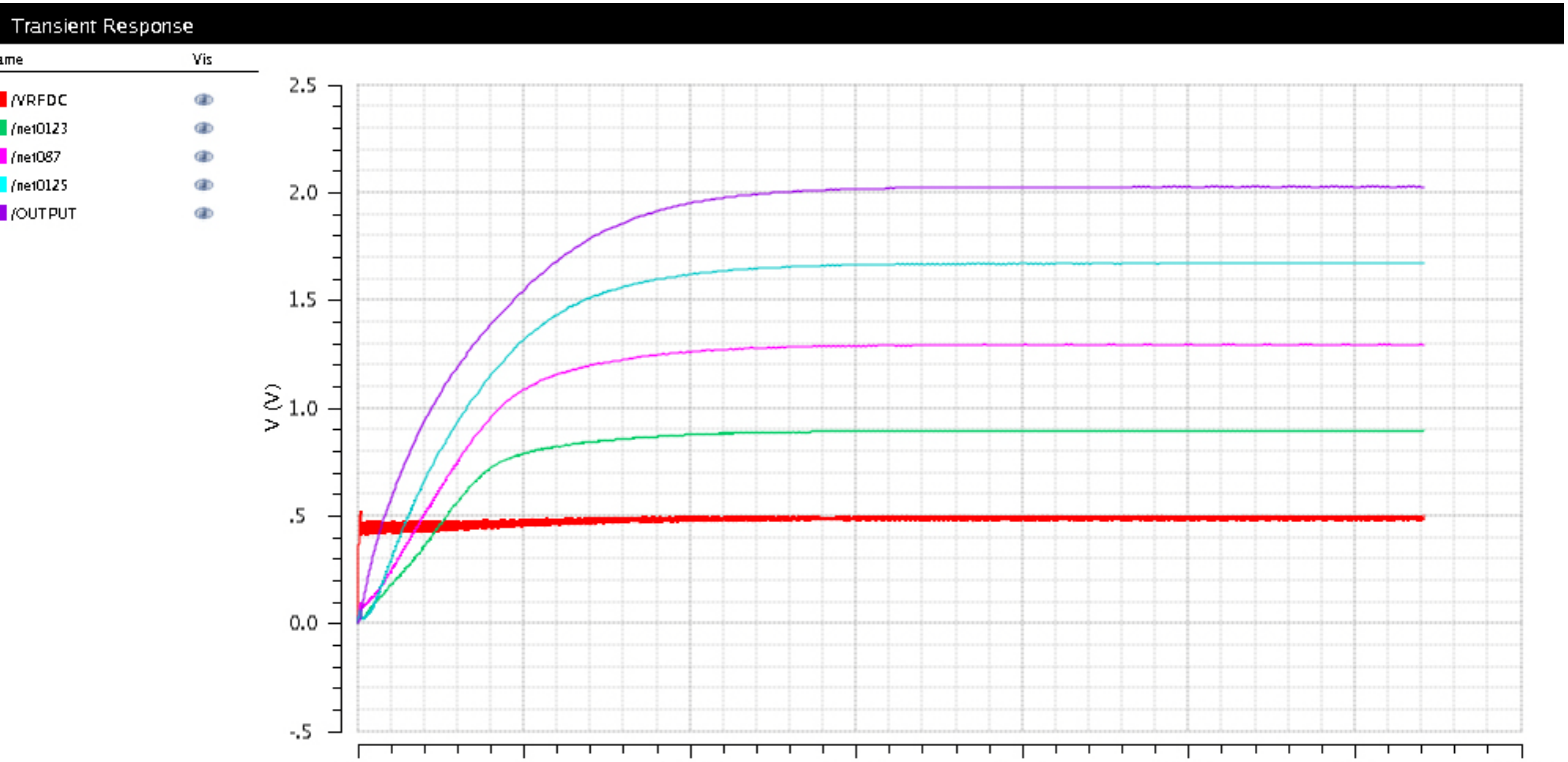

Summary with IC Design

- Low Vth NMOS based DCP gives 42.3% efficiency.
- FGCCR gives 55% efficiency.
- The overall system efficiency is 25%.
- Higher than efficiency reported in literature for RF-DC converter operating at -20dBm, 2.4GHz in 130nm technology.

Reference	This work	[5]	[7]	[6]
Power level	-20dBm	-25.7dBm	-22.6dB	-20dBm
Frequency	2.4GHz	2.45GHz	906MHz	2.4GHz
Efficiency	55%(simulated)	37%(measured)	10%(measured)	36%(simulated)
Rectifier	FGCCR in UMC 130nm CMOS	DCP in 0.5µm Silicon on Sapphire	DCP with floating gate transistors in 0.25µm CMOS	FGCCR in 130nm CMOS

6. ASIC Design for IOT

- Working on a 3-chip architecture
  - Our chip to enable sensing, and control functions
  - Communication using an external Monza chip
- Fabricated chip using commercial services!!

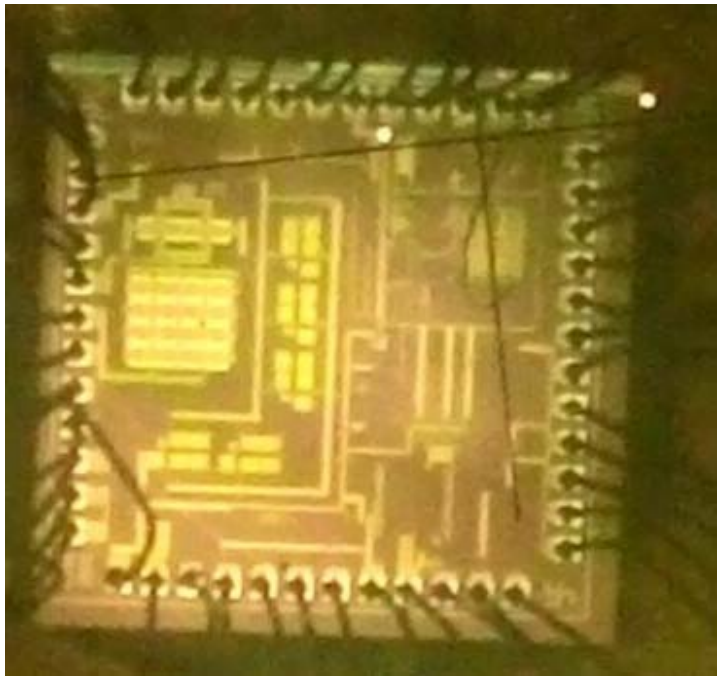

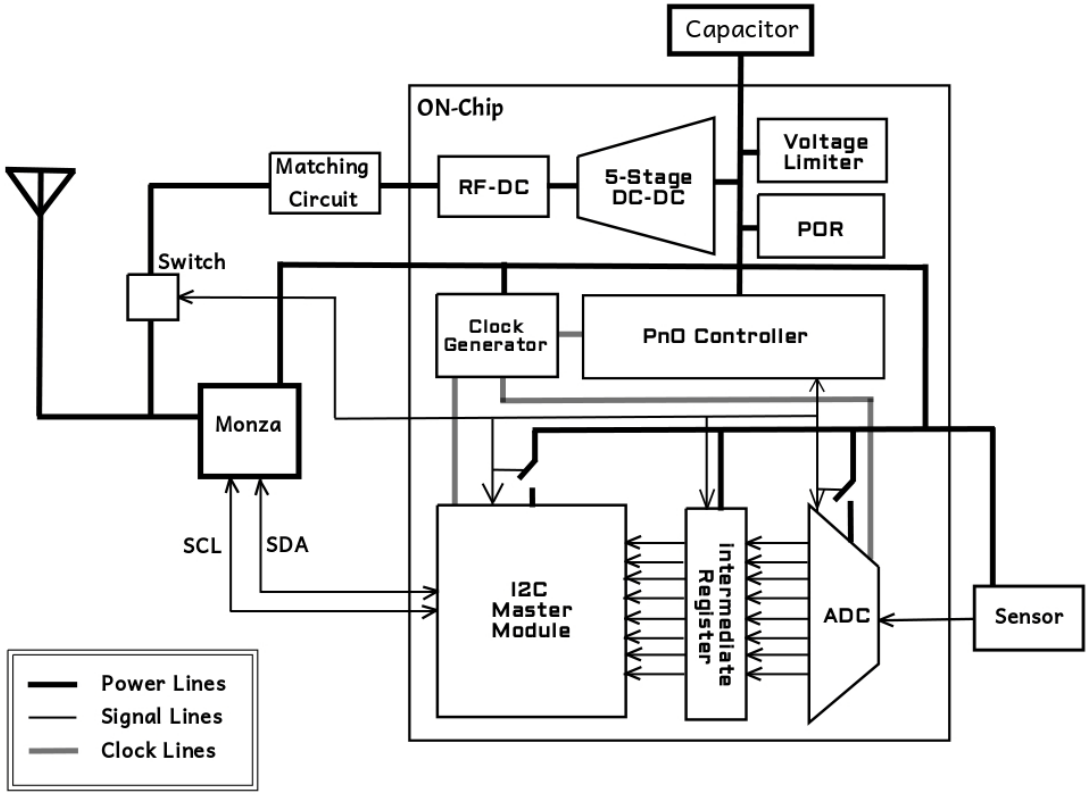

Battery-less Sensor node for BLE

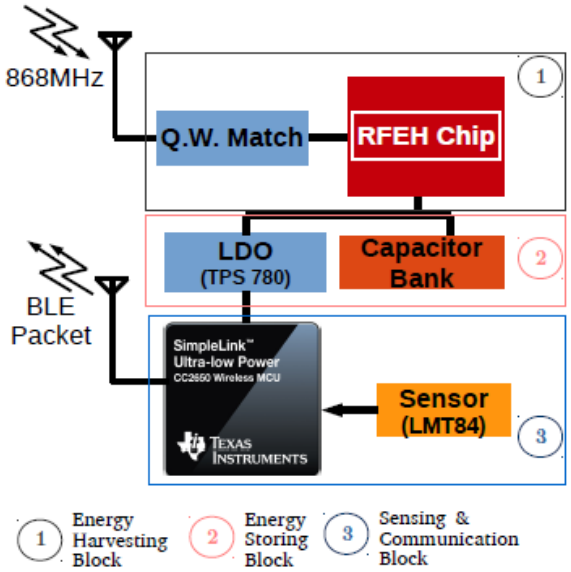

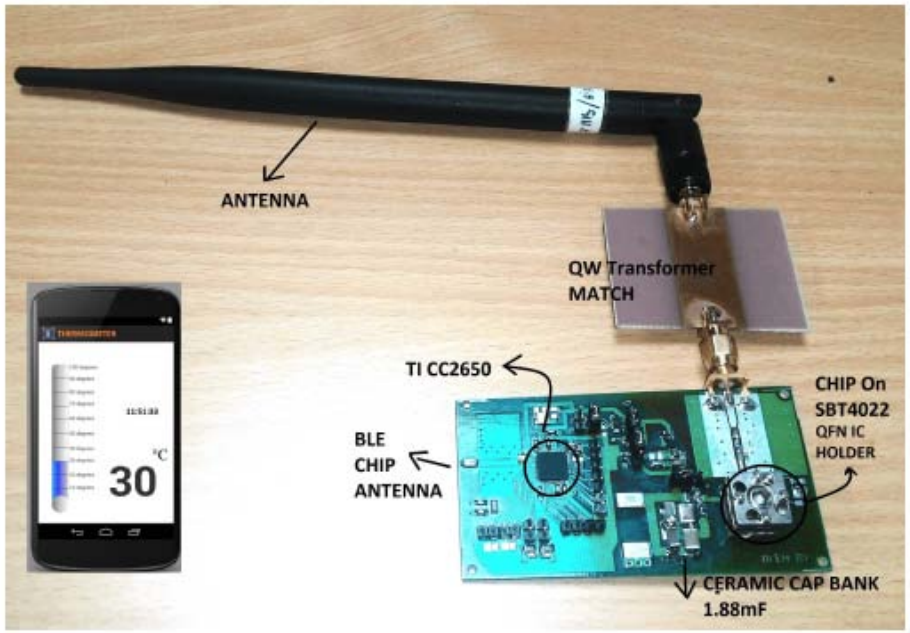

Distance from Reader (m)	Input Power (dBm)	Cold Start Time (min)	Packet Time (min)	Efficiency (%)
3	-2	15	1.75	2.2
4	-5	35	7	1.7
5	-8	120	32	1

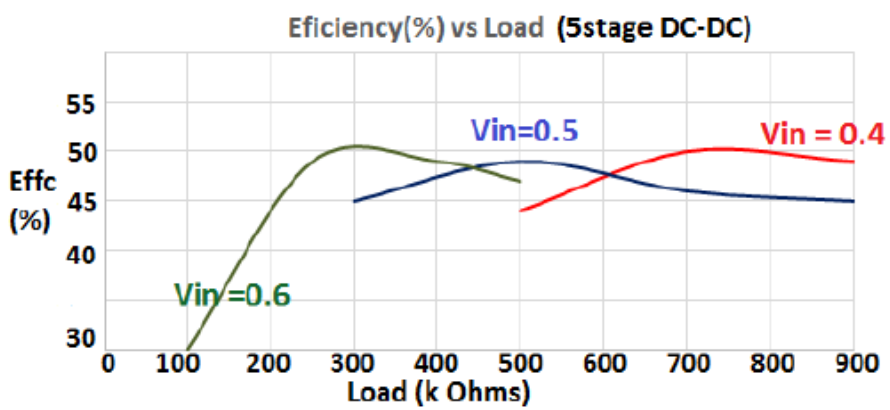

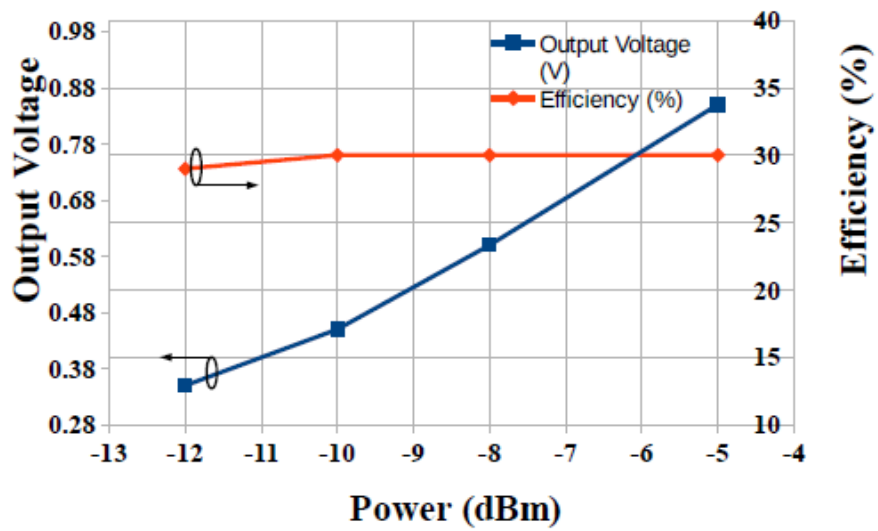

Bharat Hegde & Syed Younis 2015-16

Summary

- Most low power wireless terminals operate intermittently
- These require anywhere 50uW to about 10mW for their operation.
  - Batteries limited: cost, size, stored energy
  - Solar: not dependable through
- WPT and RF EH can enable wide use of IoT
  - Main challenges in the design is the low incident energy/power/voltage
  - High Quality factor components may help
- Several fabricated examples discussed here: All can transmit data to an aggregator wirelessly
  - Different standards implemented.

Acknowledgements

- Dr. TV Prabhakar, DESE, IISc
  - Gaurav Singh
  - Rahul P
  - Chaithanya C
  - Aditya Mitra
  - Prashuk Jain
  - Prashanth Raja
  - Nirmal John
  - Nithin Jose
  - Syed Younis
  - Bharat Hegde
  - Niharika Thakuria
- Prof Bharadwaj Amrutur
  - Uday S
  - NS Sreeram
- Others
  - Vivekanand M
  - Harikiran M
  - Manjunath M
  - Sanjeev K
  - Sandeep Rana
- Partial Funding From
  - ANRC (Boeing, Wipro, HCL)
  - Ricoh Research, India

Thank YOU

Free Energy From Air Circuit

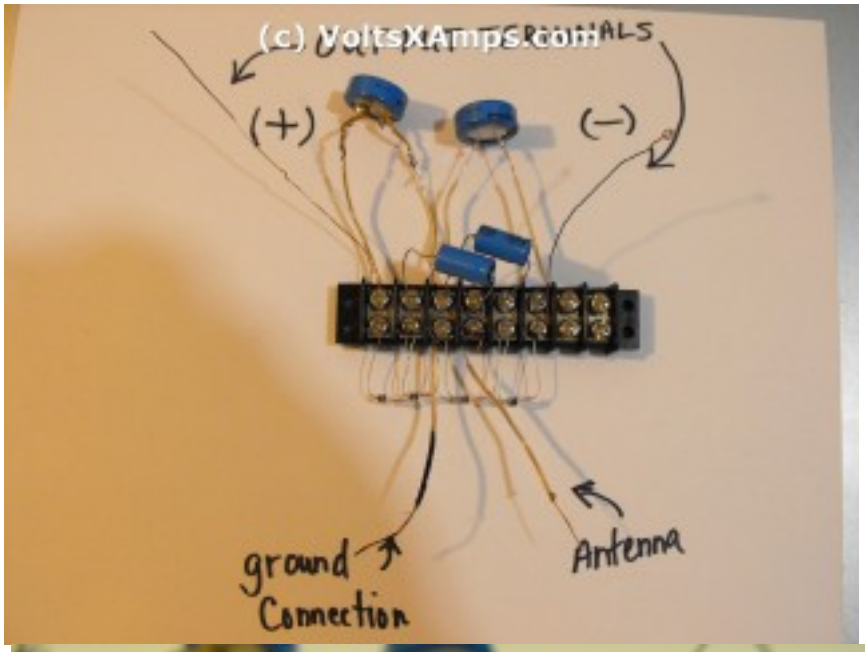

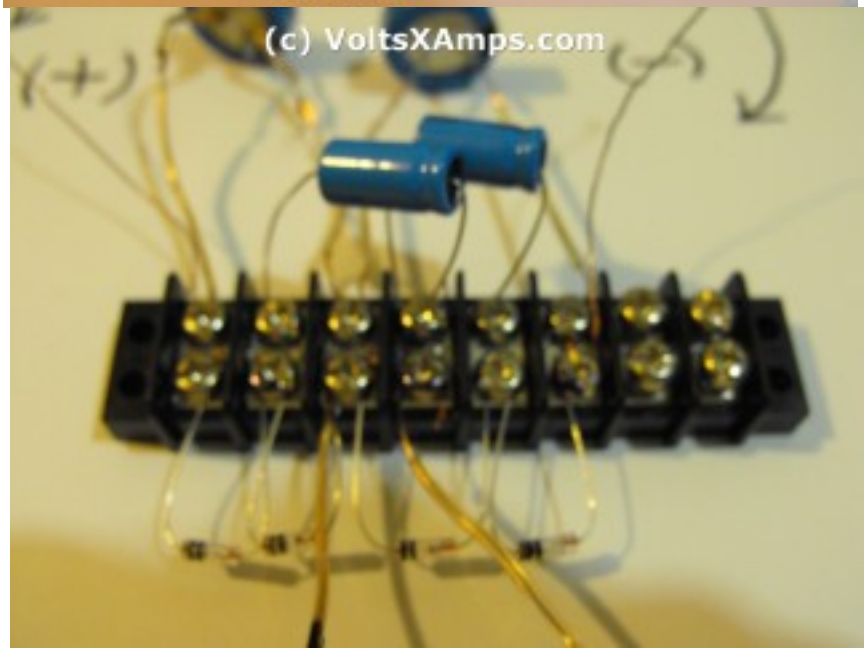

Last year I found a United States Patent that showed how to collect ambient energy right from the air. I finally decided to build this curcuit just to see what it could do.

[protected]

The above images are from the circuit I built. Most of the text and info comes direct from the US4628299filed by Joseph Tate.
US4628299

The Amazing Ambient Power Module

Parts List for the APM-2

Four 1N34 germanium diodes (Radio shack #276-1123) ~ Figure 1, X1, X2, X3, & X4
Two 0.2 mfd 50 V ceramic capacitors ~ Figure 1, C1 & C2
Two 100 mfd 50V electrolytic capacitors (Radio Shack #272-1016) ~ Figure 1, C3 & C4
Copper wire for antenna & ground connections

Introduction

The Ambient Power Module (APM) is a simple electronic circuit which, when connected to antenna and earth ground, will deliver low voltage up to several milliwatts. The amount of voltage and power will be determined by local radio noise levels and antenna dimensions

Generally a long wire antenna about 100' long and elevated in a horizontal position about 30' above ground works best. A longer antenna may be required in some locations. Any type copper wire, insulated or not, may be used for the antenna. More details about the antenna and ground will be discussed further on.

The actual circuit consists of two oppositely polarized voltage doublers (Figure 1). The DC output of each doubler is connected in series with the other to maximize voltage without using transformers. Single voltage doublers were often found in older TV sets for converting 120 VAC to 240 VDC. In the TV circuit the operating frequency is 60 Hz.

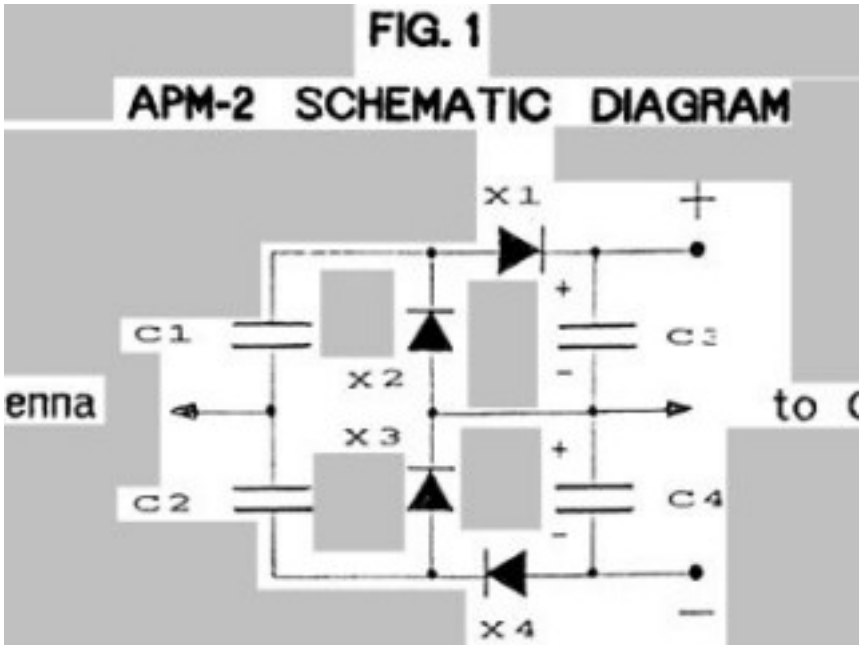

The APM operates at radio frequencies, receiving most of its power from below 1 MHz. The basic circuit may be combined with a variety of voltage regulation schemes, some of which are shown in Figure 2. Using the APM-2 to charge small NiCad batteries provides effective voltage regulation as well as convenient electrical storage. This is accomplished by connecting the APM-2 as shown in Figure 2B.

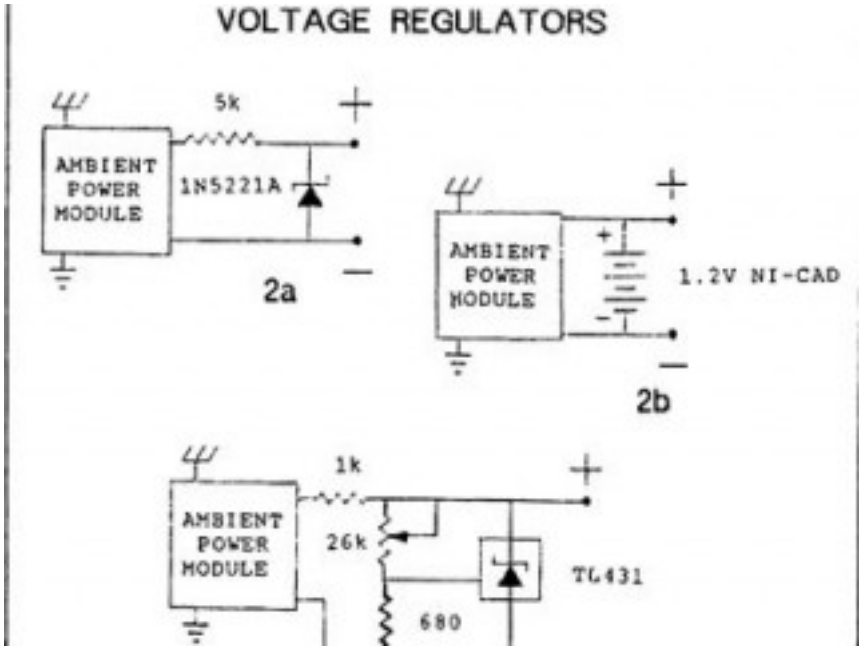

Charging lead acid batteries is not practical because their internal leakage is too high for the APM to keep up with. Similarly, this system will not provide enough power for incandescent lights except in areas of very high radio noise.

It can be used to power small electronic devices with CMOS circuitry, like clocks and calculators. Smoke alarms and low voltage LEDs also can be powered by the APM.

Figure 3 is a characteristic APM power curve measured using various loads from 0-19 kOhm. This unit was operating from a 100' horizontal wire about 25' high in Sausalito CA. As can be seen from the plot, power drops rapidly as the load resistance decrease from 2 kOhm. This means that low voltage, high impedance devices, like digital clocks, calculators and smoke alarms are the most likely applications for this power source. Some applications are shown in Figures 4 through 7.

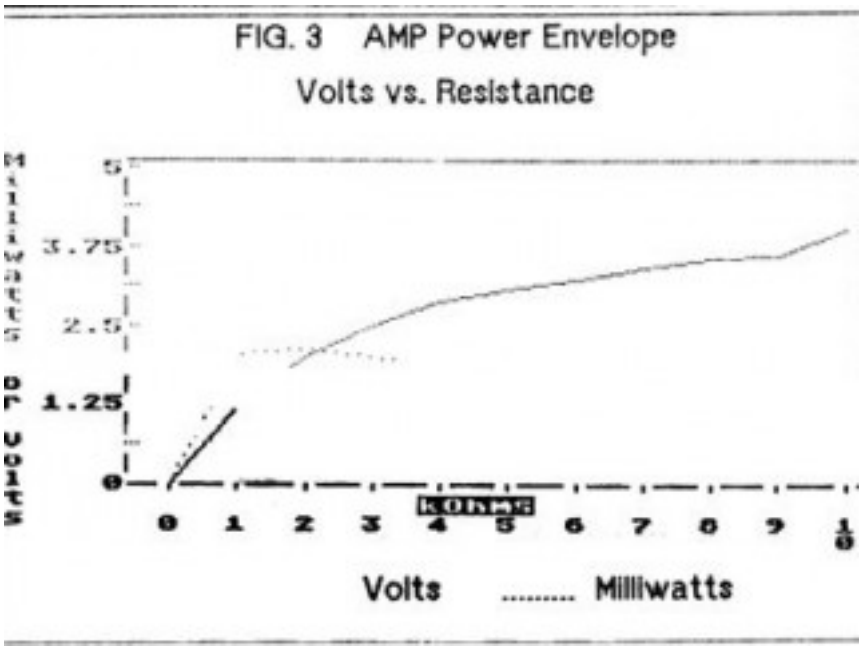

Figure 4 ~ A digital clock is shown powered by the APM-2. The 1.5 volt clock draws 28 microamps. Its position on the power envelope curve would be off the scale to the right and almost on the bottom line, dissipating only 42 microwatts.

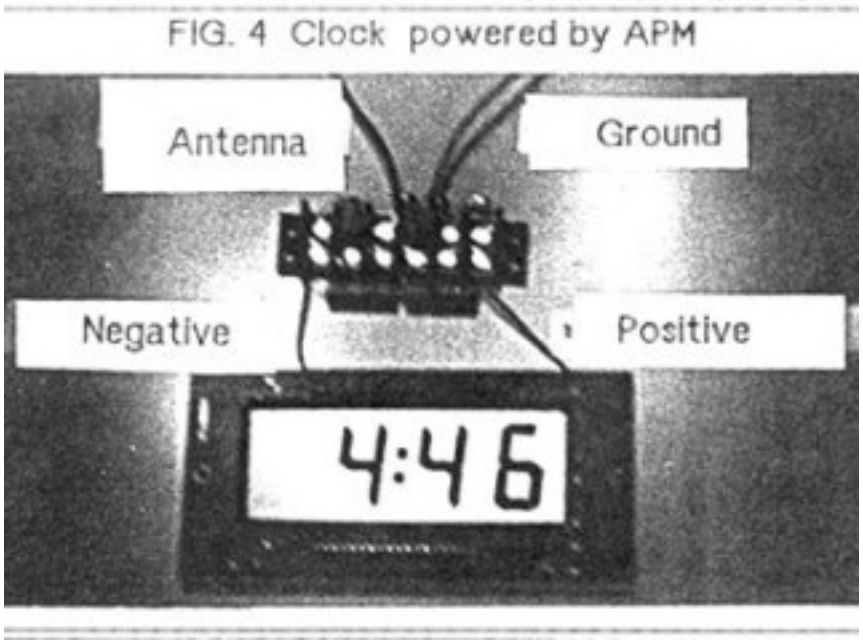

FIG. 5 APM charging a battery

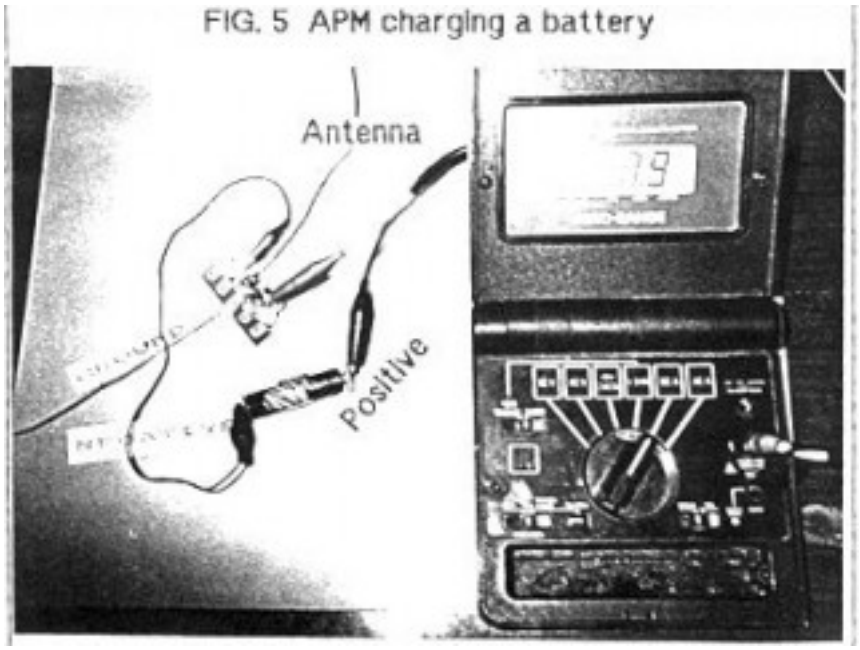

Figure 6 shows a clock which has the APM-2 built into it so it is only necessary to connect the antenna and ground wires directly to the clock. The antenna for this clock, which is a low frequency marine type, is shown in Figure 7.These antenna are expensive, not generally available, and usually don't work any better than the long wire mentioned above. But it may be necessary to use them in urban areas where space is limited and radio noise is high.

FIG. 6

Building the Module

The builder has a choice of wiring techniques which may be used to construct the module. It may be hand wired onto a terminal strip, laid out on a bread board, experiment board, or printed circuit. Figure 8 shows some of the different ways of constructing the APM-2.

Figure 8A is constructed on a screw strip terminal; Figure 8B is constructed on a perforated breadboard; Figure 8C is built on a standard experiment board; Figures 8D, 8E, and 8F are all printed circuits; Figure 8F is made up on a solder strip terminal.

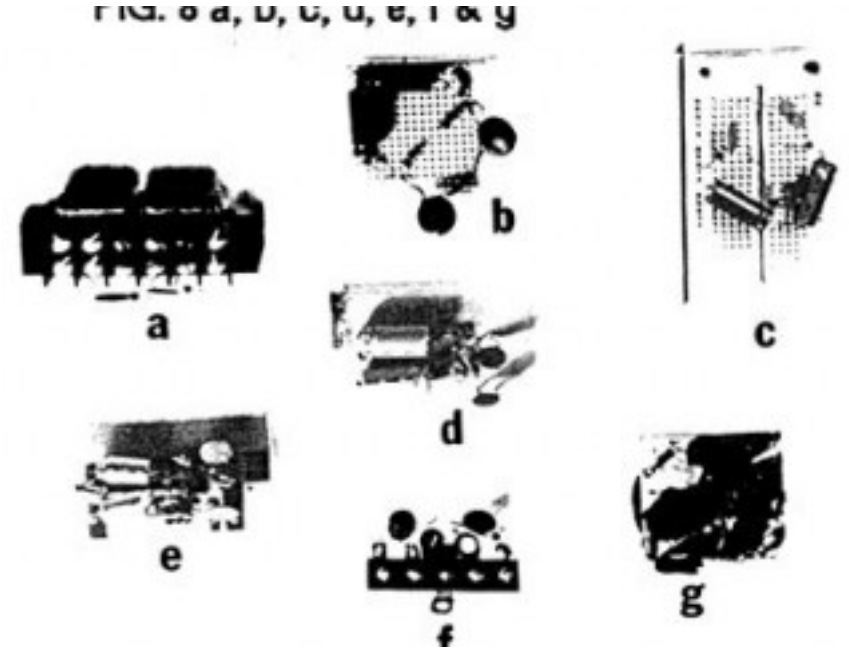

If you wish to make only one or two units, hand wiring will be most practical, either on a terminal strip or breadboard. Assembly on the terminal strip (Figure 8A) can be done easily and without soldering. It is important to get the polarity correct on the electrolytic capacitor. The arrow printed on the side of the capacitor points to negative.

Figure 9 is a closer view of the terminal strip with an illustration of the components and how they are connected.

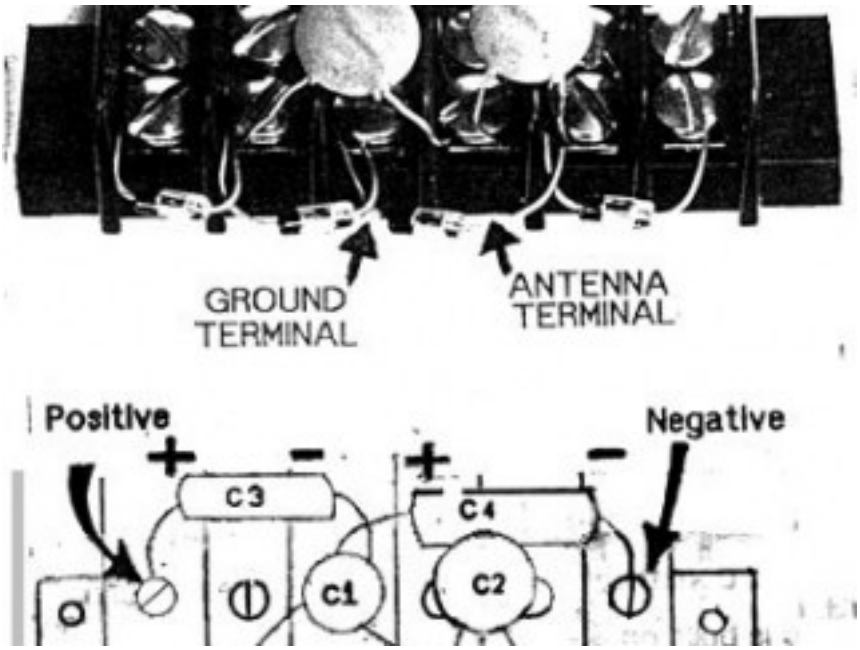

The breadboard unit is shown in Figure 10 with all components on one side and all connections on the other. All you need is a 2" x 2" piece of perforated breadboard (Radio Shack #276-1395) and the components on the parts list. Push component wires through the holes and twist them together on the other side. Just follow the pattern in the photo, making sure to observe the correct polarity on the electrolytic capacitors and the diodes. The ceramic capacitors may be inserted in either direction.

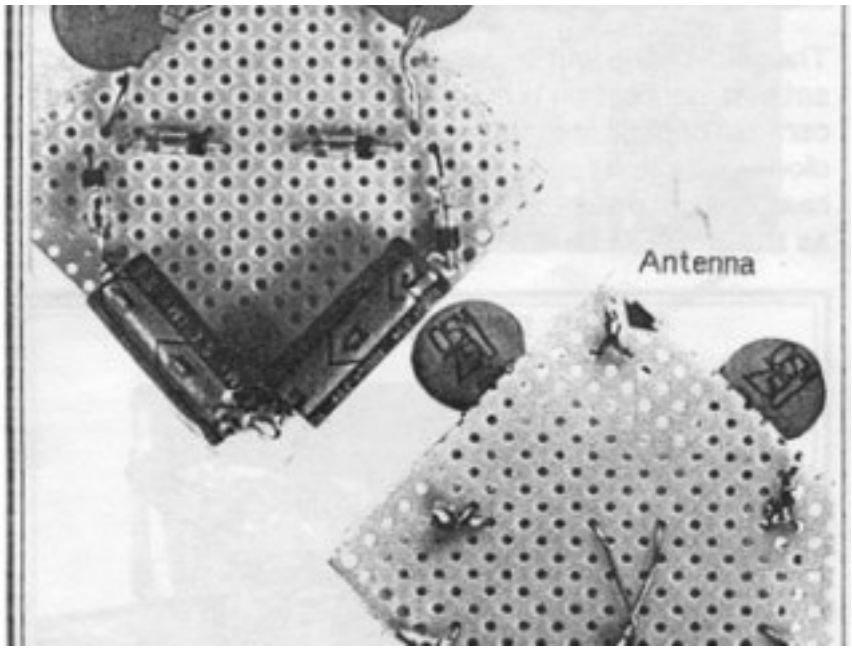

The experiment board unit is assembled by simply pushing the component leads into the board as shown in Figure 11. This unit is powering a small red LED indicated by the arrow.

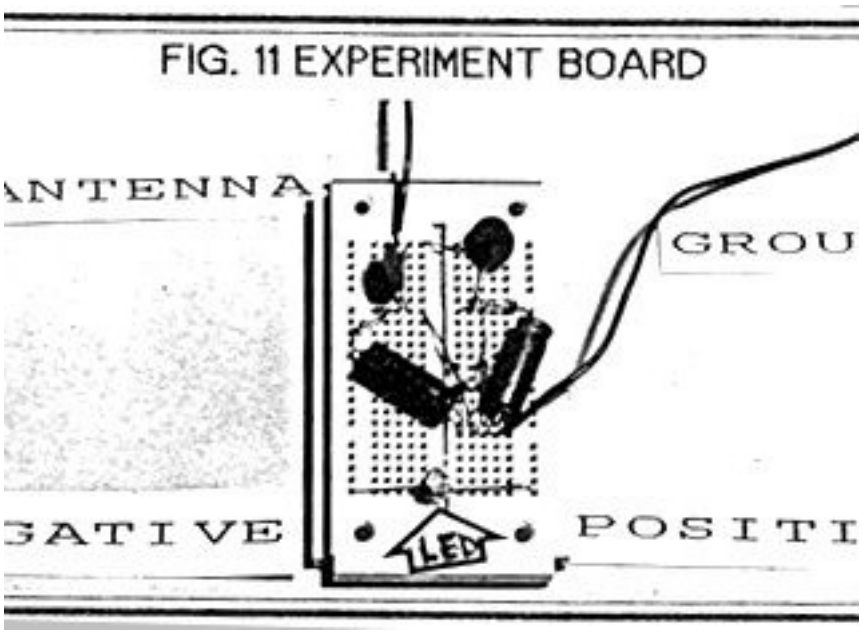

The solder strip unit is made up on a five terminal strip. The antenna connection is made to the twisted ends of the ceramic capacitors. When soldering the leads of the 1N34 diodes, care must be taken to avoid overheating. Clip a heat sink onto the lead between the diode and the terminal as shown in Figure 12.

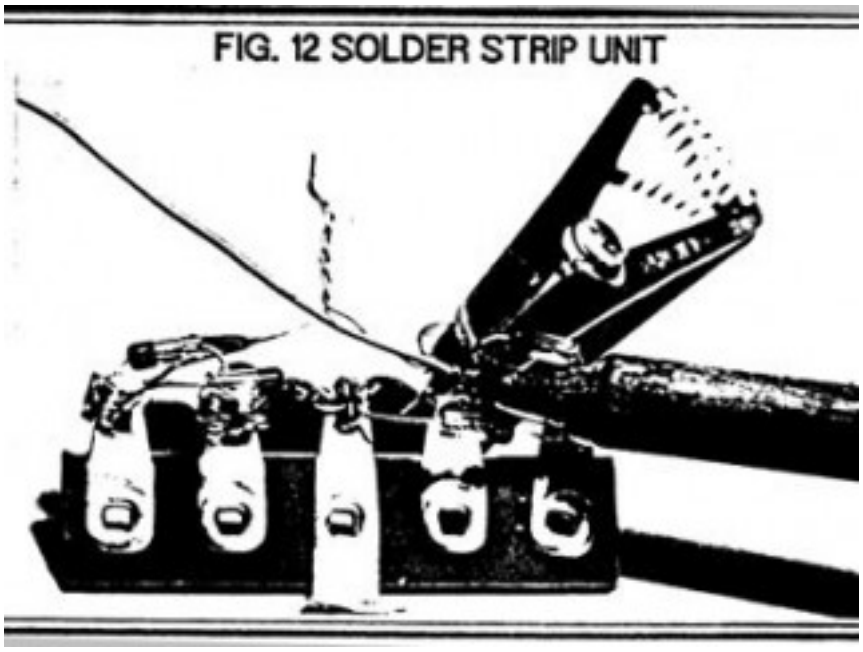

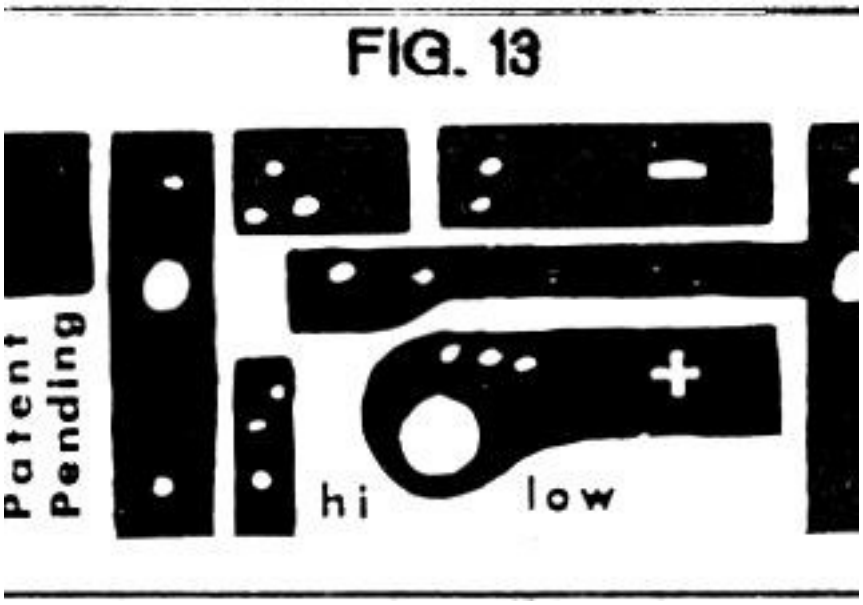

Figure 14 shows the front and back view of the completed printed circuit.

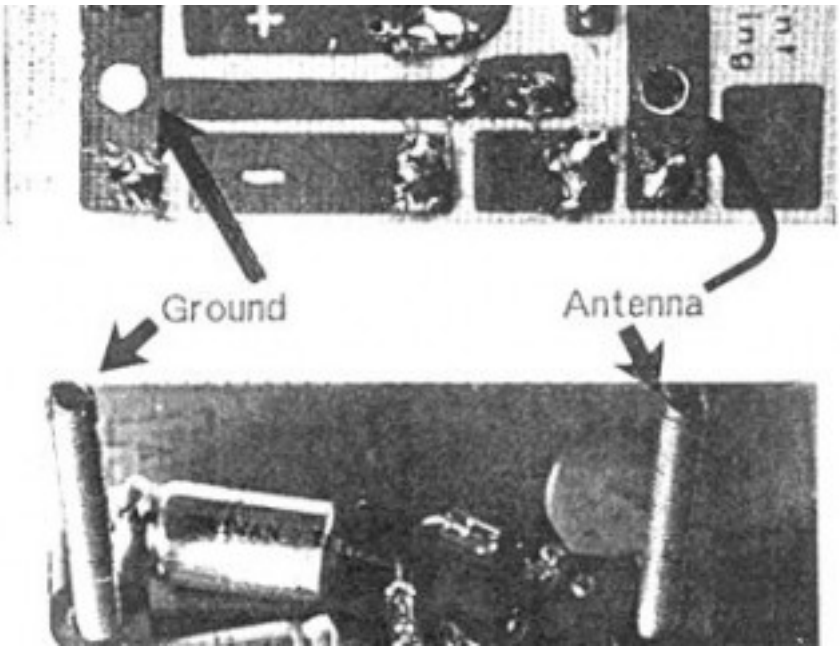

A small switch may be installed on the board to activate the zener regulator (Figure 15). This board was designed for use in clocks.

FIG. 15

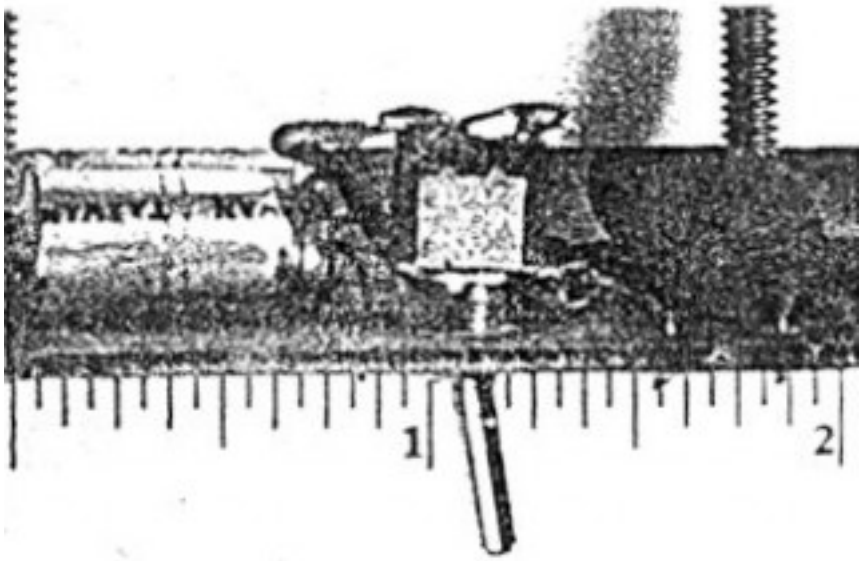

Antenna Requirements

The antenna needs to be of sufficient size to supply the APM with enough RF current to cause conduction in the germanium diodes and charge the ground coupling capacitors. It has been found that a long horizontal wire works best. It will work better when raised higher. Usually 20-30 feet is required. Lower elevations will work, but a longer wire may be necessary.

In most location, possible supporting structures already exist. The wire may be stretched between the top of a building and some nearby tree or telephone pole. If live wires are present on the building or pole, care should be taken to keep your antenna and body well clear of these hazards.

To mount the wire, standard commercial insulators may be sued as well as homemade devices. Plastic pipe makes an excellent antenna insulator. Synthetic rope also works very well, and has the advantage of being secured simply by tying a knot. It is convenient to mount a pulley at some elevated point so the antenna wire may be pulled up to it using the rope which doubles as an insulator (Figure 16).

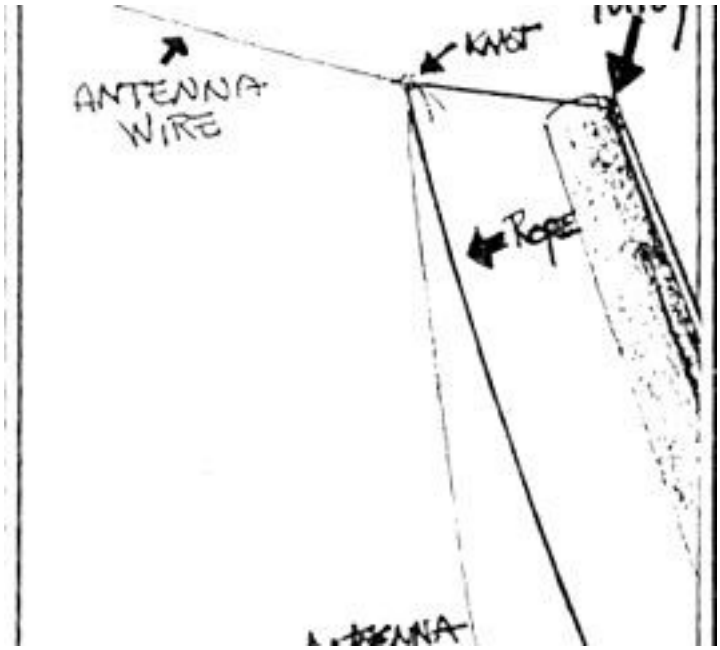

Figure 17 is an illustration of a horizontal wire antenna using a building and tree for supports.

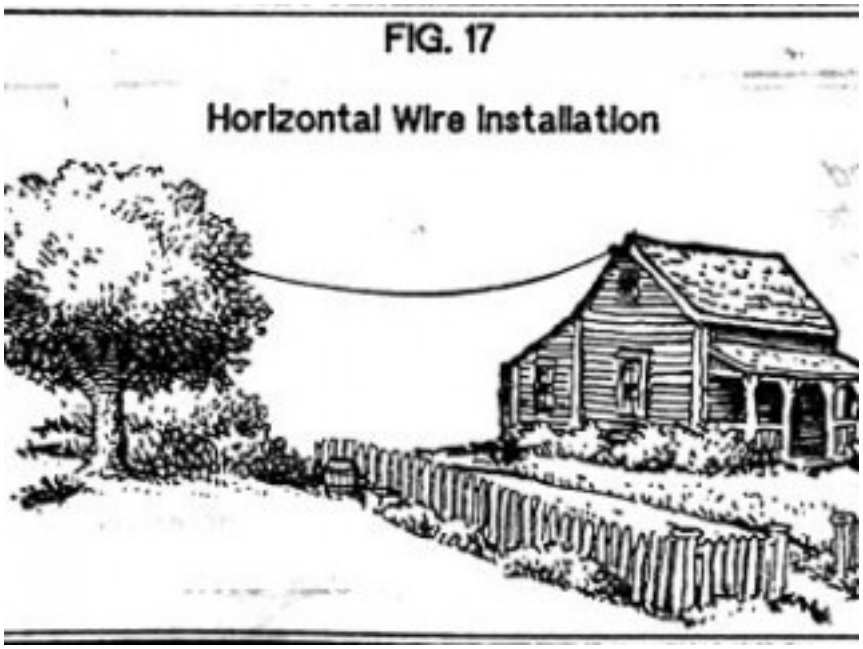

Grounding

Usually a good ground can be established by connecting a wire to the water or gas pipes of a building. Solder or screw the

wire to the APM-2 ground terminal. In buildings with plastic pipes or joints, some other hookup must be used. A metal rod or pipe may be driven into the ground in a shady location where the earth usually is damper. Special copper coated steel rods are made for grounds which have the advantage of good bonding to copper wire. A ground of this type usually is found within the electrical system of most buildings.

Conduit is a convenient ground provided that the conduit is properly grounded. This may be checked with an ohmmeter by testing continuity between the conduit and system ground (ground rod). Just as with the antenna, keep the ground wire away form the hot wires. The APM's ground wire may pass through conduit with other wires but should only be installed by qualified personnel.

Grounding in extremely dry ground can be enhanced by burying some salts around the rod. The slats will increase the conductivity of the ground and also help retain water. More information on this subject may be found in an antenna handbook.

Good luck getting your Ambient Power Module working. It is our hope that experimenters will find new applications and improve the power capabilities of the APM.

CopyRight Joseph Tate

Inventors: Tate, Joseph B. (Sausalito, CA)
Brown, David E. (Mill Valley, CA)

Application Number: 06/695632

Publication Date: 12/09/1986

Filing Date: 01/28/1985 NOTE: The images maybe hard to see as they were originally scanned and uploaded in black and white. If it helps you to replicate this device you may want to check the images of the one I built at the very top (in color) Here are some more photos of my completed unit for your review.

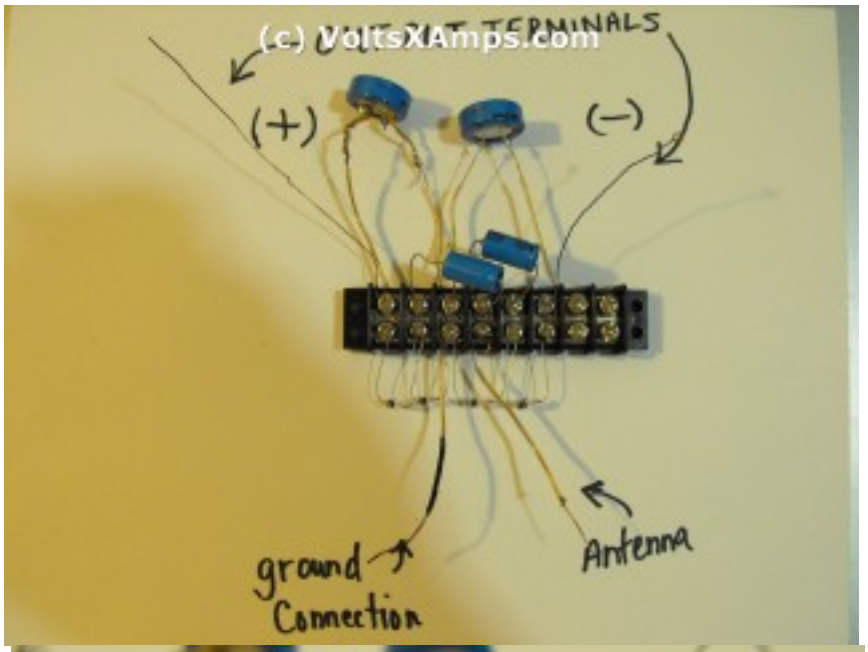
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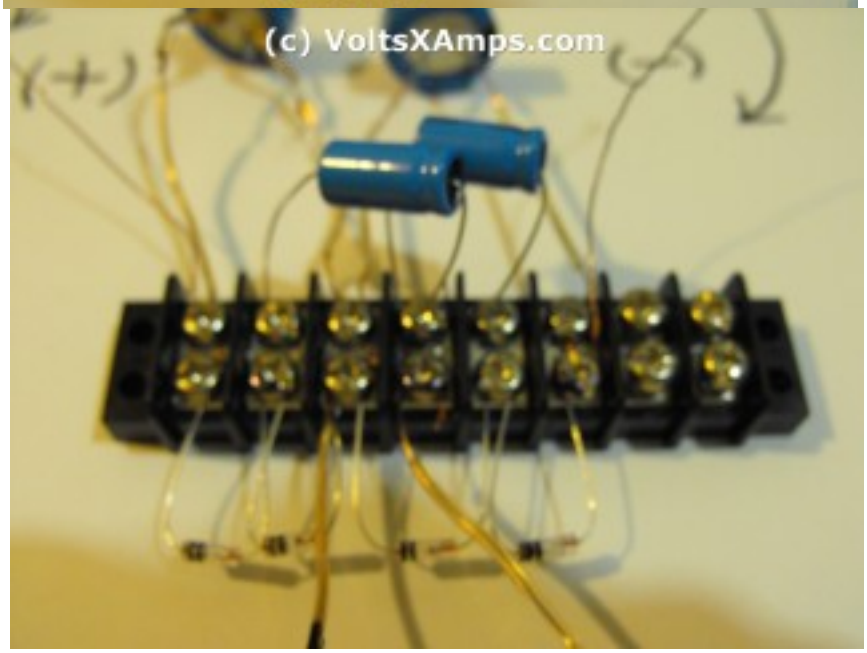
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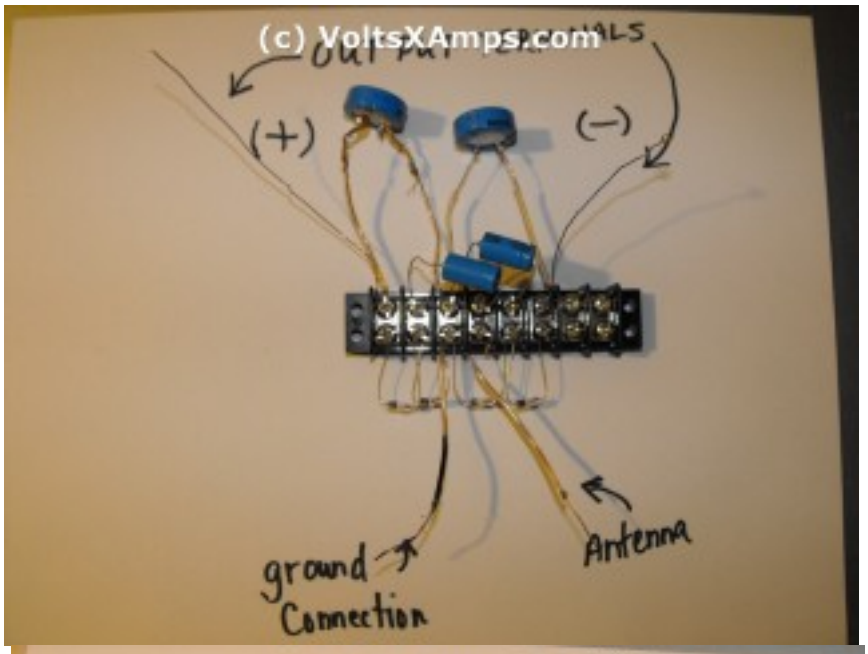
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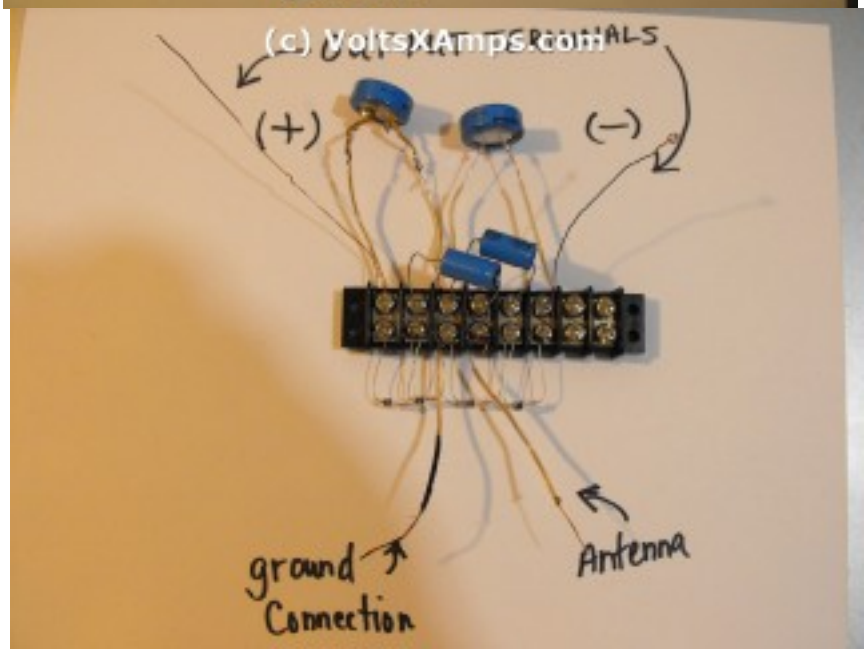
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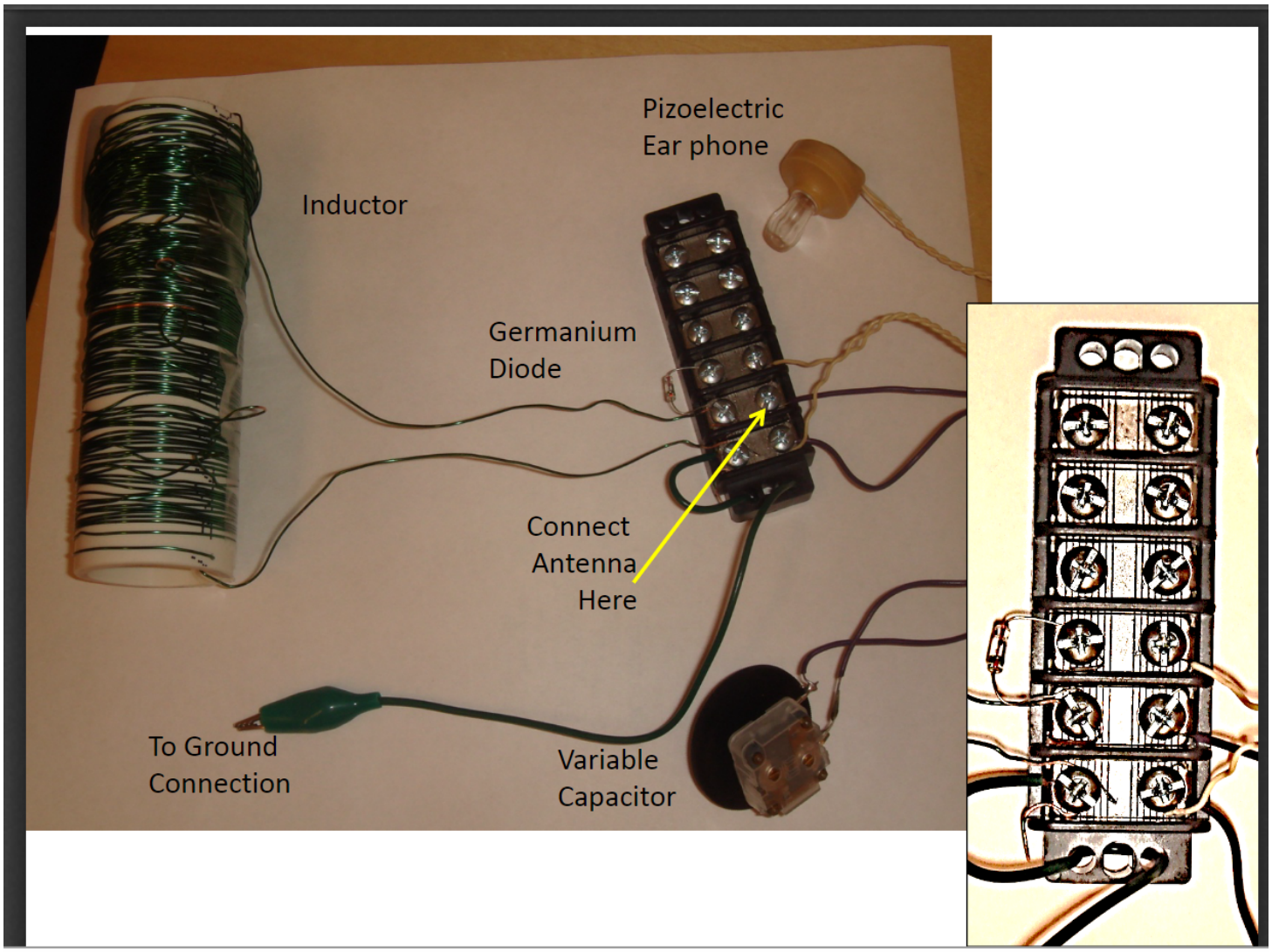
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Capacitor

FM Crystal Radios?

copyright © 2006 by Larry J Solomon

I have heard, even from a physicist, that it is impossible to build FM crystal radios. On the other hand some experimenters claim that they have built them. This argument intrigued me to try and build an FM crystal radio, which I have done successfully. To my surprise, the result is an astounding performer, pulling in four local stations in Tucson. When connected as a receiver to a good sound system the sound fidelity is as good or better than more expensive AM radios. In fact, it sounds "high-fidelity".

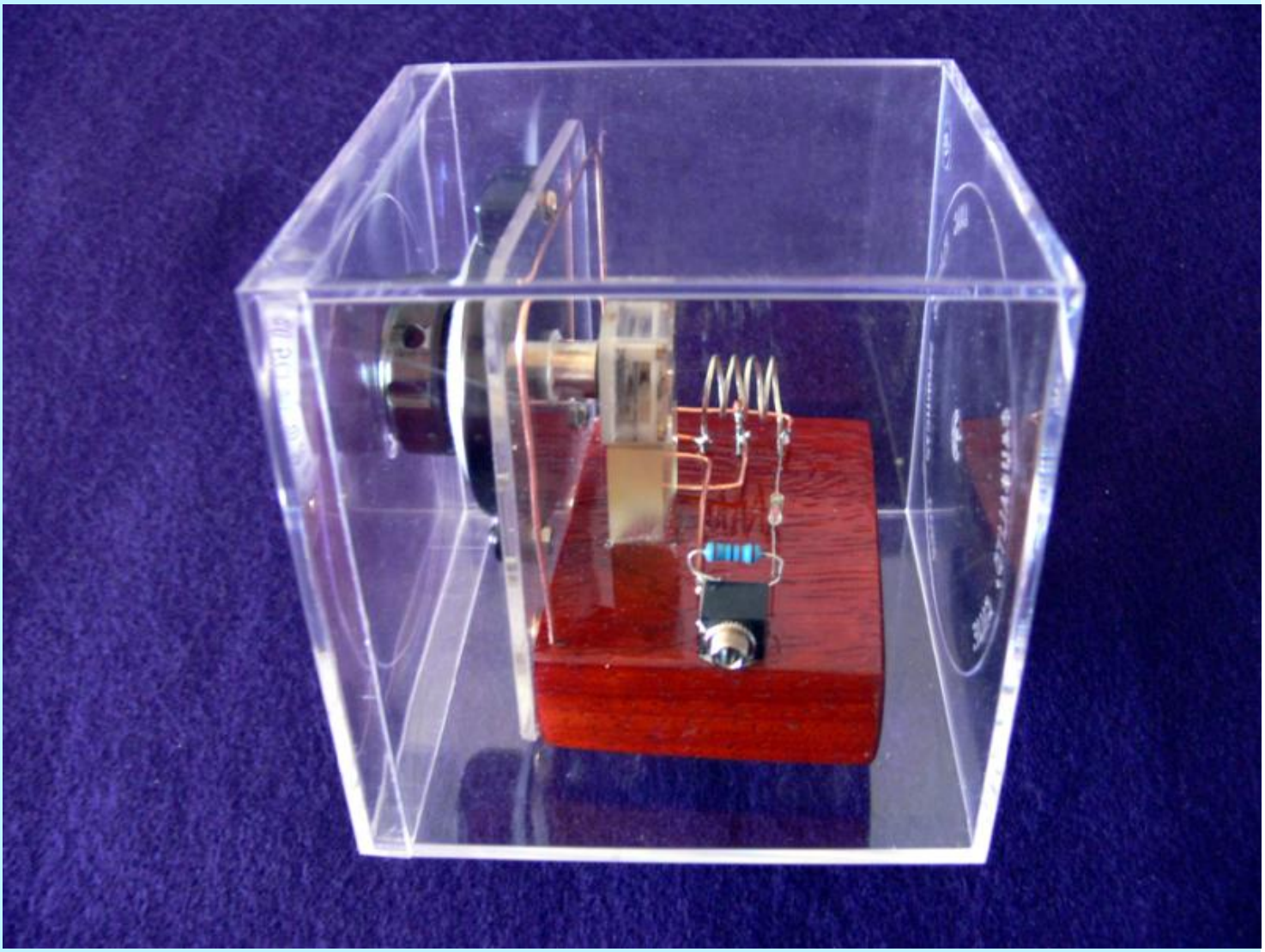

This picture shows the Solomon FM Crystal Set in an acrylic display case. I made the set specifically to fit inside this case (the case came first).

My definition of a crystal radio is one that is not powered, except by the radio transmission itself and employs a crystal detector. So, it should work without any batteries or AC power. An FM crystal receiver must be able to detect and receive FM signals well enough to be heard in earphones without any such extra power.

This FM receiver is an amazing performer. It has crystal clear reception (pun intended), good sensitivity, but only fair selectivity. This set was a discovery for me. I started out by designing and building the normal AM sets. Then one day while testing the "Mystery" set (see my other web links), to my surprise, in addition to the expected panoply of AM stations, I heard a very faint signal that I could not tune out. At first, it seemed too weak to identify. When I tuned out all the AM stations, I was astonished to hear the announcement "KiiM FM, 99.5"! This is a

country music FM station here in Tucson. It was all over the dial, untunable, but the much louder AM signals masked it when they were tuned in.

I set myself the task of trying to improve the FM reception. I tried some simple circuit modifications that did not seem to improve anything. Then I connected a dipole antenna instead of the AM antenna I normally use. Suddenly, the FM signal was much clearer, although still weak. By using the audio output and sound system amplifier, I was even more amazed that four different FM stations came in loud (or rather medium) and clear. I found that changing the telescoping antenna length and position I could tune the stations in and out. They were KRQ, KLPX, KiiM, and KHYT all local FM stations with transmitters nearby. Their reception was also affected by the length and position of the audio output cable.

After doing some research, I discovered that there was a physical theory that claimed that FM reception was possible and even probable using the same circuit as an AM receiver. The theory is called "slope detection". So, I set out to find circuit improvements. A web search yielded little, mostly theory. But there was enough information that I thought I could make some modifications to the AM circuits to make them more tunable to FM signals and less tunable to AM. Since FM operates at higher frequencies, all I had to do, I thought, was make the coil and caps smaller. After much "tinkering" I arrived at the current circuit.

The circuit looks identical to a classic AM crystal circuit but is even simpler to build. The components were reduced in dimension to resonate at higher frequencies. This was done by experimenting with smaller and smaller coils and capacitors. The antenna is also much reduced in size (from that of AM) to resonate at higher frequencies (the antenna is crucial). The air variable capacitor I used has two trimmers in it which should be adjusted for best reception.I have found that a commonly available vernier dial and knob will fit the capacitor nicely. See end of article for a picture of the variable. C3 is a ceramic capacitor of 18 pf, but may be anywhere from 10 to 50pf. A detected FM signal is converted to AM due to an effect called slope detection that modulates amplitude.

This FM Crystal Set works best near the transmitter (I have not tested it beyond about 10 miles). Secondly, the sound level is quiet, especially without an amplifier. A quiet room is needed for listening with earphones. One must be willing to move the set around to find a location for the best reception of signals. However, in addition to listening with high impedance earphones (crystal or otherwise), the set can be connected directly to an audio amplifier's low level magnetic input which can then play amplified through a sound system at any volume -- sounds GREAT. In fact, I recommend starting tests with the FM crystal set by connecting it to the low-level phono inputs of a receiver or preamplifier. (Nowadays, many receivers don't even have a phono input!) That way you can crank up the volume, which makes it more likely to find the FM stations. If no signals are detected, I also recommend connecting an external "rabbit ear" antenna or hanging a short wire (12 inches or so) in various positions next to the internal antenna. The variable length of rabbitt ears can help to tune in stations.

No additional wiring or antenna is necessary (the antenna is optimized in length for FM.)

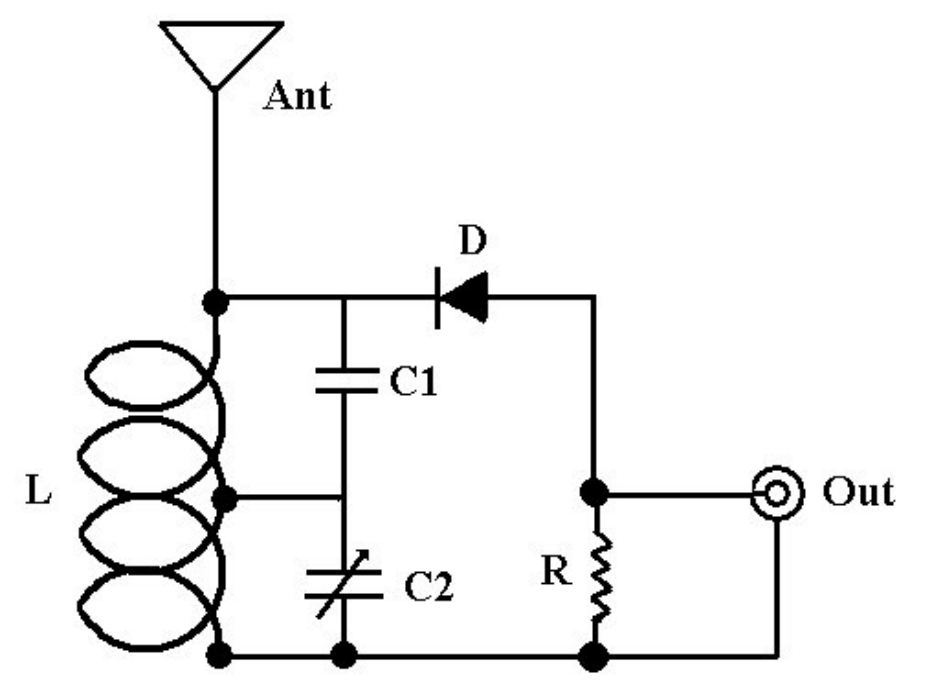

L - 4 turns #18 copper or silver wire, 12mm inside diameter, tapped at 2.5 turns
Ant - 7 inches of #18 bare copper wire
C1 - 18 pf ceramic capacitor
C2 - 50 pf air variable capacitor
D - 1N34 diode or rock crystal
R - 150K resistor

The diode is tapped directly to the antenna. The vernier dial fits directly on the tuning capacitor. The antenna parallels the perimeter of the acrylic face plate. "Military style" #18 AWG wiring is used without any insulation. It is important to keep the components physically close together. The component specifications are the same as in circuit #2. The coil is silver rather than copper, but copper does just as well. I think that the contrast of the silver and copper is beautiful. The coil was wrapped around a Sharpie Permanent Marker, then slipped off and expanded slightly. The wooden base is made from lacquered, polyurethane padouk.

I consider this set a work of art as well as science and think it is the most elegant crystal receiver I have created. I love the contrast of the silver coil, the copper antenna, the clear acrylic faceplate, the black vernier dial, the white and transparent variable capacitor, and the subtle colorings on the resistor, the diode, and the lucite base. Yet the circuit is so ridiculously simple that some will not believe it is possible without building it themselves. No shielding is necessary, and there is no problem with hand capacitance. However, the output cable position may affect reception sensitivity.

Photos of wired circuit

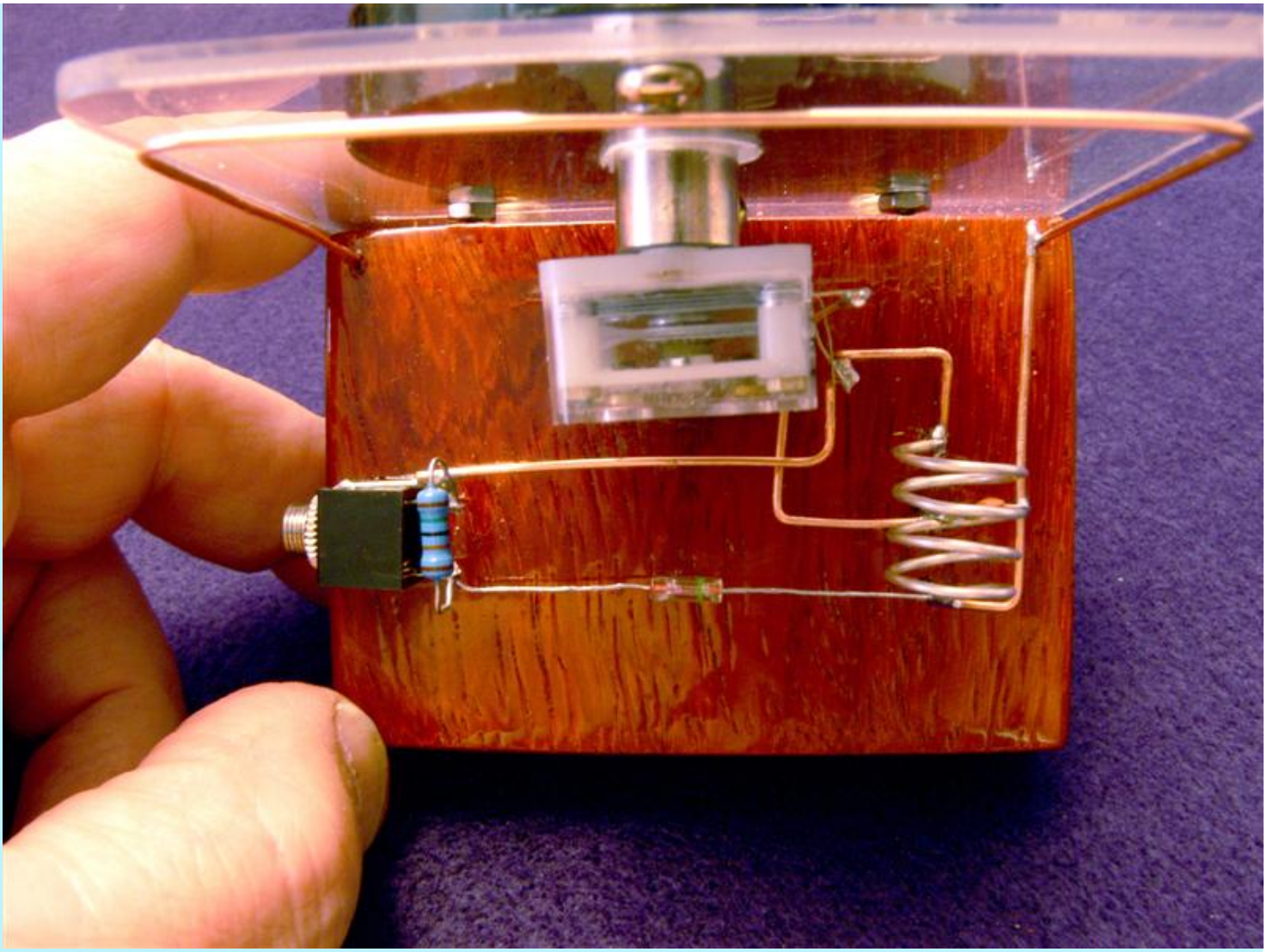

A hand is included in this photograph to show scale. Note the military style wiring, diode, and antenna. I wanted the wiring to create a modern design similar to a Mondrian painting. Not only is this set beautiful, it works! No power and no long antenna! It looks like a work of fiction.

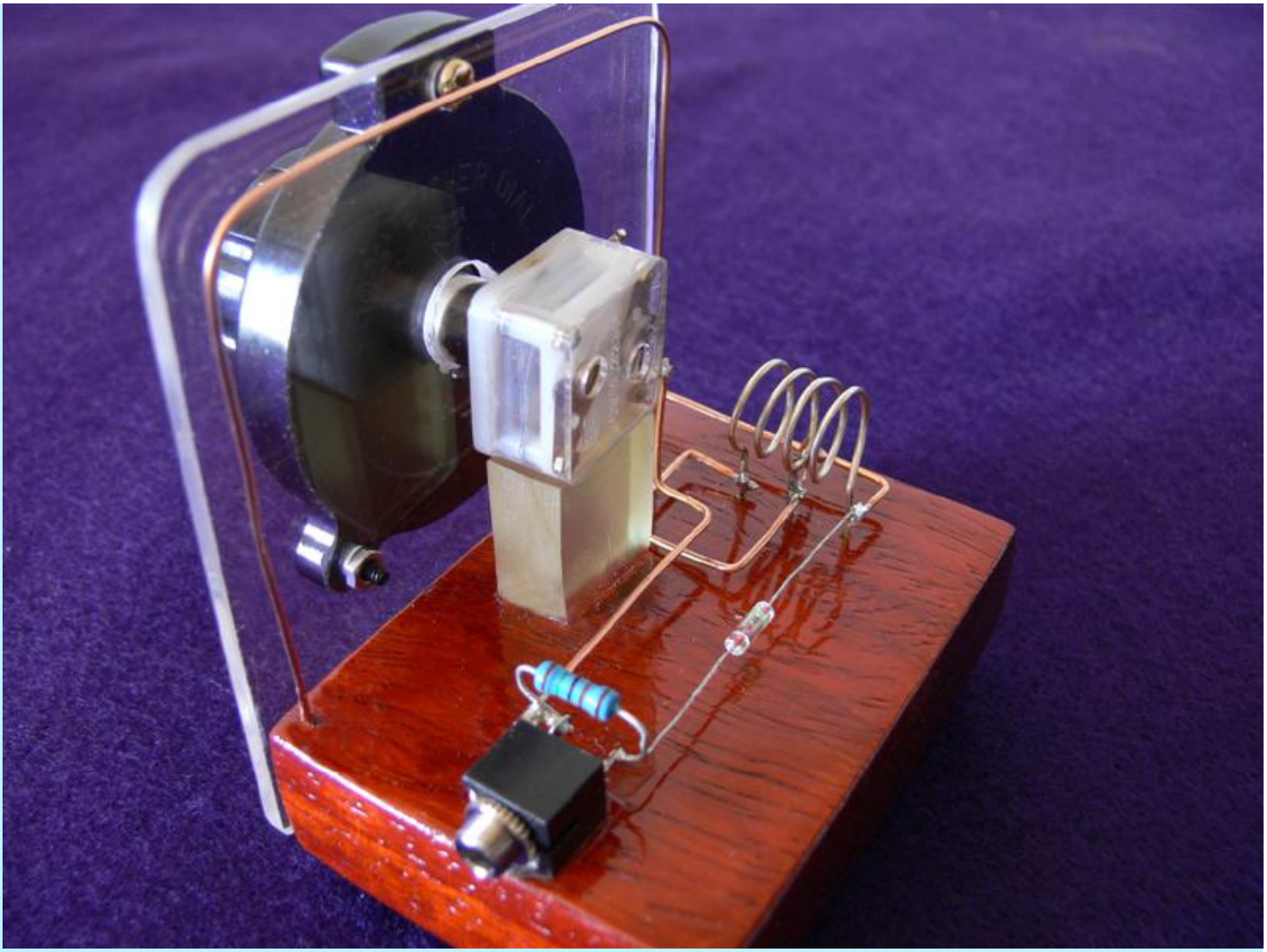

Is this thing imaginary -- science fiction? Well, imagination did play a part, but it is definitely not science fiction. This shot shows the elegance of the FM set best, I think. There is only one resistor and one fixed capacitor.

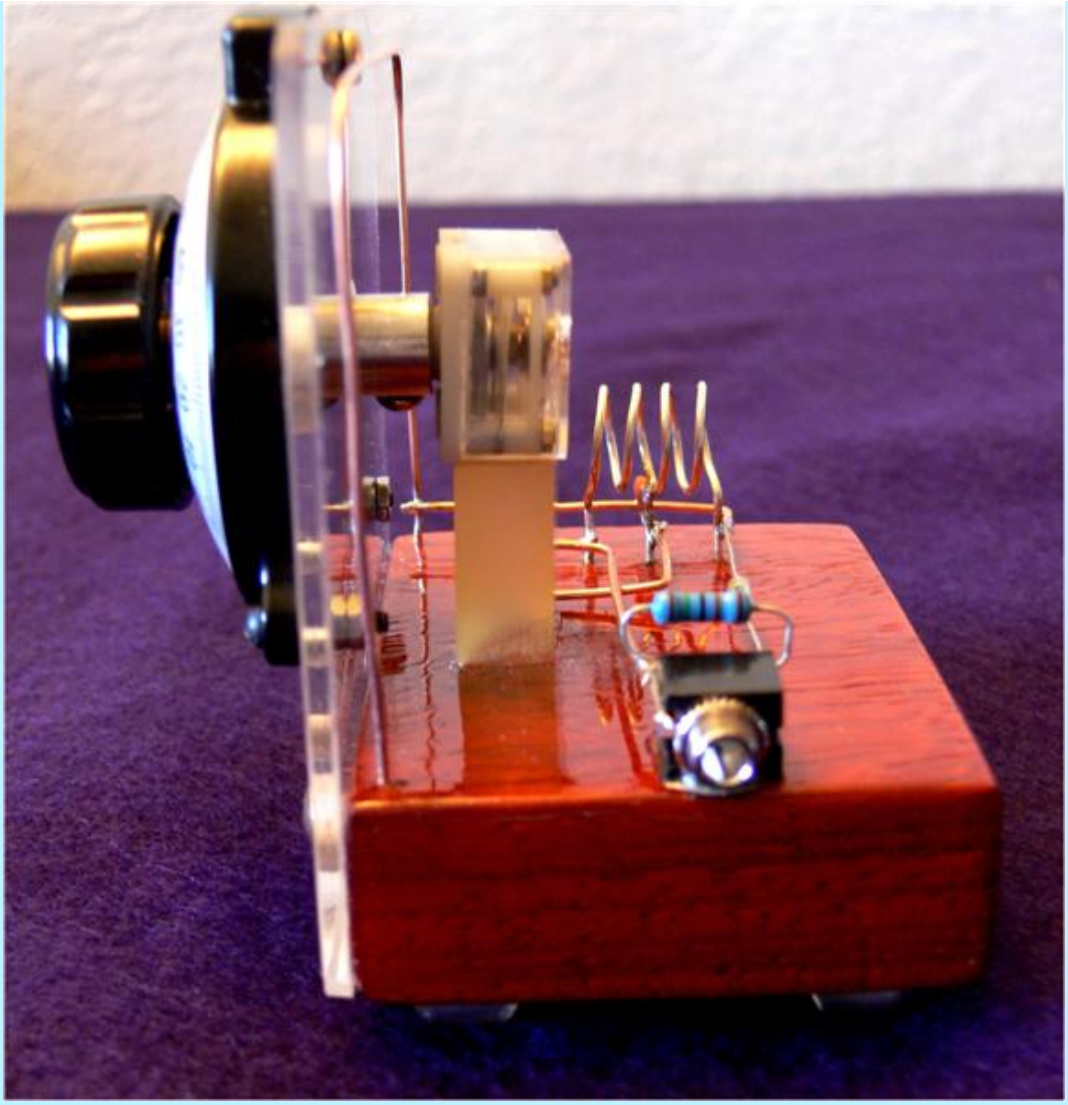

The inside of the tuning capacitor and the phono jack/output can be seen here. Can you spot the fixed ceramic capacitor? Note the polished edge of the face plate and the reflection in the wooden base.

A quarter-inch piece of lucite was fitted under the tuning capacitor to anchor it. Note the two tiny trimmers on the back of the tuning capacitor. Brass screws were used to enhance appearance.

The vernier dial is large to accomodate ease of tuning, and the vernier makes it easy to separate stations. Two golden (brass) wood screws fix the face plate to the base. Holes for the face plate were made with special plastic drills, but ordinary drills may be used if drilled very SLOWLY. The knob is removable.

FM Crystal Circuit #2

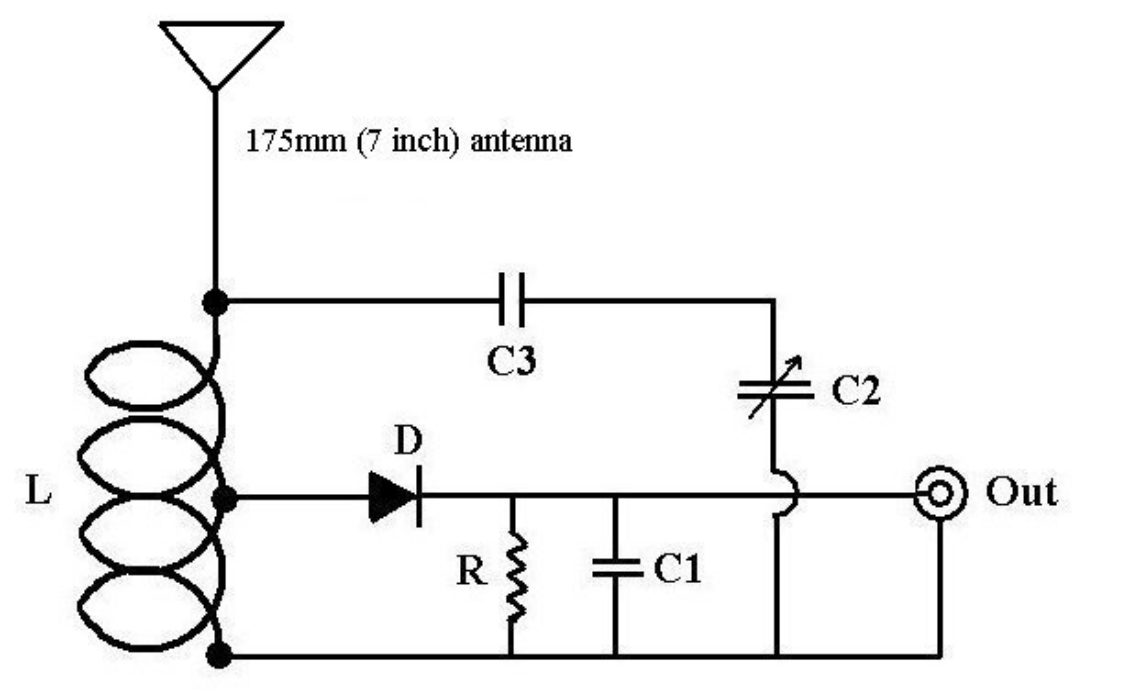

L - 5 turns AWG#18 bare copper or silver wire, 12mm inside diameter, tapped at 2.5 turns
D - 1N34 or rock crystal diode
C1 - 82 pf capacitor
C2 - 80 pf air variable capacitor
C3 - 18 pf capacitor
R - 150K resistor

The following photographs show the circuit wired with the handmade Saturn Dial. and knob. It is perhaps not as visually striking as set No. 1, but it works just as well. In fact, this set was the original version. Notice that all the wiring and coil are copper.

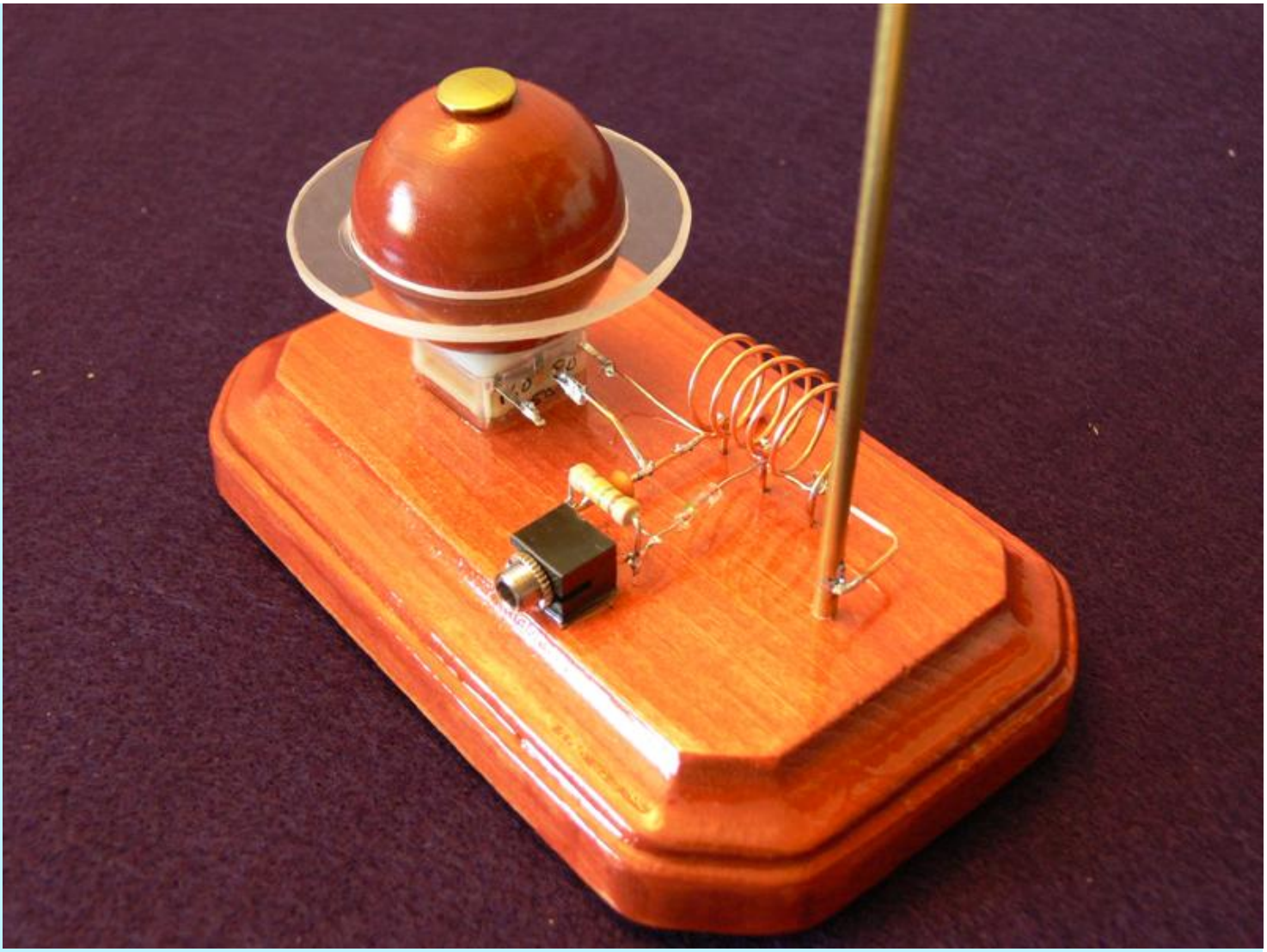

The Saturn dial and knob were fashioned from a "doll's head" from Michael's Arts and Crafts, a piece of lucite cut with two circle cutters, and a brass paper fastener. The knob is fixed to the tuning capacitor with a small machine screw that fits in the hole below the brass fastener. The most difficult part of this was fashioning "Saturn's rings". This must be done very carefully and slowly. The inside edge should be cut slightly undersized and then sanded with a drum sander to fit snugly. The outside edges can be sanded with fine sandpaper and polished with a plastic polisher.

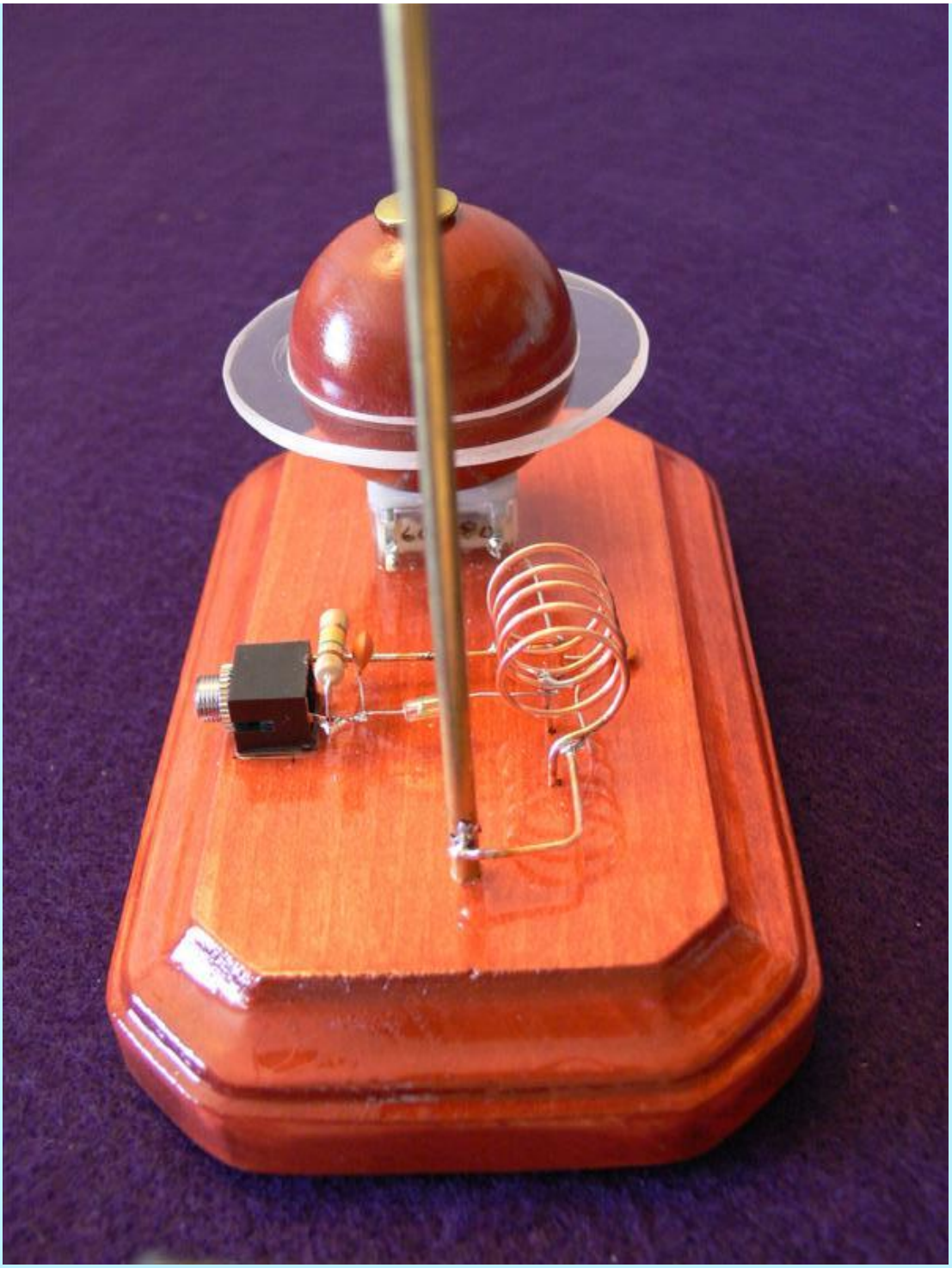

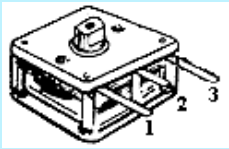

The air variable capacitor may be obtained from Electronix Express at http://www.elexp.com/. Part number 14VCRF10-280P. The 80 pf side is recommended for the second circuit, contacts 2-3. Contacts 1 and 3 were used for the first circuit (50pf).

- OSC: 5-59 pf
- ANT: 5-142 pf
- OSC and ANT Trimmer 10pf range

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FREE ENERGY FROM THIN AIR!

Technology (/technology/) > Science | by DrewPaulDesigns (/member/DrewPaulDesigns/) Follow

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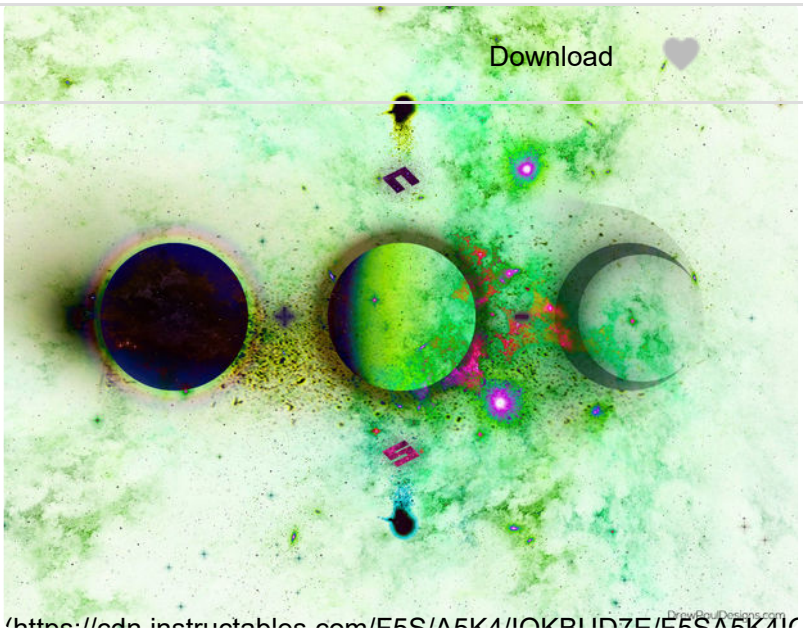

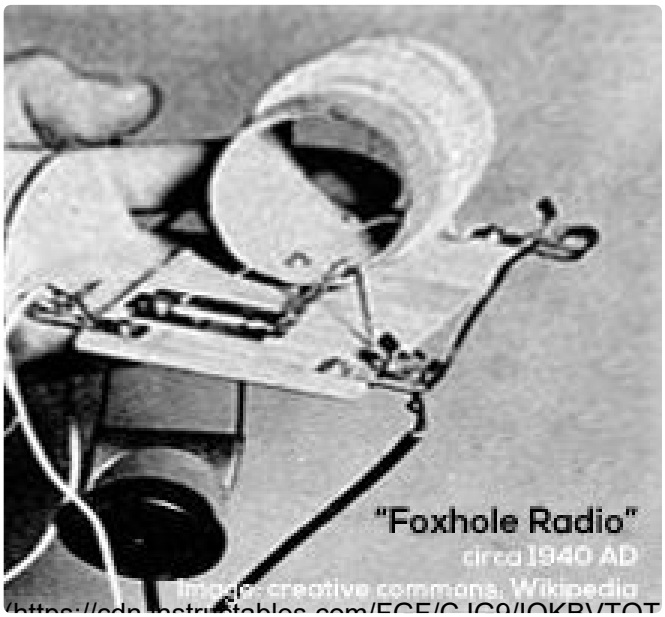

"Free energy from the air?, Yea, right!" Sardonic skepticism was my first reaction to this unusual concept, as well.

Though, its not so far out there, in fact. Light can be converted to DC current with solar panels, electricity can be converted to magnetism as I did in my last article (https://www.instructables.com/id/DIY-Electro-Magnetic-Levitation/), in a microphone sound waves are converted to an electrical signal (by vibrating a magnet near a coil (http://hyperphysics.phy-astr.gsu.edu/hbase/audio/mic.html)), solar rays can even be focused and converted to heat in awesome devices like this! (http://www.gosunstove.com/) When we think about it, energy is all around us and can be harvested in an enumerable many of ways.

Download

Today, we are going to take a rather novel approach. We are going to build a device specifically designed to sense and capture a particular band of energy which is all around us.

The earth is magnetic and anyone who has ever used a compass knows this. Magnetic bodies in motion produce electricity, we can see this in any alternator, like the one in your car. So, therefore the earth is electric as well as magnetic, by definition.

Can we detect this energy? Yes, we sure can! Ever turn on a radio in the middle of nowhere and heard static? That is your radio picking up naturally occurring energy in the RF spectrum!

Can we use this energy to do work? Absolutely! This has been known for a long time. Crystal radios (https://en.wikipedia.org/wiki/Crystal_radio) have been around since before the 1930's and can run with no input energy other than the radio signal. Even when completely isolated, but from the atmosphere, a crystal radio will produce a voltage in the earpiece resulting in a sound (albeit and undesirable one).

Well, this is where it gets interesting...

Can we replicate this effect? Yea, and with modern components like the high quality crystals found in germanium diodes, we can even increase efficiency. By applying this concept as a Crystal Energy Receiver we can take advantage of a wide range of energetic frequencies rather than tuning in to just one.

Can we scale it up? Definitely. Things like micro germanium diodes, high efficiency antennas and compact contemporary capacitors make the components that are required to build a crystal receiver fit in the palm of your hand. While there may or may not be a more efficient way, this renewable energy solution is simple to employ

and can be scaled up, or down, indefinitely.

Download

It sounds like we can build a Crystal Energy Receiver. Let's give it a shot...

Add Tip Ask Question

Step 1: What You'll Need

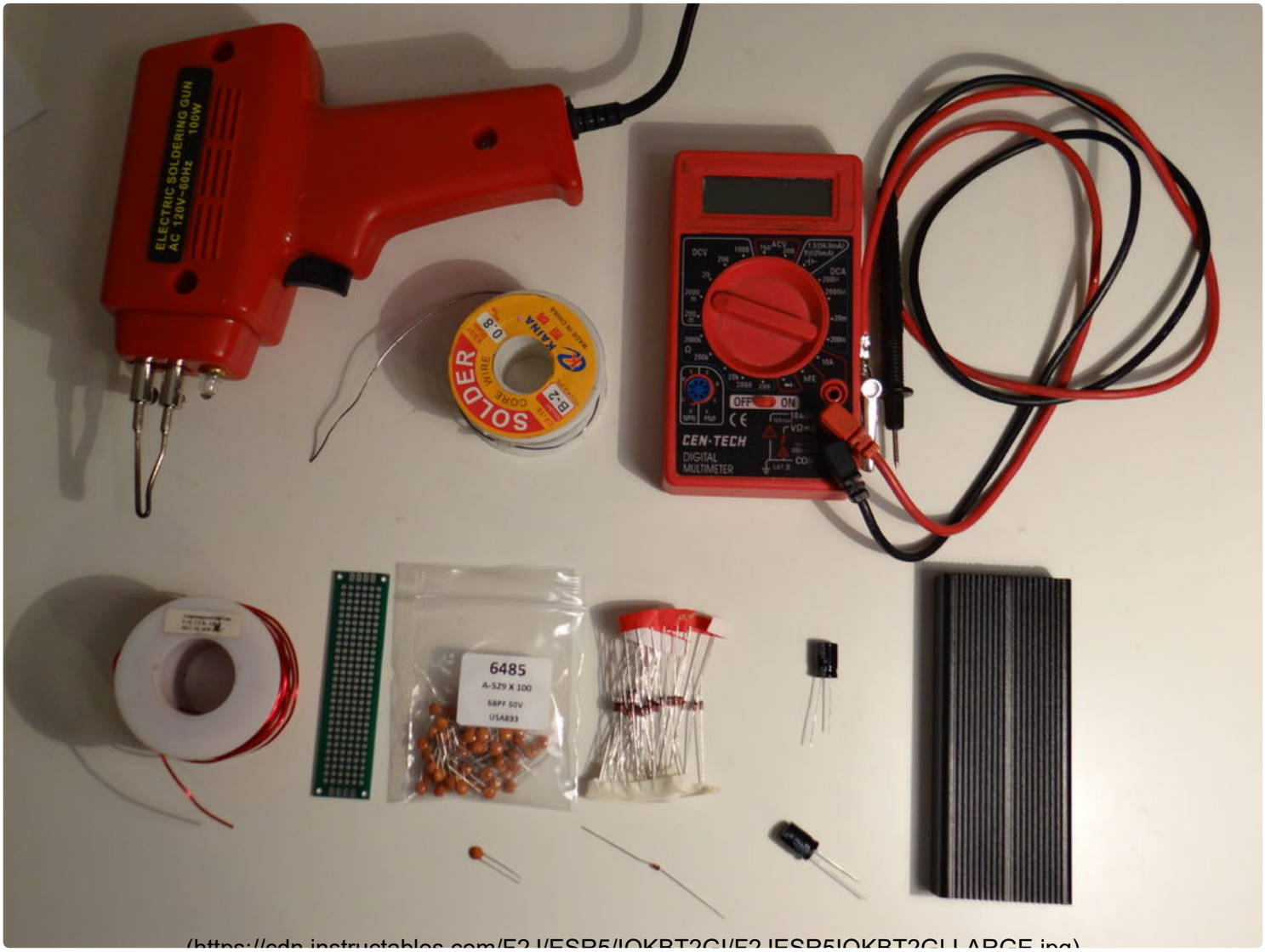

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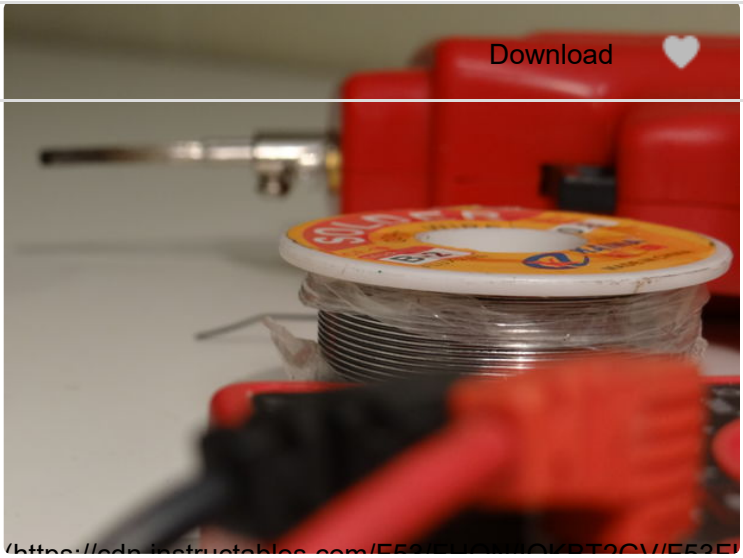
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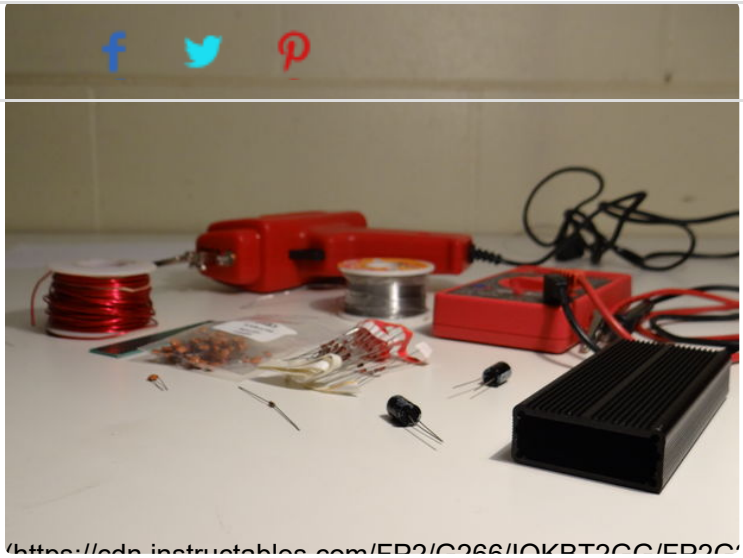

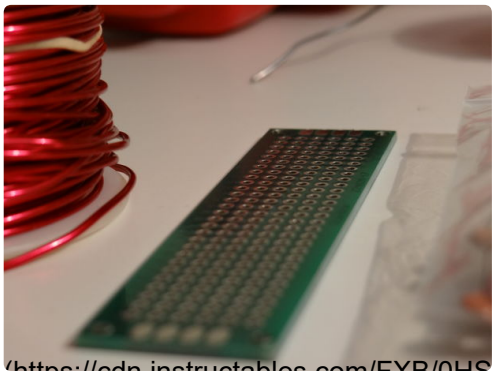

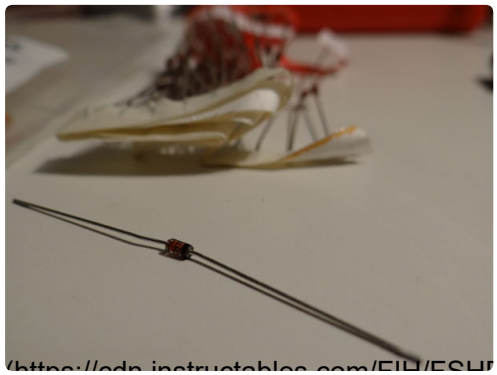

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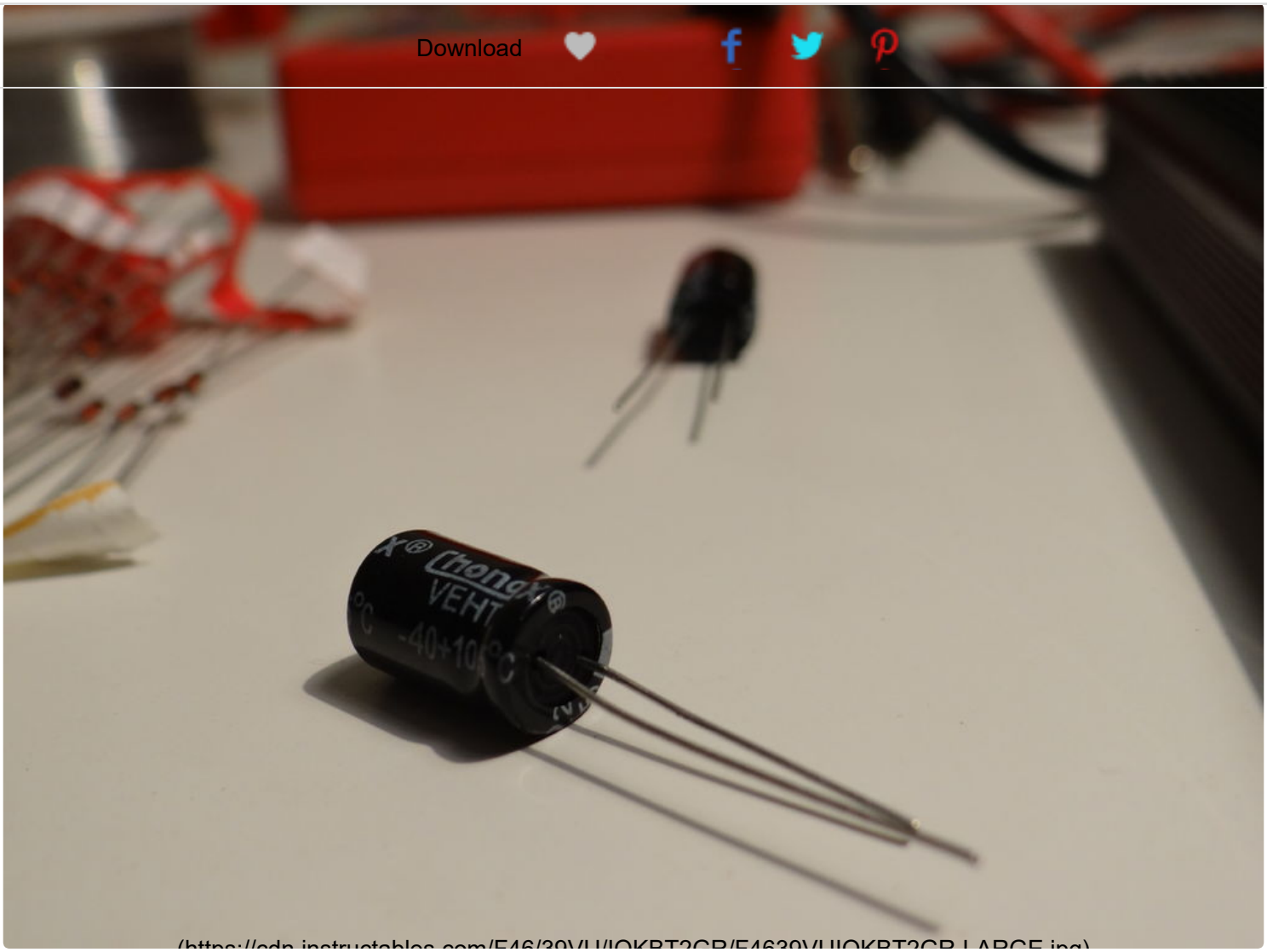

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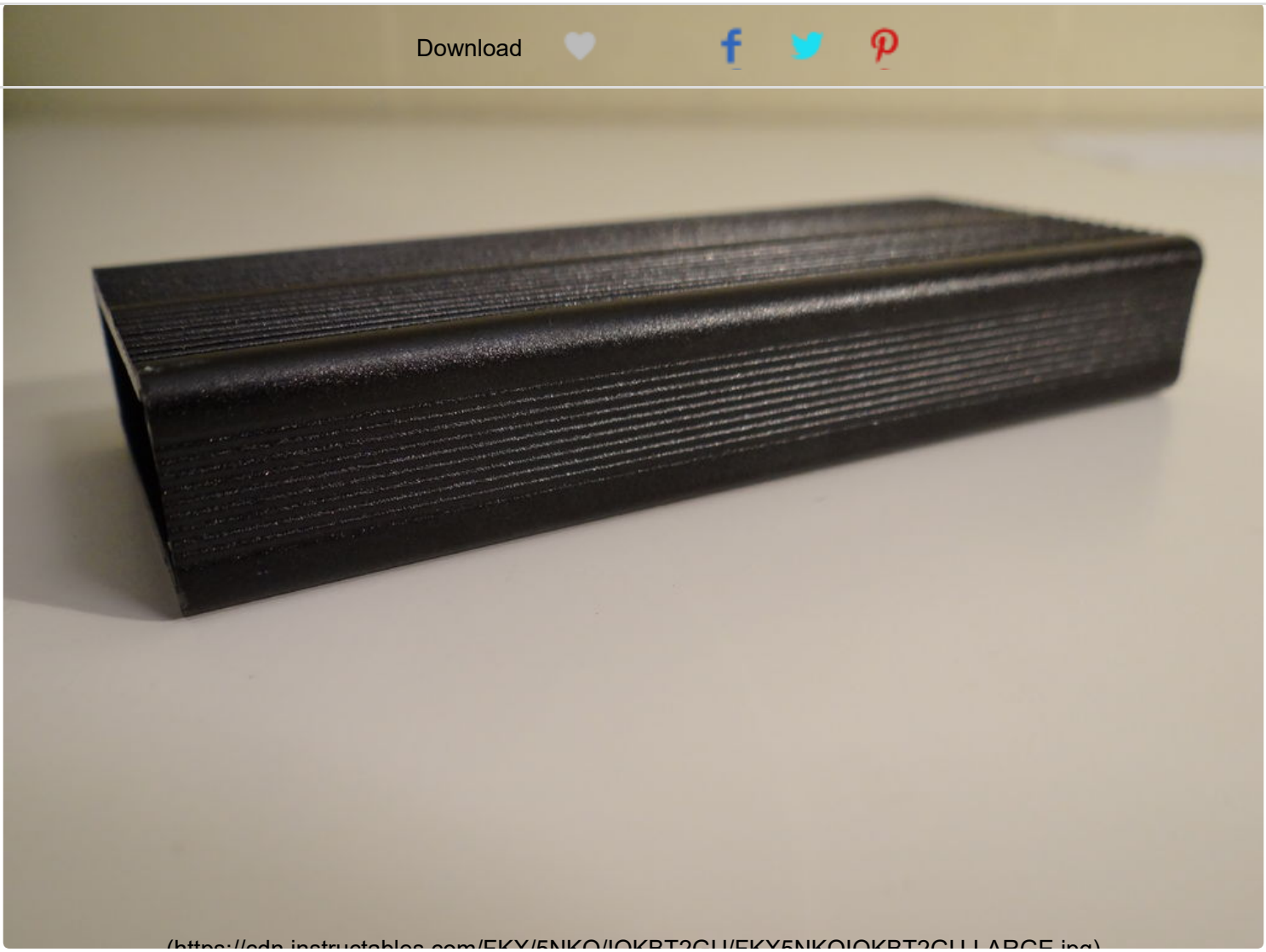

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One of the reasons this particular renewable energy harvesting method is so viable is the relatively few and easy to obtain materials required.

The simplest crystal receiver design needs no power and can be built with only three parts: a coil, a crystal and a resistor. We're going to optimize that design in order to produce a cleaner and more reliable output signal by first polarizing the input amplitude, then rectifying and filtering the signal. Then we'll add an antenna, case and connections.

Get the circuit diagram here (http://www.drewpauldesigns.com/crystal-energy-receiver-kit.html)
Get the kit here (http://www.drewpauldesigns.com/crystal-energy-receiver-kit.html)

Download

The parts for the circuit include:

(1) Circuit Board (http://www.drewpauldesigns.com/crystal-energy-receiver-kit.html)

(1) 10-18 gauge Copper Wire

(2-12+) Ceramic Capacitors (matched)

(2-6+) Electrolytic Capacitors (matched)

*note various types of capacitors can be used

(4) Germanium Crystal Diodes (1A+)

Total Unit Cost: +/- $0.40 (USD, scaled for volume of 1,000+ units)

In addition, you'll probably want to get:

(1) Project box (optional)

(1) Antenna (a loop antenna or elevated antenna is recommended and can be made with copper wire)

The tools you'll need are:

Soldering Iron/ Solder (optional)

Multimeter

Oscilloscope (http://www.seeedstudio.com/depot/DSO-Nano-v3-p-1358.html?cPath=63_65) (optional)

That's it. Yup, that's all. Once we've got it all, let's begin.

Add Tip Ask Question

Step 2: Build the Circuit

Download

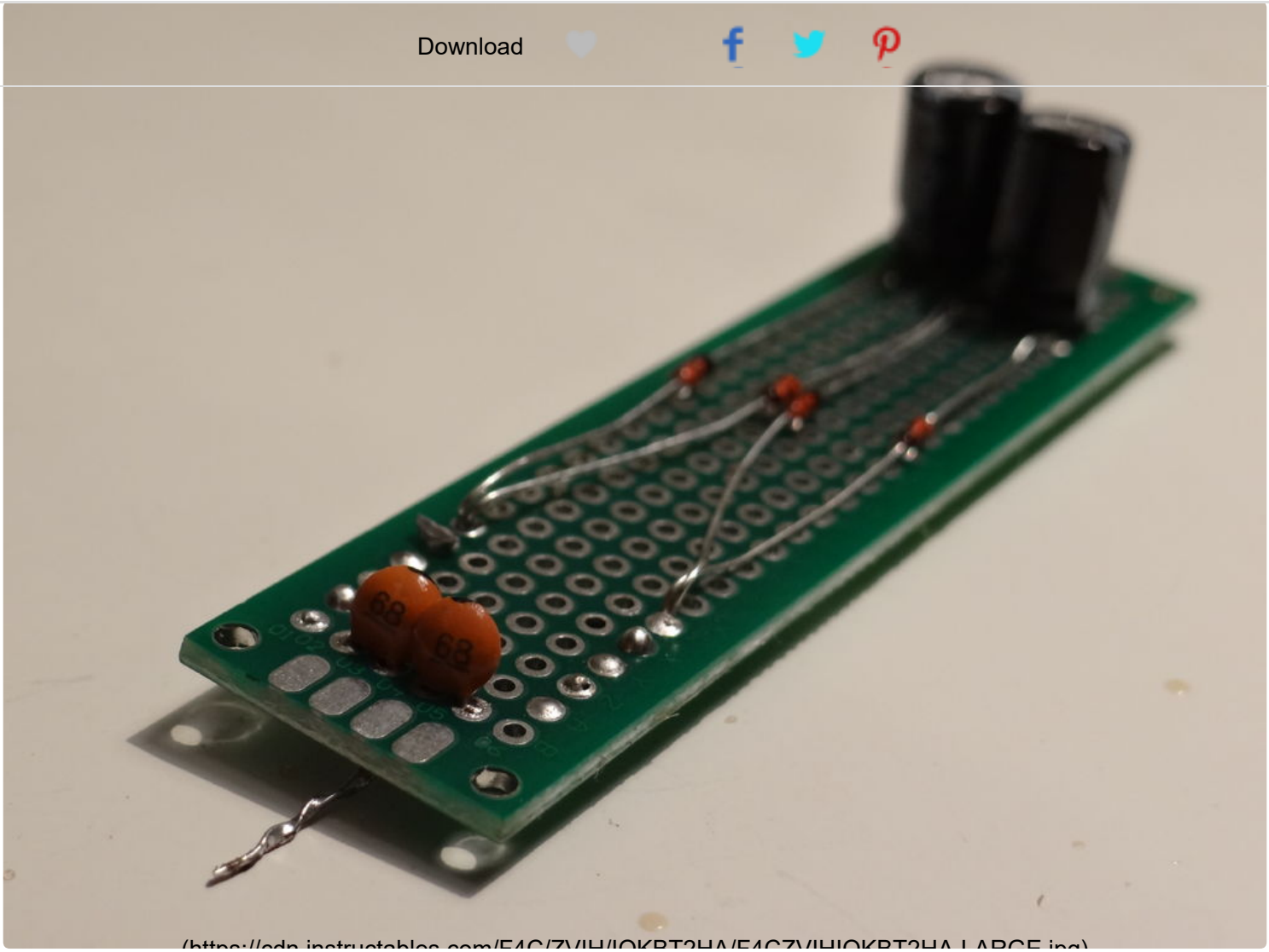

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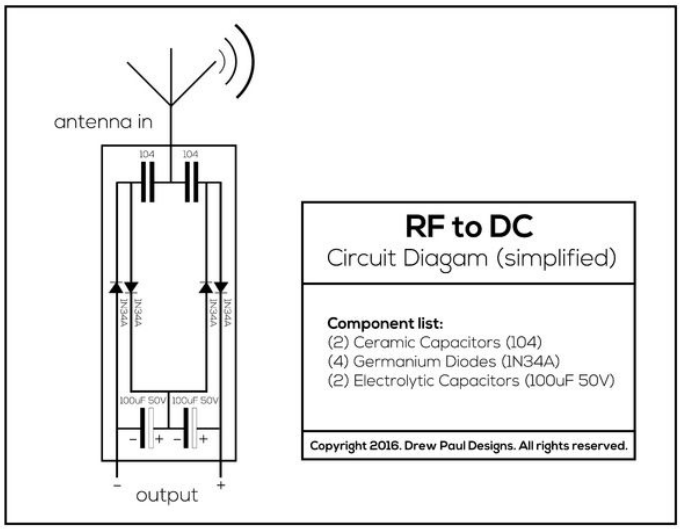

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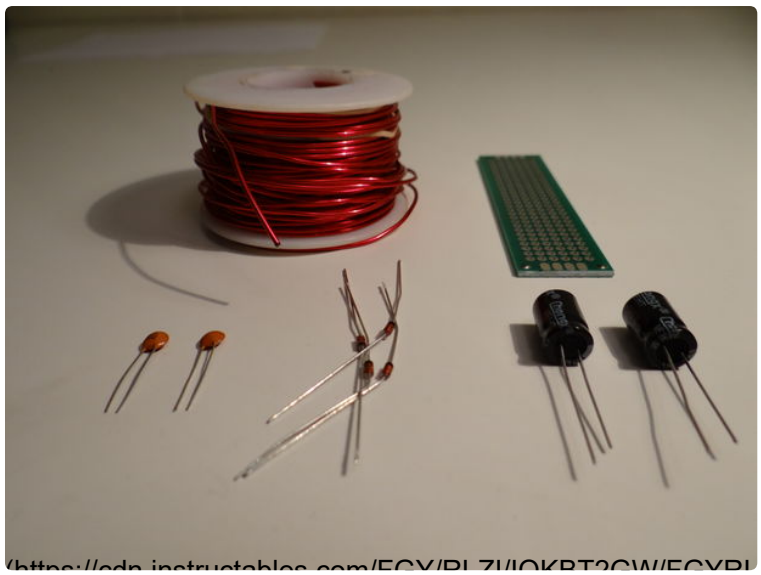

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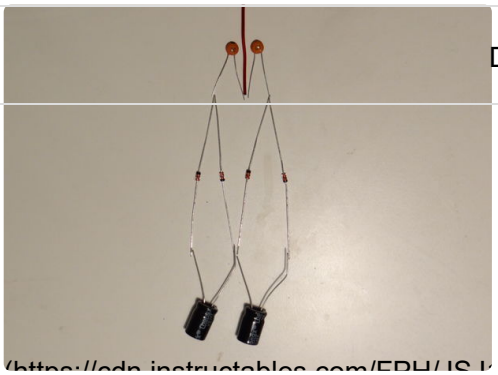

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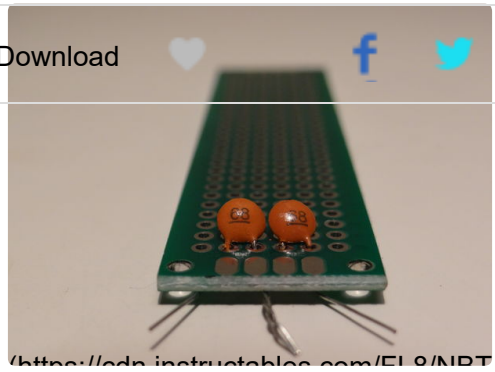

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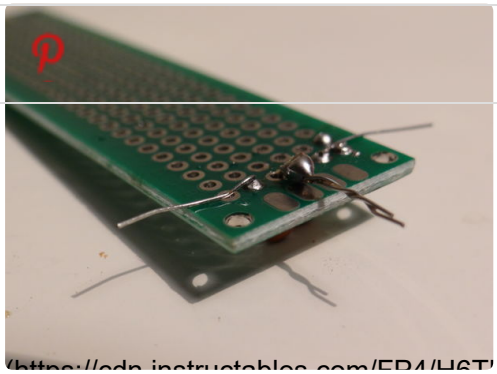

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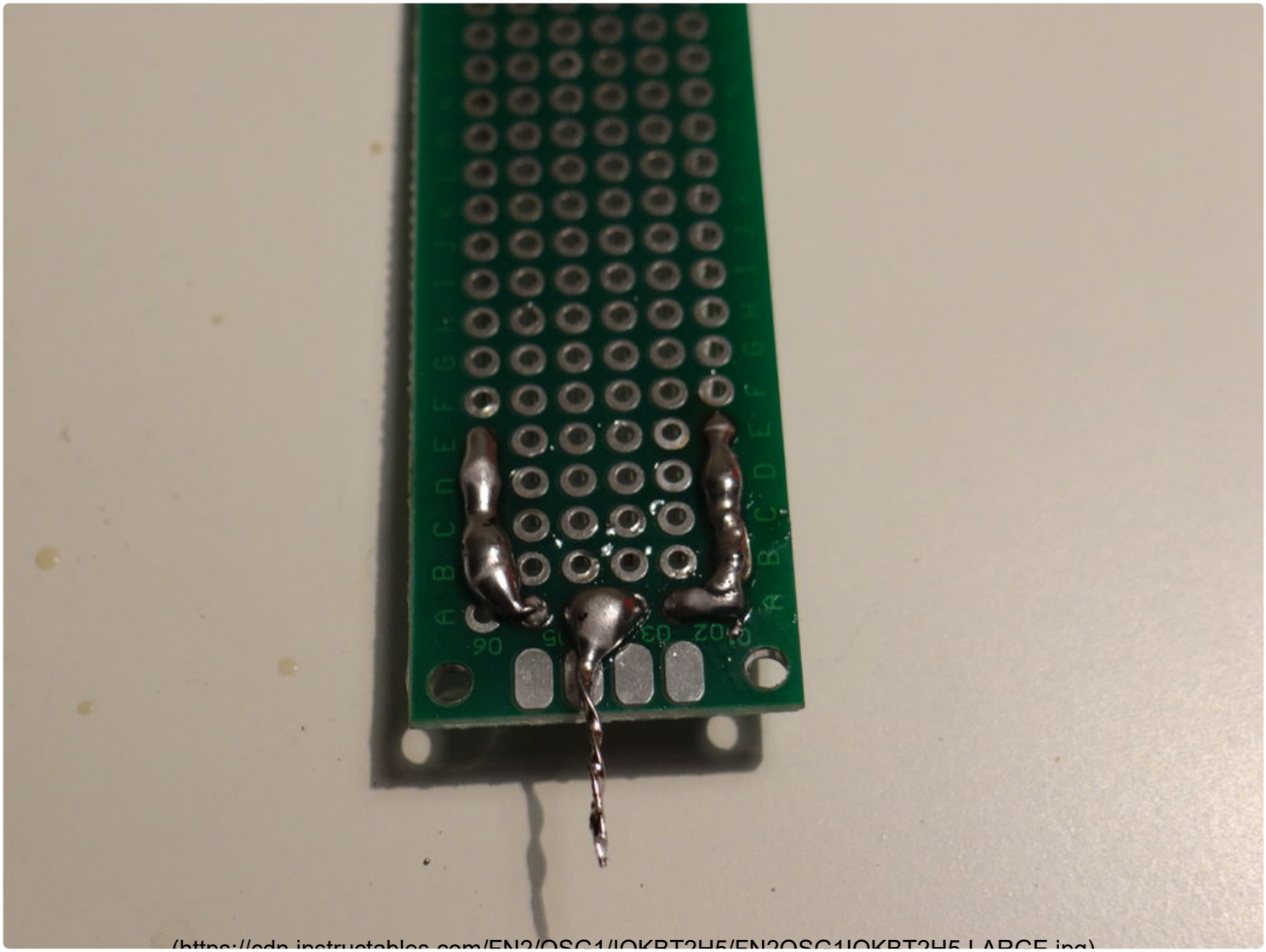

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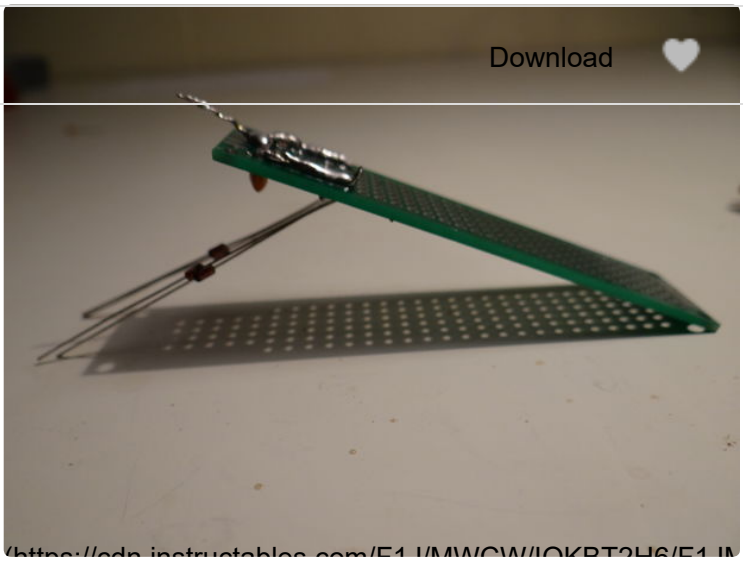

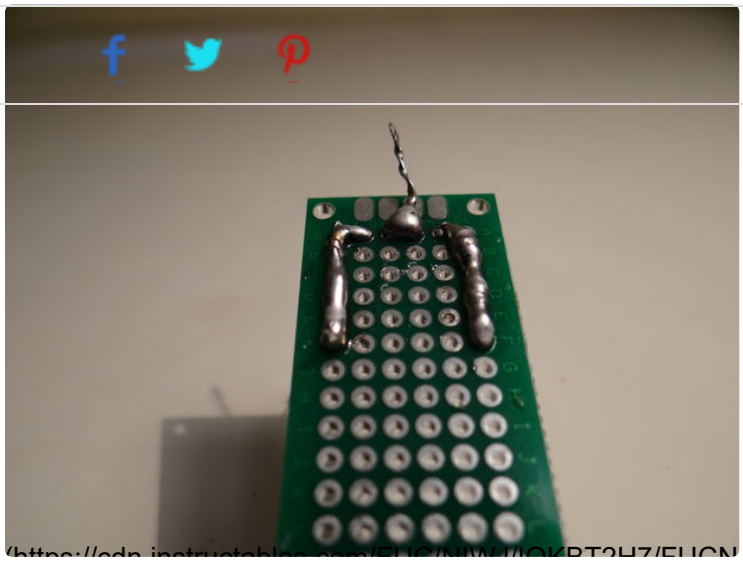

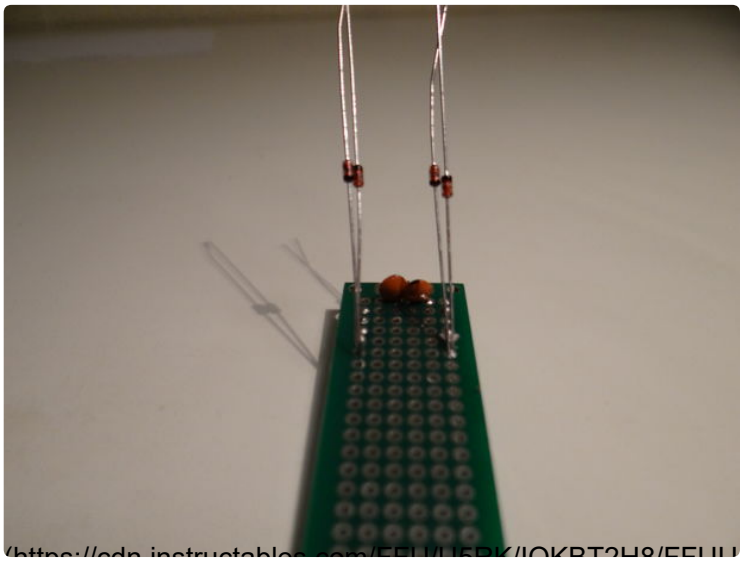

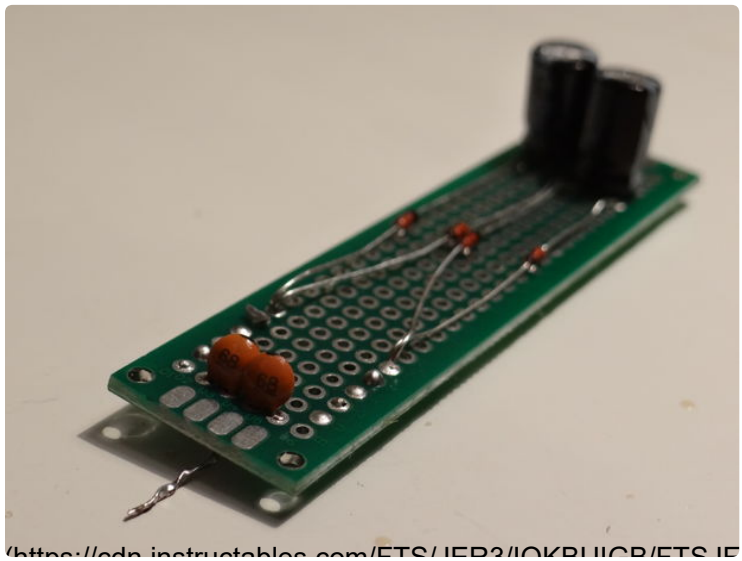

We're going to build the simplest version of this circuit variation in order to understand how each component interacts and as a proof of concept.

There are three simple systems at work in the circuit that are composed of capacitors, which store energy, and diodes that direct it.

Energy in the band of radio waves, among others, will vibrate a wire antenna on an atomic level, sending a discernible signal to its lead. This signal will then meet the junction between two ceramic capacitors wired in series. This junction will force positive charge from the wave to travel in one direction and negative charge in the other direction which, when collected again, makes the signal uniform and polar. Connecting the two capacitors in series creates leads on each end; the now positively charged side of one and the now negatively charged side of the other

creates a two cell battery. Download

This next stage of the circuit takes a signal with a net value of zero, adds the absolute values of the positive and negative amplitudes with respect to the origin and produces a positive integer. This concept can be thought of as taking:

(+1) + (-1) + (+1) + (-1) = 0

and converting it to:

| [(+1) + (+1)] | = 2
+
| [(-1) + (-1)] | = 2
= 4

Isn't math fun?

To each of these leads from our two capacitors in series, we will connect two crystal diodes, one facing each direction, to form what is called a bridge rectifier. A bridge rectifier is a configuration which will convert an alternating current to a direct one by cleverly rerouting the signal.

By connecting the bridge rectifier as shown in the circuit diagram, this direct current from the diodes then charges the electrolytic capacitors. This stage normalizes the amplitude, making the current constant and usable.

Components can easily be twisted together for testing and then soldered to a circuit board to secure.

Add Tip Ask Question

Step 3: Test and Optimize Your Circuit

Download

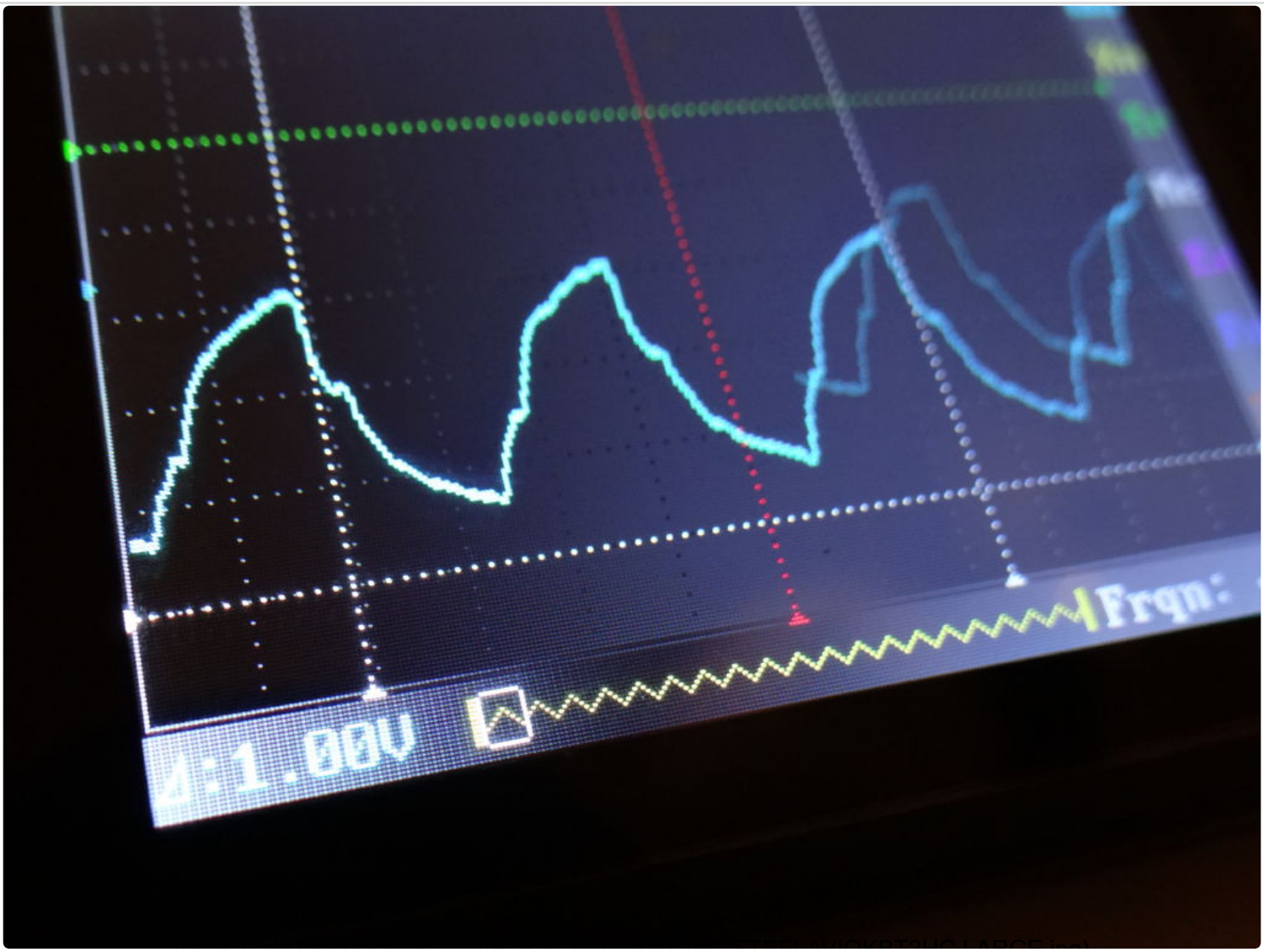

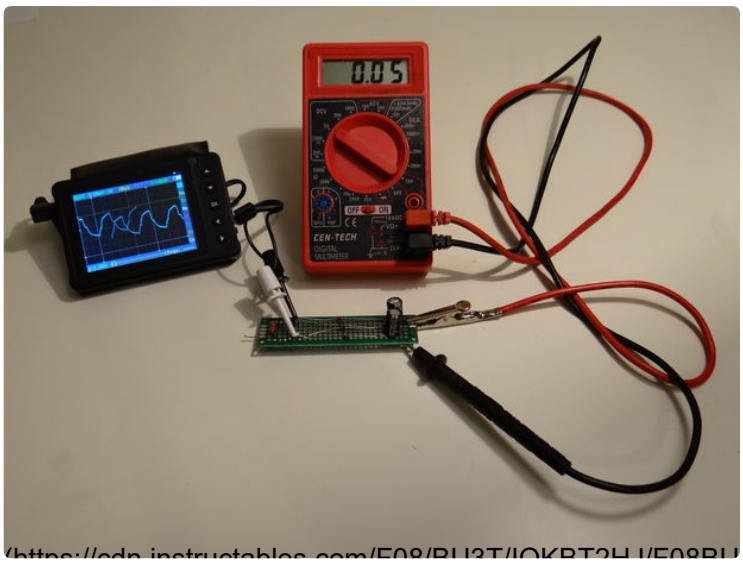

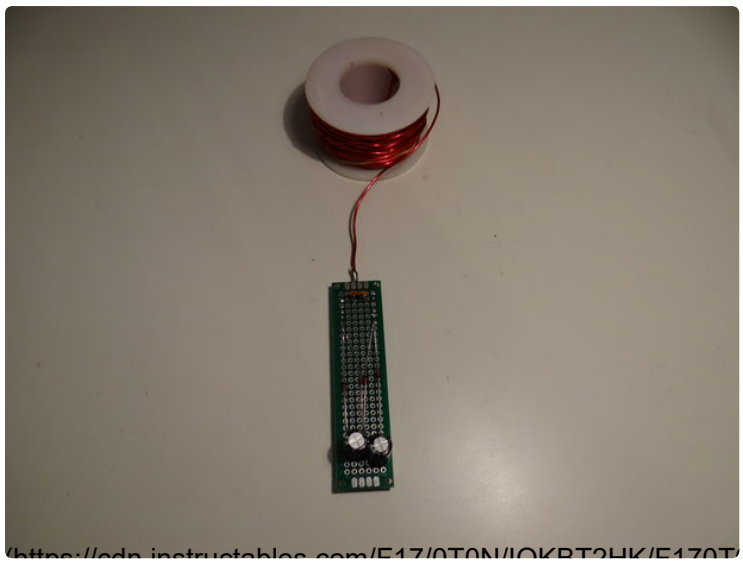

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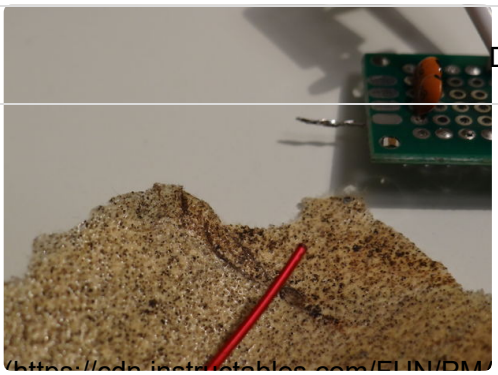

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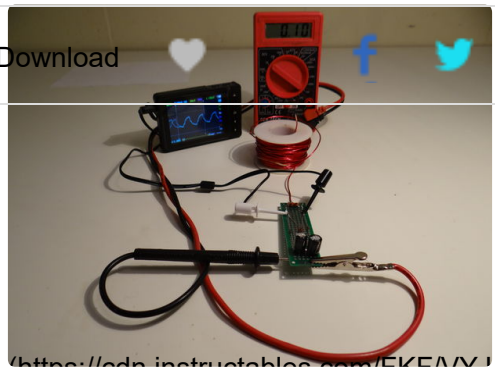

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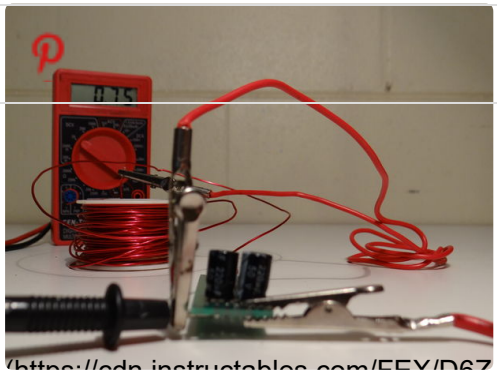

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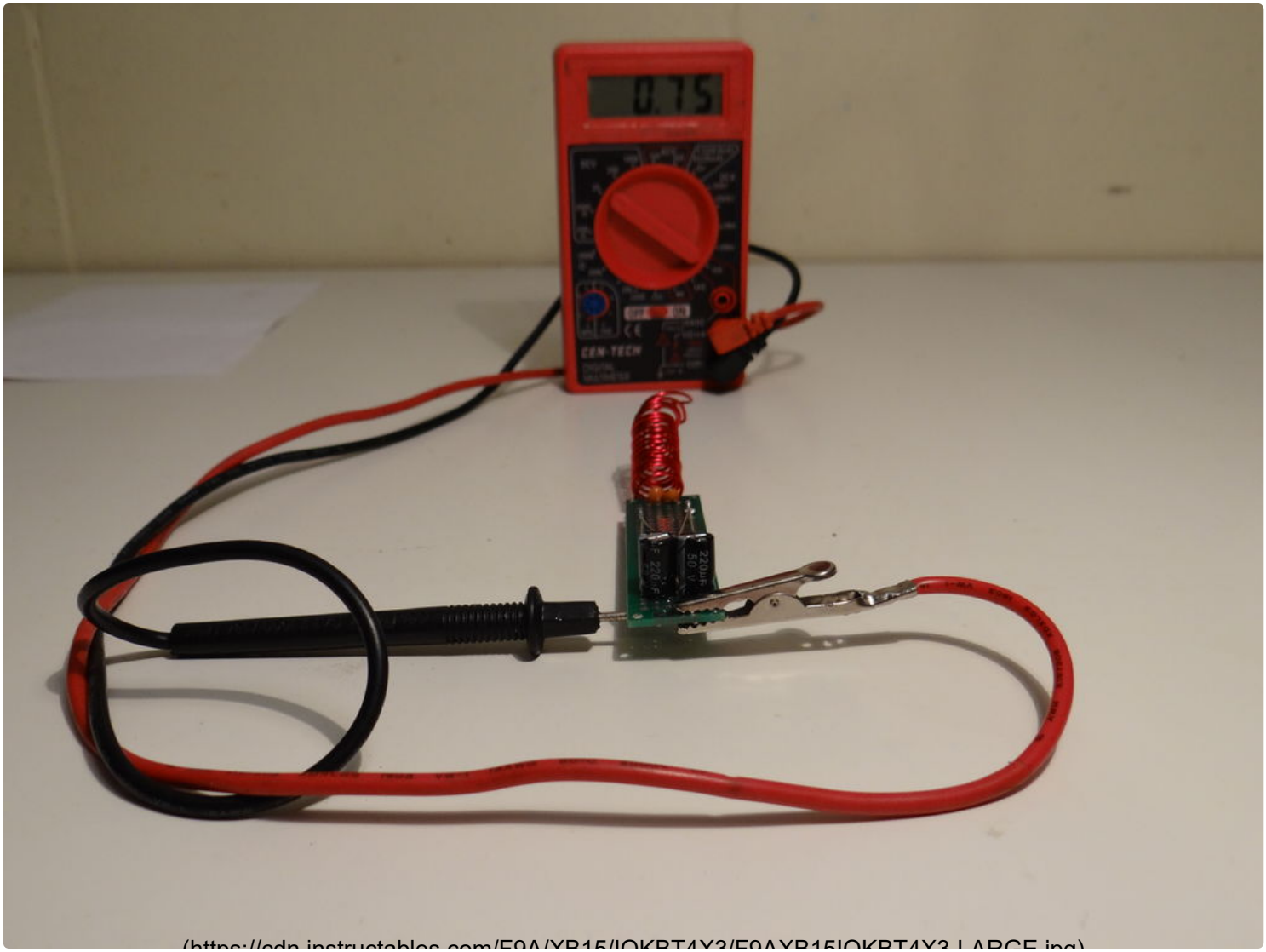

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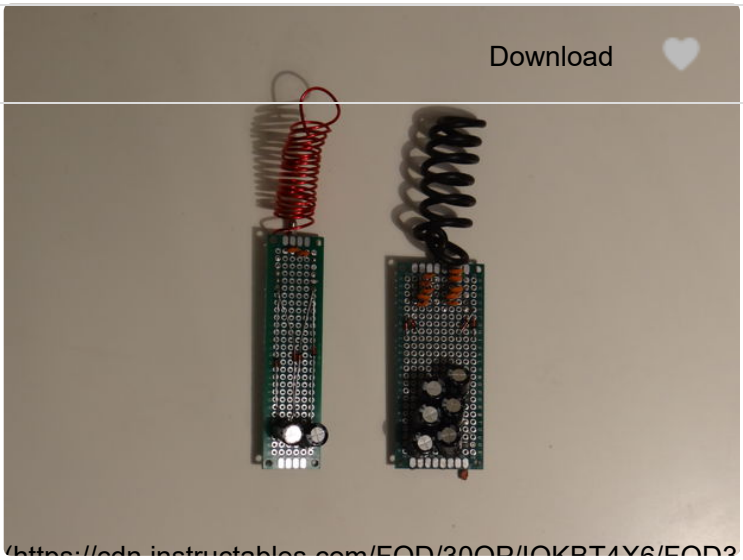

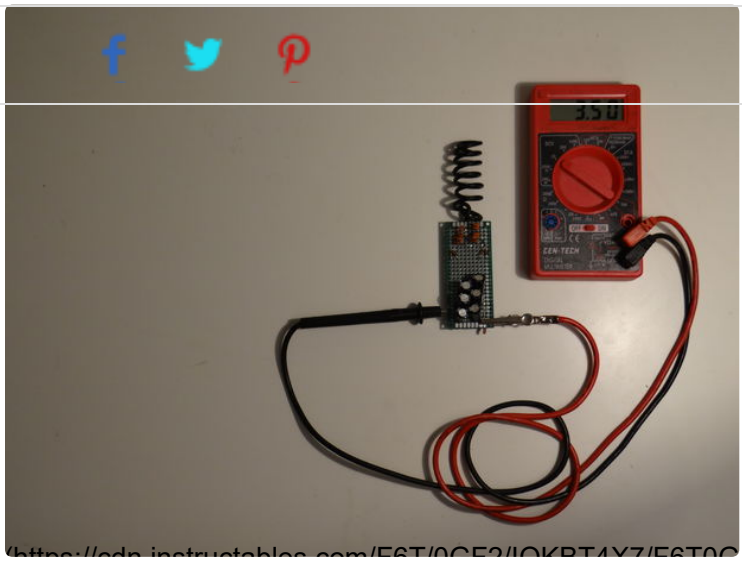

To test and analyze our circuit, we'll be using a digital voltmeter and oscilloscope.

By connecting a voltmeter to the output, we'll immediately begin to see a small voltage climbing in the 10-100mV range. If not, we'll want to check our connections and make sure the circuit is not isolated from the environment by taking it outside to a clear area.

Then, by connecting an oscilloscope to the outside leads of our two ceramic capacitor bank, we will see the the polarized signal being captured from the air around us. We can then connect after the diodes to see our varying direct current and then to after the electrolytic capacitors to see a normalized, usable direct current at our output.

We can then optimize the input resistance in two ways. Firstly, we can add additional ceramic capacitors in parallel to our original two and make sure our soldered connections are consistent and thick in this area.

We can optimize the circuit's capacity by adding electrolytic capacitors in parallel to our original two which will allow this circuit to charge slightly when not in use. For this purpose, a charging circuit can also be added here in order to incorporate an optional battery bank.

Download

We can optimize the antenna by attaching loops and coils of copper wire in various positions, store-bought antennas or by stringing some wire up to the highest point you can reach.

We don't have to stop there, either. We can now connect multiple circuits in series to increase voltage or in parallel to increase current. This can be done indefinitely.

Add Tip

Ask Question

Step 4: Add a Case and Antenna

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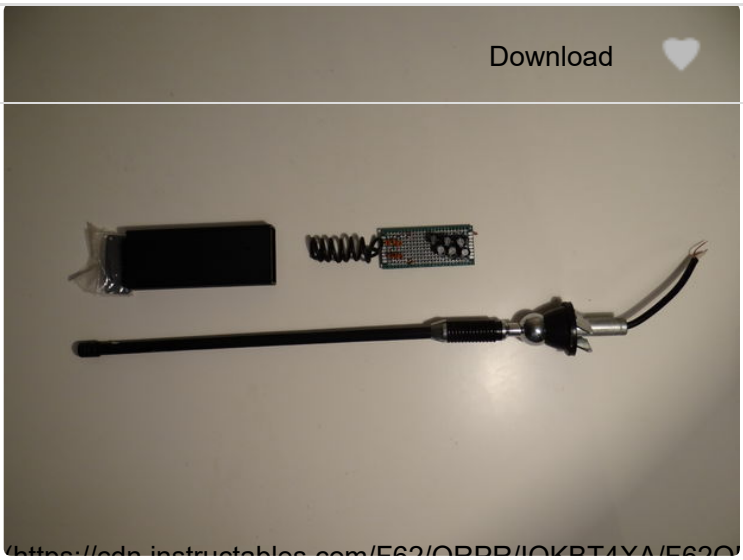
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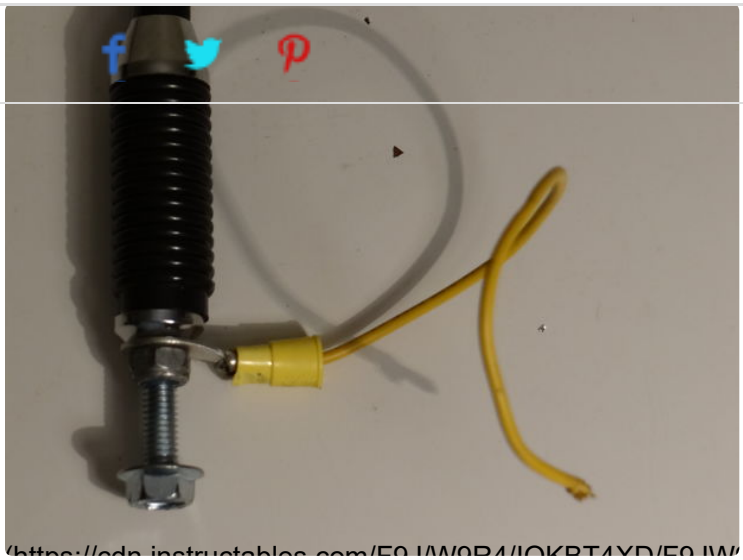

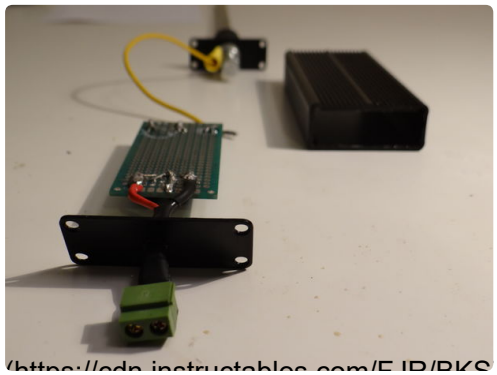

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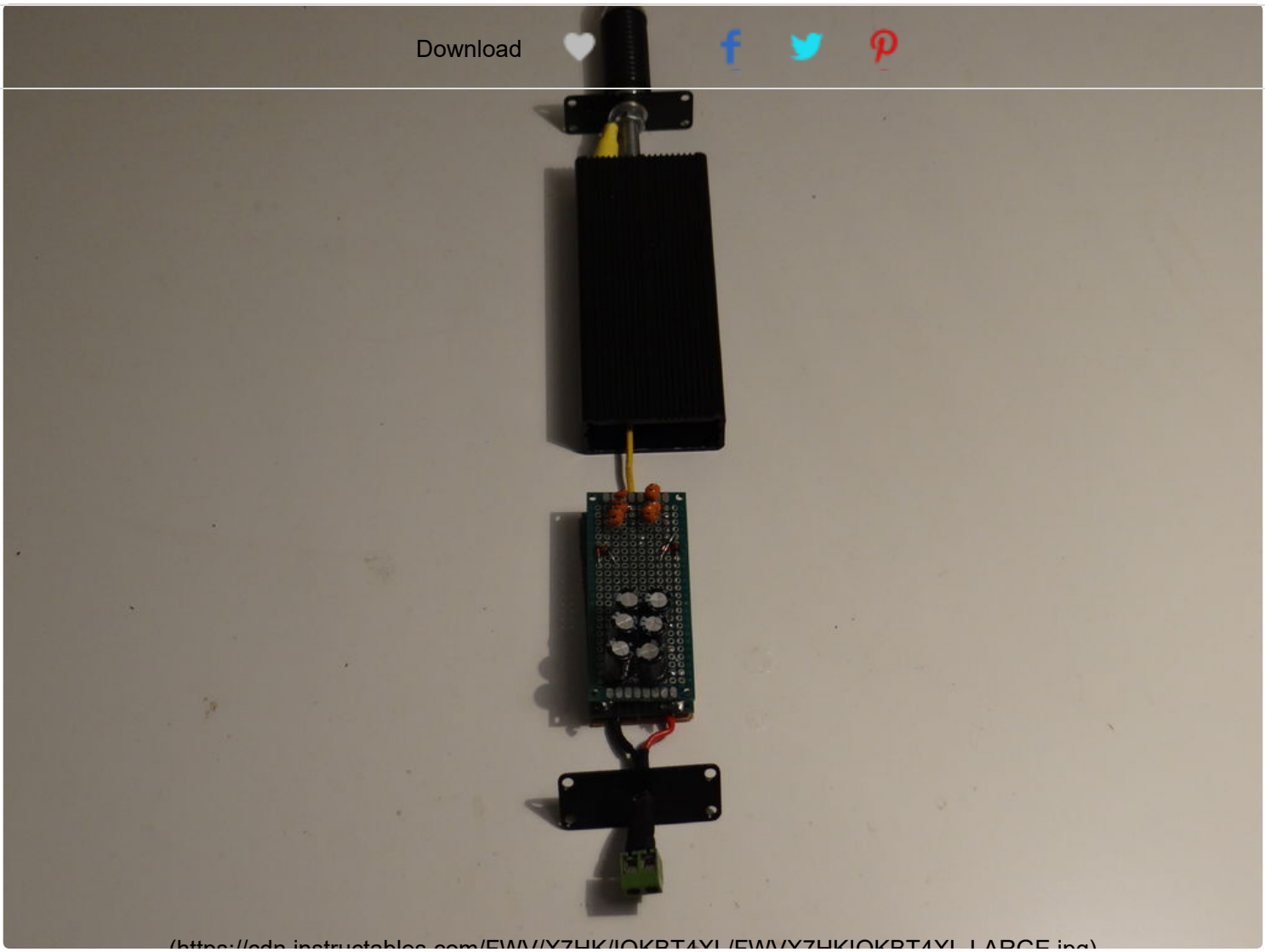

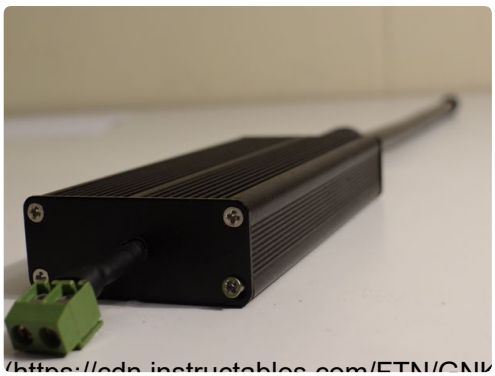

After choosing an antenna in the last step we'll now want to permanently wire it. Whether you choose a compact antenna for portability or a tall fixed antenna for power and range, we will wire it in the same manner according to the diagram in the previous step. Note that the input on the configuration here is grounded to the metallic case, and thus the users hand, and incorporation of longer antennas will require proportionally more substantial grounding.

Download

We will then attach a terminal to the output to allow us to connect this circuit to an electrical device or charging circuit and battery bank.

Next, we will add a case, making sure to isolate exposed leads with non-conductive material especially if mounting in a conductive case. A piece of cardboard secured with glue is sufficient for the circuit's bottom and shrink wrap or electrical tape can be used in the case of any additional exposed leads. Drill two holes in your enclosure, one for the antenna or antenna lead and another for your output terminals. You can then insert your components, fasten the enclosure and your device is ready to use!

Add Tip

Ask Question

Step 5: Your Crystal Energy Receiver Is Complete!

Download

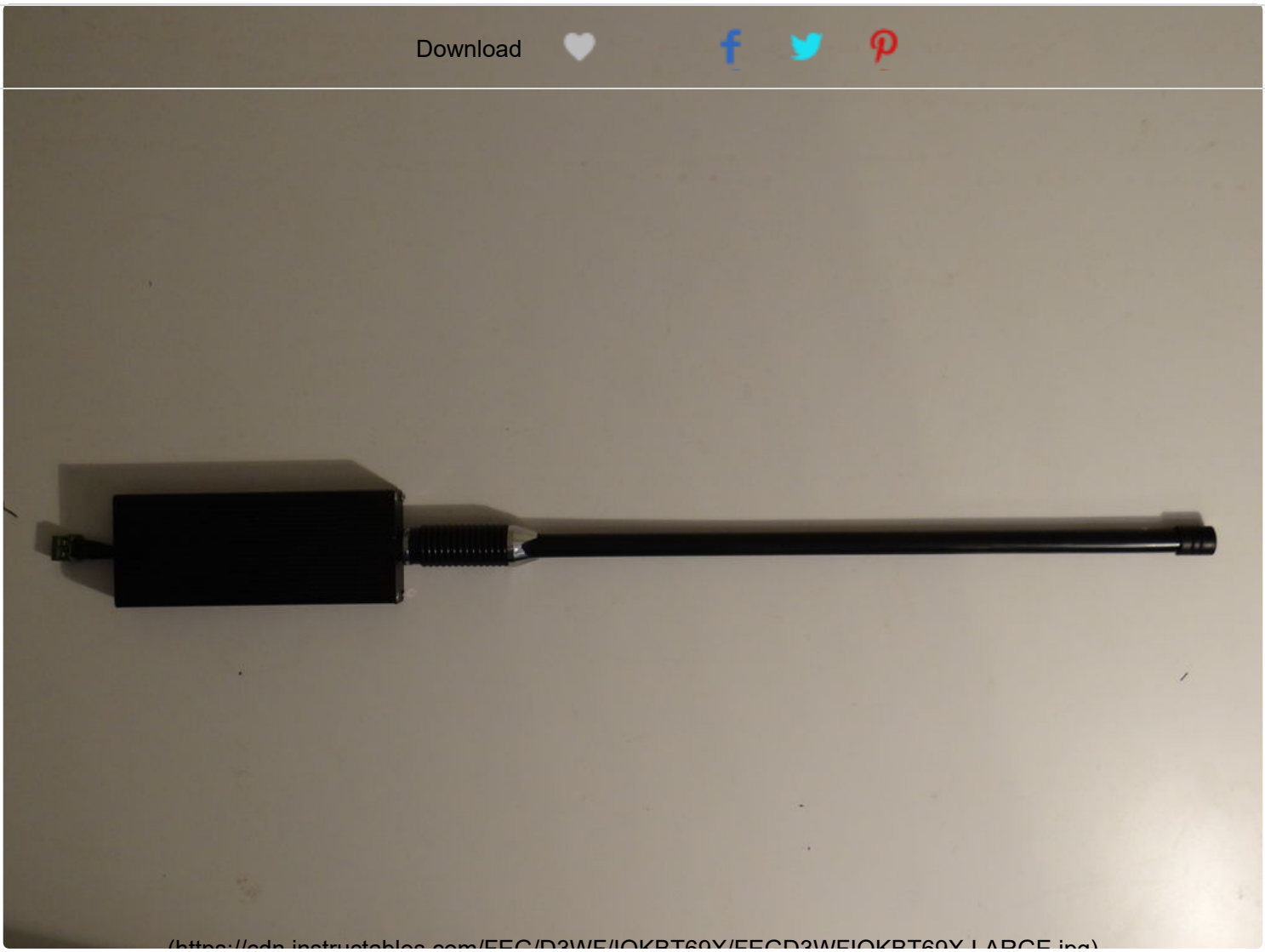

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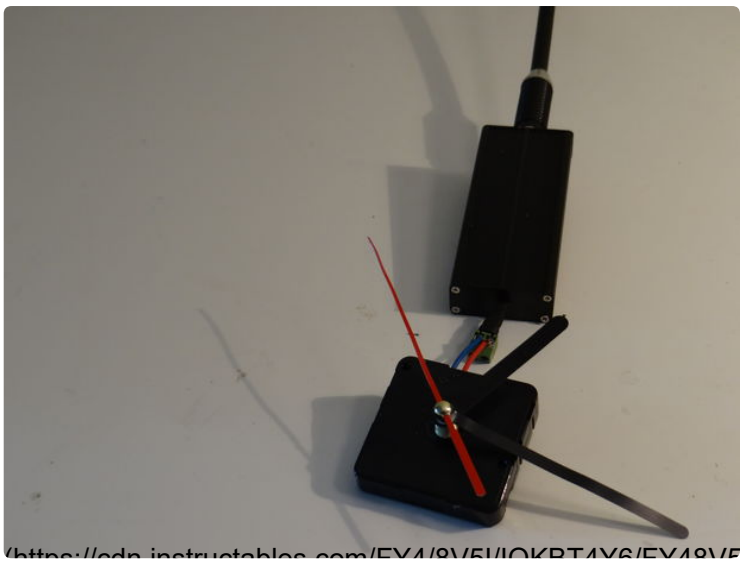

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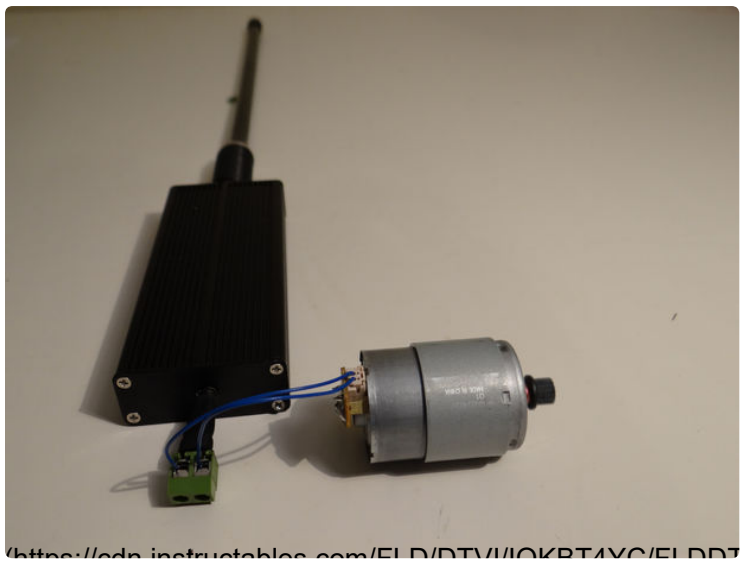

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Your Crystal Energy Receiver is now complete and ready to use!

I built a portable version, for proof of concept and demonstration purposes. However, you can go as big as you want- to passively charge batteries or run equipment remotely; or go as small as you want- to power sensors, RFID devices, small electronics and more.

I used this harvested energy to easily power a low-consumption quartz clock, a digital chronograph with integrated circuits and LCD and was even able to momentarily rotate a small dc motor.

Because of its simplicity this device is a durable, efficient and reasonably effective method of harvesting radiant energy in a simple, replicable and sustainable way. I humbly hope that the contributions made here, and by those reading, can be one day used by people worldwide to conveniently capture free energy.

Thanks for checking out my project and I look forward to seeing everyone's variations, suggestions and improvements!

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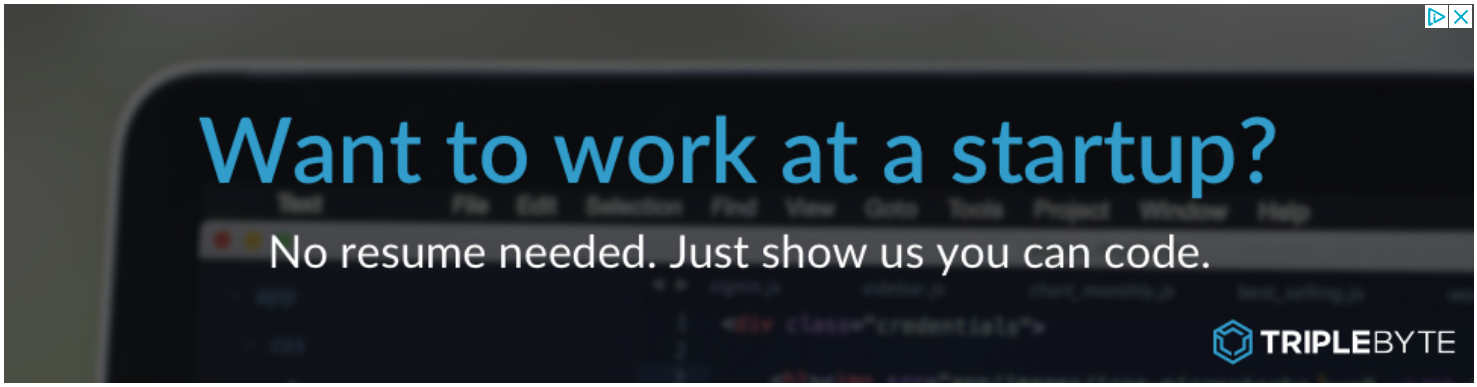

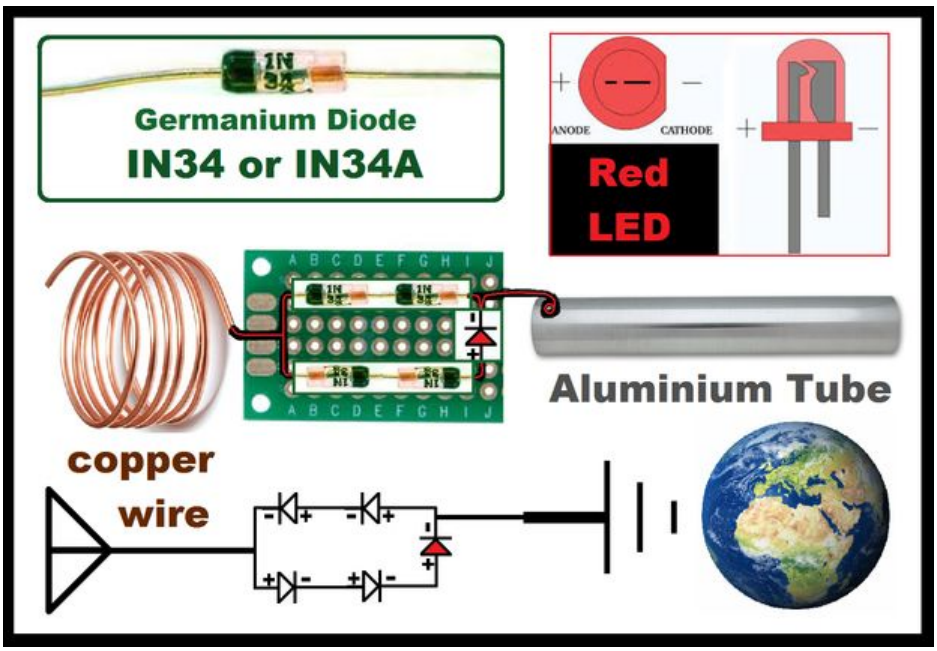

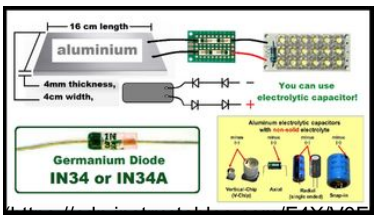

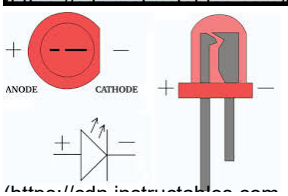

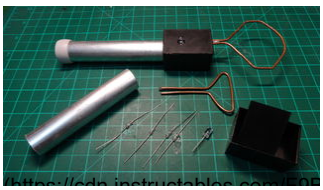

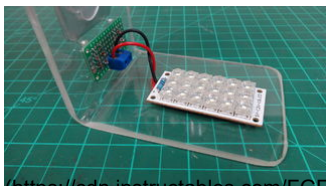

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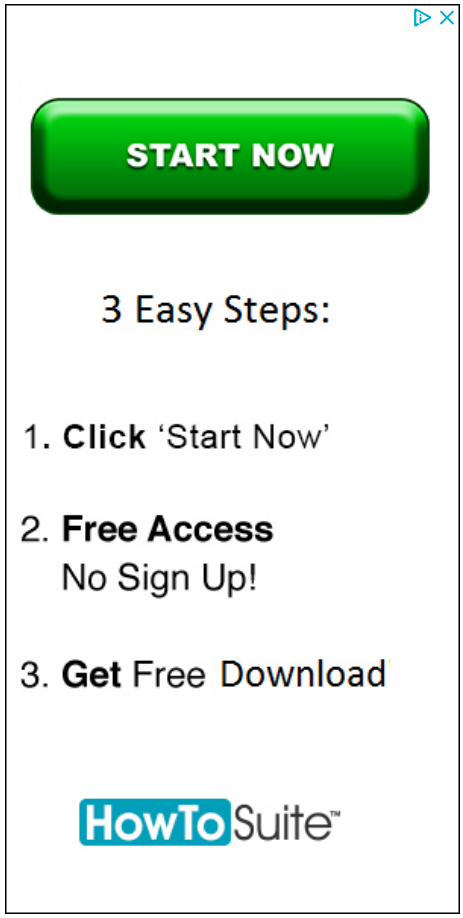

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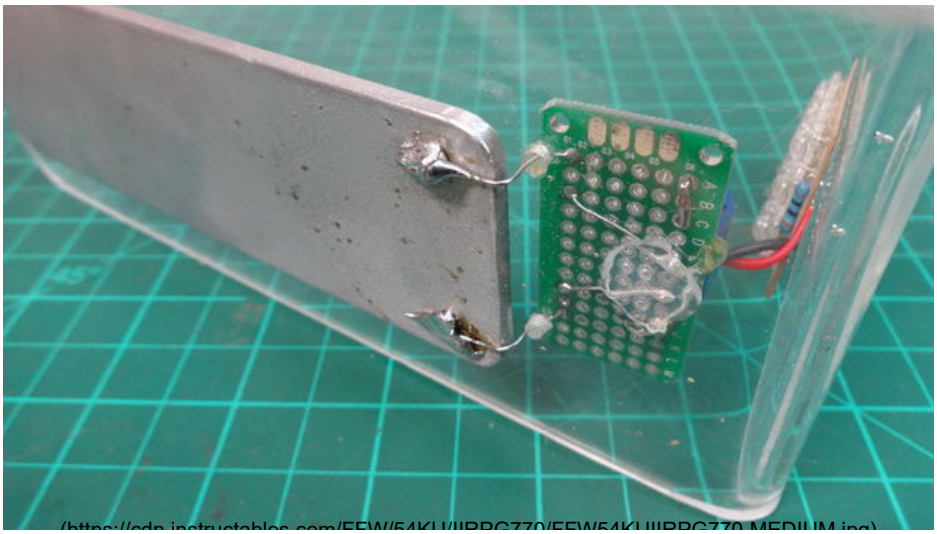

How to Make a Electrostatic RF Detector or Ghost Detector, Hunting Solution. Much cheaper and easier than you may think For Under $5 ! A simple description is that IN34 or IN34A RF Germanium Diodes for Crystal Radio can take "Ambient" or "Radio Waves" to turns them into DC energy. I would like to show the Tesla Coil Transmitter, where I made an homemade "RF Detector" this is the simplest detector! without any batteries or hardships circuit, only with IN34 diodes and Ether to Earth!.. Stay Tuned and Enjoy! Please click the "like" button, subscribe my channel, and share this with your friends... To support my "work" every little bit helps! Watch the "ADS" THANKS

- See the original video https://www.youtube.com/watch?v=cSxqeGVC9t0

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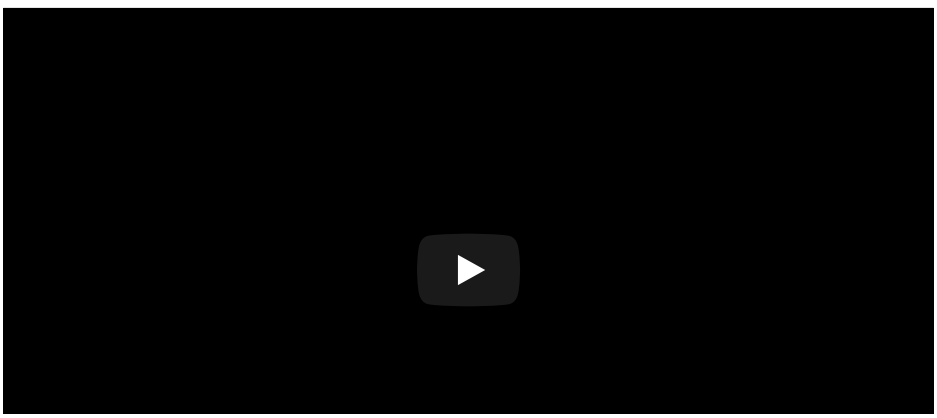

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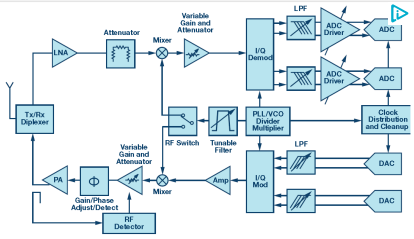

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Build a Homebrew Radio Telescope

Explore the basics of radio astronomy with this easy to construct telescope.

Mark Spencer, WA8SME

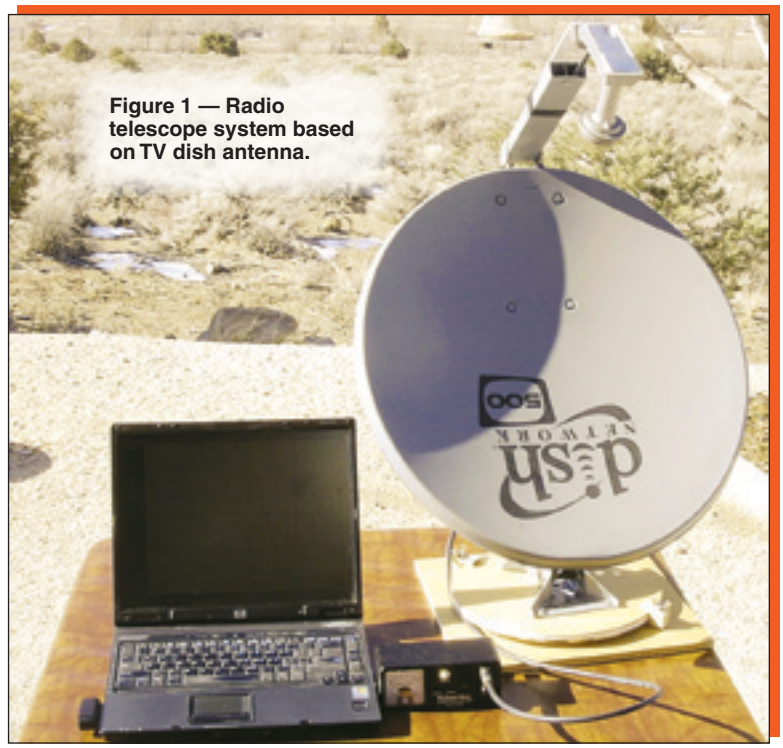

Figure 1 — Radio telescope system based on TV dish antenna.

There are many ham radio related activities that provide a rich opportunity to explore and learn more about the science of radio. One of those opportunities is radio astronomy.

All matter emits radio frequency (RF) energy dependent on the temperature and makeup of the matter, including the matter in space. The foundation of radio astronomy is to study the heavens by collecting and analyzing the RF energy that is emitted by bodies in space, very much as optical astronomers use light energy collected by telescopes. It sounds complicated. While professionals use very sophisticated and expensive equipment, you can, with some simple equipment and a little investment, build a radio telescope that will allow you to learn and explore the fundamentals of radio astronomy.

A Homemade Radio Telescope

In this article, I will build on an existing design of a radio telescope made from one of those ubiquitous TV dish antennas that you see around your neighborhood. The radio telescope (RT) project described here can easily be reproduced. Although this is not a fully capable RT, it can provide a wonderful learning opportunity for you, or perhaps students in your local school.

Figure 1 shows the radio telescope set up. The major components include a modified TV dish antenna mounted on a wooden support structure to allow pointing the antenna, a commercial satellite signal strength detector that displays the signal strength of signals collected by the dish on a meter and an interface that converts the signal strength into a amplitude modulated tone. The tone is fed into a computer sound card and finally a computer and software graphically displays the signal strength as a function of time.

The TV dish modifications are structural, and any available TV dish system can be used. The signal strength detector costs between $40 and $65 and is widely available from Web retailers. The interface circuit, which will be described shortly, is easily duplicated and costs approximately $20. Finally, the display software is free.

Figure 2 — Dual LNB mount. Note two coax connectors.

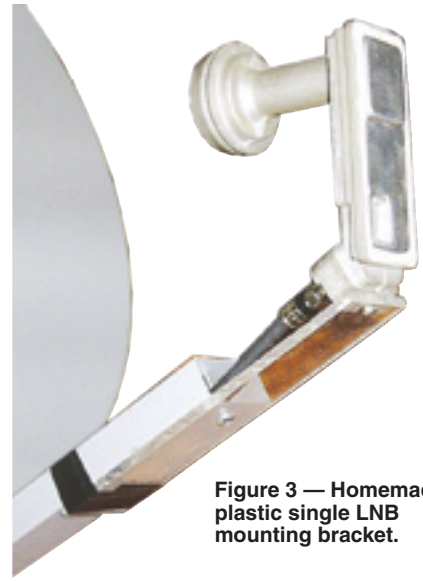

Figure 3 — Homemade plastic single LNB mounting bracket.

What it Can Do

The following is just a sample of what you can do with this simple RT:

- Use the sun to study and determine the beamwidth of the dish and verify the mathematic formula that is used to predict dish antenna performance.
- Measure the radiation intensity of the Sun and perhaps detect changes in solar activity.
- Measure the relative changes in the surface temperature of the moon.
- Learn about and explore a common radio astronomy collection technique called the *drift scan*.

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Figure 4 — Dual coax connector configured LNB. Terminate one connector with a dummy load.

Figure 5 — CM satellite signal strength meter.

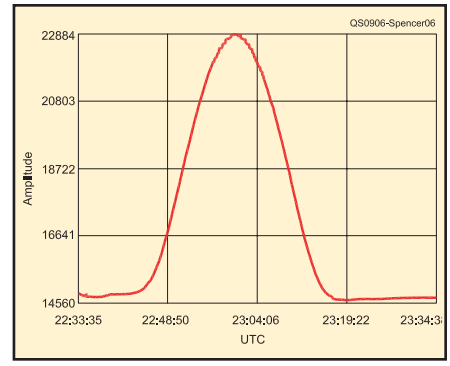

Figure 6 — *SkyPipe* screen showing antenna response.

- Explore the fundamental principle of energy emission as a function of temperature by detecting the relative differences between the temperatures of emitting bodies.
- Detect satellites parked along the Clarke Belt in geosynchronous orbit and illustrate how crowded space has become.
- Detect the Earth's rotation around the Sun and the Earth's spin on its axis by comparing daily drift scans of the horizon.

Antenna Subsystem

The basic RT system is based on the "Itty-Bitty" design that is described in two Web pages.[1,2] The TV dish is an offset 18 inch dish that has down converter(s) mounted at the focal point of the dish. The down converter is called a low noise block (LNB). The LNB is a preamplifier/down converter that converts the satellite signals from around 12 GHz down to around 2.4 GHz. Most modern dishes have two or more LNBs to access more than one TV satellite at a time without changing the pointing of the dish (Figure 2). The LNBs are mounted to share the focal point of the dish. Since only one LNB is required for the RT, I made a minor adjustment to the published Itty-Bitty design to position the single LNB at the dish focal point. Mounting the single LNB at the focal point really helps in pointing the antenna.

I used the existing LNB housing and mounting bracket as a template to determine the distance between the edge of the mounting arm to the mounting hole of the LNB. I then used a piece of plastic to fabricate a new mounting bracket for the LNB as shown

[1]Notes appear on page 45.

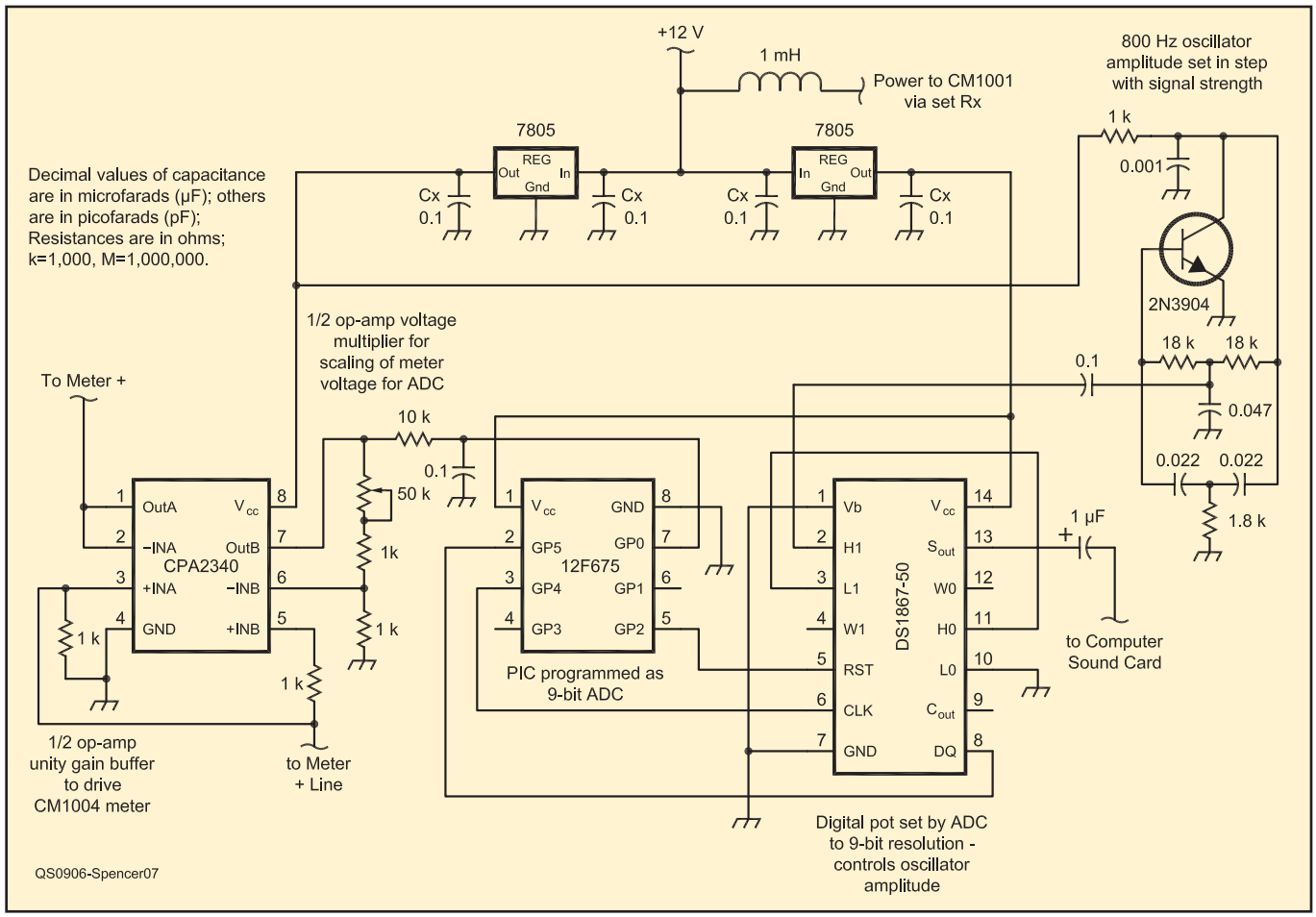

Figure 7 — RT Interface circuit diagram.

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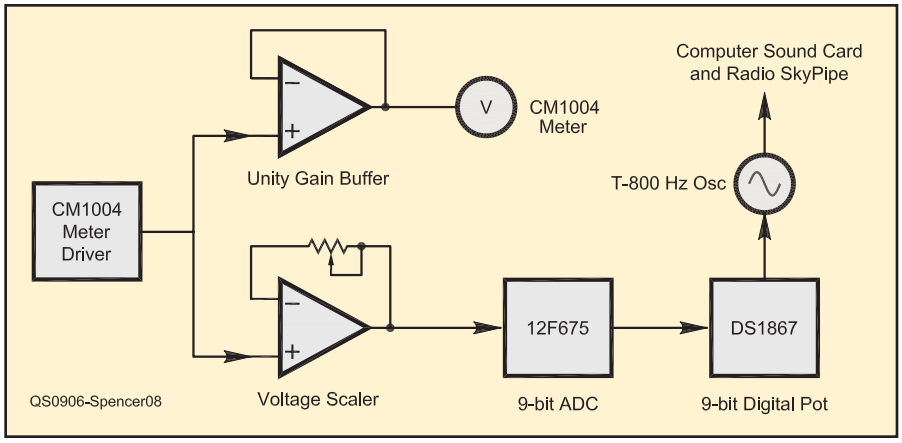

Figure 8 — RT Interface block diagram.

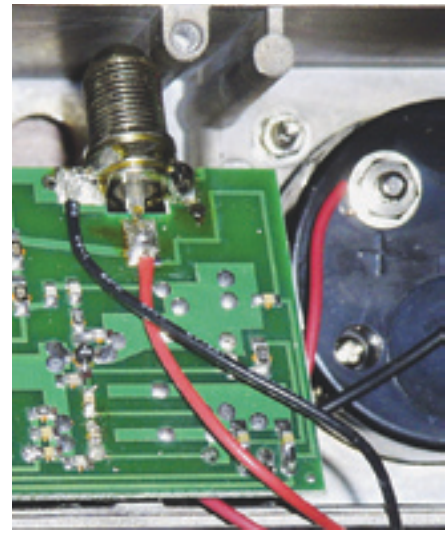

Figure 9 — Power and ground connection to CM board.

in Figure 3. The dimensions are not super critical, but careful placement certainly will improve the RT performance.

Some LNBs have two coax connectors. Only one will be used in the RT (Figure 4). It is a good idea to terminate the extra coax connector with a 75 Ω dummy load plug to balance the load on the LNB. The dummy loads for F type TV coax connectors are readily available from electronic parts retailers.

Note that the dish is mounted upside down. Though this orientation is not ideal for receiving satellite signals, this arrangement helps with pointing the dish in its radio telescope role.

Satellite Detector

The detector used in this project is the Channel Master (CM) satellite signal level meter model 1004IFD (Figure 5).[3] The CM is connected to the LNB. Power is supplied to the LNB through the coax connection from the CM. The CM detects the signal coming from the LNB and gives a meter indication of the signal strength and also varies the frequency of an audio tone to help technicians point the dish at the desired satellite. As you move the dish through the beam coming from the satellite, the meter indication will increase and then decrease coincident with the pitch of the audio tone.

The Itty-Bitty plans detail how to connect power to the CM and in turn connect power to the LNB (this power connection is handled by the interface in this project). Though somewhat effective, the CM meter and variable frequency tone indications provide limited utility in detecting changes in signal strengths required for radio astronomy.

Display

To really study the signals received by the RT, you will need to see them displayed graphically on a strip chart. There is an excellent software package called *Radio-SkyPipe* that is posted on radio astronomy Web sites.[4] The free version of this software is a good place to start. *SkyPipe* uses the computer sound card to measure the incoming signal strength and graphically displays the signal strength as a function of time. Figure 6 is illustrative of a signals detected by the RT. *SkyPipe* is very easy to use but some study of the HELP files will make it easier for you to fully tap into the capabilities of this software.

SkyPipe requires audio signals to be fed into the sound card MICROPHONE jack. The output of the CM detector is either an analog meter reading or a frequency modulated (constant amplitude) tone that is not really compatible with *SkyPipe*. An interface is required.

Interface

What is required to make the CM output work with *SkyPipe* and a sound card is to convert the signal level into an amplitude varying audio tone. The interface designed to do this is shown in Figure 7 and as a block diagram in Figure 8. Refer to the block diagram during the description of the interface function.

The unity-gain op-amp is used as a buffer between the CM meter driver circuit and the analog meter. The other op-amp is used as a voltage multiplier to scale the CM meter driver output voltage to match the 5 V reference voltage of the following analog to digital converter (ADC). The variable resistor in this voltage multiplier circuit is used to calibrate the CM to *SkyPipe*. The voltage from the multiplier is fed to a programmable interface controller (PIC) that is programmed as a 9-bit ADC to covert the analog voltage that is a function of received signal strength to a 9-bit digital word that is used to control a digitally controlled variable resistor. The interface includes a simple Twin-T audio oscillator circuit that provides a tone of approximately 800 Hz that is fed to the computer sound card. The amplitude of this audio oscillator is varied by the digital pot that is being controlled by the PIC. The result is the audio amplitude being varied in step with the signal strength detected by the CM.

The circuit provides power to the CM and the LNB. A 12 V source in the CM is tapped through an RF choke and this is connected to the LNB coax connector inside the CM (Figure 9). The 12 V is also regulated to 5 V to provide power to the interface. Though probably not required, there are two 5 V sources, one for the digital components of the interface, and the other for the analog components with one common ground point. This arrangement is used to isolate potential digital and analog noise sources within the circuit.

The interface is built on a circuit board and mounted right inside the CM box

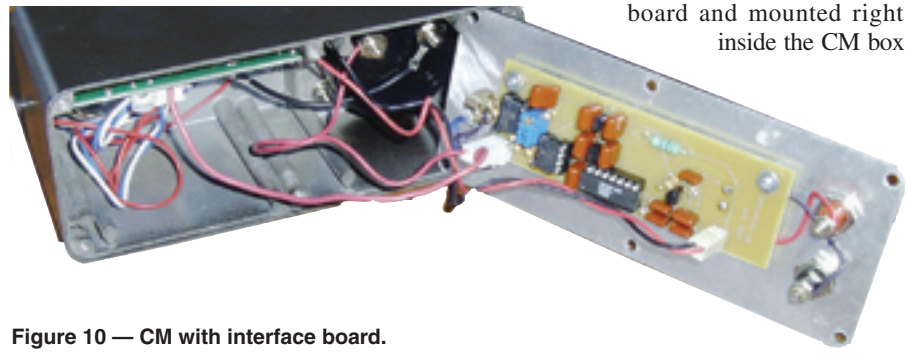

Figure 10 — CM with interface board.

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Figure 11 — Aiming the RT at the Sun, note LNB shadow location.

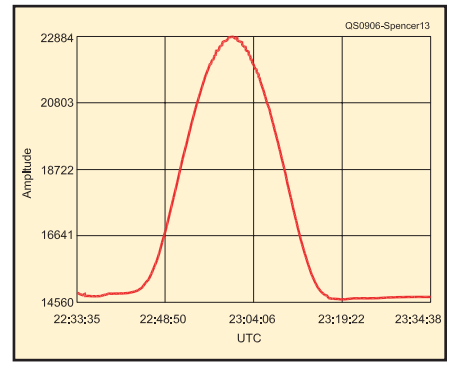

Figure 13 — Drift scan of the Sun indicating antenna's azimuth pattern.

(Figure 10). Though I made an etched circuit board for the circuit, the hand wired prototype worked equally well for those who would rather roll their own. The PIC firmware is available on the *QST* Web site.[6]

RT in Action

The first thing you need to do is learn how to point the RT antenna. The best place to start is to connect the CM to the antenna and point the antenna at the Sun. *Caution*: Do not look into the Sun as you do this, or at any time. Adjust the pointing angle and elevation until you get peak signal strength as indicated on the CM meter or hear the highest pitch audio tone. With the antenna pointed directly at the Sun, take note of the position of the shadow of the LNB on the surface of the dish (left in Figure 11). If you look from behind the dish, along the LNB

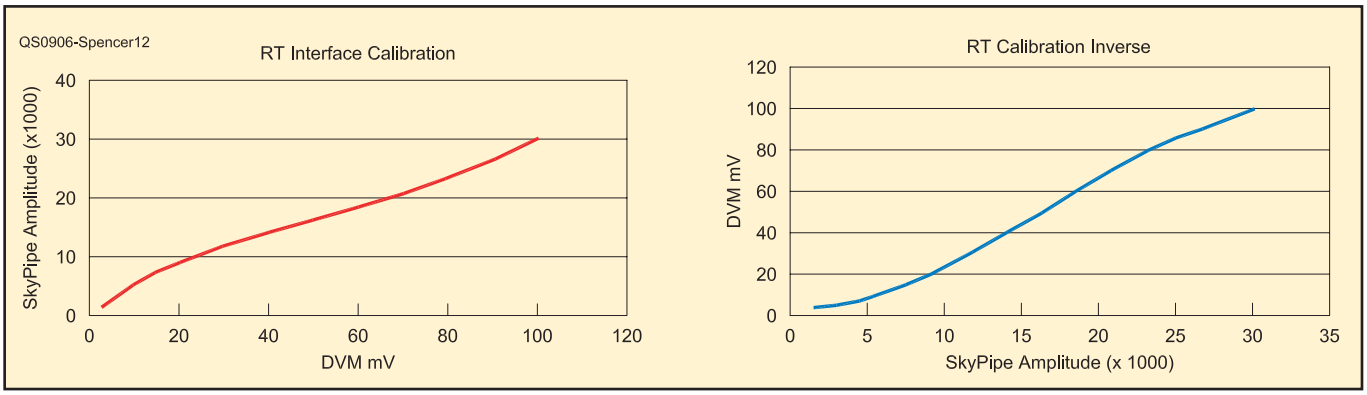

Figure 12 — Example calibration curves.

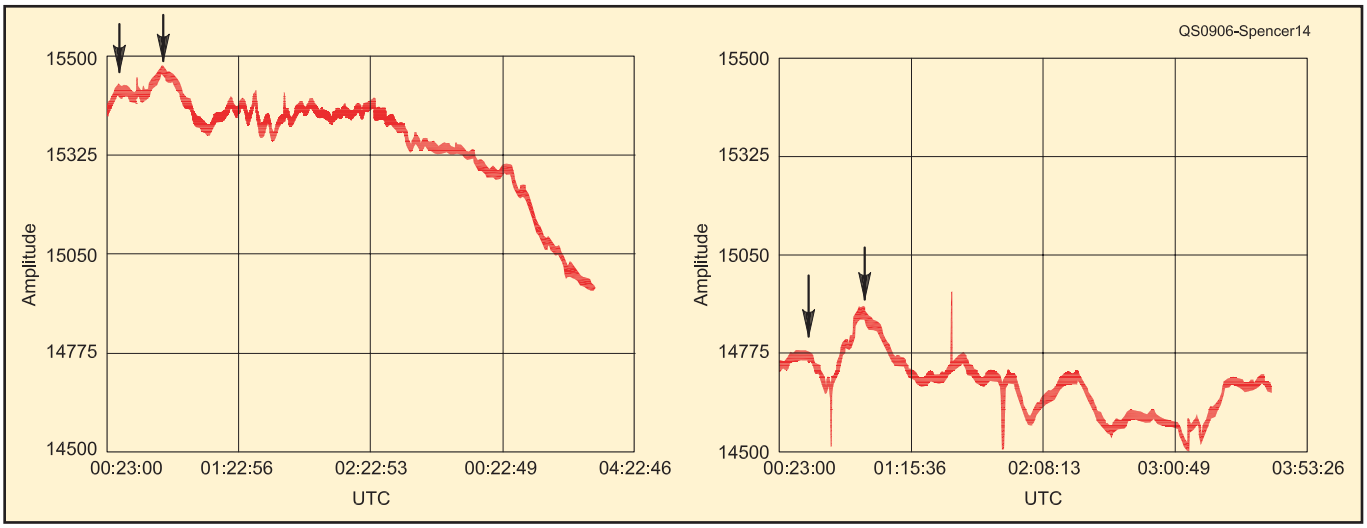

Figure 14 — Sequential drift scans. Note the time offsets between the peaks.

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supporting arm (between the arm and the rim of the dish), you will see the Sun being blocked by the LNB.

Once you have the RT set up, it needs to be calibrated to match the output of the CM to *SkyPipe*. I have developed an *Excel* spreadsheet template to help with the calibration and a few of the other activities that you can accomplish with the RT (also available from the *QST* Web site). Turn the RT to a signal source, the Sun, or the side of a building would work. Turn the gain control of the CM to set the meter to maximum. Run *SkyPipe* and adjust the variable resistor on the interface board until you get a reading on the *SkyPipe* graph vertical (y) axis of approximately 32,000. With the maximum value set, adjust the CM gain control through the voltage range (0 to 100 mV) in 10 mV steps and record the corresponding y axis value on *SkyPipe*. This data is entered into the *Excel* spreadsheet to compute the calibration curve between voltage and y axis value. Both voltage and y axis values are used in analyzing recorded signal strength data (Figure 12).

A good first activity is to do a drift scan of the Sun. A drift scan means that you set the antenna azimuth (AZ) and elevation (EL) to some fixed pointing angle and allow the Earth to serve as the rotator to drag the antenna across the sky. To do a drift scan of the Sun, first set the elevation and azimuth to point directly at the Sun (maximum signal) and then move the azimuth toward the west

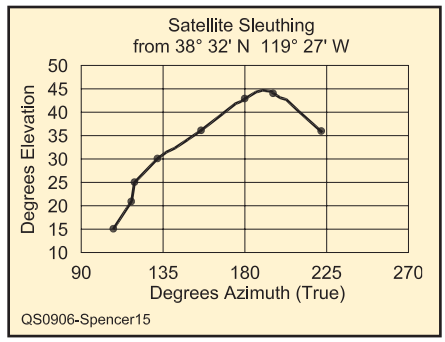

Figure 15 — Clarke Belt plot — tracking down satellites.

(leave the elevation set) until you are off the peak signal. Now start *SkyPipe*. In about 15 minutes, the Sun will pass through the antenna pattern beam width and the result will be as illustrated in Figure 13. You can also use this collection technique to explore the antenna performance parameters.

A good second activity is to do two drift scans of the night sky on two consecutive nights (beginning the scans at the same time each night) using the same fixed antenna azimuth (AZ) and elevation (EL). Figure 14 shows two such drift scans. Although at first glance they may not seem similar, there are some interesting features that are pointed to by arrows. If you compare the time that these two peaks occurred, the time difference is about 4.5 minutes. This shift is the result of the distance the Earth had traveled during the 24 hours between collections. This illustrates that the Earth's rotation as well as its travel in orbit needs to be considered when comparing drift scans. Enough to make your head spin (pun intended)?

A final good starting activity is to point the antenna toward the Clarke Belt and find all the satellites in geosynchronous orbit transmitting on 12 GHz. If you record signal strength peaks and AZ and EL for each peak, you will develop a graph of the Clarke belt as illustrated in Figure 15.

I have only scratched the surface, and the sky is the limit of this little project. The RT project can certainly broaden your horizons and expand your understanding of our universe. If you would like more detail than can be presented here, please contact the author.

Notes

[1]**www.setileague.org/articles/lbt.pdf**.
[2]**www.aoc.nrao.edu/epo/teachers/ittybitty/procedure.html**.
[3]**www.pctinternational.com/channelmaster/0612/satellite.html**.
[4]**radiosky.com/skypipeishere.html**.
[5]**en.wikipedia.org/wiki/Geostationary**.
[6]**www.arrl.org/files/qst-binaries/**.

Mark Spencer, WA8SME, is ARRL Education and Technology Program Coordinator. He is an ARRL member and holds an Amateur Extra class license. You can reach Mark at 774 Eastside Rd, Coleville, CA 96107 or at **wa8sme@arrl.org**.

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Simple demonstration to explore the radio waves generated by a mobile phone.

Dr Jonathan Hare, Sussex University, Department of Physics, Falmer, Brighton. BN1 9QH
Note: this article has been published: Simple demonstration to explore the radio waves generated by a mobile phone J P Hare, 2010, Journal of Physics Education, Institute of Physics, 45, p. 481 45 481

Also see the brief full article at: mobile phone detector

IMPORTANT NOTE: this device works very well on the old style mobile phones (as shown in the photo above). However, it does not always work well with modern smart phones. This may be because modern phones use higher frequencies, less power and use the power in a slightly different way (e.g. spread spectrum). Some smart phones do work and success may be due to the signal strength of the local mobile phone mast nearby. If you are in a low signal area the phone will create more power to ensure reliable communications. If you are in a very strong signal area (very near the local network) your phone will drop its output power and consiquently there will be less power to pick-up and to convert to a voltage to light the LED.

Described is a simple low cost home-made device that converts the radio wave energy from a mobile phone signal into electricity to light an LED. No battery or complex circuitry is required. The device can form the basis of a range of interesting experiments on the physics and technology of our mobile phones.

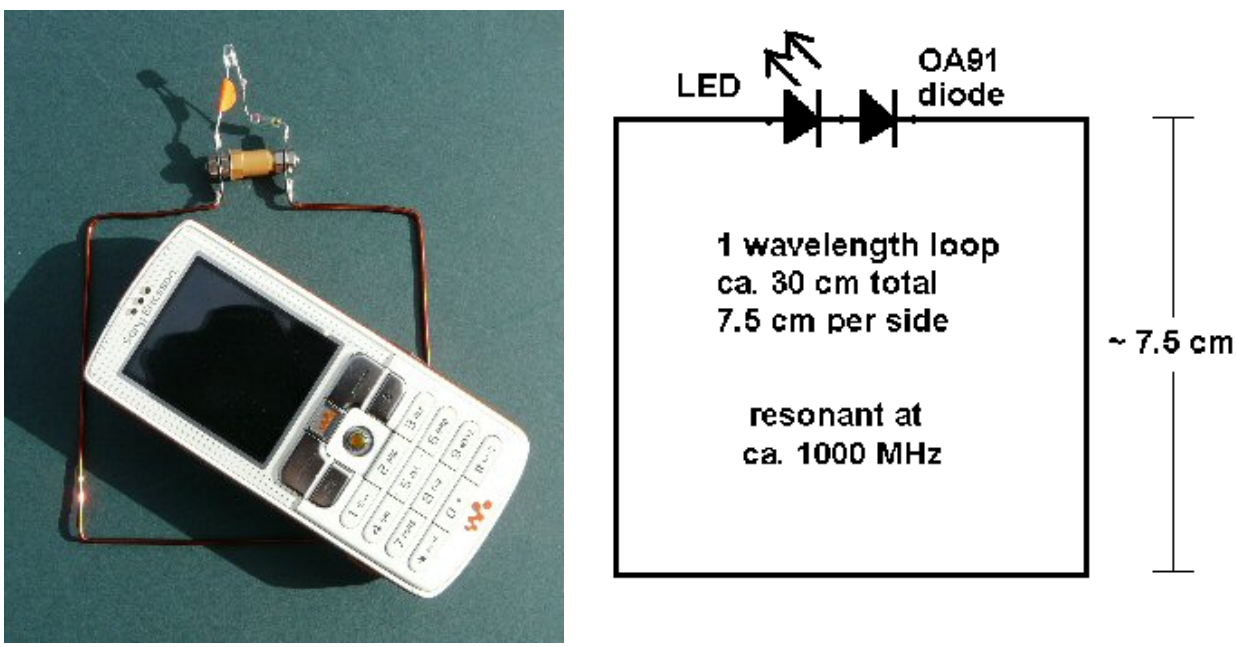

Fig. 1: left: mobile phone radio wave detector and right: the simple schematic

Introduction

Electromagnetic radiation (EMR) is at the heart of modern mobile phone data communications networks. The way a mobile phone and local base stations (the antenna covered masts you see dotted all around the place) communicate between each other is by using EMR in the radio wave part of the spectrum [1,2,3]. On switch-on your mobile sends digital information pulses by rapidly switching on and off the radio waves rather like a fast Morse code signal. Your text or voice is also converted into a series of digital pulses and sent across the network to be decoded (reassembled) by another mobile phone you dialled.

EM radiation and radio waves

Mobiles make use of various bands of radio frequencies to communicate between the mobile to base and the base to mobile: in Europe these include 900 and 1800 MHz (850 and 1900 MHz in the USA and Canada) [2, 3].

The relationship between wavelength, speed of light and the frequency follows the well known formula:

Wavelength λ (m) = speed / frequency = c (ms^{-1}) / ν (Hz)
λ (m) = 300,000,000 / ν (Hz) or approximately:
λ (m) = 300 / ν (MHz) ..... Equation 1.

So for a mid-range of about 1000 MHz (1 GHz) we get a typical mobile phone wavelength of about:
λ = 300/ 1000 = 0.3 m = 30 cm.

Simple radio wave detector

The loop consists of about a wavelength of wire, ca. 30 cm so each side is about 30/4 = 7.5 cm. The dimensions are not critical. The two ends are connected directly to a simple series circuit consisting of a high brightness LED and a germanium diode. They need to be connected correctly. All these components are cheap and readily available from electronic stores [4]. The loop can be made from a piece of copper wire roughly bent into a square (although a circular loop or rectangle will also work). If the wire is insulated remember to scrap off the insulation and solder-tin the ends. Simply solder the germanium diode and LED into circuit as shown in the diagram.
On a new LED the long lead is the positive (anode) while the short lead is the negative (cathode). The germanium diode has a line (band) around the end which is the cathode. When correctly wired the LED and the germanium diodes are connected so they both allow current to pass in the same direction, i.e. in the circuit diagram the arrows point in the same direction. In practice this means the LED and germanium diode are joined at the cathode of one and the anode of the other.
In my prototypes I used an insulator between the loop ends (light coloured cylinder in the photo) to make the whole thing more sturdy but this was purely for mechanical reasons and is not needed for the circuit to function properly. Note: a much more sensitive version using a x10 and x100 DC amplifier is described on my web site [6].

How it works and how to use it

When a radio wave passes across a metal object the EM fields cause the charged electrons in the metal to oscillate and this causes small AC currents at the same frequency to be induced into the metal. If a mobile is brought near to the loop and a call or text is made [5] the radio waves emitted from the phone pass across the loop. This induces a voltage into the antenna (the loop) and if it is close enough will be large enough to light the LED. As the loop is about one wavelength in size it is resonant and so there is a good transfer of power (low reactance) between the radio wave and LED.

The mobile phone automatically tests the network and adjusts its transmission power to maximise the battery life and minimise network interference. As a result the brightness of the LED will depend on the data being sent (the average signal), the local signal strength and how close the loop is to the phone. Why the second diode? - It's curious why the germanium diode is needed at all. The LED is a Light Emitting Diode after all and one would not think that another diode would help. However my initial experiments failed because I had not included it. The LED will have a relatively high capacitance which at these frequencies will tend to de-tune the loop and short out the LED. The germanium diode however is made up of a tiny wire which only makes a point-of-contact onto a piece of semiconducting germanium so it's 'self' capacitance is very low keeping the loop resonant.

The germanium diode will rectify the AC signal from the loop forming a series of DC pulses that will be nicely smoothed by the LED's capacitance. Without the diode however the raw AC signal from the loop will tend to be averaged to zero by the LED's capacitance.

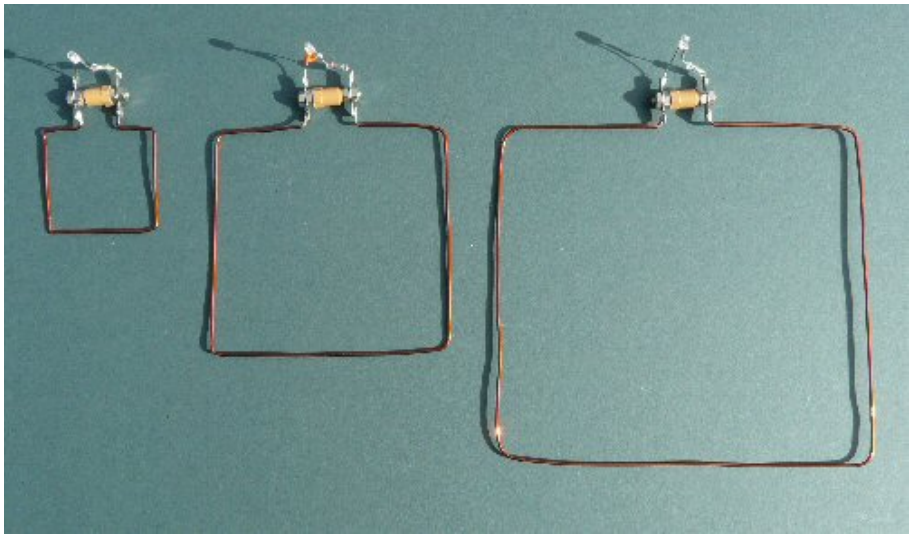

Fig. 2: Three loops in a row of varying size. The one described here and shown in Fig. 1 is shown in the middle. Smaller ones may well work better for higher frequencies such as the 3G networks (see below).

Other size loops
Fig. 2 shows a set of three loop devices with edge lengths of roughly 3.7, 7.5 and 15 cm. You can find out for yourself that the best match to the mobile signal is with the full wave loop of ca. 7.5cm per side. The other loops do work to varying degrees however (smaller ones may work better for the 3G network). The larger loop works well for the '70 cm' amateur radio bands.

Polarisation
The electric and magnetic fields making up the EM wave are orthogonal (they are at right angles to each other as they pass through space) to each other but depending how they are generated by the transmitting antenna can arrange themselves in any orientation with respect to the ground. If the electric field is parallel with the ground we say the wave is 'horizontally polarised' while if its normal to the ground we say its 'vertically polarised'. The loop antenna will respond best to one type of polarisation (depending on its orientation) so it's worth experimenting with the orientation of the mobile (or the loop) to get the strongest signal - brightest LED.

Mobile antenna
Inside your mobile phone is a transmitter / receiver and antenna. Many mobiles have this antenna at the top of the phone but some of the PDA type phones have it at the bottom. As a result you can locate the position of the antenna by moving it around the center of the loop till you get maximum LED brightness.

Networks
There are various different networks that a mobile may use both in the UK and abroad. It may be that you need to adjust the network phone settings on your mobile i.e. change from "automatic select" to set for "GSM" so as it get the strongest signal to light the LED. Note: the 3G network might not be powerful enough to light the LED. As the GMS network is currently the main network over the UK the device should work anywhere where you can get a signal as long as you check the correct selection on your mobile menus [5, 7]. The 3G network operates on a higher frequency (smaller wavelength) so you might find a smaller loop will work better than the main one described here. See 'other experiments' section below.

Test signals
In order to pick up the radio wave energy from the phone it obviously needs to be transmitting a signal. There are a few ways to do this:

1) On switch 'on' (or change of network) you can see that the mobile initially transmits for a few seconds to the network to tell it it's there (especially if you have moved since turning it off). You don't actually need to dial a number to detect these signals.
2) Even if don't text or call, throughout the day the mobile will send out data to 'keep up' with the network, especially if you are moving around (going through train tunnels etc. see below).

3) When you make a phone call you will transmit. Initially there is quite a lot of data being sent but in a few seconds data / power only gets transmitted when you speak. So to light the LED continuously you need to talk or provide some background sound continuously. Your service provider voicemail might be a good free phone number to try for these experiments [5].

4) Texting is the easiest way to show the radio wave power being transmitted. Long texts will light the LED for longer than short texts.

5) Finally set up the mobile on the loop and use another phone to text or phone the mobile. Even though you are not directly using the phone you will see that even on 'receive' the mobile phone transmits data to and fro. Ring off before you get charged.

Note: If you can use a free phone number it will save you money [5].

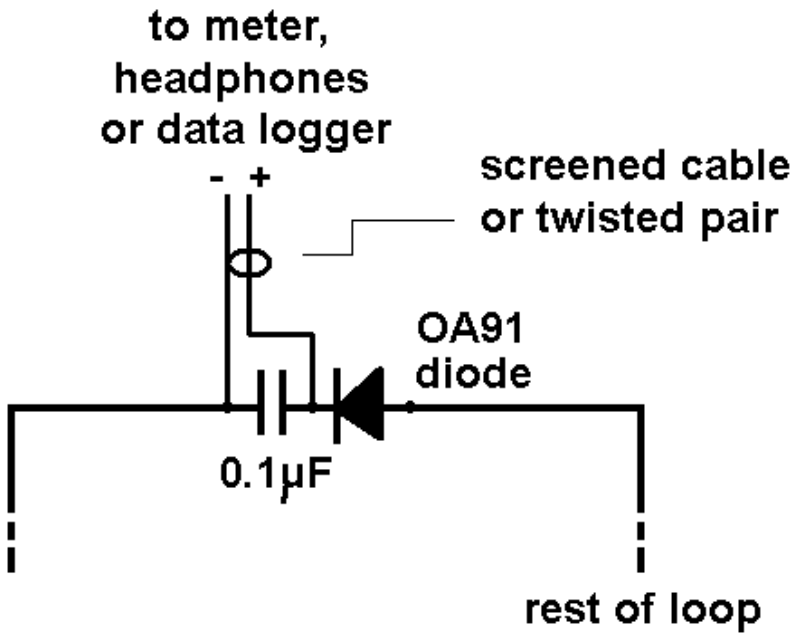

Fig. 3: Adding a capacitor and coax (or twin) lead so that headphones, a meter or a data logger can be connected (Note: diode is reverse wired compared to Fig. 1).

Other experiments:
Hearing data - if headphones are wired across the LED they will convert the voltages into sound and you can 'hear' the clicks of the digital data being transmitted. These are the same clicks that so easily get picked up by sensitive electronics such as a stereo amp or recording equipment when making a video for example. Hence - 'no phones on' when filming.

Logging data - if a meter, or better still a stand-alone data logger, is attached across the LED then one can monitor the EMR from the phone. For example even if you are not making a call your mobile will send signals too (and receive signals from) the network while travelling around. Fig. 3 shows a simple modification using a de-coupling capacitor so that a coax cable (or twisted pair) can be used to go to headphones, meter or data logger. Note the diode has been reversed so that the logger has the correct + and – connections for a unipolar input logger. The capacitor should help average the signal and stop radio frequencies going down to the logger. If one is available a few turns of the wire can be wound within a ferrite ring near to the logger so that maximum immunity to the mobile phone signal can be obtained for the logger electronics.

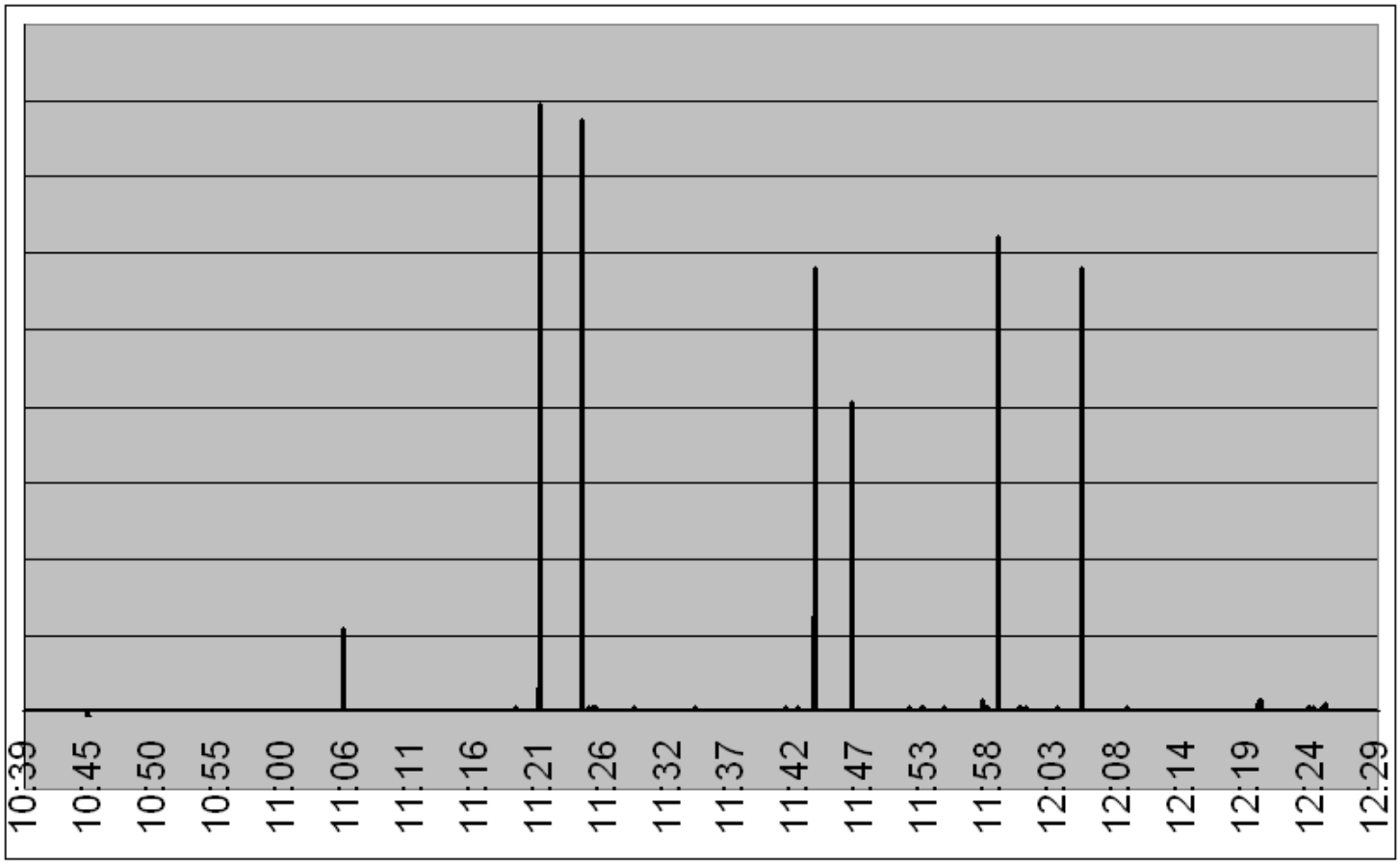

Fig. 4: Typical mobile phone data signals sent out onto the network while travelling around. These were recorded by a data logger from a mobile using the loop (no calls or text were made) while travelling on the train from Brighton to London Victoria (and then around London and return). Many of these peaks were the phone sending out 'I am here' data after coming out of one of the many long tunnels under the South Downs during the journey.

Out and about - Once you can log data you can discover all sorts of interesting things your mobile phone is doing without you realising it. Fig. 4 shows the plot over a few hours of travelling between Brighton and London (and within London) on the train. The detector was simply placed near to a phone that was not making or receiving a phone call or text, but was turned on.

The graph shows that the mobile sends out signals to tell the network where it is as it travels along and in particular goes in and out of long train tunnels. The peak heights vary because of the different powers the mobile transmits at depending on the signal strength of the local network and also because of the way the data logger 'snatches' a reading from the circuit every few seconds. As your phone sends out data onto the network to ensure the very best communications as you move around, so your mobile and the network obviously knows where you are and where you have been. Thieves and criminals beware the police can track you!

The inverse square law - If the transmitting mobile phone is moved away from the loop one would expect the signal to drop off. Unfortunately because both diodes need a certain threshold before they conduct the detector is not sensitive to small signals and not very linear. Therefore it's not very easy to use the device to measure the inverse square law (drop in signal v distance away) but of course you can see the signal go down. You could perhaps use the device to plot isobars - i.e. plot the equal intensity signals around the phone / nearby objects.

Changing the resonant frequency of the loop - you might be able to make some simple sliding mechanism (e.g. a small trombone-like mechanism) out of metal tube for example to tune the loop device for different frequencies. Then you can use it to find the average wavelength and so determine the center frequency by adjusting the size for maximum brightness of the LED. The wavelength can be determined by measuring the total distance around the loop. If we assume the antenna is one wavelength in total length then the frequency can be established by rearranging Equation 1, i.e. ν (MHz) = 30,000 / L (cm), where L is the length around the loop (cm).

Note: You will need to allow the transmitted digital signal to 'settle down' i.e. make measurements only after a few seconds after dialling / pick up so that only the sound data is being transmitted rather than the initial connection data. A constant sound will also need to be made so that the mobile phone continuously transmits data. It's worth playing music near to the phone or constantly whistling to keep sound coming into the phones microphone.

Mobile phone detector - teachers who want to know if the students / pupils really have turned-off their mobile phones (rather than just put on 'silent') can wire the loop device into the class room white-board speakers. Any mobile that is on in the class will send out signals which (if you are close enough) you will hear the data going to and fro - you will have your very own 'who's got their mobiles on' device which might be useful for exams etc.

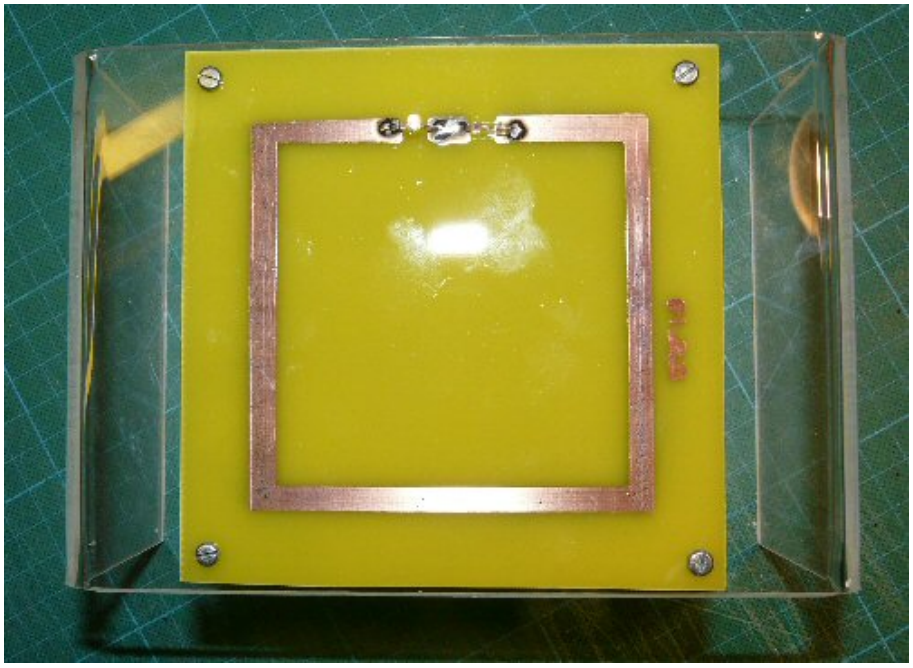

Fig. 5: The SEPNet 'deluxe' printed circuit board version (pcb) on a perspex stand where the loop is composed of a pcb copper track and the diode and LED soldered onto the board (top) [8,9].

Summary

All in all then, for such a simple easy to make device I hope you agree that there is a lot of scope for interesting science / technology investigations with your mobile phone. The device would make a good science week project (for radio amateur clubs etc.) A 'deluxe' pcb version (Fig. 5) on a perspex display case (Fig. 5) is currently going around the southern UK as part of the SEPnet outreach work, see the 'Radiation Exhibition' [8] and also as part of my on-going lecture series [9].

Post publication additions

(What follows was not included in the published article as this calculation was worked out later). A full wave loop is resonant and so looks purely resistive to the radio waves. Such a loop will have a resistance of about 100 ohms (Note: this is the AC resistance and not the DC resistance which will be very low). Now power P = V x I (V = voltage and I = current) and resistance = R = V/ I therefore $P = V^2 / R$ or rearranging $V = \sqrt{(P \times R)}$ which means that the voltage created by a power level of say 50mW (say for argument that roughly half the mobile phone power) arriving at the antenna will be about $V = \sqrt{(100 \times .05)}$ which is aprox. V = 2V, enough to light an LED.

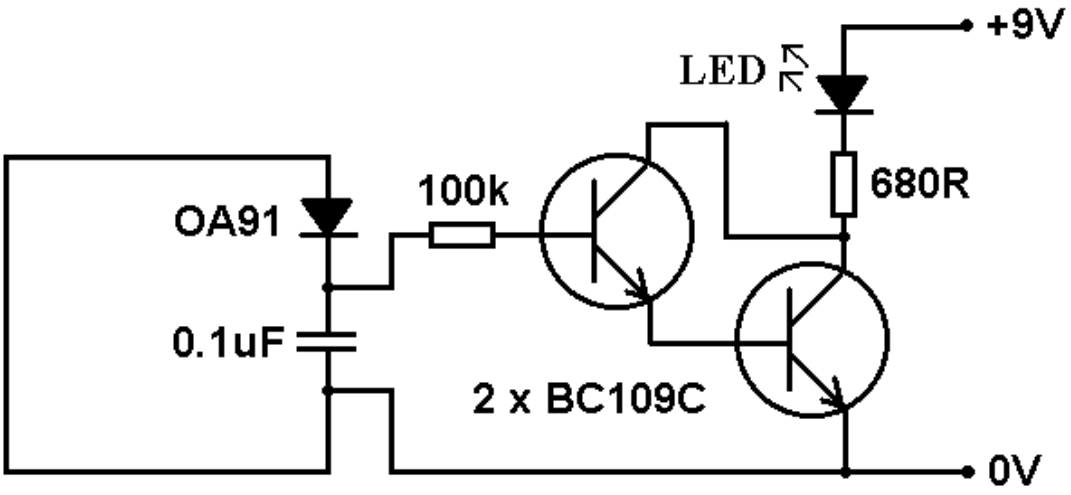

This circuit uses a two transistor darlington driver to amplify the signal from the loop and diode making the detector much more sensitive. The LED will be much brighter using this circuit. Note: the circuit needs a battery to power it (e.g. a PP3 9V)

References

[1] These ultra high frequencies (UHF, > 1000 MHz) are also often called microwaves.
[2] wiki pages
[3] Elektor Electronics magazine, June 2005
[4] order codes for the germanium diode and LED are:
e.g. Germanium diode: Maplin Electronics: QH71N, Rapid Electronics: 47-3114
e.g. LED: Maplin Electronics: UF72P , Rapid Electronics: 55-0085
[5] to save money use your voice mail service (often you simply dial 121).
[6] for details of an amplified detector see: wavemeter
[7] select 'network setting' from the mobile phone 'settings' menu and then go to 'network mode' and select 'GSM 900/1800' rather than 'automatic'.
[8] SEPnet mobile phone device on display throughout southern UK. [9] for details of my talks see: talks and workshops

THE CREATIVE SCIENCE CENTRE

Dr Jonathan Hare, Brighton, East Sussex. BN1 9QJ.

home | diary | whats on | CSC summary | latest news

Simple demonstration to show mobile phones emit radio waves

Dr Jonathan Hare, Sussex University, Department of Physics, Falmer, Brighton. BN1 9QH
Note: this article is in press: Elektor Magazine, July-August 2010, p. 56-57

For other experiments with this device please see my full article at: mobile phone detector

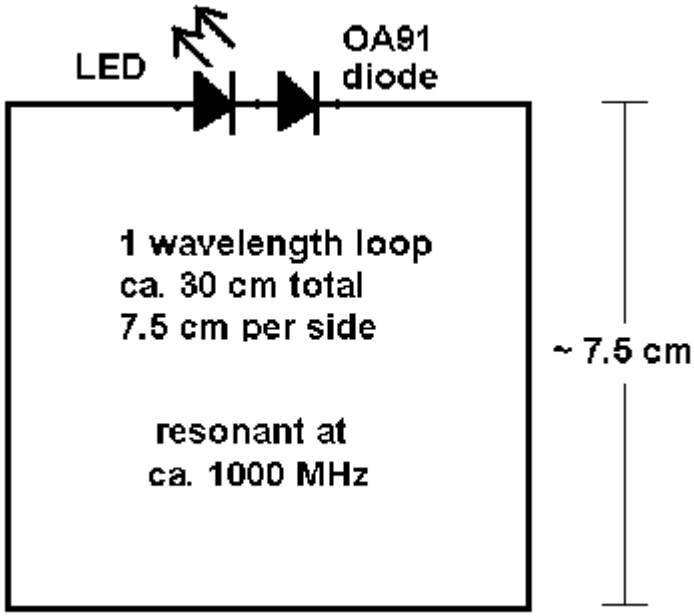

left: mobile phone radio wave detector and right: the simple schematic. Below: detail of the LED and germanium diode.

IMPORTANT NOTE: this device works very well on the old style mobile phones (as shown in the photo above). However, it does not always work well with modern smart phones. This may be because modern phones use higher frequencies, less power and use the power in a slightly different way (e.g. spread

spectrum). Some smart phones do work and success may be due to the signal strength of the local mobile phone mast nearby. If you are in a low signal area the phone will create more power to ensure reliable communications. If you are in a very strong signal area (very near the local network) your phone will drop its output power and consiquently there will be less power to pick-up and to convert to a voltage to light the LED.

This is a very simple and cheap device that demonstrates mobile phones ('cell phones' or 'handies') generate radio waves. We have a 30 cm (7.5 cm per side) full-wavelength loop antenna (a 'Quad' to radio amateurs) connected to a germanium diode and a hyper-bright LED. The loop can be made of copper wire, thin sheet metal or a track on a pcb. The diodes need to be wired correctly. I think the germanium diode is needed as the LED probably has too great a self-capacitance to perform at the very high AC frequencies generated by the phone (ca. 900 or 1800 Hz) but will work well with the DC pulses from the germanium diode (which has a very small capacitance).

To show the mobile generates radio waves put the mobile near to the loop and dial a number (use a free phone number, e.g. your voice mail) or text. The radio waves will induce a voltage into the loop, large enough to light the LED. The LED will flash indicating the digital data being sent by the mobile phone transmitter. You may need to set your phone to 'GSM 900/1800' rather than the '3G' network in the settings menu.

parts:
germanium diode: Maplin Electronics: QH71N or Rapid Electronics: 47-3114
LED: Maplin Electronics: UF72P or Rapid Electronics: 55-0085

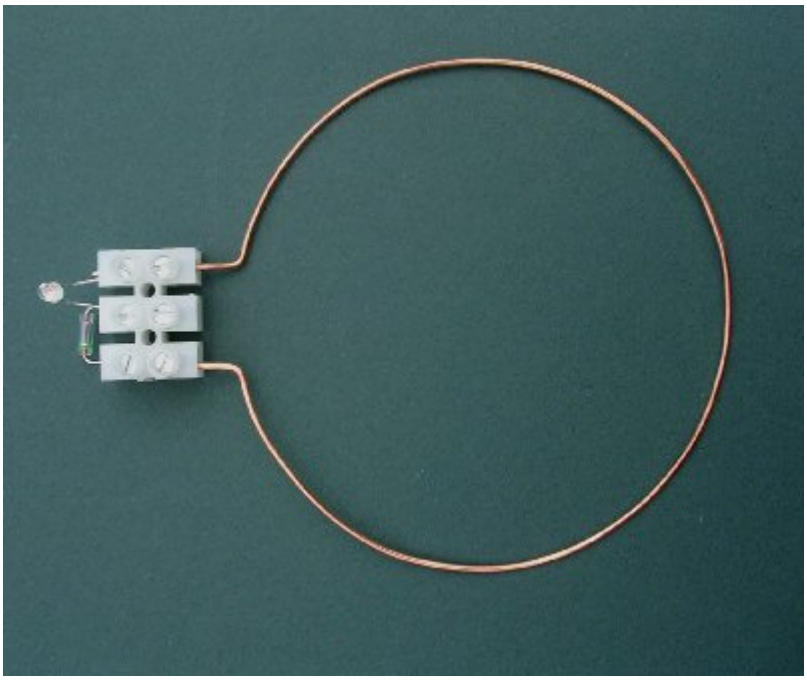

A very simple connector block version and a circular 1 wavelength loop

THE CREATIVE SCIENCE CENTRE

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BACK TO G1EXG RADIO PAGE

EPAD MOSFET - 'near zero' and 'zero' threshold devices (e.g. the ALD110900)

I will add more details to this page later on but for the moment it gives links to important and inspiring sites.

ARTICLES
1) High Sensitivity Crystal sets, Technical Topics, Pat Hawker, Rad Com, p. 77-78, May 2007.
2) A novel kind of 'crystal set' radio, Giles Read, Rad Com, p. 60-61, June 2007.
3) also see Pat Hawker, Technical Topics, Rad. Com. January 200, page 53-57.
4) High Sensitivity Crystal Set by By Bob Culter (N7FKI)
5) Next-generation Zero-Threshold Voltage EPAD™ design enables circuits with greater operating range in low voltage supply environments

LINKS ABOUT THE CHIPS / DEVICES
1) Advanced Linear Devices web site
2) EPAD MOSFET (ALD web site)
3) ALD110800 and ALD110900 page (ALD web site)
4) ALD110802 and ALD110802 page (ALD web site)

ORDERING THE CHIPS / DEVICES
1) mouser.com (USA)

'CRYSTAL SET' RADIO'S - DIFFERENT DETECTORS

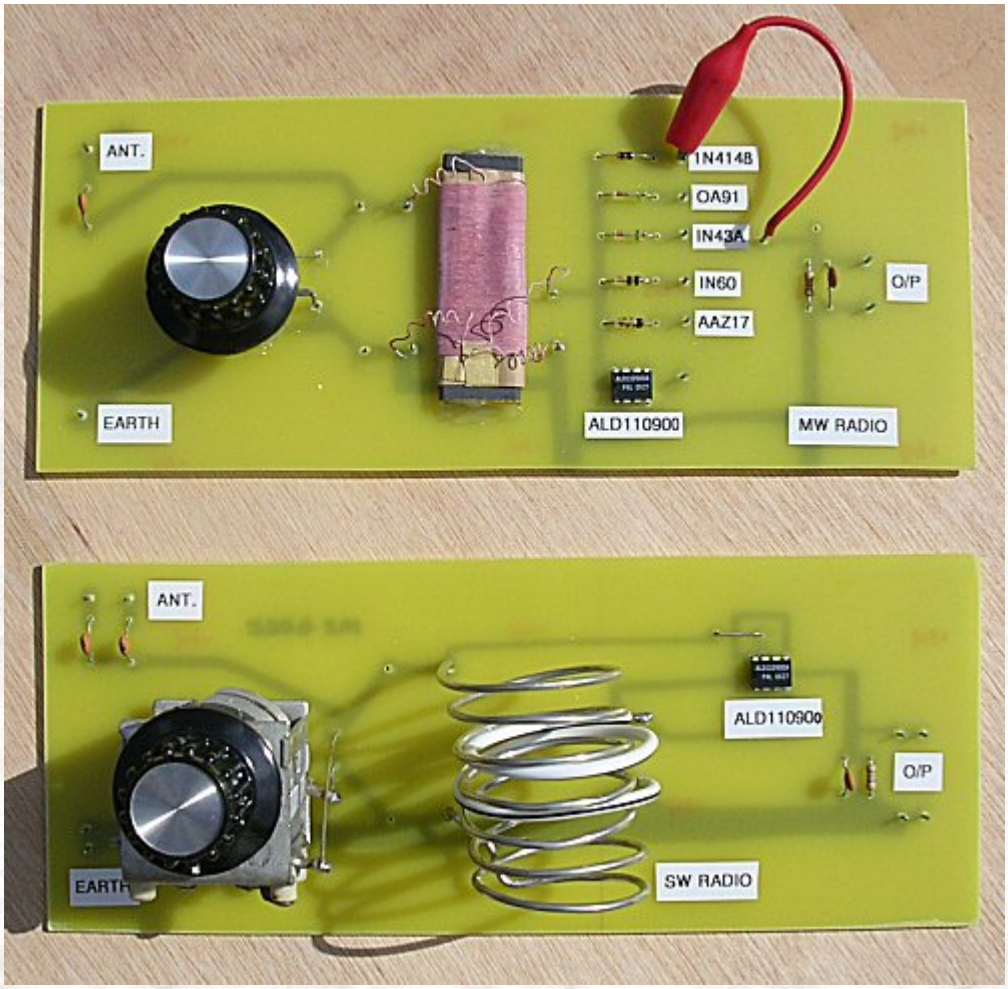

Top: the medium wave (MW) test radio with a selection of 'detectors' (selected by the croc clip lead)
Bottom: the short wave (SW) version with a ALD110900 detector
(on each circuit board the connections are: antenna - top left, Earth - bottom left, audio output (heaphones / amp) - far right.)

RADIO AND RADIO WAVES

The simplest 'radio' can be a piece of wire attached to the input of an amplifier. Why does this pick up radio signals? Well in principle it should not be able to pick up anything but in reality poor solder joints in the amplifier circuitry, as well as point contact effects between the ends of the anenna wire going into the input socket of the amp as well as other effects mean that you do often hear radio signals.

Radio waves are electromagnetic waves as they pass through a metal they induce small voltages into it. Any piece of metal e.g. metal fram specs, tape measures, metal window frames, a piece of wire etc. will act as an antenna and have tiny voltages induced into them. These voltages will be due to natural radio waves (from Space as well as the Sun and Earth), radio stations, satellites, mobile phones, garage door remote controls, microwave ovens .... the list goes on and on.

In the case of long, medium and short wave radio stations the amplitude of the radio wave signal is modified by the music, voice or program - we call it Amplitude modulation AM. Here the strength of the radio waves varies as the tones, loudness and pitch of the program vary. As a result the voltages induced in the metal object antennas distant from the radio wave stations also vary in accord this program information or modulation.

To actually hear the programs on the radio waves you cant actually take this tiny signal and listen to it directly (say with headphones or an amplifier). This is because the signal is a very high frequency signal out of the range of human hearing. To get the audible information - the program - 'off' the radio signal you need a device known

as a 'detector'. This is usually a diode but lots of other things can act as inefficent detectors for example a mineral called galena, coke (burnt coal) ... as well as rusty screws and bad solder joints which is how the ampilfier mentioned above apparently picks up radio signals.

In the early days of radio crystals of galina were used as diodes and so these radios became known as 'crystal set radios'. They did not have any amplifiers and did not require any battery to work. They got all their power from that induced into the (of very long) antenna by the radio signal(s). The radio detector is an extremely important part of the radio and its proper function determines how well the radio works.

The radio signal is an AC signal. A speaker or headphones can not resonate at such high frequencies as radio waves and if you try to wire in the RF to the headphones the diaphram just averages the power. As half the time the RF is positive and half the time negative, in an AC signal, the average is zero and so you dont hear anything. The diode or detector is a device called a diode which only conducts electricity in one direction. So it only allows the positive, or negative half (one half but but not both) of the AC signal to go through (depending on which way it is wired). After the diode the average is now no longer zero its actually a changing signal dependant on the modulation of the radio wave - which is the information we want to hear. As this is at audio frequencies, and as the diaphram can move at audio frequencies, you hear the information on the detected RF signal - the music, voice or what ever.

Why should some detectors (diodes) be 'better' than others? The answer is not that some are better at 'magnifying' the signals but rather that each diode requires a certain threshold voltage in order to start conducting (one way). Signals below this level will not get passed through and a signal only slightly larger will therefore only pass through weekly (the diode unfortunatly absorbing the majority of the signal). As a result for large signals you wont expect to see much difference between different detectors but for weak signals there can be a great deal of difference. In an ideal world the diode would start to (forward) conduct at just above zero volts and this ideal detector (which does not conduct at all in reverse) would produce the greatest signal possible for the particular strength signal applied to it.

Recently I was playing around with OA91 germanium diodes for a mobile phone detector. I made a simple 10cm per side square loop and wired it directly to an LED. I was hoping that if I brought the mobile near to the loop and texted, or made a phone call, the RF should be picked up by the loop (which is almost resonant) and the LED should light - it didnt work! But putting an OA91 in series I did get it to work. So why did I need the OA91 diode when the LED is itself a diode?

It can't be due to the threshold voltage in this case as I am still using the LED and I did get it to work with the same signal! So I guess it because the capacitance of the LED is very high compared to the point-contact germanium diode. If we extend this thinking to the crystal set radio I guess the germanium diodes have very little capacitance and so dont allow any of the 'wrong' half of the AC signal through and so act as a more perfect detector. An LED would have a high capacitance and so let some of the wrong half of the AC signal through which on averaging by headphones would be nearer zero (see above) - hence less sound.

A low threshold (turn-on) voltage and a low self capacitance are crucial things in a good detector. Point contact germanium diodes having a very small area (a point of contact) have low capacitance and the germanium semiconductor-metal junction of the contact has a low turn on voltage. EPAD Mosfets also have low capacitance, high input resistance (low loading of the signal) and low turn on voltage.

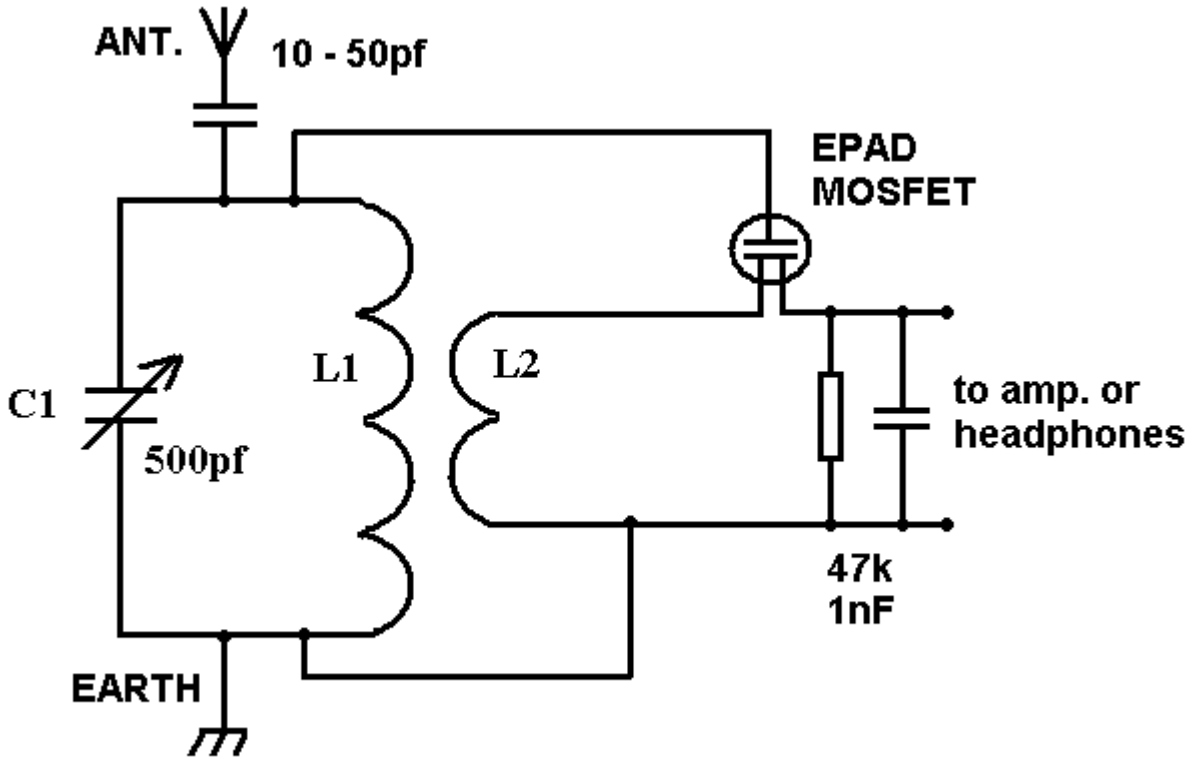

MEDIUM WAVE TEST CIRCUIT (top in photo)
As a simple test circuit to compare detectors I made up a simple 'crystal set' radio from a ferrite rod coil from an old radio, tuning capacitor an array of diodes (crystals) and a simple RF filter composed of a 47k resistor and 1nF capacitor. The coil and capacitor formed the resonant circuit which was fed via a 10 - 50pf capacitor by the antenna (long wire). This capacitor helps to reduce the effect of the antennas own capacitance and inductance from modifying the resonant frequency of the tuned circuit. Ideally this should be as small a capacitance as you can get away with but too small a value will reduce the radios sensitivity ....

An earth was connected to the ground connection of the circuit. Instead of taking the antenna end of the resonant circuit to a diode detector (as many simple crystal sets do) I used a ca. 10 turn coupling coil around the coil. This was done to limit the loading on the resonant circuit by the detector. It should help keep the tuning sharp and also help to keep the overall (band) spread of tuning as large as possible.

Because of the reduction in turns (ca. 100 turns : 10 turns, i.e. 10:1) the coupling coil reduces the signal that is available to drive the detector. For example if I use a standard silicon diode (e.g. a 1N4148) which requires about 0.6V to conduct then we might need ca. 10 x 0.6 = 6V of RF to be developed in the resonant circuit! A high Q resonant circuit might do this with a long antenna coupled to it but without such a generious antenna such a set-up wont be very sensitive.

RESULTS
I tried an array of 'crystal set' type diodes to campare them. Typical rough results are shown in the table below. This was with an Earth and about 3-4m of antenna wire randomly strung near to ground level (so its a pretty bad set up really - a good test).

The EPAD MOSFET data sheets described how the gate and drain of one of the MOSFETS can be joined together to form the anode of a diode the source then forms the cathode. I tried this arangement with the ALD110900 in order to make up a 'crystal set' diode from this MOSFET but it didnt perform well.

Then I tried the alternative arrangement as described in the references above. In these articles they dont use the MOSFETS as diodes but connect the gate directly to the resonant circuit. As the input resistance is extremely high (c.a. 1E12 ohms) and the input capacitance is very low (c.a 3pf) it does not load the tuned circuit by any appreciable amount. The source and drain are then wired between the coupling coil and filter just as the usual diode detector is in a crystal set radio. In this configuration the MOSFET is working more as a gate voltage controlled resistor rather than a diode i.e 'off' for half an RF cycle and 'on' for the rest - this lets the envelope through and you hear the music or sound. One article describes the arrangement as a synronious detector. As there are two MOSFETS in one package the two are wired in parallel i.e. gate to gate, drain to drain (there is a common source) etc.

DETECTOR TYPE	AF voltage produced after filtering
1N4148 silicon	no signal
OA91 germanium	1mV
1N43A germanium	1mV
1N60 germanium	1mV
AAZ17 germanium	1.5mV
ALD110900 EPAD MOSFET wired as diode	<1mV
ALD110900 EPAD MOSFET wired as sync. detc.	10mV

Typical results of the AF voltages produced by the detector (for use by headphones or amplifier) for an Earth connection, small (ca. 3-4m antenna wire near ground level) and the prototype 'crystal set' radio.

For the simple set-up described above there was not enough signal to get the silicon diode to work at all (although a much longer wire did provide a very small signal). A simple listening test and measurement of the AF prodiced by each diode showed that their was very little difference between the various germanium diodes. The MOSFET simply wired as a diode (gate wired directly the drain) was a poor detector - better than a silicon but not nearly so good as any of the germanium diodes. Finally the EPAD MOSFET wired as a syncronious detector worked really very well apparently producing ca. 10 times the signal (in other words it has much less loss than a germanium diode) for this particular set up and station than the germanium diodes.

As the syncronious arrangement was so succesful it got me thinking about this circuit. As the gate goes straight in on the main resonant circuit where the voltages, in a good Q circuit, might well be relatively high I thought I would try a standard FET (2N3819) and MOSFET (VN10KM) instead - and they worked! (they are a lot cheaper than an EPAD MOSFET chip and easier to get). Some FETS have a larger input capacitance so it helped to put a 10pf capacitor in series to the gate (a 10M ohm from gate to earth might reduce 50Hz pick up).

They were not as good as the EPAD MOSFET (although I only tried a single device) but the arrangment was still better than a simple 'crystal set' diode. For weak signals the EPAD MOSFET should perform better as it is able to keep going while the FET and the standard MOSFET will start to trail off as the resonant circuit voltage drops below the relatively higher gate voltage required for these devices. However it was interesting to see that it seems to be possible to get a more efficent set-up for a 'crystal' radio using a standard FET or MOSFET than with the standard germanium diode detector.

By the way I recently re-tried the 1N4148 diode but wired a 1.5V AA battery with a 100k resistor across it to forward bias it - and it worked ! It seemed to work better than a OA91!

SHORT WAVE 'CRYSTAL SET RADIO (bottom in photo)
The bottom circuit shown in the photo above is my own short wave version of the 'crystal set' radio but based on the references above. It's the same circuit as the MW radio but has a reduction drive tuning capacitor and different coil. I used about 7 turns (ca. 4cm diameter) for the resonant circuit and a couple of turns of insulated wire (white) for the coupling coil. I guess the radio tunes from about 3-8 MHz - I havent tried a sig gen on it yet.

I made this in the summer months (not the best time for listening on this part of the spectrum). Using an Earth and few meters of wire for antenna I heard 2 or 3 stations from around the world during the day while at night there were at least 7 including the voice of Russia world service, Radio Thailand as well as German and French speaking stations.

BACK TO G1EXG RADIO PAGE

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10

Design Issues in Radio Frequency Energy Harvesting System

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Japan

1. Introduction

Emerging self powered systems challenge and dictate the direction of research in energy harvesting (EH). State of the art in energy harvesting is being applied in various fields using different single energy sources or a combination of two or more sources. In certain applications like smart packaging, radio frequency (RF) is the preferred method to power the electronics while for smart building applications, the main type of energy source used is solar, with vibration & thermal being used increasingly. The main differences in these power sources is the power density; for example RF (0.01 ~ 0.1 μW/cm^2), Vibration (4 ~ 100 μW/cm^2), Photovoltaic (10 μW/cm^2 ~ 10mW/cm^2) and Thermal (20 μW/cm^2 ~ 10mW/cm^2). Obviously RF energy though principally abundant, is the most limited source on account of the incident power density metric, except when near the base stations. Therefore, in general, RF harvesting circuits must be designed to operate at the most optimal efficiencies.

This Chapter focuses on RF energy harvesting (EH) and discusses the techniques to optimize the conversion efficiency of the RF energy harvesting circuit under stringent conditions like arbitrary polarization, ultra low power (micro or nanopower) incidences and varying incident power densities. Harvested power management and application scenarios are also presented in this Chapter. Most of the design examples described are taken from the authors' recent publications.

The Chapter is organised as follows. Section 2.1 is the introduction on RF energy sources. Section 2.2 presents the antenna design for RF EH in the cellular band as well as DTV band. The key issue in RF energy harvesting is the RF-to-DC conversion efficiency and is discussed in Section 2.3, whereas Section 2.4 and 2.5 present the design of DTV and cellular energy harvesting rectifiers, respectively. The management of micropower levels of harvested energy is explained in Section 2.6. Performance analysis of the complete RF EH system is presented in Section 3.0. Finally, conclusions are drawn in Section 4.0.

1.1 RF energy sources

These include FM radio, Analogue TV (ATV), Digital TV (DTV), Cellular and Wi-Fi. We will present a survey of the measured E-field intensity (V/m) for some of these RF sources as shown in Table 1, [1]-[2]. Additionally, measured RF spectrums for DTV and Cellular signals are presented as shown in Fig. 1 to show on the potential for energy-harvesting in

these frequency bands. In general, many published papers on RF-to-DC conversion, have presented circuits capable of converting input or incident power as low as -20dBm. This means that, if an RF survey or scan finds signals in space, with power spectrum levels around -20dBm, then, it is potentially viable to harvest such signal power. In Fig. 1 (left side), the spectrum level is well above -20dBm and hence, a higher potential for energy harvesting. In Fig. 1 (right side), while the spectrum level is below -20dBm, what we observe is that the level increases with decrease in the distance toward the base station (BTS). Using free space propagation equation with this data, it was calculated that at a distance 1.4 m from the BTS, the spectrum level could measure 0dBm. An example calculation and plot for the estimated received power level, assuming 0dBi transmitter (BTS) and receiver antenna gains and free space propagation loss (FSPL) for FM and DTV is presented in Section 2.1.1. For the example estimation in Section 2.1.1, we select FM and DTV because they measured with a higher level than cellular and Wi-Fi for example.

Source	**V/m**	**dBm**	**Reference**	
FM radio	0.15~3		Asami et al.	
Analogue TV	0.3~2			
Digital TV	0.2~2.4	-40~0.0	Asami et al.	Arai et al.
Cellular		-65~0.0	Mikeka and Arai	
Wi-Fi		≅ -30		

Table 1. RF energy sources, measured data.

In Table 1, FM radio has the highest E-field intensity implying the highest potential for energy harvesting. However, due to the requirements for a large antenna size and the challenges for simulations and measurements at the FM frequency i.e. 100 MHz or less (See Section 2.2.3, example FM antenna at 80 MHz), this Chapter will focus on DTV (470~770 MHz band) and Cellular (2100 MHz band) energy harvesting.

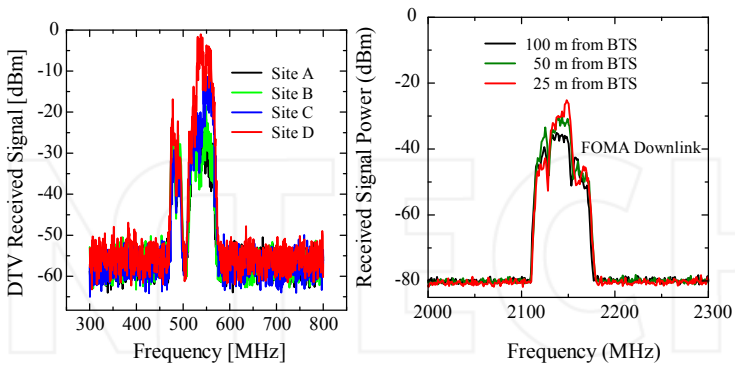

Fig. 1. DTV signal spectrum measured in Tokyo City (left side graph) and Cellular signal spectrum measured in Yokohama City (right side graph).

The received DTV signal power is high and also wide band, presenting high potential for increased energy harvesting unlike in cellular signals. We demonstrated in [2] that the total RF-to-DC converted power is roughly the integral over the DTV band (1), and is significantly larger than in the case of narrow band cellular energy harvesting.

$$P_{DC(DTV)} = \alpha \int_{470}^{770} \delta P_{DC}(f)\,df\ , \tag{1}$$

where α is the attenuation factor on the rectifying antenna's RF-to-DC conversion efficiency due to multiple incident signal excitation. δP_{DC} is the small converted DC power from each of the single DTV signals in the 470 MHz to 770 MHz band.

In detail, we derive (1) from fundamentals as follows.

The incident power density on the rectifying antenna (rectenna), $S(\theta,\phi,f,t)$, is a function of incident angles, and can vary over the DTV spectrum and in time. The effective area of the antenna, $A_{eff}(\theta,\phi,f)$, will be different at different frequencies, for different incident polarizations and incidence angles. The average RF power over a range of frequencies at any instant in time is given by:

$$P_{RF}(t) = \frac{1}{f_{high} - f_{low}} \int_{f_{low}}^{f_{high}} \int_{0}^{4\pi} S(\theta,\phi,f,t) A_{eff(\theta,\phi,f)}\, d\Omega\, df \tag{2}$$

The DC power for a single frequency (f_i) input RF power, is given by

$$P_{DC}(f_i) = P_{RF}(f_i,t).\eta\left(P_{RF}(f_i,t),\rho,Z_{DC}\right), \tag{3}$$

where η is the conversion efficiency, and depends on the impedance match $\rho(P_{RF},f)$ between the antenna and the rectifier circuit, as well as the DC load impedance. The reflection coefficient in turn is a nonlinear function of power and frequency.

The estimated conversion efficiency is calculated by P_{RF}/P_{DC} . This process should be done at each frequency in the range of interest. However, DC powers obtained in that way cannot be simply added in order to find multi-frequency efficiency, since the process is nonlinear. Thus, if simultaneous multi-frequency or broadband operation like in DTV band is required, the above characterization needs to be performed with the actual incident power levels and spectral power density. In this Chapter, we shall demonstrate DTV spectrum power harvest, given a rectenna than has been characterised in house at each single frequency in the DTV band.

1.1.1 An example calculation and plot for the estimated received power level

In this example we consider Tokyo's DTV and FM base stations (BS) as the RF sources. Both DTV and FM BS transmitter power (P_t) equals 10 kW (70dBm). The antenna gains are assumed 0dBi in both cases but also at the points of reception for easiness of calculation but with implications as follows. Assuming 0dBi antenna at each reception point, demands that we specify the frequency of the transmitted signal. For this reason we specify DTV signal frequency to be equal to 550 MHz while the FM signal frequency equals 80 MHz (Tokyo FM).

The received power, P_r is calculated using the simplest form of Friis transmission equation given by

$$P_r = P_t + G_t + G_r + FSPL\,, \tag{4}$$

where P_t = 70dBm, $G_t = G_r$ = 0dBi. G_r is the receiving antenna gain while FSPL is the free-space path loss given by

$$FSPL(dB) = 20\log(d) + 20\log(f) + 32.45\,, \tag{5}$$

where $\boldsymbol{d}$ is in (km) and $\boldsymbol{f}$ is in (MHz). The plot for the received power as a function of distance from the DTV and FM base stations is shown in Fig. 2.

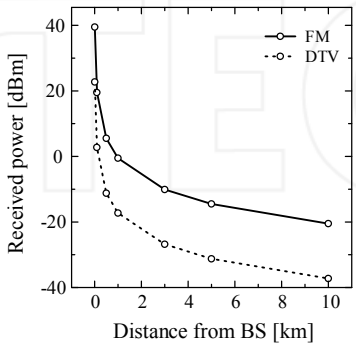

Fig. 2. DTV and FM received signal power level against distance.

With respect to Fig. 2, FM registers higher received power level than DTV at every reception point due to its lower transmit frequency and hence lower free-space path loss. For example at 1 km distance, FM received power level is -0.51dBm while for DTV, the received power is -17.26dBm. The important thing however, is that the received power level is frequency independent. It means that P_t is the transmitter power and the received power level at the position of distance $\boldsymbol{d}$ is $\frac{P_t}{4\pi d^2}$. However, if we assume 0dBi antenna at each reception point as in the above example, the power level is different because the antenna size of 0dBi is frequency dependent. As a result, high transmit power level is favorable for RF energy harvesting. Also near the base station is favorable.

1.2 Antenna design for the proposed RF energy harvesting (EH) system

It is well known that RF EH system requires the use of antenna as an efficient RF signal power receiving circuit, connected to an efficient rectifier for RF-to-DC power conversion. Depending on whether we want to harvest from cellular or DTV signals, the antenna design requirements are different. We will discuss the specific designs in the following sub sections.

1.2.1 Cellular energy harvesting antenna design

We propose a circular microstrip patch antenna (CMPA) for easy integration with the proposed rectifier (Section 2.5.1). However, the use of circular microstrip patch antennas (CMPA) is often challenged by the need for impedance matching, circular polarization (CP) and higher order harmonic suppression.

To address the above concerns, we create notches on the circular microstrip patch antenna. In our approach, we use only two, thin, fully parameterized triangular notches to achieve higher order harmonic suppression, impedance matching and circular polarization, all at once. This is the novelty in our proposed antenna. Our proposed CMPA is shown in Fig. 3. We study the behaviour of CMPA surface current vectors when notches (triangles ABC) are created on the structure at $\alpha = 45^0$ and $\alpha = 225^0$.

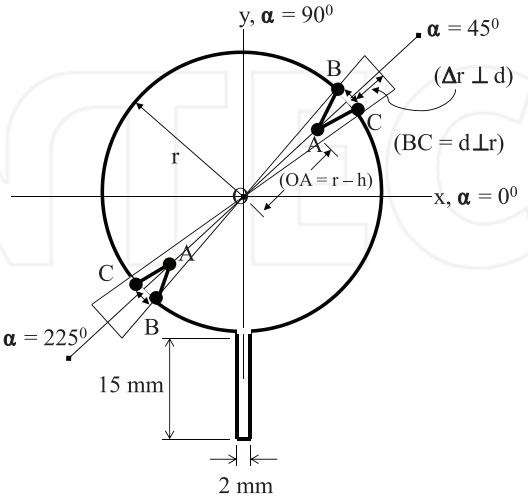

Fig. 3. Cellular energy harvesting antenna structure.

Notch parameters ***d*** and ***h*** in Fig. 3 were investigated by calculation using CST microwave Studio.

Without notches, the CMPA's input is not matched at f_c= 2.15 GHz as shown in Fig. 4 (left side). However, with notches, matching is achieved. The parameter combination ***d*** = 7 and ***h*** = 6 offers a matched and widest band input response and hence we adopt it for cellular energy harvesting applications.

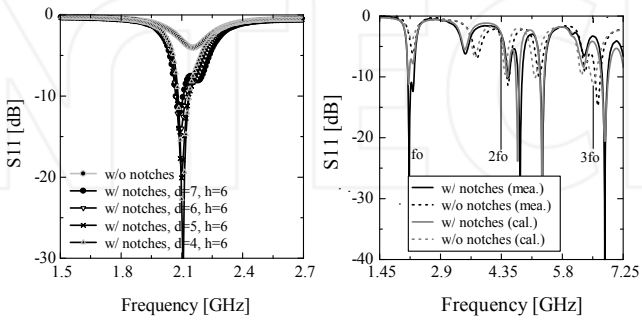

Fig. 4. *Left side:* ***d*** and ***h*** parameter investigation. *Right side:* Comparison between (cal.) and (mea.) S_{11} at f_0 = 2.175 GHz, $2f_0$ = 4.35 GHz and $3f_0$ = 6.53 GHz. The adopted notch parameters are ***d***=7 mm while ***h***= 6 mm.

The comparison between calculated and measured S_{11} is shown in Fig. 4 (right side). The 2nd and 3rd harmonics are suppressed as required by design. The comparison between calculated and measured radiation patterns is shown in Fig. 5, where $E_\vartheta \cong E_\varphi$ due to the 45^0 tilted surface current vector. Ordinarily, without notches, the surface current vector is parallel to the microstrip feeder axis. In conclusion, our proposed CMPA is sufficiently able to suppress higher order harmonics while simultaneously radiating a circularly polarized (CP) wave. The CP is required to efficiently receive the arbitrary polarization of the incident cellular signals at the rectenna.

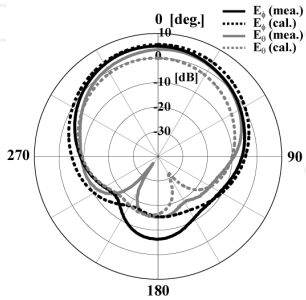

Fig. 5. Cellular energy harvesting antenna pattern at f_c= 2.15 GHz.

1.2.2 DTV energy harvesting antenna design

Unlike in the cellular energy harvesting antenna, the DTV energy harvesting antenna must be wideband (covering 470 MHz to 770 MHz), horizontally polarized and omni-directional.

The proposed antenna is typically a square patch (57 mm x 76 mm) with a partial ground plane (9 mm x 100 mm). The patch is indirectly fed by a strip line (9 mm x 3 mm). The proposed antenna geometry is shown in Fig. 6. The partial ground plane is used to achieve omni-directivity and a certain level of wide bandwidth. To tune the impedance of this antenna as well as to adjust the bandwidth within the target band, a "throttle" with stepped or graded structures is used between the microstrip feed line and the square patch, as shown in Fig. 6 (left side).

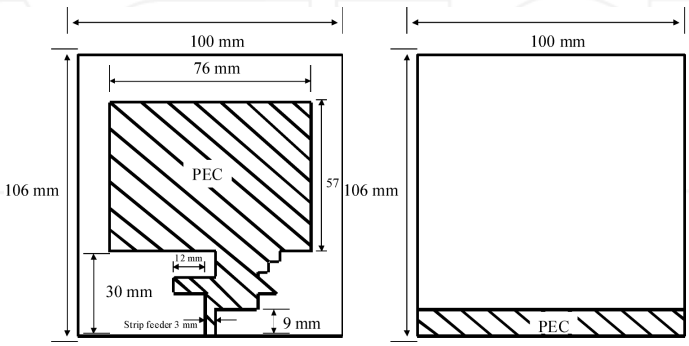

Fig. 6. Proposed DTV antenna geometry. *Left side:* Front view. *Right side:* Back view. The antenna is printed on FR4 substrate; t = 1.6 mm, ε_r = 4.4.

The input response for the proposed antenna is shown in Fig. 7 (left side). The omni directivity is confirmed by measurement at 500 MHz, 503 MHz, and 570 MHz as shown in Fig. 7 (right side). The radiation patterns shown in Fig. 7 are for the xz plane, which happens to be the vertical polarization for the antenna. DTV signals are horizontally polarized and therefore, when using this antenna, the orientation must be in such a way as to efficiently receive the DTV signal. Simply a 90 degree rotation of the antenna along the z axis achieves this requirement.

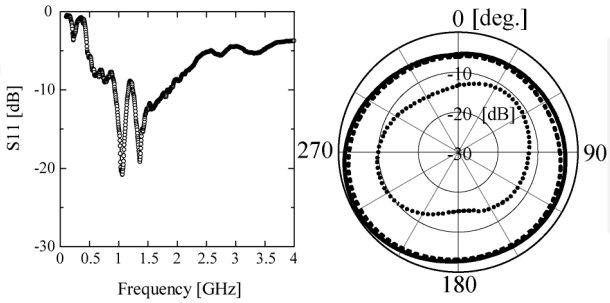

Fig. 7. Proposed DTV antenna performance. *Left side:* The antenna's measured input performance. *Right side:* The omni directivity in the vertical plane is confirmed at 500 MHz, 503 MHz, and 570 MHz. The outermost, black solid and dotted line patterns represent 503 MHz and 500 MHz directivity, respectively. The innermost dotted line pattern is the directivity at 570 MHz.

1.2.3 Example design for an 80 MHz FM half-wave dipole antenna

A half-wave dipole is the simplest practical antenna designed for picking up electromagnetic radiation signals, see Fig. 8 (courtesy of Highfields Amateur Radio Club). Calculating the optimal antenna length to pick up a certain frequency signal is fairly straightforward because antenna physics demand that the total length of wire used in the antenna be equal to one wavelength of the type of electromagnetic radiation it will be picking up. This means that the total length of the antenna should be equal to half the desired wavelength. By converting the 80 MHz frequency into a wavelength, you can thus obtain your antenna length as 1.875m by using the magic equation, $\lambda = \frac{c}{f}$. However, the actual length is typically about 95% of a half wavelength in free space, hence a half-wave dipole for this frequency should be 1.788m long, which would make each leg of the dipole 0.894m in length.

1.3 RF-to-DC conversion efficiency improvement techniques

A Schottky diode circuit connected to an antenna is used for RF-to-DC power conversion. To convert more of the antenna surface incident RF power to DC power, high RF-to-DC conversion efficiency is required of the rectifying circuit. Many authors have shown that the efficiency depends on several factors like Schottky diode type, harmonics suppression capability, load resistance selection, and the capability to handle arbitrary polarized incident waves. What is missing in most of these published works is the efficiency optimization for

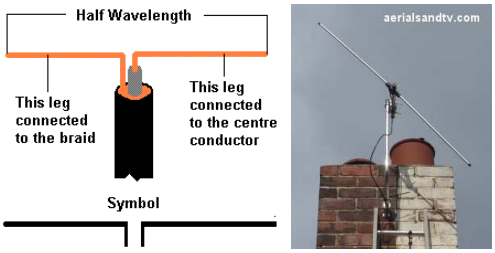

Fig. 8. Half-wave dipole. *Left side:* Antenna structure. *Right side:* Typical deployment.

ultra low power incident waves and the explanation of the physical phenomena behind most of the recommended efficiency optimization approaches.

This Chapter will show for example that a Schottky diode that delivers the highest efficiency at 0dBm incidence may not necessarily deliver the highest efficiency at lower power incidence e.g. –20dBm. We will therefore classify which diodes perform better at given power incidences; of course, this will also be compared to the diode manufacturers' application notes. Simulations in Agilent's ADS using SPICE and equivalent circuit models will compare the performance of few selected Schottky diodes namely; HSMS-2820, HSMS-2850, HSMS-2860, HSC-276A, and SMS7630. Moreover, the effect of the Schottky diode's junction capacitance (C_j) and junction bias resistance (R_j) on the conversion efficiency will be shown from which, special techniques for Schottky diode harmonic suppression and rectifying circuit loading for maximum efficiency point tracking will be presented.

1.3.1 The schottky diode

The classical *pn* junction diode commonly used at low frequencies has a relatively large junction capacitance that makes it unsuitable for high frequency application [3]. The Schottky barrier diode, however, relies on a semiconductor-metal junction that results in a much lower junction capacitance. This makes Schottky diodes suitable for higher frequency conversion applications like rectification (RF-to-DC conversion) [3]. We will demonstrate the effects of junction capacitance and resistance in the following sub section.

1.3.2 The effect of Schottky diode's C_j and R_j on the conversion efficiency

We have studied Schottky diode's C_j and R_j and published our results in [4]. In this work, we designed a rectifying antenna tuned for use at 2 GHz. The circuit proposed in [4] is a voltage doubler by configuration, but we replaced the amplitude detection diode (series diode) with its equivalent circuit adapted from [5]. The results of this investigation show that variation of C_j shifts the tuned frequency position and also introduces a mismatch in the resonant frequency, see Fig. 9 (left side graph). Therefore for this circuit at 2 GHz, we recommend using a Schottky diode having C_j = 0.2pF. In general, a smaller value of C_j is desirable at higher frequencies. Similarly, for R_j investigation, a smaller value is desirable for better matching at 2 GHz for example. If the R_j is increased towards 10kΩ, there is a mismatch in the resonant frequency but no shift in the frequency, see Fig. 9 (right side graph). Another approach to the study of Schottky diodes for higher frequency and efficiency rectenna design is presented in [6].

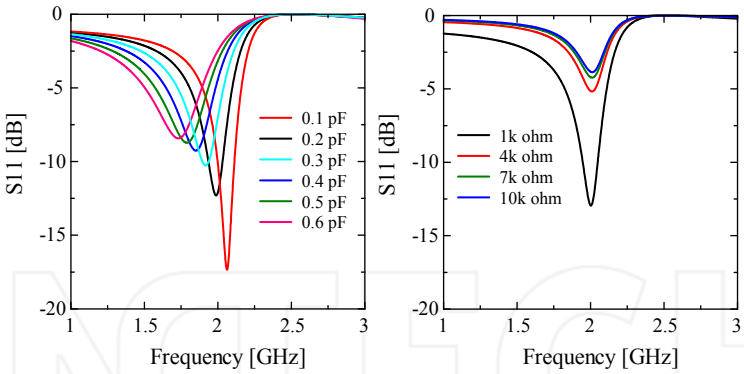

Fig. 9. Schottky diode's C_j effect (Left) and R_j effect (Right) on 2 GHz rectenna's input response.

1.4 Rectifying circuit for DTV energy harvesting

In the design of a DTV energy harvesting circuit, several basic design considerations must be paid attention to. First is the antenna; it must be wideband (covering 470 MHz to 770 MHz), horizontally polarized and omni-directional. Secondly is the rectifier; it must also be wideband, and optimized for RF-to-DC conversion for incident signal power at least -40dBm. Until recently, very few authors have published on DTV energy harvesting circuit. For the few publications, the antenna could not meet all those three requirements and a discussion on the performance of the harvesting circuit for ultra low power incidences has been neglected. In this Chapter we will present such a rectenna with conversion efficiencies above 0.4% at -40dBm, above 18.2% at -20dBm and over 50% at -5dBm signal power incidence. We will closely compare simulated and measured performance of the rectenna and discuss any observed disparities.

Agilent's ADS will be used to simulate the nonlinear behaviour of the rectifying circuit based on harmonic balance tuning methods. To simulate the multiple incident waves, a multi-tone excitation in the DTV band will be invoked. The wideband input characteristic will be achieved by the input matching inductors and capacitors.

The generic version of our proposed DTV energy harvesting circuit is shown below in Fig. 10. The implementation, however, is in two phases or scenarios as follows. First, we investigate the class called "ultra low power" DTV band rectenna. Secondly, we introduce the "medium power" DTV band rectenna.

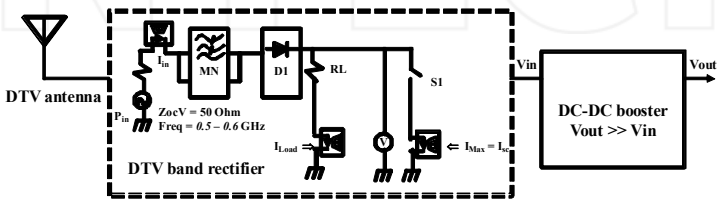

Fig. 10. Generic version of our proposed DTV energy harvesting circuit.

1.4.1 Ultra low power DTV rectenna

We define an ultra low power rectenna as one impinged by RF power incidence in the range between – 40dBm and -15dBm. Below in Fig. 11 is the circuit we designed; optimized for -20dBm input. The matching network is complex so as to achieve a wide band input characteristic. The fabricated circuit was well matched for the frequency range between 470 MHz and 600 MHz. More details about the circuit design can be found in [7].

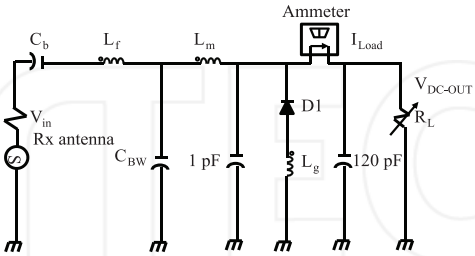

Fig. 11. Ultra low power DTV band rectenna circuit. SMS7630 Schottky diode by SKYWORKS offered the best performance.

The RF-to-DC conversion efficiency for this circuit is shown in Fig. 12 where at input power equal to -40dBm, efficiency is at least 0.4% and rectified voltage equals 1mV; at -20dBm, we have at least 18.2% by measurement and a rectified voltage of 61.7mV. The level of rectified voltage is too low and disqualifies this circuit for purposes of charging capacitors or batteries to accumulate such micropower over time. Instead, boosting the low voltage to usable levels is the option available and we shall discuss this at a later stage, (in Section 2.6).

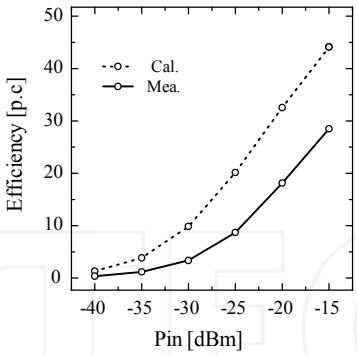

Fig. 12. Ultra low power DTV band rectenna efficiency.

1.4.2 Medium power DTV rectenna

We define a medium power rectenna as one impinged by RF power incidence in the range between – 5dBm and 0dBm. Below in Fig. 13 is the circuit we designed, optimized for -5dBm input. The matching network is simpler than as shown in section 2.4.1 since we require a narrow band around 550 MHz, with received peak power spectrum levels at least -5dBm. The circuit in Fig. 13 is a modification of Greinacher's doubler rectifier. In the circuit, C_b equals 1 pF and is used to block DC current against flowing towards the source. The shunt

capacitance, C_{BW} equals 3300 pF and is used to set the input bandwidth. The grounding inductance, L_g equals 56nH (optimal) and is used to improve the RF-to-DC conversion efficiency by cancelling the Schottky diodes (D_b and D_D) capacitive influence; thereby minimizing the harmonic levels (harmonic suppression). We used HSMS2850 diodes in these circuits for their better performance at this level of incident power.

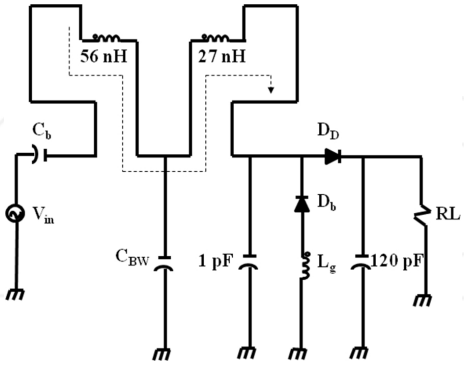

Fig. 13. Medium power DTV rectenna circuit. HSMS 2850 or 2820 from Hewlett-Packard offered the best performance.

The RF-to-DC conversion efficiency for this circuit is shown in Fig. 14 where at input power equal to -5dBm, we achieve at least 50% conversion efficiency by measurement, equivalent to 1.2 V DC rectified at 8.2kΩ optimal load. If we change the load to 47kΩ, over 2 V DC is rectified. This rectenna circuit is ideal for powering small sensors that run on 1.5 V or 2.2 V and draw around 6μA nominal current. If we need to power sensors demanding more power, say at least 2.2 V and 0.3mA to 1.47mA current consumption, we have to accumulate the power in a capacitor over time.

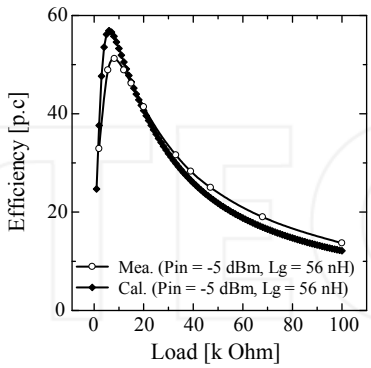

Fig. 14. Medium power DTV band rectenna efficiency.

1.4.3 DTV energy harvesting scenario and application demo

Using the medium power DTV band rectenna, connected to a gold capacitor as an accumulator, energy harvesting was initiated as shown in Fig. 15. Details about the gold

capacitor, which include its charge function, backup time and leakage losses are presented in [8]. For the scenario shown in Fig. 15, the accumulated voltage by measurement i.e. capacitor charge function follows the path;

$$V_{acc} = 0.5388\ln(t) + 1.4681 \tag{6}$$

where V_{acc} is the accumulated voltage in volts and t the time in hours. It takes 4.5 hours to accumulate 2.25 V, given a rectified charging voltage and current of 2.4 V and 51μA, respectively, supplied by the DTV band rectenna instantaneously.

With this rectenna, it was possible to power up many different kinds of sensors. Sensors with ultra low power consumption were powered directly, without need to accumulate the power in a capacitor, as shown in Fig. 16.

Fig. 15. DTV energy harvesting in a park at some line of sight from the base station.

Fig. 16. Directly powering a thermometer mounted on a car park wall (right picture). The maximum instant voltage rectification on record equals 3.7 V (left picture).

1.5 Rectifying circuit for cellular energy harvesting

Unlike in the DTV energy harvesting circuit, for cellular energy harvesting, the antenna must be narrowband (50 MHz bandwidth is acceptable), and circularly polarized even

though cellular signals are vertically polarized. The circular polarization is desired to maximize the RF-to-DC conversion efficiency of the arbitrary polarization incident signals in the multipath environment. Similarly, the rectifier must be narrowband, and optimized for RF-to-DC conversion over a wide range of incident signal power.

Thinking about the potential applications for cellular energy harvesting is useful. Other authors have reported on powering a scientific calculator or a temperature sensor from GSM energy harvesting. In this Chapter we will present a special application for energy harvesting in the vicinity of the W-CDMA cellular base station and analyze the system performance by calculation from experimental data. A cellular energy harvesting circuit optimized for over 50% RF-to-DC conversion efficiency given approximately 0dBm incidence will be presented.

1.5.1 Cellular band rectenna

Below in Fig. 17 is the circuit we designed, optimized for 0dBm input. Simple input matching network is ideal since we require a narrow band response around 2.1 GHz. The optimum value for L_g equals 5.6nH, where L_g is used to improve the RF-to-DC conversion efficiency as earlier discussed. HSMS2850 diode was used.

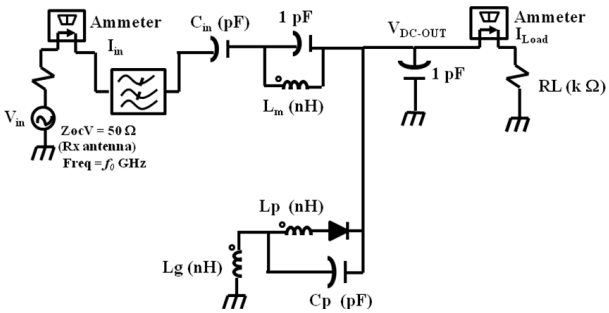

Fig. 17. Shunt rectifier configuration for the cellular band. The matching elements L_m = 3.2nH, while C_{in} =2.5pF. The load resistance is fixed at R_L = 2.1kΩ.

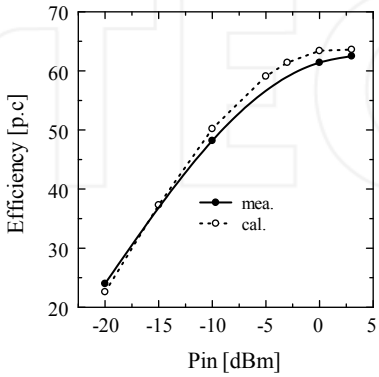

Fig. 18. Conversion efficiency as a function of input power (P_{in}) in the cellular band.

The RF-to-DC conversion efficiency for this circuit is shown in Fig. 18 where at input power equal to 0dBm, we achieve at least 60% conversion efficiency by measurement, given a 2.1kΩ optimal load. This rectenna circuit is ideal for powering small sensors that run on 1.5 V or 2.2 V and 6μA nominal current consumption. If we need to power sensors demanding more power, say at least 2.2 V and 0.3mA to 1.47mA, we have to accumulate the power in a capacitor over time as discussed in section 2.4.3 above.

1.5.2 Cellular energy harvesting application example

Environmental power generation in the neighbourhood of a cellular base station to power a temperature sensor is proposed as shown in Fig. 19 below. Electric field strength measurements in the base station neighbourhood have demonstrated the potential for environmental power generation, and the proposed temperature sensor system is designed based on these values. The rectenna described in Section 2.5.1 is used as the RF-to-DC rectifying circuit with the notched circular microstrip patch antenna (CMPA) proposed in Section 2.2.1. RF-to-DC conversion efficiency equal to 53.8% is obtained by measurement. The temperature sensor made for trial purposes clarifies the capability for temperature data wireless transmission for 20 seconds per every four hours in the base station neighbourhood.

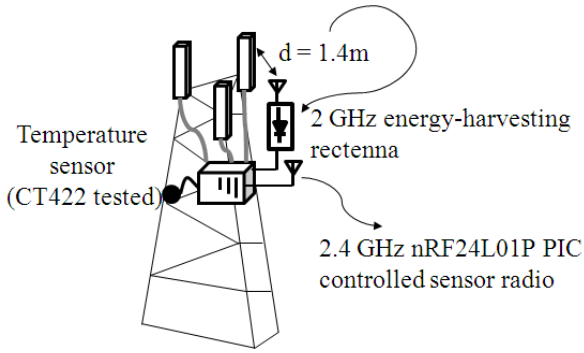

Fig. 19. Application example in the vicinity of the cellular base station.

1.6 Micropower energy harvesting management

A rectifying antenna circuit for -40dBm incident power harvesting generates 1mV at 2kΩ load, given 0.4% efficiency as presented in Section 2.4.1. At -20dBm incidence and at least 18.2% efficiency, 61.7mV is generated given a 2kΩ load [7]. The generated DC power in both of these two cases is in the μW range, hence the micropower definition. To manage such micropower, power accumulation or energy storage is required. Storage devices may either be a gold capacitor, super capacitor, thin film battery or the next generation flexible paper batteries. These storage devices have specific or standard maximum voltage and trickle charging current minimum requirements. Typically, gold capacitors have voltage ratings like 2.7 V, 5.5 V for 100 μA, 10mA or 100mA maximum discharge current. On the other hand, standard ratings for batteries are 1.8 V, 2 V, 3.3 V and 4.1 V. Therefore, to directly charge any of these storage devices from 1mV, or 61.7mV DC is impractical.

Published works have demonstrated the need for a DC-to-DC boost converter placed between the rectifying antenna circuit (rectenna) and the storage device. Recent efforts have demonstrated that a 40mV rectenna output DC voltage could be boosted to 4.1 V to trickle charge some battery. A Coilcraft transformer with turns ratio ($N_s : N_p$) equal to 100 was used in the boost converter circuit. An IC chip leading manufacturer (Linear Technology Corp., LT Journal, 2010) has released a linear DC-to-DC boost regulator IC chip capable of boosting an input DC voltage as low as 20 mV and supplying a number of possible outputs, specifically suited for energy harvesting applications. While this IC is a great milestone, readers and researchers need to understand the techniques to achieve such ICs and also the limitations that apply. In the following sub section, we will describe the methods toward designing a DC-DC boost converter, suitable for micropower RF energy harvesting.

In the design, we will attempt to clarify the parameters that affect the DC-DC conversion efficiency. For this design, Envelope simulation in Agilents's ADS is used. This simulation technique is the most efficient for the integrated rectenna and DC-DC boost converter circuits.

1.6.1 DC-DC boost converter design theory and operation

The DC-DC boost converter design theory and actual implementation are presented in this section. The inequality $V_{in} \ll V_{out}$ defines the boost operation. In this Chapter, our boost converter concept is illustrated in Fig. 20. A small voltage, V_{in} is presented at the input of the boost converter inductive pump which as a result, generates some output voltage, V_{out}. The output voltage is feedback to provide power for the oscillator. The oscillator generates a square wave, F_{OSC} that is used for gate signalling at the N-MOSFET switch.

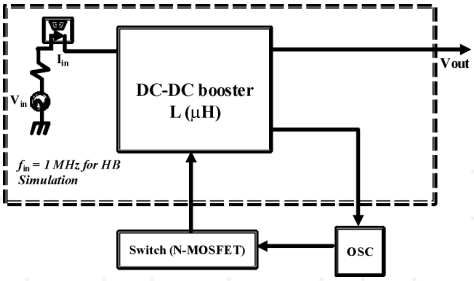

Fig. 20. Boost converter concept.

The drain signal of the N-MOSFET is used as the switch node voltage, V_{sn} at the anode of the diode inside the boost converter circuit block. From the concept presented in Fig. 20, the actual implemented circuit is shown in Fig. 21. The circuit was designed in Agilent's ADS and fabricated for investigation by measurement.

The circuit in Fig. 21 is proposed for investigation. Since a DC-DC boost converter is supposed to connect to the rectenna's output, it therefore, becomes the load to the rectenna circuit. This condition demands that the input impedance of the boost converter circuit emulates the known optimum load of the rectenna circuit. This has the benefit of ensuring

maximum power transfer and hence higher overall conversion efficiency from the rectenna input (RF power) to the boost converter output (DC power). In this investigation, as shown in [7], the optimum load for the rectenna is around 2kΩ. In general, emulation resistance R_{em} is given by

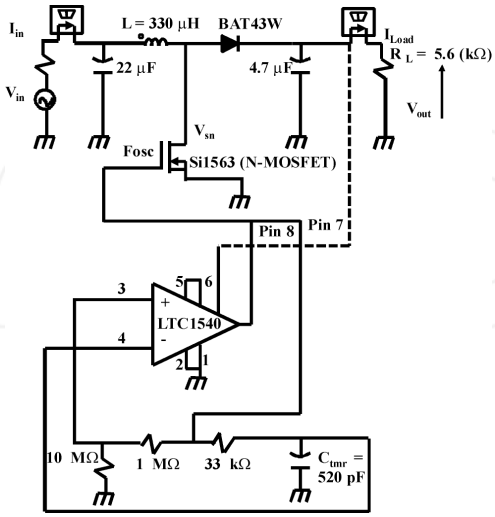

Fig. 21. The proposed boost converter circuit diagram. Designed in Agilent's ADS and fabricated for investigation by measurement.

$$R_{em} = \frac{2LT}{t_1^2 k}\left(\frac{M-1}{M}\right) \tag{7}$$

where $\boldsymbol{L}$ is the inductance equal to 330μH as shown in Fig. 20, $M = \frac{V_{out}}{V_{in}}$, $\boldsymbol{T}$ is the period of F_{OSC}, $\boldsymbol{t_1}$ is the switch"ON" time for the N-MOSFET, and $\boldsymbol{k}$ is a constant that according to [3] is a low frequency pulse duty cycle if the boost converter is run in a pulsed mode and typically, $\boldsymbol{k}$ may assume values like 0.06 or 0.0483. With reference to (7), we select L as the key parameter for higher conversion efficiency while V_{in} = 0.4 V DC is selected as the lowest start up voltage to achieve oscillations and boost operation. Computing the DC-DC boost conversion efficiency against different values of L, we have results as shown in Fig. 22.

From the results above, L = 100μH is the optimum boost inductance that ensures at least 16.5% DC-DC conversion efficiency, given R_L = 5.6kΩ.

Now having selected the optimum boost inductance given some load resistance, the emulation resistance shown in Fig. 23 is evaluated from the ratio of voltage versus current at the boost converter circuit's input.

The results show a constant resistance value against varying inductance. In general, we can say that this boost converter circuit has a constant low input impedance around 82.5Ω. This impedance is too small to match with the optimum rectenna load at 2kΩ. This directly affects the overall RF-to-DC conversion efficiency.

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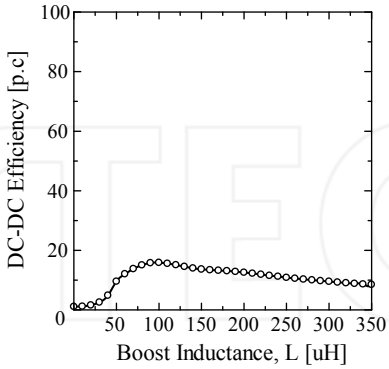

Fig. 22. Boost inductance variation with DC-DC conversion efficiency for a 5.6 kΩ load.

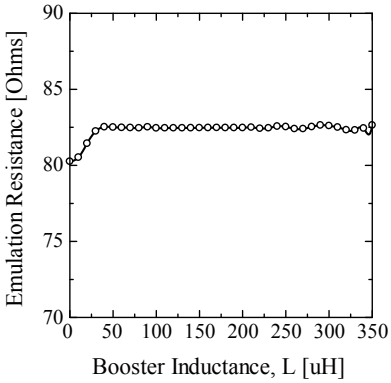

Fig. 23. Boost converter's input impedance: the emulation resistance.

Another factor, which affects the overall conversion efficiency is the power lost in the oscillator circuit. Unlike the circuit proposed in [9], which uses two oscillators; a low frequency (LF) and high frequency (HF) oscillator; in Fig. 21, we have attempted to use a single oscillator based on the LTC1540 comparator, externally biased as an astable multivibrator.

The power loss in this oscillator is the difference in the DC power measured at Pin 7 (supply) to the power measured at pin 8 (output). We term this loss, L_{osc}; converted to heat or sinks through the 10MΩ load. A comparison of the oscillator power loss to the power available at the boost converter output is shown in Fig. 24.

Looking at Fig. 24; we notice that the power loss depends on whether the oscillator output is high or low. The low loss corresponds to the quiescent period where the power lost is

almost negligible. However, during the active state, the lost power (power consumed by the oscillator) nearly approaches the DC power available at the boost converter output. This results in low operational efficiency.

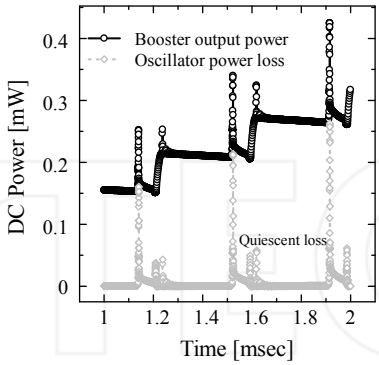

Fig. 24. The power loss in the oscillator.

To confirm whether or not the circuit of Fig. 21 works well, we did some measurements and compared them with the calculated results. Unlike in calculation (simulation), during measurement, L = 330μH was used due to availability. All the other component values remain the same both in calculation and measurement. In Fig. 25 (left side graph) and (right side graph), we see in general that the input voltage is boosted and also that the patterns of F_{osc} and V_{sn} are comparable both by simulation and measurement. To control the duty cycle of the oscillator output (F_{osc}), and the level of ripples in the boost converter output voltage (V_{out}), we change the value of the timing capacitance, C_{tmr} in the circuit of Fig. 21. Simulations in Fig. 25 (left side graph) show that C_{tmr} = 520pF realizes a better performance i.e. nearly constant V_{out} level (very low ripple).

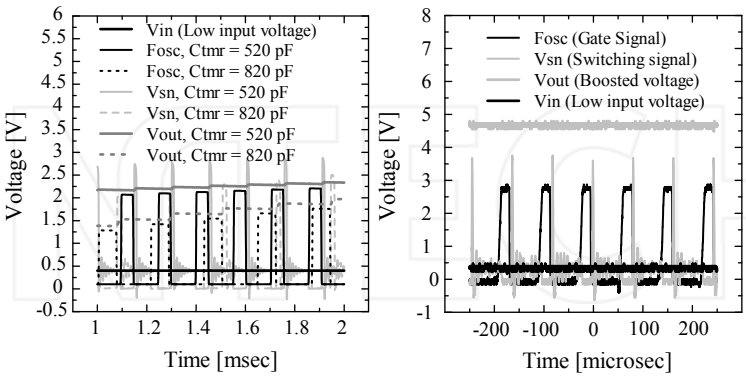

Fig. 25. Voltage characteristics of the developed boost converter circuit. The left side graph represents simulation while the right side graph is for measurements.

Generally, we observe that with this kind of boost converter circuit topology, it is difficult to start up for voltages as low as 61.7mV DC generated by the rectenna at -20dBm power

incidence and at least 18.2% rectenna RF-to-DC conversion efficiency. Self starting is the issue for this topology at very low voltages.

At least 11.3% DC-DC conversion efficiency was recorded by measurement and is comparable to the calculation in Fig. 22. During measurement it was clearly revealed that the boost converter efficiency does depend on the value of **L** and the duty cycle derived from $\mathbf{t_1}$. To efficiently simulate the complete circuit, from the RF input to the DC output, envelope transient simulation (ENV) in Agilent's ADS was used. The (ENV) tool is much more computationally efficient than transient simulation (Tran). This simulation is appropriate for the boost converter circuit's resistor emulation task. Moreover, the boost converter's DC-DC conversion efficiency, and the overall RF-to-DC conversion efficiency can be calculated at once with a single envelope transient simulation.

In summary, though not capable to operate for voltages as low as 61.7mV DC, the proposed boost converter has by simulation and measurement demonstrated the capability to boost voltages as low as 400mV DC, sufficient for battery or capacitor recharging, assuming that the battery or the capacitor has some initial charge or energy enough to provide start-up to the boost converter circuit.

The limitations of our proposed boost converter circuit include; low efficiency, lack of self starting at ultra low input voltages, and unregulated output. To address these limitations, circuit optimization is required. Moreover, alternative approaches which employ a flyback transformer to replace the boost converter inductance must be investigated. A regulator circuit with Low Drop Out (LDO) is necessary to fix the boost converter output voltage commensurate with standard values like 2.2 V DC for example. For further reading, see [7]

2. Performance analysis of the complete RF energy harvesting sensor system

To demonstrate how one may analyze the performance of an RF energy harvesting system including its application, we extend the discussion of Section 2.5.2 to this Section. We propose a transmitter assembled as in Fig. 26 for temperature sensor wireless data transmission.

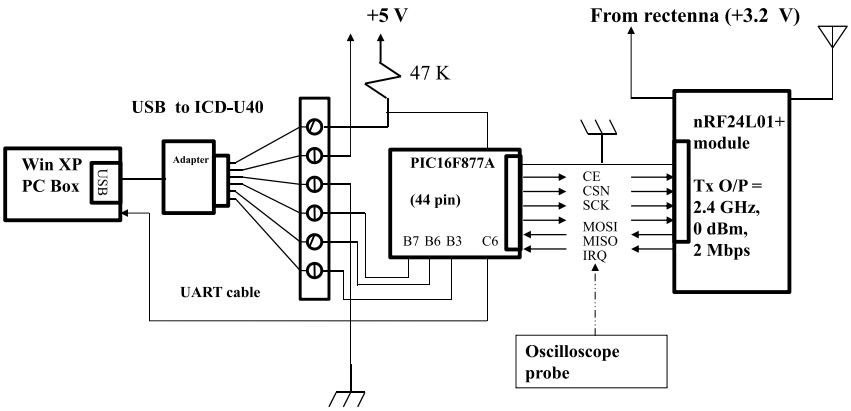

Fig. 26. The assembly and test platform for the proposed battery-free sensor transmitter.

The transmitter consists of one-chip microcomputer (MCU) PIC16F877A and wireless module nRF24L01P for the control, and MCU can be connected with an outside personal computer using ICD-U40 or RS232 cable. The wireless module operates in transmission and reception mode, and controls power supply on-off, transmitting power level, the receiving mode status, and transmission data rate via Serial Peripheral Interface (SPI). Figure 27 shows the operation flow when transmitting.

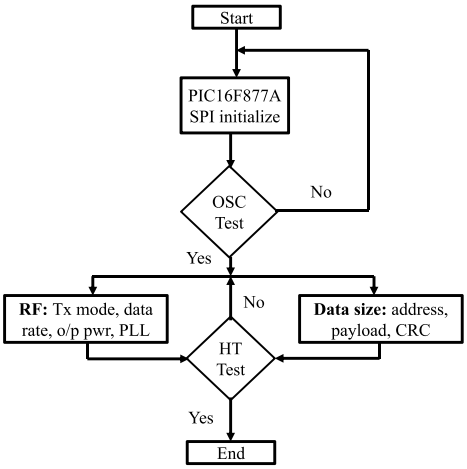

Fig. 27. Operation flow during transmission.

The experimental system composition is shown in Fig. 28 to transmit acquired data by the temperature sensor with WLAN at 2.4 GHz (ISM band). An ISM band sleeve antenna is used for the transmission. Using the cellular band rectenna shown and discussed in Section 2.5.1, at least 3.14 V is stored in the electric double layer capacitor over a period of four hours. To harvest a maximum usable power for the overall system, we charge the capacitor up to 5V. The operation voltage for the wireless module presented in Fig. 26 above is between 1.9V and 3.6V.

The signal was transmitted from the wireless module while a sleeve antenna, same like the one for transmission was used with the spectrum analyzer and the reception experiment was performed. Received signal level equal to -43.4dBm was obtained at a distance 3.5m between transmitter and reception point. The capacitor's stored voltage was used to supply the wireless module in the above-mentioned experiment. Successful transmission was possible for 5.5 minutes after which, the capacitor terminal voltage decreased from 3.16V to 1.47V, and the transmission ended. The sending and receiving distance of data can be estimated to be about 10m when the sensitivity of the receiver is assumed to be -60dBm, given 0dBm maximum transmit power.

Hereafter, the overall system examination is done by environmental power generation using the transmitted electric waves from the cellular phone base station, proposed based on the above-mentioned results. First of all, the power consumption shown in Fig. 29 is based on the fact that 120mW (5V, 24mA) is saved in the electric double layer capacitor by environmental power generation, achieved by calculation as discussed earlier.

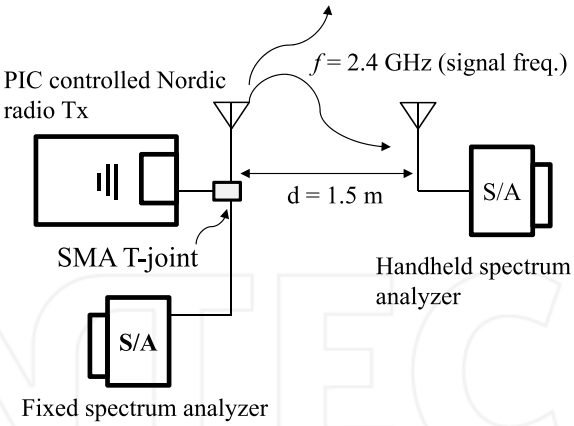

Fig. 28. Indoor measurement setup for received traffic from the sensor radio transmitter.

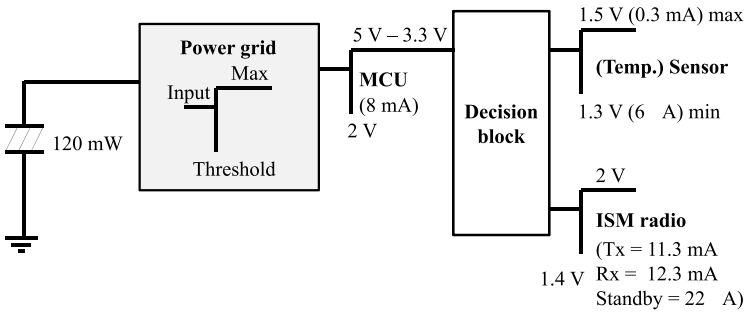

Fig. 29. Power management scheme for the cellular energy-harvesting sensor node.

The sensor data packet is transmitted wirelessly in ShockBurst mode for energy efficient communication. The data packet format includes a pre-amble (1 byte), address (3 bytes), and the payload i.e. temperature data (1 byte). The flag bit is disregarded for easiness, and cyclic redundancy check (CRC) is not used.

The operation of the proposed system is provisionally calculated. When the rectenna is set up in the place where power incidence of 0dBm is obtained in the base station neighbourhood (as depicted in Section 2.5.2), an initially discharged capacitor accumulates up to 3.3V by a rectenna with 53.8% conversion efficiency (presented in Section 2.5.1). At this point, it takes 1.5 minutes to start and to initialize a wireless module, and the voltage of the capacitor decreases to 2V. This trial calculation method depends on the capacitor's back up time discussed in [8]. After this, when the wireless module is assumed to be in sleep mode, the capacitor is charged by a 0.28mA charging current for four hours whereby the capacitor's stored voltage increases up to 5V. The power consumption in the sleep mode or standby is 33μW (1.5V, 22μA).

When the wireless module starts, after data transmission and the confirmation signal is sent, the voltage of the capacitor decreases by 0.6V, and consumes the electric power of 7.4mW.

The voltage of the capacitor decreases to 2V when 3.2mW is consumed to the acquisition of the sensor data, and the operation time of MCU is assumed to be one minute to the data storage in the wireless module etc. As for the capacitor voltage, when the wireless module continuously transmits data for 20 seconds, it decreases from 2V to 1.4V and even the following operation saves the electric power. Therefore, a temperature sensing system capable of transmitting wireless data in every four hours becomes feasible by environmental power generation from the cellular phone base station if we consider intermittent operation by sleep mode.

3. Conclusion

This Chapter has given an overview of the present energy harvesting sources, but the focus has stayed on RF energy sources and future directions for research. Design issues in RF energy harvesting have been discussed, which include low conversion efficiency and sometimes low rectified power. Solutions have been suggested by calculation and validated by measurement where possible, while highlighting the limitations of the proposed solutions. Potential applications for both DTV and cellular RF energy harvesting have been proposed and demonstrated with simple examples. A discussion is also presented on the typical performance analysis for the proposed RF energy harvesting system with sensor application.

4. Acknowledgment

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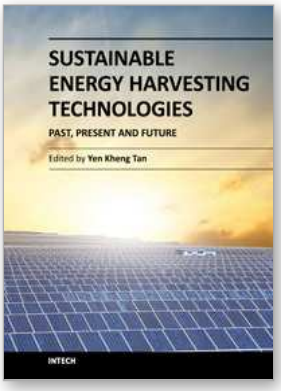

Sustainable Energy Harvesting Technologies - Past, Present and Future

Edited by Dr. Yen Kheng Tan

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In the early 21st century, research and development of sustainable energy harvesting (EH) technologies have started. Since then, many EH technologies have evolved, advanced and even been successfully developed into hardware prototypes for sustaining the operational lifetime of low?power electronic devices like mobile gadgets, smart wireless sensor networks, etc. Energy harvesting is a technology that harvests freely available renewable energy from the ambient environment to recharge or put used energy back into the energy storage devices without the hassle of disrupting or even discontinuing the normal operation of the specific application. With the prior knowledge and experience developed over a decade ago, progress of sustainable EH technologies research is still intact and ongoing. EH technologies are starting to mature and strong synergies are formulating with dedicate application areas. To move forward, now would be a good time to setup a review and brainstorm session to evaluate the past, investigate and think through the present and understand and plan for the future sustainable energy harvesting technologies.

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Multi-Service Highly Sensitive Rectifier for Enhanced RF Energy Scavenging

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Due to the growing implications of energy costs and carbon footprints, the need to adopt inexpensive, green energy harvesting strategies are of paramount importance for the long-term conservation of the environment and the global economy. To address this, the feasibility of harvesting low power density ambient RF energy simultaneously from multiple sources is examined. A high efficiency multi-resonant rectifier is proposed, which operates at two frequency bands (478–496 and 852–869 MHz) and exhibits favorable impedance matching over a broad input power range (−40 to −10 dBm). Simulation and experimental results of input reflection coefficient and rectified output power are in excellent agreement, demonstrating the usefulness of this innovative low-power rectification technique. Measurement results indicate an effective efficiency of 54.3%, and an output DC voltage of 772.8 mV is achieved for a multi-tone input power of −10 dBm. Furthermore, the measured output DC power from harvesting RF energy from multiple services concurrently exhibits a 3.14 and 7.24 fold increase over single frequency rectification at 490 and 860 MHz respectively. Therefore, the proposed multi-service highly sensitive rectifier is a promising technique for providing a sustainable energy source for low power applications in urban environments.

AMBIENT energy harvesting is attracting widespread interest as it has the potential to provide a sustainable energy source for future growth and protection of the environment. Considerable research effort has been directed toward low-profile, low-power, energy efficient and self-sustainable devices aiming to harvest energy from inexhaustible sources such as solar energy, thermal, biomass, mechanical sources (e.g. wind, kinetic, vibration, and ocean waves) wastewater, and microwave energy. A thorough set of reviews is given in the literature[1–4]. Among these green energy sources, there has been a growing interest for radio frequency (RF) energy scavenging, as the availability of ambient RF energy has increased due to advancements in broadcasting and wireless communication systems. Furthermore, the development of wireless power transmission (WPT) technologies[5] that allow micro sensors[6], mobile electronic devices[7], wireless implantable neural interfaces[8] and far-field passive RFID (Radio-Frequency Identification) systems[9–11] to operate without batteries has triggered impetus for RF energy harvesting.

Efficient RF energy harvesting is a very challenging issue, as it deals with the very low RF power levels available in the environment. Furthermore, the scavengeable power level can vary unpredictably, depending on several factors such as the distance from the power source, the transmission media, the telecommunication traffic density and the antenna orientation. The majority of available literature on RF rectification has been dedicated to narrowband rectennas, which essentially operate at a single frequency and hence provide low DC output power[12,13]. Various topologies, such as voltage doublers or multipliers have been employed in order to increase the RF to DC conversion efficiency and the output DC voltage for specific applications[14–16]. However, from an ambient RF scavenging perspective, harvesting energy from various available frequencies could maximize power collection and hence increase the output DC power. Ultra-wideband and broadband rectenna arrays have been proposed as a potential solution[17,18]. However in some cases, simulation and experimental results were not provided to demonstrate the findings[17]. A broadband rectenna consisting of a dual-circularly polarized spiral rectenna array operating over a frequency range of 2–18 GHz was demonstrated[18]. The rectified DC power was characterized as a function of DC load, RF frequency and polarization for power densities between 10^{-5} and 10^{-1} mW/cm^2. However, the proposed rectenna was matched at a single input RF power level for a specified load resistance for the characterization. Also, due to the low Q value of the rectifier circuit, the conversion efficiency was a fraction of 1% at −15.5 dBm. From a design point of view, while it is relatively easy to achieve a broadband antenna, it is very challenging to realize a broadband rectenna due to the non-linearity of the rectifier impedance with input power across the frequency band[19].

To address this, a promising approach is to use a dual-band or multi-band configuration. This can maximize the power conversion efficiency (PCE) at the specific frequencies where the maximum ambient signal level is

available. Various dual-band RF energy harvesting systems has been demonstrated[20–24], however a large signal analysis of the rectifier was commonly not provided over a broad input power range. A dual-band RF energy harvesting using frequency limited dual-band impedance matching has been proposed[20] and the PCE was shown over a high power range of 0 to 160 mW, however it was only matched at a single input power level (10 dBm). A CMOS dual-narrowband energy harvester circuit was modeled at environmental power levels[21]. Again, the rectifier efficiency was demonstrated with only single input power levels of −19 and −19.3 dBm at 2 GHz and 900 MHz respectively, and a large signal analysis was not presented. A compact dual-band rectenna operating at 915 MHz and 2.45 GHz has been demonstrated[22] and the PCE was shown for input power levels of −15, −9 and −3 dBm. However, the reflection coefficient was evaluated at a single incident power level. Furthermore, the efficiency results with dual-tone excitation simultaneously and single-tone excitation (at 915 MHz) are very similar, hence the impact of applying a dual-band technique does not demonstrate a clear advantage over a single band. A dual-frequency rectenna for WPT has been proposed[23] which achieved a conversion efficiency of 84.4% and 82.7% at 2.45 and 5.8 GHz with a high input power level of 89.84 and 49.09 mW respectively. These power levels far exceed ambient levels in the environment[19]. A conformal hybrid solar and electromagnetic (EM) energy harvesting rectenna has been presented[24] and the PCE was provided with −30 to 5 dBm input power, achieving an efficiency up to 40% at 1.85 GHz for higher input power levels (above −5 dBm). However the reflection coefficient was not provided at low input power range.

A multi-resonant rectenna that uses a multi-layer antenna and rectifier has been evaluated for a −16 dBm to +8 dBm RF received power level, but the rectifier circuit layout and large signal analysis were not provided to clarify the findings[25]. Furthermore, a rectenna for triple-band biotelemetry communications has been proposed using a triple-band antenna and single frequency rectifier[26]. However, this rectenna is not suitable for RF energy scavenging due to the low efficiency at lower input power levels. Another triple band rectenna presented an RF-DC efficiency over the input power range of −14 to +20 dBm[27], however the reflection coefficient results were only evaluated at a single input power level. This rectenna was shown to harvest 7.06 μW of DC power from three sources simultaneously at a high input power level of +10 dBm. A multi-band harvesting system has also been proposed where four individual harvesters are designed to cover four frequency bands[28]. However, a large signal analysis was not provided over a broad input power range. Furthermore, the proposed harvesting system has a minimum sensitivity of −25 dBm, whilst in a real environment more sensitive systems are required as the available RF power levels are very low[19].

Tunable impedance matching networks have been demonstrated in order to collect RF signals from various sources and convert them to DC power[29]. However from an application point of view, this is still single frequency rectification and it is not widely applicable to environmental RF energy scavenging where the available power is very low.

In order to increase the amount of RF energy scavenged by a rectenna, it is crucial to identify and harvest multiple ambient frequency sources over their realistic available energy range. Our previous research has demonstrated the feasibility of RF energy harvesting through RF field investigations and maximum available power analysis in metropolitan areas of Melbourne, Australia[19]. The maximum available power for different frequency bands based on antenna aperture and number of antennas in a given collection area was analyzed. Measured results and analysis indicated that cellular systems and broadcast sources are well suited to harvesting, with scavengeable RF power ranging from −40 to −10 dBm. This identifies two important considerations in the design of efficient rectenna for RF energy harvesting: the scavengeable ambient RF power sources available, and the significant variance of this power.

The RF to DC rectifier solutions proposed in recent literature have focused on maximizing the system efficiency at a given, and often quite high, input power level. This neglects the issues related to input power variation which can lead to unexpected variations in the matching network due to diode non-linearity. Also, the scavangeable levels of ambient RF power have been shown to be orders of magnitude lower. Therefore, based on our previous research outcomes and recommendations[19], an efficient power harvesting solution could encompass a multi-band matching circuit at the specific frequencies where maximum signal power is available, enabling greater power harvesting due to the combination of RF signals. This also results in a higher power being fed to a single rectifier, utilizing the diode function more efficiently.

This paper presents an RF energy harvesting method that can scavenge a wide range of ambient power levels which are orders of magnitude lower than previous reported techniques in the literature. An efficient dual resonant rectifier circuit is proposed, matched to a 50 Ω input port at 490 and 860 MHz over a broad low input RF power range from −40 to −10 dBm. The proposed dual resonant matching network operates efficiently at two identified harvesting frequency bands over a wide input power range, maximizing DC power by scavenging two sources simultaneously.

The remainder of this paper is organized as follows. First, the key results for the reflection coefficient and output DC power are presented. Subsequently, the Discussion section summarizes the results and demonstrates their potential implications, the limitations of this study, open questions and future research. Finally, the Method section describes the proposed rectifier design.

Results

A dual resonant rectifier was fabricated on a 1.58 mm FR-4 substrate with a dielectric constant $\varepsilon_r \approx 4.5$ and a loss tangent $\delta \approx 0.025$. These substrate parameters were measured using the Nicolson-Ross method[30] so accurate values could be used in the rectifier design. A photograph of the fabricated dual resonant rectifier is shown in Fig. 1 which depicts input RF port, dual-band matching network lumped components, Schottky diodes and the output terminal. The performance of the rectifier was verified by measuring the input reflection properties, and the output power was calculated from the measured output DC voltage for the input powers from −40 to −10 dBm.

Reflection Coefficient. The $|S_{11}|$ of the rectifier was evaluated using a vector network analyzer (VNA). The VNA was re-calibrated for each input power level. Figure 2 compares the simulated and measured $|S_{11}|$ versus frequency for the dual resonant rectifier circuit at four different input power levels from −40 to −10 dBm. The measured results show very good agreement to the simulations. Slightly higher reflection was observed for the resonant frequencies at the lower part of the input power range (due to the diode characteristics). However, the proposed rectifier circuit is well-matched ($|S_{11}| < -10$ dB) at the desired frequency bands of

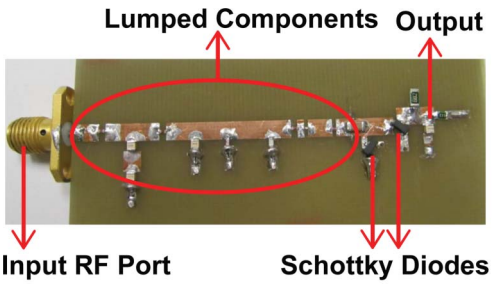

Figure 1 | **Fabricated rectifier prototype.**

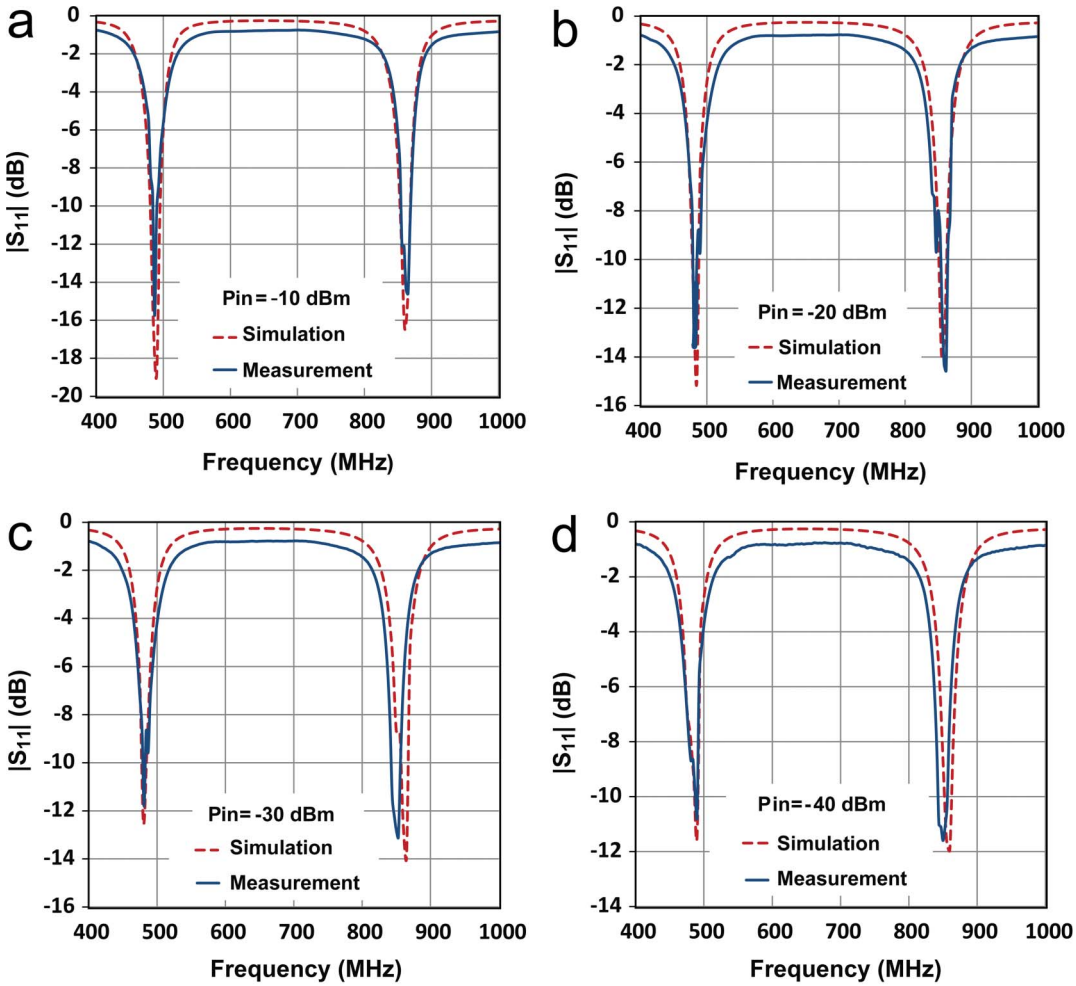

Figure 2 | Simulated and measured $|S_{11}|$ as a function of frequency and input RF power for the proposed dual resonant rectifier circuit. (a) −10 dBm. (b) −20 dBm. (c) −30 dBm. (d) −40 dBm.

478–496 MHz and 852–869 MHz over the broad range of input powers from −40 to −10 dBm. The small difference between simulation and measurement is due to the parasitic extraction accuracy.

Output DC Power. In the frequency domain, the Harmonic Balance method of analysis provides a comprehensive treatment of a multispectral problem[18]. The method intrinsically takes into account the DC component and a specified number of harmonics, while allowing the ability to specify the source impedance and harmonic terminations. A Harmonic Balance simulation was used to numerically evaluate the output DC voltage of the dual resonant rectifier for both a single and two tone input. The output DC voltage across the load resistor was also measured and used to calculate output DC power. Measurements were performed using a Wiltron 68247B synthesized signal generator as a RF power source for the rectifier circuit. Recording of the output DC voltage across the load resistance was achieved with a Fluke 79III digital voltage meter. The RF source power was initially set at −10 dBm, and decreased in 2 dB steps. In the dual-band measurement case, two RF signal generators were fed to the rectifier circuit simultaneously via a power combiner.

The simulation and measurement results for single and dual input tones are summarized in Fig. 3(a) and (b). A measured DC voltage of 772.8 mV is achieved with two simultaneous input tones at an input power of −10 dBm. For single tone measurements, DC voltages of 436 mV and 286 mV at 490 MHz and 860 MHz respectively are produced. The comparison between the 490 and 860 MHz single rectifiers highlights the impact of the input frequency on the PCE. A higher amount of DC voltage can be generated at the lower frequency. This difference comes from decreasing diode performance at the higher frequency due to the higher junction capacitance of the diode[31].

Importantly, a slightly higher DC voltage can be generated with the dual resonant rectifier as compared to the sum of output voltage from the two single bands, particularly at the lower input power levels as can be seen in Fig. 3(b) which shows the lower power section of Fig. 3(a) in more detail. By maximizing power collection from various sources of different frequencies and delivering the combined power to the rectification circuit, the diode conversion efficiency is enhanced which results in a higher level of rectified voltage. Figure 4 compares the simulated and measured output DC power for the dual resonant rectifier circuit with both single and dual input tones. A measured DC power of 17.3 μW and 7.5 μW can be generated at 490 MHz and 860 MHz respectively with a single tone input of −10 dBm (100 μW). This represents true efficiencies of 17.3% and 7.5% for the individual single band rectification (see Fig. 5). However, the measured DC output power with two concurrent input tones of −10 dBm is 54.3 μW which corresponds to an effective efficiency of 54.3% for the dual-band rectifier (see Fig. 6). This represents a 3.14 and 7.24 times increase in output DC power over the single tone excitation at 490 MHz or 860 MHz respectively. This trend is evident down to low input power levels (around 40 μW). Furthermore, there is a significant increase in the PCE of the dual resonant rectifier for lower input power levels (<40 μW).

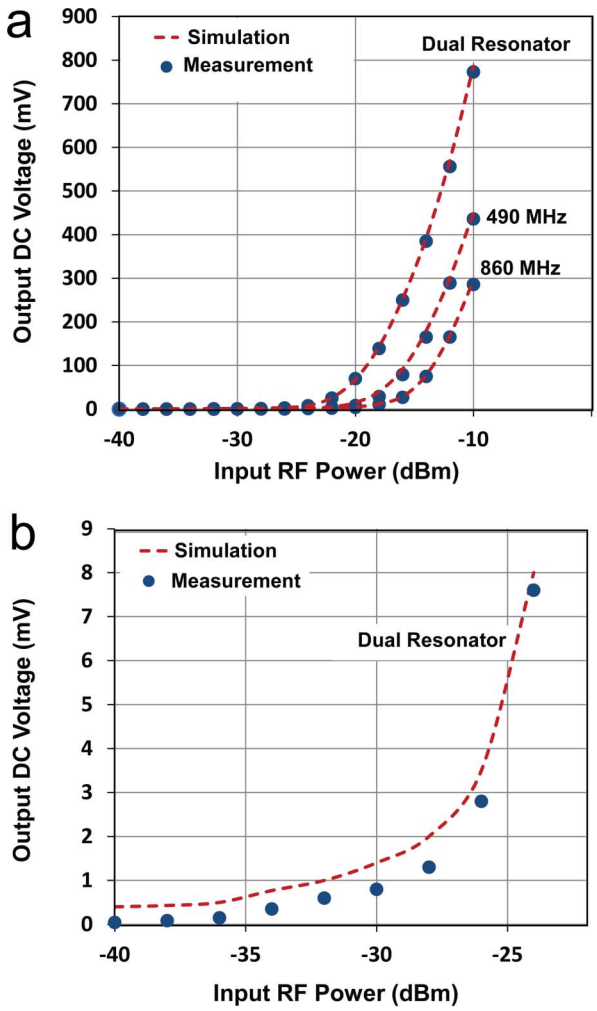

Figure 3 | Output DC voltage as a function of input RF power for single input tone at both 490 MHz and 860 MHz and for dual input tones (a) with −40 to −10 dBm input RF power (b) with −40 to −25 dBm input RF power. (This power range is associated with the signal source).

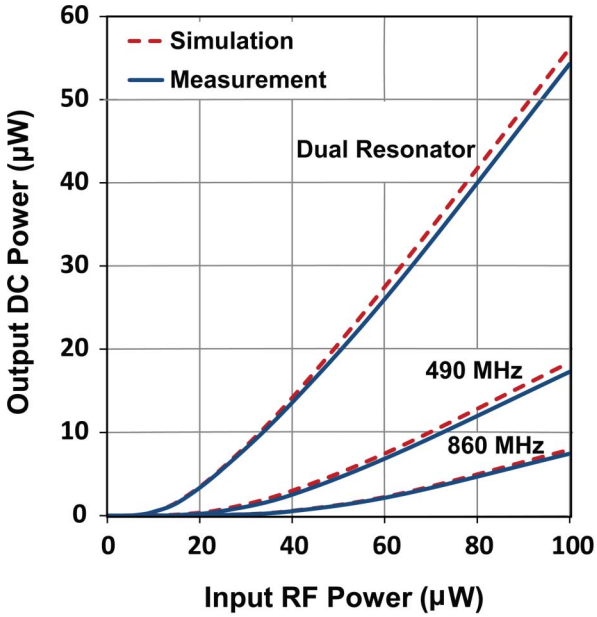

Figure 4 | Output DC power as a function of input RF power for single and dual input tones.

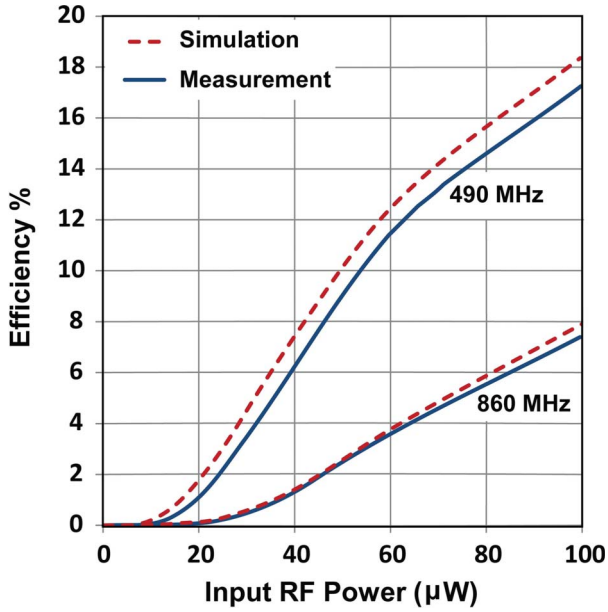

Figure 5 | RF to DC conversion efficiency as a function of input RF power for single band rectification.

Here, the effective efficiency is defined as the ratio of output DC power to the available input RF power rather than the power delivered to the diodes (equation (1)). The available power level is associated with the signal source. For the single resonator, the available input power is −10 dBm and the delivered power is also −10 dBm (assuming no loss). However, by creating a dual resonant matching network the power delivered to the diodes is −7 dBm (combined total input power from two signal generators) but the available power is still −10 dBm.

$$\eta = \frac{p_o}{p_i} = \frac{\left(\frac{V_o^2}{R_L}\right)}{p_i} \tag{1}$$

Therefore, combining input RF signals into a single rectification stage results in high sensitivity rectifier, which is widely applicable to

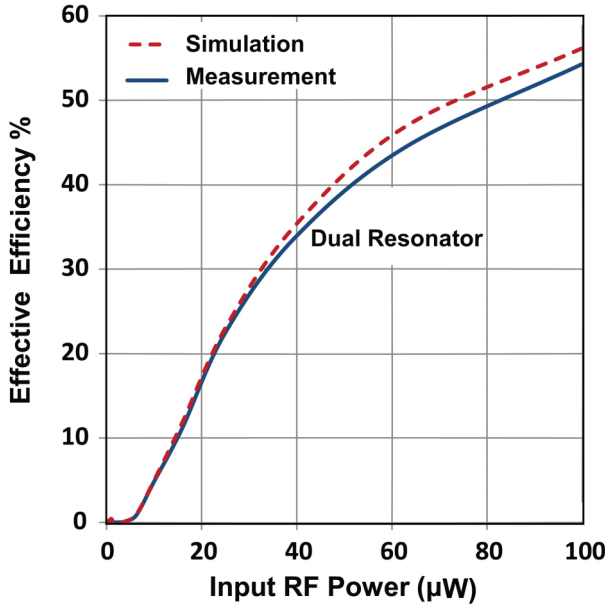

Figure 6 | Effective RF to DC conversion efficiency as a function of input RF power for dual resonant rectification.

Table 1 | Rectifier performance comparison

Ref.	Technology	Measured Efficiency (%)	RF power variation (in PCE evaluation)	Rectification Technique
13	Schottky diode	82@50 mW	N/A	Single resonator
16	Schottky diode	44@−10 dBm	N/A	Single resonator
18	Schottky diode	20@0.07 mW/cm^2 0.1@5×10^{-5} mW/cm^2	10^{-5} to10^{-1} mW/cm^2	Broad band
20	Schottky diode	77.13@22 dBm (158.49 mW)	0 to 160 mW	Dual resonator
21	CMOS	9.1@−19.3 dBm (900 MHz) 8.9@−19 dBm (2 GHz)	N/A	Dual resonator
22	Schottky diode	37 (915 MHz)@−9 dBm 30 (2.45 MHz)@−9 dBm	−40 to 0 dBm	Dual resonator
23	Schottky diode	84.4@89.84 mW (2.45 GHz) 82.7@49.09 mW (5.8 GHz)	0 to 100 mW	Dual resonator
27	Schottky diode	80@10 dBm (940 MHz) 47@8 dBm (1.95 GHz) 43@16 dBm (2.44 GHz)	−14 to 20 dBm	Triple resonator
29	Schottky diode	50@−5 dBm	−25 to 0 dBm	Dual resonator with tunable input response
This work	Schottky diode	54.3@−10 dBm 11.25@−18 dBm (490 and 860 MHz)	−40 to −10 dBm	Dual resonator

Table 2 | Environmental measurement results

Suburb	Available frequencies (MHz)	Respective available RF power (dBm) [μW]	Measured DC power (μW)
Bayswater	486, 488, 489, 490, 491, 867, 868, 869, 870, 871, 872, 873, 874	−19[12.5], −20[10], −17[19.95], −15[31.62], −22[6.3], −37[0.199], −37[0.199], −30[1], −24[3.98], −20[10], −30[1], −37[0.199], −40[0.1]	39.38
Bentleigh	491, 492, 494, 495, 865, 866, 867, 868, 869, 870, 871	−12[63.09], −46[0.02], −42[0.063], −57[0.001], −27[1.99], −27[1.99], −30[1], −37[0.199], −40[0.1], −40[0.1], −41[0.07]	30.9
RMIT University (Melbourne CBD)	487, 488, 489, 490, 491, 851, 861, 862, 866, 867, 868, 869	−30[1], −22[6.3], −29[1.25], −22[6.3], −20[10], −23[5.01], −21[7.94], −21[7.94], −30[1], −35[0.31], −40[0.1], −40[0.1]	14.5

real environmental RF energy scavenging. This multi-band technique can provide higher DC power than combining two separate single frequency rectifier circuits operating at the same frequencies. This is due to the fact that harvesting RF energy from various available sources simultaneously increases the delivered power to the rectifier, which improves the diode conversion efficiency and consequently enhances the output DC power. Table 1 summarizes this work as compared to previous published work.

In order to provide a realistic scenario for the proposed dual-band rectifier, measurement results were taken in three suburbs of Melbourne, Australia, congruent with our previous research outcomes[19]. Table 2 summarizes these environmental measurement results. It should be noted that the lower band (478–496 MHz) has a 3.67% fractional bandwidth and the higher band (852–869 MHz) has around 2% fractional bandwidth. Hence, various RF frequencies from different sources can be harvested within these two bands. The environmental measurement results demonstrate the feasibility of harvesting ambient EM energy from multiple sources simultaneously.

Discussion

The feasibility of harvesting ambient EM energy from multiple sources simultaneously is investigated in this paper. The proposed dual resonant rectifier operates at two frequency bands (478–496 and 852–869 MHz), which are used for broadcasting and cellular systems respectively. The dual resonant rectifier exhibits favorable impedance matching over a broad input power range (−40 to −10 dBm) at these two bands. The achieved sensitivity and dynamic range demonstrate the usefulness of this innovative low input power rectification technique. Simulation and experimental results of input reflection coefficient and rectified output power are in excellent agreement. The measurement results demonstrate that a two tone input to the proposed dual-band RF energy harvesting system can generate 3.14 and 7.24 times more power than a single tone at 490 or 860 MHz respectively, resulting in a measured effective efficiency of 54.3% for a dual-tone input power of −10 dBm. It is evident that this dual resonant rectification technique increases the RF to DC effective conversion efficiency, and hence the recoverable DC power for low power applications. Furthermore from a design and economic perspective, utilizing a large number of components (e.g. antennas, diodes) to realize individual rectifier circuits for each frequency band creates additional expense. In order to provide more realistic measurement results, the proposed dual-band rectifier was tested in three suburbs of Melbourne, Australia. Therefore, this dual-band technique offers a simple and cost-effective solution which is of paramount importance for environmental power harvesting systems. This innovative technique has the potential to generate a viable perpetual energy source for low power applications in urban environments.

Limitation of the study, open questions and future work

Utilizing diodes which are more suitable to low power applications ($P_i < -20$ dBm) could increase the voltage sensitivity, resulting in a higher RF-DC conversion efficiency[32]. Applying a power optimized waveform excitation to the rectifier circuit in these frequency bands, a higher amount of DC power can be generated when compared with a single and dual tone excitations with the same input power[33,34]. However this technique is not applicable to energy harvesting where the input waveform is arbitrary.

Utilizing our proposed dual resonant rectification technique to combine resonant circuits for any other arbitrary frequency bands could lead to PCE improvement, provided that suitable diodes for the desired frequency bands are selected. Note that by increasing the operating frequency the rectification performance degrades due to

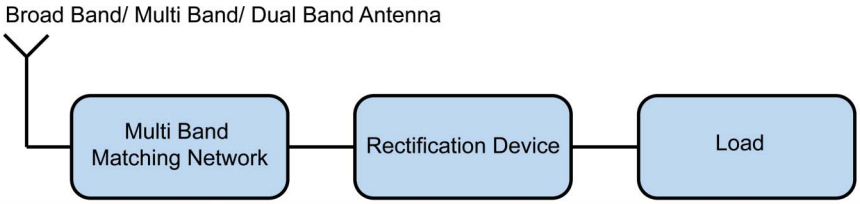

Figure 7 | General block diagram of the RF energy harvesting system.

the higher junction capacitance of the diode. Hence, lower output voltage is expected at higher frequency bands.

It is the object of our future work to design a multi-band rectenna array for enhanced RF energy harvesting. Furthermore, increasing the bandwidth, sensitivity and efficiency will also be investigated.

Methods

The major goal in designing an efficient RF harvesting system is to produce high DC output power. Toward this goal, a high sensitivity rectifier is crucial for optimum RF scavenging. A significant factor governing the sensitivity of a rectifier is the threshold voltage of the diode used for rectification. The diode must be able to "switch on" for very low ambient energy levels.

To address this sensitivity issue, a system that scavenges power from multiple frequency bands and combines them to activate a rectification circuit is proposed. The general block diagram of the proposed system is depicted in Fig. 7. Various environmental RF energy sources of different frequencies are collected by an appropriately designed antenna, and delivered to the rectification circuit via a multi-band matching network. The rectification circuit converts the combination of RF signals into DC power for low-power applications. The embodiment in this paper realizes a dual resonant matching circuit as a transition between a 50 Ω nominal antenna output and the non-linear rectification device at 490 and 860 MHz. Based on the Australian Radiofrequency Spectrum Plan[35], these bands are allocated to broadcasting services and cellular systems.

Device Selection. Due to the very low ambient power available in a real environment[19], a very low threshold voltage rectification device is required in order to increase sensitivity. For this reason, Schottky diodes (GaAs or Si) are commonly employed for RF energy harvesting. In this work, a microwave Schottky detector HSMS2820 ($C_{j0} = 0.7$ pF, $R_s = 6$ Ω, $I_s = 2.2e^{-8}$ A) is chosen due to its excellent high frequency performance, low series resistance (R_s) and junction capacitance (C_j), and low threshold voltage with high-saturation current[31]. This low threshold voltage (0.15–0.3 V) supports rectification at low input power levels.

Proposed Rectifier Design. In order to design an efficient RF harvesting system, the non-linearity of the rectifier impedance with frequency and input power should be matched to the 50 Ω output of the antenna at the desired frequency bands. Therefore, the diode input impedance as a function of frequency and different power levels were calculated and analyzed[36]. In order to match the input impedance of the rectifier to the 50 Ω output of the antenna, the total load impedance for different input power and frequencies should be determined. A circuit consisting of a pair of Schottky Barrier Diodes (SBD) terminated with a load resistor ($R_{Load} = 11$ kΩ) and an output bypass capacitor ($C2 = 6.8$ pF) was simulated using Agilent ADS software. Figure 8 shows the proposed geometry of the voltage-doubler topology[31,37]. The voltage doubler rectifier structure is employed for the design of the RF-DC power conversion system as this topology is well suited to low power rectification. The resistor and capacitor at the output will filter high frequencies. The high load resistor (11 kΩ) was chosen to observe a reasonable output voltage at very low currents. Using Large Signal S-Parameters analysis in Agilent ADS software, the load impedance and bypass capacitor were determined and optimized.

The voltage doubler rectifier in Fig. 8 consists of a peak rectifier formed by *D2* and bypass capacitor *C2* (6.8 pF) and a voltage clamp formed by *D1* and *C1* (total capacitance of the transmission lines and diode's parasitic capacitance (C_p)). In the negative phase of the input, current flows through *D1* while *D2* is cutoff. The voltage across *D1* stays constant around its threshold voltage and the voltage at node 1 is charged to $-V_{th1}$ (where $-V_{th1}$ is the threshold voltage of the *D1*). At the negative peak, the voltage across *C1* is $V_{amp} - V_{th1}$ (where V_{amp} is the amplitude of the input signal). In the positive phase of the input, current flows through *D2* while *D1* is cutoff. The voltage across *C1* remains the same as the previous phase because it has no way to discharge. At the positive peak, the voltage across *D1* is $2V_{amp} - V_{th1}$. Since *D2* is conducting current to charge *C2*, the voltage at the output is $V_{out} = 2V_{amp} - V_{th1} - V_{th2}$.

The DC equivalent circuit of the SBD is a voltage source in series with the junction resistor R_j which is obtained by differentiating the diode voltage–current characteristic and is given by equation (2)[31,38]:

$$R_j = \frac{nKT}{q(I_s + I_b)} \tag{2}$$

Where n is the diode ideality factor, K is the Boltzmann's constant, T is the temperature in degrees Kelvin, q is the electronic charge, I_s is the diode saturation current and I_b is the external bias current. At low power levels, the saturation current is very small ($I_s = 2.2\ e^{-8}$ A) and for a zero-biased diode, $I_b = 0$. Therefore, the resulting value of junction resistance at room temperature is approximately 1.7 MΩ. Since, the saturation current is highly temperature dependent, R_j will be even higher at lower temperatures which tends to decrease the output voltage. As the input power increases, some circulating rectified current will cause a drop in the value of R_j and this phenomenon will increase the value of the DC output voltage. Furthermore, it is worth to highlight that the rectified current produced by the first diode (*D1*) in Fig. 8 constitutes the external bias current of the second diode (*D2*) which will help to reduce the R_j and hence the detection sensitivity is improved. Therefore, depending on the amount of available bias current, R_j is varying (equation (2)), hence the matching network is changing which impacts the amount of delivered power to the diode and results in different values of PCE.

A Schottky barrier diode can be modeled by the linear equivalent circuit shown in Fig. 9, where L_p and C_p are the diode's parasitic inductance and capacitance respectively due to packaging ($L_p = 2$ nH and $C_p = 0.08$ pF) which are generally unwanted[39]. This linear model is used for determining the diode impedance at a given input power.

The diode impedance analyzed using a Harmonic Balance simulator and a non-linear model of the diodes over the frequency range of 400 to 900 MHz at various input power levels (Fig. 10). Due to the large junction resistor at low input RF power levels, the rectification device is turned off in absence of an appropriate matching network. Large Signal S-parameter analysis was conducted and higher input power (associated with the signal source) is applied directly to the Schottky diodes configuration of Fig. 8 which does not include a matching network in order to turn on the diodes (reduce the value of R_j) and extract approximate input impedance value as our starting point in design of a matching network. As it can be seen in Fig. 10, with increasing the source power, the diode impedance is varying and it is beginning to switch on. Hence, the input impedance needs to be determined when the diode is

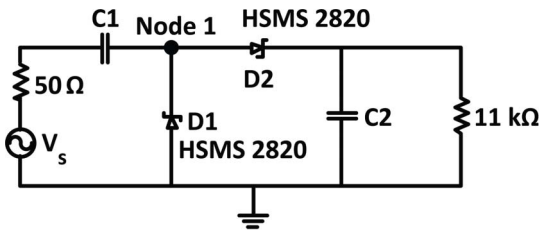

Figure 8 | Schematic of a voltage-double rectifier without matching network.

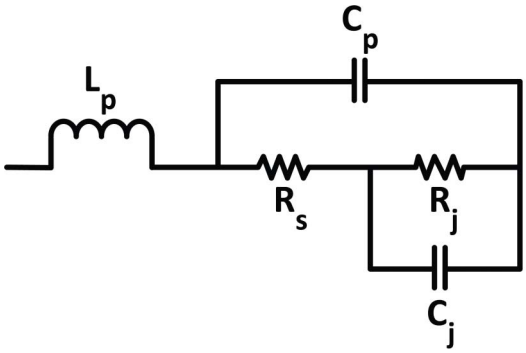

Figure 9 | HSMS 2820 Schottky diode equivalent circuit.

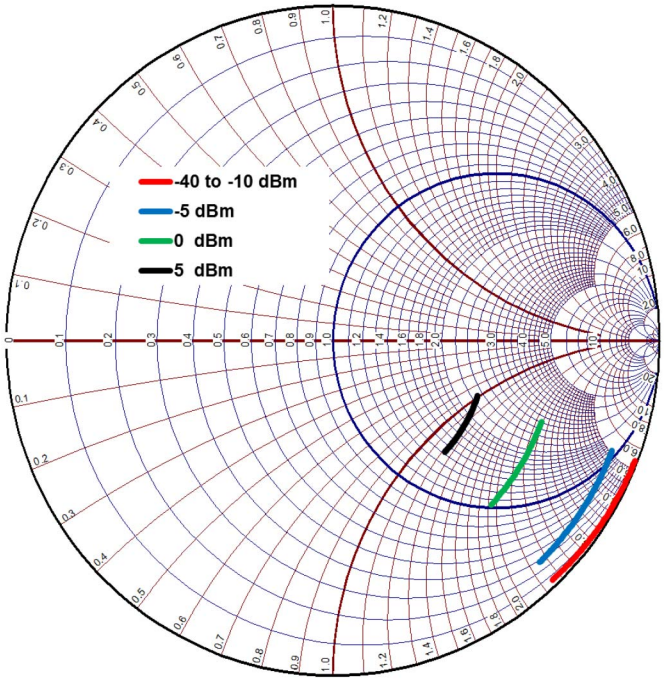

Figure 10 | Diode input impedance calculated with Large Signal S-parameter analysis over the frequency range of 400 to 900 MHz with various unmatched input power levels.

turned on to realize the matching network for a rectifier circuit. Obviously, in the presence of an appropriate matching network the rectification device can be turned on at lower power levels, whilst in the absence of a matching network a higher input power should be applied to switch on the diode. (Note that, with an unmatched rectifier the total applied input power from the signal source cannot be delivered to the diode due to the high reflection in the circuit).

The aim is to match the input impedance of the device to 50 Ω at 478–496 MHz and 852–869 MHz bands over a broad range of input RF powers. The procedure commences by matching the diode input impedance at high unmatched source power and shifting the diode input impedance at various power levels to within the voltage standing wave ratio (VSWR) <2 circle on the Smith chart. This procedure assumes that diode input impedance does not drastically change in this low power range. The simulation results of Fig. 10 prove that this is the case.

In order to provide maximum power transfer from the antenna to the rectifier circuit, a dual resonant rectifier network is designed as a transition between a 50 Ω nominal antenna output and the non-linear rectification device over the power range of −40 to −10 dBm (see Fig. 11). Hence, a coupled-resonator structure with both series and shunt resonators is designed to achieve a dual-band network[40]. The linear equivalent circuit model of the SBD chip[39] has been taken into consideration to design the dual band match at the desired frequency bands. In Fig. 11, $C_{equivalent}$ represents the total capacitance of the diodes and bypass capacitor and $L_{equivalent}$ is the overall parasitic inductance of the diodes. The series *L-C* resonator ($L4 + L_{equivalent}$ and $C_{equivalent}$) and the parallel L-C resonator (*C3* and *L3*) define the dual resonant circuit. The series resonator corresponds closely to the higher band specification of 852–869 MHz, whilst the parallel resonator approximates the lower 478–496 MHz band. A minimum number of components were used in order to reduce the ohmic and parasitic losses.

The resonant frequency of each sub-circuit was determined in isolation using the following equation:

$$f = \frac{1}{2\pi\sqrt{LC}} \tag{3}$$

The 852–869 MHz band resonator circuit components were calculated. Here, $C = C_{equivalent} \cong 1.3$ pF consists of the combination of the bypass capacitor (6.8 pF) and

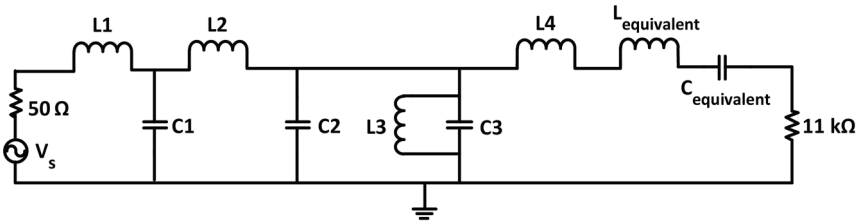

Figure 11 | Schematic of a dual resonant rectifier (optimized parameters of the chip components are: *L1* = 3.9 nH, *C1* = 0.2 pF, *L2* = 12 nH, *C2* = 1.8 pF, *L3′* = 3.9 nH, *C3′* = 7.5 pF, *L4′* = 11.6 nH, $L_{equivalent} \cong 1$ nH, $C_{equivalent} \cong 1.3$ pF).

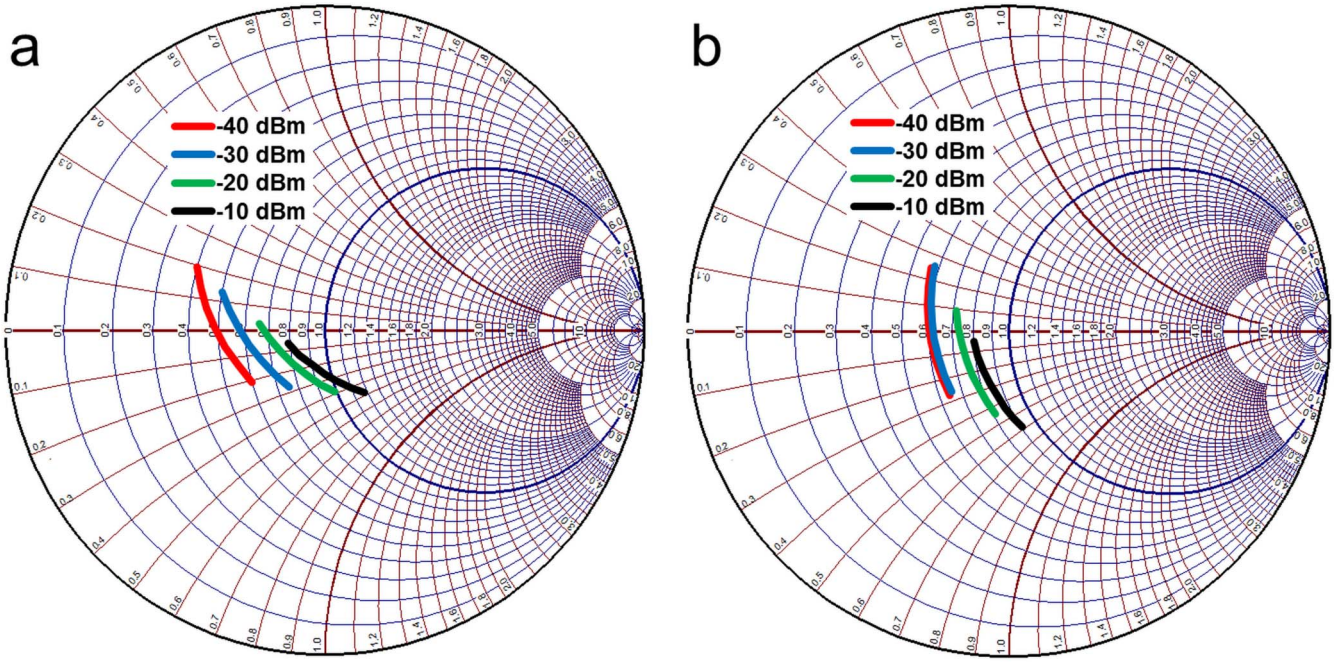

Figure 12 | Dual resonant impedance matching with −40 to −10 dBm input RF power. (a) 478–496 MHz. (b) 852–869 MHz.

the overall junction ($C_{j0} = 0.7$ pF) and parasitic capacitance ($C_p = 0.08$ pF) of *D1* and *D2*. Thus, *L* is calculated to be 26.5 nH in order to achieve an appropriate resonant frequency. Note that, *L* consists of L_4 and the overall parasitic inductance ($L_{equivalent} \cong 1$ nH) of *D1* and *D2*. The 478–496 MHz band resonator circuit components were calculated as $C3 \cong 15$ pF and $L3 \cong 7.2$ nH. Hence, the initial component values are determined for the two resonant circuits.

Initially these resonators were combined to achieve a dual-band structure. Then standard *LC* matching technique[40] is utilized to determine *C1*, *C2*, *L1*, and *L2* to achieve minimum reflection at the resonant frequencies. The substitution of realistic chip component values with their associated parasitics, and addition of 50 Ω microstrip lines and T-junctions introduce delay and shift the imaginary part of the input impedance. The via-holes also contribute to extra inductance in the circuit. Hence minor circuit adjustments are made in order to fine tune the resonant frequencies to the desired values. The final optimized values of the standard chip components are: $L3' = 3.9$ nH, $C3' = 7.5$ pF and $L4' = 11.6$ nH. Large Signal S-parameter analysis is also performed to demonstrate the matching network performance as the input power is varied. Simulation results for the input impedance of the circuit depicted in Fig. 11 are illustrated in Fig. 12. The proposed dual-resonant matching circuit achieves a VSWR <2 at 478–496 MHz and 852–869 MHz for input power ranging from -40 to -10 dBm. It should be noted that the matching circuit was designed based on the input impedance of two diodes and the output resistor and capacitor (Fig. 10). Therefore, selecting a different value for the load resistor requires a new matching circuit to be designed.

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Author contributions

N.S. designed and simulated the rectifier, carried out the measurements, interpreted results and wrote the paper. K.G. directed the research, contributed to perform the simulation and measurement and validation of design and results. W.S.T.R. supervized the research, analyzed the data and contributed to the general concept, validation of design and results. J.R.S. analyzed the data and contributed to the general concept, validation of design and results. All authors reviewed the manuscript.

Additional information

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Article

Optimization of Passive Low Power Wireless Electromagnetic Energy Harvesters

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Abstract: This work presents the optimization of antenna captured low power radio frequency (RF) to direct current (DC) power converters using Schottky diodes for powering remote wireless sensors. Linearized models using scattering parameters show that an antenna and a matched diode rectifier can be described as a form of coupled resonator with different individual resonator properties. The analytical models show that the maximum voltage gain of the coupled resonators is mainly related to the antenna, diode and load (*remote sensor*) resistances at matched conditions or resonance. The analytical models were verified with experimental results. Different passive wireless RF power harvesters offering high selectivity, broadband response and high voltage sensitivity are presented. Measured results show that with an optimal resistance of antenna and diode, it is possible to achieve high RF to DC voltage sensitivity of 0.5 V and efficiency of 20% at −30 dBm antenna input power. Additionally, a wireless harvester (*rectenna*) is built and tested for receiving range performance.

Keywords: RF energy harvesting; wireless power transmission; coupled resonators; Schottky diode; RF to DC power converter; impedance matching; PI-matching; L-matching; rectenna

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1. Introduction

For autonomous powering of sensor nodes in remote or inaccessible areas, wireless power transfer provides the only viable option to power them from an energy source. Due to the low power density of ambient RF at far-field from transmitters, there is a need to optimize each aspect of a wireless RF energy harvester for possible realistic applications. Today remote autonomous sensors are mostly powered by batteries, which have limited lifespan. Renewable powering has the potential to power autonomous sensors perpetually. Due to the expansion of telecommunications technology ambient electromagnetic (EM) power is among the most common sources of ambient energy. There are power transmitters/receivers scattered in practically any society, ranging from television transmission stations to cell phone transmitters and even wireless routers in our homes/offices or mobile phones. These transmitters in our environment and others which are on special dedicated frequencies produce ambient RF power (on the order of microwatts) which can be used as a source for powering remote microwatt budget sensors through wireless energy harvesting. This work presents different matching techniques based on different application requirements using Schottky diode-based RF to DC power converting circuits for wireless remote EM energy harvesting around 434 MHz and 13.6 MHz. Generalized analytical models and limitations of the matched RF to DC power converters are discussed. A wireless RF energy harvester consisting of an antenna and a matched diode rectifier is then realized and its performance tested. Passive wireless energy harvesting also finds applications in near field communications (NFC) [1], RFID tags [2–5], implantable electronics [6,7], and environmental monitoring [8], among others.

1.1. State of the Art

Hertz was the first to demonstrate the propagation of EM waves in free space and to demonstrate other properties of EM waves such as reflection using parabolic reflectors [9]. Wireless power transmission was then investigated and demonstrated for possible wireless remote powering by Tesla. Electromagnetic power beaming for far field wireless power transfer using collimated EM waves was proposed in the 1950s [9]. Recent advances in ultralow power sensors means ambient omni-directional EM power can be used as a source for powering remote sensors without the need to collimate the EM power through the wireless space. Mickle [10] and McSpadden [11] have presented earlier work on wireless energy harvesting systems using Schottky diodes and rectennas where the usability of ambient RF power into DC power was shown. Sample [12] presented a wireless harvester which can harvest EM power from TV and radio base stations transmitting 960 kW of effective radiated power; 60 μW was harvested at a range of about 4 km. Umeda [13] and Le [14] have presented more integrated wireless energy harvesters based on CMOS RF to DC rectifying circuits. CMOS-based rectifying power converters provide full compatibility with standard CMOS technologies and have advantages in batch processes for mass production. The drawback of CMOS-based diode connected transistors is the need to bias the gate of the transistors for the rectifying circuits to effectively function. This gate bias is provided externally, which makes the system not passive. Without the injection of external charges or a biasing of the transistor gate, the circuit has low efficiency, especially when the amplitude of the input voltage is low [15]. Shameli [2] presented a passive CMOS RF to DC power converter with a

voltage sensitivity of 1 V at −14.1 dBm input, but the circuit efficiency was only 5 %. Zbitou [16] presented an RF to DC converter based on Schottky diodes and achieved 68 % efficiency at 20 dBm RF input power. Ungan [17,18] presented antennas and high quality factor RF to DC power converters at 24 MHz and 300 MHz for RF wireless energy harvesting at -30 dBm input power. The power converter used high quality factor resonators for impedance matching the EM source and the diodes and achieved high open circuit voltage sensitivity of 1 V/μW. Boquete [19] presented a risk assessment system for calculating insurance premiums by monitoring mobile phone usage while driving. This was done by harvesting EM power from detected mobile phone usage during driving for risk assessment. Heikkinen [20] presented rectennas on different substrates at 2.4 GHz using transmisson lines to match the antennas output resistance (*at resonance*) to the rectifying diodes. Akkermans [21] presented a rectenna design by complex conjugating impedance provided by a microstrip structure to a diode so that resonance may be achieved for a working frequency. This design approach may need sophisticated tools to realize and the dominant resonance frequency of the rectenna can be unpredictable in practice. Hagerty [22] presented rectenna arrays for broadband ambient EM harvesting and characterized the harvesters from 2 GHz to 18 GHz; rectennas combine impedance matching the RF rectifying circuit and the antenna into one compact device, but an array of rectennas may increase the overall size of an EM harvester. Herb [23] and Vullers [24] have provided a comprehensive state of the art for micro energy harvesting and have explored the various techniques used for harvesting ambient renewable energy.

2. RF to DC Power Converter

2.1. Diode Rectifier

A junction diode equivalent circuit and simple Schottky diode rectifier are shown in Figure 1. R_{DS} is the diode resultant series resistance, C_{DS} is the diode resultant series capacitance, R_{DP} is the diode resultant parallel resistance, C_{DP} is the diode resultant parallel capacitance, Vs is the sinusoidal source voltage and Vc is the voltage across the capacitor.

Figure 1. (**a**) Diode series equivalent model, (**b**) Diode parallel equivalent model, (**c**) Simple diode detector.

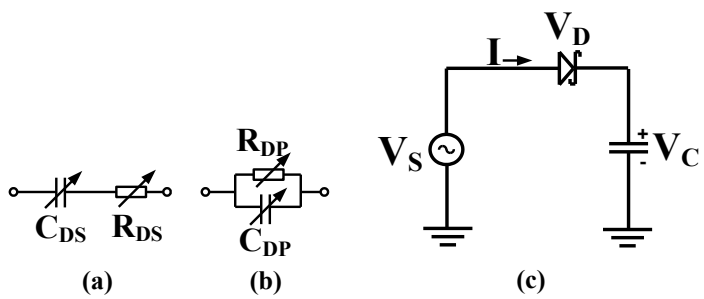

The diode capacitive impedance is mainly due to the junction capacitances provided by the metal, its passivation and the semiconductor forming the diode. AC power incident on a forward biased diode input is converted to DC power at the output. The current-voltage behavior of a single metal/semiconductor diode is described by the Richardson equation [25] as in Equation (1):

$$I = I_S\left(e^{\left(qV_D/nKT\right)} - 1\right) \tag{1}$$

where I is the current through the diode, I_S is the saturation current, q is the charge of an electron, V_D is the voltage across the diode, T is the temperature in degrees Kelvin and K is Boltzmann constant. The voltage equation around the loop can be derived from Figure 1(c) and is given in Equation (2):

$$V_D = V_S - V_C \tag{2}$$

Since the same current flows through the diode and the capacitor, one can find the average current through the circuit by integrating Equation (1) over a time period. By substituting Equation (2) into Equation (1), V_C can be expressed in terms of V_S by averaging the diode current to zero. This is given in Equation (3) [26]:

$$V_C = \frac{KT}{q}\ln\left[\vartheta_0\left(\frac{qV_S}{KT}\right)\right], \tag{3}$$

where ϑ_0 is the series expansion of the sinusoidal source voltage. Equation (3) can further be simplified for very small amplitude V_S as Equation (4):

$$V_C \approx \frac{qV_S^2}{4KT} \tag{4}$$

Equation (4) shows that for a small voltage source, the circuit output voltage is proportional to the square of the input sinusoidal voltage; hence it's so-called square law operation. Extensions of this model for voltage multipliers and other input signals are presented in [27] and [28]. Equation (4) further confirms that for low input voltage (power ≤ 10 dBm), an impedance matching network between the source and the diode is necessary to improve the detected output voltage and efficiency.

2.2. Impedance Matching

The maximum power transfer theorem states that the highest power is transferred to the load when the source resistance is the same as the load resistance. For systems with both resistive and reactive impedances from source and load, the source and the load impedance should be adjusted in a way that they are the complex conjugate of each other through impedance matching. For the purposes of this work, a 50 Ω resistive source is chosen as reference for load impedance matching. The antenna which captures the ambient RF signals is tuned to provide this source resistance at resonance for the rectifying circuit in a complete EM wireless remote harvester. The load is the resistance of the Schottky diodes and the actual connected resistance (*remote sensor*). The specific type of matching network which can be used for complex conjugation depends on the nature of load or source impedance, the desired RF to DC converter functionality and other factors like circuit size, cost, *etc.* The response of a matched RF to DC power converter depends on the matching network used as well as the source or load component quality factors and impedances.

2.3. Diode Impedance

Schottky diodes HSMS-285C and HSMS-286C from Avago [29,30] are used to build the RF to DC power converters. The HSMS-285× or 286× series diodes can be operated as zero biased with relatively low forward junction potential. This allows for the realization of completely passive RF to DC power converters for wireless energy harvesting. The HSMS-285C or 286C is a pair of series connected Schottky diodes in a SOT-323 package. The impedance of the HSMS-285C and HSMS-286C diodes was first measured so it can be matched to the resistance (50 Ω) of the antenna source. This is done by connecting the input of the diodes to a network analyzer and measuring the scattering parameters. These scattering parameters are then converted to the corresponding impedances. The input impedance of a diode depends mainly on the resistive and capacitive impedance provided by the junction of the diode and its connected load. For a couple of diodes arranged in a package such as the HSMS-285C or 286C, the input impedance is the vector sum of the impedances provided by each diode in the package arrangement, the extra impedance associated with the packaging and the connected load. The diode measuring board is as shown in Figure 2. The diodes were measured at room temperature for an input power of -30 dBm at a diode connected load of 1 MΩ with a 100 pF filter capacitor. For the sake of this work, the input impedance of the diodes will always be referred to at these connected load conditions.

Figure 2. (**left**) Reference circuit layout for measuring diodes input impedance, (**right**) measuring printed circuit board (PCB) for diodes input impedance on 1 mm FR4 substrate.

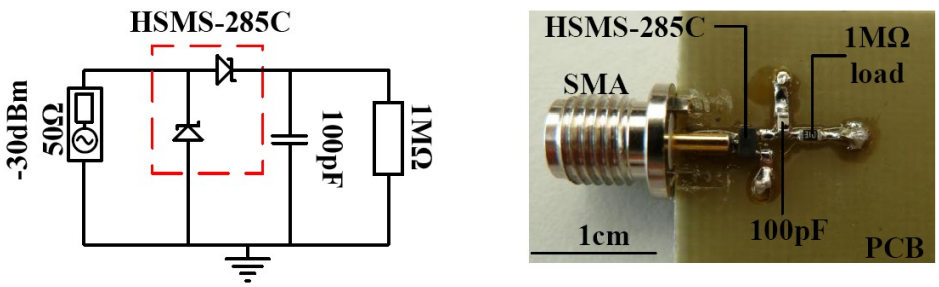

Figure 3. Measured input impedance (Δ resistive, □ capacitive) of HSMS-285C (**left**) and HSMS-286C (**right**) diodes at −30 dBm input with 1 MΩ load and 100 pF filter.

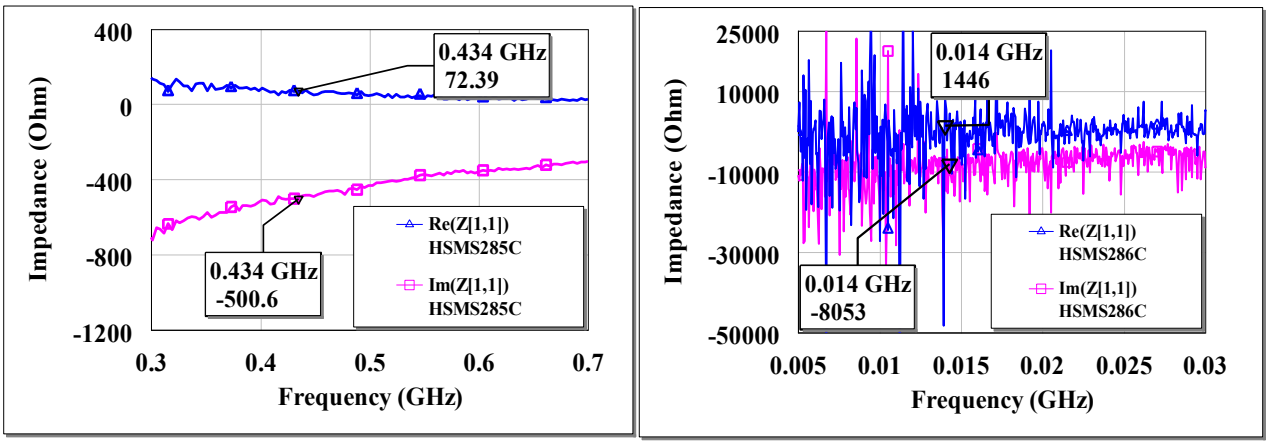

The board is fabricated such that components are soldered directly one into another to prevent additional impedances introduced by copper route. The PCB backside had the ground layer. An example of measured input impedance for HSMS-285C and HSMS-286C is shown in Figure 3.

The diodes quality factor is given by $X_{DS}R_{DS}^{-1}$, where X_{DS} is the resultant series capacitive impedance of the diodes. At an input power of −30 dBm, the measured input impedance of the HSMS-285C diodes is 72–j501 Ω at 434 MHz and 587–j1239 Ω at 13.6 MHz. For HSMS-286C diodes, it is 10–j503 Ω at 434 MHz and ~1.5–j8.1 kΩ at 13.6 MHz for −30 dBm input. The measured impedance of the HSMS-286C diodes at low frequencies (< 60 MHz) shows pronounced fluctuations. The low-frequency excess flicker noise and the shot noise observed in the HSMS-286C have been studied by several authors [31–33]. The pronounced presence of trap states in the depletion region of the semiconductor, mobility fluctuations in carriers, edge effects among other reasons is reported to cause deviations from the ideal Schottky diode behavior and hence generation-recombination noise for some diodes such as the HSMS-286C [34]. When a diode rectifier is matched at a reference operating condition, the matching network may function less effectively at other input power levels, connected load and other operating frequencies. This is due to possible changes in the diode input impedance. Throughout this work the imperfections of the matching circuit at other operating conditions away from the matched reference conditions are accepted without changes to the matching network.

2.4. Voltage Doubler

The Delon voltage doubler and Greinacher doubler are both used to realize the RF to DC power converters presented in this work. The Delon voltage doubler and Greinacher doubler are shown in Figure 4. The diodes output voltage (V_{out}) is doubled what is detected by a simple detector circuit shown in Figure 1. Both doublers produce the same output performance, the only difference is that the Delon doubler has an instantaneous input ground which is not shared with the output.

Figure 4. Circuit diagram of voltage doubler, (**a**) Delon doubler and (**b**) Greinacher doubler.

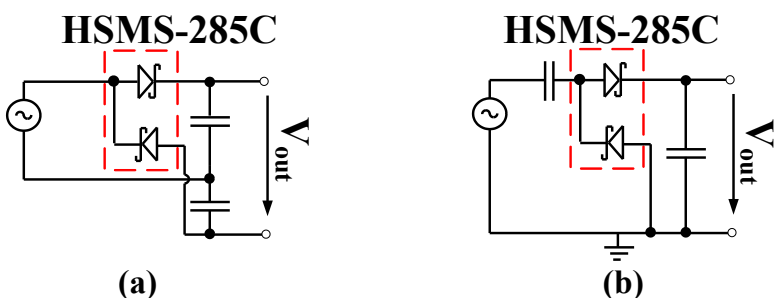

2.5. Matching Techniques for Antenna Source and RF to DC Power Converter

2.5.1. L-match RF to DC Power Converter

An L-match network converts a source series impedance to its equivalent load parallel impedance or *vice-versa* and tunes out by subtracting or adding any surplus reactance from the load or source with the counter impedance. Series impedance is converted to its parallel equivalent impedance using Equations (5–7):

$$Q_S = \frac{X_S}{R_S} \tag{5}$$

$$Q_P = \frac{R_P}{X_P} \tag{6}$$

where Xs is the total series reactive impedance, Rs is the total series resistance, R_P is the total parallel resistance, Xp is the total parallel reactive impedance, Q_S and Qp are the series and parallel quality factors respectively:

$$R_S + jX_S = \frac{R_P \times jX_P}{R_P + jX_P} \tag{7}$$

Equation (7) is the equation of a series sum of impedances and a parallel sum of impedances. It is interesting to note that Q_S and Q_P from an L-matched network may be different from the individual component quality factors as a result of the inherent resistive and reactive impedances in that component. By virtue of Equation (7), Q_S and Q_P must be equal in an L-matched network. Using Equations (5,6) and (7), the ratio of the parallel resistance (*or reactance*) to the series resistance (*or reactance*) can be derived in terms of the quality factors Q_P or Q_S [35]. Since at match conditions, only the resistive impedances dissipate power, the loaded quality factor Q, of the L-matched network can be expressed as in Equation (8):

$$R_P = (Q^2 + 1)R_S \tag{8}$$

Using Equations (5,6) and (8), series impedance can be converted to its parallel equivalent for a fixed frequency and power level. As an example; a series impedance 72–j501 Ω (HSMS-285C at 434 MHz for −30 dBm input power) is easily converted to $-j510(3519)/(-j510 + 3519)$ Ω as its parallel equivalent with a component quality factor of 6.96. The source resistance is taken as part of the parallel matching network in an L-match circuit if the source series equivalent resistance is greater than the load series equivalent resistance. On the other hand, the load resistance is taken as part of the parallel matching network if the load series equivalent resistance is greater than the source series equivalent resistance. For the purpose of this work, inductors were only used for series impedance matching and capacitors as shunts. This prevents power seeping through any shunt inductor used for impedance matching due the short circuit provided by a shunt inductor to ground and resulting in less output efficiency. Resistors were not used for impedance matching.

2.5.2. L-match RF to DC Converter Generalized Analytical Model

The classical matching technique using Equations (5,6) and (8) is first used to L-match the 50 Ω resistance of the antenna to the resistance of the HSMS-286C diodes (and load) at 434 MHz for −30 dBm input and then the generalized model is discussed. The antenna source resistance was L-matched to the resistance of the diodes (and load). The 50 Ω resistance of the antenna is taken as the parallel matching component and the diodes 10 Ω resistance is the series matching component. The loaded Q is found as 2 between the 50 Ω antenna source resistance and the 10 Ω diode series resistance using Equation (8). From this loaded Q, a shunt capacitive impedance of 25 Ω (14.6 pF at 434 MHz) using Equation (6) and a series inductive impedance of 20 Ω (7.3 nH at 434 MHz) using Equation (5)

will match the 50 Ω source to the 10 Ω HSMS-286C diodes (and load) series resistance at −30 dBm input. Since the HSMS-286C diodes inherently provides 503 Ω series capacitive impedance at −30 dBm, a resultant series inductive impedance of 523 Ω (192 nH at 434 MHz) is needed to tune the 50 Ω resistive source to the complete HSMS-286C diodes impedance at 434 MHz for −30 dBm input. The L-matched HSMS-286C diodes rectifier is as shown in Figure 5(a).

Figure 5. (**a**) L-match RF to DC harvester using the HSMS-286C diodes at 434 MHz for −30 dBm input. (**b**) Small signal impedance model of a generalized L-matched RF to DC power converter as capacitive coupled series RLC resonator with different resonator elements.

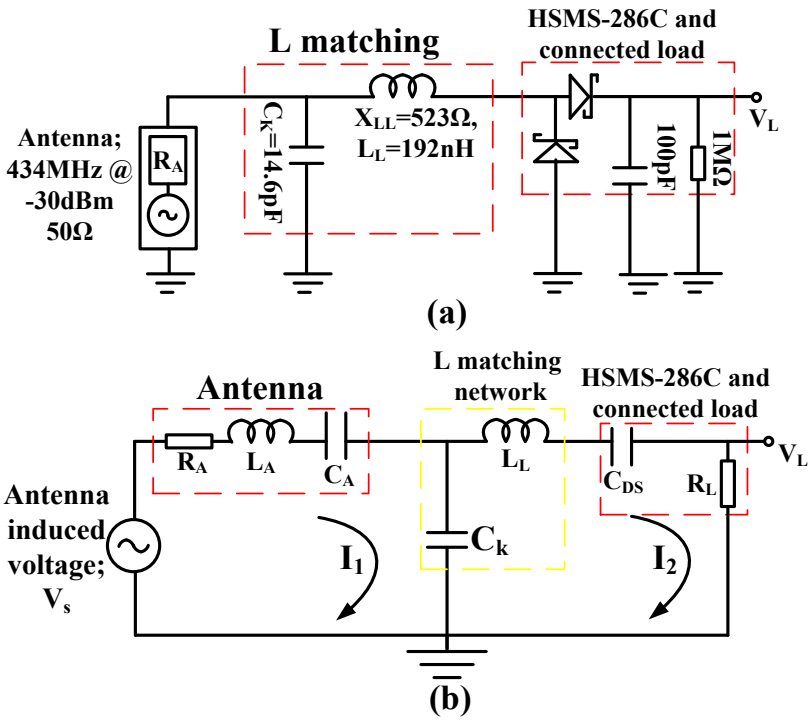

C_K is the tuning capacitance, L_L is the tuning inductance, X_{LL} is the tuning inductive impedance, C_{DS} is the diodes series capacitance, X_{DS} is the diodes series capacitive impedance, V_S is the antenna captured ambient EM voltage, R_A is the resistance of antenna, L_A is the inductance of antenna, C_A is the capacitance of antenna, R_L is the resultant series resistance from the diodes and the connected load resistance, V_L is the resistive load voltage. From Figure 5(a) the power dissipated in the resistance of the diodes (and connected load); P_L is given by Equation (9), where R_L is the series resistance of the diodes and load:

$$P_L = \frac{V_L^2}{R_L} \tag{9}$$

The source power; P_S is given by Equation (10), where V_S* is the root mean squared (RMS) antenna captured source voltage. Half of the source power is transferred to the resistance of the diodes (and connected load) at match conditions as described by the maximum power transfer theorem:

$$P_S = \frac{V_S^2}{R_A} \quad \text{or } P_S = \frac{V_{S*}^2}{2R_A} \tag{10}$$

Equating P_L and half RMS P_S gives a condition of maximum voltage gain for the matched RF to DC power converter shown in Figure 5(a):

$$\frac{V_L}{V_{S*}} = \frac{1}{2}\sqrt{\frac{R_L}{R_A}} \tag{11}$$

From Equation (8), substituting the series and parallel resistance ratio into Equation (11) the voltage gain can be expressed in terms of the loaded quality factor as in Equations (12) and (13), where Q is the loaded quality factor of the RF to DC power converter:

$$\frac{V_L}{V_{S*}} = \frac{1}{2}\sqrt{\frac{1}{1+Q^2}} \tag{12}$$

Equation (12) is the voltage gain in-terms of the loaded Q if the resistance of the diodes (and connected load) is part of the series matching network and the resistance of the antenna source is part of the parallel matching network as in Figure 5(a). If the resistance of the diodes is part of the parallel matching network, then Equation (13) may be written as the voltage gain in-terms of the loaded Q in an L-matched circuit:

$$\frac{V_L}{V_{S*}} = \frac{1}{2}\sqrt{1+Q^2} \tag{13}$$

Equations (12) and (13) shows that the maximum voltage gain is directly related to the relative differences between the diodes (and connected load) resistance and source resistance at matched conditions or the circuit loaded quality factor. It is interesting to note that the circuit shown in Figure 5(a) has a loaded Q of 2, but an HSMS-286C unloaded quality factor of 50 (at 434 MHz for −30 dBm).

Figure 5(a) is generally modeled as capacitive coupling of two series RLC resonators with a voltage source. This linearized model can be made at any defined frequency and power level. The model however neglects the metal/semiconductor physics of the diode's junction potentials which results in a Schottky barrier. The first series RLC resonator is modeled as impedance from the antenna with or without some passive matching components. The voltage source V_S, is the antenna captured electromagnetic voltage. The second series RLC resonator is the impedance from the diodes (at a defined condition), connected resistance and some passive matching components. Ck is modeled as the coupling element between the two series RLC resonators. Figure 5(b) gives a more general look at the special scenario shown in Figure 5(a). The voltage equations in the two loops are given by Equations (14,15) according to Kirchhoff's voltage loop laws, where ω is the angular frequency and I_1, I_2 are the currents in the first loop and second loop, respectively:

$$V_S = I_1\left[R_A + j\omega L_A - \frac{j}{\omega C_A} - \frac{j}{\omega C_K}\right] + \frac{jI_2}{\omega C_K} \tag{14}$$

$$0 = \frac{jI_1}{\omega C_K} + I_2\left[R_L + j\omega L_L - \frac{j}{\omega C_{DS}} - \frac{j}{\omega C_K}\right] \tag{15}$$

Using Cramers rule, I_2 can be expressed as:

$$I_2 = \frac{\dfrac{-jV_S}{\omega C_K}}{\left[R_A + j\omega L_A - \dfrac{j}{\omega C_A} - \dfrac{j}{\omega C_K}\right]\left[R_L + j\omega L_L - \dfrac{j}{\omega C_{DS}} - \dfrac{j}{\omega C_K}\right] + \dfrac{1}{\omega^2 C_K^2}}. \tag{16}$$

The voltage across R_L is V_L; given by I_2R_L:

$$V_L = \frac{\dfrac{-jV_S}{\omega C_K} R_L}{\left[R_A + j\omega L_A - \dfrac{j}{\omega C_A} - \dfrac{j}{\omega C_K}\right]\left[R_L + j\omega L_L - \dfrac{j}{\omega C_{DS}} - \dfrac{j}{\omega C_K}\right] + \dfrac{1}{\omega^2 C_K^2}} \tag{17}$$

The voltage gain of the coupled resonator can be expressed as in Equation (18):

$$\frac{V_L}{V_S} = \frac{\dfrac{-jR_L}{\omega C_K}}{\left[R_A + j\omega L_A - \dfrac{j}{\omega C_A} - \dfrac{j}{\omega C_K}\right]\left[R_L + j\omega L_L - \dfrac{j}{\omega C_{DS}} - \dfrac{j}{\omega C_K}\right] + \dfrac{1}{\omega^2 C_K^2}} \tag{18}$$

At resonance, there is no resultant reactance in the RLC resonators or the capacitive and inductive impedances become equal; hence Equation (19) can be written:

$$\omega L_A - \frac{1}{\omega}\left\{\frac{1}{C_A} + \frac{1}{C_K}\right\} = 0 \text{ and } \omega L_L - \frac{1}{\omega}\left\{\frac{1}{C_{DS}} + \frac{1}{C_K}\right\} = 0 \tag{19}$$

Equations in Equation (19) can be used to find the resonant frequencies of the series coupled resonator. The voltage gain of the coupled resonator at resonance can then be expressed as in Equation (20):

$$\frac{V_L}{V_S} = V_{gain} = \frac{\dfrac{-jR_L}{\omega C_K}}{R_A R_L + \dfrac{1}{\omega^2 C_K^2}} \tag{20}$$

where V_{gain} is the voltage gain. V_{gain} at resonance is a function of the resistance of the source and load and the coupling element. The maximum of Equation (20) is obtained when:

$$\frac{dV_{gain}}{dC_K} = 0. \tag{21}$$

This gives the results as in Equation (22):

$$\frac{dV_{gain}}{dC_K} = \frac{j2R_L}{\omega^3 C_K^4} - j\left\{R_A R_L + \frac{1}{\omega^2 C_K^2}\right\}\frac{R_L}{\omega C_K^2} = 0 \text{ or } R_A R_L^2 = \frac{R_L}{\omega^2 C_K^2} \tag{22}$$

Equation (22) can be simplified to find $C_{K(max)}$:

$$C_{K(\max)} = \pm\frac{1}{\omega}\sqrt{\frac{1}{R_A R_L}} \tag{23}$$

where C_{Kmax} is the value of the coupling element where maximum power transfer from the first resonator to the second resonator occurs. Using Equations (19) and (23) the unknown optimal matching impedances can be found from the known impedances just like the classical L-matched procedure using Equations (5,6) and (8). By substituting $C_{K(max)}$ into Equation (20) and taking the magnitude of V_{gain}, gives the maximum voltage gain of the coupled series resonator at resonance:

$$\left|\frac{V_L}{V_S}\right| = \frac{1}{2}\sqrt{\frac{R_L}{R_A}} \text{ or simply } \frac{V_L}{V_{S*}} = \frac{1}{2}\sqrt{\frac{R_L}{R_A}} \tag{24}$$

For wireless harvesters consisting of an antenna and a diode rectifying circuit, the diode resistive impedance at any condition is dependent on the diode realized parameters, signal frequency, connected load and the input power level. The source impedance is determined by the impedance of the antenna. For maximum efficiency, the ratio of the source resistance to the load resistance must tend to zero at matched conditions. The efficiency η of the circuit is given by Equation (25):

$$\eta = \frac{P_L}{P_S}; \eta \to 1 \ when \ \frac{R_A}{R_L} \to 0 \tag{25}$$

2.5.3. L-Match RF to DC Converter Experimental Results and Discussion

The presented circuit was L-matched between the 50 Ω resistance of the antenna source and the resistance of the HSMS-285C diodes (and load) at 434 MHz for −30 dBm input as shown in Figure 6. Since the series equivalent resistance of the HSMS-285C diodes and load (72 Ω) is greater than the 50 Ω series resistive antenna source, the diode is taken as parallel matching network with a parallel equivalent impedance of $-j510(3519)/(-j510 + 3519)$ Ω. The analysis follows the same procedure as in Section 2.5.2 after this step. Figure 6(b) shows the resultant L-matched RF to DC power converter. C_{DP}* is the resultant shunt matching capacitance.

Figure 6. (**a**) L-matched impedance circuit for matching the HSMS-285C diodes at 434 MHz for −30 dBm input. (**b**) Resultant network, (**c**) PCB layout of the L-matched Delon doubler with adjusted values on FR4 substrate (**d**) Fabricated PCB of the L-network matched Delon voltage doubler.

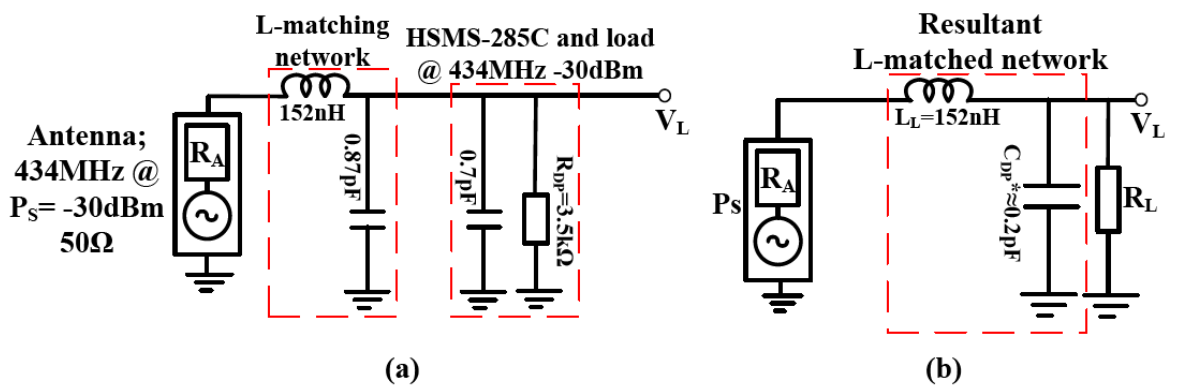

Figure 6. *Cont.*

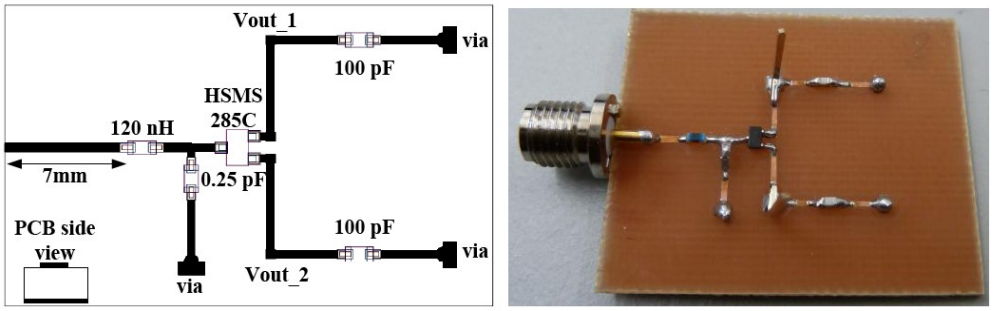

(c) (d)

Figure 6(a,b) assume perfect characteristic impedance between the various components in the matched circuit. When a copper route is introduced between components and on a material substrate, it must be accounted for in the total impedance as seen by the source or load. This PCB impedance compensation is carried out in Advance Design Systems (ADS) from Agilent [36]. ADS has extensive models for microstrip substrates to account for its impedances. The optimized layout using ADS microstrip models and its compensated values in the passive tuning components for a Delon doubler is shown in Figure 6(c).

The circuit reflection coefficient (S_{11}) and input impedance at open circuit are shown in Figure 7. There is high return loss and resonance around 434 MHz. The circuit input impedance at open circuit conditions is ~38 Ω at resonance for −40 dBm and ~17 Ω at −10 dBm input.

The measured L-matched circuit efficiency and voltage sensitivity is shown in Figure 8. The maximum measured L-matched efficiency at −30 dBm is 22% at ~20 kΩ load and an open circuit voltage of 124 mV. At −10 dBm, the maximum efficiency and open circuit voltage is 47% and 2 V respectively. At the optimal load of ~20 kΩ, the detected voltage is 58 mV and 1 V at −30 dBm and −10 dBm respectively.

Figure 7. Measured open circuit S_{11} of the L-matched Delon circuit at different input power levels from a 50 Ω source (**left**), measured open circuit input impedance at −10 dBm and −40 dBm of the L-matched circuit (**right**).

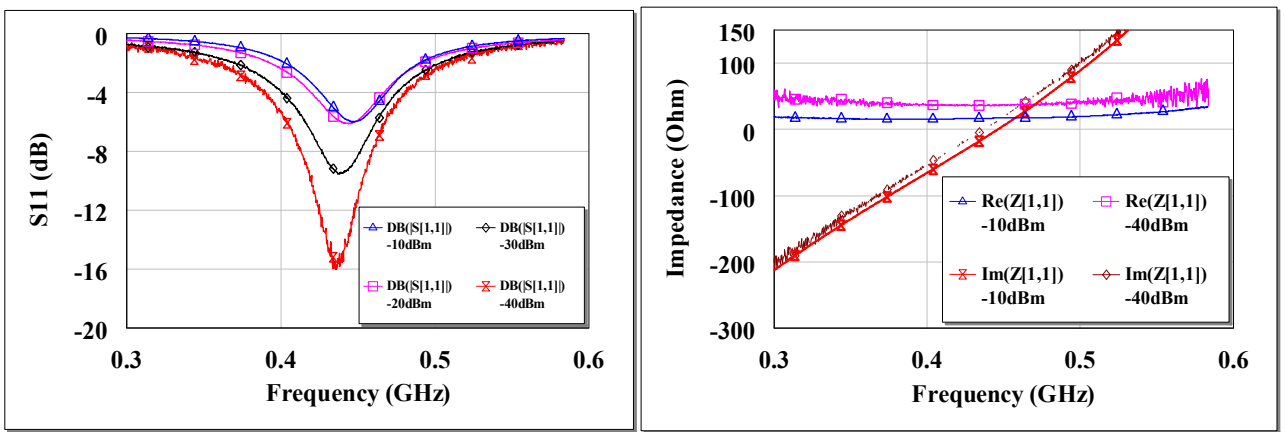

The open circuit voltage gain is 25 at −30 dBm and 40 at −10 dBm. The maximum measured efficiency at −35 dBm is 27%. This is higher than that of −30 dBm due to the better matched circuit

impedance at −35 dBm (35 Ω) than at −30 dBm (27 Ω) input. The L-matched RF to DC power converter has a loaded Q, sensitivity and efficiency determined mainly by the diodes resistance, diodes junction potential, connected resistance and antenna source resistance at matched conditions.

Figure 8. Measured L-matched circuit efficiency *versus* resistive load at various input power levels at 434 MHz (**left**), measured open circuit voltage and at 17 kΩ load *versus* input power at 434 MHz (**right**).

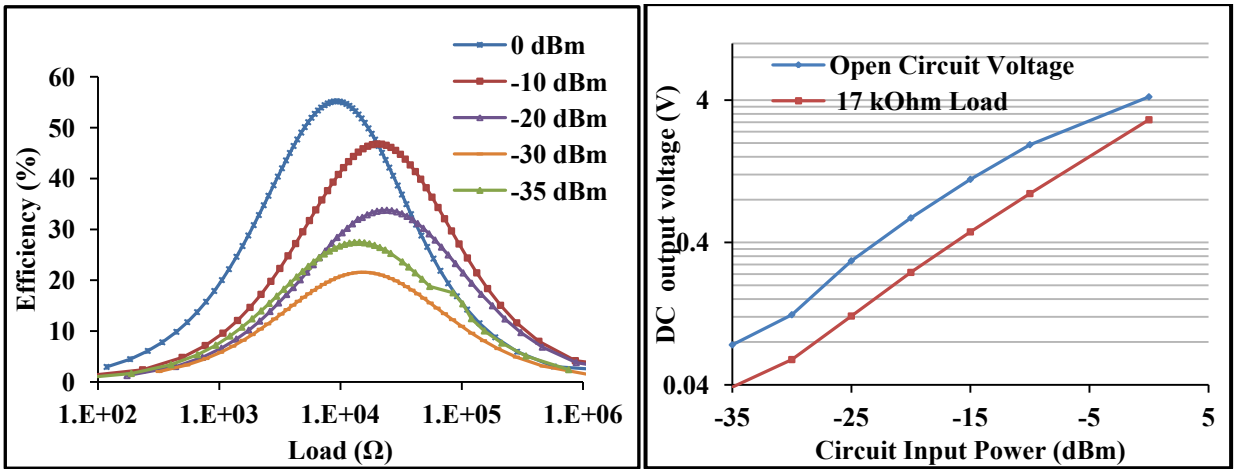

2.5.4. PI-match RF to DC Power Converter

A highly selective or small frequency bandwidth RF power converter is realized with a PI-network in-between the source impedance from the antenna and the diode rectifier. A PI-network is a 'back to back' L-network that are both configured to match the load and source impedance to an invisible resistance located at the junction between the two L-networks [37]. The quality factor of the L-network with the parallel resistance is given by Equation (26):

$$Q_P^* = \sqrt{\frac{R_P}{R^*} - 1}, \tag{26}$$

where R_P is the parallel resistance, R^* is a virtual resistance and Q_P^* is the quality factor of the L-network with the parallel resistance. The quality factor of the L-network with the series resistance is given by Equation (27):

$$Q_S^* = \sqrt{\frac{R_S}{R^*} - 1}, \tag{27}$$

where Q_S^* is the quality factor of the L-network with the series resistance. The unloaded quality factor; Q_S^* or Q_P^* is set higher than what is normally achieved with a single L-network [37] to realize the small frequency bandwidth circuit. The resistance of the load is assigned the parallel network in a PI-matched circuit if its series equivalent resistance is higher than the source series equivalent resistance; the opposite is true if the source is higher than the load. Equation (26) and Equation (27) are synonymous to Equation (8), except the lowest resistive impedance in Equation (8) is substituted with the virtual resistance which is dependent on the newly desired circuit selectivity. From Equations (26) and (27) the loaded quality factor of the PI-matched circuit can be written as Equation (34) in terms of Q_S^* and Q_P^*:

$$Q^2 = \left[\left(\frac{Q_P^{*2} + 1}{Q_S^{*2} + 1}\right) - 1\right], \tag{28}$$

where Q is the loaded quality factor of the PI-network. Q_S* or Q_P* are the unloaded quality factors of the PI-matched network. The larger value among the unloaded quality factors result in small frequency bandwidth response which is desired when matching a source and load impedance with a PI-network. Some authors approximate the highest value of Q_S* or Q_P* or their algebraic sum as the loaded quality factor of the PI-network as in [35] and [37], but Equation (28) gives the exact loaded Q of the PI-matched circuit in terms Q_S* and Q_P*. This allows for the correct estimation of the maximum voltage gain from the loaded quality factor.

2.5.5. Selectivity RF to DC Converter Generalized Analytical Model

An example of a PI-matched RF to DC converter using the HSMS-285C diodes operating at 434 MHz for −30 dBm input is presented first and then the generalized model is discussed. The circuit is matched for Q_P* of 60 between the antenna and the resistance of the diodes as shown in Figure 9.

Figure 9. Impedance diagram of PI-matched RF power converter; (**a**) Impedance diagram of 50 Ω source and the HSMS-285C diodes at 434 MHz, (**b**) Resultant PI matched network between the antenna source and load resistance.

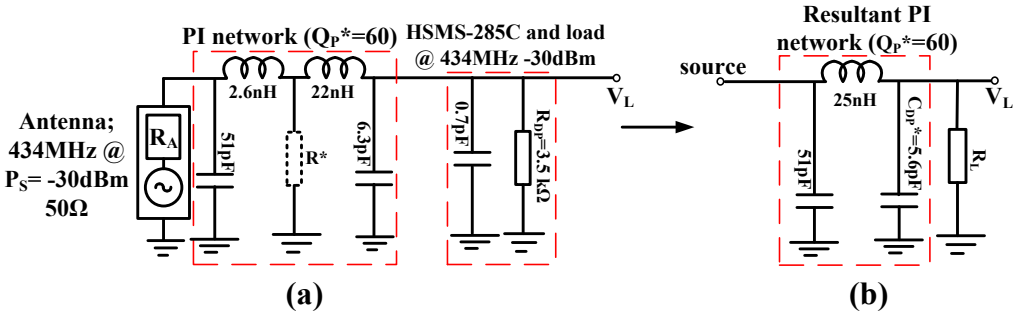

Figure 9(b) can also be modeled as an inductive coupling of two parallel RC circuits. A more general look at such a circuit is shown in Figure 10, as an inductive coupling of two parallel RLC resonators with a current source.

Figure 10. Inductive coupled parallel RLC small signal model of a generalized PI-matched antenna and diode rectifier.

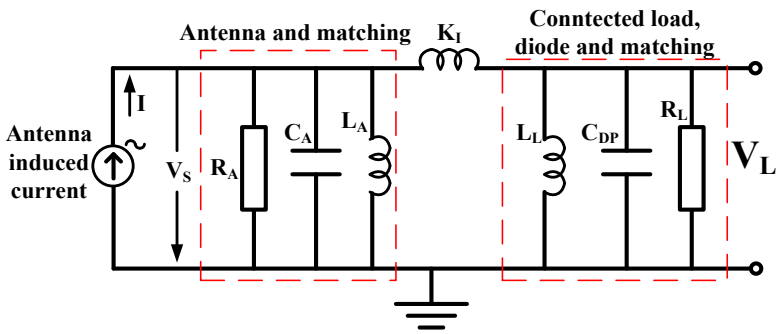

The first parallel RLC resonator is modeled as impedance from the antenna and some passive matching components. The second parallel RLC resonator is modeled as impedance from the linearized diodes, its connected load and some passive matching components. I is the antenna induced current, V_S this time is the voltage across the parallel R_A and K_1 is the coupling element between the two parallel resonators. Using Kirchoff's current laws, the node equations can be expressed as Equations (29) and (30):

$$I = V_S\left[\frac{1}{R_A} + j\omega C_A - \frac{j}{\omega L_A} - \frac{j}{\omega K_1}\right] + \frac{jV_L}{\omega K_1} \tag{29}$$

$$0 = \frac{jV_S}{\omega K_1} + V_L\left[\frac{1}{R_L} + j\omega C_{DP} - \frac{j}{\omega L_L} - \frac{j}{\omega K_1}\right] \tag{30}$$

Load voltage (V_L) and the source voltage (V_S) at resonance are given by the equations in Equation (31). The resonance frequencies are given by Equation (32):

$$V_L = \frac{\frac{-jI}{\omega K_1}}{\left[\frac{1}{R_A R_L} + \frac{1}{\omega^2 K_1^2}\right]} \quad \text{and} \quad V_S = \frac{\frac{I}{R_L}}{\left[\frac{1}{R_A R_L} + \frac{1}{\omega^2 K_1^2}\right]} \tag{31}$$

$$\omega C_A - \frac{1}{\omega}\left\{\frac{1}{L_A} + \frac{1}{K_1}\right\} = 0 \text{ and } \omega C_{DP} - \frac{1}{\omega}\left\{\frac{1}{L_L} + \frac{1}{K_1}\right\} = 0 \tag{32}$$

From V_L and Vs in Equation (31), the voltage gain at resonance can be expressed as:

$$\frac{V_L}{V_S} = \frac{R_L}{j\omega K_1} \tag{33}$$

The maximum of Equation (33) is obtained when:

$$j\omega K_1 \to 0 \;\; or \;\; R_L \to \infty \tag{34}$$

Since $j\omega K_1$ is restricted by the conditions in Equation (32) to attain resonance, one cannot manipulate $j\omega K_1$ alone without changing the resonance conditions. What can drive the voltage gain is if R_L is very large at resonance conditions. If the input impedance (V_S/I) of the coupled resonator is maximum at resonance, conditions in Equation (35) hold:

$$\left(\frac{Vs}{I}\right) \to maximum \;\; when \;\; \frac{R_L}{\omega^2 K_1^2} \to 0 \tag{35}$$

Equation (36) may be assumed when $\frac{R_L}{\omega^2 K_1^2} \to 0$:

$$\frac{V_S}{I} = R_A \tag{36}$$

Under these conditions and an optimal coupling coefficient K_{1max}, the maximum voltage gain of the parallel coupled resonator can be written as in Equation (37), where K_{1max} is given by Equation (38):

$$\left|\frac{V_L}{V_S}\right| = \left|V_{gain}\right| = \left|\frac{1}{2}\sqrt{\frac{R_L}{R_A}}\right| \tag{37}$$

$$K_{1(\max)} = \mp \frac{1}{\omega}\sqrt{R_A R_L} \tag{38}$$

The analysis of Section 2.5.2 and parallel coupled RLC resonators show that any antenna and matched rectifying diode can be described as an equivalent circuit of a coupled resonator at a defined operating point. This general model can be applied to optimize other harvesters with complex output impedance such as piezo-harvesters or vibration harvesters for maximum transfer of power or voltage to its connected load. The model can also be applied to near field magnetically coupled antennas/coils for optimization.

2.5.6. Broadband RF to DC power converter

A broadband network is preferred when an RF to DC power converter is to be operated for a wide range of frequencies. A broadband converter is realized by connecting successive L-networks together in a multi-network between the antenna source and the rectifying diodes. The result is broadband or multiband RF power converter around certain frequencies. This can be deduced from the general model of a coupled resonators that by choosing certain passive components between a source and the load, it is possible to have more frequencies (ω) fulfilling Equation (32) and hence a result of multiple resonant frequencies or broader bandwidth at match conditions. For a two stage L-connected match, the quality factor of the L-network with the parallel resistance is given by Equation (39):

$$Q_P^* = \sqrt{\frac{R_P}{R^*} - 1} \tag{39}$$

The quality factor of the L-network with the series resistance is given by Equation (40):

$$Q_S^* = \sqrt{\frac{R_*}{R_S} - 1} \tag{40}$$

From Equations (39) and (40) the loaded quality factor of the two stage L-connected broadband network may be written as Equation (41) in terms of the unloaded quality factors; Q_S* and Q_P*:

$$Q^2 = \{(Q_P^{*2} + 1)(Q_S^{*2} + 1)\} - 1 \tag{41}$$

R* in this case may be chosen if it is larger than R_S and lower than the R_P. The highest possible bandwidth between a resistive source and resistive load is found for a virtual resistance (R*) given in Equation (42) [37]:

$$R^* = \sqrt{R_S R_P} \tag{42}$$

For complex loads such as rectifying diodes or transistors, the largest achievable bandwidth prescribed by Equation (42) is limited by the load or source component quality factor, since Equation (42) does not take into account reactive impedance associated with the source or load.

2.5.7. Broadband-Match RF to DC Converter Results and Discussion

The antenna source resistance was broadband matched to the HSMS-285C diodes (and load) resistance at −30 dBm input around 434 MHz. For a desired Q_P* and Q_S* of 2.7 there is ~0.4 pF inherent diode capacitance which is un-tuned using a two stage L-matching network [Figure 11(b)]. This is because the HSMS-285C diodes provides an inherent component quality factor of 6.96 at 434 MHz for −30 dBm input, hence a broadband circuit with Q_P* lower than this inherent component quality factor of the diodes (and load) is difficult to achieve without trade-offs. However, connected L-networks with Q_P* as high as the diode component quality factor may perform worse than a single L-matched network with similar loaded quality factor. This is due to redundant components of the connected L-networks which have inherent losses.

Figure 11. Impedance diagram of broadband RF power converter; (**a**) Broadband match around 434 MHz with loaded Q of 2.7, (**b**) Resultant impedance matching network with un-turned capacitance of 0.4 pF.

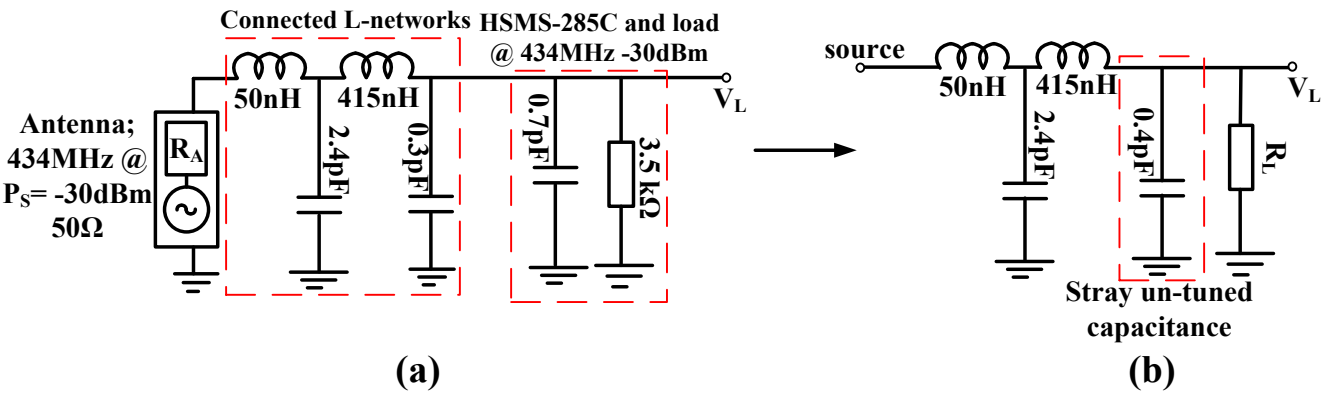

Figure 12. Measured open circuit S_{11} of the broadband circuit around 434 MHz at different input power levels from a 50 Ω source (**left**), measured open circuit input impedance at −10 dBm and −40 dBm of the broadband circuit (**right**).

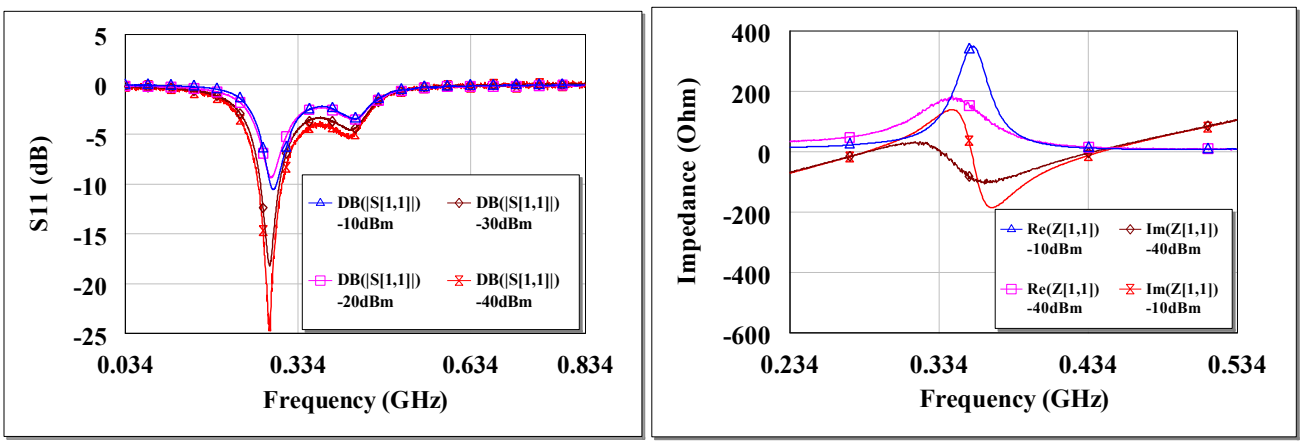

Therefore the broadband circuit is matched for Q_P* of 2.7, notwithstanding the un-tuned shunt capacitance as can be seen in Figure 11(b). Figure 12 shows the circuit S_{11} at various input power levels and input impedance at open circuit conditions. From Figure 12 (left) there is ~−5 dB return loss

from 200 MHz to 500 MHz providing an operating band of ~300 MHz. The impedance of the circuit shows resonances at ~290 MHz and ~450 MHz as shown in Figure 12(right). A third resonance occurs around 356 MHz at −10 dBm as the frequency of highest harvester input resistance (~350 Ω) and where the reactive impedances approach their extremes. Figure 12 show that a wireless EM harvester can exhibit different resonance scenarios depending on the dominant instantaneous conditions. The efficiency and voltage sensitivity of the broadband matched wireless EM harvester are shown in Figure 13. The average open circuit voltage is 47 mV and 1.1 V at −30 dBm and −10 dBm, respectively, when operating from 200 MHz to 500 MHz.

Figure 13. Measured open circuit voltage *versus* frequency sweep from 200 MHz to 500 MHz for −10 dBm and −30 dBm (**left**), measured efficiency at 17 kΩ load *versus* frequency sweep for −10 dBm and −30 dBm (**right**).

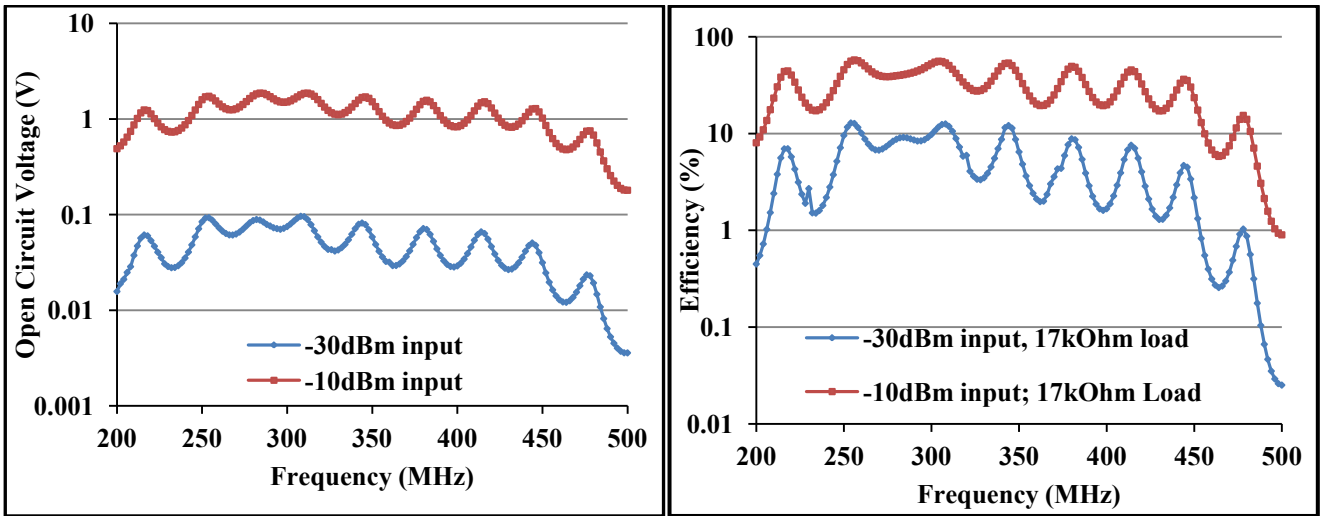

The broadband circuit achieves average efficiency of 5% at 17 kΩ load for −30 dBm and 30% at 17 kΩ load for −10 dBm input power from 200 MHz to 500 MHz. Figure 13 further confirm a direct link between frequency response and the unloaded quality factors. For Q_S* and Q_P* of ~2.7, the circuit response is broadband around 434 MHz.

2.6. High Voltage Sensitive RF to DC Converter

The current state of the art low power remote sensors would require a DC voltage supply of about 1 V and DC current of about 30 μA for operation. Therefore, the issue is not only how efficient a wireless EM harvester is in converting RF to DC power, but also what the output DC voltage and current of the EM harvester are at the RF input power level [38]. Equations (11,24) and (33) show that the maximum voltage sensitivity of a coupled resonator system or an RF to DC power converter is mostly related to the load and the source resistances at resonance. Therefore high voltage sensitive wireless EM harvester can be achieved with a diode voltage doubler with a very high input resistance relative to the antenna source without the need to cascade the diodes as in voltage multipliers. If the diodes been used for the RF to DC power conversion cannot provide high resistive impedance at the working frequency relative to the antenna source, then a DC-DC converter can be applied after the EM harvester as presented in [39] or the diodes may be cascaded by way of multipliers as presented in our

earlier work [40] and by several other authors [3,5,14]. In case of multipliers, the input voltage ought to be high enough to overcome the junction potential of the several diodes in the multiplier network. If frequency is not a constraint, then a frequency sweep *versus* impedance for the diodes can be made and the frequency where the diodes exhibits high resistive impedance can be used to realize high voltage sensitive wireless RF harvester. For Schottky diodes, high resistive impedance occurs mostly at lower frequencies (see Figure 3). The measured voltage gain of a high resistive diode pair (voltage doubler) is presented in the next results.

2.6.1. High Voltage Sensitive RF to DC Converter Results and Discussion

The presented result was L-matched using 50 Ω resistance of the antenna source and the resistance of the HSMS-286C diodes (and load). The HSMS-286C diodes do provide high resistive impedance at low frequencies; notwithstanding the flicker noise which causes its resistive (and reactive) impedance to fluctuate. The HSMS-286C has low forward junction potential (~350 mV at 1 mA) per diode and series impedance of ~1.5–j8.1 kΩ or parallel impedance of ~−*j*8.3(46.3)/(−*j*8.3 + 46.3) kΩ at 13.6 MHz for −30 dBm input. Even though the HSMS-286C diodes unloaded component quality factor at 13.6 MHz is similar to that of the HSMS-285C diodes at 434 MHz, the elevated resistive impedance at 13.6 MHz fulfills the condition for high voltage sensitivity relative to a 50 Ω antenna source at resonance conditions.

Figure 14. (**a**) L-matched impedance diagram for matching the HSMS-286C diodes at 13.6 MHz at -30 dBm input. (**b**) Resultant network, (**c**) PCB layout of the L-matched Greinacher doubler with adjusted values due to impedances provided by copper route on FR4 substrate with thickness of 1 mm. (**d**) Fabricated PCB of the L-matched RF to DC power converter.

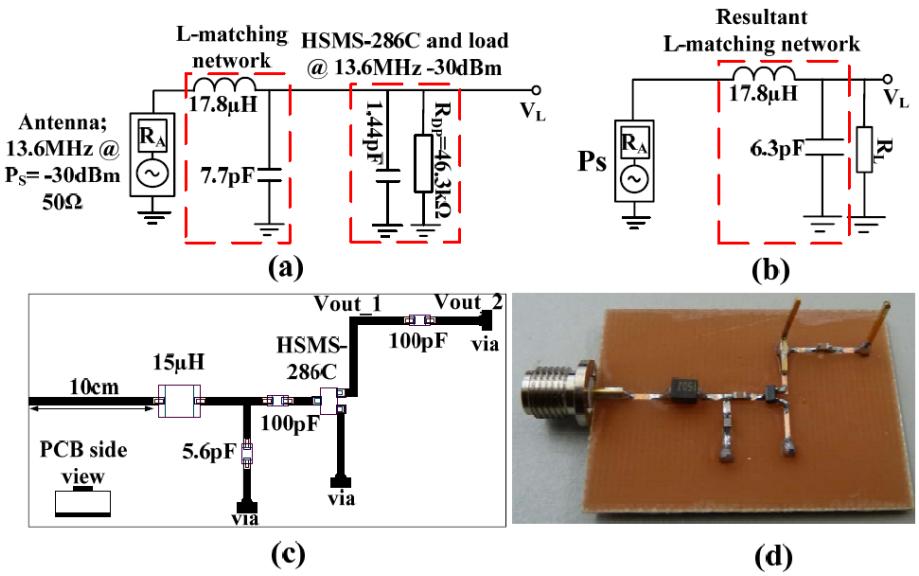

The high voltage sensitive EM harvester operating at 13.6 MHz is as shown in Figure 14. On the realized PCB is a Greinacher doubler. An inductance of 15 µH and a shunt capacitance of 5.6 pF were the adjusted values after the microstrip contributions.

The measured S_{11} and input impedance at open circuit are shown in Figure 15. There is high return loss and resonance around 13.6 MHz. The circuit input impedance at open circuit conditions is 58 Ω at resonance for both −40 dBm and −10 dBm.

Figure 15. Measured open circuit S_{11} of the L-matched HSMS-286C diodes at 13.6 MHz for different input power levels from a 50 Ω source (**left**), measured open circuit input impedance at −10 dBm and −40 dBm of the L-matched HSMS-286C diode at 13.6 MHz (**right**).

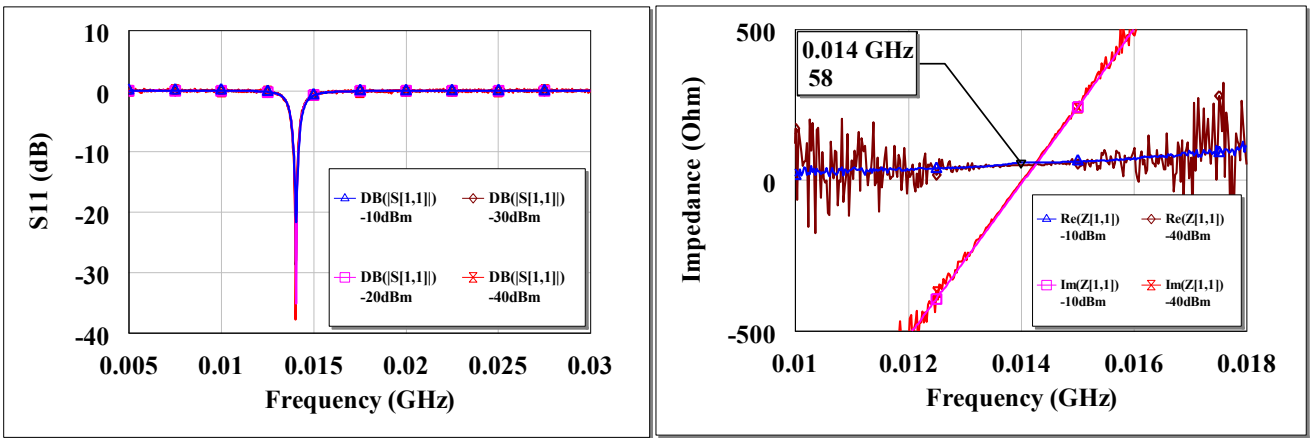

The efficiency and voltage sensitivity of the high voltage sensitive wireless EM harvester are shown in Figure 16.

Figure 16. Measured circuit efficiency *versus* load at various input power levels at 13.6 MHz (**left**), measured open circuit voltage and at 200 kΩ load *versus* input power at 13.6 MHz (**right**).

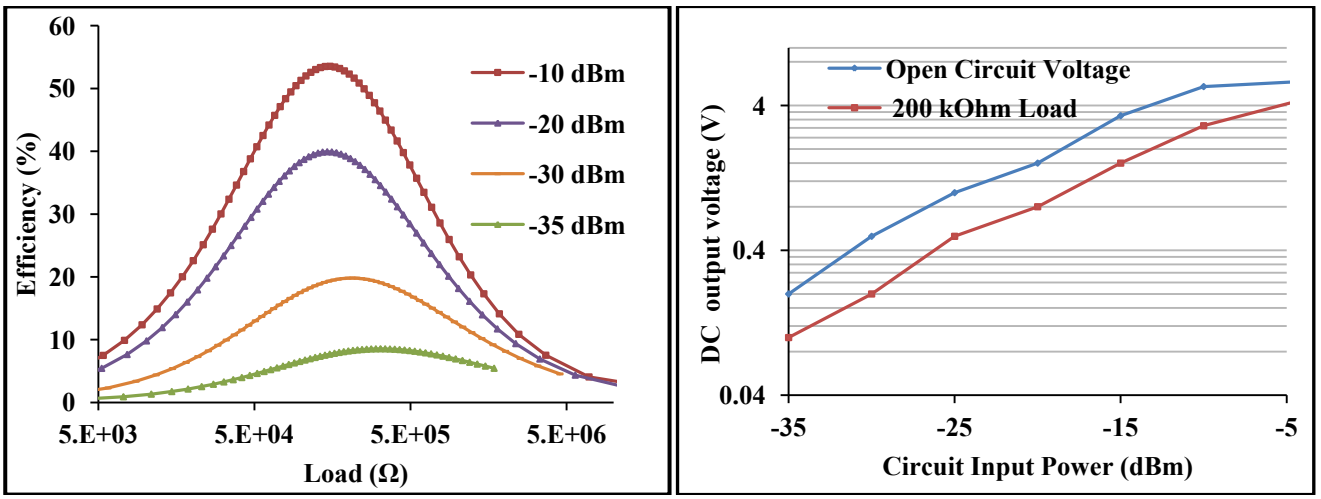

The maximum measured efficiency at −30 dBm is 20% for ~200 kΩ load and an open circuit voltage of 0.5 V. At −10 dBm, the maximum efficiency and open circuit voltage are 54% and 5.4 V respectively. At the optimal load of ~200 kΩ, the detected voltage is 0.2 V and 2.9 V at −30 dBm and −10 dBm respectively. The open circuit voltage gain is 100 at −30 dBm and 108 at −10 dBm.

Even though the RF to DC converter presented in Section 2.5.3 is the same as the L-match circuit realized with the HMSM-286C diodes at 13.6 MHz, the voltage gain is increased by a factor of 4 due to the large difference between the diodes (and load) resistance and source resistance so that at matched conditions high voltage gain occurs. The loaded Q of the L-matched circuit is 30 which results in small frequency bandwidth just like a PI-matched diode rectifier presented in our earlier work [40]. From this result and the results from our earlier presented PI-matched EM harvester, it can be inferred that all high loaded Q RF to DC circuits have high selectivity but not all highly selective RF to DC circuits have high loaded Q. The voltage sensitivity of the matched HSMS-286C diode at 13.6 MHz can be improved if its resistive impedance is not lowered by the flicker noise.

3. Wireless EM Power Harvester

A wireless EM harvester, consisting of a rectifying antenna (*rectenna*) was designed to find a compromise between size and performance of its antenna. The rectenna is shown in Figure 17.

Figure 17. Rectenna realized on a Duroid 5880, 1.57 mm substrate. (**a**) Backside of the rectenna, (**b**) cross-section of antenna output coplanar stripline dimensions (**c**) frontside of the rectenna.

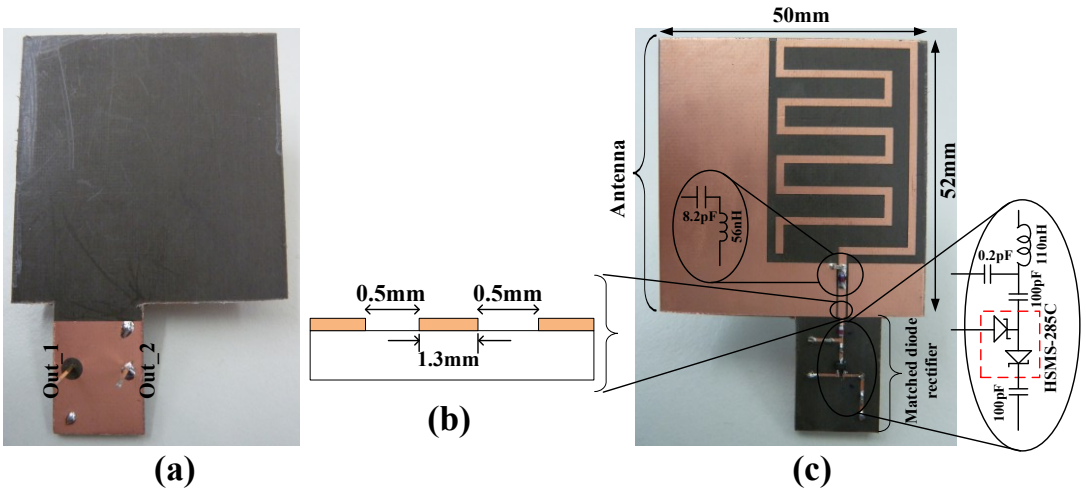

The antenna (planar) part of the rectenna is based on our earlier work [41]. In contrast to the earlier presented antenna, this rectenna is realized on a Duroid [42] substrate of thickness 1.57 mm. Duroid 5880 has lower loss tangent of 0.0004 at 1 MHz compared to 0.025 at 1 MHz for FR4. This means there is less loss in the transmission of signals on a Duroid PCB at this frequency range. The antenna part is fabricated to resonate around 434 MHz; hence its dimensions of 5 × 5.2 cm make it electrically small. The antenna is tuned with a chip inductor and a capacitor to achieve the resonance frequency around 434 MHz [Figure 17(c)]. This is done at a cost of reduced antenna radiation efficiency. An antenna is one of the few components the size of which is related to the operating frequency. Thus, if the size of an antenna is fixed, resonance frequency reduction of the antenna can only be achieved with penalty factors [10]. The antenna's output impedance is tuned with the dimensions of the coplanar stripline as shown in Figure 17(b).

HFSS [43] was used to simulate the presented antenna and to find the correct capacitive and inductive components for frequency tuning before the optimized design was fabricated. The simulated antenna resonances occur at 438 MHz and 445 MHz. At these frequencies, the radiation efficiency is 20% and a peak gain of −6 dBi. The rectifying part of the rectenna consists of L-matched HSMS-285C diodes (Figure 17(c)). The L-matched HSMS-285C part of the rectenna can be engineered to be as small as possible if required. The separate parts of the rectenna were characterized by terminating their ends and measuring the individual reflection coefficients just like the power converters presented in Section 2. Figure 18 shows the measured antenna and matched rectifier individual S_{11} and impedance. Figure 18 (left) also show the HFSS simulated S_{11} results. From Figure 18 (right), the measured antenna resonance where the input impedance is at maximum is ~434 MHz. At ~434 MHz, the antenna input resistance is 376 Ω and the reactive impedances approach their extreme (*so called anti-resonance*). The other resonance occurs when the input resistance is 'finite' and the reactive impedance is zero; at ~441 MHz. The input resistance is 57 Ω at ~441 MHz. The rectifier circuit is matched for the antenna's resistance at ~441 MHz.

Figure 18. Antenna HFSS simulated, antenna measured, and measured L-matched diode rectifier S_{11} on a Duroid 5880 PCB for −30 dBm input (**left**), Measured open circuit input impedance of antenna and rectifier at −30 dBm input (**right**).

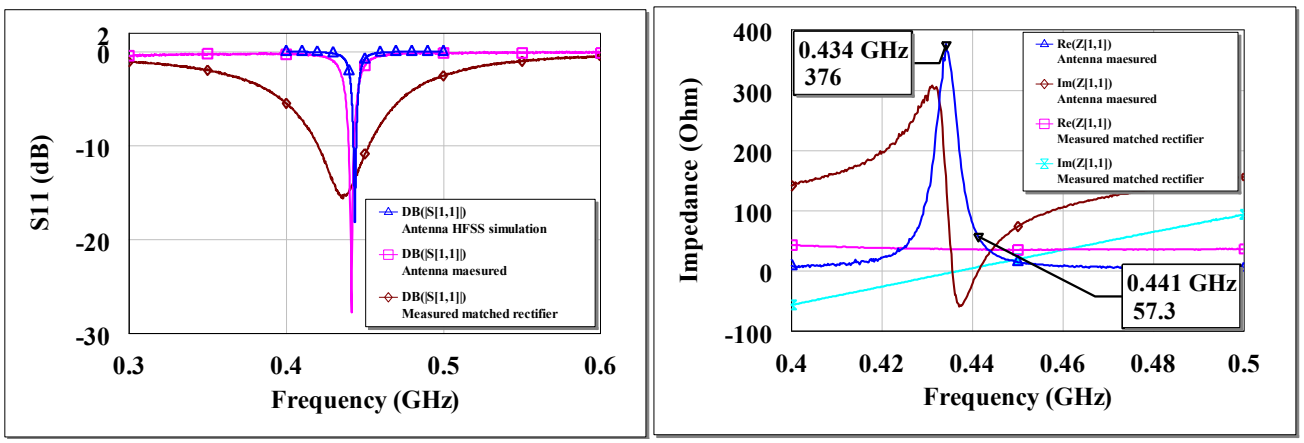

3.1. EM Range Results and Discussion

At far field between wireless EM transmitting and receiving antenna, the coupling mechanism between the transmitting and receiving antenna is neither capacitive nor inductive as is the case for the RF to DC converters. The coupling is radiative which can be described by the Friis equation of transmission on the assumption that the transmitting and receiving antenna are in free space [44]. A modified Friis equation for a transmitting and receiving antenna at far-field (R >> λ and R >> transmitting antenna largest dimension) to each other at a specified direction is given by Equation (43) [45]. Equation (43) assumes real world open space conditions:

$$\frac{P_r}{P_t} = F_{envt} G_t G_r \left(\frac{\lambda}{4\pi R} \right)^2, \tag{43}$$

where *Pr* is the power at the receiving antenna port, *Pt* is the power supplied at the transmitting antenna port, F_{envt} is a factor accounting for environmental effects as such ground reflections among others, *Gt and Gr* are the transmitting and receiving antenna gain (*at specified direction*) respectively. *R* is the distance between the transmitting and receiving antenna and λ is the wavelength of the transmitting EM wave. The rectenna receiving range measurements were carried out in an open space (*hall*) with the antennas 2 m above ground level. The transmitting and receiving antennas were arranged in the direction of their peak gain. The rectenna range performance is shown in Figure 19. According to Equation (43), the efficiency of RF power transferred between a sending and receiving antenna depends on controllable factors like the gain of the antennas in the arranged direction and the radiation efficiency of the antennas. Since the receiving/transmitting antenna's incorporated in remote harvesters for sensor powering are normally small in relation to their operating frequencies, they tend to be less efficient.

Figure 19. Rectenna receiving range performance by sending 17 dBm (50 mW) at a gain of −6 dBi at 437 MHz. Output DC voltage *versus* receiving distance for different loads (**left**), loads output power *versus* receiving distance (**right**).

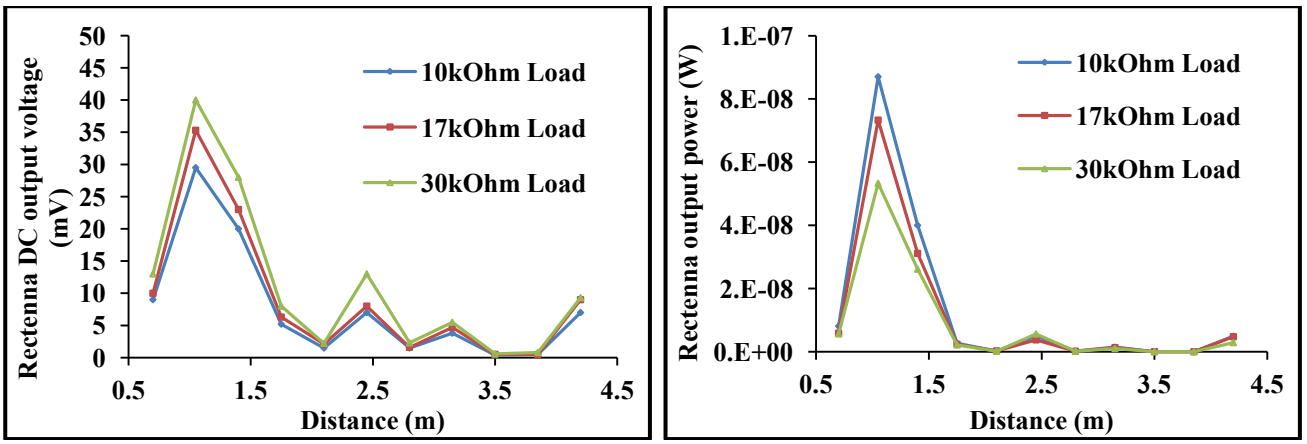

The efficiency of the rectenna's antenna is ~20% at resonance. A 'perfectly' matched RF to DC power converter operating in its square law region has efficiencies in the region of 20% as depicted in Section 2. The transmitting antenna was the same as the antenna incorporated in the rectenna. By transmitting the EM power with a small antenna (5 cm × 5.2 cm) at 437 MHz with efficiency of ~20% and at a gain of −6 dBi, the power delivered by the rectenna is generally low at far-field from the transmitter as can be seen in Figure 19. A mediocre transmitting antenna was used to transmit the EM waves due to limitations in the European Union about transmitting EM power at certain frequencies; so the goal in the rectenna range experiment is to show the lowest limit functionality of such a harvester. At 4.2 m from the electrically small transmitting antenna transmitting at 17 dBm, the rectenna harvested DC voltage and power are 9 mV and 5 nW respectively for 10 kΩ load. It can be seen from Figure 19 that the harvested voltage/power generally degrades as an inverse square of distance from transmitter as described by Friis equation. The measured received power however alternate along this R^{-2} fit as shown in Figure 19. This anomaly is accounted for by F_{envt} [Equation (43)] as influence of ground reflections and polarization in real world open field measurements [45]. For any particular distance *R*, the signals reflected from ground can be constructive with the direct signal to the rectenna,

in which case the measured power may be higher than that predicted by the original Friss equation as in [44]. The ground effect can also be destructive, in which case the measured power will be lower than what is predicted by the original Friis equation.

4. Conclusions

Optimization of Schottky diode-based RF to DC power converters using different matching techniques for wireless EM energy harvesting applications is presented. Using scattering parameters for small signal modeling, it is shown that wireless EM harvesters can be generally described as coupled resonators with efficiencies and maximum voltage sensitivity depending mostly on the source and load resistances under matched conditions. The analytical models allow systematic control in the design of passive wireless EM harvesters. Based on these analyses, a rectenna is built and tested for lower limit functionality from harvesting ambient EM waves. The analysis presented in this work may also be applied to optimize derivatives of wireless EM harvesters like RFID tags, NFC, wireless chargers *etc.*, for efficient powering of their sensors or integrated circuits. Generally, most energy harvesters and their matched loads can be described as coupled resonators and thus may be optimized with the methods presented in this work.

Acknowledgments

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Appendix A: Measuring Setup for RF Rectifier Efficiency and Voltage Sensitivity

The measuring setup is as shown in Figure A1.

Figure A1. RF to DC Power converter characterization setup.

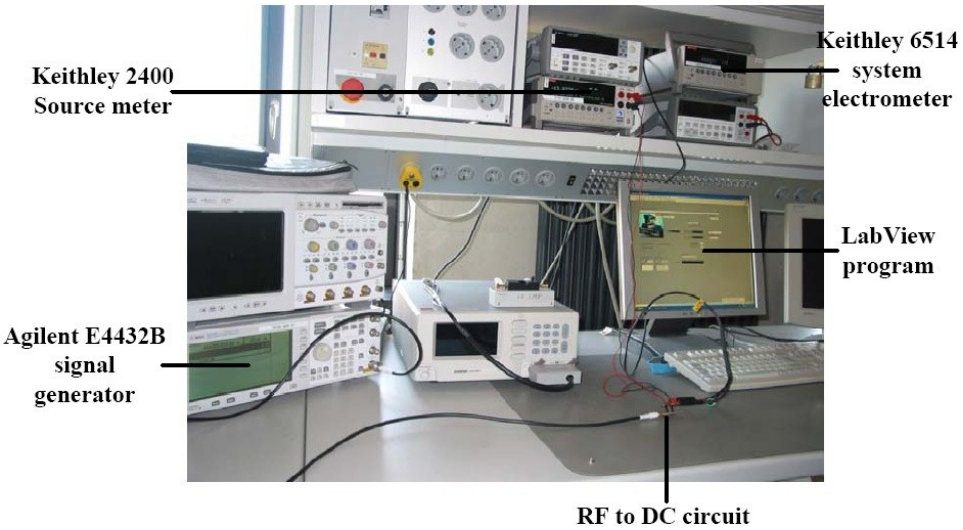

The RF to DC circuit efficiency and voltage sensitivity measurements were made with a Keithley 2400 source meter and Keithley 6514 system electrometer with an Agilent E4432B signal generator providing 50 Ω RF signal into the circuit board.

The closed circuit current drawn by the RF to DC power converter (*without load*) from the generator is first determined by the Keithley 2400 source meter; then starting from this current, the value of the current is decreased at set intervals to creates virtual load resistances to the circuit for up to a lowest current of 0.1 μA. The 6514 system electrometer is used to measure the output voltage. The number of data point is set through LabView [46] as well as the measurements. Additionally open circuit voltage or at specific loads and frequency sweep can be made through the LabView program. At −40 dBm input power and below, the detected voltages and currents were difficult to measure accurately with the measuring setup; hence measurements were made up to a minimum of -35 dBm input power. The circuit layout for the efficiency and voltage sensitivity measurements is schematically shown in Figure A2.

Figure A2. RF to DC power converter characterization circuit.

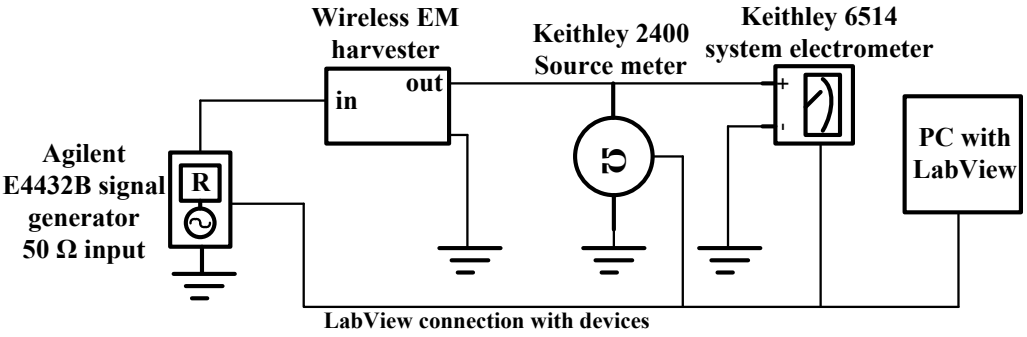

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STANDARD ANTENNA TERMS AND RELATED FORMULAS

The "IEEE Standard Definitions of Terms for Antennas" (IEEE STD-145) represents a consistent and comprehensive vocabulary suited for the effective communication and understanding of antenna theory. General use of these definitions of terms would eliminate much of the wide-spread inconsistency concerning antenna characteristics, particularly with regard to the basic parameters of gain, beamwidth, polarization and efficiency. For convenience, IEEE antenna terms of general interest are listed here. Wherever these terms appear in this catalog, the definitions given below apply. Other commonly used terms, not covered by the IEEE standard, are shown with an "*."

ANTENNA APERTURE. A surface, near or on an antenna, on which it is convenient to make assumptions regarding the field values for the purpose of computing fields at external points. **Note:** The aperture is often taken as that portion of a plane surface near the antenna, perpendicular to the direction of maximum radiation, through which the major part of the radiation passes.

ANTENNA EFFICIENCY OF APERTURE - TYPE ANTENNA. For an antenna with a specified planar aperture, the ratio of the maximum effective area of the antenna to the aperture area.

*** ANTENNA FACTOR.** That quantity by which the voltage developed across the output of an antenna is related to the incident field strength in which the antenna is immersed. **Note:** Applicable to low frequency antennas and usually refers to a 50 ohm output.

$$\mathrm{AFE}\ (\mathrm{dB\ m^{-1}}) = \mathrm{E}\ (\mathrm{dB\ V/m})\ -\ \mathrm{V}\ (\mathrm{dB\ V})$$

AFE = Electric Field Antenna Factor
E = Electric Field Strength at antenna
V = Voltage at terminals of antenna

$$\mathrm{AFH}\ (\mathrm{dB\ AV^{-1}m^{-1}}) = \mathrm{H}\ (\mathrm{dB\ A/m}) - \mathrm{V}(\mathrm{db\ V})$$

AFH = Magnetic Field Antenna Factor
H = Magnetic Field Strength at antenna
V = Voltage at terminals of antenna

$$\mathrm{AFE}\ (\mathrm{dB\ m^{-1}})\ =\ \mathrm{AFH}\ (\mathrm{dB\ AV^{-1}m^{-1}}) + 51.53$$

for a plane wave in free space.

$$\mathrm{AFB}\ (\mathrm{dB}\frac{\mathrm{pT}}{\mu\mathrm{V}})\ =\ \mathrm{B}\ (\mathrm{dBpT})\ -\ \mathrm{V_o}\ (\mathrm{dB}\mu\mathrm{V})$$

AFB = Magnetic flux Antenna Factor
B = Magnetic flux at the antenna
pT: picoTesla units
V = Voltage at the terminals of the antenna

$$\mathrm{AFB}\ (\mathrm{dB}\frac{\mathrm{pT}}{\mu\mathrm{V}}) = \mathrm{AFH}\ (\mathrm{dB}\frac{\mathrm{A}}{\mathrm{Vm}})\ +2$$

APERTURE ILLUMINATION. The field over the aperture as described by amplitude, phase, and polarization distributions.

APERTURE ILLUMINATION EFFICIENCY. For a planar antenna aperture, the ratio of its directivity to the directivity obtained when the aperture illumination is uniform.

BEAM. The major lobe of the radiation pattern.

CIRCULAR POLARIZATION. It may be either right hand circular polarization (RHCP) or left hand circular polarization (LHCP). The sense of polarization is determined by observation of the direction of rotation of the electric field vector from a point behind the source, RHCP and LHCP correspond to clockwise and counter-clockwise respectively. **Note:** RHCP transmit requires a like polarization to receive.

CO-POLARIZED. The polarization which the antenna is intended to radiate or receive. Also "like polarization".

*** CROSS POLARIZATION DISCRIMINATION (XPD).** Cross polarization discrimination is the measure of the antenna's ability to differentiate between the vertical and the horizontal polarization of an antenna. This difference, shown in relative signal level, is indicated on directional pattern envelopes (DPE's).

STANDARD ANTENNA TERMS AND RELATED FORMULAS

*** DIRECTIONAL PATTERN ENVELOPES (DPE'S).** In accordance with standard practice, radiation characteristics in any given plane of polarization are measured and plotted using 360-degree polar coordinate systems. The resultant Directional Pattern Envelope is the smoothed composite of all these measurements. The purpose of these DPE's is to emphasize the worst composite condition.

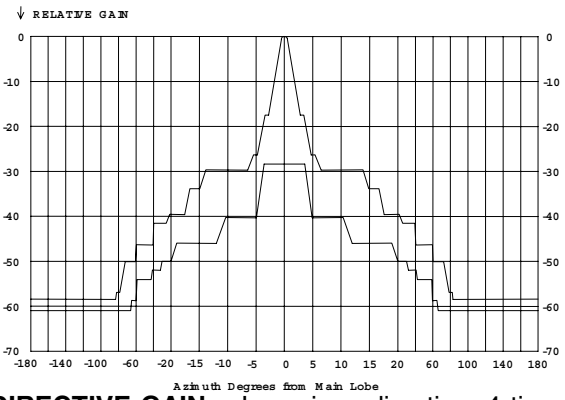

DIRECTIVE GAIN. In a given direction, 4 times the ratio of the radiation intensity in that direction to the total power radiated by the antenna.

DIRECTIVITY. The value of the directive gain in the direction of its maximum value.

EFFECTIVE AREA OF AN ANTENNA. In a given direction, the ratio of power available at the terminals of a receiving antenna to the power per unit area of a plane wave incident on the antenna from that direction, polarized coincident with the polarization that the antenna would radiate.

FAR FIELD REGION. That region of the field of an antenna where the angular field distribution is essentially independent of the distance from a specified point in the antenna region.

*** FRONT-TO-BACK RATIO**. The ratio of the maximum directivity of an antenna to its directivity in a specified rearward direction.

*** Gain, dBi**. The gain expressed in decibels relative to an isotropic radiator that is linearly polarized.

$$G(dBi) = 10\log(G) \qquad G = 10^{\frac{G(dBi)}{10}}$$

*** GAIN, dBic**. The gain expressed in decibels relative to an isotropic radiator that is circularly polarized.

HALF-POWER BEAMWIDTH. In plane containing the direction of the maximum of a beam, the angle between the directions in which the radiation intensity is one half the maximum value of the beam.

HALF-WAVE DIPOLE. A half wavelength antenna, center fed so as to have equal current distribution in both halves. Mounted vertically, it has a doughnut shaped pattern, circular in the horizontal plane. It is an antenna that can be constructed. It has some inherent losses. When used as a gain reference, the half-wave dipole has a power gain of about 1.7 dBi.

*** ISOLATION.** Refers to the ability of one port of a dual polarized feed to discriminate against a signal fed into the other port.

ISOTROPIC RADIATOR. A hypothetical antenna having equal radiation intensity in all directions. Note: An isotropic radiator represents a convenient reference for expressing the directive properties of actual antennas.

NEAR-FIELD REGION. The spherical region of space between the antenna and the far field region.

NULL. The region of a radiation pattern, either computed or measured, where the amplitude goes through a minimum value. Note: (1) It represents the angular position where the phase or the far field pattern crosses the zero axis if the pattern is plotted as a phasor instead of a scalar value. Note: (2) The region outside the main beam of a directive antenna pattern consists of a series of minor lobes separated by nulls.

PARALLEL POLARIZATION. The condition where the electric vector is parallel to the local conducting surface. Note: Over the earth, this is usually referred to as being horizontal polarization.

PHASE CENTER. The location of a point associated with an antenna such that, if it is taken as the center of a sphere whose radius extends into the far-field, the phase of a given component over the surface of that radiation sphere is essentially constant, at least over the portion of the sphere where the radiation is significant.

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STANDARD ANTENNA TERMS AND RELATED FORMULAS

POLARIZATION. The polarization of an antenna is defined as the polarization of the electromagnetic wave as described by the shape and orientation of an ellipse, which is the locus of the extremity of the field vector, and the sense in which the ellipse is traversed with time. The elliptical locus is called the polarization ellipse and the wave is said to elliptically polarized. Circular polarization and linear polarization are degenerate cases of elliptical polarization.

POWER DENSITY AT A POINT

$$S_{av} = \frac{GP_t}{4\pi r^2}$$

S_{av} = Time average power density in W/m^2
P_t = Power transmitted in watts
G = Antenna gain relative to an isotrope
r = Distance from antenna to point in meters

POWER DENSITY TO VOLTS/METER IN FREE SPACE

$$E^2 \ (V / m) = 377 \ S_{av} \ (W / m^2)$$

$$S_{av} \ (W / m^2) = E^2 \ (V / m) / 377$$

$$1 \ V / m = 2.65 \ mW / m^2$$

POWER GAIN. In a given direction, 4 times the ratio of the radiation intensity in that direction to the net power accepted by the antenna from the connected transmitter. **Note:** (1) When the direction is not stated, the power gain is usually taken to be the power gain in the direction of its maximum value. (2) Power gain does not include reflection losses arising from mismatch of impedance.

POWER GAIN IN PHYSICAL MEDIA. In a given direction and at a given point in the far field the ratio of the power flux per unit area from an antenna to the power flux per unit area from an isotropic radiator at a specified location with the same power input as the subject antenna.

Note: The isotropic radiator must be within the smallest sphere containing the antenna. Suggested locations are antenna terminals and points of symmetry, if such exist.

POWER GAIN REFERRED TO A SPECIFIED POLARIZATION. The power gain of an antenna, reduced by the ratio of that portion of the radiation intensity corresponding to the specified polarization to the radiation intensity.

POWER TRANSMISSION FORMULAS

$$P_r = P_t \frac{G_t G_r \lambda^2}{(4\pi r)^2}$$

$$P_r \ (dB \ W) = P_t \ (dB \ W) + G_t \ (dBi) + G_r \ (dBi) - 20 \log r - 20 \log f + 27.56$$

$$P_r \ (dB \ W) = P_t \ (dB \ W) - AFE_t \ (dB \ m^{-1}) - AFE \ (dB \ m^{-1}) - 20 \log r + 20 \log f - 32$$

P_r = Power received
P_t = Power transmitted
G_r = Gain of receiving antenna
G_t = Gain of transmitting antenna
f = Frequency in MHz, λ = Wavelength
r = distance between antennas in meters
AFE_r = AFE of receiving antenna
AFE_t = AFE of transmitting antenna

RADIATOR. Any antenna or radiation element that is a discrete physical and functional entity.

RADIATION, ELECTROMAGNETIC. The emission of energy in the form of electromagnetic waves.

RADIATION INTENSITY. In a given direction, the power radiated from an antenna per unit solid angle.

RADIATION LOBE. A portion of the radiation pattern bounded by regions of relatively weak radiation intensity

RADIATION PATTERN (ANTENNA PATTERN). A graphical representation of radiation properties of the antenna as a function of space coordinates. **Note:** (1) In the usual case the radiation pattern is

determined in the far-field region and is represented as a function of directional coordinates. (2) Radiation properties include power flux density, field strength, phase, and polarization.

*** RADIATION RESISTANCE OF AN ELECTRICALLY SMALL LOOP ANTENNA.** The resistive component of an antenna's input impedance that results from the coupling of the antenna to its environment. This resistance dissipates the power that is actually radiated from the antenna.

$$R_r = 20\,(2\pi/\lambda)^4\, n^2 A^2 \text{ ohms}$$

n = number of turns
A = area of the loop

REALIZED GAIN. The power gain of an antenna in its environment, reduced by the losses due to the mismatch of the antenna input impedance to a specified impedance.

*** REALIZED RADIATOR EFFICIENCY.** The efficiency of an antenna in its environment reduced by all losses suffered by it, including: ohmic losses, mismatch losses, feedline transmission losses, and radome losses.

RELATIVE POWER GAIN. The ratio of the power gain in a given direction to the power gain of a reference antenna in its reference direction. **Note:** Common reference antennas are half-wave dipoles, electric dipoles, magnetic dipoles, monopoles, and calibrated horn antennas.

RETURN LOSS. The reflection coefficient of a mismatch expressed in decibels. **Note:** Modern swept VSWR techniques actually sense the reflected component which is normalized to the forward component to yield return loss. A 2:1 VSWR is equivalent to 9.5 dB return loss.

VSWR. The voltage standing wave ratio of a component such as an antenna. It is referred to the characteristic impedance of the transmission line being used. **Note:** The most common characteristic impedance is 50 ohms, but 75 and 300 ohms are frequently used in coaxial or twin lines for VHF, UHF applications.

NOTES:

THE HANDYMAN'S GUIDE TO OSCILLOSCOPES (Part 2 of 2)

by Paul Harden, NA5N

Making some advanced measurements with your Oscilloscope

Print as .pdf file
4 pages
8½ x 11 or A4

In Part 1, oscilloscope operation was covered for making basic voltage, time and frequency measurements. In this part, we'll continue with some more advanced uses of a scope, and in particular, how to use a scope for testing and troubleshooting ham radio QRP transceivers in the homebrewer's workshop.

Receiver Filter Bandwidth.

This procedure uses a scope (a DVM can be used with less accuracy) for determining the overall filter bandwidth (or selectivity) of a receiver. It is basically measured by plotting output voltage vs. audio frequency to construct a picture of the filter response.

Connect scope to the receiver audio output (speaker or phone jack); measurement will be based on peak-to-peak voltages (Vpp) on a scope, or rms voltage (Vrms) on a DVM.

Using a signal generator, set the frequency for the band of interest on your radio. For example, on a general coverage shortwave receiver, you might set it for 10 MHz (top end of the 31M band), or perhaps to 7.040 MHz on a 40M ham radio receiver/transceiver. Tune the receiver to the signal generator signal. If you don't have a signal generator, you can also tune to a steady carrier or station to produce a hetrodyne audio "pitch." Tune in the signal to the pitch that causes the maximum peak-to-peak display. Adjust the scope and volume control to produce a 2Vpp display (4 divisions). This is the peak response of the overall filtering stages as shown in **Fig. 13**.

Now determine the audio frequency at this peak response by measuring the time period between cycles and covert to frequency. In the example to the right, the period of one cycle is 1.7mS, which is an audio tone of 750Hz (1/.0017sec). A frequency counter on the output can also be used.

Next, tune the receiver such that the sidetone pitch goes UP in frequency and the peak-to-peak signal will decrease in magnitude. Tune to the point where the signal is exactly 1Vpp on the scope. See **Fig. 12**.

This is the –6dB point of the high end of the filter (20log 1v/2v =–6dB). Determine the frequency of the audio pitch as before. In the example, this is 1100 Hz. Record the data.

From these two data points, the –6dB bandwidth can be estimated. The bandwidth from the filter peak (750 Hz) to the –6dB point (1100 Hz) is 350 Hz. The bandwidth (BW) between the two –6dB points is usually twice this value, or 700 Hz. A filter with a –6dB BW of 700Hz is a mediocre filter for CW reception, and way too narrow for SSB or AM.

Of course you can determine the exact –6dB BW by tuning the receiver back to the 2Vpp peak response, and continue tuning DOWNward in frequency until the audio is again exactly 1Vpp. Determine this frequency and record. In this example, it should occur around 400 Hz if the filter shape is symmetrical.

Plot these three data points on a sheet of graph paper as shown in **Fig. 15** to construct the filter shape. Return to the upper –6dB point (1100Hz in the example) and continue tuning upwards in audio pitch, recording the frequency at 0.5v (–12 dB), 0.25v (–18 dB), 125mV (–24 dB), etc. Everytime you "halve the voltage," it is a 6 dB change. The more points you collect, the more accurate your filter response plot will be.

Fig. 13 – Displaying Filter Peak Response

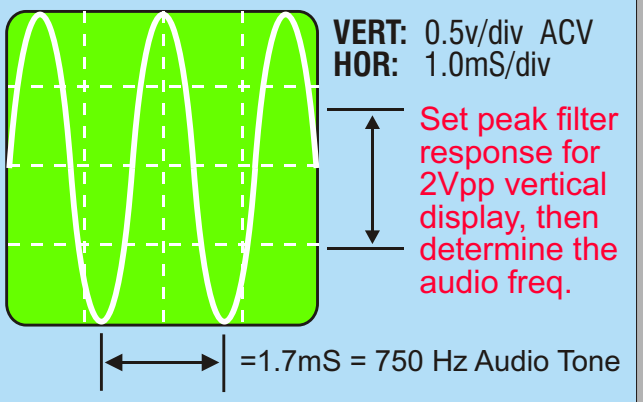

Fig. 14 – Displaying –6dB Frequency

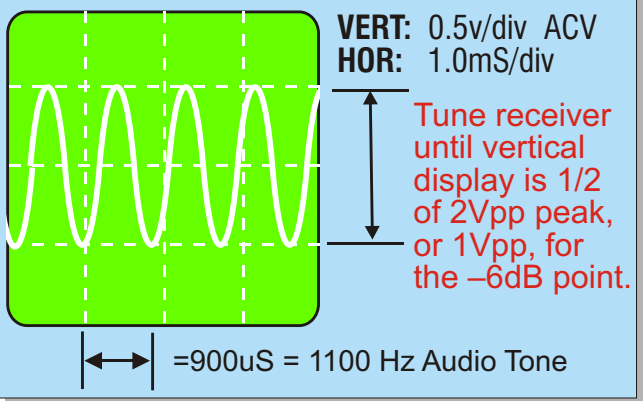

Of interest to proper rig alignment is to repeat the above using the output of the product detector. To maximize the effectiveness of the filtering, the receive offset frequency set by the BFO should be adjusted to the same frequency as the peak frequency response of the audio. In this example, with the peak audio response occuring at 750Hz, if your BFO is set for a sidetone frequency of 700 Hz, you are loosing 2–3 dB, since this is in your filter skirt. This is shown on the response plot in **Fig. 15** by the dashed lines. By adjusting your BFO for a sidetone frequency of 750 Hz, you will pick up 3-4dB of overall gain in your receiver, plus increase the selectivity a bit as well. Why? Because nearby stations, such as one at 800–900Hz tone, could actually be louder than the 700Hz tone signal you are trying to copy, since the gain of the receiver is greater at those tones than at 700Hz, as shown in the plot.

Fig. 15 – Plotting Audio Response

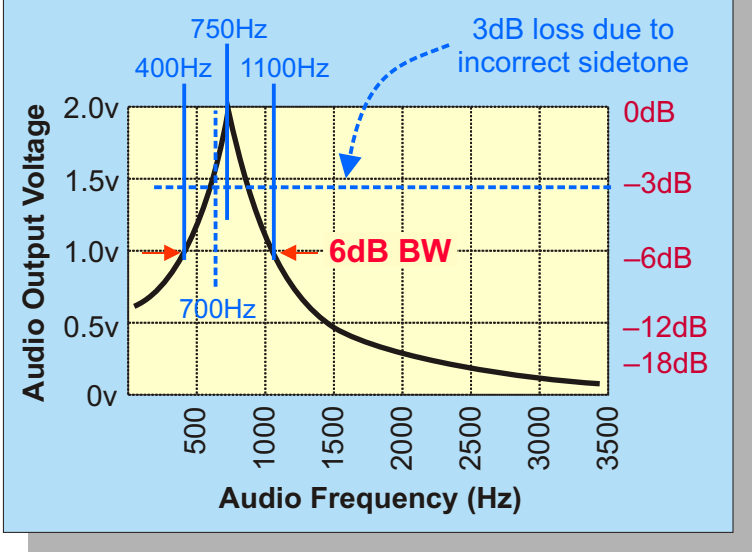

Opposite Sideband Rejection

A superhet receiver is supposed to pass just one sideband and reject the other. Poor opposite sideband rejection could indicate the crystals in your IF filter are not well matched or other problems. It is measured almost identical to plotting the filter response just described. First, you tune the receiver to the test signal to find the peak response frequency, or 750Hz in this example. Set the scope display for 2Vpp. Now tune downward in audio pitch, passing zero-beat, and continue tuning and you should hear the test signal, much weaker, now rising again in tone. This is the *opposite sideband*. Measure the peak-to-peak voltage, if you can. For example, say it is 80mVpp, as shown in **Fig. 16**. Calculate the opposite sideband rejection by:

$$\text{rejection} = 20\log\frac{80\text{mV}}{2.0\text{v}} = \frac{80\text{mV}}{2000\text{mV}} = -28\text{dB}$$

If you can't hear the opposite sideband, then obviously you have excellent filter rejection. If you can just barely hear it, you may have to increase the sensitivity of your scope (set vertical gain to 20 or 50 mV/div). In this example, –28dB rejection of the opposite sideband is quite good. A –30dB rejection means the opposite sideband is only 1/1000th of the desired sideband, a very suitable attenuation of the opposite sideband.

Fig. 16
Calculating Opposite Sideband Rejection

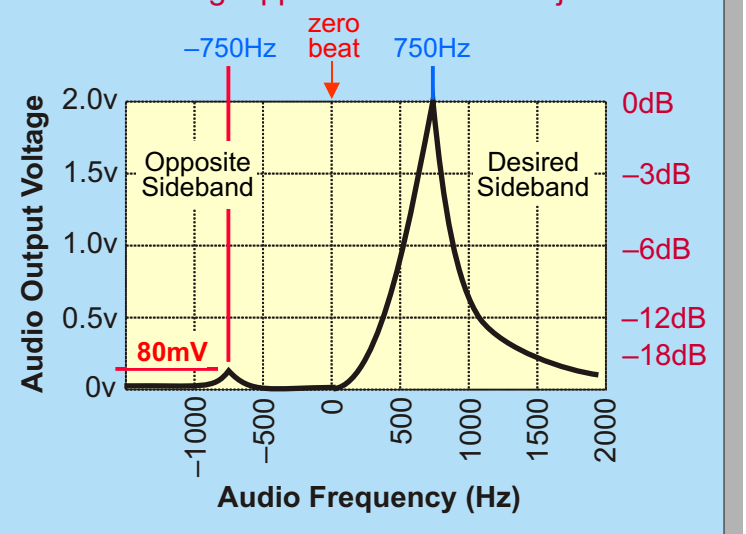

These tests are important to perform on your rig for documenting it's current performance, and repeated periodically to detect unfavorable changes or for troubleshooting when a problem is evident. For homebrewing, these tests can allow you to evaluate different circuits or when experimenting with different components or part values.

Oscillator Phase Noise

When homebrewing a basic oscillator circuit, such as a VFO, looking at the oscillator output on a scope can reveal several problems. One is to check for excessive phase noise. Phase noise is small variations of the oscillator frequency that causes power in the close-in sidebands, usually measured on laboratory equipment within 100KHz, or even within 10 KHz.

To check for oscillator phase noise, connect the oscilloscope to the oscillator output, loading the output of the oscillator as little possible. Most scopes have sufficiently high input impedances where this shouldn't be a problem, but some cheaper scopes can load an oscillator circuit. If you suspect your scope is loading the oscillator, couple the scope to the circuit with a small value capacitor, less than 20pF.

Display 2–3 cycles of the oscillator output as shown on the scope display shown in **Fig. 17**. Properly focus the scope and carefully observe if the waveform appears in focus at the peaks, but slightly out-of-focus at the zero-crossing points, that is, on the rising and falling edges of the sine wave.

Fig. 17 – Checking Oscillator Phase Noise

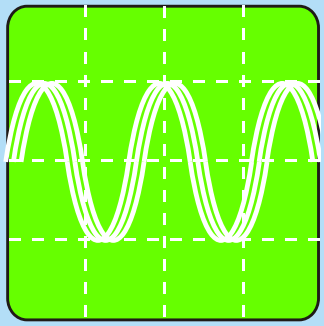

If it appears out-of-focus, this is excessive phase noise jittering the signal and "smearing" the waveform along the time (horizontal) axis. Extreme phase noise may show 2-3 sine waves very close to each other, as shown in the exagerated waveform to the right — assuming you have your scope properly triggered.

Phase noise is random, instantaneous changes in the oscillator frequency that smears the display. If you can see this on a scope, the phase noise is excessive! If you can't see it, it doesn't mean the oscillator has no phase noise (all oscillators have some phase noise), it just means it is not excessive enough to see on a scope. A scope is not a good instrument for checking phase noise, but for homebrew circuits, it is a check to ensure you do not have a serious oscillator problem.

Excessive oscillator phase noise in receivers can cause IMD products and noise in the audio range at the output of the mixer(s), including the product detector. In a transmitter, excessive oscillator phase noise will put power in the close-in sidebands of your carrier, not only wasted power for lower transmitter efficiency, but may produce strange sounds (buzzing or chirping) to the receiving station. A few causes of phase noise are excessive current in the oscillator transistor, low-Q coil(s), high dissipation in the tuning caps or poor power supply filtering at the oscillator frequency.

AM (Amplitude) Noise

Another oscillator problem may be AM noise, or amplitude modulated noise. It is an opposite effect on a scope when displaying the oscillator output — the sine wave appears out-of-focus or thicker at the peaks, and in-focus elsewhere as shown in **Fig. 18**.

If you detect AM noise, slow down the scope's sweep rate to the audio frequencies or slower to see if you can notice a lower frequency component. A common cause of AM oscillator noise is 60 Hz from the power mains leaking into the circuits. This is particularly true if using a power supply off of 120v 60 Hz, or sometimes it can be due to the AC lighting above your head! If the AM noise seems to be at the same frequency as the audio output tone, it means audio is getting into the Vcc bus, likely due to poor bypass filtering at the audio amplifier stages (particular if using an LM386 or similar).

Fig. 18 – Checking for AM Oscillator Noise

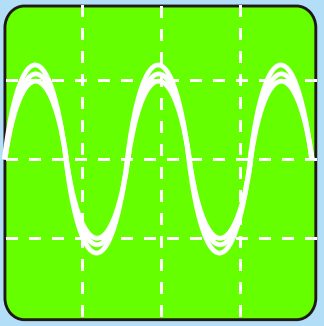

If you can't find a low frequency component, the AM noise may be random, which may indicate poor voltage regulation, a noisy voltage regulator, or perhaps a circuit in VHF oscillation. If the AM noise seems to occur on key-down only on a transmitter, the transmit current may be loading the power supply, the voltage regulator is under-rated, or just simply loading the oscillator. In the case of loading the power supply or regulator(s), perhaps a separate voltage regulator or zener circuit should be used, dedicated for the oscillator(s). In the case of transmit loading, adding a buffer amplifier or emitter follower to isolate the load from the oscillator may help.

Much of this can be diagnosed also with the scope, by looking at the AC ripple on the DC power lines. You should have less than 50mV of any AC component on the 8-12v DC wiring, whether 60Hz, audio or RF. If >50mV, then additional low or high frequency filtering on the DC power is needed.

Monitoring Transmitter RF Output

RF Power (in watts) is E^2/R, where E is in rms and R=50 . The voltage displayed on the scope (peak-to-peak) must be converted to rms by Erms=.707(Epp/2). To measure properly, the transmitter should be on a 50 dummy load using the normal hi-Z scope input. If your scope has a selectable "50 "input, it can be the transmitter dummy load directly, providing it can tolerate the 50Vpp input. (Always know what the maximum p-p input voltage your oscope will tolerate. It is often stated on your scope at the vertical channel inputs. 50Vpp to 100Vpp are typical).

Measuring Transmitter RF Output Power

Figure 19 shows how you can use an oscilloscope to fairly accurately measure output power from a low power transmitter (generally 10W or less with a 1X probe and 20-30W with a 10X probe). Connect transmitter output to a 50 dummy load. Connect the scope lead to the transmitter output (after the low pass filters) or directly to the dummy load. Do not connect the scope leads to the collector or drain of the final PA transistor. The displayed voltage in this case will be erroneous.

In the example, the output transmit voltage across the dummy load measures 24Vpp. Convert this voltage to Vrms, then use the equation (Vrms squared divided by the load resistance) to calculate the power in watts. In the example, 24Vpp, the output power is 1.4 watts. A 5W QRP transmitter should produce about 45Vpp.

The accuracy of your power measurements depend upon the condition of your oscilloscope:

1) Ensure your scope's vertical sensitivity (volts/division) is properly calibrated (see Part I)
2) Ensure your vertical sensitivity is properly calibrated with the 1X or 10X probe you are using.
3) Ensure that the transmitter frequency is well within the bandwidth of your scope. A 100 MHz scope should give reliable readings on all HF bands. A 50 MHz scope should be reliable on all HF bands except slight errors at 28MHz.

Fig. 19 –Oscilloscope as a Power Meter

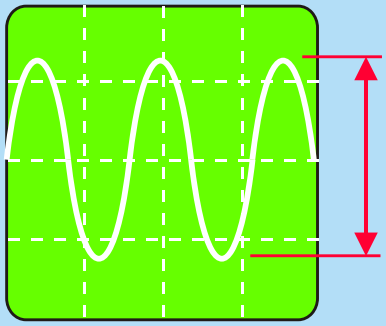

1. Measure output voltage. 24Vpp
2. Convert Vpp to Vrms
   Vrms=.707(Vpp/2) 8.5Vrms
3. Calculate power in watts

$$\frac{Vrms^2}{R} = \frac{8.5v^2}{50} = 1.4W$$

Checking Transmitter Purity

Phase Noise of the transmitter is measured identically to the phase noise checks on page 2–3. With the scope properly triggered and focused, you are looking for an out-of-focus "fuzziness" around zero crossing. If it appears phase noise exists, the fault is generally at the beginning of the transmit chain. That is, seldom does the PA transistor add phase noise; it's merely amplifying what it is given. Phase noise on the transmitter output is more likely due to the transmit oscillator, or the transmit mixer if used.

Harmonic Power can also be detected on a scope while looking at the transmitter RF output power. In **Fig. 20**, notice the "dips" or the two "peaks" on the top and bottom of each sine wave. This is caused by excessive 2nd harmonic output power. The rule-of-thumb is – if you can see any 2nd harmonic power (a dip or flattening at the peaks), then you are right at or exceeding the –30dBc FCC harmonic specification. A clean sine wave implies FCC compliance, providing the 2nd harmonic is within your scope's bandwidth. Obviously, a spectrum analyzer should be used for accurate harmonic evaluation, but a scope can be used to indicate if you have a problem. If you build your own transmitter, it is your responsibility to ensure it is compliant. An approximate method of estimating 2nd harmonic attenuation is shown.

–30dBc means the 2nd harmonic power is 1/1000th of the fundamental power. For a 5W transmitter, this means the 2nd harmonic power should be 5mW or less, or about 1Vpp. In displaying a 5W signal on a scope (45Vpp), it would be difficult to resolve much less than a 1Vpp dip or ripple.

Fig. 20 –Checking 2nd Harmonic Power

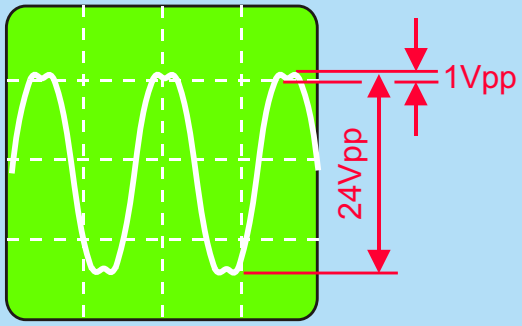

1. Measure output voltage. 24Vpp
2. Measure ripple voltage. 1Vpp
3. Calculate dBc of 2nd harmonic ripple

$$20\log\frac{V2}{V1} = 20\log\frac{1v}{24v} = -27.6\ dBc$$

or, not quite FCC compliant!

Conclusion. This concludes the NA5N "Handiman's Guide to Oscilloscopes." Hopefully, it has helped you to understand your oscilloscope to make simple measurements, and with some practice, perform the more advanced measurements discussed. An oscilloscope is a very powerful tool that is invaluable on the homebrewer's workbench. If there is a particular measurement you feel I omitted, please let me know and I will add it when time permits.

73, Paul Harden, NA5N (na5n@zianet.com or pharden@nrao.edu)

THE HANDYMAN'S GUIDE TO OSCILLOSCOPES (Part 1 of 2)

by Paul Harden, NA5N

Print as .pdf file
5 pages
8½ x 11 or A4

Getting Acquainted with your Scope and making some measurements

Updated May 2004 *with actual oscope waveforms*

When in the course of human events, it becomes necessary to look at neat signals floating around your radio, you go to a hamfest and buy that $50 o-scope. Now what? This two part article will attempt to explain basically how an oscilloscope works, operator functions, basic measurements, and some advanced applications. An o-scope is a powerful tool in any shack – even a real "cheapie" with limited bandwidth.

HOW AN OSCILLOSCOPE WORKS

A block diagram of a typical o-scope is shown in **Fig. 1**. The test probe usually plugs into the scope via a BNC connector, then passes through a switch to determine whether the input signal will be dc or ac coupled (to remove any dc component). Often this switch will have a "ground" position for setting the zero-volts reference. Next is the input attenuators. The vertical input amplifier is quite sensitive, designed for 20-50mV of input. For larger input voltages, the signal is applied to attenuators comprised of simple voltage dividers. This is the first area of concern for cheap o-scopes, as the input attenuators may not be very linear or accurate. For example, if you appy a 10Vpp signal on the 10v/division setting, the signal should be 1 division high. Switching to 1v/div., the signal should be 10 divisions (usually full-scale) high. If it is not exactly 10 divisions, the attenuator for that setting needs adjusting. Some scopes have internal adjustments for fine-tuning each attenuator setting.

Following the attenuators, the signal is applied to the first vertical amplifier, which converts the input to a differential signal. This differential signal is amplified up to high voltages for the oscilloscope deflecting plates – moving the beam up and down (in the vertical axis).

The sweep generator is usually a constant current source charging a capacitor to make a sawtooth waveform that eventually deflects the beam in the horizontal axis. The frequency of the sawtooth determines how fast the beam travels from the left to the right side of the tube, and is controlled by the sweep control, usually calibrated in seconds, milli-seconds or micro-seconds per division. This is the second area of concern for an oscilloscope – how linear the sawtooth waveform is generated. For example, a sawtooth with a nonlinear ramp will cause the signal displayed in the central portion of the tube to be expanded or compressed compared to the signal at the ends.

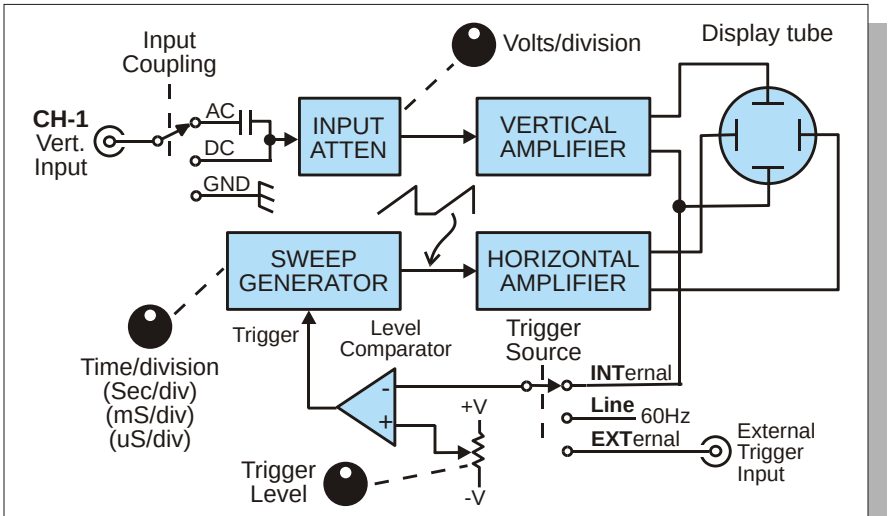

FIG. 1 - Basic block diagram of an Oscilloscpe

The sawtooth ramp is amplified to high voltages, applied to the oscope tube, to deflect the beam from left to right. An important task of an oscope is when the horizontal deflection begins. Normally a switch labeled "Trigger Source" determines what initiates the sawtooth ramp. In the "Internal" position, a sample of the input signal (in the vertical amplifiers) is sampled, with a variable resistor setting the level. When the input signal exceeds the "Trigger Level," a pulse is generated to start the sawtooth ramp and hence the horizontal sweep. The purpose of triggering is to keep the input waveform synchronized to the sweep so it appears stationary on each sweep. The trigger source usually has a "Line" position, which simply triggers the sweep off of 60Hz from the power supply. This synchronizes the sweep to the AC power frequency and is useful for checking television signals, which are synchronized to the power mains. Also, an "External" position may be present, which connects an external input signal (via a BNC connector) to trigger the sweep generator.

Other features your oscope may have are two vertical channels for dual trace operation, various modes to display both waveforms (alternate, chopped, A+B added, etc.), delayed sweep features, dual sweep time bases, built in calibrators, etc.

CALIBRATING YOUR OSCILLOSCOPE

The first thing you should do upon acquiring an o-scope is to check its calibration.

The vertical amplfiers can be checked with a known voltage source or 9v transistor radio battery. Measure the output voltage of the battery with an accurate voltmeter. Let's say it just happens to be +9v exactly. Set the input coupling to ground (0v) and move the trace to the bottom division. Switch the input coupling to DC and set the attenuators to 1v/div. The deflection should be 9

divisions. Switching to 10v/div., deflection should be 0.9 divisions. Internal to the oscope (or perhaps accessible from the outside) are adjustments for the vertical amplifier gain. Adjust this for 9 divisions of deflection in the 1v/div. range. Procedure can be repeated with a 1.5v flashlight battery (assuming you know the exact voltage from a DVM).

The horizontal amplifiers should be checked/calibrated using a signal generator. For example, a 1MHz signal has a period of 1uS. Setting the sweep rate to 1.0uS/div., a 1MHz signal should take exactly 1 division per cycle. Set the horizontal width control properly to ensure the beam starts at the first division and ends at the last division. If the sweep rate appears incorrect, an internal adjustment (Sweep gain or similar) can be set for proper display of the test signal.

The main operator controls are:

- **Intensity** - controls the brightness of the beam. **NOTE: Too bright a beam can damage to the CRT tube!**
- **Focus** - adjusts the beam for the thinnest and sharpest display.
- **VERT & HOR Position** - controls the vertical and horizontal position of the display respectively
- **VERT V/div** - controls the vertical sensitivity of the display, i.e., how many volts (or mV) per division.
- **HOR Sweep Speed** - sets the horizontal sensitivity, i.e., how many mS or uS per division.
- **VERT & HOR vernier** - allows the vertical and horizontal sensitivity settings to be varied in small steps.

Other adjustments you may find on your scope are:

Astigmatism - With the scope intensity and focus properly set, this adjustment compensates for the curvature of the CRT tube by making it in-focus across the sweep. If your trace is out-of-focus in certain areas, but in-focus elsewhere, the astigmatism needs to be adjusted. See ***Fig. 2***.

Trace Rotation - is a small coil around the CRT that skews the trace to ensure it is perfectly horizontal. On scopes without this adjustment, the trace is leveled by physically rotating the CRT to align the trace to the graticle grid. See ***Fig. 2***.

DC BAL (DC Balance) - is a dc offset in the vertical amplifiers that causes a shift in the trace baseline when changing vertical scales. It is most obvious when measuring ac voltages. For example, you are displaying a 10Vpp sine wave, centered on the center graticle, at 2v/div. Changing to 5v/div, the sine wave shifts off the center graticle ... that is, it assumes a dc bias error. The DC BAL is adjusted until the shift no longer occurs when changing vertical scales.

HV ADJ. - is the high voltage that controls the intensity of the trace. Turn up the **Intensity** control to its brightest position, then adjust the HV ADJ for a trace slightly brighter than normal intensity. The **Intensity** control now has the proper range. The HV ADJ might have to be re-adjusted to acquire proper focus.

NOTE: Very bright trace displays can cause permanent damage to the CRT, particularly on a well-used scope.

Fig. 2 – Effects of Astigmatism & Trace Rotation

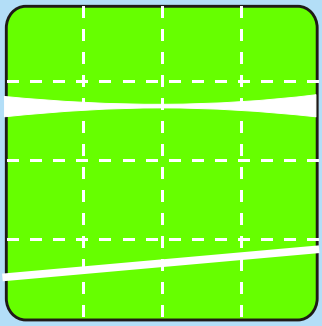

LET'S MAKE SOME MEASUREMENTS

It is assumed you have your scope relatively calibrated and familiar with the front panel controls. The sample o-scope displays are based on eight vertical and ten horizontal divisions on the CRT screen, typical to most oscilloscopes. Most waveforms are actual displays of the signal cited, photographed from my trusty Tektronix 475 oscilloscope.

First ... a word on TRIGGERING.

Most oscilloscopes have a knob or two for "Triggering." This tells the oscilloscope when to start the sweep. When the **Triggering Slope** is placed in the **(+)** position, the scope will begin its trace when the *input* signal goes positive. Likewise, when **(–)** triggering is selected, the trace will begin when the input signal goes negative, as shown in **Fig. 3**. Often there will be the option to chose the **Triggering Source**, such as "CH.1" or "LINE." Line means the scope is triggered off the 60Hz line voltage, and is useful when synchronizing on television signals or looking at 60Hz power supply noise. CH.1 or CH.2 means the scope will trigger off the signal on channel 1 or 2 respectively. **Trigger Level** is at what voltage of the input signal triggering begins. For example, if set high, triggering may not begin until the input signal reaches several volts. When set around zero, it will trigger the moment the signal goes positive (if set for (+) triggering). This setting can be troublesome if noise exists on the signal. Adjust for stable triggering.

Fig. 3 – Triggering

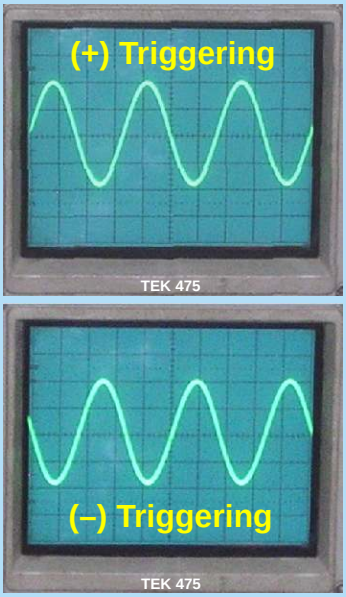

DC Voltages.

Say you want to check the transmit-receiver (T-R) switch in your QRP rig, or other digital signal. See ***Fig. 4.*** The key line is the input to the HCT240 inverter to form the 0v TX– on key- down and the 0v RX– on key- up. This switches the rig between transmit and receive (T-R Switch). It is a logic function, that is, a voltage to represent ON or OFF.

Place the scope lead on pin 13 at 10v/div. and you should see the waveform like the top trace in ***Fig. 4*** ... about +6v on key-up and 0v on key down. Move the scope lead to pin 7 and you should see 0v on key-up and about +8v on key-down (bottom trace). If the output does not go "HI" (+8v) on key-down, or does not go to a solid "LO" (<1v) on key-up, the inverter is not working properly. (It's busticated). Many shortwave receivers use similar schemes for switching filters or attenuators.

While this test could be done with a DVM, the integration time is slow, requiring long key-downs to get the voltages. A scope will also show you how clean the switching is, or if there is an ac voltage (or RF noise) riding on the T-R voltage.

Scopes are thus good dc voltmeters, with about a 5% reading accuracy.

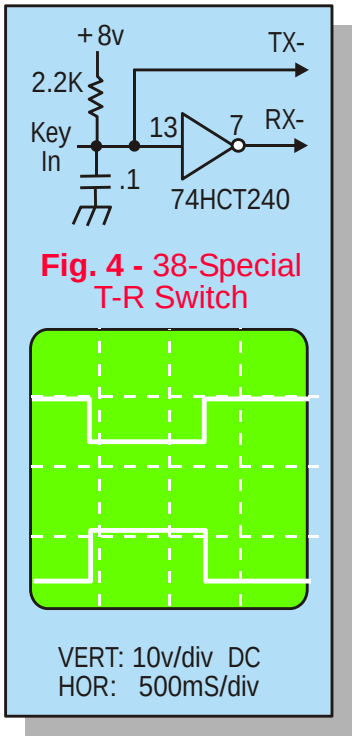

Fig. 4 - 38-Special T-R Switch

AC Voltages.

Here is where an oscilloscope pays for itself by making AC voltage (and frequency) measurements. You must remember, AC voltages are displayed on a scope as ***peak-to-peak voltages***, while a voltmeter measures in ***rms***. RMS voltages are about 1/3 the p-p voltage read on a scope, or specifically:

$$Vrms = \tfrac{1}{2}(.707 \times Vpp) = 0.354 \times Vpp$$

For example, let's measure the output voltage and frequency from the sidetone oscillator in your QRP rig. Place the scope lead on the audio amplifier output. On key-down, you get the waveform shown in ***Fig. 5***. The transmit sidetone audio is 1.9Vpp.

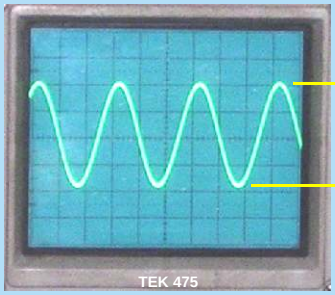

VERT: 0.5v/div ACV
HOR: 0.5mS/div

3.8 divisions peak-to-peak times 0.5v/div = 1.9 Vpp = 0.67 Vrms

Fig. 5

AC Frequency Measurement.

With this waveform, we might as well see what frequency our sidetone or transmit-offset frequency is. Most operators prefer the sidetone to be about 700–750Hz. Trigger the scope for a stable waveform and set the time-base (sweep) to display 2 or 3 cycles, as shown in ***Fig. 6***. Center the waveform between two horizontal divisions so zero volts on the waveform is on a graticle line, then move the horizontal position so the first "zero– crossing" is also on a division line.

Measure the time it takes to make one complete sine wave from one zero-crossing to the next. In this example, it is 1.5 divisions, at 1mS per division, or 1.5mS. Frequency is simply the reciprocal of time, such that the sidetone frequency is:

$$f = \frac{1}{t} = \frac{1}{1.5mS} = 667\ Hz$$

For some, this may be about right. For others, this may be a little low to your liking. To raise it to 700Hz, calculate the time period of 700Hz (1/700 = 1.4mS). At 1.0mS/div, you can adjust your sidetone or transmit offset until zero-crossings for a single sinewave is 1.4 divisions. This will be about 700 Hz. (Sidetone may not be adjustable on some rigs).

All frequency measurements are made in this fashion, by measuring the distance between zero-crossings (or from one peak to the next) and converting the time period to frequency. This should emphasize the importance of ensuring your sweep speed is calibrated; as any error in the time base will cause a corresponding error in the accuracy of your time or frequency measurements.

Fig. 6

VERT: 0.5v/div ACV
HOR: 0.5mS/div

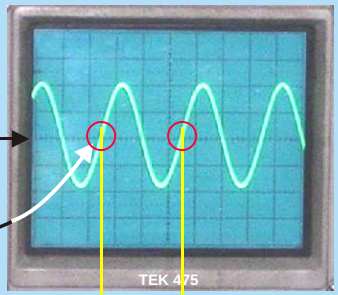

0v

First "Zero Crossing"

3 divisions between "zero-crossings"

=1.5mS
=667Hz

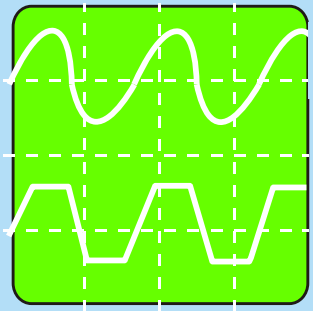

Fig. 7

Example of Waveform Quality

VERT: 2v/div ACV
HOR: 1.0mS/div

Quality of the waveform is another feature of a scope that is unsurpassed since you are "seeing" the waveform in real time. Two examples of waveform quality are shown in ***Fig. 7***.

The top trace shows the sidetone frequency with distortion, perhaps due to improper time-constant on the coupling capacitors or improperly biased audio amplifiers. The bottom trace would be a raspy sounding side tone, due to the amplifier being over-driven and in compression (clipping). The o-scope is an invaluable tool for detecting and diagnosing such impurities in the signal quality.

FIG. 8 – Full Scale Signal Display

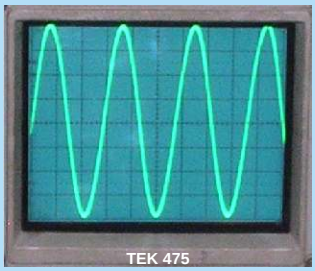

Actual display Tektronix 475

MORE NIFTY MEASUREMENTS

Amplifier Gain.

The gain of an amplifier can be measured in terms of voltage or decibels (dB). For voltage gain, it is simply Vout/Vin of the amplifier. For example, if the input is 1Vpp and the output is 4Vpp, then the amplifier has a voltage gain of 4.

Gain in dB is often more useful and is how the gains of amplifiers are usually expressed. With dB's, every-time you double the AC voltage, you add 6dB of gain. It is the **ratio** of output to the input, and this **ratio** is easy to measure on a scope.

It is often easier to start with the output. Set the vertical amplifier gain to display the amplifier **output** as a full-scale signal as shown in ***Fig. 8***. Now move the scope probe to the amplifier **input** without disturbing the scope gain. You will of course have a much smaller signal, and the ratio of the input to the output will be the gain in dB. In our example of using eight divisions for full-scale, then four divisions would be 6db, 2 divisions 12dB, etc. as shown in **Fig. 9.** You may want to add your own dB scale along your scope display to remind you of this relationship. Note: this is ***voltage gain*** (Av=20log x Vout/Vin). In this example, with 4Vpp output and 1Vpp input (Av=4), then the gain is dB=20log(4) = 20(0.602) = 12dB, or as shown directly on the CRT tube. Since this is a relative measurement, the absolute Vin or Vout voltage does not need to be determined.

Fig. 9 – Volt. vs. dB relationship

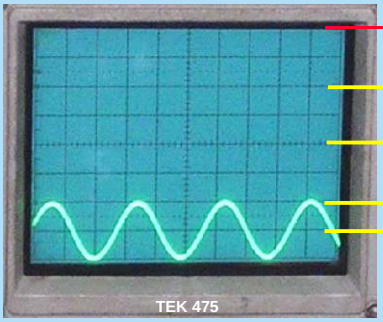

Zero Crossings

Fig. 10 Measuring Phase Shifts

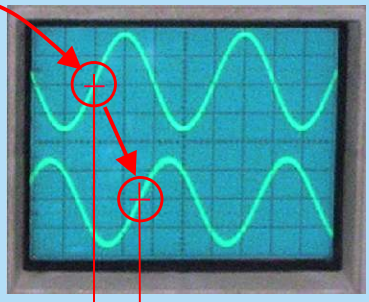

1.6 divisions x90 =145°

Insertion Loss.

In some circuits, such as filters or attenuators, the ***loss*** in the circuit needs to be measured, and like circuit gain – expressed in dB. The loss through a circuit is called the ***insertion loss.*** It is determined in the same way as amplifier gain just presented, except start with the input (the highest AC voltage) as the full-scale or reference display, then measure the output AC voltage (the lowest level). **The ratio is the insertion loss in dB.**

For example, with a signal generator connected to your receiver, you want to measure the insertion loss through the IF crystal filter. At the filter input, you can just barely squeek out 2 divisions of input signal on your scope at its most sensitive setting. The output from the crystal filter is 1.5 divisions. The insertion loss would be 20log(1.5/2.0 div.) = –2.5 dB. If the output were only 1.0 division (50% reduction), the insertion loss would be 6dB.

Fig. 11 –Phase Shift by imposition

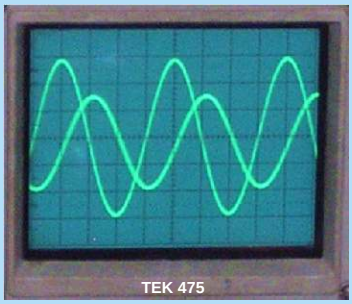

Measuring Phase Shifts.

Phase relationships between two signals at the same frequency can be measured with 2-5° accuracy with a scope, although more suited for a dual-trace scope. The reference signal is applied to CH. 1 and the signal to be measured to CH. 2. For proper phase measurements, ensure your dual trace display is in the **chopped** mode, not **alternate** mode for proper phased referenced triggering.

There are many methods to do this. One is to stretch out the signal so it takes 4 horizontal divisions, such that each division is 90° of phase, as shown in **Fig. 10**. By measuring from a common point on one signal (zero-crossing or from peak-to-peak) to the next, the phase can be measured. For example, say you are making a phased-array antenna in which one feedline must cause a 90° delay. You calculate the electrical length for a ¼λ [L=(246/f) x Velocity Factor] and cut the coax to that length. You are now working on blind faith that you have exactly 90°. With a scope, you can measure it fairly accurately by injecting a signal into one end with a signal generator (at the frequency of interest) and a 50Ω load on the other. Connect the scope CH.1 to the coax (signal) input and CH.2 to the load end and measure the phase. In the **Fig. 10** example, the CH.2 signal is delayed by 1.6 divisions, at 90° /div is 145°. ***Your delay line is too long!*** Cut off an inch or two at a time until the CH.2 signal is 90° from CH.1 for precise tuning of the delay

line. (While departing from o-scopes for a moment, the sharp null of a phased array is astounding when exactly 90° delay is achieved. More than 10-15° in error causes a very “mushy” null with little difference over a single vertical antenna. Most errors in achieving exactly 90° by the "measure-and-cut" method are due to uncertainties in the stated velocity factor of the coax).

Another method is to superimpose the two signals on top of eachother. Make one signal larger than the other so you know which one is what, as shown in **Fig. 11**. In this example, the smaller signal lags the larger signal by about 100°, estimated by where they cross. For more accurate determination, use the time base to measure the time period of one cycle (T1), then the time period one signal lags (or leads) the other (T2). The phase shift is then $\theta=(T2/T1)x360^o$.

Phase measurements can be made on a single trace scope as well. First, connect the reference signal, uisng a BNC "T," to both the *external trigger* and the normal *vertical input*. Adjust the trigger level so the zero-crossing occurs at the beginning of the trace (left-hand graticle). Remove the reference from the vertical input, but not the e*xternal trigger,* and apply the signal to be tested to the vertical input – without altering the time base or trigger level. The distance of zero-crossing of the test signal is from the left-hand graticle can now be measured to determine the phase, though with slightly less accuracy than using a dual-trace scope.

An interesting experiment is to measure the phase shift of the audio signal at different frequencies as it travels through the stages in a CW, SSB or AM active filter. What is the phase shift of the wanted vs unwanted frequencies?

Measuring Rise and Fall Times.

In digital circuits, it is sometimes important to know the rise and fall times of a signal through a gate. In amateur radio transceivers, this same interest could be applied to how fast the T-R switch switches. On key-down, if the transmitter turns on slightly before the receiver is turned off, it can produce an annoying "thump" in the receiver. Rise and fall times are measured by triggering on the edge of the signal of interest, then increase to a faster sweep speed to measure the time it takes the signal to reach 90% of its final level. The signal to be measured is shown in **Fig. 12** on the top trace, and the expanded version on the bottom. For proper rise times, the signal being measured should be well within the bandwidth of your scope and using a low capacity probe.

For example, in **Fig. 12** (bottom trace), the rise time is about 1/4th of a division. If the sweep speed is 100nS/division, the rise time would then be about 25nS.

Fig. 12 –
Rise and Fall Times

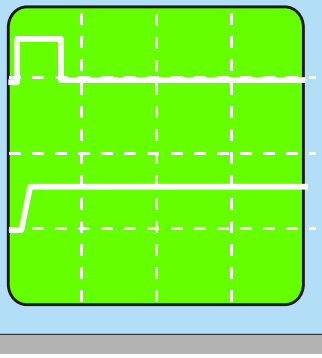

USING LIMITED BANDWIDTH SCOPES

Today's scopes have 200–500MHz bandwidths. Likely your scope is much less than that. A limited bandwidth scope is still very useful to the amateur or homebrewer. Say the bandwidth of your scope is 5MHz. This does not mean you can't see 7MHz signals. It just means the peak-to-peak value has lost meaning, and will likely be very weak, since it is beyond the bandwidth of the scope. (Like other bandwidth measurements in electronics, the “bandwidth” of a scope is usually based on the “3dB bandwidth.” That is, at the maximum bandwidth, you are already at the –3dB point, or a 25% reduction in the peak-to-peak voltage display). You can still resolve individual cycles higher than the cited bandwidth to a certain degree and make gain and phase measurements, since they are based on ***ratios.***

Most of the examples in this article explore many regions of a communications receiver or ham transceiver without the benefit of any great bandwidth. Experiment with your scope to learn its limitations. ***Use a good scope probe and make measurements with a good ground to get the most out of the bandwidth you have.***

For the homebrewer building circuits in the HF bands, a 50 MHz scope **with good calibration** will yield fairly accurate measurements up to 30 MHz with little concern for accuracy. The old 465 or 475 series of Tektronix scopes, with 100/200 MHz bandwidths, make an excellent oscilloscope for the amateur or experimenter. They can often be found at hamfests today for $100–150, and tend to maintain a fairly good calibration almost regardless of how much use they have seen.

In Part 2 **-** we'll probe (bad pun) into some advanced measurement techniques, even with a simple scope ... such as measuring sideband rejection, filter responses, VCO phase noise, etc. (and what it all means).

72, Paul NA5N

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Colophon:
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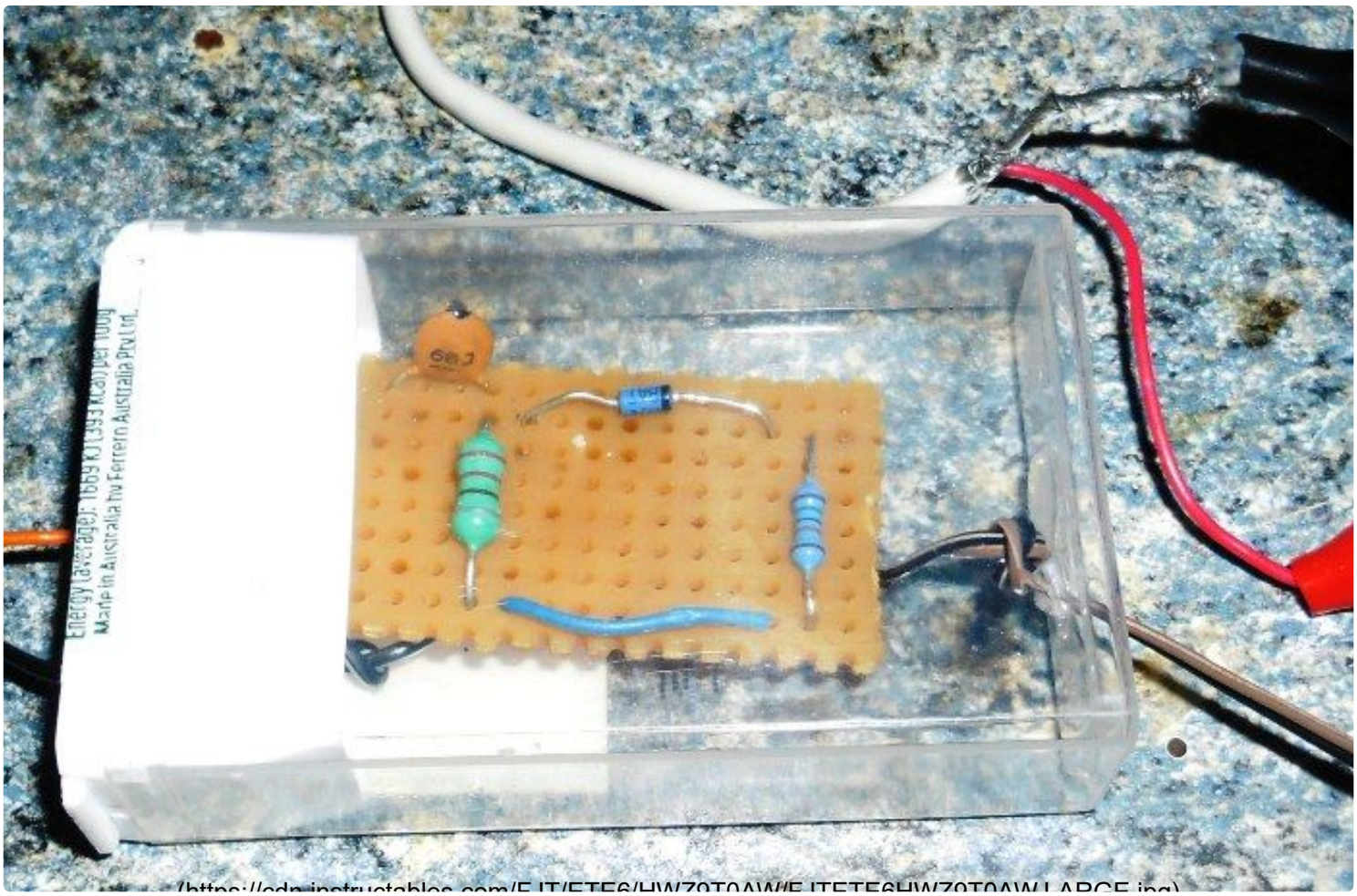

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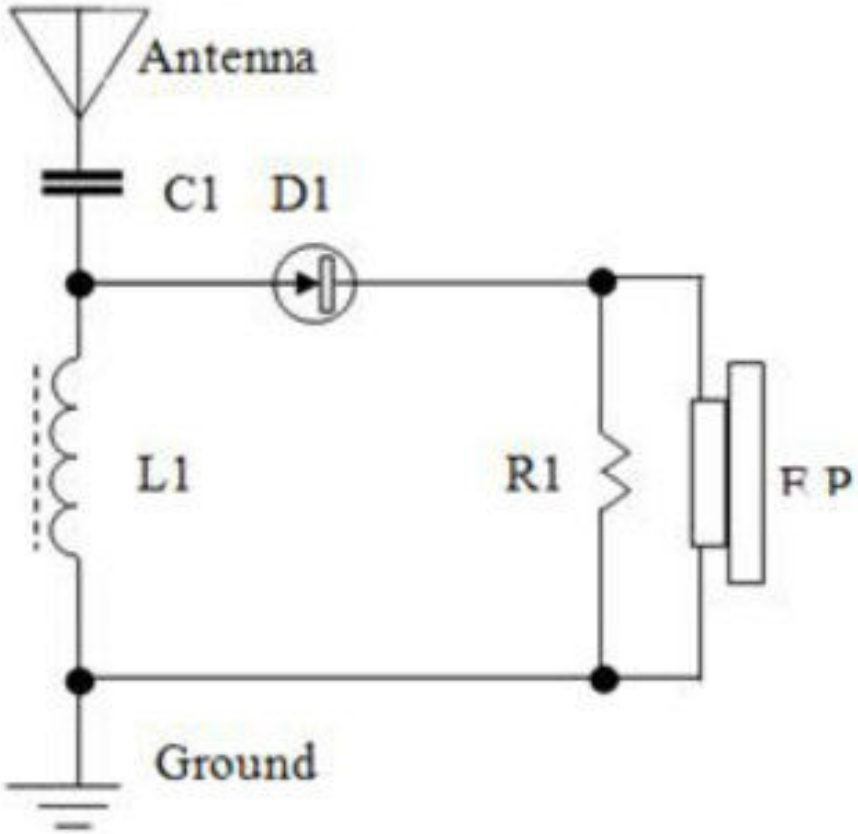

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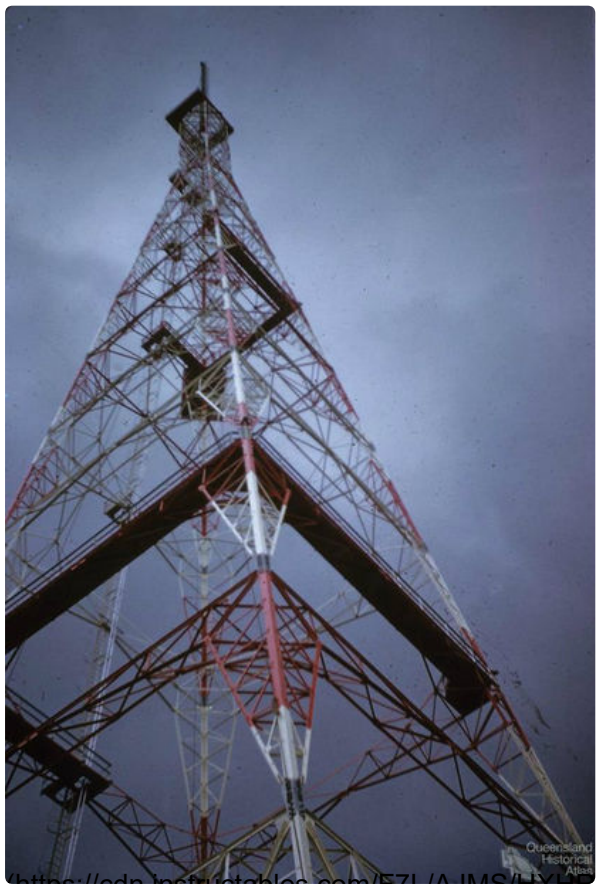

Hi there! This Instructable is all about building a basic crystal radio set that is so simple to build and understand, that a child could do it - with help from mum or dad - or even at school, as a class project. Parts can be bought "off the shelf" at Jaycar Electronics and other suppliers, or purchased online via Ebay and Paypal.

I built my first ever crystal set when I was 9 years old, but that was a different world. We're going to build a 21st century style radio with all modern components which are relatively easy to obtain at your local electronics store or on the Internet.

The radio is contained inside a Tic Tac box, and is called "The Nic Nac Tic Tac Radio". It is built on a square of matrix board, with the component leads poked through the holes in the board, and joined underneath. It is a very simple crystal set, designed to initially receive only one station, but you can expand the tuning range with the addition of only one extra component.

The Tic Tac radio can be constructed by simply twisting the component leads together, underneath the matrix board and attaching antenna/ground wires as well as the earphone wires to the board, using that same technique. You don't have to

solder any wires, but there is another way to join them all together - more on that later.

The Tic Tac Radio is a very easy set to put together - you don't need to wind bulky coils or use heavy tools and screw strange looking parts onto a large breadboard. See step 1 for the parts list you will need.

Add Tip | Ask Question

Step 1: Parts and Tools You Will Need

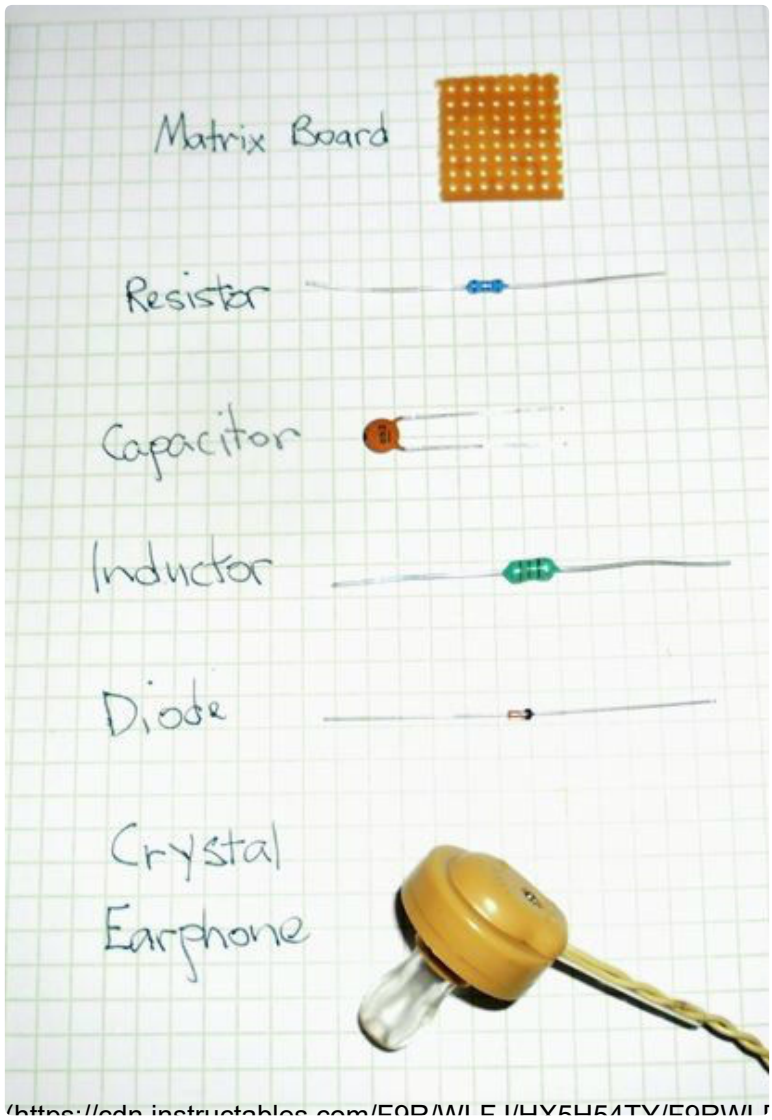

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You will need to acquire the following components from a local electronics shop or an online electronics business.

I am adding the catalogue numbers for Jaycar Electronics, so if you live in Australia or North America, you may be able to visit a Jaycar store and buy the parts over the counter, if not then you may be able to do an online mail order via Paypal:

Parts List

Resistor - 47k - yellow-purple-black-red and brown - RR 0612 (pkt of 8)

Capacitor - 68pF - ceramic x 2 - RC 5322 (pkt of 2) and a 100 or 120 pF value as well for experiments.

Inductor - 220 uH - red-red-brown silver - LF 1538 (resistive type)

Polyvaricon tuning capacitor - 220 pF - RV 5728 - with knob and mounting screws

Diode - BAT46 - ZR 1141 (You can also use a 1N34A Germanium Diode too if you have one at home)

Ceramic Earphone - AS 3305 *

A 25 meter roll of yellow hook up wire for the Antenna wire and a 3 meter length of wire for the Ground wire.

Please note that some Jaycar parts come in multiples of 2 or more per packet. And please note the following:

PLEASE NOTE: THIS PROJECT/KIT CONTAINS SMALL PARTS THAT MAY FORM A CHOKING HAZARD FOR SMALL CHILDREN OR PETS. NOT SUITABLE FOR CHILDREN UNDER FIVE (5) YEARS OLD.

*A normal crystal radio earphone is OK, but if you can't get one of these, or if the one you bought goes dead (as they sometimes do,) you can use a substitute, such as the Murata PKM44EW passive transducer (see picture above) which is available from an old Telstra TF200 touchphone, (the one on the left in the diagram above,) or an equivalent, such as the ARIO transducer, from an old Telstra T1000 pushbutton phone.

The ARIO unit is soldered to the phone's pc board so you'll need to be able to unsolder the three mounting pins underneath the board, or find someone in the neighbourhood who is able.

Take the back off the TF200 (if you've obtained one of these phones,) and you'll see a black disc shaped object 2" round by 1/2' thick - with a red and black wire. Unplug the wires from the circuit board, and unscrew any retaining screws and remove the transducer. Cut the mini plug off, carefully strip the insulation from the ends of the wires and extend them by about 18" with 2 thin lengths of hookup wire. These pietzo devices make good earphones for crystal sets and can be housed in an old pair of ear muffs.

Miscellaneous Materials:

A Tic Tac box (smaller size)

A piece of matrix board at least 7 holes long by 8 holes across. Cut the board to fit neatly inside the Tic Tac box.

A short length of 2 differently coloured wires 60 mm in length and 2 crocodile clips with red and black plastic covers

A length of antenna wire at least 25 metres long and a 3 metre length of a different colour for the Ground wire.

A metal rod or cold water pipe for the ground stake. Be careful which pipes you connect your Ground wire to.

You will need a small sharp object for punching holes in the Tic Tac box.

A small pair of wire cutters for cutting and stripping wires.

Add Tip Ask Question

Step 2: How a Crystal Radio Works

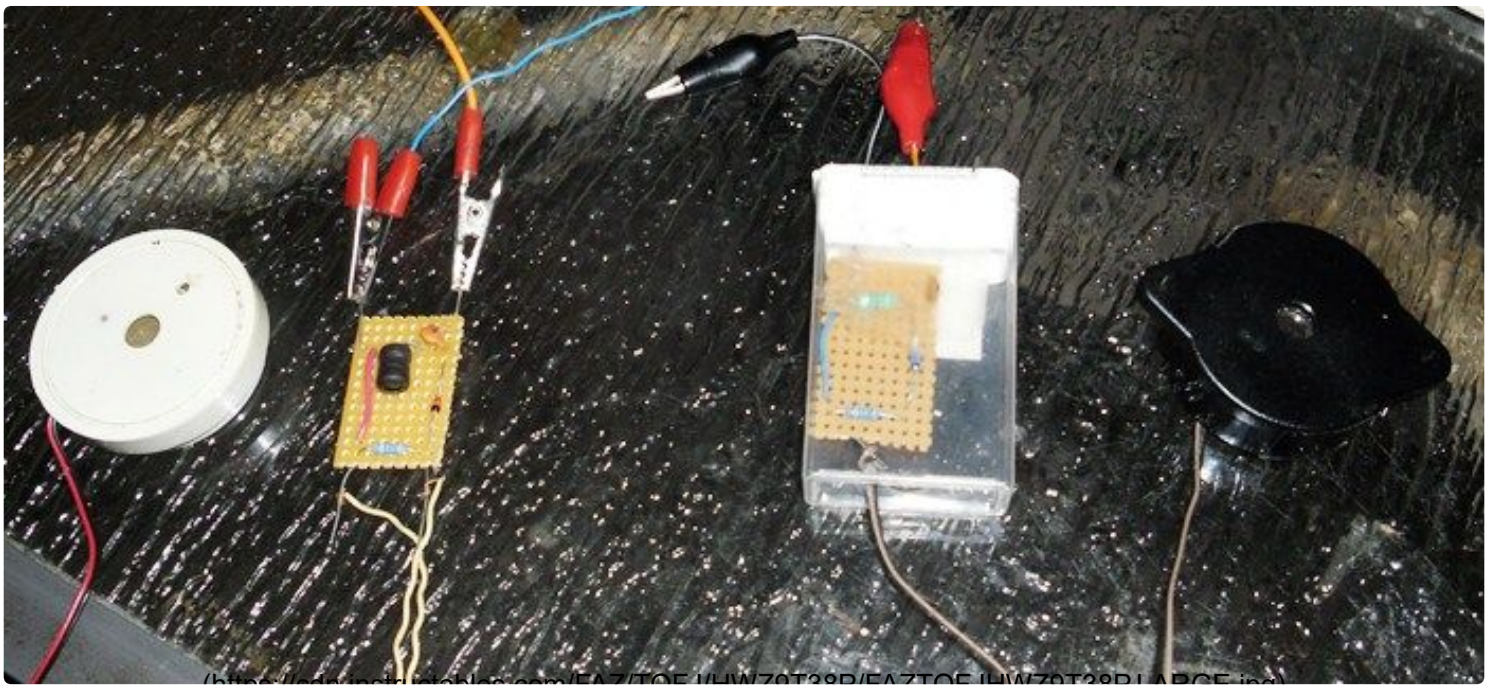

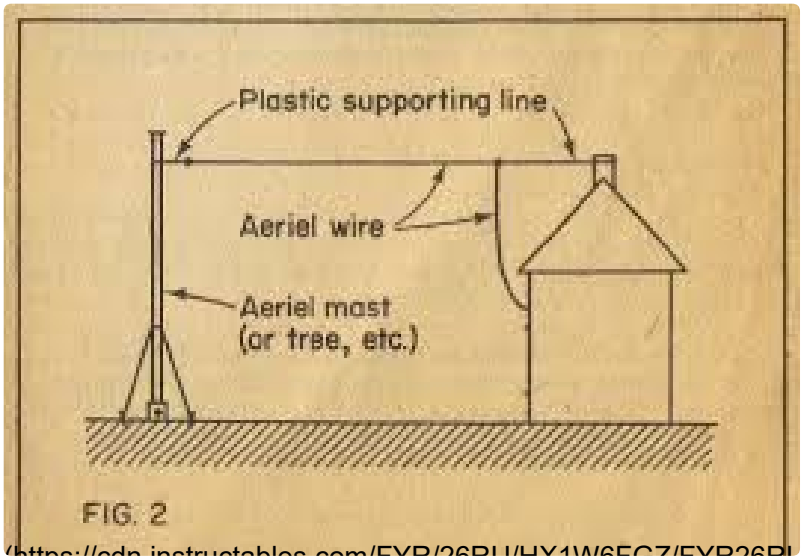

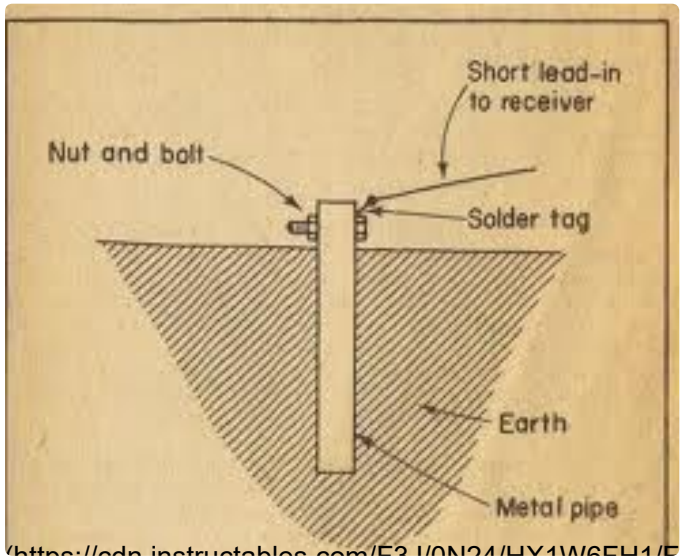

Radio signals consists of two parts - the 'carrier wave' which is the AM radio station's frequency of operation, and the 'program signal' which is mixed with the carrier wave for transmission.

Radio waves travel out from the AM transmitter tower through the atmosphere. We want to capture one specific frequency so we can listen to it, so we need the antenna/ground wire system to capture that signal. We also need a 'tuned circuit' that will filter out the desired AM signal, and discard the rest, so that all the other unwanted radio signals pass out through the ground wire to earth.

Two components in our circuit will perform that task for us. The capacitor C1, together with L1 inductor, form a basic 'series tuned' circuit. Their respective values will determine just which local AM radio station we will capture.

We also need a diode to 'detect' the voice and music, so we can hear them in our earphone, which transduces electrical signals into sound waves that we can hear.

In the photo above you can see a completed Tic Tac crystal radio. It is already inside the box. The other set is connected to the antenna/ground wire circuit, undergoing a 'soak test'. It is necessary to do this to ensure that the radio will work once inside the box!

The first diagram shows a typical antenna wire installation. Coming out of a window, the wire is anchored to the building and then over some distance (10 metres +) to a nearby tree or other building.

You must take great care not to erect antenna wires near to power or telephone cables, near your home!

The ground wire comes out the same window and is anchored to a metal pipe/water pipe or metal ground stake, embedded in soft, moist soil.

You must not connect ground wires to electrical mains wiring installations, including wall power outlets!

Another electrical hazard to consider is lightning strikes! Although it is very rare for anyone to be seriously injured or die from a lightning strike it is not impossible. So, if you hear a thunderstorm coming your way (you may hear the lightning 'crashes' in your earphone first,) then disconnect your antenna wire immediately, connect it to the ground wire and put it well up out of the way. Stay well clear of this temporary antenna/ground connection until the storm has completely passed away from your general area - miles away!

Add Tip Ask Question

Step 3: How to Build the Tic Tac Crystal Radio Set

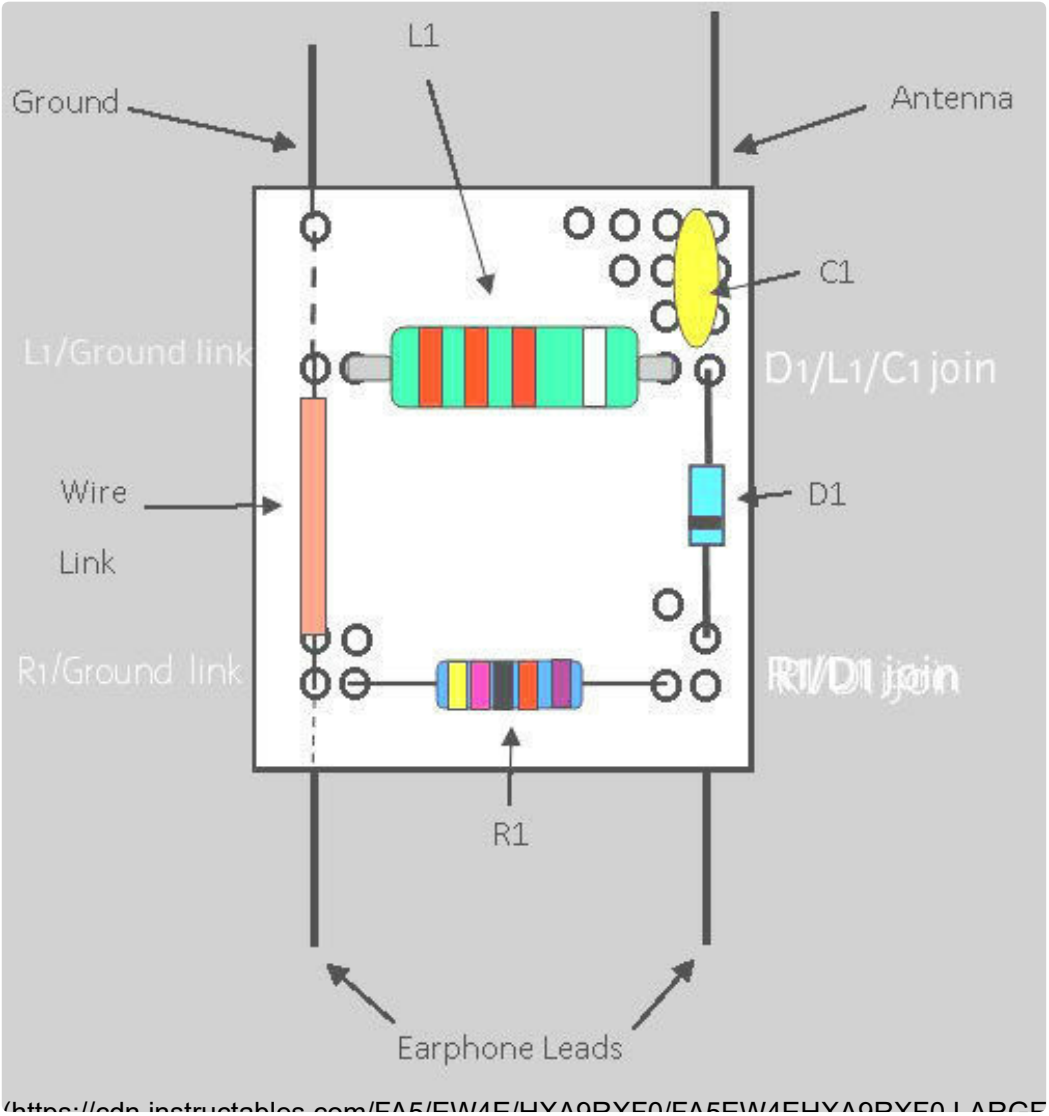

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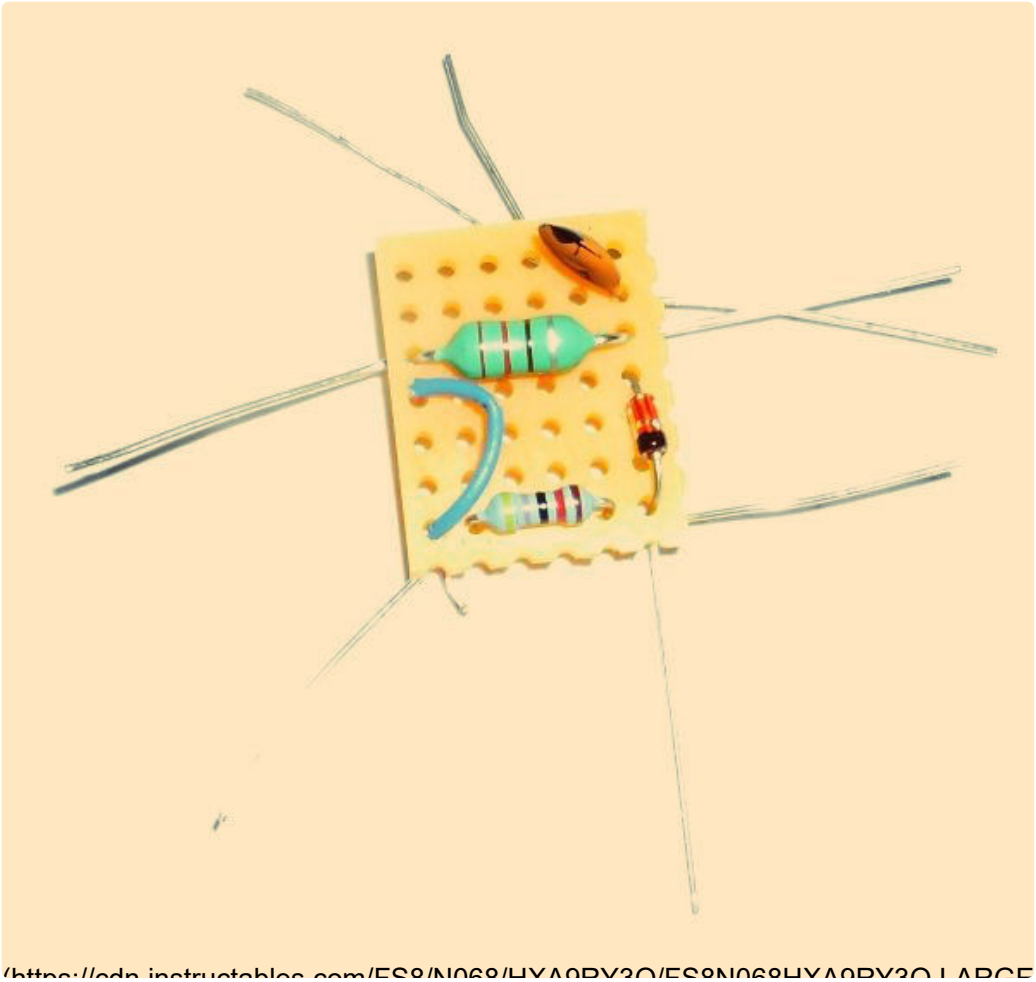

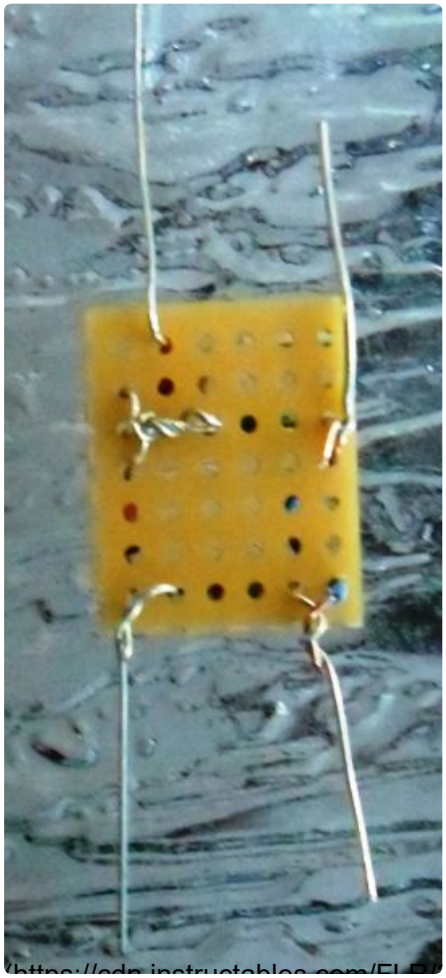

1. Take the components and lay them out on a clean surface.

2. Take the square of matrix board (this is also called 'perf board' because of all the holes or perforations in the material) and beginning with the 220uH (uH = micro-Henry) and place it as shown in the diagram.

3. Then take the diode, capacitor and resistor and place them in the places shown for them, making sure that the coloured band at one end of the diode joins with the resistor wire, as shown

4. Then take each junction where wires come together through their respective holes and gently twist them together, until they form a neat, tight bundle. Take your side cutters and cut off any excess length, taking care not to cut any one wire too short, so that it comes undone from the join.

.5. Take the link wire, strip 2 centimetres of insulation from each end of the wire and install that wire between the free ends of the inductor and resistor, and the matrix board construction is complete.

6. Then take the ceramic earphone, cut the plug off the end, and strip the 2 wire ends about 1.5 centimetres in length. Wrap each earphone wire around each end of the resistor component, underneath the matrix board.

7. Finally, strip the insulation off both ends of the 60mm long differently coloured wires, and attach them to the matrix board - one goes to the inductor/link wire junction and this will be the Ground connection wire. Attach the other one to the free end of capacitor C1 and this will be the antenna wire connection. Both connections are made underneath the matrix board. The Nic Nac Tic Tac Crystal Radio is now ready for testing.

Add Tip Ask Question

Step 4: Final Checks and Installation of Wires

24g NET
FRESHNESS IN 2 CALORIES
tic tac
Strawberry Fields

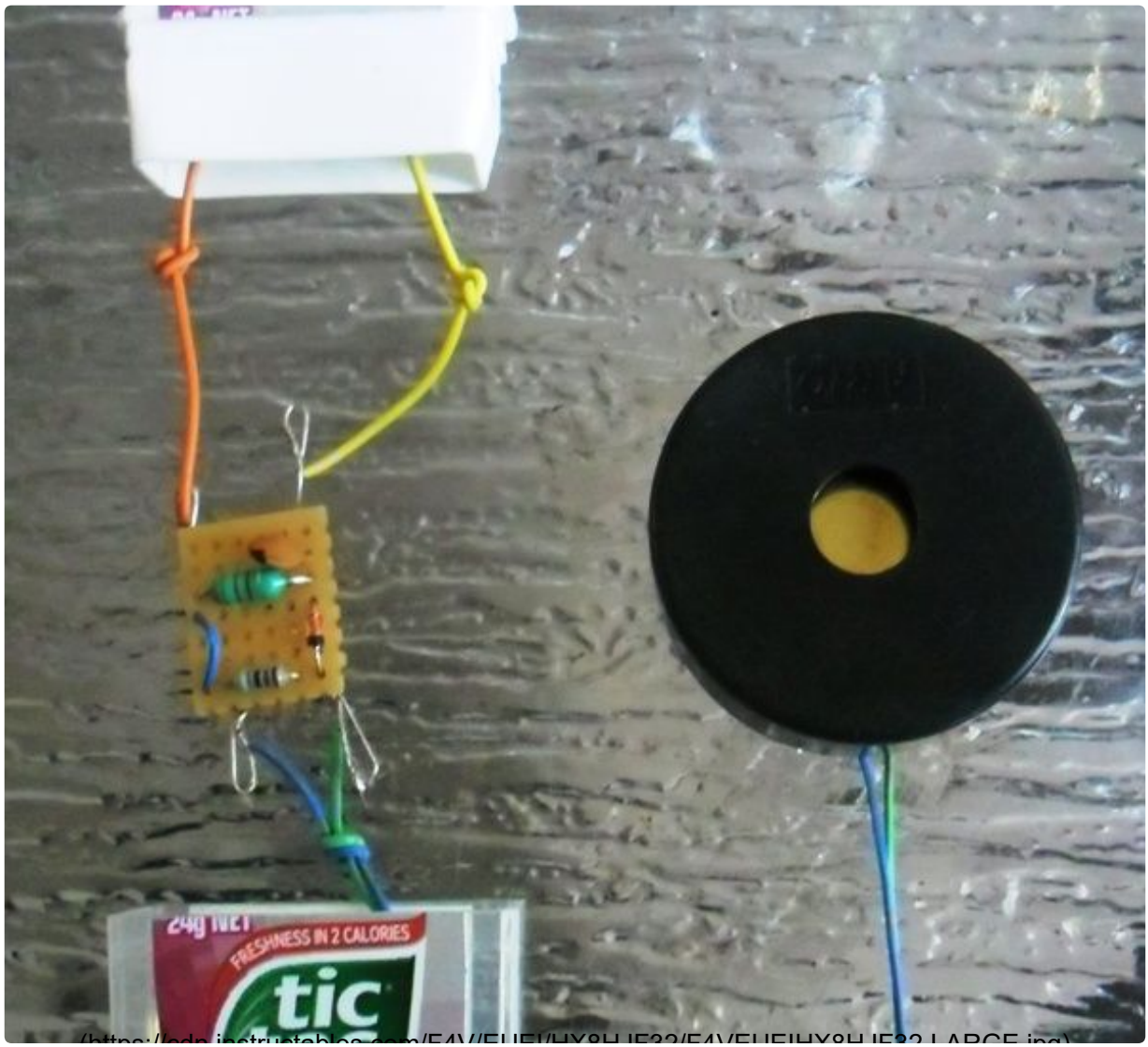

When you've finished constructing the matrix board circuit and have clipped all the excess component leads off, puncture three (3) holes in the Tic Tac box - 2 small holes on the top lid of the box, about an inch (24mm) apart, so that your antenna and ground wire leads can come through the box lid, and be connected to the matrix board at those 2 points.

Feed the wires through the holes and then tie small knots in each one, near the underside of the box lid, so that they won't pull back out if strained, and disconnect themselves from the matrix board.

Then make one larger hole in the centre of the bottom of the box (clear part) so that your earphone wires can be fed through to the connecting points on that part of the matrix board. Tie a larger knot in the earphone lead so as to prevent it from pulling

out of the box if it is strained. Strip the insulation off the earphone leads, and wrap them around the matrix board leads at those 2 points. You are now ready to test out the Nic Nac Tic Tac Crystal Radio.

Add Tip Ask Question

Step 5: Testing Out the Tic Tac Radio

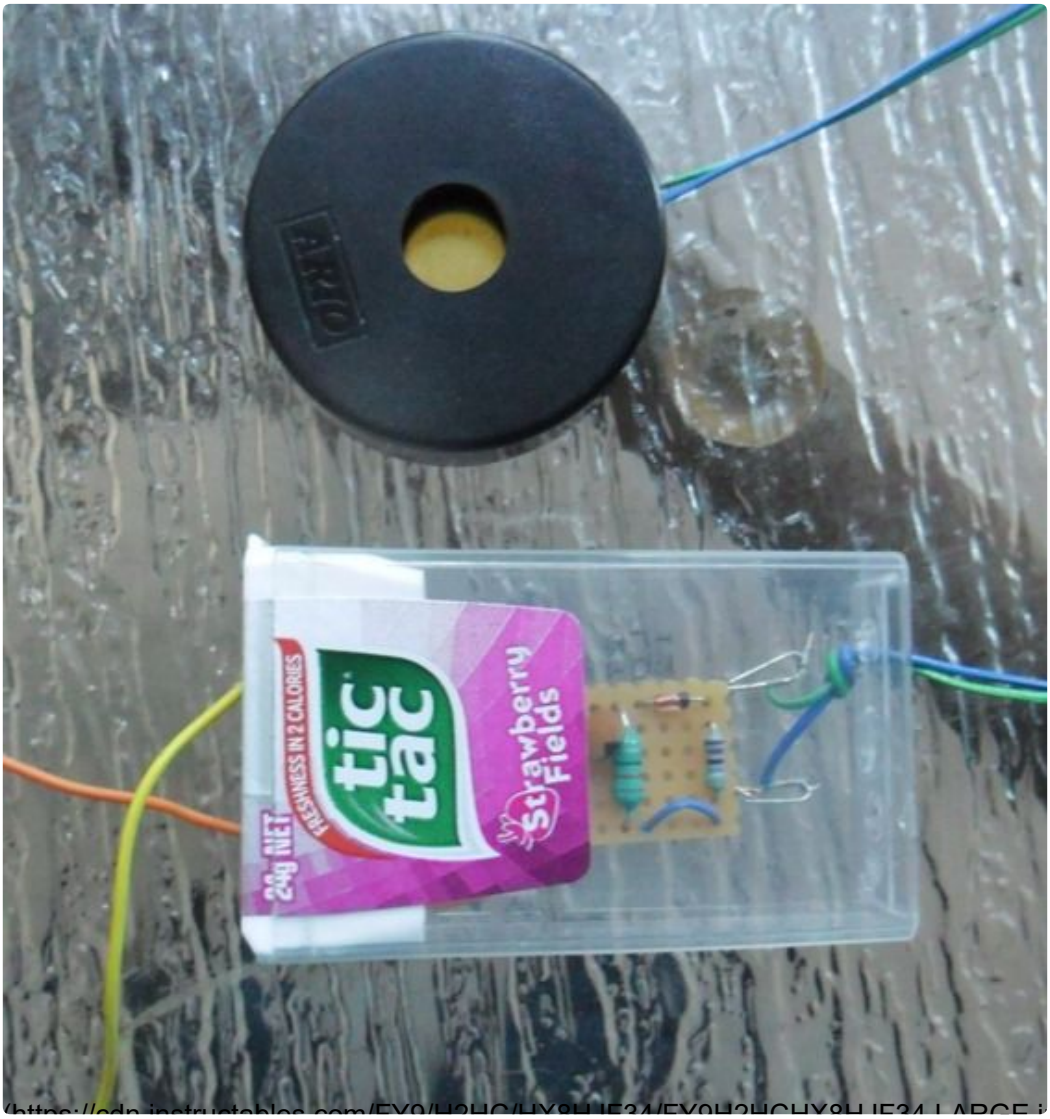

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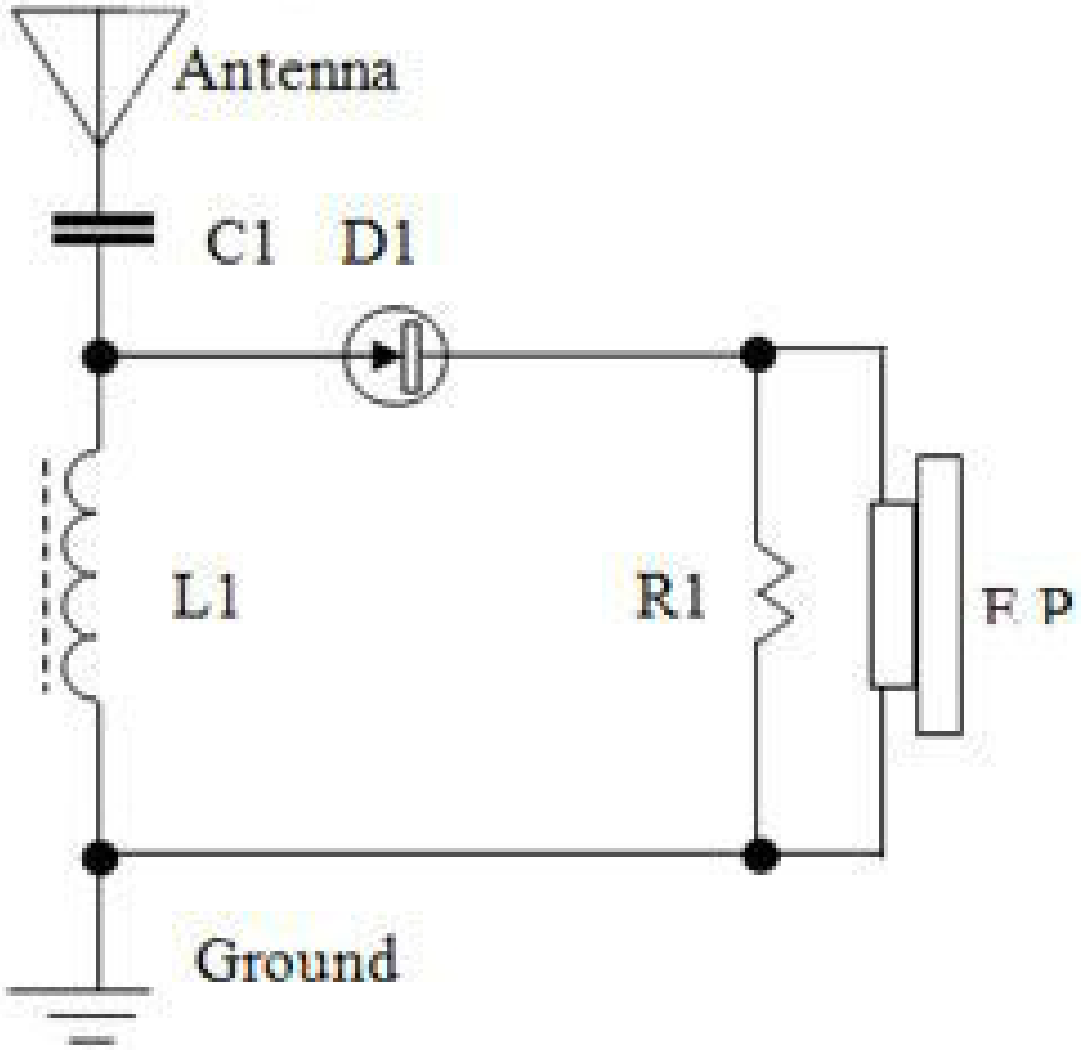

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Take your finished Tic Tac Radio (with the lid part gently pushed back inside the top of the box) and connect your Antenna and Ground wires to the lead outs from the box lid. Place the earphone in/over your ear,and listen carefully for a local AM radio station. This crystal radio is a simple one, and you may have to make one or two adjustments to the components, before you succeed in receiving one or more local AM radio stations, in your area.

If you can't hear anything in the earphone, don't panic. It might just be a simple wiring mistake, which is easily fixed. Go back over all of the steps, making sure that you have the right value components from the electronics store. Make sure that each component is in the right place on the matrix board, (don't confuse the L1 inductor with the R1 resistor - they look a lot like each other!) and that no component wires have come undone from the twisted joins you have just made. I'll

be writing up a troubleshooting step soon, so if you run into any problems, post your questions in the 'comments' section down at the bottom of the page, and I'll try and answer them as soon as possible.

Make sure that your antenna and ground wires aren't snagged on anything metal or anything dangerous!

If you have ANY doubts about the electrical safety of your antenna or ground wires, then consult a licensed electrical trades person, who will be able to advise you on electrical safety principles and procedures!

Always remember that electrical safety is your responsibility! If you don't think it is safe to proceed, then don't!

You will need at least 10 to 15 metres of antenna wire, strung between 2 insulating points (not connected to anything metallic, or that gets wet,) at least 2 to 3 metres in height - anything less than this minimum arrangement may mean that you cannot receive any signals at all.

Some places are regarded as 'radio dead spots', so you may need to try an open space, such as a park or a remote corner of a beach. If you do erect antenna and ground wires in public places, hang some streamers or balloons off of them, to alert people to their presence, otherwise people going past may become entangled with them - and get cranky with you!!!

As a final word for now, you'll be happy to know that the completed "Nic Nac Tic Tac Radio" shown in the picture above, picked up local AM radio station 1116 khz 4BC here in Brisbane, with a very clear signal and quite good volume. It works! So be safe kids, have some fun and look forward to more... mk484

Add Tip

Ask Question

Step 6: Nic Nac Extras

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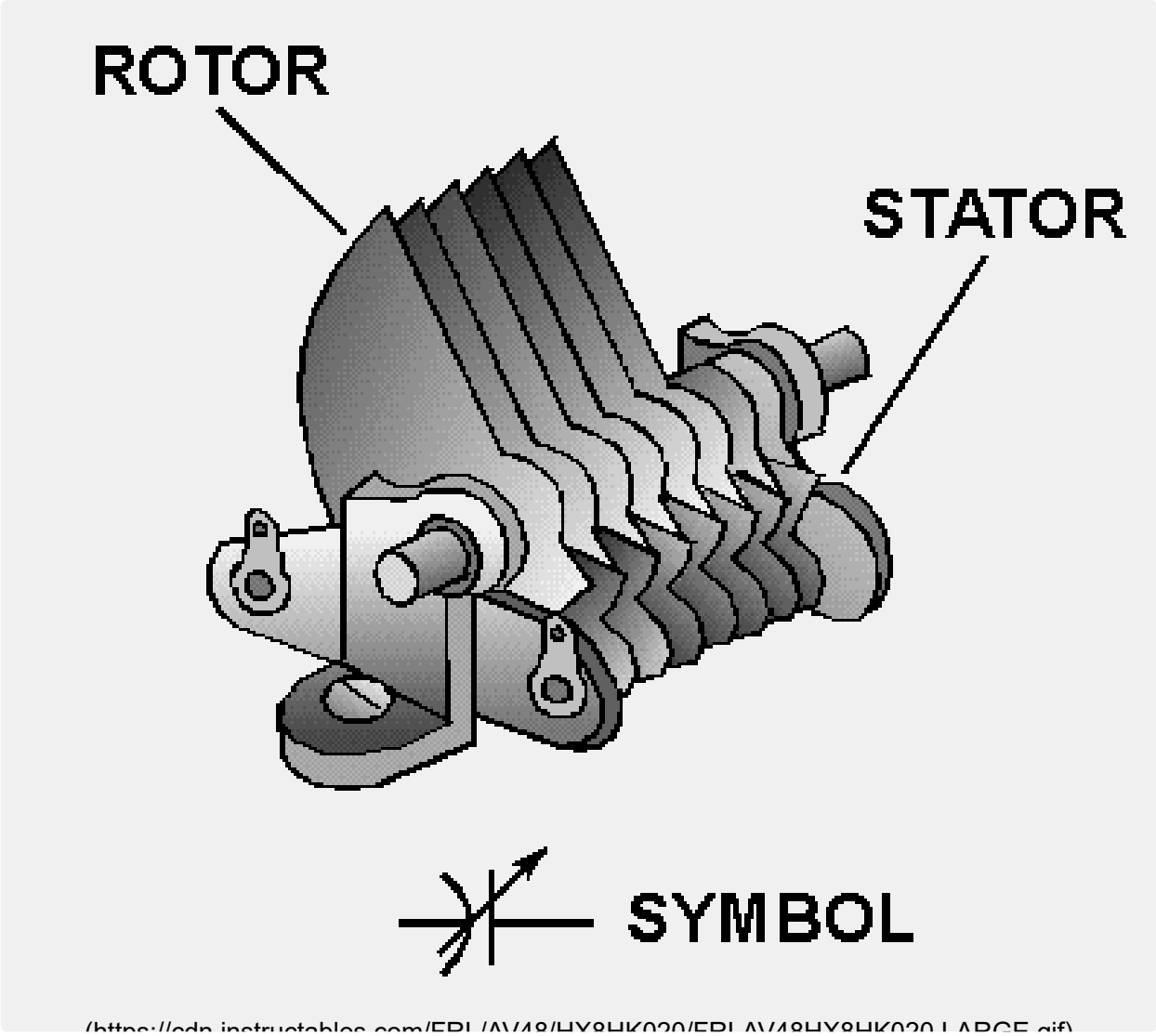

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If you've built your Tic Tac crystal set and found that you can't receive a local AM radio station yet - don't panic - help is in on the way. You have just built the simplest version of the Tic Tac crystal radio and you may need to add one more component part for it to work properly. This is called a 'polyvaricon' - a miniature tuning capacitor, which can vary the frequency that your radio will receive at. You can see a picture of one up above - the small white box with the black knob next to it. It has 3 connecting tags - the one in the middle ('G') goes to the moving plates and the shaft, while the 2 outer tags ('O' and 'A') go to 2 sets of fixed plates. the smaller set of plates has a value of 60pF - pF is short for 'picoFarad' - a unit of measurement for capacitance. The larger set of plates is valued at 160 pF so that the combined value of the polyvaricon is 220 pF - or 220 picoFarads.

The other picture shows you what happens inside a basic tuning capacitor. there are 2 sets of metal plates - one set is fixed and the other set moves on a rotating shaft, connected to the tuning knob of your radio set. Both sets of plates are mounted on an insulating frame so that they won't 'short out' by touch each other.

The fixed capacitor C1, was chosen to tune somewhere close to the middle of the AM radio band. This band of frequencies starts at 531 kilohertz (Khz) and goes as far as 1701 Khz here in Australia. So we need a combination of coil and capacitor which will tune across all of those frequencies. Our simple Tic Tac radio is known as a 'series tuned' set. If you look at the circuit diagram, you can see electronic symbols for all components in the radio set.If you start at the top with the antenna symbol, you can see the capacitor C1 underneath that, the inductor L1 underneath C1 and then finally, the ground symbol - all wired in series with each other.

The diode D1 detector, the resistor and the earphone plus the link wire, can be considered as one block - the "detector unit". The Antenna wire, ground wire, inductor/coil and capacitor/polyvaricon, can be also be considered as another block - the "tuned circuit". So joining both blocks together, we have the tuned circuit that tunes in only one frequency, passing all other unwanted signals out through the ground wire to earth. This one 'tuned frequency' passes through the diode detector, which strips away the 'carrier wave' and leaves only the 'program signal' (voice,

music etc,) behind, which is then fed via the resistor into the earphone. The earphone changes electrical impulses from the diode detector, into sound waves that we can hear. You need the R1 resistor to provide a pathway for the signals going through the diode, out to the ground wire connection. Without this resistor, the signals would sound very distorted and you couldn't hear the program signal very clearly.

Add Tip Ask Question

Step 7: Adding the Polyvaricon Tuning Capacitor

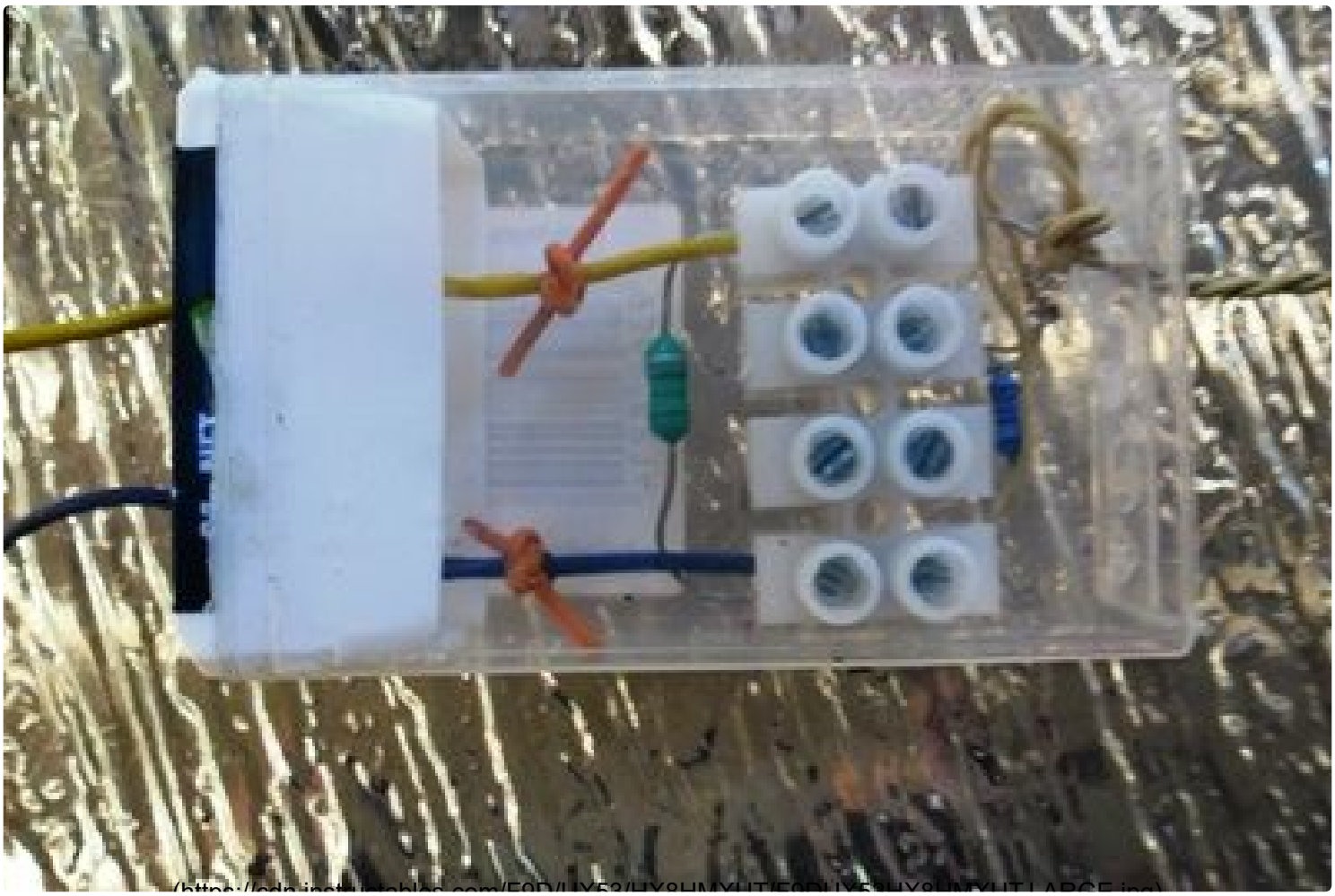

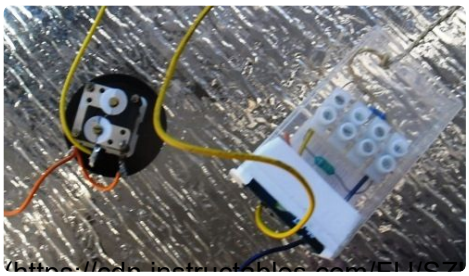

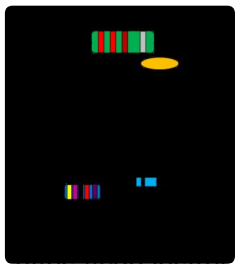

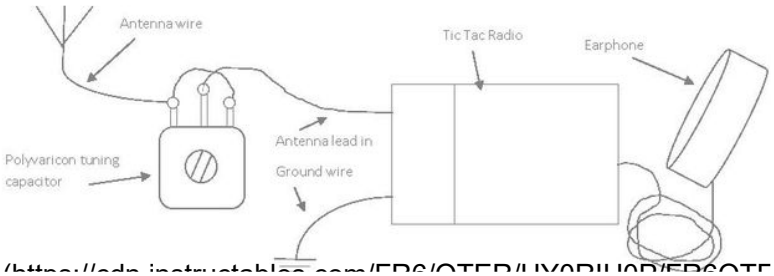

If you want to expand the tuning range of your Tic Tac Radio, than all you have to do is a simple modification (change) to the circuit of your radio set. You can see from the 2 pictures above, that there's an alternative way of building the crystal radio - you can use the matrix board method or you can use a 4 way screw terminal strip.

To use the screw terminal version, cut yourself a 4 way strip of terminals as shown in the diagram and pictures. Undo the screws right out as far as they will go without falling out of the strip. Connect the component leads and wires from the antenna/ground system as well as the earphone wires. Cut off any excess from component leads that you don't need. Wrap thin wires from the antenna/ground system and the earphones, around the thicker component leads before screwing the screws in tight.

Regardless of which method you have used, all we will now wire up the tuning capacitor between the actual Antenna wire and the junction (join) where the diode D1, the fixed capacitor C1 and one end of the inductor meet. Remove the capacitor from the matrix board, and connect the Antenna lead out wire straight to the join of the diode and inductor. Then take the polyvaricon and another piece of wire. Strip both ends of that wire and join the two outer tags (tagged 'O' and 'A' - the centre on is tagged 'G') and then connect you actual Antenna wire to one of the outer tags. Connect the antenna lead out wire, coming out of the box, to the 'G' (middle) tag of the tuning capacitor,so that the antenna wiring now looks like the picture up above.

If you're having problems following the pictures, then refer to the diagrams, which clearly shows all of the connections Make sure your ground wire is connected to the set, and then, listening with your earphone in/over your ear, slowly turn the

tuning cap's flat knob, until you hear one or more stations. Congratulations - you now have a "tuneable" Tic Tac crystal set! Happy listening! And don't forget to post in your results, questions, problems etc... mk484 :)

Add Tip Ask Question

Step 8: Tic Tac One Transistor Amplifier - Use Your Earbuds and Hear Great Sound...

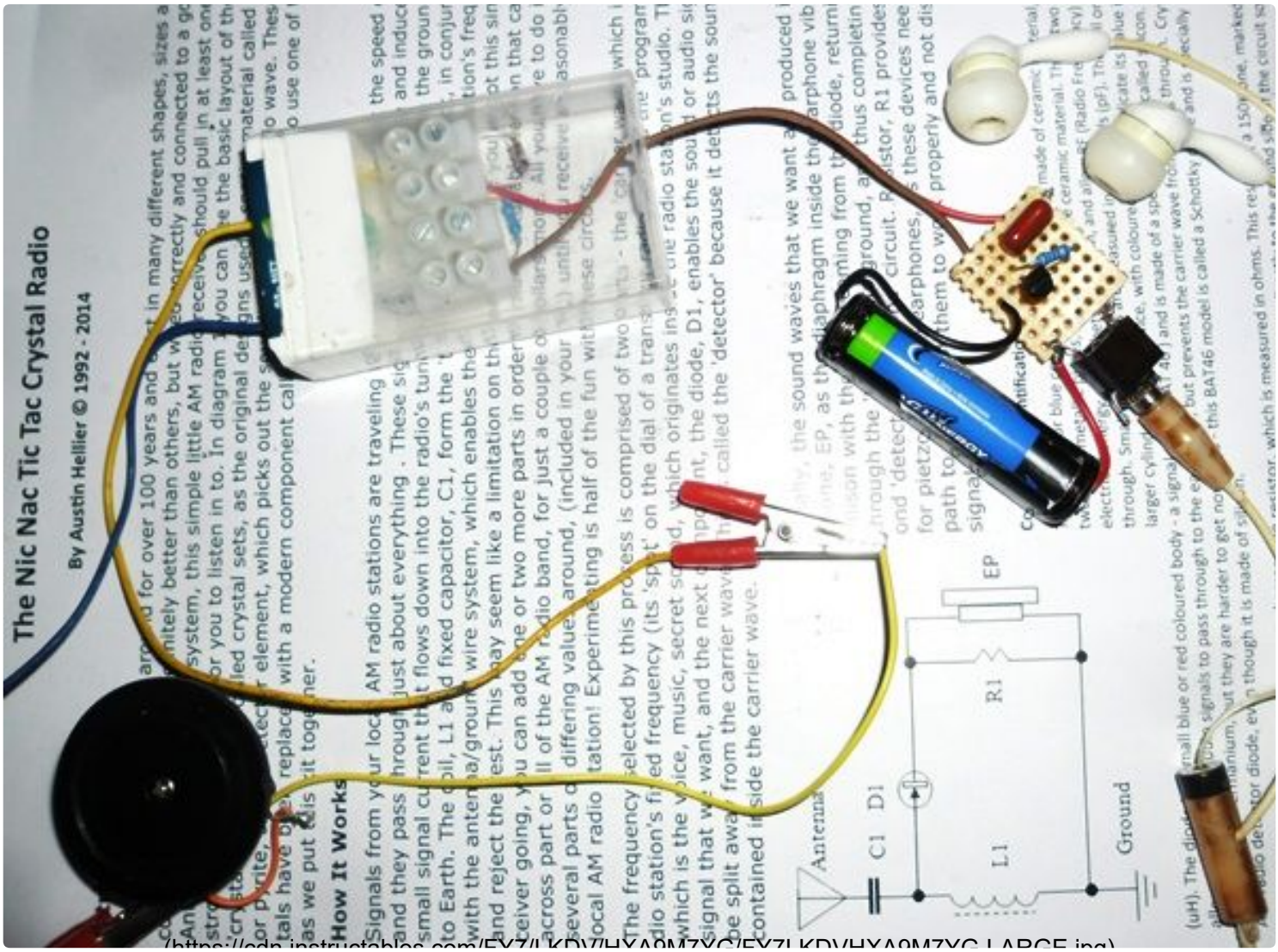

Hi there folks - this isn't really an extra 'Step' as such - it's a sneak preview at a picture of my upcoming Instructable for a one transistor amplifier, which will connect to the Tic Tac Radio - and give you some really good volume - in your Iphone

earbuds!

Yes, it's entirely possible nowadays, with modern circuit design, to fit a one transistor amp in such a small space (yes kiddies - it WILL fit inside the smaller Tic Tac box...) and at the same time, get that great sound that comes from those "inside your ear" type earbuds.

This circuit took me about a half hour to complete, uses only 3 electronic components, costing about $1.00, a stereo earphone jack and a 1.5 volt AAA battery and plastic holder costing about another $3 to $4, so you can build the amplifier for about $5 all up - don't forget to shop around and - mums and dads - cheap batteries will be OK for this project, and the battery can simply be replaced without soldering or undoing half a dozen screws....

I can hear my Tic Tac Radio with great volume and clarity - and so will you, so "stay tuned" (ha ha ha) to this series of Instructables, and you will hear great sound too...

mk484

Add Tip

Ask Question

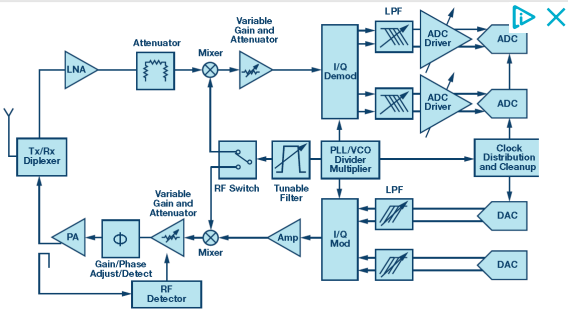

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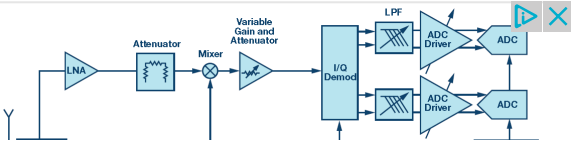

go to: Talking Electronics Website

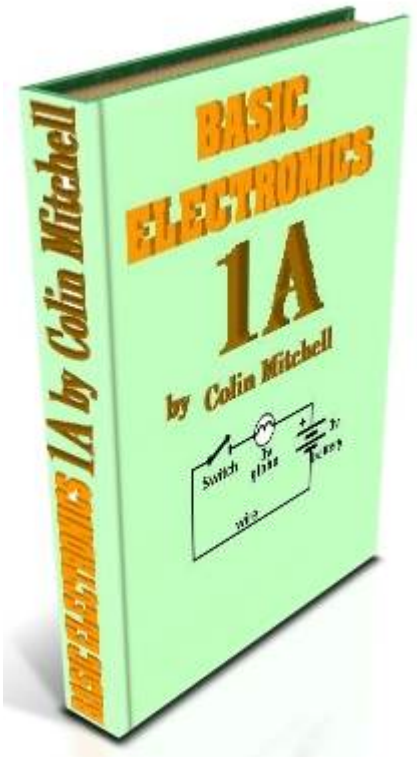

For any enquiries email Colin Mitchell

THE MULTIMETER

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The Diode - how the diode works
Circuit Symbols - EVERY Circuit Symbol
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The 555 TEST
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Diode - measuring	Voltage - measuring

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TWO MULTIMETERS

There are basically two different types of MULTIMETER. ANALOGUE and DIGITAL

Analogue Multimeters have a NEEDLE or POINTER that moves across a scale.

Digital Multimeters have a numeric display of 3 or more digits. A Digital Multimeter with 3½ digits means the first digit shows only "1."

You really need both types to cover the number of tests needed for designing and repair-work. We will discuss how they work, how to use them and some of the differences between them.

The black (negative lead) ALWAYS stays in the

black hole and the red lead changes to the other red hole to measure 10 amps

to Index

BUYING A MULTIMETER

There are many different types on the market.
The cost is determined by the number of ranges and also the extra features such as diode tester, buzzer (continuity), transistor tester, high DC current and others.
Since most multimeters are reliable and accurate, buy one with the greatest number of ranges at the lowest cost. The cheapest multimeters are on **eBay**.
This article explains the difference between an analogue meter and a digital meter.

Multimeters are sometimes called a "meter", a "VOM" (Volts-Ohms-Milliamps or Volt Ohm Meter) or "multi-tester" or even "a tester" - they are all the same.

One term used to describe a **DIGITAL MULTIMETER** is **3½ digits**.
This is the number of digits on the display. The first digit is usually made from two pixels and can only produce "1." This is called a half-digit. The other digits are full digits. The cheapest digital multimeters have 3½ digits. This will produce a reading of 1999 and the decimal point can produce values from 1.999 to 19.99 to 199.9 to 1999.
Another term is **DISPLAY COUNTS**. This is connected with the accuracy of the display, but since digital meters are accurate to 1% or less and we are using resistors with an accuracy of 5%, even a $10.00 digital meter will be perfect.

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USING A MULTIMETER

Analogue and **digital** multimeters have either a rotary selector switch or push buttons to select the appropriate function and range. Some Digital Multimeters (DMMs) are auto ranging; they automatically select the correct range of voltage, resistance, or current when doing a test. However you need to select the function.

Before making any measurement you need to know what you are checking. If you are measuring voltage, select the AC range (10v, 50v, 250v, or 1000v) or DC range (0.5v, 2.5v, 10v, 50v, 250v, or 1000v). If you are measuring resistance, select the Ohms range (x1, x10, x100, x1k, x10k). If you are measuring current, select the appropriate current range DCmA 0.5mA, 50mA, 500mA, 10A. Every multimeter is different however the photo below shows a low cost Analogue multimeter with the basic ranges.

An ANALOGUE MULTIMETER

The most important point to remember is this:
You must select a voltage or current range that is bigger or HIGHER than the maximum expected value, so the needle does not swing across the scale and hit the "end stop."
If you are using a DMM (Digital Multi Meter), the meter will indicate if the voltage or current is higher than the selected scale, by showing "OL" - this means "Overload."
If you are measuring resistance such as 1M on the x10 range the "OL" means "Open Loop" and you will need to change the range. Some meters show "1' on the display when the measurement is higher than the display will indicate and some flash a set of digits to show over-voltage or over-current. A "-1" indicates the leads should be reversed for a "positive reading."
If it is an AUTO RANGING meter, it will automatically produce a reading, otherwise the selector switch must be changed to another range.

A typical DIGITAL Multimeter

The Common (negative) lead ALWAYS fits into the "COM" socket. The red lead fits into the red socket for Voltage and Resistance. Place the red lead (red banana plug) into "A" (for HIGH CURRENT "Amps") or mA,uA for LOW CURRENT.

The black "test lead" plugs into the socket marked "-" "Common", or "Com," and the red "test lead" plugs into the meter socket marked "+" or "V-W-mA." The third banana socket measures HIGH CURRENT and the positive (red lead) plugs into this. You DO NOT move the negative "-" lead at any time.
The following two photos show the test leads fitted to a digital meter. The probes and plugs have "guards" surrounding the probe tips and also the plugs so you can measure high voltages without getting near the voltage-source.

Analogue meters have an "Ohms Adjustment" to allow for the change in voltage of the battery inside the meter (as it gets old).

"Ohms Adjust" is also called "ZERO SET"

The sensitivity of this meter is 20,000ohms/volt on the DC ranges and 5k/v on the AC ranges

Before taking a resistance reading (each time, for any of the Ohms scales) you need to "ZERO SET" the scale, by touching the two probes together and adjust the pot until the needle reads "0" (swings FULL SCALE). If the pointer does not reach full scale, the batteries need replacing. Digital multimeters do not need "zero adjustment."

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ANALOGUE Vs DIGITAL

You cannot say one meter is better than the other because BOTH have advantages and disadvantages.
An analogue multimeter is the "old style" and it puts a load on a circuit and this may change the reading to give an incorrect readout, but it has the advantage of the needle moving across the scale fairly quickly so you can sometimes see if the voltage is fluctuating.
It also gives a more-accurate result in some high frequency circuits as it does not pick up stray fields and produce a false reading.
Digital meters put almost no load on a circuit and produce accurate readings from both low-impedance and high-impedance circuits.
Digital meters can display very low resistances.
You must remember to turn a Digital meter OFF to prevent the battery going flat.

If you are testing a circuit containing a high-frequency oscillator, use BOTH an ANALOGUE and DIGITAL meter to check the reading. Sometimes the leads of a Digital multimeter will pick up signals and create a false reading.
Sometimes you will get a voltage reading with a Digital multimeter due to a high resistance leak and a zero reading with an Analogue meter. This is why you need **BOTH** meters.

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MEASURING VOLTAGE

Most of the readings taken with a multimeter will be VOLTAGE readings.
Before taking a reading, you should select the highest range and if the needle does not move up scale (to the right), you can select another range.
Always switch to the highest range before probing a circuit and keep your fingers away from the component being tested.
If the meter is Digital, select the highest range or use the auto-ranging feature, by selecting "V." The meter will automatically produce a result, even if the voltage is

AC or DC.
If the meter is not auto-ranging, you will have to select V⎓ if the voltage is from a DC source or V~ if the voltage is from an AC source. DC means Direct Current (but this does not mean you select the CURRENT range - you are taking a voltage reading that is not rising and falling. That's why we say it is **DC** and do not say the words "direct current"). The voltage is coming from a battery or supply where it is steady and not "rising and falling."
You can measure the voltage at different points in a circuit by connecting the black probe to chassis. This is the 0v reference and is commonly called "Chassis" or "Earth" or "Ground" or "0v."
The red lead is called the "measuring lead" or "measuring probe" and it can measure voltages at any point in a circuit. Sometimes there are "test points" on a circuit and these are wires or loops designed to hold the tip of the red probe (or a red probe fitted with a mini clip).
You can also measure voltages ACROSS A COMPONENT. In other words, the reading is taken in PARALLEL with the component. It may be the voltage across a transistor, resistor, capacitor, diode or coil. In most cases this voltage will be less than the supply voltage.
If you are measuring the voltage in a circuit that has a HIGH IMPEDANCE, the reading will be inaccurate, up to 90% !!!, if you use a cheap analogue meter.

Here's a simple case.

The circuit below consists of two 1M resistors in series. The voltage at the mid point will be 5v when nothing is connected to the mid point. But if we use a cheap analogue multimeter set to 10v, the resistance of the meter will be about 100k, if the meter has a sensitivity of 10k/v and the reading will be incorrect.
Here how it works:
Every meter has a sensitivity. The sensitivity of the meter is the sensitivity of the movement and is the amount of current required to deflect the needle FULL SCALE. This current is very small, normally 1/10th of a milliamp and corresponds to a sensitivity of 10k/volt (or 1/30th mA, for a sensitivity of 30k/v).
If an analogue meter is set to 10v, the internal resistance of the meter will be 100k for a 10k/v movement.
If this multimeter is used to test the following circuit, the reading will be inaccurate.
The reading should be 5v as show in diagram **A**.
But the analogue multimeter has an internal resistance of 100k and it creates a circuit shown in **C**.
The top 1M and 100k from the meter create a combined PARALLEL resistance of 90k. This forms a series circuit with the lower 1M and the meter will read less than 1v
If we measure the voltage across the lower 1M, the 100k meter will form a value of resistance with the lower 1M and it will read less than 1v
If the multimeter is 30k/v, the readings will be 2v. See how easy it is to get a totally inaccurate reading.

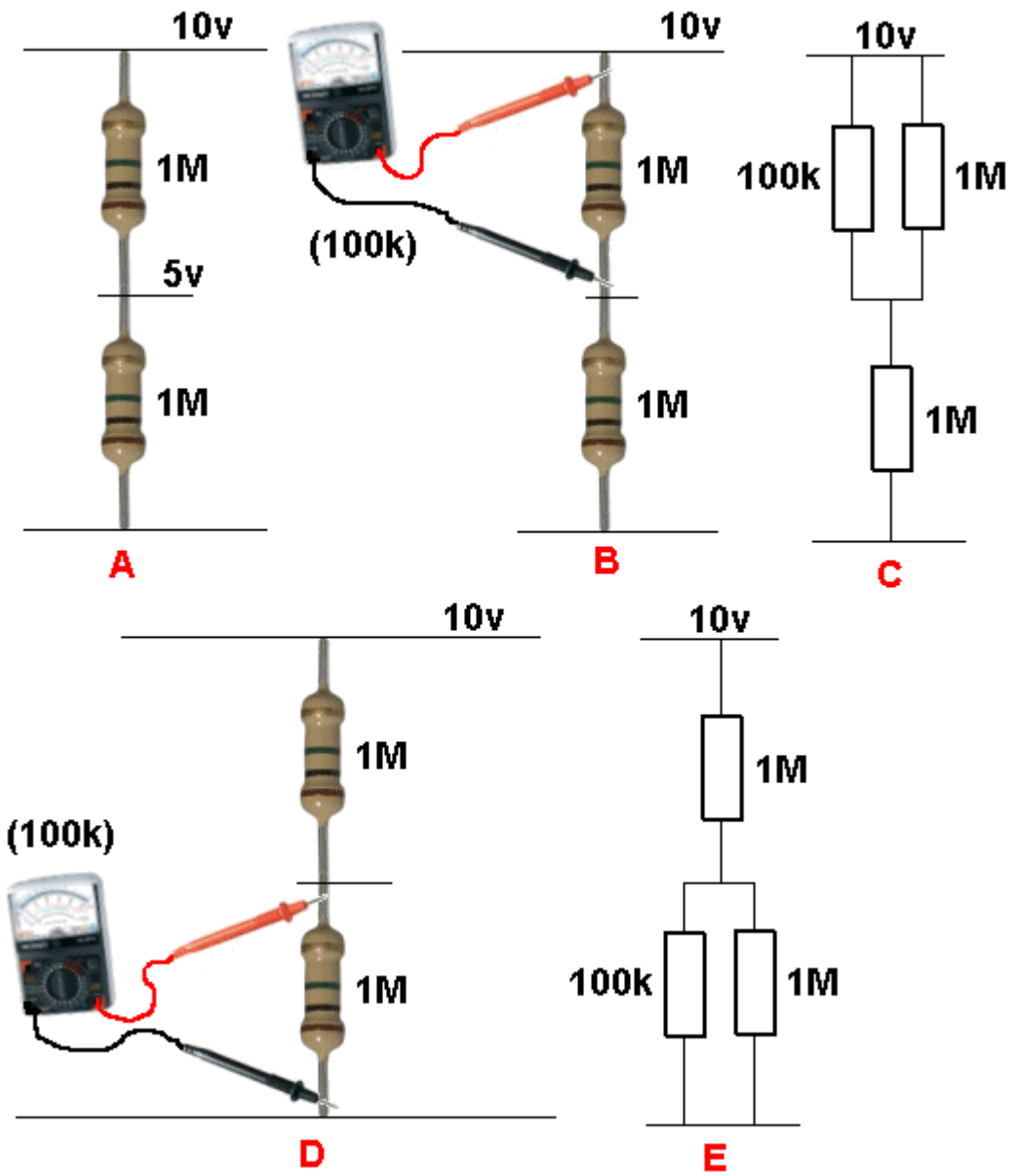

If the reading is taken with a Digital Meter, it will be more accurate as a DMM does not take any current from the circuit (to activate the meter). In other words it has a very HIGH input impedance. Most Digital Multimeters have a fixed input resistance (impedance) of 10M - no matter what scale is selected. That's the reason for choosing a DMM for high impedance circuits. It also gives a reading that is accurate to about 1%.

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MEASURING VOLTAGES in a CIRCUIT

You can take many voltage-measurements in a circuit. You can measure "across" a component, or between any point in a circuit and either the positive rail or earth rail (0v rail). In the following circuit, the 5 most important voltage-measurements are shown. Voltage "A" is across the electret microphone. It should be between 20mV and 500mV. Voltage "B" should be about 0.6v. Voltage "C" should be about half-rail voltage. This allows the transistor to amplify both the positive and negative parts of the waveform. Voltage "D" should be about 1-3v. Voltage "E" should be the battery

voltage of 12v.

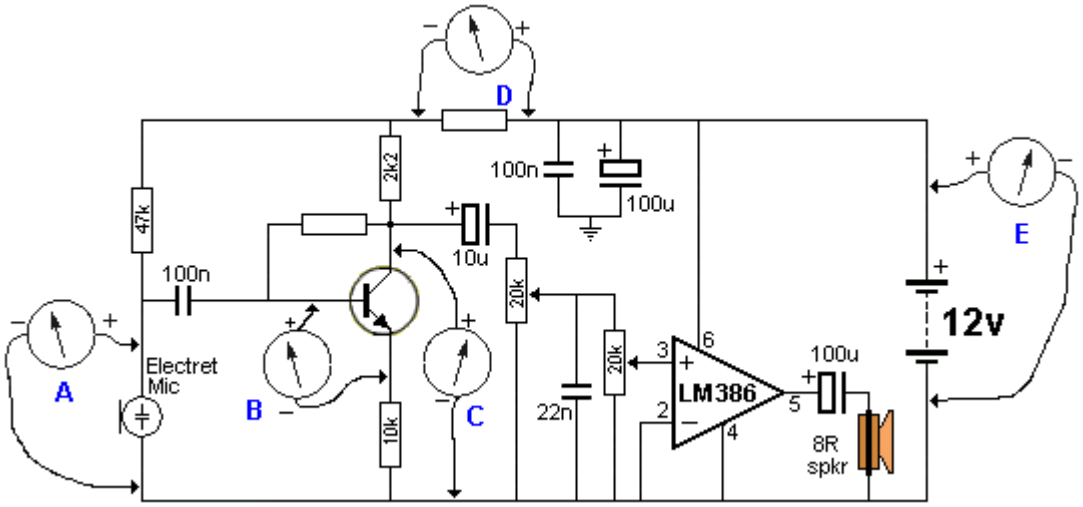

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MEASURING CURRENT

You will rarely need to take current measurements, however most multimeters have DC current ranges such as 0.5mA, 50mA, 500mA and 10Amp (via the extra banana socket) and some meters have AC current ranges. Measuring the current of a circuit will tell you a lot of things. If you know the normal current, a high or low current can let you know if the circuit is overloaded or not fully operational.

Current is always measured when the circuit is working (i.e: with power applied).
It is measured IN SERIES with the circuit or component under test.
The easiest way to measure current is to remove the fuse and take a reading across the fuse-holder. Or remove one lead of the battery or turn the project off, and measure across the switch.
If this is not possible, you will need to remove one end of a component and measure with the two probes in the "opening."
Resistors are the easiest things to desolder, but you may have to cut a track in some circuits. You have to get an "opening" so that a current reading can be taken.
The following diagrams show how to connect the probes to take a CURRENT reading.
Do not measure the current ACROSS a component as this will create a "short-circuit."
The component is designed to drop a certain voltage and when you place the probes across this component, you are effectively adding a "link" or "jumper" and the voltage at the left-side of the component will appear on the right-side. This voltage may be too high for the circuit being supplied and the result will be damage.

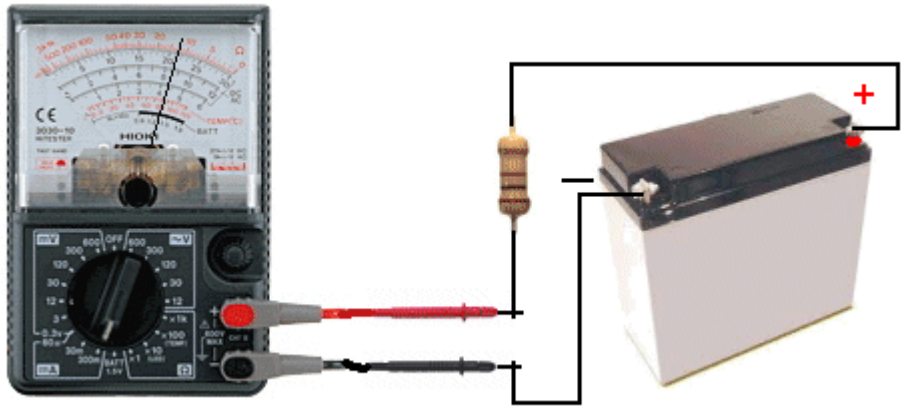

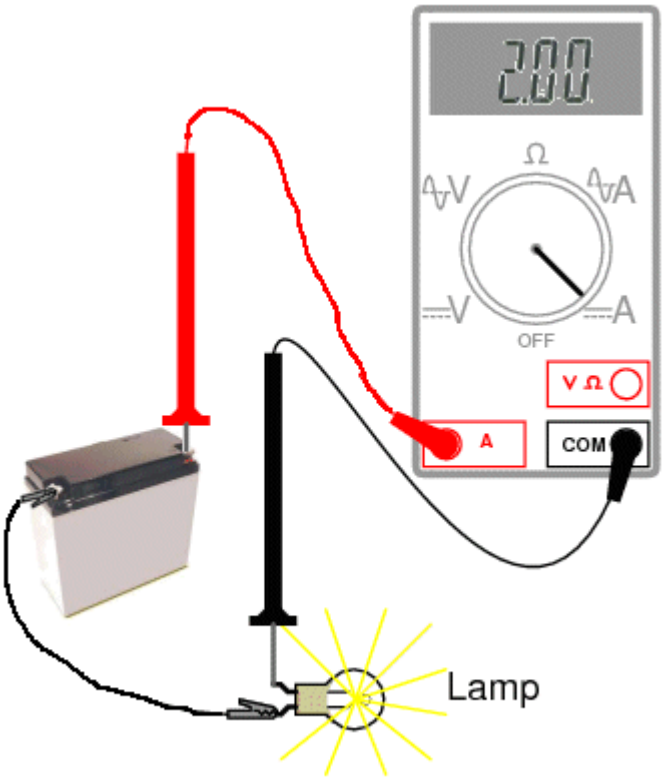

Measuring the current of a globe

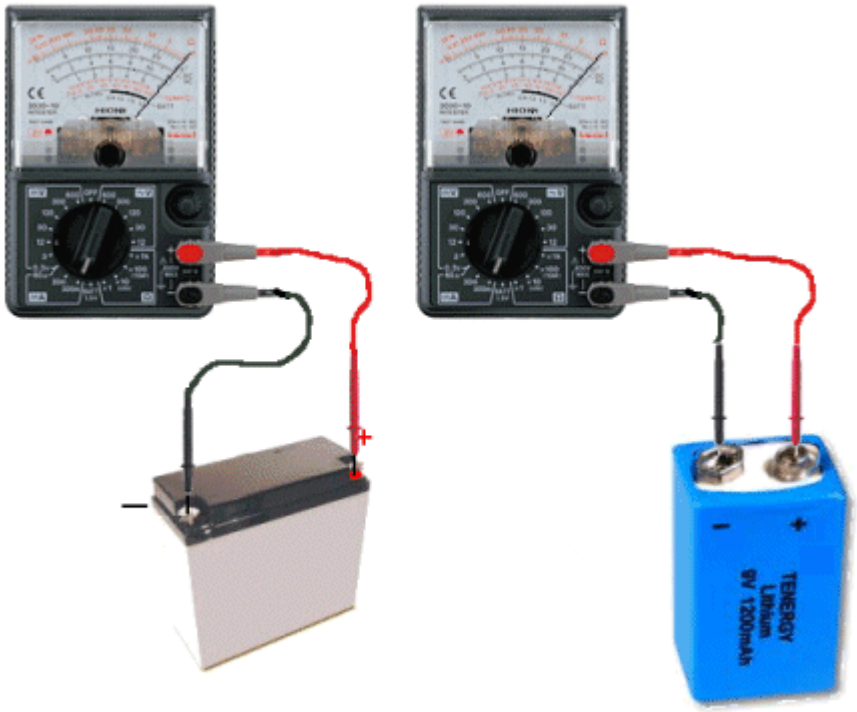

Do NOT measure the CURRENT of a battery
(by placing the meter directly across the terminals)
A battery will deliver a very HIGH current
and damage the meter

Do not measure the "current a battery will deliver" by placing the probes across the terminals. It will deliver a very high current and damage the meter instantly. There are special battery testing instruments for this purpose.

When measuring across an "opening" or "cut," place the red probe on the wire that supplies the voltage (and current) and the black probe on the other wire. This will produce a "POSITIVE" reading.
A positive reading is an UPSCALE READING and the pointer will move across the scale - to the right. A "NEGATIVE READING" will make the pointer hit the "STOP" at the left of the scale and you will not get a reading. If you are using a Digital Meter, a negative sign "-" will appear on the screen to indicate the probes are around the wrong way. No damage will be caused. It just indicates the probes are connected incorrectly.
If you want an accurate CURRENT MEASUREMENT, use a digital meter.

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MEASURING RESISTANCE

Turn a circuit off before measuring resistance.
If any voltage is present, the value of resistance will be incorrect.
In most cases you cannot measure a component while it is in-circuit. This is because the meter is actually measuring a voltage across a component and calling it a "resistance." The voltage comes from the battery inside the meter. If any other voltage is present, the meter will produce a false reading.
If you are measuring the resistance of a component while still "in circuit," (with the power off) the reading will be lower than the true reading.

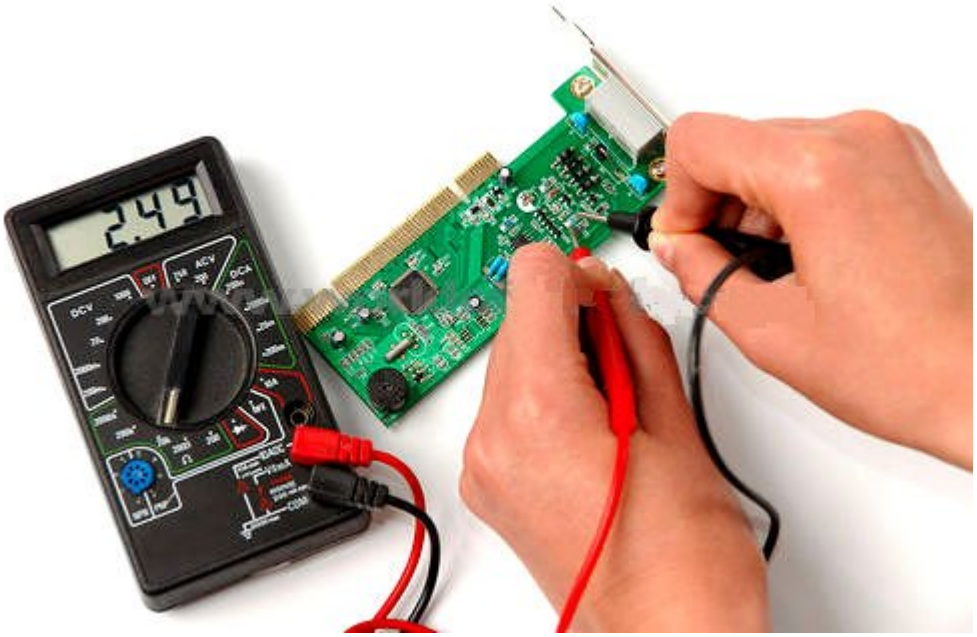

Measuring resistance

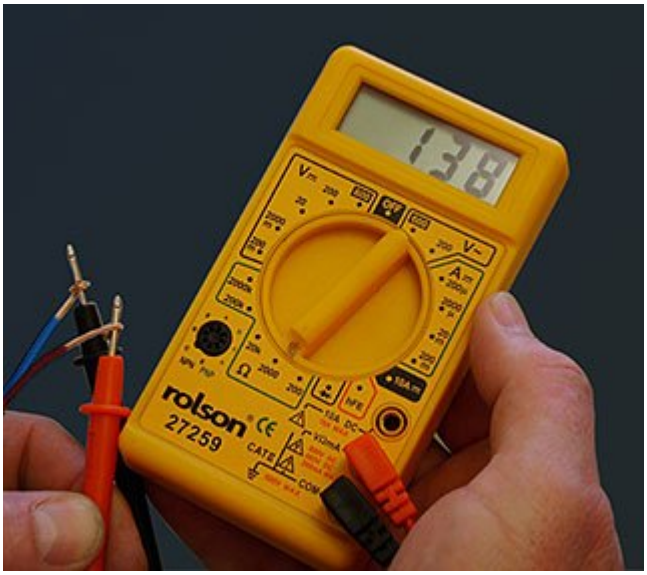

Measuring resistance of a heater
(via the leads)

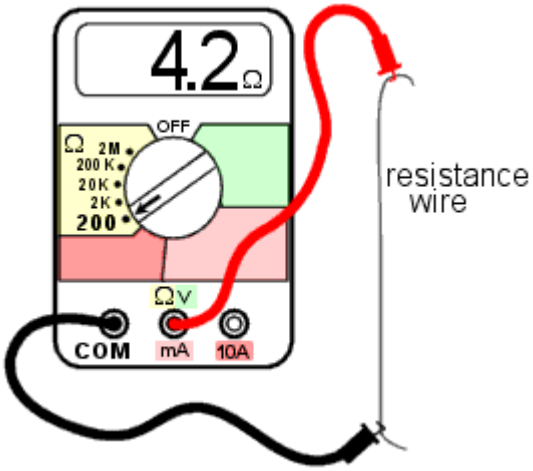

Measuring the resistance of a piece of resistance-wire

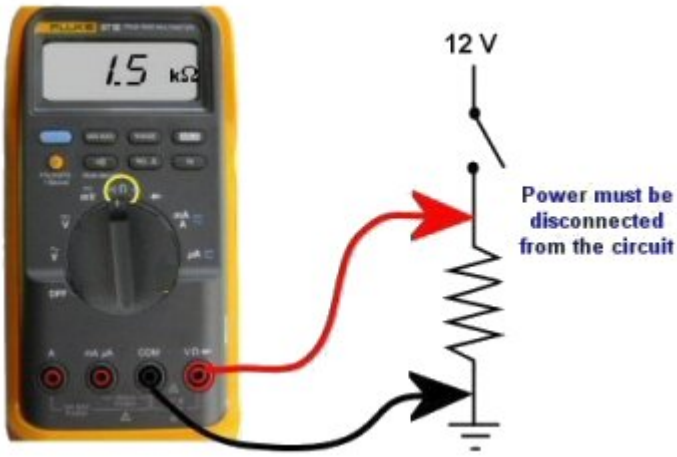

Measuring the resistance of a resistor

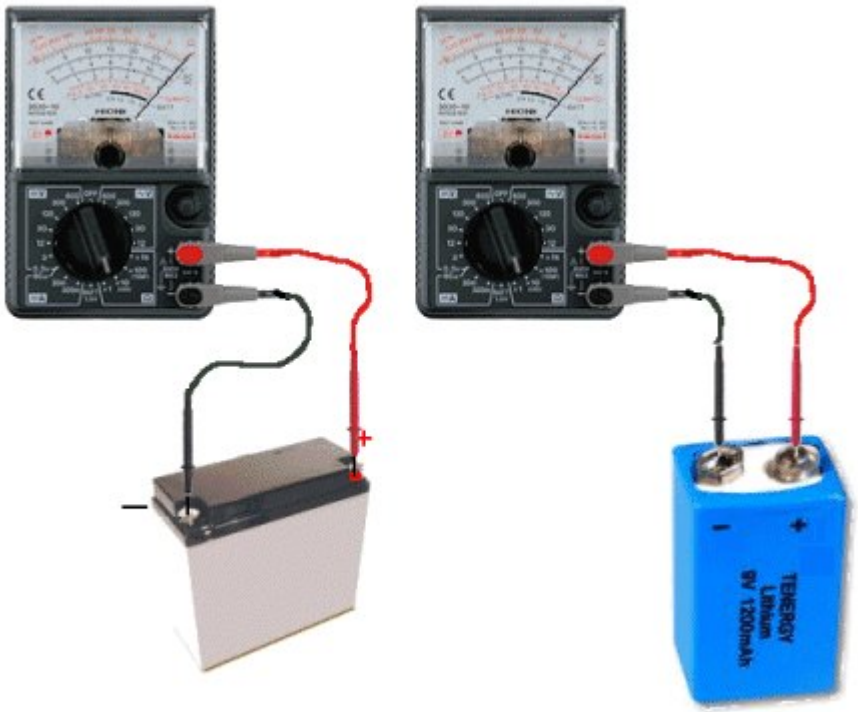

Do not measure the "Resistance of a Battery"

1. Do not measure the "resistance of a battery." The resistance of a battery (called the Internal impedance) is not measured as shown in the diagrams above. It is measured by creating a current-flow and measuring the voltage across the battery. Placing a multimeter set to **resistance** (across a battery) will destroy the meter.
2. Do not try to measure the resistance of any voltage or any "supply."

Resistance is measured in OHMs.
The resistance of a 1cm x 1cm bar, one metre long is 1 ohm.
If the bar is thinner, the resistance is higher. If the bar is longer, the resistance is higher.
If the material of the bar is changed, the resistance is higher.
When carbon is mixed with other elements, its resistance increases and this knowledge is used to make RESISTORS.
Resistors have RESISTANCE and the main purpose of a resistor is to reduce the CURRENT FLOW.
It's a bit like standing on a hose. The flow reduces.
When current flow is reduced, the output voltage is also reduced and that why the water does not spray up so high. Resistors are simple devices but they produce many different effects in a circuit.
A resistor of nearly pure carbon may be 1 ohm, but when non-conducting "impurities" are added, the same-size resistor may be 100 ohms, 1,000 ohms or 1 million ohms.
Circuits use values of less than 1 ohm to more than 22 million ohms.

Resistors are identified on a circuit with numbers and letters to show the exact value of resistance - such as 1k 2k2 4M7

The letter Ω (omega - a Greek symbol) is used to identify (or express) (or represent) the word "Ohm."
But this symbol is not available on some word-processors, so the letter "R" is used. The letter "E" is also sometimes used and both mean "Ohms."
A one-ohm resistor is written "1R" or "1E." It can also be written "1R0" or "1E0."
A resistor of one-tenth of an ohm is written "0R1" or "0E1." The letter takes the place of the decimal point.
10 ohms = 10R
100 ohms = 100R

1,000 ohms = 1k (k= kilo = one thousand)
10,000 ohms = 10k
100,000 ohms = 100k
1,000,000 ohms = 1M (M = MEG = one million)

The size of a resistor has nothing to do with its resistance. The size determines the wattage of the resistor - how much heat it can dissipate without getting too hot.
Every resistor is identified by colour bands on the body, but when the resistor is a surface-mount device, numbers are used and sometimes letters.
You MUST learn the colour code for resistors and the following table shows all the colours for the most common resistors from 1/10th of an ohm to 22 Meg ohms for resistors with 5% and 10% tolerance.

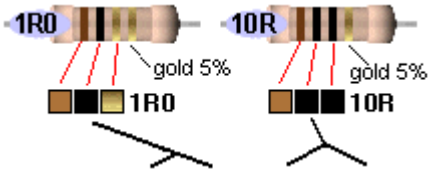

If 3rd band is gold, Divide by 10
If 3rd band is silver, Divide by 100
(to get 0.22ohms etc)

ROW	SILVER	GOLD	BLACK	BROWN	RED	ORANGE	YELLOW	GREEN
1-	R10	1R0	10R	100R	1K0	10K	100K	1M0
2-	R11	1R1	11R	110R	1K1	11K	110K	1M1
3-	R12	1R2	12R	120R	1K2	12K	120K	1M2
4-	R13	1R3	13R	130R	1K3	13K	130K	1M3
5-	R15	1R5	15R	150R	1K5	15K	150K	1M5
6-	R16	1R6	16R	160R	1K6	16K	160K	1M6
7-	R18	1R8	18R	180R	1K8	18K	180K	1M8
8-	R20	2R0	20R	200R	2K0	20K	200K	2M0
9-	R22	2R2	22R	220R	2K2	22K	220K	2M2
10-	R24	2R4	24R	240R	2K4	24K	240K	2M4
11-	R27	2R7	27R	270R	2K7	27K	270K	2M7
12-	R30	3R0	30R	300R	3K0	30K	300K	3M0
13-	R33	3R3	33R	330R	3K3	33K	330K	3M3
14-	R36	3R6	36R	360R	3K6	36K	360K	3M6
15-	R39	3R9	39R	390R	3K9	39K	390K	3M9
16-	R43	4R3	43R	430R	4K3	43K	430K	4M3
17-	R47	4R7	47R	470R	4K7	47K	470K	4M7
18-	R51	5R1	51R	510R	5K1	51K	510K	5M1
19-	R56	5R6	56R	560R	5K6	56K	560K	5M6
20-	R62	6R2	62R	620R	6K2	62K	620K	6M2
21-	R68	6R8	68R	680R	6K8	68K	680K	6M8
22-	R75	7R5	75R	750R	7K5	75K	750K	7M5
23-	R82	8R2	82R	820R	8K2	82K	820K	8M2
24-	R91	9R1	91R	910R	9K1	91K	910K	9M1
								10M (BLUE)

COLOR CODES FOR THE WHOLE E12/E24 RANGE OF RESISTORS
The twelve odd rows - 1, 3, 5... - represent values available in the E12 range only, plus 10M

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MAKE YOUR OWN RESISTOR

Make your own variable resistor that changes resistance according to the pressure.
Use a piece of conductive foam used to package Integrated Circuits. You can ask at an electronics shop.
Use two coins or pieces of printed circuit board or aluminium foil for the top and bottom conductors.
You can solder wires to the PC board or fold the aluminium foil over a few times to hold the wires.
The resistance of the foam will reduce as you press on the "cell."
The actual resistance-values will depend on the size of the foam, the thickness and

pressure.
This cell is a very simple cell called a **LOAD CELL**.

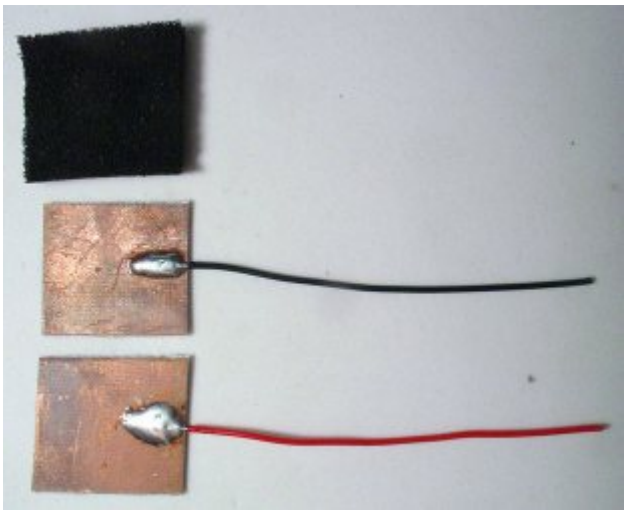
The top and bottom "plates"

The foam is placed between the plates.

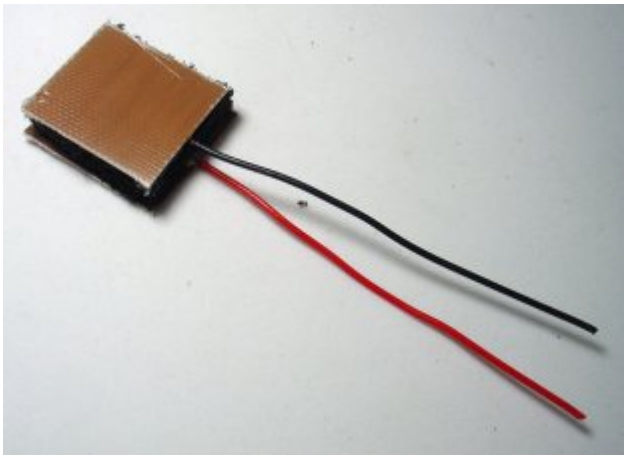
The complete LOAD CELL

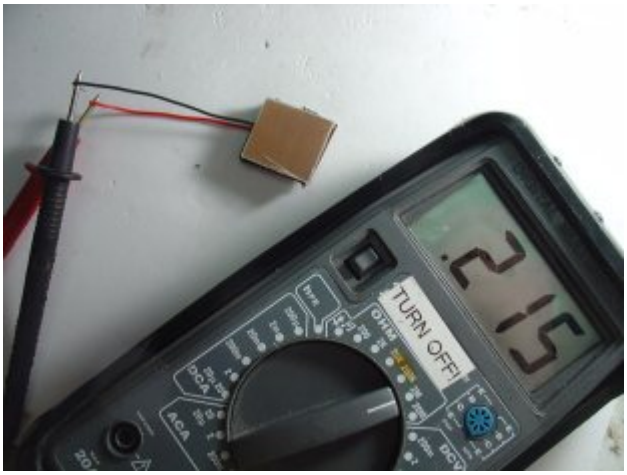

The resistance of the unloaded LOAD CELL

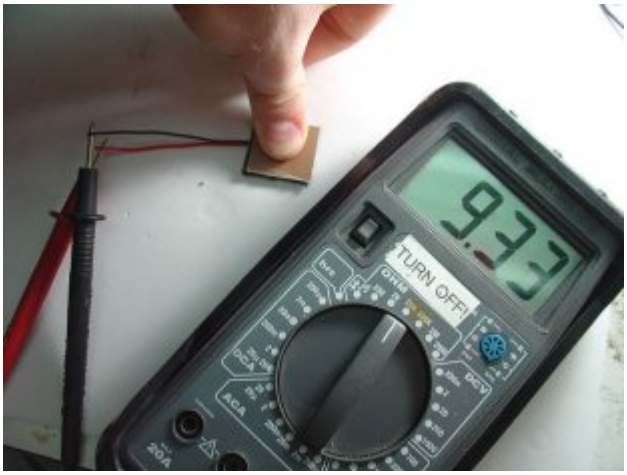

The fully loaded resistance can be as low as 9,330 ohms

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MEASURING CONTINUITY

CONTINUITY is the same as **ZERO OHMS** or the resistance of a short length of wire. It can also mean the resistance through a switch or globe or a low-value resistor.
It basically means a "PATH" and sometimes refers to a whole circuit when the switch is closed. In other words CONTINUITY means we have a "circuit." We have "current flowing" and generally refers to a low-resistance circuit.
Both ANALOGUE and DIGITAL multimeters can measure CONTINUITY and you have to work out the approximate value of resistance for the circuit you are testing, - BEFORE TAKING A READING.
If the reading is above 300 ohms or contains a diode, you cannot use a DIGITAL MULTIMETER as the buzzer on the continuity setting will not respond.

The project being tested must not have the power applied as the resistance ranges on a multimeter are actually measuring a voltage across the leads and any voltage on the circuit or contained in any electrolytics, will upset the reading.

To take a reading with an **ANALOGUE** multimeter, select the x1 setting and the pointer will move across the scale to the actual value of resistance.
It it move full scale, you have ZERO OHMS resistance and this can mean a short-circuit or continuity via a wire.
If a diode is in the circuit you must also reverse the leads to get a reading.
The resistance of a globe will be very low when it is not illuminated, so don't think a fault is present.
Measuring CONTINUITY is the same as measuring LOW RESISTANCE.

To take a reading with a **DIGITAL** multimeter, select the buzzer setting. It will respond if the resistance is less than 300 ohms. It will not respond if a diode is in the circuit.

Meter set to BUZZER - CONTINUITY

You can also use the x1 resistance setting to get an accurate value of resistance. Touch the probes together to get the initial reading and subtract this value from the final reading.
When probing a circuit containing electrolytics, you may get a beep from the buzzer. This indicates the resistance is low because the multimeter is charging the electrolytic and it will beep until the electrolytic is charged to about 0.7v.
The same applies when probing across the power rails of a circuit. The circuit may contain electrolytics that will charge when probing and the buzzer will beep.
The Digital multimeter is actually detecting a voltage less than 0.7v across the probes and is created by a voltage-divider network inside the meter.
The voltage divider put 2v across the probes and when this drops to less than 0.5v, the buzzer is activated. That why it odes not buzz when testing a diode as the diode drops the voltage to 0.6v.

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MEASURING A DIODE

A diode can be measured to see if it is "open" or "damaged" or "working" by placing the probes across the component.
If the diode is "open" (it will not work), the needle will NOT swing across the scale when touching the component with the probes in one direction or when the probes are reversed.
If the diode is "damaged" (does not work), the needle will swing fully across the scale when touching the component with the probes in one direction or when the probes are reversed.
If the diode is FUNCTIONAL, (works) the needle will swing about mid-way when touching the leads of the diode in one direction and it will not move when the probes are reversed.

WHY?

The positive of the battery inside an analogue multimeter comes out the black probe and that is why you will get a reading when the probers are "around the wrong way." The needle will swing a different amount for each resistance setting on the dial as the needle represents 0.6v drop and NOT an actual resistance.

There are two things you must remember.
1. When the diode is measured in one direction, the needle will will **not move at**

all. The technical term for this is the diode is **reverse biased**. It will not allow any current to flow. Thus the needle will not move.
When the diode is connected around the other way, the needle will swing to the right (move up scale) to about 80% of the scale. This position represents the voltage drop across the junction of the diode and is NOT a resistance value. If you change the resistance range, the needle will move to a slightly different position due to the resistances inside the meter. The technical term for this is the diode is **forward biased**. This indicates the diode is not faulty.
The needle will swing to a slightly different position for a "normal diode" compared to a Schottky diode. This is due to the different junction voltage drops.
However we are only testing the diode at very low voltage and it may break-down when fitted to a circuit due to a higher voltage being present or due to a high current flowing.

2. The leads of an **Analogue Multimeter** have the positive of the battery connected to the black probe and the readings of a "good diode" are shown in the following two diagrams:

The diode is REVERSE BIASED in the diagram above and diodes not conduct.

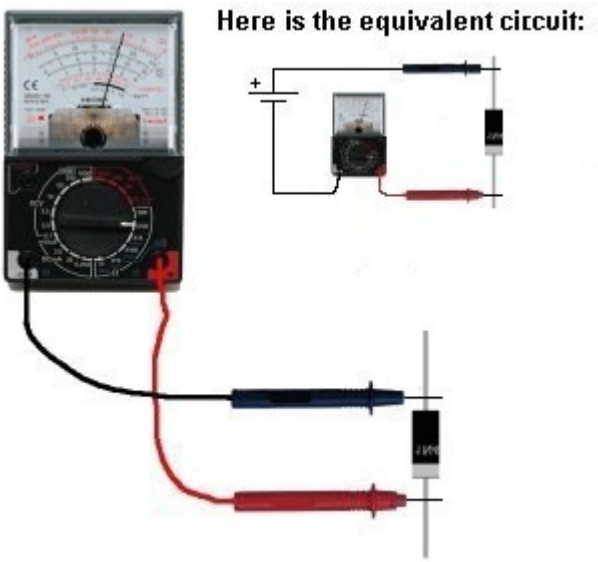

The diode is FORWARD BIASED in the diagram above and it conducts

TESTING A DIODE ON A DIGITAL METER

A Digital multimeter will measure the voltage-drop across the diode when the probes are connected in one direction (approx 0.640 on the scale) and a high reading (1) in the other direction. You need to select the "DIODE" setting on the dial as the other settings will produce a meaningless reading.

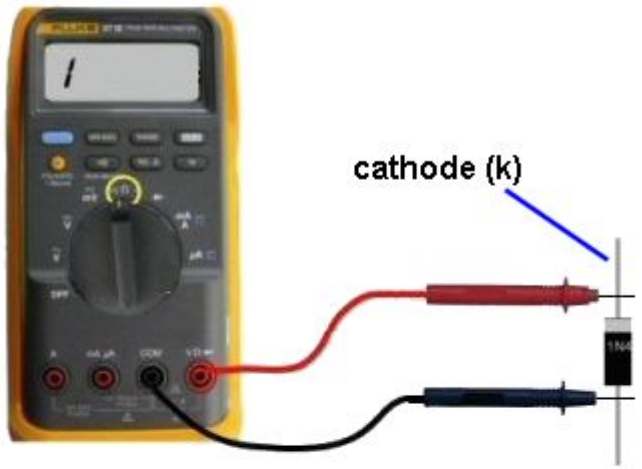

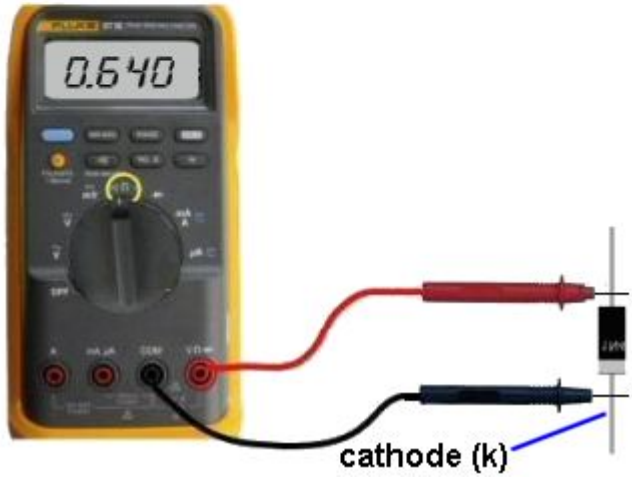

Some DIGITAL MULTIMETERS will show mV drop across the diode when the setting on the meter is "diode" or the "x1" or "x10" resistance range.

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TESTING A LED

Some multimeters will test LEDs.
It depends on the voltage of the battery inside the case of the multimeter.
Many analogue multimeters have a single 1.5v cell and these cannot test LEDs.
Analogue Multimeters with 3v (for the resistance ranges) can test some LEDs.
White LEDs need about 3.6v and they may not illuminate on 3v.

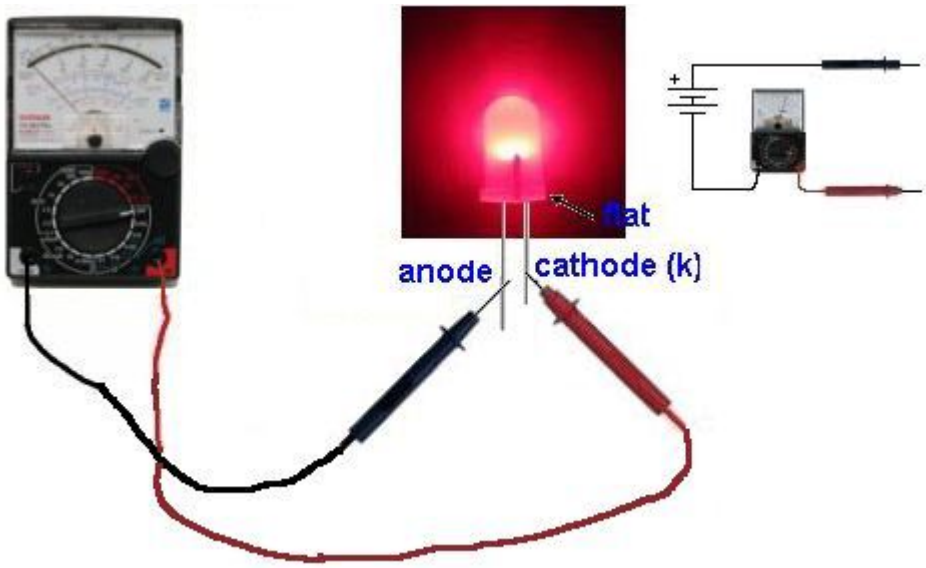

The negative lead of an ANALOGUE meter is POSITIVE!
The multimeter must have 3v (2 cells)

Digital multimeters have a 9v battery and they will illuminate all colour LEDs when the leads are placed as shown in the diagram:

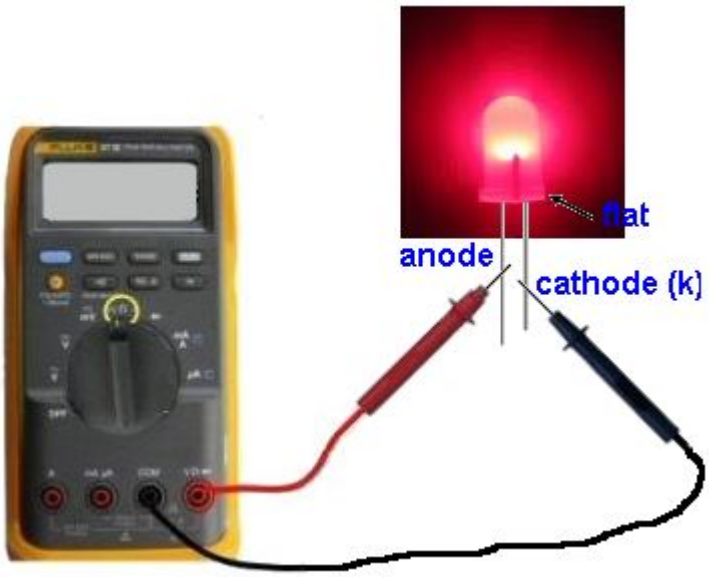

A Digital meter will illuminate all LEDs and the black probe touches the cathode.

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TESTING A TRANSISTOR WITH A DIGITAL METER

Testing a transistor with a **Digital Meter** must be done on the "DIODE" setting as a digital meter does not deliver a current through the probes on some of the resistance settings and will not produce an accurate reading.
The "DIODE" setting must be used for diodes and transistors. It should also be called a "TRANSISTOR" setting.

TESTING A TRANSISTOR WITH AN ANALOGUE METER

The first thing you may want to do is test an unknown transistor for COLLECTOR, BASE AND EMITTER. You also want to perform a test to find out if it is NPN or PNP. That's what this test will provide.
You need a cheap multimeter called an ANALOGUE METER - a multimeter with a

scale and pointer (needle).
It will measure resistance values (normally used to test resistors) - (you can also test other components) and Voltage and Current. We use the resistance settings. It may have ranges such as "x10" "x100" "x1k" "x10"
Look at the resistance scale on the meter. It will be the top scale.
The scale starts at zero on the right and the high values are on the left. This is opposite to all the other scales.
When the two probes are touched together, the needle swings FULL SCALE and reads "ZERO." Adjust the pot on the side of the meter to make the pointer read exactly zero.

How to read: "x10" "x100" "x1k" "x10"
Up-scale from the zero mark is "1"
When the needle swings to this position on the "x10" setting, the value is 10 ohms.
When the needle swings to "1" on the "x100" setting, the value is 100 ohms.
When the needle swings to "1" on the "x1k" setting, the value is 1,000 ohms = 1k.
When the needle swings to "1" on the "x10k" setting, the value is 10,000 ohms = 10k.
Use this to work out all the other values on the scale.
Resistance values get very close-together (and very inaccurate) at the high end of the scale. [This is just a point to note and does not affect testing a transistor.]

Step 1 - FINDING THE BASE and determining NPN or PNP
Get an unknown transistor and test it with a multimeter set to "x10"
Try the 6 combinations and when you have the black probe on a pin and the red probe touches the other pins and the meter swings nearly full scale, you have an NPN transistor. The black probe is BASE
If the red probe touches a pin and the black probe produces a swing on the other two pins, you have a PNP transistor. The red probe is BASE
If the needle swings FULL SCALE or if it swings for more than 2 readings, the transistor is **FAULTY**.

This is an NPN transistor
The black probe is the BASE

This is a PNP transistor
The red probe is the BASE

Step 2 - FINDING THE COLLECTOR and EMITTER
Set the meter to "x10k."
For an NPN transistor, place the leads on the transistor and when you press hard on the two leads shown in the diagram below, the needle will swing almost full scale.

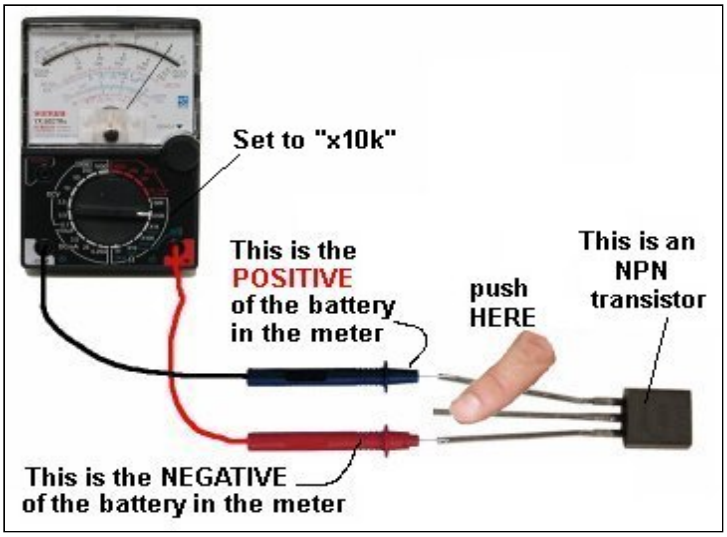

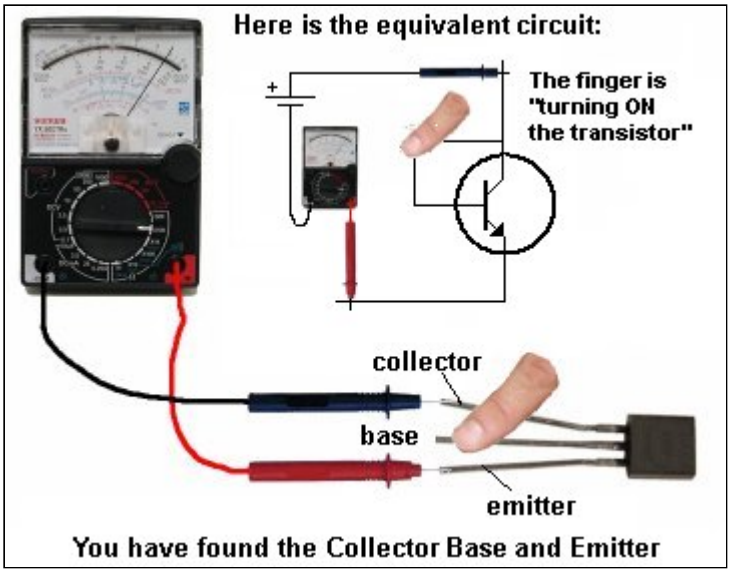

For a PNP transistor, set the meter to "x10k" place the leads on the transistor and when you press hard on the two leads shown in the diagram below, the needle will swing almost full scale.

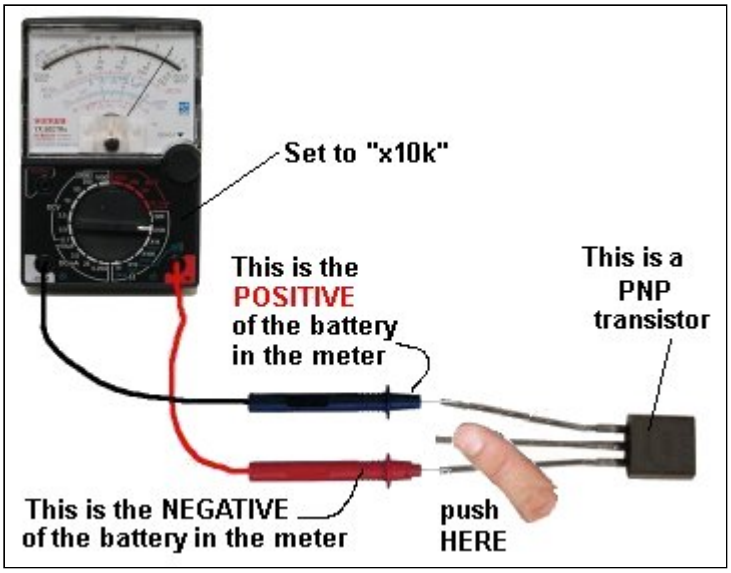

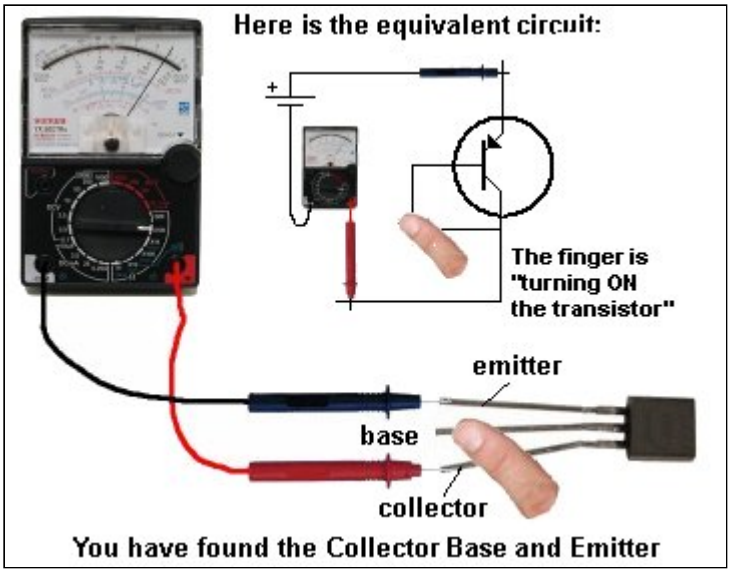

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For more details on testing components with a multimeter, see:
Testing Electronic Components.

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MULTIMETER TEST

1. What is the reading on the multimeter:

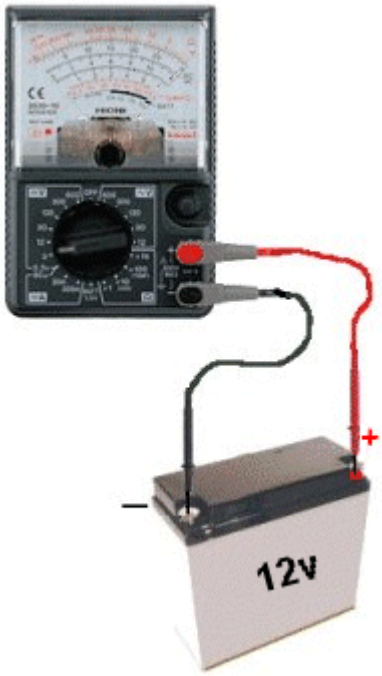

Answer

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2. What is the reading on the multimeter:

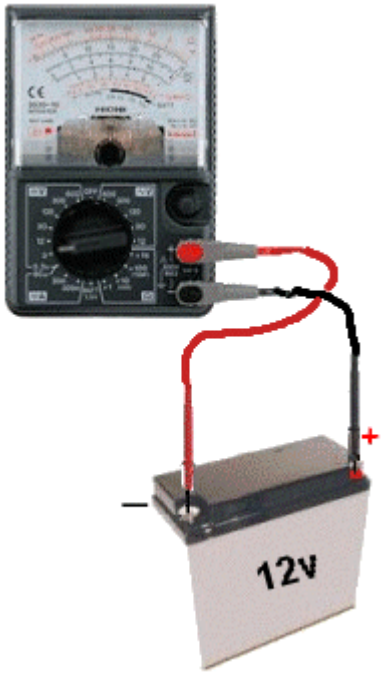

Answer

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3. What is the reading on the multimeter:

Answer

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4. What is the voltage between the following points:

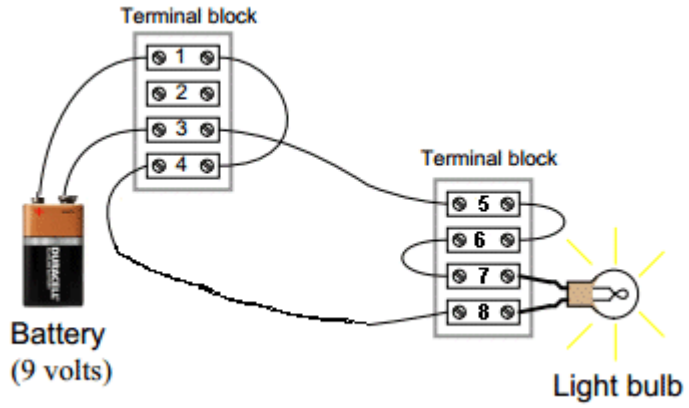

Between 1 & 3	Between 5 & 7	Between 3 & 8	Between 1 & 7
Answer	**Answer**	**Answer**	**Answer**

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5. What is the voltage on each multimeter:

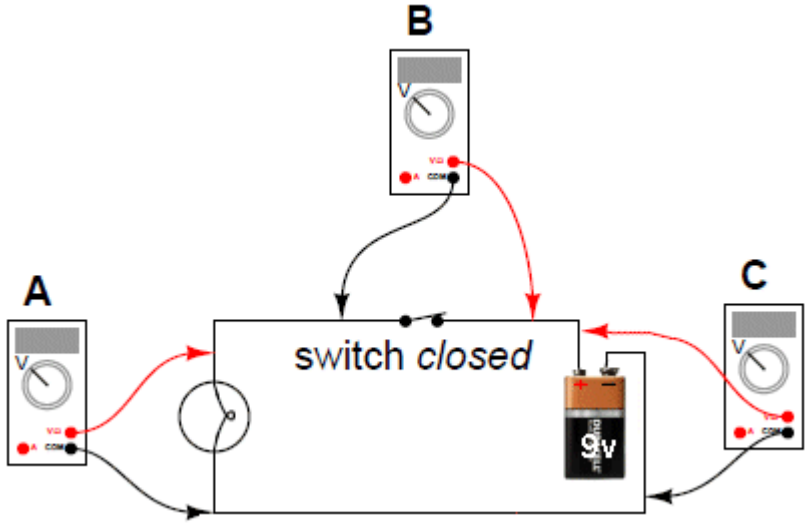

Meter A	Meter B	Meter C
Answer	**Answer**	**Answer**

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6. What is the voltage on each multimeter:

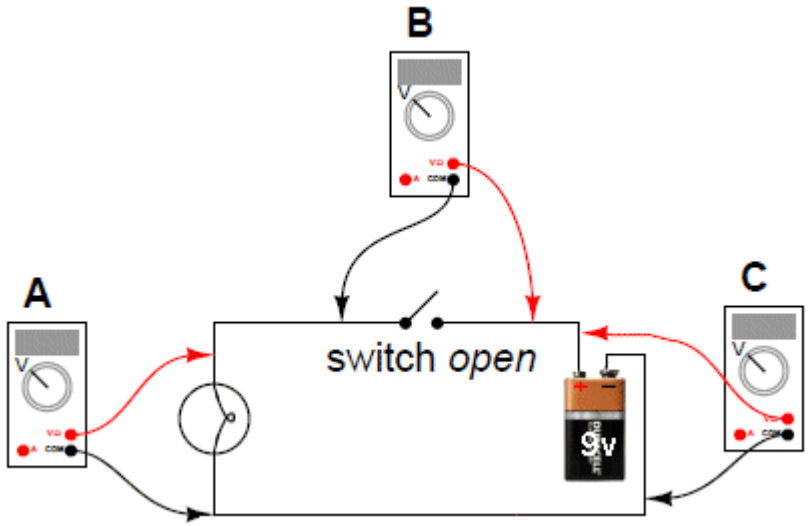

Meter A

Answer

Meter B

Answer

Meter C

Answer

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7. What is the reading on the multimeter:

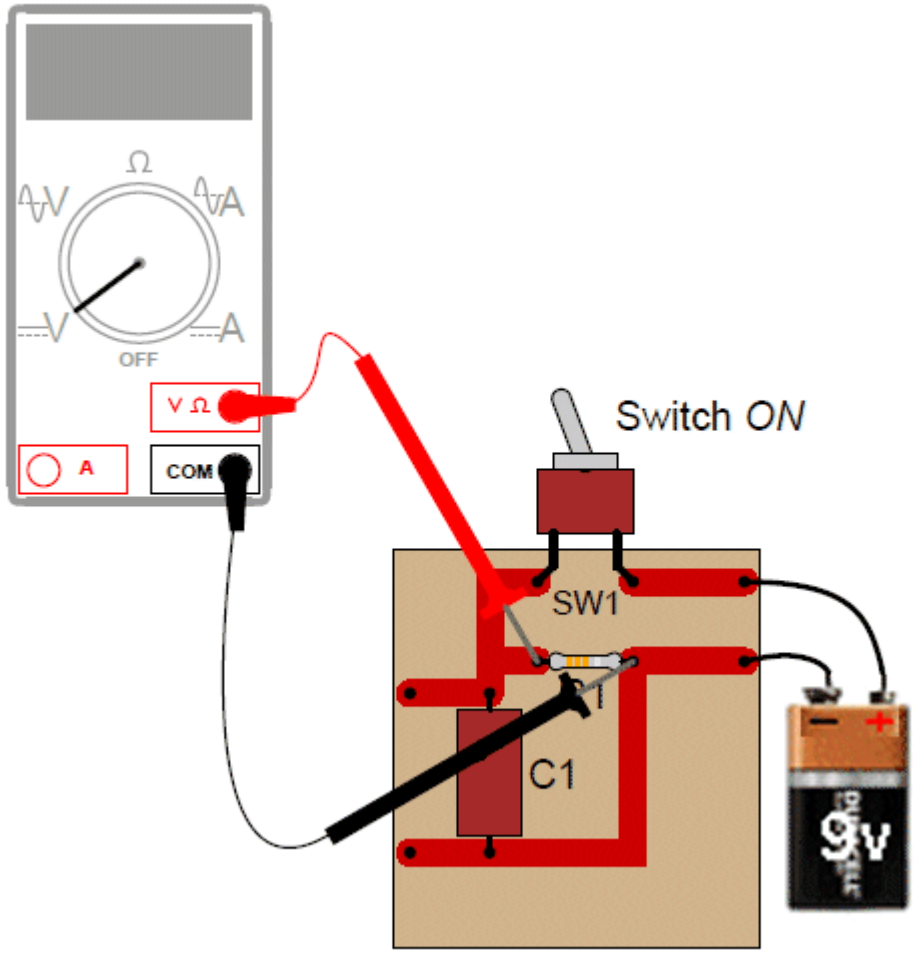

Answer

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8. The multimeter has three resistance ranges: **x1 ohms** **x100 ohms** **x10k ohms**. How far across the scale will the needle move on each range for a 4k7 resistor:

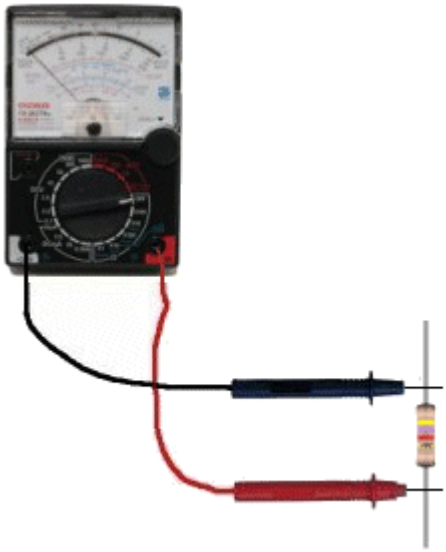

x1 **x100** **x10k**

Answer **Answer** **Answer**

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9. The resistance ranges on an ANALOGUE multimeter use the battery inside the case to move the pointer. If the multimeter is left on "**ohms range**" with the probes apart, will the battery go flat?

Answer

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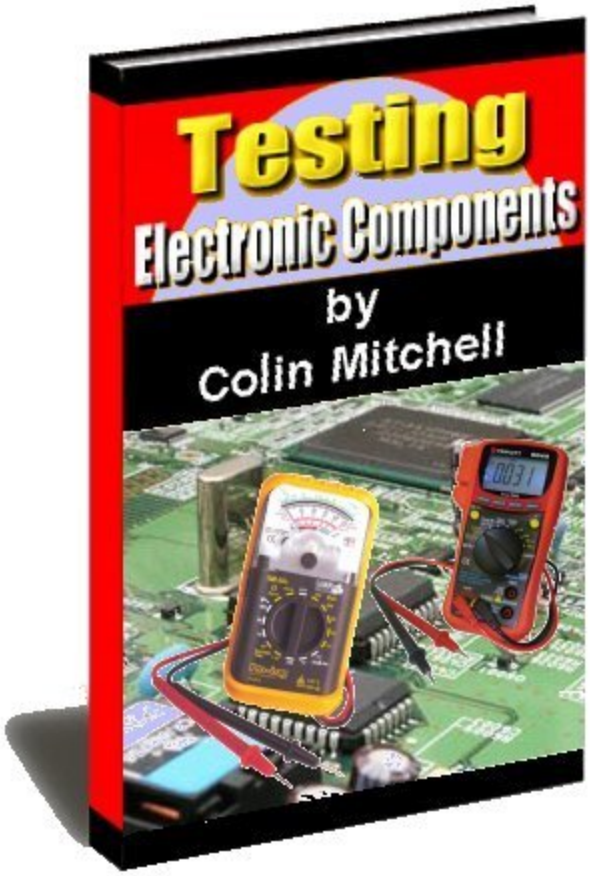

This eBook shows you how to TEST COMPONENTS.
To do this you need "TEST GEAR." The best item of Test Gear is a MULTIMETER. It can test almost 90% of all components. And that's what we will do in this eBook:

CONTENTS

Analogue Multimeter	Multimeters
Audio Stages	Non-polar Capacitor (electrolytic)
Batteries - testing	Open Circuit
Burnt Resistor	"Open" Resistor - damaged
Buying A Multimeter	Opto-couplers
Capacitors	Parallel - resistors
Capacitors - decoupling caps	Parallel and Series Capacitors
Capacitors in Parallel	Piezo Diaphragms
Capacitor Substitution Box	Piezo Buzzers
Cells - batteries	Potentiometers
Circuit Symbols	Pots - testing
Co-Ax Cables	Power Diodes
Colour Code (Resistor)	Power Supply -see Basic Electronics 1A
Coils	Reed Switch
Continuity	Relays
Creating any value of R	Remote Controls

Current - measuring
Current Sensing Resistors
Current Transformer
Damper Diodes
Darlington Transistors
Digital Chips
Digital Multimeter
Digital Transistors
Diodes replacing a diode
Discharge a Capacitor
Earth Leakage Detectors
Electrolytics
FETs
Fingers - to feel temperature
Focus pots
Fuses and 100mA fuses
Germanium Diodes
Heatsinks
Impedance - of a stage
IC's - also called Digital Chips
IC's - Analogue Chips
"In-Circuit" testing
Inductors
Inductors - measuring
Integrated Circuits
Isolation Transformer
Latching Reed Switch
LEDs
Logic Probe MkIIB
Logic Probe - Simple
Logic Probe - using CD4001
Logic Probe - using CD4011
Making your own components
Measuring Resistance
Measuring Voltage
Mica Washers and Insulators
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MOSFETs
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Surface Mount - Packs
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Voltage Divider
Voltage Regulators
Voltages on a circuit
Wire Wound Resistor
Yokes
Zener Diodes
4-Band Resistors
5-Band Resistors
10-Turn Pots

Use your "brain, knowledge and your fingers."

Before we start, fixing anything is a combination of skill, luck and good diagnosis.
Sometimes you can fix something by letting it run until it finally fails.
Some things start to work as soon as you touch them.
Some things can never be fixed.
But some things can be fixed by feeling the temperature rise and deciding if it is getting too hot.
Sometimes you can smell something getting too hot.
Sometimes you can see SMOKE.
All these things make you a very clever technician and about 50% of faults will be fixed by looking for dry joints, burnt parts, overheating and carefully inspecting an item before you disturb it.

By simply touching different items you can quite often feel a hot item and home-in on the fault - at a saving of hours of work.
Servicing is not "A bull at a gate" approach.
You may be able to service something by turning it on and leaving it for hours - and start thinking.
It may take you a day to come up with the answer.
Believe me. That's how it worked for me - while fixing over 35,000 TV's.

TEST EQUIPMENT

Everyone thinks TEST EQUIPMENT will "solve the problem."
This is a big big MISTAKE.
Test equipment can help solve a problem and it can "lead to frustration," "give an incorrect answer," "mess you up," and make things worse.
You have to be very careful with test equipment and especially EXPENSIVE equipment because it is very sensitive and can detect pulses and glitches and voltages that are not affecting the operation of the circuit.
You will learn a lot of tricks when reading through this article, but let me say two things.
There are lots of faults and components that you cannot test with "test equipment" because they are either intermittent or the equipment does not load the device to the same extent as the circuit.
And secondly you need both an ANALOGUE multimeter and a DIGITAL meter to cover all the situations.
And if you are working on a car, you only need a $5.00 analogue meter because it will be dropped or fall into a crack, and you will only lose $5.00
You will learn that a digital meter will pick up spikes and signals on a line and show an incorrect reading.
That's why you need to back-up your readings with an analogue meter.
When you charge a battery it gets a "floating voltage" and this will be higher than the actual voltage, when the battery is fitted to a project. An analogue meter will draw a slight current and remove the "floating voltage."
Component testers can also give you a false reading, either because the component is out of range of the tester or intermittent and you need to be aware of this.
Oscilloscopes can also display waveforms that are parts of glitches or noise from other chips and these do not affect the operation of the part of the circuit you are investigating.
Sometimes you cannot pickup a pulse because it is not regular and the trigger on the oscilloscope does not show it on the screen. You may think it is missing.
It all depends on the "speed of the oscilloscope" - it's maximum frequency of operation.
Lastly- Power Supplies. You cannot test globes and motors on a power supply because the starting current can be 5 times more than the operating current. The power supply may not be able to deliver this high current and thus you will think the motor or globe is faulty.

MULTIMETERS

There are two types:

DIGITAL and ANALOGUE

A **Digital Multimeter** has a set of digits on the display and an Analogue Multimeter has a scale with a pointer (or needle).
You really need both types to cover the number of tests needed for designing and repair-work. We will discuss how they work, how to use them and some of the differences between them.

DIGITAL AND ANALOGUE MULTIMETERS

BUYING A MULTIMETER

There are many different types on the market.
The cost is determined by the number of ranges and also the extra features such as diode tester, buzzer (continuity), transistor tester, high DC current and others.
Since most multimeters are reliable and accurate, buy one with the greatest number of ranges at the lowest cost.
This article explains the difference between a cheap analogue meter, an expensive analogue meter and a digital meter. You will then be able to work out which two meters you should buy.

Multimeters are sometimes called a "meter", a "VOM" (Volts-Ohms-Milliamps or Volt Ohm Meter) or "multi-tester" or even "a tester" - they are all the same.

USING A MULTIMETER

Analogue and digital multimeters have either a rotary selector switch or push buttons to select the appropriate function and range. Some Digital Multimeters (DMMs) are auto ranging; they automatically select the correct range of voltage, resistance, or current when doing a test. However you need to select the function.

Before making any measurement you need to know what you are checking. If you are measuring voltage, select the AC range (10v, 50v, 250v, or 1000v) or DC range (0.5v, 2.5v, 10v, 50v, 250v, or 1000v). If you are measuring resistance, select the Ohms range (x1, x10, x100, x1k, x10k). If you are measuring current, select the appropriate current range DCmA 0.5mA, 50mA, 500mA. Every multimeter is different however the photo below shows a low cost meter with the basic ranges.

The most important point to remember is this:
You must select a voltage or current range that is bigger or HIGHER than the maximum expected value, so the needle does not swing across the scale and hit the "end stop."
If you are using a DMM (Digital Multi Meter), the meter will indicate if the voltage or current is higher than the selected scale, by showing "OL" - this means "Overload." If you are measuring resistance such as 1M on the x10 range the "OL" means "Open Loop" and you will need to change the range. Some meters show "1' on the display when the measurement is higher than the display will indicate and some flash a set of digits to show over-voltage or over-current. A "-1" indicates the leads should be reversed for a "positive reading."
If it is an AUTO RANGING meter, it will automatically produce a reading, otherwise the selector switch must be changed to another range.

The Common (negative) lead ALWAYS fits into the "COM" socket. The red lead fits into the red socket for Voltage and Resistance. Place the red lead (red banana plug) into "A" (for HIGH CURRENT "Amps") or mA,uA for LOW CURRENT.

The black "test lead" plugs into the socket marked "-" "Common", or "Com," and the red "test lead" plugs into meter socket marked "+" or "V-W-mA." The third banana socket measures HIGH CURRENT and the positive (red lead) plugs into this. You DO NOT move the negative "-" lead at any time.
The following two photos show the test leads fitted to a digital meter. The probes and plugs have "guards" surrounding the probe tips and also the plugs so you can measure high voltages without getting near the voltage-source.

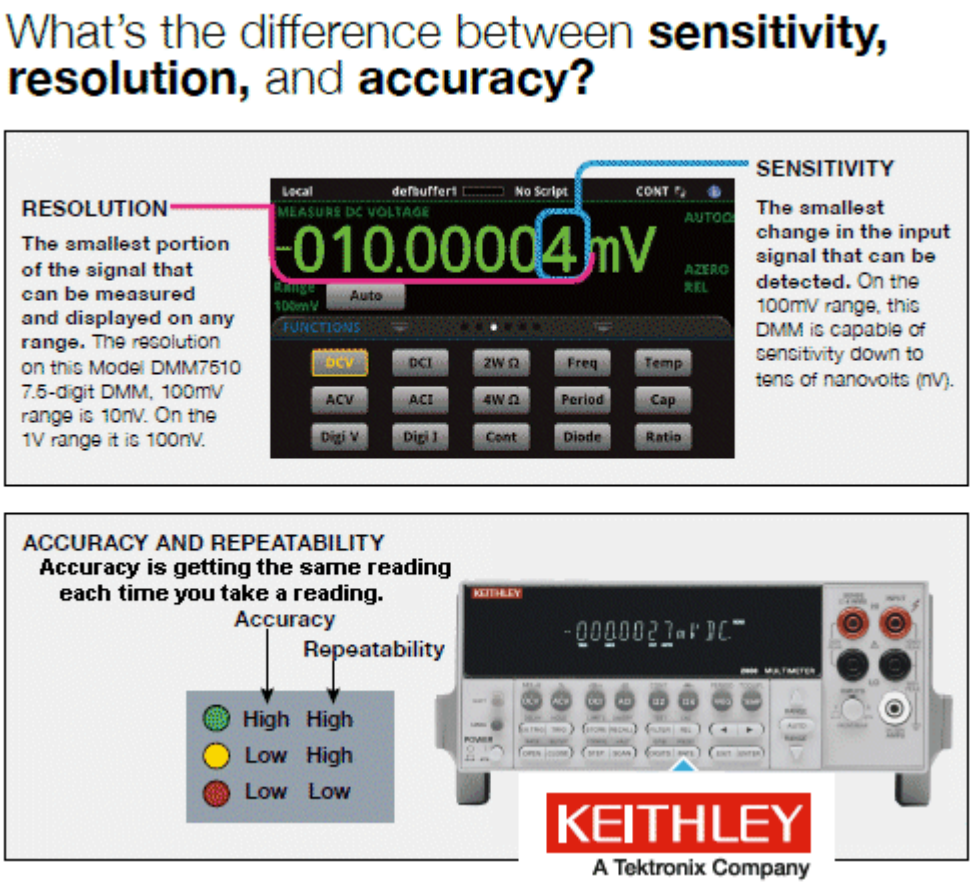

The question above applies to both (every) type of multimeter and the type of meter you use depends on the accuracy you need. Sometimes you are looking for 1mV change on a 20v rail. Only a DMM will (or a CRO) will produce a result.

Analogue meters have an "Ohms Adjustment" to allow for the change in voltage of the battery inside the meter (as it gets old).

"Ohms Adjust" is also called "ZERO SET"

The sensitivity of this meter is 20,000ohms/volt on the DC ranges and 5k/v on the AC ranges

Before taking a resistance reading (each time on any of the Ohms scales) you need to "ZERO SET" the scale, by touching the two probes together and adjust the pot until the needle reads "0" (swings FULL SCALE). If the pointer does not reach full

scale, the batteries need replacing. Digital multimeters do not need "zero adjustment."

FIXING A MULTIMETER

A multimeter can get "broken" "damaged" and go "faulty."
I don't know why, but eventually they stop working.
It can be something simple like a flat battery, corroded battery contacts, broken switch or something complex, like the circuitry failing.
Multimeters are so cheap, you can buy a new one for less than $10.00
These meters can have a 10 amp range, transistor tester and measure up to 2 meg ohms.
That's why I suggest buying a $10.00 meter. They are just as good as a $60.00 meter and the cheapest meters last the longest.
Dropping an analogue meter can cause the hair spring to loop over one of the supports and the needle will not zero correctly. You will need to open the cover on the movement and lift the spring off the support with a needle.
A faulty meter can be used in a battery-charger circuit to measure the current or voltage if that scale is still reading-correctly.
Otherwise keep the leads and throw the meter out. It is too dangerous keeping a meter that shows an incorrect reading.

MEASURING FREQUENCY

Before we cover the normal uses for a multimeter, it is interesting to note that some **Digital Multimeters (DMM)** have features such as Capacitance, Frequency and measuring the gain of a transistor as well as a number of other features using probes such as a temperature probe. The VICHY VC99 meter above is an example and costs about $40.00.

Basic function	Range
DCV	600mV/6V/60V/600V/1000V
ACV	6V/60/600/1000V
DCA	600uA/6000uA/60mA/600mA/6A/20A
ACA	600uA/6000uA/60mA/600mA/6A/20A
Capacitance	40nF/400nF/4uF/40uF/400uF/20000uF
Resistance	600Ω/6kΩ/60kΩ/600kΩ/6MΩ/60MΩ
Frequency	100Hz/1kHz/10kHz/100kHz/1MHz/60MHz

Temperature	-40°C~1000°C
	0°F~1832°F

MEASURING VOLTAGE

Most of the readings you will take with a multimeter will be VOLTAGE readings. Before taking a reading, you should select the highest range and if the needle does not move up scale (to the right), you can select another range.
Always switch to the highest range before probing a circuit and keep your fingers away from the component being tested.
If the meter is Digital, select the highest range or use the auto-ranging feature, by selecting "V." The meter will automatically produce a result, even if the voltage is AC or DC.
If the meter is not auto-ranging, you will have to select V⎓ if the voltage is from a DC source or V~ if the voltage is from an AC source. DC means Direct Current and the voltage is coming from a battery or supply where the voltage is steady and not changing and AC means Alternating Current where the voltage is coming from a voltage that is rising and falling.
You can measure the voltage at different points in a circuit by connecting the black probe to chassis. This is the 0v reference and is commonly called "Chassis" or "Earth" or "Ground" or "0v."
The red lead is called the "measuring lead" or "measuring probe" and it can measure voltages at any point in a circuit. Sometimes there are "test points" on a circuit and these are wires or loops designed to hold the tip of the red probe (or a red probe fitted with a mini clip or mini alligator clip).
You can also measure voltages ACROSS A COMPONENT. In other words, the reading is taken in PARALLEL with the component. It may be the voltage across a transistor, resistor, capacitor, diode or coil. In most cases this voltage will be less than the supply voltage.
If you are measuring the voltage in a circuit that has a HIGH IMPEDANCE, the reading will be inaccurate, up to 90% !!!, if you use a cheap analogue meter.

Here's a simple case.

The circuit below consists of two 1M resistors in series. The voltage at the mid point will be 5v when nothing is connected to the mid point. But if we use a cheap analogue multimeter set to 10v, the resistance of the meter will be about 100k, if the meter has a sensitivity of 10k/v and the reading will be incorrect.
Here how it works:
Every meter has a sensitivity. The sensitivity of the meter is the sensitivity of the movement and is the amount of current required to deflect the needle FULL SCALE. This current is very small, normally 1/10th of a milliamp and corresponds to a sensitivity of 10k/volt (or 1/30th mA, for a sensitivity of 30k/v).
If an analogue meter is set to 10v, the internal resistance of the meter will be 100k for a 10k/v movement.
If this multimeter is used to test the following circuit, the reading will be inaccurate.
The reading should be 5v as show in diagram **A**.
But the analogue multimeter has an internal resistance of 100k and it creates a circuit shown in **C**.
The top 1M and 100k from the meter create a combined PARALLEL resistance of 90k. This forms a series circuit with the lower 1M and the meter will read less than 1v
If we measure the voltage across the lower 1M, the 100k meter will form a value of resistance with the lower 1M and it will read less than 1v
If the multimeter is 30k/v, the readings will be 2v. See how easy it is to get a totally inaccurate reading.

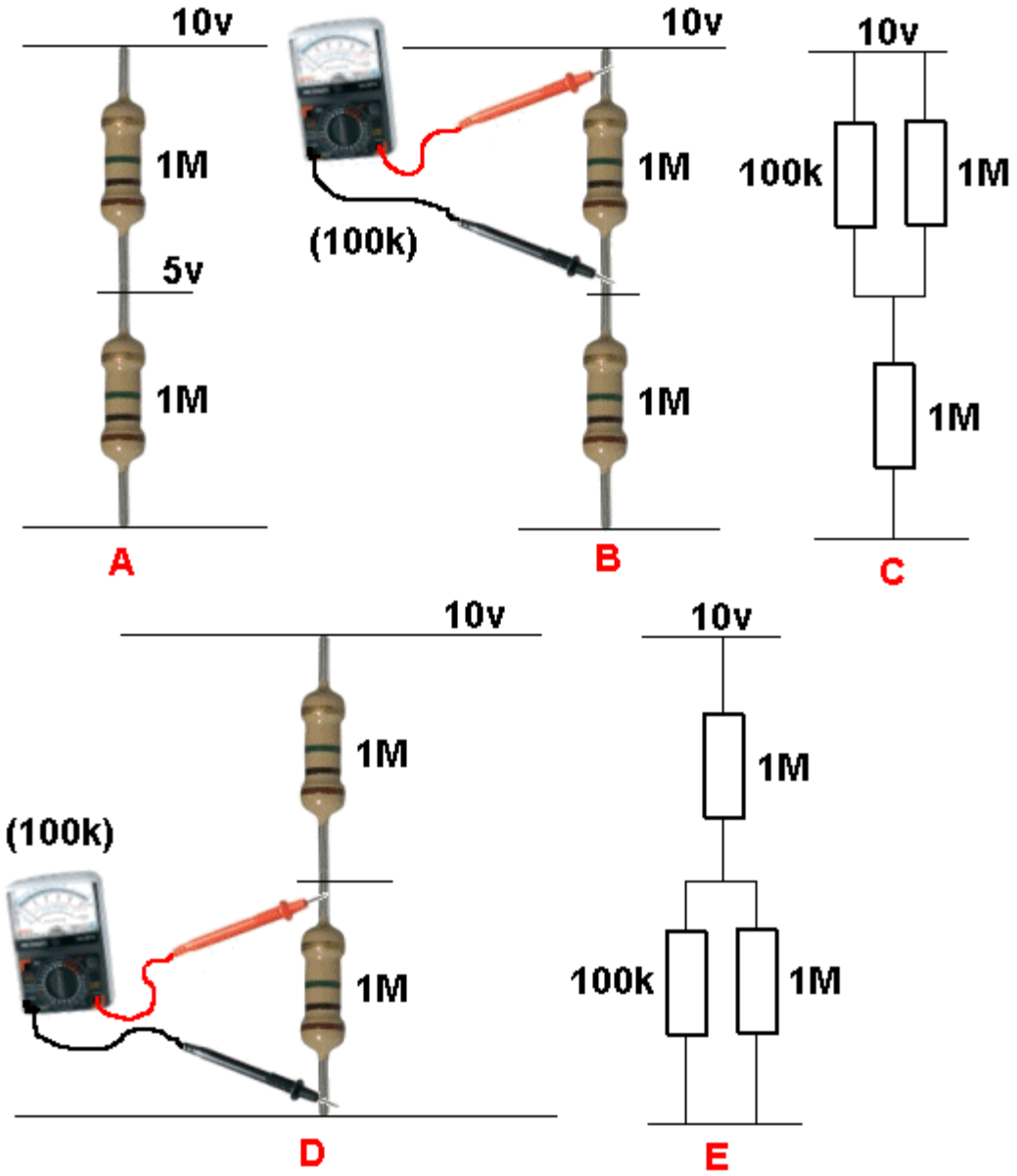

This introduces two new terms:
HIGH IMPEDANCE CIRCUIT and "RESISTORS in SERIES and PARALLEL."

If the reading is taken with a Digital Meter, it will be more accurate as a DMM does not take any current from the circuit (to activate the meter). In other words it has a very HIGH input impedance. Most Digital Multimeters have a fixed input resistance (impedance) of 10M - no matter what scale is selected. That's the reason for choosing a DMM for high impedance circuits. It also gives a reading that is accurate to about 1%.

MEASURING VOLTAGES IN A CIRCUIT

You can take many voltage-measurements in a circuit. You can measure "across" a component, or between any point in a circuit and either the positive rail or earth rail (0v rail). In the following circuit, the 5 most important voltage-measurements are shown. Voltage "A" is across the electret microphone. It should be between 20mV and 500mV. Voltage "B" should be about 0.6v. Voltage "C" should be about half-rail voltage. This allows the transistor to amplify both the positive and negative parts of the waveform. Voltage "D" should be about 1-3v. Voltage "E" should be the battery voltage of 12v.

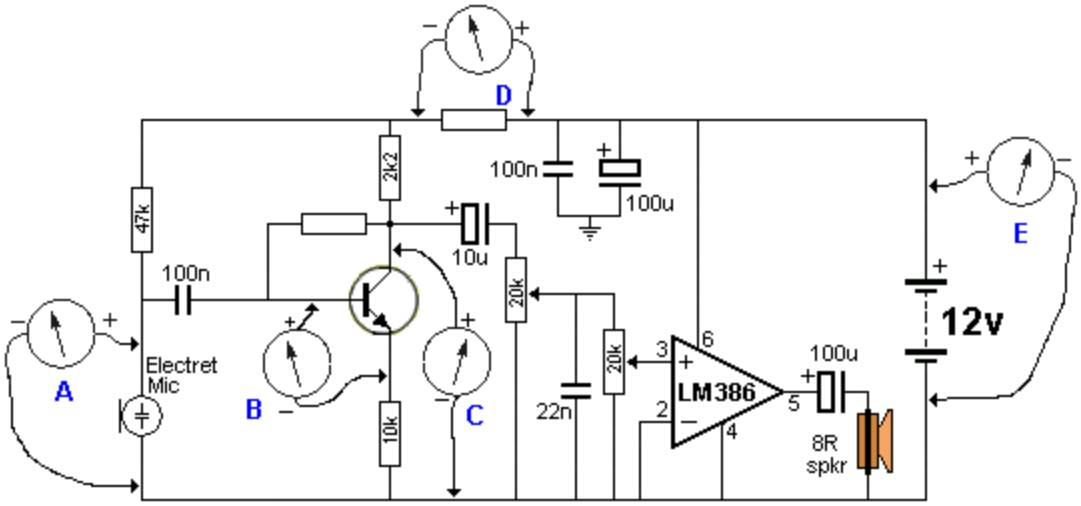

MEASURING VOLTAGES IN A CIRCUIT

MEASURING CURRENT

You will rarely need to take current measurements, however most multimeters have DC current ranges such as 0.5mA, 50mA, 500mA and 10Amp (via the extra banana socket) and some meters have AC current ranges. Measuring the current of a circuit will tell you a lot of things. If you know the normal current, a high or low current can let you know if the circuit is overloaded or not fully operational.

Current is always measured when the circuit is working (i.e: with power applied).
It is measured IN SERIES with the circuit or component under test.
The easiest way to measure current is to remove the fuse and take a reading across the fuse-holder. Or remove one lead of the battery or turn the project off, and measure across the switch.
If this is not possible, you will need to remove one end of a component and measure with the two probes in the "opening."
Resistors are the easiest things to desolder, but you may have to cut a track in some circuits. You have to get an "opening" so that a current reading can be taken.
The following diagrams show how to connect the probes to take a CURRENT reading.
Do not measure the current ACROSS a component as this will create a "short-circuit."
The component is designed to drop a certain voltage and when you place the probes across this component, you are effectively adding a "link" or "jumper" and the voltage at the left-side of the component will appear on the right-side. This voltage may be too high for the circuit being supplied and the result will be damage.

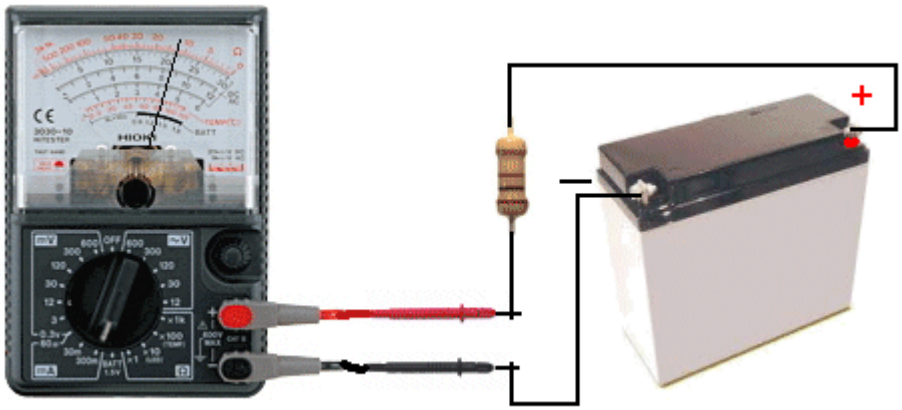

Measuring current through a resistor

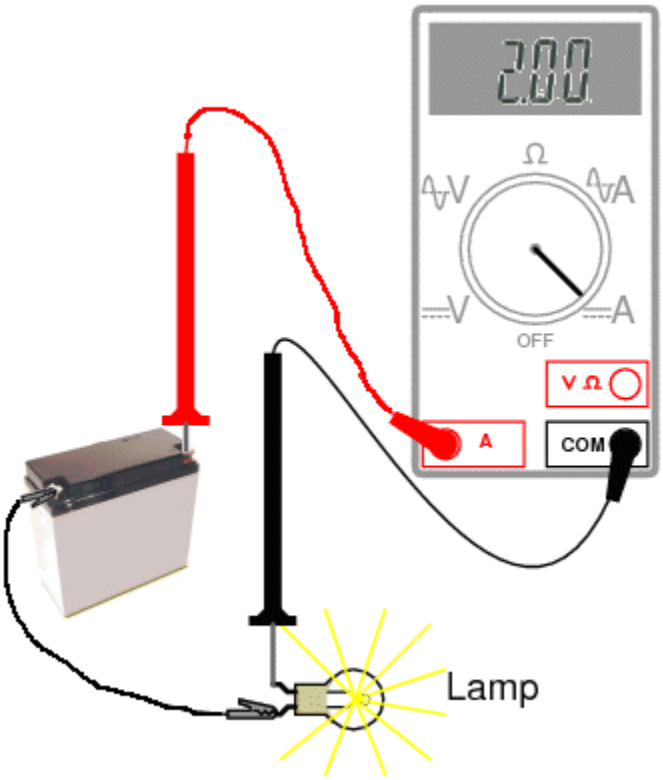

Measuring the current of a globe

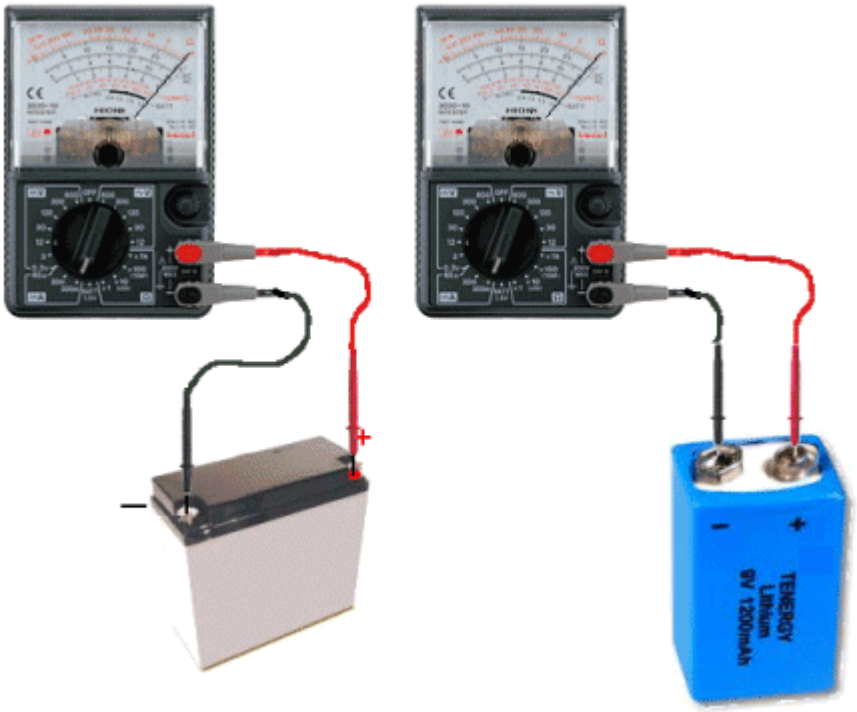

Do NOT measure the CURRENT of a battery

(by placing the meter directly across the terminals)

A battery will deliver a very HIGH current and damage the meter

Do not measure the "current a battery will deliver" by placing the probes across the terminals. It will deliver a very high current and damage the meter instantly. There are special battery testing instruments for this purpose.
When measuring across an "opening" or "cut," place the red probe on the wire that supplies the voltage (and current) and the black probe on the other wire. This will produce a "POSITIVE" reading.

A positive reading is an UPSCALE READING and the pointer will move across the scale - to the right. A "NEGATIVE READING" will make the pointer hit the "STOP" at the left of the scale and you will not get a reading. If you are using a Digital Meter, a negative sign "-" will appear on the screen to indicate the probes are around the wrong way. No damage will be caused. It just indicates the probes are connected incorrectly.
If you want an accurate CURRENT MEASUREMENT, use a digital meter.

MEASURING RESISTANCE

Turn a circuit off before measuring resistance.
If any voltage is present, the value of resistance will be incorrect.
In most cases you cannot measure a component while it is in-circuit. This is because the meter is actually measuring a voltage across a component and calling it a "resistance." The voltage comes from the battery inside the meter. If any other voltage is present, the meter will produce a false reading.
If you are measuring the resistance of a component while still "in circuit," (with the power off) the reading will be lower than the true reading.

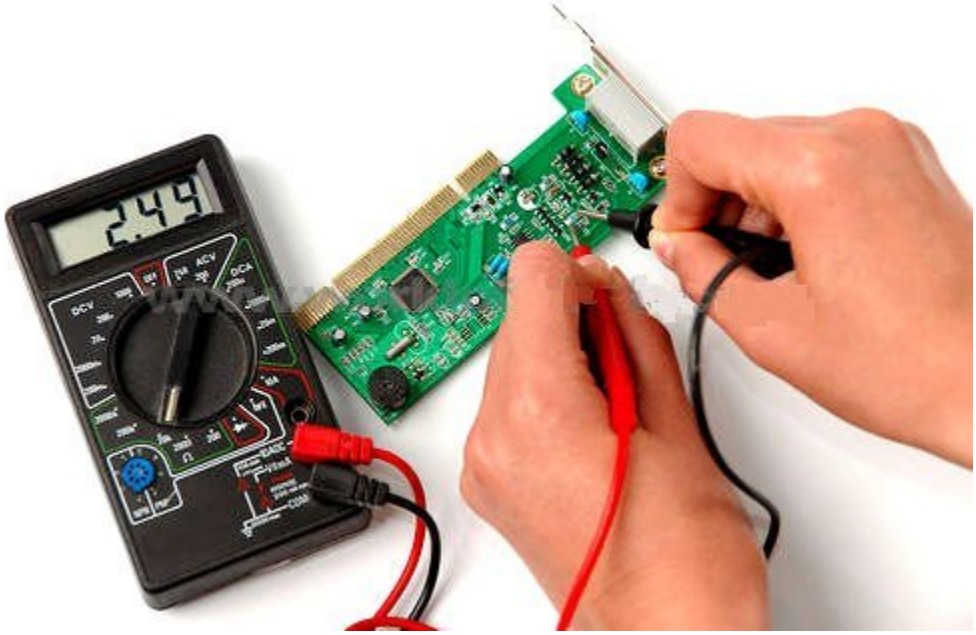

Measuring resistance

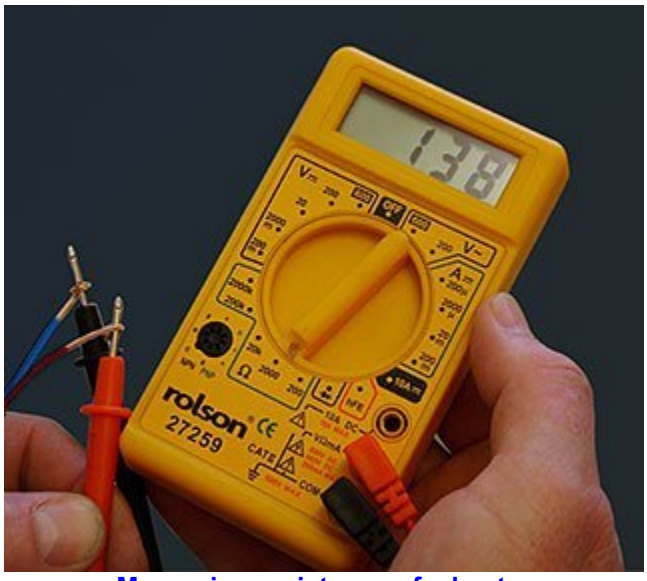

Measuring resistance of a heater (via the leads)

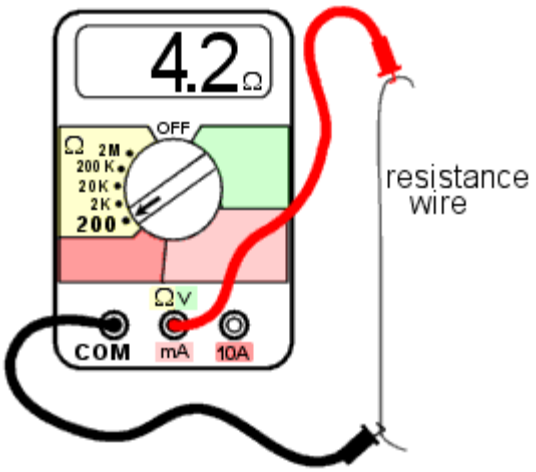

Measuring the resistance of a piece of resistance-wire

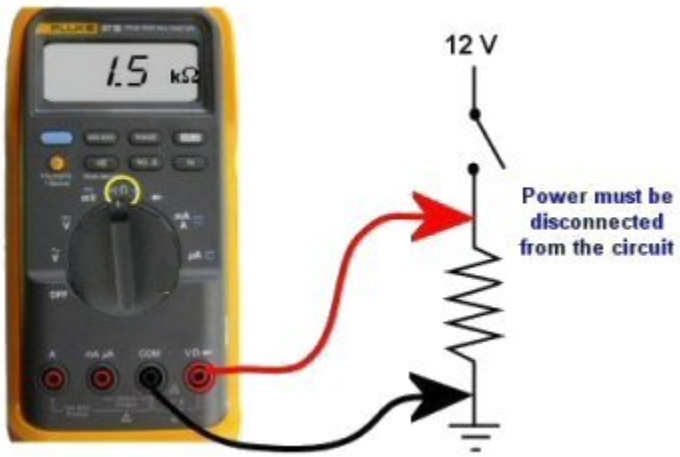

Measuring the resistance of a resistor

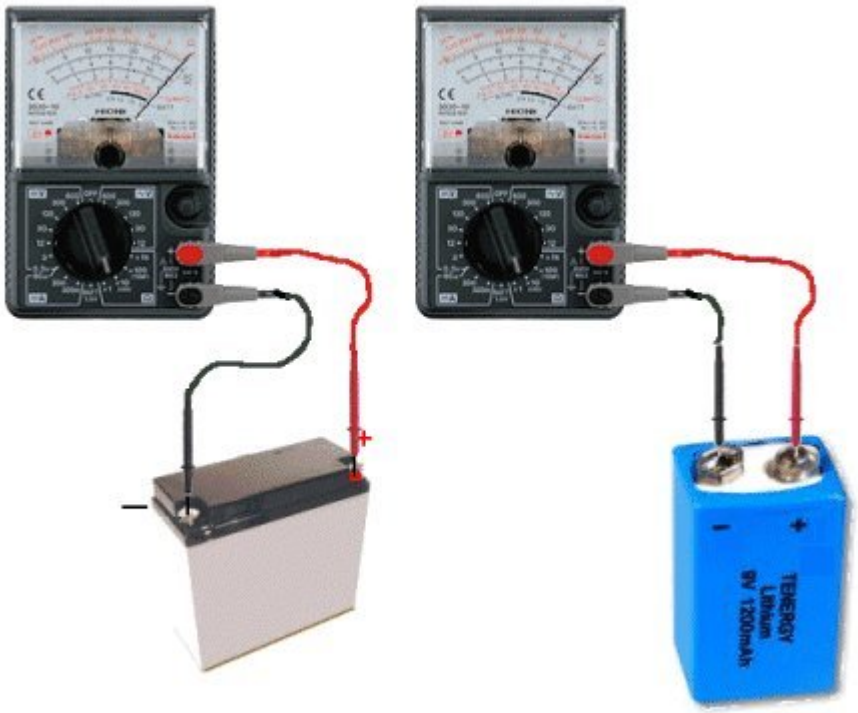

Do not measure the "Resistance of a Battery"

1. Do not measure the "resistance of a battery." The resistance of a battery (called the Internal impedance) is not measured as shown in the diagrams above. It is measured by creating a current-flow and measuring the voltage across the battery.

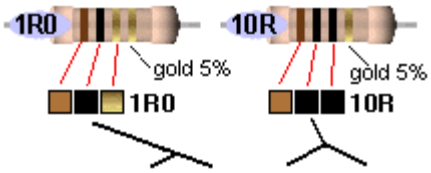

Placing a multimeter set to **resistance** (across a battery) will destroy the meter.
2. Do not try to measure the resistance of any voltage or any "supply."

Resistance is measured in OHMs.
The resistance of a 1cm x 1cm bar, one metre long is 1 ohm.
If the bar is thinner, the resistance is higher. If the bar is longer, the resistance is higher.
If the material of the bar is changed, the resistance is higher.
When carbon is mixed with other elements, its resistance increases and this knowledge is used to make RESISTORS.
Resistors have RESISTANCE and the main purpose of a resistor is to reduce the CURRENT FLOW.
It's a bit like standing on a hose. The flow reduces.
When current flow is reduced, the output voltage is also reduced and that why the water does not spray up so high. Resistors are simple devices but they produce many different effects in a circuit.
A resistor of nearly pure carbon may be 1 ohm, but when non-conducting "impurities" are added, the same-size resistor may be 100 ohms, 1,000 ohms or 1 million ohms.
Circuits use values of less than 1 ohm to more than 22 million ohms.

Resistors are identified on a circuit with numbers and letters to show the exact value of resistance - such as 1k 2k2 4M7
The letter Ω (omega - a Greek symbol) is used to identify the word "Ohm."
but this symbol is not available on some word-processors, so the letter "R" is used.
The letter "E" is also sometimes used and both mean "Ohms."
A one-ohm resistor is written "1R" or "1E." It can also be written "1R0" or "1E0."
A resistor of one-tenth of an ohm is written "0R1" or "0E1." The letter takes the place of the decimal point.
10 ohms = 10R
100 ohms = 100R
1,000 ohms = 1k (k= kilo = one thousand)
10,000 ohms = 10k
100,000 ohms = 100k
1,000,000 ohms = 1M (M = MEG = one million)

The size of a resistor has nothing to do with its resistance. The size determines the wattage of the resistor - how much heat it can dissipate without getting too hot.
Every resistor is identified by colour bands on the body, but when the resistor is a surface-mount device, numbers are used and sometimes letters.
You MUST learn the colour code for resistors and the following table shows all the colours for the most common resistors from 1/10th of an ohm to 22 Meg ohms for resistors with 5% and 10% tolerance.

If 3rd band is gold, Divide by 10
If 3rd band is silver, Divide by 100
(to get 0.22ohms etc)

ROW	SILVER	GOLD	BLACK	BROWN	RED	ORANGE	YELLOW	GREEN
1-	R10	1R0	10R	100R	1K0	10K	100K	1M0
2-	R11	1R1	11R	110R	1K1	11K	110K	1M1
3-	R12	1R2	12R	120R	1K2	12K	120K	1M2
4-	R13	1R3	13R	130R	1K3	13K	130K	1M3
5-	R15	1R5	15R	150R	1K5	15K	150K	1M5
6-	R16	1R6	16R	160R	1K6	16K	160K	1M6
7-	R18	1R8	18R	180R	1K8	18K	180K	1M8
8-	R20	2R0	20R	200R	2K0	20K	200K	2M0
9-	R22	2R2	22R	220R	2K2	22K	220K	2M2
10-	R24	2R4	24R	240R	2K4	24K	240K	2M4
11-	R27	2R7	27R	270R	2K7	27K	270K	2M7
12-	R30	3R0	30R	300R	3K0	30K	300K	3M0
13-	R33	3R3	33R	330R	3K3	33K	330K	3M3
14-	R36	3R6	36R	360R	3K6	36K	360K	3M6
15-	R39	3R9	39R	390R	3K9	39K	390K	3M9
16-	R43	4R3	43R	430R	4K3	43K	430K	4M3
17-	R47	4R7	47R	470R	4K7	47K	470K	4M7
18-	R51	5R1	51R	510R	5K1	51K	510K	5M1
19-	R56	5R6	56R	560R	5K6	56K	560K	5M6
20-	R62	6R2	62R	620R	6K2	62K	620K	6M2
21-	R68	6R8	68R	680R	6K8	68K	680K	6M8
22-	R75	7R5	75R	750R	7K5	75K	750K	7M5
23-	R82	8R2	82R	820R	8K2	82K	820K	8M2
24-	R91	9R1	91R	910R	9K1	91K	910K	9M1
								10M (BLUE)

COLOR CODES FOR THE WHOLE E12/E24 RANGE OF RESISTORS

The twelve odd rows - 1, 3, 5... - represent values available in the E12 range only, plus 10M

Reading 4-band resistors

The most "common" type of resistor has 4 bands and is called the 10% resistor. It now has a tolerance of 5% but is still called the "10% type" as the colours increase by 20% so that a resistor can be 10% higher or 10% lower than a particular value and all the resistors produced in a batch can be used.

The first 3 bands produce the resistance and the fourth band is the "tolerance" band.

Gold = 5%

(Silver =10% but no modern resistors are 10%!! - they are 5% 2% or 1%)

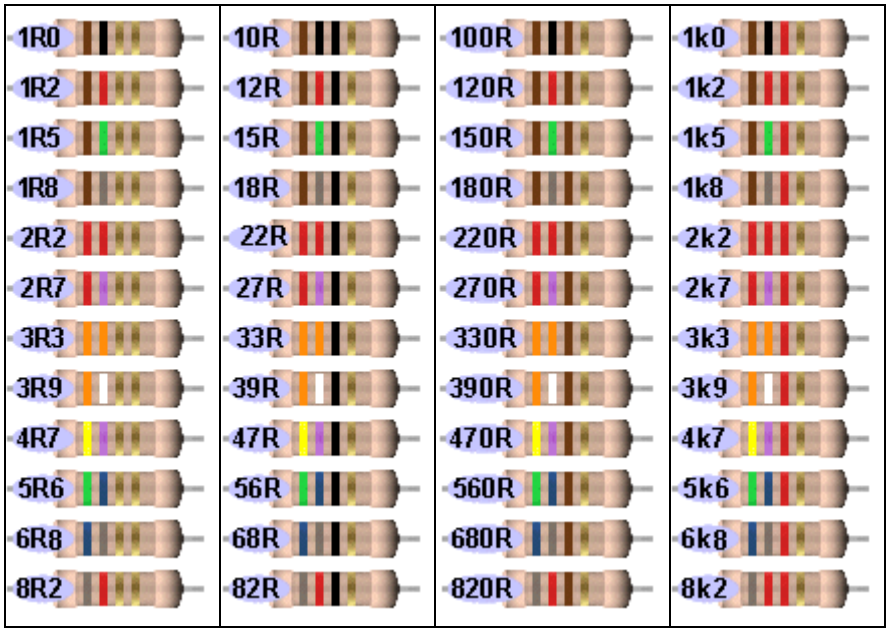

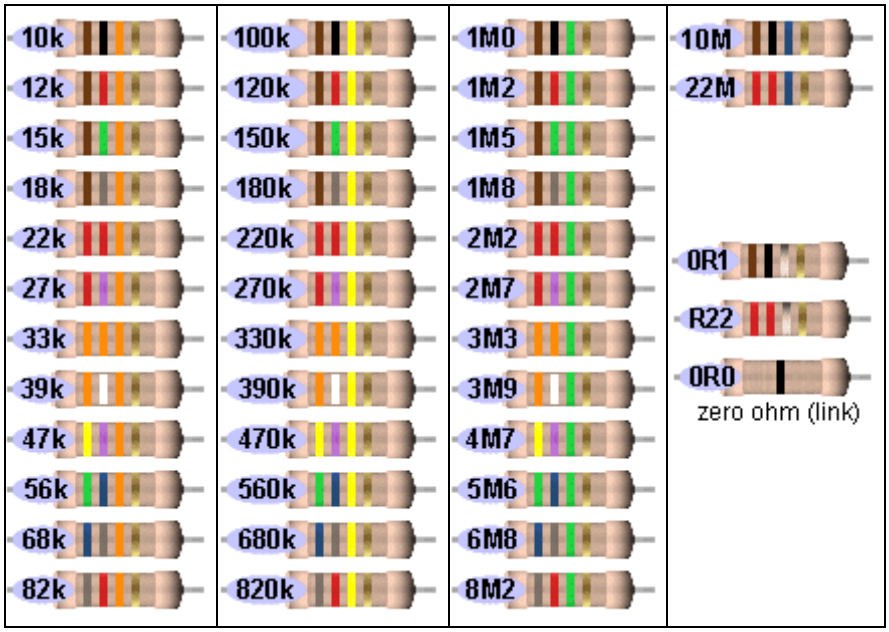

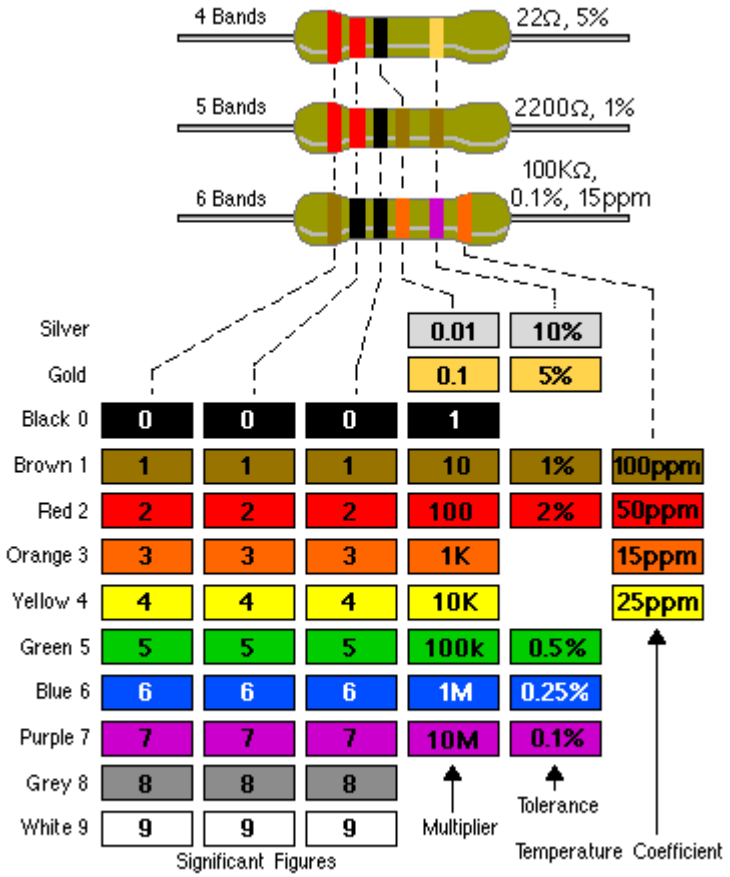

Resistor Color Code System

Here is another well-designed resistor colour code chart:

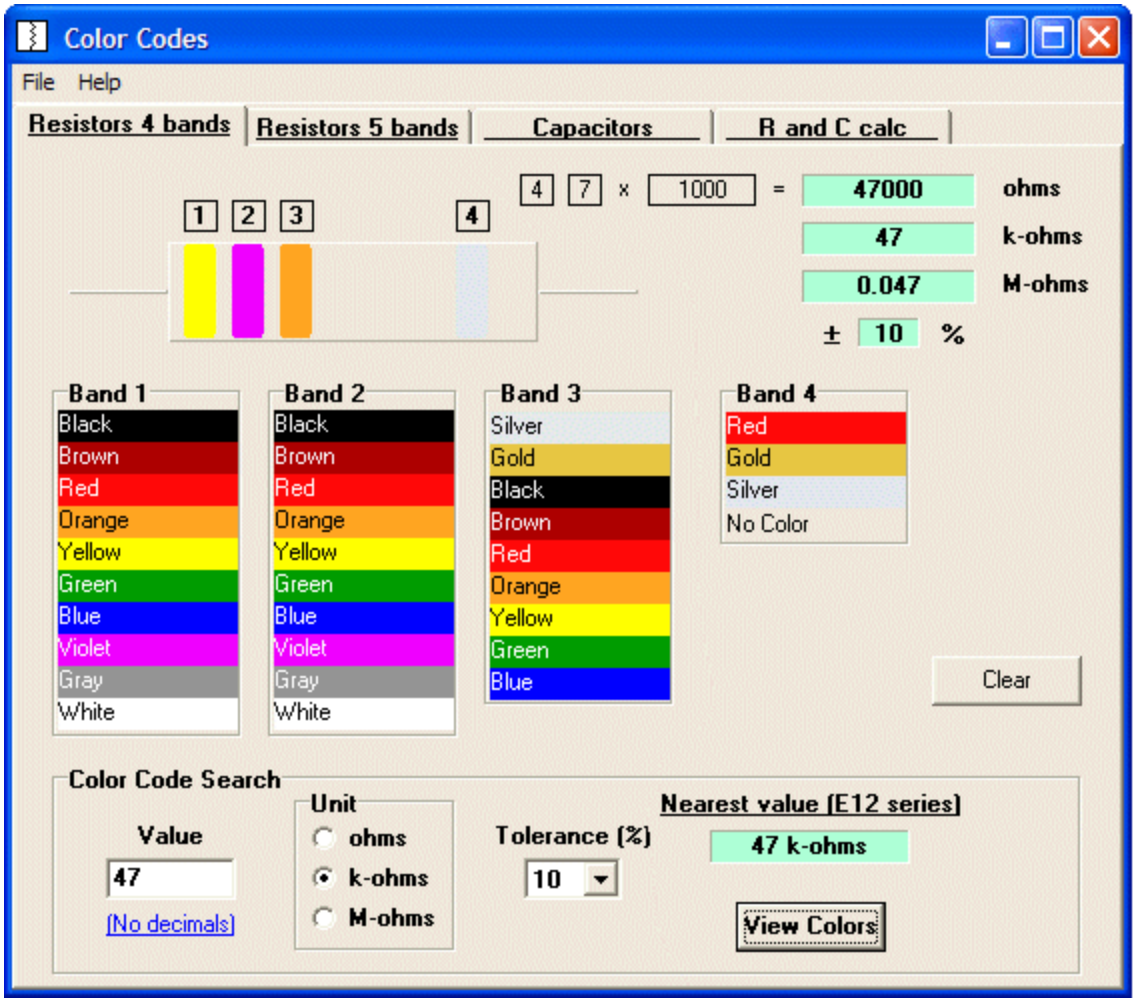

Download the program and save it on your desk-top for future reference:
ColourCode.exe (520KB)
ColourCode.zip (230KB)
ColourCode.rar (180KB)

RESISTORS LESS THAN 10 OHMS

When the **third** band is gold, it indicates the value of the "colors" must be divided by 10.
Gold = "divide by 10" to get values 1R0 to 8R2
When the **third** band is silver, it indicates the value of the "colors" must be divided by 100. (Remember: more letters in the word "silver" thus the divisor is "a larger division.")
Silver = "divide by 100" to get values R1 to R82
e.g: 0R1 = 0.1 ohm 0R22 = point 22 ohms
See 4th Column above for examples.

The letters "R, k and M" take the place of a decimal point.
e.g: 1**R**0 = 1 ohm 2**R**2 = 2 point 2 ohms 22**R** = 22 ohms
2**k**2 = 2,200 ohms 100**k** = 100,000 ohms
2**M**2 = 2,200,000 ohms

HOW TO REMEMBER THE COLOUR CODE:

Each colour has a "number" (or divisor) corresponding to it.
Most of the colours are in the same order as in the spectrum. You can see the spectrum in a rainbow. It is: ROY G BIV and the colours for resistors are in the same sequence.

black
brown - colour of increasing temperature

red
orange
yellow
green
blue
(indigo - that part of the spectrum between blue and violet)
violet
gray
white

colour	value	No of zero's
silver	-2	divide by 100
gold	-1	divide by 10
black	0	No zeros
brown	1	0
red	2	00
orange	3	,000 or k
yellow	4	0,000
green	5	00,000
blue	6	M
violet	7	
gray	8	
white	9	

Band Color	Digit	Multiplier	Tolerance
Black	0	1	---
Brown	1	10	±1%
Red	2	100	±2%
Orange	3	1,000	±3%
Yellow	4	10,000	±4%
Green	5	100,000	---
Blue	6	1,000,000	---
Violet	7	10,000,000	---
Gray	8	100,000,000	---
White	9	---	---
Gold	---	0.1	±5%
Silver	---	0.01	±10%
None	---	---	±20%

Here are some common ways to remember the colour code:

Bad Beer Rots Our Young Guts, But Vodka Goes Well
Bright Boys Rave Over Young Girls But Violet Gets Wed
Bad Boys Rave Over Young Girls But Violet Gets Wed with Gold and Silver.

Reading 5-band resistors:

5-band resistors are easy to read if you remember two simple points. The first three bands provide the digits in the answer and the 4th band supplies the number of zero's.

Reading "STANDARD VALUES" (on 5-band resistors)

5-band resistors are also made in "Standard Values" but will have different colours to 4-band "common" resistors - and will be confusing if you are just starting out. For instance, a 47k 5% resistor with 4-bands will be: yellow-purple-orange-gold. For a 47k 1% resistor the colours will be yellow-purple-black-red-brown. The brown colour-band represents 1%.
The first two colour-bands for a STANDARD VALUE or "common value" in 1% or 5% will be the SAME. These two bands provide the digits in the answer.
It's the 3rd band for a 5% resistor that is expanded into two bands in a 1% resistor. But it's easy to follow.
For a standard value, the 3rd band in a 1% resistor is BLACK. This represents a ZERO in the answer. (For 5-band resistors BLACK represents a ZERO when in the third band. This is different to 4-band resistors where black represents the word OHMS! If the third band is BROWN, the answer will be 1).
So the 4th band has to represent one-less ZERO and is one colour UP THE COLOUR CHART! In other words the 3rd and 4th bands (combined) on a 1% resistor produces the same number of zero's as the 3rd band on a 5% resistor!

Resistors come in a range of values and the two most common are the E12 and E24 series. The E12 series comes in twelve values for each decade. The E24 series comes in twenty-four values per decade.

E12 series - 10, 12, 15, 18, 22, 27, 33, 39, 47, 56, 68, 82

E24 series - 10, 11, 12, 13, 15, 16, 18, 20, 22, 24, 27, 30, 33, 36, 39, 43, 47, 51, 56, 62, 68, 75, 82, 91

Here is the complete list of 1% 1/4watt resistors from:
CIRCUIT SPECIALISTS. The following list covers 10 ohms (10R) to 1M.
To buy 1% resistors from Circuit Specialists, click: HERE.

10R	121R	806R	3k83	7k15	14k7	39k2	121k
12R1	150R	825R	3k92	7k5	15k	40k2	147k
15R	182R	909R	4k02	7k87	15k8	44k2	150k
18R2	200R	1k0	4k22	71k5	16k9	46k4	182k
22R1	221R	1k21	4k64	8k06	17k4	47k	200k
27R4	240R	1k5	4k75	8k25	17k8	47k5	212k
30R1	249R	1k82	4k7	8k45	18k2	49k9	221k
33R2	274R	2k	4k87	8k66	20k	51k1	226k
36R5	301R	2k21	4k99	8k87	22k1	53k6	249k
39R2	332R	2k2	5k11	9k09	22k6	56k2	274k
47R5	348R	2k43	5k23	9k31	23k7	61k9	301k
49R9	392R	2k49	5k36	9k53	24k9	68k1	332k
51R1	402R	2k67	5k49	9k76	27k4	69k8	357k
56R2	475R	2k74	5k62	10k	29k4	75k0	392k
68R1	499R	3k01	5k76	11k	30k1	82k5	475k
75R	565R	3k32	5k9	12k	33k2	90k	487k
82R5	604R	3k48	6k04	12k1	34k8	90k9	499k
90R9	681R	3k57	6k19	12k4	36k5	95k3	562k
100R	750R	3k74	6k81	13k	38k3	100k	604k
							1M

Here is the list of 1% resistors from suppliers (such as Farnell):

1R0	13R	68R	360R	1k8	9k1	47k	240k
1R2	15R	75R	390R	2k0	10k	51k	270k
1R5	16R	82R	430R	2k2	11k	56k	300k
2R2	18R	91R	470R	2k4	12k	62k	330k
2R7	20R	100R	510R	2k7	13k	68k	360k
3R3	22R	110R	560R	3k	15k	75k	390k
3R9	24R	120R	620R	3k3	16k	82k	430k
4R7	27R	130R	680R	3k6	18k	91k	470k
5R6	30R	150R	750R	3k9	20k	100k	510k
6R2	33R	160R	820R	4k3	22k	110k	560k
6R8	36R	180R	910R	4k7	24k	120k	620k
7R5	39R	200R	1k	5k1	27k	130k	680k
8R2	43R	220R	1k1	5k6	30k	150k	750k
9R1	47R	240R	1k2	6k2	33k	160k	820k
10R	51R	270R	1k3	6k8	36k	180k	910k
11R	56R	300R	1k5	7k5	39k	200k	1M
12R	62R	330R	1k6	8k2	43k	220k	

Surface Mount Resistors

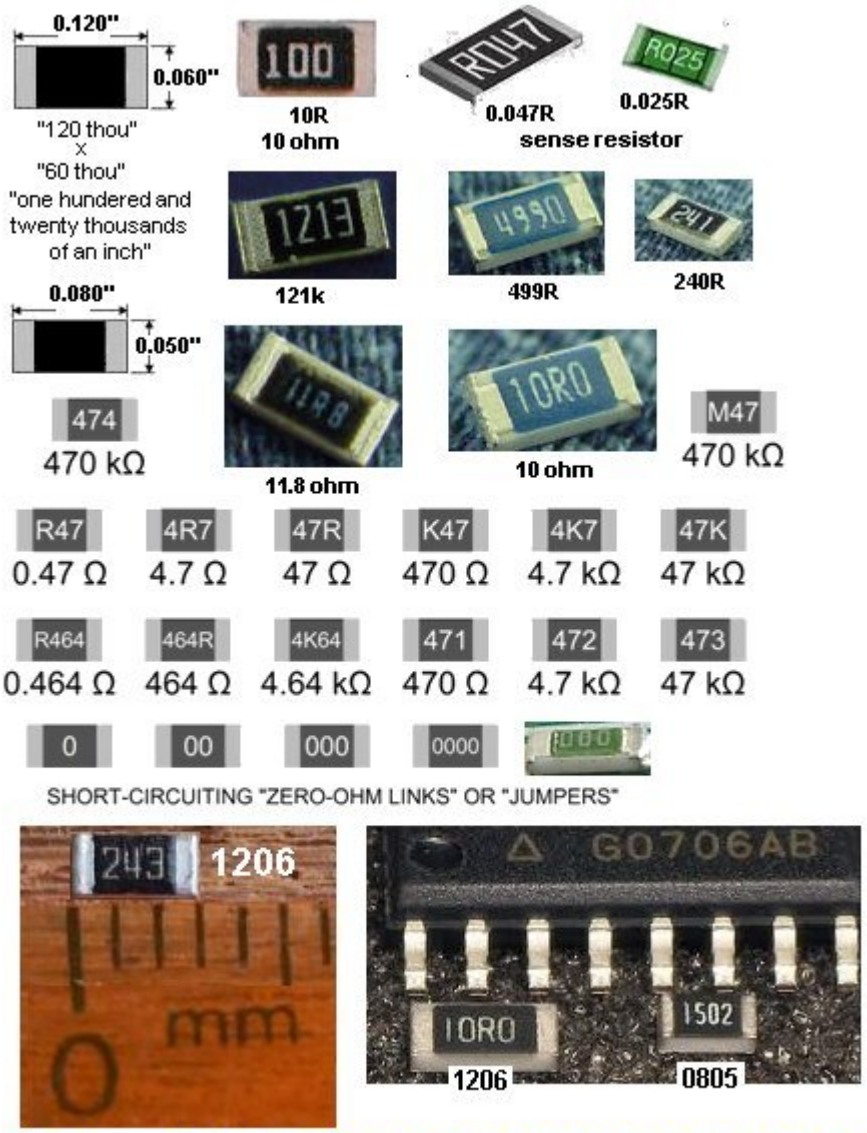

1206 and 0805 SURFACE MOUNT RESISTORS

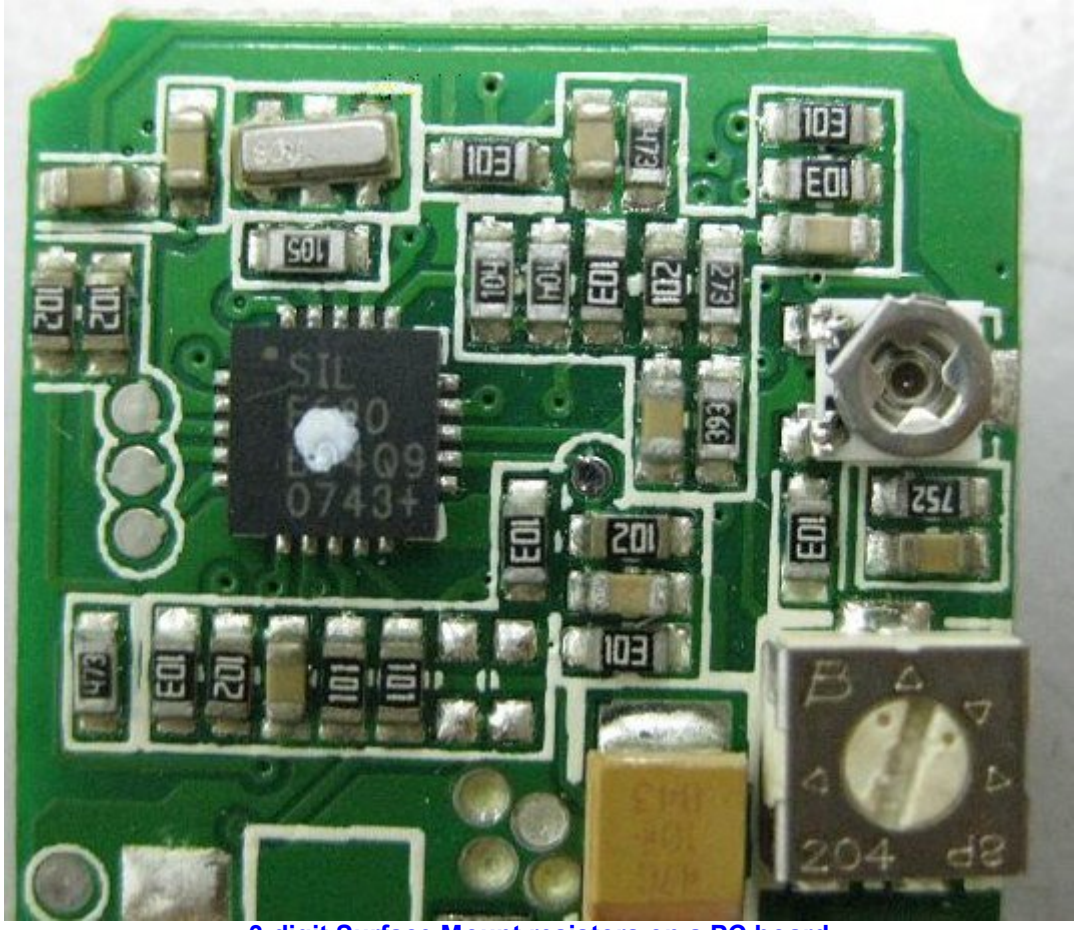

3-digit Surface Mount resistors on a PC board

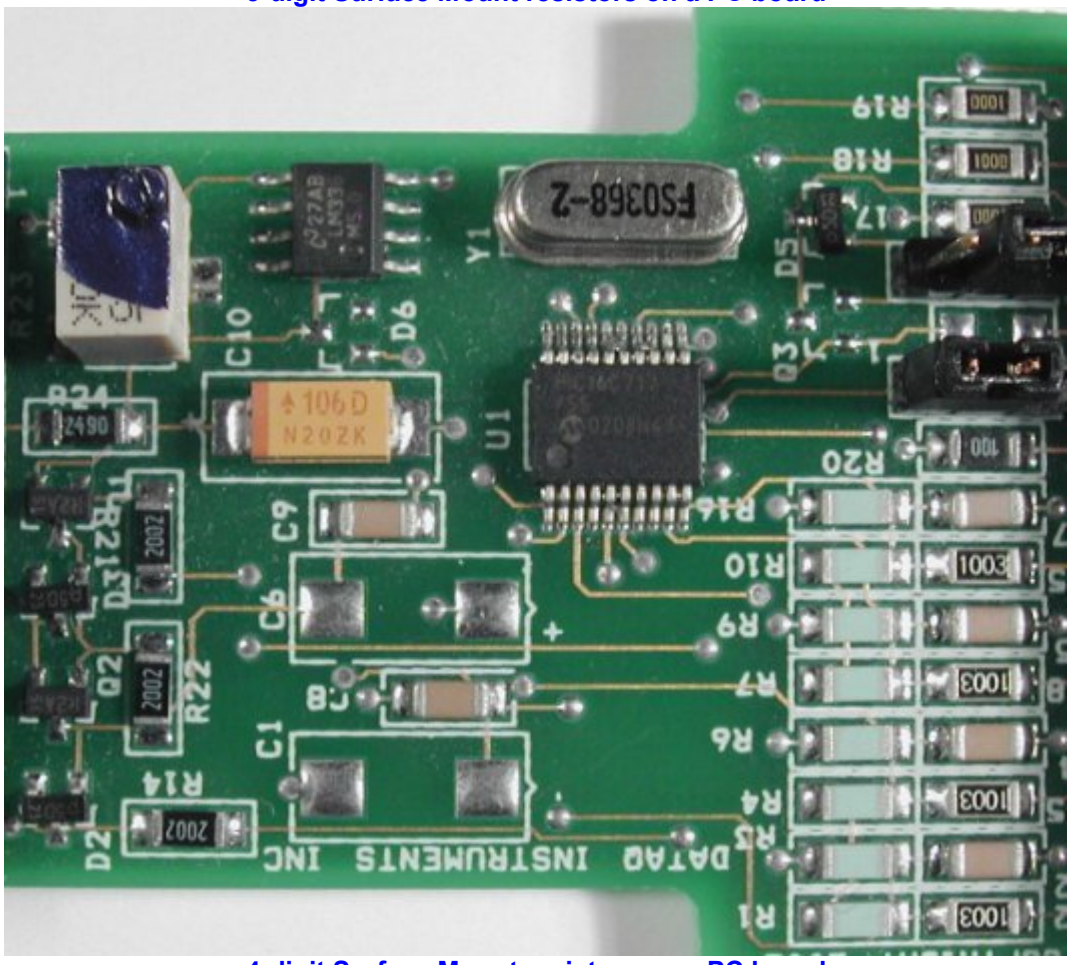

4-digit Surface Mount resistors on a PC board

The photo above shows surface mount resistors on a circuit board. The components

that are not marked are capacitors (capacitors are NEVER marked).
All the SM resistors in the above photos conform to a 3-digit or 4-digit code. But there are a number of codes, and the 4-digit code caters for high tolerance resistors, so it's getting very complicated.
Here is a basic 3-digit SM resistor:

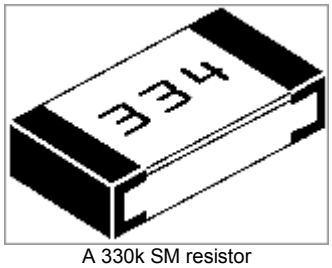

A 330k SM resistor

The first two digits represent the two digits in the answer. The third digit represents the number of zero's you must place after the two digits. The answer will be OHMS. For example: 334 is written 33 0 000. This is written 330,000 ohms. The comma can be replaced by the letter "k". The final answer is: 330k.
222 = 22 00 = 2,200 = 2k2
473 = 47 000 = 47,000 = 47k
474 = 47 0000 = 470,000 = 470k
105 = 10 00000 = 1,000,000 = 1M = one million ohms
There is one trick you have to remember. Resistances less than 100 ohms are written: 100, 220, 470. These are 10 and NO zero's = 10 ohms = 10R
or 22 and no zero's = 22R or 47 and no zero's = 47R. Sometimes the resistor is marked: 10, 22 and 47 to prevent a mistake.

Remember:
R = ohms
k = kilo ohms = 1,000 ohms
M = Meg = 1,000,000 ohms
The 3 letters (R, k and M) are put in place of the decimal point. This way you cannot make a mistake when reading a value of resistance.

Surface Mount **CURRENT SENSING** Resistors

Many new types of CURRENT SENSING surface-mount resistors are appearing on the market and these are creating lots of new problems.
Fortunately all resistors are marked with the value of resistance and these resistors are identified in MILLIOHMS. A miili ohm is one thousandth or an ohm and is written 0.001 when writing a normal mathematical number.
When written on a surface mount resistor, the letter R indicates the decimal point and it also signifies the word "OHM" or "OHMS" and one milli-ohm is written R001
Five miiliohms is R005 and one hundred milliohms is R100
Some surface mount resistors have the letter "M" after the value to indicate the resistor has a rating of 1 watt. e.g: R100M These surface-mount resistors are specially-made to withstand a high temperature and a surface-mount resistor of the same size is normally 250mW or less.
These current-sensing resistors can get extremely hot and the PC board can become burnt or damaged.
When designing a PC board, make the lands very large to dissipate the heat.
Normally a current sensing resistor is below one ohm (1R0) and it is easy to identify them as R100 etc.
You cannot measure the value of a current sensing resistor as the leads of a multimeter have a higher resistance than the resistor and few multimeters can read values below one ohm.
If the value is not visible, you will have to refer to the circuit.
Before replacing it, work out why it failed.
Generally it gets too hot. Use a larger size and add tiny heatsinks on each end.
Here are some surface=mount current-sense resistors:

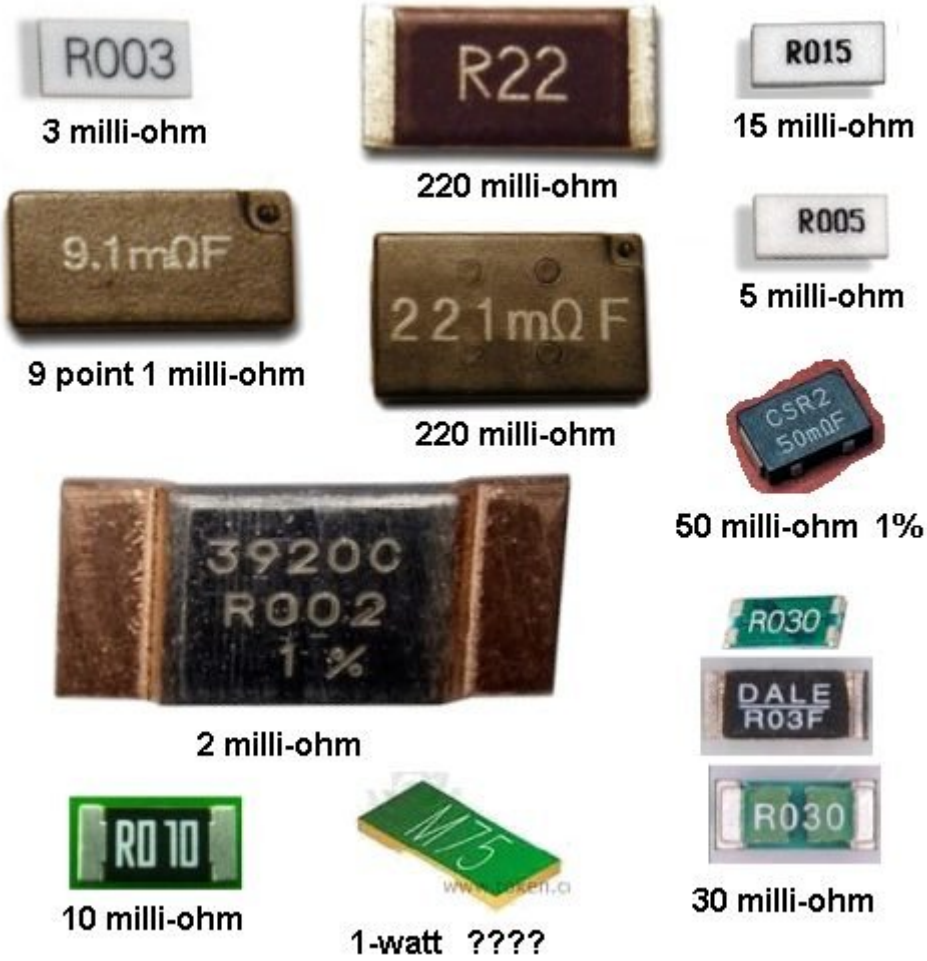

THE COMPLETE RANGE OF SM RESISTOR MARKINGS

Click to see the complete range of SM resistor markings for 3-digit code:

Click to see the complete range of SM resistor markings for 4-digit code:

0000 is a value on a surface-mount resistor. It is a zero-ohm **LINK**!
Resistances less than 10 ohms have 'R' to indicate the position of the decimal point.
Here are some examples:

Three Digit Examples	Four Digit Examples
330 is 33 ohms *- not 330 ohms*	**1000 is 100 ohms** *- not 1000 ohms*
221 is 220 ohms	**4992 is 49 900 ohms, or 49k9**
683 is 68 000 ohms, or 68k	**1623 is 162 000 ohms, or 162k**
105 is 1 000 000 ohms, or 1M	**0R56 or R56 is 0.56 ohms**
8R2 is 8.2 ohms	

A new coding system has appeared on **1% types**. This is known as the EIA-96 marking method. It consists of a three-character code. The first two digits signify the 3 significant digits of the resistor value, using the lookup table below. The third character - a letter - signifies the multiplier.

code	value	code	value	code	value	code	value	code	value	code	value
01	100	17	147	33	215	49	316	65	464	81	681
02	102	18	150	34	221	50	324	66	475	82	698
03	105	19	154	35	226	51	332	67	487	83	715
04	107	20	158	36	232	52	340	68	499	84	732
05	110	21	162	37	237	53	348	69	511	85	750
06	113	22	165	38	243	54	357	70	523	86	768
07	115	23	169	39	249	55	365	71	536	87	787
08	118	24	174	40	255	56	374	72	549	88	806
09	121	25	178	41	261	57	383	73	562	89	825
10	124	26	182	42	267	58	392	74	576	90	845
11	127	27	187	43	274	59	402	75	590	91	866
12	130	28	191	44	280	60	412	76	604	92	887
13	133	29	196	45	287	61	422	77	619	93	909
14	137	30	200	46	294	62	432	78	634	94	931
15	140	31	205	47	301	63	442	79	649	95	953
16	143	32	210	48	309	64	453	80	665	96	976

The **multiplier** letters are as follows:

letter	mult	letter	mult
F	100000	B	10
E	10000	A	1
D	1000	X or S	0.1
C	100	Y or R	0.01

22A is a 165 ohm resistor, **68C** is a 49900 ohm (49k9) and **43E** a 2740000 (2M74). This marking scheme applies to 1% resistors only.

A similar arrangement can be used for **2% and 5%** tolerance types. The multiplier letters are identical to 1% ones, but occur **before** the number code and the following **code** is used:

2%				5%			
code	value	code	value	code	value	code	value
01	100	13	330	25	100	37	330
02	110	14	360	26	110	38	360
03	120	15	390	27	120	39	390
04	130	16	430	28	130	40	430
05	150	17	470	29	150	41	470
06	160	18	510	30	160	42	510
07	180	19	560	31	180	43	560

08	200	**20**	620	**32**	200	**44**	620
09	220	**21**	680	**33**	220	**45**	680
10	240	**22**	750	**34**	240	**46**	750
11	270	**23**	820	**35**	270	**47**	820
12	300	**24**	910	**36**	300	**48**	910

With this arrangement, **C31** is 5%, 18000 ohm (18k), and **D18** is 510000 ohms (510k) 2% tolerance.
Always check with an ohm-meter (a multimeter) to make sure.

Chip resistors come in the following styles and ratings:
Style: 0402, 0603, 0805, 1206, 1210, 2010, 2512, 3616, 4022
Power Rating: 0402(1/16W), 0603(1/10W), 0805(1/8W), 1206(1/4W), 1210(1/3W), 2010(3/4W), 2512(1W), 3616(2W), 4022(3W)
Tolerance: 0.1%, 0.5%, 1%, 5%
Temperature Coefficient: 25ppm 50ppm 100ppm

EIA marking code for surface mount (SMD) resistors

01S = 1R	01R = 10R	01A = 100R	01B = 1k	01C = 10k	01D = 100k	01E = 1M	01F = 10M
02S = 1R02	02R = 10R2	02A = 102R	02B = 1k02	02C = 10k2	02D = 102k	02E = 1M02	
03S = 1R05	03R = 10R5	03A = 105R	03B = 1k05	03C = 10k5	03D = 105k	03E = 1M05	18F = 15M
04S = 1R07	04R = 10R7	04A = 107R	04B = 1k07	04C = 10k7	04D = 107k	04E = 1M07	
05S = 1R1	05R = 11R	05A = 110R	05B = 1k1	05C = 11k	05D = 110k	05E = 1M1	30F = 20M
06S = 1R13	06R = 11R3	06A = 113R	06B = 1k13	06C = 11k3	06D = 113k	06E = 1M13	
07S = 1R15	07R = 11R5	07A = 115R	07B = 1k15	07C = 11k5	07D = 115k	07E = 1M15	
08S = 1R18	08R = 11R8	08A = 118R	08B = 1k18	08C = 11k8	08D = 118k	08E = 1M18	
09S = 1R21	09R = 12R1	09A = 121R	09B = 1k21	09C = 12k1	09D = 121k	09E = 1M21	
10S = 1R24	10R = 12R4	10A = 124R	10B = 1k24	10C = 12k4	10D = 124k	10E = 1M24	
11S = 1R27	11R = 12R7	11A = 127R	11B = 1k27	11C = 12k7	11D = 127k	11E = 1M27	
12S = 1R3	12R = 13R	12A = 130R	12B = 1k3	12C = 13k	12D = 130k	12E = 1M3	
13S = 1R33	13R = 13R3	13A = 133R	13B = 1k33	13C = 13k3	13D = 133k	13E = 1M33	
14S = 1R37	14R = 13R7	14A = 137R	14B = 1k37	14C = 13k7	14D = 137k	14E = 1M37	
15S = 1R4	15R = 14R	15A = 140R	15B = 1k4	15C = 14k	15D = 140k	15E = 1M4	
16S = 1R43	16R = 14R3	16A = 143R	16B = 1k43	16C = 14k3	16D = 143k	16E = 1M43	
17S = 1R47	17R = 14R7	17A = 147R	17B = 1k47	17C = 14k7	17D = 147k	17E = 1M47	
18S = 1R5	18R = 15R	18A = 150R	18B = 1k5	18C = 15k	18D = 15k	18E = 1M5	
19S = 1R54	19R = 15R4	19A = 154R	19B = 1k54	19C = 15k4	19D = 154k	19E = 1M54	
20S = 1R58	20R = 15R8	20A = 158R	20B = 1k58	20C = 15k8	20D = 158k	20E = 1M58	
21S = 1R62	21R = 16R2	21A = 162R	21B = 1k62	21C = 16k2	21D = 162k	21E = 1M62	
22S = 1R65	22R = 16R5	22A = 165R	22B = 1k65	22C = 16k5	22D = 165k	22E = 1M65	
23S = 1R69	23R = 16R9	23A = 169R	23B = 1k69	23C = 16k9	23D = 169k	23E = 1M69	
24S = 1R74	24R = 17R4	24A = 174R	24B = 1k74	24C = 17k4	24D = 174k	24E = 1M74	
25S = 1R78	25R = 17R8	25A = 178R	25B = 1k78	25C = 17k8	25D = 178k	25E = 1M78	
26S = 1R82	26R = 18R2	26A = 182R	26B = 1k82	26C = 18k2	26D = 182k	26E = 1M82	
27S = 1R87	27R = 18R7	27A = 187R	27B = 1k87	27C = 18k7	27D = 187k	27E = 1M87	
28S = 1R91	28R = 19R1	28A = 191R	28B = 1k91	28C = 19k1	28D = 191k	28E = 1M91	
29S = 1R96	29R = 19R6	29A = 196R	29B = 1k96	29C = 19k6	29D = 196k	29E = 1M96	
30S = 2R0	30R = 20R0	30A = 200R	30B = 2k0	30C = 20k0	30D = 200k	30E = 2M0	
31S = 2R05	31R = 20R5	31A = 205R	31B = 2k05	31C = 20k5	31D = 205k	31E = 2M05	
32S = 2R10	32R = 21R0	32A = 210R	32B = 2k10	32C = 21k0	32D = 210k	32E = 2M10	
33S = 2R15	33R = 21R5	33A = 215R	33B = 2k15	33C = 21k5	33D = 215k	33E = 2M15	
34S = 2R21	34R = 22R1	34A = 221R	34B = 2k21	34C = 22k1	34D = 221k	34E = 2M21	
35S = 2R26	35R = 22R6	35A = 226R	35B = 2k26	35C = 22k6	35D = 226k	35E = 2M26	
36S = 2R32	36R = 23R2	36A = 232R	36B = 2k32	36C = 23k2	36D = 232k	36E = 2M32	
37S = 2R37	37R = 23R7	37A = 237R	37B = 2k37	37C = 23k7	37D = 237k	37E = 2M37	
38S = 2R43	38R = 24R3	38A = 243R	38B = 2k43	38C = 24k3	38D = 243k	38E = 2M43	
39S = 2R49	39R = 24R9	39A = 249R	39B = 2k49	39C = 24k9	39D = 249k	39E = 2M49	
40S = 2R55	40R = 25R5	40A = 255R	40B = 2k55	40C = 25k5	40D = 255k	40E = 2M55	
41S = 2R61	41R = 26R1	41A = 261R	41B = 2k61	41C = 26k1	41D = 261k	41E = 2M61	
42S = 2R67	42R = 26R7	42A = 267R	42B = 2k67	42C = 26k7	42D = 267k	42E = 2M67	
43S = 2R74	43R = 27R4	43A = 274R	43B = 2k74	43C = 27k4	43D = 274k	43E = 2M74	
44S = 2R80	44R = 28R0	44A = 280R	44B = 2k80	44C = 28k0	44D = 280k	44E = 2M80	
45S = 2R87	45R = 28R7	45A = 287R	45B = 2k87	45C = 28k7	45D = 287k	45E = 2M87	
46S = 2R94	46R = 29R4	46A = 294R	46B = 2k94	46C = 29k4	46D = 294k	46E = 2M94	
47S = 3R01	47R = 30R1	47A = 301R	47B = 3k01	47C = 30k1	47D = 301k	47E = 3M01	
48S = 3R09	48R = 30R9	48A = 309R	48B = 3k09	48C = 30k9	48D = 309k	48E = 3M09	
49S = 3R16	49R = 31R6	49A = 316R	49B = 3k16	49C = 31k6	49D = 316k	49E = 3M16	
50S = 3R24	50R = 32R4	50A = 324R	50B = 3k24	50C = 32k4	50D = 324k	50E = 3M24	
51S = 3R32	51R = 33R2	51A = 332R	51B = 3k32	51C = 33k2	51D = 332k	51E = 3M32	
52S = 3R4	52R = 34R0	52A = 340R	52B = 3k4	52C = 34k0	52D = 340k	52E = 3M4	
53S = 3R48	53R = 34R8	53A = 348R	53B = 3k48	53C = 34k8	53D = 348k	53E = 3M48	

54S = 3R57	54R = 35R7	54A = 357R	54B = 3k57	54C = 35k7	54D = 357k	54E = 3M57
55S = 3R65	55R = 36R5	55A = 365R	55B = 3k65	55C = 36k5	55D = 365k	55E = 3M65
56S = 3R74	56R = 37R4	56A = 374R	56B = 3k74	56C = 37k4	56D = 374k	56E = 3M74
57S = 3R83	57R = 38R3	57A = 383R	57B = 3k83	57C = 38k3	57D = 383k	57E = 3M83
58S = 3R92	58R = 39R2	58A = 392R	58B = 3k92	58C = 39k2	58D = 392k	58E = 3M92
59S = 4R02	59R = 40R2	59A = 402R	59B = 4k02	59C = 40k2	59D = 402k	59E = 4M02
60S = 4R12	60R = 41R2	60A = 412R	60B = 4k12	60C = 41k2	60D = 412k	60E = 4M12
61S = 4R22	61R = 42R2	61A = 422R	61B = 4k22	61C = 42k2	61D = 422k	61E = 4M22
62S = 4R32	62R = 43R2	62A = 432R	62B = 4k32	62C = 43k2	62D = 432k	62E = 4M32
63S = 4R42	63R = 44R2	63A = 442R	63B = 4k42	63C = 44k2	63D = 442k	63E = 4M42
64S = 4R53	64R = 45R3	64A = 453R	64B = 4k53	64C = 45k3	64D = 453k	64E = 4M53
65S = 4R64	65R = 46R4	65A = 464R	65B = 4k64	65C = 46k4	65D = 464k	65E = 4M64
66S = 4R75	66R = 47R5	66A = 475R	66B = 4k75	66C = 47k5	66D = 475k	66E = 4M75
67S = 4R87	67R = 48R7	67A = 487R	67B = 4k87	67C = 48k7	67D = 487k	67E = 4M87
68S = 4R99	68R = 49R9	68A = 499R	68B = 4k99	68C = 49k9	68D = 499k	68E = 4M99
69S = 5R11	69R = 51R1	69A = 511R	69B = 5k11	69C = 51k1	69D = 511k	69E = 5M11
70S = 5R23	70R = 52R3	70A = 523R	70B = 5k23	70C = 52k3	70D = 523k	70E = 5M23
71S = 5R36	71R = 53R6	71A = 536R	71B = 5k36	71C = 53k6	71D = 536k	71E = 5M36
72S = 5R49	72R = 54R9	72A = 549R	72B = 5k49	72C = 54k9	72D = 549k	72E = 5M49
73S = 5R62	73R = 56R2	73A = 562R	73B = 5k62	73C = 56k2	73D = 562k	73E = 5M62
74S = 5R76	74R = 57R6	74A = 576R	74B = 5k76	74C = 57k6	74D = 576k	74E = 5M76
75S = 5R9	75R = 59R0	75A = 590R	75B = 5k9	75C = 59k0	75D = 590k	75E = 5M9
76S = 6R04	76R = 60R4	76A = 604R	76B = 6k04	76C = 60k4	76D = 604k	76E = 6M04
77S = 6R19	77R = 61R9	77A = 619R	77B = 6k19	77C = 61k9	77D = 619k	77E = 6M19
78S = 6R34	78R = 63R4	78A = 634R	78B = 6k34	78C = 63k4	78D = 634k	78E = 6M34
79S = 6R49	79R = 64R9	79A = 649R	79B = 6k49	79C = 64k9	79D = 649k	79E = 6M49
80S = 6R65	80R = 66R5	80A = 665R	80B = 6k65	80C = 66k5	80D = 665k	80E = 6M65
81S = 6R81	81R = 68R1	81A = 681R	81B = 6k81	81C = 68k1	81D = 681k	81E = 6M81
82S = 6R98	82R = 69R8	82A = 698R	82B = 6k98	82C = 69k8	82D = 698k	82E = 6M98
83S = 7R15	83R = 71R5	83A = 715R	83B = 7k15	83C = 71k5	83D = 715k	83E = 7M15
84S = 7R32	84R = 73R2	84A = 732R	84B = 7k32	84C = 73k2	84D = 732k	84E = 7M32
85S = 7R5	85R = 75R0	85A = 750R	85B = 7k5	85C = 75k0	85D = 750k	85E = 7M5
86S = 7R68	86R = 76R8	86A = 768R	86B = 7k68	86C = 76k8	86D = 768k	86E = 7M68
87S = 7R87	87R = 78R7	87A = 787R	87B = 7k87	87C = 78k7	87D = 787k	87E = 7M87
88S = 8R06	88R = 80R6	88A = 806R	88B = 8k06	88C = 80k6	88D = 806k	88E = 8M06
89S = 8R25	89R = 82R5	89A = 825R	89B = 8k25	89C = 82k5	89D = 825k	89E = 8M25
90S = 8R45	90R = 84R5	90A = 845R	90B = 8k45	90C = 84k5	90D = 845k	90E = 8M45
91S = 8R66	91R = 86R6	91A = 866R	91B = 8k66	91C = 86k6	91D = 866k	91E = 8M66
92S = 8R87	92R = 88R7	92A = 887R	92B = 8k87	92C = 88k7	92D = 887k	92E = 8M87
93S = 9R09	93R = 90R9	93A = 909R	93B = 9k09	93C = 90k9	93D = 909k	93E = 9M09
94S = 9R31	94R = 93R1	94A = 931R	94B = 9k31	94C = 93k1	94D = 931k	94E = 9M31
95S = 9R53	95R = 95R3	95A = 953R	95B = 9k53	95C = 95k3	95D = 953k	95E = 9M53
96S = 9R76	96R = 97R6	96A = 976R	96B = 9k76	96C = 97k6	96D = 976k	96E = 9M76

If you want an accurate RESISTANCE measurement, remove the resistor from the circuit and use a Digital meter.

SURFACE MOUNT COMPONENTS - PACKS

Talking Electronics has packs of components for the repairman. The following packs are available:

SURFACE MOUNT RESISTOR PACK consists of 1 off each standard value
10 ohms to 1M & 2M2 (60 resistors)
$14.20 including pack and post

SURFACE MOUNT CAPACITOR PACK consists of:
2 - 10p 5 - 47p 5 - 100p 5 - 470p 5 - 1n 5 - 10n 5 - 22n 5 - 100n
5 - 1u 16v electrolytic 5 - 10u 16v electrolytic
(40 components)
$23.80 including pack and post

SURFACE MOUNT DIODE PACK consists of:
5 - 1N 4148 (marked as "A6")
$10.00 including pack and post

SURFACE MOUNT TRANSISTOR PACK consists of:
5 - BC 848 (marked as "1K") NPN
5 - BC858 PNP
$10.00 including pack and post

email **Colin Mitchell** for details on how to pay by credit card or PayPal.

CREATING ANY VALUE OF RESISTANCE

Any value of resistance can be created by connecting two resistors in PARALLEL or SERIES.
You can also create a higher wattage resistor by connecting them in SERIES OR PARALLEL.
We are only going to cover two EQUAL VALUE resistors in SERIES or in PARALLEL.
If you want to create a "Special Value," simply connect two resistors and read the value with a Digital Meter. Keep changing the values until you get the required value.
We are not going into series or Parallel formulae. You can easily find a value with a multimeter.

TWO EQUAL-VALUE RESISTORS IN SERIES

Two equal-value resistors IN SERIES creates a value of DOUBLE. You simply ADD the values.
This can be done with any to two values as shown. Three equal-value resistors in series is three times the value.

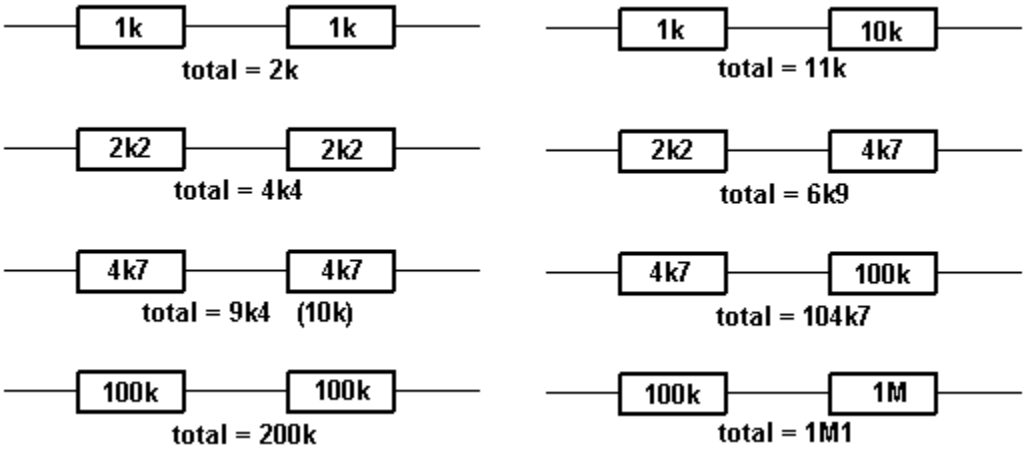

TWO EQUAL-VALUE RESISTORS IN PARALLEL

Two equal-value resistors IN PARALLEL creates a value of HALF. Three equal-value resistors in parallel is equal to one-third the value.

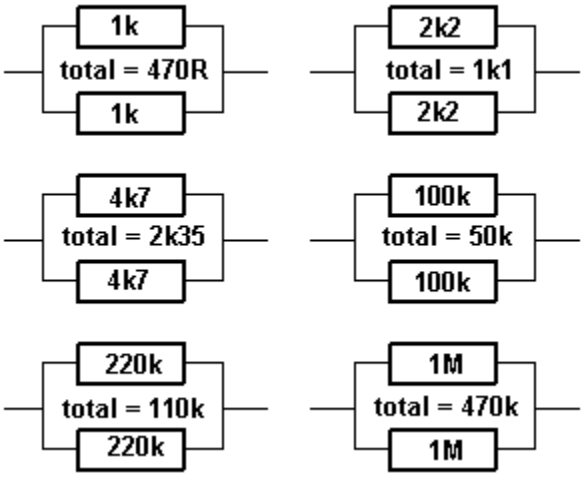

If you want a particular value and it is not available, here is a chart.
Use 2 resistors in series or parallel as shown:

Required Value	R1	Series/ Parallel	R2	Actual value:

10	4R7	S	4R7	9R4
12	10	S	2R2	12R2
15	22	P	47	14R9
18	22	P	100	18R
22	10	S	12	22
27	22	S	4R7	26R7
33	22	S	10	32R
39	220	P	47	38R7
47	22	S	27	49
56	47	S	10	57
68	33	S	33	66
82	27	S	56	83

There are other ways to combine 2 resistors in parallel or series to get a particular value. The examples above are just one way. 4R7 = 4.7 ohms

TESTING A RESISTOR

To check the value of a resistor, it should be removed from the circuit. The surrounding components can affect the reading and make it lower.
Resistors **VERY RARELY** change value, but if it is overheated or damaged, the resistance can increase. You can take the reading of a resistor "in-circuit" in one direction then the other, as the surrounding components may have diodes and this will alter the reading.
You can also test a resistor by feeling its temperature-rise. It is getting too hot if you cannot hold your finger on it (some "metal film" resistors are designed to tolerate quite high temperatures).

TESTING AN "AC" RESISTOR

There is no such thing as an "AC" resistor. Resistors are just "resistors" and they can be in AC circuits or DC circuits. Resistors can be given names such as "Safety Resistor" "Ballast Resistor" "LOAD Resistor" "Feed Resistor" "Dropper Resistor" or "Supply Resistor." These are just normal resistors with a normal resistance - except a "Safety Resistor."
A safety resistor is made of a flame-proof material such as metal-oxide-film and not carbon-composition. It is designed to "burn out" when too much current flows BUT NOT CATCH FIRE. It is a low-value resistor and has a voltage-drop across it but this is not intentional. The voltage-drop is to create a "heating-effect" to burn out the resistor. In all the other types of resistor, the voltage-drop is intentional.
A Ballast resistor is a normal resistor and can be called a Power resistor, Dropper resistor, Supply resistor or Feed resistor. It is designed to reduce the voltage from one source and deliver a lower voltage. It is a form of: "in-line" resistor.
A Load Resistor is generally connected across the output of a circuit and turns the energy it receives, into heat.

RESISTOR NETWORKS

To reduce the number of resistors in a circuit, some engineers use a set of identical resistors in a package called a Single-In-Line (SIL) resistor network. It is made with many resistors of the same value, all in one package. One end of each resistor is connected all the other resistors and this is the common pin, identified as pin 1 and has a dot on the package.
These packages are very reliable but to make sure all the resistors are as stated, you need to locate pin 1. All values will be identical when referenced to this pin.

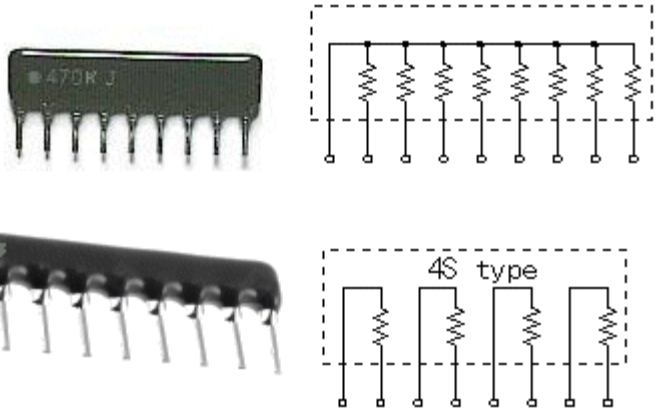

RESISTOR NETWORKS

Some resistor networks have a "4S" printed on the component. The 4S indicates the package contains 4 independent resistors that are not wired together inside. The housing has eight leads as shown in the second image.
Independent resistors have an even number of pins and measuring between each pair will produce identical values. Resistance between any pair will indicate leakage and may be a fault.

WIRE WOUND RESISTOR

A wire wound resistor is also called a POWER RESISTOR. This type of resistor can have a resistance as low as 0.1 ohms (one-tenth of an ohm) or as high as about 10k.
The image shows a 0.68 ohm resistor as the letter "R" represents the DECIMAL POINT and R68 is the same a .68 and this is 0.68 ohms. The wattage is 9 watts.
This resistor will allow xxx amps to flow. To work out the current, use the formula:
Power = Current x Current x resistance
9 = Current x Current x .68
Divide both sides by 0.68
13.2 = Current x Current
Find the square root of 13.2
Current = 3.6 amps

When 3.6 amps flow through the resistor, the voltage appearing across it will be:
V = current x resistance
= 3.6 x 0.68
= 2.5v and the wattage (heat) loss will be 9 watts.

The purpose of a resistor like this is to stop or reduce "ripple." Ripple is the noise or hum in an amplifier when the sound is turned up.
There are many reasons why you need to reduce the level of hum and this resistor will remove ripple as large as 2.5v when 3.6 amps is flowing, provided you have filter electrolytics on both side of the resistor to assist in removing the ripple.

If the letter "R" is in a different position, the value of resistance would be:

68R = 68Ω
6R8 = 6.8Ω
R68 = 0.68Ω

If you replace the R68 resistor a 6R8 resistor by mistake, the voltage across it will rise to 25v and if 3.6 amps flows, the wattage will be: 90 watts!!!
The resistor will glow red and burn out.

TESTING A POSISTOR

A Posistor is a resistor that connects in series with the degaussing coil around the picture tube or **Monitor.** When cold, it has a very low resistance and a large current flows when the monitor or TV is switched on. This current heats up the Posistor and the resistance increases. This causes the current to decrease and any magnetism in the shadow mask is removed. The posistor can one or two elements and it is kept warm so the resistance remains high. Many Posistors have a second element inside the case that connects directly to the supply to keep the Positive Temperature Coefficient resistor high so that the current through the degaussing coil falls to almost zero. This constant heat eventually destroys the package.
The heavy current that flows when a set is turned ON also causes the posistor to crack and break and this results in poor purity on the screen - as the shadow mask gradually becomes magnetic..
Posistors have different resistance values from different manufacturers and must be replaced with an identical type.
They can be checked for very low resistance when cold but any loose pieces inside the case will indicate a damaged component.

A "BURNT" RESISTOR - normally and technically called a "burnt-out" resistor.

The resistance of a "burnt" resistor can sometimes be determined by scraping away the outer coating - if the resistor has a spiral of resistance-material. You may be able to find a spot where the spiral has been damaged.

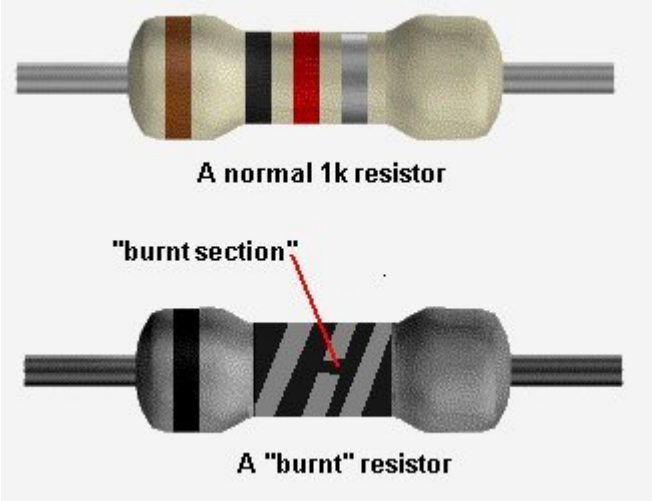

**Note the spirals of conductive carbon.
The number of spirals has nothing to with the resistance.
It is the amount of carbon particles in the "track" that
determines the resistance. It is also the thickness and width
of the track that determines the resistance.
And then it is the overall size of the resistor that determines the wattage.
And then the size of the leads, the closeness to the PCB and
the size of the lands that eventually determines how hot the resistor
will get.**

Clean the "spot" (burnt section of the spiral) very carefully and make sure you can get a good contact with the spiral and the tip of your probe. Measure from one lead of the resistor to the end of the damaged spiral. Then measure from the other lead to the other end of the spiral.
Add the two values and you have an approximate value for the resistor. You can add a small amount for the damaged section.
This process works very well for damaged wire-wound resistors. They can be pulled apart and each section of the resistance-wire (nichrome wire) measured and added to get the full resistance.

There is another way to determine the value of a damaged resistor.
Get a set of resistors of the same wattage as the damaged component and start with a high value. It's handy to know if the resistor is in the range: 10ohm to 100ohms or 1k to 10k etc, but this is not essential.
Start with a very high value and turn the circuit ON. You can perform voltage tests and if you know the expected output voltage, decrease the resistance until this voltage is obtained.
If you do not know the expected voltage, keep reducing the value of resistance until the circuit works as designed.
This is the best advice in a situation where you do not know the value of a resistor.

There is a third way to determine the value and this requires measuring the voltage drop across the resistor and the current-flow. By multiplying the two you will get a wattage and this must be less than the wattage of the resistor being replaced.

TESTING POTENTIOMETERS (variable resistors)

To check the value of a variable resistor, it should be removed from circuit or at least 2 legs should be removed. A Rheostat is a variable resistor using only one end and the middle connected to a circuit.
The resistance between the two outside pins is the value marked on the component and the centre leg will change from nearly zero to the full resistance as the shaft is rotated.
"Pots" generally suffer from "crackle" when turned and this can be fixed by spraying up the shaft and into the pot via the shaft with a tube fixed to a can of "spray-lubricant" (contact cleaner).
"Pre-set pots" and "trim pots" are miniature versions of a potentiometer and they are all tested the same. The photo shows a pot, two mini pots and 3 mini trim pots.

10-Turn POTs

A 10-turn pot is one of the worst items to be designed. I remove them immediately from any design.
You don't know the position of the wiper. You don't know which way you are turning the wiper and you can't remember which way you turned the post "the last time."
The screwdriver always falls out of the slot.
If you need fine adjustment, place fixed resistors on each side of the pot and use a normal mini trim pot with much less resistance.

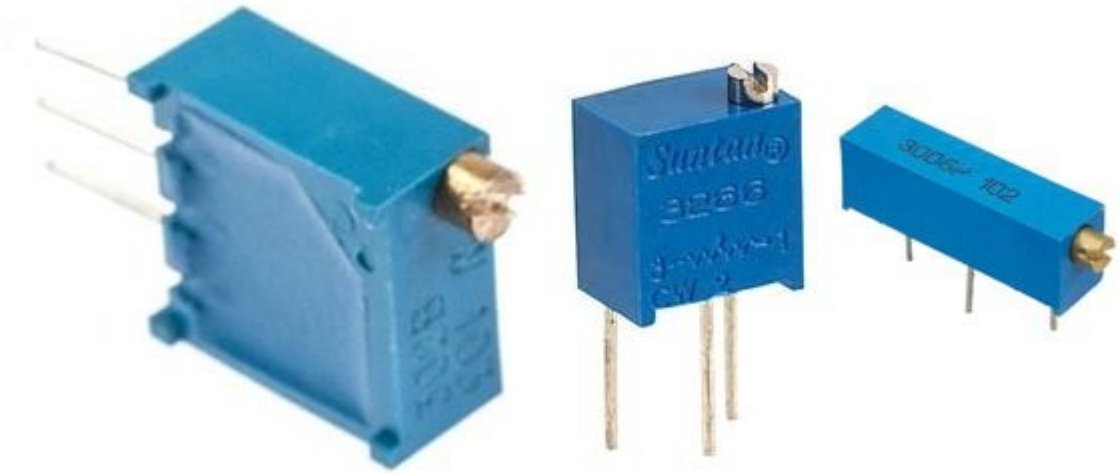

FOCUS POTS

Focus pots quite often get a spot of dirt where the wiper touches the track. Cleaning with spray fixes the bad focus but if the pot is leaking to chassis from inside the pot (due to the high voltage on the terminals) simply remove it from the chassis and leave it floating (this will restore the high voltage to the picture tube) or you can use one from an old chassis.

MAKING YOUR OWN RESISTOR, CAPACITOR, INDUCTOR or DIODE

Quite often you will not have the exact value of resistance or capacitance for a repair.
We have already covered placing resistors and capacitors in parallel and series:

Resistors in Parallel and/or Series
Capacitors in Parallel and/or Series

Here are some extras:

RESISTORS
Two 1k 0.5watt resistors in parallel produces a 470R 1watt resistor.
Two 1k 0.5watt resistors in series produces a 2k 1watt resistor.

CAPACITORS
Two 100n 100v capacitors in series produces a 50n capacitor @200v

INDUCTORS: Two inductors in series - **ADD THE VALUES**

DIODES: Two 1Amp 400v diodes in series produces a 1Amp 800v diode
Two 1Amp 400v diodes in parallel produces a 2Amp 400v diode

ZENER DIODES: Zener diodes can be connected in series to get a higher voltage.
Two 12v zener diodes in series produces a 24v zener.

CONTINUITY

Some multimeters have a "buzzer" that detects when the probes are touching each other or the resistance between the probes is very LOW. This is called a CONTINUITY TESTER.
You can use the resistance scale "x1" or "x10" to detect low values of resistance.
Set the pointer to "0" (right end of the scale) by touching the probes together and adjusting the "zero ohms" control.
When taking a reading, you will have to decide if a low value of resistance is a short-circuit or an "operating value."
For instance, the cold resistance of a 12v car globe is very low (about 2 ohms) and it increases (about 6 times) to 12 ohms when hot.
The "resistance of a circuit" may be very low as the electrolytics in the circuit are uncharged. This may not indicate a true "short-circuit."
The measurement across a diode is not a resistance-value but a "voltage-drop" and that is why the needle swings nearly full-scale.
Leads and wires and cords have a small resistance and depending on the length of the lead, this small resistance may be affecting a circuit.
Remember this:
When a circuit takes 1 amp, and the resistance of the leads is 1 ohm, the voltage drop across the leads will be 1v.
That's why a 12v battery supplying a circuit with these leads will have 11v at the circuit.
Note:
Turn off the equipment before making any continuity tests. The presence of even a small voltage (from an electrolytic) can give a false reading.
You can determine the resistance of a lead very accurately by taking the example above and applying it to your circuit.
If the battery is 12.6v and the voltage across the circuit is 10v, when the current is 2.6 amps, the resistance of the "leads" is 12.6 - 10 = 2.6 R=V/I = 2.6/2.6 = 1ohm. By making the lead shorter or using thicker wire, the resistance will be less and the voltage on the project will increase.
When taking readings in a circuit that has a number of diodes built-into IC's (Integrated Circuits) and transistors, some Continuity Testers will beep and give a false reading.
The following circuit has the advantage of providing a beep when a short-circuit is detected but does not detect the small voltage drop across a diode. This is ideal when testing logic circuits as it is quick and you can listen for the beep while

concentrating on the probe. Using a multimeter is much slower.

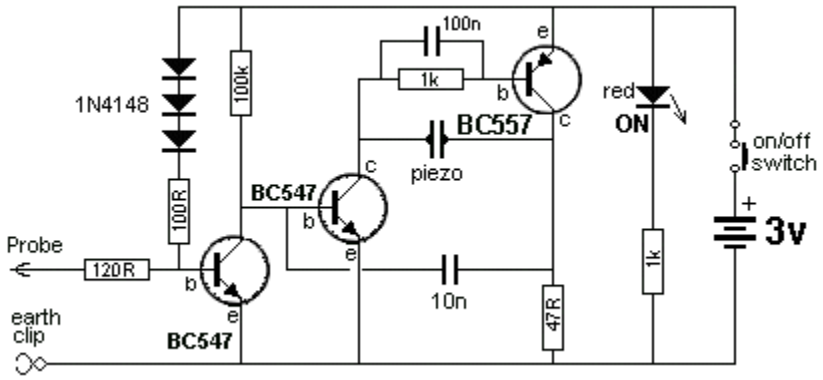

CONTINUITY TESTER

You can build the circuit on Matrix Board and add it to your Test Equipment.
You will need lots of "Test Equipment" and they can be built from circuits in this eBook.

TESTING FUSES, LEADS AND WIRES

All these components come under the heading TESTING for CONTINUITY. Turn off all power to the equipment before testing for shorts and continuity. Use the low resistance "Ohms Scale" or CONTINUITY range on your multimeter. All fuses, leads and wires should have a low, very low or zero resistance. This proves they are working.

A BLOWN FUSE

The appearance of a fuse after it has "blown" can tell you a lot about the fault in the circuit.
If the inside of the glass tube (of the fuse) is totally blackened, the fuse has been damaged very quickly. This indicates a very high current has passed through the fuse.
Depending on the rating of the fuse, (current rating) you will be able to look for components that can pass a high current when damaged - such as high power transistors, FETs, coils, electrolytics. Before re-connecting the supply, you should test the "SUPPLY RAILS" for resistance. This is done by measuring them on a low OHMs range in one direction then reverse the leads to see if the resistance is low in the other direction.
A reading can be very low at the start because electrolytics need time to charge-up and if the reading gradually increases, the power rail does not have a short. An overload can occur when the supply voltage rises to nearly full voltage, so you sometimes have to fit a fuse and see how long it takes to "blow."
If the fuse is just slightly damaged, you will need to read the next part of this eBook, to see how and why this happens:

FAST AND SLOW BLOW FUSES

There are many different sizes, shapes and ratings of a fuse. They are all current ratings as a fuse does not have a voltage rating. Some fuses are designed for cars as they fit into the special fuse holders. A fuse can be designed for 50mA, 100mA, 250mA, 315mA, 500mA, 1Amp, 1.5amp, 2amp, 3amp, 3.15amp 5amp, 10amp, 15amp, 20amp, 25amp, 30amp, 35amp, 50amp and higher.
Some fuses are fast-blow and some are slow-blow.
A "normal" fuse consists of a length of thin wire. Or it may be a loop of wire that is thin near the middle of the fuse. This is the section that will "burn-out."
A "normal" fuse is a fast-blow fuse. For instance, a 1amp fuse will remain intact when up to 1.25 amp flows. When a circuit is turned on, it may take 2-3 amps for a very short period of time and a normal 1 amp fuse will get very hot and the wire will stretch but not "burn-out." You can see the wire move when the supply turns on.
If the current increases to 2amps, the fuse will still remain intact. It needs about 3 amp to heat up the wire to red-hot and burn out.

If the current increases to 5 amp, the wire VOLATILISES (burns-out) and deposits carbon-black on the inside of the glass tube.
A slow-blow fuse uses a slightly thicker piece of wire and the fuse is made of two pieces of wire joined in the middle with a dob of low-temperature solder. Sometimes one of the pieces of wire is a spring and when the current rises to 2.5 amp, the heat generated in the wire melts the solder and the two pieces of wire "spring apart."
A slow-blow fuse will allow a higher current-surge to pass through the fuse and the wire will not heat up and sag.
Thus the fuse is not gradually being damaged and it will remain in a perfect state for a long period of time.
A fuse does not protect electronic equipment from failing. It acts AFTER the equipment has failed.
It will then protect a power supply from delivering a high current to a circuit that has failed.
If a slow-blow fuse has melted the solder, it could be due to a slight overload, slight weakening of the fuse over a period of time or the current-rating may be too low.
You can try another fuse to see what happens.
You can replace a fast-acting fuse (normal fuse) with a slow blow if the fast-acting fuse has been replaced a few times due to deterioration when the equipment is turned on.
But you cannot replace a slow-blow fuse with a fast acting fuse as it will be damaged slightly each time the equipment is turned on and eventually fail.

100mA FUSES

Fuses below about 100mA are very hard to make and very unreliable.
Many circuits take a high current when turned to charge the electrolytics and a 100mA (or 50mA or 63mA fuse) will bow and stretch and change shape, every time the equipment is turned ON.
Eventually it will break, due to it heating-up and stretching.
To produce a reliable fuse below 100mA, some manufacturers have placed a resistor inside the fuse and connected it to a spring. One end of the resistor is soldered to a wire with low-temperature metal and when the resistor gets hot, the metal softens and the spring pulls the resistor away from the wire.
Quite often you can heat up the metal and connect the wire and the fuse is perfect.
This type of fuse is called a DELAY fuse and the current rating is shown on the end-cap.
The value of the resistor determines the current rating.
There is a small voltage across this type of fuse and it means the circuit sees a slightly lower voltage than the supply voltage.
The third photo shows the pot of solder or low-temp metal and a wire connected to a spring. The heat generated in the wire is passed to the solder and it softens. The spring pulls the two components apart. You can smash the glass and set up the fuse in the two fuse-holders and repair the fuse while you wait for a new fuse to arrive.

TESTING COILS, INDUCTORS and YOKES

Coils, inductors, chokes and yokes are just coils (turns) of wire. The wire may be wrapped around a core made of iron or ferrite.
It is labeled "L" on a circuit board.
You can test this component for continuity between the ends of the winding and also make sure there is no continuity between the winding and the core.
The winding can be less than one ohm, or greater than 100 ohms. A coil of wire is also called an INDUCTOR and it might look like a very simple component, but it can operate in a very complex way.
The way it works is a discussion for another eBook. It is important to understand the turns are insulated but a slight fracture in the insulation can cause two turns to touch each other and this is called a "SHORTED TURN" or you can say the inductor has "SHORTED TURNS."
When this happens, the inductor allows the circuit to draw MORE CURRENT. This causes the fuse to "blow."
The quickest way to check an inductor is to replace it, but if you want to measure the inductance, you can use an INDUCTANCE METER. You can then compare the inductance with a known good component.
An inductor with a shorted turn will have a very low or zero inductance, however you may not be able to detect the fault when it is not working in a circuit as the fault may be created by a high voltage generated between two of the turns.
Faulty yokes (both horizontal and vertical windings) can cause the picture to reduce in size and/or bend or produce a single horizontal line.
A TV or monitor screen is the best piece of Test Equipment as it has identified the fault. It is pointless trying to test the windings further as you will not be able to test them under full operating conditions. The fault may not show up when a low voltage (test voltage) is applied.

MEASURING AND TESTING INDUCTORS

Inductors are measured with an INDUCTANCE METER but the value of some inductors is very small and some Inductance Meters do not give an accurate reading. The solution is to measure a larger inductor and note the reading. Now put the two inductors in SERIES and the values ADD UP - just like resistors in SERIES. This way you can measure very small inductors. VERY CLEVER!

Question from a reader: *Can I add an inductor to stop a fuse blowing?*

Basically, an inductor NEVER prevents a fuse blowing because an inductor prevents spikes on one lead (we will call the INPUT lead), appearing on its other lead.
This is the detection and prevention of current that exists for a very short period of time.
A fuse detects an excess of current that occurs over a very long period of time and they are entirely two different "detectors."
One cannot assist the other in any way.

An inductor is basically a coil of wire. It may be thick or thin wire. The value of the inductor is a combination of the number of turns and the material on which the wire is wound.
The value of an inductor does not change over say a period of 20 years but it can go faulty by the enamel cracking and two turns touching. This can also be due to the difference in voltage between the two turns creating a spark between the turns and creating a "short."
When you test it, the high voltage is not present and it will test ok.
You may not think a few turns of wire will have any effect on improving a circuit, but spikes are very high frequency and the inductor will have a very big effect on reducing them.
An inductor (say 100uH) can be produced in many different sizes and the thickness of the wire will be important as it determines the current that can flow through the inductor.
The term "inductor" also includes those with two or more windings and these components are called TRANSFORMERS. These devices can get "shorts" and "leaks" between the windings and sparks can be seen between the windings. These sparks do not occur when you are testing them on test-equipment so the only way to

guarantee success is to replace it with an identical replacement.

TESTING SWITCHES and RELAYS

Switches and relays have contacts that open and close mechanically and you can test them for CONTINUITY. However these components can become intermittent due to dirt or pitting of the surface of the contacts due to arcing as the switch is opened.
It is best to test these items when the operating voltage and current is present as they quite often fail due to the arcing. A switch can work 49 times then fail on each 50th operation. The same with a relay. It can fail one time in 50 due to CONTACT WEAR.
If the contacts do not touch each other with a large amount of force and with a large amount of the metal touching, the current flowing through the contacts will create HEAT and this will damage the metal and sometimes reduce the pressure holding the contact together.
This causes more arcing and eventually the switch heats up and starts to burn.
Switches are the biggest causes of fire in electrical equipment and households.

A relay also has a set of contacts that can cause problems.
There are many different types of relays and basically they can be put into two groups.
1. An electromagnetic relay is a switch operated by magnetic force. This force is generated by current through a coil. The relay opens and closes a set of contacts. The contacts allow a current to flow and this current can damage the contacts.
Connect 5v or 12v to the coil (or 24v) and listen for the "click" of the points closing.
Measure the resistance across the points to see if they are closing.
You really need to put a load on the points to see if they are clean and can carry a current.
The coil will work in either direction.
If not, the relay is possibly a CMOS relay or Solid State relay.

2. An electronic relay (Solid State Relay) does not have a winding. It works on the principle of an opto-coupler and uses a LED and Light Activated SCR or Opto-TRIAC to produce a low resistance on the output. The two pins that energise the relay (the two input pins) must be connected to 5v (or 12v) around the correct way as the voltage is driving a LED (with series resistor). The LED illuminates and activates a light-sensitive device.

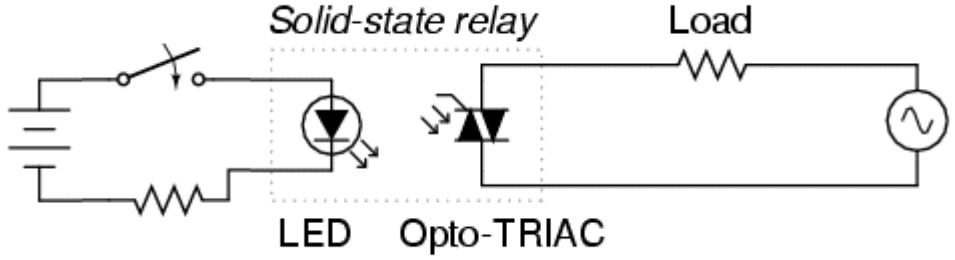

TESTING REED SWITCHES

A reed switch is generally contained in a long glass tube:

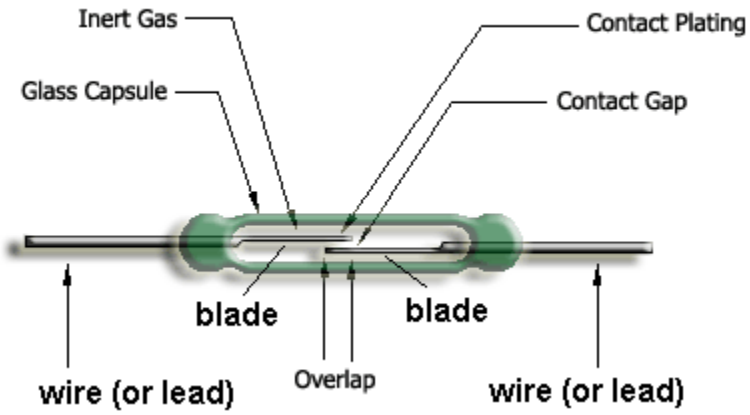

A wire or lead comes out each end for soldering to the reed switch to the project.
The two "blades" inside the switch are made from a material that can be magnetised but does not retain its magnetism. This effect is called "temporally magnetised" (not permanently magnetised) and really only "passes" magnetism from one end to the other when in the presence of a magnet. One of the blades is made of a soft material and it will bend very easily. The other one is much stiffer.

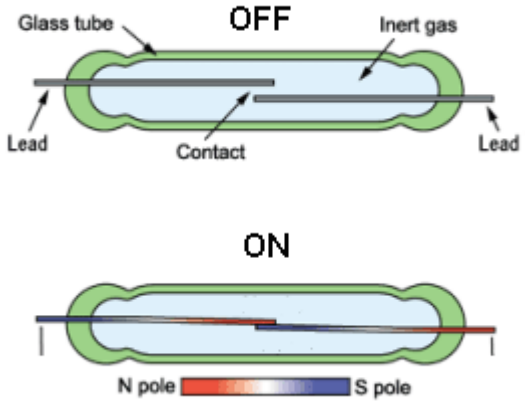

When a magnet is placed under the two blades (or on top), the magnetism from the magnet is passed to the two blades (INDUCTION or MUTUAL INDUCTION - commonly called INDUCED) and it produces a very weak magnet (in the blade) that is identical to the powerful magnet as far as the position of the north and south poles are concerned). Initially it produces a N-S and N-S set of poles and this makes the two blades click together because the top blade will be South at the contact and the bottom blade will be North.
When the two blades click together the magnetism runs through the two blades and keeps them together. The two blades attract and the switch is closed. When the magnet is removed, the magnetism in the two blades ceases and the two blades move apart.
Since there is a very small amount of movement in the top blade, this switch has a limited number of operations. Eventually it will fail. It is a mechanical device and is not suited for detecting a spinning shaft as 100,000 revolutions will very quickly weaken the switch.
If the switch does not make contact or remains closed, the moveable blade can be cracked or broken. This can be very hard to see. So replace the switch.

LATCHING REED SWITCH

A "normal" reed switch can be converted into a **LATCHING REED SWITCH** by carefully placing a magnet below the switch and moving it away so the two blades open. Now move it slightly closer but do not allow the blades to close.
This is called putting a "SET" on the switch and the two blades will have a small magnetic effect "induced" in them but not enough to close the contacts:

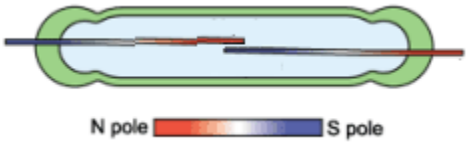

Now bring a strong magnet up to the reed switch on the other side of the glass tube with the north pole above the north of the lower magnet. This effect will increase the INDUCED MAGNETISM in the blades and close the contacts:

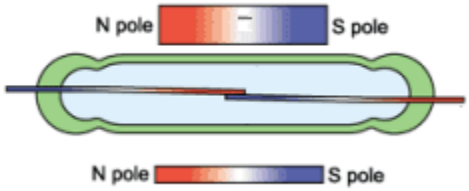

Remove the top magnet and the lower magnet will induce enough magnetism into the blades to keep them closed:

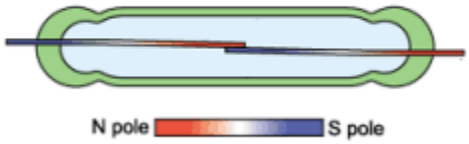

Now bring the upper magnet near the reed switch with the south pole above the north pole of the lower magnet. (In other words: AROUND THE OTHER WAY) This will have the effect of reducing the induced magnetism in the blades and a point will be reached when the two contacts will separate:

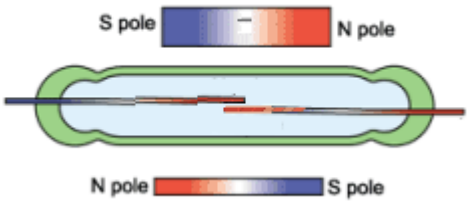

Remove the top magnet and the switch will remain separated because the lower magnet will not have sufficient influence on the blades to close the contact:

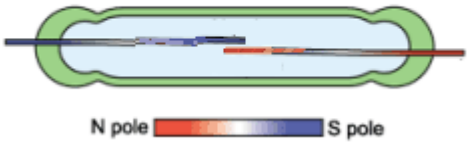

CAPACITORS

Capacitors are one of the most difficult things to test. That's because they don't give a reading on a multimeter and their value can range from 1p to 100,000u.
A faulty capacitor may be "open" when measured with a multimeter, and a good capacitor will also be "open."

You need a piece of test equipment called a CAPACITANCE METER to measure the value of a capacitor.

HOW A CAPACITOR WORKS

There are two ways to describe how a capacitor works. Both are correct and you have to combine them to get a full picture.
A capacitor has INFINITE resistance between one lead and the other.
This means no current flows **through** a capacitor. But it works in another way.
Suppose you have a strong magnet on one side of a door and a piece of metal on the other. By sliding the magnet up and down the door, the metal rises and falls.
The metal can be connected to a pump and you can pump water by sliding the magnet up and down.
A capacitor works in exactly the same way.
If you raise a voltage on one lead of a capacitor, the other lead will rise to the same voltage. This needs more explaining - we are keeping the discussion simple.
It works just like the magnetic field of the magnet through a door.
The next concept is this:
Capacitors are equivalent to a tiny rechargeable battery.
They store energy when the supply-voltage is present and release it when the supply drops.
These two concepts can be used in many ways and that's why capacitors perform tasks such as filtering, time-delays, passing a signal from one stage to another and create many different effects in a circuit.

CAPACITOR VALUES

The basic unit of capacitance is the FARAD. (C) This is the value used in all equations, but it is a very large value. A one FARAD capacitor would be the size of a car if made with plates and paper. Most electronic circuits use capacitors with smaller values such as 1p to 1,000u. 1p is about equal to two parallel wires 2cm long. 1p is one picofarad.

The easiest way to understand capacitor values is to start with a value of 1u. This is one microfarad and is one-millionth of a Farad. A 1 microfarad capacitor is about 1cm long and the diagram shows a 1u electrolytic.

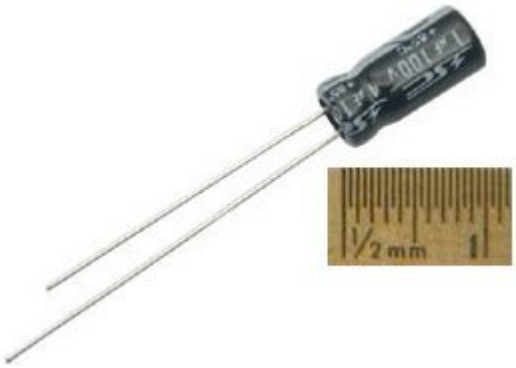

Smaller capacitors are ceramic and they look like the following. This is a 100n (0.1u)ceramic:

To read the value on a capacitor you need to know a few facts.

The basic value of capacitance is the FARAD.
1 microfarad is one millionth of 1 farad.
1 microfarad is divided into smaller parts called nanofarad.
1,000 nanofarad = 1 microfarad
Nanofarad is divided into small parts called picofarad
1,000 picofarad = 1 nanofarad.

Recapping:
1p = 1 picofarad. 1,000p = 1n (1 nanofarad)
1,000n = 1u (1 microfarad)
1,000u = 1millifarad
1,000,000u = 1 FARAD.

Examples:
All ceramic capacitors are marked in "p" (puff")
A ceramic with 22 is 22p = 22 picofarad
A ceramic with 47 is 47p = 47 picofarad
A ceramic with 470 is 470p = 470 picofarad
A ceramic with 471 is 470p = 470 picofarad
A ceramic with 102 is 1,000p = 1n
A ceramic with 223 is 22,000p = 22n
A ceramic with 104 is 100,000p = 100n = 0.1u

TYPES OF CAPACITOR
For testing purposes, there are two types of capacitor.
Capacitors from 1p to 100n are non-polar and can be inserted into a circuit around either way.
Capacitors from 1u to 100,000u are electrolytics and are polarised. They must be fitted so the positive lead goes to the supply voltage and the negative lead goes to ground (or earth).
There are many different sizes, shapes and types of capacitor. They are all the same. They consist of two plates with an insulating material between. The two plates can be stacked in layers or rolled together.
The important factor is the insulating material. It must be very thin to keep things small. This gives the capacitor its VOLTAGE RATING.
If a capacitor sees a voltage higher than its rating, the voltage will "jump through" the insulating material or around it.
If this happens, a carbon deposit is left behind and the capacitor becomes "leaky" or very low resistance, as carbon is conductive.

CERAMIC CAPACITORS

Nearly all small capacitors are **ceramic capacitors** as this material is cheap and the capacitor can be made in very thin layers to produced a high capacitance for the size of the component. This is especially true for surface-mount capacitors.
All capacitors are marked with a value and the basic unit is: "p" for "puff" However NO surface mount capacitors are marked and they are very difficult to test.

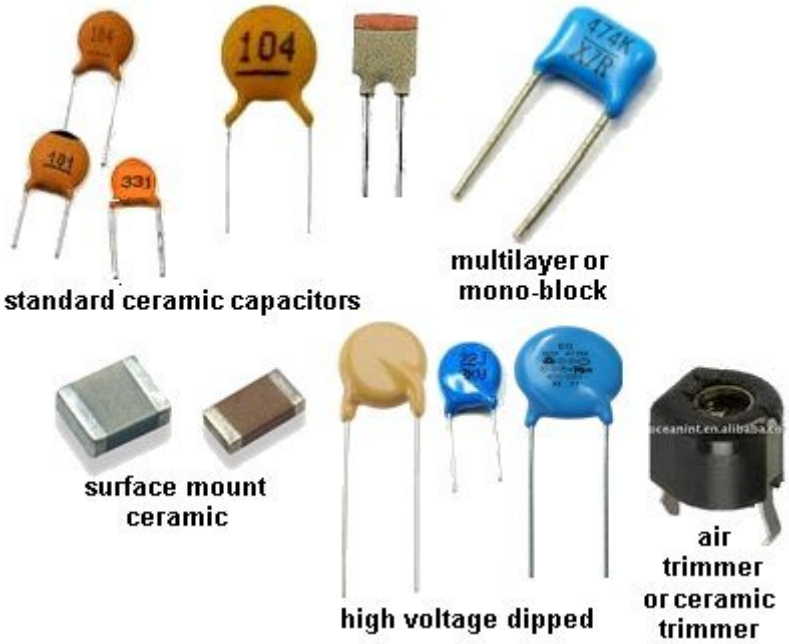

VALUE:	VALUE WRITTEN ON THE COMPONENT:
0.1p	0p1
0.22p	0p22
0.47p	0p47
1.0p	1p0
2.2p	2p2
4.7p	4p7
5.6p	5p6
8.2p	8p2
10p	10 or 10p
22p	22 or 22p
47p	47 or 47p
56p	56 or 56p
100p	100 on 101
220p	220 or 221
470p	470 or 471
560p	560 or 561
820p	820 or 821
1,000p (1n)	102
2200p (2n2)	222
4700p (4n7)	472
8200p (8n2)	822
10n	103
22n	223
47n	473
100n	104
220n	224
470n	474
1u	105

POLYESTER, POLYCARBONATE, POLYSTYRENE, MYLAR, METALLISED POLYESTER, ("POLY"), MICA and other types of CAPACITOR

There are many types of capacitor and they are chosen for their reliability, stability, temperate-range and cost.

For testing and repair work, they are all the same. Simply replace with exactly the same type and value.

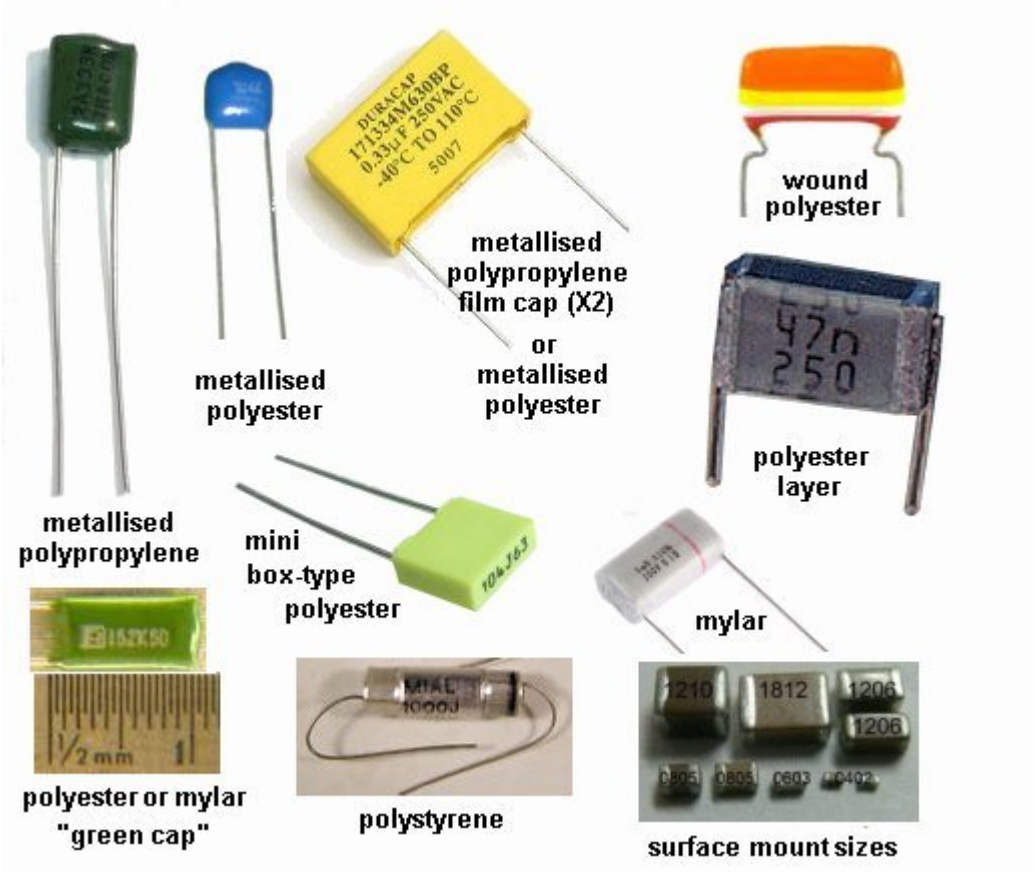

Capacitor Colour Code Table

Colour	Digit A	Digit B	Multiplier D	Tolerance (T) > 10pf	Tolerance (T) < 10pf	Temperature Coefficient (TC)
Black	0	0	x1	± 20%	± 2.0pF	
Brown	1	1	x10	± 1%	± 0.1pF	$-33x10^{-6}$
Red	2	2	x100	± 2%	± 0.25pF	$-75x10^{-6}$
Orange	3	3	x1,000	± 3%		$-150x10^{-6}$
Yellow	4	4	x10,000	± 4%		$-220x10^{-6}$
Green	5	5	x100,000	± 5%	± 0.5pF	$-330x10^{-6}$
Blue	6	6	x1,000,000			$-470x10^{-6}$
Violet	7	7				$-750x10^{-6}$
Grey	8	8	x0.01	+80%,-20%		
White	9	9	x0.1	± 10%	± 1.0pF	
Gold			x0.1	± 5%		

Silver			x0.01	± 10%		

Pico Farads (pF)	Nano Farads (nF)	Micro Farads (µF)
1	0.001	0.000001
10	0.01	0.00001
100	0.1	0.0001
1,000	1	0.001
10,000	10	0.01
100,000	100	0.1
1,000,000	1,000	1
10,000,000	10,000	10
100,000,000	100,000	100

Type ⊕ = polarized	Pic	Cap Range
Ceramic		**pF - µF**
Mica **(silver mica)**	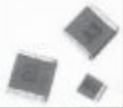	**pF - nF**
Plastic Film **(polyethylene polystyrene)**		**few µFs**
Tantalum ⊕		**µFs**
OSCON ⊕		**µFs**
Aluminum Electrolytic ⊕		**high µFs**

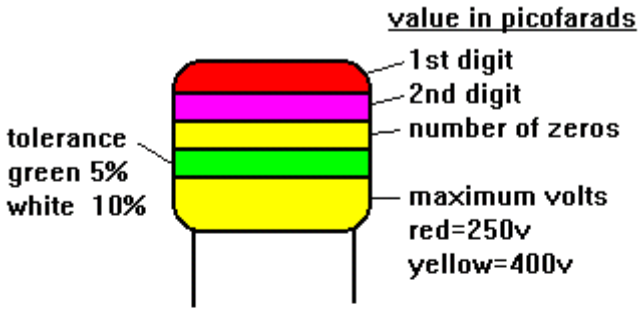

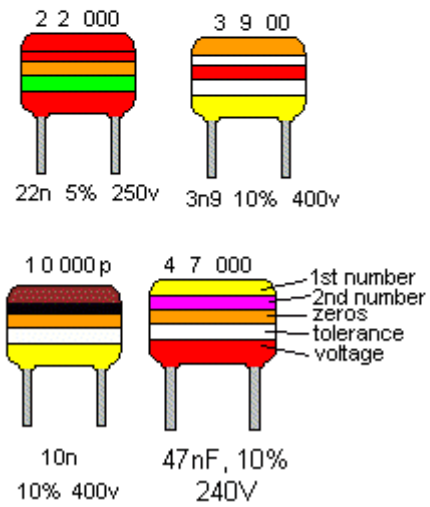

Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Grey	8
White	9

ELECTROLYTIC and TANTALUM CAPACITORS

Electrolytics and Tantalums are the same for testing purposes but their performance is slightly different in some circuits. A tantalum is smaller for the same rating as an electrolytic and has a better ability at delivering a current. They are available up to about 1,000u, at about 50v but their cost is much higher than an electrolytic.

Electrolytics are available in 1u, 2u2 3u3 4u7 10u, 22u, 47u, 100u, 220u, 330u, 470u, 1,000u, 2,200u, 3,300u, 4,700u, 10,000u and higher.
The "voltage" or "working voltage" can be: 3.3v, 10v, 16v, 25v, 63v, 100v, 200v and higher.
There is also another important factor that is rarely covered in text books. It is RIPPLE FACTOR.
This is the amount of current that can enter and leave an electrolytic. This current heats up the electrolytic and that is why some electrolytics are much larger than others, even though the capacitance and voltage-ratings are the same.
If you replace an electrolytic with a "miniature" version, it will heat up and have a very short life. This is especially important in power supplies where current (energy) is constantly entering and exiting the electrolytic as its main purpose is to provide a smooth output from a set of diodes that delivers "pulsing DC." (see "Power Diodes")

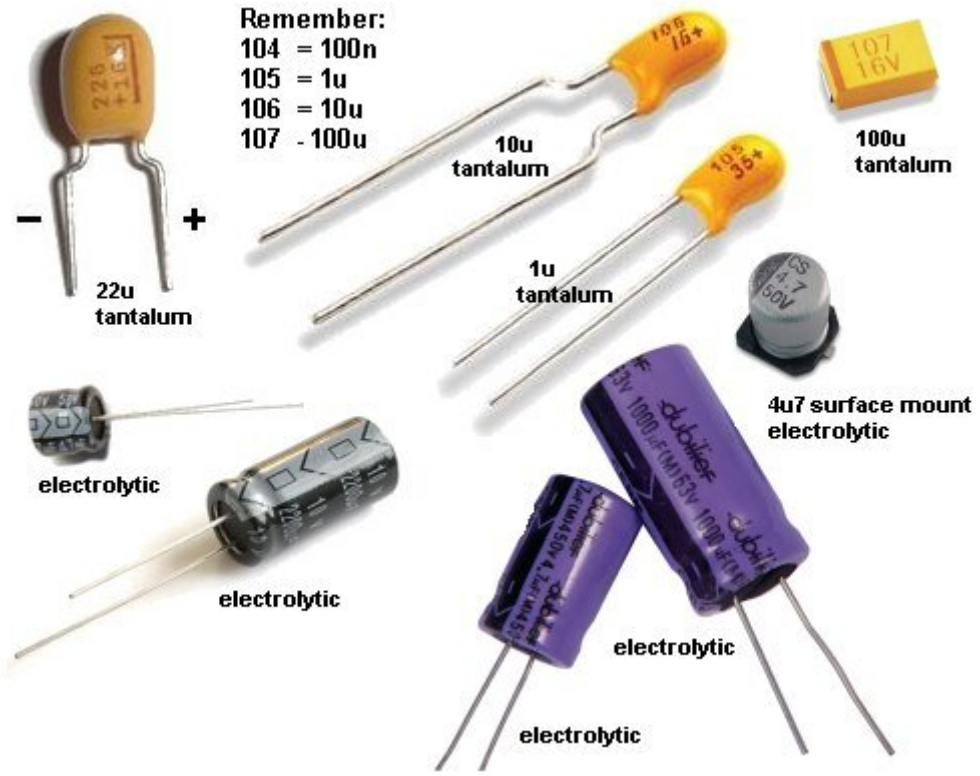

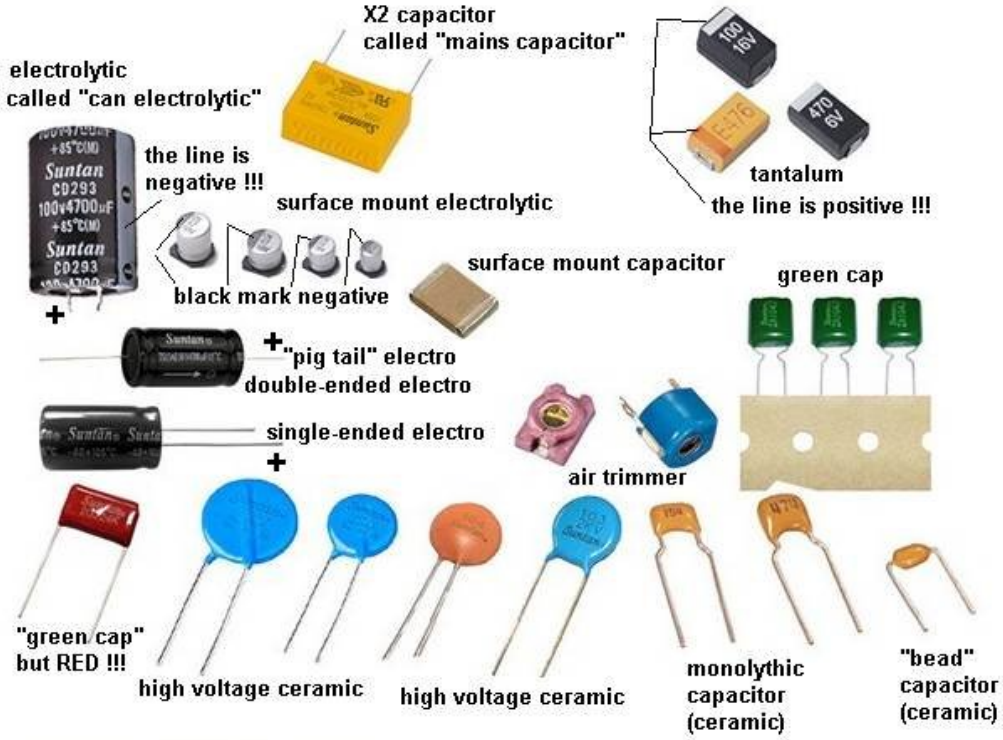

tantalum capacitors can
"go up in smoke"

"bead" tantalum

PARALLEL and SERIES CAPACITORS

Capacitors can be connected in PARALLEL and/or SERIES for a number of reasons.
1. If you do not have the exact value, two or more connected in parallel or series can produce the value you need.
2. Capacitors connected in series will produce one with a higher voltage rating.
3. Capacitors connected in parallel will produce a larger-value capacitance.

Here are examples of two equal capacitors connected in series or parallel and the results they produce:

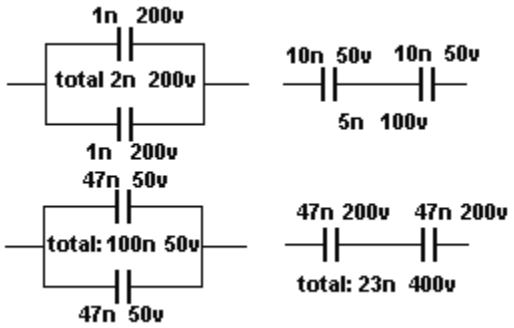

NON-POLAR CAPACITORS (ELECTROLYTICS)

Electrolytics are also available in non-polar values. It sometimes has the letters "NP" on the component. Sometimes the leads are not identified.
This is an electrolytic that does not have a positive and negative lead but two leads and either lead can be connected to the positive or negative of the circuit.
These electrolytics are usually connected to the output of an amplifier (such as in a filter near the speaker) where the signal is rising and falling.
A non-polar electrolytic can be created from two ordinary electrolytics by connecting the negative leads together and the two positive leads become the new leads.
For example: two 100u 63v electrolytics will produce a 47u 63v non-polar electrolytic.
In the circuit below, the non-polar capacitor is replaced with two electrolytics.

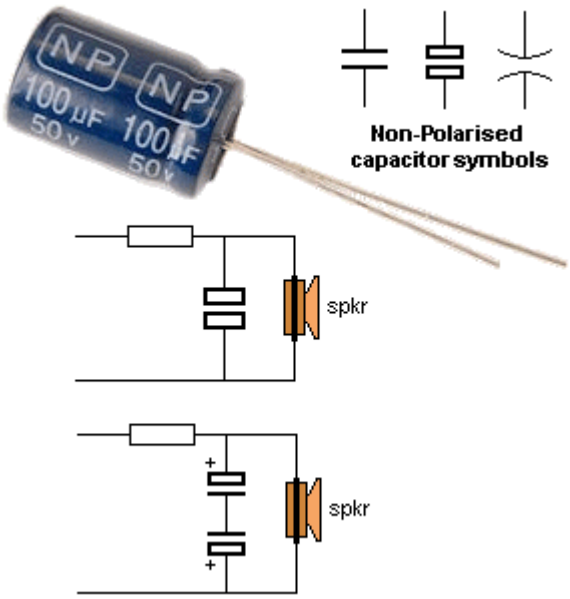

MAKING A NON-POLAR ELECTROLYTIC

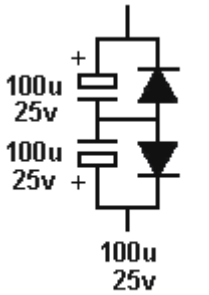

non-polar

A normal electrolytic must be connected the correct way in a circuit because it has a thin insulating layer covering the plates that has a high resistance.
If you connect the electrolytic around the wrong way, this layer "breaks-down" and the resistance of the electrolytic becomes very small and a high current flows. This heats up the electrolytic and the current increases. Very soon the capacitor produces gasses and explodes.
One big mistake in many text books shows how to make a non-polar electrolytic by connecting two "back-to-back."
They claim 2 x 100u connected back-to-back is equal to 47u.
This appears to be case when testing on a meter but the meter simply charges them for a short period of time to get a reading.
If you allow them to charge fully you will find the reverse electrolytic has a very small voltage across it.
Secondly, when you are charging them, you are putting a high current through the reverse electrolytic and damaging the layer.
To prevent this, you need to add two diodes as shown in the diagram.
In addition, 2 x 100u "back-to-back" is very near 100u.

Here is a question from a reader:
I have an amplifier with 2 x2,200u electrolytics on the output of a bridge. Can I replace them with a single 10,000u?

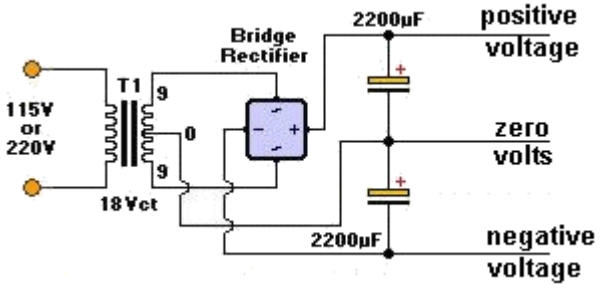

You need to look at the circuit of your amplifier. The two 2,200u electrolytics are possibly connected as shown in the circuit above and you will notice they are joined to produce a positive rail and a negative rail with zero (called earth) in the centre.
This forms two different circuits with the top electrolytic filtering the positive rail and the bottom electro filtering the negative rail. They must be connected to the zero volts rail.
A single 10,000u cannot be connected to the 0v rail and cannot be substituted for the two electro's.
You can easily determine of the two electro's are connected as shown above.
Test the positive terminal of each electro by placing the negative of the meter on the chassis.
If the positive of one electro have zero volts, it will be the lower electro in the diagram above. The negative terminal of the electro will have a minus voltage on it.

VOLTAGE RATING OF CAPACITOR
Capacitors have a voltage rating, stated as WV for working voltage, or WVDC. This specifies the maximum voltage that can be applied across the capacitor without puncturing the dielectric. Voltage ratings for "poly," mica and ceramic capacitors are typically 50v to 500 VDC. Ceramic capacitors with ratings of 1kv to 5kv are also available. Electrolytic capacitors are commonly available in 6v, 10v 16v, 25v, 50v, 100v, 150v, and 450v ratings.

THE SIZE OF A CAPACITOR - RIPPLE FACTOR
The size of a capacitor depends on a number of factors, namely the value of the capacitor (in microfarads etc) and the voltage rating. But there is also another factor that is most important. It is the RIPPLE FACTOR. **Ripple Factor** is the amount of voltage-fluctuation the capacitor (electrolytic) can withstand without getting too hot. When current flows in and out of an electrolytic, it gets hot and this will eventually dry-out the capacitor as some of the liquid inside the capacitor escapes through the seal. It's a very slow process but over a period of years, the capacitor looses its capacitance.
If you have two identical 1,000u 35v electrolytics and one is smaller, it will get hotter when operating in a circuit and that's why it is necessary to choose the largest electrolytic.

CAUTION
If a capacitor has a voltage rating of 63v, do not put it in a 100v circuit as the insulation (called the dielectric) will be punctured and the capacitor will "short-circuit." It's ok to replace a 0.22uF 50WV capacitor with 0.22uF 250WVDC.

SAFETY
A capacitor can store a charge for a period of time after the equipment is turned off. High voltage electrolytic caps can pose a safety hazard. These capacitors are in power supplies and some have a resistor across them, called a bleed resistor, to discharge the cap after power is switched off.
If a bleed resistor is not present the cap can retain a charge after the equipment is unplugged.

How to discharge a capacitor
Do not use a screwdriver to short between the terminals as this will damage the capacitor internally and the screwdriver.
Use a 1k 1 watt or 3watt or 5watt resistor on jumper leads (or held with pliers) and keep them connected for up to 15 seconds to fully discharge the electro.
Test it with a voltmeter to make sure all the energy has been removed.

Before testing any capacitors, especially electrolytics, you should look to see if any are damaged, overheated or leaking. Swelling at the top of an electrolytic indicates heating (and pressure inside the case) and will result in drying out of the electrolyte. Any hot or warm electrolytic indicates leakage and ceramic capacitors with portions missing indicates something has gone wrong (such as it being "blown apart").

Here is a 120u 330v electrolytic from a flash circuit in an old-fashioned film camera. If the flash does not "fire," the electrolytic will be charged to about 350 volts !!
Use a 1k resistor (held with pliers) to slowly discharge it. It may take 15 seconds to fully discharge.

TESTING A CAPACITOR
There are two things you can test with a multimeter:
1. A short-circuit within the capacitor
2. Capacitor values above 1u.

You can test capacitors in-circuit for short-circuits. Use the x1 ohms range.
To test a capacitor for leakage, you need to remove it or at least one lead must be removed. Use the x10k range on an analogue or digital multimeter.
For values above 1u you can determine if the capacitor is charging by using an analogue meter. The needle will initially move across the scale to indicate the cap is charging, then go to "no deflection." Any permanent deflection of the needle will indicate leakage.
You can reverse the probes to see if the needle moves in the opposite direction. This indicates it has been charged. Values below 1u will not respond to charging and the needle will not deflect.
This does not work with a digital meter as the resistance range does not output any current and the electrolytic does not charge.

Rather than spending money on a capacitance meter, it is cheaper to replace any suspect capacitor or electrolytic.
Capacitors can produce very unusual faults and no piece of test equipment is going to detect the problem.
In most cases, it is a simple matter to solder another capacitor across the suspect component and view or listen to the result.
This saves all the worry of removing the component and testing it with equipment that cannot possibly give you an accurate reading when the full voltage and current is not present.
It is complete madness to even think of testing critical components such as capacitors, with TEST EQUIPMENT. You are fooling yourself. If the Test Equipment says the component is ok, you will look somewhere else and waste a lot of time.

FINDING THE VALUE OF A CAPACITOR

If you want to find the value of a surface-mount capacitor or one where the markings have been removed, you will need a CAPACITANCE METER. Here is a simple circuit that can be added to your meter to read capacitor values from 10p to 10u.
The full article can be found HERE.

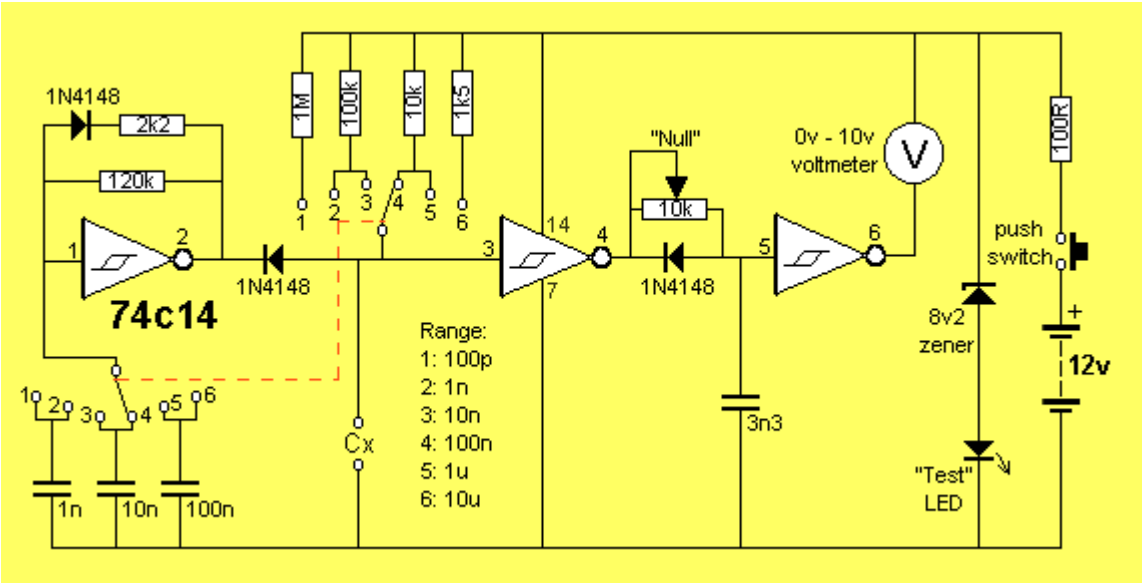

ADD-ON CAPACITANCE METER

CAPACITOR SUBSTITUTION BOX

You can get a kit or a ready-made piece of test gear called **CAPACITOR SUBSTITUTION BOX** and also **RESISTOR SUBSTITUTION BOX**.
I bought one of each 30 years ago and I have only used them ONCE.
They appear to be very handy but when you are testing a circuit, you want the component next to the other parts.
It is just as easy to pick the component you need from your junk box and connect it to the circuit via jumper leads.

REPLACING A CAPACITOR

Always replace a capacitor with the exact same type.
A capacitor may be slightly important in a circuit or it might be extremely critical.
A manufacturer may have taken years to select the right type of capacitor due to previous failures.
A capacitor just doesn't have a "value of capacitance."
It may also has an effect called "tightening of the rails."
In other words, a capacitor has the ability to react quickly and either absorb or deliver energy to prevent spikes or fluctuations on the rail.
This is due to the way it is constructed. Some capacitors are simply plates of metal film while others are wound in a coil. Some capacitors are large while others are small.
They all react differently when the voltage fluctuates.
Not only this, but some capacitors are very stable and all these features go into the decision for the type of capacitor to use.
You can completely destroy the operation of a circuit by selecting the wrong type of capacitor.
No capacitor is perfect and when it gets charged or discharged, it appears to have a small value of resistance in series with the value of capacitance. This is known as "ESR" and stands for EQUIVALENT SERIES RESISTANCE. This effectively makes the capacitor slightly slower to charge and discharge.
We cannot go into the theory on selecting a capacitor as it would be larger than this eBook so the only solution is to replace a capacitor with an identical type.
However if you get more than one repair with identical faults, you should ask other technicians if the original capacitor comes from a faulty batch.
The author has fixed TV's and fax machines where the capacitors have been inferior and alternate types have solved the problem.
Some capacitor are suitable for high frequencies, others for low frequencies.

DECOUPLING CAPACITORS

A Decoupling Capacitor can severe one, two or three functions. You need to think of a decoupling capacitor as a miniature battery with the ability to deliver a brief pulse of energy when ever the line-voltage drops and also absorb a brief pulse of energy when ever the line voltage rises (or spikes).
Decoupling capacitor can range from 100n to 1,000u.
100n capacitors are designed to absorb spikes and also have the effect of tightening-

up the rails for high frequencies. They have no effect on low frequencies such as audio frequencies.
These capacitors are generally ceramic and have very low internal impedance and thus they can operate at high frequencies.
Capacitors above about 10u are used for decoupling and these are nearly always electrolytics.
Decoupling means "tightening-up the power rails." The electrolytic acts just like a miniature rechargeable battery, supplying a small number of components in a circuit with a smooth and stable voltage.
The electrolytic is usually fed from a dropper resistor and this resistor charges the electrolytic and adds to the ability of the electrolytic to create a "separate power supply."
These two components help remove spikes as an electrolytic cannot remove spikes if connected directly to the supply rails - it's internal impedance is high and the spikes are not absorbed.
Decoupling capacitors are very difficult to test.
They rarely fail but if a project is suffering from unknown glitches and spikes, it is best to simply add more 100n decoupling caps on the underside of the board and replace all electrolytics.
Some small electrolytics will dry out due to faulty manufacture and simply replacing every one on a board will solve the problem.
Some of the functions of a decoupling capacitor are:
Removing ripple - hum or buzz in the background of an amplifier
Removing glitches or spikes.
Separating one stage from another to reduce or remove MOTORBOATING - a low frequency sound due to the output putting a pulse on the power rails that is picked up by the pre-amplifier section and amplified.

TESTING DIODES

Diodes can have 4 different faults.
1. Open circuit in both directions.
2. Low resistance in both directions.
3. Leaky.
4. Breakdown under load.

TESTING A DIODE ON AN ANALOGUE METER

Testing a diode with an **Analogue Multimeter** can be done on any of the resistance ranges. [The high resistance range is best - it sometimes has a high voltage battery for this range but this does not affect our testing]
There are two things you must remember.
1. When the diode is measured in one direction, the needle will **not move at all**. The technical term for this is the diode is **reverse biased**. It will not allow any current to flow. Thus the needle will not move.
When the diode is connected around the other way, the needle will swing to the right (move up scale) to about 80% of the scale. This position represents the voltage drop across the junction of the diode and is NOT a resistance value. If you change the resistance range, the needle will move to a slightly different position due to the resistances inside the meter. The technical term for this is the diode is **forward biased**. This indicates the diode is not faulty.
The needle will swing to a slightly different position for a "normal diode" compared to a Schottky diode. This is due to the different junction voltage drops.
However we are only testing the diode at very low voltage and it may break-down when fitted to a circuit due to a higher voltage being present or due to a high current flowing.

2. The leads of an **Analogue Multimeter** have the positive of the battery connected to the black probe and the readings of a "good diode" are shown in the following two diagrams:

The diode is REVERSE BIASED in the diagram above and diodes not conduct.

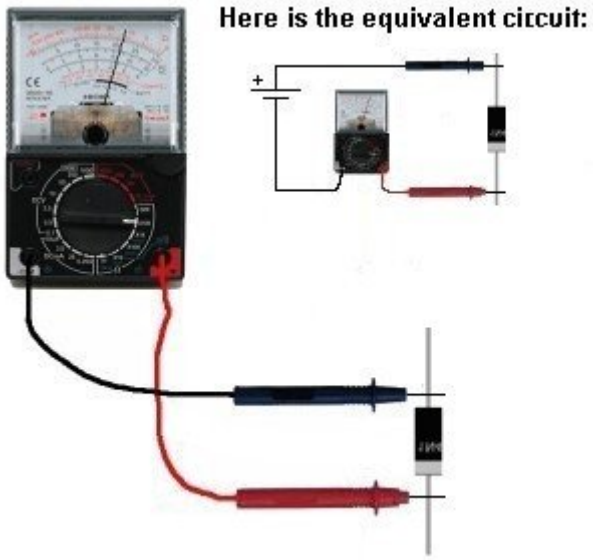

The diode is FORWARD BIASED in the diagram above and it conducts

TESTING A DIODE ON A DIGITAL METER

Testing a diode with a Digital Meter must be done on the "DIODE" setting as a digital meter does not deliver a current through the probes on some of the resistance settings and will not produce an accurate reading.

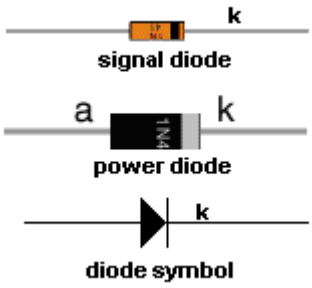

The best thing to do with a "suspect" diode is to replace it. This is because a diode has a number of characteristics that cannot be tested with simple equipment. Some diodes have a fast recovery for use in high frequency circuits. They conduct very quickly and turn off very quickly so the waveform is processed accurately and

efficiently.
If the diode is replaced with an ordinary diode, it will heat up as does not have the high-speed characteristic.
Other diodes have a low drop across them and if an ordinary is used, it will heat up.
Most diodes fail by going: SHORT-CIRCUIT. This can be detected by a low resistance (x1 or x10 Ohms range) in both directions.
A diode can also go OPEN CIRCUIT. To locate this fault, place an identical diode across the diode being tested.
A leaky diode can be detected by a low reading in one direction and a slight reading the other direction.
However this type of fault can only be detected when the circuit is working. The output of the circuit will be low and sometimes the diode heats up (more than normal).
A diode can go open under full load conditions and perform intermittently.
Diodes come in pairs in surface-mount packages and 4 diodes can be found in a bridge.
They are also available in pairs that look like a 3-leaded transistor.
The line on the end of the body of a diode indicates the cathode and you cannot say "this is the positive lead." The correct way to describe the leads is to say the "cathode lead." The other lead is the anode. The cathode is defined as the electrode (or lead) through which an electric current flows out of a device.
The following diagrams show different types of diodes:

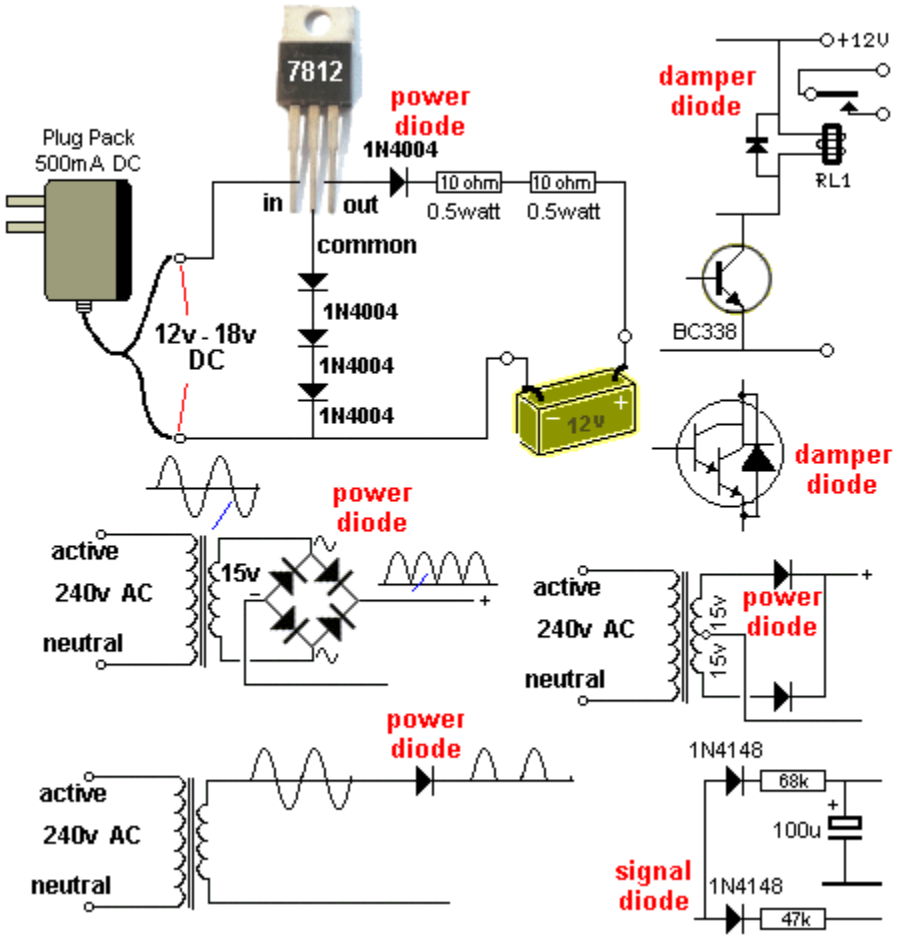

POWER DIODES

To understand how a power diode works, we need to describe a few things. This has NEVER been described before, so read carefully.
The 240v AC (called the "mains") consists of two wires, one is called the ACTIVE and the other is NEUTRAL. Suppose you touch both wires. You will get a shock. The neutral is connected to an earth wire (or rod driven into the ground or connected to a water pipe) at the point where the electricity enters the premises and you do not get a shock from the NEUTRAL.

But the voltage on the active is rising to +345v then goes to -345v at the rate of 50 times per second (for a complete cycle).
345v is the peak voltage of 240v. You never get a 240v shock. (It is a 345v shock.)
In other words, if you touch the two wires at a particular instant, you would get a POSITIVE 345v shock and at another instant you would get a negative 345v shock.
This is shown in the diagram below.
We now transfer this concept to the output of a transformer. The diagram shows an AC waveform on the output of the secondary.
This voltage is rising 15v higher than the bottom lead then it is 15v LOWER than the bottom lead. The bottom lead is called "zero volts." You have to say one lead or wire is not "rising and falling" as you need a "reference" or starting-point" or "zero point" for voltage measurements.
The diode only conducts when the voltage is "above zero" (actually when it is 0.7v above zero) and does not conduct (at all) when the voltage goes below zero.
This is shown on the output of the Power Diode. Only the positive peaks or the positive parts of the waveform appear on the output and this is called "pulsing DC."
This is called "half-wave" and is not used in a power supply. We have used it to describe how the diode works. The electrolytics charge during the peaks and deliver energy when the diode is not delivering current. This is how the output becomes a steady DC voltage.
Power supplies use FULL WAVE rectification and the other half of the AC waveform is delivered to the output (and fills in the "gaps") and appears as shown in "A."

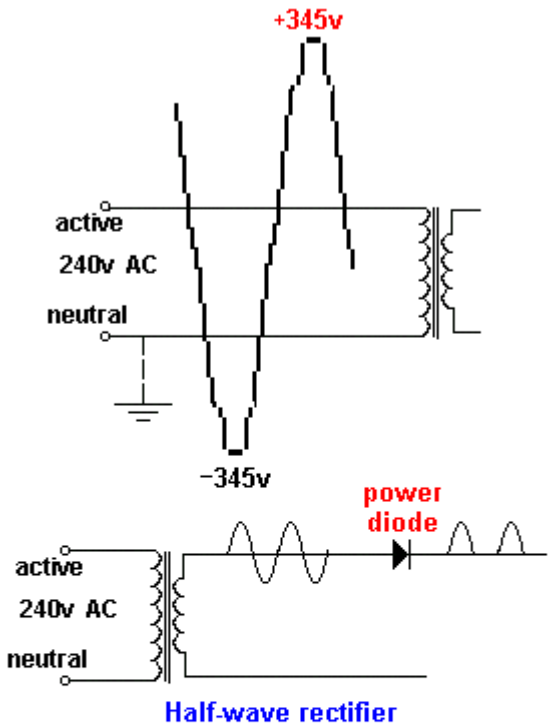

ONE FAULTY DIODE

One diode in a bridge can go open (any of the 4 diodes will produce the same effect) and produce an output voltage that can be slightly lower than the original voltage.

The actual "voltage-drop" will depend on the current taken by the circuit and the ability of the transformer to produce the required voltage and current during half-wave operation. The voltage during each half cycle (when none of the diodes is delivering any energy to the circuit) is maintained by the electrolytic and its size (relative to the current taken by the circuit) will determine the size of the ripple that will result when the diode fails. The ripple will be 100 to 1,000 times greater after the failure of a diode, depending on the value of the filter capacitor.
To locate the faulty diode, simply get a diode and place it across each of the diodes in the bridge (in turn) when the circuit is working.
For a bridge rectifier, the ripple-frequency will be twice the mains frequency and its ripple will be very small if the electrolytic is the correct value. When a diode fails, the ripple-frequency will be equal to mains-frequency and the amplitude will increase considerably. You may even hear background hum from audio equipment.
If you cannot find a faulty diode, the filter capacitor will be at fault. Turn off the equipment and connect an electrolytic across the filter capacitor via jumper leads. Turn the power ON and see if the hum has reduced.

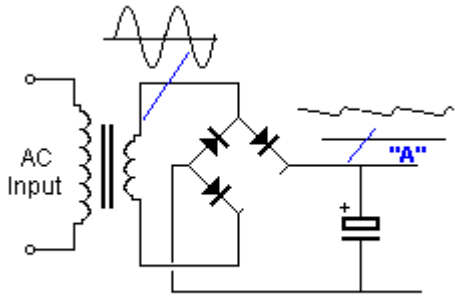

One diode "burnt-out"

DAMPER DIODES

A damper diode is a diode that detects a high voltage and SQUELCHES IT (reduces it - removes it). The signal that it squelches is a voltage that is in the opposite direction to the "supply voltage" and is produced by the collapsing of a magnetic field. Whenever a magnetic filed collapses, it produces a voltage in the winding that is opposite to the supply voltage and can be much higher. This is the principle of a flyback circuit or EHT circuit. The high voltage comes from the transformer.
The diode is placed so that the signal passes through it and less than 0.5v appears across it.
A damper diode can be placed across the coil of a relay, incorporated into a transistor or FET or placed across a winding of a flyback transformer to protect the driving transistor or FET.
It can also be called a "Reverse-Voltage Protection Diode," "Spike Suppression Diode," or "Voltage Clamp Diode."
The main characteristic of a Damper Diode is HIGH SPEED so it can detect the spike and absorb the energy.
It does not have to be a high-voltage diode as the high voltage in the circuit is being absorbed by the diode.

SILICON, GERMANIUM AND SCHOTTKY DIODES

When testing a diode with an analogue meter, you will get a low reading in one direction and a high (or NO READING) in the other direction. When reading in the LOW direction, the needle will swing nearly full scale and the reading is not a resistance-value but a reflection of the characteristic voltage drop across the junction of the diode. As we mentioned before, a resistance reading is really a voltage reading and the meter is measuring the voltage of the battery minus the voltage-drop across the diode.
Since Silicon, Germanium and Schottky Diodes have slightly different characteristic voltage drops across the junction, you will get a slightly different reading on the scale. This does not represent one diode being better than the other or capable of handling a higher current or any other feature.
The quickest, easiest and cheapest way to find, fix and solve a problem caused by a

faulty diode is to replace it.
There is no piece of test equipment capable of testing a diode fully, and the circuit you are working on is actually the best piece of test equipment as it is identifying the fault UNDER LOAD.

Only very simple tests can be done with a multimeter and it is best to check a diode with an ANALOGUE MULTIMETER as it outputs a higher current though the diode and produces a more-reliable result.
A Digital meter can produce false readings as it does not apply enough current to activate the junction.
Fortunately almost every digital multimeter has a **diode test mode.** Using this, a silicon diode should read a voltage drop between 0.5v to 0.8v in the forward direction and open in the reverse direction. For a germanium diode, the reading will be lower, around 0.2v - 0.4v in the forward direction. A bad diode will read zero volts in both directions.

REPLACING A DIODE

It is alway best to replace a diode with the same type but quite often this is not possible. Many diodes have unusual markings or colours or "in-house" letters.
This is only a general guide because many diodes have special features, especially when used in high-frequency circuits.
However if you are desperate to get a piece of equipment working, here are the steps:
Determine if the diode is a signal diode, power diode, or zener diode.
For a signal diode, try 1N4148.
For a power diode (1 amp) try 1N4004. (for up to 400v)
For a power diode (3 amp) try 1N5404. (for up to 400v)
For a high-speed diode, try UF4004 (for up to 400v)

If you put an ordinary diode in a high-speed application, it will get very hot very quickly.
To replace an unknown zener diode, start with a low voltage such as 6v2 and see if the circuit works.
The size of a diode and the thickness of the leads will give an idea of the current-capability of the diode.
Keep the leads short as the PC board acts as a heat-sink.
You can also add fins to the leads to keep the diode cool.

LIGHT EMITTING DIODES (LEDs)

Light Emitting Diodes (LEDs) are diodes that produce light when current flows from anode to cathode. The LED does not emit light when it is revered-biased. It is used as a low current indicator in many types of consumer and industrial equipment, such as monitors, TV's, printers, hi-fi systems, machinery and control panels.
The light produced by a LED can be visible, such as red, green, yellow or white. It can also be invisible and these LEDs are called Infrared LEDs. They are used in remote controls and to see if they are working, you need to point a digital camera at the LED and view the picture on the camera screen.
An LED needs about 2v - 3.6v across its leads to make it emit light, but this voltage must be exact for the type and colour of the LED. The simplest way to deliver the exact voltage is to have a supply that is higher than needed and include a voltage-dropping resistor. The value of the resistor must be selected so the current is between 2mA and 25mA.
The cathode of the LED is identified by a flat on the side of the LED. The life expectancy of a LED is about 100,000 hours. LEDs rarely fail but they are very sensitive to heat and they must be soldered and de-soldered quickly. They are one of the most heat-sensitive components.
Light emitting diodes cannot be tested with most multimeters because the characteristic voltage across them is higher than the voltage of the battery in the meter.
However a simple tester can be made by joining 3 cells together with a 220R resistor

and 2 alligator clips:

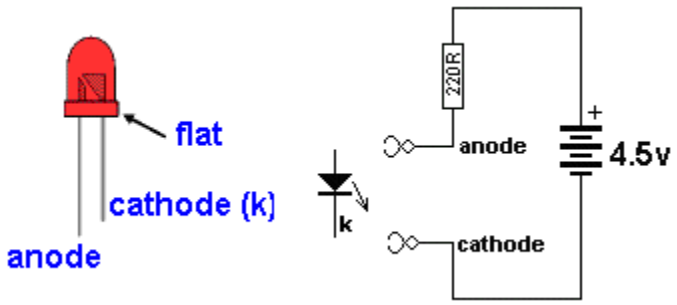

LED TESTER

Connect the clips to a LED and it will illuminate in only one direction.
The colour of the LED will determine the voltage across it. You can measure this voltage if you want to match two or more LEDs for identical operation.
Red LEDs are generally 1.7v to 1.9v. - depending on the quality such as "high-bright"
Green LEDs are 1.9v to 2.3v.
Orange LEDs are about 2.3v and
White LEDs and IR LEDs are about 3.3v to 3.6v.
The illumination produced by a LED is determined by the quality of the crystal. It is the crystal that produces the colour and you need to replace a LED with the same quality to achieve the same illumination.
Never connect a LED across a battery (such as 6v or 9v), as it will be instantly damaged. You must have a resistor in series with the LED to limit the current.

ZENER DIODES

All diodes are Zener diodes. For instance a 1N4148 is a 120v zener diode as this is its reverse breakdown voltage.
And a zener diode can be used as an ordinary diode in a circuit with a voltage that is below the zener value.
For instance, 20v zener diodes can be used in a 12v power supply as the voltage never reaches 20v, and the zener characteristic is never reached.
Most diodes have a reverse breakdown voltage above 100v, while most zeners are below 70v. A 24v zener can be created by using two 12v zeners in series and a normal diode has a characteristic voltage of 0.7v. This can be used to increase the voltage of a zener diode by 0.7v. See the diagram above. It uses 3 ordinary diodes to increase the output voltage of a 3-terminal regulator by 2.1v.
To tests a zener diode you need a power supply about 10v higher than the zener of the diode. Connect the zener across the supply with a 1k to 4k7 resistor and measure the voltage across the diode. If it measures less than 1v, reverse the zener. If the reading is high or low in both directions, the zener is damaged.

Here is a zener diode tester. The circuit will test up to 56v zeners.

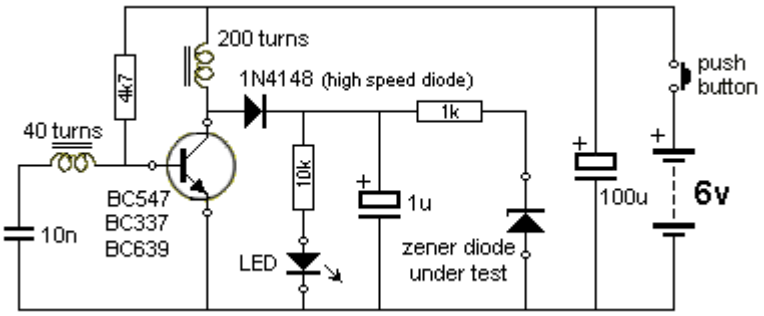

ZENER DIODE TESTER

TRANSFORMERLESS POWER SUPPLY
Here's a circuit that uses zener diodes in a power supply to show how they work. This clever design uses 4 diodes in a bridge to produce a fixed voltage power supply capable of supplying 35mA.
If we put 2 zener diodes in a bridge with two ordinary power diodes, the bridge will break-down at the voltage of the zener. This is what we have done. If we use 18v zeners, the output will be 17v4.

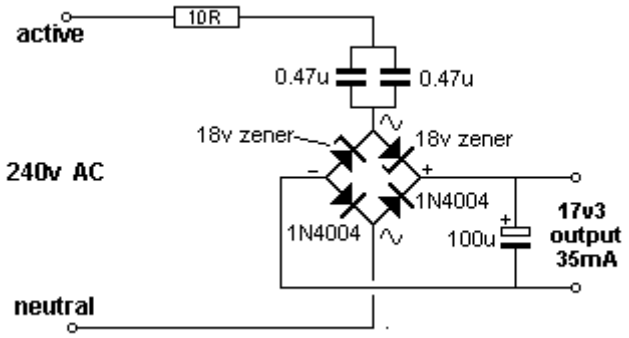

SUPPLY USING ZENER DIODES

When the incoming voltage is positive at the top, the left zener provides 18v limit (and the other zener produces a drop of 0.6v). This allows the right zener to pass current just like a normal diode. The output is 17v4. The same with the other half-cycle.
You cannot use this type of bridge in a normal power supply as the zener diode will "short" when the input voltage reaches the zener value. The concept only works in the circuit above.

VOLTAGE REGULATORS
A Voltage Regulator takes a high input voltage and delivers a fixed output voltage. Providing the input voltage is 4v above the output voltage, the regulator will deliver a fixed output voltage with almost no ripple.
Voltage regulators are also called "3-TERMINAL REGULATORS" or "REGULATOR IC's" - although this name is not generally used.
In most cases, a voltage regulator gets quite hot and for this reason it has a high failure-rate.
If a regulator is not getting hot (or warm) it has either failed or the circuit is not operating.
A regulator can only decrease the voltage. It cannot increase the current. This means the current being supplied to a circuit must also be available from the circuit supplying the regulator.
All regulators have different pin-outs, so you need to find the input pin and output pin and make sure the voltage-difference is at least 4v. Some regulators will work with a difference as low as 1v, so you need to read the specifications for the type you are servicing.
Some regulators are called "negative voltage regulators" and the input voltage will be negative and the output will be negative.
You need to test a voltage regulator with the power "ON".
Make sure you do not allow the probes to short any of the pins together as this will destroy the regulator or the circuit being supplied.
With the power turned off or the regulator removed from the circuit, you can test it with a multimeter set to resistance to see if it is ok. If any resistance readings are very low or zero ohms, the regulator is damaged.

TRANSFORMERS
All transformers and coils are tested the same way. This includes chokes, coils,

inductors, yokes, power transformers, EHT transformers (flyback transformers), switch mode transformers, isolation transformers, IF transformers, baluns, and any device that has turns of wire around a former. All these devices can go faulty.
The coating on the wire is called insulation or "enamel" and this can crack or become overheated or damaged due to vibration or movement. When two turns touch each other, a very interesting thing happens. **The winding becomes two separate windings.**

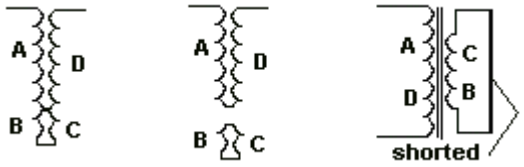

We will take the case of a single winding such as a coil. This is shown in the first diagram above and the winding is wound across a former (a former is a bobbin or plastic molding or something to hold the winding) and back again, making two layers. The bottom and top layers touch at the point shown in the diagram and the current that originally passed though A, B, C, D now passes though A & D.

Winding B C becomes a separate winding as shown in the second diagram.
In other words the coil becomes a TRANSFORMER with a SHORT CIRCUIT on the secondary winding as shown in the third diagram.
When the output wires of a transformer are shorted together, it delivers a very high current because you have created a SHORT-CIRCUIT. This short-circuit causes the transformer to get very hot.
That's exactly what happens when any coil or transformer gets a "shorted turn."
The shorted turns can be a single turn or many turns.
It is not possible to measure a fault like this with a multimeter as you don't know the exact resistance of a working coil or winding and the resistance of a faulty winding may be only 0.001 ohms less.
However when a transformer or coil is measured with an inductance meter, an oscillating voltage (or spike) is delivered into the core as magnetic flux, then the magnetic flux collapses and passes the energy into the winding to produce a waveform. The inductance meter reads this and produces a value of inductance in Henry (or milliHenry or microHenry.)
This is done with the transformer removed from the circuit and this can be a very difficult thing to do, as most transformers have a number of connections.
If the coil or transformer has a shorted turn, the energy from the magnetic flux will pass into the turns that are shorted and produce a current. Almost no voltage will be detected from winding.
The reading from the inductance meter will be low or very low and you have to work out if it is correct.
However there is one major problem with measuring a faulty transformer or coil.
It may only become faulty when power is applied.
The voltage between the turns may be sparking or jumping a gap and creating a problem. A tester is not going to find this fault.
Secondly, an inductance meter may produce a reading but you do not know if the reading is correct. An improved tester is a RING TESTER.
The circuit for a ring tester can be found here:

http://www.flippers.com/pdfs/k7205.pdf

It sends a pulse to the coil and counts the number of returning pulses or "rings." A faulty coil (or winding) may return one pulse but nearly all the energy will be passed to the shorted turns and you will be able to see this on the scale. You will only get one or two return pulses, whereas a good winding will return more pulses.

One way to detect a faulty power transformer is to connect it to the supply and feel the temperature-rise (when nothing is connected to the secondary).
It should NOT get hot.
Detecting shorted turns is not easy to diagnose as you really need another identical

component to compare the results.
Most transformers get very hot when a shorted turn has developed. It may deliver a voltage but the heat generated and a smell from the transformer will indicate a fault.

ISOLATION TRANSFORMER

An isolation transformer is a piece of **Test Equipment** that provides "Mains Voltage" but the voltage is "floating." You will still get a shock if you touch the two output leads, but it has a special use when testing unknown equipment.
Many electrical appliances are fully insulated and only have two leads connected to the mains.
When you take these appliances apart, you do not know which end of say a heating element is connected to the "live" (active) side of the mains and which end connects to the neutral.
I am not suggesting you carry out the following tests, but they are described to show how an isolation transformer works.
If you touch a soldering iron on the "live" (active) end of the heating element it will create a short-circuit.
However when the appliance is connected to the mains via an **isolation transformer**, you can touch an earthed soldering iron on either end of the heater as both leads from the isolation transformer are "floating."
Note: As soon as you earth one lead of the output an isolation transformer, the other lead becomes "active."
You can make your own **Isolation Transformer** by connecting two identical transformers "back-to-back."
The following diagram shows how this is done:

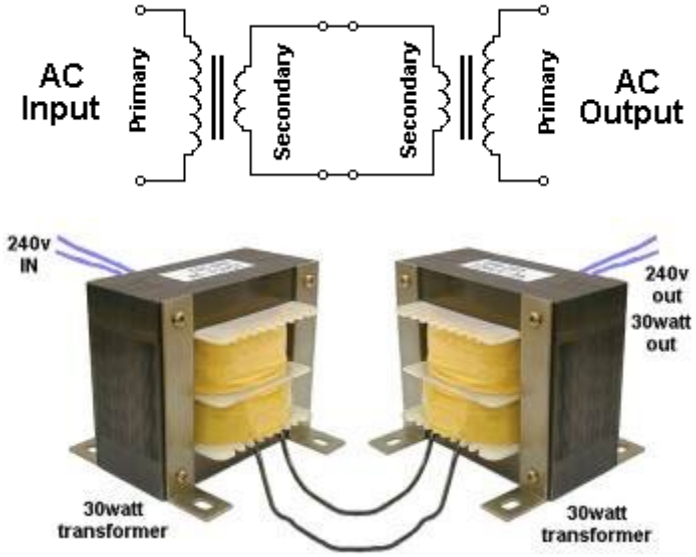

You can use any transformers providing the primary and secondary voltages are the same. The current capability of the secondary winding does not matter. However if you want a supply that has almost the same voltage as your "Mains," you need two transformers with the same voltages.
This handy isolation transformer will provide you with "Mains Voltage" but with a limited current.
In other words it will have a limited capability to supply "wattage." If you are using two 15VA transformers, you will only be able to test an appliance rated at 15 watts.
This has some advantages and some disadvantages.
If you are working on a project, and a short-circuit occurs, the damage will be limited to 15 watts.
If you are using two transformers with different VA ratings, the lower rating will be the capability of the combination.
If the secondaries are not equal, you will get a higher or lower "Mains Voltage."
If you get two transformers from TVs or Monitors, with a rating on the compliance plate of 45 watts, or 90 watts, you can assume the transformers are capable of delivering this wattage and making an isolation transformer will enable you to test

similar items with the safety of being isolated from the mains.
Colin Mitchell designs a lot of "LED lighting lamps" that are connected directly to the mains. He always works with an isolating transformer, just to be safe. Working on exposed "mains" devices is extremely nerve-wracking and you have to be very careful.
The isolation transformer will prevent a BIG EXPLOSION.

DETERMINING THE SPECS OF A TRANSFORMER
Suppose you have a "mains transformer" with unknown output voltages and unknown current capability.
You must be sure it is a mains transformer designed for operation on 50Hz or 60Hz.
Switch-Mode transformers operate at frequencies 40kHz and higher and are not covered in this discussion.
To be on the safe-side, connect the unknown transformer to the output of your isolating transformer.
Since the transformer will take almost no current when not loaded, the output voltages it produces will be fairly accurate. Measure the input AC voltage and output AC voltage.
If the transformer has loaded your isolating transformer it will be faulty.
Mains transformers are approx 15VA for 500gm, 30VA for 1kgm 50VA for 2kgm and and 100VA for 2.5kgm.
VA stands for Volts-Amps and is similar to saying watts. Watts is used for DC circuits, while VA refers to AC circuits.
Once you have the weight of the transformer and the output voltage, you can work out the current capability of the secondary.
For transformers up to 30vA, the output voltage on no-load is 30% higher than the final "loaded voltage."
This is due to the poor regulation of these small devices.
If the transformer is 15VA and the output voltage is 15v AC, the current will be 1 amp AC.
You can check the "quality" of the transformer, (the regulation) by fully loading the output and measuring the final voltage. If the transformer has a number of secondaries, the VA rating must be divided between all the windings.

240v to 110v ISOLATION TRANSFORMER

Here's how to create a 110v isolating transformer:
Find a 240v:12v transformer.
Now find a transformer that has two secondary windings, such as 240v:12v+12v.

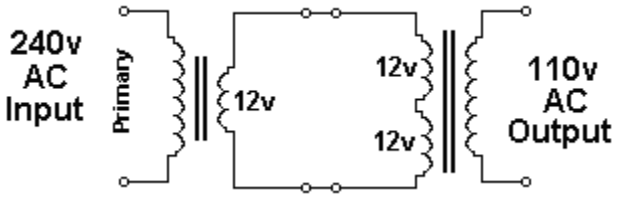

Connect the two transformers as shown in the circuit above. If the output is zero, connect ONE of the 12v windings of the second transformer around the other way.

110v to 240v ISOLATION TRANSFORMER

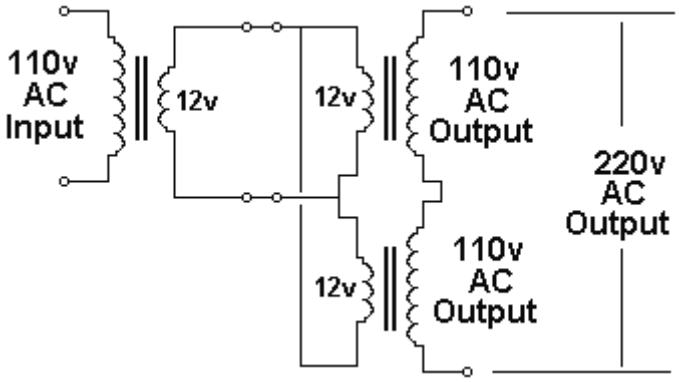

A 110v to 240v isolation transformer can be created by connecting 3 identical transformers as shown in the diagram above. If the output is zero, connect one of the outputs around the other way.

TRANSFORMER RATINGS

Question from a reader:

I have a 28v - 0 - 28v transformer @3amps. Does this mean each side is 1.5 amps?

The transformer is called CENTRE TAPPED and is shown in figures B and C.
It is designed to be connected to two diodes so each winding takes it in turn to deliver the current as shown in diagram C and the output will be 28v AC at 3 amps.
The 28v and 3 amp are both AC values.
If you connect across both outside wires, the output will be 56v at 1.5 amp.
This is because the transformer has a VA rating of 28 x 3 = 84VA. This is very similar to the term "watts."
When the 28v AC is rectified and smoothed, it becomes 28 x 1.4 = 39v (minus 0.6v across the diode) and since the transformer has a rating of 84 VA, the current must be reduced to 84/39 = 2.1 amps to maintain the VA rating.
Some transformers are specified as say: 12v - 0 - 12v, but the wiring diagram is shown as "A." This transformer should be specified as 12v + 12v as the secondaries are separate.
12v - 0 - 12v means the two secondary windings are NOT separate.
It does not make any difference to the output voltage and current, if the windings are separate or joined. The only difference is 12v +12v can be turned into two separate 12v outputs.
If you do not know the output current for a particular transformer, go to the website of electronic parts suppliers and compare the weight of your transformer with others. This will give you a VA rating and you can work out the current, once you know the output voltage.
Note: the output current finishes up ONLY 60% of the rating on the transformer tag because the rating is an **AC RATING**.
With 2 separate secondaries, you can parallel the outputs to get double the current, but don't forget 12v + 12v @ 3amp means 12v in parallel with 12v will provide 2amp DC and the DC voltage will be about 17v.

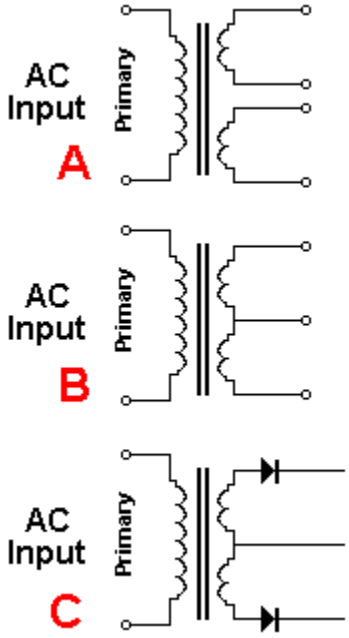

CURRENT TRANSFORMER

A Current Transformer is really an ordinary transformer.
All transformers produce a CURRENT output and a VOLTAGE output.
If you put an ammeter across the secondary, the current will increase through the meter when the primary voltage is increased.
This is because the output voltage will increase and this voltage will allow a higher current to flow.

WHY DETECT CURRENT? Why not voltage?

Because the voltage of say the "240v AC" is always 240v but the current can increase from say 1 amp to nearly 15 amps, depending what appliance is connected. So it is pointless measuring voltage.
A Current Transformer is a step-up transformer. When we say step-up and step-down, we are referring to the voltage - comparing the primary voltage to the secondary voltage. (Most transformers on the "mains" are step-down transformers and are used as power supplies to laptops, phone chargers etc.) Even a welding transformer is a step-down device and produces about 20v to 70v, while the current can be as high as 100 amps. This current is higher than the mains will deliver and is needed to melt the metal at the point of contact of the probe and the item being welded.
A Current Transformer is a step-up transformer. The primary consists of a single turn (or maybe 2 - 5 turns) and the secondary has 100 turns (or more).
This means the voltage seen by the primary will be increased 100 times and appear as anything from a few hundred millivolts to a few volts, depending on the quality of the coupling. (the magnetic coupling between the wire through the centre of the core, the quality of the core to transfer this magnetic flux to the secondary turns.)
This voltage is then passed to a low value resistor, where the voltage is reduced to a level that suits the detection circuit and the resulting millivolts is interpreted as current in the wire being tested.

Recapping:

The reading on the secondary has no relation to the current in the primary. We need to add a LOAD RESISTOR and create a table before we can use the transformer.
There is no such thing as a CURRENT TRANSFORMER. It is really an INSTRUMENT TRANSFORMER and the scale has been marked in units of CURRENT after measurements have been made. (INSTRUMENT TRANSFORMER means it is a device that helps us to produce a connection between current flowing through a wire and a reading on a meter or display).
If we connect a load to the secondary, (say an ammeter), it will produce a reading that increases when the current through the single primary turn is increased. That's because the ammeter is a LOAD. But the reading is meaningless until be calibrate the scale.

Now, lets look at the primary.
A wire (or cable) through the centre of the core is counted as one turn. If the turn is wrapped around the core, the coupling will be improved, but if we always use a straight wire, it does not matter where it is positioned inside the centre of the core.
It does not matter if the magnetic interaction of the flux from the wire is good or bad, we just have to keep to the same way of using the transformer.
The calibration can be done with any poor coupling and the result will be accurate for all future readings.
If a low-value resistor is placed across the secondary, the voltage across this resistor will increase and also the current through it will increase. But we are not going to measure the current through the resistor. We are going to measure the voltage across the resistor and by taking lots of reading we will finish up with a scale or table and this is called CALIBRATION. The results will be equated to the current flowing through the primary wire (primary turn).
A clamp meter uses a current transformer and the jaws must be closed completely and cleanly for the flux to flow around the core and produce a reading in the secondary.
Dirt in the jaws will reduce the reading considerably.
You cannot measure the current in a "power cord" because it contains both the active and neutral wires.
Even though the current is a maximum in both conductors at the same time, the current is flowing in two different directions and the magnetic flux produced by one conductor is clockwise and the other is anticlockwise and they are cancelled by each other.

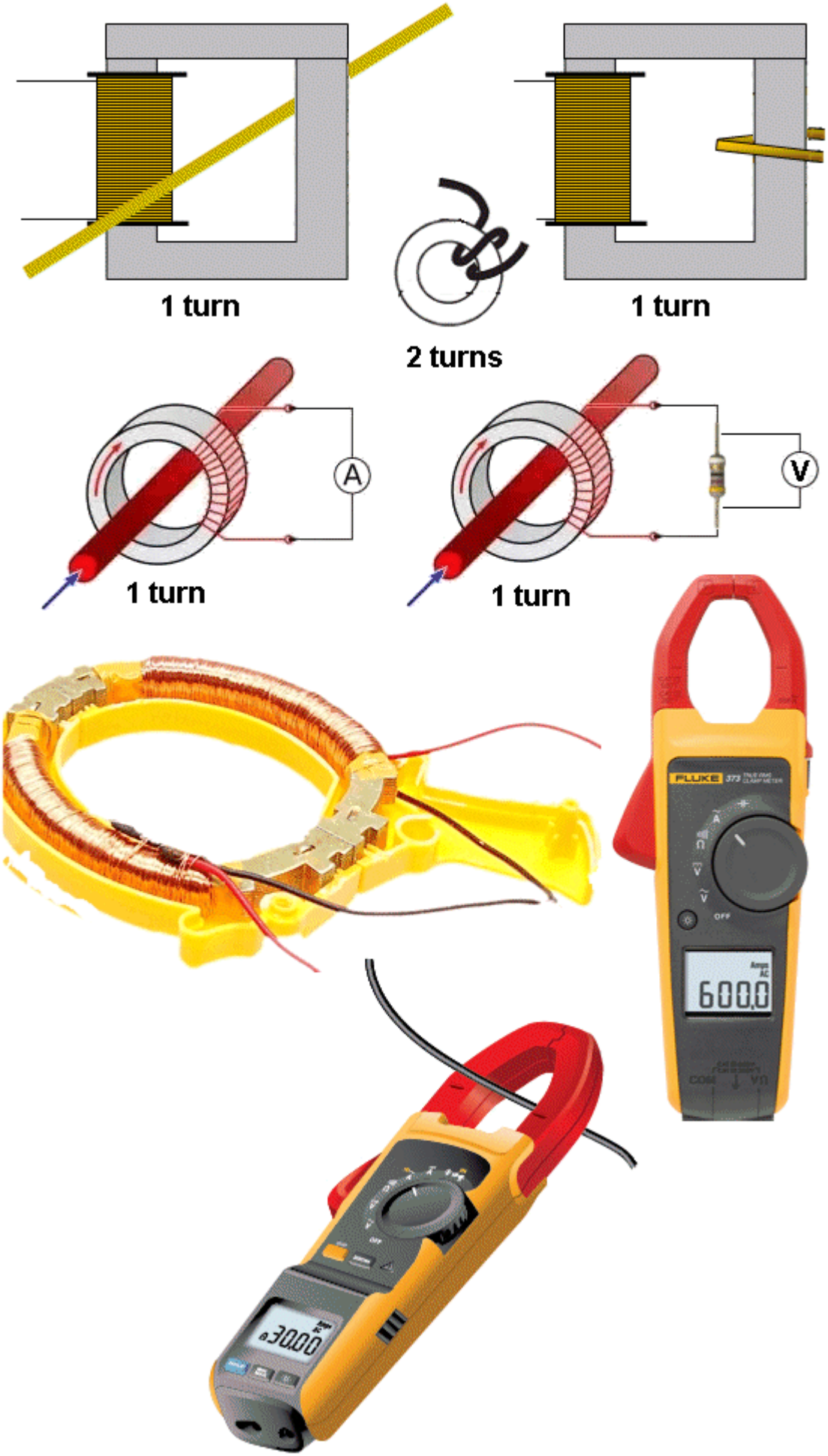

Identifying ONE TURN.
The quality (the coupling) of a single STRAIGHT wire

through the centre of a core is very poor
but if all readings are taken with this amount
of coupling, the readings will be accurate, as the
calibrations have been done with this arrangement.

OPTO ISOLATORS and OPTO COUPLERS

Opto Isolators and Opto Couplers are the same thing. A common opto-coupler is 4N35. It is used to allow two circuits to exchange signals yet remain electrically isolated. The signal is applied to the LED, which shines on a silicon NPN photo-transistor in the IC.
The light is proportional to the signal, so the signal is transferred to the photo transistor to turn it on a proportional amount. Opto-couplers can have Light Activated SCR's, photodiodes, TRIAC's and other semiconductor devices as an output. The 4N35 opto-coupler schematic is shown below:

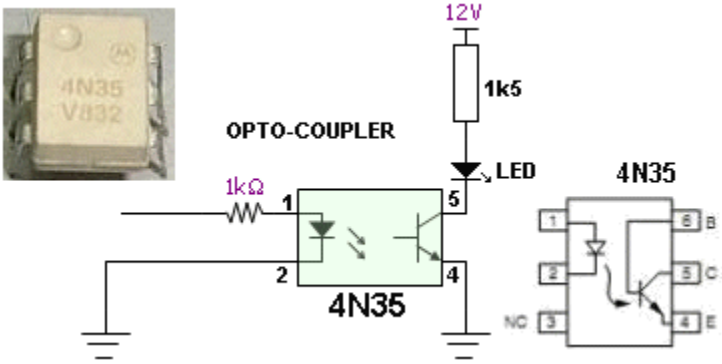

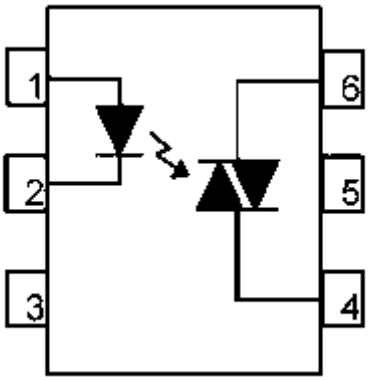

An opto-Coupler using a TRIAC
Note: the pinout is different to 4N35

TESTING AN OPTO COUPLER

Most multimeters cannot test the LED on the input of an opto-coupler because the ohms range does not have a voltage high enough to activate the LED with at least 2mA.
You need to set-up the test-circuit shown above with a 1k resistor on the input and 1k5 on the output. When the 1k is connected to 12v, the output LED will illuminate. The opto-coupler should be removed from circuit to perform this test.

TRANSISTORS

Transistors are solid-state devices and although they operate completely differently to a diode, they appear as two back-to-back diodes when tested.
There are basically 2 types of transistor NPN and PNP.
A transistor is sometimes referred to as BJT (Bi-polar Junction Transistor) to distinguish it from other types of transistor such as Field Effect transistor, Programmable Unijunction Transistor and others.

In the following diagram, two diodes are connected together and although the construction of a transistor is more complex, we see the transistor as two diodes when testing it.

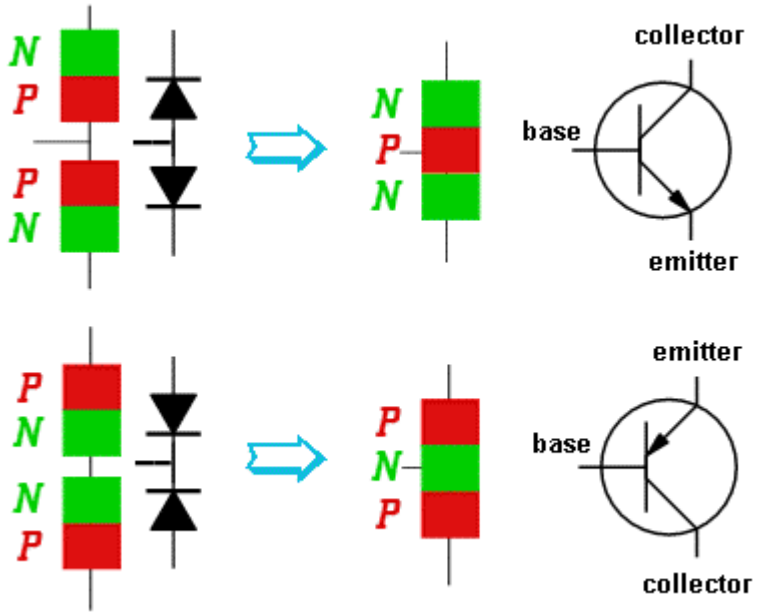

A TRANSISTOR APPEARS AS TWO DIODES WHEN TESTING IT

All transistors have three leads. Base (b), Collector (c), and Emitter (e).
For an NPN transistor, the arrow on the emitter points away from the base.
It is fortunate that the arrow on both symbols points in the direction of the flow of current (Conventional Current) and this makes it easy to describe testing methods using our simplified set of instructions. The symbols have been drawn exactly as they appear on a circuit diagram.

All transistors **are the same** but we talk about digital and analogue transistors. There is no difference between the two.
The difference is the circuit. And the only other slight difference between transistors is the fact that some have inbuilt diodes and resistors to simplify the rest of the circuit.
All transistors work the same way. The only difference is the amount of amplification they provide, the current and voltage they can withstand and the speed at which they work. For simple testing purposes, they are all the same.

NPN transistors are the most common and for an NPN transistor, the following applies.
(the opposite applies for PNP)
To test a transistor, there is **one thing** you have to know:
When the base voltage is higher than the emitter, current flows though the collector-emitter leads.
As the voltage is increased on the base, nothing happens until the voltage reaches 0.55v. At this point a very small current flows through the collector-emitter leads. As the voltage is increased, the current-flow increases. At about 0.75v, the current-flow is a MAXIMUM. (can be as high as 0.9v). That's how it works. A transistor also needs **current** to flow into the base to perform this amplifying function and this is the one feature that separates an ordinary transistor from a FET.

If the voltage on the base is 0v, then instantly goes to 0.75v, the transistor initially passes NO current, then FULL current. The transistor is said to be working in its two states: OFF then ON (sometimes called: "cut-off" and "saturation"). These are called digital states and the transistor is said to be a **DIGITAL TRANSISTOR** or a **SWITCHING TRANSISTOR** , working in **DIGITAL MODE.**

If the base is delivered 0.5v, then slowly rises to 0.75v and slowly to 0.65v, then

0.7v, then 0.56v etc, the transistor is said to be working in ANALOGUE MODE and the transistor is an **ANALOGUE TRANSISTOR**.
Since a transistor is capable of amplifying a signal, it is said to be an active device. Components such as resistors, capacitors, inductors and diodes are not able to amplify and are therefore known as passive components.

In the following tests, use your finger to provide the **TURN ON** voltage for the base (this is 0.55v to 0.7v) and as you press harder, more current flows into the base and thus more current flows through the collector-emitter terminals. As more current flows, the needle of the multimeter moves UP-SCALE.

TESTING A TRANSISTOR ON A DIGITAL METER

Testing a transistor with a **Digital Meter** must be done on the "DIODE" setting as a digital meter does not deliver a current through the probes on some of the resistance settings and will not produce an accurate reading.
The "DIODE" setting must be used for diodes and transistors. It should also be called a "TRANSISTOR" setting.

TESTING AN unknown TRANSISTOR

The first thing you may want to do is test an unknown transistor for COLLECTOR, BASE AND EMITTER. You also want to perform a test to find out if it is NPN or PNP. That's what this test will provide.
You need a cheap multimeter called an ANALOGUE METER - a multimeter with a scale and pointer (needle).
It will measure resistance values (normally used to test resistors) - (you can also test other components) and Voltage and Current. We use the resistance settings. It may have ranges such as "x10" "x100" "x1k" "x10"
Look at the resistance scale on the meter. It will be the top scale.
The scale starts at zero on the right and the high values are on the left. This is opposite to all the other scales.
When the two probes are touched together, the needle swings FULL SCALE and reads "ZERO." Adjust the pot on the side of the meter to make the pointer read exactly zero.

How to read: "x10" "x100" "x1k" "x10"

Up-scale from the zero mark is "1"
When the needle swings to this position on the "x10" setting, the value is 10 ohms.
When the needle swings to "1" on the "x100" setting, the value is 100 ohms.
When the needle swings to "1" on the "x1k" setting, the value is 1,000 ohms = 1k.
When the needle swings to "1" on the "x10k" setting, the value is 10,000 ohms = 10k.
Use this to work out all the other values on the scale.
Resistance values get very close-together (and very inaccurate) at the high end of the scale. [This is just a point to note and does not affect testing a transistor.]

Step 1 - FINDING THE BASE and determining NPN or PNP

Get an unknown transistor and test it with a multimeter set to "x10"
Try the 6 combinations and when you have the black probe on a pin and the red probe touches the other pins and the meter swings nearly full scale, you have an NPN transistor. The black probe is BASE
If the red probe touches a pin and the black probe produces a swing on the other two pins, you have a PNP transistor. The red probe is BASE
If the needle swings FULL SCALE or if it swings for more than 2 readings, the transistor is **FAULTY**.

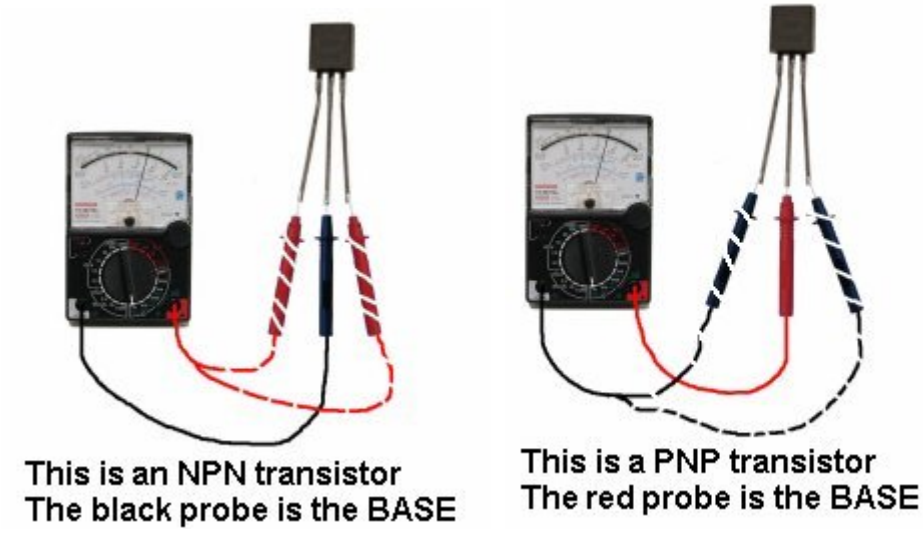

Step 2 - FINDING THE COLLECTOR and EMITTER
Set the meter to "x10k."
For an NPN transistor, place the leads on the transistor and when you press hard on the two leads shown in the diagram below, the needle will swing almost full scale.

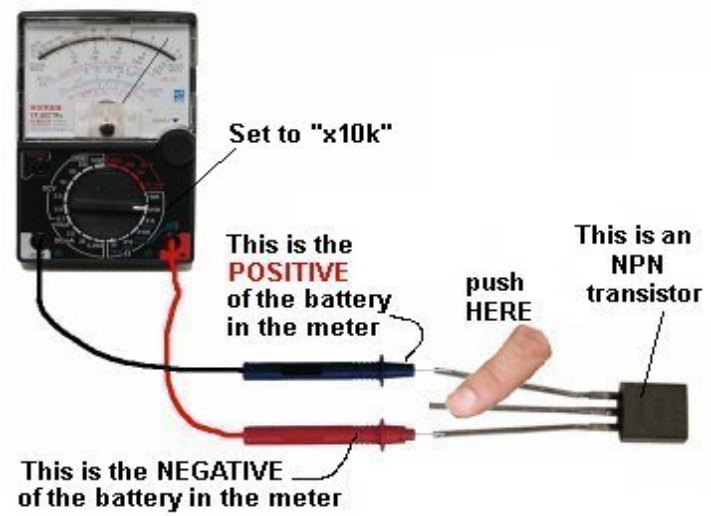

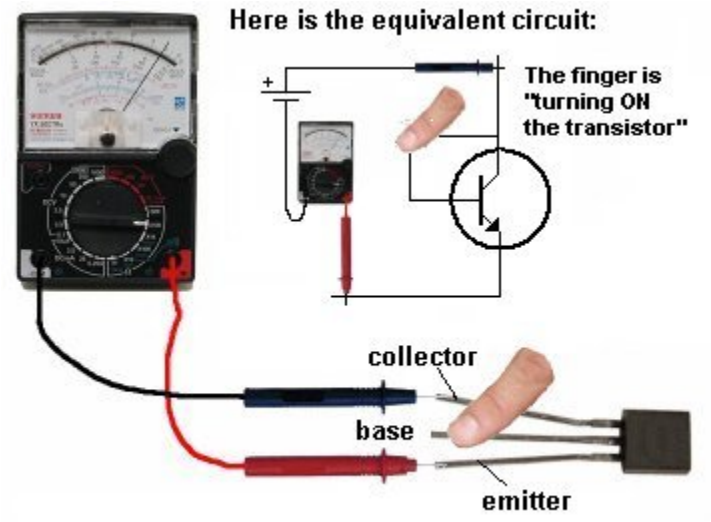

You have found the Collector Base and Emitter

For a PNP transistor, set the meter to "x10k" place the leads on the transistor and when you press hard on the two leads shown in the diagram below, the needle will swing almost full scale.

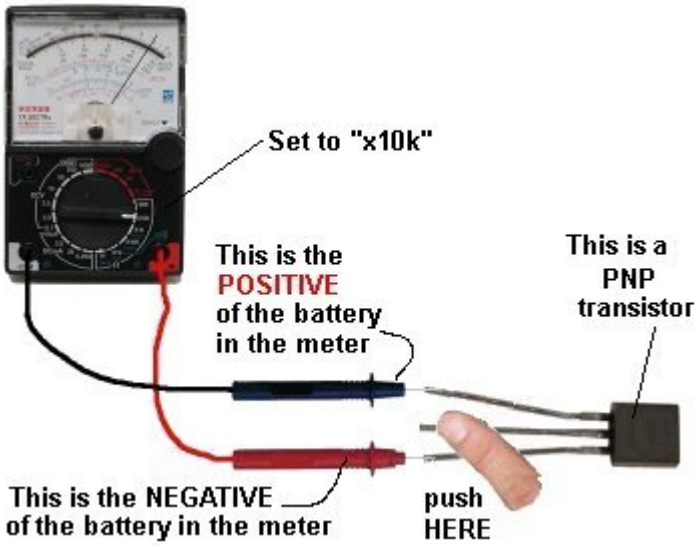

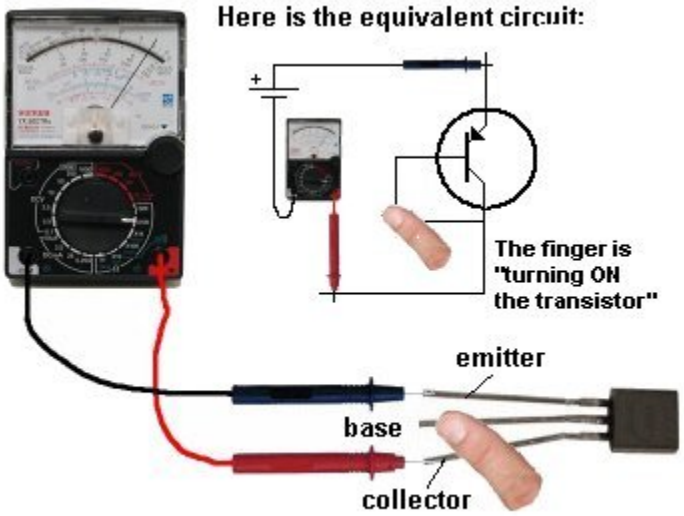

You have found the Collector Base and Emitter

SIMPLEST TRANSISTOR TESTER

The simplest transistor tester uses a 9v battery, 1k resistor and a LED (any colour). Keep trying a transistor in all different combinations until you get one of the circuits below. When you push on the two leads, the LED will get brighter.
The transistor will be NPN or PNP and the leads will be identified:

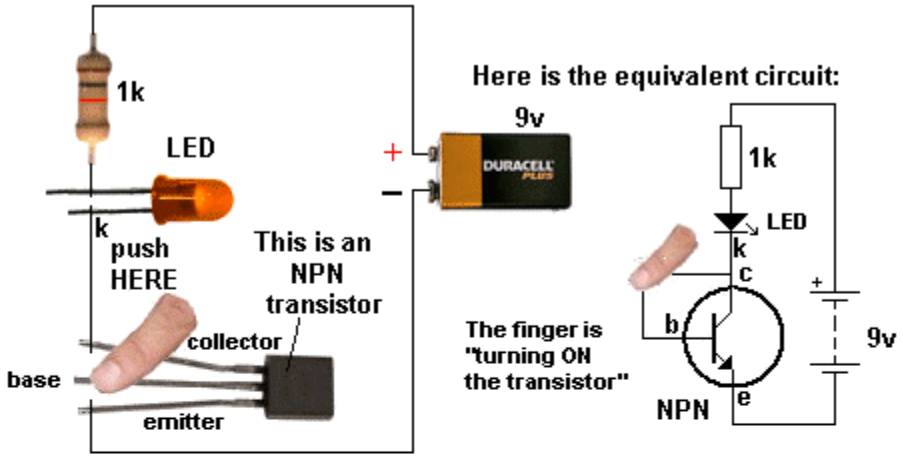

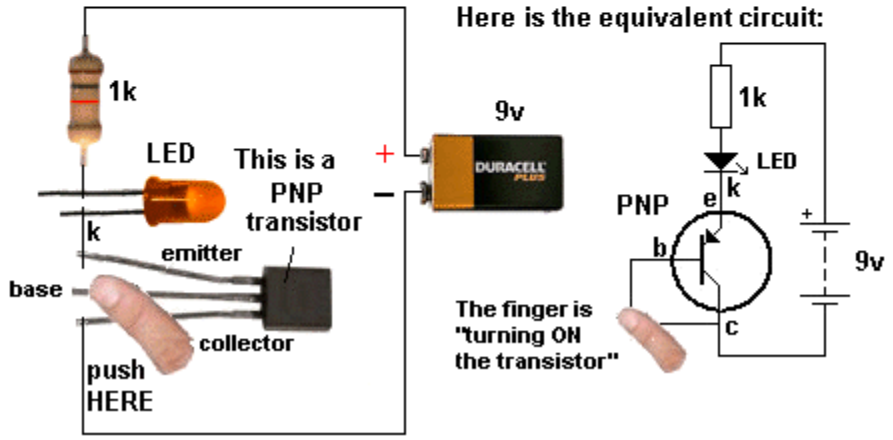

The leads of some transistors will need to be bent so the pins are in the same positions as shown in the diagrams. This helps you see how the transistor is being turned on. This works with NPN, PNP transistors and Darlington transistors.

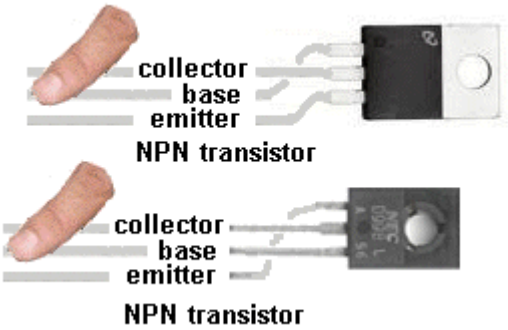

HEATSINKING

Heat generated by current flowing between the collector and emitter leads of a transistor causes its temperature to rise. This heat must be conducted away from the transistor otherwise the rise may be high enough to damage the P-N junctions inside the device. Power transistors produce a lot of heat, and are therefore usually mounted on a piece of aluminium with fins, called a **HEATSINK**.
This draws heat away, allowing it to handle more current. Low-power signal transistors do not normally require heat sinking. Some transistors have a metal body or fin to connect to a larger heatsink. If the transistor is connected to a heatsink with a mica sheet (mica washer), it can be damaged or cracked and create a short-circuit. (See Testing Mica Washers). Or a small piece of metal may be puncturing the mica. Sometimes white compound called **Heatsink Compound** is used to conduct heat through the mica. This is very important as mica is a very poor conductor of heat and the compound is needed to provide maximum thermal conduction.

TRANSISTOR FAILURE

Transistor can fail in a number of ways. They have forward and reverse voltage ratings and once these are exceeded, the transistor will ZENER or conduct and may fail. In some cases a high voltage will "puncture" the transistor and it will fail instantly. In fact it will fail much faster via a voltage-spike than a current overload.

It may fail with a "short" between any leads, with a collector-emitter short being the most common. However failures will also create shorts between all three leads.
A shorted transistor will allow a large current to flow, and cause other components to heat up.
Transistors can also develop an open circuit between base and collector, base and emitter or collector and emitter.
The first step in identifying a faulty transistor is to check for signs of overheating. It may appear to be burnt, melted or exploded. When the equipment is switched off, you can touch the transistor to see if it feels unusually hot. The amount of heat you feel should be proportional to the size of the transistor's heat sink. If the transistor has no heat sink, yet is very hot, you can suspect a problem.
DO NOT TOUCH A TRANSISTOR IF IT IS PART OF A CIRCUIT THAT CARRIES 240VAC.
Always switch off the equipment before touching any components.

TRANSISTOR REPLACEMENT

If you can't get an exact replacement, refer to a transistor substitution guide to identify a near equivalent.

The important parameters are:
- Voltage
- Current
- Wattage
- Maximum frequency of operation

The replacement part should have parameters equal to or higher than the original.

Points to remember:
- Polarity of the transistor i.e. PNP or NPN.
- At least the same voltage, current and wattage rating.
- Low frequency or high frequency type.
- Check the pinout of the replacement part
- Use a desoldering pump to remove the transistor to prevent damage to the printed circuit board.
- Fit the heat sink.
- Check the mica washer and use heat-sink compound
- Tighten the nut/bolt - not too tight or too loose.
- Horizontal output transistors with an integrated diode should be replaced with the same type.

DIGITAL TRANSISTORS

There is no such thing as a DIGITAL TRANSISTOR or an AUDIO TRANSISTOR.
All transistors are just "TRANSISTORS" and the surrounding components as well as the type of signal, make the transistor operate in DIGITAL MODE or ANALOGUE MODE.
But we have some transistors that have inbuilt resistors to make them suitable for connecting to a digital circuit without the need for a base resistor.
Here is the datasheet for an NPN transistor BCR135w and PNP datasheet for BCR185w.
These transistors are called "Digital Transistors" because the "base lead" can be connected directly to the output of a digital stage. This "lead" or "pin" is not really the base of the transistor but a 4k7 (or 10k) resistor connected to the base allows the transistor to be connected to the rest of a digital circuit.
You cannot actually get to the base. The resistor(s) are built into the chip and the transistor is converted into a "Digital Transistor" because it will accept 5v on the "b"

lead.
The 47k is not really needed but it makes sure the transistor is fully turned OFF if the signal on the "b" lead is removed (in other words - if the input signal is converted to a high-impedance signal - see tri-state output from microcontrollers for a full explanation).
This transistor is designed to be placed in a circuit where the input changes from low to high and high to low and does not stop mid-way. This is called a DIGITAL SIGNAL and that is one reason why the transistor is called a digital transistor. (However you could stop half-way but the transistor may heat up and get too hot).
Any transistor placed in a digital circuit can be called a "digital transistor" but it is better to say it is operating in DIGITAL MODE.

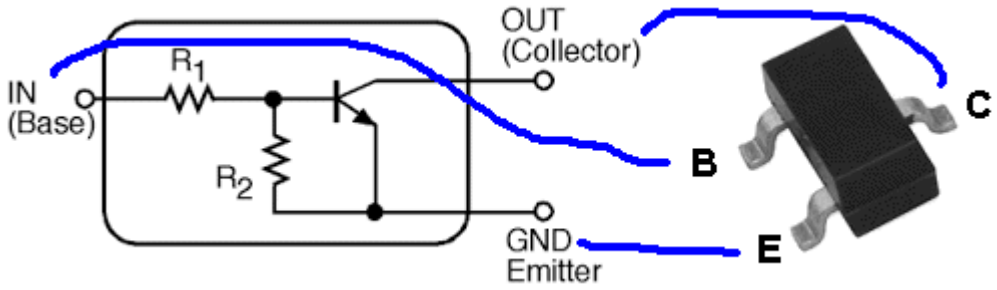

The digital transistor has two resistors included inside the case
R1 is about 10k and R2 is approx 47k

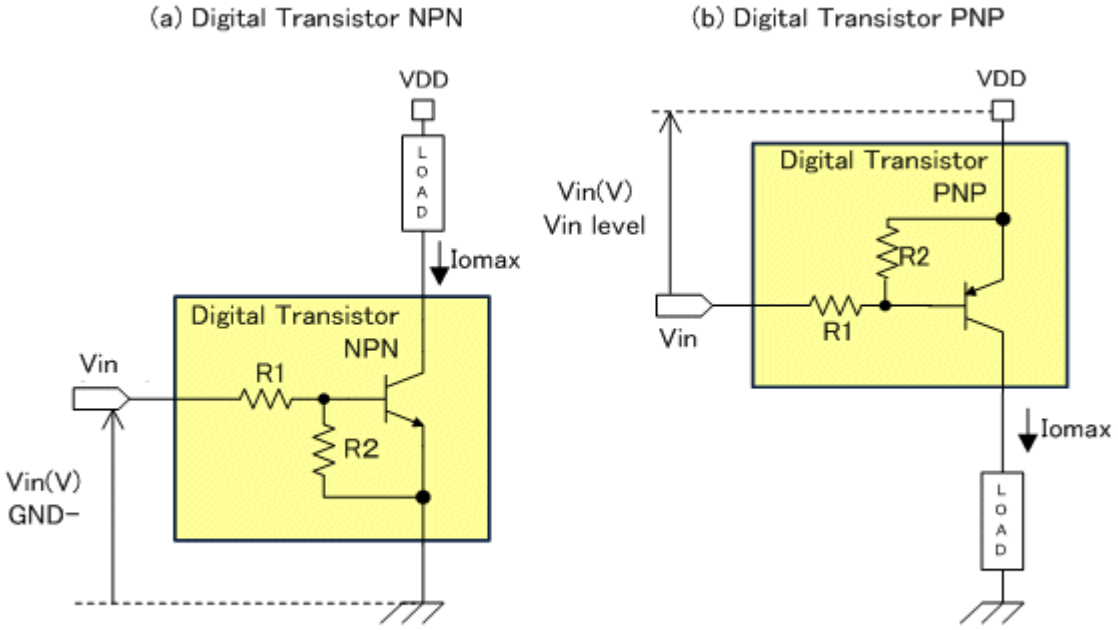

Equivalent circuit of the digital transistor

These transistors can be made to work in analogue circuits because they are ordinary transistors with a 10k base resistor, but you will have to know what you are doing.

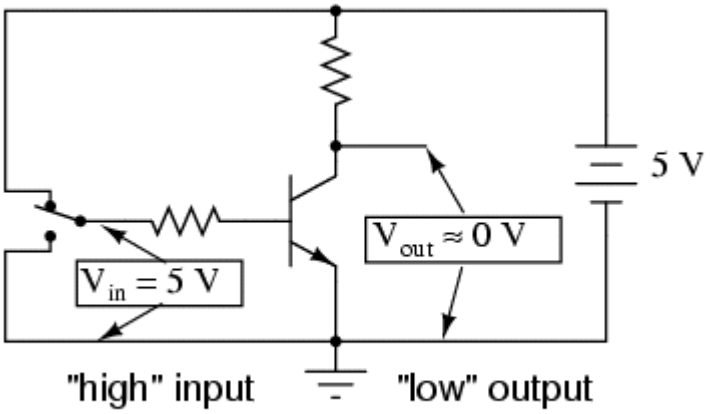

Transistor in saturation

The circuit above shows the digital transistor is designed to allow a voltage of 5v to be supplied to the "base" pin and the transistor will Fully Conduct.
This type of transistor saves putting a base resistor on the PC board.
It can be tested just like a normal transistor but the resistance between base and emitter will be about 5k to 50k in both directions. If the collector-emitter is low in both directions the transistor is damaged.
Here's how to look at how the transistor works:
The 10k resistor on the base will allow 0.5mA to flow into the base. But the 47k will reduce this to 0.4mA. If the transistor has a gain of 100, the collector-emitter current can be 40mA.
To determine the current capability of the transistor, connect 100R load and turn the transistor ON. This will allow about 100mA for the collector-emitter current. Measure the collector-emitter voltage. If it is more than 0.5v, the transistor is OVER-LOADED.

DARLINGTON TRANSISTORS

A DARLINGTON TRANSISTOR is two transistors in a single package with three leads. They are internally connected in cascade so the gain of the pair is very high. This allows a very small input signal to produce a large signal at the output. They have three leads (Base, Collector and Emitter and can be PNP or NPN) and are equivalent to the leads of a standard individual transistor, but with a very high gain. The second advantage of a Darlington Transistor is its high input impedance. It puts very little load on the previous circuit.
Some Darlington transistors have a built-in diode and/or built-in resistor and this will produce a low reading in both directions between the base and emitter leads.

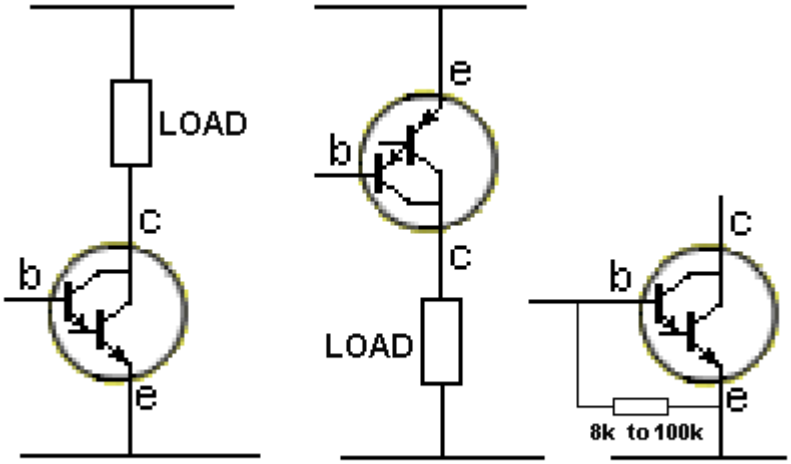

NPN Darlington PNP Darlington

Darlington transistors are tested the same as an ordinary transistor and a multimeter will produce about the same deflection, even though you will be measuring across two junctions, (and a base-emitter resistor is present).

HORIZONTAL OUTPUT TRANSISTORS, SWITCH-MODE TRANSISTORS, FLYBACK TRANSISTORS, POWER TRANSISTORS, VERTICAL TRANSISTORS . . . .

These are all names given to a transistor when it is used in a particular circuit. ALL these transistors are the same for testing purposes.
We are not testing for gain, maximum voltage, speed of operation or any special feature. We are just testing to see if the transistor is completely faulty and SHORTED.
A transistor can have lots of other faults and the circuit **using the transistor** is the best piece of TEST EQUIPMENT as it is detecting the fault.

TESTING MOSFETs and FETs

MOSFETs and **JFETs** are all part of the **FET** family.
MOSFET stands for **Metal Oxide Semiconductor Field Effect Transistor.**
FETs operate exactly the same as a "normal" transistor except they have different names for the input and output leads and the voltage between the gate and the source has to between 2v to 5v for the device to turn on fully. A FET requires almost NO CURRENT into the Gate for it to turn on and when it does, the voltage between drain and source is very low (only a few mV). This allows them to pass very high currents without getting hot. There is a point where they start to turn on and the input voltage must rise higher than this so the FET turns on FULLY and does not get hot.
Field Effect Transistors are difficult to test with a multimeter, but "fortunately" when a power **MOSFET** blows, it is completely damaged. All the leads will show a short circuit. 99% of bad **MOSFETs** will have GS, GD and DS shorted.
The following symbols show some of the different types of MOSFETs:

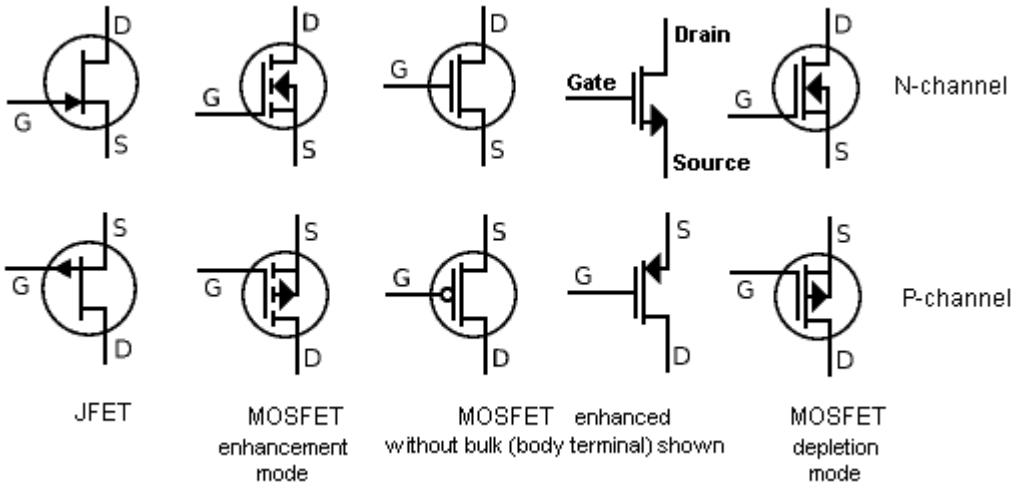

Most **MOSFET** transistors cannot be tested with a multimeter. This due to the fact that the Gate needs 2v - 5v to turn on the device and this voltage is not present on the probes of either meter set to any of the ohms ranges.
You need to build the following Test Circuit:

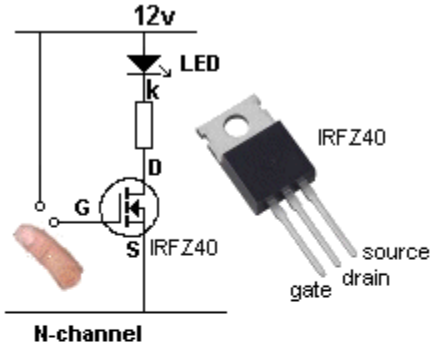

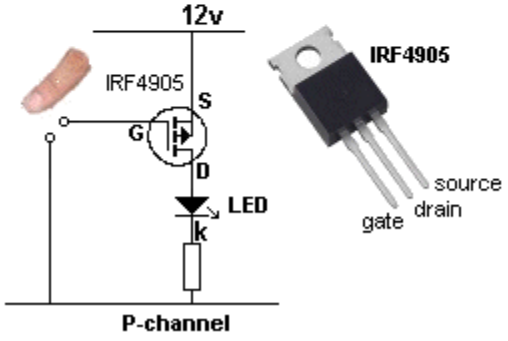

Touching the Gate will increase the voltage on the Gate and the MOSFET will turn ON and illuminate the LED. Removing your finger will turn the LED off.
Large devices such as the TO-220 types shown above do not like static electricity on the gate and you have to be careful not to "spike" the gate with any static. Generally this type of device is not "super sensitive" and you can use your finger or a large value resistor.
When replacing one of these devices, there are 2 things to match-up.
Voltage and Current.
In most cases, the "turn-ON" resistance (the resistance between Source and Drain) will be the same (something like 22 milli ohms) and the speed of operation will be ok.
Check the voltage needed to turn the gate ON and make sure you can supply the required voltage.

SILICON CONTROLLED RECTIFIERs (SCR)

The **Silicon Controlled Rectifier** (SCR) is a semiconductor device that is a member of a family of control devices known as **Thyristors**. It is a 3-leaded device and when a small current enters the Gate, the **thyristor** turns on. AND STAYS ON. It only conducts current between Anode and Cathode in one direction and it is mainly only used in DC circuits. When it is used with AC, it will only conduct for a maximum of half the cycle.

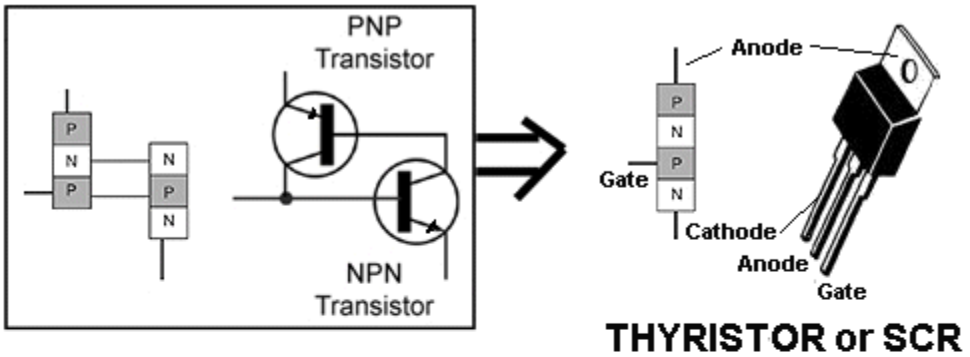

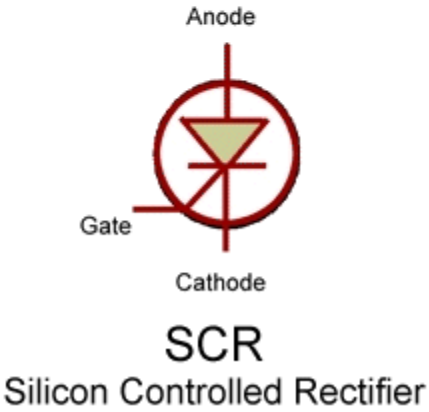

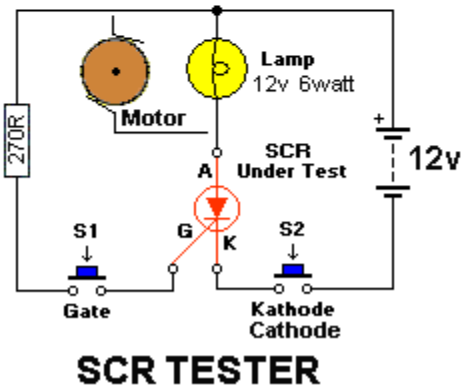

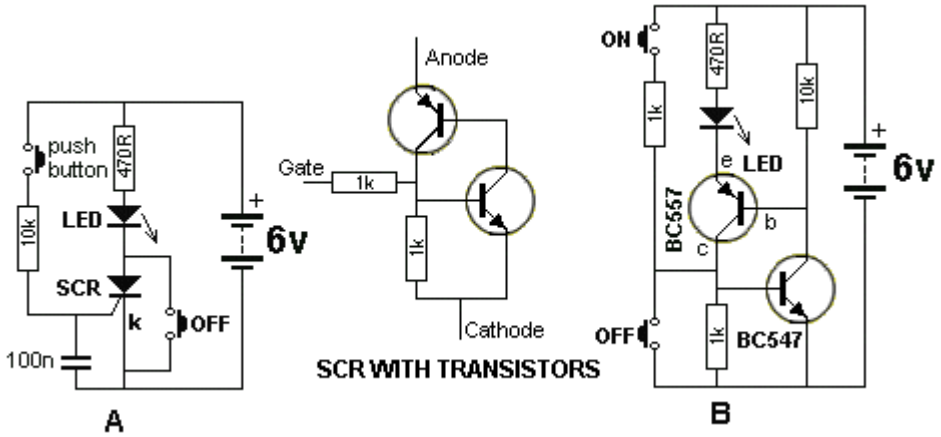

To understand how an SCR "latches" when the gate is provided with a small current, we can replace it with two transistors as shown in diagram B above. When the ON button is pressed, the BC547 transistor turns on. This turns ON the BC557 and it takes over from the action of the switch.
To turn the circuit off, the OFF button removes the voltage from the base of the BC547.

Testing an SCR

An **SCR** can be tested with some multimeters but a minimum current Anode-to-Cathode is needed to keep the device turned on. Some multimeters do not provide this amount of current and the **SCR Tester** circuit above is the best way to test these devices.
Shorted SCRs can usually be detected with an ohmmeter check (SCRs usually fail shorted rather than open).
Measure the anode-to-cathode resistance in both the forward and reverse direction; a good SCR should measure near infinity in both directions.
Small and medium-size SCRs can also be gated ON with an ohmmeter (on a digital meter use the Diode Check Function). Forward bias the SCR with the ohmmeter by connecting the black (-) lead to the anode and the red (+) lead to the cathode

(because the + of the battery is connected to the negative lead, in most analogue multimeters). Momentarily touch the gate lead to the anode while the probes are still touching both leads; this will provide a small positive turn-on voltage to the gate and the cathode-to-anode resistance reading will drop to a low value. Even after removing the gate voltage, the SCR will stay conducting. Disconnecting the meter leads from the anode or cathode will cause the SCR to revert to its non-conducting state.
When making the above test, the meter impedance acts as the SCR load. On larger SCRs, it may not latch ON because the test current is not above the SCR holding current.

Using the SCR Tester
Connect an SCR and press Switch2. The lamp should not illuminate. If it illuminates, the SCR is around the wrong way or it is faulty.
Keep Switch 2 PRESSED. Press Sw1 very briefly. The lamp or motor will turn ON and remain ON. Release Sw 2 and press it again. The Lamp or motor will be OFF.

TRIACs

A triac is a bidirectional, three-terminal dual, back-to-back thyristor (SCR) switch. This device will conduct current in both directions when a small current is constantly applied to the Gate.
If the gate is given a small, brief, current during any instant of a cycle, it will remain triggered during the completion of the cycle until the current though the Main Terminals drops to zero.
This means it will conduct both the positive and negative half-cycles of an AC waveform. If it is tuned on (with a brief pulse) half-way up the positive waveform, it will remain on until the wave rises and finally reaches zero. If it is then turned on (with a brief pulse) part-way on the negative wave, the result will be pulses of energy and the end result will be about 50% of the full-energy delivered at a rate of 100 times per second for a 50HZ supply.
TRIACs are particularly suited for AC power control applications such as motor speed control, light dimmers, temperature control and many others.

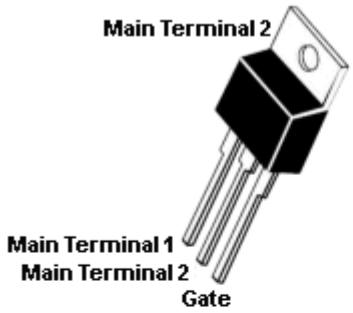

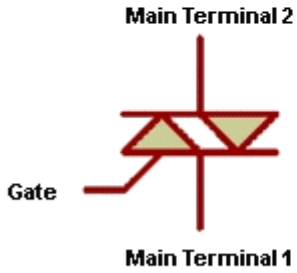

TRIAC (2 SCR's)
TRIode for Alternating Current

Using the TRIAC Tester

Connect a TRIAC and press Switch2. The lamp should not illuminate. If it illuminates, the TRIAC is faulty.
Keep Switch 2 PRESSED. Press Sw1 very briefly. The lamp or motor will turn ON and remain ON. If the lamp does not turn on, reverse the TRIAC as the current into the gate must produce a slight voltage between **Gate** and **Main Terminal 1**.
Release Sw 2 and press it again. The Lamp or motor will be OFF.

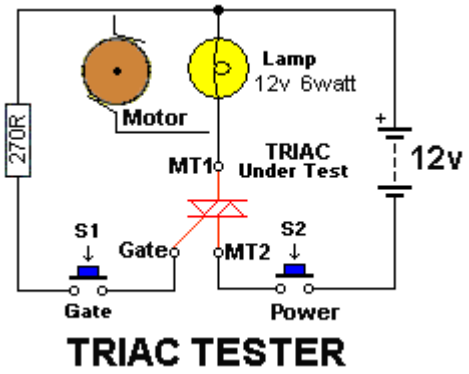

MICA WASHERS AND INSULATORS

Plastic insulating sheets (washers) between a transistor and heatsink are most often made from mica but some are plastic and these get damaged over a period of time, turn dark and become cracked.
The plastic eventually becomes carbonized and conducts current and can affect the operation of the appliance. You can see the difference between a mica sheet (washer) and plastic by looking where it extends from under the transistor. Replace all plastic insulators as they eventually fail.

SPARK GAPS

Some TV's and monitors with a CRT (picture tube), have spark gaps either on the socket at the end of the tube or on the chassis.
These can consist of two wires inside a plastic holder or a glass tube or special resistive device.
The purpose of a spark gap is to take any flash-over (from inside the tube), to earth. This prevents damage to the rest of the circuit.
However if the tube constantly flashes over, a carbon track builds up between the wires and effectively reduces the screen voltage. This can cause brightness and/or focus problems. Removing the spark-gap will restore the voltage.
These are not available as a spare component and it's best to get one from a discarded chassis.

CO-AX CABLES

Co-Ax cables can produce very high losses and it seems impossible that a few metres of cable will reduce the signal. The author has had a 3 metre cable reduce the signal to "snow" so be aware that this can occur. Faults can also come from a splitter and/or balun as well as dirty plugs and sockets. This can result in very loud bangs in the sound on digital reception.

TESTING EARTH LEAKAGE DETECTORS or Residual Current Devices or Ground Fault Circuit Interrupters or GFCI

An Earth Leakage Detector or Sensor is a circuit designed to continuously monitor the imbalance in the current in a pair of load carrying conductors.
These two conductors are normally the Active and Neutral. Should the imbalance current reach 30mA the sensor will "trip" and remove the voltage (and current) from

the line being monitored.
Some detectors will trip at 15mA.
You cannot alter the sensitivity of the device however there are a number of faults in these devices that can be fixed.
In some devices the contact pressure for the 10Amp or 15 Amp contacts is very weak and they arc and produce an open circuit. The result is this: When you press the rest button, power is not restored to the output.
Clean the contacts with a small file and bend the metal strips to the contacts so they make a very strong contact.
The other fault is the trip mechanism.
The magnetism from the coil does not allow the pin to move and "trip" the contacts. It may be due to a small metal filing or the pin not moving freely enough.
All good Earth Leakage Detectors have a TEST BUTTON. This connects a resistor between the active line and earth so that 15mA or 30mA flows.
The detector should trip immediately. Make sure the trigger mechanism trips when the test button is pressed.
None of the electronics in the detector can be replaced however you can test the mechanical operation and the pressure on the contacts when the unit is removed from the power. Do not work on the device when it is connected to the mains.

TESTING CELLS AND BATTERIES

There is an enormous number of batteries and cells on the market and a number of "battery testers." Instead of buying a battery tester that may give you a false reading, here is a method of testing cells that is guaranteed to work.
There are two types of cell: a **rechargeable** cell and a non rechargeable cell.

The easiest way to test a **rechargeable** cell is to put a group of them in an appliance and use them until the appliance "runs down" or fails to work. If you consider the cells did not last very long, remove them and check the voltage of each cell. The cell or cells with the lowest voltage will be faulty. You can replace them with new cells or good cells you have in reserve.
There is no other simple way to test a rechargeable cell.
You cannot test the "current of a cell" by using an ammeter. A rechargeable cell can deliver 10 amps or more, even when nearly discharged and you cannot determine a good cell for a faulty cell.

Dry cells are classified as "non-rechargeable" cells.
DRY CELLS and MANGANESE CELLS are the same thing. These produce 1.5v per cell (manganese means the Manganese Dioxide depolariser inside the cell. All "dry cells" use manganese dioxide).
ALKALINE CELLS produce between 2 - 10 times more energy than a "dry cell" and produce 1.5v per cell.
Alkaline cells can fail for no reason at any stage in their life and are not recommended for emergency situations.
The output voltage of some Alkaline cells can fall to 0.7v or 0.9v for not apparent reason.
There are lots of other cells including "button cells," hearing-aid cells, air cells, and they produce from 1.2v to 3v per cell.

Note:
Lithium cells are also called "button cells" and they produce 3v per cell.
Lithium cells are non-rechargeable (they are generally called "button cells") but some Lithium cells can be recharged. These are Lithium-ion cells and generally have a voltage of 3.6v. Some Lithium-ion cells look exactly like 3v Lithium cells, so you have to read the data on the cell before charging.

You cannot test the voltage of a cell and come to any conclusion as to the age of the cell or how much energy remains. The voltage of a cell is characteristic to the chemicals used and the actual voltage does not tell you its condition.
Some "dry cells" deliver 1.5v up to the end of their life whereas others drop to about 1.1v very quickly.

Once you know the name of the cell that drops to 1.1v, avoid them as the operation of the equipment "drops off" very quickly.

However if you have a number of different cells and need to know which ones to keep, here's the solution:

1. Check the voltage and use those with a voltage above 1.1v
2. Next, select 500mA or 10A range on a meter and place the probes on a cell. For a AAA or AA cell, the current should be over 500mA and the needle will swing full scale very quickly.
Keep the testing short as you are short-circuiting the cell but it is the only way to determine the internal impedance of the cell and this has a lot to do with its stage-of-charge.
This will give you a cell with a good terminal voltage and a good current capability.

This also applies to button cells, but the maximum current they will deliver will be less.
If you want to get the last of the energy out of a group of cells they can be used in the following circuits:

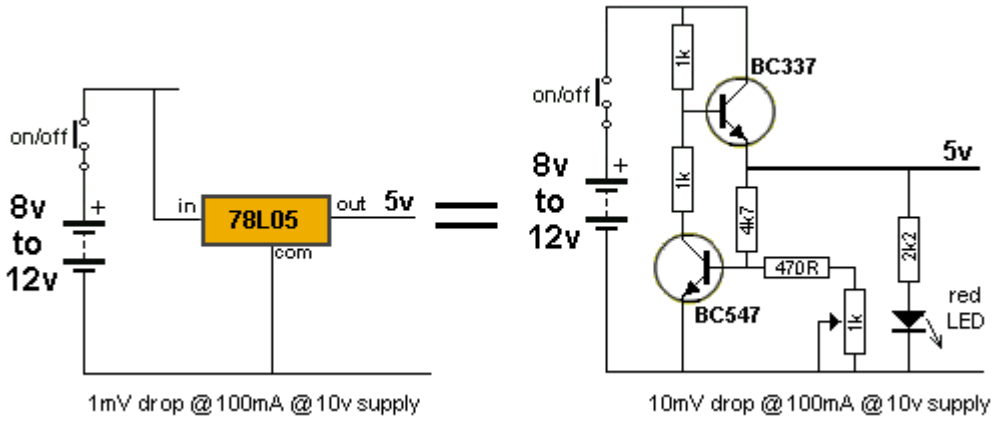

TESTING PIEZO DIAPHRAGMS and PIEZO BUZZERS

There are two types of piezo devices that produce a sound.
They are called **PIEZO DIAPHRAGMS** and **PIEZO BUZZERS**.
A **piezo diaphragm** consists of two metal plates with a ceramic material between.
The ceramic expands and contracts when an alternating voltage is placed on the two plates and this causes the main plate to "dish" and "bow."
This creates a high-pitched sound. There are no other components inside the case and it requires an AC voltage of the appropriate frequency to produce a sound.
A **piezo buzzer** has a transistor and coil enclosed and when supplied with a DC voltage, the buzzer produces a sound.
Both devices can look exactly the same and the only way to tell them apart is by connecting a 9v battery. One device may have "+' and "-" on the case to indicate it is a piezo buzzer, but supplying 9v will make the buzzer produce a sound while the piezo diaphragm will only produce a "click."

A piezo diaphragm will produce a click
when connected to 9v DC.
A piezo buzzer will produce a tone when
connected to a DC voltage.

How a PIEZO BUZZER WORKS

A Piezo Buzzer contains a transistor, coil, and piezo diaphragm and produces sound when a voltage is applied. The buzzer in the circuit above is a PIEZO BUZZER.

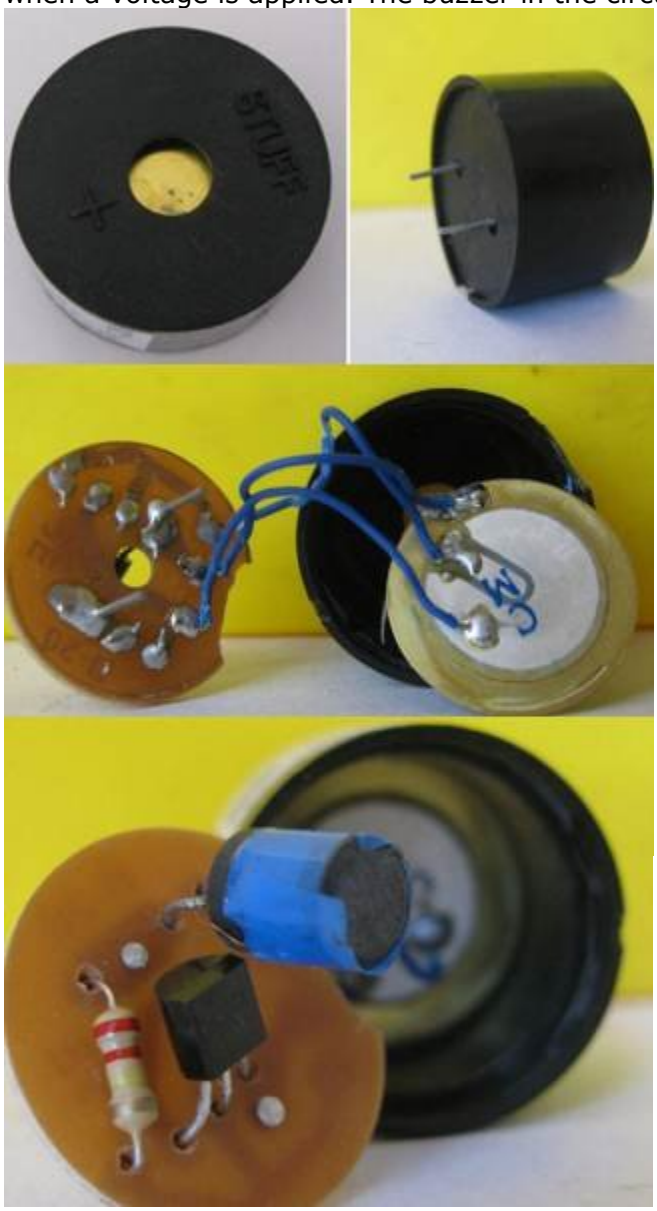

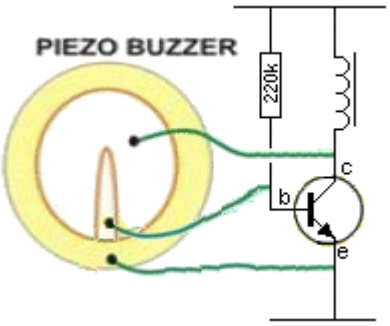

The circuit starts by the base receiving a small current from the 220k resistor. This produces a small magnetic flux in the inductor and after a very short period of time the current does not increase. This causes the magnetic flux to collapse and produce a voltage in the opposite direction that is higher than the applied voltage.
3 wires are soldered to pieces of metal on the top and bottom sides of a ceramic substrate that expands sideways when it sees a voltage. The voltage on the top surface is passed to the small electrode and this positive voltage is passed to the base to turn the transistor ON again. This time it is turned ON more and eventually the transistor is fully turned ON and the current through the inductor is not an INCREASING CURRENT by a STATIONARY CURRENT and once again the magnetic flux collapses and produces a very high voltage in the opposite direction. This voltage is passed to the piezo diaphragm and causes the electrode to "Dish" and produce the characteristic sound. At the same time a small amount is "picked-off" and sent to the transistor to create the next cycle.

TESTING A SPEAKER

A speaker (also called a **loud speaker**) has coil of wire wrapped around a magnet but it does not

touch the magnet as it is wound on a thin cardboard former so that the coil will be pulled closer to the magnet when a current flows in the coil.
When the current flows in the other direction, the coil moves away from the magnet.
The coil is called voice coil and it is connected to a sheet of thin card called a CONE and as the cone vibrates, the speaker reproduces music or noise.
Use a multimeter on a low ohms scale to read the value of resistance of the coil.
It can be as low as 2 ohms or as high as 100 ohms.
Most speakers have an 8R voice coil and the actual resistance may be slightly lower than this.
Some speakers have a resistance of 16R, 32R or 50R and even 75 ohms.
You would think putting a 16R speaker in place of 8R would reduce the sound output, but this is not always the case.
You can even use 50R or 75R and get the same performance.
This may sound amazing, but here is the reason.
The cone is deflected a certain amount due to the current flowing and the number of turns.
These two values are multiplied together to produce a value called AMP-TURNS.
If we have an 8R speaker with 80 turns and 100mA, the result is 0.1 x 80 = 8.
If we use a 16R speaker, the average current flow will be 50mA and the number of turns will be about 160. The multiplication of 0.05 x 160 = 8.
The author then tried a 50R speaker and the sound output was equal to 8R and the same with 75R speaker.
This might not apply in all situations, but the 75R speaker was slightly larger and the ticking sound form the **Metal Detector** kit was louder than using an 8R mini speaker.

To see if the cone of a speaker is undamaged, push it slightly and it will move towards the magnet. If it does not move, it is bent or damaged. If the cone is scratchy when pushed, it is rubbing against the magnet.
A cone should be able to be pushed and pulled from its rest-state. If not, it will produce a distorted sound.

TESTING A CIRCUIT

Whenever you test a circuit, the TEST EQUIPMENT puts "a load" or "a change" on it.
It does not matter if the test equipment is a multimeter, Logic Probe, CRO, Tone Injector or simply a LED and resistor.
There are two things you need to know.
1. The IMPEDANCE of the circuit at the location you are testing, and
2. The amount of load you are adding to the circuit via the test equipment.

There is also one other hidden factor. The test equipment may be injecting "hum" due to its leads or the effect of your body at absorbing hum from the surroundings or the test equipment may be connected to the mains.
These will affect the reading on the test equipment and also any output of the circuit.
Sometimes the test equipment will prevent the circuit from working and sometimes it will just change the operating conditions slightly. You have to be aware of this.
The last section of this eBook covers High and Low Impedance and understanding impedance is something you need to know.
The point to note here is the fact that the equipment (and the reading) can be upset by hum and resistance/capacitance effects of test equipment. This is particularly critical in high impedance and high frequency circuits.

TESTING INTEGRATED CIRCUITS (IC's)

Integrated Circuits can be tested with a LOGIC PROBE. A Logic Probe will tell you if a line is HIGH, LOW or PULSING.
Most logic circuits operate on 5v and a Logic Probe is connected to the 5v supply so the readings are accurate for the voltages being tested.
A Logic Probe can also be connected to a 12v CMOS circuit.
You can make your own Logic Probe and learn how to use it from the following link:

http://www.talkingelectronics.com/projects/LogicProbeMkIIB/LogicProbeMk-IIB.html

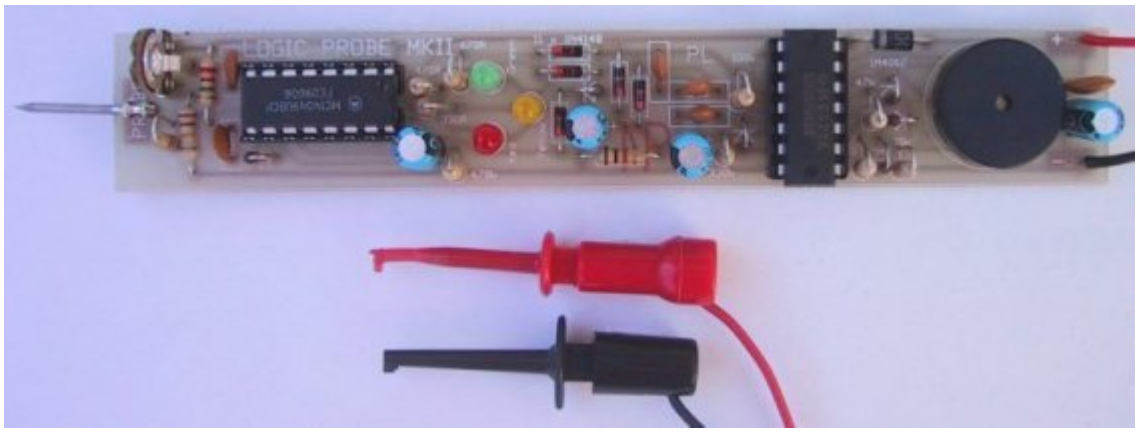

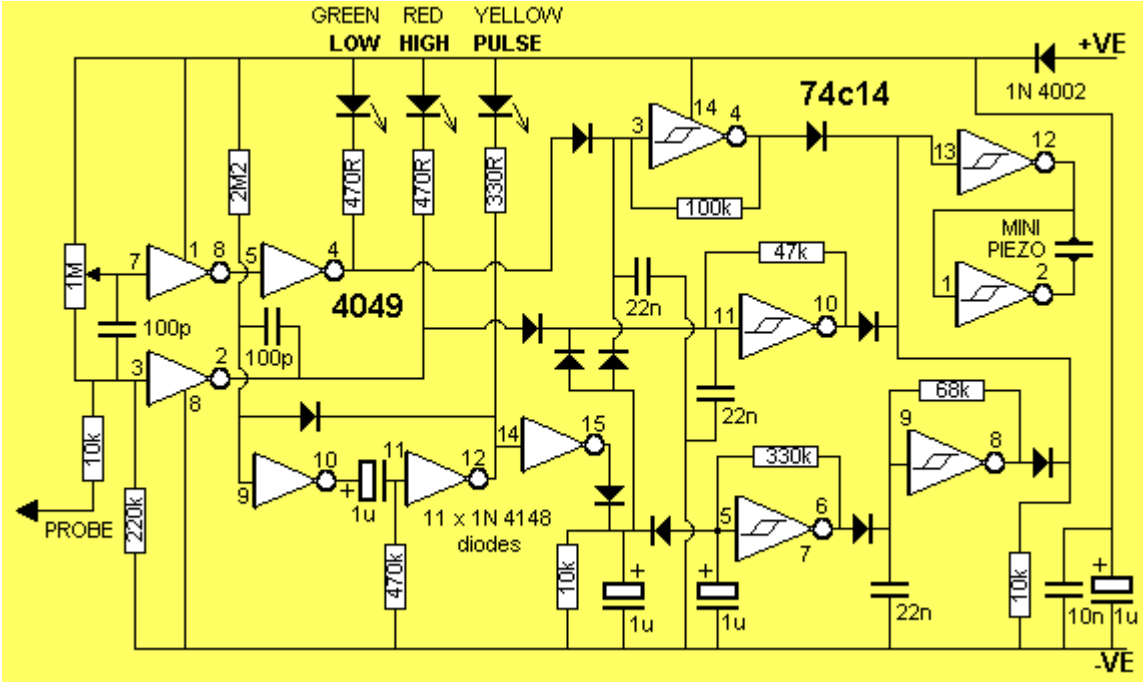

LOGIC PROBE with PULSE

This is a very simple transistor circuit to provide HIGH-LOW-PULSE indication for digital circuits. It can be built for less than $5.00 on a piece of matrix board or on a small strip of copper clad board if you are using surface mount components. The probe will detect a HIGH at 3v and thus the project can be used for 3v, 5v and CMOS circuits.

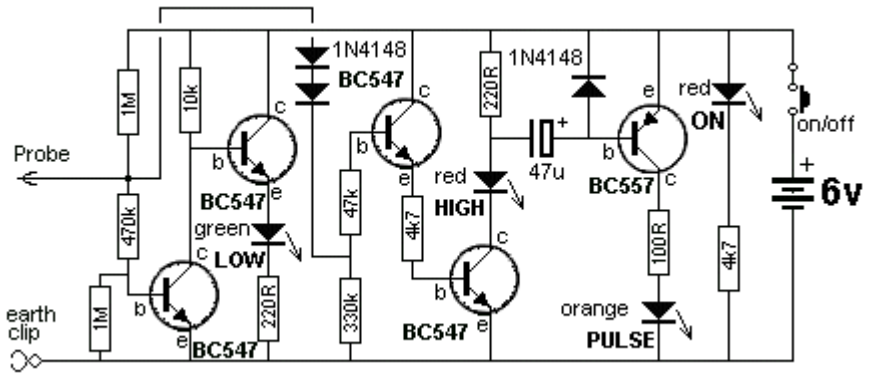

LOGIC PROBE using CD4001 and CD4011

Here is a simple Logic Probe using a single chip. The circuits have been designed for the **CD4001** CMOS quad NOR gate and **CD4011** CMOS NAND gate. The output has an active buzzer that produces a beep when the pulse LED illuminates (the buzzer is not a piezo-diaphragm but an active buzzer containing components).

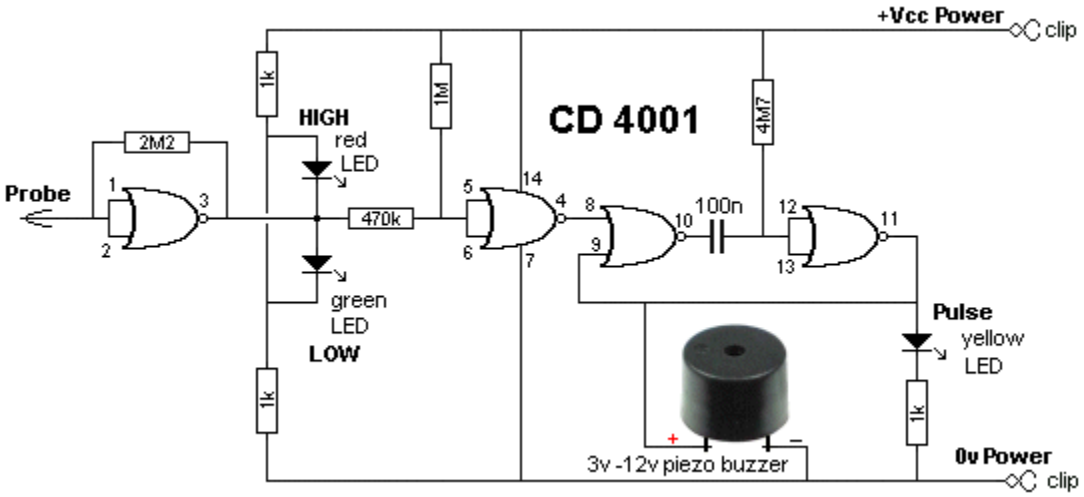

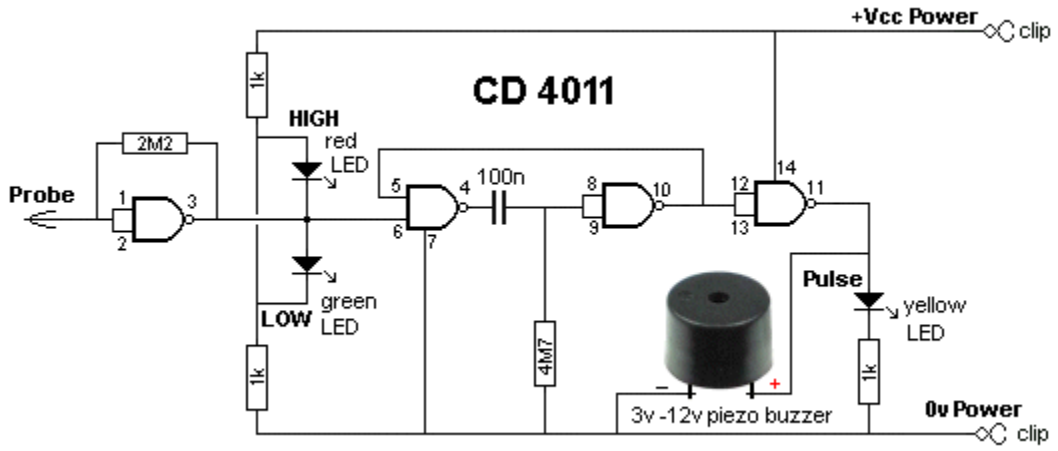

SUPER PROBE MkII has 20 different features including a Logic Probe, capacitance tester, Inductance tester, and more.

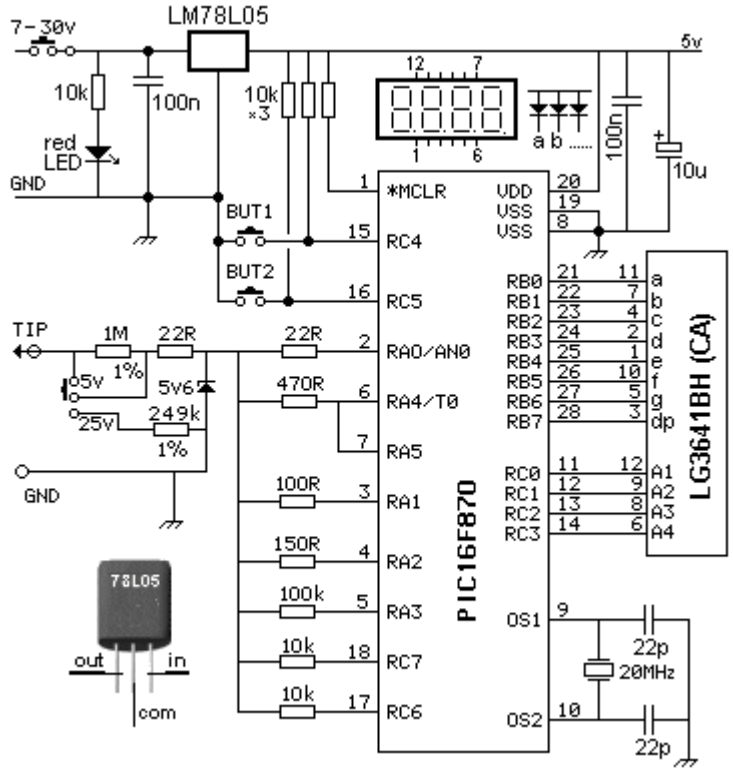

SUPER PROBE MkII Circuit

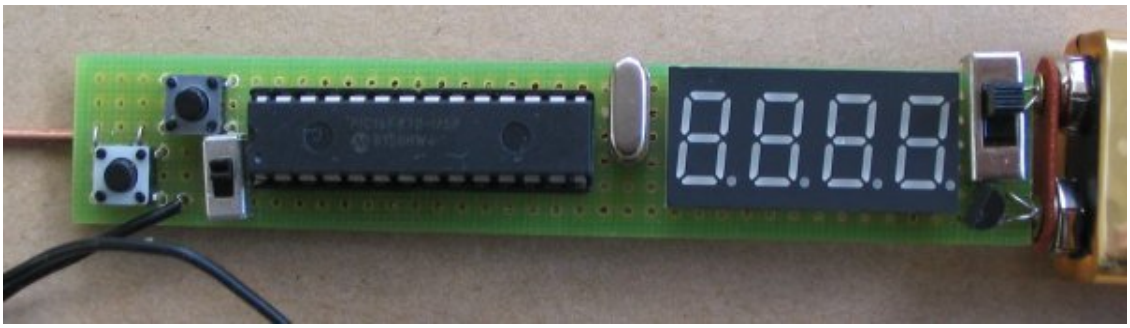

SUPER PROBE MkII

To test an IC, you need a circuit diagram with waveforms. These diagrams will show the signals and are very handy if a CRO (cathode ray Oscilloscope) is used to diagnose the problem. The CRO will reproduce the waveform and prove the circuit is functioning correctly.
A Logic Probe will just show activity and if an output is not producing a "pulse" or "activity," you should check the power to the IC and test the input line.
It is beyond the scope of this eBook to explain how to diagnose waveforms, however it is important to know if signals are entering and exiting an IC and a Logic Probe is designed for this.

SIGNAL INJECTOR
This circuit is rich in harmonics and is ideal for testing amplifier circuits. To find a fault in an amplifier, connect the earth clip to the 0v rail and move through each stage, starting at the speaker. An increase in volume should be heard at each preceding stage. This Injector will also go through the IF stages of radios and FM sound sections in TV's.

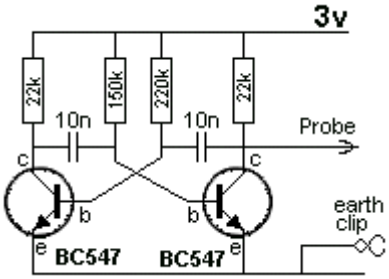

TESTING AUDIO AMPLIFIERS and AUDIO IC's

The **Super Probe MII** described above has a "noise" function and a tone function that allows you to inject a signal into an audio stage, amplifier (made from discrete components) or an audio chip, and detect the output on a speaker.
Audio stages are very difficult to work-with if you don't have a TONE GENERATOR or SIGNAL INJECTOR.
The signals are very small and not detected by a multimeter.
You can start anywhere in an amplifier and when a tone is heard, you can keep probing until the signal is not present or louder. From this you can work out which way the signal is travelling.
A Signal Injector is very handy for finding shorts and broken wires in switches, plugs, sockets and especially leads to headphones.
You can determine the gain of a stage (amplification) by probing before and after a chip or transistor and listen for the relative increase in volume from the speaker.
You can also use your finger to produce "hum" or "buzz" if a **Signal Injector** is not available.
Nearly all audio problems are plugs, sockets and cracks in the PC board, but finding them takes a lot of time and skill.

TESTING IC's - also called "CHIPS"

An Integrated Circuit is also called a "chip." It might have 8 pins or as many as 40.
Some chips are ANALOGUE. This means the input signal is rising and falling slowly and the output produces a larger version of the input.
Other chips are classified as DIGITAL and the input starts at 0v and rises to rail voltage very quickly. The output does exactly the same - it rises and falls very quickly.
You might think the chip performs no function, because the input and output voltage has the same value, but you will find the chip may have more than one output and the others only go high after a number of clock-pulses on the input, or the chip may be outputting when a combination of inputs is recognised or the output may go HIGH after a number of clock pulses.

ANALOGUE CHIPS **(also see above)**
Analogue chips are AUDIO chips or AMPLIFIER chips.
To test these chips you will need three pieces of test equipment:
1. A multimeter - this can be digital or analogue.
2. A Signal Injector
3. A Mini Bench Amplifier.

The Mini Bench Amplifier is available as a kit.

MINI BENCH AMPLIFIER

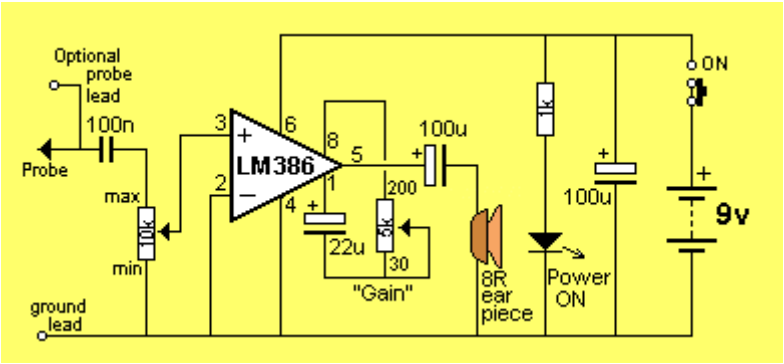

MINI BENCH AMPLIFIER CIRCUIT

Start by locating the power pin with a multimeter.
If the chip is receiving a voltage, you can use the Mini Bench Amplifier to detect an output.
Connect the Ground Lead of the Mini Bench Amplifier to 0v and touch the Probe tip on each of the pins.
You will hear faint audio on the Input pin and very loud audio on the Output pin.
If no input is detected, you can use a Signal Injector to produce a tone.

Connect the clip of the Signal Injector to 0v and the probe to the input pin of the amplifier chip. At the same time, connect the Mini Bench Amplifier to the output pin and you will hear a very loud tone.
These pieces of test equipment can also be used to diagnose an amplifier circuit constructed with individual components.
Amplifier circuits using discrete components are very hard to trouble-shoot and these pieces of test equipment make it very easy.

DIGITAL CHIPS

It is always best to have data on the chip you are testing, but if this is not available, you will need three pieces of equipment:
1. A multimeter - this can be digital or analogue.
2. A Logic Probe,
3. A logic Pulser.
Firstly test the chip to see if power is being delivered. This might be anything from 3v3 to 15v.
Place the negative lead of the multimeter on the earth rail of the project - this might be the chassis, or the track around the edge of the board or some point that is obviously 0v.
Try all the pins of the chip and if you get a reading, the chip will have "supply."
Identify pin 1 of the chip by looking for the "cut-out" at the end of the chip and you may find a small dimple below the cut-out (or notch). This is pin 1 and the "power pin" can be directly above or any of the other pins.
Next you need to now if a signal is entering the chip.
For this you will need a LOGIC PROBE.
A Logic Probe is connected to the same voltage as the chip, so it will detect a HIGH and illuminate a red LED.
Connect the Logic Probe and touch the tip of the probe on each pin.
You will not know if a signal is an input or output, however if you get two or more active pins, you can assume one is input and the other is output. If none of the pins are active, you can assume the signal is not reaching this IC.
If only one pin is active, you can assume the chip is called a CLOCK (or Clock Generator). This type of chip produces pulses. If more than two pins are active, you can assume the chip is performing its function and unless you can monitor all the pins at the same time, you don't know what is happening.
This is about all you can do without any data on the chip.

If you have data on the chip, you can identify the input(s) and output(s).
A Logic Probe on each of these pins will identify activity.
A Logic Probe has 3 LEDs. Red LED indicates a HIGH, Green indicates a LOW and Orange indicates a PULSE (activity).
Some Logic Probes include a piezo and you can hear what is happening, so you don't take your eyes off the probe-tip.
It is important not to let the probe tip slip between the pins and create a short-circuit.

LOGIC PULSER

If you have a board or a single chip and want to create activity (clock pulses), you can use a Logic Pulser. This piece of test equipment will produce a stream of pulses that can be injected into the clock-line (clock input) of a chip.
You can then use a Logic Probe at the same time on the outputs to observe the operation of the chip.

You can also use the Mini Bench Amplifier to detect "noise" or activity on the inputs and outputs of digital chips.
This only applies if the frequency is in the audio range such as scanning a keyboard or switches or a display.

This is how to approach servicing/testing in a general way. There are thousands of digital chips and if you want to test a specific chip for its exact performance, you will need to set-up a "test-bed."

REMOTE CONTROLS

There are two types of remote control - Infrared and RF. Infrared is used for short-range, line-of-sight for TV's DVD's etc.
A few faults can be fixed, but anything complex needs a new remote control.
Check the batteries and battery-contacts. See if the IR LED is illuminating by focusing it into a digital camera and looking on the screen for illumination.
The only other things are a sticky button, a worn-out button or a crack in the PC board. Water damage is generally too much work to repair.
RF remote controls for cars, garage doors etc need a second working unit to check the power output.
Here is a simple circuit that can be connected to an analog multimeter to detect the signal strength at a very close range:

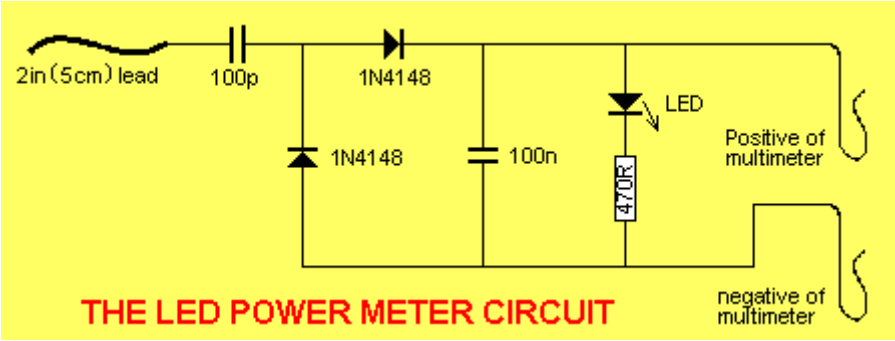

To hear the tone from a transmitter, the **Mini Bug Detector** circuit can be used:

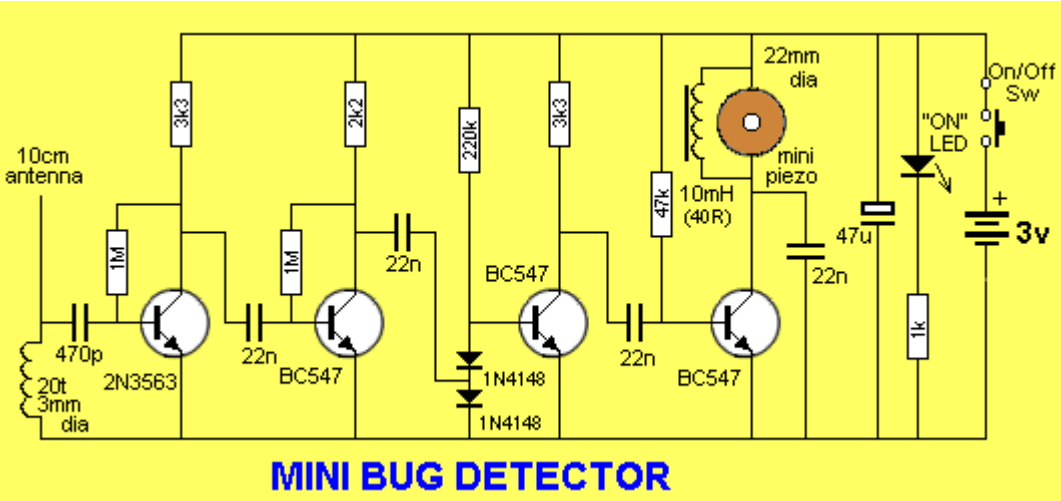

Any further investigation requires a circuit diagram so you can work out what is actually being sent from the transmitter.
Most of the time it is a faulty switch, battery or contacts. Make sure the setting is correct on the "dip switches" and use a working unit to compare all your testing.

TESTING VOLTAGES ON (in) A CIRCUIT

There are basically two different types of circuit.
1. **ANALOGUE CIRCUIT**
An analogue circuit can also be called an AUDIO CIRCUIT and the voltages at different points in a circuit can be measured with a multimeter but the changes (the waveforms) will be quite small or changing at a rapid rate and cannot be detected by a multimeter.
You need a CRO to "see" the signals or a **Signal Injector** to inject a waveform into the circuit and hear the result on the circuit's speaker.

2. **DIGITAL CIRCUIT**
A digital circuit can also be called a "Computer Circuit" or "Logic Circuit" and some of

the voltages can be measured with a multimeter (such as supply voltages) but the "signal lines" will be be changing from HIGH to LOW to HIGH very quickly and these signals are detected with a **Logic Probe**.

Here are some circuits with details of how to test the voltages.
Most circuits do not show voltages at various different points and we will explain what to expect on each "stage."

A "STAGE"

A stage is a set of components with an input and output. A "stage" can also be called a "Building Block."
Sometimes it has a capacitor on the input and one on the output.
This means the stage is completely isolated as far as DC is concerned.
The stage has a supply (a DC supply) and it is producing its own voltages on various points on the "stage." It can only process (amplify) "AC." (signals).
Sometimes the stage can be given a name, such as small-signal amplifier, push-pull amplifier or output.
If the stage has a link or resistor connected to a previous stage, the previous stage will have a "DC effect" on the stage. In other words it will be biasing or controlling the voltages on the stage. The stage may be called a "timer" or "delay" or "DC amplifier."

It is important to break every circuit into sections. This makes testing easy. If you have a capacitor at the input and output, you know all the problems lie within the two capacitors.
In a digital circuit (no capacitors) you need to work on each IC (integrated Circuit) and test the input for activity and all the outputs.

Once you have determined if the circuit is Analogue or Digital, or a combination of both, you have to look at the rail voltage and work out the size or amplitude of the voltage or waveform.
This is done before making a test, so your predictions are confirmed.
You will need a **multimeter** (either Digital or Analogue) a **Logic Probe** and a **Signal Injector** (**Tone Generator**). An analogue meter has the advantage that it will detect slight fluctuations of voltage at a test-point and its readings are faster than a digital meter. A digital meter will produce an accurate voltage-reading - so you should have both available.

HIGH IMPEDANCE AND LOW IMPEDANCE

Every point in a circuit has a characteristic called "IMPEDANCE." This has never been discussed before in any text book. That's why it will be new to you.
In other words, every point will be "sensitive to outside noise."
An audio amplifier is a good example. If you put your finger on the active input, it will produce hum or buzz in the speaker. This is because it is a HIGH IMPEDANCE line or high impedance section of the circuit.
The same applies to every part in a circuit and when you place Test Equipment on a line for testing purposes, the equipment will "upset" the line. It may be very slight but it can also alter the voltage on the point CONSIDERABLY.
We have already mentioned (above) how a cheap multimeter can produce a false reading when measuring across a 1M resistor. That's why you need high impedance test Equipment so you do not "load" the point you are testing and create an inaccurate reading.
The word **Impedance** really means resistance, but when you have surrounding components such as diodes, capacitors, transistors, coils, Integrated Circuits, supply-voltages and resistors, the combined effect is very difficult to work out as a "resistance" and that's why we call it "Impedance."
The term "**High and Low Impedance**" is a relative term and does not have any absolute values but we can mention a few points to help you decide.
In general, the base of a transistor, FET input of an IC are classified as HIGH IMPEDANCE.
The output of these devices are LOW IMPEDANCE.

Power rails are LOW IMPEDANCE.
An oscillator circuit and timing circuit are HIGH IMPEDANCE.
A LOAD is low impedance.
And it gets tricky: An input can be designed to accept a low-impedance device (called a transducer or pick-up) and when the device is connected, the circuit becomes LOW impedance, but the input circuitry is actually high impedance.
The impedance of a diode or LED is HIGH before the device sees a voltage higher than the junction voltage and then it becomes LOW Impedance.
Impedance is one of the most complex topics however it all comes down to testing a circuit without loading it.
That's why test equipment should have an input impedance higher than 1M.

The first circuit we will investigate is the **Mini Bug Detector**, shown above and below. Points on the circuit have been labelled A, B, C etc:

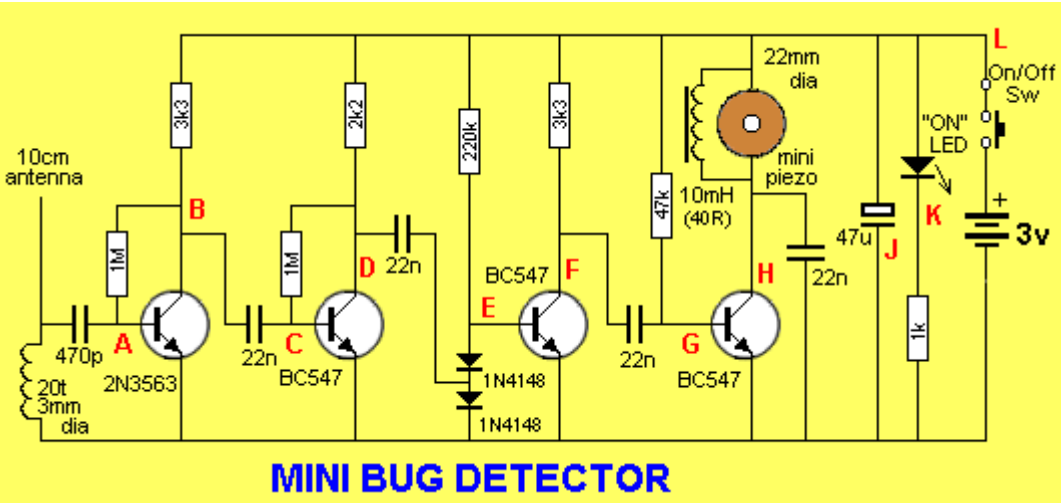

Point A - The first transistor is "self-biased" and will have 0.6v on the base. The antenna is connected to a 20 turn coil and you might think the coil will "short" the signals to earth.
But the coil and 470p capacitor form a circuit that oscillates at a high frequency when the antenna wire picks up stray signals. The coil and capacitor actually amplify the signals (see Talking Electronics website: Spy Circuits to see how a TANK CIRCUIT works) and these signals enter the base of the first transistor.
This is classified as a HIGH Impedance section because the signals are small and delicate and any loading via test equipment will kill them. The first transistor amplifies the signals about 70 times and they appear at **Point B**.

The signal passes though a 22n to **Point C** and the transistor amplifies the signal about 70 times to **point D**. **Point C** is classified as high impedance as any voltage measurement at this point will upset the biasing of the stage as a few millivolts change in base-voltage will alter the voltage on the collector considerably. **Point D** is classified as low impedance as any voltage-testing will not alter the voltage appreciably.
The output of the second stage passes through a capacitor to the join of two diodes. These two diodes are not turned on because the voltage at **Point E** can never rise above 0.7v as this is the voltage produced by the base-emitter of the third transistor.
The purpose of the two diodes is to remove background noise. Background noise is low amplitude waveforms and even though the transistor is turned on via the 220k, low amplitude signals will not be received. The third transistor works like this: It cannot be turned ON any more because any waveform from the 22n will be "clipped" by the bottom diode and it will never rise above 0.6v.
So, the only signal to affect the transistor is a negative signal - to turn it OFF.
Firstly we have to understand the voltage on the 22n. When the second transistor is sitting at mid-rail voltage, the 22n gets charged via the 2k2 and lower diode. When

the transistor gets tuned ON, the collector voltage falls and the left side of the 22n drops. The right side of the 22n also drops and when it drops 0.6v, the top diode starts to conduct and when the voltage on the 22n drops more than 0.6v the third transistor starts to turn OFF. This effect is amplified by the transistor at least 100 times and appears at **Point F.** All the voltages around the two diodes are classified as HIGH Impedance as any piece of test equipment will upset the voltage and change the output.
There are some losses in amplitude of the signal as it passes through the 22n coupling capacitors but the end result is a very high strength signal at **point G.** The 4th transistor drives a 10mH choke and the mini piezo is effectively a 20n capacitor that detects the "ringing" of the inductor to produce a very loud output.
The 22n capacitor on the collector eliminates some of the background noise. The choke and piezo form an oscillatory circuit that can produce voltages above 15v, even though the supply is 3v.
The 47n capacitor at **Point J** is to keep the supply rails "tight" (to create a LOW Impedance) to allow weak cells to operate the circuit.
The "Power-ON" LED tells you to turn the device off when not being used and **Point L** is the power supply - a low impedance line due to the 47u electrolytic.

Testing the Mini Bug Detector
To test the Mini Bug Detector, you will need a Signal Injector.
Place the Injector on **Point G** and you will hear a tone. Then go to **E**, **C** and **A**. The tone will increase in volume. If it does not increase, you have pin-pointed the faulty stage.

The next circuit is a combination of digital and analogue signals. It is a **Logic Probe**:

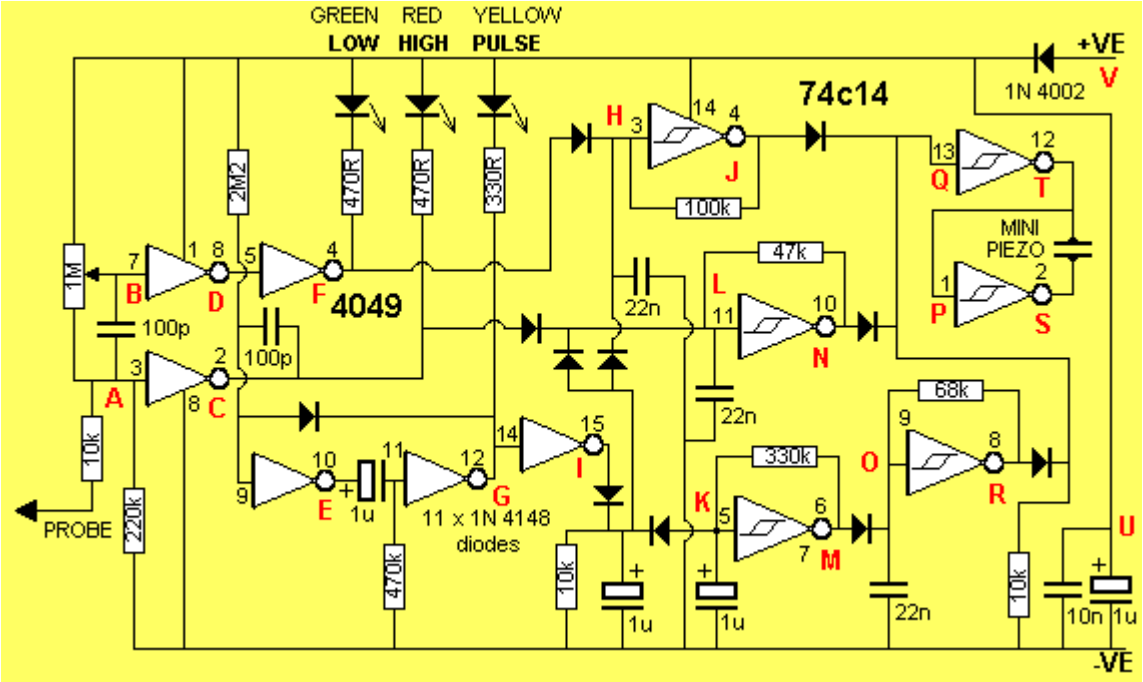

The voltage on a circuit (to be tested) is detected by the probe at **Point A** of the circuit above and the "tip" is classified as "reasonably high impedance" as it has a 220k resistor between the tip and 0v rail. The 1M reduces the impedance by about 20% but the inputs of the two inverters have no effect on the "tip" impedance as they are extremely high input-impedance devices.
The 1M trim pot is designed to put put a voltage on **point B** that is slightly higher than mid-rail so the green LED is turned off.
Point A will see a voltage below mid-rail and **point C** will be HIGH. **Point C** and **F** are low-impedance outputs.
When the tip of the probe is connected to a LOW voltage, Point B sees a LOW and Point F goes LOW to illuminate the green LED. At the same time it removes the "jamming voltage" produced by the diode between pin 4 of the 4049 and pin 3 of the

74C14 and the oscillator between **points H and J** produces a low-tone via the 100k resistor and 22n to indicate a LOW.
When the probe tip sees a HIGH, a lot more things happen.
Point C goes LOW and turns on the red LED. At the same time the 100p is in an uncharged state and the right lead goes LOW. This takes the left lead LOW as the left lead connects to a HIGH Impedance line and pin 9 goes LOW. This makes **point E** HIGH
and since the 1u is in an uncharged state, pin 11 goes HIGH. This makes **point G** LOW and the diode between pins 9 and 12 keeps pin 9 LOW and takes over from the pulse from the 100p. The yellow LED is illuminated. The 1u starts to charge via the 470k and when it is approx half-charged, pin 11 sees a HIGH and **point G** goes low. This creates the length of pulse for the yellow LED.
At the same time, **Point L** goes LOW because the "jamming diode" from pin 2 of the 4049 goes low and allows the inverter between point L and N to produce a tone for the piezo.
In addition, **Point I** goes HIGH and quickly charges a 1u electrolytic. This removes the effect of the jamming diode on pin 5 of the 74C14 and a low frequency oscillator made up of 68k and 1u between pins 5&6 turns on and off an oscillator between **points O** and **R** to get a beep. The mini piezo is driven n bridge mode via the two gates between **points QT** and **PS**.
Point U is a 1u electrolytic to reduce the impedance of the power rail and **Point V** is a protection diode to prevent damage if the probe is connected to the supply around the wrong way.

Testing the Logic Probe
You can test the Logic Probe with the simple Logic Probe with Pulse project described above. It will let you know if each point in the circuit is HIGH or LOW. You will also find out the difficulty in testing the points that are HIGH Impedance, as the Probe will upset the voltage levels and the reading may be inaccurate.

More circuits will be added here in the future.

THE VOLTAGE DIVIDER - this topic could fill a book.

You need to read lots of other sections in this eBook, including the section on measuring across a resistor with a multimeter, and high impedance circuits, to fully understand the complexities of a VOLTAGE DIVIDER CIRCUIT.
It is one of the most important BUILDING BLOCKS to understand. Even though it may consists of two components, you have to understand what is happening between these two components. You have to realise there is a voltage at their join that will be rising and falling due to one of the components changing RESISTANCE. Sometimes you can work out the voltage at the join by using Ohm's LAW but quite often it will be impossible as it is changing (rising and falling) during the operation of the circuit.
At the beginning of this discussion we will only dealing with DC circuits and the voltage across a particular component will be due to its RESISTANCE. We are not going into any formulas, as it is very easy to measure the voltages with a multimeter set to VOLTS and you will have an accurate result.
The simplest two components in series are resistors. They always have the same resistance during the operation of a circuit and the voltage across each will not change.
In a further discussion we will cover "resistors" that change value according to the temperature. These are called THERMISTORS. And we have "resistors" that change value according to the light they receive. These are called LIGHT DEPENDENT RESISTORS (LDR's) or PHOTO RESISTORS.
A transistor that is partly or fully turned ON can be considered to be similar to a resistor.
In these 3 cases we need to measure the voltage at the join with a voltmeter as it will be a lot of work to measure the resistance and work out a value.
You can also keep a voltmeter on the joint and watch the voltage change.
Finally we have some components that produce a fixed voltage across them (or nearly fixed) and the remaining voltage is dropped across a resistor. These

components MUST have a resistor connected in series to limit the current and allow the component to pass the specified in the datasheet.
These devices include LEDs, diodes and zener diodes. A LED will have a fairly fixed voltage across it from 1.7v to 3.6v depending on the colour. A diode will have a voltage of 0.7v across it when it is connected to a voltage via a resistor. And a zener diode will have a fixed voltage across it when it is connected with the cathode to the positive rail via a resistor. The voltage across it will be as marked on the zener.
The concept of a VOLTAGE DIVIDER is very simple, but it takes a lot of understanding because both VOLTAGE and CURRENT are involved in the UNDERSTANDING-PROCESS.
Each component has a resistance and this can be measured with a multimeter. When two components are connected in series, a current will flow and a voltage will develop across each item.
More voltage will develop across the item with the higher resistance and the addition of each voltage will always equal the supply voltage.
That's the simple answer.
There is a little more involved . . . It is the word CURRENT. Here is an explanation:
Suppose we have a 1k and 2k resistor on a 12v supply. The voltage at the join will be 4v.
In other words, there will be 4v across the 1k and 8v across the 2k.
If we have a 10k and 20k resistors in series, the voltage will also be 4v at the join.
If we have a 100k and 200k resistors, the voltage will also be 4v at the join.
The voltage will be the same in all cases, but the current will be different. The current in the second case will be one-tenth and only one hundredth in the third case.
If you want to go further, place a one ohm and two ohm in series and get 4v. But the resistors will get very hot and burn out very quickly.

SOLDERING

Here are three 30-minute videos on soldering.
1. **TOOLS**
2. **Soldering components**
3. Soldering **SURFACE MOUNT** components

TESTING A MOTOR

Strictly speaking, a motor is not an electronic component, but since a website gave a useless description on testing motors, I have decided to supply the correct information.
The only REAL way to test a motor is to have two identical motors and check the torque by connecting them to a low voltage and trying to stop the shaft with your fingers. This will give you two results. Firstly it will let you know the torque of the motor.
This is the twisting effect of the shaft. There is no way to determine the torque by knowing the voltage or current.
The unknown factor is the strength of the field magnets (permanent magnets) and this determines the torque.
Secondly, feeling the shaft will let you know if the torque is even for a complete revolution.
By having two identical motors, you can see if one has a lower torque.
Almost nothing can go wrong with a motor except for the brushes. If the brushes wear out, additional resistance will be produced at the interface between the brush and commutator and this can be detected by allowing the shaft to rotate slowly and feeling the resistance as it revolves. A 3-pole motor will have three places where the strength is greatest and each should have the same feeling. A 5-pole motor will have five places of strength.
If the strength is weak or not uniform, the motor is faulty.
You cannot test a motor with a multimeter as the resistance of the armature winding is very low and if the motor is allowed to spin, the back voltage produced by the spinning, increases the reading on the meter and is false.

Micro motors have a coreless armature. This means the 3 windings for the armature are wound on a machine then bent slightly into shape and glued. A circular magnet with 3 poles is in the centre and the armature rotates around this.
This type of motor is reasonably efficient because the armature is the greatest distance from the point of rotation, and the motor reaches full RPM very quickly because the armature has very little inertia.
I have not heard of the armature-winding flying apart but if you hear any scraping noise, it may be the winding.
3-pole, 5-pole and micro motors can be found in printers, eject mechanisms of CD players, toys, RC helicopters, cars etc and rarely fail.
Motors do not work on "voltage." They actually work on CURRENT and as you increase the voltage, more current will flow and produce a stronger magnetic field (by the winding on each pole). This magnetic field will be attracted by the permanent magnet surrounding the armature and repelled by the surrounding permanent magnet, depending on where the face of the pole is, during each revolution.
If the permanent magnet is not very strong, the repulsion part of the interaction will be very weak and thus the torque will be small.
Because motors work on "current" you must have a high current available when you increase the voltage as the motor will require short bursts of high current during each revolution.
It is the combination of voltage and current (called watts) that gives the motor "strength" (torque) as well as the "strength" of the permanent magnets (called the field magnets) and the number of turns of wire on each pole (and the gauge of wire).
Basically, if a motor is hard to spin, and has 3 "hard spots" on each revolution, it will be powerful.
A 2-pole motor does not self-start and will spin in either direction. But a 3-pole motor will self-start and you can determine the direction of rotation.
A 5-pole motor has a lower RPM. It is slightly smoother in output but is not more powerful than a 3-pole version.
A motor with "permanent magnets" is called a DC motor as it will not work on AC. If the magnets are replaced with a coil, it will work on AC and it will be called a "shunt wound" motor of the field coil is connected across the same terminals as the brushes or a "series wound" motor if the field coil is in series with the armature.

TESTING COMPONENTS "IN-CIRCUIT"

You can test components while they are IN CIRCUIT, but the surrounding components will have an effect on the results.
You can get all sorts of "In-Circuit" testers. They are expensive and offer little more accuracy than a multimeter.
In-Circuit testing with a multimeter can give you the same results as a tester.
All you have to do is turn the project ON and use a multimeter (set to voltage) to determine the voltage at various points. It is best to have a circuit of the equipment so you can what to expect at each point.
Only major departures from the expected can be located in this way.
Obviously the first thing to look for is burnt-out components. Then feel components such as transistors for overheating.
The look for electrolytics that may be dry. Sometimes these have changed colour or are slightly swollen.
If they are near hot components, they will be dry.
For the cost of a few dollars I change ALL THE ELECTROLYTICS in some pieces of equipment, as a dry electrolytic is very difficult to detect.
Testing a transistor "in-circuit" is firstly done with the supply ON. That's because it is quicker.
Measure the voltage between ground and collector.
In most cases you should get a voltage of about half-rail. If it is zero, or close to rail voltage, you may have a problem.
Turn off the supply and use the multimeter on low-ohms to measure all six resistances between the leads.
A low resistance in both directions on two leads will indicate a fault.
Resistors almost NEVER go "HIGH." For instance, a 22k will never go to 50k.
However a low-value resistor will "burn-out" and you will read the value of the surrounding components.

Don't forget, some low-value resistors are designed to burn-out (called fusible resistors) and anytime you find a damaged low-value resistor, you will need to look for the associated semiconductor.
You can replace the resistor quickly and turn the circuit ON to see it burn out again.
Alternatively you can trace though the circuit and find the shorted semiconductor.
It's always nice to "see the fault" then "fix the fault."
Sometimes a transistor will only break-down when a voltage is present, or it may be influenced by other components.
When the piece of equipment is turned OFF, you can test for resistance values. The main thing you are looking for is "dry joints" and continuity. Dry joints occur around the termination of transformers and any components that get hot. Rather than wasting time checking for dry joints, it is better to simply go over the connections with a hot iron and fresh solder.
You may need to check the continuity of a track (trace) and it may go from one side of the PC board to the other.
Use a multimeter set to low-ohms and make sure the needle reads "zero-ohms."
It is very dangerous to do any testing on a project using a multimeter set to "amps" or "milliamps."
You cannot test "current flowing through a component" by placing the probes across a component. You will simply over-load the rest of the circuit and create a problem.
To find out if current is flowing though a circuit or a low-value resistor, turn the project ON and measure the voltage either across the component or the voltage on one end then the other.
A voltage-drop indicates current is flowing.
That's about it for testing "in-circuit." Use the rest of this eBook to help you with diagnosis.
Don't think an IN-CIRCUIT COMPONENT TESTER is going to find a fault any faster than a multimeter. They all use a multimeter principle.

SHORT CIRCUIT

Nearly every component can fail and produce an effect called a SHORT CIRCUIT.
This basically means the component takes more current than normal and it may fail completely or simply take more current and the operation of the circuit may be reduced only a small amount.
The resistance of the component may reduce a very small amount but this may have a very large effect on the operation of the circuit.
For instance, two turns in the horizontal or vertical winding of a yoke on the picture tube or monitor may arc and weld together and reduce the size of the picture on the screen, but measuring the winding will not detect the difference in resistance.
The same with the windings on a motor and a short between two winding in a transformer.
If the "short" is between two near-by turns, the change in resistance will be very small. If the "short" is between to different layers, the resistance will be reduced and it may be detected.
When a "short" occurs, the winding turns into a transformer. To be exact, an AUTO-TRANSFORMER.
In the following diagram you can see a normal winding in fig A:

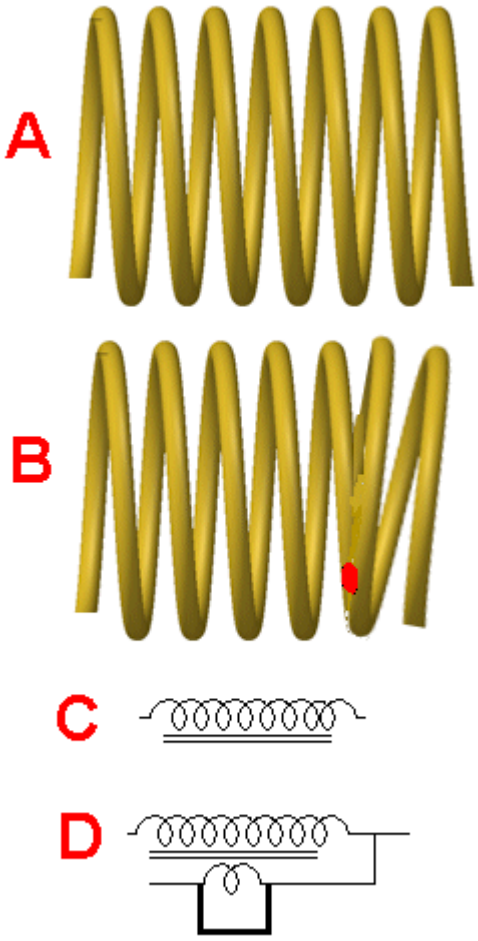

Fig B shows two turns touching each other and if the wire is enamelled, the coating has been damaged so the copper wire from the two turns is touching. This is called a SHORTED TURN.
In fig C you can see two turns touching.
In fig D the shorted-turn has been moved to the other side of the symbol to show the effect it has on the operation of the winding.
The shorted-turn is exactly like the secondary of a transformer with a "jumper" across the output.
This will produce a very high current in the secondary.
A very high current flows through the shorted turn and this changes the operation of the rest of the winding.

1. In most cases a SHORT CIRCUIT can be detected by feeling the additional heat generated by the component.
2. Next, turn off the supply and measure the resistance of the component. If it is lower than expected, the component will be faulty.
3. Next, measure the voltage across the component. If it is lower than normal, the component will be faulty.
4. Next, measure the current taken by the component. If it is higher than normal, the component will be faulty.
5. If the component is an inductor, such as a motor, coil or transformer, you can use an inductance meter. Compare a good winding with a faulty winding. Sometimes the fault will disappear because an arc develops across the fault when the component is operating.

INTERNAL AND EXTERNAL SHORTS

An **internal short** refers to two windings shorting together and the winding has a very high resistance between the winding and the frame on which it is wound. An external short refers to a winding shorting to the frame of the component - such as one of the armature windings shorting to the metal core, around which the wire is

wound.
This may not be important unless another winding shorts to the metal frame and creates "**inter winding**" problems (**inner winding** problems is within the same winding).

The opposite to a short circuit is an OPEN CIRCUIT.

This is generally a broken lead or contact or a wire that has "burnt-out" or been "eaten-away" by acid attack or galvanic action by water and voltage (current).
1. No current will flow when an OPEN CIRCUIT exists.
2. The voltage on each end of the OPEN CIRCUIT will not be the same.
3. Measure the current across the OPEN CIRCUIT and determine if excess current is flowing.
4. Join the two ends of the OPEN CIRCUIT and see if the circuit operates normally.

> HEATSINKS

This is not an electronic component but it can certainly affect the operation of a circuit.
If you cannot hold your fingers on a heatsink, it is getting too hot. This is because the actual location where the heat is being generated is much hotter than the part you are touching.
Transistors and IC's can withstand a high temperature but if they go above this temp, they BLOW UP.
They also have a shorter life when operating at a high temperature.
The secret to a good heatsink is called an INFINITE HEATSINK.
This is the metal frame of a case.
There are lots of charts and data on choosing a heatsink but they don't take into account two factors:
Sometimes a circuit takes a very high current for a short time and this creates a high temperature gradient. This will cause the transistor to get very hot and fail.
The solution is to have two or more transistors in parallel to separate the "heat spots."
The second problem with designing a heatsink is the unknown location of the heatsink and the air-flow. Products placed on a shelf or in a cupboard will get very little air-flow.
Remember: some transistors are mounted on thermal insulators. This means the transistor will have a voltage on it but the heatsink will be zero voltage.
The temperature of the transistor will be MUCH HIGHER than the heatsink under the transistor and the transfer of the heat from the transistor to the heatsink will be very slow. This can be the cause of the transistor failing. Sometimes the transistor will fail because insulation is high temp plastic and it gets brittle. The plastic can carbonise and leak and sometimes a voltage can flash through the insulator. Some amazing things have happened under these transistors and you may need to pull it apart and replace all the insulation.
Finally, feel the heatsink after 15 minutes and feel right up to the transistor. If you cannot touch the transistor, increase the thickness of the heatsink or use two transistors to dissipate the heat.
To design a heatsink, you have to have some idea of the size of a heatsink for the application.
Charts and data can send you in the wrong direction.
Start with a heatsink twice the recommended size and feel the temp after 15 minutes. Put the project in a cupboard and see how the temperature rises.
If possible, connect the heatsink to the metal case to get added dissipation and if you include fan-cooling, remember the fan will eventually gather dust and reduce its efficiency.
It is very difficult to explain how heat passes through a mica washer or plastic washer, but if the transistor has a copper base, the heat transfer has a value of 400. For aluminium it is 200. If it is steel, the transfer has a value of 50. For a mica sheet it is 1 and for plastic it is 0.1
Even though the sheet is very thin, the transfer is a lot less than metal-to-metal transfer.

Most references state the temperature difference is about one degree C for each watt of heat generated by the transistor.
Don't believe anything you read.
Feel the temperature yourself and if you cannot hold your finger on the transistor, fix the problem.

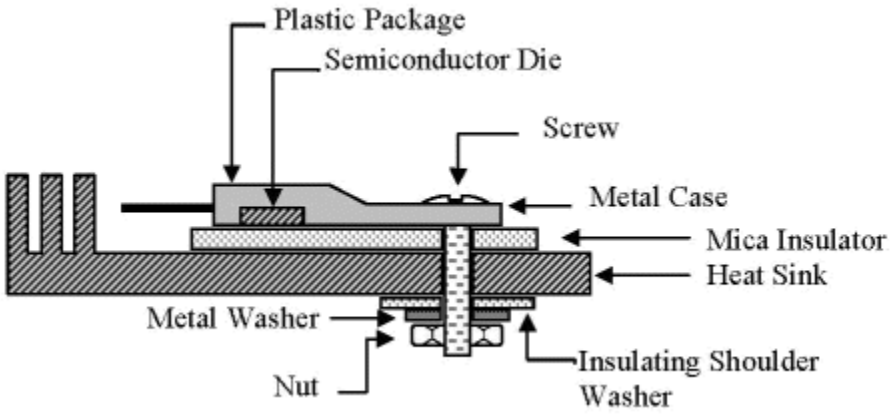

In the end, use a heatsink 50% larger than recommended.

THE END

This is not the full story to learning about servicing. It is just the beginning.
We have only covered the simplest tests and shown how 90% of faults can be found by checking voltages, waveforms and looking for obvious things such as burnt out components, cracks in PC boards.
The author has fixed over 35,000 TV's, radios, stereos, VCRs and all those things that were on the market 30 years ago.
Things have not changed. It's just that some repairs cost nearly as much as buying a new product and half the customers opt for dumping a faulty item and buying the latest "flat screen" version. That's why you have to get things through the workshop as fast and as cheaply as possible, to make a living.

If you want any more devices added to this list, email **Colin Mitchell**.

To help with understanding how a transistor circuit works, we have produced an eBook: **The Transistor Amplifier.** It covers a whole range of circuits using a transistor.

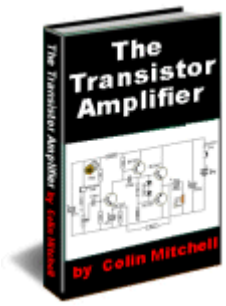

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Nearly all text books are also downloadable for free on "Download.com" etc and when you see a used copy of a $74.00 textbook on Amazon for $12.00 you realise many users have already discarded their copy. A good textbook never gets thrown out or sold for $12.00!!!

See the enormous amount of information on Talking Electronics website

CIRCUIT SYMBOLS by TALKING ELECTRONICS

AC current: voltage:	ALTERNISTOR TRIAC A TRIAC and 33 - 43v DIAC Main Terminal1 Gate Main Terminal 2	Ammeter (amp meter)
AND Gate	AND Gate	Antenna balanced
Antenna Loop, Shielded	Antenna Loop, Unshielded	Antenna unbalanced
Attenuator, fixed (see Resistor)	Attenuator, variable (see Resistor)	Battery
Bilateral Switch (DIAC)	Bridge Rectifier (Diode Bridge)	BUFFER (Amplifier Gate)
BUFFER (Amplifier Gate)	Buzzer	Capacitor feedthrough
Capacitor non-polarised	Capacitor polarised (see electrolytic)	Capacitor Variable
Cavity Resonator	Cell	Circuit Breaker
Coaxial Cable	CRO – Cathode Ray Oscilloscope	Crystal Microphone (Piezoelectric)
Connectors Plug (male) Jack (female) connected Plug (male) (female)	Crystal Piezoelectric Darlington Transistor collector base emitter DIAC (Bilateral Switch)	DC current: voltage: Delay Line Diode
Diode - Gunn	Diode - Light Emitting (LED)	Diode Photo Sensitive
Diode Photovoltaic	Diode Bridge (Bridge Rectifier)	Diode - Pin
Diode - Varactor	Diode - Zener	Earth Ground
Earpiece (earphone, crystal earpiece)	Electroluminescence el	Electret Microphone (Condenser mic)
Electrolytic (Polarised Capacitor) alternate symbols: (positive on top)	Electrolytic - Tanatalum positive end black band or chamfer 106 10u tantalum	Exclusive-OR Gate (XOR Gate) Exclusive-OR Gate (XOR Gate)
Field Effect Transistor (FET) n-channel also: N-Channel J FET Gate Drain Source	Field Effect Transistor (FET) p-channel also: P-Channel J FET Gate Drain Source	Flashing LED (Light Emitting Diode) (Indicates chip inside LED)

Ferrite Bead	Fuse	Galvanometer
Globe	Ground Chassis	Ground Earth
Heater (immersion heater) (cooker etc)	IC Integrated Circuit power ground	Inductor Air Core
Headphone		Inductor Iron Core or ferrite core
Inductor Tapped	Inductor Variable	Integrated Circuit
Inverter (NOT Gate)	INVERTER (NOT Gate)	
Jack Co-axial	Jack Phone (Phone Jack)	Jack Phone (Switched)
Jack Phone (3 conductor)	Key Telegraph (Morse Key)	Lamp Incandescent
Lamp - Neon	LASCR (Light Activated Silicon Controlled Rectifier)	LDR (Light Dependent Resistor)
LASER diode laser diode photo diode	Light Emitting Diode (LED)	Light Emitting Diode (LED - flashing) (Indicates chip inside LED)
Mercury Switch	Micro-amp meter (micro-ammeter)	Microphone (see Electret Mic)
Microphone (Crystal - piezoelectric)	Milliamp meter (milli-ammeter)	Motor
NAND Gate	NAND Gate	Nitinol wire "Muscle wire"
Negative Voltage Connection	NOR Gate	NOR Gate
NOT Gate Inverter	NOT Gate Inverter	Ohm meter
Operational Amplifier (Op Amp)	Optocoupler (Transistor output)	Opto Coupler (Opto-isolator) a c k e Photo-transistor output
Optocoupler (Darlington output)	Opto Coupler (Opto-isolator) a c k e TRIAC output	OR Gate
OR Gate	Oscilloscope see CRO	Outlet (Power Outlet)
Piezo Diaphragm	Photo Cell (photo sensitive resistor)	Photo Diode
Photo Darlington Transistor	Photo FET (Field Effect Transistor) Gate Drain Source	Photo Transistor

Photovoltaic Cell
(Solar Cell)

Piezo Tweeter
(Piezo Speaker)

Positive Voltage
Connection

Potentiometer
(variable resistor)

Programmable
Unijunction
Transistor PUT
gate
anode
cathode

Rectifier
Silicon Controlled
(SCR)
Anode
Gate
Cathode

Rectifier
Semiconductor
k

Reed Switch
N

Relay - spst

Relay - spdt

Relay - dpst

Relay - dpdt

Resistor
Fixed

Resistor
Non Inductive

Resistor
preset

Resistor
variable

Resonator
3-pin

RFC
Radio Frequency Choke

Rheostat
(Variable Resistor)

Saturable Reactor

Schmitt Trigger
(Inverter Gate)

Schottky Diode
(also Shottky)
Low forward voltage 0.3v
Fast switching
also called Schottky Barrier Diode
k
k

Shielding

Signal Generator

Shockley Diode
k
4-layer PNPN device
Remains off until forward current
reaches the forward break-over voltage.

Silicon Bilateral Switch (SBS)
T_2 Terminal
Gate
T_1 Terminal
e.g: BS08D
T_2 G T_1

Silicon Unilateral Switch (SUS)
Anode
Gate
Cathode(k)
A G k

Silicon Controlled
Rectifier (SCR)
Anode
Gate
Cathode

Solar Cell

Surface Mount
SOT-23
c
b
e
c
b
e
b
e
k
k
k
A
no connection
& LED

Switch - spst

Switch - spdt

Switch - dpst

Switch - dpdt

Switch - mercury
tilt switch

Spark Gap

Switch - process activated
normally open: normally closed:
Flow
Level
Pressure
Temperature

Speaker
8R

Switch - push
(Push Button)

Switch - push off
(used in alarms etc)

Switch - Rotary

Test Point

Thermal Probe
NTC: as temp rises,
resistance decreases
t° = ?
NTC

Thyristors: Main Terminal1
Bilateral
Switch
Anode
Gate
Cathode
MT2
Anode
Gate
Cathode
DIAC **SCR** **TRIAC** **TRIAC**

Thermocouple

Tilt switch
mercury

Touch Sensor

Transformer
Air Core

Transformer
Iron Core

Transformer
(Tapped Primary/Sec)

Transistor Bipolar - NPN collector base emitter	Transistor Bipolar - PNP emitter base collector	Transistor n-channel Field Effect Gate Drain Source
Transistor p-channel Field Effect Gate Drain Source	Transistor Metal Oxide Single Gate	Transistor Metal Oxide Dual Gate
Transistor Photosensitive	Transistor Schottky - NPN collector base emitter	Transistor Unijunction - UJT Emitter Base 1 Base 2 Unijunction Transistor (UJT) N-type
TRIAC Main Terminal1 Anode Gate MT2 Cathode	Transistor Unijunction - UJT Emitter Base 1 Base 2 Unijunction Transistor (UJT) P-type	Tunnel Diode Unijunction Transistor - UJT Emitter Base 2 Base 1
Varactor varactor diode	Voltage Regulator (7805 etc) in out 7805 out common in 7805	Voltmeter
Wattmeter	Wires	Wires Connected
Wires Not Connected	XOR Gate (exclusive OR)	XOR Gate (exclusive OR)
Zener Diode k k	Learn **BASIC ELECTRONICS** Go to: http://www.talkingelectronics.com	

More chapters of this eBook on: Talking Electronics.com

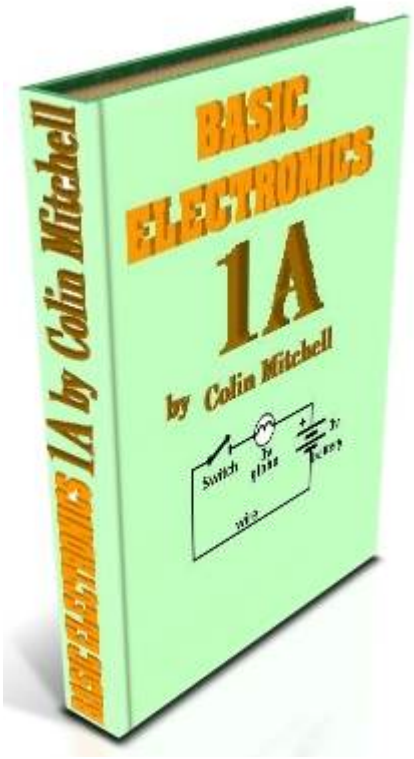

For any enquiries email Colin Mitchell

BASIC ELECTRONICS

(this is the Basic Electronics section i.e. Page 1)

(Chapters 1 and 3 are available as .pdf)

Quick Quiz - to see how much you know
Encyclopedia of Components - this is excellent !!!

Page 1: Basic Electronics (this page) - .pdf (1.2MB) or .zip
The capacitor - how it works
The Diode - how the diode works
Circuit Symbols - EVERY Circuit Symbol
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Page 2: The Transistor
- PNP or NPN Transistor TEST
Page 2a: The 555 IC
The 555 - 1
The 555 - 2
The 555 - 3
The 555 TEST
Page 3: The Power Supply download as .pdf (900kB)
3a: - Constant Current
3b: - Voltage Regulator
3c: - Capacitor-fed Power Supply
Page 4: Digital Electronics

4a: - Gates Touch Switch Gating
4b: - The DELAY CIRCUIT
Page 5: Oscillators
Page 6: Test - Basic Electronics (50 Questions)
Page 7: The Multimeter - using the Multimeter
Page 8: Constructing a Project
Page 9: Inductance

Remember: the animations do not work in .pdf

the site is being constantly updated

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KIT OF PARTS

Talking Electronics supplies a kit of parts that can be used to build the majority of the circuits in this eBook.
The kit costs $15.00 plus postage.

Kit for Transistor Circuits - $15.00

BUY NOW

A kit of components to make many of the circuits described in this eBook is available for $15.00 plus $7.00 post.
Or email Colin Mitchell: talking@tpg.com.au

The kit contains the following components:
(plus **extra** 30 resistors and 10 capacitors for experimenting), plus:

3 - 47R
5 - 220R
5 - 470R
5 - 1k
5 - 4k7
5 - 10k
2 - 33k
4- 100k
4 - 1M
1 - 10k mini pot
1 - 100k mini pot
2 - 10n
2 - 100n
5 - 10u electrolytics
5- 100u electrolytics

5 - 1N4148 signal diodes
6 - BC547 transistors - NPN - 100mA
2 - BC557 transistors - PNP - 100mA
1 - BC338 transistor - NPN - 800mA
3 - BD679 Darlington transistors - NPN - 4amp
5 - red LEDs
5 - green LEDs
5 - orange LEDs
2 - super-bright WHITE LEDs - 20,000mcd
1 - 3mm flashing LED
1 - mini 8R speaker
1 - mini piezo
1 - LDR (Light Dependent Resistor)
1 - electret microphone
1m - 0.25mm wire
1m - 0.5mm wire
1 - 10mH inductor
1 - push button
5 - tactile push buttons
1 - Experimenter Board (will take 8, 14 and 16 pin chips)
5 - mini Matrix Boards: 7 x 11 hole,
11 x 15 hole, 6 x 40 hole, surface-mount 6 x 40 hole board and others.

Photo of kit of components.
Each batch is slightly different:

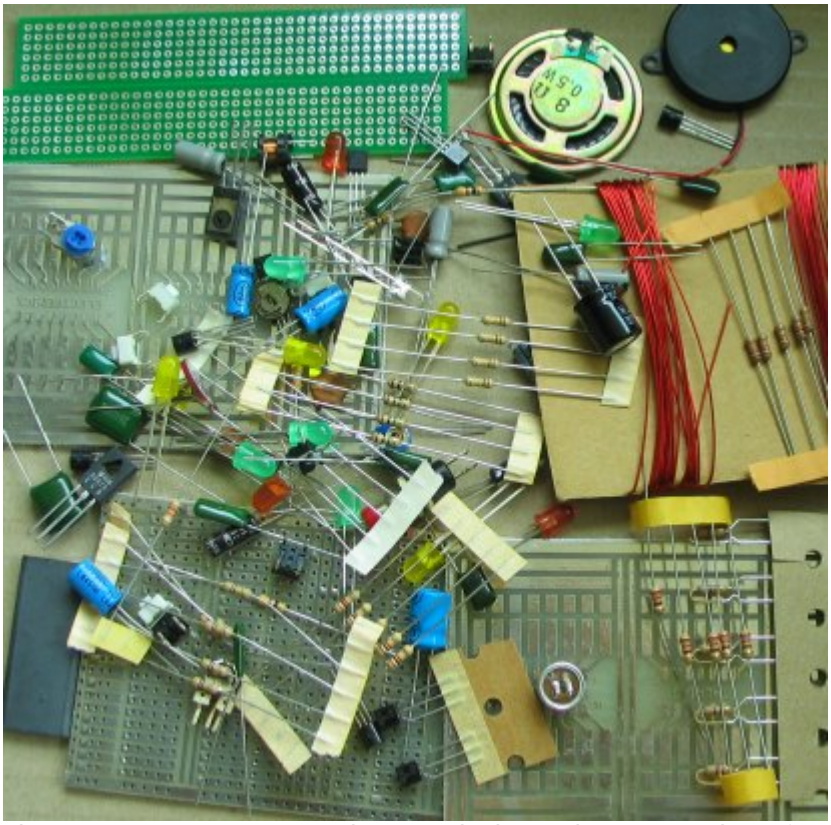

There are more components than you think. . . plus an extra bag of approx 30 components. The 8 little components are switches and the LDR and flashing LED is hiding.
In many cases, a resistor or capacitor not in the kit, can be created by putting two resistors or capacitors in series or parallel or the next higher or lower value can be used.

BEFORE WE START

Too many text books start with the physics of the atom and have equations and mathematics to show how smart the author is.
Don't worry, we wont have any physics or equations.
The reason . . .
This is not a physics course. It is a practical electronics course to teach the basics as quickly as possible. There are no equations because most transistor circuits cannot be worked out mathematically as the gain of a transistor changes according to the current-flow and these gain-values are never provided. So the mathematics is worthless.
To get an answer, all you have to do its build the circuit and measure the values with a multimeter.
Also lots of discussions in text books will never be used in your next 40 years of electronics, so this course doesn't have any unnecessary material and is much-more concentrated than anything you have read before.
Every frame contains important points - especially the animations - as they show you how a circuit works in slow-motion - something that has NEVER been done before.

ELECTRONICS BLOCKS

Here is an idea from Instructables to produce blocks with screws, containing a single component and they can be connected with jumper leads (alligator clips).

Use a slotted head for the negative screw and a philips head for the positive screw.

Learn electronics from the beginning . . .

START HERE:

	All electrical and electronic components need wire to connect them to the circuit. In a diagram called a CIRCUIT DIAGRAM, the wires are drawn as lines. When the wires (or lines) cross, they may be joined or just passing. It is **VERY IMPORTANT** to show the difference between lines that are **JOINED** and lines that are **NOT JOINED**. When the lines are joined, it is best to place a dot

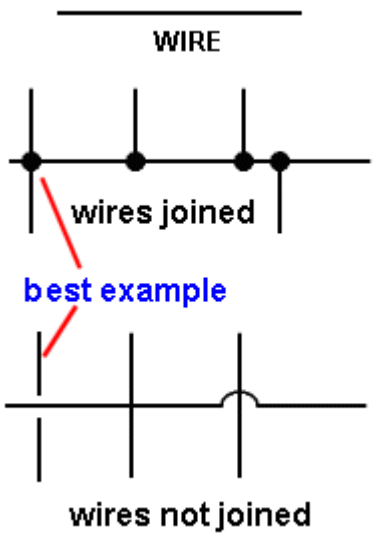

Fig 1 The wire in a circuit diagram

on the connection to PROVE the lines are joined. When the lines are just crossing, a gap should be made so it is obvious that one wire goes under the other and does not touch.
Lines should be "across the page" or "up and down." Very few lines should be at 45°.
You can make a line thicker to indicate a power rail or a wire that will be thick in reality.

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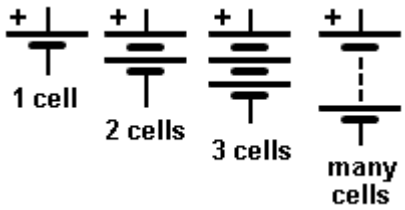

Fig 2 A single Cell and many Cells

Next we need a **battery**. A battery consists of two or more cells. The positive terminal of a battery is the long line in the diagram and you must add the voltage (of the cell or battery) to the symbol as a single cells can be 1.2v, 1.5v, 2.2v or up to 3.6v.
The symbol does not let you know the voltage.
The positive is always at the top and is the longest line on the battery symbol.

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Fig 3: A Globe

Next we need a globe. A globe has two connections (a fine wire inside a glass bulb glows when the globe is connected to a battery).

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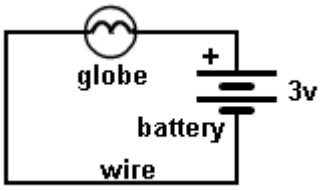

Fig 4: A Circuit

With a globe, battery and wire we have produced a **CIRCUIT**.
A **CIRCUIT** is a complete path and we say the "electricity" the **CURRENT** emerges from the positive of the battery, moves through the globe and returns to the battery via the wire.
If the globe is a "3v GLOBE" it will glow when connected to a 3v battery.
The globe can be connected either way around.
The circuit we have shown is called a **SCHEMATIC** and consists of symbols: a globe symbol and a battery symbol.
The line connecting the two components is called WIRE.

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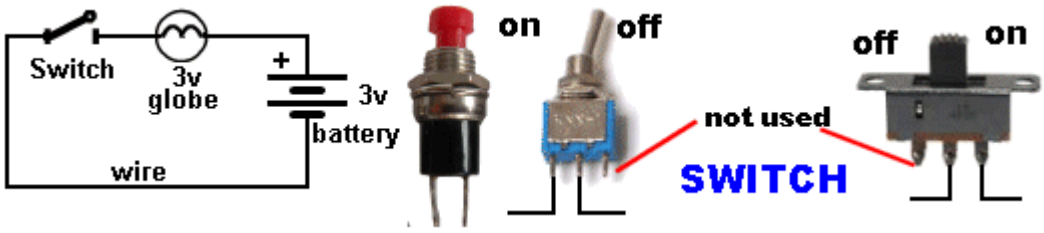

Fig 5:Adding a SWITCH
To turn the globe ON and OFF we need a SWITCH.
The switch may be a push button, a toggle switch (a "click" action) or a slide switch. You could

twist the wires together and untwist them. The result is the same. We say the circuit is "broken" or "open" via the switch and the lamp does not glow. Closing the switch turns ON the globe.

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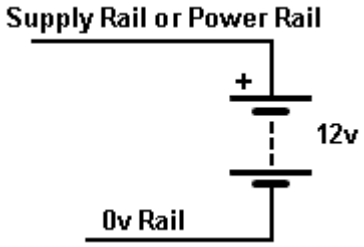

Fig 6: Naming the RAILS

The top rail of the **CIRCUIT DIAGRAM** is called the **SUPPLY RAIL** or **POWER RAIL**.
The lower rail is called the **0v Rail** or **EARTH RAIL**.
Do not connect the Supply rail (+12v) to the 0v rail as this will cause a high current to flow and is called a **SHORT CIRCUIT**:

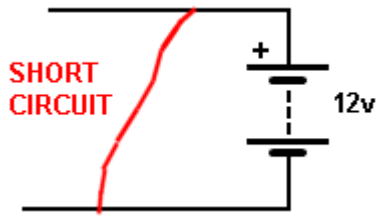

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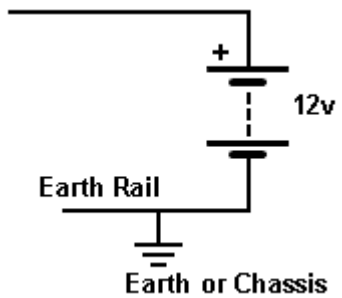

Fig 7: The **EARTH RAIL**

The lower rail is also called the **Chassis**.
This comes from the "old days" when electronics constructors build radios on a metal chassis (metal box) and it was connected via wire to a pipe in the ground to help the radio pick up distant radio stations.
The term also comes from car and truck wiring where one side of each globe is connected to the frame or chassis so that only one wire is needed to each globe and the return "path" is via the chassis.

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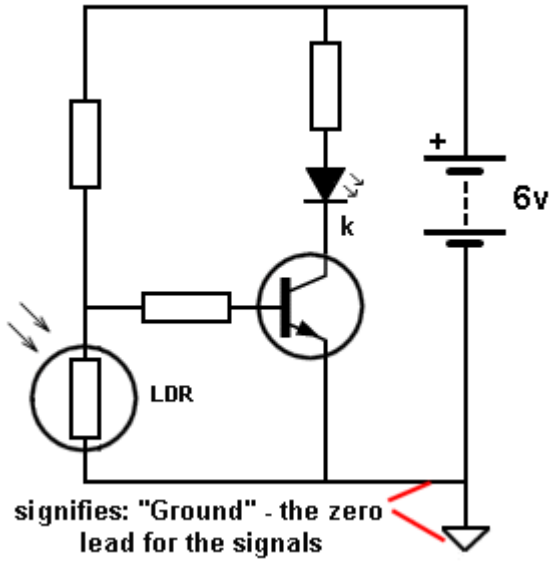

Fig 7a: Ground

Some circuits identify the "**Ground Lead**" or "**Ground Wire**" of a project to show where all the **signals** have been "referenced to." In other words, all the signals rise and fall above and below this "Ground wire" or "Ground Lead." This lead may not be at **earth potential** as the project may be in a plastic box but it identifies where the earth lead of a Cathode Ray Oscilloscope or the negative lead of a multimeter is connected.
On some printed circuit boards, the negative terminal of the battery (the 0v wire or terminal) is connected to a very large area of copper and this is called the EARTH PLANE or GROUND PLANE. It is designed to prevent signals travelling along the tracks (called traces) being radiated and also prevents outside interference upsetting the project. It also "tightens-up" the earth rail.

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The circuit shows a 12v globe connected to a 12v battery and the circuit appears to be "broken" (not continuous).
But the **current returns** via the earth connection.

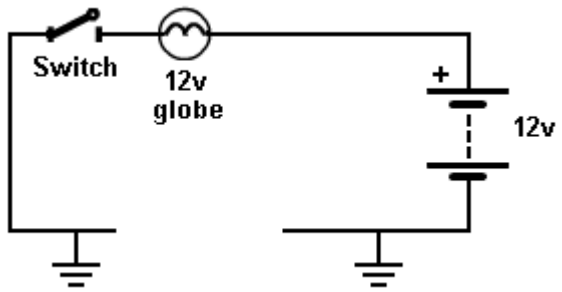

Fig 8: EARTH Return

We talk about the **CURRENT RETURNING**. We don't say: the voltage returning.
The voltage of the globe must be the same as the battery voltage, otherwise it will not glow fully or it will **burn out** if it is say a 6v globe.

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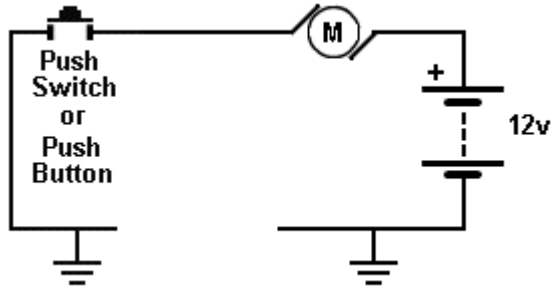

Fig 9: Connecting a Motor

The circuit shows a 12v **Motor**.
It is turned ON when the push-switch is pressed.

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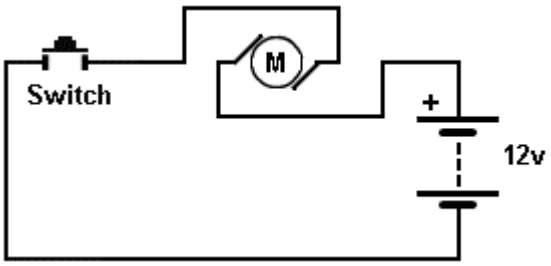

Fig 10: Reversing a Motor

If the wires are connected to the motor "around the other way," the motor will reverse direction.

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VOLTAGE AND CURRENT

What is voltage and what is current?
Here is a very simple description.
A battery produces a voltage called DC. (This is a very confusing name because the letter actually refer to Direct Current, so we just say **DC Voltage**).
A battery also produces current called DC - Direct Current. We say **DC current**.

VOLTAGE

Voltage is a value produced by an electrical component called a battery or cell.
A single cell produces one and a half volts. (1.5v) and although this is not a high voltage, when cells are connected together we get higher voltages.
If 6 cells are connected in series we get 9v.
Here is a 9v battery:

CURRENT

You cannot feel current with your tongue so we have to carry out another experiment:

Touch the two terminals with your tongue. You get a tingle. This is a 9v tingle. Now you have "felt" electricity. This is a 9v tingle.

Place a 22 ohm or 47 ohm resistor across the terminals of the battery and hold your fingers on the resistor. It will get hot. This is the result of current flowing through the resistor and heating it up. The current will be about half an amp and the voltage is 9v, so the wattage will be about 2 to 4 watts. Feel the heat produced.

Milli - milli means 1/1,000th (one thousandth) - such as one milliamp or one millivolt.
In other words one thousand milliamps is equal to 1 amp.
One volts is not a very large value as a battery produces 9v and a cell produces 1.5v to 3.6v (depending on the type of cell.
But 1 amp is a large quality when talking about electronic circuits involving LEDs, motors and transistors.
The globe used in the experiments above requires about 300mA. (1,000mA = 1 amp)
The 3v motor used in the experiments requires about 250mA
The LEDs used in the experiments require about 20mA.
Transistors can pass about 100mA to 800mA via the collector-emitter.
In most cases current-flow in the circuits we will be discussing will be less than 1 amp and will be shown as 25mA, 100mA, 350mA etc.

WATTAGE and CAPACITY

A 9v battery has 6 very small cells and they will not last very long.
A "AAA" cell is larger and a "D" cell is much larger.

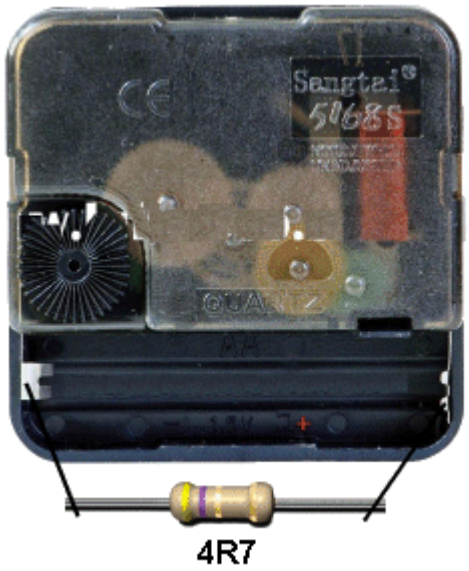

A large cell is said to have a **LARGE CAPACITY.** This means it will deliver a larger current for a longer period of time.
The **WATTAGE** of a cell is the multiplication of the voltage x current. The answer is milliwatts or watts.
The **CAPACITY** of a cell is the wattage x hours. The answer is milliwatt-hours or watt-hours. This is also called watt-hours.
You can determine the capacity of a cell (such as a rechargeable cell) by connecting it to a clock-mechanism that has a 4R7 connected across the terminals. The resistor will take a considerable current and deplete the cell in a few hours. The clock will let you know exactly how long the cell delivered the current. You can then compare other cells.

The simplest electrical circuit consists of a battery and resistor. The current flowing through the circuit will depend on the voltage of the battery and the resistance of the resistor R.

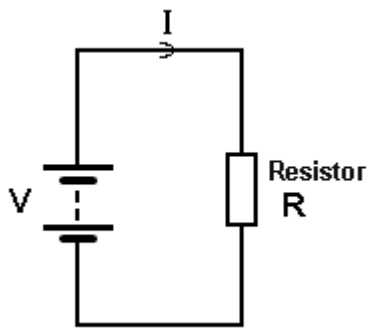

The formula connecting these three quantities is:

$$I = \frac{V}{R}$$

Ohm's Law

$$I = \frac{12}{3}$$

$$I = 4 \text{ amps}$$

This is called **Ohm's Law**. Suppose you have a 12v battery and the resistor is 3 ohms. The current flowing through the resistor will be 4 amps.
Increasing the resistance will decrease the current if the voltage remains fixed.

All the above circuits are called ELECTRICAL CIRCUITS because they contain electrical components (such as a motor, globe, relay, switch).
When the circuit contains an ELECTRONIC component such as a diode, transistor, LED, it is called an ELECTRONIC CIRCUIT or ELECTRONIC SCHEMATIC.

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POWER and ENERGY

Here's an easy way to remember the difference between POWER and ENERGY:
A 9v alkaline battery has enough ENERGY to start a car. But it does not have enough POWER (strength).
Energy is effectively the strength of the battery (and this is the voltage and the current it can deliver) multiplied by the time it can deliver this energy. When the answer is obtained, it consists of three factors ((3 quantities) VOLTS, AMPS and TIME.
This results in an answer called xxxx WATT-HOURS.
For a 9v battery the quantities are: 9 volts, 500mA and the battery will deliver this 9x0.5 = 4.5watts for about 1 hour. This is equal to 4.5 x 60 x 60 = 16,200 watt-seconds.
To start a car requires 250 amps from a 12v battery for 5 seconds.
This is: 12 x 250 x 5 = 15,000 watt-seconds.
This means the energy stored in a 9v battery could start a car if all the energy could be delivered in 5 seconds.
This is not possible however the FACT is this: A 9v battery has enough stored energy to START A CAR.

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BATTERY BOOSTER

One of the simplest things we can do is start a car with a flat battery with the assistance of a BATTERY BOOSTER.
This consists of a 12v rechargeable battery in a handy case with leads to connect to the flat battery in your car.
This simple operation puts two 12v batteries in parallel, but no-one has actually described what happens and why.
That's because the explanation is very complex. We have included it here to show that a simple explanation involves a lot of technical terms and you will understand more after reading the course.

The flat battery in the car is not fully charged but it has some percentage of charge and when it sits for a period of time in a non-fully charged condition, the voltage drops from 12.6v to less than 12v as the battery gradually self-discharges due to the potential at the top of the cell being different to that at the bottom of the cell and the specific gravity of the electrolyte being different at the top and bottom. This causes an internal current to flow within the cell and slowly discharge the cell. But if you try to start the car, the voltage drops to less than 7v because the electrolyte cannot carry the high current and a slight potential is developed across the liquid.

The result is the starter-motor does not crank the car.
The reason is this: When the battery is fully charged, the current taken by the starter motor is about 300 amps. This is about 11v x 300 amps = 3300 watts = 4.4Horsepower.
But when the voltage drops to 7v, the current will drop to 190 amps to deliver 1336 watts = 1.8HP. This is only 40% of normal and that's why the car does not start. The engine needs 4HP to overcome the pressure in the cylinders due to the compression of the air during the "firing stroke."
Let's put it this way. If we have a brand new 7v battery, the car will not start. The starter-motor will only accept 190 amps when the supply is 7v.
So, we have to increase the voltage.
We do this by placing a 12v battery across the flat battery. The voltage of the flat battery will immediately rise to 12.6v. It might take 2 minutes but the flat battery will take a small current (1 to 10amps) from the battery in the "booster" and the output of the combination will be 12.6v. The current-carrying capacity of the electrolyte will improve very quickly and you have effectively given the "flat battery" a very quick charge.
The starter-motor will now accept 300 amps from the combination and **SURPRISINGLY** the cells of the "flat battery" will deliver about 200 amps and the booster battery will deliver about 100 amps. The actual sharing of current will depend on the two batteries but the secret behind the success is the increase in voltage we call **TERMINAL VOLTAGE**. The voltage on the terminals (the alligator clips).
The capacity of the booster battery is not important. It can be from 7AHr to 40AHr. We are just using a very small amount of its capacity to start the car and nearly all batteries will provide 200 Amps for a short period of time.
The voltage of the car battery is very important. The Horsepower taken by the starter-motor is defined by the formula: Pwatts = V^2/R Since the resistance remains constant, a voltage of 7 volts will produce 7x7=49 units and a voltage of 11v will produce 121units. This gives the ratio of 40% to 100% as explained above.

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BATTERY BOOST

Continuing from the previous frame where we showed the effect of placing a weak battery in parallel with a good battery, we can show what happens when a weak cell is placed IN SERIES with a good cell.
This also applies when you have 5 good cells and one weak cell.
Basically, the weak cell will reduce the current. In other words, if the 5 cells are driving a motor and supplying 250mA, the 5 cells and 1 weak cell will deliver 200mA or less, depending if it is weak or very weak. The current flowing through the weak cell will have the effect of giving it a small charge - in other words, you will be charging the weak cell from the good cells when the motor is operating.

BUT . . . .

There is a way to use weak cells. If you have say 6 weak cells driving a motor and the RPM is reducing, you can add 2 more weak cells to increase the RPM.
The effect is this: The voltage from the 8 cells will be higher than from 6 cells and this will allow a higher current to flow. Sometimes the cells will provide this higher current and thus more of the energy will be delivered and you will get the last of the energy from the cells.

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INTERNAL RESISTANCE

All batteries and also all individual cells have a "secret, hidden" value of resistance inside each cell due to the resistance of the chemicals. This resistance is very small when the cell is new but it increases as the cell gets older.
It is very easy to measure this value. Simply put an ammeter directly across the cell and measure the current. Use Ohm's law to work out the resistance. But this not always a wise thing to do as some cells will deliver 10 amps and some will deliver 100 amps and damage the meter.
The diagram opposite shows a large internal resistance for the weak cell and a small internal resistance for the good cell.
If a cell did not have any INTERNAL RESISTANCE it would deliver thousands of amps. It's the Internal Resistance that limits the current.

In most cases we neglect (do not consider) the value of internal resistance when making tests and when using a battery in a project.
But when a battery gets old, it cannot deliver a high current and the internal resistance gets so high that the output voltage drops from say 9v to 7v, even when the battery is not connected to a circuit.
This is the result of the INTERNAL RESISTANCE of the chemicals increasing to a point where they become noticeable and what we call "poisoning" of the chemicals due to the cell "aging" and new chemicals being produced in the cell that have a high resistance. Some of the terms we use are: "drying out and sulphating. Some cells produce spikes or needles that completely short-circuit the cell and make it totally useless.

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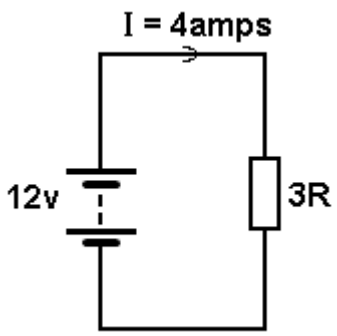

This resistor is dissipating 48 watts.
As a comparison, a soldering iron is dissipating about 10 to 20 watts.

RESISTOR WATTAGE

Resistor Wattage means two things.
1. The physical size of a resistor tells you number of watts it is capable of dissipating. This is called RESISTOR WATTAGE. It is really RESISTOR-SIZE or RESISTOR-CAPABILITY.
2. The multiplication of the voltage across a resistor and the current flowing though it will produce a value called WATTAGE. This is also called RESISTOR-WATTAGE or RESISTOR-LOSS or RESISTOR-DISSIPATION or HEAT-LOSS.
In the circuit shown, the wattage being lost in the resistor is: 12 x 4 = 48 watts.
Most of the resistors we will be using in our projects are 0.25watts. This means they will dissipate 250milliwatts, however the actual wattage being dissipated may be only 70 milliwatts and the resistor will not get hot.
0.25watts is the maximum wattage it can dissipate without overheating.
If it is dissipating 400milliwatts, it will be VERY HOT.
The wattage it is dissipating (the heat it is getting rid of) will depend on the supply voltage and the value of the surrounding components.

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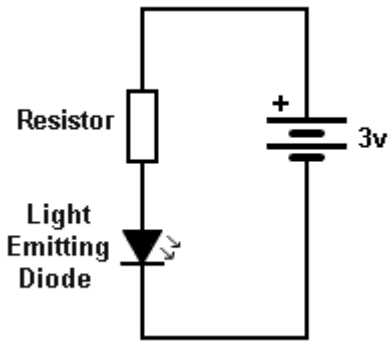

Fig 11. The LED

This simple **ELECTRONIC CIRCUIT** contains a **LIGHT EMITTING DIODE (LED), RESISTOR** and battery.

The circuit is classified as electronic because the LED is not an electrical item (such as a globe) but more-complex, as it produces light when current flows through a crystal and the crystal produces the colour.

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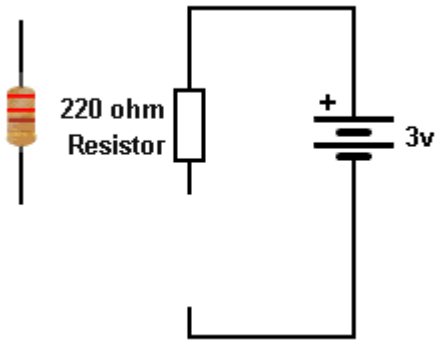

Fig 12. **The Resistor**

A **RESISTOR** must be included in the circuit to prevent the LED being damaged.
The resistor in this circuit must be 220 ohms.
This is shown by the colours on the resistor. The colours for 220 ohms: **red - red - brown**. The 4th band is gold - indicating a tolerance of 5%.
A resistor has **RESISTANCE**.
It reduces the current from the battery to a required amount to prevent the LED glowing too bright.
A resistor is just like putting your foot on a hose. The water trickles out the end. The resistor "resists" the high current-flow that the battery is able to deliver.

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Fig 12a. The **Resistor Colours**

There are hundreds of different resistors because the resistance-values need to cover the range one ohm to 10 million ohms.
There are also small, medium and large resistors. The resistors on the left are just a few in the range. (See the full range below). They show colour bands for 1 ohm to 8.2 ohms and 1 million ohms to 8.2 million ohms. All the other values are shown below.
An electronics engineer does not have the room to store 10 million different resistors so they make each resistor 5% or 10% higher than the previous. This reduces the number to about 100 to 200.

TOLERANCE

The first 3 bands indicate the value of the resistor and the 4th band indicates either 5% or 10% tolerance.
All modern resistors are 5% or 2% or 1%. The "old" 10% resistors are no longer made.
Gold = 5%
Silver = 10%

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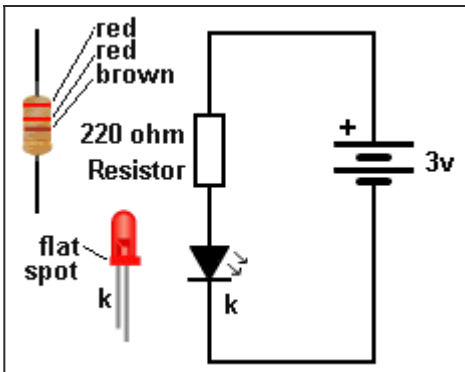

Fig 13. The **Resistor and LED**

The **LIGHT EMITTING DIODE** is called an electronic component (mainly because it is more complex than a globe and it produces light by a more-complex means than heating a wire).
A **LED** must be connected around the correct way. It will not illuminate if connected around the wrong way.
All **LEDs** have one lead longer than the other. The SHORT lead is called the **CATHODE** (k).
All LEDs have a flat on one side and this is the **CATHODE** lead.
The arrows on the diagram indicate light is "given off" (emitted - produced).

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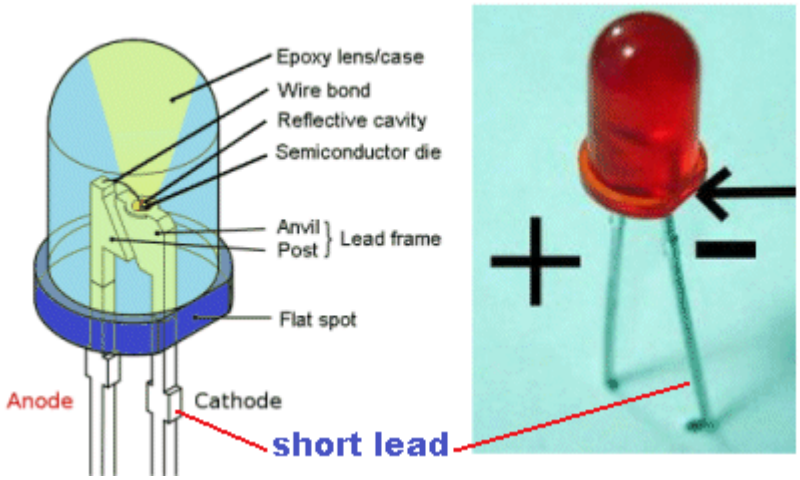

Fig 14. The **LED - showing the flat spot**
A close-up of a red LED. The cathode lead is the short lead and next to a flat side on the LED.
DO NOT show "+" or "-" on a diagram. Only show the letter "k" to indicate cathode.
The symbols "+" and "-" are used when a component produces a voltage or is connected directly to "+" and
"-" A LED is connected via a resistor.

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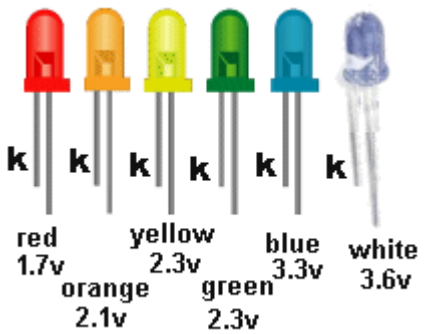

Fig 15. LED VOLTAGES

When a LED is connected to a circuit, (and the correct-value resistor is included), a voltage will be develop across the LED called the **CHARACTERISTIC VOLTAGE DROP**.
This voltage is due to the colour of the LED and the crystal inside the LED that produces the colour.
The diagram on the left shows the approximate voltage developed for each LED.
The voltage **does not change** for small, medium, surface-mount, or large LEDs.

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When a LED is connected to 3v battery, the following **CHARACTERISTIC VOLTAGE DROPs** will develop across each LED.
You will notice we **have not changed** the value of the resistor. It is 220R.
The LED creates the voltage and if the value of resistance is decreased, the LED will illuminate BRIGHTER.
If the LED illuminates too bright it will be DAMAGED.

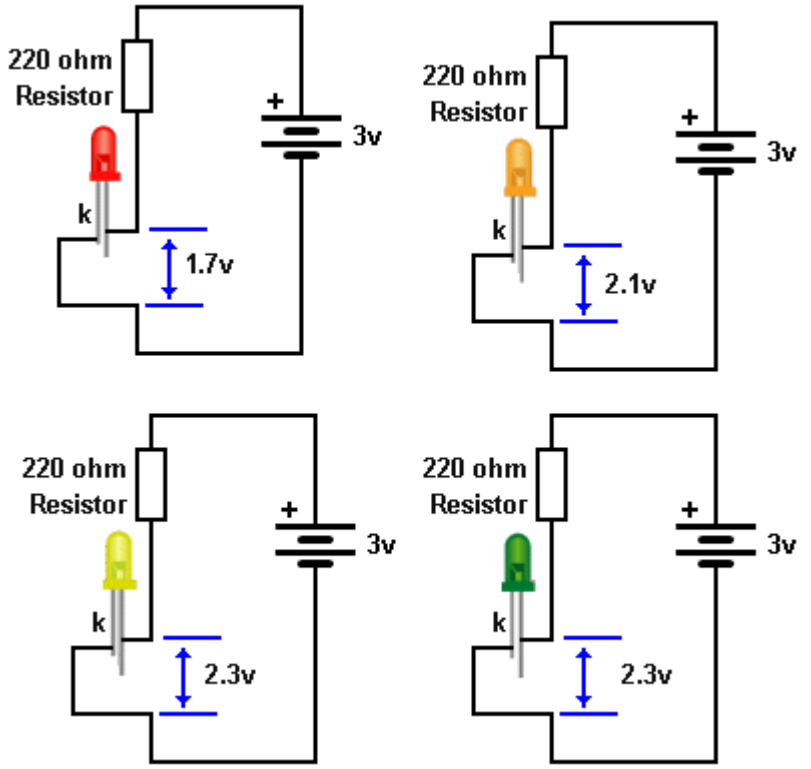

Fig 16. LED VOLTAGES

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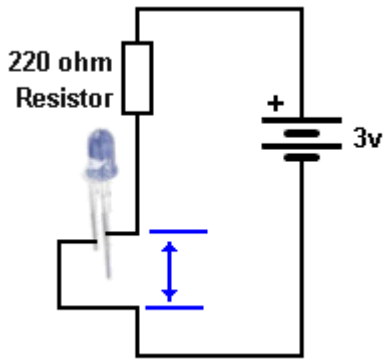

Fig 17. WHITE LED VOLTAGE

If we connect a WHITE LED to 3v supply, it will not illuminate because it needs a supply higher than 3.6v.

The resistor in series with the LED is called a **CURRENT LIMITING RESISTOR**.

In this circuit **no current flows** because the supply is not high enough.

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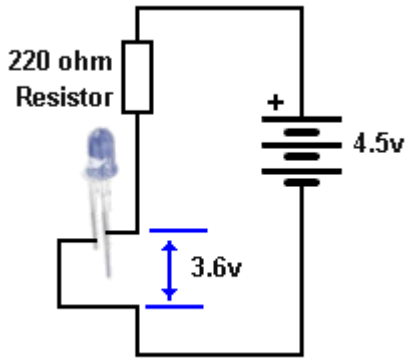

Fig 18. WHITE LED VOLTAGE

When the supply is increased to 4.5v, the 220R resistor will allow a current to flow through the white LED and it will develop a CHARACTERISTIC VOLTAGE DROP of 3.6v across it.

The supply (the voltage of the battery) must be higher than the CHARACTERISTIC VOLTAGE DROP of the LED so the resistor will allow the correct amount of current to flow.
The ideal current for a LED is 20mA, however some LEDs will work when 1mA flows, so you have to know what you are doing.

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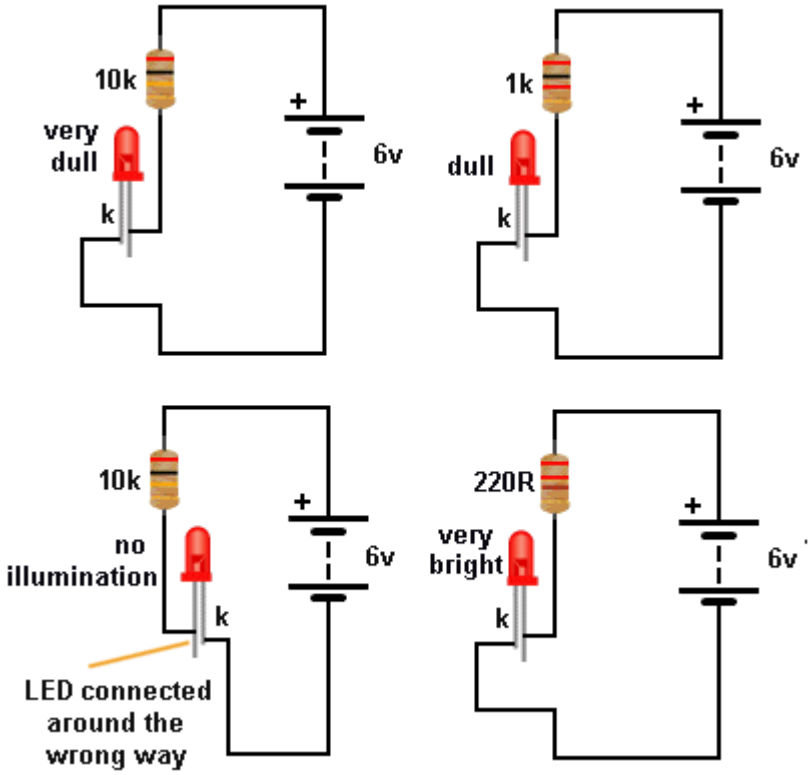

Fig 19. Testing A LED

Now connect either the 1k, 470R or 220R and determine the brightness you need.
As the brightness increases, the current will be higher.
You can use 3v supply for all LEDs except blue and white.

HOW TO TEST A LED

Some clear LEDs produce red or orange and some LEDs do not have the cathode lead clearly identified.
Here's how to find the colour, cathode lead and the current.
You need a 6v battery, 10k resistor, 1k resistor, 470R resistor and 220R resistor.
Connect the 6v battery and 10k resistor to the LED and it will only illuminate when the cathode is connected to the negative of the battery. This is the short lead.

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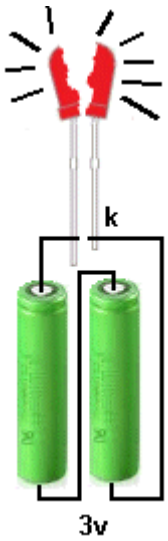

Fig 20. Damage a LED

Do not connect a 3v battery directly across a LED.
It will be DAMAGED. You MUST include a resistor.

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A LED IS CURRENT DRIVEN

You may have seen this statement and tried to work out what it means.
Basically it means an increase in current will make the LED brighter.
But a LED needs 2 things:
It needs a voltage that is EXACTLY the voltage required to produce illumination. And this voltage depends on the colour of the LED.
As soon as you supply the exact voltage, the crystal will begin to glow and as you increase the current, the illumination will increase.
But doing this is VERY VERY difficult.
It is very easy to supply an exact voltage such as 1.7v or 3.4v, but delivering a current such as 10mA or 20mA at the same time is very difficult. You cannot get a 1.7v battery and deliver 10mA to a LED.
As we have shown above, you need a simple components such as a resistor between the battery and LED to achieve the desired result.
A LED is CURRENT DRIVEN but firstly you need to provide a VOLTAGE that is exactly the connect value for the colour of the LED and then the current can be increased.

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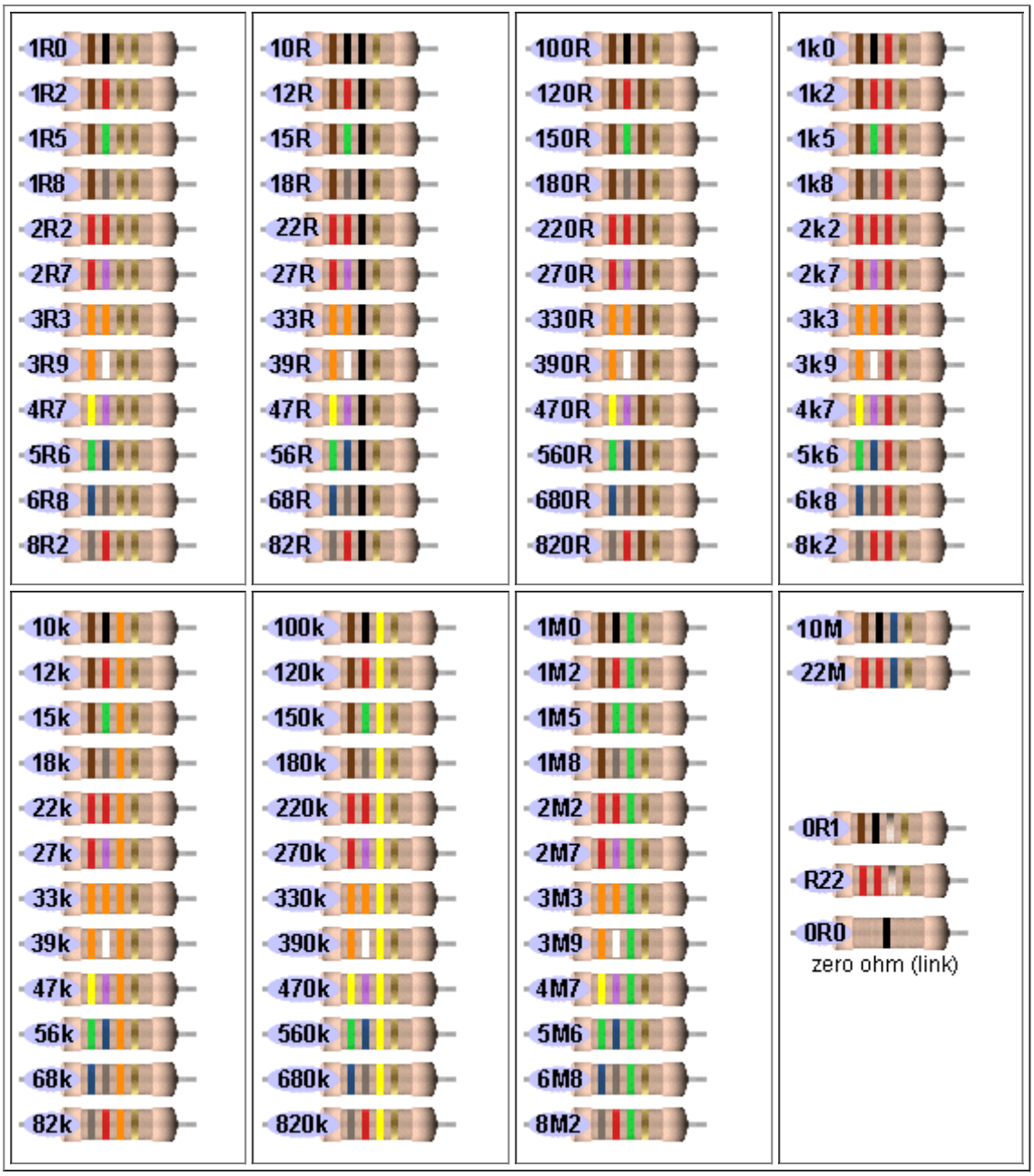

Fig 21. All the resistor values

Here are all the colours and values for the resistors you will using in this course. Just match-up the

colours on your resistor with the resistors above and you will find the value.

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Resistor values are always OHM values. One ohm is a small value. It might be the resistance of a length of wire 3 metres long.
When a switch is open the resistance is infinite - millions and millions of ohms.
The resistance of your body from one hand to the other will be about 70,000 ohms.
The resistance between two wires dipped in water will be about 1,000 to 100,000 ohms (depending on the dissolved-salts in the water - pure water has a very high resistance)
The resistance of the filament of a 3v globe will be about 30 ohms.
The resistance of the winding of a 3v motor will be about 3 ohms.
Resistors are made with values from less than one ohm to more than 10 million ohms by adding carbon to the mixture inside the resistor (and cutting a track around the outside of the resistor) then connecting a lead to each end. Adding more carbon reduces the value of resistance.
Carbon has a low resistance.
Resistance-values are measured with the RESISTANCE settings on a MULTIMETER.
This is called the "Ohms Range." Sometimes with the symbol: Ω
A Multimeter will have 2, 3 4 or more scales to cover the range one ohm to 10 million ohms.
Low value resistors (from 1 ohm to 999 ohms) are written as 1R, 220R, 470R, 999R. with the letter "R" indicating Resistance (ohms). You can also use the symbol "omega" **(Ω)**
For values above 1,000 ohms to 99,999 ohms, they are written as: 1k, 2k2, 4k7, 10k, 100k, 220k, 470k, with the letter "k" indicating "kilo" (thousand).
1M = 1,000,000 - one million ohms 1M2, 2M2, 4M7, 10M.
The letters "R, k and M" are placed so they take the place of the decimal point. This prevents any mistake, as a decimal point can be missing in a poor photocopy.

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MULTIMETERS

There are two types of **MULTIMETER**. The top two are called **DIGITAL MULTIMETERS** (DMM) and show numbers on a display.
The lower two meters are called **ANALOGUE MULTIMETERS** and have a pointer and scale.
All meters come with a set of red and black leads.

The **red lead** is always connected to the positive of the battery or the positive on a project and the **black lead** is connected to the negative or earth or chassis.
When making a resistance measurement, the leads can be around either way.
Resistance measurements are always made with the power removed from a circuit. Any voltage on a circuit will upset the resistance reading.

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Fig 22. Resistance Measurement with Analogue Multimeter

The resistance of a resistor is measured by placing the leads of the multimeter on the ends of a resistor and turning the dial on the analogue multimeter to the resistance scale to make the pointer move to about the centre of the scale.
The resistance scale is marked with a high value on the left and 0 ohm on the right.
This is opposite to all the other scales.
You must get the pointer to move to the middle of the scale as it is not accurate at left-end.
Analogue multimeters are only suitable for reading values from 1 ohm to 100,000 ohms. The scale is too hard to read above 100k.
To find the value of a resistor, you can compare the colours with the table above.

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Fig 23. Resistance Measurement with a DMM

A digital multimeter produces a more-accurate reading of resistance.
It is accurate from 1 ohm to 10M ohms.
Select the scale that provides a reading.

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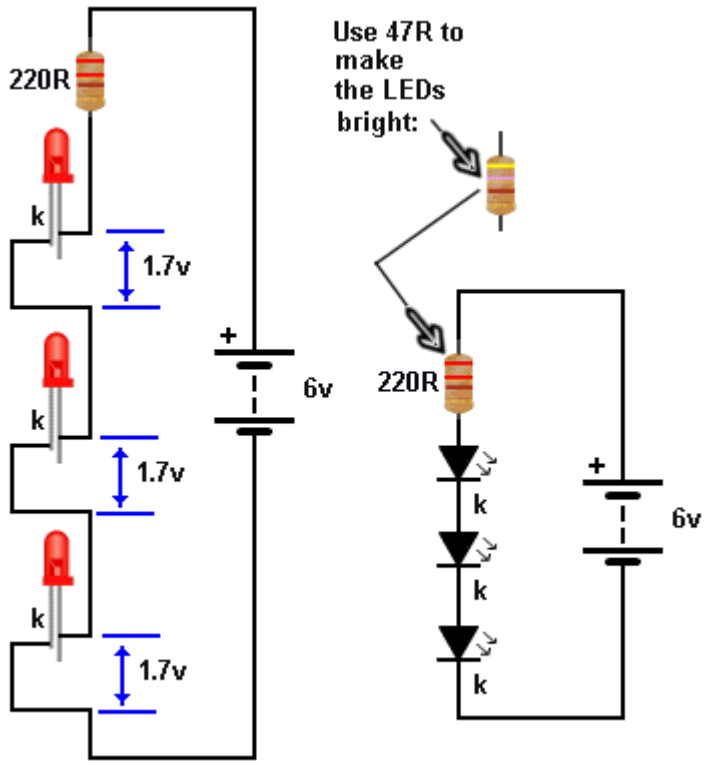

Fig 24. Connecting **LEDs in series**
LEDs can be placed in series provided the total **CHARACTERISTIC VOLTAGE DROP** across the LEDs is LESS than the supply voltage.
In this case the voltage across the LEDs is 1.7v + 1.7v + 1.7v = 5.1v
The supply is 6v and this allows 0.9v for the CURRENT LIMITING RESISTOR.
The LEDs will not be very bright with 220R.
Change the resistor to 47R
If you connect 4 LEDs in series, the total **CHARACTERISTIC VOLTAGE DROP** will be 6.8v and no LEDs will illuminate because the total is higher than the 6v supply.

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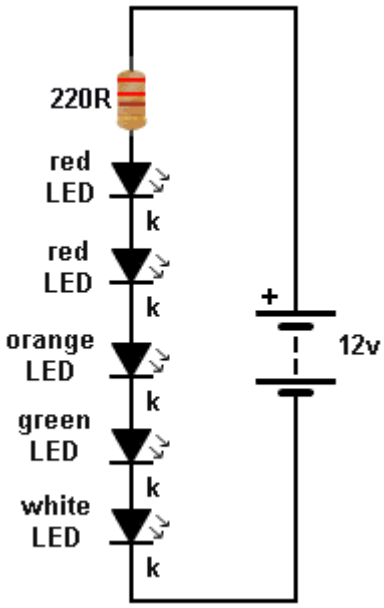

Fig 25. Connecting LEDs in series

Different-colour LEDs can be connected in series. Add up the total Characteristic Voltage for the 5 LEDs and see if it is less than 12v.

The 220R resistor will have to be reduced to 47R to make the LEDs bright.

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LEDs can be connected in parallel if they are the

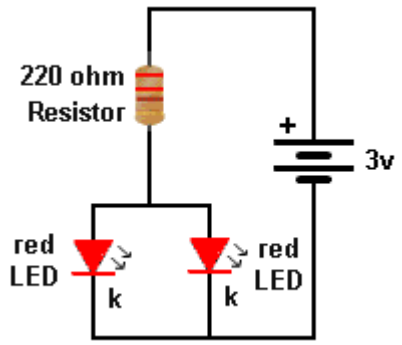

Fig 26. Connecting LEDs in parallel

same colour.
In the diagram a red LED drops a CHARACTERISTIC VOLTAGE of 1.7v and if they are from the same manufacturer or the same batch, they will work ok.
Although we say the characteristic voltage for a red LED is 1.7v, this can change slightly from different manufacturers and one LED may glow brightly while the other is dull.
You have to build the circuit and see the result.

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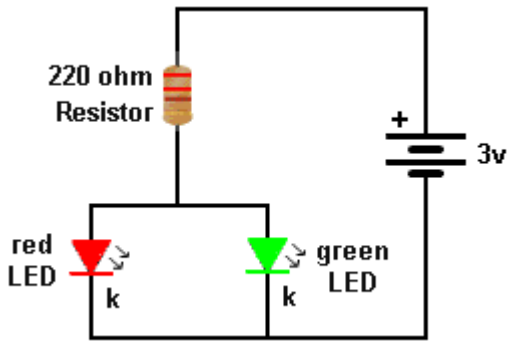

Fig 27. Connecting LEDs in parallel

Different colour LEDs cannot be connected in parallel. The voltage across a red LED is 1.7v. This becomes the "Supply Voltage" for the green LED and it is too low. The green LED needs a supply of 2.1v to 2.3v.
Only the red LED will illuminate.

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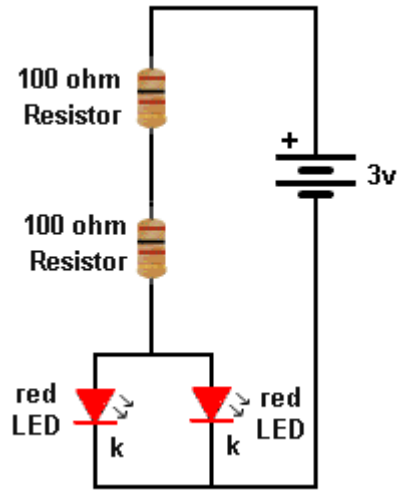

Fig 28. Connecting Resistors in Series

Suppose you don't have a 220 ohm resistor.
You can make a 220 ohm resistor with two resistors in series. The total resistance will be 200 ohms, but resistors are not accurate and the result will be very close to 220R.
Electronic circuits are not very critical. You will not be able to see the difference in brightness between 200 ohms and 220 ohms.

When resistors are connected in series, the total resistance is found by adding the resistance of each resistor.

$$R_{total} = R_1 + R_2 + R_3 + \cdots$$

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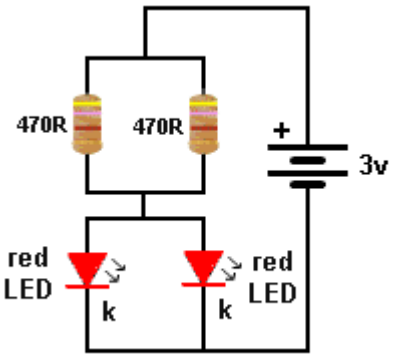

You can create a 220 ohm resistor by connecting two resistors in Parallel.
When two equal-value resistors are connected in Parallel, the total resistance across the combination is HALF.
470R in parallel with 470R produces 235R.
This is very close to 220R.
We are not going into the formula as it is very complex.
Three equal-value resistors in parallel produce a total of **one-third.**
Simply get two resistors and connect them in

Fig 29. Connecting Resistors in Parallel

parallel and measure them with a multimeter.

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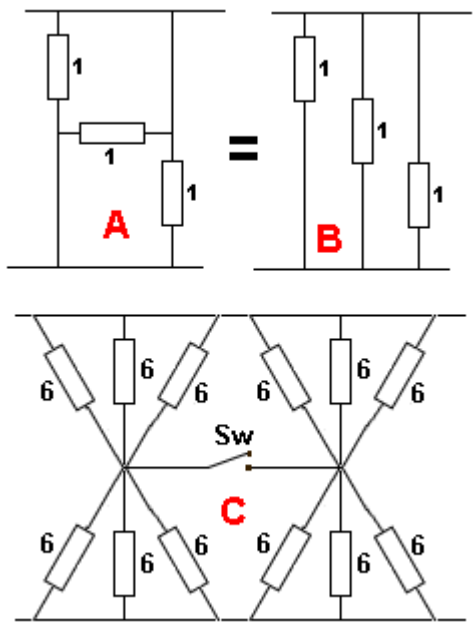

Fig 29a. Two tricky resistor questions

Figure **A** shows three resistors. It looks hard to solve so the middle resistor is turned so it connects directly to the top and bottom rail. Now you can see the circuit is three resistors in parallel. The result is one-third of an ohm.

Figure **C** shows twelve 6 ohm resistors. Replace each group with a 2 ohm resistor, because three 6 ohm resistors in parallel is equal to 2 ohms.

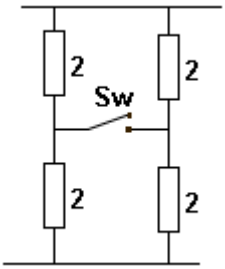

The two left resistors create 4 ohms and the two right resistors create 4 ohms. The result of two 4 ohm resistors in parallel is 2 ohms.
The resistance of the circuit does not change if the switch is open or closed.

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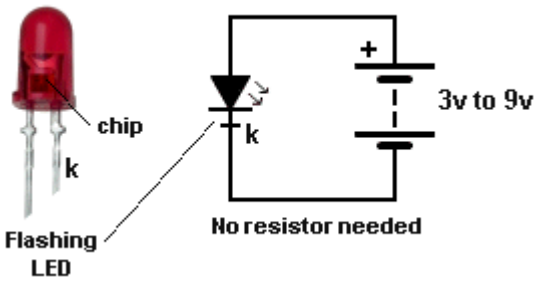

Fig 30. Flashing LED

There are some special LEDs that can be connected to 3v to 9v and they flash or produce a range of colours.
These LEDs have a chip and resistor inside the body of the LED to produce the effect and allow the LED to operate on a voltage without the need for a current limiting resistor.

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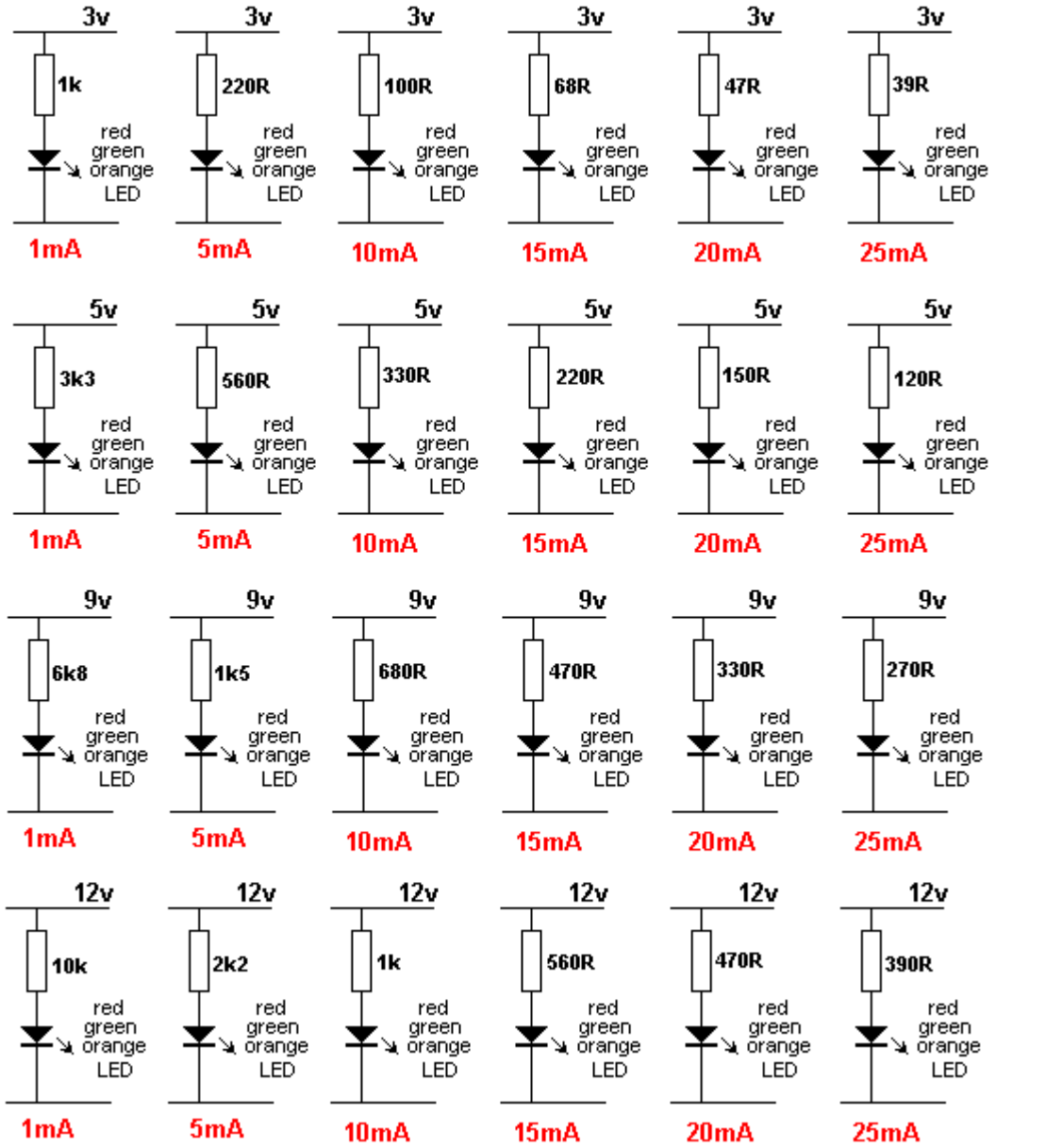

Fig 31. These diagrams show the resistor needed to produce 1mA to 25mA current through a single LED on 3v, 5v, 9v and 12v supply.

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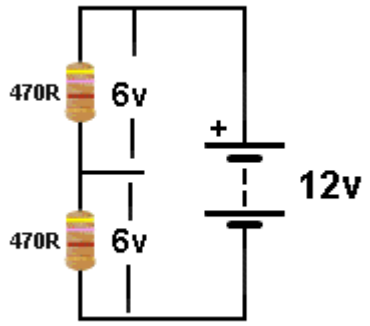

Fig 31a. Voltage Divider Circuit.

THE VOLTAGE DIVIDER

In the circuits above, the resistor and LED are forming a VOLTAGE DIVIDER.
A red LED is dropping 1.7v across it and the resistor is dropping the remaining voltage.
Whenever two (or more) components are placed across a battery, they form a **VOLTAGE DIVIDER**.
Sometimes we want a 6v supply and only have 12v.
We can produce the 6v supply by putting two equal-value resistors across the 12v as shown in the circuit opposite.
We are not going into the mathematics because the selection of the correct value is very complex and the circuit is very wasteful.

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THE CURRENT DIVIDER

The **CURRENT DIVIDER CIRCUIT** is actually a

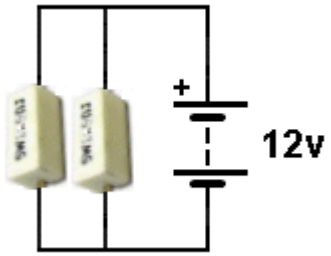

Fig 31b. Current Divider Circuit.

LOAD SHARING CIRCUIT.
Suppose you are testing a Power Supply and need a 10 watt LOAD. But you only have 5 watt resistors.
Placing two 5watt resistors in parallel across the output of the power supply will allow half the current to flow though each resistor. This is called **CURRENT SHARING** or **LOAD SHARING** and the current is divided (or passed) through each resistor according to the value of resistance.

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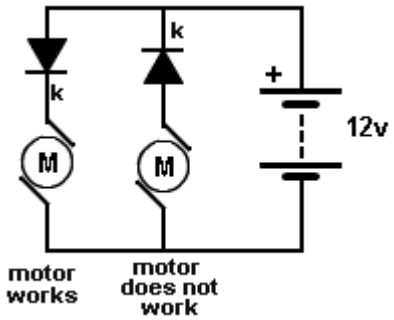

Fig 32. The DIODE

THE DIODE
The next simple electronic component is the **DIODE.**
It only works when connected correctly.
A DIODE allows current to flow through it when it is connected as shown in the diagram.
A Diode is similar to a one-way water valve.
When the diode is "facing down," the motor spins.
When it is "facing up" the motor does not spin.

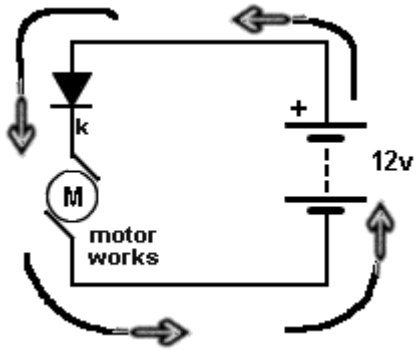

The diagram shows the "current path" around the circuit. The current is measured in AMPS and we discuss current as CONVENTIONAL CURRENT. This is the way current was thought to flow when electricity was born and they said it flows out the POSITIVE TERMINAL of the battery, around the circuit and into the NEGATIVE TERMINAL.
The arrow on the diode shows the current will flow through the diode and allow the motor to spin.
The diode is said to be **FORWARD BIASED**.

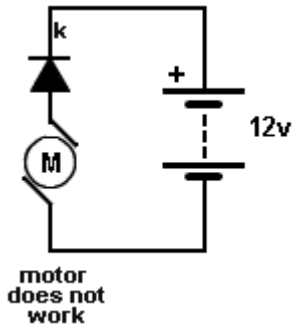

There is no flow of current because the diode prevents any current-flow when connected as shown.
The motor DOES NOT WORK.
The diode is said to be **REVERSE BIASED**.

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There are hundreds of different types of diodes.
Power diodes, signal diodes, low voltage diodes, high voltage diodes, high-speed diodes and many other types.
They all do one thing.
They pass current in one direction and if turned around, they **do not pass** any current.

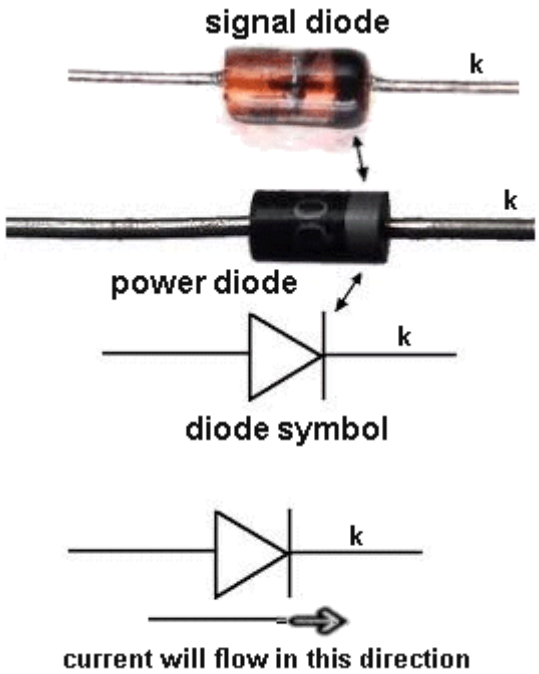

Fig 33. **A Signal diode and a Power diode**

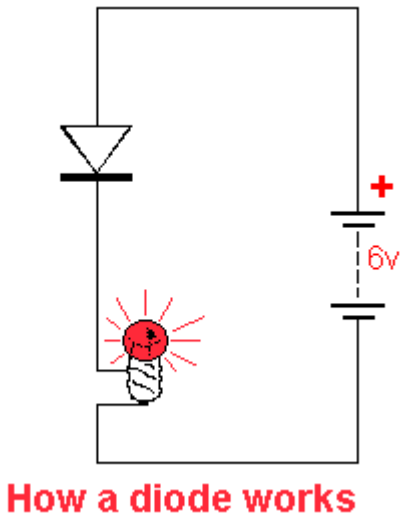

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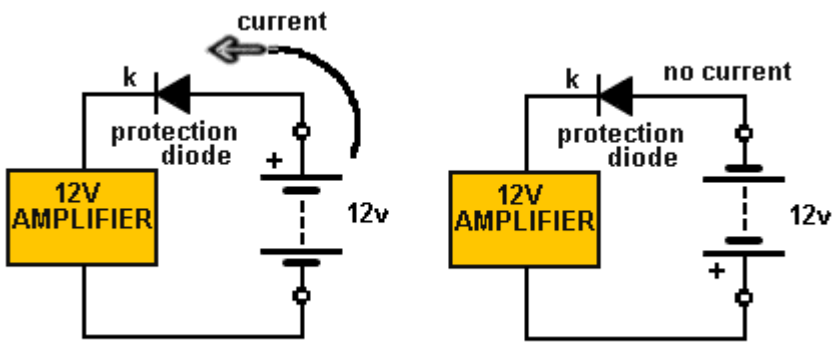

Fig 34. A Protection diode

Diodes perform many function in electrical and electronic circuits. Here is an application as a **PROTECTION DIODE.**
It protects the amplifier. If the 12v battery is connected around the wrong way, no current will flow.

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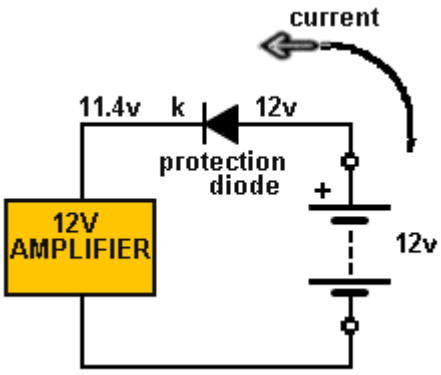

Fig 35. Diode "Voltage Drop"

When a diode is placed in a circuit (and current is flowing), a small voltage develops across the diode. This voltage is called the **FORWARD VOLTAGE DROP.**
This voltage is approximately 0.6v.
This is due to a junction inside the diode where two different materials are joined.
Normally, this voltage is not important because it is only small, but sometimes you need to take it into account.
For the circuit above, the amplifier only gets 11.4v

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Voltage is measured with a

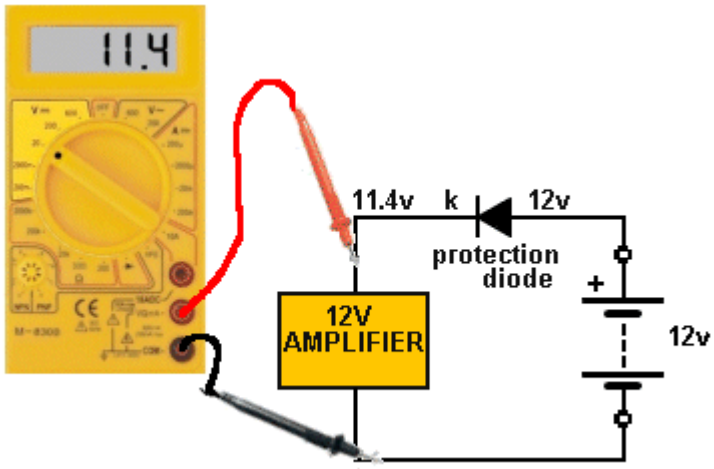

Fig 36. Measuring Voltage with a Digital Multimeter

VOLTMETER.
Multimeters have 2 or 3 voltage ranges so you can measure low voltage (0v to 20v), medium voltages (0v to 200v and high voltages (0v to 500v).
A voltmeter is placed across the component being tested, as shown in the diagram.
The Digital Multimeter is detecting 11.4v across the amplifier.

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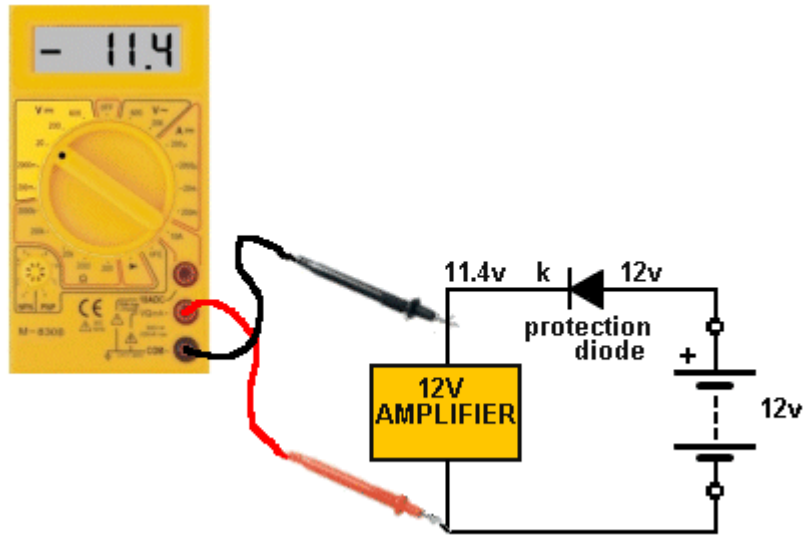

Fig 37. Measuring Voltage with a Digital Multimeter

If you place the probes of a digital multimeter around the wrong way on a component, the display will show a "-" The meter will not be damaged.

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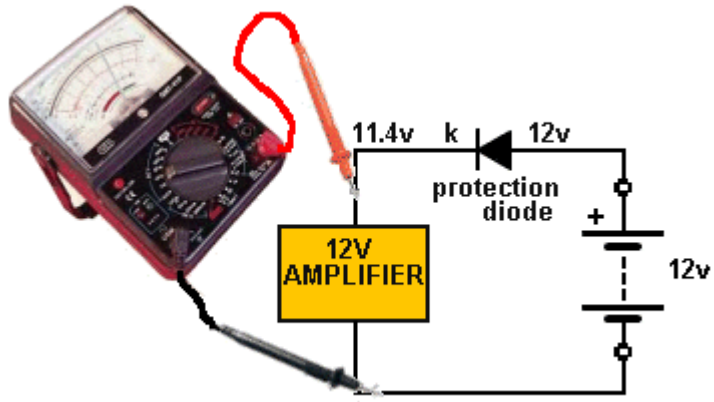

Fig 38. Measuring Voltage with an Analogue Multimeter

An analogue Multimeter must be connected around the correct way to make the pointer move "up scale."
Select the range that will allow the pointer to show somewhere in the middle of the scale.

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Current is measured by

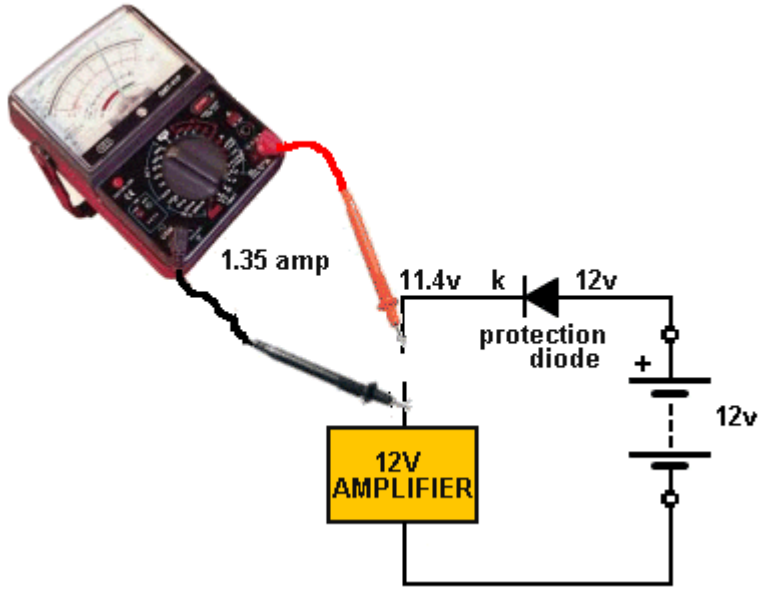

Fig 39. Measuring Current with an Analogue Multimeter

"breaking into the circuit" and inserting the leads so the positive probe is closest to the positive of the battery.
If you connect the leads around the other way, the needle will not move but it will hit the "end stop" and you may have to "bump" the meter to get the pointer to move from its jammed position.

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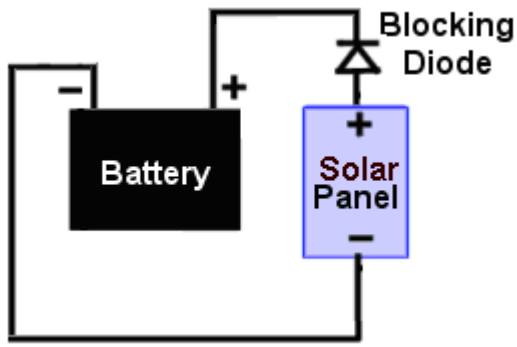

Fig 39a. The Solar Panel and the Blocking Diode

A DIODE is also used with a solar panel to prevent the battery discharging into the solar panel when the sun is not shining.
When the solar panel is not receiving any light it becomes a resistor with a large value and a small current can flow through it from the battery. The diode prevents this current-flow. The diode is called a **BLOCKING DIODE**.

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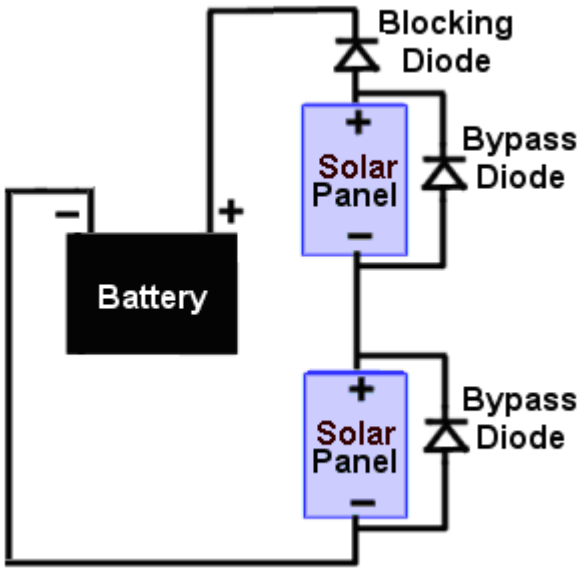

Fig 39b. The Solar Panel with diodes

Diodes are given different names, according to their function. They all perform the same job by passing current in one direction and prevent current-flow in the opposite direction.
When the top solar panel is shaded by a cloud, it generates less current and this will reduce the current into the battery.
By placing a diode across the panel, the diode will pass the current produced by the lower panel to the battery.
These diodes are called **BYPASS DIODES.**

called BLOCKING DIODES and BYPASS DIODES.

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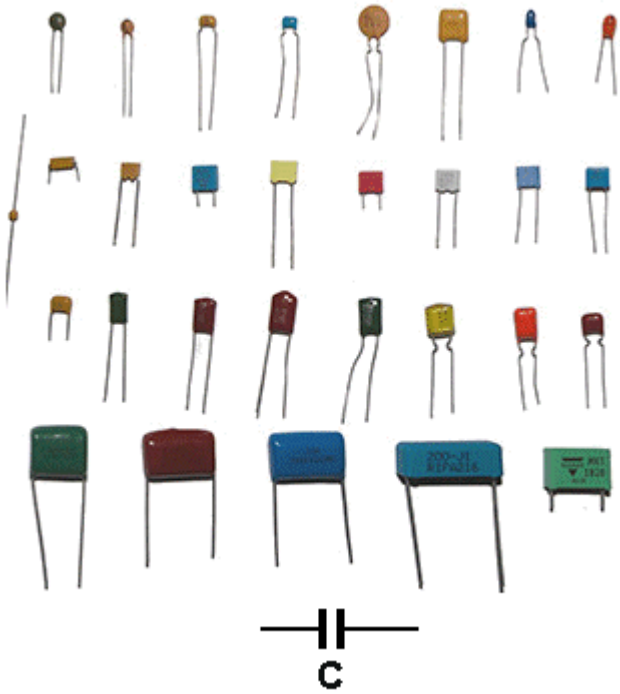

Fig 40. Capacitors and symbol

The next component we cover is the **CAPACITOR**.
There are thousands of different types of capacitor.
Each value of capacitor can have a low voltage rating, medium voltage or high voltage.
Capacitors can be very small in size and shape or very stable with temperature-rise or simply very cheap to make.
A capacitor consists of two thin sheets of metal such as aluminium with a thin sheet of plastic between.
The sheets may be rolled up in a cylinder or laid on top of each other.
The fact is this: the top sheet of metal does not touch the bottom sheet. This is shown in the symbol.
The resistance between the two terminals is INFINITE.
The 6th capacitor in the top row is called a **MONOBLOCK**.

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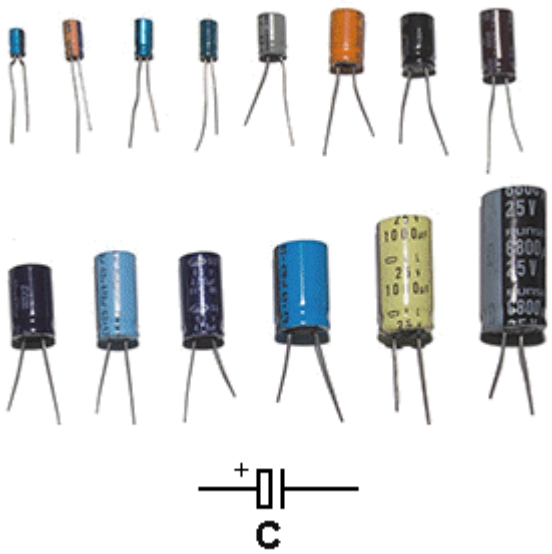

Fig 41. Electrolytic Capacitor

A capacitor gets bigger as its value increases.
It also gets bigger when the voltage-rating increases.
The basic unit of capacitance is the FARAD. A one-farad capacitor would be the size of a house. To make the capacitor smaller the sheets are etched to increase the surface-area and different insulating materials are used between the sheets.
The result is a capacitor called an **ELECTROLYTIC**. It is a bit like a rechargeable battery. It stores a lot of energy in a small space.
The negative lead is shorter and has a black stripe on the side of the electrolytic.

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One FARAD is too big to handle. We use smaller values.
The middle of the range is one microfarad. This is written as 1u. (sometimes you see uF)
This is one-millionth of a FARAD.
The smallest value of capacitance is one picofarad. This is one millionth of a microfarad.
It is written as 1p.
Capacitors are broadly separated into two groups. 1p to 1u and 1u to 100,000u
Capacitors 1p to 1u are ceramic, polyester, air, styroseal, monoblock and other names.
Capacitors 1u to 100,000u are electrolytic or tantalum. A tantalum is the same as an electrolytic - for testing purposes - it is a more-compact electrolytic.

1 microfarad is one millionth of 1 farad.
1 microfarad is divided into smaller parts called nanofarad.
1,000 nanofarad = 1 microfarad
Nanofarad is divided into small parts called picofarad
1,000 picofarad = 1 nanofarad.

Recapping:
1p = 1 picofarad. 1,000p = 1n (1 nanofarad) 1,000,000p = 1u
1,000n = 1u (1 microfarad)
1,000u = 1millifarad
1,000,000u = 1 FARAD.

Examples:
All ceramic capacitors are marked in "p" (puff")
A ceramic with 22 is 22p = 22 picofarad
A ceramic with 47 is 47p = 47 picofarad
A ceramic with 470 is 470p = 470 picofarad
A ceramic with 471 is 470p = 470 picofarad
A ceramic with 101 is 100p (it can also be 100)
A ceramic with 102 is 1,000p = 1n
A ceramic with 223 is 22,000p = 22n
A ceramic with 104 is 100,000p = 100n = 0.1u A common 100n is called a **MONOBLOCK**.
A ceramic with 105 is 1u

TYPES OF CAPACITOR
For testing purposes, there are two types of capacitor.
Capacitors from 1p to 100n are non-polar and can be inserted into a circuit around either way.
Capacitors from 1u to 100,000u are electrolytics (or tantalum) and are polarised. They must be fitted so the positive lead goes to the supply voltage and the negative lead goes to ground (or earth).

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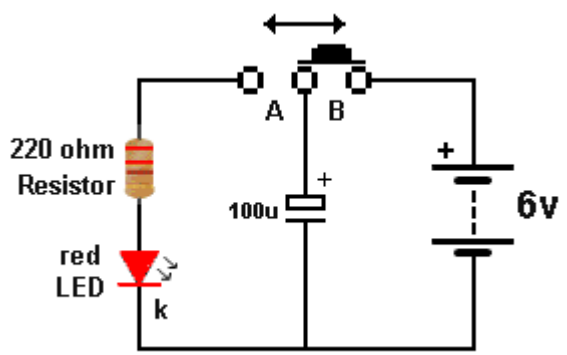

Fig 42. Charging a Capacitor

Here is an experiment to show how much (little) energy is stored in a 100u electrolytic.
When the slide-switch is in position "B", the 100u is charged by the 6v battery.
When the slide switch is moved to position "A" the electrolytic supplies energy to illuminate the red LED via the 220R resistor. It will illuminate for a short period of time.
By moving the switch back and forth, you can keep the LED illuminated.

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Capacitors can be connected in **Series or Parallel** to obtain a value of capacitance you may not have available.
They are also connected in series to increase the effective **VOLTAGE RATING**.
However when two equal-value capacitors are connected in series, the final value is HALF, and thus you need two with double the final-value to get a value with an increased voltage-rating.
When two equal-value capacitors are connected in series, the result is HALF.
(This is the opposite to connecting resistors)

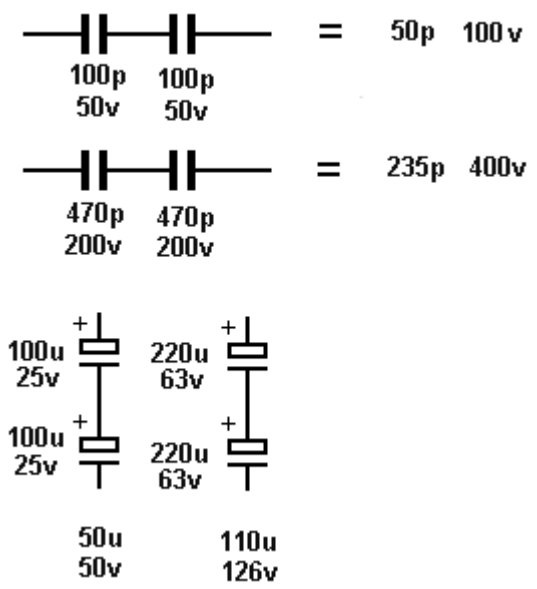

Fig 43. Capacitors in Series

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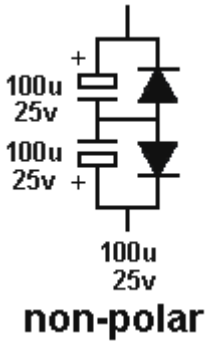

Fig 43a. Non-polar Capacitor

Non-polar Capacitor (electrolytic)

A normal electrolytic must be connected the correct way in a circuit because it has a thin insulating layer covering the plates that has a high resistance.

If you connect the electrolytic around the wrong way, this layer "breaks-down" and the resistance of the electrolytic becomes very small and a high current flows. This heats up the electrolytic and the current increases. Very soon the capacitor produces gasses and explodes.
One big mistake in many text books shows how to make a non-polar electrolytic by connecting two "back-to-back."
They claim 2 x 100u connected back-to-back is equal to 47u.
This appears to be case when testing on a meter but the meter simply charges them for a short period of time to get a reading.
If you allow them to charge fully you will find the reverse electrolytic has a very small voltage across it.
Secondly, when you are charging them, you are putting a high current through the reverse electrolytic and damaging the layer.
To prevent this, you need to add two diodes as shown in the diagram.
In addition, 2 x 100u "back-to-back" is very near 100u.

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Capacitors can be connected in **Parallel** to obtain a value of capacitance you may not have available.
(This does not change the **VOLTAGE RATING**.)
When two equal-value capacitors are connected in parallel, the result is DOUBLE.
(This is the opposite to connecting resistors).
If one electrolytic is 25v

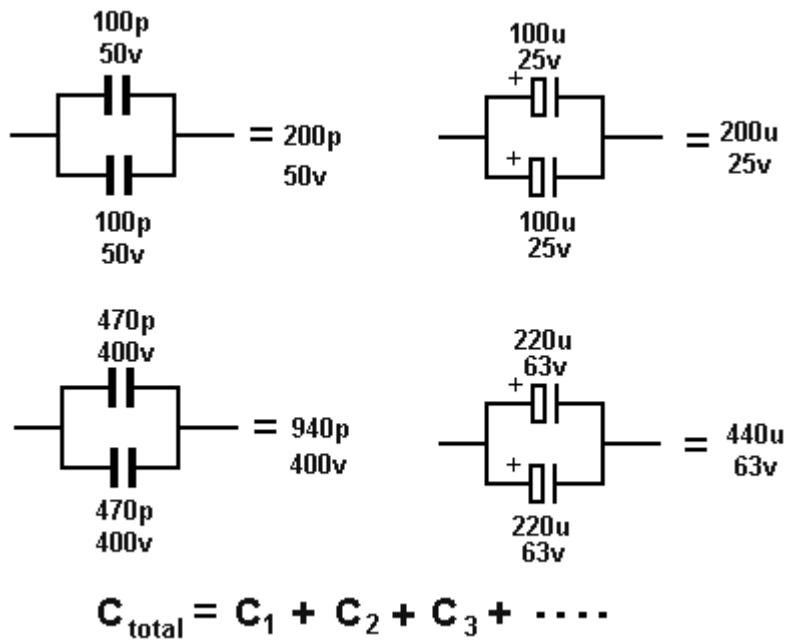

Fig 44. Capacitors in Parallel

and the other 63v, the answer is the LOWER VOLTAGE = 25v.

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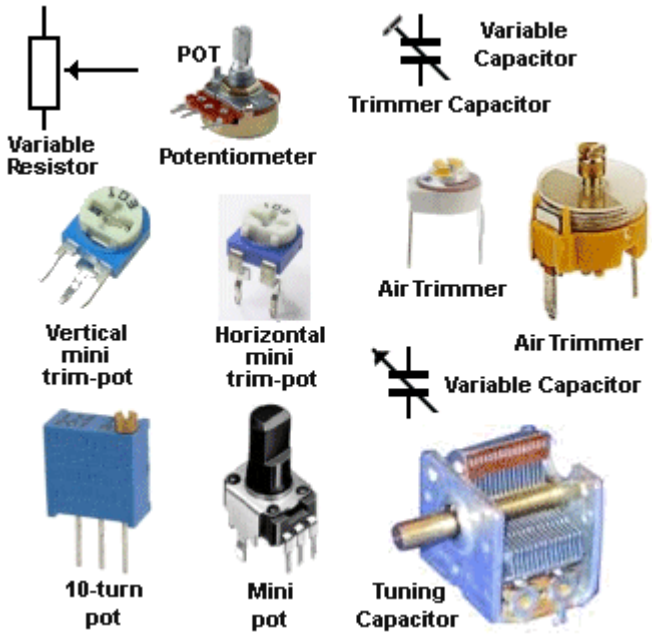

Fig 45. Variable Capacitors and Resistors

The value of a capacitor or resistor may need to be increased or decreased in a circuit to tune in radio stations or increase and decrease the volume of a speaker. The symbol for these components have an arrow to show they can be adjusted.
The resistance of a potentiometer can be from 1 ohm to 5M
They come in many different shapes and sizes to suit the PC board or front-panel layout.
The "T" represents a trimmer capacitor and this can be from 1p to about 120p.
A variable capacitor will be from about 10p to 415p.

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Simple CIRCUITS
We have covered enough symbols and components to create a number of simple circuits.
These circuits will show how to connect a motor, a LED, (how to make it bright or dull) and how to connect 4 cells to make a battery.

Note: The flashing LED

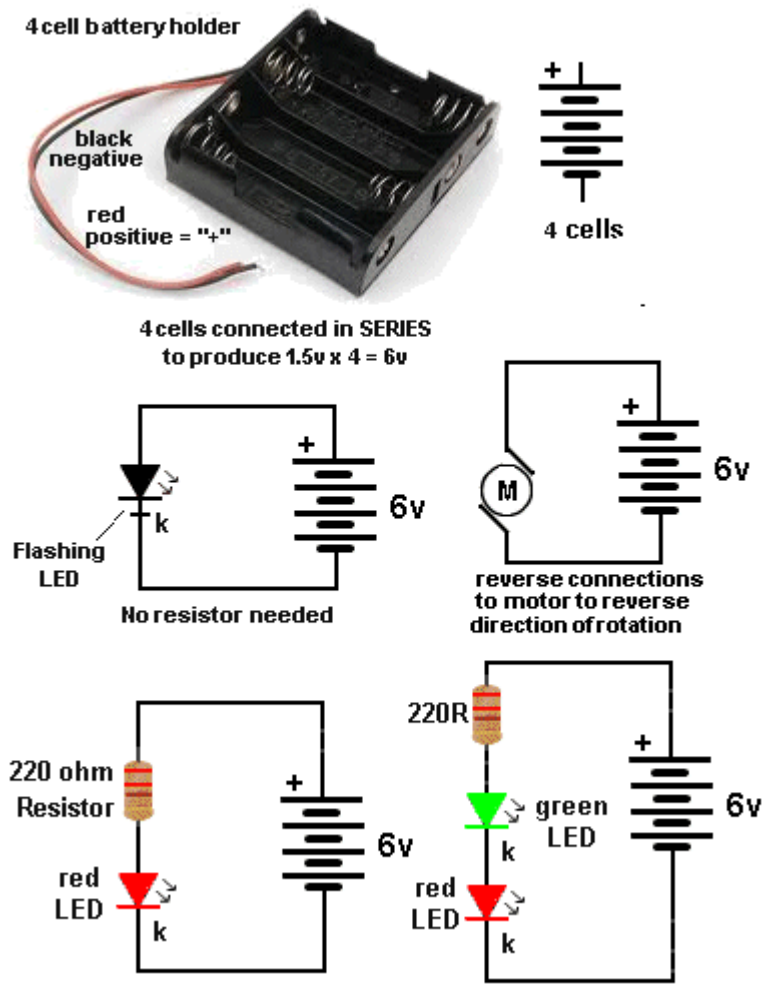

Fig 46. Simple Circuits

does not need a resistor because a resistor and chip are inside the LED, to make it flash and control the current.

Connect all the components around the correct way and then connect them around the wrong way to see what happens.
Connect the flashing LED in series with a red LED and see what happens.

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QUESTIONS

1. Explain why the Flashing LED circuit has no external resistor.
2. How many 1.5v cells are needed to produce a 6v battery
3. Explain what happens when you reverse the leads to a motor.
4. Identify the positive terminal:

5. Can 3 green LEDs be connected in series to a 6v supply?
6. A variable resistor is also called: _____
7. The combined resistance of two 1k resistors in series is: _____
8. The combined resistance of two 1k resistors in parallel is: _____
9. Name the short lead on a LED
10. Name the type of multimeter with a pointer and scale: _____
11. The total capacitance of two 100u electrolytics in series is: _____
12. The total capacitance of two 100u electrolytics in series is: _____
13. Write these values in words:

22R _____
4k7 _____
1n _____
100u _____

14. How many 1.5v cells in a 9v battery?

15. The red probe is: _____ (positive/negative)
16. Conventional current flows from: _____ (positive to negative / negative to positive)
17. Make a 470u electrolytic with two electrolytics:
18. What is the voltage drop across a diode?
19. Name the component that only allows current to flow in one direction: _____
20. Name this symbol:

21. When resistors are connected in series, the resistance of the combination: _____ (increases / decreases)
22. When two capacitors are connected in parallel, the voltage-rating of the combination: _____ (increases / equal to the capacitor with the lowest voltage-rating)
23. Draw two 2k2 resistors in parallel.
24. Which is larger: 470R or 22k
25. What is the value of this combination:

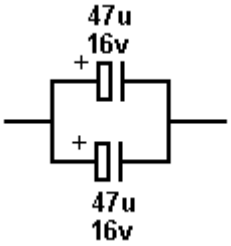

26. What is the name of the resistor in series with a LED: _____
27. What is the voltage across the amplifier: _____

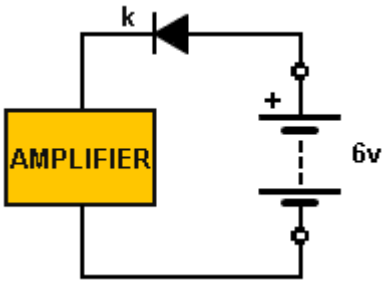

28. Identify the fault with these circuits:

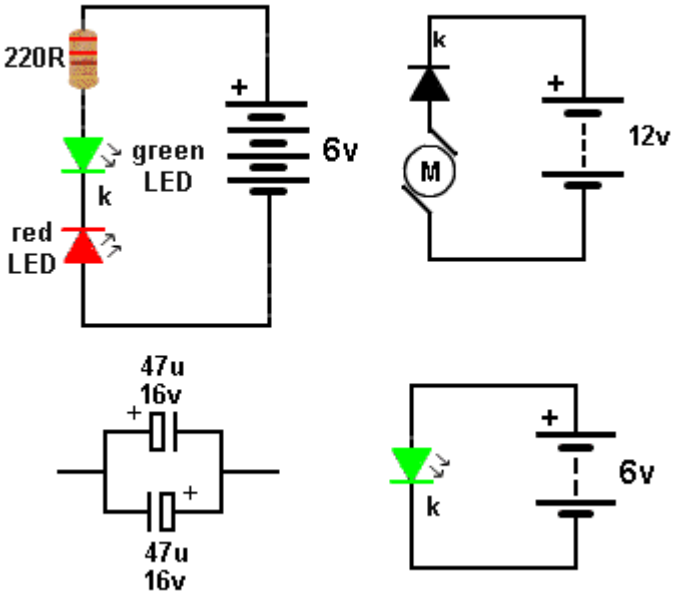

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Passive Components
All the components shown

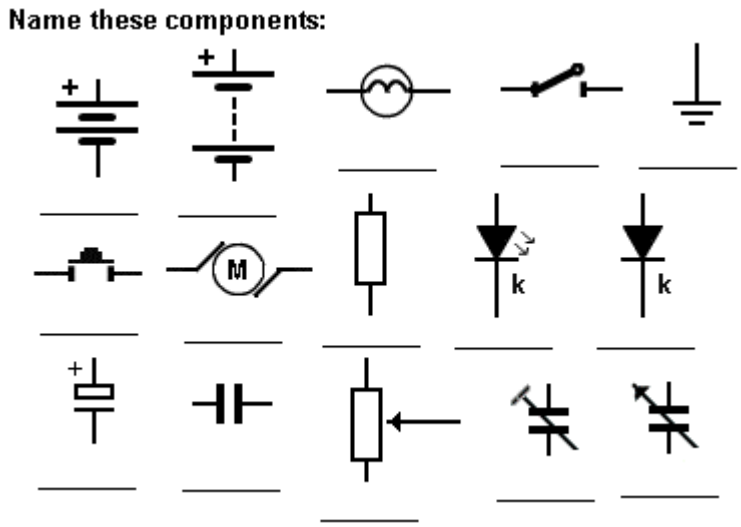

Fig 47. Passive Components

on the left are called PASSIVE COMPONENTS. This means they do not amplify.
Write the name beside each symbol.

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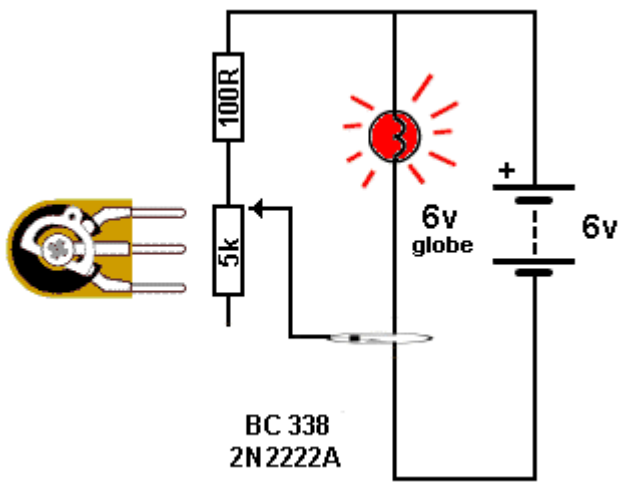

Fig 47a. The Potentiometer in action

The Potentiometer is a variable resistor.
It consists of a curved carbon track with a wiper that touches the track and can be turned via a screwdriver or knob.
The wiper is the middle wire on the circuit symbol and it moves up and down as shown in the animation.
When the three leads are connected the symbol is called a potentiometer.
When two leads are connected it is a variable resistor.
When the resistance increases, less current flows through the pot.

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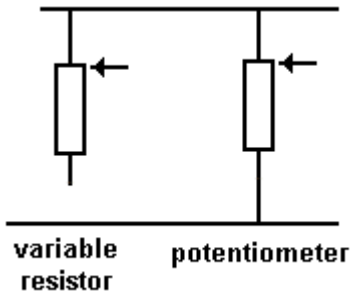

Fig 47b. The Variable Resistor and Potentiometer

There is a difference in operation between a **Variable Resistor** and a **Potentiometer**.
Both will increase or decrease the sound level as a volume control or the speed of a motor or the brightness of a globe, but a Potentiometer will guarantee zero volume or zero brightness when the pot is turned fully anticlockwise (as shown in the animation).
This is because the output will be zero volts, but the variable resistor may still deliver some "energy" (voltage and current) to the circuit when turned fully anticlockwise.

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Potentiometers come in values from 100 ohms to 5 Meg ohms (500R, 1k, 2k, 5k, 10k, 50k, 100k, 200k, 250k, 500k, 1M are most popular).
They come as linear, or logarithmic where the resistance of the track (per mm) is higher at one end. Because our hearing is not linear, these pots can be used as volume controls to produce a gradual (very nearly linear) increase in volume.
Selecting the correct value of resistance for a circuit is VERY complex. If the value is not correct, the volume will not be loud or it will drop to zero before the pot is turned fully anticlockwise. Or

the motor will drop to zero at mid-turn of the pot or it will not reduce in RPM to the desired amount.
The simple answer is to copy a circuit.
Or you can try the whole range of pots and you will find one value is the best.
A Potentiometer can be used in hundreds of different circuits to produce hundreds of different effects, but the actual "thing" that flows between the input and output is a percentage of the voltage. At the same time the current will also be passed to the output at a reduced value. A pot actually delivers BOTH reduced values at the same time and the receiving circuit will be designed to "look for" the change in voltage or current. If the supply voltage is not rising or falling, the "values" are called DC values.
The voltage can also be in the form of a signal (volume). This is called an AC signal.

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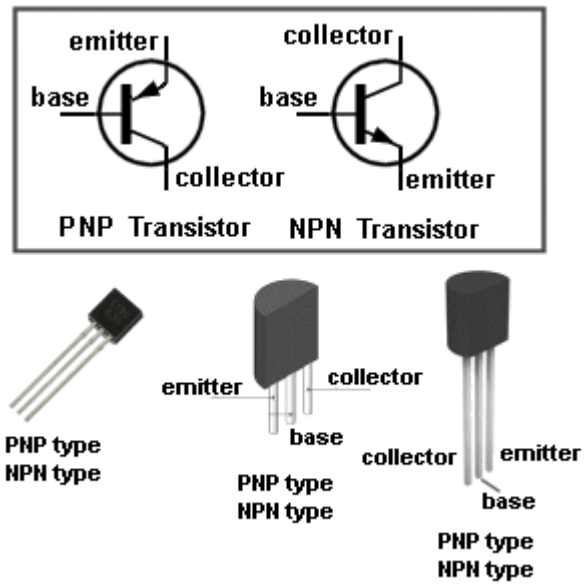

Fig 48. The TRANSISTOR

The TRANSISTOR

A TRANSISTOR is an ACTIVE device. It AMPLIFIES.
There are many types of transistor (over 20,000 different types) from hundreds of manufacturers and they have many different names.
We are going to study the simplest.
It has the technical name **BIPOLAR JUNCTION TRANSISTOR (BJT)** but we are going to call it a **TRANSISTOR**.
There are two types in this group: **PNP** and **NPN**.

The type we will study is also called a **SMALL-SIGNAL TRANSISTOR.**

You cannot tell an **NPN** transistor from **PNP** by looking at it. You must test it in a circuit.
In **Fig 65** you will make a **Transistor Tester** project, but first some basic facts:

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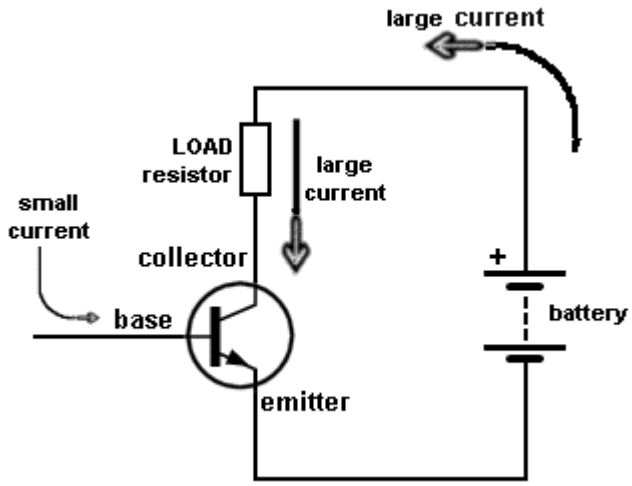

Fig 49. The NPN TRANSISTOR in a Circuit

The first type of transistor we are going to study is the **NPN**.
A transistor has three leads:
BASE, COLLECTOR and **EMITTER**
Basically, a small current enters the base and a large current flows through the collector-emitter leads as shown in the diagram.
The resistor in the collector lead is called the LOAD Resistor.
Sometimes the load is a speaker.

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The transistor is similar to the diagram opposite. A small drop of water entering the base is amplified to

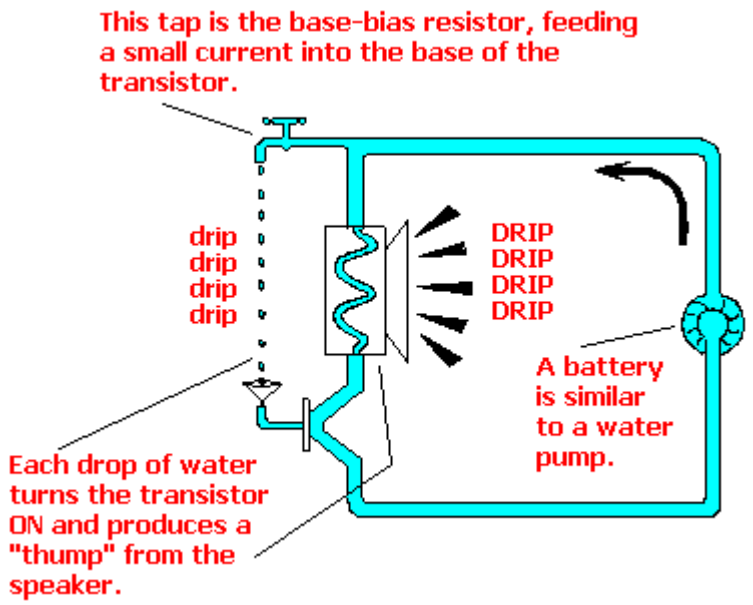

Fig 50. The Water TRANSISTOR

produce a loud DRIP from the speaker.

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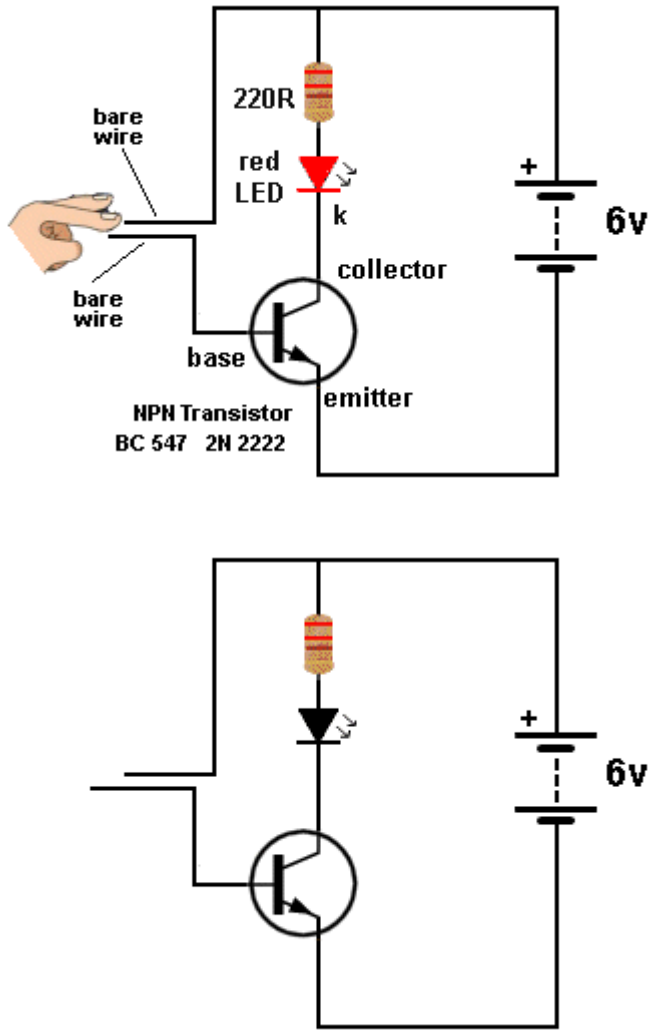

Fig 51. One Transistor Circuit

In this experiment we will construct a ONE TRANSISTOR circuit similar to the WATER TRANSISTOR above and observe the results.
Make sure the two leads DO NOT TOUCH. If they touch, the transistor will be DESTROYED.

The transistor is amplifying the current through your finger via the two leads and it will be very dim.

ANIMATION

The lower diagram shows the transistor turning ON when a finger is pressed against the two wires. The finger produces a resistance that turns the transistor ON and this turns the transistor into a smaller and smaller resistor. That's how more and more current flows through the LED and it gets brighter and brighter.

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By adding another transistor we amplify the

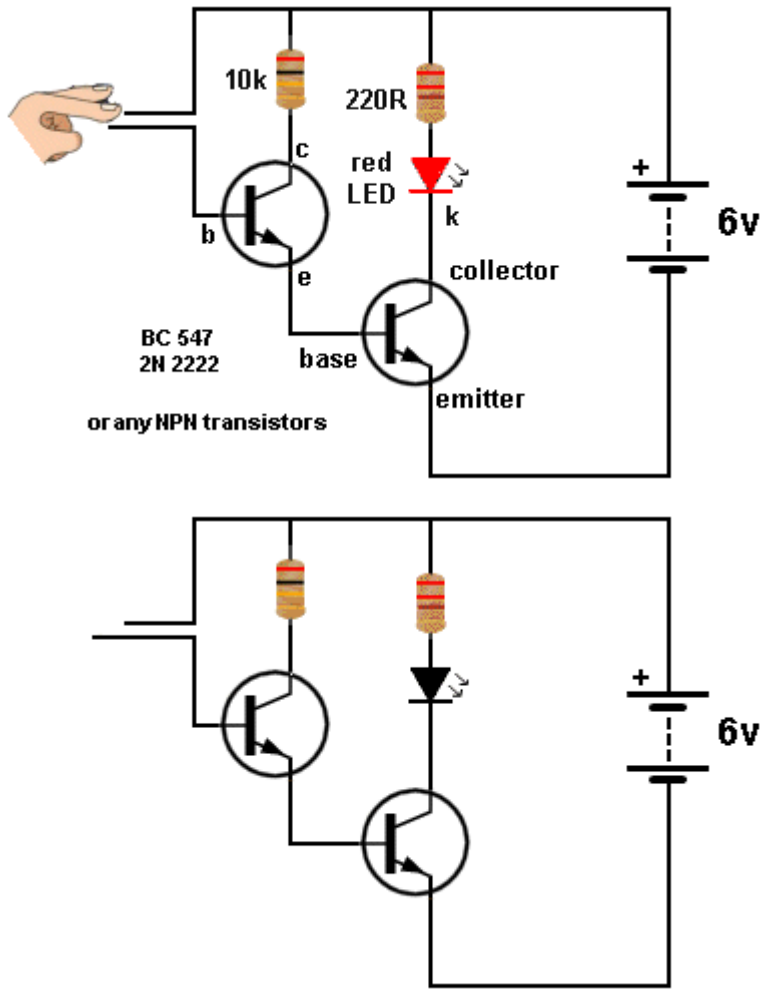

Fig 52. Two Transistor Circuit

current through the finger about 200 times and now the LED will glow bright.

Make sure the bare wires do not touch each other as this will destroy BOTH transistors.

ANIMATION

The lower diagram shows both transistors turning **ON** when a finger is pressed against the two wires.
They both becomes smaller and smaller resistors.
The first transistor allows more current to flow into the base of the second transistor and this is how the second transistor turns on more and more. This allows more current to flow through the LED and it gets brighter and brighter.

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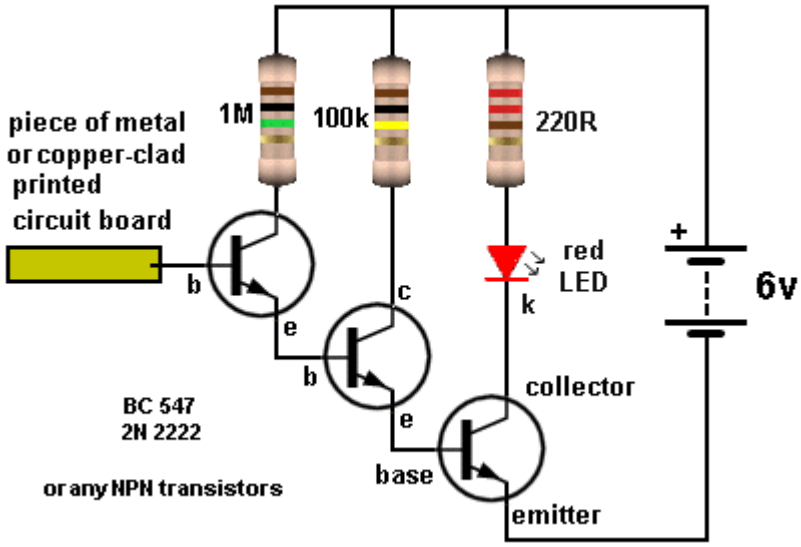

This circuit has enormous gain.
Each transistor has a gain or more than 200 and the final gain will be more than:
200 x 200 x 200 = 8,000,000
8 MILLION!

The circuit is very sensitive to static voltages in the air or electrical waves such as the waveform produced by the electrical wiring in a house.
Move the project around a room and detect all the electrical signals.

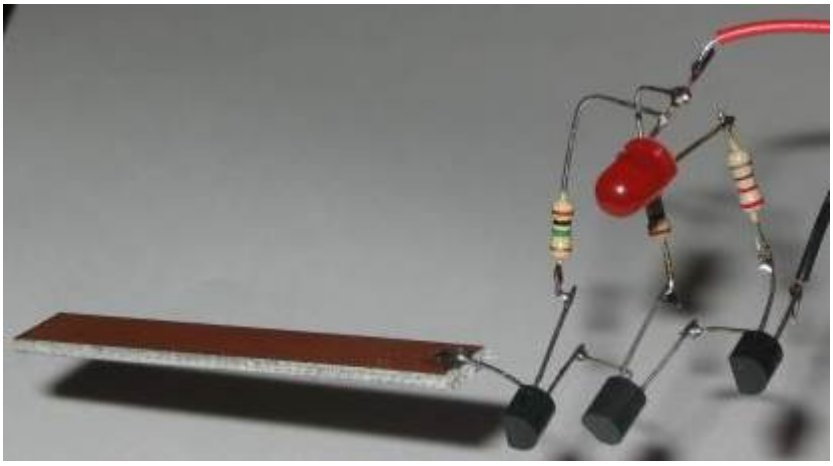

Fig 53. Three Transistors

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You can see the effect of one transistor. It does not do much.
The two transistor circuit allows the resistance of your finger to deliver current into the base of the first transistor and this transistor delivers more current into the base of the second transistor.
The result is more collector-emitter current and the LED illuminates.
The three transistor circuit produce an ENORMOUS effect.
It will pick up STATIC ELECTRICITY and all forms of electro-magnetic energy (radiation) and illuminate the LED.

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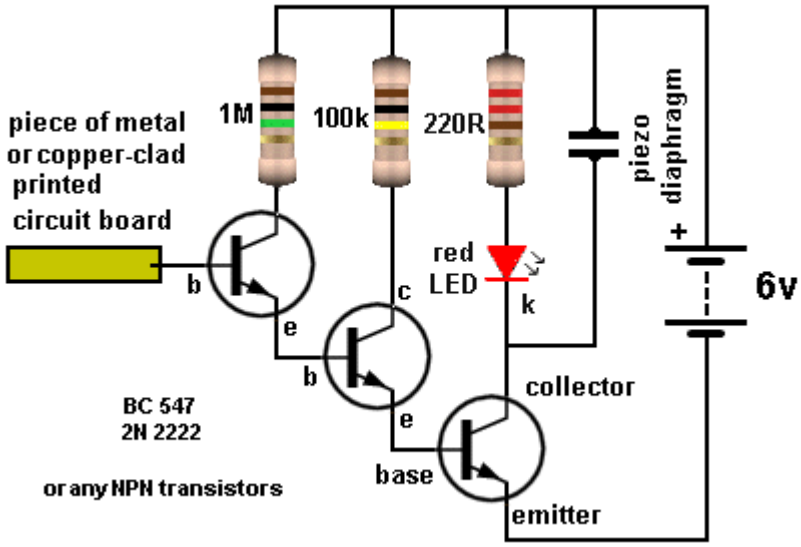

Fig 54. Adding a PIEZO

By adding a piezo diaphragm to the output you will be able to hear the hum of the mains.
This is the frequency of the supply into your house. It will be either 50 cycles per second or 60 cycles per second.
The term: "cycles per second" is given the name HERTZ after **Heinrich Rudolf Hertz**, who was the first to prove the existence of electromagnetic waves.

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The Piezo diaphragm is held around the outer edge inside a plastic case and when a voltage is applied to the two leads, the thin plate curves very slightly.
When the voltage is removed, the plate returns to its flat shape.
If the voltage is reversed, the plate curves in the opposite direction.

The curving is due to a thin layer of ceramic material under the plate and

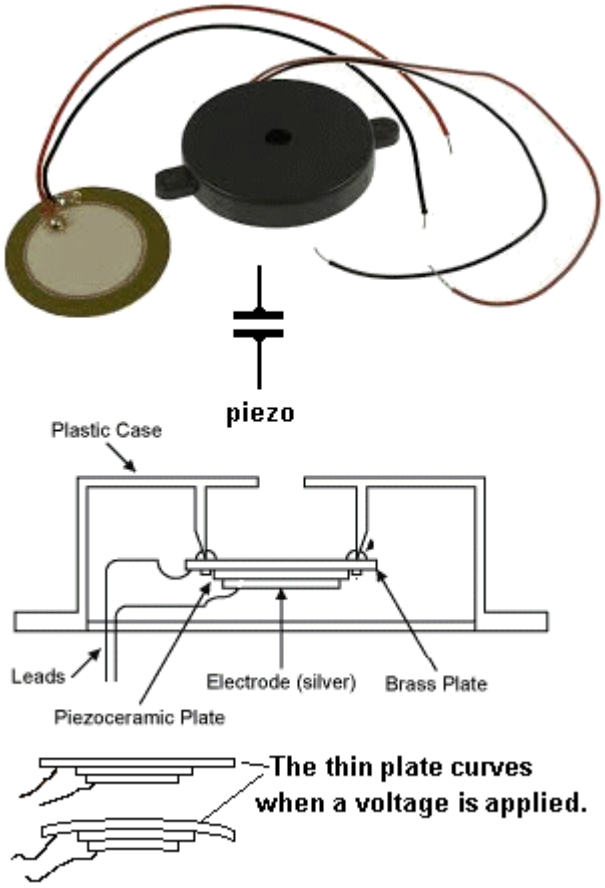

Fig 55. The Piezo

then a film of metal is deposited onto the ceramic so a lead can be soldered.

There is infinite resistance between the two leads as the ceramic material is an INSULATOR.
The capacitance between the two leads is approx 22n.
The Piezo is a passive device. It needs a pulse or frequency for it to produce an output.

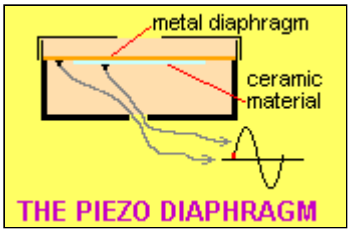

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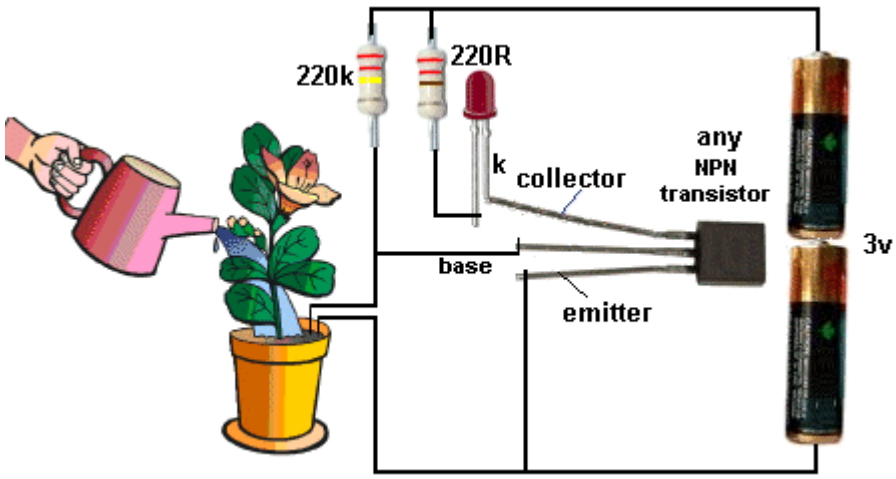

Fig 56. Plant Needs Water

The **ONE TRANSISTOR CIRCUIT** above can be turned into a detector to show when a plant needs water.
Place the two probes into the soil and water the plant. The LED will turn off. As the water evaporates the LED will turn **ON** to let you know the plant needs watering.

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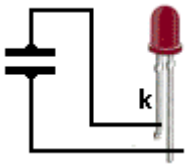

Fig 57. Tap the Piezo

This experiment produces a pulse from the piezo when it is tapped and the LED illuminates briefly.

The LED can be connected either way around.

This proves the diaphragm flexes when a voltage is applied and also in the reverse situation. A voltage is produces when the diaphragm is tapped.

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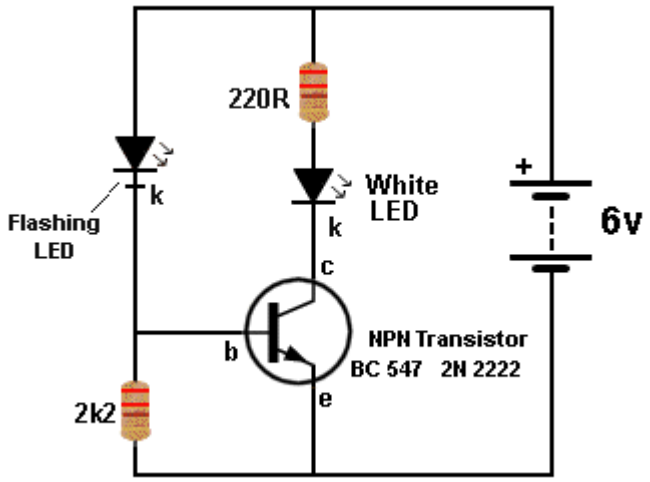

Fig 58. Flashing LED and White LED

A flashing LED is not very bright.
It can be connected to a transistor and the transistor will drive a very bright white LED.
The transistor is an amplifier.
It is amplifying the current flowing through the flashing LED and supplying a higher current for the white LED.

We cannot discuss any further details of the circuit at the moment because the actual operation of the circuit is quite complex.

At the moment we just need to experiment with simple transistor circuits.

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Fig 59. Soldering Iron

We now come to the point of HELPING YOU WITH CONSTRUCTION.
We have already shown you 6 different circuits and there are many ways to build them.
You can:
1. Solder them.
2. Build them on an Experimenter Board
3. Connect the components with clips or twist the leads together.
It does not matter how you build the circuits.
The fact is this: YOU MUST START BUILDING.
The best soldering iron for a beginner is a CONSTANT TEMPERATURE soldering iron.
It has a dial that can be turned to set the desired temperature.
An ordinary soldering iron GETS TOO HOT. It is not suitable for soldering electronic circuits.
This is something that no-one has mentioned before. An ordinary soldering iron will melt the solder TOO QUICKLY and burn the resin inside the solder and make soldering very difficult for a beginner.
Soldering must be done slowly so the resin in the middle of the solder gets hot and cleans the leads of the components so the solder will "stick."
That's why you must apply the solder to the leads you are soldering and allow the resin to "attack" the leads and clean them.
The cheapest TEMPERATURE CONTROLLED soldering Iron is available on eBay for les than $10.00 (post FREE).
You will also need a small roll of solder (0.9mm) and a soldering Iron stand.
Email Colin Mitchell for links to eBay. (talking@tpg.com.au)
A whole book could be written on the ART OF SOLDERING.
Look on the web for articles and videos on SOLDERING.

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SOLDERING

1. Soldering is very easy and very simple. You just need a **Temperature Controlled Soldering Iron**, **Fine solder** and clean components.
2. Remember this: It is **NOT** the solder you need for a joint, but the **FLUX**. And the flux lasts for only 2 seconds. When the flux is **HOT** it attacks and cleans the joint so that the solder will stick.
3. Turn ON the Temperature Controlled Soldering Iron to a low temperature. Put solder on the tip. It will not melt. Turn up the temperature slightly. Try more solder. As soon as the solder starts to melt, this is your starting point. Turn up the temperature slightly MORE and this is the correct temperature for **small, delicate, fine soldering**.
4. Place a component through a hole and bend the lead slightly so the component does not move. Turn the board over and touch the iron on the component and bring the solder **FROM THE OTHER SIDE** so the solder melts and flows towards the iron.
From start-to-finish, count one-two-three and remove the solder. Count four-five and remove the iron. You will have a perfect joint.
If you are soldering thick leads or large pads on a circuit board, you will need to turn the temperature UP slightly.
You must add enough solder to make the joint "bulge" slightly.
Fine solder (1mm or 0.9mm or 0.8mm) makes the best joint because it is easier to use.
Use a wet sponge to clean the tip or a ball of "Steel Wool." Steel wool is the best.
Here is the steel wool, bending the leads and some examples of poor joints due to insufficient solder:

Steel wool cleans the tip beautifully

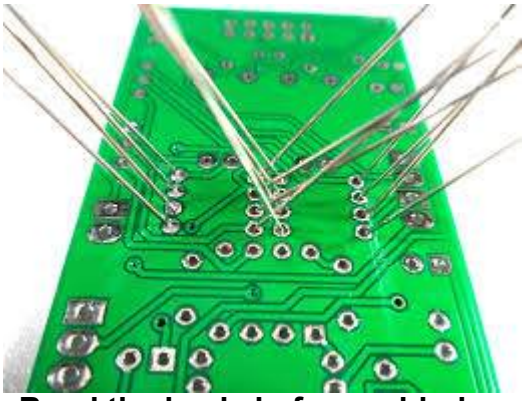

Bend the leads before soldering

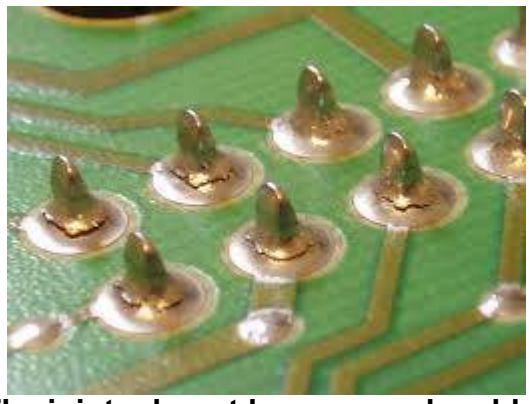

The joints do not have enough solder and that's why they fractured. Called a DRY JOINT.

More "Dry Joints."

This is the cheapest and simplest soldering iron stand.

This stand is very messy as the spring grabs the iron and makes it difficult to remove from the stand. Test the stand before buying. You will se why not to buy this type of soldering stand. Get one with a "wide mouth" and a heavy stand is best as it does not move.

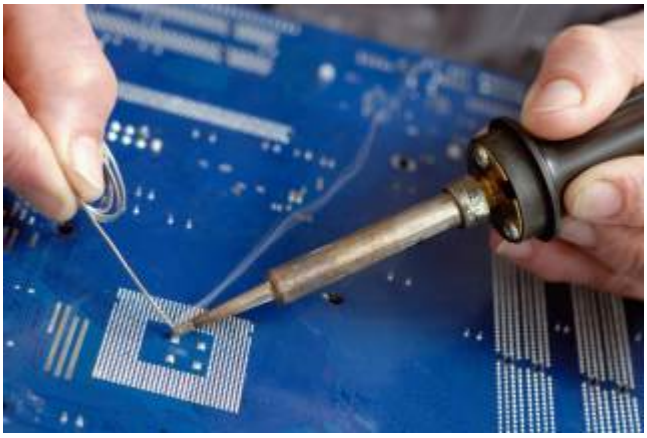

This photo clearly shows how to hold a soldering iron and solder.

This is NOT a temperature-controlled soldering iron and you can see it is too hot as it is burning off the flux too quickly.
Temperature Controlled Soldering Irons are now cheaper than the JUNK soldering iron shown in the photo. See eBay for prices.

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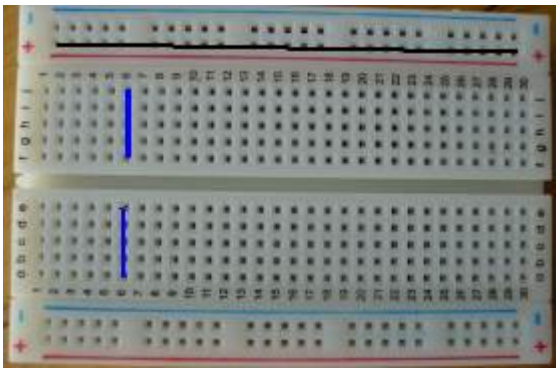

Photo shows a number of components fitted to the breadboard.

BREADBOARD

The term BREADBOARD refers to any piece of wood or plastic containing pins or pegs or clips or holes where you can build a circuit.
The components can be soldered, twisted clipped or fitted into holes.
Breadboard also means the circuit can be easily pulled apart.
Some breadboards do not have two rows for the positive and negative rails.
Connections under the board for the positive rail is shown with a black line in the photo. Connections on the main section of the board are shown with blue lines. Your breadboard MUST look exactly like the photo opposite.
Other breadboards are quite useless.
The breadboard in the photo can be purchased on eBay for less than $5.00 (post FREE).

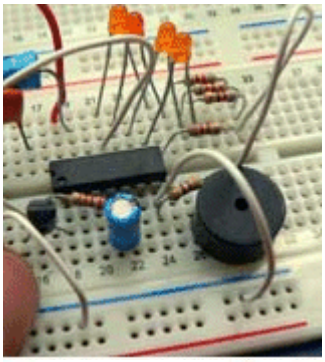

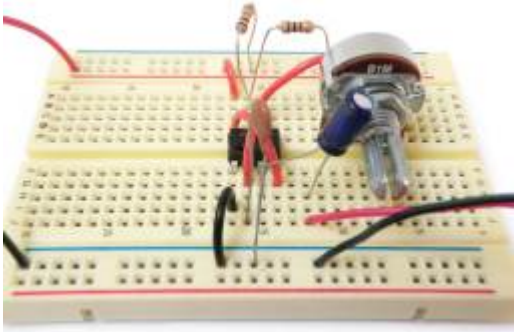

Fig 60. BREADBOARD and Components

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Fig 61. Jumpers

The components on the BREADBOARD are fitted down the holes and metal strips under the board join each column of 5 holes. If you want to join one hole with another, you can use 0.5mm tinned copper wire or JUMPERS. See photo opposite. Jumpers can be purchased on eBay for less than $3.00 posted.

Email Colin Mitchell for links to eBay. (talking@tpg.com.au)

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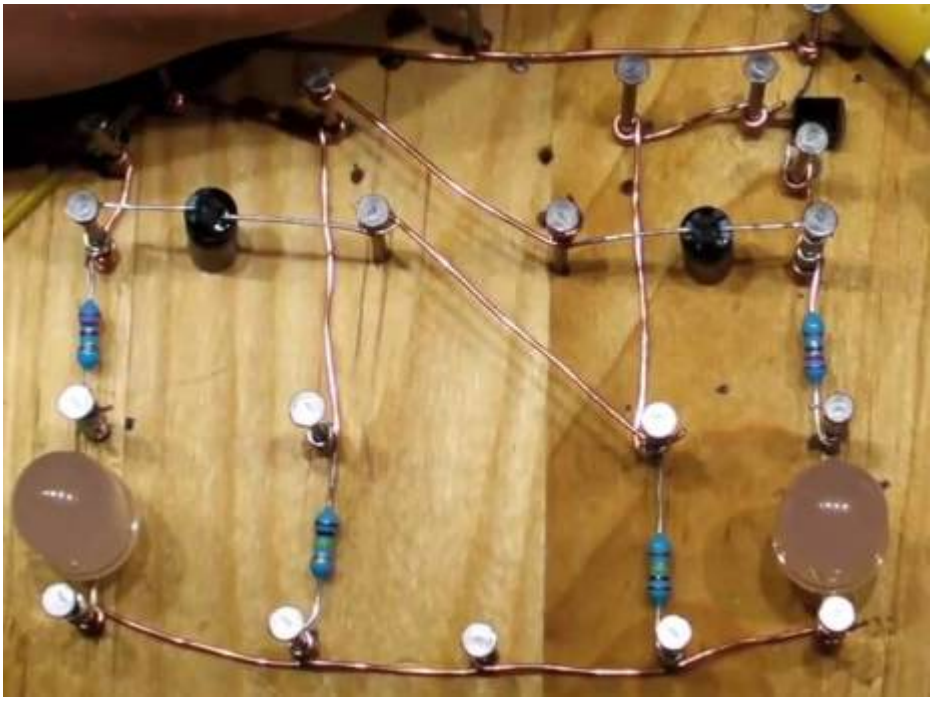

Fig 62. Breadboard with Nails

If you don't have a soldering iron or experimental breadboard, you can make your own board with nails. See the photo above. It is a multivibrator circuit and we will be presenting this circuit in a moment. The components can be twisted around the nails and bare wire used to join some of the nails to complete the circuit.

Another method of connecting the components is called BIRD-NESTING. This involves soldering the components "in the air" as shown in the 27MHz transmitter circuit below:

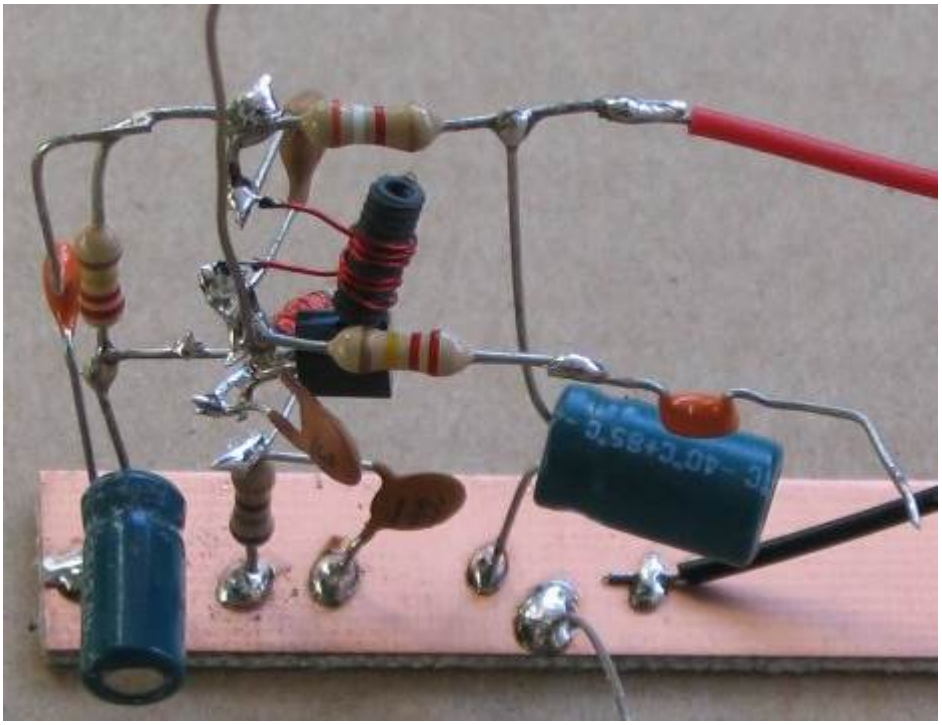

Another way to connect the component(if you don't have a soldering iron), is to wind 6 turns of bare wire around each connection and leaving all the components "in the air." The bare wire can be obtained from hook-up flex. This is plastic coated "wire" containing up to 15 fine strands of wire. Use a single strand for the connections. None of the components will touch each other BY MISTAKE and the circuit will work perfectly. Bird-nesting is a good way to build a quick circuit and test its performance. It might look messy but you can easily change any component.

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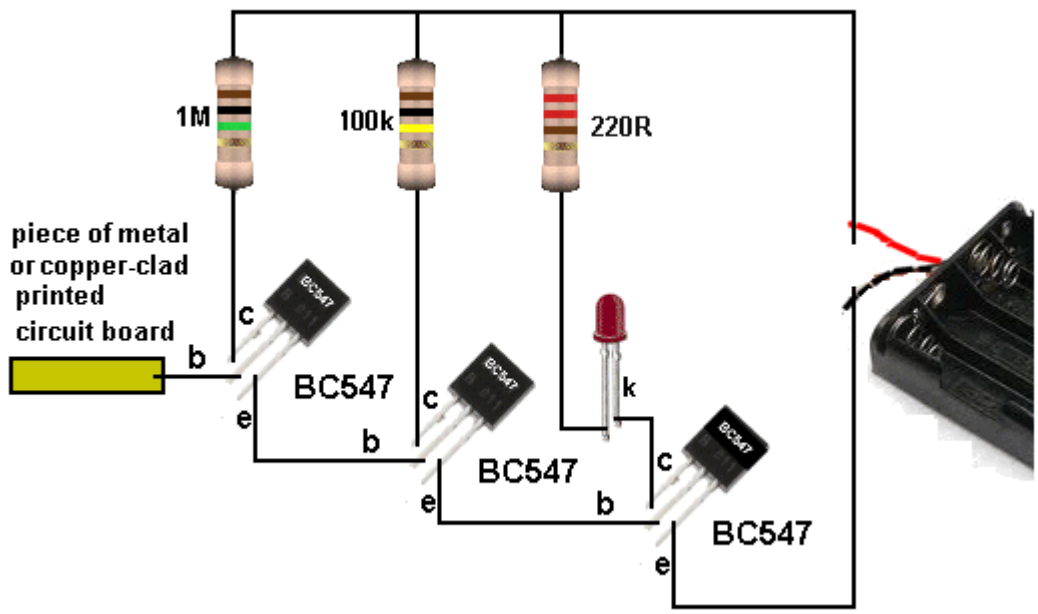

Fig 63. Wiring the 3-Transistor Circuit using BC547 Transistors
The diagram shows how to connect 3 x BC 547 transistors.
The leads of a transistor can be collector-base-emitter OR
emitter-base-collector and that's why we have provided 2 different wiring diagrams.

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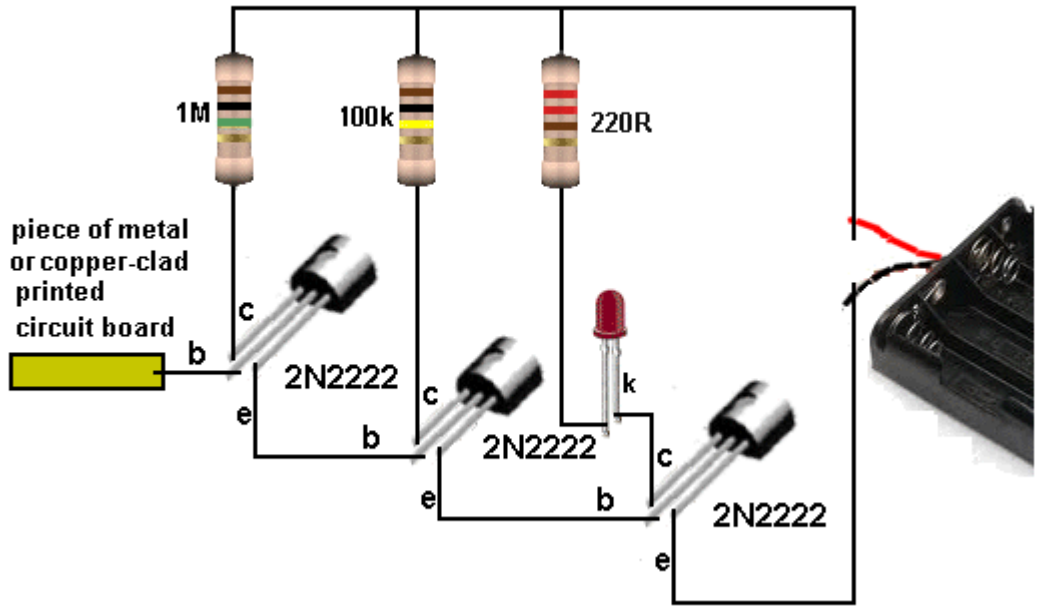

Fig 64. Wiring the 3-Transistor Circuit using 2N2222 Transistors
The diagram shows how to connect 3 x 2N2222 transistors.

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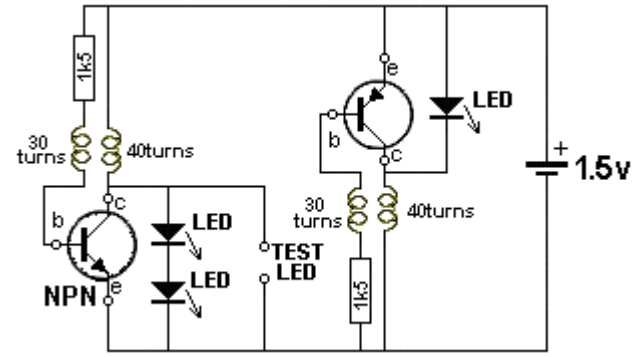

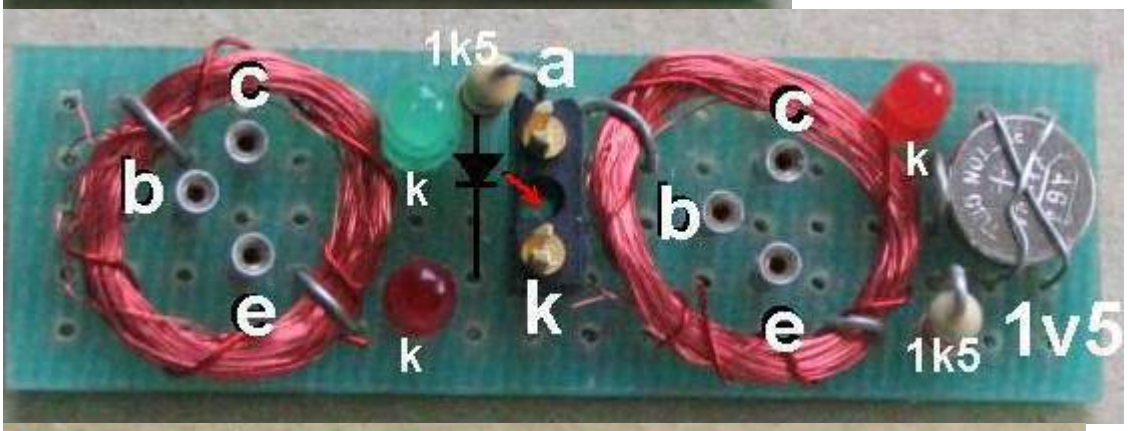

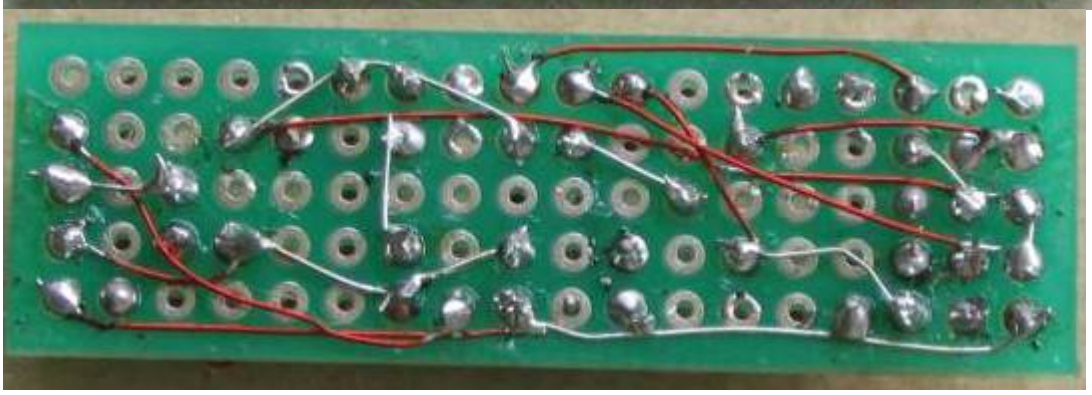

Fig 65. Transistor Tester

This handy transistor and LED tester can be built to test LEDs and both PNP and NPN transistors.
The project consists of two identical circuits, one for NPN and one for PNP.
You can build just the NPN section and then build the PNP section later.

LED VOLTAGE

We have shown a LED needs at least 1.7v supply for it to operate.
This circuit works on 1.5v and thus the action of the transistor and coil (called a Transformer) MUST be increasing the voltage for the LED to illuminate.
This circuit works on two "actions."
1. Transistor ACTION - this is the action of a transistor providing gain to make the circuit oscillate.
2. Transformer ACTION - this is the action of a coil of wire producing a voltage higher than the

supply voltage when it is turned off.

This circuit is very technical and very complex.
We will be explaining it in a very simple way because this is a **Basic Electronics Course**.

THE TRANSFORMER - the two coils of wire on the left and the two coils of wire on the right.
When the voltage (actually the current) is switched off, the 40 turn coil in either of the circuits in this project; the voltage across the coil rises to more than the 1.5v supply and is in the opposite direction to the voltage of the supply.
The circuit looks to be very simple but it uses an air-cored transformer to produce the voltage needed to illuminate the LED indicators and the circuit only works when the transistor is connected correctly. There are two separate circuits, one for NPN transistors and one for PNP transistors. We will cover the NPN section:
The circuit turns ON when the NPN transistor is fitted and the current through the 30 turn coil and 1k5 resistor turns ON the transistor and produces expanding flux in the 40 turn coil. This flux cuts the turns of the 30 turn coil and produces a voltage in the coil that adds to the supply voltage and increases the current into the base. This turns the NPN transistor ON more. This action continues until the transistor is fully turned ON. At this point the current in the 40 turn coil is a maximum but it is not expanding flux and the 30 turn coil ceases to see the extra voltage. Thus the current into the base reduces and this turns the transistor OFF slightly. The flux produced by the 40 turn coil now becomes collapsing (or reducing) flux and it produces a voltage in the opposite direction to greatly reduce the current into the base. In a very short period of time the transistor becomes TURNED OFF and it is effectively removed from the circuit. The flux in the 40 turn coil collapses quickly and it produces a voltage in the 40 turn coil that is higher than the supply voltage and is in the opposite direction. This means the voltage produced by the 40 turns ADDS to the supply voltage and is delivered to the LEDs to illuminate them.
The NPN circuit has two LEDs in series so that a LED of any colour (including white) can be connected to the TEST LED terminals and it will illuminate. You can use any colour LED for any of the LEDs, however it is best to use either green or yellow or white for the single LED.
The two "coils" are wound on a 10mm dia pen with 0.1mm wire (very fine wire). The loops of tinned copper wire holding the coils on the board are connected to separate lands under the board and MUST NOT produce a complete loop as this will create a “Shorted Turn” and the circuit WILL NOT WORK.
If the LEDs do not illuminate, simply reverse the wires to the 30 turn coil.
The circuit does not need an ON/OFF switch because the LEDs require a voltage of over 2v to illuminate (the orange LED) and the supply is only 1.5v. A red LED needs about 1.5v to 1.7v to operate but when it is in series with a green LED, this voltage is over 3.5v.
All the components fit on a small matrix board 5 holes x 18 holes. A kit of parts for the project is available for $4.00 plus $3.00 postage and ordering details can be obtained by emailing Colin Mitchell. (talking@tpg.com.au)
Build the circuit and test your transistors and LEDs.
We will be covering more on the action of a transistor and the action of a transformer in the discussion below, but it is important to build the circuit and see it working.
It is your first piece of **TEST EQUIPMENT**.

Questions

1. Identify the letters "c" "b" and "e"
2. What type of transistor is tested in the first set of hollow pins?
3. Put a PNP transistor into the first set of hollow pins and try all positions. Does the red and green LEDs illuminate?
4. When both the red and green LEDs illuminate, what is the approximate voltage across the pair?
5. When you fit a red LED to the test-socket, what is the approximate voltage across it?
6. When you fit a red LED to the test-socket, why does the red LED and green LED on the PC board turn off?
7. Why doesn't the project need an on/off switch?
8. The two coils for the circuit on the left is called a TRANSFORMER. Do the connections of the windings have to be connected to the circuit around a particular way?

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ROBOT MAN

This multivibrator circuit will flash the Robot Man's eyes as shown

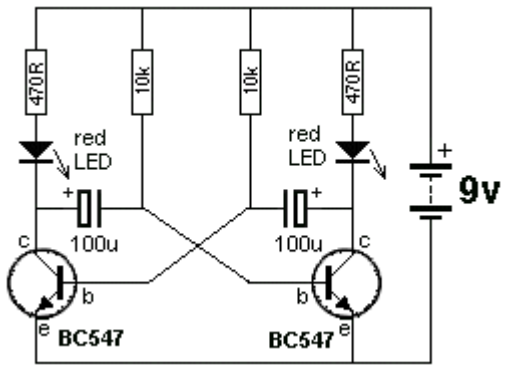

Fig 66. ROBOT MAN
The ASTABLE MULTIVIBRATOR or "free-running" multivibrator.

in the photo. The kit of components is available from Talking Electronics for $8.50 plus postage. Send an email to find out the cost of postage: talking@tpg.com.au
The photo shows the LEDs flashing.
The circuit is called an **ASTABLE MULTIVIBRATOR** and this means it is not stable but keeps switching from one transistor to the other.
It is also called a **FLIP FLOP** circuit.

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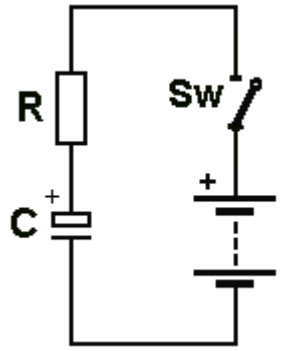

Fig 67. The TIME DELAY

The **TIME DELAY** circuit consists of a Resistor **R** and Capacitor **C** in **SERIES**.
When the switch is closed, the electrolytic (called the CAPACITOR) charges slowly because the resistor only allows a small amount of current to flow.
It's just like charging your mobile phone. The battery takes time to charge because there is a resistor in the circuit to limit the current. If we remove the resistor in the mobile phone, the battery will get too hot when it is being charged but in the **TIME DELAY** circuit, we want the capacitor to charge slowly, because we want a **TIME DELAY.** .

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Fig 68. The charging of a capacitor is the same as building a brick wall.

CHARGING A CAPACITOR

The capacitor in **Fig 67** charges via the resistor **R**.
But the voltage on the capacitor does not rise at a constant rate.
It starts off charging very quickly and as the voltage across it get higher, the voltage increases at a slower and slower rate.
In the photo I am building a brick wall.
I am working at a constant rate.
When I started building the brick wall, I laid 5 rows of bricks (5 courses) in the first hour.
As the wall increased in height, I had to climb the ladder and I could only lay 3 courses an hour and finally the wall was so high I could only lay 1 course per hour.
This is exactly the same as a capacitor charging.
When the capacitor is uncharged, the supply voltage allows a high current to pass through the resistor **R** and the energy quickly fills the capacitor. This results in a rapidly increasing voltage on the capacitor. But as the voltage on the capacitor increases, the difference in voltage between that on the capacitor and the supply is very small and only a small current will pass through the resistor. This means the voltage on the capacitor increases at a slower rate.

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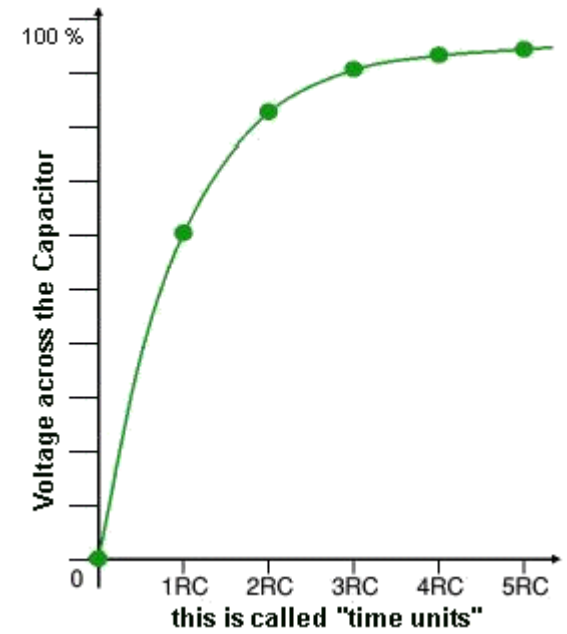

Fig 69. Time Units

It really does not matter how fast or slow or uneven a capacitor charges because most circuits detect a voltage on a capacitor and the time taken to reach this voltage is called the **TIME DELAY**.
But to prevent you thinking the capacitor charges "smoothly" we have to explain what actually happens.
The graph on the left shows the capacitor charging. You can see it charges quickly at the beginning and then charges slowly and then very slowly.
You can see the first part of the graph is fairly "straight" (constant charging) - NOT "straight up and down" but a straight line - and this applies to a voltage of about 63%.
The time taken to reach this voltage is called **ONE TIME UNIT** - also called **ONE TIME CONSTANT**. The graph continues for another 4 "time units" (time-constants) and the final voltage is very nearly 100%. (It never reaches 100%.)

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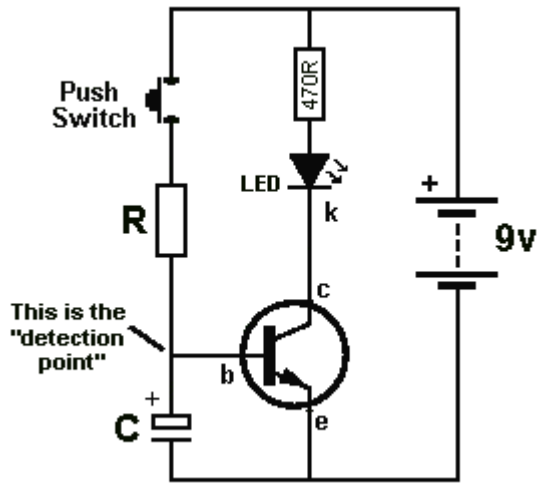

Fig 70. Time Delay Circuit

A **TIME DELAY** circuit needs three things:
1. A Resistor (R)
2. A Capacitor (C)
3. A "Detection Point."

When the switch is pressed, capacitor (**C**) takes time to charge via resistor (**R**) and after a short period of time the voltage at the **DETECTION POINT** is 0.6v and the transistor is TURNED ON. The LED illuminates.

Build the circuit with 100u and 100k and see how long it takes before the LED illuminates.

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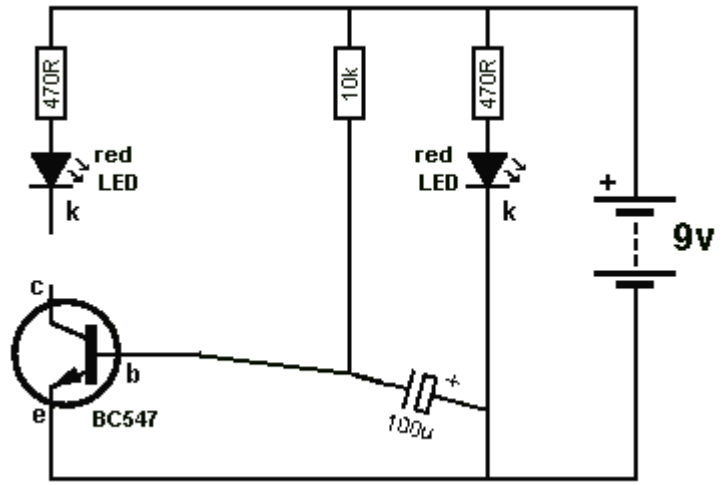

In the **ROBOT MAN** project you can see the "**TIME DELAY**" circuit made up of the 100u, 10k resistor and the base of the transistor.

This is one of the most important **BUILDING BLOCKS** in electronics.
It is the basis of all oscillators and will be discussed below, after we explain a few more details.

Fig 71. The "TIME DELAY" in the ROBOT MAN Project

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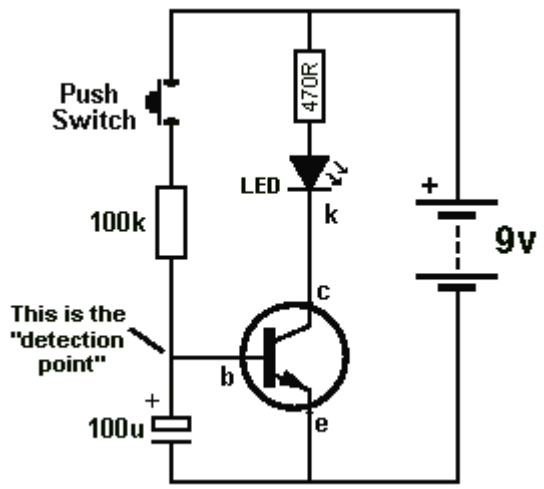

Fig 72. Turning A Transistor ON

We will use the **TIME DELAY** circuit to turn the transistor **ON**.
Make sure the 100u is uncharged by touching both leads (both ends of the capacitor) at the same time with a JUMPER - this is a piece of wire shown in Fig 61.
Push the switch and noting happens. After a short period of time the LED starts to glow and then comes on fully.
This shows two things:
1. The transistor is not turned ON when the base voltage is zero.
2. The base voltage must be 0.6v for the transistor to start to turn ON and when the voltage is 0.65v the transistor is turned **ON FULLY.**

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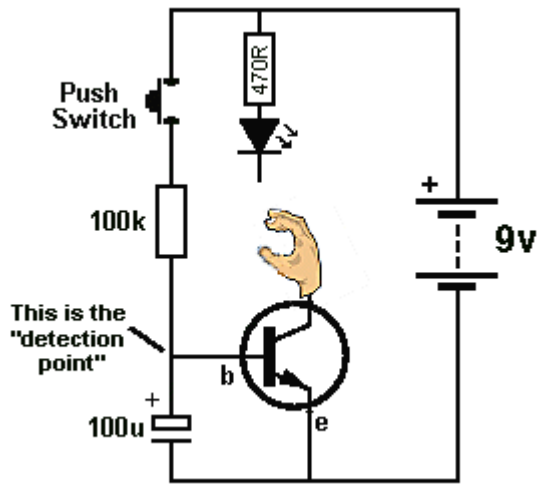

Fig 73. How the LED turns ON

Here is an explanation of how the LED turns ON.
When the circuit is first assembled and the switch is not pressed, the transistor is not turned on and it is just like the diagram opposite. The LED is not connected to the transistor.

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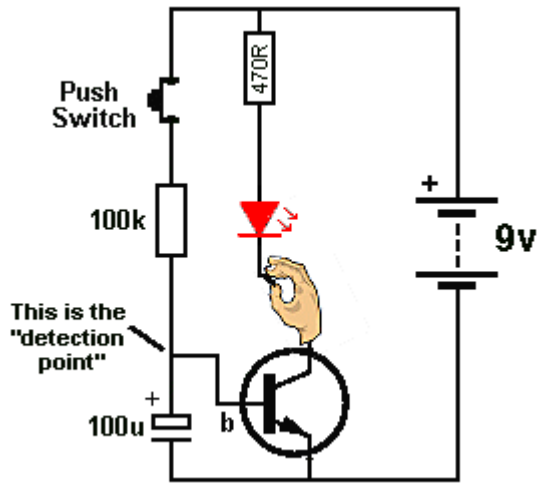

Fig 74. The LED turned ON

When the switch is pushed, the transistor turns **ON** (after a few seconds) and it pulls the lower lead of the LED down towards the 0v rail and this action turns the LED **ON**.

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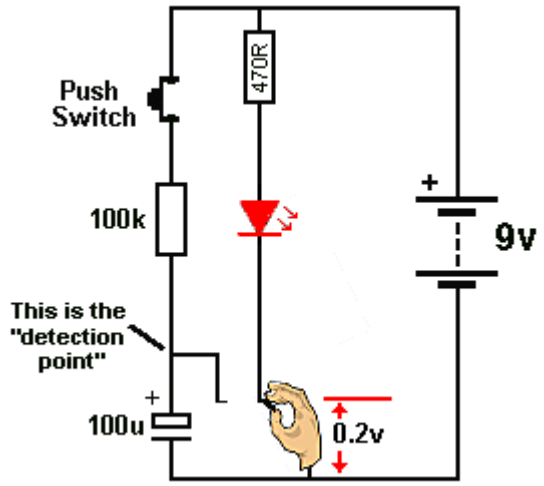

Fig 75. The LED fully turned ON

When the LED is **fully turned ON**, the lower lead of the LED is almost directly connected to the 0v rail.
In other words:
When the transistor is **FULLY TURNED ON**, the lower lead of the LED is almost directly connected to the 0v rail.
The voltage between the lead of the LED and 0v rail is 0.2v. This is the characteristic voltage across the collector-emitter terminals of a transistor when it is TURNED ON.

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In the three diagrams above you can see the LED is changed from an **OFF** condition to an **ON** condition by the action of the transistor.
The transistor is acting **LIKE A SWITCH.**
This action is one of the most important actions in electronics.
It is called: **"The Transistor as a SWITCH"**
It is the basis to ALL Digital Circuits.
It is the basis because of these two facts:
1. When the transistor is **OFF**, the circuit is taking **no current** and no power is being lost or wasted.
2. When the transistor is **ON**, the LED is almost at 0v and no resistor is in the lower lead to waste any power.
Thus we can turn things **ON** and **OFF** without wasting and power.
This is the basis to **DIGITAL ELECTRONICS**.

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DIGITAL ELECTRONICS revolves around circuits that are either **FULLY ON** or **FULLY OFF**. This means they take almost no power and we can combines lots of circuits and still take almost no power.
This means they do not get hot and it also means they will last a long time.
You may not think turning a transistor **ON** and **OFF** will achieve any worthwhile outcome but a circuit can be designed to use two transistors (similar to the **ROBOT MAN** above). The circuit does not Flip-Flop but requires a switch and when the switch is pressed, the circuit changes state. The two transistors are connected together and it takes two presses of the switch to make the output of the second transistor change state ONCE.
The circuit is a divider. It is called a: **divide-by-two** and is the basis of all counting in a computer.
By adding more "**divide-by-two"** circuits we can get "**divide by 4**, **divide by 8**" etc. Two transistors don't do much but when you combine millions of transistors we have a **COMPUTER.**

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Two transistors can do one more thing. They can "**REMEMBER**."
Here is a manual circuit.
Pressing Switch **A** turns the LED **ON** and pressing switch **B** turns the LED **OFF**.
The circuit "remembers" or remains in each state called a stable state.

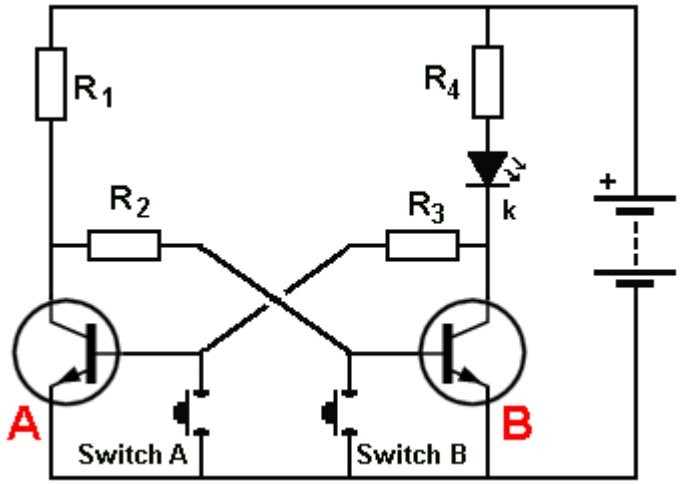

Fig 76. The "MEMORY CELL"

When Switch **A** is pressed, the voltage on the base is removed and transistor **A** turns OFF.
Transistor **B** turns ON via resistors R_1 and R_2 and the LED is turned **ON**.
When the switch is released, the voltage on the collector of transistor **B** is less than 0.6v and the two transistors remain in this state.
Pressing switch **B** turns the LED **OFF.** (transistor **A** turns ON via R_3, R_4 and the LED - very little current flows through the LED and you can hardly see it glowing). The voltage on the collector of transistor **A** is less than 0.6v and the two transistors remain in this state.

The technical name for this circuit is:
BISTABLE MULTIVIBRATOR or **BISTABLE SWITCH** or **BISTABLE LATCH**.

This is the basis to all the memory in a computer.

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In electronics, we talk about the **DIGITAL TRANSISTOR** and **ANALOGUE TRANSISTOR**.
This is just an ordinary transistor (called a Bipolar Junction Transistor) in a **DIGITAL CIRCUIT** or **ANALOGUE CIRCUIT**.
We are now discussing the **DIGITAL CIRCUIT** - The Multivibrator - Astable Multivibrator and Bistable Multivibrator (Memory Circuit).
The **DIGITAL CIRCUIT** has **2 STATES**.
The **ON STATE** and the **OFF STATE**.
It is conducting in the ON STATE and the LED is illuminated.
In the OFF STATE, the LED is not illuminated.
In the ON STATE the transistor is said to be **CONDUCTING** or **BOTTOMED**.
In the OFF STATE the transistor is said to be "**CUT OFF** or "**OFF**."
These two states are reliable and guaranteed. They are not "half on" or "quarter on" or "75% off."
These states are easy to transmit "down a wire." The ON STATE is transmitted as "1" (voltage present) and the OFF STATE is transmitted as "0" (voltage not present).
These are the two **DIGITAL STATES**.

The **ROBOT MAN** is a **DIGITAL CIRCUIT**.
Each LED is ON or OFF.
The waveform on the output of each transistor is called a **DIGITAL SIGNAL**.

The waveform is said to be **DIGITAL** or **SQUARE WAVE**.
The top line of the graph represents the LED OFF.
The bottom line of the graph represents the LED ON. The LED is ON when the collector voltage is LOW because we are pulling the lead of the LED to the 0v rail as shown above.
The circuit changes from one state to the other very quickly and this is called the **RISE TIME**.

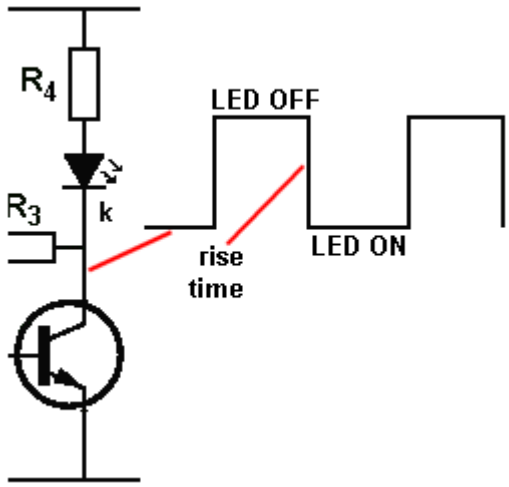

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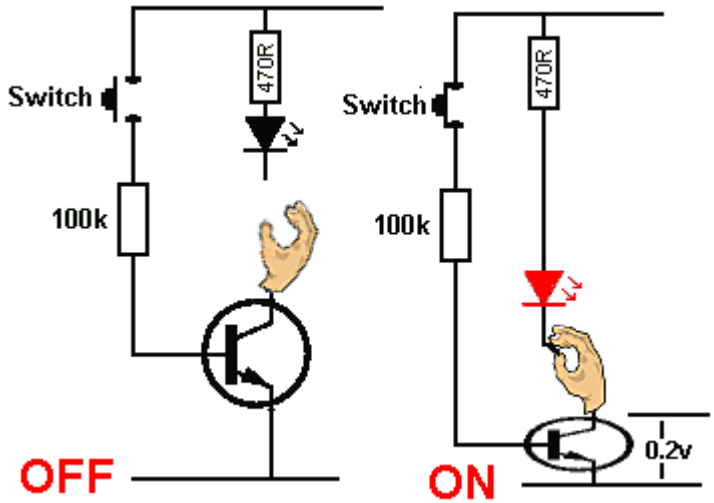

Fig 77. The two Digital States

Going over the two **DIGITAL STATES** for a transistor.

In the first diagram the switch is not pressed and the base does not see a voltage to turn the transistor on. The transistor is "**OFF**" (not conducting) and it is not "grabbing" the LED. The LED is not illuminated.
In the second diagram the base of the transistor sees a voltage via the switch and it is TURNED on. The LED is illuminated.

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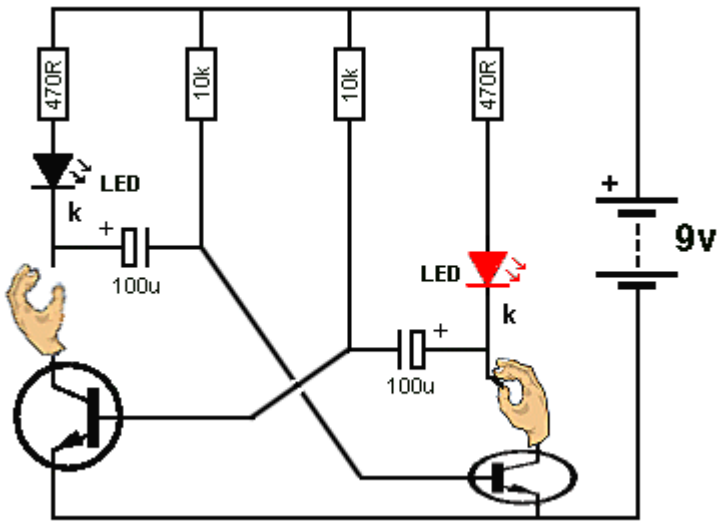

Fig 78. ROBOT MAN Animation
This animation shows how a transistor grabs a LED and pulls it towards the 0v rail to turn it ON.

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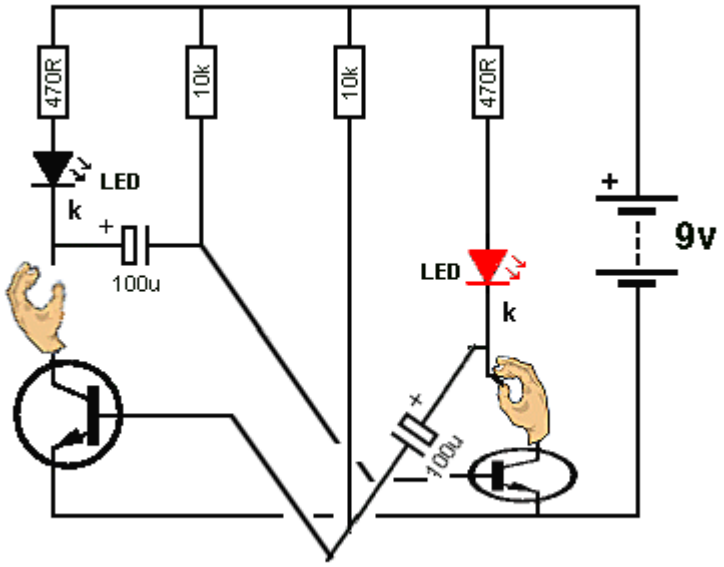

Fig 79. TIME DELAY Animation

The animation in **Fig 78** shows the two transistors turning the LEDs **ON** and **OFF** in a **FLIP FLOP** circuit.
We know the 10k and 100u components form a **TIME DELAY** to create the time for each LED to be illuminated. The timing for one LED plus the other LED creates a **CYCLE** and this is the **FREQUENCY OF OPERATION** for the circuit. It is measured in cycles per second - Hertz - Hz.
We will now go into more detail of how the **TIMING COMPONENTS** create the **TIME DELAY** for each LED.
The circuit is more-complex than you think.
The 100u is already charged from a previous cycle and we show how it gets discharged via the 10k and charged in the opposite direction by the 10k to create a **TIME DELAY**.

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THE CAPACITOR

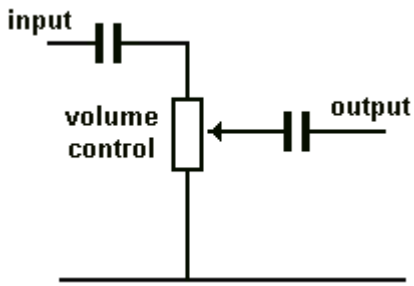

The capacitor can perform many different functions and produce many different effects, depending on its value and the surrounding components.
In this circuit the capacitors on the input and output prevent DC on the volume control creating "scratchy sounds" when the volume is altered.
This is called "DC blocking."
The AC (the signal) passes through the capacitors but the DC voltage on the input is blocked.

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CHARGING A CAPACITOR Part II

It is easy to see how a capacitor charges via a resistor in the **TIMING CIRCUIT** (Delay Circuit) above but many capacitors are not connected to the 0v rail.
They are connected as show in the animation below and their "job" is to pass a waveform.
When they pass the waveform they **CHARGE** and **DISCHARGE**.
The waveform is called an **AC SIGNAL** and the output is smaller than the input.
The circuit is taken from the circuit above, but the same effect applies to all capacitors that "pass a signal."
Here's why:

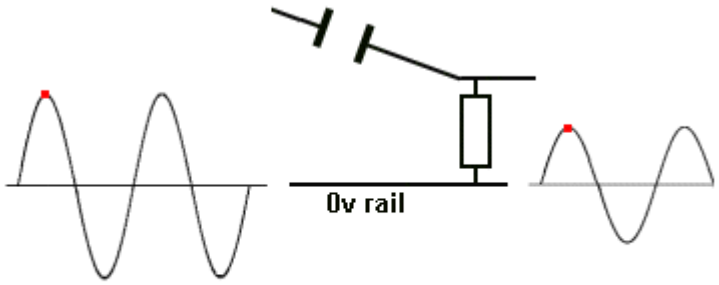

The capacitor charges slightly during the rise of the signal and the right-plate of the capacitor does not rise as high as the left-plate. That's why the output signal is not as large as the input signal.
If the capacitor did not charge, the output would be as large as the input. If you use a capacitor with a large value, it will not charge and thus the output will be as large as the input.
That's why you use a large capacitor !!!!

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CHARGING A CAPACITOR Part III

Here is another CAPACITOR in action.

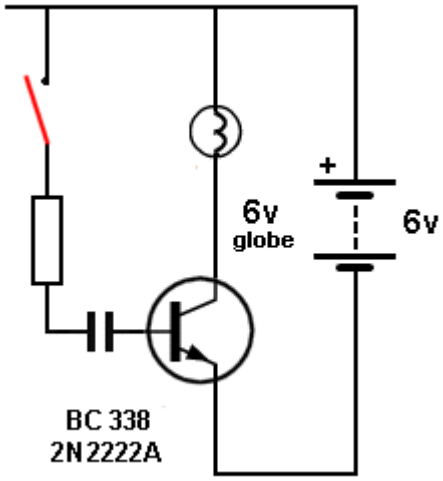

The animation shows a capacitor charging (via a resistor). The initial current is LARGE and this turns the transistor FULLY ON and the globe illuminates. As the capacitor charges, the base current reduces and the transistor starts to turn OFF. Eventually the capacitor is fully charged and the voltage on the base falls to 0v, turning the transistor OFF.

This animation shows three features:
1. The initial charging current is HIGH.
2. It gradually falls to zero.
3.The voltage on the base drops below 0.6v and the transistor turns OFF.

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NEGATIVE VOLTAGE

You will be surprised to learn that many circuits produce a negative voltage or negative spike at some point (when doing circuit-analysis, each location or point or join of components is called a NODE) on the circuit. In other words the voltage will be LESS than the 0v rail of the circuit.
This is due to the presence of a capacitor and the animation shows how a capacitor can produce a negative voltage:

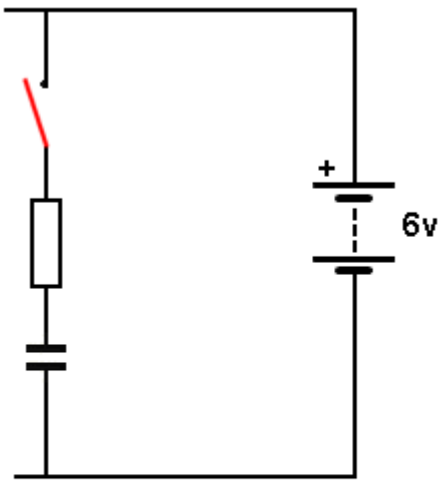

When a charged capacitor is "lowered from one position in a circuit" the positive lead may be lowered by say 3v. This means the other lead will be lowered by 3v. We are assuming the capacitor can be lowered and is not directly connected to the 0v rail.

You can see the electrolytic produces a NEGATIVE VOLTAGE on the base in the following animation, when the two transistors change states:

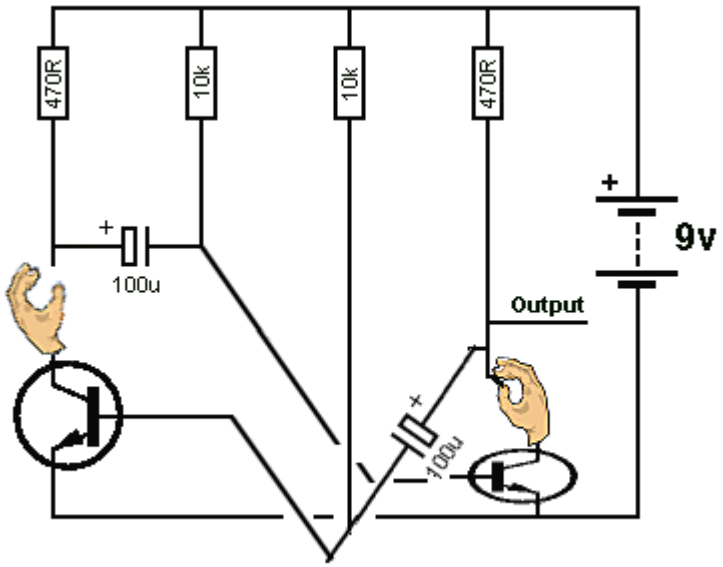

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The Electret Microphone

The most common type of microphone is the ELECTRET MICROPHONE.
It is incorrectly termed the "Capacitor Microphone" or Condenser Microphone." "Capacitor Microphone" descriptions make no mention of a FET as the amplifying device and a polarized diaphragm to detect the audio, so they are something different.
The electret microphone consists of a FET (transistor)

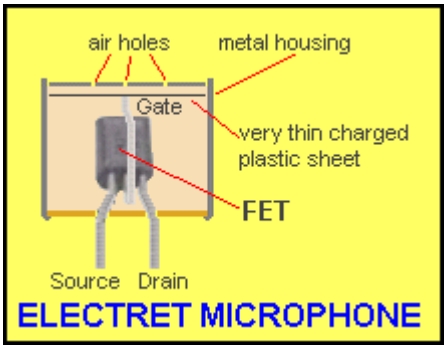

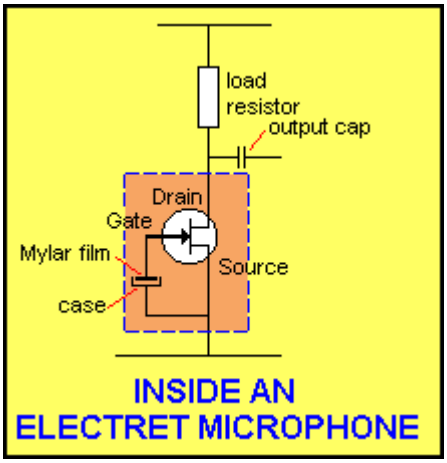

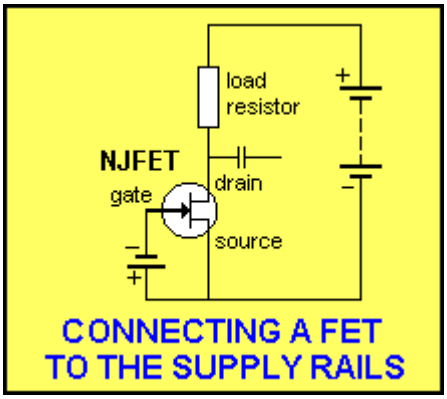

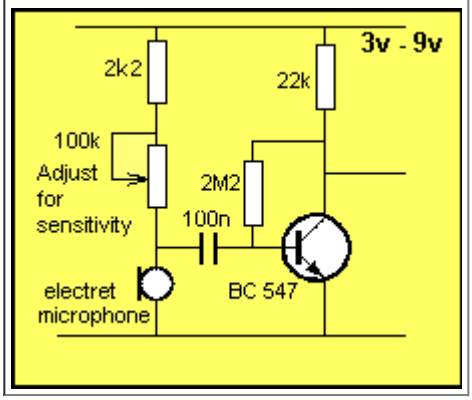

inside an aluminium case with a very thin Mylar film at the front. This is charged and when it moves (due to the audio it receives via a small hole in the front of the case), it vibrates and sends a very small voltage to the GATE lead of the Field Effect Transistor. This transistor amplifies the signal and produces a waveform of about 2mV to 20mV at the output.
The electret microphone requires about 0.5mA and will operate from 1.5v supply with 4k7 LOAD RESISTOR.
For 3v supply, the Load Resistor can be 22k to 47k.
For higher supply voltages the resistor will be 68k or higher.
Electret microphones are extremely sensitive and will detect a pin-drop at 3 metres.

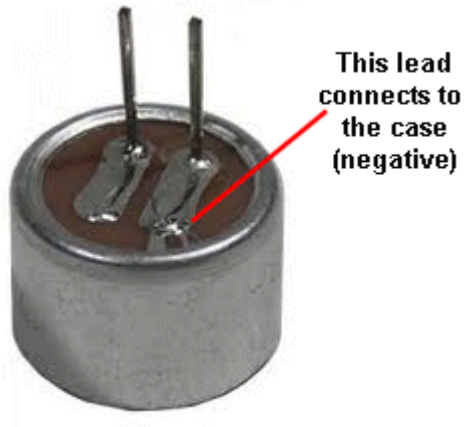

Most electret microphones have two leads. One lead is connected to the case and this lead goes to the 0v rail.
The other lead goes to a LOAD RESISTOR (4k7 to 68k - depending on the voltage of the project).
Reducing the value of the load resistor will increase the sensitivity until the background noise is very noticeable.
They are used in Hearing Aids and are more-sensitive than the human ear.
They are very small, low-cost and very sensitive.

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The Speaker

The most common speaker is about 30mm to 60mm diameter and 8 ohm impedance. This means the voice coil is about 8 ohms resistance.
The two leads can be connected either way to a circuit.
The speaker shown is 32mm diameter and has a realistic wattage of 100mW (NOT 1watt).

These speakers have a Mylar cone and the magnet is a "super magnet" and very small. That's why it is so flat.

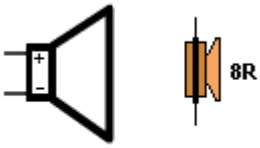

Speaker Symbol

A speaker can be used as a microphone (called a Dynamic Microphone) and a circuit to connect the speaker (mic) to an amplifier can be found on Talking Electronics website. It is not as sensitive as an electret microphone and does not produce the same output amplitude, but it is an emergency microphone.

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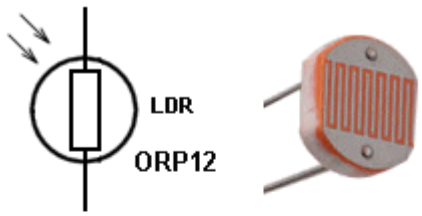

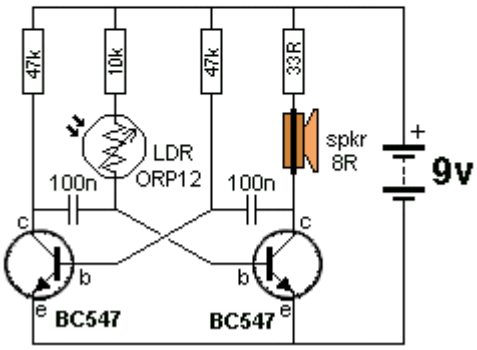

LDR and Light Alarm Circuit

Light Dependent Resistor

(LDR)

Also called **PHOTOCELL** or **PHOTO RESISTOR**
A **Light Dependent Resistor** is a 2-leaded component containing a layer of semiconductor material.
The top contains two interleaving combs of conducting wires with a path of semiconductor material between. When light falls on the component, the resistance of the semiconductor material decreases.
In darkness the LDR will be about 300k. In very bright light the resistance will be about 200 ohms.
But if the light changes only a very small amount, the resistance CHANGE is VERY SMALL. For a large change, see **Photo Transistor**.
The **Light Alarm** circuit will produce a squeal when light falls on the LDR.

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Photo Transistor

The **Photo Transistor** is very sensitive to changes in illumination. It is about 100 times more sensitive than the **LDR**.
The **Photo Transistor** is also available as a **DARLINGTON.**
The Darlington Photo-transistor is 100 x 100 times (10,000) more sensitive than the LDR.

The **Photo Transistor** and **Photo Darlington Transistor** are connected just like a normal transistor but the base lead is not connected. If the value of the LOAD RESISTOR is large, the

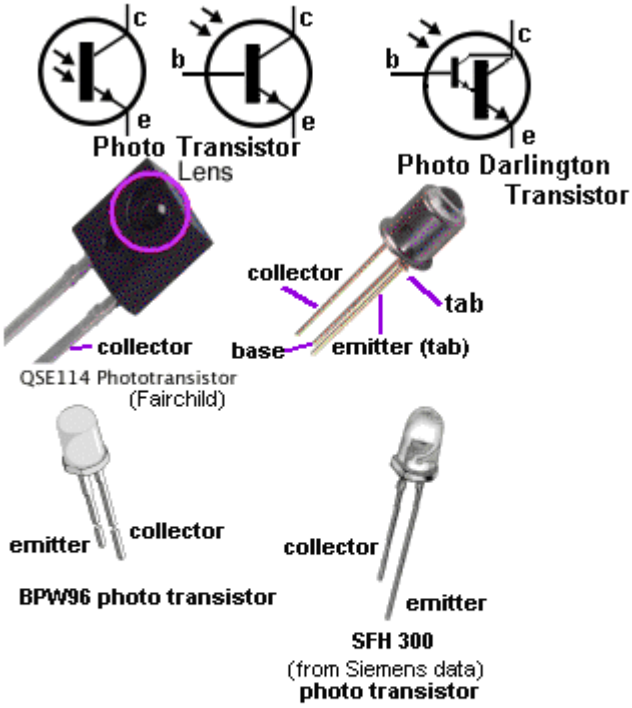

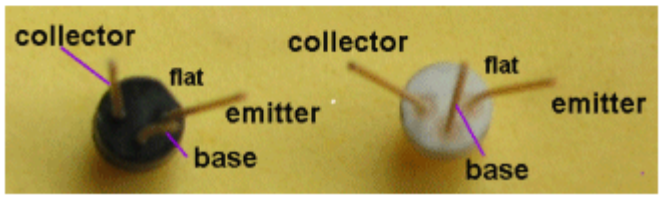

FPT100 Photo Darlington Transistor

The FPT-100 Darlington Photo Transistor is available from Talking Electronics for $1.00 each plus postage.

transistor will not be very sensitive.

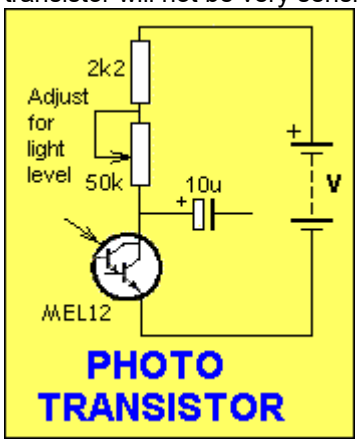

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The Inductor

Also called **"coil,"** or **"Choke."**
An **Inductor** consists of one to many turns of wire wrapped around a former (tube of cardboard). The wire can be jumble-wound or wound in layers. The result is the same. This is called an **air-cored coil** or **air-cored inductor**.
The centre can be filled with a metal such as iron or laminations (thin sheets of metal) or a ferrite material. Different cores operate at higher frequencies.
The core can be circular (doughnut) or rectangular and it is called a **MAGNETIC CIRCUIT** (when it is a closed loop).
Additional turns or increasing the diameter of the turns will increase the inductance.
A coil with a magnetic core can be used to pick up nails and metal items. It is called an **electromagnet**. It can be

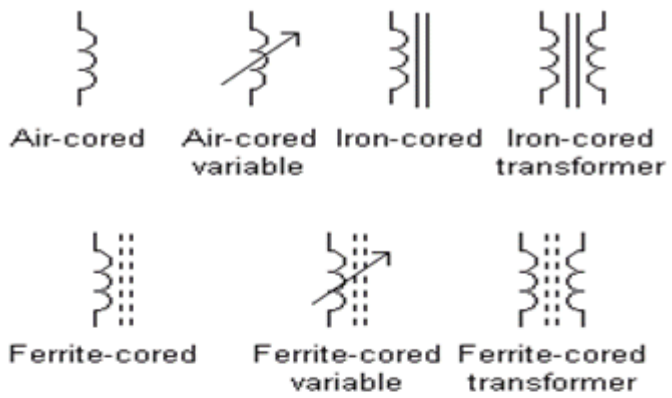

The emerging **magnetic lines of force** from an inductor produce the NORTH POLE - this is just "convention," a simple way to explain things - to get the explanation started.
When two or more coils are wound near each other, the inductor is called a **TRANSFORMER** (but not the armature above).

operated on AC or DC.
When the metal core is loose and gets pulled into the coil it is called a **SOLENOID** or **ACTUATOR** or **LINEAR ACTUATOR**. It can be operated on AC or DC.
The way an inductor works is very complex but we can say it resists any rise or fall in voltage by turning the rise or fall into magnetic flux.
If the applied voltage is suddenly turned off, the inductor produces **a very high voltage** of **opposite polarity** (these are the **two** most important things for you to remember).

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The Antenna

The first time you will need an antenna is when making an FM transmitter.
The antenna is usually a length of wire equal to half the wavelength of the transmitter. The frequency is about 100MHz and the wavelength is 3 metres.
A half-wave antenna is 1.5metres.
The length is important but the height is more important.
The wire should be as high as possible and "up-and-down" if the antenna on the radio is vertical, to get the maximum range.
This is called an **end-fed half-wave antenna** or **half-wave**

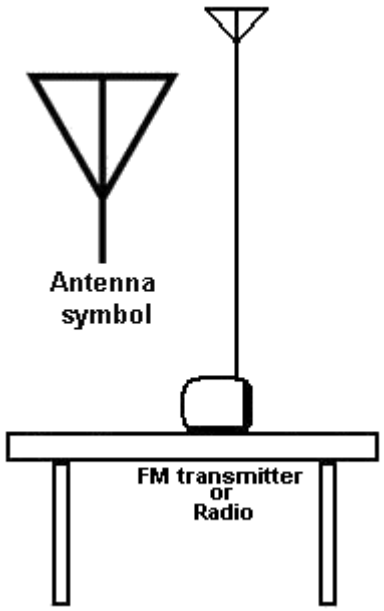

Monopole.
The transmitting circuit should have a good ground-plane such as connection to large batteries so the signal can be pushed and pulled into and out of the antenna.
This signal is then radiated as electromagnetic radiation to the surroundings.

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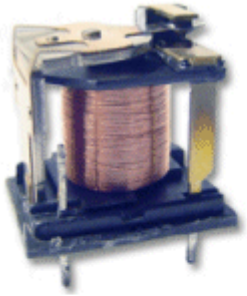

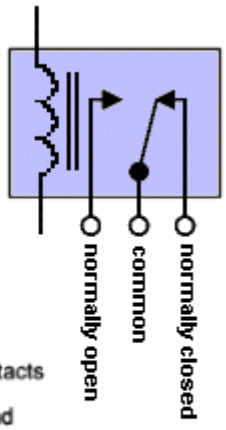

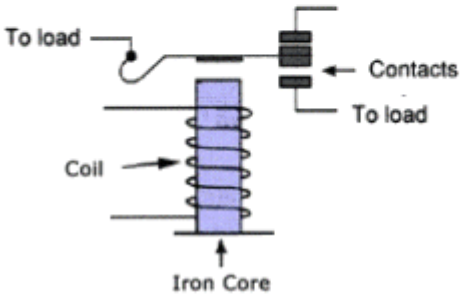

A single contact consists of 2 pins -called SPST (single-pole single-throw).
Or a single pair of contacts can consist of 3 pins - called change-over or SPDT (single-pole double-throw).
A double set of contacts consists of 6 pins, called DPDT (double-pole, double-throw). This is also called a **CHANGE-OVER RELAY** or **REVERSING RELAY** (when connected to a motor).

The RELAY

The word **Relay** comes from the days of Morse Code where a coil of wire (an electromagnet) closed a switch to allow the Morse code to travel further down the telegraph line.
It would "relay" or "pass-on" the information.
A relay allows a "weak circuit" (one with low current) to operate a LOAD that needs a large current. It also separates the two circuits electrically and prevents a voltage such as 240v connecting to a 12v circuit. The coil is separated from the contacts and this gives the two circuits isolation.
A double-pole double-throw relay can be used to reverse a motor as shown here:

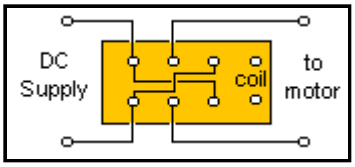

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Driving A Relay

(Powering A Relay)
The first thing you must decide is the voltage of the relay. This will depend on the voltage(s) available. The relay will be driven (activated) by a transistor and the base of the transistor only needs a signal (less than about 1v). This means the project can be operated on a voltage from 3v to 12v and the relay can be connected to a 5v to 12v supply.

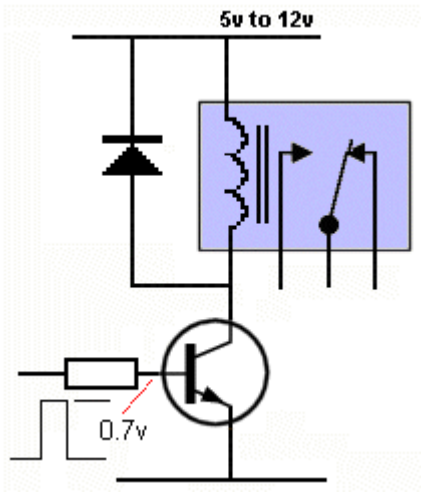

Driving A Relay

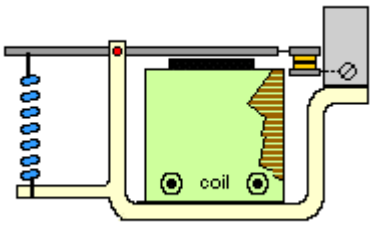

The armature is drawn towards the coil when a current flows through the coil.

Next you need to know the current-rating of the contacts. This will depend on the current taken by the LOAD. The rating of most relays is: 1 amp, 5 amp or 10 amp.
Finally you need to know how many contacts are required.
For a single circuit you will need 2 pins and for two circuits you will need 4 pins (but relays only come with 6 pins).
You can get relays that need a very small current for activation. These are called CMOS relays. But most relays need about 100mA.
To protect the driving-transistor from spikes when the relay is turned off, you will need a diode across the coil.
The top animation shows a "single set of change-over contacts."
The lower animation shows the ARMATURE being drawn to the electromagnet. The electromagnet is the coil with a core of magnetic material that becomes a magnet (an electromagnet) when a current flows through the coil.

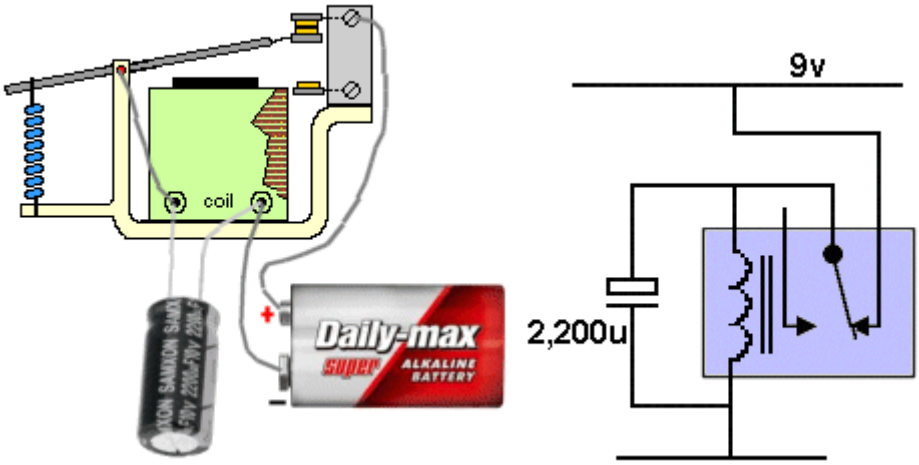

When the circuit is turned ON, the voltage across the 2,200u electrolytic is zero and it gradually charges. When the voltage is about 8v, the coil has enough voltage across it to pull the armature and open the contacts. The electrolytic supplies voltage to the coil for about 1 second and then the electromagnet does not have sufficient magnetism to hold the armature and it returns to close the contacts.

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GATES

Animations of **GATES** and more details of their operation is covered in **DIGITAL ELECTRONICS** chapter.

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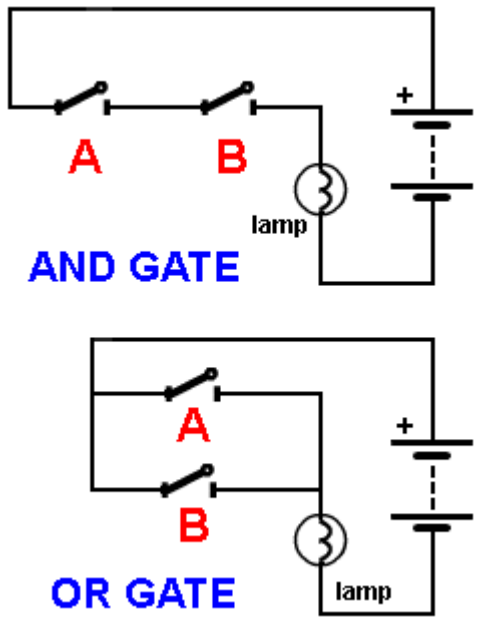

Fig 80. The "AND" GATE and "OR" GATE with switches

The next **BUILDING BLOCK** we will cover is called the **GATE**.
In its simplest form it is an electrical circuit consisting of switches.
Its just two or more switches connected in series or parallel.
We give each circuit a name so we can talk about it and explain its action with a single word.
Later we will cover the electronic version and show how diodes and a transistor are needed to perform a **GATING FUNCTION.**
The type of GATE we are talking about is a **LOGIC GATE**.
The circuit performs an operation called a **LOGICAL OPERATION** on an input or a number of inputs and creates a single output - called a **LOGICAL OUTPUT**.
LOGICAL means "understandable" or "correct" and in this case it means DIGITAL - the signal will rise to full rail voltage or fall to zero voltage. The output will not be half rail or quarter-rail voltage.
The diagram show an **"AND" GATE** and **"OR" GATE** with switches.
For the **AND GATE** close switch A **AND** switch B for the lamp to illuminate.
For the **OR GATE** close switch A **OR** switch B for the lamp to illuminate.

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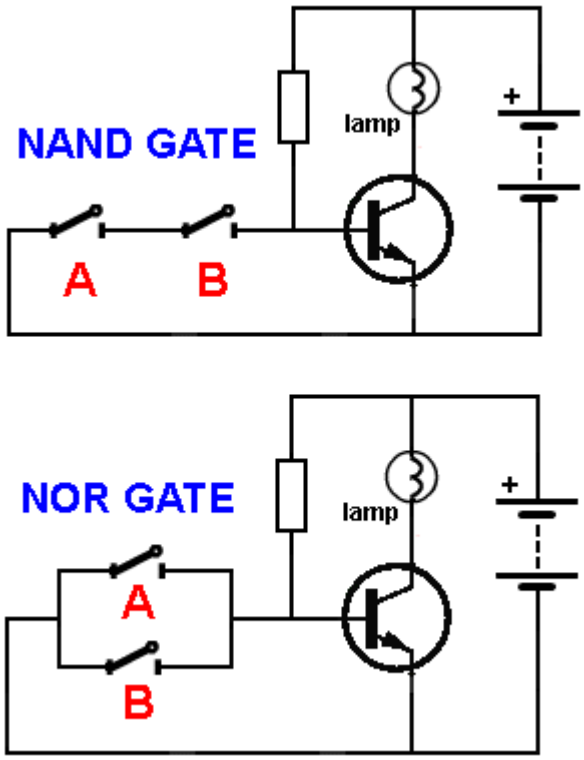

Fig 81. The "NAND" GATE and "NOR" GATE with switches and a transistor

INVERSION

Inversion produces the opposite effect to the results above.
Suppose we want to turn OFF a lamp when one or two switches are pressed.
We need a transistor.
The technical word for Inversion is **NOT**.
It is simplified to the letter "**N**."

For the **NAND GATE** close switch A **PLUS** switch B for the lamp to turn OFF.
For the **NOR GATE** close switch A **OR** switch B for the lamp to turn OFF.

These gates are only **demonstration-gates** to show how one or two switches will turn a lamp OFF.

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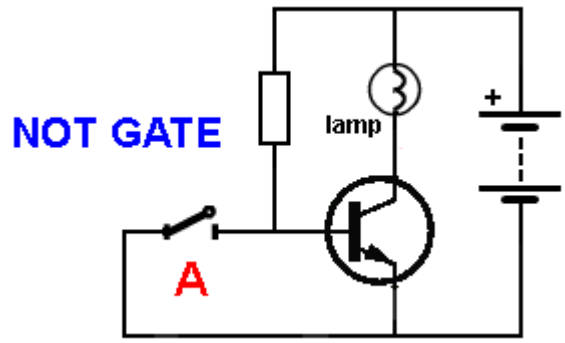

Fig 82. The "NOT" GATE

NOT GATE

A single switch and transistor produces a **NOT GATE.**
This is simply an **INVERSION**.

The resistor turns the transistor **ON** and the lamp illuminates. The switch removes the voltage on the base and the transistor turns **OFF**.
This is only a demonstration circuit to show how a switch can turn a lamp OFF.

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The 5 gates above form the basis to turning a circuit **ON** and **OFF**. We will discuss these gates later in the digital section.

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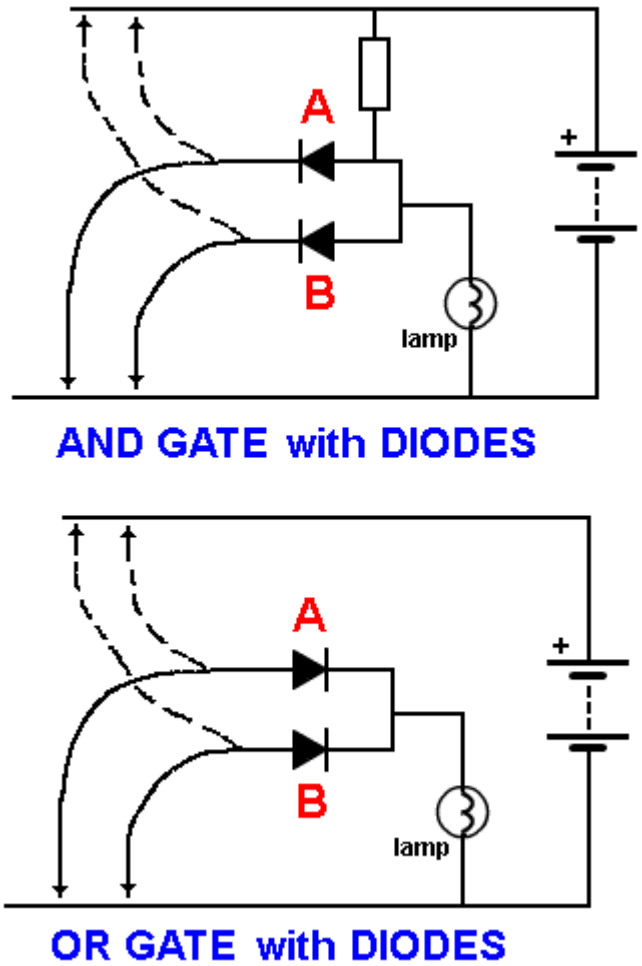

Fig 83. "AND and "OR" gate with diodes

The next building block is the **GATING DIODE**.
We have shown a diode allows current to flow when the diode is correctly placed in a circuit and blocks current when it is reversed.
The 5 gates above are electrical circuits but an electronic circuit works in a slightly different way.
The electronic circuit will be covered later in the DIGITAL section.
For the moment we will explain how a diode can be used to create a **GATE**.
In other words it creates a ONE-WAY PATH to allows signals to pass from one stage to another and prevents signals passing in the opposite direction.
In the AND GATE circuit, both inputs are LOW and current flows through the resistor (it will get HOT). When one input is taken HIGH, current still flows through the other diode and the lamp does not illuminate.
When BOTH inputs are HIGH, current flows through the resistor to illuminate the lamp. No current flows through the diodes.
In the OR GATE, when one input is taken HIGH, current flows through the diode to illuminate the lamp. This can be done with EITHER input.

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A **NAND** and **NOR** gate can be made with diodes and a transistor. This time we the output is either HIGH or LOW. We are gradually producing circuits that

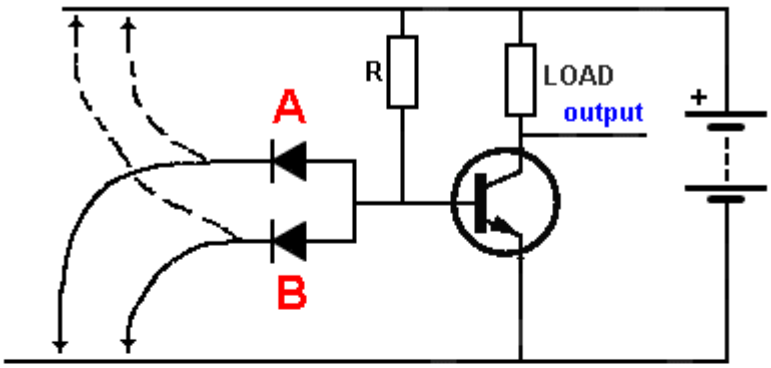

NAND GATE with DIODES and Transistor

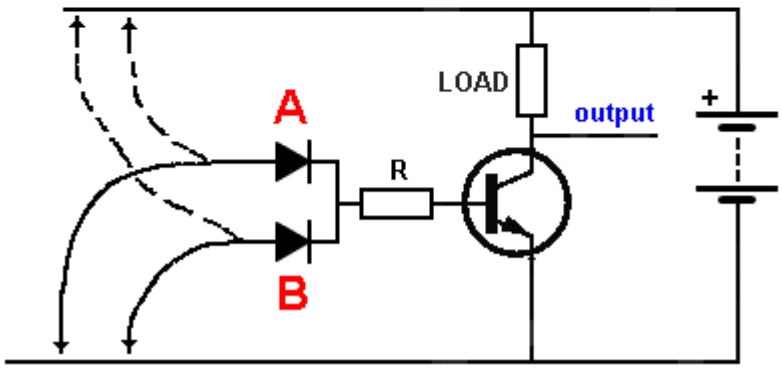

NOR GATE with DIODES and Transistor

Fig 84. "NAND" and "NOR" gate with diodes and a transistor.

are electronic, rather than electrical circuits.
In the **NAND GATE** circuit, taking one of the inputs HIGH will still allow the other input to prevent the transistor turning ON.
When BOTH inputs are HIGH, the transistor turns on via resistor R and the output is LOW.

In the **NOR GATE** circuit, taking one of the inputs HIGH will turn the transistor ON and the output will be LOW.

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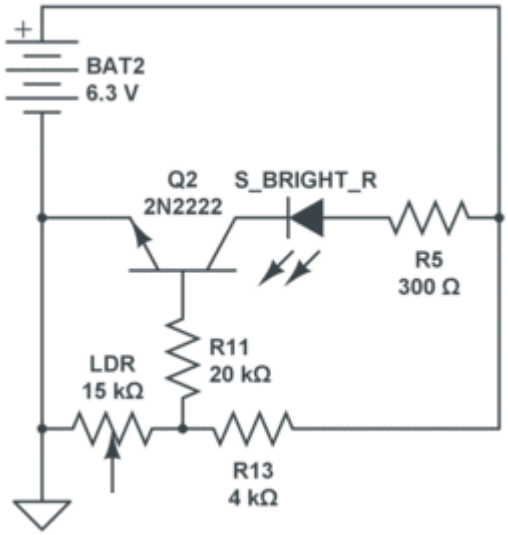

Drawing A Circuit

A circuit must be drawn according to simple rules so it can be instantly recognised.
An electronics engineer can "**see a circuit working**" when it is drawn correctly and can see if it is drawn correctly; if the parts-values are correct and can use the circuit to assist in diagnosing a problem with a faulty circuit.

The top circuit on is very difficult to visualise because it is not drawn in the normal way.
All the components have to be "**turned around in your mind**," to see what the circuit is doing.

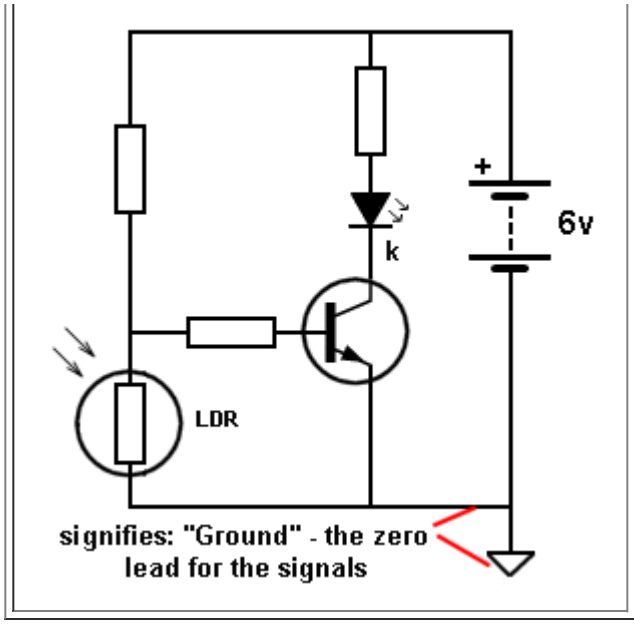

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QUICK QUIZ - to see how much you know

Answer the following 50 questions . . . JavaScript is required!
This test will see how much you have learnt.

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- [ ] An open circuit help

4. What is the approximate characteristic voltage that develops across a red LED?

- [ ] 1.7v
- [ ] 3.4v
- [ ] 0.6v
- [ ] 5v help

5. If two resistors are placed in series, is the final resistance:

- [ ] Higher
- [ ] Lower
- [ ] The same
- [ ] Cannot be determined help

6. Which is not a "common" value of resistance:

- [ ] 2k7
- [ ] 1M8
- [ ] 330R
- [ ] 4k4 help

7. Which value of resistance, placed across a 9v battery will get hot:

- [ ] 22k
- [ ] 22R
- [ ] 220k help

8. If the voltage on the base of a transistor increases, does it:

- [ ] Turn on
- [ ] Turn off
- [ ] Not enough information
- [ ] Remain the same help

9. The resistor identified in brown is called the:

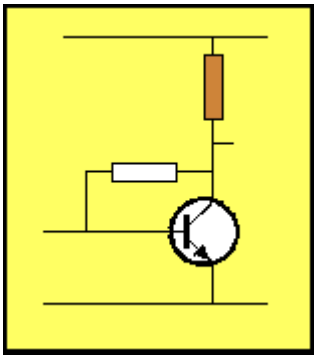

- [ ] Base Bias Resistor
- [ ] Load Resistor
- [ ] Emitter Feedback Resistor
- [ ] Bypass Resistor

help

10. The first three colour bands on a resistor are: yellow - purple - orange

- [ ] 47k
- [ ] 4k7
- [ ] 470k
- [ ] 4R7 help

11. A resistor with colour bands: red-red-red-gold, has the value:

- [ ] 22k 5%
- [ ] 2k2 5%
- [ ] 220R 5%
- [ ] 22R 5% help

12. The lead marked with the arrow is:

- [ ] The Collector
- [ ] The Base
- [ ] The Emitter
- [ ] The case **help**

13. A 10k resistor in parallel with 10k produces:

- [ ] 10k
- [ ] 5k
- [ ] 20k
- [ ] Cannot be determined **help**

14. The symbol is:

- [ ] NPN Transistor
- [ ] PNP Transistor
- [ ] Photo Transistor
- [ ] Field Effect Transistor **help**

15. Two 3v batteries are connected as shown.
The output voltage is:

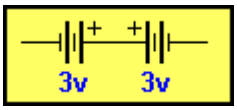

- [ ] 3v
- [ ] 0v
- [ ] 6v **help**

16. 4 resistors in ascending order are:

- [ ] 22R 270k 2k2 1M
- [ ] 4k7 10k 47R 330k
- [ ] 3R3 4R7 22R 5k6
- [ ] 100R 10k 1M 3k3 **help**

17. The closest value for this combination is:

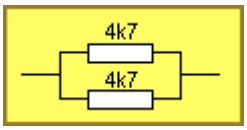

- [ ] 4k7
- [ ] 2k3
- [ ] 9k4 **help**

18. Which LED will illuminate:

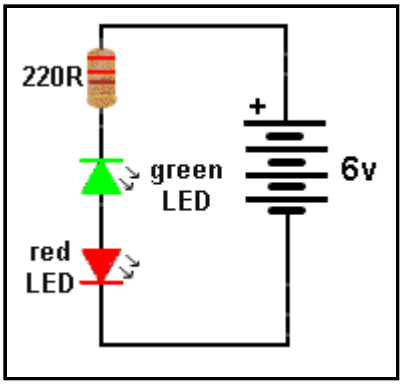

- [ ] Green
- [ ] Both
- [ ] RED
- [ ] None

19. The four symbols are:

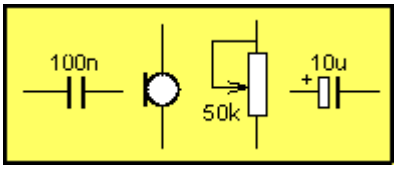

- [ ] Capacitor, Microphone, Potentiometer, Electrolytic
- [ ] Electrolytic, Microphone, Resistor, Capacitor
- [ ] Capacitor, Piezo, Resistor, Electrolytic
- [ ] Electrolytic, Coil, Resistor, Capacitor help

20. The closest value of the combination is:

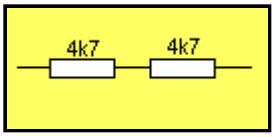

- [ ] 10k
- [ ] 2k3
- [ ] 2k5

21. Which motor will work:

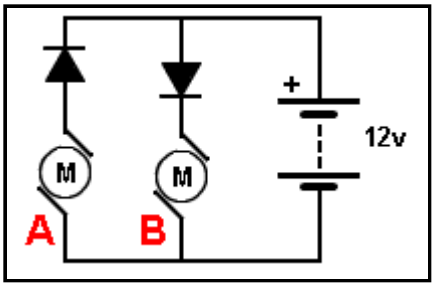

- [ ] A
- [ ] B
- [ ] A and B

22. A resistor and capacitor in series is called a:

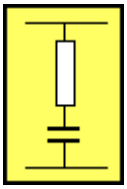

- [ ] Pulse Circuit
- [ ] Timing Circuit/Time Delay Circuit
- [ ] Oscillator Circuit/Frequency Circuit
- [ ] Schmitt Circuit help

23. A red-red-red-gold resistor in series with an orange-orange-orange-gold resistor produces:

- [ ] 5k5
- [ ] 35,200 ohms
- [ ] 55k
- [ ] None of the above help

24. Name the 4 components:

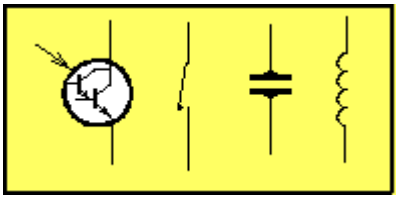

- [ ] Photo transistor, switch, capacitor, coil
- [ ] Transistor, mercury switch, piezo, inductor
- [ ] Photo transistor, reed switch, piezo, coil
- [ ] Photo Darlington transistor, switch, piezo, inductor help

25. To obtain a higher value of resistance, resistors are connected in:

- [ ] Reverse
- [ ] Forward

- [ ] Parallel
- [ ] Series help

26. Which LED will illuminate:

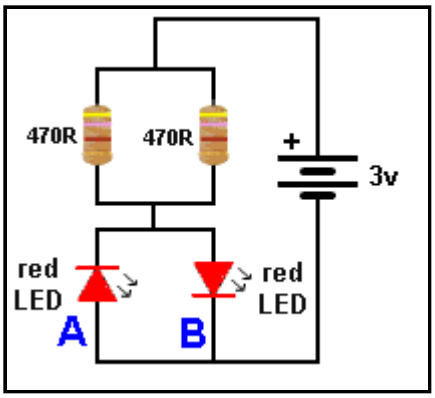

- [ ] A
- [ ] B
- [ ] Both
- [ ] None

27. Name the component that detects light:

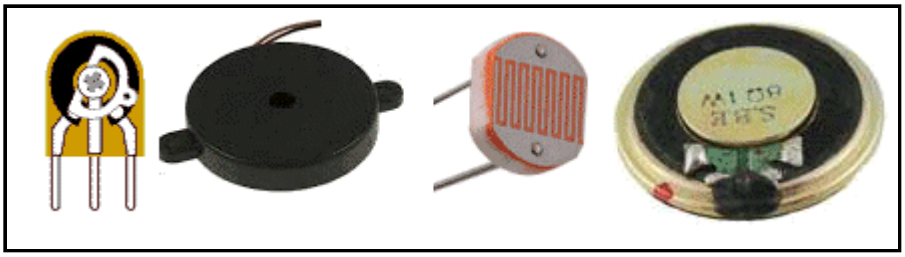

- [ ] mini trim pot
- [ ] Light Dependent Resistor
- [ ] piezo
- [ ] speaker help

28. What is 1,000p?

- [ ] 0.01n
- [ ] 0.0001u
- [ ] 0.1n
- [ ] 1n help

29. The current in a circuit is 45mA. This is:

- [ ] 0.045Amp
- [ ] 0.00045A
- [ ] 0.0045A
- [ ] 0.45A help

30. A 100n capacitor can be expressed as:

- [ ] 0.1u u = microfarad
- [ ] 0.01u
- [ ] 0.001u
- [ ] none of the above help

31. 1mA is equal to:

- [ ] 0.001A
- [ ] 0.00001A
- [ ] 0.01A
- [ ] 0.1A help

32. 1,200mV is equal to:

- 12v
- 1.2v
- 0.12v
- 0.0012v help

33. The approximate current for a toy 3v motor is:

- 10mA
- 100mA to 300mA
- 1 amp

34. What is the resistance of this resistor:

- 47k
- 4k7
- 4R7

35. Identify the correctly connected LED:

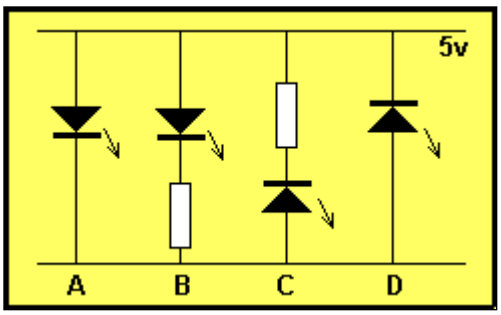

- A
- B
- C
- D help

36. Identify the correct statement:

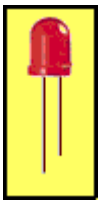

- The cathode lead is longer. It goes to the negative rail
- The cathode lead is shorter. It goes to the negative rail
- The cathode lead is shorter. It goes to the positive rail
- The cathode lead is longer. It goes to the positive rail help

37. The current requirement of a LED is:

- 1.7mA
- 25mA
- Between 3 and 35mA
- 65mA help

38. The multimeter is measuring . . .

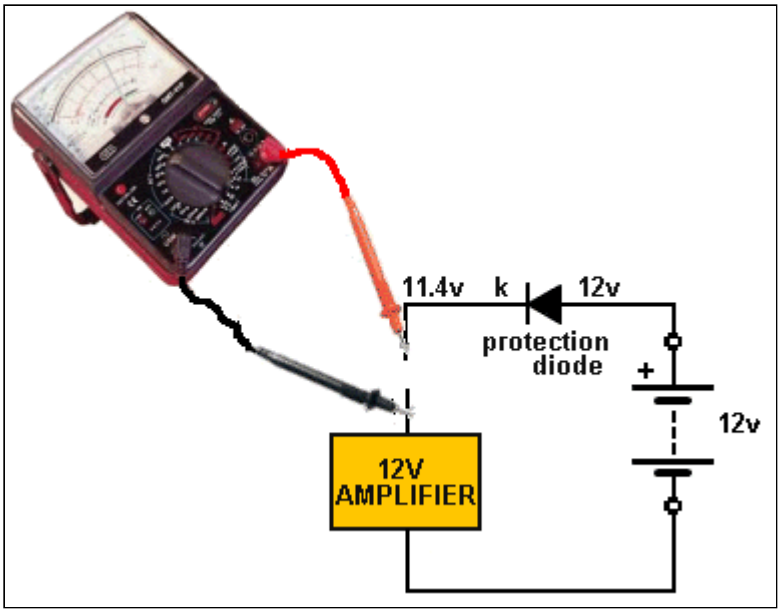

- [ ] Voltage
- [ ] Current
- [ ] Resistance

39. The purpose of the two capacitors:

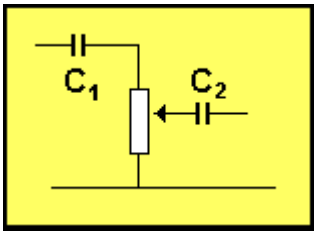

- [ ] To pass AC from the input to the output
- [ ] To allow the signal to oscillate
- [ ] To pass DC from the input to the output
- [ ] To amplify the signal help

40. The direction of conduction for a diode is:

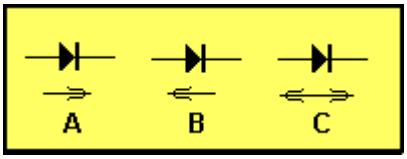

- [ ] A
- [ ] B
- [ ] C help

41. A DC voltage . . .

- [ ] rises and falls
- [ ] is a sinewave
- [ ] remains constant
- [ ] is an audio waveform help

42. Arrange these in ascending order: k, R, M (as applied to resistor values)

- [ ] R, k, M
- [ ] M, R, k
- [ ] k, M, R
- [ ] M, k, R help

43. A battery produces AC current:

- [ ] true
- [ ] false

44. The tolerance bands: gold, silver, represent:

- [ ] 5%, 10%
- [ ] 10%, 5% help

45. 223 on a capacitor represents:

- ☐ 0.022u u = microfarad
- ☐ 22n n = nanofarad
- ☐ 22,000p p = picofarad
- ☐ All of the above **help**

46. Arrange these in ascending order: n, p, u (as applied to capacitor values)

- ☐ p, u, n,
- ☐ n, u, p
- ☐ p, n, u **help**

47. What is the resistance of this resistor:

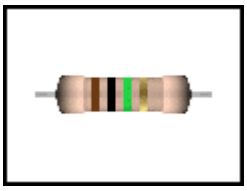

- ☐ 100k
- ☐ 1k
- ☐ 1M
- ☐ 100R

48. The number "104" on a capacitor indicates:

- ☐ 0.1u
- ☐ 100n
- ☐ 1n
- ☐ 10n **help**

49. What is the multimeter detecting:

- ☐ Voltage
- ☐ Current
- ☐ Resistance

50. For the LEDs, what is the characteristic voltage for the red and white LEDs:

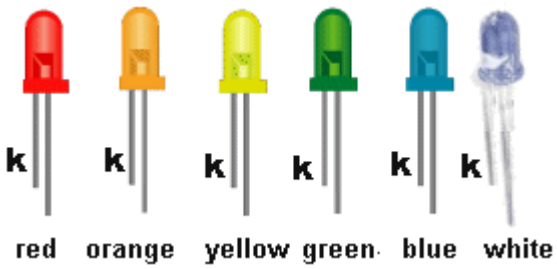

- ☐ 3.6v, 1.7v
- ☐ 2.4v, 3.3v
- ☐ 1.7v, 3.6v

- [ ] Cannot be determined

Final Assessment

THE CRYSTAL-SET RADIO

100 more Crystal Set plans

Everyone wants to make a RADIO.

The simplest radio is a **CRYSTAL SET**. (Sometimes called a **Crystal-Set Radio** or **Xtal Radio Set** or **Crystal Diode Radio**.)

However a **Crystal Set** needs a number of components that are very hard to get: (tuning capacitor with knob) and (crystal earpiece for $1.25).
The "air" TUNING CAPACITOR (20p to 415p) is not easily available and the postage is expensive. The germanium diode is a special component and the aerial coil wound on a ferrite slab is difficult to obtain.

But you don't need these components. They can be substituted.

There are hundreds of websites on the internet describing the **CRYSTAL SET** and if you want to build a "normal" set, you can Google these sites or **100 more Crystal Set plans**. Many of them sell kits too.

But this article is different.

We are going to have all the fun of making a **CRYSTAL SET** but with modern components and easy-to-make components and with an amplifier stage. The output is loud so you don't need a long antenna. And we are going to make our own TUNING CAPACITOR and a very simple aerial coil (called a FRAME AERIAL) as well as replacements for the germanium diode (use a TRF radio IC or a transistor) and in place of hi-impedance headphones (use a piezo diaphragm) and a crystal earpiece equivalent (a piezo diaphragm).
It's even better to have one of each type of component so you can compare the performance, so no matter how many parts your get, nothing will be wasted.

We are also going to explain the fundaments of how the circuit works as even the simplest circuit has a number of very important features that are used in many other circuits.

But first we are going to learn about the components and how they combine to make the circuit work.
When two or more components are connected together they sometimes produce a completely different result to the capabilities of either item.
This is the case with a capacitor and inductor in parallel. An inductor is simply a coil - turns of wire on a cardboard tube - called a former and the centre of the coil is AIR. It is called an air-cored coil or air-cored inductor.
Each component (the coil and capacitor) is called a PASSIVE DEVICE - in other words it does not amplify, but when the are connected together they create a result very near to amplification. And they also produce a result of picking up a huge number of signals and only allowing one signal to appear across the pair. A truly amazing result.

We start by placing a capacitor across the coil.
There is so much activity in the air, from radio, TV, taxi and mobile phone usage that the air is filled with electromagnetic radiation.
This radiation will cut the turns of the inductor (the coil) and produce a microscopic voltage in the turns. This is enough to start the two components passing energy back and forth at a rate

determined by their values. This is the basis of our first discussion.
These two components are called a TUNED CIRCUIT and make up our first building block called THE FRONT END.
.

THE FRONT END

This consists of a coil and capacitor. These two components are in PARALLEL and the signal (called the RADIO SIGNAL or RADIO WAVE) passes through the centre of the coil and produces a voltage in the turns of the coil. The electromagnetic wave has to pass through the centre of the coil.
This voltage is the result of a mass of signals that are interfering with each other and producing a signal called BACKGROUND NOISE.
The voltage can be increased by an external aerial (called an ANTENNA) and it consists of ALL THE LOCAL radio stations (and everything else).
The voltage is a mass of signals and is absolutely useless as it represents all the stations AT THE SAME TIME.
However, across the coil is a capacitor and these signals charge the capacitor with the very small voltage produced by the energy of the signals. When the capacitor is charged, it delivers its voltage to the coil. The coil accepts the energy and converts it to magnetic flux.
After a very short period of time the capacitor becomes discharged and the magnetic flux collapses and produces a voltage in the coil of the opposite polarity to charge the capacitor again in the opposite direction.
These two components keep oscillating back and forth, using the tiny amount of energy from the stations.
There is a natural frequency for the capacitor and coil to pass energy back and forth and one of the stations will provide energy to assist this natural frequency.
When this happens, the amplitude of the signal increases and the signals from all the other stations cancel themselves out and only one signal (waveform) remains.
This signal is called the NATURAL FREQUENCY OF RESONANCE and it corresponds exactly to one of the radio stations.

The end result is a waveform that is the exact same frequency as one of the radio stations and when voice or music is played, the amplitude of the waveform increases and decreases. This will be the signal you hear in the earpiece or speaker.
It is called an AMPLITUDE MODULATED signal and that is where we get **AM RADIO** from.

Understanding the concept of a CAPACITOR and INDUCTOR in parallel is very important. They form a TUNED CIRCUIT that has a natural RESONANT FREQUENCY.
Here is a very similar analogy. You have a heavy metal ball on a long string attached to the gutter on your house - just like a pendulum. You can push the ball very lightly with a finger and after a number of pushes you will be able to get the heavy ball swinging in a very large arc.
The only way to keep it swinging is to push it very lightly at exactly the right time. If you push it at the wrong time it will eventually stop swinging.
The parallel tuned circuit is exactly like the ball. It wants to oscillate at a particular frequency.
All the radio stations are pushing and pulling the circuit at the wrong times and nothing is happening. But one radio station pushes at exactly the right time and the circuit starts to oscillate.
All the other stations are fighting each other just like one person pushing the ball sideways and another pushing the ball from the opposite side. The results cancel each other and you are the only one assisting the swing.
The TUNED CIRCUIT can also be called a FILTER with a very narrow BAND-PASS frequency but our simple explanation describes the operation much more clearly.

There are a few other terms used to describe the components in the font end:

LOOP STICK ANTENNA -This is an alternate name given to the coil of wire wound on a ferrite rod or slab. It also has the name ROD ANTENNA or FERRITE ROD ANTENNA.
The winding can be enamelled wire or flexible wire called LITZ WIRE. This is very fine strands of enamelled wire twisted together and covered in cotton. The purpose of changing a thick wire to lots of very thin wires is to prevent the radio signals creating loops of signals within the wire and these signals will cancel each other and not produce a signal out the end of the wire.
In our experiments, we have not noticed any difference in a coil made with ordinary enamelled wire and Litz wire.

Here is a set of components to make your own Crystal set from **Scott's Electronic Parts**:
You can see the rod antenna, germanium diode, crystal earpiece, capacitor and resistor. The kit costs about $9.00 plus postage and includes knob, clips and screws but no board to mount the parts.

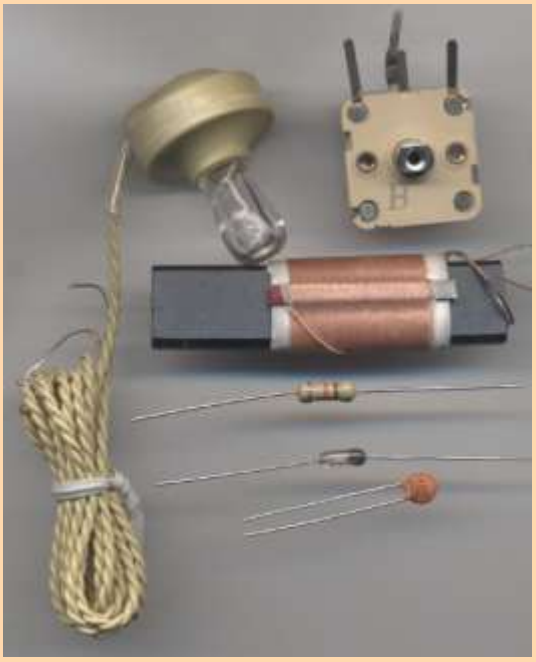

Here is the circuit for a Crystal Set:

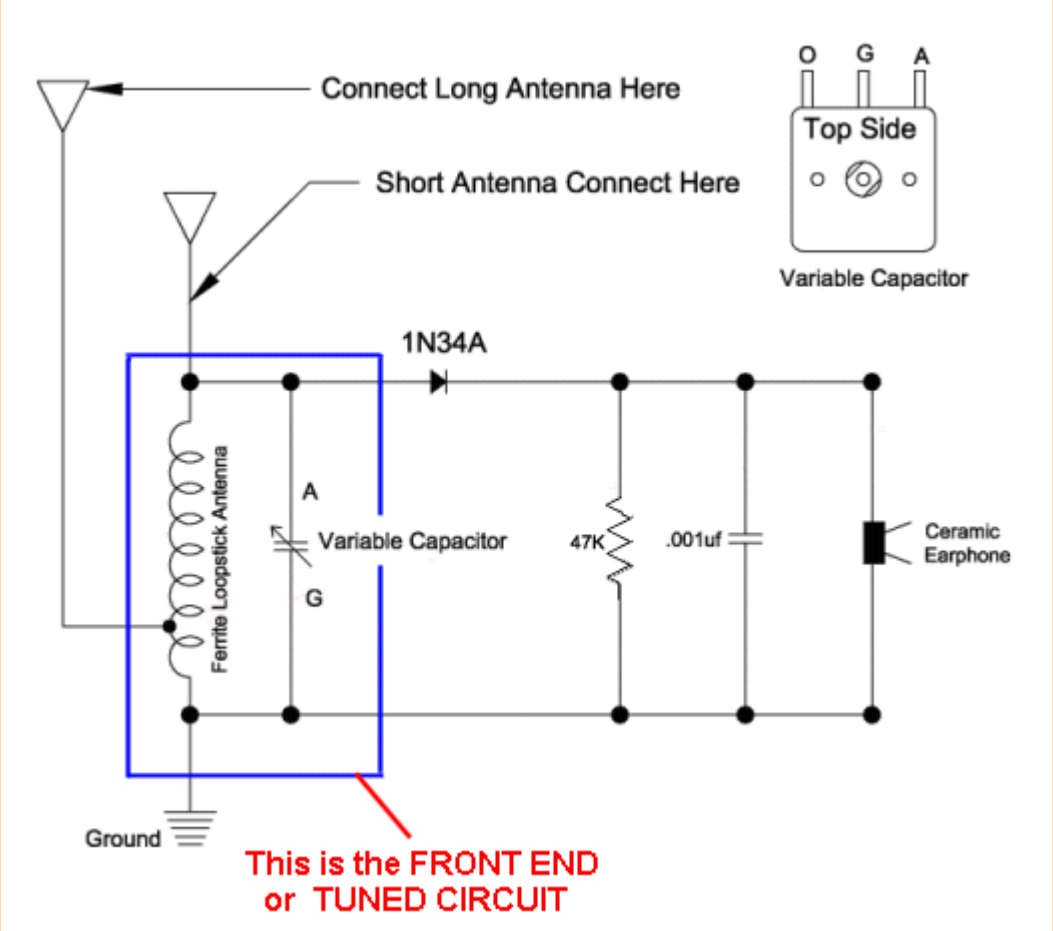

Here are the components mounted on a board called BREADBOARD:

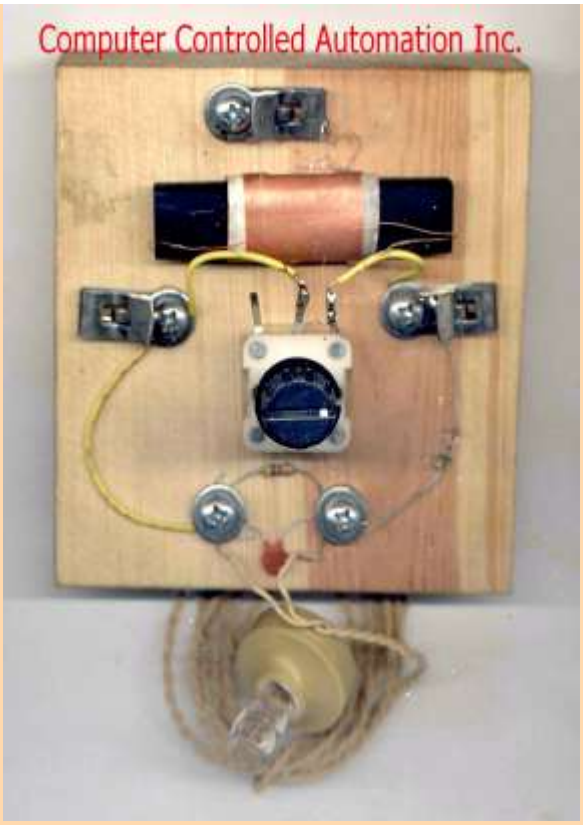

The top clip connects to a long antenna. The left clip connects to ground and the right clip connects to a short antenna.

Let me clear up a point. You do not need a ferrite rod antenna for the coil. You can use an ordinary coil wound on a cardboard tube and it will work just as well if you are using an outside antenna.
Here is the circuit using a home-made coil.

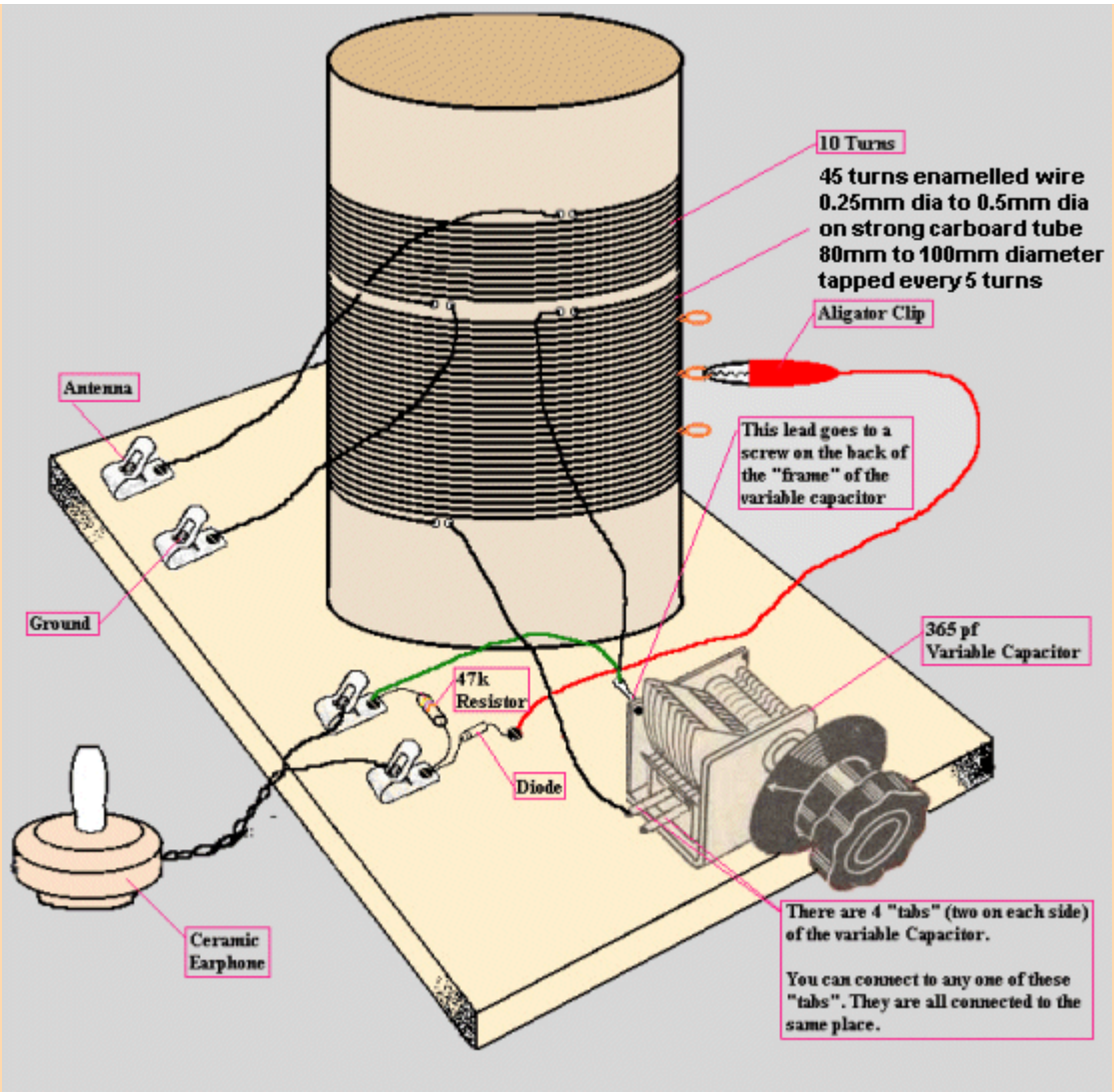

The tappings on the coil allow a wide band of radio stations to be tuned.
Each tapping allows a different portion of the band to be covered.

The next part to understand is this:
The coil and capacitor must not be LOADED. In other words, you cannot connect anything to this combination because the signal it is producing will be "taken away" or "removed" or "considerably reduced" by the item you are connecting to the circuit.
These two components are called a TUNED CIRCUIT and when they are not loaded they pick up all the radio stations, one station at a time, when the natural resonant frequency of the coil and capacitor exactly match the frequency of the radio station. The circuit actually "rejects" all the radio stations except one. Because all the other stations are trying to make the Tuned Circuit oscillate at a different frequency and it does not do this.
The result of the TUNED CIRCUIT oscillating under NO LOAD conditions produces a waveform that is very high and this gives the circuit GOOD SELECTIVITY. The circuit can select one station and reject nearby stations.
It also has good SENSITIVITY as it can pick up weak stations.
If you load the circuit, only the strongest signal will be detected and it will be spread across the full range of the tuning capacitor.
Obviously the theory is more-complex but we are explaining the end-result.
Theory talks about the "Q" value of the coil and this is its ability to produce a very good output when the magnetic flux collapses and the "Q" value increases when the circuit is not loaded. .
Although these voltages are very small (in the order of microvolts or millivolts) the result is very important as the rest of the circuit will be amplifying this waveform a few thousand times.
As we explained above, pushing the weight on a string only needs a push of 1 cm and eventually the weight will swing 1 metre. This is a gain of 100:1 The same thing happens with the tuned circuit. The incoming radio signal is in the order of microvolts, but the coil and capacitor will produce a signal as high as 500 millivolts. This is an improvement or "gain" of more than 1,000 and is referred to as the "Q" of the circuit.
You will also notice the TUNED CIRCUIT is not connected to any supply voltage. It does not have

be connected. It generates its own waveform from the signals in the air.
It should not have any DC current flowing through it via the supply as this would put a load on the circuit and reduce its operation.

However we must "pick-off" the signal so it can be amplified.
This must be done with a very high impedance circuit.

THE CONVERTER (detector) - THE DIODE

The next part of the circuit is the CONVERTER. Commonly called the DETECTOR.
It converts the RADIO FREQUENCY signal to an AUDIO FREQUENCY signal.
This is the job of the DIODE.
The radio frequency signal is a very high frequency signal (say one million cycles per second) and it is sending a tone of one thousand cycles per second through the air-waves.
What is happening is this: The one megahertz signal has a certain amplitude and over a range of the first one-thousand cycles, the amplitude gradually decreases and then increases again. If you look at the tops of this 1,000 cycles you will see a waveform that corresponds to the one kilo-Hertz signal.
The 1MHz signal is picked up by the coil and capacitor in the front end and makes it oscillate.
The radio frequency signal is gradually getting larger over 500 cycles then smaller over the next 500 cycles and this increase and decrease represents the 1,000 cycles per second tone.
This is the waveform (the signal) that passes through the diode. This will be explained further in a moment.
The diode does not pass any signals less than 200mV as the first 200mV is lost in the junction of the diode. This means the signals start to appear on the other end of the diode when they are above 200mV.

This is how the diode works:
Across the crystal earpiece is a capacitor. The capacitor gets charged via the diode.
The diode is present to stop the capacitor getting discharged when the waveform is in the wrong direction. (by this we mean - when the waveform is lower or smaller in amplitude than the voltage on the capacitor).
And the waveform is in the wrong direction about 50% of the time. To charge the capacitor for one-half-cycle requires 500 "little increments" in voltage with each increment adding a microscopic increase in voltage. We don't want this voltage to reduce when the waveform is reversing direction and the diode stops the voltage flowing back to the Tuned Circuit.
During the next half of the cycle when the pulses are getting smaller and smaller, the voltage on the capacitor is "bled off" by the load resistor.
The crystal earpiece detects this voltage. What we mean, is the diode allows the voltage to rise (increase) on the capacitor via lots of little "pulses" and the voltage increases in the form of a sinewave to a maximum amount. This voltage is passed to the crystal earpiece.
Once the voltage rises to a maximum, the little pulses of energy are not quite as strong, and the voltage on the capacitor reduces to form the second portion of the sinewave. This voltage is always being passed to the crystal earpiece and you can hear it as an audio signal.

GERMANIUM OR SILICON DIODE

The preferred type of diode for a Crystal Set is germanium. This is because it drops only about 0.3v.
But a silicon diode can be used, even though it drops about 0.7v, if the radio stations are very loud (close by).
You have to remember, you need a very good aerial (and a water-pipe earth) to get any results with a Crystal Set because you are asking the signal to provide the energy to drive the earpiece.
By simply adding a transistor, you are improving the performance 100 times and the long antenna can be reduced to a FRAME ANTENNA and the earth can be the metal frame of your soldering iron.

THE EARPIECE or EARPHONE
also The Magnetic Earpiece or CRYSTAL EARPIECE

The earphone or earpiece used in a Crystal Set must be a high impedance device because the crystal set does not produce a high current and cannot drive a low-impedance earpiece. That's why a CRYSTAL EARPIECE is ideal.
It has a crystal glued to the back of the earpiece and connected to its top surface is an aluminium diaphragm. When the crystal expands and contracts as a result of a voltage applied via two electrodes, the diaphragm moves and you can hear the signal. It exhibits a very high impedance

because it consists of a crystal and no coil of wire is contained inside the case.
If you do not have a Crystal Earpiece, you can make your own from the shell of an 8 ohm earpiece and a piezo diaphragm. Only the front part of the earpiece is used.

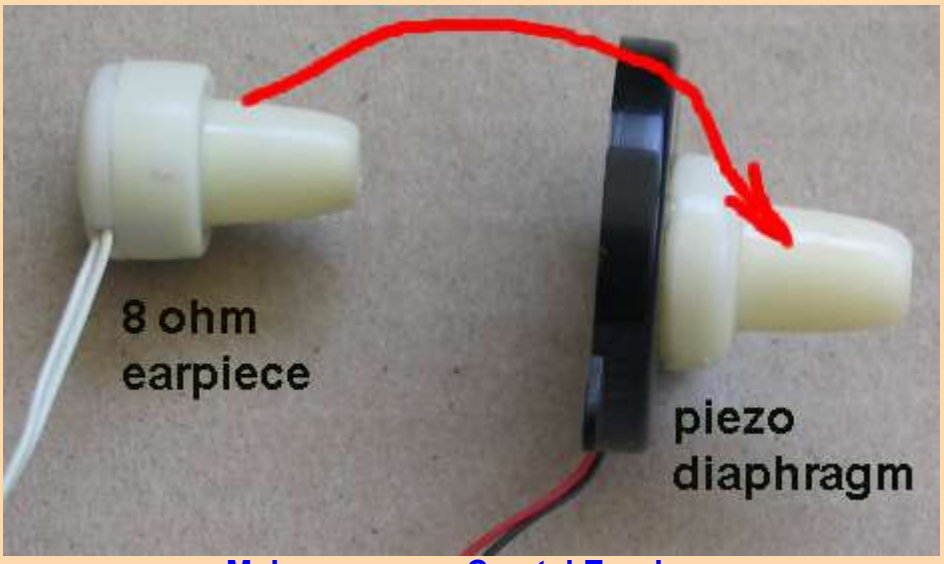

Make your own Crystal Earpiece

Hit the 8 ohm earpiece on the side and the front comes off. Glue the front onto a piezo diaphragm with hot-melt glue. See photo above.
The piezo diaphragm is a ceramic substrate that deflects in the presence of a voltage. It is quite sensitive and you can hear the audio quite clearly.
The waveform emerging from the diode in a Crystal Set is called AUDIO and although it has an amplitude of a few hundred millivolts, it does not have any current associated with it. The crystal earpiece and the piezo diaphragm react to this voltage.

THE 8ohm EARPIECE

The 8 ohm earpiece can be used with our 8ohm Buffer stage shown below.

16ohm 32 ohm and 64 ohm EARPIECE(s)

Earpieces and headsets from mobile phones are 16 ohm or 32 ohm per earpiece and are terminated via a stereo 2.5mm or 3.5mm plug. The earpieces are connected in SERIES to get the best coupling to our radio circuits and you need to find the two pins on a stereo socket to produce series connection. Get a multimeter and switch to "ohms." Try all the pins and you will get a click in the left ear then the right ear. Keep searching until you get a click in both earpieces at the same time. Use these two pins.

Stereo mobile phone headset - unusually 32R or 64R

PROBLEMS

The biggest problem with a Crystal Set is the need for a long antenna.
The first 200mV to 300mV of a signal is lost in the diode and you need a long antenna to pick up a signal so the output of the TUNED CIRCUIT has enough voltage to drive the high-impedance earpiece.
This requires an outside aerial 5 metres long and 3 metres high.
This is not practical for most hobbyists so we will be adding an amplifying stage to the crystal set so a shorter (smaller) aerial can be used.

THE FRAME AERIAL or FRAME ANTENNA or FRAME COIL

The aerial coil shown in the photo above is a ferrite slab with about 80 turns of Litz wire. You can find one of these in an old broken AM radio or from a parts-shop. In the instructions below we show how to make your own Ferrite Rod Antenna
An equally-good substitute is a frame antenna made by winding insulated wire in a rectangle around wooden sticks.

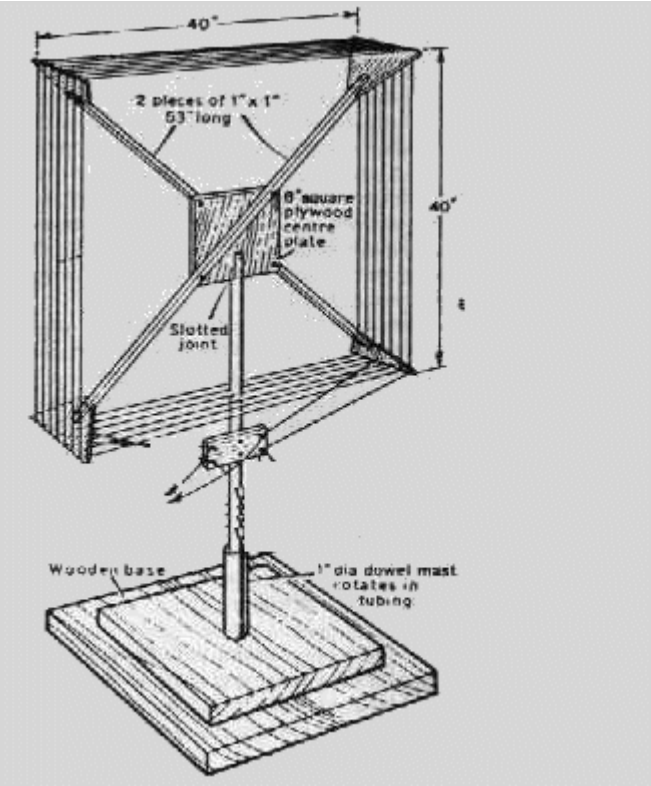

FRAME ANTENNA

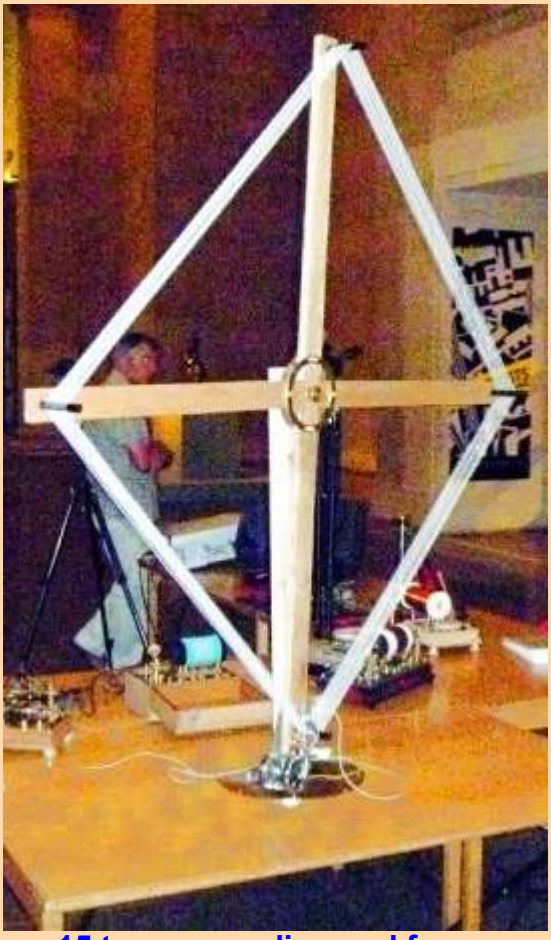

15 turns on a diamond frame

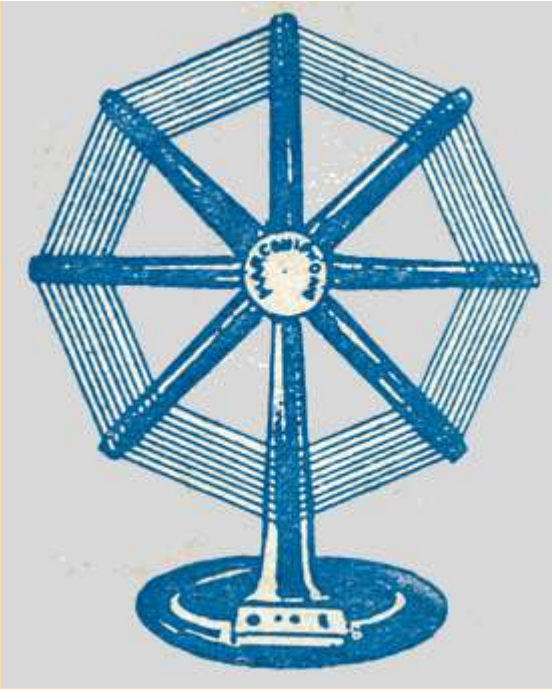

One of the earliest Frame Antennas

The Frame Aerial can be as large as 100cm x 100cm or as small as 10cm x 10cm around a plastic chocolate box.

Here are two FRAME ANTENNAS:

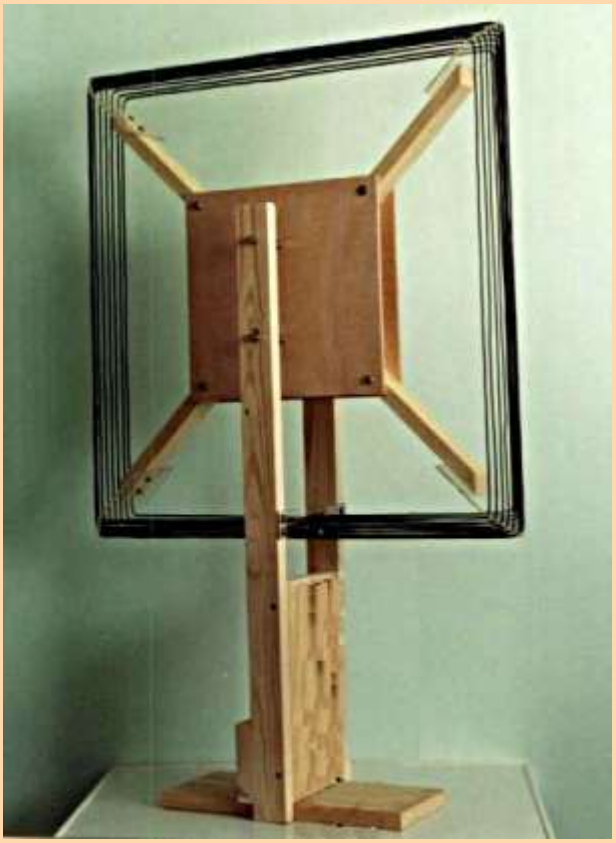

This will work just as good as a ferrite slab antenna. The slab antenna is just 100 times smaller. The slab antenna was invented so a transistor radio could be built in a small case. But if it is not available, you can wind 20 turns around a plastic chocolate box and it will work just as good.

Alternately you can wind 20 turns around a biscuit tin. Put a pencil on the tin and wind the turns over the pencil too. Remove the pencil and it will be easy to remove the turns. Use tape to keep

the turns together.

The FRAME AERIAL does two things. It picks up the radio waves and it becomes the coil (called the INDUCTOR) in the TUNED CIRCUIT. It must be placed away from metal objects, such as a refrigerator.

BASKET WEAVE COIL

There is no point making a complex BASKET WEAVE COIL as it will not work any better than simply jumble winding all the turns at the maximum circumference of the coil, because the energy capturing capability of the coil relies entirely on the amount of flux lines passing through the centre of the coil.
By increasing the centre of the coil, the amount of flux is increased for the same coil size.
In fact, the simplest and cheapest is to wind turns around a box, as explained later in this article, or make a frame antenna as shown above. Technically speaking, a round coil has the best performance but only by a few percent.

A BASKET WEAVE COIL

THE VARIABLE INDUCTANCE TUNING COIL

Whenever the size or shape of the coil is changed, (or the number of turns), the natural frequency of the Tuned Circuit will change and a different radio station will be picked up.
This means tuning across the band can be done by altering the characteristics of the coil while keeping the value of the capacitor fixed.
Changing the inductance can be done in many different ways.
The coil can have taps every 5 turns and an alligator clips selects the correct tap. But very few radio stations will correspond exactly to each tap.
Another way is to have a slider move up and down the turns as shown in the following image:

The slider makes contact where the insulation has been removed. But it may touch two turns at the same time and create a "shorted turn" and reduce the "Q" of the coil.

Another way is to move a ferrite bar (rod) in and out of the coil:

THE SLUG TUNED COIL

To tune across the radio band, the natural frequency of oscillation of the TUNED CIRCUIT must be adjusted (changed). This can be done by changing the value of the capacitor or the value of the inductor.

The value of the inductor can be changed by adding or removing turns or changing the amount of magnetic material in the centre of the coil.
A ferrite bar can be screwed in and out of the coil or slid in and out and this component is called a **SLUG TUNED COIL**.
The following diagram shows a **SLUG TUNED CRYSTAL SET**:

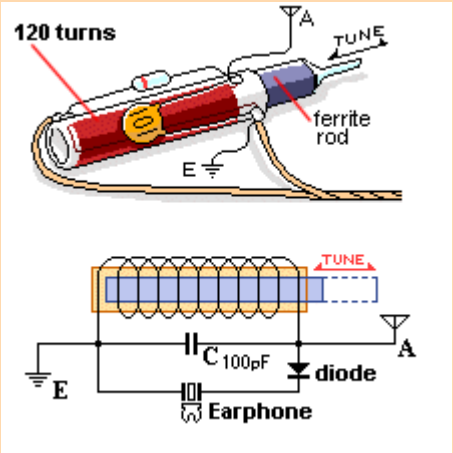

By changing the value of the 100p capacitor, different parts of the band can be picked up.

The photo shows a slug tuned coil using 60 turns of insulated wire on a 10mm tube (or any tube that will fit over a 8-10mm ferrite rod) and a circuit containing an AM radio chip plus a buffer driver transistor:

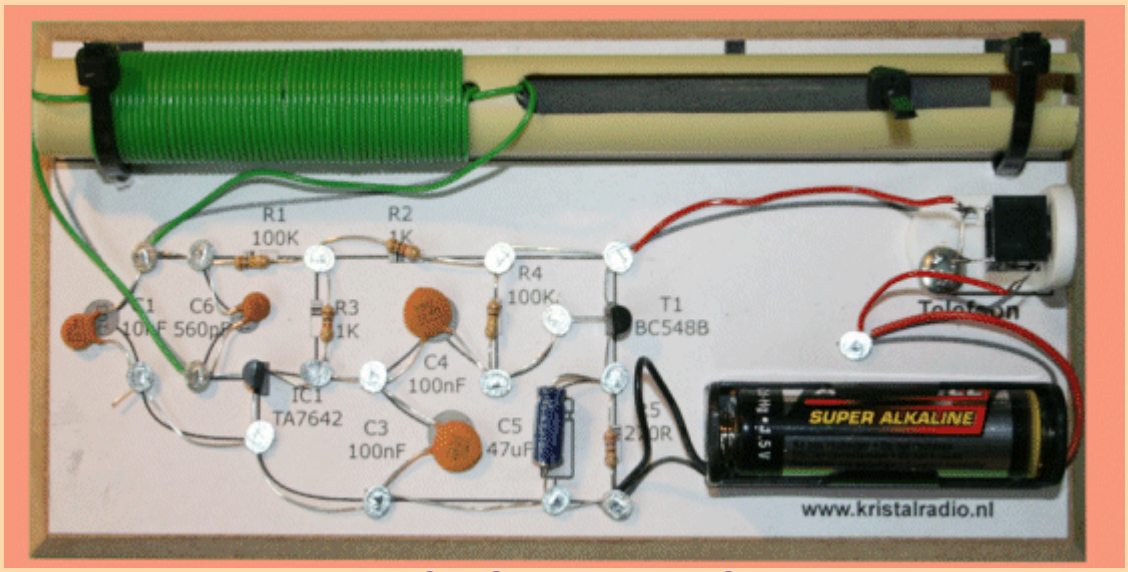

A SLUG-TUNED RADIO

The circuit above is has a broad-band amplifier consisting of 10 transistors (IC1) and they are directly coupled (connected) to each other because it is not possible to "manufacture" a capacitor inside the IC. The IC has 3 terminals (pins, legs) and it looks like an ordinary transistor. Experimenting with this type of IC has shown that it is no better than 2 ordinary transistors connected in a direct-coupling arrangement.

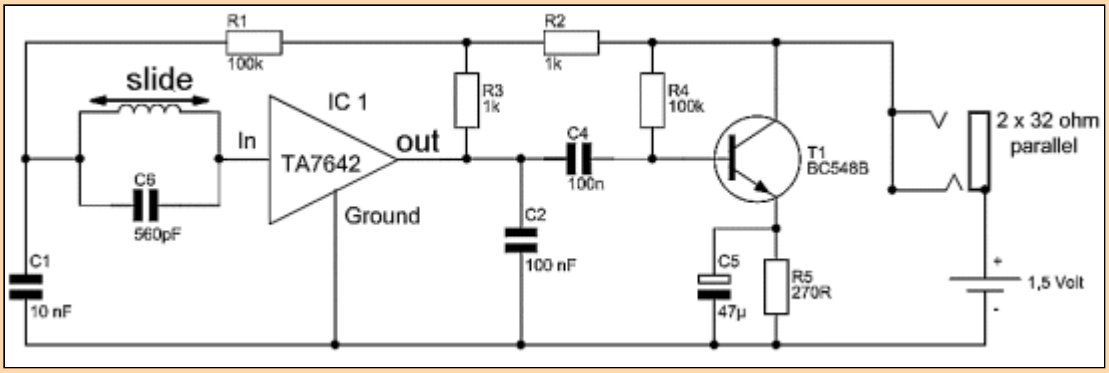

Here is the address of the site for the slug-tuned radio.
http://www.kristalradio.nl/
Unfortunately the site is in Dutch and the kit is not available. However the photos give a clear picture of the how the parts are connected.

The inductance of the coil can also be altered by winding another coil and placing it near the first coil so that the magnetic field interacts with each other and changes the inductance of the circuit. This is called a VARIABLE INDUCTANCE TUNING COIL.
You can have one coil inside the other, two coils near each other or two flat coils side-by-side. Any two coils will interact with each other.

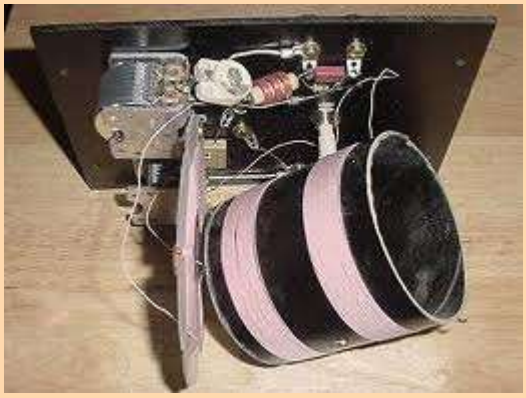

An Inductive TUNING COIL called a VARIOMETER

MAKING YOUR OWN FERRITE ROD ANTENNA

You can make your own FERRITE ROD ANTENNA by winding 60 to 80 turns of 0.25mm enamelled wire onto a 9mm ferrite rod or slab. If you wind it on a paper sleeve, you can move the coil along the rod to get the best performance. When the rod is slid out of the coil, the inductance changes considerably. However the inductance does change very slightly when the coil is moved along the rod.

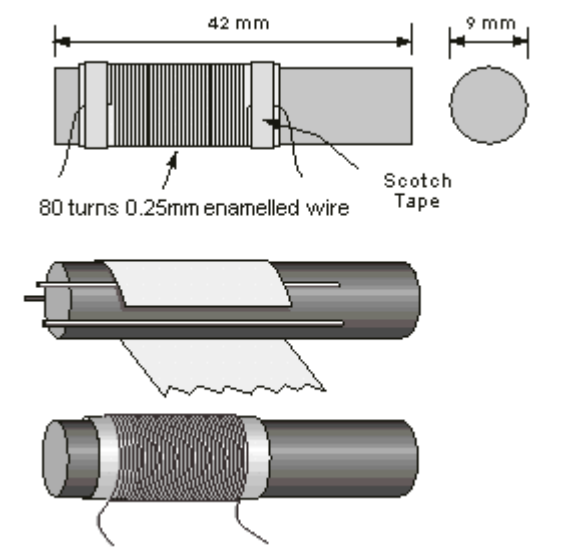

Make your own ferrite antenna

Now we come to the tuning capacitor::

THE TUNING CAPACITOR

The "C" in the "LC" TUNED CIRCUIT can be fixed or variable. When it is variable, it is called a TUNING CAPACITOR. The sheets of aluminium in the air tuning capacitor below are called PLATES and the moving plates are called VANES. The fixed plates make up the STATOR.
The space between the plates is AIR. The photo shows a single capacitor. If two capacitors are connected to the same shaft it is called a GANGED CAPACITOR.
The plates do not come fully out of mesh and that's why the capacitor has a minimum value. The maximum capacitance is when the plates are fully meshed. The odd shape of the plates is designed to produce a fairly constant increase in capacitance as the plates are engaged.

An air tuning capacitor:

Air Tuning Capacitor
(Variable Capacitor)

The capacitor can be made much smaller by using thinner vanes and placing plastic between the vanes. Plastic increases the capacitance about 3 times to 10 times.

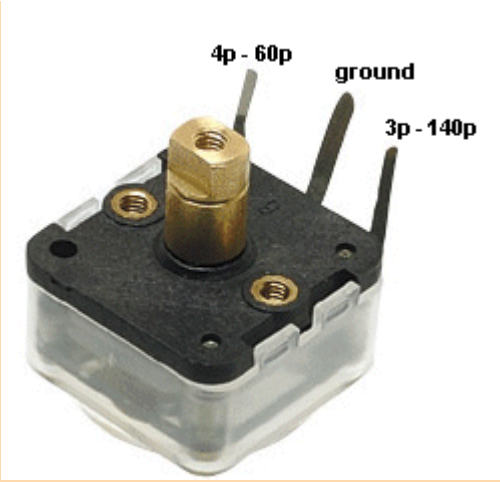

Tuning Capacitor as found in a pocket radio

The tuning capacitor can be replaced with a home-made equivalent that will work just the same.
You need:
4 sheets of aluminium foil (cooking foil) 10cm x 10cm.
4 sheets of thin cardboard 15cm x 20cm (cut A4 sheets in half).

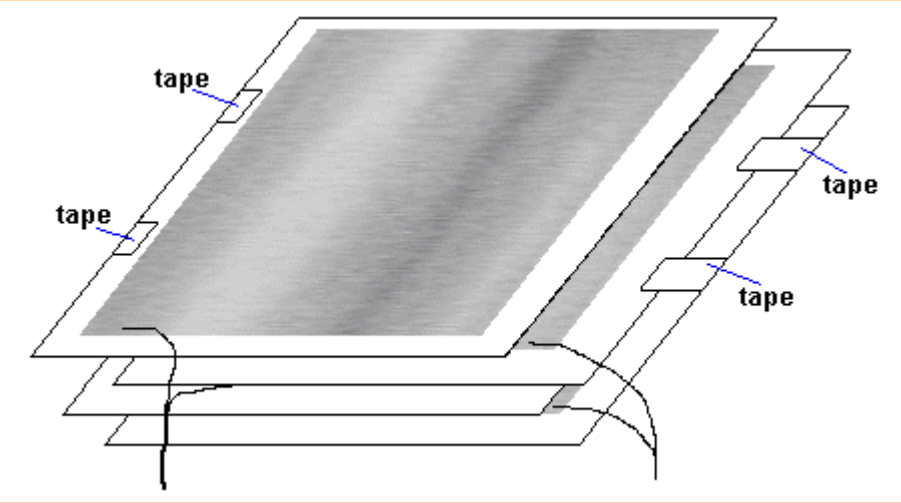

HOME-MADE CAPACITOR

Tape a sheet of aluminium foil to each sheet of cardboard with sticky-tape around all 4 sides. Take one strand of wire from a length of hook-up flex and sticky-tape the end to each sheet of aluminium to make good contact. Place 2 sheets on top of each other and move the top sheet slightly to the left and sticky-tape the edge so they don't move. Do this with the other two sheets but move the top sheet to the right. Now interleave the sets. Connect the wire from the first sheet to the third sheet. Connect the wire from the second sheet to the fourth sheet.
The cardboard (or paper) between the aluminium sheets increases the capacitance three times. The capacitance decreases when the sheets are moved apart and the capacitance increases when the sheets are moved in. The capacitance also INCREASES when the sheets are squashed together such as when a book is placed on them.
You can also make a smaller capacitor by making each sheet smaller and using 6 sheets. You can then add a 100p or 220p in parallel with the home-made capacitor, to select the lower part of the band.

EACH CIRCUIT

Each circuit we describe in the following set of circuits is an improvement or advancement on the previous. We also offer a number of different types of aerial coils, amplifying stages and earphones. Some of the circuits use easy-to-obtain components and home-made equivalents for hard-to-get items. There will be something in this section for everyone to build.

In all radio circuits you will encounter **TWO MAIN PROBLEMS**:

If the FRONT END (the Coil and Capacitor) is loaded too much by the "pick-off" of the amplifying stages, you will only get one station.
If you get squealing or "motor-boating," try a different circuit and layout as the components you are using, plus the voltage of the battery, will need changing.
You cannot always increase the voltage of the supply and get a louder output. Sometimes the increased voltage will stop the circuit working or it may introduce too much gain that the circuit starts to squeal.
The Radio IC (ZN414) DOES NOT WORK on a voltage above 1.5v and some of the transistor circuits completely stop working with a higher voltage. This has to do with the biasing arrangements and if the circuit is designed for a low voltage, you need to keep to the suggested voltage and experiment with a slight increase in voltage and see what happens.
Building a radio is not easy as the enormous amount of amplification of the combined stages creates a feedback loop via the power rail that sets the circuit into oscillation. This effect gets worse with a higher supply voltage and we will explain this further with each of the circuits.

MAKING A CRYSTAL SET

You can buy a **CRYSTAL SET** kit (see the photo of the kit, above) or the individual components (a kit is the cheapest) or use the replacement for the **FERRITE ANTENNA COIL** (16 turns to 20 turns on a 150mm biscuit tin) and/or the **TUNING CAPACITOR** made from aluminium foil and cardboard sheets.
You will need an outside antenna and an earth (such as a water tap or the frame of your soldering iron) to pick up the radio stations.
If you cannot put up an outside antenna, you will need to add one or more amplifying stages and this will allow you to reduce the length of the antenna and increase the volume of the audio.

ADDING AMPLIFYING STAGES TO A CRYSTAL SET

You can add two different types of amplifying stages to a crystal set.
You can connect amplifying stage(s) to the FRONT END and these will be designed to put less load on the front end so the sensitivity and selectivity increases. These stages work at the frequency of the radio signal and they are called RF STAGES (Radio Frequency Stages).
You can build these stages out of individual components or use a chip called a RADIO CHIP or RADIO IC (integrated circuit) for less than $2.00.
The chip contains 5 stages of amplification and these are RF stages (or RF AMPLIFYING STAGES) and the concept is called TRF. (Tuned Radio Frequency).
It is not easy to get this type of amplifier working because the stages produce a very high overall gain and you get a lot of "motor-boating" and squealing if the gain is not controlled. The gain must be reduced when a strong signal is being passed through the circuit because a strong signal will produce a large output and this will be so large that some of the waveform will find its way to the front of the amplifier via the power rail and start to be amplified again. To prevent the output getting too large, the circuit has a negative feedback line - called the AGC line - Automatic Gain Control.
It would be very difficult to reproduce these 5 stages of amplification with discreet components and that's why it is best to use an IC.

The next stage is a DIODE to convert the RF (Radio Frequency) to AF (Audio Frequency). This can be done with the diode-characteristics of a base-emitter junction in a transistor and we will show the alternatives.

Any stages after the diode are AUDIO STAGES or AUDIO AMPLIFIER STAGES.
The main job of the AUDIO AMPLIFIER is to increase the DRIVE CAPABILITY.
In other words, increase the current capability of the circuit for an 8 ohm speaker or 8ohm earpiece (or 16 or 32 ohm).
This is a very difficult thing to do and requires at least 2 stages.
The LOAD you can put on a Crystal Set must be 10,000 ohms or higher. (if you put a lower resistance (impedance) on the output, you will load the FRONT END and reduce its ability to separate the stations.
That's why a crystal earpiece is normally used with a crystal set. It puts almost NO LOAD on the circuit.
If you put a load on the circuit the result will be only one or two stations across the whole dial and only the most powerful station will be received.

If you don't have a crystal earpiece, you will have to use an 8 ohm earpiece. This will require an IMPEDANCE CONVERTING CIRCUIT of 1,250:1
This is a simple way of saying we want the 8 ohm earpiece to appear as 10,000 ohms to the

crystal set.
To produce an overall gain of 1250, we need two stages of amplification.
If a transistor has a gain of 70, it will it will produce an impedance conversion of 70 times. This is a realistic value. Transistors with a gain of 200 will have a gain of about 70 when fitted to a circuit. This means the other transistor needs to have a gain of about 20 and that is easy to achieve.

ADDING AMPLIFYING STAGES TO THE FRONT OF A CRYSTAL SET

Adding stages to the front of a crystal set are called RF STAGES (Radio Frequency Stages) because they amplify the RADIO STATION SIGNAL.
It does not matter if you amplify RF signals or AF signals. The result is the same.
The only difference is this: The frequency of RF signals is much higher (1,000 times higher) and the coupling capacitors can be much smaller.
This allows an RF amplifier to be built into an IC - called a Radio Chip.
One of the most popular Radio IC's is ZN414 or YS414. This chip has been copied by other manufacturers as: MK484, TA7642 and LMF501T.
All the chips are the same but the pinout is different.
These chips work on a 1.5v supply and if the voltage is increased above 1.5v, the gain of the stages increases to a point of total distortion.
To prevent strong signals producing distortion on 1.5v supply, the output is passed back to the input via a 150k resistor. This feedback line is called the AGC (Automatic Gain Control).
The chip contains 5 stages of amplification plus a stage that converts the RF signal to AF (Detector Stage). This means the signal diode in a Crystal Set is not needed.

Here is the circuit of the TA7642 Radio Chip. It performs the same as the ZN414 Radio Chip.

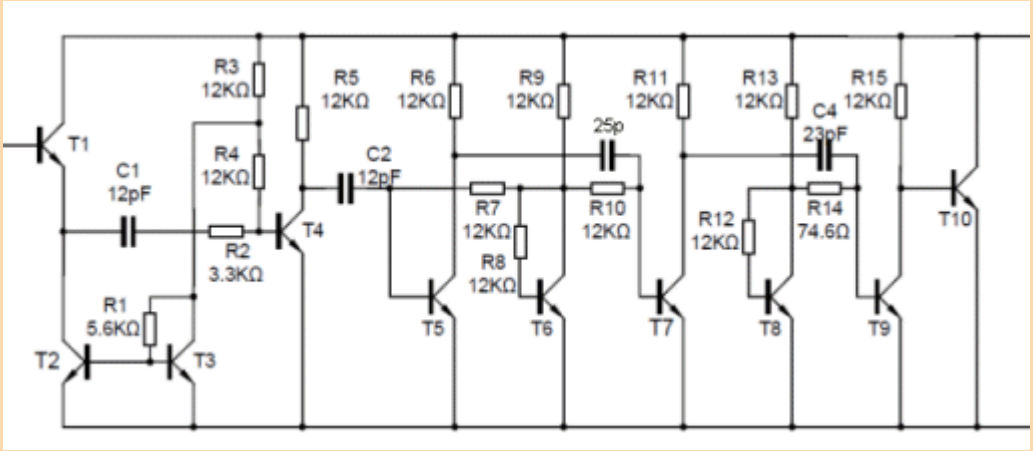

Here is the BLOCK DIAGRAM of the ZN414 Radio Chip:

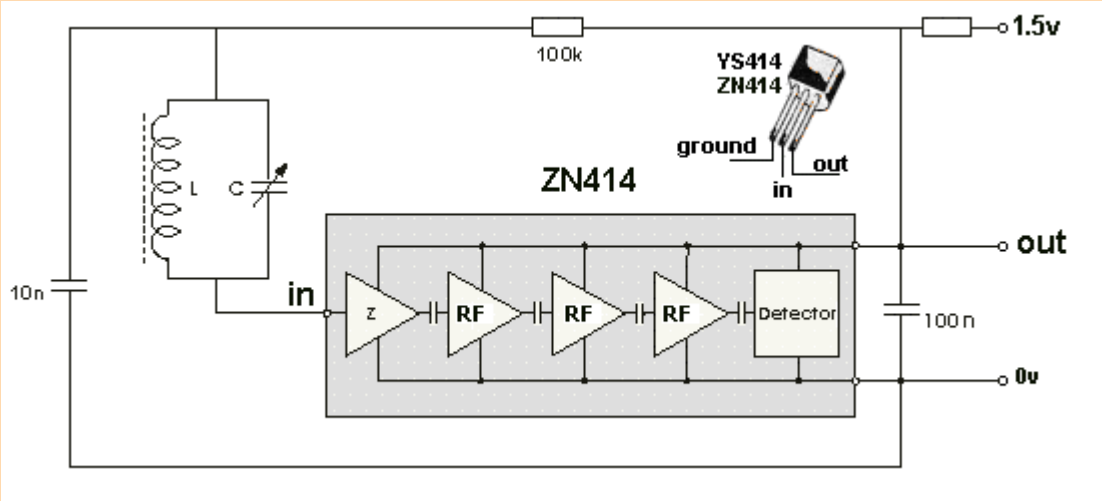

The ZN414 chip can be purchased from Talking Electronics for $1.00 plus postage

USING THE ZN414 RADIO IC

By using the ZN414 radio IC (or any if the equivalents) you can create a POCKET RADIO to drive a headphone or speaker.
But it is not easy to use the chip. The main problem is receiving the strong signals without producing distortion and then being able to pick up the weak stations.
A fixed 100k feedback resistor does not provide adequate control and a TRF radio has limited capabilities.
That's why radio manufacturers make SUPERHETRODYNE receivers. Even though they are more complex, the result is far superior.
However a simple TRF set can be made with the Radio IC and a few stages of audio amplification.

The following circuit uses just the Radio IC and a crystal earpiece or the home-made earpiece described above:
You can use a home-made FRAME ANTENNA or a home-made FERRITE ROD ANTENNA and a home-made VARIABLE CAPACITOR.

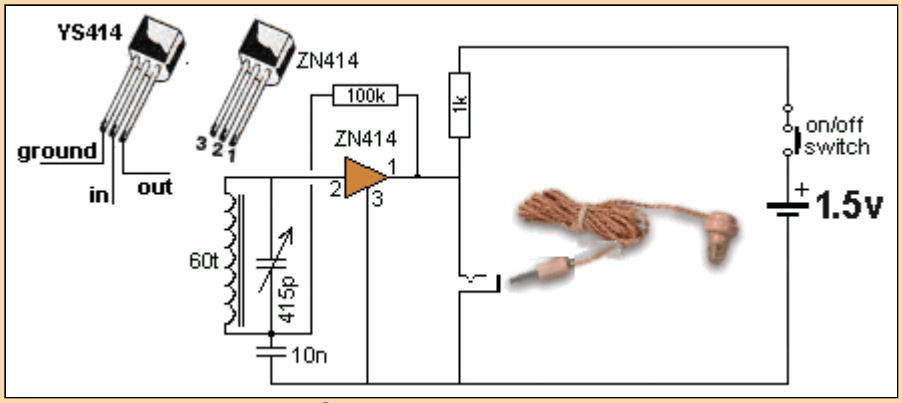

The Simplest ZN414 Radio

Connecting the ground (0v rail) to the frame of your soldering iron or a water tap will increase the output volume. The circuit above shows a Crystal Earpiece. Using a Crystal Earpiece may require adding a 10n across the earpiece to improve the output volume. The substitute Piezo Earpiece is effectively a 20n capacitor and an additional capacitor is not needed.

2 TRANSISTOR RADIO

Here is a simple 2-Transistor radio.
The secret to its performance is the 7 turn "pick-off" from the FRONT END (the TUNED CIRCUIT).
The ratio of 7 turns to 60 turns means a small percentage of the voltage generated in the tuned circuit is passed to the transistor. Thus it puts a small load on the TUNED CIRCUIT.
I don't want to go into any mathematics. The turns ratio is 60:7 = 8 but the effect of the 7 turns "pick-off" has an effect called the IMPEDANCE EFFECT and this is the SQUARE OF THE TURNS RATIO. Thus the IMPEDANCE EFFECT is 8 x 8 = 64. This means the "pick-off" (the LOADING EFFECT) is just a few percent. The front end can produce voltages as high as 500mV because a crystal set can produce a voltage high enough to pass through a diode (350mV) and have sufficient to drive a crystal earpiece.
Even though the front end has a "step-down" ratio, the voltage out the 7 turns will be sufficient to drive the first transistor.
The "transformer" does 2 things: It reduces the loading on the tuned circuit ENORMOUSLY and it produces an output with a higher current than is circuiting in the front end. Even though the transistor is turned ON and biased by the 33k, it is classified as a low-impedance load as far as the front end is concerned and the input signal has to be accompanied by a certain amount of current, otherwise the transistor will not respond to the voltage. The 7-turn "pick-off" is able to provide this current.
Both transistors are biased ON via the 33k base-bias resistors and thus the first transistor responds to the slightest millivolt signal.
This circuit was tested and had the same performance as the **Simplest ZN414 Radio Circuit** above. It can be operated on 1.5v to 6v and the strongest stations tend to overload on 6v. A short antenna is needed.

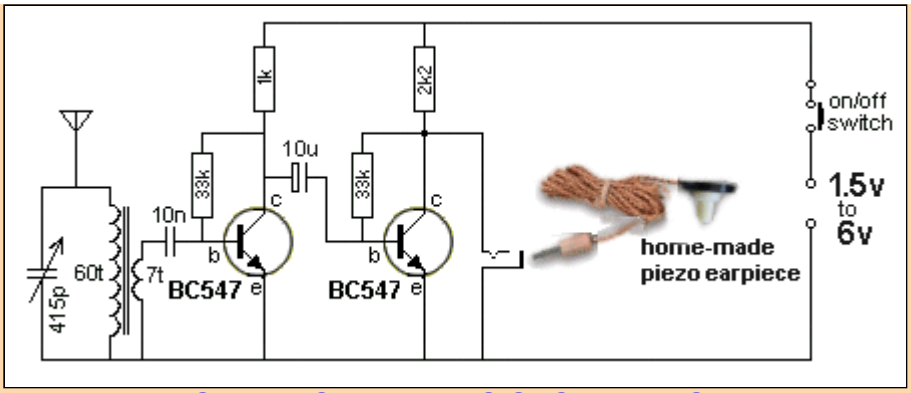

SIMPLEST 2-TRANSISTOR RADIO
using a very-high-impedance earpiece

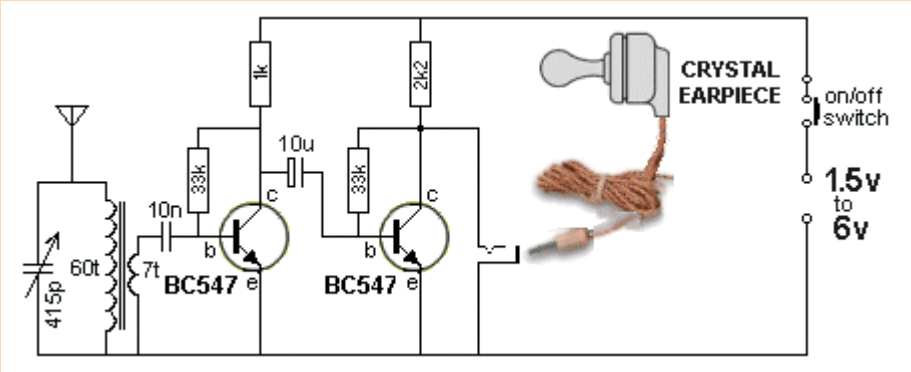

SIMPLEST 2-TRANSISTOR RADIO
using a crystal earpiece

ADDING AN IMPEDANCE MATCHING STAGE

You can add an IMPEDANCE MATCHING STAGE to the output of the circuit above so a low-impedance earpiece can be used.
We call it an IMPEDANCE MATCHING STAGE because this is the correct technical term. It is an AMPLIFYING stage but it amplifies the CURRENT because the second transistor cannot drive an 8 ohm LOAD. 8 ohms is a very low resistance and if it is connected directly to the second transistor, the output will be almost zero.
The reason for this is covered in our discussion: The Transistor Amplifier.
This stage will not increase the volume but simply match the 8 ohm load to the circuit above.
It is very difficult to connect a LOAD to this type of circuit because it will take more current from the battery and cause the supply voltage to fluctuate. These fluctuations will be passed to the first stage and cause variations in the signal. This will be amplified by the first and second transistors in the form of a low-frequency buzzing called **MOTOR-BOATING**.
The only way to reduce or remove this noise is to add an electrolytic across the power rails and reduce the supply voltage. The third transistor simply takes the waveform on the output of the second transistor and delivers it to the earphone with a higher current. It is called an IMPEDANCE MATCHING STAGE as it effectively increases the 8 ohm load by a factor of about 100.

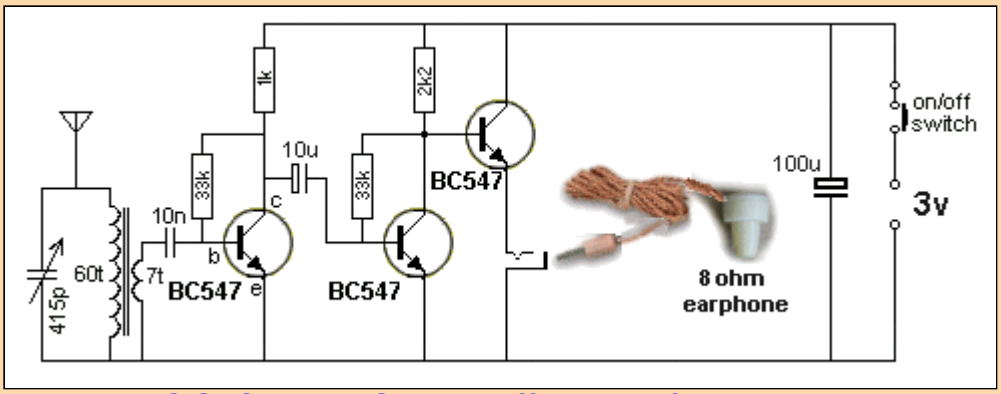

3-TRANSISTOR RADIO with buffer stage for 8 ohm earpiece

The 3rd transistor converts the 8R to about 800R

You can use 16 ohm, 32 ohm or 64 ohm in place of the 8R earpiece and these will give better performance as they will take less current and improve the stability of the circuit.
Low-impedance earphones create "motor-boating" due to the peaks of current and this can be very hard to fix.

A 2-TRANSISTOR RADIO with REGENERATION

The next stage in our discussion to get better performance is a feature called **REGENERATION**. Regeneration sends a small output signal back to a previous stage in the form of POSITIVE FEEDBACK to INCREASE the original signal. The signal on the emitter of the first transistor is the same amplitude as the signal entering the base but the FRAME ANTENNA has a turns ratio of 5:15 and this increases the signal on the receiving section of the antenna by up to 3 times. But we want the returning signal to be just above the amplitude of the receiving signal and so a resistive adjustment (attenuator) is provided on the emitter to deliver just the right amplitude.
This has the effect of increasing the amplitude on the TUNED CIRCUIT and is just like reducing the load on the circuit.
As we have mentioned above, when the tuned circuit is lightly loaded, it will pick up a station at the exact frequency of transmission and if the dial is changed slightly, the station will disappear. This quality is called SELECTIVITY.
At the same time, the Tuned Circuit will pick up weak stations and this is called SENSITIVITY.
The quality of a receiver depends on the loading of the TUNED CIRCUIT.

Here is the original circuit from Elektor Magazine with the prototype made on matrix board and fixed to a base-board with a frame antenna made from two sticks of wood. The photo shows a speaker but the output is so low that you really need headphones.

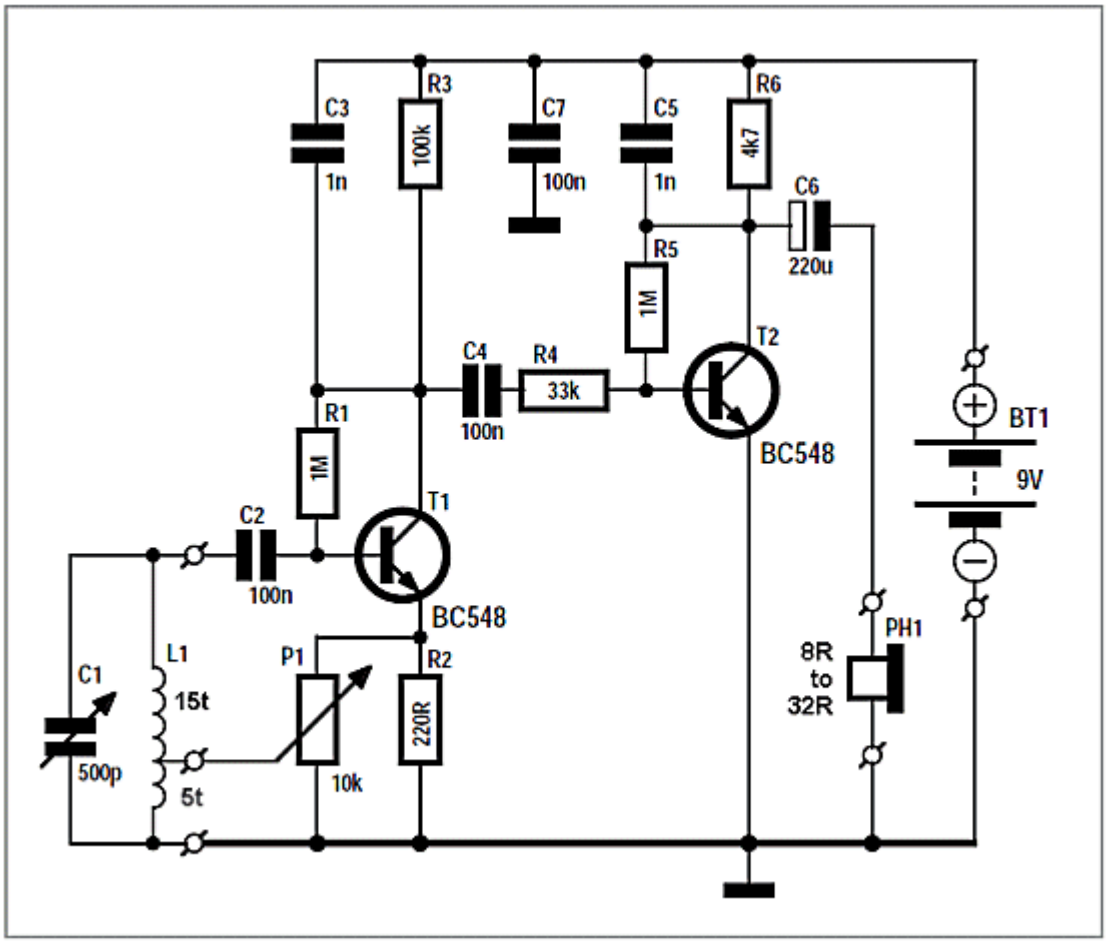

2 TRANSISTOR REGENERATIVE RADIO from Elektor Magazine

The circuit is very complex and the output will be very low as the circuit cannot drive a low-impedance earphone via a 4k7 load resistor. The 4k7 resistor is actually driving the speaker (the transistor is simply discharging the 220u). The 4k7 only allows 32/4700 x 9 = 61mV to appear across the earphone - a very poor result.
The skill of designing a transistor stage is covered in our comprehensive eBook: The Transistor Amplifier and you wont make a mistake like this !!!
The circuit above can be simplified and we can add the REGENERATIVE feature to our **Simplest 2-Transistor Radio** circuit:

Our circuit uses a 15 turn circular FRAME ANTENNA 15cm diameter and a 5 turn REGENERATION coil.

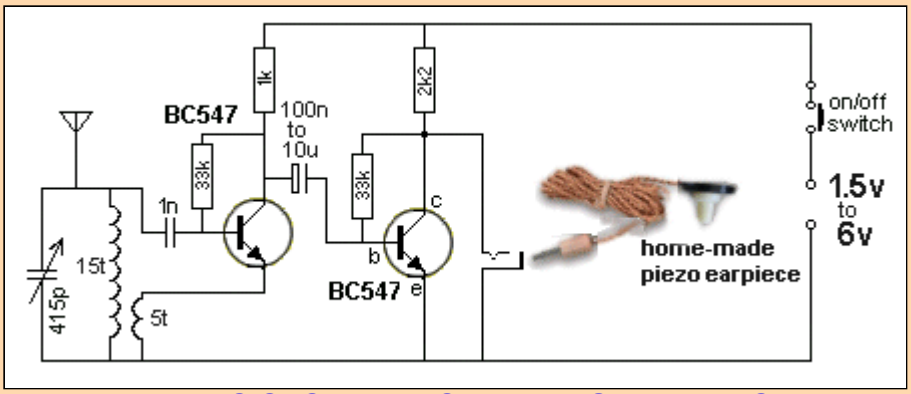

2 TRANSISTOR RADIO with REGENERATION

The regeneration coil is brought near the main coil and as it gets closer you can hear the audio get louder. If this does not happen, turn the coil around.
Early radios used this technique and the operator had to adjust the coil by hand. No-one minded because radio was a fascination and the simplest radio cost more than a weeks wages. To listen

to a broadcast through headphones was an amazement and listeners would sit all night with headphones listening to music.
This is very fiddly and by adding an extra buffer stage, we can use a Frame Antenna with a very clever "pick-off" that does not load the front end. This gives the circuit very good sensitivity and selectivity without regeneration.

3 TRANSISTOR RADIO

Here is our final design for the simplest self-contained 3-Transistor Radio using our home-made Tuning Capacitor and 250mm x 350mm Frame Antenna. It picks up the local stations and drives a low-impedance earphone or set of earphones (from a mobile phone).

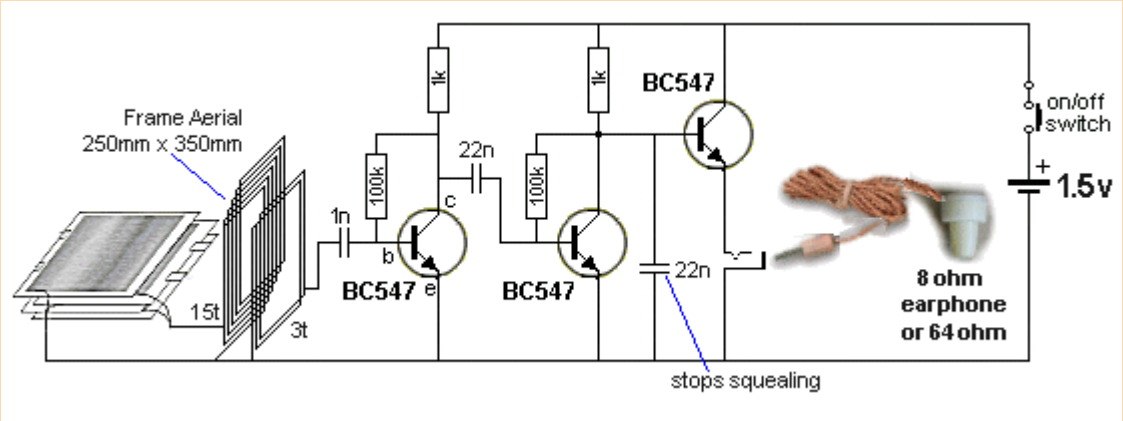

3-TRANSISTOR RADIO

The circuit performs very well and uses readily-available components. The 22n across the output is essential to stop squealing.
The secret to sensitivity and selectivity is the turns-ratio on the Frame Antenna. The 3-turn "pick-off" puts very little load on the front end and this allows the stations to be tuned with our home-made Tuning Capacitor.
The circuit contains all the features we have discussed above and only needs a 1.5v supply.
Build this circuit before you buy any expensive tuning capacitors, IC's or ferrite slab antennas as you will not get any better results.
This is called a TRF circuit and because the stages operate at Radio Frequency or Audio Frequency. Due to the high amount of amplification, the circuit can start to squeal (feedback, motorboat) due to the layout.
You may need to shorten or lengthen the leads or move the parts slightly - it's that critical.
However the result is a portable radio that needs no earth and will pick up the strong stations.
You can try connecting the 0v rail to the metal part of a soldering iron to increase the number of stations.

LOADING

The whole success of picking up a radio station is the RECEIVING CIRCUIT. The receiving circuit is the coil and the signal in the air (from the radio station) must go down the centre of the coil.
It cannot pass over the top or the bottom of the coil. Only the signal that goes down the centre of the coil is received.
As you can see, the centre of the coil is not very big and it is amazing that the signal can pass down the centre. But it does, and that is the only signal that will be amplified.
This signal is passed to the capacitor and we have explained how the signal is gradually increased and increased in amplitude until it is as large as 500mV. The signal from the radio station may be as small as a few millivolts, but as it keeps pushing the "swing" back and forth, the amplitude get larger and larger.
If you put your finger on the "swing" you will prevent it get larger and larger and it only requires the slightest touch of your finger to prevent the swing gaining full amplitude.
In electronic terms, your finger is called LOADING THE CIRCUIT and since we have to pass the signal to further stages of amplification, we need to "tap" or "load" or "pick-off" a signal.
The aim is to load the circuit as least as possible because the actual energy entering the circuit is very small.
In fact, this is all the energy we can remove as that is all the energy entering it.
Because a very small amount of energy is entering the "front-end" we classify it having a very

high impedance. It is very difficult to provide a value of impedance for this circuit because impedance has the term "Z" and the circuit is operating a very high frequency so resistance values are not the same as impedance values.
The actual resistance of the circuit is ONE OHM but the impedance is more like 10,000 ohms to 100,000 ohms.
We can explain its high impedance if we put a 100,000 ohm resistor across the circuit. The waveform will be reduced very slightly. If we put a 10,000 ohm resistor across the circuit, the signal will be reduced a reasonably large amount. If we put 1,000 ohms across the circuit it will stop working.
This means a load of 100,000 ohms will have the least effect.
In a crystal set, the diode creates NO LOAD until a voltage of 350mV is reached. It then passes excess voltage to a crystal earpiece that has a very high impedance. That's why a crystal set will produce a good output. The LOADING is very small.
When a transistor is connected to the TUNED CIRCUIT, it starts to put a load on the circuit after 600mV and this load is VERY HIGH. The "resistance" of the base-emitter junction is about 1k and the signal will find it very difficult to rise above 600mV because the incoming energy is not sufficient to increase the voltage.
Adding a capacitor between the base and the front end allows the transistor to be self-biased and get a turn-on voltage of about 600mV from a base-bias resistor.
The FRONT END is now separated from the transistor and ANY voltage it is producing will be passed to the transistor via the capacitor.
Whereas, with the crystal set, the first 350mV could be produced without any loading, the circuit is now loaded AT ALL TIMES.
This means we have to load the circuit as lightly as possible to be able to pick up individual stations.
The only way we can do this is to use a capacitor of the smallest practical value and this has to be worked out by trying different values. If the value is too small, the transistor will not detect a small signal. If the value is too large, the circuit will stop working.
Values such as 1n, 10n and 100n are suitable.
Values such as 1u, or 10u will be too large.
The CRYSTAL SET loading and a transistor load are completely different.
The transistor loads the front end ALL THE TIME and that's why you need to use a transformer or other ways to reduce the loading. Sometimes a Field Effect Transistor is used as it puts almost no load on the front end.

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Recreating an Alfred P. Morgan crystal set

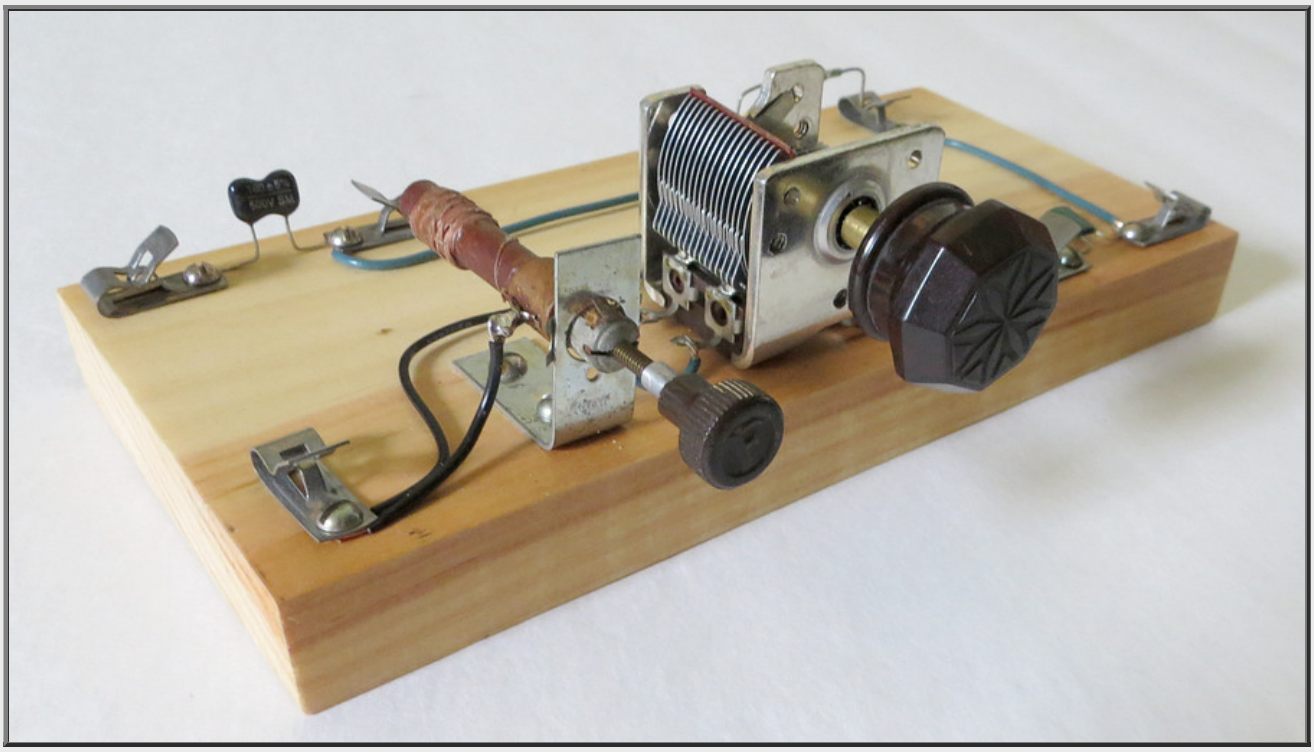

A recreation of my first (working) crystal set, originally built in 1966.

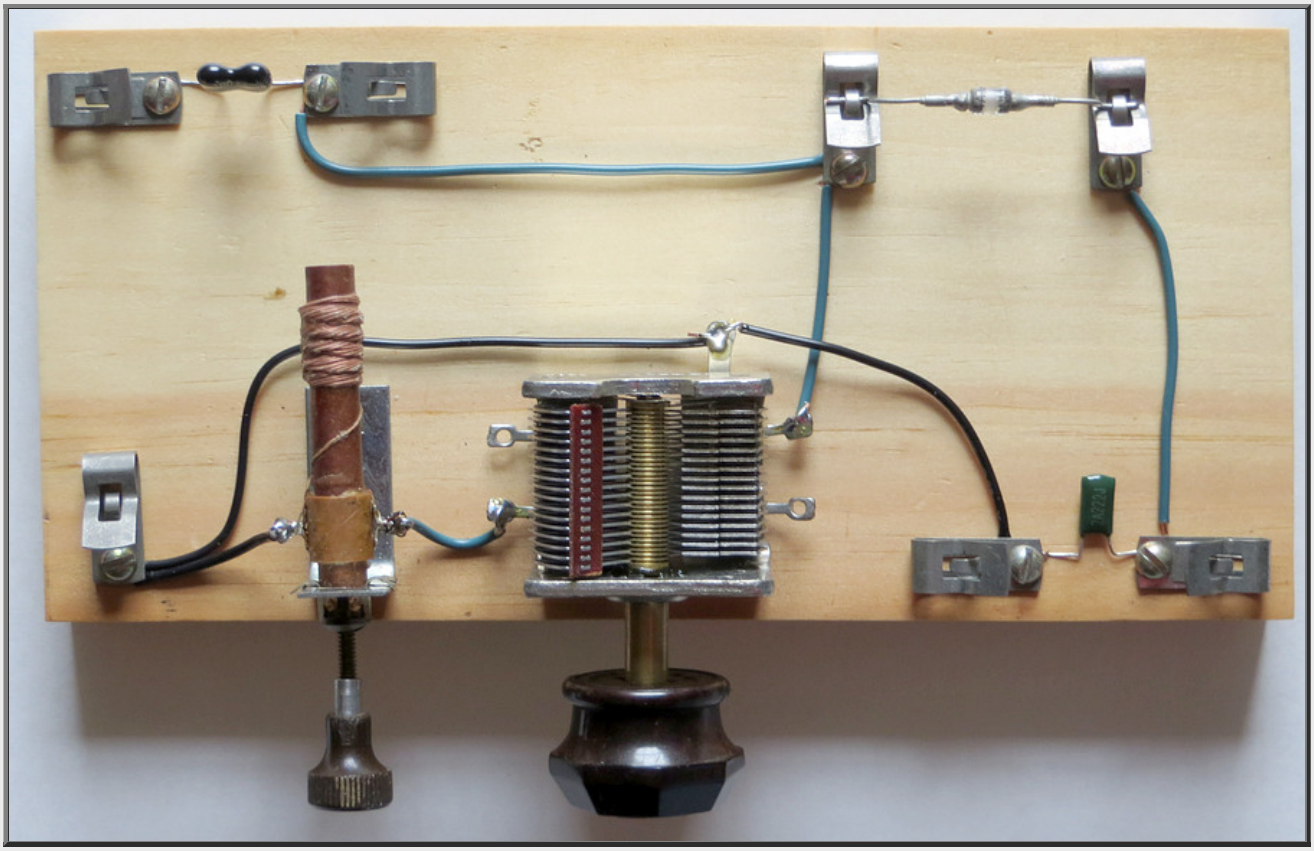

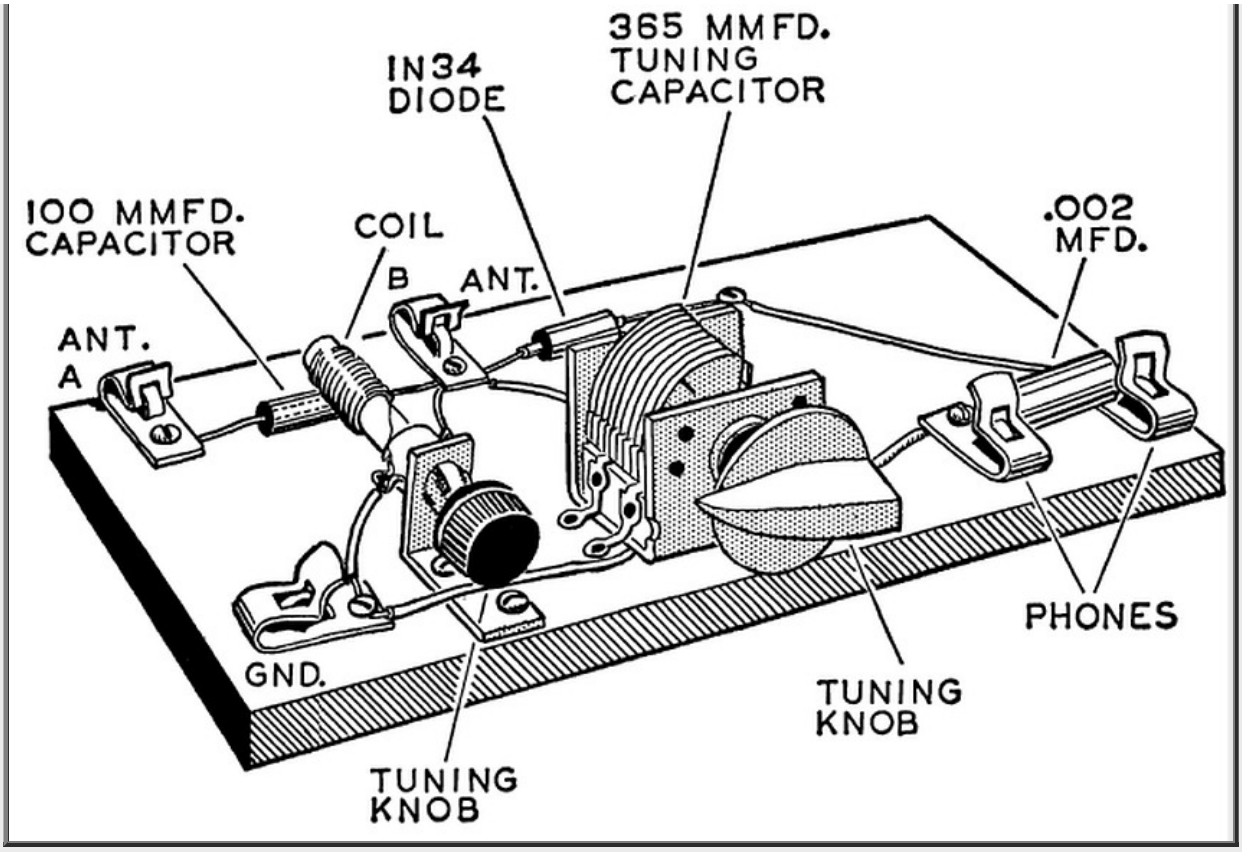

Page from "The Boys' Third Book of Radio and Electronics" by Alfred P. Morgan.

Back Story:

In the Summer of 1966 I was 10 1/2 years old and one of my favorite TV shows was "Get Smart". It was a show about a bumbling secret agent named Maxwell Smart who had all sorts of gadgets at his disposal. My friend Billy Meyers and I decided we wanted to be secret agents, like Max. One of the "secret agent" things we'd do was to pick out a guy with a briefcase walking home from work and declare him a Soviet spy. Then we would "tail" him for a few blocks, making up stories about him.

Billy and I had no way to communicate with each other after we had to come in for the night. He lived half a block away. Kids didn't use the phone back then. There was only one phone in the house and I don't remember using it before I was about 14 years old. Maxwell Smart had a phone in the sole of his shoe. We needed something like that!

Maxwell Smart (Don Adams) Agent 86.

Remco "Monkey Division" Wrist Radios.

One thing I DID have was a set of Monkey Division Wrist Radios. These were powered by a single C battery in the "Master" unit, which also had a button on it that would buzz the other receiver to get the users attention (apparently, the other user was unworthy of a button). A metallic speaker doubled as a microphone. The sound was very tinny, but you could make it out. Unfortunately, they were wired to each other. There was nothing "radio" about them.

I remember taking them outside with my brother Rob, and I could see and hear him talking at the same time his voice was coming over the wrist radio. They were pretty much useless, unless you like running around with a wire connecting you to your brother.

BUT... with some extra wire strung across the driveway, down the backs of the houses and into Billy's bedroom, Billy and I would be able to talk to each other! I immediately presented this great idea to my mom with a request the she fund the cost of the wire, and she immediately refused and told me the electric company would just come out and take the wire down.

Location of my house and Billy's house (actually his grandparent's house) The wire would have to be strung across the driveway. This is part of the West Oak Lane section of Philadelphia.

There was only one thing left to do. Build a radio. I went down the basement and connected a battery to a speaker and used a coat

hanger as an antenna. This was similar to the wrist radio, but the coat hanger antenna replaced the wire. It didn't work! All it did was make clicking sounds in the speaker. I had to wait for my dad to come home from work and ask him why.

When my dad came home I showed him the setup and he said, "You don't have a detector." I asked him what a detector was and he told me to go the library and get a book on radio. The next day I had a copy of "**The Boys' Second Book of Radio and Electronics**" by Alfred P. Morgan. Chapter 2, page 15 was titled "Building Your First Radio Receiver". I wouldn't be able to talk to Billy with it, but that was OK. My mom wouldn't buy me a secret agent coat, we didn't have any gadgets, and our secret agent days were coming to an end.

Now there was another problem. None of the parts needed to build anything in the book could be found around my dad's workbench. There was a store on Ogontz Avenue named REE Electronics, so I headed up there with a list of parts. The store sold stereo equipment and fortunately for me, also repaired stereo equipment. I asked the man in the store if he sold diodes or "capacitaters" and he sent me into the back of the place. There were two guys back there and bins of parts along the wall.

REE Electronics was located at 7709 - 7711 Ogontz Avenue in Philadelphia. The entire block has been razed and rebuilt, and is no longer recognizable. The picture above is the 7900 block of Ogontz Avenue. The store on the left is the only one that retains its original appearance, with the glass store window and the apartment overhead. This is how REE Electronics looked in 1966.

The two guys were pretty cool. I announced that I would like a "three hundred and sixty five micro micro farad variable capacitater". They asked me a couple of questions and told me to come back with the book. They had all the parts I needed except the coil. No problem, I would just build the set with no coil. I came home with Fahnestock clips, a 1N34 Germanium diode, a variable capacitor and a crystal earplug.

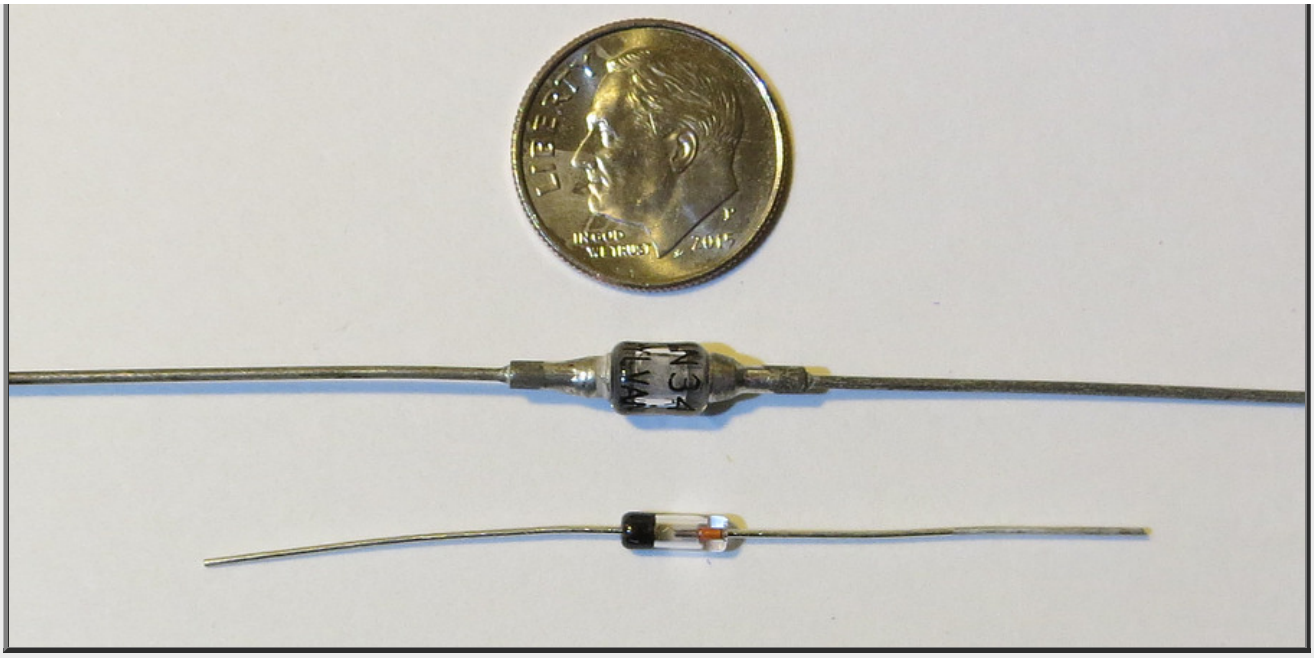

A Sylvania 1N34A Germanium diode (top) from 1949 and its modern counterpart. The new diodes are literally a dime a dozen, less than one cent each. The 1949 Sylvania diode cost me $9.00 in 2015. It is a duplicate of the one I bought at REE Electronics in 1966.

The diode was 65 cents in 1966. I can't use the $9.00 diode because I don't want to bend the leads, so I sort of just look at it.

Of course the radio didn't work without a coil. It did pick up the slightest whisper of KYW AM 1060 mingled with WIBG AM 990. There seemed to be some buzzing associated with it, as what I could hear sounded distorted. I HEARD something, that was the really, really neat part. It made such an impression on me that I remember the date. July 26, 1966.

The "problem" with the Alfred P. Morgan books was that they were not written for anybody as dumb as I was. Morgan didn't write, "If you can't find the coil you can make one." He just said to go buy a coil. Not only that, but there were no photographs in the book, though there were excellent drawings on almost every page. Since I had never seen some of the parts in real life, I didn't know exactly what the coil looked like, and I didn't understand what it did. That's because I didn't read the book! I was stuck on page 15.

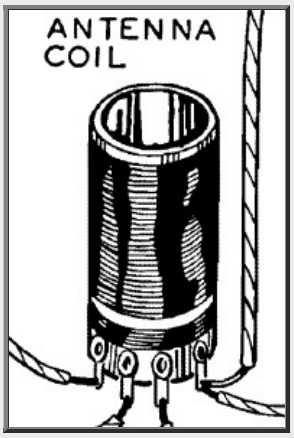

This is the picture of the coil from the book. I didn't know what I was looking at.

I returned the book to the library and came home with "**The Boys' Third Book of Radio and Electronics**." I found a simple radio on page 104 and soon headed back to REE Electronics. This time, they DID have the coil! I can't remember how much time passed after the first non-functioning radio was built. Probably a month or so.

I asked my dad to cut me a wooden base for the radio. I started building the radio and, if I remember correctly, it took me a long time. I didn't have a drill, so any holes in the base were made with the point of a compass. There were three connections that needed soldering. I got some solder from the basement, and the tweezers and alcohol lamp from my chemistry set. The tweezers were heated in the flame of the lamp till the tips began to glow, then I would quickly solder the joint.

One day a friend from school named Leo Pound stopped by on his bicycle. This was a bit unusual because Leo lived miles away. I don't even know how he knew where I lived. He recently told me (via Facebook) that he remembers helping me build the radio. Odd that it was the one and only time he came by. Apparently, we got the radio working that very day.

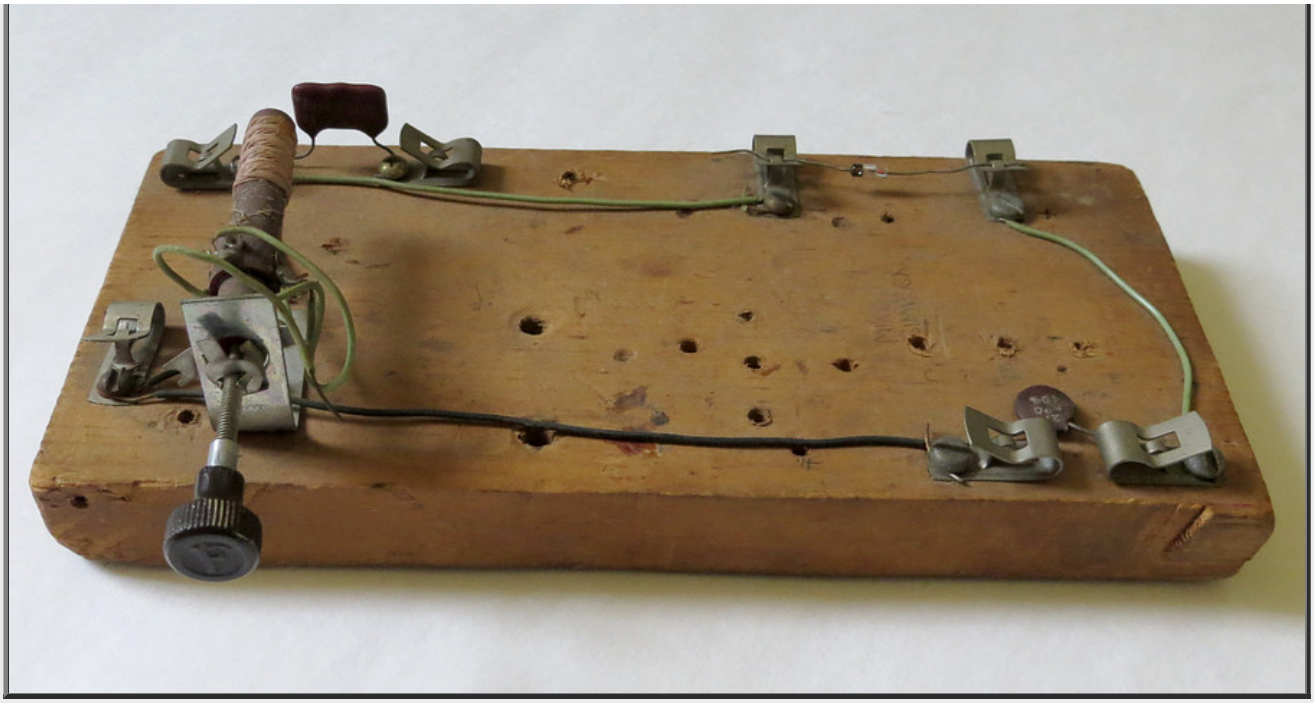

Here is the base of the radio made in 1966.

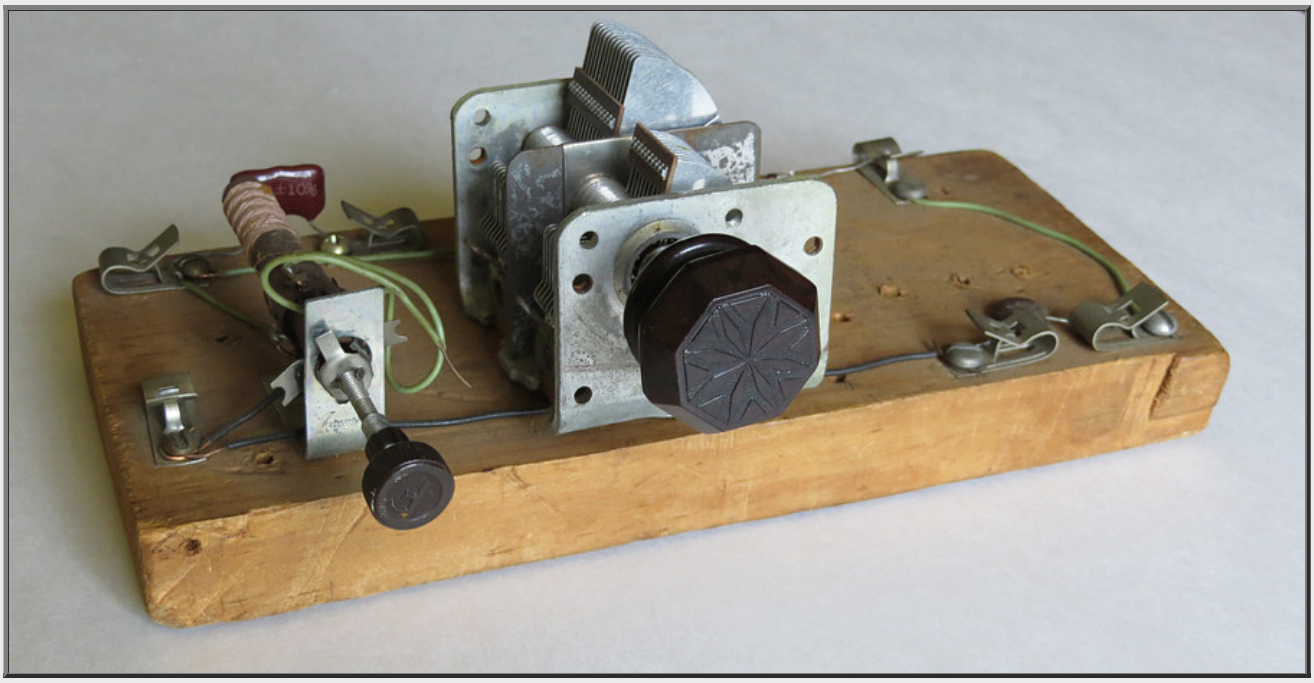

I found all the original parts except for the tuning capacitor. However, it looked like this one. It's just sitting on the base in this photo, but the radio pretty much looked exactly like this. My dad gave me the big tuning knob. The smaller knob came from a lamp in my bedroom. I didn't tell my mom you could no longer turn on the lamp, but eventually I found a lamp in somebody's trash and took the knob off to replace the one on my lamp.

Original coil, diode and main tuning knob from the 1966 radio. The wires on the coil were soldered with a pair of red hot tweezers.

My dad gave me the large knob for the tuning capacitor. He had a second job on the weekends at "John Cusimina's Moving and Storage." I've always wondered if he pulled that knob off of somebody's radio while they were moving. I hope not. He probably did.

Next

CRYSTAL SETS 5
Experimental Crystal Sets

CRYSTAL SETS 5: EXPERIMENTAL CRYSTAL SETS

.

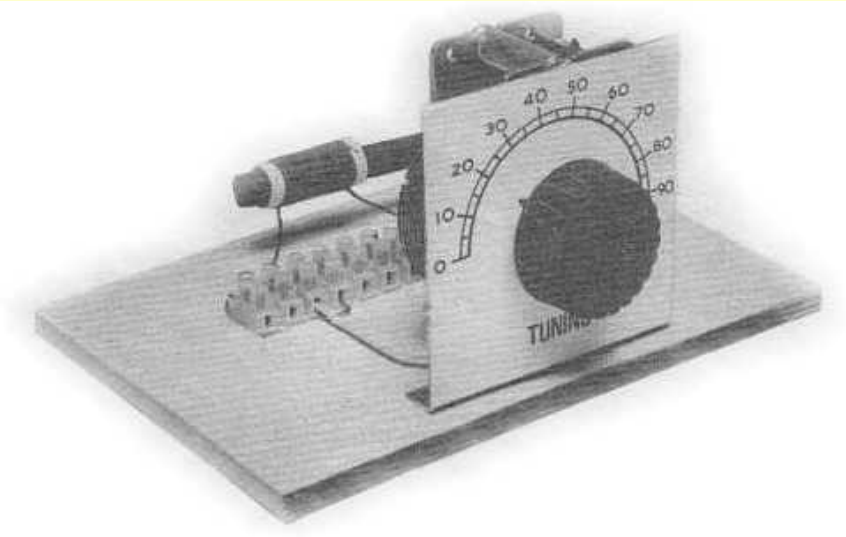

Picture 1 - The Complete Experimental Crystal Set

THE POPULARITY of the crystal radio arises from its simplicity, and the fact that it needs no power supply. The circuit here allows for easy experiments with tuning, aerial and diode coupling, and frequency coverage. Wrong connections can cause no damage to any components.

A Crystal Set is more often than not used for the reception of medium and long wave radio, but short wave reception is also quite feasible. It will normally be possible to receive some of the stronger international radio stations.

This is adapted from an article that appeared in the 1970's in Everyday Electronics, and gave me almost endless hours of fun!

BASIC CIRCUIT

The basic circuit is shown in Picture 2 below. The coil L1 can be air cored, or have a ferrite rod placed in its winding. The variable capacitor C1, in conjunction with aerial-earth capacitance, tunes the circuit to resonate with the wanted radio station frequency. The diode D1 "detects" or demodulates the radio signal so that the programme is heard in the earpiece.

This basic circuit can be modified in various ways to obtain better performance.

EARPHONE

As most constructors will be using a Crystal Earpice to listen to the crystal set it is essential that a 47k Ohm resistor is connected across the earphone terminals (TB1/1 and TB1/2 in the diagram), i.e. in parallel with the earphone, otherwise results will be very quiet.

A High Impedance headset of 20k Ohms (20,000 Ohms) may give even better results, but these are very difficult to obtain , so unless you happen to already own such a headset the Crystal Earphone with 47k resistor will be the only option. An ordinary magnetic earpiece or Walkman headphones will not work with a crystal set.

ASSEMBLY

Construction is of a 'breadboard' type using a wooden board of about 165 x 130 mm. A 12-way block connector, TB1, is used to connected together the components and this is screwed onto the wooden board. The use of a block connector provides an easy method of connecting the components together and then subsequently rearranging them as the experiments progress.

Tuning capacitor C1 is screwed to a bracket made of some scrap metal which is then also screwed firmly down to the baseboard, see Picture 1 above. Thin plywood screwed to the front edge of the baseboard would also provide a suitable method of fixing the tuning capacitor to the base. A knob with pointer is fitted to C1, and a scale is drawn and fitted behind this.

Except for C1, all connections are made by the terminals of the 12-way terminal block as shown in Picture 4. Loosen the screws with a small screwdriver, insert the bared ends of the wires, and tighten the screws. The various locations on the terminal block, TB1, are also shown in the circuit diagram, Picture 2.

AERIAL AND EARTH

Crystal receivers need a long wire aerial preferably strung outside and about 25m long, or as long as is possible to install. If this is outside it should be high and clear of earthed objects as this will improve performance.

An earth is absolutely essential for a crystal set to work properly. The earth lead can be run to an earth rod or spike that is buried to a depth of about 1 meter into damp soil. Or it may be soldered to a bare metal can which is buried in damp soil.

It is feasible, though not recommended, that the earth lead can be connected to the earthing terminal of a hi-fi system or even to the bare metal case of a personal computer that is plugged into an earthed mains outlet, but is switched OFF.

Stranded, insulated wire, or purpose made aerial wire can be used for the aerial and earth leads.

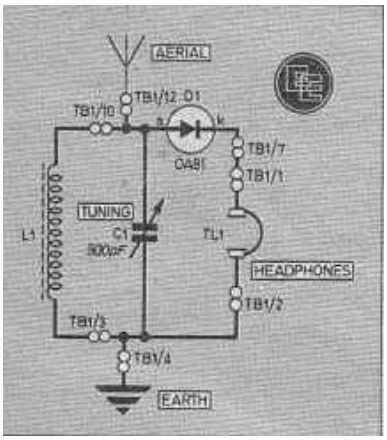

Picture 2 - The Basic Circuit

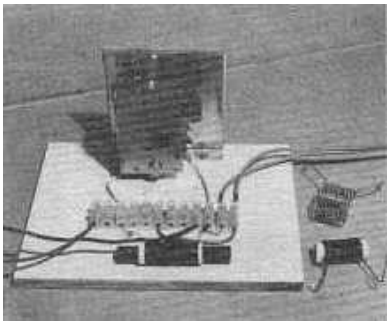

Picture 3 - Photo Of The General Layout

INDUCTORS (The Tuning Coils)

The following four coils are suggested for initial use as L1 :

Coil 1: Make a thin card tube to slide on a 10mm diameter ferrite rod, and on this tube wind about 105 turns of 32 s.w.g. enamelled copper wire, side by side. Secure ends with sticky tape.

Coil 2: Make a similar coil to to coil 1 having about 15 turns of 24 s.w.g. enamelled wire on the card tube. Loops of cotton will help hold the ends in place.

Coil 3: Wind 9 turns of 20 s.w.g. bare tinned copper wire on an object about 20mm in diameter. Remove and stretch to separate the turns, to obtain a coil about 25mm long.

Coil 4: Make a similar coil to coil 3, but with 5 turns.

The Ferrite Rod

It will be necessary to have a ferrite rod of about 60mm to 75mm long available. Coils 1 and 2 will provide reception of medium wave and the longer short wave bands. Coil 3 should cover about 3 - 10MHz shortwave with the ferrite placed in it, or about 6 - 18MHz with the ferrite rod removed. Coil 4 should cover about 6 -13MHz with the rod in, and about 9 - 20MHz without the' rod.

It will be noted that as the ferrite rod is inserted, any particular signal has to be re-tuned by opening Cl. This arises because the ferrite increases the inductance of the winding, so less parallel capacitance is needed for the same resonant frequency.

EFFICIENCY CHECKS

Tune in a m.w. transmission using coil 1 which gives good headphone volume. Place a microammeter or multi-range meter on a sensitive range in series with the headphones. A reading of 50-100uA or more may be obtained, depending on aerial, earth, earphone resistance and resistor value, coil and detector efficiency and strength of signals at your locality.

Placing the ferrite rod in the coil and re-tuning should boost the meter reading to some extent. Surplus or other detector diodes can be tried by substituting them in turn and noting the meter reading. Improvements to the aerial (or earth) will also show up as a rise in meter reading.

If experimenting with a crystal earpiece, which gives no direct current circuit, the meter may be clipped across the phone leads, i.e. D1 cathode to earth.

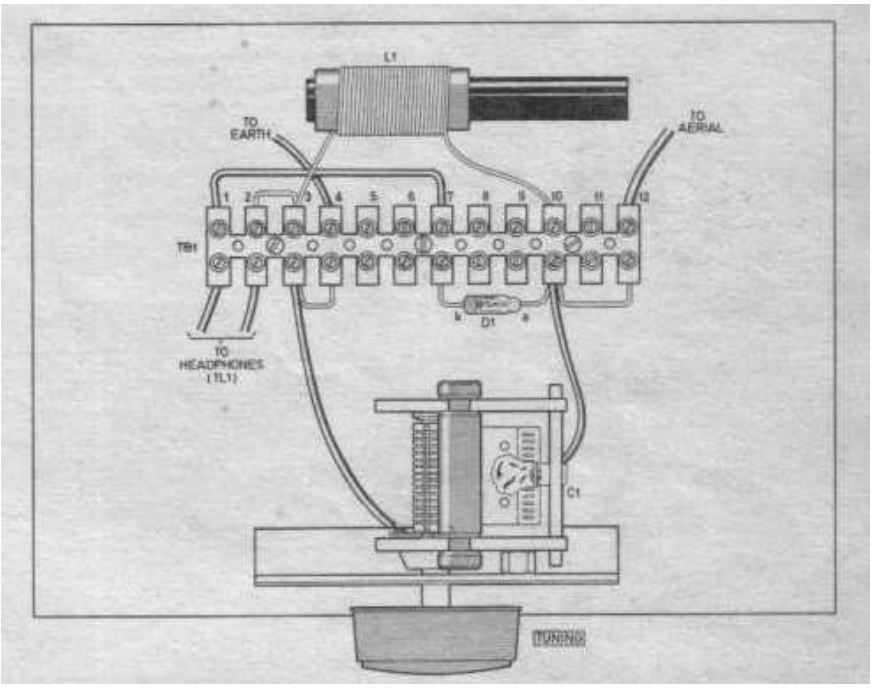

Picture 4 - Baseboard Layout Of The Crystal Set

AERIAL COUPLING

The aerial loads the tuned circuit heavily when connected directly to the top of the tuned circuit, as in Picture 2. This damps the tuning action and it can be found that stations spread out all over the dial, which is unsatisfactory.

The series capacitor, C2 connected in Picture 5(a) reduces the loading and thus improves the sharpness of the tuning. A variable or pre-set capacitor of about 250pF maximum is most suitable. for this role, though it is possible to experiment with a variety of fixed value capacitors in this range also.

Connecting the aerial to a tapping on the coil, as in Picture 5 (b) also sharpens tuning. It may also increase volume. Try about 2 turns from earth for coil 4, or 4 turns from earth for coil 3.

Another method is to have a coupling primary, as in Picture 5 (c). This consists of a second coil, with about one third the turns of the original wound on top of the existing coil.

You can even combine these methods to find what arrangement best suits the aerial in use.

The diode can be disconnected from the end of L1 and taken to a spare position on TB1 for example location TB1/9. You can then run a flying-lead fitted with a crocodile clip from this position, connecting it to various tappings on the coil as required as in Picture 5 (d). This method also reduces loading on the tuned circuit.

Coils with spaced turns of bare wire are readily tapped. For other coils, small loops can be made every ten turns or so, and crocodile clips can be attached to these when selecting tapping points.

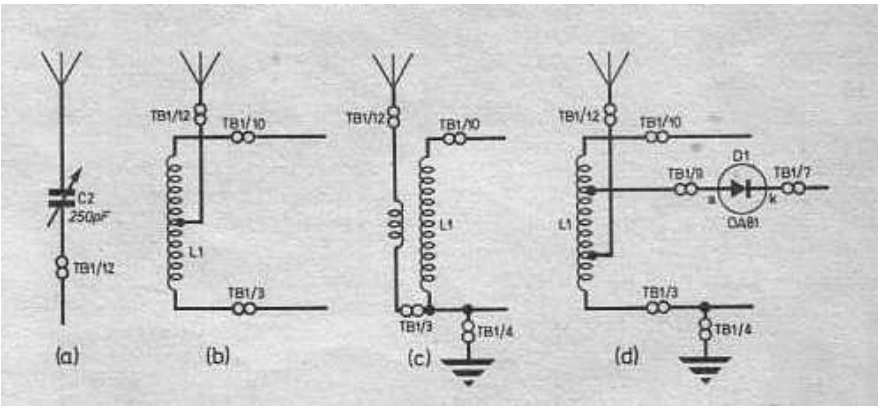

Picture 5 - Alternative Methods Of Aerial Coupling

SHORT WAVES

For shortwave reception, a good efficient outdoor aerial is certainly recommended. Evening listening in the region around 5 - 9MHz in often proves to be the most fruitful.

Since there is no amplification, as with a valve or transistor receiver, certain frequencies will seem to be completely dead at particular times of day. So if the crystal receiver works satisfactorily on medium wave and longwave, but no shortwave signals are heard, check again in the evening, or after dark, when conditions are different.

PARTS REQUIRED

C1	**365pF or 500pF Air Spaced Tuning Capacitor**
D1*	**OA47, IN34, OA81, OA90, OA91, IN94 or similar point contact small signal Germanium Diode** * The OA47 will be of particular interest since it has the lowest forward bias voltage of any of these diodes which will make the crystal set somewhat more sensitive and therefore louder. The US equivalent of the British OA47 is the IN34.
TL1	**High Impedance Headphones (20,000 Ohms) or Crystal Earphone**
TB1	**12-Way Plastic Screw Block Terminal**
Also Required:	**47 k Ohm Resistor for Crystal Earphone: Enamelled Copper Wire: 32 and 24 s.w.g. for L1: 20 s.w.g. tinned wire for L1: Ferrite Rod 10mm diameter x 75 mm long: 25m of wire for aerial: Wire and rod or spike etc for earth: Wood for base e.g. 10mm x165mm x 130mm: Scrap of metal of thin plywood for C1 bracket/front panel: Knob: Crocodile clip(s)**

Adapted from an article in Everyday Electronics magazine, November 1981, By F.G. Rayer.

HERE ARE A COUPLE OF VERY INTERESTING CRYSTAL SET DESIGNS SENT IN BY KRYSATEC - "THE RAT" - FROM THE CZECH REPUBLIC

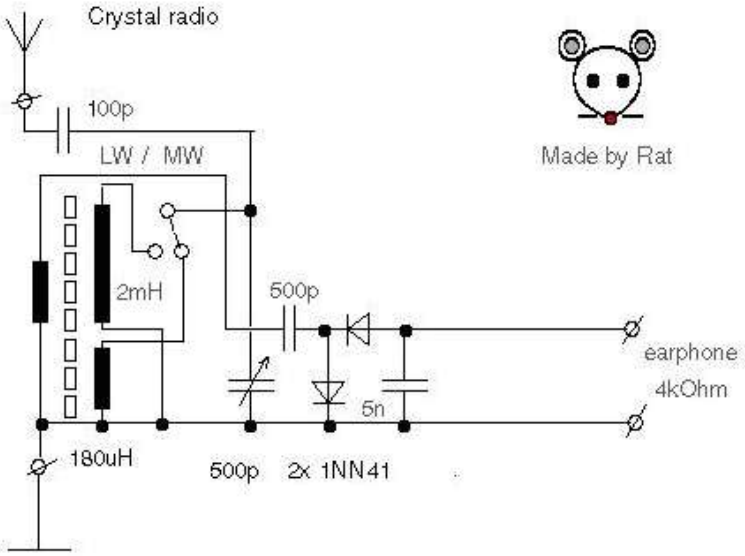

1/ Using old coils from old bulb radio for MW and LW band. Though it would be straightforward to wind the coils - one for Long Wave, one for Medium Wave and a coupling coil. Variable capacitor is 2 x 500pF only one half is used: 500pF. For the crystal earphone a resistor of about 82k ohm in parallel is required. This set also uses two Ge diodes as a multiplier in the quest for for higher audio signal output.

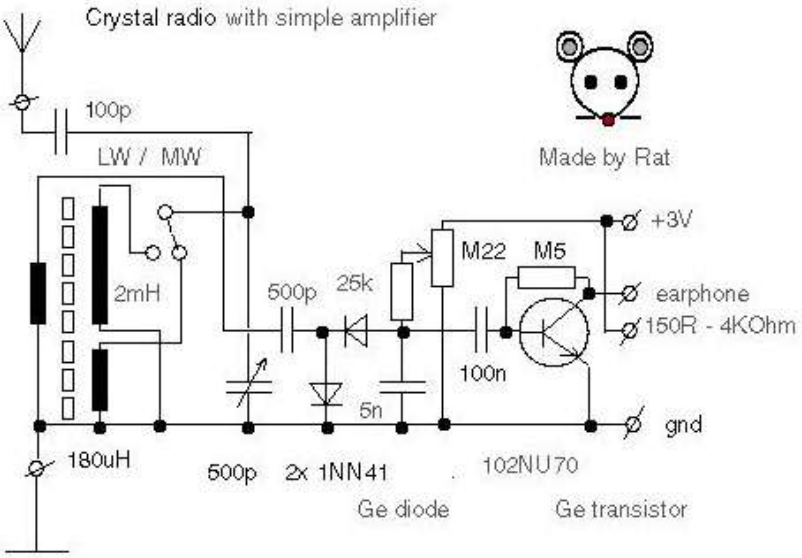

2. If signals are not strong signal in your location, then the above circuit design can be considered. A simple transistor amplifier is used. A variable resistor M22 is used for better sensitivity which can be adjusted for poor signals. This crystal radio is aversion from cca 1960 - 1970 y.

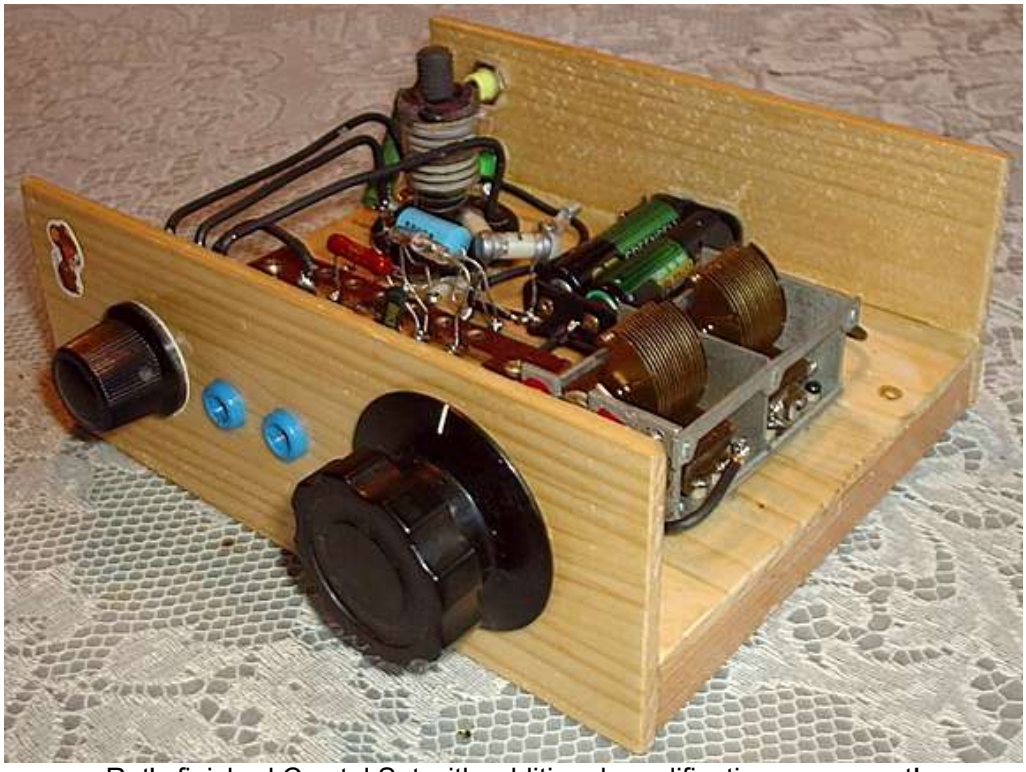

Rat's finished Crystal Set with additional amplification - very neat!

'Minilabs' Crystal Radio

BELOW: Ian Tomlinson kindly sent in a photograph of the box that contained the kit for his John Adams Toys 'Minilabs' Crystal Radio.

It is a very simple circuit consisting of the coil (inductor) with a sliding contact that provides variable tapping points, a diode and crystal earphone. All that is added is the aerial and earth. There is no variable tuning capacitor for simplicity and to keep costs down.

The coil provides the inductance required for tuning into a certain frequency (wavelength). These days a variable "tuning" capacitor is normally wired in parallel across the inductance (coil) in order to vary the resonance of the tuned circuit and therefore enable to easily tune into various transmitters on different frequencies. This crystal is tuned varying the number of turns on the coil (ie varying the inductance) by tapping off at different points using the sliding contact ("ball").

The crystal earpiece, or high Z headphone, is connected between the output of the detector diode (the other end from the coil) and earth. The volume from a crystal earpiece may be considerably improved by connecting a resistor of - somewhere between - 4.7 k and 47k ohms in parallel with the earpiece. A crystal earpiece cannot directly allow current to flow through it and the parallel resistor therefore allows current to better flow through the circuit.

'Minilabs' crystal set by John Adams Toys

A discussion on configurations for Crystal Sets by Felix Scerri VK4FUQ

This discussion, by Felix Scerri VK4FUQ, was posted at this address which no longer appears on the web www.tarc.org.au/techinfo2.htm (error 404) so here it is reproduced:

Crystal Set design is one of my passions closely allied with my obsession for audio and high fidelity.

My main interest in crystal sets, apart from the wonder of a radio receiver that does not require a power source, is the potential excellence of the recovered audio quality from normal AM broadcast stations.

Personally, it is one of my great laments that most people have never heard how good wideband AM can sound. A high performance crystal set or similar TRF approach is, in my opinion,the only way to do it. There are a few people around who have heard the audible results of my efforts,and can only agree.

I have often wondered,given the ultimate simplicity of the crystal set, being essentially a tuned circuit,a diode detector and some form of output device, what it takes to achieve optimum performance. What follows are my thoughts on the matter.

Crystal Set optimisation, is in my opinion, all about reduction of circuit losses. Essentially this means high "Q" tuned circuits and high quality detectors. Efficient output devices also help too. But as we will see, there are some trade-offs required as well. A high "Q" tuned circuit is always benefical, as a high "Q" tuned circuit has lowest RF losses,highest potential selectivity,and highest voltage at resonance, which is very useful for the diode being fed from the tuned circuit. Variable capacitors, even the "modern" miniature variable capacitors (although the older air dielectric units, as used in old valve receivers are more desirable) for various reasons,are generally quite efficient, and a higher "Q" coil will produce the most worthwhile improvements.The best (highest "Q") coils are wound with "Litz" wire, which is a multistranded woven wire with all strands insulated from each other. The performance of Litz wire wound coils is spectacular, unfortunately, although I know Litz wire is still being made, from personal

experience, it is VERY rare in Australia.

Efficient coil design can be quite complex and all my coils are wound on ferrite rods. There seems to be,at least for ordinary single wire windings (close wound), an optimum wire thickness for optimum coil "Q". I have determined .315 mm winding wire to be about optimum for simple (single wire) coils on ferrite rods. Thicker wire is NOT better, believe it or not.

Lacking Litz wire, an interesting winding approach I have developed is to use two slightly thinner wires wound as a bifilar winding connected together at the beginning and end of the coil, yields considerably higher "Q" compared to a simple single wire winding. I have found 0.25 mm winding wire optimum in this application.

Whilst high "Q" coils are beneficial from the RF point of view, there is a possible downside. If one is interested in maximum selectivity and sensitivity, there is no problem, but remember highest "Q" results in a narrowed audio band-width as a simple consequence of band-width. For high fidelity applications this could be a disadvantage under some circumstances, although there are clever ways around this.

Regardless of ultimate coil "Q", selectivity is a major issue with crystal sets generally. Here another trade-off is evident. For the maximum voltage into the diode, connecting the diode to the high impedance end of the coil (i.e. the top) yields the greatest voltage but the selectivity is usually terrible, because of severe "loading" by the diode circuit. For this reason, tapping well own the coil improves selectivity at the expense of signal volume (reduced voltage). Once again there are ways around this. As described in my "Double Tuned Crystal Set Tuner" article in "Amateur Radio" magazine, March 2002, the use of two separately tuned coupled resonant circuits allows top connection into the diode without compromising overall selectivity, thanks to the use of a second tuned circuit which is fed from the external antenna. The whole network forms a double tuned input bandpass filter and in practice this approach works very well. For single coil crystal sets I recommend the use of an un-tuned "antenna" winding adjacent to the "hot" end of the main coil, preferably adjustable (old paper reels from sewing cotton threads are ideal). This allows the degree of coupling to be optimised under actual listening conditions. The double tuned set up is best, yielding superb selectivity, but the un-tuned antenna coil arrangement also works quite well, especially if the diode is tapped well down the main coil.Tapping halfway works well.

The other method of performance improvement involves the use of the most effective detector system possible. Here things get very interesting. In fact the temptation is to use more complex circuitry, but that gets away from the charming simplicity of the crystal set. As an example, my own crystal set tuner has at times mutated into a TRF tuner complete with FET RF preamplifiers, active(powered) detectors and other enhancements. These modifications do work well, but loses the simplicity of a basic crystal set. In actuality, a simple diode detector can work extremely well, subject to some qualification. Diodes like to work with a reasonable level of RF input voltage. Audio distortion can result under conditions of low signal level, due to diode transfer curve non linearity and other factors, such as the widespread use of broadcast station "processing". The actual type of diode makes a difference. The 1N34A germanium diode is very popular for crystal set use, although in my experience just about ANY germanium diode will work, although it is worth trying different specimens. Some are definitely better than others. Even from a pack of twenty 1N34A's from the same source, some were definitely better than others. Measuring the average value of rectified output voltage across the diode load resistor will show which diodes are best. By the way, I regard a diode load resistor as being mandatory. I find a value of about 47K about right, especially if a crystal earpiece is being used or the crystal set is being used as a tuner feeding an audio pre-amplifier and following amplifier. If using high impedance magnetic type headphones, the headphones provide the diode DC load.

Another type of diode that is very interesting, is the hot carrier diode. There seem to be a lot of different hot carrier diodes around these days. There are even hot carrier diodes now being sold as "germanium diode equivalents". I have tried them and they do work acceptably well, but they are not quite as good as genuine germanium diodes such as the 1N34A. Typical UHF mixer hot carrier diodes, such as the 1N5711 will not work well in crystal set service simply because their "turn on voltage"is too high, similar to silicon diodes such as the 1N4148/914 series, which require a lot of RF input to function adequately as RF detectors, however a simple technique can be used to turn hot carrier diodes such as the 1N5711 into superlative detectors.

I guess we are cheating a little, because the technique is to use a little voltage bias supplied via a 1.5v battery, through a simple potentiometer voltage divider arrangement, with capacitor (for DC isolation) fed into the diode from the tuned circuit. With applied adjustable bias, I find the 1N5711 diodes absolutely superlative detectors under ANY signal strength conditions. I find the detection quality also superlative, with a clarity and low noise profile unmatched by any other diode arrangement. In my opinion, hot carrier diodes, running bias,are the best detectors overall.

Regarding other detector arrangements, the diode "voltage doubler" is often recommended, however my own

experiments with the doubler arrangement have been inconclusive and slightly disappointing overall. I have found no real advantage in their use over a simple (one) diode detector, believe it or not.

Yes, they do work, but they're nothing special, at least in my opinion.

Any comments on this general subject of crystal set optimisation would be welcome.

73's Felix Scerri VK4FUQ.
22nd July 2002

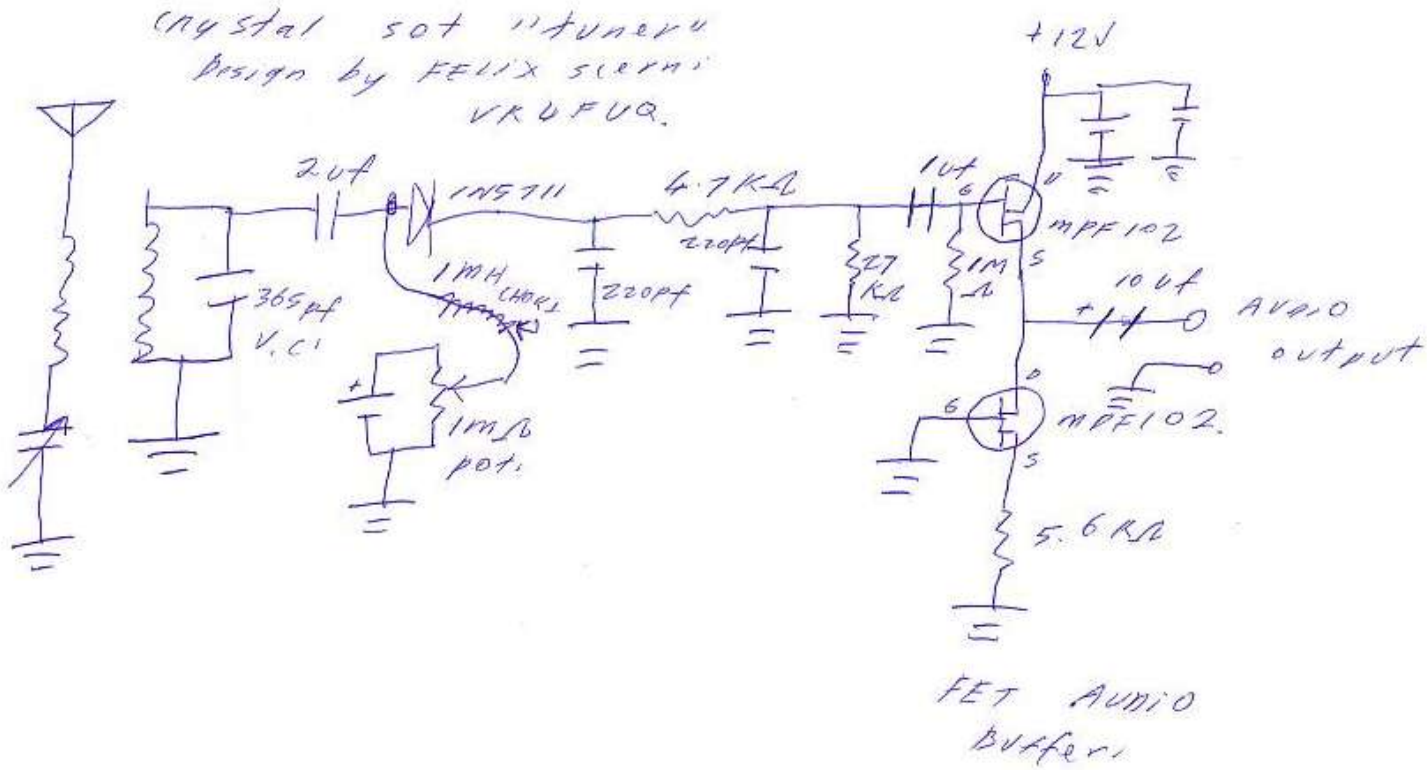

Above: CRYSTAL SET BASED CIRCUIT PROVIDING A HIGH QUALITY PROGRAMME SOURCE

IMPROVED VERSION OF THE ABOVE CONCEPT !! New update from Felix Scerri February 2010:

New 'two FET infinite impedance AM detector'

I've developed a new version of my old favourite FET 'infinite impedance' AM detector that I think sounds very nice. I include a short audio of one of our local AM stations. I picked this station as it is my reference 'torture test AM station' as they run very heavy 'processing' which normally sounds yuck with all my other (diode and non diode) detectors! However it's quite clean with this detector. What do you reckon? I'll do up a circuit if you'd like to feature it in your TRF radio section. A general draft article follows.

'A favourite non diode based AM detector that I've built and used many times over the years is the FET based infinite impedance detector, offering very good general AM detector performance, especially under weak RF signal conditions where diode based detectors do not perform well, especially in terms of audio distortion.

However one of the slightly strange things I've noticed about the simple FET based infinite impedance detector is the variable audio quality noted, even when using the same type of FET. Some I've built have sounded good and others slightly fuzzy when used with an audio preamp and fed into a high quality audio system. I've been giving this a considerable bit of thought of late and I've wondered if the audio distortion might be a result not necessarily of the detection process itself, but the FET stage in its guise as a 'source follower' audio stage which essentially, it is.

I have long been aware that as a simple audio buffer stage, the FET based 'source follower' can exhibit a considerable amount of audio distortion, and a technique I've long used to greatly reduce this audio distortion is to use a second FET in the source lead of the first FET as a 'constant current source' which serves to 'linearise' and

greatly reduce audio distortion in the buffer stage overall. So, to test the theory I built a simple one FET infinite impedance AM detector which worked well, but with just a hint of audio 'fuzziness' on received AM stations. So I added a second FET in the source lead of the first FET wired as a constant current source, taking the output from the source of the first RF detector FET and the source resistor and RF bypass capacitor off the source lead of the second FET 'constant current source'. The result, totally clean audio! The theory seems proved! I call this modified detector the 'Two FET infinite impedance detector'

))) Here's what is sounds like - click to play the audio file (((

Here is the circuit diagram:

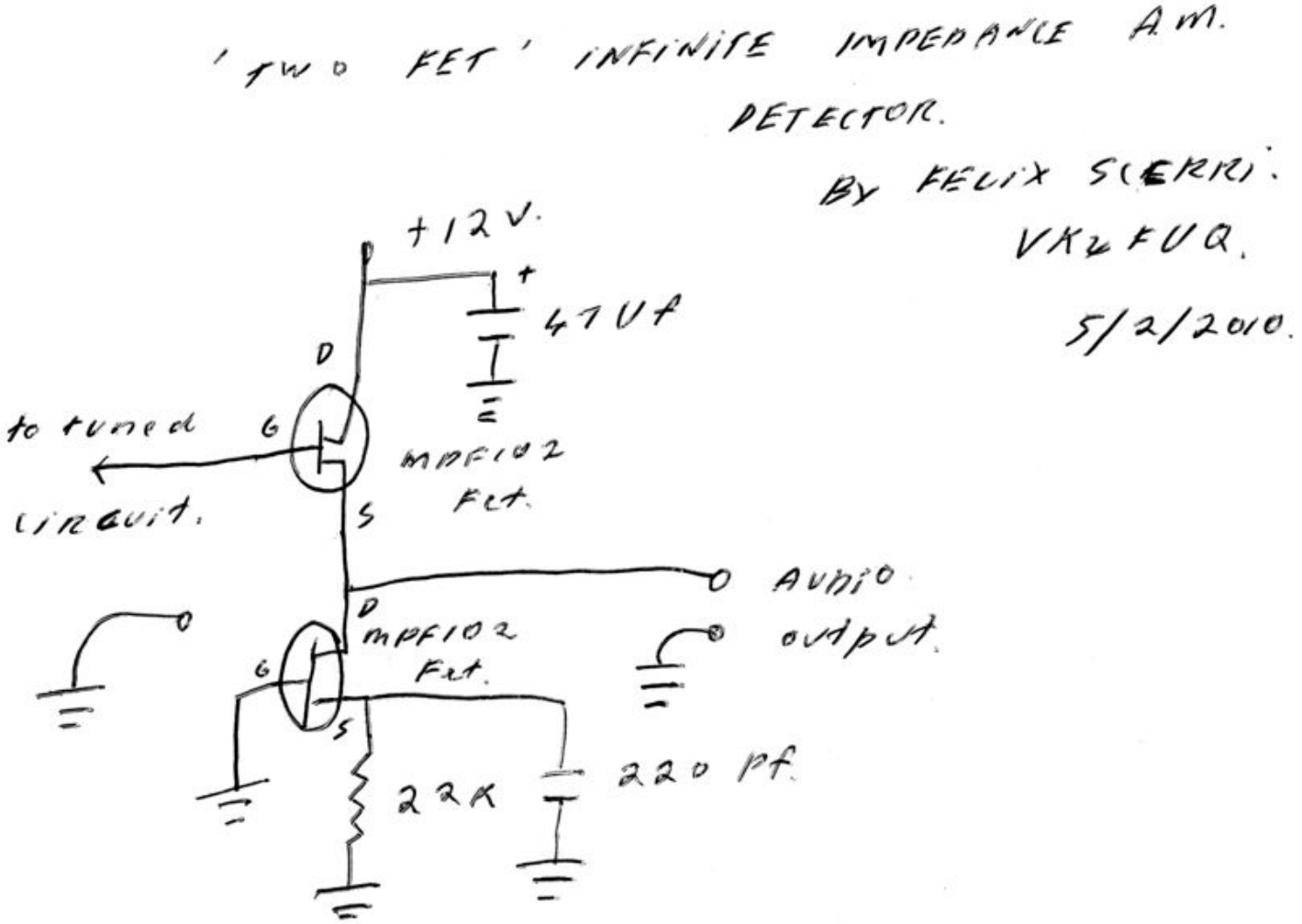

This detector has been a real eye opener for me in terms of its excellent performance, especially considering its circuit simplicity. Indeed in the past I have designed other more complex FET based infinite impedance circuits that do not quite work as well in practical terms as this latest circuit, at least according to my well calibrated ears!

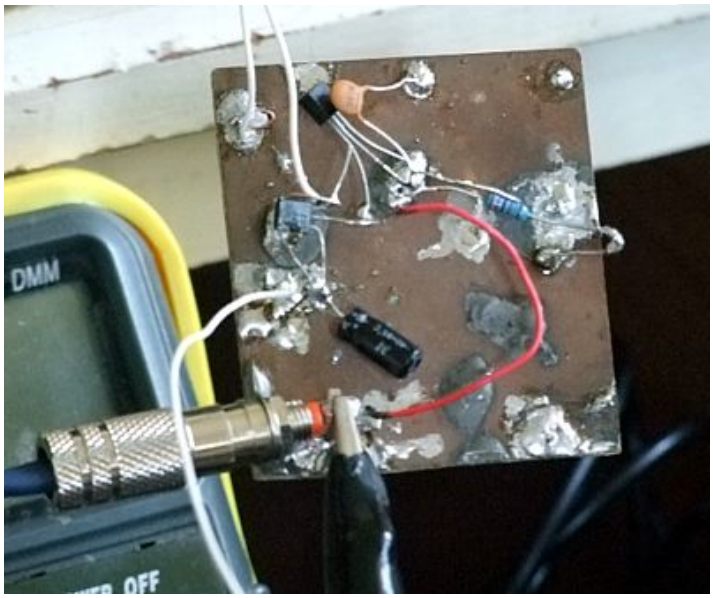

I do not have access to any precise test equipment but my well calibrated ears tell me this 'two FET infinite impedance detector' is a beauty, surpassing practically every other AM detector I've built even at low RF input, and that's rather a impressive claim and the audio quality when used as an AM tuner feeding a high quality audio system is quite remarkable. Possibly the best thing about this detector is its excellent performance under weak signal conditions. Diode based detectors also work beautifully, but the use of an RF stage to ensure detection over a linear portion of the diode's curve is mandatory! This compound infinite impedance detector works

beautifully on the sniff of a useable RF signal.

Just add a high Q tuned circuit and that's it!

Felix Scerri
VK4FUQ

A better FET for the 'basic' Infinite Impedance Detector:

Quite recently by accident, I've realised the MPF102 FET that I've long used in my FET based infinite impedance detectors is possibly not the best FET to use. This was the reason why I developed the 'two FET' infinite impedance detector some time ago which works very well.

However I've found the choice of a more suitable FET works beautifully in the basic FET based infinite impedance detector circuit, which has appeared for many years in many editions of the ARRL Handbook.

I use the 2N5457 and others of the same 'family' may be equally suitable, but I haven't tried them! However with a 2N5457 in place of an MPF102, the basic infinite impedance detector has became my AM detector of choice. It works beautifully even at low signal input with lovely and clean low distortion audio along with a very high input impedance for good tuning selectivity. It's a beauty! The basic generic circuit is attached, courtesy of Rod Elliott's ESP website.

73 Felix VK4FUQ
10 / 02 / 2012.

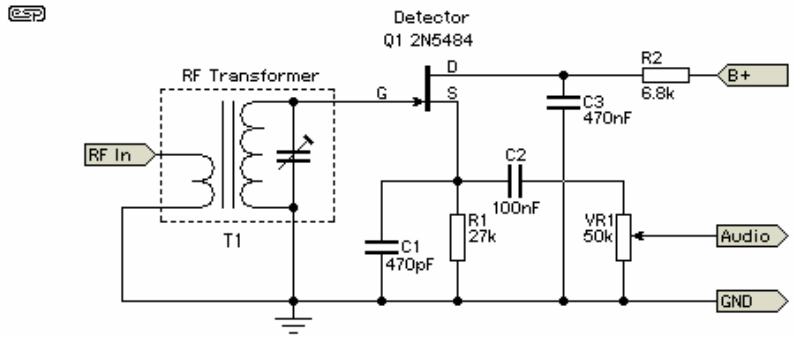

The basic generic circuit is attached, courtesy of Rod Elliott's ESP website
Felix Scerri VK4FUQ

As often happens with me, my renewed interest in FET based 'infinite impedance detectors' of late has led to some interesting new research and I may have considerably improved the 'two FET infinite impedance detector' as a result.

My research suggests that although the use of a CCS (constant current source) reduces audio distortion in an audio stage, the value of the 'source resistor' in the CCS stage is somewhat critical for best results.

By using a potentiometer in lieu of a fixed resistor I have found that a resistance value of around 470 kohms cleaned up all overall audio distortion. I used an MPF102 as the CCS in this circuit. An interesting and worthwhile little circuit refinement.

73 Felix VK4FUQ
21 / 02 / 2012.

A Minimum Component Count High Quality AM Detector

I was generally messing around with various circuit ideas and I came up with this AM detector circuit, a simple diode detector along with a FET stage. It was an attempt to provide good performance along with minimum number of components. Actually I've been pleasantly surprised at the excellent level of general performance and the best of all, it sounds great!

The circuit is quite conventional being a BAT 46 diode detector feeding an MPF102 FET buffer/ common source amplifier stage. I would ordinarily use a FET source buffer stage in this application, but opted to use a simple low gain FET 'common source' amplifier stage instead, with excellent results. I also used a BAT 46 Schottky diode instead of an ordinary germanium signal diode.

This was done for several reasons. Firstly, germanium diodes are now very hard to find but in any case these 'germanium diode equivalent' Schottky diodes are actually a superior diode, having very low noise, almost zero back leakage and an essentially complete absence of carrier storage effects and very good weak signal sensitivity. I call these diodes high fidelity diodes as they sound wonderful as RF detectors.

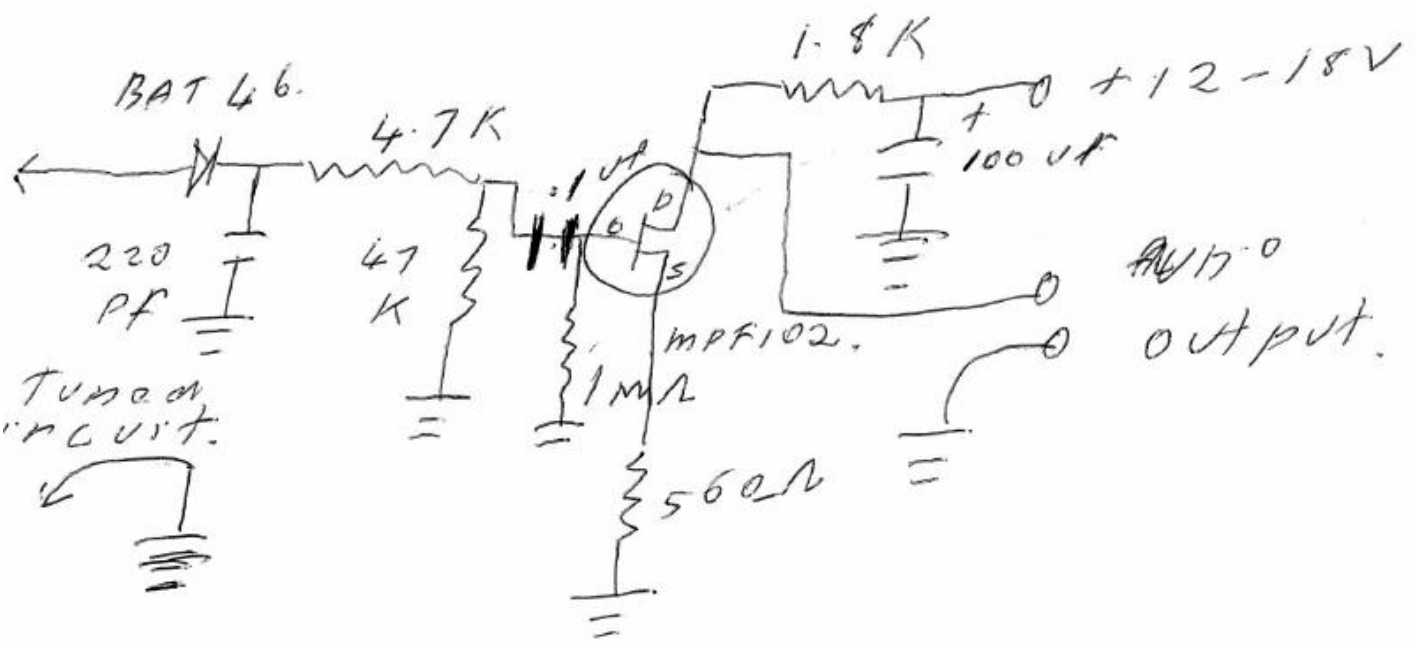

Circuit Diagram of the Minimum Component Count AM Detector by Felix Scerri

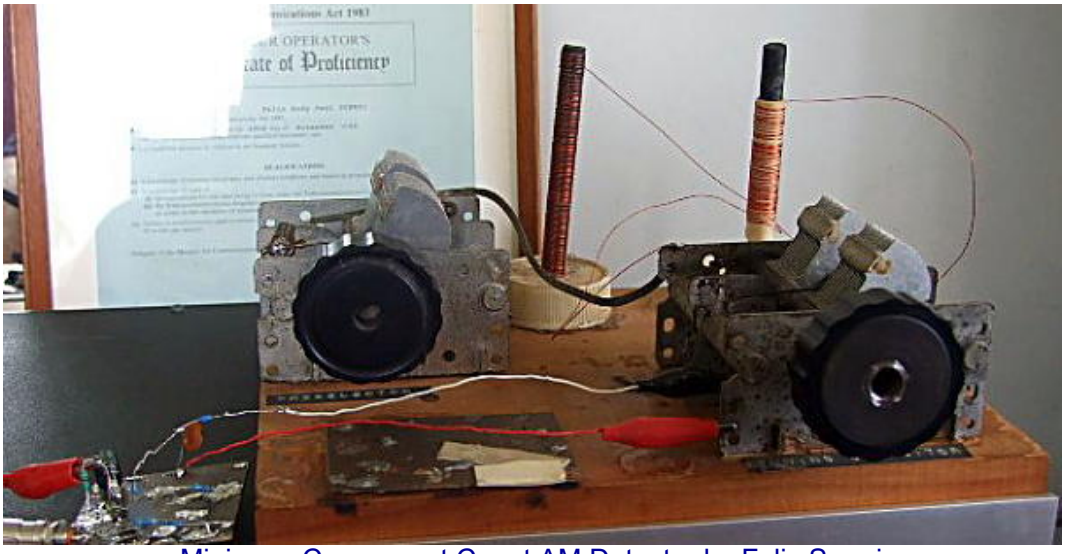

Minimum Component Count AM Detector by Felix Scerri

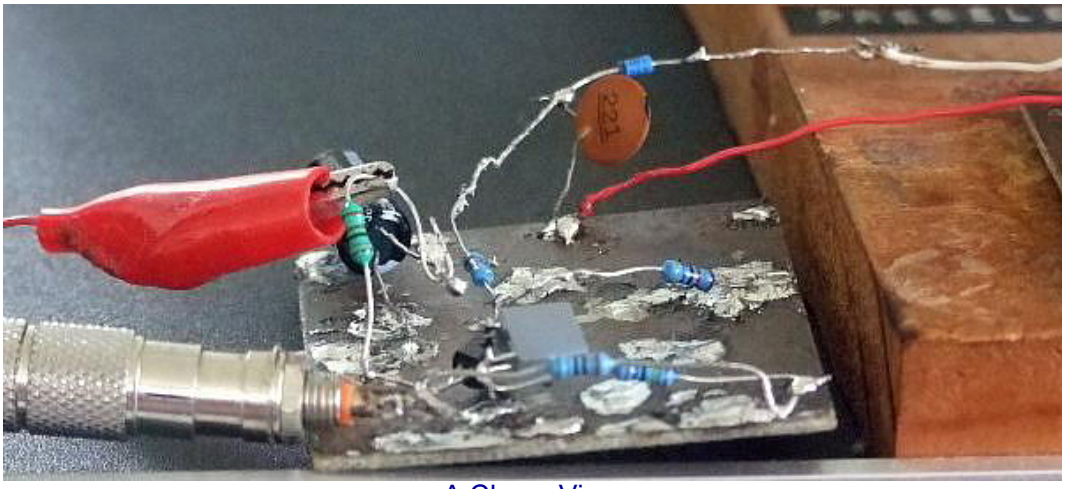

A Closer View

The high impedance of the FET's gate circuit is perfect for optimal buffering of the diode detector, something very important for good low distortion diode detector performance. Apart from providing slight voltage gain, the use of the common source FET amplifier is a new idea, as this prevents the possibility of incidental RF rectification occurring in a FET source follower stage, which can happen. A 1 uf plastic film capacitor may be added in series with the audio 'hot' output lead to block the DC offset out of the FET drain, if required.

Despite no additional RF stage ahead of the diode, audio quality on even relatively weak RF strength stations is actually very good, and of course the audio quality will be even better with increasing RF signal strength, something which will also increase the audio output level. Just on this, for a long time I was somewhat negative regarding diode detectors, as one AM station locally (the strongest one) was always distorted when using a diode detector.

I strongly suspected a transmitter fault, but my complaints were ignored, until one day some time ago when all audio distortion suddenly disappeared! Nothing was ever 'said', but I realised that my suspicions of a long standing transmitter fault were correct, after all!

73 Felix
VK4FUQ
02 March 2012

Voltage Doubler Detector

This is an AM detector circuit that I've long known about and which worked ok, but never seemed to work as well as it should have. However I spent some time late last night trying to optimise the circuit, with some success.

It is a curious circuit being essentially a 'voltage doubler' originally developed for power supply applications, and its use as an AM detector is hard to analyse! It seems that the component values in the circuit are somewhat critical for good performance and if not, the performance is rather 'ordinary'. The circuit that I eventually came up with uses a 150 picofarad 'input capacitor' with a 150 kohm 'load' resistor and loaded into a FET common source voltage amplifier stage (as previously described) through a coupling capacitor with a 1 Mohm input resistance.

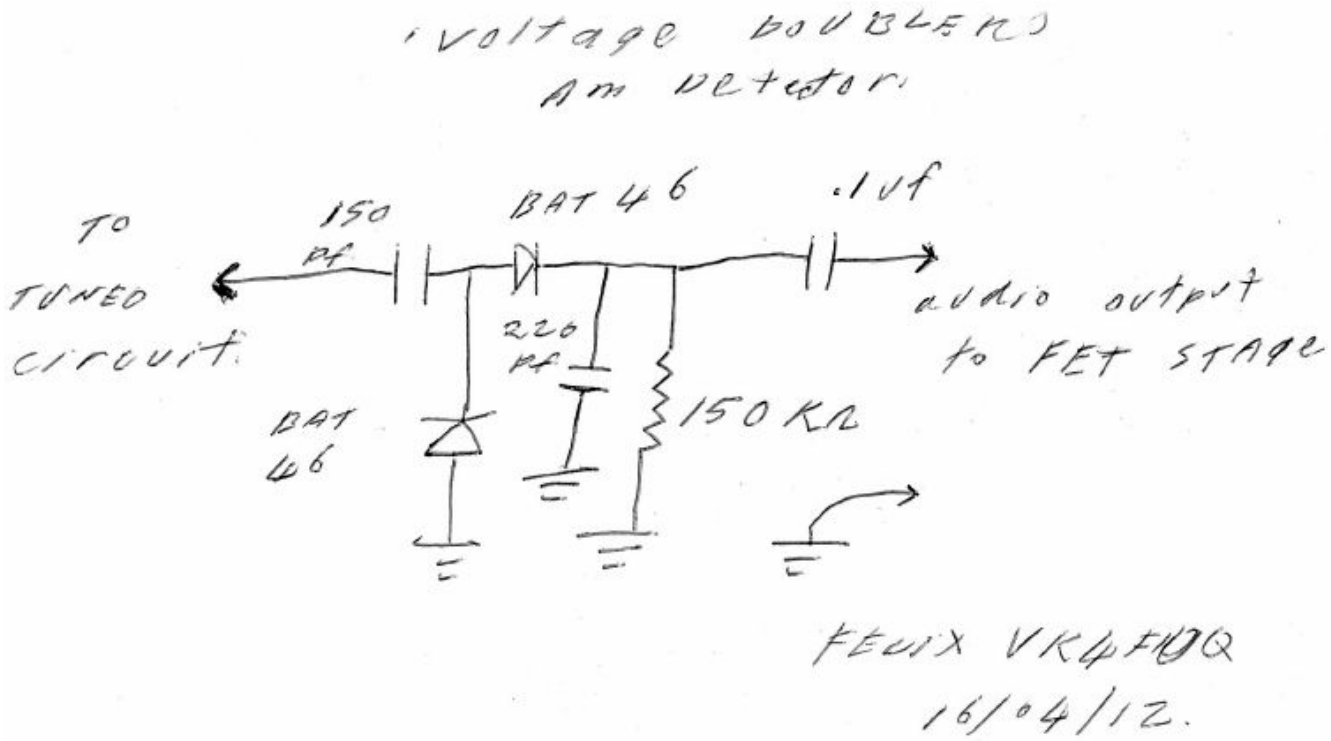

With these circuit values, it all works 'quite well'. Give it a go! It's an interesting AM detector with quite good 'sensitivity' and clean audio quality, and it seems to work well at low signal levels.

73 Felix
vk4fuq.

16th April 2012.

Simple AM detectors: What works best? A practical experimenters viewpoint.

I have written a lot about simple AM detectors for use as tuners for feeding into an audio amplifier, and it has been a long time interest. These days I use either diode based or 'infinite impedance' types of AM detectors. In this location our 'local' AM stations are quite distant and are therefore quite weak in terms of signal strength.

As such I find infinite impedance detectors based on field effect transistors give consistently better results for tuner applications due to their lower apparent overall detector distortion. Diode based detectors are quite 'fussy' as they require both optimal output buffering (AC/DC ratio) and an 'adequate' (beyond the diode knee) level of RF signal injection. http://www.tonnesoftware.com/appnotes/demodulator/diodedemod.html

Diode based detectors will happily 'detect' at very low signal levels, however the (inevitable) audio distortion that results, can be extremely irritating to the ear! Under these conditions I find infinite impedance detectors (even without additional RF preamplification and subject to individual FET characteristics), generally sound 'cleaner' and more pleasant to the ear.

FET's of course require a power source for operation whereas diodes are passive (un-powered) detectors (most of the time), however this is of no real advantage in a tuner application as an 'active' audio amplifier stage will generally be required anyway for audio level boosting, buffering etc.

In the end it will come down to a consideration of prevailing RF signal levels and other related circuit considerations at one's location. If local RF levels are strong, a well designed diode detector will give excellent results. If not, an 'infinite impedance' type of detector is most likely the better option unless one goes towards the option of additional RF preamplification prior to the diode detector.

73 Felix
vk4fuq.

17th April 2012.

ANOTHER DETECTOR by Felix Scerri !

I've tried diode based 'voltage doubler' (or more correctly 'diode integrator') AM detectors before with indifferent results, however the other day, just trying a few ideas I came up with this version that works rather well, with low audio distortion, high audio output and really 'nice' audio quality and the best of all, it seems to work very at very low RF input level.

The two diode 'voltage doubler' detector using two BAT 46 silicon schottky diodes feed directly into a MPF102 source follower stage set at 1 Megohm input resistance. The 'input' capacitor feeding the diodes from a tuned circuit is 68 picofarads.

I have the simple RF filter right on the output of the FET stage. In that respect this circuit is vaguely similar to the old 'Selstead-Smith' valve AM detector of the past. An interesting one! I am very happy with its general performance. Regards, Felix vk4fuq 11/04/2013

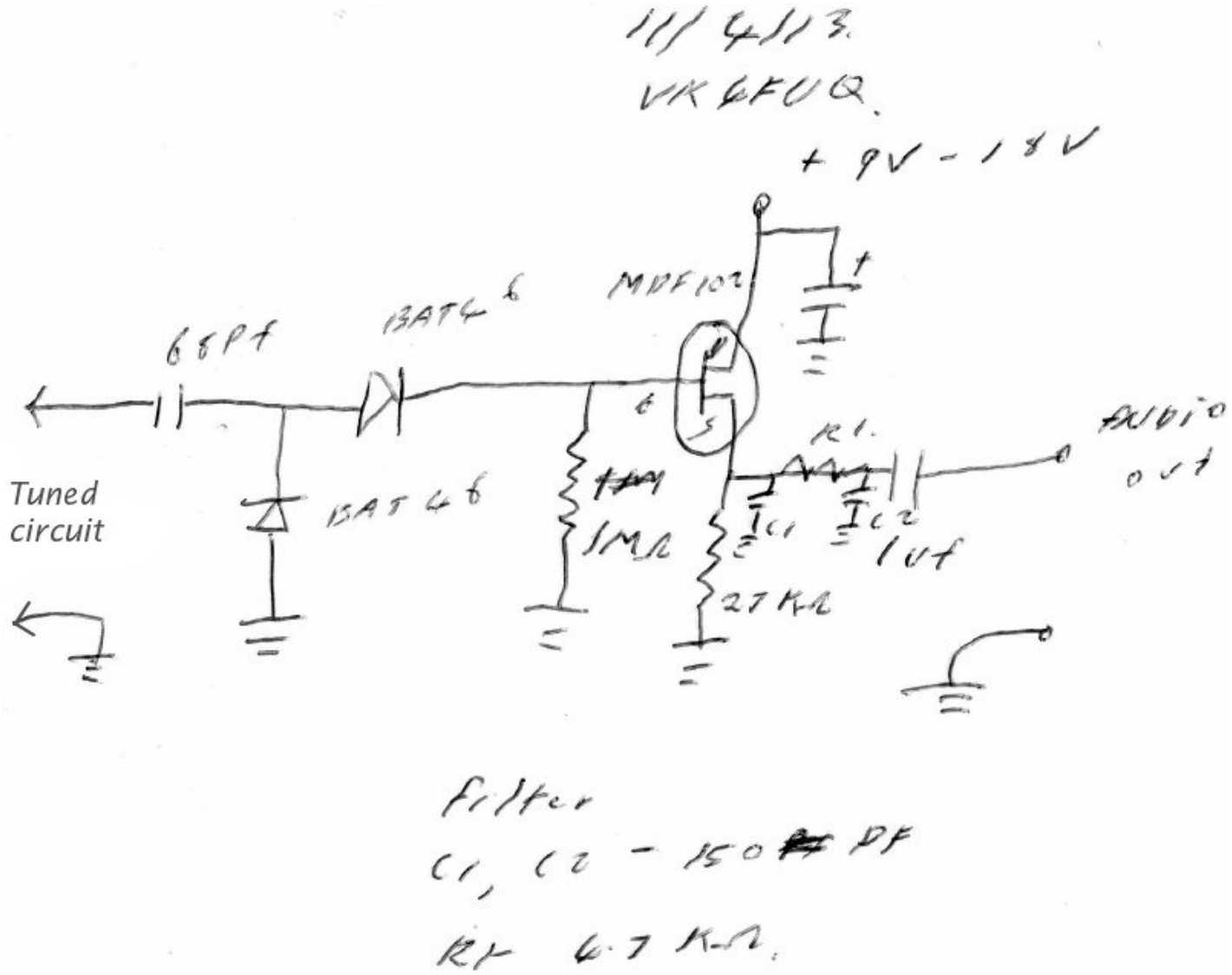

Felix Scerri VK4FUQ

UPDATE - JUNE 2013

G'day all, readers may recall the two FET infinite impedance detector I developed some time ago. That circuit worked well, but some samples of the MPF102 regretfully produced distorted output. However a recent discovery has resulted in an improved version that has truly exemplary performance.

The MPF102 is in all honesty a device essentially designed for VHF applications, but is often used in simple audio applications albeit with occasionally indifferent results, due to general device parameter 'spread'. More or less by empirical trial and error I have found that a simple change in source resistor value to 100 k (from a much lower value), pretty well fixes everything.

In a FET source follower circuit this is interesting as the output impedance is actually a lot lower than 100 k due to the action of the FET's transconductance. It is similar to the action of a bipolar transistor emitter follower circuit. In fact a simple infinite impedance detector with a 100 k source resistor actually works very well and will be good enough for many applications, however the addition of a second FET as a constant current source does markedly reduce overall audio distortion in the stage overall, and produces very clean and low distortion audio quality and also reduces the output impedance considerably (good for tuner applications), so take your pick!

Regards, Felix vk4fuq 02/06/2013.

UPDATE - JANUARY 2014
A simple modification to the basic FET 'infinite impedance' AM detector that dramatically improves performance.

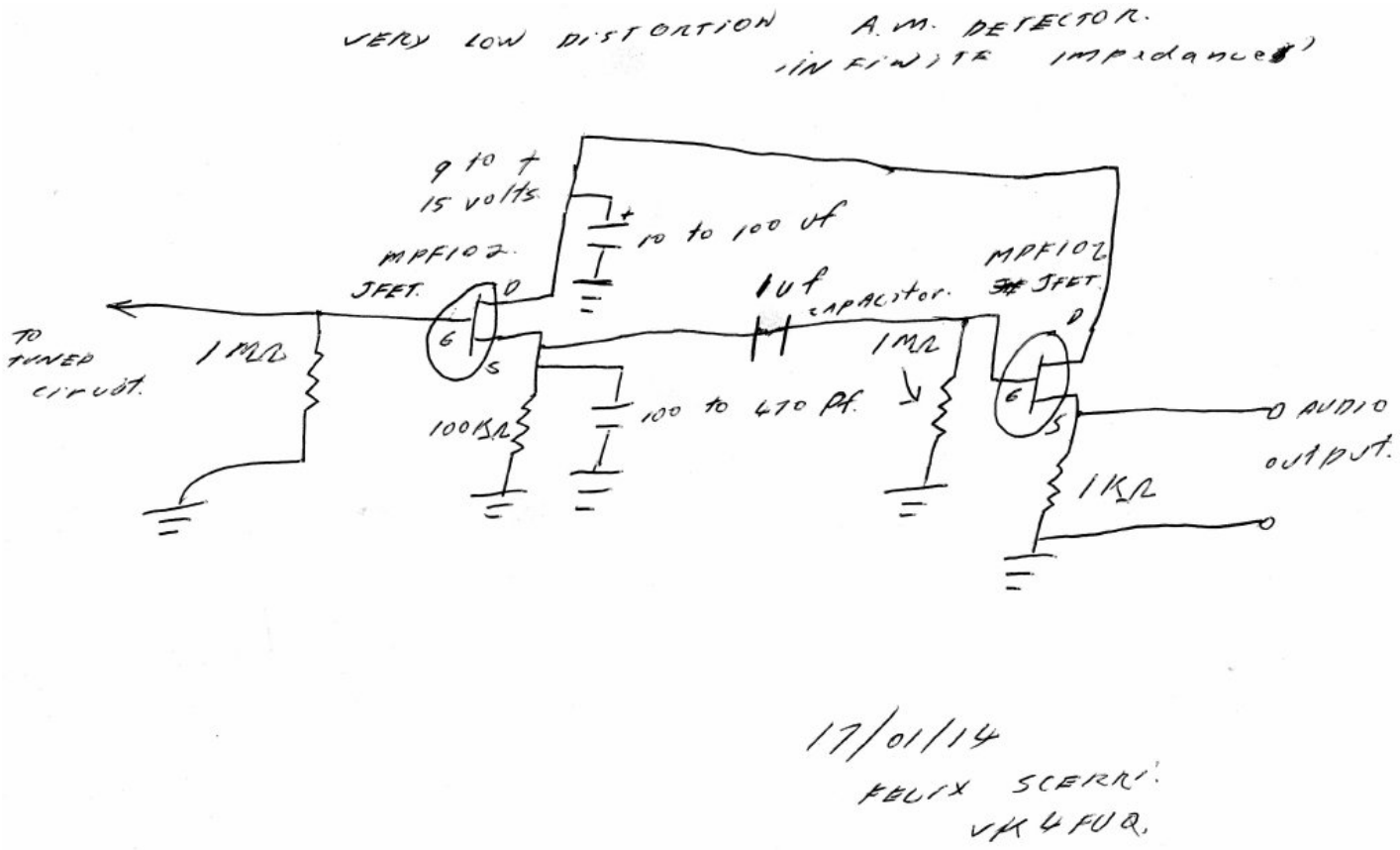

G'day all, over the Christmas break just messing around I worked out (mostly by accident), a simple modification for the simple FET based 'infinite impedance' detector circuit that dramatically improves weak signal performance and also greatly reduces audio distortion.

Essentially by the addition of another FET 'buffer' stage, another source follower, capacitively coupled from the first detector stage. The circuit is actually a simplified version of the circuit that I described in this link, http://sound.westhost.com/articles/am-radio.htm (figure 6) and testing the two head to head, they both sound superb and the simpler version is actually somewhat easier to build. I cannot get over how low distortion and 'nice' the recovered audio sounds. It is a joy to listen to!

Regards, Felix vk4fuq 12/01/2014.

Diodes for ‘weak signal’ crystal set applications.

As I am primarily interested in using crystal sets as AM tuners for feeding into a preamplifier/amplifier and loudspeakers, the actual type of diode can be relatively critical. In a strong signal area, not so much, but in a weak signal area such as where I reside, definitely. A diode with a good ‘square law’ performance (the area below the ‘knee’ in the diode curve), generally results in much cleaner and lower distortion than other good performing diodes, and believe me diode distortion under weak conditions, even with optimised diode ‘buffering’ used is very nasty sounding to the ear!

Testing many, many diodes in actual working crystal sets and listening critically to the audio output, it seems to me that the best diodes to use under weak signal conditions are the so called ‘gold bonded’ germanium diodes. I have sampled many different gold bonded germanium diodes and they all work well in this specific application, although sometimes the rectified output voltage may not be as high as other germanium or silicon schottky diodes, however the audio quality is much cleaner and shows much less apparent distortion!

I have tried OA5, OA47, IN141 and several ‘CG’ gold bonded germanium diodes with consistently excellent results. Other ‘ordinary’ germanium diodes may also work well under weak signal conditions, but they will need to be tested individually to check actual performance in a working circuit. One thing that I have noticed about germanium diodes is that due the ‘point contact’ nature of their construction, even diodes of the same specific type can exhibit rather different levels of performance!

The otherwise very good BAT46 silicon schottky diode works extremely well at good RF input level but not so well at weak RF input, especially when heavy broadcast ‘processing’ (commonplace these days), is used. New ‘gold bonded’ germanium diodes are probably no longer made although I am aware that they can be purchased through vendors over the internet. Apart from that, they may be found in old gear. As stated earlier, ordinary germanium diodes may be quite good but will need to be checked individually. Diodes are complex things!

Felix (vk4fuq). 29/01/2014.

* * * * * * * * * * * * * *

Just when I thought that I’ve tried everything I realised that I’ve not tried a voltage doubler (diode integrator) detector with an RF stage in front. It is an unfortunate fact that all diode detectors ‘need’ a good RF injection level (and buffering) or audio distortion becomes ‘bad’ (an understatement!)

Consider yourself very lucky if you live in a strong signal area! (unfortunately I don’t). Anyway I quickly built a couple of prototypes which worked ok but not as well as hoped. Initially I tried using a source follower buffer (no voltage gain), but converting it to a common source amplifier (with appreciable voltage gain), seemed no better, which was strange.

After staring at my prototype for what seemed like forever with my magnifiers on, I (finally) realised my mistake. A common source stage takes its output off the ‘drain’ terminal of the FET, not the ‘source’ terminal as it does with the FET source follower buffer stage. I shifted one wire, and all worked as expected and it sounds fantastic! All diode detectors (one diode envelope detectors, doubler detectors etc), need good RF input and a simple untuned FET RF gain stage works very well. As to the sound, it sounds great.

73 vk4fuq 10/03/2014.

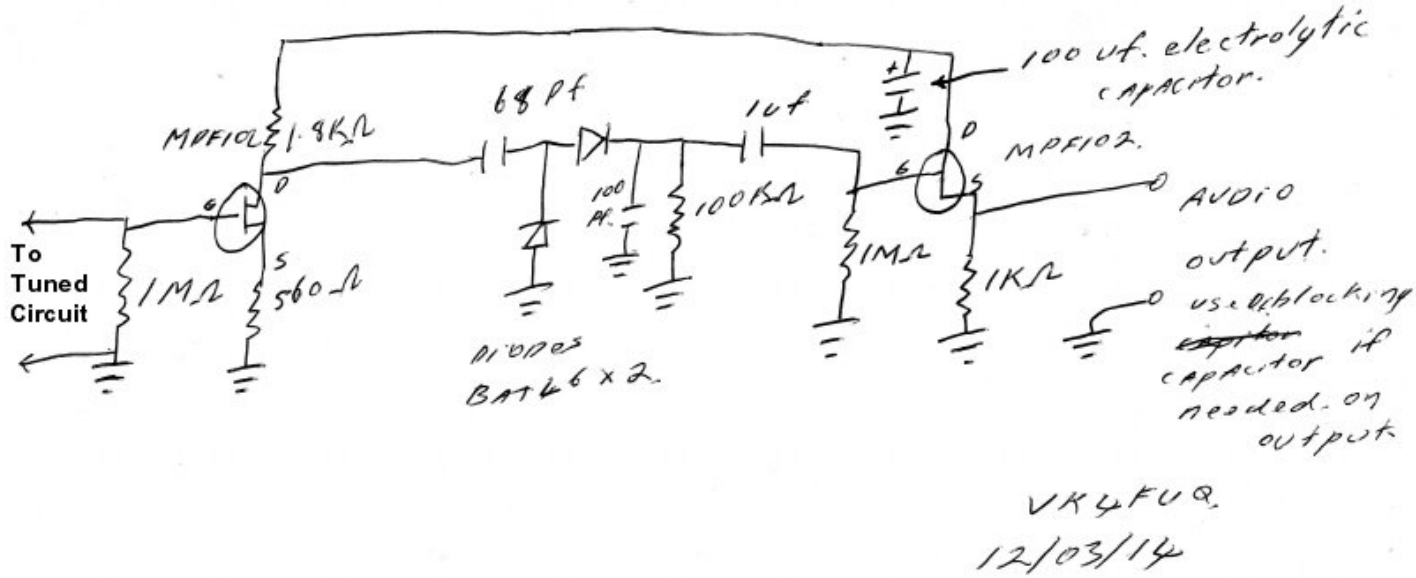

Felix Scerri's FET Crystal Set with Voltage Doubler

A 'nice sounding' AM detector - update October 2015

Looking through these pages the other day I was slightly shocked to realize that I've completely forgotten about some of the circuits that I've contributed in earlier days! They all work pretty well, however in my advancing older age and a little like my tastes in high fidelity generally, I'm starting to show a particular preference for 'nice sounding' bits of audio gear.

I guess that this also means low noise/low distortion too, although with AM broadcasting, at least in this country and probably elsewhere in the world too, the very common use of broadcasting 'processing' tends to make it hard for AM detectors generally, often resulting in a 'hard/compressed' sort of sound although still low in distortion, is not 'nice sounding', if that makes any sense!

Well of all the AM detectors that I've tried and/or developed, only one sounds 'nice' when confronted by heavy broadcast processing and that is an AM detector 'based' on a voltage doubler/diode integrator circuit (similar to the above circuit, actually the 68 pf capacitor should be changed to .1 uf, for slightly greater output).

It has taken me a very long time (years) to 'optimise' this circuit, but as it presently stands this is my favourite 'nice sounding' AM detector, and gets most use for general high quality listening on the AM broadcast band. It sounds really good! It somewhat reminds me of an old OA47 gold bonded diode detector from years ago before such abhorrent 'processing' became commonplace!

Ah yes the OA47….now that is a lovely sounding detector diode!

Regards, Felix vk4fuq. 17 / 10 / 2015.

* * * * * * * * * * * * * *

That's it for crystal sets. I hope you try building one, it's easy and great fun!

See some useful links below....

73's
Mike

Crystal Sets (Part1) | Build Your Own Crystal Set (Part 2)

Spider's Web Crystal Set (Part 3) | Crystal Set By Kenneth Rankin (Part 4) | Crystal Radio Links

Amateur Radio
MØMTJ Visit my amateur radio pages MØMTJ
Visit my Amateur Radio Pages >

No AM radio stations or transmitters in your locality or country?

Has your local medium wave broadcast station closed or been moved to VHF/FM or Digital? Don't worry. You can still build and experiment with crystal sets and TRF radios by also buying or even building a simple low power AM transmitter. So, not only can you use your crystal sets but you can also run your own radio station that can be heard in and around your home - playing the music or programmes that you want to hear!

SSTRAN AMT3000 Superb high fidelity medium wave AM transmitter kits from SSTRAN. Versions available for 10kHz spacing in the Americas (AMT3000 or AMT3000-SM) and 9kHz spacing in Europe and other areas (AMT3000-9 and AMT3000-9SM). Superb audio quality and a great and well designed little kit to build: http://www.sstran.com/pages/products.html

http://www.sstran.com/

Other AM transmitters available:

Spitfire & Metzo Complete, high quality ready built medium wave AM Transmitters from Vintage Components: http://www.vcomp.co.uk/index.htm Vintage Components offer a choice of the high quality Spitfire and Metzo transmitters:

SPITFIRE AM Medium Wave Transmitter with 100 milliwatt RF output power:

http://www.vcomp.co.uk/spitfire/spitfire.htm

METZO AM Medium Wave Transmitter with built in compressor:

http://www.vcomp.co.uk/metzo/metzo.htm

AM88 LP A basic AM transmitter kit from North County Radio.
http://www.northcountryradio.com/Kitpages/am88.htm

LINKS: Fine links to more Crystal Radio websites here

Component Suppliers: Links to electronic component suppliers here

Visit my Amateur Radio Pages >

Crystal Sets (Part1) | Build Your Own Crystal Set (Part 2)

Spider's Web Crystal Set (Part 3) | Crystal Set By Kenneth Rankin (Part 4) | Crystal Radio Links

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Crystal Sets Introduction | Resistor & Capacitor Conversion Tables

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CRYSTAL SETS 2

Some Practical Designs
MAKE YOUR OWN
CRYSTAL SET !!

CRYSTAL SETS 2: SOME PRACTICAL DESIGNS

I hope that you attempt building one or two of these crystal set designs and I really do recommend that the components are carefully connected up using soldered joints onto a piece of tag-strip for reliability. However if you are new to constructing such electronic circuits then some simple solder-less techniques could be employed and these are suggested at the bottom of the page. Also see Crystal Sets Part 5 for more ideas on experimenting with crystal sets.

An early and very basic crystal set would have been nothing more than a coil of wire, perhaps 50 -100 turns, wound around a cardboard tube about 3 inches (7cm) in diameter, a detector (or cats whisker) and a pair of special High Impedance headphones (as discussed in part 1).

There would be a very large aerial strung up around the garden and the all important connection to earth.

The coil would have tapping points (connection points) at intervals of around 5 or 10 turns. See the circuit diagram on the right for details of who the set is wired together.

The tapping points on the coil allow the set to be tuned to different frequencies by adjusting the position of tap B. Tap B would be connected to the coil at differently positions by way of a crocodile clip. The fewer turns between the top (aerial end) of the coil and tap B, the shorter the wavelength received (ie the higher the frequency). Tap A would allow the detector to be connected at different positions to vary performance. There is an additional component drawn in the above diagram, the *capacitor* (value 1000pF), this is included in crystal sets that used the *High Impedance* magnetic headphones, and bypassed any remaining radio frequencies (RF) to earth.

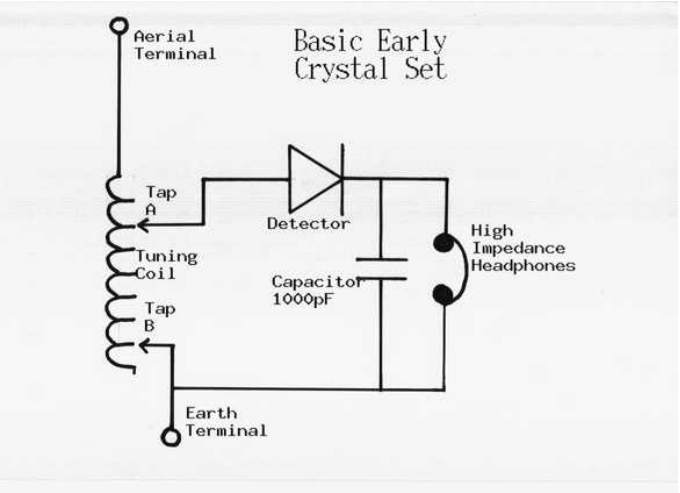

A very basic crystal set circuit.

I have not built the set described above as it is so basic. Such a crystal set above would probably have been adequate in 1920 - 1923 when there would have been only one local transmitter receivable.

When the BBC expanded transmissions and it became possible to hear more than a single station it would have became necessary to include a more convenient means of tuning the set.

This was achieved by including a Variable Tuning Capacitor, of about 500pF (0.0005uF) connected in parallel with the tuning

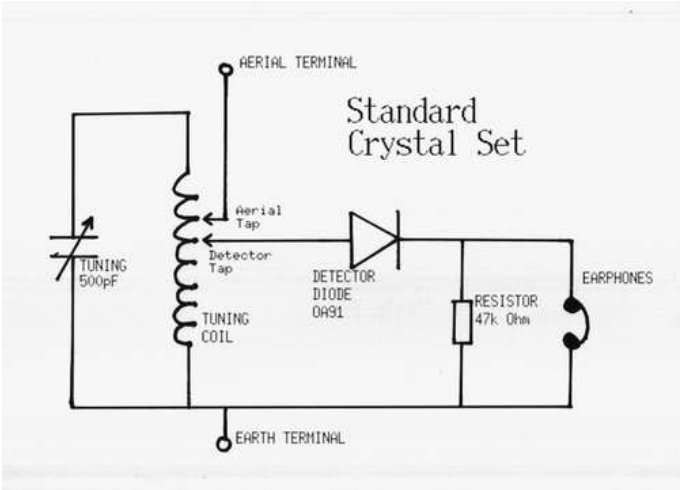

The Standard Crystal Set

coil forming a *tuned circuit*. The tuning capacitor would have a Bakelite knob on the spindle to aid tuning.

Because of the simplicity of crystal sets, it is often difficult to separate stations. When tuned into one station it is often possible to hear another close by station in the background, this is due to lack of *selectivity*. This can be reduced somewhat by adjusting the positions of the Aerial Tap and Detector Tap. Moving them closer to the bottom of the coil, the earthy end, reduces the load on the tuned circuit and this improves selectivity, however it does also reduce *sensitivity* which can make the station quieter. Headphones will often swamp a tuned circuit and reduce its selectivity (Q factor), so moving the tapping point lower down improves this situation. Every circumstance is bound to be different though so the best balance has to be found by experimentation. My crystal set has both the diode and the aerial connected to the same tapping point on the coil, about a quarter of the way down.

The modern 'standard crystal set' shown above uses a Crystal Earphone, since suitable high impedance magnetic headphones (of 2000 to 4000 ohms) are no longer widely available. When using a crystal earpiece the 1000pF capacitor shown in the first diagram can usually be omitted an in its place a 47k ohm resistor is connected, this ensures that the Crystal Earphone will work at its most efficient i.e. the sounds will be as loud as possible. The resistor allows DC current to flow through the circuit efficiently - this would otherwise be blocked when using a crystal earphone. In a modern crystal set the detector used is a *Diode.* Suitable diodes include OA80, OA81, OA90 OA91 and IN94 which are usually available from component stockists.

A Better Diode For Increased Efficiency

The OA47 will be of particular interest since it has the lowest forward bias voltage of any of these diodes which will make the crystal set somewhat more sensitive and therefore louder. The US equivalent of the British OA47 is the IN34.

On the right you will see my real working example of a crystal set

The large plastic knob on the front turns the variable tuning capacitor. This set receives the three UK national stations and also three local radio stations very well at my location.

There is a small 3.5mm jack socket mounted on the front of the plastic case (MB5 from Maplin Electronics) that the crystal earphone plugs into.

The coil can be seen inside the case, it is 70 turns of 30 gauge enamelled copper wire wound around the centre of a toilet roll and tapped every 10 turns, by scraping off the enamel insulation and making a small twist. The croc' clips can be seen clipped on to these twists to connect to the aerial and detector tap points.

A real working crystal set. Radio as if by magic with no battery or mains power.

THE MEDIUM WAVE COIL - MORE DETAILS

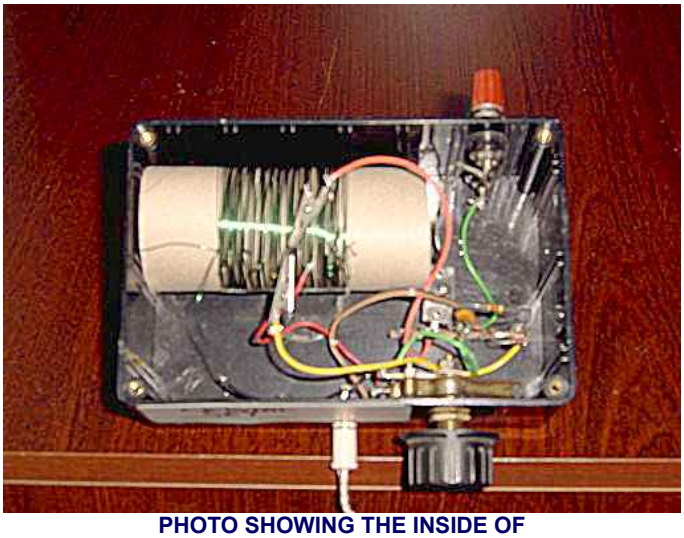

PHOTO SHOWING THE INSIDE OF THE COMPLETED CRYSTAL SET

Medium Wave Coil

The number of turns of wire required on the coil will vary depending on the size of the former (in this case the inside toilet roll) and the thickness of the wire. So to obtain the correct coverage of the medium wave band may need a little experimentation.

I usually find that between 50 to 90 turns is right and I generally use enamelled copper wire that is between 30 s.w.g. and 26 s.w.g (i.e. 0.315mm and 0.45mm diameter), so it's best to start with too many turns and then work down.

The more turns that you use the lower the frequency range will be, i.e. too many and the coverage of the top end of medium wave around 1500 - 1600 kHz will be lost, while too few and the coverage down to 500 kHz will be lost.

It is also important that the coil former is non conducting, i.e. not metallic. It could be wood or cardboard or a short piece of PVC piping and with a diameter of between 1½ and 4 inches (4 to 15 cm) are common sizes. You could try using a ferrite rod too, see below.

This particular set has a coil wound onto a toilet roll tube which consists of 70 turns of 30 s.w.g. (0.315mm dia) enamelled copper wire tapped at every 10 turns. It also has the additional small trimmer capacitor that helps match the aerial to the tuned circuit thereby improving selectivity, see below.

USING A FERRITE ROD AS THE COIL FORMER

The aerial coil could be wound onto a ferrite rod.

A piece of 10mm diameter ferrite rod of between 3 and 6 inches long (80 to 150mm) will be most suitable and will require between 50 and 90 turns of enamelled copper wire to provide coverage of the medium wave band: First make a paper tube that is held together with sticky tape that will easily slide up and down the ferrite rod. Then wind the coil over this with the windings neatly side by side. Make tapping points every 10 or 15 turns so that the aerial and diode tapping points can be adjusted.

Adjustments to the tuning range can be made by removing some wire from the coil so it is best to start off with too many turns and then work down. Fine adjustments can be made to the completed coil by sliding it up and down the ferrite rod.

AN IMPROVEMENT TO THE DESIGN

The crystal set above also has one small, but significant, improvement over the standard crystal set and that is an Aerial Trimmer. A trimmer is a variable capacitor, very similar to the tuning capacitor, except smaller and adjusted with a screwdriver.

The value of the trimmer is usually around 10 - 50pF, but if a small tuning capacitor is available that will probably be just as effective. In the absence of such a variable capacitor, individual fixed ceramic capacitors of e.g. 10pF, 50pF and 100pF can be tried in this position to judge which gives the best results with the particular aerial being used.

The trimmer capacitor adjusts the coupling to the tuned circuit, reducing the load of the aerial on the tuned circuit will improve

the selectivity (Q), and it will be easier to separate stations. Again tapping points are used and I find this to be an excellent arrangement.

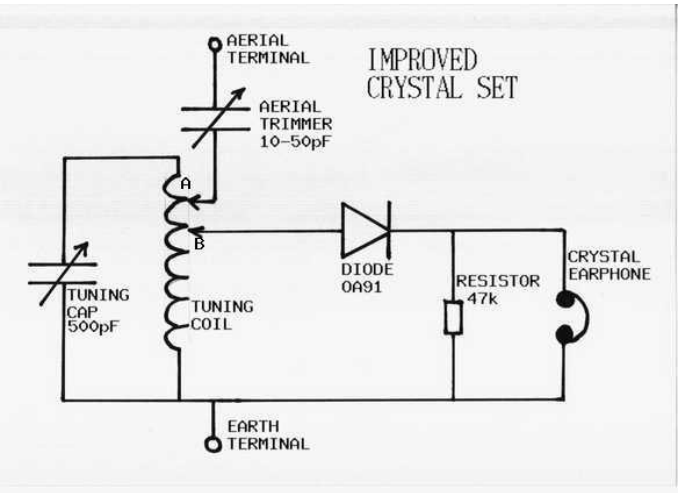

Improved Crystal Set design, with good selectivity

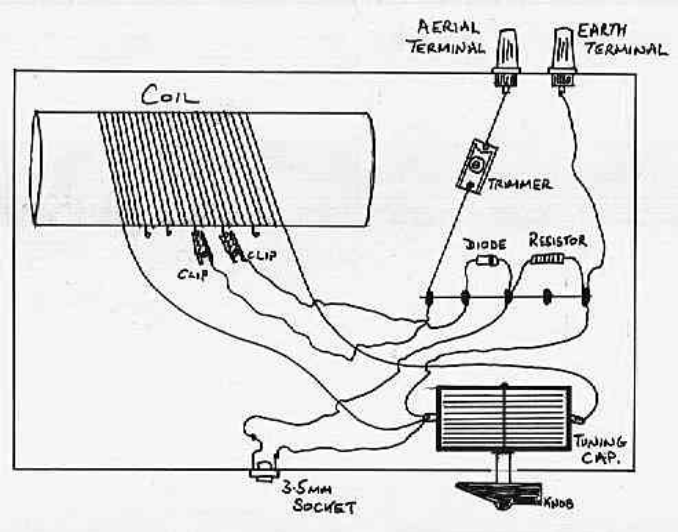

Layout Of The Crystal Set - Although this is soldered together an alternative to tagstrip would be a 5amp mains connector block so that components can be trapped in place with screws. See article below.

The picture on the right shows the general layout of the crystal set above. The coil is of approximately 70 turns is wound on the centre of a toilet roll, and has tapping points at 10 turn intervals.

The trimmer is soldered between the Aerial terminal and the piece of 5-way tag strip, and a wire goes from there to a croc' clip which is clipped onto a tap on the coil. The Diode is also soldered onto the tag strip, one end connected to a piece of wire going to a second croc' clip & connected to a tapping point on the coil, the other end of the diode is connected to the 3.5mm jack socket that the Crystal Earphone plugs into.

The 47k resistor is also connected to the earphone end of the diode and goes to earth, the earth terminal wire is soldered to the tag strip at this point too. The tuning capacitor has two terminals, one connected to each end of the coil, and one of them is also connected to earth as shown. [Where the wires cross over in the diagram, they do not touch and are not connected together].

LONG WAVES

In most areas around Europe and certainly around much of the UK you will be able to hear a Long Wave station. To receive Long Wave on a crystal set will require an aerial coil with a greater number of turns to increase its inductance.

As a good general guide a coil wound on a piece of 10mm diameter ferrite rod will require about 250 turns of enamelled copper wire: First make a paper tube that is held together with sticky tape that will slide up and down the ferrite rod. Then wind the 250 turn coil over this, the windings will have to be made over the top of each other. Make tapping points at, say, 50, 75 and 100 turns to tap the aerial and diode to.

As with the medium wave ferrite rod aerial, adjustments to the tuning range can be made by adding or removing some wire from the coil, and fine adjustments can be made to the completed coil by sliding it up and down the ferrite rod. The longer the ferrite rod the better and anything between 3 and 6 inches long (80 to 150mm) will be very good.

SHORT WAVES

If you like experimenting, then reducing the number of turns on the coil to say 10 to 30 will allow reception of the higher frequencies, the Short Waves. I have found

that winding the coil around a 'ferrite rod' often works even better with short wave reception.

Obtain a ferrite rod about 7 to 15 cm long and about 1cm in diameter. Make a couple of small tubes of card, about 4cm long, that will fit tightly over the rod.

On one tube wind two coils using 0.5mm diameter enamelled copper wire - one coil of about 30 turns and a second one of 2 or 3 turns wound over the top of the first. Secure the windings in place with Sellotape.

On the other card tube wind a similar coil, but use about 15 turns for the first coil and for the second coil wind about 3 to 4 turns over the top, and secure with Sellotape tape.

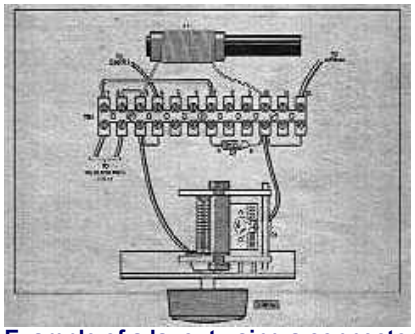

Example of a layout using a connector block to wire up a crystal set

These coils will provide coverage of short wave in two bands using the first coil for the longer wavelengths, typically 60 to 31 metre bands and the second coil for the shorter wavelengths typically 25 to 19 metre band. Wire up the circuit as shown in the circuit diagram below.

USING A TOROID INDUCTOR FOR SHORT WAVES

Even better selectivity performance can be achieved by winding the inductors (coils) on a ferrite toroids (T50-2 yellow, or green will do). The aerial trimmer need not be used if selectivity and sensitivity is found to be adequate. It's all about experimenting, and I find it best to use a trimmer or small coupling capacitor to obtain the best selectivity.

Up to 30 turns of 0.5mm enamelled copper wire can be used for the longer short waves below 10 MHz, while a winding of around 15 turns will provide coverage of the shorter short waves above 10MHz.

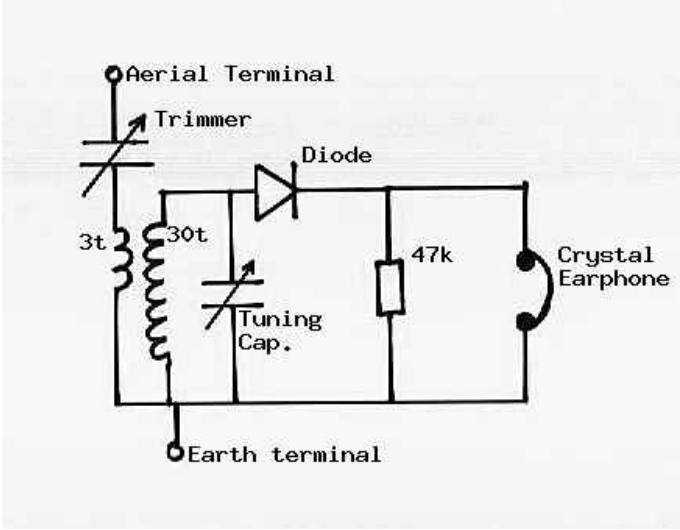

The circuit diagram of the Short Wave Crystal Set

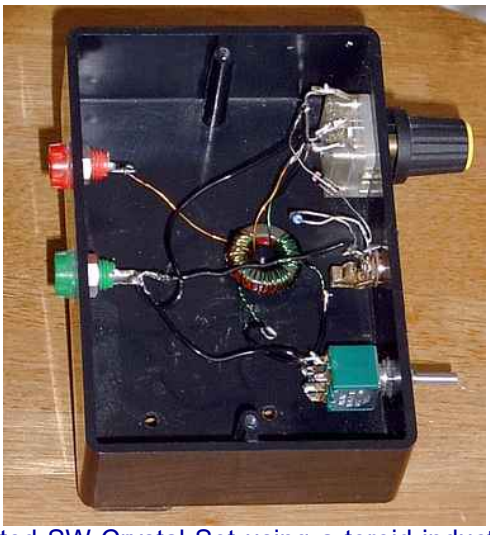

A completed SW Crystal Set using a toroid inductor. Note: the main winding has a tap to allow the switch to short part of the winding and thereby give two ranges.

AUSTRALIAN DESIGN

Moving back to the Medium Waves, here is a circuit for a very interesting Australian design that promises extremely good station separation (selectivity), and having built it I can vouch for that claim, it's really excellent.

I receive three national stations and three local stations at my location with excellent clarity using a modest antenna and standard crystal earphone.

The coil is different to the other crystal sets described above, it is

The front panel of the Australian Crystal Set

much bigger at 3¼ inches (8cm) diameter and 5inches (12cm) long. I made my coil former out of the cardboard from a breakfast cereal box - just like Blue Peter!

The design is often referred to as The Mystery Crystal Set, by Proton.

Two distinct coils are wound on it, the first one consists of about 50 turns of 24 s.w.g (approx) enamelled copper wire. The second coil is 25 turns, very close wound right over the top of the first coil using 30 s.w.g. (approx) wire, try to get this second coil wound in between the windings of the first, for better inductive coupling.

Then carefully wire up the set according to the diagram. Notice that the tuned circuit is not connected to earth and has no *direct* connection to the detector circuit. The detector circuit *is* connected to earth however. The two aerial terminals offer alternative selectivity performance, terminal A gives very good selectivity while B is very wide. I never bother with B.

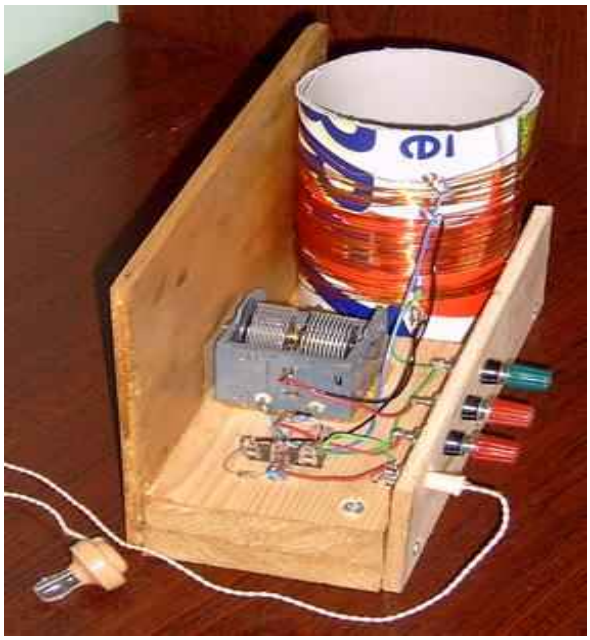

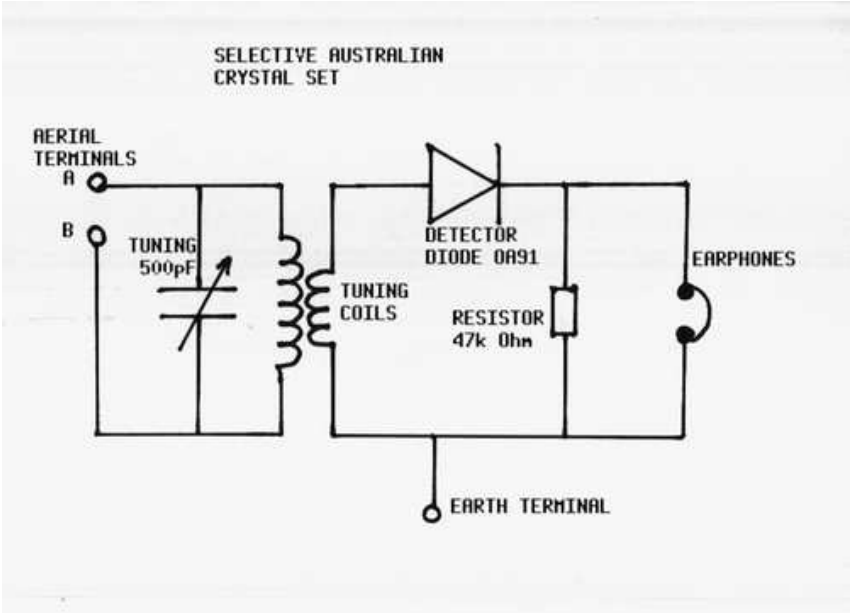

Make the coil carefully and wire up this crystal set according to the circuit diagram opposite and you will be rewarded with a really high performance crystal set of a type that was used in the very early days of broadcasting in 1930's in Australia.

This is probably my favourite crystal set!

THE DENCO PCC1 COIL

The PPC1 coil was a commercially manufactured by Denco Clacton Ltd and was popular among hobbyists not keen on going to the bother of winding their own fiddly little coils. As a child I wanted try one of these coils and sent away for one by mail order. It arrived a few days later in a little cloth bag, like a miniature pump bag, with protective wrapping inside.

The coil windings are entirely enclosed in what I can only describe as a cylindrical ferrite 'shell', the four very thin connecting wires exiting, two either side, from small apertures in the 'shell'. The performance of the circuit shown below I seem to remember was quite pleasing. Unfortunately I cannot find the set or the PPC1 coil at the moment, but here is

a reproduction of the circuit diagram and data:

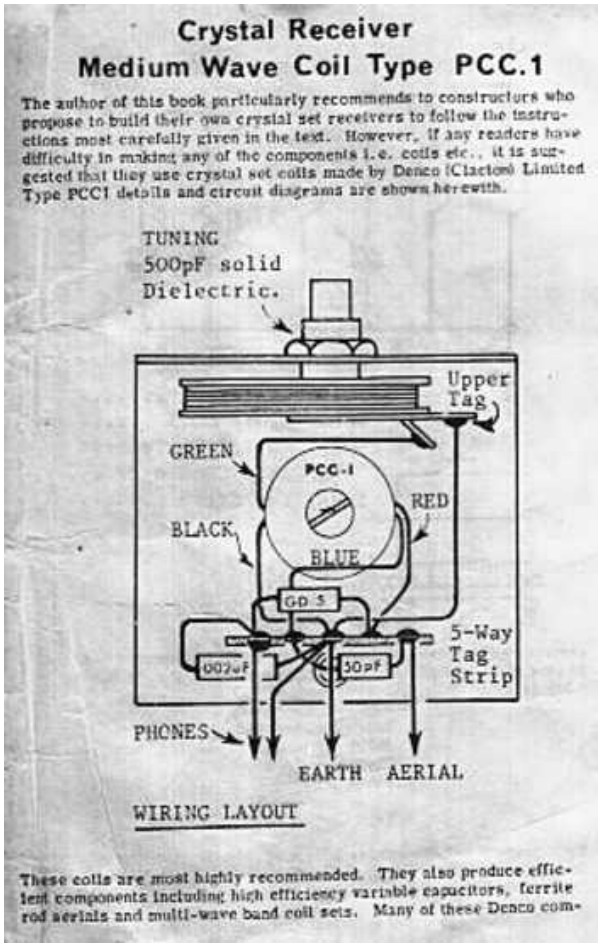

Crystal Receiver
Medium Wave Coil Type PCC.1

The author of this book particularly recommends to constructors who propose to build their own crystal set receivers to follow the instructions most carefully given in the text. However, if any readers have difficulty in making any of the components i.e. coils etc., it is suggested that they use crystal set coils made by Denco (Clacton) Limited Type PCC1 details and circuit diagrams are shown herewith.

WIRING LAYOUT

These coils are most highly recommended. They also produce efficient components including high efficiency variable capacitors, ferrite rod aerials and multi-wave band coil sets. Many of these Denco com-

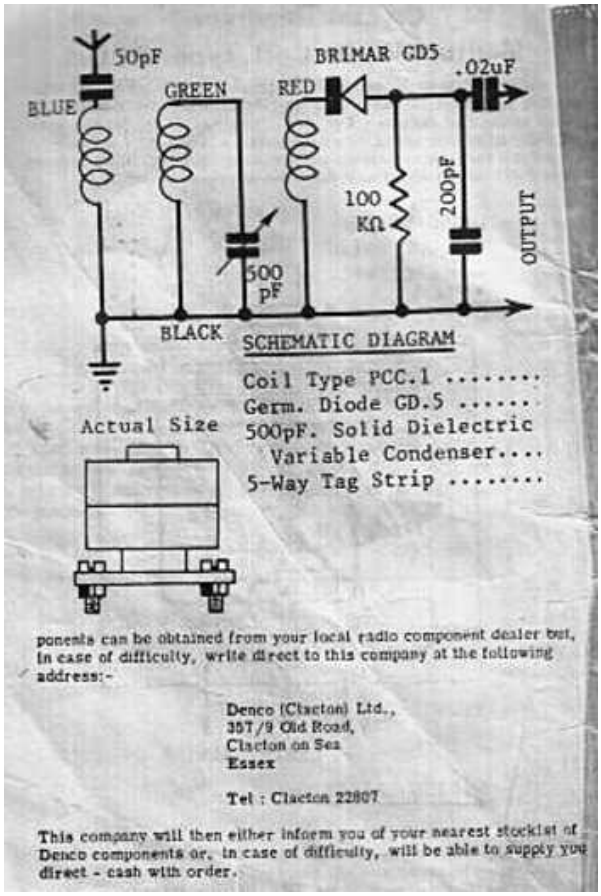

SCHEMATIC DIAGRAM

Coil Type PCC.1 .....
Germ. Diode GD.5 .....
500pF. Solid Dielectric
Variable Condenser....
5-Way Tag Strip .....

Actual Size

ponents can be obtained from your local radio component dealer but, in case of difficulty, write direct to this company at the following address:-

Denco (Clacton) Ltd.,
357/9 Old Road,
Clacton on Sea
Essex

Tel : Clacton 22807

This company will then either inform you of your nearest stockist of Denco components or, in case of difficulty, will be able to supply you direct - cash with order.

THE REPANCO DRR2 COIL

I recently rediscovered an old Repanco DRR2 Longwave / Mediumwave coil that must have been kicking around in my junk box since the 1970's.

The DRR2 coil was made by Repanco in Coventry. It came with a page of suggested circuit diagrams which I thought had been lost to the mists of time, but it recently came to light again, so I have now copied it below.

Once again I included an aerial trimmer which can be adjusted to improve selectivity.

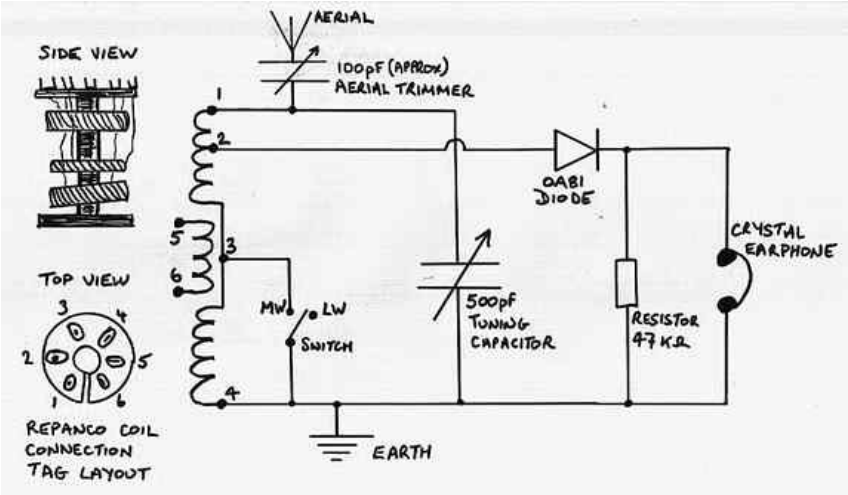

The circuit diagram of the crystal set using the Repanco DRR2 coil

Repanco Ltd was formed by two ex-army signals engineers and from the earliest days of radio supplied crystal set kits and coils to radio construction enthusiasts.

The Repanco DRR2 coil was for medium wave and long wave intended for use in when building simple crystal set and valve radio

A 'lash-up' of the Repanco crystal set

circuits.

It consists of three coils; a Medium Wave coil at the top that includes a tapping point (for the aerial); a coupling coil or tickler in the middle; a lower coil which can be connected in series with to top coil to provide Long Wave reception.

I have built a quick crystal set with the coil and it provides good reception with excellent selectivity, so it must have a very good Q factor.

The Repanco DDR2 coil was provided with a simple Foolscap size information sheet that showed four different radio circuits. Sadly the sheet does not give a huge amount of information and my copy is now rather tatty and faded - it is copied below:

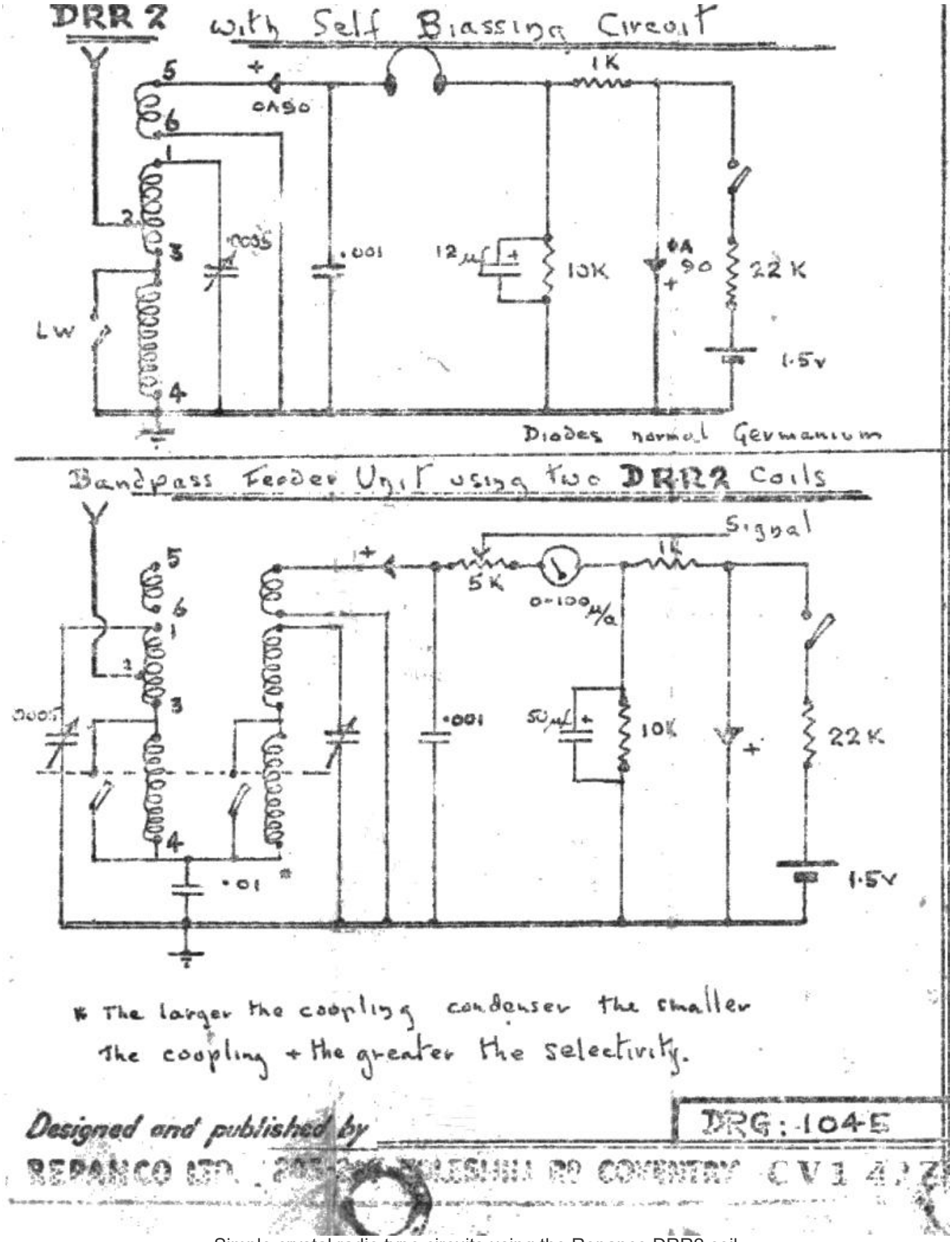

Simple crystal radio type circuits using the Repanco DRR2 coil

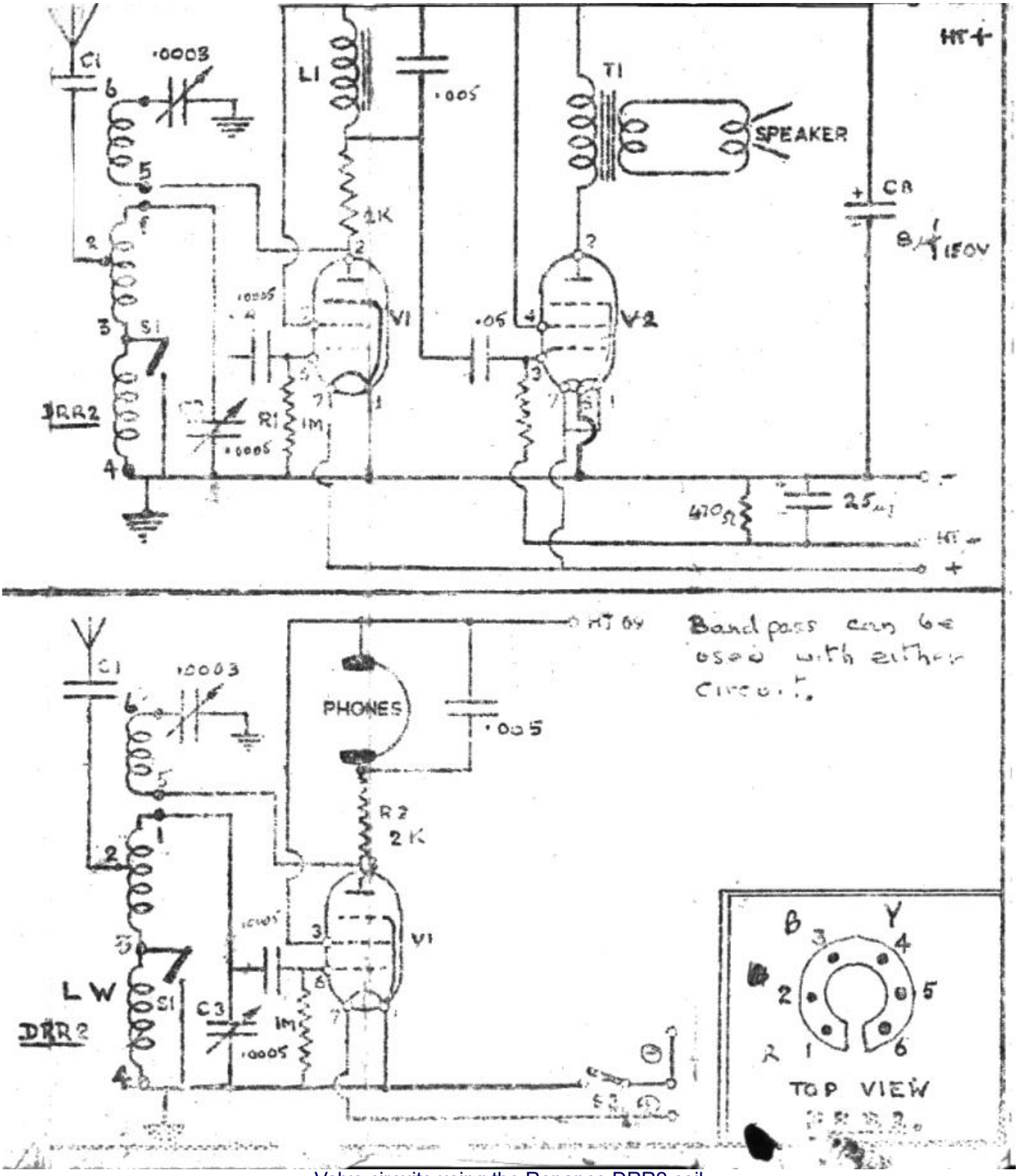

Valve circuits using the Repanco DRR2 coil

Repanco Ltd no longer produces radio coils and crystal set kits for the radio construction enthusiast, as it did in the early days of radio. In 1986 it was renamed Repanco Bartlett Ltd when it merged with Bartlett Electronics. The company moved from the Foleshill Road to Unit 24, Albion Industrial Estate, Endemere Road, Coventry CV6 5NT and now specialises in transformers and wound components and can design and manufacture to commercial customer requirements, their website is: http://www.repancobartlett.co.uk/

CRYSTAL EARPHONES

Here is a good idea and well worth trying, to maximise the use of sound output from your crystal set why not use dual crystal earphones? Having an earphone in each ear helps to block out extraneous noises helping the listener to better concentrate on any weaker stations received.

Using the circuit below, one earphone makes use of one half cycle of the radio wave while the second earphone uses the other half cycle of the wave that would have previously gone to waste when using just one diode. Ensure that the diodes are connected up according to the diagram i.e. one diode is connected the opposite way round to the other.

Also try to make sure that the diodes and crystal earphones are similar to obtain the best results. (You could simply connect two crystal earphones to the same terminals of the single diode, but this would not be as efficient and the sounds would be much quieter.)

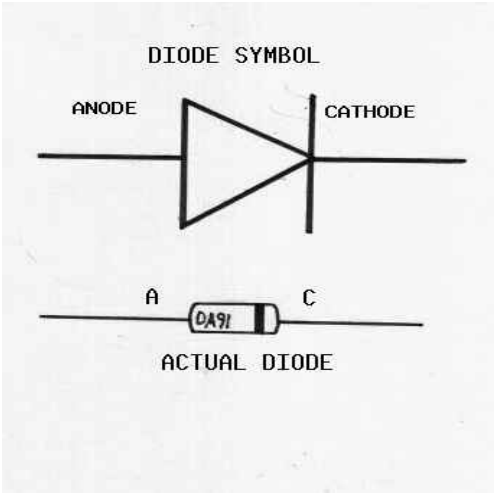

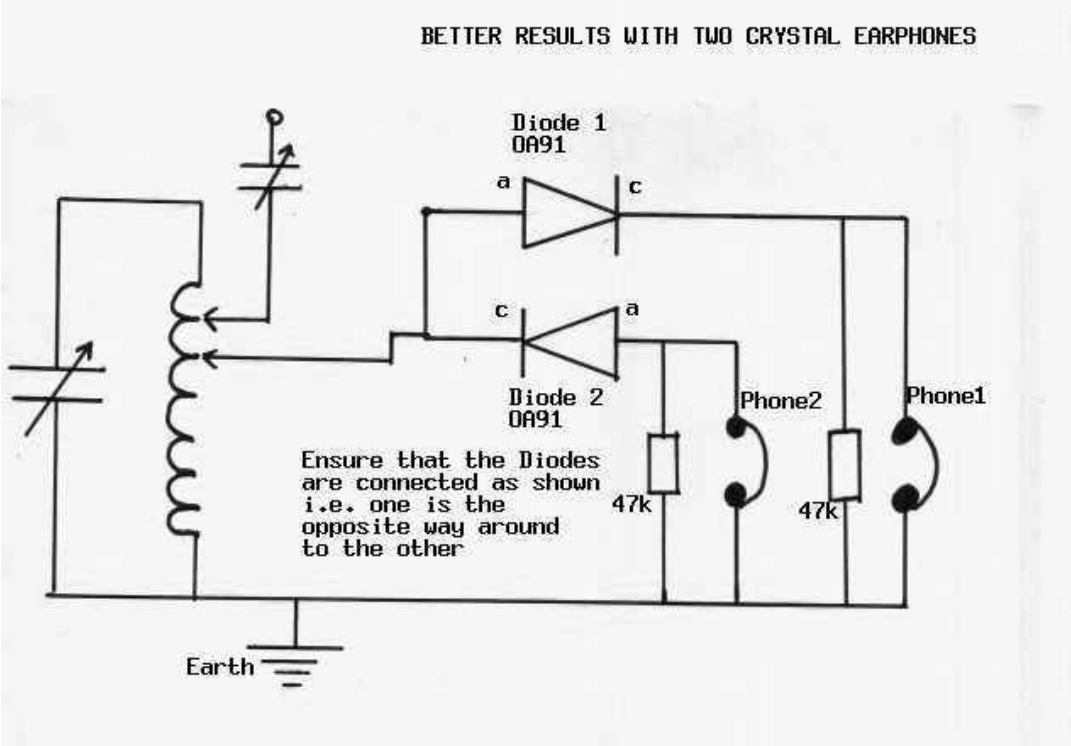

A note about Crystal Earphones: It will be worthwhile buying several different ones from different sources as performance varies between manufacturers quite markedly. I have found the ones marked 'Japan' on the back are the most sensitive and therefore loudest, whereas ones marked 'Receiver' 'Taiwan' are often a little less sensitive and therefore quieter and sometimes more 'tinny' sounding.

As mentioned previously it has been noted that the OA47 diode will be of particular interest since it has the lowest forward bias voltage of any of the common diodes available. This will make the crystal set somewhat more sensitive and therefore louder. The US equivalent of the British OA47 is the IN34.

SPIDERS WEB' COIL

Here is an interesting concept sent in by Chris Dorna of the Vught North Scouts in the Netherlands. It is a crystal set made out of a coil wound in the form of a spiders web:

See more HERE.

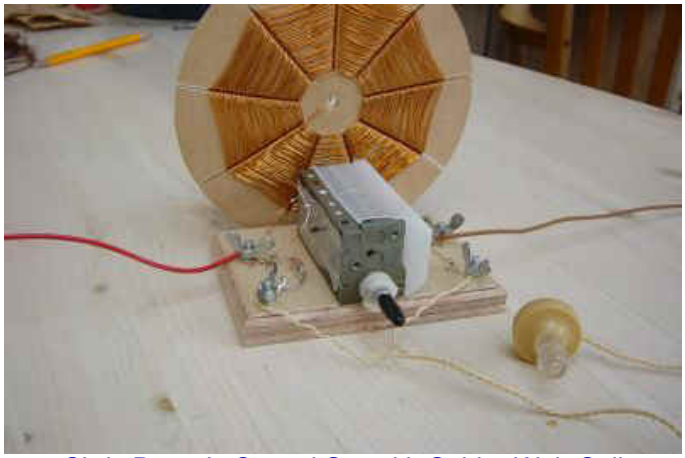

Chris Dorna's Crystal Set with Spider Web Coil

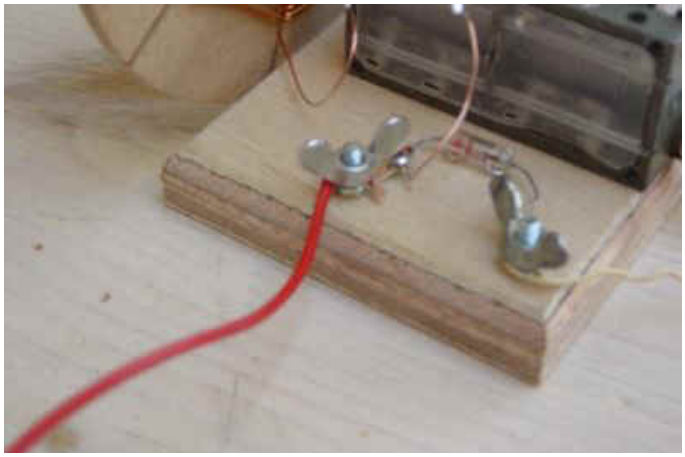

Detail of the germanium diode

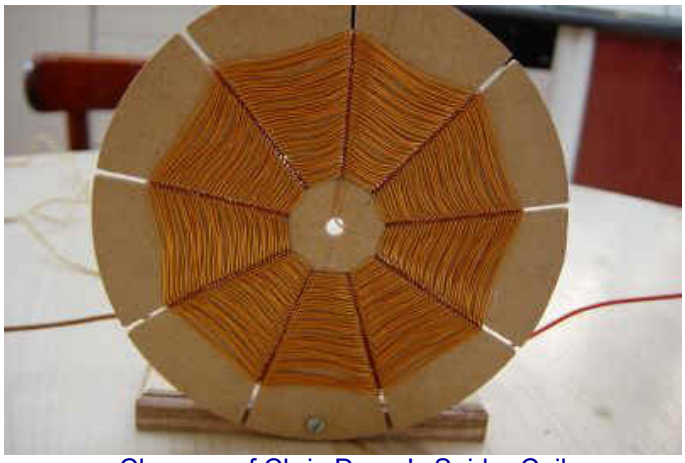

Close up of Chris Dorna's Spider Coil

LOOP THE LOOP!

A crystal set can also be made that does not need a large long wire aerial. If you have ever made a loop aerial for medium wave or long wave DX-ing, then it is a simple matter to add a diode, resistor and a socket to connect a crystal earphone that will allow reception of nearby stations.

See my section on Loop Aerials and ATU's for more constructional details.

A portable loop aerial, that incorporates a crystal set

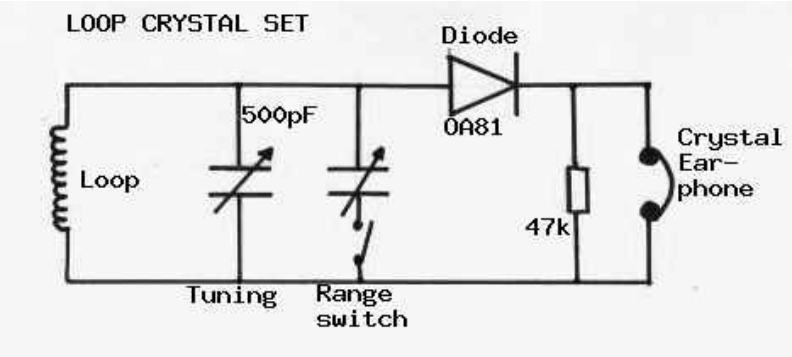

The circuit diagram of the Loop Crystal Set. The loop is 10 turns of 7/0.2mm 'hook-up' wire wound on a 40cm (17") former made of attractive plastic edging strip available from many DIY stores. The loop is very directional in its pick up pattern, which can help eliminate interference from some stations by rotating the loop. The switch and additional capacitor allow tuning of the lower medium wave band from about 650 to 520 kHz. Having a loop with 50 to 60 turns of wire will tune into the Long Wave band.

DIODES - For Crystal Set Use - some notes by Felix Scerri

Germanium diodes for crystal set use.

Although I'm a fan of these new silicon schottky BAT 46 diodes, good germanium diodes still have a lot to offer, especially in terms of 'weak signal' sensitivity. Last night I did an experiment.

I sorted through quite a few of my hundreds of acquired random germanium diodes looking for particularly 'sensitive' ones. I tested this by tuning in a weak AM station and comparing the detected DC output level and also the apparent 'loudness' of the audio signal.

Even amongst germanium diodes of the same type, there was enormous variation all the way from excellent to poor! For very weak signals, germanium diodes 'detect' in the 'square law' region below the diode conduction 'knee', in a rather different part of the curve than with much stronger signals (way beyond the diode knee).

When testing germanium diodes for weak signal sensitivity, the inherent capacitance of the diodes is also a factor, and the 'tuning' may change somewhat and will need to be readjusted with every diode tested!

In the end, out of a large number of germanium diodes tested, I found three or four germanium diodes with excellent weak signal sensitivity and the rest were poor. One other interesting thing, good germanium diodes 'sound' different, rather more 'rounded and smoother' than the schottky's which tend to sound mercilessly clean, almost clinical. I also found almost no variation in weak signal sensitivity with my BAT 46 schottky diodes. Take your pick!

Regards, Felix Scerri VK4FUQ 14/03/2012

SOLDERLESS CONSTRUCTION IDEAS

For a novice the use of a soldering iron may seem a bit daunting at first and while the most reliable results will be obtained with a good soldered joint using a tag strip as shown below, the circuits can still be made without the use of a soldering iron.

5 WAY TAG STRIP

36 WAY TAG STRIP - TWO ROWS

The very simplest circuits could be wired together ,with a little ingenuity, with the component wires being held together in the grip of solderless crocodile clips, whereby the connecting hook-up wire is fixed to the croc' clip by a screw rather than solder.

For more the slightly more complex circuits a plastic Terminal Block (sometimes referred to as a choc' or chocolate block) can be utilised very effectively indeed. These are used in mains wiring and are available in various sizes; 2 Amp, 5 Amp, 15 Amp and 30 Amp. The 5 and 15 Amp Terminal Blocks I have found to be the most suitable. The various component wires can be trapped securely with the screw at each junction point. This method also makes it easy to change the components around when experiment with different circuits. See The EXPERMENTAL CRYSTAL SET for more details in Part 5.

'CHOCOLATE' TERMINAL BLOCK

The Ladybird book called 'Making A Transistor Radio' (also shown on the TRF Radio pages) detailed a very novel approach using brass screws with screw-cups to trap the component wires at each junction point:

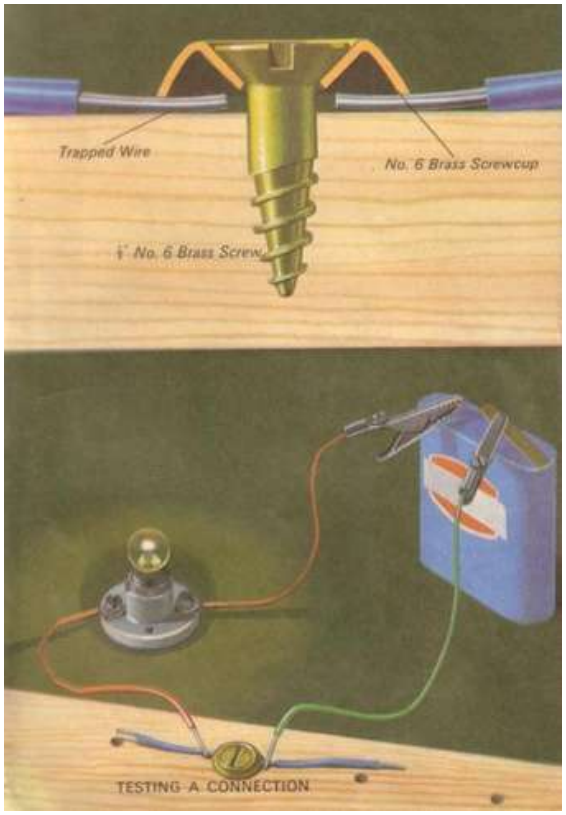

THE BRASS SCREW AND SCREW-CUP METHOD OF CONSTRUCTION

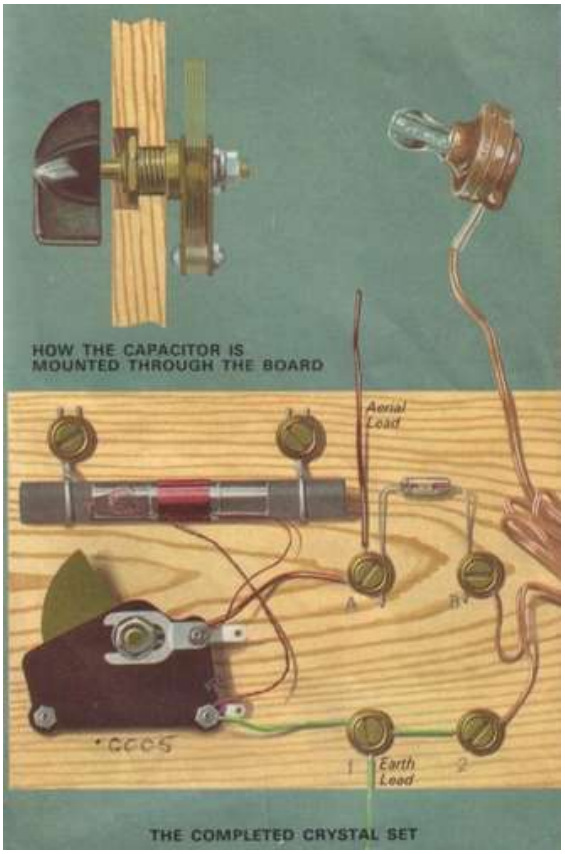

A VERY SIMPLE CRYSTAL SET USING THE BRASS SCREW AND CUP METHOD

Crystal Sets Part Part 3 >

No AM radio stations or transmitters in your locality or country?

Has your local medium wave broadcast station closed or been moved to VHF/FM or Digital? Don't worry. You can still build and experiment with crystal sets and TRF radios by also buying or even building a simple low power AM transmitter. So, not only can you use your crystal sets but you can also run your own radio station that can be heard in and around your home - playing the music or programmes that you want to hear!

SSTRAN AMT3000: Superb high fidelity medium wave AM transmitter kits from SSTRAN. Versions available for 10kHz spacing in the Americas (AMT3000 or AMT3000-SM) and 9kHz spacing in Europe and other areas (AMT3000-9 and AMT3000-9SM). Superb audio quality and a great and well designed little kit to build:
http://www.sstran.com/pages/products.html

http://www.sstran.com/

Other AM transmitters available:

Spitfire & Metzo: Complete, high quality ready built medium wave AM Transmitters from Vintage Components: http://www.vcomp.co.uk/index.htm Vintage Components offer a choice of the high quality Spitfire and Metzo transmitters:

SPITFIRE AM Medium Wave Transmitter with 100 milliwatt RF output power:

http://www.vcomp.co.uk/spitfire/spitfire.htm

METZO AM Medium Wave Transmitter with built in compressor:

http://www.vcomp.co.uk/metzo/metzo.htm

AM88 LP: A basic AM transmitter kit from North County Radio.
http://www.northcountryradio.com/Kitpages/am88.htm

LINKS:

BOWOOD ELECTRONICS - A friendly, helpful and very speedy source for many of your electronic components at prices that won't frighten your wallet!

THE FOXHOLE and P.O.W RADIOS - Simple crystal set receivers used by soldiers during the war and by prisoners of war (P.O.W.'s).

VINTAGE COMPONENTS - A great resource for crystal sets, components, valve radio kits and medium wave AM transmitters!

6V6 - Electronic Nostalgia and Vintage Components

Crystal Sets Part 3 >

Crystal Sets (Part1) | **Spider's Web Crystal Set (Part 3**

Crystal Set by Kenneth Rankin (Part 4) | **Experimental Crystal Sets (Part 5)** | **Crystal Radio Links**

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Crystal Sets Introduction | Resistor & Capacitor Conversion Tables

www.mds975.co.uk © 2004 - 2014

Mike's Electronic Parts, LLC
Simple Crystal Radio Kit 2

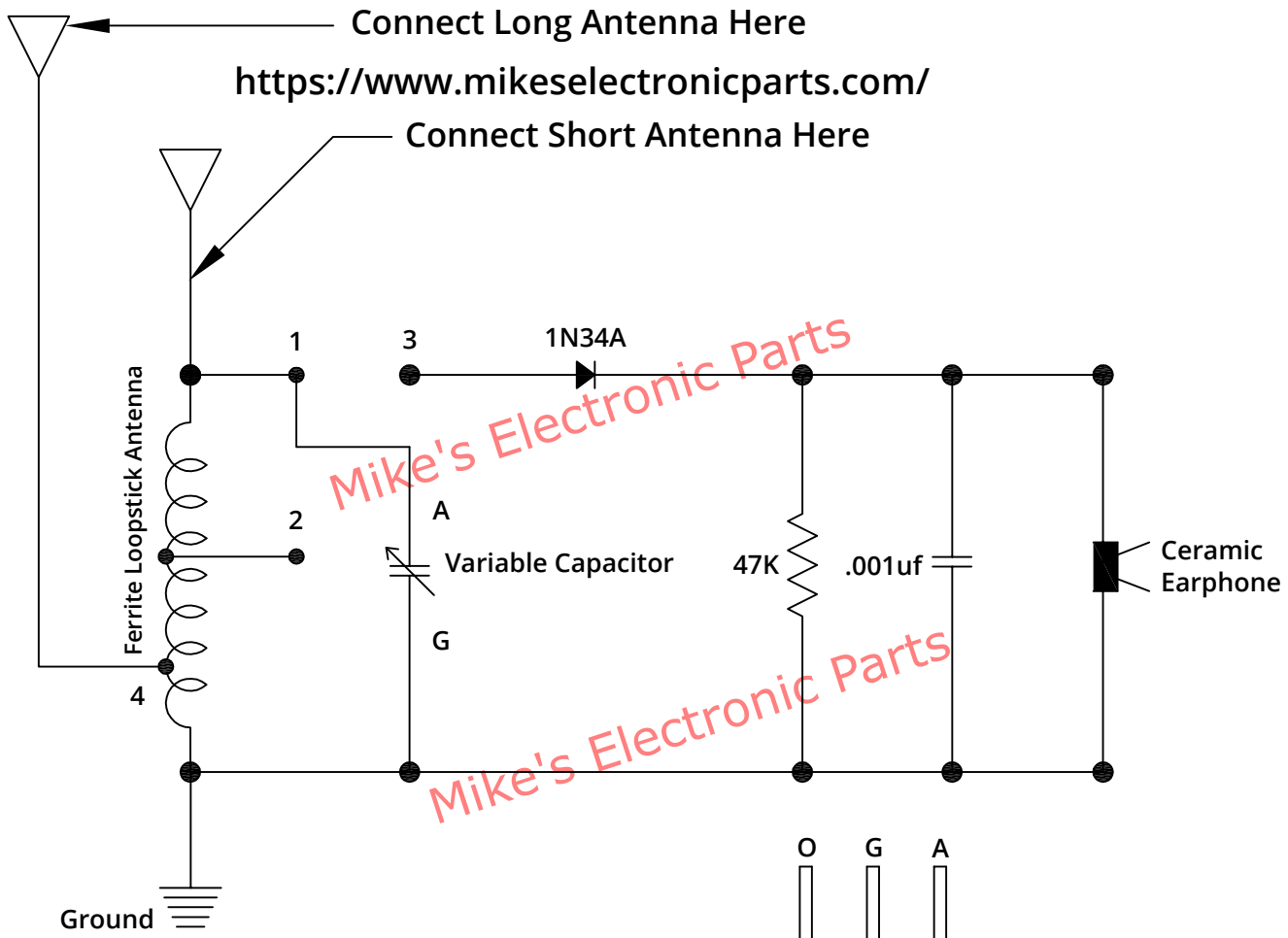

Mike's Electronic Parts
Mike's Electronic Parts

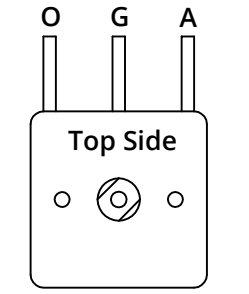

Parts List
1 - Ferrite Loopstick Antenna
1 - Variable Capacitor
1 - Germanium Diode 1N34A
1 - .001uf Capacitor Marked 102
1 - 47K Resistor
1 - 20 Million Ohm Ceramic Earphone
Antenna and Ground wire not include with parts

For short antenna connect a 15ft to 30ft length of wire to "1". For long antenna 40ft to 100ft connect to "4". It is best to use a long wire antenna. If you are not using the taps do not cut the wires. Doing so will cause the coil not to work. Various connections are, Connect 1 to 3 or Connect 2 to 3. Most volume can be had at 1 to 3 less volume but better selectivity connect 2 to 3 and the antenna connected at 1. It is best to solder the coil wire, not doing so may cause a bad connection and the radio will not work.
Drawn By: Scott Lowe
This Kit can be bought at my web site Part Number CRK#2 Kit.

https://www.mikeselectronicparts.com/

THE SMITHSONIAN INSTITUTION

The Smithsonian Institution is home to more than 141 million objects, ranging in size from insects and diamonds to locomotives and spacecraft. It is the world's largest museum complex, comprising 15 museums and galleries and the National Zoo in Washington DC, and two additional museums in New York City. Millions of visitors each year visit the nation's capital to view such treasures as the Hope Diamond, the Star Spangled Banner, and the Wright Flyer. A broad range of exhibits ensures a fun and educational experience for young and old alike.

One of the world's leading scientific research centers, the Institution has facilities in eight states and the Republic of Panama. Research projects in the arts, history and science are carried out by the Smithsonian all over the world. Some of the Smithsonian's research centers include the Smithsonian Astrophysical Observatory in Cambridge, Massachusetts, the Smithsonian Marine Station at Link Port, in Florida, and the Smithsonian Tropical Research Institute, in Panama.

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HISTORY

James Smithson (1765 –1829), a British scientist, drew up his will in 1826 naming his nephew, Henry James Hungerford, as beneficiary. Smithson stipulated that, should the nephew die without heirs (as he did in 1835), the estate would go to the United States to found "at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge..."

On July 1, 1836, Congress accepted the legacy bequeathed to the nation by James Smithson, and pledged the faith of the United States to the charitable trust. In 1838, following approval of the bequest by the British courts, the United States received Smithson's estate—bags of gold sovereigns—then the equivalent of $515,169. Eight years later, on August 10, 1846, an Act of Congress signed by President James K. Polk, established the Smithsonian Institution in its present form and provided for the administration of the trust, independent of the government itself, by a Board of Regents and Secretary of the Smithsonian.

SMITHSONIAN MUSEUMS, GALLERIES AND ZOOS

Smithsonian Institution Building
Anacostia Museum
Arthur M. Sackler Gallery
Arts and Industries Building
Cooper-Hewitt, National Design Museum
Freer Gallery of Art
Hirshhorn Museum and Sculpture Garden
National Air and Space Museum
National Museum of African Art
National Museum of American History, Behring Center
National Museum of the American Indian
National Museum of Natural History
National Portrait Gallery
National Postal Museum
National Zoological Park
Renwick Gallery
S. Dillon Ripley Center
Smithsonian American Art Museum

SMITHSONIAN®

CRYSTAL RADIO™

WARNING!
ONLY FOR USE BY CHILDREN OVER 8 YEARS OLD.

READ THE INSTRUCTIONS BEFORE USE, FOLLOW THEM AND KEEP THEM FOR REFERENCE. STORE THE SET OUT OF REACH OF SMALL CHILDREN.

PLEASE KEEP A NOTE OF OUR NAME AND ADDRESS DETAILS FOR FUTURE REFERENCE. IN EUROPE CONTACT:

CE

NSI SIMM GAmbH
D 76162 KARLSRUHE
GERMANY
49-0721-9584-116

PLEASE BE SURE TO READ THE ADVISE FOR SUPERVISING ADULTS AND THE SAFETY RULES CONTAINED IN THIS BOOKLET.

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ITEM NO. 3261-08

ADVICE FOR SUPERVISING ADULTS:

• READ AND FOLLOW THESE SAFETY INSTRUCTIONS, THE SAFETY RULES AND KEEP THEM FOR REFERENCE.

• SUPERVISING ADULTS SHOULD DISCUSS ANY WARNINGS AND SAFETY INFORMATION WITH THE CHILD BEFORE COMMENCING THE ACTIVITIES.

SAFETY RULES:

• DO READ THE INSTRUCTIONS BEFORE USE, FOLLOW THEM AND KEEP THEM FOR REFERENCE.

• DO KEEP YOUNG CHILDREN AND ANIMALS AWAY FROM THE ACTIVITY AREA.

• DO STORE THE SET OUT OF REACH OF YOUNG CHILDREN.

Facts about early crystal development

Several inventors receive credit for developing a "crystal detector", a device which can pass current better in one direction than the other in an electrical circuit. In Germany, in the 1870's, Karl F. Braun noticed this property in certain mineral substances. Commercial development required a technology that would be suitable. This came with the advent of wireless communication and radio after 1900.

In Japan, Wichi Torikata investigated many minerals, including zincite, pyrolusite, iron pyrites and galena. In the United States, Greenleaf W. Pickard, associated with the Wireless Specialty Apparatus Co. of Boston, conducted extensive experiments as well. He became well known for the PERIKON Detector which employed zincite and chalcopyrite. The early 20th century work was generally done between 1900 and 1912. Included among the scientists is General H.H.C. Dunwoody of the U.S.Army who developed a carborundum detector.

Until radio broadcasting began in 1920 (Station KDKA Pittsburgh) experimenters utilized the crystal detector for radiotelephone communications and for reception of certain Morse Code signals. There was also extensive use by the U.S.Navy and other maritime services.

The modern crystal diode, such as provided with your set, is a spin-off of radar technology developed during World War II. The basic principle, however, remains the same..i.e. to remove the AUDIO (speech, music or Morse-Code) from the radio frequency carrier wave. In one early Pickard crystal design (left) a stiff metal point is adjustable over the crystal surface. In a later version a "Catswhisker" spring impinged on a piece of galena (right) and was varied to give a louder signal.

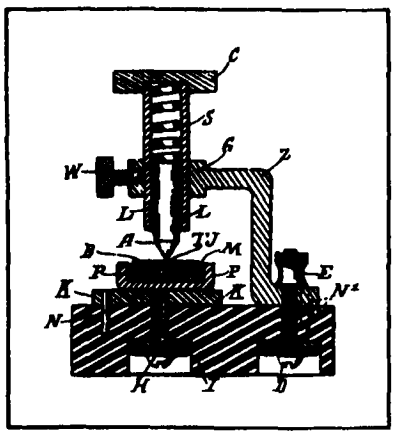

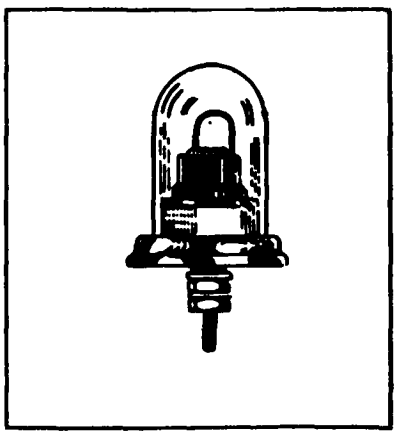

Your Smithsonian Smart Lab Crystal Radio Set contains the following items

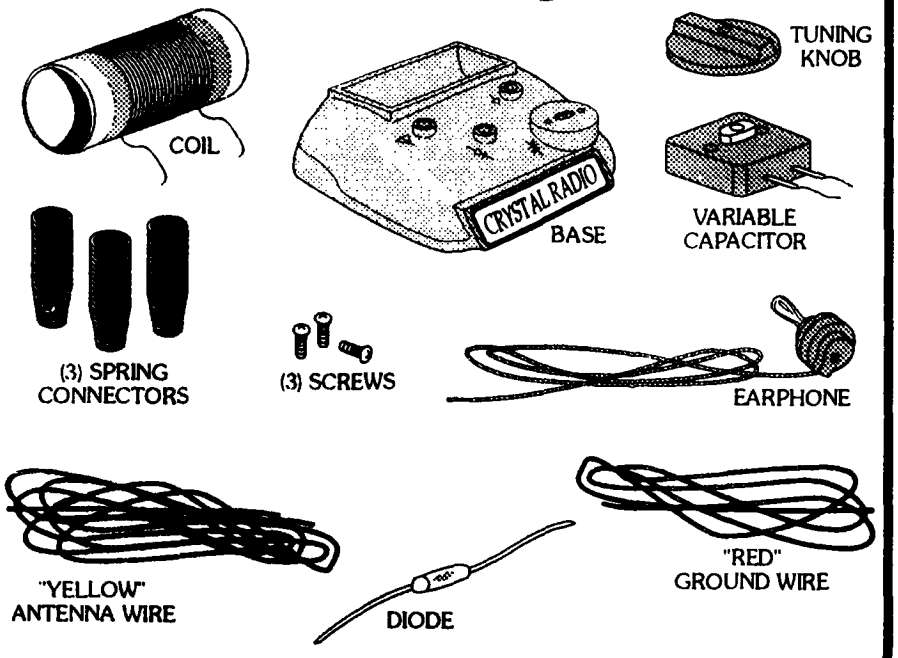

Shown below is a typical wiring diagram of your crystal radio.

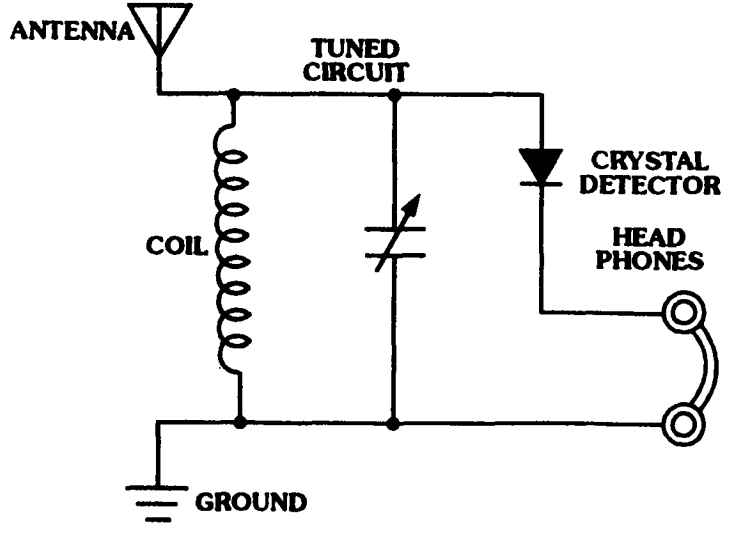

Radio Technology (cont'd)

When these two different energy waves are put together by the mixer stage of the transmitter, the resulting wave, which is the signal that the station broadcasts, looks like this:

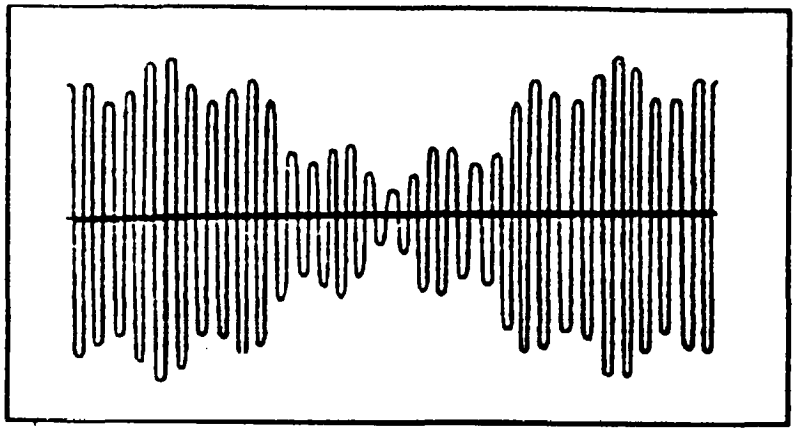

AM Broadcast Wave

The signal is called a MODULATED wave. You will notice that each of the waves is the same length, but the heights vary. Since the height of a wave is called its AMPLITUDE, The type of transmission that WXYZ uses is called AMPLITUDE MODULATION. That's why WXYZ is called an AM station.

The crystal radio that you built works in just the opposite way as the radio station. The modulated signal broadcast by WXYZ is "picked up" by the antenna on your radio.

The antenna is connected to the tuner circuit of the radio, which is made up of a coil of wire and a variable capacitor connected together. As you move the tuning knob, you are able to select, or isolate, the particular

This signal is then DEMODULATED by the diode, separating the voice (audio) wave from the carrier wave.

The voice (audio) wave then moves to the earphone, where it is changed back into sound waves that you can hear.

Learn the basic electronic symbols

Before starting to assemble your Smart Lab Crystal Radio please learn the basic electronic symbols that are shown on the plastic base.

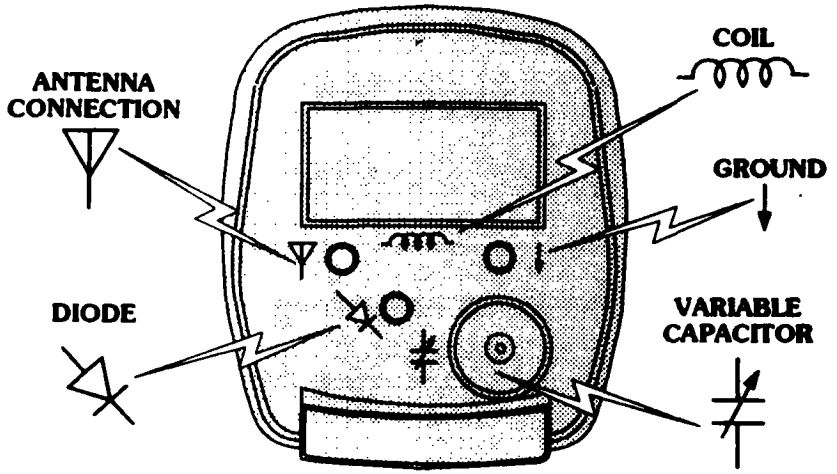

Explanation of components

Variable Capacitor - It is used to tune the radio to a station. The leads that are soldered to the lugs are used to connect it to the circuit.

Diode - A small crystal is sealed inside with leads connected to it. Pay careful attention to the position of the black bands painted on the diode close to one end.

Coil- This is a radio-tuning COIL. It was made by winding enameled copper wire around a paper core 80 times. The leads have been stripped and tinned so it can be connected to the circuit.

Earphone - It contains a small crystal that can make enough electricity to drive a metal diaphragm to produce sound. The leads have been stripped and tinned so it can be connected to the circuit.

Antenna - This is a wire used for radiating or receiving radio waves.

Ground - This is a wire used to make a electric connection with the earth or other type of grounding source to create a common return for an electric circuit.

DEAR CUSTOMER:

If we made an error and left something out of this set, or if something is damaged, we are sorry and wish to correct our error.
Please **DO NOT** return the set to the store where purchased, as the store does not have replacement parts. Instead, write us:

Please include:
1. Date of Purchase
2. Where purchased
3. Price paid
4. Model Number
5. Name of item
6. Brief Description of Problem
7. Include Sales Slip

We will do our best to satisfy you. Send your letter to:

NATURAL SCIENCE INDUSTRIES, LTD.
910 ORLANDO AVENUE
WEST HEMPSTEAD, N.Y. 11552-3942
ATTENTION: QUALITY CONTROL DEPT.

How to assemble your Crystal Radio

Before starting, it's important to assemble the parts correctly. Carefully read the following instructions step by step and have fun . . . half the fun is knowing you made your very own crystal radio.

Step 1

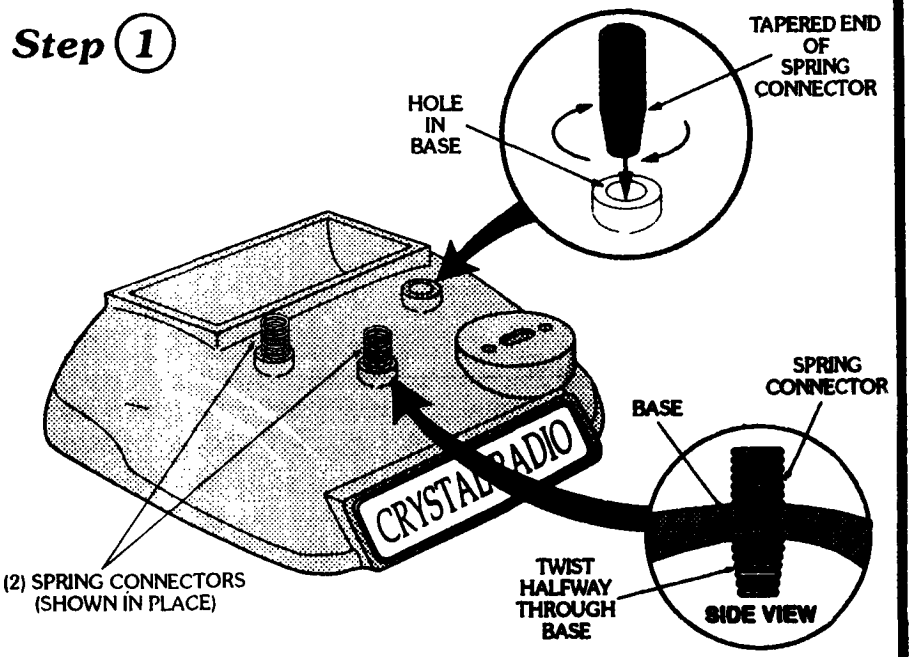

A. Locate the three Spring Connectors.
B. Insert one of the Spring Connectors (tapered end first) into one of the three holes on the Base.
C. Push down on the Spring Connector and twist to the right until the Connector is approximately half way through the base.

NOTE: Check to see if the Spring Connecter is inserted halfway through the Base by turning Base upside down (see insert).
D. Insert the remaining two Spring Connectors into the holes on Base the same way.

Radio Technology

Now that you have your crystal radio assembled and working, it is time to take a brief look at how it works. To do this you are going to take an imaginary trip to a radio station WXYZ, in anytown,USA.

When you arrive at WXYZ, you are met by the station's general manager, Mr. Smith, who is going to show you around.

First, Mr. Smith takes you to a STUDIO, a special room that a program comes from. There is a lot of equipment, including dials and switches, record players, lots and lots of records, and microphones.

Mr. Smith tells you that when you talk into one of the microphones, your words go into the station's electronic equipment. There, it is mixed with the station's carrier wave, and sent out into the air through the station's transmitting antenna - that tall tower you saw on top of the radio station building.

Then Mr. Smith takes a piece of paper and a pencil, and draws diagrams to show you what happens. He begins by saying that all energy travels in waves, and since the sound we make when we talk is a form of energy, it might look something like this:

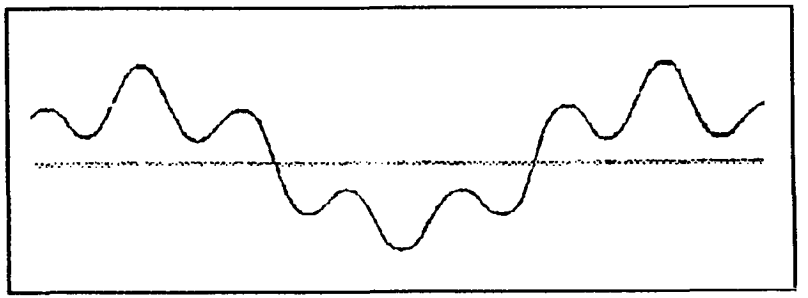

Sound Wave

The station's carrier wave is a radio wave, which is also a form of energy, which looks something like this:

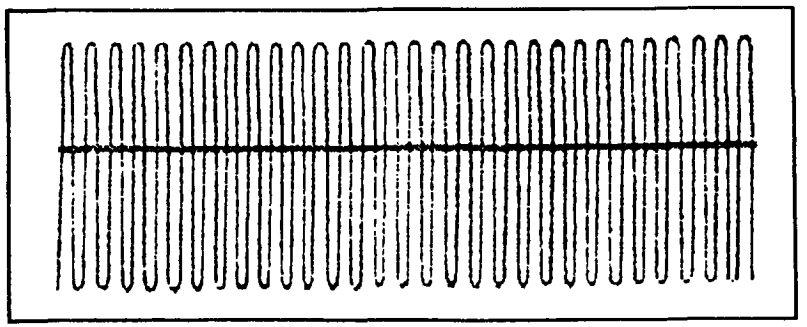

Radio Carrier Wave

How to properly operate your Smart Lab Crystal Radio and troubleshoot

After you have attached all the wires, carefully read the following instructions to make sure your crystal radio operates properly.

A. Place the earphone in your ear and turn the Tuning Knob clockwise and counterclockwise until you pick up the strongest signal.
Note: If you do not pick up a strong signal or do not hear anything, please read some of the troubleshooting solutions explained below.

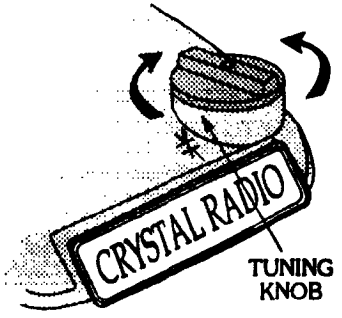

TROUBLESHOOTING HINTS

1. There may be a bad connection caused by improper assembly of your radio. Check all the spring connectors to make sure the wires are attached correctly. If a wire is loose or the bare wire is not making good contact with the spring connector, the radio may not work.

2. If the uninsulated part of the Antenna wire touches anything other than the Antenna Connection on the radio, the radio may work improperly or not at all..

3. If the bare stripped end of the Ground wire is not wrapped tightly around a water pipe (so that it makes good contact), try taping the wire to the shiny part of the pipe using duct tape. If the pipe is dull or rusty, use a piece of sandpaper to gently sand the area where the wire makes contact. Also make sure the wire doesn't touch anything other than the Ground Connection or the radio may not work properly.

4. You may live in an area where radio reception is generally poor. Instead of trying to use your radio during the day, try at night when many radio stations are received better.

5. The Antenna on your radio is a very important component. Make the Antenna as long and high above the ground as possible. If you live in a multi-story dwelling the highest floor should be used when operating the radio. Insulated bell-wire, which is available in hardware stores, makes a very good substitution for your present Antenna.

How to assemble your Crystal Radio (cont'd)

For this step you will need the variable capacitor, (3) screws and turning knob. Be carefull not to misplace the small screws when assembling.

Step 2

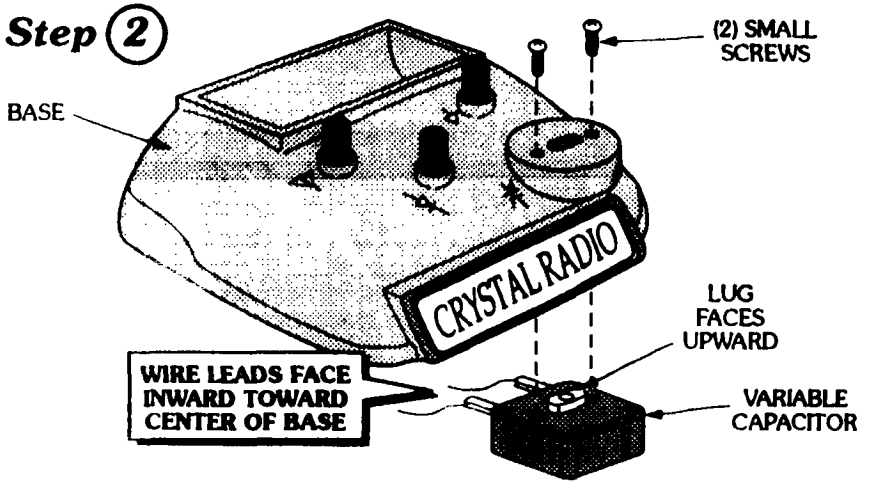

A. First place the Variable Capacitor up into the base so the holes on the capacitor line up with the holes on the base.
Note: When you do this be sure the wire leads face inward toward the base as shown and lug faces upward.

B. Next insert the two small screws into the holes on top of the Base and tighten using a small phillips screwdriver.

Step 3

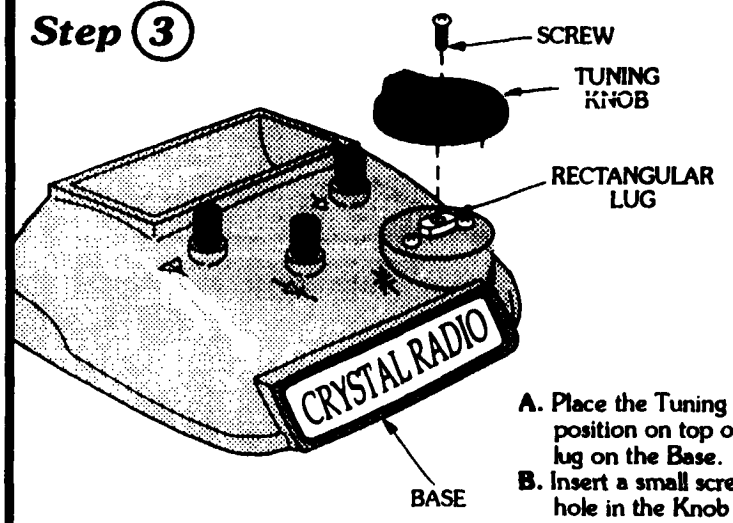

A. Place the Tuning Knob into position on top of the rectangular lug on the Base.
B. Insert a small screw into the hole in the Knob and tighten using a phillips screwdriver.

How to assemble your Crystal Radio (cont'd)

Step 4 **For this step turn the Base upside down.**

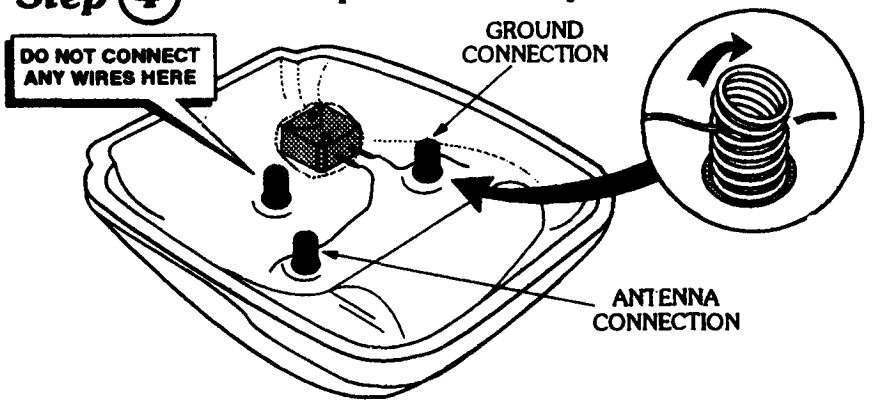

A. Turn the Base upside down.
B. Connect one wire to the Antenna spring connector by bending the spring slightly to one side and inserting the wire through as shown in inset.
C. Connect the other wire to the Ground spring connector in the same manner.
NOTE: Do not connect any of the wires to the Diode spring connector or your crystal set will not work properly.

Step 5

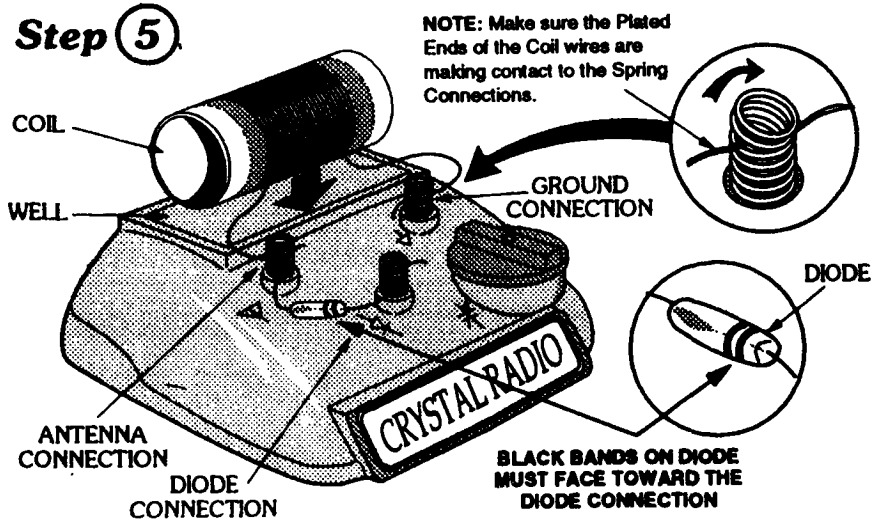

A. Next place the Coil in the well of Base with the wires hanging loosely toward the connectors .
B. Connect one of the plated ends of Coil wires to the Ground Connector by bending the Spring Connector as shown in inset. Connect the other Coil wire to the Antenna Connector.
C. Place the Diode between the Diode and Antenna Connections carefully noting the black bands face toward the Diode Connection.
D. Connect ends of Diode wires to Antenna and Diode spring connectors shown.

How to attach the earphones

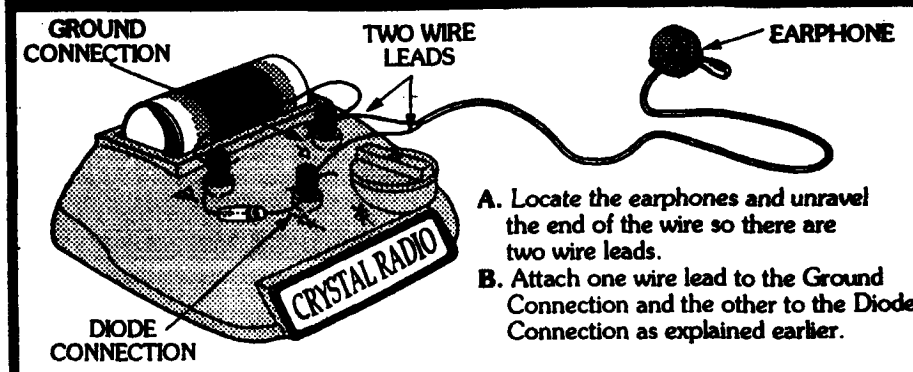

A. Locate the earphones and unravel the end of the wire so there are two wire leads.
B. Attach one wire lead to the Ground Connection and the other to the Diode Connection as explained earlier.

Final assembly and operation

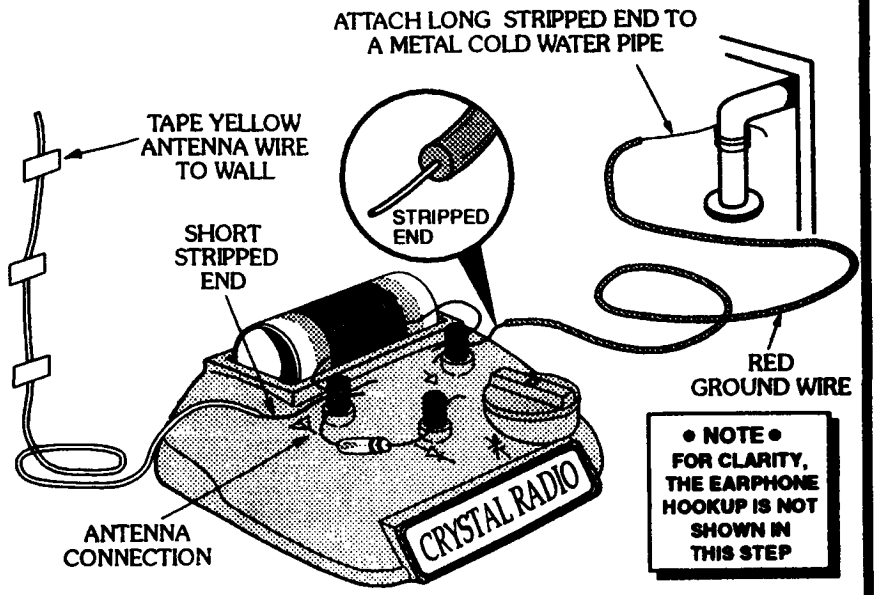

A. Locate the Red Ground and Yellow Antenna wire.
B. Attach the stripped end of Yellow Antenna wire to the Antenna Connection on the Base.
Note: The Antenna should be strung in a straight line away from power lines and large metal objects. We suggest taping it high up on a wall using masking tape as shown.
C. Next attach the short stripped end of the Ground wire to the Ground Connection.
D. Attach the Long stripped end to a metal cold water pipe, metal radiator pipe, etc., near where the radio will be used. Have a adult help you with this since some pipes may be hot.
Note: If there is not enough stripped, bare wire to wrap around a pipe then ask an adult to strip more insulation off the end using a pair of wire strippers.

Germanium vs Silicon Diode Testing: Read this document carefully, so you will not be the victim of cheap knock-off or the wrong type diodes.

The general rule is that ***SILICON*** diodes have a voltage drop across the Anode to Cathode of 0.7 V (7/10 tenths), and the ***GERMANIUM*** diodes have a voltage drop of 0.3 V (3/10 tenths) more or less. Either diode voltage drop (silicon or germanium) will display a reading within approximately 5% of these readings.

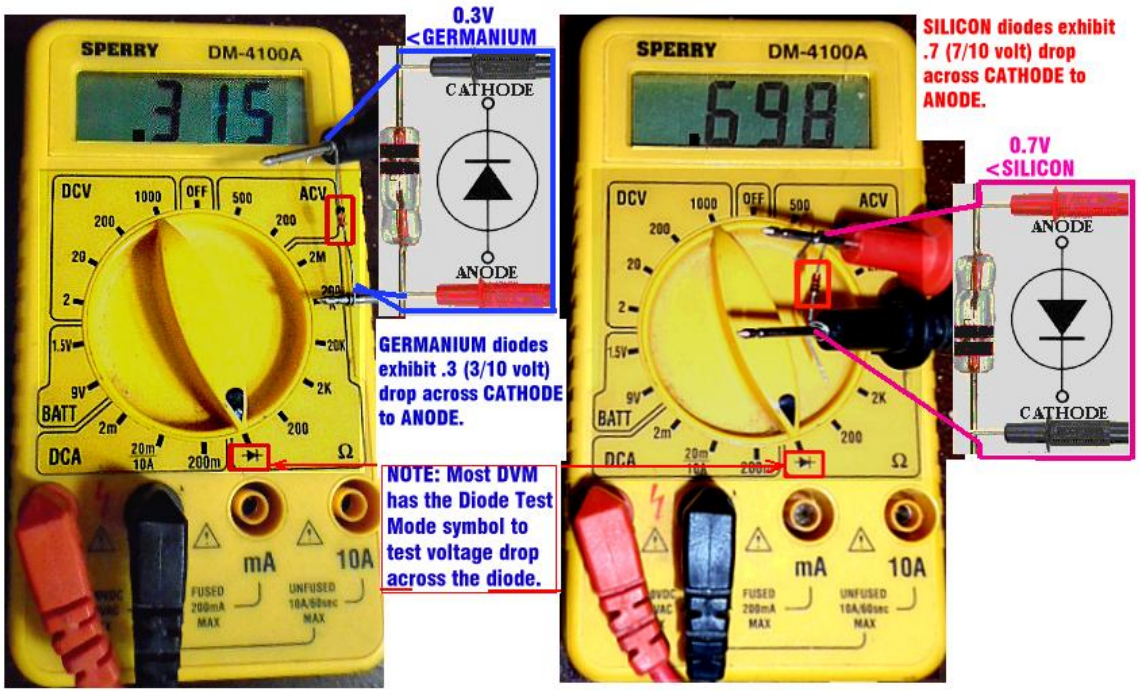

Most digital meters (DVM) have a switch setting ▶|- that is used to measure voltage drop across these diodes. This setting is usually indicated by a diode symbol to let the user know the DVM is capable of measuring forward bias voltage. This setting will tell you immediately if the diode is a **germanium**, or **silicon** diode. You need to set the selector switch on your meter to the diode test symbol ▶|-.

Measuring Forward Bias Voltage

To measure the forward bias voltage characteristic you connect the black probe of your meter to the cathode terminal. The cathode terminal is on the end with a band. You then connect the red probe to the anode terminal.

Set your DVM/DMM to the *diode test mode* ▶|-, it should provide you with the respective voltage drop. If the figure is 0.3 V or less, the diode is a *germanium* type. If the voltage drop is 0.7 V or less the diode is a *silicon* diode.

Sensitivity and Forward Bias Characteristics:

The sensitivity of a diode to radio waves depends upon its *forward bias voltage*. This is the voltage across the diode terminals. When it falls below this threshold value, the diode will stop conducting. Obviously, the lower this threshold value is, the greater the sensitivity of the diode to the weak radio signals.

CONCLUSIONS:

When comparing germanium diodes with silicon diodes of similar forward bias voltage, silicon diodes do not perform as well as the germanium.

Germanium has many properties that silicon diodes do not have. Germanium requires very little forward current. Forward current in a germanium diode is in the *micro*ampere region, while silicon diodes require *amperes*. This makes *germanium* a much better choice for both medium and high frequency radio signals.

Germanium also exhibits a very low, point-contact junction capacitance, while the silicon diode has much higher capacitance. A low junction capacitance allows germanium diodes to operate more effectively at high RF frequencies.

In addition, reverse leakage current for germanium diodes is in the magnitude of 1000, much more than silicon. This makes the non-linear characteristics of the germanium diode much more effective for RF detection and demodulation than silicon.

Therefore, our conclusions are; germanium diodes provide the best performance in crystal radios, RF probes, HF, and VHF signal detection.

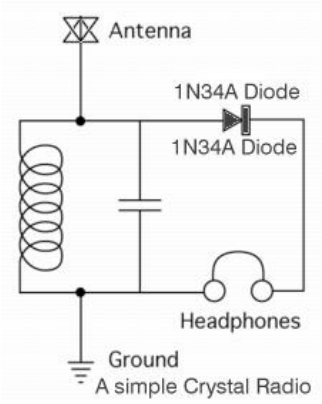

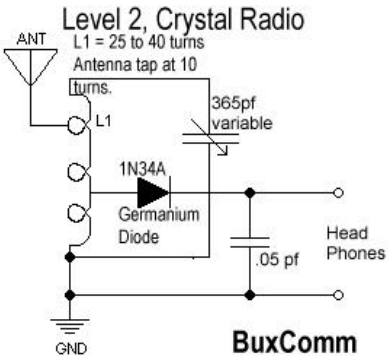

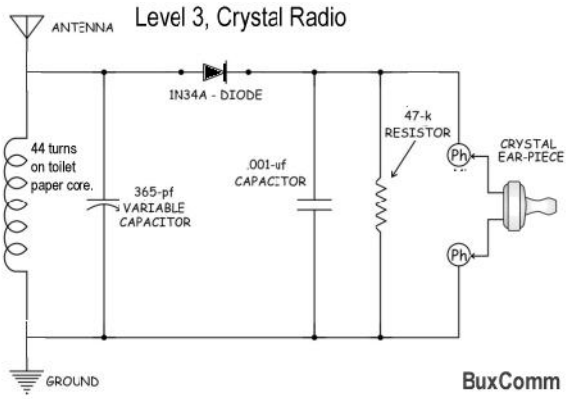

BuxComm High Quality, CRYSTAL RADIO ANTENNA KIT, $14.95 cat# 50CRAK

This Crystal Radio Antenna kit consists of 50 feet of #16 AWG insulated & stranded copper antenna wire, two heavy-duty, Delrin, UV resistant antenna insulators and instruction sheet.

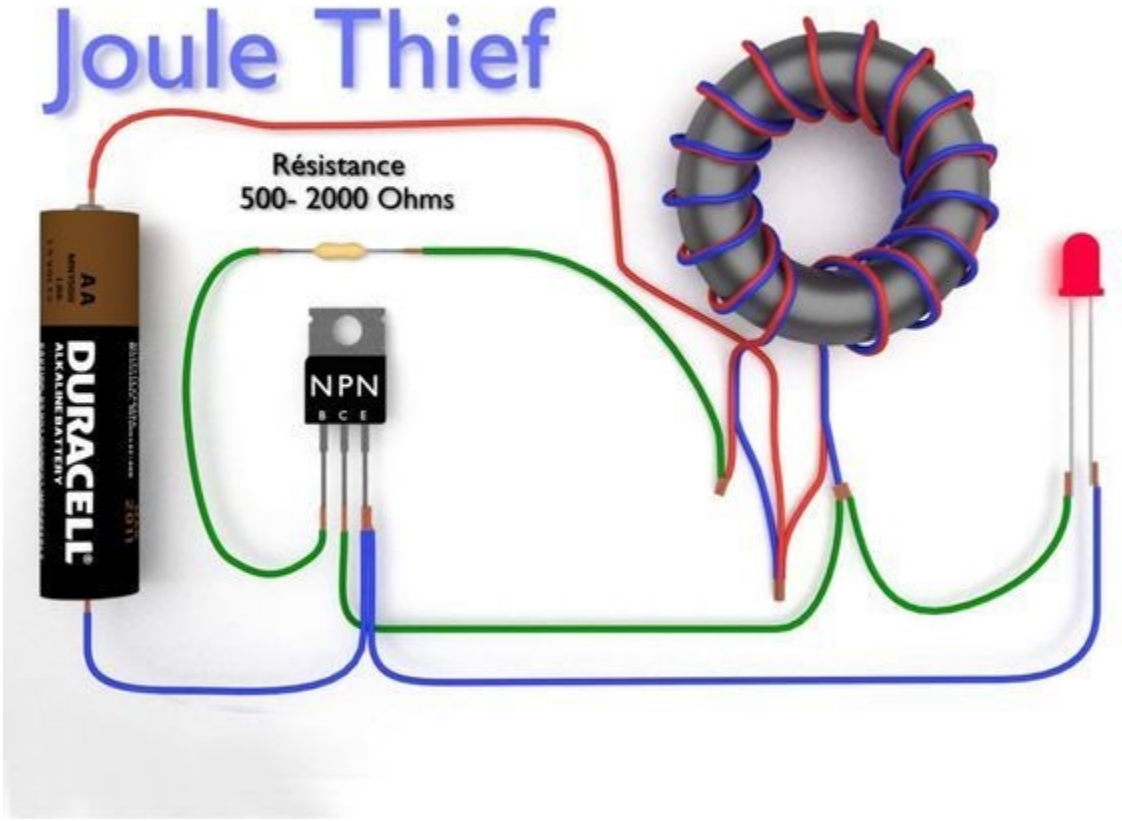
Joule Thief
Résistance
500- 2000 Ohms
NPN
B C E
AA
DURACELL
ALKALINE BATTERY

The joule thief circuit.

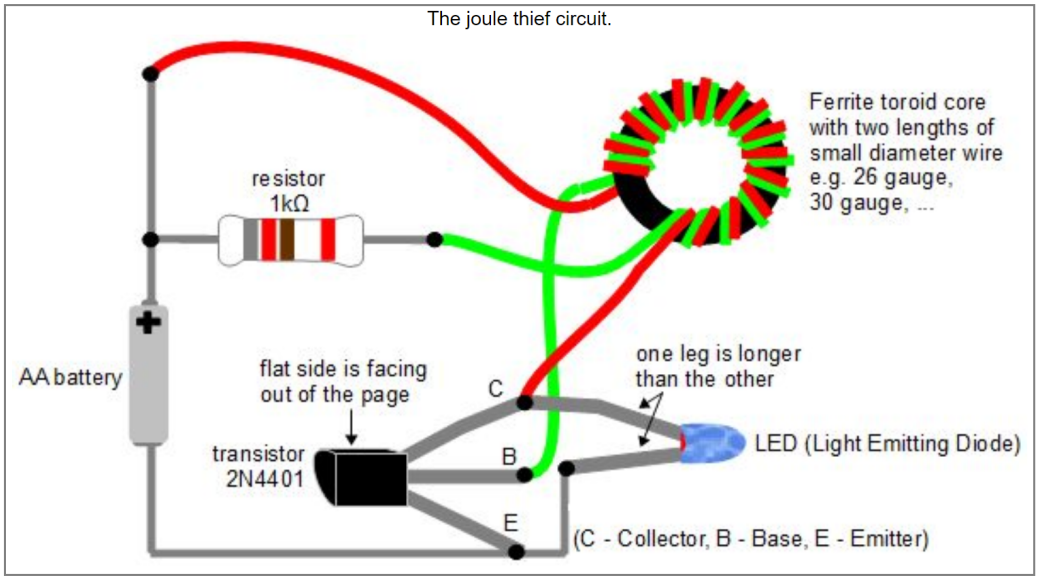

Transistor - The legs of the transistor can be determined by noticing that there's a flat side to the transistor case. See the diagram above. A large number of transistors have been reported to work: 2N4401, NET123AP, BC547B, 2SC2500, BC337, PN2222, to name just a few.

LED - One leg of the LED is longer than the other leg. Use this to determine which one goes where. See the diagram above.

Resistor - The diagram says use a 1 kilo ohm resistor but I've used an 820 ohm one just fine. I've also seen a 2 kilo ohm one in use. Use whatever works for you. You can also use a potentiometer (a variable resistor) so that you can easily adjust it to select the resistance that gives the best light.

Toroid ferrite core - Some people have gotten these by opening up compact fluorescent lightbulbs (CFLs). I took mine out of some device whose original function I don't know. To get it working, my first one had just 13 turns for each wire and I used a 30 gauge wire and a 26 gauge wire. The wire must be insulated. A variety of number of turns will work. This is something you can play with. Look at the diagram carefully to determine where the wires connect to.

Its a Rubbish Challenge
Dog Light
Joule Thief
electronics circuit

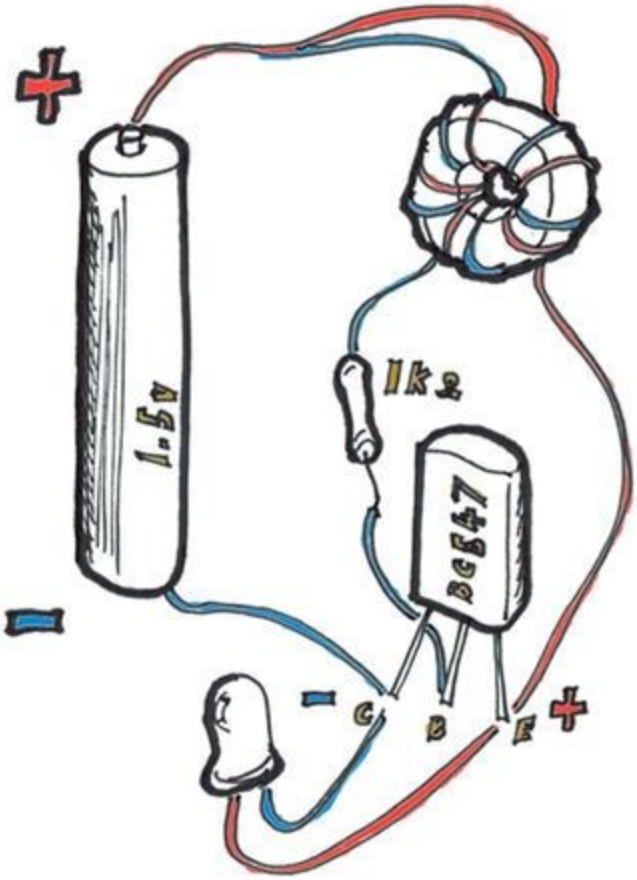

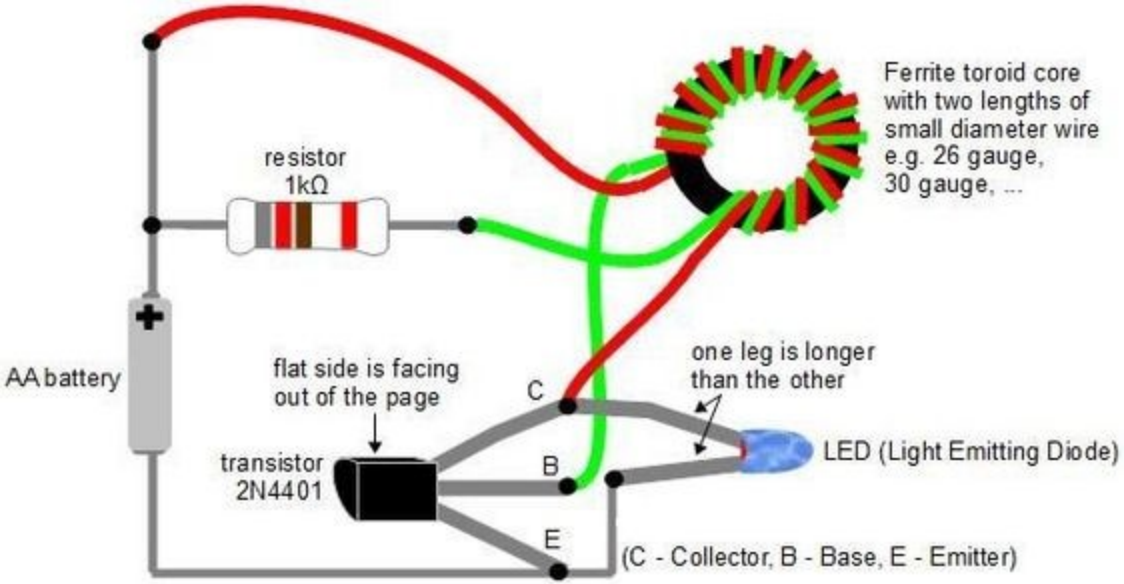
Ferrite toroid core
with two lengths of
small diameter wire
e.g. 26 gauge,
30 gauge, ...
resistor
1kΩ
AA battery
flat side is facing
out of the page
one leg is longer
than the other
C
B
E
transistor
2N4401
LED (Light Emitting Diode)
(C - Collector, B - Base, E - Emitter)

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MAKING A SIMPLE JOULE THIEF (MADE EASY)

Technology (/technology/) > Leds | by ASCAS (/member/ASCAS/) Follow

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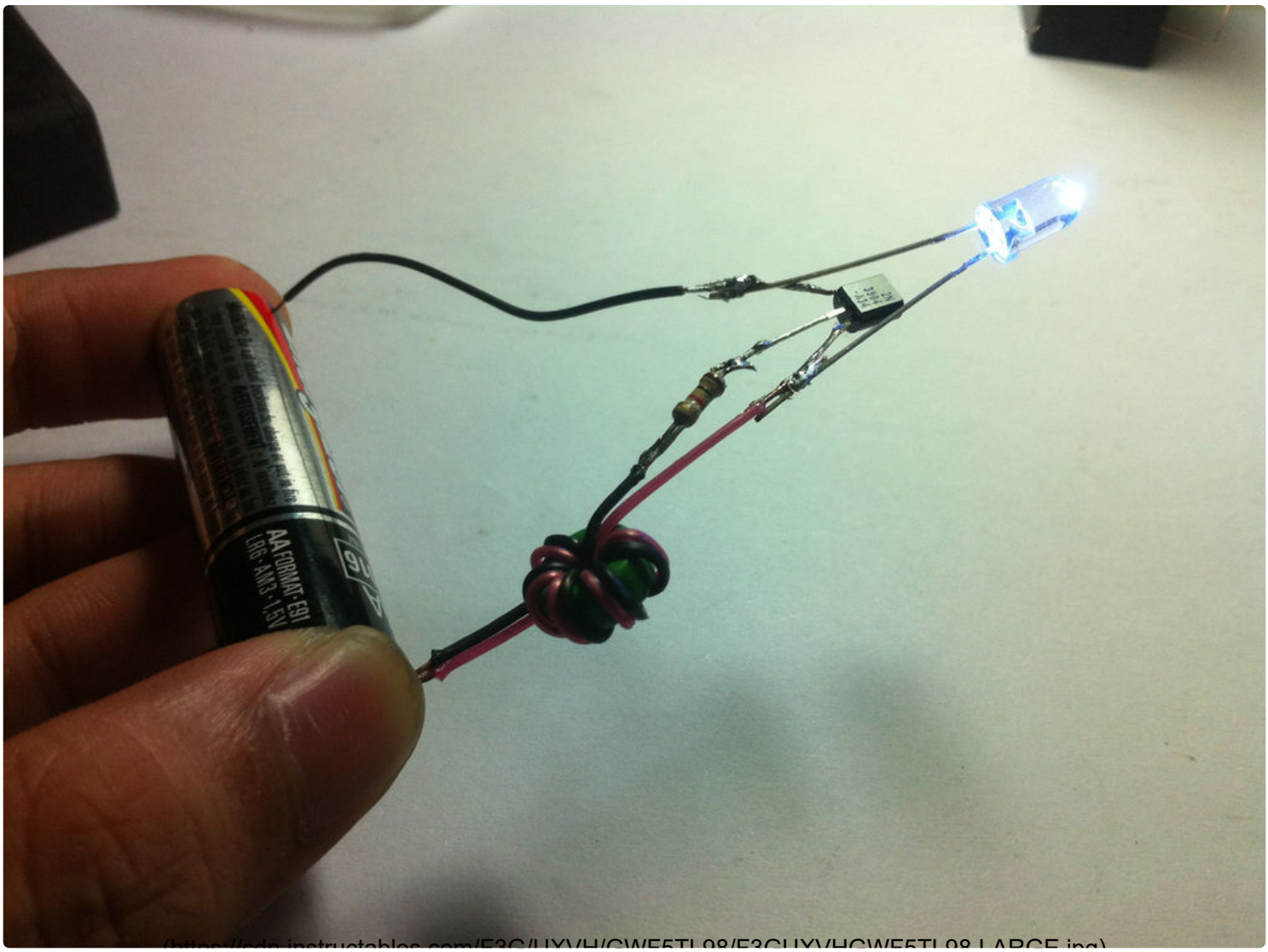

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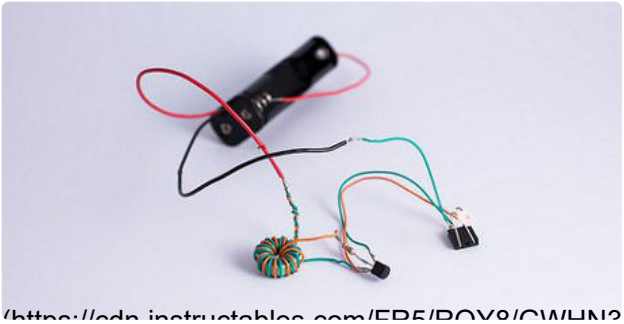

Today I am showing you how to make a very simple joule thief. A joule thief has many applications, the best gadget that I made with was a "Water Powered Lamp", soon I'm going to post on a guide about it but first I need to post this guide. I used an iPhone 4S as my camera :)))

What Is A Joule Thief ?

To simplify everything, a "joule thief" is a circuit that helps drive an LED light even though your power supply is low. What can we do with it? We can use it to squeeze the life out of our old, almost drained, non functioning batteries. This project can also be considered as a green and environmental experiment, we can also use it as a flashlight that can be ran by an old, weak, almost drained battery. I even tried to use my water powered battery from my previous instructable the "Water Powered Calculator (https://www.instructables.com/id/Water-Powered-Calculator/)", the project was featured and displayed in instructable's front page in the "Technologies" category.

My Next Projects That Involves A Joule Thief: (soon to be posted)
- Water Powered Lamp
- Water Powered Flash Light
- Dead Battery Drainer Lamp

Here's A Video From Make Magazine:

Add Tip

Ask Question

Step 1: Parts and Materials

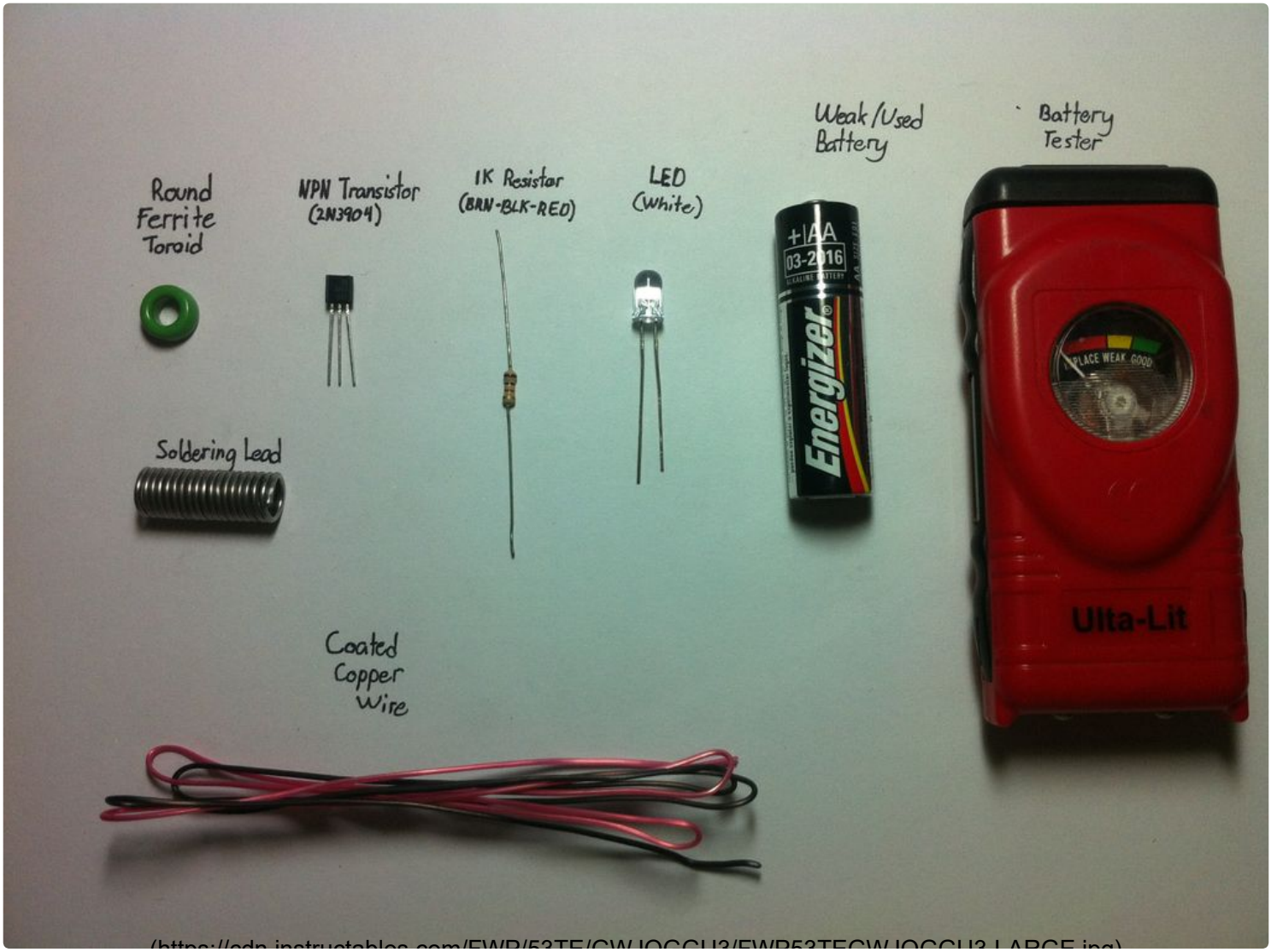

The Parts Needed Are: (click the item to know where to find/ buy)

- Round Ferrite Toroid (can be found in old CFL bulbs)
- Old/ Used Batteries (can be found in garbage cans)
- NPN Transistor (2N3904) (http://www.radioshack.com/product/index.jsp?productId=2062609)
- 1K Resistor (BRN-BLK-RED) (http://www.radioshack.com/product/index.jsp?productId=2062343)
- LED Light (http://www.radioshack.com/product/index.jsp?productId=3096133)
- Battery Tester (http://www.tooldistrict.com/Ulta-Lit-Battery-Tester-5001-p/901233.htm) (optional)
- Soldering Lead (http://www.radioshack.com/product/index.jsp?productId=2062717)

- Copper Wire/ Magnet Wire (http://www.radioshack.com/product/index.jsp?productId=2036277)
- Battery Case/ Holder (http://www.radioshack.com/product/index.jsp?productId=2062247)

I want to share something. Here in the Philippines electronic parts are extremely cheap, they are extremely far cheaper from
radio shack, for example one transistor costs (2 phil. pesos - 6 US cents), a LED cost (9 phil. peso - 29 US cents) and a 1K resistor cost (25 phil. cents - 0.8 US cents). I usually buy thing from Deeco or Alexan. Usually prices here are 15x cheaper from radio shack. Price conversion - $1 US Dollar = P0.31 Philippine Peso (12/24/11).

Add Tip Ask Question

Step 2: Schematic Diagrams

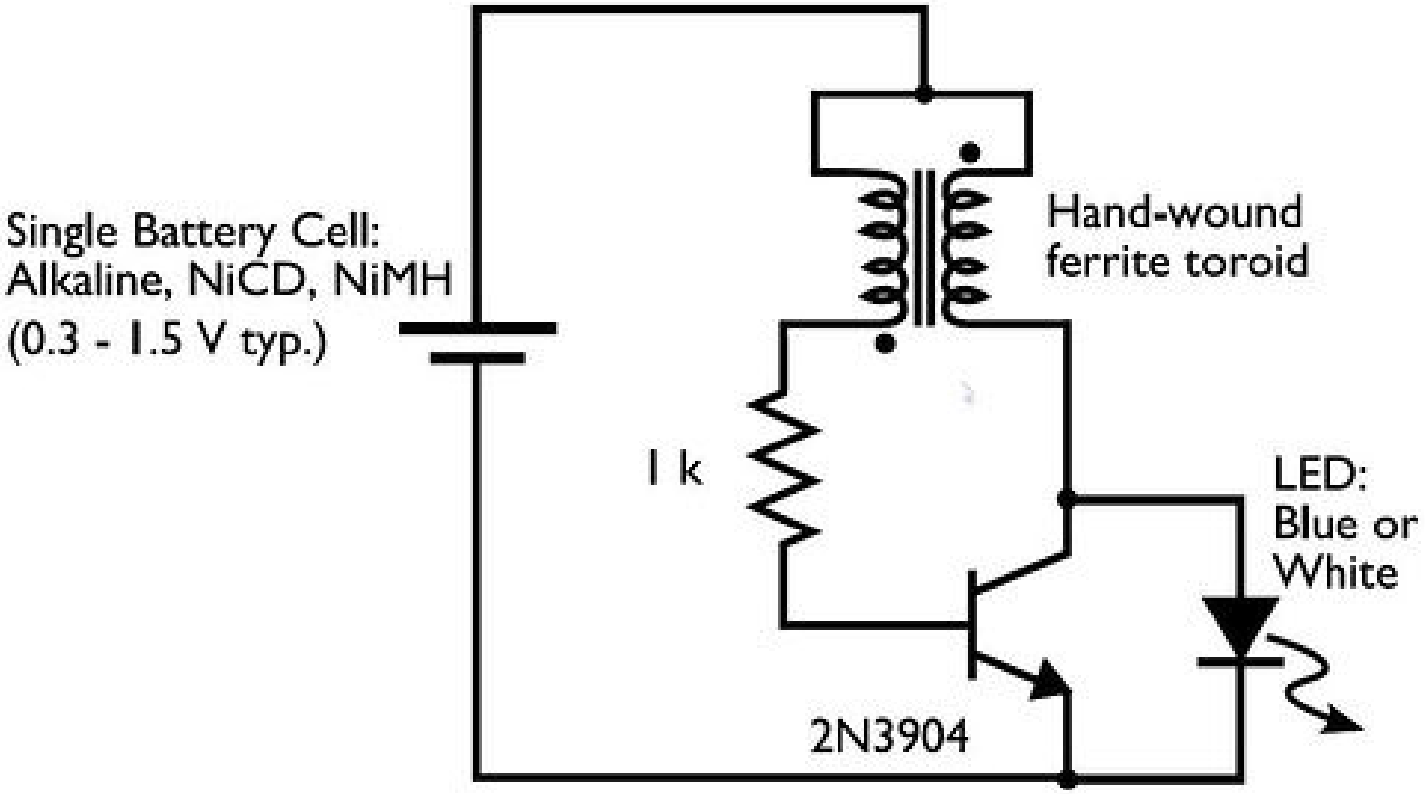

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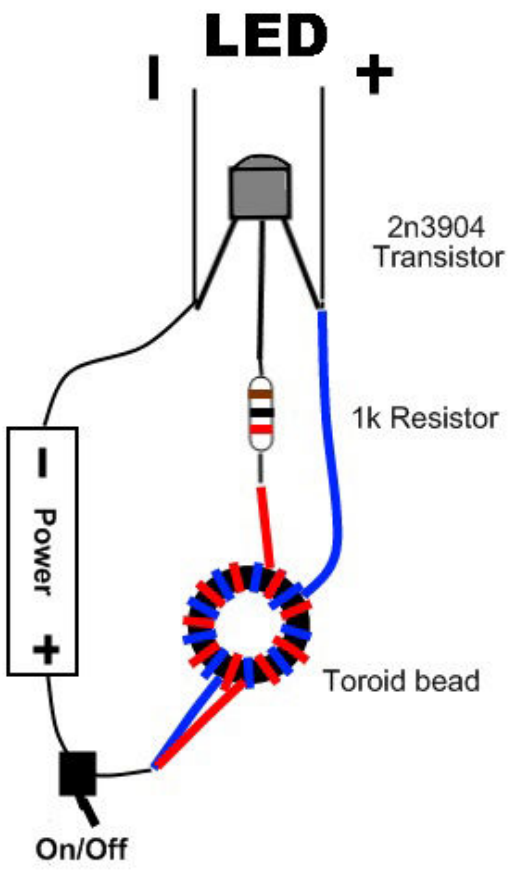

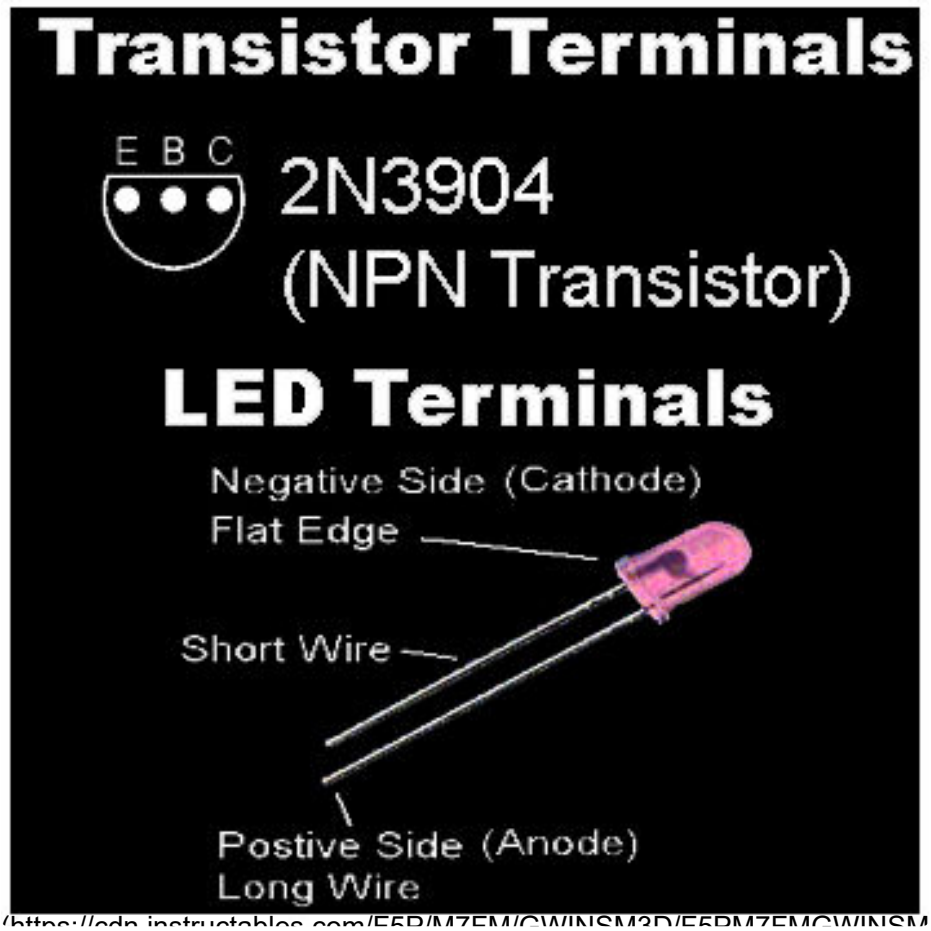

(https://cdn.instructables.com/FN0/CRF6/G (https://cdn.instructables.com/F5P/MZFM/GWINSM3D/F5PMZFMGWINSM

Here are the schematic diagrams that are involved with the joule thief circuit.

Add Tip

Ask Question

Step 3: Winding Wire at the Toroid

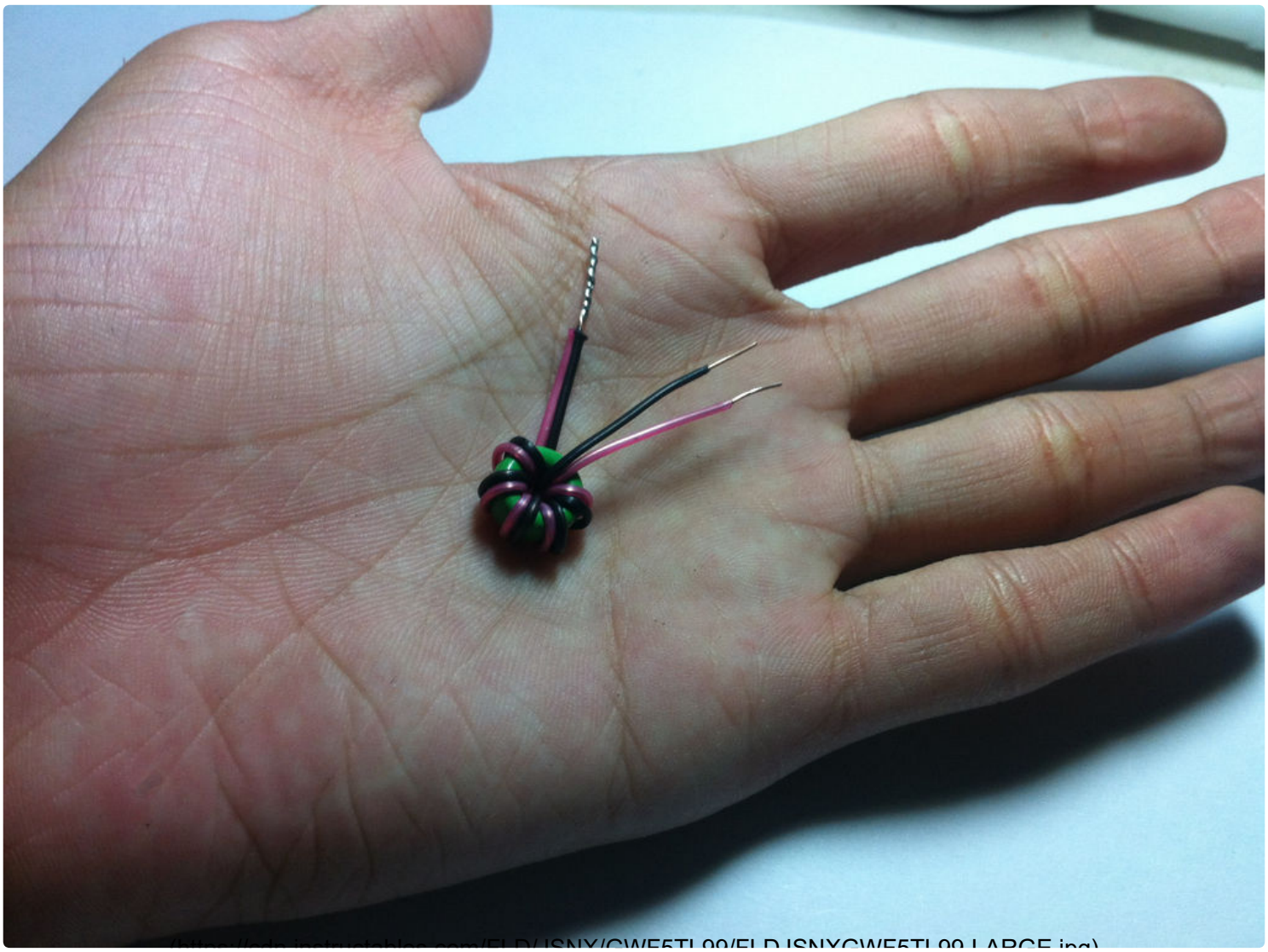

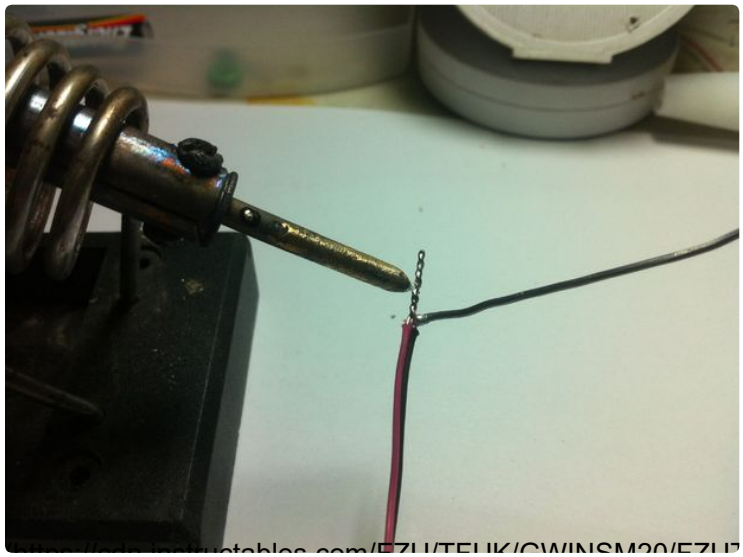

First, connect both ends of the copper wire before wounding, be sure to remove the insulation. Then try to solder the ends so it would not split up. Second, wind the wire until you run out of space in the round ferrite toroid. I have some tips for you, try to use a gauge #22 enamel coated copper wire for better performance, oh! my last tip is that "the more you wind the wire to the ferrite toroid the better".

Add Tip

Ask Question

Step 4: Soldering the Resistor

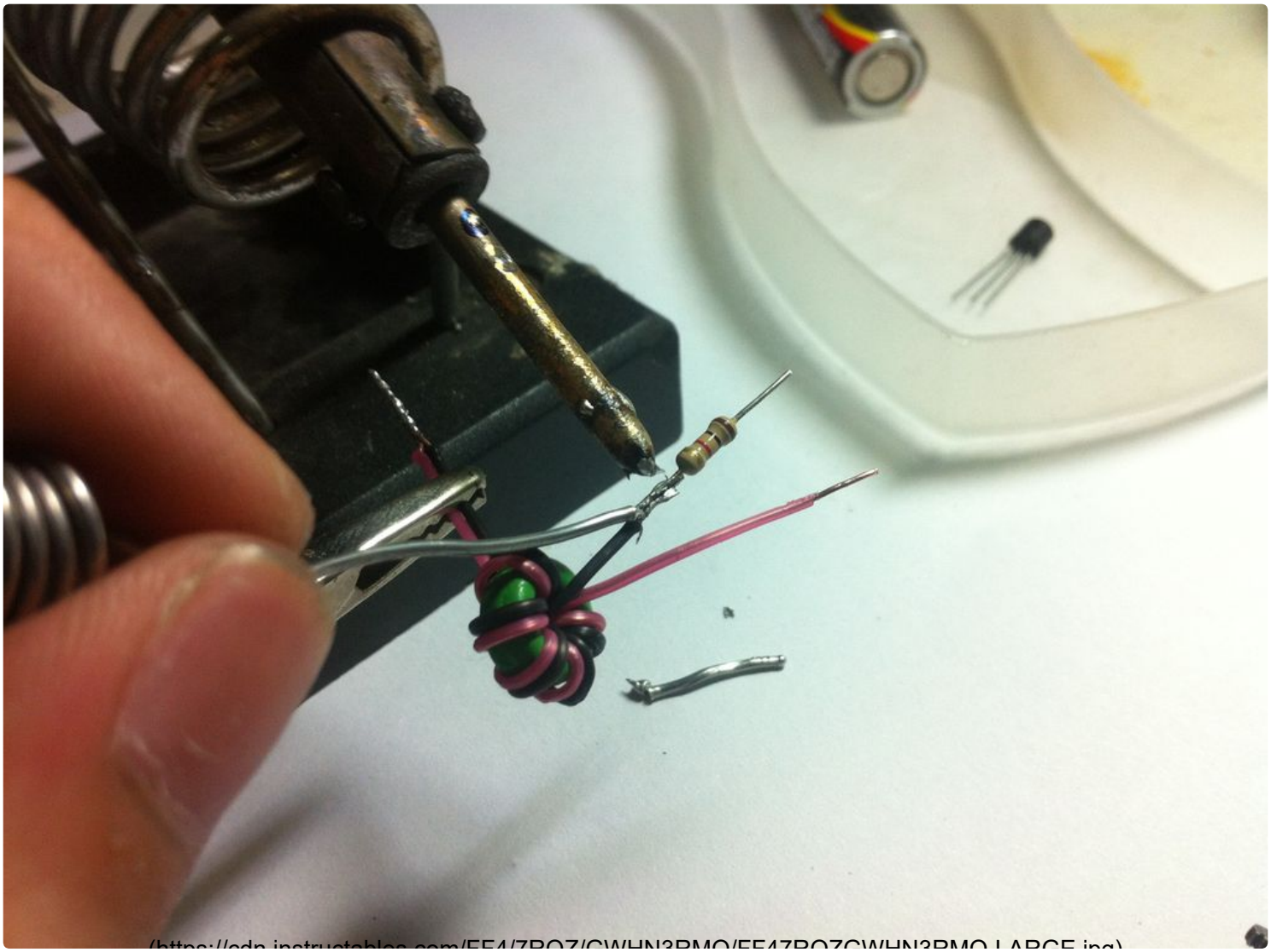

Solder the resistor with one end of the wounded ferrite toroid's wire. Oh! also don't forget to level the other end of the resistor with the other unused wire from the wounded ferrite toroid.

Add Tip

Ask Question

Step 5: Soldering the Transistor

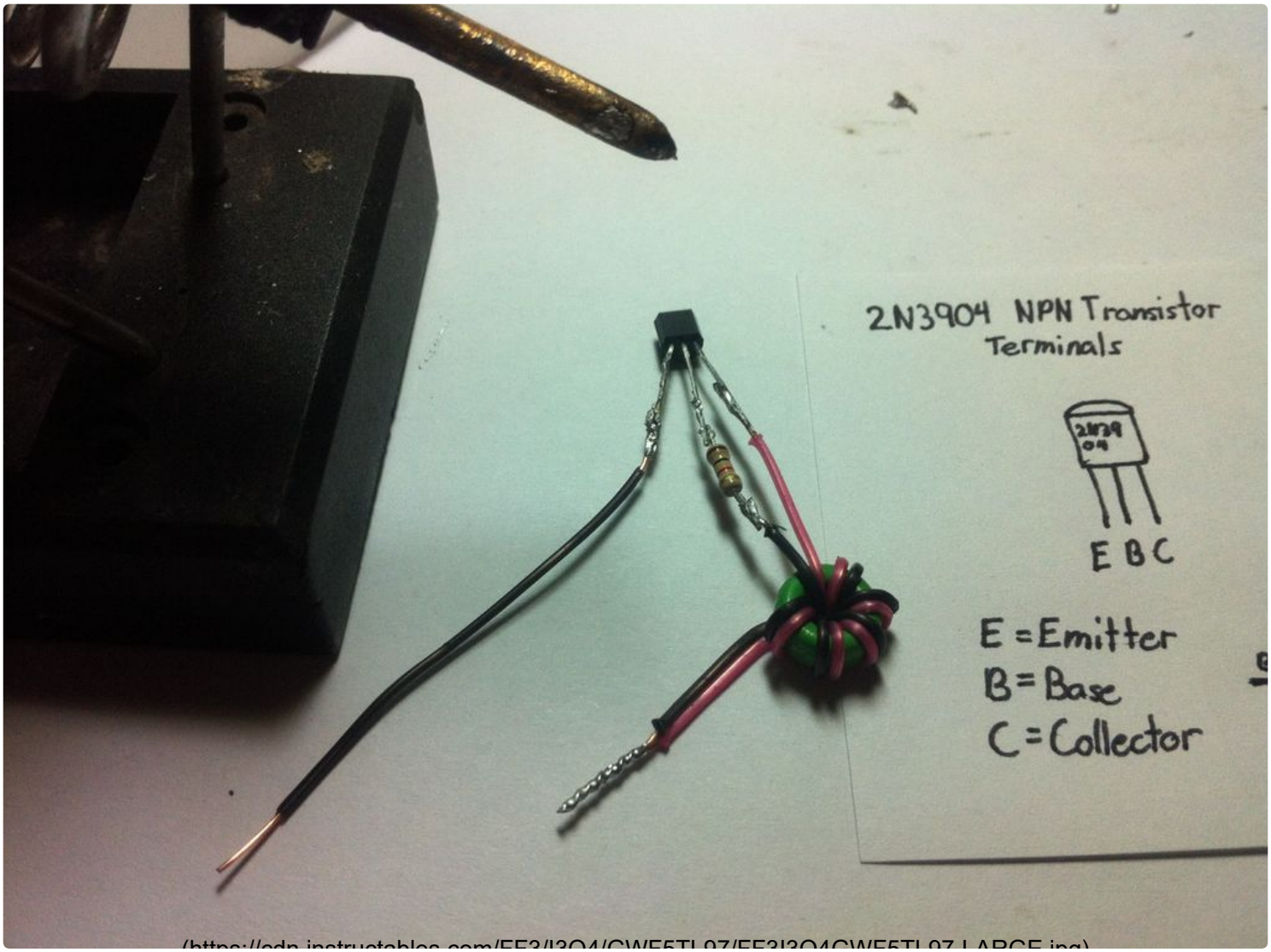

(https://cdn.instructables.com/FF3/I3O4/GWF5TL97/FF3I3O4GWF5TL97.LARGE.jpg)

Solder the proper connections to the transistor. For the emitter - connect another wire, the wire will be connected to the negative part of the battery. For the base - solder the other end of the resistor to the base. For the Collector Solder the unused wire of the ferrite toroid.

Add Tip Ask Question

Step 6: Soldering the LED

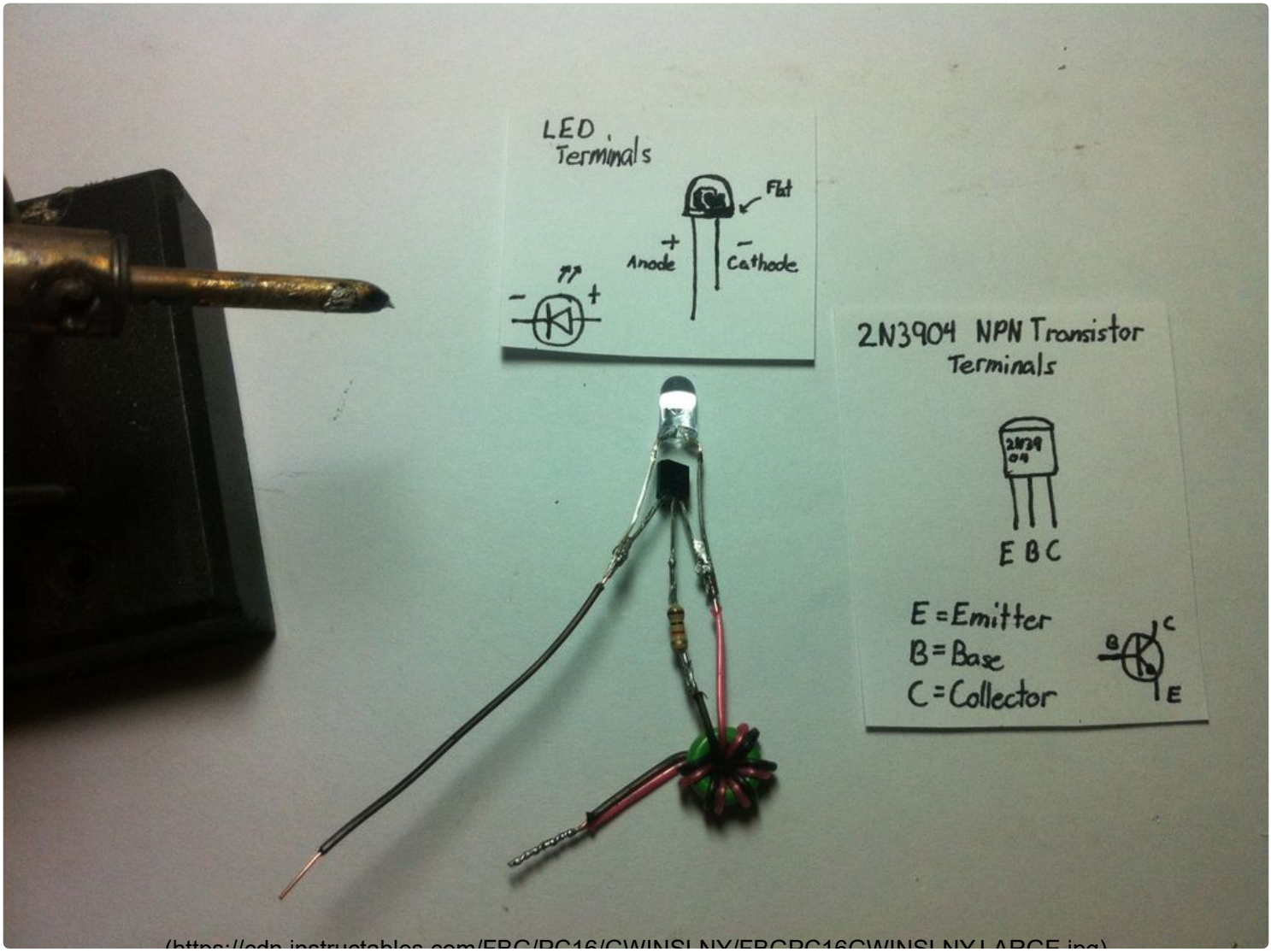

(https://cdn.instructables.com/FBC/RC16/CWINSLNY/FBCRC16CWINSLNY.LARGE.jpg)

Solder the shorter wire of the LED to the tansistor's emitter and the longer part of the LED to the transistor's collector. After all that, you can now trim the excess wires.

Add Tip

Ask Question

Step 7: Time to Look for Old Batteries

Use your battery tester to confirm that your battery is close to death. The tester is only an optional tool, it's just used to determine the battery's remaining power.

Add Tip

Ask Question

Step 8: Time to Test It - You're Done !!

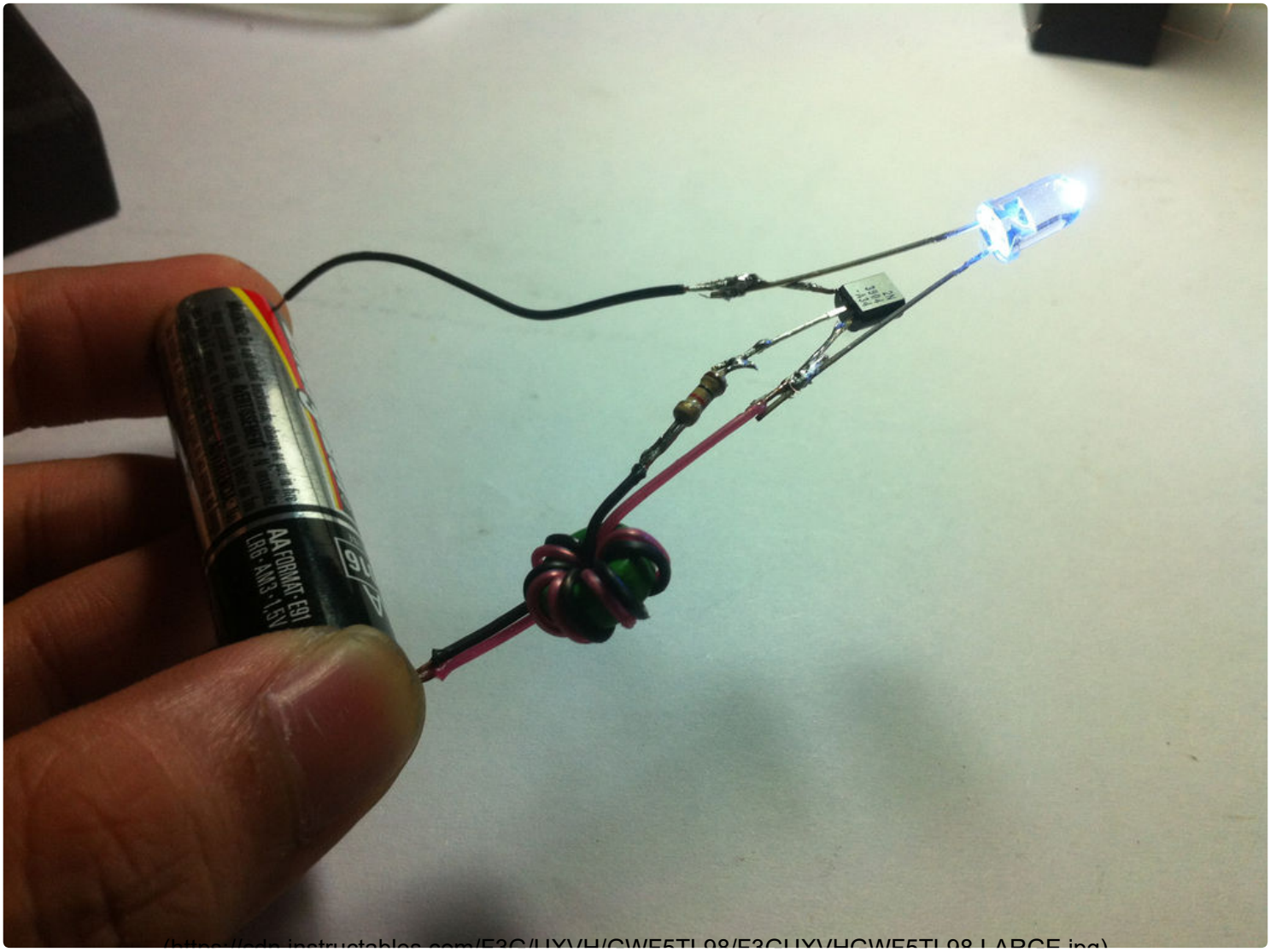

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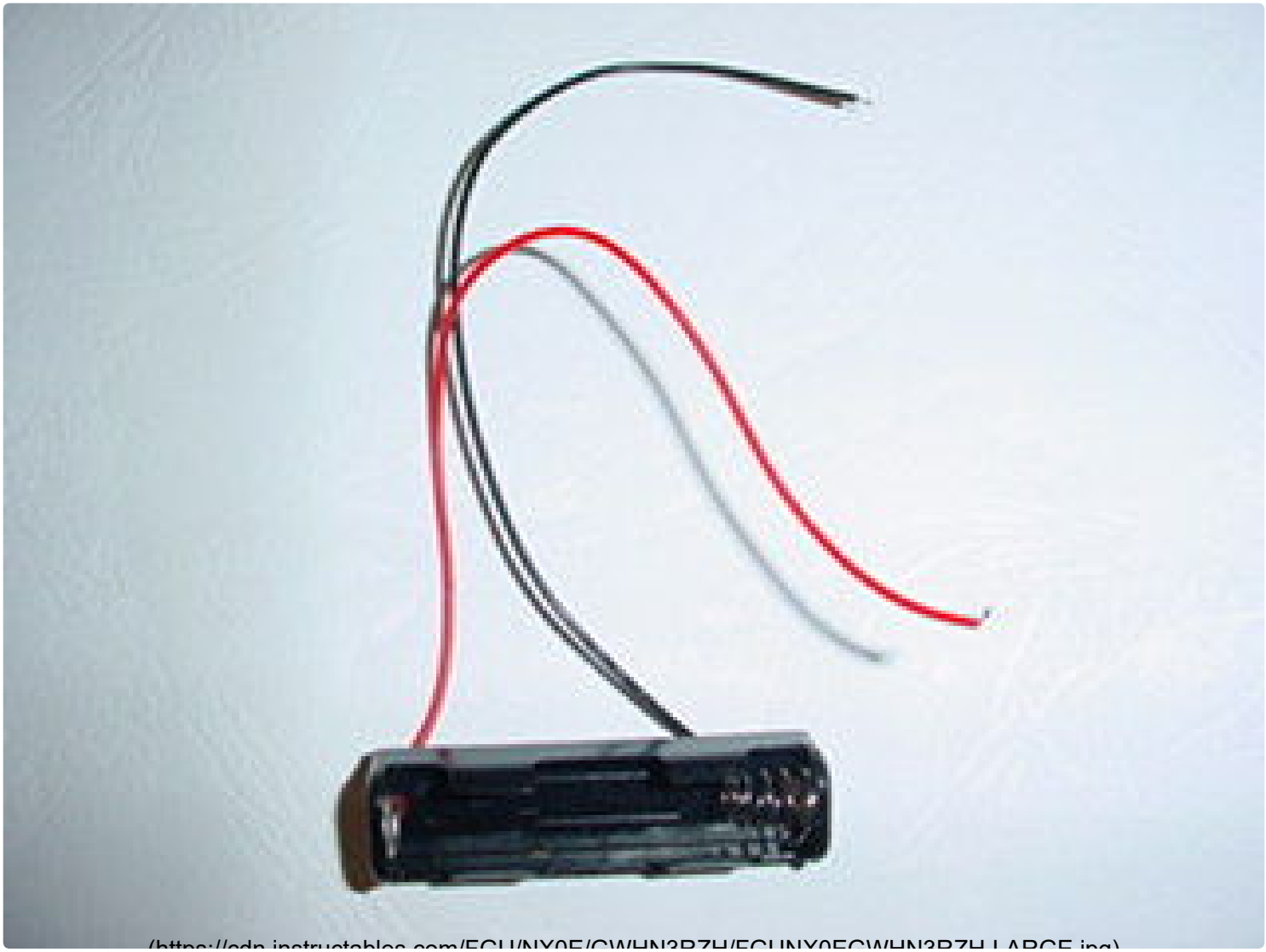

(https://cdn.instructables.com/FGU/NX0F/GWHN3BZH/FGUNX0FGWHN3BZH.LARGE.jpg)

The wire connected to the transistor's emitter should be connected to the battery's negative side and the remaining wire of the ferrite toroid should be connected to the battery's positive side. Oh! one more thing, I advise everyone to use a battery case or attach a conductive magnet for each wire, so you wouldn't hold it all the time.

Add Tip

Ask Question

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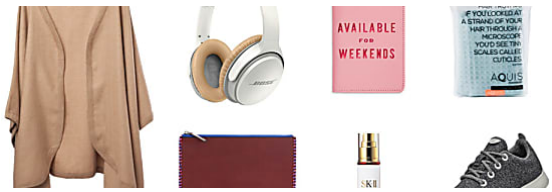

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8 People Made This Project!

"Joule Thief" LED Night Light

by **ledartist** on September 2, 2011

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Comments 6

Author:ledartist My Blog
I work with LEDs and microcontrollers to create beautiful objects.

Intro: "Joule Thief" LED Night Light

I have many used batteries around. Remote controls, cameras, many electronic gadgets all use batteries, mostly AA size. I always felt guilty for throwing away the used batteries. I know there are rechargeable batteries, but many electronics don't work well with rechargeables.

I also know that those "used" or "spent" batteries usually have some juice left in them. So to come up with a good use of used batteries, I've created a LED night light.

I like having a little night light on when I sleep. LEDs are perfect for this purpose, because they are energy efficient, and good at providing low intensity illumination.

This LED night light operates with just one battery. It utilizes a little circuit called Joule Thief to boost voltage out of an AA battery. I also added a light sensor to turn it on automatically when the surrounding is dark.

The circuit is energy efficient, and requires very low voltage to work. So it effectively sucks every bit of energy out of batteries. This type of circuit is often called "Joule Thief", because it works as though stealing every bit of energy (Joule is a unit for energy) out of battery.

I'm calling this project Night Joule Thief.

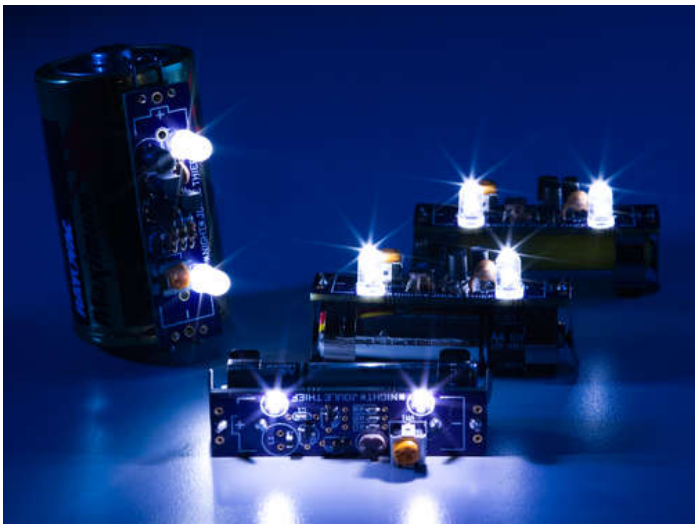

Step 1: Features

Here are the highlights of the Night Joule Thief.

- Compact & streamlined design
- Uses only one AA battery (or any 1.5V battery you can hook up to)
- Easily adaptable to different size batteries - hook up holes to attach home made clips
- Two white LEDs
- Automatic turn on via a light sensor (adjustable sensitivity level)
- Energy efficient - works even with a run-down battery, down to 0.6V
- Choice of through-hole only components or SMD - mix & match on the same PCB

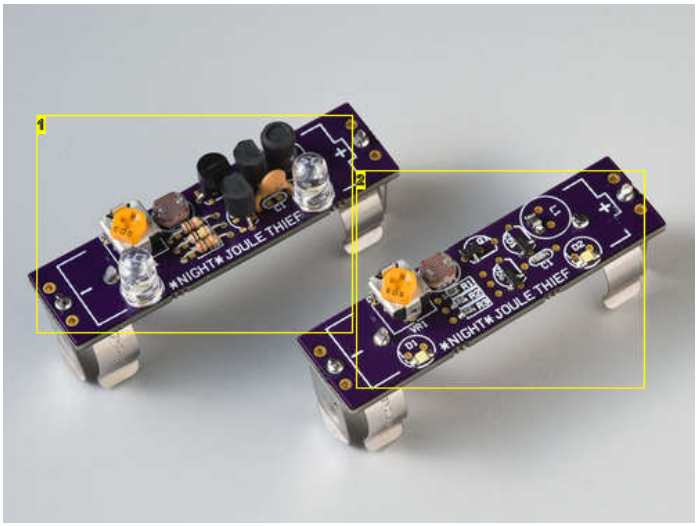

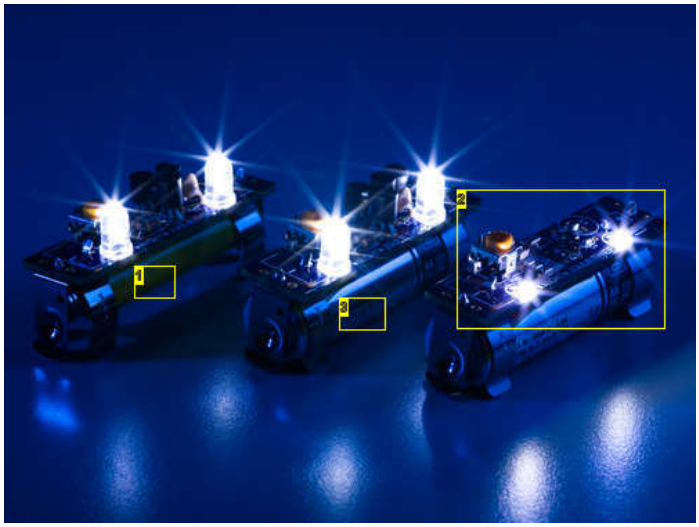

Image Notes
1. Through-hole version.
2. SMD (Surface Mount Device) version. Hard to believe this is the same circuit, but it works exactly the same as one on left. Ok, the LEDs are slightly less bright.

Image Notes
1. AAA battery inserted with a help of small magnets.
2. SMD version - very low profile.
3. Standard AA battery snugly fit in the clips.

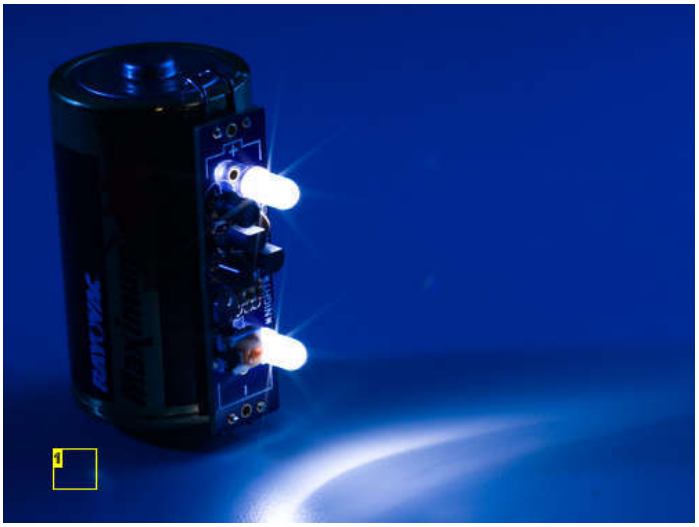

Image Notes
1. Other sizes, such as D cell can be attached by making a pair of little metal clips. Just cut and bend paper clips.

Step 2: Technical Overview

"Joule Thief" circuit is an inductor based voltage booster circuit to light LEDs with low supply voltage. As most of you know LEDs need higher than 2V (3V for white LEDs), so usually at least two batteries are needed to light them. The "Joule Thief" circuit was published in 1999 and has been quite popular. You can see the principle of the circuit here. http://en.wikipedia.org/wiki/Joule_thief

My version is a variation that uses single coil inductor, to make the inductor easily obtainable. I design the circuit using readily available parts only, to make it an ideal DIY project.

Circuit

The L1, Q2, Q3, C1, R2, and LEDs D1 & D2 make the Joule Thief. And the Q1, and the rest of the parts form the light sensor. CdS is the device that actually senses the light and change its resistance accordingly. When the surrounding of CdS is bright, it has low resistance (anywhere around 1k to 3k ohm), and when the surrounding is dark, the resistance goes up to 100k to 3M ohm range. So in this circuit, the base voltage of Q1 is controlled by the ambient light level. When the base voltage of Q1 goes more than 0.6V below the power supply(battery) voltage, current goes through R1, turning the Joule Thief circuit on.

The Joule Thief circuit is boosting the battery voltage up to over 6V to light two LEDs in series. LEDs light up with the battery voltage as low as 0.6V! Amazing!

PCB layout can be downloaded as an editable PDF, so you can etch your own board if you like. Custom 2 layer PCB and kit are available for sale as well. The 2 layer PCBs have extra front pads for SMD where possible, so you can build the same circuit with SMD parts as you wish.

Parts List
1x CdS Photoresistor (rated 3k - 0.3M ohm) (CDS1)
1x 1k ohm (R1)
1x 100k ohm (R2)
1x 10k ohm (R3)
1x 50k ohm trim pot (VR1)
1x 22pF (C1)
1x 470uH (L1) (anywhere between 22 - 470uH would work - might have to reduce the C1 value however)
1x 2N5401 or equivalent (Q1) (or just about any general purpose PNP transistor, such as PN2907, 2N3906, etc...)
2x MPSA06 or equivalent (Q2, Q3) (or just about any general purpose NPN transistor, such as PN2222A, 2N3904, 2N4400, etc...)
2x LED (D1, D2) (Just about any LEDs can be used)
2x Battery Clips

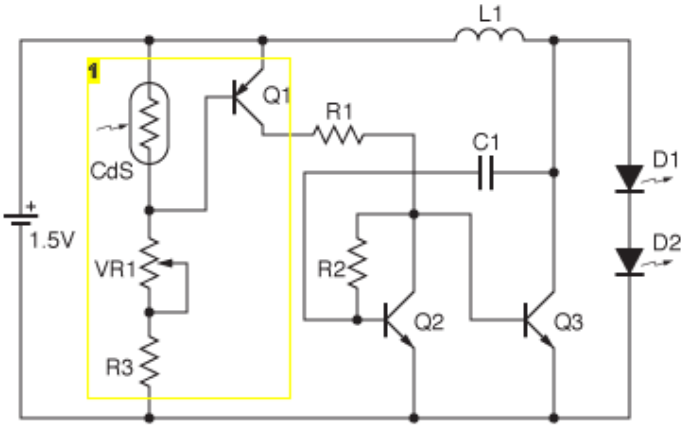

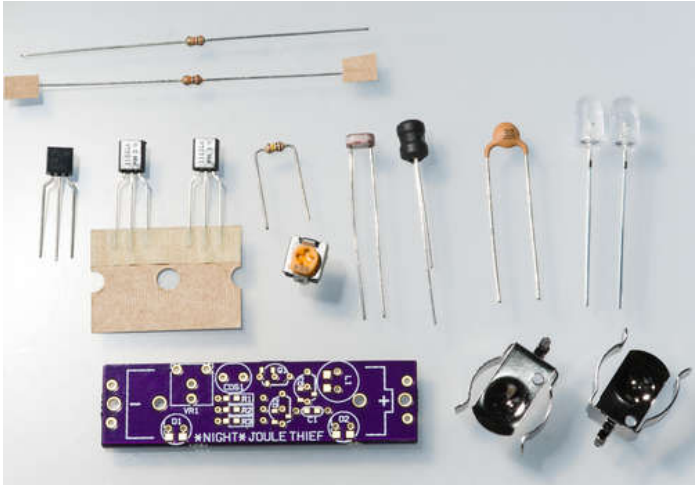

Image Notes
1. Light sensor circuit with sensitivity adjust.

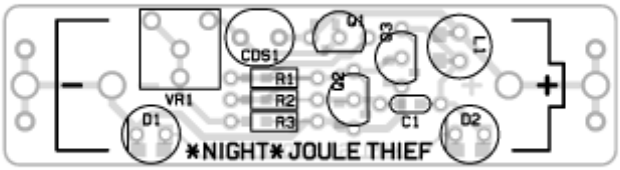

File Downloads

NightJouleThief-PCB.pdf (54 KB)
[NOTE: When saving, if you see .tmp as the file ext, rename it to 'NightJouleThief-PCB.pdf']

Step 3: Assembly

The assembly is very straight forward. Insert the parts into the PCB, and solder them. Start with small components, follow the order below.

Parts List (in assembly order)
1x 1k ohm (R1)
1x 100k ohm (R2)
1x 10k ohm (R3)
1x Photoresistor (rated 3k - 0.3M ohm) (CDS1)
1x 50k ohm trim pot (VR1)
1x 22pF (C1)
1x 470uH (L1)
1x 2N5401 or equivalent (Q1)
2x MPSA06 or equivalent (Q2, Q3)
2x LED (D1, D2)
2x Battery Clips

Transistors, and LEDs have polarities, so make sure to insert them in the correct orientation. Battery holders need a bit of force to snap into the holes. They attach from the back side of PCB as you can see in the picture.

Once everything is soldered in place, double check the part placement, orientation and solder joints. Then insert a battery. The polarity is marked on the front side of PCB.
If you don't see the LEDs light up, don't worry. The room is probably too bright. Take a piece of black paper or tape and block the light from hitting CdS light sensor. (and/or darken the room) If the LEDs still don't come on, turn the trimmer (the little orange thing) with a screw driver, counter clockwise. This makes the sensor less sensitive to light, so the LEDs will come on by just placing the sensor under shade, or turning off the room light.

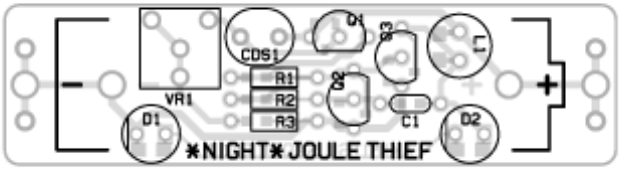

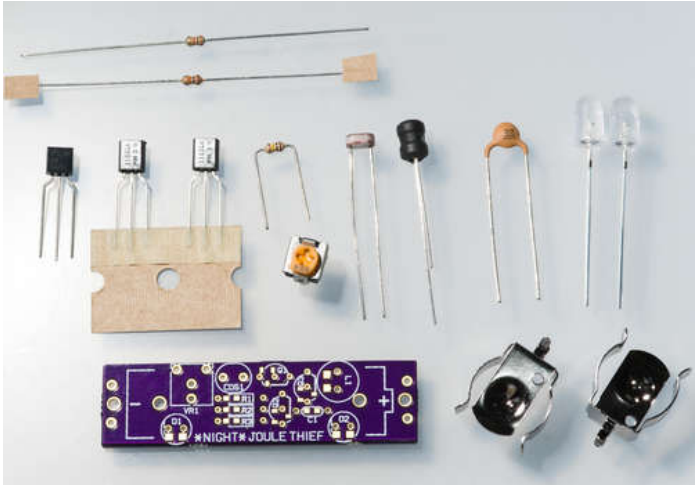

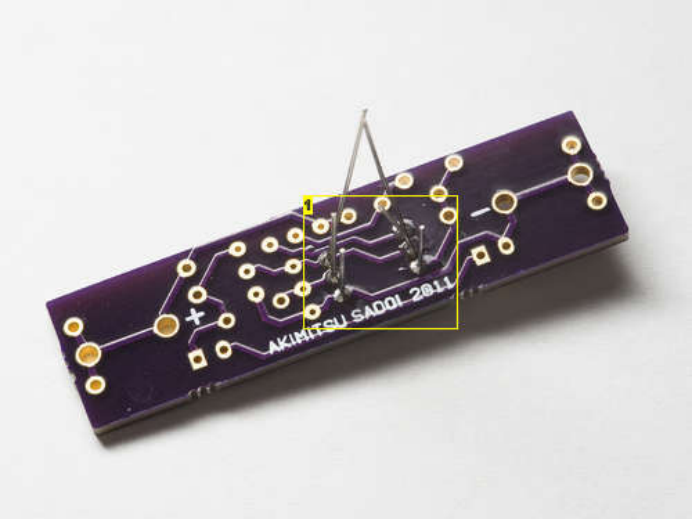

Image Notes
1. Resistors soldered in.

Step 4: Performance

This little night light performs very well. For starters, the brightness is not bad for using just one AA battery. I've been using these as flashlights as well.

The light sensor also works very well. Once adjusted, the light is steadily off during the day, even when you put the sensor under shade. Only when you block the sensor by a black object, the light would turn on. Yet after dusk, the light would come on when you turn off the room light.

A fresh battery lasts for weeks if only used as a night light. And the best use of this light is to "revive" used batteries. Those batteries from remote controls, cameras, etc. usually have quite a bit of juice left in them. Joule Thief sucks the juice out of those batteries till the last drop. It's like getting free energy when you can use something that were going to be thrown out.

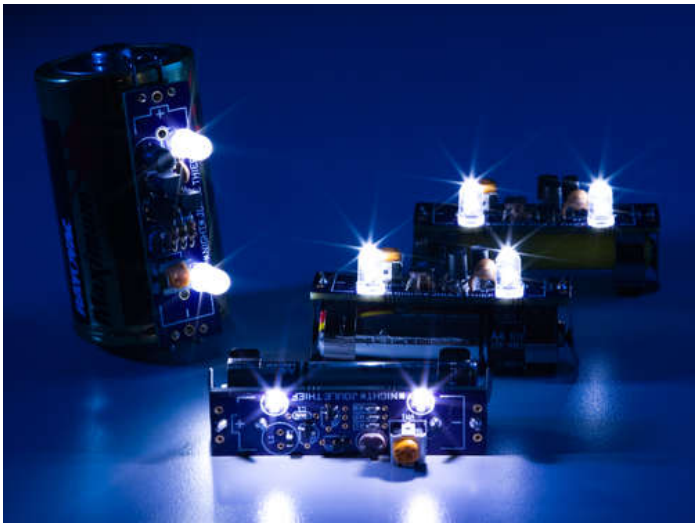

Step 5: PCB & Kit

If you are handy, you can etch your own PCB, and build this night light entirely DIY.

However, to spread the goodness of Joule Thief and to contribute to the greener earth, I am putting together the PCB & kit available.

The details can be found here: http://www.instructables.com/community/Joule-Thief-LED-Night-Light-Kit-PCB/

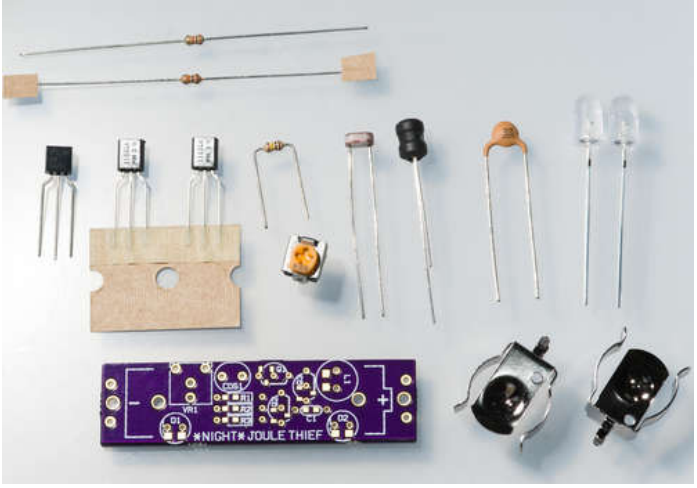

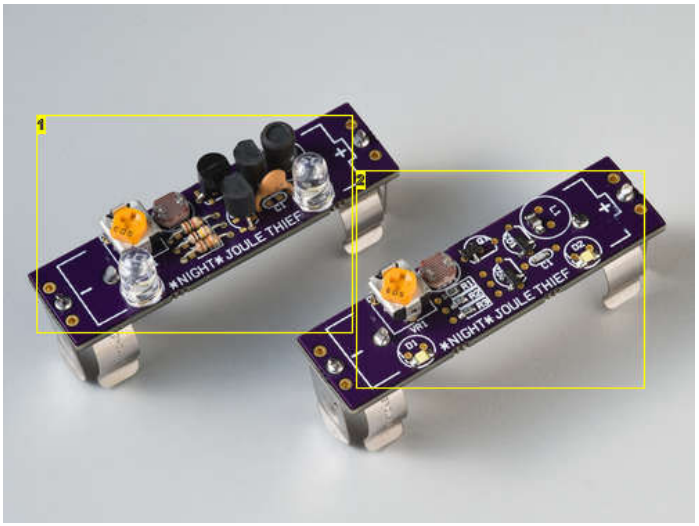

Image Notes
1. Through-hole version.
2. SMD (Surface Mount Device) version. Hard to believe this is the same circuit, but it works exactly the same as one on left. Ok, the LEDs are slightly less bright.

Related Instructables

Joule Thief - use LEDs with only one AA battery! by RazorConcepts

Ferrite, the joule thief (Photos) by botronics

Electronic Night Light by TinkerJim

Ultraviolet Light Pen by junits15

Mini 'Joule Thief' (Photos) by Mudbud

Altoids Joule Thief Flashlight (Photos) by cynical_chemical

Comments

33 comments **Add Comment**

tosacj says: Sep 4, 2011. 10:47 AM **REPLY**
Great idea. Let me know when the kit becomes available.

ledartist says: Sep 4, 2011. 12:38 PM **REPLY**
I will post the information on "Kits" section of the forum and on my blog (theLEDart.com). The kit & PCB are scheduled to be ready in mid September. Thanks, Aki

haxcess says: Sep 5, 2011. 8:16 AM **REPLY**
This is a very neat application of the joule thief. I am wondering if it would be possible to replace the light-sensor circuit with a small battery charging circuit (solar). I suppose that would ruin the beautiful form factor you have here.

apalacios2 says: Sep 5, 2011. 7:07 AM **REPLY**
Excellent circuit. May I remove the CdS circuit and use a button switch instead (thru the resistor connected to the transistor)?
I find great that it uses a coil instead of a toroid transformer. Kudos!

ledartist says: Sep 5, 2011. 7:28 AM **REPLY**

Yes, you can. In fact I made sure that you can fit a 6mm tactile switch in place of trimmer pot. You can omit the CdS, and solder a switch in place of trimmer pot.

You can also remove Q1 and put a switch there as well, but my PCB won't accommodate that.

Yeah I found having to wind my own inductor a hassle, so I designed this circuit to use off-the-shelf inductors.

Aki

---

bhvm says: Sep 4, 2011. 9:17 PM **REPLY**

Excellent build!
How many mA does this circuit give? Can we use a single 150mA power LED in place of 2x 5mm LEDs?

---

ledartist says: Sep 5, 2011. 7:20 AM **REPLY**

The current through the LEDs is about 20mA or less peak (it's pulsed current in about 50kHz)
So you won't get any more light by using a high power LED. By using only one LED, you do get a bit more brightness per LED though. However just a regular LED will give you the same brightness as a high power LED because you are not driving the LED with high current anyway...

It's not that you can't drive high current LED, but this circuit is designed to run with as little power as possible.

Aki

---

abbtech says: Sep 4, 2011. 7:10 PM **REPLY**

Great looking project.

---

ledartist says: Sep 4, 2011. 7:18 PM **REPLY**

Thanks!

---

vruiz3 says: Sep 4, 2011. 1:56 PM **REPLY**

afraid of the night??? :D

---

timotet says: Sep 4, 2011. 1:21 PM **REPLY**

great job!

---

gnafpliotis says: Sep 3, 2011. 3:06 PM **REPLY**

Can't we hack laptop's batteries that way to perform more? Is it only letting through a small amount of amps?

---

ledartist says: Sep 4, 2011. 1:17 PM **REPLY**

Laptops and many other "high-tech" gadget has many of inductor based boost/buck (to reduce voltage) voltage converter circuit in them. Especially LED back light screens use voltage converter to efficiently drive LEDs.
So in a way the battery life is already enhanced. (Some gadgets are better than others, of course...)

Aki

---

jolshefsky says: Sep 4, 2011. 6:19 AM **REPLY**

Yes, but only if you wanted to use your batteries once. Once a lithium rechargeable (like in laptops) is discharged past a certain point, it can no longer be recharged. So there is always some energy left in a laptop battery even when it says it's dead — albeit energy you can't use without ruining the battery.

---

stoobers says: Sep 4, 2011. 7:29 PM **REPLY**

I've heard this theory. Have you done any experiments that might validate this theory?

---

jamwaffles says: Sep 4, 2011. 6:14 AM **REPLY**

This might not be 100% accurate but yes, that's why we can't use the same technique for laptops. Joule thieves ramp the voltage up, but the current goes down due to V = IR, assuming the load is constant which it is if it's the same laptop ;-)

---

jamwaffles says: Sep 4, 2011. 6:15 AM **REPLY**

A very professional looking product. This is a great idea; the amount of power saved using old batteries instead of a herd of plug-in night lights, as well as the amount of batteries re-used is incredible.

Just out of interest, how long do these night lights last on one "averagely discharged" battery?

---

ledartist says: Sep 4, 2011. 1:10 PM **REPLY**

The battery lasts very long, most likely much longer than you might think.
It's hard to define "averagely discharged", but I had one cell that was already at 0.7V (to low to be used with anything), and the although the LEDs were dim, they lighted for over 48 hours.
With my "dead" batteries coming out of a wireless mouse still have over 1V, I have plenty of light.

Aki

YakAttack says: Sep 4, 2011. 8:24 AM **REPLY**

I concur!
@ledartist: Any tests on battery life so far?

nymgeek says: Sep 4, 2011. 7:42 AM **REPLY**

Are those PCBs made by Laen at dorkbot pdx?

ledartist says: Sep 4, 2011. 1:04 PM **REPLY**

Yup. They are very good!

acmefixer says: Sep 4, 2011. 10:06 AM **REPLY**

I should have said in my previous comment that this does not mean there is anything wrong with your circuit. I think I would change Q2 and Q3 to an easier to obtain transistor such as a 2N4401 or PN2222A. Q1 could be a 2N3906 or just about any PNP transistor. If these changes are made, the resistors, especially R2, might need to be reduced. Thanks.

ledartist says: Sep 4, 2011. 1:03 PM **REPLY**

Yes, you can use just about any general purpose transistors. R2 should be fine with most transistors, but 47k ohm might work better with some of them.

Aki

acmefixer says: Sep 4, 2011. 10:00 AM **REPLY**

Unfortunately the link you gave to Joule Thief in Wikipedia is for a poorly written and totally inadequate definition. The authors (apparently several over time) do not have a firm understanding of how a JT works, and furthermore, they have made a mess of it. I have added comments in the discussion and some errors have been deleted, but it is still unworthy of use for a reference.

Also, by definition, the original blocking oscillator circuit later given the Joule Thief name used only a single transistor. Your circuit is not a one transistor blocking oscillator and bears little resemblance to the original JT, so I don't believe it should use the same name.

ledartist says: Sep 4, 2011. 12:59 PM **REPLY**

I know the original circuit only uses one transistor, but the two conductor inductor is harder/expensive to purchase, and winding own inductors is a bit of work. I think using one extra transistor is a good trade off for not having to wind an inductor by hand. It also makes economical sense. (transistors are very cheap, so are single coil inductors.)

I did mention that my version is a _variation_ of original, which I find very often on the net. I also think that showing different ways to achieve the same result can be inspirational.

I also contacted the person who named the circuit "Joule Thief" (Big Clive) and he did not have a problem with me using the name.

Aki

StoryAddict says: Sep 4, 2011. 12:54 PM **REPLY**

"Joule Thief" - I love a clever pun!

MikeDel says: Sep 4, 2011. 10:21 AM **REPLY**

Looks good. I'm interested!

Admiral Aaron Ravensdale says: Sep 4, 2011. 7:30 AM **REPLY**

I like your "green" thinking.
I also use a joule thief in my expedition light.

I am very glad that you will provide the parts as a kit because many kits are able to solder a circuit but etching a little bit too dangerous for them.

Thanks for your endeavour to make this instructables buyable for many people…

kevinhannan says: Sep 4, 2011. 6:35 AM **REPLY**

fantasic project and incredibly well explained.

UOS says: Sep 3, 2011. 2:59 PM **REPLY**

Great instructable! Waiting the kit version to buy one but also I'm gonna make mine from scratch :D

tphillips2 says: Sep 3, 2011. 8:07 AM **REPLY**

You are so inventive! Cool idea and great looking light!

ledartist says: Sep 3, 2011. 8:18 AM **REPLY**

Thanks!

gweeds says: Sep 3, 2011. 4:41 AM **REPLY**

What a great idea! must build one and see how long it gets out of a "used'ish" battery

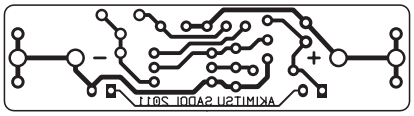
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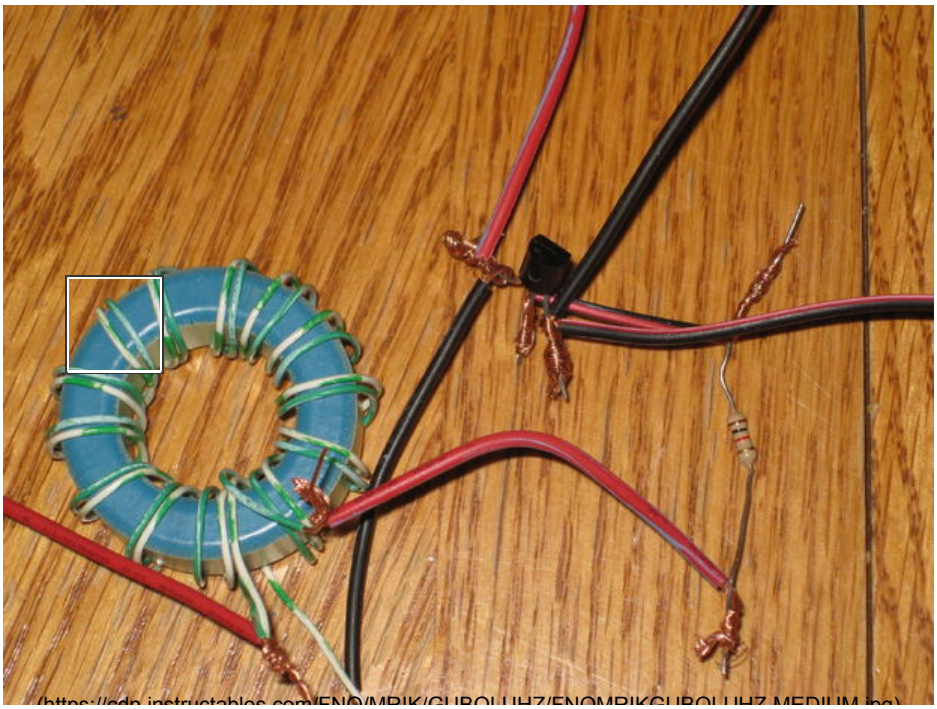

this is my version of the famous joule thief. there's alot of these things out there so i did alot of research and made it as simple as i can without soldering or complicated math. i harvested these parts from an older dell computer that was given to me to scrap. there is only a few parts needed to build this project:

1: toroid bead (ferrite core)
2: 1k ohm resister (brown black red)
3: npn transistor (i used the 2n3904)
4: thin wire

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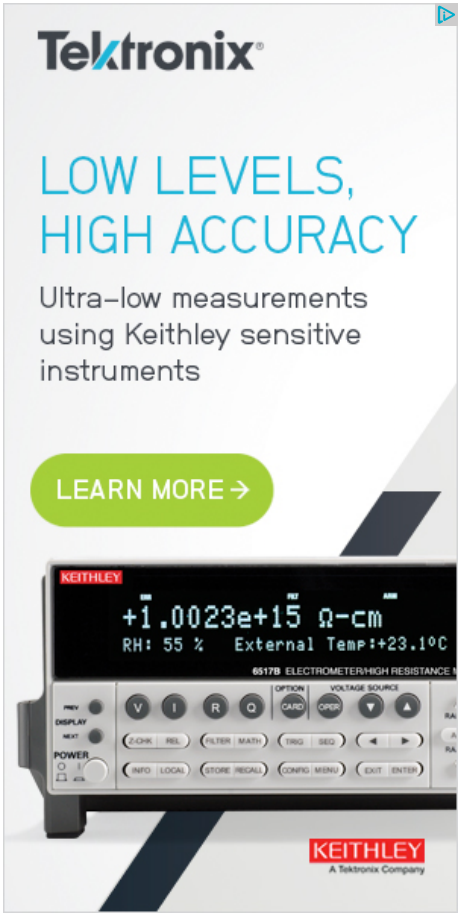

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Step 1: Wind the Coil

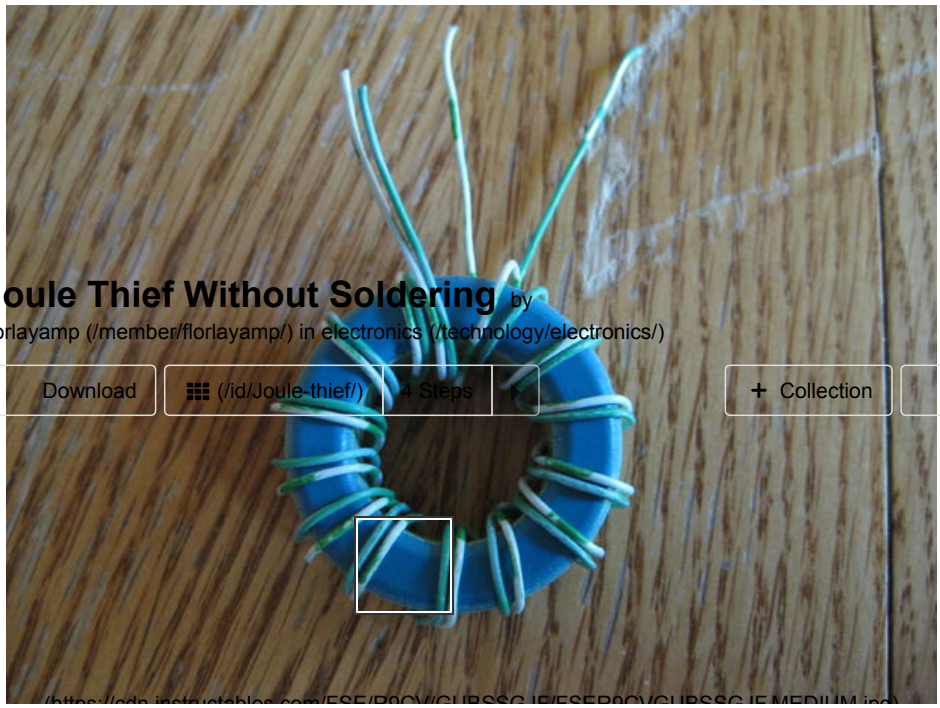

Joule Thief Without Soldering by

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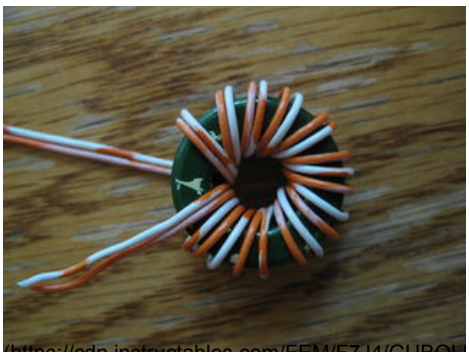

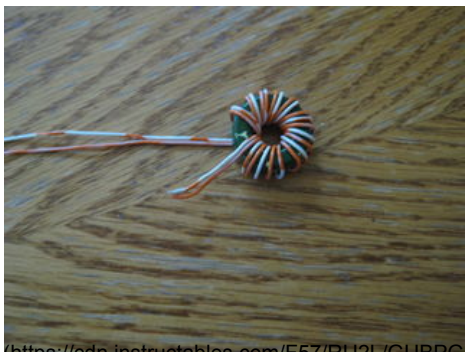

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Bio: I love building things, and I'm a twin, we both are electrical engineers and inventors. Feel free to ask anything else

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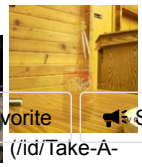

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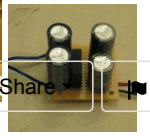

(/id/Voltage-doubler-for-wind-generators/)

i wound a couple sizes of these things using the same wire. the type of wire i used came from an ethernet cat5 cable. i like it because its a solid core wire that stays in place where i put it. i have 11 turns of wire in the orange one and 13 in the green one. i looked all over the internet to find the reason for the number of turns but couldnt find an exact answer, and 11 winds is all the smaller (orange one) could take, and the green one i just put the 13 turns in it from the same length of wire. the orange coil is half the size (about the size of a dime) of the green one (little bit smaller than a 50cent coin).

Step 2: Connect the Resistor

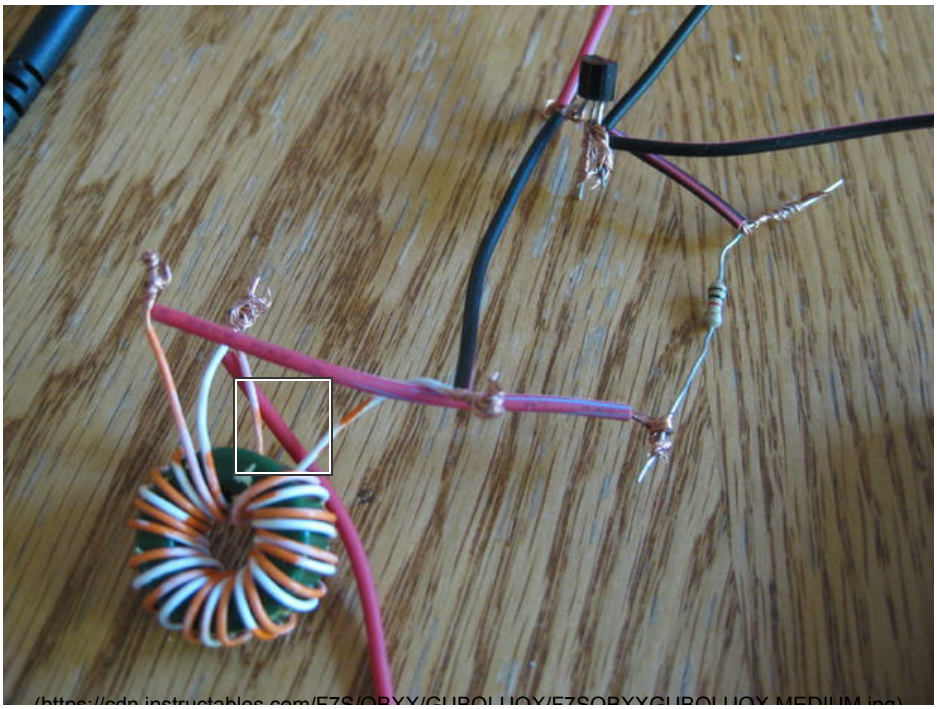

once the coil is wound, cut off the excess wire but make sure to leave enough to work with. strip the ends of all four wires, then take 1 wire of **opposite color from each side** and twist them together. then since i didnt solder any wire, i cut up several small wires to piece the rest of it together. unless you want to solder it you can skip this part. but i took a piece of wire and attached it to one of the single wires on the coil (it doesnt matter which one) and attach the other end of the piece of wire to the 1k ohm resister, then take another piece of wire and attach it to the other single wire which will go to the **collector** leg of the transistor. the final piece of wire for this step attaches to the twisted pair of wires which will become the positive input for the circuit.

Step 3: Connect the Transistor

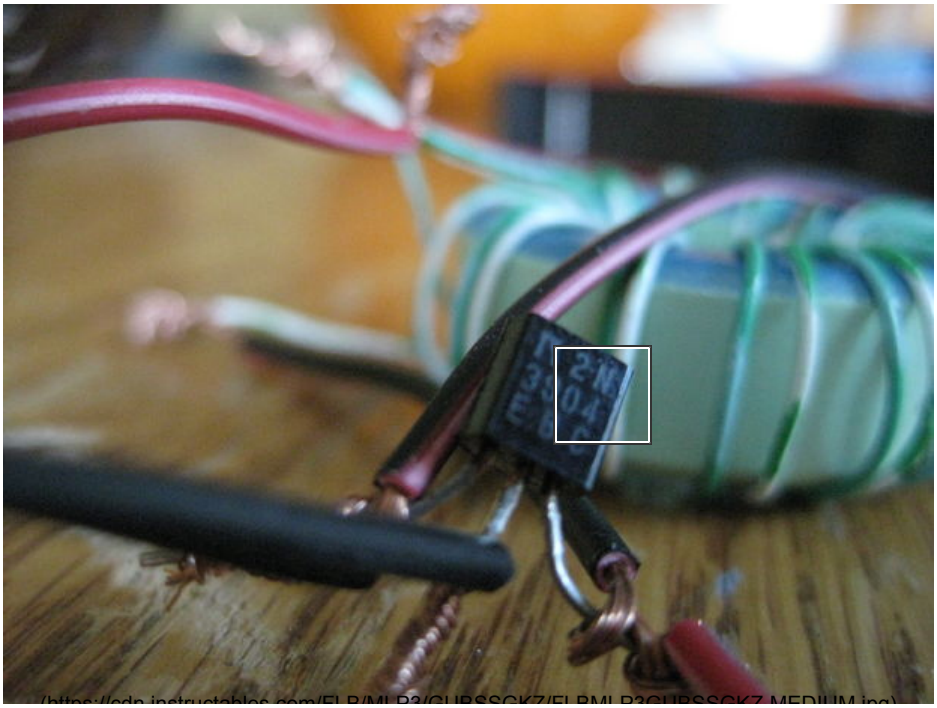

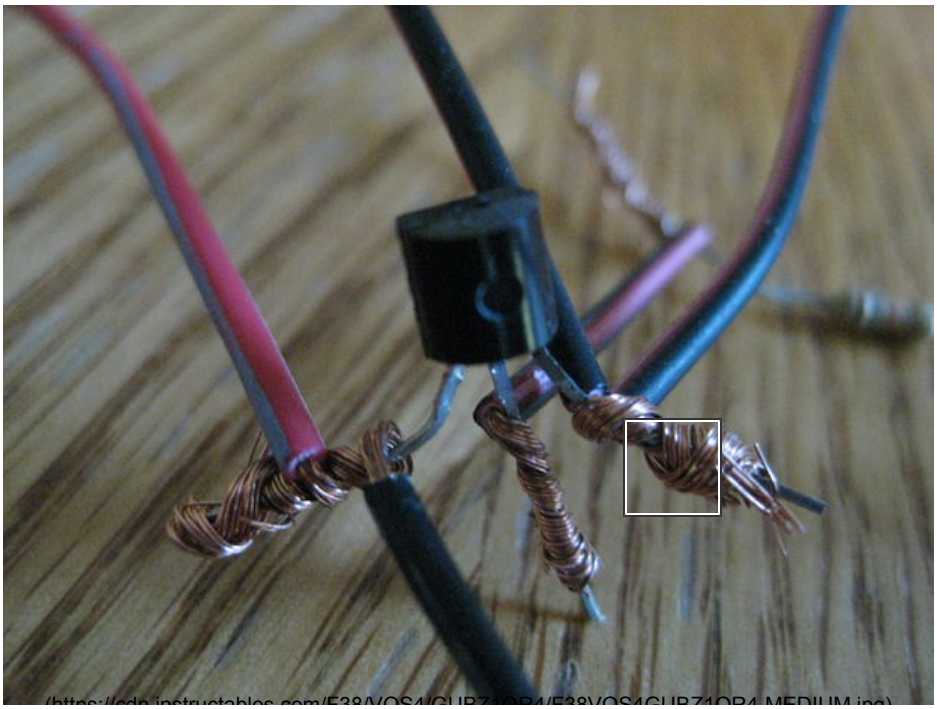

next take a piece of wire and attach it to the other side of the resistor, and then take the other end of the piece of wire and attach it to the **base leg** of the transistor. next, as i mentioned in the previous step, take the open piece of wire from the coil and attach it to the **collector leg** of the transistor, also i attached another piece of wire to this leg for the positive output side . last of all connect two wires to the **emitter leg** which will be the negative side of the circuit. (one wire to negative on battery, then one to the negative output side of an LED light or whatever else you put on it).

Step 4: Hook It Up and Enjoy!

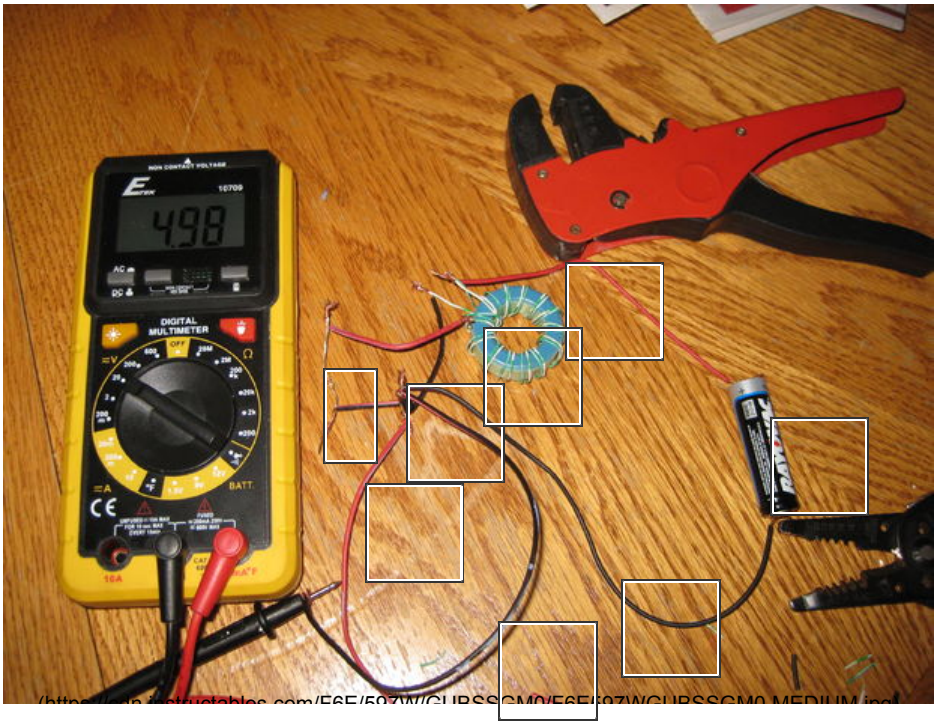

time to hook it up! the positive wire from the double twisted wire on the coil goes to the positive power source, and one of the negative wires on the transistor go to the negative side on the power source. the positive wire on the transistor and the other negative wire on the transistor go to the output power. once its all wired up its ready for use. as you can see in the picture, i hooked up a new AA battery and got about 5 volts! not bad for a 1.5v to 5v boost. and the orange coil circuit i also made produces about 2.5v from a 1.5v source, so this orange one only produces another volt while the green one produces alot more. i dont know why this is really. my only guess is the size of the toroid coil and the 2 winding difference. other than that its all the same parts. below is the results of some playing around with it.

green coil circuit:
1: 1.5v AA produces 5 volts
2: 2 AA 3v produces 20 volts
3: 3v input can power a 12v .25a computer fan.
4: 1.5v lights 3 green LED lights.

orange coil circuit
1: 1.5v AA produces 2.5 volts
2: 2 AA 3v produces 8 volts
3: 3v input also powers same 12v computer fan for 5 seconds...

very inconsistent results between the two but thats what is going on. thanks for looking and hope this helps with your project.

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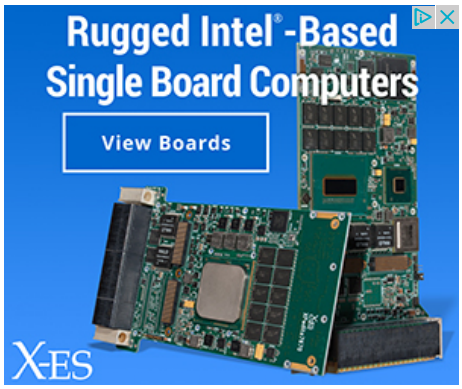

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ToXiCATOM (/member/ToXiCATOM/) 2014-02-01 Reply

can i use 2n2222 transistor?

kyooby (/member/kyooby/) ▸ ToXiCATOM (/member/ToXiCATOM/) Reply

2014-03-27

2N3904 = GP NPN Bi-Polar transistor commonly found in toys and small radios. Otherwise you can get them at radio shack, fry's electronics or order them online.

Other compatible ones are:

NPN

2N2222

2N2222A

2N1613

BC107

2N1711

2N2369

2N2484

2N3704

2N3705

2N3706

2N3903

2N3904

Also, if you use a 2N4401 or BC337 transistor, your LED will be brighter because they can handle more amps.

You can get the toroid and transistor from a dead CFL; the transistor is usually labeled 13002

florlayamp (/member/florlayamp/) ▸ ToXiCATOM (/member/ToXiCATOM/) Reply

2014-02-01

I tried that transistor also and I couldnt get it to output anything, I think the internal circuits inside it are backwards for a joule thief.

More Comments

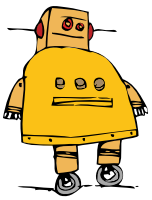

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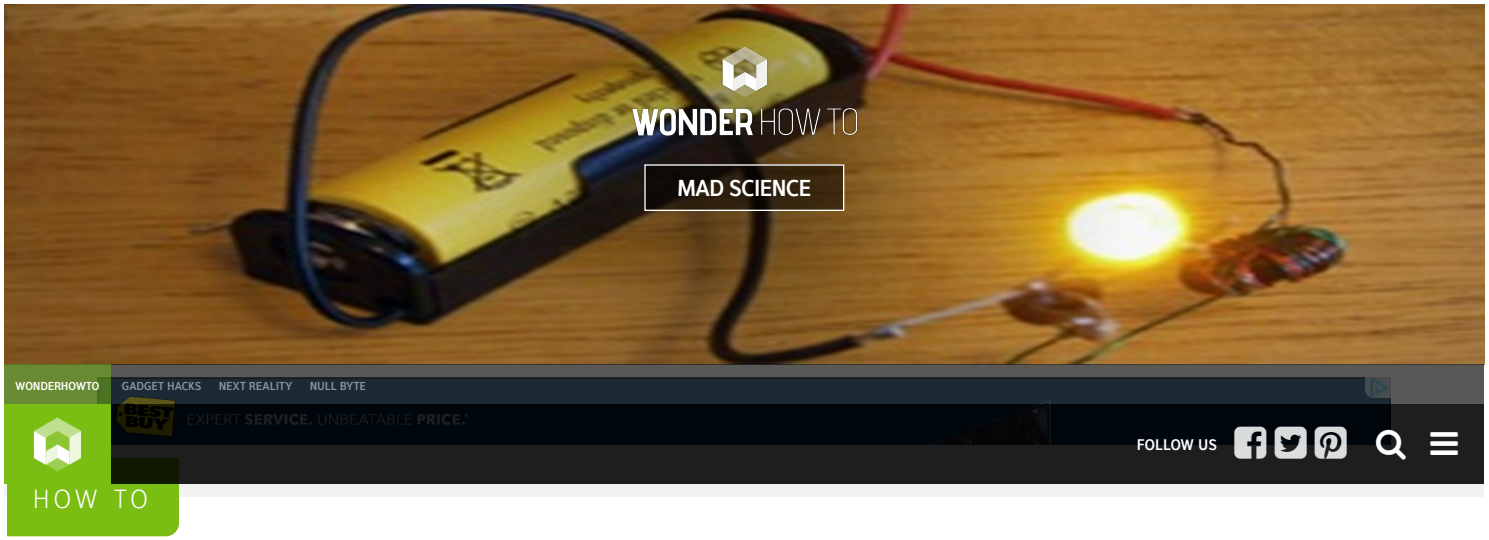

Make a "Joule Thief" and Create Zombie Batteries for More Power After Death

BY WILLIAM FINUCANE 08/23/2013 5:22 PM MAD POWER!

Just about every household gadget we own runs on 1.5 volt batteries of one size or another. Wouldn't it be great if you could reuse all of those dead AA, AAA, and D batteries after they've passed on? It turns out you can make a simple circuit called a "Joule Thief" to reanimate the undead flesh of your deceased batteries and create a zombie battery.

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Materials

- LED
- 1k resistor
- 2n904 transistor
- Thin magnet wire
- Solder
- Soldering iron
- Battery clip
- Ferrite core
- Dead battery

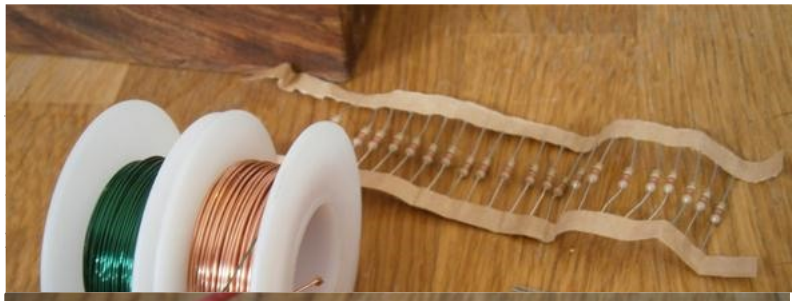

sistor for easy soldering.

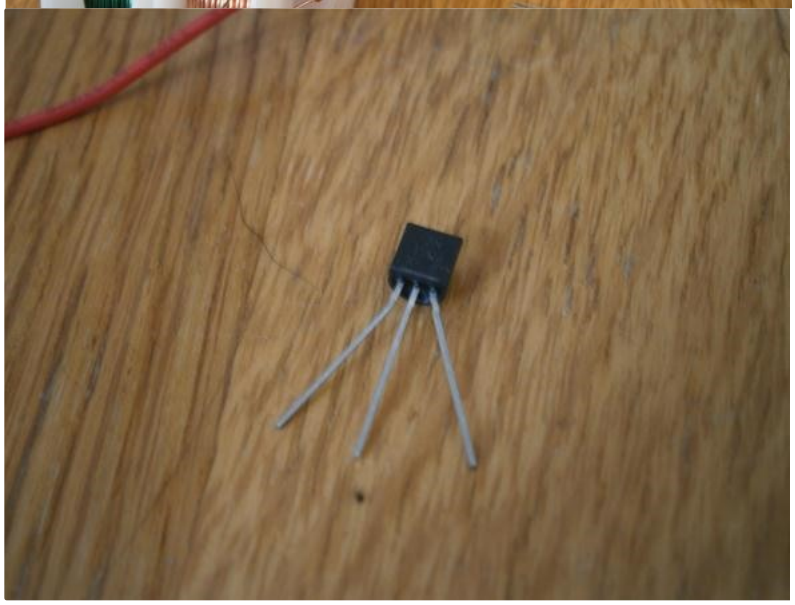

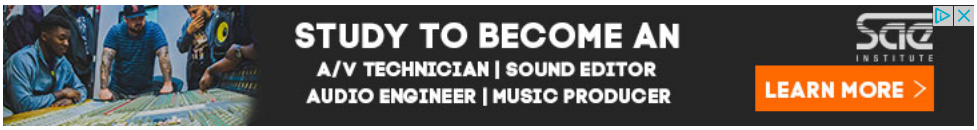

Bend the middle pin back and up behind the black plastic case of the transistor.

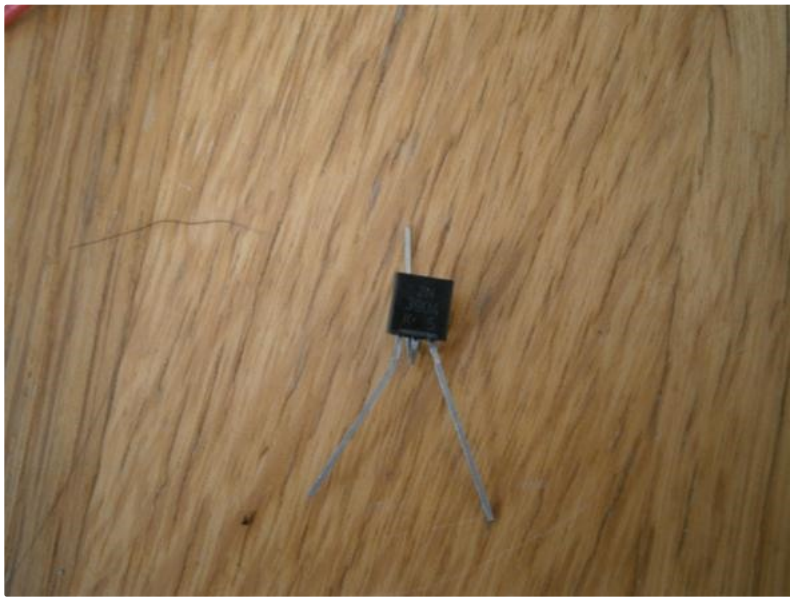

Step 2

Place the LED

The LED is a polarized component. This means it will only work when it is facing the right way in our circuit. The positive lead of the LED is usually longer. Below, the positive lead is on the left, the shorter negative lead is on the right.

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Place the LED on the transistor as shown below, with the positive side facing to the right.

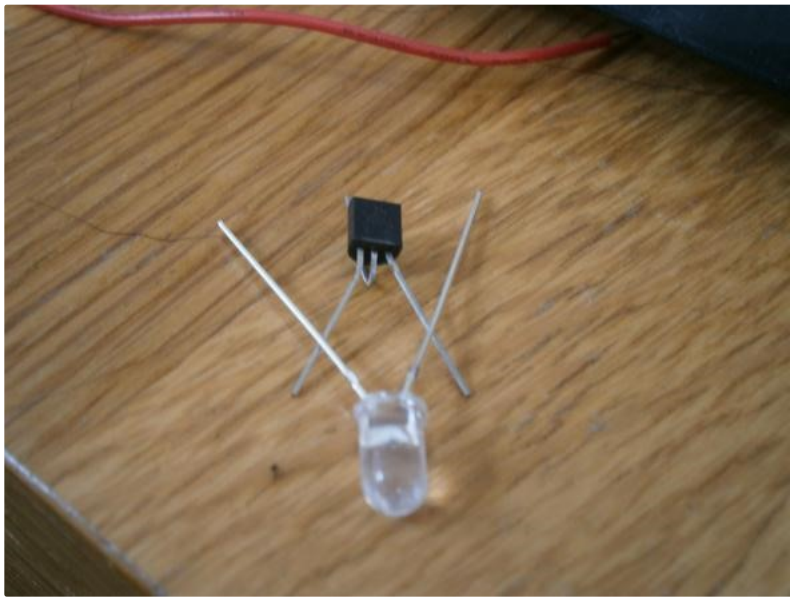

Now, solder the LED to the transistor.

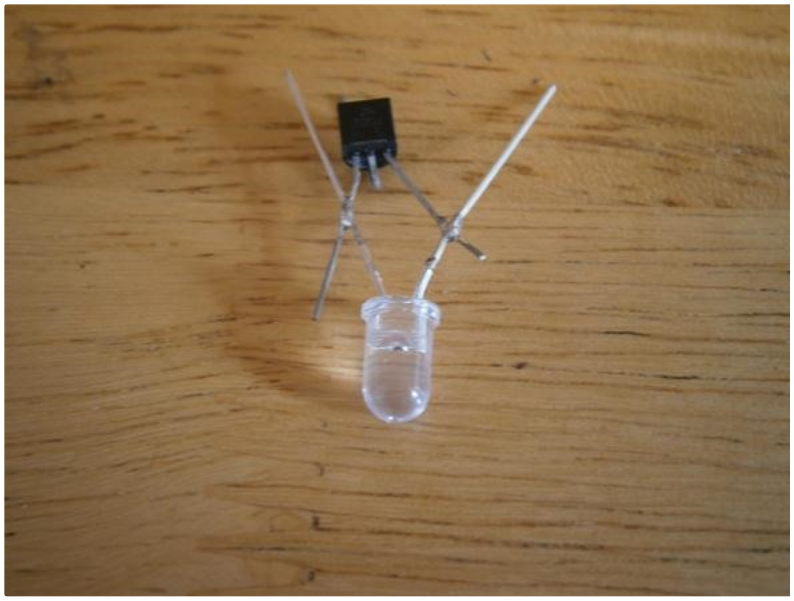

Step 3

Place the Resistor

Place one end of the resistor on the middle pin of the transistor. Make sure the components stay in contact while you solder them.

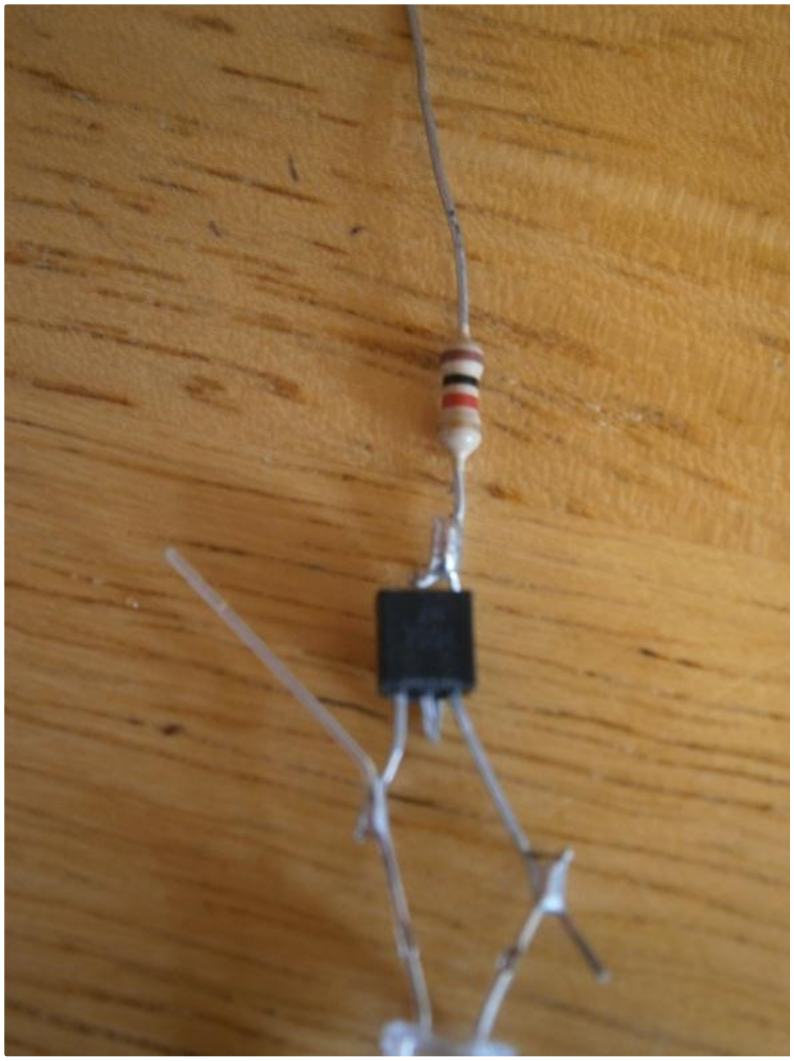

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Step 4

Wrap the Coil

This is where the dark magic happens. Wrap two enamel coated wires around the edge of a ferrite core. More wire will mean a stronger joule thief and a brighter LED. When you have wrapped the core, you should have two pairs of end wires. Connect one pair together as shown below on the right. Splay the other pair apart as shown below on the left.

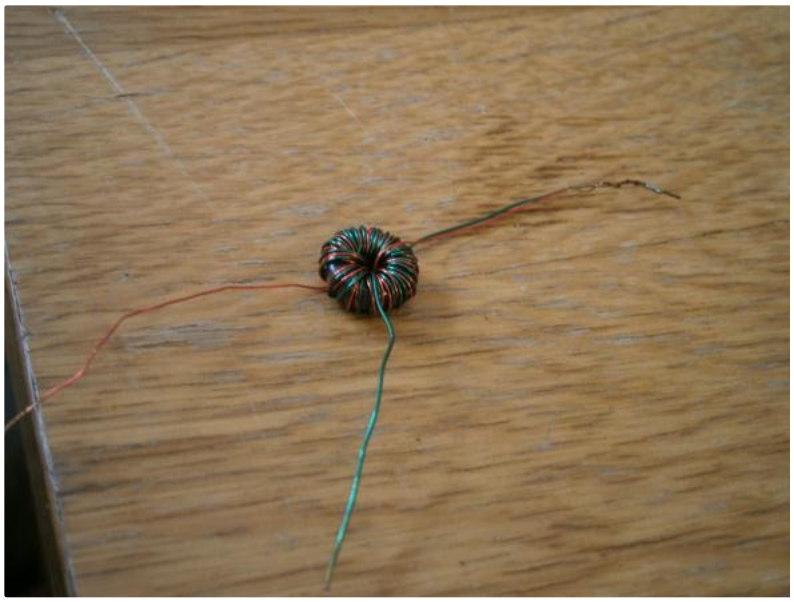

Step 5

Attach Coil

Remember to burn away the enamel on the end of the thin wire with a lighter. With the wires burned and exposed, solder one free coil wire to the 1k resistor. Solder the other free coil wire to the positive side of the LED.

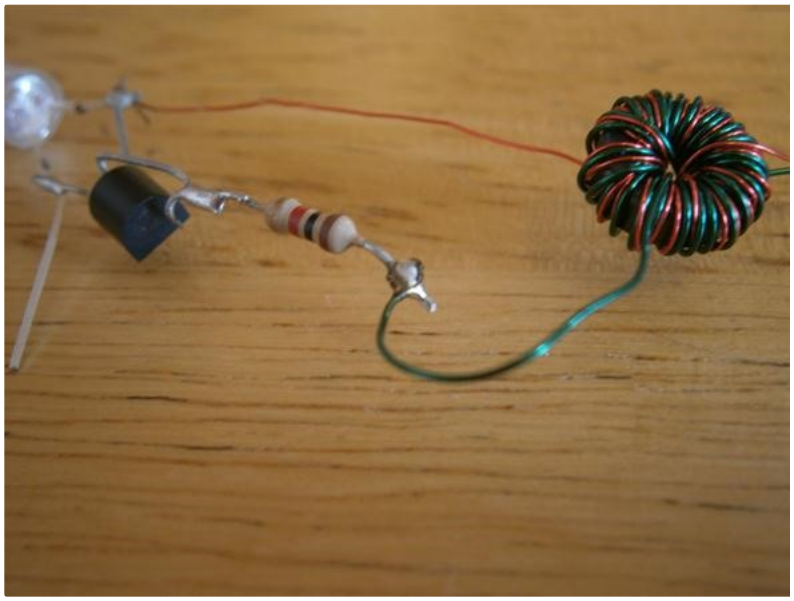

Below, we have to solder a coil wire to the intersection of the transistor and the positive leg of the LED.

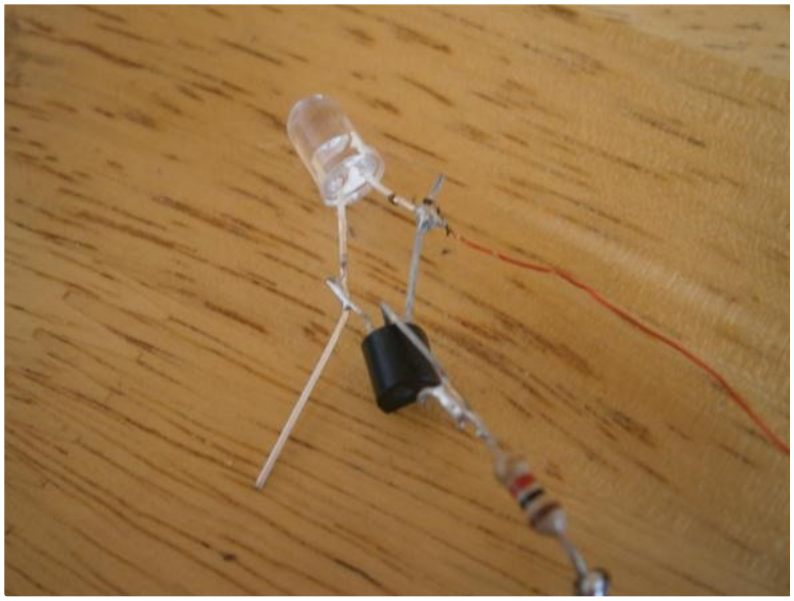

Below, notice that the end of the green enameled wire is exposed because the enamel was burned off.

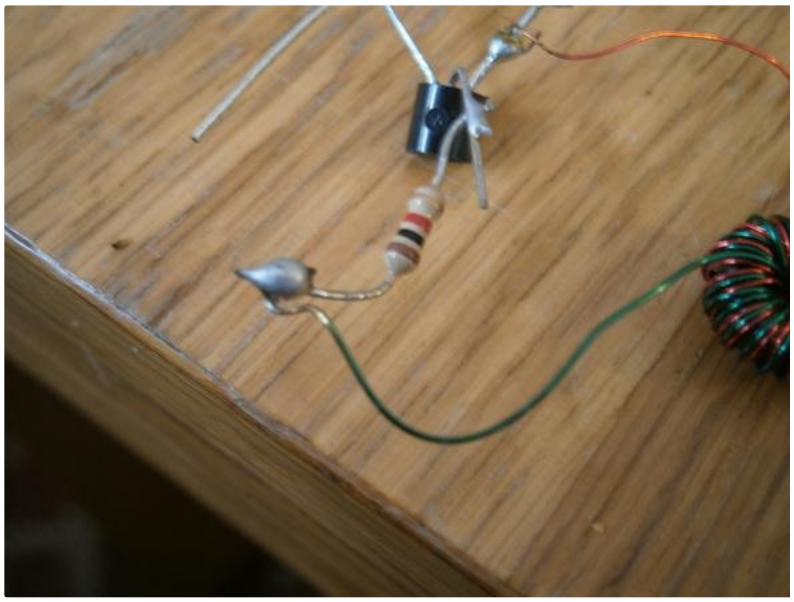

Step 6

Solder Clip

Now that the main joule thief is done, we can attach a battery clip for easy use. The joule thief will work without the battery clip, but only if you hold the wires in place with your fingers.

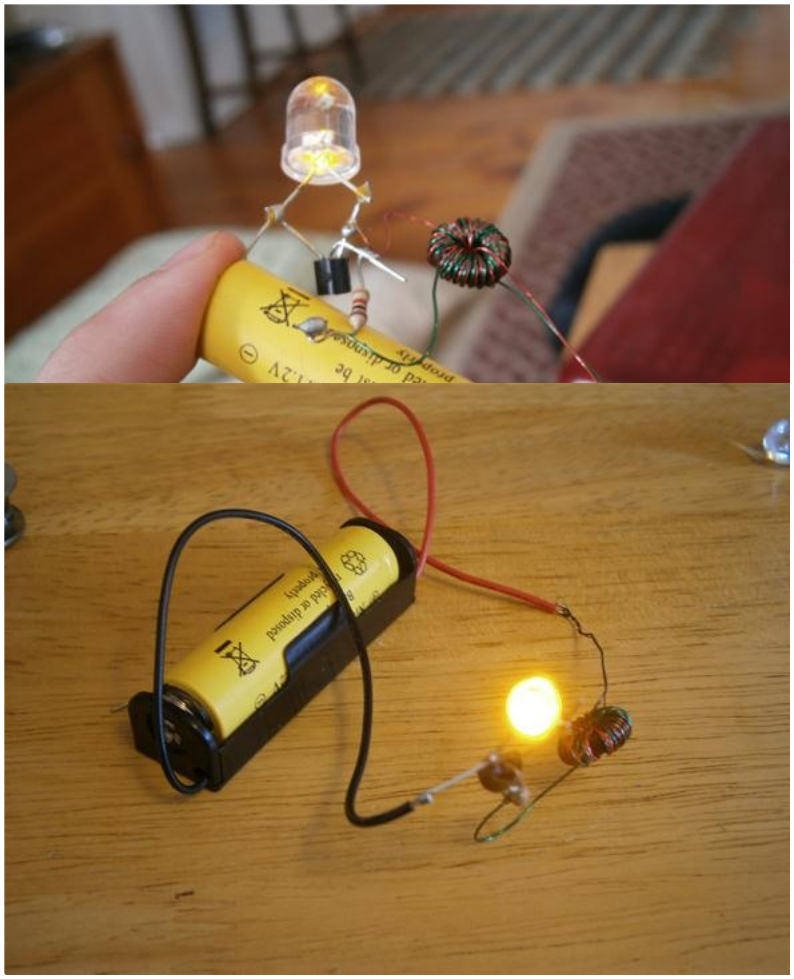

e that both wires in the pair are soldered to the red wire.

For those who need the schematics, this is what we just built:

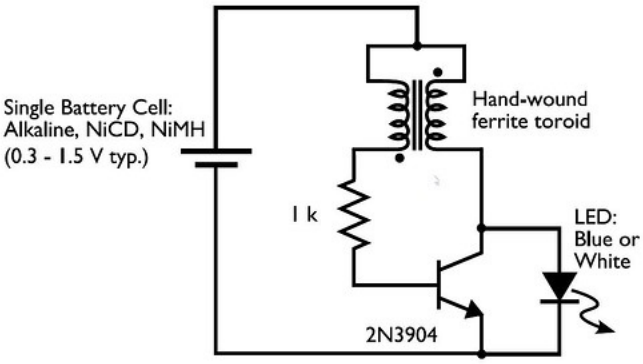

When the current flows through the coil and around the magnet, it produce an electromagnetic field (EMF). When the coil is not powered, the field collapses and produces an EMF kick in the coil that is of a higher voltage than the source was. The last of the electricity gets stored up in the field and released in large bursts to flicker the LED. The magnetic field oscillates so quickly that the blinking LED appears solid to the naked eye.

Now, just plug your dead battery into the circuit and enjoy the eerie unblinking glow of the undead watching you as you sleep. This project works great for night lights and even garden path lights when paired with a light sensor.

What could you light up with all your zombie batteries? Post your ideas and discussion in the forum.

Diagram image from Evil Mad Scientist Laboratories

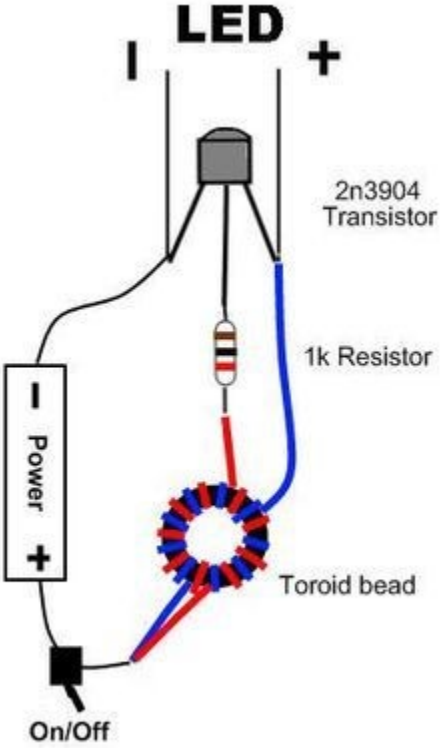
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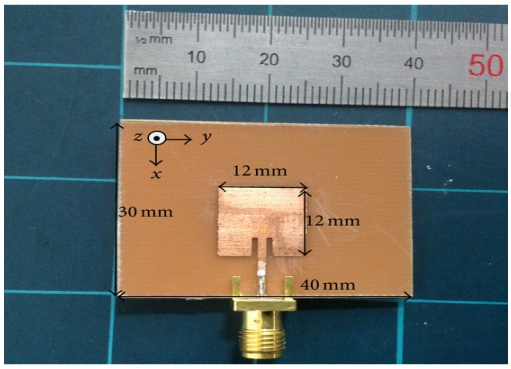

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Also, a lesser degree component design a. Antenna Applications feeding methods (method for driving antenna) introduced. References 1 java@falstad. J yadav r. Pin-pitch Dimensions ii.

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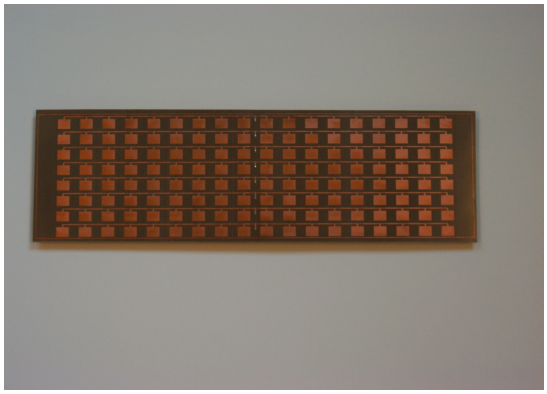

Microstrip patch antennas by kai fong lee

Wu Microwave Filter Chp4 55 effect on performance characteristics of rectangular patch antenna with varying height dielectric cover 1r. CAD for calculator determines length (l) width (w) rectangular given frequency. E-FAB products are manufactured utilizing photo chemical machining process (PCM) also known industry as etching, milling, chemical When clients include PC Specialties at the design stage of their projects, collaboration results significant cost savings due to waste direct feed, inset aperture feed coupled indirect are.

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N5ESE's Classic RF Probe

(click on any picture to see larger version)

NOTE: 'N5FC' is my former call.
This project was constructed while that call was valid, and you may observe references to it.

The RF Probe is one of the handiest accessories you can have around the shack. Using only 3 electronic components, it may rank as one of the simplest and cheapest homebrew projects. The one featured here cost about $10 in parts and supplies, not counting the wire, which I scrounged. When used with a high-impedance DC Voltmeter, it can be used to measure RF voltage (and power), trace RF signals in a new design, and troubleshoot malfunctioning RF circuits. It has its limits, of course, and we'll discuss those here. But once you understand how it's used, and how easy it is to build, you'll wonder why you never built one before.

What's an RF probe, and how does it work?

You might think of an RF probe as a special test lead that converts your regular ol' DC voltmeter to a RF reading voltmeter. Why not just read it using your trusty voltmeter, set on AC? Well, because most voltmeters wont read AC signals having a frequency above 10 or 100 KHz, and RF is way above that. [You can buy special RF-reading voltmeters, but they're very expensive... a homebrew RF probe is dirt-cheap]. Let's examine how an RF Probe works.

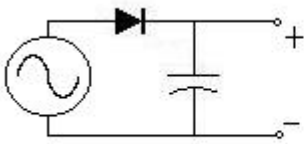

Classic Peak Rectifier

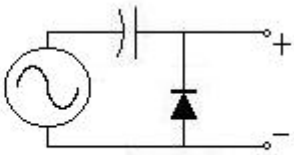

Simplified RF Probe

Above left, we see the schematic of a classic half-wave peak rectifier, commonly seen in power supplies. It's pupose is to take an AC signal at the input (usually from a transformer or the AC line), rectify it, and charge a capacitor. If you don't take a lot of power from the circuit (i.e., if your load doesn't draw a lot of current), the capacitor charges up to the peak voltage of the AC signal, and stays prettty much constant. Notice the simplicity of the circuit: not counting the load, we see it is an AC Source, a diode, and a capacitor in series.

Above right, we see a simplified schematic of the RF Probe. At first glance, it looks quite different from the circuit at the left. But notice: just like the first, it consists of an AC Source, a diode, and a capacitor in series. It's pupose is to take an AC signal at the input (usually from a circuit under test), rectify it, and charge a capacitor.

And just like the first circuit, If you don't take a lot of power from the circuit (i.e., if your load doesn't draw a lot of current), the capacitor charges up to the peak voltage of the AC signal, and stays prettty much constant.

What's the difference between these two circuits, then? One small little thing, really. In the first circuit (the half-wave peak rectifier), any *positive* DC component gets added to the voltage at the output. In the second circuit (the RF Probe), the circuit is insensitive to *positive* DC components. This is good for an RF probe, because we're going to be testing circuits with DC biases applied, and we don't want those biases to affect our readings (we're interested in the AC only, i.e., the RF)

In both these circuits, if we place a DC (not AC) voltmeter at the place where it says "+" and "-" we'll read a DC voltage that is approximately equal to the *peak* of the applied AC voltage. If we knew our applied AC was a sinusoidal signal (or sine wave), then we could divide our reading by 1.414 to obtain the RMS value, which is the way we usually measure AC voltages. Even if it's not a sinusoid, at least we know what the peak voltage is, and that's something we didn't know before we started.

We'll do one more little trick to make the RF Probe more useful, and it will only cost us the addition of a 2-cent resistor. So that we don't have to manually divide our readings by 1.414, we'll use a resistor to create a voltage divider that will do it for us. Here's a classic voltage divider, added to our RF Probe circuit:

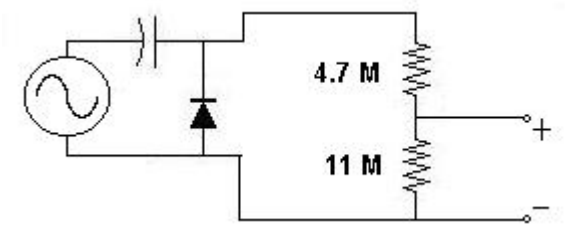

As we know from elemental electronic theory, the voltage across the second resistor (where it says "+" and "-") is equal to the applied voltage multiplied times the ratio of the second resistance divided by the total resistance in series. In our case, for a sinusoidal input, we know the applied DC voltage is equal to the PEAK of the AC voltage. We would like the resistor divider to divide by 1.414, which means that the total resistance in series (including the second resistor) needs to be equal to 1.414 times the second resistance. In our example circuit, shown above, the second resistor is 11 Megohms, and the total series resistance is 11 Megohms PLUS 4.7 megohms, or 15.7 Megohms. Is this ratio 1.414? Pretty close, about 1.427, closer than the typical resistor tolerances.

But wait! I said we would add one resistor, not two! What's up with that? Well, the 11 Megohms is the typical input resistance of a high-impedance voltmeter, like an electronic VTVM or a digital voltmeter. As long as it's 10-11 Megohms, it'll give results close enough for government work (HI). Obviously, it's important to know what your voltmeter's input resistance is, and you can find this out in your voltmeter's specifications, or measure it (I wont get into that). And really, accuracy is often not that important, especially when you're signal-tracing.

Enough! Let's get real... let's build something!

Here's a complete schematic of the classic RF Probe. Simple, eh?

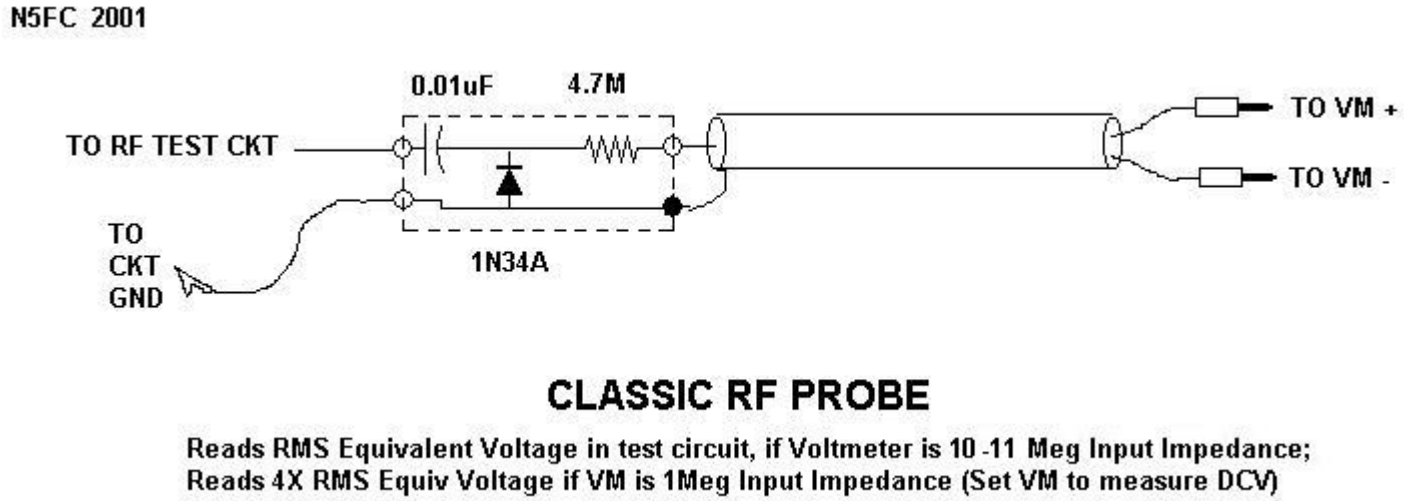

We've added a few things from our theoretical discussion that we'll make short note of. Obviously, for "probing" we need a "probe". (Hey! No wonder I get paid the big bucks...). We add a SHORT lead with an alligator clip. The alligator clip goes to our circuit "ground" and the probe goes to our test circuit, where we're probing. Brilliant! We don't want either of these to be long leads, because we're talking RF here, and long leads = antennas, and we don't want to be picking up stray signals or broadcasting them. 10-12 inches for our ground lead is sufficient for circuits to up to 30 MHz.

As shown in the schematic, we'll need to shield the RF Probe circuit, or else our hand and body will pick up stray RF and couple it into the circuit, causing erroneous readings. We'll also shield our leads all the way back to the Voltmeter, as shown, for the same reason. At the far end of the shielded wire, we'll mount banana plugs (or whatever will fit our DC Voltmeter).

In case you're tempted, don't make poor substitutions for the diode. We chose the 1N34A because it had the following key characteristics: Reverse Breakdown Voltage greater than 40 Volts, forward voltage (barrier potential) of less than 0.3 Volts, and good RF qualities. Any diode with these qualities (example, the 1N458A) would work as well, but the 1N34A is readily available (at Radio Shack and others). Silicon and Shottky (hot-carrier) diodes, while good RF devices, have higher barrier voltages, and will not work as well at low RF voltages. The 1N34A is a germanium device, and with a barrier voltage of around 0.25 V, provides about the best performance you can get with this simple circuit.

For best accuracy, size the resistor to match your DC Voltmeter's input impedance:

R = 4.7 Meg for Zin = 11-Meg;
R = 4.3 Meg for Zin = 10-Meg;
R = 430 K for Zin = 1-Meg;

Here's one cheap-and-easy approach to building the RF Probe:

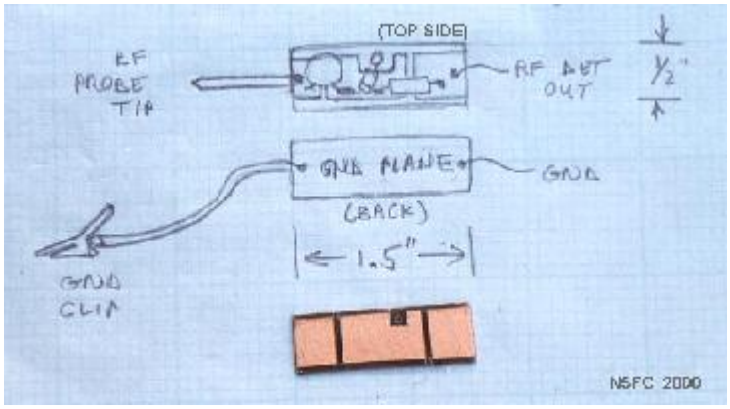

Click on the image above to see a larger

Take a small piece of scrap double-sided printed-circuit board, about 1-1/2 x 1/2 inches, Groove it on one side only, similiar to the image above, to create pads for soldering, but leave the back side as a "ground plane". Mount your diode, capacitor, and resistor as shown, soldering to the pads you made. One side of the diode (the non-banded isde) gets connected to the ground plane (drill a hole through to the other side and solder it). Try to fit all the components neatly inside the edges of the pc board. Solder the braid of the shielded wire (3-4 ft long) to the ground plane, and the center conductor to the pad with the resistor. Also, solder a 10-12 inch hook-up wire to the ground plane. Check that there are no shorts between the center conductor and the ground-plane. Solder the probe tip to the pad with the capacitor (I used a discarded probe tip from a broken test probe).

Here's where we get creative: packaging! One way or another, whatever method we use, it's important to shield the probe circuit, yet without shorting any part of the circuit to our shield (except the ground plane). I was on a kick of using copper pipe, which is very cheap, so I built my shield out of 1/2-inch copper pipe and end caps, commonly available at your local hardware store. I drilled a hole in the end of each end-cap, to pass the shielded cable and the probe tip. I used a shouldered washer to insulate the probe tip from the end cap, but a small rubber grommet would have worked as well. Stuff the assembly inside the copper pipe, and you end up with a completed probe that looks like the following:

Click on the image above to see a larger version

So, how do we use this thing?

Before we use it, a few precautions are in order. Don't use the probe in any circuit where the highest DC supply voltage is greater than the diode's reverse-breakdown voltage. For the 1N34A, this is 50 Volts. Same goes for the capacitor, which should be rated at least 50 Volts. This probably means that the probe cannot be used in most tube circuits. Also, don't try to measure RF power in circuits where the peak voltage will exceed 50 Volts. What will happen if you exceed these voltages by a little? Well, probably nothing; possibly, the diode or capacitor will fail open or short.

The first thing you'll always do in using the RF Probe is to connect the banana-plug end to the +/- jacks of your DC Voltmeter; set the Voltmeter to DC-Volts (not AC).

To use the RF Probe for signal tracing in a malfunctioning RF circuit or a homebrew circuit, connect the aligator clip to a convenient "ground" or "common" point in your circuit. Often this is the chassis. Most of the time, you'll be probing at the base/gate, emitter/source, or collector/drain of a transistor, one either side of a coupling capacitor or transformer, or at the input or output of an IC. Because the circuit's RF must overcome the diode's barrier potential (of 0.25V, for our 1N34A), voltages much less than that won't read at all, and voltages less than about a volt won't read very accurately. Typically, RF and post-mixer-amps in receivers don't have enough RF voltage, unless you inject a very strong signal at the input.

I recently used my RF probe to troubleshoot my dead TenTec Scout, which had suddenly quit transmitting in mid-QSO. I connected the rig to a dummy load, then keyed it while probing. Using the probe, I was able to follow a steadily increasing RF signal through the transmit chain, from the oscillator through the transmit mixer, to the pre-driver, and the driver. The actual voltage measurements weren't important, just that they were increasing from stage to stage where expected. Then, (whoops!) the driver's base circuit had 6 Volts, but the collector circuit only had only 0.1 Volts! The driver transistors had gone south!

You can also use the RF probe to measure RF power with reasonable accuracy, up to about 50 watts in a 50-ohm circuit. By 50-ohm circuit, I mean a 50-ohm antenna system at 1:1 SWR (higher SWRs are not 50 ohms), or a 50-ohm dummy load. Assuming the resistor in your RF probe is sized to match your DC Voltmeter's input impedance (as explained above), you will get quite reasonably accurate measurements using the following formula:

$$PWR = \frac{(V_{(read)} + 0.25)^2}{R_{(load)}}$$

For example, I want to measure the power out of my TenTec 1340 40-Meter QRP transceiver. I place it on a 50-ohm dummy load, and key down. I generally use a BNC-Tee adapter to gain access to the output line, but I could as easily pop the cover off. Using the RF probe (alligator clip to chassis ground), I measure12.2 Volts (DC) (and the same RF RMS Volts). Plugging this into the formula above I have PWR= (12.2 + 0.25) * (12.2 + 0.25) / 50 = 3.1 Watts. The rated power for this rig is 3 Watts, so I've verified everything is hunky-dorey.

We've added the potential barrier to the measured voltage above, but that little trick doesn't work so well when you get down around a volt, and for voltages less than about a volt, the measurement accuracy suffers greatly. Also, the diode's response is severely non-linear below the barrier potential, and will generally read much less than expected in circuits where the RF voltage is less than 1/4 volt. So if you see tiny readings in circuits where it's normal to have voltages less than 1/4 volt RF, don't get too spun-up about the low readings... it may mean everything is normal. My rule of thumb for guessing at this is as follows: For collector/drain circuits in oscillators or transmit-chain amplifiers in key-down, expect RF Voltages about 20-50% of the applied DC (supply) voltage. This depends on the circuitry, of course, but it's a reasonable gesstimate. Base/gate and emitter/source circuits will generally be much less, maybe 5-10%. Circuit impedance will affect this too.

How good is this thing?

Well, we're not talking high performance test equipment here, but we *are* talking very useful. If you account for the barrier voltage, the readings can be quite accurate when measuring most low-impedance circuits (20-200 ohms), provided that the voltage is above 1 or 2 volts. How accurate? +/-10% from 200 KHz to 150 MHz would be a reasonable expectation. Also, the voltage divider is only accurate for sinusoidal signals. If you want "peak" measurements, simply multiply your reading by 1.414. The "peak" measurement should be good regardless of

whether the waveform is sinusoidal. Regarding ultimate accuracy, your results may vary, and you may want to compare it to a laboratory instrument at the frequency of interest if you're really interested in accuracy. If you shield it well, and keep the ground clip lead reasonably short, it should be good in low-impedance circuits up into the VHF region, and down into the upper-audio region. In higher-impedance circuits, the junction capacitance of the diode may cause a low-pass effect at higher frequencies, and you're most likely to see this as a loss of measurement accuracy (i.e., low readings) at frequencies above 30 MHz. This doesn't mean it's not useful; it just means it reads low. Also, the capacitance of the probe may affect some sensitive RF circuits. For example, if you're probing a LC-tuned oscillator circuit, it may stop oscillating or change frequency or become unstable. Actually, most any probe will do this. Also, as we said before, the barrier voltage becomes a bigger part of the measurement error as the circuit voltage drops below a volt or so, and becomes dominant as you approach the barrier voltage. Just keep this in mind as one of it's limits.

Enjoy, good luck, and 73!
monty N5ESE

Return to N5ESE home page

Overseer: Monty Northrup ... ... leave e-mail ...

Visit our regular (non-ham, but very popular) homepage

N5ESE's Ballpoint RF Probe

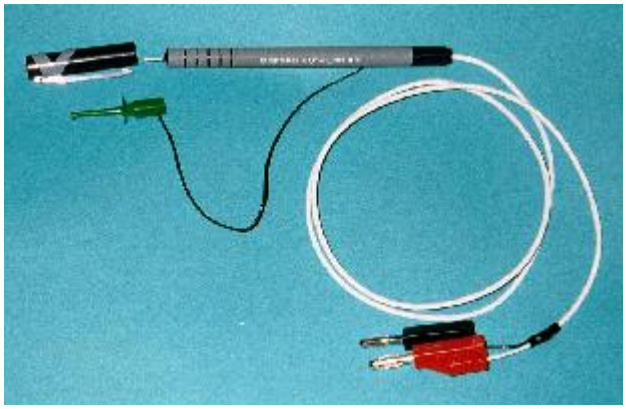

(click on any picture to see larger version)

NOTE: 'N5FC' is my former call.
This project was constructed while that call was valid, and you may observe references to it.

This is one of those afternoon projects that can really be both rewarding to build and useful to have. Electrically, it's identical to the Classic RF Probe described elsewhere (where you can also find the theory discussion for this one). Like the Classic RF Probe, this one is used in conjunction with a high-impedance-input Voltmeter or Digital Voltmeter (DVM). See the schematic below. Cost? About $5, if you can scrounge the ballpoint pen, heat shrink, shielded cable, and copper tape.

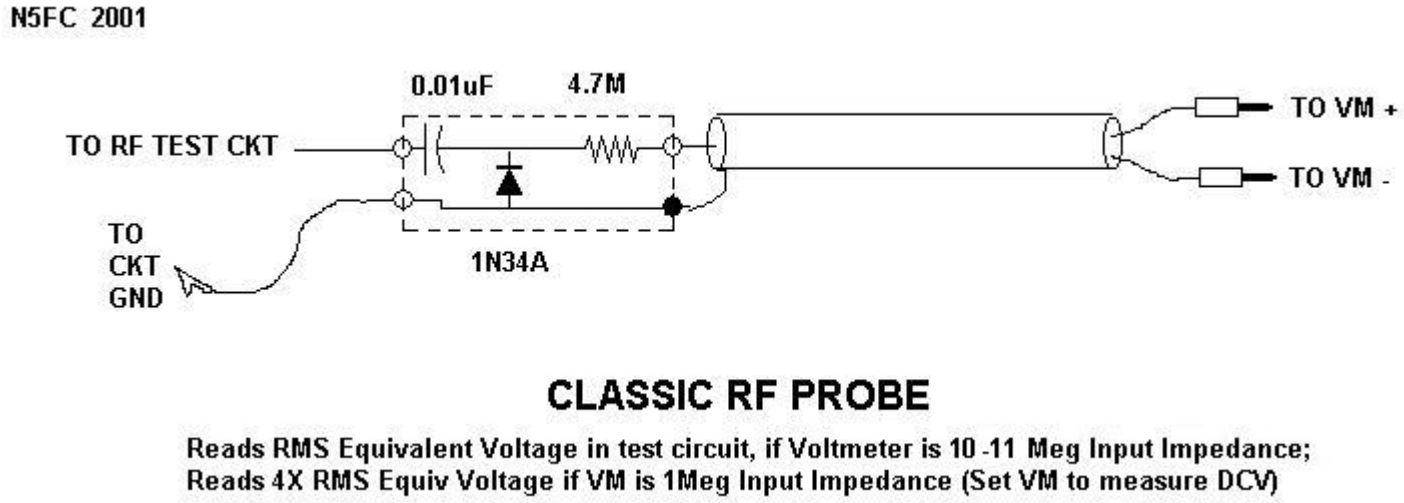

What makes this probe unique is that it's built inside the shell of a regular ol' ballpoint pen. Besides being conveniently compact, the unit sports a needle-probe suitable for use in probing surface-mount circuits, and good overall shielding. The pen cap protects the needle probe when not in use. When measuring sinusoidal signals, it should provide RMS-corrected readings, using a 10 or 11-Meg input impedance VTVM or DVM. With a 1-Meg DVM, it reads 25% of the sinusoidal RMS voltage. Reasonable accuracy (+/- 10%) can be expected over the HF/VHF range (2-150 MHz), although this hasn't been verified. When used to measure non-sinusoidal signals, the accuracy will be unknown, but it still affords good relative measurements, and most of the time, that's all that's required. It makes an excellent, compact, and portable accessory for troubleshooting or homebrewing QRP equipment with peak voltages less than 50 Volts (i.e., most solid-state equipment)

Construction

The figure below shows the parts required to build the Ballpoint RF Probe. Click on the image to open an larger, annotated image with parts labled, and construction notes. Pick a ballpoint pen with a non-metalized plastic body, and plenty of room inside. The Papermate Flexgrip model I used had an inside diameter a little over 1/4-inch. We'll use an itty-bitty scrap of double-sided printed-circuit-board to mount the electronic components. Trim the PC board to about 2-12" long and 3/16" wide; don't make it too wide, or it won't fit inside the ballpoint pen. Notch or file a little out of the middle of the pc board, so the 1N34A diode will fit easily inside the pen body. then, on one side only, groove in two places, so as to create 3 lands on the "top" side of the board. In addition to the parts shown, you'll need a 2-1/2" piece of heat-shrinkable tubing to cover the electronic assembly (although electrical tape would do instead), and about a foot of 1/4"-wide adhesive-backed copper tape, commonly available in rolls of 200-300 inches at large hobby stores (like Michaels, and Hobby Lobby). Although a chip capacitor is shown in the photo, a very small disc capacitor will do as well.

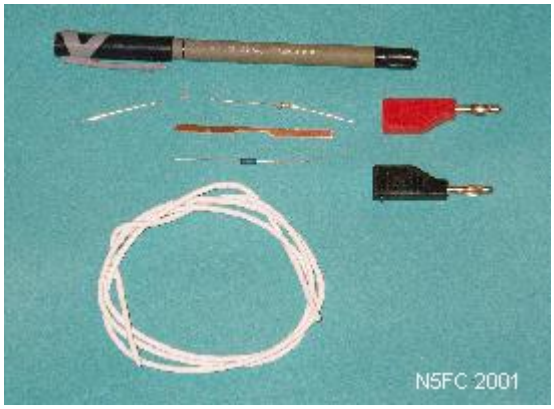

Click on the image above to see a larger, annotated image

In the next image (below), we get a close-up of the electronics assembly. You can see the input capacitor straddling the front-to middle lands, and the 4.7 Meg resistor straddling the middle-to-rear lands. The diode, which snuggles into the notch, connects from the middle land to the ground plane on the rear side of the pc board. The diode's banded end goes to the middle land. Break the sewing needle in half, using two needle nose pliers. **WARNING! Use eye and face protection!!** *ALSO NOTE: Don't try to cut a sewing needle with wire-cutters... you'll ruin the cutters.* Avoid straight pins, which dont have the hardness to perform well as probes. Then, solder the sewing needle to the front land, centering it carefully. You might benefit from burnishing the solder-half of the sewing needle with some fine grit sandpaper, to make it take solder a little better. Center it up nicely, as that will make for a professional-looking probe. Solder the shielded cable to the top/bottom of the pc board, center conductor to the rear land on top, and shield to the ground plane on the bottom. Be careful to aviod straggling shield-wires which could short the electronics. Also,solder a 10-12" pigtail of good, flexible insulated wire onto the ground plane, pigtailed rearward. This will be used as the ground wire in our test circuit. Before you shrink the tubing over the electronic assembly, check for shorts between lands and from lands to ground plane, make sure you have the diode polarity correct, and check that the needle is making solid electrical contact, and is mechanically secure.

Click on the image above to see a larger, annotated image

See the next image, below. After the electronic assembly has been heat-shrunk overall, wrap the copper tape all around the electronic assembly. This will be our shield. Near the rear of the electronic assembly, solder the electonic assembly's ground to the copper tape, near or on the cable shield. Alternative shielding methods can be

tried, for example, you might pull the shield out of a piece of RG-59, and sleeve it over the electronic assembly, soldering it to the ground plane. Whatever you do, be certain that the shield cannot unravel and short against the probe itself or any of the electronics.

Although not shown in the picture, we drill a small hole about 2/3 back on the pen casing, threading the ground pigtail through the hole. This really tests your hand-to-eye coordination. If the pen has a threaded-in rear-cap, drill a hole in it just big enough to accommodate your main shielded cable. Thread the whole cable into the pen casing, and out the other side, and if you had a threaded rear-cap, like I did, thread it on. Pull the electronic assembly gently back into the casing, so that the needle probe sticks out about 1/2 inch. Mix some clear 5-minute epoxy, and let it thicken ever so slightly. Then , while holding the assembly vertically (i.e., probe-tip up), and using a small toothpick or screwdriver, drop epoxy into the probe area, sealing the electronics and probe into place. Allow to dry thoroughly before applying any pressure to the assembly.

When dry, attach your favorite ground-clip to the pigtail, and banana plugs on the end of the shielded cable (red to the center-conductor, black to the shield, to match your Voltmeter)

Click on the image above to see a larger, annotated image

See the next image, below, which shows the completed assembly, annotated. Sometimes, seeing the entire assembly makes everything perfectly clear. Place the pen cap over the needle probe to protect the assembly when not in use.

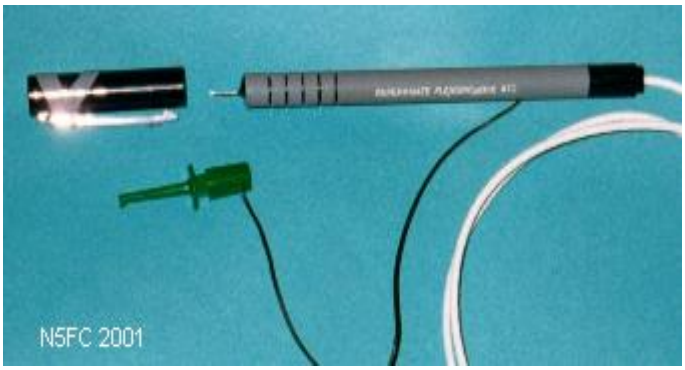

Click on the image above to see a larger, annotated image

And speaking of use, here's our lovely model (OK...XYL) making a measurement in the N0SS Noise Generator. She has the ground clip connected to a convenient place in the circuit's ground, and the probe touches the test point we want to measure. As you can see, we read 0.710 Volts. Since this is broadband noise, the actual voltage reading is not accurate, but it was seen to be much greater than the previous stage, as we expected.

Click on the image above to see a larger, more readable image

Let me know if you build one of these... and send me a picture!

73, monty N5ESE

Return to N5ESE home page

Overseer: Monty Northrup ... ... leave e-mail ...

Visit our regular (non-ham, but very popular) homepage

A Coax Switch

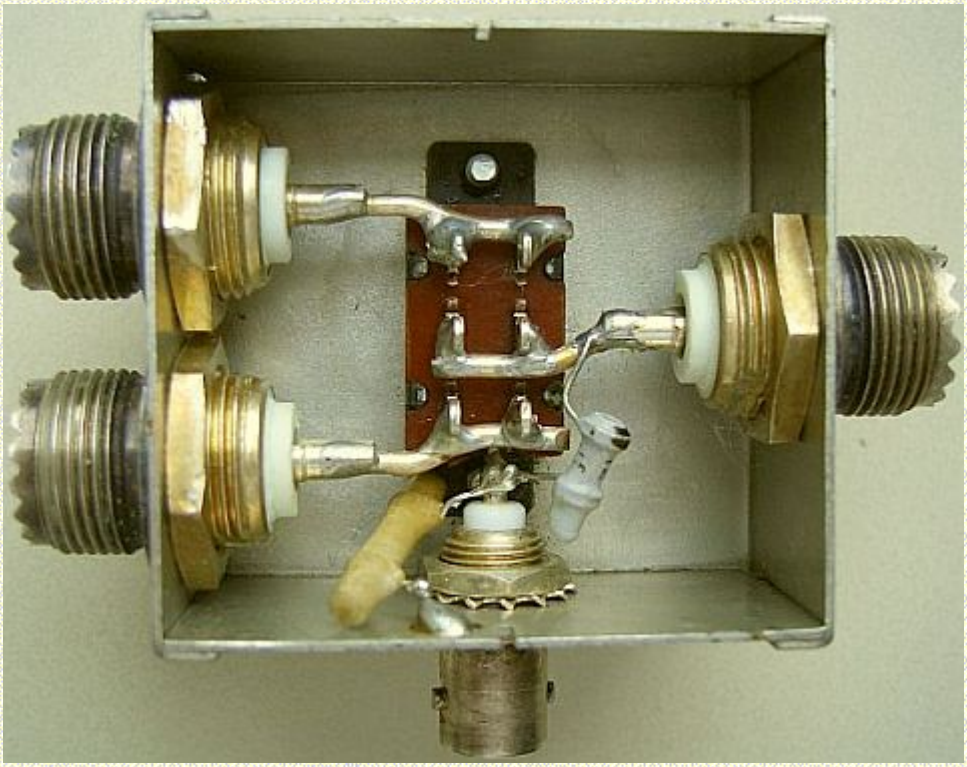

Cheap slide switch in a standard 54 × 50 × 26 mm box.

THE SWITCH

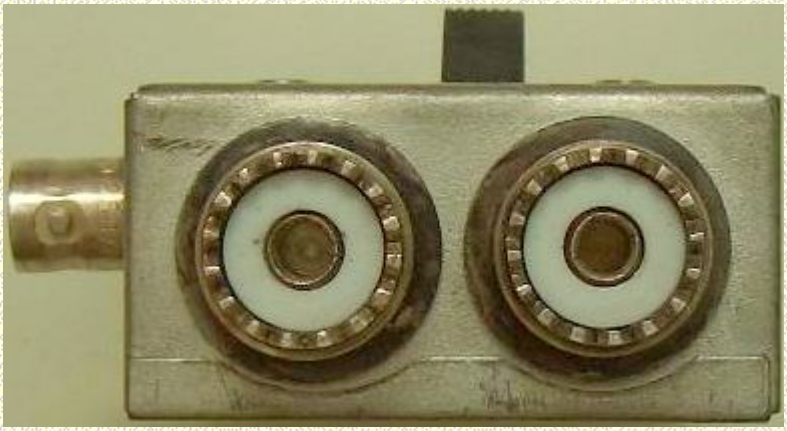

Fig » shows a proven inexpensive home-made antenna selection switch. If you question the use of a cheap slide switch and SO239 coax sockets, read on. Measurements in a physics lab showed there to be practically no reflection on HF and even on 70 cm the SWR was below 1.3 : 1! That is explained as follows:

- The contacts in the slide switch have larger contact surfaces than many a bought coaxial switch.

- The wiring and switch contacts, between the top and bottom of the metal case, act as the centre conductor of a coax of near 50 ?.

It is a standard box measuring 54 × 50 × 26 mm (l × w × h) and the wiring between the switch and the coax sockets is done in 2 mm silver plated wire.

POWER HANDLING CAPABILITY

If the switching is done with power off, the switch can stand 800 W. I have used this switch for more than 15 years and even with 1500 W there have been no problems.

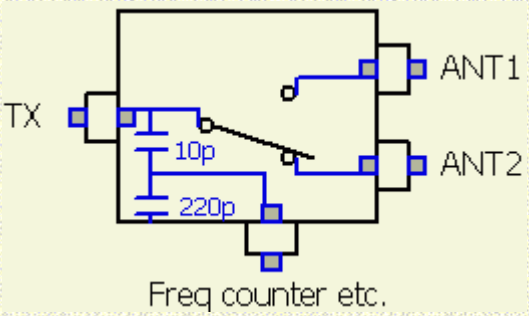

While building this switch, you might as well add a test point, e.g. to connect a 'scope' or frequency counter. The capacitors of 10 and 220 pF make a capacitive voltage divider and the extra loading, 9.6 pF, does not affect performance on HF. In fact, on 10 m it improves the SWR as the extra capacity, in combination with the wiring it makes a filter which favours that frequency.

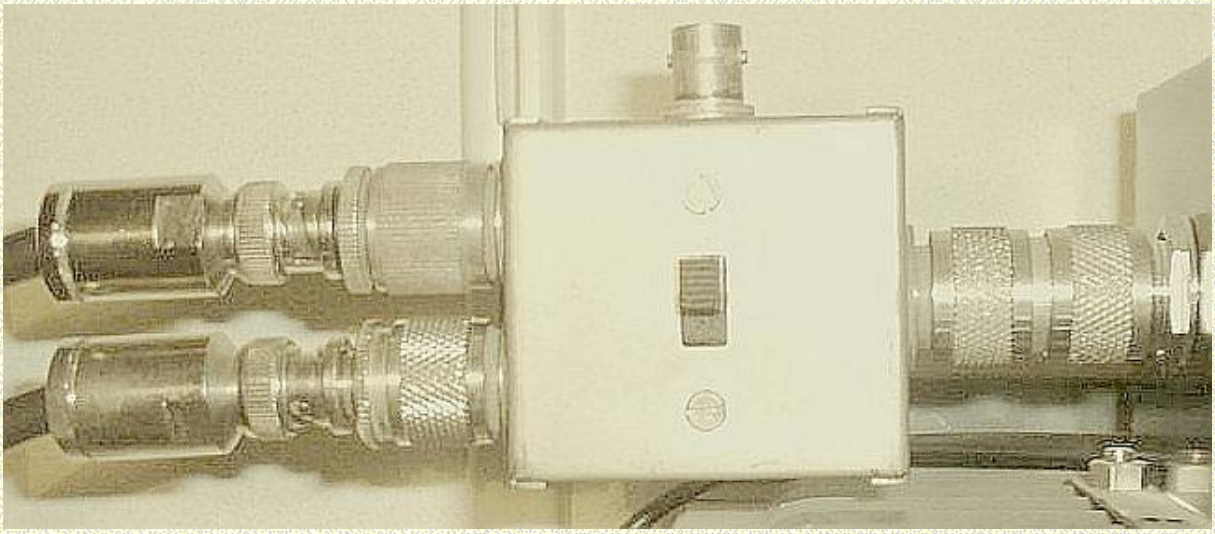

This shows how the switch is used in my station.

«Back
AØFRI

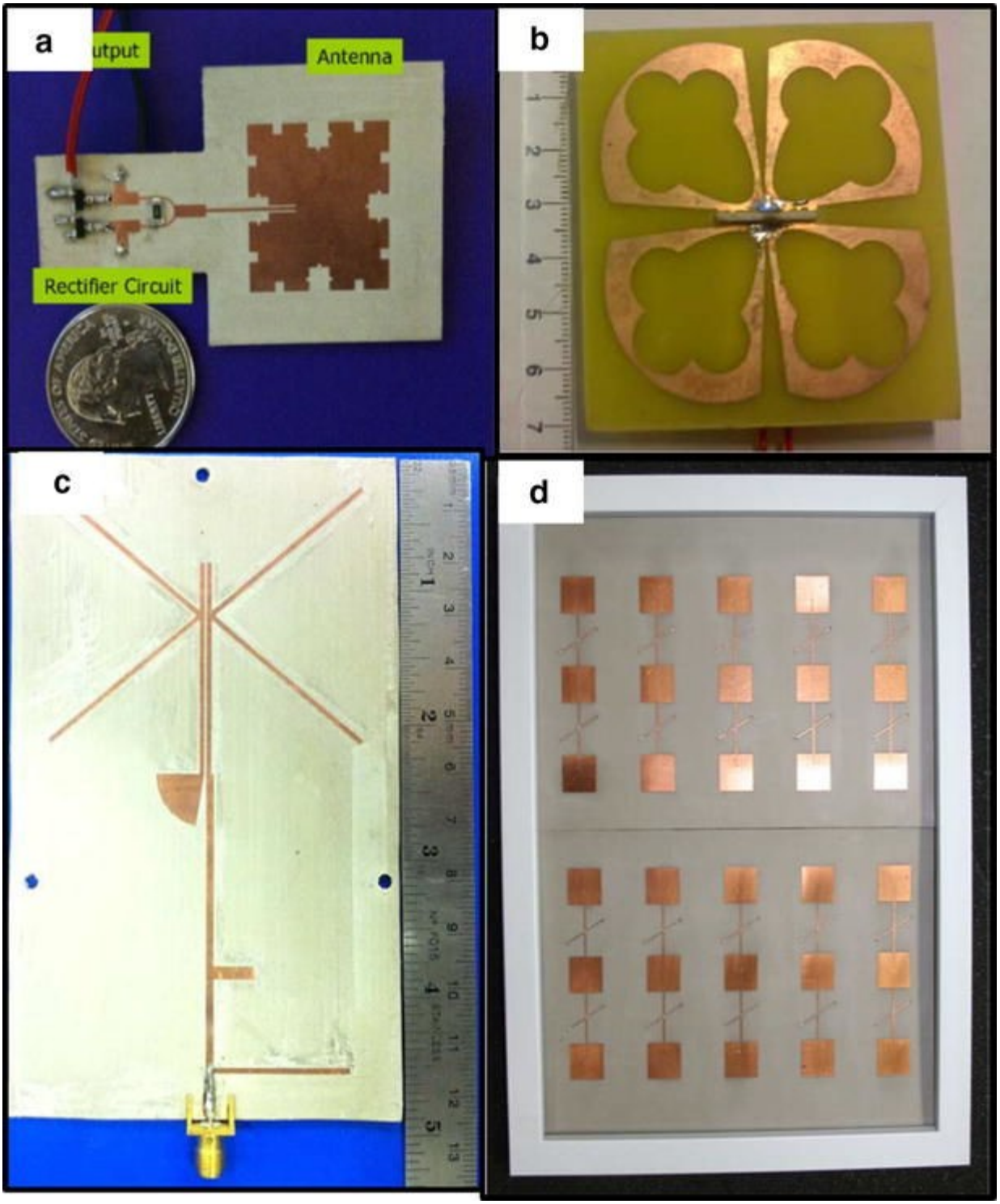
a
utput
Antenna
Rectifier Circuit
b
c
d

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Geometry Aspects and Experimental Results of a Printed Dipole Antenna

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Abstract

Detail experimental measurements of a 2.4 GHz printed dipole antenna for wireless communication systems is presented and discussed. A group of printed dipoles with integrated balun have been designed and constructed on a dielectric substrate. This paper is based on modifications of the known printed dipole architecture. The corresponding printed dipole antennas have differences on their forms that are provided by two essential geometry parameters. The first parameter *l* is related to the bend on microstrip line that feeds the dipole and the second *w* corresponds to the form of the dipole's gap. The impact of these parameters on reflection coefficient and radiation pattern of antenna has been investigated. The corresponding measured results indicate that the return loss and radiation pattern of a printed dipole antenna are independent of the *w* parameter. Instead, variations in the value of the *l* parameter in the dipole's structure affect the form of the corresponding return loss. These observations are very important and provide interesting considerations on affecting design and construction of antenna elements at frequency range of 2.4 GHz.

Keywords: Printed Dipole, Scattering Parameters, Radiation Pattern

1. Introduction

Modern wireless communications offer higher bit rates and efficient quality of services. The majority of the equipment used today introduces requirements for better performance and lower cost. Antennas with quite small sizes, low profiles and versatile features represent interesting solutions that provide modern wireless applications. The printed dipole antenna with integrated balun is widely used as a radiation element on communication systems because of its omni-directional features, narrowband character and simple structure [1–4]. This type of antenna because of its small size can be integrated on the same PCB with other electronics circuits and devices. For the same reason, it can also be used as element on antenna array architecture. The last feature is very interesting and attractive in MIMO modern wireless systems. This printed dipole architecture offers versatile characteristics for design and implementation of antenna arrays on both ends of a MIMO wireless system.

Identify applicable sponsor/s here. *(sponsors)*

In the present paper, we will study and discuss the effect of the variation of the two geometrical parameters (*l*, *w*) of the printed dipole antenna structure. The first corresponds to a discontinuity on microstrip line of printed dipole and the second is related to the discontinuity in the gap. Details of structure concept and design process are presented in Section 2; the experimental results for return loss and radiation pattern for each of the printed dipoles are presented and discussed in Section 3. The paper concludes in Section 4.

2. Design and Structure Aspects

As mentioned above, the proposed analysis is based on geometrical characteristics of a prototype printed dipole antenna with integrated balun. This kind of printed dipole antenna is considered for use in many applications [1–3]. In our study the geometrical parameters of the printed dipole antenna were modified to achieve better performance in the frequency range of 2.4 GHz. This modified design and the corresponding parameters are shown in Figure 1 while the values summarized in Table 1.

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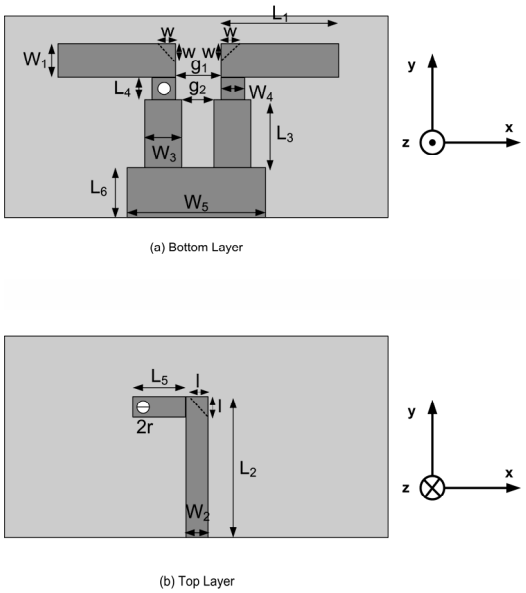

Figure 1. Geometry of printed dipole.

Table 1. Printed dipole dimensions.

Parameter	Values
Dipole strips	L1 = 20.8 mm W1 = 6 mm g1 = 3 mm
Microstrip Balun	L2 = 32 mm L3 = 16 mm L4 = 3 mm L5 = 3 mm W2 = 2 mm W3 = 5 mm W4 = 3 mm g2 = 1 mm
Via radius	r = 0.375 mm
Ground plane	L6 = 12 mm W5 = 17 mm
Side of microstrip bend	l variable (0 mm – 3 mm)
Side of dipole's arms in the gap	w variable (0 mm – 3 mm)

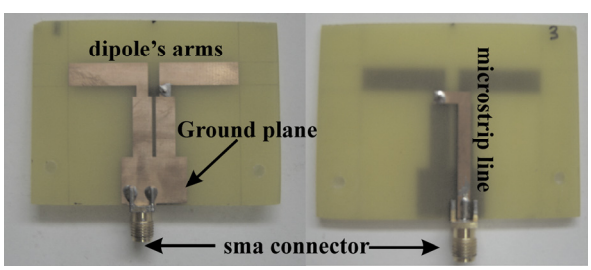

Figure 2. Prototype printed dipole antenna: Top Layer (left) –Bottom Layer (right).

An Fr-4 substrate with thickness of 1.5 mm and permittivity ε_r =4.4 has been used for the fabrication of the dipoles. Figure 2 shows the top and bottom layer for the one of them. It also presents the dipole's arms and gap, the balun, the ground plane and the microstrip line that interface the dipole with the coaxial feed line via sma connector.

From this Figure, we can also see the right angle at the microstrip line and the other two right angles at the dipole's gap. It is known that the presence of right angles in conductors cause discontinuities that leads to degradation in circuit performance [5]. Microwave theory suggests that these angles introduce parasitic reactances which can lead to phase and amplitude errors, input and output mismatch and possibly spurious coupling [5–7]. In order to reduce this effect it is proposed to modify these discontinuities directly, by mitering the conductor. Our investigation and the experimental measurements show the effect of mitering these discontinuities. At first, a prototype printed dipole antenna with unaffected geometrical parameters has been designed and constructed. Secondly, we constructed and measured six different printed dipoles. Three of them had *w = 0 mm* and different *l* values (1 mm, 2 mm, 3 mm) and the other three dipoles had *l = 0 mm* and different values of *w* (1 mm, 2 mm, 3 mm). All these seven dipoles we constructed, the unaffected one and the mitered ones were measured in an anechoic environment. Figures 3 and 4 show a printed dipole for *l = 2 mm* and *w = 0* mm and for *l = 0 mm* and *w = 3 mm*, respectively. The aim of this study is to investigate the return loss coefficient and radiation pattern in each of these seven dipole's forms. The next section discusses the obtained results and presents the significant observations.

3. Results and Discussion

The return loss of the prototype dipole and the six different modified printed dipole antenna we constructed are measured using a Network Analyzer. These results are shown in two Figures. The first (Figure 5) corresponds to *l* parameter's variations keeping the *w* parameter equal to zero. The second (Figure 6) shows the return loss curves where *w* parameter varies but the *l* parameter equals to zero. In both figures we can see the return loss curve that belongs to the prototype printed dipole (*l* and *w equal to 0 mm*).

From these curves, it seems that this dipole antenna design has a resonance point at 2.4 GHz with 500 MHz –

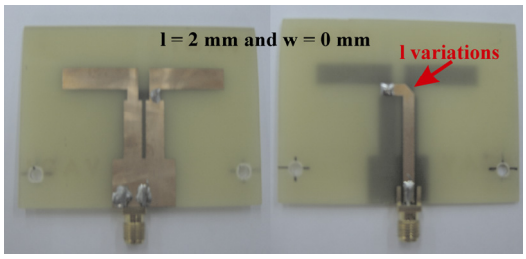

Figure 3. Printed dipole antenna for *l = 2 mm* and *w = 0 mm* Top Layer (left) – Bottom Layer (right).

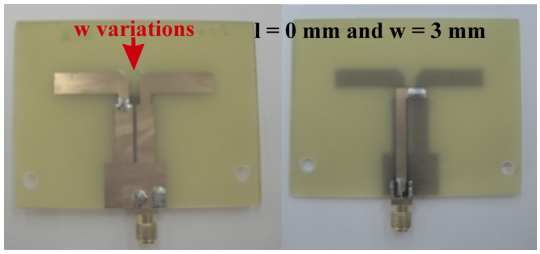

Figure 4. Printed dipole antenna for *l = 0 mm* and *w = 3 mm* Top Layer (left) – Bottom Layer (right).

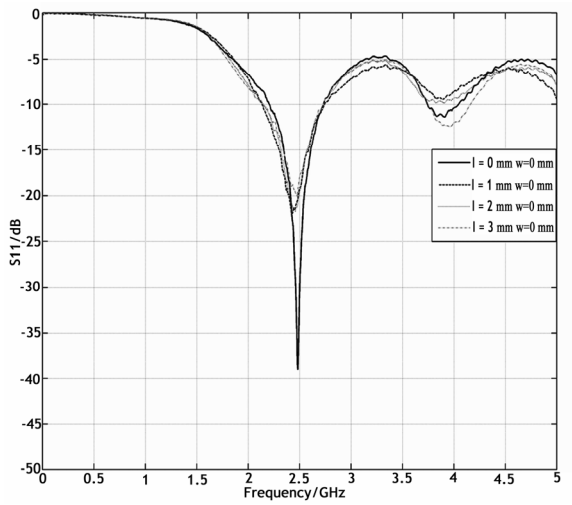

Figure 5. Measured return loss of printed dipole for each value of *l* parameter and *w = 0* mm.

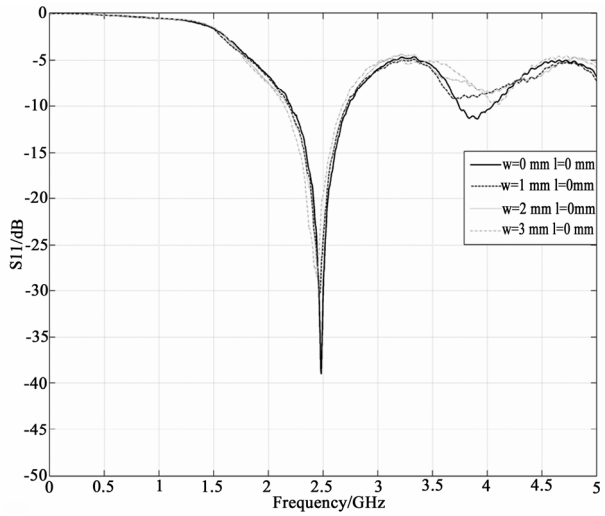

Figure 6. Measured return loss of printed dipole for each value of *w* parameter and *l = 0 mm*.

10 dB bandwidth. The last frequency range has center frequency close to 2.4 GHz which is the frequency value that the return loss is minimized. For these frequencies the corresponding values of return loss are smaller or equal to -10 dB. From Figure 5, it is obvious that as the value of *l* parameter increases, the form of the corresponding return loss curve changes and becomes more flat at the resonance frequency range. On the other hand, the value of *w* parameter does not affect the form of the return loss curve. Each of these seven forms of printed dipole antenna has quite similar return loss curves and introduces narrowband operation at the frequency range of 2.4 GHz. Moreover, for a wireless application that requires design and construction of many identical printed dipoles, it is recommended to choose *l* parameter equals to *2 mm* and *w* parameter equals to *0 mm* for better performance. As it can be seen from Figure 5 the above investigation ensures that the printed dipole antennas will have quite identical return loss curves and performance as elements in an antenna array configuration.

For deeper analysis on this topic, experimental measurements on radiation pattern of these antennas have also been made. Measurements were carried out in a RF anechoic chamber using a calibrated measuring system. In particular, Figure 7 shows the measurements of radiation pattern in E- plane and in H – plane for each dipole

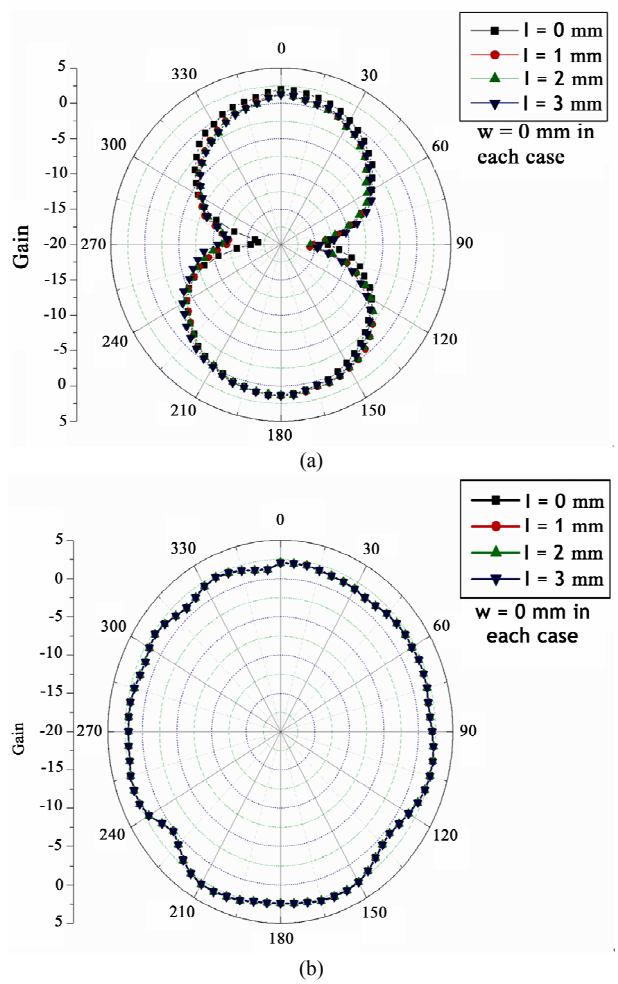

Figure 7. Radiation pattern of dipole for each value of *l* parameter (a) E – plane, (b) H -plane.

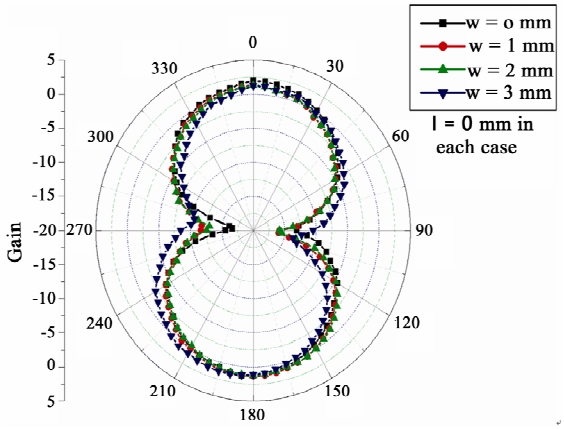

(a)

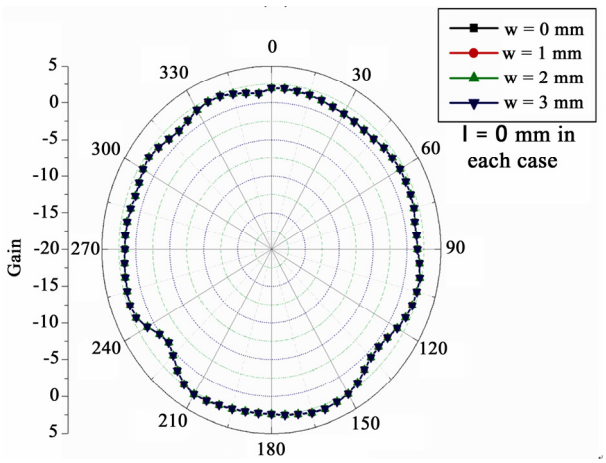

(b)

Figure 8. Radiation pattern of dipole for each value of *w* parameter (a) E – plane, (b) H – plane.

with *w* parameter equals to 0 mm and *l* parameter equals to integer values that ranging from *0 mm* to *3 mm*,. Figure 8 shows the corresponding results for each dipole with *l* parameter equals to *0 mm* and *w* parameter's integer values ranging from *0 mm* to *3 mm*. All these dipole structures introduce radiation characteristics that correspond to a fundamental dipole antenna [6,7]. Each of them has a measured peak gain that equals to quite 2 dBi and introduces omni-directional features. Quite small variations on these curves are on the limits of measurements' accuracy. For this reason, it can be observed that the radiation characteristics of the printed dipole antenna are not affected by the variations on *l* and *w* geometrical parameters. Therefore, the radiation diagrams of them are independent of the *l* and *w* parameters.

4. Conclusions

A number of printed dipole antennas with integrated balun are constructed and studied in terms of return loss and radiation pattern. Each of them has a defined form and geometry. Starting from a dipole antenna we mitered the angles introducing the parameters *l* and *w* that we varied. Experimental measurements on return loss provide the obtained results. These are quite similar and also introduce a resonance point at frequency range of 2.4 GHz with narrow resonance bandwidth. The form of this resonance range is affected only by the *l* parameter. The radiation pattern of these dipoles is also investigated. The corresponding radiation diagrams are independent of these geometrical parameters (*l*, *w*) and are similar to that of the fundamental dipole. These observations on printed dipole architecture are very crucial for wireless communication engineering and antenna design. This is because they introduce the ability of constructing a group of identical dipoles choosing an appropriate value of *l* parameter (*l =2 mm*) with quite identical resonance and radiation characteristics.

5. Acknowledgment

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Optimization of the Voltage Doubler Stages in an RF-DC Convertor Module for Energy Harvesting

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ABSTRACT

This paper presents an optimization of the voltage doubler stages in an energy conversion module for Radio Frequency (RF) energy harvesting system at 900 MHz band. The function of the energy conversion module is to convert the (RF) signals into direct-current (DC) voltage at the given frequency band to power the low power devices/circuits. The design is based on the Villard voltage doubler circuit. A 7 stage Schottky diode voltage doubler circuit is designed, modeled, simulated, fabricated and tested in this work. Multisim was used for the modeling and simulation work. Simulation and measurement were carried out for various input power levels at the specified frequency band. For an equivalent incident signal of –40 dBm, the circuit can produce 3 mV across a 100 kΩ load. The results also show that there is a multiplication factor of 22 at 0 dBm and produces DC output voltage of 5.0 V in measurement. This voltage can be used to power low power sensors in sensor networks ultimately in place of batteries.

Keywords: Energy Conversion; RF; Schottky Diode; Villard; Energy Harvesting

1. Introduction

RF energy harvesting is one type of energy harvesting that can be potentially harvested such as solar, vibration and wind. The RF energy harvesting uses the idea of capturing transmitted RF energy at ambient and either using it directly to power a low power circuit or storing it for later use. The concept needs an efficient antenna along with a circuit capable of converting RF signals to DC voltage. The efficiency of an antenna mainly depends on its impedance and the impedance of the energy converting circuit. If the two impedances aren't matched then it will be unable to receive all the available power from the free space at the desired frequency band. Matching of the impedances means that the impedance of the antenna is the complex conjugate of the impedance of the circuit (voltage doubler circuit).

The concept of energy harvesting system is shown in **Figure 1**, which consists of matching network, RF-DC conversion and load circuits. The authors in [1], used a 2.4 GHz operating frequency with an integrated zero bias detector circuit using BiCMOS technology which produced an output voltage of 1 V into a 1 MΩ load at an input power level of 0 dBm. H. Yan and co-authors revealed that a DC voltage of 0.8 volts can be achieved from a –20 dBm RF input signal at 868.3 MHz through simulation results [2]. In [3], work was carried out on a firm frequency of 900 MHz by matching to a 50 Ω impedance and resonance circuit transformation in front of the Schottky diode which yields an output voltage of over 300 mV at an input power level of 2.5 µ. W. J. Wang, L. Dong and Y. Fu [4] used a Cockcroft-Walton multiplier circuit that produced a voltage level of 1.0 V into a 200 MΩ load for an input power level of less than –30 dBm at a fixed frequency of 2.4 GHz.

The energy conversion module designed in this paper is based on a voltage doubler circuit which can be able to output a DC voltage typically larger than a simple diode rectifier circuit as in [5], in which switched capacitor charge pump circuits are used to design two phase voltage doubler and a multiphase voltage doubler. The module presented in this can function as an AC to DC converter that not only rectifies the input AC signal but also elevates the DC voltage level. The output voltage of the

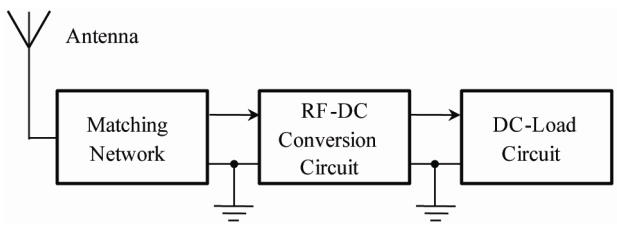

Figure 1. Schematic view of a RF energy harvesting system.

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energy conversion module can be used to energize the low power devices for example sensors for a sensor network in application to agriculture.

Section 2 of this paper discusses on the theoretical background of the voltage doubler circuit. Section 3 presents the simulation study and implementation of the circuit design. Section 4 provides the results and analysis. Section 5 concludes with a discussion on the findings from the simulated and measured results.

2. Voltage Multiplier

There are various voltage multiplier circuit topologies. The design used in this module is derived from the function of peak detector or a half wave peak rectifier. The Villard voltage multiplier circuit was chosen in the circuit design of this paper because it produces two times of the input signal voltage towards ground at a single output and can be cascaded to form a voltage multiplier with an arbitrary output voltage and its design simplicity.

2.1. Diode Modeling

The voltage multiplier circuit in this design uses zero bias Schottky diode HSMS-2850 from Agilent. The attractive feature of these Schottky diodes are low substrate losses and very fast switching but leads to a fabrication overhead. This diode has been modeled for the energy harvesting circuit which comes in a one-diode configuration. The modeling parameters for these diodes are given by Agilent in their data sheets. These parameters are used in Multisim for its own modeling purposes. The modeling is done by transforming the diode into an equivalent circuit using passive components which are described by the SPICE parameters in **Table 1** [6].

The diode used in this design is shown in **Figure 2** and its equivalent model is shown in **Figure 3**. The special features of HSMS-2850 diode is that it provides a low forward voltage, low substrate leakage and uses the non symmetric properties of a diode that allows unidirectional flow of current under ideal condition.

Table 1. SPICE parameters.

Parameters	Units	HSMS 2850
B_V	V	3.8
C_{J0}	pF	0.18
E_G	Ev	0.69
I_{BV}	A	3E–4
I_S	A	3E–6
N	No unite	1.06
R_S	Ω	25
P_B (V_J)	V	0.35
P_T (XTI)	No units	2
M	No units	0.5

Figure 2. Schottky diode.

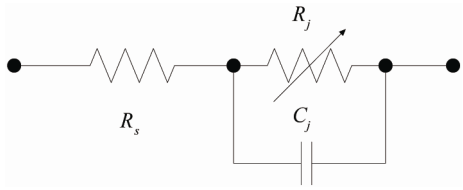

Figure 3. Linear circuit model of the Schottky diode [6].

The diodes are fixed and are not subject of optimization or tuning. This is described using the following derivations. By neglecting the effect of diode substrate, an equivalent linear model that can be used for the diode as shown in **Figure 3**. When C_j is the junction capacitance and R_j is the junction resistance, the admittance Y_z of the linear model is given by

$$Y_Z = Y_{C_j} + Y_{R_j} \tag{1}$$

Equation (1) related to the frequency of operation is given by

$$Y_Z = jwC_j + \frac{1}{R_j} \tag{2}$$

$$= \frac{jwC_jR_j + 1}{R_j} \tag{3}$$

The impedance Z of the linear model is given by

$$Z = \frac{R_j}{1 + jwR_jC_j} \tag{4}$$

The total impedance Z_T is given by

$$Z_T = R_S + \frac{R_j}{1 + jwR_jC_j} \tag{5}$$

where R_S is the series resistance of the circuit and R_j is given by

$$R_j = \frac{8.33 \times 10^{-5} \times N \times T}{I_b + I_S}$$

where:

I_b = bias current in μA;

I_s = saturation current in μA;

T = temperature (K);

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N = ideality factor.

In Equation (5), R_j and C_j are constants and the frequency of operation (w) is the only variable parameter. As the frequency increases, the value of Z is almost negligible compared to the series resistance R_S of the diode. From this it is concluded that the function of the diode is independent of the frequency of operation.

2.2. Single Stage Voltage Multiplier

Figure 4 represents a single stage voltage multiplier circuit. The circuit is also called as a voltage doubler because in theory, the voltage that is arrived on the output is approximately twice that at the input. The circuit consists of two sections; each comprises a diode and a capacitor for rectification. The RF input signal is rectified in the positive half of the input cycle, followed by the negative half of the input cycle. But, the voltage stored on the input capacitor during one half cycle is transferred to the output capacitor during the next half cycle of the input signal. Thus, the voltage on output capacitor is roughly two times the peak voltage of the RF source minus the turn-on voltage of the diode.

The most interesting feature of this circuit is that when these stages are connected in series. This method behaves akin to the principle of stacking batteries in series to get more voltage at the output. The output of the first stage is not exactly pure DC voltage and it is basically an AC signal with a DC offset voltage. This is equivalent to a DC signal superimposed by ripple content. Due to this distinctive feature, succeeding stages in the circuit can get more voltage than the preceding stages. If a second stage is added on top of the first multiplier circuit, the only waveform that the second stage receives is the noise of the first stage. This noise is then doubled and added to the DC voltage of the first stage. Therefore, the more stages that are added, theoretically, more voltage will come from the system regardless of the input. Each independent stage with its dedicated voltage doubler circuit can be seen as a single battery with open circuit output voltage V_0, internal resistance R_0 with load resistance R_L, the output voltage, V_{out} is expressed as in Equation (7).

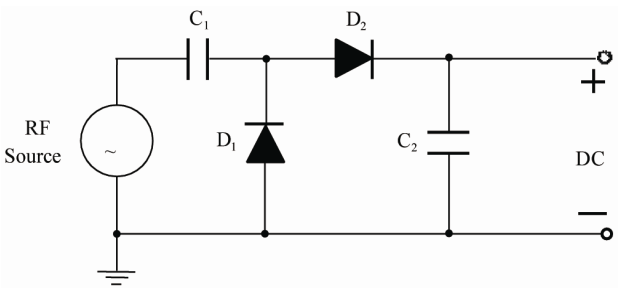

Figure 4. Single stage voltage multiplier circuit [7].

$$V_{out} = \frac{V_0}{R_0 + R_L} R_L \tag{6}$$

When n number of these circuits are put in series and connected to a load of R_L in Equation (6) the output voltage V_{out} obtained is given by this change in RC value will make the time constant longer which in turn retains the multiplication effect of two in this design of seven stage voltage doubler.

$$V_{out} = \frac{nV_0}{nR_0 + R_L} = V_0 \frac{1}{\frac{R_0}{R_L} + \frac{1}{n}} \tag{7}$$

The number of stages in the system has the greatest effect on the DC output voltage, as shown from Equations (6) and (7).

It is inferred that the output voltage V_{out} is determined by the addition of R_0/R_L and $1/n$, if V_0 is fixed. From this analysis it is observed that V_0, R_0 and R_L are all constants. Assume that V_0 = 1 V, R_0/R_L = 0.25, n = 2, 3, 4, 5, 6 and 7, the output voltage V_{out} = 1.33 V, 1.72 V, 2.0 V, 2.22 V, 2.43 V and 2.56 V respectively when substituted analytically in the Equation (7). This analysis can be compared with the results obtained in the circuit design of this module. In simulation at n = 4, V_{out} = 1.42 V, n = 5, V_{out} = 1.67 V; n = 6, V_{out} = 1.92; n = 7, V_{out} = 2.15 V; n = 8, V_{out} = 1.92 V; n = 9, V_{out} = 1.81 V. Also in measurement, for n = 4, V_{out} = 2.1 V; n = 5, V_{out} =2.9 V; n = 6, V_{out} = 3.72 V; and n = 7, V_{out} = 5 V. As n increases, the increase in output voltage will be almost double the input voltage up to some number of stages. But at some point, *i.e.* beyond seven stages, in this circuit the output voltage gained (8 and 9 stages) will be negligible as shown in **Figure 5**.

The capacitors are charged to the peak value of the input RF signal and discharge to the series resistance (R_s) of the diode. Thus the output voltage across the capacitor of the first stage is approximately twice that of the input signal. As the signal swings from one stage to other, there is an additive resistance in the discharge path of the

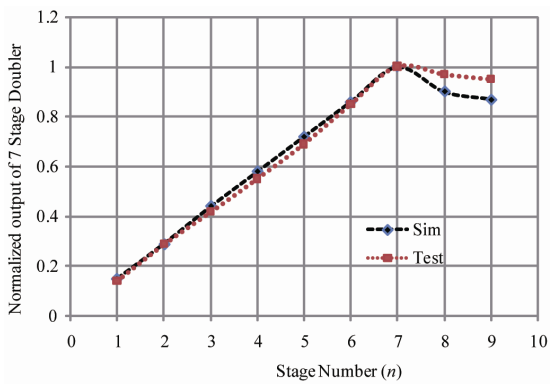

Figure 5. Normalized output voltage multiplier versus number of stages.

diode and increase of capacitance due to the stage capacitors.

2.3. Seven Stage Voltage Multiplier

The seven stage voltage multiplier circuit design implemented in this paper is shown in **Figure 6**. Starting on the left side, there is a RF signal source for the circuit followed by the first stage of the voltage multiplier circuit. Each stage is stacked onto the previous stage as shown in the **Figure 6**. Stacking was done from left to right for simplicity instead of conventional stacking from bottom to top.

The circuit uses eight zero bias Schottky surface-mount Agilent HSMS-285X series, HSMS-2850 diodes. The special features of these diode is that, it provides a low forward voltage, low substrate leakage and uses the non-symmetric properties of a diode that allows unidirectional flow of current under ideal conditions. The diodes are fixed and are not subject of optimization or tuning. This type of multiplier produces a DC voltage which depends on the incident RF voltage. Input to the circuit is a predefined RF source. The voltage conversion can be effective only if the input voltage is higher than the Schottky forward voltage.

The other components associated with the circuit are the stage capacitors. The chosen capacitors for this circuit are of through-hole type, which make it easier to modify for optimization, where in [8] the optimization was accomplished at the input impedance of the CMOS chip for a three stage voltage multiplier. The circuit design in this paper uses a capacitor across the load to store and provide DC leveling of the output voltage and its value only affects the speed of the transient response. Without a capacitor across the load, the output is not a good DC signal, but more of an offset AC signal.

In addition to the above, an equivalent load resistor is connected at the final node. The output voltage across the load decreases during the negative half cycle of the AC input signal. The voltage decreases is inversely proportional to the product of resistance and capacitance across the load. Without the load resistor on the circuit, the voltage would be hold indefinitely on the capacitor and look like a DC signal, assuming ideal components. In the design, the individual components of the stages need not to be rated to withstand the entire output voltage. Each component only needs to be concerned with the relative voltage differences directly across its own terminals and of the components immediately adjacent to it. In this type of circuitry, the circuit does not change the output voltage but increases the possible output current by a factor of two. The number of stages in the system is directly proportional to the amount of voltage obtained and has the greatest effect on the output voltage as explained in the Equation (7) and shown in **Figure 5**.

3. Simulation and Implementation

Multisim software was chosen for modeling and simulation which is a circuit simulation tool by Texas Instruments. The simulation and practical implementation were carried out with fixed RF at 945 MHz ± 100 MHz, which are close to the down link center radio frequency (947.5 MHz) of the GSM-900 transmitter. The voltages obtained at the final node V_{DC} of the multiplier circuit were recorded for various input power levels from –40 dBm - +5 dBm with power level interval (spacing) of 5 dBm.

The simulations were also carried out using same stage capacitance value (3.3 nF) and then with a varied capacitance value for all stages from 4 stages through 9 stages [9]. The capacitance value was varied in such a way that, from one stage to the next, it was halved. For example, if the first stage was 3.3 nF, the second stage was 1.65 nF, third stage was 825 pF, fourth stage was 415 pF and so on. But keeping in view of testing, the capacitance values were chosen to have a close match with the standard available values in the market.

Simulation was carried out through 4 to 9 voltage doubler stages. Based on results obtained a 7 stage doubler is best to implemented for this application.

The design of the printed circuit board (PCB) was carried out using DipTrace software. The material used to

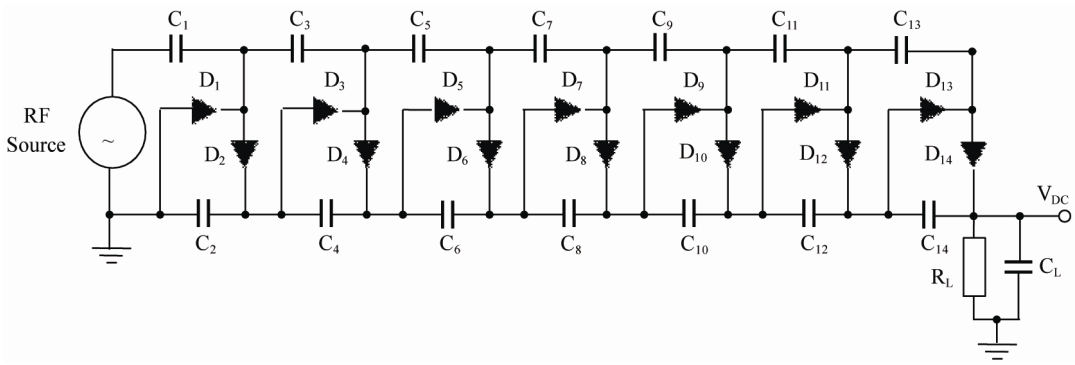

Figure 6. Schematic of 7 stage voltage multiplier.

manufacture the printed circuit board (PCB) is the standard Fiberglass Reinforced Epoxy (FR4), with the thickness of 1.6 mm and dielectric constant of 3.9. The topology is constructed on the PCB with the dimensions of 98 mm × 34 mm (W × H). The Sub Miniature version A (SMA) connectors are used at the input and output of PCB to carry out the measurements. The circuit components consist of active and passive components. The component used in circuit is shown in **Table 2**.

Special handling precautions have been taken to avoid Electro Static Discharge (ESD), while assembling of the surface-mount zero bias Schottky diodes. Also special attention has been given to mount other components and the SMA connectors on to the PCB. The Photograph of Assembled circuit board I shown in **Figure 7**.

4. Results and Analysis

The simulated and measured results at the output voltage of voltage multiplier circuit are shown graphically in **Figure 8**. From the graph analysis, the simulated and the measured results agree considerably with each other. The measured results are shown to be better than the simulation results. The reason behind this may be due to the uncertainty in series resistance value of the diode obtained from SPICE parameters in modeling as explained in Equation (5). This resistance vale of diodes in practical circuit may be lower than in the model, which provides fast discharge path, in turn rise in voltage as passes through the stages and reaches to final output. In this work, the DC output voltages obtained through simulation and measurement at 0 dBm re 2.12 V and 5.0 V respectively. These results are comparatively much better than in ref. [9], where in at 0 dBm, 900 MHz they achieved 0.5 V and 0.8 V through simulation and measurement respectively.

Figures 9 and **10** show the result of a 4 stage voltage doubler circuit with equal and varied capacitance values between the stages as described in Section 3.

From the analysis of these two simulations, it can be observed that the resulting output voltages are equal. The only difference between these two graphs is the rise time of the circuit with varied capacitance value is a little bit slower. But, overall result on the performance of rise time is still under 20 µs to 24 µs and the difference is negligible. From these results, the use of equal stage capacitance of each being 3.3 nF was hence considered for the design of the multiplier.

The results from **Figure 11**, shows that the output voltage reaches to 1.0 V within 20 µS and then uniformly increasing to 1.4 V, 1.67 V, 1.87 V and 2.12 V for 4, 5, 6 and 7 stages respectively compared to 2 mS as shown in [10]. **Figure 12** shows that the conversion ratio of 22 is achieved at 0 dBm input power and drops to 2.5 at –40 dBm. The highest value at 0 dBm is due to the innate characteristics of the zero bias Schottky diodes which conduct fairly well at higher input voltages.

5. Conclusion

From the experimental results, it is found that the pro-

Table 2. Component used in 7 stage voltage multiplier.

Name of component	Label	Value
Stage capacitors	C_1 - C_{14}	3.3 nF
Stage diodes	D_1 - D_{14}	HSMS 2850
Filter capacitor	C_L	100 nF
Load resister	R_L	100 kΩ

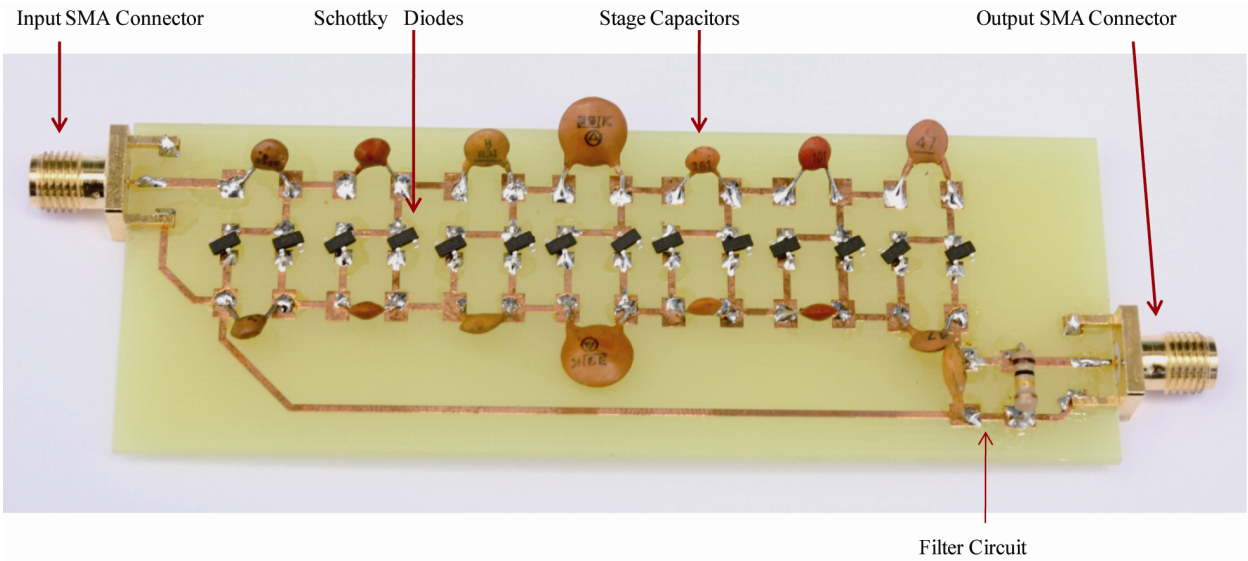

Figure 7. Photograph of assembled circuit board.

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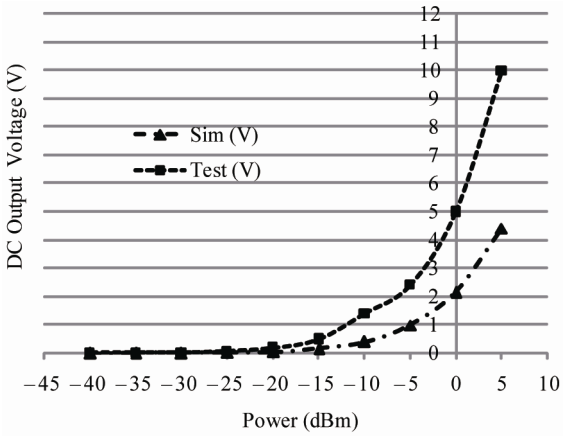

Figure 8. Simulated and test DC output voltage of multiplier as a function of input power.

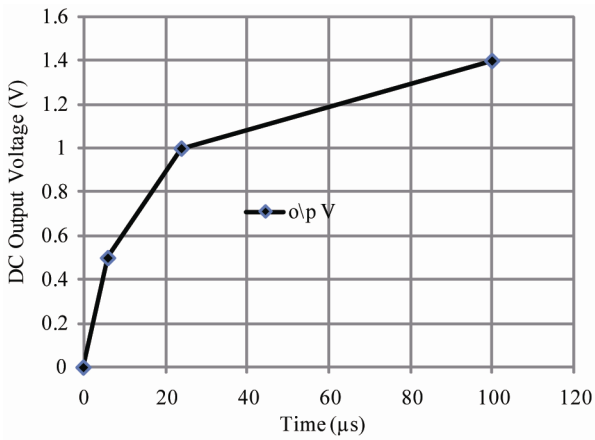

Figure 9. DC output voltage verses rise time of 4 stage voltage doubler circuit with equal stage capacitance [8].

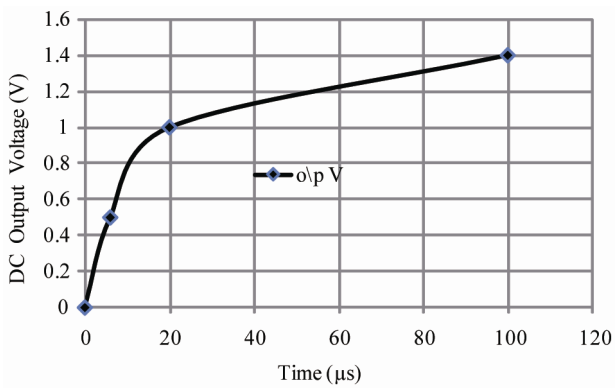

Figure 10. DC output voltage verses rise time of 4 stage voltage doubler with varied stage capacitance [8].

posed voltage multiplier circuit operates at the frequency of 945 MHz with the specified input power levels. The results have shown that there is multiplication of the input voltage. From **Figure 12**, it is shown that at 0 dBm input power, the multiplication factor is 22. This is significant, as the work shows that RF energy in the GSM-900 band can be harvested from the ambient RF source using the Villard circuit topology. The power density levels from a GSM base station is expected from 0.1 mW/m^2 to 1 mW/m^2 for a distance ranging from 25 m - 100 m. These power levels may be elevated by a factor between one and three for the GSM-900 downlink frequency bands depending on the traffic density [10]. The next phase of the research work is to interface the voltage multiplier circuit through a matching network to the antenna at the input side and a low power device to power from the system at the output side to complete the RF energy harvesting system.

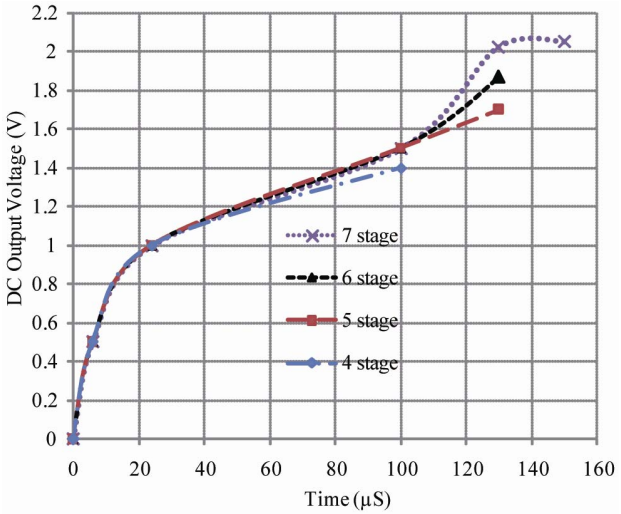

Figure 11. DC output voltage verses rise time of voltage doubler circuit through 4 - 7 stages with equal stage capacitance.

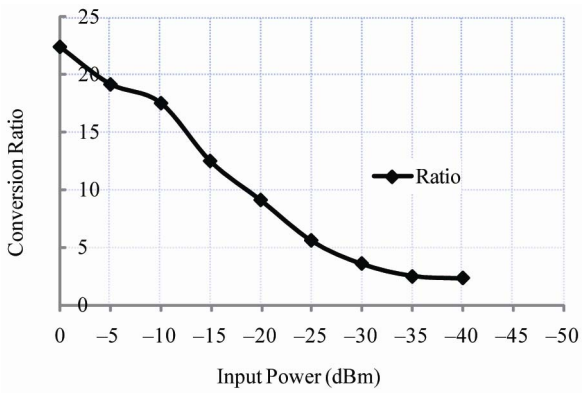

Figure 12. Conversion ratio as a function of input power.

6. Acknowledgements

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Double-Sided Microstrip Circular Antenna Array for WLAN/WiMAX Applications

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ABSTRACT

The design, fabrication, and characterization of the microstrip circular antenna arrays were presented. The proposed antennas were designed for single band at 2.45 GHz and dual bands at 3.3 - 3.6 and 5.0 - 6.0 GHz to support WLAN/WiMAX applications. The proposed single and dual band antennas showed omnidirectional radiation pattern with the gain values of 3.5 dBi at 2.45 GHz, 4.0 dBi at 3.45 GHz, and 3.3 dBi at 5.5 GHz. The dual band antenna array was placed on both top and bottom layers to obtain the desired antenna characteristics. The proposed double-sided dual band antenna provides omnidirectional radiation pattern with high gain.

Keywords: Antenna Arrays; Circular Patch; Dual Band; Single Band; Omnidirectional; WLAN/WiMAX Applications; UWB

1. Introduction

Ultra-wideband (UWB: 3.1 to 10.6 GHz) frequency spectrum has been approved by the US Federal Communications Commission (FCC) for unlicensed short range wireless communications since 2002. In this frequency range, wireless local-area network (WLAN) IEEE802.11a and HIPERLAN/2 WLAN operates in 5.0 - 6.0 GHz band. In some European and Asian countries, world interoperability for microwave access (WiMAX) service is provided in the frequency range of 3.3 - 3.6 GHz [1-4]. To support the WLAN/WiMAX application, antenna arrays that provide omnidirectional radiation pattern are required. To respond to this need, recent antenna design efforts were focused on omnidirectional antennas with high gain and no sidelobes [5-8]. Rectangular arrays are common type used for antenna arrays. Studies on dual band antennas employing rectangular arrays were reported [9-12]. Compared to rectangular patch antenna arrays, there are limited numbers of studies performed on circular patch antenna arrays due to difficulties in fabrication [13]. Advantages of circular antenna array include high gain and narrow beam width [13].

In this paper, a new microstrip circular antenna arrays were designed, fabricated, and characterized to provide omnidirectional radiation pattern for WLAN/WiMAX applications. Two antenna arrays were designed—one for single band at 2.45 GHz and the other for dual bands at 3.3 - 3.6 GHz and 5.0 - 6.0 GHz. For single band operation, circular patch array was placed on the top layer of the microtrip and a small rectangular patch was placed on the bottom layer for ground connection. For dual band operation, similar circular patch array was placed on both top and bottom layers of the microstrip with larger rectangular patch placed on the bottom layer. Both single band (single sided) and dual band (double-sided) microstrip antenna arrays provided desirable antenna characteristics for the intended application.

2. Design and Simulation

2.1. Single-Band Antenna at 2.45 GHz

The configuration of the proposed single band antenna at 2.45 GHz is shown in **Figure 1**. It consists of six circular patches which are placed only on the top layer. The small rectangular patch is placed on the bottom layer for ground connection.

The directivity for the circular patch antenna is

$$D_0 = \frac{(k_0 a_e)^2}{120 G_{\text{rad}}} \tag{1}$$

*Corresponding author.

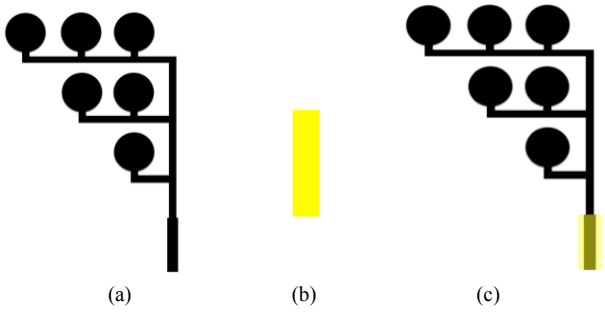

Figure 1. Configuration of the proposed antenna for single band at 2.45 GHz: (a) Top layer; (b) Bottom layer; (c) Top and bottom layers overlaid.

$$k_0 = \frac{2\pi}{\lambda_0} \tag{2}$$

$$a_e = a\left\{1 + \frac{2h}{\pi a \epsilon_r}\left[\ln\left(\frac{\pi a}{2h}\right) + 1.7726\right]\right\}^{1/2} \tag{3}$$

$$G_{\text{rad}} = \frac{(k_0 a_e)^2}{480}\int_0^{\pi/2}\left[J_{02}'^2 + \cos^2\theta J_{02}^2\right]\sin\theta \mathrm{d}\theta \tag{4}$$

$$J_{02}' = J_0(k_0 a_e \sin\theta) - J_2(k_0 a_e \sin\theta) \tag{5}$$

$$J_{02} = J_0(k_0 a_e \sin\theta) + J_2(k_0 a_e \sin\theta) \tag{6}$$

where a_e is the effective radius, a is the actual radius, ϵ_r is the relative permittivity of the microstrip dielectric substrate, h is the height of the microstrip substrate, and J_0 and J_2 are Bessel functions.

The gain of the antenna was calculated using

$$\text{Gain} = \text{Antenna Efficiency} \times \text{Directivity}(D_0) \tag{7}$$

$$\text{Antenna Efficiency} = \frac{\text{Total Efficiency}}{\text{Reflection Efficiency}} \tag{8}$$

The variable corresponding to each dimensions and values for the dimensions of the proposed antenna are shown in **Figure 2** and **Table 1**, respectively. Here, *L*, *W*, and *R* represent the length, the width, and the radius of the circular patch, respectively.

The gain of the proposed antenna shown in **Figure 1** was calculated using (1) - (8) and the dimensions were optimized using ADS [14] which resulted in gain of 3.5 dBi at 2.45 GHz.

2.2. Dual-Band Antenna at 3.3 - 3.6 and 5.0 - 6.0 GHz

The configuration for the doubled-sided microstrip dual band antenna is shown in **Figure 3**. The proposed microstrip antenna has circular arrays both on the top and bottom layers. It consists of three circular patched on each layer.

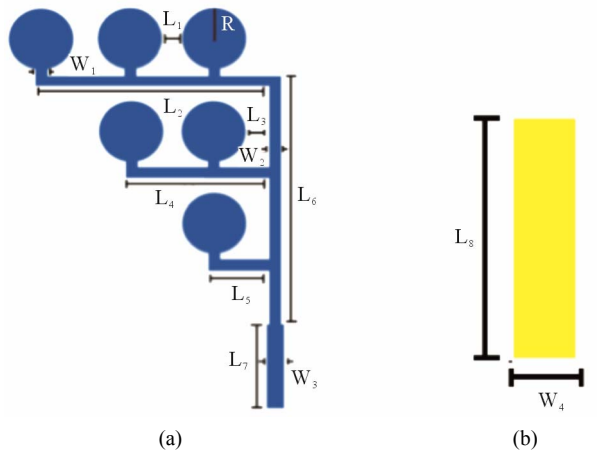

Figure 2. Variables corresponding to each dimension of the proposed single band antenna: (a) Top layer; (b) Bottom layer.

Table 1. Dimensions for the proposed single band antenna at 2.4 GHz.

Variable	Value (mm)
L_1	1.15
L_2	28.9
L_3	1.13
L_4	17.6
L_5	6.60
L_6	35.3
L_7	18.4
L_8	18.4
W_1	1.02
W_2	1.52
W_3	3.30
W_4	6.86
R	5.10

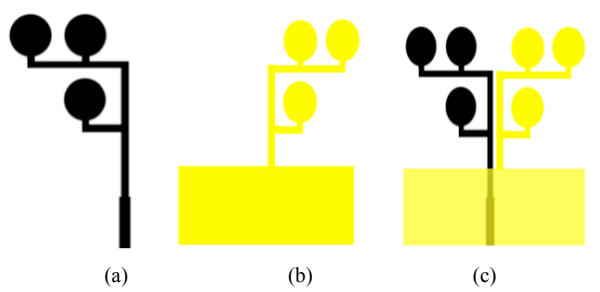

Figure 3. Configuration of the proposed antenna for dual band at 3.3 - 3.6 and 5.0 - 6.0 GHz: (a) Top layer; (b) Bottom layer; (c) Top and bottom layers overlaid.

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The configuration in **Figure 3(a)** is similar to the top layer of the single band antenna as shown in **Figure 1(a)** but with less circular patches. However, the bottom layer in **Figure 3(b)** is different compared to the bottom layer of the single band antenna shown in **Figure 1(b)**. The double-side nature of the antenna provides dual band characteristics. Identical equations were used for the single band antenna were employed in the design process. The variable corresponding to each dimensions and the dimensions for the proposed dual band antenna are shown in **Figure 4** and **Table 2**, respectively.

Simulation was performed using ADS for the configuration shown in **Figure 3(c)**. The simulated gains of the proposed dual band antenna were 4.0 dBi at 3.45 GHz and 3.3 dBi at 5.5 GHz. The double-sided configuration of the antenna provided higher gain compared to the singled-sided antenna.

3. Measurement Results and Discussions

3.1. Single-Band Atnenna at 2.45 GHz

The antennas were fabricated using LPKF Protomat [15] on FR-4 material with height of 1.524 mm. The photos of the fabricated single band antenna are shown in **Figure 5** which has a size of 6.7 × 4.4 (in cm).

Figure 6 shows the comparison between the simulated and the measured S_{11} results.

The measured operating frequency is close to 2.45 GHz with S_{11} value below −15 dB. The 3 dB bandwidth at 2.45 GHz was approximately 18%. The measurement and simulation are in fairly good agreement, and the differences are due to microstrip loss and fabrication errors.

Figure 7 shows the comparison between the simulated and measured radiation pattern in xy-plane at 2.45 GHz which is close to omnidirectional pattern.

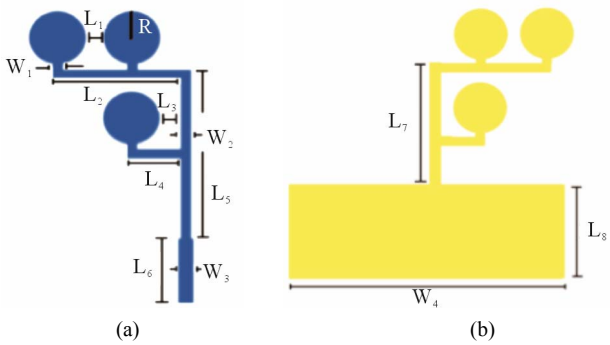

Figure 4. Variables corresponding to each dimension of the proposed dual-band antenna: (a) Top layer; (b) Bottom layer.

Table 2. Dimensions for the proposed dual band antenna at 3.3 - 3.6 and 5.0 - 6.0 GHz.

Variable	Value (mm)
L_1	1.20
L_2	17.8
L_3	1.08
L_4	6.60
L_5	29.3
L_6	10.0
L_7	21.6
L_8	17.8
W_1	1.02
W_2	1.52
W_3	2.54
W_4	49.1
R	5.21

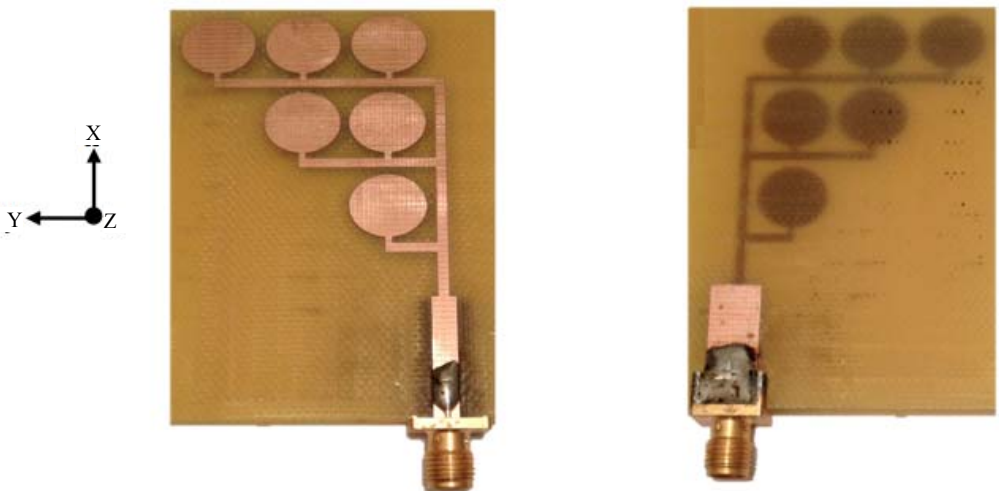

Figure 5. Photo of the fabricated single-band antenna: (a) Top layer; (b) Bottom layer.

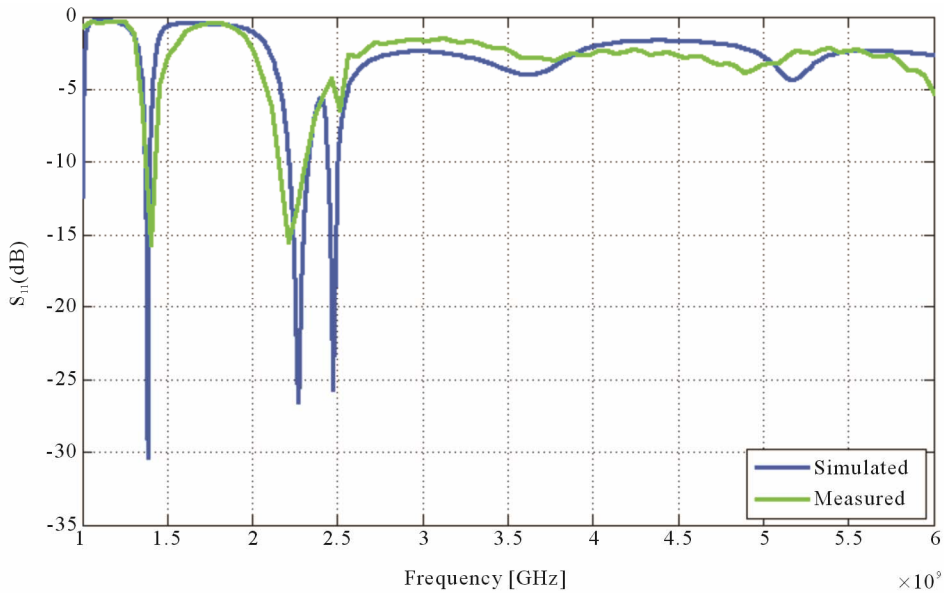

Figure 6. Simulated and measured return loss for the proposed single-band antenna.

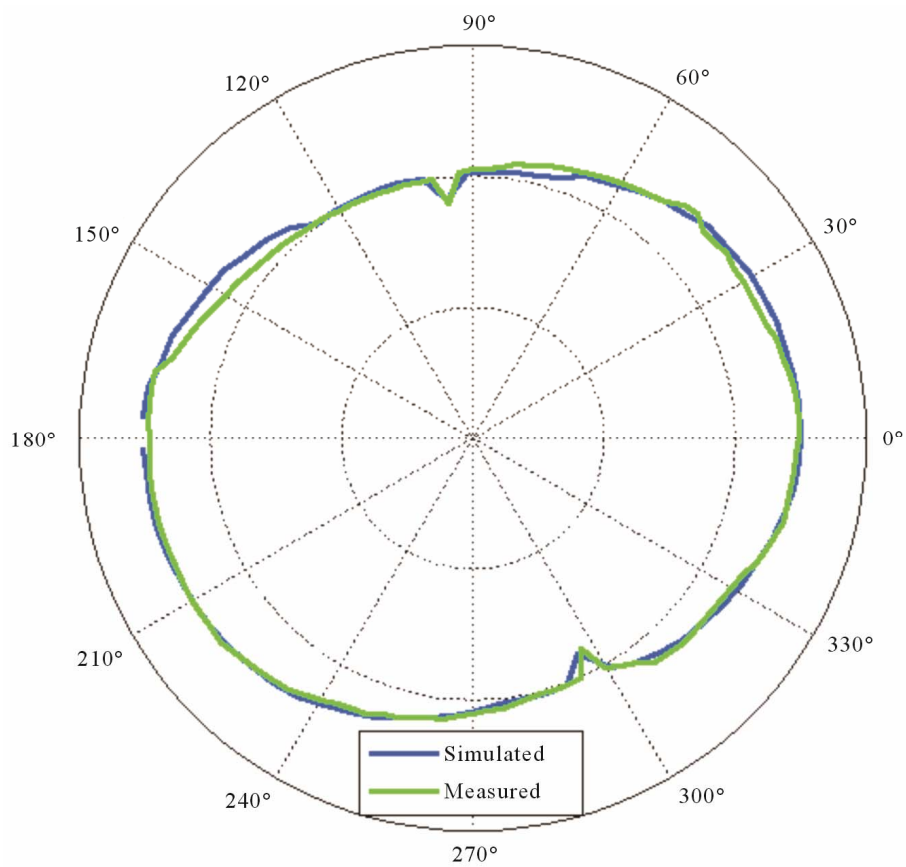

Figure 7. Simulated and measured radiation pattern in xy-plane (coordinate system shown in Figure 5) at 2.45 GHz.

3.2. Dual-Band Antenna at 3.3 - 3.6 and 5.0 - 6.0 GHz

The antennas were fabricated using LPKF Protomat [15] on double-sided FR-4 materials. The photos of the fabricated dual band antenna are shown in **Figure 8** which has a size of 6.6 × 5.2 (in cm).

Figure 9 shows the comparison between the simulated

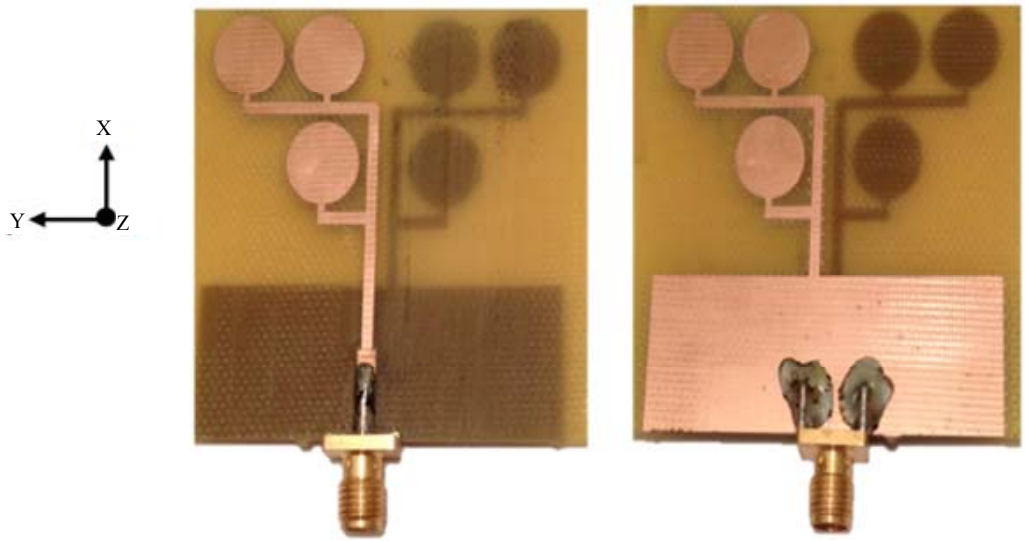

(a) (b)

Figure 8. Photo of the fabricated dual-band antenna: (a) Top layer; (b) Bottom layer.

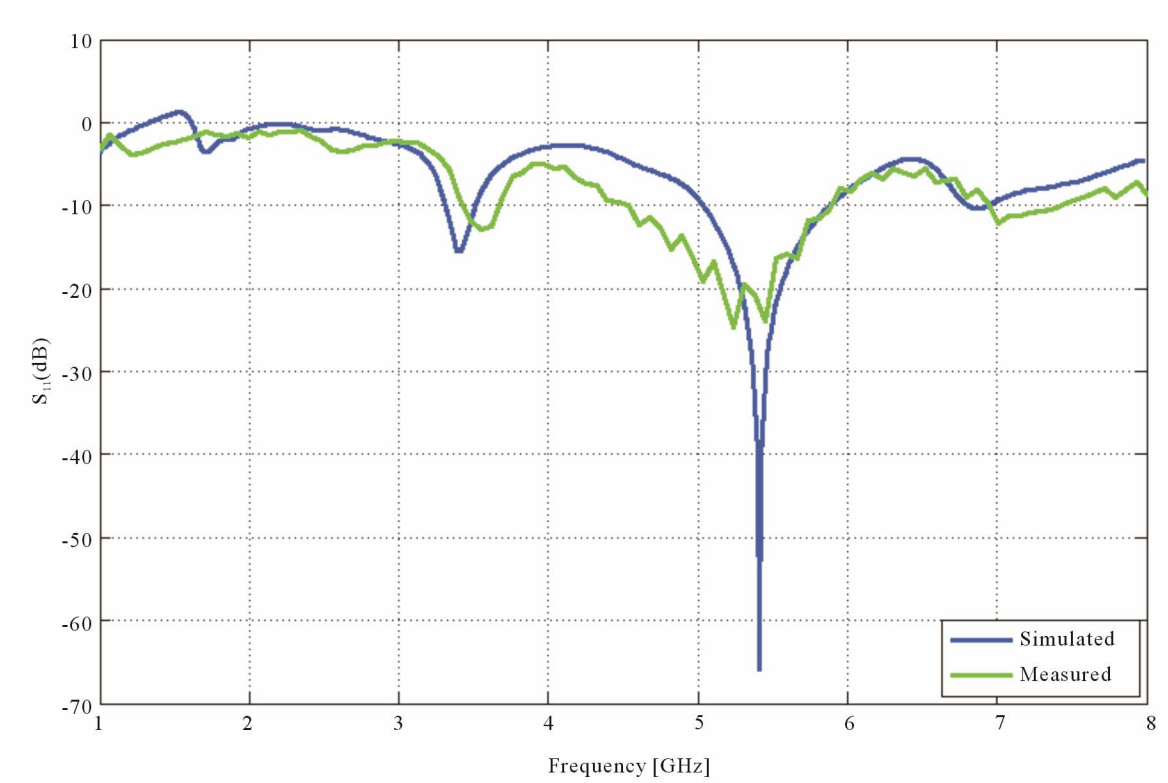

Figure 9. Simulated and measured return loss for the dual band antenna.

and the measured S_{11} results.

The measured S_{11} shows dual band near the designed bands with S_{11} values below −10 dB for both bands. The simulated and measured results give fairly good agreement, and the differences are due to board loss and fabrication errors.

Figure 10 shows the comparison between the simulated and measured radiation pattern in xy-plane at 3.45 and 5.5 GHz which is close to omnidirectional pattern.

4. Conclusion

A microstrip circular antenna arrays were presented for single band at 2.45 GHz and dual bands at 3.3 - 3.6 and

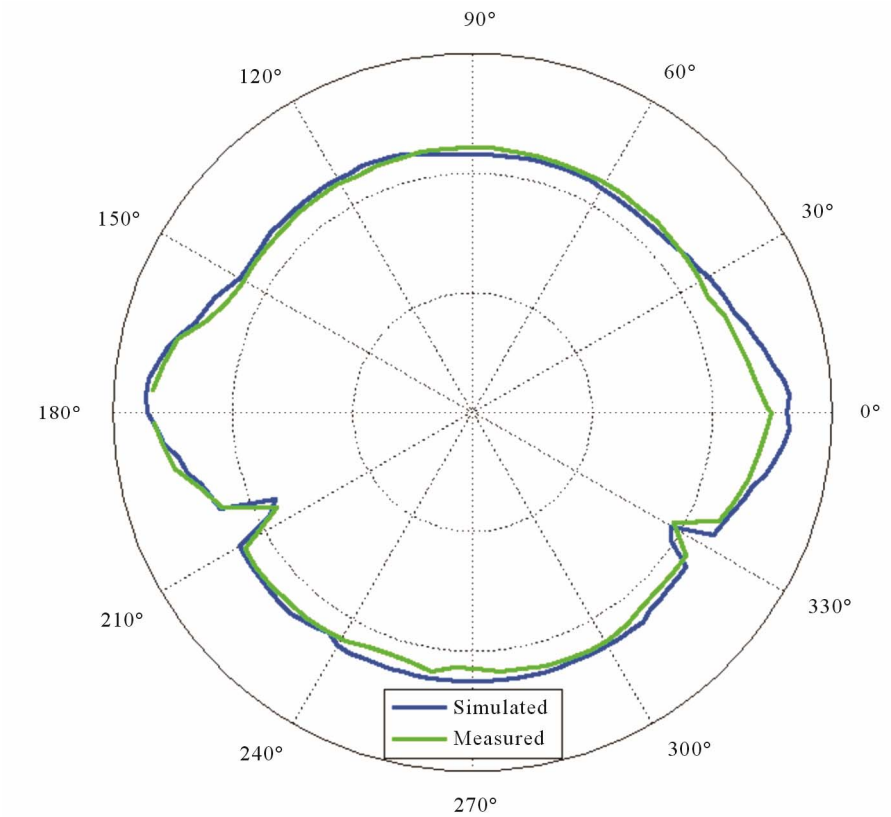

(a)

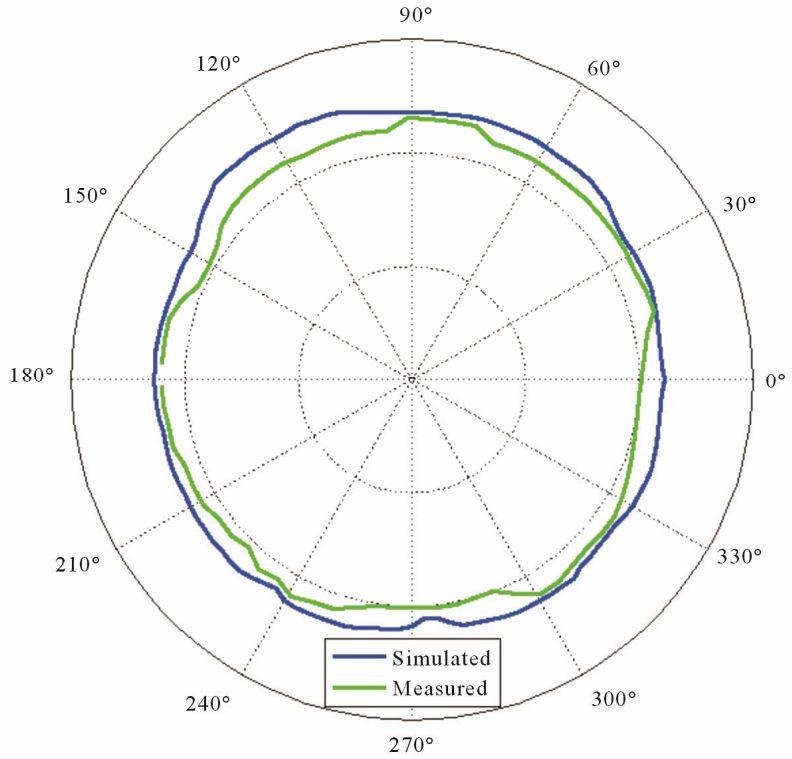

(b)

Figure 10. Simulated and measured radiation pattern in xy-plane (coordinate system shown in Figure 8) at (a) 3.45 GHz and (b) 5.5 GHz.

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5.0 - 6.0 GHz for WLAN/WiMAX applications. Both antennas were designed with ADS, fabricated on a FR-4 microstrip material, and characterized. Both single band (single sided) and dual band (double-sided) antenna arrays provided omnidirectional pattern with desired gain.

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Back to Back Combined Single Feed Proximity Coupled Antenna with Dumbbell Shaped DGS

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ABSTRACT

Use of defected ground structure (DGS) to reduce the size of patch antenna is presented in this paper. In order to get a dipole like radiation pattern for some specific application a dumbbell shaped DGS is used in the common ground plane of back to back combined single fed proximity coupled antenna. A size reduction of about 60% is achieved. Parametric analysis has been done to see the resonance behavior of the antenna with DGS.

***Keywords*:** *Defected Ground structure, Microstrip Antennas, Proximity Coupling*

1. Introduction

The continuous shrinking size of electronic equipments demands similar size antenna elements in order to fit properly in wireless devices without compromising the other radiation properties of the antenna. In this respect microstrip patch antennas are quite an obvious choice because of its other benefits like low profile, light weight, low cost and easy fabrication.

But as far as size of these patches concerned, the patch length should be around half-a-wavelength for the structure to act as a good radiator. Different techniques have already been used for the antenna size reduction such as using the substrate with high dielectric constant [1] , edge shorted patches with shorting plates or shorting walls, use of the shorting pin at the suitable position etc [2,3].

As far as our understanding goes much has not been reported regarding the use of DGS for size reduction of microstrip antennas, although its application have been reported for harmonic reduction [4], cross-polarization suppression [5] and mutual coupling reduction [6] in antenna arrays etc. Although the back to back geometries have been reported by the various researchers [7,8] but here a new coupling method *i.e.* proximity coupling with the defected ground structure is used for the consideration of the increased bandwidth.

This paper presents the application of DGS for size reduction of microstrip antennas. A dumbbell shaped DGS is used in the common ground plane of a back to back combined single feed proximity coupled microstrip antenna.

2. Defected Ground Structure

Recently there has been an increasing interest in the use of DGSs for performance enhancement of microstrip antennas and arrays. These are realized by etching off a simple shape defect from the ground plane of the planer circuits.

Although various complicated DGSs were reported in the literature, but the simplest one is the dumbbell shaped DGS. **Figure 1(a)** shows the simple and mostly used dumbbell shaped DGS that is etched in the ground plane below the microstrip line, in which both the areas (L_g*W_g) and the slot gap (g) play a very important role to find the resonance behavior of the DGS.

The head areas (L_g*W_g) is very useful for the variation in the inductance (L) and the slot (g) produces the capacitance (C). The L and C may be calculated from the formulae given below [9].

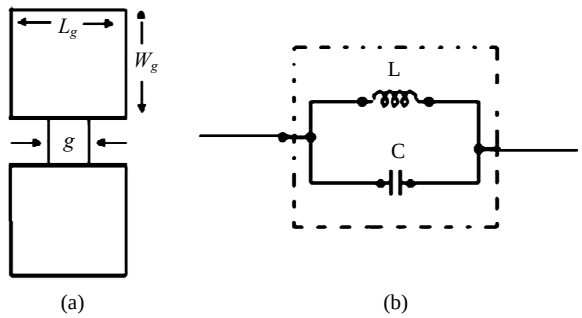

Figure 1. (a) Dumbbell shaped DGS, and (b) DGS Equivalent Circuit.

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$$L = \frac{1}{4\pi^2 f_0^2 C} \quad (1)$$

$$C = \frac{f_c}{2Z_0} \times \frac{1}{2\pi(f_0^2 - f_c^2)} \quad (2)$$

When this DGS is applied to the antenna, the equivalent inductive part due to the DGS increases and produces equivalently the high effective dielectric constant, thereby decreasing the resonant frequency when the DGS is incorporated in the ground plane of a micro strip antenna.

3. Antenna Design with DGS

In this section, the design approach and the performance of the basic antenna and the antenna with DGS is described. At the outset, the single patch antenna was designed and simulated using the CST Microwave studio [10], for the operating frequency at 5.0 GHz. Then another patch of the same size was added in the opposite side of the ground plane and fed in the same way as the first one. The configuration seems as two patch antennas having a common ground plane working at the same frequency. Next the feed lines were combined for the antenna for single feed design. For this purpose the antenna feed lines W_f = 0.934 mm with d_f = 1.5 mm were designed of 100 ohm and for matching to the 50 ohm transmission line (W_p = 3.86 mm) a quarter wave length transformer (W_t = 2 mm) was used to give proper matching (**Figure 2**).

The cross-sectional view of the single fed back to back combined proximity coupled antenna is shown in the **Figure 2(a)**. The layouts of matching networks only are emphasized in this **Figure 2(b)** for convenience. It is observed that the antenna designed in this configuration gives the bandwidth of 137 MHz whereas single antenna gives a bandwidth of 67 MHz. This is due to the fact that as the antenna height increases the quality factor decreases and the bandwidth increases. This becomes a multilayer antenna with more height and higher bandwidth as compared to the single patch antenna.

The simple transmission line model was used for the antenna size calculation. The dielectric constant was taken as 3.38 with the loss tangent 0.0025 and of 1.524 mm thickness. The patch lengths L_p and widths W_p are 15 mm and 19 mm respectively. The feed line has been inserted inside the dielectric at a height equal to the half of the height (h = 3.048 mm) of the antenna on either side. The dumbbell shaped DGS with dimensions L_g = W_g = 8.6 mm and g = 0.76 mm was created in the ground plane of the antenna as shown in the **Figure 2(c)**. A small slot was also created for making the antenna with single feed. The two feed lines were connected with a metal strip which goes through the small slot in the ground plane. The fabricated antenna is shown in **Figure 2(d)**.

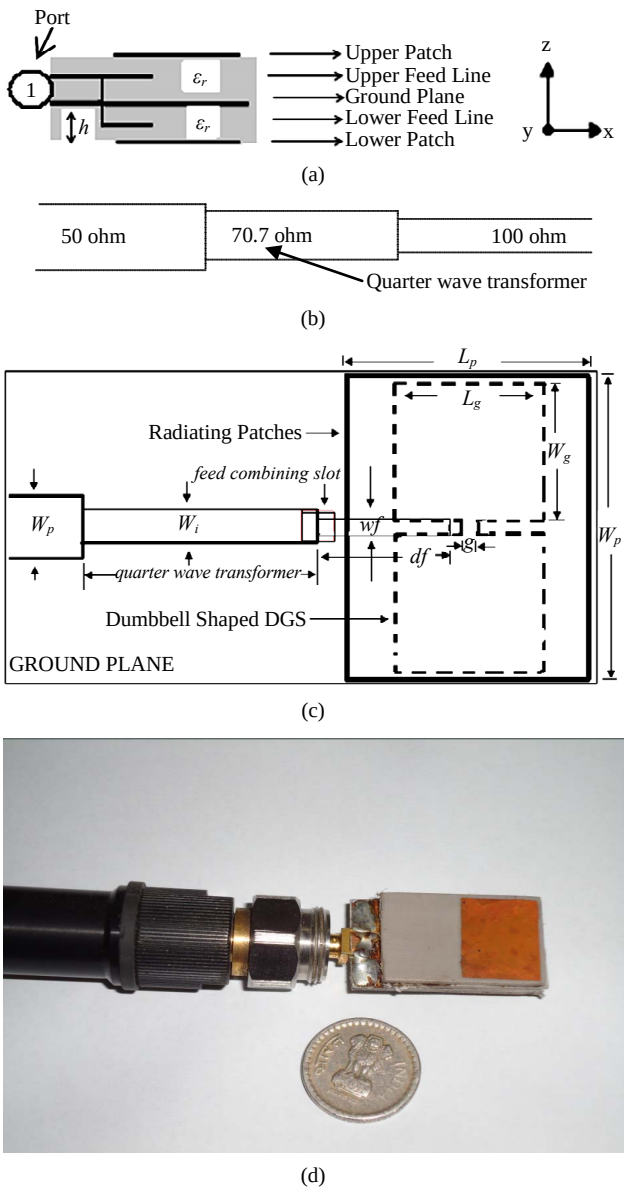

Figure 2. (a) Cross-sectional view of antenna configuration, (b) Feeding Network, (c) Top-View of the antenna, (d) Fabricated Antenna.

4. Results and Discussion

At first the antenna without the DGS in the common ground was simulated and was found to resonate at 5 GHz with 137 MHz Bandwidth.

Then the structure was simulated with the dumbbell shaped DGS. Before reaching to the final size of the DGS, a parametric study was done by varying L_g, W_g and g of

the DGS. As shown in **Figure 3**, with the increase in the value of L_g, the resonant frequency of the antenna is decreasing. Infect, increase in the length of the DGS head gives increasing inductance which in turn decreases the resonant frequency of the antenna.

At this point the increment in the (g) was not possible due to the accuracy in fabrication, so for this reason the other dimension (g) was kept constant for the requirement of the desired frequency (2 GHz). The size of the DGS single square head for the antenna to resonate at 2 GHz (UHF Band) was found to be 8.6 mm × 8.6 mm. The return loss (S11 [dB]) plot of the structure with and without DGS is shown in **Figure 4(a)**. **Figure 4(b)** shows the measured S11 parameter using the HP 8720 B network analyzer. The marker's position near to peak shows the resonance frequency 2.08 GHz with return loss of -13 dB. The result shows good agreement with the simulation results. The measured -10 dB bandwidth is about 60 MHz. The maximum size reduction achieved is about 60%.

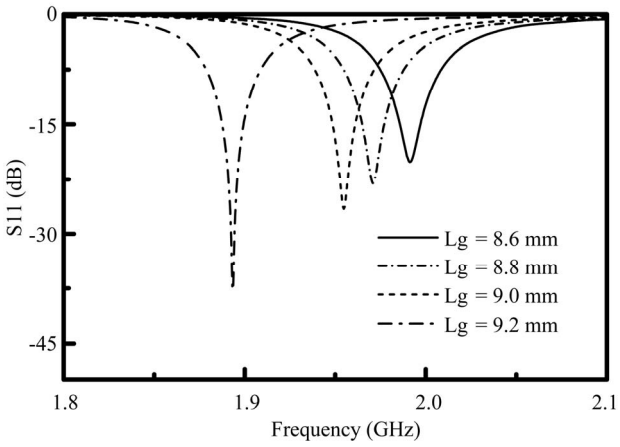

Figure 3. S11 Vs. Frequency response by varying DGS length (Lg).

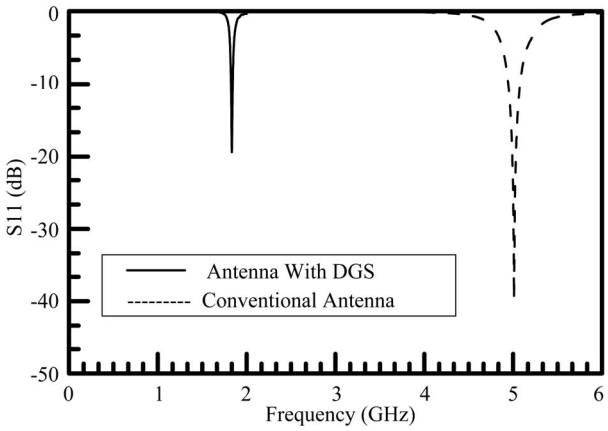

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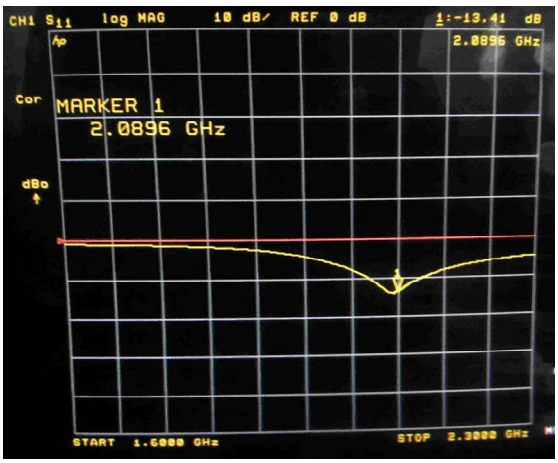

(b)

Figure 4. Antenna Return Loss (a) simulated (b) measured.

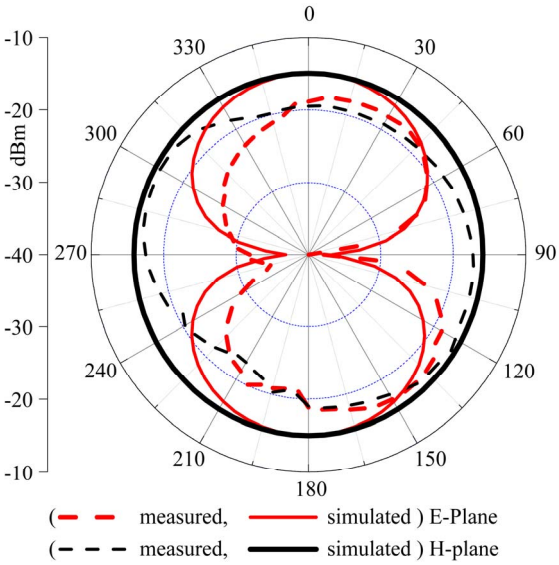

Figure 5. Antenna radiation pattern (measured and simulated) at 2 GHz Frequency.

The measured and simulated power patterns of the antenna are shown in **Figure 5**. It can be observed that the E-plane radiation pattern is similar to the pattern for a dipole antenna. Measurement errors are mainly due to the spurious radiation created by the feeding end and the improper coupling of the elements. However the gain measured experimentally for the proposed antennas with DGS is about -6.9 dB and -7.8 dB (where simulated gain with DGS is 3.8 dB and 5.7 dB is for the antenna without DGS, for both the planes) in both the E and H plane respectively, which is consistent with the size reduction of the antenna.

5. Conclusion

Microstrip patch antenna size reduction with DGS is car-

ried out in this work. A dumbbell shaped DGS in the common ground plane of a back to back microstrip structure was found to give a size reduction of about 60% and shifts the resonance frequency from 5 GHz to 2 GHz, with 60 MHz bandwidth facilitating the antenna, to be used for UHF band applications.

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Vehicular Radio Scanner Using Phased Array Antenna for Dedicated Short Range Communication Service

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ABSTRACT

Now a day's accidents are very common due to increased population of vehicle. In order to ensure safety measures in the vehicle this paper has proposed some methodologies regarding careful driving by automatically scanning and analyzing the blind spot area of an intelligent mobile vehicle. A vehicular antenna with minimum perturbation is proposed to be fitted on the vehicle and collect information of the concern area which would ensure visibility of the operator *i.e.* masked or integrated within the car body. This paper has dealt with the design of Tchebyscheff polynomial based prototype planar microstrip phased array antenna and also redesigned the same when implemented in the body of the car being considered as an electromagnetically large element. Both the design has been experimentally verified with the measurement. The simulated and the measured results in both the cases are found to be in good agreement. More than 11 dB gain was observed at perfectly 30° angles from its broad side direction as desired for blind spot detection with minimum amount of electromagnetic interference inside the car.

Keywords: Intelligent Transportation System; Microstrip Phased Array Antenna; Tchebyscheff Polynomial; Electromagnetic Interference

1. Introduction

Intelligent Transport System (ITS) ensures mobility comfort and safety in transportation system. It also absorbs the hazards due to environmental impact. With the progress of the information processing technology, control systems to minimize accidents for the roadways have also been advanced hence one approach to improve the traffic safety is found and that is automatic collection of data by scanning the blind spot area of the vehicle [1] as shown in **Figure 1**. Many methods were proposed to detect the blind spot area but all of them had certain limitations. Devices like dynamic angling side view mirror [2], side view camera model [3], and shadow or edge features detector [4] were used for detecting blind spot area but their performance was affected during bad weather, fog or mist. Also we know that the mechanical systems, response time is more and the system is prone to wear and tear.

A radio frequency method has been proposed in this paper to scan the blind spot zone efficiently. Four rectangular microstrip antennas (RMSA) are arranged in linear configuration with optimal spacing between the patch elements to construct the phased array radar. A corporate feed network is used to feed the patch element unequally and a progressive phase shifter is designed with 108˚ delay elements to tilt the main beam in the desired direction and then the total unit is simulated and experimented after placing it on the car body which is electromagnetically a large element. The antenna works in the Dedicated Short-Range Communication Service (DSRCS) frequency band [5]. The design of the microstrip phased array antenna is discussed in Section 2 and after that to place the antenna; the design of the entire car is given in Section 3. Results and discussion are portrayed in Section 4 along with conclusion in Section 5.

2. Design of Microstrip Phased Array Antenna

The microstrip phased array antenna is designed for Dedicated Short Range Communication Service at 5.88 GHz with dielectric constant of 2.32 and substrate thickness of 0.785 mm. Firstly the dimension of the rectangular patch is computed as 16.322 mm by 19.8 mm using the method outlined in [6]. With computed inset feed length of 3.8 mm and for the above dimensions of the rectangular patch the return loss is found to be –8.09 dB

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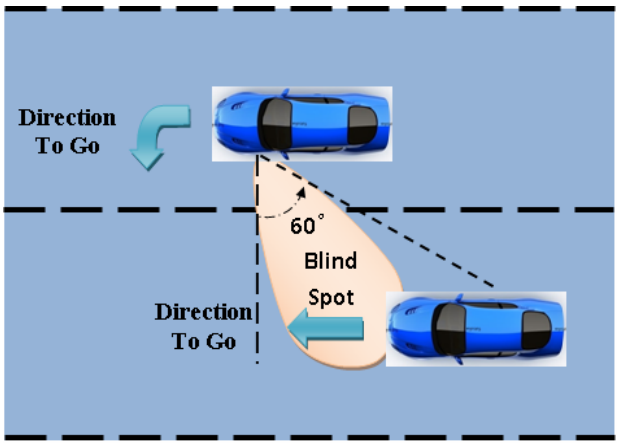

Figure 1. Surrounding regions of a vehicle.

with (30.1 + j26.7) ohm impedance at the feed position. The RMSA is simulated and optimized using Ansoft HFSS™. After optimization the final length is found to be 16.4363 mm with inset feed length of 4.8225 mm keeping the width of the patch unchanged as shown in **Figure 2**.

By considering the above designed patch element, a four element linear array is realized and powered by Tchebyscheff current distribution. The spacing between the elements is kept considering the desired maximum scan angle in order to eliminate the grating lobes within the visible space of the phased array antenna. To optimize the performance of the antenna in respect of its side lobe level (SLL), mutual coupling and gain of the antenna array, the spacing between the elements is studied parametrically [7]. The results of the said study are tabulated in **Table 1**.

After optimization it is found that the optimum spacing between the elements is 0.6 λ_0 while considering, the main lobe to side lobe ratio below 20 dB, optimum mutual coupling and overall gain.

From **Figure 1**, it is observed that the beam of the antenna array is required to be tilted by an angle 30˚ away from the broad side direction. In view of the above a progressive phase shifter of –108˚ is designed with the help of 11.16 mm feed line length. The actual line length is considered as mτ, where m = 0, 1, 2, 3.

To enhance the gain by maintaining the beam width and main lobe to side lobe ratio, the antenna elements are excited by Dolph Chebyshev current distribution. The array consist of four elements, thus third order Tchebyscheff polynomial is calculated. Hence the polynomial is solved and relative current ratio is computed as 1:1.7795:1.7795:1. Both equal and unequal power dividers are designed along with the progressive phase shifter.

For equal power division, a 3 dB equal power divider is designed whose vertical arm is of 50 Ω line and two horizontal quarter-wavelength branch-lines are of 70.71 Ω is used [8]. It is shown in **Figure 3(a)**.

Table 1. Effect on mutual coupling and gain due to variation in spacing (d) between the elements.

d with respect to guided wavelength	d with respect to operating wavelength	Mutual coupling (dB)	Gain (dBi)
0.6 λ_g	0.41 λ_0	>10	7.6
0.7 λ_g	0.48 λ_0	>13	9.9412
0.8 λ_g	0.55 λ_0	>20	10.647
0.9 λ_g	0.6 λ_0	>22	10.919

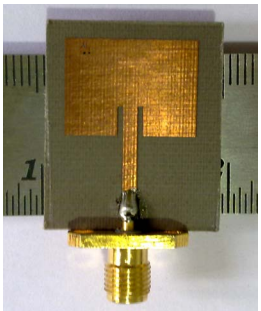

Figure 2. Photograph of the rectangular microstrip antenna element.

To get the unequal current distribution, both the horizontal arm of the microstrip unequal power divider should be of different resistance and it is calculated as 46.368 Ω and 82.49 Ω. The structure is shown in **Figure 3(b)**.

Generally for practical design purpose the gap between the corporate feed networks is taken small but the value of the gap less than 0.11 λ_0 disturbs the frequency response of overall antenna array. The effects of the feed network on the side-lobes are significant in the E-plane pattern. The influence on the H-plane is less important due to the orthogonality of the drive current and the symmetry of all the other currents in this cut [9]. By maintaining the SLL and the surface wave loss, the gaps are taken as 0.11 λ_0 as portrayed in **Figure 4**.

3. Placement of Antenna on the Vehicle

In order to compute the electromagnetic effect of the body of the car on the antenna performance, the entire structure of the car is designed in Ansoft HFSS™. The complete structure of the car consist of hood, roof, trunk, left and right side doors, left and right side quarter panel for front and rear side which are made up of conducting material but the bumpers and wheels are assigned by layered impedance due to their hard rubber and polyester materials as shown in **Figure 5**.

After going through the typical requirement for scanning the blind spot, the antenna is placed just beside the side view mirror. The following problems in the designed are addressed while simulating the effect of the radiation

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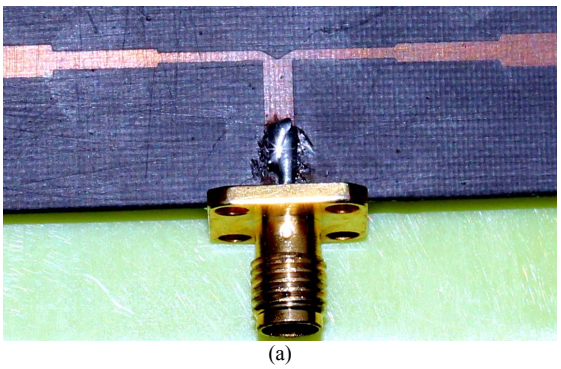

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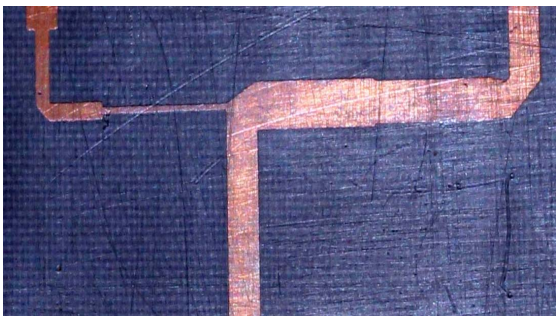

(b)

Figure 3. (a) Photograph of the equal microstrip power divider; (b) Photograph of the unequal microstrip power divider.

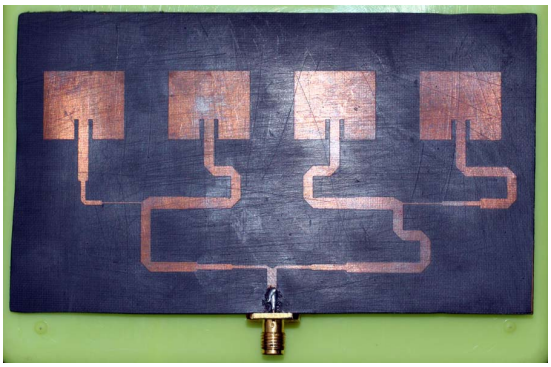

Figure 4. Photograph of the antenna array with corporate feed network.

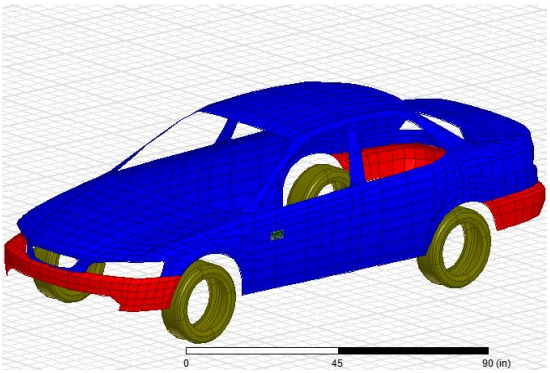

Figure 5. The entire structure of the car along with the antenna array.

characteristics of the antenna after placing it on the vehicle:

1) Spans a large computational domain compared to the wavelength;

2) Requires a fine grid resolution to resolve the detailed antenna structure;

3) Contains largely non-conformal PEC and dielectric structures.

4. Results and Discussion

For obtaining the scattering parameter characteristics, the microstrip antenna has been simulated over the frequency bandwidth ranging from 5.5 GHz to 6.5 GHz and two different circumstances is observed. The first experiments involve the design, simulation and measurement after fabrication of an individual element and then the array with the same without involving the effect of the car. Both of them should used for optimized performance.

The scattering parameter is measured by Agilent Technology Vector Network Analyzer model no. N5320A (10 MHz - 20 GHz) and the radiation pattern is measured by Hittite HMC-T2100 synthesized signal generator (10 MHz - 20 GHz) and Krytar 9000 B power meter (10 MHz - 40 GHz) with 9530 B power sensor (10 MHz - 20 GHz) as shown in **Figure 6**. From **Figure 7**, it is found

(a)

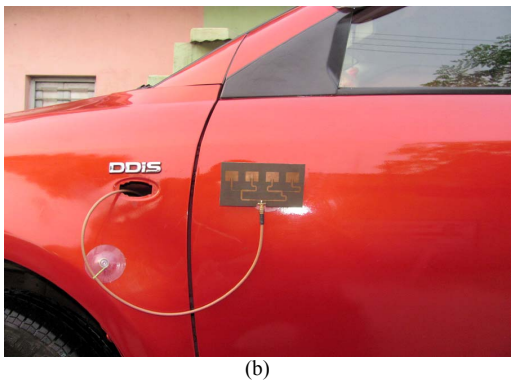

(b)

Figure 6. (a) Experimental set-up to measure the radiation pattern of the antenna array; (b) Experimental set-up to measure the radiation pattern of the antenna array after placing it on the car.

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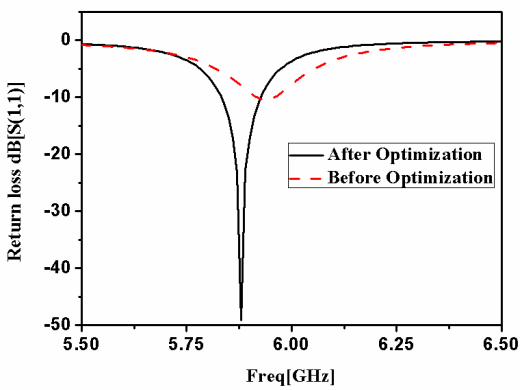

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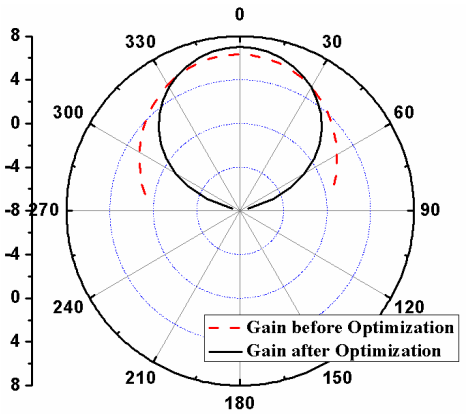

(b)

Figure 7. (a) Return loss a single patch before and after optimization; (b) Gain of a single patch before and after optimization.

that after optimization a perfect match is obtained exactly at 5.88 GHz and gain is also improved from 6.33 dB to 7.01 dB with a very good return loss of –47 dB. The current distribution and the radiation pattern of a single RMSA is portrayed in **Figure 8**.

A parametric study of the return loss of antenna array with different spacing between the elements of the corporate feed network is done and is compared in **Figure 9**. The results of the computational model of the entire antenna array with feed network were compared with the measured data and a good agreement is observed in **Figure 10**.

After getting the satisfactory results, next the same array antenna is experimented again with considering the electromagnetic effect of the car. In order to test the antenna array in association with the vehicle, a numerical model of the car is created using Ansoft HFSS^{TM} and the simulated data is compared with the measured in **Figure 11**. **Figure 12** graphically represents the 3D radiation pattern of the antenna array in presence of the computational model of the vehicle. From **Figure 13**, it is clear that the inside electric field strength is not more than 15 Volt per meter which is very less compare to the standard

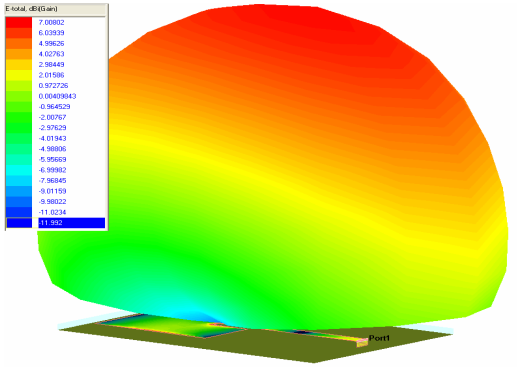

Figure 8. Current distribution and the radiation pattern of the rectangular microstrip antenna.

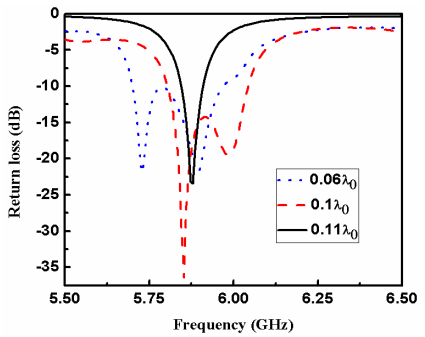

Figure 9. Parametric study of return loss of the antenna array with different spacing between the elements of corporate feed network.

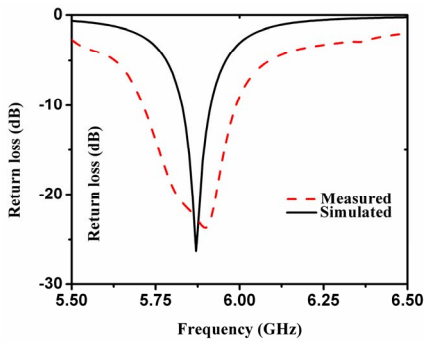

(a)

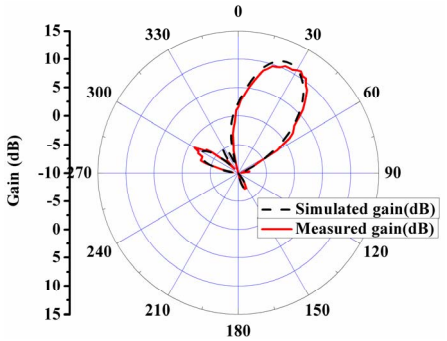

(b)

Figure 10. (a) Return loss of the antenna array; (b) Radiation pattern of the antenna array.

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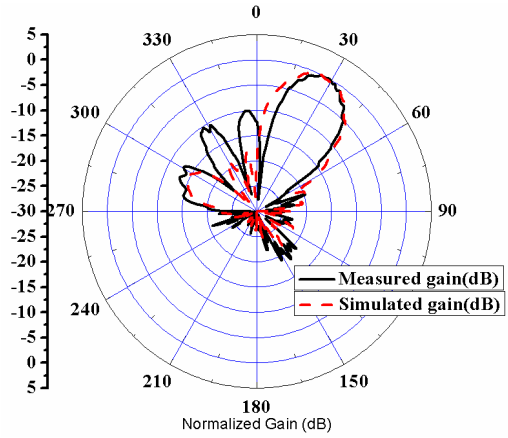

Figure 11. Normalized radiation pattern of the antenna array after placing it on the body of the car.

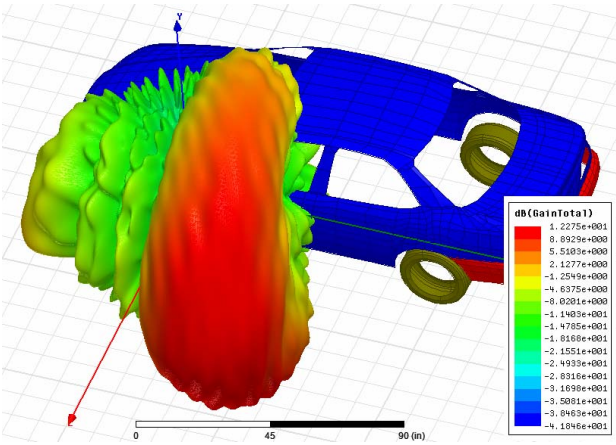

Figure 12. 3D radiation pattern of the antenna array after placing it on a vehicle body.

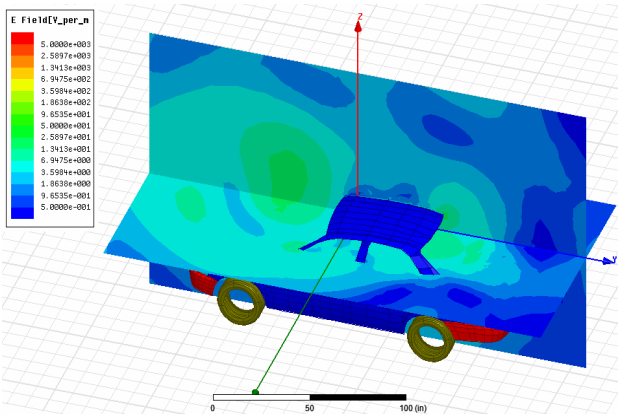

Figure 13. Inside electric field interference of the array after placing it on a vehicle body.

electromagnetic hazards.

5. Conclusion

A Tchebyscheff polynomial based microstrip phased array antenna is designed to detect the blind spot area of the intelligent mobile vehicle. The design is further simulated in Ansoft HFSS™ after placing the antenna on the body of the car and the results are observed. The result of the computational model of the entire antenna array is compared with the measured data before and after placing the said antenna array on the body of the car and found to be in good agreement. An overall 11 dB gain is obtained while measuring in the desired direction with minimum amount of electromagnetic interference inside the car.

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Plus Shape Slotted Fractal Antenna for Wireless Applications

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ABSTRACT

Fractal antennas are characterized by space filling and self-similarity properties which results in considerable size reduction and multiband operation as compared to conventional microstrip antenna. This paper outlines a multiband antenna design based on fractal concepts. Fractal antennas show multiband behavior due to self-similarity in their structure. The plus shaped fractal antenna has been designed on a substrate of dielectric constant $€_r$ = 4.4 and thickness 1.6 mm. The proposed antenna is characterized by a compact size and it is microstrip feed fractal patch of order 1/3. It is observed that the antenna is radiating at multiple resonant frequencies. The resonant frequency is reduced from 2.2 GHz to 900 MHz after I & II iterations respectively. Thus considerable size reduction of 81.77% & overall bandwidth of 12.92% are achieved. The proposed antenna is simulated using the method of moment based commercial software (IE3D) and it is found that simulated results are in good agreement with the experimental results.

Keywords: Fractal Antenna; Multi Frequency; Size Reduction; Wireless Application; Plus Shape Antenna; Slotted Antenna

1. Introduction

In the study of antennas, fractal antenna theory is a relatively new area. The emergence of antennas with fractal geometries has given an answer to two of the main limitations started by Werner (1999) of the classical antennas, which are single band performance and dependence between size and operating frequency. The term "fractal" means broken or irregular fragments. It was originally coined by Mandelbrot (1983) to describe a family of complex shapes that possess an inherent self-similarity or self-affinity in their geometrical structure. Jaggered (1990) defined fractal electrodynamics as an area in which fractal geometry was combined with electromagnetic theory for the purpose of investigating a new class of radiation, propagation and scattering problems. One of the most promising area fractal electrodynamics researches is in its application to antenna theory and design. There are varieties of approaches that have been developed over the years, which can be utilized to archive one or more of these design objectives. The development of fractal geometry came largely from an in depth study of the pattern nature, with the advance of wireless communication system and their increasing importance wide band and low profile antennas are in great demand for both commercial and military applications [1]. A fractal is a rough or fragmented geometric shape that can be split into parts, each of which is a reduced-size copy of the whole and this property is called self-similarity. Fractal [2] geometries are composite designs that repeat themselves or their statistical characteristics and are thus "self-similar" fractal geometry finds a variety of applications in engineering. Fractal geometry is space filling contours of regular or irregular shapes [3-6], and is super imposed of too much iteration and they describe the self-similar property of fractal geometry [7]. Fractals are a class of shapes which have not characteristic size. Each fractal is composed of multiple iterations of a single elementary shape the iteration can continue infinitely, thus forming a shape within a finite boundary but of infinite length or area. Fractal has the following features 1) It has a finite structure at arbitrarily small scales; 2) It is too irregular to be easily described in traditional Euclidean geometric; 3) It is self-similar; 4) Simple and recursive [8]. Modern telecommunication systems require the antenna with wider bandwidth and smaller dimension than conventionally possible. This has initiated antenna research in various directions, are of which is by using fractal shaped antenna elements. In recent years several fractal geometries have been introduced for antenna application with varying degree of success in improving antenna

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characteristics. Some of these geometries have been particularly useful in reducing the size of the antenna, while other designs aim at incorporating multiband characteristics. These are low profile antennas with moderate gain and can be made operative at multiple frequency bands and hence are multifunctional [9]. In our present work we focus on generation of multifrequency which yields increases the bandwidth and size reduction of antenna. A plus shape patch is taken as a base shape and in first iteration four other plus shape patches of the order of 1/3 of base shape are placed touching the base shape. Similarly second iterations are taken by further placing plus shaped patches at even reduced scales. It is found that as the iteration number and iteration factor increases, the resonance frequencies become lower than those of the zero iteration, which represents a conventional plus shape patch.

2. Design Consideration

The base shape of the plus shaped slotted fractal antenna is designed on a dielectric substrate having a relative dielectric constant $€_r$ = 4.4 and thickness 1.6 mm as shown in **Figure 1**. This is the reference antenna or base shape antenna. Further this base shape antenna is modified by inserting horizontal slots on both sides with respect to center of patch as shown in **Figure 2** and it is named as antenna1. The length of the slot Ls is varied on either side of the edge as 5 mm, 10 mm, 15 mm, 20 mm, 21.175 mm, 21.675 mm and the frequency variation has been studied. The optimum length obtained is Ls = 21.675 mm *i.e.*, the distance between slots q = 2 mm is considered for further design.

The first iteration patch is designed with four plus shapes of order (1/3) of base shape are placed touching the base shape as shown in **Figure 3** and it is named as antenna 2 and same procedure is repeated for second iteration. This antenna is as shown in **Figure 4** and it is named as antenna 3. For each iteration plus shapes of the order of $(1/3)^n$ of base shape are taken, where n is the number of iterations. The dimension of first iteration can be calculated as

e = (1/3) a & g = (1/3) c also f = (1/3) b & h = (1/3) d.

i = (1/3) e & k = (1/3) g also j = (1/3) f & L = (1/3) h

So with optimized design the dimensions obtained are a = 45.3 mm, b = 15.1 mm, c = 35.4 mm, d = 11.8 mm. The length of the slot is Ls = 21.675 mm and width of the slot Ws *i.e.* r = 2 mm. The dimension of the ground plan is 55 mm × 85 mm. A 50 ohm SMA connector is used to feed the antenna by using microstrip feed technique. Optimized microstripline with following dimension, m = 0.5 mm, n = 18.55 mm, o = 3.05 mm, p = 18.4 mm. The suitable feed location is obtained through optimization process by using the IE3D software. The fabricated photographic view of all proposed antennas is shown from **Figures 5(a)-(e)**.

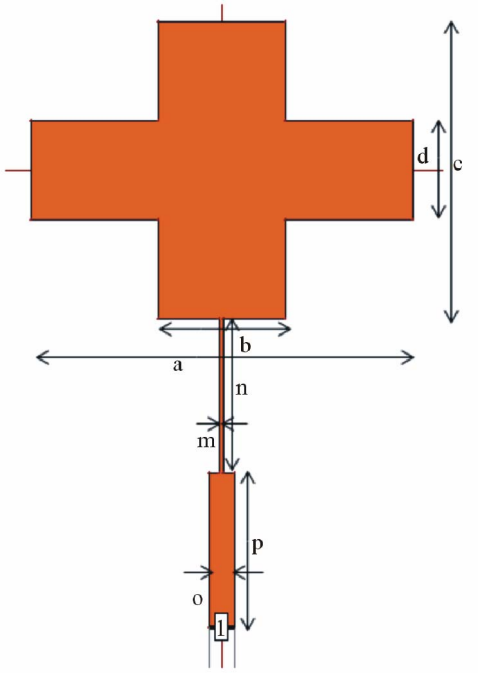

Figure 1. Geometry of base antenna.

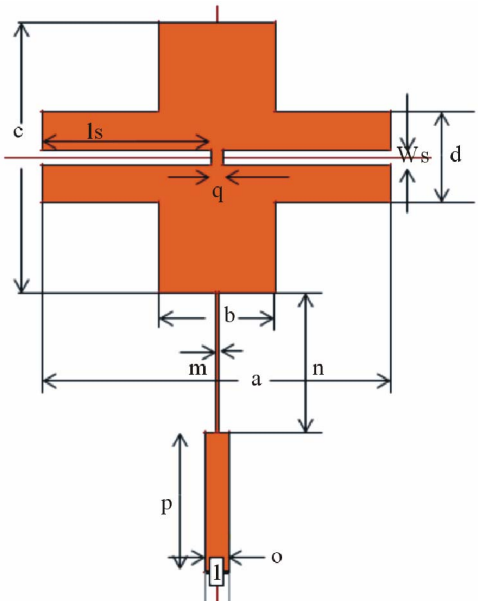

Figure 2. Geometry of antenna 1.

3. Results and Discussion

The characteristic of the fractal antenna with slot and with iterations has been studied by using IE3D software. Also the results have been verified practically with by using Vector Network Analyzer model Rohde and schewarz, German make ZVK model No.8651.

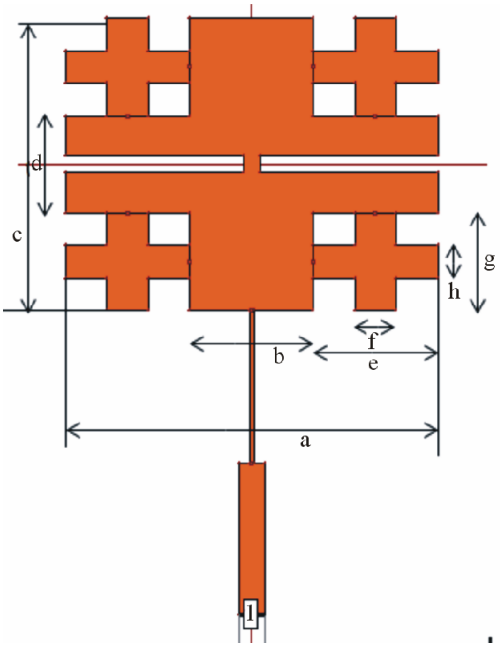

Figure 3. Geometry of base antenna 2.

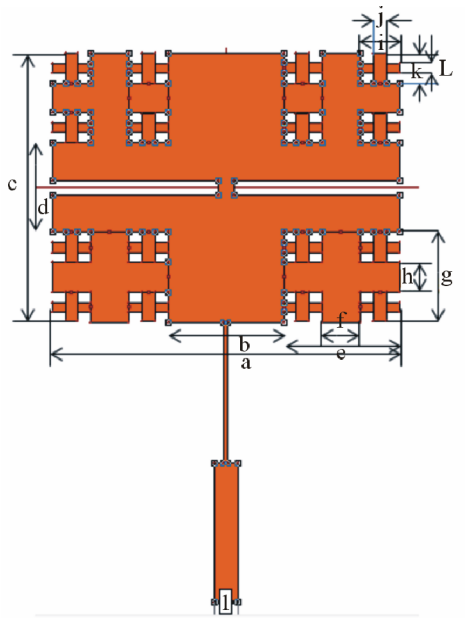

Figure 4. Geometry of antenna 3.

The modified base shape antenna with slots as been optimized by varying slot length Ls. The variation of Ls with resonant frequency of the antenna is shown in **Table 1** and same is presented in graphical form in **Figure 6**. From the tabular results it is found that by increasing slot length Ls on both sides from the edge of the patch, resonant frequency decreases. The lowest possible resonant frequency 1.27 GHz is obtained for Ls = 21.675 mm (*i.e.*, distance between the slots q = 2 mm) & this is taken as optimized length of the slot for further iteration.

The results of all proposed antennas are shown in **Table 2**. The simulated and measured return loss characteristics of proposed antennas are shown from **Figures 7(a)-(d)**.

From the results it is clear that the resonant frequency of the antenna 1 *i.e.*, modified base antenna with slot is fr = 1.27 GHz which is lower compared to the base antenna without slot (fr = 2.199 GHz). So the size reduction obtained is 66.85%. The antenna 2 *i.e.* the modified antenna with slots and first iteration gives multiple bands with lower frequency of 0.99 GHz. The size reduction obtained for antenna 2 is 79.88%. Further antenna 3 *i.e.*, with slot and second iteration gives multiple bands with

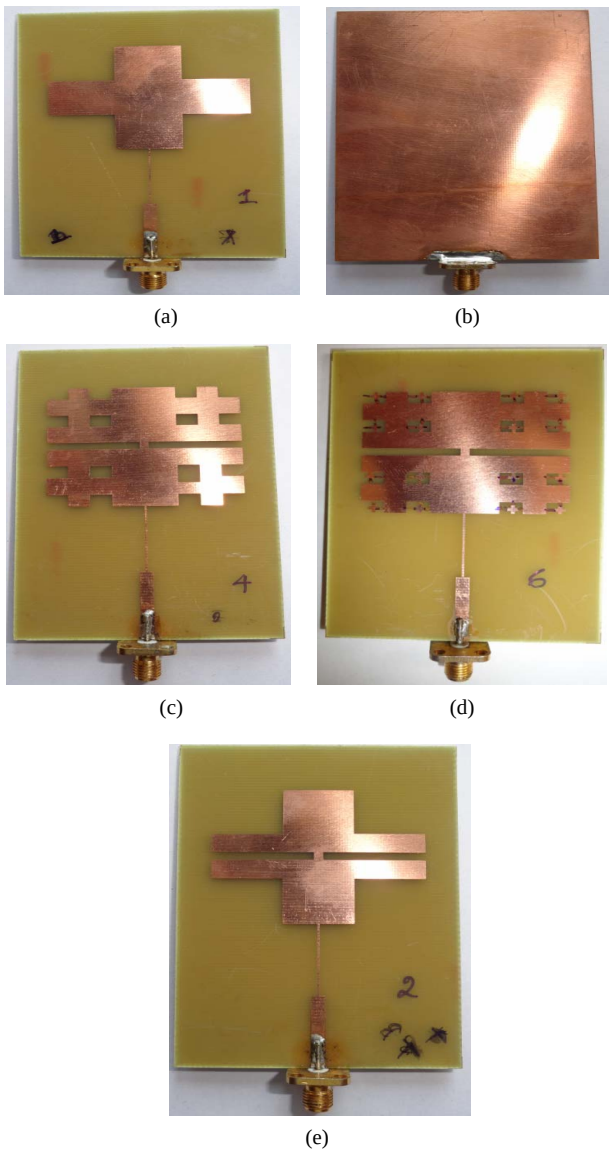

Figure 5. (a) Photograph of top view of base antenna; (b) Photograph of bottom view of base antenna; (c) Photograph of antenna 1; (d) Photograph of antenna 2; (e) Photograph of antenna 3.

Table 1. Variation of slot length v/s resonant frequency.

Slot length (Ls) variation in mm	Resonating frequency (GHz)
0	2.22
5	2.197
10	2.155
15	1.93
20	1.436
12.175	1.34
21.675	1.27

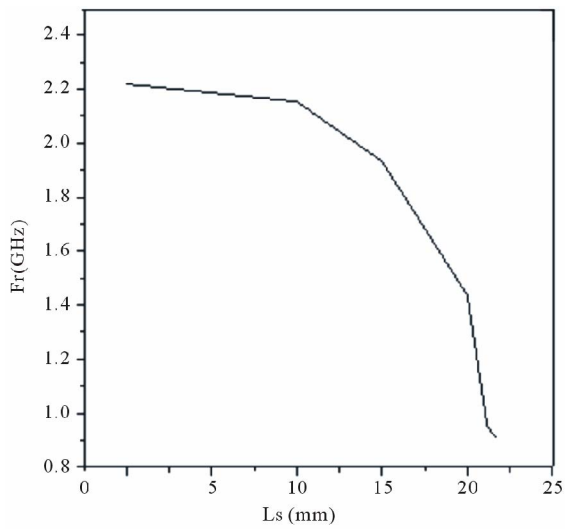

Figure 6. Variation of resonant frequency v/s slot length.

lower resonant frequency of 0.90 GHz. The size reduction obtained for antenna 3 is 81.77% which is more compared to all other proposed antennas.

Further the bandwidths of proposed antennas have been studied through simulation and measurements and the results are shown in **Table 2**. From the results it is clear that the bandwidths of modified antenna with slot, first & second iteration are more compared to base antenna. The measured bandwidth of antenna 1 is 106 MHz (4.895%), antenna 2 is 190 MHz (11.93%) and antenna 3 is 215 MHz (12.92%). The radiation patterns of all proposed antennas are studied and all are giving broadside radiation. Splitting of beam *i.e.* dip is found in **Figure 8(a)** of simulated radiation pattern of base shape at 2.19 GHz. In **Figure 8(b)** splitting of beams merged into broadside pattern at 0.91 GHz at second iterations this results into broadside radiation pattern.

4. Conclusion

This paper presents a new plus shape slotted fractal antenna with first and second iterations. The antenna.3 *i.e.*, slotted fractal antenna with second iteration gives size reduction of 81.77% and band width of 12.92% with broad side radiation pattern. So from the results we conclude that the modified base antenna with slots of second iterations gives a good size reduction and enhanced band width compared to that of modified base antenna with

Table 2. Results of proposed antennas.

Prototype antenna	Resonant frequency fr (GHz)		Return loss (db)		Bandwidth (MHz)		Overall bandwidth (MHz)	
	Sim	Pract	Sim	Pract	Sim	Pract	Sim	Pract
Base antenna	f1 – 2.19	f1 ± 2.19	–19	–24	53	53	79	71
	f2 – 3.42	f2 ± 2.46	–14	–15	26	18		
Antennal with q = 2 mm	f1 ± 1.19	f1 ± 1.27	15.8	–12.8	20	18	133	106
	f2 ± 2.52	f2 ± 2.48	18.4	–20.1	113	44		
		f3 ± 2.56		–18.7		44		
Antennal 2 with q = 2 mm (1st itr)	f1 ± 0.96	f1 ± 0.99	16.7	–14.5	22	80	136	190
	f2 ± 2.9	f2 ± 2.97	–14	–26.9	44	50		
	f3 ± 3.08	f3 ± 3.17	21.5	–21	70	60		
Antennal 3 with q = 2 mm (2nd itr)	f1 ± 0.91	f1 ± 0.990	15.2	–14.2	11	87	81	215
	f2 ± 3.07	f2 ± 2.976	19.4	–17.6	70	50		
		f3 ± 3.168		–18.9		78		

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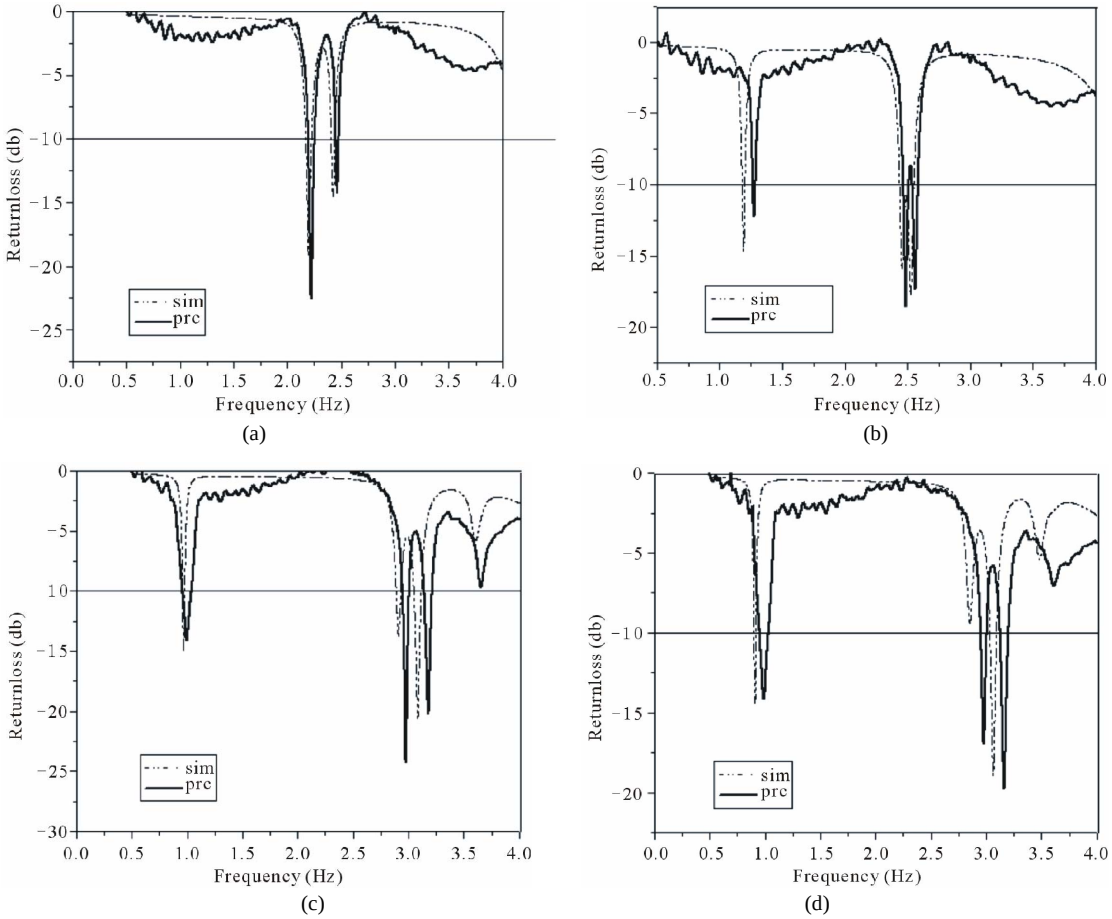

Figure 7. (a) Return loss characteristic of antenna 1 with q = 2 mm; (b) Return loss characteristic of base antenna 2 with q = 2 mm; (c) Return loss characteristic of antenna 2 with q = 2 mm; (d) Return loss characteristic of antenna 3 with q = 2 mm.

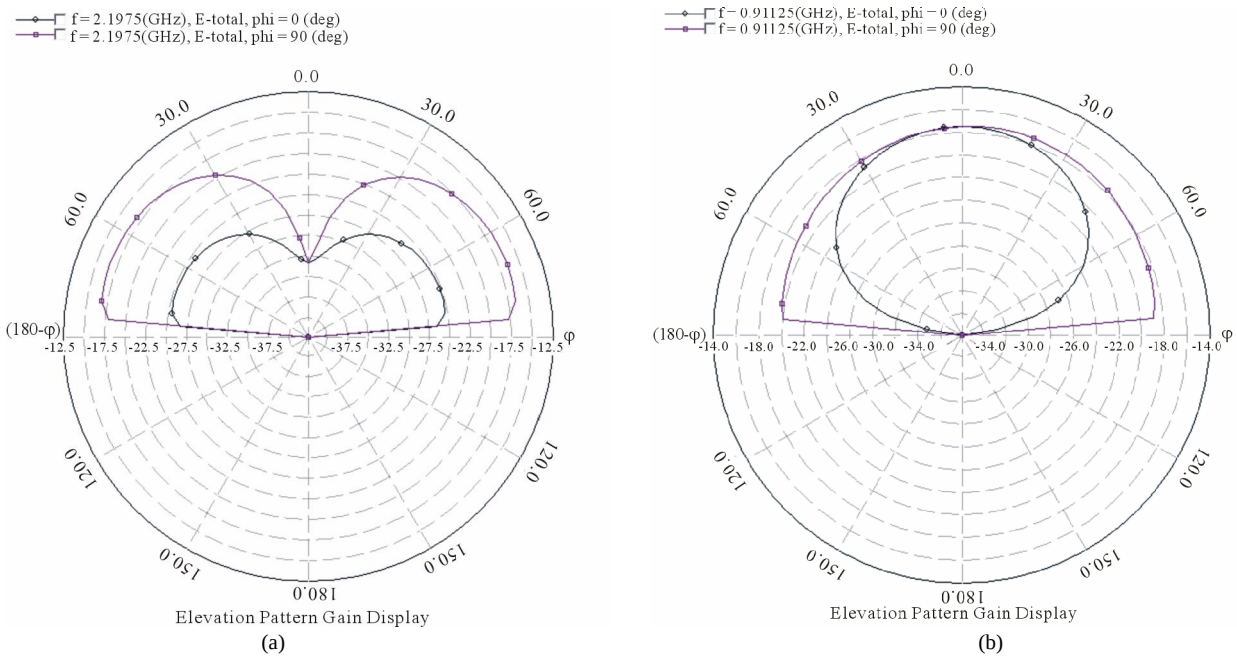

Figure 8. (a) Simulated radiation pattern of base shape at 2.19 GHz; (b) Simulated radiation pattern at 0.91 GHz for second iteration.

slot of first iteration. These antennas may find application in wireless communication systems.

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7

New Antenna Array Architectures for Satellite Communications

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Universidad Politécnica de Madrid, Spain

1. Introduction

Ground stations which integrate the control segment of a satellite mission have as a common feature, the use of large reflector antennas for space communication. Apart from many advantages, large dishes pose a number of impairments regarding their mechanical complexity, low flexibility, and high operation and maintenance costs. hus, reflector antennas are expensive and require the installation of a complex mechanical system to track only one satellite at the same time reducing the efficiency of the segment (Torre et al., 2006).
With the increase of new satellite launches, as well as new satellites and constellation of low earth orbit (LEO), medium earth orbit (MEO), and geostationary earth orbit (GEO), the data download capacity will be saturated for some satellite communication systems and applications. Thus, the feasibility of other antenna technologies must be evaluated to improve the performance of traditional earth stations to serve as the gateway for satellite tracking, telemetry and command (TT&C) operation, payload and payload message or data routing (Tomasic et al., 2002). One alternative is the use of antenna arrays with smaller radiating elements combined with signal processing and beamforming (Godara, 1997).
Main advantages of antenna arrays over large reflectors are the higher flexibility, lower production and maintenance cost, modularity and a more efficient use of the spectrum. Moreover, multi-mission stations can be designed to track different satellites simultaneously by dividing the array in sub-arrays with simultaneous beamforming processes. However, some issues must be considered during the design and implementation of a ground station antenna array: first of all, the architecture (geometry, number of antenna elements) and the beamforming process (optimization criteria, algorithm) must be selected according to the specifications of the system: gain requirements, interference cancellation capabilities, reference signal, complexity, etc. During implementation, deviations will appear as compared to the design due to the manufacturing process: sensor location deviation and sensor gain and phase errors (Martínez & Salas, 2010). In an antenna array, the computation of a close approach of the direction of arrival (DoA) and the correct performance of the beamformer depends on the calibration procedure implemented.

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This chapter is organized with the following sections. Section 2, introduces the relationship between applications and antenna design architectures. Section 3, introduces the new antenna array architectures for satellite communication including motivation and explains experimental examples. Section 4, explains adaptive antenna array and receiver architectures for adaptive antennas systems considering the beamforming with synchronization algorithms. Finally, Section 5 explains the A3TB concept.

2. Applications and antenna design architectures

In recent effort, new antenna array architectures have been under analysis and development. In (Tomasic et al., 2002) a highly effective, multi-function, low cost spherical phased array antenna design that provides hemispherical coverage is analyzed. This kind of novel architecture design, as the geodesic dome phased array antenna (GDPAA) presented in (Tomasic et al., 2002) preserves all the advantages of spherical phased array antennas while the fabrication is based on well-developed, easily manufacturable, and affordable planar array technology (Liu et al., 2006; Tomasic, 1998). This antenna architecture consists of a number of planar phased sub-arrays arranged in an icosahedral geodesic dome configuration.

In contrast to the about 10 *m* diameters dome of the GDPAA, there is the geodesic dome array (GEODA) (Sierra et al., 2007) with 5 *m* diameters dome. This antenna, presented in Fig. 1, has two geometrical structure parts. The first one, is based on a cylinder conformed by 30 triangular planar active arrays, and the second is a half dodecahedron geodesic dome conformed by 30 triangular planar active arrays. The GEODA is specified in a first version for satellite tracking at 1.7 GHz, including multi-mission and multi-beam scenarios (Martínez & Salas, 2010). Subsequently, the system of the GEODA has been upgraded also for transmission (Arias et al., 2010).

a b c

Fig. 1. a) The GEODA, b) The active sub-array demonstration, and c) The 45 elements planar active sub-array.

The antenna arrays technology in the user segment for satellite communications will substitute reflectors providing a more compact and easy to install antenna system, which is an interesting solution e.g. for satellite on the move (SOTM) system. There is a great diversity of solutions for fixed and mobile satellite communication systems including a large number of applications. Inmarsat broadband global area network (Inmarsat-BGAN) (Franchi et al., 2000) is the most representative example among mobile satellite systems (MSS), which gives land, maritime and aeronautical high speed voice and data services with global coverage using GEO satellites at L-band.

MSS services are divided into two groups, those that offer a regional coverage usually with GEO satellites, and those which offer a global coverage based on LEO or MEO satellite constellations. Depending on the coverage, there are some examples for MSS with regional coverage as the mobile satellite system (MSAT) in EEUU, Canada and South America, Optus in Australia, N-Star in Japan, Asia cellular satellite (ACeS) in Asia or Thuraya in the Middle East and in the North of Africa. While for MSS of global coverage there are some examples as Iridium, ICO Global Communications, Globalstar, Teledesic, etc. (Evans, 2009; Wu, 1994). Most of the MSSs work at L and S band, new applications on satellite to mobile terminal links work at X, Ku and Ka band, and satellite to base station connections work at L, S and C band. A number of applications is broad and lead terrestrial telecommunications market to offer a wider coverage: high speed voice and data (internet access, SMS, VoIP), digital video broadcasting by satellite 2 (DVB-S2) and digital video broadcasting satellite services to handhelds (DVB-SH), global position system (GPS) and Galileo, security, control and machinery monitoring on ships and aircrafts, teleeducation or telemedicine.

These modern satellite communications systems require new antenna solutions for base stations, aeronautical applications or personal communications services (PCS) on-the-move (Fujimoto & James, 2001). Within these applications, antenna array systems are potentially the best choice due to, as discussed above, its capability to perform electronically steering or beamforming, increase the antenna gain, and conform over curved or multifaceted surfaces the radiating elements. Portable antennas for PCS must be easy to install and mechanically robust, besides compact and lightweight (García et al., 2010) as the antenna array presented in Fig. 4.a. The design of antenna systems to provide high data rates for reliable PCS boarded on ships is not so strict in term of the geometrical requirements because it does not have space limitations (Geissler et al., 2010). However, in the case of land or airborne vehicles, geometrical and mechanical constraints are more severe. Antennas for terrestrial vehicles must be low profile, and for airborne vehicles aerodynamic shapes must be considered (Baggen et al., 2007; Vaccaro et al., 2010). Moreover, for the civil market conformal antenna arrays (Schippers, 2008; Kanno et al., 1996), or multi-surface arrays (Khalifa & Vaughan, 2007) are suitable choices to deal with the system aesthetic partiality.

Technological challenges have been faced during the implementation of satellite communication systems in the last decades. The design of a Test-Bed flexible and modular for testing or debugging beamforming algorithms and receiver architectures is an invaluable contribution in the educational, research and development area on satellite communication systems. The adaptive antenna array Test-Bed (A3TB) concept is based on the use of antenna arrays with beamforming capability to receive signals from LEO satellites (Salas et al., 2008). The scope of the A3TB is to probe the concept of antenna arrays applied to ground stations instead of reflectors for different applications, such as telemetry data downloading. It is also a good chance for Universities and Research Centers aiming to have their own ground station sited in their installations.

The A3TB ground station relies on the use of an antenna array to smartly combine the received signals from the satellite thanks to the implementation based on software defined radio (SDR) technology. The advantages of the SDR implementation is that A3TB architecture can be used to process any received signal from LEO satellites in the band imposed by the radio frequency (RF) circuits. Moreover, most of the processing is performed in software, so that appropriate routines can be used to process any received signal. The A3TB can be used to analyze the feasibility of different receivers and beamformer

algorithms, regarding the capability to switch the receiver architecture in terms of the synchronizer algorithm configuration (Salas et al., 2007).
The current version has been developed to track The National Oceanic and Atmospheric Administration (NOAA) satellites in the very high frequency (VHF) band, in particular, the automated picture transmission (APT) channel (Salas et al., 2008). Previous versions of A3TB dealt with low rate picture transmission (LRPT) signals from the meteorological operational satellite-A (MetOp-A), where a complete receiver with beamforming and synchronization stages has been implemented (Salas et al., 2007; Martínez et al., 2007).

3. Antenna arrays for satellite communications

Satellite applications require compactness, lightweight and low cost antenna systems to be mounted on a terrestrial vehicle, an aircraft or a ship, or as a portable man-pack or a handset, and to be competitive against ground systems. Its major advantage is the possibility of getting a wider or even a global coverage. For such purposes, antenna arrays offer the technology to get a directive system whose steering direction can be electronically and/or mechanically controlled. However, planar arrays usually cannot steer more than 60º-70º from the normal direction of the antenna (Mailloux, 2005). Thus, when a wider angular coverage is required conformal arrays are an appropriate option (Josefsson & Persson, 2006). Arrays can approximate conformal shapes, such as spheres or cylinders, using several planar arrays, simplifying fabrication of active components (Sierra et al., 2007).
Since the low cost and low weight specifications are of importance, micro-strip antennas are mostly used, due to its capacity to be printed over a dielectric substrate with photolithography techniques. Low cost and low permittivity substrates are usually used such as FR4 or PTFE with different quantities of glass or ceramic impurities. For more demanding applications, ceramics, like alumina or high/low temperature co-fired ceramics (HTCC/LTTC) allow the use of smaller components thanks to its high permittivity, and give robustness against mechanical stresses and high temperatures.

3.1 Geodesic antenna array for satellite tracking in ground station

The aim of using a single antenna for tracking many satellites at the same time avoiding mechanical movements as well as its inexpensive cost make these antennas an alternative to be considered (Salas et al., 2008). Multi-beam ability and interference rejection are facilitated thanks to the electronic control system of such antennas that improves the versatility of the ground stations.
The GEODA is a conformal adaptive antenna array designed for MetOp satellite communications with specifications shown in Table 1. This antenna was conceived to receive signals in single circular polarization (Montesinos et al., 2009). Subsequently, in recent efforts the system has been upgraded also for transmission and double circular polarization (Arias et al., 2010). Hence, operating at 1.7 GHz with double circular polarization it can communicate with several LEO satellites at once in Downlink and Uplink. Current structure is the result of a comprehensive study that valued the ability to cover a given spatial range considering conformal shape surface and a given beamwidth (Montesinos et al., 2009). As Fig. 1 shows, GEODA structure consists of a hemispherical dome placed on a cylinder of 1.5 meters height. Both cylinder and dome are conformed by 30 similar triangular planar arrays (panels). Each panel consists of 15 sub-arrays of 3 elements (cells). The radiating element consists of 2 stacked circular patches with their own

RF circuits. The principal patch is fed in quadrature in 2 points separated 90º in order to obtain circular polarization. The upper coupled patch is used in the aim of improving the bandwidth.

Each panel is able to work itself as an antenna since they have a complete receiver that drives the 1.7 GHz signal to an analog to digital converter (ADC). In order to adapt the signal power to the ADC, it is mandatory to implement a complete intermediate frequency (IF) receiver consisting of heterodyne receiver with an automatic gain control block. Hence, each triangular array has active pointing direction control and leads the signal to a digital receiver through an RF conversion and filtering process. To follow the signal from the satellite, the main beam direction has to be able to sweep an angle of 60º. In this way, it is needed a phase shift in the feeding currents of the single radiating element. Previous calculations have demonstrated that 6 steps of 60 degrees are needed to achieve the required sweeping angle. An adaptive digital system allows the adequate signal combination from several triangular antennas. The control system is explained in (Salas et al., 2010).

Parameter	Specification	Parameter	Specification
Frequency range [GHz] **Tx:** **Rx:**	 1.65 to 1.75 1.65 to 1.75	**Isolation between Tx and Rx [dB]**	>20
Polarization	Dual circular for Tx and Rx bands	**VSWR**	1.2:1
G/T [dB/K] **For elevation >30º** **For elevation 5º**	 3 6	**SLL [dB]**	-11
EIRP [dBW]	36	**Size [m]**	1.5x1.5x3
3dB beamwidth [deg.]	5	**Accuracy steering [deg.]**	±1.4
Maximum gain [dBi]	29	**Coverage [deg.]:** **Azimuth** **Elevation**	 360º >5º
Efficiency [%]	50		

Table 1. Main specifications for GEODA antenna.

3.1.1 Cell radiation pattern

Based on the study presented in (Sierra et al., 2007), the single radiating element is a double stacked circular patch that works at 1.7 GHz with 100 MHz bandwidth. In order to obtain circular polarization, the lower patch, which has 90 mm diameter, is fed by 2 coaxial cables in quadrature. Both coaxial cables connect the patch with a hybrid coupler to transmit and

receive signals with both, right and left, circular polarizations. The upper patch is a circular plate with 78.8 mm diameter, and it is coupled to the lower patch increasing the bandwidth by overlapping both resonant frequencies tuning the substrate thickness and the patch diameter size. Fig. 2.a shows the radiating element scheme and main features of the layer structure are specified in (Montesinos et al., 2009).

A cell sub-array of 3 radiating elements shown in Fig. 2.b is considered the basic module to build the planar triangular arrays. The whole cell fulfills radiation requirements since it has a good polar to crosspolar ratio and a very low axial ratio. Likewise, as it is presented in Fig. 2.c, the radiation pattern shows symmetry and low side lobes for full azimuth.

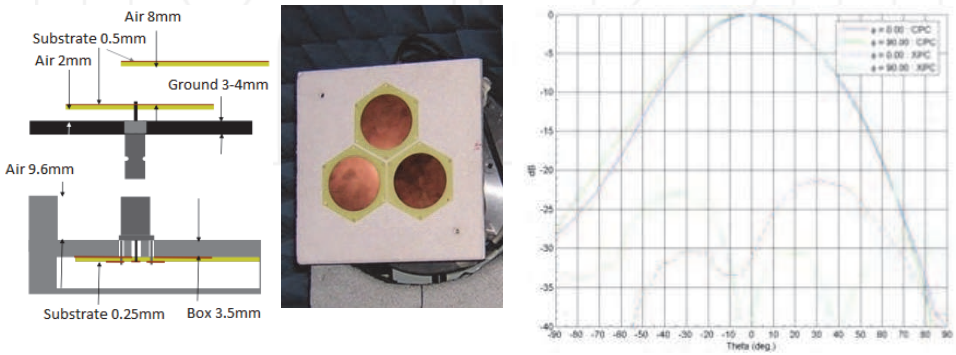

a b c

Fig. 2. a) Assembly of the single radiating element, b) Cell scheme, and c) Cell radiation pattern.

3.1.2 Transmission and Reception (T/R) module and cell distribution

Different T/R module configurations have been considered, providing either single or double polarization (Arias et al., 2010). T/R module allows amplifying and controlling the phase shift between signals, received and transmitted, providing an adaptive beam and steering direction controller in the whole working pointing range. As Fig. 3 shows, the design implemented contains a hybrid coupler, enabling double circular polarization; a double pole double throw (DPDT) switch, selecting polarization associated with transmission and reception way; 2 low noise amplifiers (LNAs), which amplify the signal received or transmitted; a single pole double throw (SPDT) switch, choosing transmission or reception way; and phase shifters, introducing multiples of 22.5º relative shift phases to form the desired beam. These surface mount devices have been chosen in order to reduce space and simplify the design.

Signals transmitted/received by the 3 T/R modules placed in a cell are divided/combined thanks to a divider/combiner circuit composed of 3 hybrid couplers that leads the signal to a general T/R module where signal is amplified. Due to transmission and reception duality, 2 SPDT switches are used to select the amplification way. Furthermore, each T/R module has associated a -25dB directional coupler that is used to test T/R modules in the transmission mode. Additionally, reception mode is tested by measuring signal in the divider/combiner circuit. A single pole 6 throw (SP6T) switch selects the path that is tested.

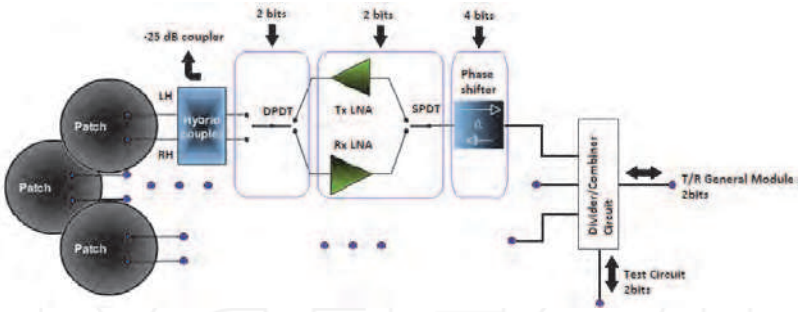

Fig. 3. Cell sub-array and RF circuit.

3.1.3 Control system

The control system has two main parts (Salas et al., 2010), the hardware structure and the control software. The two level hardware structure has the lowest possible number of elements, making the control simpler in contrast to the previous in (Salas et al., 2010). Finally, an inter-integrated circuit (I2C) expander is used to govern T/R modules individually, and one more cover cell needs (LNA of call and test). A multipoint serial standard RS-485 is used to connect the computer with the panels.

3.2 Portable antenna for personal satellite services

New fix and mobile satellite systems (Evans, 2000) require antenna systems which can be portable, low profile and low weight. Planar antennas are perfect candidates to fulfill these specifications. Usually slots (Sierra-Castañer et al., 2005) and printed elements (García et al., 2010) are most used as radiating elements.

3.2.1 Antenna system structure

In this subsection it is introduced a printed antenna for personal satellite communications at X band, in Fig. 4. Table 2 shows main antenna characteristics.

Parameter	Specification	Parameter	Specification
Frequency range[GHz] **Tx:** **Rx:**	7.9 to 8.4 7.25 to 7.75	**Efficiency [%]**	50
Polarization	Dual circular polarization for Tx and Rx bands	**Isolation between Tx and Rx [dB]**	>17
G/T [dB/K]	7	**VSWR**	1.4:1
EIRP [dBW]	32	**SLL [dB]**	-11
3dB beamwidth [deg.]	5	**Size [m]**	40x40x2.5
Maximum gain [dBi]	25	**Weight [Kg]**	2

Table 2. Portable antenna specifications.

This is a planar, compact, modular, low loss and dual circular polarized antenna, for Tx and Rx bands, simultaneously. It is made up by a square planar array of 16x16 double stacked micro-strip patches, fed by two coaxial probes. A hybrid circuit allows the dual circular polarization (Garg et al., 2001). Elements are divided in 16 sub-arrays excited by a global power distribution network of very low losses, minimizing the losses due to the feeding network and maximizing the antenna efficiency. In order to reduce side lobe levels (SLL), the signal distribution decreases from the centre to the antenna edges, keeping symmetry with respect to the main antenna axes. The antenna works at X band from 7.25 up to 8.4 GHz with a 14.7% relative bandwidth for a 1.4:1 VSWR and a maximum gain of 25 dBi.

3.2.2 Sub-array configuration

The sub-array configuration can be seen in Fig. 4.a. It makes possible to separate the fabrication of these sub-arrays from the global distribution network, simplifying the corporative network and getting a modular structure suitable for a serial fabrication process. Each sub-array is a unique multilayer board, where PTFE-Glass substrate of very low losses has been used as base material. The power distribution network is connected to each sub-array through (SMP-type) coaxial connectors.

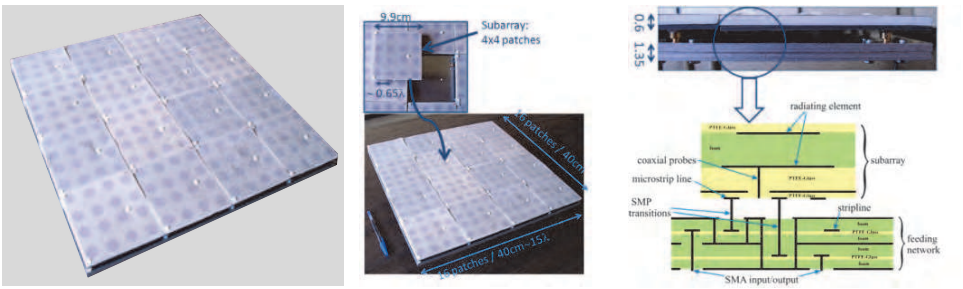

a b c

Fig. 4. a) Dual polarized portable printed antenna for satellite communication at X band, b) Sub-array perspective view, and c) Side view and multilayer scheme.

Fig. 5.a and Fig. 5.b show the sub-array unit cell. In order to obtain better polarization purity, each element is rotated 90º and excited by a 90º phase-shifted signal. Moreover, in Fig. 5.c is showed a miniaturized branch-line coupler (BLC) of three branches working as a wide band hybrid circuit (García et al., 2010; Tang & Chen, 2007).

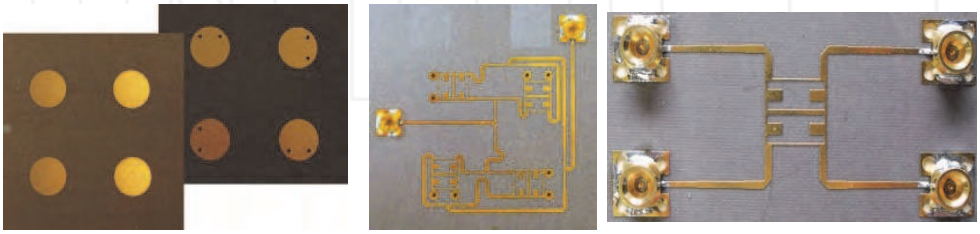

a b c

Fig. 5. Unit cell test board, a) Unit cell test board 2x2 stacked patches, b) Micro-strip feeding network, and c) Miniaturized BLC Prototype.

A conventional configuration takes up an area of 13.3 cm² which is big compared to the radiating element and the sub-array subsystem size. Therefore, a miniaturization of the BLC is needed using the equivalence between a λ/4 transmission line and a line with an open-ended shunt stub. An area reduction about 35% is achieved and the hybrid circuit behaves like a conventional BLC. In Fig. 6.b and Fig. 6.c measurement results for the BLC in Fig. 5.c are shown compared with simulations.
Fig. 7 depicts some sub-array measurements. The copular to crosspolar ratio is better than 25 dB and axial ratio is under 0.9 dB in the whole bandwidth.

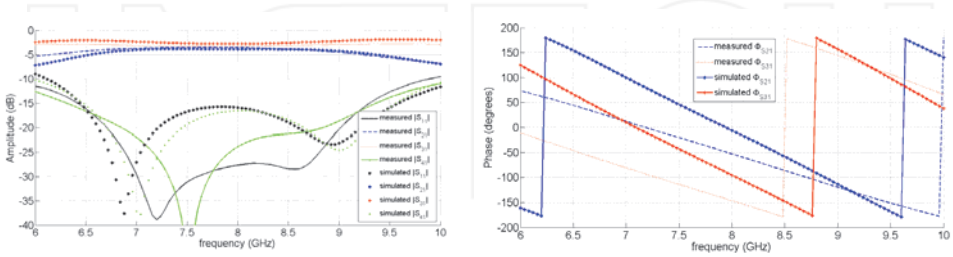

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Fig. 6. Miniaturized BLC, Measured and simulated S-parameters in: a) Amplitude, and b) Phase.

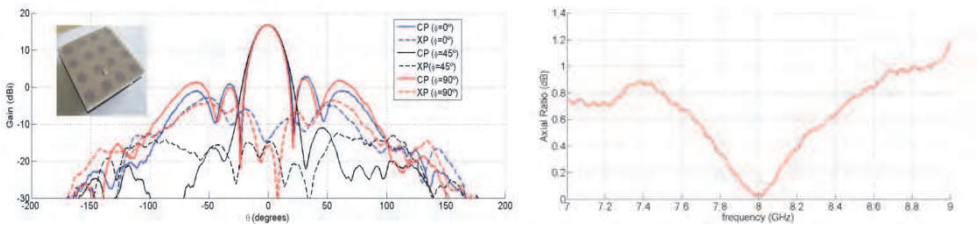

a b

Fig. 7. 4x4 patch sub-array measurements, a) Radiation pattern at 7.75 GHz, and c) Axial ratio for right-handed circular polarization.

3.2.3 Low losses power distribution network

The global feeding network presented in Fig. 8.a is a protected strip-line, where foam sheets of high thickness are used to get low losses. Such a kind of feeding network allows keeping a trade-off between the simplicity of exciting the radiating elements using printed circuits and the loss reduction when the distribution network is separated in a designed structure to have low losses. Losses in the structure are around 0.6 dB/m which yields to 0.3 dB of losses in the line. Two global inputs/outputs using SMA-type connectors, one for each polarization, excite the strip-line networks.
Vertical transitions have to be treated carefully and must be protected to avoid undesired higher order mode excitation. Thereby, it has been design a short-ended pseudo-waveguide, adding some extra losses about 0.3 dB, for two kinds of vertical transitions, as can be seen in Fig. 8.b and Fig. 8.c.

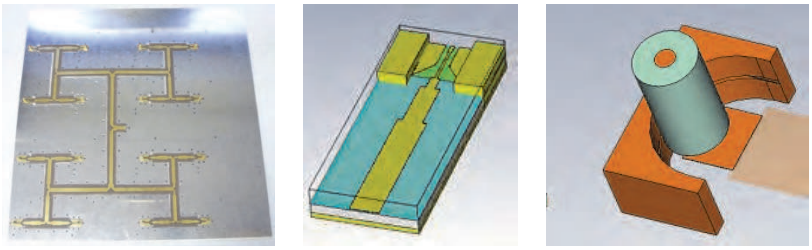

a b c

Fig. 8. a) Protected strip-line global corporative network for one polarization, b) Transitions from strip-line to SMA-type connector, and c) Transitions from strip-line to SMP-type connector.

3.2.4 Antenna performance

Fig. 9 depicts measured radiation pattern at 7.75 GHz, gain and axial ratio for the antenna system. It is shown a maximum gain of 25 dBi in the lower band and about 22 dBi in the upper band, and a SLL around 11 dB. Copolar to crosspolar ratio is better than 30 dB and axial ratio is under 0.7 dB. Total losses are about 4 dB in the working band.

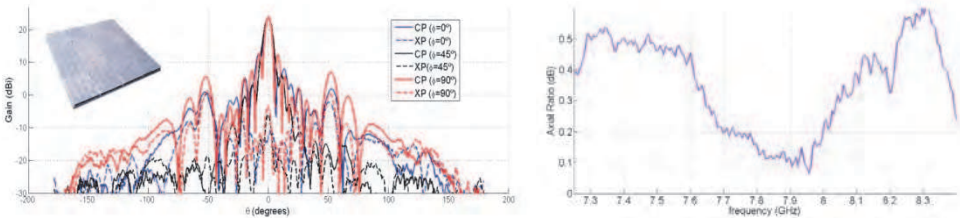

a b

Fig. 9. Antenna measurements results, a) Radiation pattern at 7.75 GHz, and c) Axial ratio for right-handed circular polarization.

3.3 Electronically steerable antennas for mobile and fixed portable systems

At present, two types of electric steerable antenna systems can be used to access the satellite communication services (Bialkwoski et al., 1996). These are: fixed position portable systems and mobile systems such as those installed on a land vehicle. The fixed portable antenna system is relatively easy to be accomplished by the antenna designer. The design involves standard procedures that concern the operational bandwidth, polarization and moderate gain (García et al., 2010). One drawback of the fixed position portable system is that they require the user to be stationary with respect to the ground. This inconvenience can be overcome with the mobile antenna system. A mobile user complicates the scenario since the ground mobile antenna needs to track the satellite (Alonso et al., 1996). The design of such a system is more challenging as new features associated with the mobility of the system have to be incorporated (Fernández et al., 2009). The requirement leads to a narrow beamwidth, for which satellite tracking is required as the vehicle moves around. Electronically steerable antennas enable the development of reconfigurable antennas for satellite applications.

3.3.1 Steerable antenna for fixed position portable systems

This antenna is a fixed satellite communication system with high gain at X band, consisting of an antenna array that integrates 32 2x2 sub-array modules in the complete antenna, as shown in Fig. 10.a. It is a planar and dual circular polarized antenna for Tx and Rx bands simultaneously. It is made up by a planar array of double stacked circular micro-strip patches, fed by 2 coaxial probes to generate circular polarization. A hybrid circuit allows the dual circular polarization as shown in Fig. 10.b.

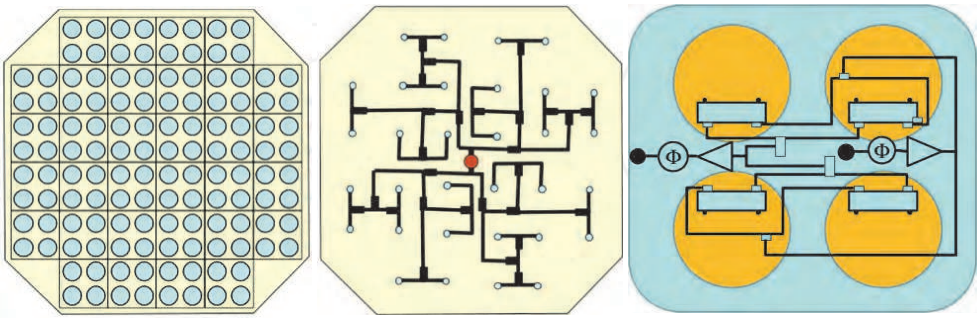

a b c

Fig. 10. Active multi-beam antenna, a) Top view, b) Feeding network of the complete antenna, and c) Beamforming network of the 2x2 sub-array module

The antenna has the same design parameters, structure and configuration as the antenna explained in Section 3.2 but with a different feeding network, as previously shown. In this case, the beamforming network requires changes in the feeding phase in the 2x2 sub-arrays, which can be achieved by phase shifters (ϕ) associated with different sub-arrays (Fig. 10.c). All these sub-arrays are connected to a feeding network, in Fig. 10.b, formed by transmission lines with low losses in strip-line. General specifications of the steerable antenna for fixed position portable systems are provided in Table 3.(a).

3.3.2 Automatic steerable antenna for mobile systems

A broadband circularly polarized antenna for satellite communication in X band is presented in Fig. 11 and specified in Table 3.(b). The arrangement features and compactness are required for highly integrated antenna arrays. It is desired to get a low-gain antenna for mobile satellite communications with low speed of transmission. In this system, the antennas are formed by 5 planar 4x4 arrays of antennas, which form a truncated pyramid with a pointing capability in a wide angular range, so that among the 5 planar arrays the complete antenna can cover any of the relative positions between the mobile system and the satellite in a practical way. The scheme of the active antenna can be seen in Fig. 11.

As it can be observed in Fig. 11.a, the antenna terminal is a multi-beam printed antenna shaped as a trunk pyramid capable of directing a main beam in the direction of the satellite. The antenna steering system consists of a multi-beam feeding structure with switches that lets combine the feed of each 4x4 arrays to form multiple beams. Switching the different 4x4 arrays, it is achieved different multiple beams and the variation of the steering direction.

The complete antenna consists of a Tx and Rx module that works independently in the 2 frequency bands.
The antenna has multiple beams covering the entire space to capture the satellite signal without moving the antenna. The signal detected in each of the beams is connected to a switch, which, by comparison, is chosen the most appropriate 4x4 array. The steering direction of the 4x4 array can vary between a range of directions that covers a cone angle range of 90º. To obtain the required gain and cover the indicated range, it is required around 15 beams, which can be obtained by integrating the beamforming networks with switches in the design as presented in (Fernández et al., 2009).

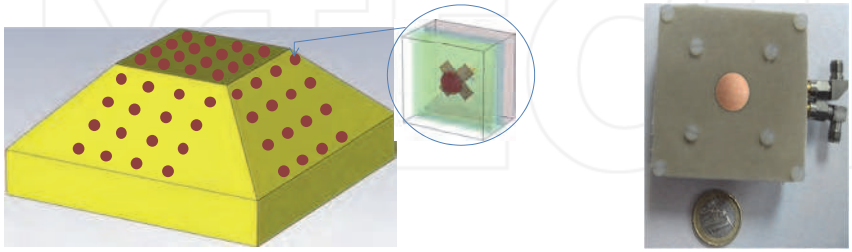

a b

Fig. 11. Complete antenna structure, a) Radiating element of the 4x4 arrays, and b) Prototype top view.

The radiating element of the 4x4 array is one 2 crossed dipoles with a stacked circular patch as shown in Fig. 11.a and Fig. 11.b. In Fig. 12 the cross-section of the radiating element structure is presented.

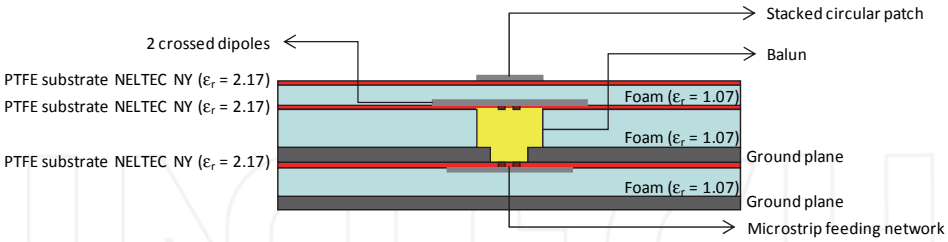

Fig. 12. Cross-section scheme of the radiating element.

The key element of the radiating element feeding structure (Fig. 14.b) is a resonant micro-strip feed ring that has been implemented, as well as a micro-strip 90º branch-line coupler to obtain the desired right hand or left hand circular polarizations (RHCP or LHCP) which ensures adequate port coupling isolation. The S-parameters in amplitude and phase of the micro-strip feeding structure are shown in Fig. 13.a and Fig. 13.b.
Fig. 14.a depicts the S-parameters of the radiating element with the micro-strip feed structure and they fulfill the specification, in Table 3.(b). In Fig. 14.c, the radiation pattern of the radiating element at 7.825 GHz is shown and in Fig. 14.d the radiation pattern of the 4x4

arrays is presented. It is shown a maximum gain of 19.4 dBi at the center frequency band (7.825 GHz). Copolar (CP) to crosspolar (XP) ratio is better than 17 dB and the axial ratio is under -3dB.

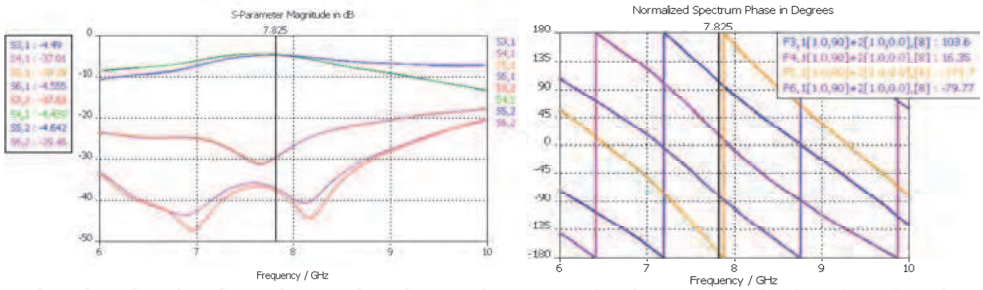

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Fig. 13. Micro-strip feeding structure, a) Amplitude of S-parameters, and b) Phase of S-parameters.

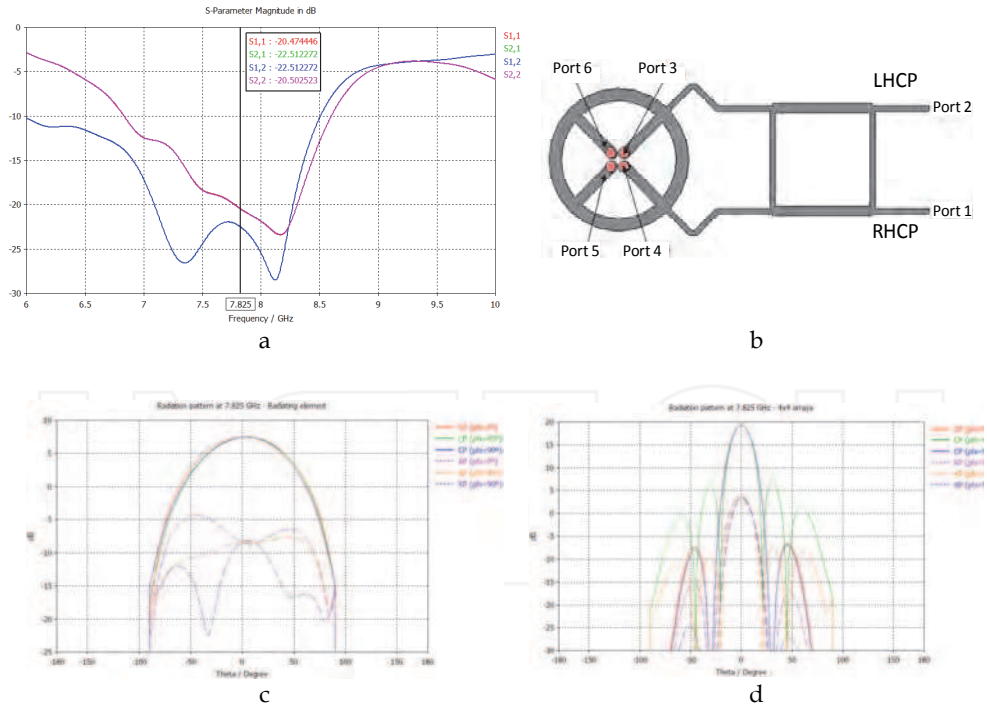

a b

c d

Fig. 14. a) S-parameters, b) Resonant ring + 90º branch-line coupler, c) radiation pattern at 7.825 GHz, and d) 4x4 array radiation pattern.

Parameter	Value (a)	Value (b)	Comments
Freq. range [GHz] **Rx** **Tx**	7.25 - 7.75 7.9 - 8.4	7.25 - 7.75 7.9 - 8.4	Microwave applications.
G/T (in Rx) [dB/K]	7	7	
EIRP (in Tx) [dBW]	32	32	
Beamwidth at -3dB [deg.]	4	20	
Polarization	circular	circular	In both, reception and transmission.
Gain [dBi]	>28	>15	
Axial ratio [dB]	< 1	<3	**(a)** Between ±50º. **(b)** Between ±45º.
VSWR	< 1.4:1 (-15.6 dB)	< 1.5:1 (-13.9 dB)	
Isolation between ports [dB]	< -17	< -15	
Radiation pattern [deg.]	±35	±90	Steering direction tilt.
Dimensions [cm]	40x40x4	20x20x15	

Table 3. (a) General specifications of the steerable antenna for fixed position portable systems , and (b) General features of the automatic steerable antenna for mobile systems.

3.4 Transmit-array-type lens antenna for terrestrial and on board receivers

Technology in satellite communications has revealed an increasing interest in novel smart antenna designs. Phased-array based designs are basic in electronically reconfigurable devices for satellite applications, which are more and more demanding. The strict requirements in terms of architecture, shape and robustness are important constraints for the development of planar lens-type devices. Regarding the usage and location, lens-type devices are useful for either terrestrial or on board receivers, in vehicular technology. Some clear examples are satellite communications for aircrafts preserving the fuselage aerodynamics or for some other kind of vehicles such as trains, etc.

3.4.1 Introduction to lens-type structures

In a general view, in lens-type a particular signal is received (in our case, an electromagnetic wave with specific features in terms of frequency, wave-front, etc.), it is processed (either complex signal processing techniques or only phase correction tasks can be considered in this interface), and finally, the processed signal is retransmitted.

Regarding the lens configuration, a transmit-array lens consists of three well distinguished interfaces: the first one for signal reception, one interface for signal processing, and the last one for processed signal re-radiation, as depicted in Fig. 15.

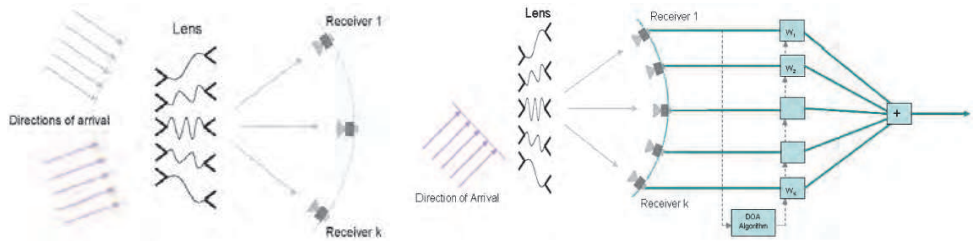

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Fig. 15. a) Multi-user scheme with different receivers and transmitters, and b) Adaptive scheme with DoA determination.

These structures are intimately related to reflect-array ones, where the reception and transmission interfaces are turned to be the same interface, with a reflection-type behavior (Encinar & Zornoza, 2001). Although in an equal output phase configuration a transmit-array device behavior would be similar to the one obtained with a reflect-array, the transmit-array offers the advantage of removing the feed blockage.
In a transmission scheme, depending on the transmitter position regarding the lens, a different steering direction is achieved and a different user is pointed. In the case of reception, the situation is the same: the user position configures the direction of arrival, which determines the receiver position around the lens (Padilla et al., 2010a). In adaptive schemes, applying the proper processing algorithm to the signal received in the different receivers around the lens, it is possible to develop an adaptive steering vector, in terms of the desired direction of arrival.

3.4.2 Transmit-array lens architecture and design

Lens-type structures provide two fundamental advantages. First, phase error correction due to spherical wave front coming from the feeding antenna. Fig. 16.a shows this effect. Second, new radiation patterns configuration. Fig. 16.b depicts this fact.

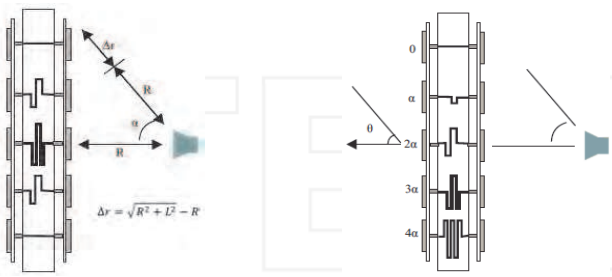

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Fig. 16. a) Phase error correction, and b) Radiation pattern reconfiguration.

3.4.3 Electronically reconfigurable devices for active transmit-array lenses

The addition of reconfigurability on transmit-array devices requires the possibility of controlling the phase response of the transmitted signal at each cell of the lens. Electronic control of phase signal may be added in two different ways: First, electronic tuning of the

radiating element phase response (Padilla et al., 2010a): Modifications in the radiating element circuital behavior lead to changes in phase response (arg[S_{21}]). Fig. 17 shows an electronically reconfigurable microwave patch antenna for this purpose, along with the equivalent circuit and prototype outcomes in terms of phase.

Second, electronic tuning of phase shifters in transmission lines (Padilla et al., 2010c): Modifications in the phase response of the phase shifters lead to corresponding changes in phase response. Some options are applied for these devices, such as hybrid couplers, etc. Fig. 18 shows a microwave phase shifter prototype for this purpose, along with the working scheme and its outcomes in phase.

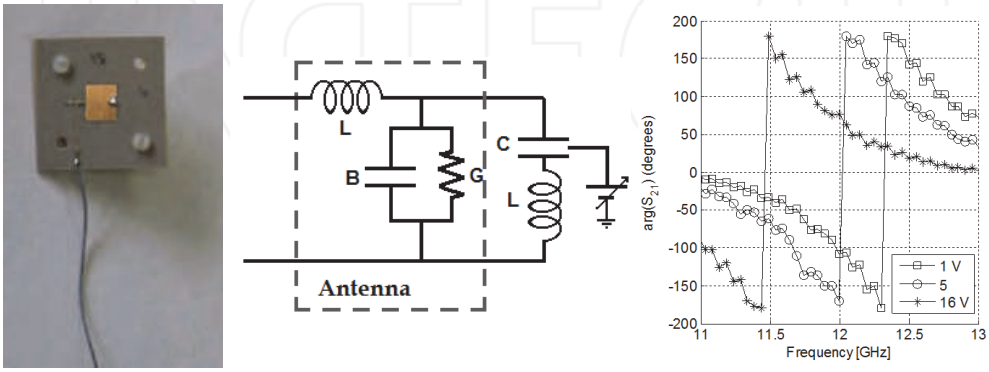

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Fig. 17. Electronically reconfigurable antenna, a) Patch antenna prototypes, b) Equivalent circuit, and c) Phase behavior in frequency.

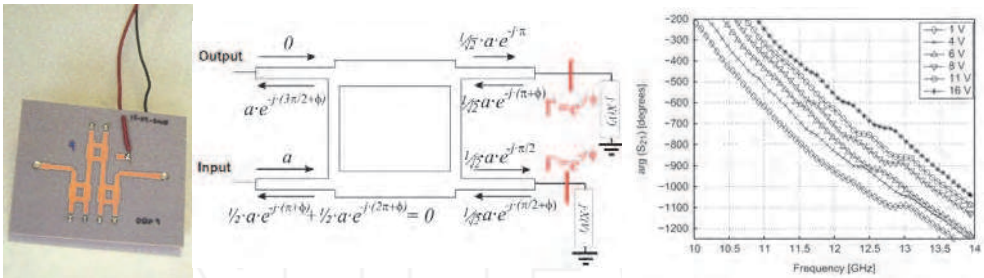

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Fig. 18. Electronically reconfigurable phase shifter, a) Phase shifter prototype, b) Working scheme, and c) Phase behavior in frequency.

3.4.4 Electronically reconfigurable active transmit-array prototype

One electronically reconfigurable prototype is presented in Fig. 19 and detailed in this section. The prototype design implies the use of microwave phase shifters according to the design specified in section 3.4.3. This transmit-array lens prototype operates at 12 GHz. Main specifications are provided in Table 4.

Parameter	Value	Comments
Frequency range [GHz]	12 ± 0.5	Microwave applications.
Polarization	Linear	In both, reception and transmission.
Directivity [dBi]	>21	
Axial ratio [dB]	< 1	Between ±50º elevation.
S_{11} [dB]	< -20	
Radiation pattern [deg.]	±30	Steering direction tilt, for both H and V planes.
Feeding antenna [mm]	120	Corrugated horn linearly polarized
Phase shifters [deg.]	360	Full phase range variation.
Transmit-array elements	36	6x6 array topology.
Separation between elements	$0.7\lambda_0$	Related to the wavelength

Table 4. Main features of the electronically reconfigurable transmit-array prototype.

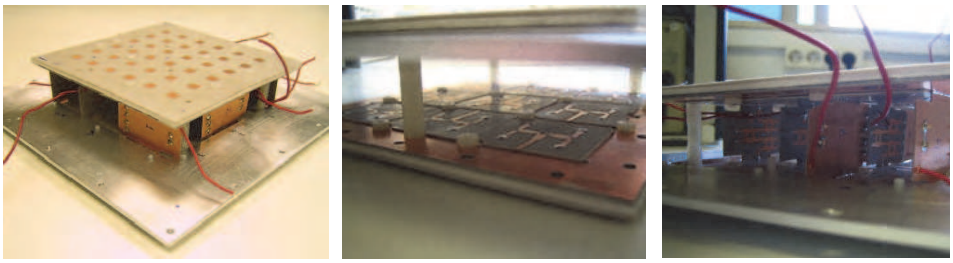

a b c

Fig. 19. Transmit-array core, a) Transmit-array prototype, b) Distribution networks, and c) Phase shifter integration.

The electronically controllable steering capabilities are tested and assured for a range of ± 30ºin each main axis. An example of radiation pattern is provided in Fig. 20, for 9º tilt in one of the main axes.

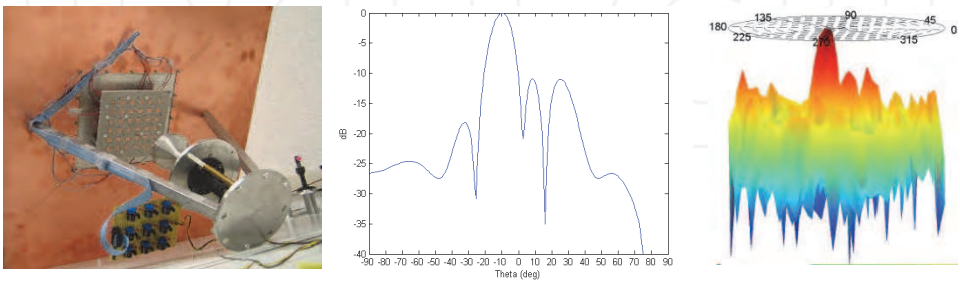

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Fig. 20. a) Complete transmit-array with feeder and control circuits; and transmit-array measurement results for 9º tilt in one axis, b) H plane, and c) 3D plot.

4. Adaptive antenna array

Adaptive antennas can be described as systems usually based on three main parts: the antenna array, the receiver architecture and the beamforming scheme. Thus, adaptive antennas have those advantages owing to those three main parts. The system capabilities increase as complexity and development cost do. Furthermore, since signal processing is the basement of the adaptive antenna concept it is important to analyze the design challenges in terms of hardware architecture and components such as processors and embedded systems.
The antenna array provides the capability of performing the antenna pattern meeting the environment requirement under study. Besides, receiver architectures have some interesting advantages depending on the implemented receiver arraying technique such as signal to noise ratio (SNR) and bit error rate (BER) performance enhancement. Furthermore, symbol synchronization and carrier recovery can be used increasing the receiver complexity but providing higher performances. Finally, beamforming schemes use multiple antennas in order to maximize the strength of the signals being sent and received while eliminating, or at least reducing, interference as discussed in Section 4.3.
Adaptive antenna arrays are often called Smart Antennas because they have some key benefits over traditional antennas, by adjusting traffic patterns, space diversity or using multiple access techniques. The main four key benefits are: First, enhanced coverage through range extension by increasing the gain and steering capability of the ground station antenna; Second, enhanced signal quality through multi-target capability and reduction of interferences; finally, adaptive antennas improve the data download capacity in the ground segment of satellite communication by increasing the coverage range (Martínez et al., 2007).

4.1 Design and architecture based on software defined radio

For design there is the well known waterfall life cyclic model (Royce, 1970) that can be used to manage main aspects of the design of architectures. Thus, some tasks must be fulfilled subsequently as follow in Fig. 21.a.
Fig. 21.b shows the design schemes resulting of the requirement analysis stage corresponding software and hardware system specifications. In the depicted scheme, there are some system components such as the radiating element and RF circuits that are often designed under iterative prototyping model.

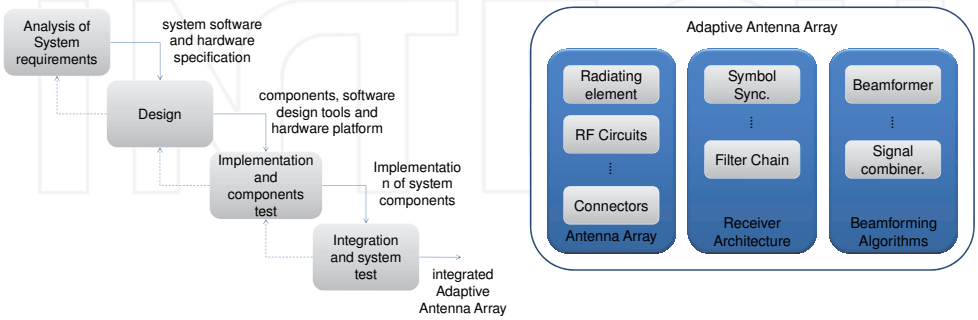

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Fig. 21. a) Water life cyclic model of the adaptive antenna array design, and b) Simplified design scheme of adaptive antenna arrays.

Regarding the hardware implementation, tables presented in (Martínez et al., 2007) show the hardware resource consumption in the field programmable gate array (FPGA) Virtex-4 for the least mean squared (LMS) beamforming algorithm with full spectrum combining (FSC) receiver architecture and SIMPLE beamforming algorithm with symbol combining (SC) receiver architecture. Both scheme designs have an antenna array of 2 elements. The algorithm based on correlation requires less hardware. The main difference can be appreciated in the amount of digital signal processing oriented component (DSP48) resources, typically used for filtering applications (Martínez et al., 2007).

4.2 Receiver architectures based on algorithms type

Several receiver architectures can be implemented, and they are frequently based on the type of the beamforming algorithm used. When training signals are available in the transmitted frame, a time-based reference algorithm can be used. However, this solution is only valid when the earth station is capable of demodulating the received training sequence. Other algorithms used in deep space communications are based on signal correlation and they avoid performing the demodulating process. This kind of algorithms are blind techniques that do not require any additional signal demodulation before applying some beamforming technique and work better in low SNR conditions than time-based algorithms. Several receiver architectures can be implemented exploiting the processing capabilities of the SDR, such as FPGA, application-specific integrated circuits (ASICS), and digital signal processing (DSPs). The design of the receiver architecture fundamentally depends on the selection of beamforming algorithms. An example of beamforming technique is the LMS algorithm whose estimation of coefficients or weights requires a temporal reference and is implemented through SC receiver architecture (Fig. 22.a). In the other hand, the SIMPLE algorithm (Rogstad, 1997) constitutes a beamforming technique that is implemented using FSC receiver architecture (Fig. 22.b) in order to perform the calculation of weights.

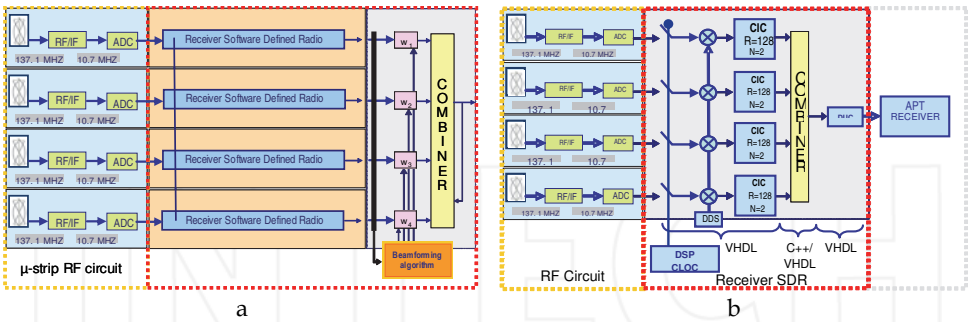

Fig. 22. Comparison of receiver architectures. a) Symbol Combining (SC), and b) Full Spectrum Combining (FSC).

The SC architecture can be divided into two more sub-classes which work on a phase-recovery basis. The complex symbol combining (CSC) recovers the phase information with regard to a reference element using feed-forward and feedback algorithms. One of the advantages of this scheme is that the rate of data sent to the combining module has a rate slightly higher than the symbol rate. For most applications, the symbol rate is relatively low and is a multiple of the data rate. In this kind of schemes, there is an important cost

consideration in real-time applications and the requirements of instrumental phase stability are very severe (Rogstad et al., 2003). Other type of SC architecture is the stream symbol combining (SSC). In this kind of scheme, data are sent to the combining module at a rate equal to the symbol rate. The symbol rate depends on the coding scheme and for most applications is relatively modest. Also, the requirements of instrumental phase stability are no severe, as in the case of CSC scheme. The disadvantage of the SSC is the additional hardware required for each antenna.

Furthermore, there are the baseband combining (BC) and carrier arraying (CA) architectures discussed in (Rogstad et al., 2003). In BC architectures the signal from each antenna is carrier locked and combining in baseband for further demodulation and synchronization. In effect, the carrier signal from the spacecraft is used as a phase reference so that locking to the carrier eliminates the radio-frequency phase differences between antennas imposed by the propagation medium. Besides, in CA architectures, one individual carrier-tracking loop is implemented on each array element. Then, the elements branches are coupled in order to increase the carrier-to-noise ratio (CNR), but losses of radio channel are far compensated (Rogstad et al., 2003).

In general, the selection of the beamforming algorithms is determined by the following aspects: Hardware and computational resources; Speed of convergence and residual error of adaptive algorithms; Calibration requirements and auto-compensation ability; and system signal-transmission characteristics.

4.3 Beamforming techniques for satellite tracking

Some satellites transmit useful information inside its frames for synchronization and tracking purposes. The gathering of satellite data requires the tracking operation along its earth orbit. To accomplish this goal with adaptive array architectures, some beamforming techniques should be implemented. Fig. 23 illustrates a simple example of a narrowband linear adaptive beamformer system.

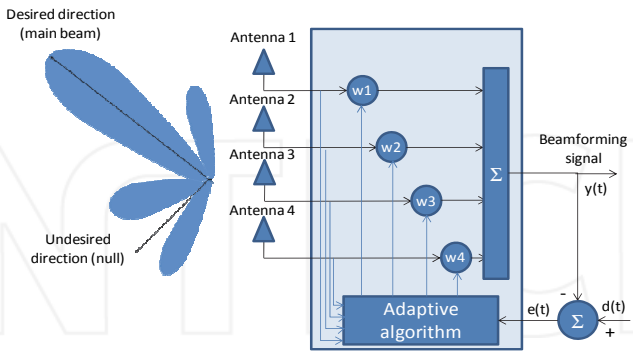

Fig. 23. Adaptive antenna system.

A linear beamformer combines signals according to some weights w_i, to produce a desired radiation pattern. The mathematical expression of a linear beamformer at the array output in vector notation can be expressed as $y = w^H x$, where x is the received signal vector to be combined, w are the weights computed by the beamforming algorithm and ^{H} denotes transposition and conjugate of $(\cdot)$.

In adaptive antennas design, weights are dynamically calculated with a certain algorithm in order to optimize some signal parameter like signal to interference-plus-noise ratio (SINR), SNR, or BER. An extended variety of algorithms exist in the literature for beamforming purpose and the most appropriated selection is done depending on the signal characteristics of the received signal.

4.3.1 Blind techniques

Blind beamformers make use of an inherent property of the received signal, such as the ciclo-stationarity of the constant modulus. In the latter, the algorithm eliminates the fluctuation of the signal amplitude and computes the weights to minimize the effect produced by those variations. The algorithms that make use of these methods are denoted as Constant Modulus Algorithms (CMA) (Biedka, 2001).

CMA algorithms present an important disadvantage: as the phase information is not considered, the constellation of quadrature phase shift keying (QPSK) signals commonly used in satellite communications appears rotated after beamforming, which imposes the need of an additional phase recovery subsystem in the array output.

4.3.2 Temporal-reference algorithms

Algorithms based on a temporal reference require a known reference included in the frame of the signal, such as training sequences, unique word (UW) or pilot bits. Thus, these schemes are normally used for digital signals. The aim of these beamformers is the minimization of the energy of an error signal integrated by interferences and noise. In order to reduce the order of the problem, the weight calculation is usually done iteratively.

The most popular adaptive filters are the LMS and Recursive Least Squares (RLS) algorithms (Haykin, 2002). Briefly, the main differences lie in the method to calculate and the final convergence behavior: while LMS has a linear complexity order with the number of antennas in the array, RLS makes use of matrix operation, so that the complexity order is quadratic, but the convergence is faster.

An interesting alternative to the LMS is the Normalized LMS (NLMS), which normalizes the adaptive step to avoid variation during the convergence process. The counterpart is the more intensive processing requirements to calculate signal power and normalization operation.

4.3.3 Correlation-based algorithm

In contrast to beamformers based on temporal reference, schemes based on signal correlation do not require the demodulation of any signal. These techniques are the most popular to extract the spatial information for beamforming, and we have focused on the use of the SIMPLE algorithm (Rogstad, 1997). This algorithm has been used by the Deep Space Network (DSN) of National Aeronautics and Space Administration (NASA) to combine the signals received from spatial probes in radio telescopes located in different sites around the Earth surface. The main disadvantage of correlation based schemes is the lack of ability to cancel interference signals.

4.4 Performance comparison

Some simulation comparisons between spatial and blind algorithms are presented to show benefits and drawbacks. Four algorithms have been selected with a 4-element uniform linear

array (ULA). The spatial algorithms simulated are post-beamformer interference canceller – orthogonal interference beamformer (PIC-OIB) (Godara, 2004) and minimum power distortionless response (MPDR) (Van Trees, 2002). On the other hand, the blind algorithms are the matrix-free EIGEN and the SUMPLE (Rogstad, 1997). The convergence process is compared as a function of the input SNR as depicted in Fig. 24.
As it can be observed from the above results, spatial algorithms outperform blind ones at low SNR, and vice versa. On the other hand, with medium-low SNR and low or absence of interferences, the behavior of all algorithms is quite similar.

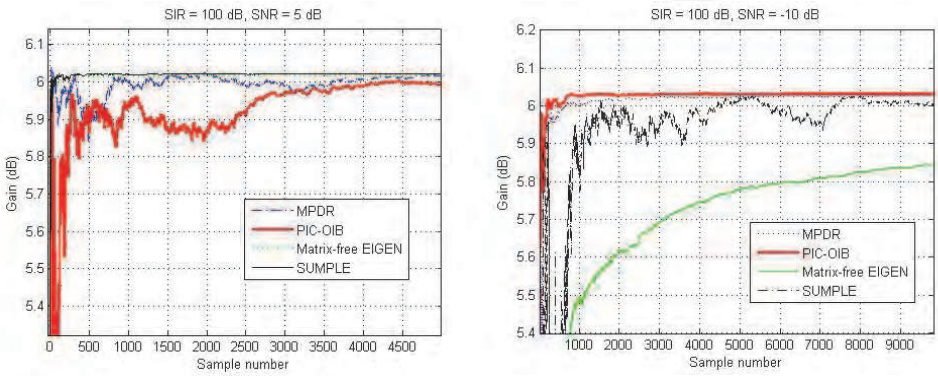

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Fig. 24. Convergence behavior of spatial versus blind algorithms in the absence of interferences with several input SNR. a) SNR = 5 dB, and b) SNR = -10 dB.

5. Experimental Test-Bed based on SDR platform

This section presents a test platform known as Adaptive Antenna Array Test-Bed - A3TB, where a comparative study of several beamforming algorithms can be performed and modularity of the architecture is a well proved advantage. The test bed is based on SDR technology and uses a novel architecture that can be used with both blind and spatial-based beamforming algorithms. The A3TB concept can be applied to a number of scenarios as the current version is independent of the signal properties. Simulation results using the A3TB with the APT channel from NOAA satellites show the performance of the concept and the feasibility of the proposed implementation.
The scope of the system development was is to prove the concept of antenna arrays applied to ground stations instead of reflectors for different applications, such as telemetry data downloading or end-user in mobile applications as discussed in the introduction section. In contrast to reflector antennas, antenna arrays offer the possibility of electronic beam-steering avoiding the use of complex mechanical parts and therefore reducing the cost of the antenna. It is also a good chance for Universities and Research Centers aiming to have their own ground station sited in their installations.

5.1 A3TB concept

The A3TB can be defined as *a software-defined radio beamformer applied to a ground station for tracking LEO satellites*. The novelty relies on the use of an antenna array to smartly combine

the received signals from the satellite and its implementation based on SDR technology. The reason to use an antenna array instead of a single antenna is to electronically steer the beam in the direction of the satellite along its orbit without requiring a mechanical system for tracking. In addition to the advantages of the use of SDR technology and antenna array, it is the modularity and flexible architecture implemented in the A3TB. Fig. 25 shows the A3TB architecture where it is evident the feasibility to update or change during operation any of the main blocks. It is possible to change during operation the beamforming algorithm and to include new beamforming modules to the system. Furthermore, changes on the BENADC are possible to implement not during operation, but new receiver architecture at off-line such as those options discussed at follow.

In (Salas et al., 2007), the block diagram represents the software system implementation of the first version of the test-bed prototype and most of it is based on VHDL. Depending on the firmware, three options could be installed into the FPGA Virtex4. The option A is implemented with the signal processing on the PC, so the SIMPLE beamforming is done in the module developed in C++. The option B is implemented completely on VHDL and this option need to export the beamforming weights just to draw the array pattern diagram. Finally, in contrast to the option B, the option C is implemented for the LMS beamforming algorithm.

With the first version of the Test-Bed, the modularity on the selection of firmwares was proved switching between A, B or C receiver architectures, and an important result of the Test-Bed development is the hardware resources occupation presented in (Salas et al., 2007).

The advantage of the SDR implementation is that A3TB architecture can be used to process any received signal from a LEO satellite in the appropriate band imposed by the RF stages. Moreover, most of the processing tasks are performed on software, using appropriate routines to process any receive signal. There are 2 main schemes to implement the beamforming stage: SC and FSC [41]. Both schemes are compared in Section 4.2.

The current version of the A3TB in Fig. 25.a was updated to track NOAA satellites in the VHF band, in particular the APT channel. Previous versions of A3TB dealt with LRPT signals from MetOp-A, where a complete receiver with beamforming and synchronization stages has been implemented(Salas et al., 2007; Martínes et al., 2007).

5.2 Implementation of the A3TB

The A3TB prototype consists of 4 main parts as shown in Fig. 25.a. The first part is the antenna array, which has 4 crossed-dipole antennas as depicted in Fig. 25.b. The second part consists of RF-IF circuits which amplify and down convert to IF incoming signals. Furthermore, an automatic gain control (AGC) was implemented using two steps of variable attenuators in the IF domain.

The third part is the SDR platform which consists of the beamforming algorithms implemented on C++ and the FPGA firmware on VHDL, PC and BENADC blocks show in Fig. 25, respectively. The hardware resources occupation for this Test-Bed implementation is similar to one presented in (Martínes et al., 2007). The last part is the software from weather satellite signal to image decoder (WXtoImg) on the PC using the sound card output/input in order to get the weather satellite image.

Since the implemented architecture is FSC the demodulation is not required and the IF signal is digitized. For the signal processing hardware design the BenADC-v4 has been chosen. This solution includes a FPGA Xilinx Virtex4-SX55 with four 12-bit analog inputs at

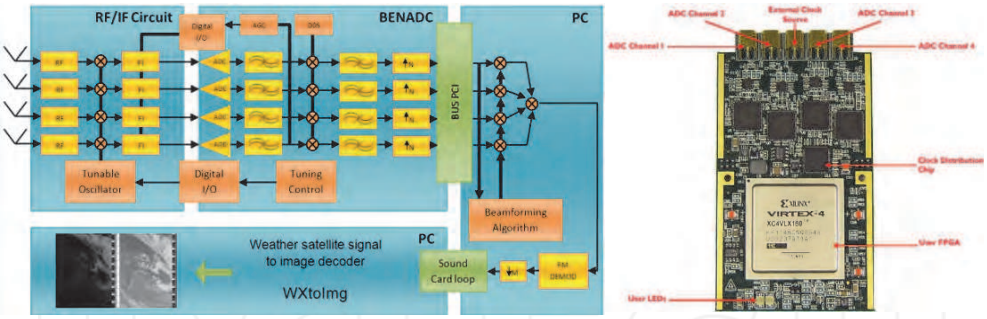

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Fig. 25. a) Block diagram of the A3TB, and b) BenADC – Virtex 4-sx55.

250 Msps (Martínes et al., 2007). Digital samples are transferred to the PC where beamforming and subsequent APT demodulation of the array output are performed using C++ routines. This implementation design offers higher flexibility for testing different beamforming schemes. Finally, demodulated APR frames are sent to the WXtoImg software to show meteorological maps.

The A3TB is controlled by the PC for simulations and field trials. The graphical user interface allows presented in (Salas et al., 2008) the user to choose the beamforming algorithm and set all the parameters of the LEO satellite for tracking such as the number of antennas of the array, distance between the elements, direction of arrival and IF frequency. The C++ routine calculates the beamforming weights and plots the synthesized array factor. Subsequently, the reception of meteorological images has real time system requirements. Thus, it is necessary a data transfer from the FPGA to the C++ module to process the samples continuously, and give APT frames to the audio output of the PC. Since, the meteorological satellites often have a low baud rate, in the case of study with NOAA satellites the data transfer is made using two buffers controlled by a thread.

It is important to mention that the A3TB with SDR architecture can evaluate different beamforming algorithms and receiver schemes. The update of A3TB for larger arrays is immediate, as the basis for algorithms is independent of the number of elements in the array. The architecture of a new ground station concept to track LEO satellites based on software defined radio and antenna arraying as Test-Bed is a well proved choice to evaluate future antenna array architectures for satellite communication and benchmark features of the proposed system. As the A3TB VHF version is based on FSC scheme, the concept can be applied to a number of satellite tracing scenarios.

6. Conclusions

The performance analysis of different beamforming algorithms is an important issue in the new generation antenna array development and research. Thus, A3TB helps to analyze beamforming algorithms paving the way for testing and debugging for posteriori use in larger arrays, such as GEODA. Results obtained in real scenarios with A3TB state, for example, that spatial reference algorithms such as MPDR should be used in the absence of interferences, whereas blind algorithms are appropriate for low SNR conditions. Finally, the A3TB can also serve to validate the performance of calibration procedures.

In future work, the A3TB will deal with the system combining of full modularity with the capability of change firmwares based on the first version design of the Test-Bed, plus the flexible architecture of the current design of the Test-Bed based on VHDL, C++ and Antenna Arraying. Furthermore, the addition of more modules to increase the number of antenna array elements is evident in next generations.

7. Acknowledgment

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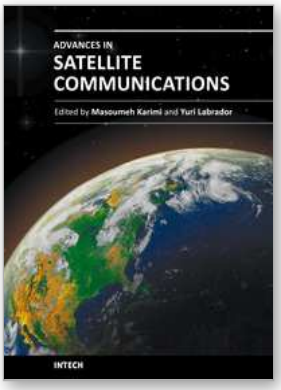

Advances in Satellite Communications

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Satellite communication systems are now a major part of most telecommunications networks as well as our everyday lives through mobile personal communication systems and broadcast television. A sound understanding of such systems is therefore important for a wide range of system designers, engineers and users. This book provides a comprehensive review of some applications that have driven this growth. It analyzes various aspects of Satellite Communications from Antenna design, Real Time applications, Quality of Service (QoS), Atmospheric effects, Hybrid Satellite-Terrestrial Networks, Sensor Networks and High Capacity Satellite Links. It is the desire of the authors that the topics selected for the book can give the reader an overview of the current trends in Satellite Systems, and also an in depth analysis of the technical aspects of each one of them.

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Review Article

Some Recent Developments of Microstrip Antenna

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Although the microstrip antenna has been extensively studied in the past few decades as one of the standard planar antennas, it still has a huge potential for further developments. The paper suggests three areas for further research based on our previous works on microstrip antenna elements and arrays. One is exploring the variety of microstrip antenna topologies to meet the desired requirement such as ultrawide band (UWB), high gain, miniaturization, circular polarization, multipolarized, and so on. Another is to apply microstrip antenna to form composite antenna which is more potent than the individual antenna. The last is growing towards highly integration of antenna/array and feeding network or operating at relatively high frequencies, like sub-millimeter wave or terahertz (THz) wave regime, by using the advanced machining techniques. To support our points of view, some examples of antennas developed in our group are presented and discussed.

1. Introduction

The concept of microstrip antenna was first introduced in the 1950s [1]. However, this idea had to wait nearly 20 years to be realized after the development of the printed circuit board (PCB) technology in the 1970s [2, 3]. Since then, microstrip antennas are considered as the most common types of antennas due to their obvious advantages of light weight, low cost, low profile, planar configuration, easy of conformal, superior portability, suitable for arrays, easy for fabrication, and easy integration with microwave monolithic integrate circuits (MMICs) [4–7]. They have been widely employed for the civilian and military applications such as television, broadcast radio, mobile systems, global positioning system (GPS), radio-frequency identification (RFID), multiple-input multiple-output (MIMO) systems, vehicle collision avoidance system, satellite communications, surveillance systems, direction founding, radar systems, remote sensing, biological imaging, missile guidance, and so on [8].

Despite the many advantages of typical microstrip antennas, they also have three basic disadvantages: narrow bandwidth, low gain, and relatively large size. The narrow bandwidth is one of the main drawbacks of these types of antennas. A straightforward method of improving the bandwidth is increasing the substrate thickness. However, surface wave power increases and radiation power decreases with the increasing substrate thickness [7], which leads to poor radiation efficiency. Thus, various other techniques are presented to provide wide-impedance bandwidths of microstrip antennas, including impedance matching networks using stub [9, 10] and negative capacitor/inductor [11], microstrip slot antennas using the U, L, T, and inverted T slots in the ground plane (sometimes termed defected ground structures (DGSs)) [12, 13], surface wave suppressing using magneto-dielectric substrate [14] and electromagnetic bandgap (EBG) structures [15], and composite-resonator microstrip antennas using metamaterial resonators [16, 17]. Another problem to be solved is the low gain for conventional microstrip antenna element. Cavity backing has been used to eliminate the bidirectional radiation, thereby providing higher gain compared with conventional microstrip antenna [18]. Lens covering is an alternative way to achieve gain enhancement. The lens with canonical profile, like elliptical, hemielliptical, hyper-hemispherical, extended hemispherical, used to focus the radiation beam from the radiator elements. The integrated lens microstrip antenna can be treated as composite antenna combined by microstrip radiator elements and dielectric lens, which is very useful for high frequencies (mm, sub-mm, terahertz (THz), and optical waves) applications

[19]. It is also well known that antenna array is an effective means for improving the gain [20–25].

The last limitation of conventional microstrip antennas is the relatively large size, particularly at lower microwave frequencies, since their operation frequencies are related to the electrical size of antenna. In general, the size of the rectangular microstrip antenna should be of order of a half-guided wavelength. This limitation was mathematically studied by Wheeler [26] and Chu [27]. There have been numerous efforts to minimize the antenna size and obtain the electrically small microstrip antenna with the raised demand towards smaller and smaller wireless devices. Inductive or capacitive loading are effective ways to reduce the size of microstrip antennas [28]. In the former work, we demonstrated that the size of microstrip antenna can be miniaturized using composite metamaterial resonators [16, 17]. Magneto-dielectric substrates have been widely used to miniaturize microstrip antennas due to magnetic substrates and could provide wider bandwidths than dielectric substrates [29–32]. Fractal geometries, which are composed by self-similar structures, have opened an alternative way for antenna miniaturization [33].

From the above discussions, we see that many methods and materials are used to improve the properties of microstrip antennas. However, there should be a relationship among bandwidth, gain, and size of the microstrip antennas. Antenna engineers have recognized that the improvement in one antenna property is frequently accompanied by decline in its other performances. For example, the antenna size is reduced usually at the expense of its bandwidth and gain. Therefore, a more comprehensive consideration must be given on further developments of microstrip antennas.

In this paper, we will suggest three areas for further research based on our previous works on microstrip antenna elements and arrays [16–25, 34–41]. We first note that novel microstrip antenna topologies are proposed to meet the desired requirement of variety of potential wireless applications, such as ultrawide band (UWB), high gain, miniaturization, circular polarization, multipolarized, and so on. Next, we discuss the composite antennas based on microstrip antennas which have more potent than each individual antenna. Finally, with the development of micro-/nano-machining techniques, antennas/arrays with highly integration and with highly operating frequencies are discussed. We present some examples of antennas developed in our group to support our points of view.

2. Variety of Microstrip Antenna Topologies

Microstrip antennas have extensively used in commercial and military applications due to their attractive advantages. However, the traditional microstrip antennas have the impedance bandwidth of only a few percent and radiation pattern with omnidirection, which obviously does not meet the requirements of various wireless applications. To this end, a wide variety of microstrip antenna topologies, including different microstrip antenna element structures and different microstrip array arrangements, have been studied to meet the desired requirement such as ultrawide band (UWB), high gain, miniaturization, circular polarization, multipolarized, and so forth.

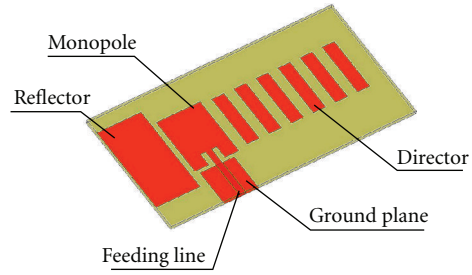

(a) The structure of the quasi-Yagi antenna

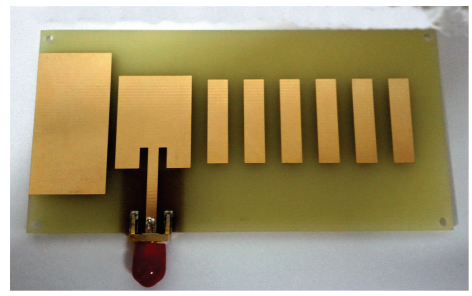

(b) The photograph of the quasi-Yagi antenna

Figure 1: Compact broad-band quasi-Yagi antenna.

As we know, microstrip antennas inherently have narrower bandwidth and lower gain compared to conventional bulky antennas. Some microstrip antennas with special topologies, like quasi-Yagi, planar reflector antenna, are proposed to replace the conventional bulky antennas. Here, we will take a quai-Yagi antenna as an example to show how to design a planar microstrip antenna with Yagi-Uda end-fire radiation pattern. In addition, a microstrip array with special array topology is designed to get dual-polarized property.

2.1. Compact Broad-Band Quasi-Yagi Antenna. A novel S-band compact quasi-Yagi antenna has been designed, fabricated and measured by our group, as shown in Figure 1. This antenna is composed of a printed monopole-driven element, a printed reflector element, and six printed director elements.

To explain the end-fire radiation behavior of the quasi-Yagi antenna, a comparison of radiation patterns, among (1) microstrip monopole only, (2) microstrip monopole and a reflector, (3) microstrip monopole and a director, (4) microstrip monopole and a reflector with one director, and (5) microstrip monopole and a reflector with six director, is shown in Figure 2. We can observe that both the reflector and the director can increase the end-fire radiation, and it could be substantially improved by increasing the number of directors.

The measured VSWR results are shown in Table 1. A bandwidth of 14% for VSWR less than 1.5 is achieved. The gain of the antenna is above 7.5 dBi, as shown in Table 2. In this design, we see that the microstrip antenna with special topology could be conveniently used to replace the bulky Yagi-Uda antenna.

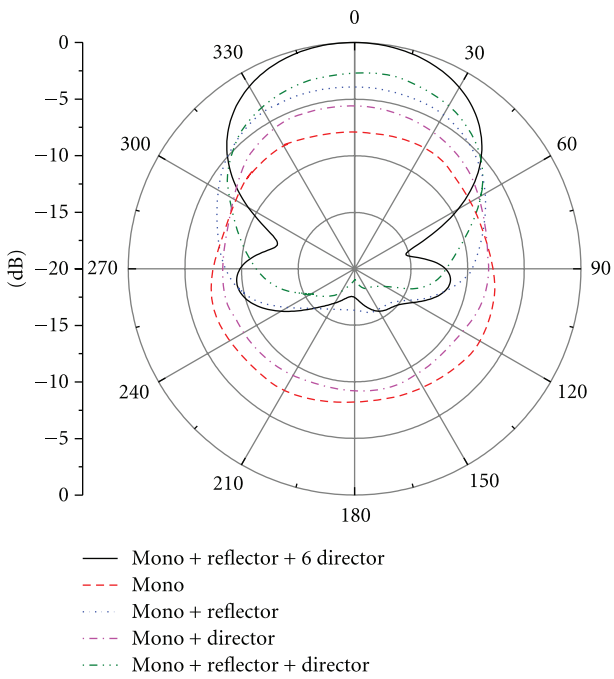

Figure 2: Radiation patterns of microstrip monopole only, microstrip monopole and a reflector, microstrip monopole and a director, microstrip monopole and a reflector with one director, and microstrip monopole and a reflector with six director.

Table 1: The measured VSWR of the quasi-Yagi antenna.

No.	Frequency (GHz)			
	3.25	3.5	3.75	Inband
1	1.36	1.34	1.47	<1.5
2	1.37	1.26	1.49	<1.5
3	1.36	1.25	1.48	<1.5

Table 2: The measured gain of the quasi-Yagi antenna (unit: dBi).

No.	Frequency (GHz)		
	3.25	3.5	3.75
1	7.57	8.73	8.35
2	7.58	8.55	8.37
3	7.56	8.77	8.51

2.2. Dual-Polarized Microstrip Antenna Array. The dual-polarized antenna is highly required for the radar, electronic countermeasure, and aerospace systems. It is known that the microstrip antenna can easily be integrated with microwave circuits and feeding network. Here, a novel Ku-band dual-polarization microstrip antenna array with a mixed feeding network, that is, the slot coupled feeding (V-port) and the co-plane feeding (H-port), is designed by our group, as shown in Figure 3. It is a three layers structure: top microstrip patch layer, middle stripline feeding network layer, and bottom coplane microstrip feeding network layer. Through proper array arrangement, very good isolation can be obtained.

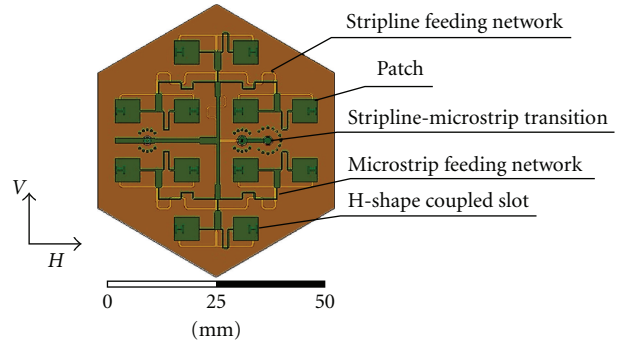

(a) The structure of the dual-polarized microstrip antenna array

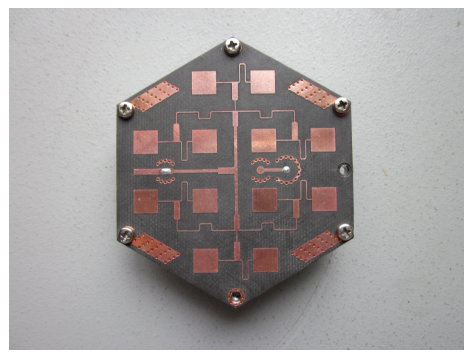

(b) The photograph of the dual-polarized microstrip antenna array

Figure 3: Dual-polarized microstrip antenna array.

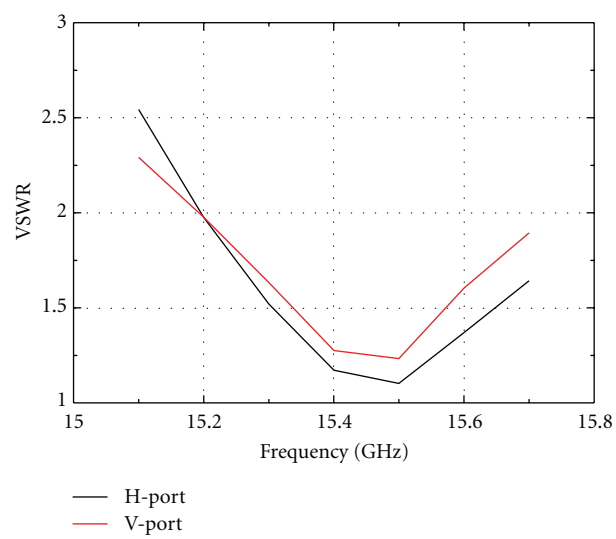

Figure 4: The VSWR of the dual-polarized microstrip antenna array.

The VSWR, radiation patterns, and the isolation between two polarizations of the proposed dual-polarized microstrip antenna array are shown in Figures 4, 5, and 6, respectively. The results indicate that this microstrip antenna array has a good impedance matching, good radiation performance, as well as very high isolation (less than −25 dB), which can be an idea candidate for the dual-polarized wireless systems.

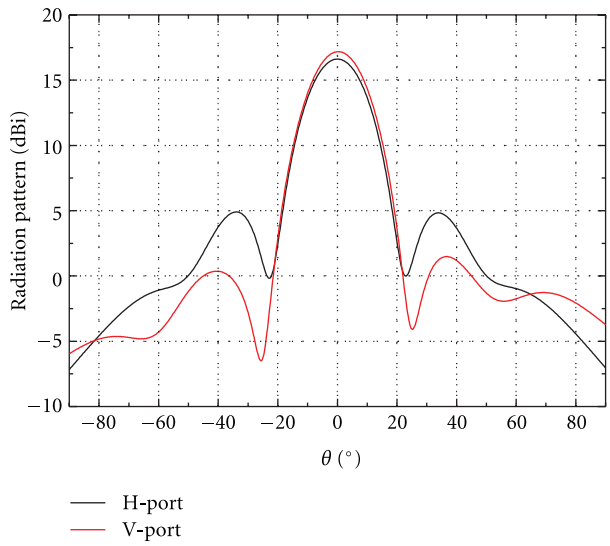

Figure 5: The radiation patterns of the dual-polarized microstrip antenna array at the center frequency.

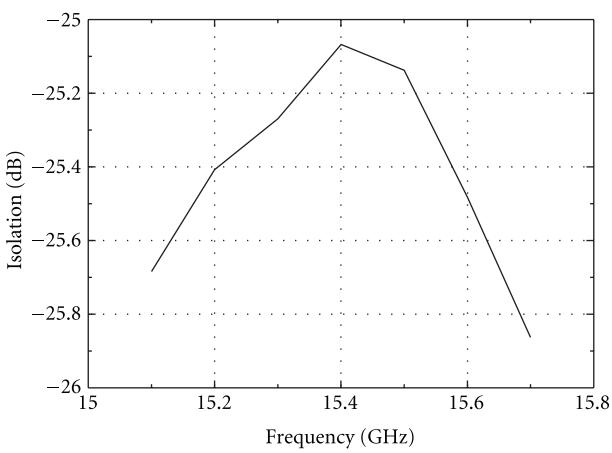

Figure 6: The isolation of the dual-polarized microstrip antenna array.

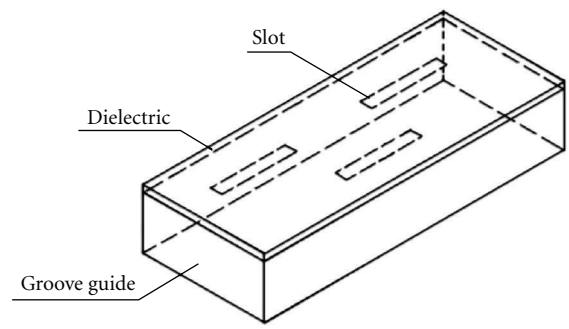

Figure 7: The structure of the DCWS.

3. Microstrip-Antenna-Based Composite Antenna

As many antenna designers have found, it is not easy to design an antenna to meet the user-defined stringent performance requirements demanded by special wireless applications like military radars, surveillances, and missile guidance, if only one type of antenna is considered. This difficulty may require the use of two more different types or structures of antenna elements with different characteristics. Composite antenna formed by two more types or structures of antennas is particularly suitable for these applications due to more advantages offered by different types or structures of antennas. For example, it is a challenging task to use single type of antenna to design a dual-band dual-polarization antenna for satellite digital multimedia broadcast (S-DMB) application [36]. A composite antenna composed with a left-handed circularly polarized (LHCP) microstrip antenna and a linear polarized omnidirectional biconical antenna is proposed by our group to meet this requirement [36]. Another example of composite antenna is comprised of a dielectric lens and microstrip log-period antenna, which has been widely applied to THz systems (this type of antenna will be further discussed in Section 4.2). Here, we will give an example of composite antenna with "structure composite" method.

3.1. Monopulse Circular-Polarized Dielectric Complex Waveguide Slot Antenna Array. Waveguide slot antenna array has been widely used for wireless system, due to its advantages of high radiation efficiency, high power capacity, and high reliability. However, it is hard to overcome the disadvantage of high cost of fabrication.

One composite antenna with waveguide slot antenna array property, termed dielectric complex waveguide slot (DCWS), is composed with slot microstrip line and groove guide, as shown in Figure 7. The slot microstrip line is formed by a metal clad dielectric substrate and slots etched in the metal. This composite antenna not only maintains the advantages of the traditional waveguide slot antenna array but also has the characteristics of high consistence, easy for fabrication, and low cost.

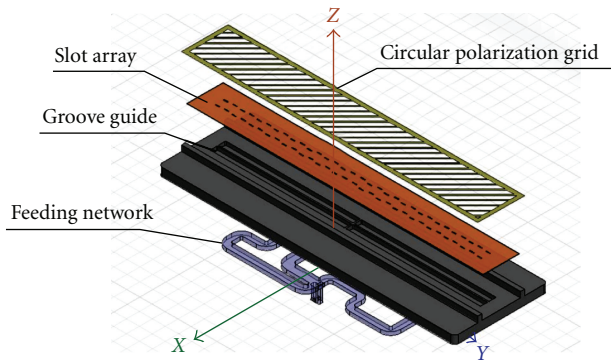

(a) The structure of the monopulse circular-polarized DCWS antenna array (separating view)

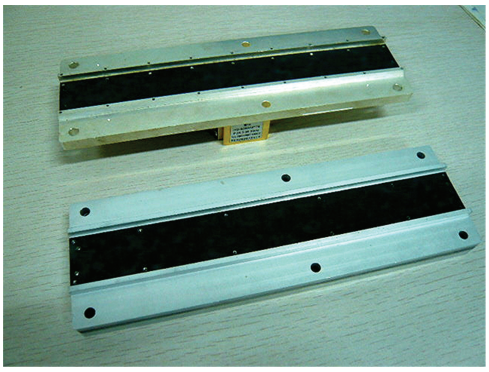

(b) The photograph of the monopulse circular-polarized DCWS antenna array.

Figure 8: Ka-band monopulse circular-polarized dielectric complex waveguide slot (DCWS) antenna array.

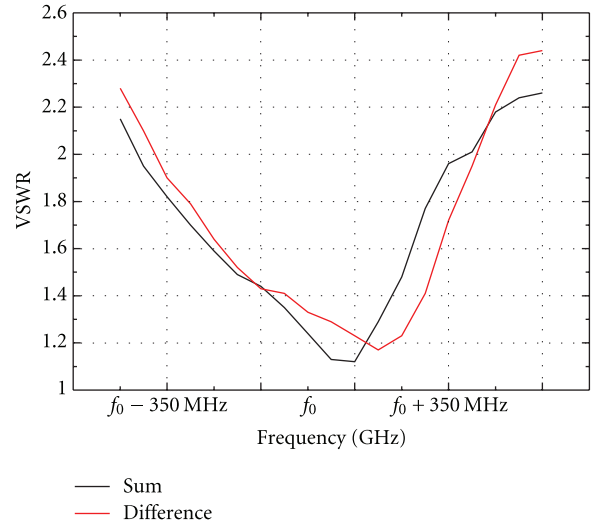

Figure 9: The VSWR of sum and difference port of the monopulse circular-polarized DCWS antenna array.

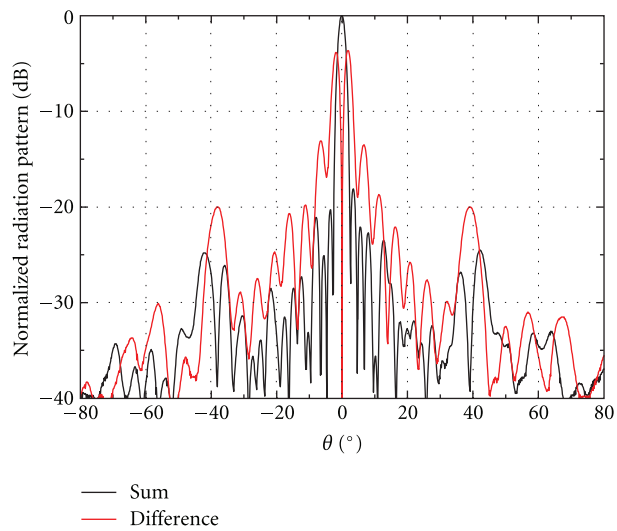

Figure 10: The radiation pattern of the monopulse circular-polarized DCWS antenna array at the center frequency.

A Ka-band monopulse circular-polarized dielectric complex waveguide slot (DCWS) antenna array is designed, fabricated, and measured by our group, as shown in Figure 8. It consists of a circular polarization grid, a slot microstrip array, and a groove guide and feeding network. The slot microstrip array is fabricated on a Rogers 5880 film with dielectric constant of 2.2 and the thickness of 0.254 mm. The measured results of VSWR of sum and different port are shown in Figure 9. Figure 10 shows the measured radiation pattern at the center frequency. Some important array performance parameters such as gain, null depth and axial ratio (AR) are also given in Table 3. As shown in the measured results, very good performance can be obtained with the DCWS antenna array. The radiating efficiency of the DCWS antenna array is 80%, which is almost the same as the traditional waveguide slot antenna array. Moreover, the DCWS antenna array has 40% larger bandwidth than the traditional waveguide slot antenna array.

4. Highly Integration and Highly Operating Frequency Antennas Based on Advanced Machining Techniques

It is known that the microstrip antenna was first fabricated using PCB technology in 1970s, nearly 20 years after its concept was first presented in 1950s [1–3]. Clearly, the development of microstrip antennas is closely related with the machining techniques. Recently, various machining techniques, including multilayer printed circuit board (MPCB), complementary metal oxide semiconductor (CMOS), low-temperature cofired ceramics (LTCC), and micro-electro-mechanical systems (MEMS), are highly developed, opening opportunities for innovative antennas, such as active antennas, reconfigurable antennas, metamaterial-based antennas, THz antennas, and so forth. With the availability of high-precision and high-speed advanced machining techniques, microstrip antennas are growing towards highly integration of antenna/array and feed network and operating at relatively high frequencies. Since they are all based on the advanced

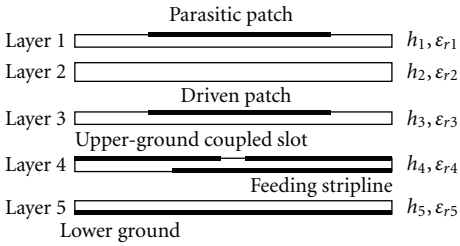

(a) Schematic side view of the structure of the high integrate broadband microstrip antenna array

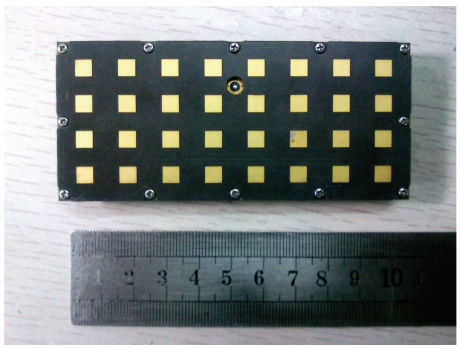

(b) The photograph of the high integrate broadband microstrip antenna array

Figure 11: Ku-band high integrate broadband microstrip antenna array using MPCB technology.

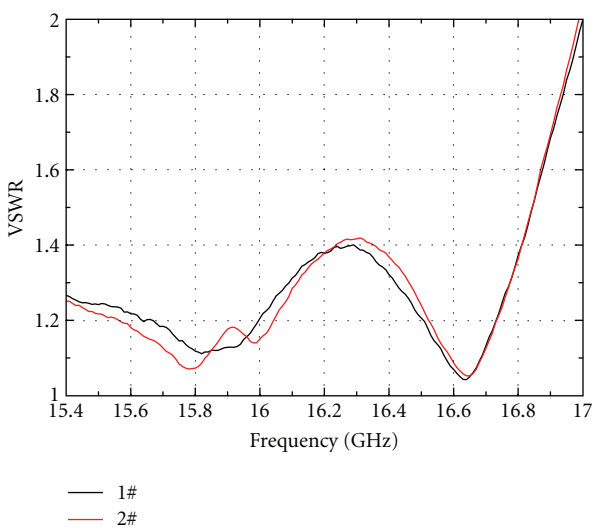

Figure 12: The VSWR of the high integrate broad-band microstrip antenna array using MPCB technology.

machining techniques, we suggest that a third research area of microstrip antennas is constantly introducing novel advanced machining techniques. In the following, two examples will be presented to show how important the advanced machining technique is to fabricate microstrip antennas. One is the highly integrate broad-band microstrip antenna array fabricated using MPCB technology. Another is THz wave planar integrated active microstrip antenna using MEMS technology.

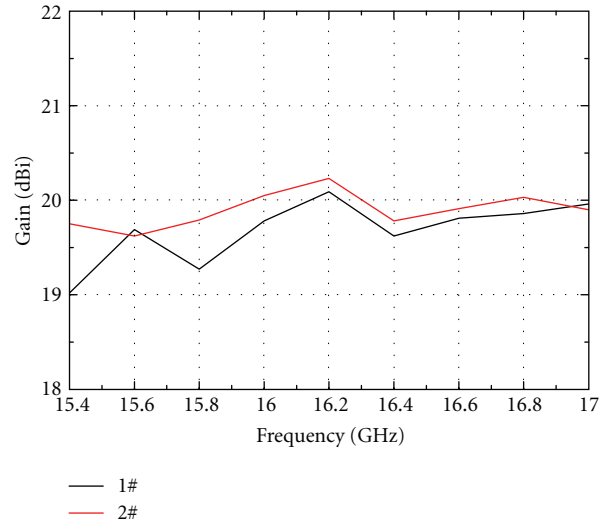

Figure 13: The gain of the high integrate broad-band microstrip antenna array using MPCB technology.

Table 3: The measured data of the monopulse circular-polarized DCWS antenna array.

Fre. (GHz)	Gain (dBi)	Null depth (dB)	AR (dB)
$f_0 - 0.2$	22.8	−37.3	3.8
f_0	21.9	−29.9	2.9
$f_0 + 0.2$	22.1	−26	4.1

4.1. High Integrate Broad-Band Microstrip Antenna Array Using Multilayer Printed Circuit Board (MPCB) Technology. Recently, with the development of the multilayer printed circuit board (MPCB) technology, the microstrip antennas can be designed and fabricated from one-dimensional (1D) to 2D and even 3D structures.

Based on the MPCB technology, a high integrated broad-band Ku-band microstrip antenna array is designed, fabricated, and measured by our group, as shown in Figure 11. This antenna consists of a parasitic patch, a driven patch, a stripline feeding network, a broad-band coaxial line to stripline transition, some buried screw holes, and some via holes. The feeding network is integrated in the bottom of the substrate of the antenna. As all of the structures fabricated at once, the accuracy and the uniformity can be assured. Two antennas of this type are measured. The measured VSWR, gain, and radiation pattern at the center frequency are shown in Figures 12, 13, and 14, respectively. The measured results show that this antenna maintains good radiation and matching performances with relative bandwidth of 13%. They have also shown good uniformity by using MPCB technology.

4.2. THz Wave Planar Integrated Active Microstrip Antenna Using Micro-Electromechanical Systems (MEMSs) Technology. THz waves typically include frequencies between 0.1 THz and 10 THz. THz technology is now becoming a promising technology which has potential applications in many fields, such as short-range communication, biosensor, imaging,

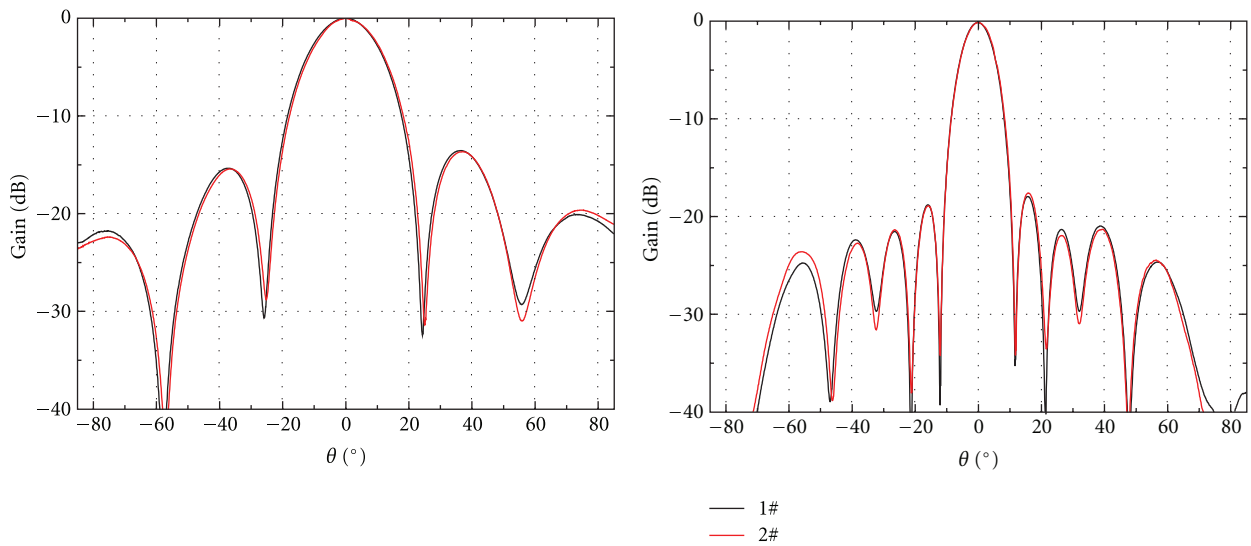

(a) E-plane

(b) H-plane

Figure 14: The radiation pattern of the high integrate broad-band microstrip antenna array using MPCB technology at the center frequency.

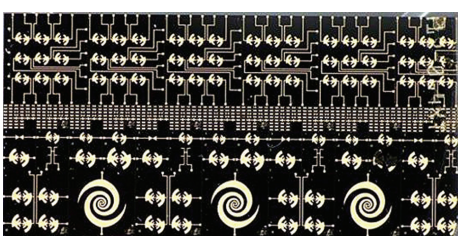

(a) The photograph of the THz monolithic antenna

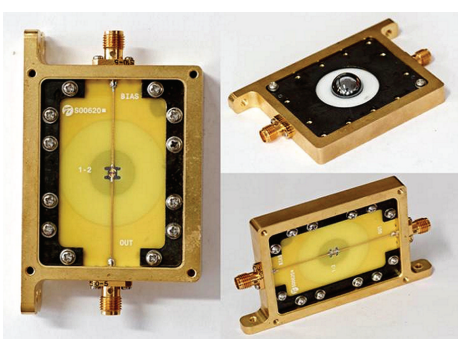

(b) The photograph of the THz monolithic antenna covered by a dielectric lens

Figure 15: THz wave planar integrated active microstrip antenna using micro-electromechanical systems (MEMSs).

national security, space exploration and communication, and so forth [39–46]. To realize THz transceiver system, antenna is an essential component. We often use horn antenna, lens antenna, and dielectric parabolic antenna, for THz systems. However, they are not easy to integrate with monolithic integrate circuits. Although the microstrip antenna has the merits of small volume, light weight, and easy integration with circuit, it is difficult to be processed in such high-frequency regions. MEMS technology opens the way to design of THz antennas, circuits, and systems. THz monolithic antenna fabricated using MEMS technology and covered by a dielectric lens, which can be considered a composite antenna, are designed, fabricated, and measured by our group, as shown in Figure 15.

Diodes have the functions of mixing and/or modulating the carrier-wave signal. It is an effective way to reduce the propagation path for detectors application by integrating the diode and microstrip antenna. The extended hyper-hemispherical dielectric lens is used to increase the gain of the microstrip antenna. An antenna-coupled detector integrated with a dielectric lens is designed and fabricated up to THz range by our group. The planar microstrip log-spiral antenna and log-period antenna have been fabricated using micro-electromechanical systems (MEMSs) technology. The photographs of the antennas are demonstrated in Figure 15. The measured responses of the antenna-coupled detector working at different frequency bands are shown in Figure 16, which can be considered to determine the effective operating frequencies [19, 40]. This detector gave a valid response from 12 GHz to 110 GHz frequencies. The results prove the validity and feasibility of the THz antenna designed using micro-electromechanical systems (MEMSs) technology.

5. Conclusion

The advantages and disadvantages of microstrip antennas are discussed in this paper. In particular, three areas for further development of microstrip antennas are presented based on our previous works on microstrip antenna elements and arrays. Variety of microstrip antenna topologies and microstrip-antenna-based composite antenna are discussed, and

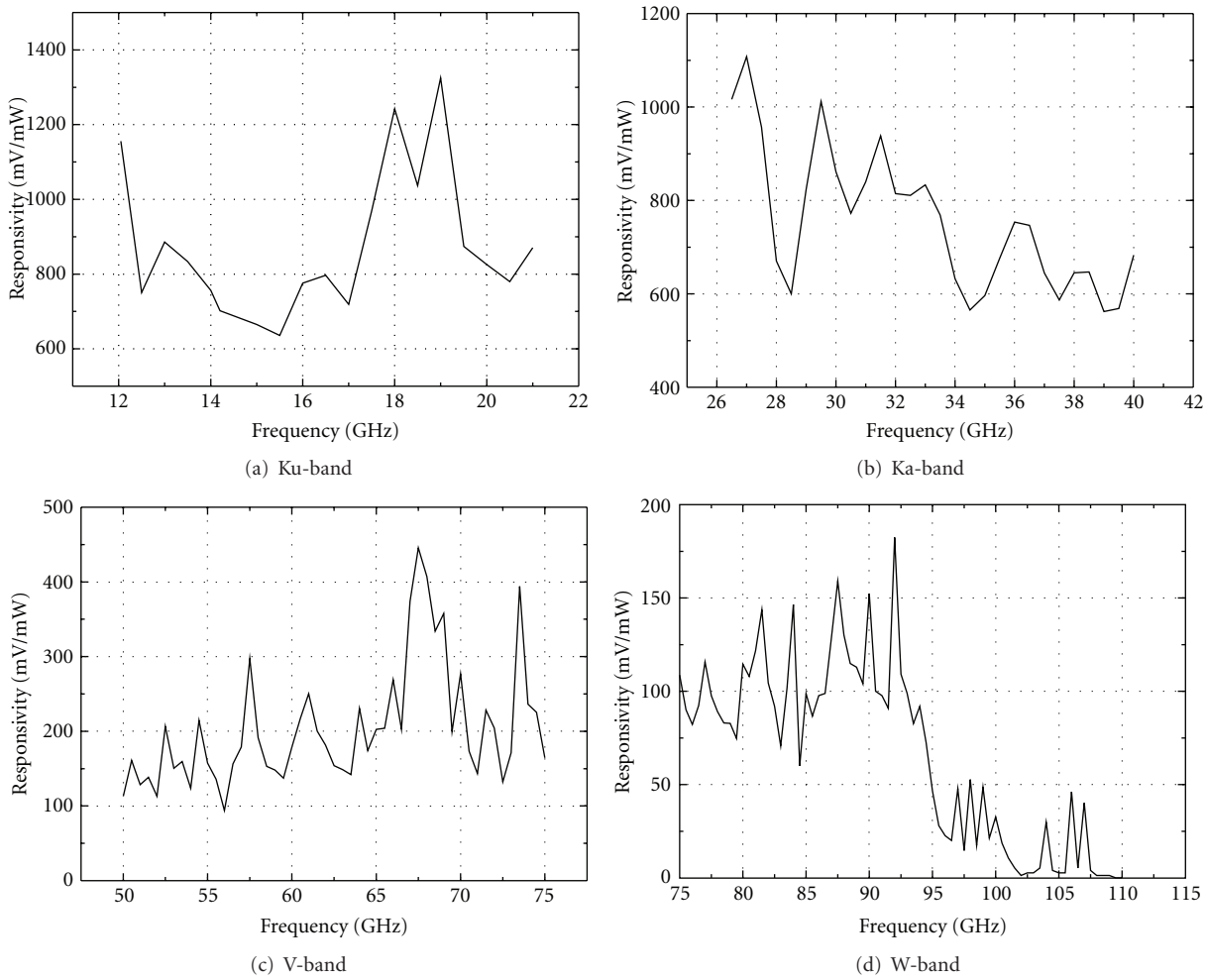

Figure 16: Frequency responses test results of the THz wave planar integrated active microstrip antenna covered by a dielectric lens.

the advanced machining techniques pushing the microstrip antennas towards the highly integration of antenna/array and feeding network and the highly operating frequencies are described. To demonstrate the distinctive features of novel microstrip antennas, various antenna elements and arrays for different applications are presented. This paper has shown that the microstrip antennas are still very promising paradigm for civilian and military wireless applications.

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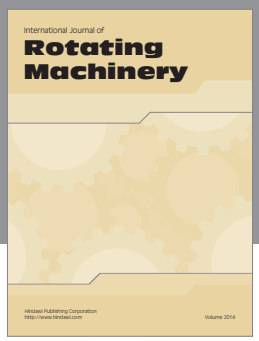

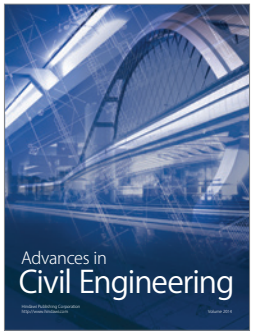

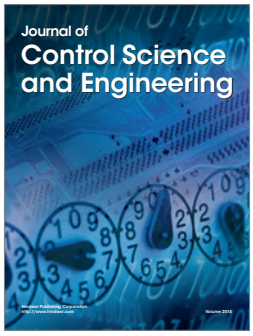

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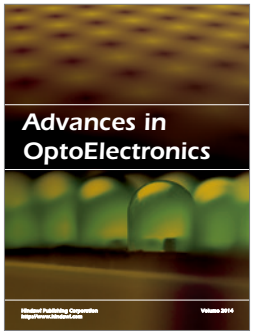

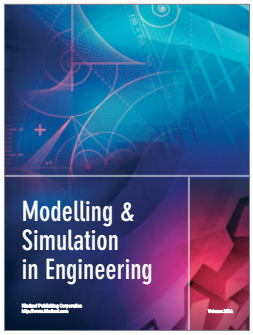

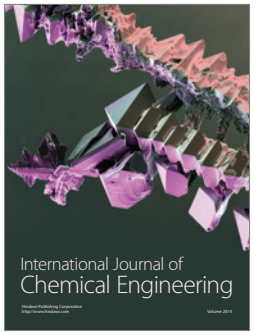

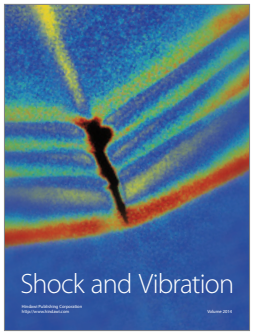

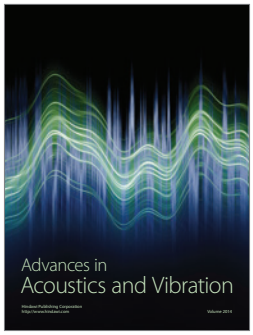

A 2.4 GHz Polarization-diversity Planar Printed Dipole Antenna for WLAN and Wireless Communication Applications

This article presents the design simulation, fabrication and measured performance of a 2.4 GHz polarization-diversity printed dipole antenna for wireless communication applications. Two orthogonal printed dipole antennas, each with a microstrip via-hole balun for vertical and horizontal polarization, are combined and fabricated on a PCB substrate. PIN diodes are used as switches to select the desired antenna polarization. The 3D finite-element-method (FEM) electromagnetic EM simulator, HFSS, is used in the design simulation of this planar antenna structure. Numerical and measured results of the antenna radiation characteristics, including input SWR, radiation pattern coverage and polarization-diversity, are presented and compared.

In wireless communication systems, such as wireless local area networks (WLAN), research and development efforts are aiming at smaller size and better performance. In addition to the use of signal processing techniques to improve communication channel capacity, the radiation characteristics of the portable antenna system is also very important for communication performance.

In urban or indoor environments, the radio wave will propagate through complicated reflection or scattering processes. The polarization of the radio wave may change significantly. In order to effectively receive the communications signal, a polarization-diversity antenna for wireless communications may become an important requirement. A polarization-diversity antenna may have a pair of linearly-polarized antennas, and the radio signal received on both antenna is sampled and compared at

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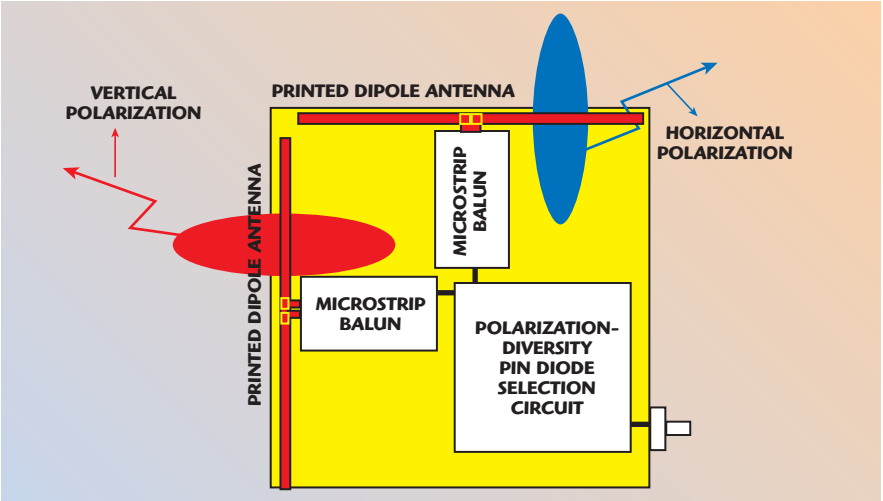

▲ *Fig. 1 A 2.4 GHz polarization-diversity antenna.*

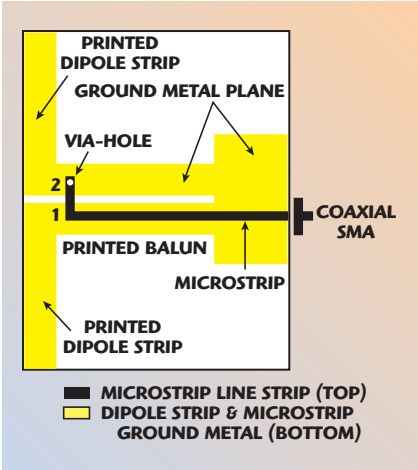

▲ *Fig. 2 Printed dipole antenna with a microstrip balun.*

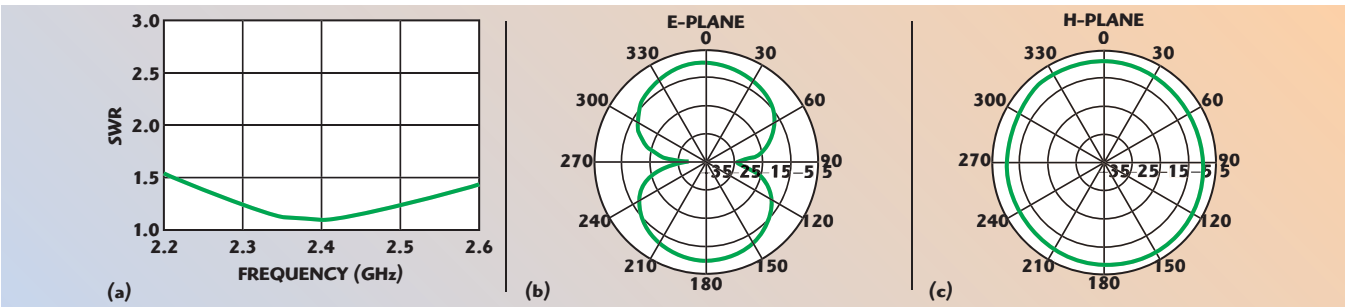

▲ *Fig. 3 Simulated performance of a 2.4 GHz printed dipole antenna placed horizontally; (a) input SWR, (b) E-plane pattern and (c) H-plane pattern.*

certain time intervals. Then the antenna with the best signal quality is selected.

A typical dipole antenna radiates a vertically polarized EM wave and has an omnidirectional antenna pattern. In order to have a preferred planar antenna structure for this 2.4 GHz polarization-diversity antenna, a printed dipole antenna with a microstrip via-hole balun is designed. As shown in ***Figure 1***, two orthogonal printed dipole antennas, for vertical and horizontal polarization, respectively, are combined and fabricated on a PCB substrate. PIN diodes are used to switch and select the desired antenna polarization.

In the antenna design, the high frequency structure simulator (HFSS), based on a 3D FEM, was employed for design simulation of the complete printed dipole structure. A printed dipole antenna and a polarization-diversity planar dipole antenna board (with a polarization-selection PIN diode circuit) have been fabricated on FR-4 PCB substrates. A complete 3D structure FEM simulation and the measured performance of the realized printed dipole-antenna are compared. The measured radiation characteristics of the polarization-diversity planar dipole antenna, including input SWR, radiation pattern coverage and polarization diversity, are presented.

PRINTED DIPOLE ANTENNA WITH MICROSTRIP BALUN

As shown in ***Figure 2***, a printed dipole antenna has a printed microstrip balun which acts as an unbalanced-to-balanced transformer from the feed coaxial line to the two printed dipole strips. The length of the dipole strip and the balun microstrip are both about 1/4 wavelength. The ground plane of the microstrip line and the dipole antenna strips are in the same plane. A via-hole permits the feed point 2 of a printed dipole strip to have the same phase as the feed point 1 of the other printed dipole strip. Due to the 180° phase difference between the top strip and the ground plane of the microstrip line, the feed point 2 of the printed dipole strip will have 180° phase difference with the other feed point 1. Accurate dimensions of the printed dipole strip and the microstrip balun structure are determined by numerical simulation, using HFSS.

The simulation results for a 2.4 GHz printed dipole antenna placed horizontally with a microstrip via-hole balun and fabricated on an FR-4 substrate are shown in ***Figure 3***. The input SWR is less than 1.5 from 2.2 to 2.6 GHz. The simulated E- and H-plane antenna patterns are very close to those of an ideal dipole antenna, where the H-plane pattern is omnidirectional. ***Figure 4*** is a photograph of a realized antenna. The measured input SWR and antenna patterns (measured with the dipole placed vertically) agree well with the simulation results, as shown in ***Figure 5***.

PLANAR POLARIZATION-DIVERSITY PRINTED DIPOLE ANTENNA

Figure 6 shows photographs of a realized 2.4 GHz planar polarization-diversity antenna consisting of two orthogonal printed dipole antennas with a polarization-switched PIN diode circuit. Each printed dipole has

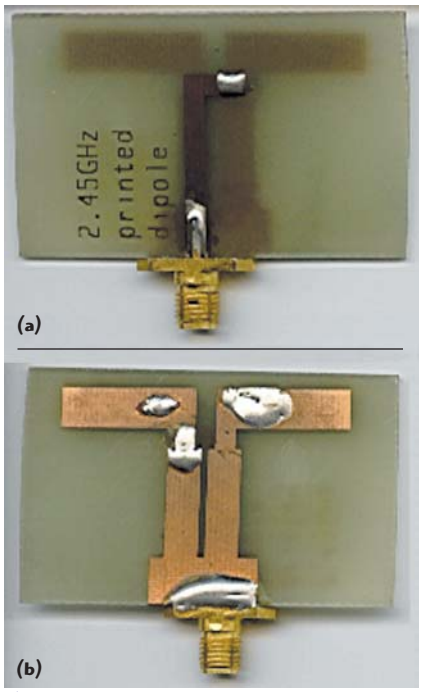

▲ *Fig. 4 A 2.4 GHz printed dipole antenna with a microstrip via-hole balun; (a) top view and (b) bottom view.*

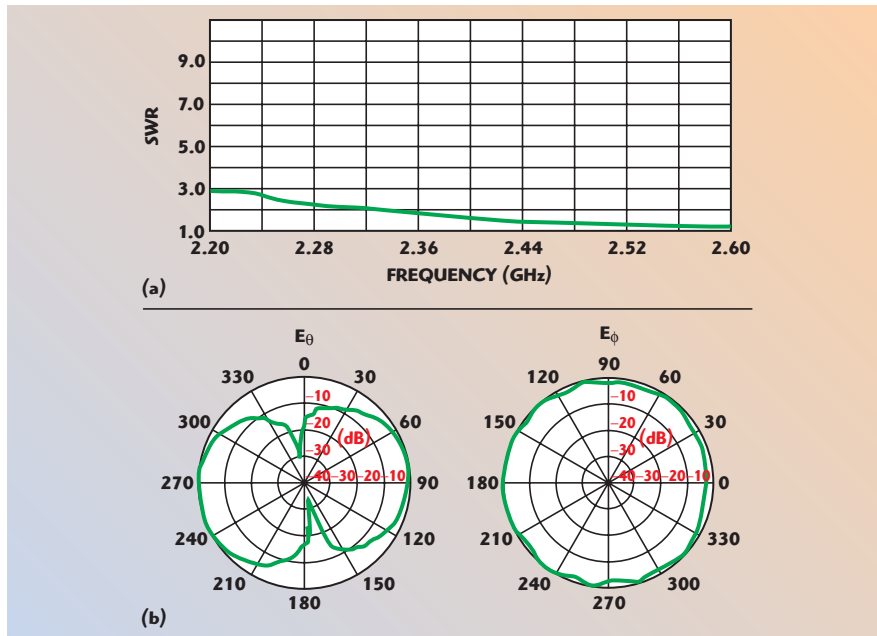

▲ *Fig. 5 Measured input SWR (a) and radiation patterns (b).*

a microstrip via-hole balun. The terminals of the two baluns are connected to a PIN diode selection circuit. Voltages from the transceiver circuit (±5.0V) are fed through a cable to the input of the PIN diode circuit section, to short or open-circuit the PIN diodes. Hence, either the vertical or horizontal printed dipole can be selected and connected to the transceiver.

Since the two dipoles are very close to each other and near the PIN diode circuit section, EM coupling will degrade the performance of each dipole. ***Figure 7*** shows the input SWR simulation results with the vertical dipole antenna selected (+5V to PIN diode switching circuit). The input SWR is less than 2 from 2.25 to 2.60 GHz. The simulated E- and H-plane antenna patterns are all very close to those of an ideal dipole antenna, of which the H-plane pattern is still omnidirectional, as shown in ***Figure 8***. Note that the dominant polarization is the vertical (E_θ) field, which agrees with the selection of the vertical dipole. The antenna pattern has some attenuation in the direction of the PIN diode circuit board. It can also be seen that a certain level of the input RF signal is induced to the horizontal antenna path by EM coupling, which generates some level of cross-

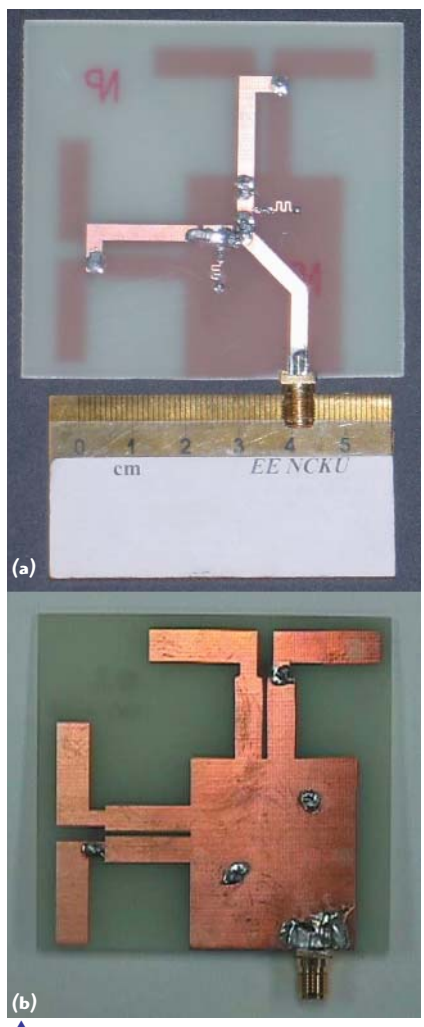

▲ *Fig. 6 A 2.4 GHz planar polarization-diversity antenna with a polarization-switched PIN diode circuit; (a) top view and (b) bottom view.*

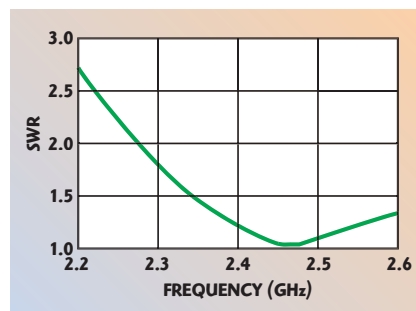

▲ *Fig. 7 Input SWR simulation of a 2.5 GHz polarization-diversity dipole antenna with the vertical dipole selected.*

polarization field. ***Figure 9*** shows the simulation results with the horizontal dipole antenna selected (–5V to PIN diode switching circuit). Results similar to the ones obtained for the vertical dipole antenna can be observed, except that the dominant polarization is the horizontal (E_ϕ) field, which agrees with the selection of the horizontal dipole.

The measured antenna input SWR with vertical or horizontal dipole selection confirms the input SWR of each dipole antenna (through the PIN diode selection circuit) is less than 1.5 from 2.2 to 2.6 GHz, which agrees with the HFSS simulation results. The measured antenna patterns with the selection of the vertical or horizontal dipole shows that for the selection of the vertical dipole, the H-plane pattern is still quite omnidirectional (as an ideal vertical dipole) with some attenuation in the direc-

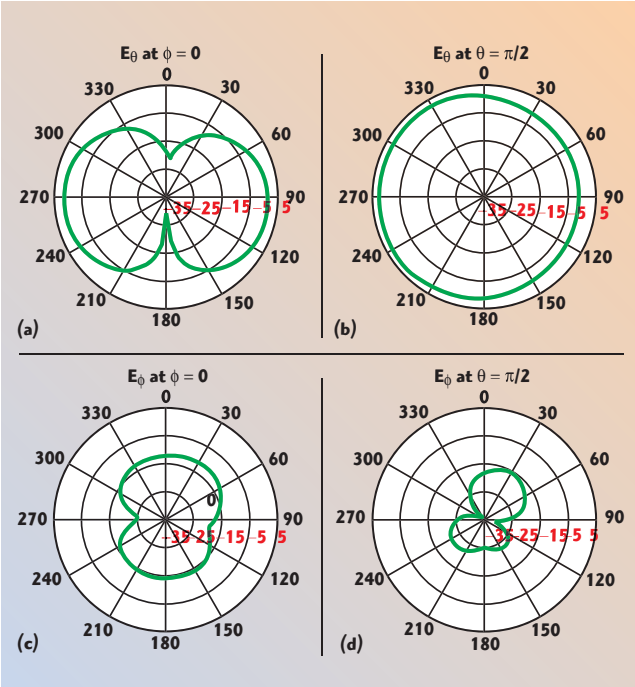

▲ *Fig. 8 Simulation of a 2.5 GHz polarization-diversity dipole antenna with the vertical dipole selected; (a) E_θ-field E-plane pattern, (b) E_θ-field H-plane pattern, (c) E_ϕ-field (cross-polarization) E-plane pattern and (d) E_ϕ-field (cross-polarization) H-plane pattern.*

tion of the PIN diode circuit board. ***Figures 10*** and ***11*** show the mesured SWR and antenna patterns, respectively. A certain level of the induced cross-polarization pattern is observed as predicted by the HFSS simulation due to the proximity of the horizontal dipole strip and the PIN diode circuit board. As for the selection of the horizontal dipole, the E-plane pattern is also close to that of an ideal horizontal dipole. Also, the induced cross-polarization pattern is observed, which is the same situation as the selection of the vertical dipole. The measured data shows a good agreement with the HFSS simulation results and how the antenna polarization-diversity is working.

CONCLUSION

3D FEM design simulation, realization and measurements of a 2.4 GHz printed dipole antenna (with a microstrip via-hole balun) and a planar polarization-diversity printed dipole antenna are presented. The planar polarization-diversity antenna consists of two orthogonal printed dipole antennas for vertical and horizontal polarization and is fabricated on a FR-4 PCB board. A PIN diode switching circuit is used to select the desired antenna polarization. Satisfactory agreement between simulation and measurements is observed. The measured input SWR of the realized printed dipole antenna is less than 1.5 from 2.2 to 2.6 GHz. The measured input SWR of the vertical and horizontal dipole (through the PIN diode switching circuit) of the realized planar polarization-diversity antenna is less than 1.5 from 2.3 to 2.6 GHz. The measured E- and H-plane patterns of the polarization-diversity antenna show that the selected vertical or horizontal dipole have a performance close to a single dipole antenna in a vertical or horizontal position. The designed planar polarization-diversity antenna can be used for wireless communication and WLAN applications.

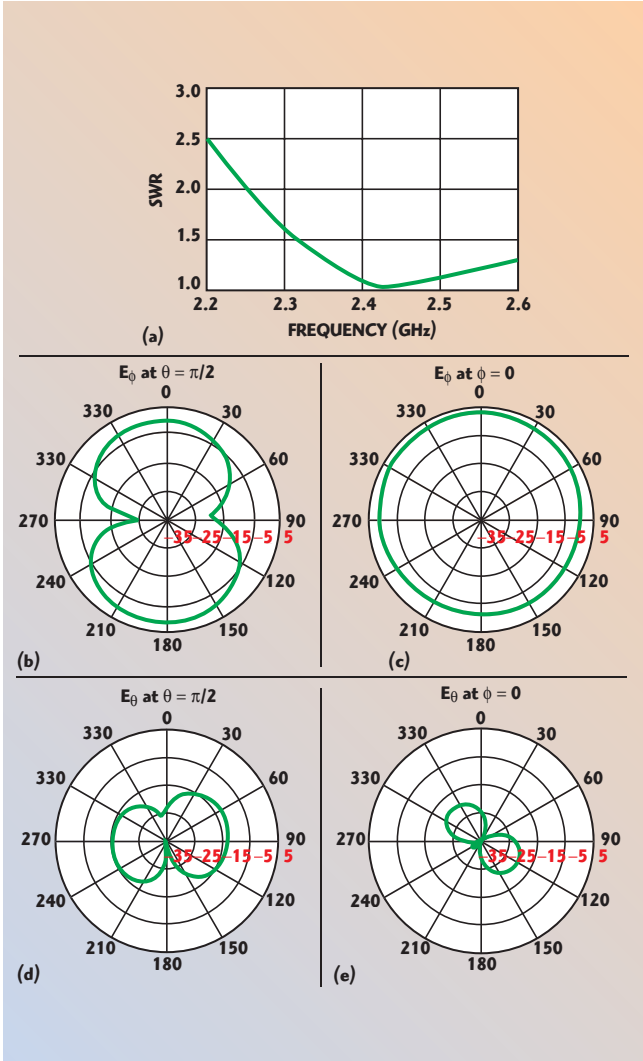

▲ *Fig. 9 Simulation of a 2.4 GHz polarization-diversity printed dipole antenna (with the horizontal dipole selected); (a) input SWR, (b) E_ϕ-field E-plane pattern, (c) E_ϕ-field H-plane pattern, (d) E_θ-field (cross-polarization) E-plane pattern and (e) E_θ-field (cross-polarization) H-plane pattern.*

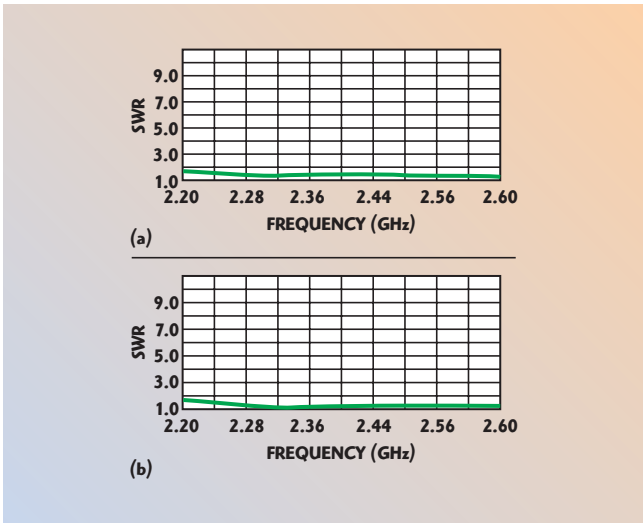

▲ *Fig. 10 Measured input SWR of a 2.4 GHz polarization-diversity printed dipole antenna; (a) vertical dipole selection and (b) horizontal dipole section.*

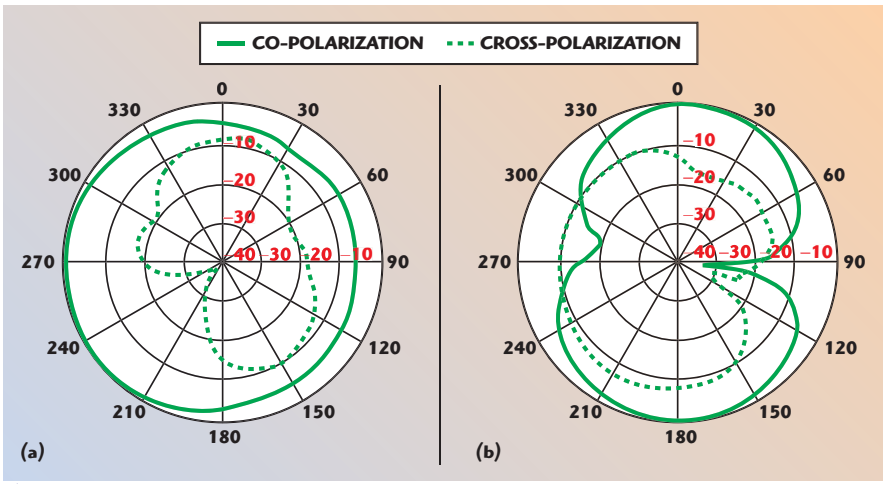

▲ *Fig. 11 Measured co-and cross-polarized patterns of a 2.4 GHz polarization-diversity printed dipole antenna; (a) vertical dipole selected and (b) horizontal dipole selected.*

ACKNOWLEDGMENT

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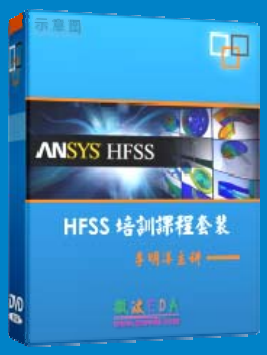

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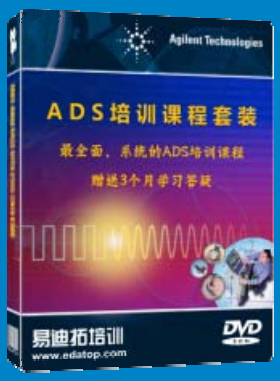

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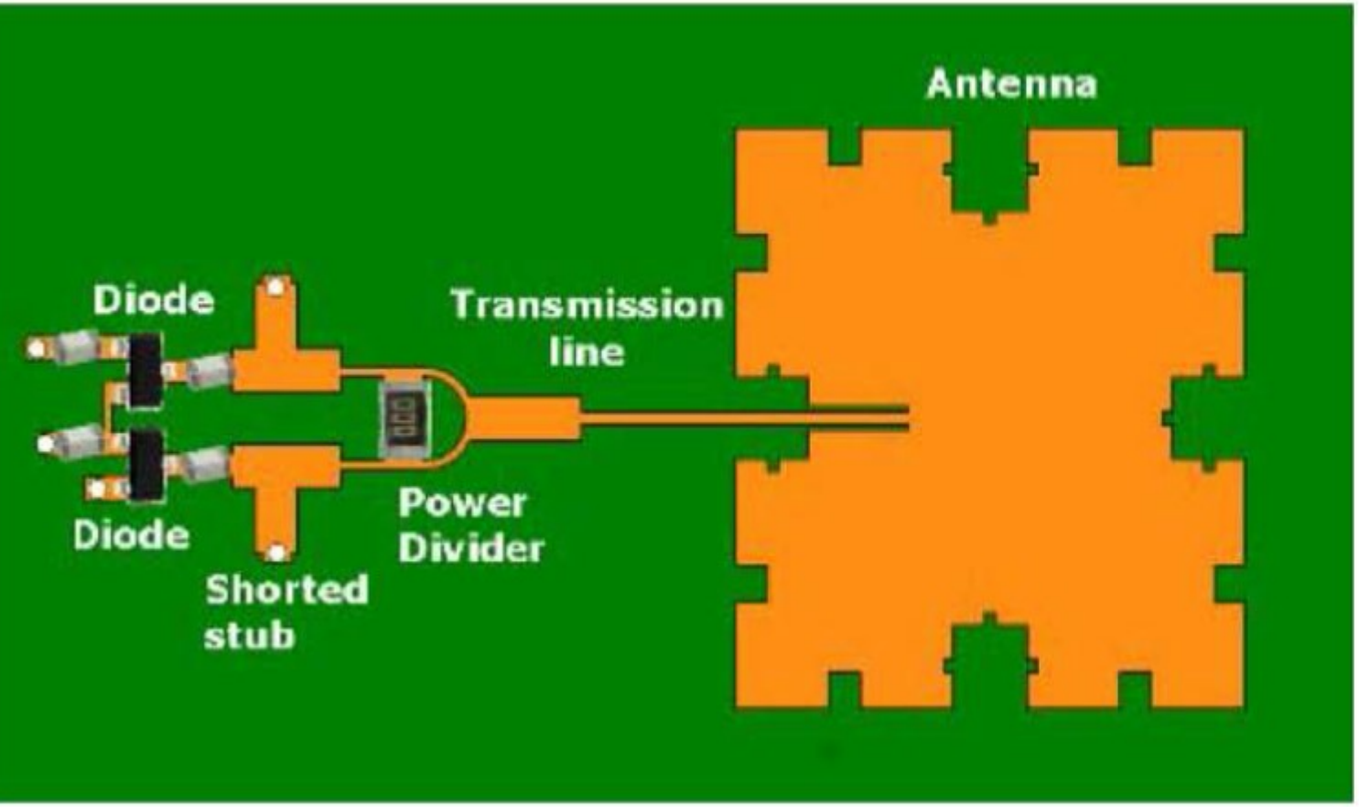
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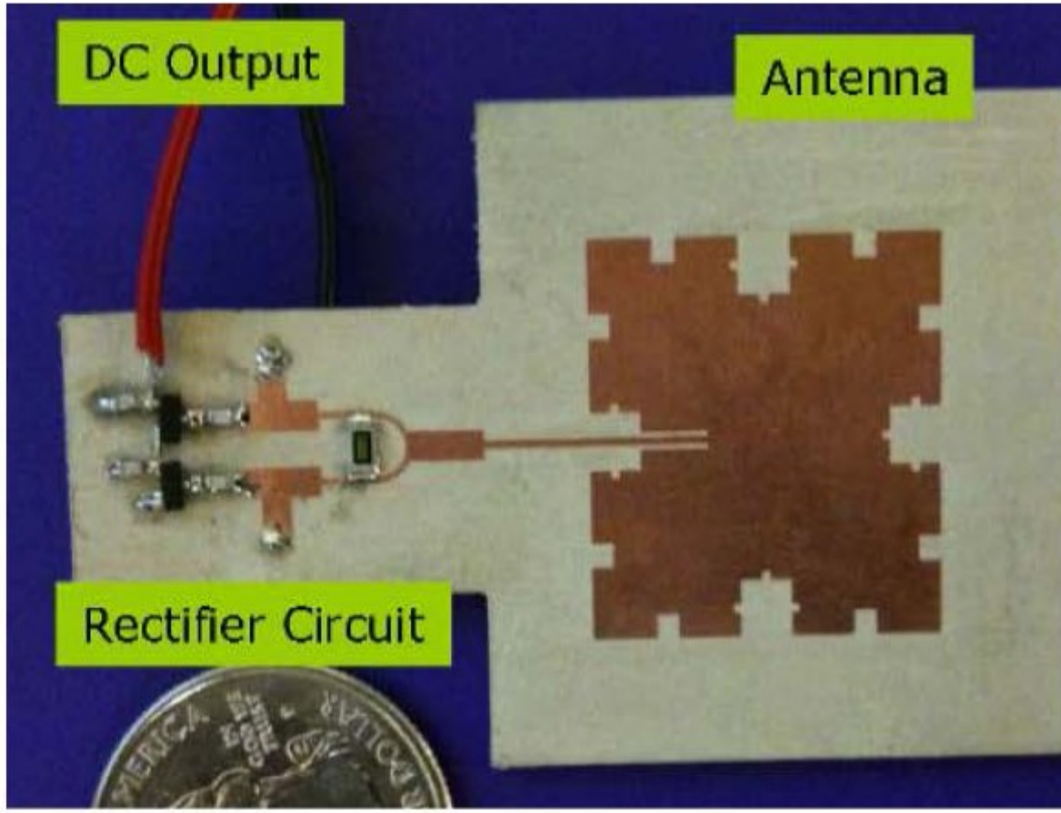
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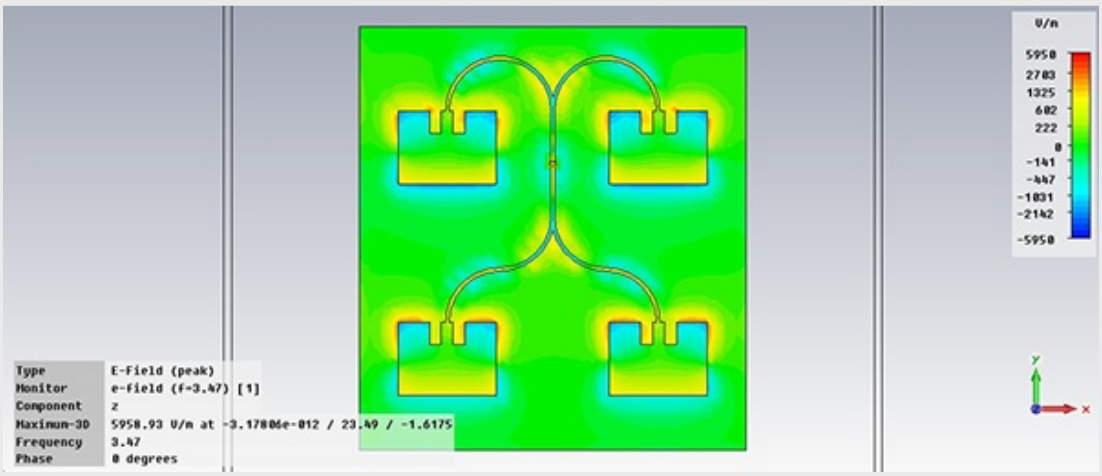

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The particular technology allows improved performance as well as reduced costs and size.

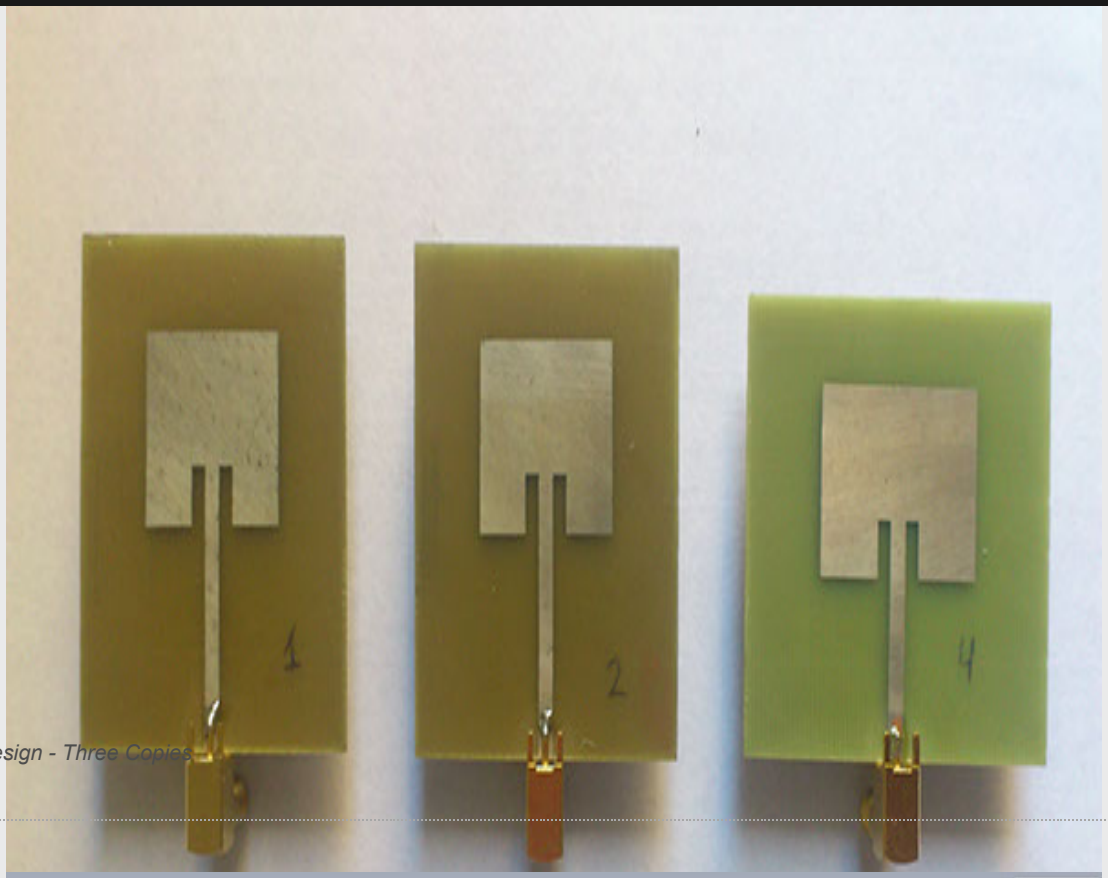

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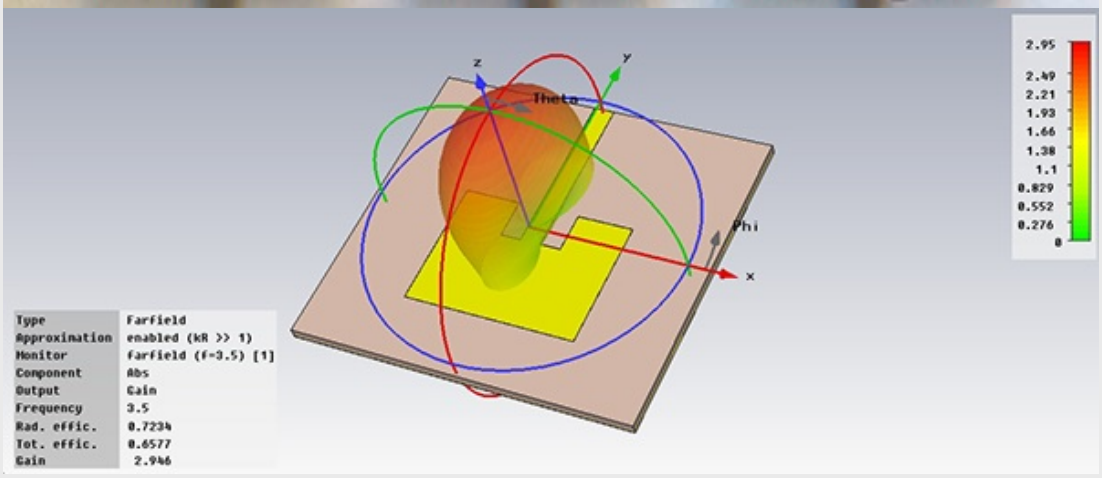

Square Patch Antenna - Farfield Simulation Results

Two-Element Array

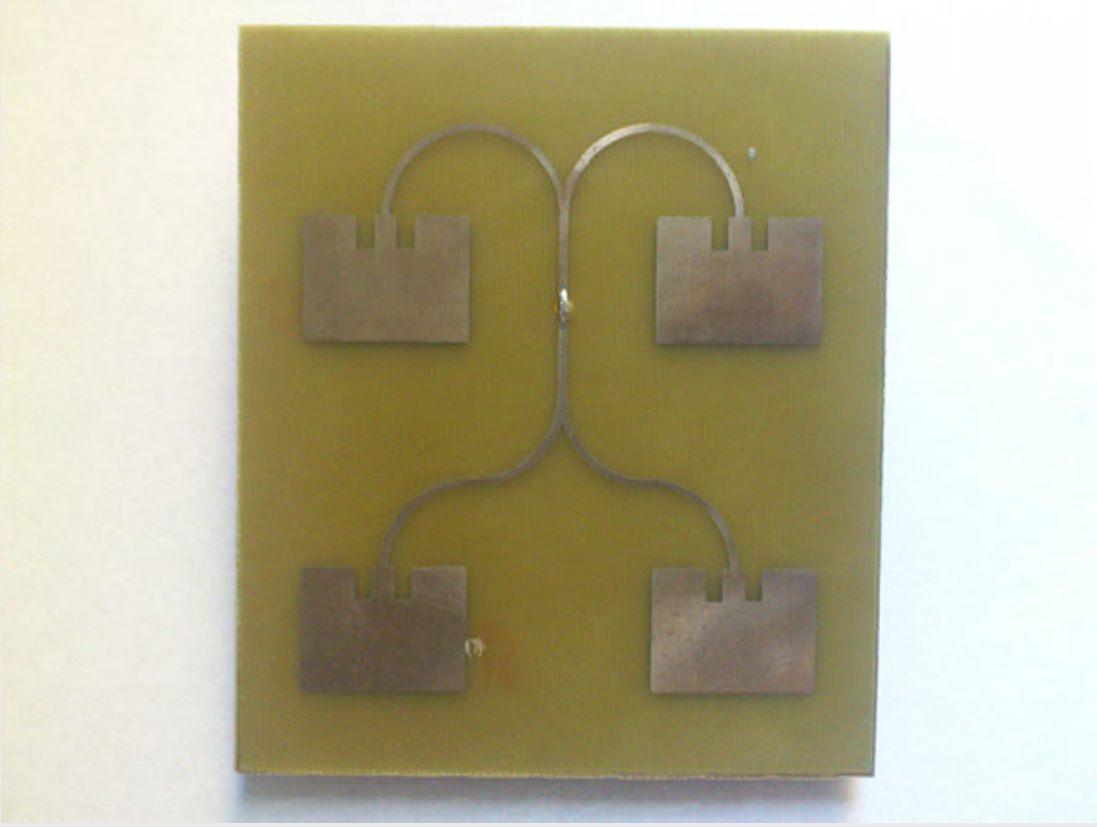

Four-Element Array

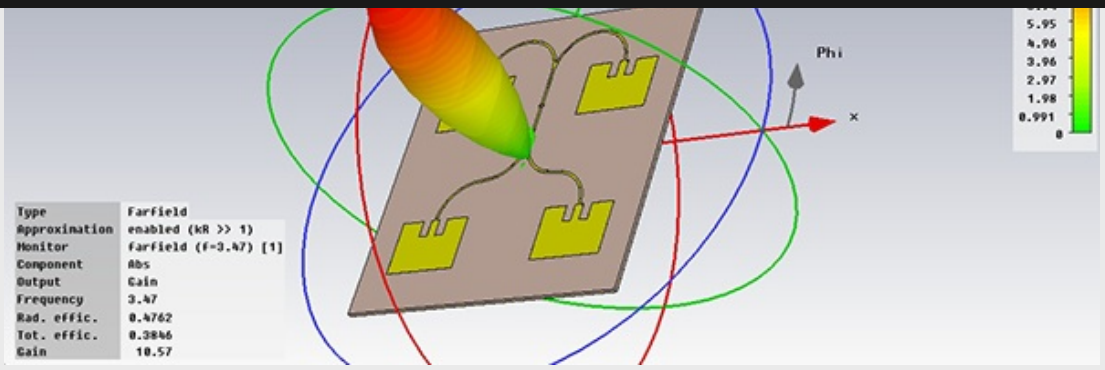

Four-Element Array - CST Microwave Studio Simulation Results

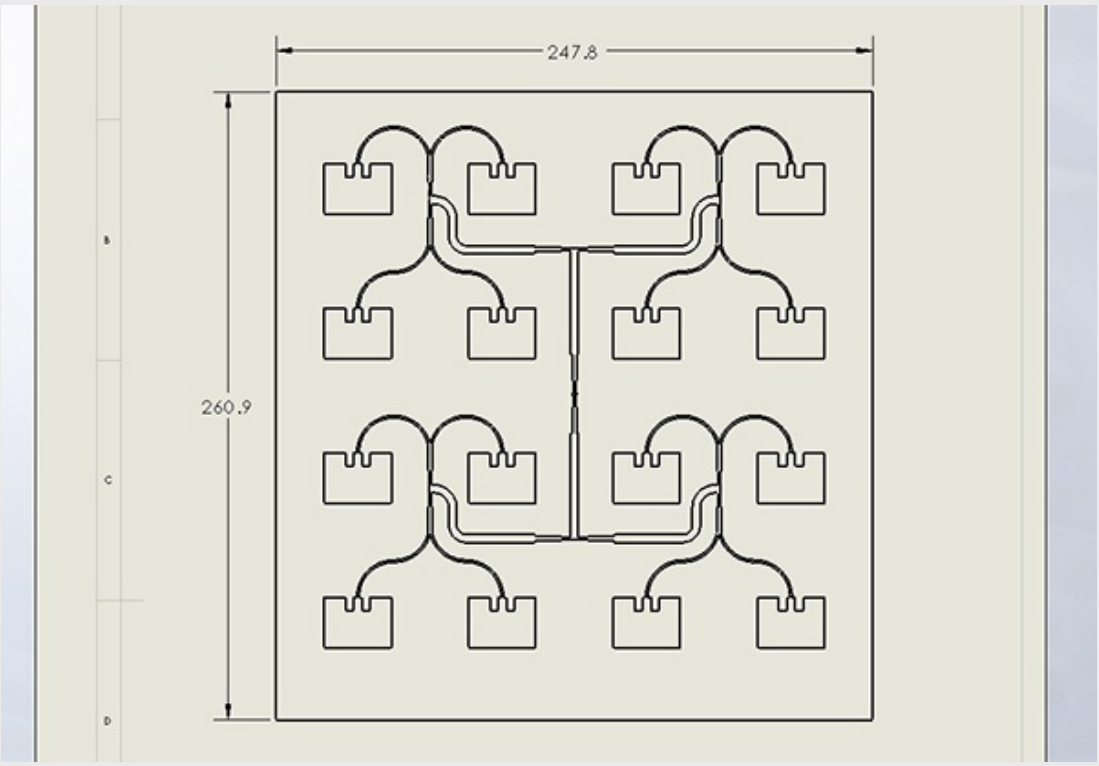

Sixteen-Element Array Design

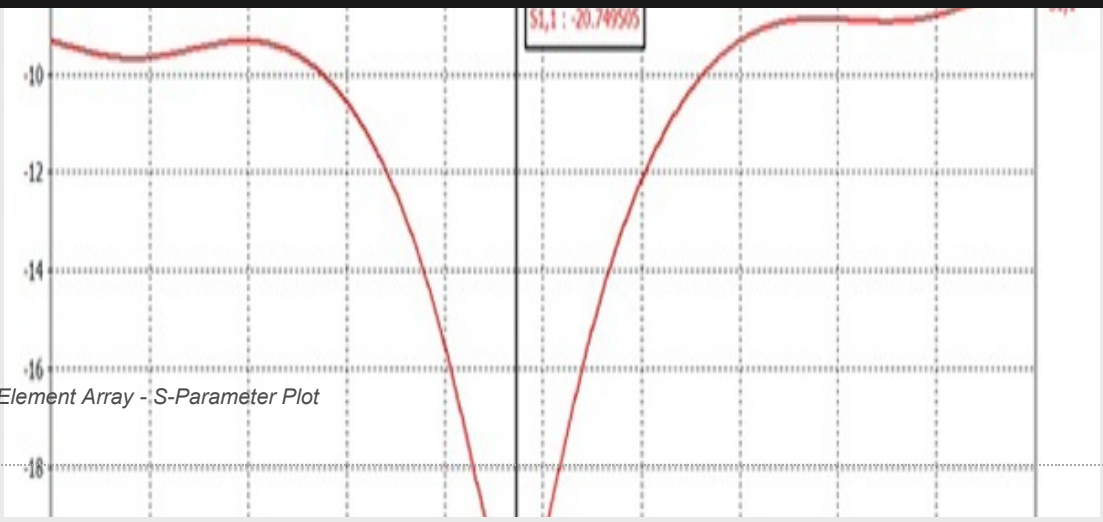

Sixteen-Element Array - S-Parameter Plot

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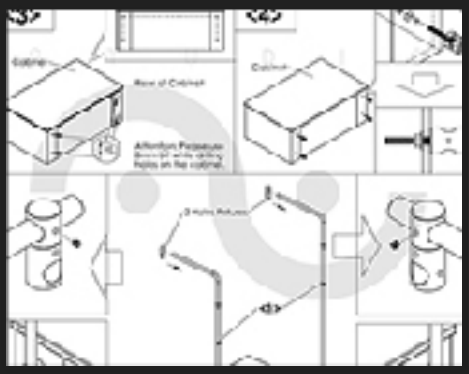

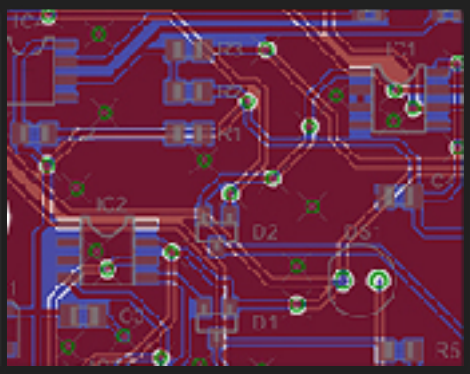

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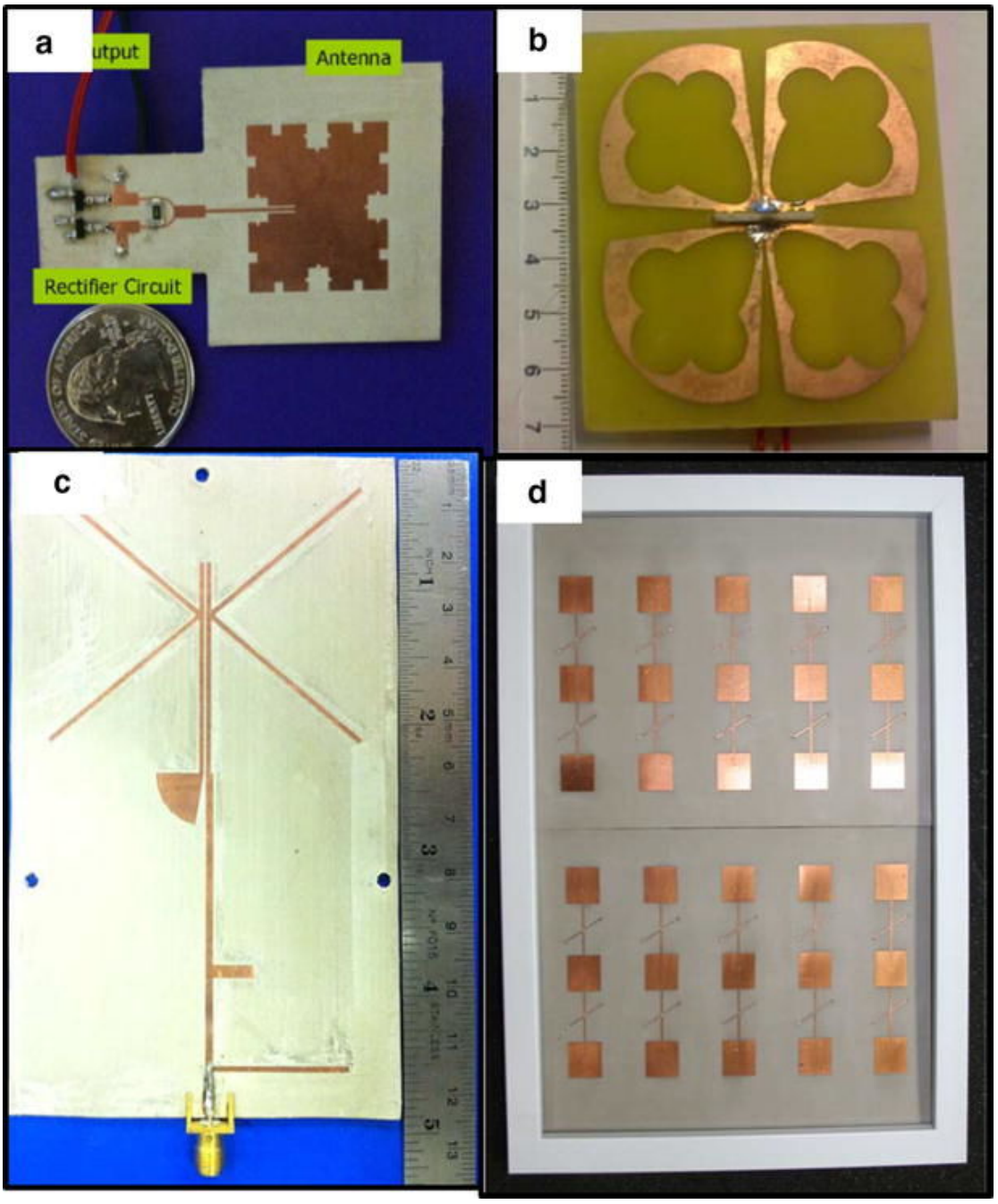

Fig. 4

Types of antennas **a** 2.45 GHz patch antenna with rectifier [38]. ©2010 IEEE. All rights reserved; **b** Planar dual-polarized antenna [24]. ©2015 IEEE. All rights reserved; **c** Microstrip antenna [37]. ©2012 IEEE. All rights reserved; **d** Array of stacked differential patch antenna [33]. ©2015 IEEE. All rights reserved

The plate antennas are popular and have many applications [27, 34, 38]; on-chip antennas are preferred for small and compact applications. Recently, many publications addressed wide-band and multi-band antennas. It has been proven that narrow-band antennas offer high energy conversion efficiencies but can only retrieve a limited amount of energy. On the other hand, wide-band or multi-band frequency antennas can retrieve more RF energy in space. However, the tradeoffs are low overall efficiency and large aperture. In [32], antennas with a resonance frequency of 4.9 and 5.9 GHz were designed with PCEs of 65.2 and 64.8%, respectively. Further work by Lu et al. [26] on polarization antennas supports the assertion that expanding the bandwidth of an antenna leads to increasing the amount of power harvested. In this work, the demonstration of broadband polarization antennas with three separate modes allows the antenna to operate in a wider range of frequencies. One common mechanism in the aforementioned works is the control of the antenna configuration by switching the diodes on and off, thus altering its resonant frequencies. However, since it uses separate modes for different frequencies, this antenna is not able to simultaneously resonate at two frequencies. On the other hand, the antenna presented in [39] is capable of operating at 2.45 and 5.8 GHz, simultaneously, providing 2.6 V output with a PCE of 65% and power density of 10 mW/cm^2.

The main purpose of aligning antennas in arrays is to enhance the antenna gain and obtain high voltage/current. Array antennas are preferred over large aperture antennas because they do not require large breakdown voltage diodes to operate. Antenna arrays can be connected before or after rectification. The first configuration enhances the retrieved power at the main beam while the second configuration expands the ability to retrieve power from various angles away from the main beam [40]. In case the RF waves are combined before rectification, the rectifier requires a large breakdown diode. If RF waves are combined after rectification, combining DC current becomes problematic. Antenna arrays can be connected in series or parallel to obtain high voltage or large current. Nonetheless, expanding the arrays yields better output but this might cause a deduction in conversion efficiency [33].

For demonstrating antenna arrays, Sun et al. [35] invented a T-junction to connect four quasi-Yagi antennas together. The advancement in this work was that the T-junction was flexible in changing from 1 × 4 array to 2 × 2 array topologies. Consequently, the system was able to operate at an ambient power level as low as 455 μW/cm^2 while obtaining 40% PCE.

Impedance matching network

In low-power consumption electrical systems, power leakage during transmission may lead to energy insufficiency. In these circumstances, adding an impedance matching network (IMN) ensures that the maximum power transfers between the RF source and load. For WPH applications, the receiving antenna is considered as the source while the rectifier/voltage multiplier is considered as the load. It is acknowledged that in DC, power transfer is optimum when the resistances of the source and load are indistinguishable. In an RF circuit, the impedance is referred to instead of resistance. An impedance mismatch between the source and load creates reflected power flow in the circuit that lowers the efficiency of the system. As its name indicates, the IMN ensures that the impedance of the source and load are identical by adding reactive components in between.

There are three basics matching configurations i.e. L, T and π matching networks (Fig. 5). The L matching is commonly used since it typically has two components, which simplifies the designing and controlling process. Additionally, the L matching networks do not alter the quality factor (Q) of the circuit.

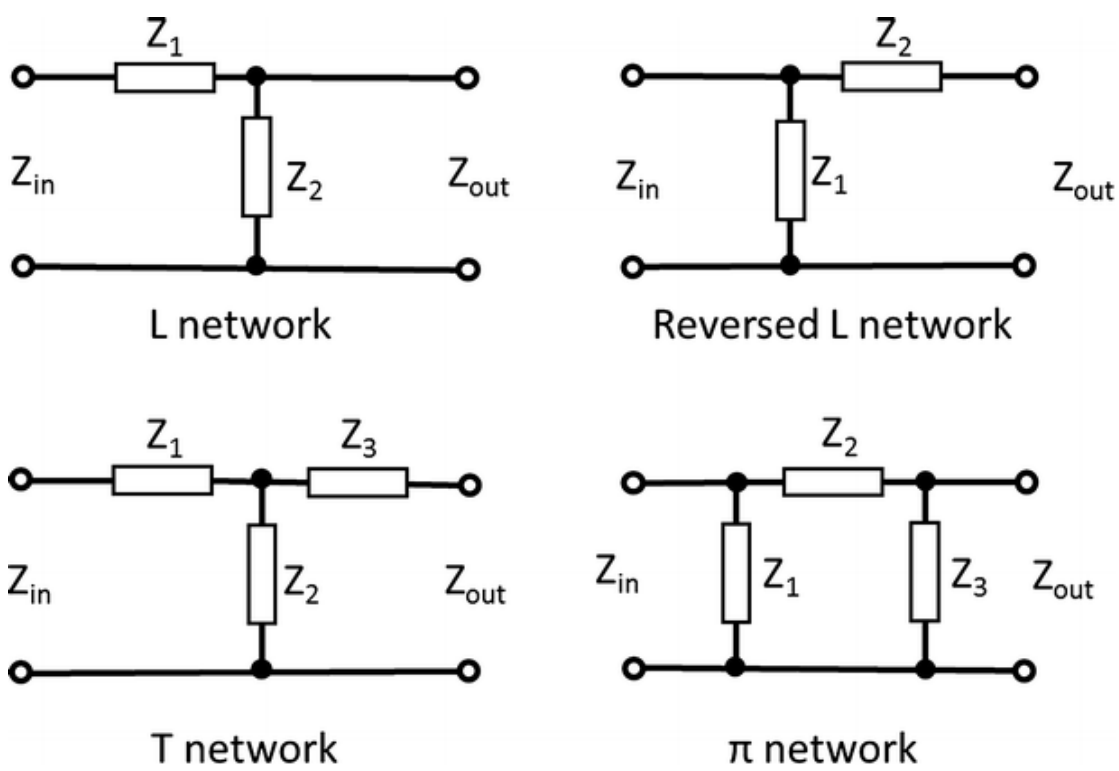

Fig. 5

Configuration of common impedance matching networks

The T and π matching configurations are more complex than the L network. Furthermore, organizing the T and π configurations into multiple stages will retain the final matching results but will change the Q factor. This strategy is useful in improving voltage boost.

There are tradeoffs between the attributes of an IMN, which include frequency, bandwidth, adjustability, and complexity. For instant, in [41], the suboptimal impedance matching and multiport ladder matching methods were introduced to enhance the

matching performance and harvested power of antennas, respectively. However, the tradeoff was that implementation of these configurations required more components than traditional matching networks, thus, escalating the circuit's complexity.

Etor et al. [42] designed an IMN for THz frequencies applications using transmission lines and self-designed metal–insulator-metal diodes instead of lumped components. Moreover, fixed IMN and tunable IMN [43, 44, 45] were introduced as a technique for better matching with wide-band and multi-band antennas.

Rectifier/voltage multiplier

RF energy extracted from free space usually possesses low power density since the electric field power density decreases at the rate of $1/d^2$, where d is the distance from the RF source [46]. Therefore, a power amplifier circuit is required that yields enough DC energy from the electromagnetic waves to drive the loads. This gives rise to two possibilities, if the power consumption of the load is lower than the average power harvesting, the electronic devices at the load may work continuously; otherwise, if the load consumes more energy than the power harvesting circuit can generate, the devices cannot work continuously [47].

Rectifying is the most popular application of diodes, which refers to the conversion of AC current to DC current. In terms of power harvesting application, the RF signal retrieved in the antenna has a sinusoidal waveform. The signal after transformation through IMN would be rectified and boosted to meet the power requirements of the application.

The most fundamental topology of the rectifier is the half-wave rectifier that comprises of a single diode D1 (Fig. 6a). When AC voltage transfers through D1, only the positive cycle remains and the negative cycle is cutoff; thus, it diminishes half of the AC power. Moreover, the output V_{out} is discontinuous since the negative cycle is cutoff. Despite its simplicity, a half-wave rectifier is usually inadequate for common applications. Hence, a full-wave rectifier is more preferable. The circuit design of the full-wave rectifier is shown in Fig. 6b. During the first negative cycle of AC input, diode D1 is conductive and capacitor C1 is charged to the corresponding energy level of V_{peak} of the input. Then, at the next positive cycle, diode D1 is blocked, diode D2 is conductive so that capacitor C2 is also charged. In consequence, the output V_{out} would see two capacitors in series (each one is storing a voltage of V_{peak}). Thus, V_{out} is twice V_{peak}. Therefore, this topology is more stable and efficient than the half-wave rectifier. There is also a bridge rectifier that rectifies both positive and negative cycles of the AC input but retains $V_{out} = V_{peak}$ by alternatively blocking pairs of diodes D1, D4 and D2, D3 (Fig. 6c).

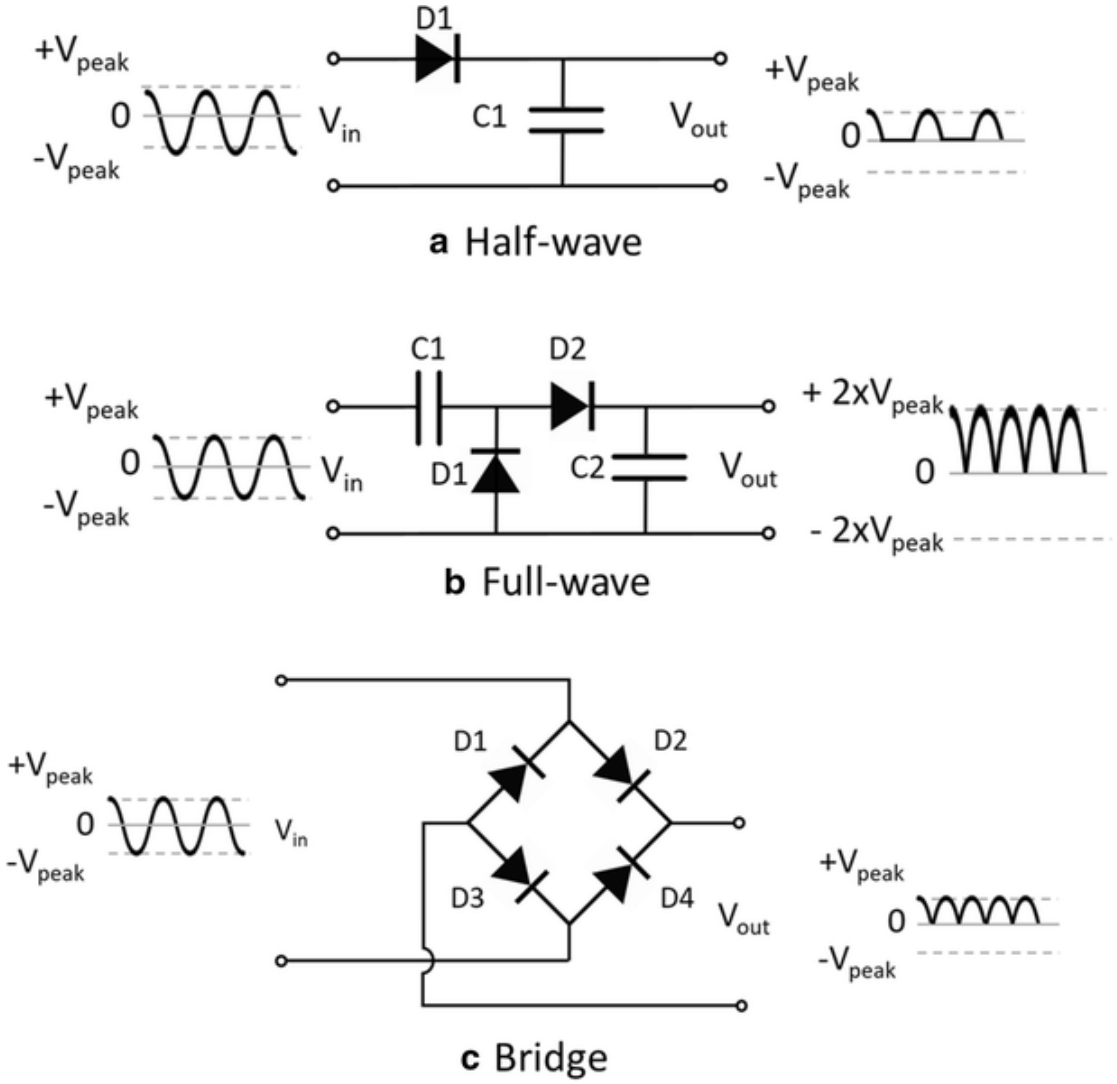

Fig. 6

Some common topologies of a rectifier

Voltage multiplier is a special type of rectifier circuit that converts and boosts AC input to DC output. In some case where the rectified power is inadequate for the application, there is a need for boosting the output DC by stacking single rectifiers into series, forming the voltage multiplier [48]. Several configurations of the voltage multiplier are shown in Fig. 7. The most fundamental configuration is the Cockcroft–Walton voltage multiplier (Fig. 7a). This circuit's operational principle is similar to the full-wave rectifier (Fig. 6b) but has more stages for higher voltage gain. The Dickson multiplier in Fig. 7b is a modification of Cockcroft–Walton's configuration with stage capacitors being shunted to reduce parasitic effects. Thus, the Dickson multiplier is preferable for small voltage applications. However, it is challenging to obtain high PCE due to the high threshold voltage among diodes creating leakage current, thus reducing the overall efficiency. Additionally, for high resistance loads, output voltage drops drastically leading to low current supply to the load. A summary of recent works related to voltage multiplier is shown in Table 3.

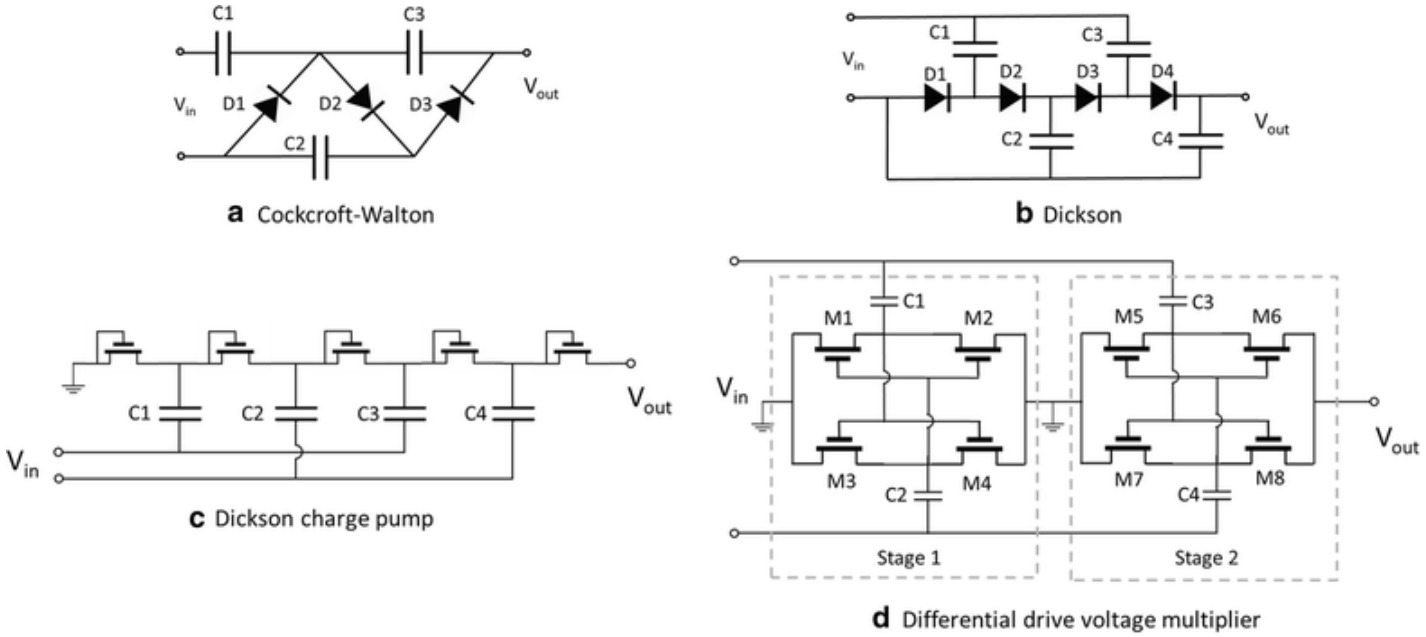

Fig. 7

Common voltage multiplier configurations: **a** Three stages Cockcroft–Walton voltage multiplier, **b** Four stages Dickson voltage multiplier, **c** Four stage Dickson voltage multiplier using CMOS technology, **d** Two stages voltage multiplier comprised of differential drive unit

Table 3

Published work comparison regarding voltage multiplier

Ref.	Rectifier topology	No. of stage	Freq. (MHz)	Tech.	Range (dBm)	Maximum PCE	Size
[51]	Differential	2	433	0.18 µm CMOS	0–20	74% @ 2 dBm	–
[52]	PMOS transistors	7	900	40 nm CMOS	–	44% @ > 390 mV	0.04 mm^2
[53]	Half-wave	4	900	0.18 µm CMOS	–	37.42% @ 390 mV	–
[54]	Comparator-based/active-diode	3	13.56	0.18 µm CMOS	8–15	67.9% @ 12.8 dBm	–
[55]	Dickson	3	13.56	250 nm CMOS	–	72%	0.13 mm^2
[56]	–	–	915	0.13 µm CMOS	−21.6	22.6% @ −16.8 dBm	0.186 mm^2

Prototyping Methods

There's more on this in Scherz, *Practical Electronics for Inventors*.

Solderless Breadboard or **Plugboard**

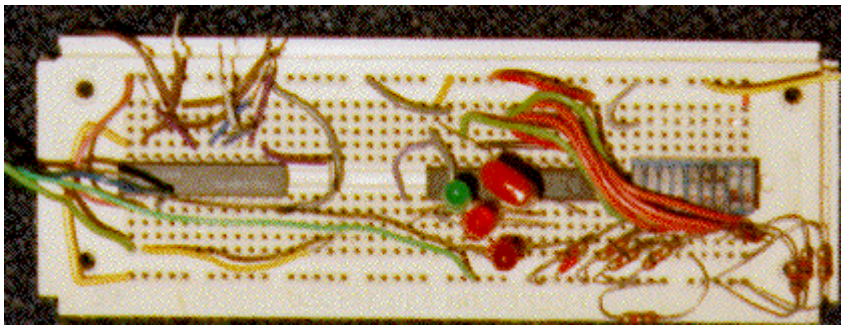

This is what we've been using in lab.

Advantages

- Very fast to build and make changes.
- Works well with DIP ICs

Disadvantages

- Limited reliability—lab testing only, for limited-size circuits.
- High capacitance between adjacent rows (~ 10 pF).
- Only for small-lead-size components (.032" or 0.82 mm max—a 1 A diode lead is just barely too big to meet the spec.)

Springboard

Used in ENGS 22

Advantages

- Fast to build and make changes.
- Accomodates large wire sizes.
- Secure, reliable connections.
- Can handle higher current/power.

Disadvantages

- Can't accommodate small lead spacings such as on ICs.
- Although it is reliable enough for long-term use, it's expensive for that purpose.

Wirewrap

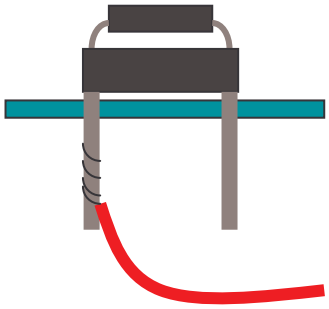

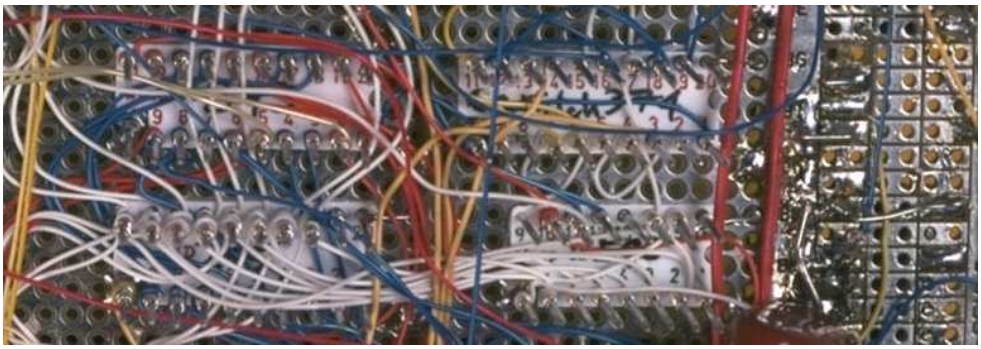

Connections made by fine wire wrapped tightly around square pins of special IC sockets. This is a great way to make a permanent version of a digital circuit almost as quickly as using a solderless breadboard. Used in ENGS 31.

Advantages

- Fast to build and make changes.
- Can make a complex circuit compact.
- Reliable.
- Can be used permanently.
- Inexpensive.

Disadvantages

- Low current—limited to under a few hundred mA.
- High inductance/resistance—on the order of 0.1 ohm, 0.25 μH per foot.
- Only makes reliable connections to square leads (as are on wire-wrap IC sockets). Discrete components (e.g., resistors, capacitors, transistors) need to be soldered to a "header" that goes in an IC socket or to individual wire-wrap pins.

Perfboard and Solder.

Using the same perfboard as used in wire-wrap work, it is possible to simply twist and solder leads, and run wires where needed.

Advantages

- Reliable, if done well.
- Can be used permanently.
- Inexpensive.
- Can handle any size components
- Convenient for working with discrete components.

Disadvantages

- Slow, requires skill to do well.
- Works for ICs, but not very easily.

Variations:

- Perfboard with individual copper pads on each hole so that the solder will better hold things in place. (Photo below)
- Perfboard with a perforated ground plane. Provides the shielding and grounding benefits of a ground plane, and makes ground connections easy, but requires care to avoid shorts. Some have the ground plane etched from around the holes; others require you to cut the copper away from the holes with a special tool. This is also possible with wire-wrap, as in the photo in that section.

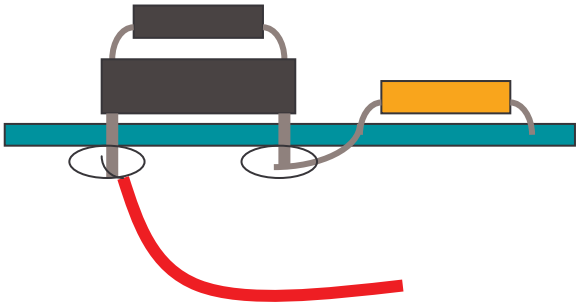

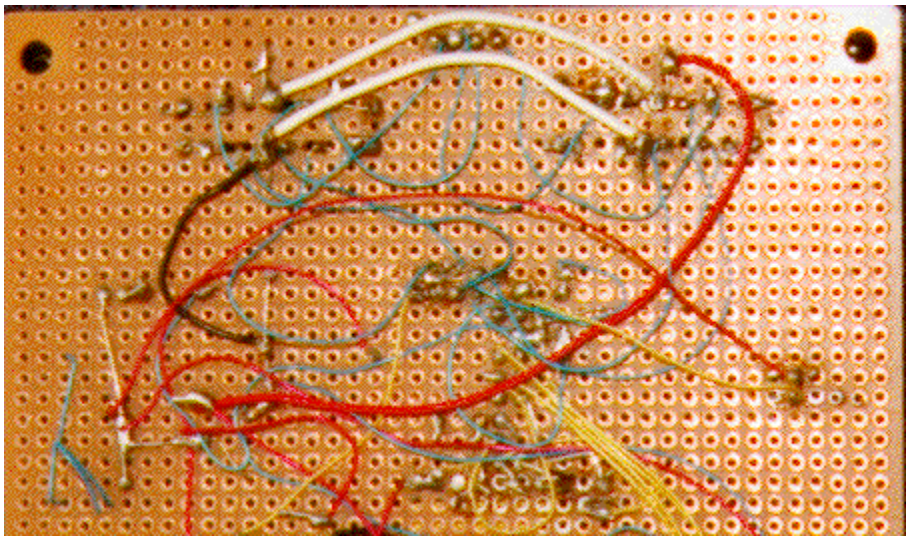

Generic Printed-Circuit Board—multiple hole-per-pad.

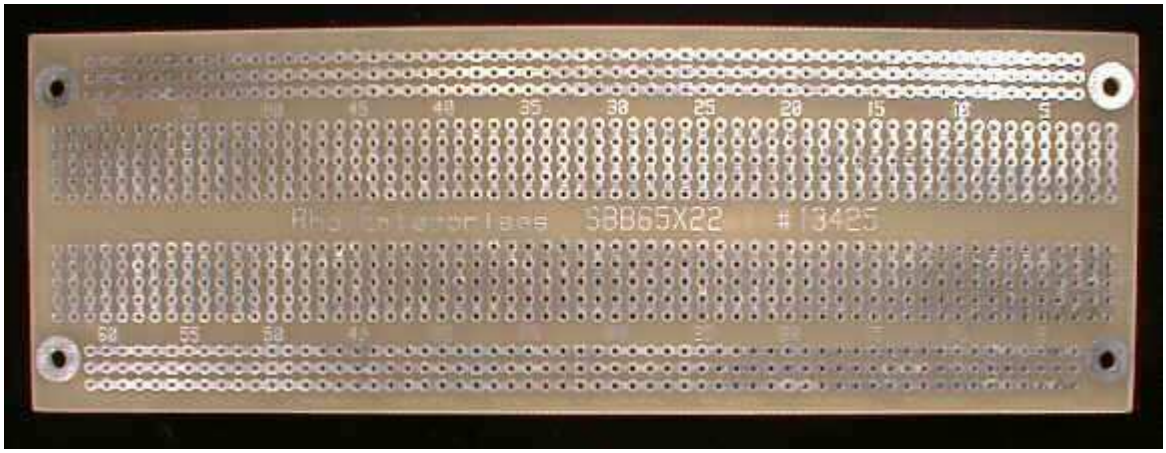

A printed circuit board with a pattern of holes and connections similar to a solderless breadboard.

Advantages

- Easier than using plain perfboard, especially for ICs.
- Reliable.
- Can be used permanently.
- Available with ground planes if needed.

Disadvantages

- Usually not as compact a final circuit as some alternatives, because you are constrained by layout.
- Pads bigger than needed can add capacitance, but not much.
- Can be expensive, especially the “vectorboard” brand.
- Sometimes awkward for odd sized or large components.

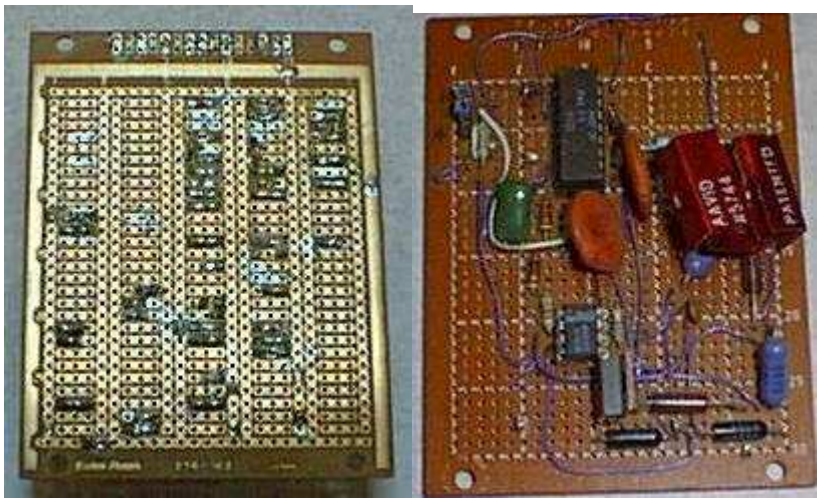

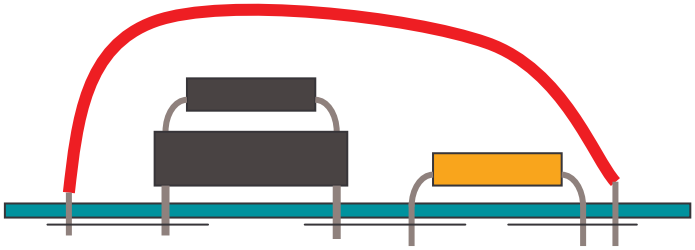

“Dead Bug,” or “Ugly-board”

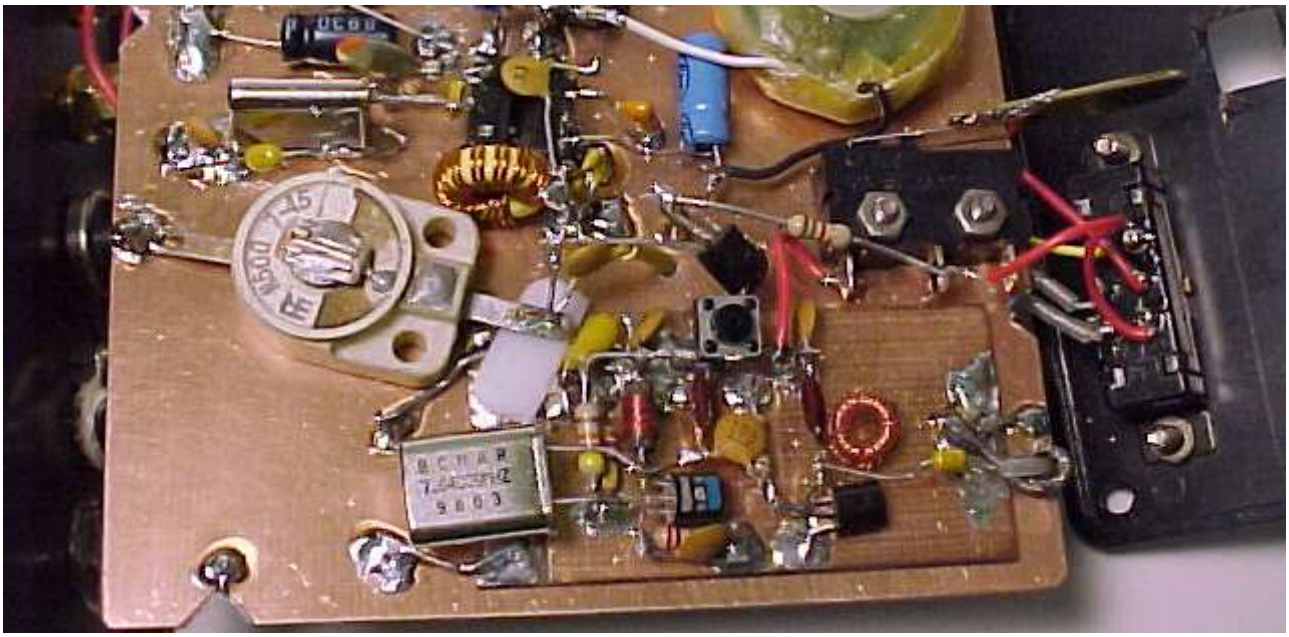

Start with a plain copper-clad board. Glue ICs down with the leads sticking up in the air. Then solder to them

Advantages

- Provides an excellent ground plane. Can be a high performance way to build sensitive and/or high-frequency analog circuits
- Can make a complex circuit compact.
- Reliable.
- Can be used permanently.
- Inexpensive.

Disadvantages

- Requires high soldering skill.
- Takes a long time to build.
- Mechanical support for components is marginal; can add glue (“RTV”) after debugging.
- Only makes reliable connections to square leads (as are on wire-wrap IC sockets). Other components (e.g., resistors, capacitors, transistors) need to be soldered to a “header” that goes in an IC socket or to individual wire-wrap pins.

Variations:

- Manually cut the board with a dremel tool to isolate sections for purposes other than ground plane (use the back for ground plane). See photo below.
- Glue on little rectangles of cut-out board to add power busses, etc.

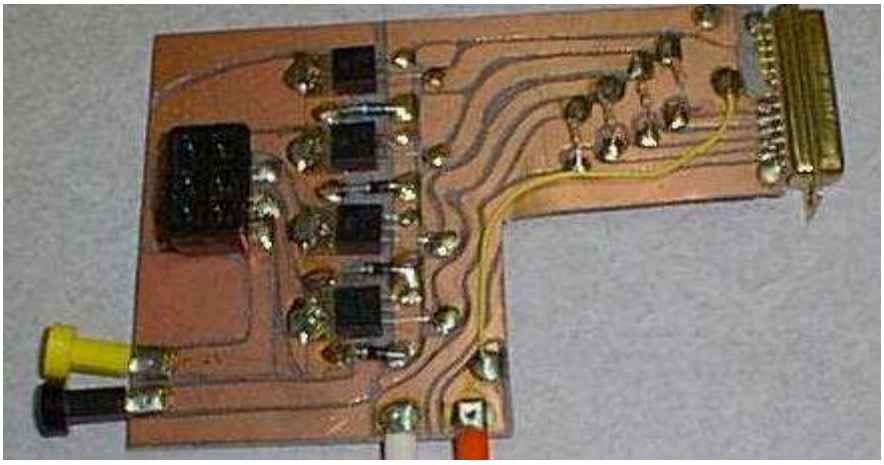

Printed circuit board (PCB)

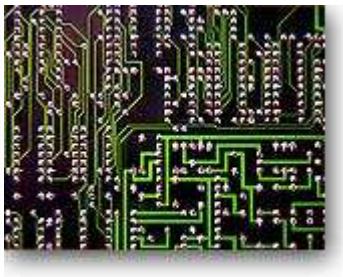

This is what is used virtually universally in production of electronics.

Advantages

- Easy to build in production.
- Repeatable, controllable stray L, C.
- Can handle virtually any component, power level.
- Highly reliable.
- Can make very compact.
- Design can be (somewhat) automated from a schematic you have entered.

Disadvantages

- Laying out the board and getting it fabricated takes time, although you can pay for fabrication in a few days if you can afford it.
- Expensive, on the order of hundreds of dollars for one, but with almost no increase in cost to make many.
- Hard to make changes, but making changes may be easier than building another type of prototype.

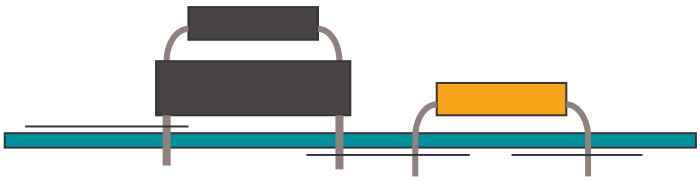

Notes on surface-mount components

Most modern production designs now use surface-mount components instead of “through hole” components. The circuits can be more compact, and the board layout is easier because different things can be done on each side (and in additional layers between sides) without through-holes interfering. But prototyping gets much more difficult!

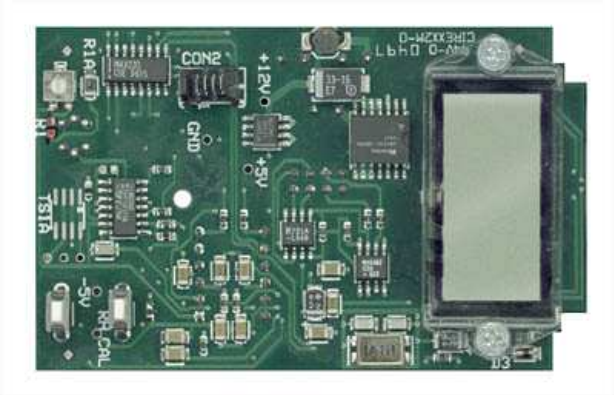

Prototyping options for surface mount

- Simulate, and then lay out a PCB. Don’t ever make a breadboard.
- Order DIP ICs and leaded passives for the prototype, and then switch to surface mount for production.
- Get adaptors that have pads to solder surface-mount ICs to, and then standard-spacing (0.1”) pins in DIP or SIP layout. Digikey carries “surfboards” made by Capital Advanced Technologies, and adaptors made by Aries Electronics. In addition to DIP and SIP adaptors, there are boards with solder pads for connecting larger wires; these work well for prototypes built in “dead bug” style.

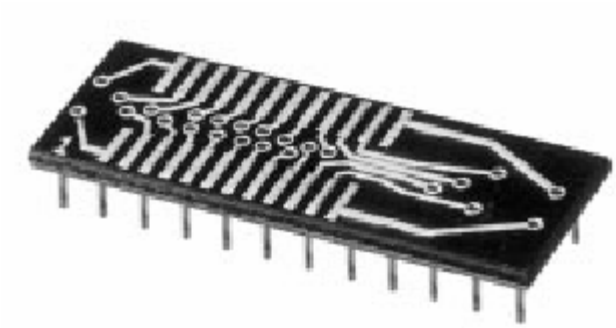

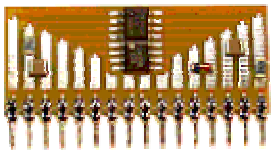

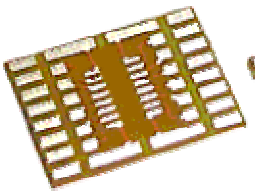

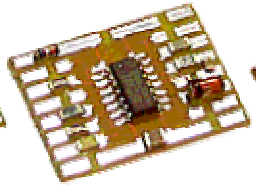

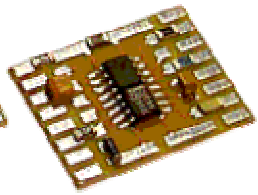

Crystal receiver set 11

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This receiver has a single tuned circuit, the Q factor of the tuned circuit is quite low.
The receiver can be used well for reception of local stations, for reception of distant stations it is less suitable.

I tried to give this receiver a nice "old-fashioned" look, the reception performance was in this design of less importance.
This receiver is for sale, I made a series production of these, and will build more on request.
This receiver is also for sale as do-it-yourself kit.
See the shop for more information.

The front panel of the receiver.
On the left side the socket for the headphone.
In the middle the tuning knob.
On the right the connections for antenna (upper) and ground (lower).

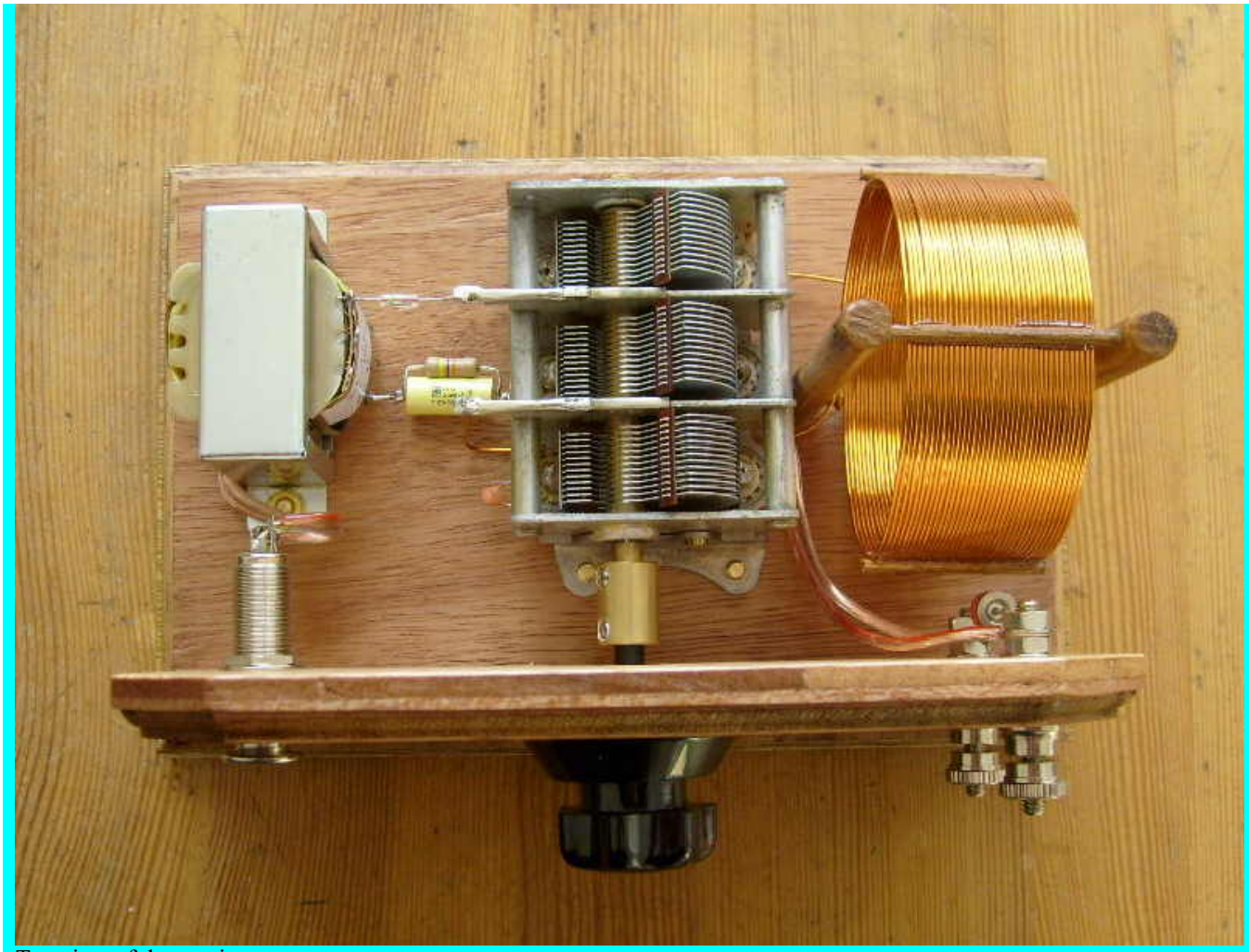

Top view of the receiver.

Circuit diagram of receiver set 11

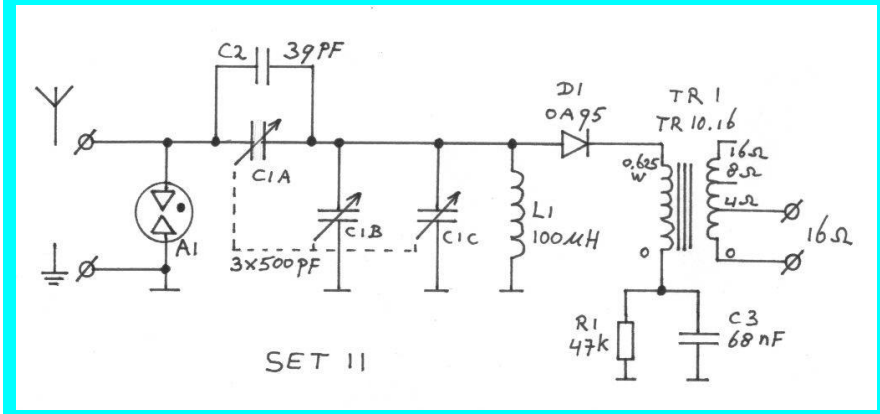

Circuit description.
The resonance circuit is formed by coil L1 and C1b and C1c (together 1000 pF).
Capacitor C1a and C2 provide the matching between antenna and tuned circuit.
The frame (rotor) of the tuning capacitor is carrying the RF signal, by this it is possible to tune simultaneously the tuned circuit (C1b and C1c) and the antenna matching (C1a).
Germanium diode D1 provides the signal detection.
Transformer TR1 is loaded with 16 Ω at its 4 Ω output, through this the input impedance increases from 16 kΩ to about 43 kΩ.
At the output a headphone of 2x 32 Ω can be connected, with the two speakers parallel, the impedance is 16 Ω.

Component A1 is a *gas discharge tube* (also called: *surge arrester*) with type number: N81-A90X.
The gas discharge tube protects the antenna input for too high voltages.

These high voltages can occur if the antenna picks up static charge from the air (especially occurs with long outdoor antennas from non insulated antenna wire).
As the voltage at the antenna is higher then 90 Volt, the gas discharge tube will start to conduct and short the high voltage to ground.
As soon as the charge has flown to ground, the conduction stops automatically.

Frequency range of the receiver.
Frequency range without antenna: 500 - 2500 kHz.
Frequency range with 10 meter antenna connected: 487 - 1860 kHz.
Both with and without antenna connected, the whole medium wave band can be tuned.

Q factor of the LC circuit (Without antenna and without diode connected):
600 kHz: Q= 83
900 kHz: Q= 81
1200 kHz: Q= 75
1500 kHz: Q= 65
The circuit Q is rather low, one reason for this is because the RF signal is in this design on the frame of the tuning capacitor.
Because the frame of the tuning capacitor is directly connected to the wooden bottom plate losses occur here.

You can find a complete building instruction op the following pages:

Step 1 Preparing the components

Step 2 Making the frame of the receiver

Step 3 Making the coil

Step 4 Placing the components

You will find here the part list of this receiver.

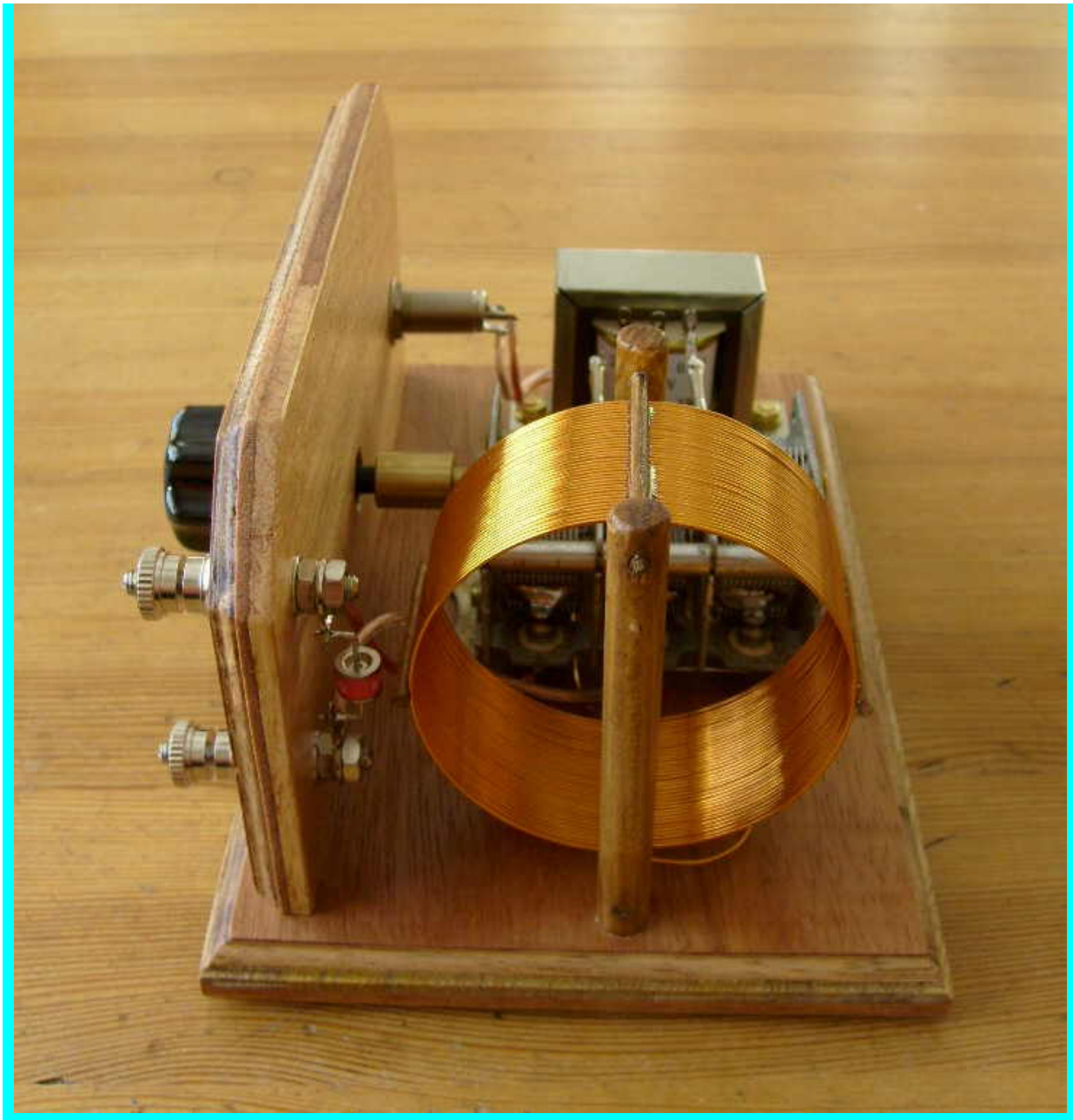

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How to make a batteryless (crystal set) radio

By **Sagar Sapkota** - July 21, 2012

CRYSTAL SET

The simplest radio receiver, known as a Crystal Set, consists of nothing more than a coil, tuning capacitor, diode detector, and a pair of earphones. A typical circuit diagram for a Crystal Set Radio is given below where inductor or coil L1 is tuned by variable capacitor VC1 to the transmitter frequency. Diode D1 demodulates the signal, which is fed straight to the earphones. There is no amplification.

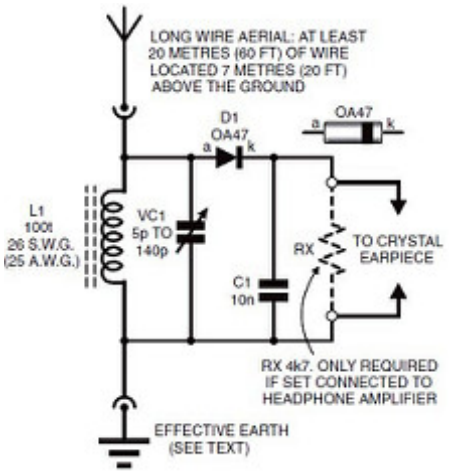

CLICK HERE FOR BIGGER PHOTO

** You can use 1N34 Germanium diode in place of OA47*

A long (at least 20 metres), high (17 metres or more) aerial and a good earth (a buried biscuit tin or a metre of copper pipe driven into damp ground) are required in order to ensure audible headphone reception. The earphones originally used with these receivers had an impedance of around 4000 ohms and were very sensitive (and heavy and uncomfortable). They are no longer available, but a crystal earpiece, which relies on the piezoelectric effect, will give acceptable results.

Low impedance "Walkman" type earphones are NOT suitable.

Component details:

Resistor- RX-4.7k, 0.25 W- only required if set is connect to audio amplifier

Capacitors- C1- 10nF disc ceramic VC1- 5p to 140p, polythene dielectric variable capacitor.

Semiconductors: D1: OA47 or 1N34- Germanium Diode

Miscellaneous: L1- Ferrite Rod, 100mm(4 inch)x9mm/10mm dia., with coil.

Crystal earpiece and jack socket to suit; plastic control knob; plastic insulated flexible cable for aerial wire, downlead and earth connection, 30 meters minimum; buried biscuit tin or 1 meter of copper pipe for earth system; 50gm reel of 26SWG enamelled copper wire, for tuning coil; card and glue for coil former; multistrand connecting wire; crocodile clips or terminals for aerial and earth lead connection; solder, etc.

READ MY EXPERIENCES- HOW EASILY I MADE A BATTERYLESS RADIO

DRAWBACKS

Quite apart from the absence of amplification, two factors seriously limit the performance of crystal receivers. Germanium diodes become increasingly reluctant to conduct as the applied voltage falls below 0.2V, and this makes the receiver insensitive to weak signals. Silicon diodes have a threshold of around 0.6V, and are, therefore, unsuitable for circuits of this kind.

** Silicon diodes like 1N4001 are not suitable*

The earphone loading imposes heavy damping on the tuned circuit, hence, reduces its ability to separate signals. With such low selectivity insensitivity can be a blessing, and crystal sets are normally only capable of receiving a single, strong transmission on the long and medium wavebands. They will sometimes receive more than one if a shortwave coil is fitted.

The aerial and diode can be connected to tappings on the tuning coil in order to reduce damping, but the improvement in selectivity is usually at the expense of audio output. When valves cost a week's wages and had to be powered by large dry batteries and lead/acid accumulators, the construction of simple receivers of this kind could be justified. With high performance transistors now costing only a few pence or cents, crystal sets are now regarded as 'nostalgic pieces". Some readers may, however, wish to build one out of curiosity, or for the novelty of having a receiver that **does not require a power supply.**

CIRCUIT DETAILS

Ferrite loop aerial L1 and polythene dielectric variable capacitor VC1 form the tuned circuit. Point contact germanium diode D1 (1N34 or OA47) demodulates the signal; capacitor C1 bypasses residual r.f. (radio frequency) to earth and also exhibits a reservoir action, enabling the a.f. (audio frequency) output to approach its peak value. The recovered audio signal is fed directly to a crystal earpiece. Signal voltages

introduced in the ferrite loop aerial by the radiated magnetic field are much too much to produce an output from the detector, and the component is used here simply as a tuning coil. The ferrite core does, however, reduce the number of turns required for the coil winding, thereby reducing its resistance and increasing its audio quality.

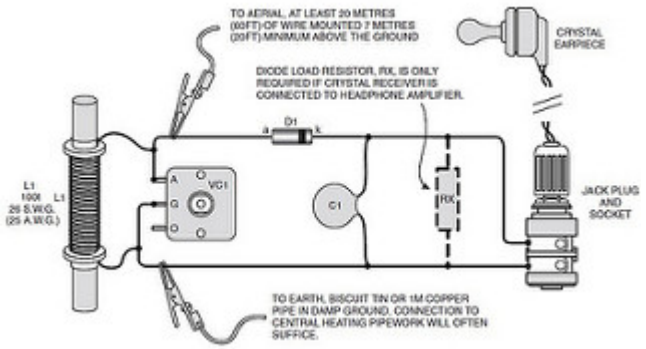

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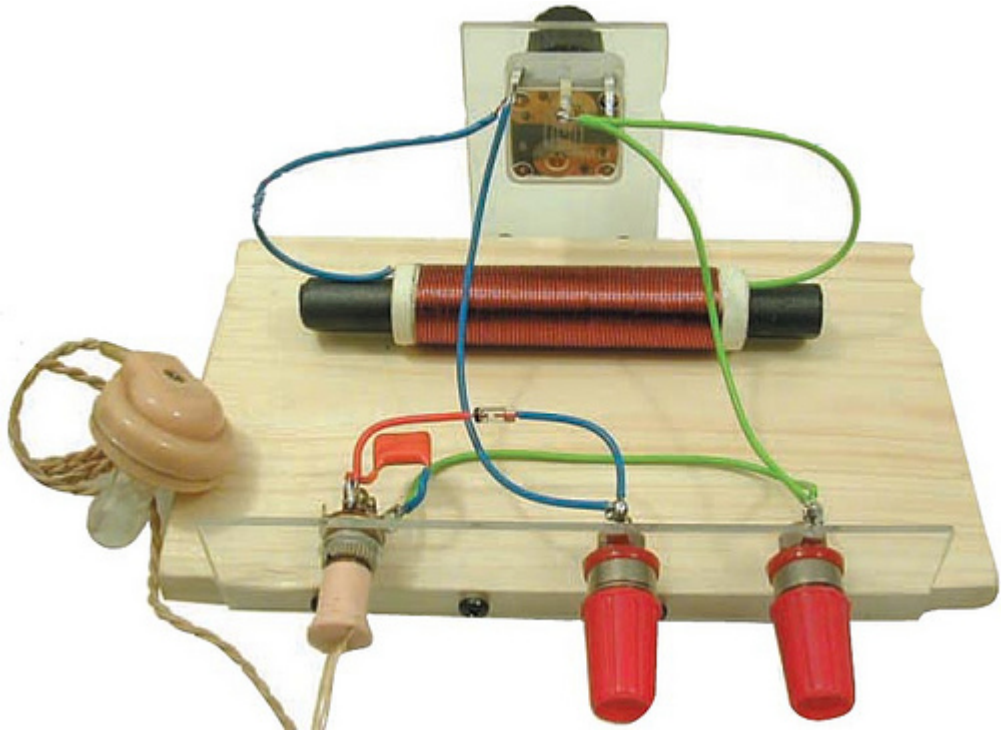

COIL DETAILS

Full construction and winding details for the ferrite tuning/ aerial coil L1 are shown in figure.

The coil is made from 26 SWG(25 AWG) enamelled copper wire, close wound on a cardboard former.

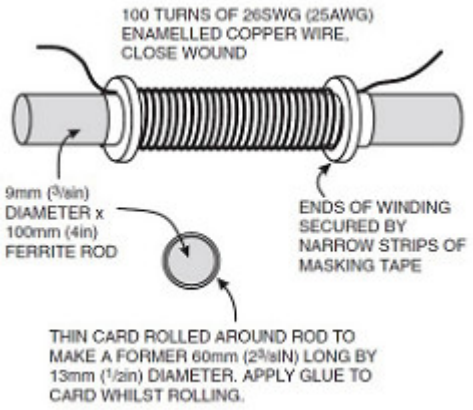

The r.f. bypass capacitor C1 can in practice, be omitted with no noticeable reduction in performance. However, if the set is to be connected to either the headphone amplifier or speaker amplifier decribed next month, the component together with diode, load resistor, RX, must be included.

AMPLIFICATION Audio frequency amplification, after the diode detector will permit the use of low impedance Walkman type earphones or even loud speaker operation. It will do nothing, however, to overcome the diode's insensitivity to weak signals. For this we must have radio frequency amplification of the signals picked up by the aerial before they reach the detector(The standard circuit for a transistor portable receiver has three stages of radio frequency amplification ahead of the diode).

For amplification, you can use a simple audio amplifier using LM386.

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Fully printed flexible and disposable wireless cyclic voltammetry tag

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A disposable cyclic voltammetry (CV) tag is printed on a plastic film by integrating wireless power transmitter, polarized triangle wave generator, electrochemical cell and signage through a scalable gravure printing method. By proximity of 13.56 MHz RF reader, the printed CV tag generates 320 mHz of triangular sweep wave from +500 mV to −500 mV which enable to scan a printed electrochemical cell in the CV tag. By simply dropping any specimen solution on the electrochemical cell in the CV tag, the presence of solutes in the solution can be detected and shown on the signage of the CV tag in five sec. 10 mM of N,N,N′,N′-tetramethyl-p-phenylenediamine (TMPD) was used as a standard solute to prove the working concept of fully printed disposable wireless CV tag. Within five seconds, we can wirelessly diagnose the presence of TMPD in the solution using the CV tag in the proximity of the 13.56 MHz RF reader. This fully printed and wirelessly operated flexible CV tag is the first of its kind and marks the path for the utilization of inexpensive and disposable wireless electrochemical sensor systems for initial diagnose hazardous chemicals and biological molecules to improve public hygiene and health.

Cyclic voltammetry (CV) has been used as a powerful tool for the study of electrochemical redox reactions between the electrodes and the solutions of all kind of solutes such as metals[1], organic molecules[2], proteins[3], bacteria[4], viruses[5], and DNA[6]. Because of the high sensitivity of the electron transfer redox reactions, CV could become a very promising ubiquitous electrochemical sensor protocol if the cost and size of the CV system were significantly reduced to commercially viable single-use disposable units for checking traces of hazardous materials such as lead[7], mercury[8], arsenic[9], e-*coli*[10], and pesticides[11] in water or to diagnose the level of glucose[12], cholesterol[13] and specific enzymes[14] in blood. This single-use disposable CV would dramatically reduce the cost of maintaining the public health system[15]. Therefore, inexpensive and disposable CV measurement system that can be operated wirelessly using a smartphone or RF (radio frequency) reader without complicate operation processes is in high demand for the realization of an ubiquitous sensor network system (Figure 1a). They would mainly be used as ubiquitous diagnostic and testing tools for detecting and monitoring the level of target specimens. However, there is no technology that is advanced enough yet to build a wireless, inexpensive and disposable CV system. In this paper, as a form of RF-tag, an extremely inexpensive, disposable and fully printed CV system is demonstrated for the first time by mimicking and combining basic CV concepts and wireless power transmission technologies of RF devices. To realize the fully printed CV tag, a key issue of wirelessly generating triangular waveform (±500 mV) that can scan the electrochemical cell at a low frequency (<1 Hz) to set up a redox reaction needs to be addressed through a minimum number of printed thin film transistors (TFTs). Fully printed 13.56 MHz rectenna and a ring oscillator with large trap charges in the channels of printed TFTs were respectively utilized to wirelessly generate triangular waveform by using only 10 printed TFTs.

Results

Based on two key units of the wireless power transmitter (Figure 1b-①) and the triangular wave generator (Figure 1b-②), the circuit layout of the fully printed wireless CV tag was designed by using a minimum number of printed thin film transistors (TFTs) to alleviate the issue of V_{th} shift and shown in Figure 1b as a platform of disposable CV system. The circuit of CV tag was fabricated using all scalable printing methods, a roll-to-roll gravure, a roll-to-plate gravure, a drop casting, and a screen printer (Figure S1 in Supplementary Information).

To provide a polarized DC voltage from the coupled 13.56 MHz AC signal of the reader, we modified our previously reported R2R gravure printed rectenna[16,17], as shown in the layout in Figure 2a and the resulting

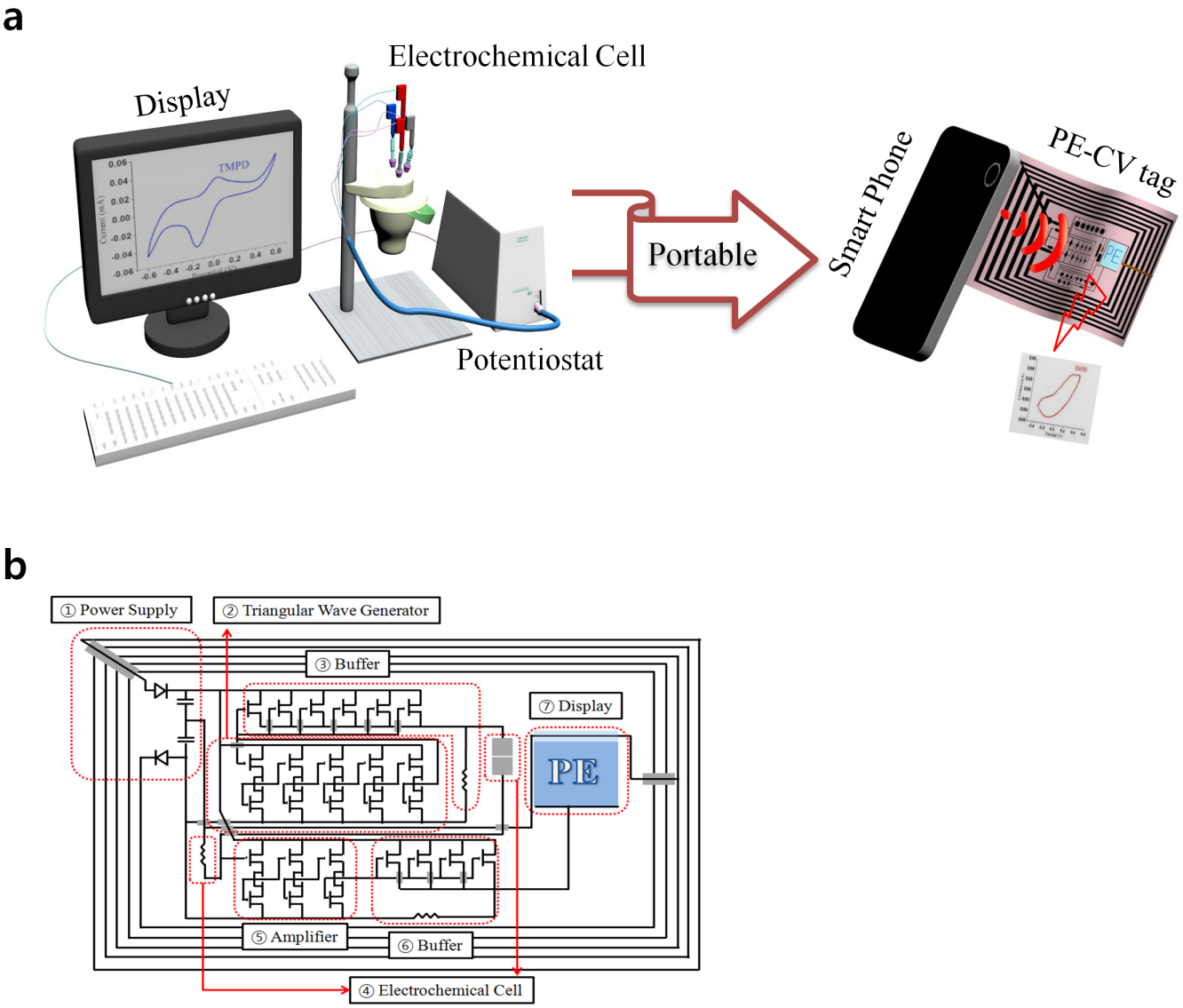

Figure 1 | (a) Informative illustration of typical CV system and disposable printed CV tag. (b) Schematic circuit diagram of the gravure printed wireless cyclic voltammetry (CV) tags. The circuit was designed to couple AC power from a 13.56 MHz reader and then convert the coupled AC to polarized DC ±10 V (① in Figure 1b). Polarized DC will operate the printed ring oscillator to generate a triangular voltage waveform (② in Figure 1b). The generated waveform will pass through the buffer to meet the impedance difference from the electrochemical cell (③ in Figure 1b). The electrochemical cell will run the redox reaction with a single drop of specimen solution (④ in Figure 1b) by the voltage triangular waveform. The output current of the electrochemical redox reaction will be amplified *via* an amplifier circuit (⑤ in Figure b) and the signal will pass through the buffer to meet the impedance difference from the printed signage (⑥ in Figure b). The signage will indicate the concentration level of specimen in the solution (⑦ in Figure b). It will indicate whether the concentration is above or below a pre-determined value.

printed diodes and capacitors are shown in Figure 2b. The printed diodes showed a rectifying ratio of 10^3, and capacitances of two printed capacitors were all about 8 nF/cm^2. The polarized DC voltages (Figure 2c) were measured by placing the printed rectenna on the RF (13.56 MHz) reader with a distance of 2 cm. We adapted a center tap transformer, consisted by divided antenna, 2 diodes and 2 capacitors, to provide the + and − DC voltage for printed triangle wave generator. Using a load of 1 MΩ, voltages of +9.4 V and −10.8 V DC were attained for the optimized printed antenna by monitoring the rectified polarized DC voltages and varying the values of the inductance of the antenna (Figure S2 in Supplementary Information). The polarized DC voltage was also decreased with decreasing load's resistance (Figure 2d).

To generate a cyclic waveform with a low frequency (<1 Hz) from the rectified polarized DC voltage, fully gravure printed *p*-type SWNT-based channel network thin film transistors (*cn*TFTs) were used to construct a five stage ring oscillator with *p*-type inverters. The *cn*TFTs can operate under less than 20 V and their mobility range (0.01 to 10 cm^2/Vs) can be controlled through the loading concentration of SWNT in the ink[18–21]. To print the five stage ring oscillator, we used the same silver and $BaTiO_3$ inks as in the printing of the rectenna for reducing a number of printing steps while SWNT ink was used for printing the channel of the *cn*TFTs. To manufacture the ring oscillator, roll-to-plate (R2P) gravure was used to print 10 *cn*TFTs with a gate width of 300 μm and channel length of 160 μm for both the drive and load *cn*TFTs (Figure S3 in Supplementary Information). The optimized cell depth of gravure plate was 37–40 μm with the cell wall thickness of 50–55 μm for the printing active layers of drive and load TFTs using low viscosity of SWNT based ink (~30 cp) (Figure S4 in Supplementary Information). By repeating the printing of active layers on load TFTs, a higher SWNT network density can be achieved to generate higher current in the

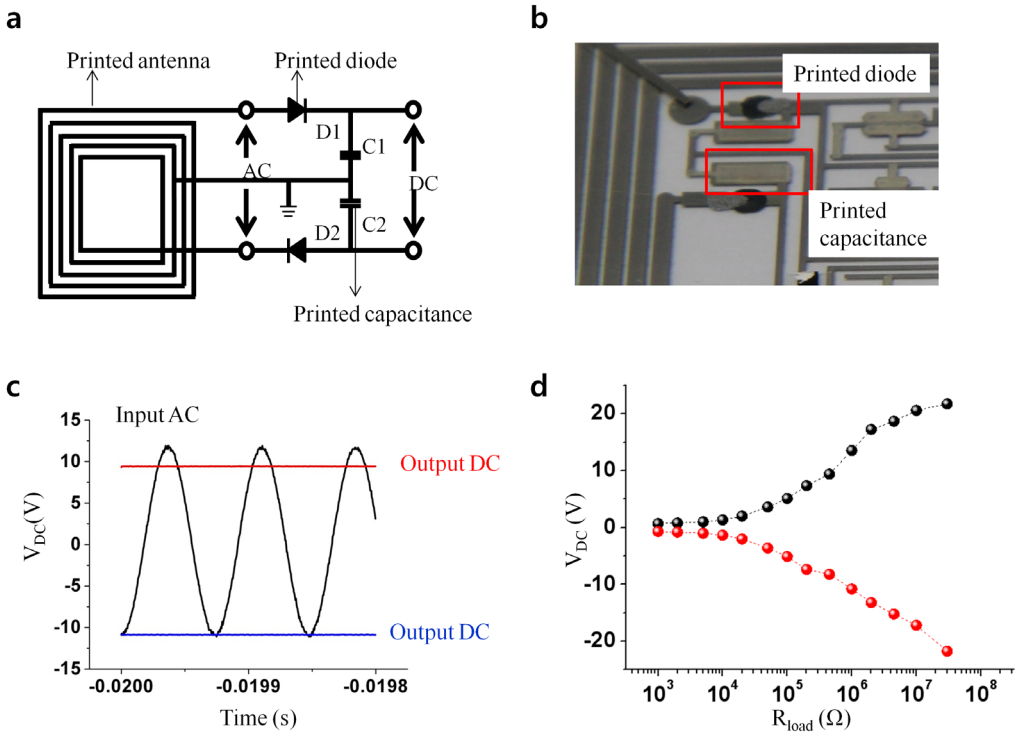

Figure 2 | (a) Circuit layout of the printed rectenna to provide polarized DC power, (b) a real image of printed diodes and capacitors, (c) input-output electrical characteristics of the rectifier at 13.56 MHz AC input and (d) output ± DC voltages under variations in load resistance.

channels while thicknesses of all printed gate, dielectric and drain-source electrodes are kept same (Figure S5 in Supplementary Information).

Their output and transfer characteristics are shown in Figure 3a and 3b respectively. Based on the attained transfer characteristics, the mobility (μ), transconductance (g_m), on-off current ratios from I_{DS}-V_{DS} and threshold voltages (V_{th}) for both five drive *cn*TFTs and five load *cn*TFTs were extracted and shown in Table S1 (Supplementary Information). The shift range of V_{th} from the fully gravure printed 10 *cn*TFTs were about ±0.4 V for the drive *cn*TFTs and ±0.6 V for load *cn*TFTs. Those shift ranges are narrow enough to run the printed ring oscillator for generating the triangular wave. Each inverter delivered a gain of 3 (Figure 3c), and the ring oscillator with five inverters generated a pseudo triangular waveform with a voltage amplitude of 7 V at 320 mHz (Figure 3d). In fact, the pseudo triangular wave can be only generated by the printed *cn*TFTs based ring oscillator because of the parasitic and trapped channel capacitances due to carbon nanotube network structures in *cn*TFTs. Although we only showed the frequency of 320 mHz at here, the frequency can be varied from 0.3 Hz to 2 Hz based on the printed network density of SWNT of printed *cn*TFTs. This is an advantage of our printed *cn*TFTs for scanning electrochemical cell in CV tag over other technologies such as amorphous silicon TFTs where only a sine wave with a designed single frequency can be generated because of no trap capacitance in the channel (Figure S6 in Supplementary Information). The frequency of the triangular waveform can be fine-tuned in the range of 0.3 Hz to 2 Hz as shown in the Figure S7 (Supplementary Information) by simply changing loading concentration of SWNTs.

When the generated triangular waveform is supplied directly into the printed electro-chemical cell (Figure S8 in Supplementary Information), wherein printed silver and carbon electrodes were used with a poly(ethylene oxide) and $LiCF_3SO_3$ gel type electrolyte, the output voltage range is reduced to zero because of improper impedance matching between the electrochemical cell (10 KΩ) and ring oscillator (1 MΩ). Therefore, a buffer unit is needed to match the impedance levels between the ring oscillator and electrochemical cell. The printed buffer unit (Figure 1b-③) with high on currents and low on-off current ratios (Figure 3e) is consists of 6 *cn*TFTs and a resistor (~7 KΩ). In the printed CV tag, three resistors were printed by screen printer using a carbon paste (DC-20, purchased from Dozen Co. Korea) for the buffer units (Figure 1b-③ and ⑥) and the electrochemical cell (Figure 1b-④). Their electrical parameters are listed in Table S1 (Supplementary Information). The 6 *cn*TFTs of buffer unit were printed using R2P gravure with high SWNT concentration in the semiconducting ink. Each *cn*TFTs exhibited on-currents in the range of 400 ~ 500 μA with a very low on-off ratio due to the enhanced metallic percolation in the dense SWNT networks. The buffer units with low on-off ratio were employed to reduce the input voltage to ±500 mV (Figure 3f) which is the appropriate scanning range of the electrochemical cell. The printed electrochemical cell with two electrodes was proven to be well operated under commercial CV (Figure S9 in Supplementary Information). The resulting current after scanning printed electrochemical cell in the CV tag can be converted to voltage by connecting the printed resistor (Figure 1b-④: ~5 × 10^3 ohm) which provides the output voltage for electrochromic indicator and re-plotted into the cyclic voltammogram.

Because these output voltage (±70 mV) and current (~40 μA) were low after scanning the electrochemical cell, they need to be amplified to turn on the electrochromic indicator for showing predetermined concentration (10 mM) level of N,N,N′,N′-tetramethyl-p-phenylenediamine (TMPD, purchased from Aldrich) as a standard reference in this work (Figure 3g). After running the redox reaction of TMPD (Figure 3h) in the printed cell, the output voltage and current needed to be amplified to reach 1.5 V and 500 μA, respectively, to provide sufficient power to display the letters "PE" as an indicator of the presence of TMPD in the specimen. To construct the amplifier, *cn*TFTs based three inverters were printed with a gain of three to five (Figure S10 in Supplementary Information) to amplify the output signal as shown in Figure 3i. The electrical characteristics of the 6 *cn*TFTs in the inverters with extracted mobility, transcon-

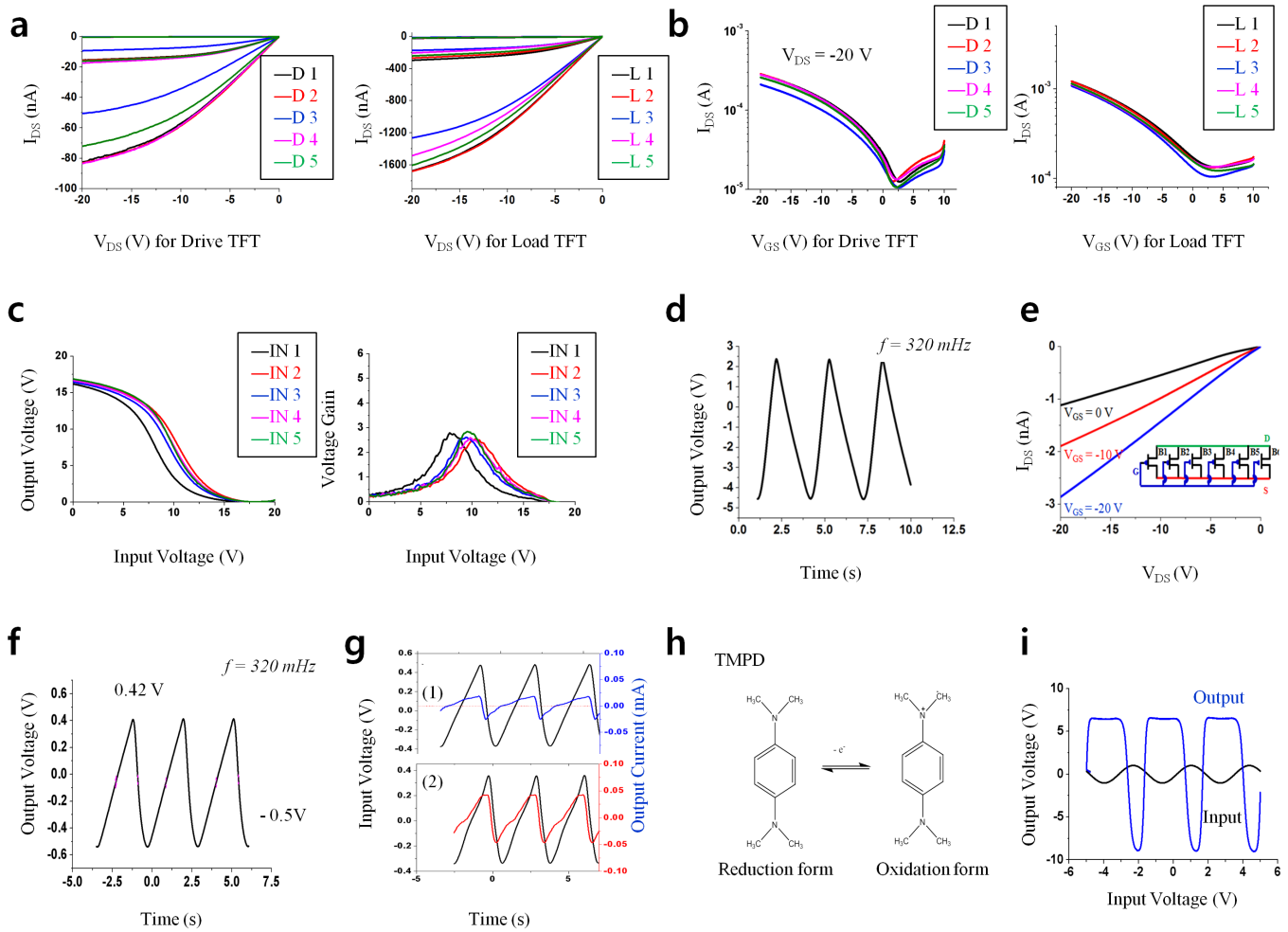

Figure 3 | (a and b) Output and transfer characteristics of the printed *cn*TFTs for 5 drive and 5 load TFTs respectively in the printed ring oscillator. (c) Electrical characteristics of inverters and (d) output characteristic of the ring oscillator. (e) Total output characteristics of the printed buffer unit consisting of 6 *cn*TFTs and a resistor (measured based on contacting gate and drain-source electrodes as shown in the inset circuit). (f) Modified triangular wave following the buffer unit. (g) Generated signals before scanning (black) and after scanning the electrochemical cells without (1, blue) and with TMPD (2, red) in a drop of solution. (h) TMPD structure for oxidation and reduction reaction. (i) The input and amplified output signals after passing through three amplifying inverters.

ductance, on-off current ratios and threshold voltage are shown in Table S2 (Supplementary Information). As the impedance was matched between the ring oscillator and the electrochemical cell using the buffer unit, another buffer unit (Figure 1b-⑥) is also needed between the electrochromic signage (20 KΩ) and the amplifier (1 MΩ) for impedance matching. The electrical parameters of the buffer are listed in Table S2 (Supplementary Information).

The amplified output signal was used to run the reduction and oxidation of the patterned conducting polymer in the electrochromic signage, and thus the blinking signage will be used to indicate the presence of chemicals in the specimens. The signage was fully printed and attached on printed CV tag. A clear concept of the printing sequence for the electrochromic signage was given in Figure S11 in Supplementary Information.

Discussion

The fully printed flexible CV tag was completed by assembling the printed circuits including ring oscillator, buffer, electrochemical cell, amplifier, and signage onto the previously R2R gravure printed rectenna. The resultant CV tag is shown in Figure 4a. The working concept of the wireless and flexible CV tag is demonstrated in the following sequences (watch the video file by clicking Figure S12 in Supplementary Information). After dropping 500 μl of TMPD solution (10 mM) on the printed electrochemical cell, the CV tag was placed on the custom made RF (13.56 MHz) reader (Figure S13 in Supplementary Information). The antenna was subsequently coupled to 13.56 MHz AC. The coupled AC was rectified into polarized DC (> ± 10 V) through two diodes and two capacitors which caused the ring oscillator to generate a pseudo triangular waveform with output voltage of 7 V at 320 mHz. This was then passed through the buffer unit to scan the electrochemical cell. The output signal after scanning the electrochemical cell was amplified to turn on the signage according to the concentration level of TMPD in the solution. In this work, whenever the concentration of TMPD was higher than 10 mM, the signage "PE" blinked (Figure 4b) while it did not show anything (Figure 4c) when it was lower than 10 mM. Furthermore, clear cyclic voltammograms for scanning the electrochemical cell with and without 10 mM of TMPD were obtained by re-plotting the output triangular voltage waveform (Figure 4d). The attained half potential ($E_{1/2}$ ~ 0.05 V, oxidation potential is 0.22 V and reduction potential is −0.17 V) of TMPD from the CV tag was nearly identical to the value obtained from a commercial CV instrument, SP-240, Biologic, which uses the same frequency for the triangular voltage waveform and printed electrochemical cell (Figure 4e). However, when the generated triangle wave frequency is higher than 0.6 Hz in the CV tag, the clear redox peaks cannot be

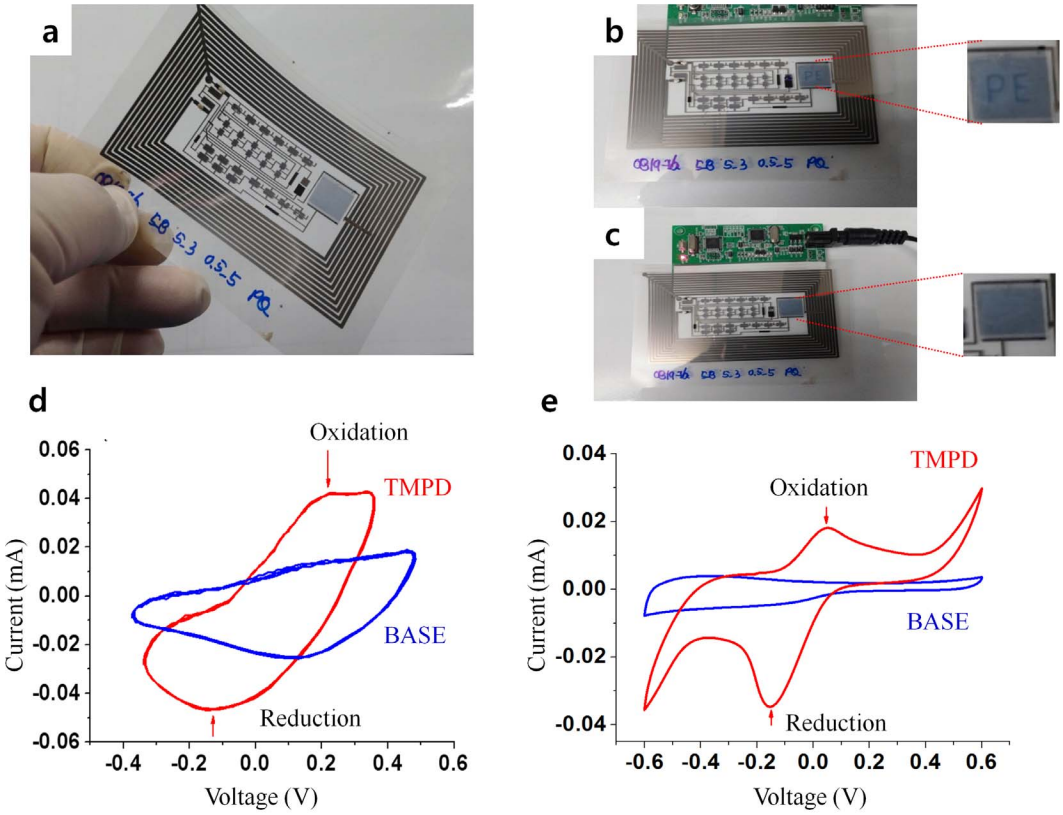

Figure 4 | (a) Optical image of fully printed wireless cyclic voltammetry tag. (b) Operation images of CV tag with and (c) without TMPD in the solution on 13.56 MHz reader. (d) Converted cyclic voltammogram from the printed wireless CV tag *vs* (e) a commercial CV instrument (please refer the interconnected video file for the demonstration of wireless CV tag operation in Figure S12 in Supplementary Information).

observed as shown in Figure S14 (Supplementary Information). Furthermore, as a typical example of testing a specimen in aqueous solution, 10 mM of $K_3(FeCN)_6$ aqueous solution was checked using the CV tag, and results of converted cyclic voltammogram was shown in Figure S15 (Supplementary Information). Those results support that the CV tag can examine specimens not only in organic solution, but also in aqueous one.

Up to present, there has been no commercial success in fully printed TFT-based electronic devices due to some kind of difficulties in integrating a number of printed TFTs through a scalable printing method. As increasing a number of integrated TFTs, the range of threshold voltage shits of TFTs needs to be controlled as narrow as possible to properly operate designed function of printed devices. However, the scalable printing method is not fully understood to integrate a number of TFTs on plastic foils while keeping the constant range of threshold voltage shifts because of difficulty in controlling a constant charge transport through the printed channels. Therefore, the printed TFT-based devices should be constructed by using a minimum number of printed TFTs while a function of printed device needs to be competitive over Si based one. Since the fully printed CV tag required the integration of only 26 *cn*TFTs, the acceptable range of threshold voltage shits of *cn*TFTs is controllable and achievable by using a scalable printing method such as a roll-to-roll gravure. Furthermore, the unique function of printed CV tags cannot be simply reproduced using a Si technology with a comparable cost to the R2R printing process. Therefore, the fully printed CV tag will be the first leading model to show a way of how printed TFT-based electronic devices should go for the successful launching in the IT markets.

In the core of the printed CV tag, fully gravure-printed *cn*TFTs were employed for constructing a circuit consisting of a ring oscillator to generate triangular waveforms, buffer units for an impedance matching, and an amplifier for enhancing output signal to turn on the signage. Those simple units can be combined with a variety of printable sensors and RF devices to create novel devices with an extremely low cost. In other words, the printed rectenna, ring oscillator, buffer and amplifier units in the printed CV tag will be key elements for the construction of variety of printed RF-sensors, this CV tag will be used as a platform for the further construction of a variety of RF based electrochemical sensors.

In conclusion, we have presented a fully printed flexible CV tag with the size of 9.5×5.5 cm^2 that can operate wirelessly using a 13.56 MHz RF reader. However, for the practical purpose, the size of the CV tag can be reduced up to the half (4×2 cm^2) of the current one by optimizing spaces between *cn*TFTs in the circuit of the CV tag and reducing the operation power to less than DC 5 V as the current size of 13.56 MHz antenna is designed to provide maximum coupled AC power using a sufficient length of printed antenna pattern (higher inductance). Furthermore, although we utilized R2P gravure, screen printer and drop casting method for the convenience of fabricating the CV tag in the Lab, the whole fabricating process can be repeated by R2R gravure because the rectenna, ring oscillator, buffers, electrochemical cell, amplifier and signage in the CV tag were all designed to compromise the limit (± 20 μm) of a registration accuracy of a current R2R gravure system. Therefore, this technology could be used as a platform for disposable wireless electrochemical sensors to a variety of specimens in aqueous and organic solutions to monitor or diagnose pathogens and hazardous materials by modifying the electrodes of the electrochemical cells.

Methods

Roll-to-roll (R2R) gravure printed antenna, bottom electrodes, gate electrodes and wires. Two color units of R2R gravure system (Taejin Co. Korea: Figure S1 in the Supplementary Information) was employed to print antenna, bottom electrodes and wires on a roll of poly(ethylene terephthalate) (PET) film (width of 200 mm and

thickness of 100 μm, purchased from SKC, Korea) with silver nanoparticle based conducting ink (PG-007 BB type, Paru Co. Korea) and the web transfer speed of 8 m/min under roll pressure of 0.5 MPa and web tension of 60 N. The silver ink was further formulated to meet the viscosity of 500 cp and surface tension of 47 mN/m using respectively ethylene glycol (Aldrich) and Dipropylene glycol methyl ether (Aldrich). The curing time of printed silver layer was 10 sec by passing through a heating chamber of 150°C, installed in R2R gravure system. The resulting printed silver patterns on PET roll showed the thickness of 450 (±50) nm without any defects and were shown in Figure S16a (Supplementary Information).

Roll-to-plate (R2P) gravure printed ring oscillator, buffer, and amplifier. Full R2P gravure system (Figure S1 in the Supplementary Information) was employed to print single walled carbon nanotube network based thin film transistors (*cn*TFTs), used as a building block to construct all the integrated circuit of printed cyclic voltammetry (CV) tag (Figure 1). 26 *cn*TFTs for the integration of circuit in printed CV tag were printed on the previously R2R gravure printed film (printed antenna, bottom electrodes and wires with thickness of 450 nm; Figure S16b in Supplementary Information) following printing sequences. First, $BaTiO_3$ nanoparticle based dielectric ink (PD-100, Paru Co., Korea) was further formulated to meet viscosity (75 cP) and surface tension (31.8 mN/m) using the ethyl 2-cynoacrylate (Aldrich). As shown in R2P gravure printing scheme (Figure S17 in Supplementary Information), the homogeneous and defect free dielectric layers were first R2P gravure printed with a printing speed of 200 mm/s and roll pressure 7.5 kg_f on previously printed gate electrodes and bottom electrodes (for capacitors) with a thickness of 2.3 (±0.1) μm and width of 940 (±2) μm (Figure S5 in Supplementary Information). The printed dielectric layers were cured for 1 min 20 sec at 150°C. Second, single walled carbon nanotube (SWNT) based semiconducting ink (PR-040, Paru Co., Korea) was diluted by diethylene glycol monobutyl ether (Daejung Co., Korea) to 1 : 1 volume ratio for printing active layers using R2P gravure on the printed dielectric layers with a printing speed of 350 mm/s and a roll pressure of 4 kg_f. The viscosity and surface tension of diluted SWNT ink were respectively 30 cP and 29 mN/m. The resulting SWNT printed films were dried 1 min at 150°C. For using *cn*TFTs in the buffer unit, we used the dilution volume ratio of 5 : 1 between SWNT ink (PR-040, Paru Co., Korea) and diethylene glycol monobutyl ether for printing only on the TFTs in the buffer unit to increase SWNT network density for providing the high current (Figure S5 in Supplementary Information). Finally, drain-source electrodes were R2P gravure printed using silver nanoparticle based ink (PG-007 AA type, Paru Co., Korea) on SWNT printed film with a viscosity of 800 cP and a surface tension of 42 mN/m. The R2P gravure printing was carried out under a printing speed of 200 mm/s and a role pressure of 5 kg_f.

Diode fabrication. Although Shottky diodes were able to print using R2R gravure based on our previous reported process[16,17], the drop casting method was used for the convenience in this work. First, dropping ZnO based hybrid semiconducting ink (PD-070, Paru Co., Korea) on printed silver electrode and then, Al ink (PA-009, Paru Co., Korea) was dropped on the top of ZnO ink. The resulting diodes were further cured for 5 min at 120°C.

Measurements. Formulated and diluted inks were characterized using DCAT21 (Dataphysics Co., Germany) and SV-10 Vibro viscometer (AND Co., Japan) for respectively measure surface tension and viscosity. All measurements in this work were carried out under ambient condition if there are no other comments. Resistance of printed antenna, bottom electrodes, gate electrodes and wires were measured using two probe methods with HP3457A multimeter. Both surface morphology and thickness of printed layers was characterized using surface profiler (NV-2200, Nanosystem, Korea). LCR meter (E4980A, Agilent, USA), semiconductor parameter analyzer (4155C, Agilent, USA) and digital phosphor oscilloscope (DPO 4054, Tektronix, USA) were respectively used to characterize printed *cn*TFT based circuits.

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Author contributions

Y.J., A.J. and G.C. designed the experiments. Y.J., H.P., J.P., Y.C. and M.J. carried out the experiments. J.N., K.J. and K.C. performed device simulations. Y.J. and K.C. performed mobility calculations. Y.J. and M.P. performed electrochemistry and analyzed electrochemical data. Y.J., H.P., M.P., A.J. and G.C. contributed to analyzing the data. M.J., M.P., A.J. and G.C. wrote the paper while all authors provided feedback.

Additional information

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A microwave metamaterial with integrated power harvesting functionality

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A microwave metamaterial with integrated power harvesting functionality

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We present the design and experimental implementation of a power harvesting metamaterial. A maximum of 36.8% of the incident power from a 900 MHz signal is experimentally rectified by an array of metamaterial unit cells. We demonstrate that the maximum harvested power occurs for a resistive load close to 70 Ω in both simulation and experiment. The power harvesting metamaterial is an example of a functional metamaterial that may be suitable for a wide variety of applications that require power delivery to any active components integrated into the metamaterial. © *2013 AIP Publishing LLC*. [http://dx.doi.org/10.1063/1.4824473]

Metamaterials are composed of sub-wavelength particles that exhibit bulk properties that are different from their individual components. Electromagnetic metamaterials are engineered materials that can achieve parameters not possible within naturally occurring materials, such as a negative index of refraction[1] or a zero index of refraction.[2] Exotic properties like these allow for a variety of interesting applications including a superlens device[3] and an invisibility cloak.[4] Integrating active and nonlinear functionality into metamaterials has been demonstrated in the form of dynamic resonant frequency tuning,[5,6] phase conjugation,[7] and wave mixing.[8,9] More specific functional behavior has also been demonstrated in metamaterials, including radio frequency (RF) limiting[10] and harmonic generation.[11]

Metamaterials are also well-suited for other functional behaviors, including electromagnetic power harvesting, the focus of this work. Power harvesting devices convert one type of energy to another, typically converting to a direct current (DC) signal. Many types of energy can be harvested, from acoustic (using a piezoelectric harvester)[12] to electromagnetic (using a rectenna).[13] Power harvesting devices require a method to couple to the energy that will be harvested as well as a device to convert the energy from one form to another. By their very nature, metamaterials are designed to couple to various types of energy, e.g., from acoustic[14] to optical,[15] and thus provide a natural platform for power harvesting. Electromagnetic metamaterials provide flexibility in design due to their electrically small, low-profile nature.[16] Since metamaterials are typically designed as infinite arrays, the resonant frequency and input impedance include coupling effects. Metamaterials can be adapted to various applications, such as flexible sheets to cover surfaces.[17] Moreover, many metamaterials that have been presented in the literature require some form of external signal. This could be a DC bias voltage[18] or a large external pump signal.[7] In general, metamaterials could be modified to harvest such an external signal that is already present for other purposes. With these design advantages, power harvesting metamaterials offer design flexibility for a large number of applications that general antenna-based microwave power harvesting devices may lack.

A recent simulation-based study[19] investigated the conversion efficiency between incident RF power and induced power in a split-ring resonator (SRR). Our work is focused on the experimental measurement of RF to DC efficiency based on the conventional effective area of the SRR. We demonstrate that metamaterials can also include embedded devices to convert the incident RF energy to a DC voltage, providing a platform for power harvesting that utilizes the advantages of metamaterial design.

An SRR is a canonical example of a resonant metamaterial particle and is used as the basis for the unit cells of the metamaterial power harvester designed here. By tuning the SRR parameters, we design an SRR (Fig. 1) to resonate at 900 MHz using an S-parameter simulation within Computer Simulation Technology (CST) Microwave Studio software. Using CST Microwave Studio, we can also simulate the effects of embedding devices within the SRR by retrieving its S-parameters using a lumped port. The retrieved S-parameters are loaded into Agilent Advanced Design System (ADS), allowing us to simulate both fullwave 3D effects and circuit-level nonlinear effects.

An SRR couples strongly to an incident magnetic field and can be loaded with a wide variety of circuit elements. In this work, we embed a rectifying circuit within an SRR to convert the incident RF power to DC power. A number of rectifying circuits could be chosen depending on the particular application for the power harvesting metamaterial. We choose to use a Greinacher[20] circuit because the output voltage is double the input voltage maximum, which allows for

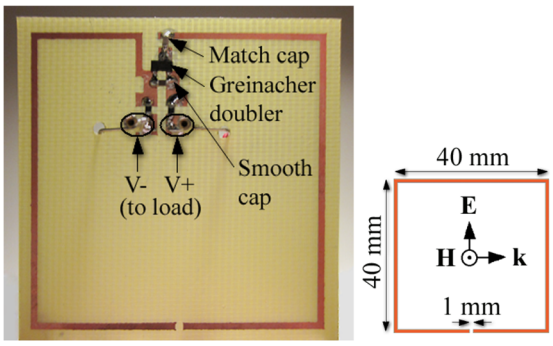

FIG. 1. (Left) Power harvesting SRR. (Right) Plain SRR with dimensions shown, 1 mm traces. Incident wave polarization is also shown.

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easier power transmission and measurement. A Greinacher circuit has a lower effective capacitance in comparison to other rectification circuits (such as a bridge rectifier), allowing faster switching and thus a higher frequency of operation. A Greinacher circuit also has a low threshold voltage, allowing operation at lower incident power levels. A Greinacher voltage doubler can be placed across a gap (Fig. 1) in the top side of the copper trace to rectify the induced current present in the SRR. Schottky diodes are used for the voltage doubler due to their typically low open junction capacitance and fast switching capabilities, which allow for rectification of a high-frequency RF signal, as well as their typically low threshold voltage. A resistive load placed across the output of the voltage doubler is a simple way to determine DC power out using $P = V^2/R$. This DC power is maximized through ADS for matching capacitor and resistor values. The parameters of our selected Schottky diode (HSMS 2862) and the simulated S-parameters of the above SRR in a model of our actual parallel-plate waveguide are input into ADS for the simulation, shown in a schematic in Fig. 2.

The simulated components lead to a maximum efficiency of 61% for an input power of 24.25 dBM, the maximum available experimental power (at an incident power density of approximately 1.6 mW/cm^2). One important figure of merit for a power harvester is its RF-to-DC power conversion efficiency:

$$\eta = \frac{P_{DC}}{P_{RF}}.$$

We determine P_{RF} by measuring the total incident power in our measurement apparatus. For a large metamaterial sample, we assume that the total incident power to the measurement apparatus is incident on the metamaterial. For a single unit cell, it is necessary to use the effective area of the unit cell to determine the incident P_{RF}. The maximum effective area may be calculated by[21]

$$A_{e,max} = \frac{\lambda^2}{4\pi} D_0,$$

where $D_0 = 1.5$ since the SRR is effectively a small loop illuminated by a transverse electromagnetic (TEM) wave. For an SRR resonant at 900 MHz, the effective area is thus $A_{e,max} = 5.3A_{physical}$. The full waveguide area is

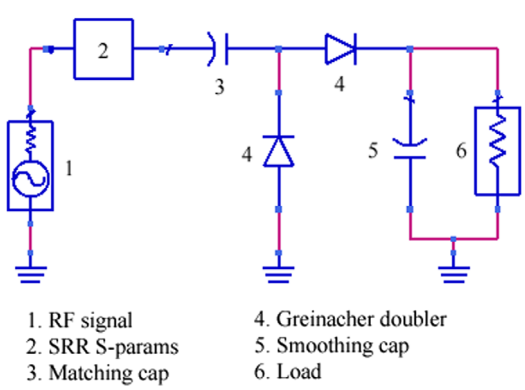

FIG. 2. ADS simulation schematic of SRR power harvester. CST Microwave Studio was used to determine the SRR S-parameters.

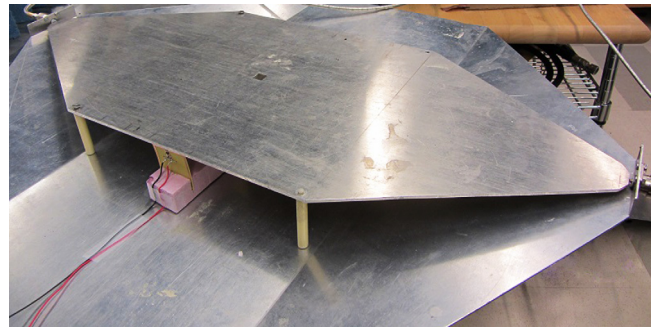

FIG. 3. Placement of SRR within open waveguide.

approximately $6.8A_{physical}$ where $A_{physical}$ is the physical area of a single SRR unit cell. As $A_{e,max}$ is 78% of the open wave guide area, 78% of the incident power density is used as input power for simulation of the single cell.

The designed voltage doubler and resistive load are added to an SRR as shown in Fig. 1, resulting in the power harvesting metamaterial unit cell. To observe power harvesting capabilities, the cell is placed in an open, TEM waveguide (Fig. 3) where input power is produced by a signal generator and amplifier, and output power is measured with an oscilloscope via leads placed across the resistive load (Fig. 4). The DC power harvested is determined by $P = V^2/R$ as previously mentioned, and input power is measured with a spectrum analyzer connected to the signal generator and amplifier via the open waveguide. By increasing the incident power from 13 to 24 dBm and measuring the DC output from the SRR, the normalized harvested power, $P_{DC}/P_{RF,incident}$, as a function of incident power $P_{RF,incident}$ and resulting efficiency are determined at each point. The maximum efficiency of the single cell is 14.2%, setting $P_{RF,incident}$ as 78% of the total input power from effective area calculations.

Multiple power harvesting SRR cells are then tested simultaneously to create the power harvesting metamaterial, which is accomplished through a 5×1 array shown in Fig. 5. Through a parallel connection of the leads from each SRR's resistive load, the total power harvested by the metamaterial is found in the same way as the single cell. The maximum efficiency for the 5×1 array is 36.8%, where P_{in} is the entire input power because the array spans the entire length. Measured efficiencies of both the single and the array of power harvesting SRRs are shown in Fig. 6. Also shown in Fig. 6 is the open circuit voltage, V_{OC}, a load-independent measure of the available voltage harvested by the array of SRRs.

The power harvesting metamaterial array is more efficient than the single unit cell. This is partially due to the

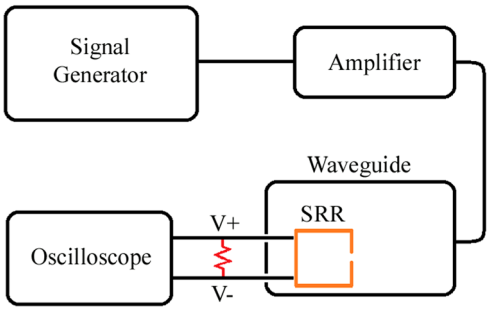

FIG. 4. Experimental test setup schematic.

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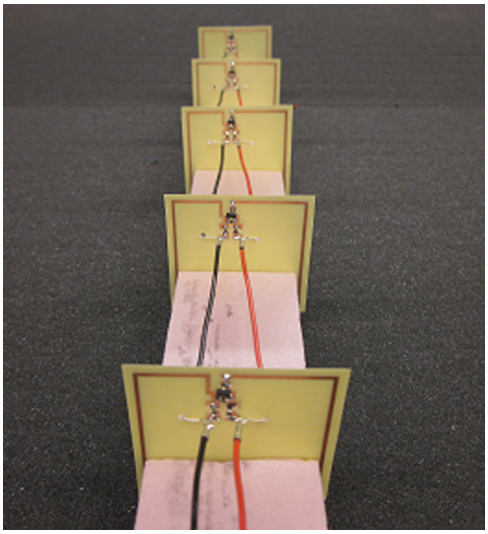

FIG. 5. 5×1 array of power-harvesting SRRs.

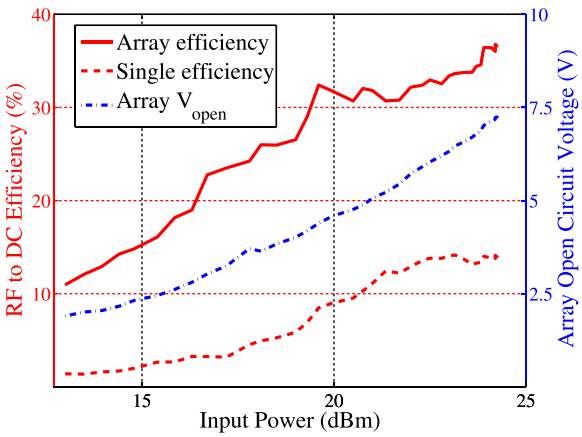

FIG. 6. RF to DC efficiency of power harvesters. The open-circuit voltage of the array is also shown.

larger effective area of the array. While the effective area of the single cell is 78% the entire width of the waveguide, some of this power is not harvested by the single unit cell due to fringing effects on the sides of the waveguide. For this reason, placement of multiple cells that together span the entire waveguide width results in a higher efficiency as the array captures more of the electromagnetic energy that undergoes the fringing effect.

Another important relationship is the efficiency of the power harvesting metamaterial as a function of load resistance. Simulated and experimental efficiencies for the 5×1 array are shown in Fig. 7. Though the experimental efficiencies do not match the values from simulation, the simulation does accurately predict the maximum harvested power as falling approximately within the range of 70–80 Ω, confirmed by the experimental data. The experimental efficiency maximum occurs at 70 Ω, and the simulated maximum occurs at 82 Ω, showing close correspondence.

In summary, we have designed, simulated, and experimentally measured a functional metamaterial power harvester capable of converting up to 36.8% of the incident RF power to DC power. Through a parallel connection of five SRRs, a V_{OC} of 7.3 V is achieved. Simulations match

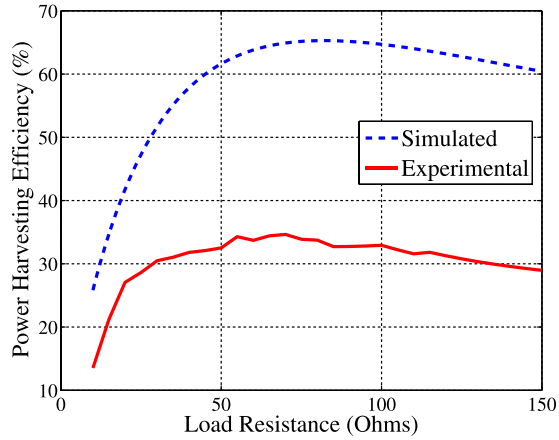

FIG. 7. RF to DC efficiency of SRR array as a function of load resistance, for both simulation and experiment. Note that both show maximum efficiency for around 70–80 Ω.

experimental results showing an optimal resistive load for DC power transfer of 70–80 Ω. The SRR power harvester is an example of functional metamaterial that may be suitable for a wide variety of RF applications that require power delivery to any active integrated components.

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Ambient RF Energy Harvesting in Urban and Semi-Urban Environments

Manuel Piñuela, *Student Member, IEEE*, Paul D. Mitcheson, *Senior Member, IEEE*, and Stepan Lucyszyn, *Senior Member, IEEE*

***Abstract*—RF harvesting circuits have been demonstrated for more than 50 years, but only a few have been able to harvest energy from freely available ambient (i.e., non-dedicated) RF sources. In this paper, our objectives were to realize harvester operation at typical ambient RF power levels found within urban and semi-urban environments. To explore the potential for ambient RF energy harvesting, a city-wide RF spectral survey was undertaken from outside all of the 270 London Underground stations at street level. Using the results from this survey, four harvesters (comprising antenna, impedance-matching network, rectifier, maximum power point tracking interface, and storage element) were designed to cover four frequency bands from the largest RF contributors (DTV, GSM900, GSM1800, and 3G) within the ultrahigh frequency (0.3–3 GHz) part of the frequency spectrum. Prototypes were designed and fabricated for each band. The overall end-to-end efficiency of the prototypes using realistic input RF power sources is measured; with our first GSM900 prototype giving an efficiency of 40%. Approximately half of the London Underground stations were found to be suitable locations for harvesting ambient RF energy using our four prototypes. Furthermore, multiband array architectures were designed and fabricated to provide a broader freedom of operation. Finally, an output dc power density comparison was made between all the ambient RF energy harvesters, as well as alternative energy harvesting technologies, and for the first time, it is shown that ambient RF harvesting can be competitive with the other technologies.**

***Index Terms*—Ambient RF, energy harvesting, maximum power point tracking (MPPT), multiband, rectenna, RF survey, RF-dc.**

I. Introduction

FOR ALMOST 50 years, far-field RF technology has been used to remotely power systems from relatively large unmanned helicopters [1] to very small smart dust sensors [2] and contact lenses that measure eye pressure [3]. With all these systems, a dedicated RF source is used, where the operator may have control over the effective isotropically radiated power (i.e., both transmit power and antenna characteristics), beam pointing and polarization of the RF source, ensuring optimal line-of-sight operation between the source transmitter (TX) and harvesting receiver (RX). It is important to highlight that this work will focus only in radiative power transfer and not inductive or near-field power transfer, as demonstrated in [4]. A more convenient solution, however, is to power these devices from ambient RF energy sources, such as television and mobile phone signals, thus removing the need for a dedicated source. As ambient RF levels are lower than those that can be provided by a dedicated RF source, the efficiency of the harvesting system, and its minimum startup power are of critical importance.

In order to assess the feasibility of deploying ambient RF energy harvesters, the available RF power needs to be measured in different locations. Such measurements, in conjunction with knowledge on harvester performance, can then be used to determine the locations at which RF harvester powered devices can be successfully deployed. Several RF spectral surveys, which measure ambient RF power levels from sources such as television and mobile phone base stations, have been previously reported. Many have been undertaken using personal exposimeters or spectrum analyzers, where the exact location of each measurement is unknown and with RF power levels only being reported under general scenarios (e.g., outdoor, indoor, street, bus, etc.) [5], [6]. While being of academic interest for health-related research [7], the lack of power level and specific time/location information limits their usefulness for exploitation in ambient RF energy harvesting applications.

Most rectennas (normally comprising an antenna, impedance matching network, rectifier, storage element, and load) presented in the open literature have been tested using dedicated sources rather than harvesting from ambient RF energy [8]. In recent years, efficiencies as high as 78% [9] and 90% [10] have been demonstrated with relatively high input RF power levels (i.e., $> +10$ dBm). Moderate efficiencies have also been achieved using dedicated TXs that provided relatively low input RF power levels; e.g., an efficiency of 60% was achieved with -22.6-dBm input power [11]. In one demonstrator [12], designed to operate over a broad range of input RF power levels, (-30 to $+30$ dBm), the efficiency increased from 5% at a low input RF power to a peak of 80% at $+25$ dBm.

Despite advancements in end-to-end (i.e., input RF to output dc) power conversion efficiencies at low input RF power levels (similar to those measured in the spectral surveys), only a few attempts at true ambient RF energy harvesting have been reported. For example, one relatively efficient rectenna, utilizing a modified omnidirectional patch antenna, has an efficiency of 18% with a single-tone input RF power of -20 dBm [13]. This dedicated signal source was meant to emulate the input RF power levels measured from a nearby digital TV (DTV) TX in Tokyo, Japan, but did not take into account the more realistic effect of harvesting from a modulated broadband signal. Another attempt

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at harvesting ambient RF energy from a mobile phone base station at 845 MHz was reported in [14]. This prototype managed to power an LCD thermometer for 4 min, but only after harvesting for 65 h. In that work, when the authors used a dedicated signal source with a single-tone input RF power of -15 dBm, an efficiency of 3% was recorded. A batteryless location sensor has also been demonstrated [15], powered by a rectenna with a printed antenna on a flexible substrate and a solar cell, although no details for the RF-dc efficiency were reported. Finally, successful prototypes capable of harvesting energy using TV antennas were presented, but again no details of their efficiency were given [16], [17].

In order to demonstrate the feasibility for implementing ambient RF energy harvesting, here we first present the results of a citywide RF spectral survey, indicating suitable locations and associated RF bands with sufficient input RF power density levels for harvesting. Based on these results, rectennas were then fabricated and their efficiencies, under ambient RF energy harvesting operation, were calculated using *in-situ* field strength measurements. Furthermore, an investigation of multiband rectenna arrays is also presented, demonstrating the tradeoffs between series (voltage summing) and parallel (current summing) topologies with the aim of reducing the minimum input power required for harvester operation. Finally, a comparison between measured ambient RF energy harvesting and alternative forms of energy harvesting technologies is presented; highlighting, for the first time, the practical feasibility of exploiting existing freely available sources of RF energy.

II. London RF Survey

In order to quantify input RF power density levels present in a typical urban and semi-urban environment, a citywide RF spectral survey within the ultrahigh frequency (0.3–3 GHz) part of the frequency spectrum was conducted within Greater London. A number of citywide RF spectral surveys have previously been conducted, but in general, only a few samples were taken, giving little insight into (semi-)urban environments [14], [18], [19]. Other surveys [20], [21] compare their measurements relative to the distance from the nearest TX. In a (semi-)urban environment, this may not provide enough information about the RF spectrum since there is likely to be local geographical variations in base-station density and propagation characteristics (e.g., multipath effects and diffraction around and attenuation through buildings).

Each station on the London Underground network was used as a survey point to provide a robust dataset for representing Greater London in terms of geographical distribution and population density, having a combination of urban (in the center) and semi-urban (in surrounding areas) characteristics. Measurements were taken at each of the 270 stations (from a randomly chosen exit, at street level and a height of 1.6 m). To provide traceability and for use as a historical reference, time stamps and GPS locations were recorded. In addition, measurements were taken inside a building at Imperial College London (ICL), to represent a typical office block within an urban environment.

A. Methodology

Mobile phone usage varies during the daytime, and hence, ambient RF energy in their bands is expected to be time dependant, with more energy available during the daytime than at night time. Therefore, in order to be able to make fair comparisons between locations, measurements were taken between 10:00 am and 3:00 pm on weekdays over a period of one month (between March 5, and April 4, 2012). Electric field strength was measured between 0.3–2.5 GHz using an Agilent N9912A FieldFox RF analyzer [22] with a calibrated Aaronia BicoLOG 20300 omnidirectional antenna [23]. It is important to note that the spectral measurements were undertaken during the analog-to-digital switchover period in the U.K. and so the measurements for DTV may represent an underestimate of present RF power levels measured now that the switch over is complete [24]. It should also be noted that this survey was conducted prior to the 4G network being switched on within the U.K.

A "panning method," which complies with international regulations for measuring exposure limits, was used [25]–[27]. Here, the calibrated antenna is rotated to three orthogonal axes while the spectrum analyser is set to "max-hold," ensuring that the maximum reading is recorded. For each measurement, more than 1 min was allocated to allow for more than three sweeps across the selected frequency range. Additionally, to maintain a comparable signal-to-noise (S/N) ratio, attenuation was introduced (with a minimum set at 5 dB) to avoid compression when high input RF power levels were detected. For all measurements, the resolution bandwidth (BW) was fixed at 100 kHz, the internal amplifier was turned on and the highest resolution of 1001 points was selected. These settings provide the ability to obtain a snapshot of the power density that can be expected in an urban or semi-urban environment from continuously variable sources.

B. Results

After inputting the manufacturers' frequency-banded antenna factors into the spectrum analyzer, to ensure a fully calibrated system, the electric field strength measurements were taken. The input RF power density (S) is then calculated from the electric field strength measurement. Fig. 1 shows the input RF power density measured outside the Northfields London Underground station, where the spectral bands for DTV, GSM900, GSM1800, 3G, and Wi-Fi can been clearly identified.

A well-designed rectenna should ideally be capable of harvesting energy across an entire band, and thus it is important to calculate the total band power. The banded input RF power density S_{BA} $(\mathrm{nW/cm^2})$ is calculated by summing all the spectral peaks across the band (i.e., in a similar way, the spectrum analyzer calculates channel power). These levels provide a snapshot of source availability at the time and location of the measurement. Moreover, they are used as a harvester design starting point since the power density at each band will define the input impedance of a rectenna.

The exact frequencies for each band are set by the U.K.'s official frequency band allocation [28]; the GSM900, GSM1800 and 3G base transmit (BTx) bands were separated from the associated mobile transmit (MTx) bands. Table I shows average

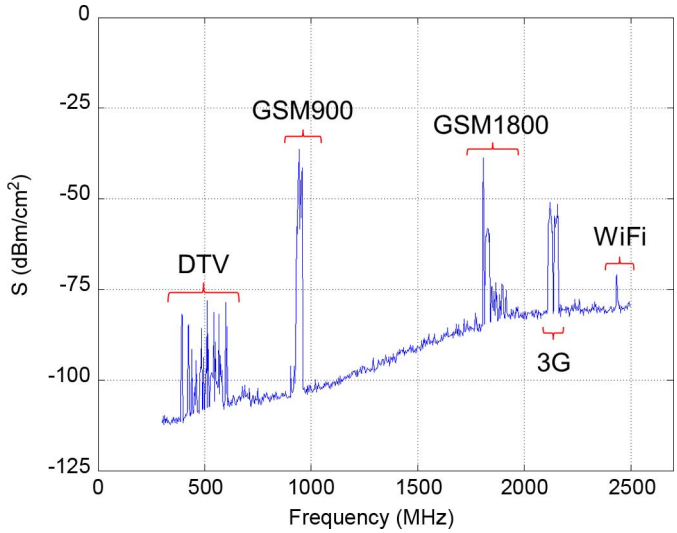

Fig. 1. Input RF power density measurements outside the Northfields London Underground station.

TABLE I
SUMMARY OF LONDON RF SURVEY MEASUREMENTS

Band	Frequencies (MHz)	Average S_{BA} (nW/cm^2)	Maximum S_{BA} (nW/cm^2)
DTV (during switch over)	470-610	0.89	460
GSM900 (MTx)	880-915	0.45	39
GSM900 (BTx)	925-960	36	1,930
GSM1800 (MTx)	1710-1785	0.5	20
GSM1800 (BTx)	1805-1880	84	6,390
3G (MTx)	1920-1980	0.46	66
3G (BTx)	2110-2170	12	240
WiFi	2400-2500	0.18	6

RF power levels across all London Underground stations for the banded input RF power density measurements. It can be seen that all base-station transmit levels are between one and three orders of magnitude greater than the associated MTx levels. For this reason, and the fact that the population of transmitting mobile phones in close proximity of the harvester is highly variable, only base-station TXs will be considered further.

From our London RF survey, DTV, GSM900, GSM1800, 3G, and Wi-Fi were identified as potentially useful ambient RF energy harvesting sources, although DTV appears to be heavily dependent on line-of-sight and sudden changes in atmospheric conditions (e.g., temperature inversion) and Wi-Fi is very dependent on user traffic. It should be noted that the mobile phone base-station TXs employ vertically polarized antennas, placing a constraint on harvester orientation in deployment. With DTV, within the U.K., the main TXs have horizontally polarized antennas, while repeater TXs have vertically polarized antennas.

It is convenient to define the boundary between urban and semi-urban environments by the line that separates zones 3 and 4 on the London Underground map [29]. As one would expect, the central zones 1–3 host the highest density of base stations. As shown in Table II, a banded input RF power density threshold was selected to filter the ten London Underground stations with the highest measurements for each band. With DTV, the highest

TABLE II
INPUT RF POWER DENSITY THRESHOLD: LONDON UNDERGROUND STATIONS WITHIN CENTRAL ZONES 1–3 (URBAN) AND OUTER ZONES 4–9 (SEMI-URBAN)

Band	S_{BA} *Threshold* (nW/cm^2)	Number of Stations	
		Urban	Semi-urban
DTV (during switch over)	40	10	0
GSM900	230	8	2
GSM1800	450	7	3
3G	62	6	4

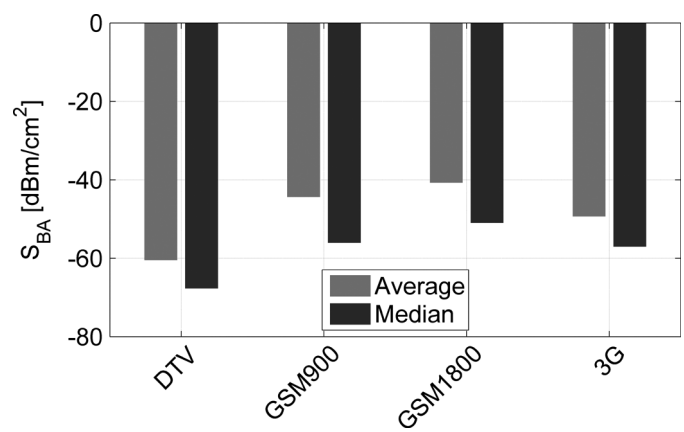

Fig. 2. Banded input RF power density measurements for the four largest ambient sources in Greater London.

recorded measurements were all found within the urban environment. This is because Greater London's main DTV TX (at Crystal Palace) is located on the southeastern boarder of zones 3 and 4 and there are no London Underground stations further south. With mobile phones, more than 50% of the stations were inside the urban environment and those in a semi-urban environment were all located in close proximity to a cluster of base-station TXs.

Using the complete dataset from the London RF survey, Fig. 2 shows the average and median of the banded input RF power density measurements for the four largest ambient RF sources in Greater London. It can be seen that more than half of the locations have below average power levels. This is due to the fact that several stations had maximum levels that were considerably higher than the average because of their close proximity to TV TXs (e.g., Crystal Palace), extremes in base-station density and propagation characteristics.

In addition to the London RF survey, measurements within the Department of Electrical and Electronic Engineering building at ICL were taken on the 11th floor of the south stairwell. These are shown in Table III. As can be seen, DTV and GSM900 have a higher than average power level, due to a near line of sight from the TV TX and a close proximity to the 2G GSM900/1800 base stations.

The dataset from the London RF survey, with all relevant information (e.g., locations, timestamps, and banded input RF power density measurements), can be found at our interactive website: www.londonrfsurvey.org [30]. These measurements were used to design efficient harvesters and compared to ICL

TABLE III
MEASURED BANDED INPUT RF POWER DENSITIES AT ICL

	DTV	GSM900 (BTx)	GSM1800 (BTx)	3G (BTx)
S_{BA} [nW/cm^2]	18	48	50	3

measurements to identify locations in Greater London where the designed harvesters could operate. The design procedures and prototype test measurements will be presented in the following sections.

III. SINGLE-BAND AMBIENT RF ENERGY HARVESTERS

In order to implement efficient ambient RF energy harvesters, designed for the banded input RF power density levels measured at ICL, a set of single-band prototypes were realized and characterized; these will be compared to multiband array architectures in Section V.

A. Antenna Design and Measurements

Since our harvesters are intended to operate within a general (semi-)urban environment, where the exact location of the TX source is unknown, the rectennas' antennas need to be as close to omnidirectional as possible, avoiding the need for beam-pointing during deployment. This is at the obvious expense of limited antenna gain, and therefore, the corresponding levels of P_{RF} that the rectifier can receive. Conversely, if the location of the TX is known, then it may be tempting to use a high gain antenna, but this would require an appropriate level of beam-pointing and polarization matching that can be established and maintained.

Another requirement is that the antennas need to be easily scalable across all frequency bands since one important objective for this work is to compare and contrast different banded harvesters. Finally, the antennas need to be easily fabricated. For all these reasons, a linear polarized folded dipole was selected, although a monopole would also be suitable [31].

To simplify impedance matching between the antenna and rectifier, a modified folded dipole was used to obtain the required 50-Ω reference input impedance. A balun does not need to be employed, as there is no significant degradation in performance for this particular application, even with the use of an unbalanced microstrip rectifying circuit [32]. Furthermore, the antenna was not integrated onto a substrate, to give the additional freedom to embed the harvester on windows or within walls, furnishings, fixtures, or fittings. To this end, two different antennas were fabricated for each band; one made using a 560-μm diameter copper wire and the other with 75-μm-thick 25-mm-wide copper tape. The fabricated antennas are shown in Fig. 3. Since the copper tape was not rigid enough to retain its shape, it was placed on a Perspex substrate, to represent a flat panel.

To design the antennas, full-wave 3-D electromagnetic simulations were performed using CST Microwave Studio. As discussed previously, the antennas were designed to be as omnidirectional as possible, while covering as much of the ambient RF source BW as possible. Fig. 4 shows the typical simulated gain profile for the DTV tape antenna, having a front-to-back ratio of unity. Table IV shows the simulated gain and the 10-dB return-loss fractional BW for the optimized copper wire and tape antennas.

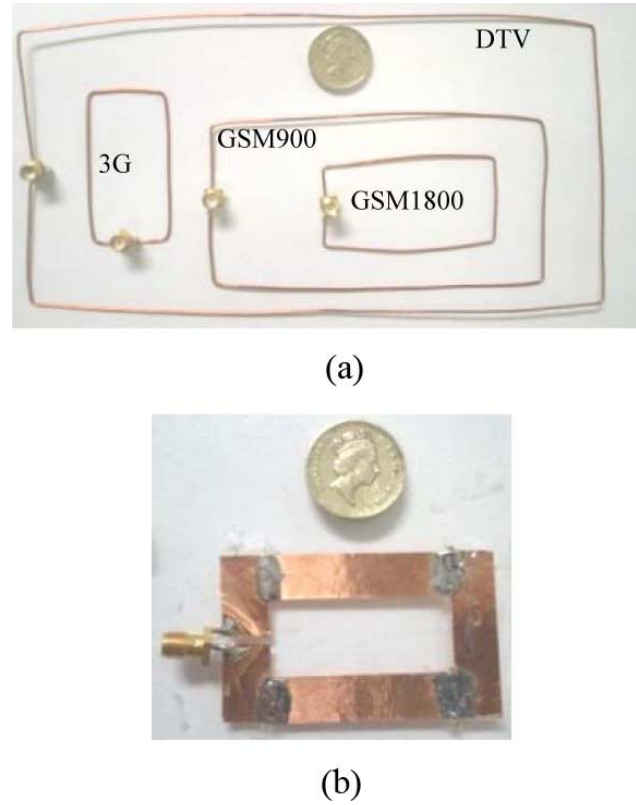

Fig. 3. 50-Ω folded-dipole antennas shown next to a British £1 coin. (a) DTV, GSM900 (BTx), GSM 1800 (BTx) and 3G (BTx) copper wire antennas. (b) 3G (BTx) copper tape antenna on Perspex.

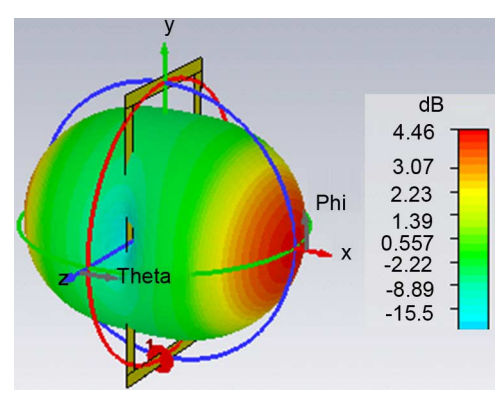

Fig. 4. Simulated beam profile for the DTV tape antenna.

Fig. 5 shows excellent agreement between predicted and measured return-loss results, within a 10-dB return-loss bandwidth, for the eight fabricated single-band antennas. As one would expect with such a simple classical antenna, the out-of-band performances (not shown) were also in good agreement. It was found that better return-loss measurements are achieved with our single-band antennas when compared to other reported single-band omnidirectional [13] and multiband [33] designs. The latter may be important, as it may be tempting to implement a more compact multiband rectenna, but which

TABLE IV
SIMULATED GAIN AND 10-dB RETURN LOSS FRACTIONAL BW FOR FOLDED-DIPOLE SINGLE-BAND ANTENNAS

Band		Wire		Tape	
	BW (%)	Gain (dBi)	BW (%)	Gain (dBi)	BW (%)
DTV	26	4.35	4	4.48	6
GSM900	3.7	4.42	4.3	4.73	4.3
GSM1800	4.1	4.32	5.3	4.73	10.7
3G	2.8	4.39	5.4	4.76	12

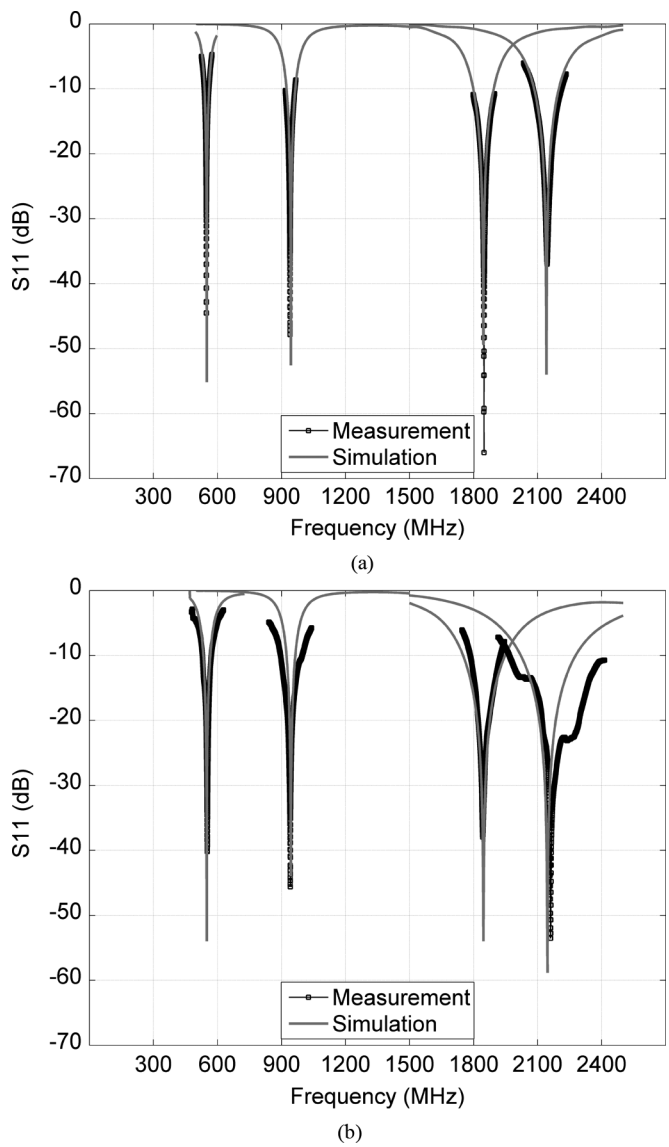

Fig. 5. Input return-loss predictions and measurements for all single-band folded-dipole antennas. (a) Wire. (b) Tape.

may ultimately not give better ambient RF energy harvesting performance.

Obtaining a minimum acceptable return loss over an antenna fractional bandwidth as large as that of the source is key to harvest as much input RF energy as possible. As can be seen in Table IV, where the fractional bandwidth is defined for a 10-dB return loss, our antennas have a fractional bandwidth greater than those of the sources, with the exception of DTV, which

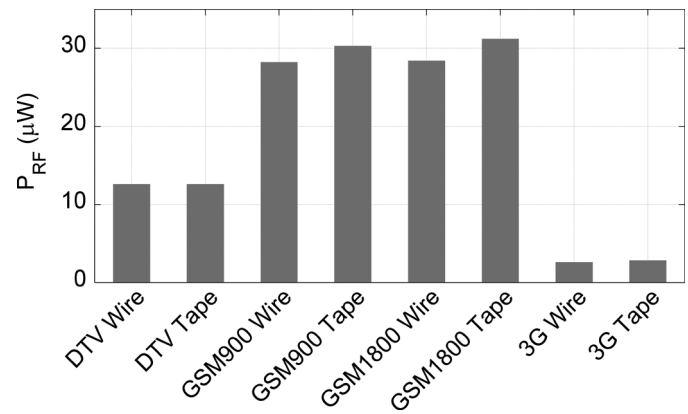

Fig. 6. Predicted input RF power levels for the four largest ambient sources at the ICL testing location.

only covers approximately 35% of the target frequency range. In other work [13], 5-dB return-loss fractional bandwidth is adopted for RF energy harvesting applications.

The fractional bandwidth of the antennas having a minimum return loss of 5 dB is too great to assume a constant antenna gain over the whole band. Therefore, an additional advantage of using 10-dB return-loss fraction bandwidths is that (1) can be used to calculate the input RF power with the assumption that the midband antenna gain is constant with frequency [34]. Therefore, the time-averaged input RF power P_{RF} is given by

$$P_{\mathrm{RF}} = S_{BA} \cdot A_{\mathrm{real}} \text{ and } A_{\mathrm{real}} \approx G(f_o)\frac{\lambda_o^2}{4\pi} \tag{1}$$

where A_{real} is the real aperture (or capture area) of the antenna, λ_o is the free-space wavelength at the midband frequency f_o, and $G(f_o)$ is the rectenna's antenna gain at f_o.

Substituting the measured banded input RF power densities recorded in Table III and the predicted midband antenna gains in Table IV into (1), realistic values for P_{RF} can be calculated for all four bands, with the results shown in Fig. 6. It can be seen that with all antenna gains being in the region of $\sim$ 4.5 dBi, the 2G GSM900/1800 harvesters will generate the highest input RF power levels, due to the high-banded input RF power density levels measured *in situ*. At the other extreme, the 3G harvesters will be the worst performers. As only a small fraction of the required frequency range is covered by the DTV antennas, the predicted values for P_{RF} represent an overestimation.

B. Rectifier Design and Measurements

Based on a previously reported analysis [35] and the predicted input RF power levels presented in Fig. 6, the zero-bias SMS7630 diode (in a series configuration) was selected as the optimal solution for our ambient RF energy harvesters, as shown in Fig. 7. In a series configuration, the junction capacitance $(C_j(V))$ of the diode dominates the detector's impedance, as long as $C_{\mathrm{out}} > C_j(V)$, and thus C_{out} has little or no effect on the matching circuit. This allows C_{out} to be large enough to provide a ripple-free output voltage. In contrast, C_{out} must be less than 1 pF to achieve a good impedance match with a shunt configuration as C_{out} appears in parallel with $C_j(V)$ and the packaging parasitic capacitance. However, C_{out} is too small to

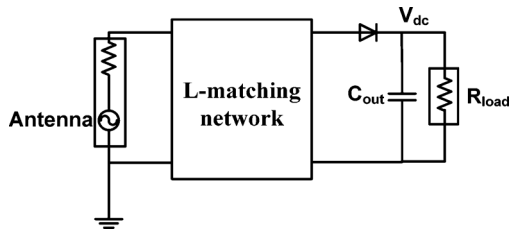

Fig. 7. Series detector configuration with L-matching network.

provide a ripple-free dc voltage to the load. This can be overcome with a matching network that will allow a good impedance match with a large output capacitor, but at the expense of introducing losses. Furthermore, as shown in [36], these issues start to become negligible with a shunt configuration as the shunt diode becomes more self-biased as the input power increases. Simulations were performed using Agilent Technologies' ADS software. Its Momentum package not only takes into account the losses from the low-cost FR4 substrate, but also calculates fringing fields, effects from which are passed on to the harmonic-balance package for simulating the nonlinear behavior of the rectifier.

A good impedance match was achieved by employing a simple matching network; a series lumped-element inductor was used to absorb part of the capacitive reactance from the series diode and an additional quarter-wavelength short-circuit shunt stub was employed to achieve the desired 50-Ω impedance [37]. Since the impedance of the diode varies with frequency and input RF power, impedance matching between the antenna and rectifier was first undertaken by finding the optimal output load resistance for an input RF power level of -20 dBm with a single-tone source at the midband frequency. After the optimal load was found, further broadband optimization was performed to the matching network and the load to ensure good impedance matching throughout the target frequency range and the measured P_{RF} for each band.

As with the antenna analysis, and unlike conventional RF circuits that adopt the more traditional half-power bandwidth definition, the rectifier should adopt the 10-dB-input return-loss bandwidth. The reason for this is that, for ambient RF energy harvesting applications, the input RF power is at a premium and so what little energy is available should not be wasted by being reflected back from avoidable impedance mismatches at either the antenna or rectifier.

Fig. 8 shows excellent agreement between predicted and measured input return loss results, within the -10-dB bandwidth, for the DTV and GSM900 rectifiers, having fractional bandwidths of 5.7% (below target) and 4.8%, respectively. With these lower frequency designs, the fundamental and higher order harmonics were below -55 dBm, ensuring a clean dc voltage at the load, without the need for any output filtering. Reasonable agreement was found with the GSM1800 and 3G rectifiers, having fractional bandwidths of 1.6% (below target) and 7.4%, respectively. It was found that with these two higher frequency designs, the higher order harmonics were -40 dBm at the output. This reduced performance, as illustrated in Fig. 8, is due to the higher series inductive reactance leads of the output shunt storage capacitor. For this reason, a

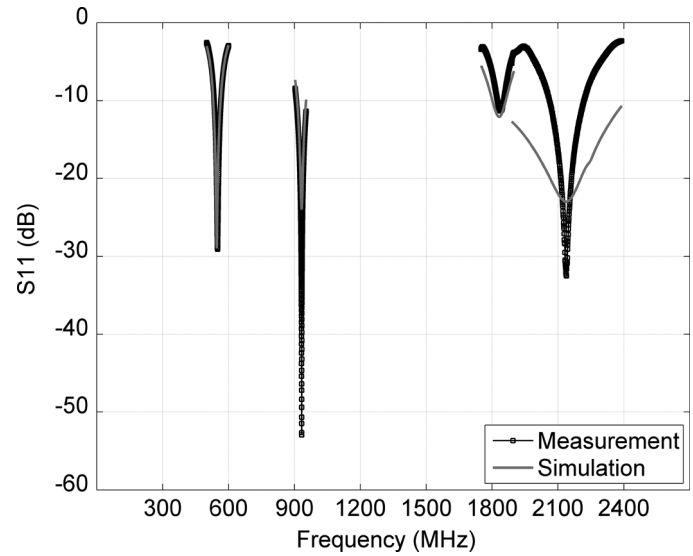

Fig. 8. Input return-loss predictions and measurements for all first prototype single-band rectifiers, with $P_{\mathrm{RF}} = -20$ dBm at the input and optimal load resistances at the output.

second prototype version (v2) was designed for the 3G rectifier, using distributed-element components for the input impedance matching stage and an additional output filter stage. With the lumped-element matching network, it was found that in order to achieve good input impedance matching to 50 Ω, all the microstrip transmission lines had to have a characteristic impedance of 92 Ω. With the distributed-element matching network, a simple shunt quarter-wavelength open-circuit stub, designed for operation at the fundamental frequency, was employed. A microstrip line was added between the cathode of the diode and the stub to absorb the capacitive reactance of the diode. The stub effectively filters to < -50 dBm the higher order harmonics. The microstrip design can be seen in Fig. 13.

C. PMM

Since the input RF power from ambient sources can be represented as a multi-tone source, with power levels fluctuating across the target frequency range, the output impedance of the rectifier is time varying. A power management module (PMM) capable of performing maximum power point tracking (MPPT) is required.

For our work, a low-power integrated-circuit PMM from Texas Instruments Incorporated (BQ25504) was selected, due to its low quiescent current ($<$ 330 nA) and low input voltage operation ($\sim$ 80 mV hot-start and 330-mV cold-start) [38]. It is worth noting that its startup voltage is lower than PMMs previously reported and realized using hybrid circuits for RF energy harvesting [13]. The BQ25504 PMM includes a boost converter that steps up its input voltage (having a 350-mV average value during ambient operation) to useful levels between 2.4–5.3 V. The BQ25504 also has a built-in battery management module, which is used to control the duty cycle of the output power to the load.

MPPT operation on the BQ25504 is achieved by periodically sampling the open-circuit voltage (OCV) at the input of the converter, which then draws a current causing the converter

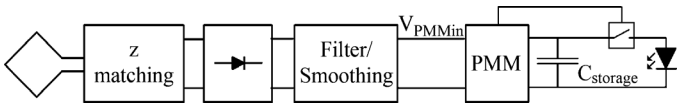

Fig. 9. System block diagram.

input voltage to fall and be held at a pre-programmed fraction of the OCV (set by a potential divider). In a simple dc circuit, with a resistive source impedance, the optimal ratio is 0.5. For the rectenna-based system, a ratio of 0.48–0.53 was found to maximize the power output of the system. The BQ25504 is designed to charge a storage element, and in this case, a capacitor C_{storage} was used. The programmed PMM continuously charges the storage capacitor, and the load (a low-power LED) was automatically connected to the storage capacitor when the capacitor voltage reaches an upper limit $V_{\mathrm{high}} = 2.84$ V and automatically disconnected when it reaches a lower limit $V_{\mathrm{low}} = 2.40$ V. The duty cycle of the LED can then be used to calculate the efficiency of the system, as will now be described. A diagram of the system is shown in Fig. 9.

IV. End-to-End Efficiency Analysis

The efficiency η of an RF energy harvesting system is

$$\eta = \frac{P_{\mathrm{dc}}}{P_{\mathrm{RF}}} \tag{2}$$

where P_{dc} is the time-averaged output (i.e., equivalent dc) power into the storage element (e.g., battery or supercapacitor) and load and P_{RF} is as previously defined. Measurements for this type of system are usually performed in a controlled environment (e.g., an anechoic chamber or TEM cell), using a dedicated constant or variable amplitude single-tone RF signal source [32], [39]. However, the former is not suitable for evaluating ambient RF energy harvesting operation, which has a much broader spectrum of nonconstant input frequencies and where the instantaneous input RF power is time variant. The use of a constant single-tone dedicated source provides a convenient stable reference power to the harvester; while the latter reflects a more realistic signal source having fluctuating power levels across a nonzero bandwidth, multipath, and reflection effects which are very difficult to emulate in a controlled environment.

Therefore, to determine the overall end-to-end efficiency $\eta_{\text{e-e}}$ for a complete ambient RF energy harvester, the input RF energy U_{RF} was calculated based on the harvester's antenna characteristics and the actual banded input RF power density measurements taken at the time of harvester operation, using the Agilent Fieldfox and the calibrated antenna. It is important to note that since the impedance mismatch between the antenna and detector is not taken into account, U_{RF} is higher than expected, providing an underestimate of end-to-end efficiency. The output dc energy U_{dc} was then calculated by measuring the charge–discharge cycle time, t_{cycle} of the storage capacitor between V_{high} and V_{low}, as the LED is repeatedly connected and disconnected. The output dc energy equation is already taking into account the efficiency of the PMM given the fact that the measurements

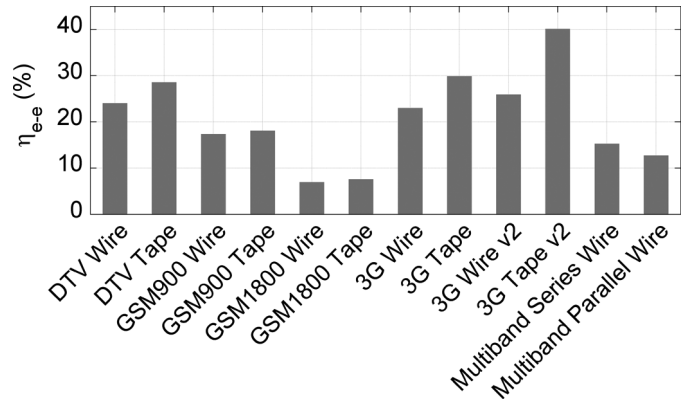

Fig. 10. End-to-end efficiencies for ambient RF energy harvesting at ICL.

are taken at its output voltage. The end-to-end efficiency of one charge–discharge cycle of C_{storage} is

$$\eta_{\text{e-e}} = \frac{U_{\mathrm{dc}}}{U_{\mathrm{RF}}} \tag{3}$$

where the input RF energy is given by integrating the time-averaged input RF power over a cycle time, as

$$U_{\mathrm{RF}} = \int_0^{t_{\mathrm{cycle}}} P_{\mathrm{RF}} dt \tag{4}$$

and the output dc energy is given by the energy supplied to the load, as follows:

$$U_{\mathrm{dc}} = C_{\mathrm{storage}} \frac{({V_{\mathrm{high}}}^2 - V_{\mathrm{low}}^2)}{2}. \tag{5}$$

A. ICL Field Trials

Four single-band ambient RF energy harvesters were assembled by connecting the rectifiers to the wire/tape antennas and PMMs programmed for the optimal load. A 100-μF shunt capacitor was employed as the storage element, providing $U_{\mathrm{dc}} = 115\ \mu$J. Our system is capable of cold-starting the boost converter and MPPT since the rectenna is capable of providing the minimum starting voltage of 330 mV. When the minimum voltage is reached, the boost converter and MPPT start to operate and the charge–discharge cycle at the load begins, causing the LED to flash. During field trials, t_{cycle} took up to 170 s for the harvester with lowest banded input RF power density, corresponding to 3G with the wire antenna. Table V summarizes the results where t_c and t_d are the charge and discharge times, respectively, and ΣV and ΣI are the multiband voltage and current summing array architectures, respectively. A detailed discussion on the multiband rectenna arrays will be presented in the following section. The end-to-end efficiency was calculated using (3) with data from Fig. 6 and measuring the charge–discharge cycle time during harvesting operation.

Fig. 10 shows the overall end-to-end efficiencies for all the harvester demonstrators, deployed and tested at ICL. As predicted by simulations, the improved 3G v2 demonstrator with

TABLE V
HARVESTERS CHARGE AND DISCHARGE TIMES (t_c, t_d, RESPECTIVELY) FOR A SPECIFIED LOAD

Band	Wire					Tape				
	t_c (s) load independent	t_d (s) load dependant	t_{cycle} (s) load dependant	P_{dc} (t_d) (μW)	P_{dc} (t_{cycle}) (μW)	t_c (s) load independent	t_d (s) load dependant	t_{cycle} (s) load dependant	P_{dc}(t_d) (μW)	P_{dc} (t_{cycle}) (μW)
DTV	26	12	38	9.6	3	14	18	32	8.2	3.6
GSM900	14	10	24	11.5	4.8	8	13	21	14.4	5.5
GSM1800	43	15	58	7.7	2	22	27	49	5.2	2.4
3G v2	167	3	170	38.4	0.7	96	5	101	1.2	1.1
Multiband ΣV	43	7	50	66	2.3	-	-	-	-	-
Multiband ΣI	55	5	60	92.2	2	-	-	-	-	-

tape antenna outperformed its original design by 11%; achieving an end-to-end efficiency of 40% with an input RF power of only −25.4 dBm.

It is believed that a much greater efficiency can be achieved for the DTV harvester if the fractional bandwidths for the first prototype circuits (i.e., 4.4/4.5% for the antennas and 5.8% for the rectifier) could be increased to match the much greater target value of 26%. Likewise, the reduced efficiency of the GSM1800 harvesters can be attributed to the detrimental effects of the narrowband input impedance matching of the rectifier (i.e., having a fractional bandwidth of only 1.6%, when compared to its target value of 4.1%). Finally, with all the harvesters, the end-to-end efficiencies can be enhanced through better antenna design and optimal polarization matching.

Table VI, shows the number of locations from the London RF survey that would be able to support our harvesters. Unlike the single-band 3G harvester, which can operate at 45% of the locations, our DTV harvester can only be used at two locations (one in zone 2 and the other in zone 3). Therefore, for the general deployment of an ambient RF energy harvester within an (semi-)urban environment, at street level, the single-band DTV harvester may not be practical

TABLE VI
NUMBER OF LOCATIONS FROM THE LONDON RF SURVEY CAPABLE OF SUPPORTING IDENTICAL HARVESTERS AT THE SAME EFFICIENCY LEVELS

	DTV	GSM900 (BTx)	GSM1800 (BTx)	3G (BTx)
Stations with higher S_{BA}	2	28	68	122

V. ARRAY ARCHITECTURES

Since ambient input RF power levels can be low (i.e., below −25 dBm) and dependent on both time and spatial considerations, harvesters could be designed to extract energy with spatial-diversity within the same frequency band or using different frequency bands. For example, with the former, at a particular location there may be only one band that has significant levels of RF energy worth harvesting. In this case, spatial-diversity array architectures may provide more usable output power. Alternatively, with the latter, multiband array architectures may provide more robust operation.

With both forms of parallel array architecture (i.e., spatial-diversity and multiband), a further classification can be seen through the use of either diversity/band switching or a summing node. With the former, physical switches automatically select whichever signal path delivers the highest input RF power level; with the latter, power from all signals is combined. Fig. 11 illustrates generic forms of parallel array architectures, showing that switching/summing can be performed electromagnetically at a single antenna or at the output from multiple antennas, rectifiers, or PMMs.

Multiband array architectures, similar to those in Fig. 11(c) and (d), capable of RF harvesting from the four previously identified bands, were selected as possible optimal solutions, given no size/cost constraints. Our objectives were to reach the minimum cold-start voltage at the lowest possible input RF power levels and increase the harvesters' operational capabilities within (semi-)urban environments.

To this end, two different multiple rectenna architectures were investigated. The first with a single shared PMM and the second with multiple PMMs, as illustrated in Fig. 12. To simplify assembly, the wire antennas were selected since they did not require a substrate. Unwanted coupling between the single-band antennas was minimized by placing them a minimum distance of $\lambda_L/5$ apart; where λ_L is the wavelength of the lowest frequency band antenna [40]. For example, the DTV and the 3G antennas were kept at least 11 cm apart, as shown in Fig. 13. This allowed S_{11} measurements to be the same as in Fig. 5 once all antennas were assembled into the array.

A. Multiple Rectennas With a Shared PMM

In order to improve the cold-start performance of the system, the outputs of multiple rectennas can be connected in series, as shown in Fig. 12(a). This increases the probability of the voltage on the input of the PMM reaching the cold-start level (330 mV for the BQ25504) under any given scenario. While cold-starting the PMM, each rectenna harvests (albeit not optimally). Once

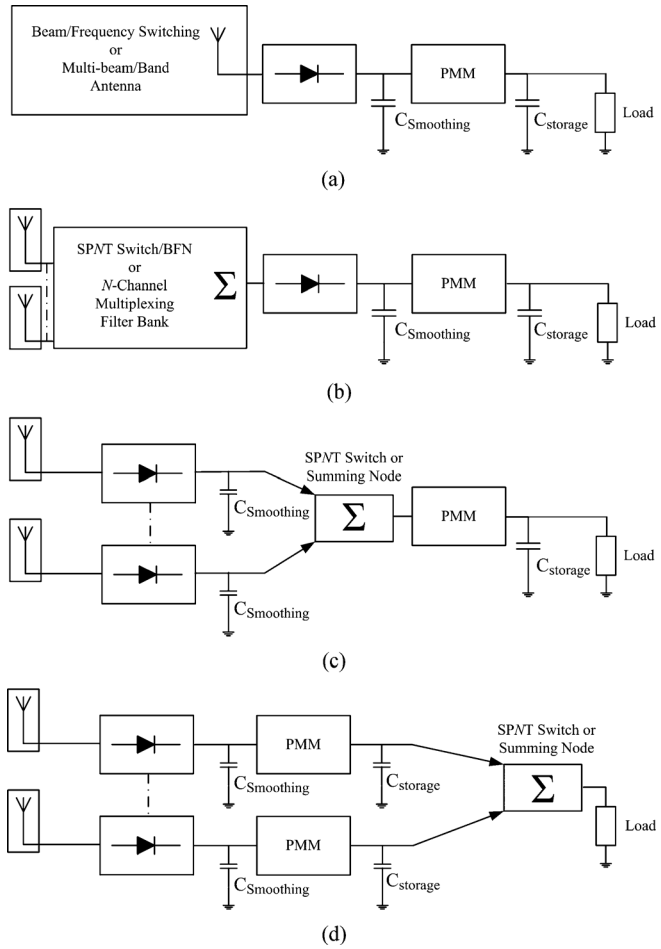

Fig. 11. Parallel array architectures with switching/summing at the: (a) antenna, (b) output of multiple antennas, (c) output of multiple rectifiers, and (d) output of multiple PMMs.

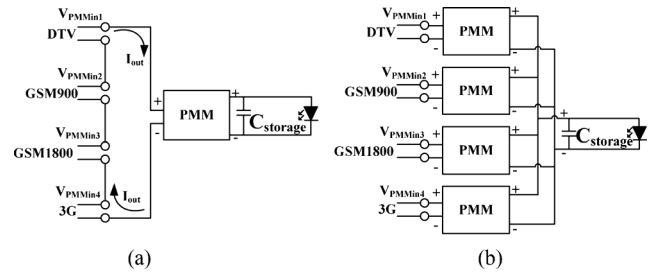

Fig. 12. Multiband array architectures (with $N = 4$ bands). (a) Voltage summing at the outputs of the single-band rectennas. (b) Current summing at the outputs of the single-band harvesters.

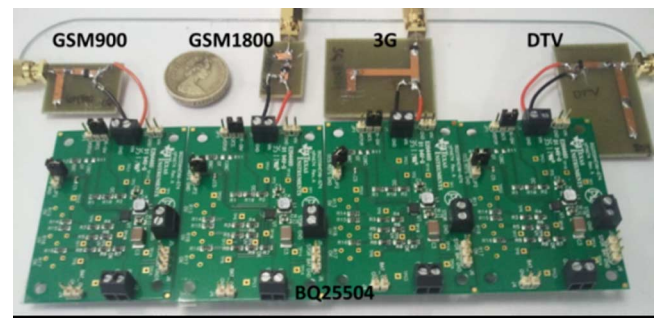

Fig. 13. Rectenna array architecture with individual PMMs for the four largest contributors with wire antennas.

the PMM circuit starts, with the MPPT operating, the harvested power level increases.

The behavior of the series rectenna topology with a shared PMM requires some discussion. As the output impedance and the OCV for each rectenna is different, since they operate at different frequencies and input RF power levels, the rectennas are forced to share the same output current in a series configuration, which does not allow them all to operate at their individual maximum power points. This causes the voltage on each rectenna output, except the one having the highest input RF power, to collapse. This operation is analogous to the partial shading problem with a series string of solar panels [41] sharing a common boost converter. With this photovoltaic system, bypass diodes placed around individual cells stop the poorly lit cells contributing a negative voltage (and power) to the string. In our case, the series circuit formed by the loop antennas and rectifying diodes performs the same task. This means that while all rectennas contribute to system startup, only the rectenna with the highest input RF power contributes significant power for continuous operation once the PMM starts. Fig. 10 shows the end-to-end efficiency for the voltage summing multiband harvester array when tested at ICL. An efficiency of only 15% was achieved with a combined input RF power of -12 dBm. The lower efficiency, when compared to a single-band harvester, is due to the imbalance of rectifier outputs, as discussed above. Here, the charge time was 43 s, compared to 167 s with the lowest contributing single-band 3G harvester with wire antenna.

B. Multiple Rectennas With Individual PMMs

In order to overcome the balancing issues when multiple rectennas share a common PMM, as discussed previously, each rectenna can have its own PMM, whose outputs can be connected to a common storage element (in this case, a 400-μF shunt capacitor, providing $U_{\rm dc} = 461$ μJ), as illustrated in Fig. 12(b) and shown in Fig. 13. Although not achieving cold-start as quickly as the series topology, this parallel topology has the advantage of being able to run each rectenna at its maximum power point. In addition, once one rectenna is able to harvest enough energy for a cold-start, all PMMs will start because they share a common storage element, allowing the rectennas with low-input RF power levels to harvest at levels below which they could not do so independently.

This parallel topology was tested and found to be capable of operating in many locations where the series array was unable to operate; e.g., if only one of the bands had $P_{\rm in} > -25$ dBm. As expected, the largest contributor hot-started the other PMMs, allowing them to harvest at an input RF power level down to -29 dBm.

However, as with the previous results for voltage summing, having a combined input RF power of -12 dBm, the efficiency using multiple PMMs is slightly lower, at 13%, as shown in Fig. 10. This is because useful dc output power from the cold-

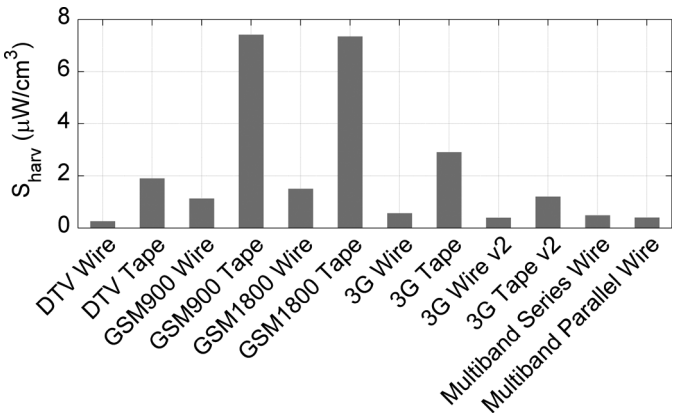

Fig. 14. Output dc power density for all harvesters at ICL.

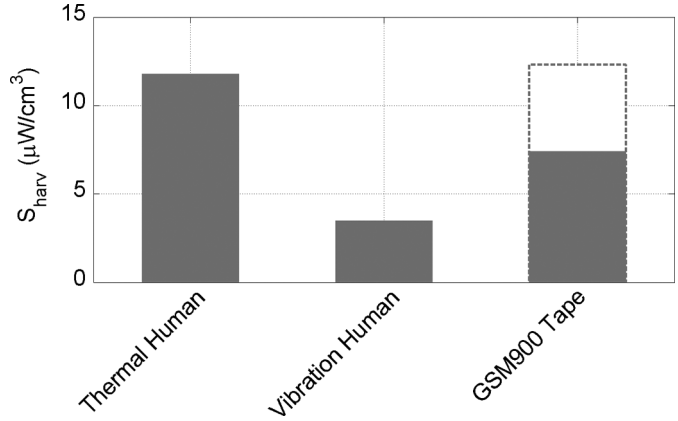

Fig. 15. Output dc power density comparison for alternative ambient harvesting technologies [40]–[43] against the best current generation of RF harvesters at ICL.

starting harvester is being supplied to the other harvesters for hot-starting, even though some of them may not actually be contributing any of their own harvested power.

VI. Output DC Power Density Comparison

The volumetric output dc power density S_{harv} $(\mu\mathrm{W/cm}^3)$ represents an important figure of merit for comparing alternative energy harvesting technologies. For ambient RF energy harvesting, the output dc power is calculated by multiplying the effective input RF power by the overall end-to-end-efficiency. The total volume (including that of the antenna, rectifier, and PMM; not including energy storage, as this does not directly affect the dc power output) must be determined. It is important to note that the volume for the antenna could effectively disappear if it is assembled onto a window or within a wall, furnishing, fixture, or fitting. Moreover, the required PMM printed circuit board (PCB) size used throughout these calculations was assumed to be ten times the size of the BQ25504 chip, to account for any necessary additional components.

Fig. 14 shows the output dc power density for all the harvesters demonstrated here. It can be seen that the 2G GSM900/1800 harvesters with tape antennas both have the highest value of $S_{\mathrm{harv}} = 7.4$ $(\mu\mathrm{W/cm}^3)$, when tested at ICL, due to the high-banded input RF power density S_{BA}. The value for the most efficient harvester (i.e., 3G v2 with tape antenna) was not the highest in terms of output RF power because S_{BA} in this band was more than an order of magnitude lower than with GSM900.

S_{harv} allows a direct and meaningful comparison to be made with other alternative energy harvesting technologies. Our best performing ambient RF energy harvester (i.e., GSM900 with tape antenna) was compared against alternative energy harvesting technologies, assuming they used the same PMM board size [42]–[44].

It can be seen in Fig. 15 that ambient RF energy harvesting has a low output dc power density when compared to alternative energy harvesting technologies, but only when the total volume of the first prototype demonstrator is considered. However, when the antenna is absorbed onto or into a background feature and when the PMM is fully integrated into the rectifier, it can outperform (as indicated by the dotted column) the alternative energy harvesting technologies, while providing a complimentary means of extracting energy from the environment. The RF harvesters, however, have the additional advantage in that they do not require a thermal gradient, and unlike vibration-driven devices, they have no moving parts.

VII. Conclusions

Our objectives were to reach the lowest possible ambient input RF power levels and extend the harvesters' operational capabilities within (semi-)urban environments. To this end, a comprehensive citywide RF spectral survey was undertaken, indicating that more than 50% of the 270 London Underground stations are suitable locations for the deployment of our ambient RF energy harvesters. It has been demonstrated that single-band harvesters can operate with efficiencies of up to 40% in a (semi-)urban environment, and can start to operate from power levels as low as -25 dBm.

To increase the freedom of operation, multiband array architectures were investigated. With the current summing harvester arrays, RF harvesting was achieved at an input RF power level as low as -29 dBm, without any external dc power supply to hot-start the PMM. Limitations on the multiband array architectures were discussed, highlighting the need for further work in balancing rectennas with voltage summing rectenna arrays when operating at lower input RF power levels.

Finally an output dc power density comparison against alternative energy harvesting technologies has shown that RF harvesting can represent a competitive solution within (semi-)urban environments, especially when the antenna can be absorbed into background features.

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ELECTRICAL & ELECTRONIC ENGINEERING | RESEARCH ARTICLE

A dual-band RF energy harvesting circuit using 4th order dual-band matching network

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Abstract: A novel compact rectifier for dual-band operation in the RF energy harvesting is presented. The circuit comprises a 4th order dual-band impedance matching and a single-series circuit with one double diode, both are integrating into a compact shape to occupy a small area of $30 \times 35\ \text{mm}^2$. The merit of the proposed rectifier circuit is that it can be extended to *n* number of the frequency band by using only $2 \times n$ matching elements. To validate the design method experimentally, a prototype of a dual-band rectifier is fabricated for two public telecommunication bands of GSM-900 and 1800. In order to reduce the circuit complexity and sensitivity arising due to lumped elements, the meander line and the open stub are used to realize the proposed circuit. A good agreement is obtained between the simulation and the measurement. The measured results show that the proposed rectifier circuit exhibits the conversion efficiency of 25.7 and 65% for an input power of −20 and 0 dBm, respectively. In addition, diode nonlinearity which affects the performance of the rectifier in terms of impedance matching is also investigated.

Subjects: Electromagnetics & Microwaves; Electronics; Circuits & Devices

Keywords: RF energy harvesting; dual band impedance matching; rectifier; RF-to-dc-conversion efficiency; frequency transformation

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PUBLIC INTEREST STATEMENT

With rapid growth in wireless communication, a huge amount of radio frequency (RF) energy broadcasted through billions of microwave sources such as mobile phones, handheld radios, and radio broadcast stations. Therefore, it is meaningful to collect and supply it to many electrical devices like mobile headsets, wearable medical sensors through RF energy harvesting. Since the ambient RF energy is distributed in multiple frequency bands, therefore the amount of energy harvested could increase if the circuit is designed for multiple frequency bands. In this work, we present a compact dual-band energy harvesting circuit to harvest energy from two most useful frequency bands, GSM-900 and 1800. The merit of the proposed rectifier circuit is it can be extended to *n* number of the frequency band by using only $2 \times n$ matching elements. A prototype is fabricated, and its performance is evaluated using Vector Network Analyzer (VNA). The total size of the rectifier is about $30 \times 35\ \text{mm}^2$.

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1. Introduction

A revolutionary growth in wireless technology attracts huge attention from research community to make the self-sustainable device feasible through RF energy harvesting. It exploits ambient electromagnetic energy transmitted from different RF systems to remotely feed the electronic devices (Nintanavongsa, Muncuk, Lewis, & Chowdhury, 2012). Compared to other harvesting techniques, RF energy harvesting provides relatively predictable energy supply owing to the features of easy availability and less dependency on environmental variations. The typical block diagram of RF energy harvesting circuit is shown in Figure 1. It consists of three major blocks viz; antenna, matching network (MN), diode detector followed by an energy storage. The first element, antenna is employed to capture the RF signals of different frequencies and polarization, while second MN is for maximum power transfer, and the last rectifier is used to convert the RF energy to dc voltage. It means harvesting circuit performance can be evaluated in terms of accessible ambient RF energy and its conversion rate (Agrawal, Pandey, Singh,& Parihar, 2014). These parameters are heavily influenced by surrounding terrain conditions as the multiple reflection and dissipation certainly deteriorate the level of available ambient RF energy. As a result, conversion efficiency and dc output voltage may degrade. Previously, the majority of available RF energy harvesting circuits focused on single frequency band hence offer low dc output voltage. As the multiple RF energy sources of different frequency bands are available, thus from an ambient RF harvesting perspective, the output dc voltage could be increased if the circuit is designed for multiple frequency bands rather than a single band. A wide-band energy harvester can also promise a high output voltage by accumulating the number of RF signals at a time. However, due to nonlinear behavior of the diode, harvesting circuit itself exhibits nonlinearity i.e. its input impedance varies with the received RF power. Thus, it is quite difficult to retain the impedance match and high conversion efficiency over a large frequency range (Song, Huang, Zhou, & Carter, 2014). The losses due to impedance mismatch over a large bandwidth can be illustrated in Collado and Georgiadis (2013), where only 8% conversion efficiency is achieved at −20 dBm.

To address this, it is preferable to harvest energy from several narrow frequency bands rather than a single large one. In literature, numerous topologies have been proposed to accomplish the multi-band energy harvesting (Bergès, Fadel, Oyhenart, Vigneras, & Taris, 2015; Hamano et al., 2016; Ho et al., 2016; Keyrouz, Visser, & Tijhuis, 2013; Kuhn, Lahuec, Seguin, & Person, 2015; Liu, Zhong, & Guo, 2015; Niotaki, Georgiadis, Collado, & Vardakas, 2014; Pinuela, Mitcheson, & Lucyszyn, 2013; Scheeler, Korhummel, & Popovic, 2014; Shariati, Rowe, Scott, & Ghorban, 2015; Sun, Guo, He, & Zhong, 2013). These topologies can be differentiated in terms of filter functionality i.e. how the antenna or source impedance is matched to the rectifier circuit. For instance, in Pinuela et al. (2013) and Keyrouz et al. (2013) several single-band rectennas (combination of antenna and rectifier circuit) were stacked to constitute a multi-band harvesting circuit. In this case, each rectenna was designed for a specific frequency band. Thus, for compact applications, this architecture is not suitable due to the number of antennas used. Moreover, in most of the reported works, the quality assessment of the output voltages combination was not taken into consideration. In Kuhn et al. (2015), the circuit complexity is reduced to a certain extent by replacing the multiple antennas with a single wide-band antenna. However, in this topology too, the number of rectifiers increases with the frequency bands, which leads to prolonging the circuit complexity.

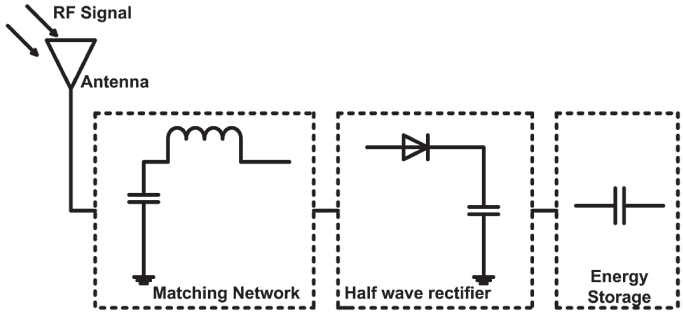

Figure 1. Typical block diagram of RF energy harvesting circuit.

Besides, a multi-band harvesting circuit can also be formed by simply embedding a multi-band matching network between the multi-band antenna and the rectifying circuit (Bergès et al., 2015; Hamano et al., 2016; Ho et al., 2016; Liu et al., 2015; Niotaki et al., 2014; Scheeler et al., 2014; Shariati et al., 2015; Sun et al., 2013). The multi-band matching network can be designed either by distributed or by lumped element. In general, the multi-band rectifier circuit experiences two types of losses: first due to shift in resonance frequency from the optimum frequency point, and second due to the filter complexity. Because of the diode nonlinearity, the input impedance of the circuit varies as a function of power and frequency which causes a shift in resonance frequency. The difficulty due to diode nonlinearity can be observed in Sun et al. (2013) where the dual-band rectifier circuit exhibits impedance matching for a small range of input power. The losses induced because of filter complexity can be observed in the recently reported works on dual band harvesting circuit (Niotaki et al., 2014; Scheeler et al., 2014; Shariati et al., 2015). In Niotaki et al. (2014), for $P_{\text{in}} = -15$ dBm, author achieved the conversion efficiency of 23% at the expense of increased filter complexity consisting two series and two shunt pairs of reactive elements. Thus, for more than dual band applications, the proposed circuit topology is not suitable due to excessive filtering components used. To obtain good conversion efficiency a dual-band rectenna reported in Scheeler et al. (2014). However, the rectenna was large in size and requiring a complex impedance tuning circuit. In Shariati et al. (2015) also, a dual-band matching network consisting nine reactive elements was employed to achieve the dual-band characteristics.

In order to reduce the filter complexity, this work proposed a compact dual-band harvesting circuit for GSM-900 and 1800. It consists of a 4th order dual-band matching network based on $1 - n$ frequency transformation, which is optimized for the energy harvesting circuit to reduce the complexity up to $2 \times n$ reactive elements (n is the number of frequency bands). Similar to frequency transformation method, the proposed dual-band rectifier circuit can be extended to n number of frequency bands by using the $2 \times n$ number of reactive elements. The detailed analysis and design guidelines of dual band rectifier circuit are discussed in Section 2.

2. Dual band rectifier design and analysis

This section presents the design and analysis of a dual-band harvesting circuit in terms of impedance matching, DC output voltage and RF-to-dc conversion efficiency. The topology of the proposed dual-band RF energy harvesting circuit is shown in Figure 2(a). As seen, the low-cost Schottky diode is used to transform the input RF power to DC voltage. The impedance matching at two frequency is achieved using a series and parallel combination of the *LC* pair. The main idea underlying the suggested multi-band matching network is $1 - n$ frequency transformation (one to many mapping of frequency), which transforms a single-band matching network to multi-band matching network (Nallam & Chatterjee, 2013). As the name ($1 - n$) suggests that for designing a multi-band matching network, primarily a single-band matching network is required whose resonant frequency is dependent on the frequencies for which multi-band matching network proposed to designed.

Moreover, this frequency transformation method depends on the type of load impedance, whether it is series or parallel combination of *RC* or *RL*. Since the selected diode (HSMS-2852) has capacitive behavior throughout the frequency, it can be represented in a series or parallel combination of *R* and *C*. In the case of parallel *RC* load, the following equations are used to transform the single-band matching network into multi-band matching network.

$$\omega = \frac{\omega_t^n + a_m \omega_t^{n-m} + a_{m+2} \omega_t^{n-(m+2)} + \cdots}{\omega_t^{n-1} + a_{m+1} \omega_t^{n-(m+1)} + a_{m+3} \omega_t^{n-(m+3)} + \cdots} \tag{1}$$

where, n is the number of bands and m varies from 2 to n. After substituting the value of n, Equation (1) can be expanded in partial fraction form using the causal foster analysis as:

$$\omega = \omega_t + \frac{1}{\frac{\omega_t}{a_2 - a_3} + \frac{1}{\cdots}} \tag{2}$$

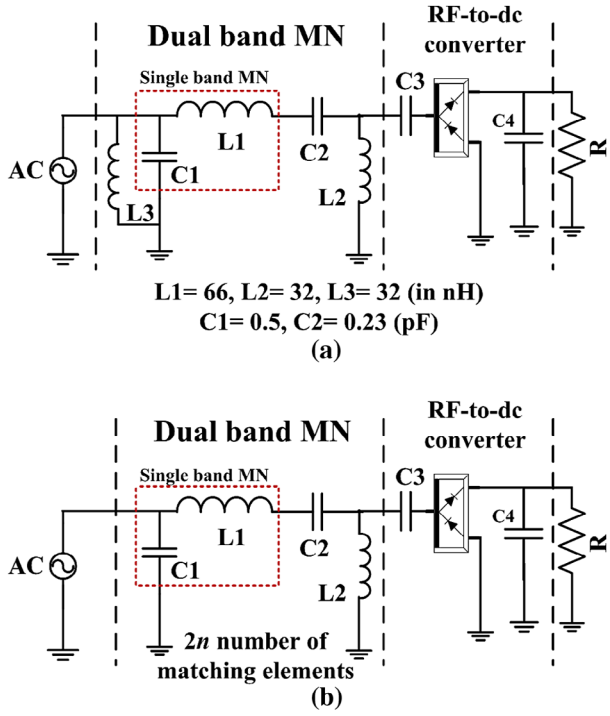

Figure 2. (a) Circuit diagram of the proposed dual-band rectifier circuit and (b) optimized dual-band rectifier circuit.

The coefficients a_2 and a_3 can be calculated as:

$$\omega_m = \sum_{i=1}^{n} (-1)^{i-1} \omega_i \tag{3}$$

$$a_m = (-1)^m \sum_{i,j=1,1\,\&\,i\neq j}^{n,n} (-1)^{i+j} \omega_i \omega_j \tag{4}$$

$$a_{m+1} = (-1)^{m+1} \sum_{i,j,k=1,1,1\,\&\,i\neq j\neq k}^{n,n,n} (-1)^{i+j+k} \omega_i \omega_j \omega_k \tag{5}$$

$$a_{m+n} = (-1)^{m+n} \sum_{i,j,k\ldots=1,1,1\ldots i\neq j\neq k}^{n,n,n\ldots} (-1)^{i+j+k+\cdots} \omega_i \omega_j \omega_k \ldots \tag{6}$$

$$a_n = \prod_{i=1}^{n} (-1)^n \omega_i \tag{7}$$

Equation (6) is similar to that presented in Nallam and Chatterjee (2013), except the term $(-1)^{m+n}$, which is included here to realize the multi-band matching network for more than three frequency bands i.e. for $n \geq 3$.

With this transformation, the capacitor of the matching network is transformed to the combination of prototype capacitor parallel with inductor whereas, an inductor is transformed into a combination of the same inductor with a series capacitor. Figure 3 shows the circuit schematic of transformation of a single-band matching network to the dual-band matching network. It can be seen that C_1 is transformed to $C_1 \| L_2$ and L_1 transformed to L_1 series with C_2. After successful usage of (1)–(7), the resultant multi-band matching network requires $3n - 1$ and $4n - 1$ reactive elements for L and Π-type topology, respectively.

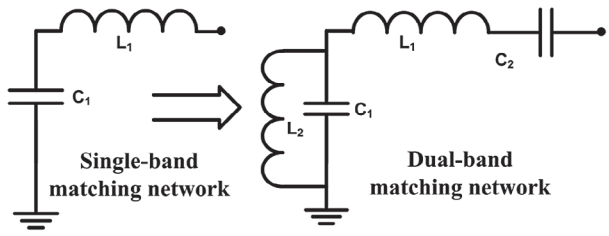

Figure 3. Conversion of a single-band matching network to dual-band matching network using $1-n$ frequency transformation.

As the aim is to design a dual-band harvesting circuit, therefore, we require here only 5 or 7 reactive elements with L and Π-type topologies, respectively. From Figure 2(a), it can be seen that the resultant matching network consists of five elements, where the inductor L_3 and capacitor C_2 results after the transformation of capacitor C_1 and inductor L_1, respectively. Besides, the inductor L_2 occurrs due to the diode reactive element, which is generally a capacitor.

In this work, two frequencies 0.9 and 1.8 GHz that correspond to the maximum signal strength are chosen for dual-band harvesting circuit. According to this method, it is necessary to assign the frequencies in descending order e.g. $\omega_1 = 1.8, \omega_2 = 0.9$. Therefore, from (3) single-band matching network frequency is equal to $\omega_1 - \omega_2 = 2\pi(1.8 - 0.9) \times 10^9 = 0.9 \times 2\pi \times 10^9$. In order to match the source impedance with the rectifier at the calculated frequency 0.9 GHz, the chosen matching topology is L-type as shown by the encircled portion in Figure 2(a). The corresponding element values can be approximated using the various methods some of which are described in Pozar (2010). Subsequently, this single-band matching network is transformed to dual-band matching network using (1)–(7). The detailed design steps of the dual-band rectifier circuit are summarized as follows:

(1) As we are interested in matching the diode to 50 Ω at two frequencies (0.9 and 1.8 GHz) so, the order of transformation is equal to 2 or $n = 2$.
(2) In the first step, single-band matching network is designed at the frequency f calculated as: $f = f_2 - f_1 = 1.8 - 0.9 = 0.9$ GHz. In this case, any matching topology that matches the diode to 50 Ω, at 0.9 GHz for an input power $P_{in} = -20$ dBm, and load resistance 4.7 kΩ can be used. The chosen single-band matching network is shown by the encircled portion in Figure 2(a).
(3) Afterwards, this single-band matching network is transformed into dual-band using the (1)–(7) as shown below:

Since $n = 2$ therefore, from (2)

$$\omega = \omega_t + \frac{1}{\frac{\omega_t}{a_2}} \tag{8}$$

From (4) a_2 can be calculated as:

$$a_2 = (-1)^{2+2} \sum (-1)^{1+2} \omega_1 \omega_2 = \omega_1 \omega_2 \tag{9}$$

$$a_2 = -1.62 \times 4\pi^2 \times 10^8 = 0.64 \times 10^{20} \tag{10}$$

Thus, inductor L_1 (=66 nH) is transformed to impedance as:

$$j66 \times 10^9 \omega = j66 \times 10^9 \omega_t + \frac{1}{j0.23 \times 10^{-12} \omega_t} \tag{11}$$

Similarly, capacitors (=0.5 pF) are transformed to the admittance as:

$$j5 \times 10^{-13} \omega = j5 \times 10^{-13} \omega_t + \frac{1}{j32 \times 10^{-9} \omega_t} \tag{12}$$

The circuit schematic of the dual-band harvesting circuit is shown in Figure 2(a). It can be seen that resultant matching network consists of five reactive elements according to $3n - 1$. In order to reduce the circuit complexity and sensitivity due to reactive elements, a parametric study has been carried out to eliminate the elements showing minimum influence on the circuit performance.

Figure 4 shows the simulated $|S_{11}|$ for the different combination of matching elements. The simulated results demonstrate that $|S_{11}|$ experiences maximum change when inductor L_2 and capacitor C_2 are removed from the circuit, whereas it remains almost unaffected when L_3 is not present in the circuit. Therefore, inductor L_3 can be extruded from the circuit and the resultant matching circuit requires only $2n$ and $3n$ reactive elements in place of $3n - 1$ and $4n - 1$ elements. In this way, for each topology, the proposed circuit reduces $n - 1$ elements compared to the conventional method. Figure 2(b) demonstrates the optimized circuit diagram of the dual-band rectifier. It can be observed that circuit requires large inductors value of 32 and 66 nH. Thus, it is quite difficult to realize the practical rectifier circuit whose response is similar to the response of simulated result. In order to avoid any impedance mismatch due to the small difference in elements value, the meander line inductor and open stub are used to realize the inductors and capacitors, respectively. In this case, not only fabrication and optimization process become so easy but the cost will also reduced.

Figure 5, shows the layout of the dual-band rectifier circuit. In Nintanavongsa et al. (2012) and Agrawal et al. (2014), it has been demonstrated that the number of rectifying diodes or equivalently voltage multiplier stages are very much sensitive to the RF-to-dc conversion efficiency. In low-power region (≤ -20 dBm), efficiency decreases if voltage multiplier stages increase, whereas in higher power region (≥ -20 dBm), an opposite effect occurs. As the demand is to harvest energy in low-power region, single-series circuit with a double diode is used to convert received RF energy into dc voltage. From the left side of the circuit, the first meander line corresponds to the inductor L_1, while the second meander line represents the inductor L_2, of the Figure 2(b). The shunt stub is accounted

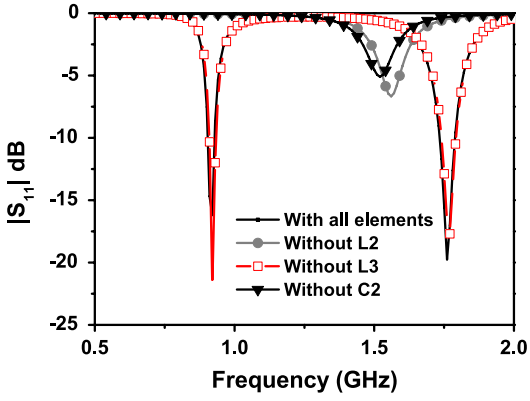

Figure 4. Simulated $|S_{11}|$ vs. frequency for different combination of circuit elements.

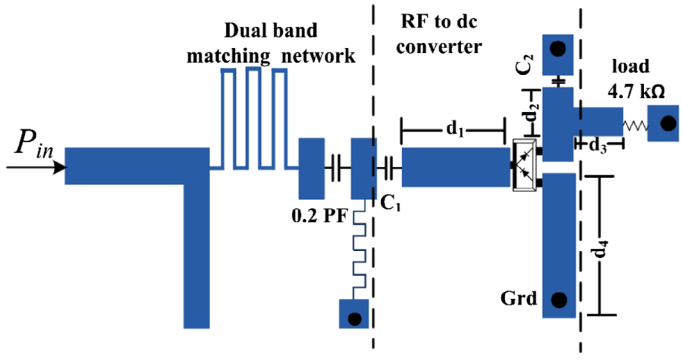

Figure 5. Layout of the proposed dual-band RF energy harvesting circuit.

for the shunt capacitor C_1 of Figure 2(b). The dimensions of each element are calculated according to their respective reactive element value and the substrate on which circuit has to be fabricated. In Assimonis, Daskalakis, and Bletsas (2016), it has been demonstrated that traces (microstrips) connected to the rectifier terminals (e.g. distance between the diode and via and diode and load) are highly sensitive for RF-to-dc efficiency. Therefore, traces d_1, d_2 between diode and capacitor C_1 and C_2, d_3 between diode and load and d_4 between diode and ground are adjusted to optimize the impedance matching as well as the conversion efficiency of the rectifier. Due to nonlinear behavior of the diode, harvesting circuit itself exhibits nonlinearity i.e. its input impedance varies with received RF power, therefore harmonic-balance (HB) and large signal analysis (LSSP) were employed to take into consideration the nonlinear behavior of the rectifier.

The photograph of the fabricated dual-band rectifier is shown in Figure 6. It is fabricated on a 1.54 mm thick FR-4 substrate with a dielectric constant (ϵ_r) of 4.3 using chemical etching method. The rectifier performance is evaluated in terms of $|S_{11}|$ and output voltage using the Agilent vector network analyzer (VNA). The simulated and measured $|S_{11}|$ is illustrated in Figure 7(a). The measured result shows reasonable agreement with the simulated one; the slight difference can be accounted for the fabrication imperfections. It is well known that impedance matching is a function of frequency and input power, due to the nonlinearity of the diode. Such a characteristic is examined in Figure 7(b), where the measured $|S_{11}|$ is demonstrated as a function of input power level for three different load impedance values. From results, it is clear that impedance matching of the harvesting circuit is greatly affected by the input power and the load impedance. Figure 7(b) demonstrates that as power increases, the impedance matching at 0.9 GHz degraded drastically, while at 1.8 GHz, it improves. Moreover, it is noticed that the impedance matching at higher power level is more sensitive to the variation of load impedance (*RL*).

The measured RF-to-dc conversion efficiency and output voltage vs. input power for both frequencies are demonstrated in Figure 8(a). For 0.9 GHz, efficiency is equal to 25.7 and 65.1% for an input power of -20 and 0 dBm, respectively. However, at 1.8 GHz the efficiency is relatively small that might be due to the increased parasitic losses in the rectifier diode. Figure 8(b) shows the relation between the output voltage and frequency for various input power levels at fixed load resistance value of 4.7 kΩ. It can be seen that maximum output voltage is achieved in the frequency range of 860–900 and 1770–1800 MHz, showing the rectifier's capability to harvest RF energy in the GSM-900 and 1800 bands.

Figure 9, depicts the measured conversion for various values of load resistance. It can be noticed that the circuit yields maximum efficiency when the load impedance is 4.7 kΩ. It starts decreasing as the load impedance varies from 4.7 kΩ. Table 1 shows the comparison of the conversion efficiency and the size of the proposed rectifier with the similar works reported previously. Only measured results are compared in Table 1. It can be seen that in low-power condition maximum efficiency is achieved in Sun et al. (2013), but the expense of bulky circuit size. However, the proposed rectifier offers an optimal conversion efficiency with compact circuit size.

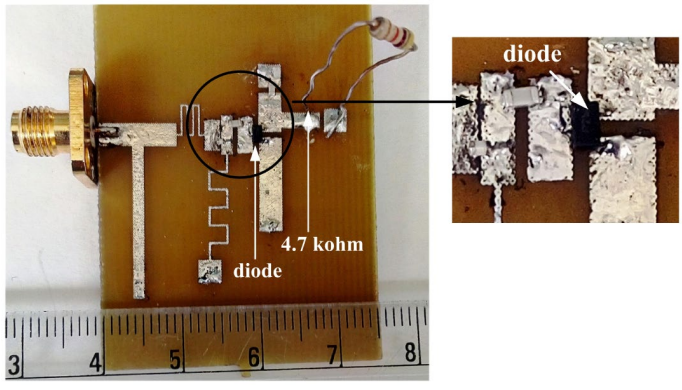

Figure 6. Photograph of the fabricated dual-band RF energy harvesting circuit.

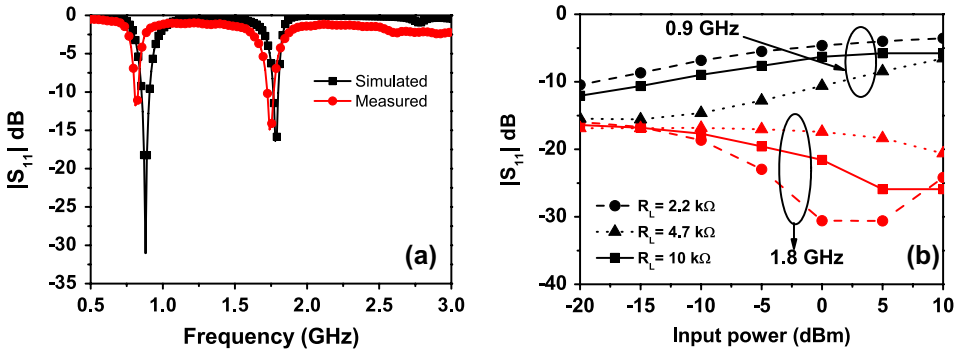

Figure 7. (a) Simulated and measured $|S_{11}|$ vs. frequency and (b) measured $|S_{11}|$ for various power levels.

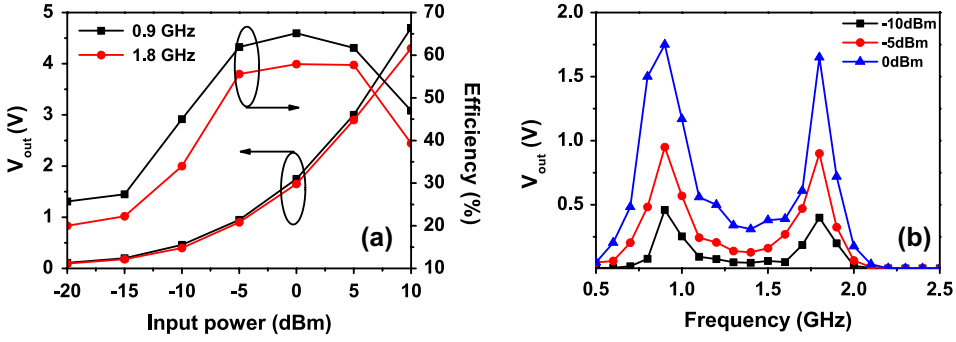

Figure 8. (a) Measured output dc voltage and RF-to-dc conversion efficiency and (b) measured dc voltage vs. frequency.

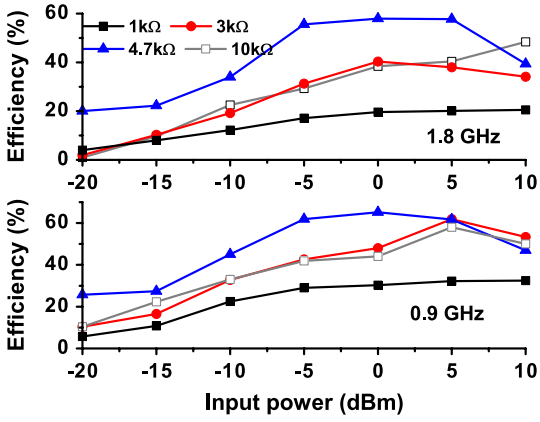

Figure 9. Measured RF-to-dc conversion efficiency for different load impedance.

Table 1. Performance comparison of the proposed dual rectifier with recently published works

Ref.	Measured rectifier efficiency (%)	Input power (dBm)	Rectifier size
Ho et al. (2016)	15.8 @ 0.89 GHz	−20	100 × 65 mm^2
	11.2 @ 1.76 GHz		
Hamano et al. (2016)	10 @ 2.15 GHz	−10	37 × 71 mm^2
	15 @ 5.84 GHz		
Bergès et al. (2015)	27 @ 0.91/2.4 GHz	−16	78 × 88 mm^2
Sun et al. (2013)	30 @ 2.14 GHz	−20	145 mm
	35 @ 1.84 GHz		
Liu et al. (15)	20 @ (0.91+1.8) GHz	−20	23 × 37 mm^2
This work	27.5 @ 0.9 GHz	−20	30 × 35 mm^2
	20 @ 1.8 GHz		

3. Conclusion

A new compact 4th order dual-band rectifier has been designed to harvest the RF power of GSM-900 and 1800 bands. In order to reduce the circuit complexity and sensitivity due to reactive elements, the meander line and the open stub are used to fabricate the matching network. For $P_{in} = -20$ dBm, the measured RF-to-dc conversion efficiency of 27.5 and 20% is achieved at 0.9 and 1.8 GHz, respectively. Further, more than 45 and 34% conversion efficiency is maintained from -10 to 10 dBm for 0.9 and 1.8 GHz, respectively.

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Optimization of the Voltage Doubler Stages in an RF-DC Convertor Module for Energy Harvesting

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ABSTRACT

This paper presents an optimization of the voltage doubler stages in an energy conversion module for Radio Frequency (RF) energy harvesting system at 900 MHz band. The function of the energy conversion module is to convert the (RF) signals into direct-current (DC) voltage at the given frequency band to power the low power devices/circuits. The design is based on the Villard voltage doubler circuit. A 7 stage Schottky diode voltage doubler circuit is designed, modeled, simulated, fabricated and tested in this work. Multisim was used for the modeling and simulation work. Simulation and measurement were carried out for various input power levels at the specified frequency band. For an equivalent incident signal of –40 dBm, the circuit can produce 3 mV across a 100 kΩ load. The results also show that there is a multiplication factor of 22 at 0 dBm and produces DC output voltage of 5.0 V in measurement. This voltage can be used to power low power sensors in sensor networks ultimately in place of batteries.

Keywords: Energy Conversion; RF; Schottky Diode; Villard; Energy Harvesting

1. Introduction

RF energy harvesting is one type of energy harvesting that can be potentially harvested such as solar, vibration and wind. The RF energy harvesting uses the idea of capturing transmitted RF energy at ambient and either using it directly to power a low power circuit or storing it for later use. The concept needs an efficient antenna along with a circuit capable of converting RF signals to DC voltage. The efficiency of an antenna mainly depends on its impedance and the impedance of the energy converting circuit. If the two impedances aren't matched then it will be unable to receive all the available power from the free space at the desired frequency band. Matching of the impedances means that the impedance of the antenna is the complex conjugate of the impedance of the circuit (voltage doubler circuit).

The concept of energy harvesting system is shown in **Figure 1**, which consists of matching network, RF-DC conversion and load circuits. The authors in [1], used a 2.4 GHz operating frequency with an integrated zero bias detector circuit using BiCMOS technology which produced an output voltage of 1 V into a 1 MΩ load at an input power level of 0 dBm. H. Yan and co-authors revealed that a DC voltage of 0.8 volts can be achieved from a –20 dBm RF input signal at 868.3 MHz through simulation results [2]. In [3], work was carried out on a firm frequency of 900 MHz by matching to a 50 Ω impedance and resonance circuit transformation in front of the Schottky diode which yields an output voltage of over 300 mV at an input power level of 2.5 µ. W. J. Wang, L. Dong and Y. Fu [4] used a Cockcroft-Walton multiplier circuit that produced a voltage level of 1.0 V into a 200 MΩ load for an input power level of less than –30 dBm at a fixed frequency of 2.4 GHz.

The energy conversion module designed in this paper is based on a voltage doubler circuit which can be able to output a DC voltage typically larger than a simple diode rectifier circuit as in [5], in which switched capacitor charge pump circuits are used to design two phase voltage doubler and a multiphase voltage doubler. The module presented in this can function as an AC to DC converter that not only rectifies the input AC signal but also elevates the DC voltage level. The output voltage of the

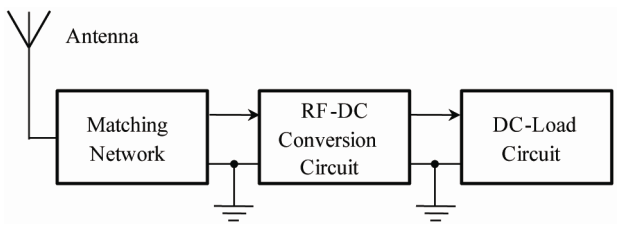

Figure 1. Schematic view of a RF energy harvesting system.

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energy conversion module can be used to energize the low power devices for example sensors for a sensor network in application to agriculture.

Section 2 of this paper discusses on the theoretical background of the voltage doubler circuit. Section 3 presents the simulation study and implementation of the circuit design. Section 4 provides the results and analysis. Section 5 concludes with a discussion on the findings from the simulated and measured results.

2. Voltage Multiplier

There are various voltage multiplier circuit topologies. The design used in this module is derived from the function of peak detector or a half wave peak rectifier. The Villard voltage multiplier circuit was chosen in the circuit design of this paper because it produces two times of the input signal voltage towards ground at a single output and can be cascaded to form a voltage multiplier with an arbitrary output voltage and its design simplicity.

2.1. Diode Modeling

The voltage multiplier circuit in this design uses zero bias Schottky diode HSMS-2850 from Agilent. The attractive feature of these Schottky diodes are low substrate losses and very fast switching but leads to a fabrication overhead. This diode has been modeled for the energy harvesting circuit which comes in a one-diode configuration. The modeling parameters for these diodes are given by Agilent in their data sheets. These parameters are used in Multisim for its own modeling purposes. The modeling is done by transforming the diode into an equivalent circuit using passive components which are described by the SPICE parameters in **Table 1** [6].

The diode used in this design is shown in **Figure 2** and its equivalent model is shown in **Figure 3**. The special features of HSMS-2850 diode is that it provides a low forward voltage, low substrate leakage and uses the non symmetric properties of a diode that allows unidirectional flow of current under ideal condition.

Table 1. SPICE parameters.

Parameters	Units	HSMS 2850
B_V	V	3.8
C_{J0}	pF	0.18
E_G	Ev	0.69
I_{BV}	A	3E–4
I_S	A	3E–6
N	No unite	1.06
R_S	Ω	25
P_B (V_J)	V	0.35
P_T (XTI)	No units	2
M	No units	0.5

Figure 2. Schottky diode.

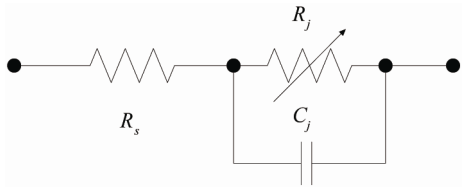

Figure 3. Linear circuit model of the Schottky diode [6].

The diodes are fixed and are not subject of optimization or tuning. This is described using the following derivations. By neglecting the effect of diode substrate, an equivalent linear model that can be used for the diode as shown in **Figure 3**. When C_j is the junction capacitance and R_j is the junction resistance, the admittance Y_z of the linear model is given by

$$Y_Z = Y_{C_j} + Y_{R_j} \tag{1}$$

Equation (1) related to the frequency of operation is given by

$$Y_Z = jwC_j + \frac{1}{R_j} \tag{2}$$

$$= \frac{jwC_jR_j + 1}{R_j} \tag{3}$$

The impedance Z of the linear model is given by

$$Z = \frac{R_j}{1 + jwR_jC_j} \tag{4}$$

The total impedance Z_T is given by

$$Z_T = R_S + \frac{R_j}{1 + jwR_jC_j} \tag{5}$$

where R_S is the series resistance of the circuit and R_j is given by

$$R_j = \frac{8.33 \times 10^{-5} \times N \times T}{I_b + I_S}$$

where:

I_b = bias current in μA;

I_s = saturation current in μA;

T = temperature (K);

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N = ideality factor.

In Equation (5), R_j and C_j are constants and the frequency of operation (w) is the only variable parameter. As the frequency increases, the value of Z is almost negligible compared to the series resistance R_S of the diode. From this it is concluded that the function of the diode is independent of the frequency of operation.

2.2. Single Stage Voltage Multiplier

Figure 4 represents a single stage voltage multiplier circuit. The circuit is also called as a voltage doubler because in theory, the voltage that is arrived on the output is approximately twice that at the input. The circuit consists of two sections; each comprises a diode and a capacitor for rectification. The RF input signal is rectified in the positive half of the input cycle, followed by the negative half of the input cycle. But, the voltage stored on the input capacitor during one half cycle is transferred to the output capacitor during the next half cycle of the input signal. Thus, the voltage on output capacitor is roughly two times the peak voltage of the RF source minus the turn-on voltage of the diode.

The most interesting feature of this circuit is that when these stages are connected in series. This method behaves akin to the principle of stacking batteries in series to get more voltage at the output. The output of the first stage is not exactly pure DC voltage and it is basically an AC signal with a DC offset voltage. This is equivalent to a DC signal superimposed by ripple content. Due to this distinctive feature, succeeding stages in the circuit can get more voltage than the preceding stages. If a second stage is added on top of the first multiplier circuit, the only waveform that the second stage receives is the noise of the first stage. This noise is then doubled and added to the DC voltage of the first stage. Therefore, the more stages that are added, theoretically, more voltage will come from the system regardless of the input. Each independent stage with its dedicated voltage doubler circuit can be seen as a single battery with open circuit output voltage V_0, internal resistance R_0 with load resistance R_L, the output voltage, V_{out} is expressed as in Equation (7).

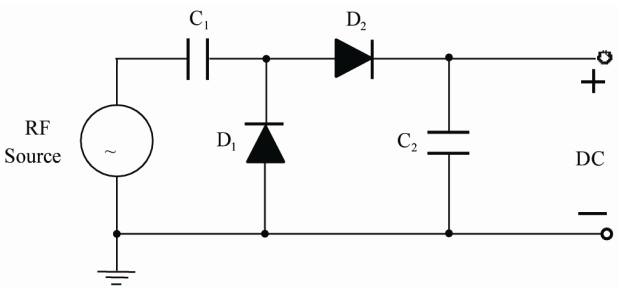

Figure 4. Single stage voltage multiplier circuit [7].

$$V_{out} = \frac{V_0}{R_0 + R_L} R_L \tag{6}$$

When n number of these circuits are put in series and connected to a load of R_L in Equation (6) the output voltage V_{out} obtained is given by this change in RC value will make the time constant longer which in turn retains the multiplication effect of two in this design of seven stage voltage doubler.

$$V_{out} = \frac{nV_0}{nR_0 + R_L} = V_0 \frac{1}{\frac{R_0}{R_L} + \frac{1}{n}} \tag{7}$$

The number of stages in the system has the greatest effect on the DC output voltage, as shown from Equations (6) and (7).

It is inferred that the output voltage V_{out} is determined by the addition of R_0/R_L and $1/n$, if V_0 is fixed. From this analysis it is observed that V_0, R_0 and R_L are all constants. Assume that V_0 = 1 V, R_0/R_L = 0.25, n = 2, 3, 4, 5, 6 and 7, the output voltage V_{out} = 1.33 V, 1.72 V, 2.0 V, 2.22 V, 2.43 V and 2.56 V respectively when substituted analytically in the Equation (7). This analysis can be compared with the results obtained in the circuit design of this module. In simulation at n = 4, V_{out} = 1.42 V, n = 5, V_{out} = 1.67 V; n = 6, V_{out} = 1.92; n = 7, V_{out} = 2.15 V; n = 8, V_{out} = 1.92 V; n = 9, V_{out} = 1.81 V. Also in measurement, for n = 4, V_{out} = 2.1 V; n = 5, V_{out} =2.9 V; n = 6, V_{out} = 3.72 V; and n = 7, V_{out} = 5 V. As n increases, the increase in output voltage will be almost double the input voltage up to some number of stages. But at some point, *i.e.* beyond seven stages, in this circuit the output voltage gained (8 and 9 stages) will be negligible as shown in **Figure 5**.

The capacitors are charged to the peak value of the input RF signal and discharge to the series resistance (R_s) of the diode. Thus the output voltage across the capacitor of the first stage is approximately twice that of the input signal. As the signal swings from one stage to other, there is an additive resistance in the discharge path of the

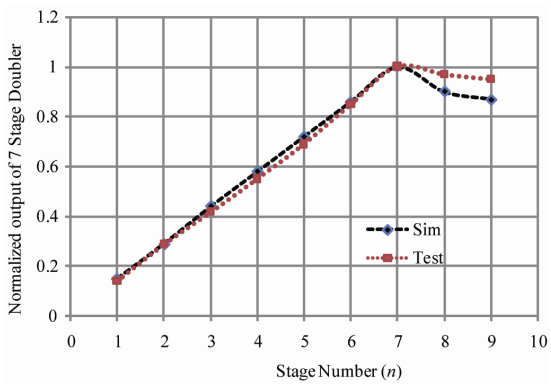

Figure 5. Normalized output voltage multiplier versus number of stages.

diode and increase of capacitance due to the stage capacitors.

2.3. Seven Stage Voltage Multiplier

The seven stage voltage multiplier circuit design implemented in this paper is shown in **Figure 6**. Starting on the left side, there is a RF signal source for the circuit followed by the first stage of the voltage multiplier circuit. Each stage is stacked onto the previous stage as shown in the **Figure 6**. Stacking was done from left to right for simplicity instead of conventional stacking from bottom to top.

The circuit uses eight zero bias Schottky surface-mount Agilent HSMS-285X series, HSMS-2850 diodes. The special features of these diode is that, it provides a low forward voltage, low substrate leakage and uses the non-symmetric properties of a diode that allows unidirectional flow of current under ideal conditions. The diodes are fixed and are not subject of optimization or tuning. This type of multiplier produces a DC voltage which depends on the incident RF voltage. Input to the circuit is a predefined RF source. The voltage conversion can be effective only if the input voltage is higher than the Schottky forward voltage.

The other components associated with the circuit are the stage capacitors. The chosen capacitors for this circuit are of through-hole type, which make it easier to modify for optimization, where in [8] the optimization was accomplished at the input impedance of the CMOS chip for a three stage voltage multiplier. The circuit design in this paper uses a capacitor across the load to store and provide DC leveling of the output voltage and its value only affects the speed of the transient response. Without a capacitor across the load, the output is not a good DC signal, but more of an offset AC signal.

In addition to the above, an equivalent load resistor is connected at the final node. The output voltage across the load decreases during the negative half cycle of the AC input signal. The voltage decreases is inversely proportional to the product of resistance and capacitance across the load. Without the load resistor on the circuit, the voltage would be hold indefinitely on the capacitor and look like a DC signal, assuming ideal components. In the design, the individual components of the stages need not to be rated to withstand the entire output voltage. Each component only needs to be concerned with the relative voltage differences directly across its own terminals and of the components immediately adjacent to it. In this type of circuitry, the circuit does not change the output voltage but increases the possible output current by a factor of two. The number of stages in the system is directly proportional to the amount of voltage obtained and has the greatest effect on the output voltage as explained in the Equation (7) and shown in **Figure 5**.

3. Simulation and Implementation

Multisim software was chosen for modeling and simulation which is a circuit simulation tool by Texas Instruments. The simulation and practical implementation were carried out with fixed RF at 945 MHz ± 100 MHz, which are close to the down link center radio frequency (947.5 MHz) of the GSM-900 transmitter. The voltages obtained at the final node V_{DC} of the multiplier circuit were recorded for various input power levels from –40 dBm - +5 dBm with power level interval (spacing) of 5 dBm.

The simulations were also carried out using same stage capacitance value (3.3 nF) and then with a varied capacitance value for all stages from 4 stages through 9 stages [9]. The capacitance value was varied in such a way that, from one stage to the next, it was halved. For example, if the first stage was 3.3 nF, the second stage was 1.65 nF, third stage was 825 pF, fourth stage was 415 pF and so on. But keeping in view of testing, the capacitance values were chosen to have a close match with the standard available values in the market.

Simulation was carried out through 4 to 9 voltage doubler stages. Based on results obtained a 7 stage doubler is best to implemented for this application.

The design of the printed circuit board (PCB) was carried out using DipTrace software. The material used to

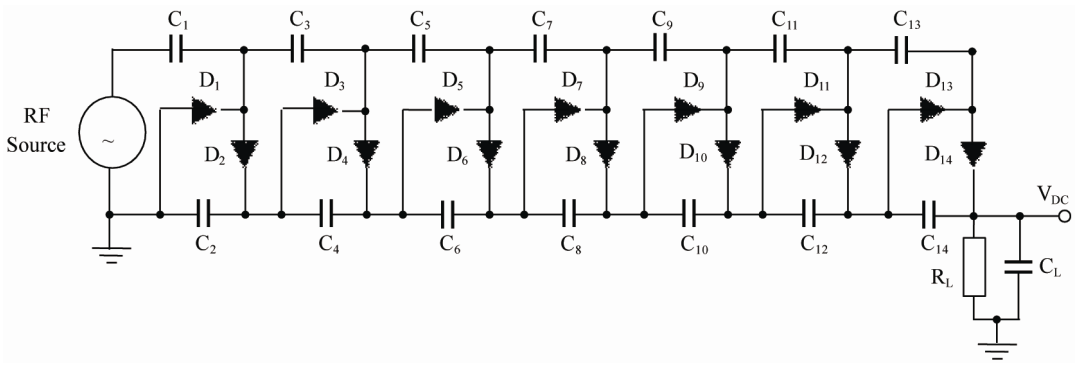

Figure 6. Schematic of 7 stage voltage multiplier.

manufacture the printed circuit board (PCB) is the standard Fiberglass Reinforced Epoxy (FR4), with the thickness of 1.6 mm and dielectric constant of 3.9. The topology is constructed on the PCB with the dimensions of 98 mm × 34 mm (W × H). The Sub Miniature version A (SMA) connectors are used at the input and output of PCB to carry out the measurements. The circuit components consist of active and passive components. The component used in circuit is shown in **Table 2**.

Special handling precautions have been taken to avoid Electro Static Discharge (ESD), while assembling of the surface-mount zero bias Schottky diodes. Also special attention has been given to mount other components and the SMA connectors on to the PCB. The Photograph of Assembled circuit board I shown in **Figure 7**.

4. Results and Analysis

The simulated and measured results at the output voltage of voltage multiplier circuit are shown graphically in **Figure 8**. From the graph analysis, the simulated and the measured results agree considerably with each other. The measured results are shown to be better than the simulation results. The reason behind this may be due to the uncertainty in series resistance value of the diode obtained from SPICE parameters in modeling as explained in Equation (5). This resistance vale of diodes in practical circuit may be lower than in the model, which provides fast discharge path, in turn rise in voltage as passes through the stages and reaches to final output. In this work, the DC output voltages obtained through simulation and measurement at 0 dBm re 2.12 V and 5.0 V respectively. These results are comparatively much better than in ref. [9], where in at 0 dBm, 900 MHz they achieved 0.5 V and 0.8 V through simulation and measurement respectively.

Figures 9 and **10** show the result of a 4 stage voltage doubler circuit with equal and varied capacitance values between the stages as described in Section 3.

From the analysis of these two simulations, it can be observed that the resulting output voltages are equal. The only difference between these two graphs is the rise time of the circuit with varied capacitance value is a little bit slower. But, overall result on the performance of rise time is still under 20 µs to 24 µs and the difference is negligible. From these results, the use of equal stage capacitance of each being 3.3 nF was hence considered for the design of the multiplier.

The results from **Figure 11**, shows that the output voltage reaches to 1.0 V within 20 µS and then uniformly increasing to 1.4 V, 1.67 V, 1.87 V and 2.12 V for 4, 5, 6 and 7 stages respectively compared to 2 mS as shown in [10]. **Figure 12** shows that the conversion ratio of 22 is achieved at 0 dBm input power and drops to 2.5 at –40 dBm. The highest value at 0 dBm is due to the innate characteristics of the zero bias Schottky diodes which conduct fairly well at higher input voltages.

5. Conclusion

From the experimental results, it is found that the pro-

Table 2. Component used in 7 stage voltage multiplier.

Name of component	Label	Value
Stage capacitors	C_1 - C_{14}	3.3 nF
Stage diodes	D_1 - D_{14}	HSMS 2850
Filter capacitor	C_L	100 nF
Load resister	R_L	100 kΩ

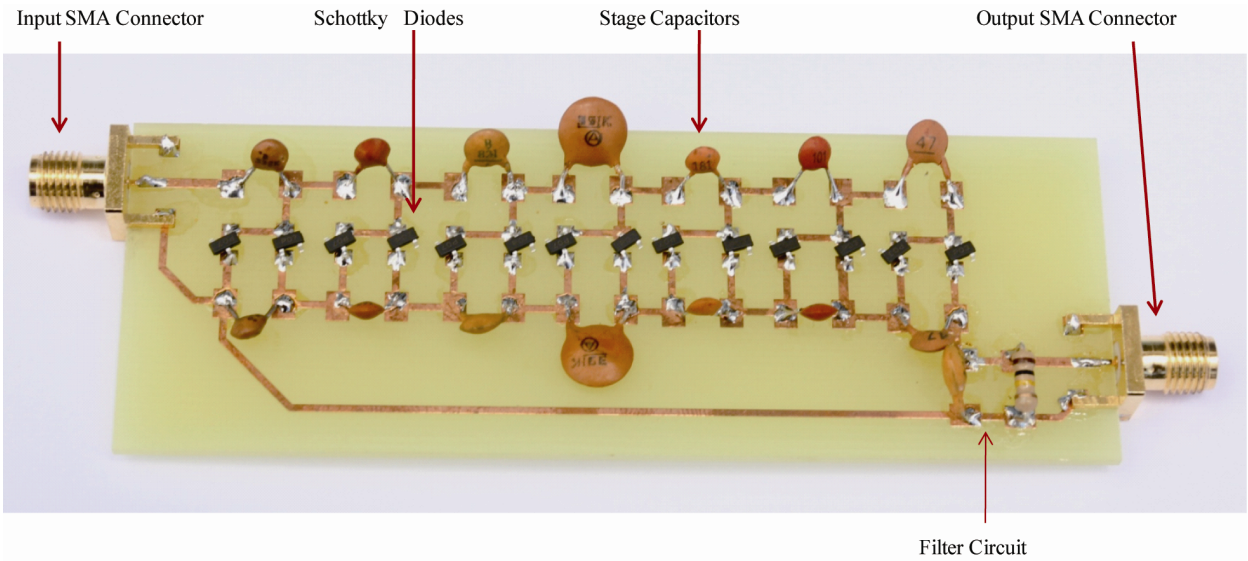

Figure 7. Photograph of assembled circuit board.

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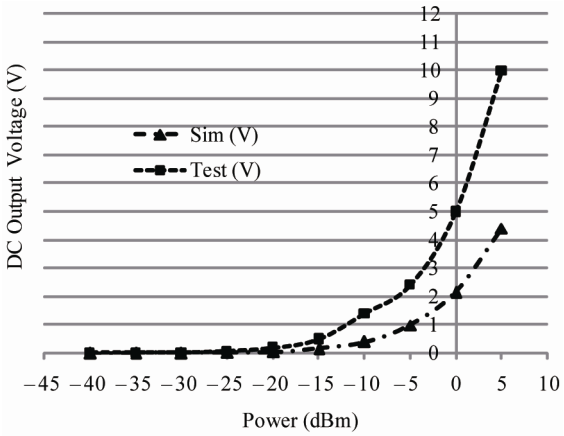

Figure 8. Simulated and test DC output voltage of multiplier as a function of input power.

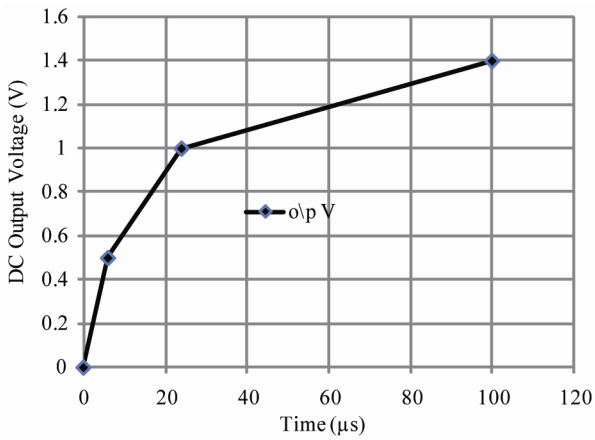

Figure 9. DC output voltage verses rise time of 4 stage voltage doubler circuit with equal stage capacitance [8].

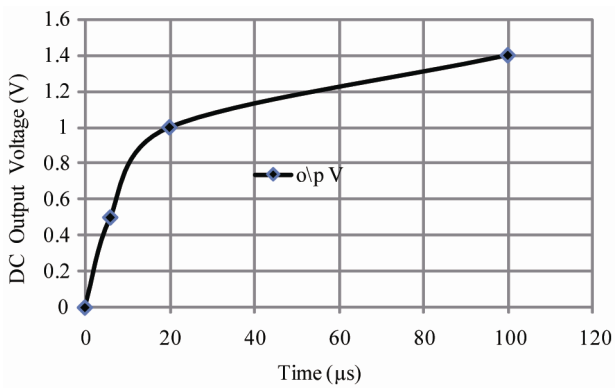

Figure 10. DC output voltage verses rise time of 4 stage voltage doubler with varied stage capacitance [8].

posed voltage multiplier circuit operates at the frequency of 945 MHz with the specified input power levels. The results have shown that there is multiplication of the input voltage. From **Figure 12**, it is shown that at 0 dBm input power, the multiplication factor is 22. This is significant, as the work shows that RF energy in the GSM-900 band can be harvested from the ambient RF source using the Villard circuit topology. The power density levels from a GSM base station is expected from 0.1 mW/m^2 to 1 mW/m^2 for a distance ranging from 25 m - 100 m. These power levels may be elevated by a factor between one and three for the GSM-900 downlink frequency bands depending on the traffic density [10]. The next phase of the research work is to interface the voltage multiplier circuit through a matching network to the antenna at the input side and a low power device to power from the system at the output side to complete the RF energy harvesting system.

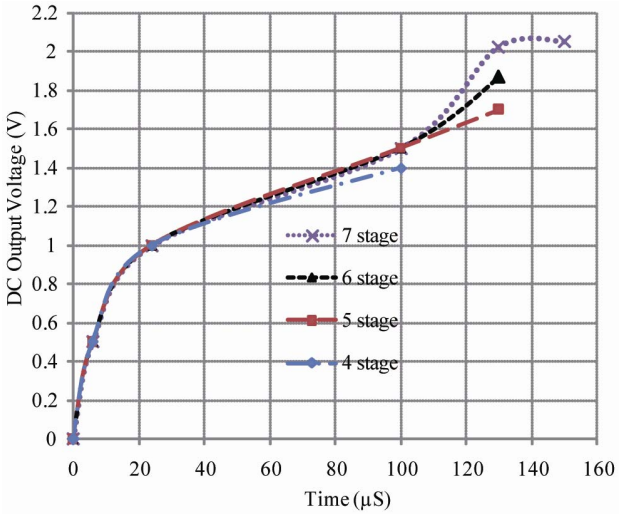

Figure 11. DC output voltage verses rise time of voltage doubler circuit through 4 - 7 stages with equal stage capacitance.

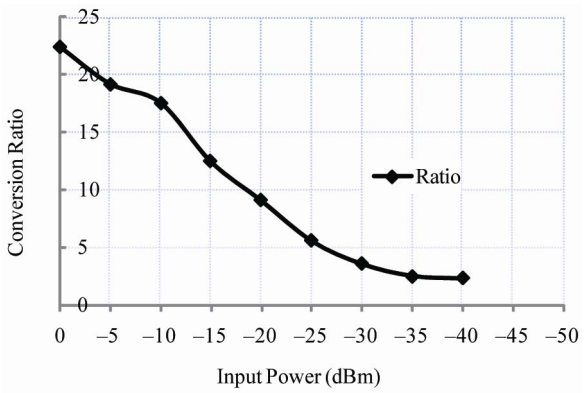

Figure 12. Conversion ratio as a function of input power.

6. Acknowledgements

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Homebrew at ACØC
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100W Speaker Amp
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2xSi570 RF Gen
SB200 Sleeper
SB-200 Tank Mods
High Perf Xtal Osc
CW-Skimmer Array
Leakage Tester
XR2206 Sig Gen
Fixed Bench PS
Dual Variable Bench PS
Station Interface
Speaker/Paddle Switching

RF Current Meter

Stop Guessing and Built This Simple Meter Making Measurements Easy to Take

Why a Hand Held RF Current Meter

There are two things that I wanted to do which would be made easy with a current meter... Both are related to the unusual nature of the antenna here at AC0C.

1. Checking common mode surface current on coax and control cables up in the attic antennas.

With the high cost of ferrites, placing them with the aid of a current meter is very helpful in that you can compare the before (no ferrite) and after (with ferrites attached) - and know that you have addressed the current problem on a given bit of line.

Otherwise, it seemed to me, that ferrite placement was more of a guess than a science.

2. Measuring relative antenna currents along an element

With the W8WWV RVM system, I can measure element currents where ever a current sensor is placed. This is typically at the center of a dipole element.

However, the center may or may not be the actual high-current point for the element depending on the frequency. My EZNEC models can indicate where the current peaks are - and by looking along these lines manually - comparing them with readings taken from the driven element, I can make current checks even in non-standard location of the array.

The meter described below accomplishes these two tasks very nicely.

Design Idea

The design follows an old RSGB design that I found on G3SEK's excellent web site:

http://www.ifwtech.co.uk/g3sek/clamp-on/clamp-on.htm

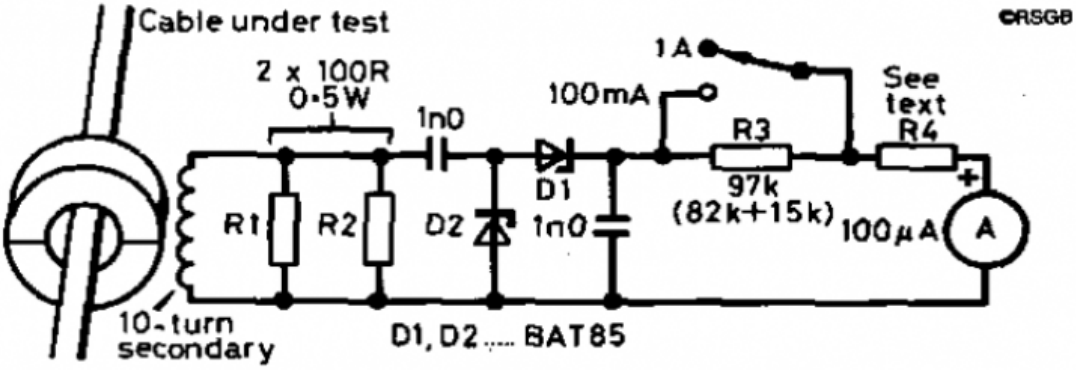

I followed this design pretty close except for the R3/R4 which I used variable trim pots. Due to the voltage-doubler nature of the circuit, it's capable of exceptional sensitivity.

The meter was calibrated for full-scale @ 1A on the higher scale, but I have left the lower scale set on a very high sensitivity setting which I find very handy for the common mode checking. Here, a sensitive meter providing a relative

current indication is needed.

Construction Details

Once parts were in hand, construction was very easy and took perhaps an hour.

No attempt was made to beautify the work - it's 100% orientated toward functionality and utility.

I had a 100 uA meter in the junk box along with the other parts needed and orienting them on the back-side of the meter was really the most time consuming aspect.

The switch is held in position with hot-glue. And a bit of hot glue is applied to the meter terminations as a safety precaution - just in case I were to brush the meter up against something carrying high levels of current.

Wraps around the toroid were made with wire-wrap type wire, 30 Gage.

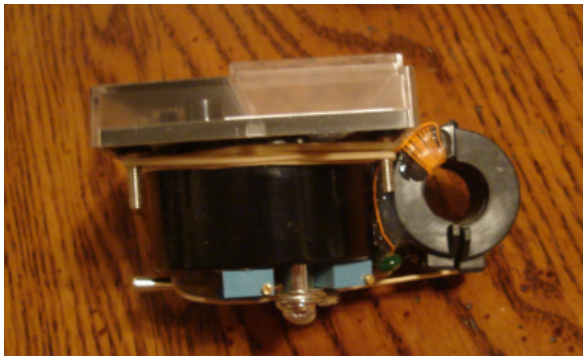

Selection of the toroid used was based on what would physically fit around the RG-213 sized cable and could be easily opened and closed.

The rubber band shown in the picture makes for a very convenient closing mechanism - and in a lot of applications, I simply hold the toroid closed with my finger pressure which makes moving the meter along a wire - and moving from cable to cable - very quick and easy.

For more ideas, check out Frank N4SPP's very nice RF current meter found HERE.

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Bread board Arrangement:

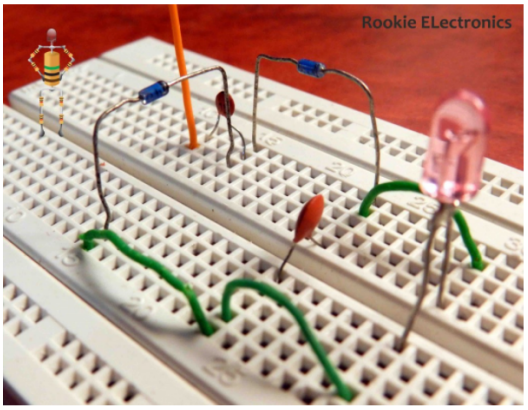

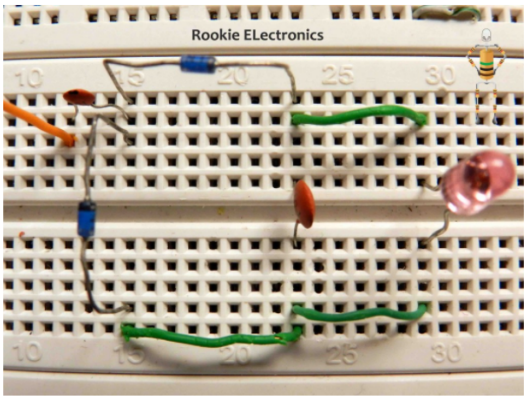

Strip Board:

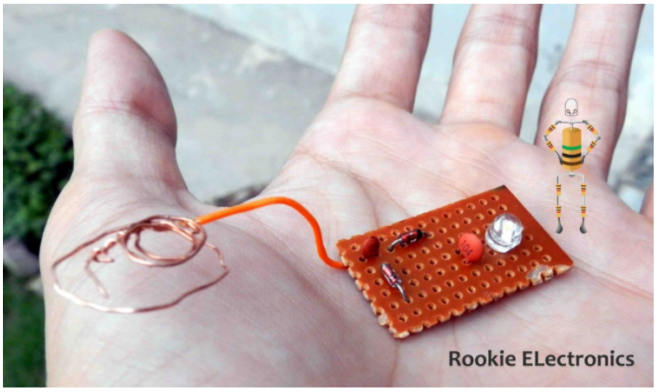

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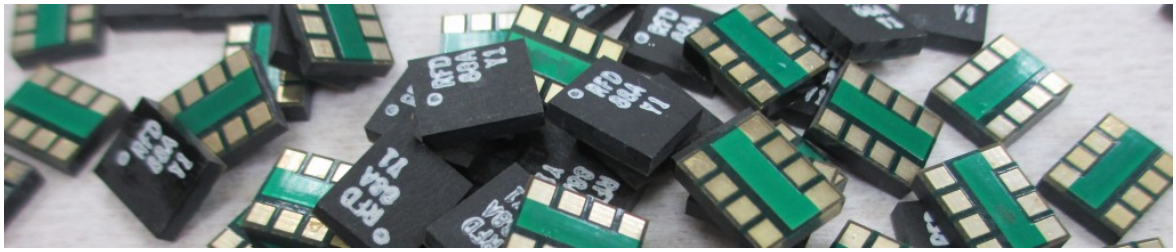

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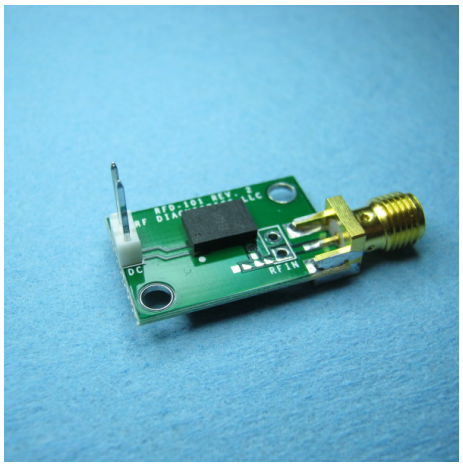

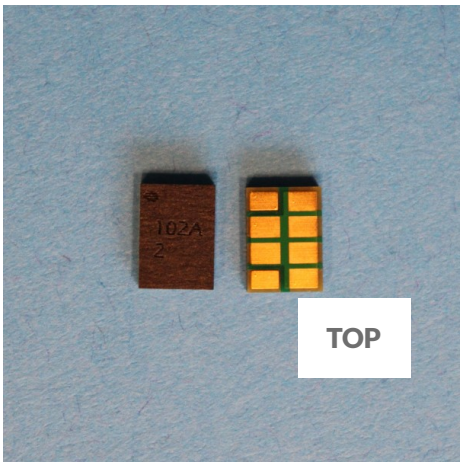

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Front End Module Design

We use Agilent's Advanced Design System and Orcad PCB Editor for Front-End Module designs. Previous design examples are high-volume switch filter modules, dual-band 802.11a/b/g front end modules, 76GHz car radar module, RFID card design.

RFID Detector System

On an NSF Phase I & II grant to one of our clients, operating as a subcontractor, the RF Diagnostics design team created a complete RFID MEMS resonator detection system. Both hardware and software were developed under this contract. The work was published at an SPIE conference in July 2010.

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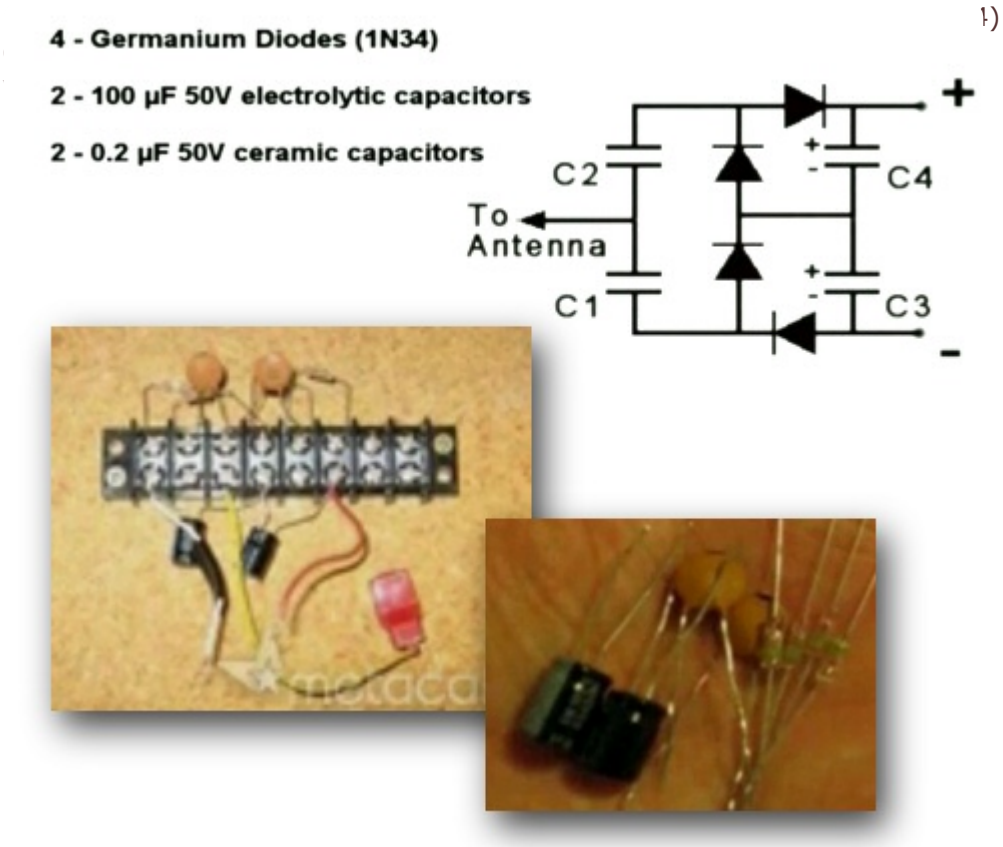

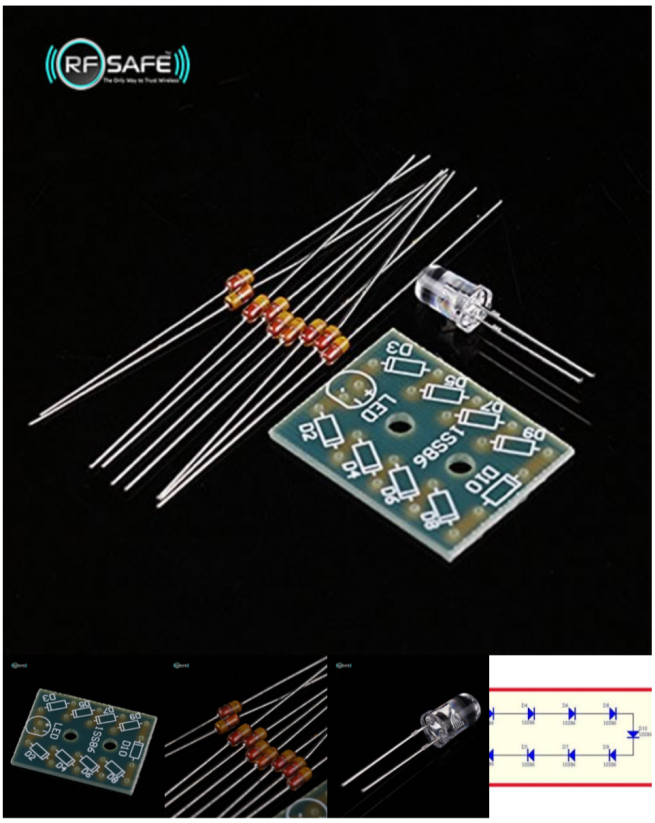

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A concurrent 915 MHz / 2440 MHz RF Energy Harvester

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This paper presents the development of two dual-band RF harvesters optimized to convert far-field RF energy to DC voltage at very low received power. The first one is based on a patch antenna and the second on a dipole antenna. They are both implemented on a standard FR4 substrate with commercially off-the-shelf (COTS) devices. The two RF harvesters provide a rectified voltage of 1V for a combined power respectively of -19.5 dBm at 915 MHz and -25 dBm at 2.44 GHz and of -20 dBm at 915 MHz and -15 dBm at 2.44 GHz. The remote powering of a clock consuming 1V/5µA is demonstrated, and the rectenna yields a power efficiency of 12 %.

Keywords: Antennas and Propagation for Wireless Systems, Applications and Standards (mobile, Wireless, networks), Circuit Design and Applications.

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I. INTRODUCTION

Today's the society is evolving toward creating smart environments where a multitude of sensors and devices are interacting to deliver an abundance of useful information. Essential to the implementation of this Internet Of Things (IOT) is the design of energy efficient solutions aiming toward a low-carbon-emission, namely green, society. Within this context, the energy harvesting appears as an alternative to provide systems with self-sustained operation. Many electronic devices operate in conditions where it is costly, inconvenient, or impossible to replace the battery. Examples include sensors for health monitoring of patients [1],[2], aircraft or building structural monitoring [3],[4], sensors in natural, industrial or hazardous environments, etc. The scavenging of natural ambient energy requires some specific conditions such as: daylight for solar energy [5], breeze for wind energy or motion for kinetic energy [6] to name a few. As consequences the exploitation of natural source does not fit with many cases of applications. On the other hand the electromagnetic (EM) [7], or Radio-Frequency (RF), energy is a human made source that is not dependent of weather conditions nor the daytime. It is so very attractive for wireless powering of remote devices. Furthermore the ever growing of commercial and personal wireless installations opens up to a 24 hour a day available energy in the vicinity of any human activity areas. The schematic of a general Wireless RF Power Transmission (WPT) system is shown in Fig.1. We talk here about far-field RF energy transmission [8], which is different from near-field RF energy transmission [9]. This later including inductive, capacitive or resonant coupling is a close contact transmission and is not relevant for remote devices. In Fig. 1, the receiver antenna

collects the EM energy radiated by a RF source, and converts it into a RF signal. This RF signal is transferred to the rectifier by an impedance matching network, to be converted into DC power, which is further accumulated in a storage element. The main purpose in the deployment of WPT systems is the development of compact and efficient solutions. Most of the challenge concerns the implementation of harvesting modules, especially the antenna as its design defines the scavenging capability and the size of the RF harvester. At low frequency the transfer of energy is efficient, but the antenna footprint is large. To address the trade off between the efficiency of the WPT and the size of the modules, the frequency band located in the 433 MHz to 6 GHz frequency spectrums are preferred.

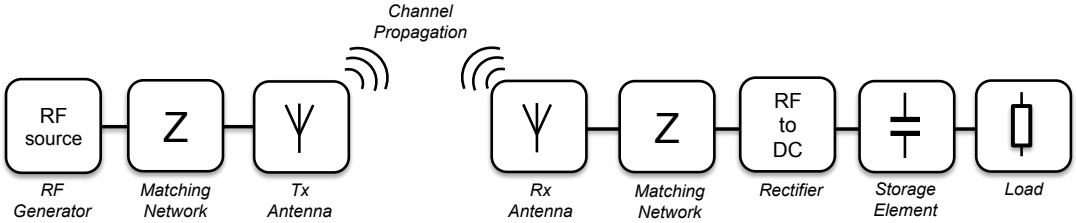

Fig. 1: Schematic of a Wireless RF Power Transmission (WPT) system

Over the last decade the research effort has focused on the development of WPT systems according two scenarios: the RF energy scavenging [10] and the RF energy transfer [11]. The two RF energy scavenging is an opportunistic collection of the RF ambient energy from the surrounding communication traffic. To improve the harvesting capability the scavenging RF harvesters are of wide-band type [12] and cover popular standards such as: DTV (470-610 MHz), GSM900, GSM1800, 3G (2.1GHz) and WiFi (2.4 GHz). Unfortunately these standards dedicated to convey wireless communications do not radiate a large RF power. As consequences the collected energy is weak, unpredictable and out of control. The RF energy scavenging remains a promising solution in the future as the increase of communication traffic could make it more reliable, and consistent with IOT applications. The second concept, namely RF energy transfer, assumes an identified source that is dedicated to perform the WPT. The amount of transmitted power is controlled by the source and the collected energy is larger than in scavenging approach. The licence-free Industry-Science-Medical (ISM) frequency bands located at 0.9, 2.4 and 5.8 GHz are usually exploited to support such a WPT scenario. Today the RF energy transfer in ISM Bands is not only promising, it becomes a reality as some pioneer companies propose some full kits: Powercast Corporation, AnSem and MicroChip to name a few. However there is still a lot of work to make the RF energy transfer an appropriate, low cost and easy-to-use solution for remote powering. One of the most critical point concerns the harvesting capability of the RF modules. So far the commercial kits referenced above only explore the 900 MHz ISM allocations to perform the WPT. This work proposes to demonstrate the interest of a concurrent harvesting at 915 MHz and 2.44 GHz. The design and implementation of a modified 4-stage doubler RF to DC converter, including a concurrent matching network, is first presented. The section III details the design of two types of multi-band antenna. The comparison between a single frequency and a multi-band WPT is exposed and the demonstration of the remote powering of a clock is reported as a case of application. To conclude a comparison of our results with the state of the art is exposed.

II. CONCURRENT RF TO DC CONVERTER

The Radio-Frequency IDentification (RFID) applications are the most popular systems exploiting the principle of RF energy transport. In passive RFID applications the reader transmits the RF power to the tag, and also sets up the communication. The RF to DC converter is designed to yield a maximum of power efficiency to the tag. Most of the time the reader and the tag are in line of sight and close to each other, these conditions improve the transmission of RF energy, the amount of power available at the tag antenna is large, typically between -15 dBm and -20 dBm. In RF energy harvesting the scenario is different. The distance between the RF source and the RF harvester ranges from 0.5 meter to 10 meters. The amount of collectable power is low, from -10 dBm to -25 dBm, and the remote powering is difficult. The RF harvesters are supposed to collect and to store the energy during a long period of time. Once the level of stored energy is large enough, it can be released to the application. For these reasons a rectifier dedicated to RF energy harvesting is first designed to yield a maximum of sensitive to increase its scavenging time and capability.

A) Rectifier Architecture

The rectifier architecture is based on voltage multipliers to provide an adequate output DC voltage. The architecture of the RF to DC converter, reported in Fig.2, includes a matching network based on a L-section, and a N-stage voltage multiplier based on Schottky diodes from Avago (HSMS285). The choice of the Schottky diode is very important in the design of the rectifier. A key parameter is its threshold voltage $V_{TH.}$ When only low power levels are available in the environment, the amplitude of the incident signal may be close to or even below this voltage. Below this voltage value, the diode will no longer conduct and the losses become predominant. For COTS devices the two Schottky diodes performing the best conversion efficiency in a 2.4 GHz range are HSMS-2850 from Avago and SMS-7630 from Skyworks [13].

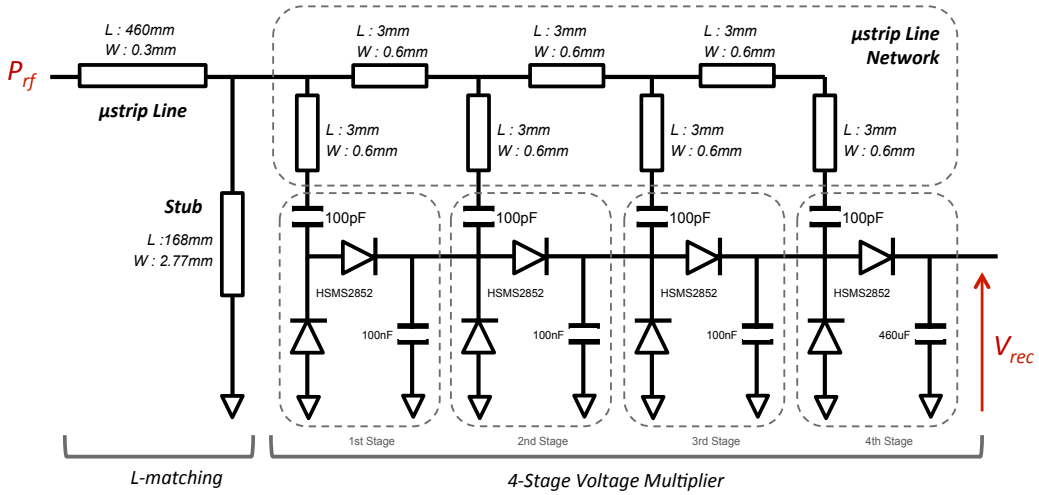

Fig. 2: Architecture of the RF to DC converter

Focusing on the sensitivity, the RF to DC converter is designed to maximize the rectified voltage for an input power close to -20 dBm. The optimum number of stage is fixed to four according [14]. The footprint of each voltage doubler imposes the micro-strip line network. The micro-strip lines namely "junction" is set to minimum length, the micro-strip lines "access" are used as an additional degree to tune the input-matching network. Indeed, the L section in combination with the micro-strip distributed network is equivalent to a T section (Fig.3). Many combinations of Z_1, Z_2, Z_3 can achieve input matching at 900 MHz or 2.4 GHz. Some of them are very close for each frequency, so we choose one that allows a return loss (< - 10 dB at least) both at 900 MHz and 2.4 GHz.

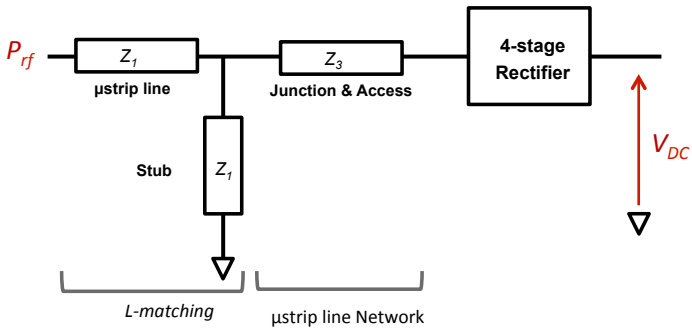

Fig. 3: Topology of the input-matching network

The equivalent narrow band model of the matching network is proposed for each frequency (Fig.4). At 915 MHz, the voltage multiplier, including the rectification stages and the micro-strip line network, is modelled with a shunt capacitor (5pF) and a shunt resistor of 270 Ω (Fig.4a). The stub, (Fig.3) is equivalent to an inductor (Fig.4a), which compensates the shunt capacitor. The input micro-strip line, (Fig.3), is a quarter wave impedance transformer, (Fig.4a) it converts the 270 Ω into 50 Ω. At 2.44 GHz the micro-strip line network distributing the RF signal to the voltage doublers (Fig.3), becomes inductive (Fig.4b). The stub is equivalent to a shunt capacitor of 120fF, its effect is negligible. The impedance transformation is actually performed by the input micro-strip line, which is modelled by a shunt capacitor (0,6 pF) and a series inductor of 5.6 nH.

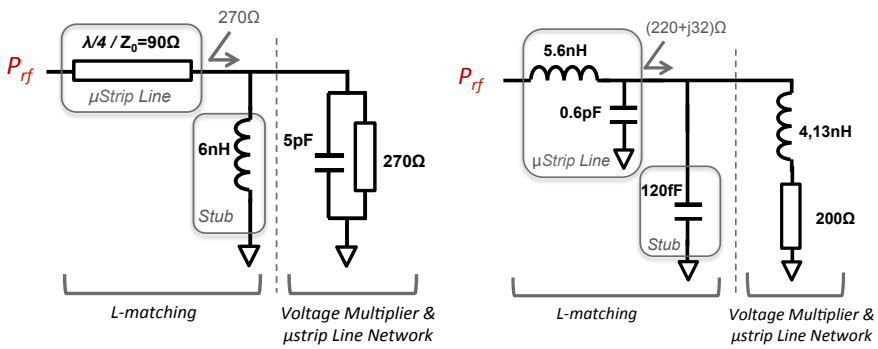

(a) *(b)*

Fig. 4: Equivalent model of the input matching network at 915 MHz (a) at 2,44 GHz (b)

To study the impact of the power on the diode, and input matching, behaviour the return loss of the 4-stage rectifier has been measured and plotted (Fig.5) for various input power P_{rf} at 9000MHz.

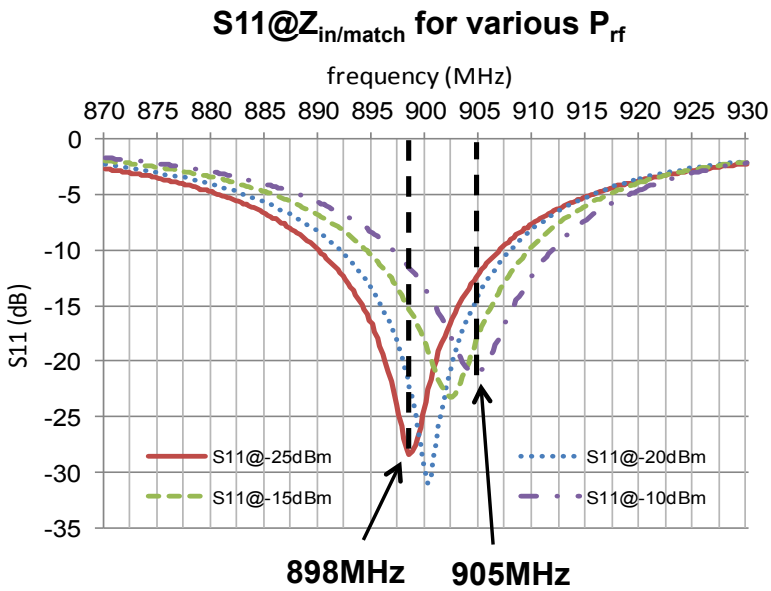

Fig. 5: Measured S_{11} of a 4-stage voltage multiplier with a L section at 900 MHz for various input power P_{rf}

As illustrated in the figure 5, the input return loss is not strongly affected by the input power if P_{rf} < -15 dBm. The RF harvesters developed in this work are dedicated to collect power from – 15 to – 25 dBm. Over this range the diode model can be considered as stable, and the slight frequency shift is still covered by the antenna bandwidth.

B) Rectifier Characterization

The power efficiency and the power sensitivity are two conversion characteristics of importance in RF harvesters. However, the RF harvester operating at low power level accumulates the energy in a storage element, to further release it to the application. In such accumulation mode the power sensitivity becomes more important than the power efficiency.

For the characterization the rectifier is not connected to a load. The load represents the equivalent impedance of the application (clock, sensor) to power. The effectiveness of RF-DC conversion of the rectenna and its DC ouput voltage varies depending on the load value. The rectifier is first characterized in a single tone mode, 915 MHz and 2.44 GHz respectively, and then in a dual-band mode. Measurements of the unloaded rectified voltage versus various input power P_{rf} are reported in Figure 6.

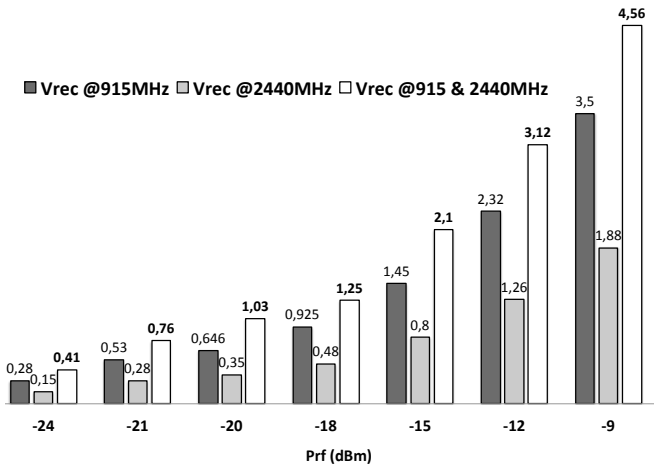

Fig. 6: Unloaded rectified voltage for various input power

To compare the results of the two considered tones, the target is fixed to a value of 1V. In a single tone mode, the required P_{rf} to rectify 1V is close to -18 dBm at 915 MHz, and would be larger than -15 dBm at 2.44 GHz. In a dual-band mode the circuit only needs a power P_{rf} of -20 dBm at each frequency. The dual-band rectification significantly improves the power sensitivity. The reverse breakdown voltage of the HSMS285 Schottky diode limits the input power to - 9 dBm, for which V_{rec} is 4,56 V.

III. ANTENNA DESIGN

To meet the low-cost constraints, the RF energy harvester will be implemented on a single low cost substrate, an FR4 PCB. For the antenna, there are more efficient substrates with a higher permittivity to reduce the size of the antenna or a lower losses but their cost is much higher than the improved performance. These powerful substrates fail to build low cost energy harvesters. This section exposes the design of two dual-band antennas implemented on a 1.6 mm FR4 printed circuit board. The fabrication uses a mechanical etching process with a 200µm resolution. We have chosen two complementary antenna topologies with a directional and omnidirectional radiation pattern.

A) Dual - band patch antenna

Emitting and receiving antennas do not usually meet the same constraints. Mobile devices such as smartphones and tablets use compact antennas (ifa, pifa…) to address the trade off between performance and size. Base stations can afford large efficient radiating elements (omnidirectional or directional antennas depending on the application). For energy harvesting purpose, micro-strip patch antennas are commonly used [15-17]. A rectangular micro-strip patch antenna (RMPA) is first developed to suit with both low cost technology of implementation and co-integration with the rectifier. Based on the cavity-model approximation, the resonant frequencies of the RMPA for the TM_{mn} mode is described in (1).

$$f_{mn} = \frac{c}{2\sqrt{\varepsilon_r}}\sqrt{\left(\frac{m}{L}\right)^2 + \left(\frac{n}{W}\right)^2} \quad (1)$$

W, L are the patch dimensions, c = 3.10^8m/s

The antenna dimensions, 68 cm^2 (8.8 x 7.8 cm), described Fig.7a are dependent to the frequency bands and the feed location is selected to only excite the fundamental modes TM_{01} and TM_{10}. Those modes permit to obtain a large aspect ratio (W/L = 2,7) but reduce the performance of the RMPA. On the other hand, TM_{01} and TM_{30} modes require an aspect ratio close to one but offer beneficial radiation patterns for our application. The RMPA is fed by a probe whose position (x,y) adjusts the matching both at 915 MHz and 2.44 GHz. This two operating bands of the proposed antenna are on cross polarization planes. The geometric parameters of RMPA have been optimized with an approximate model, the TL model [18], and with a full wave method. Details of the two approaches have been studied in [19]. The return loss of the RMPA is better at 915 MHz than 2.44 GHz because the maximum impedance of TM30 mode is 31 Ω [19]. The TM30 mode does not achieve 50 Ω because it is not a fundamental mode. This antenna has a maximum gain of 1.3 dB at 915 MHz (Fig.7b) and 2.5 dB at 2.44 GHz (Fig.7c). This two operating bands of the proposed antenna are on cross polarization planes.

The realized gains of the dual band patch antenna are lower than the classical patch antenna because the radiating efficiency is low, 60% for the TM_{01} mode and 30% for the TM_{30} mode. The FR4 substrate has a loss tangent of 0.02. The radiation efficiency of the dual band patch antenna is highly dependent of the substrate losses.

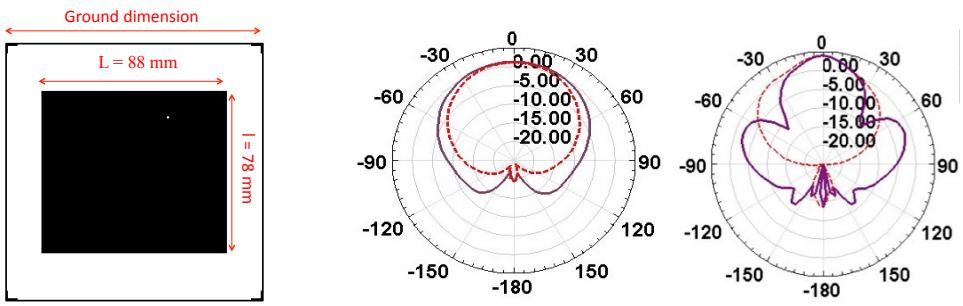

(a) *(b)* *(c)*

Fig. 7. Layout of the RMPA antenna (a) - Radiation pattern at 915MHz (b) and 2.44 GHz (c) Solid and dashed lines correspond to E-plane and H-plane respectively

B) Multi-band arm dipole antenna

The second antenna is a multi-band dipole type composed of three arms. Its dimension is about 23 cm^2 (11.1x2.1 cm), Fig.8a. Each arm is designed to work at one band of frequency. The longer one is for the 915 MHz, the middle one, not useful in our case, is for the 1.4 GHz and the last one, the smaller, is dedicated to 2.4 GHz [20].

All the geometric parameters have been optimized with a full-wave method in order to be matched both at 915/ 2440MHz. On Fig.6b and 6c, the radiation pattern is plotted for the elevation plane (orthogonal to substrate) of the simulated antenna. The maximum gain is 0.5 dB at 915 MHz and 3.4 dB at 2.44 GHz at 90°, on the substrate plane. The radiation efficiency is 99% at 915 MHz and 95% at 2.44 GHz.

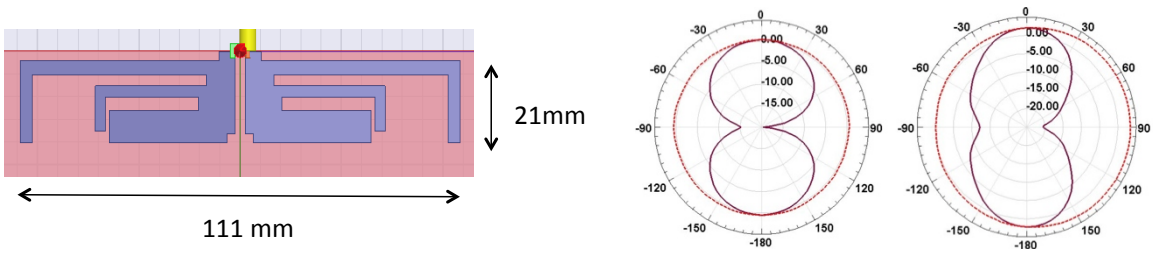

(a) *(b)* *(c)*

Fig. 8. Layout of the multi-band arms dipole antenna (a) - Radiation pattern at 915 MHz (b) and 2.44 GHz (c). Solid and dashed lines correspond to E-plane and H-plane respectively

It is interesting to compare the characteristics and performances of the two types of antennas. Although the radiation efficiency of the dipole antenna is better than the patch antenna, the antenna gains are similar because the high directivity of the RMPA antenna compensates the low values of radiation efficiency. When there are no cost constraints, it is interesting to use high performance substrates for the design of RMPA antennas because they improve the radiation efficiency and consequently antenna gain.

Moreover, the integration of the antenna with the rectifier will not be made in the same way. Considering the patch antenna, the rectifier can be integrated on the ground plane allowing a more compact solution. The dipole antenna, which is ground plane free, is less sensitive to the surrounding environment in our case. The performance of the dipole antenna and especially the radiation efficiency are very weakly dependent of the substrate characteristics. The design of a dipole antenna can be easily reuse with other material such as Kapton®, paper, Plexiglas to name a few.

IV. WIRELESS POWER TRANSMISSION

This part presents the measurement results of the assembled RF harvesters in the context of Wireless Power transfer. The two dual-band harvesters are realized with COTS devices such as HSMS diodes and capacitors. Those elements are reported by heat-treating. The RF to DC converter board, including the matching network and the rectifier, is reported on the backside and connected to the radiation part, on the front side, through a via (Fig.9a). The dipole antenna is connected to the rectifier circuit using SMA connector (Fig.9b).

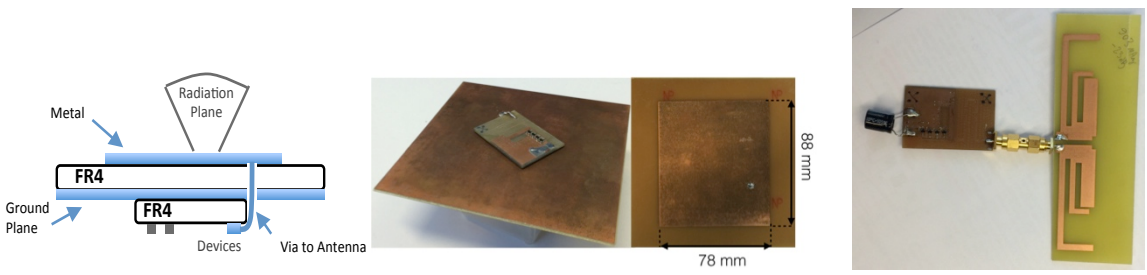

(a) *(b)*

Fig. 9. Dual-band RF harvesters based on patch antenna (a) – arms dipole antenna (b)

For the dual-band RF harvester based on patch antenna, the return loss, S_{11}, is measured for an input power of -20 dBm with a HP8720 network analyser. The patch antenna, the rectifier and the dipole antenna are centered at 915 MHz and 2.44 GHz with a low return loss ($S_{11} < -15$ dB), Fig.10. The return loss of the RMPA antenna is better at 915 MHz than 2.44 GHz because the maximum impedance of TM30 mode is 31 Ω (Fig. 6 and Fig. 7 of [16]). The TM30 mode does not achieve 50 Ω because it is not a fundamental mode.

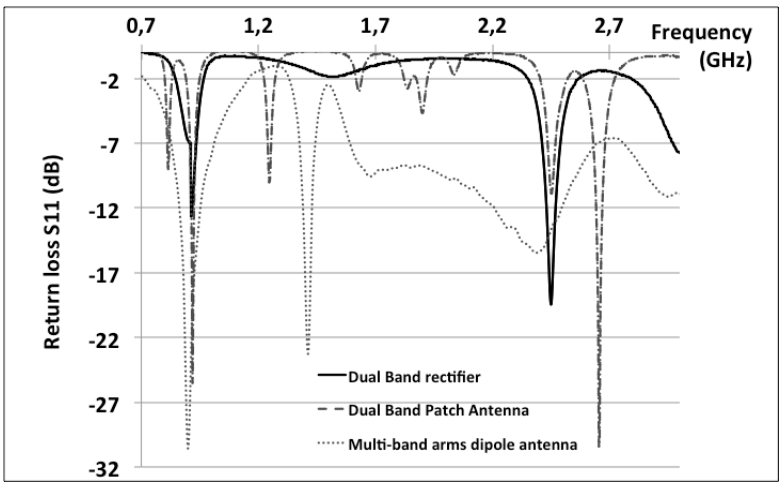

Fig. 10. Measured return loss S_{11} of the dual-band rectfier, patch and arms dipole antenna

A) Remote Powering and Power Efficiency

The rectenna is connected to a clock, which mimics a low power application. The remote powering of this clock is performed in a furnished room of the lab according the schematic of Fig.11. The distance between the source and the antenna is fixed to 2 m. The clock is turned on for different scenarios of transmitted power. For each combination of power proposed in Fig.12, the RF power is first measured with a calibrated antenna and a power meter. Then, the rectenna is measured and P_{eff} is the ration between the power delivered to the load (here the clock) and the power available at the antenna.

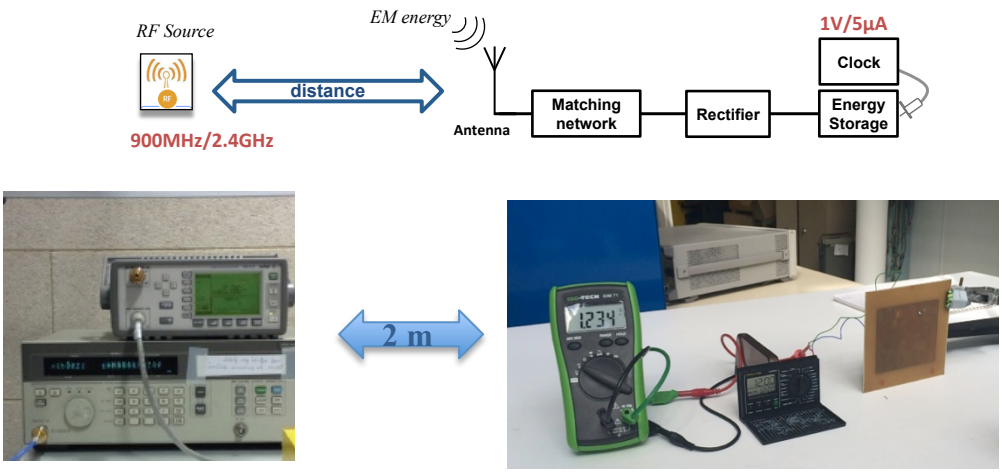

Fig. 11. Schematic and picture of the scene of remote powering of a clock

The power efficiency of the patch and the dipole rectenna is worked out from these experiments and reported in Fig.12. The power efficiency η is defined as the ratio between the DC power delivered to the clock and the RF power collected by the antenna.

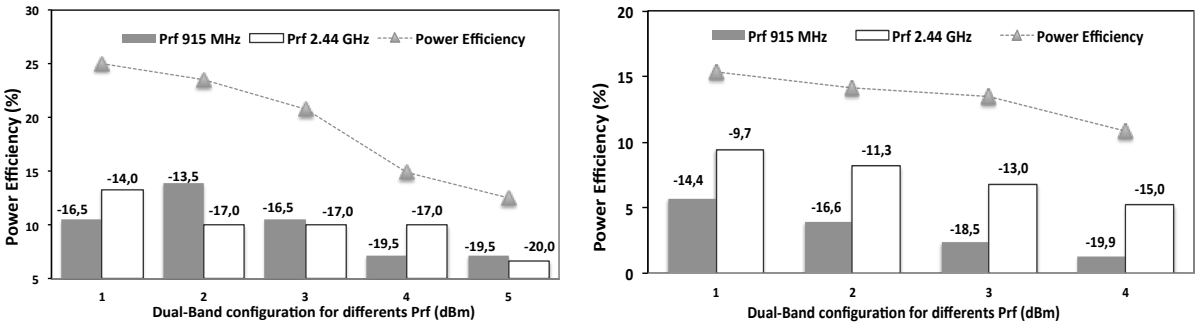

(a) *(b)*

Fig. 12. Power efficiency of the dual-band RF harvester based on the patch (a) and the arms dipole (b) antenna

The minimum power required to turn on the clock with the patch-based harvester, Fig. 10.a, is a two tone signal featuring: -19.5 dBm at 915 MHz and -20 dBm at 2.44 GHz. At this point, the power efficiency is 12.5 %, which corresponds to a DC output power of 2.7 µW/1V.

A maximum efficiency of 24 % occurs for a combined power of -16.5 dBm at 915 MHz and -14 dBm at 2.44 GHz. The harvester is able to deliver a DC ouput power of 15 µW. The harvester based on the arm dipole antenna needs a minimum power of -19.9 dBm at 915 MHz and -15 dBm at 2.44 GHz at the antenna to turn on the clock. For these conditions of remote powering, the efficiency of the harvester is 11 %. It delivers a DC power of 3.8 µW/1.15 V. The maximum power efficiency, 15.5 %, yields for an input power of -14.4 dBm at 915 MHz and -9.7 dBm at 2.44 GHz, the DC output power is 21 µW.

This scenario of remote powering figures out that the harvester based on the patch antenna exhibits a better power efficiency than the harvester combined with the dipole element. This difference is due to the antenna gains. Referring to Fig. 7 and Fig. 8, the gain of the patch antenna is larger (+0.8dB) at 915 MHz and lower (-0.9 dB) at 2.44 GHz than the dipole element. However the rectifier, referenced in [16], achieves a power efficiency of 17% at 915 MHz and only 5% at 2.44 GHz for an input signal of -15 dBm. As consequences the patch-based harvester is able to extract more power from a 915 MHz signal than the dipole-based harvester can do at 2.44 GHz. For this reason the overall efficiency of the patch harvester is better.

B) Power Sensitivity

The power sensitivity is measured with the same scenario of Fig.11 but the clock is disconnected. The output voltage is reported for different combination of collectable power at the antenna in a dual-band configuration.

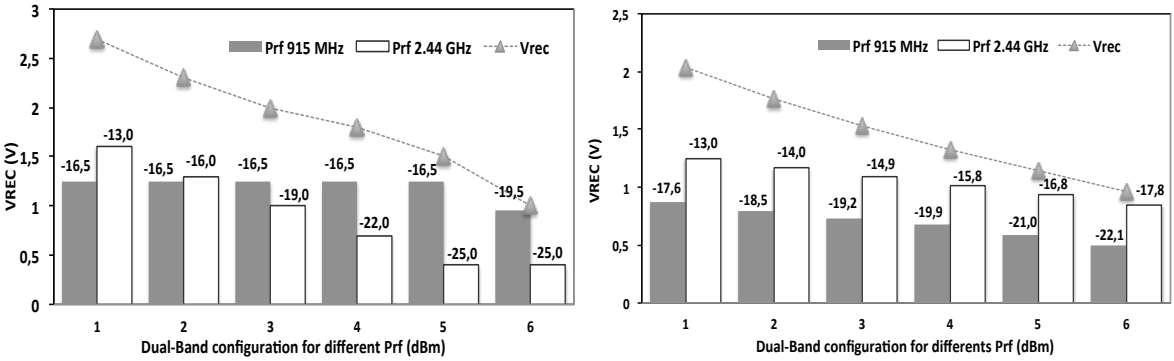

(a) *(b)*

Fig. 13. Rectified voltage of the RF harvester based on patch (a) and arm dipole (b) antenna

To rectify a 1V DC voltage, the patch-based harvester, Fig.13a, requires a two dual-band configuration: -19.5 dBm at 915 MHz and -25 dBm at 2.44 GHz, which is equivalent to an input power of -18.4 dBm (or 14 µW). For the same purpose the dipole-based harvester, Fig.13b, needs a dual-tone of -22.1 dBm at 915 MHz and -17.8 dBm at 2.44 GHz. The equivalent input power of this 2-tone signal is -16.5 dBm (or 22 µW). The patch-based harvester exhibits a better sensitivity than the dipole harvester for the same reason exposed in the part A of this section. In Fig.6, which reports the power sensitivity of the rectifier part only, the overall sensitivity is almost the same for the dipole harvester. It is improved by 1.8 dB for the patch harvester due to the additional gain of the antenna at 915 MHz.

C) Discussion and Comparison with the state of the art

An important characteristic of a remote powered device is its size. Indeed it is expected to be as small as possible to make it unobtrusive to our closest environment. In a scenario of RF harvesting the antenna footprint determines the compactness of a harvester operating Ultra High Frequency (UHF) bands. To complete the comparison between the two harvesting modules developed in this work, two figures of merit, FOM_{sens} and FOM_{eff}, including the size of the antenna, are proposed in (2) and (3).

$$FOM_{sens} = \frac{V_{REC@Psens}(V)}{\frac{P_{sens}(\mu W)}{100\mu W} \cdot \frac{A_{ant}(cm^2)}{100cm^2}} \quad (2)$$

With: P_{sens} the input RF power required to provide $V_{REC@Psens}$ the unloaded rectified output DC voltage, and A_{ant} the area of the antenna.

$$FOM_{eff} = \frac{\eta(\%)}{\frac{P_{eff}(\mu W)}{100\mu W} \cdot \frac{A_{ant}(cm^2)}{100cm^2}} \quad (3)$$

With: P_{eff} the input RF power required to achieve η the overall power efficiency.

FOM_{sens} and FOM_{eff} do not represent the same scenario of application. The FOM_{sens} illustrates the capability of the rectenna to start collecting energy and store it in an element such as a capacitor or a battery to further release it. FOM_{eff} demonstrates the capability of the RF harvester to yield "on time powering": the rectenna is connected to an application and

supply it on time. Both are reported in the Table I, which also includes some references of the state of the art. The ability of the proposed rectenna to simultaneously operate in two frequency bands, significantly improves the power sensitivity.

Table I. Comparison with the state of the art

Ref.	Freq (GHz)	Efficiency (%@P_{rf})	Sensitivity (V_{rec}@Prf)	Number of stage	Schottky diodes	Size (cm^2)	FOM Sens	FOM Eff
[21]	0.9	15% @ -10dBm	0.75V @ -10dBm	1	SMS-7630	15×15	1.9	6.6
[21]	2.4	9% @ -13dBm	0.9V @ -13dBm	1	SMS-7630	15×15	1.25	8
[22]	2.45	10.5% @ -20dBm	0.075V @ -20dBm	1	SMS-7630	3.4×3.4	6.5	905
[23]	0.915/ 2.45	14%@ -20/-20	0,36V@ -10/-10	1	SMS-7630	6×6	0.5	185
[24]	1.8/2.2 /2.5	55%@ -10dBm	300mV@ -32dBm 3tones	1	SMS-7630	7×7	20	112
This work Dipole	0.915/ 2.44	**11% @ -20/-15dBm**	**1V @ -22/-18dBm**	4	HSMS-2850	2.1×11	**19.8**	**136**
This work Patch	0.915/ 2.44	**12.5% @ - 19.5 dBm/ -20dBm**	**1V @ -19.5dBm/ -25dBm**	4	HSMS-2850	7.8×8.8	**10.5**	**100**

According the Table I, the patch-based harvester exhibits the highest sensitivity to rectify 1V with a dual-tone featuring: -19.5 dBm at 915 MHz and only -25 dBm at 2440 MHz. The FOM_{sens} represents the trade-off between the sensitivity performances of a rectenna and the antenna area. The FOM_{eff} rates the efficiency performances to the antenna area. For these two figures of merit, the rectenna based on the multi-arm dipole element yields the best trade-off, both for FOM_{sens} and FOM_{eff}, compared to the patch-based solution. This dual tone and multi-arm dipole harvester is close to the work proposed in [24] which exhibits the highest FOM_{sens} reported so far in the literature to our knowledge.

V. CONCLUSION

The range of power collectable in a scenario of RF harvesting varies from -15dBm to -25dBm. To address this purpose the rectenna proposed in this work are optimized to operate at a RF input power close to -20 dBm (or 10 µW). To further improve the ability to collect the RF energy, these rectenna, developed with Schottky diodes HSMS285 from Avago, perform a concurrent harvesting in the 915 MHz and 2.44 GHz ISM bands. The harvester including a patch antenna implemented on a 1.6mm FR4 PCB achieves the highest sensitivity. It provides a 1V-rectified voltage for a dual-tone excitation of -19.5 dBm at 915 MHz and -25 dBm at 2.44 GHz. For these conditions of operation the rectenna yields a power efficiency of 12.5%. To take into account the dimensions of the haverster, two figures of merit, FOM_{sens} and FOM_{eff} including the size of the antenna, respectively related to the power sensitivity and the power efficiency are proposed. The rectenna developed with the arm dipole element exhibits the highest figures of merit. A case of application is proposed with the remote powering of a

digital clock consuming 1V/5μA. The patch based harvester turns on the device with a dual tone excitation at the antenna of -19.5 dBm at 915 MHz and -20 dBm at 2.44 GHz. For the same scenario the harvester connected to the multi-arm dipole element needs a power of -22.1 dBm at 915 MHz and -17.8 dBm at 2.44 GHz.

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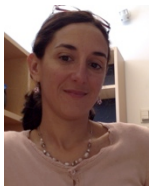

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Valérie Vigneras is a full professor in the Polytechnic Institute of Bordeaux and conducts research in the IMS Laboratory on complex structures (mixtures, structured media, self-assembled media) both by simulation to predict or optimize their properties and by characterization before their integration in high frequency systems (antennas, electromagnetic compatibility, radar shieldness…).

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Table I. Comparison with the state of the art.

Fun with Less Kilowatts: The Lectenna

By Vernon Trollinger, March 14, 2017, Energy Efficiency, Events & Fun, Family

Welcome to Fun with Less Kilowatts! We believe that science experiments at home can be a creative way to engage kids in learning while having fun. They can be educational AND great activities to keep your kids busy and away from the television. Each month, we'll feature a new science experiment that can be a great resource for parents and teachers.

The Lectenna

Did you know you that the energy from radio waves can be converted back into electric energy? It's true and you can make a *simple* two-component circuit that you and your kids can use to find 2.45 Ghz radio waves around your home. These are the same radio waves used by microwaves, WiFi network routers, bluetooth devices, smart phones, cordless phones, smart meters, and smart home systems that use Zigbee.

YouTuber pjaffeva posted this brilliant project showing how. Plus, there's also a link to a PDF set of instructions on Google Drive that you can download.

The Materials

- One HLMP-D150 Avago low current LED. Costs about 50¢/each. Available from: Amazon, Digikey, Mouser
- One Hitachi 1SS106 low capacitance Schottky diode. Pjaffeva recommends this Hitachi-made diode as being the only one in this shape that will work. But they're also hard to find. Currently, you can get them from LittleDiode's ebay store in the UK. Costs $6.38 but the bulk of that price is shipping from the UK.

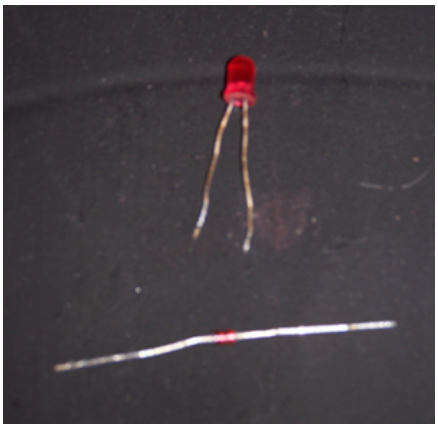

You'll also need:

- An operating WiFi router
- A bamboo kabob skewer
- Two pieces of tape

The Directions

1) Look on the base of the LED and find the side with the flat edge. This marks the negative or cathode side. Carefully splay the two wire leads away from each other as far as they will go. Make sure the one adjacent to the negative side gets bent over the flat edge so identify it. You can also mark it with a little spot of colored nail polish.

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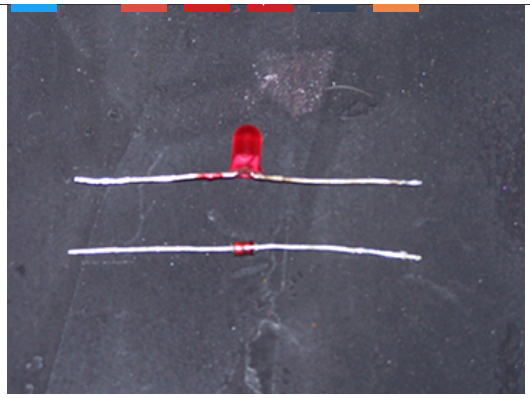

2) Next, find the band that runs around the Schottky diode. This identifies the negative end of this diode. The other end is the positive or anode end.

Using your fingers:

3) Twist the end of the negative or cathode wire from the LED onto to the positive or anode end of the Schottky diode.

4) Then twist the end of the negative or cathode end of the Schottky diode onto to the positive or anode end of the LED.

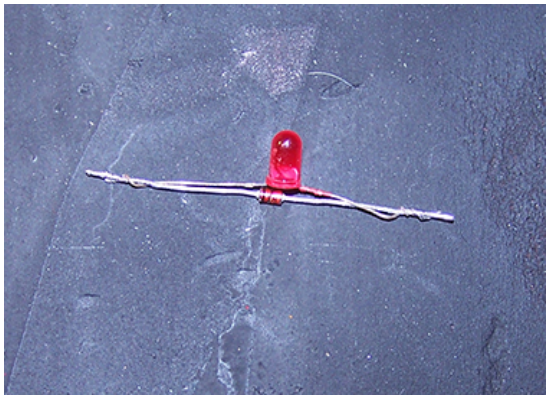

You have just made a “rectenna” and you’ll need to keep the assembly and the wires straight as possible. The length of the wires should be about 6 cm long (a hair short of 2 3/8 inches).

5) Tape the two diodes to one end of the bamboo skewer.

6) With a WiFi router on and running, hold the diode near an antenna on the WiFi router.

The Result

The LED should light up as it draws closer to the antenna (signal). The further away it is, the weaker the signal and the less it can grab to light up.

The Science

The WiFi routers uses radio waves to transmit data to and from computers and other devices in your home. Radio waves behave like water in a glass, they ripple or oscillate at a certain number of times or frequency per second. A radio wave’s wavelength is the distance covered by one complete cycle of a radio wave — from peak to valley.

Radio waves used by WiFi routers, bluetooth devices, microwaves, etc., broadcast signals in the 2.45 gigaherz (Ghz) range or 2.45 billion oscillations per second. That means the signal wavelength is about 12 cm. To pick up signal, however, you only need an antenna that’s half as big – 6 cm. When the radio waves strike this antenna, called a 1/2 dipole (“di”=two), the energy excites the antenna’s

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The "Rectenna": Because the radio waves cause voltage to flow one direction and then the opposite direction, the current is called an alternating current (AC). By connecting a diode to both poles of the antenna it converts the AC current to flow only in one direction, called direct current (DC). The antenna becomes a "rectenna".

How the diodes work: The diodes work as one-way valves for electricity, allowing voltage to flow forward but not back. In the case of the rectenna, AC current caused by the radio wave sends a positive charge down one of the antenna poles and then the other. By putting the Hitachi 1SS106 diode across both poles, the diode only lets the positive charge coming down one of the antenna poles through. The LED is actually a Light Emitting Diode and works the same way as a regular diode except that when it's on, it lights up. Meanwhile, Schottky diodes turn on at a lower voltage than other diodesand because the rectenna can only catch a fraction of the WiFi's broadcast power, the Schottky diode can rectify that little bit of AC to DC.

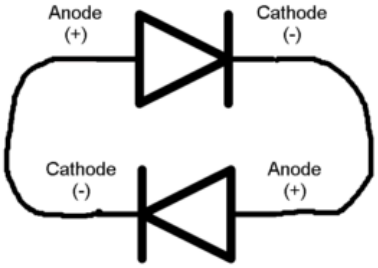

When we connected our diodes together, their polarity formed a loop that only allowed voltage to flow one way and thus light the LED. Brilliant job, pjaffeva!

Do you have any fun and kid-friendly science experiments you'd like to see us try for Fun with Less Kilowatts? Share with us in the comments!

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About Vernon Trollinger

A native of Wyomissing Hills, PA, Vernon Trollinger studied writing and film at the University of Iowa, later earning his MA in writing there as well. Following a decade of digging in CRM archaeology, he now writes about green energy technology, home energy efficiency, DIY projects, the natural gas industry, and the electrical grid.

Tags: family fun, Fun with Less Kilowatts, kids, science experiments

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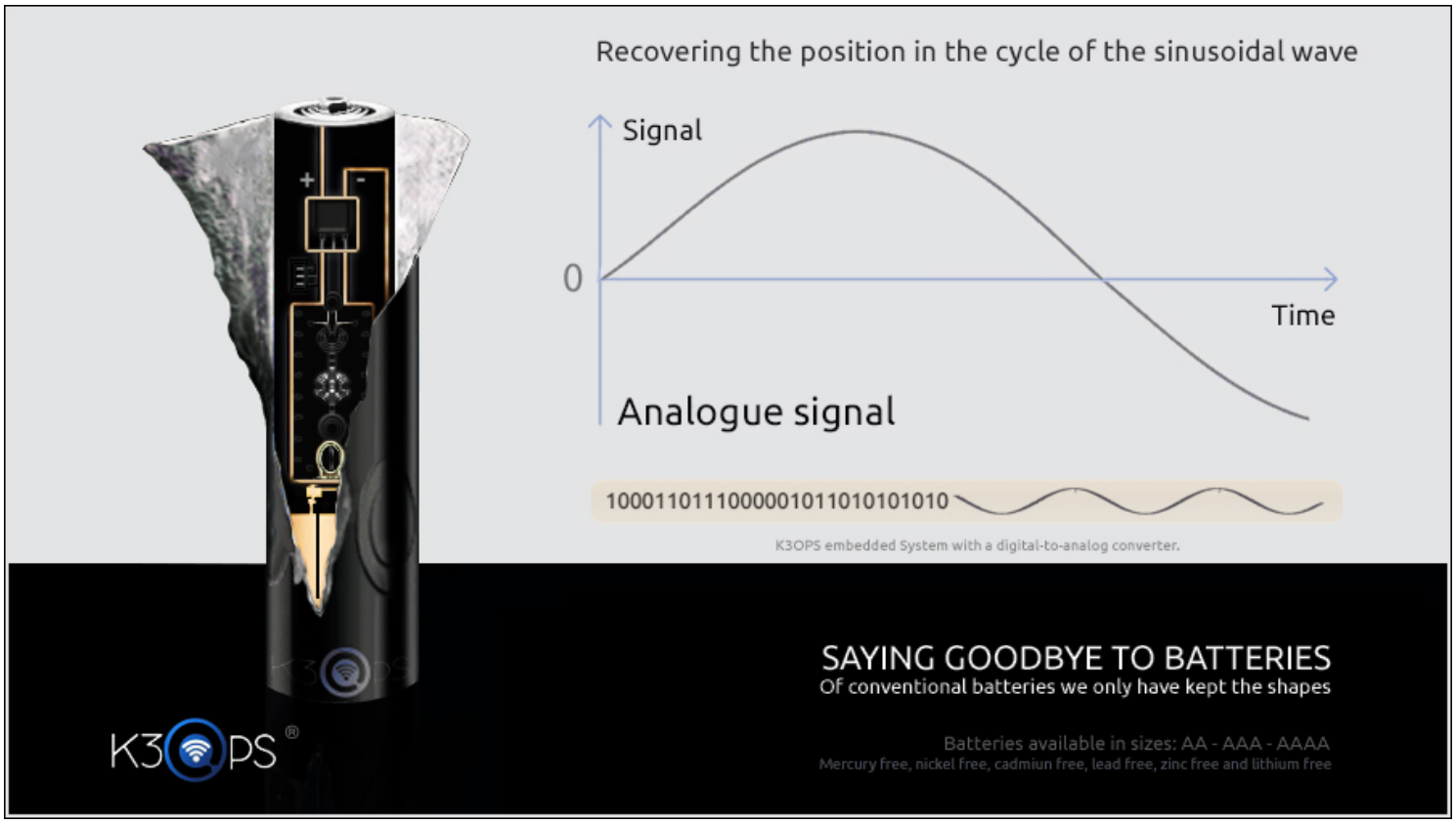

An electromagnetic field uses the photon as an elementary particle to transmit force. It combines:

- **A magnetic field** *force resulting from the movement of loads µT.*
- **An electric field** *force created by the attraction of repulsion loads, measured in volts per meter - V/m.*

With an energy determined according to the speed of light, the RF are by far the best medium to transmit any kind of information.

The multiplication of wireless communications systems in our environment ensures sufficient microwave leakages to harvest from the ambiant and enough energy to convert into DC electricity. Electromagnetic fields are everywhere and since they carry energy, they became the best candidate to deliver an endless source of renewable energy.

$\vec{B}$ is the magnetic induction expressed in T refered to **Nikola Tesla**, "Father of Free Energy", which is at the origin of the electromagnetism.

Using meta-materials combined with nanotechnology has deeply increased the performance and miniaturization of rectennas embedded in K3OPS system. Our products operate autonomously, offering an endless supply of green energy in a respectful and environment-friendly approach.

principles and beautiful sentences. At that point in time I would have simply been Xin, a child like any other...

But one day I dreamed. I woke up far away, somewhere else, in another past. I decided to change my destiny and even if I was supposed to become a mathematician, I eventually decided to create, because already as a child my heart was chasing the stars.

Of the hundreds of directions shown to me after graduating, only one captured my attention: a single goal... Build the impossible for a safer world. So, over the past 3 years, our real challenge to overcome for all RF Energy Harvesting technics was to optimize electricity conversion. The massive proliferation of wireless telecommunication systems since the past two decades brought a saturation of the electromagnetic fields with a constant growth of 15% every year in our environments. As a result, this situation reversed the base problem that makes today Harvesting RF Energy a game changer. The key was the Power Management System.

We are far beyond the conversion constraint and performance by controlling "RF-interferences", by harvesting different frequencies *from near and far*, by using Metamaterials combined with nanotechnologies. We dramatically have improved power conversion efficiency and reduced the size of our Energy Harvesting systems embedded in all K3OPS' products.

Thanks to Nikola Tesla, my inspiring mentor, K3OPS' products have reached by far their objectives in terms of converting and performance, offering an endless efficient source of green energy, reliable in an environmentally friendly approach.

Xin WEI Co-Founder of K3OPS technology with Alexandre Despallieres

K3OPS®

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The Rectenna was invented in 1964 by William C. Brown, patented in 1969. It is a rectifying antenna used to convert microwave energy into DC. A simple Rectenna consists of a dipole antenna with an RF diode connected across the dipole elements. The diode rectifies the AC current induced in the antenna to produce DC power.

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Centre for Collaboration in Electromagnetics and Antenna Engineering is a centre for research collaboration established to foster research in electromagnetics and engineering conducted by Macquarie University researchers and prominent collaborators from external institutions, including people from industry and overseas ins We have state of the art research ficilities including a NSI-700S-50 spherical nearfield anechoic chamber, 3 Vector Network Analyzers (capable up to 22GHz, 50GHz, anc respectively), state-of-the-art embroidery machine DreamCreator-XE-VM5100 for embroided antennas, Dielectric Characterization Kit - High Temperature Probe (2(20GHz), as well as several in-house and commercial licenced softwares.

Our recent and ongoing research projects are:

- Wireless Implantable Bio-Telemetry System and Miniature Antenna Design
- Wireless Freedom for Lab Rats
- Flexible and Wearable Antennas for Biomedical and Healthcare Applications
- Characterizing Properties of Carbon nano Tubes at Microwave Frequencies
- Electromagnetic Band Gap (EBG) Resonator Antennas
- Leaky-Wave Antennas for Advanced Wireless Systems
- Shared Aperture Arrays for Space Borne Applications
- Novel Dielectric Resonator Antennas
- Super Wideband Antennas
- Focal Plane Arrays for Radio Astronomy
- Archimedian Spiral Metamaterials
- Frequency Selective Surfaces for Energy-Saving Glass Panels
- Dual-Band Artificial Magnetic Conductor (AMC) Surfaces
- Antenna Technologies for Ultrawideband (UWB) Systems
- High Gain Antennas with Planar Surface-Mounted Short Horns
- Photonic Crystal/EBG Based Horn Antennas
- Broadband Microstrip Patch Antennas for Wireless Computer Networks
- Theoretical Analysis of Photonic Crystal Structures
- New Closed-form Green's Functions for Microstrip Circuits and other Layered Structures
- Integrated-design of Hybrid-resonator Antennas for Broadband Wireless and other Communication Systems
- Singularity-enhanced Finite-different Time-domain (FDTD) Method for Diagonal Metal Edges, Strips and Films
- Low-profile Dielectric-resonator (DR) Antennas

Wireless Implantable Bio-Telemetry System and Miniature Antenna Design

The two major challenges associated with the conversion of a wireless system operating in air to an implantable version, antenna detuning and biocompatibility, are a in a coherent way. An RFID-based biomedical telemetry system designed for free-space operation was chosen as the starting reference. A new, pin-compatible, spa antenna with a ground plane was designed, fabricated and tested, to replace the original “free-space” antenna in the active RFID tag without making any other chang tag circuit, such that the tag would function well when it is placed under rat skin and fat. Biocompatibility and potential antenna detuning due to rat tissue variati addressed in the design process, without significantly increasing the tag physical height, by applying a thin coating of biocompatible material directly over the ante operation of the medical telemetry system was successfully demonstrated, with the tag placed under rat skin and fat, and its range of 60-72 cm was found to be suf support medical research experiments conducted with rats in cages. Due to the biocompatible coating over the antenna, antenna matching is very insensitive to ch tissue dielectric constants and thickness. The footprint of the new antenna is 33% less than that of the original antenna, its measured 10 dB return-loss bandwidth is 1(11%, and overall efficiency is 0.82% at 920 MHz.

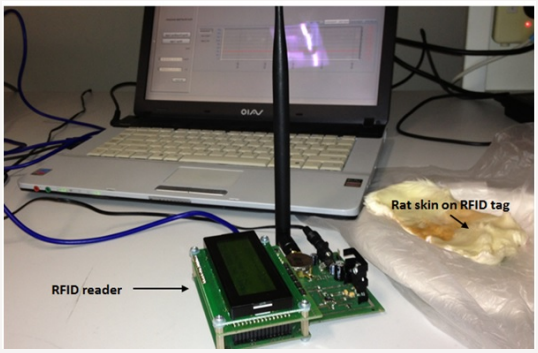

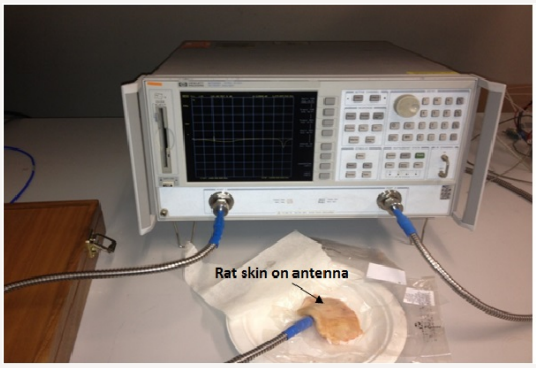

Wireless Freedom for Lab Rats

We are developing a fully implantable wireless telemetry system. This is a joint research project with BCS Innovations and the Australian School of Advanced Medicine (will be first used in the research conducted in ASAM, with rats, on hypertension. To date the major method of controlling hypertension is through the use o pharmaceuticals. The pathway to approval for most drugs for human use involves pre-clinical (animal) trials. Lab rats are considered biologically similar to humans, pa

in terms of their social behaviour. Therefore, it is very important to not compromise the pharmaceutical trials by unnecessarily stressing the rats by harnessing the monitoring equipment. One of the technical challenges of developing an implantable system that monitors the various signals, is the relatively small size requ implantable telemetry system is a miniature transceiver implanted in an animal that senses, processes and transmits data via a wireless link to monitor vital signals of c freely moving laboratory animals. This is crucial in giving researchers flexibility and reliability, especially in studies with special experimental settings using mazes wheels and treadmills. We have plans to develop a fully implantable telemetry system for subcutaneous or intraperitoneal placement in rats that monitors th parameters as well as blood pH and chemistry, nerve activity and circadian respiratory rate rhythms. The aim of this project is to eventually develop a system with e capabilities that costs less than what is currently available, to provide more universities and researchers with the opportunity to use this technology.

In this sequel, initially, when a module of our original system was placed under the skin of a rat, the wireless link failed completely. It could not send a temperature reac a centimetre! The point of failure was the commercial antenna in the module that had been designed to work outside the body, in air. Such antennas do not work unde because the electrical characteristics of skin (rat or human) are significantly different from that of air. Hence the main challenge was to design an antenna that works v placed under the skin. In addition, it was necessary to cover the module and the antenna by biocompatible material, which also affects antenna performance. Possible v of skin characteristics from one rat to another or one person to another were considered. Unlike the commercial antenna, we wanted our antenna to radiate less into th the rat/person and more away from the body because that not only increases the quality of the wireless link, maximum range (distance between implanted mo monitoring station) and battery life but also reduces the exposure of the body to radio-frequency waves. Indeed we had to consider the electromagnetic effects of fat a material around the antenna. We were able to meet all these requirements with a novel compact antenna design that is approx. one third the size of the original co antenna. We successfully demonstrated wireless telemetry transmission of temperature with the new module placed under rat skin and the monitoring station pl distance of up to 80 cm! This range is sufficient for our immediate target application supporting new medical research by Professor Paul Pilowsky's team. If necessary, further extended by increasing the power level at the monitoring station.

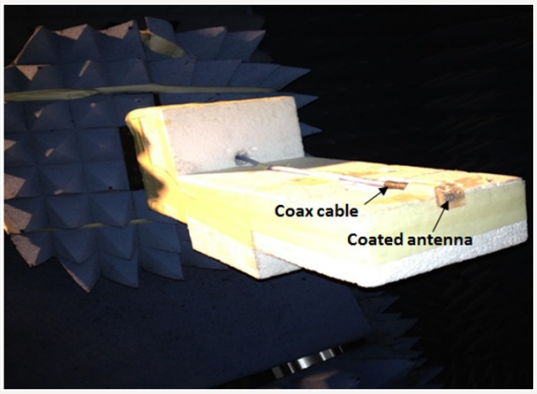

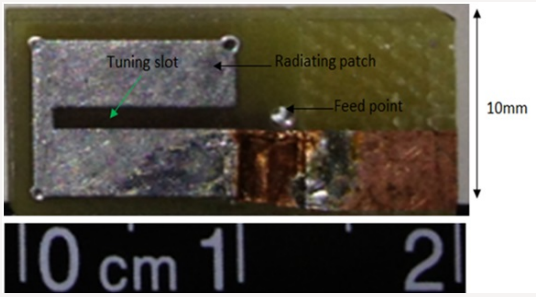

Flexible and Wearable Antennas for Bio-Medical and Healthcare Applications

Body Centric Wireless Communication is a rapidly growing research area targeted for medical, healthcare, public safety and defense applications. The need to address transceiver specifications and real-time scenarios in close proximity to human body is continuously evolving antenna system research. Several novel miniature antennas havi dual- and wide-band operations have been designed and tested for Wireless Body Area Network (WBAN). They have significant advantages of small size, wide radiation pat the human body for maximum coverage and are less sensitive to the gap variation between human body and antenna.

A compact ultra wideband antenna is shown below with strong notch-band rejections up to VSWR = 26, that is tunable over a wide frequency range from 3.55GHz to 6.8 been designed. To estimate the stub length to notch frequency for a given interfering application, analytical expressions for the normalized stub length which is indep substrate dielectric constant is also presented. This helps to avoid hit-an-trail method and gives a good estimate of initial design parameters for notch. Proposed antenna radiation patterns and yields a measured 10dB return-loss bandwidth from 3GHz to 10.5GHz.

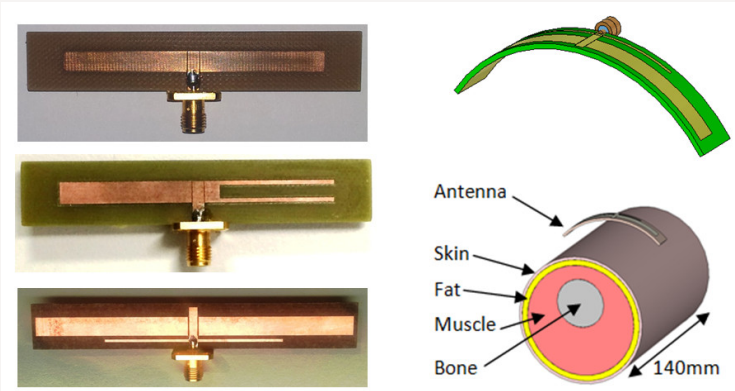

Characterizing Properties of Carbon Nano Tubes at Microwave Frequencies

Carbon Nanotube (CNT) yarns are novel CNT-based materials that extend the advantages of CNT from the nano-scale to macro-scale applications. We have modelled CNT potential data transmission lines. Test structures have been designed to measure electrical properties of CNT yarns, which are attached to these test structures using gold p testing and microwave S-parameter measurements have been conducted for characterisation. The observed frequency independent resistive behaviour of the CNT yarn promising indicator that this material, with its added values of mechanical resilience and thermal conductivity, could be invaluable for a range of applications such as B Networks (BAN). A model is developed for CNT yarn, which fits the measured data collected and agrees in general with similar data for non-yarn CNTs.

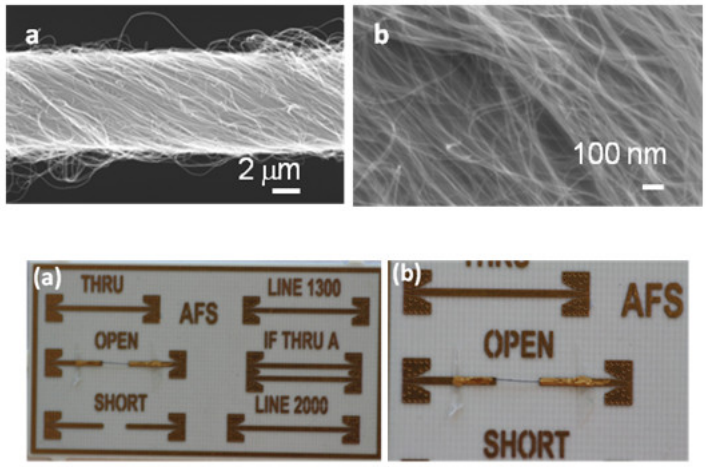

Electromagnetic Band Gap (EBG) Resonator Antennas (ERA)

We have designed, fabricated, and measured antennas based on 3D, planar and 1D EBG structures (i.e. photonic crystals). These flat microwave antennas, known as EBG antennas or Fabry-Perot cavity antennas, can give gains of about 20dB and very good efficiencies.

Enhancing Radiation Characteristics of ERAs by Improving Aperture Phase Distribution

This work focuses on achieving superior radiation characteristics of ERAs by improving their aperture phase distributions. A unique method, utilizing full-wave simula analytical analysis, has been developed to design Phase Correcting Structures (PCS) for ERAs. This method uses actual phase distribution on the physical aperture of ERAs relying on geometric optics. Several Phase Correcting Structures (PCSs) have been designed, which were later validated with the measurements of their fabricated p Tremendous improvement in the radiation performance is witnessed in both simulated and measured results. These exciting initial results validate our proposed method indicate an existence of a great potential to be explored. The figure below shows the field propagation above an ERA: (a) without PCS, and (b) with PCS. It is clear that the the PCS is much more uniform and the energy is focussed towards broadside direction, thus, resulting in increased directivity.

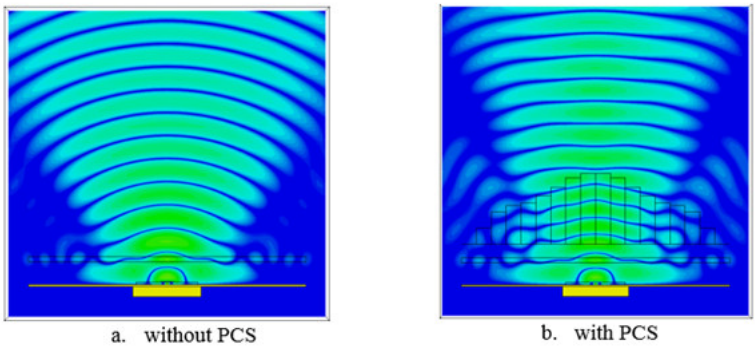

a. without PCS b. with PCS

Extremely Wideband High-Gain ERAs (Gain~15-20dBi, Bandwidths >50%)

In 2014-15, we invented an innovative class of electromagnetic band-gap (EBG) resonator antennas which provide high gain and wide bandwidth with an extremely footprint. One of the prototype developed has only 8% of the area as compared to conventional EBG resonator antennas but its performance (gain bandwidth) is a record hi for this class of antennas, while providing gain in the range of 15-20 dBi. This represents an improvement of nearly two orders of magnitude in the bandwidth compared to EBG resonator antennas. Thanks to its practical advantages of flat shape and low-cost manufacturability, it can be easily attached to a wall of a building, for example, to co building wirelessly to the National Broadband Network.

Our most recent results on such wideband high gain antennas can be found in: "Achieving high gain-bandwidth through flat GRIN superstrates in Fabry-Perot cavity antenn 2014 IEEE International Symposium on Antennas and Propagation (AP-S/USNC-URSI), pp. 1748 – 1749, Memphis, Tennessee, USA, July 6-11, 2014.

Detailed antenna design along with experimental data of another of our wideband EBG resonator antenna having composite multi-layer superstrate, is published in the pa "Wideband high-gain EBG resonator antenna with a small footprint and all-dielectric superstructures" in IEEE Transactions on Antennas and Propagation, vol. 62, no. 6, 201

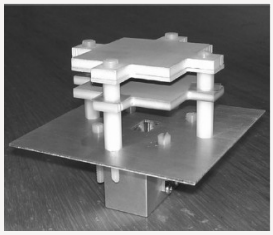

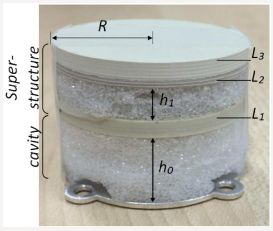

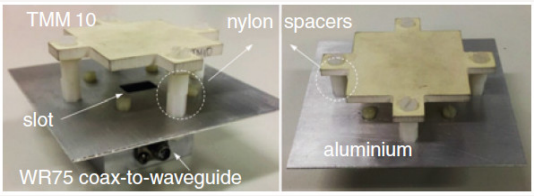

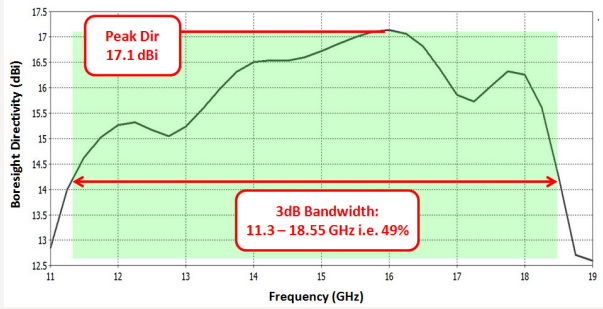

Frequency response of one of our Wideband ERA Prototypes

Simple Dual-Band ERAs

We developed a new method to obtain dual-band operation from a simple electromagnetic band gap resonator antenna. The antenna is based on a one-dimensional EBG made out of two low-cost unprinted dielectric slabs. The EBG structure is implemented as the antenna superstrate, which has been designed to provide a locally-inverted reflection phase gradient with high reflectivity, in two pre-determined frequency bands. The linearly polarised antenna design and experimental results are described in entitled: "A simple dual-band electromagnetic band gap resonator antenna based on inverted reflection phase gradient" published in IEEE Transactions on Antennas and Pro vol. 60, no. 10, pp. 4522-4529, 2012.

We have extended this concept for dual-band, dual-polarised and circularly-polarised antennas. We also designed a tri-band antenna following this concept. It needs only t cost unprinted dielectric slabs.

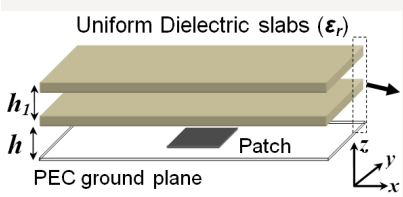

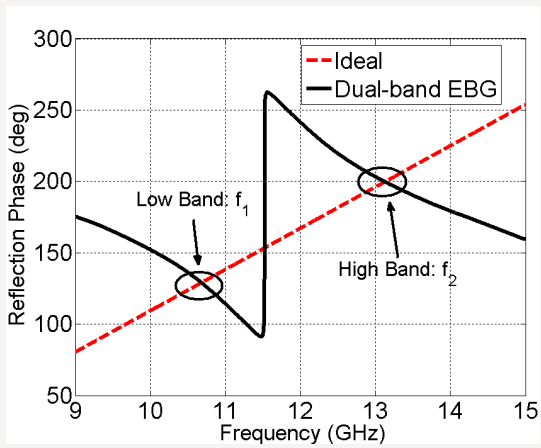

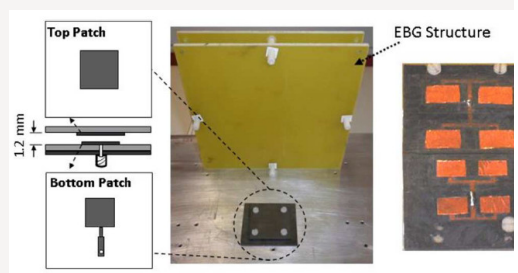

Low-Profile Wideband ERAs

We have designed and successfully tested wideband low-profile (thin) EBG resonator antennas. The breakthrough that contributed to this success is our design of a partially surface (PRS) with a positive reflection phase gradient. Thin single-dielectric-slab PRSs with printed patterns on both sides were investigated to minimise the PRS thickne simplify fabrication. Three such surfaces, each with printed dipoles on both sides, have been designed to obtain different positive reflection phase gradients and reflection r levels in the operating frequency bands. These surfaces, and the EBG resonator antennas formed from them, were analysed theoretically and experimentally to highlight t compromises involved and to reveal the relationships between the antenna peak gain, gain bandwidth, the reflection profile (i.e. positive phase gradient and magnitude) of th and the relative dimensions of dipoles. A small feed antenna, designed to operate in the cavity field environment, provides good impedance matching (|S11|< -10 dB) a operating frequency bands of all three EBG resonator antennas. Experimental results confirmed the wideband performance of a simple, low-profile EBG resonator antenna thickness is only 1.6mm, effective bandwidth is 12.6%, measured peak gain is 16.2 dBi at 11.5 GHz and 3dB gain bandwidth is 15.7%. Please find details in a paper entitled of Simple Thin Partially Reflective Surfaces with Positive Reflection Phase Gradients to Design Wideband, Low-Profile EBG Resonator Antennas," published in IEEE Tra on Antennas and Propagation in 2012.

Low-Profile Dual-Band ERAs

We have achieved dual-band operation in a low-profile EBGRA using a single dielectric superstate with a printed pattern only on one side. This also made use of our r inverting the gradient of the PRS reflection coefficient.

Woodpile EBG Material and Antennas

In 2003, we designed and built a woodpile 3D photonic crystal, also known as a EBG crystal, operating in microwave frequencies, and demonstrated experimentally the ex the electromagnetic band gap. The crystal is made out of cermain material.

Then we designed a planar EBG resonator antenna. Shown below, it has a resonant cavity between a ground place and a 3D woodpile photonic crystal. We employed both m and slots to feed the cavity, and investigated both linearly and circularly polarised antennas. The linearly polarised antenna design and experimental results are described in entitled "A planar resonator antenna based on a woodpile EBG material," published in IEEE Transactions on Antennas and Propagation,vol. 53, no. 1, pp. 216-223, January 2

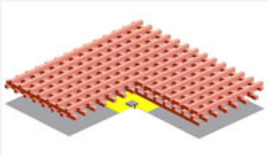
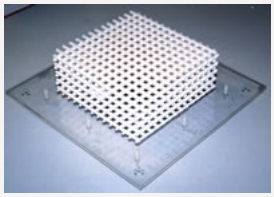
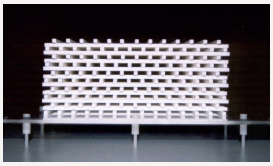
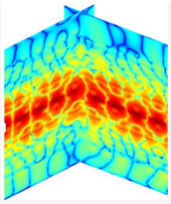

Leaky-Wave Antennas for Advanced Wireless Systems

Antenna beam steering can bring significant benefits to advanced wireless systems. Microstrip leaky-wave antennas (MLWAs) are of particular practical interest becaus planar low-profile configuration, ease of fabrication, and beam-scanning capabilities. In this research several planar MLWAs and arrays are developed to radiate at bores conical beam around the boresight, with simultaneous dual-side-beam scanning, dual-band forward and backward beam-scanning, and continuous beam scanning from the to the forward direction. Moreover, methods and antenna designs are proposed to steer the beam at a fixed frequency, shifting beam-steering range, and fixed-frequency bean in forward and backward directions.

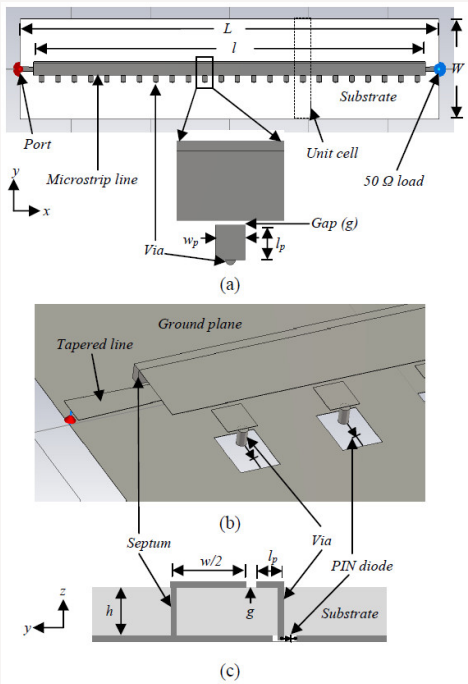

Figure 1. Proposed reconfigurable HW-MLWA: (a) top view, (b) perspective view, and (c) side view.

TABLE I. SWITCH CONFIGURATIONS AND CORRESPONDING MAIN BEAM DIRECTIONS AT 6.5 GHZ

	Switch Configuration	Main Beam Direction (θ)
1	111111111111111111111111	21°
2	111100111100111100111100	26°
3	000011000011000011000011	32°
4	000000000000000000000000	37°

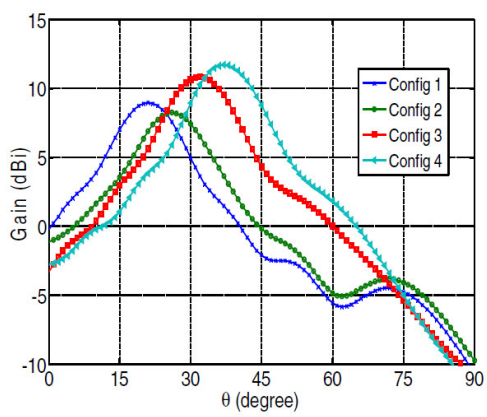

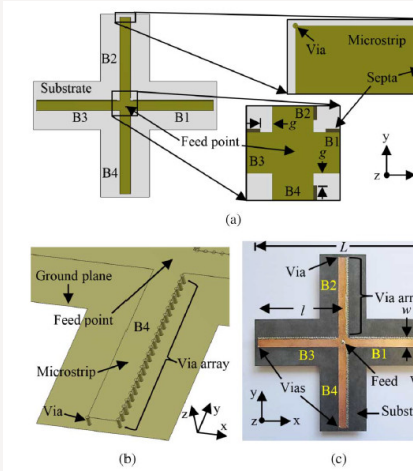

Fig. 1. HW-MLWA array design steps: (a) top view of the initial de septa, (b) perspective view of one branch of the final design with v (substrate omitted, not to scale), and (c) top view of the fabricated pro

Multi-band Dual-Polarized Shared Aperture Array

Multi-band dual-polarized shared-aperture (MBDP-SA) arrays are antenna arrays that operate in two (or more) frequency bands with dual-polarization in each band, a elements are integrated together into a common physical space by sharing the single aperture. The MBDP-SA array is of great interest in space-borne SAR system, bec technique can effectively reduce the payload and size of the antenna sub-system. In this research project, main efforts are focussed on three aspects: 1) improve the specifi current Dual-Band Dual-Polarized Shared-Aperture (DBDP-SA) array; 2) construct Tri-Band Dual-Polarized Shared-Aperture (TBDP-SA) array; and 3) explore some new for DBDP-SA antenna.

(a) Rear (b) Front

Fig.1 Improved DBDP-SA array.

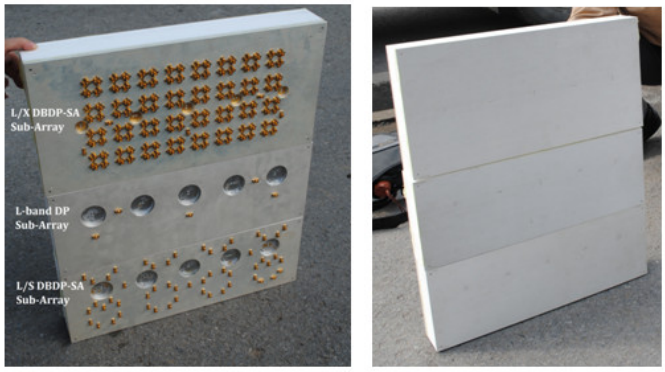

(a) Rear (b) Front

Fig.2 Photos of the TBDP shared aperture prototype array.

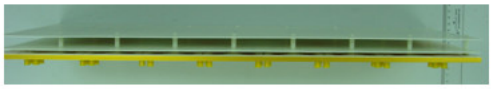

Side view

Fig.3 Novel structure DBDP-SA array

Compact Dielectric Resonator Antennas with Ultra-Wide 60%-110% Bandwidths

We have recently made a significant achievement in the emerging ultra wide-band (UWB) wireless communication systems, which require antennas with bandwidths gr 106%. In the past, the only way antenna engineers knew how to get such a bandwidth from a thin antenna was by removing the metal sheet underneath the antenna (known a plane"). This is not an acceptable solution for practical systems because the lack of it allows the antenna to radiate both upwards and (unnecessarily) downwards (i.e. electronic device on which the antenna is installed), wasting about half of its power. Saving power is crucial in UWB systems due to the severe power limits imposed by regu 2011, we made a breakthrough in dielectric-resonator (DR) antenna research, by inventing a novel DR antenna with a full ground plane and a 110% bandwidth. This disp myth that such bandwidths cannot be achieved with full ground planes. This antenna, published in the prestigious IEEE Transactions on Antennas and Propagation in Decem is 29% smaller but has a 30% greater bandwidth than the next-best DR antenna, which does not even have a full ground plane. Hence it is ideal for next-generation ultra-fas and sensor applications.

We theoretically and experimentally demonstrated that, by introducing a lower-permittivity full-length insert between the ground plane and a higher-permittivity dielectric dielectric resonator antennas (DRA) with ultra-wide bandwidths, in the range of 60%-110%, can be designed. Furthermore, the volume of such DRAs is reduced by appr 50% using a finite planar conducting wall. Unlike vertical monopole-type hybrid UWB DRAs, these antennas radiate sufficiently in the upward direction. Unlike in printed UWB antennas, the power radiated into the lower hemisphere is significantly less. An example prototype antenna, designed to operate in the FCC UWB band, has a dielectri of 12 x 8 x 15.2 mm3 (or 0.124 x 0.083 x 0.157 lambda3 at 3.1 GHz), and an average measured gain of 5 dBi from 3.1 to 10.6 GHz. These antennas exploit multiple low- with overlapping bandwidths to form an ultra-wide contiguous bandwidth. With the proposed dielectric arrangement, it is possible to efficiently couple a sufficient numbe overlapping modes to a 50 ohm feedline using a single, simple feed.

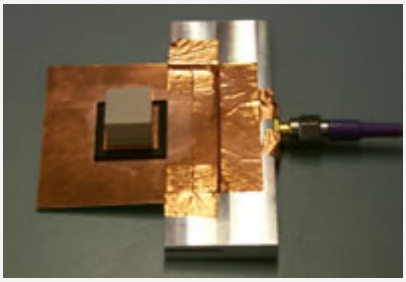

The antenna has a remarkably small footprint of 12x8 mm2 at 3.1 GHz - the lowest frequency of the FCC UWB band. Its dielectric volume is 1459 mm3, or 1.7x10-3 lamb lowest operating frequency of 3.1 GHz, and overall height is 15.2 mm or 0.157 lambda0. To place these results in perspective, it is worth comparing the new designs with wideband DR designs available in the literature. To the best of our knowledge, prior to this, the widest bandwidth ever obtained from a pure DRA design is 84% . The volu DR in that design is 0.225 x 0.172 x 0.062 lambda3 (= 2.4x10-3 lambda3) at its lowest operating frequency of 3.69 GHz. In that DRA, the DR is positioned in a non-traditi close to the edge of an orthogonal, "vertical" ground plane, which does not block radiation towards the lower hemisphere. The widest bandwidth demonstrated by a pure DI traditional "horizontal" ground plane, (which can be employed to shield the rest from the antenna, as discussed previously) is 78%. The dielectric volume of that design is 0. x 0.21 lambda3 (= 5.8x10-3 lambda3) at its lowest operating frequency of 6.7 GHz.

Super Wide-band Antennas

We have demonstrated that extremely wide bandwidths (ratio-bandwidths up to 1:25) can be obtained from a specially designed printed antenna with a tapered semi-ring design is described in "A Printed Elliptical Monopole Antenna with Modified feeding Structure for Bandwidth Enhancement," in IEEE Transactions on Antennas and Pro vol. 59, no. 2, pp. 667-670, Feb. 2011.

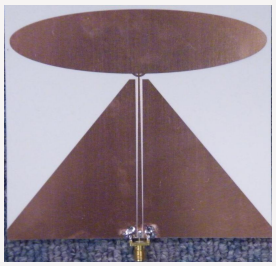

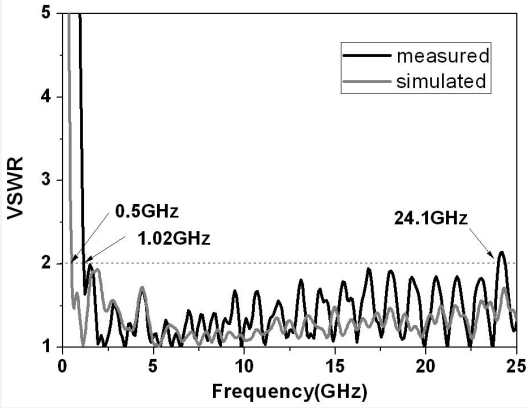

Focal Plane Arrays for Radio Astronomy

Dense focal plane arrays (FPAs) are a key technology for a new generation of Radio-telescopes. Their primary benefit is the rapid survey speed facilitated by the wide fiel provided by multiple beams. Recent advances have brought dense FPAs within reach of radio astronomy applications. A number of institutions have significant research pr this field. This technology is being considered for the Square Kilometre Array (SKA) (www.skatelescope.org). The PhD project of Douglas Hayman, conducted with CS Centre and Division of Astronomy and Space Science, investigated beamforming aspects of FPAs and evaluated their performance in Radio Astronomy. A prototype interf radiotelescope, built at CSIRO's Radiophysics Laboratory in Sydney, is used to demonstrate a suite of techniques forFPA beamforming and evaluation for this thesis. Bea solutions were experimentally demonstrated in our paper in IEEE Transactions on Antennas and Propagation, entitled “Experimental Demonstration of Beamforming Sol Focal Plane Arrays”.The THEA tile, shown below, is designed by ASTRON and used for the experimental component of this research.

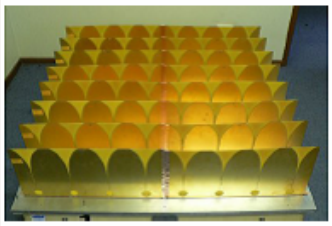

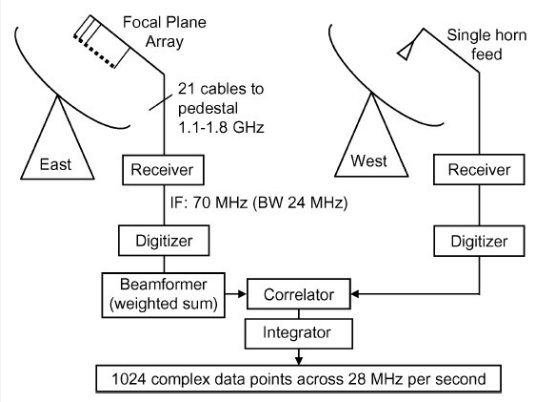

Negative Permeability of Spiral Metamaterials

Archimedean spirals and complementary Archimedean spirals are super-compact metamaterial particles. Thanks to their convoluted geometry, unit cells can be made electri small. We theoretically analysed monofilar, bifilar, trifilar and quadrifilar Archimedean spiral metamaterial particles using point group theory and crystallography. From the s properties electromagnetic response was determined. Magnetic, electric and magnetoelectric modes of the particles were identified along with their isotropy characteristics. shown that all the particles, except monofilar spiral, are nonbianisotropic. Further, effective medium theory was applied to extract the effective permeability of the spiral mec results indicated negative values for permeability in certain frequency ranges. Detailed theory and numerical simulation results are available in the paper entitled “Analysis metamaterials by use of group theory,” published in the Metamaterials Journal, vol. 3, no. 1, pp. 33-43, March 2009.

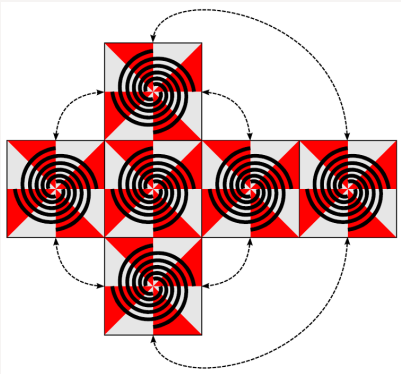

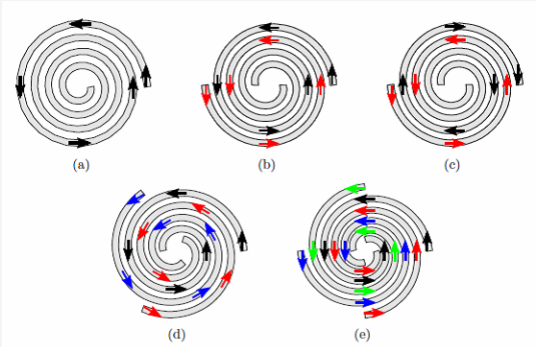

Archimedean Spiral Metamaterials and Backward Waves

We have shown backward wave propagation and double negative parameters over a 19% bandwidth in a microstrip line loaded with series gap discontinuities and super complementary Archimedean spiral resonator metamaterial particles. Moreover, our equivalent-circuit model for such unit cells almost perfectly described the structu practically important frequencies (by comparison with full-wave results). We also fabricated and tested compact filter circuits with only one or two complementary spiral met particles. Our results sre summarized in the paper entitled "Backward Wave Microstrip Lines with Complementary Spiral Resonators," published in IEEE Transactions on and Propagation, Vol. 56, Issue: 10, pp. 3173-3178, Oct 2008.

We derived design equations for Archimedean spiral resonators and tested them against full-wave simulations. The details are in the paper entitled "Design of monofilar a Archimedean spiral resonators for metamaterial applications," published in IET Microwaves, Antennas & Propagation, vol. 3, no.6, p. 929-935, Sep.2009.

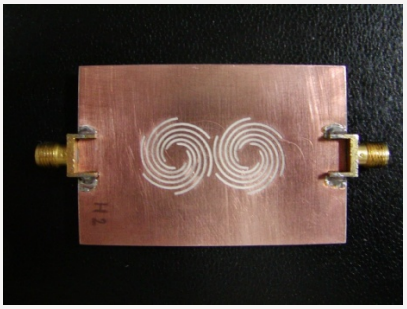

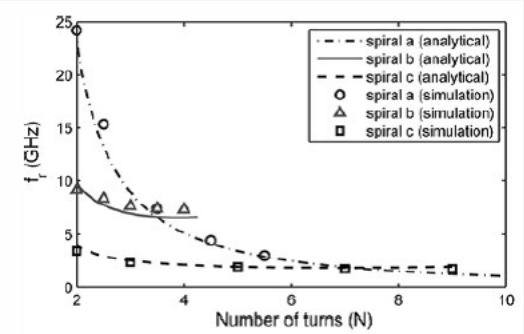

Frequency Selective Surfaces for Energy-Saving Glass Panel

Energy-saving glass is becoming very popular in building design due to their effective shielding of building interior against heat entering the building with infrared (IR) wave obtained by depositing a thin layer of metallic-oxide on the glass surface using special sputtering processes. This layer attenuates IR waves and hence keeps buildings summer and warmer in winter. However, this resistive coating also attenuates useful microwave/RF signals required for mobile phone, GPS and personal communication sy by as much as 30 dB. To overcome this drawback, we designed and tested a bandpass aperture type cross-dipole frequency selective surface (FSS), etched in the coatings c saving glass to improve the transmission of useful signals while preserving IR attenuation as much as possible. With this FSS, 15-18 dB peak transmission improveme achieved, for waves incident with 45 degrees from normal for both TE and TM polarizations.

Measurements and other results of this research, conducted in collaboration with the Lund University in Sweden, are available in the paper entitled "Cross-Dipole Frequency Selective Surface for Energy-Saving Glass Used in Buildings," published in IEEE Transactions on Antennas and Propagation, vol. 59, no. 2, pp. 520-525, Feb. effect of these FSSs on the transmission of infrared and visible wavelengths through energy-saving glass was investigated theoretically and experimentally in another pap Microwaves, Antennas & Propagation, Vol. 4, Iss. 7, pp. 955–961, 2010.

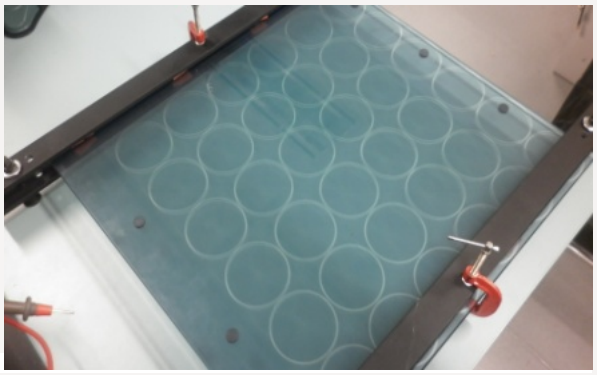

Switchable Frequency Selective Surfaces to Reconfigure Electromagnetic Architecture of Buildings

In large buildings and offices, frequency re-use methods will be required to enhance the spectral efficiency and capacity of wireless communication systems. This observatio to the concept of electromagnetic architecture of buildings. Passive bandstop FSSs can be used to enhance the electromagnetic architecture of a building, and hence to spectral efficiency and system capacity, but switchable FSSs can provide a better reconfigurable solution. If switchable FSSs are placed in strategic locations of a building, th reconfigured remotely and rapidly, which is not possible with passive FSSs.

With collaborators in UK and Sweden, we designed and successfully tested a single-layer active Frequency Selective Surface (FSS) that is electronically switchable between and transparent states. It can be used to provide a spatial filter solution to reconfigure the electromagnetic architecture of buildings. The FSS measurements show that the response of the filter does not change significantly when the wave polarization changes or the angle of incidence changes up to ±45º from normal. The FSS is based on sq aperture geometry, with each unit cell having four PIN diodes across the aperture at 90 degree intervals. Experiments demonstrated that almost 10 dB additional transmissio be introduced on average at the resonance frequency, for both polarizations, by switching PIN diodes to ON from OFF state.

For details, please refer to "Switchable Frequency Selective Surface for Reconfigurable Electromagnetic Architecture of Buildings," in IEEE Transactions on Ante Propagation, Vol. 58, Issue 2, pp 581-584, February 2010.

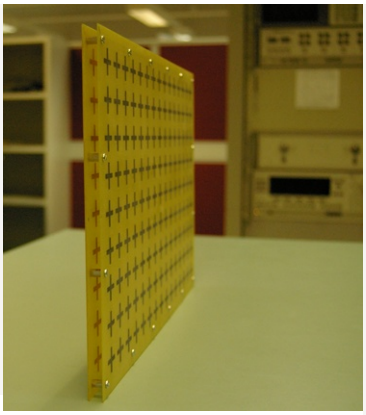

Absorb/Transit FSS

We designed and tested a novel absorb/transmit frequency selective surface (FSS) for 5-GHz wireless local area network (WLAN) applications. The novelty of the design i capable of absorbing, as opposed to rejecting, WLAN signals while passing mobile signals. The absorption of the WLAN signal is important to reduce additional multipa spread and resultant fading caused by typical reflect/transmit FSSs. Our FSS consists of two layers, one with conventional conducting cross dipoles and the other with resis dipoles. The FSS has good transmission characteristics for 900/ 1800/1900-MHz mobile bands and performs well for both horizontal and vertical polarizations.

Later we modified the FSS to obtain even better performance, for example, for both horizontal and vertical polarizations at oblique angles of incidence. The distance betwee layers has been successfully reduced to one eighth of free-space wavelength. This small distance makes it more compact as compared to the conventional Salisbury screen achieving an acceptable absorption in the stopband.

The details of our designs and test results can be found at "Oblique Incidence Performance of a Novel Frequency Selective Surface Absorber," in IEEE Transactions on Ant Propagation, Vol. 55, no. 10, pp. 2931 – 2934, Oct. 2007, and "A Novel Absorb/Transmit FSS for Secure Indoor Wireless Networks with Reduced Multi-path Fadin Microwave and Wireless Component Letters, Vol. 16 (6), pp. 378 - 380, June 2006.

Dual-Band Artificial Magnetic Conductor (AMC) Surfaces

AMC surfaces have many advantages and interesting properties due to their unique reflection characteristics, with near zero reflection phase. We have designed and pro novel dual-band AMC surface, which has a very wide upper AMC band and a narrow lower AMC band, and therefore suitable for multi-band wireless/mobile applications.

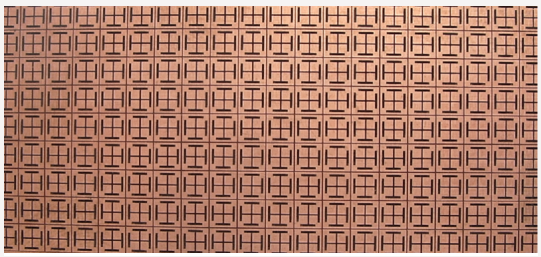

Fully Printed Quad-band Antennas for Wi-Fi IEEE802.11 and other WLAN Applications

Our fully-printed antennas can be fabricated and integrated to WLAN systems at almost zero cost by printing them on the same circuit board (e.g. FR4) with the radio circuit same standard fabrication methods. They are extremely compact: an antenna with a radiating element of 1cmx1cm covers all four IEEE standards (802.11a, 802.11b, 80 802.11n) as well as HiperLAN2 with a VSWR less than 2. We have also developed a packaging solution where the rest of the circuit can be shielded to satisfy EMC regulati leaving the antenna (on the same board) open for radiation. The advantages of the antennas based on this technology are: Lightweight; Radiates almost every direction in shadow region); Microstrip and co-planar waveguide (CPW) designs available; Compatible with all printed microwave circuits, including stripline circuits; Excellent because no cables, connectors, soldering or any mechanical attachments are required to connect the antenna to the radio; No protruding parts that are likely to break; Covers WLAN bands with one antenna (e.g. Wi-Fi IEEE 802.11 a, b, g, n, HiperLAN2 etc.); Excellent matching, i.e. input reflection < -10 dB (VSWR < 2) in all WLAN bands (e. GHz, 4.9-5.1 GHz, 5.15-5.35 GHz, 5.725 – 5.825 GHz); High efficiency (~60-70% on FR4; can be increased to over 90% on Duroid.); Ideal for internal mounting in a c device, to achieve very wide beam coverage; diversity reception or MIMO arrangements available; can be dsigned to cover other multiple bands (e.g. multiple mobile/c bands) and other applications.

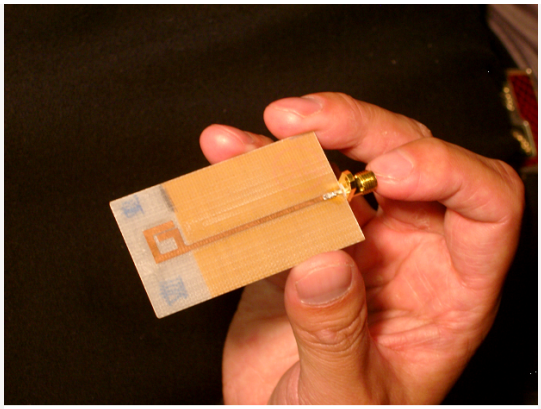

How can I optimise a UWB System to operate well over a range of directions?

Emerging ultra-wideband (UWB) communication devices will need to operate well, not just in one direction but over a range of directions. However previous UWB system optimisation techni been limited to one direction only. A system optimised in one direction may not work well in other directions due to pattern instability, or direction-dependent transfer function, of the an developed the concept of frequency-domain correlation patterns and proposed a figure of merit, the pattern stability factor (PSF), which can be determined from simulation of experimen With these new concepts, we have demonstrated the optimisation of UWB systems to operate well over a range of directions. The concepts and their applications are available in the PhD papers by Tharaka Dissanayake.

Antenna Techniques and Technologies for Ultrawideband (UWB) Systems

We developed antenna solutions for emerging UWB systems with very high data rates. Our research includes investigation of band-notching techniques to reduce UWB inference wi wireless systems and studies of antenna dispersion and pattern stability in the time domain.

High Gain Antennas with Planar Surface-Mounted Short Horns

In collaboration with University of Delhi, we have developed compact rectangular dielectric resonator antennas with surface mounted planar horns for gain enhancement. One configuration an aperture-fed rectangular dielectric resonator antenna and a planar surface mounted horn. We have achieved 10 dBi gain and a good efficiency from this configuration. The surface mou increases the gain of the standard dielectric resonator antenna by 4.9 dB. Total height of the prototype antenna shown in the figure is only 0.172 lambda and the aperture size is 0.96 lamb antennas can be easily adapted to low-profile, high-gain and array applications.

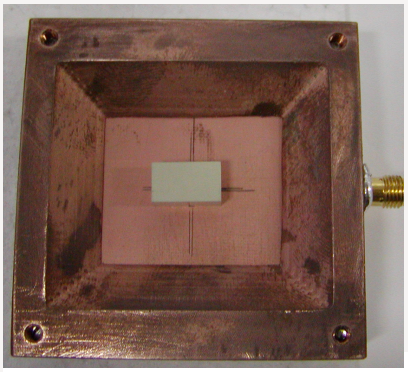

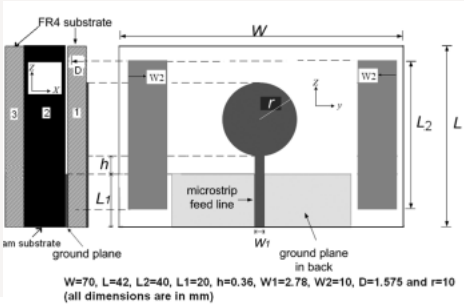

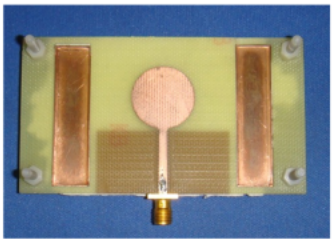

Photonic Crystal/EBG Based Horn Antennas

Waveguides and antennas made out of dielectric, as opposed to metal, are expected to perform better at Terahertz frequencies, as they do not suffer from the skin-effect loss of metal investigated horn antennas, horn arrays, waveguides, bends and junctions made out of 3D woodpile photonic crystals, which can be implemented at THz frequencies in high-resistivity S other materials. Our concepts have been tested by fabricating and measuring scaled-up prototypes operating in microwave frequencies. We have also designed a special broadband couple a photonic crystal waveguide to a rectangular waveguide or a coaxial cable, for example for testing using a vector network analyser. We demonstrated > 6% bandwidth both theore experimentally.

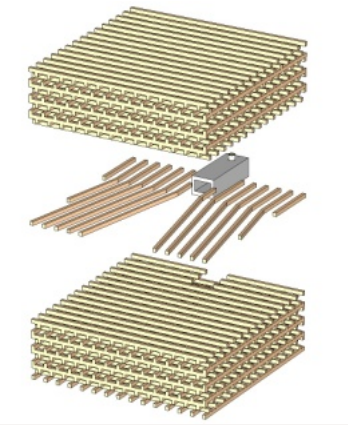

Broadband Microstrip Patch Antennas for Wireless Computer Networks

We have designed and tested broadband, compact E-shaped patch antennas for wireless communication networks, operating in frequencies from 4.9 GHz to 6.0 GHz. We made two achievements. First, we designed an E-shaped antenna, which is intrinsically compatible with a printed microstrip circuit. It can be made out of a single sheet of metal and can be mou microstrip circuit without expensive coaxial connector. Second, we designed a unique E-shaped antenna with corrugation to reduce the width of antenna. We successfully miniaturised the fit it inside a thin (4mm) PC (or PCMCIA) card extension. In fact, we were able to squeeze in two of these antennas into a single PC card of standard width (54mm), for diversity communica achieve excellent isolation (>20 dB) and matching (<-10 dB) over the whole WLAN frequency band.

Theoretical Analysis of Photonic Crystal Structures

We have developed and successfully implemented, in both personal computers and supercomputers, efficient theoretical methods to analyse and design complex electromagnetic (micro optical) circuits based on photonic crystals (PC). Among our novel techniques is a PC-based Perfectly Matched Layer (PML) absorbing boundary for use with the finite difference time doma method in the analysis of waveguides in 3D photonic crystals.

We have applied these techniques to model wave propagation in various guiding structures such as bends, junctions and tapers in 2D and 3D crystals. From this analysis, we can transmission and reflection coefficients, propagation characteristics, phase and delay response, etc., of a component or a system.

New Closed-form Green's Functions for Microstrip Circuits and other Layered Structures

When combined with the spatial-domain Method of Moments (MoM), our new closed-form functions now enable efficient and accurate analysis of microstrip circuits and antennas with approximations. The key feature in this new MoM is that the four-dimensional integrations in MoM matrix elements can be solved analytically, completely eliminating the need for expensive integrations. Our new closed-form functions are simpler and more flexible than previous such functions, and (unlike previous ones) they do not require additional (Taylor series approximations. The computer time required for the analysis of an example microstrip line using the new MoM was three times less than the next best method, which required some integrations.

Integrated-design of Hybrid-resonator Antennas for Broadband Wireless and other Communication Systems

Shown below is the first baby of our recent project on broadband hybrid-resonator antennas. This first prototype of a Dielectric Resonator on Patch (DRoP) antenna demonstrated a ba 24%. This design also proved, both theoretically and experimentally, that the electromagnetic fields in a dielectric resonator can be efficiently coupled to the fields in a patch resona perturbing the radiation characteristics of each resonator.

Singularity-enhanced Finite-different Time-domain (FDTD) Method for Diagonal Metal Edges, Strips and Films

We developed the world's first and still the only singularity-enhanced FDTD method for metal edges not parallel to the grid. The edges were assumed to be diagonal to cell faces. Compare conventional spit-cell model, the computer memory required for an FDTD analysis of a structure could be reduced by up to 27 times and the computing time could be reduced by up to without sacrificing the accuracy of results. On the other hand, when the same grid was used, the accuracy of results improved by a factor of more than 3 compared to the split-cell model, a of more than 7 compared to the staircase model. The new equations were stable in all tests, and even in most demanding tests when the computational speed was further maximised by the time step (Dt) to the maximum allowed by the FDTD method! (i.e. stability factor of 1!)

The key to this success was the derivation of enhanced FDTD equations for nodes near the edges by considering rigorously the singular nature of the electromagnetic fields. The table here improvement of accuracy achieved by using the enhanced FDTD equations. The new equations are simple to implement in a standard FDTD code. They are ideal for the analysis and microstrip components and high-speed digital circuits where thin metal films or strips with diagonal edges are encountered.

Low-profile Dielectric-resonator (DR) Antennas

We designed and tested the world's first low-profile, circularly polarised, rectangular dielectric-resonator antenna (DRA) in 1995. The radiating element of this antenna is shown in the photo have also designed many other dielectric-resonator antennas, including a low-profile linearly polarised DRA, for various applications (see publications). We pioneered the FDTD analy antennas and published the first radiation patterns of a DR antenna obtained using the FDTD method in 1995.

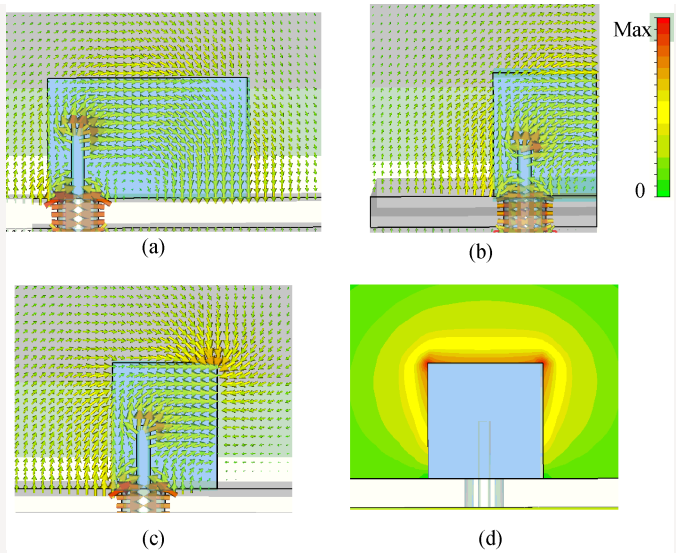

Australian Antenna Measurement Facility (AusAMF)

AusAMF is operated by a consortium of Australian Universities, Industry and CSIRO. The facility provides access to a shielded anechoic chamber offeri spherical near-field measurement capability for small antennas operating in the frequency range of 1-20 GHz, primarily for research purposes.

The facility was established under an ARC LIEF (Australian Research Council Linkage-Infrastructure Equipment and Facilities) grant and is hosted by C ICT Centre located in the Sydney suburb of Marsfield.

The facility currently consists of a spherical near-field turn-key NSI-700S-50 system within a 6m x 3.3m x 3.3m anechoic chamber. It has been designed to operate up to fre of 20 GHz, and uses an Agilent PNA (E8362B) as a receiver. The measurement system is capable of supporting a ~40kg antenna under test (AUT) up to a diameter of approximately 1.2m. I the standard gain horns and the probes available at AusAMF are as follows:

Waveguide Band	Frequency (GHz)	Probe	Standard Gain Horn
WR975	0.75 - 1.12	x	x
WR650	1.12 – 1.70	x	x
WR430	1.70 – 2.60	x	x
WR340	2.20 - 3.30	x	x
WR229	3.30 – 4.90	x	x
WR159	4.90 – 7.05	x	x
WR112	7.05 – 10.00	x	x
WR90	8.20 – 12.40	x	
WR75	10.00 - 15.00	x	x
WR51	15.00 - 22.00	x	x

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Smart Surfaces: Large Area Electronics Systems for Internet of Things Enabled by Energy Harvesting

Article *in* Proceedings of the IEEE · November 2014

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INVITED PAPER

Smart Surfaces: Large Area Electronics Systems for Internet of Things Enabled by Energy Harvesting

This paper focuses on large-area "smart surfaces," RFID systems, and wearable RF electronics that could substantially benefit from multisource energy harvesting.

By Luca Roselli, *Senior Member IEEE*, Nuno Borges Carvalho, *Senior Member IEEE*, Federico Alimenti, *Senior Member IEEE*, Paolo Mezzanotte, *Member IEEE*, Giulia Orecchini, Marco Virili, *Student Member IEEE*, Chiara Mariotti, *Student Member IEEE*, Ricardo Gonçalves, *Student Member IEEE*, and Pedro Pinho, *Member IEEE*

ABSTRACT | Energy harvesting is well established as one of the prominent enabling technologies [along with radio-frequency identification (RFID), wireless power transfer, and green electronics] for the pervasive development of Internet of Things (IoT). This paper focuses on a particular, yet broad, class of systems that falls in the IoT category of large area electronics (LAE). This class is represented by "smart surfaces." The paper, after an introductory overview about how smart surfaces are collocated in the IoT and LAE scenario, first deals with technologies and architectures involved, namely, materials, antennas, RFID systems, and chipless structures; then, some exemplifying solutions are illustrated to show the present development of these concurrent technologies in this area and to stimulate further solutions. Conclusions and future trends are then drawn.

KEYWORDS | Energy harvesting; green electronics; Internet of Things (IoT); large area electronics (LAE); radio-frequency identification (RFID) systems

I. INTRODUCTION

Looking at the telecommunication (TLC) market development worldwide in the last five years, we see an average decrease of about 5% per year, in both gross domestic product (GDP) contribution and employment [1]. Against this trend, the global information and communication technology (ICT) market has remained grossly constant. Some compartments, in fact, are experiencing an opposite trend. Beside some sectors related to new consumer products, such as tablets and smartphones, new Internet of Things (IoT) related products are growing at two digits per year and some estimations from big players report a market value in the order of trillions of dollars in the next decade [2], [3].

The vision behind IoT is in fact to connect objects directly to the Internet so as to allow them to provide information directly to the web without any human intermediation [4]. This vision will have a great impact on several electrical and electronic technologies, ranging from the basic physical layers (technology platforms) to the highest ones: communication protocols, software, human interface, and information management.

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In terms of physical layer, IoT actually inherits the technologies developed for wireless sensor networks (WSNs), bringing the distributed nature of that to the extreme. WSN, in fact, can be synthetically seen as a mesh of sensor nodes purposely conceived to build and communicate a sensed image of a monitored area. Within IoT, the sensing nodes are not purposely deployed to monitor something specific; instead, they are simply hosted by "objects" in order to provide the information they are able to collect and make it available on the web. Conceptually speaking, there is not a big difference, but in terms of related technological challenges, there is. Nodes must be hostable by objects; objects are of many types, and the better the nodes fit themselves transparently to the hosting objects, the denser and more reliable the information they are able to provide.

Several challenges can be envisioned in this evolution: first, electronic systems must be mechanically flexible, thin, and miniaturized in order to conform to the shape of as many objects as possible; second, the adopted materials have to be as recyclable as the hosting objects in order to avoid pollution from guest apparatuses; last but not least, hosted nodes must be autonomous, because they cannot be either connected to the grid or powered by life batteries.

A great technological paradigm shift is going to be pulled by the development of IoT; green materials, autonomous systems, ultralow-power circuits, energy saving protocols, and energy harvesting (EH) are concurrently mandatory.

Conversely, this technological evolution is pushing new solutions and architectures, so far constrained by the limits of conventional technologies. The development of inkjet printing techniques, the introduction of very cheap and eco-friendly materials compatible with roll-to-roll (R2R) circuit realization techniques [5] and so forth, open new horizons also to large area electronics (LAE).

LAE, first applied to printed photovoltaic and organic screens [6], is actually at the onset of its development. The development of R2R techniques and related materials, in fact, is allowing for tremendously increasing the dimensions of LAE circuits and systems, from the present tens of centimeters to meters and beyond. Along this evolutionary scenario, new configurations and architectures, based on massive integration of large circuits over conformable surfaces, can be envisioned, opening the way to what can be called the smart surfaces (SSs) approach.

SS, in turn, can be seen as a branch of IoT evolution. Large 2-D arrays of autonomous sensor nodes, for instance, make possible granular tracking of whatever parameter, ultimately providing augmented imaging of the environment; large 2-D arrays of tags can provide a very low-cost platform for precise localization and location-based services (LBS), thus enabling the realization, for instance, of smart floors [7] and smart wallpapers [8]; inheriting quasi-optical approach [9] contact-less electromagnetic (EM) wave processing (filtering, frequency conversion, selective shielding, etc.) can be conceived even at low frequencies.

On the one hand, SS is thus an approach stimulated by technologies pulled by IoT; on the other hand, it contributes to a class of architectures, within LAE, that can even widen the huge horizons of IoT applications in a sort of virtuous circle.

According to this wide vision, the paper is organized as follows. A review of the technologies suitable for distributed systems implementation to a large extent is given in Section II; then, the explanation about how radio-frequency identification (RFID) can be considered one of the most suitable technologies for the implementation of IoT architecture, and how it can be naturally integrated with SSs, is provided (Section III). In order to deal with the implications of the development of RFID systems compatible with SS and LAE evolution of IoT, two specific sessions have been provided: the first relates to antenna implications (Section IV), and the second relates to electronic architectures for RFID tags (mainly chipless ones; Section V). In order to smoothly bring the reader from relevant technologies to applications, quasi-optics, as an example of general approach concurrently exploiting the mentioned technologies to provide a platform suitable for LAE, is described in Section VI. After this, some application examples of how SS concept can be articulated, according to the IoT paradigm, are described; specifically, smart floor (Section VII), smart shoes as useful subsystems for the implementation of smart floors (Section VIII), and energy skin (Section IX). In order to have a vision of the logical links behind the many topics dealt with in this paper, a synoptic picture can be found in Fig. 1.

II. TECHNOLOGY FOR LAE DISTRIBUTED SYSTEMS

Given the described scenarios of SS, it is clear that the technologies involved have to be compatible with LAE

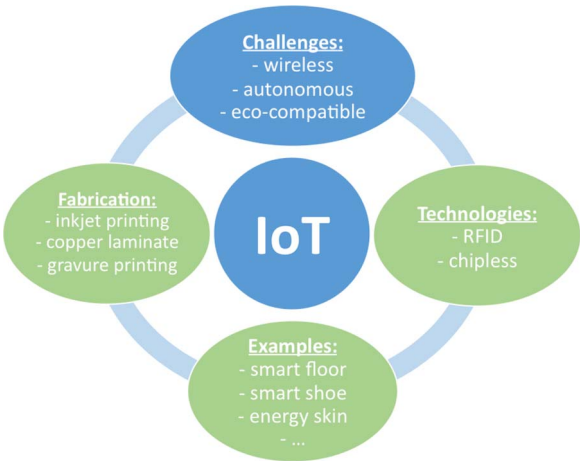

Fig. 1. ***Synoptic view of the paper structure reflecting the IoT vision described in the Introduction.***

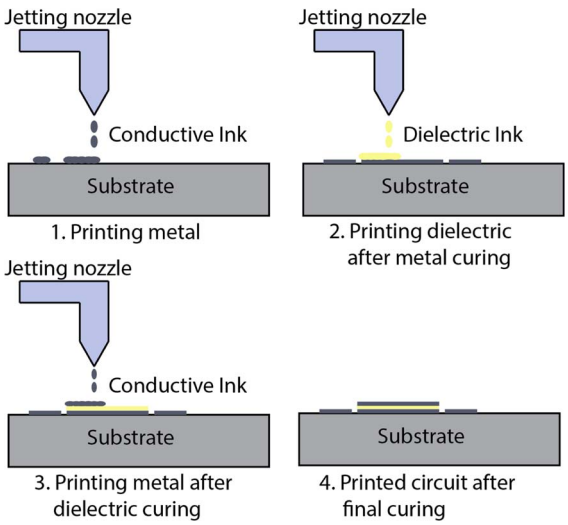

Fig. 2. ***Inkjet printing technique, synoptic description. The ink is deposited on the substrate with the desired pattern and after a curing procedure the next layer can be printed. The thickness of each film depends on the number of passes.***

approach, as described in the Introduction; according to [6], for example, the eco-compatibility of the materials, the mechanical flexibility of the substrates to make the device conformable to the hosting surface, and the life cycle (operability and biodegradability) have to be accounted for.

The new techniques proposed from different research groups [10]–[12] focus mostly on the printing techniques that can be industrialized easily with R2R methods, already investigated for the traditional printing on paper. Within the printing methods, one of the most attractive and investigated in the last decade is the inkjet printing of conductive and dielectric layers (Fig. 2). This technique allows circuits to be printed on almost any kind of substrate: from the photographic paper to liquid crystalline polymers (LCP) or Kapton, that are flexible, thin, and eco-compatible; to glass or poly methyl meta acrylate (PMMA, commonly referred to as Plexiglas) that are usually thicker but not flexible.

A first proof of concept for the inkjet printing technique at radio frequency (RF) and microwaves has been obtained on photographic paper by printing simple structures, such as antennas and other planar circuits and devices [10], [13]–[22], with a technology stack simply composed by the substrate and the conductive layer (usually realized by means of nanoparticle silver ink).

Recently, this method has been improved thanks to the development of new inks, usually composed by a polymer and a solvent (i.e., SU-8, PVP, PMMA, PEDOT, etc.); more complex fabrication procedures of multilayer structures are now possible, as shown in [23] and [24]. Another noticeable feature of this technology is represented by the resolution: conductive tracks of 50 μm of width and space gaps of 50 μm can be printed, allowing the design of millimeter-wave (mm-wave) frequency devices [25]. The combination of the quite high resolution (considering the simplicity of the technology) with the multilayer featuring also gives the opportunity to manufacture very easily matrix of passive and active devices that can be used in the SS development. It is worth noting that the process can be developed in a few steps based on the design and mostly on the number of layers needed. For example, a metal–insulator–metal (MIM) device can be realized by printing silver on the substrate [26], curing it in the oven in order to create a surface that, with the proper treatment (for instance, UV–Ozone exposure or preheating), is ready for the insulator printing. Then, the dielectric is cured as well and the last metal layer can be printed on top of it. The entire structure can be then cured at temperatures ranging between 130 °C and 200 °C.

In a perspective of industrialization of the inkjet printing technology, the hypothesis of R2R manufacturing of circuits is being investigated and some examples are already reported in literature for solar cells and other devices [27], [28].

Today, many pros have been mentioned for the inkjet printing method, and others can be found in the non-use of wasted chemicals (as is for the traditional lithographic technologies), in the no-need of clean-room environment for the fabrications, in the low-cost and rapidity of manufacture, and in a R2R perspective compatibility. However, the necessity of a curing procedure after the printing of a layer still represents the biggest inkjet limit for two main reasons: first, the time and type of curing are dependent on the inkjeted materials and on the material stack-up; second, especially on a laboratory level, the curing can cause misalignment issues, given the fact that the sample is removed and then replaced in the printer after the last layer curing.

Currently, the platform mostly used worldwide by researchers is the Dimatix 2800 DMP. In terms of inks, it is possible either to buy printable solutions or mix solutions in labs; for example, the combination of polymers and solvents allows layers to be printed with different electrical properties and thicknesses.

Besides the inkjet printing method, in [11], a new technique, suitable for LAE, has been proposed. It uses a metal (copper in that case) adhesive laminate technology based on the application of the standard etching process to an adhesive copper laminate material. This technique was already adopted to produce mm-wave circuits and to characterize the resulting compound substrates, as reported in [29]–[31]. A brief illustration of the metal laminate technique is here reported referring to Fig. 3.

The production process can be divided in five steps. The first step consists of the deposition of a (positive) photoresist film on the copper surface; then, the circuit layout is transferred to the photoresist by means of a photomask and ultraviolet exposure. After that, the unimpressed film of photoresist is removed using a NaOH

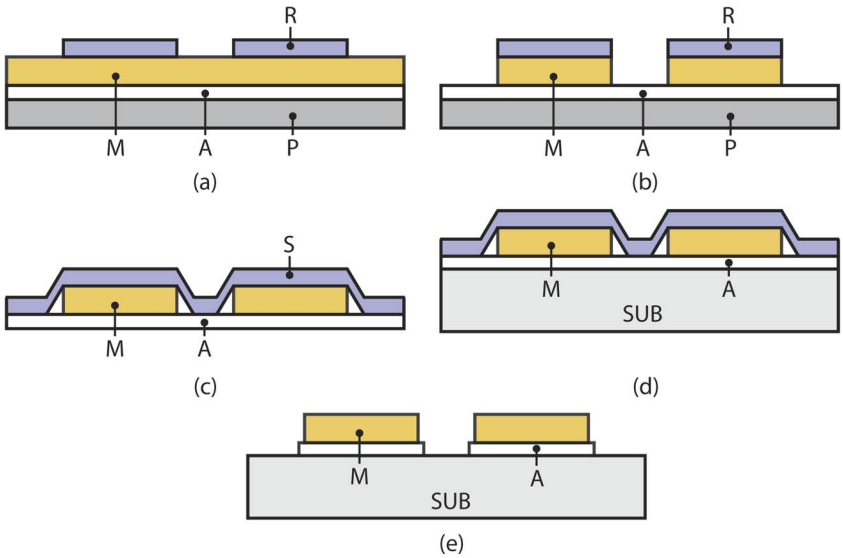

Fig. 3. ***Process steps for the circuit fabrication using the adhesive metal laminate. M: metal, A: adhesive, P: protection, R: photoresist, S: sacrificial layer, SUB: hosting substrate. After the standard lithographic procedure, the copper pattern can be transferred on top of any substrate by means of a sacrificial layer and exploiting the adhesive face of the copper tape.***

developer solution [Fig. 3(a)]. In the second step, the copper tape is wet etched. As can be seen in Fig. 3(b), in this way, the adhesive layer is exposed where the copper was removed, while it remains everywhere else covered by the original copper tape that serves as protection for the adhesive underneath.

The first two steps are, in this example, similar to those adopted in standard photolithographic technology. Moreover, different ways to remove the not needed metal can be used, as, for example, by means of numerical control pattern cutting plotters.

In the third step, depicted in Fig. 3(c), a sacrificial layer is stuck on the top copper side and, finally, the protection layer on the bottom is removed. The sacrificial layer is very important because it keeps the relative distances among the layout features constant even when these are not physically connected.

The fourth step is characterized by the transfer of the etched metal to the hosting paper substrate and, finally, the sacrificial layer can be removed [see Fig. 3(d) and (e)]. The last step is also useful to remove most of the exposed adhesive material.

With this method, quasi-fully-organic circuits and devices can be realized. The performance in terms of tracks width and pitch are, at present, a bit lower than what can be obtained with the inkjet printing, with the advantages of no curing processes, the possibility to fix devices on the circuit using standard soldering techniques, and a better conductivity (the conductivity of copper laminate, in fact, is one order of magnitude higher than that of the cured nanoparticle silver ink: 5.8×10^7 S/m versus about $6 \times 10^6 - 1 \times 10^7$ S/m obtained with at least five layers of silver).

To verify the validity of the metal laminate technology at microwave frequencies, a 50-Ω microstrip line was manufactured exploiting the Mitsubishi photografic paper as the substrate (thickness 250 μm, relative permittivity $\varepsilon_r = 3.2$, and loss tangent $\tan\delta = 0.08$). The line is 30 mm long, and the measured scattering parameters are shown in Fig. 4. The same graph also compares the performance of a similar transmission line manufactured with an inkjet printing process. The performance of the

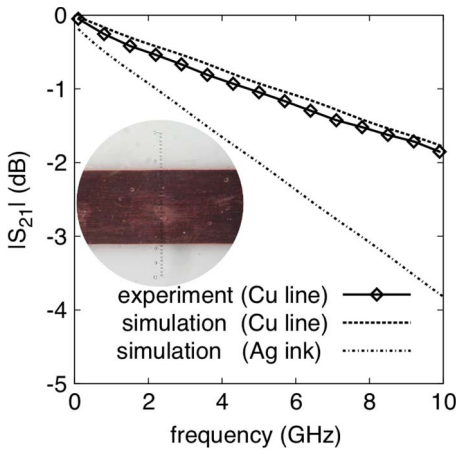

Fig. 4. ***Measured scattering parameters versus frequency for a 50-Ω microstrip line on paper substrate. The line, shown in the inset, is 30 mm long; the ruler division corresponds to 17.2 μm. The graph also reports a comparison with a microstrip line of equal dimensions made with an inkjet printing process (Ag ink, 3-μm thickness, $\sigma_{\text{ink}} = 1.1 \times 10^7$ S/m after curing). After [11].***

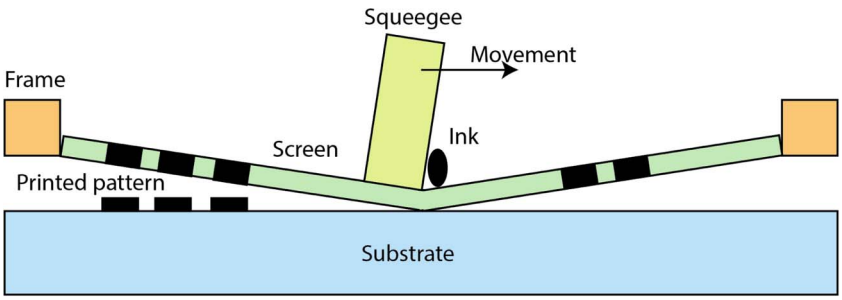

Fig. 5. ***Screen printing technique. The squeegee is used to press the screen with impressed pattern and transfer it on top of the substrate.***

metal laminate structure is superior compared to that of the inkjet printed line. At 10 GHz, the measured specific losses for the metal laminate microstrip are about 0.6 dB/cm [11]. Results at higher frequencies are also reported in [31]; in particular, an insertion loss of about 1.8 dBm/cm at 30 GHz is demonstrated.

The tradeoff is the adoption of a photolithographic step; it is worth mentioning, however, that the process is still compatible with R2R implementation.

Other possibilities for LAE are the screen printing [12] and the gravure printing [12], both of them adaptable to R2R industrialization techniques.

Screen printing consists of dragging a layer of ink across the surface of a screen and squeezing it through the open pores of the patterned mesh onto the substrate (Fig. 5). In general, the thickness of the printed layer and the achievable resolution depend on the density of the mesh and on the ink properties. Usually, the ink viscosity is in a range of 1–50 Pa $\times$ s, and this allows for printing with a resolution of about 100 μm and a thickness up to 100 μm. Until now screen printing has been adopted to realize low-resistance structures, solar cells, and field effect transistors (FETs), exploiting the possibility of printing very thick layers.

Gravure printing, also known as rotogravure, is considered a very high volume printing (Fig. 6) process, and it is being adopted to produce very conductive structures as, for example, capacitors, antennas, and organic devices such as pentacene-based diodes, organic light-emitting diodes (OLEDs), organic field effect transistors (OFETs), and organic thin film transistors (OTFTs).

The resolution can be of about 20 μm. The method is implemented by engraving the patterns into a metallic cylinder by a laser, by chemical etching, or electromechanically (as separate cells or intaglio trenches). Typically, the print pressure is high (1–5 MPa) in order to achieve a good ink transfer and to reduce the percentage of unprinted dots caused by the surface roughness of the flexible substrate. However, this high pressure of printing makes this technique suitable only for robust substrates with no soft, previously printed, layers that could be damaged.

To summarize, the technologies described in this section are characterized by some common features, such as: flexibility and conformability, compatibility with large area realization of circuits and interconnections, use of additive or mixed (subtractive/additive) deposition techniques, easy use of eco-friendly materials and, in some cases, compatibility with classical bond wiring as well as soldering techniques for electronic device placement.

Table 1 summarizes the main features of the described technologies.

III. RFID: A MIX OF CONCURRENT TECHNOLOGIES FOR SS IMPLEMENTATION

As mentioned in the outline paragraph at the end of the Introduction, after describing the technologies enabling SS development (Section II), here we illustrate RFID as a suitable means to transfer information through EM transmission between tags and readers to the Internet.

An RFID tag has a unique identification code and a memory used to store information, while the reader can

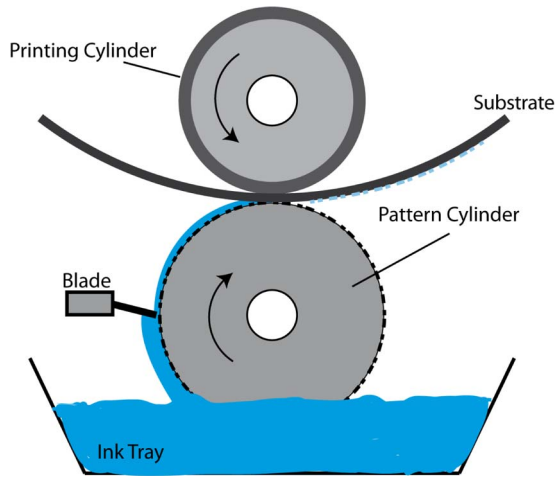

Fig. 6. ***Gravure printing process. Note that these machines can be from 20 cm to 3 m wide with a diameter ranging from 5 cm to 5 m.***

Table 1 Technologies Comparison

Technology	Resolution	Cost	Waste	Speed
Inkjet	50 μm	Low	Low	Fast
Copper	100 μm	Low	High	Medium
Gravure	20 μm	High	Medium	Very fast
Screen	100 μm	Medium	Low	Very fast

write or read data on and from the tag through RF transmissions. The tag is usually attached to an object that needs to be identified and monitored, or contains information to be read. In typical RFID applications [32], the main goal is to provide mapping of physical objects that are equipped with an RFID tag attached or embedded. In this way, RFID technology inherently leads to identifying, tracking, and localizing, but it can also enable the storage and transmission of information regarding object status and surrounding environments by embedding sensing capabilities.

As mentioned previously, IoT is most commonly described as a structured system of technologies concurrently working to capture meaningful data from objects and communicate them through networks to a decision-taking level. Useful keywords, whenever a definition of IoT is given, include: smart objects, autonomous logistics, machine-to-machine communication, RF technologies, centralized information, and so on.

In order to implement these functionalities, an IoT platform, an SS for instance, has to provide at least unique object identification together with wireless communication for data management.

The IoT physical layer can thus be naturally thought of as meshes of RFID and sensor nodes. The RFID tag that embeds a sensor can use the same working principles and protocols of the conventional RFID tags; a differentiation can be made, considering the way sensor tags are powered up, in active, semipassive, and passive tags; actually, the difference consists of the way they are powered.

Active tag sensors may use customarily conceived communication protocols or rely on RFID standards enabling the tag to be easily integrated into the existing wireless infrastructures so that they will not require expensive readers. In [33], a system architecture was developed to integrate WSNs and the RFID systems. Bluetooth and ZigBee technologies are adopted as the communication protocol of WSNs to meet the requirements of a large number of sensor nodes, large areas, and low cost.

Active tags with integrated sensors are used in several applications, including temperature and position monitoring, vibration detection, blood pressure, heart beat monitoring, and more. This type of sensor tags, besides having larger amount of energy provided by batteries, affords both a large range and multiple functionalities; some of them have also external buses that enable the use of connected external sensors [34].

Passive tags with an integrated sensor operate without battery, collecting the needed operational energy from external environment sources. The main requirements of this class are high energy conversion efficiency, large storage capability, and overall low-power consumption. Passive systems have usually low operating range and limited processing capability.

In this field, research activities are directed toward ultralow-power design of integrated sensor tags [35], antenna design for improving reading range [36], sensor overall performance optimization [37], and development of optimum protocols allowing for additional power saving [38], [39].

Typical applications are, for instance, temperature monitoring [40], photodetection [41], motion detections [42], etc.

Semipassive tags use both batteries and energy sources coming from the environment; they can integrate more operational capabilities than the passive ones, since they can exploit a higher amount of energy. For the same reason, semipassive RFID tags are more suitable to integrate a sensor; the operational methodology is similar to the passive one, using the reader signal to interrogate and cause a response from the tag. The primary difference is that the semipassive tag does have a battery used not to generate a response, but only to power electronics, like sensors incorporated in the tag, while exploiting RF circulation to reply to the reader interrogation. Just like passive tags, semipassive ones are limited in terms of slow reading speeds and short reading distances. In [43], the design, realization, and experimental validation of a battery-assisted RFID tag with sensing and computing capabilities, conceived to explore heterogeneous RFID-based sensor network applications, was presented.

Dealing with battery-less devices that are, by far, the most interesting ones for IoT, LAE, and SS applications, we can now focus on the typical energy sources adopted. No battery devices can exploit solar scavenging [44], [45], vibrational [46], [47], or RF radiations [48]–[52].

In many cases, wirelessly powered systems can harvest energy from the incident RF waves, thus generating the required direct current (dc) voltage to power the system. The EM energy present in the environment may be significant in some regions (some urban areas or indoor sites); here the use of proper conversion devices may allow enough energy to be scavenged. RF power harvesters usually consist of an antenna, an impedance transformation network, a rectifier, and a storage element. In [53], a design example of integrated rectifier antennas (rectennas) for wireless powering at low incident power densities, from 25 to 200 μW/cm^2, is given.

Regarding mechanical energy scavengers, they may be categorized upon the kind of energy source exploited; there are scavengers providing energy from a constant motion over extended periods of time (e.g., turbine air flow) or others based on intermittent motion (e.g., human

step). Particular attention is given to vibrational energy sources; in this case, the amount of energy that can be harvested depends mainly on the vibration amplitude and frequency and on the vibrating mass (mass of the harvesting device) [54]–[56].

In order to power the systems by using energy sources available in the working environment, proper energy transducers thus have to be chosen. Focusing on distributed systems (IoT, LAE, and SS), it is worth referring to typical parameters for optimum transducer design since, in these applications, the different kinds of energy available in the various scenarios may lead to the need of integrating more than one energy conversion system into the same device, in order to take advantage of all the accessible energies. The main design parameters are the available power output, the electrical impedance, and the operating voltage. Table 2 summarizes them for the most common energy transductions [57], [58].

To conclude this section, the mentioned reasons why RFID can be considered a useful technology for the implementation and development of LAE and, more specifically for SSs, are summarized. RFID systems, especially in the passive version of tags, are communication systems characterized by the following characteristics: compatibility with very low-power communication protocols, compatibility with the constrains posed by the hosting objects, especially when they are implemented by adopting the technologies described in Section II, inherent capability to gather information from the environment (sensor tags) and from the hosting objects, a low number of electronic devices (inherent circuital simplicity) and, finally, proven compatibility with printing technologies.

For all these reasons, RFID technology has to be considered the leading one to pursue the development of LAE and SSs as a communication platform for the evolution of IoT.

IV. ANTENNA DESIGN FOR NODES

Distributed systems for ubiquitous electronics (UE) and WSNs [59], [60] are, today, increasingly employed for monitoring and sensing applications. These systems can be seen as networks of nodes, massively distributed in the environment and communicating wirelessly with a base station. This massive deployment can be designed and structured to monitor a set of specified parameters by means of purposely conceived sensor nodes, as in the classical WSNs, or it can be obtained by integrating nodes into existing objects, which is the vision of IoT evolution. In general, the nodes can have different functionalities, however they have to provide information collected by embedded sensors (such as, for instance, identification codes, position and monitored environment parameters as well as object status) whenever it is required.

In this scenario, the RFID technology, summarized in Section III, is attractive. When RFID technology meets sensor nodes, information goes from the node to the Internet via a question-and-reply protocol between nodes, hosted by tagged objects, and readers.

Thinking about distributed systems and specifically SS, it is natural to think about radiative coupling in the available industrial–scientific–medical (ISM) frequency bands, including mainly the ultrahigh frequency (UHF) and microwave frequencies (around 0.9, 2.4, 5.8 GHz, and higher), exploiting the communication standard such as the WiFi [61]. Recently, also the ultrawideband (UWB) has been considered in order to minimize the limitations of narrowband systems (mainly localization accuracy and sensitivity to interference) [62].

Multistandard systems are often adopted for large compatibility and higher use flexibility. An example of this recent approach is given in [61] where near-field UHF nodes are combined with far-field transceivers. This allows application fields with compromised radiation capability,

Table 2 Transducer Characteristics for Several Forms of Ambient EH [57], [58]

Energy Source	Typical Electrical Impedance	Typical Voltage	Typical output power
Light	From low to 10s of KΩ	DC: 0.5 V to 5 V	Outdoors: 100s mW/cm^2 Indoors: < 500 μmW/cm^2
Vibrational	Constant Impedance 10s of kΩ to 100 kΩ	AC: 10s of Volts	100s μW/cm^2
Thermal	Constant Impedance 1 Ω to 100s of Ω	DC: 10s of mV to 10 V	10s μW/cm^2 (20° gradient)
Radio Frequency	Constant Impedance Low KΩs	AC: Varies with distance and power 0.5 V to 5 V	Wide-range

such as in proximity of metal and liquids at short ranges, to be improved.

It is clear that antenna systems are key elements in these apparatuses. The foundation of antenna design rules can be found in [63]. The antenna design specific for distributed systems, in turn, has to take into account several instances. Beyond the typical design criteria, other aspects are: the communication standard, the form and the size in agreement with the application, the communication range as a function of the equivalent isotropic radiated power (EIRP) limits, of the environment and of the orientation, the reliability under several conditions and processes, and the material cost considering massive production [64]–[67]. Among them, the operating environment is the most critical aspect that influences the node behavior [68].

As a consequence, antenna topology and materials for SS and IoT systems, in general, have to be chosen in order to make the antennas capable of operating in variable environmental conditions and to be integrated into objects. As an example, let us think about wearable antennas for body area networks (BANs): they must be washable, flexible, and able to shield the body from radiation [69].

In general, antennas for SS should be flexible, planar, and low profile; moreover, by adopting low-cost materials and technologies (see Section II), cost per unit surface is low, thus large arrays and big elements can be adopted more easily, ultimately allowing for easy developments of LAE distributed systems and SS, even at low frequency.

Materials compliant with SS implementations must be, in turn, mechanically robust, flexible, and very low cost, while exhibiting acceptable EM performance. These materials must also exhibit high tolerance levels in terms of bending repeatability. Flexible materials, often used, are polymers and polymer-ceramics composites such as the poly-di-methyl-siloxane (PDMS) and the titanate-based ceramic [68], which provide flexibility, robustness, and resistance to harsh environments in order to protect antenna and circuit. Moreover, when eco-compatibility has to be guaranteed, recyclable materials and related technologies have to be adopted; among them, cellulose substrates in combination with inkjet printing of conductive inks [18], [70] or with conductive adhesive laminate technology [11] are increasingly frequently adopted. The aforementioned techniques, compatible with the well-known industrial printing and the R2R processes [5], are in agreement with the low-cost fabrication and are expected to facilitate widespread and very low-cost electronics for distributed systems. These fabrication technologies can also be adopted for electronic devices on flexible polymeric substrates. An example of cellulose-based antenna for smart floor applications, such as indoor localization, is documented in [71]: a low-profile planar loop antenna is realized on cellulose substrate exploiting adhesive copper tape.

Although beyond the scope of this paper, which focuses on SS, it is worth mentioning here that this evolution toward the development of more and more sophisticated "unconventional" materials for electronics has a great impact on other IoT related developments such as, for instance, implantable systems.

When applications require devices with soft visual impact (think about SS, such as smart windows, glass integrated inside and outside buildings and glass for automotive applications, or smart skins [72]), transparent and conductive materials, such as transparent conducting oxides (TCOs), and in particular indium-tin-oxide (ITO) and ITO-based multilayers, have been proposed [73]. These materials afford a good compromise between minimum electrical resistivity and high optical transmittivity in the visible light spectrum when patterned on see-through materials such as glass or transparent polymers. A technique to improve the efficiency of the transparent antennas, without affecting their transparency, is the application of a layer of highly conductive coating or metallization strips on the antenna edges where the current density is high [72].

Among SSs, or in general distributed systems within the IoT vision, a fast growing field of research is represented by wearable electronics for BANs [74]. In this case, the integration of electronic devices in the garments requires the development of wearable and washable antennas and antenna arrays on fabrics. Washable antennas can be realized by covering textile antennas by a breathable thermoplastic polyurethane coating in order to protect the device against water absorption and corrosion [69].

Although dimension constraints are not very critical for distributed systems on cheap materials, they cannot be neglected thoroughly. At RF, for example, high permittivity materials [68] and magnetic composite substrates [75] can be adopted. Artificial magnetic conductors (AMC) can be employed alternatively to the magnetic composites with similar results [76]. These approaches are simply demonstrated from the wavelength equation: wavelength is a function of the relative permittivity and permeability and adopting suitable materials to increase these values, the effective wavelength, and therefore the antenna size, decreases. Anyway, the use of these materials introduces a tradeoff between dimensions and performance: generally the substrate losses decrease the antenna radiation efficiency, thus affecting the communication range of the overall wireless system, as documented in [68], [75], and [76].

In terms of design methodology, the introduction of unconventional materials as well as the environmental constraints posed by distributed systems and systems for IoT influence and drive the design strategies. Some solutions are proposed in the literature to cope simultaneously with these constraints; in [68], shielded configurations have been analyzed to mitigate environmental sensitivity. In [69], an example of robust patch antenna for BAN application that reduces the effect of the body on the performance is illustrated; in [77], the use of broadband antennas, such as the Chebyshev monopoles with a fractional bandwidth of about 40%, is proposed to reduce the frequency

shift introduced by the background materials or by the bending effects.

In SSs, and in general in IoT applications, antennas are used both to transmit and receive information and to harvest the necessary energy from the surrounding environment. Regardless of the fact that the available energy is randomly released in the environment by existing services (GSM, WiFi, and so on, in urban and semi-urban environments [78], [79]) or purposely delivered to empower a distributed population of nodes [80], antennas have to be able to harvest EM energy. This kind of "double effect" antenna is widely referred to in the literature as "rectenna": it combines rectifying circuitry with EM to electrical energy transduction.

The fundamental codesign techniques of antennas and rectifiers, focusing on the improvement of the conversion efficiency exploiting matching circuits, are described in [53]. Harmonic-balance and load-pull simulations are often used in order to find the optimal impedances that allow best efficiency to be obtained as a function of the EM incident power.

Multiband, broadband, and circularly polarized antennas are often adopted in EH applications to reduce the overall sensitivity to the environment. An example of planar antenna array for EH applications, in agreement with the SS principle, is documented in [81]: spiral antennas are proposed in order to provide a wide operating frequency band, and the rectification circuitry is optimized and characterized for low incident power levels. Similar antenna array for UWB EH is shown in Fig. 7.

A rectenna can be used in addition to the communication antenna or, alternatively, the same antenna can be used for both EH and data transmission. The use of different antennas is generally adopted if harvesting and communication are carried out at different frequencies

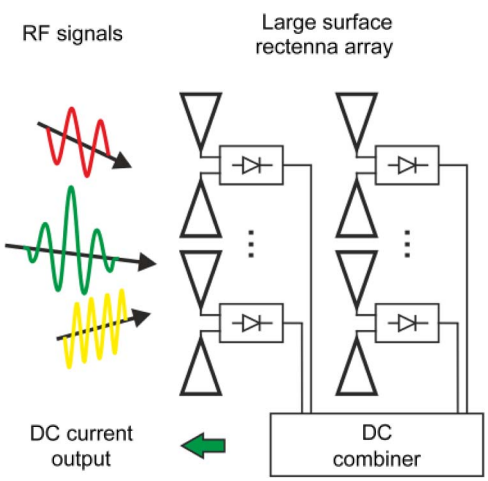

Fig. 7. ***Scheme of the rectenna array able to collect RF energy even in a broadband (depending of the kind of receiving antenna element), according to the solution adopted in [81].***

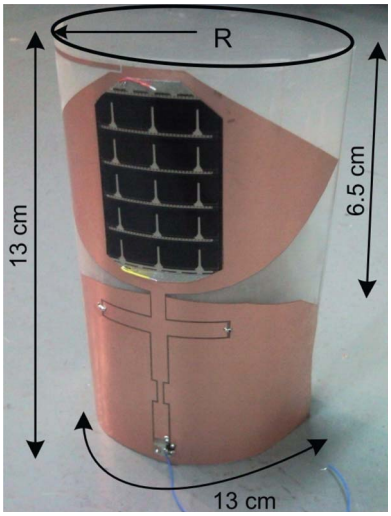

Fig. 8. ***Hybrid rectenna for solar and EM–EH. The hybrid rectenna consists of a broadband antenna and a solar cell combined in the same structure. After [82].***

and, mainly, in order to enhance harvesting efficiency without decreasing communication performance. In any case, this requires a codesign and can affect the node dimension and complexity. Alternatively, a single antenna can be a feasible compromise if communication and harvesting share the same frequency band and if the antenna harvesting efficiency is not the main issue; examples are the passive RFID tags empowered by the reader with a standard RFID antenna able to provide both EH and communication capability, as documented in [64] and [65].

However, the EM–EH is not the only solution to energize nodes and SS elements: hybrid EH, in fact, can be performed by exploiting different energy sources; that is, combining the rectennas with other sources of energy.

Recently, a low-cost and conformal structure for hybrid EH, based on low-cost and flexible poly-ethylene terephthalate (PET) substrate and an amorphous silicon solar cell, has been proposed in [82]; other examples are discussed in [20] and [83]. The use of low-cost, printable photovoltaics deposited on flexible substrates to form part of the antenna radiating structure is documented in [84]. In all these contributions, the main challenge appears to be the codesign of the antenna and solar cell in order to avoid reciprocal detrimental effects. The antenna is designed with a solar cell integrated on top of the radiating surface to obtain good radiation characteristics and to incorporate connections for the extraction of the dc provided by the solar cell. In [82], it was demonstrated that, by adopting thin film solar cells and paying attention to not exceeding the perimeter of the RF antenna, the solar cell can be integrated so as not to significantly affect the performance of the antenna. The hybrid rectenna for solar and EM–EH documented in [82] is shown in Fig. 8.

In terms of industrial assembly, the use of new materials and the need for low-cost and large-scale fabrication techniques would be fostered by architectures more insensitive against geometrical errors and placement misalignments. Following this direction, EM coupling can be exploited instead of ohmic contact to connect antennas on a flexible substrate to Si chips or, more generally, to the active circuitry [85]. This technique exploits a planar heterogeneous transformer, with the primary and secondary windings implemented on the antenna substrate and the Si chip, respectively. In this way, the galvanic contacts and the soldering process are avoided, and the final structures have been proven much more robust to alignment errors than traditional ohmic techniques without any significant performance degradation. By artificially applying a misalignment of 150 μm, which is the common dimension of a soldering pad, the technology proposed in [85] causes a loss increment of only 0.1 dB, due to the applied misalignment, while the same misalignment, when adopting ball grid arrays, would have implied missing the contact. This approach is quite attractive especially in combination with nonrigid materials where mechanical stress can result in significant substrate deformations. Recent contributions show the application of the aforementioned approach to inkjet printed antenna on PET substrate coupled to the chip for wireless nodes [86] and a textile patch antenna, magnetically coupled to the active circuitry, suitable for garment integration (see Fig. 9) [87], the reflection coefficient of which is shown in Fig. 10.

In order to testify the robustness of the proposed solution against uncertainties inherent to textile and garment electronics assembly, the radiation efficiency of the antenna, as a function of horizontal and vertical misalignment of the two transformer windings, used to perform the magnetic coupling, is plotted in Fig. 11(a) and (b), respectively. This technique can be extended also to interlayer communications of multilayer devices, and an example is documented in [88], where the circuitry fabricated on different garments communicates by means of overlapped coils.

V. CHIPLESS APPROACH

It has already been discussed that SS represents a possible technology for the development of killer applications within the IoT paradigm. Thanks to the convergence of several technologies, ranging from EH and sensing to RFID and LAE, SS can afford complex functions. For example, SSs can be used in intelligent buildings for structural monitoring and alarms (fire, for instance). To achieve these goals, SS must be equipped with a huge number of tags, each one monitoring a small portion of the surface itself.

The passive RFID systems can be divided into two families, namely, chip-based and chipless tags. The first family usually exploits a low-power complementary metal–oxide–semiconductor (CMOS) chip to implement the main tag functions [RF carrier rectification, dc voltage regulation, amplitude shift-keying (ASK) demodulation, IDentification code (ID) decoding, load modulation, etc.] and thus can be adapted to sensor applications by a few additional circuit blocks [signal conditioning,

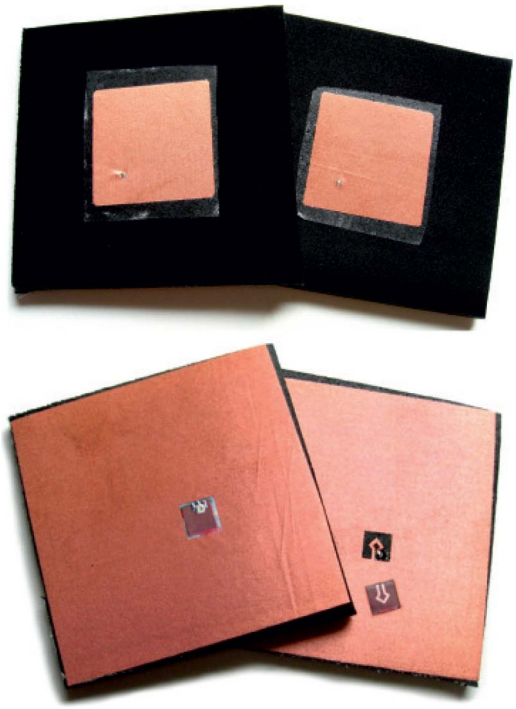

Fig. 9. ***Example of textile patch antennas operating at 2.4 GHz. The antenna and the ground plane are made of Flectron, a conductive textile, and the substrate is black foam. These materials are flexible and integrable in the garments. Magnetic coupling is exploited to connect the antenna and the active circuitry on flexible substrate. After [87].***

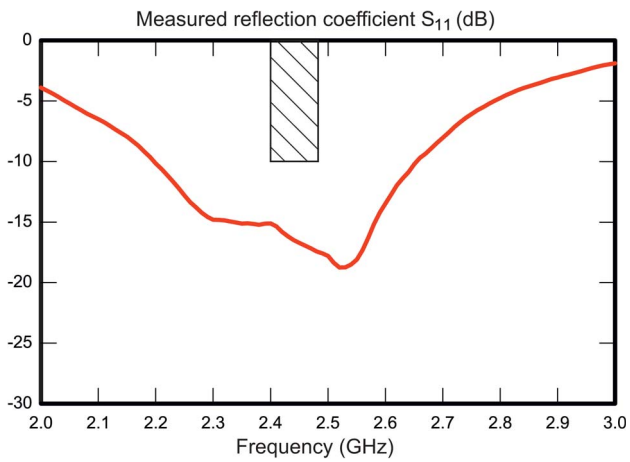

Fig. 10. ***Measured reflection coefficient of the previous textile antenna in the frequency band 2.4–2.48 GHz. After [87].***

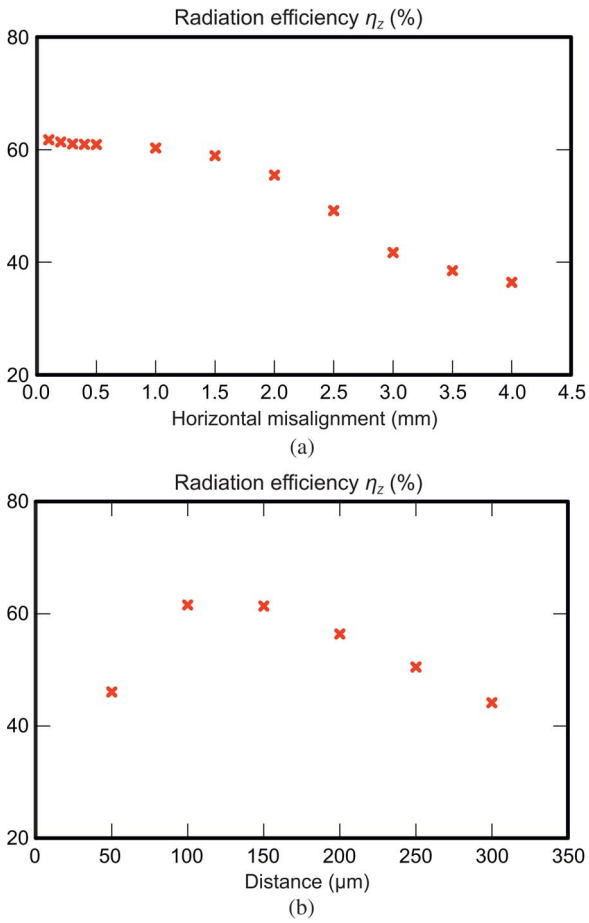

Fig. 11. ***Variation of the radiation efficiency evaluated versus (a) horizontal and (b) vertical misalignment between the antenna and the circuit windings. This test allows the robustness of the antenna performances against mounting uncertainties inherent to textile electronics to be evaluated at glance. After [87].***

analog-to-digital converter (ADC), etc.]. The main advantage of such an approach is the digital modulation of the transmitted signal, and thus the flexibility of the related data treatment, as shown in [89] and [90]. The production costs of chip-based tags are mostly associated with the heterogeneous integration of the silicon chip with the antenna [85], [91], the latter being manufactured typically on a flexible substrate or a textile substrate [92]–[97].

In order to reduce the aforementioned costs and to save as much energy as possible, solutions requiring minimum amount of electronics must be pursued. For this purpose, the chipless tag family was introduced and applied to wireless sensing in the recent years [98]–[103]. It is worth recalling here that the introduced buzzword "chipless" stands for a family of tags that are actually able to implement their functionalities by using only a few lumped components and passive distributed elements, without requiring any electronic integrated circuit (IC), the chip indeed, to be mounted.

The standard chipless tags (i.e., only coding and no sensing) exploit, basically, two mechanisms, namely, time-domain and frequency-domain scattering [64]. In the first case, the elapsed time between multiple reflections is used for coding. These reflections are obtained, at tag level, by connecting the antenna to a transmission line structure with several discontinuities. In the second case, instead, the tag has a specific frequency signature that is decoded at the reader level; to implement such a behavior, a coded series of resonators is realized on the tag antenna in order to reflect or not the corresponding frequency. Both approaches (time and frequency domain) lead to tag circuits that are not necessarily easy to miniaturize; nevertheless, it is worth noting that they are compliant with the LAE paradigm.

When dynamic sensor information has to be added to the static identification, we talk about chipless RFID sensor tags; these exploit an antenna, the electrical properties of which are controlled by the change of the physical parameter to be detected. There are, mostly, two proposed approaches for this. The first one is to induce a permanent change in the antenna property when a certain critical threshold (acceleration, temperature, fluid level, etc.) is exceeded [104]; this is useful for alarm type operations. The second one exploits a sensing load, i.e., a load the impedance of which is controlled by the sensed variable, connected to an antenna [105]. In both cases, the whole wireless sensor system (tag and reader) needs to have absolute accuracy, thus limiting the system performance with respect to both distance and fabrication tolerances.

A different method has been recently introduced in [106]. In this paper, a novel sensing principle is associated to the generation of an intermodulation signal from a tag, the latter being illuminated by two waves at different frequencies. The advantage of this idea is that the tag response is generated at a known frequency, thus the presence or the absence of such a signal can hardly be misinterpreted. Similar techniques have been used in harmonic radar systems [107] and in one-bit frequency doubling tags [108].

In line with the above ideas, a novel and completely original approach was proposed in [20] and [109] to solve the issue of absolute accuracy of the most of the passive chipless RFID sensors. The chipless tag described in [109] is based on the harmonic radar concept [110], [111], i.e., on a tag that, being illuminated by a carrier at frequency f_0, is capable of generating the second harmonic $2f_0$.

A simplified block diagram of the tag is illustrated in Fig. 12. For this purpose, the sensor information is encoded as the phase difference between two signals, one acting as the reference signal for the other one. First, the tag receives a carrier at frequency f_0. Then, two equal signals at frequency $2f_0$ are generated by means of a diode-based frequency doubler and a power divider. At this point, one of the two signals is phase-shifted using a passive sensing element. Finally, the $2f_0$ signals are reirradiated by

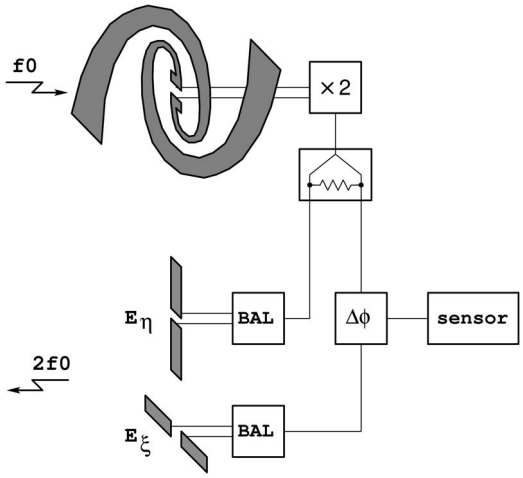

Fig. 12. ***Simplified block diagram of a harmonic chipless tag with sensing capabilities. After [109].***

exploiting two orthogonally polarized antennas. With this approach, the sensor information can be extracted by a suitable reader equipped with two complex (I/Q) receivers.

It must be observed that chipless tags, due to their inherent simplicity and extremely low number of lumped components, are easily realizable on flexible substrates by means of metal laminate [29], [30] and inkjet printing technologies. In particular, antennas [112], diodes [113], and passive sensing elements [114]–[117], i.e., all the main tag components, have already been experimented in cellulose-based materials. This will soon make SSs, equipped with sensing chipless tags, feasible at affordable prices.

VI. QUASI-OPTICS

"Quasi-optics concerns the propagation of EM radiation when the size of the wavelength is comparable to the size of the optical components (e.g., lenses, mirrors, and apertures) and hence diffraction effects become significant" [118].

In optics, operations are usually performed by using lenses. At EM frequencies, by following the quasi-optics analogy, lenses become large arrays, several wavelengths in size, of unconnected elements, each of them being able to get part of the signal incident on the array (usually focused by using a Gaussian beam), to carry out an operation and to irradiate the modified signal. The sum of the radiated signals modified by the array elements ends up in a radiated beacon elaborated with respect to the incident one [118]–[120]. From a historical point of view, quasi-optics was first introduced experimentally by Heinrich Hertz in the late 1880s [120] when he demonstrated the possibility of collimating EM signals on a multiwavelength surface by using cylindrical reflectors and studying effects that, until that time, were observed only at infrared and visible EM spectrum.

After more than 70 years, owing to the increasing demand for bandwidth and to the development of optical wavelength systems, quasi-optics experienced its palingenesis at the millimeter and submillimeter wavelengths.

We can classify the quasi-optical components into three main categories: frequency independent, frequency selective, and active devices. Frequency-independent surfaces include: delay lines, polarizing grids, hybrid junctions [121], attenuators [122], power dividers [123] and combiners [124], nonreciprocal devices [125], [126], absorbers, and calibration loads. Frequency-selective surfaces [127]–[129] include: inductive grids, capacitive grids, resonant grids, thick structures (perforated plates), and interferometers. Active devices include: oscillators [129], [130], amplifiers [131], [132], mixers [133], [134], phase shifters [135], [136], multipliers [108], [137]–[139], and switches [140]. This approach has been used so far mainly at millimeter and submillimeter frequencies because, being the size of the apparatuses proportional to the wavelength of the radiated wave, lower frequencies would have been prohibitive due to the very large size required. With the present development of technologies for LAE, however, quasi-optics has become a feasible approach even at RF and microwave bands, where large arrays of operational elements can be conceived.

Inheriting the quasi-optical approach, contact-less EM wave processing (filtering, frequency conversion, selective shielding, etc.) can be implemented even at low frequencies (in the order of megahertz). Two pioneer examples are switches [140] and the cross-dipole frequency doubler, proposed in [108], and implemented in [141], where, among various operating principles, the generation of harmonics is chosen to demonstrate the feasibility of such a component at microwave frequencies.

The layout of the proposed quasi-optical frequency doubler is shown in Fig. 13. The structure is inkjet printed on a cellulose-based substrate (a piece of photografic paper from Kodak). It consists of two crossed $\lambda/2$ dipoles. The longest dipole receives the incoming power at the fundamental frequency $f_0 = 3.5$ GHz, while the shortest one transmits the generated power at the doubled frequency $2f_0$ in an orthogonally polarized orientation. The length of the dipole operating at f_0 is 32 mm, while the $2f_0$ dipole is 16 mm long. The width of the tracks used to implement the dipoles is about 2 mm. The multiplication is provided by four diodes in a bridge configuration, thus forming a fully balanced multiplier unit.

Due to the omnidirectional nature of the dipole antenna, the harmonic signal is irradiated with the same intensity in the azimuthal plane (small differences are due to both the dielectric substrate and the planar nature of the dipole conductors). This means that the harmonic signal is reflected toward the reader and the transmitter toward other directions at the same time. A measurement of the received power at $2f_0 = 7$ GHz is reported in Fig. 13(b). Here the interrogation distance is 10 cm and the

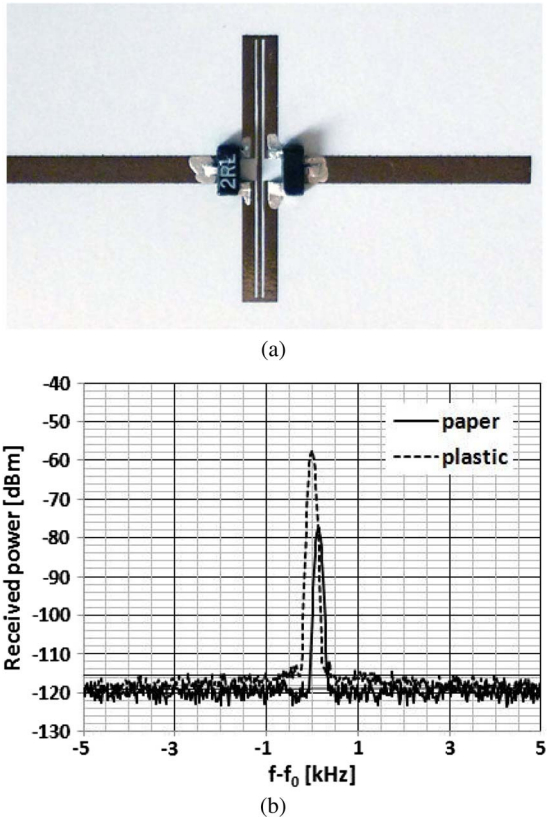

Fig. 13. ***Cellulose-based prototype of the (a) crossed-dipole frequency doubling tag and (b) measured second-harmonic response. The measurements have been carried out interrogating the tag at $f_0 = 3.5$ GHz and receiving the $2f_0 = 7$ GHz frequency component. The interrogation distance is 10 cm, and the transmitted power is equal to 20 dBm. The transmitter is equipped with a two-element Yagi antenna at f_0, while the receiver uses a helix antenna at $2f_0$. The fundamental frequency dipole is 32 mm long. After [141].***

transmitted power is equal to 20 dBm. The transmitter (reader side) is equipped with a two-element Yagi antenna at f_0, while the receiver (reader side) uses a helix antenna at $2f_0$. In these conditions, the power received from the cellulose-based (paper) tag prototype at $2f_0$ is about −80 dBm. The same structure implemented on a plastic substrate produces more power, mainly because of a better frequency tuning. An improved efficiency could be achieved by: 1) adopting a frequency multiplier with better harmonic terminations; and 2) using directive antennas in order to address the power only toward the reader.

In the frame of the IoT, the crossed-dipole tag is a very simple one-bit tag that can alarm a system when it is placed within the range of the reader. However, with very simple modifications, this idea can be used to implement a variety of on/off sensors (the paper substrate can be easily torn when a certain mechanical strain is exceeded).

The crossed-dipole structure can also be used as a building block to form arrays, an example being shown in Fig. 14. These arrays are mainly intended for LAE applications where a complete surface can be interrogated and answered by generating a harmonic signal. The fabricated prototype uses a Rogers substrate, thus it is not flexible. However, adopting a cellulose-based substrate, a flexible structure can be built. The bending capability of cellulose-based circuits is quite good and only limited by the discrete components mounted on them.

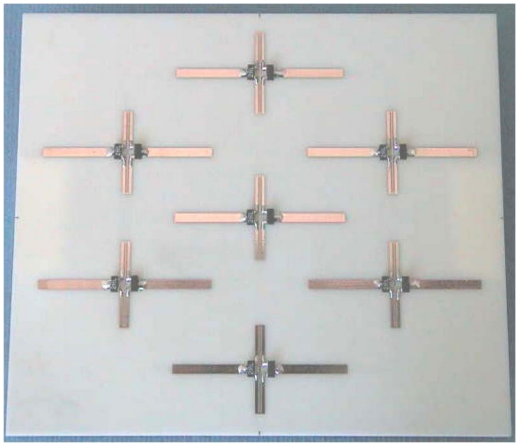

Fig. 14. ***Example of quasi-optical frequency doubler based on an array of crossed dipoles. This structure is implemented on a Rogers substrate, but this can be substituted with a cellulose-based material to reduce costs and obtain mechanical flexibility.***

The second example consists of a paper-based contactless frequency doubler for harmonic RFID applications [142]. The doubler, realized on paper substrate, generates the harmonic signal by means of a single Schottky diode. The system operates at 7.5 and 15 MHz, and these frequencies are chosen, without lack of generality, to accomplish the realization of a fully organic frequency doubler exploiting paper printed coils and organic diode (pentacene-based), the present frequency limit of which is around 15 MHz [143]. Fig. 15 shows a picture of the organic tag, while Fig. 16 shows the doubling efficiency of the organic tag versus transmitting/receiving (TX/RX) distance, assuming TX power as a parameter (for the sake of completeness, it is worth noting that TX and RX antennas of the reader are equal to the RX and TX antennas of the tag, respectively).

As a final remark, it is worth noting that, to the authors' knowledge, only planar developments of quasi-optical arrays have been proposed so far; reasonably, combining quasi-optics with LAE related technologies can lead, in the near future, to new SS solutions only in a limited planar extent.

VII. SMART FLOOR

The new concept of smart cities is generating a group of new scenarios that will impose a new way people interact with the environment. This immersion brings the IoT to a new level of relationship with people and environment,

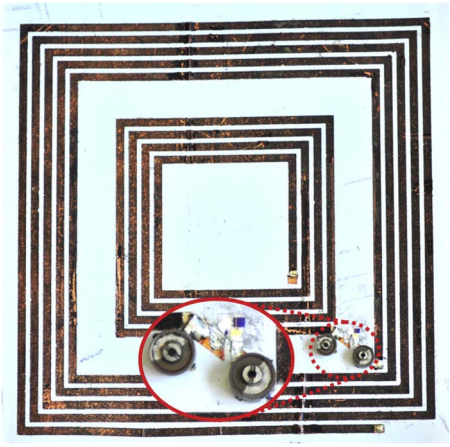

Fig. 15. ***Fully organic tag prototype of the frequency doubling tag operating at 7.5–15 MHz. After [142].***

where the scenario around is aware of people's needs and can interact with their way of living.

This new concept brings IoT to areas that cover broad topics, including transportation, energy distribution, data communications, and all technologies in a sense that they will become transparent to the normal users and citizens.

The growth of smart cities will significantly increase the quality of life, the reduction of energy waste, and the availability of information by using ICT. All these developments have, as a motivation, the overall inclusion of people into the city in a way that ICT should become completely embedded into our surroundings.

These new concepts are viable only if the smart environments are enabled by IoT. IoT is actually taking shape and is growing everyday through the number of devices that get connected to each other.

Nevertheless, most of these devices that team up with each other to build up the IoT world are powered by some kind of power sources. This is actually the main limitation of present IoT solutions. In order to be able to create real IoT environments, RFID, wireless power transfer (WPT), and EH devices appear as a major enabling technology for the IoT, due to their inherent simplicity and ability to provide sensing to remote objects without the need for constant powering.

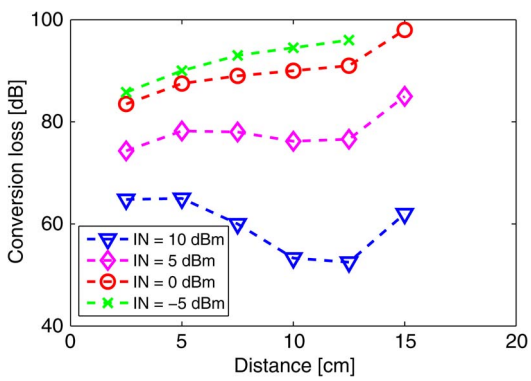

Fig. 16. ***Conversion (doubling) loss of the reader tag harmonic RFID system as a function of the reader tag distance, assuming the output reader power as a parameter. After [142].***

In this scenario, the concept of a smart floor becomes real. Smart floors should be capable of interacting with the environment seamlessly and be aware of persons and objects on top of them.

The focus of this section is going to be smart floors as an information system, where RFID capabilities are used to provide an identification and information source embedded into the floor. This massive RFID immersion will allow to create low-power high accuracy location, navigation, and, generally speaking, an information system that can team up with passers in a noninvasive way.

In this approach, the system uses passive RFID tags that are spread beneath a flooring in order to create a map that can be read with a mobile unit that might be self-powered through energy harvested from the movements of the subject to be located [144], [145].

This new location system based on smart floors can actually be extremely competitive when compared with existing solutions; among them, we can take into consideration those based on image processing [146]; they provide a high level of information at the price of high cost, power consumption, and intrusiveness. Another approach is based on pressure sensors [146], [147], providing actually a different type of smart floors; pressure sensors are nonintrusive and can be less expensive in terms of equipment when compared to the imaging systems; however, they can still be quite expensive to install into the floors; moreover, they do not allow for seamless identification of an individual in a given space. Eventually, ultrasounds [148] and RF localization system detection [149] have to be listed; although very flexible, they require dedicated communication infrastructures, additional complexity and costs, and they are mostly sensitive to environmental changes, both in terms of accuracy and functionalities.

The just mentioned smart-floor-based system tackles most of these challenges as it is very low cost, able to have a good, and precisely predictable, accuracy, and able to detect different users in a given space.

A. RFID-Based Smart Floor Including Material Aspects

Smart environments and floors should be completely seamless to the users. This entails the need to embed electronic devices into the environment in a noninvasive way. Nevertheless, this embedding of electronic devices, mainly wireless transceivers into the floor, is not a simple matter. Floors, in fact, have been made by almost the same kind of materials for centuries; tile industries are weakly available to introduce new materials to match

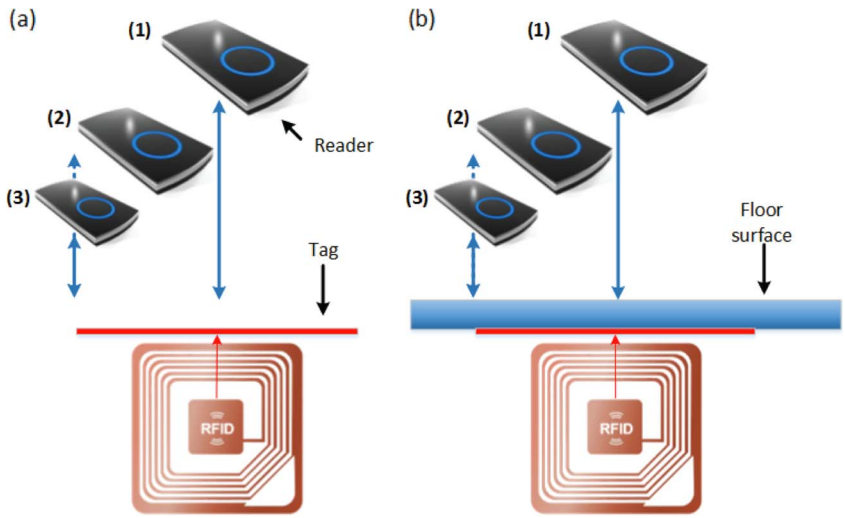

Fig. 17. ***Readable distance test scheme (a) without and (b) with tile. After [144].***

requirements posed by embedded electronics. Similar considerations can be made about the consolidated techniques to build apartments and houses: they are quite mature and whatever adaptation of them to embedded electronic systems is unrealistic. The consequence of this is that constitutive elements of SSs embedded into the floors must be suitable to materials and technologies already present: materials available are those adopted for tiles and SSs must be adapted to building constraints.

In this section, we focus on the most important approaches for the characterization of the EM properties of the materials, commonly adopted in floors, and their interactions with our electronic radio systems. As an example, ceramic tiles are going to be selected as the floor element where electronic tags have to be embedded.

Ceramic tiles have been used for ages to pave floors. These make up a great deal of most floor types in public buildings, from airports to banks, therefore, they are the most interesting flooring elements to investigate.

As the first approach, the study of the influence of some materials for floor surfaces, such as ceramic, cork laminates, and wood, in the communication between the transmitter and receiver devices has to be made; in this case, low-frequency (13 MHz) inductors are going to be used as the wireless interface.

In order to do the measurements, traditional RFIDs are used, which simplify the measurement approach significantly. A test setup is shown in Fig. 17, and experimental results are summarized in Table 3. What can be seen from the results presented in the table is that none of the tested materials affect the electrical characteristics of the RFID propagation significantly.

Another approach to the measurement is to evaluate the impact of the presence of metal inclusions beneath the ground; these can appear from pipes or from buildings supporting structures. In order to test this scenario, the presence of a metal sheet close to the coil was tested to verify its impact on the RFID reading distance. The test setup is presented in Fig. 18. In this case, when the reader is aligned (1) with the center of the coil beneath the tile, a minimum distance of 10 mm between the metallic sheet and the tag must be guaranteed in order to allow for the proper reading of the tag. In the other approach, the edge aligned scenario (2), the minimum distance between the metallic sheet and the tag increases to 30 mm to allow for communication.

Table 3 Results From Average Readable Distance Test

Tile type	Aligned (1)	Edge aligned (2)	Unaligned (3)
Without tile	4.5 cm	4.3 cm	2.4cm
Ceramic tile 4 mm thick	4.5 cm	4.3 cm	2.4cm
Ceramic tile 6 mm thick	4.5 cm	4.3 cm	2.4cm
Ceramic tile 7 mm thick	4.5 cm	4.3 cm	2.4cm
Cork laminate 5 mm thick	4.5 cm	4.3 cm	2.2cm
Wooden floor 8 mm thick	4.3 cm	4.2 cm	2.2cm

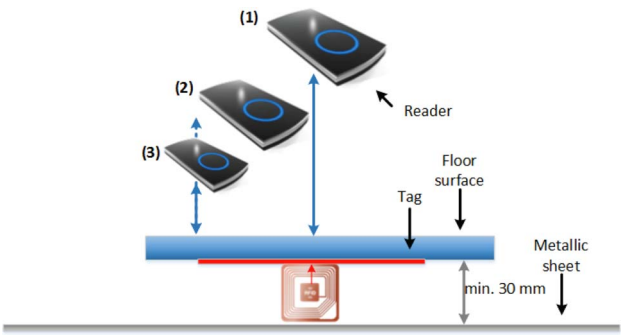

Fig. 18. ***Readable distance test scheme with metallic sheet presence. After [144].***

This test allows us to conclude that, in a real scenario, when considering the typical distance from the antenna to the floor, where the reader is usually embedded into a mobile device, a minimum distance from the tile to any metal inclusions in the ground has to be guaranteed. As seen, this safe distance should be at least 30 mm.

B. Navigation Approach Based on Smart Floors

A meaningful example of the applications of the smart floor concept is the demonstrator developed at the University of Aveiro, Aveiro, Portugal. It allows a nomadic RFID reader on top of it to be identified and localized by means of a smart floor.

The prototype in the present state is composed of four main components: a set of tagged tiles forming the smart floor, the nomadic reader, a wireless communication device to connect the reader to the information system, and a computer on which the location and navigation software is installed. A potential scenario of application for the monitoring of elderly housing is shown in Fig. 19. In the demonstrator presented, the RFID reader is connected to the radio unit and inserted into the user's shoes in order to read the passive tags as the user walks around a given area. The tile IDs are detected by the reader and sent to a centralized information system using, without lack of generality, a nonstandard wireless communication system, purposely developed in the laboratory.

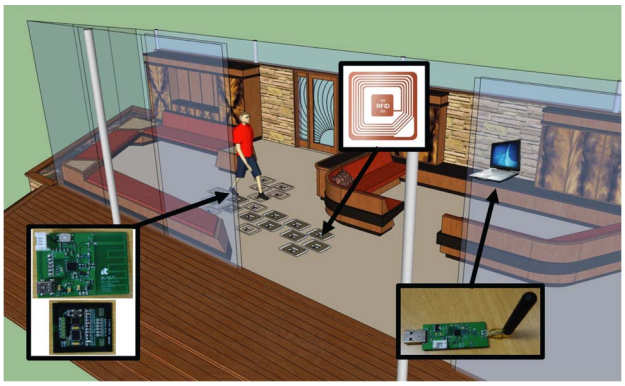

Fig. 19. ***Example of smart floor application scenario.***

The software in the computer then decodes the ID of the smart tile, and correlates it with a preloaded referenced map, thus being able to provide the precise position of the walker in the environment.

The location can be subsequently translated to a navigation system, and combined with artificial intelligence to allow navigation, situation awareness, etc.

Plenty of applications and related solutions can be envisioned on the basis of this smart floor approach: robot control, automatic pallet managements, prevention in harsh environments, and so forth.

VIII. SMART SHOES AND BAN

The aforementioned smart floor (Section VII), initially proposed to localize moving subjects in a given area, actually allows for the implementation of a very low-cost, accurate, and reliable system able to provide each kind of detectable information from an equipped area to the Internet.

To exploit the potentiality of a smart floor, it is obvious that developing purposely conceived communication units acting, on the one hand, as readers for tag tiles and, on the other hand, as communication systems with the web is needed.

One of the investigated systems for this is the so-called smart shoe [21]. Smart shoes are intended as shoes incorporating a reader able to illuminate the tag embedded into the tile and a wireless interface to communicate data to the web. To this extent, smart shoes can be seen as hubs of BANs able, on the one hand, to get information from the surrounding environment (body included) and, on the other hand, to communicate the collected information to the Internet. According to common buzzwords, they can be seen as the second technological layer, just above the first physical one consisting of tagged objects, in a hierarchical picture of IoT. Alternatively, they provide the cloud of nomadic readers with networking capabilities required for the implementation of the so-called networked RFID (N–RFID) [150] strategies. In the referred structure [21], the necessary antenna system is inkjet printed on paper, thus exploiting the process described in Section II, and it is a trademark-logo-shaped dual-band antenna working at 900 MHz and 2.4 GHz. A block diagram and its equivalent realization are shown in Fig. 20: it is worth noting that the reader itself works at 13.5 MHz exploiting the near-field communication (NFC) concept, according to what is stated in the smart floor section; as a consequence, there are no issues about the interference between the dual-band antenna and the NFC reader. Moreover, an approach similar to [145] is proposed to power the reader: the idea here is as well to harvest the energy produced by the human walking by means of piezoelectric materials embedded into the sole of the shoe.

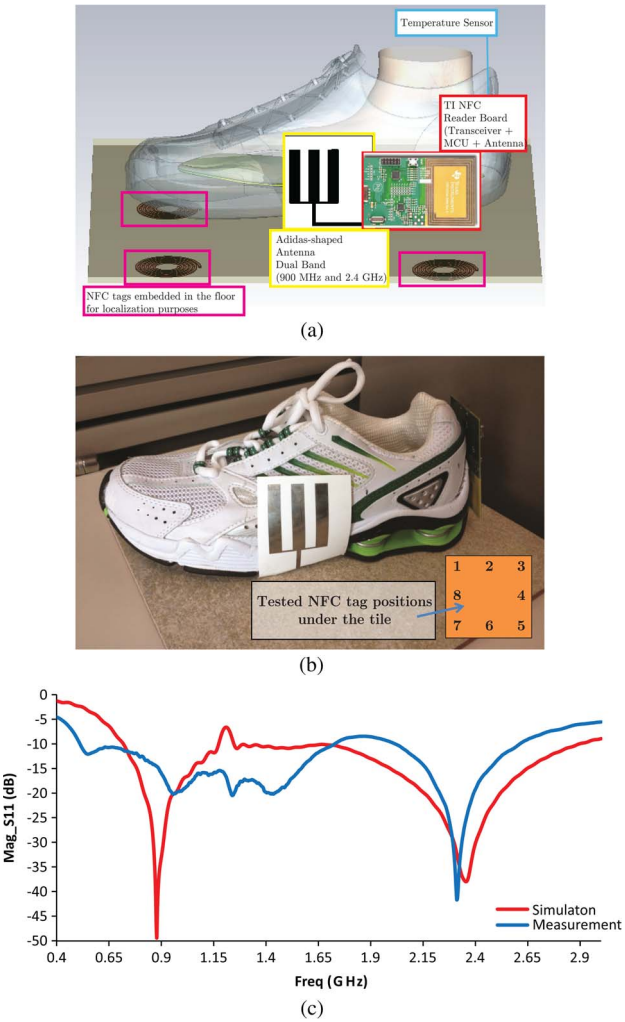

Fig. 20. ***(a) Block diagram, (b) photo, and (c) dual-band antenna results of the smart shoe that works as an energy autonomous reader for smart floors able to collect the localization data from the smart tiles and send them to a centralized system. After [21].***

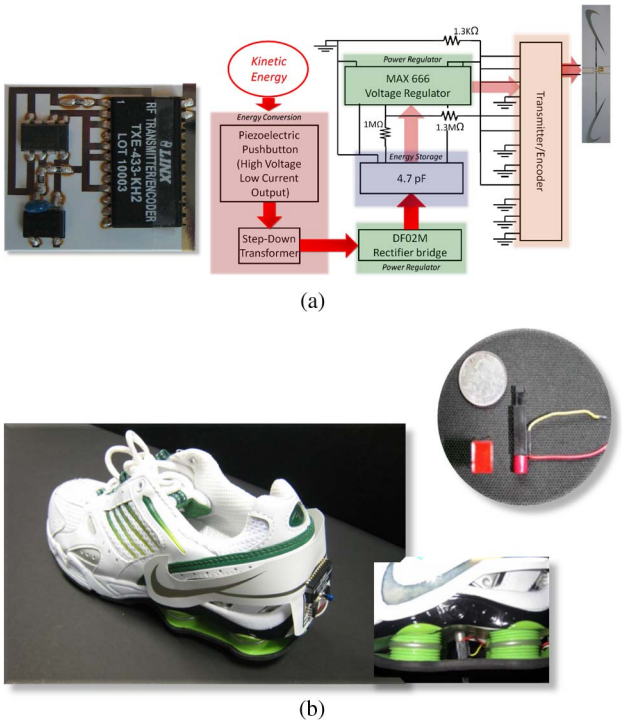

Fig. 21. ***(a) Mounted electronics on shoe with piezoelectric energy harvester and block diagram of the transmitting tag, driven by the EH unit. (b) Photograph of the assembled prototype showing the key components packaged on an organic flexible substrate. After [145].***

Fig. 21(a) shows the shoe with the mounted electronics consisting of a trademark-logo antenna inkjet printed on a flexible paper substrate together with the circuits in which the components [Fig. 21(b)] are fixed by conductive epoxy glue. A piezoelectric push button was embedded in the shoe to scavenge energy from human walking strike. This energy is then collected by a simple electronic circuit based on off-the-shelf components and used to supply the RFID transmitter. As reported in [145], the system is composed by the power-generator/energy-conversion device, the energy storage device, the power regulator circuit, and the RF transmitter that can broadcast the tag ID and the stored information.

When the push button is pressed, an inner spring is compressed and when the pressure exceeds a fixed threshold, the spring-loaded hammer will be released to deliver the dynamic mechanical force to the piezoelectric component; once the hammer strikes the piezoelectric element, a pressure wave is generated and reflected a few times between the hammer and the element, creating a mechanical resonance [151]. As a result, the generated output voltage follows closely an alternating current (ac) signal course. The signal out of the piezoelectric element is characterized by high voltage and low current; therefore, since this RF circuitry requires lower voltages at higher currents, a step-down transformer is used for better impedance matching to the following circuitry.

An energy storage device is adopted to collect the electrical energy and to provide it to the transmitter even when the external power source is temporarily unavailable; in fact, the RF transmitter takes tens of milliseconds to transmit one complete word, while the piezoelectric push button harvests energy in a transient time. To store the collected energy, a 4.7-μF tank capacitor was chosen. An ac–dc full wave diode bridge rectifier is used to convert the ac voltage from a piezoelectric element into a dc source and a dc linear regulator is added to adapt the dc voltage across the capacitor to 3-V transmitter operating voltage. For this purpose, a MAX666 low-dropout linear regulator, providing a stable 3-V supply until the tank capacitor charge is drained below the reference level of the dc linear regulator itself, is chosen. The transmitter used, the LINX

Table 4 Shoe Energy Performance Summary

Energy provided by the pushbutton	stored in the capacitor	848.4 μJ
Utilized energy	below 2.7 V capacitor voltage, the active RFID tag stops transmitting	17.1 μJ
Available energy	848.4 μJ − 17.1 μJ	831.3 μJ
Energy required by the circuit for a one-word transmission	Power Needed for 50 ms operation: 9 mW	450 μJ

TXE-433-KH2 [152], is able to combine a highly optimized RF transmitter with an onboard encoder.

The maximum voltage across the capacitor is 19 V; therefore, the energy stored in the capacitor can be calculated to be close to 850 μJ. After the strike, the regulator becomes active, providing power to the tag circuitry; its 3-V output remains constant before it starts to drop to zero according to the capacitor discharge rate. When the voltage across the capacitor drops below 2.7 V, the active tag stops transmitting. The resulting energy left in the capacitor and not used is about 17 μJ. The required time for successful completion has been measured to be close to 50 ms; the total circuit energy consumption for a 50-ms transmission is then approximately 9 mW (Section IV). Consequently, the energy required for a one word transmission is approximately 450 μJ, much less than the power collected by the energy conversion and regulation unit. The energy performance of the smart shoe is summarized in Table 4.

"Smart" solutions like smart shoes are suitable for smart floor interaction and for collecting information (position included) from them. The smart shoe has actually a double functionality: on the one hand, it is a means to collect information from the environment (smart floor included) and from the on-body sensors and apparatuses; on the other hand, it transfers data to the Internet, via WiFi, for instance, while likely receiving control and feedback signals. To this extent, it contributes to the development of wearable electronics for body-centric communication systems, according to the scheme of Fig. 22. This class of devices is based on the BAN concept (see Fig. 22): a network of wearable computational units, sensors, energy harvesters, and transceivers networked and implemented around the human body. The information is acquired by means of several sensors and, after processing and digital modulation, is transmitted by means of off-body transceivers. The most attractive application of BANs and wearable systems, so far, is probably health monitoring [88], but the number of foreseeable applications is constantly increasing (personal fitness monitoring, personal audio system, personal alarm set, and so on). Today, a big contribution to the BANs is being given by the interaction with portable devices such as smartphones which can be exploited as gateways.

Low-power ICs, sensors, and wireless communications are key elements of the BANs, and the use of EH techniques and mixed technologies such as RFID, as in the above described smart shoe, can contribute to the development of autonomous BANs. According to the notation adopted in [74] and [153], BANs can exploit wireless communication not only for off-body communications with other systems, but also for on-body and in-body communications to interconnect networked devices [wireless body area networks (WBANs)]. Generally, the proposed WBAN solutions are based on existing communication standards; but, recently, the IEEE 802.15.6 working group has provided a standard for short-range, wireless communications in the vicinity of, or inside, a human body based on ISM bands for BANs [154]. In this rapidly evolving scenario, smart shoes can be seen, in turn, as a promising mean to interface information coming from smart floors to the BANs and ultimately to the Internet, directly or via portable devices.

IX. ENERGY SKIN

Within SSs, another area is emerging, which requires dc energy. The availability of devices that can actually increase the battery life of our electronic gadgets [155] is the holy grail of IoT; the idea is actually to convert energy from

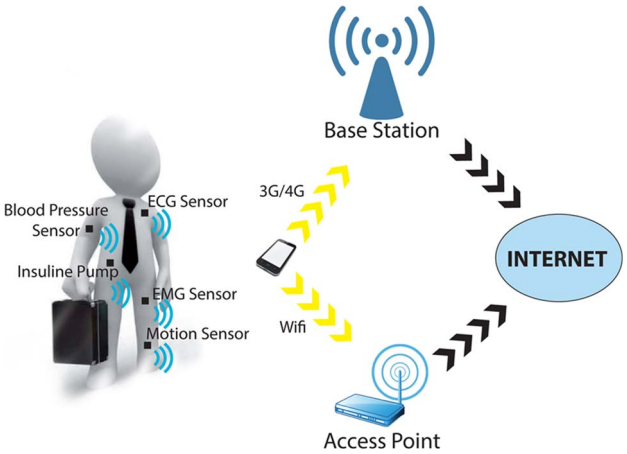

Fig. 22. ***BAN integrated with IoT: the data sensed on the human body and collected by smart devices are sent to the Internet through the standard protocols like third generation/fourth generation (3G/4G) and WiFi.***

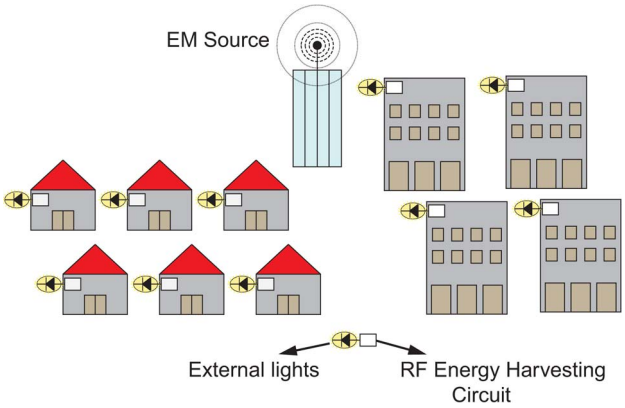

Fig. 23. ***EM source, likely supplied by solar energy in order to keep eco-friendliness, is used to broadcast energy to the urban neighborhood where houses are equipped with local RF–dc converters able to power supply local devices (external lamps in the example).***

different sources, as solar to dc [156], EM radio signals to dc, thermal to dc [156], vibration to dc [157], etc. [158].

Portable converters from solar to dc are today commonly available on the market at very low prize. Similar portable scavengers can be easily envisioned even for other energy converters. On this basis, plenty of sophisticated and more complex solutions are being proposed. Just as an example, we report the solution in Fig. 23, where the solar energy is used to supply an EM source that broadcasts RF energy in the surrounding urban environment; this energy is converted to dc energy at building level and, in turn, exploited to supply external local lamps. This approach was conceived for space applications [159], [160], but could be used in certain conditions in earth stations as well. The concept can actually move forward and be integrated into a smart skin, in the sense that all devices could be powered up by the skin energy conversion that a person can carry (vibrational, thermal, RF, etc.). This will become possible by integrating paper and textile radio electronic circuits in the smart skin surfaces of our clothes.

X. CONCLUSION

This paper focused on smart surfaces concept. This concept was introduced as a way to provide solutions to societal instances by means of technologies and techniques that today are gaining great momentum thanks to IoT development. The foreseeable IoT evolution, in fact, calls for systems and subsystems that are more and more energy conservative, fully autonomous (battery-less and not connected to the grid), as recyclable as possible (ultimately 100% biodegradable), flexible, and extremely low cost to be embedded in as many objects as possible. In order to meet these expectations, several technologies have to be implemented concurrently. This paper illustrates some of them, namely, recyclable and reliable materials, printing and R2R compatible techniques, conformal antennas on unconventional materials, and chipless RFID.

Subsequently, it has been shown how these technologies enable a fairly new branch of IoT development, represented just by SSs.

SSs are in their infancy; nevertheless, some examples, enabled by the aforementioned technologies, can be cited. Among them, the way to inherit "quasi-optics" and extend them to RF frequencies even below gigahertz is shown, and the smart floor implementation as a means to provide precise localization as well as assisted paths platforms has been reported. Energy skin as a means to convert several energy sources (solar, thermal, vibrational, EM, etc.) in electric one is described as well.

The reported examples must be researched as a new paradigm for potential promising developments aiming at providing new LAE solutions for the future networked society. ■

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In Spring 2012, she joined the ATHENA Research Group, Georgia Institute of Technology, Atlanta, GA, USA, for six months, working on eco-compatible indoor localization systems and other types of sensors fabricated by means of inkjet printing technology. At the end of 2013, she again joined the ATHENA Research Group for six months to work on multilayer inkjet printed systems and devices such as passives and microfluidics sensors.

Ricardo Gonçalves (Student Member, IEEE) was born in Lisbon, Portugal, in 1988. He received the B.Sc. and M.Sc. (*magna cum laude*) degrees in electronics and telecommunications engineering from the Instituto Superior de Engenharia de Lisboa, Lisbon, Portugal, in 2010 and 2012, respectively. He is currently working toward the Ph.D. degree in electrical engineering at the University of Aveiro, Aveiro, Portugal.

He is a Researcher at the Instituto de Telecomunicações, Aveiro, Portugal. In 2011, he was awarded with merit scholarship for exceptional academic performances. From 2010 to 2012, he worked at Dailywork I&D as a Developer Engineer in Embedded Electronic Systems for Vehicular Location Systems and Healthcare Platforms. His main research interests include wireless power transfer systems, radio-frequency identification (RFID), and wireless passive sensor networks. His current focus is on the development of printed antennas and microwave circuits in nonconventional materials such as textiles, ceramics, plastic, paper, and cork, for the former applications.

Pedro Pinho (Member, IEEE) was born in Vale de Cambra, Portugal, in 1974. He received the Licenciado and M.S. degrees in electrical and telecommunications engineering and the Ph.D. degree in electrical engineering from the University of Aveiro, Aveiro, Portugal, in 1995 and 2000, respectively. from the University of Aveiro, Aveiro, Portugal, in 1997, 2000, and 2004, respectively.

He is currently a Professor Adjunto at the Department of Electrical Telecommunications and Computers Engineering, Instituto Superior de Engenharia de Lisboa, Instituto Politécnico de Lisboa, Lisbon, Portugal, and a Member of the Research Staff at the Institute for Telecommunications, Aveiro, Portugal (since 1997). He authored or coauthored more than 90 papers in conferences and international journals and four book chapters. His current research interest is in antennas for location systems, reconfigurable antennas, and antenna design for passive sensors in nonconventional materials.

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RFID READER DETECTOR AND TILT-SENSITIVE RFID TAG

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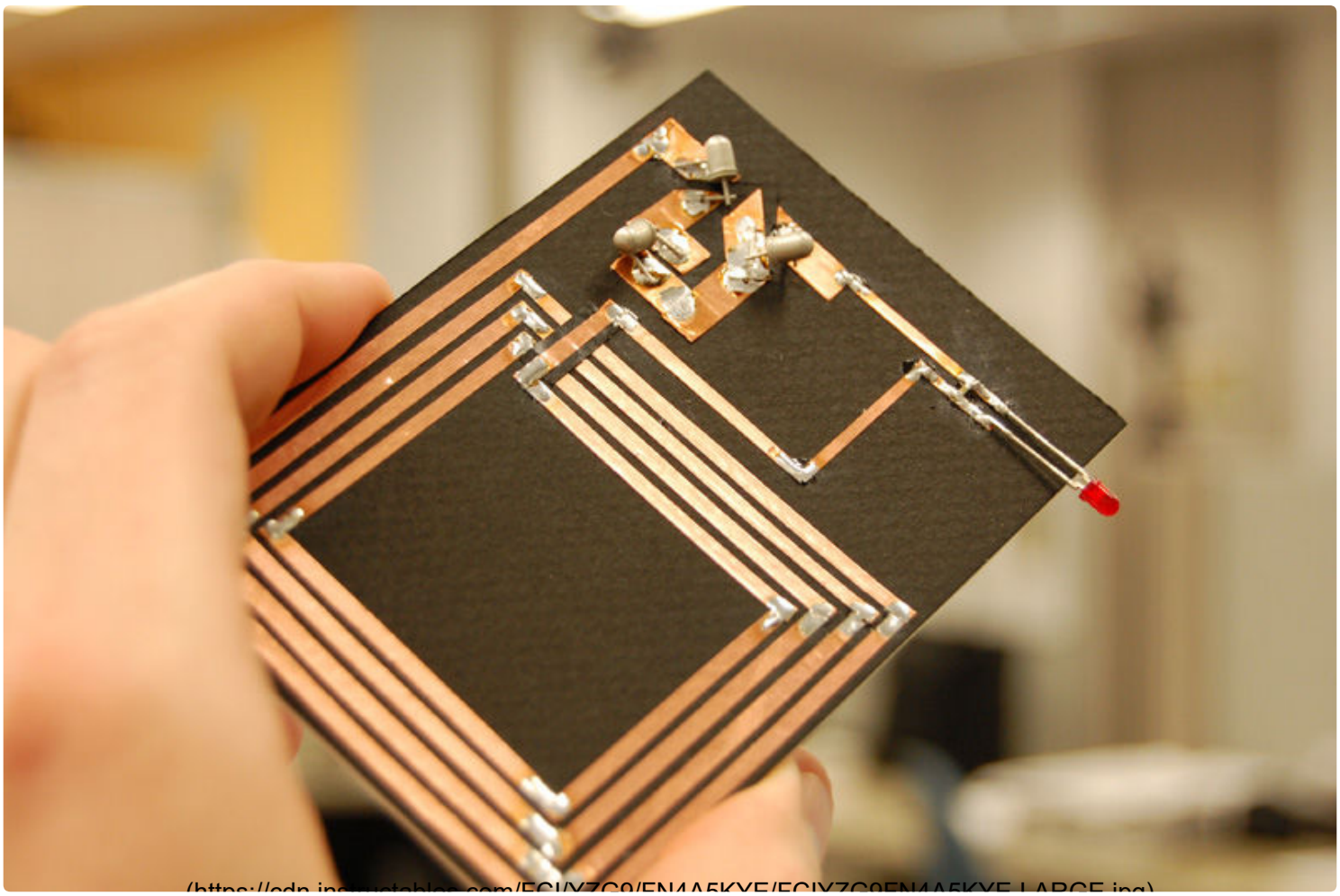

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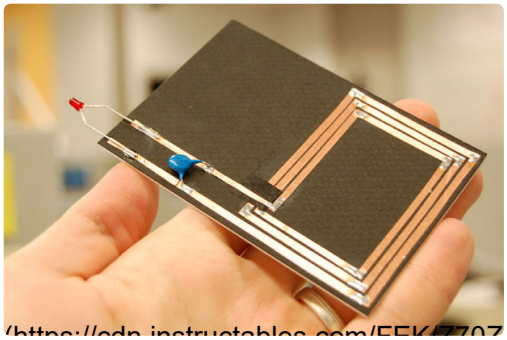
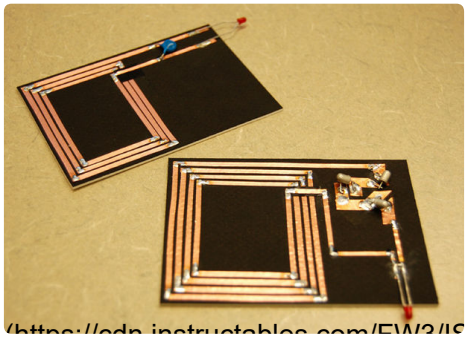
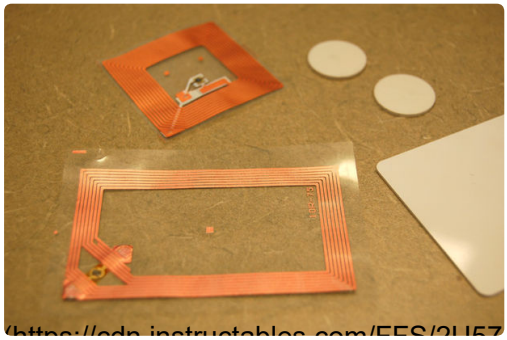

The 'rub' (http://www.usingenglish.com/reference/idioms/there%27s+the+rub.html)
Want to detect the presence of RFID readers? Want to control when a RFID tag is active or readable? We describe how to do both using bits of copper and card, and some readily available electronics hardware.

Longer preamble
Radio frequency identification (RFID (http://en.wikipedia.org/wiki/RFID)) is rapidly growing in popularity. RFID *tags* are found everywhere. They're attached to container freight, in those funny-looking white labels you find in newly purchased books, embedded in many corporate ID cards and passports, etc. The tags have a few common properties: they transmit a unique ID number, are optimized to be 'read' from predefined distances, and are usually small so they can remain unobtrusive or hidden.

RFID *readers* are used to track nearby tags by wirelessly reading a tag's unique ID (see Figure 4); a tag simply has to be brought into physical proximity with a reader to be read. Readers are mostly used for industrial or commercial purposes, e.g. asset tracking or electronic payment. Wal-mart use RFID tags and readers in their supply chain. The technology is also used in mass transit systems in cities like London (http://en.wikipedia.org/wiki/Oyster_card) and Hong Kong (http://en.wikipedia.org/wiki/Octopus_card). In Japan, many mobile phones incorporate readers to enable e-money payments in shops and vending machines.

For those of us who want to experiment with RFID, the problem is that the technology is almost always black boxed (http://en.wikipedia.org/wiki/Black_box).

That is, the inner workings of a tag and its interaction with a reader is hidden from view, and thus difficult to have much control over.

In the two exercises that follow (building a RFID reader detector (https://www.instructables.com/id/SX28QZ1FN4H8QCG/) and a tilt-sensitive RFID tag (https://www.instructables.com/id/SGW3J0SFN49WUIF/)), we offer an example of how you can start revealing some of the workings of RFID and thus gain some control over the technology. The two exercises also hopefully show that the technology is relatively simple and how it can be extended to support some interesting interactions. We offer some other possibilities that build on our examples at the end (https://www.instructables.com/id/SQKIRD4FN49ZUS1/).

Add Tip Ask Question

Step 1: Material and Tools

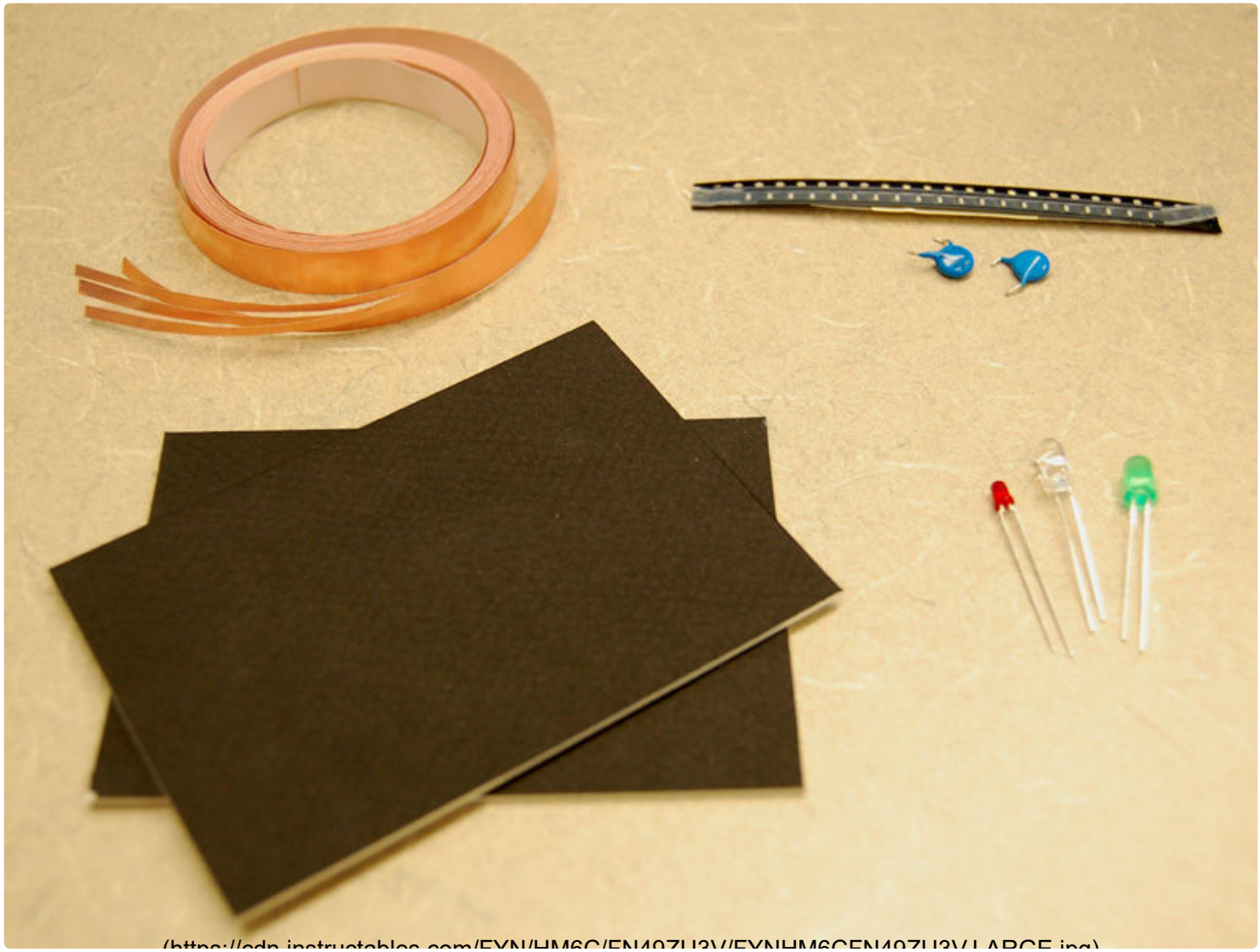

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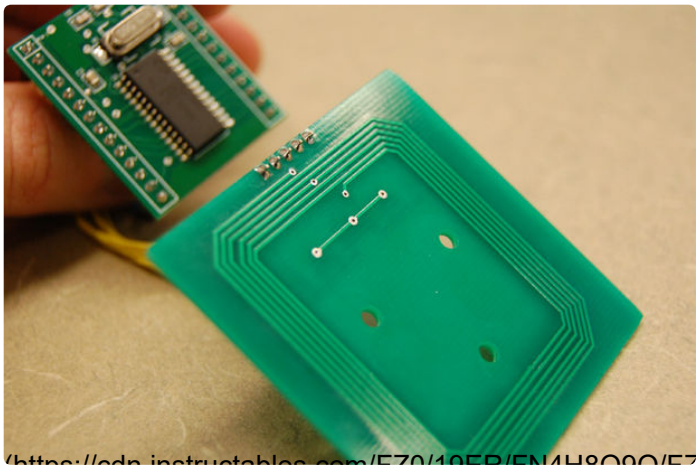

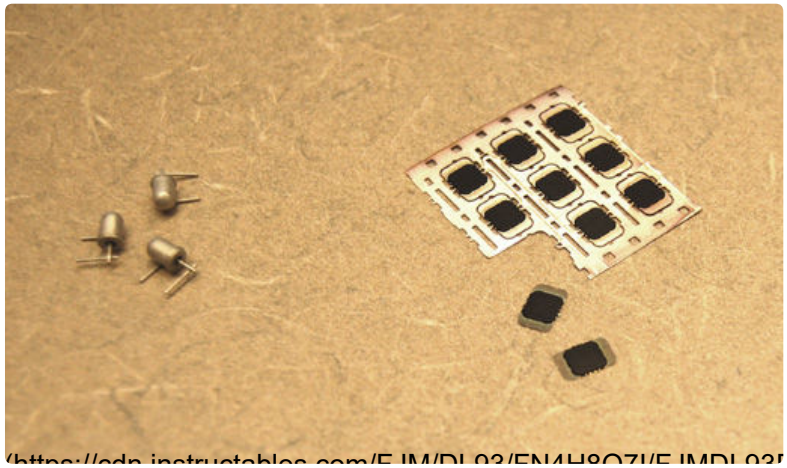

This section provides an overview of the necessary materials and tools.

Materials (see Figure 1):
We need the following material to built the basic RFID reader detector.
- Cardboard (around 100x70 mm)
- Conductive copper tape (e.g., order number 1218478 at www.farnell.com)
- Capacitor 82 pF (picofarad) (e.g., order number 1138852 at www.farnell.com)
- Low current LED (light-emitting diode) (e.g., order number 1003207at www.farnell.com)

Tools (see Figure 2 and 3):
- Craft knife and scissors
- Insulating tape (e.g., order number 1373979 at www.farnell.com)
- Soldering iron and solder

RFID reader for testing (see Figure 4):
To test our RFID tags we need an RFID reader that can operate at a frequency of 13.56 MHz.
There many readers for this widely used RFID standard, for instance the Sonmicro MIFARE USB reader (http://www.sonmicro.com/).
Note: The Phidget RFID reader does *not* work with the tags created in this project, as it uses a different frequency for communication with the tags (125 kHz).

Advanced material (see Figure 5):
The following material is necessary to build the second part of the project: the tilt-sensitive RFID tag.
- Micro tilt switches (e.g., www.digikey.com)
- RFID ICs (e.g., MIFARE Standard 1k, part no. 568-2219-1-ND at www.digikey.com)

Add Tip Ask Question

Step 2: Building the RFID Antenna

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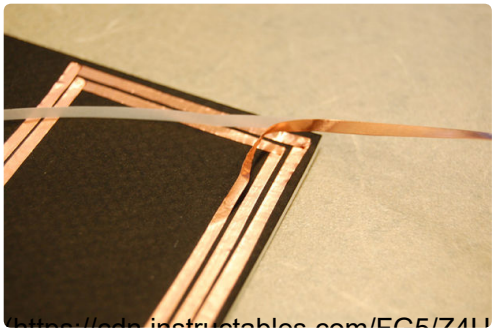
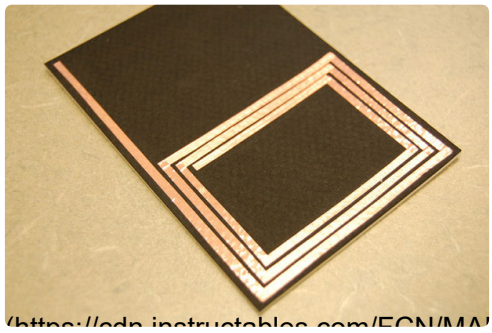
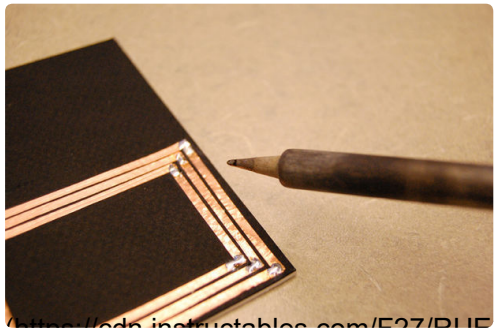

This step describes how to build the antenna for the RFID tag.

Building the RFID tag antenna

To build the tag's antenna follow these three steps.

1. Cut the conductive copper tape into thin stripes of around 2mm (see Figure 1).
2. Tape these stripes (see Figure 2) in loops around one half of the cardboard (see Figure 3 for the layout of the antenna). The tag should have between 3-4 loops for the antenna.
3. Solder all the connections between the copper tape. Sometimes, this isn't necessary as the tape's adhesive backing is conductive, but solder the connections if you want to be on the safe side.

Now we have created our RFID tag antenna, and we will add the "RFID reader detection" functionality in the following step.

A little background

RFID readers transmit an electromagnetic (EM) field with their reader antenna. This EM field induces a current in the antenna for all RFID tags within reading distance. This induced current activates the RFID chip that is connected to the tag's antenna. This chip then modulates a response (usually the unique ID number) that is transmitted back to the reader. The antenna of an RFID tag is usually a thin copper wire that is arranged in loops. The loops allow the emitted EM field of the RFID reader to induce current to the antenna of the tag.

Add Tip Ask Question

Step 3: RFID Reader Detection

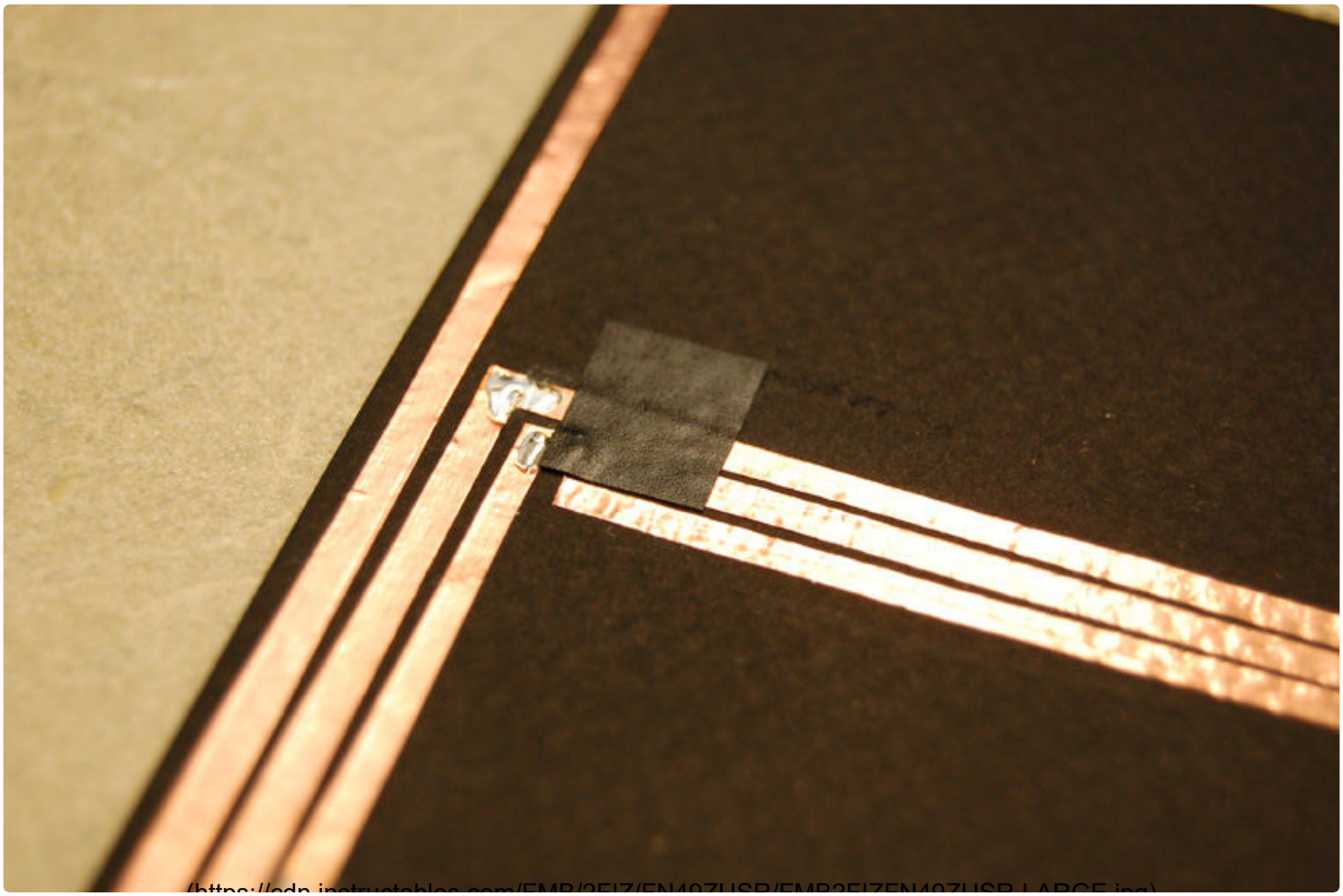

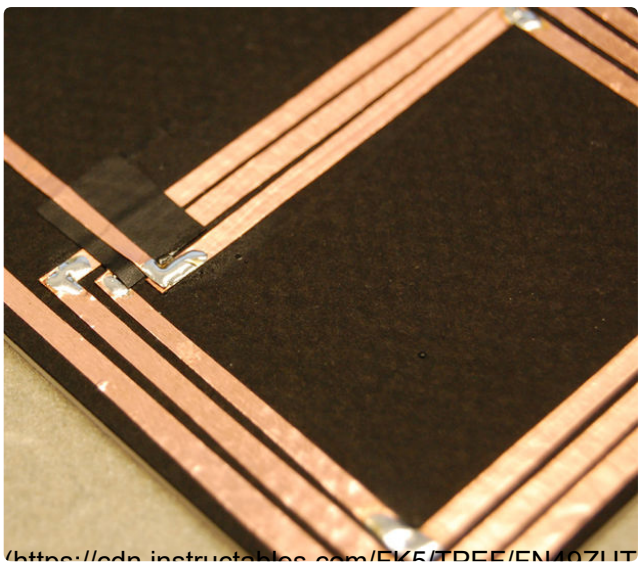

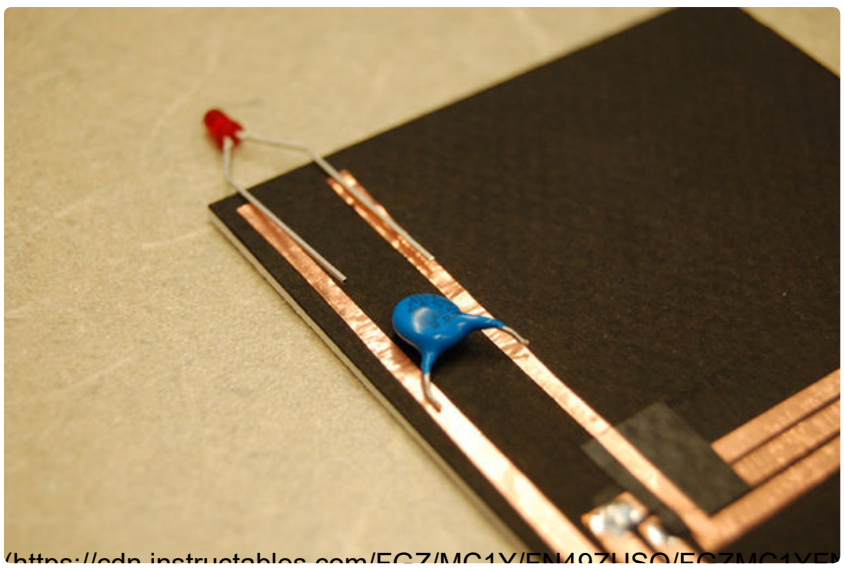

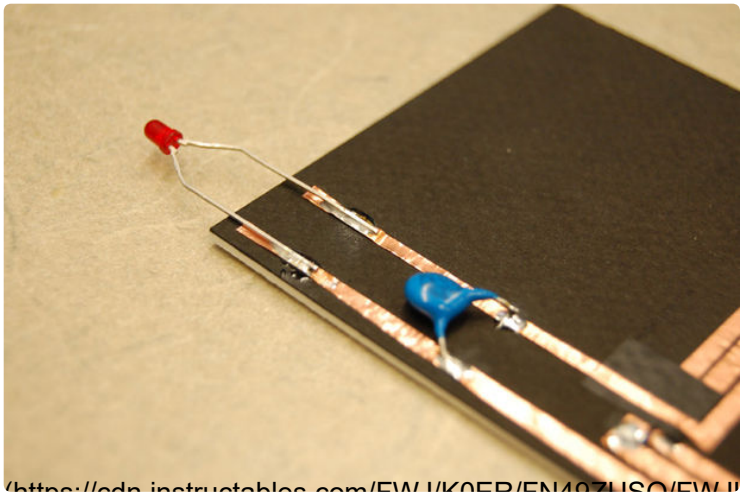

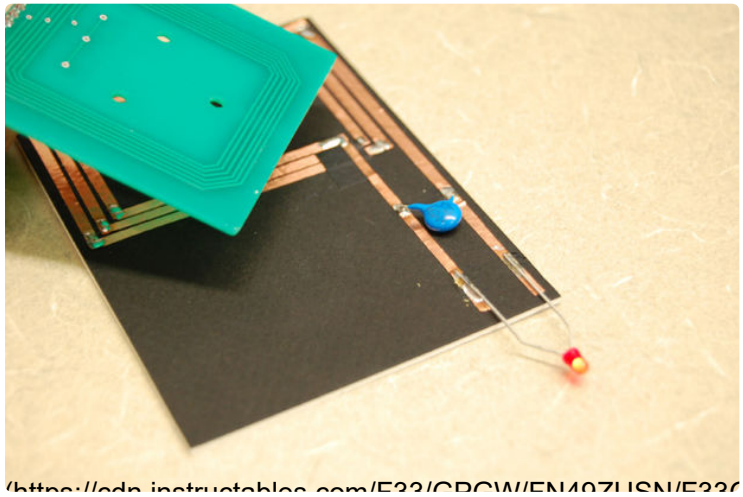

This step describes how to add a simple mechanism to the RFID tag antenna that allows us detect nearby RFID readers.

Antenna connection

First, we add a small piece of insulation tape for the connection of the inner end of the antenna loop (as illustrated in Figure 1). This is to insulate the outer loops. Then we add another copper tape strip to the inner end of the antenna as shown in Figure 2. Here again we solder the two ends of the conductive copper tape together.

Capacitor and LED

Next, we add the capacitor (82 pF) and the low current LED to the tag as shown in Figure 3. They are connected in parallel. We also solder these two components to the copper tape (see Figure 4).

Testing

With these simple steps, our RFID reader detector is finished! By bringing our DIY RFID detector close to an RFID reader (as shown in Figure 5), the connected LED lights up. With the Sonmicro reader hardware the distance to the reader has to be below 8-10 cm; however, there are RFID readers available with a stronger EM field and therefore a higher maximum reading distance.

In the next step of the instructable we will show how to extend a basic RFID tag and make it tilt-sensitive.

Add Tip Ask Question

Step 4: Tilt-Sensitive RFID Tag

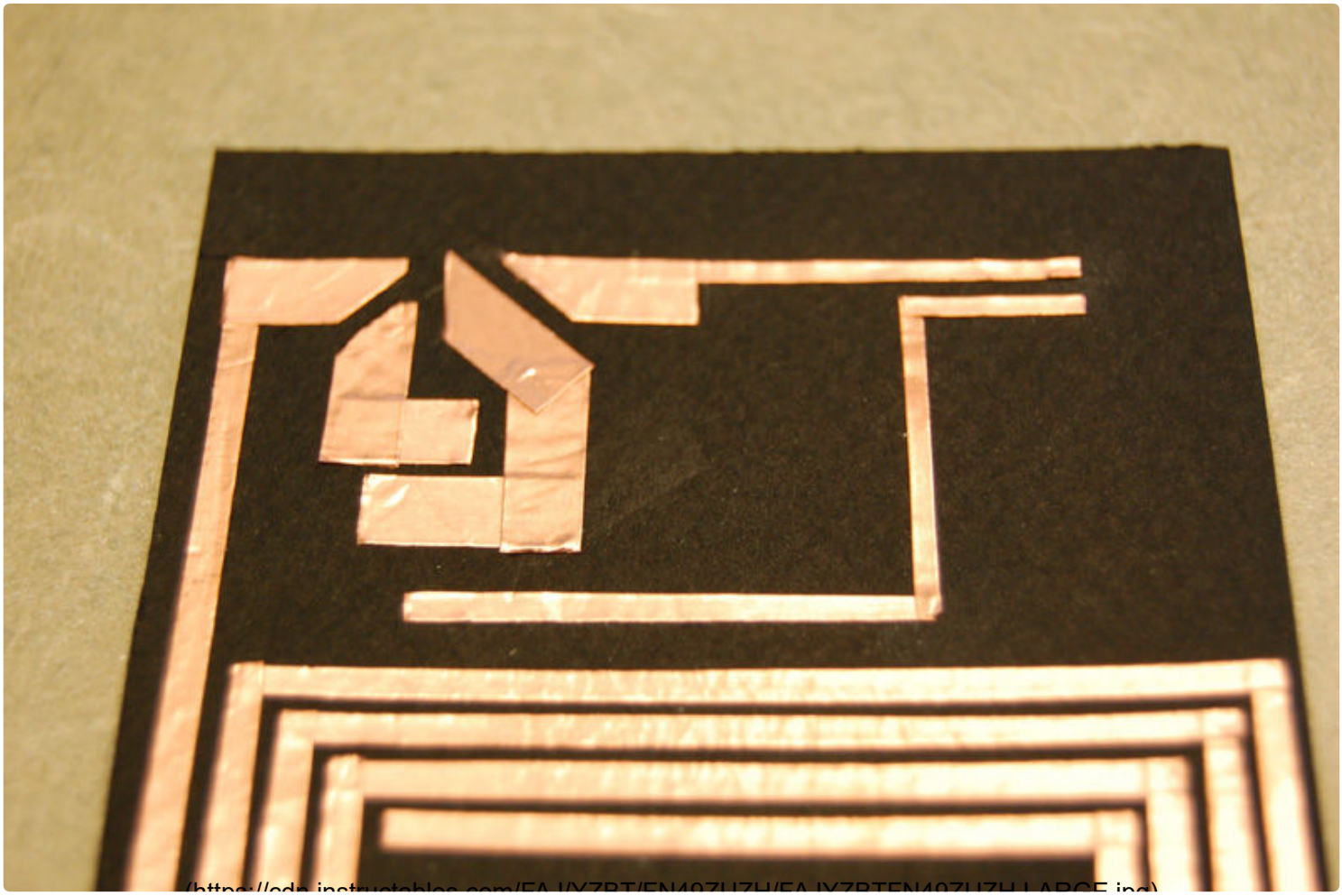

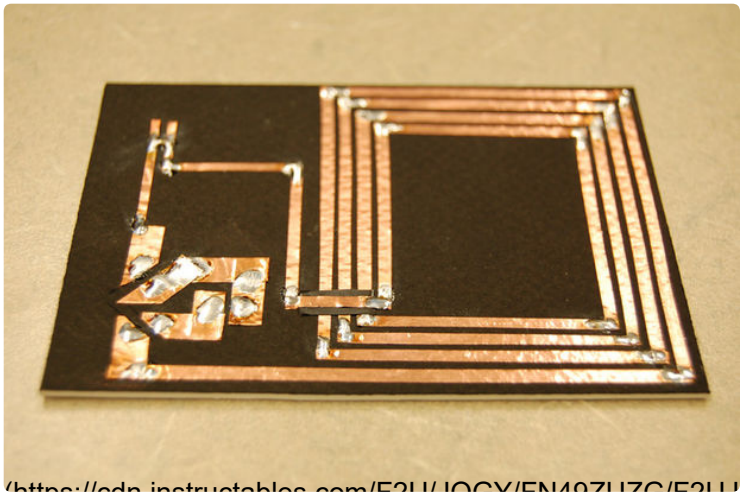

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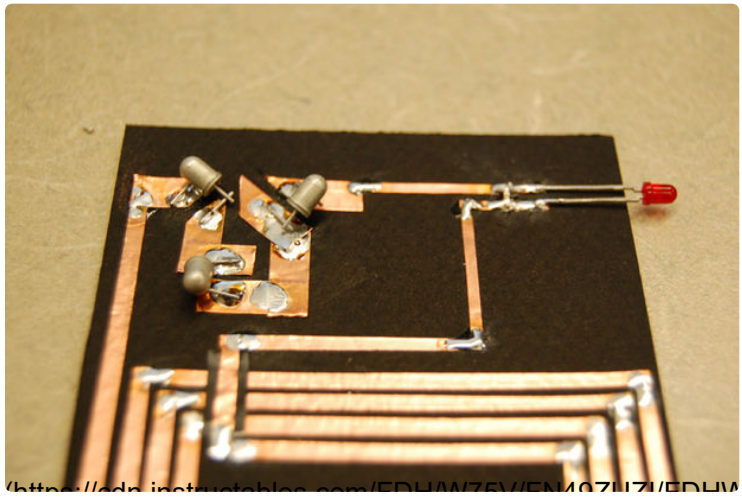

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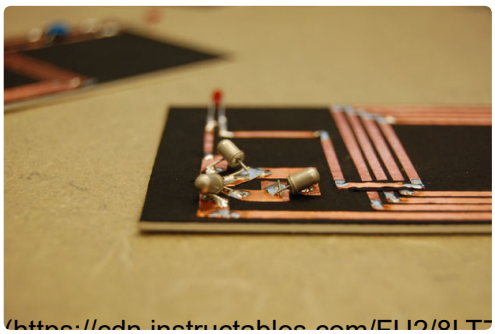

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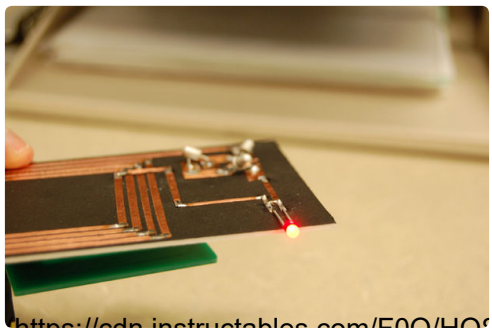

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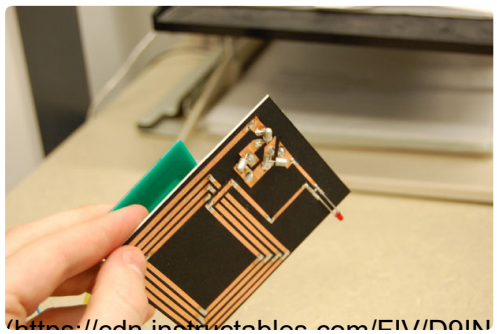

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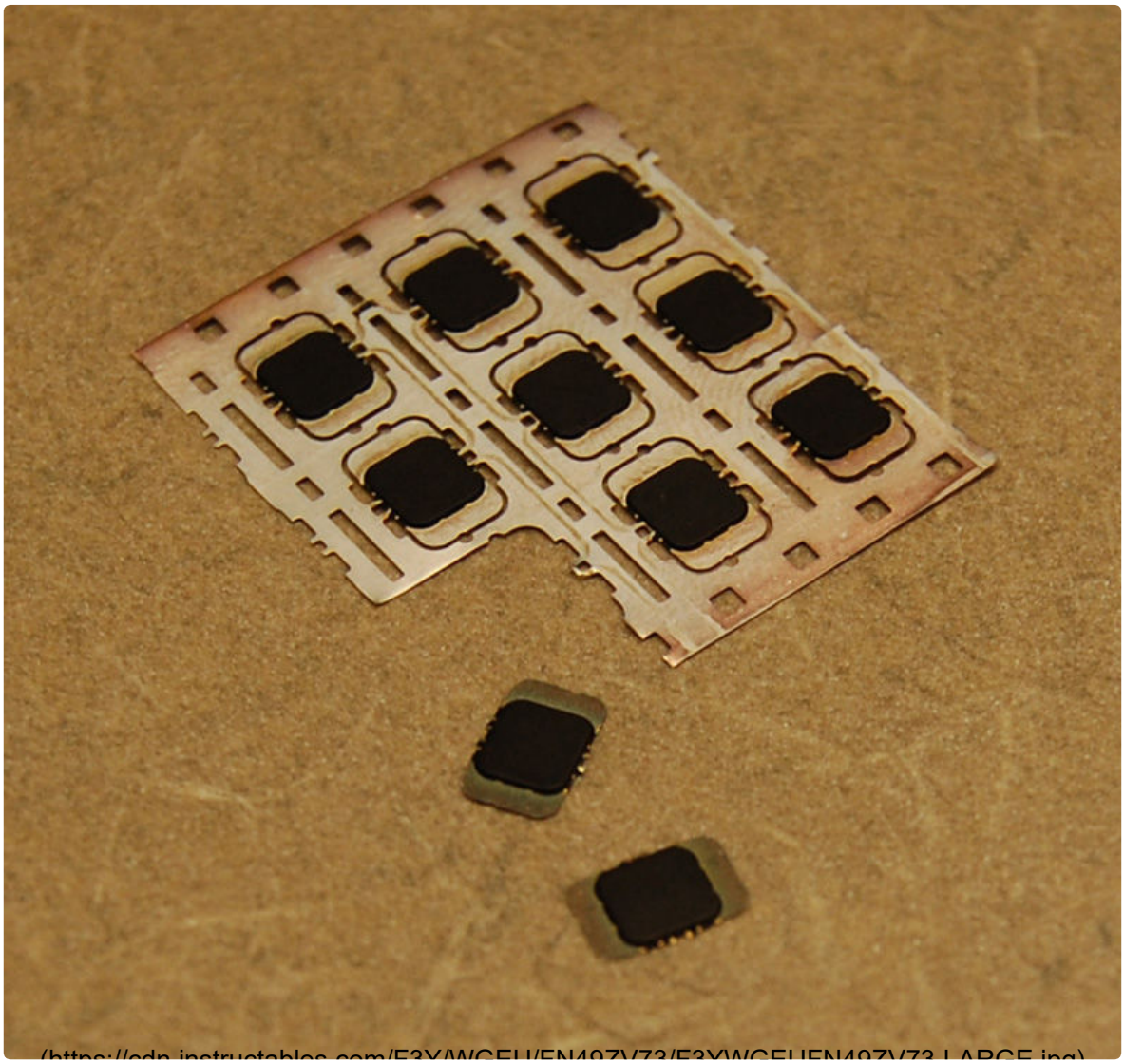

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We now describe the process of how to build a tilt-sensitive RFID tag. This extends the previous exercise.

Antenna

The antenna for this second RFID tag is similar to the first antenna we built. We thus need another piece of cardboard and to repeat the steps described earlier in STEP 2 (https://www.instructables.com/id/S2YO8NWFN4H8Q8A/) of this instructable.

Tilt-sensitive tag

Next, we add additional copper tape connections to the tag, as shown in Figure 1. These connections allow us to connect three tilt switches, a capacitor, and the LED to the antenna. Again, all the connections of the copper tape are soldered together. We add the three tilt switches to the tag as shown in Figure 3. The tilt switches are soldered to the copper tape, and it is important to connect them in a slight angle (around 5-10 degrees) as shown in Figure 4. This makes sure that the silt switches are in a *closed* state while the RFID tag is in a horizontal position, and in a *open* state while the tag is in a vertical position.

Again, we also add an LED and a capacitor to the antenna as shown in Figure 3 (we use a different form factor of the capacitor here just to illustrate the alternative options).

Testing the tilt-sensitive tag

We can now use our Sonmicro RFID reader again to test our new tilt-sensitive RFID tag. The tag is activate while in a horizontal position as in Figure 5, and is inactive when in a vertical position as in Figure 6.

Using RFID chips

We can now replace the connected capacitor and LED from our tag with an RFID

MICROWAVE AND RADIO FREQUENCY ENGINEERING

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TRANSMISSION LINES

TELEGRAPHER'S EQUATIONS

$$(1)\quad \frac{\partial V}{\partial z} = -L\frac{\partial I}{\partial t} \qquad (2)\quad \frac{\partial I}{\partial z} = -C\frac{\partial V}{\partial t}$$

By taking the partial derivative with respect to *z* of equation 1 and partial with respect to *t* of equation 2, we can get:

$$(\text{i})\quad \frac{\partial^2 V}{\partial z^2} = LC\frac{\partial^2 V}{\partial t^2} \qquad (\text{ii})\quad \frac{\partial^2 I}{\partial z^2} = LC\frac{\partial^2 I}{\partial t^2}$$

SOLVING THE EQUATIONS

To solve the equations (i) and (ii) above, we guess that $F(u) = F(z \pm vt)$ is a solution to the equations. It is found that the unknown constant v is the wave propagation velocity.

$$\boxed{V_{total} = V_+(z - vt) + V_-(v + vt)}$$ where:

z is the position along the transmission line, where the load is at z=0 and the source is at z=-l, with l the length of the line.

v is the **velocity of propagation** $1/\sqrt{LC}$ or ω/β, the speed at which the waveform moves down the line; see p 2

t is time

THE COMPLEX WAVE EQUATION

The general solutions of equations (i) and (ii) above yield the complex wave equations for voltage and current. These are applicable when the excitation is sinusoidal and the circuit is under steady state conditions.

$$\boxed{V(z) = V^+ e^{-j\beta z} + V^- e^{+j\beta z}}$$

$$\boxed{I(z) = I^+ e^{-j\beta z} + I^- e^{+j\beta z}}$$

$$\boxed{I(z) = \frac{V^+ e^{-j\beta z} + V^- e^{+j\beta z}}{Z_0}}$$ where:

$e^{-j\beta z}$ and $e^{+j\beta z}$ represent wave propagation in the $+z$ and $-z$ directions respectively,

$\beta = \omega\sqrt{LC} = \omega / v$ is the **phase constant,**

$Z_0 = \sqrt{L/C}$ is the **characteristic impedance** of the line.

These equations represent the voltage and current **phasors**.

+/- WATCHING SIGNS

By convention z is the variable used to describe position along a transmission line with the origin z=0 set at the load so that all other points along the line are described by **negative** position values.

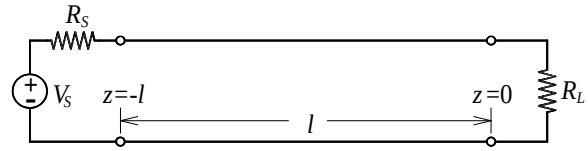

Ohm's law for right- and left-traveling disturbances:

$$V_+ = I_+ Z_0 \qquad V_- = -I_- Z_0$$

v_p VELOCITY OF PROPAGATION [cm/s]

The velocity of propagation is the speed at which a wave moves down a transmission line. The velocity approaches the speed of light but may not exceed the speed of light since this is the maximum speed at which information can be transmitted. But v_p may exceed the speed of light mathematically in some calculations.

$$\boxed{v_p = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{\varepsilon\mu}} = \frac{\omega}{\beta}}$$ where:

L = inductance per unit length [H/cm]
C = capacitance per unit length [F/cm]
ε = permittivity of the material [F/cm]
μ = permeability of the material [H/cm]
ω = frequency [radians/second]
β = phase constant

Phase Velocity The velocity of propagation of a TEM wave may also be referred to as the *phase velocity*. The phase velocity of a TEM wave in conducting material may be described by:

$$\boxed{v_p = \omega\delta = \frac{\omega}{k} = c\frac{2\pi\delta}{\lambda_0} = c\frac{1}{\sqrt{\varepsilon_{r\ \mathrm{eff}}}}}$$ where:

δ = skin depth [m]
c = speed of light 2.998×10^8 m/s
λ_0 = wavelength in the material [m]

Z_0 CHARACTERISTIC IMPEDANCE [Ω]

The **characteristic impedance** is the resistance initially *seen* when a signal is applied to the line. It is a physical characteristic resulting from the materials and geometry of the line.

Lossless line: $$Z_0 \equiv \sqrt{\frac{L}{C}} = \frac{V_+}{I_+} = -\frac{V_-}{I_-}$$

Lossy line: $$Z_0 \equiv \sqrt{\frac{R + j\omega L}{G + j\omega C}} = |Z_0| e^{j\phi_z}$$

L = inductance per unit length [H/cm]
C = capacitance per unit length [F/cm]
V_+ = the forward-traveling (left to right) voltage [V]
I_+ = the forward-traveling (left to right) current [I]
V_- = the reverse-traveling (right to left) voltage [V]
I_- = the reverse-traveling (right to left) current [I]
R = the line resistance per unit length [Ω/cm]
G = the conductance per unit length [Ω^{-1}/cm]
ϕ = phase angle of the complex impedance [radians]

y_0 CHARACTERISTIC ADMITTANCE [Ω^{-1}]

The **characteristic admittance** is the reciprocal of the characteristic impedance.

$$y_0 \equiv \sqrt{\frac{C}{L}} = \frac{I_+}{V_+} = -\frac{I_-}{V_-}$$

r REFLECTION COEFFICIENT

The **reflection coefficient** is the ratio of reflected voltage to the forward-traveling voltage, a value ranging from –1 to +1 which, when multiplied by the wave voltage, determines the amount of voltage reflected at one end of the transmission line.

$$\rho \equiv \frac{V_-}{V_+} = -\frac{I_-}{I_+}$$

A reflection coefficient is present at each end of the transmission line:

$$\rho_{source} = \frac{R_S - z_0}{R_S + z_0} \qquad \rho_{load} = \frac{R_L - z_0}{R_L + z_0}$$

t TRANSMISSION COEFFICIENT

The **transmission coefficient** is the ratio of total voltage to the forward-traveling voltage, a value ranging from 0 to 2.

$$\tau \equiv \frac{V_{total}}{V_+} = 1 + \rho$$

TOF TIME OF FLIGHT [s]

The **time of flight** is how long it takes a signal to travel the length of the transmission line

$$TOF \equiv \frac{l}{v} = l\sqrt{LC} = \sqrt{L_{TOT} C_{TOT}}$$

l = length of the transmission line [cm]
v = the velocity of propagation $1/\sqrt{LC}$, the speed at which the waveform moves down the line
L = inductance per unit length [H/cm]
C = capacitance per unit length [F/cm]
L_{TOT} = total inductance [H]
C_{TOT} = total capacitance [F]

DERIVED EQUATIONS

$$V_+ = z_0 I_+ = (V_{TOT} + I_{TOT} z_0)/2$$
$$V_- = -z_0 I_- = (V_{TOT} - I_{TOT} z_0)/2$$
$$I_+ = y_0 V_+ = (I_{TOT} + V_{TOT} y_0)/2$$
$$I_- = -y_0 V_- = (I_{TOT} - V_{TOT} y_0)/2$$

C_n FOURIER SERIES

The function $x(t)$ must be periodic in order to employ the Fourier series. The following is the exponential Fourier series, which involves simpler calculations than other forms but is not as easy to visualize as the trigonometric forms.

$$C_n = \frac{1}{T}\int_{t_1}^{t_1+T} x(t) e^{-jn\omega_0 t}\, dt$$

C_n = amplitude
T = period [s]
t = time [s]
n = the harmonic (an integer)
w_0 = frequency $2\pi/T$ [radians]

The function $x(t)$ may be delayed in time. All this does in a Fourier series is to shift the phase. If you know the C_ns for $x(t)$, then the C_ns for $x(t\text{-}\alpha)$ are just $C_n e^{-jn\omega 0\alpha}$. (Here, C_ns is just the plural of C_n.)

C CAPACITANCE [F]

$$v(t) = \frac{1}{C}\int_0^t i\,d\tau + v(0) \qquad I_{cap} = C\frac{dV_{cap}}{dt}$$

$$\boxed{v(t) = v_f + (v_0 - v_f)e^{-t/t}} \qquad i(t) = i_f + (i_0 - i_f)e^{-t/t}$$

$$P(t) = i_0^{\,2} R e^{-2t/\tau}$$

$v(t)$ = voltage across the capacitor, at time t [V]
v_f = final voltage across the capacitor, steady-state voltage [V]
v_0 = initial voltage across the capacitor [V]
t = time [s]
τ = the time constant, RC [seconds]
C = capacitance [F]
Natural log: $\ln x = b \Leftrightarrow e^b = x$

C PARALLEL PLATE CAPACITANCE

$$C = \frac{\varepsilon A}{h} \qquad C_{\text{per unit length}} = \frac{\varepsilon A}{lh} = \frac{\varepsilon wl}{lh} = \frac{\varepsilon w}{h}$$

ε = permittivity of the material [F/cm]
A = area of one of the capacitor plates [cm^2]
h = plate separation [cm]
w = plate width [cm]
l = plate length [cm]
C = capacitance [F]

CAPACITOR-TERMINATED LINE

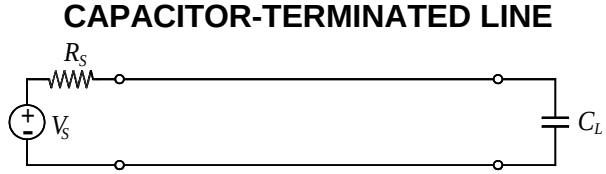

Where the incident voltage is $V_+ = V_0\left(1 - e^{-t/\tau_0}\right)$,

$$V_{cap} = V_+ + V_- = V_0\left(2 + \frac{2\tau_1}{\tau_0 - \tau_1}e^{-t/\tau_1} - \frac{2\tau_0}{\tau_0 - \tau_1}e^{-t/\tau_0}\right)$$

V_0 = final voltage across the capacitor [V]
t = time [s]
τ_0 = time constant of the incident wave, RC [s]
τ_1 = time constant effect due to the load, Z_0C_L [s]
C = capacitance [F]

SMITH CHART

First **normalize the load impedance** by dividing by the characteristic impedance, and find this point on the chart.

When working in terms of **reactance** X, an inductive load will be located on the top half of the chart, a capacitive load on the bottom half. It's the other way around when working in terms of **susceptance** B [Siemens].

Draw a straight line from the center of the chart through the normalized load impedance point to the edge of the chart.

Anchor a compass at the center of the chart and draw a circle through the normalized load impedance point. Points along this circle represent the normalized impedance at various points along the transmission line. Clockwise movement along the circle represents movement from the load toward the source with one full revolution representing 1/2 wavelength as marked on the outer circle. The two points where the circle intersects the horizontal axis are the voltage maxima (right) and the voltage minima (left).

The point opposite the impedance (180° around the circle) is the **admittance** Y [Siemens]. The reason admittance (or susceptibility) is useful is because admittances in parallel are simply added. (**Admittance** is the reciprocal of impedance; **susceptance** is the reciprocal of reactance.)

$$\boxed{\Gamma(z) = \Gamma_L e^{j2\beta z}}$$

$$e^{j2\beta z} = 1\angle 2\beta z$$

$$\mathbf{G}(z) = \frac{\mathbf{Z}(z) - 1}{\mathbf{Z}(z) + 1}$$

$$\mathbf{Z}_L = \frac{\Gamma_L - 1}{\Gamma_L + 1} \qquad \boxed{\mathbf{Z} = \frac{Z_L}{Z_0}}$$

z = distance from load [m]
$j = \sqrt{-1}$
ρ = magnitude of the reflection coefficient
β = phase constant
Γ = reflection coefficient
Z = normalized impedance [Ω]

SINGLE-STUB TUNING

The basic idea is to connect a line stub in parallel (shunt) or series a distance d from the load so that the imaginary part of the load impedance will be canceled.

Shunt-stub: Select d so that the admittance Y looking toward the load from a distance d is of the form $Y_0 + jB$. Then the stub susceptance is chosen as $-jB$, resulting in a matched condition.

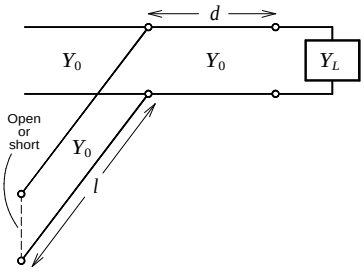

Series-stub: Select d so that the admittance Z looking toward the load from a distance d is of the form $Z_0 + jX$. Then the stub susceptance is chosen as $-jX$, resulting in a matched condition.

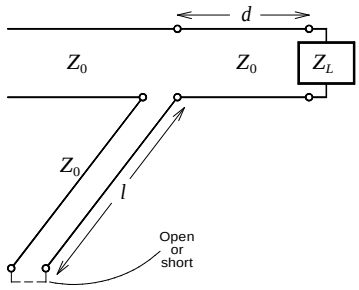

FINDING A STUB LENGTH

Example: Find the lengths of open and shorted shunt stubs to match an admittance of 1-j0.5. The admittance of an open shunt (zero length) is Y=0; this point is located at the left end of the Smith Chart x-axis. We proceed clockwise around the Smith chart, i.e. away from the end of the stub, to the +j0.5 arc (the value needed to match –j0.5). The difference in the starting point and the end point on the wavelength scale is the length of the stub in wavelengths. The length of a shorted-type stub is found in the same manner but with the starting point at Y=∞.

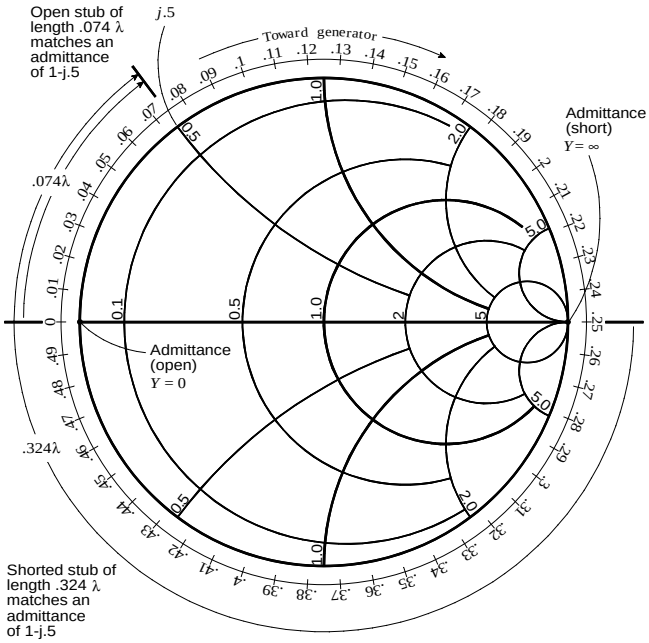

In this example, all values were in units of admittance. If we were interested in finding a stub length for a series stub problem, the units would be in impedance. The problem would be worked in exactly the same way. Of course in impedance, an open shunt (zero length) would have the value Z=∞, representing a point at the right end of the x-axis.

LINE IMPEDANCE [Ω]

The impedance seen at the source end of a lossless transmission line:

$$Z_{in} = Z_0 \frac{1+\rho}{1-\rho} = Z_0 \frac{Z_L + jZ_0 \tan(\beta l)}{Z_0 + jZ_L \tan(\beta l)}$$

For a lossy transmission line:

$$Z_{in} = Z_0 \frac{Z_L + Z_0 \tanh(\gamma l)}{Z_0 + Z_L \tanh(\gamma l)}$$

Line impedance is periodic with spatial period λ/2.

$Z_0 = \sqrt{L/C}$, the characteristic impedance of the line. [Ω]

ρ = the reflection coefficient

Z_L = the load impedance [Ω]

β = 2π/λ, phase constant

γ = α+*j*β, complex propagation constant

l WAVELENGTH [cm]

The physical distance that a traveling wave moves during one period of its periodic cycle.

$$\boxed{\lambda = \frac{2\pi}{\beta} = \frac{2\pi}{k} = \frac{v_p}{f}}$$

β = $\omega\sqrt{LC}$ = 2π/λ, phase constant

k = $\omega\sqrt{\mu\varepsilon}$ = 2π/λ, wave number

v_p = velocity of propagation [m/s] see p 2.

f = frequency [Hz]

l/4 QUARTER-WAVE SECTION

A quarter-wave section of transmission line has the effect of inverting the <u>normalized</u> impedance of the load.

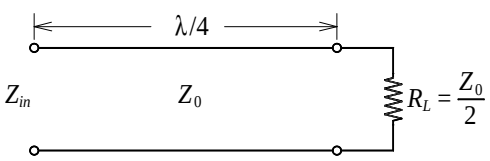

To find Z_{in}, we can normalize the load (by dividing by the characteristic impedance), invert the result, and "unnormalize" this value by multiplying by the characteristic impedance.

In this case, the normalized load is $\frac{Z_0}{2} \div Z_0 = \frac{1}{2}$

so the normalized input impedance is $\left(\frac{1}{2}\right)^{-1} = 2$

and the actual input impedance is $Z_{in} = 2Z_0$

g COMPLEX PROPAGATION CONSTANT

The propagation constant for lossy lines, taking into account the resistance along the line as well as the resistive path between the conductors.

$$\gamma = \alpha + j\beta = \sqrt{ZY} = \sqrt{(R + j\omega L)(G + j\omega C)}$$

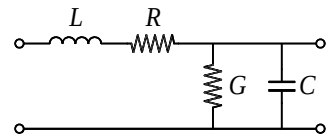

α = $\sqrt{RG}$ **attenuation constant**, the real part of the complex propagation constant, describes the loss

β = 2π/λ, **phase constant**, the complex part of the complex propagation constant

Z = **series impedance** (complex, inductive) per unit length [Ω/cm]

Y = **shunt admittance** (complex, capacitive) per unit length [Ω^{-1}/cm]

R = the resistance per unit length along the transmission line [Ω/cm]

G = the conductance between conductors per unit length [Ω^{-1}/cm]

L = inductance per unit length [H/cm]

C = capacitance per unit length [F/cm]

MODULATED WAVE

Suppose we have a disturbance composed of two frequencies:

$$\sin\left[\left(\omega_0 - \delta\omega\right)t - \left(\beta_0 - \delta\beta\right)z\right]$$

and $$\sin\left[\left(\omega_0 + \delta\omega\right)t - \left(\beta_0 + \delta\beta\right)z\right]$$

where ω_0 is the average frequency and β_0 is the average phase.

Using the identity $2\cos\left(\frac{A-B}{2}\right)\sin\left(\frac{A+B}{2}\right) = \sin A + \sin B$

The combination (sum) of these two waves is

$$\boxed{2\underbrace{\cos\left(\delta\omega t - \delta\beta z\right)}_{\text{envelope}}\underbrace{\sin\left(\omega_0 t - \beta_0 z\right)}_{\text{carrier}}}$$

The envelope moves at the group velocity, see p 7.

δ = "the difference in"…
ω_0 = carrier frequency [radians/second]
ω = modulating frequency [radians/second]
β_0 = carrier frequency phase constant
β = phase constant

So the sum of two waves will be a modulated wave having a **carrier** frequency equal to the average frequency of the two waves, and an **envelope** with a frequency equal to half the difference between the two original wave frequencies.

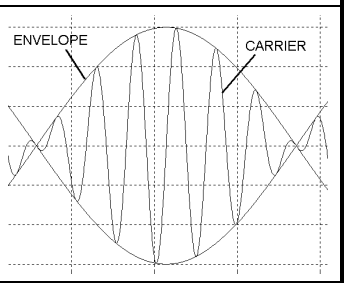

v_g GROUP VELOCITY [cm/s]

The velocity at which the envelope of a modulated wave moves.

$$\boxed{v_g = \frac{\delta\omega}{\delta\beta} = \frac{1}{\sqrt{LC_P}}\sqrt{1 - \frac{\omega_c^2}{\omega^2}}}$$ where:

L = inductance per unit length [H/cm]
C_P = capacitance per unit length [F/cm]
ε = permittivity of the material [F/cm]
μ = permeability of the material, dielectric constant [H/cm]
ω_c = carrier frequency [radians/second]
ω = modulating frequency [radians/second]
β = phase constant

Also, since β may be given as a function of ω, remember

$$v_g = \left(\frac{d\beta}{d\omega}\right)^{-1}$$

OMEGA - BETA GRAPH

This representation is commonly used for modulated waves.

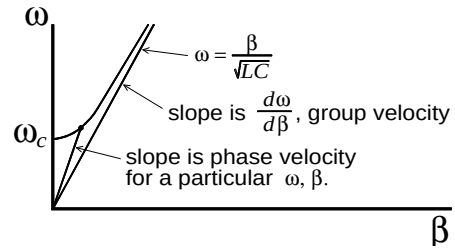

d SKIN DEPTH [cm]

The depth into a material at which a wave is attenuated by 1/e (about 36.8%) of its original intensity. This isn't the same δ that appears in the *loss tangent*, tan δ.

$$\boxed{\delta = \frac{1}{\alpha} = \sqrt{\frac{2}{\omega\mu\sigma}}}$$ where:

$\alpha = \sqrt{RG}$ **attenuation constant**, the real part of the complex propagation constant, describes loss
μ = permeability of the material, dielectric constant [H/cm]
ω = frequency [radians/second]
σ = (*sigma*) conductivity [Siemens/meter] see p12.

Skin Depths of Selected Materials

	60 Hz	1 MHz	1 GHz
silver	8.27 mm	0.064 mm	0.0020 mm
copper	8.53 mm	0.066 mm	0.0021 mm
gold	10.14 mm	0.079 mm	0.0025 mm
aluminum	10.92 mm	0.084 mm	0.0027 mm
iron	0.65 mm	0.005 mm	0.00016 mm

MAXWELL'S EQUATIONS

Maxwell's equations govern the principles of guiding and propagation of electromagnetic energy and provide the foundations of all electromagnetic phenomena and their applications. The time-harmonic expressions can be used only when the wave is sinusoidal.

	STANDARD FORM (Time Domain)	**TIME-HARMONIC** (Frequency Domain)
Faraday's Law	$\nabla\times\vec{\mathscr{E}} = -\dfrac{\partial\vec{\mathscr{B}}}{\partial t}$	$\nabla\times\vec{E} = -j\omega\vec{B}$
Ampere's Law*	$\nabla\times\vec{\mathscr{H}} = \vec{\mathscr{J}} + \dfrac{\partial\vec{\mathscr{D}}}{\partial t}$	$\nabla\times\vec{H} = j\omega\vec{D} + \vec{J}$
Gauss' Law	$\nabla\cdot\vec{\mathscr{D}} = \rho_v$	$\nabla\cdot\vec{D} = \rho_v$
no name law	$\nabla\cdot\vec{\mathscr{B}} = 0$	$\nabla\cdot\vec{B} = 0$

$\mathscr{E}$ = electric field [V/m]
$\mathscr{B}$ = magnetic flux density [W/m^2 or T] $\mathscr{B} = \mu_0\mathscr{H}$
t = time [s]
$\mathscr{D}$ = electric flux density [C/m^2] $\mathscr{D} = \varepsilon_0\mathscr{E}$
ρ = volume charge density [C/m^3]
$\mathscr{H}$ = magnetic field intensity [A/m]
$\mathscr{J}$ = current density [A/m^2]

*Maxwell added the $\dfrac{\partial\vec{\mathscr{D}}}{\partial t}$ term to Ampere's Law.

ELECTROMAGNETIC WAVES

MODELING MAXWELL'S EQUATIONS

This is a model of a wave, analogous to a transmission line model.

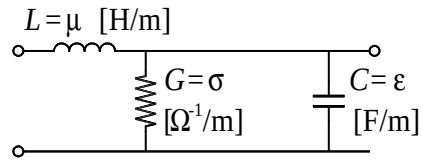

L = inductance per unit length [H/cm]
μ = permeability of the material, dielectric constant [H/cm]
G = the conductance per unit length [Ω^{-1}/cm]
σ = (*sigma*) conductivity [Siemens/meter]
C = capacitance per unit length [F/cm]
ε = permittivity of the material [F/cm]

propagation constant: $\gamma = \sqrt{(j\omega\mu)(j\omega\varepsilon+\sigma)}$

LOW FREQUENCY

At low frequencies, more materials behave as **conductors**. A wave is considered low frequency when

$\boxed{\omega \ll \dfrac{\sigma}{\varepsilon}}$ $\dfrac{\sigma}{\varepsilon}$ is the dielectric relaxation frequency

$\boxed{\eta = \dfrac{1}{\sigma\delta}(1+j)}$ intrinsic wave impedance, see p 12.

What happens to the complex propagation constant at low frequency? From the wave model above, gamma is

$$\gamma = \sqrt{(j\omega\mu)(j\omega\varepsilon+\sigma)} = \sqrt{j\omega\mu\sigma}\sqrt{1+\frac{j\omega\varepsilon}{\sigma}}$$

Since both ω and ε/σ are small

$$\gamma = \sqrt{j\omega\mu\sigma}\left(1+\frac{1}{2}j\omega\frac{\varepsilon}{\sigma}\right) = \sqrt{j\omega\mu\sigma}\,(1)$$

Since $\sqrt{j} = \frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}$

$$\gamma = \sqrt{\omega\mu\sigma}\left(\frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}\right) = \sqrt{\frac{\omega\mu\sigma}{2}} + j\sqrt{\frac{\omega\mu\sigma}{2}}$$

So that, with $\gamma = \alpha + j\beta$

we get $\boxed{\alpha = \sqrt{\dfrac{\omega\mu\sigma}{2}}}$, $\boxed{\beta = \sqrt{\dfrac{\omega\mu\sigma}{2}}}$ or $\boxed{\gamma = \dfrac{1}{\delta}(1+j)}$

α = **attenuation constant**, the real part of the complex propagation constant, describes the loss
β = **phase constant**, the complex part of the complex propagation constant
σ = (*sigma*) conductivity [Siemens/cm]
δ = skin depth [cm]
So the wave is attenuating at the same rate that it is propagating.

HIGH FREQUENCY

At high frequencies, more materials behave as **dielectrics**, i.e. copper is a dielectric in the gamma ray range. A wave is considered high frequency when

$$\boxed{\omega \gg \frac{\sigma}{\varepsilon}}$$

$\frac{\sigma}{\varepsilon}$ is the dielectric relaxation frequency

$$\boxed{\eta = \sqrt{\frac{\mu}{\varepsilon}}}$$

intrinsic wave impedance, see p 12.

What happens to the complex propagation constant at high frequency?

$$\gamma = \sqrt{(j\omega\mu)(j\omega\varepsilon + \sigma)} = \sqrt{j\omega\mu\, j\omega\varepsilon\left(1 + \frac{\sigma}{j\omega\varepsilon}\right)}$$

Since both $1/\omega$ and σ/ε are small

$$\gamma = j\omega\sqrt{\mu\varepsilon}\left(1 + \frac{1}{2}\frac{\sigma}{j\omega\varepsilon}\right) \qquad \boxed{\gamma = \frac{\sigma}{2}\sqrt{\frac{\mu}{\varepsilon}} + j\omega\sqrt{\mu\varepsilon}}$$

With $\gamma = \alpha + j\beta$

we get $\boxed{\alpha = \frac{\sigma}{2}\sqrt{\frac{\mu}{\varepsilon}}}$, $\boxed{\beta = \omega\sqrt{\mu\varepsilon}}$,

tan d LOSS TANGENT

The loss tangent, a value between 0 and 1, is the loss coefficient of a wave after it has traveled one wavelength. This is the way data is usually presented in texts. This is not the same δ that is used for skin depth.

$$\boxed{\tan\delta = \frac{\sigma}{\omega\varepsilon}}$$

Graphical representation of loss tangent:

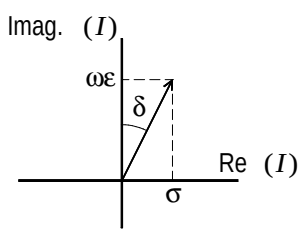

For a dielectric,
$\tan\delta \ll 1$.

$$\alpha \approx \frac{1}{2}(\tan\delta)\beta = \frac{\pi}{\lambda}\tan\delta$$

$\omega\varepsilon$ is proportional to the amount of current going through the capacitance C.
σ is proportional to the amount current going through the conductance G.

TEM WAVES

Transverse Electromagnetic Waves

Electromagnetic waves that have single, orthogonal vector electric and magnetic field components (e.g., $\mathscr{E}_x$ and $\mathscr{H}_y$), both varying with a single coordinate of space (e.g., z), are known as *uniform plane waves* or *transverse electromagnetic (TEM) waves*. TEM calculations may be made using formulas from electrostatics; this is referred to as *quasi-static* solution.

Characteristics of TEM Waves

- The velocity of propagation (always in the *z* direction) is $v_p = 1/\sqrt{\mu\varepsilon}$, which is the speed of light in the material
- There is no electric or magnetic field in the direction of propagation. Since this means there is no voltage drop in the direction of propagation, it suggests that no current flows in that direction.
- The electric field is normal to the magnetic field
- The value of the electric field is η times that of the magnetic field at any instant.
- The direction of propagation is given by the direction of $\mathbf{E} \times \mathbf{H}$.
- The energy stored in the electric field per unit volume at any instant and any point is equal to the energy stored in the magnetic field.

TEM ASSUMPTIONS

Some assumptions are made for TEM waves.

$\mathscr{E}_z = 0$ $\qquad$ $\mathscr{H}_z = 0$

$\sigma = 0$ $\qquad$ time dependence $e^{j\omega t}$

WAVE ANALOGIES

Plane waves have many characteristics analogous to transmission line problems.

Transmission Lines	Plane Waves
Phase constant $\beta = \omega\sqrt{LC} = \frac{\omega}{v_p} = \frac{2\pi}{\lambda}$	Wave number $k = \omega\sqrt{\mu\varepsilon} = \frac{\omega}{v_p} = \frac{2\pi}{\lambda}$
Complex propagation const. $\gamma = \alpha + j\beta = \sqrt{(R + j\omega L)(G + j\omega C)}$	Complex propagation constant $\gamma = \sqrt{(j\omega\mu)(j\omega\varepsilon + \sigma)}$
Velocity of propagation $v_p = \frac{1}{\sqrt{LC}} = \frac{\omega}{\beta}$	Phase velocity $v_p = \frac{1}{\sqrt{\mu\varepsilon}} = \frac{\omega}{k} = \omega\delta = c\frac{2\pi\delta}{\lambda}$
Characteristic impedance $Z_0 = \sqrt{\frac{L}{C}} = \frac{V_+}{I_+}$	Intrinsic impedance $\eta = \sqrt{\frac{\mu}{\varepsilon}} = \frac{E_{x+}}{H_{y+}}$
Voltage $V(z) = V_+ e^{-j\beta z} + V_- e^{j\beta z}$	Electric Field $E_x(z) = E_+ e^{-jkz} + E_- e^{jkz}$
Current $I(z) = \frac{1}{Z_0}\left[V_+ e^{-j\beta z} - V_- e^{j\beta z}\right]$	Magnetic Field $H_y(z) = \frac{1}{\eta}\left[E_+ e^{-jkz} - E_- e^{jkz}\right]$
Line input impedance $Z_{in} = Z_0 \frac{Z_L + jZ_0 \tan(\beta l)}{Z_0 + jZ_L \tan(\beta l)}$ $Z_{in} = Z_0 \frac{Z_L + Z_0 \tanh(\gamma l)}{Z_0 + Z_L \tanh(\gamma l)}$	Wave input impedance $\eta_{in} = \eta_0 \frac{\eta_L + j\eta_0 \tan(kl)}{\eta_0 + j\eta_L \tan(kl)}$ $\eta_{in} = \eta_0 \frac{\eta_L + \eta_0 \tanh(\gamma l)}{\eta_0 + \eta_L \tanh(\gamma l)}$
Reflection coefficient $\rho = \frac{Z_L - Z_0}{Z_L + Z_0}$	Reflection coefficient $\rho = \frac{\eta_L - \eta_0}{\eta_L + \eta_0}$

k WAVE NUMBER [rad./cm]

The phase constant for the uniform plane wave; the change in phase per unit length. It can be considered a constant for the medium at a particular frequency.

$$k = \frac{\omega}{v} = \omega\sqrt{\mu\varepsilon} = \frac{2\pi}{\lambda}$$

k appears in the phasor forms of the uniform plane wave

$E_x(z) = E_1 e^{-jkz} + E_2 e^{jkz}$, etc.

k has also been used as in the "*k* of a dielectric" meaning ε_r.

h (eta) INTRINSIC WAVE IMPEDANCE [Ω]

The ratio of electric to magnetic field components. Can be considered a constant of the medium. For free space, η = 376.73Ω. The units of η are in ohms.

$$\eta = \frac{E_{x+}}{H_{y+}} = -\frac{E_{y+}}{H_{x+}} \qquad -\eta = \frac{E_{x-}}{H_{y-}} = -\frac{E_{y-}}{H_{x-}}$$

at low frequencies	at high frequencies
$\eta = \frac{1}{\sigma\delta}(1 + j)$	$\eta = \sqrt{\frac{\mu}{\varepsilon}}$

When an electromagnetic wave encounters a sheet of conductive material it sees an impedance. K is the direction of the wave, **H** is the magnetic component and **E** is the electrical field. **E** × **H** gives the direction of propagation K.

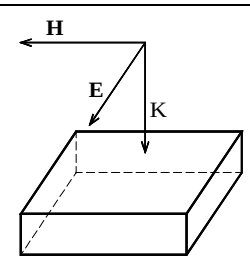

SHEET RESISTANCE [Ω]

Consider a block of material with conductivity σ.

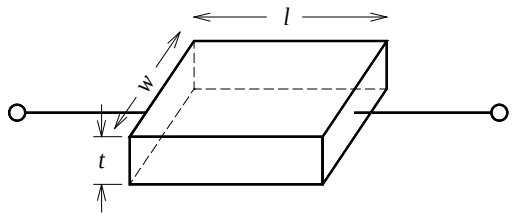

It's resistance is $R = \dfrac{l}{wt\sigma}$ Ω.

If the length is equal to the width, this reduces to

$$R = \frac{1}{t\sigma} \ \Omega.$$

And this is sheet resistance.

HIGH FREQUENCY RESISTANCE [Ω]

When a conductor carries current at high frequency, the electric field penetrates the outer surface only about 1 skin depth so that current travels near the surface of the conductor. Since the entire cross-section is not utilized, this affects the resistance of the conductor.

Cross-section of a conductor showing current flow near the surface:

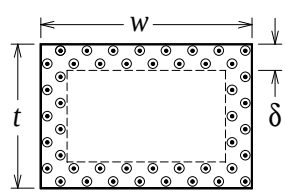

$$R \approx \frac{1}{\sigma\delta(\text{perimeter})} = \sqrt{\frac{\omega\mu_0}{2\sigma}}\,\frac{1}{2w+2t}$$

σ = (*sigma*) conductivity (5.8×10^5 S/cm for copper) [Siemens/meter]

ω = frequency [radians/second]

δ = skin depth [cm]

μ_0 = permeability of free space $\mu_0 = 4\pi\times10^{-9}$ [H/cm]

w = width of the conductor [cm]

t = thickness of the conductor [cm]

h_{in} WAVE INPUT IMPEDANCE [Ω]

The impedance seen by a wave in a medium.

For example, the impedance of a metal sheet in a vacuum:

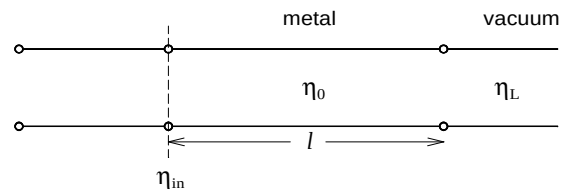

Note that a transmission line model is used here because it is analogous to a wave traveling in a medium. The "load" is the element most remote in the direction of propagation.

The input impedance is $\eta_{in} = \eta_0 \dfrac{\eta_L + \eta_0 \tanh(\gamma l)}{\eta_0 + \eta_L \tanh(\gamma l)}$ Ω.

In this example, *l* is the thickness of a metal sheet. If the metal thickness is much greater than the skin depth, then

$$\tanh(\lambda l) = \tanh\left[\frac{1}{\delta}(1+j)l\right] = \tanh[(\text{big number})(1+j)] \approx 1$$

If *l* is much less than the skin depth δ, then

$$\tanh(\lambda l) = \tanh\left[\frac{1}{\delta}(1+j)l\right] = \tanh[(\text{small number})(1+j)]$$

$$= (\text{same small number})(1+j) = \frac{l}{\delta}(1+j)$$

m MAGNETIC PERMEABILITY [H/m]

The relative increase or decrease in the resultant magnetic field inside a material compared with the magnetizing field in which the given material is located. The product of the permeability constant and the relative permeability of the material.

$$\mu = \mu_0\mu_r \quad \text{where } \mu_0 = 4\pi\times10^{-7} \text{ H/m}$$

Relative Permeabilities of Selected Materials

Air	1.00000037	Mercury	0.999968
Aluminum	1.000021	Nickel	600
Copper	0.9999833	Oxygen	1.000002
Gold	0.99996	Platinum	1.0003
Iron (99.96% pure)	280,000	Silver	0.9999736
Iron (motor grade)	5000	Titanium	1.00018
Lead	0.9999831	Tungsten	1.00008
Manganese	1.001	Water	0.9999912

e ELECTRIC PERMITTIVITY [F/m]

The property of a dielectric material that determines how much electrostatic energy can be stored per unit of volume when unit voltage is applied, also called the ***dielectric constant***. The product of the constant of permittivity and the relative permittivity of a material.

$$\varepsilon = \varepsilon_0 \varepsilon_r \quad \text{where } \varepsilon_0 = 8.85\times10^{-14} \text{ F/cm}$$

e_c COMPLEX PERMITTIVITY

$$\varepsilon_c = \varepsilon' - j\varepsilon'' \quad \text{where } \frac{\varepsilon''}{\varepsilon'} = \tan\delta_c$$

In general, both ε' and ε'' depend on frequency in complicated ways. ε' will typically have a constant maximum value at low frequencies, tapering off at higher frequencies with several peaks along the way. ε'' will typically have a peak at the frequency at which ε' begins to decline in magnitude as well as at frequencies where ε' has peaks, and will be zero at low frequencies and between peaks.

e_r RELATIVE PERMITTIVITY

The permittivity of a material is the relative permittivity multiplied by the permittivity of free space

$$\varepsilon = \varepsilon_r \times \varepsilon_0$$

In old terminology, ε_r is called the "*k* of a dielectric". Glass (SiO_2) at ε_r = 4.5 is considered the division between low *k* and high *k* dielectrics.

Relative Permittivities of Selected Materials

Air (sea level)	1.0006	Polystyrene	2.6
Ammonia	22	Polyethylene	2.25
Bakelite	5	Rubber	2.2-4.1
Glass	4.5-10	Silicon	11.9
Ice	3.2	Soil, dry	2.5-3.5
Mica	5.4-6	Styrofoam	1.03
most metals	~1	Teflon	2.1
Plexiglass	3.4	Vacuum	1
Porcelain	5.7	Water, distilled	81
Paper	2-4	Water, seawater	72-80
Oil	2.1-2.3		

NOTE: Relative permittivity data is given for materials at **low or static frequency conditions**. The permittivity for most materials varies with frequency. The relative permittivities of most materials lie in the range of 1-25. At high frequencies, the permittivity of a material can be quite different (usually less), but will have resonant peaks.

s CONDUCTIVITY [S/m] or [1/(Ω·m)]

A measure of the ability of a material to conduct electricity, the higher the value the better the material conducts. The reciprocal is *resistivity*. Values for common materials vary over about 24 orders of magnitude. Conductivity may often be determined from skin depth or the loss tangent.

$$\sigma = \frac{n_c q_e^2 \bar{l}}{m_e v_{th}} \text{ S/m} \quad \text{where}$$

n_c = density of conduction electrons (for copper this is 8.45×10^{28}) [m^{-3}]
q_e = electron charge? 1.602×10^{-23} [C]
$\bar{l}$ = $v_{th}t_c$ the product of the thermal speed and the mean free time between collisions of electrons, the average distance an electron travels between collisions [m]
m_e = the effective electron mass? [kg]
v_{th} = thermal speed, usually much larger than the drift velocity v_d. [m/s]

Conductivities of Selected Materials [1/(Ω·m)]

Aluminum	3.82×10^7	Mercury	1.04×10^6
Carbon	7.14×10^4	Nicrome	1.00×10^6
Copper (annealed)	5.80×10^7	Nickel	1.45×10^7
Copper (in class)	6.80×10^7	Seawater	4
Fresh water	$\sim10^{-2}$	Silicon	$\sim4.35\times10^{-4}$
Germanium	~2.13	Silver	6.17×10^7
Glass	$\sim10^{-12}$	Sodium	2.17×10^7
Gold	4.10×10^7	Stainless steel	1.11×10^6
Iron	1.03×10^7	Tin	8.77×10^6
Lead	4.57×10	Titanium	2.09×10^6
		Zinc	1.67×10^7

P POWER [W]

Power is the time rate of change of energy.

Power reflected at a discontinuity: $\%\text{ power} = |\rho|^2 \times 100$

Power transmitted at a discontinuity: $\%\text{ power} = \left(1 - |\rho|^2\right)\times 100$

MICROSTRIP CONDUCTORS

How fast does a wave travel in a microstrip? The question is complicated by the fact that the dielectric on one side of the strip may be different from the dielectric on the other side and a wave may travel at different speeds in different dielectrics. The solution is to find an **effective relative permittivity** $\varepsilon_{r\,\mathrm{eff}}$ for the combination.

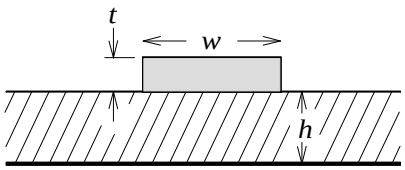

Some Microstrip Relations

$$Z_0^{\text{air}} = Z_0\sqrt{\varepsilon_{r\,\mathrm{eff}}} \qquad C^{\text{air}} Z_0^{\text{air}} = \sqrt{\varepsilon_0\mu_0}$$

$$L = Z_0^{\text{air}}\sqrt{\varepsilon_0\mu_0} = C^{\text{total}}\left(Z_0\right)^2 \qquad L\,C^{\text{air}} = \varepsilon_0\mu_0$$

$$Z_0 = \sqrt{\frac{L}{C^{\text{total}}}} \qquad Z_0^{\text{air}} = \sqrt{\frac{L}{C^{\text{air}}}}$$

$$\gamma = j\beta = j\omega\sqrt{\varepsilon_0\mu_0}\sqrt{\varepsilon_{r\,\mathrm{eff}}} \qquad \varepsilon_{r\,\mathrm{eff}} = \frac{C^{\text{total}}}{C^{\text{air}}}$$

$$v_p = \frac{1}{\sqrt{\varepsilon_0\mu_0\varepsilon_{r\,\mathrm{eff}}}} = \frac{1}{\sqrt{L\,C^{\text{total}}}}$$

It's difficult to get more than 200Ω for Z_0 in a microstrip.

Microstrip Approximations

$$\varepsilon_{r\,\mathrm{eff}} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2\sqrt{1 + 12h/w}}$$

$$Z_0 = \begin{cases} \dfrac{60}{\sqrt{\varepsilon_{r\,\mathrm{eff}}}}\ln\left[\dfrac{8h}{w} + \dfrac{w}{4h}\right], & \text{for } \dfrac{w}{h} \le 1 \\[2ex] \dfrac{120\pi}{\sqrt{\varepsilon_{r\,\mathrm{eff}}}\left[\dfrac{w}{h} + 1.393 + 0.667\ln\left(\dfrac{w}{h} + 1.444\right)\right]}, & \text{for } \dfrac{w}{h} > 1 \end{cases}$$

$$\frac{w}{h} = \begin{cases} \dfrac{8e^A}{e^{2A} - 2}, & \dfrac{w}{h} < 2 \\[2ex] \dfrac{2}{\pi}\left\{B - 1 - \ln\left(2B - 1\right) + \dfrac{\varepsilon_r - 1}{2\varepsilon_r}\left[\ln\left(B - 1\right) + 0.39 - \dfrac{0.61}{\varepsilon_r}\right]\right\}, & \dfrac{w}{h} > 2 \end{cases}$$

where $A = \dfrac{Z_0}{60}\sqrt{\dfrac{\varepsilon_r + 1}{2}} + \dfrac{\varepsilon_r - 1}{\varepsilon_r + 1}\left(0.23 + \dfrac{0.11}{\varepsilon_r}\right)$, $B = \dfrac{377\pi}{2Z_0\sqrt{\varepsilon_r}}$

STRIPLINE CONDUCTOR

Also called *shielded microstrip*. The effective relative permittivity is used in calculations.

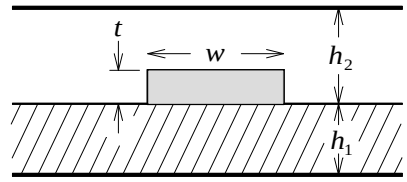

assuming $w \ge 10h$, $\varepsilon_{r\,\mathrm{eff}} = \dfrac{\varepsilon_{r1}h_1 + \varepsilon_{r2}h_2}{h_1 + h_2}$ where

ε_{r1} = the relative permittivity of the dielectric of thickness h_1.
ε_{r2} = the relative permittivity of the dielectric of thickness h_2.

COPPER CLADDING

The thickness of copper on a circuit board is measured in ounces. 1-ounce cladding means that 1 square foot of the copper weighs 1 ounce. 1-ounce copper is 0.0014" or 35.6 µm thick.

a_d DIELECTRIC LOSS FACTOR [dB/cm]

$$\alpha_d = 8.68\frac{\beta_0\varepsilon_r\left(\varepsilon_{r\,\mathrm{eff}} - 1\right)}{2\sqrt{\varepsilon_{r\,\mathrm{eff}}}\left(\varepsilon_r - 1\right)}\tan\delta$$

a_c CONDUCTOR LOSS FACTOR [dB/cm]

$$\alpha_c = 8.68\frac{R}{2Z_0}, \qquad R = \frac{1}{\sigma\delta(\text{perimeter})} = \sqrt{\frac{\omega\mu_0}{2\sigma}}\frac{1}{(\text{perimeter})}$$

WHEELER'S EQUATION

Another approximation for microstrip calculations is Wheeler's equation.

$$Z_0 = \frac{42.4}{\sqrt{1+\varepsilon_r}} \ln\left(1+\left\{\frac{4h}{w'}\left[\frac{14+\frac{8}{\varepsilon_r}}{11}\times\frac{4h}{w'}+\sqrt{\left(\frac{14+\frac{8}{\varepsilon_r}}{11}\times\frac{4h}{w'}\right)^2+\pi^2\frac{1+\frac{1}{\varepsilon_r}}{2}}\right]\right\}\right)$$

where $$w' = \frac{8h\sqrt{\frac{7+\frac{4}{\varepsilon_r}}{11}\left[\exp\left(\frac{Z_0}{42.4}\sqrt{\varepsilon_r+1}\right)-1\right]+\frac{1+\frac{1}{\varepsilon_r}}{0.81}}}{\exp\left(\frac{Z_0}{42.4}\sqrt{\varepsilon_r+1}\right)-1}$$

NETWORK THEORY

S_{ij} SCATTERING PARAMETER

$$S_{ij}$$

observation port → i, excitation port → j

A scattering parameter, represented by S_{ij}, is a dimensionless value representing the fraction of wave amplitude transmitted from port j into port i, provided that all other ports are terminated with matched loads and only port j is receiving a signal. Under these same conditions, S_{ii} is the reflection coefficient at port i.

To experimentally determine the scattering parameters, attach an impedance-matched generator to one of the ports (***excitation port***), attach impedance-matched loads to the remaining ports, and observe the signal received at each of the ports (***observation ports***). The fractional amounts of signal amplitude received at each port i will make up one column j of the **scattering matrix**. Repeating the process for each column would require n^2 measurements to determine the scattering matrix for an n-port network.

S_{ij} SCATTERING MATRIX

$$\begin{bmatrix} S_{11} & S_{12} & \cdots & S_{1N} \\ S_{21} & S_{22} & \cdots & S_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ S_{N1} & S_{N2} & \cdots & S_{NN} \end{bmatrix}$$

The scattering matrix is an $n \times n$ matrix composed of scattering parameters that describes an n-port network.

The elements of the diagonal of the scattering matrix are reflection coefficients of each port. The elements of the off-diagonal are transmission coefficients, under the conditions outlined in "SCATTERING PARAMETER".

If the network is **internally matched** or **self-matched**, then $S_{11} = S_{22} = \cdots = S_{NN} = 0$, that is, the diagonal is all zeros.

The sum of the squares of each column of a scattering matrix is equal to one, provided the network is lossless.

a_n, b_n INCIDENT/REFLECTED WAVE AMPLITUDES

The parameters a_n and b_n describe the incident and reflected waves respectively at each port n. These parameters are used for power and scattering matrix calculations.

The amplitude of the wave incident to port n is equal to the amplitude of the incident voltage at the port divided by the square root of the port impedance.	$a_n = \frac{V_n^+}{\sqrt{Z_{0n}}}$
Amplitude of the wave reflected at port n is equal to the amplitude of the reflected voltage at the port divided by the square root of the port impedance.	$b_n = \frac{V_n^-}{\sqrt{Z_{0n}}}$
The scattering parameter is equal to the wave amplitude output at port i divided by the wave amplitude input at port j provided the only source is a matched source at port j and all other ports are connected to matched loads.	$S_{\mathrm{ij}} = \frac{b_{\mathrm{i}}}{a_{\mathrm{j}}}$
The relationship between the S-parameters and the a- and b-parameters can be written in matrix form where **S** is the scattering matrix and **a** and **b** are column vectors.	$\mathbf{b} = \mathbf{Sa}$
Power flow into any port is shown as a function of a- and b-parameters.	$P = \frac{1}{2}\left(\lvert a\rvert^2 - \lvert b\rvert^2\right)$
The ratio of the input power at port j to the output power at port I can be written as a function of a- and b-parameters or the S-parameter.	$\frac{P_{in\,\mathrm{j}}}{P_{out\,\mathrm{i}}} = \frac{\lvert a_{\mathrm{j}}\rvert^2}{\lvert b_{\mathrm{j}}\rvert^2} = \frac{1}{\lvert S_{\mathrm{ij}}\rvert^2}$

RECIPROCITY

A network is reciprocal when $S_{\mathrm{ij}} = S_{\mathrm{ji}}$ in the scattering matrix, i.e. the matrix is symmetric across the diagonal. Also, $Z_{\mathrm{ij}} = Z_{\mathrm{ji}}$ and $Y_{\mathrm{ij}} = Y_{\mathrm{ji}}$. Networks constructed of "normal materials" exhibit reciprocity.

Reciprocity Theorem:

$$\oint_S \vec{E}_a \times \vec{H}_b \cdot ds = \oint_S \vec{E}_b \times \vec{H}_a \cdot ds$$

E_a and H_b are fields from two different sources.

LOSSLESS NETWORK

A network is lossless when

$$\underline{S}\ \ \underline{S}^{\dagger} = I$$

† means to take the complex conjugate and transpose the matrix. If the network is reciprocal, then the transpose is the same as the original matrix.

I = a unitary matrix. A **unitary matrix** has the properties:

$$\sum_{k=1}^{N} S_{ki} S_{ki}^* = 1 \qquad \sum_{k=1}^{N} S_{ki} S_{kj}^* = 0$$

In other words, a column of a unitary matrix multiplied by its complex conjugate equals one, and a column of a unitary matrix multiplied by the complex conjugate of a different column equals zero.

RAT RACE OR HYBRID RING NETWORK

The rat race or hybrid ring network is lossless, reciprocal, and internally matched.

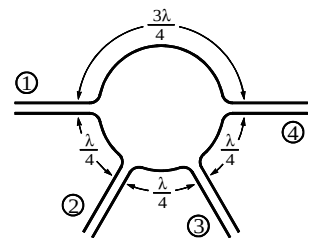

The signal splits upon entering the network and half travels around each side. A signal entering at port 1 and exiting at port 4 travels ¾ of a wavelength along each side, so the signals are in phase and additive. From port 1 to port 3 the signal travels one wavelength along one side and ½ wavelength along the other, arriving a port 3 out of phase and thus canceling. From port 1 to port 2 the paths are ¼ and 5/4 wavelengths respectively, thus they are in phase and additive.

DIRECTIONAL COUPLER

The directional coupler is a 4-port network similar to the rat race. It can be used to measure reflected and transmitted power to an antenna.

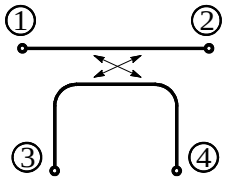

An input at one port is divided between two of the remaining ports. The **coupling factor**, measured in dB, describes the division of signal strength at the two ports. For example if the coupler has a coupling factor of –10 dB, then a signal input at port 1 would appear at port 4 attenuated by 10 dB with the majority of the signal passing to port 2. In other words, 90% of the signal would appear at port 2 and 10% at port 4. (-10 dB means "**10 dB down**" or 0.1 power, -6 dB means 0.25 power, and –3 dB means 0.5 power.) A reflection from port 2 would appear at port 3 attenuated by the same amount. Meters attached to ports 3 and 4 could be used to measure reflected and transmitted power for a system with a transmitter connected to port 1 and an antenna at port 2. The **directivity** of a coupler is a measurement of how well the coupler transfers the signal to the appropriate output without reflection due to the coupler itself; the directivity approaches infinity for a perfect coupler. $\text{directivity} = 10\log\left(p_3 / p_1\right)$, where the source is at port 1 and the load is at port 2.

The directional coupler is **lossless** and **reciprocal**. The scattering matrix looks like this. In a real coupler, the off-diagonal zeros would be near zero due to leakage.

$$\begin{bmatrix} 0 & p & 0 & -q \\ p & 0 & q & 0 \\ 0 & q & 0 & p \\ -q & 0 & p & 0 \end{bmatrix}$$

CIRCULATOR

The circulator is a 3-port network that can be used to prevent reflection at the antenna from returning to the source.

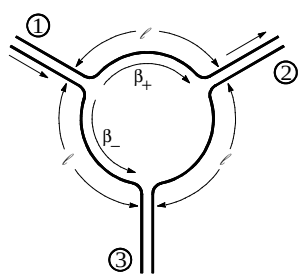

Port 3 is terminated internally by a matched load. With a source at 1 and a load at 2, any power reflected at the load is absorbed by the load resistance at port 3. A 3-port network cannot be both lossless and reciprocal, so the circulator is <u>not</u> reciprocal.

Schematically, the circulator may be depicted like this:

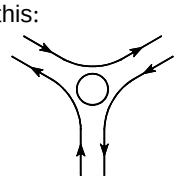

The circulator is **lossless** but is <u>not</u> **reciprocal**. The scattering matrix looks like this:

$$\begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

MAXWELL'S EQUATIONS, TIME HARMONIC FORM

$$\nabla \times \bar{\mathscr{E}} = -j\omega\mu\mathbf{H} \qquad \text{"curl on E"}$$

$$\nabla \times \bar{\mathscr{H}} = -j\omega\mu\mathbf{E} \qquad \text{"curl on H"}$$

$$\bar{\mathscr{E}} = \left[E_x(x,y)\hat{\mathbf{x}} + E_y(x,y)\hat{\mathbf{y}} + E_z(x,y)\hat{\mathbf{z}}\right]e^{j\omega t - \gamma z}$$

$$\bar{\mathscr{H}} = \left[H_x(x,y)\hat{\mathbf{x}} + H_y(x,y)\hat{\mathbf{y}} + H_z(x,y)\hat{\mathbf{z}}\right]e^{j\omega t - \gamma z}$$

From the curl equations we can derive:

(1) $\dfrac{\partial E_z}{\partial y} + \gamma E_y = -j\omega\mu H_x$ (4) $\dfrac{\partial H_z}{\partial y} + \gamma H_y = j\omega\varepsilon E_x$

(2) $-\dfrac{\partial E_z}{\partial x} - \gamma E_x = -j\omega\mu H_y$ (5) $-\dfrac{\partial H_z}{\partial x} - \gamma H_x = j\omega\varepsilon E_y$

(3) $\dfrac{\partial E_y}{\partial x} - \dfrac{\partial E_x}{\partial y} = -j\omega\mu H_z$ (6) $\dfrac{\partial H_y}{\partial x} - \dfrac{\partial H_x}{\partial y} = j\omega\varepsilon E_z$

From the above equations we can obtain:

(1) & (5) $H_x = \dfrac{1}{\gamma^2 + \omega^2\mu\varepsilon}\left(j\omega\varepsilon\dfrac{\partial E_z}{\partial y} - \gamma\dfrac{\partial H_z}{\partial x}\right)$

(2) & (4) $H_y = \dfrac{1}{\gamma^2 + \omega^2\mu\varepsilon}\left(j\omega\varepsilon\dfrac{\partial E_z}{\partial x} - \gamma\dfrac{\partial H_z}{\partial y}\right)$

(2) & (4) $E_x = -\dfrac{1}{\gamma^2 + \omega^2\mu\varepsilon}\left(-\gamma\dfrac{\partial E_z}{\partial x} + j\omega\mu\dfrac{\partial H_z}{\partial y}\right)$

(1) & (5) $E_y = -\dfrac{1}{\gamma^2 + \omega^2\mu\varepsilon}\left(-\gamma\dfrac{\partial E_z}{\partial y} + j\omega\mu\dfrac{\partial H_z}{\partial x}\right)$

This makes it look like if E_z and H_z are zero, then H_x, H_y, E_x, and E_y are all zero. But since $\infty \times 0 \neq 0$, we could have non-zero result for the TEM wave if $\gamma^2 = -\omega^2\mu\varepsilon \Rightarrow \gamma = j\omega\sqrt{\mu\varepsilon}$. This should look familiar.

WAVE EQUATIONS

From Maxwell's equations and a vector identity on curl, we can get the following wave equations:

$$\nabla^2 \overline{\mathscr{E}} = -\omega^2 \mu\varepsilon \overline{\mathscr{E}} \qquad \text{"del squared on E"}$$

$$\nabla^2 \overline{\mathscr{H}} = \omega^2 \mu\varepsilon \overline{\mathscr{H}} \qquad \text{"del squared on H"}$$

The z part or "del squared on E_z" is:

$$\nabla^2 E_z = \frac{\gamma^2 E_z}{\partial x^2} + \frac{\gamma^2 E_z}{\partial y^2} + \frac{\gamma^2 E_z}{\partial z^2} = -\omega^2 \mu\varepsilon E_z$$

Using the separation of variables, we can let:

$$E_z = X(x) \cdot Y(y) \cdot Z(z)$$

We substitute this into the previous equation and divide by $X \cdot Y \cdot Z$ to get:

$$\underbrace{\frac{1}{X}\frac{d^2X}{dx^2}}_{-k_x^2} + \underbrace{\frac{1}{Y}\frac{d^2Y}{dy^2}}_{-k_y^2} + \underbrace{\frac{1}{Z}\frac{d^2Z}{dz^2}}_{-k_z^2} = \underbrace{-\omega^2\mu\varepsilon}_{\text{a constant}}$$

Since X, Y, and Z are independent variables, the only way the sum of these 3 expressions can equal a constant is if all 3 expressions are constants.

So we are letting $\frac{1}{Z}\frac{d^2Z}{dz^2} = -k_z^2 \Rightarrow \frac{d^2Z}{dz^2} = -Zk_z^2$

A solution could be $Z = e^{-\gamma z}$

so that $\gamma^2 e^{-\gamma z} = -k_z^2 e^{-\gamma z}$ and $-k_z^2 = \gamma^2$

Solutions for X and Y are found

$$\frac{1}{X}\frac{d^2X}{dx^2} = -k_x^2 \Rightarrow X = A\sin(k_x x) + B\cos(k_x x)$$

$$\frac{1}{Y}\frac{d^2Y}{dy^2} = -k_y^2 \Rightarrow Y = C\sin(k_y y) + D\cos(k_y y)$$

giving us the general solution $k_x^2 + k_y^2 - \gamma^2 = \omega^2\mu\varepsilon$

For a particular solution we need to specify initial conditions and boundary conditions. For some reason, initial conditions are not an issue. The unknowns are k_x, k_y, A, B, C, D. The boundary conditions are

$$E_{\tan} = 0 \qquad \frac{\partial H_{\tan}}{\partial n} = 0$$

$E_{\tan}$ = the electric field tangential to a conducting surface
$H_{\tan}$ = the magnetic field tangential to a conducting surface
n = I don't know

TM, TE WAVES IN PARALLEL PLATES

TM, or transverse magnetic, means that magnetic waves are confined to the *transverse plane*. Similarly, TE (transverse electric) means that electrical waves are confined to the transverse plane.

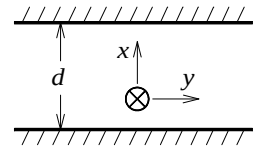

(z direction is into page)

Transverse plane means the plane that is transverse to (perpendicular to) the direction of propagation. The direction of propagation is taken to be in the z direction, so the transverse plane is the x-y plane. So for a TM wave, there is no H_z component (magnetic component in the z direction) but there is an E_z component.

$$\boxed{E_z = A\sin(k_x x)e^{-\gamma z}}$$

A = amplitude [V]

$k_x = \frac{m\pi}{d}$ The magnetic field must be zero at the plate boundaries. This value provides that characteristic. [cm^{-1}]

x = position; perpendicular distance from one plate. [cm]
d = plate separation [cm]
γ = propagation constant
z = position along the direction of propagation [cm]
m = mode number; an integer greater than or equal to 1

$$\boxed{\gamma = \sqrt{-\omega^2\mu\varepsilon + (kx)^2}}$$

Notice than when $(kx)^2 \geq \omega^2\mu\varepsilon$, the quantity under the square root sign will be positive and γ will be purely real. In this circumstance, the wave is said to be evanescent. The wavelength goes to infinity; there is no oscillation or propagation. On the other hand, when $(kx)^2 < \omega^2\mu\varepsilon$, γ is purely imaginary.

The magnitude of E_z is related to its position between the plates and the mode number m. Note that for m = 2 that $d = \lambda$.

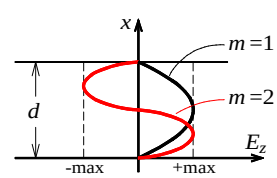

GENERAL MATHEMATICAL

COMPLEX TO POLAR NOTATION

j in polar notation:

$$j = e^{j\frac{\pi}{2}}$$

So we can find the square root of j:

$$\sqrt{j} = \sqrt{e^{j\frac{\pi}{2}}} = e^{j\frac{\pi}{4}} = \frac{1}{\sqrt{2}} + j\frac{1}{\sqrt{2}}$$

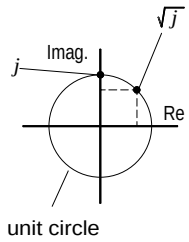

dBm DECIBELS RELATIVE TO 1 mW

The decibel expression for power. The logarithmic nature of decibel units translates the multiplication and division associated with gains and losses into addition and subtraction.

0 dBm = 1 mW
20 dBm = 100 mW
-20 dBm = 0.01 mW

$$P(\text{dBm}) = 10\log\left[P(\text{mW})\right]$$

$$P(\text{mW}) = 10^{P(\text{dBm})/10}$$

PHASOR NOTATION

To express a derivative in phasor notation, replace $\frac{\partial}{\partial t}$ with $j\omega$. For example, the

Telegrapher's equation $\frac{\partial V}{\partial z} = -L\frac{\partial I}{\partial t}$

becomes $\frac{\partial V}{\partial z} = -Lj\omega I$.

Ñ NABLA, DEL OR GRAD OPERATOR

Compare the ∇ operation to taking the time derivative. Where $\partial/\partial t$ means to take the derivative with respect to time and introduces a s^{-1} component to the units of the result, the ∇ operation means to take the derivative with respect to distance (in 3 dimensions) and introduces a m^{-1} component to the units of the result. ∇ terms may be called space derivatives and an equation which contains the ∇ operator may be called a vector differential equation. In other words $\nabla\mathbf{A}$ is how fast $\mathbf{A}$ changes as you move through space.

in rectangular coordinates: $\nabla\mathbf{A} = \hat{x}\frac{\partial A}{\partial x} + \hat{y}\frac{\partial A}{\partial y} + \hat{z}\frac{\partial A}{\partial z}$

in cylindrical coordinates: $\nabla\mathbf{A} = \hat{r}\frac{\partial A}{\partial r} + \hat{\phi}\frac{1}{r}\frac{\partial A}{\partial \phi} + \hat{z}\frac{\partial A}{\partial z}$

in spherical coordinates: $\nabla\mathbf{A} = \hat{r}\frac{\partial A}{\partial r} + \hat{\theta}\frac{1}{r}\frac{\partial A}{\partial \theta} + \hat{\phi}\frac{1}{r\sin\theta}\frac{\partial A}{\partial \phi}$

∇ GRADIENT

$$\boxed{\nabla\vec{\Phi} = -\mathbf{E}}$$

"The gradient of the vector Φ" or "del Φ" is equal to the negative of the electric field vector.

$\nabla\Phi$ is a vector giving the direction and magnitude of the maximum spatial variation of the scalar function Φ at a point in space.

$$\nabla\vec{\Phi} = \hat{\mathbf{x}}\frac{\partial\Phi}{\partial x} + \hat{\mathbf{y}}\frac{\partial\Phi}{\partial y} + \hat{\mathbf{z}}\frac{\partial\Phi}{\partial z}$$

Ñ· DIVERGENCE

$\nabla\cdot$ is also a vector operator, combining the "del" or "grad" operator with the dot product operator and is read as "the divergence of". In this form of Gauss' law, where $\mathbf{D}$ is a density per unit area, with the operators applied, $\nabla\cdot\mathbf{D}$ becomes a density per unit volume.

$$\boxed{\text{div}\,\mathbf{D} = \nabla\cdot\mathbf{D} = \frac{\partial D_x}{\partial x} + \frac{\partial D_y}{\partial y} + \frac{\partial D_z}{\partial z} = \rho}$$

$\mathbf{D}$ = electric flux density vector $\mathbf{D} = \varepsilon\mathbf{E}$ [C/m^2]
ρ = source charge density [C/m^3]

Ñ² THE LAPLACIAN

∇^2 is a combination of the divergence and del operations, i.e. $\text{div}(\text{grad}\,\Phi) = \nabla\cdot\nabla\,\Phi = \nabla^2\,\Phi$. It is read as "the LaPlacian of" or "del squared".

$$\boxed{\nabla^2\mathbf{F} = \frac{\partial^2\Phi}{\partial x^2} + \frac{\partial^2\Phi}{\partial y^2} + \frac{\partial^2\Phi}{\partial z^2}}$$

F = electric potential [V]

GRAPHING TERMINOLOGY

With *x* being the horizontal axis and *y* the vertical, we have a graph of ***y* versus *x*** or ***y* as a function of *x***. The *x*-axis represents the **independent variable** and the *y*-axis represents the **dependent variable**, so that when a graph is used to illustrate data, the data of regular interval (often this is time) is plotted on the *x*-axis and the corresponding data is dependent on those values and is plotted on the *y*-axis.

HYPERBOLIC FUNCTIONS

$$j\sin\theta = \sinh(j\theta)$$

$$j\cos\theta = \cosh(j\theta)$$

$$j\tan\theta = \tanh(j\theta)$$

TAYLOR SERIES

$$\sqrt{1+x} \approx 1 + \frac{1}{2}x, \quad x \ll 1$$

$$\frac{1}{1-x^2} \approx 1 + x^2 + x^4 + x^6 + \cdots, \quad |x| < 1$$

$$\frac{1}{1\pm x} \approx 1 \mp x, \quad x \ll 1$$

ELECTROMAGNETIC SPECTRUM

FREQUENCY	WAVELENGTH (free space)	DESIGNATION	APPLICATIONS
< 3 Hz	> 100 Mm		Geophysical prospecting
3-30 Hz	10-100 Mm	ELF	Detection of buried metals
30-300 Hz	1-10 Mm	SLF	Power transmission, submarine communications
0.3-3 kHz	0.1-1 Mm	ULF	Telephone, audio
3-30 kHz	10-100 km	VLF	Navigation, positioning, naval communications
30-300 kHz	1-10 km	LF	Navigation, radio beacons
0.3-3 MHz	0.1-1 km	MF	AM broadcasting
3-30 MHz	10-100 m	HF	Short wave, citizens' band
30-300 MHz 54-72 76-88 88-108 174-216	1-10 m	VHF	TV, FM, police TV channels 2-4 TV channels 5-6 FM radio TV channels 7-13
0.3-3 GHz 470-890 MHz 915 MHz 800-2500 MHz 1-2 2.45 2-4	10-100 cm	UHF "money band"	Radar, TV, GPS, cellular phone TV channels 14-83 Microwave ovens (Europe) PCS cellular phones, analog at 900 MHz, GSM/CDMA at 1900 L-band, GPS system Microwave ovens (U.S.) S-band
3-30 GHz 4-8 8-12 12-18 18-27	1-10 cm	SHF	Radar, satellite communications C-band X-band (Police radar at 11 GHz) K_u-band (dBS Primestar at 14 GHz) K-band (Police radar at 22 GHz)
30-300 GHz 27-40 40-60 60-80 80-100	0.1-1 cm	EHF	Radar, remote sensing K_a-band (Police radar at 35 GHz) U-band V-band W-band
0.3-1 THz	0.3-1 mm	Millimeter	Astromony, meteorology
10^{12}-10^{14} Hz	3-300 μm	Infrared	Heating, night vision, optical communications
3.95×10^{14}- 7.7×10^{14} Hz	390-760 nm 625-760 600-625 577-600 492-577 455-492 390-455	Visible light	Vision, astronomy, optical communications Red Orange Yellow Green Blue Violet
10^{15}-10^{18} Hz	0.3-300 nm	Ultraviolet	Sterilization
10^{16}-10^{21} Hz		X-rays	Medical diagnosis
10^{18}-10^{22} Hz		γ-rays	Cancer therapy, astrophysics
> 10^{22} Hz		Cosmic rays	Astrophysics

GLOSSARY

anisotropic materials materials in which the electric polarization vector is not in the same direction as the electric field. The values of ε, μ, and σ are dependent on the field direction. Examples are crystal structures and ionized gases.

complex permittivity e The imaginary part accounts for heat loss in the medium due to damping of the vibrating dipole moments.

dielectric An insulator. When the presence of an applied field displaces electrons within a molecule away from their average positions, the material is said to be polarized. When we consider the polarizations of insulators, we refer to them as *dielectrics*.

empirical A result based on observation or experience rather than theory, e.g. *empirical data*, *empirical formulas*. Capable of being verified or disproved by observation or experiment, e.g. *empirical laws*.

evanescent wave A wave for which $\beta=0$. α will be negative. That is, γ is purely real. The wave has infinite wavelength—there is no oscillation.

isotropic materials materials in which the electric polarization vector is in the same direction as the electric field. The material responds in the same way for all directions of an electric field vector, i.e. the values of ε, μ, and σ are constant regardless of the field direction.

linear materials materials which respond proportionally to increased field levels. The value of μ is not related to $\mathbf{H}$ and the value of ε is not related to $\mathbf{E}$. Glass is linear, iron is non-linear.

overdamped system in the case of a transmission line, this means that when the source voltage is applied the line voltage rises to the final voltage without exceeding it.

time variable materials materials whose response to an electric field changes over time, e.g. when a sound wave passes through them.

transverse plane perpendicular, e.g. the x-y plane is *transverse* to z.

underdamped system in the case of a transmission line, this means that after the source voltage is applied the line voltage periodically exceeds the final voltage.

wave number *k* The phase constant for the uniform plane wave. k may be considered a constant of the medium at a particular frequency.

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5G

Ixia Special Edition

by Kalyan Sundhar and Lawrence C. Miller

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Introduction

The next-generation mobile network (NGMN) is on the horizon. 5G, the next iteration of 4G Long Term Evolution (LTE) networks, will enable significantly greater mobile speeds — as much as 20 gigabits per second (Gbps) with less than one millisecond (ms) latency — to enable real-time connectivity for mission-critical and potentially lifesaving devices and applications. 5G will also provide truly ubiquitous connectivity in the most challenging and remote areas of the world whether on land, in the air, or at sea — even on the 42nd floor of an office building in downtown Chicago! Finally, 5G networks will connect billions of Internet of Things (IoT) devices with a wide variety of speed and data volume requirements.

But 5G is an ambitious goal. Work on key technologies to enable 5G has already begun. In much the same way that 4G LTE was rolled out in 2008, but is only now achieving the 4G LTE goal of 1 Gbps speeds with the 4G LTE Advanced standard, 5G will be a steady evolution that begins with commercial availability expected in 2020. Many technologies that have emerged in the evolution of 4G LTE, such as carrier aggregation (CA) and multiple input multiple output (MIMO), will continue to develop to achieve the massive speed and scale required in 5G. Innovative new technologies will leverage unlicensed spectrum — where Wi-Fi operates — to offload certain traffic from the carrier networks to create more capacity in their data pipes. Low-power technologies such as NarrowBand IoT (NB-IoT), LTE for Machines (LTE-M), Long Range Wide Area Network (LoRaWAN), Sigfox, and others, will be used in billions of IoT devices, and a new radio interface technology — 5G New Radio (5G NR) — will be developed for connections between User Equipment (UE) and carrier enhanced Node B (eNodeB) stations. Finally, carriers will fully embrace virtualization technologies in their core networks to enable massive scale and efficiency.

In this book, you learn about the technological innovations that are being developed today to enable a 5G future. You also learn about potential use cases that will transform entire businesses and industries, and create new business models and opportunities.

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About This Book

5G For Dummies, Ixia Special Edition, consists of eight short chapters that explore

- How wireless communications technology has evolved and where it's going next (Chapter 1).
- How developments in today's networks are blazing the 5G trail to higher speeds (Chapter 2).
- Which technologies in unlicensed spectrum will be leveraged in the 5G networks of the future (Chapter 3).
- Why the Internet of Things requires 5G connectivity (Chapter 4).
- Where virtualization in mobile networks can help address the need for scale and elasticity (Chapter 5).
- What 5G New Radio (5G NR) is and how it will help create a 5G future (Chapter 6).
- How 5G will be used in various use case scenarios (Chapter 7).
- Ten common myths and the reality of 5G (Chapter 8).

Foolish Assumptions

It's been said that most assumptions have outlived their uselessness, but we assume a few things nonetheless!

Mainly, we assume that you either work in a technology profession or you're an avid user of wireless communications technology — if you have a smartphone within arm's distance of you, we're talking about you!

Beyond a basic knowledge of wireless communications and mobile technology in general, we don't assume you have a particularly strong technical background. As such, this book is written primarily for nontechnical readers — we explain any technical terms and concepts that come up in this book.

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If any of these assumptions describe you, this book is for you! If none of these assumptions describe you, keep reading anyway. It's a great book, and when you finish reading it, you'll know enough about 5G to be dangerous!

Icons Used in This Book

Throughout this book, we occasionally use special icons to call attention to important information. Here's what to expect:

REMEMBER

This icon points out information you should commit to your non-volatile memory, your gray matter, or your noggin' – along with anniversaries and birthdays!

TECHNICAL STUFF

You won't find a map of the human genome here, but if you seek to attain the seventh level of NERD-vana, perk up! This icon explains the jargon beneath the jargon.

TIP

Tips are appreciated, never expected — and we sure hope you'll appreciate these tips! This icon points out useful nuggets of information.

Beyond the Book

There's only so much we can cover in 48 short pages, so if you find yourself at the end of this book thinking "gosh, this is a great book; where can I learn more?" just go to `www.ixiacom.com`.

Where to Go from Here

With our apologies to Lewis Carroll, Alice, and the Cheshire cat:

"Would you tell me, please, which way I ought to go from here?"

"That depends a good deal on where you want to get to," said the Cat — er, the Dummies Man.

"I don't much care where . . . ," said Alice.

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"Then it doesn't matter which way you go!"

That's certainly true of *5G For Dummies*, which, like Alice in Wonderland, is also destined to become a timeless classic!

If you don't know where you're going, any chapter will get you there — but Chapter 1 might be a good place to start! However, if you see a particular topic that piques your interest, feel free to jump ahead to that chapter. Each chapter is written to stand on its own, so you can read this book in any order that suits you (though we don't recommend upside down or backward).

We promise you won't get lost falling down the rabbit hole!

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IN THIS CHAPTER

- Recapping a century of innovation in wireless communications
- Addressing speed, scale, and responsiveness with 5G networks
- Unlocking the five key fundamentals of 5G

Chapter 1
Understanding the Journey to a 5G Future

In this chapter, you take a glimpse back at the evolution of wireless communications and a look ahead to the 5G future.

Tracing the Evolution of Wireless Communications

For more than a century, radio technology has been enabling wireless communications over ever greater distances and with ever greater capabilities.

In the late nineteenth century, Guglielmo Marconi built the first wireless telegraphy system, capable of transmitting Morse code via radio signals up to one-half mile. Today, more than seven billion mobile devices enable us to communicate with anyone, anywhere in the world.

The first truly mobile two-way radio was developed in 1923 and used in Australian police cars — although it took up the entire back seat of a patrol car. Hand-held radios — "walkie-talkies" — were first used in World War II.

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In 1973, the first call on a hand-held cellular phone was made — the cellular phone was described as a "brick" weighing nearly two pounds, with just 30 minutes of talk time and a ten-hour battery recharge time. Ten years later, Motorola introduced the DynaTAC phone, weighing just one pound and costing $3,500.

To support modern wireless communications, cellular networks have evolved over several generations, as follows:

- **1G (analog cellular):** The first analog cellular service was launched in Japan in 1979. In 1983, the Advanced Mobile Phone Service (AMPS) was launched in North America. Analog cellular signals permitted only voice traffic and were not encrypted, so they could be easily intercepted.

  1G service consumed lots of spectrum and used the frequency division multiple access (FDMA) channel access method. FDMA allocates one or more frequency bands (or channels) to a user for communication.

TECHNICAL STUFF

- **2G (digital cellular):** The second generation of cellular technology was launched in 1991 with the commercial release of the Global Standard for Mobile Communications (GSM) in Finland. Major innovations in 2G networks included:
  - **Digital:** Digital signals generally have less static and background noise, and they use available spectrum more efficiently than do analog signals.
  - **Encryption:** 2G digital calls can be encrypted to make eavesdropping and intercept more difficult.
  - **Data:** Short message service (SMS) text messages were first introduced in 2G networks — O-M-2G!

  2G technologies use either time division multiple access (TDMA) or code division multiple access (CDMA) channel access methods. TDMA divides a signal into different time slots, enabling multiple callers to share the same frequency channel. CDMA assigns a code to each caller and uses spread-spectrum technology to create a signal with a wider bandwidth.

  In 2000, the European Telecommunications Standards Institute (ETSI) created the General Packet Radio Service (GPRS), which implemented packet-switched domains, in addition to existing circuit-switched domains. GPRS was

TECHNICAL STUFF

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dubbed "2.5G" and had nothing to do with *Two and a Half Men,* introduced by CBS three years later.

- **3G (data driven):** Apple and Google brought smartphones to the masses with iPhones and Android devices, respectively, in the early 21st century. These powerful devices — and the mobile apps installed on them (including Global Positioning System or GPS, location-based services, and on-demand video) — created an insatiable appetite for faster download speeds. The first 3G networks, introduced in 1998, provided minimum information transfer rates of 200 kilobits per second (Kbps). The International Telecommunication Union (ITU) has never formally defined a standard for 3G data rates, so downlink data speeds vary widely — from 384 Kbps in a moving vehicle for Wideband Code Division Multiple Access (W-CDMA) to 42.2 megabits per second (Mbps) for Evolved High Speed Packet Access (HSPA+), also known as 3.5G, and 168 Mbps for Advanced HSPA+.
- **4G (Long Term Evolution):** Commercially available 4G mobile networks were rolled out in 2008, and 4G LTE followed in 2010. However, unlike 3G, the ITU Radiocommunication Sector (ITU-R) defined minimum 4G standards — but neither "4G" nor "4G LTE" meets those standards! The ITU-R International Mobile Telecommunications Advanced (IMT-Advanced) requirements include (among other things):
  - Packet-switched all-IP core networks
  - Peak data rates of approximately 100 Mbps for high mobility (such as moving vehicles)
  - Peak data rates of approximately 1 gigabit per second (Gbps) for low mobility (such as walking — or your authors sprinting)

  With the introduction of LTE Advanced, true 4G speeds of up to 1 Gbps finally arrived. LTE Advanced Pro is the next evolution of LTE technology, and it establishes the foundation for 5G. LTE Advanced Pro will deliver speeds in excess of 3 Gbps with less than 2 milliseconds (ms) of latency.

REMEMBER

At this point you may be thinking, "Long Term Evolution — no kidding! Will 5G ever get here?" However, the trend has been for each generation of mobile technology innovation to take about a decade — most of us just didn't pay attention before we got our first smartphones midway through the 3G era.

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Focusing on the 5G Vision

The vision for the 5G future is bold: It is much more than just the next iteration of mobile networks. 5G will achieve three main goals:

- **Speed (ultra-high speed radio access):** 5G will provide download speeds of up to 20 Gbps. If you're wondering "Why would anyone ever need that much speed?" first answer this question: When have you ever heard anyone complain that their phone was *too fast*? It's also important to remember that bandwidth is shared by all the users on a cell tower. Today, if a few users are streaming a video at the airport or watching replays of a touchdown in a stadium, chances are that the download is choppy with lots of buffering, and the experience isn't so great. With 5G, you could theoretically download a 40 gigabyte (GB) 4K Ultra-High-Definition (UHD) movie (like *Jaws*) in less than a minute — you're gonna need a bigger data plan!
- **Responsiveness (ultra-low latency):** 5G networks will be used to control autonomous cars and high precision, mission-critical industrial devices in real-time. High reliability and availability at all times is a necessity for these use cases. For this to happen safely, end-to-end latency — the time it takes for data or commands to travel across the network — has to be extremely low. Latency in 5G networks will be five times faster than today's networks — less than 1ms.
- **Scale (massive connectivity):** By 2020, Gartner conservatively forecasts that there will be more than 21 billion connected devices in the Internet of Things (IoT). Some estimates predict more than 50 billion connected IoT devices by 2020. That's anywhere from three to seven connected devices for every person on the planet in 2020 — not including smartphones, tablets, and computers! These devices will have widely varying network requirements — from environmental sensors for agricultural applications installed in remote areas that might send a few bits of data every few days or weeks, to extremely high-precision, low-latency devices in nanobiotechnology, autonomous cars, and mission-critical industrial environments that rely on real-time communication for potentially lifesaving functions. 5G networks will need to handle the massive scale and

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challenging connectivity requirements for all these diverse devices, sensors, and applications.

Ordering Up 5G in Five Easy Pieces

5G will be a quantum leap beyond today's networks and will require many technological innovations. We serve them up here in five easy pieces (easier than making wheat toast for Jack Nicholson — "hold the butter, the lettuce, the mayonnaise . . . and the chicken") in this section and the chapters that follow (see Figure 1-1):

- **Speeds and feeds.** Speeds of up to 20 Gbps will be achieved using a combination of innovations such as carrier aggregation (CA), massive multiple input multiple output (MIMO), and quadrature amplitude modulation (QAM). You learn about speeds and feeds in Chapter 2.
- **Unlicensed spectrum:** MNOs are increasingly using unlicensed spectrum in the 2.4 and 5 Gigahertz (GHz) frequency bands. 5G networks will need to tap into the vast amount of spectrum available in these unlicensed bands to offload traffic in heavily congested areas and provide connectivity for billions of IoT devices. Advancements in Wi-Fi, LTE in Unlicensed spectrum (LTE-U), License Assisted Access (LAA), and MulteFire, among others, provide better quality and regulated access to unlicensed spectrum. You learn about these advancements in Chapter 3.
- **Internet of Things (IoT):** IoT devices pose a diverse set of requirements and challenges for 5G networks. It's only fair that IoT should likewise pose a diverse set of solutions as well! You learn about a few of these solutions — including NarrowBand IoT (NB-IoT), LTE Category M1 (LTE-M), Long Range (LoRa) and Sigfox — in Chapter 4.
- **Virtualization:** Network functions virtualization (NFV) enables the massive scale and rapid elasticity that MNOs will require in their 5G networks. Virtualization enables a virtual evolved packet core (vEPC), centralized radio access network (C-RAN), mobile edge computing (MEC), and network slicing — all explained in Chapter 5.

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- **New Radio (NR):** Although the other 5G innovations introduced in this section all have strong starting points in LTE Advanced Pro, 5G NR is a true 5G native technology that has yet to be standardized. 5G NR addresses the need for a new radio access technology that will enable access speeds up to 20 Gbps — and you learn about it in Chapter 6!

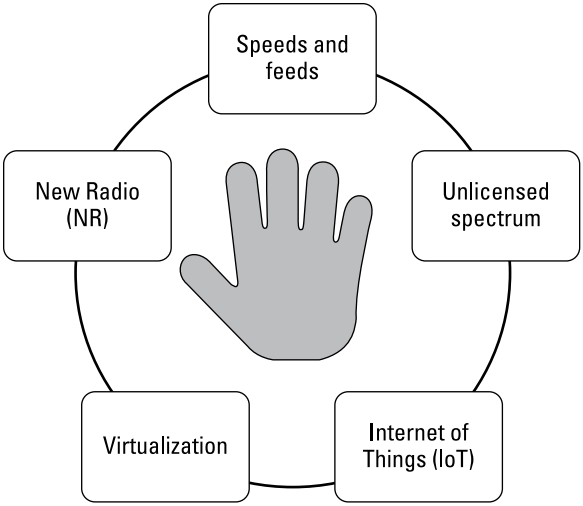

FIGURE 1-1: The five keys to 5G.

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IN THIS CHAPTER

- Issuing a license to thrill — with higher speeds
- Cobbling together spectrum with carrier aggregation
- Going well beyond "rabbit ears" with massive antenna arrays
- Seeing stars with quadrature amplitude modulation

Chapter 2
Achieving Faster Speeds and Larger Feeds

Over the past decade, the need for speed in mobile networks has increased dramatically. To address this need, 5G will increase the speeds of today's most advanced Long Term Evolution (LTE) networks by an order of magnitude — from a few gigabits per second (Gbps) to as much as 20 Gbps. In this chapter, you get a glimpse of the engine — or, more correctly, the parts and components of the engine — that will power the 5G networks of the future.

Fattening the Data Pipe

Wireless spectrum is limited and highly regulated throughout the world. The International Telecommunication Union (ITU) allocates frequency spectrum worldwide, and governing bodies within the respective countries then license that spectrum for use by individual mobile network operators (MNOs). The ITU has identified three International Telecommunication Regions

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throughout the world with distinct frequency bands allocated to each region (see Figure 2-1).

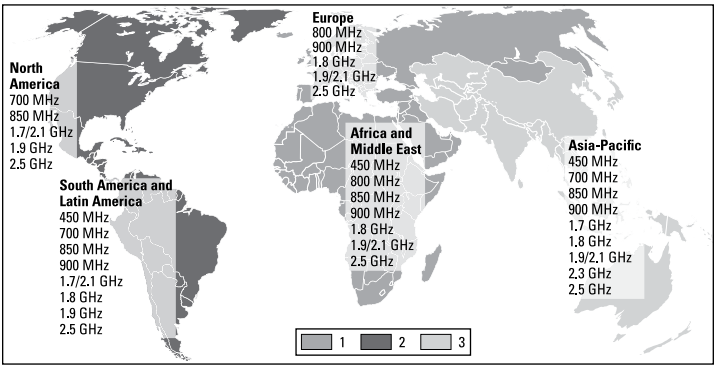

FIGURE 2-1: ITU International Telecommunication Regions and spectrum allocations.

MNOs must pay for the right to transmit and receive data using this shared medium in each country in which they operate. To fatten a wireless data pipe, an MNO must procure additional licenses to use a designated frequency spectrum.

In the U.S., the Federal Communications Commission (FCC) auctions spectrum to MNOs — and we aren't talking about eBay auctions here! In the U.S. alone, spectrum auctions have raised more than 60 billion dollars since 1994. Another challenge for MNOs is that available spectrum is limited and going once . . . going twice . . . sold!

Thus, MNOs must find new ways to use existing spectrum more efficiently. LTE Advanced and LTE Advanced Pro are pioneering the path to 5G, using several innovations to get more data through existing spectrum, including:

- Carrier aggregation (CA)
- Multiple input multiple output (MIMO)
- Quadrature amplitude modulation (QAM)

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We All Bundle — with CA

As you might imagine, the process of buying and selling spectrum, over time, causes spectrum to be sliced and diced in some pretty creative ways. MNOs also come and go, or get merged, acquired, and divested (for example, Cingular Wireless and MCI). All of this causes yet another challenge — contiguous spectrum is hard to find and MNOs must cobble together different bands to maximize their available bandwidth. It's sort of like a business being so unreasonable as to want a continuous range of direct inward dialing (DID) phone numbers to simplify its phone switch programming, company directories, and business cards! Except that in the case of frequency spectrum, non-contiguous bands aren't just a messy inconvenience — they limit available bandwidth.

For LTE networks, including LTE Advanced and LTE Advanced Pro, four carrier bandwidths (or sizes) are available for transporting data:

- 5 megahertz (MHz)
- 10 MHz
- 15 MHz
- 20 MHz

Larger bandwidths can transport more data. For example, 10 MHz can transport data at 37.5 megabits per second (Mbps) and 20 MHz can transport data at 75 Mbps. These data transfer rates assume a single antenna on the user equipment (UE) side and on the Evolved Node B (eNodeB) side. This is known as single input single output (SISO).

TECHNICAL STUFF

User equipment (UE) refers to an end-user device in a mobile network, such as a smartphone. *Evolved Node B (eNodeB)* is the MNO hardware — for example, a base transceiver station (BTS) — that wirelessly communicates directly with the UE.

Carrier aggregation (CA) is a technique that allows an MNO to use more than one component carrier (CC) — known as the *secondary carrier* — as an additional data pipe. For example, 2CA enables any of the four carrier bandwidths (5, 10, 15, or 20 MHz) to be used as the primary carrier and any of the other four carrier bandwidths to be used as the secondary carrier.

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In the simplest deployment scenario, known as *intra-band contiguous CA*, a 20 MHz primary and a 20 MHz secondary carrier (totaling 40 MHz) would provide twice the maximum possible bandwidth and throughput of a single carrier.

For SISO, a 2CA of 20+20 MHz would provide 150 Mbps of data throughput.

TIP

MNOs in the U.S. are currently deploying 3CA and some are already moving to 4CA (see Figure 2-2). The challenge for MNOs now is to find three or more CCs that they own the license to operate in and can aggregate. The LTE Advanced standard specifies 5CA totaling 100 MHz, while LTE Advanced Pro calls for 32CA totaling 640 MHz of aggregated carrier bandwidth.

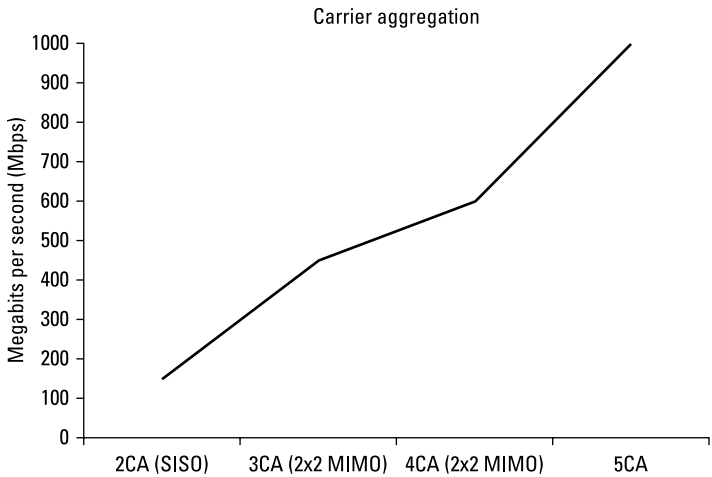

FIGURE 2-2: Carrier aggregation (CA) increases available bandwidth and data throughput.

Eeny, Meeny, Miny, MIMO

One of the techniques for fattening the data pipe defined from day one in 4G LTE networks is multiple input multiple output (MIMO) — using multiple antennas on the transmit and receive side in the wireless network. Using a technique called *spatial multiplexing*, it's possible to send a different data stream on each antenna, thereby increasing the throughput to the cell tower and to the user device.

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While 2x2 MIMO deployments (two antennas in, two antennas out) are common today, 4x4 MIMO (four antennas in, four antennas out) is becoming more practical. 4x4 MIMO effectively enables four independent data streams, thereby increasing the throughput by four times. Thus, the 2CA deployment example (described in the previous section) with two 20 MHz channels and a 2x2 MIMO configuration would increase the data throughput from 150 Mbps to 300 Mbps. The same scenario with a 4x4 MIMO configuration would theoretically increase data throughput to 600 Mbps.

LTE Advanced specifications for MIMO accommodate 8-, 16-, and 32-antenna configurations. LTE Advanced Pro specifications increase MIMO configurations to 64 antenna elements. Realistically, using 64 antenna streams to increase the throughput of a single UE isn't practical. However, using a technique called *beamforming,* the eNodeB can focus energy (that is, steer beams of data) to a particular UE, thereby increasing the throughput of that UE while simultaneously handling other UEs through a different set of beams. Massive MIMO will utilize massive antenna arrays — comprised of hundreds of antennas — to provide efficient signal coverage and higher data rates with lower latency in 5G networks.

No Qualms About QAM

Quadrature amplitude modulation (QAM) is a technique widely used to vary data signals on a carrier used for radio communication. When used for digital transmission of radio communication applications, QAM can carry higher data rates than ordinary amplitude modulated and phase modulated schemes. In QAM, the constellation points are normally arranged in a square grid with equal vertical and horizontal spacing. As a result, the most common forms of QAM use a constellation with the number of points equal to a power of 2 (such as 4, 16, and 64). Thus, 16-QAM uses a 16-point constellation while 256-QAM uses a 256-point constellation.

By using higher order modulation formats (that is, more points on the constellation), it is possible to transmit more bits per symbol. So, 64-QAM has six bits per symbol (more data transmitted), whereas 16-QAM uses only four bits per symbol (less data transmitted). However, the points for a higher QAM are closer together and are therefore more susceptible to noise and data errors. 256-QAM has been used for data in digital cable

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communications and is now starting to be used for radio communications. 256-QAM is included as part of the LTE Advanced Release 12 standard from the Third Generation Partnership Project (3GPP) because it is likely to work with small cell towers. T-Mobile has achieved 400Mbps downlink speeds in trials through a combination of 4x4 MIMO and 256-QAM.

REMEMBER

5CA and beyond, massive MIMO, and higher-order QAM are all techniques defined as part of the LTE Advanced and LTE Advance Pro standards. With LTE Advanced deployments in full swing, 1 Gbps download speeds are getting closer to becoming a reality in operational networks. 5G will use all these techniques to achieve 20 Gbps data speeds. For example, these are a few of the developments on the 5G horizon:

- CA on very large bandwidths, leading to aggregate totals of 800 MHz (and even 1 GHz) carrier bandwidth
- Massive MIMO antenna arrays of 128 elements or more
- 1024-QAM, and even 4096-QAM

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IN THIS CHAPTER

- Expanding cellular traffic to unlicensed spectrum
- Getting LTE-U and LAA to coexist with Wi-Fi in unlicensed spectrum
- Going it alone in unlicensed spectrum with MulteFire

Chapter 3
Tapping into Unlicensed Spectrum

Unlicensed spectrum is used by low-power devices to transmit and receive wireless signals over short distances — typically a few meters. Although specific devices are permitted to operate only in specific bands, the process of getting certifications is not time-consuming or costly, compared to getting a cellular operator license. Some common devices in this category include garage door openers, nursery monitors, home security systems, cordless phones, and Bluetooth speakers/headsets. In this chapter, you learn about the role of unlicensed spectrum in the 5G future.

Giving a "High 5(G)" to Wi-Fi Advancements

Wi-Fi operates in the unlicensed 2.4 gigahertz (GHz) and 5 GHz spectrums. There are fewer rules on who can access these bands and more available spectrum compared to licensed frequency bands. Wi-Fi devices must therefore compete to use the same spectrum as other devices.

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Over the past few years, improvements in speed and the advancement of new capabilities have made Wi-Fi viable (and lucrative) for many mobile network operators (MNOs).

MNOs now regularly use Wi-Fi to offload their cellular networks wherever possible. Newer Wi-Fi standards enable massive speed increases. The standards utilize many of the latest multiple input multiple output (MIMO) beamforming techniques and higher quadrature amplitude modulation (QAM) schemes as those used in the licensed spectrum (discussed in Chapter 2).

For example, 802.11ac delivers Wi-Fi speeds of up to several gigabits per second (Gbps) operating in the 5 GHz band, using 80 or 160 megahertz (MHz) wide channels, advanced beamforming techniques, eight spatial streams (MIMO), multi-user MIMO (MU-MIMO), and 256-QAM (which produces four times the spectral efficiency of the previous 802.11n Wi-Fi standard).

The next wave in Wi-Fi is 802.11ax. 802.11ax will use orthogonal frequency-division multiple access (OFDMA) — the same technique used in Long Term Evolution (LTE) networks — in which different subcarriers within a carrier can be used to transport data for different users. As a result, more than one user equipment (UE) device can access the same medium at a given instant without having to back off or concede the medium to another UE device.

TIP

In case you're wondering, other standards exist between 802.11ac and 802.11ax, but they define Wi-Fi standards in unlicensed spectrum other than 2.4 GHz and 5 GHz — and they don't sound as cool as "A-X"!

LTE in Unlicensed Spectrum

LTE in Unlicensed spectrum (LTE-U) is a proposal that was originally developed by Qualcomm for LTE to co-exist with Wi-Fi in shared unlicensed spectrum. In LTE-U, calls are initially set up using licensed LTE spectrum. Additional carriers (for data) can then be aggregated from the unlicensed spectrum. This method will allow the operators to use unlicensed spectrum to "fatten the data pipe."

The Wi-Fi Alliance developed a Wi-Fi co-existence test plan to ensure that Wi-Fi and LTE could peacefully co-exist, and MNOs (including T-Mobile, AT&T, and Verizon) began experimenting with unlicensed spectrum in addition to their licensed spectrum.

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LTE-U has also generated a lot of interest from a small cell perspective because this approach potentially makes small cells a viable alternative to Wi-Fi hot spots.

As you might imagine, strong reservations about LTE-U exist, because of concerns that it will unfairly use the unlicensed spectrum and potentially interfere with other Wi-Fi users. Cable companies, such as Comcast, Charter Communications, and Time Warner Cable (TWC), as well as Google and Microsoft, are opposed to LTE-U. As of February 2017, the U.S. Federal Communications Commission (FCC) has approved Ericsson and Nokia equipment as LTE-U certified.

License Assisted Access

Unlike LTE-U, License Assisted Access (LAA) is a standard defined in the Release 13 specification from the Third Generation Partnership Project (3GPP). LAA attempts to resolve contention issues with Wi-Fi in unlicensed spectrum using a protocol many of us learned as children — Listen Before Talk (LBT). The LBT contention protocol requires LAA to listen to the unlicensed channel first, and then, if there is no other active Wi-Fi user (the channel is silent), the LTE user can use the channel.

TIP

A recent report by Strategy Analytics states that only 16 percent of operators can achieve gigabit LTE without using unlicensed spectrum. Using LTE-U and LAA, 64 percent of operators can achieve gigabit LTE.

Qualcomm's over-the-air trials with Deutsche Telecom in Germany showed that LAA had increased coverage and capacity compared to Wi-Fi on the same spectrum. By respecting the LBT maxim (uh, protocol), the behavior of LAA is more closely modeled to the principle "love thy neighbor" and is a better neighbor to Wi-Fi than Wi-Fi is to LTE. Wi-Fi was more of an imp during its formative years and ignores LBT, trying to access the same medium at the same time as others.

Enhanced LAA (eLAA), which aggregates the uplink on unlicensed spectrum, is the next step in the evolution of LAA. eLAA will be defined in the 3GPP Release 14 specification.

REMEMBER

Both LAA and eLAA require the initial call to be set up on LTE licensed spectrum as the primary channel. Unlicensed spectrum is only used to "fatten" the data pipes.

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MulteFire

MulteFire goes beyond LTE-U and LAA by enabling the LTE primary channel on unlicensed spectrum. In fact, MulteFire uses unlicensed spectrum exclusively. This means MulteFire can be deployed for LTE by anyone — without owning licensed spectrum — such as Internet service providers (ISPs) and commercial enterprises. MulteFire also benefits MNOs by providing new deployment opportunities for offloading and augmenting their cellular networks.

In January 2017, the MulteFire Alliance released version 1.0, defining an LTE-like network that can run entirely on unlicensed spectrum and, in some cases, may be an alternative to Wi-Fi with more capacity, better security, and easier handoffs across carrier networks.

REMEMBER

Today's 4G spectrum has around 500 MHz of unlicensed spectrum available to deploy LTE-U, LAA, and MulteFire. In July 2016, the FCC opened up 5G spectrum in the U.S., which has 10.85 GHz of total spectrum (3.85 GHz of licensed spectrum and 7 GHz of unlicensed spectrum). The techniques that are now evolving in LTE Advanced Pro (Releases 13 and 14) — LTE-U, LAA (and eLAA), MulteFire, and others (see Figure 3-1) — will be vital as even more unlicensed spectrum becomes available in 5G. The key goal will be to provide users with a seamless experience, irrespective of whether they are operating on a licensed or unlicensed band.

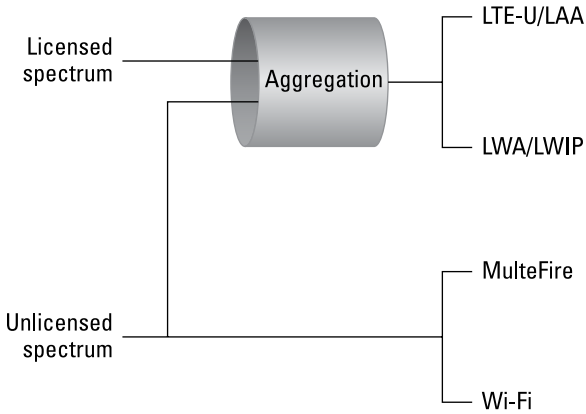

FIGURE 3-1: Leveraging licensed and unlicensed spectrum.

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IN THIS CHAPTER

- Defining IoT connectivity requirements
- Handling massive scale with NB-IoT
- Slicing up spectrum for the rise of the machines
- Exploring LoRaWAN and Sigfox for low-power networks

Chapter 4
Enabling Massive IoT

When 4G networks were introduced in 2008, there were close to 700 million mobile subscribers worldwide. Today, there are more than 7 billion mobile subscribers worldwide. By 2020, according to the most conservative estimates, there will be approximately 20 billion Internet of Things (IoT) devices, in addition to the 9 billion mobile subscribers that are expected worldwide.

Thus, 5G networks must not only deliver extreme speeds and feeds, they must provide massive scale, predictability, and reliability to eventually support as many as a trillion connected devices, including mission-critical and potentially lifesaving applications and scenarios. In this chapter, you learn about the key requirements for IoT device connectivity and the innovations that are being developed to support IoT.

Key Connectivity Requirements for IoT Devices

Unlike smartphones and other cellular devices, IoT device communications can be sporadic in nature. Many of these devices "sleep" (to extend battery life for ten or more years in some cases)

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for long periods of time — hours, days, or weeks — before transmitting a few bytes of data, and thus needn't always be connected to the network. 5G networks must be designed to handle infrequent, but important communications from these types of IoT devices. Although the amount of data these devices send may be significantly lower, they may still be of a time-critical nature. For example, a sensor that detects a hazardous condition may instruct an Evolved Node B (eNodeB) element to shut down equipment in an industrial plant or building. These types of communication, though extremely rare, must be handled with the utmost responsiveness and reliability.

Additionally, eNodeB elements will require massive capacity to scale to support tens of thousands of IoT devices — all with different communications requirements and characteristics — in a single cell.

Finally, a wide variety of security threats and new attack vectors will be surfaced in IoT devices. Unlike many of today's threats — identity theft and credit card fraud, for example — many IoT security threats will be potentially life threatening. Future threats may include hacked control systems in autonomous vehicles and smart grids, or compromised medical devices such as insulin pumps and pacemakers. Thus, 5G technologies will need to provide secure end-to-end communications throughout the network.

NarrowBand IoT (NB-IoT)

The Third Generation Partnership Project (3GPP) Long Term Evolution (LTE) Advanced Pro Release 13 specification defines a new standard — NarrowBand IoT (NB-IoT) — for handling low volumes of data (similar to 2G) from tens of thousands of devices in a single cell (tower, not amoeba).

NB-IoT extends LTE to even narrower bandwidths optimized for low data rate, latency-tolerant IoT applications. NB-IoT reduces device complexity, enables multiyear battery life, and provides deeper coverage to reach sensors in challenging locations, such as remote rural areas or inside buildings.

Perhaps one of the most attractive features of NB-IoT is its ability to leverage already ubiquitous LTE networks, in addition to providing high quality of service (QoS) and comprehensive security.

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NB-IoT can be deployed in three different modes:

- **Standalone as a dedicated carrier:** Can use GSM frequencies in a bandwidth of 200 kHz. This does not require LTE.
- **Guard band:** Uses a free resource block within the LTE guard band. This allows the IoT devices to not compete with other LTE devices for the resource blocks within the carrier.
- **LTE in-band:** Uses a resource block within the LTE frequency band. The rest of the blocks are used by the regular LTE devices.

Long Term Evolution for Machines (LTE-M)

Like NB-IoT, Long Term Evolution for Machines (LTE-M or LTE Category M1) leverages a narrow slice of existing LTE spectrum to send and receive data for IoT devices. LTE-M has the same benefits as NB-IoT, but uses a larger network slice than NB-IoT (1.4 MHz compared to 180 KHz in NB-IoT) and leverages the LTE protocol more than the NB-IoT in terms of reusing the same control, data, and transport channels.

TIP

Verizon launched the first LTE-M network in the U.S. on March 31, 2017, and ATT Wireless was expected to follow shortly after.

LoRaWAN and Sigfox

Long Range Wide Area Network (LoRaWAN) is a Low Power Wide Area Network (LPWAN) specification for wireless, battery-operated IoT devices. LoRaWAN operates in the sub-1 GHz unlicensed spectrum band. This limits the volume and frequency of traffic, as well as the ability of the base station to control the network and send traffic down. However, LoRaWAN has great advantages in terms of battery life and cost, and communication is bi-directional.

Sigfox is a French company that created a technology similar to LoRaWAN for IoT device communication. Sigfox technology uses

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very low bandwidth connections. It is not bi-directional and is only used for sending sparse uplink data with very limited downlink. Like LoRaWAN, Sigfox operates in the sub-1 GHz space and thus uses very low power.

LoRaWAN and Sigfox will be used with certain types of sensors, smart meters, and other low data IoT devices. A disadvantage for these technologies is that, unlike NB-IoT, which is built on top of existing LTE infrastructure, LoRaWAN and Sigfox are not integrated with LTE. However, the cost of deploying a LoRaWAN or Sigfox based IoT device is far less than for an NB-IoT or LTE-M device — by an order of magnitude, since NB-IoT and LTE-M devices must integrate LTE modules into their devices.

REMEMBER

As countries and mobile network operators (MNOs) make IoT technology decisions, it is likely that many standards, protocols, and technologies will need to co-exist. Factors such as cost, coverage, battery life, and integration with older 4G networks will determine which standards, protocols, and technologies are best for each use case.

The 3GPP specifications for IoT technologies are just starting to come out as part of the LTE-A Pro standards. Many IoT devices will need to operate at very low power, ideally suited for sub-1 GHz spectrum rather than the millimeter wave (mmWave) spectrum (discussed in Chapter 6). That said, there are some compelling 5G techniques, like resource spread multiple access (RSMA) waveforms that allow grant-free transmissions for "things" to send their data without prior scheduling by the eNodeB. As a result, the scheduling algorithm becomes less complex. 5G will also enable multi-hop mesh for these low-power devices, allowing out-of-coverage devices to relay to other connected devices in order to send data to the eNodeB.

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IN THIS CHAPTER

» Virtualizing the network for 5G and IoT

» Knowing which network elements to virtualize

Chapter 5
Getting Real About the Need to Virtualize

Virtualization has been a hot topic in the technology industry for many years and its advantages transcend the cellular industry. In this chapter, you learn about the network elements that can be virtualized and the essential role of virtualization in 5G.

Driving 5G and IoT with Virtualization

Telecommunications companies and mobile network operators (MNOs) have invested heavily in their 4G and Long Term Evolution (LTE) networks. These organizations have embraced virtualization to enable faster, more agile, and scalable deployments that can keep pace with the explosion in subscriber data traffic and consumption, all while keeping control of their overall capital and operating costs. Even though these investments have already given users mobile connectivity of unprecedented speed and pervasiveness, they have only laid the foundation of what's to come, as 5G and smart, connected devices start to roll out.

A recent study by a division of Nokia Bell Labs provides a glimpse of what's coming. The study found that the number of Internet of Things (IoT) connected devices is expected to expand from 1.6 billion in 2014 to well over 20 billion by 2020. Also, by 2020, global consumption demand for digital content and services on portable devices will see an average increase of 30 to 45 times the

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levels seen in 2014. Thus, MNOs will need to further accelerate their technology investments to meet ever-increasing consumer and business connectivity demands.

Recognizing the IoT explosion

Although MNOs in the U.S. are starting to embrace "pre-standard" 5G, vying for the first mover's advantage, the standards are not expected until 2018. This has echoes of the early days of 3G in the late 1990s and early 2000s, before proprietary implementations were standardized. It isn't surprising that some operators in the U.S. have already announced their plans to deploy 5G later this year, and some of the early adopters in Korea, Japan, and China are also ready to roll out 5G. Because of the rapid deployment, many 5G concepts are being solidified quickly.

5G is sometimes narrowly classified as a higher bandwidth radio access technology. But it is much more than that. It will also be the network for low-power devices and sensors that are classified as IoT devices, as well as low-latency applications. One example is the low latency required for some mission-critical devices, such as autonomous vehicles. The need for low latency will dictate that key LTE base station functions are distributed, with some moving closer to the edge and others being pooled in the cloud.

Another example is that vertical sectors will require different types of services from the 5G network. Some will need high bandwidth, while others will need low power. Some will need very low latency, and others will need very high availability. The vast volume of IoT devices will range from those that send multiple gigabits of data per second to those that will only send a few bits every month. This flexibility and elasticity can be supported only by advanced network virtualization.

Focusing on service

To support such varying 5G use cases across multiple verticals, MNOs need to shift from being network-centric to being more service-oriented.

To understand this shift, consider the concept of network slicing (see Figure 5-1). Here are a few typical cases:

- Mobile broadband with higher bandwidth video requiring high availability everywhere

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- Low-power sensors that can operate on a pair of AA batteries for 10 years
- Autonomous vehicles that can zip through crowded city streets but brake within microseconds when they sense potential obstructions in their paths

TECHNICAL STUFF

Each of these scenarios requires a different configuration of the requirements and parameters in the network, potentially including:

- Home Subscriber Server (HSS)
- Mobility Management Entity (MME)
- User equipment (UE)
- Enhanced Node B (ENB or eNodeB)
- Serving Gateway (SGW)
- Packet Data Network Gateway (PGW)
- Policy and Charging Rules Function (PCRF)
- LTE Evolved Packet Core (EPC) interfaces (S1-MME, S11, S1-U, SGi)

In essence, each use case requires its own network slice. Networks must be built in a manner that allows speed, availability, capacity, and coverage to be allocated in logical slices to meet the demands of each use case.

The best way to implement network slices will be via virtualization — to use service provider software-defined networking (SDN), network functions virtualization (NFV), and network orchestration (see Figure 5-2). In each of these cases, the SDN controller will configure and build network slices that include service chains such as deep packet inspection (DPI), emails, and security scans per user or per service. The network services — including the Centralized Radio Access Network (C-RAN), Virtual Evolved Packet Core (vEPC), and Virtual IP Multimedia Subsystem (vIMS) — are virtualized as virtual network functions (VNFs) that allow MNOs to set up services rapidly, and scale them in response to network and service demands.

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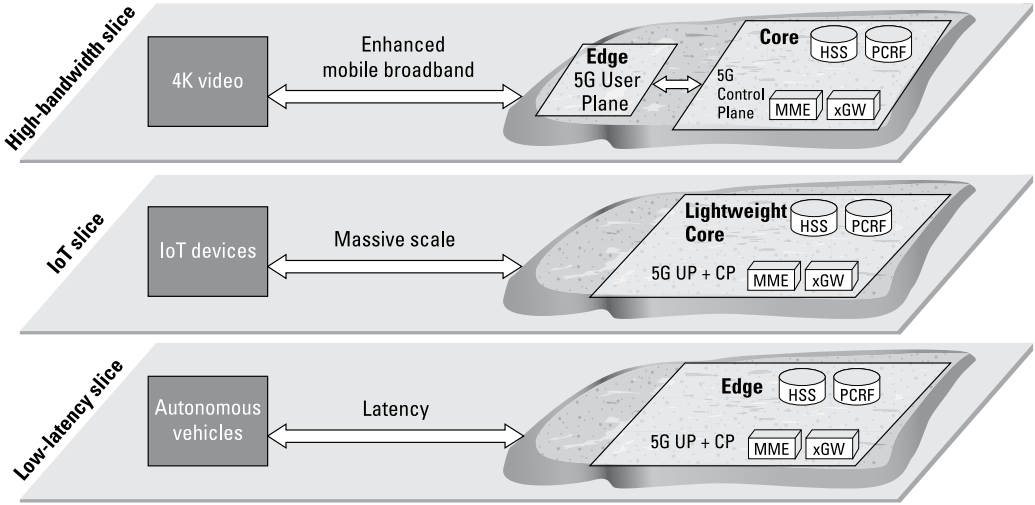

FIGURE 5-1: 5G network slices.

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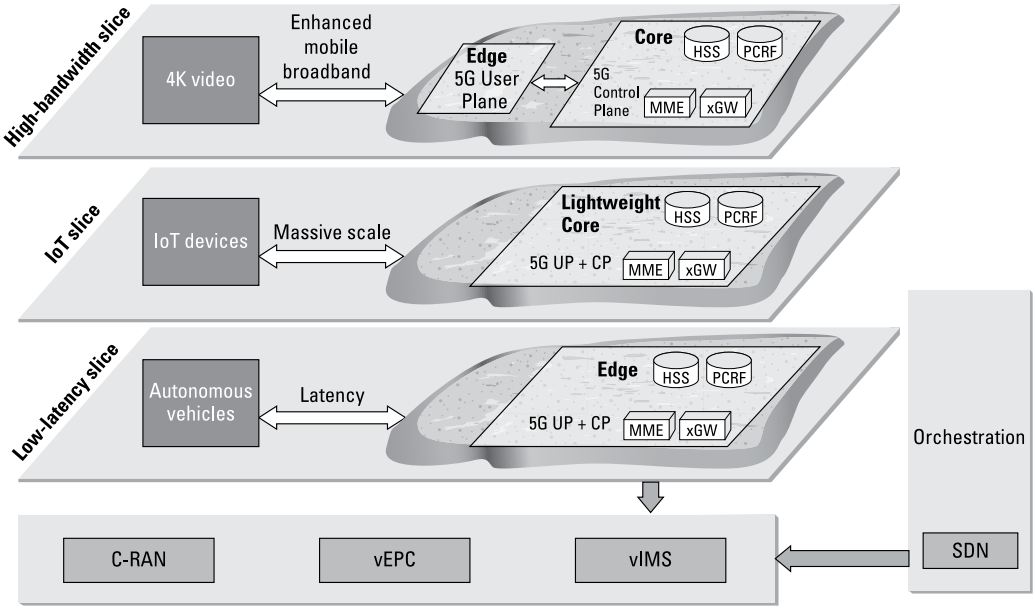

FIGURE 5-2: Network slices, VNFs, and management and orchestration in a 5G architecture.

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Managing the migration

Thus, virtualization will be a vital piece of the puzzle as 5G is rolled out and the IoT grows. But the speed and agility that virtualization enables must be balanced against the need for network visibility, resilience, manageability and security, throughout the development, roll-out, and mass usage of each service.

MNOs and service providers must weigh the trade-offs between

- Quality and cost.
- Flexibility and control.
- Moving too quickly and not moving fast enough.

REMEMBER

As a result, the demand for simple, end-to-end solutions that can efficiently test and validate the effectiveness and benefits of virtualization at every stage is only going to increase. Network virtualization will be a key driver of the IoT ecosystem as it develops — and full-lifecycle reliability and performance testing will be a key element of this shift.

Virtualizing Network Components

When LTE networks were conceptualized, one notable difference from earlier 3G architectures was the idea of a central "brain" — the evolved Node B (eNodeB). From the eNodeB — the point at which the cellular network wirelessly connects directly to user equipment (UE) — to the Internet, the connectivity would all be Internet Protocol (IP) based.

When data centers and other wired network components (such as routers, switches, and firewalls) started being virtualized on standard off-the-shelf servers, it was only natural for the wireless, IP-based 4G evolved packet core (EPC) to follow.

Virtual EPC (vEPC)

Because packet gateways, policy servers, and subscriber databases are all IP-based in the LTE network, the EPC is an excellent

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candidate for replacing proprietary hardware with virtualized functions hosted on standard, off-the-shelf servers. The benefit for MNOs is the elasticity this model enables — no more dedicated hardware and no need to oversubscribe every part of the network. Servers can be quickly and easily provisioned or de-provisioned based on real-time subscriber capacity needs. With SDN controllers and EPC functions migrated to NFV, and orchestration schemes added to manage it all, the wireless core could be fully virtualized and cloud ready!

Centralized Radio Access Network (C-RAN)

Virtualization in the radio access network (RAN) requires separating out latency-sensitive elements and the radio itself, then pooling the rest of the baseband functions into centralized baseband units (BBUs). Which functions should stay with the remote radio head (RRH) and which ones should move to centralized BBUs has been extensively studied, and a few options exist.

The C-RAN model, which requires a fiber connection between the RRH and the BBUs, is popular in some regions of the world, such as China and Korea. This front-haul interface is challenging because it has distance limitations and is bandwidth limited. It uses a protocol known as the Common Public Radio Interface (CPRI). China Mobile has been in the forefront of the C-RAN architecture. Other countries such as Japan and Korea have also adopted C-RAN. In the U.S., Verizon is looking at implementing C-RAN for small cells.

Mobile Edge Computing (MEC)

Mobile Edge Computing (MEC) offers an important balance as cellular networks move to a central model. MEC allows certain latency-sensitive components to be moved to the network edge. For example, even though it may make business sense for MNOs to centralize several functions into VNFs running on standard off-the-shelf servers, some critical functions may need to be

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closer to the edge of the network to ensure high availability, low latency, and higher levels of security.

TIP

The network edge is also a good place to host application servers that require local context. For example, if you are driving around and you receive restaurant ads on your mobile device based on your current location, you need the application service to be close to the edge to avoid a lengthy delay in the app that could render the information obsolete.

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IN THIS CHAPTER

- Tuning in to the basic functions of 5G New Radio
- Catching the millimeter wave

Chapter 6

Creating a New 5G World Order with New Radio (NR)

In this chapter, you learn about a completely new technology that creates the foundation for 5G — the 5G New Radio (NR) physical air interface.

5G NR Basics

Unlike the other 5G elements (covered in previous chapters), that advance the industry toward the goals of 5G networks, 5G New Radio (NR) is not an evolution of 4G Long Term Evolution (LTE) innovations. 5G NR is a completely new technology specification — a physical air interface — that is required to achieve the extreme bandwidth, low latency, and massive scalability requirements of 5G.

REMEMBER

The other four areas of 4G LTE innovation that are being further developed for 5G include:

- **Speeds and feeds:** Discussed in Chapter 2, innovations such as carrier aggregation (CA), massive multiple input multiple output (MIMO), and quadrature amplitude modulation (QAM), among others, enables carriers to "fatten" the data pipe.

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- **Unlicensed spectrum:** Discussed in Chapter 3, LTE in unlicensed spectrum (LTE-U), License Assisted Access (LAA and enhanced LAA, or eLAA), and MulteFire enable carriers to leverage unlicensed spectrum as additional data pipes.
- **Internet of Things (IoT):** Discussed in Chapter 4, IoT developments include NarrowBand IoT (NB-IoT), LTE for Machines (LTE-M or LTE Category M1), and Low Power Wide Area Network (LPWAN) specifications such as Long Range WAN (LoRaWAN) and Sigfox. These developments enable wireless communication with a diverse array of billions of IoT devices.
- **Virtualization:** Discussed in Chapter 5, software-defined networking (SDN) and network functions virtualization (NFV) enable mobile network operators (MNOs) to achieve cost-effective scalability and elasticity in their core networks with innovations that include network slicing, virtual evolved packet core (vEPC), centralized radio access network (C-RAN), and mobile edge computing (MEC).

The 5G NR specification enables the following goals of 5G:

- **Extreme bandwidths:** 5G NR aggregates eight component carriers (CCs). The carrier width specifications are still in development, but will likely be 100 megahertz (MHz) or greater, providing a total of approximately one gigahertz (GHz) of aggregated bandwidth — wide enough to carry 20 gigabits of data per second.
- **Low latency:** In LTE Advanced, each subframe (there are 10 subframes) is handled in one millisecond (ms). 5G will be five to ten times faster — each subframe is handled in 100 to 200 microseconds (µs). 5G NR will use new channel coding techniques, such as low density parity check (LDPC), that are more efficient than existing techniques, resulting in shorter transmission time intervals (TTIs).

  A technique called *scalable orthogonal frequency-division multiplexing (OFDM) numerology* will be used to support different use cases and scenarios within the same frame. Effectively, shorter TTIs will be used for low latency, high reliability use cases, and longer TTIs for higher spectral efficiency, higher bandwidth use cases. 5G NR can also effectively multiplex between short and long TTIs, thereby allowing a diverse set of users to simultaneously use the system.

TECHNICAL STUFF

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- **Massive MIMO:** 5G NR extends MIMO up to 256 antenna elements and enables massive MIMO. This is a key enabler for higher spectrum bands. The antenna elements in this case are smaller, thereby making it less complex to build a massive array.
- **Massive IoT:** 5G NR will use resource spread multiple access (RSMA) on the uplink to enable grant-free transmission of data on the uplink. A device does not need an enhanced Node B (eNodeB) to give it a grant (or slot) in the pipe to transmit data. This capability eliminates the need for signaling and allows devices to send small packets asynchronously. 5G NR will also address distance and location challenges in low-power IoT devices, using a technique called *multi-hop mesh* to relay uplink data via nearby devices.

5G NR is part of the Release 15 specification from the Third Generation Partnership Project (3GPP). Two versions of 5G NR exist:

- **Non-standalone (NSA) 5G NR:** NSA will use the existing LTE radio and core network as the control plane anchor for mobility management and coverage, while adding a new 5G carrier. Early 2019 deployments of 5G NR will use this configuration. In this mode, the connection is anchored in 4G LTE while 5G NR carriers are used to boost data rates and reduce latency.
- **Standalone (SA) 5G NR:** SA will use the new 5G core network (5GCN) architecture, including the full control and user plane offered by 5G.

An interim release of the 5G NR NSA specification was accelerated to the end of 2017 to enable large-scale trials and deployments for enhanced mobile broadband (eMBB) use cases to begin in 2019. The 5G NR SA specification is expected in mid-2018.

More Spectrum — mmWave Bands

In the U.S., the Federal Communications Commission (FCC) has opened a total of 10.85 GHz of spectrum above 24 GHz to enable 5G use cases. The new spectrum includes 3.85 GHz of licensed spectrum from 27.5 to 28.35 GHz and 37 to 40 GHz, and 7 GHz of unlicensed spectrum from 64 to 71 GHz.

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These bands — between 30 GHz and 300 GHz — are known as millimeter wave bands (mmWave). These high frequency bands translate to narrow wavelengths in the range of one to ten millimeters. There are some challenges with mmWave, including:

- Short transmission paths and high propagation losses over long distances and anything that is not line of sight
- Weakened signals in gases and precipitation

However, the short transmission paths and propagation loss characteristics of mmWave enable spectrum reuse, by limiting the interference between adjacent cells. Additionally, because of the extremely short wavelengths of mmWave signals, transmission paths can be extended using small, multi-element dynamic beamforming antennas that can be installed in user equipment (UE) such as smartphones.

TIP

5G NR, operating at very high frequencies with small coverage areas (because of propagation and line-of-sight issues), is ideal for dense urban locations, where cell sizes are generally small (approximately 200 meters).

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IN THIS CHAPTER

- Bringing 5G home
- Staying entertained on the move
- Getting a dose of virtual and augmented reality
- Driving 5G for smart cars and autonomous vehicles
- Living in a connected world
- Assimilating humans and machines

Chapter 7
Exploring 5G Use Cases

In this chapter, you learn about some of the key use cases that will be enabled by 5G.

Fixed Wireless Broadband Service

5G will begin its commercial drive with the fixed wireless broadband use case in the U.S. AT&T and Verizon are racing to be the first to deliver fixed wireless broadband service to their customers.

Verizon acquired XO Communications, which included the 28 gigahertz (GHz) spectrum, in 2016. One of the primary drivers for Verizon will be to offer 5G as an alternative to cable/advanced digital subscriber line (ADSL) for high-speed broadband access to residential customers for gigabit speed Internet, 4K content, virtual reality (VR), and more. The goal is to achieve greater than one gigabit per second (Gbps) speeds without digging trenches to get fiber to your home.

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AT&T is also pursuing 5G on fixed wireless in both the 28 GHz and 37 GHz spectrum bands. 5G video trials are currently underway for some residential customers, allowing them to stream DIRECTV NOW video service over a fixed wireless 5G connection. In its internal testing, AT&T Wireless claims it can now achieve 13 Gbps over a 5G connection. Like Verizon, AT&T is also looking at 5G to replace home broadband connections delivered by cable companies.

If successful, these use case trials could signal the end of the "cable guy" coming out "sometime between 1 p.m. and 4 p.m." to route a coaxial cable through your home. In areas where there is currently only one option for home broadband or television service, this technology could also lead to more competition, better service, and lower rates for subscribers.

Cable companies, such as Charter Communications, are also exploring 5G technologies. Charter is planning to conduct 28 GHz 5G experiments in the near future with antennas mounted on a mobile trailer and van with hydraulic masts, which will be moved to each of the test locations.

TIP

The motivation for a company like Charter is that 5G will enable a host of new products that take advantage of low-latency, high-capacity networks, including virtual reality (VR) and augmented reality (AR) applications, many of which will be used in a fixed home or office location.

Entertainment Everywhere

The natural progression of the fixed wireless broadband use case (discussed in the previous section) enables mobile broadband at extreme data rates "everywhere" — not only to a fixed home or office location.

Although some of the envisioned mobile broadband experience started in Long Term Evolution (LTE) networks, 5G takes it to a different level with 4K (and subsequently 8K) television, high dynamic range video streaming, 3D videos, and more. All these applications require very high bandwidth, and many require always-on connectivity to push real-time information to the users. The transformation from fixed wireless to wireless everywhere

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requires several mobility-specific factors to be addressed, such as fast handoffs, seamless connectivity at very high speeds and low latency, high reliability when mobile, and others.

REMEMBER

Cloud storage is also driving the growth of uplink data rates. In the past, content was mostly downloaded and thus required a "fat" pipe in only one direction: the downlink from the base station to the mobile device. However, content is increasingly being uploaded to different cloud storage platforms, requiring robust data pipes in both the downlink and uplink directions. Cloud gaming is another 5G driver that requires fast responsiveness and high broadband capacity.

Virtual Reality (VR) and Augmented Reality (AR)

Virtual reality (VR) technology creates a fully immersive, computer-generated experience that simulates or re-creates real-life situations and environments. In contrast to VR, augmented reality (AR) layers computer-generated images and enhancements onto a real-world situation or environment to provide a more meaningful context for user interaction.

Although current 4G networks are sufficient for some early-adopter VR and AR experiences, the introduction of 5G will enable more novel VR and AR experiences and make them available for mass adoption by consumers. Offering much more capacity, lower latency, and a more uniform experience, 5G will not only improve, but will also be a requirement for some of the most exciting AR and VR use cases, including:

- Sharing live streaming content on social media from event venues along with 50,000 other people in a stadium becomes even more challenging with 4K 360-degree video because each user is uploading 25 Mbps at the same time.
- Next-generation VR and AR experiences will have "six degrees of freedom" (6DoF) — the next level of immersion — allowing users to move within and intuitively interact with the environment. 6DoF content is an order of magnitude richer in naturalness and interactivity than current "three degrees of freedom" (3DoF) video. 3DoF experiences, such as 360-degree

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video, allow the user to look around rotationally from a fixed position. 6DoF experiences, which are available in video games today, allow the user to move spatially through the environment just by walking or leaning their head forward.

6DoF head-motion tracking is required to enjoy 6DoF content in an intuitive manner. Many industries such as tourism, education, and other forms of immersive video will flourish as 6DoF technologies evolve. Most components of the video delivery pipeline are currently ill-suited for 6DoF video, including capture devices, production software, codecs, compression algorithms, the network, and players. 6DoF video also demands bit rates in the range of 200 Mbps to 1Gbps, depending on the end-to-end latency.

Connected and Autonomous Vehicles

Smart, connected cars are already here — and some security risks have already been notoriously demonstrated — and self-driving autonomous vehicles are beginning to appear on our roads. Other applications that 5G will enable for smart, connected cars include:

- **Traffic safety:** This includes the ability to detect hazardous road conditions, such as inclement weather or nearby accidents, and provide real-time guidance for appropriate courses of action to enable safer driving and reduce the risk of accidents. For example, imagine a situation in which your driverless car gets a real-time message (in microseconds) that a truck is rapidly approaching the intersection that you are about to cross. Your car then automatically slows down to let the truck pass the intersection, thereby avoiding a possible accident.
- **Entertainment (for passengers):** Live video and music streaming (including 4K ultra high-definition movies), interactive video games, cloud connectivity, and data exchange elaborate the need for high capacity and high mobility mobile broadband.
- **Augmented reality (AR):** Displaying key information in near real-time for drivers requires low latency so that the information is timely and relevant. In the earlier truck

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example, a live situation is being tracked by the involved IoT devices and infrastructure, and relayed in real-time to the users — vehicle and human.

- **Self-driving, autonomous vehicles:** These will require ultra-reliable, high-speed communication between different driverless cars, and between cars and infrastructure.

The Connected World

Smart homes, smart cities, multiple industries (such as health, retail, smart grids, and remote factories) have a common thread — they are using more and more devices and sensors that communicate with one another and the rest of the world.

Many of these devices are mission critical; others may send high-definition video, requiring high availability and very low latency. Yet another set of devices may send small data packets relatively infrequently (for example, every few hours, days, or weeks). Some examples of common use cases with diverse connectivity requirements include:

- **Logistics and freight:** These devices and sensors typically require lower data rates, but need wide coverage and reliable location information.
- **Smart grid:** A smart grid requires low latency sensors to regulate the use of utilities such as electricity, natural gas, and water. Leveraging digital information, such as the behaviors of suppliers and consumers, allows the smart grid to improve the efficiency, reliability, economics, and sustainability of the production and distribution of these resources.
- **Remote medical:** Collaborating about a medical case with other surgeons located thousands of miles away was a use case scenario discussed as part of the Long Term Evolution (LTE) rollout. It can become a reality with the extreme bandwidth, low latency, and high availability of 5G networks.
- **Hazardous areas:** The ability to remotely explore mining areas or shut down a nuclear power plant during an emergency — in a fraction of the time required for human interaction, and without risk to human life — is possible with 5G.

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Augmented Humans

Looking ahead to the more distant future — perhaps 30 years from now — Google futurist Ray Kurzweil predicts humans will be able to upload their entire minds to computers and become "digitally immortal" — an event called *singularity.*

In 2011, IBM's Watson beat former winners on the television game show *Jeopardy!,* proving that computers can outperform the best of humans when it comes to synthesizing information and beating them to the buzzer. Google Home and Amazon Echo are becoming more common in homes — perhaps a bit unnerving at first as they start entering our private lives, and increasingly taking center stage when we want them to tell us more about the weather, play our favorite song, read us our favorite *5G For Dummies* book, or tell a few jokes. As machine learning and artificial intelligence develop further, these intelligent devices will better understand human behavior and evolve beyond databases of information. Eventually, they will also become more mobile and intrinsic in our lives, rather than sitting on a shelf in our living rooms.

REMEMBER

5G — with its extreme bandwidths, very low latency, and massive scale support — will be a critical component in creating these real-time experiences, initially as an assistant to humans, and eventually even "thinking" for humans (in some cases). Shopping for clothes with your kids or selecting your next car will become a more immersive experience. 5G technology might also assist humans as an augmented partner, offloading some of the tasks humans don't want to "expend their own brain cells" on. Although it may sound like science fiction, 5G might be a starting point for the next evolution of humans and machines.

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IN THIS CHAPTER

- Going beyond speed and latency
- Looking at drivers and timelines
- Overcoming misconceptions about limitations
- Recognizing complementary technologies
- Transforming entire industries

Chapter 8
Ten Myths About 5G — Debunked

In this chapter, we expose ten common myths about 5G — and we clue you in to the reality behind them. Keep these points in mind:

- **5G is all about higher speeds to the user.** Although one of the key goals of 5G is to provide extreme bandwidth (high-speed data) to users, low latency and massive scale are other key goals of 5G. So, 5G isn't just about speed!
- **5G requires less than one millisecond latency.** Although less than one millisecond of latency is a goal of 5G, 5G networks will be deployed before that target is actually achieved.
- **Smartphones will lead the charge to 5G.** The iPhone and Android were born in the 3G era and virtually exploded (literally, in some cases) during the 4G LTE era. However, 5G will not only enable faster and better smartphones — it will also lead to mass-market consumer VR and AR devices, sensors and applications for smart homes and cars, industrial robots, and billions of other Internet of Things (IoT) devices yet to be conceived.

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- **5G will be commercially available in 2017.** Although Verizon plans to roll out 5G fixed mobility in 2017 and Olympic 5G trials will be underway during the 2018 Winter Olympics, 5G standards will not be finalized until the end of 2017. Thus, although some early, pre-standard versions of 5G will be coming soon, the 5G standard is not complete. Standards-compliant 5G will be coming much later.
- **5G is only for short-range, line-of-sight communication.** In addition to other frequency bands, 5G uses mmWave bands, which are ideal for very short ranges. However, plenty of ongoing experiments demonstrate how techniques such as beamforming can achieve greater ranges to users in challenging environments beyond line-of-sight.
- **5G will be used only in very high bands.** Although 5G will be deployed in very high millimeter wave (mmWave) bands, it will also re-use spectrum in lower bands, both licensed and unlicensed.
- **5G will replace 4G LTE.** 5G will coexist with 4G LTE for a long time to come. 4G has plenty to offer for many current applications such as voice, data, and even IoT.
- **5G will be a revolution, not an evolution.** Although 5G brings in a new physical layer (in 5G New Radio, or 5G NR), there is plenty of evolution from LTE-A Pro technologies such as carrier aggregation (CA), massive multiple input/multiple output (MIMO), quadrature amplitude modulation (QAM), unlicensed spectrum (LTE in unlicensed spectrum or LTE-U, License Assisted Access or LAA, and MulteFire, among others), IoT, and virtualization.
- **5G will be required to drive IoT.** IoT will initially be driven by LTE-A Pro where NarrowBand IoT (NB-IoT) is specified. In addition, other low-power technologies, such as Long Range Wide Area Network (LoRaWAN) and Sigfox, have been defined for IoT.
- **The 5G winners will be the operators and vendors.** Mobile network operators (MNOs), network equipment manufacturers (NEMs), and smartphone manufacturers were the primary business beneficiaries of 4G LTE. However, 5G will transform many industries, including car manufacturing, agriculture, health and medicine, transportation and logistics, and many more.

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5 Keys to 5G

1 — 5G-NR (New Radio)
Next-Gen XAir

2 — 5G Speeds/Feeds
Ixia Multi-Gig LTE with XAir2

3 — Wi-Fi Coexistence
Ixia LTE Unlicensed

4 — Massive IoT
Ixia IoT

5 — Testing NFV Deployments
IxLoad Wireless VE

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Dream up new opportunities in the 5G future

The next-generation mobile network is on the horizon. 5G, the successor to 4G LTE networks, will enable significantly greater mobile speeds — as much as 20 gigabits per second — with very low latency. 5G will support a massive array of devices, from smart phones to virtual reality devices to small sensors. In this book, you learn about the technological innovations being developed today to enable a 5G future. You also learn about potential use cases that will transform entire industries and create new business models and opportunities.

Inside...

- Where wireless communication is headed
- Why higher speeds are the future
- How the IoT will employ 5G connectivity
- Why the unlicensed spectrum matters
- Why New Radio is a starting point for 5G
- How 5G will enable new business models

ixia

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AUGUST 2017

LTE to 5G: Cellular and Broadband Innovation

This white paper was written for 5G Americas by Rysavy Research (http://www.rysavy.com) and utilized a composite of statistical information from multiple resources.

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Introduction

Mobile computing with wireless communications has already changed how people socialize and how companies do business. Yet, we are still in the nascent stages of the transformation that ubiquitous connectivity is enabling. Early examples of this exciting future include virtual and augmented reality, autonomous driving, smart cities, wearable computers, and connected devices throughout our environment. While no one can predict the full extent of innovation that the new global broadband fabric, aided by complementary innovations such as AI, will unleash, one thing is certain: We are rushing toward an extraordinary time.

The step from 3G to 4G was dramatic, and industry advances occurring now in LTE and 5G will be even greater. Standards bodies are standardizing 5G, a process that will continue through the 2020 timeframe, with ongoing enhancements continuing during the next decade. Some operators are deploying pre-standard 5G in trials this year, and initial standards-based networks could be deployed as early as 2019. 5G will not replace LTE; in most deployments, the two technologies will be tightly integrated and co-exist through at least the late-2020s.

Many of the capabilities that will make 5G so effective are appearing in advanced forms of LTE. With carrier aggregation, for example, operators have not only harnessed the potential of their spectrum holdings to augment capacity and performance, but the technology is also the foundation for entirely new capabilities, such as operating LTE in unlicensed bands.

The computing power of today's handheld computers rivals that of past mainframe computers, powering intuitive operating systems and millions of applications. Coupled with affordable mobile broadband connectivity, these devices provide such unprecedented utility that billions of people are using them.

With long term growth in smartphone and other mobile device use limited by population, innovators are increasingly turning their attention to the Internet of Things (IoT), which already encompasses a wide array of applications. Enhancements to LTE, followed by 5G IoT capabilities, will connect wearable computers, sensors, and other devices, leading to better health, economic gains, and other advantages. 5G addresses not only IoT deployments on a massive scale but also enables applications previously not possible that depend on ultra-reliable and low-latency communications, sometimes called "mission-critical applications." Although a far more fragmented market than smartphones, the benefits will be so great that the realization of IoT on a massive scale is inevitable.

Regulatory policies are striving to keep pace, addressing complex issues that include how best to allocate and manage new spectrum, network neutrality, and privacy. Policy decisions will have a major impact on the evolution of mobile broadband.

These are exciting times for both people working in the industry and those who use the technology—which today is nearly everybody. This paper attempts to capture the scope of what the industry is developing, beginning with Table 1, which summarizes some of the most important advances.

Table 1: Most Important Wireless Industry Developments in 2017

Development	Summary
5G Research and Development Accelerates	5G, in early stages of definition through global efforts and many proposed technical approaches, could be deployed in non-standalone versions as early as 2019. Deployment will continue through 2030. Some operators will deploy pre-standard networks for fixed-wireless access in 2017. 5G is being designed to integrate with LTE, and some 5G features may be implemented as LTE-Advanced Pro extensions prior to full 5G availability.
5G New Radio (NR) Being Defined	Key aspects of the 5G NR have been determined, such as radio channel widths and use of OFDMA. The first version, specified in Release 15, will support low-latency, beam-based channels, massive Multiple Input Multiple Output (MIMO) with large numbers of controllable antenna elements, scalable-width subchannels, carrier aggregation, Cloud Radio-Access Network (RAN) capability, and dynamic co-existence with LTE.
LTE Has Become the Global Cellular Standard	A previously fragmented wireless industry has consolidated globally on LTE. LTE is being deployed more quickly than any previous-generation wireless technology.
LTE-Advanced Provides Dramatic Advantages	LTE capabilities continue to improve with carrier aggregation, 1 Gbps peak throughputs, higher-order MIMO, multiple methods for expanding capacity in unlicensed spectrum, new IoT capabilities, vehicle-based communications, small-cell support including Enhanced Inter-Cell Interference Coordination (eICIC), lower latency, Self-Organizing Network (SON) capabilities and Enhanced Coordinated Multi Point (eCoMP).
Internet of Things Poised for Massive Adoption	IoT, evolving from machine-to-machine (M2M) communications, is seeing rapid adoption, with tens of billions of new connected devices expected over the next decade. Drivers include improved LTE support, such as low-cost and low-power modems, enhanced coverage, higher capacity, and service-layer standardization, such as oneM2M.
Unlicensed Spectrum Becomes More Tightly Integrated with Cellular	The industry has developed increasingly sophisticated means for integrating Wi-Fi and cellular networks, such as LTE-WLAN Aggregation (LWA) and LTE-WLAN Aggregation with IPSec Tunnel (LWIP), making the user experience ever more seamless. The industry has also developed and is now deploying versions of LTE that can operate in unlicensed spectrum, such as LTE-Unlicensed (LTE-U), LTE-Licensed Assisted Access (LTE-LAA), and

Development	Summary
	MulteFire. Cellular and Wi-Fi industry members are successfully collaborating to ensure fair spectrum co-existence.
Spectrum Still Precious	Spectrum in general, and in particular licensed spectrum, remains a precious commodity for the industry. Recently added spectrum in the United States includes the 600 MHz band, auctioned in 2017, and the 3.5 GHz Citizens Broadband Radio Service (CBRS) "small-cell" band, which could see initial deployments in 2018. 5G spectrum will include bands above 6 GHz, including "mmWave" (30 GHz to 100 GHz), with the potential of ten times (or more) as much spectrum as is currently available for cellular. Radio channels of 200 MHz and 400 MHz, and even wider in the future, will enable multi-Gbps peak throughput.
Small Cells Take Baby Steps, Preparing to Stride	Operators have begun installing small cells, which now number in the tens of thousands. Eventually, hundreds of thousands if not millions of small cells will lead to massive increases in capacity. The industry is slowly overcoming challenges that include restrictive regulations, site acquisition, self-organization, interference management, power, and backhaul.
Network Function Virtualization (NFV) Emerges	Network function virtualization (NFV) and software-defined networking (SDN) tools and architectures are enabling operators to reduce network costs, simplify deployment of new services, reduce deployment time, and scale their networks. Some operators are also virtualizing the radio-access network, as well as pursuing a related development called cloud radio-access network (cloud RAN). NFV and cloud RAN will be integral components of 5G.

The main part of this paper covers the transformation of broadband, exploding demand for wireless services, the path to 5G including planned and expected capabilities, new LTE innovations, supporting technologies and architectures, voice over LTE (VoLTE), Wi-Fi Calling, LTE for public safety, options to expand capacity, and spectrum developments.

The appendix delves into more technical aspects of the following topics: 3GPP Releases, Data Throughput, latency, 5G, LTE, LTE-Advanced, LTE-Advanced Pro, HetNets and small cells, IoT, cloud RANs, Unlicensed Spectrum Integration, self-organizing networks, the IP Multimedia Subsystem, broadcast/multicast services, backhaul, UMTS/WCDMA,[1] HSPA, HSPA+, UMTS TDD, and EDGE/EGPRS.

[1] Although many use the terms "UMTS" and "WCDMA" interchangeably, in this paper "WCDMA" refers to the radio interface technology used within UMTS, and "UMTS" refers to the complete system. HSPA is an enhancement to WCDMA.

Broadband Transformation

Broadband networks rely on a fiber core with various access technologies, such as fiber to the premises, coaxial cable, digital subscriber line (DSL), or wireless connections. LTE provides a broadband experience, but capacity limitations prevent it from being the only broadband connection for most users. As a result, a majority of consumers in developed countries have both mobile broadband and fixed broadband accounts.

Two developments will transform the current situation:

1. **Fiber Densification**. Multiple companies are investing to extend the reach of fiber, decreasing the distance from the fiber network to the end node.
2. **5G Standardization and Deployment.** As 5G mmWave technology, including massive MIMO and beamforming, becomes commoditized, it will increasingly be a viable alternative to fixed-access technologies such as coaxial, DSL, and even fiber connections. 5G commercial services will enable a new innovation cycle. The ability to create new applications and services with fewer limitations will take the connected society to a new level.

Consequently, the companies that provide broadband service may change, and eventually, fixed and mobile broadband services may converge. For a more detailed discussion of trends in broadband, including the disruptive role of mmWave, refer to the 2017 Datacomm Research and Rysavy Research report, *Broadband Disruption: How 5G Will Reshape the Competitive Landscape*.[2]

As shown in Figure 1, the emerging broadband network is one with denser fiber and competing access technologies in which wireless connectivity plays a larger role.

[2] Details at https://datacommresearch.com/reports-broadband/.

Figure 1: Fiber Densification with Multiple Access Technologies, including mmWave

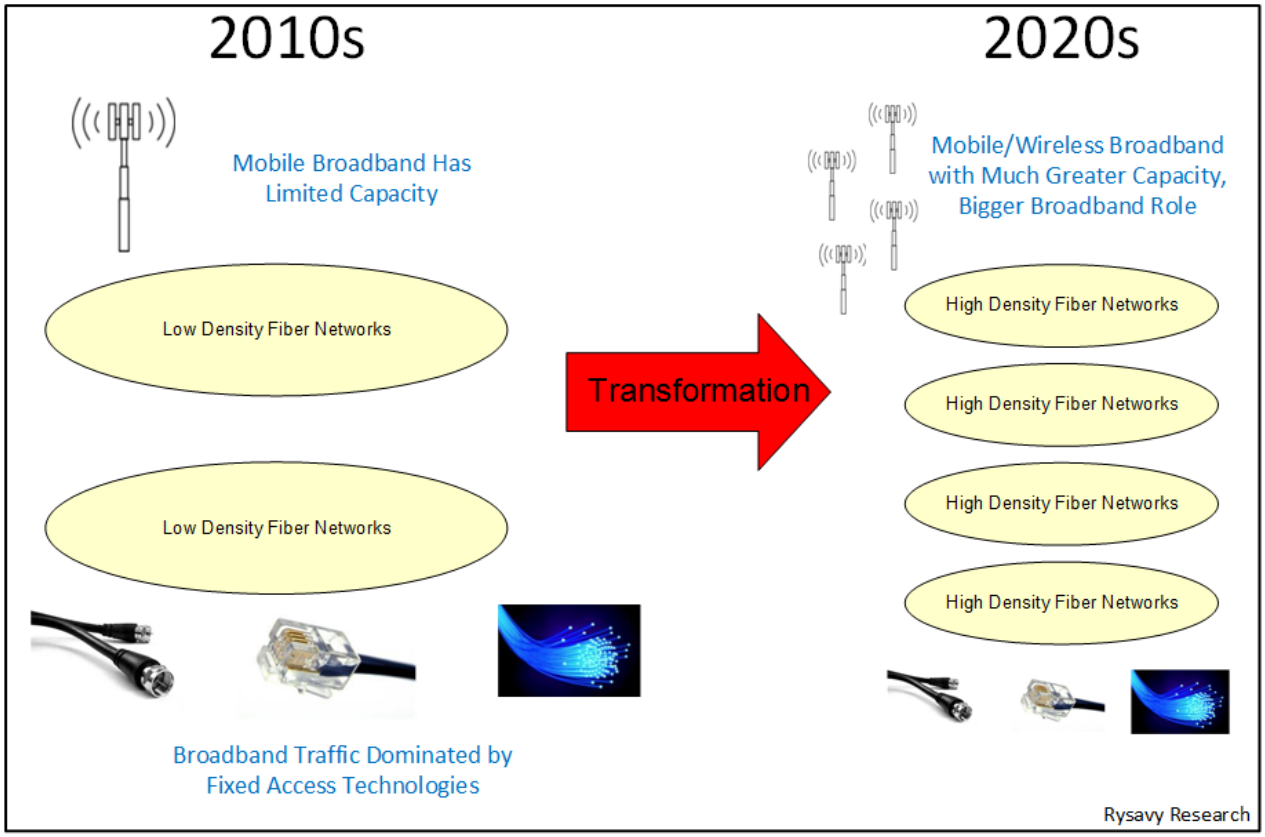

Many elements are interacting to transform mobile broadband, but the factors playing the most important roles are emerging capabilities for IoT, radio advances granting access to far more spectrum, small cells, new network architectures that leverage network function virtualization and software-defined networking, and new means to employ unlicensed spectrum. Except for access to high-band spectrum, a 5G objective, these advances apply to both LTE and 5G.

Figure 2: Fundamental Mobile Broadband Transformational Elements

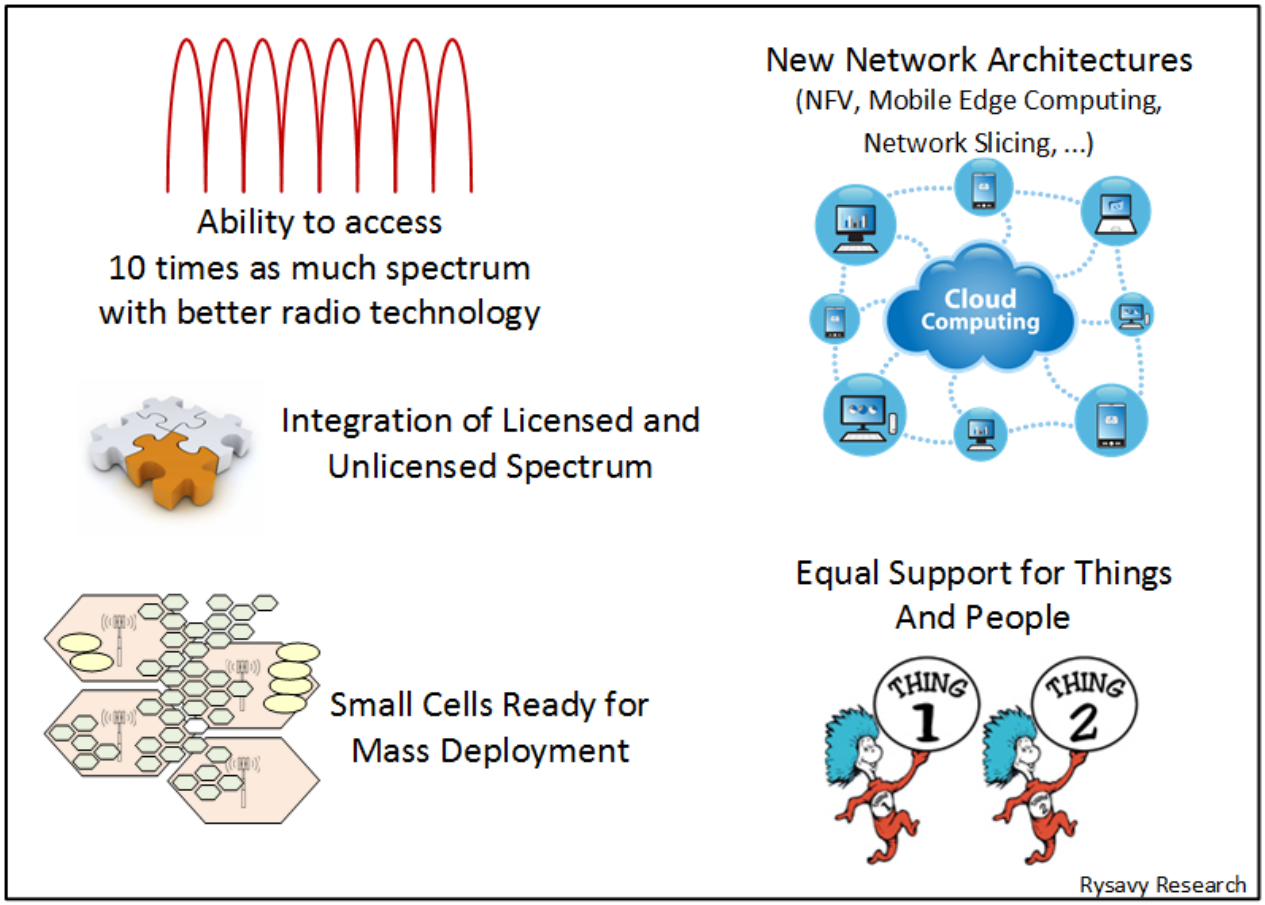

In the past, developers used modems and networks designed for human communication for machine-type applications. But now, new modes of network operation, initially in LTE then enhanced further in 5G, will cater to the unique needs of a wide variety of machine applications, addressing low-cost, long battery life, long communications range, and a wide variety of throughputs. For instance, some IoT applications need only low-throughput communications, some sending only a small number of bits per day.

As for spectrum, throughout radio history, technology has climbed up a ladder to use higher frequencies. What were called "ultra-high frequencies" when made available for television are now considered low-band frequencies for cellular. Frequencies above 6 GHz, particularly mmWave frequencies, are the new frontier. Networks will ultimately take advantage of ten times as much spectrum as they use now, and likely even more over time. Although challenging to use because of propagation limitations and higher penetration loss, massive MIMO, beam steering, beam tracking, dual connectivity, carrier aggregation, small-cell architectures with self-backhauling, and other methods will help mitigate the challenges at these frequencies. The result: massive increases in capacity in localized areas.

In addition to accessing higher bands, cellular technologies are integrating unlicensed spectrum more efficiently, using technologies such as LTE-U, LAA, MulteFire, LWA, and LWIP. This integration will immediately augment small-cell capacity, improving the business case for small cells.

Small cells, on the roadmap for many years but held back by implementation difficulties, such as backhaul, are on the verge of large scale deployment, leading ultimately to densities as high as ten small cells or more for every macro cell. Paving the way are better wireless backhaul solutions, neutral-host capabilities enabled by new technologies, and soon, access to mmWave bands.

Facilitating the capabilities listed above, networks are becoming programmable. Using a distributed, software-enabled network based on virtualization and new architectural approaches such as Multi-access Edge Computing (MEC) and network slicing, operators and third parties will be able to deploy new services and applications more rapidly, and in a more scalable fashion. Centralizing RAN signal processing will also play a huge role; depending on the deployment scenario, such centralization will increase RAN efficiency and decrease deployment cost.

This paper lists the dozens of other innovations also fueling mobile and cellular technology transformation. Together, these transformed networks will mean that for millions, and ultimately billions, of people, wireless connections will be the only connections that they need. These networks will also provide the foundation for entire new industries, ones not yet even conceived.

Exploding Demand

Two technology trajectories have created critical mass: handheld computing and fast wireless connections. This combined computing and communications platform inspires the innovation that has produced millions of mobile applications.

IoT is a third trajectory. LTE, and eventually 5G, will connect tens of billions of devices. And fixed-wireless access could be a fourth. 5G, with expected network capacity a hundred times greater than 4G networks, will make wireless connections not only a viable substitute for wireline broadband connections for tens of millions of users over the next ten years, but make that broadband connection the only connection that many users need.

Figure 3: Exploding Demand from Critical Mass of Factors

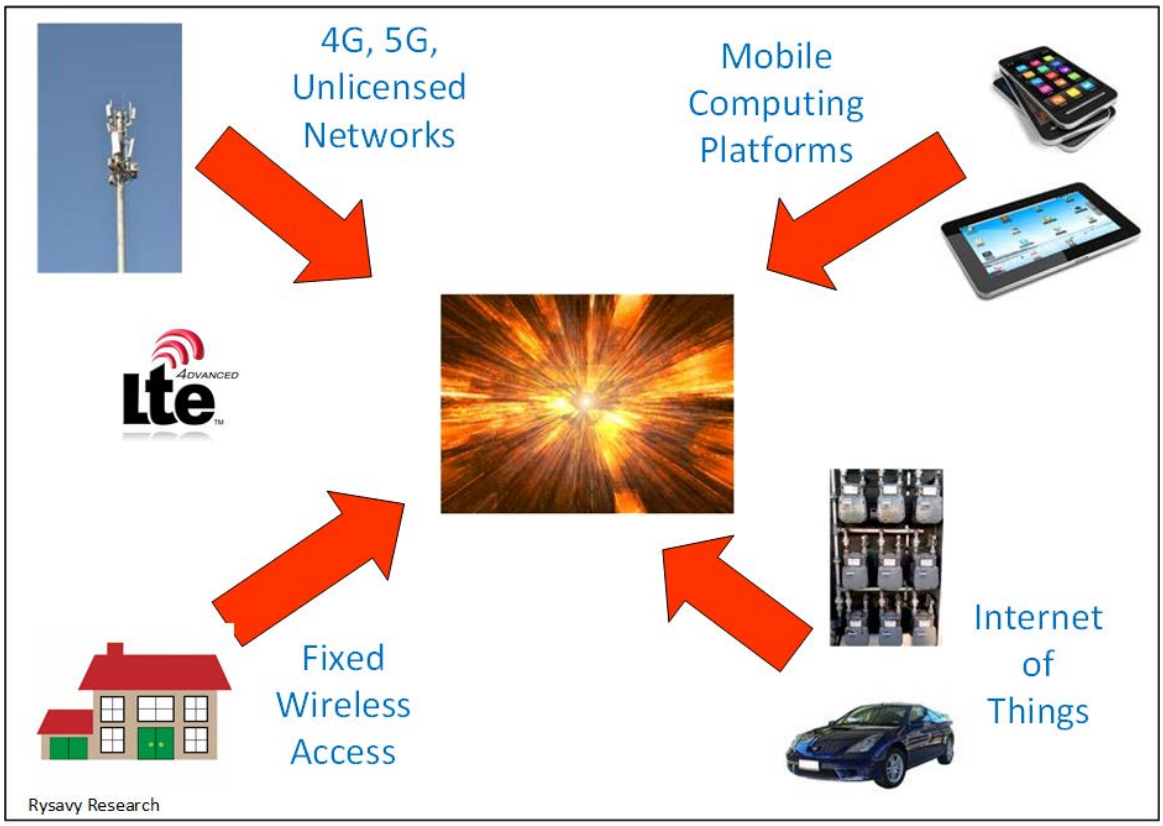

This section analyzes some of these demand factors.

Application Innovation

When planning 4G network technology, who could have predicted applications such as Uber and Lyft, which combine location information with mapping and online payment and are now disrupting the taxi industry and even challenging notions of private vehicle ownership? While some applications of new technology can be predicted, many cannot.

More efficient technology not only addresses escalating demand, it also provides higher performance, thus encouraging new usage models and further increasing demand.

Today's smartphones and tablets, dominated by the iOS and Android ecosystems, in combination with sophisticated cloud-based services, provide a stable, well-defined application environment, allowing developers to target billions of users. Developers have rich platform-specific development tools; web-based tools such as HTML5; application programming interfaces (APIs) for mobile-specific functions, such as WebRTC (Web Real-Time Communications); and cloud-based services for applications and application services, such as notifications, IoT support, and mobile-commerce.

Of concern to some companies in the wireless industry, however, are current network neutrality rules that could possibly hamper innovation. By restricting prioritization, for example, the rules seem to fail to recognize that traffic streams from different applications have inherently different quality of service requirements.[3]

Internet of Things

Current M2M and Internet of Things applications include vehicle infotainment, connected healthcare, transportation and logistics, connected cars, home security and automation, manufacturing, construction and heavy equipment, energy management, video surveillance, environmental monitoring, smart buildings, wearable computing, object tracking, and digital signage. Municipalities, evaluating the concept of "smart cities," are exploring how to optimize pedestrian and vehicular traffic, connect utility meters, and deploy trash containers that can report when they need emptying.

Although promising, the IoT market is also challenging, with varying communications requirements, long installation lifetimes, power demands that challenge current battery technology, cost sensitivity, security and data privacy concerns, unsuitability of conventional networking protocols for some applications, and other factors that developers must address. Consequently, the IoT opportunity is not uniform; it will eventually comprise thousands of markets. Success will occur one sector at a time, with advances in one area providing building blocks for the next.

Cloud-based support platforms and standardized interfaces are essential for development and deployment of IoT applications. For example, oneM2M has developed a service-layer that can be embedded in hardware and software to simplify communications with application servers.[4]

To address the IoT opportunity, 3GPP is defining progressive LTE refinements that will occur over multiple 3GPP releases. These refinements include low-cost modules that approach 2G module pricing and enable multi-year battery life. See the section "Internet of Things and Machine-to-Machine" in the appendix for more details.

Video Streaming

Video represents the greatest usage of data on smartphones. Just an hour a day of mobile video at 1.0 Mbps throughput, common with YouTube or Netflix, consumes 13.5 GB per month. Many streams, now available in high-definition (HD), consume even more data.

---

[3] For further discussion, see Rysavy Research, *How "Title II" Net Neutrality Undermines 5G*, April 19, 2017. Available at http://www.rysavy.com/Articles/2017-04-How-Title-II-Net-Neutrality-Undermines-5G.pdf. Also see *How Wireless is Different – Considerations for the Open Internet Rulemaking*, September 12, 2014. Available at http://www.rysavy.com/Articles/2014-09-Wireless-Open-Internet.pdf.

[4] OneM2M home page: http://onem2m.org/.

See the Appendix section “Data Consumed by Video” for a quantification of data consumed by video for multiple usage scenarios.

An increasing number of video applications adapt their streaming rates based on available bandwidth. By doing so, they can continue to operate even when throughput rates drop. Conversely, they take advantage of higher available bandwidth to present video at higher resolution. Fortunately, application developers are becoming sensitive to bandwidth constraints and are offering options for users to reduce consumption.

Nevertheless, video can consume so much data that cutting the broadband cord at the same time as the television cord is not possible for most consumers. With 5G’s massive increase in capacity, however, an increasing percentage of users will use wireless connections as their only broadband connections, including for all their entertainment needs.

Cloud Computing

Cloud computing inherently increases data consumption because it requires communications for all operations. Examples include data synchronization and backup, cloud-based applications (such as email, word processing, and spreadsheets), automatic photo uploads, and music and video streaming.

5G Data Drivers

Futurists can predict some 5G applications, but many others will arise as industries evolve or come into existence to take advantage of new network capabilities. Some potential applications of 5G include:

- Ultra-high-definition, such as 4K and 8K, and 3D video.
- Augmented and immersive virtual reality. Ultra-high-fidelity virtual reality can consume 50 times the bandwidth of a high-definition video stream.
- Realization of the tactile internet—real-time, immediate sensing and control, enabling a vast array of new applications.
- Automotive, including autonomous vehicles, driver-assistance systems, vehicular internet, infotainment, inter-vehicle information exchange, and vehicle pre-crash sensing and mitigation.
- Monitoring of critical infrastructure, such as transmission lines, using long battery life and low-latency sensors.
- Smart transportation using data from vehicles, road sensors, and cameras to optimize traffic flow.
- Mobile health and telemedicine systems that rely on ready availability of high-resolution and detailed medical records, imaging, and diagnostic video.
- Public safety, including broadband data and mission-critical voice.
- Sports and fitness enhancement through biometric sensing, real-time monitoring, and data analysis.
- Fixed broadband replacement.

Some of these applications are already being addressed by 4G, but 5G's lower costs, higher throughputs, and lower latency will hasten realization of their potential.

Specific industries expected to take advantage of 5G include manufacturing, healthcare, media and entertainment, financial services, public safety, automotive, public transport, and energy utilities.[5]

Global Mobile Adoption

Figure 4 shows the often-cited Cisco projection of global mobile data consumption through 2021, measured in exabytes (billion gigabytes) per month, demonstrating traffic growing at a compound annual rate of 47%.

Figure 4: Global Mobile Data 2016 to 2021[6]

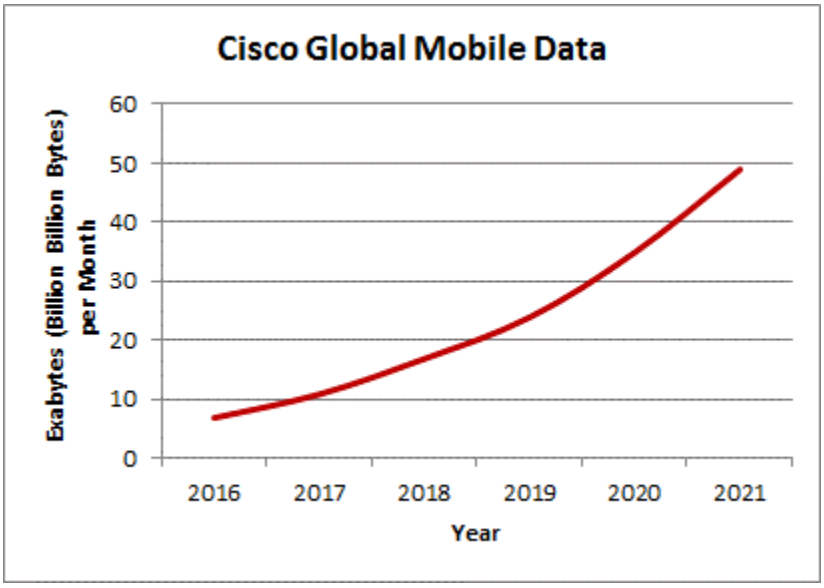

Figure 5 shows another data projection, predicting 45% annual growth in data for the 2016-to-2022 period, resulting in eight-fold growth.

[5] For further insight, refer to the Ericsson white paper, *The 5G Business Potential,* February 2017. Available at https://www.ericsson.com/en/networks/insights/the-5g-business-potential.

[6] Cisco, *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016-2021*, February 2017.

Figure 5: Global Mobile Voice and Data (Exabytes/Month) 2012 to 2022[7]

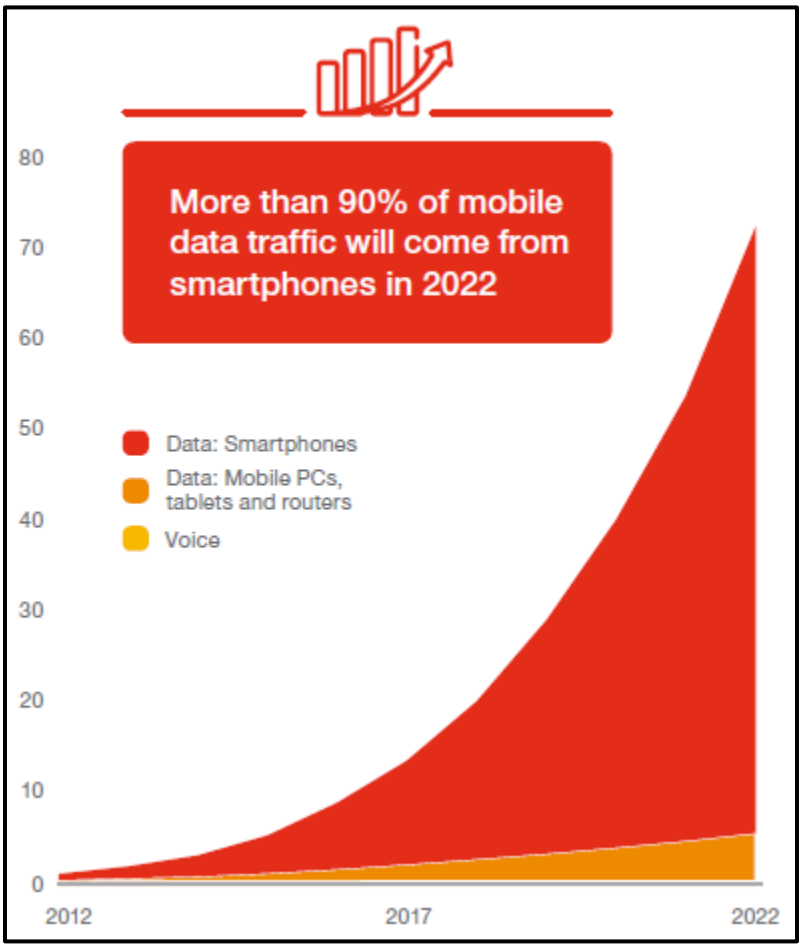

Figure 6 shows how the Internet of Things will drive far more connections than are launched by people.

[7] Ericsson, *Ericsson Mobility Report*, June 2017.

Figure 6: Connections of Places Versus People Versus Things[8]

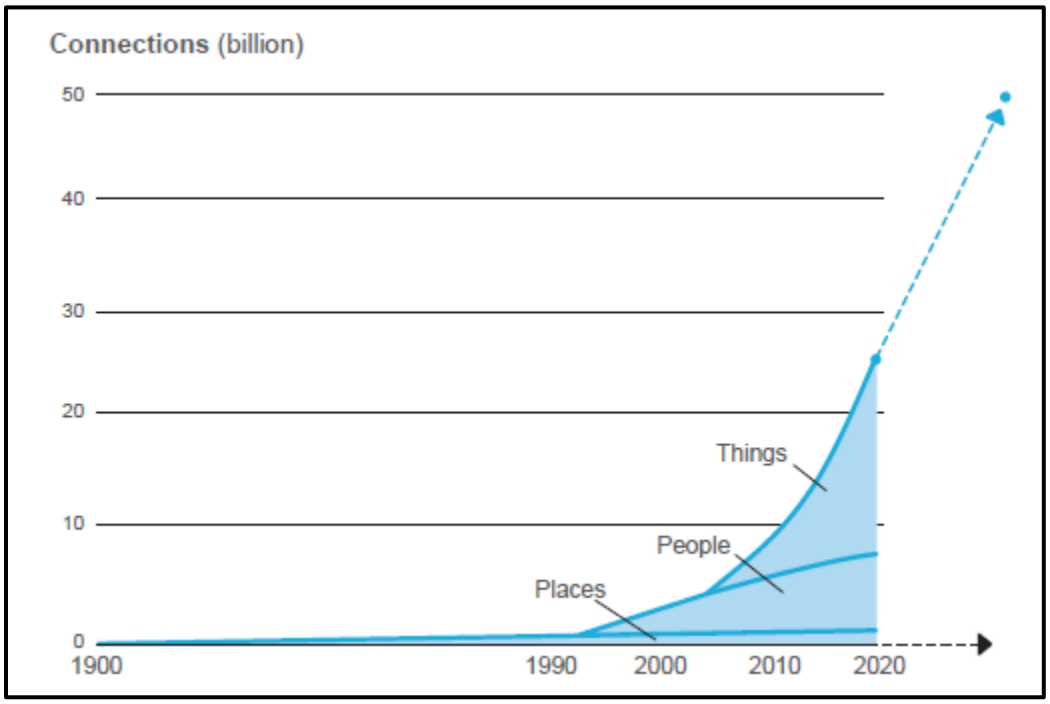

In June 2017, more than 7.56 billion GSM-HSPA-LTE connections were in effect[9]—greater than the world's 7.40 billion population.[10] By the end of 2022, the global mobile broadband market is expected to include nearly 9.4 billion subscribers, with 9.3 billion using 3GPP technologies, representing more than 99% market share.[11]

LTE has experienced faster deployment than any mobile technology ever developed. All major U.S. operators now offer nationwide LTE coverage. LTE has also been chosen by U.S. national public-safety organizations as their broadband technology of choice.

As shown in Figure 7, 2G GSM has peaked and is now declining, as is CDMA. Both HSPA and LTE subscriptions will continue to rise through the rest of the decade.

[8] Ericsson, *IoT Security*, February 2017, available at https://www.ericsson.com/assets/local/publications/white-papers/wp-iot-security-february-2017.pdf.

[9] Ovum, July 2017.

[10] U.S. Census Bureau, "U.S. and World Population Clock," http://www.census.gov/popclock/, accessed July 18, 2017.

[11] Ovum, July 2017. Note that the 2018 mobile broadband market figures include GSM/EDGE, because most GSM networks are likely to include Evolved EDGE, which provides mobile broadband capability.

Figure 7: Global Adoption of 2G-4G Technologies 2010 to 2020[12]

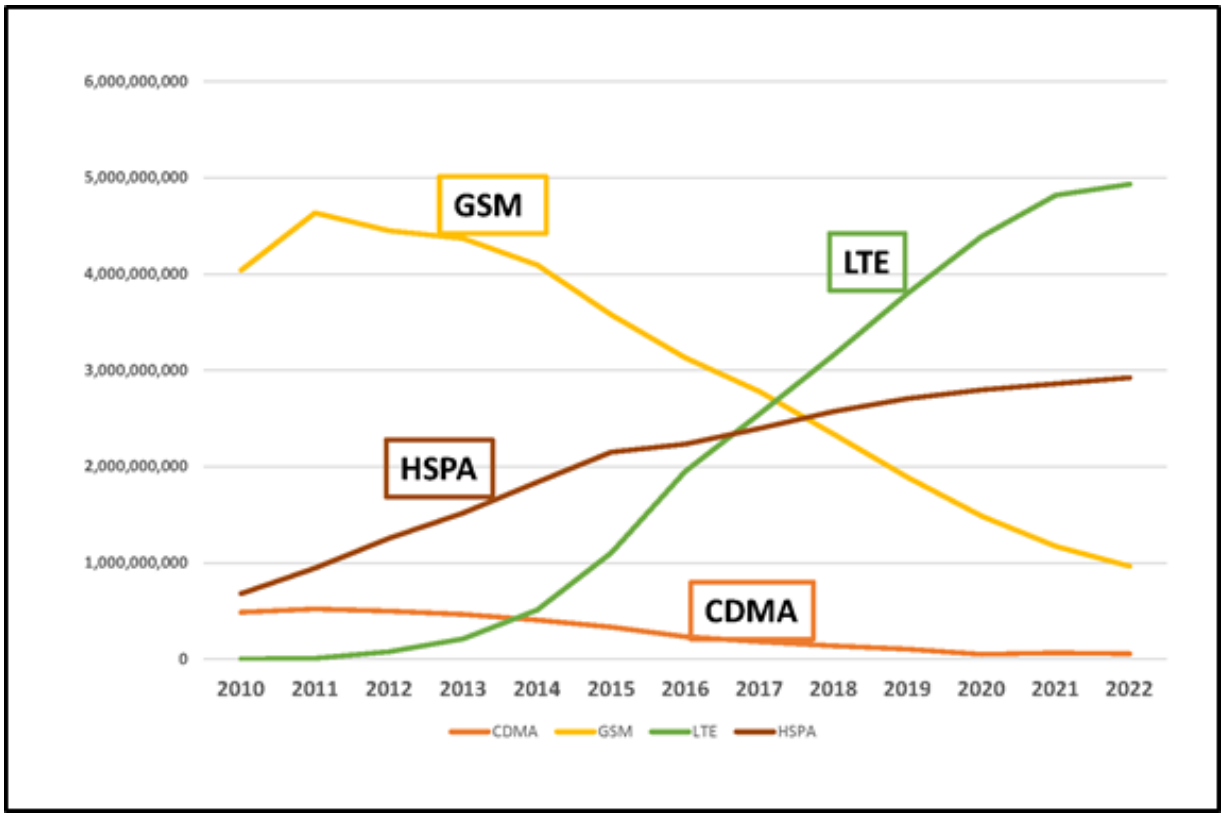

IoT is growing rapidly as well, although connections so far are well below phone-type connections. Cisco projects 3.3 billion IoT connections by 2021, with 6% on 2G cellular, 16% on 3G, and 46% on 4G.[13]

[12] Ovum (WCIS), July 2017.

[13] Cisco, *Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016-2021*, February 2017.

Almost at 5G

With intensive development occurring within 3GPP, the first 5G specification will be completed in early 2018, enabling the first standards-based networks to be deployed in the 2019-2020 timeframe. This section includes expanding use cases, 1G-to-5G evolution, 4G LTE advances, 5G radio and architectures, Information-Centric Networking, phasing of 5G releases, and an overview of 3GPP releases.

Expanding Use Cases

Many wireless technology discussions focus on radio capabilities, but other equally important aspects include use cases, the services built on top of the technology, how different networks integrate with one another, and the topology of the networks. As summarized in Figure 8, these aspects are expanding, making mobile/wireless technology the foundation for other enterprises, including business-process optimization, consumer electronics, M2M, connected devices, and a multitude of vertical industries.

Figure 8: Expanding Use Cases

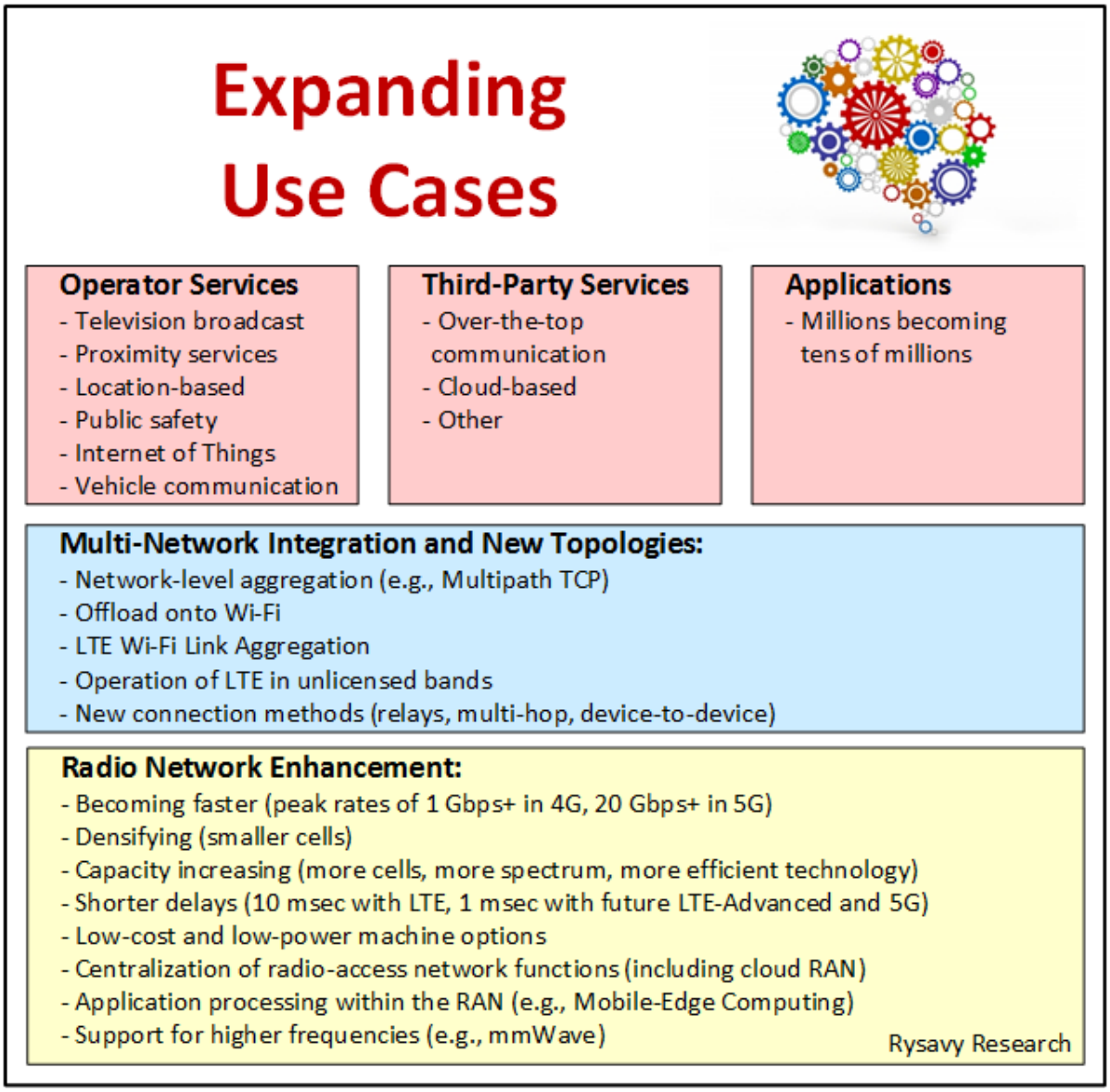

Table 2 summarizes the requirements of the expanding number of use cases that employ wireless technology.

Table 2: Requirements for Different Use Cases[14]

Use Cases	Requirements	Desired Value
Autonomous vehicle control	Latency	5 msec
	Availability	99.999 percent
	Reliability	99.999 percent

[14] Ericsson, *5G Systems – Enabling the Transformation of Industry and Society*, January 2017. Available at https://www.ericsson.com/assets/local/publications/white-papers/wp-5g-systems.pdf. Adapted from Table 1.

Use Cases	Requirements	Desired Value
Emergency communication	Availability	99.9 percent victim discovery rate
	Energy efficiency	One-week battery life
Factory cell automation	Latency	Down to below 1ms
	Reliability	Down to packet loss of less than 10^{-9}
High-speed train	Traffic density	Downlink (DL): 100Gbps/km^2, uplink (UL): 50 Gbps/km^2
	User throughput	DL: 50Mbps, UL: 25Mbps
	Mobility	500 km/h
	Latency	10ms
Large outdoor event	User throughput	30Mbps
	Traffic density	900Gbps/km^2
	Connection density	Four devices/m^2
Massive IoT	Connection density	1,000,000 devices/km^2
	Availability	99.9 percent coverage
	Energy efficiency	10-year battery life
Remote surgery and examination	Latency	Down to 1ms
	Reliability	99.999 percent
Smart city	User throughput	DL: 300Mbps, UL: 60Mbps
	Traffic density	700 Gbps/km^2
	Connection density	200,000 devices/km^2
Virtual and augmented reality	User throughput	4-28Gbps
	Latency	< 7msec
Broadband to the home	Connection density	4,000 devices/km^2
	Traffic density	60Gbps/km^2

The economic role that wireless technology plays keeps increasing. One study anticipates that in 2035, 5G will enable $12.3 trillion of global economic output.[15]

1G to 5G Evolution

5G is almost upon us; it is a technology that will be constructed from millions of ideas, methods, algorithms, and processes. Just as 4G LTE became available when previous technologies, such as HSPA, could be further improved, 5G enters the stage when the roadmap for LTE has not been exhausted. And just as 2G coexists today with 3G and 4G, 5G will co-exist with previous generations of technology.

For historical context, "1G" refers to analog cellular technologies that became available in the 1980s. "2G" denotes initial digital systems that became available in the 1990s and that introduced services such as short messaging and lower-speed data. 3G requirements were specified by the International Telecommunication Union (ITU) as part of the International Mobile Telephone 2000 (IMT-2000) project, for which significant voice capacity improvement was a focus and digital networks had to provide 144 Kbps of throughput at mobile speeds, 384 Kbps at pedestrian speeds, and 2 Mbps in indoor environments. UMTS-

[15] HIS Economics and HIS Technology, *The 5G Economy: How 5G Technology will contribute to the global economy,* January 2017. Commissioned by Qualcomm Technologies.

HSPA and CDMA2000 are the primary 3G technologies. 3G technologies began to be deployed early last decade.

In 2008, the ITU issued requirements for IMT-Advanced, which many people initially used as a definition of 4G. The focus on 4G was to improve data coverage, capacity, and quality of experience. Requirements included operation in up to-40 MHz radio channels and extremely high Spectral Efficiency. The ITU required peak spectral efficiency of 15 bps/Hz and recommended operation in up-to-100 MHz radio channels, resulting in a theoretical throughput rate of 1.5 Gbps. In 2009 and 2010, the term "4G" became associated with mobile broadband technologies deployed at the time, such as HSPA+, WiMAX, and initial LTE deployments. Today, 4G usually refers to HSPA+ or LTE.

Although the industry is preparing for 5G, LTE capabilities will continue to improve in LTE-Advanced Pro through the rest of the decade. Many of these enhancements will come through incremental network investments. Given the scope of global wireless infrastructure, measured in hundreds of billions of dollars, offering users the most affordable service requires operators to leverage investments they have already made. 5G will eventually play an important role, but it must be timed appropriately so that the jump in capability justifies the new investment.

5G groups researching next generation wireless architecture and requirements include, among others, the International Telecommunication Union (ITU),[16] the European Union's 5G Infrastructure Public-Private-Partnership (5G PPP), which is the framework for several projects, including METIS II (Mobile and wireless communications Enablers for the Twenty-twenty Information Society), and Next Generation Mobile Networks (NGMN). Finally, 5G Americas is actively involved in developing the vision and requirements of 5G for North, Central, and South America. 5G Americas signed an MoU to collaborate with 5G-PPP.[17]

The ITU, the standardization group of the United Nations, has set the following standardization timetable in its IMT-2020 project:[18]

- 2016-2017: Definition of technical performance requirements, evaluation criteria and methods, and submission templates.
- 2018-2019: Submission of proposals.
- 2019: Evaluation of proposed technologies.
- 2019 and 2020: Publication of IMT-2020 specifications.

[16] International Telecommunication Union, "Working Party 5D (WP 5D) - IMT Systems," http://www.itu.int/ITU-R/index.asp?category=study-groups&rlink=rwp5d&lang=en, accessed May 16, 2017.

[17] 5GPPP, "5G-PPP MoU with 4G Americas," March 2, 2015. http://5g-ppp.eu/5g-ppp-mou-with-4g-amerericas/

[18] ITU, "ITU towards 'IMT for 2020 and beyond'," http://www.itu.int/en/ITU-R/study-groups/rsg5/rwp5d/imt-2020/Pages/default.aspx, viewed May 16, 2017.

Wireless technology has progressed to the extent that significant new capabilities are inevitable, making 5G a possible alternative to wireline broadband for many subscribers.[19]

Table 3 summarizes the generations of wireless technology.

Table 3: 1G to 5G

Generation	Requirements	Comments
1G	No official requirements. Analog technology.	Deployed in the 1980s.
2G	No official requirements. Digital technology.	First digital systems. Deployed in the 1990s. New services such as SMS and low-rate data. Primary technologies include IS-95 CDMA (cdmaOne), IS-136 (D-AMPS), and GSM.
3G	ITU's IMT-2000 required 144 Kbps mobile, 384 Kbps pedestrian, 2 Mbps indoors.	First deployment in 2000. Primary technologies include CDMA2000 1X/EV-DO and UMTS-HSPA. WiMAX.
4G (Initial Technical Designation)	ITU's IMT-Advanced requirements include the ability to operate in up-to-40-MHz radio channels and with very high spectral efficiency.	First deployment in 2010. IEEE 802.16m and LTE-Advanced meet the requirements.
4G (Current Marketing Designation)	Systems that significantly exceed the performance of initial 3G networks. No quantitative requirements.	Today's HSPA+, LTE, and WiMAX networks meet this requirement.
5G	ITU IMT-2020 has defined technical requirements for 5G, and 3GPP is developing specifications.	First standards-based deployments in 2019 and 2020.

The interval between each significant technology platform has been about ten years. Within each platform, however, innovation surges unabated. For example, with 2G technology,

[19] Rysavy Research, "How will 5G compare to fiber, cable or DSL?" Fierce Wireless, May 2014. Available at http://www.rysavy.com/Articles/2014-05-5G-Comparison-Wireline.pdf.

EDGE significantly improved data performance compared with initial General Packet Radio Service (GPRS) capabilities. Similarly, HSPA hugely increased data speeds compared with initial 3G capabilities. LTE and LTE-Advanced are also acquiring continual improvements that include faster speeds, greater efficiency, and the ability to aggregate spectrum more flexibly.

Figure 9 presents the timeline of technology generations, including past and future, showing initial deployment, the year of the peak number of subscribers, and decline. Each cellular generation spans multiple decades, with peak adoption occurring some 20 years after initial deployment. 6G deployment in 2030, though highly speculative, is consistent with deployment of previous generations.

Figure 9: Timeline of Cellular Generations

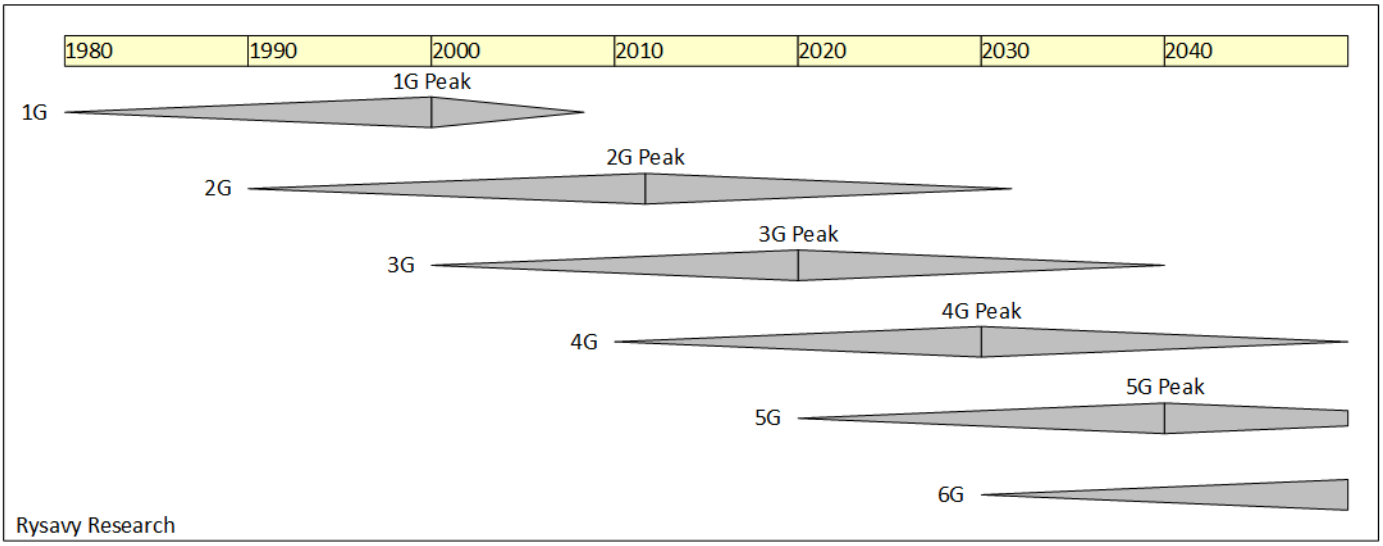

4G LTE Advances

As competitive pressures in the mobile broadband market intensified, and as demand for capacity persistently grew, LTE became the favored 4G solution because of its high data throughputs, low-latency, and high spectral efficiency. Specifically:

- **Wider Radio Channels.** LTE can be deployed in wide radio channels (for example, 10 MHz or 20 MHz) with carrier aggregation now up to 640 MHz, although inter-band aggregation of four or five carriers (up to 100 MHz) represents a practical upper limit.
- **Easiest MIMO Deployment.** By using new radios and antennas, LTE facilitates MIMO Deployment, in contrast to the logistical challenges of adding antennas for MIMO to existing legacy technologies. Furthermore, MIMO gains are maximized because all user equipment supports it from the beginning.
- **Best Latency Performance.** For some applications, low latency (packet traversal delay) is as important as high throughput. With a low transmission time interval (TTI) of 1 millisecond (msec) and a flat architecture (fewer nodes in the core network), LTE has the lowest latency of any cellular technology.

In the same way that 3G coexists with 2G systems in integrated networks, LTE systems co-exist with both 3G and 2G systems, with devices capable of 2G, 3G, and 4G modes.

Beyond radio technology, the Evolved Packet Core (EPC) provides a core architecture that integrates with both legacy GSM-HSPA networks and other wireless technologies, such as CDMA2000 and Wi-Fi. The combination of EPC and LTE is referred to as the Evolved Packet System (EPS).

LTE is available in both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes. Many deployments are based on FDD in paired spectrum. The TDD mode, however, is important for deployments in which paired spectrum is unavailable. Instances of TDD deployment include China, Europe at 2.6 GHz, U.S. Broadband Radio Service (BRS) spectrum at 2.6 GHz, and the 3.5 GHz band.

The versions of LTE most widely deployed today are just the first in a series of innovations that will increase performance, efficiency, and capabilities. Enhancements in the 2013 to 2016 period were the ones defined in 3GPP Releases 10, 11, and 12 and are commonly referred to as LTE-Advanced.[20] Subsequent releases, including Releases 13 to 15, specify LTE-Advanced Pro.

Keeping in mind that different operators have varying priorities, the following list roughly ranks the most important features of LTE-Advanced and LTE-Advanced Pro for the 2017 to 2020 timeframe:

1. **Carrier Aggregation.** With this capability, already in use, operators can aggregate radio carriers in the same band or across disparate bands to improve throughputs (under light network load), capacity, and efficiency. Carrier aggregation can also combine FDD and TDD and is the basis of LTE-U and LTE-LAA. As examples, in 2015, AT&T aggregated 700 MHz with AWS, and 700 MHz with PCS. T-Mobile aggregated 700 MHz with AWS, and AWS with PCS.[21] Operators are now deploying three-carrier aggregation and eventually may aggregate four carriers.[22] Release 13 introduced support for carrier aggregation of up to 32 carriers, addressing primarily the opportunity to aggregate multiple unlicensed channels. Release 14 specifies interband carrier aggregation for up to five downlink carriers and 2 uplink carriers.

2. **VoLTE.** Initially launched in 2015 and with widespread availability in 2017, VoLTE enables operators to roll out packetized voice for LTE networks, resulting in greater voice capacity and higher voice quality.

3. **Tighter Integration of LTE with Unlicensed Bands.** LTE-U became available for testing in 2016, and 3GPP completed specifications for LAA in Release 13, with deployment expected around 2018. MulteFire, building on LAA, will operate without requiring a licensed carrier anchor. LTE/Wi-Fi Aggregation through LWA and LWIP are other options for operators with large Wi-Fi deployments.

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[20] From a strict standards-development point of view, the term “LTE-Advanced” refers to the following features: carrier aggregation, 8X8 downlink MIMO, and 4XN uplink MIMO with N the number of receive antennas in the base station.

[21] AT&T band combinations are 3GPP Band 13 + Band 4, Band 17 + Band 4, and Band 17 + Band 2. T-Mobile band combinations are Band 12 + Band 4, Band 12 + Band 2, and Band 4 + Band 2.

[22] For carrier aggregation to operate, both the network and the device have to support the particular band combination. Legacy devices typically do not support new network aggregation capabilities.

4. **Enhanced Support for IoT.** Release 13 brings Category M1, a low-cost device option, along with Narrowband-IoT (NB-IoT), a version of the LTE radio interface specifically for IoT devices, called Category NB1.

5. **Higher-Order and Full-Dimension MIMO.** Deployments in 2017 use up to 4X4 MIMO. Release 14 specifies a capability called Full-Dimension MIMO, which supports configurations with as many as 32 antennas at the base station. See the section "Smart Antennas and MIMO" and Appendix section "LTE Smart Antennas" for further detail.

6. **Dual Connectivity.** Release 12 introduced the capability to combine carriers from different sectors and/or base stations (i.e. evolved Node Bs [eNBs]) through a feature called Dual Connectivity. Two architectures were defined: one that supports Packet Data Convergence Protocol (PDCP) aggregation between the different eNBs and one that supports separate S1 connections on the user-plane from the different eNBs to the EPC.

7. **256 QAM Downlink and 64 QAM Uplink.** Defined in Release 12 and already deployed in some networks, higher-order modulation increases user throughput rates in favorable radio conditions.

8. **1 Gbps Capability.** Using a combination of 256 QAM modulation, 4X4 MIMO, and aggregation of three carriers, operator networks can now reach 1 Gbps peak speeds. See below for more information.

9. **V2X Communications.** Release 14 specifies vehicle-to-vehicle and vehicle-to-infrastructure communications. See the section "Cellular V2X Communications" for more information.

10. **Coordinated Multi Point.** CoMP (and enhanced CoMP [eCoMP]) is a process by which multiple base stations or cell sectors process a User Equipment (UE) signal simultaneously, or coordinate the transmissions to a UE, improving cell-edge performance and network efficiency. Initial usage will be on the uplink because no user device changes are required. Some networks had implemented this feature in 2017.

11. **HetNet Support.** HetNets integrate macro cells and small cells. A key feature is enhanced inter-cell interference coordination (eICIC), which improves the ability of a macro and a small-cell to use the same spectrum. This approach is valuable when the operator cannot dedicate spectrum to small cells. Operators are currently evaluating eICIC, and at least one operator has deployed it.[23] Further enhanced ICIC (feICIC) introduced in Rel-11 added advanced interference cancellation receivers into devices.

12. **Ultra-Reliable and Low-Latency Communications.** Being specified in Release 15, URLLC in LTE will shorten radio latency to a 1 msec range using a combination of shorter transmission time intervals and faster hybrid automatic repeat request (HARQ) error processing. See the Appendix section "LTE Ultra-Reliable and Low-Latency Communications" for further details.

13. **Self-Organizing Networks.** With SON, networks can automatically configure and optimize themselves, a capability that will be particularly important as small cells begin

[23] Fierce Wireless, "SK Telecom teams with Nokia Networks on eICIC," January 2015.

to proliferate. Vendor-specific methods are common for 3G networks, and trials are now occurring for 4G LTE standards-based approaches.

Other key features that will become available in the 2016-to-2020 timeframe include full-dimension MIMO, enhanced Multimedia Broadcast/Multicast Services (eMBMS), User-Plane Congestion Management (UPCON), and device-to-device communication (targeted initially at public-safety applications).

The appendix explains these features and quantifies performance gains, and Figure 10 illustrates the transition from LTE to LTE-Advanced and LTE-Advanced Pro, which include these features.

Figure 10: LTE to LTE-Advanced Pro Migration[24]

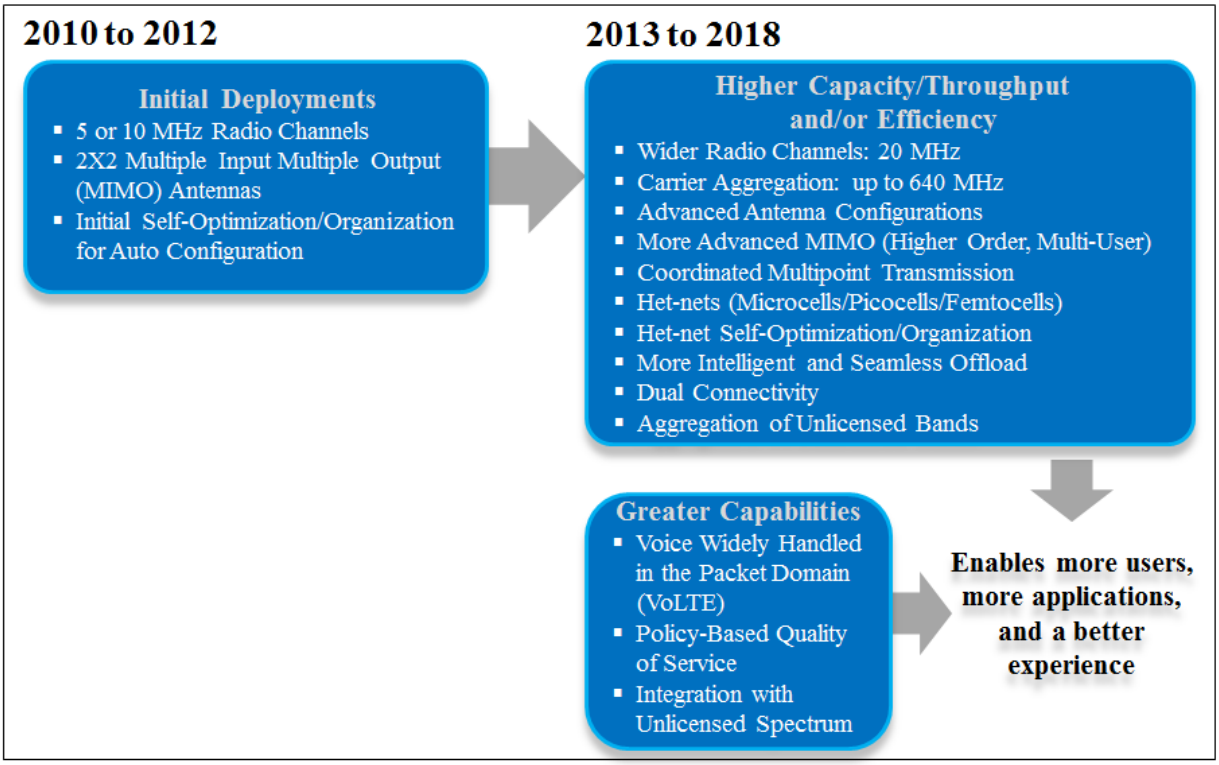

Figure 11 illustrates gains in peak downlink speeds through carrier aggregation, higher-order MIMO, and higher-order modulation.

[24] 5G Americas/Rysavy Research

Figure 11: Successive Gains in Peak LTE Downlink Throughput[25]

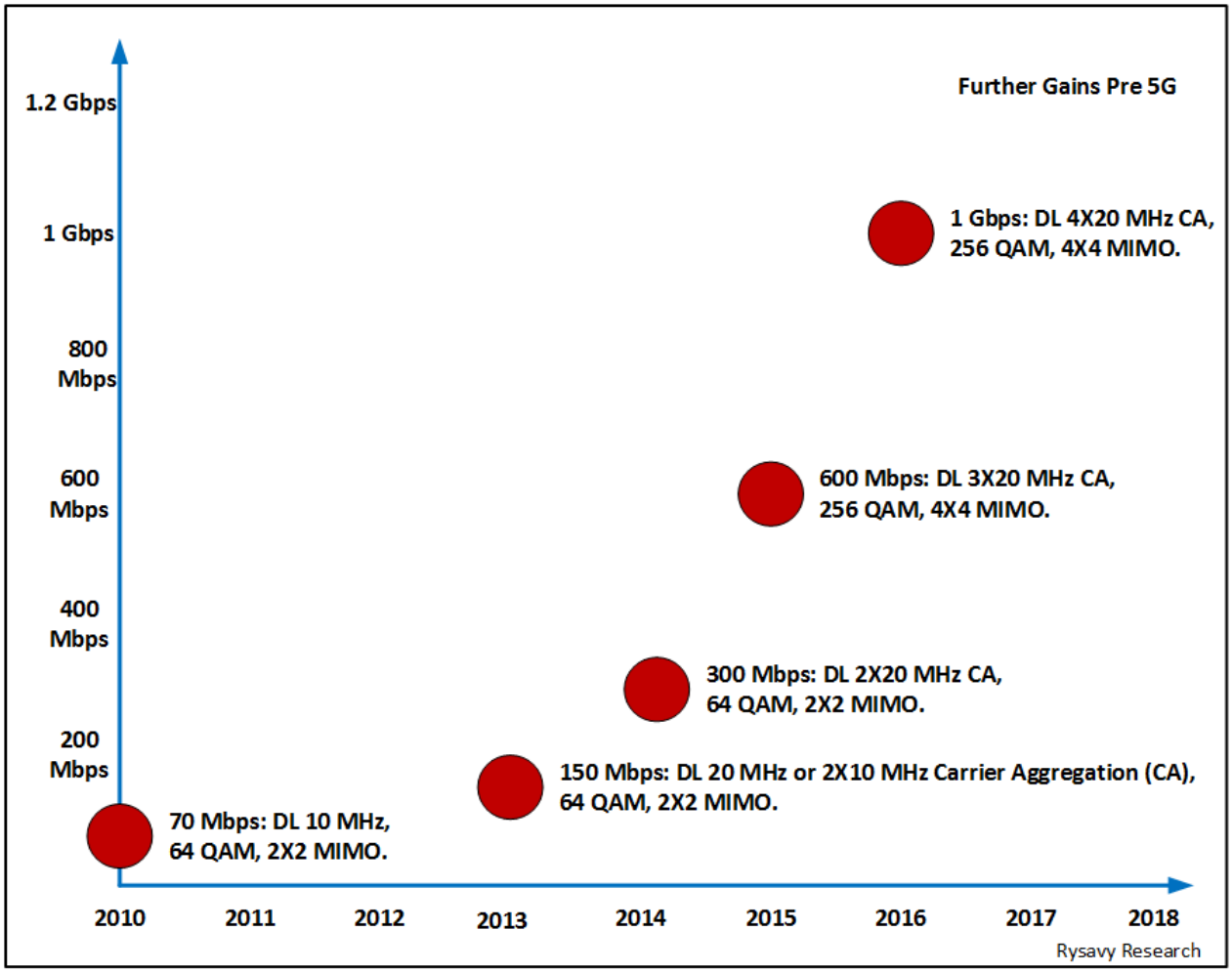

5G Use Cases (ITU and 3GPP)

The ITU, in its 5G recommendations, divides use cases into three main categories, as shown in Figure 12.

1. **Enhanced Mobile Broadband (eMBB).** eMBB is the most obvious extension of LTE capability, providing higher speeds for applications such as streaming, Web access, video conferencing, and virtual reality. Highest speeds will occur in small cells with limited movement speed of end users, such as with pedestrians.

2. **Massive Machine-Type Communications (mMTC).** Massive machine-type communications extends LTE Internet of Things capabilities—for example, NB-IoT—

[25] Rysavy Research analysis based on information about commercially available chipsets. Not all LTE features are available simultaneously, and thus throughputs do not necessarily scale linearly with items such as bandwidth. See also the following article about achieving gigabit speeds with LTE: Ars Technica, "Qualcomm's new LTE modem will make gigabit download speeds easier to hit," February 21, 2017. Available at https://arstechnica.com/gadgets/2017/02/qualcomms-new-lte-modem-will-make-gigabit-download-speeds-easier-to-hit/#p3.

to support huge numbers of devices with lower costs, enhanced coverage, and long battery life. As shown in the ITU objectives, below, 5G will support ten times as many devices in an area as LTE.

3. **Ultra-Reliable and Low Latency Communications (URLLC).** Of the three categories, URLLC enables wireless applications never before possible. Driven by high dependability and extremely short network traversal time, URLLC, also referred to as "mission-critical" communications, will enable industrial automation, drone control, new medical applications, and autonomous vehicles. These types of applications are potentially the ones that will deliver the greatest societal benefits, yet unfortunately, at least in the United States, they could possibly be undermined by current network neutrality regulations. This category is also referred to as critical machine-type communications (cMTC).

Figure 12: ITU Use Case Model[26]

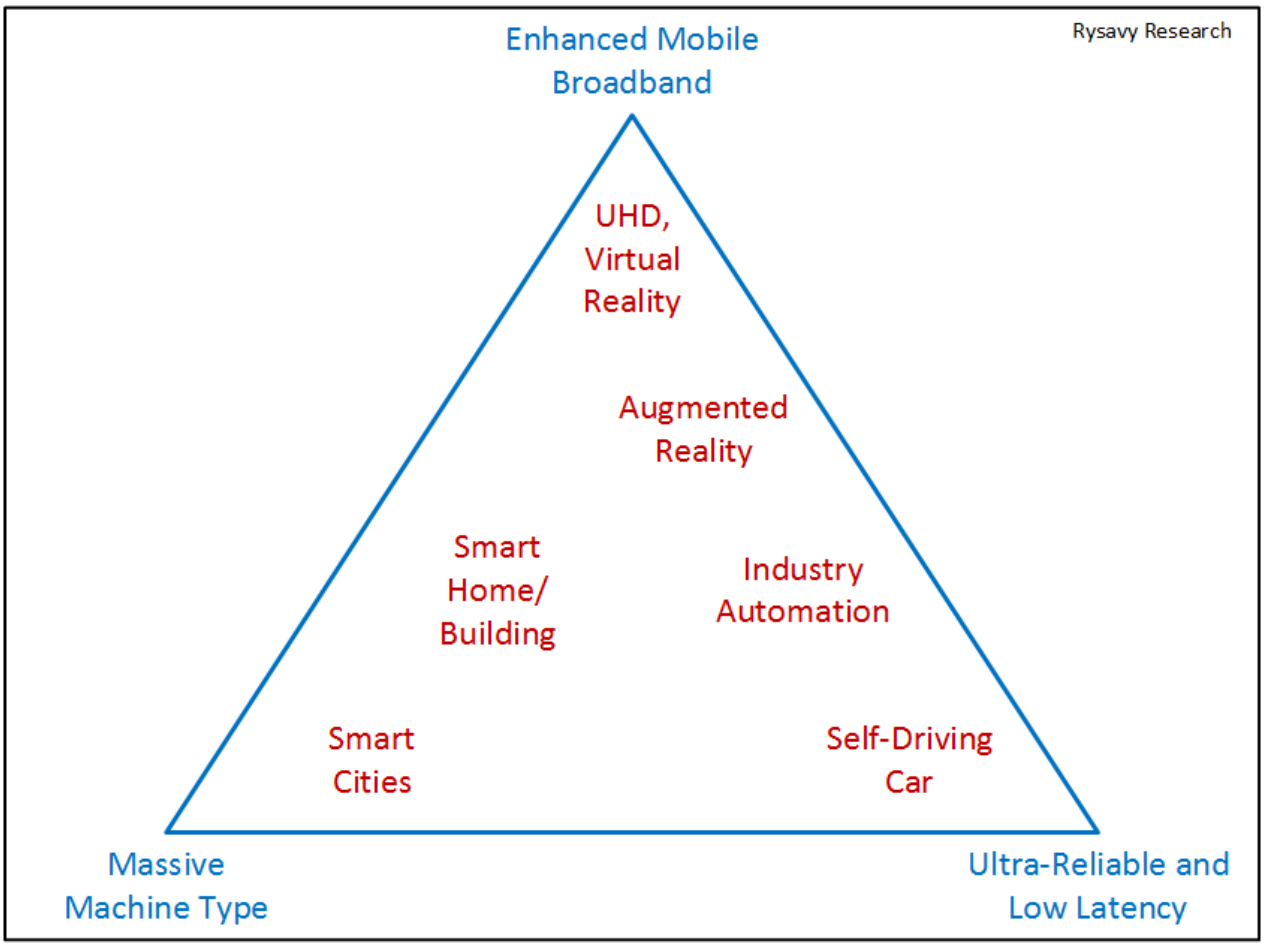

[26] For background, see ITU, *IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond*, Recommendation ITU-R M.2083-0, Sep. 2015.

3GPP, in studying 5G, has methodically identified multiple specific use cases in a project called "SMARTER," which are consistent with ITU's model.[27] 3GPP's service dimensions include:

- Massive Internet of Things (eHealth, wearables, eCity, eFarm).
- Critical Communications (e.g., vehicles, drones, industry robots).
- Enhanced Mobile Broadband (e.g., augmented reality, virtual reality, ultra-high definition).
- Network Operation (e.g., network slicing, connectivity/routing, migration/interworking).

Using small cells and mmWave radio channels, a 5G network built for capacity will deliver 1 Tbps/km^2 or higher, enabling 5G to compete with wireline broadband services.[28]

5G Technical Objectives

Table 4 shows the ITU's objectives for IMT-2020 (5G) relative to IMT-Advanced (4G).

Table 4: ITU Objectives for IMT-2020 compared with IMT-Advanced[29]

	IMT-Advanced	IMT-2020
Peak Data Rate	DL: 1 Gbps UL: 0.05 Gbps	DL: 20 Gbps UL: 10 Gbps
User Experienced Data Rate	10 Mbps	100 Mbps[30]
Peak Spectral Efficiency	DL: 15 bps/Hz UL: 6.75 bps/Hz	DL: 30 bps/Hz UL: 15 bps/Hz
Average Spectral Efficiency		DL eMBB indoor: 9 bps/Hz DL eMBB urban: 7.8 bps/Hz DL eMBB rural: 3.3 bps/Hz UL eMBB indoor: 6.75 bps/Hz UL eMBB urban: 5.4 bps/Hz UL eMBB rural: 1.6 bps/Hz

[27] 3GPP TR22.891, *Feasibility Study on New Services and Markets Technology Enablers*; TR22.861 (Massive Internet of Things); TR22.862 (Critical Communications); TR 22.863 (Enhanced Mobile Broadband); TR22.864 (Network Operation).

[28] The hotspot capacity requirement of 10 Mbps/sq. m. is equivalent to 10 Tbps/sq. km. See also *Nokia, Ten key rules of 5G deployment, Enabling 1 Tbit/s/km^2 in 2030*, 2015.

[29] ITU Working Party 5D, *Minimal Requirements Related to Technical Performance for IMT-2020 Radio Interfaces,* Feb 22, 2017. See also 3GPP TR 38.913, *Study on Scenarios and Requirements for Next Generation Access Technologies (Release 14),* V14.2.0, Mar. 2017.

[30] Per ITU, "User experienced data rate is the 5% point of the cumulative distribution function (CDF) of the user throughput."

	IMT-Advanced	IMT-2020
Mobility	350 km/h	500 km/h
User Plane Latency	10 msec	1 msec[31]
Connection Density	100 thousand devices/sq.km.	1 million devices sq./km.
Network Energy Efficiency	1 (normalized)	100X over IMT-Advanced
Area Traffic Capacity	0.1 Mbps/sq. m.	10 Mbps/sq. m. (hot spots)
Bandwidth	Up to 20 MHz/radio channel (up to 100 MHz aggregated)	Up to 1 GHz (single or multipole RF carriers)

In supporting different usage scenarios, not all of these objectives will necessarily be simultaneously available. For example, an IoT application may need to support a large number of devices but at lower throughput rates, while a vehicular application may need high mobility and low latency.

Other expected enhancements include:

- Deep coverage for machines buried within environments.
- Extremely low energy demands for ten years or more of battery operation.
- Low complexity options for inexpensive machine communications.
- Auto-awareness through discovery and self-optimization.

5G Concepts and Architectures

Standards bodies have not yet defined 5G requirements, but various groups are analyzing the possibilities of what might constitute 5G for network deployments in 2020 or beyond. Often stated goals of 5G include:

- Being able to support a greater number of end-systems, including IoT applications, at lower average revenue than 4G systems.
- Peak data rates of multi Gbps (see Table 4 above).
- Rather than emphasizing peak rates, a more uniform user experience across the coverage area.
- Support for many frequencies, including existing cellular bands and frequencies above 6 GHz.

[31] Per 3GPP TR 38.913 (V14.2.0, Mar. 2017), 0.5 msec for DL and 0.5 msec for UL for URLCC and 4 msec for UL and 4 msec for DL for eMBB.

- Availability of TDD and FDD modes for all bands.
- Hierarchical/planned and ad hoc deployment models.
- Use of licensed and unlicensed bands.
- Equal support for human-type and machine-type communications. Includes highly efficient small data transmission.
- Advanced Spectrum Sharing, possibly based on spectrum sharing approaches being developed for the 3.5 GHz band.

Figure 13 shows the transformation of networks, moving from today's LTE-Advanced networks to future LTE-Advanced and eventually 5G networks.

Figure 13: Network Transformation[32]

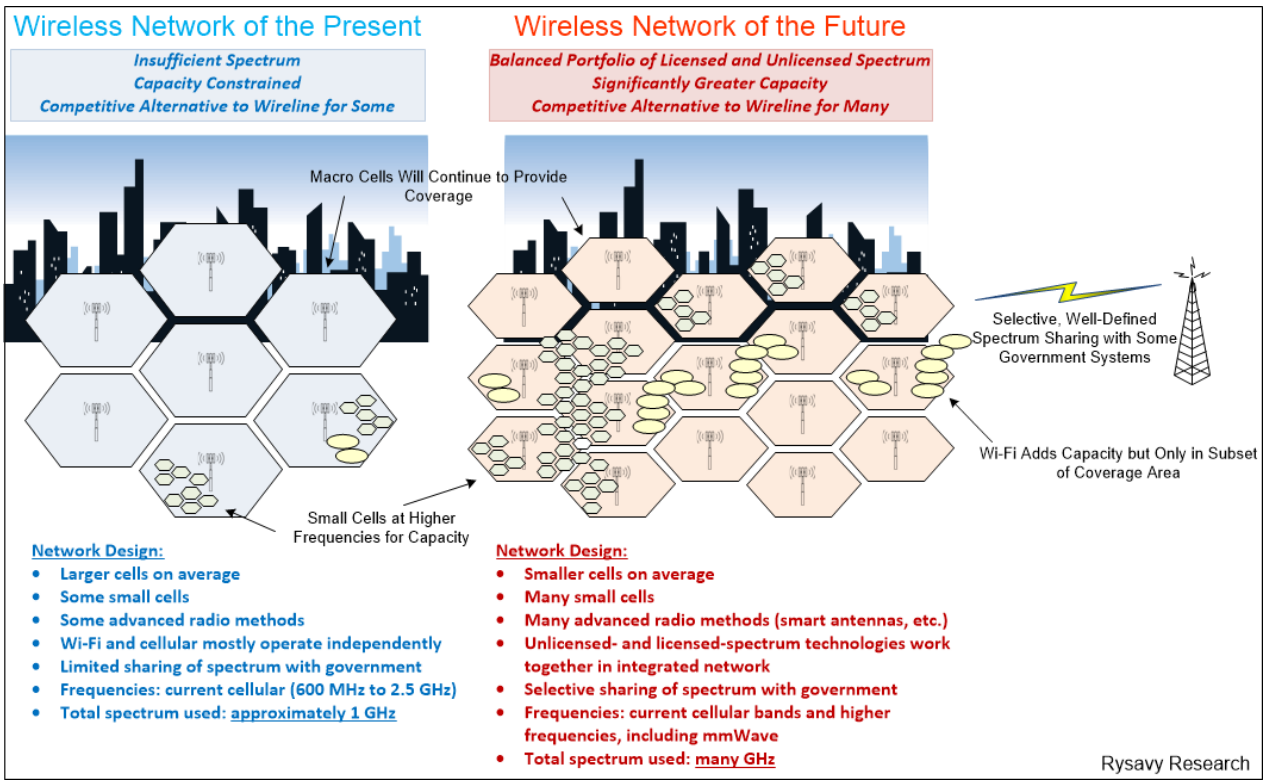

The fundamental decision for 5G is how to best leverage existing technology investments in LTE while exploiting new spectrum and new technology capabilities. 5G design emphasizes ways to combine existing 4G LTE networks with capabilities provided by 5G. One approach likely to be used by many operators is to use LTE in existing frequency bands and the 5G NR in new bands, such as mmWave, as shown in Figure 14. 5G NR, however,

[32] See also Rysavy Research infographic, "Mobile Broadband Networks of the Future," April 2014. Available at http://www.rysavy.com/Articles/2014-05-Networks-of-the-Future-Infographic.pdf.

will operate in all frequencies, and just as 2G and 3G spectrum has been re-farmed for LTE, existing cellular bands will eventually be re-farmed for 5G.

Figure 14: 5G Combining of LTE and New Radio Technologies

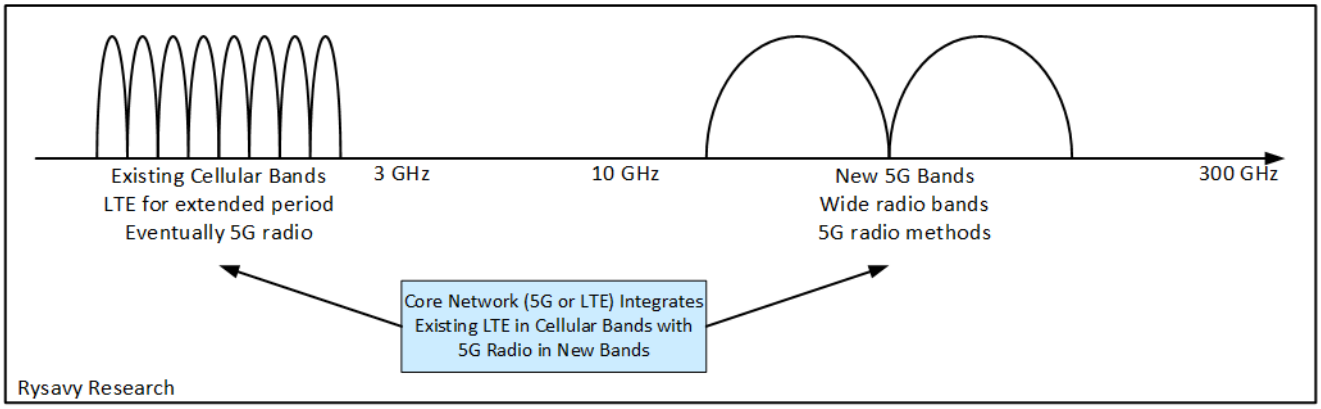

As shown in Figure 15, higher frequency bands in 5G will provide capacity with smaller cells, and lower bands will provide coverage with larger cells. This is similar to the approach taken in 4G.

Figure 15: Characteristics of Different Bands[33]

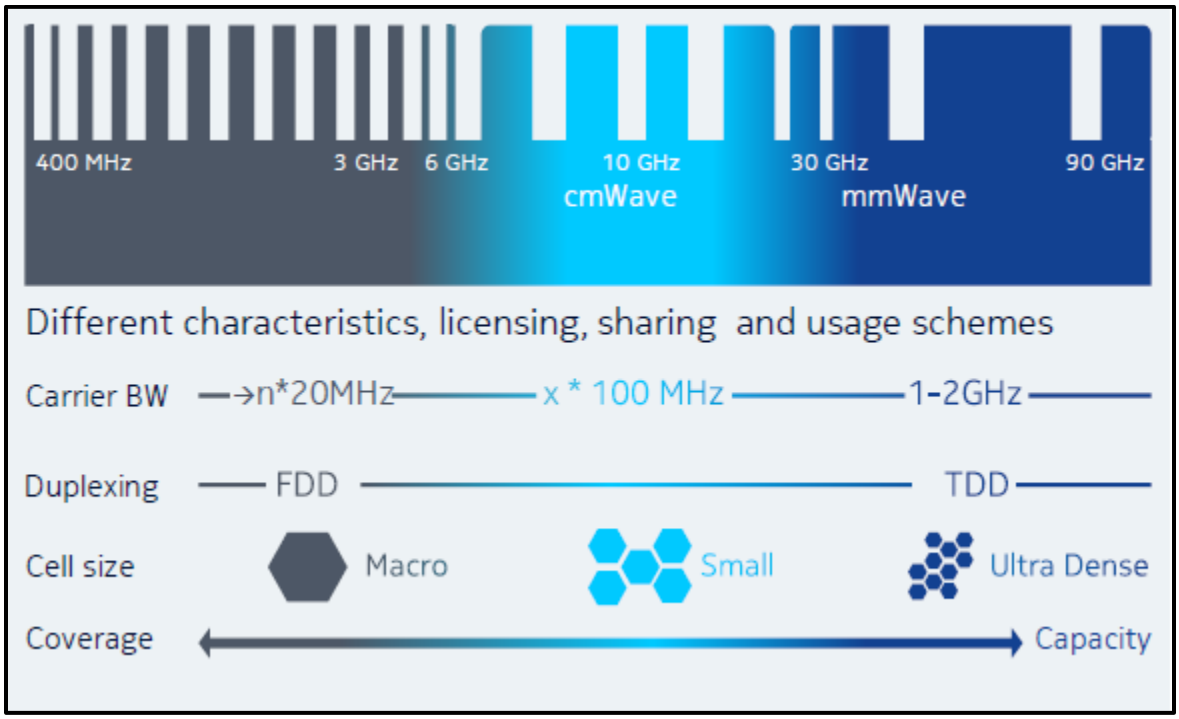

[33] Nokia, *Vision & Priorities for Next Generation Radio Technology*, 3GPP RAN workshop on 5G, Sep. 17-18, 2015.

New radio methods in NR will boost performance and will co-exist with future versions of LTE. 3GPP, in Release 14, completed a study item on 5G NR and will specify NR in Release 15.

Figure 16: Evolution to 5G Including LTE Improvements and New 5G Radio Methods

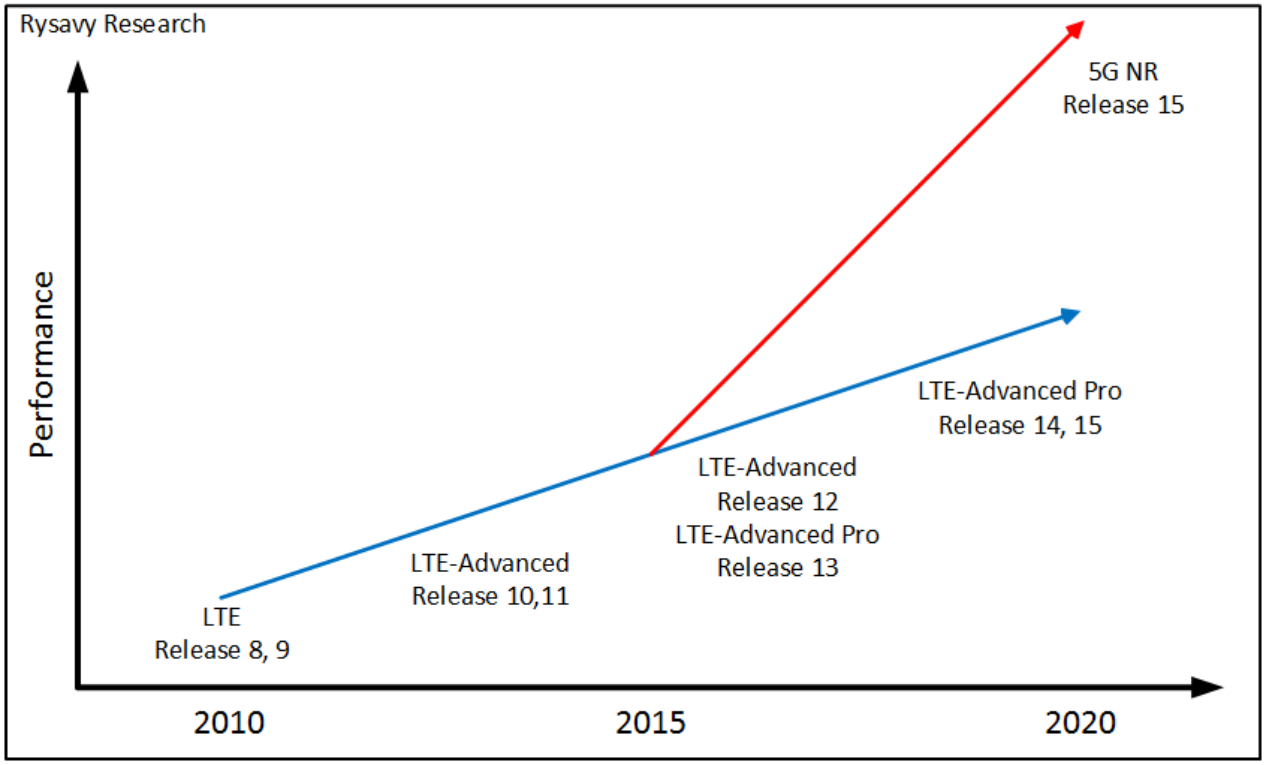

While many deployments will integrate LTE and NR, some operators could choose NR-only deployments.

5G New Radio (NR)

3GPP is defining 5G NR in Release 15, with an initial release for non-standalone operation scheduled for March 2018 and full release for standalone version scheduled for September 2018. Release 16 will add additional capabilities to the radio, such as support for URLLC. Despite specifications not being finalized, the following are planned capabilities and features of NR in Release 15:

- Ability to operate in any frequency band, including low, mid, and high bands.
- Network can support both LTE and 5G NR, including dual connectivity with which devices have simultaneous connections to LTE and NR.
- Carrier aggregation for multiple NR carriers.
- 5 Gbps peak downlink throughput in initial releases, increasing to 50 Gbps in subsequent versions.
- OFDMA in downlink and uplink, with optional Single Carrier Frequency Division Multiple Access (SC-FDMA) for uplink. Radio approach for URLLC to be defined in

Release 16, but Release 15 will provide physical layer frame structure and numerology support.

- Massive MIMO and beamforming.
- Ability to support either FDD or TDD modes for 5G radio bands.
- Numerologies of 2^N X 15 kHz for subcarrier spacing up to 120 kHz or 240 kHz. This approach, depicted in Figure 17, supports both narrow radio channels (for example, 1 MHz), or wide ones (for example, 400 MHz). Phase 1 likely to support a maximum of 400 MHz bandwidth with 240 kHz subcarrier spacing.
- Error correction through low-density parity codes (LDPC), which are computationally more efficient than LTE turbo codes at higher data rates.
- Standards-based cloud RAN support, compared with proprietary LTE approaches, that specifies a split between the PDCP and Radio Link Control (RLC) protocol layers.
- Self-contained integrated subframes that combine scheduling, data, and acknowledgement.
- Future-proofing by providing a flexible radio framework that has forward compatibility to support future, currently unknown services, such as URLLC to be specified in Release 16.
- Scalable transmission time intervals with short time intervals for low latency and longer time intervals for higher spectral efficiency.
- QoS support using a new model.
- Dynamic co-existence with LTE in the same radio channels. (See the Appendix section "LTE-NR Co-existence" for more details.)

According to one 5G Americas member company in 2017, operators globally have expressed interest in deploying NR in a wide variety of bands, including current cellular bands, 3.5 GHz, and mmWave bands.

Release 16 will add support for:

- URLCC.
- Shared spectrum operation.
- 5 GHz unlicensed spectrum operation based on current LTE approaches such as LAA, LWA, LWIP, and RAN Controlled LTE Wireless LAN Interworking (RCLWI).
- Possibly integrated access and backhaul based on a Release 15 study item. See the appendix section, "Integrated Access and Backhaul," for more details.
- Other, as yet unknown, features.

The ability to simultaneously transmit and receive on the same frequency has been stated in the past as an objective of 5G, and although such capability remains of interest, it is not currently being specified.

Figure 17: Hypothetical Example of 5G Numerology

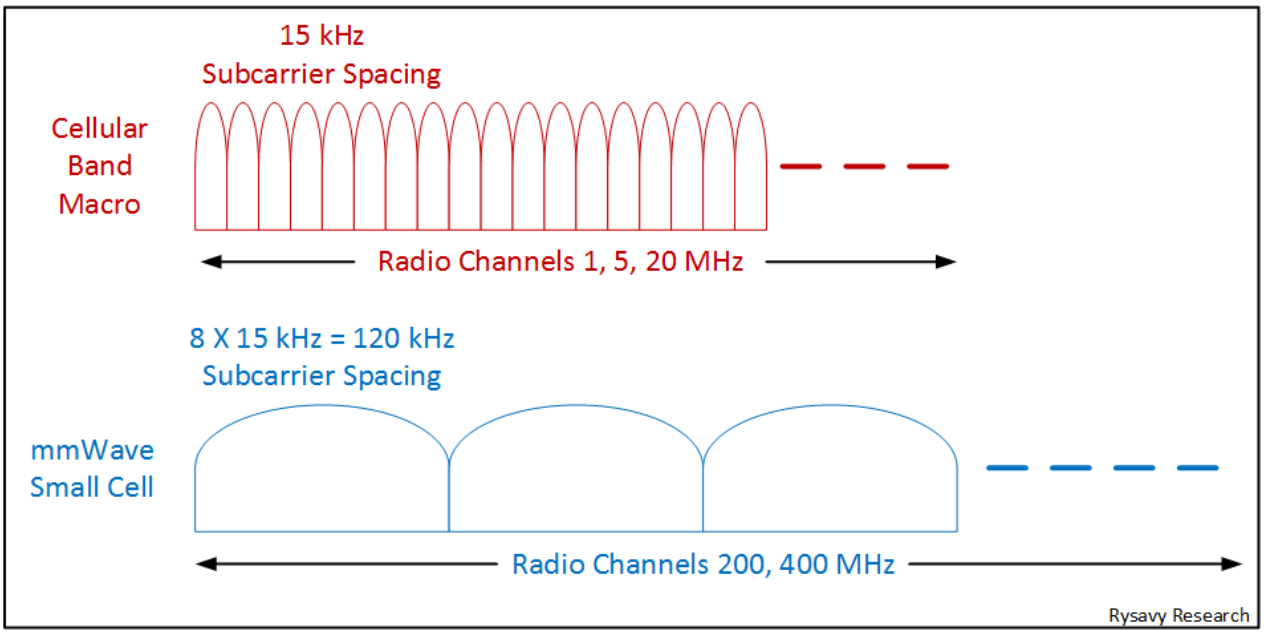

Expected 5G Performance

Predicting the 5G user experience is challenging because 5G will be deployed in many configurations, including different bands and with varying width radio channels. In addition, the throughput rates a user experiences depend on signal quality, device capability, and network loading. Some early predictions, however, are possible by examining the ITU objectives, the expected width of radio channels, and results from simulation studies.

The ITU objectives are that in a 5G network, 95% or more users should be able to experience at least 100 Mbps, which is also termed as cell-edge throughput. Examining the simulation results in the appendix section on 5G, "Performance," such results appear feasible using 200 MHz or wider radio channels. The results also suggest that average or typical rates could reach 500 Mbps using 200 MHz radio channels and 1 Gbps using 400 MHz radio channels.

Just as LTE throughputs have increased significantly over this decade, 5G performance will keep improving over the next ten years. One 5G Americas member expects that the 5G theoretical peak rate could be 5 Gbps in 2020, rising to 50 Gbps by 2024.

Release 15 Non-Standalone and Standalone Options

3GPP is specifying the first phase of 5G in Release 15. So that operators can deploy 5G sooner, 3GPP divided Release 15 into two sets of specifications. The first and earlier set of specifications define how a 5G RAN can integrate with an LTE network in what 3GPP calls a non-standalone option. In this earliest version (architecture option 3), NR will rely on an existing LTE network, both in the RAN and in the core.

The complete Release 15 specifications will also define a 5G core network. Figure 18 shows some of the architecture options. Options 3, 4 and 7 are the non-standalone options and options 1, 2, and 5 are standalone. The appendix section, "5G Architecture Options," discusses all of the deployment options in greater detail.

Figure 18**: Release 15 Non-Standalone and Standalone Options**

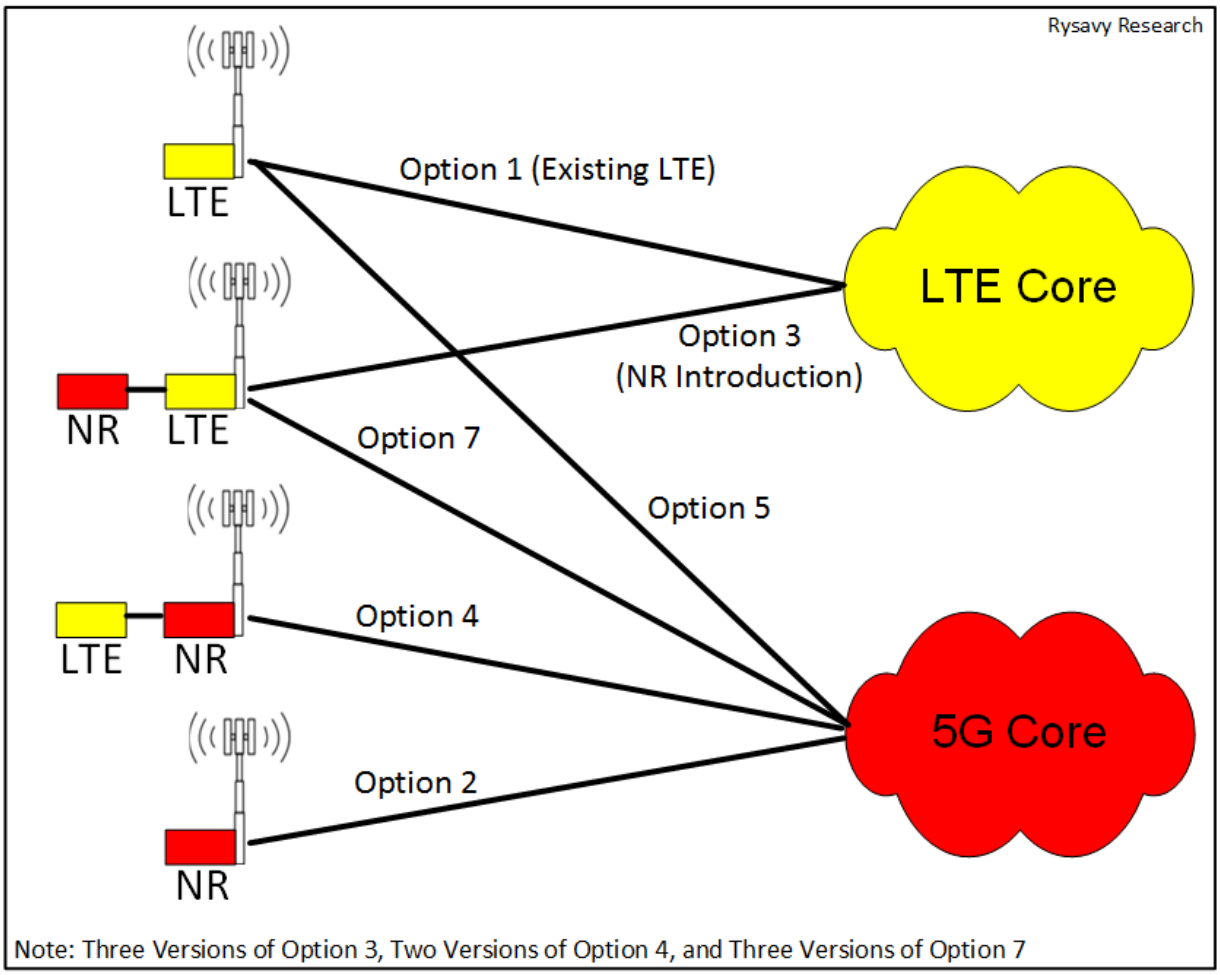

5G Schedule3GPP is currently standardizing 5G in Release 15, which will complete the non-standalone version of 5G in March 2018. Based on a typical minimum period of 18 months to build and deploy the technology, initial 5G NSA deployments could occur toward the end of 2019 or the beginning of 2020. 3GPP will complete the full Release 15 specifications in September 2018, enabling deployments in 2020. Release 16, which is the second phase of 5G, will be complete at the end of 2019, and Release 16 deployments could occur in 2021. In 2020, 3GPP will begin work on Release 17 which will include as yet unknown capabilities.

Figure 19Figure 19 shows the current schedule for 5G development and deployment. 3GPP is currently standardizing 5G in Release 15, which will complete the non-standalone version

of 5G in March 2018. Based on a typical minimum period of 18 months to build and deploy the technology, initial 5G NSA deployments could occur toward the end of 2019 or the beginning of 2020. 3GPP will complete the full Release 15 specifications in September 2018, enabling deployments in 2020. Release 16, which is the second phase of 5G, will be complete at the end of 2019, and Release 16 deployments could occur in 2021. In 2020, 3GPP will begin work on Release 17 which will include as yet unknown capabilities.

Figure 19: 5G Schedule[34]

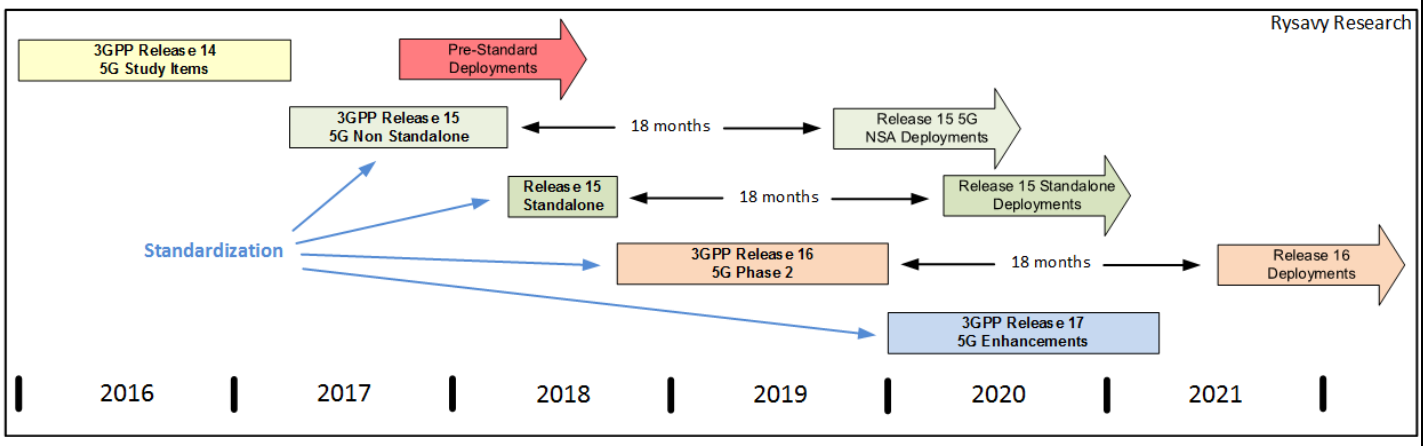

5G Core Network

Release 15 also defines initial core network capabilities that support QoS and network slicing. See the 5G appendix section, "Architecture," for more details. A study item in Release 15 will study integrated access and backhaul, with which base stations can use the 5G radio channel for backhaul. This capability could become a work item for Release 16. See the appendix section, "Integrated Access and Backhaul," for more details.

Many operators will virtualize their 5G core networks, just as they have for LTE, but such virtualization is outside the scope of 3GPP specifications.

5G Device Availability

User devices capable of 5G operation have not yet been announced, but availability will likely follow the trends of previous generations of networks. Initial devices, possibly in the 2019 timeframe, will likely include routers that have a 5G radio and use Wi-Fi for local Hotspot capability and USB modems. Handset vendors are in the early stages of designing mmWave support into smartphones.[35] These devices could come online in the 2021 timeframe, although this estimate could tighten or lengthen depending on chipset availability and handset vendor plans.

[34] 3GPP and 5G Americas member contribution. Completion based on anticipated ASN.1 freeze dates.

[35] For example, see "Wireless Week, Apple Wants to Test Performance at 28 GHz, 39 GHz for 5G Devices," May 24, 2017, https://www.wirelessweek.com/news/2017/05/apple-wants-test-performance-28-ghz-39-ghz-5g-devices, viewed May 29, 2017.

mmWave

Use of higher frequencies, such as above 6 GHz, represents one of the greatest opportunities for higher throughputs and higher capacity. This benefit derives from the potential availability of ten times the amount of spectrum as is currently available, with multiple GHz of contiguous spectrum. But these higher frequencies, especially mmWave frequencies (above 30 GHz), are suitable only over short distances, as explained below. The combination of lower and higher frequencies is therefore crucial for 5G operation. Lower bands can be devoted to coverage and control, while higher bands can provide opportunistic access for high data rates. The lower and higher spectrum bands can operate in a carrier aggregation or dual connectivity model. Initial 5G specifications include such dual-connectivity capability.

Compared with lower frequencies, mmWave frequencies suffer from worse propagation characteristics, even in line-of-sight conditions, because the comparatively smaller aperture area of the receiver's antenna requires some form of beamforming at the transmit side, and potentially even at the receive side. Fortunately, the smaller form factors of mmWave antennas allow for dense packing of antenna arrays. Experimental systems using antenna arrays have demonstrated reliable communications at 28 GHz, even in dense, urban, non-line-of-sight conditions, for distances up to 200 meters.[36] Arrays at the terminal side are space-constrained, but some basic beamforming at the terminal is possible. On the base station side, the arrays may include hundreds of antennas in an approach called "massive MIMO."

Figure 20 shows how an increasing number of antenna elements can extend coverage through tighter beams. A 77 X 77 antenna array (6,000 elements) can exceed a kilometer at 3.5 GHz (33 dBm transmit power) and reach over 800 meters, even at 30 GHz.

[36] Samsung, *5G Vision,* February 2015. Available at http://www.samsung.com/global/business-images/insights/2015/Samsung-5G-Vision-0.pdf.

Figure 20: Range Relative to Number of Antenna Elements[37]

More typically, mmWave cells will employ shorter ranges of 50 to 200 meters. Extreme densification is another way that 5G networks will achieve massive increases in capacity. 3G networks reached densities of four to five base stations per sq. km, 4G networks eight to 10, but 5G networks may reach densities of 40 to 50.[38] A likely 5G architecture will use the macro cell for control information, coverage, and fallback, but small cells, often operating at higher frequencies, for high-bandwidth data communication. Either wireless connections or fiber will provide backhaul. Figure 21 shows how such an approach could also employ beamforming and beam tracking when using mmWave bands in the small cells.

[37] Dr. Seizo Onoe, NTT DOCOMO, presentation at Brooklyn 5G Summit, Apr. 21, 2016. Used by permission.

[38] IEEE Wireless Communications, *5G Ultra-Dense Cellular Networks,* Feb. 2016.

Figure 21: 5G Architecture for Low-Band / High-Band Integration

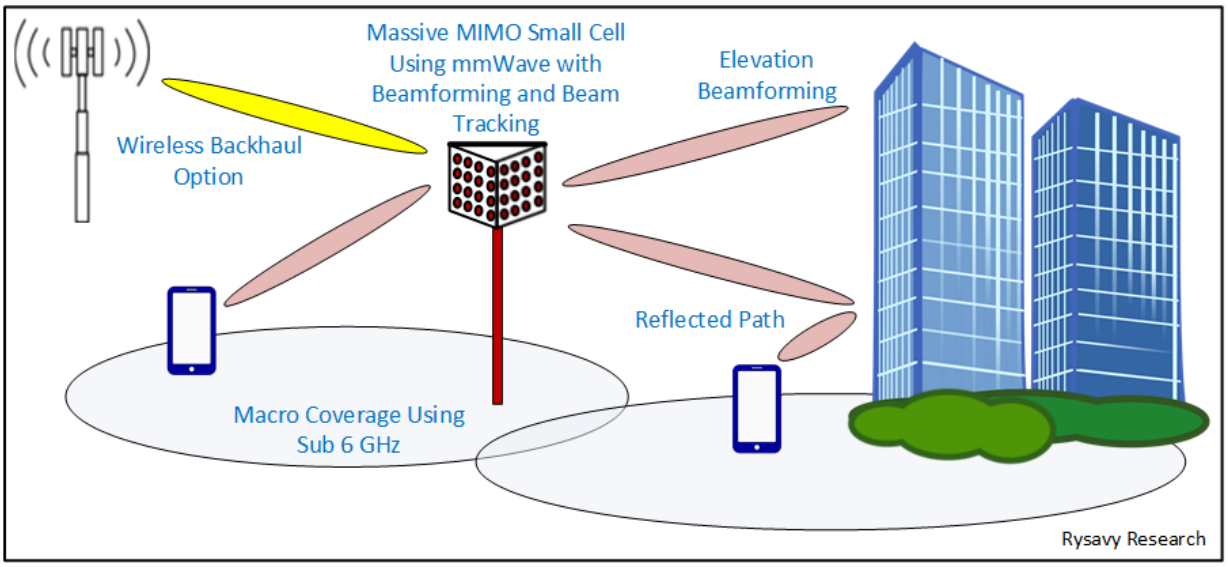

In combination, the various methods expected in 5G will provide users in mmWave band hotspot coverage at least a 100-fold increase in throughput over LTE, achieved by:

- Five- to 10-fold gains due to fewer users in each small cell. (Five to ten times as many cells.)
- 10-fold gains from access to much larger amounts of spectrum.
- Three-fold gains or more from improved spectral efficiency.

It is this huge increase in capacity, combined with Gbps performance, that will allow 5G to compete with wireline networks.[39]

Network Slicing

Not only will 5G networks include a new radio, but thanks to virtualization, these networks will be able to present multiple faces for different use cases using a concept called network slicing. This architecture allows an operator to provide multiple services with different performance characteristics. Each network slice operates as an independent, virtualized version of the network. For an application, the network slice is the only network it sees. The other slices, to which the customer is not subscribed, are invisible and inaccessible. The advantage of this architecture is that the operator can create slices that are fine-tuned for specific use cases. One slice could target autonomous vehicles, another enhanced mobile broadband, another low-throughput IoT sensors, and so on.

Figure 22 shows the network slicing architecture, with devices having access to only the slice or slices for which they have subscriptions. Each slice has radio resources allocated,

[39] For a further discussion of 5G capacity and ability to compete with wireline networks, refer to Datacomm Research and Rysavy Research, *Broadband Disruption: How 5G Will Reshape the Competitive Landscape*, 2017, available at https://datacommresearch.com/reports-broadband/.

with specific QoS characteristics. Within the core network, virtualized core network functions support each slice and provide connections to external networks.[40]

Figure 22: Network Slicing Architecture

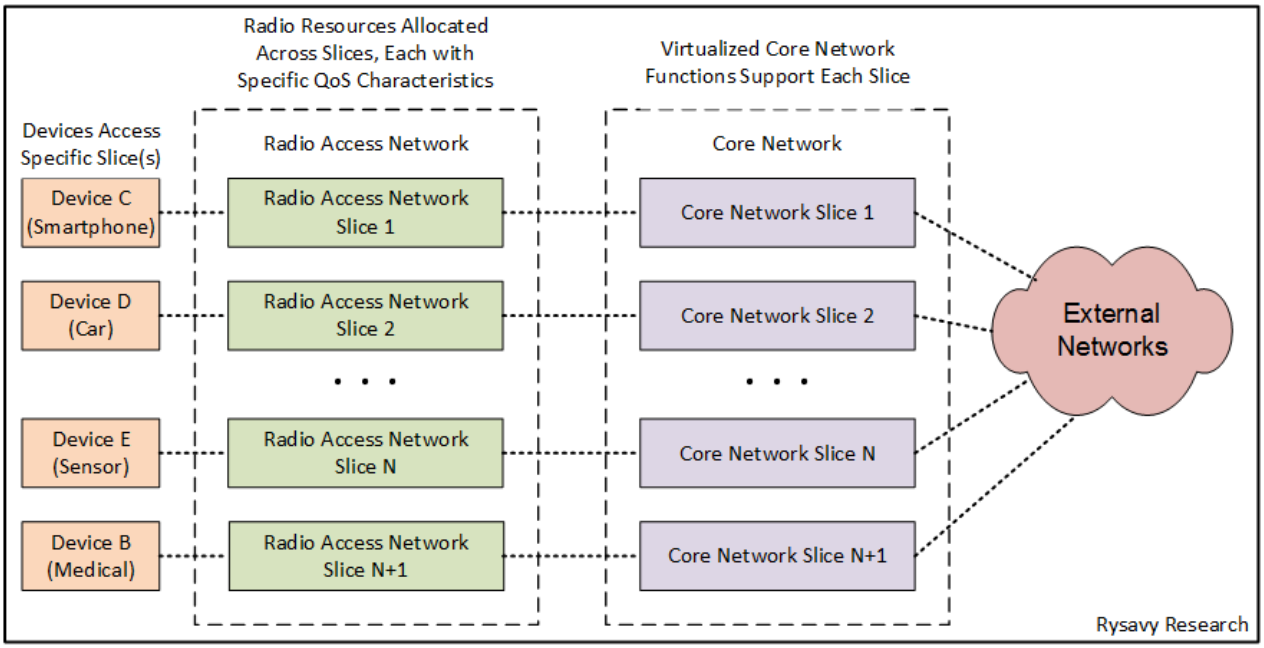

Information-Centric Networking

For many usage scenarios, wireless networks provide broadband access to the internet, a network that itself is evolving. The internet is based on a node-centric design developed forty years ago. The point-to-point method of communication the internet uses has functioned well for a vast array of applications but is not optimal for the way content is developed and distributed today. Industry and academic organizations are researching a concept called "Information-Centric Networking." ICN seeks a new approach of in-network caching that distributes content on a large scale, cost-efficiently and securely.

Most internet content uses Uniform Resource Identifiers (URIs) to locate objects and define specific location-dependent IP addresses. This approach, however, causes problems when content moves, sites change domains, or content is replicated and each copy appears as a different object. Developments such as peer-to-peer overlays and content distribution networks (such as Akamai) that distribute cached copies of content are a first step toward an information-centric communication model.

ICN is built from the ground up on the assumption of mobility, so it eliminates the mobility overlays on which current mobile broadband networks depend. The approach will be able to place information anywhere in the network with immediate and easy retrieval.

Key principles of ICN include:

[40] For more details, see 5G Americas, *Network Slicing for 5G Networks & Services*, November 2016. Available at: http://www.5gamericas.org/files/3214/7975/0104/5G_Americas_Network_Slicing_11.21_Final.pdf.

- The architecture inherently supports user mobility.
- Network operations are name-based instead of address- or node-based.
- The network itself stores, processes, and forwards information.
- Intrinsic security guarantees the integrity of every data object.

The goal of ICN is to simplify the storage and distribution of gigantic amounts of content while reducing the amount of traffic and latency users face when accessing the content. The internet cannot just be replaced, however, so in initial stages, ICN would operate as an overlay, and over time would assume an increasing percentage of the functions within the internet. ICN would not discard IP; rather, it seeks to generalize the routing concept to enrich networking with new capabilities.

Some technology aspects of ICN include:

- Information retrieval from multiple sources without needing to know the location of the information.
- Multipath communications that improves user performance and traffic load balancing.
- Subsequent requests for the same data will be served locally without needing to fetch it from original repository.
- Elimination of the name-to-location indirection associated with Domain Name Service (DNS).

Because mobility is such a central aspect of ICN, mobile network operators are in a unique position to participate in ICN-related research and development, and to do so as part of 5G development. ICN has not progressed to a level at which 3GPP specification work could include it, so instead promoters are ensuring that 5G specification work does not preclude it. With this approach, operators in the 2020s will have the option of overlaying ICN capability on their 5G networks. ICN could even be implemented as a 5G network slice for mobile and end-systems capable of ICN.

3GPP Releases

3GPP standards development falls into three principal areas: radio interfaces, core networks, and services. Progress in the 3GPP family of technologies has occurred in multiple phases, first with GSM, then GPRS, EDGE, UMTS, HSPA, HSPA+, LTE, LTE-Advanced, and now LTE-Advanced Pro. Underlying radio approaches have evolved from Time Division Multiple Access (TDMA) to CDMA to Orthogonal Frequency Division Multiple Access (OFDMA), which is the basis of LTE. 3GPP is also involved in standardization of 5G technology.

Table 5 summarizes the key 3GPP technologies and their characteristics.

Table 5: Characteristics of 3GPP Technologies

Technology Name	Type	Characteristics	Typical Downlink Speed	Typical Uplink Speed
HSPA[41]	WCDMA	Data service for UMTS networks. An enhancement to original UMTS data service.	1 Mbps to 4 Mbps	500 Kbps to 2 Mbps
HSPA+	WCDMA	Evolution of HSPA in various stages to increase throughput and capacity and to lower latency.	1.9 Mbps to 8.8 Mbps in 5+5 MHz[42] 3.8 Mbps to 17.6 Mbps with dual-carrier in 10+5 MHz	1 Mbps to 4 Mbps in 5+5 MHz or in 10+5 MHz
LTE	OFDMA	New radio interface that can use wide radio channels and deliver extremely high throughput rates. All communications handled in IP domain.	6.5 to 26.3 Mbps in 10+10 MHz[43]	6.0 to 13.0 Mbps in 10+10 MHz
LTE-Advanced	OFDMA	Advanced version of LTE designed to meet IMT-Advanced requirements.	Significant gains through carrier aggregation, 4X2 and 4X4 MIMO, and 256 QAM modulation.	

User-achievable rates and additional details on typical rates are covered in the appendix section "Data Throughput."

3GPP develops specifications in releases, with each release addressing multiple technologies. For example, Release 8 defined dual-carrier operation for HSPA but also introduced LTE. Each release adds new features and improves performance of existing functionality in different ways. Table 6 summarizes some key features of different 3GPP releases.

[41] HSPA and HSPA+ throughput rates are for a 5+5 MHz deployment.

[42] "5+5 MHz" means 5 MHz used for the downlink and 5 MHz used for the uplink.

[43] 5G Americas member company analysis for downlink and uplink. Assumes single user with 50% load in other sectors. AT&T and Verizon are quoting typical user rates of 5-12 Mbps on the downlink and 2-5 Mbps on the uplink for their networks. See additional LTE throughput information in the section below, "LTE Throughput."

Table 6: Key Features in 3GPP Releases[44]

Release	Year	Key Features
99	1999	First deployable version of UMTS.
5	2002	High Speed Downlink Packet Access (HSDPA) for UMTS.
6	2005	High Speed Uplink Packet Access (HSUPA) for UMTS.
7	2008	HSPA+ with higher-order modulation and MIMO.
8	2009	Long Term Evolution. Dual-carrier HSDPA.
10	2011	LTE-Advanced, including carrier aggregation and eICIC.
11	2013	Coordinated Multi Point (CoMP).
12	2015	Public safety support. Device-to-device communications. Dual Connectivity. 256 QAM on the downlink.
13	2016	LTE-Advanced Pro features. LTE operation in unlicensed bands using LAA. Full-dimension MIMO. LTE-WLAN Aggregation. Narrowband Internet of Things.
14	2017	LTE-Advanced Pro additional features, such as eLAA (adding uplink to LAA) and cellular V2X communications. Study item for 5G "New Radio."
15	2018	Additional LTE-Advanced Pro features, such as ultra-reliable low-latency communications. Phase 1 of 5G. Will emphasize enhanced mobile broadband use case and sub-40 GHz operation. Includes Massive MIMO, beamforming, and 4G-5G interworking, including ability for LTE connectivity to a 5G CN.
16	2019	Phase 2 of 5G. Full compliance with ITU IMT-2020 requirements. Will add URLLC, spectrum sharing, unlicensed operation, and multiple other enhancements.
17	2021	Further LTE and 5G enhancements.

Refer to the Appendix section "3GPP Releases" for a more detailed listing of features in each 3GPP Release.

[44] After Release 99, release versions went to a numerical designation beginning with Release 4, instead of designation by year.

Supporting Technologies and Architectures

Network architects design networks using a deep and wide toolkit, including multiples types of cell sizes, integration with unlicensed spectrum, smart antennas, converged services, and virtualization.

Multiple Cell Types

Operators have many choices for providing coverage. Lower frequencies propagate further and thus require fewer cells for coverage. The resulting network, however, has lower capacity than one with more cells, so operators must continually evaluate cell placement with respect to both coverage and capacity.

Table 7 lists the many types of cells. Note that the distinctions, such as radius, are not absolute—perhaps one reason the term "small cell" has become popular, as it encompasses picocells, metrocells, femtocells, and sometimes Wi-Fi.

With "plug-and-play" capability derived from self-configuring and self-organizing features, small cells will increasingly be deployed in an ad hoc manner, anywhere power and backhaul are available, yet will operate in tight coordination with the rest of the network.

A proliferation of small cells inside buildings will also provide coverage from inside to outside, such as in city streets, the reverse of traditional coverage that extends from outdoor cells to inside.

Table 7: Types of Cells and Typical Characteristics (Not Formally Defined)

Type of Cell	Characteristics
Macro cell	Wide-area coverage. LTE supports cells up to 100 km in range, but typical distances are .5 to 5 km radius. Always installed outdoors.
Microcell	Covers a smaller area, such as a hotel or mall. Range to 2 km, 5-10W, and 256-512 users. Usually installed outdoors.
Picocell	Indoor or outdoor. Outdoor cells, also called "metrocells." Typical range 15 to 200 meters outdoors and 10 to 25 meters indoors, 1-2W, 64-128 users. Deployed by operators primarily to expand capacity.
Consumer Femtocell	Indoors. Range to 10 meters, less than 50 mW, and 4 to 6 users. Capacity and coverage benefit. Usually deployed by end users using their own backhaul.
Enterprise Femtocell	Indoors. Range to 25 meters, 100-250 mW, 16-32 users. Capacity and coverage benefit. Deployed by operators.
Distributed antenna system	Expands indoor or outdoor coverage. Same hardware can support multiple operators (neutral-host) since antenna can support broad frequency range and multiple technologies. Indoor deployments are typically in larger spaces such as airports. Has also been deployed outdoors for coverage and capacity expansion.

Type of Cell	Characteristics
Remote radio head (RRH)	Uses baseband at existing macro site or centralized baseband equipment. If centralized, the system is called "cloud RAN." Requires fiber connection.
Wi-Fi	Primarily provides capacity expansion. Neutral-host capability allows multiple operators to share infrastructure.

Smalls Cells and Heterogeneous Networks

Historically, increasing the number of cell sites has been the primary method for increasing capacity, providing gains far greater than what can be achieved by improvements in spectral efficiency alone. The next wave of densification is by using what the industry calls "small cells."

Central to small-cell support is the heterogeneous network architecture, with multiple types of cells serving a coverage area, varying in frequencies used, radius, and even radio technology used.

HetNets offer significant increases in capacity and improvements, including:

1. Smaller cells, such as open femtocells (home-area coverage) and picocells (city-block-area coverage), inherently increase capacity because each cell serves a smaller number of users.
2. Strategic placement of picocells within the macro cell provides the means to absorb traffic in areas where there are higher concentrations of users. Locations can include businesses, airports, stadiums, convention centers, hotels, hospitals, shopping malls, high-rise residential complexes, and college campuses.
3. Smaller cells can also improve signal quality in areas where the signal from the macro cell is weak.

Essential elements for practical HetNet deployment are self-optimization and self-configuration, especially as the industry transitions from tens of thousands of cells to hundreds of thousands, and eventually to millions. The appendix covers technical aspects of HetNets in the sections, "Heterogeneous Networks and Small Cells" and "Self-Organizing Networks."

While promising in the long term, one immediate challenge in deploying a large number of small cells is backhaul, since access to fiber is not necessarily available and line-of-sight microwave links are not always feasible. Site acquisition and the need for multiple operators to deploy their own cells in a coverage area are additional challenges.[45] Figure 23 depicts the challenges.

[45] For further discussion of this topic, refer to 5G Americas and Small Cell Forum, *Small cell siting challenges,"* February 2017.

Figure 23: Small-Cell Challenges

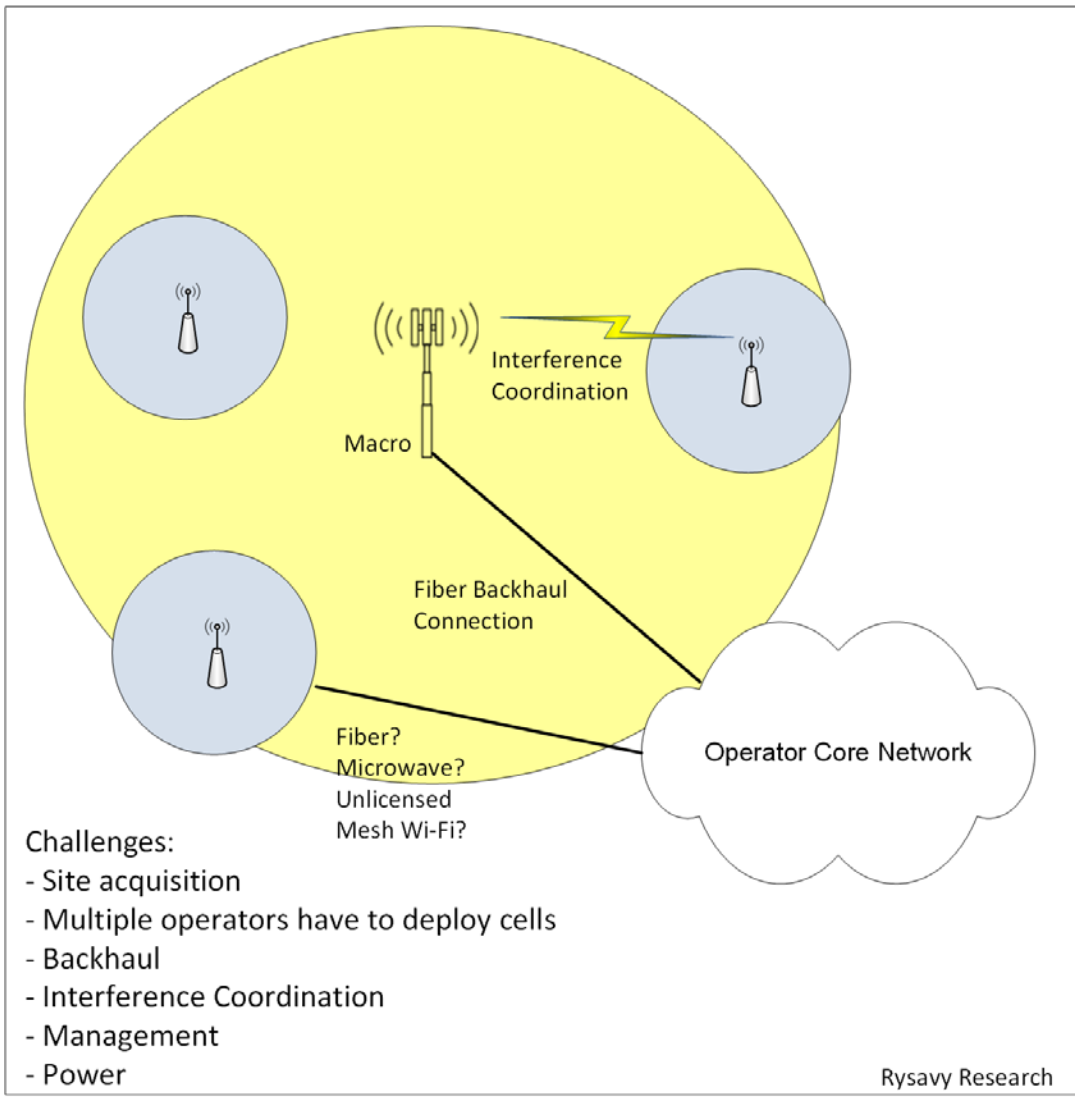

Despite these challenges and the relatively small number of small cells deployed today, many believe small-cell deployments will accelerate.[46]

In the United States, the FCC in April 2017 issued a Notice of Proposed Rulemaking, titled "Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure

[46] For example, see Fierce Wireless, "Crown Castle expects its small cell business to double in next 2 years," April 25, 2017. Available at http://www.fiercewireless.com/wireless/crown-castle-expects-its-small-cell-business-to-double-next-two-years.

Investment," that seeks to streamline items such as site acquisition and consistent pricing.[47]

5G small-cell considerations include:

- Due to limited propagation at mmWave frequencies, 5G small-cell deployments will be dense and involve large numbers of sites. Inter-site distances (ISDs) will range from 100 to 300 meters in many deployments, with 200 meters a typical value.[48]
- The high-capacity of mmWave small cells will require multi-Gbps backhaul connections using an expected combination of fiber, mmWave radio in point-to-point connections, and 5G self-backhaul.
- The expected use of cloud RAN and centralized base station facilities will simplify equipment at the site, facilitating dense deployments.
- Dense deployments will motivate neutral-host (multi-tenant) approaches, but these are outside the scope of specification efforts.

The effective range of a mmWave small cell depends on multiple factors, including whether line-of-sight is available, extent of foliage, pole height, whether user equipment is indoors or outdoors, and the types of building materials the signal must pass through to reach indoor equipment.

Despite the challenges, small cells will ultimately contribute greatly to increased network capacity. Table 8 lists possible configurations. Note that many of these approaches can be combined, such as using picos and Wi-Fi offload.

Table 8: Small-Cell Approaches

Small-Cell Approach	Characteristics
Macro plus small cells in select areas.	Significant standards support. Femtocells or picocells can use the same radio carriers as macro (less total spectrum needed) or can use different radio carriers (greater total capacity).
Macro in licensed band plus LTE operation in unlicensed bands.	Promising approach for augmenting LTE capacity in scenarios where operator is deploying LTE small cells.[49] See discussion below in the section on unlicensed spectrum integration.

[47] FCC, *Wireless Infrastructure NPRM and NOI*, April 21, 2017. Available at https://www.fcc.gov/document/wireless-infrastructure-nprm-and-noi.

[48] 5G Americas member contributions.

[49] See Rysavy Research, *Accelerating Innovation in Unlicensed Spectrum,* Fierce Wireless, November 2016. Available at http://www.rysavy.com/Articles/2016-11-Innovation-Unlicensed-Spectrum.pdf. See also Rysavy Research, *Will LTE in Unlicensed Spectrum Unlock a Vast Store of Mobile Broadband Capacity?* MIMO World, June 2014. Available at http://www.mimoworld.com/?p=2377.

Small-Cell Approach	Characteristics
Macro (or small-cell) cellular in licensed band plus Wi-Fi.	Extensively used today with increased use anticipated. Particularly attractive for expanding capacity in coverage areas where Wi-Fi infrastructure exists but small cells with LTE do not. LTE Wi-Fi Aggregation (being specified in Release 13) is another approach, as are MP-TCP and MP-QUIC.
Wi-Fi only.	Low-cost approach for high-capacity mobile broadband coverage, but impossible to provide large-area continuous coverage without cellular component.

Neutral-Host Small Cells

Multi-operator and neutral-host solutions could accelerate deployment of small cells.[50] Currently, nearly all small-cell deployments are operator-specific, but in the future, deployments supporting multiple operators could reduce the cost per operator to provide coverage.

A candidate band for neutral-host small cells is 3.5 GHz, using LTE TDD and MulteFire as potential technologies. Wi-Fi technology also addresses neutral-host configurations at the access level, but it has roaming and authentication challenges. HotSpot 2.0 (covered in the appendix) addresses roaming and authentication.

Unlicensed Spectrum Integration

Unlicensed spectrum is becoming ever more important to mobile broadband networks. Initial use was rudimentary offload onto Wi-Fi networks, but now, Wi-Fi networks are becoming more tightly integrated into cellular networks. Efforts are also underway to use LTE in unlicensed spectrum.

Unlicensed spectrum adds to capacity in two ways. First, a large amount of spectrum (approximately 500 MHz) is available across the 2.4 GHz and 5 GHz bands, with the 3.5 GHz band adding further spectrum in the future. A significant amount of unlicensed spectrum is also available in mmWave bands, with 7 GHz already in use in the United States (57 to 64 GHz) and an additional 7 GHz in 5G spectrum allocations. Second, unlicensed spectrum is mostly used in small coverage areas, resulting in high-frequency re-use and much higher throughput rates per square meter of coverage versus typical cellular deployments.

The IEEE 802.11 family of technologies has experienced rapid growth, mainly in private deployments. The latest 802.11 standard, 802.11ac, offers peak theoretical throughputs in excess of 1 Gbps and improved range through use of higher-order MIMO. 802.11ac Wave 2 products include a Multi-user MIMO capability that further increases capacity and throughput. IEEE is developing a subsequent version, 802.11ax, that emphasizes capacity

[50] 5G Americas and Small Cell Forum, *Multi-operator and neutral host small cells; Drivers, architectures, planning and regulation,* December 2016. Report available at http://www.5gamericas.org/files/4914/8193/1104/SCF191_Multi-operator_neutral_host_small_cells.pdf.

improvements as well as higher throughputs. In the mmWave frequencies, IEEE has developed 802.11ad, which operates at 60 GHz, and the standards body is currently working on a successor technology, 802.11ay.

Integration between mobile broadband and Wi-Fi networks can be either loose or tight. Loose integration means data traffic routes directly to the internet and minimizes traversal of the operator network. This is called "local breakout." Tight integration means data traffic, or select portions thereof, may traverse the operator core network. An example is Wi-Fi calling, which uses IP Multimedia Subsystem.

Although offloading onto Wi-Fi can reduce traffic on the core network, the Wi-Fi network does not necessarily always have greater spare capacity than the cellular network. The goal of future integrated cellular/Wi-Fi networks is to intelligently load balance between the two. Simultaneous cellular/Wi-Fi connections will also become possible. For example, in Release 13, 3GPP introduces link aggregation of Wi-Fi and LTE through LWA and LWIP.

Successfully offloading data and providing users a good experience mandates measures such as automatically provisioning subscriber devices with the necessary Wi-Fi configuration options and automatically authenticating subscribers on supported public Wi-Fi networks. Many stakeholders are working toward tighter integration between Wi-Fi and cellular networks.

Another approach for using unlicensed spectrum employs LTE as the radio technology, initially in a version referred to as LTE-Unlicensed, which works with Releases 10-12 of LTE, as defined in the LTE-U Forum. In Release 13, 3GPP specified LAA, which implements listen-before-talk capability, a requirement for unlicensed operation in Europe and Japan. Initially, carrier aggregation combines a licensed carrier with an unlicensed 20 MHz carrier in the 5 GHz band as a supplemental channel, with the aggregation of multiple unlicensed channels an eventual possibility. Operating LTE in unlicensed bands could decrease the need for handoffs to Wi-Fi. Up to 32 unlicensed carriers (of 20 MHz each) can be aggregated to theoretically access 640 MHz of unlicensed spectrum. LAA may also be deployed in 3.5 GHz bands. Enhanced LAA (eLAA), specified in Release 14, adds uplink use of unlicensed spectrum. Carriers are now conducting LAA trials.[51]

A concern with using LTE in unlicensed bands is whether it will be a fair neighbor to Wi-Fi users. LTE-U based on Release 10-12 addresses this concern by selecting clear channels to use and measuring the channel activity of Wi-Fi users, then using an appropriate duty cycle for fair sharing. License-Assisted Access in Release 13 adds listen-before-talk (LBT) and implements other regulatory requirements that exist in some countries. 3GPP conducted a study and concluded that, "A majority of sources providing evaluation results showed at least one LBT scheme for LAA that does not impact Wi-Fi more than another Wi-Fi network."[52]

To address co-existence, the cellular industry worked with the Wi-Fi Alliance in 2016 to develop a test plan for LTE-U. The testing goal was to verify that, in a laboratory

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[51] For example, see AT&T, "AT&T Reaches Wireless Speeds of More than 750 Mbps with LTE Licensed Assisted Access (LTE-LAA) Field Trials," available at http://about.att.com/story/lte_licensed_assisted_access_field_trials.html.

[52] 3GPP, *Technical Specification Group Radio Access Network; Study on Licensed-Assisted Access to Unlicensed Spectrum; (Release 13). 36.889.* See section 9, "Conclusions."

environment, an LTE-U base station does not impact a Wi-Fi network any more than another Wi-Fi access point.[53]

MulteFire, specified by the MulteFire Alliance, is an application of LTE in unlicensed bands that does not require an anchor in licensed spectrum, opening up the possibility of deployments by non-operator entities, including internet service providers, venue operators, and enterprises. Under a roaming arrangement with cellular operators, LTE customers could roam into MulteFire networks. Figure 24 shows the evolution of the different versions of LTE for unlicensed bands.

Figure 24: Timeline Relationship of LTE-U, LAA, eLAA, and MulteFire

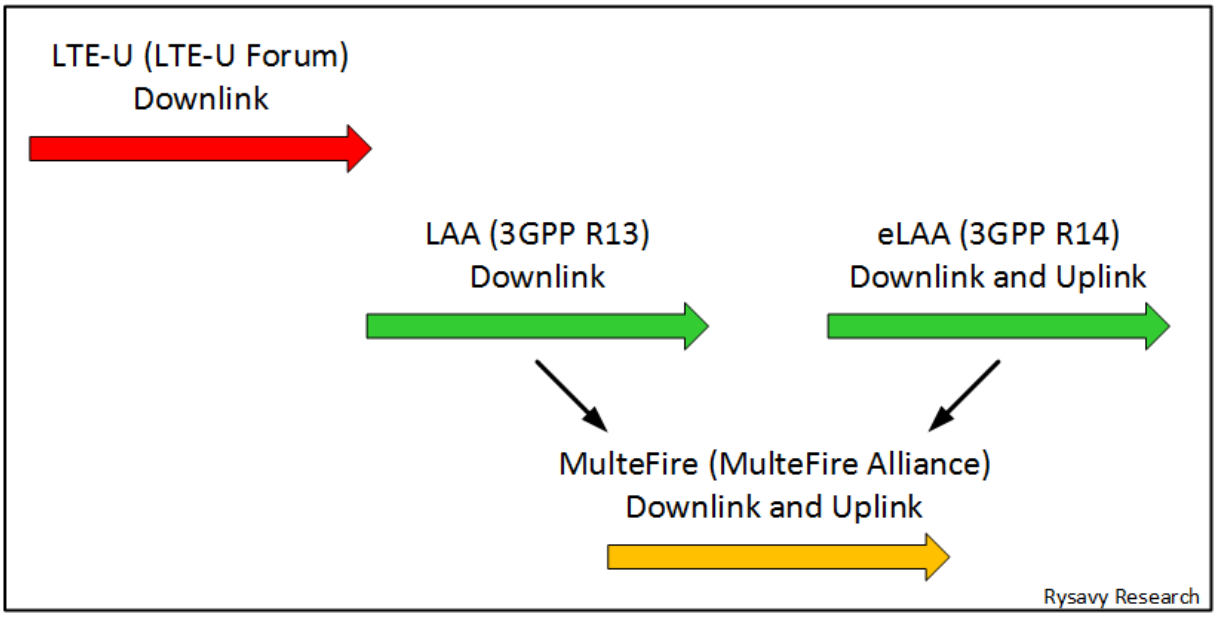

An alternative approach for integrating Wi-Fi is LWA. LTE handles the control plane, but connections occur over separate LTE base stations and Wi-Fi access points. LWA benefits operators that wish to emphasize Wi-Fi technology for harnessing capacity in unlicensed spectrum. LWIP is a variation of LWA that also integrates LTE and Wi-Fi, but by integrating at a higher level of the protocol stack (IP instead of PDCP), it facilitates use of existing Wi-Fi equipment and devices, with integration typically occurring at the eNodeB.

Figure 25 shows how the different technologies exploit licensed and unlicensed spectrum.

[53] See Wi-Fi Alliance, "Unlicensed Spectrum," http://www.wi-fi.org/discover-wi-fi/unlicensed-spectrum.

Figure 25: How Different Technologies Harness Spectrum

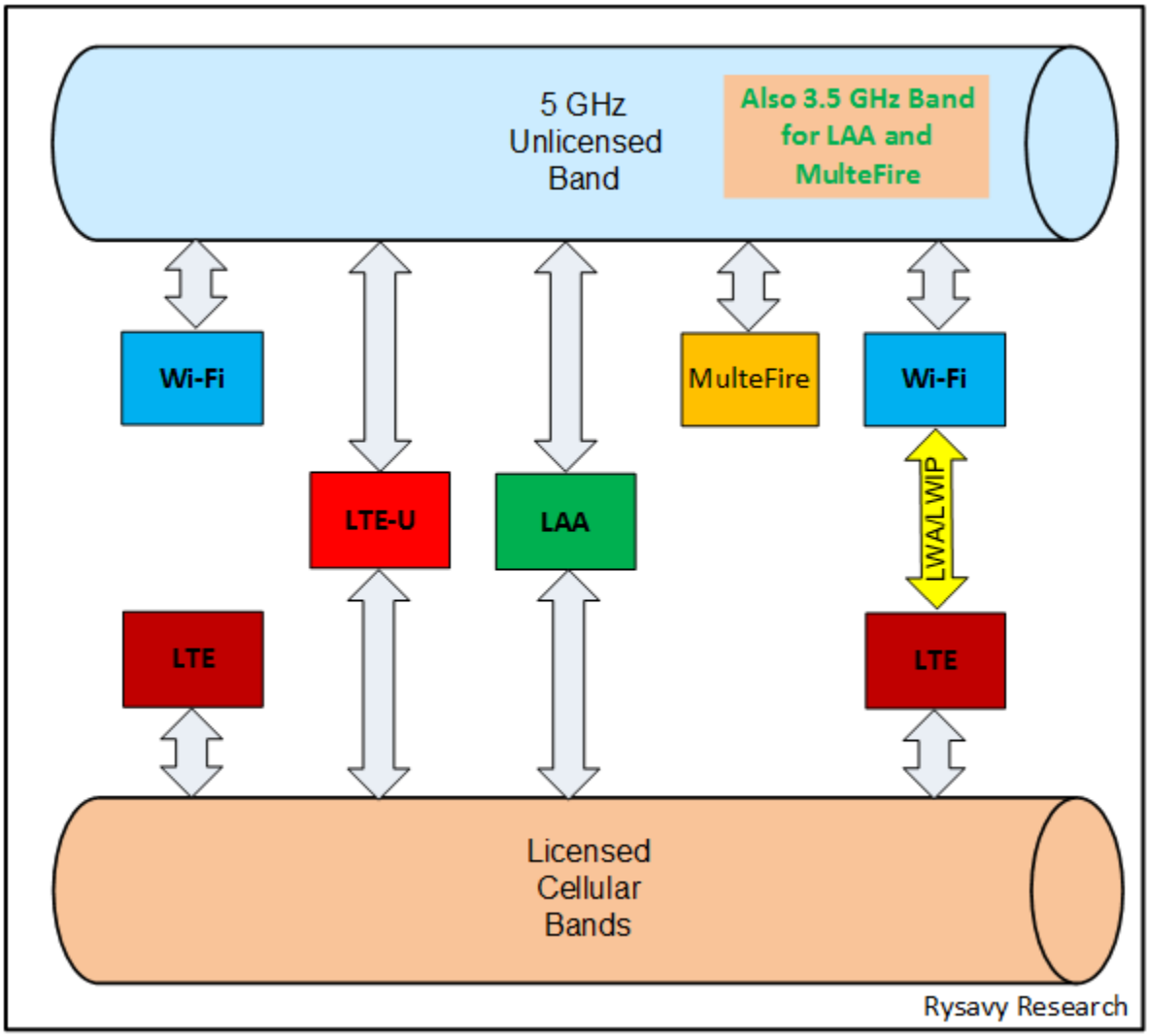

Table 9 summarizes the different uses of unlicensed spectrum for public mobile broadband networks.

Table 9: Approaches for Using Unlicensed Spectrum.

	Technology	Attributes
Wi-Fi	Ever-more-sophisticated means to integrate Wi-Fi in successive 3GPP Releases.	Combining Wi-Fi with cellular increases capacity.
Release 13 RAN Controlled LTE WLAN Interworking	Base station can instruct the UE to connect to a WLAN for offload.	Available in late 2017 or 2018 timeframe.

Release 10-12 LTE-U Based on LTE-U Forum Specifications	LTE-U Forum-specified approach for operating LTE in unlicensed spectrum.	Available in 2017. More seamless than Wi-Fi. Cannot be used in some regions (e.g., Europe, Japan).
Release 13 Licensed-Assisted Access	3GPP-specified approach for operating LTE in unlicensed spectrum. Downlink only.	Available in late 2017 or 2018 timeframe. Designed to address global regulatory requirements.
Release 14 Enhanced Licensed-Assisted Access	Addition of uplink operation.	Available in 2019 or 2020 timeframe.
5G Unlicensed Operation	Release 15 has a study item for approaches that Release 16 will standardize.	Potentially available in 2021.
MulteFire	Does not require a licensed anchor.	Potentially creates a neutral-host small cell solution.
LWA	Aggregation of LTE and Wi-Fi connections at PDCP layer.	Part of Release 13. Available in late 2017 or 2018 timeframe.
LWIP	Aggregation of LTE and Wi-Fi connections at IP layer.	Part of Release 13. Available in late 2017 or 2018 timeframe.

Cellular operators are currently emphasizing simple offload to Wi-Fi or LTE-U/LAA. Aggregation techniques, such as LWA and LWIP, do not currently have market traction.

Refer to the appendix section “Unlicensed Spectrum Integration” for further technical details.

Internet of Things and Machine-to-Machine

Machine-to-machine communications, now evolving into the Internet of Things, is a vast opportunity for wireless communications, with all 3GPP technologies potentially playing roles.

The lowest-cost cellular devices enabling M2M communications today are GPRS modems, which risk becoming obsolete as operators sunset their GSM systems. HSPA is also used for M2M communications, as is LTE, which has been optimized to efficiently communicate small bursts of information, making it particularly well suited for M2M.

Low-cost GSM (through Enhanced Coverage GSM IoT [EC-GSM-IoT]) and LTE modem options in 3GPP releases 10 through 13 reduce cost, improve communications range, and extend battery life. See the appendix section “Internet of Things and Machine-to-Machine” for details.

3GPP had a Release 13 study item on how LTE technologies can operate for vehicle communications, including vehicle-to-vehicle and vehicle-to-infrastructure, leveraging

device-to-device communications capabilities already specified for LTE in Releases 12 and 13.[54] This work is now being standardized in Release 14.

Developers will use 3GPP wireless technologies for many IoT applications. In other instances, developers will use local area technologies, such as Wi-Fi, Bluetooth Low Energy, and ZigBee. New Low-Power Wide-Area (LPWA) wireless technologies emerging specifically to support IoT include Ingenu, LoRa, and Sigfox. The low-power operation of some of these technologies, including LTE, will permit battery operation over multiple years. Table 10 summarizes the various technologies.

Table 10: Wireless Networks for IoT

Technology	Coverage	Characteristics	Standardization / Specifications
GSM/GPRS/EC-GSM-IoT	Wide area. Huge global coverage.	Lowest-cost cellular modems, risk of network sunsets. Low-throughput.	3GPP
HSPA	Wide area. Huge global coverage.	Low-cost cellular modems. Higher power, high throughput.	3GPP
LTE, NB-IoT	Wide area. Increasing global coverage.	Wide area, expanding coverage, cost/power reductions in successive 3GPP releases. Low to high throughput options.	3GPP
Wi-Fi	Local area.	High throughput, higher power.	IEEE
ZigBee	Local area.	Low throughput, low power.	IEEE
Bluetooth Low Energy	Personal area.	Low throughput, low power.	Bluetooth Special Interest Group
LoRa	Wide area. Emerging deployments.	Low throughput, low power. Unlicensed bands (sub 1 GHz, such as 900 MHz in the U.S.)	LoRa Alliance[55]
Sigfox	Wide area. Emerging deployments.	Low throughput, low power. Unlicensed bands (sub 1 GHz such as 900 MHz in the U.S.)	Sigfox[56]

[54] 3GPP, *3GPP TR 36.885, Technical Specification Group Radio Access Network; Study on LTE-based V2X Services; (Release 14).*

[55] For details, see LoRa Alliance, https://www.lora-alliance.org/.

[56] For details, see Sigfox, https://www.sigfox.com/en.

Technology	Coverage	Characteristics	Standardization / Specifications
Ingenu (previously OnRamp Wireless)	Wide area. Emerging deployments.	Low throughput, low power. Using 2.4 GHz ISM band. Uses IEEE 802.15.4k.	Ingenu[57]
Weightless	Wide area. Expected deployments.	Low throughput, low power. Unlicensed bands (sub 1 GHz such as TV White-Space and 900 MHz in the U.S.)	Weightless Special Interest Group[58]

Security is of particular concern to both developers and users of IoT technology. An increasing amount of network-connected infrastructure will result in new security vulnerabilities that are being addressed by concerted effort from the industry.[59]

Smart Antennas and MIMO

Smart antennas, defined with progressively greater capabilities in successive 3GPP releases, provide significant gains in throughput and capacity. By employing multiple antennas at the base station and the subscriber unit, the technology either exploits signals traveling through multiple paths in the environment or does beam steering, in which multiple antennas coordinate their transmissions to focus radio energy in a particular direction.

Initial low-band LTE deployments used 2X2 MIMO on the downlink (two base station transmit antennas, two mobiles receive antennas) and 1X2 on the uplink (one mobile transmit antenna, two base station receive antennas). In the higher bands, 2X2 downlink MIMO has been deployed, but it is more common to employ four antennas for uplink reception in a 1X4 configuration. LTE deployments are now using 4X2 MIMO and 4X4 MIMO on the downlink (four base station transmit antennas). LTE specifications encompass higher-order configurations, such as 4X4 MIMO, 8X2 MIMO, and MU-MIMO on the downlink and 1X4 on the uplink. Practical considerations, such as antenna sizes that are proportional to wavelength, dictate MIMO options for different bands.

Engineers are now experimenting with what are called massive MIMO systems, which employ a far larger number of antenna elements at the base station—64, 128, and eventually even more. Use in 5G of cmWave and mmWave bands, with their short wavelengths, will facilitate massive MIMO, but even before then, 3GPP is developing specifications for massive MIMO for 4G systems in what it calls full-dimension MIMO (FD-MIMO). Release 14 specifies configurations with up to 32 antennas at the base station.

[57] For details, see Ingenu, https://www.ingenu.com/.

[58] For details, see http://www.weightless.org/.

[59] For further insight, refer to the Ericsson white paper, *IoT Security,* February 2017, available at https://www.ericsson.com/assets/local/publications/white-papers/wp-iot-security-february-2017.pdf.

Massive MIMO is practical even in cellular frequencies. For example, at 2.5 GHz, an 8X8 array using half wavelength spacing would produce a form factor of 50 cm X 50 cm. Applications of such arrays include beamforming along a horizontal direction as well as beamforming in a vertical direction, such as to serve different levels of high-rise buildings.

See the appendix section "LTE Smart Antennas" and "LTE-Advanced Antenna Technologies" for further details.

Virtualization

Virtualization refers to implementing the functions of infrastructure nodes in software on commercial "off-the-shelf" computing equipment. The approach promises lower capital expenditures, lower operating costs, faster deployment of new services, energy savings, and improved network efficiency. With NFV, multiple tenants will be able to share the same infrastructure, facilitating, for example, mobile virtual network operator (MVNO) and multi-operator virtualized RAN arrangements. NFV, however, also constitutes an entirely new way of building and managing networks, so widespread adoption will occur over a long period.

Both the core network and portions of the radio-access network can be virtualized. The core network, consisting of fewer nodes, is an easier starting point. Virtualizing RAN elements, although more complex, could eventually provide the greatest network efficiency gains, particularly for small-cell deployments where it can facilitate coordination among cells and use of methods such as CoMP and interference coordination. Unlike the core, virtualizing the entire RAN is not possible because a Physical Network Function must terminate the radio interface. As operators virtualize their core networks, they put in place the systems and know-how to extend virtualization to the RAN.

The European Telecommunications Standards Institute (ETSI) is standardizing a framework, including interfaces and reference architectures for virtualization. Other standards and industry groups involved include 3GPP, the Open Networking Foundation, OpenStack, OpenDaylight, and OPNFV.

Figure 26 shows the ETSI framework, in which virtualized network functions are the nodes or applications by which operators build services.

Figure 26: ETSI NFV High-Level Framework

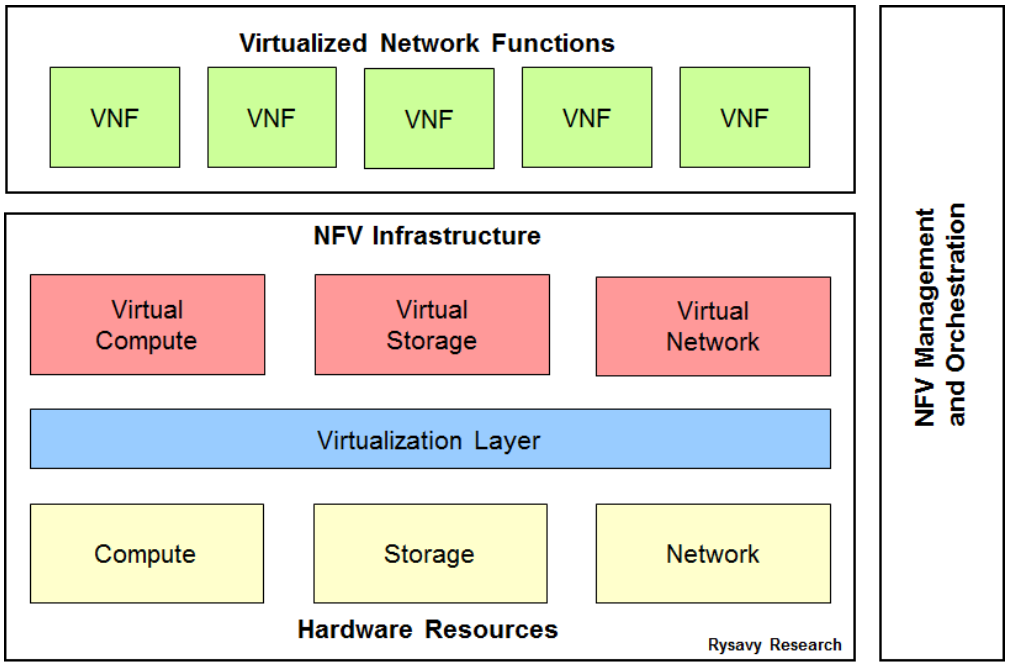

Some specific use cases for NFV include:

- **5G.** 5G networks will likely be fully virtualized.
- **IMS and VoLTE.** IMS is necessary for VoLTE, but an NFV approach could reduce the complexity associated with the multiple nodes and interfaces in the IMS architecture.
- **Virtualized EPC (VEPC).** The Evolved Packet Core, consisting of the Serving Gateway (SGW), the Packet Gateway (PGW), and Mobile Management Entity (MME), can be virtualized, but doing so will require meeting operator bandwidth, latency, and control plane service requirements.
- **New VEPC Services.** With a virtualized EPC, an operator can more easily create MVNO services, each with its own virtualized MME, SGW, and PGW. An M2M virtualized service is another example of offering a more finely tuned service for the target application. Because the PGW connects to external networks, further opportunities exist for virtualized services to augment networking functions, including video caching, video optimization, parental controls, ad insertion, and firewalls.
- **Cloud RAN.** Pooling of baseband processing in a cloud RAN can, but does not necessarily, use virtualization techniques. Separating the radio function from baseband processing typically requires transporting digitized radio signals across high-bandwidth (multi-Gbps) fiber connections, sometimes referred to as

fronthauling. Refer to the appendix section "Cloud Radio-Access Network (RAN) and Network Virtualization" for a more detailed technical discussion.[60]

Because of higher investment demands, RAN virtualization will take longer to deploy than core network virtualization and likely will occur selectively for small-cell deployments.

For additional details, refer to the 5G Americas white paper, *Bringing Network Function Virtualization to LTE*.[61]

Multi-Access Edge Computing

ETSI is standardizing Multi-access Edge Computing, previously known as Mobile-Edge Computing, a technology that empowers a programmable application environment at the edge of the network, within the RAN.[62] Goals include reduced latency, more efficient network operation for certain applications, and an improved user experience. Although MEC emphasizes 5G, it can also be applied to 4G LTE networks.

Applications that will benefit are ones that require server-side processing but are location specific. Examples include:

- Augmented reality.
- Intelligent video processing, such as transcoding, caching, and acceleration.
- Connected cars.
- Premise-based IoT gateways.

Multicast and Broadcast

Another important new service is video streaming via multicast or broadcast functions. 3GPP has defined multicast/broadcast capabilities for both HSPA and LTE. Mobile TV services have experienced little business success so far, but broadcasting uses the radio resource much more efficiently than having separate point-to-point streams for each user. For example, users at a sporting event might enjoy watching replays on their smartphones. The technology supports these applications; it is a matter of operators and content providers finding appealing applications. The appendix covers technical aspects in more detail.

Remote SIM Provisioning

The GSM Association (GSMA) is developing specifications that make it possible for consumers to purchase unprovisioned devices, select the operator of their choice and then download the subscriber identity module (SIM) application into the device.[63] This capability

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[60] For further details, see "Network Functions Virtualisation," http://www.etsi.org/technologies-clusters/technologies/nfv. Viewed May 17, 2017.

[61] Available at http://www.4gamericas.org/files/1014/1653/1309/4G_Americas_-_NFV_to_LTE_-_November_2014_-_FINAL.pdf.

[62] For further details, see ETSI, "Multi-access Edge Computing," http://www.etsi.org/technologies-clusters/technologies/multi-access-edge-computing. Accessed May 17, 2017.

[63] For details, see GSMA, "A New SIM," available at https://www.gsma.com/rsp/, viewed June 8, 2017.

benefits devices such as watches, health bands, health monitors, and other small connected items. Initial products may be available in 2017.

VoLTE, RCS, WebRTC, and Wi-Fi Calling

Voice has evolved from a separate circuit-switched service in 2G and 3G networks to a packet-switched service in 4G LTE networks that can integrate with other services and applications, such as messaging and video calling. Elements that make these capabilities possible include the quality-of-service mechanisms in LTE, the IMS platform discussed above, implementation of Rich Communications Suite, compliance with GSMA IR.92 guidelines, and optional support for WebRTC.

Voice Support and VoLTE

While 2G and 3G technologies were deployed from the beginning with both voice and data capabilities, LTE networks can be deployed with or without voice support. Moreover, there are two methods available: circuit-switched fallback (CSFB) to 2G/3G and VoIP. Most operators deploying LTE used CSFB initially but are now migrating to VoIP methods with VoLTE that uses IMS. Initial VoLTE deployments occurred in 2012. Because VoLTE needs new software in phones, the transition from circuit-switched voice to VoLTE on a large scale will occur over a number of years as users upgrade their devices.

For the time being, 3GPP operators with UMTS/HSPA networks will continue to use circuit-switched voice for their 3G connections.

Using VoLTE, operators can offer high-definition (HD) voice using the new Adaptive Multi-Rate Wideband (AMR-WB) voice codec. HD voice not only improves voice clarity and intelligibility, it suppresses background noise. AMR-WB extends audio bandwidth to 50-7000 Hz compared with the narrowband codec that provides audio bandwidth of 80-3700 Hz. HD voice will initially function only between callers on the same network. 3GPP has also developed a new voice codec, called “Enhanced Voice Services” (EVS), which will be the successor to AMR and AMR-WB codecs.

Other advantages of LTE’s packetized voice include being able to combine it with other services, such as video calling and presence; half the call set-up time of a 3G connection; and high voice spectral efficiency. With VoLTE’s HD voice quality, lower delay, and higher capacity, operators can compete against OTT VoIP providers. Due to traffic prioritization, VoLTE voice quality remains high even under heavy loads that cause OTT-voice service to deteriorate.

Applications based on WebRTC will also increasingly carry voice sessions. See the section “VoLTE and RCS” in the appendix for more details on LTE voice support.

Rich Communications Suite

An initiative called “Rich Communications Suite” (RCS), supported by many operators and vendors, builds on IMS technology to provide a consistent feature set as well as implementation guidelines, use cases, and reference implementations. RCS uses existing standards and specifications from 3GPP, Open Mobile Alliance (OMA), and GSMA and enables interoperability of supported features across operators that support the suite. RCS supports both circuit-switched and packet-switched voice and can interoperate with LTE packet voice.

Core features include:

- A user capability exchange or service discovery with which users can know the capabilities of other users.

- Enhanced (IP-based) messaging (supporting text, IM, and multimedia) with chat and messaging history.
- Enriched calls that include multimedia content (such as photo or video sharing) during voice calls. This could become the primary way operators offer video calling.

The primary drivers for RCS adoption are the ability to deploy VoLTE in a well-defined manner and to support messaging in the IP domain. RCS addresses the market trend of users moving away from traditional text-based messaging and provides a platform for operator-based services that compete with OTT messaging applications. Figure 27 shows the evolution of RCS capability, including the addition of such features as messaging across multiple devices, video calling, video sharing, and synchronized contact information across multiple devices.

Figure 27: Evolution of RCS Capability.[64]

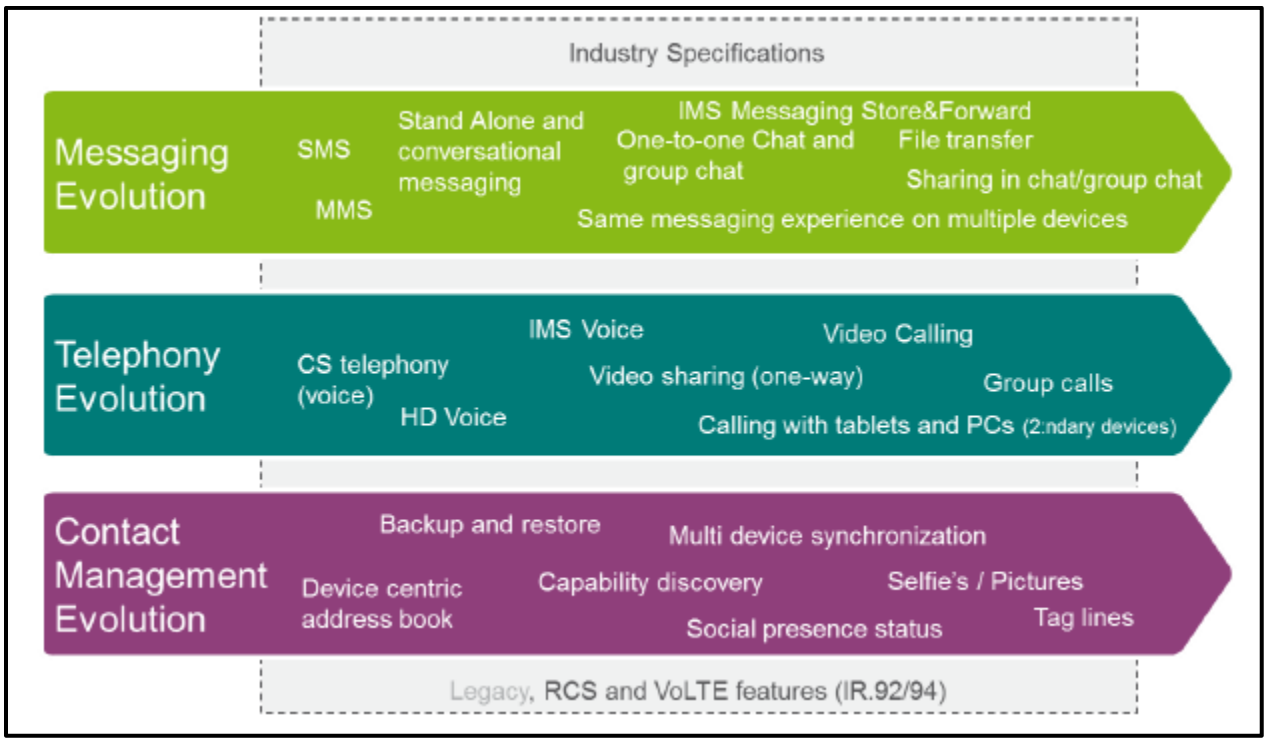

WebRTC

WebRTC is an open project supported by Google, Mozilla, and Opera within the Internet Engineering Taskforce (IETF) that enables real-time communications in Web browsers via JavaScript APIs. 3GPP Release 12 specifications define how WebRTC clients can access IMS services, including packet voice and video communication. WebRTC operating over IMS gains the additional benefit of seamless transition across transport networks, for example, LTE to Wi-Fi.

Operators can integrate WebRTC with RTC, facilitating development of vertical applications such as telemedicine and customer service. WebRTC and RCS are more complementary

[64] 4G Americas, *VoLTE and RCS Technology - Evolution and Ecosystem*, Nov. 2014.

than competitive. Both, through application interfaces, can provide access to underlying network functions.

Wi-Fi Calling

Another advantage of the VoLTE/IMS/RCS architecture is that it is agnostic to the user connection, meaning voice and video service can extend to Wi-Fi connections as easily as LTE connections. Wi-Fi calling can be advantageous in coverage areas were the Wi-Fi signal has better quality than an LTE signal. For video calling, use of Wi-Fi will also reduce data consumption over the cellular connection. By implementing a standards-based approach, as opposed to OTT-voice approaches, called parties see the same phone number regardless of network and can reach the subscriber using that phone number.

Previous technical approaches, such as Generic Access Network (GAN, initially called Unlicensed Mobile Access [UMA]), did not include as robust a handover mechanism as is provided by VoLTE/IMS.

For the best-quality voice in a Wi-Fi network, the device and Wi-Fi network should implement Wi-Fi Multimedia (WMM), which gives voice packets higher priority than other data traffic. WMM is especially necessary in congested networks. In addition, the Access Network Discovery and Selection Function (ANDSF) and cellular-WLAN enhancement features in 3GPP Release 12 have policies for enabling voice handover between LTE and Wi-Fi.

Roaming with Wi-Fi calling will need to address whether the visited network's IMS infrastructure handles the Wi-Fi call or whether the home network's IMS does.

Public Safety

An important LTE application is for public safety, initially as a broadband data service and eventually for mission-critical voice service. Current public safety networks use technologies, such as Terrestrial Trunked Radio (TETRA) in Europe and Project 25 (P25) in the United States, that provide mission-critical voice but only narrowband data.

In the United States, the government has made 20 MHz of spectrum available at 700 MHz in Band 14 and created the First Responder Network Authority (FirstNet), an independent authority within the National Telecommunications and Information Administration (NTIA) to provide a nationwide public-safety broadband network. AT&T will build and deploy the network.[65]

Another country driving the use of LTE for public safety is the United Kingdom, where the UK Home Office has a program for the Emergency Service Network.

Using LTE for public safety is a complex undertaking because public-safety needs differ from those of consumers. Addressing these needs requires both different features, which 3GPP is incorporating in multiple releases of LTE specifications, and different network deployment approaches. Public safety also has different device-level needs than consumers.

LTE Features for Public Safety

Some broadband applications for public safety can use standard LTE capability. For example, sending email, accessing a database, or streaming a video may not require any special features. Other applications, however, require new capabilities from 3GPP standards, including:

Group Communication

Available in Release 12, the Group Communication Service (GCS) application server, using one-to-one (unicast) and one-to-many communications (broadcast), will be able to send voice, video, or data traffic to multiple public-safety devices. The broadcast mode will employ eMBMS to use radio resources efficiently, but if coverage is weak, a unicast approach may deliver data more reliably. The system will be able to dynamically switch between broadcast and unicast modes. Release 14 adds single-cell point-to-multipoint transmission.

Proximity-Based Services (Device-to-Device)

With proximity-based services, defined in Release 12, user devices can communicate directly, a capability that benefits both consumers and public safety. This type of communication is called sidelink communication. Consumer devices can find other devices only with assistance from the network, but for public safety, devices will be able to communicate directly with other devices independently of the network.

With Release 13, devices will be able to act as relays for out-of-coverage devices, such as inside a building.

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[65] For details, see "FirstNet AT&T," https://www.corp.att.com/public-safety/att-firstnet/. See also RCR Wireless, *Editorial Report: Public Safety LTE*, March 2017. Available at http://content.rcrwireless.com/20170322_Public_Safety_Report.

The appendix section “Proximity Services (Device-to-Device)” discusses this feature in greater detail.

Mission-Critical Push-to-Talk

MCPTT, being defined in Release 13, provides one-to-one and one-to-many push-to-talk communications services. With this feature, available in the 2018 timeframe, public-safety organizations will be able to consider retiring legacy voice-based systems.

Mission-Critical Video over LTE and Mission-Critical Data over LTE

Release 14 adds Mission-Critical Video over LTE and Mission-Critical Data over LTE, designed to work with Mission-Critical Push-to-Talk, giving first responders more communications options.

Prioritization

To prevent interference with public-safety operations in emergency situations experiencing high load, the network can prioritize at multiple levels. First, the network can bar consumer devices from attempting to access the network, thus reducing signaling load. Second, the network can prioritize radio resources, giving public-safety users higher priority. Third, using a new capability called “Multimedia Priority Service” (MPS), the network can prioritize a connection between an emergency worker and a regular subscriber. Finally, the network can assign specific quality-of-service (QoS) parameters to specific traffic flows, including guaranteed bit rate. 3GPP has defined specific QoS quality-class identifiers for public safety.

High Power

Release 11 defines higher power devices for the public safety band that can operate at 1.25 Watts, improving coverage and reducing network deployment costs.

Isolated operation

With Release 13, a base station can continue offering service even with the loss of backhaul, a capability that will benefit public-safety personnel in disaster situations.

Relays

Figure 28 summarizes the more than eighteen features in 3GPP relays that apply to public safety.

Figure 28: Summary of 3GPP LTE Features to Support Public Safety[66]

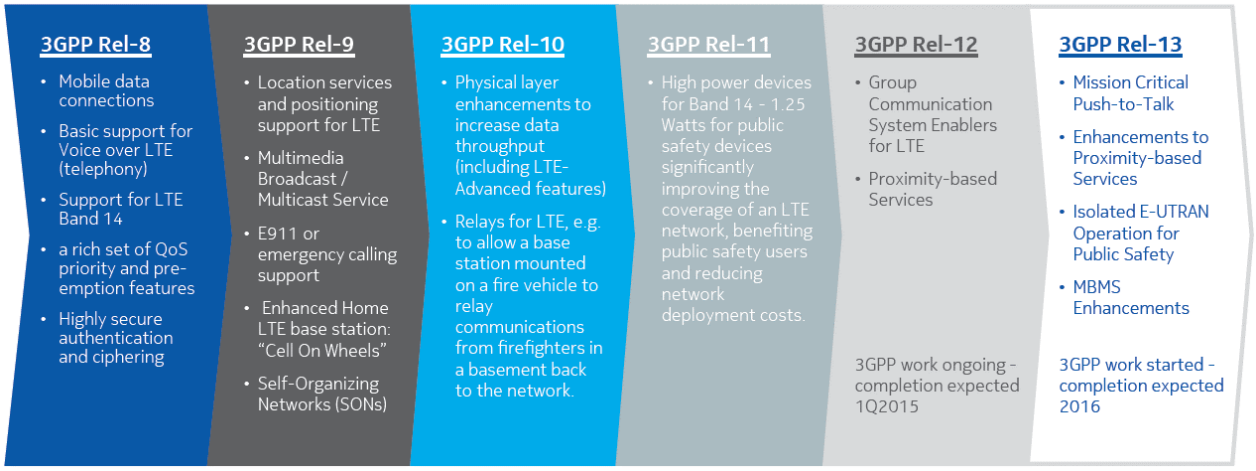

Deployment Approaches

Because huge infrastructure investments would be required for a network dedicated solely to public safety, industry and government are evaluating approaches in which public-safety uses can leverage existing commercial network deployments. One caveat is that public-safety networks have more stringent resilience and security requirements than commercial networks.

Shared Network

As depicted in Figure 29, multiple sharing approaches are possible:

1. In this scenario, a public-safety entity owns and operates the entire network, an approach that gives public-safety organizations the greatest control over the network but at the highest cost.

2. A commercial operator shares its radio-access network, including cell sites and backhaul, but the public-safety entity manages core network functions including gateways, the Mobile Management Entity, the Home Subscriber Server (HSS), and public-safety application servers. Because the radio-access network is the costliest part of the network, this approach significantly reduces the amount public safety must invest in the network. Even though the RAN is shared, public safety still can use its dedicated spectrum.

3. In an MVNO approach, the operator shares its cell sites and backhaul as well as some core network functions, such as the MME and Serving Gateway. Public safety manages a small number of network functions, such as the Packet Gateway, HSS, and its application servers.

[66] Nokia, *LTE networks for public safety services*, 2014. Available at http://networks.nokia.com/sites/default/files/document/nokia_lte_for_public_safety_white_paper.pdf.

4. A final approach, not shown in the figure, is one in which the mobile operator hosts all of the elements shown in the figure and public safety manages only its application servers.

Figure 29: Sharing Approaches for Public-Safety Networks

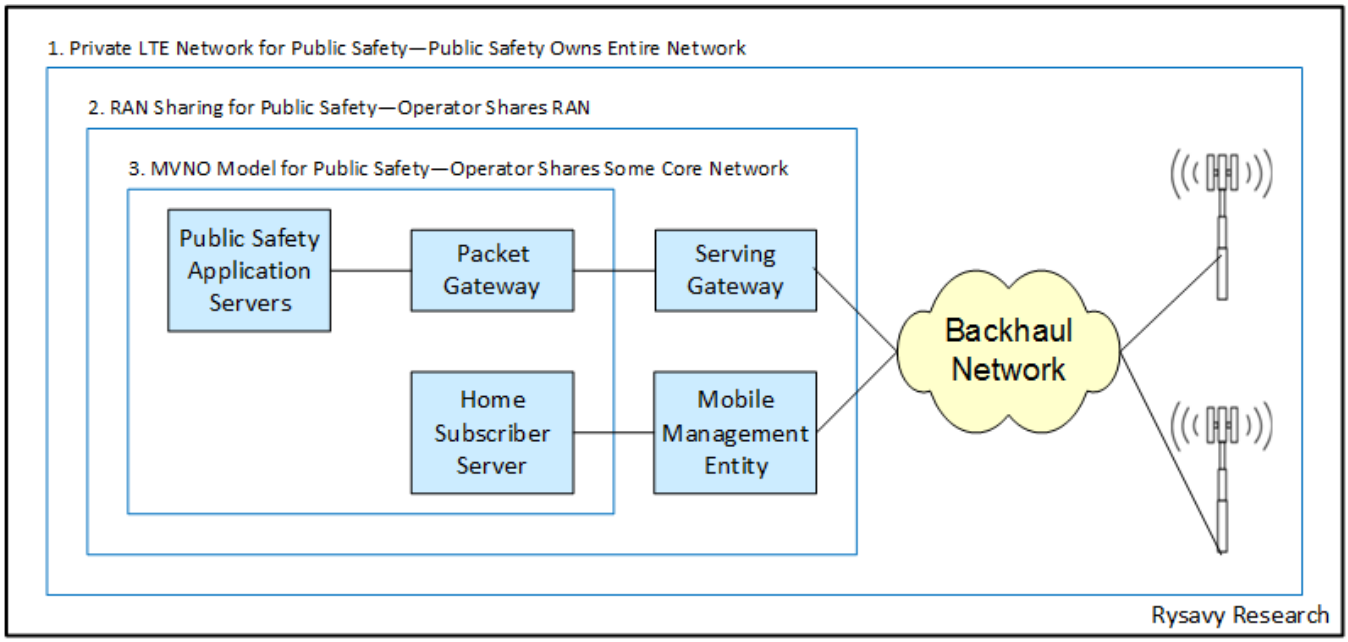

Resilience

Public safety may need greater resilience than found in commercial networks, including hardware redundancy, geographic redundancy, load balancing, fast re-routing in IP networks, interface protection, outage detection, self-healing, and automatic reconfiguration.

Security

Public-safety networks may have higher security requirements than commercial networks, including physical security of data centers, core sites, and cell sites. Whereas LTE networks do not have to encrypt traffic in backhaul and core networks, public-safety applications may choose to encrypt all IP traffic using virtual private networking approaches.

Coverage

A number of approaches can ensure the broadest possible coverage for public-safety networks. First, public-safety frequencies at 700 MHz already propagate and penetrate well. Next, public-safety devices will be able to transmit at higher power. In addition, base stations can employ four-way receiver diversity and higher-order sectorization. For disaster situations, public safety can also use rapidly deployable small cells, such as on trailers. Finally, proximity-based services operating in a relay mode, as discussed above, can extend coverage.

Device Considerations for Public Safety

Public-safety devices will have unique requirements, including guaranteed network access under all conditions and guidelines for how devices are shared among users.

Access to Commercial Networks

Public-safety devices could be designed to also communicate on commercial LTE networks, providing an alternative communications avenue when the device cannot connect to a public-safety network. Subscriptions to all major commercial networks would make this approach the most effective. Wi-Fi capability further extends this concept.

Device Sharing

Because public-safety devices may be shared among personnel, user profiles cannot be stored on USIM cards stored in the devices. Bluetooth-based remote SIMs are one approach to address this problem.

Expanding Capacity

Wireless technology is playing a profound role in networking and communications, even though wireline technologies such as fiber have inherent capacity advantages.

Over time, wireless networks will gain substantial additional capacity through the methods discussed in the next section. While they will compete with copper twisted pair and coax, they will never catch up to fiber. The infrared frequencies used in fiber-optic communications have far greater bandwidth than radio. As a result, one fiber-optic strand has greater bandwidth than the entire usable radio spectrum to 100 GHz, as illustrated in Figure 30.[67]

Figure 30: RF Capacity vs. Fiber-Optic Cable Capacity

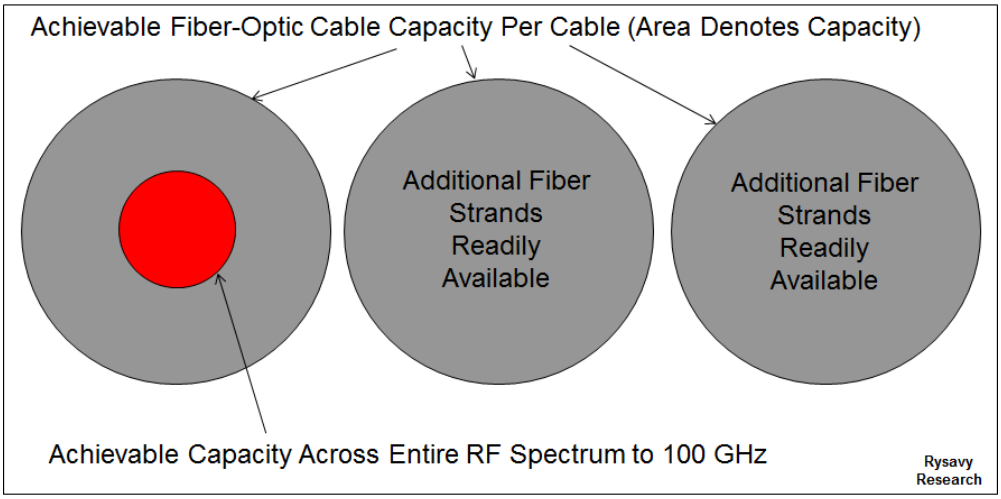

A dilemma of 4G mobile broadband is that it *can* provide a broadband experience similar to wireline, but it *cannot* do so for all subscribers in a coverage area at the same time. Hence, operators must carefully manage capacity, demand, policies, pricing plans, and user expectations. Similarly, application developers must become more conscious of the inherent constraints of wireless networks. 5G, with its far greater capacity, at least in small deployments, will increase the percentage of users that use wireless connections as their only broadband.

Three factors determine wireless network capacity, as shown in Figure 31: the amount of spectrum, the spectral efficiency of the technology, and the size of the cell. Because smaller cells serve fewer people in each cell and because there are more of them, small cells are a major contributor to increased capacity.

[67] One fiber-optic cable can transmit over 10,000 Gbps compared with all wireless spectrum to 100 GHz, which, even at an extremely high spectral efficiency 10 bps/Hz, would have only 1,000 Gbps of capacity.

Figure 31: Dimensions of Capacity

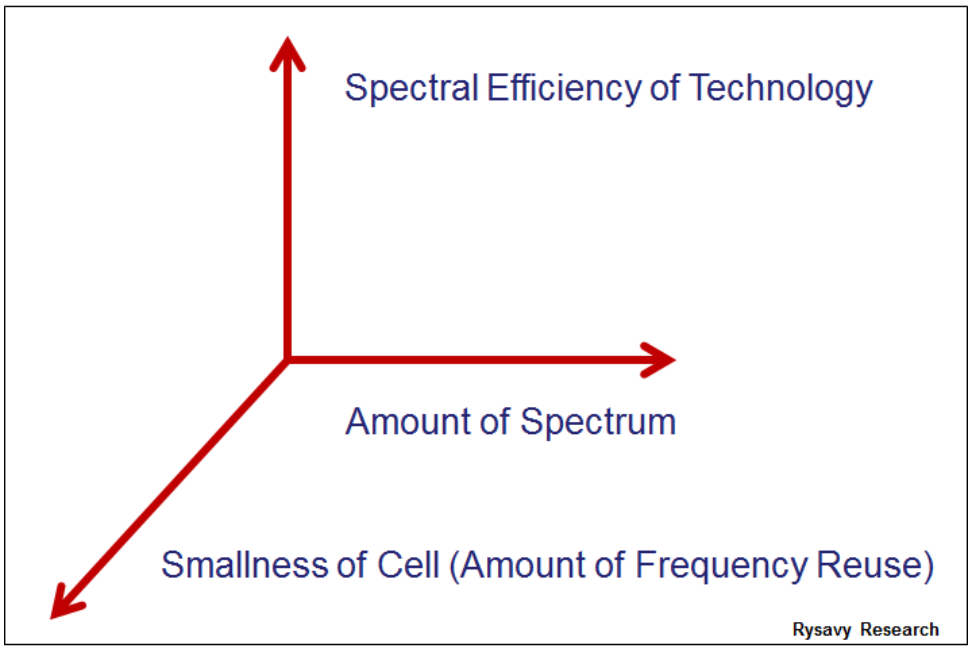

Given the relentless growth in usage, mobile operators are combining multiple approaches to increase capacity and managing congestion:

- **More spectrum.** Spectrum correlates almost directly to capacity, and more spectrum is becoming available globally for mobile broadband. In the U.S. market, the 2010 FCC National Broadband Plan is in the process of adding an additional 500 MHz of spectrum by 2020. mmWave band spectrum for 5G will provide far more spectrum, but propagation characteristics will restrict its use to small cells. Multiple papers by Rysavy Research and others[68] argue the critical need for additional spectrum.
- **Unpaired spectrum.** LTE TDD operates in unpaired spectrum. In addition, technologies such as HSPA+ and LTE permit the use of different amounts of spectrum between downlink and uplink. Additional unpaired downlink spectrum can be combined with paired spectrum to increase capacity and user throughputs.
- **Supplemental downlink.** With downlink traffic five to ten times greater than uplink traffic, operators often need to expand downlink capacity rather than uplink capacity. Using carrier aggregation, operators can augment downlink capacity by combining separate radio channels.
- **Spectrum sharing.** Policy makers are evaluating how spectrum might be shared between government and commercial entities. Although a potentially promising approach for the long term, sharing raises complex issues, as discussed further in the section "Spectrum Developments."
- **Increased spectral efficiency.** Newer technologies are spectrally more efficient, meaning greater aggregate throughput using the same amount of spectrum. Wireless technologies such as LTE, however, are reaching the theoretical limits of spectral

[68] See multiple papers on spectrum and capacity at http://www.rysavy.com/writing.

efficiency, and future gains will be quite modest, allowing for a possible doubling of LTE efficiency over currently deployed versions. See the section "Spectral Efficiency" for a further discussion.

- **Smart antennas.** Through higher-order MIMO and beamforming, smart antennas gain added sophistication in each 3GPP release and are the primary contributor to increased spectral efficiency (bps/Hz). Massive MIMO, beginning in Release 13, will support 16-antenna-element systems and in 5G, will expand to potentially hundreds of antenna elements.
- **Uplink gains combined with downlink carrier aggregation.** Operators can increase network capacity by applying new receive technologies at the base station (for example, large-scale antenna systems such as massive MIMO) that do not necessarily require standards support. Combined with carrier aggregation on the downlink, these receive technologies produce a high-capacity balanced network, suggesting that regulators should in some cases consider licensing just downlink spectrum.
- **Small cells and heterogeneous networks.** Selective addition of picocells to macrocells to address localized demand can significantly boost overall capacity, with a linear increase in capacity relative to the number of small cells. HetNets, which also can include femtocells, hold the promise of increasing capacity gains by a factor of four and even higher with the introduction of interference cancellation in devices. Distributed antenna systems (DAS), used principally for improved indoor coverage, can also function like small cells and increase capacity. Actual gain will depend on a number of factors, including number and placement of small cells,[69] user distribution, and any small-cell selection bias that might be applied.
- **Offload to unlicensed spectrum.** Using unlicensed spectrum with Wi-Fi or LTE operation in unlicensed spectrum offers another means of offloading heavy traffic. Unlicensed spectrum favors smaller coverage areas because interference can be better managed, so spectral re-use is high, resulting in significant capacity gains.
- **Higher level sectorization.** For some base stations, despite the more complex configuration involved, six sectors can prove advantageous versus the more traditional three sectors, deployed either in a 6X1 horizontal plane or 3X2 vertical plane.[70]

Strategies to manage demand include:

- **Quality of service (QoS) management.** Through prioritization, certain traffic, such as non-time-critical downloads, could occur with lower priority, thus not affecting other active users. Current network neutrality rules, however, may constrain use of traffic prioritization.[71]
- **Off-peak hours.** Operators could offer user incentives or perhaps fewer restrictions on large data transfers during off-peak hours.

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[69] With small-cell range expansion using a large selection bias, small cells can be distributed uniformly.

[70] An example of vertical layering would be a 3X1 layer at ground level and a separate 3X1 layer for higher levels of surrounding buildings.

[71] For a discussion of this issue, see Rysavy Research, *LTE Congestion Management – Enabling Innovation and Improving the Consumer Experience*, January 2015. Available at http://www.rysavy.com/Articles/2015-01-Rysavy-LTE-Congestion-Management.pdf.

Given a goal of increasing capacity by a factor of 1,000, 50X could roughly be achieved through network densification; 10X through more spectrum, including higher frequencies such as mmWave; and 2X by increases in spectral efficiency.

Based on historical increases in the availability of new spectrum, technologies delivering better spectral efficiency, and increases in the number of cell sites, Rysavy Research has calculated that, over the last thirty-year period, aggregate network capacity has doubled every three years. Rysavy Research expects this trend to continue into the future.

Rysavy Research Analysis:

Aggregate Wireless Network Capacity Doubles Every Three Years.

Spectrum Developments

Licensed spectrum scarcity continues to challenge the industry. Tactics to make the best use of this limited resource include deploying technologies that have higher spectral efficiency; adapting specifications to enable operation of UMTS-HSPA and LTE in all available bands; designing both FDD and TDD versions of technology to take advantage of both paired and unpaired bands; designing carrier aggregation techniques in HSPA+ and LTE-Advanced Pro; and deploying as many new cells, large and small, as is economically and technically feasible. Although all of these industry initiatives greatly expand capacity, they do not obviate the need for additional spectrum. 5G technology will be able to employ frequencies not previously used in cellular systems, spanning 6 GHz to 100 GHz.

An important aspect of UMTS-HSPA and LTE deployment is for infrastructure and mobile devices to accommodate the expanding number of available radio bands. The fundamental system design and networking protocols remain the same for each band; only the frequency-dependent portions of the radios must change. As other frequency bands become available for deployment, standards bodies adapt UMTS-HSPA and LTE for these bands as well.

3GPP has specified LTE for operation in many different bands, and initial use will be more fragmented than the four bands (850 MHz, 900 MHz, 1.8 GHz, 1.9 GHz) that enable global roaming on 2G and the additional two bands (1.7 GHz and 2.1 GHz) that enable 3G roaming. In the Americas, LTE roaming may occur in the 1.7/2.1 GHz (AWS) bands, and globally, LTE roaming may occur in the 1.8 and 2.6 GHz bands. Longer term, operators will re-farm spectrum used for 2G and 3G and apply it to LTE. Unfortunately, the process of identifying new spectrum and making it available for the industry is a lengthy one, as shown in Figure 32.

Figure 32: Spectrum Acquisition Time[72]

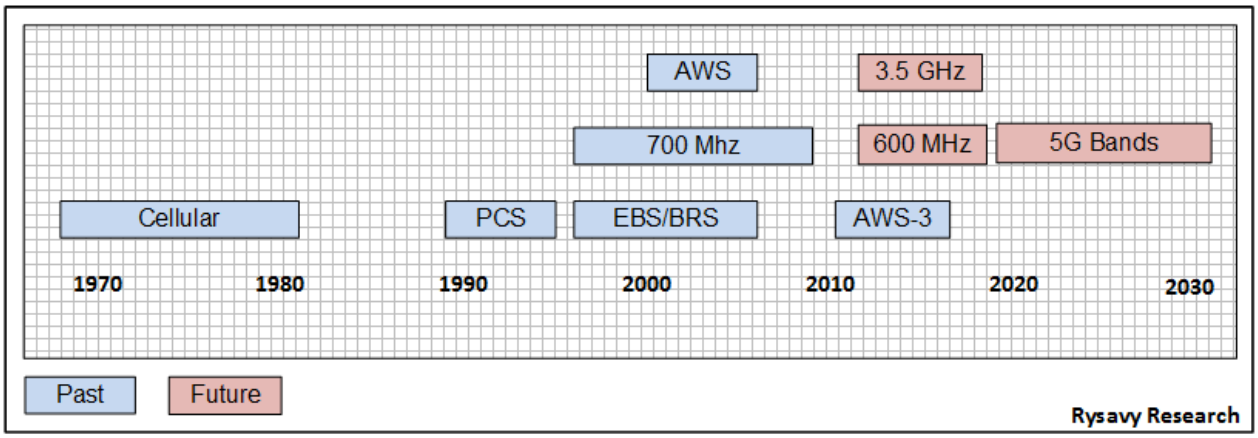

New short-term spectrum opportunities in the United States include the "small-cell" band from 3550 to 3700 MHz and 5G spectrum.

[72] Source for historical data, FCC, *National Broadband Plan*, Chapter 5. Available at http://www.broadband.gov/plan/5-spectrum/, accessed May 18, 2017. Future based on Rysavy Research analysis.

Table 11 summarizes current and future spectrum allocations in the United States.[73]

Table 11: United States Current and Future Licensed Spectrum Allocations

Frequency Band	Amount of Spectrum	Comments
600 MHz	70 MHz	Ultra-High-Frequency (UHF).
700 MHz	70 MHz	Ultra-High Frequency (UHF).
850 MHz	64 MHz	Cellular and Specialized Mobile Radio.
1.7/2.1 GHz	90 MHz	Advanced Wireless Services (AWS)-1.
1695-1710 MHz, 1755 to 1780 MHz, 2155 to 2180 MHz	65 MHz	AWS-3. Uses spectrum sharing.
1.9 GHz	140 MHz	Personal Communications Service (PCS).
2000 to 2020, 2180 to 2200 MHz	40 MHz	AWS-4 (Previously Mobile Satellite Service).[74]
2.3 GHz	20 MHz	Wireless Communications Service (WCS).
2.5 GHz	194 MHz	Broadband Radio Service. Closer to 160 MHz deployable.
	FUTURE	
3.55 to 3.70 GHz	150 MHz	Small-cell band with spectrum sharing and unlicensed use.
Above 6 GHz	Multi GHz	Anticipated for 5G systems beginning in 2017. Based on wavelengths, 3 GHz to 30 GHz is referred to as the cmWave band and 30 GHz to 300 GHz is referred to as the mmWave band.

Today's licensed spectrum networks operate most efficiently and are deployed most cost-effectively using a combination of low-band spectrum, below 1 GHz, for coverage and 1 GHz

[73] For international allocations, refer to Wik-Consult, Study for the European Commission, *Inventory and review of spectrum use: Assessment of the EU potential for improving spectrum efficiency*, September 2012. Available at http://ec.europa.eu/digital-agenda/sites/digital-agenda/files/cion_spectrum_inventory_executive_summary_en.pdf.

[74] Supported in 3GPP Band 70, which adds 1995-2000 MHz, pairing it with 1695-1710 MHz in AWS-3 band.

to 3 GHz for capacity. As technology improves, bands in 3 GHz to 100 GHz, and eventually higher, will supplement capacity.

The subsections below provide additional information about the recently completed AWS-3 auction, incentive auctions, the 3.5 GHz, 5G, spectrum harmonization, unlicensed spectrum, and spectrum sharing.

AWS-3

In early 2015, the FCC received close to $45 billion for the U.S. Treasury in the AWS-3 auction, more than twice the amount of any previous auction, demonstrating the value of mid-band spectrum.[75] The auction adds 65 MHz of desirable spectrum to the mobile-broadband industry. The plan is to employ spectrum sharing among commercial networks and select government systems. Eventually, most of these government systems will migrate to another spectrum. 3GPP has specified use of both AWS-3 and AWS-4 spectrum in what it refers to as "Band 66."

This band is asymmetrical, with a downlink of 90 MHz and an uplink of 70 MHz. An operator can use the upper-most 20 MHz of the downlink only with carrier aggregation.

Broadcast Incentive Auction (600 MHz)

The broadcast incentive auction completed in 2017 will reallocate 84 MHz of UHF channels in the 600 MHz band that are currently used by TV broadcasters, with 70 MHz of licensed spectrum and 14 MHz of unlicensed spectrum. The auction was more complicated than past spectrum auctions, when the FCC simply reassigned or designated spectrum for commercial mobile use and then conducted an auction.

In the first stage, the FCC conducted a reverse auction to determine how much spectrum broadcasters might wish to relinquish in exchange for how much compensation. In the second stage, mobile operators bid for spectrum in a forward auction, similar to past spectrum auctions.

Figure 33 shows the final band plan.

Figure 33: 600 MHz Band Plan[76]

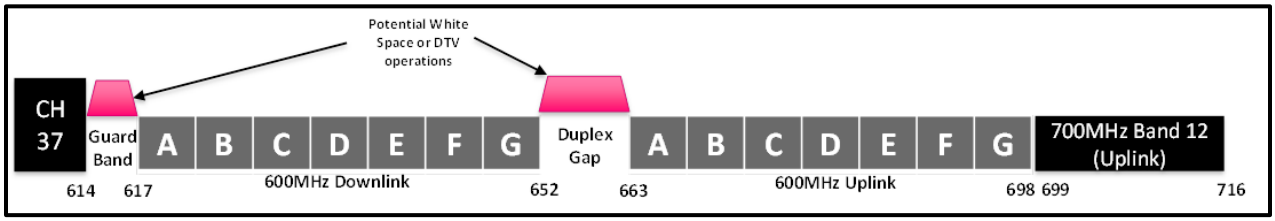

Part of the auction process reorganizes and repacks relinquished channels, as well as channels needed for broadcasters that want to keep broadcasting, to make useful blocks of spectrum for mobile broadband. The FCC's goal is to design an auction that will result in

[75] For further details, see Rysavy Research, "Latest FCC auction shatters spectrum myths," January 2015. Available at https://gigaom.com/2015/01/17/latest-fcc-auction-shatters-spectrum-myths/.

[76] 5G Americas member contribution.

a uniform nationwide band plan, but in some markets, there may be deviations from that plan.

With a 39-month schedule for winning bidders to move into their new spectrum, the 600 MHz band will be fully available by 2020. However, some operators, will begin using this spectrum in advance of this date, possibly as soon as the second half of 2017, as the spectrum becomes available for use.[77] Operators will use the band for LTE and 5G.

3550 to 3700 MHz "Small-Cell" Band

In the United States, the FCC is in the process of opening the 3550 to 3700 MHz CBRS band. The best use of this band will be small cells and backhaul. The FCC is implementing a three-tier model with incumbent access, priority access with priority access licenses (PALs), and General Authorized Access (GAA) for unlicensed users.[78] Incumbent access will include government radar systems.

Two industry organizations, the Wireless Innovation Forum[79] and the CBRS Alliance,[80] are working for the realization of 3.5 GHz systems.

The mobile broadband industry will mostly use LTE TDD in small-cell configurations, in either a licensed mode or an unlicensed mode using LAA or MulteFire.

Although this band represents a significant amount of new spectrum, potential adopters of the band have expressed concern about proposed rules for use of the band. For example:

- IEEE has stated it will not pursue a version of 802.11 for this band because exclusion zones are so large that the percentage of the U.S. population that could be served is below what is required for a successful market.[81]
- Licensed users will only be able to obtain three-year licenses with no automatic renewal.[82]

Assuming LAA auctions in early 2018, initial 3.5 GHz deployments could occur in 2018. Because an Environmental Sensing Capability (ESC) has not yet been developed and

[77] For example, see FierceWireless, "T-Mobile confirms speedy 600 MHz rollout for 2017, covering 1 million+ square miles," August 8, 2017, available at http://www.fiercewireless.com/node/334911.

[78] For further details, see Official FCC Blog, "Innovation in the 3.5 GHz Band: Creating a New Citizens Broadband Radio Service," March 2015, available at http://www.fcc.gov/blog/innovation-35-ghz-band-creating-new-citizens-broadband-radio-service. See also FCC, *Further Notice of Proposed Rulemaking--Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550- 3650 MHz Band*, April 23, 2014.

[79] See http://www.wirelessinnovation.org/.

[80] See https://www.cbrsalliance.org/.

[81] IEEE 802.11, *Comments of IEEE 802.11, In the Matter of Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band,"* Jul, 2015. Available at http://apps.fcc.gov/ecfs/document/view?id=60001115064.

[82] See Rysavy article about this band, "Scary Experimentation at 3.5 GHz," Jun. 2016, available at http://www.rysavy.com/Articles/2016-06-Scary-Experimentation-3-5-GHz.pdf. See also AT&T ex-parte FCC communication, http://apps.fcc.gov/ecfs/document/view?id=60001569272.

approved, these initial deployments may not come to fruition in coastal areas where the ESC is needed for co-existence with military systems using those frequencies.

See the section "Spectrum Sharing" for further details of this band.

2.5 GHz Band

In the United States, the primary operator at 2.5 GHz is Sprint. In 2017, Sprint announced that they will deploy 5G in its 2.5 GHz spectrum as soon as the second half of 2019.[83] Having an average of 160 MHz of spectrum at 2.5 GHz in its top 100 markets, Sprint is in the process of deploying LTE-Advanced. In addition, Sprint is in an LTE deployment mode that includes the following features:

- Carrier aggregation capability between 2.5 GHz and lower bands (800MHz and 1900 MHz) and aggregating three carriers in a single band.
- TDD operation at 2.5 GHz and FDD operation in lower bands.
- 8 transmit and 8 receive radios at the base station that enables 4X2 MIMO in combination with beamforming.[84]

5G Bands

As radio technology progresses, it can handle higher frequencies, and it occupies greater bandwidth. 1G systems used 30 kHz radio carriers, 2G in GSM uses 200 kHz carriers, 3G in UMTS uses 5 MHz carriers, and 4G in LTE uses carriers of up to 640 MHz through carrier aggregation.

3GPP is specifying 5G NR to be band agnostic. 5G will use low-band, mid-band, and high-band spectrum, and 3GPP is in the process of identifying candidate bands for 5G across all frequency ranges. 3GPP Technical Services Group - Radio Access Networks (TSG-RAN) agreed to a process of efficiently adding LTE/NR band combinations and carrier-aggregated NR/NR band combinations. Initial bands being considered by the 3GPP specification process include low band bands 5, 20, 28 and 71, mid-band bands 1, 3, 7, 66 and 41, and key mmWave bands. Just as it has done with LTE, over time, 3GPP will specify additional 5G bands spanning multiple frequencies.

Although 5G research and development is in its infancy, to achieve the 20 Gbps or higher throughput rates envisioned for 5G will require radio carriers such as 200 MHz or 400 MHz, bandwidths available only at frequencies above 5 GHz. Researchers globally are studying high-frequency spectrum options including both cmWave frequencies (3 GHz to 30 GHz) and mmWave (30 GHz to 300 GHz). Ten times as much spectrum, or more, could be available in these higher frequencies than in all current cellular spectrum.

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[83] For more details, see Sprint press release, "Qualcomm, SoftBank and Sprint Announce Collaboration on 2.5 GHz 5G," May 10, 2017, available at http://newsroom.sprint.com/qualcomm-softbank-and-sprint-announce-collaboration-on-25-ghz-5g.htm.

[84] For more details, see Sprint article at: http://newsroom.sprint.com/blogs/sprint-perspectives/introducing-the-sprint-lte-plus-network--faster-stronger-more-reliable-than-ever-before.htm

5G NR is being designed to operate in any frequency band. These bands encompass 600 MHz, current cellular bands, 3.5 GHz, and higher bands such as mmWave. Because 5G will be the first cellular technology to be able to operate in mmWave bands, industry and government are working to make such bands available for 5G.

During the World Radiocommunication Conference (WRC) 15, the ITU proposed a set of global frequencies for 5G[85], which it intends to finalize at the next conference in 2019 (WRC 19):

- 24.25–27.5GHz
- 31.8–33.4GHz
- 37–40.5GHz
- 40.5–42.5GHz
- 45.5–50.2GHz
- 50.4–52.6GHz
- 66–76GHz
- 81–86GHz
- In 2014, the FCC published a Notice of Inquiry into use of spectrum bands above 24 GHz for Mobile Radio Services,[86] followed by a Notice of Proposed Rulemaking in October 2015. [87]

The FCC issued adopted rules to identify and open up 5G mmWave spectrum allocation in July 2016 that identify 3.85 GHz of licensed spectrum and 7 GHz of unlicensed spectrum: licensed use in 28 GHz, 37 GHz, and 39 GHz bands; unlicensed use in 64-71 GHz; and shared access in the 37-37.6 GHz band.

On July 24, 2016, the FCC adopted a report and order and further notice of proposed rulemaking that creates a new Part 30 for rules governing 28 GHz, 36 GHz, and 39 GHz bands, summarized in Table 12.

Table 12: United States 5G mmWave Bands[88]

Bands	Details
28 GHz Band (27.5-28.35 GHz)	Currently licensed for Local Multipoint Distribution Service (LMDS). Could be licensed using either 200 or 400 MHz wide channels.

[85] 5G Americas Webcast, "LTE-Steps to 5G," Feb 12, 2016.

[86] FCC, *Notice of Inquiry, Use of Spectrum Bands above 24 GHz for Mobile Radio Services*, Oct. 17, 2014.

[87] FCC, *Notice of Proposed Rulemaking, Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, GN Docket No. 14-177,* Oct 23, 2015.

[88] For more details, refer to FCC, *Report and Order and Further Notice of Proposed Rulemaking, Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*, July 14, 2016. See also 5G Americas, *5G*

Bands	Details
39 GHz Band (38.6-40 GHz)	Currently licensed for fixed microwave in 50 MHz channels. Segment will be auctioned in 200 MHz blocks.
37 GHz Band (37-38.6 GHz)	Lower 37-37.6 GHz segment will be shared between federal and non-federal users. Upper 37.6-38.6 GHz segment will be auctioned in 200 MHz blocks.
64-71 GHz Band	Available for unlicensed use with same Part 15 rules as existing 57-64 GHz band.

In the 28 GHz band, satellite operations are secondary, but these operations are co-primary in the 37/39 GHz bands. Spectrum sharing may be required in some 5G bands, including 38.6 to 40 GHz, such as with fixed satellite service.

In the further notice of proposed rulemaking, the FCC is investigating additional bands, including 24 GHz, 32 GHz, 42 GHz, 47 GHz, 50 GHz, 70/80 GHz, and bands above 95 GHz.

The complex ITU harmonization process may mean that some regions, or even countries, pursue 5G bands that are not globally harmonized. For example, U.S. operators, along with operators in Korea and Japan, are planning 5G trials in the 28 GHz band, even though it is not one of the ITU bands.

Harmonization

Spectrum harmonization delivers many benefits, including higher economies of scale, better battery life, improved roaming, and reduced interference along borders.

As regulators make more spectrum available, it is important that they follow guidelines such as those espoused by 5G Americas:[89]

- Configure licenses with wider bandwidths.
- Group like services together.
- Be mindful of global technology standards.
- Pursue harmonized/contiguous spectrum allocations.
- Exhaust exclusive use options before pursuing shared use.
- Because not all spectrum is fungible, align allocation with demand.

Emerging technologies such as LTE benefit from wider radio channels. These wider channels are not only spectrally more efficient, they also offer greater capacity. Figure 34 shows increasing LTE spectral efficiency obtained with wider radio channels, with 20 MHz on the

Spectrum Recommendations, April 2017, available at http://www.5gamericas.org/files/9114/9324/1786/5GA_5G_Spectrum_Recommendations_2017_FINAL.pdf. This report covers global 5G spectrum developments.

[89] 4G Americas, *Sustaining the Mobile Miracle – A 4G Americas Blueprint for Securing Mobile Broadband Spectrum in this Decade*, March 2011.

downlink and 20 MHz (20+20 MHz) on the uplink comprising the most efficient configuration.

Figure 34: LTE Spectral Efficiency as Function of Radio Channel Size[90]

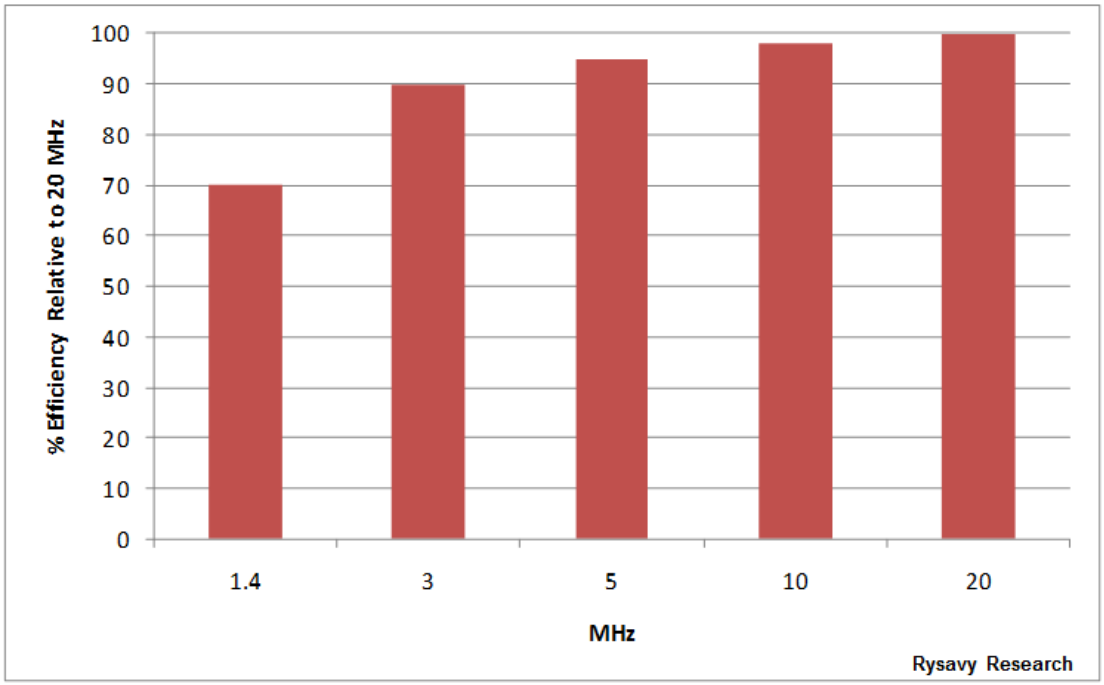

The organization tasked with global spectrum harmonization, the International Telecommunication Union, periodically holds World Radiocommunication Conferences.[91]

Harmonization occurs at multiple levels:

- Allocation of radio frequencies to a mobile service in the ITU frequency allocation table.
- Establishment of global or regional frequency arrangements, including channel blocks and specific duplexing modes.
- Development of detailed technical specifications and standards, including system performance, RF performance, and coexistence with other systems in neighboring bands.
- Assignment for frequency blocks with associated technical conditions and specifications to appropriate operators and service providers.[92]

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[90] 5G Americas member company analysis.

[91] International Telecommunication Union, "World Radiocommunication Conferences (WRC)," http://www.itu.int/ITU-R/index.asp?category=conferences&rlink=wrc&lang=en, viewed May 18, 2017.

[92] International Telecommunication Union Radiocommunication Study Groups, *Technical Perspective on Benefits Of Spectrum Harmonization for Mobile Services and IMT*, Document 5D/246-E, January 2013.

Unlicensed Spectrum

Wi-Fi uses spectrum efficiently because its small coverage areas result in high-frequency reuse and high data density (bps per square meter). Less efficient are white-space unlicensed networks, sometimes called "super Wi-Fi," that, because of large coverage areas, have much lower throughput per square meter. While white-space networks may be a practical broadband solution in rural or undeveloped areas, they face significant challenges in urban areas that already have mobile and fixed broadband available.[93] See the section on "White Space Networks" in the appendix for further details.

Advocates argue that unlicensed spectrum unleashes innovation and that government should allocate greater amounts of unlicensed spectrum. Although Wi-Fi has been successful, the core elements that make unlicensed spectrum extremely successful are also the source of inherent disadvantages: local coverage and its unlicensed status. Local coverage enables high data density and high frequency reuse but makes widespread continuous coverage almost impossible. Similarly, unlicensed operation facilitates deployment by millions of entities but results in overlapping coverage and interference.

Networks built using unlicensed spectrum cannot replace networks built using licensed spectrum, and vice versa. The two are complementary and helpful to each other, as summarized in Table 13.[94]

Table 13: Pros and Cons of Unlicensed and Licensed Spectrum

Unlicensed Spectrum			Licensed Spectrum	
Pros	**Cons**		**Pros**	**Cons**
Easy and quick to deploy	Potential of other entities using same frequencies		Huge coverage areas	Expensive infrastructure
Low-cost hardware	Difficult to impossible to provide wide-scale coverage		Able to manage quality of service	Each operator has access to only a small amount of spectrum

Some operators offer a "Wi-Fi first" capability with which devices always attempt to use a Wi-Fi connection and fall back to a cellular connection only if no Wi-Fi is available. Such cellular backup is essential because Wi-Fi, due to low-power operation in many bands, is inherently unsuited for providing continuous coverage. The sharp drop-off in signal strength due to low transmit power makes coverage gaps over large areas inevitable, especially outdoors.

[93] For further analysis, see Rysavy Research, "White spaces networks are not 'super' nor even Wi-Fi," Gigaom, March 2013. Available at http://gigaom.com/2013/03/17/white-spaces-networks-are-not-super-nor-even-wi-fi/.

[94] For further analysis, see Rysavy Research, "It's Time for a Rational Perspective on Wi-Fi," Gigaom, April, 2014. Available at http://gigaom.com/2014/04/27/its-time-for-a-rational-perspective-on-wi-fi/.

Figure 35: Propagation Losses of Cellular vs. Wi-Fi[95]

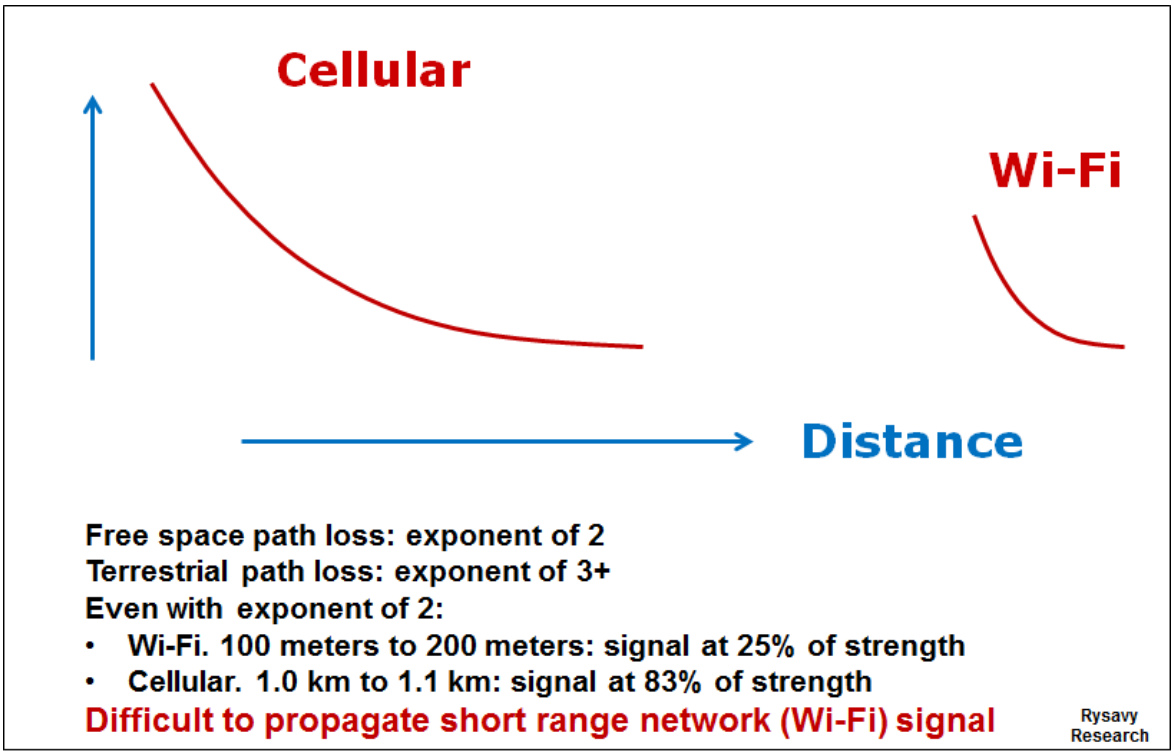

Spectrum Sharing

In 2012, the President's Council of Advisors on Science and Technology issued a report titled, "Realizing the Full Potential of Government-Held Spectrum to Spur Economic Growth." The report recommended spectrum sharing between government and commercial entities.

The U.S. government can designate spectrum for exclusive, shared, or unlicensed use, as shown in Figure 36. Shared use can be opportunistic, as with TV white spaces; two-tier with incumbents and licensed users; or three-tier, which adds opportunistic access. The bands initially targeted for spectrum sharing include AWS-3 (two tiers on a temporary basis) and the 3.5 GHz band (three tiers).

The three-tier plan envisioned by the U.S. government for the 3.5 GHz band gives more entities access to the spectrum but at the cost of increased complexity.

[95] Assumes 1.0 km radius for cellular and 100-meter radius for Wi-Fi.

Figure 36: Spectrum Use and Sharing Approaches

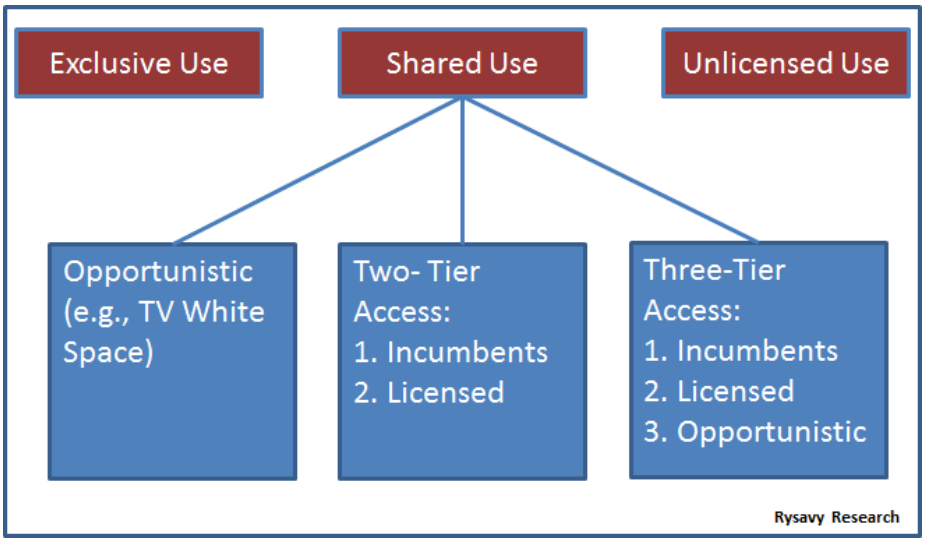

The European Telecommunications Standards Institute (ETSI) is the leading organization standardizing cognitive radios. The most relevant effort is called "Licensed Shared Access" (LSA), a two-tier spectrum sharing system that includes incumbents and licensed secondary users that access shared spectrum via a database, as depicted in Figure 37.

Figure 37: Licensed Shared Access (LSA)

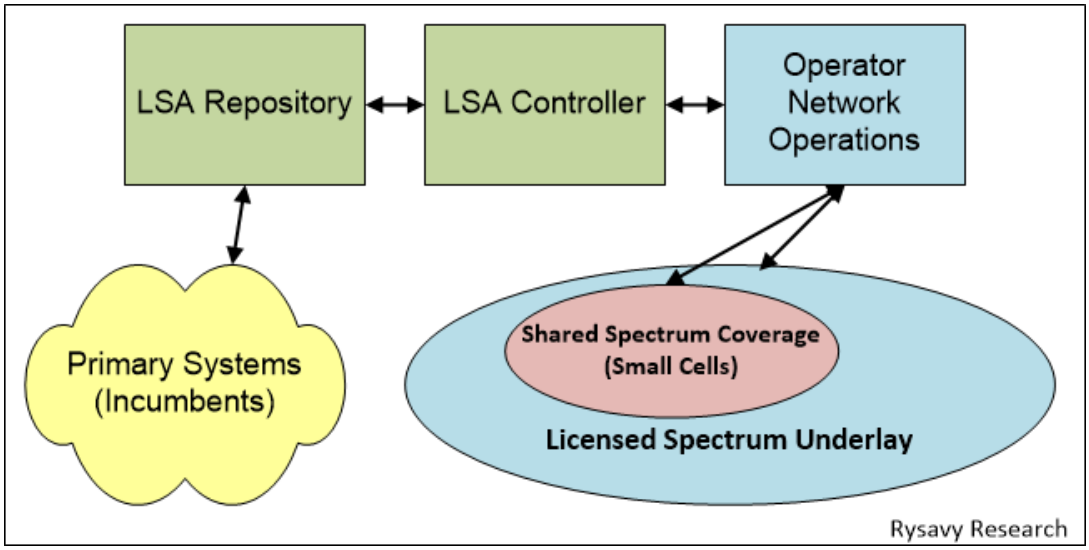

The three-tier system expected for the 3.5 GHz band in the United States will be complex, necessitating a real-time Spectrum Access System, the SAS, the design and development of which will encompass:

- Algorithms and methods;
- Methods of nesting hierarchical SAS entities (federal secure SAS versus commercial SASs);

- Coordination among multiple, competing commercial SAS managing entities;
- Interface definitions;
- Communication protocol definitions;
- Database and protocol security;
- Policy enforcement;
- Speed of channel allocation/reallocation;
- Time intervals for spectrum allocation;
- Effectively managing large numbers of Tier 3 users; and
- Data ownership, fees, rules, fairness, and conflict resolutions, all of which have policy, regulatory, and business implications.

TVWS databases available today address only a tiny subset of these requirements.[96]

Figure 38 shows the proposed architecture of the 3.5 GHz system. The system consists of incumbents (government systems), Priority Access Licenses, and General Authorized Access. Government systems include military ship-borne radar, military ground-based radar, fixed satellite service earth stations (receive only), and government broadband services (3650 to 3700 MHz). PAL licenses will be used by entities such as cellular operators and will be available for three-year periods. GAA users are licensed by rule and must protect both incumbents and PALs. Incumbents are protected by an Environmental Sensing Capability that detects incumbents and informs the SAS. Some examples of GAA use cases are small-business hotspots, campus hotspots, and backhaul.

Citizens Broadband Radio Service Devices (CBSDs) are the base stations operating under this service; they can operate only under the authority and management of the SAS, either by direct communications or a proxy node.

[96] For further analysis, see Rysavy Research and Mobile Future, *Complexities of Spectrum Sharing: How to Move Forward*, April 2014. Available at http://www.rysavy.com/Articles/2014-04-Spectrum-Sharing-Complexities.pdf.

Figure 38: United States 3.5 GHz System Currently Being Developed

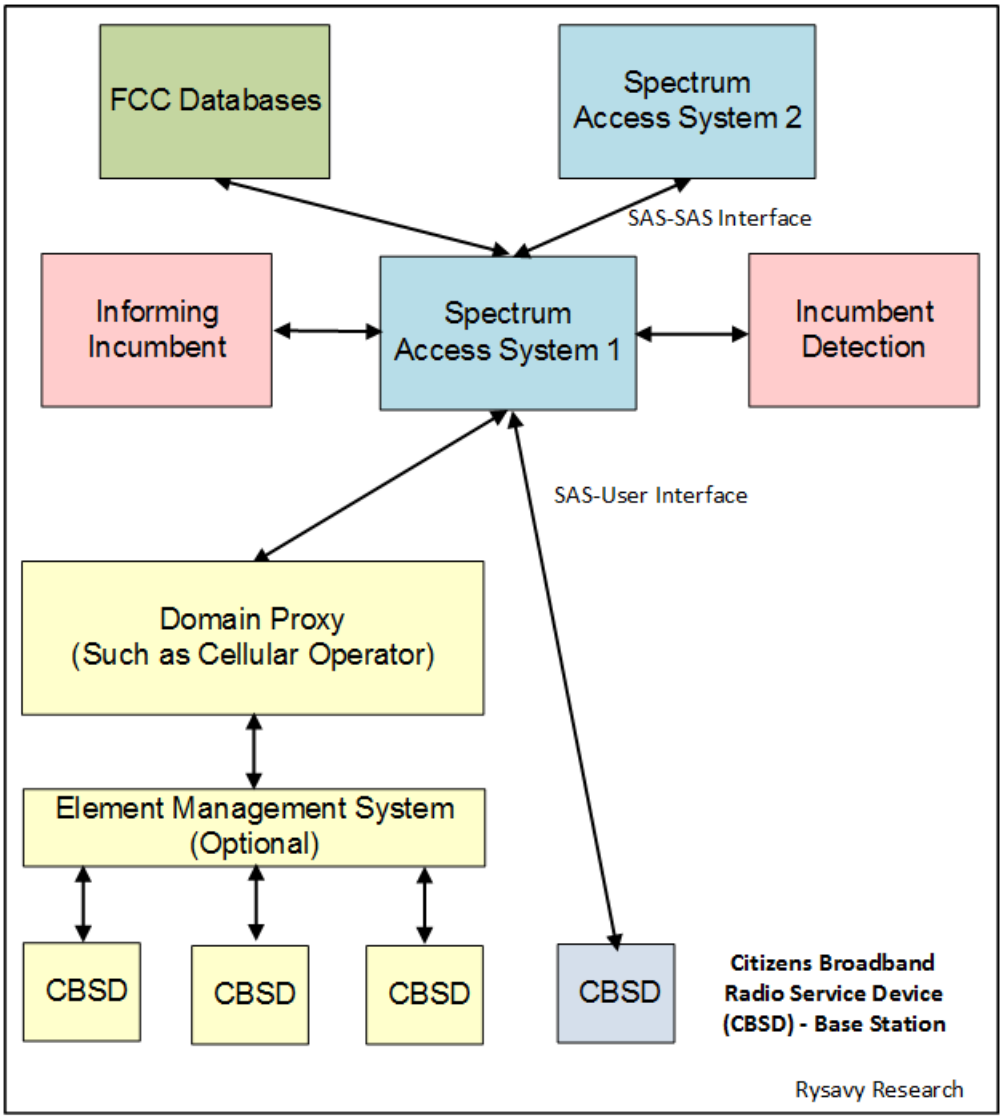

Conclusion

Mobile broadband remains at the forefront of innovation and development in computing, networking, and application development. As users, and now machines, consume ever more wireless data, the industry is responding with more efficient, faster, and higher capacity networks. Even as excitement builds about 5G, LTE, through ongoing advances, has become the global standard.

LTE-Advanced and LTE-Advanced Pro innovations include VoLTE, 1 Gbps peak rate capability, higher-order MIMO, carrier aggregation, LAA/LWA/LWIP, IoT capabilities in Narrowband-IoT and Category M-1, V2X communications, small-cell support, URLLC, SON, dual connectivity, and CoMP—all capabilities that will improve performance, efficiency, and capacity and enable support for new vertical segments. Carriers are implementing NFV and SDN to reduce network costs, improve service velocity, and simplify deployment of new services. Such improvements also facilitate cloud RANs that promise further efficiency gains.

5G research and development efforts have accelerated; standards-based deployment will begin in 2019 and continue through 2030. Operators have announced pre-standard fixed-wireless deployments for 2017. 3GPP has implemented a 5G standardization process that began in Release 14 with a study of the new 5G radio, continues now with a first phase of specifications in Release 15 that provides both non-standalone and standalone options, then moves ahead with a second phase of complete specifications in Release 16.

By harnessing new spectrum, such as mmWave bands above 24 GHz, 5G will eventually be able to access ten times as much spectrum as is currently available for cellular operation. Using radio bands 200 MHz or wider will result in multi-Gbps throughput capabilities. 5G will be designed to integrate with LTE networks, and many 5G features may be implemented as LTE-Advanced Pro extensions prior to full 5G availability.

Small cells will play an ever-more-important role in boosting capacity, benefiting from a number of technologies and developments, including SON, eICIC, Dual Connectivity, LWA/LWIP, LTE-U, LTE-LAA, MulteFire, improved backhaul options, and spectrum ideal for small cells, such as the 3.5 GHz and mmWave bands.

Obtaining more spectrum remains a priority globally. In U.S. markets, the recently completed television incentive auctions for 600 MHz spectrum supplied 70 MHz of new licensed spectrum; the 3.5 GHz small-cell band will provide 150 MHz; and the 5G spectrum bands, with both licensed and unlicensed bands, will add about 10 GHz of new spectrum.

The future of mobile broadband, including both LTE-Advanced and 5G, is bright, with no end in sight for continued growth in capability, nor for the limitless application innovation that mobile broadband enables.

Appendix: Technology Details

The 3GPP family of data technologies provides ever increasing capabilities that support ever more demanding applications. Services obviously need to provide broad coverage and high data throughput. Less obvious for users, but as critical for effective application performance, are the need for low latency, QoS control, and spectral efficiency. Higher spectral efficiency translates to higher average throughputs (and thus more responsive applications) for more active users in a coverage area. The discussion below details the progression of capability for each technology, including throughput, security, latency, QoS, and spectral efficiency.

This appendix provides details on 5G, UMTS/HSPA, and EDGE.

3GPP Releases

- **Release 99**: Completed. First deployable version of UMTS. Enhancements to GSM data (EDGE). Provides support for GSM/EDGE/GPRS/WCDMA radio-access networks.
- **Release 4**: Completed. Multimedia messaging support. First steps toward using IP transport in the core network.
- **Release 5**: Completed. HSDPA. First phase of Internet Protocol Multimedia Subsystem (IMS). Full ability to use IP-based transport instead of just Asynchronous Transfer Mode (ATM) in the core network.
- **Release 6**: Completed. HSUPA. Enhanced multimedia support through Multimedia Broadcast/Multicast Services (MBMS). Performance specifications for advanced receivers. Wireless Local Area Network (WLAN) integration option. IMS enhancements. Initial VoIP capability.
- **Release 7**: Completed. Provides enhanced GSM data functionality with Evolved EDGE. Specifies HSPA+, which includes higher-order modulation and MIMO. Performance enhancements, improved spectral efficiency, increased capacity, and better resistance to interference. Continuous Packet Connectivity (CPC) enables efficient “always-on” service and enhanced uplink UL VoIP capacity, as well as reductions in call set-up delay for Push-to-Talk Over Cellular (PoC). Radio enhancements to HSPA include 64 Quadrature Amplitude Modulation (QAM) in the downlink and 16 QAM in the uplink. Also includes optimization of MBMS capabilities through the multicast/broadcast, single frequency network (MBSFN) function.
- **Release 8**: Completed. Comprises further HSPA Evolution features such as simultaneous use of MIMO and 64 QAM. Includes dual-carrier HSDPA (DC-HSDPA) wherein two downlink carriers can be combined for a doubling of throughput performance. Specifies OFDMA-based 3GPP LTE. Defines EPC and EPS.
- **Release 9**: Completed. HSPA and LTE enhancements including HSPA dual-carrier downlink operation in combination with MIMO, Multimedia Broadcast Multicast Services (MBMS), HSDPA dual-band operation, HSPA dual-carrier uplink operation, EPC enhancements, femtocell support, support for regulatory features such as emergency user equipment positioning and Commercial Mobile Alert System (CMAS), and evolution of IMS architecture.
- **Release 10**: Completed. Specifies LTE-Advanced that meets the requirements set by ITU’s IMT-Advanced project. Key features include carrier aggregation, multi-antenna enhancements such as enhanced downlink eight-branch MIMO and uplink MIMO, relays,

enhanced LTE Self-Organizing Network capability, Evolved Multimedia Broadcast Multicast Services (eMBMS), HetNet enhancements that include eICIC, Local IP Packet Access, and new frequency bands. For HSPA, includes quad-carrier operation and additional MIMO options. Also includes femtocell enhancements, optimizations for M2M communications, and local IP traffic offload.

- **Release 11**: Completed. For LTE, emphasizes Coordinated Multi Point (CoMP), carrier-aggregation enhancements, devices with interference cancellation, development of the Enhanced Physical Downlink Control Channel (EPDCCH), and further enhanced eICIC including devices with CRS (Cell-specific Reference Signal) interference cancellation. The release includes further DL and UL MIMO enhancements for LTE. For HSPA, provides eight-carrier on the downlink, uplink enhancements to improve latency, dual-antenna beamforming and MIMO, CELL Forward Access Channel (FACH) state enhancement for smartphone-type traffic, four-branch MIMO enhancements and transmissions for HSDPA, 64 QAM in the uplink, downlink multipoint transmission, and noncontiguous HSDPA carrier aggregation. Wi-Fi integration is promoted through S2a Mobility over GPRS Tunneling Protocol (SaMOG). An additional architectural element called "Machine-Type Communications Interworking Function" (MTC-IWF) will more flexibly support machine-to-machine communications.

- **Release 12**: Completed. Enhancements include improved small cells/HetNets for LTE, LTE multi-antenna/site technologies (including Active Antenna Systems), Dual Connectivity, 256 QAM modulation option, further CoMP/MIMO enhancements, enhancements for interworking with Wi-Fi, enhancements for MTC, SON, support for emergency and public safety, Minimization of Drive Tests (MDT), advanced receivers, device-to-device communication (also referred to as Proximity Services), group communication enablers in LTE, addition of Web Real Time Communication (WebRTC) to IMS, energy efficiency, more flexible carrier aggregation, dynamic adaptation of uplink-downlink ratios in TDD mode, further enhancements for HSPA+, small cells/HetNets, Scalable-UMTS, and FDD-TDD carrier aggregation.

- **Release 13**: Completed. LTE features include Active Antenna Systems (AAS) with support for as many as 16 antenna elements (full-dimension MIMO) and beamforming, Network-Assisted Interference Cancellation and Suppression (NAICS), radio-access network sharing, carrier aggregation supporting 32 component carriers,[97] carrier aggregation of up to four carriers on the downlink and two carriers on the uplink, LAA for operation in unlicensed bands, LTE Wi-Fi Aggregation including LWIP, RCLWI, isolated operation and mission-critical voice communications for public safety, application-specific congestion management, User-Plane Congestion Management, enhancement to WebRTC interoperability, architecture enhancement for dedicated core networks, enhancement to proximity-based services, Mission-Critical Push-to-Talk, group communications, CoMP enhancements, small cell enhancements, machine-type communications enhancements including NB-IoT and Extended Coverage GSM (EC-GSM), VoLTE enhancements, SON enhancements, shared network enhancements, indoor positioning based on WLAN access points, Bluetooth beacons and barometric pressure, and enhanced circuit-switched fallback. HSPA+ features include support for dual-band uplink carrier aggregation.

[97] This level of aggregation refers to signaling capabilities. The number of carriers that can be combined in an actual deployment is smaller and depends on RAN co-existence studies. Refer to the appendix section on "Carrier Aggregation" for additional details.

- **Release 14**: Expected completion June 2017. Contemplated features include uplink operation for LAA (enhanced LAA), full-dimension MIMO enhanced with up to 32 antenna elements, dual-connectivity of licensed and unlicensed carriers across non-collocated nodes, vehicle-to-vehicle and vehicle-to-infrastructure (V2X) communications built on Release 12 Proximity Services, shared LTE broadcast in which different operators broadcast the same content on the same frequency, non-IP operation for IoT, Downlink Multi-user Superposition Transmission (MUST), enhanced LWA, VoLTE enhancements, LWIP/LWA enhancements, eMBMS enhancements, NB-IoT enhancements, and LTE latency reduction.

- **Release 15**: Expected completion September 2018. Non-standalone (using LTE core network) option expected March 2018. Specifies phase 1 of 5G. NR radio, 4G-5G interworking, and MIMO/beamforming. Further LTE enhancements include ultra-reliable low-latency communications, NB-IoT enhancements, LAA enhancements, V2X enhancements, DL 1024 QAM, CoMP enhancements, AAS enhancements, and LTE/5G core network capability.

- **Release 16**: Expected completion end of 2019. Specifies phase 2 of 5G. Adds URLLC, spectrum sharing, unlicensed spectrum operation and integration, and multiple other enhancements. Further LTE enhancements.

Data Throughput Comparison

Data throughput is an important metric for quantifying network throughput performance. Unfortunately, the ways in which various organizations quote throughputs vary tremendously, often resulting in misleading claims. The intent of this paper is to realistically represent the capabilities of these technologies.

One method of representing a technology's throughput is what people call "peak throughput" or "peak network speed," which refers to the fastest possible transmission speed over the radio link and is generally based on the highest-order modulation available and the least amount of coding (error correction) overhead. Peak network speed is also usually quoted at layer 2 of the radio link. Because of protocol overhead, actual application throughput may be up to 10% lower than this layer-2 value.

Another method is to disclose throughputs actually measured in deployed networks with applications such as File Transfer Protocol (FTP) under favorable conditions, which assume light network load (as low as one active data user in the cell sector) and favorable signal propagation. This number is useful because it demonstrates the high-end, actual capability of the technology in current deployments, referred to in this paper as the "peak user rate." Average rates are lower than this peak rate and are difficult to predict because they depend on a multitude of operational and network factors. Except when the network is congested, however, the majority of users should experience throughput rates higher than one-half of the peak achievable rate.

Some operators, primarily in the United States, also quote typical throughput rates, which are based on throughput tests the operators have done across their operating networks and incorporate a higher level of network load. Although the operators do not disclose the precise methodologies they use to establish these figures, the values provide a good indication of what users can realistically expect.

Table 14 presents the technologies in terms of peak network throughput rates, peak user rates (under favorable conditions), and typical rates. It omits values that are not yet known, such as for future technologies.

The projected typical rates for HSPA+ and LTE show a wide range because these technologies exploit favorable radio conditions to achieve high throughput rates, but under poor radio conditions, throughput rates are lower.

Table 14: Throughput Performance of Different Wireless Technologies (Blue Indicates Theoretical Peak Rates, Green Typical)

	Downlink		Uplink	
	Peak Network Speed	Peak and/or Typical User Rate	Peak Network Speed	Peak and/or Typical User Rate
5G in mmWave, early versions[98]	5 Gbps	500 Mbps	2 Gbps	250 Mbps
5G in mmWave, later versions	50 Gbps	5 Gbps	25 Gbps	2 Gbps
LTE (2X2 MIMO, 10+10 MHz, DL 64 QAM, UL 16 QAM)	70 Mbps	6.5 to 26.3 Mbps[99]	35 Mbps[100]	6.0 to 13.0 Mbps
LTE-Advanced (2X2 or 4X4 MIMO, 20+20 MHz or 40+20 MHz with Carrier Aggregation [CA], DL 64 QAM, UL 16 QAM)	300 Mbps	N/A	71 Mbps[101]	N/A
LTE Advanced (4X4 MIMO, 60+20MHz, CA, 256 QAM DL, 64 QAM UL)	600 Mbps		150 Mbps	
LTE Advanced (4X4 MIMO, 80+20 MHz, CA, 256 QAM DL, 64 QAM UL)	> 1 Gbps		150 Mbps	

[98] Speculative values, Rysavy Research estimates. Assumes 200 MHz radio channel, 2:1 TDD. Throughput rates would double using 400 MHz.

[99] 5G Americas member company analysis for downlink and uplink. Assumes single user with 50% load in other sectors. AT&T and Verizon are quoting typical user rates of 5-12 Mbps on the downlink and 2-5 Mbps on the uplink for their networks. See additional LTE throughput information in the section below, "LTE Throughput."

[100] Assumes 64 QAM. Otherwise 22 Mbps with 16 QAM.

[101] Assumes 64 QAM. Otherwise 45 Mbps with 16 QAM.

	Downlink		Uplink	
	Peak Network Speed	Peak and/or Typical User Rate	Peak Network Speed	Peak and/or Typical User Rate
LTE Advanced (8X8 MIMO, 20+20 MHz, DL 64 QAM, UL 64 QAM)	1.2 Gbps	N/A	568 Mbps	N/A
LTE Advanced, 100 MHz + 100 MHz	3 Gbps		1.5 Gbps	
LTE Advanced 32 Carriers	>> 3 Gbps			
EDGE (type 2 MS)	473.6 Kbps	Not Applicable (N/A)	473.6 Kbps	N/A
EDGE (type 1 MS) (Practical Terminal)	236.8 Kbps	200 Kbps peak 160 to 200 Kbps typical[102]	236.8 Kbps	200 Kbps peak 80 to 160 Kbps typical[103]
HSDPA Initial Devices (2006)	1.8 Mbps	> 1 Mbps peak	384 Kbps	350 Kbps peak
HSDPA	14.4 Mbps	N/A	384 Kbps	N/A

[102] Assumes four-to-five downlink timeslot devices (each timeslot capable of 40 Kbps).

[103] Assumes two-to-four uplink timeslot devices (each timeslot capable of 40 Kbps).

	Downlink		Uplink	
	Peak Network Speed	Peak and/or Typical User Rate	Peak Network Speed	Peak and/or Typical User Rate
HSPA[104] Initial Implementation	7.2 Mbps	> 5 Mbps peak 700 Kbps to 1.7 Mbps typical[105]	2 Mbps	> 1.5 Mbps peak 500 Kbps to 1.2 Mbps typical
HSPA	14.4 Mbps	N/A	5.76 Mbps	N/A
HSPA+ (DL 64 QAM, UL 16 QAM, 5+5 MHz)	21.6 Mbps	1.9 Mbps to 8.8 Mbps typical[106]	11.5 Mbps	1 Mbps to 4 Mbps typical
HSPA+ (2X2 MIMO, DL 16 QAM, UL 16 QAM, 5+5 MHz)	28 Mbps	N/A	11.5 Mbps	N/A
HSPA+ (2X2 MIMO, DL 64 QAM, UL 16 QAM, 5+5 MHz)	42 Mbps	N/A	11.5 Mbps	N/A
HSPA+ (DL 64 QAM, UL 16 QAM, Dual Carrier, 10+5 MHz)	42 Mbps	Approximate doubling of 5+5 MHz rates - 3.8 to 17.6 Mbps.	11.5 Mbps	1 Mbps to 4 Mbps typical
HSPA+ (2X2 MIMO DL, DL 64 QAM, UL 16 QAM, Dual Carrier, 10+10 MHz)	84 Mbps	N/A	23 Mbps	N/A

[104] High Speed Packet Access (HSPA) consists of systems supporting both High Speed Downlink Packet Access (HSDPA) and High Speed Uplink Packet Access (HSUPA).

[105] Typical downlink and uplink throughput rates based on AT&T press release, June 4, 2008

[106] 5G Americas member company analysis. Assumes Release 7 with 64 QAM and F-DPCH. Single user. 50% loading in neighboring cells. Higher rates expected with subsequent 3GPP releases.

	Downlink		Uplink	
	Peak Network Speed	Peak and/or Typical User Rate	Peak Network Speed	Peak and/or Typical User Rate
HSPA+ (2X2 MIMO DL, DL 64 QAM, UL 16 QAM, Quad-Carrier,[107] 20+10 MHz)	168 Mbps	N/A	23 Mbps	N/A
HSPA+ (2X2 MIMO DL and UL, DL 64 QAM, UL 16 QAM, Eight-Carrier, 40+10 MHz)	336 Mbps	N/A	69 Mbps	N/A
HSPA+ (4X2 MIMO DL, 2X2 MIMO UL, DL 64 QAM, UL 16 QAM, 8 carrier, 40+10 MHz)	672 Mbps	N/A	69 Mbps	N/A
EDGE (type 2 MS)	473.6 Kbps	Not Applicable (N/A)	473.6 Kbps	N/A
EDGE (type 1 MS) (Practical Terminal)	236.8 Kbps	200 Kbps peak 160 to 200 Kbps typical[108]	236.8 Kbps	200 Kbps peak 80 to 160 Kbps typical[109]
CDMA2000 EV-DO Rel. 0	2.4 Mbps	> 1 Mbps peak	153 Kbps	150 Kbps peak

[107] No operators have announced plans to deploy HSPA in a quad (or greater) carrier configuration. Three carrier configurations, however, have been deployed.

[108] Assumes four-to-five downlink timeslot devices (each timeslot capable of 40 Kbps).

[109] Assumes two-to-four uplink timeslot devices (each timeslot capable of 40 Kbps).

	Downlink		Uplink	
	Peak Network Speed	Peak and/or Typical User Rate	Peak Network Speed	Peak and/or Typical User Rate
CDMA2000 EV-DO Rev. A	3.1 Mbps	> 1.5 Mbps peak 600 Kbps to 1.4 Mbps typical[110]	1.8 Mbps	> 1 Mbps peak 300 to 500 Kbps typical
CDMA2000 EV-DO Rev. B (3 radio channels 5+5 MHz)	14.7[111] Mbps	Proportional increase of Rev A typical rates based on number of carriers.	5.4 Mbps	N/A
CDMA2000 EV-DO Rev B Theoretical (15 radio channels 20+20 MHz)	73.5 Mbps	N/A	27 Mbps	N/A

Additional information about LTE throughput appears below in the section "LTE Throughput."

Latency Comparison

As important as throughput is network latency, defined as the round-trip time it takes data to traverse the network. Each successive data technology from GPRS forward reduces latency, with LTE networks having latency as low as 15 msec. Ongoing improvements in each technology mean that all of these values will go down as vendors and operators fine-tune their systems. Figure 39 shows the latency of different 3GPP technologies.

[110] Typical downlink and uplink throughput rates based on Sprint press release Jan. 30, 2007.

[111] Assuming use of 64 QAM.

Figure 39: Latency of Different Technologies[112]

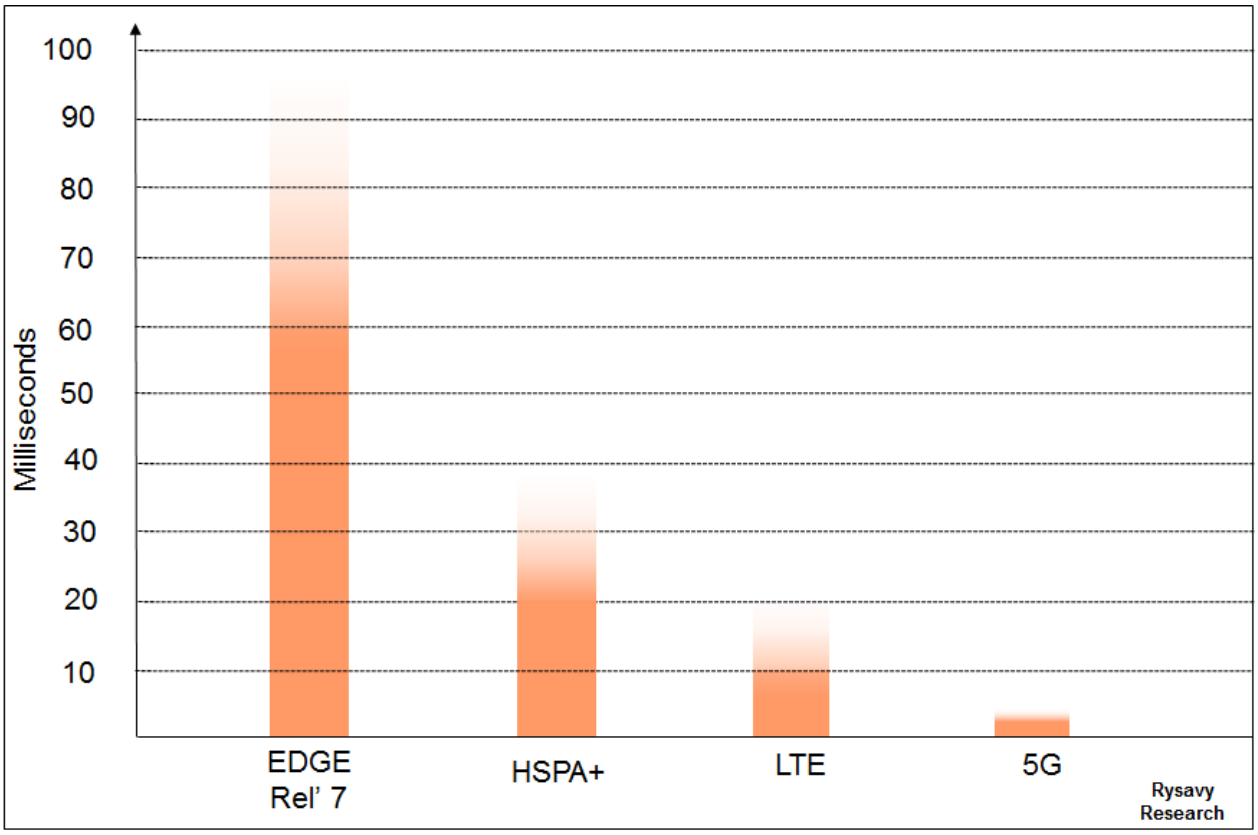

The values shown in Figure 39 reflect measurements of commercially deployed technologies, with EDGE Release 7 achieving 70 to 95 msec, HSPA+ 25 to 30 msec, and LTE 15 to 20 msec. A latency goal for 5G is less than 4 msec for broadband and 0.5 msec for mission-critical applications.

Spectral Efficiency

The evolution of data services is characterized by an increasing number of users with ever-higher bandwidth demands. As the wireless data market grows, deploying wireless technologies with high spectral efficiency is of paramount importance. Keeping all other things equal, including frequency band, amount of spectrum, and cell site spacing, an increase in spectral efficiency translates to a proportional increase in the number of users supported at the same load per user—or, for the same number of users, an increase in throughput available to each user.

Increased spectral efficiency, however, comes at a price because it generally involves greater complexity for both user and base station equipment. Complexity can arise from the increased number of calculations performed to process signals or from additional radio

[112] 5G Americas member companies. Measured between subscriber unit and a node immediately external to wireless network. Does not include internet latency. Note that there is some variation in latency based on network configuration and operating conditions.

components. Hence, operators and vendors must balance market needs against network and equipment costs. OFDMA technologies, such as LTE and planned 5G approaches, achieve higher spectral efficiency with lower overall complexity, especially in larger bandwidths.

As shown in Figure 40, the link-layer performance of modern wireless technologies is approaching the theoretical limits as defined by the Shannon bound. (The Shannon bound is a theoretical limit to the information transfer rate [per unit bandwidth] that can be supported by any communications link. The bound is a function of the SNRs of the communications link.) Figure 40 also shows that HSDPA, 1xEV-DO, and IEEE 802.16e-2005 are all within 2 to 3 decibels (dB) of the Shannon bound, indicating that there is not much room for improvement from a link-layer perspective.

Figure 40: Performance Relative to Theoretical Limits for HSDPA, EV-DO, and WiMAX (IEEE 802.16e-2005)[113]

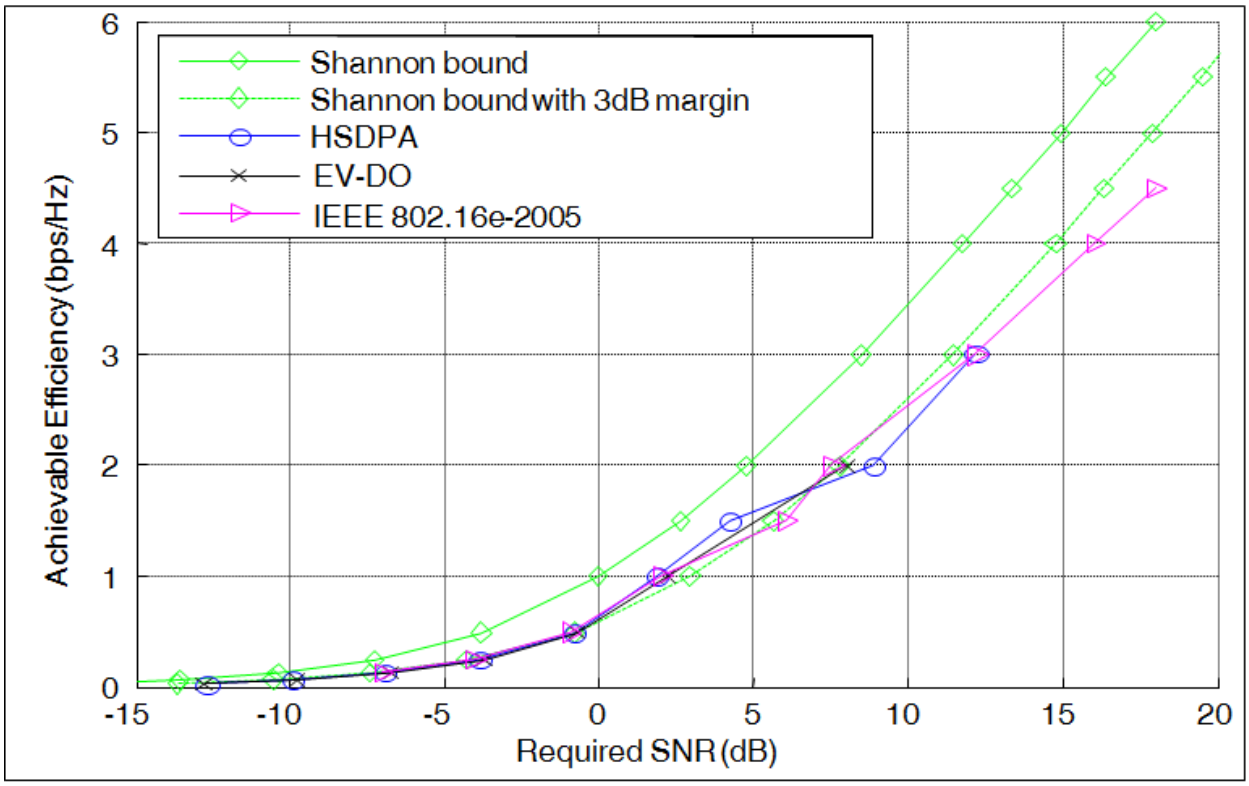

The curves in Figure 40 are for an Additive White Gaussian Noise Channel (AWGN). If the channel is slowly varying and the frame interval is significantly shorter than the coherence time, the effects of fading can be compensated for by practical channel estimation algorithms—thus justifying the AWGN assumption. For instance, at 3 km per hour and fading at 2 GHz, the Doppler spread is about 5.5 Hz. The coherence time of the channel is thus 1 second (sec)/5.5 or 180 msec. Frames are well within the coherence time of the channel, because they are typically 20 msec or less. As such, the channel appears

[113] 5G Americas member contribution.

“constant” over a frame, and the Shannon bound applies. Furthermore, significantly more of the traffic in a cellular system is at slow speeds (for example, 3 km/hr. or less) rather than at higher speeds. The Shannon bound is consequently also relevant for a realistic deployment environment.

As the speed of the mobile station increases and the channel estimation becomes less accurate, additional margin is needed. This additional margin, however, would impact the different standards fairly equally.

The focus of future technology enhancements is on improving system performance aspects that reduce interference to maximize the experienced SNRs in the system and antenna techniques (such as MIMO) that exploit multiple links or steer the beam rather than on investigating new air interfaces that attempt to improve link-layer performance.

MIMO techniques using spatial multiplexing to increase the overall information transfer rate by a factor proportional to the number of transmit or receive antennas do not violate the Shannon bound because the per-antenna transfer rate (that is, the per-communications link transfer rate) is still limited by the Shannon bound.

Figure 41 compares the spectral efficiency of different wireless technologies based on a consensus view of 5G Americas contributors to this paper. It shows the continuing evolution of the capabilities of all the technologies discussed. The values shown are reasonably representative of real-world conditions. Most simulation results produce values under idealized conditions; as such, some of the values shown are lower (for all technologies) than the values indicated in other papers and publications. For instance, 3GPP studies indicate higher HSPA and LTE spectral efficiencies. Nevertheless, there are practical considerations in implementing technologies that can prevent actual deployments from reaching calculated values. Consequently, initial versions of technology may operate at lower levels but then improve over time as designs are optimized. Therefore, readers should interpret the values shown as achievable, but not as the actual values that might be measured in any specific deployed network.

Figure 41: Comparison of Downlink Spectral Efficiency[114]

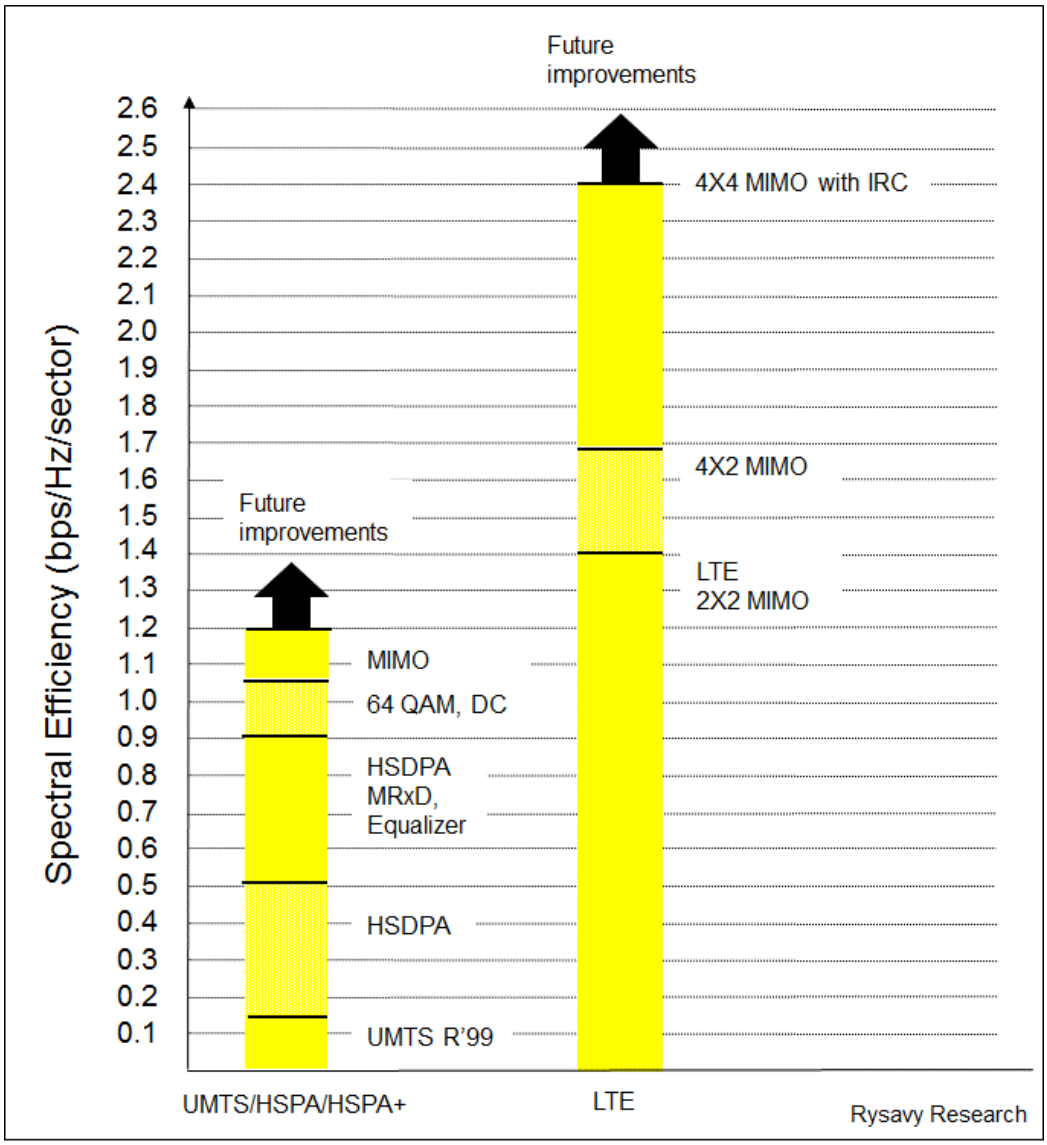

The values shown in Figure 41 are not all possible combinations of available features. Rather, they are representative milestones in ongoing improvements in spectral efficiency. For instance, terminals may employ Mobile Receive Diversity but not equalization.

The figure does not include EDGE, but EDGE itself is spectrally efficient at 0.6 bps/Hz using mobile receive diversity and, potentially, 0.7 bps/Hz with MIMO. Relative to WCDMA Release 99, HSDPA increases capacity by almost a factor of three. Type 3 receivers that include MMSE equalization and Mobile Receive Diversity (MRxD) effectively double HSDPA spectral efficiency. The addition of dual-carrier operation and 64 QAM increases spectral efficiency by about 15%, and MIMO can increase spectral efficiency by another 15%,

[114] Joint analysis by 5G Americas members. 5+5 MHz FDD for UMTS-HSPA/LTE. Mix of mobile and stationary users.

reaching 1.2 bps/Hz. Dual-carrier HSPA+ offers a gain in spectral efficiency from cross-carrier scheduling with possible gains of about 10%.[115]

Some enhancements, such as 64 QAM for HSPA, are simpler to deploy than other enhancements, such as 2X2 MIMO. The former can be done as a software upgrade, whereas the latter requires additional hardware at the base station. Thus, the figure does not necessarily show the actual progression of technologies that operators will deploy to increase spectral efficiency.

Beyond HSPA, 3GPP LTE results in further spectral efficiency gains, initially with 2X2 MIMO, then 4X2 MIMO, and then 4X4 MIMO. The gain for 4X2 MIMO will be 20% more than LTE with 2X2 MIMO; the gain for 4X4 MIMO in combination with interference rejection combining (IRC) will be 70% greater than 2X2 MIMO, reaching 2.4 bps/Hz. This value represents a practical deployment of 4X4 MIMO, with random phase and some timing-alignment error included in each of the four transmit paths. CoMP, discussed below in the appendix, provides a minimal contribution to spectral efficiency.

LTE is even more spectrally efficient when deployed using wider radio channels of 10+10 MHz and 20+20 MHz, although most of the gain is realized at 10+10 MHz. LTE TDD has spectral efficiency that is within 1% or 2% of LTE FDD.[116]

Figure 42 compares the uplink spectral efficiency of the different systems.

[115] 5G Americas member analysis. Vendor estimates for spectral-efficiency gains from dual-carrier operation range from 5% to 20%. Lower spectral efficiency gains are due to full-buffer traffic assumptions. In more realistic operating scenarios, gains will be significantly higher.

[116] Assumes best-effort traffic. Performance between LTE-TDD and FDD differs for real-time traffic for the following reasons: a.) The maximum number of HARQ process should be made as small as possible to reduce the packet re-transmission latency. b.) In FDD, the maximum number of HARQ process is fixed and, as such, the re-transmission latency is 7ms. c.) For TDD, the maximum number of HARQ process depends on the DL:UL configurations. As an example, the re-transmission latency for TDD config-1 is 9ms. d.) Because of higher re-transmission latency, the capacity of real-time services cannot be scaled for TDD from FDD based on the DL:UL ratio.

Figure 42: Comparison of Uplink Spectral Efficiency[117]

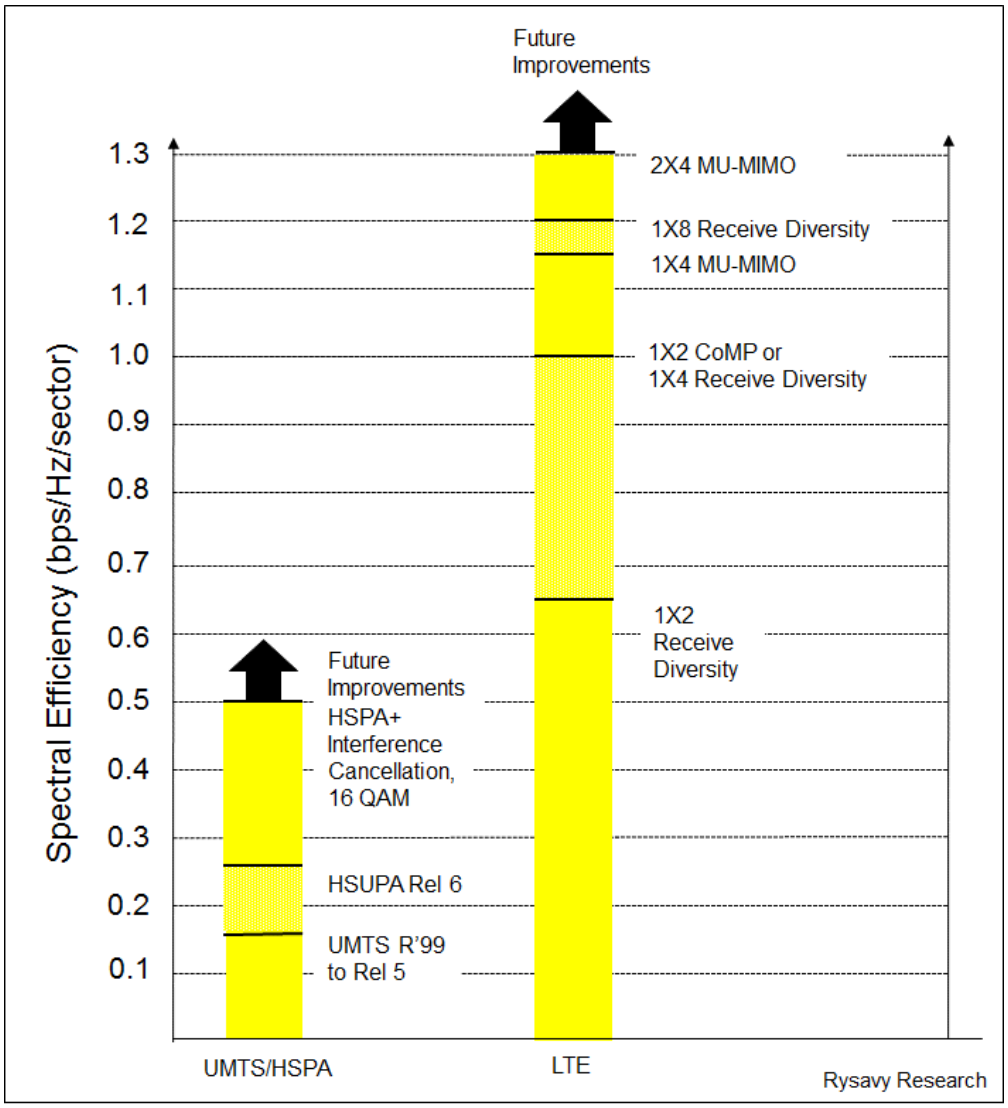

The implementation of HSUPA in HSPA significantly increases uplink capacity.

With LTE, spectral efficiency increases by use of receive diversity. Initial systems will employ 1X2 receive diversity (two antennas at the base station). 1X4 diversity will increase spectral efficiency by 50%, to 1.0 bps/Hz, and 1X8 diversity will provide a further 20% increase, from 1.0 bps/Hz to 1.2 bps/Hz.

It is also possible to employ Multi-User MIMO (MU-MIMO), which allows simultaneous transmission by multiple users on the same physical uplink resource to increase spectral efficiency. MU-MIMO will provide a 15% to 20% spectral efficiency gain, with actual increases depending on how well link adaptation is implemented. The figure uses a conservative 15% gain, showing MU-MIMO with a 1X4 antenna configuration increasing

[117] Joint analysis by 5G Americas members. 5+5 MHz for UMTS-HSPA/LTE. Mix of mobile and stationary users.

spectral efficiency by 15%, to 1.15 bps/Hz, and 2X4 MU-MIMO a further 15%, to 1.3 bps/Hz.

In Release 11, uplink CoMP using 1X2 increases efficiency from .65 bps/Hz to 1.0 bps/Hz. Many of the techniques used to improve LTE spectral efficiency can also be applied to HSPA since they are independent of the radio interface.

Figure 43 compares voice spectral efficiency.

Figure 43: Comparison of Voice Spectral Efficiency[118]

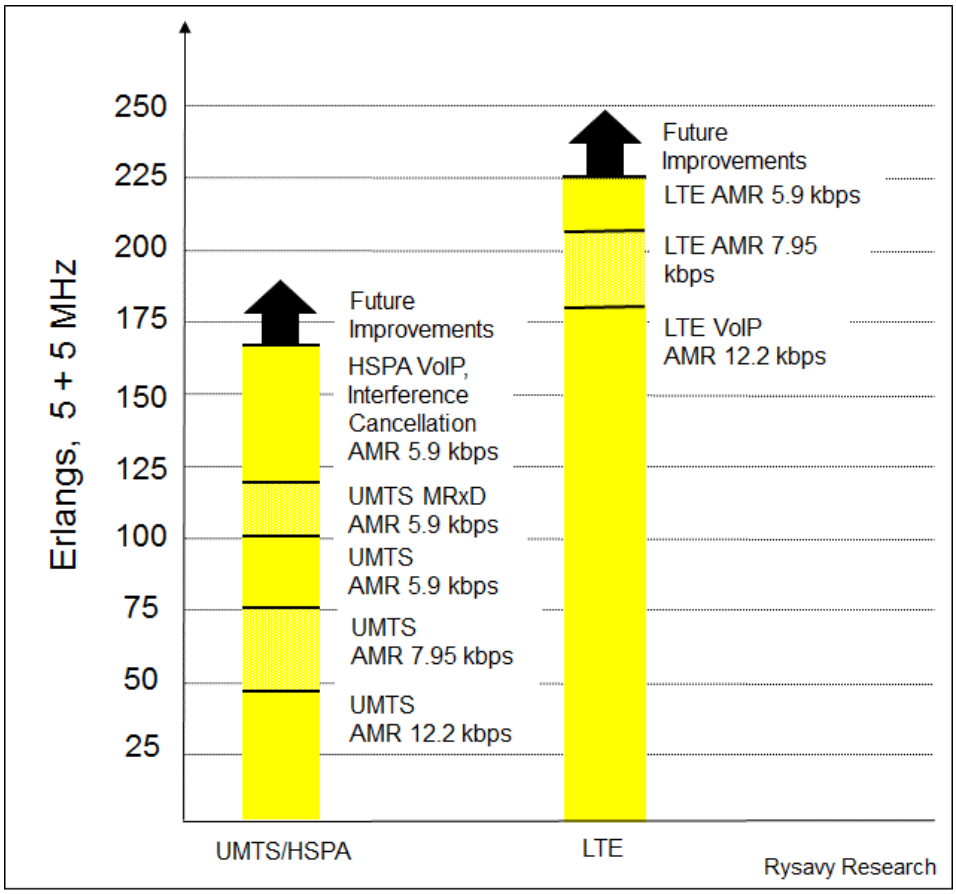

Figure 43 shows UMTS Release 99 with AMR 12.2 Kbps, 7.95 Kbps, and 5.9 Kbps vocoders. The AMR 12.2 Kbps vocoder provides superior voice quality in good (for example, static and indoor) channel conditions.

UMTS has dynamic adaptation between vocoder rates, enabling enhanced voice quality compared with EVRC at the expense of capacity in situations that are not capacity limited. With the addition of mobile receive diversity, UMTS circuit-switched voice capacity could reach 120 Erlangs in 5+5 MHz.

[118] Joint analysis by 5G Americas members. 5 + 5 MHz for UMTS-HSPA/LTE. Mix of mobile and stationary users.

VoIP Erlangs in this paper are defined as the average number of concurrent VoIP users that can be supported over a defined period of time (often one hour) assuming a Poisson arrival process and meeting a specified outage criteria (often less than 2% of the users exhibiting greater than 1% frame-error rate). Depending on the specific enhancements implemented, voice capacity could double over existing circuit-switched systems. These gains do not derive through use of VoIP, but rather from advances in radio techniques applied to the data channels. Many of these same advances may also be applied to current circuit-switched modes.

LTE achieves very high voice spectral efficiency because of better uplink performance since there is no in-cell interference. The figure shows LTE VoIP spectral efficiency using AMR at 12.2 Kbps, 7.95 Kbps, and 5.9 Kbps.

VoIP for LTE can use a variety of codecs. The figures show performance assuming specific codecs at representative bit rates. For Enhanced Variable Rate Codecs (EVRCs), the figure shows the average bit rate.

The voice efficiency of the wideband AMR voice codec, operating at 12.65 Kbps, is similar to the AMR codec at 12.2 Kbps, with a value of 180 Erlangs for both since both codecs operate at approximately the same bit rate. 1xRTT has voice capacity of 85 Erlangs in 5+5 MHz with EVRC-A and reaches voice capacity of 120 Erlangs with the use of Quasi-Linear Interference Cancellation (QLIC) and EVRC-B at 6 Kbps.

Data Consumed by Streaming and Virtual Reality

Table 15 quantifies usage based on advanced video compression schemes such as H.264 and H.265, the type of application, and usage per day.

Table 15: Data Consumed by Streaming and Virtual Reality[119]

Application	Throughput (Mbps)	MByte/hour	Hrs./day	GB/month
Audio or Music	0.1	58	0.5	0.9
			1.0	1.7
			2.0	3.5
			4.0	6.9
Small Screen Video (e.g., Feature Phone)	0.2	90	0.5	1.4
			1.0	2.7
			2.0	5.4
			4.0	10.8
Medium Screen Video (e.g., Smartphone, Tablet, Laptop)	1.0	450	0.5	6.8
			1.0	13.5
			2.0	27.0
			4.0	54.0
Larger Screen Video (e.g., 720p medium definition)	3.0	1350	0.5	20.3
			1.0	40.5
			2.0	81.0
			4.0	162.0
High Definition (e.g., 1080p Netflix HD)	5.0	2250	0.5	33.8
			1.0	67.5
			2.0	135
			4.0	270
4K Ultra-High Definition (Rates will range 12 to 30 Mbps)	20.0	9000	0.5	135
			1.0	270
			2.0	540
			4.0	1080
4G, 30 FPS, Virtual Reality (Rates will range 10 to 50 Mbps)	25.0	11250	0.5	169
			1.0	338
			2.0	675
			4.0	1350
8K, 90 FPS, Virtual Reality (Rates will exceed 200 Mbps)	200.0	90000	0.5	1350
			1.0	2700
			2.0	5400
			4.0	10800
6 Degrees Freedom VR (Rates will range 200 to 1,000 Mbps)	500.0	225000	0.5	3375
			1.0	6750
			2.0	13500
Rysavy Research			4.0	27000

[119] Rysavy Research analysis. For virtual reality-data requirements, refer to ABI Research/Qualcomm, *Augmented and Virtual Reality: the First Wave of 5G Killer Apps*, 2017. See also Netflix discussion of usage, "How can I control how much data Netflix uses?" https://help.netflix.com/en/node/87. Viewed May 3, 2016.

Spectrum Bands

3GPP technologies operate in a wide range of radio bands. As new spectrum becomes available, 3GPP updates its specifications for these bands. Although the support of a new frequency band may be introduced in a particular release, 3GPP specifies ways to implement devices and infrastructure operating on any frequency band, according to releases previous to the introduction of that particular frequency band. For example, although band 5 (US Cellular Band) was introduced in Release 6, the first devices operating on this band were compliant with the release 5 of the standard.

Table 16 shows the UMTS FDD bands.

Table 16: UMTS FDD Bands[120]

Operating Band	UL Frequencies UE Transmit, Node B Receive	DL Frequencies UE Receive, Node B Transmit
I	1920 - 1980 MHz	2110 -2170 MHz
II	1850 -1910 MHz	1930 -1990 MHz
III	1710-1785 MHz	1805-1880 MHz
IV	1710-1755 MHz	2110-2155 MHz
V	824 - 849MHz	869-894MHz
VI	830-840 MHz	875-885 MHz
VII	2500 - 2570 MHz	2620 - 2690 MHz
VIII	880 - 915 MHz	925 - 960 MHz
IX	1749.9 - 1784.9 MHz	1844.9 - 1879.9 MHz
X	1710-1770 MHz	2110-2170 MHz
XI	1427.9 - 1447.9 MHz	1475.9 - 1495.9 MHz
XII	699 - 716 MHz	729 - 746 MHz
XIII	777 - 787 MHz	746 - 756 MHz
XIV	788 - 798 MHz	758 - 768 MHz
XV	Reserved	Reserved
XVI	Reserved	Reserved
XVII	Reserved	Reserved
XVIII	Reserved	Reserved
XIX	830 – 845 MHz	875 -890 MHz
XX	832 - 862 MHz	791 - 821 MHz
XXI	1447.9 - 1462.9 MHz	1495.9 - 1510.9 MHz
XXII	3410 – 3490 MHz	3510 – 3590 MHz
XXV	1850 -1915 MHz	1930 -1995 MHz
XXVI	814-849 MHz	859-894 MHz
XXXII (NOTE 1)	N/A	1452 – 1496 MHz
NOTE 1: Restricted to UTRA operation when dual-band is configured (e.g., DB-DC-HSDPA or dual band 4C-HSDPA). The down link frequenc(ies) of this band are paired with the uplink frequenc(ies) of the other FDD band (external) of the dual band configuration.		

[120] 3GPP, *Base Station (BS) radio transmission and reception (FDD) (Release 14),* December 2016, Technical Specification 25.104, V14.1.0.

Universal Mobile Telecommunications System (UMTS) Time Division Duplex (TDD) bands are the same as the LTE TDD bands. Table 17 details the LTE Frequency Division Duplex (FDD) and TDD bands.

Table 17: LTE FDD and TDD bands[121]

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit	Downlink (DL) operating band BS transmit UE receive	Duplex Mode
	$F_{UL\ low}$ – $F_{UL\ high}$	$F_{DL\ low}$ – $F_{DL\ high}$	
1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
4	1710 MHz – 1755 MHz	2110 MHz – 2155 MHz	FDD
5	824 MHz – 849 MHz	869 MHz – 894MHz	FDD
6 (NOTE 1)	830 MHz – 840 MHz	875 MHz – 885 MHz	FDD
7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
9	1749.9 MHz – 1784.9 MHz	1844.9 MHz – 1879.9 MHz	FDD
10	1710 MHz – 1770 MHz	2110 MHz – 2170 MHz	FDD
11	1427.9 MHz – 1447.9 MHz	1475.9 MHz – 1495.9 MHz	FDD
12	699 MHz – 716 MHz	729 MHz – 746 MHz	FDD
13	777 MHz – 787 MHz	746 MHz – 756 MHz	FDD
14	788 MHz – 798 MHz	758 MHz – 768 MHz	FDD
15	Reserved	Reserved	FDD
16	Reserved	Reserved	FDD
17	704 MHz – 716 MHz	734 MHz – 746 MHz	FDD
18	815 MHz – 830 MHz	860 MHz – 875 MHz	FDD
19	830 MHz – 845 MHz	875 MHz – 890 MHz	FDD
20	832 MHz – 862 MHz	791 MHz – 821 MHz	
21	1447.9 MHz – 1462.9 MHz	1495.9 MHz – 1510.9 MHz	FDD
22	3410 MHz – 3490 MHz	3510 MHz – 3590 MHz	FDD
23[1]	2000 MHz – 2020 MHz	2180 MHz – 2200 MHz	FDD
24	1626.5 MHz – 1660.5 MHz	1525 MHz – 1559 MHz	FDD
25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	FDD
26	814 MHz – 849 MHz	859 MHz – 894 MHz	FDD
27	807 MHz – 824 MHz	852 MHz – 869 MHz	FDD
28	703 MHz – 748 MHz	758 MHz – 803 MHz	FDD
29	N/A	717 MHz – 728 MHz	FDD (NOTE 2)
30	2305 MHz – 2315 MHz	2350 MHz – 2360 MHz	FDD
31	452.5 MHz – 457.5 MHz	462.5 MHz – 467.5 MHz	FDD
32	N/A	1452 MHz – 1496 MHz	FDD (NOTE 2)
33	1900 MHz – 1920 MHz	1900 MHz – 1920 MHz	TDD
34	2010 MHz – 2025 MHz	2010 MHz – 2025 MHz	TDD
35	1850 MHz – 1910 MHz	1850 MHz – 1910 MHz	TDD
36	1930 MHz – 1990 MHz	1930 MHz – 1990 MHz	TDD
37	1910 MHz – 1930 MHz	1910 MHz – 1930 MHz	TDD
38	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	TDD
39	1880 MHz – 1920 MHz	1880 MHz – 1920 MHz	TDD
40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD
42	3400 MHz – 3600 MHz	3400 MHz – 3600 MHz	TDD
43	3600 MHz – 3800 MHz	3600 MHz – 3800 MHz	TDD
44	703 MHz – 803 MHz	703 MHz – 803 MHz	TDD
45	1447 MHz – 1467 MHz	1447 MHz – 1467 MHz	TDD
46	5150 MHz – 5925 MHz	5150 MHz – 5925 MHz	TDD (NOTE 3, NOTE 4)
47	5855 MHz – 5925 MHz	5855 MHz – 5925 MHz	TDD (NOTE 7)
48	3550 MHz – 3700 MHz	3550 MHz – 3700 MHz	TDD
65	1920 MHz – 2010 MHz	2110 MHz – 2200 MHz	FDD
66	1710 MHz – 1780 MHz	2110 MHz – 2200 MHz	FDD (NOTE 5)
67	N/A	738 MHz – 758 MHz	FDD (NOTE 2)
68	698 MHz – 728 MHz	753 MHz – 783 MHz	FDD
69	N/A	2570 MHz – 2620 MHz	FDD (NOTE 2)
70	1695 MHz – 1710 MHz	1995 MHz – 2020 MHz	FDD[6]

NOTE 1: Band 6, 23 are not applicable.
NOTE 2: Restricted to E-UTRA operation when carrier aggregation is configured. The downlink operating band is paired with the uplink operating band (external) of the carrier aggregation configuration that is supporting the configured Pcell.
NOTE 3: This band is an unlicensed band restricted to licensed-assisted operation using Frame Structure Type 3.
NOTE 4: Band 46 is divided into four sub-bands as in Table 5.5-1A.
NOTE 5: The range 2180 – 2200 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured.
NOTE 6: The range 2010-2020 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured and TX-RX separation is 300 MHz. The range 2005-2020 MHz of the DL operating band is restricted to E-UTRA operation when carrier aggregation is configured and TX-RX separation is 295 MHz.
NOTE 7: No BS requirement is defined for this band..

5G

This section provides early details on aspects of 5G, including architecture, LTE-NR coexistence, integrated access and backhaul, and performance.

Architecture

The overall 5G architecture consists of what 3GPP calls the New Generation Radio-Access Network (NG-RAN) and the 5G Core (5GC), as shown in Figure 44. The figure shows the Access and Mobility Management Function (AMF); the User Plane Function (UPF); the NR NodeB (gNB), which is the 5G base station; and the NG and Xn interfaces.

Figure 44: 5G Architecture[122]

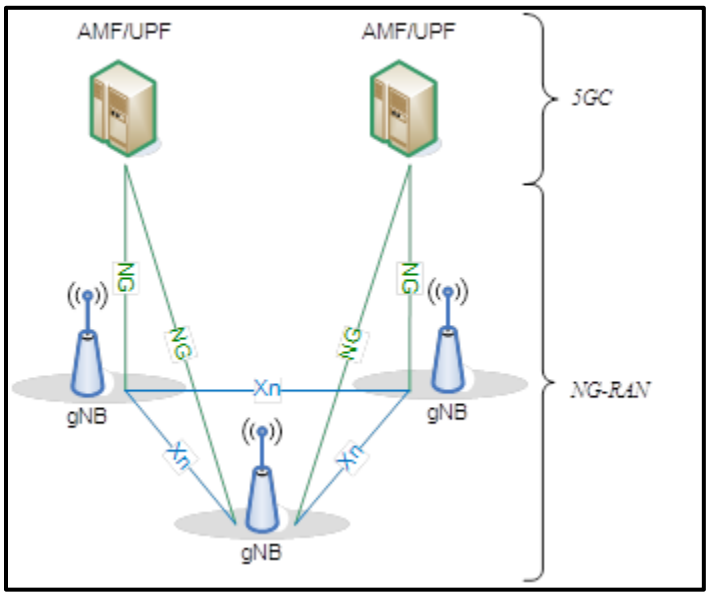

Figure 45 shows the functional split between the NG-RAN and 5GC.

[121] 3GPP, *Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception (Release 14),* March 2017, Technical Specification 36.104, V14.3.0.

[122] 3GPP, *3GPP TS 38.300, NR; NR and NG-RAN Overall Description; Stage 2 (Release 15), V0.3.0 (2017-05).*

Figure 45: Functional Split between NG-RAN and 5GC[123]

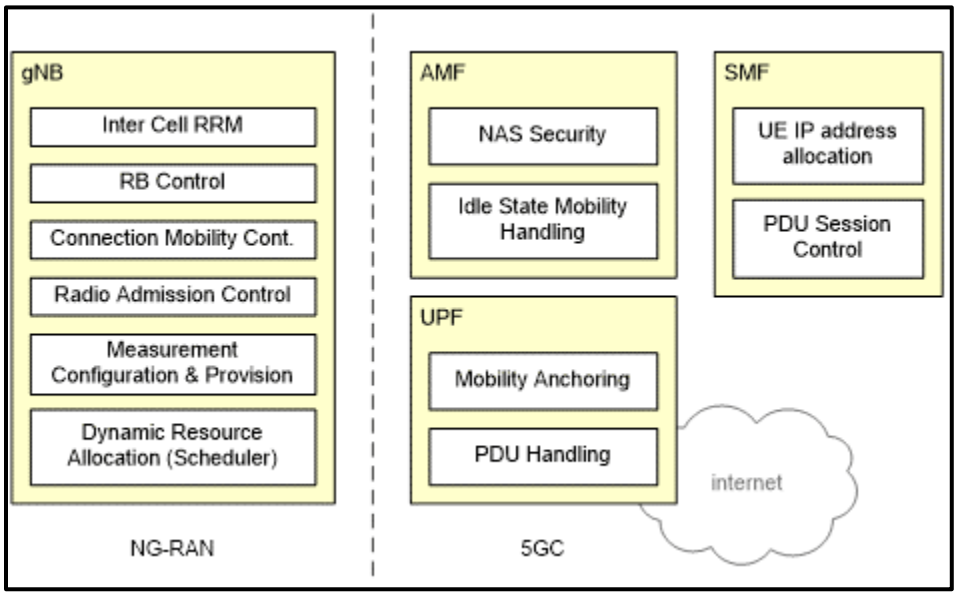

The main body of this paper summarizes the features being specified in Releases 15 and 16 for NR and the core network. Additional capabilities that will be part of Release 15 include:

- A PDCP packet duplication function to allow redundant transmission of signaling or user data on two bearer paths.
- A new protocol layer called Service Data Adaptation Protocol (SDAP) that offers 5GC QoS flows.
- A new Radio Resource Control (RRC) inactive state designed for low-latency communications.
- A new system information broadcast model that allows on-demand system information instead of always having to broadcast system information (to reduce overhead in 5G beam sweeping).

Architecture Options

This topic was introduced in the main part of the paper and is covered here in more detail. In Release 15, 3GPP defines a number of different architecture options, shown in the following three figures. In many of these options, although not all, the 5G network integrates with LTE.

[123] Ibid.

Figure 46: 5G Network Architecture Options in 3GPP Release 15[124]

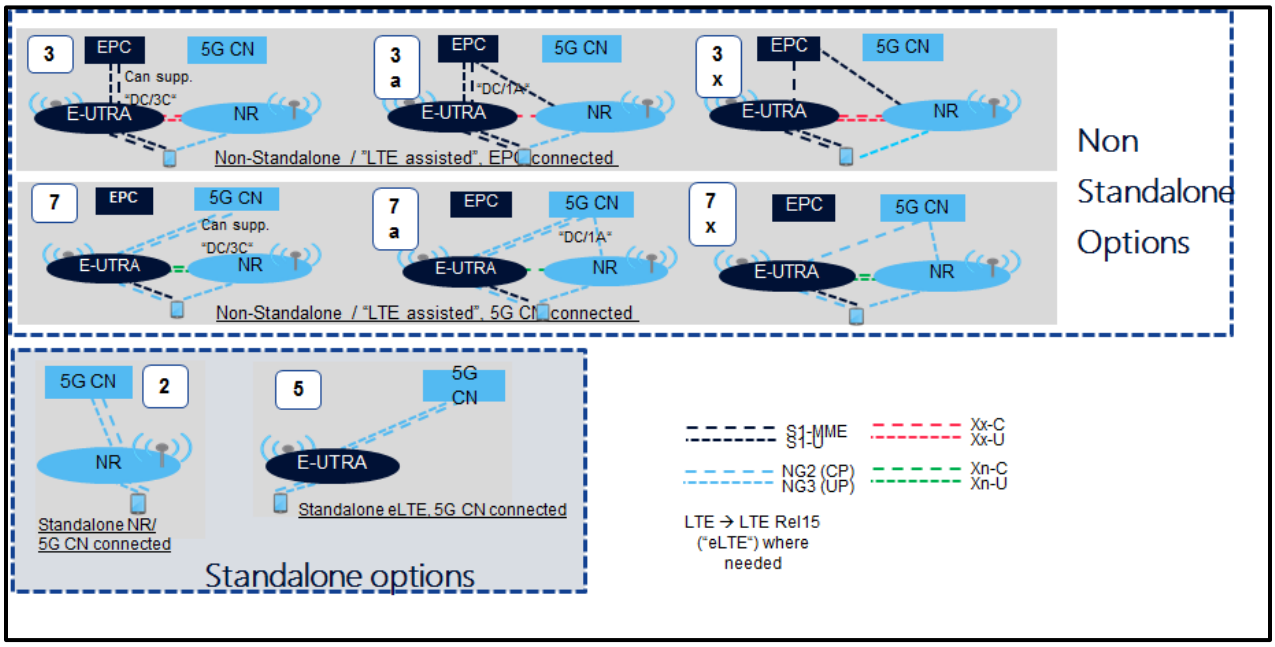

Figure 47: De-Prioritized 5G Network Architecture Options in 3GPP Release 15

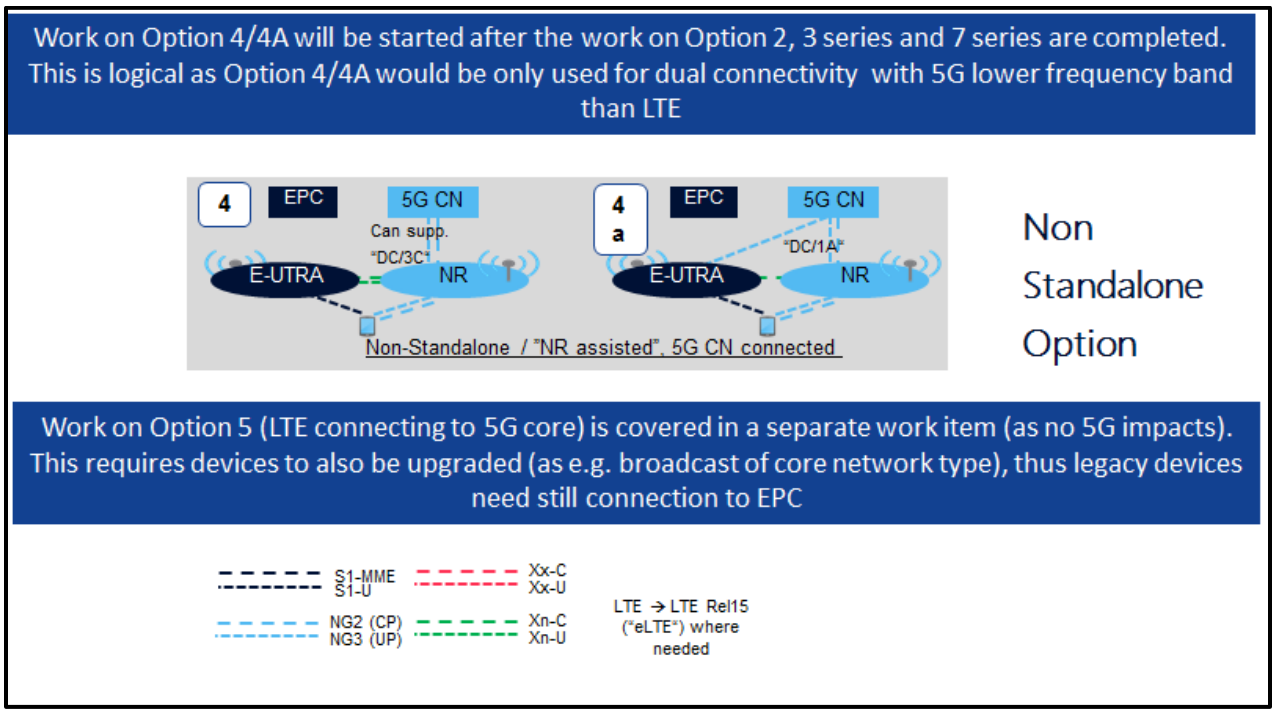

[124] Nokia contribution, including subsequent two figures. For further details, refer to section 7.2, "5G Architecture Options," 3GPP TR 38.801, "Radio access architecture and interfaces."

Figure 48: Dual-Connectivity Options with LTE as Master

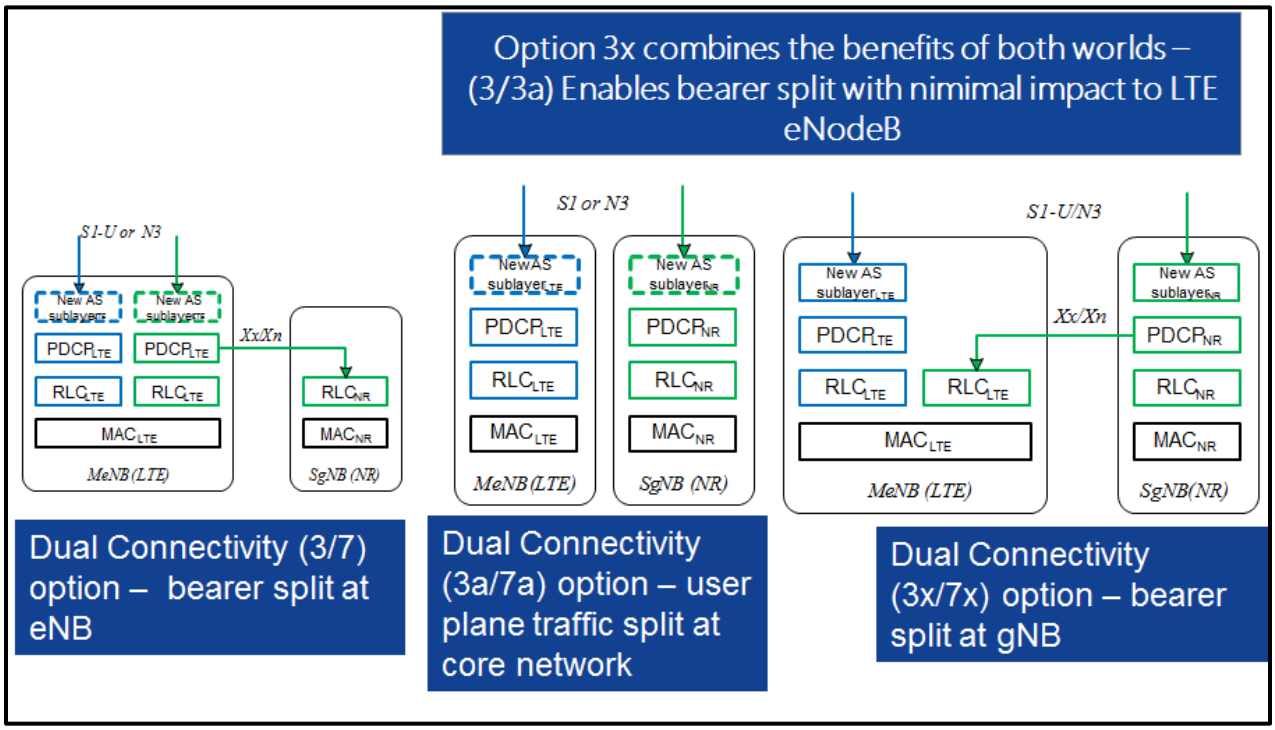

LTE-NR Coexistence

LTE-NR coexistence is a Release 15 work item. This section describes how such co-existence may be achieved. Different LTE-NR co-existence cases include the following: time domain LTE/NR adjacent channel coexistence; LTE Secondary Cell on/off for LTE/NR adaptation; in-carrier LTE+NR coexistence in downlink, and in-carrier LTE+NR coexistence in uplink.

NR coexistence is required for LTE UEs of all releases. Because carrier aggregation was not introduced into LTE until LTE Release 10, CA-based techniques cannot be used as the sole means to achieve LTE/NR coexistence. However, CA techniques can be used for both time domain coexistence and frequency domain coexistence. For time domain coexistence, on a given carrier, LTE and NR are time-multiplexed by means of Secondary Cell (SCell) activation or deactivation. For frequency domain coexistence, the network configures a carrier, such as a 20MHz carrier, into multiple carriers, with, for example, 10MHz allocated to LTE and the remaining 10MHz to NR. Note that frequency domain coexistence can be accomplished without using carrier aggregation.

Figure 49 illustrates the frequency domain technique. Note that when splitting the 20MHz carrier into two allocations of 10MHz, the LTE carrier remains centered at the same frequency and the NR allocation is not consecutive.

Figure 49: Frequency Domain Coexistence of LTE and NR[125]

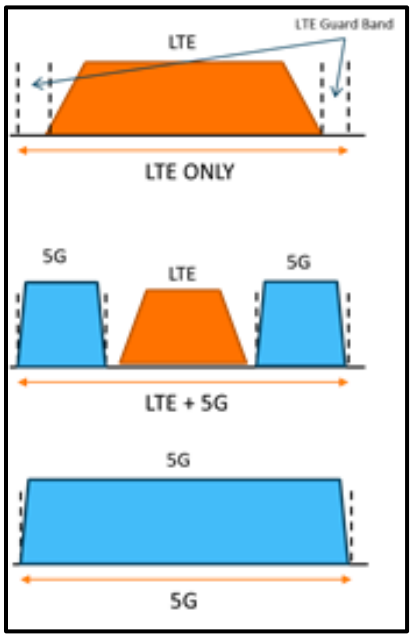

Time Domain LTE/NR Coexistence Techniques

Time domain coexistence of LTE and NR can be dynamic (subframe level) or semi-static (MAC/RRC). In the latter case, spectrum resources are configured as SCell for a LTE UE, and the network can turn these resources on or off by means of SCell activation or deactivation using MAC control elements or by adding and removing the SCell via RRC signaling. Whenever the SCell is deactivated or not configured, the spectrum resources can be used for NR transmissions. In LTE Rel. 12, small-cell enhancements were introduced that allow a UE to measure discovery reference signals (DRS) on a deactivated SCell. In that case, further coordination between LTE and NR may be required even when the SCell is deactivated, as DRS may still be transmitted periodically. Generally, though, this kind of coexistence can be achieved by network implementation.

For the case of dynamic coexistence, LTE and NR co-exist in the same spectrum, and the network can multiplex the two on a subframe level. Because LTE transmits Cell-Specific Reference Signals (CRS) in all DL subframes and in the Downlink Pilot Time Slot (DwPTS) and non-Multicast-Broadcast Single-Frequency network (non-MBSFN) region of special and MBSFN subframes, respectively, dynamic coexistence is not as straightforward as semi-static coexistence.

Similar to the case of time domain coexistence based on CA techniques, whenever OFDM symbols do not carry CRS, coexistence can be achieved by a gNB scheduler implementation. In particular, the gNB can schedule mini-slot-based transmissions in the Uplink Pilot Time Slot (UpPTS) region of a special subframe and in the MBSFN region of an MBSFN subframe, neither of which carry CRS. In LTE UL subframes, the gNB can schedule NR transmissions using either slots or mini-slots. For example, when Sounding Reference Signal (SRS) is transmitted at the end of a subframe, all 14 OFDM symbols may not be available for NR, and mini-slots can be used. Otherwise, slots can be used to transmit NR

[125] AT&T contribution, including explanatory text.

signals and channels in LTE UL subframes. Even in normal downlink subframes, mini-slots could be used to transmit NR channels and signals on OFDM symbols not carrying CRS. This, however, may leave almost half the resources of a normal DL subframe unusable for NR, so other techniques may be preferable. For example, symbols carrying CRS could also puncture NR transmissions, similar to URLLC transmissions that pre-empt NR transmissions. The same mechanisms specified for eMBB/URLLC coexistence could be used for LTE/NR coexistence.

Frequency Domain LTE/NR Coexistence Techniques

Frequency domain coexistence between LTE and NR can also be dynamic or semi-static. Semi-static FDM-based coexistence is illustrated in Figure 49. Dynamic frequency domain coexistence is possible when the (e/g) NB schedules both LTE and NR in the same subframe on a Physical Resource Block (PRB) level.

There also exists the possibility of mixing semi-static and dynamic schemes as well as time division multiplexing (TDM)- and frequency division multiplexing (FDM)-based schemes based on the duplex direction. UL resources could be dynamically shared in a TDM fashion, whereas DL resources would be semi-statically configured and frequency division multiplexed between LTE and NR. For example, LTE could operate in paired spectrum, and NR could use LTE UL resources for NR UL transmissions but be configured with a separate DL or dynamic TDD carrier, such as at a higher frequency band. In this scenario, the LTE DL would be semi-statically frequency division multiplexed with NR, but LTE UL resources would need to be dynamically shared between LTE and NR. The semi-statically frequency division multiplexed NR resources could be for DL only or for both DL and UL. For example, it could be beneficial to allow for NR SRS transmissions on the frequency division multiplexed NR-only carrier.

Several issues need to be addressed for the shared LTE UL carrier. For example, if the non-shared NR carrier operates in mmWave spectrum while the shared NR/LTE carrier operates below 6GHz, the UE does not receive NR DL signals that can be used for power control and timing advance of the NR UL transmissions in the shared LTE UL resources. In this case, NR signals may have to be sent in the LTE-only DL resources or, alternatively, the NR-only UE needs to receive and process LTE signals in the LTE-only DL carrier. To avoid NR UEs processing LTE signals or LTE eNBs transmitting NR signals, 3GPP will need to investigate whether the aforementioned problem could be solved by signaling mechanisms. Regardless, further studies are needed to address these issues.

Coordination Requirements for LTE/NR Coexistence

While semi-static techniques identified for coexistence may require minimal coordination, dynamic (for example, per-TTI) sharing can be done by coordinating the LTE and NR transmissions via three different mechanisms:

1. Co-locating the NR and LTE scheduling.
2. Via the X2 interface (or the evolved version of the X2 interface in the new RAN architecture).
3. Over-the-air.

Options 1 and 2 do not impact any RAN1 specification, whereas Option 3 requires RAN1 specifications. Also, over-the-air coordination is desirable because it does not require LTE and NR scheduling and transmission to be handled by a single eNodeB, nor does it require an ultra-low-latency transport between them, thereby providing much more deployment

flexibility. This can even allow NR and LTE to be deployed on different tiers (for example, macro and pico) and share the same channel.

Integrated Access and Backhaul

A study item for Release 15 with the likelihood of standardization in Release 16 is integrated access and backhaul, with which the 5G radio can provide both access and backhaul functions, as shown in Figure 50.

Figure 50: 5G Integrated Access and Backhaul

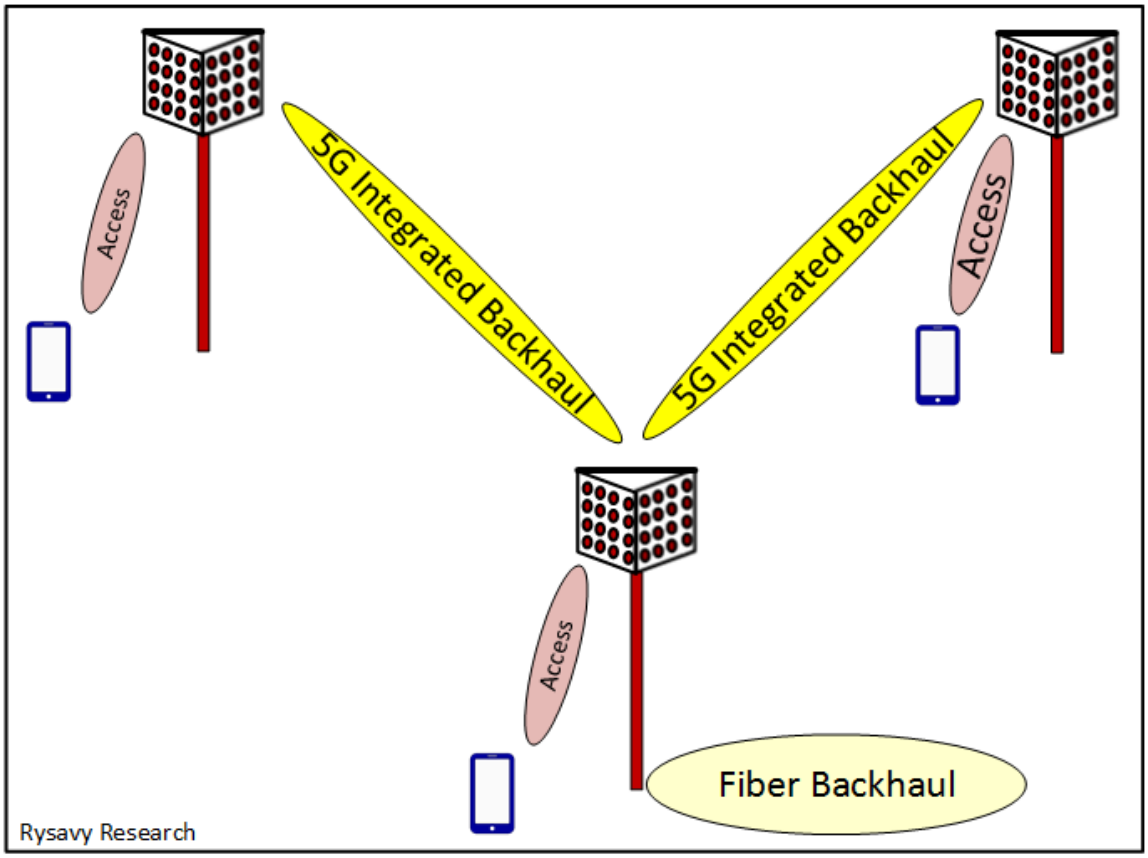

This 3GPP Study item, which has not yet begun, could address the following capabilities:[126]

- Wireless backhaul using 5G or LTE.
- Both indoor and outdoor scenarios.
- Flexible partitioning between access and backhaul functions.
- Autonomous configuration of access and wireless self-backhaul functions.
- Multi-hop wireless self-backhauling to enable flexible extension of range and coverage area.

[126] 3GPP, "Study on Integrated Access and Backhaul for NR," RP-170831, March 2017.

- Autonomous adaptation on wireless self-backhaul to minimize service disruptions.
- Topological redundant connectivity on the wireless self-backhaul to enhance reliability and capacity and to reduce latency.

Performance

5G, with the ability to use wider radio channels than LTE, will be able to deliver much higher peak and average speeds, with initial estimates listed above in the section, "Data Throughput Comparison." In the absence of deployed networks to measure, companies have performed simulations, concentrating initially on one of the first uses cases of fixed wireless access.

Figure 51 shows downlink performance for a network using different base station ISDs, and with and without foliage. The Nokia simulation used base stations with 512 antenna elements, outdoor-mounted user equipment, 28 GHz, and an 800-MHz radio channel, mostly allocated to the downlink.

Figure 51: Downlink Performance, Different ISDs, Foliage vs. None[127]

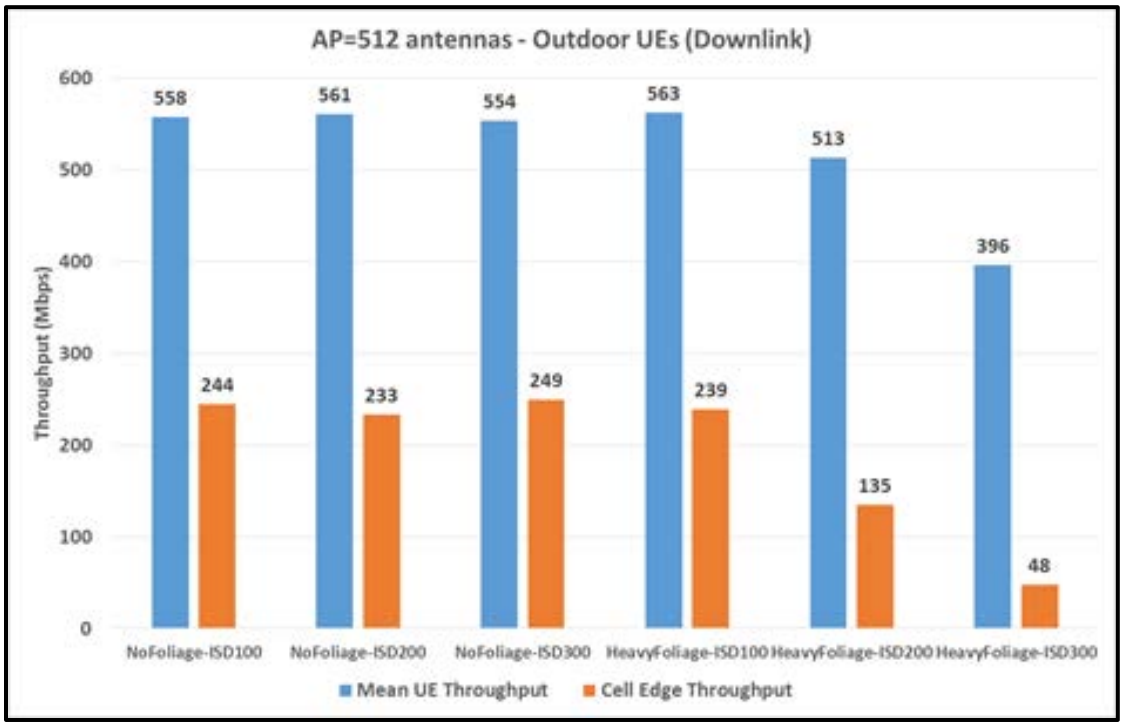

The conclusion of this simulation is that a minimum performance of 100 Mbps at the cell-edge, a 5G objective, is possible at ISDs up to 200 meters, with and without foliage.

The following three figures are from another simulation study by Ericsson, this one also for fixed-wireless access, with the following key assumptions: 350-meter ISD, 96-antenna base stations, 200 MHz radio channels, 57% allocated to downlink, 1000 homes per sq.

[127] Nokia contribution. For a full discussion, refer to the associated paper by Frederick W. Vook, Eugene Visotsky, Timothy A. Thomas, and Amitava Ghosh, Nokia Bell Labs, *Performance Characteristics of 5G mmWave Wireless-to-the-Home*, available at http://ieeexplore.ieee.org/document/7869558/.

km., 25% of homes using 4K UHD video service at 15 Mbps, building heights of 4 to 10 meters, and trees from 5 to 15 meters.

Figure 52 shows the throughputs available across the coverage area, with many locations able to receive close to 1 Gbps.

Figure 52: Throughput Map of Suburban Area at Low Load[128]

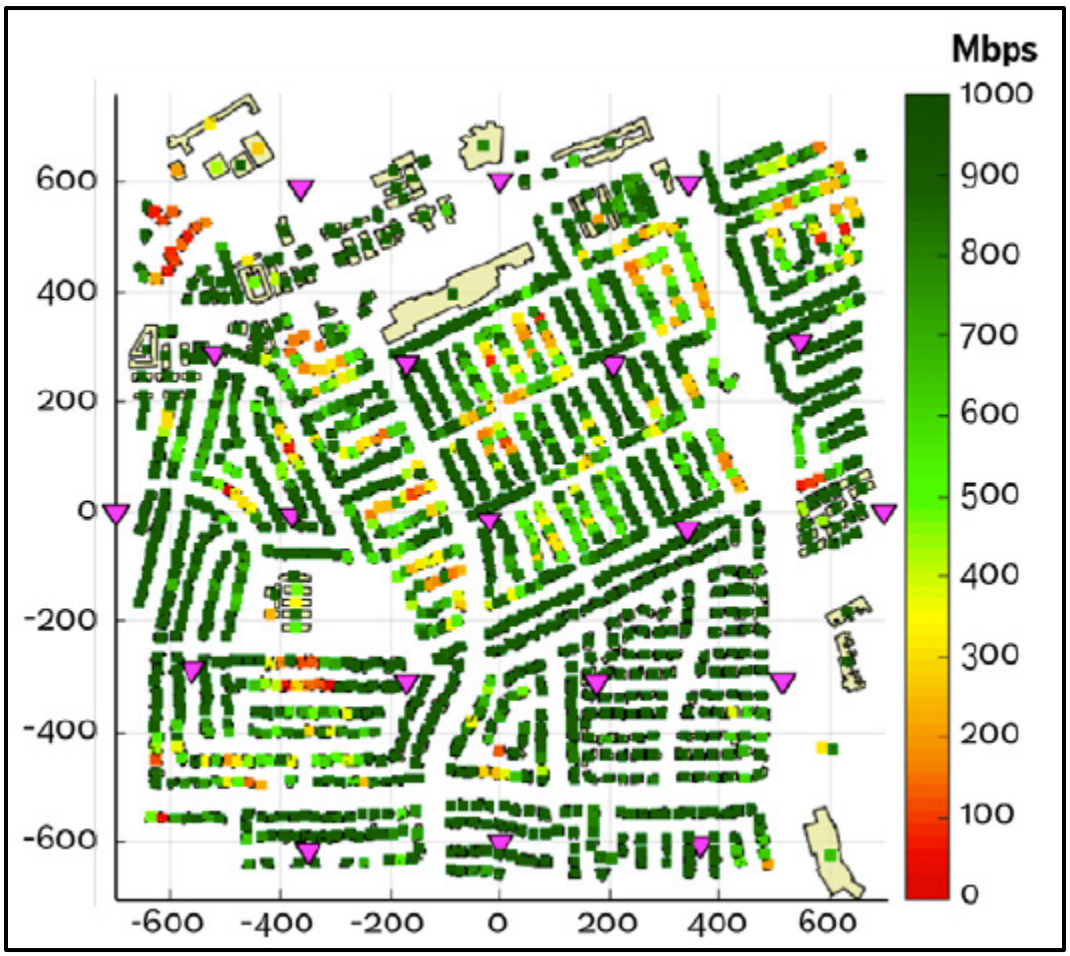

Figure 53 shows the proportion of users that can obtain 15 Mbps and 100 Mbps service relative to monthly traffic volume. Note that the system supports thousands of GBs of service per subscriber per month.

[128] Ericsson contribution, Ericsson Technical Review, *5G and Fixed Wireless Access*, 2016, available at https://www.ericsson.com/assets/local/publications/ericsson-technology-review/docs/2016/etr-5g-and-fixed-wireless-access.pdf.

Figure 53: Proportion of Satisfied Users Relative to Monthly Usage[129]

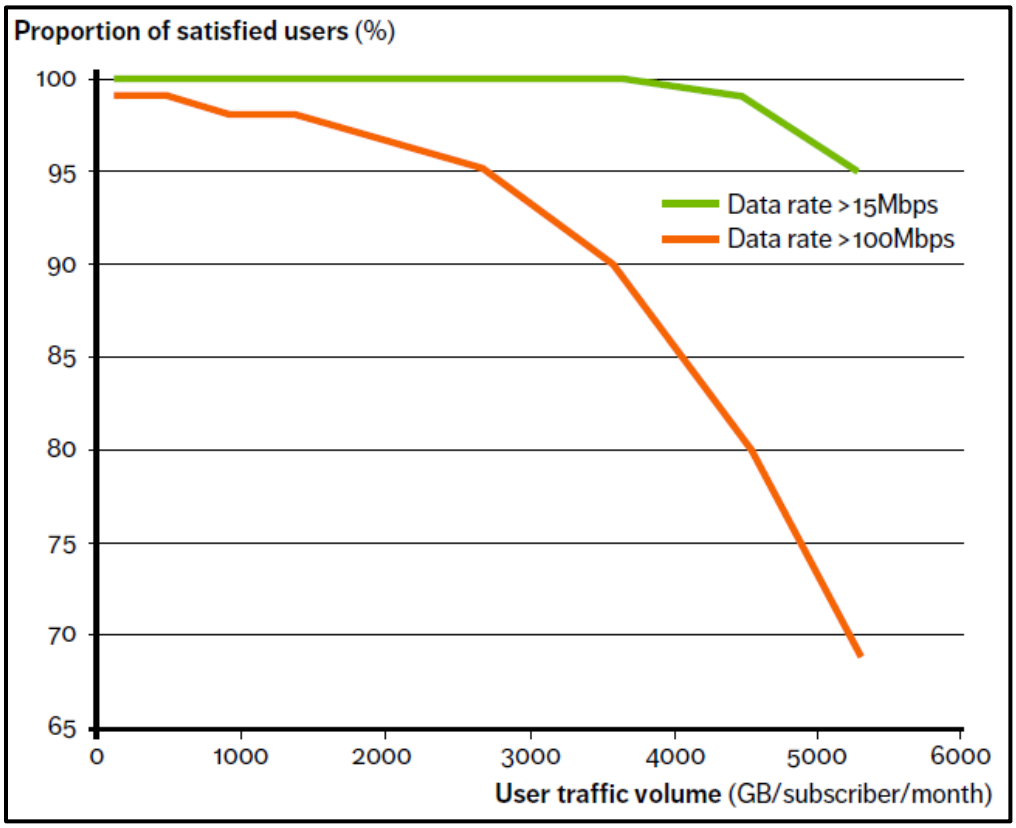

Figure 54 shows that an ISD of 350 can be used with a combination of indoor, wall-mounted, and rooftop antennas. A large percentage of users, 78%, can use indoor antennas, facilitating deployment.

Figure 54: Breakdown of Indoor, Wall-Mounted, and Rooftop Antennas[130]

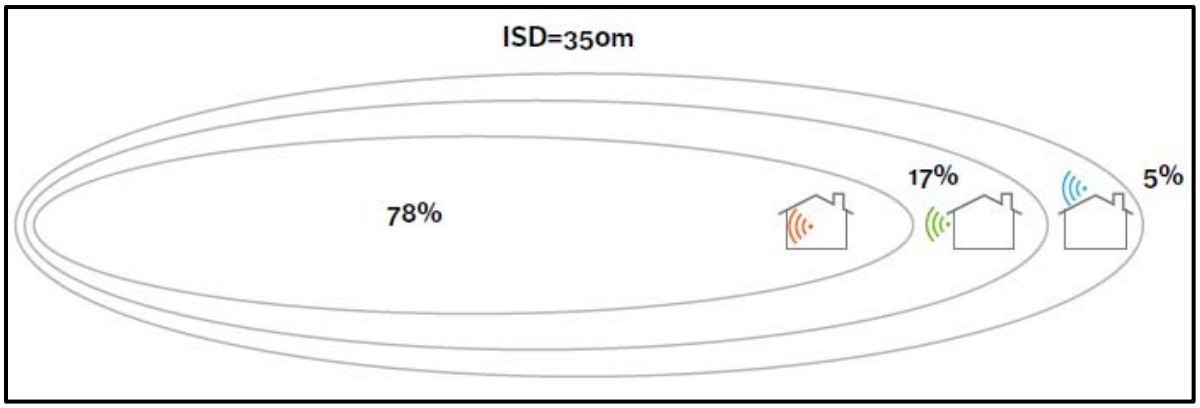

[129] Ibid.

[130] Ibid.

The simulation study shows that 5G fixed wireless access deployments using a larger ISD of 350 meters, translating to 11 base stations per square kilometer, can provide competitive broadband service.

In this environment, handsets with 5G mmWave capability will also be able to access the networks, but the antennas they use may not be as effective as the fixed-wireless equipment, so handsets may need to fall back to 4G, depending on their precise locations. For this reason, the dual-connectivity being planned for 5G will play an important role.

Figure 55 shows another simulation study, this one from Intel, using the following assumptions: 28 GHz operation, 2:1 DL:UL ratio, 25% control overhead, 10 bps/Hz maximum downlink spectral efficiency, CPEs placed either north or south side of house and one with best SNR chosen, and indoor CPE equipment with 30dB outdoor-to-indoor penetration loss. Scenario 1 is 60 access points per sq. km. Scenario 2 is 120 access points per sq. km. (Base grid of 40 houses in a 250x200m area with four rows of 10 houses per row, APs placed along streets and alleys, single-family homes, 4 sectors per AP, and 4.5-meter pole height.)

Figure 55: 5G Fixed Wireless Simulation with Different Loading and Densities[131]

DL	Scenario 1 (3 APs per 40 homes)				Scenario 2 (6 APs per 40 homes)			
	10% loading		50% loading		10% loading		50% loading	
	Cell-edge (Mbps)	Average (Mbps)	Cell-edge (Mbps)	Average (Mbps)	Cell-edge (Mbps)	Average (Mbps)	Cell-edge (Mbps)	Average (Mbps)
100 MHz, 64x8	5	200	4	160	50	290	45	230
100 MHz, 128x16	22	280	20	210	150	370	145	275
400 MHz, 128x16	88	1,120	80	840	600	1,480	580	1,100

UL	Scenario 1 (3 APs per 40 homes)				Scenario 2 (6 APs per 40 homes)			
	10% loading		50% loading		10% loading		50% loading	
	Cell-edge (Mbps)	Average (Mbps)	Cell-edge (Mbps)	Average (Mbps)	Cell-edge (Mbps)	Average (Mbps)	Cell-edge (Mbps)	Average (Mbps)
100MHz, 16x64	2	85	1	75	35	120	30	100
100MHz, 16x128	4	95	2	80	50	140	40	110
100MHz, 32x64	7	100	4	85	70	150	60	115

Using 400 MHz and six access points per 40 homes, and 50% loading, the average throughput was more than 1 Gbps.

LTE and LTE-Advanced

Although HSPA and HSPA+ offer a highly efficient broadband-wireless service that will enjoy success for the remainder of this decade and well into the next, 3GPP completed the specification for Long Term Evolution as part of Release 8. LTE offers even higher peak throughputs in wider spectrum bandwidth. Work on LTE began in 2004 with an official work item started in 2006 and a completed specification early 2009. Initial deployments began in 2010.

LTE uses OFDMA on the downlink, which is well suited to achieve high peak data rates in high-spectrum bandwidth. WCDMA radio technology is basically as efficient as OFDM for delivering peak data rates of about 10 Mbps in 5 MHz of bandwidth. Achieving peak rates

[131] Intel contribution.

in the 100 Mbps range with wider radio channels, however, would result in highly complex terminals, and it is not practical with current technology, whereas OFDM provides a practical implementation advantage. Scheduling approaches in the frequency domain can also minimize interference, thereby boosting spectral efficiency. The OFDMA approach is also flexible in channelization: LTE operates in various radio channel sizes ranging from 1.4 to 20 MHz.

On the uplink, however, a pure OFDMA approach results in high Peak to Average Ratio (PAR) of the signal, which compromises power efficiency and, ultimately, battery life. Hence, LTE uses an approach called "SC-FDMA," which is somewhat similar to OFDMA, but has a 2 to 6 dB PAR advantage over the OFDMA method used by other technologies such as WiMAX.

LTE capabilities include:

- Downlink peak data rates up to 300 Mbps with 20+20 MHz bandwidth in initial versions, increasing to over 1 Gbps in subsequent versions through carrier aggregation, higher-order modulation, and 4X4 MIMO.
- Uplink peak data rates up to 71 Mbps with 20+20 MHz bandwidth in initial versions, increasing to over 1 Gbps in subsequent versions.
- Operation in both TDD and FDD modes.
- Scalable bandwidth up to 20+20 MHz covering 1.4, 3, 5, 10, 15, and 20 MHz radio carriers.
- Increased spectral efficiency over HSPA by a factor of two to four.
- Reduced latency, to 15 msec round-trip times between user equipment and the base station, and to less than 100 msec transition times from inactive to active.
- Self-organizing capabilities under operator control and preferences that will automate network planning and will result in lower operator costs.

LTE-Advanced Terminology

LTE-Advanced, as specified in Release 10, is a term used for the version of LTE that addresses IMT-Advanced requirements. The ITU ratified LTE-Advanced as IMT-Advanced in November 2010. LTE-Advanced is both backward- and forward-compatible with LTE, meaning LTE devices operate in newer LTE-Advanced networks, and LTE-Advanced devices operate in older, pre-Release 10 LTE networks.

The following lists at a high level the most important features of LTE-Advanced, as well as other features planned for subsequent releases, including Release 11:

- Carrier aggregation.
- Higher-order downlink MIMO (up to 8X8 in Release 10).
- Uplink MIMO (two transmit antennas in the device).
- Coordinated multipoint transmission (CoMP) in Release 11.
- Heterogeneous network (HetNet) support including Enhanced Inter-cell Interference Coordination (eICIC).
- Relays.

3GPP, from Release 13, has referred to LTE as LTE-Advanced Pro, which includes features such as LAA, LWA, low latency, and massive MIMO.

OFDMA and Scheduling

LTE implements OFDM in the downlink. The basic principle of OFDM is to split a high-rate data stream into a number of parallel, low-rate data streams, each a narrowband signal carried by a subcarrier. The different narrowband streams are generated in the frequency domain, and then combined to form the broadband stream using a mathematical algorithm called an "Inverse Fast Fourier Transform" (IFFT) that is implemented in digital signal processors. In LTE, the subcarriers have 15 kHz spacing from each other. LTE maintains this spacing regardless of the overall channel bandwidth, which simplifies radio design, especially in supporting radio channels of different widths. The number of subcarriers ranges from 72 in a 1.4 MHz radio channel to 1,200 in a 20 MHz radio channel.

The composite signal obtained after the IFFT is extended by repeating the initial part of the signal (called the Cyclic Prefix [CP]). This extended signal represents an OFDM symbol. The CP is basically a guard time during which reflected signals will reach the receiver. It results in an almost complete elimination of multipath-induced Intersymbol Interference (ISI), which otherwise makes extremely high data rate transmissions problematic. The system is called orthogonal because the subcarriers are generated in the frequency domain (making them inherently orthogonal), and the IFFT conserves that characteristic.

OFDM systems may lose their orthogonal nature as a result of the Doppler shift induced by the speed of the transmitter or the receiver. 3GPP specifically selected the subcarrier spacing of 15 kHz to avoid any performance degradation in high-speed conditions. WiMAX systems that use a lower subcarrier spacing (~11 kHz) are more impacted in high-speed conditions than LTE.

Figure 56: OFDM Symbol with Cyclic Prefix

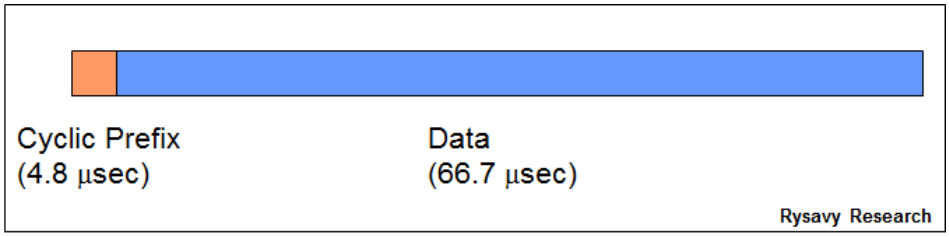

The multiple access aspect of OFDMA comes from being able to assign different users different subcarriers over time. A minimum resource block that the system can assign to a user transmission consists of 12 subcarriers over 14 symbols in 1.0 msec. Figure 57 shows how the system can assign these resource blocks to different users over both time and frequency.

Figure 57: LTE OFDMA Downlink Resource Assignment in Time and Frequency

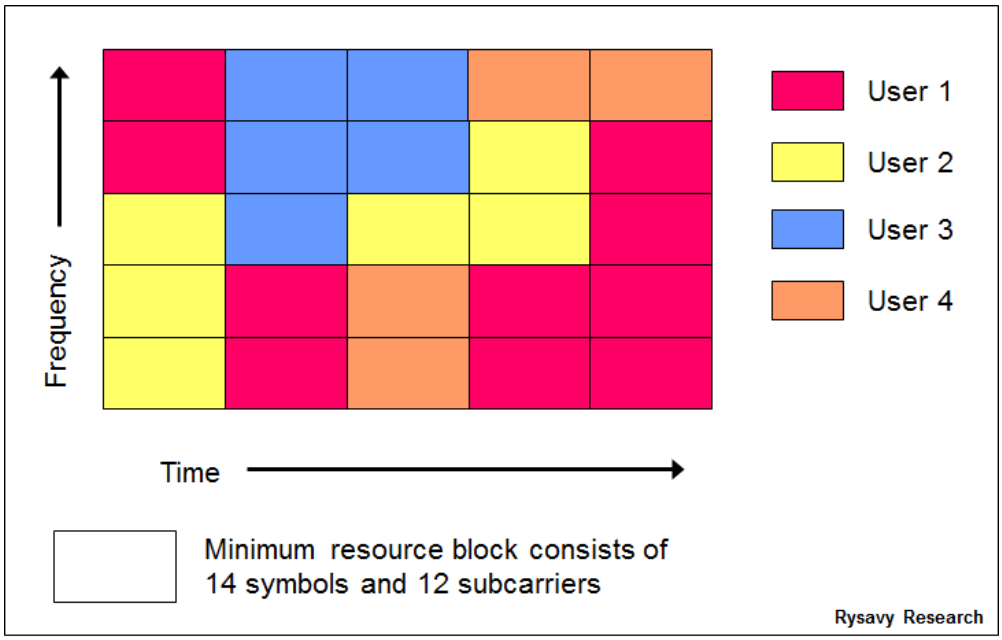

By controlling which subcarriers are assigned in which sectors, LTE can easily control frequency reuse. Using all the subcarriers in each sector, the system would operate at a frequency reuse of 1; but by using a different one third of the subcarriers in each sector, the system can achieve a looser frequency reuse of 1/3. The looser frequency reduces overall spectral efficiency but delivers high peak rates to users.

Beyond controlling frequency reuse, frequency domain scheduling, as shown in Figure 58 can use those resource blocks that are not faded, not possible in CDMA-based systems. Since different frequencies may fade differently for different users, the system can allocate those frequencies for each user that result in the greatest throughput. This results in up to a 40% gain in average cell throughput for low user speed (3 km/hour), assuming a large number of users and no MIMO. The benefit decreases at higher user speeds.

Figure 58: Frequency Domain Scheduling in LTE[132]

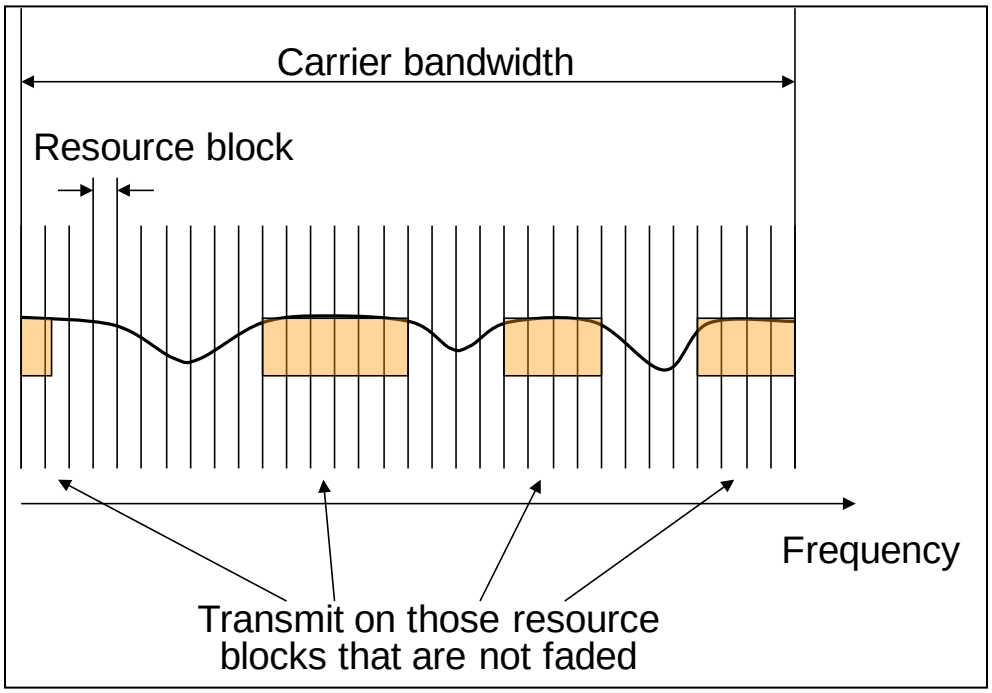

LTE Smart Antennas

Wireless networks can achieve significant gains by employing multiple antennas, either at the base station, the mobile device, or both. LTE uses multiple antennas in three fundamentally different ways:

- **Diversity.** So long as the antennas are spaced or polarized appropriately, the antennas provide protection against fading.
- **Beamforming.** Multiple antennas can shape a beam to increase the gain for a specific receiver. Beamforming can also suppress specific interfering signals. Beamforming is particularly helpful for improving cell-edge performance.
- **Spatial Multiplexing.** Often referred to as MIMO antenna processing, spatial multiplexing creates multiple transmission paths through the environment, effectively sending data in parallel through these paths, thus increasing both throughput and spectral efficiency.

Table 18 shows the varous antenna transmission modes.

[132] 5G Americas member contribution.

Table 18: LTE Transmission Modes[133]

Transmission Mode	Description
1	Single antenna transmission.
2	Transmit Diversity.
3	Transmit diversity for one layer, open-loop codebook-based precoding if more than one layer.
4	Closed-loop codebook-based precoding.
5	Multi-user MIMO version of transmission mode 4.
6	Special case of closed-loop codebook-based precoding limited to single layer transmission.
7	Beamforming. (Non-codebook-based precoding supporting one layer.)
8	Dual-layer beamforming. (Release 9. Non-codebook-based precoding supporting up to two layers.)
9	8-layer transmission. (Release 10. Non-codebook-based precoding supporting up to eight layers.)
10	8-layer transmission with support for CoMP. (Release 11.)

Being able to exploit different antenna modes based on local conditions produces huge efficiency and performance gains, and is the reason that 3GPP is developing even more advanced antenna modes in subsequent LTE releases.

Precoding refers to a mathematical matrix operation performed on radio symbols to determine how they are combined and mapped onto antenna ports. The precoder matrix can operate in either open-loop or closed-loop modes. For each transmission rank for a given number of transmission ports (antennas), there is a limited set of precoder matrices defined, called the codebook. This helps limit the amount of signaling needed on uplink and downlink.

Fundamental variables distinguish the different antenna modes:

- **Single base station antenna versus multiple antennas.** Single antennas provide for Single Input Single Output (SISO), SIMO, and planar-array beamforming. (Multiple Output means the UE has multiple antennas.) Multiple antennas at the base station provide for different MIMO modes such as 2X2, 4X2, and 4X4.

[133] Erik Dahlman, Stefan Parkvall, Johan Skold, *4G - LTE/LTE Advanced for Mobile Broadband*, Academic Press, 2011.

- **Single-user MIMO versus multi-user MIMO.** Release 8 only provides for single-user MIMO on the downlink. Release 10 includes multi-user MIMO.

- **Open-Loop versus Closed-Loop.** High vehicular speeds require open-loop operation whereas slow speeds enabled closed-loop operation in which feedback from the UE modifies the transmission. In closed-loop operation, the precoder matrix is based on this feedback.

- **Rank.** In a MIMO system, the channel rank is formally defined as the rank of the channel matrix and is a measure of the degree of scattering that the channel exhibits. For example, in a 2x2 MIMO system, a rank of one indicates a low-scattering environment, while a rank of two indicates a high-scattering environment. The rank two channel is highly uncorrelated, and is thus able to support the spatial multiplexing of two data streams, while a rank one channel is highly correlated, and thus can only support single stream transmission (the resulting multi-stream interference in a rank one channel as seen at the receiver would lead to degraded performance). Higher Signal to Interference plus Noise Ratios (SINR) are typically required to support spatial multiplexing, while lower SINRs are typically sufficient for single stream transmission. In a 4x4 MIMO system channel rank values of three and four are possible in addition to values of one and two. The number of data streams, however, or more specifically codewords in LTE is limited to a value of two. Thus, LTE has defined the concept of layers, in which the DL transmitter includes a codeword-to-layer mapping, and in which the number of layers is equal to the channel rank. An antenna mapping or precoding operation follows, which maps the layers to the antenna ports. A 4x2 MIMO system is also possible with LTE Release 8, but here the channel rank is limited to the number of UE antennas, which is equal to two.

The network can dynamically choose between different modes based on instantaneous radio conditions between the base station and the UE. Figure 59 shows the decision tree. The antenna configuration (AC) values refer to the transmission modes. Not every network will support every mode. Operators will choose which modes are the most effective and economical. AC2, 3, 4, and 6 are typical modes that will be implemented.

Figure 59: Decision Tree for Different Antenna Schemes[134]

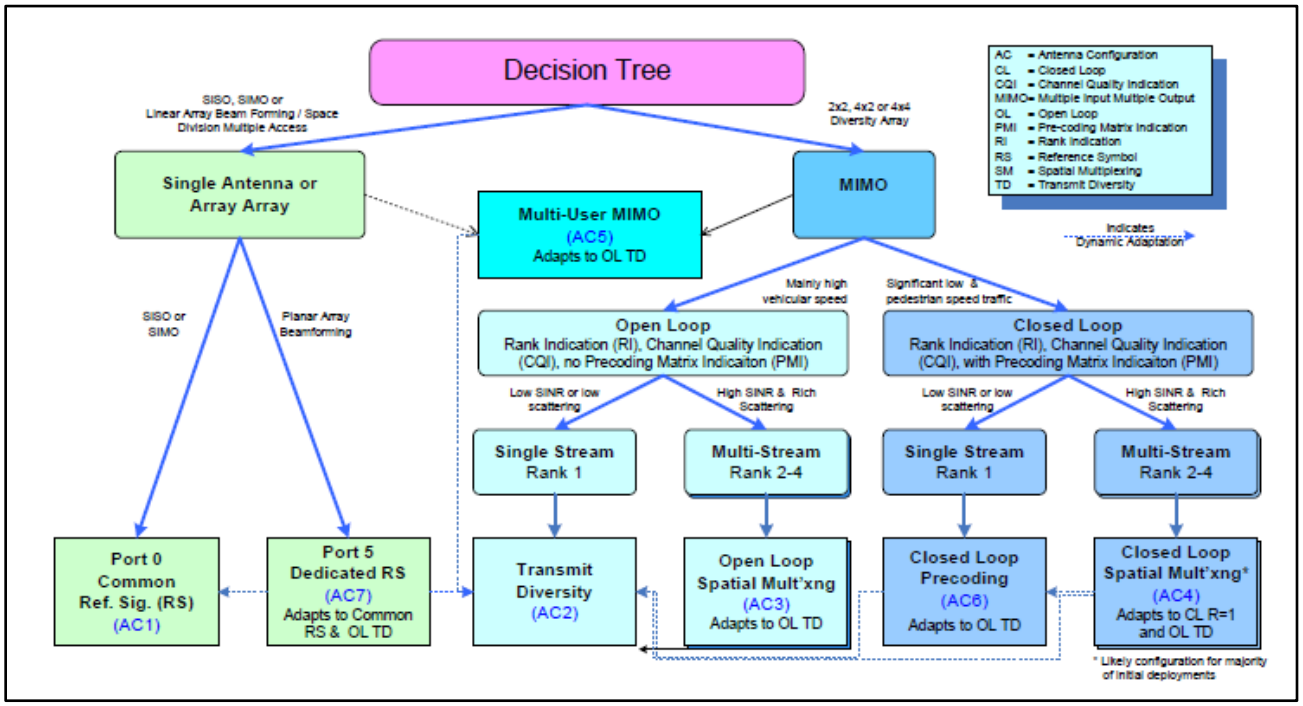

The simplest mode is AC2, referred to as Transmit Diversity (TD) or sometimes Space Frequency Block Code (SFBC) or even Open Loop Transmit Diversity. TD can operate under all conditions, meaning it works under low SINR, high mobility, and low channel rank (rank = 1). This rank means that the channel is not sufficiently scattered or de-correlated to support two spatial streams. Thus, in TD, only one spatial stream or what is sometimes referred as a single codeword (SCW) is transmitted. If the channel rank increases to a value of two, indicating a more scattered channel, and the SINR is a bit higher, then the system can adapt to AC3 or Open-Loop Spatial Multiplexing (OL-SM), also referred to as large-delay Cyclic Delay Diversity (CDD). This mode supports two spatial streams or two codewords. This mode, also called multiple codeword (MCW) operation, increases throughput over SCW transmission.

If the rank of the channel is one, but the device is not moving very fast or is stationary, then the system can adapt to AC6, called closed-loop (CL) precoding (or CL-rank 1 or CL-R1). In this mode, the network receives from the device with Precoding Matrix Indication (PMI) bits that inform the base station what precoding matrix to use in the transmitter to optimize link performance. This feedback is only relevant for low-mobility or stationary conditions since in high mobility conditions the feedback will most likely be outdated by the time the base station can use it.

Another mode is AC4 or Closed Loop Spatial Multiplexing (CL-SM), which is enabled for low-mobility, high SINR, and channel rank of two. This mode theoretically provides the best user throughput. The figure above shows how these modes can adapt downwards to either OL TD, or if in CL-SM mode, down to either OL TD or CL R1.

[134] 4G Americas *MIMO and Smart Antennas for 3G and 4G Wireless Systems – Practical Aspects and Deployment Considerations*, May 2010.

For a 4x4 MIMO configuration, the channel rank can take on values of three and four in addition to one or two. Initial deployment at the base station, however, will likely be two TX antennas and most devices will only have 2 RX antennas, and thus the rank is limited to 2.

AC5 is MU-MIMO, which is not defined for the downlink in Release 8.

AC1 and AC7 are single antenna port modes in which AC1 uses a common Reference Signal (RS), while AC7 uses a dedicated RS or what is also called a user specific RS. AC1 implies a single TX antenna at the base station. AC7 implies an antenna array with antennal elements closely spaced so that a physical or spatial beam can be formed toward an intended user.

LTE operates in a variety of MIMO configurations. On the downlink, these include 2X2, 4X2 (four antennas at the base station), and 4X4. Initial deployment will likely be 2x2 whereas 4X4 will be most likely used initially in femtocells. On the uplink, there are two possible approaches: single-user MIMO (SU-MIMO) and multi-user MIMO (MU-MIMO). SU-MIMO is more complex to implement as it requires two parallel radio transmit chains in the mobile device, whereas MU-MIMO does not require any additional implementation at the device but relies on simultaneous transmission on the same tones from multiple mobile devices.

The first LTE Release thus incorporates MU-MIMO with SU-MIMO deferred for subsequent LTE releases. An alternate form of MIMO, originally called network MIMO, and now called CoMP, relies on MIMO implemented (on either the downlink or uplink or both) using antennas across multiple base stations, as opposed to multiple antennas at the same base station. This paper explains CoMP in the section on LTE Advanced below.

Peak data rates are approximately proportional to the number of send and receive antennas. 4X4 MIMO is thus theoretically capable of twice the data rate of a 2X2 MIMO system. The spatial multiplexing MIMO modes that support the highest throughput rates will be available in early deployments.

For a more detailed discussion of 3GPP antenna technologies, refer to the 5G Americas white paper “MIMO and Smart Antennas for 3G and 4G Wireless Systems – Practical Aspects and Deployment Considerations,” May 2010.

For advancements in LTE Smart Antennas, see the next section.

LTE-Advanced Antenna Technologies

Release 10 added significant enhancements to antenna capabilities, including four-layer transmission resulting in peak spectral efficiency exceeding 15 bps/Hz. Uplink techniques fall into two categories: those relying on channel reciprocity and those that do not. With channel reciprocity, the eNB determines the channel state by processing a Sounding Reference Signal from the UE. It then forms transmission beams accordingly. The assumption is that the channel received by the eNB is the same as the UE. Techniques that use channel reciprocity are beamforming, SU-MIMO, and MU-MIMO. Channel reciprocity works especially well with TDD since both forward and reverse links use the same frequency.

Non-reciprocity approaches apply when the transmitter has no knowledge of the channel state. Techniques in this instance include open-loop MIMO, closed-loop MIMO, and MU-MIMO. These techniques are more applicable for higher speed mobile communications.

For the downlink, the technology can transmit in as many as eight layers using an 8X8 configuration for a peak spectral efficiency of 30 bps/Hz. This exceeds the IMT-Advanced requirements, conceivably supporting a peak rate of 1 Gbps in just 40+40 MHz, and even higher rates in wider bandwidths. This would require additional reference signals for channel estimation and for measurements, including channel quality, to enable adaptive, multi-antenna transmission.

Release 10 supports a maximum of two codewords, the same as previous LTE releases. The release specifies a new transmission mode (TM-9) that supports SU-MIMO up to Rank 8 (up to eight layers), as well as the ability to dynamically switch between SU-MIMO and MU-MIMO.

Figure 60 shows the different forms of single-user MIMO in Releases 8, 9, and 10. Release 8 supports only a single layer, whereas two-layer beamforming is possible in Release 9, and eight layers are possible in Release 10 with eight antennas at the base station.

Figure 60: Single-User MIMO[135]

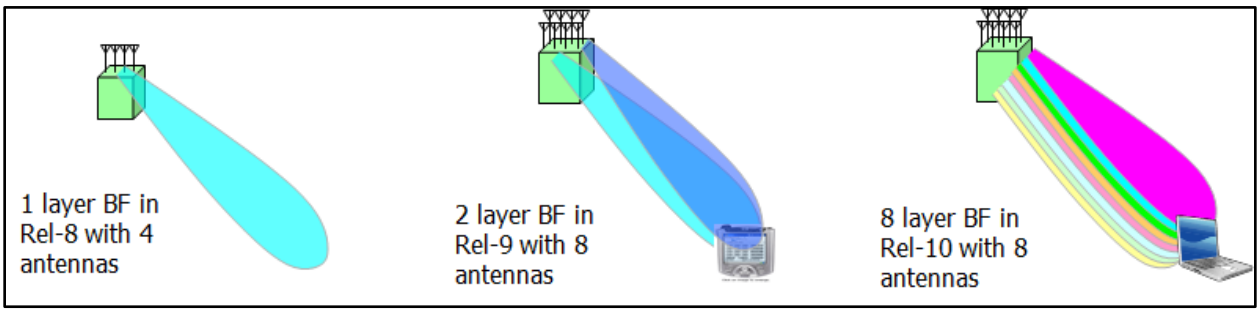

Figure 61 shows multi-user MIMO options across different releases. Release 8 supports two simultaneous users, each with one layer using four antennas, while Releases 9 and 10 support four simultaneous users, each with one layer.

Figure 61: Multi-User MIMO[136]

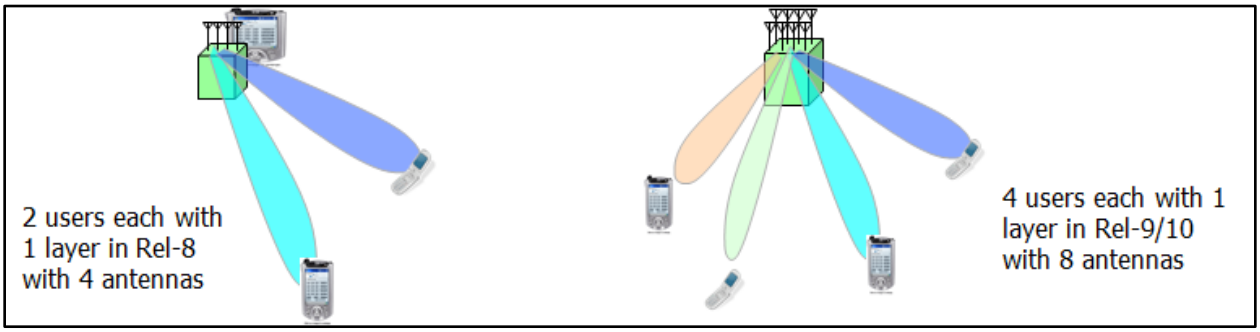

For four-antenna configurations at the base station, Release 12 improves throughput by adding a feedback mode, called mode 3-2, in which sub-band precoders and sub-band

[135] 5G Americas member contribution.

[136] 5G Americas member contribution.

channel quality indicators (CQIs) are included in the UE's feedback to the eNodeB. Release 12 also adds a new codebook that further improves throughput.

As depicted in Figure 62 and Figure 63, compared with the Release 8 codebook, the new Release 12 codebook provides a 10% gain for both median and cell-edge throughputs. Compared with feedback mode 3-1, feedback mode 3-2 provides an 18% to 20% gain in median and cell-edge throughput. Jointly, the two methods provide a 28% to 30% gain.

Figure 62: Median Throughput of Feedback Mode 3-2 and New Codebook.[137]

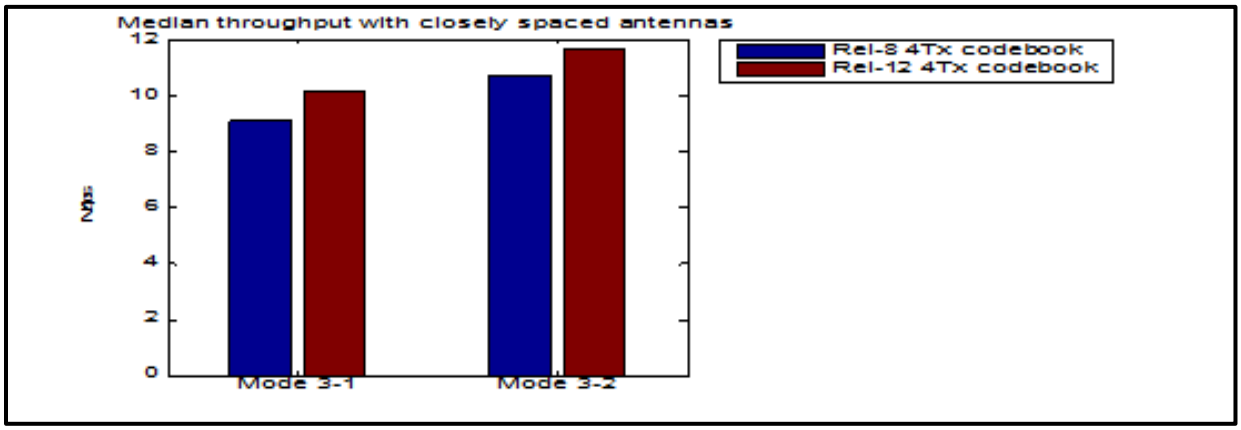

Figure 63: Cell-Edge Throughput of Feedback Mode 3-2 and New Codebook[138]

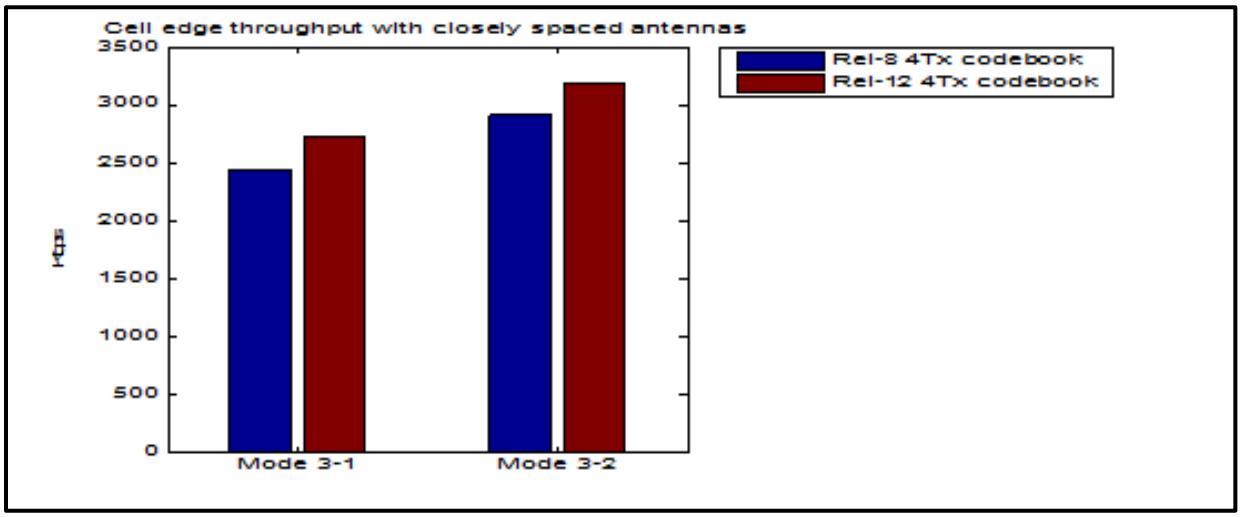

Release 12 also defines how Active Antenna Systems can use multiple transceivers on an antenna array to dynamically adjust a radiation pattern.

[137] 5G Americas member contribution. Assumptions include: cellular layout of 19 sites hexagonal grid with three sectors per site and 500-meter inter-site distance; simulation case ITU uMa for macro; carrier frequency 2 GHz, deployment scenario A homogenous macro; SU-MIMO with maximum two layers per UE; proportional fair scheduler; and bursty traffic model.

[138] 5G Americas member contribution. Same assumptions as previous figure.

Release 13 is likely to define full-dimension MIMO, which adds a large number of antenna elements, potentially as many as 64 elements.

A practical consideration with antennas is that many towers today already support multiple operators, with tower companies having to manage interference placement, spectrum allocations, and wind and snow load. At higher frequencies, a single radome (antenna enclosure) can support 4X2 MIMO, but higher-order MIMO may prove impractical for many deployments.

5G systems operating at much higher frequencies will have an advantage since the antenna arrays will be much smaller due to the much smaller wavelengths.

Initial massive MIMO techniques applied to LTE, such as full-dimension MIMO using 8, 16, and 64 transmit antennas, can provide dramatic performance gains, particularly in dense deployments, as shown in Figure 64.

Figure 64: Performance Gains with FD-MIMO Using 200 Meter ISD[139]

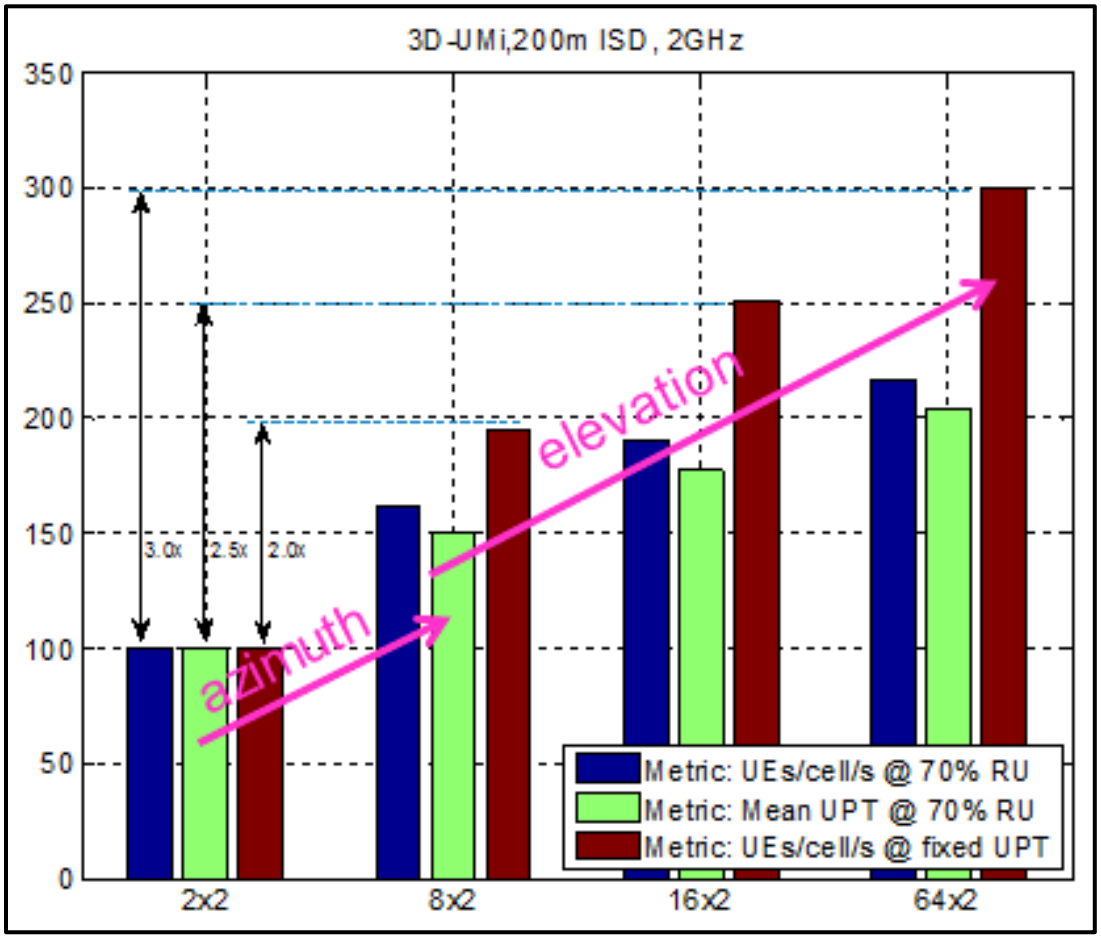

This figure compares 8X2, 16X2, and 64X2 MIMO performance relative to 2X2 MIMO (normalized to value 100). The blue bars (case 1) show the supported number of users per sector (referred to as "cell" in the figure) at a fixed resource utilization (RU) of 70%; the

[139] 5G Americas member contribution.

green bars (case 2) show mean user throughput (UPT) at a fixed RU of 70%; and the red bars (case 3) show system capacity in terms of supported number of users for a given user throughput. Resulting gains are:

- Case 2 (green bars): 1.5X with 8X2, 1.75X with 16X2, and 2X with 64X2 MIMO.
- Case 3 (red bars): 2X with 8X2, 2.5X with 16X2, and 3X with 64X2 MIMO.

The primary gains are from azimuth (horizontal dimension) in going from 2X2 to 8X2, and from elevation in going to 16X2 and 64X2. FD-MIMO gains are lower with larger ISD values, such as 500 meters.

3GPP has also studied FD-MIMO and conducted a field trial showing impressive throughput gains, particularly in a high-rise scenario.[140]

Carrier Aggregation

Carrier aggregation, first available in Release 10, plays an important role in providing operators maximum flexibility for using all of their available spectrum. By combining spectrum blocks, LTE can deliver much higher throughputs than otherwise possible. Asymmetric aggregation (for example, different amounts of spectrum used on the downlink versus the uplink) provides further flexibility and addresses the greater demand on downlink traffic.

Specific types of aggregation include:

- Intra-band on adjacent channels.
- Intra-band on non-adjacent channels.
- Inter-band (700 MHz, 1.9 GHz).
- Inter-technology (for example, LTE on one channel, HSPA+ on another). This approach is not currently specified nor being developed. While theoretically promising, a considerable number of technical issues would have to be addressed.[141] See Figure 65.

[140] 3GPP, *3D-MIMO Prototyping and Initial Field Trial Results*, TSG RAN WG1 Meeting #80, Agenda Item: 7.2.4.4, Document R1-150451.

[141] For further details, see 4G Americas, *HSPA+ LTE Carrier Aggregation*, June 2012.

Figure 65: Inter-Technology Carrier Aggregation[142]

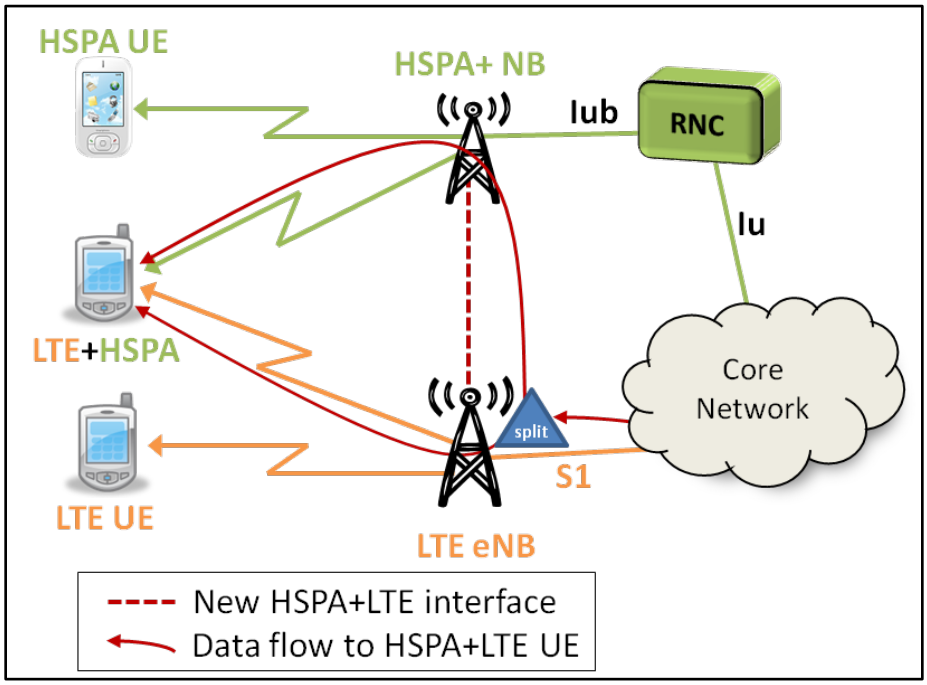

Figure 66 depicts the carrier-aggregation capabilities of different 3GPP releases.

[142] 5G Americas member contribution.

Figure 66: Carrier Aggregation Capabilities across 3GPP Releases[143]

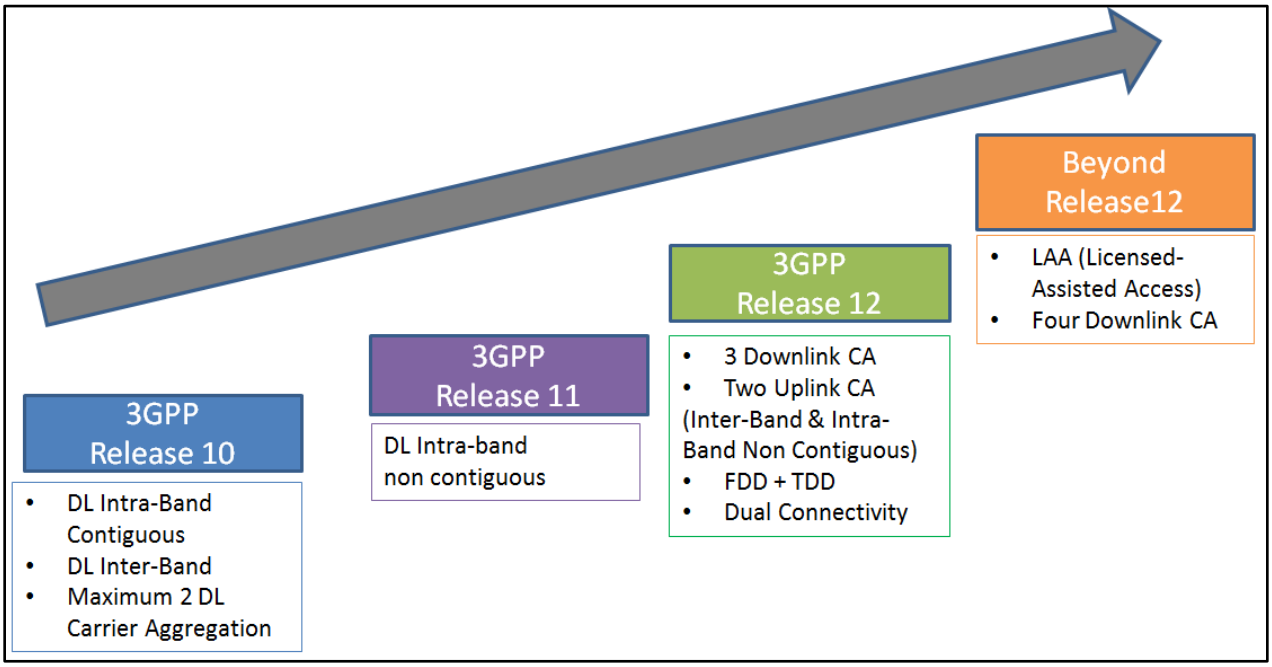

One anticipated benefit of inter-band aggregation stems from using the lower-frequency band for users who are at the cell edge, to boost their throughput rates. Though this approach improves average aggregate throughput of the cell by only a small amount (say, 10%), it results in a more uniform user experience across the cell coverage area.

Figure 67 shows an example of intra-band carrier aggregation using adjacent channels with up to 100+100 MHz of bandwidth supported. Radio-access network specifications, however, limit the number of carriers to two in Release 10 and Release 11.

Figure 67: Release 10 LTE-Advanced Carrier Aggregation[144]

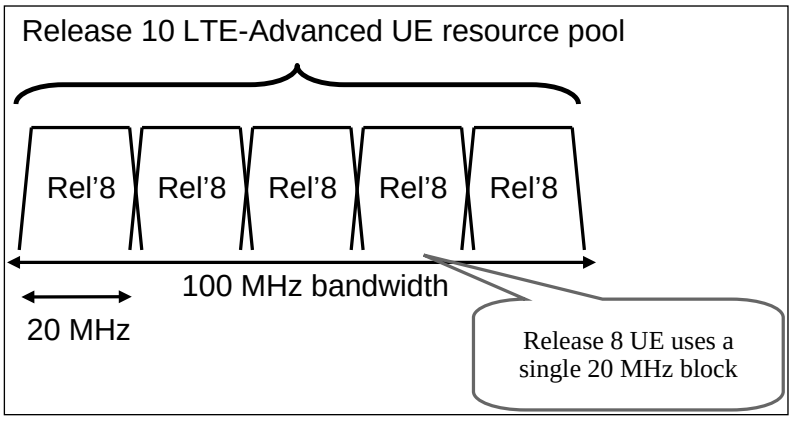

[143] 4G Americas, *Mobile Broadband Evolution: Rel-12 & Rel-13 and Beyond*, 2015.

[144] Harri Holma and Antti Toskala, *LTE for UMTS, OFDMA and SC-FDMA Based Radio Access*, Wiley, 2009.

Figure 68 shows the carrier aggregation operating at different protocol layers.

Figure 68: Carrier Aggregation at Different Protocol Layers[145]

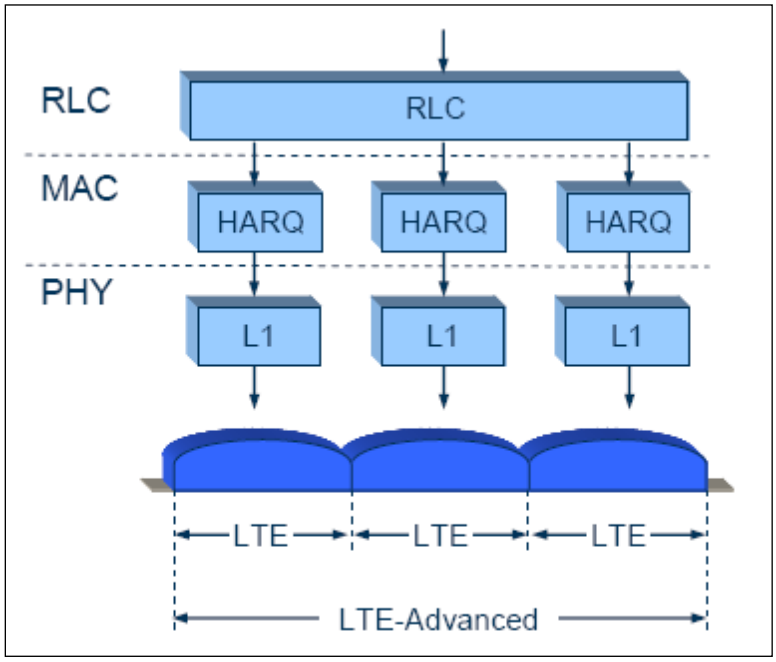

For a list of band combinations, refer to the 5G Americas white paper, *Wireless Technology Evolution Towards 5G: 3GPP Release 13 to Release 15 and Beyond,* February 2017, at section 3.4.3.

Figure 69 shows the result of one simulation study that compares download throughput rates between the blue line, which shows five user devices in 700 MHz and five user devices in AWS not using CA, and the pink line, which shows ten user devices that have access to both bands. Assuming a lightly loaded network with CA, 50% or more users (the median) experience 91% greater throughput, and 95% or more users experience 50% greater throughput. These trunking gains are less pronounced in heavily loaded networks.

[145] Stefan Parkvall and David Astely, Ericsson Research, "The Evolution of LTE towards IMT-Advanced," Journal of Communications, Vol. 4, No. 3, April 2009. Available at http://www.academypublisher.com/jcm/vol04/no03/jcm0403146154.pdf.

Figure 69: Gains from Carrier Aggregation[146]

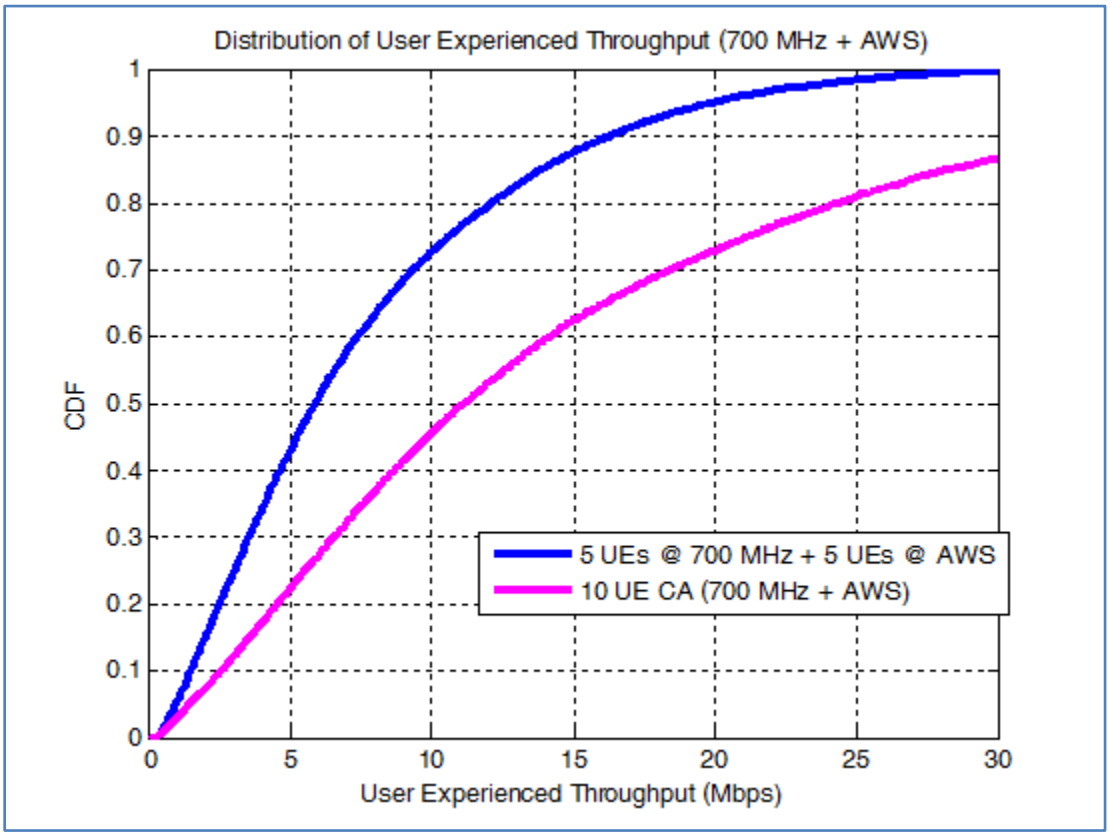

Work in Release 12 is investigating aggregation of joint TDD and FDD carriers.

Coordinated Multi Point (CoMP)

Coordinated Multi Point (CoMP) is a communications technique that can improve coverage, cell-edge throughput, and/or system spectrum efficiency by reducing interference. This technique was thoroughly studied during the development of LTE-Advanced Release 10 and was standardized in Release 11.

CoMP coordinates transmissions at different cell sites, thereby achieving higher system capacity and improving cell-edge data rates.

The main principle of CoMP is that a UE at a cell edge location can receive signals from multiple transmission points, and/or its transmitted signal can be received by multiple reception points. Consequently, if these multiple transmission points coordinate their transmissions, the DL throughput performance and coverage can improve.

For the UL, signals from the UE received at multiple reception points can significantly improve the link performance. Techniques can range from simple interference avoidance methods, such as Coordinated Beam Switching (CBS) and Coordinated Beam Forming

[146] 5G Americas member contribution. Assumptions: lightly-loaded network, 2.0 site-to-site distance, file size is 750 Kbytes, traffic model bursty with mean inter-arrival time of five seconds.

(CBF), to complex joint processing techniques that include Joint Transmission (JT), Joint Reception (JR), and Dynamic Point Selection (DPS).

CoMP architectures include inter-site CoMP, intra-site CoMP, as well as CoMP with distributed eNBs (i.e., an eNB with distributed remote radio heads). Figure 70 shows two possible levels of coordination.

Figure 70: Different Coordination Levels for CoMP[147]

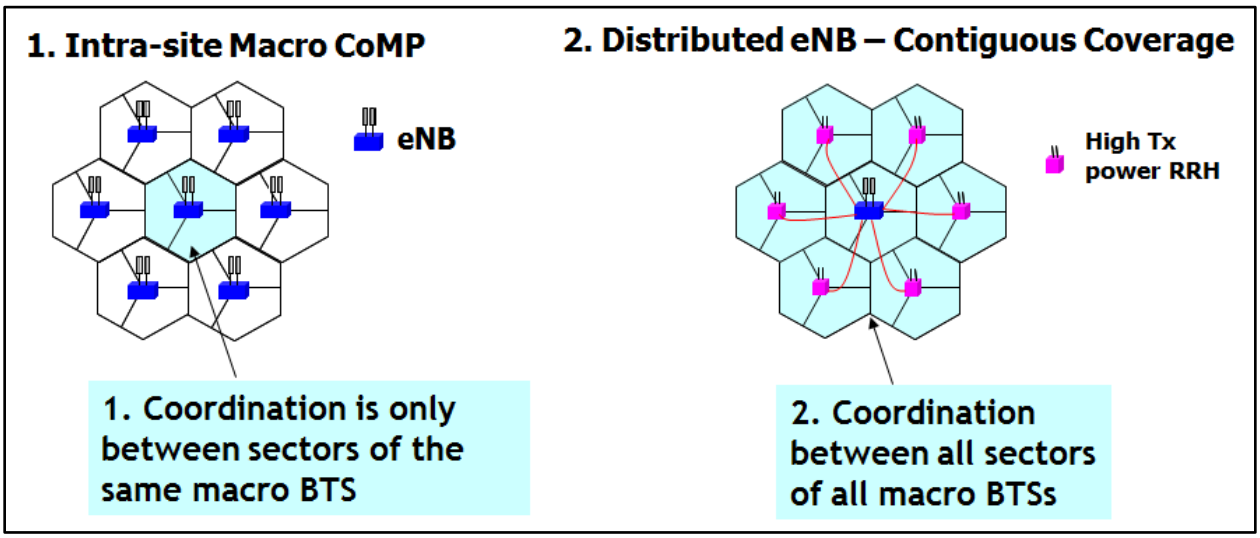

In one CoMP approach, called coordinated scheduling and shown in Figure 71, a single site transmits to the user, but with scheduling, including any associated beamforming, coordinated between the cells to reduce interference between the different cells and to increase the served user's signal strength. In Joint Transmission, another CoMP approach also shown in Figure 71, multiple sites transmit simultaneously to a single-user. This approach can achieve higher performance than coordinated scheduling, but it has more stringent backhaul communications requirements. One simpler form of CoMP that will be available in Release 10, and then further developed in Release 11, is ICIC. Release 11 of LTE defines a common feedback and signaling framework for enhanced CoMP operation.

Figure 71: Coordinated Scheduling / BF and Joint Processing CoMP Approaches[148]

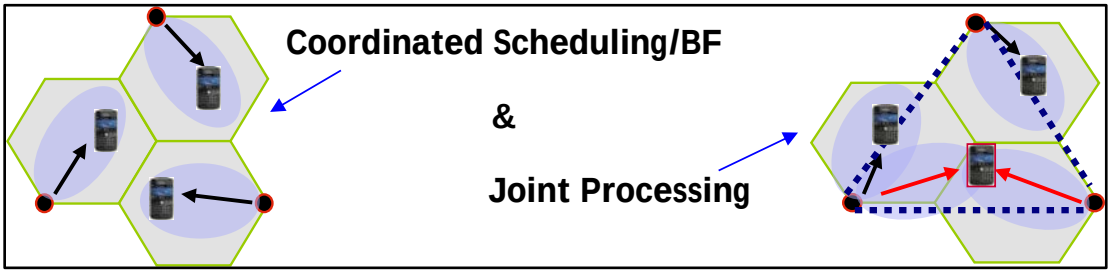

[147] 5G Americas member contribution.

[148] 5G Americas member contribution.

Release 11 also implements CoMP on the uplink, by which multiple base stations receive uplink transmissions and jointly process the signal, resulting in significant interference cancellation and improvements to spectral efficiency.

The performance gains expected from CoMP are under discussion in the industry. According to 3GPP document TR 36.819, for the case of resource utilization below 35%, CoMP may provide a 5.8% performance gain on the downlink for the mean user and a 17% gain for cell-edge users relative to HetNets without eICIC. For resource utilization of more than 35%, CoMP may provide a 17% mean gain and a 40% cell-edge gain.[149] CoMP can also be used in combination with eICIC for additional gains.

In the same 3GPP TR 36.819 document, 3GPP estimates the downlink CoMP gain in spectral efficiency, defined as average sector throughput for full buffer traffic using JT and 4x2 MU-MIMO as defined in R11, compared with 4x2 MU-MIMO based on R10, to be about 3% for intra-eNodeB CoMP. That gain drops to about 9% for inter-eNodeB CoMP in the case of no delay in the backhaul used to exchange information between eNodeBs. The corresponding gains in cell-edge user throughput are 20% and 31%, respectively.

When increasing the backhaul latency to a more realistic value of 10 msec for inter-eNodeB, spectral efficiency decreases to zero, and the cell edge gain decreases to 10%.

The gains for DL CoMP based on Coordinated Scheduling/Coordinated Beamforming (CS/CB) and intra-eNodeB are less than that provided by JT, with spectral efficiency at 1% and cell edge gains at 4%.

All of the above gains are for FDD networks with cross-polarized antennas at the eNodeBs. For TDD networks, the gains are higher by virtue of being able to invoke channel reciprocity and thus infer the DL channel directly from the UL channel. For example, for intra-eNodeB CoMP with JT 4x2 MU-MIMO, the respective gains in spectral efficiency and cell-edge throughput are 14% and 29%, respectively.

The gains for UL CoMP based on Joint Reception (JR) are greater than the DL gains. For intra-eNodeB CoMP, the average and cell-edge throughputs are increased to 22% and 40%, assuming two receive antenna paths with SU-MIMO. These respective gains increase to 31% and 66% for inter-eNodeB CoMP. In addition, UL CoMP does not require standardization and thus facilitates vendor implementation.

Uplink CoMP assists VoLTE because it improves cell-edge performance, making voice handover more reliable when traversing between cells. The benefit is analogous to CDMA soft handover; in both cases, the mobile device communicates with two sites simultaneously.

Cellular V2X Communications

In Release 14, 3GPP is specifying cellular vehicle-to-X (C-V2X) communications with two complementary transmission modes: direct communications between vehicles and network communications.

Direct communications will use bands such as the Intelligent Transportation Systems (ITS) 5.9 GHz band, using the PC5 interface specified for LTE device-to-device communications,

[149] 3GPP, *Coordinated Multi-Point Operation for LTE Physical Layer Aspects, TR 36.819 v11.1.0,* Tables 7.3.1.2-3 and 7.3.1.2-4, September 2011.

and will not require a Universal Integrated Circuit Card (UICC) SIM (USIM) card. By operating on different channels in the ITS band, direct cellular V2X will be able to co-exist with IEEE 802.11p, another automotive communications protocol.

In the network communications mode, the system will use traditional cellular licensed spectrum.

Use cases include do-not-pass warnings, blind-curve hazard warnings, road-works warnings, blind-intersection assistance, bicyclist and pedestrian alerts, and left-turn assistance.

C-V2X is being designed to be compatible with other automotive standards, such as those from ETSI and the Society of Automotive Engineers.

User-Plane Congestion Management (UPCON)

With User-Plane Congestion Management, specified in Release 13, operators have additional tools to mitigate network congestion in specific coverage areas. Mechanisms include traffic prioritization by adjusting QoS for specific services; reducing traffic by, for example, compression; and limiting traffic, such as by prohibiting or deferring certain traffic.

3GPP specifications add a new architectural entity, called the "RAN Congestion Awareness Function" (RCAF), that determines whether a cell is congested, determines the UEs supported by that cell, and informs the Policy Control and Charging Rules Function (PCRF), which can subsequently apply different policies to mitigate the congestion.[150]

Network-Assisted Interference Cancellation and Suppression (NAICS)

NAICS, a Release 13 capability, enhances the interference cancellation and suppression capability of UEs by using more information from the network. The fundamental goal of NAICS is to identify and cancel the dominant interferer, not an easy task when the dominant interferer can be on or off and can change in time and frequency. One analysis estimates an average performance gain of 7.4% relative to Release 11 Interference Rejection Combining and 11.7% at the cell edge.[151] 5G Americas members expect even higher performance gains, for example 20%, with implementation-specific scheduling and as NAICS methods are refined.

Multi-User Superposition Transmission (MUST)

MUST, a study item in Release 13 and tentatively planned for Release 14 uses simultaneous transmissions of data for more than one UE within a cell without time, frequency, or spatial layer separation. The concept relies on a UE close to the base station having low propagation loss and a UE far from the base station having high propagation loss. The far UE is not aware of, nor interfered by the near UE transmission. The near UE cancels the far UE interference. The capacity gain grows with the SNR/SINR difference between the close and far UEs.

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[150] For further details, see 3GPP TR 23.705, "Study on system enhancements for user plane congestion management (Release 13)."

[151] Harri Holma, Antti Toskala, Jussi Reunanen, *LTE Small Cell Optimization: 3GPP Evolution to Release 13*, Jan 2016, Wiley, ISBN: 978-1-118-91257-7.

IPv4/IPv6

Release 8 defines support for IPv6 for both LTE and UMTS networks. An Evolved Packet System bearer can carry both IPv4 and IPv6 traffic, enabling a UE to communicate both IPv4 and IPv6 packets (assuming it has a dual stack) while connected through a single EPS bearer. It is up to the operator, however, whether to assign IPv4, IPv6, or both types of addresses to UE.

Communicating between IPv6-only devices and IPv4 endpoints will require protocol-conversion or proxies. For further details, refer to the 5G Americas white paper, "IPv6 – Transition Considerations for LTE and Evolved Packet Core," February 2009.

TDD Harmonization

3GPP developed LTE TDD to be fully harmonized with LTE FDD including alignment of frame structures, identical symbol-level numerology, the possibility of using similar Reference Signal patterns, and similar synchronization and control channels. Also, there is only one TDD variant. Furthermore, LTE TDD has been designed to co-exist with TD-SCDMA and TD-CDMA/UTRA (both low-chip rate and high-chip rate versions). LTE TDD achieves compatibility and co-existence with TD-SCDMA by defining frame structures in which the DL and UL time periods can be time aligned to prevent BTS to BTS and UE to UE interference to support operation in adjacent carriers without the need for large guardbands between the technologies. This will simplify deployment of LTE TDD in countries such as China that are deploying TD-SCDMA. Figure 72 demonstrates the synchronization between TC-SCDMA and LTE-TDD in adjacent channels.

Figure 72: TDD Frame Co-Existence between TD-SCDMA and LTE TDD[152]

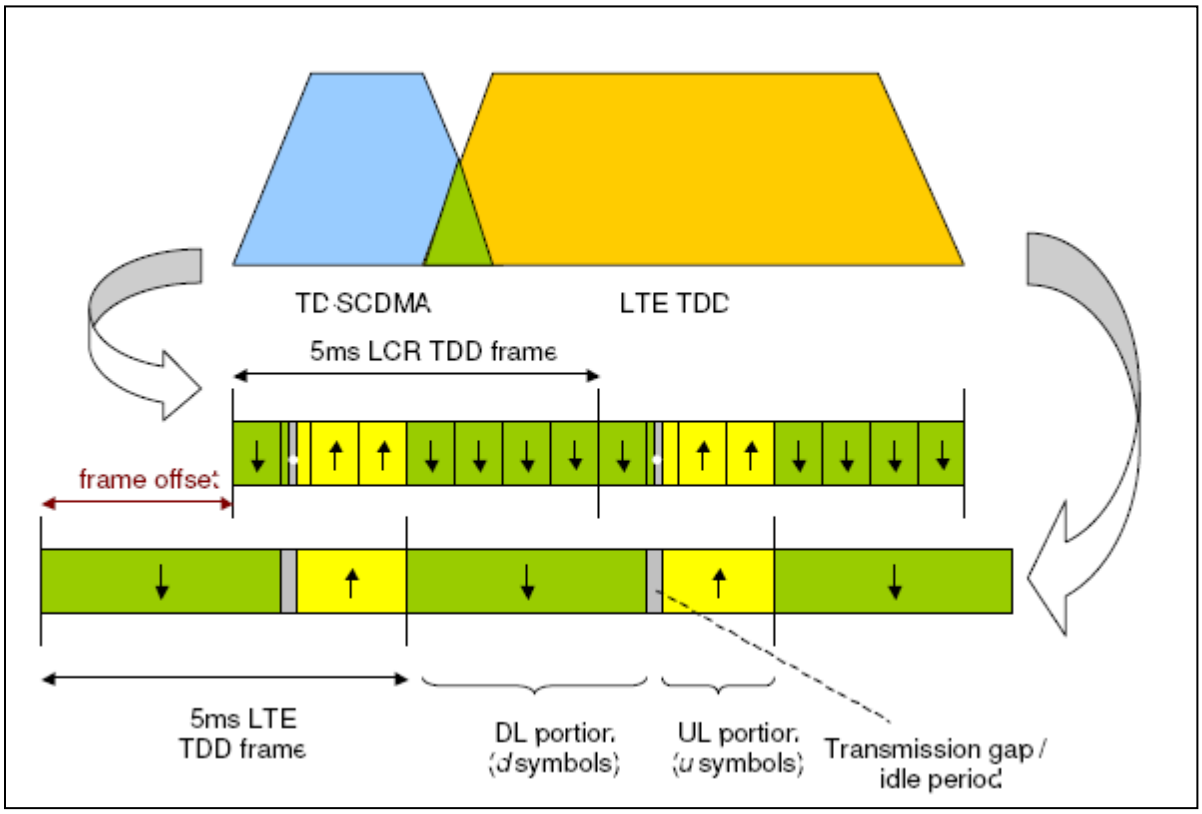

For LTE FDD and TDD to co-exist, large guardbands will be needed to prevent interference.

SMS in LTE

Even if an LTE network uses CSFB for voice, LTE devices will be able to send and receive SMS messages while on the LTE network. In this case, the 2G/3G core network will handle SMS messaging, but will tunnel the message to the MME in the EPC via the SGs interface. Once an LTE network uses IMS and VoLTE for packet voice service, SMS will be handled as SMS over IP and will use IMS infrastructure.[153]

User Equipment Categories

LTE specifications define categories of UE, which mainly determine the maximum throughputs of devices but also govern the number of downlink MIMO layers, as shown in Table .

Higher throughput capabilities are possible with 64 QAM and 256 QAM modulation. 3GPP is also defining Category 0 and Category M devices for M2M, as discussed in the section "Internet of Things and Machine-to-Machines."

[152] 5G Americas member company contribution.

[153] For further details, see 4G Americas, *Coexistence of GSM, HSPA and LTE*, May 2011, 35.

Table 19: UE Categories[154]

UE Category	Max DL Throughput	Maximum DL MIMO Layers	Maximum UL Throughput
1	10.3 Mbps	1	5.2 Mbps
2	51.0 Mbps	2	25.5 Mbps
3	102.0 Mbps	2	51.0 Mbps
4	150.8 Mbps	2	51.0 Mbps
5	299.6 Mbps	4	75.4 Mbps
6	301.5 Mbps	2 or 4	51.0 Mbps
7	301.5 Mbps	2 or 4	102.0 Mbps
8	2998.6 Mbps	8	1497.8 Mbps
9	452.3 Mbps	2 or 4	51.0 Mbps
10	452.3 Mbps	2 or 4	102.0 Mbps
11	603.0 Mbps	2 or 4	51.0 Mbps
12	603.0 Mbps	2 or 4	102.0 Mbps
13	391.6 Mbps	2 or 4	150.8 Mbps
14	3916.6 Mbps	8	9587.7 Mbps
15	798.8 Mbps	2 or 4	226.1 Mbps
16	1051.4 Mbps	2 or 4	105.5 Mbps
17	2506.6 Mbps	8	2119.4 Mbps
18	1206.0 Mbps	2 or 4 (or 8)	211.0 Mbps
19	1658.3 Mbps	2 or 4 (or 8)	13563.9 Mbps

LTE-Advanced Relays

Another capability being planned for LTE-Advanced is relays, as shown in Figure 73. The idea is to relay frames at an intermediate node, resulting in much better in-building penetration, and with better signal quality, user rates will improve. Relay nodes can also improve cell-edge performance by making it easier to add picocells at strategic locations.

[154] 3GPP, E*volved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities,* Technical Specification 36.306 V14.2.0, March 2017.

Relays provide a means for lowering deployment costs in initial deployments in which usage is relatively low. As usage increases and spectrum needs to be allocated to access only, operators can then employ alternate backhaul schemes.

Figure 73: LTE-Advanced Relay[155]

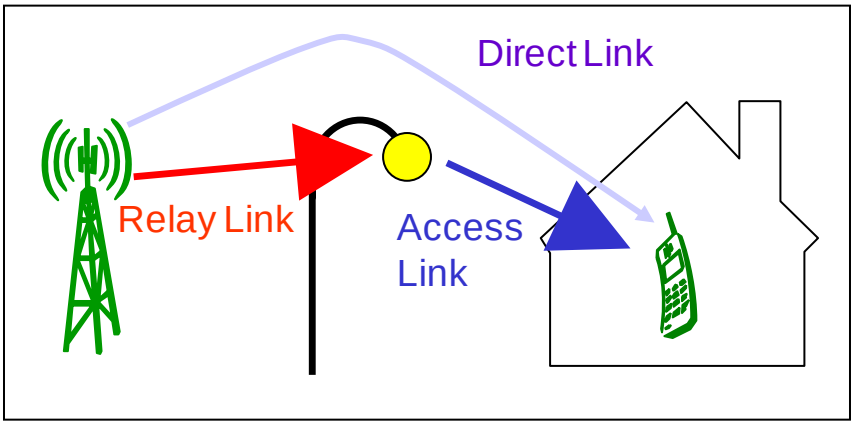

Proximity Services (Device-to-Device)

Release 12 defined a capability for devices to communicate directly with one another using LTE spectrum, a feature also called "operator-enabled proximity services." With this capability, devices can autonomously discover nearby relevant devices and services in a battery-efficient manner. Devices broadcast their needs and services and can also passively identify services without user intervention. The communication between devices is called "sidelink communications" and uses an interface called "PC5." Release 12, emphasizing public-safety applications, supports only one-to-many sidelink communications, whereas Release 13 supports one-to-one sidelink communications between two group member UEs and between a remote UE and a relay UE.

Initial emphasis of this capability, in both Release 12 and Release 13, is on public safety. Examples of potential consumer or commercial applications include discovering friends and family (social matching), push advertising for relevant notifications, tourist bulletins, venue services, crime alerts, home automation, vehicle-to-vehicle communication, and detecting children leaving the vicinity of their homes. The service is designed to work during infrastructure failures, even in emergencies and natural disasters. As a new means of communicating, proximity services could result in innovative types of applications.

The LTE network performs configuration and authentication; however, communication can be either via the network or directly between devices. To minimize battery consumption, devices synchronously wake up for brief intervals to discover services. The impact on LTE network capacity is minimal.

As with other location-based services, operators and application developers will need to address privacy concerns.

[155] 5G Americas member contribution.

LTE Throughput

The section "4G LTE Advances" above in the main section of the paper and "Data Throughput Comparison" in the appendix provide an overview of LTE throughputs. This section provides additional details.

Table shows initial (Release 8) LTE peak data rates based on different downlink and uplink designs.

Table20: LTE Peak Throughput Rates

LTE Configuration	Downlink (Mbps) Peak Data Rate	Uplink (Mbps) Peak Data Rate
Using 2X2 MIMO in the Downlink and 16 QAM in the Uplink, 10+10 MHz	70.0	22.0
Using 4X4 MIMO in the Downlink and 64 QAM in the Uplink, 20+20 MHz	300.0	71.0

LTE is not only efficient for data but, because of a highly efficient uplink, is extremely efficient for VoIP traffic. As discussed in the "Spectral Efficiency" section above, in 10+10 MHz of spectrum, LTE VoIP capacity will reach 500 users.[156]

Table 19 analyzes LTE median and average throughput values in greater detail for different LTE configurations.

Table 19: LTE FDD User Throughputs Based on Simulation Analysis[157]

Configuration	User Throughput, Mbps			
	Downlink (DL)		Uplink (UL)	
	Median	Average	Median	Average
LTE FDD: Low Band, 2x2 MIMO-DL, 1x2 SIMO-UL, 10+10 MHz, R8	8.6	10.9	4.5	5.0
LTE FDD: High Band, 4x2 MIMO-DL, 1x4 SIMO-UL, 10+10 MHz, R8	10.6	12.2	5.4	6.4
LTE FDD: High Band, 2x2 MIMO-DL, 1x2 SIMO UL, 20+20 MHz, R8	15.2	17.9	5.4	7.0
LTE FDD: High Band, 4x4 MIMO-DL, 1x4 SIMO UL, 20+20 MHz, R12	25.4	29.2	6.9	9.1

[156] 3GPP Multi-member analysis.

[157] 5G Americas member contribution. SIMO refers to Single Input Multiple Output antenna configuration, which in the uplink means one transmit antenna at the UE and multiple receive antennas at the eNodeB.

The simulation results represent a consensus view of 5G Americas members working on this white paper project. The goal of the analysis was to quantify LTE throughputs in realistic deployments. Simulation assumptions include:

- Traffic is FTP-like at a 50% load with a 75/25 mix of indoor/outdoor users.
- Throughput is at the medium-access control (MAC) protocol layer. (Application-layer throughputs may be 5 to 8 percent lower due to protocol overhead.)
- The 3GPP specification release numbers shown correspond to the infrastructure capability.
- The configuration in the first row corresponds to low-frequency band operation, representative of 700 MHz or cellular, while the remaining configurations assume high-frequency band operation, representative of PCS, AWS, or WCS. (Higher frequencies facilitate higher-order MIMO configurations and have wider radio channels available.)
- The downlink value for the first row corresponds to Release 8 device-receive capability (Minimum Mean Square Error [MMSE]), while the values in the other rows correspond to Release 11 device-receive capability (MMSE – Interference Rejection Combining [IRC]).
- The uplink value for the first row corresponds to a Maximal Ratio Combining (MRC) receiver at the eNodeB, while the remaining values correspond to an IRC receiver.
- Low-band operation assumes 1,732-meter inter-site distance, while high-band operation assumes 500-meter ISD. The remaining simulation assumptions are listed in Table 20.

Table 20: LTE FDD User Throughput Simulation Assumptions[158]

Parameter	Value
Frequency	Low Band (LB): B17; High Band (HB): B30
Channel bandwidth	10 MHz, 20 MHz
System configuration	DL: 2x2, 4x2, and 4x4 Closed-Loop (CL) MIMO UL: 1x2 and 1x4 SIMO
Traffic type	FTP model 2: File size = 0.15 Mbyte, 1 second inter-arrival time, Load varied by changing number of users
Inter-Site Distance (ISD)	LB: 1732 m; HB: 500 m
Pathloss model	LB: HATA; HB: COST231 with correction
eNodeB transmit power	LB: 60 watts total; HB: 80 watts total
eNodeB antenna type	2 Tx = +-45 degrees cross-pol (DIV-1X); 4 Tx = Closely separated pair of cross-pols (CLA-2X)
eNodeB antenna gain	LB: 14.8 dBi; HB: 17.5 dBi
eNodeB antenna pattern	Actual antenna patterns as used in RF planning tool
eNodeB Rx type	LB: MRC; HB: IRC
Downtilt	LB: 7 degrees; HB: 9 degrees
Penetration loss	75/25 mix of indoor/outdoor users LB: 12 dB for indoor users; HB: 22 dB for indoor users
Device speed	3 km/h all users
Channel model	Modified SCME-WINNER+, LB: Suburban Macro (SMa) scenario; HB: Urban Macro (UMa)
Device antenna type	+-45 degrees cross-pol with built in correlation of 0.5
Device antenna gain and mismatch	LB: - 5 dBi and 3 dB; HB: -3 dBi and 3 dB
Device body loss	3 dB for both bands
Device Rx type	MMSE, MMSE-IRC
Uplink power control	LB: alpha = 1, Po = -100 dBm; HB: alpha = 0.9, Po = -100 dBm
Scheduler	Proportional fair, frequency selective

The assumptions, emphasizing realistic deployments, do not necessarily match assumptions used by other organizations, such as 3GPP, so results may differ.

Additional insight into LTE performance under different configuration comes from a test performed on a cluster of cells in an LTE operator's network, comparing downlink performance of 4X2 MIMO against 2X2 MIMO, and uplink performance of 1X4 SIMO against 1X2 SIMO. The test employed LTE category 4 devices.[159]

[158] 5G Americas member contribution.

[159] 5G Americas member contribution.

These tests, which were performed in a 20+20 MHz cluster, show significant improvements in cell edge uplink and downlink throughput, in addition to an overall increase in uplink and downlink throughputs. Specific results include:

- A 100% increase in uplink throughput at the cell edge with 1X4 SIMO compared to 1x2 SIMO.
- A 40% increase in downlink throughput at the cell edge with 4x2 closed-loop MIMO compared to 2x2 open-loop MIMO.
- A 50 to 75% increase in downlink throughput with closed loop MIMO compared to transmit diversity modes.
- Up to 6dB gains in uplink transmit power with 1X4 SIMO, which directly translates into UE battery savings.
- Peak speeds of 144 Mbps with 4X2 MIMO in the downlink and 47 Mbps with 1X4 SIMO in the uplink.

Another LTE operator's testing results for LTE in a TDD configuration, using 20 MHz channels, 3:2 DL to UL ratio, and category 3 devices, showed:

- Peak speeds of 55 Mbps.
- Typical speeds of 6 to 15 Mbps.[160]

Figure 74 shows the result of a drive test in a commercial LTE network with a 10 MHz downlink carrier demonstrating 20 Mbps to 50 Mbps throughput rates across much of the coverage area. Throughput rates would double with a 20+20 MHz configuration.

[160] 5G Americas member contribution.

Figure 74: Drive Test of Commercial European LTE Network (10+10 MHz)[161]

[161] Ericsson contribution.

Figure 75 provides additional insight into LTE downlink throughput, showing Layer 1 throughput simulated at 10 MHz bandwidth using the Extended Vehicular A 3 km/hour channel model. The figure shows the increased performance obtained with the addition of different orders of MIMO. Note how throughput improves based on higher signal to noise ratio (SNR).

Figure 75: LTE Throughput in Various Modes[162]

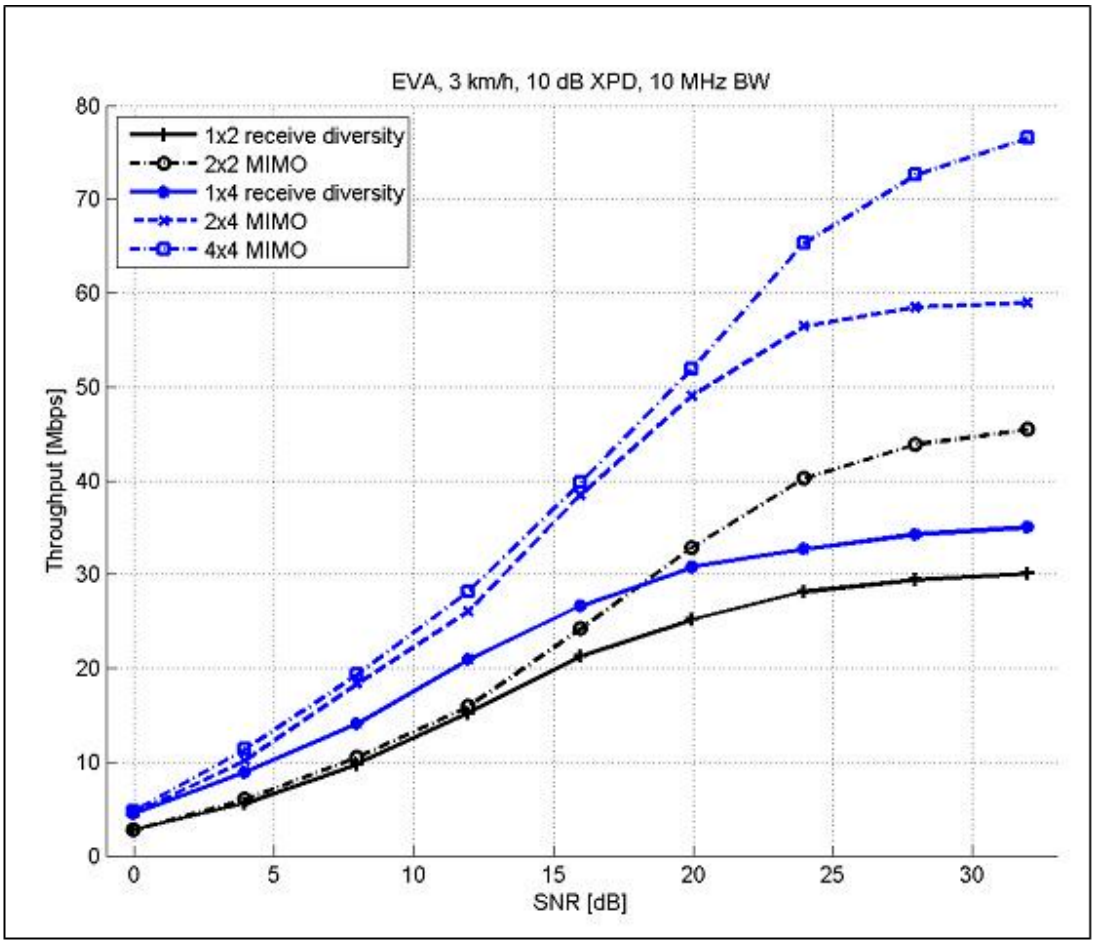

Actual throughput rates that users experience are lower than the peak rates and depend on a variety of factors:

- **RF Conditions and User Speed.** Peak rates depend on optimal conditions. Suboptimal conditions include being at the edge of the cell or moving at high speed, resulting in lower throughput.
- **Network Loading.** Like all wireless systems, throughput rates go down as more devices simultaneously use the network. Throughput degradation is linear.

[162] Jonas Karlsson, Mathias Refback, "Initial Field Performance Measurements of LTE," *Ericsson Review*, No. 3, 2008.

Figure 76 shows how dramatically throughput rates can vary by number of active users and radio conditions. The higher curves are for better radio conditions.

Figure 76: LTE Actual Throughput Rates Based on Conditions[163]

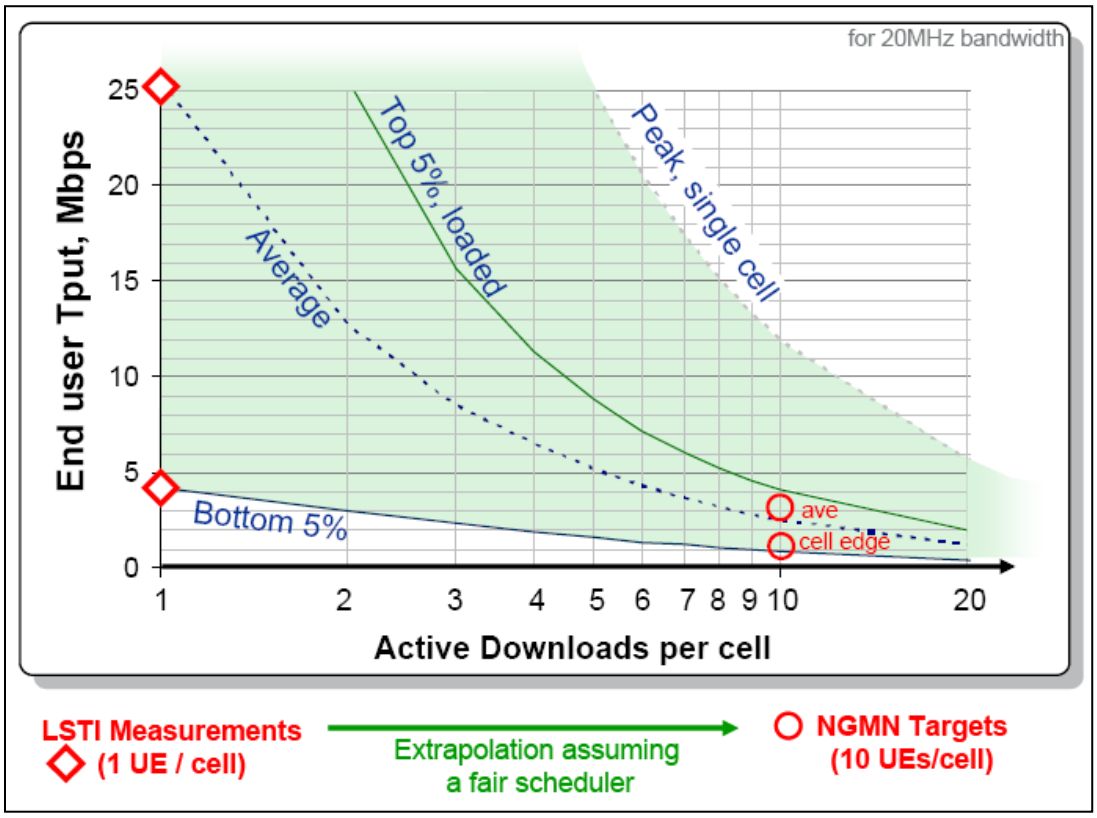

[163] LTE/SAE Trial Initiative, "Latest Results from the LSTI, Feb 2009," http://www.lstiforum.org.

VoLTE and RCS

This paper introduced VoLTE and voice support in the earlier section, "VoLTE, RCS, WebRTC, and Wi-Fi Calling." This section in the appendix provides additional technical detail about the operation of VoLTE and RCS.

Voice in LTE can encompass: no voice support, voice implemented in a circuit-switched fallback (CSFB) mode using 2G or 3G, and VoIP implemented with IMS.

Initial LTE network deployments used CSFB, with which the LTE network carries circuit-switched signaling over LTE interfaces, allowing the subscriber to be registered with the 2G/3G MSC even while on the LTE network. When there is a CS event, such as an incoming voice call, the MSC sends the page to the LTE core network, which delivers it to the subscriber device. The device then switches to 2G/3G operation to answer the call.

Voice over LTE using VoIP requires IMS infrastructure. To facilitate IMS-based voice, vendors and operators created the One Voice initiative to define required baseline functionality for user equipment, the LTE access network, the Evolved Packet Core, and the IMS. GSMA adopted the One Voice initiative in what it calls VoLTE, specified in GSMA reference document IR.92.[164] GSMA specifies interconnection and international roaming among LTE networks through the IR.88[165] specification. Another specification, IR.94, provides the IMS Profile for Conversational Video Service, a service referred to as "Video over LTE" (ViLTE).[166]

For a phone to support VoLTE, it needs software implementing the IMS protocol stack. For example, the iPhone 6 was the first iPhone to implement such software. Additional software implementing RCS application programming interfaces can provide applications with access to IMS-based services, such as voice, messaging, and video. The Open Mobile Alliance has defined RESTful network APIs for RCS that support the following functions: notification channel, chat, file transfer, third-party calls, call notification, video sharing, image sharing, and capability discovery. As shown in Figure 77, over time, new profile releases will broaden the scope of these APIs.

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[164] GSMA, "IMS Profile for Voice and SMS," Document IR.92. Available at http://www.gsma.com/newsroom/wp-content/uploads/2013/04/IR.92-v7.0.pdf.

[165] GSMA, "LTE Roaming Guidelines," GSMA Document IR.88. Available at http://www.gsma.com/newsroom/wp-content/uploads/2013/04/IR.88-v9.0.pdf.

[166] GSMA, "IMS Profile for Conversational Video Service," Document IR.94. Available at http://www.gsma.com/newsroom/all-documents/ir-94-ims-profile-for-conversational-video-service/.

Figure 77: Evolution of RCS API Profiles[167]

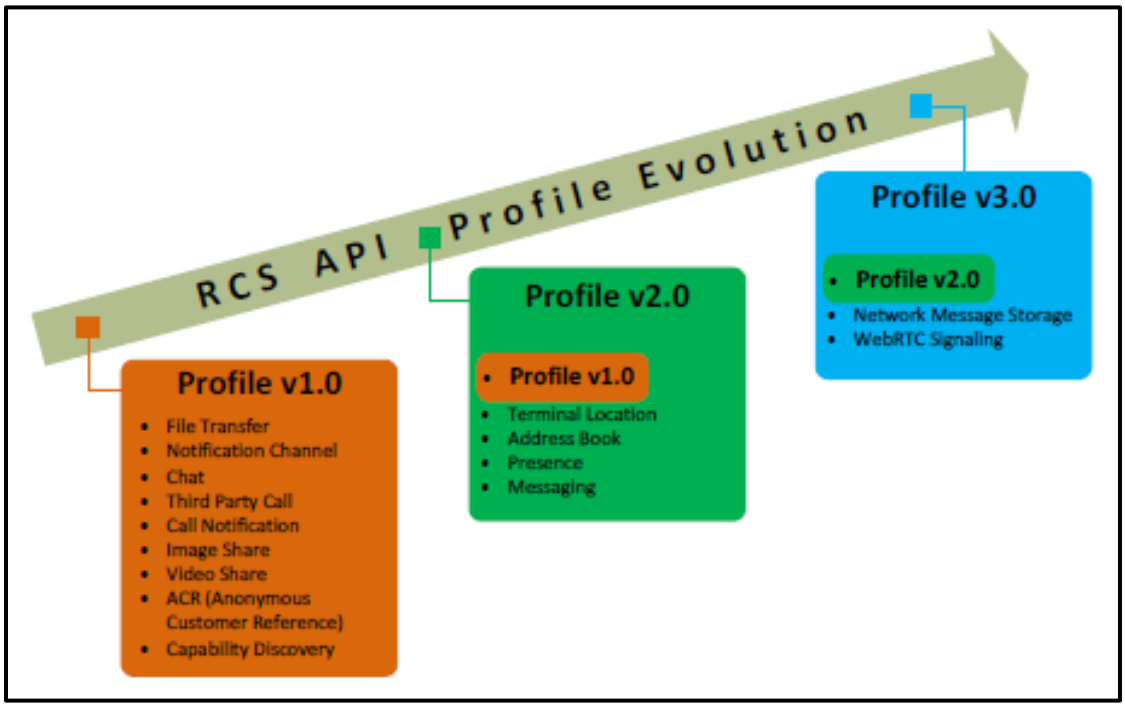

LTE VoIP leverages the QoS capabilities defined for EPC, which specify different quality classes. Features available in LTE to make voice operation more efficient include Semi-Persistent Scheduling (SPS) and TTI bundling. SPS reduces control channel overhead for applications (like VoIP) that require a persistent radio resource. Meanwhile, TTI bundling improves subframe utilization by reducing IP overhead, while in the process optimizing uplink coverage.

Another way to increase voice capacity in LTE and to support operation in congestion situations is vocoder rate adaptation, a mechanism with which operators can control the codec rate based on network load, thus dynamically trading off voice quality against capacity.

VoLTE roaming across operators will require network-to-network interfaces between their respective IMS networks. Such roaming and interconnect will follow initial VoLTE deployments. Different IMS stack implementations between vendors will also complicate roaming.

One roaming consideration is how operators handle data roaming. LTE roaming can send all visited network traffic back to the home network, which for a voice call, increases voice latency. For voice calls, the local breakout option would mitigate this latency.

Using Single-Radio Voice Call Continuity (SR-VCC) and Enhanced SR-VCC (eSRVCC), user equipment can switch mid-call to a circuit-switched network, in the event that the user moves out of LTE coverage. Similarly, data sessions can be handed over in what is called "Packet-Switched Handover" (PSHO).

[167] 4G Americas, *VoLTE and RCS Technology – Evolution and Ecosystem,* Nov. 2014.

Figure 78 shows how an LTE network might evolve in three stages. Initially, LTE performs only data service, and the underlying 2G/3G network provides voice service via CSFB. In the second stage, voice over LTE is available, but LTE covers only a portion of the total 2G/3G coverage area. Hence, voice in 2G/3G can occur via CSFB or SR-VCC. Eventually, LTE coverage will match 2G/3G coverage, and LTE devices will use only the LTE network.

Figure 78: Evolution of Voice in an LTE Network[168]

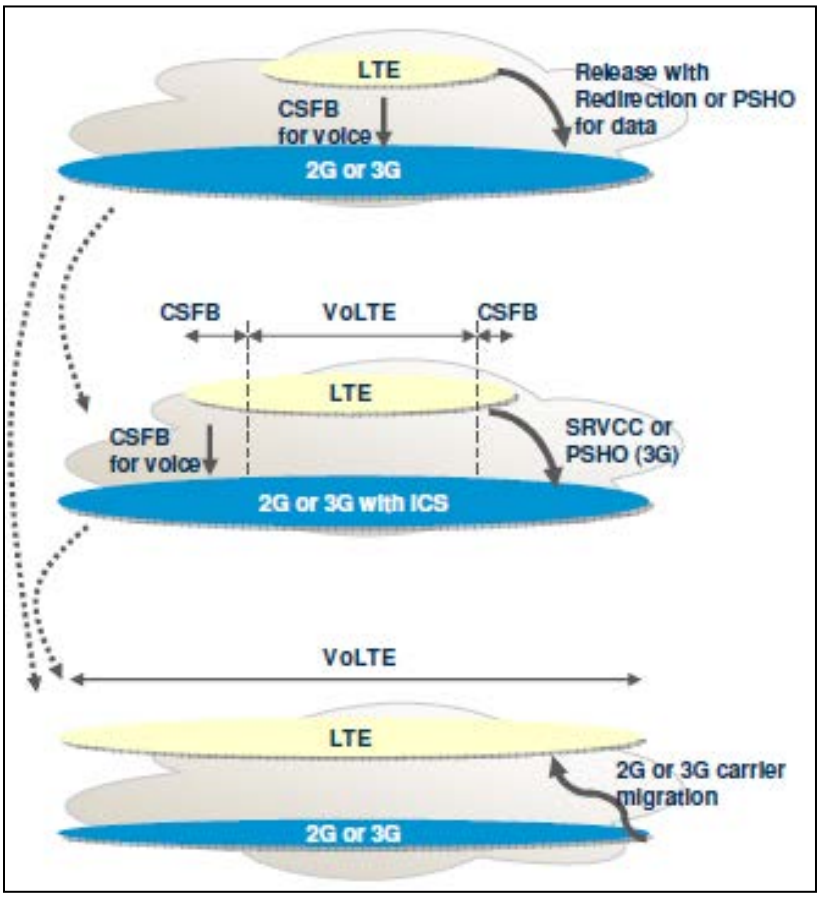

Another voice approach, called "Voice over LTE via Generic Access" (VoLGA), defined circuit-switched operation through an LTE IP tunnel. 3GPP, however, has stopped official standards work that would support VoLGA.

3GPP has developed a new codec, called "Enhanced Voice Services" (EVS), which will include super-wideband voice capability. For the same bit rate, EVS provides higher voice quality than the other codecs.[169] Table 21 summarizes the features and parameters of the three 3GPP codecs used in LTE.

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[168] 5G Americas member contribution.

[169] See Figure 9.2. 3GPP, *TR 26.952 V12.1.0, Codec for Enhanced Voice Services (EVS); Performance Characterization*, March 2015.

Table 21: Comparison of AMR, AMR-WB and EVS Codecs[170]

Features	AMR	AMR-WB	EVS
Input and output sampling frequencies supported	8KHz	16KHz	8KHz, 16KHz, 32KHz, 48 KHz
Audio bandwidth	Narrowband	Wideband	Narrowband, Wideband, Super-wideband, Fullband
Coding capabilities	Optimized for coding human voice signals	Optimized for coding human voice signals	Optimized for coding human voice and general-purpose audio (music, ringtones, mixed content) signals
Bit rates supported (in kb/s)	4.75, 5.15, 5.90, 6.70, 7.4, 7.95, 10.20, 12.20	6.6, 8.85, 12.65, 14.25, 15.85, 18.25, 19.85, 23.05, 23.85	5.9, 7.2, 8, 9.6 (NB and WB only), 13.2 (NB, WB and SWB), 16.4, 24.4, 32, 48, 64, 96, 128 (WB and SWB only)
Number of audio channels	Mono	Mono	Mono and Stereo
Frame size	20 ms	20 ms	20 ms
Algorithmic Delay	20-25 ms	25 ms	Up to 32 ms

Figure 79 shows mean opinion scores (MOS) for different codecs at different bit rates, illustrating the advantage of EVS, particularly for bit rates below 32 kbps that cellular networks use.

[170] 4G Americas, *Mobile Broadband Evolution: Rel-12 & Rel-13 and Beyond*, 2015. See also T-Mobile 2016 EVS announcement: https://newsroom.t-mobile.com/news-and-blogs/volte-enhanced-voice-services.htm.

Figure 79: Combined Mean Opinion Score Values[171]

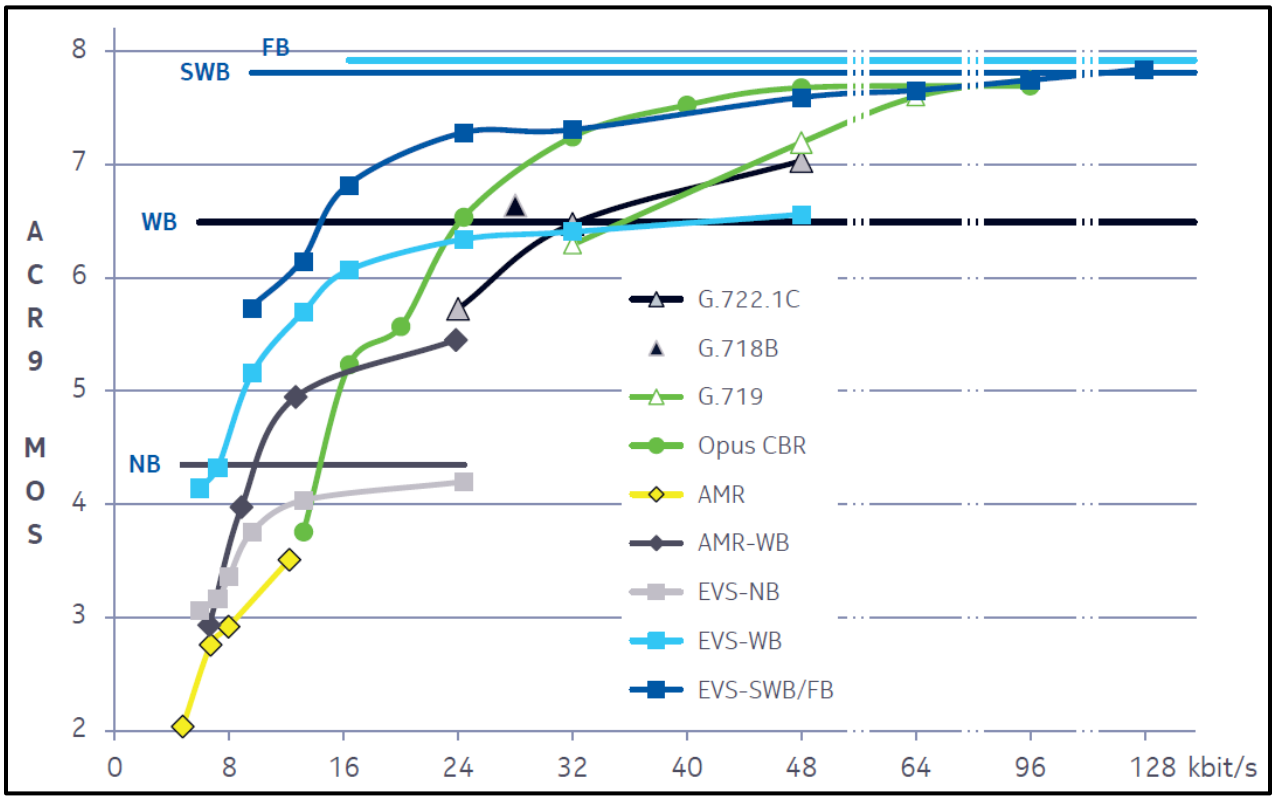

Table 22 shows EVS (narrowband, wideband, super-wideband) audio bandwidths and bitrates that create subjective quality equal to or better than AMR or AMR-WB for typical conversational voice scenarios.

Table 22: EVS Compared to AMR and AMR-WB[172]

Reference	Equal bandwidth	Wider bandwidth
AMR 12.2 kbit/s	EVS-NB 8.0 kbit/s	EVS-WB 5.9 kbit/s
AMR-WB 12.65 kbit/s	EVS-WB 9.6 kbit/s	EVS-SWB 9.6 kbit/s
AMR-WB 23.85 kbits/s	EVS-WB 13.2 kbit/s	EVS-SWB 9.6 kbit/s

Figure 80 compares EVS capacity gains over AMR and AMR-WB for the references cases shown in Table 22. EVS-SWB at 9.6 kbps almost doubles voice capacity compared to AMW-WB at 23.85 kbps.

[171] Nokia, *The 3GPP Enhanced Voice Services (EVS) codec*, 2015.

[172] Ibid.

Figure 80: EVS Voice Capacity Compared to AMR and AMR-WB[173]

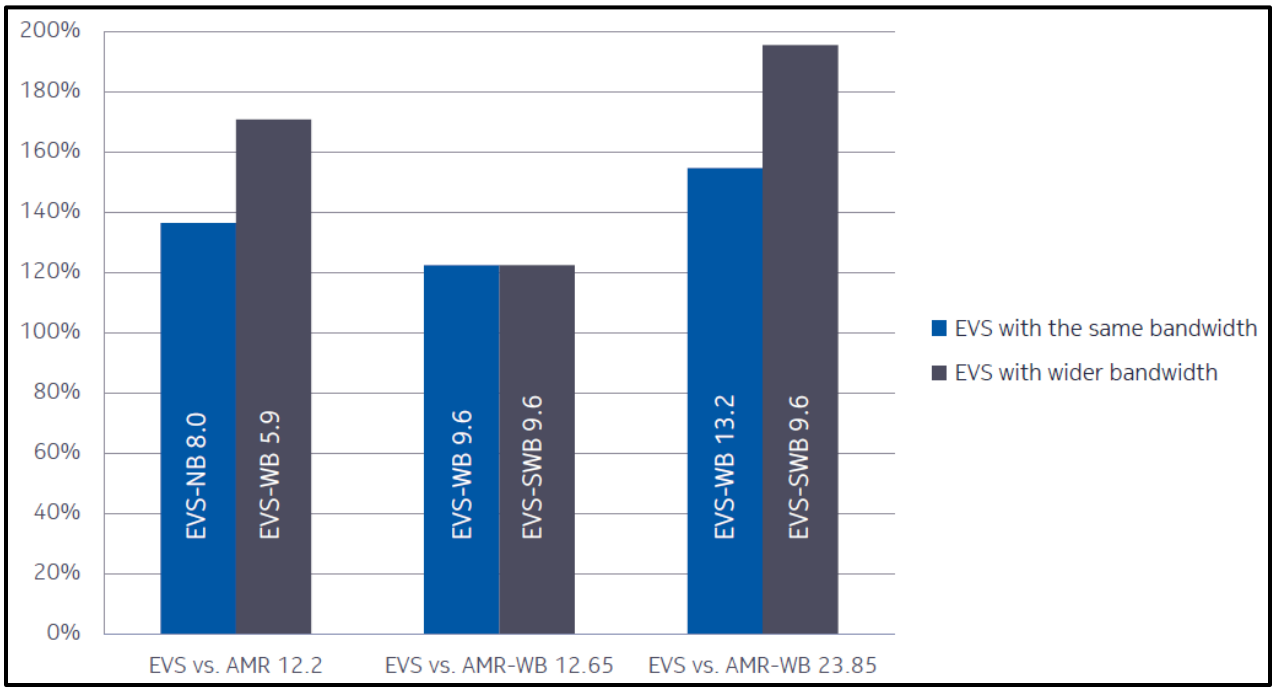

LTE Ultra-Reliable and Low-Latency Communications

The 3GPP work item for this feature states, "3GPP LTE technology enhancements are needed to serve such new use cases and to remain technologically competitive up to and beyond 2020. As a candidate technology for ITU IMT-2020 submission, it is motivated to further enhance the LTE system such that it can meet the key IMT-2020 requirements including those for URLLC in terms of reliability ($1\text{-}10^{-5}$ reliability for small data packets within a latency of 1ms) as well as latency (≤1ms one way user plane latency)."[174]

Evolved Packet Core (EPC)

3GPP defined the Evolved Packet Core (EPC) in Release 8 as a framework for an evolution or migration of the network to a higher-data-rate, lower latency, packet-optimized system that supports multiple radio-access technologies including LTE, as well as and legacy GSM/EDGE and UMTS/HSPA networks. EPC also integrates CDMA2000 networks and Wi-Fi.

EPC is optimized for all services to be delivered via IP in a manner that is as efficient as possible—through minimization of latency within the system, for example. It also provides service continuity across heterogeneous networks, which is important for LTE operators who must simultaneously support GSM-HSPA customers.

One important performance-enhancing aspect of EPC is a flatter architecture. For packet flow, EPC includes two network elements, called "Evolved Node B" (eNodeB) and the Access Gateway (AGW). The eNodeB (base station) integrates the functions traditionally

[173] Ibid.

[174] RP-170796, 3GPP Work Item Description, "Ultra Reliable Low Latency Communication for LTE," March 2017.

performed by the radio network controller, which previously was a separate node controlling multiple Node Bs. Meanwhile, the AGW integrates the functions traditionally performed by the SGSN and GGSN. The AGW includes both control functions, handled through the Mobile Management Entity (MME), and user plane (data communications) functions. The user plane functions consist of two elements: A serving gateway that addresses 3GPP mobility and terminates eNodeB connections, and a Packet Data Network (PDN) gateway that addresses service requirements and also terminates access by non-3GPP networks. The MME serving gateway and PDN gateways can be collocated in the same physical node or distributed, based on vendor implementations and deployment scenarios.

EPC uses IMS as a component. It also manages QoS across the whole system, an important enabler for voice and other multimedia-based services.

Figure 81 shows the EPC architecture.

Figure 81: EPC Architecture

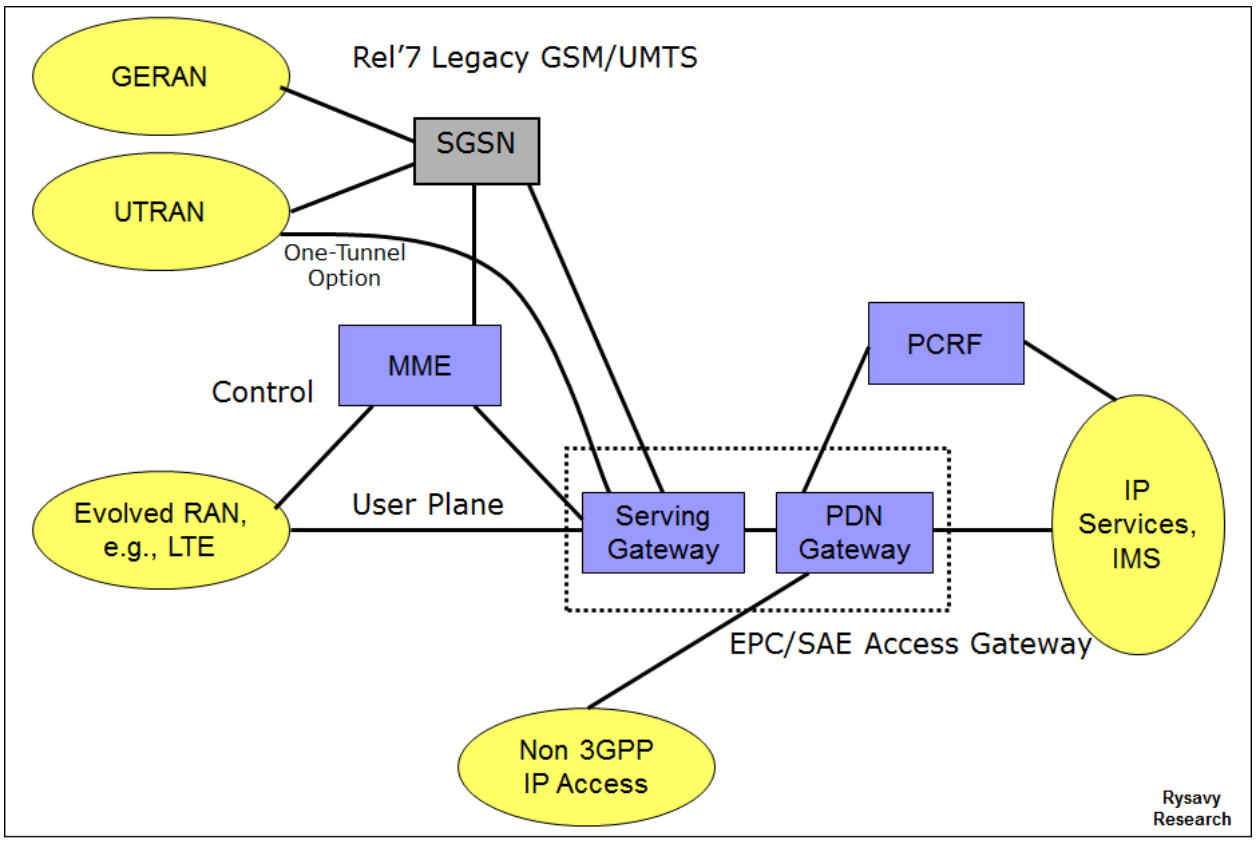

Elements of the EPC architecture include:

- Support for legacy GERAN and UTRAN networks connected via SGSN.
- Support for new radio-access networks such as LTE.
- Support for non-3GPP networks such as EV-DO and Wi-Fi. (See section below on Wi-Fi integration).
- The Serving Gateway that terminates the interface toward the 3GPP radio-access networks.

- The PDN gateway that controls IP data services, does routing, allocates IP addresses, enforces policy, and provides access for non-3GPP access networks.
- The MME that supports user equipment context and identity, as well as authenticating and authorizing users.
- The Policy Control and Charging Rules Function that manages QoS aspects.

QoS in EPS employs the QoS Class Identifier (QCI), a number denoting a set of transport characteristics (bearer with/without guaranteed bit rate, priority, packet delay budget, packet error loss rate) and used to infer nodes specific parameters that control packet forwarding treatment (such as scheduling weights, admission thresholds, queue management thresholds, or link-layer protocol configuration). The network maps each packet flow to a single QCI value (nine are defined in the Release 8 version of the specification) according to the level of service required by the application. Use of the QCI avoids the transmission of a full set of QoS-related parameters over the network interfaces and reduces the complexity of QoS negotiation. The QCI, together with Allocation Retention Priority (ARP) and, if applicable, Guaranteed Bit Rate (GBR) and Maximum Bit Rate (MBR), determines the QoS associated to an EPS bearer. A mapping between EPS and pre-Release 8 QoS parameters permits interworking with legacy networks.

The QoS architecture in EPC enables a number of important capabilities for both operators and users:

- **VoIP support with IMS.** QoS is a crucial element for providing LTE/IMS voice service. (See section below on IMS).
- **Enhanced application performance.** Applications such as gaming or video can operate more reliably.
- **More flexible business models.** With flexible, policy-based charging control, operators and third parties will be able to offer content in creative new ways. For example, an enhanced video stream to a user could be paid for by an advertiser.
- **Congestion control.** In congestion situations, certain traffic flows (bulk transfers, abusive users) can be throttled down to provide a better user experience for others.

Table 23 shows the nine QCI used by LTE.

Table 23: LTE Quality of Service

QCI	Resource Type	Priority	Delay Budget	Packet Loss	Examples
1	GBR (Guaranteed Bit Rate)	2	100 msec.	10^{-2}	Conversational voice
2	GBR	4	150 msec.	10^{-3}	Conversational video (live streaming)
3	GBR	3	50 msec.	10^{-3}	Real-time gaming
4	GBR	5	300 msec.	10^{-6}	Non-conversational video (buffered streaming)
5	Non-GBR	1	100 msec.	10^{-6}	IMS signaling

QCI	Resource Type	Priority	Delay Budget	Packet Loss	Examples
6	Non-GBR	6	300 msec.	10^{-6}	Video (buffered streaming), TCP Web, email, and FTP
7	Non-GBR	7	100 msec.	10^{-3}	Voice, video (live streaming), interactive gaming
8	Non-GBR	8	300 msec.	10^{-6}	Premium bearer for video (buffered streaming), TCP Web, e-mail, and FTP
9	Non-GBR	9	300 msec.	10^{-6}	Default bearer for video, TCP for non-privileged users

Heterogeneous Networks and Small Cells

A fundamental concept in the evolution of next-generation networks is the blending of multiple types of networks to create a "network of networks" characterized by:

- Variations in coverage areas, including femtocells (either enterprise femtos or home femtos, called HeNBs), picocells (also referred to as metro cells), and macro cells. Cell range can vary from 10 meters to 50 kilometers.
- Different frequency bands.
- Different technologies spanning Wi-Fi, 2G, 3G, 4G, and 5G.
- Relaying capability in which wireless links can serve as backhaul.

Figure 82 shows how user equipment might access different network layers.

Figure 82: Load Balancing with Heterogeneous Networks[175]

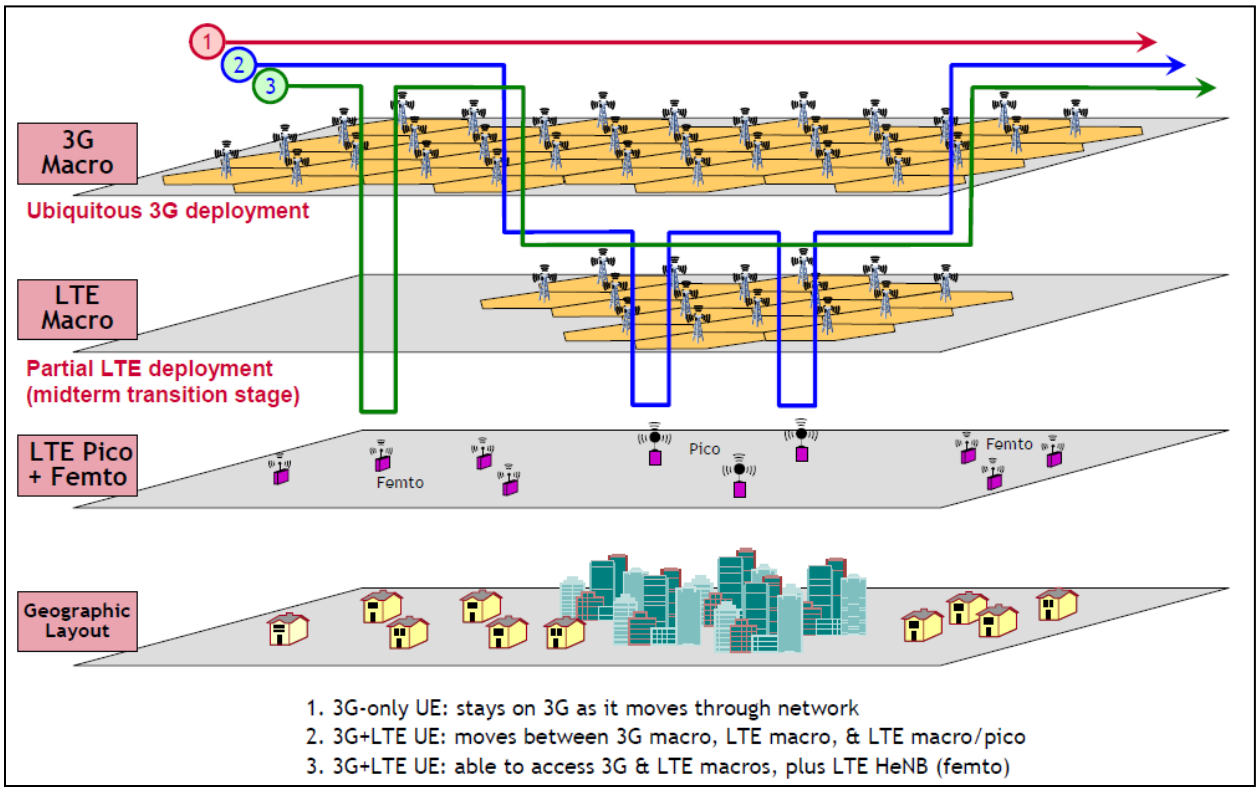

HetNets will allow significant capacity expansion in configurations in which operators can add picocells to coverage areas served by macrocells, particularly if there are hot spots with higher user densities.

Small cells differentiate themselves from macrocells according to the parameters shown in Table 24.

Table 24: Small Cell Vs. Macro Cell Parameters: Typical Values

Parameter	Small Cell	Macro Cell
Transmission Power	24 dBm (0.25 W)	43 dBm (20 W)
Antenna Gain	2 dBi	15 dBi
Users	Tens	Hundreds
Mobility	30 km/hr	350 km/hr

[175] 5G Americas member contribution.

Whether or not the small cell uses the same radio carriers as the macro cell involves multiple tradeoffs. In Figure 83 Scenario 1, the small cells and macro cell use different radio carriers, the two not interfering with each other. Although this configuration requires more spectrum, the small cells are able to cover larger areas than if they were deployed using the same radio carrier as the macro. This configuration supports medium-to-high penetration levels of small cells, allowing the network to reach huge capacity.

In Scenario 2, the small cells and macro cells use the same radio carrier, accommodating operators with more limited spectrum, but the network must manage interference using the techniques discussed below. Operators must carefully manage small-cell transmission power in this configuration.

Figure 83: Scenarios for Radio Carriers in Small Cells

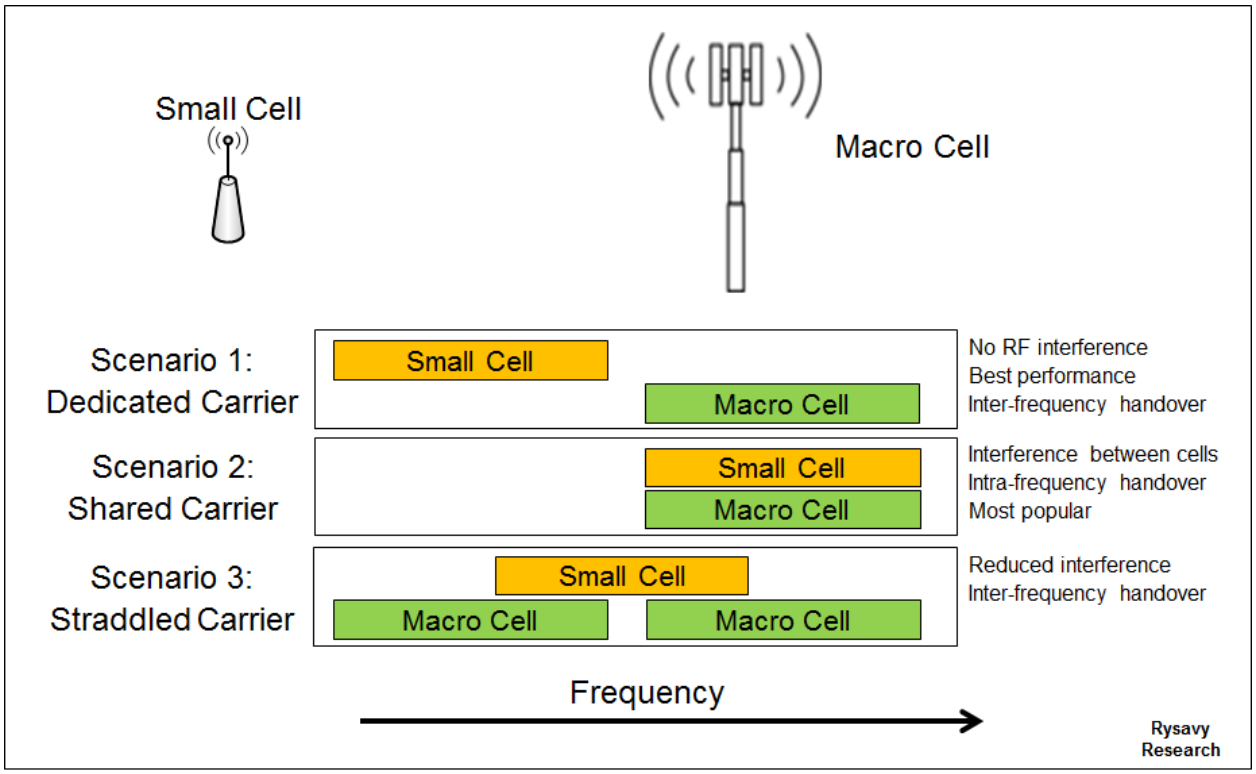

In Scenario 3, the small cells use a straddled radio carrier, accommodating operators with more spectrum, but the network still needs to manage interference using techniques discussed below. Compared with a shared carrier configuration, this configuration has benefits similar to dedicated carriers in terms of radio-parameter planning and reduced interference.

Figure 84 shows two different traffic distribution scenarios, with a uniform distribution of devices in the first and higher densities serviced by picocells in the second. The second scenario can result in significant capacity gains as well as improved user throughput.

Figure 84: Different Traffic Distributions Scenarios

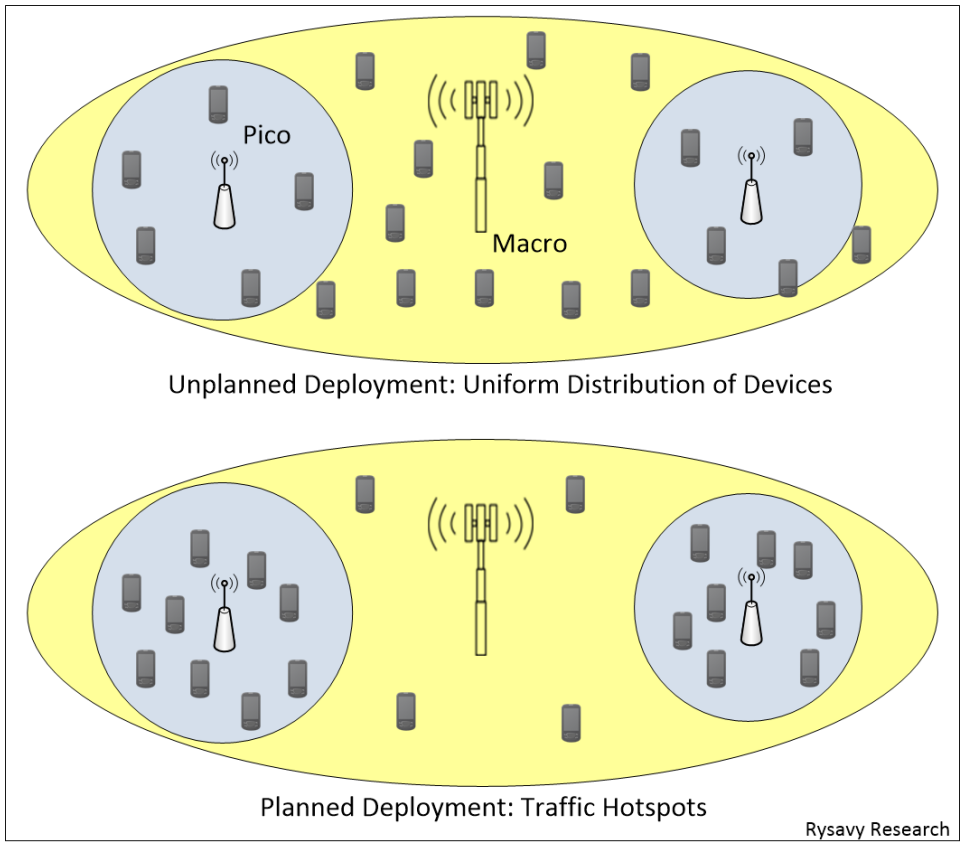

One vendor calculated expected HetNet gains assuming no eICIC, no picocell range extension, and no eICIC. For the case of four picocells without picocell range extension and uniform user distribution, the median-user-throughput gain compared with a macro-only configuration was 85%. For a similar case of four picocells but using a hotspot user distribution, the gain was much higher, 467%.[176] Additional gains will occur with picocell range extension.

Expected picocell gains rise proportionally to the number of picocells, so long as a sufficient number of UEs connect to the picocells.

Release 10 and Release 11 added enhanced support to manage the interference in the HetNet scenario in the time domain with Enhanced Inter-cell Interference Coordination (eICIC) and Further Enhanced Intercell Interference Coordination (feICIC), as well as in the frequency domain with carrier-aggregation-based ICIC.

HetNet capability keeps becoming more sophisticated through successive 3GPP releases as summarized in Table 25.

[176] 5G Americas member contribution. Further assumes 2X1 W picocell transmit power, cell-edge placement (planned picocell deployment), 67% of all the users within 40m of the pico locations, and 3GPP Technical Report 36.814 adapted to 700 MHz.

Table 25: 3GPP HetNet Evolution

3GPP Release	HetNet Feature
8	Initial SON capabilities, most for auto configuration. Initial intercell interference coordination (ICIC) available.
9	More mobility options (for example, handover between HeNBs), operator customer subscriber group (SCG) lists, load-balancing, coverage and capacity improvements.
10	An interface for HeNBs, called "Iurh," that improves coordination and synchronization, LTE time domain eICIC. Carrier-aggregation-based ICIC also defined.
11	Improved eICIC, further mobility enhancements.

Enhanced Intercell Interference Coordination

Significant challenges must be addressed in these heterogeneous networks. One is near-far effects, in which local small-cell signals can easily interfere with macro cells if they are using the same radio carriers.

Interference management is of particular concern in HetNets since, by design, coverage areas of small coverage cells overlap with the macro cell. Beginning with Release 10, eICIC introduces an approach of almost-blank subframes by which subframe transmission can be muted to prevent interference. Figure 85 illustrates eICIC for the macro layer and pico layer coordination. If a UE is on a picocell but in a location where it is sensitive to interference from the macro layer, the macro layer can mute its transmission during specific frames when the pico layer is transmitting.

Figure 85: Example of Enhanced Intercell Interference Coordination[177]

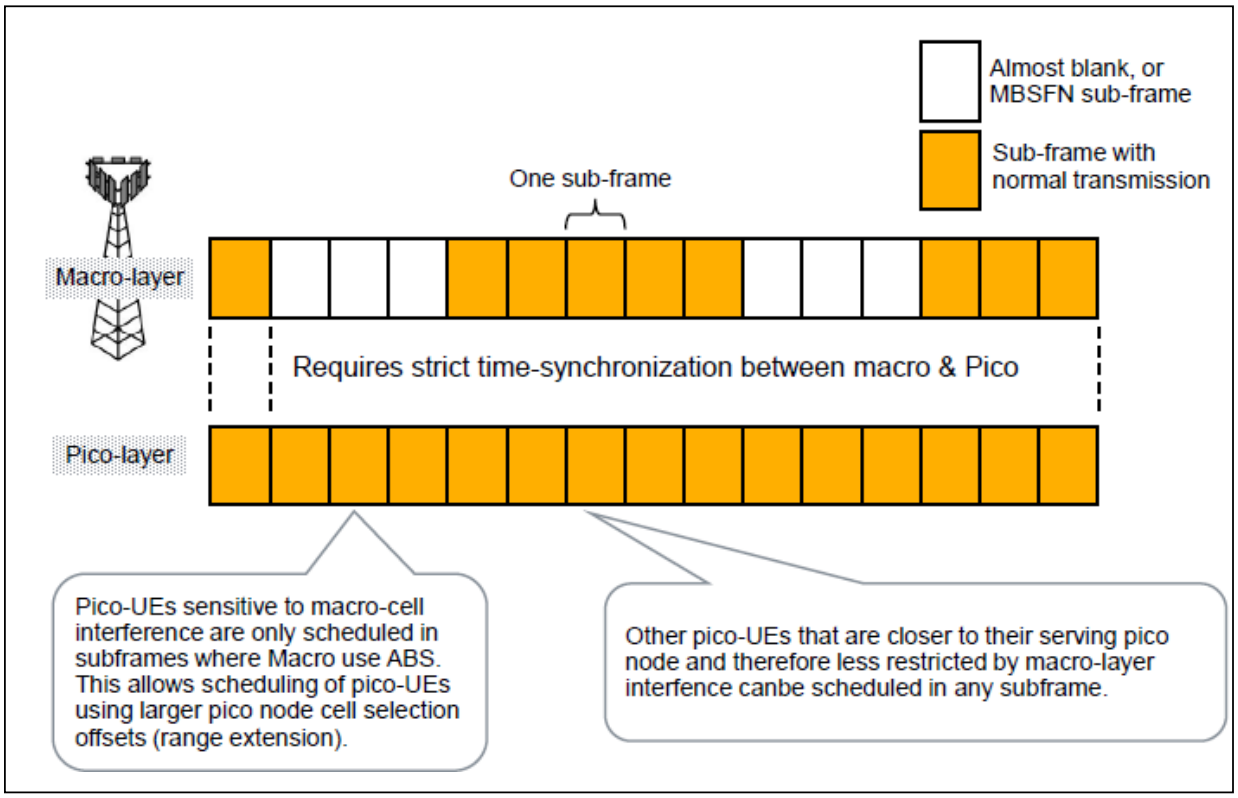

LTE can also combine eICIC with interference-cancellation-based devices to minimize the harmful effects of interference between picocells and macro cells.

Figure 86 shows one 4G America member's analysis of anticipated median throughput gains using picocells and Release 11 Further Enhanced ICIC.

[177] 5G Americas member contribution.

Figure 86: Median Throughput Gains in Hotspot Scenarios[178]

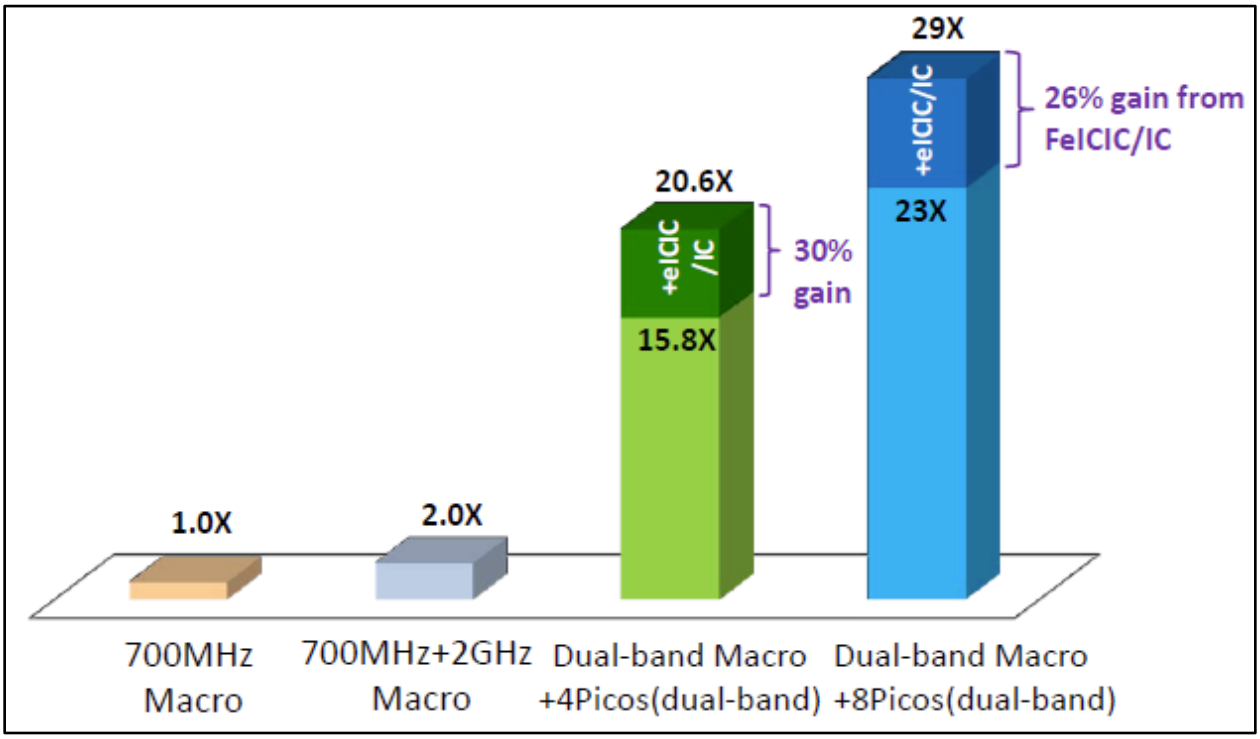

FeICIC is also beneficial in non-hotspot scenarios. In the case of a uniform distribution of picocells, this same 5G Americas member estimates a 130% gain from FeICIC for an eight picocell per macro-cell scenario, increasing capacity from a factor of 3.3 for the picocells alone to a factor of 7.6 with the addition of FeICIC.[179]

Further insight is available from Figure 87, which shows 5 percentile and 50 percentile throughput with and without eICIC under different conditions of range extension and almost blanked subframes.

[178] 5G Americas member contribution. Assumes 3GPP evaluation methodology TR 36.814, carrier-aggregation UEs, macro ISD = 1732m, 700 MHz and 2GHz carrier frequency, full-buffer traffic, FDD 10+10 MHz per carrier, 6-degree antenna downtilt, 4 or 8 Picos and 30 UEs per Macro cell, hotspot distribution with 20 of 30 UEs near picos, PF scheduler, 2x2 MIMO, TU3 channel, NLOS, local partitioning algorithm.

[179] Assumes 3GPP evaluation methodology TR 36.814, macro ISD = 1732m, 700 MHz and 2GHz carrier frequency, full-buffer traffic, 6-degree antenna downtilt, 30 carrier-aggregation UEs per Macro cell, uniform random layout, PF scheduler, FDD, 10+10 MHz per carrier, 2x2 MIMO, TU3 channel, NLOS, local partitioning algorithm. Additional information is available at ftp://ftp.3gpp.org/tsg_ran/WG1_RL1/TSGR1_66b/Docs/R1-113383.zip.

Figure 87: User Throughput Performance With / Without eICIC for Dynamic Traffic vs. Average Offered Load per Macro Cell Area[180]

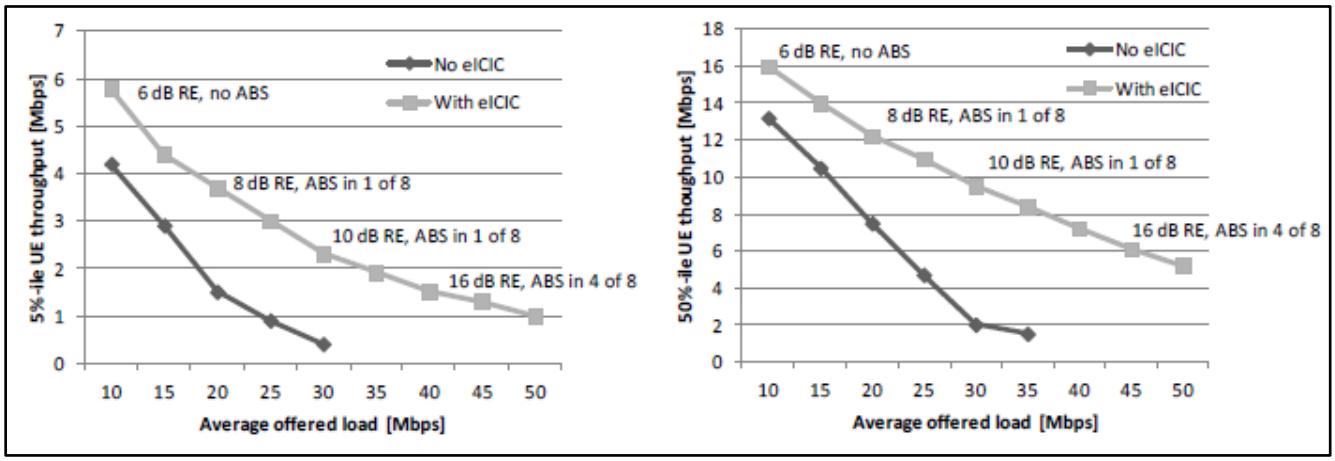

The muting of certain subframes in eICIC is dynamic and depends on identifying, on a per user basis, whether an interfering cell's signal exceeds a threshold relative to the serving cell signal. Coordinating muting among small cells can be complicated because a small cell can simultaneously be an interferer while serving a UE that is a victim of another cell. The network must therefore coordinate muting among multiple small cells.

Figure 88 below at left shows user throughput gains of time domain interference relative to network load. Throughput gains are higher at higher network loads because of more active users and the higher likelihood of interference between the small cells.

Figure 88 below at right shows the maximum muting ratio, which increases with higher network load.

[180] 5G Americas member contribution. Assumes 3GPP evaluation methodology TR 36.814, 500 meter ISD, 4 picos per macro-cell area, Poisson call arrival, finite payload for each call, and termination of call upon successful delivery.

Figure 88: Throughput Gain of Time-Domain Interference Coordination[181]

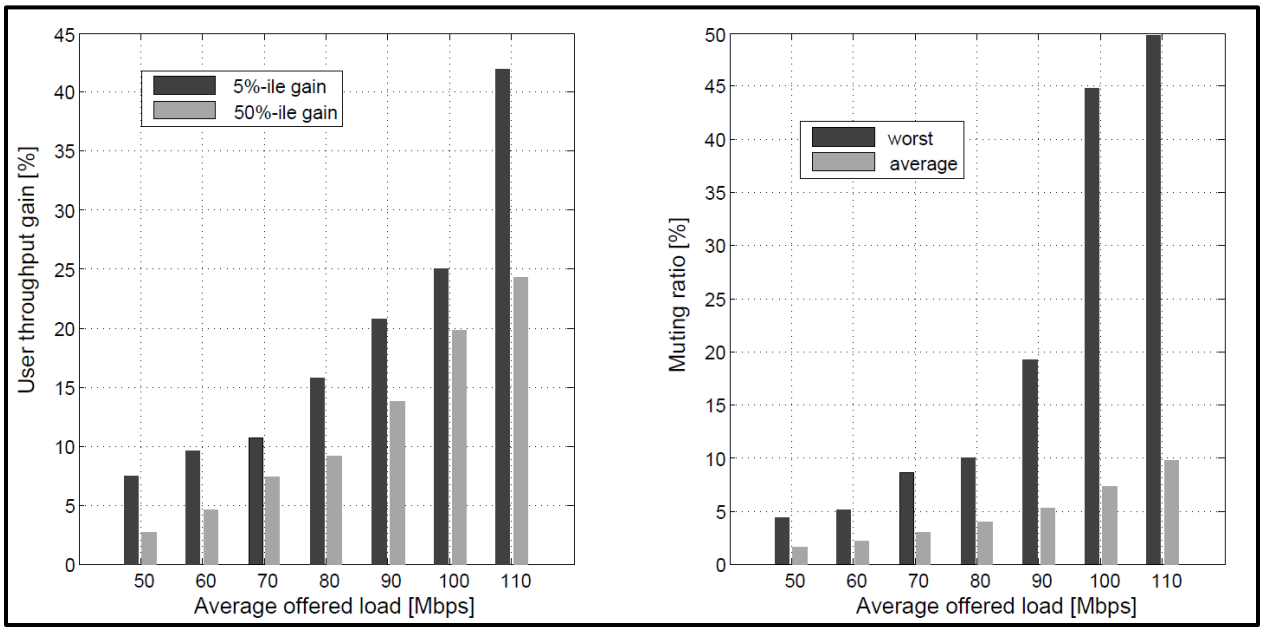

Another approach for addressing inter-layer interference cancellation in HetNets can come from carrier aggregation with no further additions or requirements and realizable with Release 10 LTE networks. Consider the scenario in Figure 89, in which both the macro eNB and the pico eNB are allocated two component carriers (namely CC1 and CC2). The idea is to create a "protected" component carrier for downlink control signals and critical information (Physical Downlink Control Channel, system information, and other control channels) while data can be conveniently scheduled on both component carriers through cross-carrier scheduling.

Figure 89: Carrier-Aggregation Based ICIC[182]

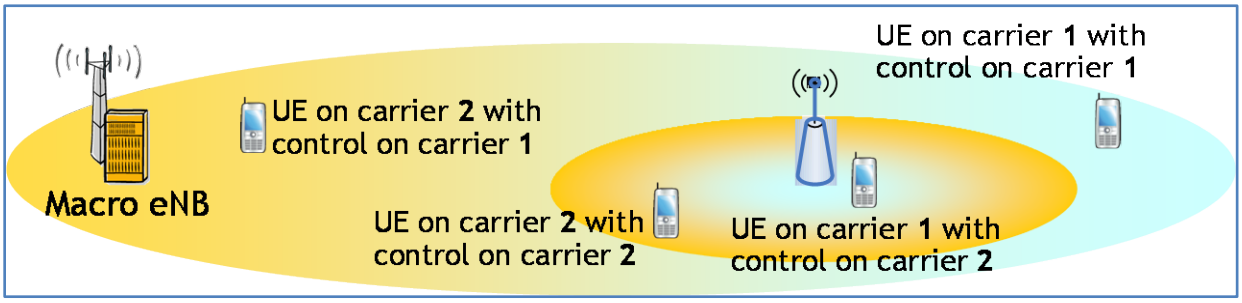

CC1 is the primary component carrier for the macro cell, while CC2 is the primary for the picocell; hence the protected carriers are CC1 for the macro cell and CC2 for the picocell. The macro cell allocates a lower transmission power for its secondary CC in order to reduce

[181] 5G Americas member contribution. Simulations based on 12 densely deployed small cells at 3.5 GHz and 3GPP Release 12 simulation assumptions in TR 36.842.

[182] 5G Americas member contribution.

interference to the picocell's primary component carrier. The network can schedule data on both the primary and secondary component carriers. In the figure, users in the cell range expansion (CRE) zone can receive data via cross-carrier scheduling from the secondary CC at subcarrier frequencies on which interference from the other cell can be reduced if the cells exchange appropriate signaling over what is called an "X2 interface." Users operating close to the eNodeBs can receive data from both component carriers as their interference levels will hopefully be lower. Therefore, a CA-capable receiver will enjoy the enhanced throughput capabilities of carrier aggregation, while simultaneously receiving extra protection for control and data channels at locations with potentially high inter-layer interference.

Thus, carrier aggregation can be a useful tool for deployment of heterogeneous networks without causing a loss of bandwidth. These solutions, however, do not scale well (in Release 10 systems) to small system bandwidths (say, 3+3 MHz or 1.4+1.4 MHz radio carriers) because control channels occupy a high percentage of total traffic. Additionally, interference between the cell reference signals (CRS) would also be significant.

Dual Connectivity

A major enhancement in Release 12 is a UE being served at the same time by both a macro cell and a small cell operating at different carrier frequencies, a capability called dual connectivity and illustrated in Figure 90. Data first reaches the macro eNodeB and is split, with part of it transmitted from the macro and the balance sent via an X2 interface to the small cell for transmission to the UE.

Figure 90: Dual Connectivity[183]

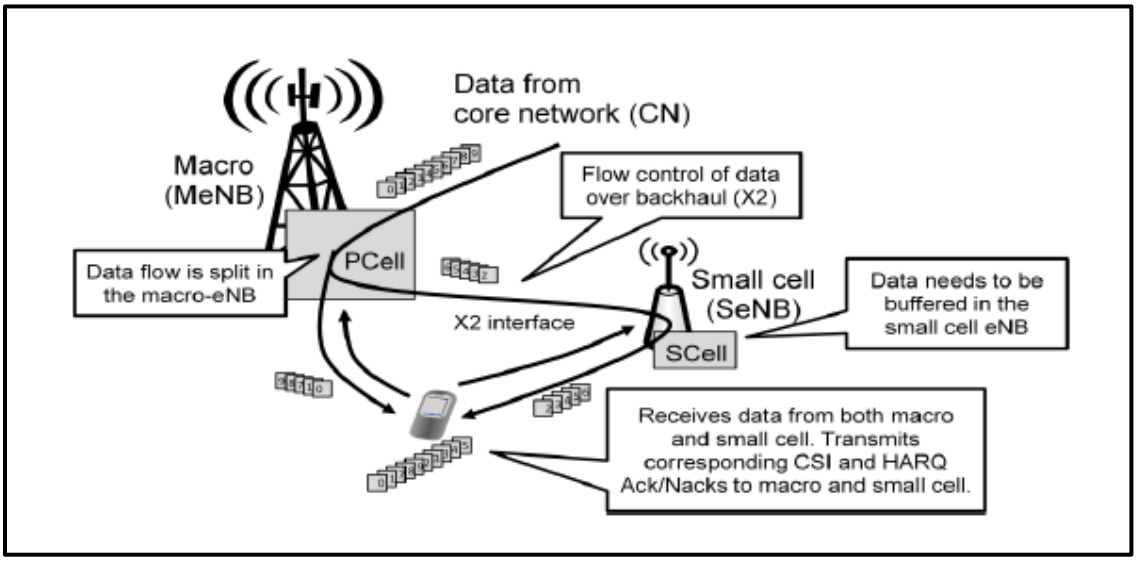

Figure 91 shows throughput gains of dual connectivity at 5 percentile and 50 percentile (median) levels relative to the load on the network and different degrees of latency in the X2 interface. Benefits are higher with lower network load and with lower X2 latency.

[183] Source: 5G Americas member contribution.

Figure 91: Dual Connectivity User Throughput[184]

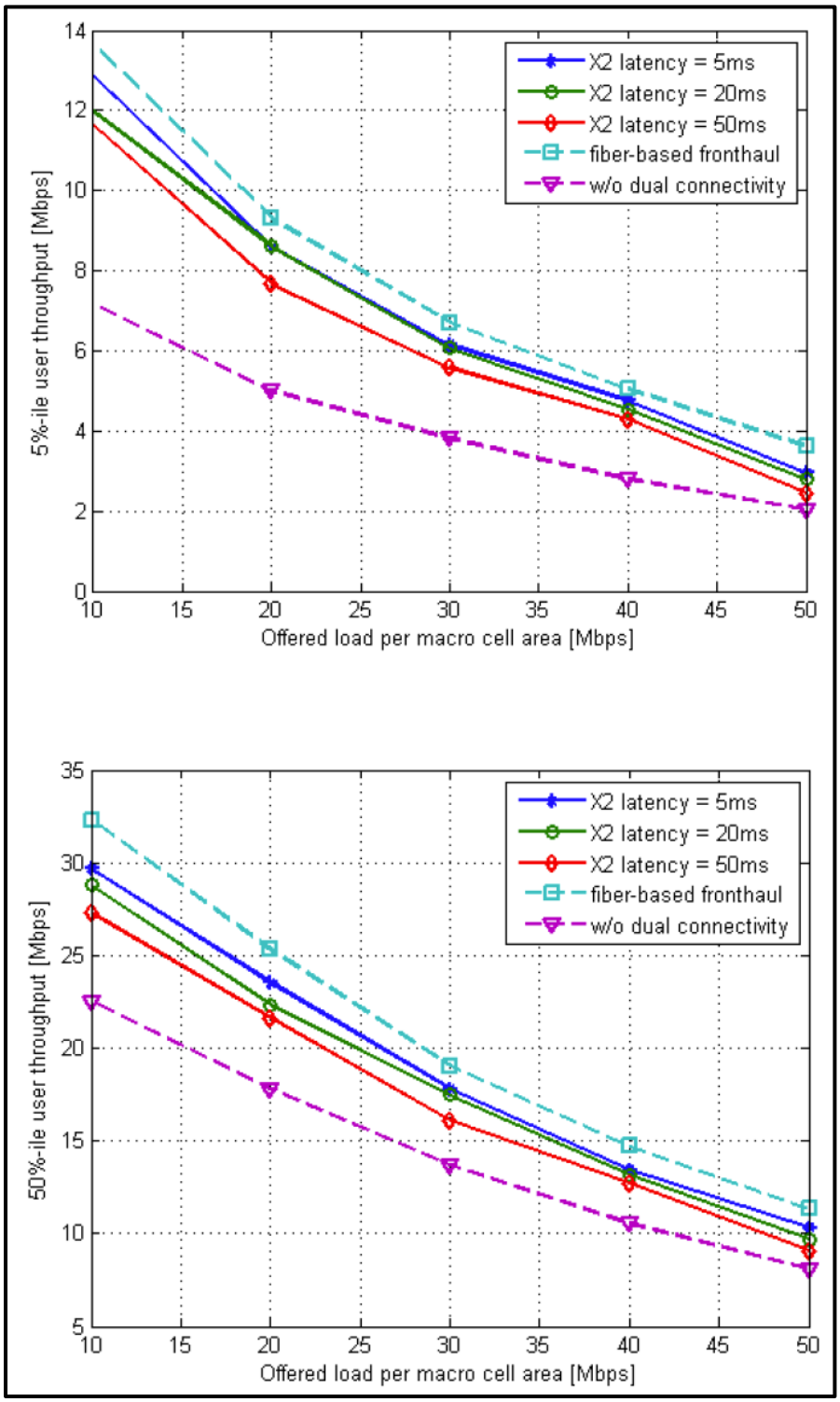

[184] 5G Americas member contribution.

Internet of Things and Machine-to-Machine

Anticipating huge growth in machine-to-machine communications, Release 11 added a Machine Type Communications (MTC) Interworking Function and Service Capability Server. Release 12 defined a category 0 device designed to deliver low cost through a single antenna design and other simplifications.[185] Release 13 went even further, with a category M-1 architecture that further reduces cost, improves range, and extends battery life. Category 13 also added Narrowband-IoT capability with Category NB-1 and an IoT solution for GSM, called "EC-GSM-IoT," that extends coverage by 20 dB. Category M-1 and NB-IoT devices could achieve battery life as high as 10 years.

Figure 92 depicts the methods used to reduce cost in a Category M device compared with a Category 4 device.

Figure 92: Means of Achieving Lower Cost in IoT Devices[186]

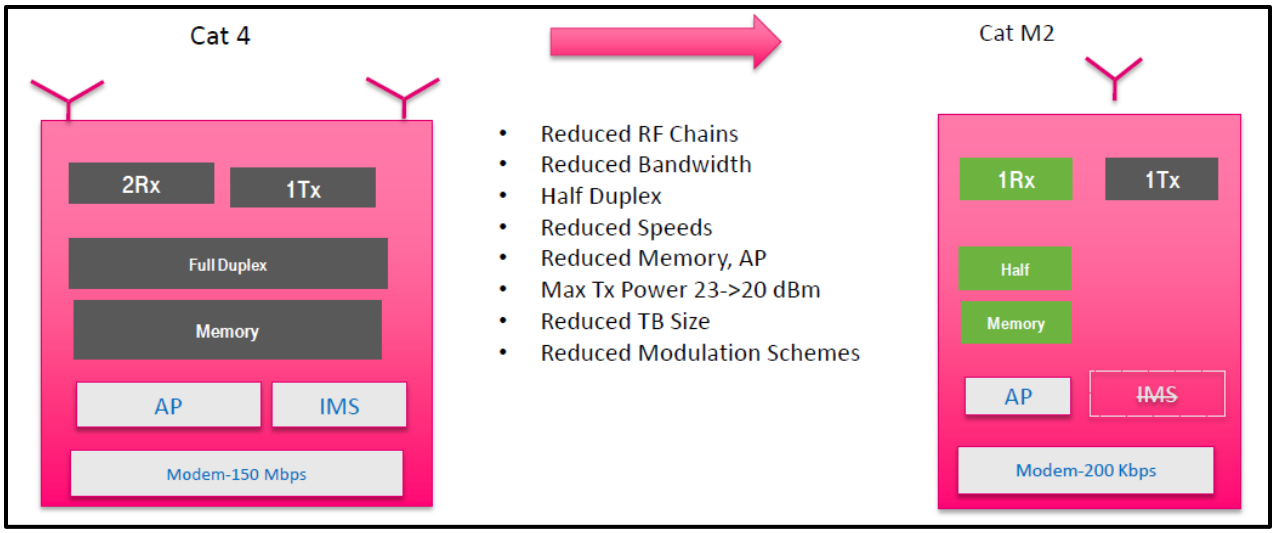

Table 26 summarizes the features of different LTE IoT devices based on 3GPP Release.

Table 26: Summary of IoT Features in LTE Devices

Device Category	Category 3	Category 1	Category 0	Category M-1	Category NB-1	EC-GSM-IoT
3GPP Release	10	11	12	13	13	13

[185] 3GPP, *Access System for Ultra Low Complexity and Low Throughput Internet of Things based on Cellular,* GP-140301, May 2014.

[186] 5G Americas member contribution.

Device Category	Category 3	Category 1	Category 0	Category M-1	Category NB-1	EC-GSM-IoT
Max. Data Rate Downlink	100 Mbps	10 Mbps	1 Mbps	1 Mbps	200 Kbps	74 Kbps
Max. Data Rate Uplink	50 Mbps	5 Mbps	1 Mbps	1 Mbps	200 Kbps	74 Kbps
Max. Bandwidth	20 MHz	20 MHz	20 MHz	1.08 MHz	0.18 MHz	0.2 MHz
Duplex	Full	Full	Optional half-duplex	Optional half-duplex	Half	Half
Max. Receive Antennas	Two	Two	One	One	One	One
Power		Power Save Mode[187]	Power Save Mode	Power Save Mode		
Sleep				Longer sleep cycles using Idle Discontinuous Reception (DRX)		
Coverage				Extended through redundant transmissions and Single Frequency Multicast		

Cloud Radio-Access Network (RAN) and Network Virtualization

Still in the early stages of development, cloud RAN (C-RAN) is a distributed architecture in which multiple remote radio heads connect to a "cloud" that consists of a farm of baseband processing nodes. This approach can improve centralized processing, as is needed for

[187] Power Save Mode specified in Release 12, but applicable to Category 1 device configured as Release 12.

CoMP, centralized scheduling, and Multiflow, without the need to exchange information among many access nodes. The performance of both LTE and HSPA technologies could be enhanced by the application of cloud RAN architectures. The term "fronthauling" has been used to describe the transport of "raw" radio signals to central processing locations, such as between the Physical Network Function (PNF) and a Virtual Network Function (VNF).

This architecture, shown in Figure 93, comes at the cost of requiring high-speed, low-latency backhaul links between these radio heads and the central controller. One vendor states that carrying 10+10 MHz of LTE with 2X2 MIMO requires 2.5 Gbps of bandwidth and imposes less than 0.1 msec of delay.[188] A standard called "Common Public Radio Interface" (CPRI) addresses generic formats and protocols for such a high-speed link. ETSI has also developed the Open Radio Equipment Interface (ORI). The feasibility of cloud RAN depends to a large extent on the cost and availability of fiber links between the remote radio heads and the centralized baseband processing location.

Unlike virtualizing the EPC, in which the entirety of the function can be virtualized, cloud RAN needs a PNF that terminates the RF interface. Cloud RAN therefore requires a split to be defined within the RAN. As a consequence, initial deployments of cloud RAN have looked to ruse the CPRI interface between the RRH and the baseband unit.

Figure 93: Potential Cloud RAN Approach

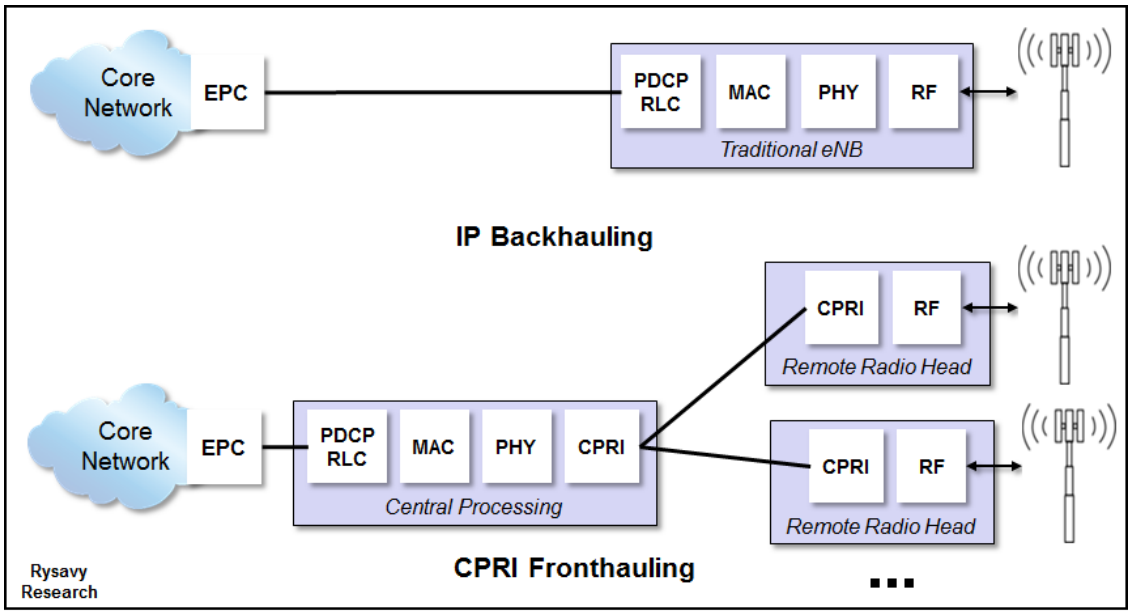

The next evolutionary step after centralizing baseband processing is to virtualize the processing by implementing the functions in software on commodity computing platforms, thus abstracting the functions from any specific hardware implementation.

C-RANs can vary by the extent of coverage, ranging from being highly localized and operating across a small number of sites to metropolitan-wide solutions. Other variables

[188] Dudu Bercovich, Ran Avital, "Holistic HetNet Hauling (3H)," Ceragon, February 2013. Available at http://www.ceragon.com/images/Reasource_Center/White_Papers/Ceragon_Holistic_Hetnet_Hauling_White_Paper.pdf.

include existing deployments versus greenfield situations, new LTE and 5G technologies versus integrating legacy 2G and 3G technologies, and integrating Wi-Fi. Greater scope increases complexity but yields benefits including better load-balancing and greater flexibility in spectrum re-farming.

Another design choice, as detailed in Table 27, is whether to centralize Layer 1 and Layer 2 functions (an RF-PHY split), or whether to keep Layer 1 at the base stations and centralize only Layer 2 (a PHY-MAC split).

Table 27: Partially Centralized Versus Fully Centralized C-RAN

	Fully Centralized	Partially Centralized
Transport Requirements	Multi-Gbps, usually using fiber	20 to 50 times less
Fronthaul Latency Requirement	Less than 100 microseconds	Greater than 5 milliseconds
Applications	Supports eICIC and CoMP	Supports centralized scheduling
Complexity	High	Lower
Benefit	Capacity gain	Lower capacity gain

Figure 94 analyzes the different possible RAN decompositions in greater detail.

Figure 94: Costs and Benefits of Various RAN Decompositions[189]

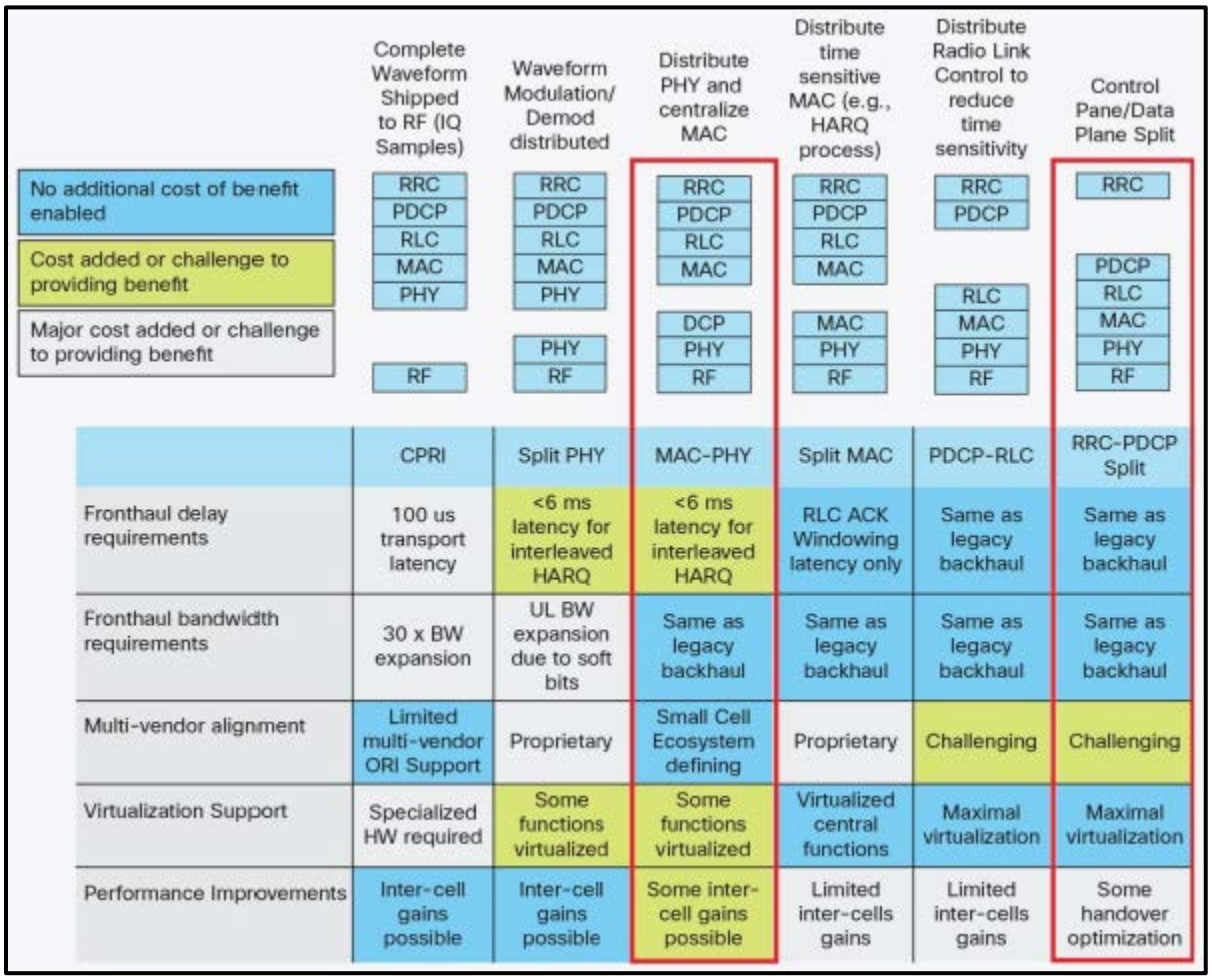

Although some operators in dense deployments with rich fiber assets may centralize all functions, Figure 94 uses the red rectangles to show the two most likely functional splits for LTE-Advanced and 5G:

1. **Distributed PHY and Centralized MAC.** This approach relaxes the fronthaul delay requirement to 6 msec, compared with the CPRI requirement of 250 microseconds. Fronthaul bandwidth requirement is only 10-20% greater than conventional backhaul.

2. **Control Plane/Data Plane Split.** This approach further relaxes fronthaul requirements to 30 msec and is the approach used for dual-connectivity, such as a macro and small cell simultaneously connecting to a user. For 5G, 3GPP Release 15 specifications standardize a split for cloud RAN between the PDCP and RLC layers.

[189] Cisco, *Cisco 5G Vision Series: Small Cell Evolution*, 2016.

Next Generation Mobile Networks studied the pros and cons of different fronthauling interfaces and published the results in March 2015.[190]

Longer-term, perhaps in the 5G context, virtualized C-RANs may take away the very concept of cells. With methods such as beamforming and device-to-device communication, coverage may extend dynamically from a multitude of sources based on instantaneous load notifications and the radio resources available at different nodes.

In the past, RAN and core networks have been distinct entities, but over the next decade, the two may merge with more centralized, virtualized, and cloud-driven approaches.

Another form of virtualization is software-defined networking, an emerging trend in both wired and wireless networks. For cellular, SDN promises to reduce OPEX costs, simplify the introduction of new services, and improve scalability; all major infrastructure vendors are involved. The Open Networking Foundation explains that an SDN decouples the control and data planes, centralizing network state and intelligence, while abstracting the underlying network infrastructure from applications.[191] Virtualization of network functions will be a complex, multi-year undertaking and will occur in stages, as shown in Figure 95.

[190] Next Generation Mobile Networks, *Further Study on Critical C-RAN Technologies, Version 1.0*, March 2015. See sections 2.2 and 2.3. Available at https://www.ngmn.org/uploads/media/NGMN_RANEV_D2_Further_Study_on_Critical_C-RAN_Technologes_v1.0.pdf.

[191] Open Networking Foundation, "Software-Defined Networking: The New Norm for Networks," http://www.opennetworking.org/sdn-resources/sdn-library/whitepapers, accessed June 20, 2014.

Figure 95: Software-Defined Networking and Cloud Architectures[192]

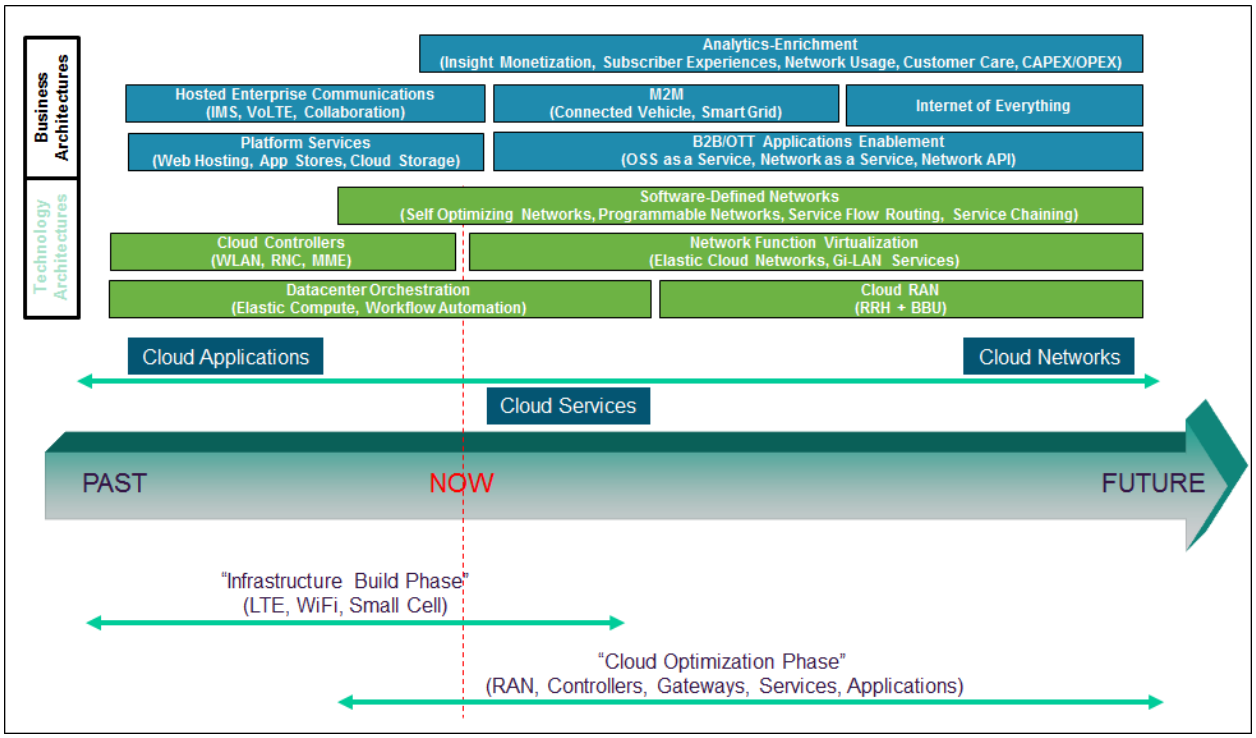

Unlicensed Spectrum Integration

See the earlier section in this report on unlicensed spectrum integration, which includes a discussion of LTE-U, LTE-LAA, MulteFire, LWA, LWIP, and RCLWI. This section covers integration approaches other than these.

3GPP has evolved its thinking on how best to integrate Wi-Fi with 3GPP networks. At the same time, the Wi-Fi Alliance and other groups have also addressed hotspot roaming, namely the ability to enable an account with one public Wi-Fi network provider to use the services of another provider that has a roaming arrangement with the first provider.

The multiple attempts to make Wi-Fi networks universally available have made for a confusing landscape of integration methods, which this section attempts to clarify. Most integration today is fairly loose, meaning that either a device communicates data via the cellular connection or via Wi-Fi. If via Wi-Fi, the connection is directly to the internet and bypasses the operator core network. In addition, any automatic handover to hotspots occurs only between the operator cellular network and operator-controlled hotspots. The goals moving forward are to:

- Support roaming relationships so that users can automatically access Wi-Fi hotspots operated by other entities.
- Enable automatic connections so that users do not have to enter usernames and passwords. In most cases, this will mean authentication based on SIM credentials.

[192] 5G Americas member contribution.

- Provide secure communications on the radio link as provided by the IEEE 802.11i standard.
- Allow policy-based mechanisms that define the rules by which devices connect to various Wi-Fi networks.
- Enable simultaneous connections to both cellular and Wi-Fi, with control over which applications use which connections.
- Support different types of Wi-Fi deployments, including third-party access points and carrier access points.

Release 6 I-WLAN

3GPP Release 6 was the first release to offer the option of integrating Wi-Fi in a feature called "Interworking WLAN" (I-WLAN), using a separate IP address for each network type.

Release 8 Dual Stack Mobile IPv6 and Proxy Mobile IPv6

3GPP Release 8 specified Wi-Fi integration with the EPC using two different approaches: host-based mobility with Dual Stack Mobile IPv6 (DSMIPv6) in the client, and network based mobility with Proxy Mobile IPv6 (PMIPv6) using an intermediary node called an "Enhanced Packet Data Gateway" (ePDG).[193] This method is intended for untrusted (non-carrier-controlled) Wi-Fi networks.

Release 11 S2a-based Mobility over GTP

Release 11, however, implements a new and advantageous approach as shown in Figure 96, one that eliminates the ePDG. Called "S2a-based Mobility over GTP" (SaMOG), a trusted WLAN Access Gateway connects to multiple 3GPP-compliant access points. Traffic can route directly to the internet or traverse the packet core. This method is intended for trusted (carrier-controlled) Wi-Fi networks.

[193] 3GPP, *System Architecture Evolution (SAE); Security aspects of non-3GPP accesses*. TS 33.402.

Figure 96: Release 11 SaMOG-based Wi-Fi Integration

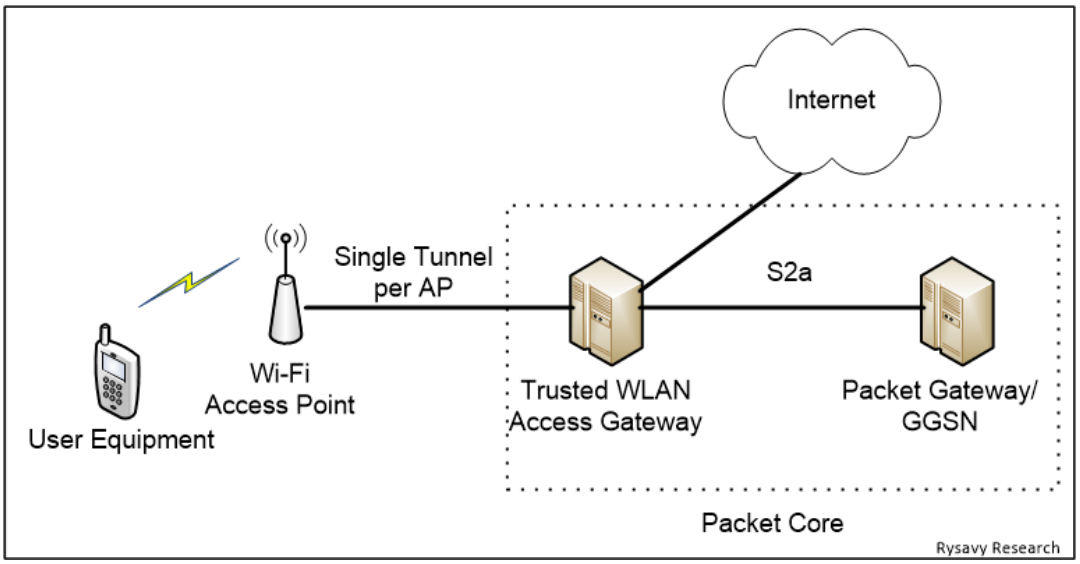

Release 12 improves SaMOG capabilities in Enhanced SaMOG (eSaMOG), in which UEs can:

- Request the connectivity type
- Indicate the Access Point Name (APN) to establish PDN connectivity
- Request to hand over an existing PDN connection
- Establish multiple PDN connections in parallel over the WLAN
- Establish a non-seamless WLAN offload connection in parallel to a Packet Data Network connection over WLAN.

Multipath TCP

A new method for potentially integrating Wi-Fi and 3GPP networks is based on work by the Internet Engineering Taskforce (IETF). Called "Multipath TCP," the approach allows a TCP connection to occur simultaneously over two different paths. The advantages of this approach include higher speeds by aggregating links and not requiring any special provisions for link-layer handovers.

The IETF has published an experimental specification, *Request for Comments 6824: CP Extensions for Multipath Operation with Multiple Addresses*, which explains this approach. The IETF is also specifying Multipath QUIC.

ANDSF

Another relevant specification is 3GPP Access Network Discovery and Selection Function (ANDSF), which provides mechanisms by which mobile devices can know where, when, and how to connect to non-3GPP access networks, such as Wi-Fi.[194] ANDSF operates independently of SaMOG or other ways that Wi-Fi networks might be connected.

[194] 3GPP, *Architecture enhancements for non-3GPP accesses, Technical Specification 23.402*.

ANDSF functionality increases with successive 3GPP versions, as summarized in Table 28.

Table 28: ANDSF Policy Management Objects and 3GPP Releases[195]

ANDSF Policy Type	Policy Rule & Management Object	Release 8, 9	Release 10, 11	Release 12
Inter-System Mobility Policy (ISMP)	Policy, Rule priority, Prioritized Access, Validity Area (3G,4G, WI-FI, Geo), PLMN, Time-of-Day	X	X	X
Discovery Info	Access Network Type, Access Network Area (3G, 4G, Wi-Fi, Geo), Access Network Reference	X	X	X
UE Location	3GPP, 3GPP2, WiMAX, Wi-Fi network ID, Geo Location, PLMN	X	X	X
Inter-System Routing Policy (ISRP)	Flow Based routing, Service Based routing, Non-Seamless Offload, Roaming, PLMN, Routing Criteria, Time-of-Day, Routing rule		X	X
UE Profile	Device app/OS capability		X	X
Inter-APN Routing Policy (IARP)	Inter-APN routing over IP interface (in progress)			X
WLAN Selection Policy	Operator defined WLAN selection policy			X
Rule Selection Information	VPLMN with preferred WLAN roaming			X
Home Operator Preference	Home SP preference for S2a PDN session			X

Bidirectional Offloading Challenges

Eventually, operators will be able to closely manage user mobile broadband and Wi-Fi connections, dynamically selecting a particular network for a user based on real-time changes in loads and application requirements. Work is occurring in Release 12 to define parameters that would control switching from LTE to Wi-Fi or from Wi-Fi to LTE.[196]

Bidirectional offloading, however, creates various challenges, as shown in Figure 97 and discussed below.

[195] Courtesy Smith Micro Software, 2014. http://www.smithmicro.com.

[196] 3GPP, *Study on Wireless Local Area Network (WLAN) - 3GPP radio interworking (Release 12)*, TR 37.834.

Figure 97: Bidirectional Offloading Challenges

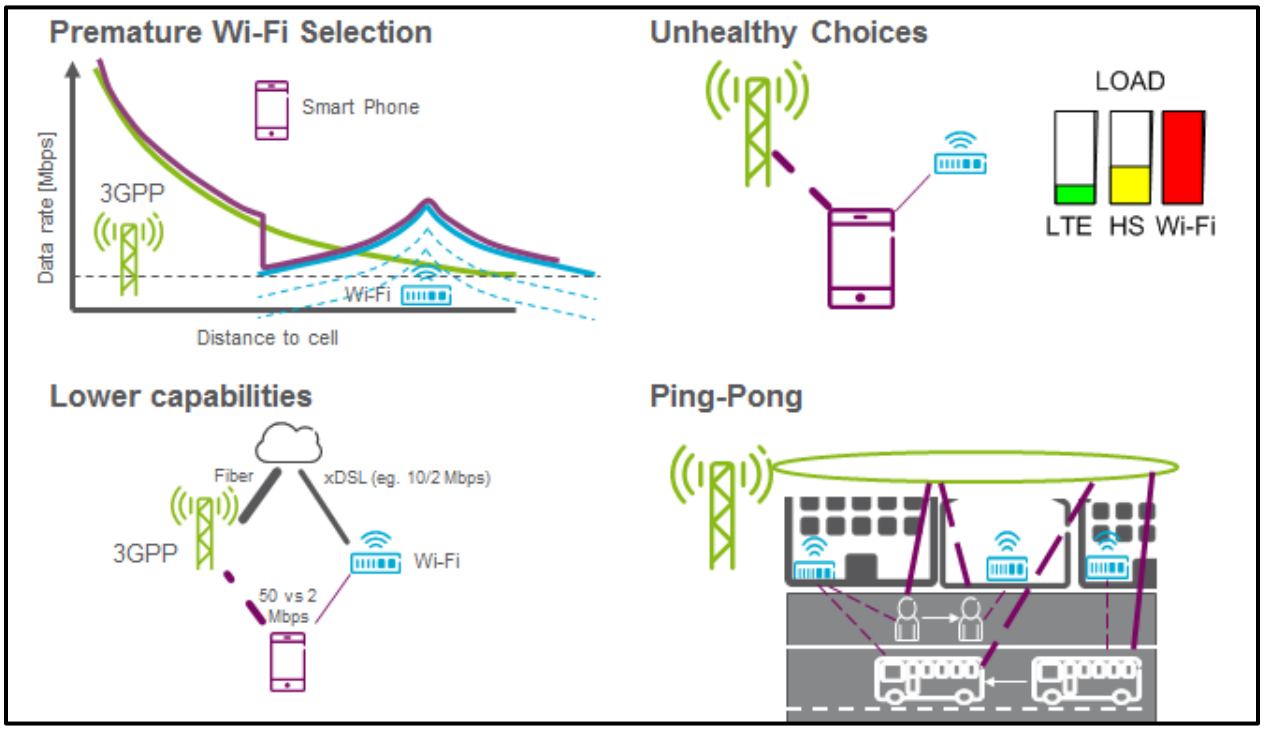

- **Premature Wi-Fi Selection.** As Wi-Fi-capable devices move into Wi-Fi coverage, they can prematurely reselect to Wi-Fi without comparative evaluation of existing cellular and incoming Wi-Fi capabilities, possibly resulting in the degradation of the end user experience. Real-time throughput-based traffic steering can mitigate this effect.
- **Unhealthy choices.** In a mixed network of LTE, HSPA, and Wi-Fi, reselection can occur due to a strong Wi-Fi network signal even though the network is under heavy load. The resulting "unhealthy" choice degrades the end user experience because the performance on the cell edge of a lightly loaded cellular network may be superior to that of the heavily loaded Wi-Fi network. Real-time load-based traffic steering can be beneficial in this scenario.
- **Lower capabilities.** In some cases, selection to a Wi-Fi network may result in reduced performance even if it offers a strong signal because of other factors, such as lower-bandwidth backhaul. Evaluation of criteria beyond wireless capabilities prior to access selection can improve this circumstance.
- **Ping-Pong.** Ping-ponging between Wi-Fi and cellular, especially if both offer similar signal strengths, can also degrade the user experience. Hysteresis approaches, similar to those used in cellular inter-radio transfer, can better manage transfer between Wi-Fi and cellular accesses.

3GPP RAN2 is discussing real-time or near-real-time methods to address the challenges discussed above.

Other Integration Technologies (SIPTO, LIPA, IFOM, MAPCON)

Release 10 defines additional options for Wi-Fi integration, including Selected IP Traffic Offload (SIPTO), Local IP Access (LIPA), Multi-Access PDN Connectivity (MAPCON), and IP Flow and Seamless Offload (IFOM).

SIPTO is mostly a mechanism to offload traffic that does not need to flow through the core, such as internet-destined traffic. SIPTO can operate on a home femtocell, or it can operate in the macro network.

Local IP Access (LIPA) provides access to local networks, useful with femtocells that normally route all traffic back to the operator network. With LIPA, the UE in a home environment can access local printers, scanners, file servers, media servers, and other resources.

IFOM, as shown in Figure 98, enables simultaneous cellular and Wi-Fi connections, with different traffic flowing over the different connections. A Netflix movie could stream over Wi-Fi, while a VoIP call might flow over the cellular-data connection. IFOM requires the UE to implement Dual Stack Mobile IPv6 (DSMIPv6).

Figure 98: 3GPP IP Flow and Seamless Mobility

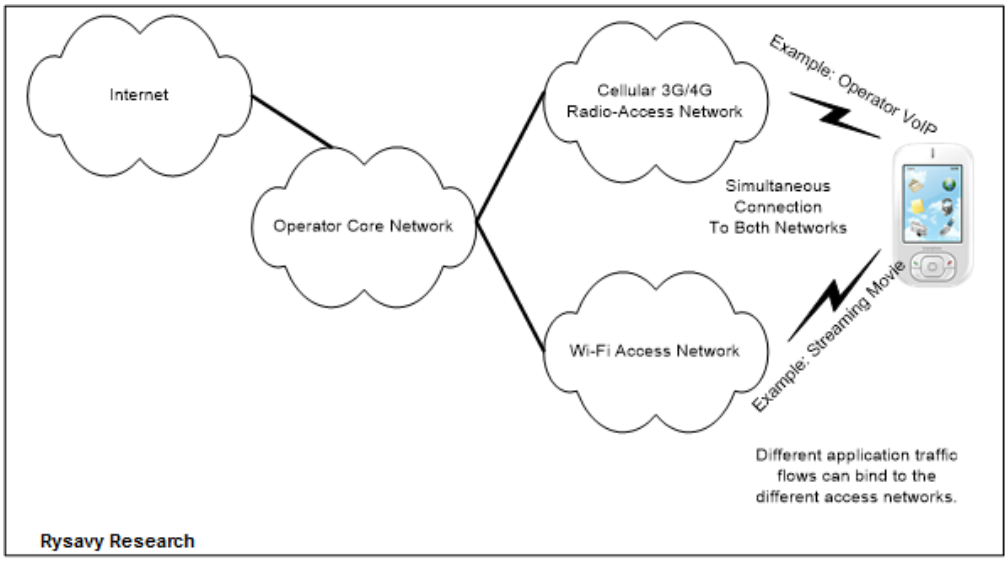

Similar to IFOM, Release 10 feature MAPCON allows multiple simultaneous PDN connections (each with a separate APN), such as Wi-Fi and 3GPP radio access. The UE uses separate IP addresses for each connection but does not need Dual Stack Mobile IPv6 (DSMIPv6).

Hotspot 2.0

Developed by the Wi-Fi Alliance, Hotspot 2.0 specifications, also called “Next Generation Hotspot,” facilitate Wi-Fi roaming. Using the IEEE 802.11u standard that allows devices to determine what services are available from an access point, Hotspot 2.0 simplifies the process by which users connect to hotspots, automatically identifying roaming partnerships

and simplifying authentication and connections, as shown in Figure 99.[197] It also provides for encrypted communications over the radio link.[198]

Figure 99: Roaming Using Hotspot 2.0

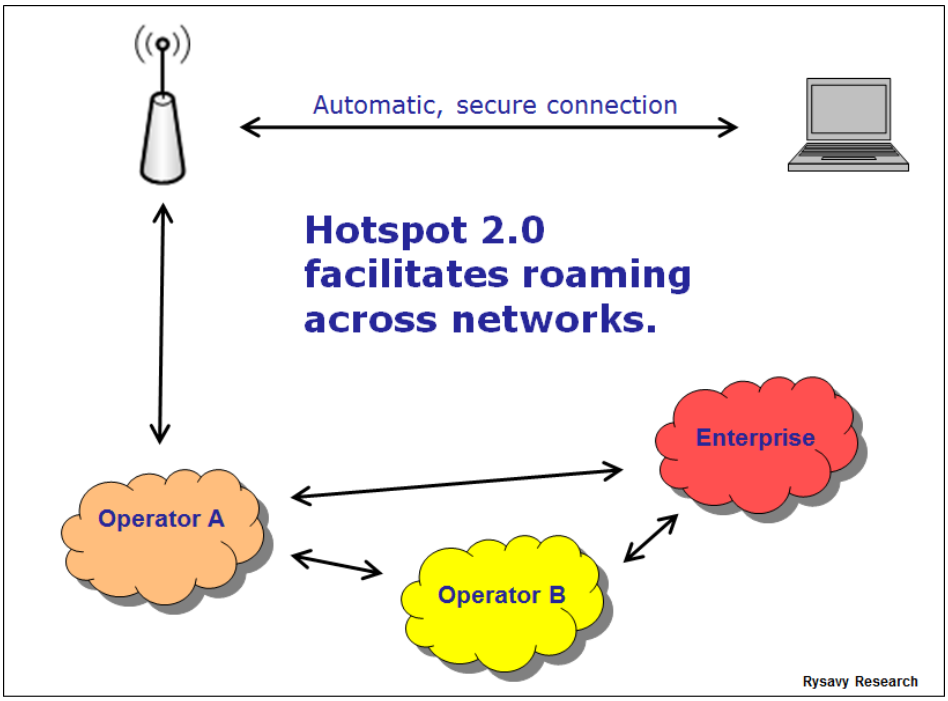

Using IEEE 802.11u, devices can determine what roaming relationships an access point supports and can then securely connect to the Wi-Fi network using one of these roaming arrangements, as shown in Figure 100. Hotspot 2.0 authentication is based on the Extended Authentication Protocol (EAP) using SIM credentials. There are plans to enhance the Hotspot 2.0 protocols in Phase 2, which will define online signup to enable non-SIM-based devices to easily and securely register for services. The Wi-Fi Alliance began a Hotspot 2.0 certification process for devices and access points in June 2012 and uses the designation "Wi-Fi Certified Passpoint" for compliant devices.

[197] For example, user devices can be authenticated based on their SIM credentials. Or, users can register or click through an agreement and then not need to redo that with future associations.

[198] The IEEE 802.11i standard has provided encryption for 802.11 communications for many years; however, most hotspots have not implemented this encryption, whereas Hotspot 2.0 does.

Figure 100: Hotspot 2.0 Connection Procedure

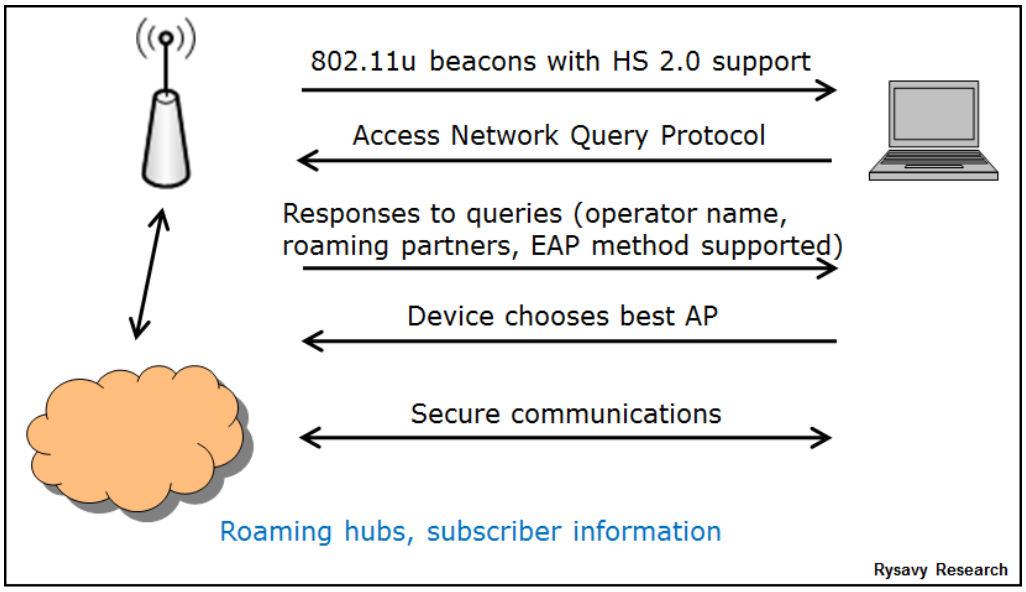

Release 2 of Passpoint, available in 2014, added immediate account provisioning, which facilitates a user establishing an account at the point of access. The new version also provides for policies to be downloaded from the network operator; these policies control network selection priorities when multiple networks are available.

Self-Organizing Networks (SON)

As the number of base stations increase through denser deployments and through deployment of femtocells and picocells, manual configuration and maintenance of this infrastructure becomes impractical. With SON, base stations organize and configure themselves by communicating with one another and with the core network. SONs can also self-heal in failure situations.

3GPP began standardization of self-optimization and self-organization in Releases 8 and 9, a key goal being support of multi-vendor environments. Successive releases have augmented SON capabilities.

Features being defined in SON include:

- Automatic inventory;
- Automatic software download;
- Automatic neighbor relation;
- Automatic physical Cell ID assignment;
- Mobility robustness/handover optimization;
- Random access channel optimization;
- Load-balancing optimization;
- Inter-cell interference coordination (ICIC) management;

- Enhanced inter-cell interference coordination (eICIC) management;
- Coverage and capacity optimization;
- Cell outage detection and compensation;
- Self-healing functions;
- Minimization of drive testing;
- Energy savings; and
- Coordination among various SON functions.

3GPP categorizes SON as centralized, distributed, or hybrid, which is a combination of centralized and distributed approaches.

In a centralized architecture, SON algorithms operate on a central network management system or central SON server. In contrast, in a distributed approach, the SON algorithms operate at the eNBs, which make autonomous decisions based on local measurements as well as from other nearby eNBs received via an X2 interface that interconnects eNBs.

The distributed architecture permits faster and easier deployment but is not necessarily as efficient or as consistent in operation, especially in multi-vendor infrastructure deployments.

In a hybrid approach, shown in Figure 101, SON algorithms operate both at the eNB and at a central SON server, with the server supplying values of initial parameters, for example. The eNBs may then update and refine those parameters in response to local measurements.

The hybrid approach resolves deployment scenarios that cannot be resolved by dSON, for example, cases such as:

- No X2 interface between the eNBs.
- Multi-vendor deployment with different dSON algorithms.
- Multi-technology load balancing and user steering.

Figure 101: Hybrid SON Architecture[199]

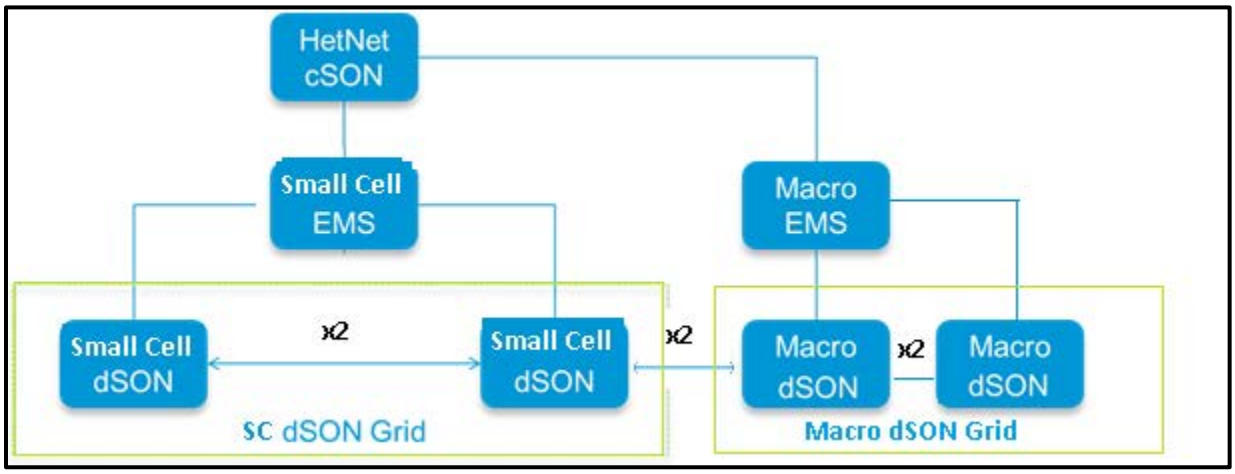

With increasing numbers of macro cells and small cells, interference opportunities increase as well. Optimizing power settings through intelligent power management algorithms is crucial for maximum efficiency with the least amount of interference, including pilot pollution. Pilot pollution can result in low data rates and ping-pong handovers due to channel fading. A hybrid SON approach is well suited for optimized power management.

IP Multimedia Subsystem (IMS)

IP Multimedia Subsystem (IMS) is a service platform for IP multimedia applications: video sharing, PoC, VoIP, streaming video, interactive gaming, and others. IMS by itself does not provide all these applications. Rather, it provides a framework of application servers, subscriber databases, and gateways to make them possible. The exact services will depend on cellular operators and the application developers that make these applications available to operators. The primary application in 2016, however, is VoLTE.

The core networking protocol used within IMS is Session Initiation Protocol (SIP), which includes the companion Session Description Protocol (SDP) used to convey configuration information such as supported voice codecs. Other protocols include Real Time Transport Protocol (RTP) and Real Time Streaming Protocol (RTSP) for transporting actual sessions. The QoS mechanisms in UMTS will be an important component of some IMS applications.

Although originally specified by 3GPP, numerous other organizations around the world are supporting IMS. These include the IETF, which specifies key protocols such as SIP, and the Open Mobile Alliance, which specifies end-to-end, service-layer applications. Other organizations supporting IMS include the GSMA, ETSI, CableLabs, 3GPP2, The Parlay Group, the ITU, ANSI, the Telecoms and Internet Converged Services and Protocols for Advanced Networks (TISPAN), and the Java Community Process (JCP).

IMS is relatively independent of the radio-access network and can, and likely will, be used by other radio-access networks or wireline networks. Other applications include picture and video sharing that occur in parallel with voice communications. Operators looking to roll out VoIP over networks will use IMS. For example, VoLTE depends on IMS infrastructure.

[199] 5G Americas member contribution.

3GPP initially introduced IMS in Release 5 and has enhanced it in each subsequent specification release.

As shown in Figure 102, IMS operates just outside the packet core.

Figure 102: IP Multimedia Subsystem

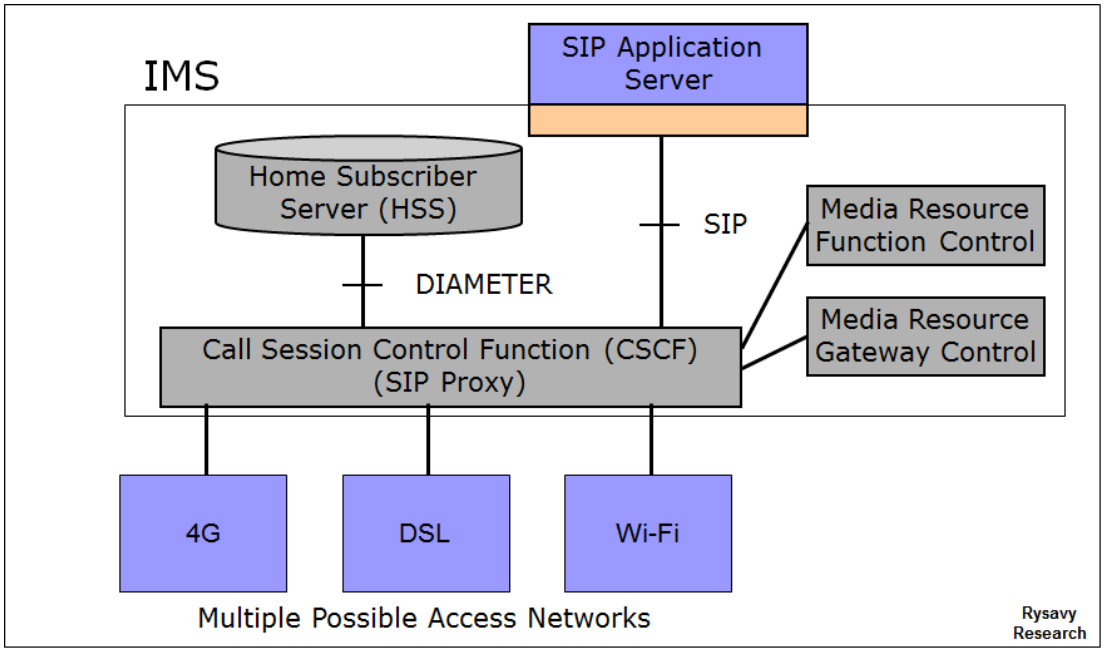

The benefits of using IMS include handling all communication in the packet domain, tighter integration with the internet, and a lower cost infrastructure based on IP building blocks for both voice and data services.

IMS applications can reside either in the operator's network or in third-party networks including those of enterprises. By managing services and applications centrally—and independently of the access network—IMS can enable network convergence. This allows operators to offer common services across 3G, Wi-Fi, and wireline networks.

Service Continuity, defined in Release 8, provided for a user's entire session to continue seamlessly as the user moves from one access network to another. Release 9 expanded this concept to allow sessions to move across different device types. For example, the user could transfer a video call in midsession from a mobile phone to a large-screen TV, assuming both have an IMS appearance in the network.

Release 8 introduced the IMS Centralized Services (ICS) feature, which allows for IMS-controlled voice features to use either packet-switched or circuit-switched access.

Given that LTE operators will integrate their 5G networks with their current LTE networks, operators are likely to keep using IMS in conjunction with LTE for their voice and other services that use IMS, even as they begin deploying 5G.

Broadcast/Multicast Services

An important capability for 3G and evolved 3G systems is broadcasting and multicasting, wherein multiple users receive the same information using the same radio resource. This

creates a more efficient approach to deliver video when multiple users desire the same content simultaneously. In a broadcast, every subscriber unit in a service area receives the information, whereas in a multicast, only users with subscriptions receive the information. Service areas for both broadcast and multicast can span either the entire network or a specific geographical area. Potential applications include sporting events, select news, venue-specific (shopping mall, museum) information, and even delivery of software upgrades. Giving users the ability to store and replay select content could further expand the scope of applications.

3GPP defined highly efficient broadcast/multicast capabilities for UMTS in Release 6 with MBMS. Release 7 defined optimizations through a feature called multicast/broadcast, single-frequency network operation that involves simultaneous transmission of the exact waveform across multiple cells. This enables the receiver to constructively superpose multiple MBMS Single Frequency Network (SFN), or MBSFN, cell transmissions. The result is highly efficient, WCDMA-based broadcast transmission technology that matches the benefits of OFDMA-based broadcast approaches.

LTE also has a broadcast/multicast capability called eMBMS. OFDM is particularly well suited for efficient broadcasting, as shown in Figure 103, because the mobile system can combine the signal from multiple base stations, also an MBSFN approach, and because of the narrowband nature of OFDM. Normally, these signals would interfere with one another. The single frequency network is a cluster of cells that transmit the same content synchronously with a common carrier frequency.

Figure 103: OFDM Enables Efficient Broadcasting

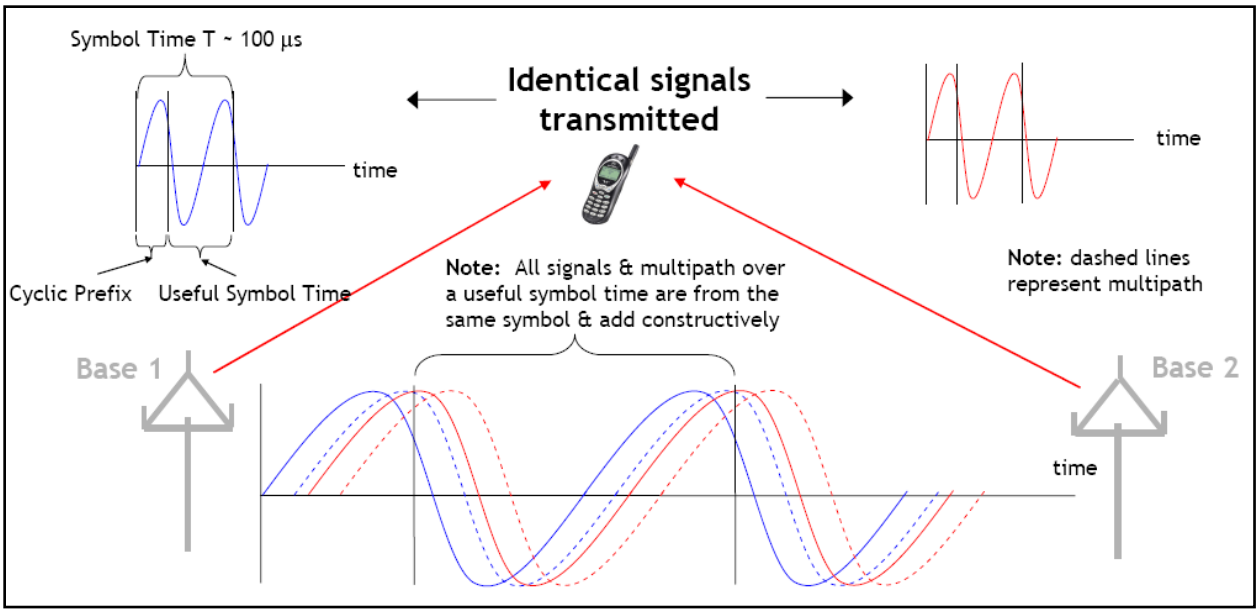

Despite various broadcast technologies being available, market adoption to date has been relatively slow. Internet trends have favored unicast approaches, with users viewing videos of their selection on demand, but there is increasing interest in using eMBMS with LTE to alleviate capacity demands.

Backhaul

Connecting sites to core networks remains a challenge, whether for small cells or macro cells, especially as networks need to deliver higher bandwidth. Fiber is the gold standard, but it is not available everywhere and can be expensive, so operators use a combination of wired and wireless links.

Today's backhaul requirements for LTE can range from 1 to 10 Gbps. By 2020, backhaul requirements could exceed 10 Gbps.[200]

Table 29 and Table 30 summarize the methods and capabilities of the various available approaches.

Table 29: Wired Backhaul Methods and Capabilities[201]

Technology	Distance	Throughput Speed
Direct Fiber	80 km	Hundreds of Mbps to Gbps
Bonded VDSL2	To 5,000 feet	75 Mbps down, 12 Mbps up
FTTX	Most urban areas	Up to 2.5 Gbps down, 1.5 Gbps up
DOCSIS	Most urban areas	Up to 285 Mbps down, 105 Mbps up

Table 30: Wireless Backhaul Methods and Capabilities[202]

Technology	Distance	Line-of-Sight	Throughput Speed
5G Integrated Access and Backhaul	1 km	Yes	1 to 10 Gbps
Millimeter Wave (60 GHz)	1 km	Yes	1 Gbps
Millimeter Wave (70-80 GHz)	3 km (with speed tradeoff)	Yes	10 Gbps
Microwave (6-60 GHz)	Varies by frequency: 2-4 km typical at 30-42 GHz	Yes	1 Gbps+

[200] Arthur D. Little, *Creating a Gigabit Society – The Rule of 5G; A report by Arthur D. Little for Vodafone Group,* 2017. See Figure 6.

[201] Small Cell Forum, "Backhaul Technologies for Small Cells," February 2013.

[202] Ibid.

Technology	Distance	Line-of-Sight	Throughput Speed
Licensed sub 6 GHz	1.5 to 10 km	No	170 Mbps (20 MHz TDD), 400 Mbps+ with new technology
Unlicensed sub-6 GHz	Up to 250 meters	No	450 Mbps (IEEE 802.11n 3X3 MIMO)
TV White Space (802.11af-based)	1 to 5 km max throughput, 10 km+ possible	Depends on deployment model	80 Mbps in 6 MHz TDD with 4X4 MIMO
Satellite	Available everywhere	Yes	Up to 50 Mbps downlink, 15 Mbps uplink

UMTS-HSPA

UMTS technology is mature and benefits from research and development that began in the early 1990s. It has been thoroughly trialed, tested, and commercially deployed. UMTS employs a wideband CDMA radio-access technology. The primary benefits of UMTS include high spectral efficiency for voice and data, simultaneous voice and data capability, high user densities that can be supported with low infrastructure costs, and support for high-bandwidth data applications. Operators can also use their entire available spectrum for both voice and high-speed data services.

Additionally, operators can use a common core network, called the UMTS multi-radio network as shown in Figure 104, which supports multiple radio-access networks including GSM, EDGE, WCDMA, HSPA, and evolutions of these technologies.

Figure 104: UMTS Multi-radio Network

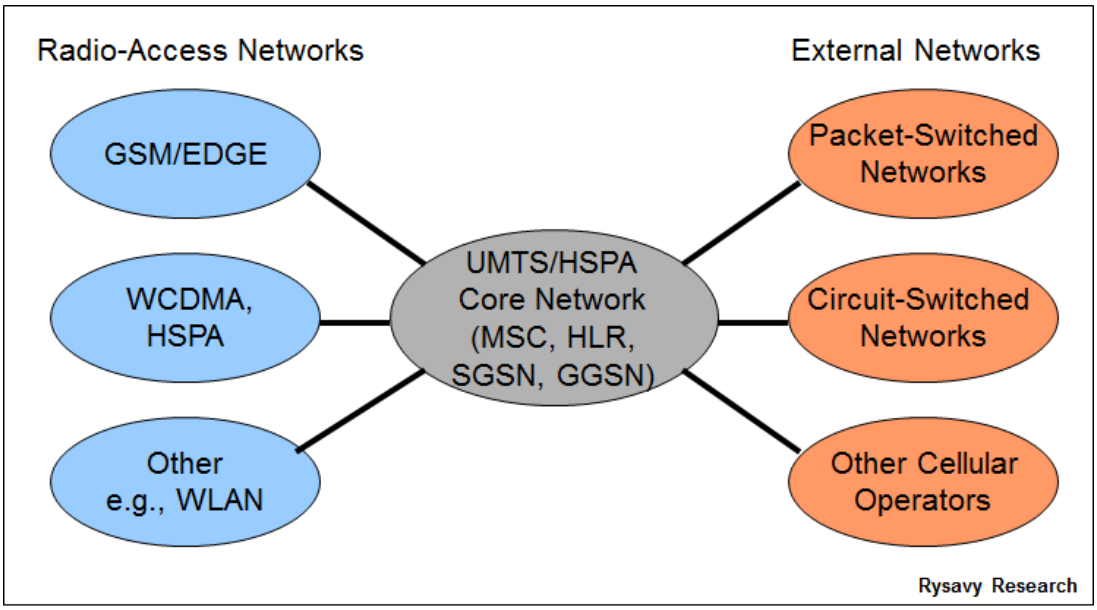

HSPA refers to networks that support both HSDPA and HSUPA. All new deployments today are HSPA, and many operators have upgraded their HSDPA networks to HSPA. For example, in 2008, AT&T upgraded most of its network to HSPA. By the end of 2008, HSPA was deployed throughout the Americas.

The UMTS radio-access network consists of base stations referred to as Node B (corresponding to GSM base transceiver systems) that connect to RNCs (corresponding to GSM base station controllers [BSCs]). The RNCs connect to the core network as do the BSCs. When both GSM and WCDMA access networks are available, the network can hand users over between these networks. This is important for managing capacity, as well as in areas in which the operator has continuous GSM coverage, but has only deployed WCDMA in some locations.

Whereas GSM can effectively operate like a spread-spectrum system[203], based on time division in combination with frequency hopping, WCDMA is a direct-sequence, spread-spectrum system. WCDMA is spectrally more efficient than GSM, but it is the wideband nature of WCDMA that provides its greatest advantage—the ability to translate the available spectrum into high data rates. This wideband technology approach results in the flexibility to manage multiple traffic types including voice, narrowband data, and wideband data.

HSDPA

HSDPA, specified in 3GPP Release 5, saw the introduction of high-performance, packet data service that delivers peak theoretical rates of 14 Mbps. Peak user-achievable throughput rates in initial deployments are well over 1 Mbps and as high as 4 Mbps in some networks. The same radio carrier can simultaneously service UMTS voice and data users, as well as HSDPA data users.

HSDPA achieves its high speeds through techniques similar to those that push EDGE performance past GPRS including higher order modulation, variable coding, and soft combining, as well as through the addition of fast scheduling and other techniques.

HSDPA achieves its performance gains from the following radio features:

- High-speed channels shared in both code and time domains
- Short TTI
- Fast scheduling and user diversity
- Higher order modulation
- Fast link adaptation
- Fast HARQ

These features function as follows:

High-Speed Shared Channels and Short Transmission Time Interval: First, HSDPA uses high-speed data channels called “High Speed Physical Downlink Shared Channels” (HS-PDSCH). Up to 15 of these channels can operate in the 5 MHz WCDMA radio channel. Each uses a fixed spreading factor of 16. User transmissions are assigned to one or more of these channels for a short TTI of 2 msec. The network can then readjust how users are assigned to different HS-PDSCH every 2 msec. Resources are thus assigned in both time

[203] Spread spectrum systems can either be direct sequence or frequency hopping.

(the TTI interval) and code domains (the HS-PDSCH channels). Figure 105 illustrates different users obtaining different radio resources.

Figure 105: High Speed–Downlink Shared Channels (Example)

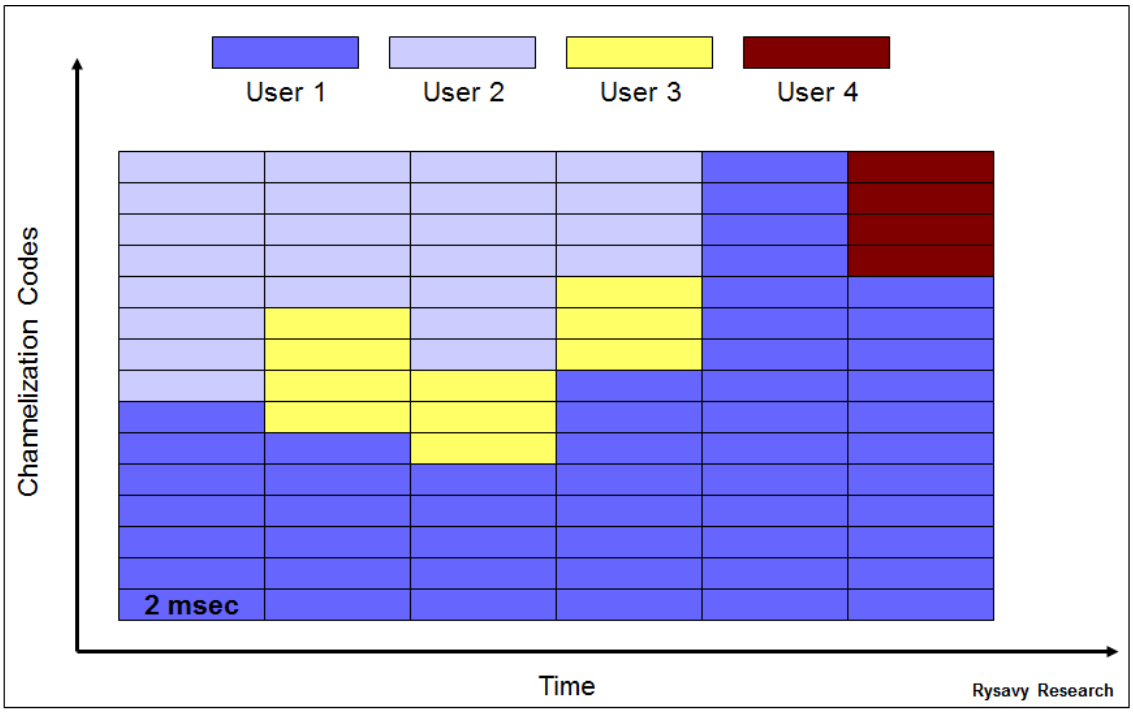

Fast Scheduling and User Diversity: Fast scheduling exploits the short TTI by assigning users channels that have the best instantaneous channel conditions, rather than in a round-robin fashion. Because channel conditions vary somewhat randomly across users, most users can be serviced with optimum radio conditions and thereby obtain optimum data throughput. Figure 106 shows how a scheduler might choose between two users based on their varying radio conditions to emphasize the user with better instantaneous signal quality. With about 30 users active in a sector, the network achieves significant user diversity and much higher spectral efficiency. The system also ensures that each user receives a minimum level of throughput, an approach called proportional fair scheduling.

Figure 106: User Diversity

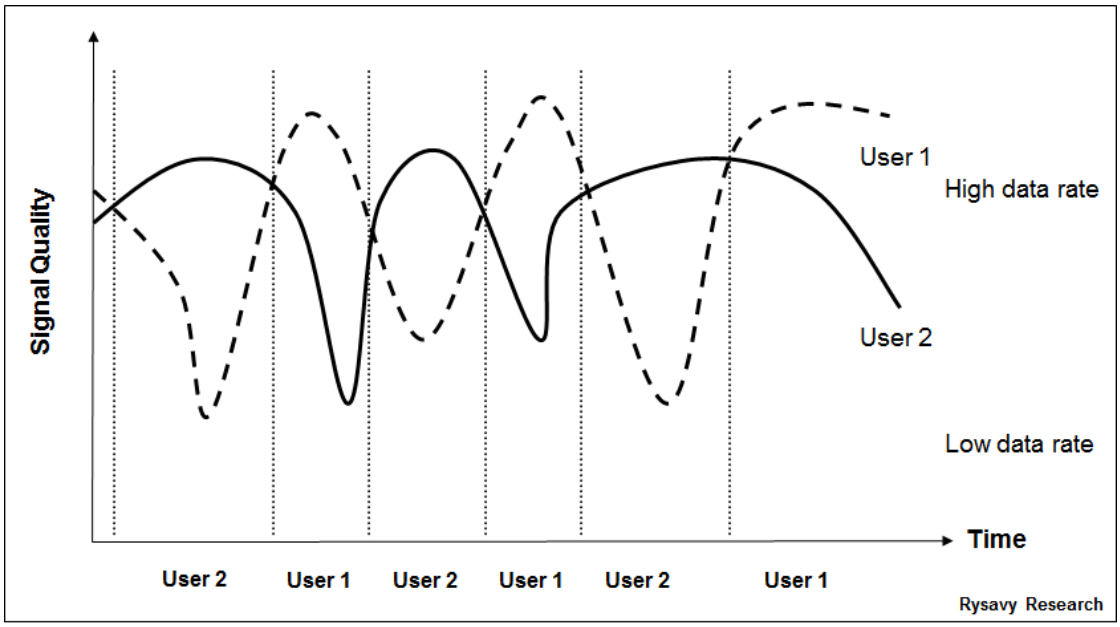

Higher Order Modulation: HSDPA uses both the modulation used in WCDMA—namely QPSK—and, under good radio conditions, an advanced modulation scheme—16 QAM. 16 QAM transmits 4 bits of data in each radio symbol compared to 2 bits with QPSK. Data throughput is increased with 16 QAM, while QPSK is available for adverse radio conditions. HSPA Evolution adds 64 QAM modulation to further increase throughput rates. 64 QAM became available in Release 7, and the combination of MIMO and 64 QAM became available in Release 8.

Fast Link Adaptation: Depending on the condition of the radio channel, different levels of forward-error correction (channel coding) can also be employed. For example, a three-quarter coding rate means that three quarters of the bits transmitted are user bits, and one quarter are error-correcting bits. Fast link adaptation refers to the process of selecting and quickly updating the optimum modulation and coding rate and occurs in coordination with fast scheduling.

Fast Hybrid Automatic Repeat Request: Another HSDPA technique is Fast Hybrid Automatic Repeat Request (Fast Hybrid ARQ). "Fast" refers to the medium-access control mechanisms implemented in Node B (along with scheduling and link adaptation), as opposed to the BSC in GPRS/EDGE, and "hybrid" refers to a process of combining repeated data transmissions with prior transmissions to increase the likelihood of successful decoding. Managing and responding to real-time radio variations at the base station, as opposed to an internal network node, reduces delays and further improves overall data throughput.

Using the approaches just described, HSDPA maximizes data throughputs and capacity and minimizes delays. For users, this translates to better network performance under loaded conditions, faster application performance, and a greater range of applications that function well.

Field results validate the theoretical throughput results. With initial 1.8 Mbps peak rate devices, vendors measured consistent throughput rates in actual deployments of more than 1 Mbps. These rates rose to more than 2 Mbps for 3.6 Mbps devices and then close to 4 Mbps for 7.2 Mbps devices.

In 2008, typical devices supporting peak data rates of 3.6 Mbps or 7.2 Mbps became available. Many operator networks support 7.2 Mbps peak operation, and some even support the maximum rate of 14.4 Mbps.

HSUPA

Whereas HSDPA optimizes downlink performance, HSUPA—which uses the Enhanced Dedicated Channel (E-DCH)—constitutes a set of improvements that optimizes uplink performance. Networks and devices supporting HSUPA became available in 2007. These improvements include higher throughputs, reduced latency, and increased spectral efficiency. HSUPA was standardized in Release 6. It results in an approximately 85% increase in overall cell throughput on the uplink and more than a 50% gain in user throughput. HSUPA also reduces packet delays, a significant benefit resulting in much improved application performance on HSPA networks

Although the primary downlink traffic channel supporting HSDPA serves as a shared channel designed for the support of services delivered through the packet-switched domain, the primary uplink traffic channel defined for HSUPA is a dedicated channel that could be used for services delivered through either the circuit-switched or the packet-switched domains. Nevertheless, by extension and for simplicity, the WCDMA-enhanced uplink capabilities are often identified in the literature as HSUPA.

HSUPA achieves its performance gains through the following approaches:

- An enhanced dedicated physical channel.
- A short TTI, as low as 2 msec, which allows faster responses to changing radio conditions and error conditions.
- Fast Node B-based scheduling, which allows the base station to efficiently allocate radio resources.
- Fast Hybrid ARQ, which improves the efficiency of error processing.

The combination of TTI, fast scheduling, and Fast Hybrid ARQ also serves to reduce latency. HSUPA can operate with or without HSDPA in the downlink, although use the two approaches together. The improved uplink mechanisms also translate to better coverage and, for rural deployments, larger cell sizes.

HSUPA can achieve different throughput rates based on various parameters including the number of codes used, the spreading factor of the codes, the TTI value, and the transport block size in bytes.

Initial devices enabled peak user rates of close to 2 Mbps as measured in actual network deployments, while current devices have throughputs of more than 5 Mbps. Future devices could have network rates as high as 69 Mbps, as discussed further below.

Beyond throughput enhancements, HSUPA also significantly reduces latency.

Evolution of HSPA (HSPA+)

The goal in evolving HSPA is to exploit available radio technologies—largely enabled by increases in digital signal processing power—to maximize CDMA-based radio performance. This evolution has significantly advanced HSPA and extends the life of sizeable operator infrastructure investments.

Wireless and networking technologists have defined a series of enhancements for HSPA, beginning in Release 7 and now continuing through Release 14. These include advanced receivers, multi-carrier operation, MIMO, Continuous Packet Connectivity, Higher-Order Modulation, One-Tunnel Architecture, HetNet support, and advanced voice capabilities both in circuit- and packet-switched domains.

Taking advantage of these various radio technologies, 3GPP has standardized a number of features, beginning in Release 7 including higher order modulation and MIMO. Collectively, these capabilities are referred to as HSPA+. Release 8 through Release 12 include further enhancements.

The goals of HSPA+ were to:

- Exploit the full potential of a CDMA approach.
- Provide smooth interworking between HSPA+ and LTE, thereby facilitating the operation of both technologies. As such, operators may choose to leverage the EPC planned for LTE.
- Allow operation in a packet-only mode for both voice and data.
- Be backward-compatible with previous systems while incurring no performance degradation with either earlier or newer devices.
- Facilitate migration from current HSPA infrastructure to HSPA+ infrastructure.

HSPA improvements have continued through successive 3GPP releases, including Release 14, which has downlink interference mitigation. Release 15 has work items for quality of experience, multi-carrier enhancements, and various protocol enhancements.

The following sections discuss specific enhancements that have already been implemented in HSPA.

Advanced Receivers

3GPP has specified a number advanced-received designs including: Type 1, which uses mobile-receive diversity; Type 2, which uses channel equalization; and Type 3, which includes a combination of receive diversity and channel equalization. Type 3i devices, which became available in 2012, employ interference cancellation. Note that the different types of receivers are release-independent. For example, Type 3i receivers will work and provide a capacity gain in an earlier Release 5 network.

The first approach is mobile-receive diversity. This technique relies on the optimal combination of received signals from separate receiving antennas. The antenna spacing yields signals that have somewhat independent fading characteristics. Hence, the combined signal can be more effectively decoded, which almost doubles downlink capacity when done in combination with channel equalization. Receive diversity is effective even with smaller devices such as like PC Card modems and smartphones.

Current receiver architectures based on rake receivers are effective for speeds up to a few megabits per second. But at higher speeds, the combination of reduced symbol period and multipath interference results in Intersymbol Interference and diminishes rake receiver performance. This problem can be solved by advanced-receiver architectures with channel equalizers that yield additional capacity gains over HSDPA with receive diversity. Alternate advanced-receiver approaches include interference cancellation and generalized rake receivers (G-Rake). Different vendors are emphasizing different approaches. The performance requirements for advanced-receiver architectures, however, were specified in 3GPP Release 6. The combination of mobile-receive diversity and channel equalization (Type 3) is especially attractive, because it results in a large capacity gain independent of the radio channel.

What makes such enhancements attractive is that the networks do not require any changes other than increased capacity within the infrastructure to support the higher bandwidth. Moreover, the network can support a combination of devices including both earlier devices that do not include these enhancements and later devices that do. Device vendors can selectively apply these enhancements to their higher-end devices.

MIMO

Another standardized capability is MIMO, a technique that employs multiple transmit antennas and multiple receive antennas, often in combination with multiple radios and multiple parallel data streams. The most common use of the term "MIMO" applies to spatial multiplexing. The transmitter sends different data streams over each antenna. Whereas multipath is an impediment for other radio systems, MIMO—as illustrated in Figure 107—actually exploits multipath, relying on signals to travel across different uncorrelated communications paths. The multiple data paths effectively operate in parallel and, with appropriate decoding, in a multiplicative gain in throughput.

Figure 107: MIMO Using Multiple Paths to Boost Throughput and Capacity

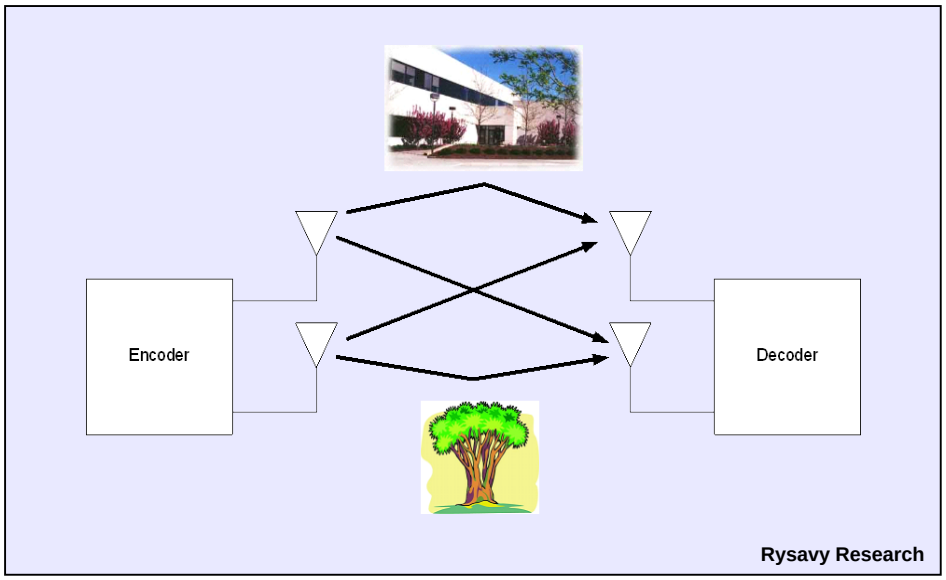

Tests of MIMO have proven effective in WLANs operating in relative isolation where interference is not a dominant factor. Spatial multiplexing MIMO can also benefit HSPA "hotspots" serving local areas including airports, campuses, and malls. In a fully loaded network with interference from adjacent cells, however, overall capacity gains will be more

modest—in the range of 20% to 33% over mobile-receive diversity. Relative to a 1x1 antenna system, however, 2X2 MIMO can deliver cell throughput gains of about 80%. 3GPP has standardized spatial multiplexing MIMO in Release 7 using Double Transmit Adaptive Array (D-TxAA).

Release 9 provides for a means to leverage MIMO antennas at the base station when transmitting to user equipment that does not support MIMO. The two transmit antennas in the base station can transmit a single stream using beam forming. This is called "single stream MIMO" or "MIMO with single-stream restriction" and results in higher throughput rates because of the improved signal received by the user equipment.

3GPP designed uplink dual-antenna beamforming and 2X2 MIMO for HSPA+ in Release 11.

Continuous Packet Connectivity

Continuous Packet Connectivity (CPC) specified in Release 7 reduces the uplink interference created by the dedicated physical control channels of packet data users when those channels have no user data to transmit, which increases the number of simultaneously connected HSUPA users. CPC allows both discontinuous uplink transmission and discontinuous downlink reception, wherein the modem can turn off its receiver after a certain period of HSDPA inactivity. CPC is especially beneficial to VoIP on the uplink because the radio can turn off between VoIP packets, as shown in Figure 108.

Figure 108: Continuous Packet Connectivity

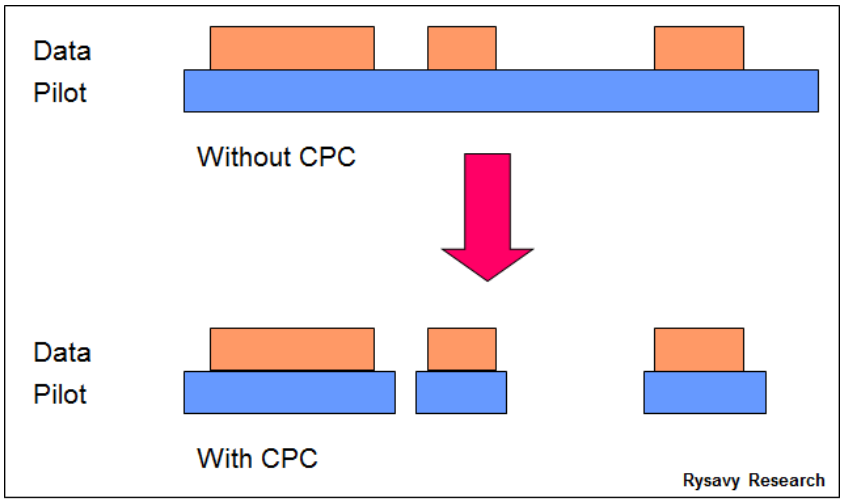

Higher Order Modulation

Another way of increasing performance is with higher order modulation. HSPA uses 16 QAM on the downlink and QPSK on the uplink, but HSPA+ adds 64 QAM to the downlink and 16 QAM to the uplink. 3GPP has also introduced 64 QAM to the uplink for HSPA+ in Release 11. Higher order modulation requires a better SNR, achieved through receive diversity and equalization.

Multi-Carrier HSPA

3GPP defined dual-carrier HSPA operation in Release 8, which coordinates the operation of HSPA on two adjacent 5 MHz carriers so that data transmissions can achieve higher

throughput rates, as shown in Figure 109. The work item assumed two adjacent carriers, downlink operation and no MIMO. This configuration achieves a doubling of the 21 Mbps maximum rate available on each channel to 42 Mbps.

Figure 109: Dual-Carrier Operation with One Uplink Carrier[204]

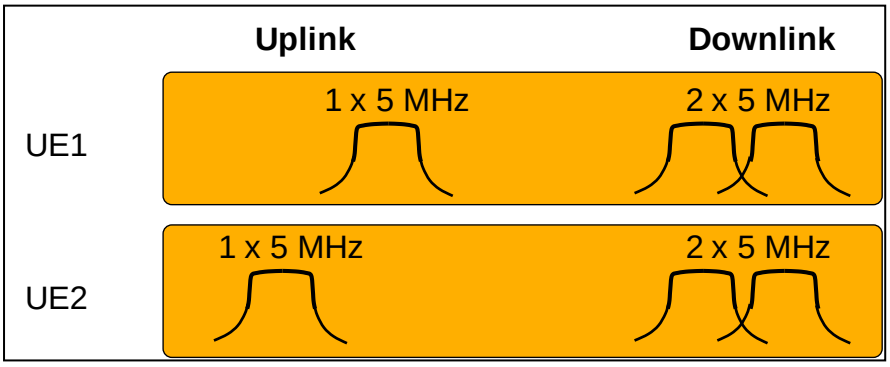

Benefits include:

- An increase in spectral efficiency of about 15%, comparable to what can be obtained with 2X2 MIMO.
- Significantly higher peak throughputs available to users, especially in lightly-loaded networks.
- Same maximum-throughput rate of 42 Mbps as using MIMO, but with a less expensive infrastructure upgrade.

Scheduling packets across two carriers is a more efficient use of resources, resulting in what is called "trunking gain." Multi-user diversity also improves from an increased number of users across the two channels.

Release 9 also supports dual-carrier operation in the uplink. Release 10 specifies the use of up to four channels, resulting in peak downlink data rates of 168 Mbps. Release 11 supports eight radio channels on the downlink, resulting in a further doubling of theoretical throughput to 336 Mbps. On the uplink, devices can transmit using two antennas for either rank 1 (single stream beamforming) or rank 2 (dual-stream MIMO) transmission modes. Rank 1 beamforming helps with coverage (approximately 40%), while rank 2 MIMO helps with throughput speeds (approximately 20% median and 80% at cell edge). In addition, 64 QAM will be possible on the uplink, enabling uplink speeds to 69 Mbps in dual-carrier operation.

Downlink Multiflow Transmission

Release 11 specifies means by which two cells can transmit to the mobile station at the same time. The two cells transmit independent data, in effect a spatial multiplexing approach, improving both peak and average data.

[204] Harri Holma and Antti Toskala, *LTE for UMTS, OFDMA and SC-FDMA Based Radio Access*, Wiley, April 2009.

Multiflow transmission with HSPA+ also enhances HetNet operation in which picocell coverage can be expanded within a macrocell coverage area, as shown in Figure 110.

Figure 110: HSPA+ HetNet Using Multipoint Transmission[205]

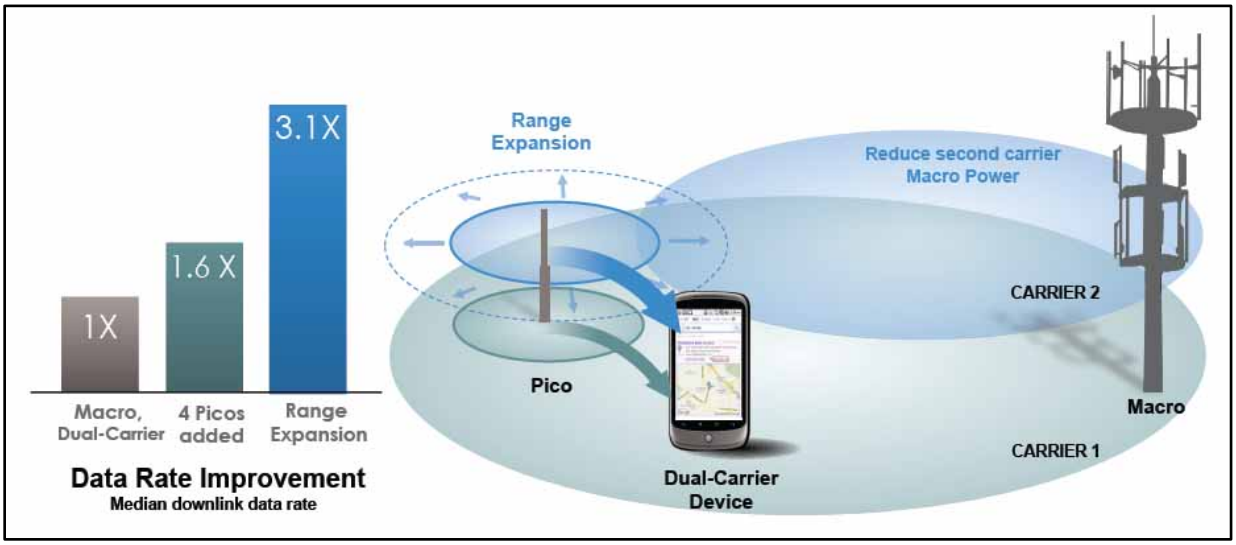

Multiflow enhances HSPA+ network operation using the following approaches:

- **Single Frequency Dual Cell.** The UE communicates with two different cells using the same frequency, improving cell-edge performance and providing network load balancing.
- **Dual Frequency Three Cell.** The UE communicates with two different cells using the same frequency. In addition, it communicates with one other cell on a different frequency.
- **Dual Frequency Four Cells.** The UE communicates using two instances of Single Frequency Dual Cell operation as described above.

In Release 12, 3GPP is considering the following enhancement to Multiflow operation, which is primarily targeted towards HetNet operation:

- **Dual Frequency Dual Carrier.** The UE aggregates cells on two different frequencies from two different sites.

HSPA+ Throughput Rates

Table 31 summarizes the capabilities of HSPA and HSPA+ based on the various methods discussed above.

[205] Qualcomm, "HSPA+ Advanced: Taking HSPA+ to the Next Level," February 2012, http://www.qualcomm.com/media/documents/hspa-advanced-taking-hspa-next-level-whitepaper, accessed June 20, 2014.

Table 31: HSPA Throughput Evolution

Technology	Downlink (Mbps) Peak Data Rate	Uplink (Mbps) Peak Data Rate
HSPA as defined in Release 6	14.4	5.76
Release 7 HSPA+ DL 64 QAM, UL 16 QAM, 5+5 MHz	21.1	11.5
Release 7 HSPA+ 2X2 MIMO, DL 16 QAM, UL 16 QAM, 5+5 MHz	28.0	11.5
Release 8 HSPA+ 2X2 MIMO DL 64 QAM, UL 16 QAM, 5+5 MHz	42.2	11.5
Release 8 HSPA+ (no MIMO) Dual Carrier, 10+5 MHz	42.2	11.5
Release 9 HSPA+ 2X2 MIMO, Dual Carrier DL and UL, 10+10 MHz	84.0	23.0
Release 10 HSPA+ 2X2 MIMO, Quad Carrier[206] DL, Dual Carrier UL, 20+10 MHz	168.0	23.0
Release 11 HSPA+ 2X2 MIMO DL and UL, 8 Carrier DL, Dual Carrier UL, 40+10 MHz	336.0	69.0

Release 13 enables aggregation of two UL carriers across bands.

Figure 111 shows the cumulative distribution function of throughput values in a commercially deployed Release 8 HSPA+ network in an indoor coverage scenario. The figure shows significant performance gains from higher-order modulation and MIMO.

[206] No operators have announced plans to deploy HSPA in a quad (or greater) carrier configuration. Three carrier configurations, however, have been deployed.

Figure 111: HSPA+ Performance Measurements Commercial Network (5+5 MHz)[207]

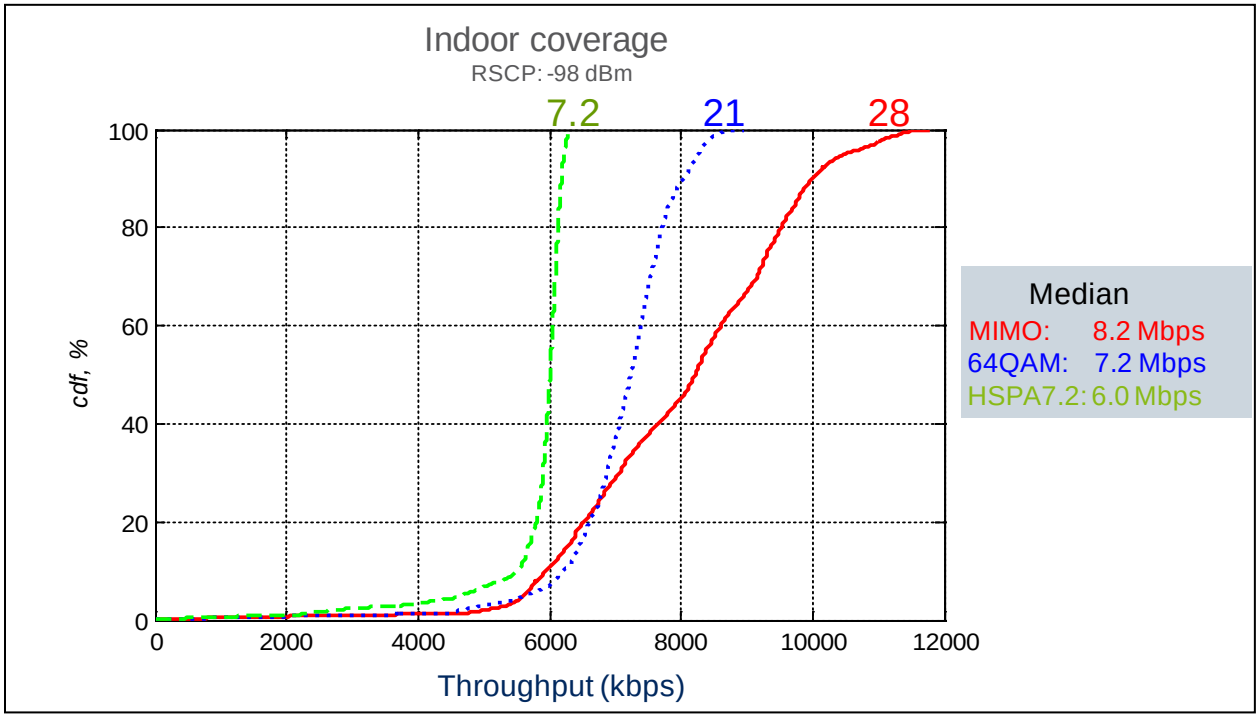

The figure shows a reasonably typical indoor scenario in a macro-cell deployment. Under better radio conditions, HSPA+ will achieve higher performance results.

Figure 112 shows the benefit of dual-carrier operation (no MIMO employed), which essentially doubles throughputs over single carrier operation.

[207] 5G Americas member company contribution.

Figure 112: Dual-Carrier HSPA+ Throughputs[208]

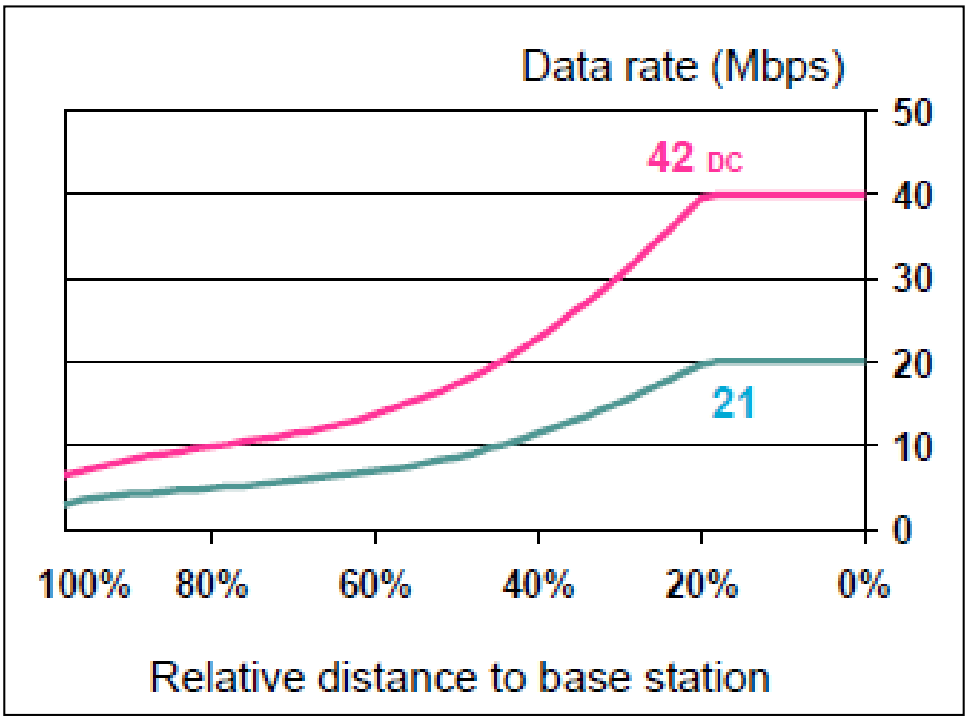

HSPA+ also has improved latency performance of as low as 25 msec and improved packet call setup time of below 500 msec.

Figure 113 summarizes the key capabilities and benefits of the features being deployed in HSPA+.

[208] 5G Americas member company contribution. 64 QAM.

Figure 113: Summary of HSPA Functions and Benefits[209]

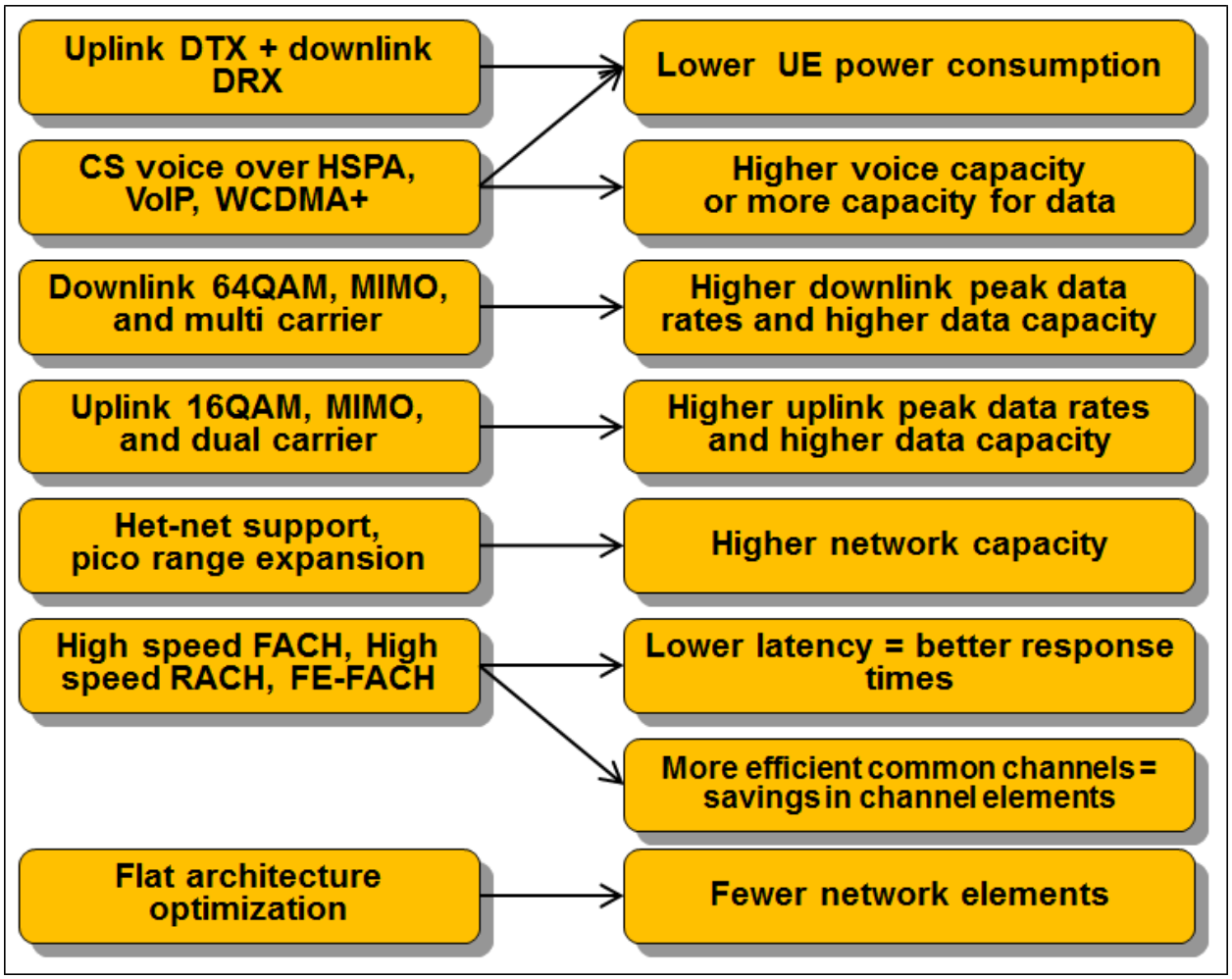

UMTS TDD and TD-SCDMA

Most WCDMA and HSDPA deployments are based on FDD, which uses different radio bands for transmit and receive. In the alternate TDD approach, transmit and receive functions alternate in time on the same radio channel. 3GPP specifications include a TDD version of UMTS, called "UMTS TDD."

TDD does not provide any inherent advantage for voice functions, which need balanced links—namely, the same amount of capacity in both the uplink and the downlink. Many data applications, however, are asymmetric, often with the downlink consuming more bandwidth than the uplink. A TDD radio interface can dynamically adjust the downlink-to-uplink ratio accordingly, hence balancing both forward-link and reverse-link capacity. Note that for UMTS FDD, the higher spectral efficiency achievable in the downlink versus the uplink addresses the asymmetrical nature of average data traffic.

[209] 5G Americas member contribution.

The UMTS TDD specification also includes the capability to use joint detection in receiver-signal processing, which offers improved performance.

One consideration, however, relates to available spectrum. Various countries around the world including those in Europe, Asia, and the Pacific region have licensed spectrum available specifically for TDD systems. TDD is also a good choice for any spectrum that does not provide a duplex gap between forward and reverse links.

In the United States, there is limited spectrum specifically allocated for TDD systems, the major band being BRS at 2.5 GHz used by Clearwire for WiMAX and now LTE TDD.[210] UMTS TDD is not a good choice in FDD bands; it would not be able to operate effectively in both bands, thereby making the overall system efficiency relatively poor.

TDD systems require network synchronization and careful coordination between operators or guardbands, which may be problematic in certain bands.

There has not been widespread deployment of UMTS TDD.

Time Division Synchronous Code Division Multiple Access (TD-SCDMA) is one of the official 3G wireless technologies, mostly for deployment in China. Specified through 3GPP as a variant of the UMTS TDD System and operating with a 1.28 megachips per second (Mcps) chip rate versus 3.84 Mcps for UMTS TDD, TD-SCDMA's primary attribute is that it supports very high subscriber densities, making it a possible alternative for wireless local loops. TD-SCDMA uses the same core network as UMTS, and it is possible for the same core network to support both UMTS and TD-SCDMA radio-access networks.

Although there are no planned deployments in any country other than China, TD-SCDMA could theoretically be deployed anywhere unpaired spectrum is available—such as the bands licensed for UMTS TDD—assuming appropriate resolution of regulatory issues.

EDGE/EGPRS

Today, most GSM networks support EDGE, an enhancement to GPRS, which is the original packet data service for GSM networks.[211] GPRS provides a packet-based IP connectivity solution supporting a wide range of enterprise and consumer applications. GSM networks with EDGE operate as wireless extensions to the internet and give users internet access, as well as access to their organizations from anywhere. Peak EDGE user-achievable[212] throughput rates are up to 200 Kbps. Figure depicts the system architecture.

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[210] The 1910-1920 MHz band targeted unlicensed TDD systems but has never been used.

[211] GSM technology also provides circuit-switched data services, which are not described in this paper since they are seldom used.

[212] "Peak user-achievable" means users, under favorable conditions of network loading and signal propagation, can achieve this rate as measured by applications such as file transfer. Average rates depend on many factors and will be lower than these rates.

Figure 114: GSM / GPRS / EDGE Architecture

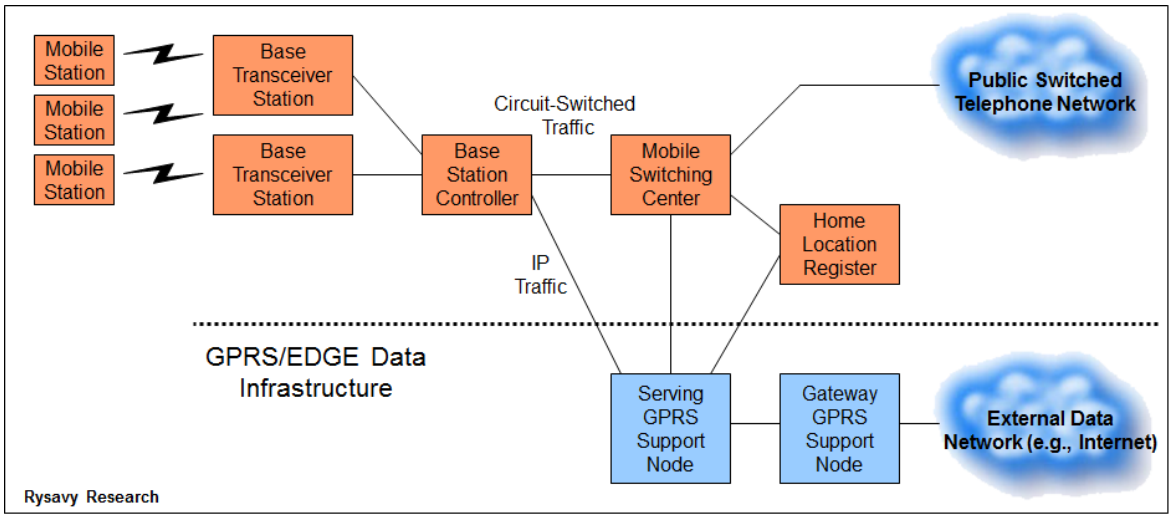

EDGE is essentially the addition of a packet-data infrastructure to GSM. In fact, this same data architecture is preserved in UMTS and HSPA networks, and the data architecture is technically referred to as GPRS for the core-data function in all of these networks. The term GPRS may also be used to refer to the initial radio interface, now supplanted by EDGE. Functions of the data elements are as follows:

- The base station controller directs/receives packet data to/from the Serving GPRS Support Node (SGSN), an element that authenticates and tracks the location of mobile stations.
- The SGSN performs the types of functions for data that the Mobile Switching Center (MSC) performs for voice. Each serving area has one SGSN, and it is often collocated with the MSC.
- The SGSN forwards/receives user data to/from the Gateway GPRS Support Node (GGSN), which can be viewed as a mobile IP router to external IP networks. Typically, there is one GGSN per external network (for example, the internet). The GGSN also manages IP addresses, dynamically assigning them to mobile stations for their data sessions.

Another important element is the Home Location Register (HLR), which stores users' account information for both voice and data services. Of significance is that this same data architecture supports data services in GSM and in UMTS-HSPA networks, thereby simplifying operator network upgrades.

In the radio link, GSM uses radio channels of 200 kilohertz (kHz) width, divided in time into eight timeslots comprising 577 microseconds (μs) that repeat every 4.6 msec, as shown in Figure . The network can have multiple radio channels (referred to as transceivers) operating in each cell sector. The network assigns different functions to each timeslot such as the Broadcast Control Channel (BCCH), circuit-switched functions like voice calls or data calls, the optional Packet Broadcast Control Channel (PBCCH), and packet data channels. The network can dynamically adjust capacity between voice and data functions, and it can also reserve minimum resources for each service. This scheduling approach enables more data traffic when voice traffic is low or, likewise, more voice traffic when data traffic is low, thereby maximizing overall use of the network. For example, the PBCCH, which expands

the capabilities of the normal BCCH, may be set-up on an additional timeslot of a Time Division Multiple Access (TDMA) frame when justified by the volume of data traffic.

Figure 115: Example of GSM/EDGE Timeslot Structure[213]

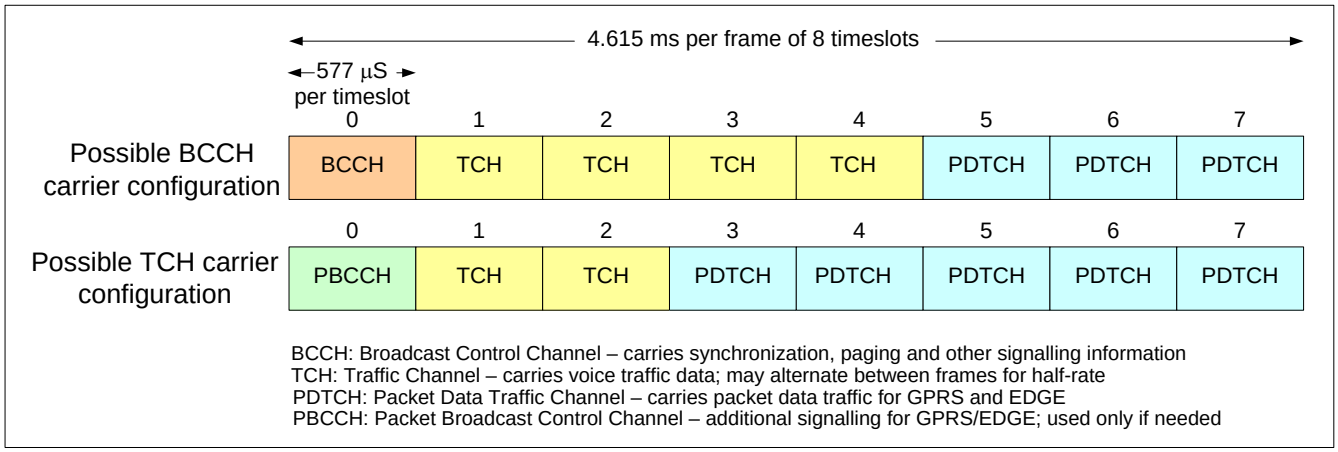

EDGE offers close coupling between voice and data services. In most networks, while in a data session, users can accept an incoming voice call, which suspends the data session, and then resume their data session automatically when the voice session ends. Users can also receive SMS messages and data notifications[214] while on a voice call, as described below.

With respect to data performance, each data timeslot can deliver peak user-achievable data rates of up to about 40 Kbps. The network can aggregate up to five timeslots on the downlink and up to four timeslots on the uplink with current devices.

If multiple data users are active in a sector, they share the available data channels. As demand for data services increases, however, an operator can accommodate customers by assigning an increasing number of channels for data service that is limited only by that operator's total available spectrum and radio planning.

EDGE is an official 3G cellular technology that can be deployed within an operator's existing 850, 900, 1800, and 1900 MHz spectrum bands. EDGE capability is now largely standard in new GSM deployments. A GPRS network using the EDGE radio interface is technically called an "Enhanced GPRS" (EGPRS) network, and a GSM network with EDGE capability is referred to as GSM Edge Radio Access Network (GERAN). EDGE has been an inherent part of GSM specifications since Release 99. It is fully backward-compatible with older GSM networks, meaning that GPRS devices work on EDGE networks and that GPRS and EDGE terminals can operate simultaneously on the same traffic channels.

Dual Transfer Mode (DTM) devices can simultaneously communicate voice and data. DTM is a 3GPP-specified technology that enables new applications like video sharing while providing a consistent service experience (service continuity) with UMTS. Typically, a DTM

[213] 5G Americas member company contribution.

[214] Example: WAP notification message delivered via SMS.

end-to-end solution requires only a software upgrade to the GSM/EDGE radio network. There are a number of networks and devices supporting DTM.

A feature in Release 9 that applies to EDGE is the Enhanced Flexible Timeslot Assignment (EFTA), which allows for more efficient adaptation to varying uplink versus downlink transmission needs. The network allocates uplink and downlink timeslots that overlap in time, and the mobile station may either use the corresponding uplink timeslots for transmission or receive on the overlapping downlink time slot, if it has nothing to transmit. In addition, alternative EFTA multi-slot classes enable the support of as many as eight timeslots per downlink carrier (instead of five or six timeslots with multi-slot classes 30 to 45).

Abbreviations and Acronyms

The following abbreviations are used in this paper. Abbreviations are defined on first use.

1G – First Generation

1xEV-DO – One Carrier Evolution, Data Optimized

1xEV-DV – One Carrier Evolution, Data Voice

1XRTT – One Carrier Radio Transmission Technology

2G – Second Generation

3G – Third Generation (meeting requirements set forth by the ITU IMT project)

3GPP – Third Generation Partnership Project

3GPP2 – Third Generation Partnership Project 2

4G – Fourth Generation (meeting requirements set forth by the ITU IMT-Advanced project)

5GC – 5G Core

8-PSK – Octagonal Phase Shift Keying

AAS – Adaptive Antenna Systems

ABR – Allocation Retention Priority

AGW – Access Gateway

AMF – Access and Mobility Management Function

AMR – Adaptive Multi Rate

AMR-WB – Adaptive Multi-Rate Wideband

ANDSF – Access Network Discovery and Selection Function.

ANSI – American National Standards Institute

APCO – Association of Public Safety Officials

API – Application Programming Interface

APN – Access Point Name

ARP – Allocation Retention Priority

ARPU – Average Revenue per User

ARQ – Automatic Repeat Request

ATM – Asynchronous Transfer Mode

AWGN – Additive White Gaussian Noise Channel

AWS – Advanced Wireless Services

BCCH – Broadcast Control Channel

bps – bits per second

BRS – Broadband Radio Service

BSC – Base Station Controller

BTS – Base Transceiver Station

C/I – Carrier to Intermodulation Ratio

CAPEX- Capital Expenditure

CBF – Coordinated Beam Forming

CBRS – Citizens Broadband Radio Service

CBS – Coordinated Beam Switching
CSS3 – Cascading Style Sheets 3 (CSS3)
CDD – Cyclic Delay Diversity
CDF – Cumulative Distribution Function
CDMA – Code Division Multiple Access
CL – Closed Loop
CL-SM – Closed Loop Spatial Multiplexing
CMAS – Commercial Mobile Alert System
CMOS – Complementary Metal Oxide Semiconductor
CoMP – Coordinated Multi Point
cMTC – Critical Machine Type Communications
CP – Cyclic Prefix
CPC – Continuous Packet Connectivity
CPRI – Common Public Radio Interface
CQI - Channel Quality Indicators
C-RAN – Cloud Radio Access Network
CRM – Customer Relationship Management
CRS – Cell-specific Reference Signal
CS – Convergence Sublayer
CSFB – Circuit-Switched Fallback
CTIA – Cellular Telephone Industries Association
C-V2X – Cellular Vehicle-to-X
D-AMPS – Digital Advanced Mobile Phone Service
DAS – Distributed Antenna System
DAS – Downlink EGPRS2-A Level Scheme
dB – Decibel
DBS – Downlink EGPRS2-B Level Scheme
DC-HSPA – Dual Carrier HSPA
DFT – Discrete Fourier Transform
DL – Downlink
DNS – Domain Name Service
DPCCH – Dedicated Physical Control Channel
DPS – Dynamic Point Selection
DSL – Digital Subscriber Line
DSMIPv6 – Dual Stack Mobile IPv6
DTM – Dual Transfer Mode
DRX – Discontinuous Reception
D-TxAA – Double Transmit Adaptive Array
DVB-H – Digital Video Broadcasting Handheld

E-DCH – Enhanced Dedicated Channel
EBCMCS – Enhanced Broadcast Multicast Services
EC-GSM – Extended Coverage GSM
eCoMP – enhanced CoMP
EDGE – Enhanced Data Rates for GSM Evolution
EFTA – Enhanced Flexible Timeslot Assignment
EGPRS – Enhanced General Packet Radio Service
eICIC – Enhanced Inter-Cell Interference Coordination
eMBMS – Enhanced Multimedia Broadcast Multicast Services
eNodeB – Evolved Node B
EAP – Extensible Authentication Protocol
eLAA – Enhanced Licensed-Assisted Access
eNB – Evolved Node B
EPC – Evolved Packet Core
EPDCCH – Enhanced Physical Downlink Control Channel
eMBB – Enhanced Mobile Broadband
ePDG – Enhanced Packet Data Gateway
EPS – Evolved Packet System
ERP – Enterprise Resource Planning
eSaMOG – Enhanced S2a-based Mobility over GTP
ESC – Environmental Sensing Capability
eSRVCC – Enhanced Single-Radio Voice Call Continuity
ETRI – Electronic and Telecommunications Research Institute
ETSI – European Telecommunications Standards Institute
E-UTRAN – Enhanced UMTS Terrestrial Radio Access Network
EVS – Enhanced Voice Services (codec)
FE-FACH – Further Enhanced Forward Access Channel
EV-DO –Evolution, Data Optimized
EV-DV –Evolution, Data Voice
EVRC – Enhanced Variable Rate Codec
FBMC – Filter-Bank Multi-Carrier
FCC – Federal Communications Commission
FDD – Frequency Division Duplex
FeCoMP – Further Enhanced Coordinated Multi Point
feICIC – Further enhanced ICIC
FirstNet – First Responder Network Authority
Flash OFDM – Fast Low-Latency Access with Seamless Handoff OFDM
FLO – Forward-Link Only
FMC – Fixed Mobile Convergence

FP7 – Seventh Framework Programme
FTP – File Transfer Protocol
GAA – General Authorized Access
GAN – Generic Access Network
GB – Gigabyte
Gbps – Gigabits Per Second
GBR – Guaranteed Bit Rate
GByte – Gigabyte
GCS – Group Communication Service
GERAN – GSM EDGE Radio Access Network
GFDM – Generalized Frequency Division Multiplexing
GGSN – Gateway GPRS Support Node
GHz — Gigahertz
GMSK – Gaussian Minimum Shift Keying
gNB – NR NodeB
GPRS – General Packet Radio Service
G-Rake – Generalized Rake Receiver
GSM – Global System for Mobile Communications
GSMA – GSM Association
HARQ – Hybrid Automatic Repeat Request
HD – High Definition
HetNet – heterogeneous network
HLR – Home Location Register
Hr – Hour
HSDPA – High Speed Downlink Packet Access
HS-FACH – High Speed Forward Access Channel
HS-PDSCH - High Speed Physical Downlink Shared Channels
HS-RACH – High Speed Reverse Access Channel
HSPA – High Speed Packet Access (HSDPA with HSUPA)
HSPA+ – HSPA Evolution
HSS – Home Subscriber Server
HSUPA – High Speed Uplink Packet Access
Hz – Hertz
ICIC – Inter-Cell Interference Coordination
ICN – Information-Centric Networking
ICS – IMS Centralized Services
ICT – Information and Communication Technologies
IEEE – Institute of Electrical and Electronic Engineers
IETF – Internet Engineering Taskforce

IFFT – Inverse Fast Fourier Transform
IFOM – IP Flow and Seamless Offload
IM – Instant Messaging
IMS – IP Multimedia Subsystem
IMT – International Mobile Telecommunications
IMT-Advanced - International Mobile Telecommunications-Advanced
IRC – Interference Rejection Combining
IoT – Internet of Things
IPR - Intellectual Property Rights
IP – Internet Protocol
IPTV – Internet Protocol Television
IR – Incremental Redundancy
ISD – Inter-site Distance
ISI – Intersymbol Interference
ISP – Internet Service Provider
ITU – International Telecommunication Union
JCP – Java Community Process
JR – Joint Reception
JT – Joint Transmission
Kbps – Kilobits Per Second
kHz — Kilohertz
km – Kilometer
LAA – License-Assisted Access
LBT – Listen-Before-Talk
LDPC - Low-Density Parity Code
LIPA – Local IP Access
LMDS – Local Multipoint Distribution Service
LPWA – Low-Power Wide-Area
LTE – Long Term Evolution
LTE-A – LTE-Advanced
LTE-TDD – LTE Time Division Duplex
LTE-U – LTE-Unlicensed
LSTI – LTE/SAE Trial Initiative
LWA – LTE Wi-Fi Aggregation
LWIP – LTE WLAN Radio Level Integration with IPsec Tunnel
M2M – Machine-to-machine
MAC – Medium-Access Control
MAPCON – Multi-Access PDN Connectivity
MB - Megabyte

MBMS - Multimedia Broadcast/Multicast Service

Mbps – Megabits Per Second

MBR – Maximum Bit Rate

MBSFN – Multicast/broadcast, Single Frequency

MCPA – Mobile Consumer Application Platform

Mcps – Megachips Per Second

MCPTT – Mission-Critical Push-to-Talk

MCS – Modulation and Coding Scheme

MCW – Multiple Codeword

MDT – Minimization of Drive Tests

MEAP – Mobile Enterprise Application Platforms

MEC – Multi-access Edge Computing

MediaFLO – Media Forward Link Only

METIS – Mobile and wireless communications Enablers for the Twenty-twenty Information Society

MHz – Megahertz

MID – Mobile Internet Devices

MIMO – Multiple Input Multiple Output

MMSE – Minimum Mean Square Error

mITF – Japan Mobile IT Forum

MMDS – Multichannel Multipoint Distribution Service

MME – Mobile Management Entity

mMTC – Massive Machine Type Communications

MOS – Mean Opinion Score

MP-QUIC – Multipath Quick UDP Internet Connections

MP-TCP – Multipath TCP

MRxD – Mobile Receive Diversity

ms – millisecond

MS – Mobile Station

MSA – Mobile Service Architecture

MSC – Mobile Switching Center

MTC – Machine Type Communications

MTC-IWF – Machine-Type Communications Interworking Function (MTC-IWF)

msec – millisecond

MU-MIMO – Multi-User MIMO

MUST – Downlink Multiuser Superposition Transmission

NAICS – Network-Assisted Interference Cancellation and Suppression

NB-IoT – Narrowband Internet of Things

NENA – National Emergency Number Association

NGMC – Next Generation Mobile Committee

NGMN – Next Generation Mobile Networks Alliance
NG-RAN – New Generation Radio Access Network
NOMA – Non-Orthogonal Multiple Access
NR – New Radio
NTIA – National Telecommunications and Information Administration
OFDM – Orthogonal Frequency Division Multiplexing
OFDMA – Orthogonal Frequency Division Multiple Access
OL-SM – Open Loop Spatial Multiplexing
OMA – Open Mobile Alliance
ORI – Open Radio Equipment Interface
PA – Priority Access
PAL – Priority Access License
PAR – Peak to Average Ratio
PBCCH – Packet Broadcast Control Channel
PCH – Paging Channel
PCRF – Policy Control and Charging Rules Function
PCS – Personal Communications Service
PDCP – Packet Data Convergence Protocol
PDN – Packet Data Network
PGW – Packet Gateway
PHY – Physical Layer
PMI – Precoding Matrix Indication
PMIPv6 – Proxy Mobile IPv6
PNF – Physical Network Function
PoC – Push-to-Talk Over Cellular
PSH – Packet Switched Handover
PSK – Phase-Shift Keying
QAM – Quadrature Amplitude Modulation
QCI – Quality of Service Class Identifier
QLIC – Quasi-Linear Interference Cancellation
QoS – Quality of Service
QPSK – Quadrature Phase Shift Keying
QUIC – Quick UDP Internet Connections.
RAB – Radio Access Bearer
RAN – Radio Access Network
RCAF – RAN Congestion Awareness Function
RCLWI - RAN Controlled LTE WLAN Interworking
RCS – Rich Communications Suite
REST – Representational State Transfer

RF – Radio Frequency
RLC – Radio Link Control
RNC – Radio Network Controller
ROHC – Robust Header Compression
RRC – Radio Resource Control
RRH – Remote Radio Head
RRU – Remote Radio Unit
RTP – Real Time Transport Protocol
RTSP – Real Time Streaming Protocol
SAE – System Architecture Evolution
SaMOG – S2a-based Mobility over GTP
SAS – Spectrum Access System
SC-FDMA – Single Carrier Frequency Division Multiple Access
SCMA – Sparse Coded Multiple Access
SCRI – Signaling Connection Release Indication
SCW – Single Codeword
SDAP – Service Data Adaptation Protocol
SDMA – Space Division Multiple Access
SDN – Software-Defined Networking
SDP – Session Description Protocol
sec – Second
SFBA – Space Frequency Block Code
SFN – Single Frequency Network
SGSN – Serving GPRS Support Node
SGW – Serving Gateway
SIC – Successive Interference Cancellation
SIM – Subscriber Identity Module
SIMO – Single Input Multiple Output
SINR – Signal to Interference Plus Noise Ratio
SIP – Session Initiation Protocol
SIPTO – Selected IP Traffic Offload
SISO – Single Input Single Output
SMS – Short Message Service
SNR – Signal to Noise Ratio
SON – Self-Organizing Network
SPS – Semi-Persistent Scheduling
SRVCC – Single-Radio Voice Call Continuity
SU-MIMO – Single User MIMO
SVDO – Simultaneous 1XRTT Voice and EV-DO Data

SVLTE – Simultaneous Voice and LTE
TCH – Traffic Channel
TCP/IP – Transmission Control Protocol/IP
TD – Transmit Diversity
TDD – Time Division Duplex
TDMA – Time Division Multiple Access
TD-SCDMA – Time Division Synchronous Code Division Multiple Access
TD-CDMA – Time Division Code Division Multiple Access
TETRA – Terrestrial Trunked Radio
TIA/EIA – Telecommunications Industry Association/Electronics Industry Association
TISPAN – Telecoms and Internet Converged Services and Protocols for Advanced Networks
TSG-RAN – Technical Services Group Radio Access Network
TTI – Transmission Time Interval
UAS – Uplink EGPRS2-A Level Scheme
UBS – Uplink EGPRS2-B Level Scheme
UE – User Equipment
UFMC – Universal Filtered Multi-Carrier
UICC – Universal Integrated Circuit Card
UL – Uplink
UMA – Unlicensed Mobile Access
UMB – Ultra Mobile Broadband
UMTS – Universal Mobile Telecommunications System
UPCON – User-Plane Congestion Management
UPF – User Plane Function
URA-PCH – UTRAN Registration Area Paging Channel
URI – Uniform Resource Identifier
URLLC – Ultra-Reliable and Low Latency Communications
us – Microsecond
USIM – UICC SIM
UTRAN – UMTS Terrestrial Radio Access Network
V2X – vehicle -to-infrastructure
VAMOS – Voice Services over Adaptive Multi-User Channels on One Slot
VDSL – Very-High-Bit-Rate DSL
VEPC – Virtualized EPC
ViLTE – Video Over LTE
VoIP – Voice over Internet Protocol
VoHSPA – Voice over HSPA
VoLGA – Voice over LTE Generic Access
VoLTE – Voice over LTE

VNF- Virtual Network Function

VPN – Virtual Private Network

WAP – Wireless Application Protocol

WBA – Wireless Broadband Alliance

WCDMA – Wideband Code Division Multiple Access

WCS – Wireless Communication Service

WebRTC – Web Real-Time Communication

Wi-Fi – Wireless Fidelity

WiMAX – Worldwide Interoperability for Microwave Access

WLAN – Wireless Local Area Network

WMAN – Wireless Metropolitan Area Network

WMM – Wi-Fi Multimedia

WRC – World Radiocommunication Conference

Additional Information

5G Americas maintains market information, LTE deployment lists, and numerous white papers, available for free download on its web site: http://www.5gamericas.org.

If there are any questions regarding the download of this information, please call +1 425 372 8922 or e-mail Anushka Bishen, Public Relations Coordinator at info@5gamericas.org.

This white paper was written for 5G Americas by Rysavy Research (http://www.rysavy.com) and utilized a composite of statistical information from multiple resources.

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http://www.rysavy.com

Select Language

Robert P. Duncan A.B., S.M., M.B.A., Ph.D.: Government warfare and surveillance system architect, author, and independent investigator..

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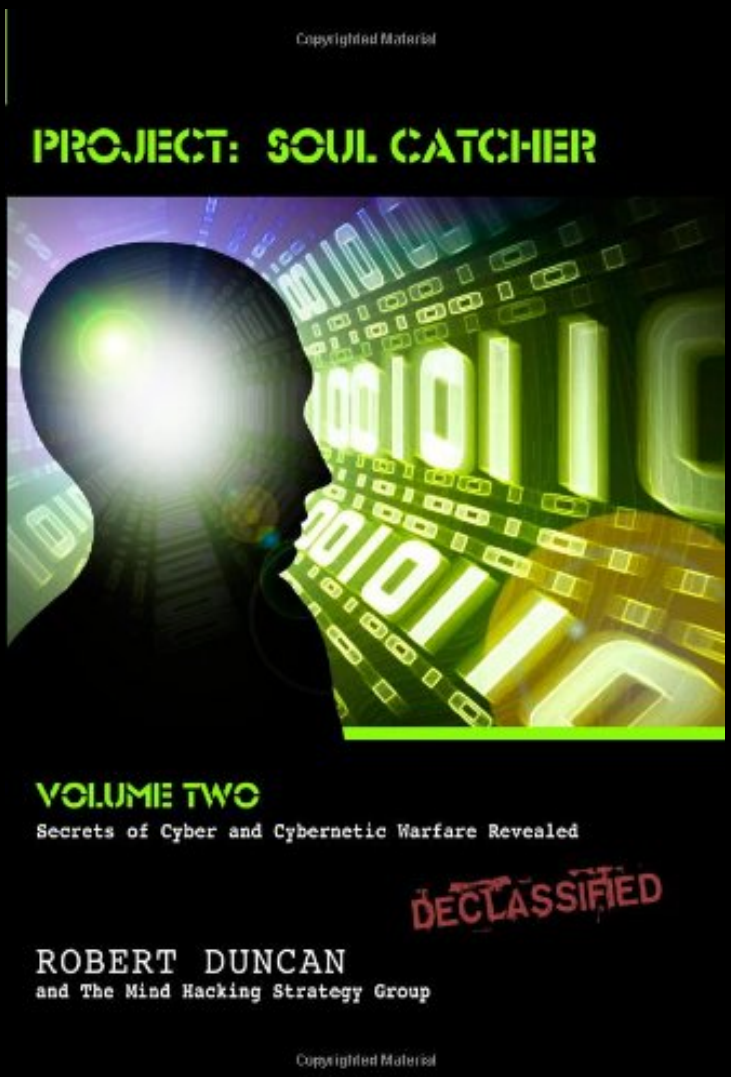

Volume 2 details the CIA's practices of interrogation and cybernetic mind control in their pursuit to weaponize neuropsychology. It covers the art of bio-communication war. Human beings are complex machines but their inner workings have been deciphered. Mind control and brainwashing have been perfected in the last 60 years. Hacking computers and hacking into individual minds are similar. The 21st century will be known as the age of spiritual machines and soulless men.

Check out Dr. Robert Duncan's other book, How to Tame a Demon: A short practical guide to organized intimidation stalking, electronic torture, and mind

control.

More information on Dr. Robert Duncan is available at drrobertduncan.com.

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Free eBook: The Matrix Deciphered by Dr. Robert Duncan, A.B., S.M., M.B.A., Ph.D., the book discloses secret details on government operations and gives a hint to what it's like to live like a victim targeted..

Bio of Dr. Robert Duncan, from his book The Matrix Deciphered:

"True nobility is exempt from fear".
– King Henry the Sixth, Part II (Act IV, Scene I).

Call me The Saint. I am the all American - prep school, Harvard College graduating with honors in computer science and a minor in premedical studies, and advanced degrees from Harvard and Dartmouth in business and science. My famous ancestors are President Lincoln, King Duncan of Scotland, and Governor William Bradford, the first governor of Massachusetts.

My research interests have been neural networks, virtual reality, and EEG controlled robotics. Before graduate school I worked for the Department of Defense, Navy, NATO, and various intelligence agencies computer science projects. I have done business consulting and computer consulting for the largest companies in the world. I have been a professor, inventor, artist, and writer. I am one of the last Renaissance men.

My projects have included algorithms for Echelon and CIA natural language parsing and classification of document content, IRS formula for red flagging audits, writing the artificial intelligence code to automate tracking of the Soviet Nuclear Submarine Fleet and all water vessels, work integrating HAARP with SIGINT SIGCOM and SPAWAR. I have worked on projects for the Justice Department connecting local, state, and federal databases for the tracking of terrorists. I developed a system for the FBI to track license plates past toll booths and other locations. I worked on the soldier 2000 program to create body networks for reading vital signs and other information. A system I worked on called Snyper is operational in Iraq which triangulates on intercity conflict gun shots. I have been to a couple secret bases in the so called free world. I have developed telemedicine robotic surgery and virtual reality applications for the Army. For DARPA, I have worked on satellite computer vision target tracking applications and tank simulation as well as integration of the land, sea, and air surveillance systems like SOSSUS, towed arrays, and others.

Projects that I have worked on outside of government contracts include my thesis on computer generated holography, a project making paralyzed people walk again using choreographed stimulated muscles movements, face recognition, voice identification and recognition, finger print recognition, and neural network robotic controller. My research interests moved to enhanced reality heads up displays and wearable computing systems. My current research involves finding a cure for the mind control directed energy weapons fiasco. The integrated global surveillance grid is actually part of the holy grail of weapons and human control systems.

My apologies to the human race for my contribution to tyranny. I was tricked into thinking it would not be misused by corrupt government especially in my beloved country. I was wrong. The Joint Non-Lethal Weapons Directorate has Skip Green on the governing board. One of my old colleagues at a technology think tank in Cambridge partly in charge of the radio frequency weapons testing for neurological disruption now torturing and killing people worldwide. Several other US Navy and UK Navy scientists have been knocked-off and that is why I have come forward. I know my time maybe near. I am currently a professor in computer science and business, helping to educate the public on government corruption, greed, and stupidity. Like my ancestor Lincoln, I am fighting against mental slavery in a new Civil War engineered by the same useless elements in over 80 government agencies who have tested radiological, drug, and viral weapons on unsuspecting Americans for over 45 years.

I have great pride in the fundamental and constitutional values of America and mean no disrespect by my blasting the incompetence, apathy, and stupidity of those involved in the conspiracy of involuntary biological, chemical, and psychotronic human effects testing. There are so many brave men and women serving in the armed forces who fight and protect us for the American values they believe in. But because of the silos of information called compartmentalization in the security agencies and the lack of accountability and oversight of black operations and some top secret projects, diabolical elements become rogue or worse destroying the very country they are tasked with protecting turning it into a hypocracy rather than a democracy.

My goal is to awaken Americans to the continued horrific acts of military and CIA weapons testers in this country and the other branches of government’s inability to stop them and hold them accountable.

All I ask from the reader is to listen to testimony and validate facts presented here and come to their own conclusion. Then fight to win back America from this silent overthrow. This has been my project for about two years, investigating government corruption, incompetence, and cover-up upon which I accidentally stumbled one day while looking at a reverse MRI scheme to inject electromagnetic signals into the brain for virtual reality applications. I have interviewed over two hundred people and worked on the highest level of military projects for the U.S., NATO, and U.K. and have given videotaped testimony to senators and representatives on this topic resulting in lip service since they have no real power to enforce. Two high level FBI agents and a couple CIA agents have come forward to validate the existence of a MKULTRA like project that continues to grab random people for mind control experimentation. Two of these have since become part of the program and endure daily psychotronic tortures. All the torture can be done using directed energy psychotronic weapons with the so called continental ballistic missile surveillance defense grids.

I apologize to the human race for any contribution to these 4th generation weapons that I may have worked on that are more horrific than the nuclear bomb and whose cover-up is more pervasive than the Manhattan Project. And because of the horrific acts of violence being committed on as many as two thousand Americans as far as my research has uncovered and many others in other countries, I understand the extreme risk to my own welfare that publishing this material will have. But freedom is so important to me that I know full heartedly that the human race

must have an open discussion on these weapons to decide their own fate before the point of decision is gone, that I am willing to risk divulging so called national secrets. All I offer you is the truth.

All information presented in this book was received through legitimate channels such as the Freedom of Information Act, military documents, victim testimony, and turned agents. I still hold valid the oath I took to keep secret the details of the projects that I worked on under DoD budgets. The majority of the proceeds of this book will go towards helping the psychotronic experiment survivors and surviving families of those that have perished. When the government fails, business and the citizens must look out for each other.

Dr. Robert Duncan in Energy Weapons & Testing, Coast to Coast AM broadcast December 5th 2006 (2.75+ million listeners weekly, syndicated in most cities and areas of the United States, and other places around the world.)..

0:57 / 1:53:43

Download - Dr. Robert Duncan, Coast to Coast AM interview - Energy Weapons & Testing.

Energy Weapons & Testing synopsis:

Independent investigator Robert Duncan discussed directed energy and neurological weapons and his contention that they've been tested on the public at large. While directed energy is used in microwaves, to remove kidney stones, and in non-invasive surgery, it's also been developed extensively for military purposes, he reported.

The civilian population was targeted for experiments, in programs such as MK-ULTRA, starting after WW II, when Nazi scientists were imported to the US, some working on scalar or gravity weapons, said Duncan. The town of Taos, NM, where a hum was heard by many citizens, was the subject of a directed energy experiment by the U.S. Navy, he claimed. And most recently the Active Denial System (see article below) was tested on human subjects.

Duncan said he interviewed over 600 mind control victims (Dec 5th 2006 report), and found some validity to their allegations. There are weapons that can project voices into people's heads such as one system known as "The Voice of God," he detailed. Blocking techniques include jamming the signals with electronic scramblers, and using shields with metal alloys or mylar. He recommended the following websites for further information/assistance: mindjustice.org, raven1.net, freedomfchs.com.

The Goodbye Weapon

A new non-lethal weapon, the Air Force's Active Denial System, or ADS, has been certified for use in Iraq, after extensive testing. The ADS shoots a beam of waves that causes extreme (but temporary) pain and induces what experimenters call the "Goodbye effect," or "prompt and highly motivated escape behavior." Wired News obtained documents about the weapon and has published two reports (article(1)/documentation(2)). Additionally, the report's author David Hambling has posted a commentary(3) on the subject at Defense Tech.

1. http://www.wired.com/news/technology/0,72134-0.html
2. http://www.wired.com/news/technology/0,72236-0.html
3. http://www.defensetech.org/archives/003036.html

Coast to Coast AM guest bio:

Dr. Robert Duncan holds multiple degrees from Harvard University and Dartmouth College amongst others. He has had the most expensive American education money can buy. He is an investigator, author, and soon be movie producer on the topics of directed energy, neurological weapons, psychological, and information warfare. His movie is called "The Enemy Within - Psychic Warfare". A book he is co-authoring will be out in a few months called "Hacking the Human Mind".

Dr. Duncan has worked as a business and information technology consultant to the Fortune 500. He has worked for companies like Oracle Corporation, BEA systems, HP, BBN, and as a professor at a college. For the department of defense he has written the artificial intelligence code to track the Soviet nuclear submarine fleet with passive and active acoustical arrays and has been to a couple secret NATA Navy underground bases in Europe.

-Todd Giffen
Target since birth as I was born into American enslavement, surveillance, and control, under attack with directed energy since 2008
503-967-5202
case@oregonstatehospital.net
obamasweapon.com

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"The Use of Psychotronic Weapons"
"What everyone should know"

(courtesy : http://www.mindjustice.org/cherkova.htm)

Definition:

Definition of psychotronic (psycho-physical) weapons.

Psychotronic Weapons (PF- weapons) this is the totality of all possible methods and means (techno-genic, suggestive, pharmacological, paranormal, complexes, and others) of hidden, forced influences on the psyche of a person for the purpose of modifying his consciousness, behavior and health for what is desired in the way of influencing aspects of control..."

Second definition of psychotronic weapons (as an epigraph): "Applications in military and for antisocial purposes are possibilities also for knowledge of psychotronics, its means, methods, systems, 'generators', and there is the path for the transformation of the humanitarian, essential attributes of life and society in the weapons. These are also psychotronic weapons. This is not only dangerous, this is deadly!"

Types of Weapons:

- Electromagnetic Weapons
- Microwave Weapons
- Non-Lethal Weapons
- ELF (Extremely Low Frequency) Weapons
- Directed Energy Weapons
- Acoustic Weapons
- Psychotronic Weapons
- RF (Radio Frequency) Weapons
- Soft Kill Weapons
- Less-Than-Lethal Weapons

How it affects (Physical & psycho-physical damages):

Physical damage, visible results achieved at the moment of influence.

* burns, pricks, cuts, wounds (ray weapons, laser)
* bleeding into the brain (laser ray with energy pulses of 40 joules) and on the skin energy in pulses: 3 - 100 joules)
* Blindness in the eyes, loping of eyelashes (laser ray)
* loss of memory (influence of frequency of up to 100Hz. and a reduction to 5 Hz.)
* destruction of the vestibulary [inner ear] apparatus, spatial orientation
* symptoms of [***] [with a large exposure and strength, paralysis (UBCh) in the area of the beginning of the spinal column
* irregular sleeping, heart-beating
* numbness of the hands; at night, cramping of the legs
* sharp decrease in hemoglobin, micro-burns to the skin, ionization of the blood and body fluids, an increase in the deterioration rate of clothing material, photographic material [illuminating], (thermal-electronic emissions from lamps in the room with the feeding units of electrical networks and fittings of the wall, [...]
* vibrations (separate organs can vibrate: the heart, kidneys, etc.), [...] (from

* vibrational technologies)
* pressure, coolness of the skin
* feelings of non-specific fear and panic (from the weapons) [...] tremors, tapping, destruction of fragile objects from the waves, from the impulses and from other manifestations of technological poltergeist

Psycho-physical damage depending on intensity and duration of effects. Damage in the physical sphere (up to programmed premature death).

Stage I.

* changes in the blood (early signs)
* overheating substances especially and increase in crystallization, leading to cataracts (early sign)
* ill reactions along the path of the bio-energetic potential from the effects [...]
* prickly sensations, tremors to the muscles of the feet
* aggravation of chronic illnesses
* internal bleeding (nose, stomach, gynecological)
* auditory tones of various frequencies
* sharp pain in the internal ear
* dull pains in the area behind the ears
* internal trembling, vibrations
* head pain in the temple and a warmness in that area, pain in the eye-sockets
* likelihood of miscarriage, an increase of 80% for chances of premature births, anomalous
* development of the fetus, often with defective brains

Stage II.

* "radio-sound" effect (before this is long-conducted the resonance-loosening of spinal and brain fluids at the frequency of 2-10 Hz. for maintaining the fluids of theskull and brain in stimulation
* steady reactions to all aspects of coding
* lowering of energy (observed with irradiation at the frequency carrying frequencies of ~780 Hz.and amplitude modulation ~71 Hz.)
* aggravation of dermatosis
* eye pains (cataracts, asymmetry in lenses of the eyes, puffiness [?] of the retinas)
* aggravation of the course of chronic illnesses
* destruction of the functions of the kidneys, liver, organs of digestion, circulatory system, bleeding in gingivae, gums, peridontal and others
* gauntness
* "sand" in the eyes, burning sensation, loss of hair, brittleness of nails
* compression pain in the heart fits of coughing
* changes of the color of the face (bronze shading of the skin)
* asymmetrical puffiness of the face
* disfiguration of the face, the intentional emaciation of separate muscles, cartilage
* syndromes of destruction to the external nerves of the thighs
* impotence

Stage III.

* destruction of the brain, irreversible changes to the structure of the brain (academician V.P. Vekhtereva)

* irreversible processes in the muscle material, in the bones of the skull, and in the structures of neurons "..minimalization of life" --external reaction to EMP appears as an illness, up to heavy, sharp, chronic, organic pathological processes (academician V.P. Kaznacheev)
* "..the entire speeding up of the aging process, sclerosis, oncogenesis (academician V.P. Kaznacheev)
* destruction of bio-chemical processes in the cells with distrophic changes in the organs (academician V.P. Kaznacheev)
* destruction of the cell membranes, chemical connections in the cells -leading to leukemia, cancer of the brain and prostate gland, breast cancer, (even with weak EMP, but of long duration "...the genetic apparatus is altered..." (academician V.P. Kaznacheev)
* the reflex activities are destroyed
* the functioning of the hormonal system is destroyed
* [....] Parkinson's disease (trembling of the hands) and Alzheimer's disease (from changes in the production of the hormone melanin ([...] gland) that causes degenerative changes in substances at the molecular level disfunctions of the sino-atrial node of the heart (even with a low frequency)
* infarction, cerebral thrombosis, osteo-[***], peridontal, sugar diabetes
* allergies
* epilepsy (especially caused by the multiple-rapid stimulation by a weak, low frequency waves)
* hypertension, hypotension
* programmed or instantaneous (with the subjection to extreme effects -up to the border of deadly conditions) premature death --it is well known by the experimentors that cases of death do occur (academician V.P. Kaznacheev)
* a decrease and dying off of the population, humanity, mankind

Damage in the mental sphere (up to the point of insanity).
Stage I.

* manifestations of depression
* lowering in the interest in perceived information
* shortness of temper (irritability)

Stage II.

* steady depression
* lowering of abilities for analytical thinking, some worsening of the memory
* symptoms of chronic fatigue
* superficial nature of sleep
* higher incidents of conflicts

Stage III.

* confusion in the accounting of events in real life
* loss of ability for analytical thinking
* lowering and a loss of memory
* feelings of the lack of sleep
* indifference to personal external appearance [...]
* lowering of self-control from the deficit of the hormone seratonin due to SVCh irradiation
* suicide (as the experimentors "practice" provocation techniques)
* "...invisible weak fields ...their ignoring that they are carrying with them a deadly danger"... "...people simply start going crazy and nobody understands why..." (academician V.P. Kaznacheev)

"Consequences of effects of micro-leptonic generators are described by the leading developer in this area [from the] V. Lab. of Micro-leptonic Technologies D. Okhatryym: in 1982 there began extremely unpleasant things with the health our co-workers. At first, there arose their feeling unwell, then the loss of logic, then after this, the loss of spatial orientation. Finally, a breakdown of diseased [affected] organs. The coming out of this condition -and this includes myself -was achieved with great difficulty."

(in the book by Ju. Vorob'evskii" Knock at the Golden Gate, Moscow, 1999.

Manipulation with the memory.

* Erasure
* Blockage
* Recording of information needed by the experimentor
* training -"prompting" (after erasure)
* comparison,
* reproduction of picture a from a prior testing as though bifurcated [?]
* a shifting of the effective frequency up to 100 Hz. or a lowering to 5 Hz., with memory loss

Control of Stimulation in the brain.

* by states of consciousness (up to the loss of these)
* in sleep
* emotions
* intellectual capabilities
* attention
* speech
* activeness
* muscle tone
* stimulation of one and the same zone with stimulations of:
o 30 -40 mV- activization of attention, memory, movement;
o 60-70 mV- "emotiono-genic" effects

Different methods:

Types of Psychotronic, psychotropic and other Psy-Influences.

* radio-waves
* laser-irradiation
* infra-red irradiation
* ultra-violet irradiation UF
* x-ray irradiation
* gravitational fields
* torsional fields (hypothetical)
* leptonic and other fields

Acoustic Waves.

* infra-sonic (IZ) from 0 Hz. to 15-20 KHz.
* ultra-sonic(UZ) from 15-20 KHz. to 10**9 Hz. (ranges for IZ and UZ)

see more similar information in -Table 3

Formation of fields:

* electro-magnetic charge
* gravitational-mass
* torsional (surrounding spin fields) -spin, with any rotating body
* micro-leptonic energy (in free aspect) -[over-abundance of stable particles]?

Operator is secretly brought in, or in a secret installation nearby

BG: Biogenerator (could be tomography)
A: Antenna (irradiation and reception)
D: operator for the gathering of information, transmission and control
ZU: reminding sytem on a magnetic strip, holographic
BIP: bio-informational [...]
KC: channel connections (IK, radio, telephone, telegraph)
E: screen display
O: operator
SP: light pen with which the operator indicates on the screen, the point of influence

Stress systems and methods of harassment.

* slander
* gestures, hand movements, expressions, tests, practical "jokes"
* taking off what is needed for the eyes (vision) [?]
* psychological pressure through family, neighbors or surrounding people, vehicle drivers
* discrediting: along 5 directions (often with the involvement of the police)
o irresponsibility
o spy
o drug dealer
o vagrant
o accomplice in a crime (in an alleged crime)
* torture, assault
* blackmail, threats
* attempts on their lives with PTOs
* death to someone close or in immediate surrounding life
* murder

Stages of Zombification (Substitution of consciousness with external control).

* programming, modeling of a cybernetic double
* conducting of programs according to non-differentiation of a proper and artificial "I"-"Not-I"
* extreme influencing, stress, harassment, irradiation, special-preparations [substances], chemicals
* taking to the limits of mental and physical capacities (survivability)
* loss of will, memory
* shutting off of his own consciousness
* replacement of consciousness with the control from his cybernetic twin

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ACQUISITION, AIR, INTEL & CYBER

Pentagon Studies Weapons That Can Read Users' Mind

By SYDNEY J. FREEDBERG JR.
on July 14, 2017 at 3:15 PM
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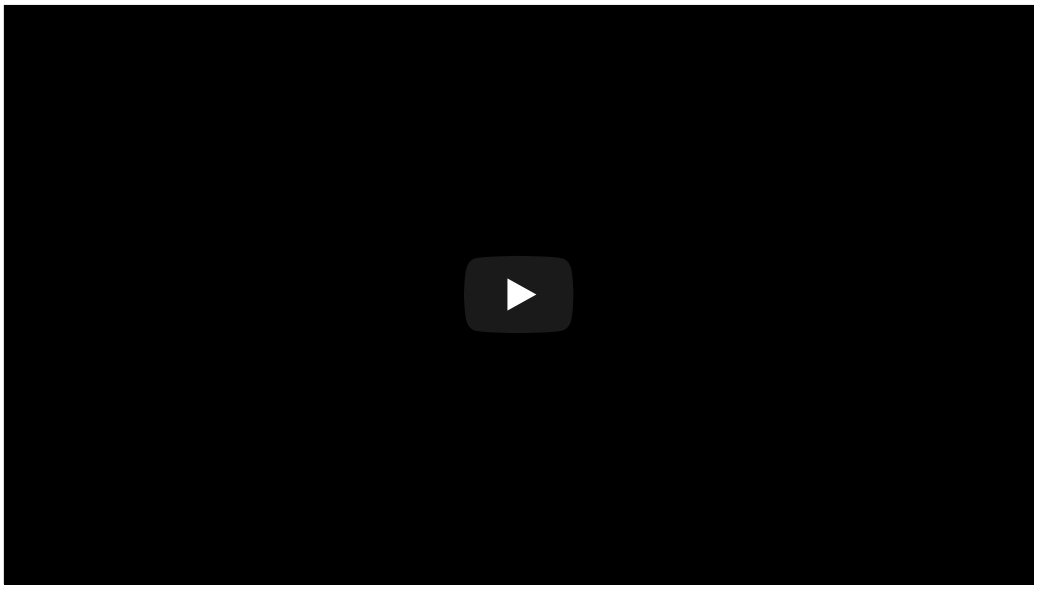

NEWSEUM: The troops of tomorrow may be able to pull the trigger using only their minds. As artificially intelligent drones, hacking, jamming, and missiles accelerate the pace of combat, some of the military's leading scientists are studying how mere humans can keep up with the incredible speed of cyber warfare, missiles and other threats.

One option: Bypass crude physical controls — triggers, throttles, keyboards — and plug the computer directly into the human brain. In one DARPA experiment, a quadriplegic first controlled an artificial limb and then flew a flight simulator. Future systems might monitor the users' nervous system and compensate for stress, fatigue, or injury. Is this the path to what the Pentagon calls human-machine teaming?

This is an unnerving scenario for those humans, like Stephen Hawking, who mistrust artificial intelligence. If your nightmare scenario is robots getting out of control, "let's teach them to read our minds!" is probably *not* your preferred solution. It sounds more like the beginning of a movie where cyborg Arnold Schwarzenegger goes back in time to kill someone.

Navy X-47B drone.

But the Pentagon officials who talked up this research yesterday at Defense One's annual tech conference emphasized the objective was to *improve* human control over artificial intelligence. Teaching AI to monitor its user's level of stress, exhaustion, distraction, and so on helps the machine adapt itself to better serve the human — instead of the other way around. Teaching AI to instantly detect its user's *intention* to give a command, instead of requiring a relatively laborious push of a button, helps the human keep control — instead of having to let the AI off the leash because no human can keep up with it.

Official Defense Department policy, as then-Secretary Ash Carter put it, is that the US will "never" allow an artificial intelligence to decide for itself whether or not to kill a human being. However, no less a figure than the Carter's undersecretary of acquisition and technology, Frank Kendall, fretted publicly that making our robots wait for human permission would slow them down so much that enemy AI without such constraints would beat us. Vice-Chairman of the Joint Chiefs, Gen. Paul Selva, calls this the "Terminator Conundrum." Neuroscience suggests a way out of this dilemma: Instead of slowing the AIs down, make the humans' orders come faster.

DARPA's Revolutionizing Prosthetics program is devising new kinds of artificial limbs — and new ways to control them.

Accelerate Humanity

"We will continue to have humans on the loop, we will have human input in decisions, but the way we go about that is going to have to shift, just to cope with the speed and the capabilities that autonomous systems bring," said Dr. James Christensen, portfolio manager at the Air Force Research Laboratory's 711th Human Performance Wing. "The decision cycle with these systems is going to be so fast that they have to be sensitive to and responsive to the state of the individual (operator's) *intent*, as much as overt actions and control inputs that human's providing."

In other words, instead of the weapon system responding to the human operator *physically* touching a control, have it respond to the human's brain cells forming the *intention* to use a control. "When you start to have a direct neural interface of this type, you don't necessarily need to command and control the aircraft using the stick," said Justin Sanchez, director of DARPA's Biological Technologies Office. "You could potentially re-map your neural signatures onto the different control surfaces" — the tail, the flaps — "or maybe any other part of the aircraft" — say landing gear or weapons. "That part hasn't really been explored in a huge amount of depth yet."

Reading minds, even in this limited fashion, will require deep understanding and close monitoring of the brain, where thoughts take measurable form as electrical impulses running from neuron to neuron. "Can we develop precise neurotechnologies that can go to those circuits in the brain or the peripheral nervous system in real time?" Sanchez asked aloud. "Do we have computational systems that allow us to understand what the changes in those signals (mean)? And can we give meaningful feedback, either to the person or to the machine to help them to do their job better?"

DARPA's Revolutionizing Prosthetics program hooked up the brain of a quadriplegic — someone who could move neither arms nor legs — to a prosthetic arm, allowing the patient to control it directly with their thoughts. Then, "they said, 'I'd like to try to fly an airplane,'" Sanchez recounted. "So we created a virtual flight simulator for this person, allowed this neural interface to interface with the virtual aircraft, and that person flew."

"That was a real wake-up call for everybody involved," Sanchez said. "We didn't initially think you could do that."

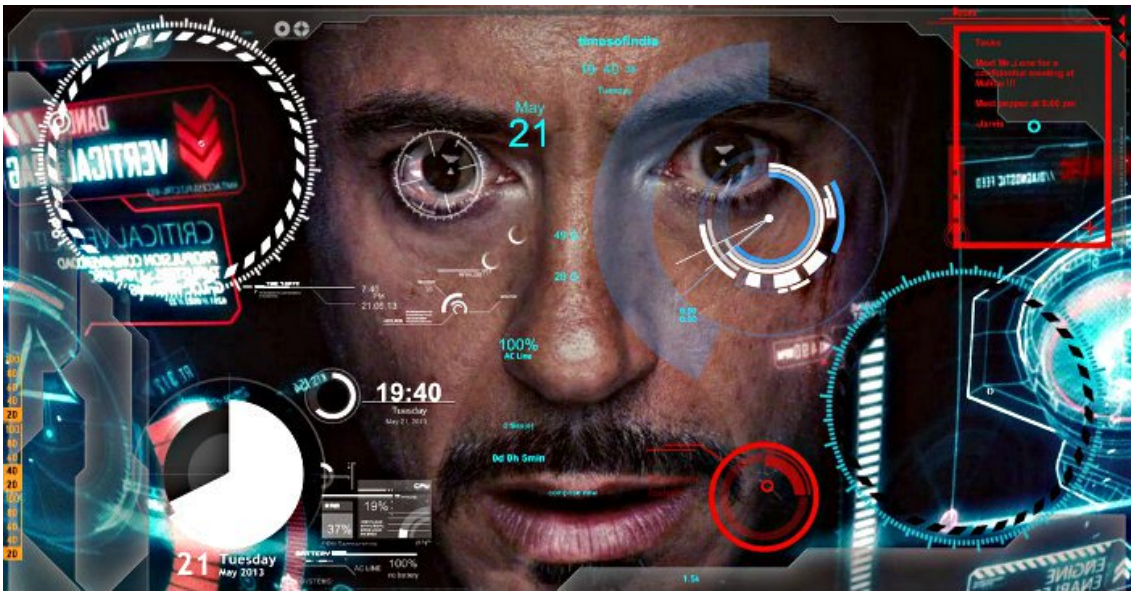

Tony Stark (Robert Downey Jr.) relies on the JARVIS artificial intelligence — exquisitely adapted to his personal strengths and weaknesses — to help pilot his Iron Man suit. (Marvel Comics/Paramount Pictures)

Adapting To The Human

Applying direct neural control to real aircraft — or tanks, or ships, or network cybersecurity systems — will require a fundamental change in design philosophy. Today, said Christensen, we give the pilots tremendous information on the aircraft, then expect them to adapt to it. In the future, we could give the aircraft tremendous information on its pilots, then have it use artificial intelligence to adapt itself to *them*. The AI could customize the displays, the controls, even the mix of tasks it took on versus those it left up to the humans — all exquisitely tailored not just to the preferences of the individual operator but to his or her current mental and physical state.

When we build planes today, "they're incredible sensor platforms that collect data on the world around them and on the aircraft systems themselves, (but) at this point, very little data is being collected on the pilot," Christensen said. "The opportunity there with the technology we're trying to build now is to provide a continuous monitoring and assessment capability so that the aircraft knows the state of that individual. Are they awake, alert, conscious, fully capable of performing their role as part of this man-machine system? Are there things that the aircraft then can do? Can it unload gees (i.e. reduce g-forces)? Can it reduce the strain on the pilot?"

Air Force MQ-9 Reaper operators in training. Today's drones require extensive human oversight and are hardly user friendly.

"This kind of ability to sense and understand to the state and the capabilities of the human is absolutely critical to the successful employment of highly automated systems," Christensen said. "The way all of our systems are architected right now, they're fixed, they're predictable, they're deterministic" — that is, any given input always produces the exact same output.

Predictability has its advantages: "We can train to that, they behave in very consistent ways, it's easier to test and evaluate," Christensen said. "What we lose in that, though is the real power of highly automated systems, autonomous systems, as *learning systems*, of being able to adapt themselves. "

"That adaptation, though, it creates unpredictability," he continued. "So the human has to adapt alongside the system, and in order to do that, there has to be some mutual awareness, right, so the human has to understand what is the system doing, what is it trying to do, why is that happening; and vice versa, the system has to has some understanding of

the human's intent and also their state and capabilities."

This kind of synergy between human and artificial intelligence is what some theorists refer to as the "centaur," after the mythical creature that combined human and horse — with the human part firmly in control, but benefiting from the beast's strength and speed. The centaur concept, in turn, lies at the heart of the Pentagon's ideas of human-machine teaming and what's known as the Third Offset, which seeks to counter (offset) adversaries' advancing technology with revolutionary uses of AI.

The neuroscience here is in its infancy. But it holds the promise of a happy medium between hamstringing our robots with too-close control or letting them run rampant.

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Internet of Things (IoT) in 5G Wireless Communications

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GUEST EDITORIAL

Internet of Things (IoT) in 5G Wireless Communications

During the past decade, the Internet of Things (IoT) has revolutionized the ubiquitous computing with multitude of applications built around various types of sensors. A vast amount of activity is seen in IoT based product-lines and this activity is expected to grow in years to come with projections as high as billions of devices with on average 6-7 devices per person by year 2020. With most of the issues at device and protocol levels solved during the past decade, there is now a growing trend in integration of sensors and sensor based systems with cyber physical systems and device-to-device (D2D) communications. 5th generation wireless systems (5G) are on the horizon and IoT is taking the center stage as devices are expected to form a major portion of this 5G network paradigm. IoT technologies such as machine to machine communication complemented with intelligent data analytics are expected to drastically change landscape of various industries. The emergence of cloud computing and its extension to fog paradigm with proliferation of intelligent 'smart' devices is expected to lead further innovation in IoT. These developments excite us and form a motivation to survey existing work, design new techniques, and identify new applications of IoT. Researchers, scientists, and engineers face emerging challenges in designing IoT based systems that can efficiently be integrated with the 5G wireless communications.

We received enthusiastic response to our special issue call for papers. A total of nine high quality papers were received out of which only seven were selected after a thorough review process. Invited articles were sought from two highly cited and accomplished researchers. Dr. Mischa Dohler (Fellow IEEE, Kings College London, UK) and Dr. Mung Chiang (Fellow IEEE, Princeton University, USA).

The first article "MIMO-NOMA design for small packet transmission in the Internet of Things", written by a collaborative team of researchers Ding et al.,, opportunistic serving mechanism is designed as part of the effort in the novel paradigm of Multiple Input Multiple Output Non-Orthogonal Multiple Access transmission scheme. Under the proposed method, one user is completely served with their quality of service requirements completely taken care of whereas second user is served opportunistically under the NOMA paradigm. The main contribution of this article is a design with two sets of system parameters, precoding and power allocation coefficients, in order to ensure that the potential of NOMA can be realized even if the users' channel conditions are similar. Two types of power allocation policies are developed in this paper. One is to meet first user's QoS requirements in the long term. For example, in order to satisfy its targeted outage probability. The other is in which to realize second user's QoS requirements instantaneously, e.g., the power allocation coefficients are designed to realize its targeted data rate for each channel realization.

Machine to machine communication has a significant role to play in emerging internet of things paradigm in years and decades to come. The emerging IoT-5G scenario extends sensor based IoT capabilities to robots, actuators and drones for distributed coordination and low-latency reliable execution of tasks at hand. In the invited work titled "Enabling the IoT machine age with 5G: Machine-type multicast services for innovative real-time applications" by Condoluci et al., core attention is focused on the end-to-end reliability, latency, and energy consumption comprising both up and downlinks for 5G-IoT communication. The authors propose the definition, design, and analysis of machine-type multicast service (MTMS). They recommend different procedures that need to be redesigned for MTMS and derive the most appropriate design drivers by analyzing different performance indicators, such as scalability, reliability, latency, and energy consumption. Overall, a very interesting read complemented by open problems and future research directions to pursue.

Security is one of the biggest challenges faced by Internet of Things. With devices becoming ubiquitous and pervasive in day to day lives necessitate reliable and secure algorithms. The third article, "Security enhancement for IoT communications exposed to eavesdroppers with uncertain locations" by Xu et al., develops a secure framework for eavesdroppers with Uncertain Locations in IoT. With the assumption that the locations of eavesdroppers change independently from hop to hop, authors derive an expression for the secrecy outage probability of the two-hop transmission, which is shown to be the upper bound of the outage probability when the locations of eavesdroppers remain unchanged. Following this expression, the end users formulate a secrecy rate maximization problem with the secrecy-outage probability constraint. The optimal rate design for codebooks and power allocation between the source and relay are derived. By studying the performance of the optimal scheme in some special cases, we obtain several insights concerning the setting of system parameters.

In the article, "Enabling massive IoT in 5G and beyond systems: PHY radio frame design considerations" by Ayesha Ijaz et al., the authors propose a flexible frame structure and design for massive Internet of Things (IoT) devices working in 5G wireless network. The authors also discussed

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the interdependence of different frame design parameters, service requirements and characteristics of radio environment. Based on these interdependency, they provide guidelines for radio numerology design and elaborated on the frame design for IoT communications in 5G networks to support massive connection density of low-rate, low-power devices. The article concludes with some key research findings and challenges massive IoT in 5G wireless network.

It is estimated that in year 2020, 20 to 40 billion devices will be connected to the Internet as part of the Internet of Things. A critical bottleneck for realizing the efficient IoT is the pressure it puts on the existing communication infrastructures, requiring transfer of enormous data volumes. In the article "CONDENSE: A reconfigurable knowledge acquisition architecture for future 5G IoT", by Dejan Vukobratovic et al., the authors propose a architecture named 'Condense' which integrates the acquisition of IoT-generated data within the 3GPP MTC (machine type communications) systems. The proposed Condense architecture introduces a service within 3GPP MTC systems – computing linear and non-linear functions over the data generated by MTC devices This service brings about the possibility that the underlying communication infrastructure communicates only the desired function of the MTC- generated data (as required by the given application at hand), and not the raw data in its entirety. This transformational approach has the potential to dramatically reduce the pressure on the 3GPP MTC communication infrastructure. The article concludes by discussing challenges, provides insights, and identifies future research directions for implementing function computation and function decomposition within practical 3GPP MTC systems.

In the article, "Frequency-domain oversampling for cognitive CDMA systems: Enabling robust and massive multiple access for Internet of Things" by Su Hu et al., the authors utilize the concept of cognitive radio with dynamic non-continuous spectrum bands and code division multiple access to tackle the challenge of massive spectrum resource management in IoT. In order to suppress multiple access interference resulting from the non-orthogonality of partial available spectrum bins, carrier frequency offset, and spectrum sensing mismatch, the authors propose an enhanced receiver design that combines the frequency-domain oversampling scheme (FDO) and linear minimum mean square error (MMSE) method. The simulation results show that the cognitive-CDMA with FDO-MMSE receiver outperforms that with conventional per-user MMSE receiver in the presence of multipath fading channels, carrier frequency offset, and spectrum sensing mismatch.

In the invited article, "A survey of client-controlled HetNets for 5G" by Michael Wang et al., a comprehensive review is provided on spectrum of client-controlled HetNets for 5G networks: from the fully devolved distributed local control approach to the hybrid control approach where clients may make the decisions given some global information provided by the network. After giving a thorough review, the authors also provide future research directions and recommendations for evolution of 5G heterogeneous networks as an enabler for next generation internet of things.

To conclude, the Editors would like to thank all authors who submitted their manuscripts against this Special issue. There had been some very exciting submissions though we could only accept best seven high quality submissions. The editorial staff also thanks the reviewers for their timely comments on the manuscript which helped us improve the presentation and quality of the content manifold. All the associate editors thank the Editor in Chief Dr. Michael Pecht for his assistance in making this special issue a reality. We would also like to thank the publications editor Ms. Kimberly Shumard for her continuous follow up on timelines and management of articles to ensure timely completion of the review process. We complete this note by letting the readers know to stay tuned with IEEE Access as we expect even more exciting issues in months to come.

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He has led a number of multimillion-funded international research projects encompassing the areas of energy efficiency, fundamental performance limits, sensor networks, and self-organizing cellular networks. He also led the new physical layer work area for 5G Innovation center at Surrey. He has a global collaborative research network spanning both academia and key industrial players in the field of wireless communications. He has supervised 21 successful Ph.D. graduates and published over 200 peer-reviewed research papers, including over 20 IEEE Transaction papers. He secured first rank in his B.Sc. and a distinction in his M.Sc. degree along with an award of excellence in recognition of his academic achievements conferred by the President of Pakistan. He received the IEEE Comsoc's Fred Ellersick Award 2014, the Sentinel of Science Award 2016, and the FEPS Learning and Teaching Award 2014 and twice nominated for Tony Jean's Inspirational Teaching Award. He is a shortlisted finalist for The Wharton-QS Stars Awards 2014, the Reimagine Education Award for innovative teaching, and the VC's learning and teaching award in the University of Surrey. He is a Senior Fellow of the Higher Education Academy, U.K.

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5G RADIO ACCESS

CAPABILITIES AND TECHNOLOGIES

The capabilities of 5G wireless access must extend far beyond previous generations of mobile communication. Examples of these capabilities include very high data rates, very low latency, ultra-high reliability, energy efficiency and extreme device densities, and will be realized by the development of LTE in combination with new radio-access technologies. Key technology components include extension to higher frequency bands, access/backhaul integration, device-to-device communication, flexible duplex, flexible spectrum usage, multi-antenna transmission, ultra-lean design, and user/control separation.

WHAT IS 5G?

5G radio access technology will be a key component of the Networked Society. It will address high traffic growth and increasing demand for high-bandwidth connectivity. It will also support massive numbers of connected devices and meet the real-time, high-reliability communication needs of mission-critical applications.

5G will provide wireless connectivity for a wide range of new applications and use cases, including wearables, smart homes, traffic safety/control, critical infrastructure, industry processes and very-high-speed media delivery. As a result, it will also accelerate the development of the Internet of Things.

The overall aim of 5G is to provide ubiquitous connectivity for any kind of device and any kind of application that may benefit from being connected.

5G networks will not be based on one specific radio-access technology. Rather, 5G is a portfolio of access and connectivity solutions addressing the demands and requirements of mobile communication beyond 2020.

The specification of 5G will include the development of a new flexible air interface, NX, which will be directed to extreme mobile broadband deployments. NX will also target high-bandwidth and high-traffic-usage scenarios, as well as new scenarios that involve mission-critical and real-time communications with extreme requirements in terms of latency and reliability.

In parallel, the development of Narrow-Band IoT (NB-IoT) in 3GPP is expected to support massive machine connectivity in wide area applications. NB-IoT will most likely be deployed in bands below 2GHz and will provide high capacity and deep coverage for enormous numbers of connected devices.

Ensuring interoperability with past generations of mobile communications has been a key principle of the ICT industry since the development of GSM and later wireless technologies within the 3GPP family of standards. In a similar manner, LTE will evolve in a way that recognizes its role in providing excellent coverage for mobile users, and 5G networks will incorporate LTE access (based on Orthogonal Frequency Division Multiplexing (OFDM)) along with new air interfaces in a transparent manner toward both the service layer and users.

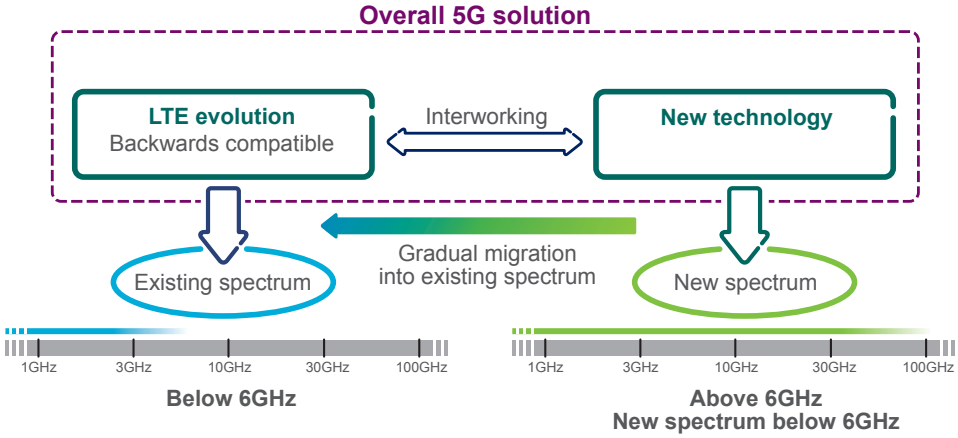

Figure 1: The overall 5G wireless-access solution consisting of LTE evolution and new technology.

Around 2020, much of the available wireless coverage will continue to be provided by LTE, and it is important that operators with deployed 4G networks have the opportunity to transition some – or all – of their spectrum to newer wireless access technologies. For operators with limited spectrum resources, the possibility of introducing 5G capabilities in an interoperable way – thereby allowing legacy devices to continue to be served on a compatible carrier – is highly beneficial and, in some cases, even vital.

At the same time, the evolution of LTE to a point where it is a full member of the 5G family of air interfaces is essential, especially since initial deployment of new air interfaces may not operate in the same bands. The 5G network will enable dual-connectivity between LTE operating within bands below 6GHz and the NX air interface in bands within the range 6GHz to100GHz. NX should also allow for user-plane aggregation, i.e. joint delivery of data via LTE and NX component carriers.

This paper explains the key requirements and capabilities of 5G, along with its technology components and spectrum needs.

5G – REQUIREMENTS AND CAPABILITIES

In order to enable connectivity for a very wide range of applications with new characteristics and requirements, the capabilities of 5G wireless access must extend far beyond those of previous generations of mobile communication. These capabilities will include massive system capacity, very high data rates everywhere, very low latency, ultra-high reliability and availability, very low device cost and energy consumption, and energy-efficient networks.

MASSIVE SYSTEM CAPACITY

Traffic demands for mobile-communication systems are predicted to increase dramatically [1] [2]. To support this traffic in an affordable way, 5G networks must deliver data with much lower cost per bit compared with the networks of today. Furthermore, the increase in data consumption will result in an increased energy footprint from networks. 5G must therefore consume significantly lower energy per delivered bit than current cellular networks.

The exponential increase in connected devices, such as the deployment of billions of wirelessly connected sensors, actuators and similar devices for massive machine connectivity, will place demands on the network to support new paradigms in device and connectivity management that do not compromise security. Each device will generate or consume very small amounts of data, to the extent that they will individually, or even jointly, have limited impact on the overall traffic volume. However, the sheer number of connected devices seriously challenges the ability of the network to provision signaling and manage connections.

VERY HIGH DATA RATES EVERYWHERE

Every generation of mobile communication has been associated with higher data rates compared with the previous generation. In the past, much of the focus has been on the peak data rate that can be supported by a wireless-access technology under ideal conditions. However, a more important capability is the data rate that can actually be provided under real-life conditions in different scenarios.

- 5G should support data rates exceeding 10Gbps in specific scenarios such as indoor and dense outdoor environments.
- Data rates of several 100Mbps should generally be achievable in urban and suburban environments.
- Data rates of at least 10Mbps should be accessible almost everywhere, including sparsely-populated rural areas in both developed and developing countries.

VERY LOW LATENCY

Very low latency will be driven by the need to support new applications. Some envisioned 5G use cases, such as traffic safety and control of critical infrastructure and industry processes, may require much lower latency compared with what is possible with the mobile-communication systems of today.

To support such latency-critical applications, 5G should allow for an application end-to-end latency of 1ms or less, although application-level framing requirements and codec limitations for media may lead to higher latencies in practice. Many services will distribute computational capacity and storage close to the air interface. This will create new capabilities for real-time communication and will allow ultra-high service reliability in a variety of scenarios, ranging from entertainment to industrial process control.

ULTRA-HIGH RELIABILITY AND AVAILABILITY

In addition to very low latency, 5G should also enable connectivity with ultra-high reliability and ultra-high availability. For critical services, such as control of critical infrastructure and traffic

safety, connectivity with certain characteristics, such as a specific maximum latency, should not merely be 'typically available.' Rather, loss of connectivity and deviation from quality of service requirements must be extremely rare. For example, some industrial applications might need to guarantee successful packet delivery within 1 ms with a probability higher than 99.9999 percent.

VERY LOW DEVICE COST AND ENERGY CONSUMPTION

Low-cost, low-energy mobile devices have been a key market requirement since the early days of mobile communication. However, to enable the vision of billions of wirelessly connected sensors, actuators and similar devices, a further step has to be taken in terms of device cost and energy consumption. It should be possible for 5G devices to be available at very low cost and with a battery life of several years without recharging.

ENERGY-EFFICIENT NETWORKS

While device energy consumption has always been prioritized, energy efficiency on the network side has recently emerged as an additional KPI, for three main reasons:

- Energy efficiency is an important component in reducing operational cost, as well as a driver for better dimensioned nodes, leading to lower total cost of ownership.
- Energy efficiency enables off-grid network deployments that rely on medium-sized solar panels as power supplies, thereby enabling wireless connectivity to reach even the most remote areas.
- Energy efficiency is essential to realizing operators' ambition of providing wireless access in a sustainable and more resource-efficient way.

The importance of these factors will increase further in the 5G era, and energy efficiency will therefore be an important requirement in the design of 5G wireless access.

MACHINE-TYPE COMMUNICATION

Fundamentally, applications such as mobile telephony, mobile broadband and media delivery are about information for humans. In contrast, many of the new applications and use cases that drive the requirements and capabilities of 5G are about end-to-end communication between machines. To distinguish them from the more human-centric wireless-communication use cases, these applications are often termed machine-type communication (MTC).

Although spanning a wide range of applications, MTC applications can be divided into two main categories – massive MTC and critical MTC – depending on their characteristics and requirements.

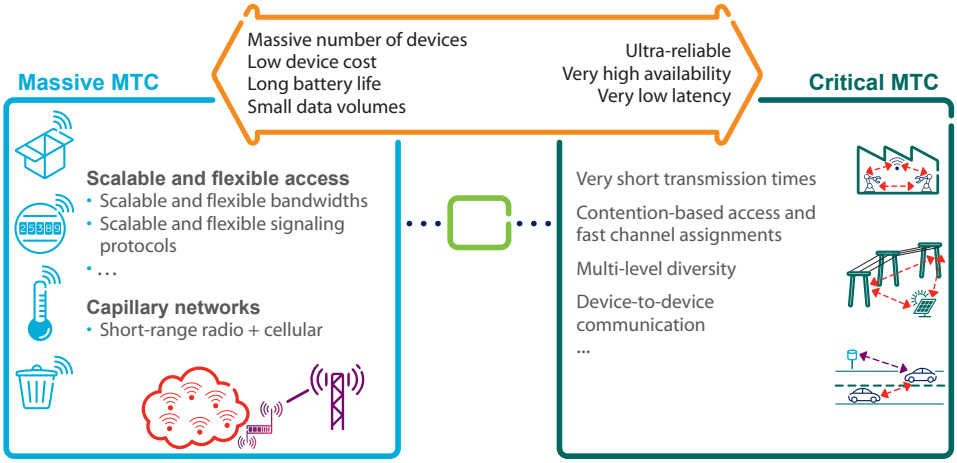

Figure 2: Massive MTC and critical MTC.

Massive MTC refers to services that typically span a very large numbers of devices, usually sensors and actuators. Sensors are extremely low cost and consume very low amounts of energy in order to sustain long battery life. Clearly, the amount of data generated by each sensor is normally very small, and very low latency is not a critical requirement. While actuators are similarly limited in cost, they will likely have varying energy footprints ranging from very low to moderate energy consumption.

Sometimes, the mobile network may be used to bridge connectivity to the device by means of capillary networks. Here, local connectivity is provided by means of a short-range radio access technology, for example Wi-Fi, Bluetooth [3] or 802.15.4/6LoWPAN [4]. Wireless connectivity beyond the local area is then provided by the mobile network via a gateway node.

Critical MTC refers to applications such as traffic safety/control, control of critical infrastructure and wireless connectivity for industrial processes. Such applications require very high reliability and availability in terms of wireless connectivity, as well as very low latency. On the other hand, low device cost and energy consumption is not as critical as for massive MTC applications. While the average volume of data transported to and from devices may not be large, wide instantaneous bandwidths are useful in being able to meet capacity and latency requirements.

There is much to gain from a network being able to handle as many different applications as possible, including mobile broadband, media delivery and a wide range of MTC applications by means of the same basic wireless-access technology and within the same spectrum. This avoids spectrum fragmentation and allows operators to offer support for new MTC services for which the business potential is inherently uncertain, without having to deploy a separate network and reassign spectrum specifically for these applications.

SPECTRUM FOR 5G

In order to support increased traffic capacity and to enable the transmission bandwidths needed to support very high data rates, 5G will extend the range of frequencies used for mobile communication. This includes new spectrum below 6GHz, as well as spectrum in higher frequency bands.

Specific candidate spectrum for mobile communication in higher frequency bands is yet to be identified by the ITU-R or by individual regulatory bodies. The mobile industry remains agnostic about particular choices, and the entire frequency range up to approximately 100GHz is under consideration at this stage, although there is significant interest in large contiguous allocations that can provide dedicated and licensed spectrum for use by multiple competing network providers.

The lower part of this frequency range, below 30GHz, is preferred from the point of view of propagation properties. At the same time, very large amounts of spectrum and the possibility of wide transmission frequency bands of the order of 1GHz or more are more likely above 30GHz.

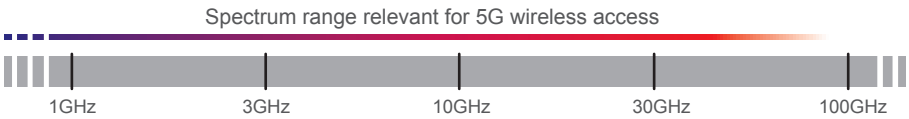

Figure 3: Spectrum relevant for 5G wireless access.

Spectrum relevant for 5G wireless access therefore ranges from below 1GHz up to approximately 100GHz, as Figure 3 shows.

It is important to understand that high frequencies, especially those above 10GHz, can only serve as a complement to lower frequency bands, and will mainly provide additional system capacity and very wide transmission bandwidths for extreme data rates in dense deployments. Spectrum allocations at lower bands will remain the backbone for mobile-communication networks in the 5G era, providing ubiquitous wide-area connectivity.

The World Radio Conference (WRC)-15 discussions have resulted in an agreement to include an agenda item for IMT-2020, the designated ITU-R qualifier for 5G, in WRC-19. The conference also reached agreement on a set of bands that will be studied for 5G, with direct applicability to NX. Many of the proposed bands are in the millimeter wave region and include:

- 24.25GHz to 27.5GHz, 37GHz to 40.5GHz, 42.5GHz to 43.5GHz, 45.5GHz to 47GHz, 47.2GHz to 50.2GHz, 50.4GHz to 52.6GHz, 66 GHz to 76GHz and 81GHz to 86GHz, which have allocations to the mobile service on a primary basis; and
- 31.8GHz to 33.4GHz, 40.5GHz to 42.5GHz and 47GHz to 47.2GHz, which may require additional allocations to the mobile service on a primary basis.

The mobile industry will strive to gain access to spectrum in the 6GHz to 20GHz range, but the policy directions being followed by regulators seem to be focused on frequency bands above 30GHz. In the US, the FCC has issued two Notices of Public Rule Making (NPRM) on bands above 24GHz. Ofcom has likewise indicated a preference for bands above 30GHz within the mobile industry.

The capacity needs of the mobile industry will continue to be served by licensed spectrum, although novel sharing arrangements for spectrum will become progressively more important as restricted opportunities for new spectrum start to impact incumbent services such as satellite communication and radio location. Two examples of sharing arrangements include LSA planned in Europe for the 2.3GHz band and the Citizens Band Radio Service for 3.5GHz in the US.

5G TECHNOLOGY COMPONENTS

Beyond extending operation to higher frequencies, there are several other key technology components relevant for the evolution to 5G wireless access. These components include access/backhaul integration, device-to-device communication, flexible duplex, flexible spectrum usage, multi-antenna transmission, ultra-lean design, and user/control separation.

ACCESS/BACKHAUL INTEGRATION

Wireless technology is already frequently used as part of the backhaul solution. Such wireless-backhaul solutions typically operate under line-of-sight conditions using proprietary radio technology in higher frequency bands, including the millimeter wave (mmW) band.

In the future, the access (base-station-to-device) link will also extend to higher frequencies. Furthermore, to support dense low-power deployments, wireless backhaul will have to extend to cover non-line-of-sight conditions, similar to access links.

In the 5G era, the wireless-access link and wireless backhaul should not therefore be seen as two separate entities with separate technical solutions. Rather, backhaul and access should be seen as an integrated wireless-access solution able to use the same basic technology and operate using a common spectrum pool. This will lead to more efficient overall spectrum utilization as well as reduced operation and management effort.

DIRECT DEVICE-TO-DEVICE COMMUNICATION

The possibility of limited direct device-to-device (D2D) communication has recently been introduced as an extension to the LTE specifications. In the 5G era, support for D2D as part of the overall wireless-access solution should be considered from the start. This includes peer-to-peer user-data communication directly between devices, but also, for example, the use of mobile devices as relays to extend network coverage.

D2D communication in the context of 5G should be an integral part of the overall wireless-access solution, rather than a stand-alone solution. Direct D2D communication can be used to offload traffic, extend capabilities and enhance the overall efficiency of the wireless-access network. Furthermore, in order to avoid uncontrolled interference to other links, direct D2D communication should be under network control. This is especially important for the case of D2D communication in licensed spectrum.

FLEXIBLE DUPLEX

Frequency Division Duplex (FDD) has been the dominating duplex arrangement since the beginning of the mobile communication era. In the 5G era, FDD will remain the main duplex scheme for lower frequency bands. However, for higher frequency bands – especially above 10GHz – targeting very dense deployments, Time Division Duplex (TDD) will play a more important role.

In very dense deployments with low-power nodes, the TDD-specific interference scenarios (direct base-station-to-base-station and device-to-device interference) will be similar to the 'normal' base-station-to-device and device-to-base-station interference that also occurs for FDD.

Furthermore, for the dynamic traffic variations expected in very dense deployments, the ability to dynamically assign transmission resources (time slots) to different transmission directions may allow more efficient utilization of the available spectrum.

To reach its full potential, 5G should therefore allow for very flexible and dynamic assignment of TDD transmission resources. This is in contrast to current TDD-based mobile technologies, including TD-LTE, for which there are restrictions on the downlink/uplink configurations, and for which there typically exist assumptions about the same configuration for neighbor cells and also between neighbor operators.

FLEXIBLE SPECTRUM USAGE

Since its inception, mobile communication has relied on spectrum licensed on a per-operator basis within a geographical area. This will remain the foundation for mobile communication in the 5G era, allowing operators to provide high-quality connectivity in a controlled-interference environment.

However, per-operator licensing of spectrum will be complemented with the possibility to share spectrum. Such sharing may be between a limited set of operators, or may occur in license-exempt scenarios. The

Citizens Band Radio Service in the US in the 3.5GHz band and the 5GHz unlicensed spectrum are examples of managed and unlicensed sharing regimes respectively.

New air interfaces like NX will likely be well served by more conventional licensed allocations of spectrum, mainly due to the need to establish a basic foundation for the technology to operate in an independent manner while interoperability is established with technologies like LTE. At some point, further allocations of spectrum for 5G may leverage the mobile industry's experience of sharing approaches in lower cellular bands.

MULTI-ANTENNA TRANSMISSION

Multi-antenna transmission already plays an important role in current generations of mobile communication and will be even more central in the 5G era, due to the physical limitations of small antennas. Path loss between a transmitter and receiver does not change as a function of frequency, as long as the effective aperture of the transmitting and receiving antennas does not change. The antenna aperture does reduce in proportion to the square of the frequency, and that reduction can be compensated by the use of higher antenna directivity. The 5G radio will employ hundreds of antenna elements to increase antenna aperture beyond what may be possible with current cellular technology.

In addition, the transmitter and receiver will use beamforming to track one another and improve energy transfer over an instantaneously configured link. Beamforming will also improve the radio environment by limiting interference to small fractions of the entire space around a transmitter and likewise limiting the impact of interference on a receiver to infrequent stochastic events. The use of beamforming will also be an important technology for lower frequencies; for example, to extend coverage and to provide higher data rates in sparse deployments.

ULTRA-LEAN DESIGN

Ultra-lean radio-access design is important to achieve high efficiency in 5G networks. The basic principle of ultra-lean design can be expressed as: minimize any transmissions not directly related to the delivery of user data. Such transmissions include signals for synchronization, network acquisition and channel estimation, as well as the broadcast of different types of system and control information.

Ultra-lean design is especially important for dense deployments with a large number of network nodes and highly variable traffic conditions. However, lean transmission is beneficial for all kinds of deployments, including macro deployments.

By enabling network nodes to enter low-energy states rapidly when there is no user-data transmission, ultra-lean design is an important component in delivering high network energy performance. Ultra-lean design will also enable higher achievable data rates by reducing interference from non-user-data-related transmissions.

USER/CONTROL SEPARATION

Another important design principle for 5G is to decouple user data and system control functionality. The latter includes the provisioning of system information; that is, the information and procedures needed for a device to access the system.

Such a decoupling will allow separate scaling of user-plane capacity and basic system control functionality. For example, user data may be delivered by a dense layer of access nodes, while system information is only provided via an overlaid macro layer on which a device also initially accesses the system.

It should be possible to extend the separation of user data delivery and system control functionality over multiple frequency bands and RATs. As an example, the system control functionality for a dense layer based on new high-frequency radio access could be provided by means of an overlaid LTE layer.

User/control separation is also an important component for future radio-access deployments relying heavily on beamforming for user data delivery. Combining ultra-lean design with a logical separation of user-plane data delivery and basic system connectivity functionality will enable a much higher degree of device-centric network optimization of the active radio links in the network. Since only the ultra-lean signals related to the system control plane need to be static, it is possible to design a system where almost everything can be dynamically optimized in real time.

An ultra-lean design combined with a system control plane logically separated from the user data delivery function also provides higher flexibility in terms of evolution of the RAT as, with such separation, the user plane can evolve while retaining system control functionality.

CONCLUSION

5G is the next step in the evolution of mobile communication and will be a key component of the Networked Society. In particular, 5G will accelerate the development of the Internet of Things. To enable connectivity for a wide range of applications and use cases, the capabilities of 5G wireless access must extend far beyond those of previous generations of mobile communications.

These capabilities include very high achievable data rates, very low latency and ultra-high reliability. Furthermore, 5G wireless access needs to support a massive increase in traffic in an affordable and sustainable way, implying a need for a dramatic reduction in the cost and energy consumption per delivered bit.

5G wireless access will be realized by the evolution of LTE for existing spectrum in combination with new radio access technologies that primarily target new spectrum. Key technology components of 5G wireless access include access/backhaul integration, device-to-device communication, flexible duplex, flexible spectrum usage, multi-antenna transmission, ultra-lean design, and user/control separation.

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GLOSSARY

D2D	device-to-device
FDD	Frequency Division Duplex
mmW	millimeter wave
MTC	Machine-Type Communication
NPRM	Notices of Public Rule Making
OFDM	Orthogonal Frequency Division Multiplexing
TDD	Time Division Duplex
WRC	World Radio Conference

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ERICSSON

CELLULAR NETWORKS FOR MASSIVE IOT

ENABLING LOW POWER WIDE AREA APPLICATIONS

With new standards specifically targeting the connectivity requirements of Massive Internet of Things (IoT) applications, cellular networks can deliver reliable, secure and diverse IoT services using existing network infrastructure.

DELIVERING NEW VALUE IN THE NETWORKED SOCIETY

In the future, all devices that benefit from an internet connection will be connected. In this Networked Society, every person and every industry will be empowered to reach their full potential. Internet of Things (IoT) technology is a key enabler of this vision by delivering machine-to-machine (M2M) and machine-to-person communications on a massive scale.

As shown in Figure 1, Ericsson predicts there will be around 28 billion connected devices by 2021, of which more than 15 billion will be connected M2M and consumer-electronics devices [1]. A large share of these will be applications served by short-range radio technologies such as Wi-Fi and Bluetooth, while a significant proportion will be enabled by wide area networks (WANs) that are primarily facilitated by cellular networks.

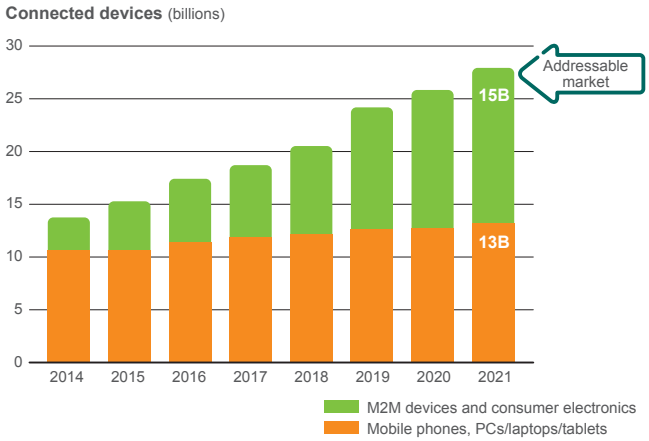

Figure 1: Growth in connected devices.

THE NEW IOT LANDSCAPE

The IoT revolution offers huge potential value in terms of improved efficiency, sustainability and safety for industry and society. Analysts predict that the total added value of the IoT will be USD 1.9 trillion by 2020 [2].

The variety of applications and solutions designed for individuals, business and industry is spurring the rapid expansion of the IoT market. The IoT is playing a major role across a variety of vertical sectors, generating cost savings, new revenue streams and other benefits.

Each IoT application needs a clear value proposition and business logic in line with the prevailing ecosystem, business models and value chains of the various stakeholders. For all applications, solutions need to be integrated on platforms that can scale and handle millions of devices efficiently. Business processes for administration, provisioning and charging will have to be streamlined to minimize costs and enhance the business case.

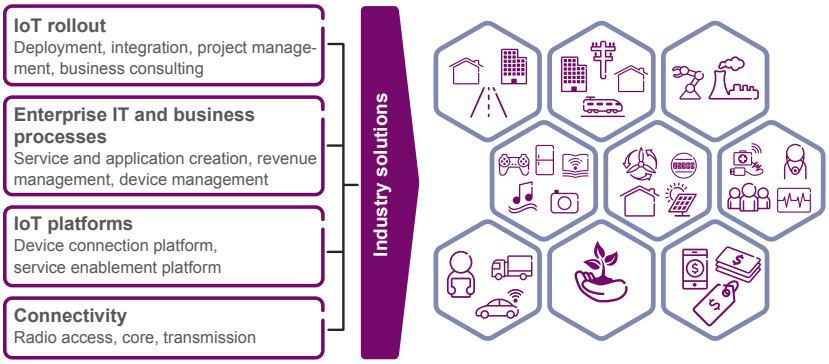

Figure 2: The new IoT landscape.

As they are largely responsible for wireless connectivity on a global scale, operators are in an excellent position to capture a share of the added value generated by the emerging IoT market. The size of this share will depend on the role that operators adopt in the value chain. This could range from being a straightforward connectivity provider (monetizing connectivity in new ways), all the way to being an end-to-end solution provider of turnkey solutions to vertical markets [3].

DIFFERENT IOT CONNECTIVITY ALTERNATIVES

Connectivity is the foundation for IoT, and the type of access required will depend on the nature of the application. Many IoT devices will be served by radio technologies that operate on unlicensed spectrum and that are designed for short-range connectivity with limited QoS and security requirements typically applicable for a home or indoor environment. Currently, there are two alternative connectivity tracks for the many IoT applications that depend on wide-area coverage:

Cellular technologies: 3GPP technologies like GSM, WCDMA, LTE and future 5G. These WANs operate on licensed spectrum and historically have primarily targeted high-quality mobile voice and data services. Now, however, they are being rapidly evolved with new functionality and the new radio access technology narrowband IoT (NB-IoT) specifically tailored to form an attractive solution for emerging low power wide area (LPWA) applications.

Unlicensed LPWA: new proprietary radio technologies, provided by, for example, SIGFOX and LoRa, have been developed and designed solely for machine-type communication (MTC) applications addressing the ultra-low-end sensor segment, with very limited demands on throughput, reliability or QoS.

One way to segment IoT applications is to categorize them according to coverage needs and performance requirements (such as data speed or latency demands).

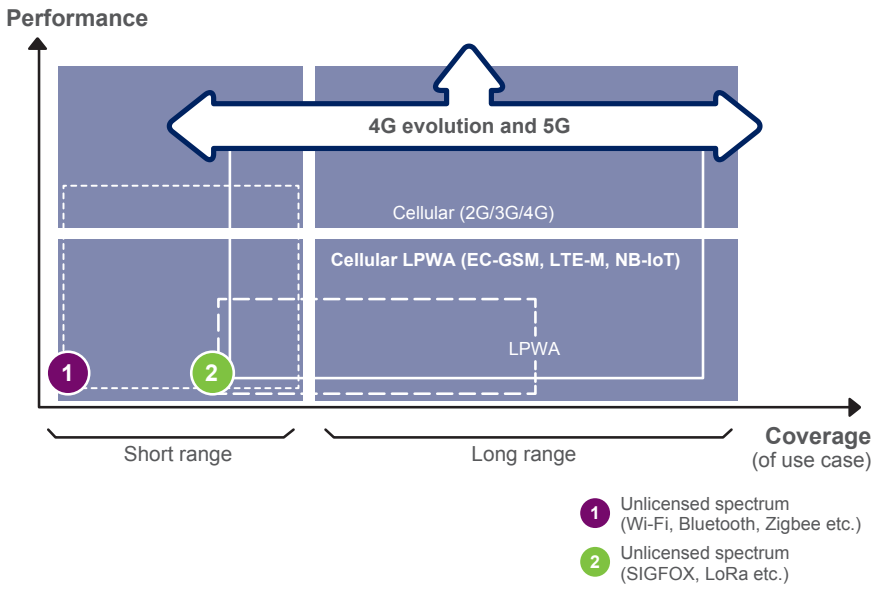

Figure 3: Technologies addressing different IoT segments.

The coverage needs of a particular use case may be highly localized (such as a stationary installation within a building), while other use cases require global service coverage (such as container tracking). 3GPP technologies already dominate use cases with large geographic coverage needs and medium- to high-performance requirements.

With new feature sets specifically tailored for LPWA IoT applications, 3GPP technologies are taking a large leap forward to cover segments with low-cost, low-performance requirements too.

CAPILLARY NETWORKS COMBINING CELLULAR AND UNLICENSED STRENGTHS

Even when existing 3GPP end-to-end connectivity is not feasible, cellular technology can still provide key benefits when used as a bridging option, i.e. as an aggregation and routing solution. This capillary network approach allows end devices to utilize varying access solutions from either the short range or LPWA domain and access the cellular networks via a gateway device. Capillary networks enable the reuse of cellular functions and assets such as security, device management, billing and QoS without requiring each end device to be cellular-enabled.

A WIDE RANGE OF IOT REQUIREMENTS

There will be a wide range of IoT use cases in the future, and the market is now expanding toward both Massive IoT deployment as well as more advanced solutions that may be categorized as Critical IoT, as shown in Figure 4.

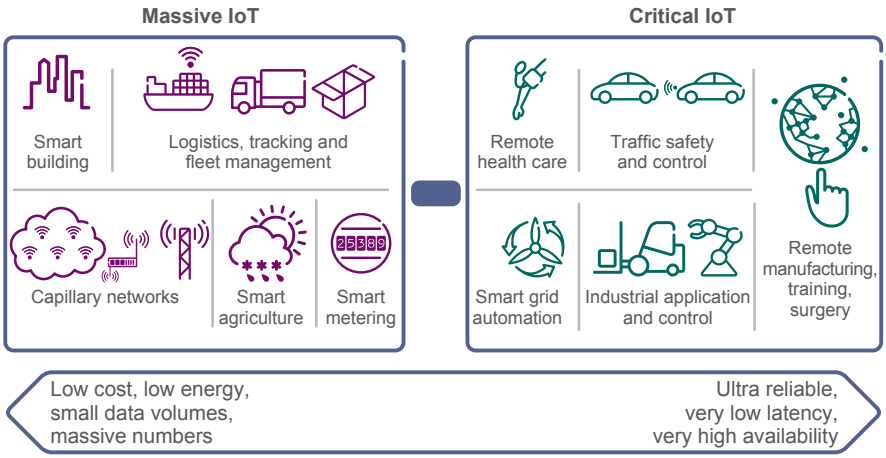

Figure 4: Differing requirements for Massive and Critical IoT applications.

At one end of the scale, in Massive IoT applications – typically sensors that report to the cloud on a regular basis – the end-to-end cost must be low enough for the business case to make sense. Here, the requirement is for low-cost devices with low energy consumption and good coverage.

At the other end of the scale, Critical IoT applications will have very high demands for reliability, availability and low latency. These use cases are enabled by LTE or 5G capabilities. Here, the volumes are typically much smaller, but the business value is significantly higher.

There are, however, many other use cases between the two extremes, which today rely on 2G, 3G or 4G connectivity.

MASSIVE IOT USE CASE DIVERSITY

The Massive IoT market segment includes several applications widely used in industries and societies, as shown in Figure 5.

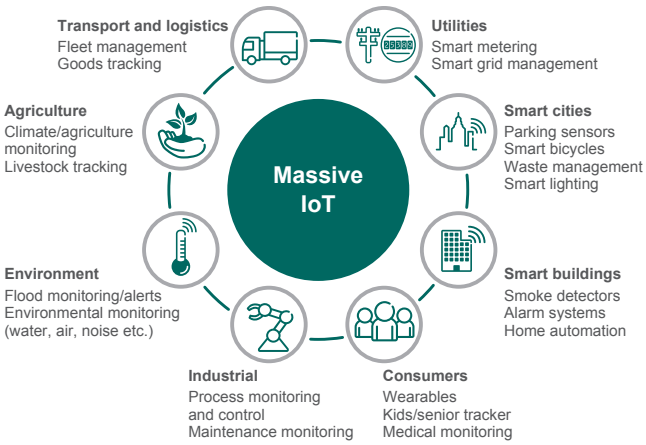

Figure 5: Industry and society applications enabled by LPWA.

The potential applications for the IoT run into the millions, with a huge variety of requirements regarding cost, battery life, coverage, connectivity performance (throughput and capacity), security and reliability. Figure 6 illustrates some such applications and their requirements regarding devices and connectivity.

Some devices will only send a few messages per day – such as status indicators for temperature – while others may need to transmit a video stream to guide a remote repair technician, for example. The difference in throughput requirements is huge. If operators or service providers handle several applications, it may be of great benefit to be able to harmonize communication modules, so that they all use the same underlying radio solution to reduce operational and fault management effort and complexity.

Many higher-value applications will require two-way communications – in other words, an uplink as well as a downlink – to enable monitoring and control of devices in systems like heating, ventilation and cooling plants. The long lifetime of many IoT applications makes it invaluable to be able to perform over-the-air device updates for new functionality or parameter settings. The amount of data sent for such updates can often be more demanding for the network than the monitoring or control application itself.

Relatively simple uplink-focused applications can benefit greatly from a bi-directional link to provide robustness. For example, a connected smoke detector must deliver a smoke alarm with absolute certainty. The ability of a network to provide acknowledgements of a received message enables better fault management and the required level of reliability. Positioning can be used to locate the sensor at the point it failed and simplify operations. For tracking applications, location information is essential.

In applications like building security, sensitive information could be reported over the air, which will require strict security. Furthermore, in the case of a break-in, it is crucial that the alarm information reaches the control center in time – making QoS and two-way communication vital.

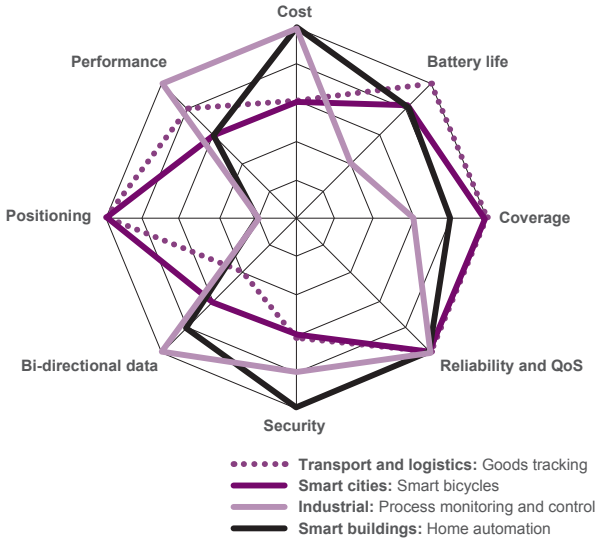

Figure 6: Device and connectivity requirements for sample IoT use cases.

KEY CHALLENGES FOR MASSIVE IOT

The key challenges to enabling large-scale uptake of Massive IoT include:

Device cost – clearly a key enabler for high-volume, mass-market applications, enabling many of the use cases.

Battery life – many IoT devices will be battery-powered, and often the cost of replacing batteries in the field is not viable.

Coverage – deep indoor connectivity is a requirement for many applications in the utility area. Furthermore, regional (or even national or global) coverage is a prerequisite for many use cases, especially within the transport area.

Scalability – in order to enable a Massive IoT market, networks need to scale efficiently. The initial investment required for supporting a limited number of devices has to be manageable, while on the other hand, the network capacity must be easy to scale to handle thousands – or millions – of devices.

Diversity – connectivity should be able to support diverse requirements from different use cases. One network supporting everything from simple static sensors to tracking services, to applications requiring higher throughput and lower latency is essential in terms of total cost of ownership (TCO).

THE ADVANTAGES OF CELLULAR TECHNOLOGIES

Each of the technologies available for IoT connectivity has its own advantages and disadvantages. However, the range of IoT connectivity requirements – both technical and commercial – means cellular technologies can provide clear benefits across a wide variety of applications, as summarized in Figure 7.

Figure 7: Advantages of cellular technologies.

In terms of global reach, cellular networks already cover 90 percent of the world's population. WCDMA and LTE are catching up, but GSM will offer superior coverage in many markets for years to come. Cellular networks have been developed and deployed over three decades, and they will be around for the foreseeable future.

The cellular mobile industry represents a huge and mature ecosystem, incorporating chipset, device and network equipment vendors, operators, application providers and many others. The global cellular ecosystem is governed by the 3GPP standardization forum, which guarantees broad industry support for future development.

When it comes to scalability, cellular networks are built to handle massive volumes of mobile broadband traffic; the traffic from most IoT applications will be relatively small and easily absorbed. Operators are able to offer connectivity for IoT applications from the start-up phase and grow this business with low TCO and only limited additional investment and effort. Operation in licensed spectrum also provides predictable and controlled interference, which enables efficient use of the spectrum to support massive volumes of devices.

Cellular connectivity offers the diversity to serve a wide range of applications with varying requirements within one network. While competing unlicensed LPWA technologies are designed solely for very low-end MTC applications, cellular networks can address everything from Massive to Critical IoT use cases.

QoS mechanisms will be essential for many IoT applications. Cellular systems have mature QoS functionality, and this enables critical MTC applications to be handled together with traffic from sensors, voice and mobile-broadband traffic on the same carrier. QoS, along with licensed spectrum as described above, provides a foundation for long-term Service Level Agreements with a specific grade of service.

Traditionally, the security mechanisms of cellular networks have been based on a physical SIM attached to the device, referred to as a Universal Integrated Circuit Card (UICC). This has also enabled roaming between operators, which has been one of the main factors behind the huge success of mobile networks. The SIM will also be essential in future IoT applications, with SIM functionality embedded in the chipset (eUICC) or handled as a soft-SIM solution running in a trusted run-time environment of the module.

With a straightforward rollout of new software, cellular networks will be able to support the full breadth of applications, ranging from low-end use cases in the LPWA segment, to the high-end segments of in-car entertainment and video surveillance. One network connecting the whole diversifying IoT market will guarantee the lowest possible TCO as well as fast time to market.

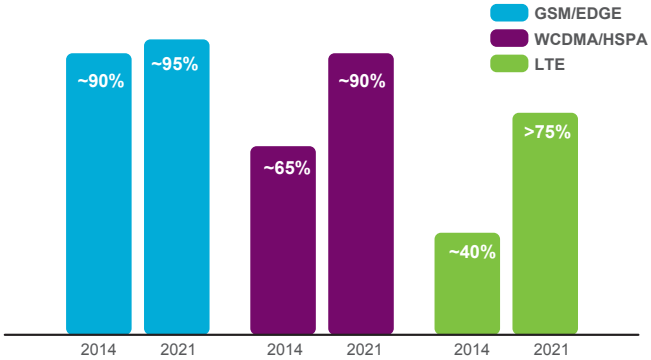

Figure 8: World population coverage by cellular 3GPP technology.

EVOLVING STANDARDS

To meet the new connectivity requirements of the emerging Massive IoT segment, 3GPP has taken evolutionary steps on both the network side and the device side.

The key improvement areas addressed in 3GPP up to Release 13 are:

- Lower device cost – cutting module cost for LTE devices by reducing peak rate, memory requirement and device complexity. The LTE module cost-reduction evolution started in Release 8 with the introduction of LTE for machine-type communication (LTE-M) Cat 1 devices with reduced peak rate to a maximum of 10Mbps, and continued in Releases 12 and 13 with reduced device complexity for lower performance and using less bandwidth or a narrowband IoT carrier to cut costs further.
- Improved battery life – more than 10 years of battery life can be achieved by introducing Power Saving Mode and/or extended discontinuous reception (eDRX) functionality. These features allow the device to contact the network – or to be contacted – on a per-need basis, meaning that it can stay in sleep mode for minutes, hours or even days.
- Improved coverage – an improvement of 15dB on LTE-M and of 20dB on NB-IoT and GSM, which translates into a seven-fold increase in the outdoor coverage area and significantly improved indoor signal penetration to reach deep indoors. This supports many IoT devices like smart meters, which are often placed in a basement.
- Support for massive numbers of IoT connections – specifically, one LTE cell site can support millions of IoT devices, depending on the use case. Core network enhancements include software upgrades for service differentiation handling, signaling optimization and high-capacity platforms (more than 30 million devices per node).

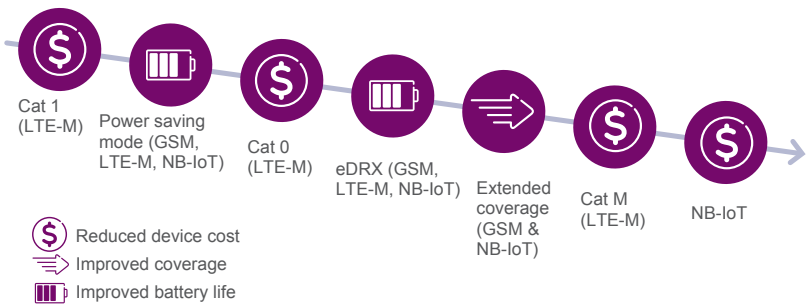

Figure 9: 3GPP evolution steps for Massive IoT.

A FULL RANGE OF CELLULAR LPWA SOLUTIONS

No single technology or solution is ideally suited to all the different potential Massive IoT applications, market situations and spectrum availability. As a result, the mobile industry is standardizing several LPWA technologies, including Extended Coverage GSM (EC-GSM), LTE-M and NB-IoT.

LTE-M, NB-IoT and EC-GSM are all superior solutions to meet Massive IoT requirements as a family of solutions, and can complement each other based on technology availability, use case requirements and deployment scenarios. LTE-M consisting of Cat 1, Cat 0 and Cat M supports a wide range of IoT applications, including those that are content-rich; NB-IoT covers ultra-low-end IoT applications with a cost and coverage advantage over LTE-M; and EC-GSM serves IoT services for all GSM markets.

For example, a smart city application such as waste management may use EC-GSM technology to provide LPWA connectivity in markets where it can be deployed on existing 2G networks; NB-IoT technology may be used for water-metering applications, which have some of the most extreme coverage requirements in underground locations. On the other hand, asset-tracking applications that can support a relatively high number of messages triggered by certain events may employ LTE-M.

EC-GSM – GLOBAL CELLULAR IOT FOR ALL GSM MARKETS

GSM is still the dominant mobile technology in many markets, and the vast majority of cellular M2M applications today use GPRS/EDGE for connectivity. GSM is likely to continue playing a key role in the IoT well into the future, due to its global coverage footprint, time to market and cost advantages.

Recognizing this – and identifying the requirements for Massive IoT discussed earlier in this paper – an initiative was undertaken in 3GPP Release 13 to further improve GSM.

The resulting EC-GSM functionality enables coverage improvements of up to 20dB with respect to GPRS on the 900MHz band.

This coverage extension is achieved for both the data and control planes by utilizing the concept of repetitions and signal combining techniques. It is handled in a dynamic manner with multiple coverage classes to ensure optimal balance between coverage and performance.

EC-GSM is achieved by defining new control and data channels mapped over legacy GSM. It allows multiplexing of new EC-GSM devices and traffic with legacy EDGE and GPRS. No new network carriers are required: new software on existing GSM networks is sufficient and provides combined capacity of up to 50,000 devices per cell on a single transceiver.

Initially part of EC-GSM but now a separate 3GPP item, eDRX improves the power efficiency – and therefore the battery life – for many use cases. eDRX improves the idle mode behavior by allowing the use of a number of inactivity timers, where the device can choose to tune in to the network and listen for downlink pages and traffic.

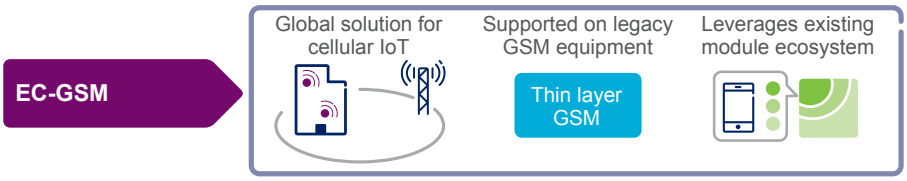

Figure 10: EC-GSM.

EC-GSM extends the data handling and power efficiency advantages that GSM/GPRS technology already offers for MTC, and it will help operators extend the service life of their huge 2G legacy base.

LTE-M – SUPPORTING A WIDE RANGE OF MASSIVE IOT USE CASES

LTE is the leading mobile broadband technology and its coverage is expanding rapidly. So far, the focus has been on meeting the huge demand for mobile data with highly capable devices that utilize new spectrum. With features like Carrier Aggregation, MIMO and Lean Carrier, the gigabit per second performance for LTE cell throughput is now reaching levels that result in an excellent mobile broadband user experience.

The advent of LTE-M signifies an important step in addressing MTC capabilities over LTE. LTE-M brings new power-saving functionality suitable for serving a variety of IoT applications; Power Saving Mode and eDRX extend battery life for LTE-M to 10 years or more. LTE-M traffic is multiplexed over a full LTE carrier, and it is therefore able to tap into the full capacity of LTE. Additionally, new functionality for substantially reduced device cost and extended coverage for LTE-M are also specified within 3GPP.

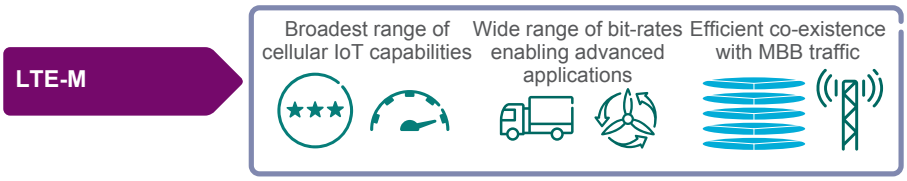

Figure 11: LTE M.

NB-IOT – SUPPORTING ULTRA-LOW-END MASSIVE IOT APPLICATIONS

In addition to LTE-M, NB-IoT technology is being standardized in time for 3GPP Release 13. NB-IoT is a self-contained carrier that can be deployed with a system bandwidth of only 200kHz, and is specifically tailored for ultra-low-end IoT applications. It is enabled using new network software on an existing LTE network, which will result in rapid time to market.

Figure 12: NB-IoT.

NB-IoT provides lean setup procedures, and a capacity evaluation indicates that each 200kHz NB-IoT carrier can support more than 200,000 subscribers. The solution can easily be scaled up by adding multiple NB-IoT carriers when needed. NB-IoT also comes with an extended coverage of up to 20dB, and battery saving features, Power Saving Mode and eDRX for more than 10 years of battery life.

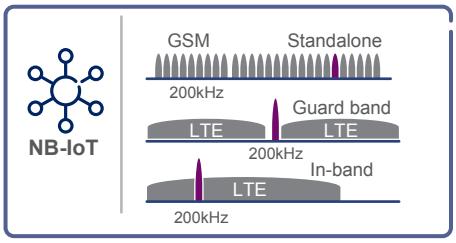

Figure 13: NB-IoT deployment.

NB-IoT is designed to be tightly integrated and interwork with LTE, which provides great deployment flexibility. The NB-IoT carrier can be deployed in the LTE guard band, embedded within a normal LTE carrier, or as a standalone carrier in, for example, GSM bands.

- Standalone deployment in a GSM low band: this is an option when LTE is deployed in a higher band and GSM is still in use, providing coverage for basic services.
- Guard band deployment, typically next to an LTE carrier: NB-IoT is designed to enable deployment in the guard band immediately adjacent to an LTE carrier, without affecting the capacity of the LTE carrier. This is particularly suitable for spectrum allocations that do not match the set of LTE system bandwidths, leaving gaps of unused spectrum next to the LTE carrier.
- Efficient in-band deployment, allowing flexible assignment of resources between LTE and NB-IoT: it will be possible for an NB-IoT carrier to time-share a resource with an existing LTE carrier. The in-band deployment also allows for highly flexible migration scenarios. For example, if the NB-IoT service is first deployed as a standalone deployment in a GSM band, it can subsequently be migrated to an in-band deployment if the GSM spectrum is re-farmed to LTE, thereby avoiding any fragmentation of the LTE carrier.

NB-IoT reduces device complexity below that of LTE-M with the potential to rival module costs of unlicensed LPWA technologies, and it will be ideal for addressing ultra-low-end applications in markets with a mature LTE installed base.

CONCLUSION

Uptake of Massive IoT is set to take off, and operators have a unique opportunity to drive the implementation of new IoT applications by offering affordable connectivity on a global scale.

For IoT applications, existing cellular networks offer distinct advantages over alternative WAN technologies, such as unlicensed LPWA. The global reach, QoS, ecosystem, TCO, scalability, diversity and security of cellular networks are all vital factors that can support the fast uptake and success of IoT. Enabled by new software in existing legacy networks, cellular networks can support a diverse range of IoT applications – ensuring the lowest possible TCO.

3GPP standardization work for GSM and LTE, and the recent addition of NB-IoT, is further improving the ability of cellular networks to address the Massive IoT market, where ultra-low end-to-end cost is a prerequisite.

GSM/GPRS, which already serves the majority of cellular-based MTC applications, is evolving with a new EC-GSM standard, which delivers significantly better energy efficiency and increased coverage. EC-GSM enhancements will cement GSM's position as a highly relevant connectivity platform for low-end, Massive IoT applications globally.

New downsized NB-IoT and LTE-M chipsets, designed for MTC, and features that improve both coverage and device battery life will boost the ability of LTE infrastructure to address the IoT market. One network that supports all applications – from advanced mobile broadband services, VoIP and all kinds of low- to high-end IoT use cases – creates a very strong value proposition.

Whether operators choose the GSM, NB-IoT or LTE-M track – or a combination of these – will depend on several factors such as technology coverage, future technology strategies and targeted market segments. Whichever path they take, they have a huge opportunity to benefit from the emerging IoT revolution. Operators can choose to continue offering telecom-grade connectivity as they do today, or they can evolve to become a platform or fully-fledged IoT service provider targeting a larger slice of future IoT revenues.

GLOSSARY

EC-GSM	Extended Coverage GSM
eDRX	extended discontinuous reception
eUICC	embedded Universal Integrated Circuit Card
IoT	Internet of Things
LPWA	low power wide area
LTE-M	LTE for machine-type communication
M2M	machine-to-machine
MIMO	multiple-input, multiple-output
MTC	machine-type communication
NB-IoT	narrowband IoT
TCO	total cost of ownership
UICC	Universal Integrated Circuit Card
WAN	wide area network

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THE Next Wave

The National Security Agency's review of emerging technologies

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THE Next Wave
The National Security Agency's review of emerging technologies

Editor's column

While the global mobile telecommunications industry has been attempting to keep pace with ever-changing technology and consumer needs, it has not had a strong development roadmap like the International Technology Roadmap for Semiconductors (ITRS). Instead, mobile technology's development has been characterized by multinational companies pushing proposed standards for adoption by international standards bodies. These standards are subsequently adopted in a haphazard, nation-by-nation process. However, consumer desire for faster, more fully featured mobile devices has proven to be as strong a driving force as the ITRS, and has led the industry to roll out generations of new technology on a roughly 10-year basis (approximate dates: 1G - 1981, 2G - 1992, 3G - 2001, and 4G - 2009). This decade-by-decade introduction of new mobile communication technology has led to the common prediction for fifth-generation (5G) mobile to appear around 2020, in keeping with the observed linear cadence.

But why create 5G mobile anyway? The push for 5G is not just a mad rush to keep pace and provide more bandwidth to services that can already stream high-definition video. The Internet of Things (IoT; see TNW Vol. 21 No. 2) is a major driving force (among several) behind technologies being developed for 5G mobile. As personal mobile devices are more enmeshed into machine-to-machine (M2M) communications and the number of IoT sensors explodes, 5G technologies must address several needs: high-speed data rates for many more users, increased density of users, greatly increased simultaneous connections, and reduced latencies. These needs will propel many of the technologies that Dr. Farroha et al. describe in their introduction to 5G article (page 2).

One of those technologies, virtualization, has been instrumental in making efficient use of servers (virtual machine or VM) and computer networking (software-defined networking or SDN). Over the course of continuing improvement to 4G implementations, the networks are evolving into an all-digital Internet protocol packet-switched system. This evolution means that those efficiencies developed for SDN and used in computing can be applied to mobile networking. We can see this application in more depth in the article on 5G virtualization (page 16).

Several markets have already taken advantage of 4G mobile technology, most notably media. This market is expected to expand with 5G as consumer desire for high-resolution video and augmented/virtual reality increases. Automotive, energy, health, and public safety are several areas of M2M that will be greatly enhanced by increased bandwidth and, most importantly, low-latency networks. On 13 December 2016, the US Department of Transportation proposed a rule for vehicle-to-vehicle communication and announced a vehicle-to-infrastructure communication rule to be proposed. The article on 5G and the automotive industry (page 20) provides insight into how this market segment is enhanced by 5G connectivity.

Although mobile technological developments are typically categorized into different generations, each generation covers a vast array of individual technologies and protocols that roll out as they mature. In practice, mobile service providers often work across a range of generations. This is highlighted by the fact that in many cases voice calling is handled by the 3G network while data is handled on the 4G network. Domestically, T-Mobile and AT&T did not enable voice over LTE (VoLTE) until May 2014, and did not meet the International Telecommunication Union (ITU) standard until Verizon launched LTE-Advanced in August 2016.

Many factors can impact the broad global deployment of 5G networks, such as existing technologies, geography, spectrum, and national interests. Some countries may jump to the current network generation while others may delay deployment because their current networks are considered to be "good enough." The decreased per-customer costs of updating networks in densely populated countries makes it more attractive to keep on the leading edge. The increased data rates and simultaneous connections require increased spectrum allocations, which are handled by national regulatory organizations. Several countries, most notably South Korea, have tied their technological identity to the increased

connectivity of next-generation wireless technologies. All these factors give rise to a patchwork international environment for 5G implementation.

Current forecasts for the rollout of 5G networks are in the 2020 time frame. Recent news indicates that it may be earlier than that. Samples of Qualcomm's new Snapdragon X50 4G/5G modem that uses the 27.5 gigahertz (GHz) to 28.35 GHz band—part of the spectrum opened by the Federal Communications Commission for 5G—will be available in the second half of 2017. Samsung and KT, one of South Korea's mobile providers, have announced that they will be the first to provide mobile 5G trial service at the PyeungChang 2018 Winter Olympic Games. Undoubtedly, this trial 5G service will not be fully compliant with 5G standards, which have yet to be adopted. However, we should expect things to advance quickly following the Korean introduction of 5G.

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Introducing 5G

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The evolution of modern cellular communications has been marked by a series of technology generations. Although the technology itself tends to evolve continuously, a new generation of standards marks a revolutionary step forward, with a substantial increase in system requirements to drive fundamentally new applications. With fourth-generation (4G) networks now widely deployed, the industry has turned its sights on "the next big thing." Fifth-generation (5G) networks are expected to enable a seamlessly connected society in the time frame beyond 2020 for both people and things, including vehicles, homes, smart cities, sensor networks, and the power grid. While the Long-Term Evolution (LTE) standard will continue to evolve and play a critical role in the wireless ecosystem, 5G represents an opportunity to architect a new system that is fundamentally different without the constraint of backward compatibility with existing technologies.

What is 5G?

Although there are as yet no standards for 5G mobile networks, a number of key technology trends have emerged. This article describes seven major technology trends that will pave the way to the next generation of 5G networks.

- **New Flexible Radio Access Technology (RAT):** A new, non-backward-compatible RAT will be defined for 5G that is distinct from previous generations, such as 4G LTE and its evolution. New multiple access schemes under consideration include various modified Orthogonal Frequency-Division Multiplexing (OFDM)-based solutions with improved spectral efficiency. The new RAT must be flexible enough to accommodate a variety of traffic types with often conflicting radio requirements. The concept of a unified air interface has been proposed for multiplexing multiple physical layer (PHY) regions with different characteristics [e.g., transmission time interval (TTI), subcarrier spacing] on a contiguous block of spectrum [1, 2, 3]. Spectrum for the new RAT will include existing bands below 6 gigahertz (GHz), as well as new centimeter-wave (cmWave) and millimeter-wave (mmWave) bands in the 6- to 100 GHz range [4]. The new RAT must also support significantly reduced latency, with as low as 100 microsecond (μs) transmission time interval (TTI) at the PHY for the ultra-reliable and low-latency communications (URLLC) use case [5]. Lastly, to further improve spectral efficiency, full-duplex transmission schemes have been proposed, potentially allowing the same time-frequency resources to be used for uplink and downlink transmissions simultaneously [6].
- **Virtualization:** Software-Defined Networking (SDN) and Network Function Virtualization (NFV) are two key architecture concepts in development to support the flexibility and mobility demands of the 5G network infrastructure [7, 8, 9]. Virtualization of network functions, which were traditionally implemented in hardware, will pave the way for commercial telecommunications operators and service providers to introduce new features and integrate new standards releases at an accelerated rate. NFV enables providers to move toward a decentralized network to increase flexibility, pushing core functions toward the edge to reduce latency, and virtualizing those functions on cloud-based servers. The proposed Cloud Radio Access Network (C-RAN) architecture, a specific use case of NFV applied to the RAN, uses a pooled architecture of baseband resources to increase scalability, physical layer flexibility, and spectral efficiency [7, 10].
- **Millimeter Wave (mmWave) Communications:** The term mmWave refers to carrier frequencies in the International Telecommunication Union (ITU) extremely high-frequency (EHF) band, from 30 to 300 GHz. Within the context

of 5G, the term has recently been loosely used by industry to refer to the higher frequencies from 6 to 100 GHz that are under consideration for new mobile spectrum [11, 12]. mmWave technologies are becoming an increasingly attractive solution to the problems of frequency reuse, cell density, raw data throughput, and antenna array size. This has led to a synergy between mmWave, small cell deployments, and massive multiple-input, multiple-output (MMIMO) techniques [13, 14].

- **Massive Multiple-Input, Multiple-Output (MMIMO) Techniques:** MMIMO is a new concept in antenna arrays that provides a number of advantages over traditional MIMO arrays currently deployed in 4G networks. Traditional MIMO arrays use only a few antenna elements (i.e., 2 to 16), whereas MMIMO uses a large number of elements in the array, currently considering a range of 128 to 512 at a minimum. Highly directional beamforming to multiple users simultaneously allows for increased user density and higher aggregate cell throughput [15]. So-called hybrid MMIMO has also been proposed; it combines beam steering with array processing techniques, such as spatial multiplexing, to increase single-user throughput [16].
- **Heterogeneous Networks (HetNets):** HetNets expand the mobile access network capacity by coordinating small cells with larger macro cells or offloading traffic to wireless local area network (WLAN) access points. There are two types of heterogeneity: 1) various cell sizes (e.g., macro, pico, femto) and 2) heterogeneous RATs [e.g., third-generation (3G), 4G, 5G, WLAN]. Small cells may include femto, pico, and micro cells, which can range in capacity from less than 10 to several hundred simultaneous active users. While HetNet deployments have already been introduced in 4G networks, network densification through the aggressive deployment of small cells is expected to increase significantly in future 5G networks [17, 18].
- **Native Machine-Type Communications (MTC) Support:** 5G networks are expected to incorporate a new model for connectivity specifically designed for MTC [19]. With the significant increase in connected machines over the last several years, a new 5G standard is seen as a prime opportunity to ensure new RATs can efficiently support a large number of connected devices with their own unique access constraints. Two categories of MTC are discussed: 1) general MTC and 2) vehicle-to-everything (V2X) MTC. General MTC devices have a few unique design and deployment considerations—namely, lower bandwidth needs, stringent power budgets, and relaxed latency requirements. V2X MTC devices, in contrast, require low-latency communications, out-of-coverage networks, and limited operation on a subscription-free basis [20].
- **Device-centric Architectures:** New network architectures will focus on a uniform quality of experience (QoE) for the user device, in contrast to traditional base-station-centric architectures. A number of new device-centric approaches are under consideration: decoupling the user plane and control plane, decoupling the uplink and downlink, and device-to-device communications [4, 21]. Another novel proposal is the user-centric cell or virtual cell model, which uses distributed beamforming and decoupled user/control planes to create a virtual cell around each user [2, 3]. Because the virtual cell follows the user, QoE variations are reduced and the cell-edge problem is mitigated. New device-centric architectures may significantly alter the traditional concept of cell handovers or eliminate it entirely.

Many of these technologies are already being added to the evolution of existing technologies beyond 4G, such as LTE-Advanced Pro [22].

In 2015, there was a significant increase in industry activities surrounding 5G networks. Major standards bodies, including the ITU and the Third-Generation Partnership Project (3GPP), reached important milestones in the early development of the eventual 5G standards. In September, the ITU published its vision for 5G networks [19]. The vision for International Mobile Telecommunications for 2020 and beyond (IMT-2020) defines three future-looking, high-level use cases for 5G:

- **Enhanced Mobile Broadband (eMBB):** This is generally a human-centric use case driven by the exponential increase in demand for mobile access to multimedia content, services, and data.

The eMBB use case will come with new application areas and requirements that go beyond existing mobile broadband applications for improved performance and increasingly seamless user experience. This use case covers a range of scenarios, including wide-area coverage and localized high-throughput spot coverage, which will have different requirements.

- **Massive Machine-Type Communications (mMTC):** This use case is characterized by a large number of connected devices typically transmitting a relatively low volume of nondelay-sensitive data. Devices are intended to be low cost and have a very long battery life.
- **Ultra-Reliable and Low-Latency Communications (URLLC):** This use case is characterized by stringent requirements for latency, throughput, and availability. Examples include wireless control of industrial manufacturing processes, remote medical surgery, distributed smart grid automation, and transportation safety [e.g., vehicle-to-vehicle (V2V) or vehicle-to-everything (V2X) communication]. Many companies have referred to this use case as critical MTC (cMTC) or ultra-reliable MTC (uMTC). However, based on the ITU definition in [19], this use case is not strictly limited to MTC applications.

It is important to consider that the applications that will use 5G technology do not necessarily correspond to a single use case but are more accurately described as a combination of multiple use cases. Figure 1 illustrates some examples of currently envisioned 5G applications and their relationship to these three IMT-2020 use cases [19]. Figure 2 illustrates eight key capabilities identified by ITU for IMT-2020 and their relative importance to the same three use cases [19]. Furthermore, additional future use cases are expected to emerge but cannot be accurately predicted (i.e., what will be the "killer app" in 2025?). Therefore, it is desired that 5G standards will provide the flexibility to adapt to new use cases.

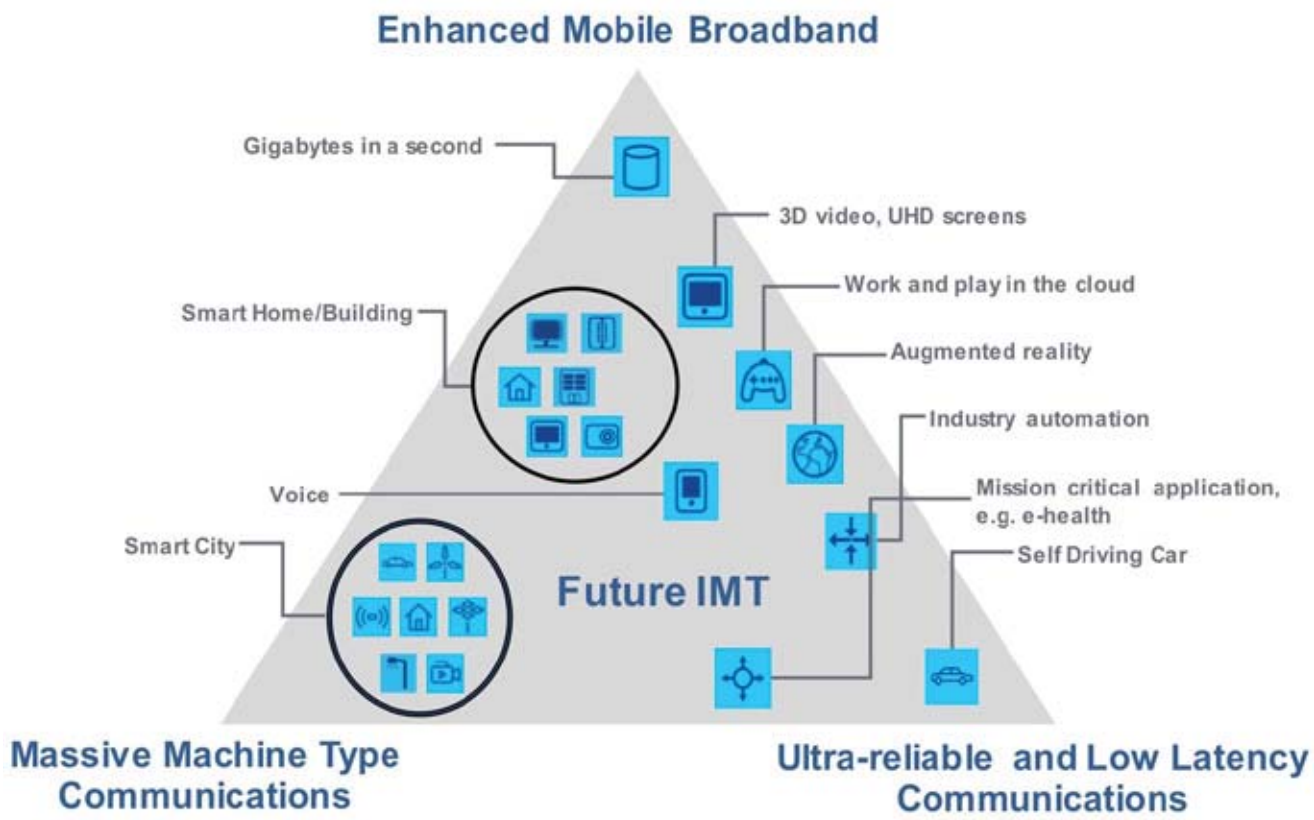

FIGURE 1. 5G use cases as defined by ITU for IMT-2020 [19].

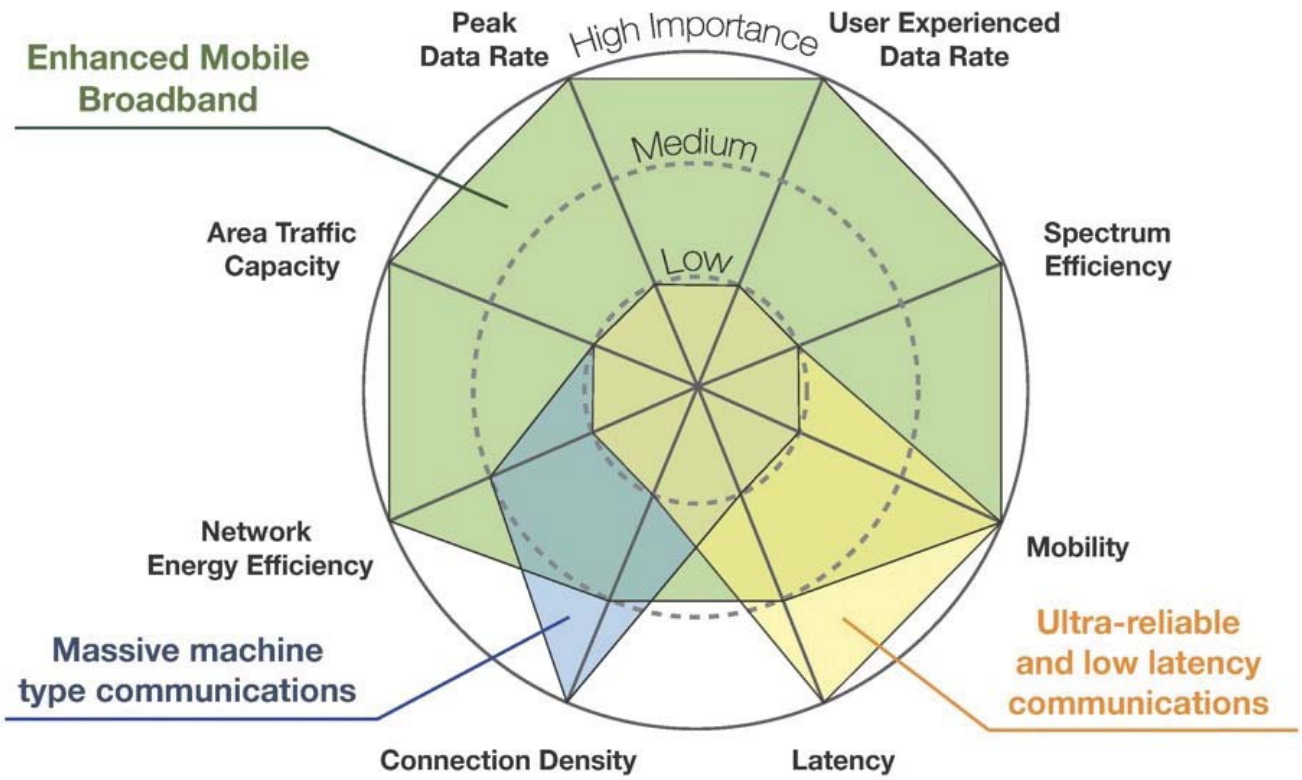

FIGURE 2. Eight key capabilities and their relative importance to 5G use cases [19].

5G Standardization

Development work toward 5G is well under way. Standards bodies are actively working on new 5G mobile technologies to be deployed in the 2020 time frame. This section summarizes the activities and corresponding 5G development timelines for three major standards bodies: ITU, 3GPP, and the Institute of Electrical and Electronics Engineers (IEEE).

Standardization in ITU

ITU is the United Nations agency responsible for promoting worldwide improvement and rational use of information and communication technology. Its members include industry, academia, and standards organizations from more than 190 member nations. The ITU Radiocommunication Sector (ITU-R) works toward worldwide consensus in the use of terrestrial and space radiocommunication services, including mobile communication technologies. Although compliance with ITU-R recommendations is not mandatory, they nevertheless have a high degree of adoption worldwide and hold the status of international standards [23].

International Mobile Telecommunications framework

ITU-R Working Party 5D (WP 5D) is responsible for overall radio aspects of terrestrial mobile systems, referred to as International Mobile Telecommunications (IMT). The purpose of IMT is to provide high-quality mobile services with a high degree of interoperability worldwide. Since 2000, the ITU has developed the IMT standards framework in a manner that parallels cellular generations from an industry perspective. Although ITU-R WP 5D defines the requirements for IMT, it does not develop the actual radio technologies. Rather, candidate radio technologies are submitted for inclusion by external standards bodies, such as 3GPP and IEEE. For this reason, ITU-R WP 5D maintains strong cooperation with the major global standards bodies.

The first family of standards derived from the IMT concept (IMT-2000) aligned with 3G cellular. Radio technologies accepted into IMT-2000 included 3GPP Wideband Code-Division Multiple Access (WCDMA), 3GPP2 cdma2000, and IEEE 802.16 [i.e., Mobile Worldwide Wireless Interoperability for Microwave Access (WiMAX)]. The next generation of IMT standards (IMT-Advanced) aligned with 4G cellular. Radio technologies accepted into IMT-Advanced included 3GPP LTE-Advanced and IEEE 802.16m [i.e., Wireless Metropolitan Area Network (WMAN)-Advanced].

Timeline for IMT-2020

In 2012, ITU embarked on a program to develop "IMT for 2020 and beyond," setting the stage for emerging 5G research activities around the world. The program has since adopted the name IMT-2020 and forms the framework for the next generation of mobile broadband standards. The timeline for the development of IMT-2020 is shown in figure 3 [24]. The IMT 2020 timeline will essentially follow the same process used in the development of IMT-Advanced.

The IMT-2020 program is well under way, with a number of key milestones completed. In September 2015, ITU published its vision of the 5G mobile broadband connected society [19]. This document defined three high-level use cases for 5G, described earlier in this article, which have already been widely adopted by 3GPP and industry in general. In the next phase, the 2016–2017 time frame, ITU-R WP 5D will define in detail the performance requirements, evaluation criteria, and methodology for the assessment of the new IMT radio interfaces. It is anticipated that the time frame for proposals will be focused in 2018. In the 2018–2020 time frame, independent, external groups will evaluate proposals and the definition of the new radio interfaces to be included in IMT-2020 will take place. ITU-R WP 5D also plans to hold a workshop in late 2017 to discuss the performance requirements and evaluation criteria for candidate technologies for IMT-2020, as well as to provide an opportunity for presentations by potential proponents for IMT-2020 in an informal setting. The whole process is planned to be completed in 2020, when a new draft of the ITU-R recommendation with detailed

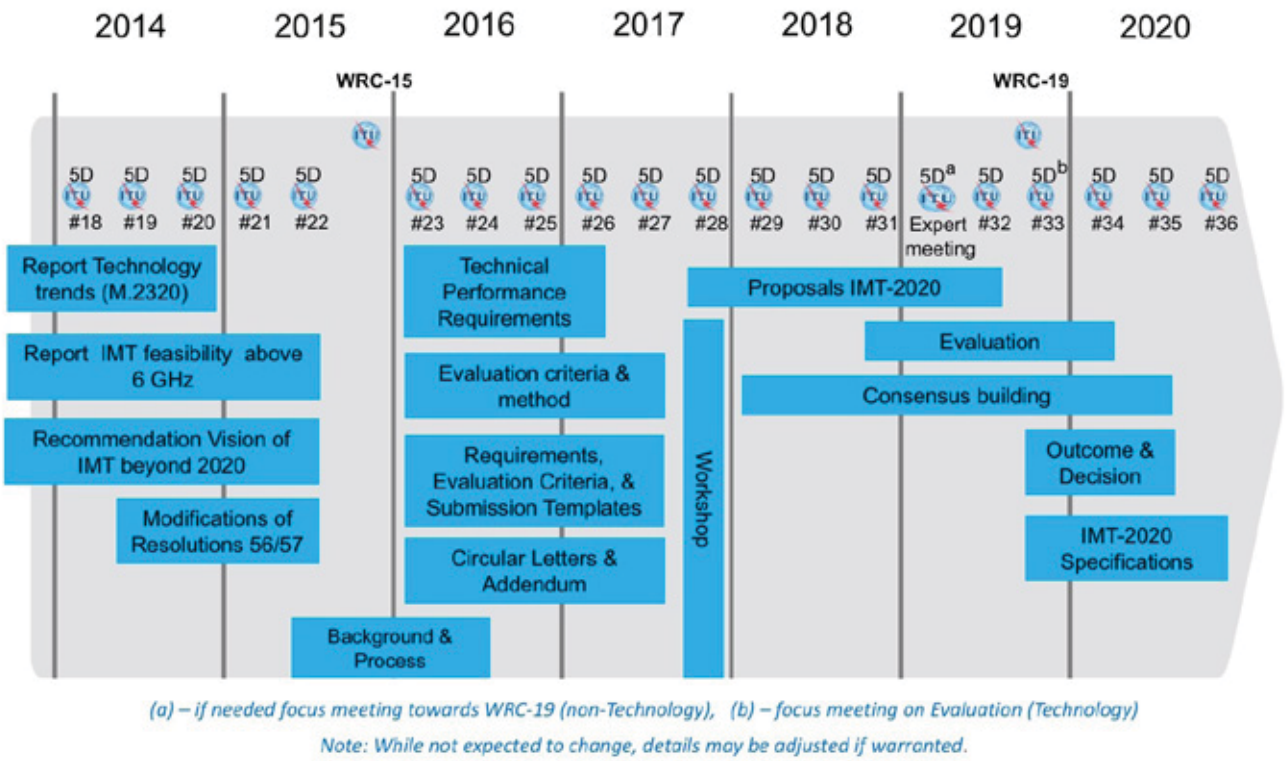

FIGURE 3. Detailed timeline and process for IMT-2020 in ITU-R [24].

specifications for the new radio technologies will be submitted for approval within ITU-R [24].

Standardization in 3GPP

3GPP is the international standards body responsible for the development and maintenance of major second-generation (2G), 3G, and 4G cellular standards. The purpose of the organization is to produce interoperable cellular communications standards, as well as studies and reports that define 3GPP technologies. The following technologies are currently maintained and evolved by 3GPP:

- Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), and Enhanced Data Rates for GSM Evolution (EDGE);
- Universal Mobile Telecommunications System (UMTS), WCDMA, High-Speed Packet Access (HSPA), and HSPA Evolution (HSPA+); and
- LTE, LTE-Advanced, and LTE-Advanced Pro.

These 3GPP technologies are constantly evolving through a series of backward-compatible releases. Since the completion of the first LTE and Evolved Packet Core (EPC) specifications, 3GPP has become the focal point for mobile systems beyond 3G. Therefore, 3GPP is expected to be a critical player in the development of 5G, and their timeline will have a direct influence on the timeline of the emerging 5G market.

3GPP is currently defining a new 5G RAT and corresponding network architecture. These are being developed within 3GPP under the working names "new radio (NR)" and "next-generation (NextGen) architecture," respectively [25]. In October 2016, 3GPP announced that the new 3GPP system will officially be known by the name "5G" from Release 15 onward [26]. Some initial standardization steps that have been taken to date include the following:

- **SMARTER study item:** In March 2015, 3GPP Technical Specification Group (TSG) System Aspects (SA) began a study item on technology enablers for new 5G services and markets, known as the SMARTER study item [27]. The objective of this study was to develop high-level use cases and identify the related high-level potential requirements to enable 3GPP network operators to support new services and markets in 5G. Phase 1 of the SMARTER study item was completed in March 2016; results are documented in 3GPP Technical Report (TR) 22.891 to be included in Release 14 [28]. A total of 74 use cases were identified. This work prompted four building block studies that grouped the use cases into families with common requirements: massive Internet of Things (IoT), critical communications, eMBB, and network operation. The building block studies were completed in June 2016; results are documented in 3GPP TRs 22.861, 22.862, 22.863, and 22.864 to be included in Release 14 [29]. The results of the SMARTER study will form the basis for a work item to define normative stage 1 requirements for the next-generation 5G system. The work item is scheduled for completion in March 2017; results will be documented in 3GPP Technical Specification (TS) 22.261 to be included in Release 15 [29].
- **Study item on channel model for frequency spectrum above 6 GHz:** The first 5G study conducted by TSG RAN focused on developing new channel models to support high-frequency spectrum from 6 GHz to 100 GHz. The models consider a variety of scenarios including urban, rural, and indoor, as well as the impact of line-of-sight (LOS) versus non-LOS (NLOS). The study was completed in June 2016, and results are documented in 3GPP TR 38.900 to be included in Release 14 [30].
- **Study item on architecture for next-generation system:** In December 2015, 3GPP TSG SA approved a study item to design a system architecture for the next generation of mobile networks. The new architecture will support at least the new 5G RAT(s), the evolution of LTE, and non-3GPP access types and will minimize access dependencies. The study considers new approaches such as NFV and network slicing. The study item was scheduled for completion in December 2016; results will be documented in 3GPP TR 23.799 to be included in Release 14 [31].
- **Study item on scenarios and requirements for next-generation access technologies:** In December 2015, 3GPP TSG RAN approved a study item to develop deployment scenarios and requirements of next-generation access

technologies. The study identifies 12 deployment scenarios that are more diverse than those originally envisioned for legacy RATs, such as LTE and its predecessors. It also identifies key performance indicators (KPIs) and other requirements for 5G NR. The bulk of the study was completed in September 2016 to provide guidance to the ongoing technical work being performed in the RAN working groups. However, the study item will remain open until March 2017 to match the IMT-2020 timeline and ensure all IMT-2020 requirements are captured. Final results are documented in 3GPP TR 38.913 to be included in Release 14 [32, 4].

- **Study item on NR access technology:** In March 2016, 3GPP TSG RAN approved a study item to develop the 5G NR access technology capable of meeting the broad range of use cases defined for 5G. The study seeks to develop a single technical framework capable of addressing all usage scenarios and requirements defined in TR 38.913 for eMBB, mMTC, and URLLC, with an emphasis on forward compatibility. The study is scheduled for completion in March 2017; results will be documented in 3GPP TR 38.912 to be included in Release 14 [1].

5G standardization activities in 3GPP will continue through 2020 and beyond, as described next.

Emerging 3GPP standardization timeline

In March 2015, 3GPP announced a tentative standardization timeline for 5G based on the ITU work plan timeline for IMT-2020 [33]. Since then, a more detailed timeline has come into focus as study items have commenced and completed, and as the 3GPP TSGs coordinate for the initial release of 5G. The timeline shown in figure 4 is a composite from multiple sources.

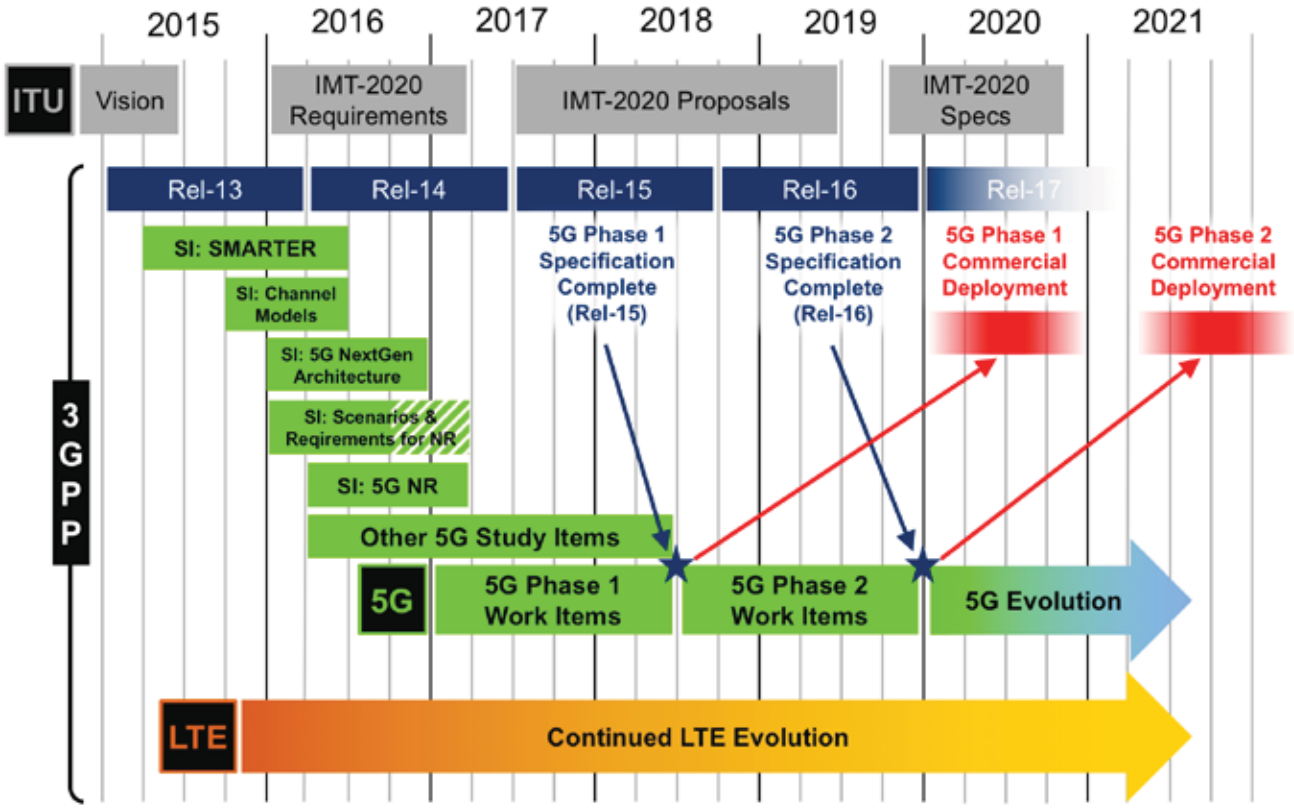

FIGURE 4. Emerging 5G standardization timeline for 3GPP. (Figure is a composite from [34] and [35] that includes additional data from various sources.)

The initial 5G study items in TSG SA and TSG RAN commenced in 2015 and 2016, as described previously. These initial 5G study items will be included in 3GPP Release 14. This work is carried out in parallel with ongoing LTE work. At the 3GPP plenary meeting in June 2016, the TSGs agreed on a work plan for the first release of 5G in 3GPP Release 15, including a clear work division between the TSGs [25].

5G work items were scheduled to begin in December 2016 for TSG SA and March 2017 for TSG RAN. The Phase 1 5G work items will fall into Release 15, with planned completion in June 2018. Additional 5G study items will continue during Release 15 in support of Phase 2. Subsequently, the Phase 2 5G work items will fall into Release 16, which will be completed around December 2019 in time for the final submission to ITU for IMT-2020. Phase 1 commercial deployments are expected to begin in 2020, followed by Phase 2 deployments in the 2021–2022 time frame. However, early pre-5G mmWave deployments may emerge in limited markets, such as South Korea or the United States, before 2020.

For example, Verizon Wireless has announced its plans to pilot a 28-GHz mmWave deployment in the United States for fixed wireless applications starting in 2017 [36]. To support this effort, the Verizon 5G Technology Forum (V5GTF)—an industry consortium led by Verizon—published an open radio interface specification in July 2016 [37]. The Verizon specification uses an OFDM-based PHY similar to time-division LTE (TD-LTE) with enhanced beamforming for operation in 28 and 39 GHz mmWave spectrum. However, with the initial focus on fixed wireless, the first release does not support user mobility. The Verizon specification can be considered pre-5G in the sense that it supports new mmWave capabilities beyond 4G but does not address all the use cases and associated requirements for 5G. The Verizon specification is expected to be incompatible with the eventual 3GPP 5G standard, potentially leading to market fragmentation [38].

3GPP phased approach to 5G standardization

3GPP TSG RAN will take a two-phased approach to developing the new 5G RAT [35]. The Phase 1 standard will define a new, non-backward-compatible 5G RAT. A subset of prioritized features and use cases will be addressed in Phase 1 to allow for early commercial deployments targeted for the year 2020. The Phase 2 standard will implement the full set of features and use cases necessary to meet the requirements for 5G. An initial proposal will be submitted to ITU as a candidate radio interface technology for IMT-2020 by the June 2019 submission deadline. The Phase 2 standard will later form the final submission around December 2019. The Phase 1 standard will be designed for forward compatibility with Phase 2 [35]. Forward compatibility means that Phase 1 must be designed from the beginning to optimally accommodate all of the features and use cases expected to be added later in Phase 2, even though those features are not yet fully implemented. Although the forward-compatibility requirement may sound straightforward, it represents a fundamental shift from the normal 3GPP standardization process, which historically has focused on a series of backward-compatible releases.

While prioritization of features between the two phases has been a topic of much debate, it is clear that the 5G Phase 1 standard will support tight interworking with LTE to simplify initial rollout. The phased approach and tight interworking with LTE means that elements of the LTE system architecture may persist in 5G deployments for some time to come. This implies that current and future work on LTE, LTE-Advanced, and LTE-Advanced Pro networks and technologies may have direct applicability to eventual 5G network deployments.

Standardization in IEEE

Initial 5G standards activities within the IEEE suggest that they do not intend to be a direct competitor with organizations like 3GPP on the radio interface between the RAN and the user equipment. Instead, IEEE has begun developing complementary technologies to support other communications requirements within the 5G ecosystem. In 2016, IEEE established two new working groups related to 5G: IEEE 1914 and IEEE 1918.

IEEE 1914 is the Next Generation Fronthaul Interface Working Group. This working group is currently developing two standards: the 1914.1 standard

for packet-based fronthaul transport networks and the 1914.3 standard for radio over Ethernet encapsulations and mappings [39, 40]. These standards focus on the fronthaul interface within the RAN between baseband units (BBUs) and remote radio heads (RRHs) to support novel RAN architectures like C-RAN, and antenna techniques like MMIMO and coordinated multi-point (CoMP) transmission and reception. The projected completion dates for these standards are August 2018 for 1914.1 and October 2017 for 1914.3.

IEEE 1918 is the Tactile Internet Working Group. This working group is currently developing the 1918.1 standard, which defines a framework for the Tactile Internet [41]. The purpose of this framework is to establish a basis for the rapid development of the Tactile Internet as a 5G and beyond application, with the expectation of additional IEEE 1918 standards to follow. The projected completion date for the 1918.1 standard is October 2018.

With respect to IMT-2020, IEEE may seek to expand the role of WLAN in 5G as a complementary radio interface for next-generation HetNets. In September 2016, the IEEE 802.11 working group sent a liaison statement to 3GPP TSG RAN and TSG SA inviting them to consider the use of IEEE 802.11-based WLAN in unlicensed spectrum as a complementary means of meeting the performance requirements of IMT-2020, potentially leading to inclusion in a joint submission to IMT-2020 [42]. This approach would be a logical extension of the increasing level of interworking between LTE and WLAN in recent standards releases. WLAN is already widely used in 3GPP networks for high data rate offloading.

Recent enhancements in radio-level interworking have increased the efficiency of these networks. Enhancements include LTE-WLAN Aggregation (LWA) and LTE WLAN Radio Level Integration with IPsec Tunnel (LWIP) in 3GPP Release 13, with further enhancements in 3GPP Release 14. Although 3GPP declined to make a decision at the September 2016 plenary meeting, the concept of a potential joint submission could represent a novel approach to IMT-2020. In contrast, previous generations of IMT saw IEEE in competition with 3GPP, with the submission of the IEEE 802.16 WiMAX family of standards to IMT-2000 and IMT-Advanced as a direct competitor in the 3G and 4G markets.

Conclusion

This article provided an introduction to major technology trends in the emergence of next-generation 5G mobile networks. These networks are expected to see initial commercial deployment starting around the year 2020. Early 5G standardization activities in the ITU, 3GPP, and IEEE were addressed.

For further information on the latest developments in 5G, the interested reader is directed to the following resources. ITU publications for IMT-2020 can be found on the IMT-2020 web page [24]. Notable documents include the ITU vision for IMT-2020 [19] as well as the technical performance requirements for IMT-2020 (scheduled for completion in February 2017). The 3GPP web site (www.3GPP.org) is the most direct source for 3GPP-related technical information. 3GPP press releases provide high-level summaries of ongoing standards activities and often include links to more detailed further reading. The latest versions of the 3GPP TR and TS documents mentioned in this article can be accessed there as well. Information on the IEEE 1914.1, 1914.3, and 1918.1 standards can be found in the approved project authorization request (PAR) documents [39, 40, 41] and the corresponding working group web pages. Lastly, the Verizon mmWave specification is available on the V5GTF website (www.5GTF.org). This pre-5G specification defines layers 1 to 3 of an open radio interface using a document structure similar to that of LTE.

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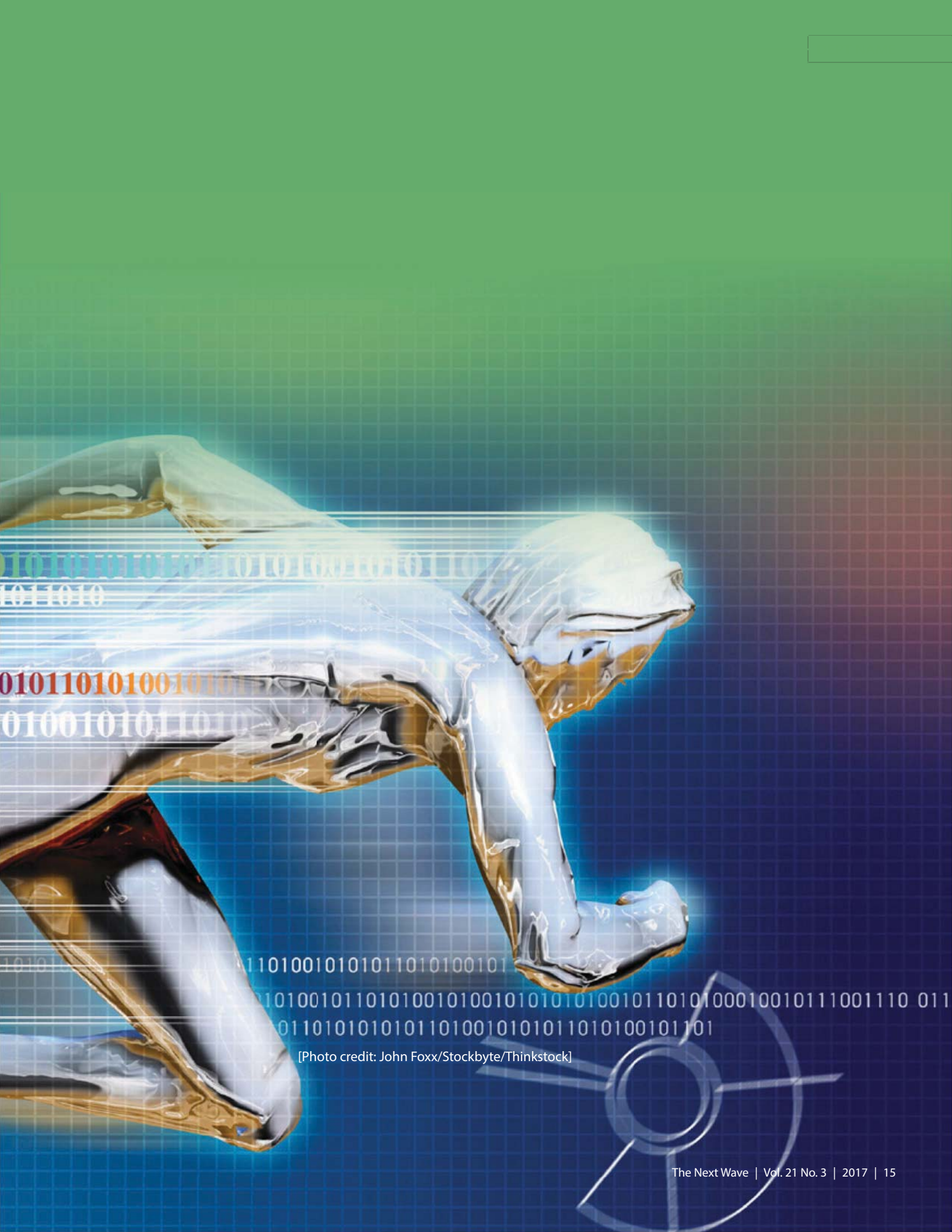

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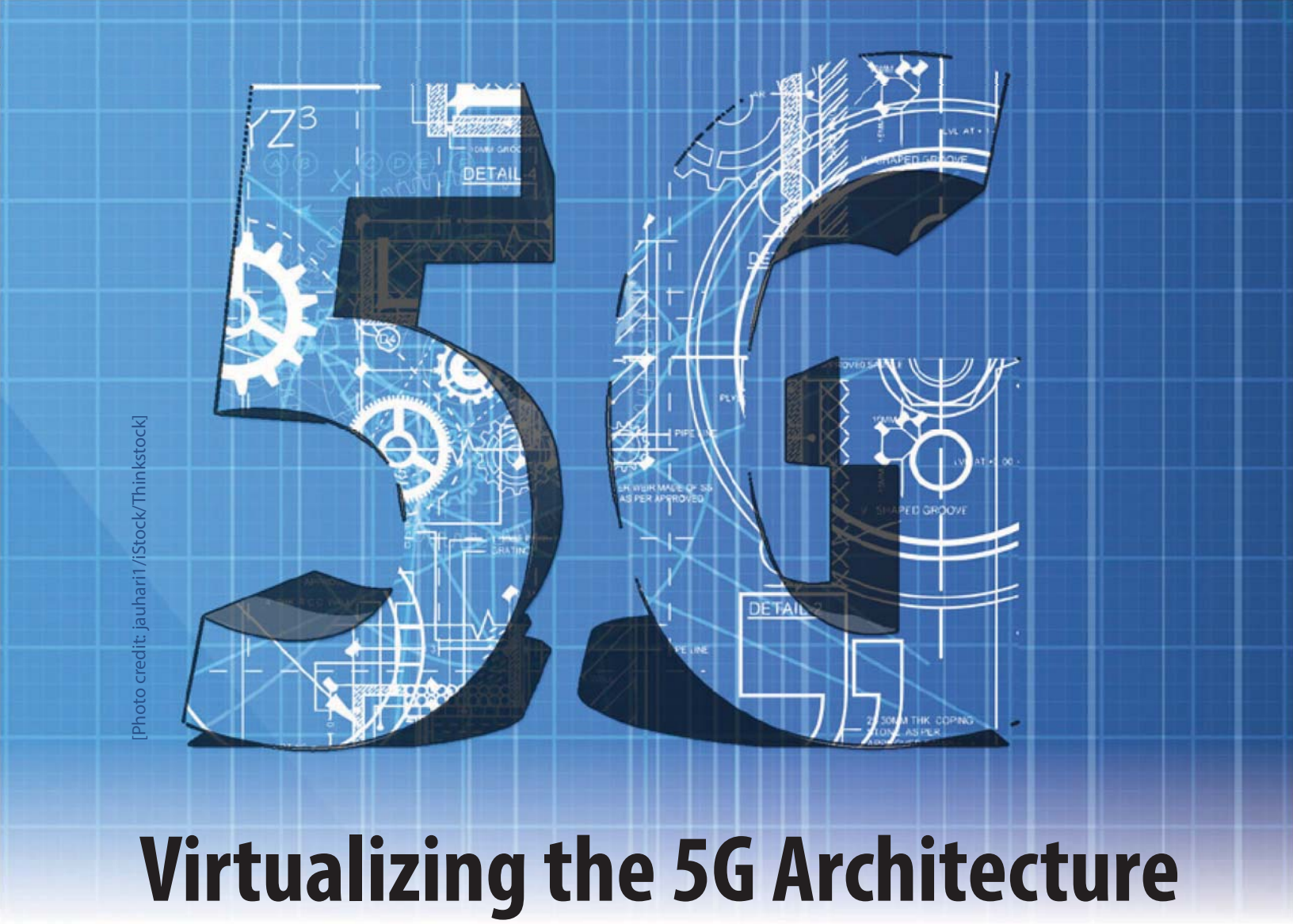

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Virtualizing the 5G Architecture

Staff Writer

Virtually changing the 5G architecture

Virtualization is set to play a major role in the evolution of the fifth-generation (5G) core network. According to industry experts, 5G will use software-centric networking technologies such as software-defined networking (SDN) and network functions virtualization (NFV), and will be natively cloud based. If correct, this will represent a major transition in system architecture and will require much greater collaboration across the networking ecosystem. The push to incorporate more cloud- or software-based components is driven by the need for greater flexibility and scalability to respond to the demands of radio access technologies that offer more bandwidth, reduced latency, and stringent quality of service (QoS) requirements. The new 5G core network must be adaptable and better equipped to handle various devices and manage capacity in near-real time. Mobile network operators see the advances in cost and efficiency that virtualization brings to other market segments and will use the emerging 5G technology to determine if these same advances can benefit the mobile market [1, 2].

SDN and NFV are two key architecture concepts in development to support the flexibility and mobility demands of the 5G network infrastructure. Virtualizing network functions that were previously implemented in hardware will allow providers to introduce new features and integrate new standards at a faster rate. SDN/NFV provides an avenue for providers to decentralize their networks, thereby increasing flexibility and reducing latency. Two areas where SDN/NFV will benefit 5G networks, and in some cases even fourth-generation (4G) mobile technology, are network slicing and cloud-radio access network (C-RAN).

Network slicing

Network slicing would promote end-to-end mobile network virtualization by "slicing" the network into virtual channels. These virtual channels would be autonomous and encompass a set of resources—physical or virtual—including bandwidth on a network link, processing capacity of servers, processing capacity of network elements, as well as operations support system (OSS) and business support system (BSS) processes. Operators could then use these channels to dynamically devote the appropriate network resources to create a "lane" in the network specifically designed for a particular use or service. This would accommodate the many use cases being put forth for 5G. The operator-led Next Generation Mobile Networks (NGMN) Alliance has sought to define categories of 5G use cases (i.e., service types) that have distinct performance characteristics and commercial potential. In a 2015 white paper, the NGMN listed eight application categories for 5G [3, 4, 5]:

1. Broadband access in dense areas,
2. Broadband access everywhere,
3. Higher user mobility,
4. Massive Internet of Things,
5. Extreme real-time communications,
6. Lifeline communications,
7. Ultra-reliable communications, and
8. Broadcast-like services.

Each of these service types demand different network requirements that are determined by the types of traffic being sent and even the types of devices sending the traffic. For example, someone downloading cat videos will not have the same bandwidth or low latency requirements as a doctor in Los Angeles performing surgery virtually on a patient in Mumbai. The end-to-end notion of network slicing could be key to 5G's ability to effectively accommodate all of these disparate use cases.

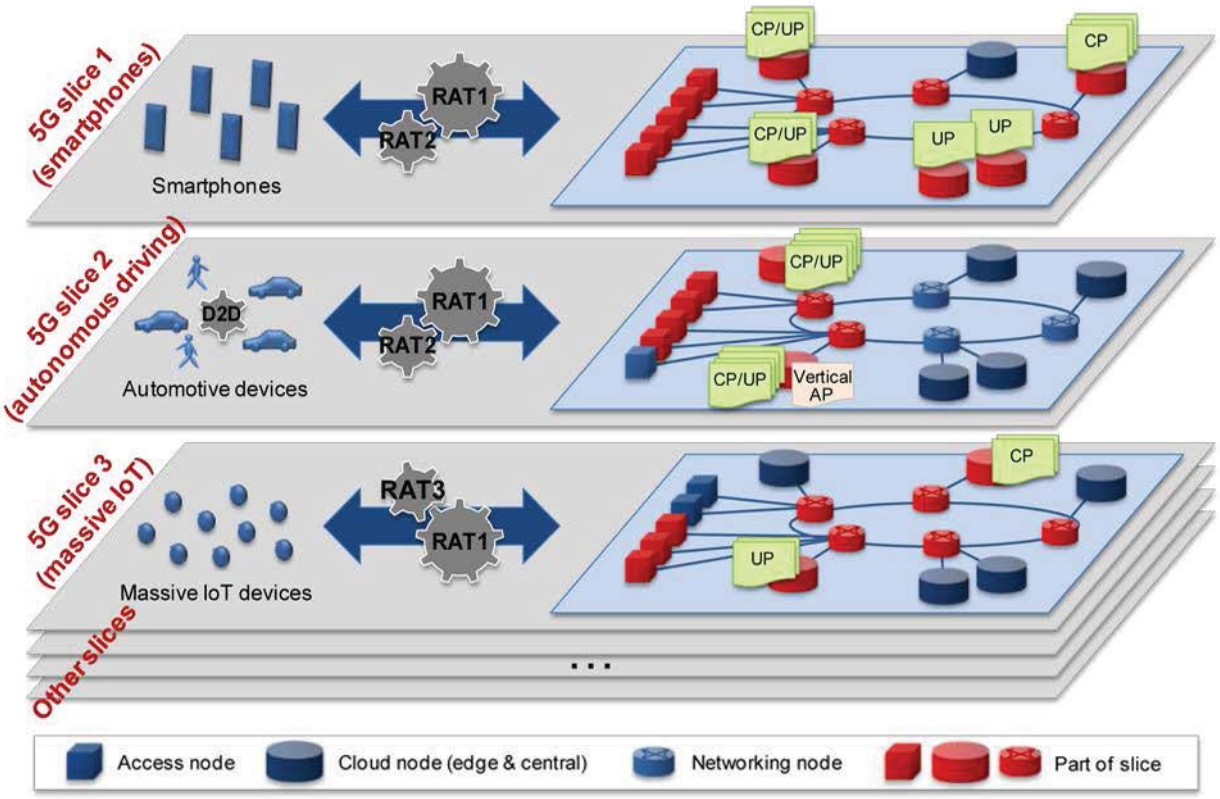

FIGURE 1. 5G's incorporation of SDN and NFV would allow network slices to be created dynamically and deployed as needed to accommodate a variety of scenarios [2].

The Open Networking Foundation, in an April 2016 white paper, called out SDN's ability to support multiple services over a common architecture as a key enabler for network slicing. SDN also allows for slices to be created dynamically and deployed as needed to accommodate a variety of scenarios (see figure 1). Currently, 4G mobile networks prioritize traffic to get a similar effect, but with more rigidity and limitations. However, as 4G networks incorporate SDN and NFV, network slicing will become an option.

C-RAN

There are more than six million base stations (excluding small cells) deployed worldwide across approximately five million different cell sites serving close to four billion users. The surge in demand for connectivity has network operators searching for ways to shrink their network footprint, lower operational expenditures (OPEX), and still meet users' demand for access. C-RAN meets these requirements and has either been implemented or trialed by several operators including Verizon, AT&T, KT (South Korea), and China Mobile. Radio base stations currently depend on special purpose-built hardware deployed at the cell site. The baseband processing unit (BBU) is the part of the RAN that is responsible for managing the radio functions (or all functions that require an antenna). The BBU is one of the parts of the RAN that can be moved to a central location, creating a pool of BBUs to serve multiple base stations. C-RAN aims to centralize and virtualize baseband processing to reduce cell site costs and enable coordinated scheduling of resource blocks across a coverage area [6].

Figure 2 illustrates the evolution from the classic RAN model to a C-RAN setup. On the left, the classic model has the BBU deployed at the cell site connecting to the core network over IP/Ethernet transport. Any coordination between cell sites takes place over the X2 interface, which allows two sites to communicate. In a C-RAN architecture, the BBUs are pooled at a location away from the cell site. Pooling BBUs negates the need for the X2 interface as communications between cell sites now takes place internally. This is one of the reasons for the increased performance in C-RANs. The C-RAN model also makes updating the waveform and protocols easier as it only requires a software upgrade at the centralized BBU and not at each individual cell site

The move to a C-RAN architecture increases the flexibility of the network by allowing providers to, in theory, even change the types of RANs used—from 3G to 4G. For instance, in an area that has a mix of 3G and 4G users, operators can rebalance radio frequency resources by shifting more resources to 4G when 4G

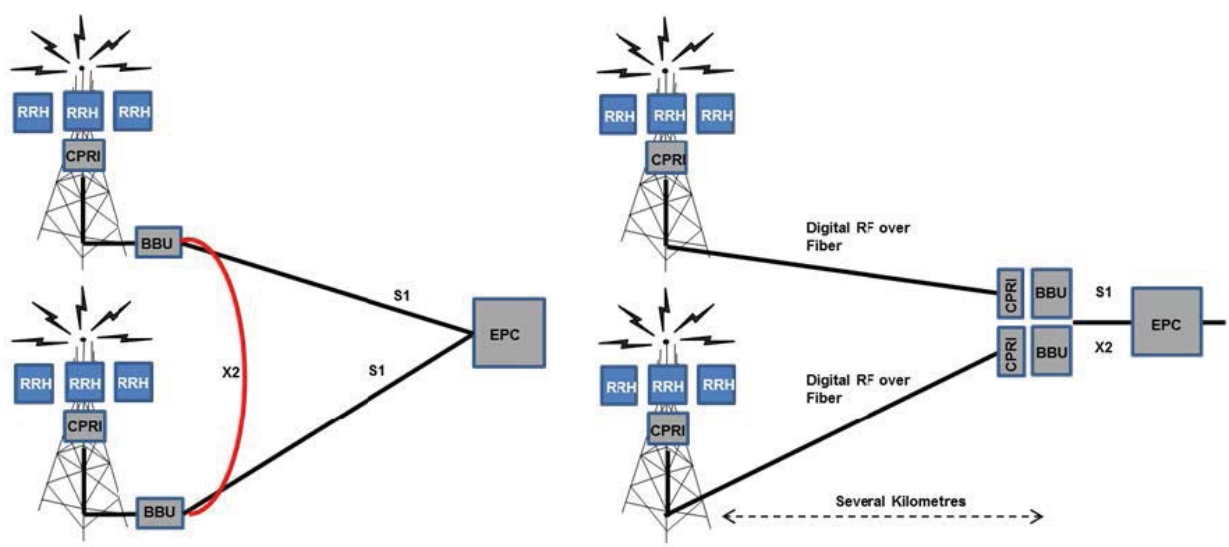

FIGURE 2. Unlike the traditional RAN model (on the left), C-RAN technology (on the right) pools the BBUs at a location away from the cell site offering an increase in performance and simpler upgrade path [6].

users are prevalent in the covered area. This shuffling of resources ensures that there is sufficient capacity for subscribers. C-RAN will also enable RAN-as-a-Service (RaaS), which will allow operators to rent RAN capacity to other operators.

Conclusion

On the face of it, virtualizing the 5G architecture seems like a necessary step towards preparing for the low latency requirements associated with 5G services. However, there are many uncertainties around 5G and a lack of visibility into what 5G will actually become through the standardization process, and at which phase different performance requirements will be supported or required. Phase II, the phase that is expected to meet International Mobile Telecommunication system for the year 2020 (IMT-2020) requirements, is expected in 2020. However, early versions or "pre-5G" offerings could be on the market before the final standard is approved. So, while these pre-5G solutions will have some 5G functionality, they will not field the full complement of improvements offered by an approved 5G system. For this reason, it is unclear to what degree virtualization techniques like C-RAN and network slicing will need to be implemented. It may come down to what the industry leaders in 5G implement in their "pre-5G" networks that will decide what a virtual 5G network will look like and when we can expect to see one.

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5G and the Auto

Staff Writer

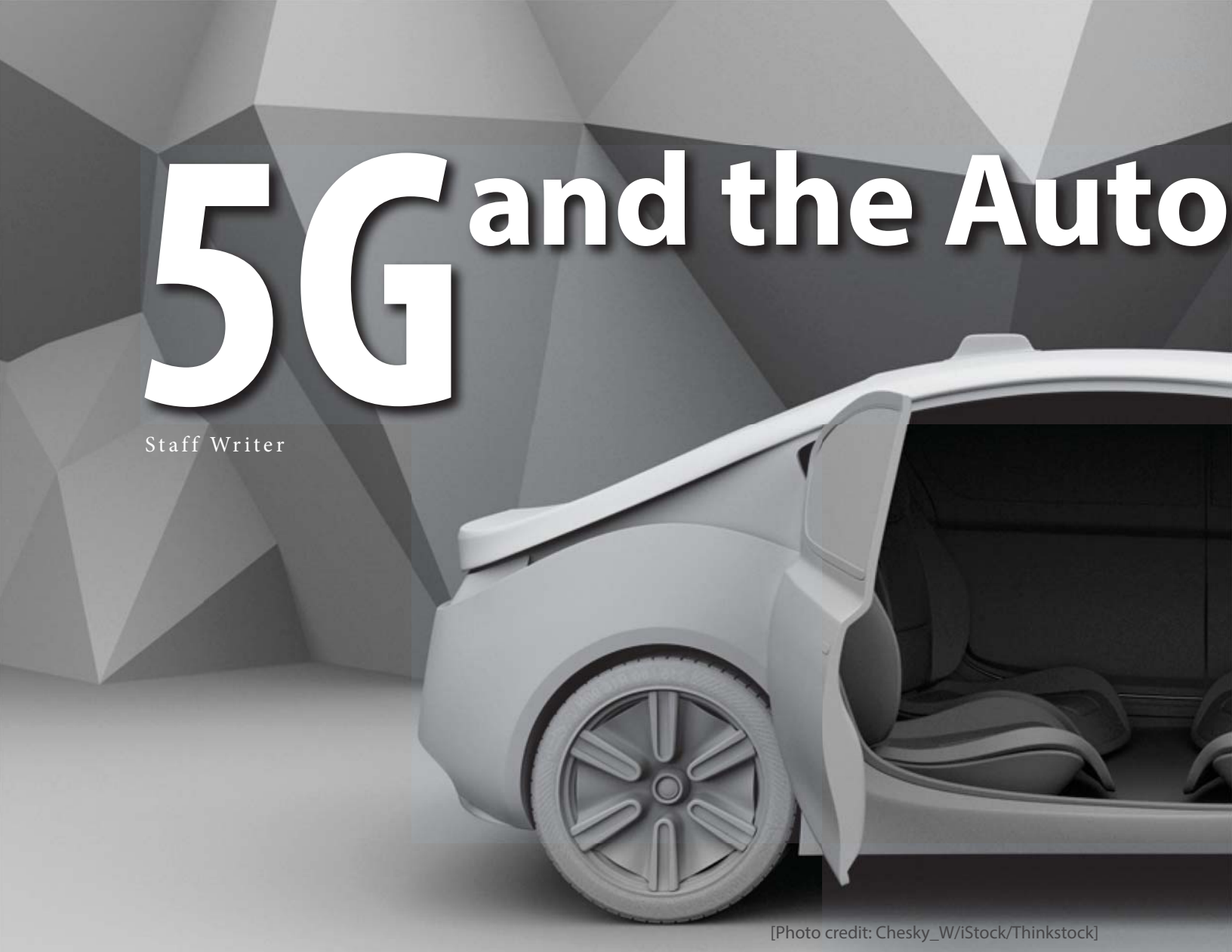

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Industry stakeholders envision 5G as a key enabler that allows network connectivity in vehicles to shift in status from an optional accessory to a core feature that supports not only the individual vehicle, but also communication with other vehicles and sensors that inform traffic, parking, and navigation—while also ensuring passenger safety and data security. For consumers, a connected vehicle provides a growing number of features and services that make the driving experience safer, convenient, and less costly. 5G connectivity will enable information from in-car sensors to continuously be passed to the cloud. By sharing information and alerts about micro-level weather, road temperature, surface conditions, and violent breaking ahead, more efficient and consistent traffic flows will be achieved that reduce congestion and emissions. The aggregated and interpreted data will provide more informed driving information, as well as alert and activate onboard safety systems to prevent accidents [1].

Autonomous vehicles

Autonomous vehicles—also referred to as driverless or piloted vehicles—are predicted to hit the market by 2020, but stable 5G infrastructure will play a key role, according to a white paper by ABI Research [2]. Estimates indicate that 5G latency could be as low as one millisecond (ms) over-the-air, and 5 ms end-to-end, enabling the following automotive use cases:

- Broadband multimedia streaming (driverless vehicles as mobile living rooms).
- Cloud services for vehicle lifecycle management, apps, security, and over-the-air updates (cloud-to-vehicle).
- Capturing or uploading huge volumes of sensor data for real-time traffic, weather, parking, and mapping services (vehicle-to-cloud).
- Cooperative mobility: low latency vehicle-to-vehicle and vehicle-to-infrastructure for active safety and autonomy [redundancy for advanced driver assistance systems (ADAS)] [2].

The current ADAS being delivered on 2016 vehicles already facilitate SAE Level 1 (see figure 1) and are beginning to incorporate features that would be considered Level 2. However, Level 4 and 5 capabilities may not be that far away. In October 2015, Robot Taxi, a joint venture between Japanese mobile Internet company DeNA and vehicle technology developer ZMP,

announced that it would offer driverless transportation to about 50 people in an area near Tokyo. Its goal is to commercialize the service by 2020, in time for the Tokyo Olympics [1]. While Robot Taxi is shooting for full automation (Level 5) in time for the games, it is likely that the use of such vehicles will initially be limited to shuttling passengers between Olympic venues. However, this venture is particularly notable because the technology is brand-agnostic and can be retrofitted to any vehicle [4].

Clearly, experimentation with autonomous vehicles is increasing, and 2020 as a date for some form of commercial implementation is certainly feasible from a technology perspective. Probably the best-known self-driving car project belongs to Google, which was started in 2009 and has clocked more than two million miles on public roads to date [5]. However, Google is not alone; Tesla, BMW, Audi, Mercedes, and most recently GM, have all showcased self-driving concept cars and demonstration projects. In mid-October 2016, Tesla announced that all cars currently being produced in their factories would include the hardware needed for full self-driving capability at a level of safety far greater than that of a human driver. However, the company added that the technology first needed to be tested and calibrated via "millions of miles of real-world driving" before the hardware would be activated on consumer vehicles [6]. In addition to traditional car manufacturers, companies such as Uber and Chinese search giant Baidu are also working on autonomous technology and self-driving cars [1].

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	No Automation	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	Conditional Automation	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	High Automation	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	Full Automation	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

FIGURE 1. SAE Levels of automation. The Society of Automotive Engineers (SAE) has defined levels of automation to clarify what role (if any) drivers have in operating a vehicle while a driving automation system is engaged. These levels are intended to establish a consistent framework that can be used across industries as the dialogue about autonomous vehicles continues. (Figure credit: SAE International J3016 [3].)

The motivations for creating an autonomous vehicle are beyond just technology. It's about reducing emissions through better fuel consumption, as well as addressing the demographic changes of an aging population that increase, rather than decrease, the potential for human error-induced accidents. It's also about leveraging the convergence of the shared economy and urban living, where young and old people no longer feel the need to own a car if there is a cost-effective and convenient alternative, such as Zip Car rentals, or on-demand ride-sharing services such as Uber [1].

Looking forward

Geographical coverage will be a key condition for 5G to have any relevance in the automotive sector. Initial 5G coverage can be supplemented by 4G and Wi-Fi connectivity on phones and other devices while the infrastructure is being built up, but these multimode, multiconnectivity solutions will not suffice for critical automotive use cases relying on the unique capabilities of 5G in terms of latency, reliability, and security [2]. Even once 5G is fully deployed, the adoption of self-driving technology will likely play out differently in the various markets in different regions since the forces shaping it are diverse at both the global and local level [1].

Government and industry cooperation

The continuous progression of ADAS-enabled cars and the gradual adoption of the autonomous vehicle will significantly reduce, and possibly eliminate, the number of crashes. This could, in turn, allow the removal of some regulations that relate to safety considerations, such as crumple zones, bumpers, and airbags. It also means that a review of laws relating to driving age, drunk driving, and speed restriction enforcement may be required, but not until all vehicles are compliant [1].

In September 2016, the US Department of Transportation (DOT) released the Federal Automated Vehicles Policy for highly automated vehicles (HAVs), or those intended to operate at Levels 3 to 5 as defined by SAE. The document—which is currently intended as guidance rather than formal policy—lays out standards for safe design, development, and testing of HAVs before they are commercially sold or operated on public roads. It also proposes guidelines for state governments to ensure a consistent national framework for regulation of motor vehicles with all levels of automated technology [7]. DOT's National Highway Traffic Safety Administration released additional nonbinding guidance in October 2016, outlining best cybersecurity practices for motor vehicle manufacturers and individuals and organizations involved in developing self-driving technology. The guidance aims to make cybersecurity a top priority for the automotive industry and proposes layered solutions to ensure that automated driving systems are designed to take appropriate and safe actions, even when an attack is successful [8].

A challenge yet to be addressed is that, historically, car manufacturers have completely controlled the design and development of vehicles. The advent of computers and software that effectively become the "mind" of the car means that manufacturers could lose control to technology and software companies, and yet still remain liable for any issues or catastrophes related to the car. It also remains to be seen how much and what type of data car manufacturers and network providers would be expected to share to improve overall safety and security of connected vehicles [1].

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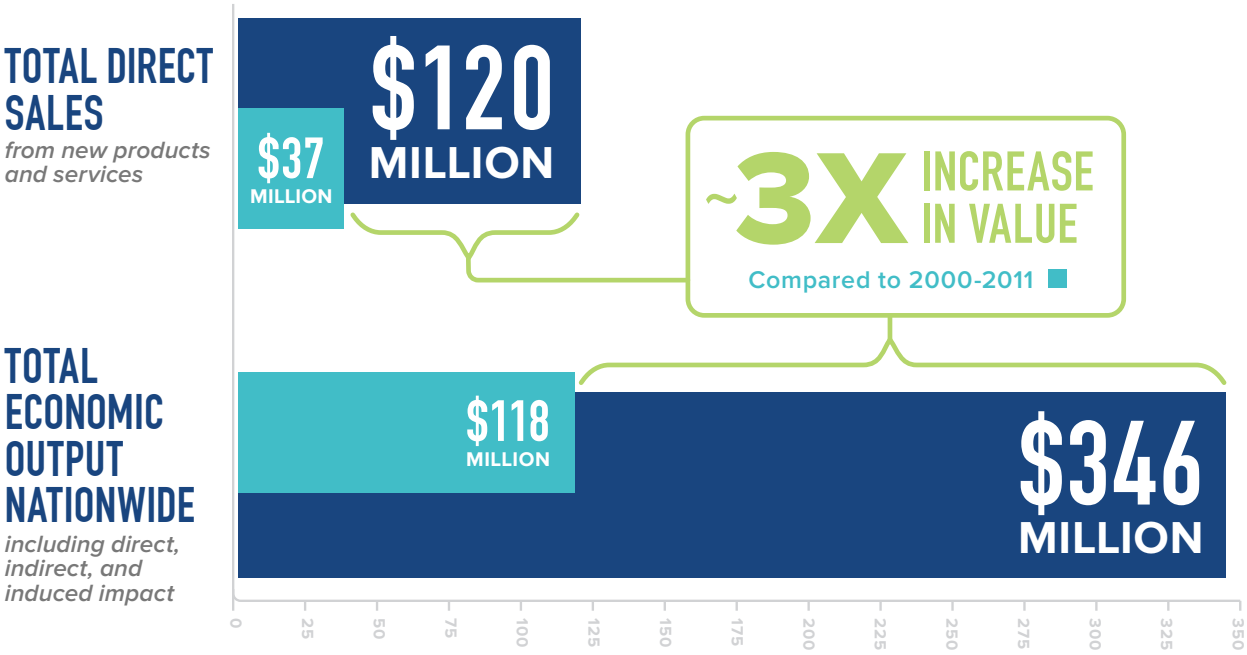

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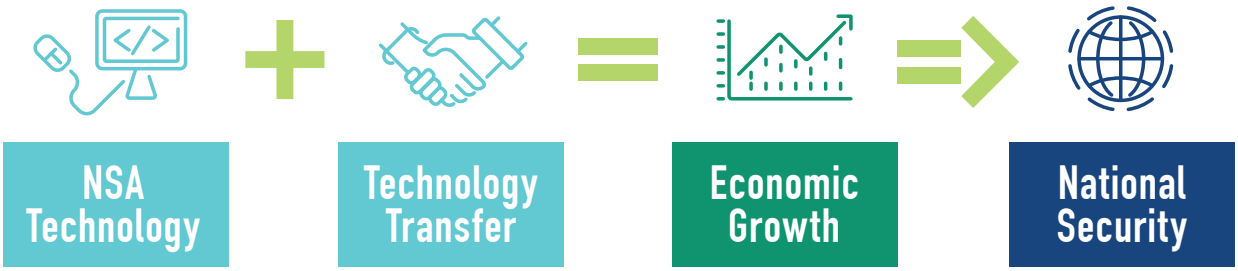

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Article

IoT's Tiny Steps towards 5G: Telco's Perspective

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Abstract: The numerous and diverse applications of the Internet of Things (IoT) have the potential to change all areas of daily life of individuals, businesses, and society as a whole. The vision of a pervasive IoT spans a wide range of application domains and addresses the enabling technologies needed to meet the performance requirements of various IoT applications. In order to accomplish this vision, this paper aims to provide an analysis of literature in order to propose a new classification of IoT applications, specify and prioritize performance requirements of such IoT application classes, and give an insight into state-of-the-art technologies used to meet these requirements, all from telco's perspective. A deep and comprehensive understanding of the scope and classification of IoT applications is an essential precondition for determining their performance requirements with the overall goal of defining the enabling technologies towards fifth generation (5G) networks, while avoiding over-specification and high costs. Given the fact that this paper presents an overview of current research for the given topic, it also targets the research community and other stakeholders interested in this contemporary and attractive field for the purpose of recognizing research gaps and recommending new research directions.

Keywords: 5G mobile communication; Internet of Things; applications classification; performance requirements; enabling technologies

1. Introduction

Telecom operators (telcos) had the most power and influence over business in the information and communication technology (ICT) industry during past decades. This dominance was the result of owning and provisioning communication infrastructures which nowadays have become more of a commodity than a luxury. Telco's revenue streams were mainly based on the provisioning of traditional services, such as voice calls and short message services (SMS). Recent work of regulatory agencies and the appearance of alternative service providers have led telecom operators to form the opinion that alternative service providers have conflicting interests and provide competitive services, thus decreasing telco's revenue from traditional services [1]. However, the latest econometric analysis presented in [2] has shown that telecom operators and alternative service providers have aligned interests and their collaboration could be favorable to both parties. The interests of alternative service providers and telcos are not inevitably conflicting, since the economic growth of the alternative service providers are positively correlated with telco revenues and vice versa.

The development of a digital society has changed the traditional value chain and introduced new issues for telcos as they seek a way how to monetize new digital services [3]. These services

are diversified across various domains of industry, such as agriculture, construction, utilities, transportation, healthcare, finance, etc., and delivered to customers through connected devices building thereby the concept of Internet of Things (IoT).

IoT can be defined as an interconnected network of things/objects that are able to interact with each other and cooperate with other things/objects through wireless and wired connections in order to create new services/applications for the benefit of society. In this way, IoT brings almost limitless benefit's, which have the potential to radically change our daily life by saving time and resources while creating possibilities for growth and innovation [4]. IoT has disruptive potential in almost every application domain, which has created many challenges that need to be faced when implementing IoT-based solutions, such as prevailing over obstacles generated by the fragmentation of IoT, both in terms of application domains and in terms of technologies. Therefore, recognizing all potential IoT applications while having in mind the development of technology and the requirements of individuals, businesses, and society as a whole is quite challenging.

Telcos now have the opportunity to seize a share of the value that is generated by IoT implementation. The size of this share will depend on telco's role in the value chain that ranges from being a traditional provider of communication infrastructure to being an end-to-end solution provider [3]. In order to monetize IoT, telcos will have to address many challenges which can be summarized as follows: (1) strategic challenges relating to decisions on future directions; (2) business challenges relating to successful management, investment, partnerships; and (3) technical challenges relating to changing connectivity and performance requirements. This paper focuses on the technical challenges since connectivity and performance requirements of IoT objects/things cannot be fulfilled using existing cellular networks that limit numerous IoT applications. In order to overcome issues associated with the current cellular networks, new types of technologies are being introduced leading towards the fifth generation (5G) network [5–7].

The architecture of the 5G network has to seamlessly integrate the requirements of diverse IoT applications: from delay-sensitive video applications to ultra-low latency, from high-speed entertainment applications in a vehicle to mobility on demand for connected objects and from best effort applications to reliable and ultra-reliable ones for health and safety [8]. A full understanding of emerging IoT applications and the variability of their performance requirements can serve telecom operators as input for specifying 5G enabling technologies. These technologies should be flexible and scalable to meet the aforementioned requirements. Since IoT applications sometimes demand extreme requirements, the 5G network must simultaneously satisfy all of them, which can lead to over-specification and high cost. In order to avoid this, telecom operators first have to adequately classify IoT applications to facilitate the selection of 5G enabling technologies being capable to efficiently meet their performance requirements.

The 5G classification concept includes three different service classes [9], i.e., (1) extreme mobile broadband (xMBB); (2) massive machine-type communications (mMTC); and (3) ultra-reliable machine-type communications (uMTC). Nevertheless, this classification concept can be considered insufficient to properly select 5G enabling technologies to meet the diverse requirements of IoT applications. Furthermore, it will be challenging to classify the emerging IoT applications given that there is many criteria for their categorization. The definition of the IoT domain in many cases overlaps with the definition of IoT application, which may at the same time belong to another IoT domain. For example, Smart Buildings may either be considered as a standalone IoT application or as an element needed to form a Smart City application domain. IoT applications are usually classified according to spheres of human life [4,10–12] or performance requirements [9,13–15]. However, these classifications are not suitable for telecom operators which have to fulfil the performance requirements of particular IoT applications, since it is difficult to choose the most important one from a class containing a wide range of IoT applications.

Telecom operators can easily specify performance requirements for current communication services since traffic patterns generated by these services are driven by predictable activities, such as

making calls, receiving email, surfing the web, and watching videos. However, traffic patterns generated by emerging IoT applications are driven by less predictable activities. Hence, the idea is to determine a common set of activities based on customer service requests which describe the reasonably foreseeable function/purpose of emerging IoT applications. Then these activities can be used by telcos as a new classification criterion of IoT applications. The assumption is that such a classification can help telecom operators meet performance requirements of future IoT applications and select appropriate 5G enabling technologies. Therefore, the aims of this paper are to classify IoT applications according to relevant activities, specify and prioritize the performance requirements of each IoT application class, and consider enabling technologies used to accomplish specified demands on the radio access part of 5G networks, all according to telco's perspective. In addition, the intention is to provide a literature review which covers 258 references dominantly published in the period between 2012 and 2017. As this paper provides a state-of-the-art review of IoT applications, their performance requirements and 5G enabling technologies, it can also be of use to the research community and other stakeholders interested in this contemporary and attractive field in order to recognize the research gaps and recommend new research directions.

The remainder of the paper is thusly organized. In order to answer research questions, Section 2 describes the methodological approach in regard to the conducted research. Section 3 identifies a common set of activities as a new classification criterion for IoT applications and assigns them the relevant 5G service classes. This facilitates the determining of performance requirements of activity-based IoT application classes, which are summarized and prioritized in Section 4. The enabling technologies used to accomplish these requirements in 5G networks are contemplated in Section 5. Finally, Section 6 discusses the outcomes of the paper by clarifying the contribution of our research in identifying open issues for future work, while Section 7 concludes this paper.

2. Research Approach and Design

The main objectives of this paper can be summarized as follows: (1) to identify activities relevant to IoT customer service requests and use them as a new classification criterion of IoT applications; (2) to specify and prioritize performance requirements of such IoT application classes; (3) to analyze relevant literature in order to provide insight into 5G radio technologies used to fulfil the requirements of activity-based IoT application classes; (4) to recognize research gaps and directions.

The research questions posed in this study are: (1) Which activities can be used as classification criteria for IoT applications? (2) What are the performance requirements of such IoT application classes? (3) Which enabling technologies in the radio access part of the 5G network can be used to meet the requirements of IoT application classes?

Investigation of different criteria for the classification of IoT applications underlines to what extent various classification concepts have been covered by existing literature and provides a basis for the introduction of a new classification criterion called the activity. We thus surveyed and compared different studies contributing to the understanding of the scope and classification of a wide range of IoT applications. This approach has been motivated by the challenge to propose an activity-based classification of IoT applications, the determination and prioritization of performance requirements of such IoT application classes and the review of 5G enabling technologies used to meet them. These findings can be utilized by telecom operators and other interested parties (e.g., the research community, software network function providers, network infrastructure manufactures, etc.) depending on their interest and potential to utilize these findings towards 5G implementation and commercialization.

The methodological approach to research conducted in this paper is illustrated in Figure 1 and includes four phases.

Phase I included searching, identifying, and extracting papers from three categories, i.e., IoT in 5G service classification, IoT in 5G performance requirements and IoT in 5G enabling technologies. The keywords used to search relevant scholar databases are shown in Figure 2. This search has

resulted in the selection of 258 recently published papers, which can be categorized into three groups (i.e., review papers, technical papers, research effectiveness), as shown in Table 1. Review papers summarize the status of knowledge and outline future directions in a given area of research. Technical papers describe the process, progress, or result of research, whereas research effectiveness directly provides an answer to the research question raised for this study. The reference distribution by year of publication is shown in Figure 3a, while the total percentage of references per publication type is presented in Figure 3b.

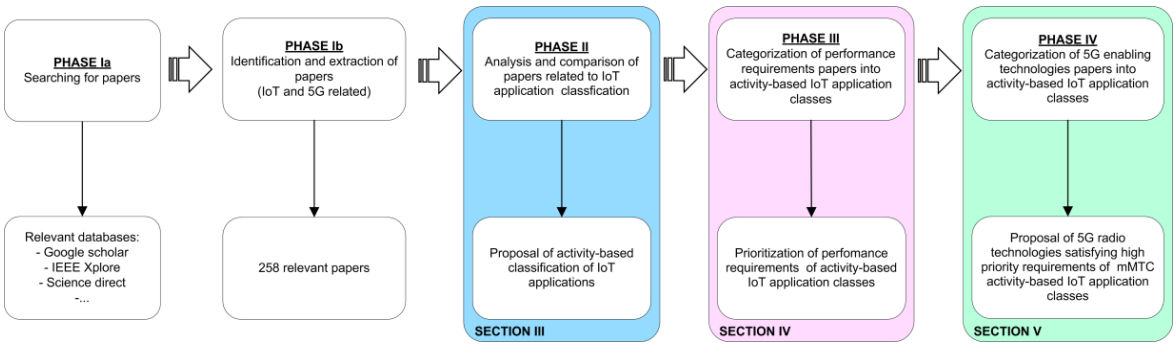

Figure 1. Methodological approach to research.

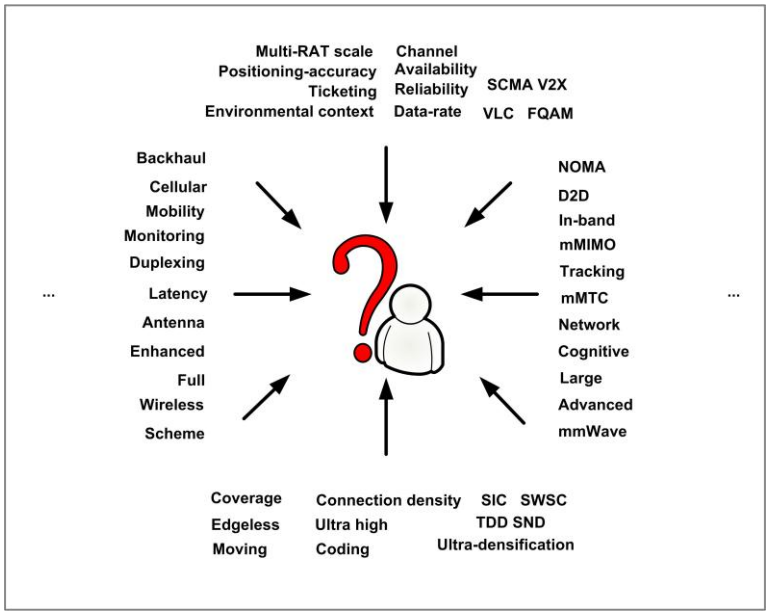

Figure 2. Keywords for searching relevant databases.

Table 1. Reference categorization.

Reference Type	Reference Number
Review paper	[1,2,10,12,14–88]
Technical paper	[8,89–197]
Research effectiveness	[3–7,9,11–13,29,52,198–258]

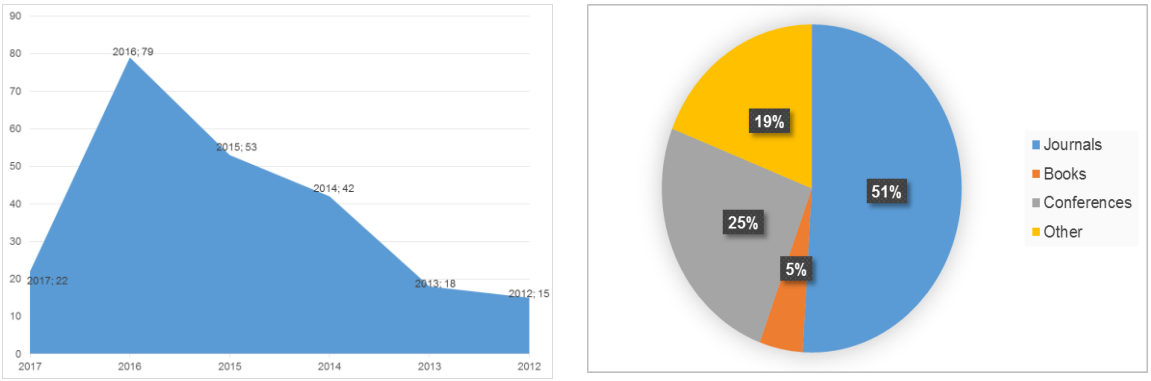

(**a**) (**b**)

Figure 3. Reference distribution by (**a**) year of publication; (**b**) type of publication.

Phase II included the analysis and comparison of papers related to the category of IoT in 5G service classification. Papers were first sorted according to the existing classification criteria of IoT applications in order to underline their deficiencies from telco's perspective. Since emerging IoT applications generate traffic driven by less predictable activities, specifying their performance requirements and enabling technologies is not an easy task from telco's point of view. Therefore, we have proposed a common set of activities to serve as classification criteria of IoT applications. Four activities were selected based on IoT customer service requests denoting the function/purpose of existing IoT applications. According to the authors' knowledge, existing IoT applications can be grouped around following activities: ticketing, tracking, monitoring, and managing/controlling. Such a classification makes it easier for telecom operators to associate particular IoT applications to the relevant 5G service class. Finally, Phase II has resulted in the proposal of an activity-based classification of IoT applications which was associated with the 5G service classification.

Phase III included the analysis of papers related to the category of IoT in 5G performance requirements. Papers were grouped according to eight key performance indicators, i.e., data rate, mobility, latency, connection density, reliability, positioning accuracy, coverage, and energy efficiency. These performance requirements were prioritized indicating high, medium, and low importance of each requirement for specific activity-based IoT application classes proposed in Phase II. Finally, Phase III resulted in the identification of highly important performance requirements for each activity-based IoT application class which can be utilized by telcos to identify 5G enabling technologies used to meet them.

Phase IV provided a review of papers from the category of IoT in 5G enabling technologies. Papers were first sorted according to eight technological groups used in the radio access part of 5G networks, i.e., wide and flexible bandwidth technology, advanced modulation and coding, duplexing, multiple access and waveform, advanced interface management, access architecture related radio technologies, energy related technologies, and other technologies. These technologies have been discussed in terms of their possibility to meet the high priority performance requirements of mMTC activity-based IoT application classes, since this area is more mature from telco's perspective. The results of Phase III were reflected in a proposal of technologies in the radio access part of 5G networks that can be used to meet the high priority performance requirements of the mMTC activity-based IoT class, as well as the identification of research gaps and directions for future work.

3. IoT in 5G Service Classification

As mentioned in the Introduction, various challenges awaiting telcos can be identified on the basis of the role that they will play in the IoT value chain. Regardless of this role, telcos will face many technical challenges, such as the necessity for global deployment, the need for rapid infrastructure scaling, unpredictable IoT application behavior, etc. Even now, existing IoT applications accelerate

the growth rate of traffic driven by less predictable activities which require new strategies towards 5G networks. These networks will be the key enabler for IoT applications by providing a unified infrastructure capable of meeting the high variability of their performance requirements [8,16]. Various stakeholders have recently described what 5G networks may be and grouped the major types of 5G services into three different classes: (1) xMBB—Requiring extremely high data rates and low-latency communication; (2) mMTC—Requiring scalable connectivity for an extremely large number of devices; and (3) uMTC—Requiring ultra-reliable low-latency and resilient communication [198]. This 5G service classification can be used by telcos to identify performance requirements of various IoT applications, and, as such, was used in this research study. However, emerging IoT applications will have extreme requirements, so an analysis based solely on 5G service classifications may not be sufficient. Therefore, telcos need a more precise classification of IoT applications which is an important precondition for meeting their diverse requirements.

IoT covers human-to-human (H2H), human-to-machine (H2M) and machine-to-machine (M2M) communication, which will be the main driving force towards 5G networks. In addition, the terms M2M communication (M2MC) and machine type communication (MTC) are used interchangeably as in [17–19,89–93,199,200]. Although IoT is a broader concept which evolves from M2M, this paper assumes that IoT and M2M are synonyms as in [94].

3.1. Existing Classifications of IoT Applications

In order to meet the requirements of a wide range of IoT applications, they have to be classified in an appropriate manner. The existing approaches to the classification of IoT applications are summarized in Table 2. IoT serves different user categories, including individuals, businesses, and society as a whole, and may span through a broad range of application domains [4,10–12], such as transportation and logistics, healthcare, smart environment, personal and social, futuristic applications, food sustainability, smart living, smart manufacturing, smart energy, smart city, etc. These application domains are created to be human-centric, which means that they cover different domains of human life. IoT applications belonging to these domains have diverse requirements for 5G networks, and should not be treated equally. Therefore, the acceptance of these domains as a classification criterion raises the issue of assigning IoT application to a particular domain. Moreover, the emergence of new applications of IoT may require defining new application domains, which makes this classification inappropriate from telco's perspective.

The M2M applications may be classified by the mobility and the amount of dispersion that needs to be supported into four categories [13]: (1) fixed and concentrated; (2) fixed and dispersed; (3) mobile and concentrated; and (4) mobile and dispersed. However, the mobility and amount of dispersion present very rough classification criteria and cannot meet the precise network requirements of individual IoT applications.

Additionally, M2M applications can be grouped according to delay tolerance into four categories [14]: (1) elastic (delay tolerant); (2) hard real-time (delay constraint); (3) delay-adaptive (delay sensitive but tolerant); and (4) rate-adaptive application (adjust their transmission rates according to available radio resource). However, the main drawback of this classification is the lack of consideration of other IoT application requirements except delay tolerance, although its importance as a classification criterion has been recognized.

According to data reporting mode, the M2M applications can be classified into five categories [91]: (1) time-driven; (2) query-driven; (3) event-driven; (4) continuous-based; and (5) hybrid-driven. This classification is specific for the former IoT concept, which is narrower in nature than the definition adopted in this study.

Another study considered the reliability, availability, and end-to-end latency in order to classify IoT applications into two groups [15]: (1) monitoring-based and mission-critical; (2) monitoring-based and non-mission critical; (3) control-oriented and mission-critical; and (4) control-oriented and non-mission critical. Monitor-based IoT applications periodically collect sensor data from smart

objects and transmit them. The majority of monitoring-based IoT applications are not mission-critical. Control-oriented IoT applications use sensor data to control actuators in real-time, and rely on mission critical communication. This classification is based on multiple criteria and represents the precursor of the Mobile and wireless communications Enablers for Twenty-twenty Information Society (METIS) 5G service classification.

Table 2. Internet of Things (IoT) application classification—summary.

Criteria for Classification	IoT Classes	References
Domains	(1) Transportation and logistics (2) Healthcare (3) Environment (4) Personal and social (5) Futuristic applications (6) Food/water monitoring (7) Living (8) Manufacturing (9) Energy (10) Building (11) Industry (12) City (13) Security and safety (14) Communication (15) e-society (16) Vehicular (17) Sport and leisure	[4,10–12]
Mobility and amount of dispersion	(1) Fixed and concentrated (2) Fixed and dispersed (3) Mobile and concentrated (4) Mobile and dispersed	[13]
Delay tolerance	(1) Elastic (2) Hard real time (3) Delay-adaptive (4) Rate-adaptive	[14]
Data reporting mode	(1) Time-driven (2) Query-driven (3) Event-driven (4) Continuous-based (5) Hybrid-driven	[198]
Reliability, availability, and end-to-end latency	(1) Monitoring-based and mission critical (2) Monitoring-based and non-mission critical (3) Control-oriented and mission critical (4) Control-oriented and non-mission critical	[15]
Characteristics and requirements	mMTC and uMTC	[12]

Legend: IoT (Internet of Things), mMTC (massive Machine Type Communication), uMTC (ultra-reliable Machine Type Communication).

Although it spans through a wide range of different applications, MTC can be divided in two main categories, i.e., massive and ultra-reliable MTC, which depend on their characteristics and requirements [89]. As mentioned above, this categorization is a part of 5G service classification which was used in this study as a basis to identify performance requirements of IoT applications and will be described in more detail in Section 4. Massive MTC (mMTC) typically involves a very large number of devices (tens of billions [9]), such as sensors, actuators, and similar devices [12], different in complexity and cost [9], and with varying quality of service (QoS) requirements. These devices should be of very low cost with very low energy consumption, enabling very long battery life [12]. At the same time, the amount of data generated by each device is normally very small, and very low latency is not a critical requirement [12]. Ultra-reliable MTC (uMTC) requires very high reliability and availability, and very low latency [9,12]. Low device cost and energy consumption are not as critical as they are for mMTC applications [12], and the number of devices and required data rates are relatively low [198].

The vision of a pervasive IoT requires the integration of various domains into a single and unified domain. It addresses the enabling technologies needed for these domains while taking into account the elements that form the third dimension like security, privacy, trust, and safety [11]. The current classification criteria and IoT application classes do not clearly differentiate IoT domains from IoT applications. IoT domains are usually viewed as a specific area of IoT applications that support a huge variety of use cases across industries impacting businesses and customers. Therefore, IoT domains overlap with IoT applications within existing IoT classifications. Moreover, IoT classification based on certain QoS parameters is difficult to apply from telco's perspective, because it is challenging to choose the most important parameter for the wide range of IoT applications. However, these problems need to be solved for upcoming 5G networks.

3.2. Activity-Based Classification of IoT Applications

The aforementioned issues motivated us to propose a new approach to the classification of IoT applications. This approach is based on "**the activity**", which primarily characterizes specific IoT application. In this sense, the activities are defined as new classification criteria, which denote a main function/purpose of specific IoT application observed from telco's point of view. Telecom operators observe the technical challenges of IoT through systems, tools, devices, and platforms because their availability and integration complexity determines the opportunity to capture a share of the value that is generated by IoT implementation. Based on the literature review, it was found that the most commonly mentioned terms in this sense were related to: (1) ticketing system [201]; (2) monitoring: devices [199,201–204]/services [199,201,202,205,206]/tools [207]/systems [11,12,199,201,205,206,208–210]/data [95,201]/framework [12,201]/solutions [20,205]/networks [211]/process [7]/activity [203,204,207]; (3) tracking technologies [4]/devices [204]/systems [204]/applications [11,210]/system [201]/services [202,205]; (4) managing/controlling applications [15,210,212]/operation [211]/services [4,208]/tools [208,211]/devices [204]/system [95,198,204,210]/concepts [211]/solutions [95]/platforms [95,199]. This has led us to identify four activities, i.e., ticketing, monitoring, tracking, and managing/controlling, as new classification criteria of IoT applications. According to the authors' knowledge, it was found that these activities can cover reasonably foreseeable functions/purposes of IoT in existing application domains. Using activities as classification criteria, telcos can specify IoT application performance requirements more easily, which are in that case dictated by the specific activity, not by the IoT application domain, and determine enabling technologies in the radio access part of 5G networks.

In addition, our classification approach allows better service differentiation and service delivery closer to customer expectations. According to BH Telecom's experience, customers typically come up with the following service requests when it comes to IoT: (1) they need to track their products and determine products' distribution across different regions based on their own data analysis; (2) they want to monitor their products since they do not have a department for supervision and analysis; (3) they need information panels about their outlets and working time to be downloaded by a scanning tab-ticket; (4) they want to manage/control their products according to market needs. This way of expressing customer needs has inspired us to propose the activity-based classification of IoT applications as it allows telcos to define performance requirements more precisely, and thereby improve the customer experience.

The activity-based classification of IoT applications is presented in Table 3. Each activity is associated with the application domain where that activity may be applied. The requirements of identified activities and associated application domains are then mapped to 5G service classes in order to be further able to identify their performance requirements and enabling technologies necessary to meet them. For example, according to Table 3, the managing/controlling activity can be realized in several domains, such as healthcare, food, energy, transportation and logistics. For each domain, we have identified an application example, such as remote surgery [213] in the healthcare domain, food processing facilities [96] in the food domain, energy distribution [12] in the energy domain and traffic/driving [12,213] in the transportation and logistics domain. According to diverse

performance requirements of these IoT applications [214], managing/controlling activity in healthcare, food, transportation, and logistic domains can be associated with the uMTC service class, while the energy domain can be mapped to the mMTC service class. A more detailed description of performance requirements for each activity-based class of IoT applications is provided in Section 4, while in Section 5 it is discussed how these requirements can be accomplished in the radio access part of 5G networks.

Table 3. Activity-based classification of IoT applications.

Activity	Domain Examples	5G Service Classification	Application Examples
Ticketing	Smart Transportation and Logistics	mMTC	POS Terminal [4]
Monitoring	Smart Healthcare	uMTC	Health condition [97]
	Smart Buildings	uMTC	Structures (buildings, tunnels, etc.) [12,25,213]
	Smart Buildings/Smart City	mMTC	Parking spaces
	Smart Buildings/Smart Environment	mMTC	Home video [12]
	Smart food/water monitoring	mMTC	Food growth condition [10]
Tracking	Smart Healthcare/Sport and Leisure	mMTC	Medical assets, wearables [200,213]
	Smart Transportation and Logistics	mMTC	Transport fleet [200,213]
	Smart Industry/Social Networking	mMTC	Shipping of products
	Smart Healthcare	mMTC	People in science museum
Managing/ controlling	Smart Healthcare	uMTC	Remote surgery [213]
	Smart food/water monitoring	uMTC	Food processing facilities [96]
	Smart Transportation and Logistics	uMTC	Traffic, driving [12,213]
	Smart Energy	mMTC	Energy distribution [12,98]

Legend: 5G (Fifth Generation), POS (Point Of Sale), mMTC (massive Machine Type Communication), uMTC (ultra-reliable Machine Type Communication).

As such, the activity-based classification of IoT applications can be used for the creation of new business models, which represent the stakeholder's plan to generate revenue and make a profit from operations, and thereby include many components and functions of the business [21]. However, there is no common opinion which components constitute a business model. The business model architecture can be illustrated by four dimensions [22]: (1) who, identifying the definition of the target customer as one central dimension in designing a new business model; (2) what, describing what is offered to the target customer; (3) how, referring to the construction and distribution of the value proposition; (4) value, explaining why the business model is financially viable. Answering these four questions allows the creation of IoT business models. According to this business model definition, the activity-based classification of IoT applications affects the who and the how dimensions in the following manner. In terms of the who dimension, it directly allows customer segmentation according to considered activities as a way to express their requirements (e.g., customers that require tracking or monitoring of their products). Being aware of the current customer requirements, the proposed classification of IoT applications around four activities (i.e., ticketing, monitoring, tracking, and managing/controlling) can be considered complete. At the same time, the activity-based classification of IoT applications is flexible since additional activities as classification criterion can be concerned with emerging customer requirements. On the other hand, the activity-based classification of IoT applications indirectly impacts the how dimension of new business models which among others includes relevant resources and capabilities in the focal stakeholder's internal value chain. This indicates that the proposed activity-based classification of IoT applications can be easily applied to IoT business models.

Various categories of IoT business models can be identified according to eight IoT architectural layers [23], i.e., collaboration and processes layer, application layer, service layer, abstraction layer, storage layer, processing layer, network communication layer, physical layer. Along with IoT architectural layer, the IoT business model needs also to address the IoT value proposition [24] and

IoT stakeholders that can participate in more than one layer. Based on their role in the IoT ecosystem, telecom operators usually take a part in the network communication layer. In this regard, they follow four evolutionary business models [23]: (1) selling connectivity services only; (2) selling third-party products; (3) selling internal products; (4) providing a broad menu of IoT products. Each of these IoT business models includes traditional telcos strength, i.e., connectivity which determines the how dimension of the IoT business model. In this sense, our activity-based classification of IoT applications indirectly allows the construction and distribution of performance as IoT value proposition using enabling technologies as IoT resources in telco's internal value chain.

3.3. Summary of IoT in 5G Service Classification

The previous discussion has shown that the classification of IoT applications is a complex task due to their numerosity and diversity. The existing classifications of IoT applications pose some drawbacks that can be summarized as follows. The domain-based classification does not allow clear differentiation between IoT domains and IoT applications due to either an imprecise classification criterion or the diversity and unpredictability of IoT applications. On the other hand, QoS-based classifications need to identify the common and most important performance metric for a broad range of IoT applications. Therefore, on the basis of the literature review and IoT customer service requests, we have proposed a new approach to the classification of IoT applications. It is based on the activity as new classification criterion, which denotes a main function/purpose of specific IoT application observed from telco's point of view. According to the authors' knowledge, four activities, i.e., ticketing, monitoring, tracking, and managing/controlling, have been identified to cover reasonably foreseeable functions/purposes of existing IoT applications. The resulting activity-based IoT application classes have been associated with 5G service classes in order to determine and prioritize their performance requirements as described in next section. Finally, the proposed classification of IoT applications was discussed in terms of its completeness, flexibility, and applicability to new business models.

4. IoT in 5G Performance Requirements

This section provides an insight into performance requirements of activity-based classes of IoT applications proposed in Section 3. The analysis is based on eight key performance indicators identified in [5,207] as shown in Table 4: data rate, mobility, latency, connection density, reliability, positioning accuracy, coverage, and energy efficiency. These performance indicators are usually well described for specific IoT applications. However, one of the main challenges of 5G is to support a variety of performance requirements for numerous IoT applications in a flexible, reliable, and cost-effective way [15]. Hence, there is a need for a comprehensive understanding of these requirements for activity-based IoT application classes. The 5G service classification defined the performance requirements for mMTC and uMTC [9]. We have assigned these requirements to the activity-based IoT application classes introduced in Section 3 for the purpose of proposing priorities of each requirement for a specific class. Three levels of priorities (high, medium, low) are associated with the performance requirements of activity-based classes of IoT applications as shown in Table 4. The prioritization of performance requirements is inspired by analysis of related work undertaken in [213]. Some activity-based classes of IoT applications may demand optimization of multiple performance requirements. Table 4 illustrates the main differences between activity-based IoT application classes, and therefore, the need for a 5G network that enables support of optimal configurations for a variety of, sometimes opposite, requirements. For example, the mMTC tracking-based IoT application class requires support for high mobility, high positioning accuracy, and high connection density, while the mMTC monitoring-based IoT application class also requires high connection density but low mobility and low positioning accuracy. A more detailed description of considered performance requirements is contained in the following subsections.

Table 4. Activity-based classes of IoT applications—performance requirements.

5G Service Classification	Activity	User Experienced Data Rate [Gbps] Outdoor: 0.1 [5] Indoor: 1 [5]	Mobility [km/h] Required: 500 [5]	Latency [ms] Control Plane: 50 [5] User Plane: 1 [5]	Connection Density [Connections/km^2] Required: 10^6 [5]	Reliability [%] Required: 99.999 [207]	Positioning Accuracy Required: A Few cm [5]	Coverage/ Availability [%] Required: 99.999 [207]	Energy Efficiency [bits/J]
mMTC	Ticketing	L to M	L	L	H	M	H	H	H
	Tracking	M	H	L	H	M	H	H	M to H
	Monitoring	M to H	L	L	H	L to M	L	H	M
	Managing/controlling	L	L	L	H	M	L	M to H	M
uMTC	Monitoring	L	L to M	H	H	H	M to H	H	M
	Managing/controlling	L	M to H	H	L	H	H	M to H	M

Legend: 5G (Fifth Generation), mMTC (massive Machine Type Communication), uMTC (ultra-reliable Machine Type Communication), L (Low), M (Medium), H (High).

4.1. Data Rate

Data rate is the most important evaluation factor for generations of wireless communication networks [6]. It is contemplated in two ways: (1) peak data rate—defined as the maximum achievable data rate by the user; and (2) minimum guaranteed user data rate—defined as the minimum experience data rate by the user [16]. New mobile technologies are primarily driven by users' needs for higher data rates, as discussed in [8,16,99,215,216]. The expected values in 5G networks are 10 Gbps for minimum peak data rate and 100 Mbps as minimum guaranteed user data rate [5]. High data rate requirements are mainly posed by xMBB related use cases [9] like hotspots [214] or dense urban areas where in 95% of locations and time experience data rate by user should be 300 Mbps in downlink and 60 Mbps in uplink [100]. High data rate is also important in some activity-based classes of IoT applications, as shown in Table 4. Medium (e.g., monitoring of parking spaces) to high (e.g., monitoring of home video) data rate is needed in cases of mMTC monitoring activities. High data rate can be achieved by using a millimeter wave (mmWave) spectrum to share multi-gigabit data in the surrounding environment (i.e., mMTC monitoring with high data rate requirement) and to recognize an object via cloud in real time to find the optimal driving strategy instantaneously for IoT—autonomous vehicles application [101]. Data rates generated during transmissions of tracked medical assets, transport fleets, and ticked point of sale (POS) terminals is low (e.g., medium importance for ticketing and tracking activities in mMTC). In addition, low data rates are needed in uMTC monitoring and controlling (e.g., monitoring of health condition, control of driving).

4.2. Mobility

Mobility is defined as relative velocity between the receiver and the transmitter [16]. The applications of IoT pose very diverse requirements for mobility in 5G networks, which range from static to high mobile, even up to 500 km/h [16,102,207]. Use cases in which except ultra-high mobility, ultra-high traffic volume density, and ultra-high connection density are needed may be quite challenging for 5G networks [215], like V2X communication [5]. High mobility is a very important requirement for mMTC tracking activity (e.g., tracking of assets in high speed trains [214]). Moreover, the support for high mobility is needed in uMTC management activities, if the monitor/control object is moving (e.g., high speed trains [207]). Low mobility is needed for ticketing, monitoring, and managing/controlling activities in the mMTC class, as shown in Table 4. This is the reason why 5G networks should not assume mobility for all devices and services but rather provide mobility on demand [8].

4.3. Latency

Latency requirements are usually expressed in terms of end-to-end (E2E) latency perceived by the end user [8]. 5G networks should enable "zero latency" [103] represented by the millisecond level of E2E latency [16,26,27,213] through significant enhancements and new technology in architecture aspects [6,28,214], such as device-to-device (D2D) communication [5]. The IoT applications associated with uMTC monitoring and managing/controlling activities require low latency, as they tend to be real time. Required latency levels depend on the particular IoT application [8,16,28], being the narrowest in uMTC managing/controlling activity with a value that should not exceed 1 ms [8]. For example, the tolerable delay for use case mobile health [215] and remote surgery application is in order of sub-milliseconds [213]. For V2X communications, latencies should be ultra-low for some warning signals [8].

4.4. Connection Density

Connection density is defined as the number of connected devices per unit area [16]. It can usually be expressed in terms of an extremely high number of simultaneous active connections, such as 1 million connections per square meter [207,215], or 10 to 100 times higher number of connected

devices [29]. The performance values of connection and traffic density for various 5G services are listed in [8,212]. This performance requirement is highly correlated with identified activity-based classes of IoT applications, since it is the main characteristic of mMTC. High device density brings the need for rapid internet protocol version 6 (IPv6) deployment, and high quality security algorithms and techniques, which lead to new system design and implementation, as described in [104].

4.5. Reliability

Reliability is the maximum tolerable packet loss rate at the application layer [105]. 5G must bring a reliability of 99,999% [27,30,31,212], or higher for specific use cases [212], (e.g., tele-protection in a smart grid network [207] or driverless cars [106]). Reliability is the main characteristic of uMTC monitoring and managing/controlling activities. Reliability will be a particularly challenging task in high-speed trains because of speed, load, and cell distance [16,107].

4.6. Position Accuracy

Position accuracy is the maximum positioning error tolerated by the application [105]. 5G should ensure accurate positioning of the device outdoors [108] with accuracy from 10 m to <1 m on 80% of occasions and better than 1 m in indoor deployment [212]. Accuracy positioning is very important in uMTC monitoring-based activities (e.g., monitoring remote cameras), and uMTC managing/controlling-based activities (e.g., driving) [213]. Moreover, the mMTC tracking-and ticketing-based activities pose high performance requirements in terms of position accuracy.

4.7. Coverage

Coverage requirements in 5G should provide connectivity anytime and anywhere with a minimum user experience data rate of 1 Gbps [32]. However, the perception of 100% coverage is rather a technical decision than a business one [33], which could be extended through ultra-cell deployment [31] and vehicle-to-infrastructure (V2I) communications [30]. Almost every activity-based IoT application class requires very high levels of coverage (99,999% availability) [207]. Total coverage will enable new unmanned aerial vehicles (UAV) to use single network connection, instead of connection steering mechanism, as one described in [109].

4.8. Energy Efficiency

Energy efficiency is defined as the number of bits that can be transmitted per joule of energy [216]. Compared with current wireless technologies, the energy efficiency (measured in b/J) of the 5G network may need to be improved by a factor of 1000 [4,7,34,110,217]. High energy efficiency is important in case of ticketing- and in some cases of tracking-based activities (e.g., smart industry [205] or implantable medical devices [35]). Other activities, such as both mMTC and uMTC monitoring- and managing/controlling-based activities (e.g., health condition [205]) and some tracking-based activities (e.g., sports wearables [205]) require medium energy efficiency. Energy efficiency is very important design objective for the reduction of operating costs of telecom operators, as well as for minimizing the environmental impact of the wireless domain [217]. On a higher layer of the network protocol stack, adaptive base station switch on/off algorithms use renewable energy sources to save energy [218] along with an energy scheduler, as in the with heating, ventilation and air conditioning (HVAC) [111]. However, at the physical layer, adaptively switching off unused carriers is a key strategy that can be used to save energy from the radio-frequency (RF) transceiver chain of base stations [218].

4.9. Spectrum Efficiency

Spectrum efficiency is defined as the data throughput per unit of spectrum resource per cell or per unit area (bps/Hz/cellar bps/Hz/km^2) [216]. In order to achieve network sustainability, required for 5G networks [216], spectrum efficiency needs to be improved 3–5 times [20,32,216]. Minimum

peak spectrum efficiency is 30 bps/Hz for downlink and 15 bps/Hz for uplink [32]. This is mostly important for the xMBB services class [212,214]. Since this performance requirement is not relevant for activity-based IoT application classes which are associated with the mMTC and uMTC service class, it has not been further considered herein.

4.10. Summary of IoT in 5G Performance Requirements

Activity-based classes of IoT applications are associated with performance requirements of 5G service classes, i.e., mMTC and uMTC. On the basis of the literature review, each activity-based class (ticketing-, tracking-, monitoring-, and managing/controlling-based class) is associated with mMTC service class, while the monitoring- and managing/controlling-based classes are the only ones linked to the uMTC service class. According to the authors' best knowledge, there is no available literature concerning the uMTC ticketing- and tracking-based classes of IoT applications or such IoT customer service requests.

Activity-based IoT application classes pose many performance requirements, which have been discussed in terms of data rate, mobility (speed), latency, connection density, reliability, positioning accuracy, coverage, and energy efficiency. These performance requirements have been assigned three-level priorities (high, medium, low) for the purpose of facilitating identification of the enabling technologies used to fulfill them. Based on the literature review, it was found that each activity-based IoT application class poses high requirements in terms of connection density except the uMTC managing/controlling-based IoT application class. Moreover, ticketing- and tracking-based IoT application classes have high requirements in terms of positioning accuracy, coverage, and energy efficiency. Additionally, positioning accuracy is a highly important performance requirement for the uMTC managing/controlling-based IoT application class, whereas coverage is important for both uMTC and mMTC monitoring-based IoT application classes. Finally, latency and reliability represent highly important performance requirements for uMTC monitoring- and managing/controlling-based IoT application classes. A deep and comprehensive understanding of performance requirements of each activity-based IoT application class may facilitate the selection of 5G enabling technologies needed to meet them as described in the following section.

5. IoT in 5G Enabling Technologies

Activity-based classification of IoT applications proposed in Section 3 allows telecom operators to identify performance requirements of each class relying on 5G service classification, as discussed in Section 4. However, these performance requirements cannot be satisfied for many IoT applications with current cellular (2nd, 3rd, and 4th generation) network technologies, since they limit their potential due to many issues [3], i.e., protocol implementation complexity, poor coverage in non-urban environments, high cost of networking equipment and data transmission. In order to overcome these issues, many dedicated communication technologies are being installed.

From the very beginning of IoT, many proprietary technologies, such as radio-frequency identification (RFID), wireless highway addressable remote transducer (WirelessHART) or Z-Wave, have first appeared, and then, more generic ones, such as Bluetooth, IEEE 802.15.4, IPv6 over low-power wireless personal area networks (6LoWPAN). However, none of these technologies have become a market leader mainly because of technology shortcomings and business model uncertainty [219]. Hence, new solutions, such as low-power wireless fidelity (LP Wi-Fi), low-power wide area (LPWA) or several improvements for cellular M2M communications have become serious candidates for IoT implementation. LP Wi-Fi is an IEEE 802.11ah standard designed to extend the application area of Wi-Fi networks in order to meet IoT requirements (i.e., large number of devices, large coverage range, energy constrains). First performance studies indicate that this standard will support a broad range of M2M scenarios with a required QoS level, and enable scalable and cost-effective solutions. In addition, LPWA networks have been deployed for some time in the form of many different proprietary solutions (e.g., Amber Wireless, Coronis, Huawei's CIoT, LoRa, M2M Spectrum Networks, Sigfox, Weightless,

etc.), but only the LoRa Alliance, Sigfox and Weightless are involved in LPWA standardization activities. Despite some drawbacks which are mainly related to use of an unlicensed spectrum, LPWA networks are expected to become a key enabler for IoT deployment in early market rollouts and for limited IoT applications [219].

The appearance of these IoT communication technologies was considered as competition to current cellular networks from the telco's point of view from the start. But, in the meanwhile, telcos have realized that the aforementioned communication technologies can be utilized to meet the changing connectivity and performance requirements of IoT applications. Therefore, many dedicated communication technologies have already been deployed in various IoT applications. For example, Orange, Swisscom and South Korea (SK) Telecom have built nationwide networks based on LoRa [3], whereas Deutsche Telekom (DT), Vodafone and all three Chinese operators have completed the rollout of narrowband IoT (NB-IoT), as another LPWA standard utilizing existing long term evolution (LTE) networks [36]. In this context, standardization and interoperability becomes critical because there is a need to consider a broad range of connectivity solutions as presented in Figure 4 [37]. One of those solutions includes satellite technologies which integrated with 5G radio technologies form the 6th generation (6G) standard for providing global coverage [38].

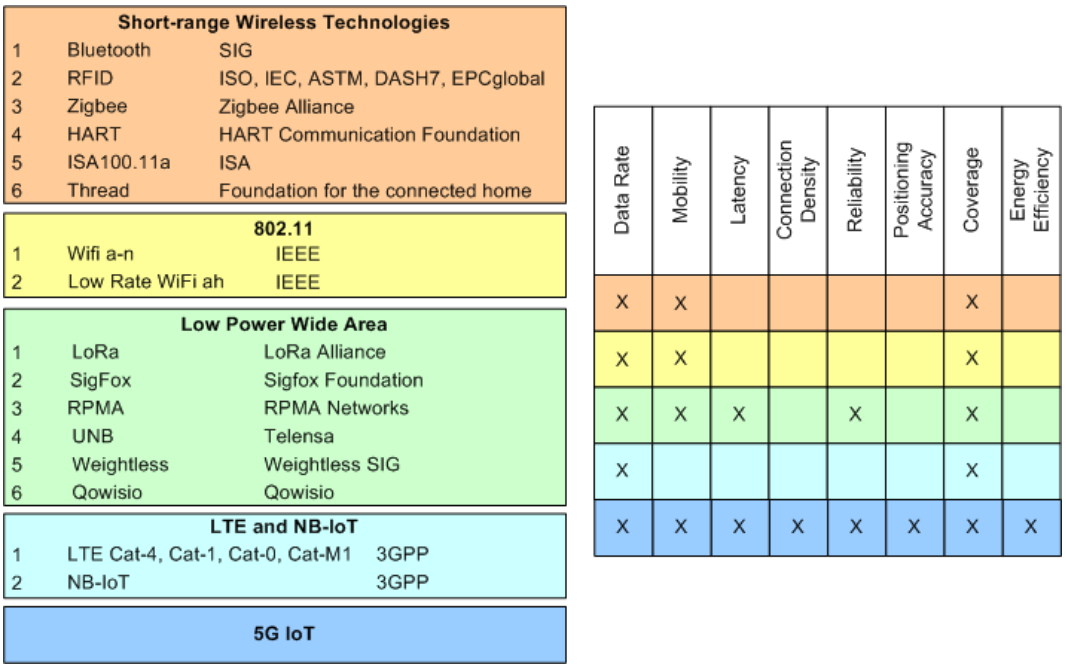

Figure 4. IoT performance requirements and enabling technologies.

In this regard, standardization activities of 5G and beyond are being undertaken by several standards bodies, such as the Institute of Electrical and Electronics Engineers (IEEE), the 3rd Generation Partnership Project (3GPP), the Internet Engineering Task Force (IETF), ITU Radiocommunication Sector (ITU-R), and ITU Telecommunication Standardization Sector (ITU-T). An overview on these standards bodies and their effort to develop communication standards for 5G and beyond are provided in [112]. Due to the envisioned 5G applicability, these standards have defined an air interface that can significantly improve the performance, and network architectures that allow the deployment and coexistence of various 5G technologies. A detailed discussion of these technologies regarding both technological and standardization aspects indicates that 5G can be perceived as the main driving force for enabling the vision of a truly global IoT [219].

In this sense, the technologies described in this section will allow 5G networks to form a unified communication infrastructure for the realization of a wide range of IoT applications. These technologies

will bring performance enhancement which will trigger a complete revolution in almost all spheres of human life creating a new "everything connected" era. Future 5G networks in such an era will face a serious problem regarding a huge number of different service types [220]. To meet the diverse requirements for a huge number of IoT applications, 5G introduces the concept of network slicing to offer programmable network instances [220]. Using network slicing, multiple independent and dedicated network instances can be created within the same infrastructure to run services that have completely different requirements for latency, reliability, throughput, and mobility [220]. This technology primarily targets a portion of the 5G core network, but also indicates that 5G radio access network (RAN) functionalities can be different for each network slice [221]. To deploy network slices, network functions need to be enabled on an on-demand basis, which has driven the use of virtualization and softwarization in 5G core network [221]. Network function virtualization (NFV) is a paradigm that enables that 5G network functions to run in a virtual environment instead of dedicated hardware [221]. The software define networking (SDN) paradigm facilitates isolation of network slices avoiding the traffic of one slice affecting the performance of another slice [221]. These two paradigms make the network much more dynamic, agile, on-demand, and flexible [222,223]. Since the aforementioned technologies are used to deal with a variety of 5G applications, they will not be further discussed. This paper will focus on technologies used to meet performance requirements for specific applications (inter slice performance) which are implemented in the radio access part of 5G networks.

These technologies are briefly described and discussed in terms of their advantages, disadvantages, and research gaps. Given the fact that the realization of particular technology affects multiple performance requirements, tiny steps towards its implementation will allow telcos to deploy 5G networks, and thereby provide a performance improvement in terms of more capacity, lower latency, more mobility, more position accuracy, increased reliability, and availability [6,214,224]. In other words, 5G networks will accommodate many more users and devices while delivering more data [113,114] to each user requiring high data rates [108] in a more energy-efficient way [115,116].

Table 5 summarizes considered radio technologies used to implement future 5G networks being capable of achieving performance requirements identified in Section 4. On the basis of the literature review, one may conclude that the 5G radio access network is crowded with multiple technologies, and there seems to be a duplication of technologies, all eager to grab telco's attention and convince them to buy into the particular choice. As Table 5 shows, multiple technologies and techniques can be used to meet each performance requirement. Since the mMTC activity-based IoT classes are more mature, we have primarily focused on technologies used to fulfil their high performance requirements (i.e., connection density, positioning, and coverage). We have selected 5G enabling technologies considered from telco's perspective as the most representative and promising candidates to meet these requirements. The implementation of these technologies will also significantly affect the fulfillment of uMTC service class requirements, which will lead to complete automation in all spheres of human life. Therefore, the following subsections will discuss these technologies in more detail with the final goal of identifying research gaps and providing recommendations for future work, which are summarized in Table 6.

Table 5. IoT in 5G enabling radio technologies.

Enabling Technologies		IoT in 5G Service Requirements								
		Data Rate	Mobility	Latency	Connection Density	Reliability	Positioning	Coverage	Energy Efficiency	Spectrum Efficiency
Wide and flexible bandwidth technology	mmWave Band Communication and large-scale antenna	[7,202,225–227]		[202]			[233]	[5]	[202]	[7,29,214]
	Heterogeneous Multi-RAT Integration	[5,217,228–232]						[5]		
	Cognitive Radio and Spectrum Sharing							[5]		
Advanced modulation and coding	Advanced Modulation	[52,234–236]	[237,238]	[239]		[237,239]		[237]		
	Advanced Channel Coding	[235]		[235]						[216]
Duplexing	In-band FD			[124]				[5]		[7,29,214]
	Dynamic TDD	[240]		[240]						[9]
Multiple access and waveform	Multiple access			[216]					[218]	[7,9,29,216,256,257]
	New waveform				[5]					[7,9,29,216,256,257]
Advanced interface management	SND and SWSC	[5]								
Access architecture related radio technologies	Advanced small cell	[7,202]					[5]	[5,251]	[7,202,217]	[202,257]
	MN	[202]	[202]					[5]	[202]	
	Enhanced wireless backhaul							[5]		
	D2D	[202,248]	[7,241,244]					[245–247]	[7,202,215]	[7,9,29,202,252]
Energy related technologies	Energy harvesting						[100,253]			
	UAV	[254]				[254]		[183–185]		
Other important technologies	mMIMO	[7,202,249]		[13,202]		[249]		[200]	[217]	[7,9,214,216,257]
	VLC	[202,250]		[202]					[202,258]	
	SIC		[202]	[202,236]						
	V2X			[255]				[255]		

Legend: IoT (Internet of Things), 5G (Fifth Generation), mmWave (Milimeter-wave), RAT (Radio Access Technology), FQAM (Frequency Quadrature Amplitude Modulation), FD (Full Duplexing), TDD (Time Division Duplexing), SND (Simultaneous Non-unique Decoding), SWSC (Sliding Window Superposition Coding), MN (Moving Network), D2D (Device-to-Device), mMIMO (massive Multiple Input Multiple Output), VLC (Visible Light Communication), SIC (Self Interference Cancelation), V2X (Vehicle to Everything), UAV (Unmanned Aerial Vehicles).

Table 6. 5G enabling technologies—research directions.

5G Enabling Technologies		Research Gaps and Directions	References
Wide and flexible bandwidth technology	mmWave band communication and large-scale antenna	(1) 3D channel modeling; (2) dynamic power control; (3) user scheduling and congestion control; (4) hardware limitation and adaptive beam-steering technique; (5) design of mobility management and admission control for mmWave-based dense HetNet; (6) design of frequency management schemes for mmWave; (7) Tactile Internet; (8) effective and efficient mmWave implementation in HetNets (access and networking).	[7,87,217]
	Heterogeneous multi-RAT integration	(1) cell-association; (2) traffic-offloading algorithms; (3) interference management schemes in case of inter user and inter cell interference; (4) cross-tier handover, access admission, and mobility management schemes of a multi-tier HetNets.	[196,217]
	Cognitive radio and spectrum sharing	(1) Spectrum sensing (design of cooperative frameworks, choose cooperative secondary users and transmit cooperative information); (2) develop framework and algorithms for group handoff of secondary users and security; (3) simulation of different attacks and scenarios to enhance security; (4) in-depth performance analysis between GFDM and UFMC in CR settings.	[29,110]
Duplexing	In-band full duplexing	(1) Redesign of network and management; (2) antenna and circuit design and development of the theoretical foundation; (3) analyze the throughput of a network of randomly deployment terminals sing stochastic geometry; (4) characterize the capacity advantage due to IFDB in various network scenarios; (5) guidelines to practical design: coding, modulation, power allocation, beamforming, channel estimation, equalization, digital interference cancellation and decoding, (6) design of a MAC layer.	[55,197]
Multiple access and waveform	New waveform	(1) Performance of SIC cancelation or filtering on f-OFDMA; (2) balance of time and frequency dispersion and design an efficient filter prototype for UFMC.	
Access architecture related radio technologies	Advanced small cell	(1) Expect of wireless backhauling on user experience; (2) exploitation of location data and fingerprints in optimizing small cell discovery in terms of time and energy- efficiency; (3) interference management when integrating D2D and small cells.	[34,80]
	Enhanced wireless backhaul	(1) TDD multi-flow coordination schemes to avoid bottlenecks in the downlink backhaul; (2) Backhaul aware association in ultra-dense deployment; (3) reliability and security of the backhaul.	[34,88,198]
	Moving network	(1) Resource allocation and interference in the mobile relay when trains are moving from opposite directions; (2) handover decision of users (more than one train arrive or depart, stop or pass); (3) group mobility for users on board very high-speed vehicles; (4) design od cooperative communication schemes; (5) deployment of moving networks in various vehicle environments, not just on fixes route railways.	[5]
	D2D communication	(1) Interference management (mode selection, resource allocation and power control); (2) integration of novel reputation-based mechanism for identify and avoid malicious users from multiple users in multi-hop D2D communications; (3) testing of D2D interference management schemes in 5G scenarios (mmWave, cell densification).	[29,208,209]
Energy related technologies	Energy harvesting	(1) Improving energy harvesting schemes; (2) simulation of proposed models; (3) integration with other 5G technologies.	[100,182,253]
	UAV	(1) Optimal deployment, mobility and energy-efficient use of UAVs; (2) integration with other 5G technologies.	[81]
Other technologies	mMIMO	(1) Performance of practical mMIMO.	

Legend: IoT (Internet of Things), 5G (Fifth Generation), mmWave (Milimeter-wave), RAT (Radio Access Technology), D2D (Device-to-Device communication), mMIMO (massive Multiple Input Multiple Output), 3D (Three Dimensional), HetNet (Heterogeneous Network), GFDM (Generalized Frequency Division Multiplexing), UFMC (Universal Filtered Multi Carrier), CR (Cognitive Radio), IFDB (In-band Full Duplexing), MAC (Medium Access Control), f-OFDMA (filtered Orthogonal Frequency Division Multiple Access), TDD (Time Division Duplexing), UAV (Unmanned Aerial Vehicle).

5.1. Wide and Flexible Bandwidth Technology

mmWave band communication and large-scale antennas are promising technologies for future 5G networks. The mmWave band covers frequencies from 30 GHz to 300 GHz [202], and from an industry and wireless academia point of view, it is a unique solution for solving 5G capacity requirements [96]. mmWave band communications will provide high data rates [7,202,225–227] utilizing a much larger spectrum bandwidth that can reach up to 5 GHz [39] and by using directional antennas and high attenuation [40]. To provide sufficient antenna gain mmWave requires implementation of large-scale antennas at the transmitter and receiver side [96]. Deployment of large antenna arrays with mmWave will also bring high spectral efficiency, high throughput and channel gain [7]. Despite all of its advantages, mmWave needs line of sight (LOS) operation [41], while the effective communication distance of mmWave signals is within 200 m due to the propagation characteristic of this frequency band [29]. Open problems associated with mmWave include three dimensional (3D) channel modeling, dynamic power control, user scheduling and congestion control, hardware limitation and the adaptive beam-steering technique, as described in [7]. The problem of high power consumption of a large number of antennas in an array [7], high efficiency low complexity adaptive antenna array processing algorithms [29] and innovative hardware architecture of large-scale antenna transmitters [29] still remain unsolved. A proposal of design guidelines in architectures and protocols for mmWave communications is presented in [42]. It is demonstrated that new mmWave technologies, which are under investigation for 5G communications systems, will be able to provide indoor centimeter (cm)-accuracy localization in a robust manner, ideally suited for Assisted Living (AL) [228].

Heterogeneous multi-radio access technologies (multi-RAT) integration is specific to 5G networks radio design that coexists with existing networks. Since 5G networks will not be developed to replace current wireless networks, but rather to advance and integrate existing network infrastructures with new ones [217], we refer to 5G as a heterogeneous network. Multi-RAT is defined as the capability of a mobile network to support multiple radio access technology with seamless interworking among them [229]. When deployed in heterogeneous networks (HetNets), with traffic offloading among different RATs, multi-RAT improves capacity [230], supports better communication rates [34,117–119,231,232], better energy efficiency [34,117–119,231,232], and ensures seamless connectivity with higher QoS [230]. In designing a heterogeneous RAT, researches are finding solutions for cell-association and traffic-offloading algorithms [217].

Cognitive radio with spectrum sharing is a new software defined technology, which is expected to improve the utilization of the congested radio frequency (RF) spectrum [43]. In 5G networks, it is used for designing multi-tier architectures, removing interference among cells, and minimizing energy consumption in the network [44–47,120,233]. Moreover, a spectrum sharing technique can be used along with the CR technology to integrate the 5G spectrum [48,121]. During the practical implementation of the CR and spectrum sensing (SS) technique researchers had to design cooperative frameworks, choose cooperative secondary users and transmit cooperative information during the spectrum sensing, further developing the framework and algorithms for the group handoff of secondary users and enhancing security [29]. Researchers are already working on designs of protocols for different IoT application, based on cognitive radio, and some of them are presented in [49–51,122]. Technologies in this group are used together to optimize 5G performance requirements (e.g., a prototype of mmWave integrated HetNet in [123] and HetNet that incorporates massive multiple-input and multiple-output (mMIMO) and mmWave technologies [217]).

5.2. Advanced Modulation and Coding

This technological group involves advanced modulation (i.e., frequency and quadrature amplitude modulation (FQAM)) and advanced channel coding schemes.

Advanced modulation schemes group includes FQAM, Amplitude and Phase Shift Keying (APSK), Unitary Space-Time Modulation (USTM), Spatial Modulation (SM), Wave Modulation

(WAM), and Orthogonal Time Frequency and Space (OTFS). The FQAM is a combination of frequency shift keying (FSK) and quadrature shift keying (QAM) [124–126]. This modulation can achieve a higher transmission rate for cell edge users reducing interference at cell edge [52,234–236]. FQAM also improves energy efficiency, which makes it adequate for MTC devices with stringent energy consumption requirements [124]. Due to performance advantages in terms of Frame Error Rate (FER) [53,236], FQAM is an ideal candidate for services with high coverage and reliability requirements [237]. APSK is another modulation which draws a lot of attention. It is shown that its main performance gain (i.e., to achieve a channel capacity very close to Shannon's) relies on advanced channel coding and demodulation algorithms [237]. This adds more complexity at the APSK transmitter and receiver. Another modulation, which does not need Channel State Information (CSI) to enable high throughput, is called USTM [237]. USTM and its extension (see [238]) is very useful for 5G services with high mobility [127] or latency and reliability constraints [239]. Other modulation schemes involve SM [128], and proprietary WAM and OTFS [237]. On the basis of the foregoing, researches have analyzed and compared many modulation forms, but still have not found a practical guide on how to choose modulation in any of the 5G use cases.

Advanced channel coding techniques are used for correcting the communication errors caused by noise, interference, and poor signal strength [129]. Authors in [54,129,130] compared turbo, low density parity check (LDPC) and polar codes in decoders in contrast to 5G requirements: (1) maturity; (2) throughput and latency; (3) error correction capability; (4) flexibility; (5) computation complexity; (6) interconnect complexity; (7) high-performance flexible implementation complexity; and (8) backward compatibility. This comparison showed that turbo codes hold the greatest promise for offering high performance throughputs, latencies and error correction capabilities, as well as high degrees of flexibility at the lowest implementation complexity [129] in most 5G use cases. However, further work is needed to implement a decoder based on this code followed by detail analysis.

5.3. Duplexing

This technological group includes in-band full duplexing (FD) and dynamic time division duplexing (TDD).

In-band FD or simultaneous data transmission and reception will provide a 1000-fold increase in throughput [131,240], double spectral efficiency [132,240], and reduce the air interface delay [240]. The central research problem for the practical implementation of an in-band full-duplex radio is the attenuation of the self-interference signal by an adequate amount [132]. For the practical implementation of an in-band full-duplex radio, many aspects of network design and management need to be restructured, where terminals antenna and circuit design and the development of theoretical foundation are in focus [55]. One practical implementation of the full-duplex radio is shown in [133]. Authors in [134] commented that for the design of a full-duplex radio, it is necessary to unify researches from three domains, i.e., RF circuit and system design, digital signal processing and networking.

Dynamic TDD is the predecessor of FD transmission technology and a candidate for 5G [133,135]. It represents a scheduling technique in which every base station (BS) is free to choose its own uplink/downlink (UL/DL) split [136–139]. This technique is used to adapt the allocation of network resources to variable traffic requirements [139,140], often found in ultra-densely deployed networks [141]. The dynamic TDD can significantly increase bandwidth efficiency [142] and provide higher throughput and low latency [141]. However, it is characterized by the severe co-channel interference (CCI) [141–143]. Dynamic TDD could be used in combination with D2D communication and in the self-backhauling scenario, as described in [55].

5.4. Multiple Access and Waveforms

Multiple access techniques are becoming an important technology in 5G because of their ability to support mMTC activity-based IoT classes with urgent deploy demand [144]. They include several non-orthogonal multiple access (NOMA) forms: multi-user shared multiple access (MUSA) [145–148],

resource spread multiple access (RSMA) [149], sparse code multiple access (SCMA) [150–152], pattern division multiple access (PDMA) [153–155], interleave-division multiple access (IDMA) [156,157], and NOMA by power domain [158]. The NOMA is a radio access technology design for enabling greater spectrum efficiency [56,159–162,207], higher cell-edge throughput, relaxed channel feedback, and low transmission latency [99]. NOMA can be employed to enhance user fairness and to support massive connections with diverse QoS requirements [163]. In NOMA, there are several challenges and open issues, such as dynamic user pairing, the impact of transmission distortion, the impact of interference, resource allocation, NOMA with multiple antennas, heterogeneous networks, outage probability analysis, practical channel model, uniform fairness, NOMA with antenna selection, carrier aggregation and other challenges as discussed in [216]. There are still many challenging issues for SCMA, which need to be solved in future work. For example, there are several open issues in SCMA transceiver design [57], the optimization of algorithms for user grouping and power allocation [164], and further enhancement of the SCMA and MIMO combination.

New waveforms have become a serious candidate for 5G being studied in terms of: (1) modulation based on pulse shaping: filter bank multicarrier (FBMC) [58], generalized frequency division multiplexing (GFDM) [59], pulse shaped OFDM [165] and QAM-FBMC [241]; (2) modulation based on sub-band filtering: universal filtered multi carrier (UFMC) [242], filtered OFDM (f-OFDM) [243] and resource block f-OFDM (RB-f-OFDM) [244]; other modulation format: guard interval discrete Fourier transform spread OFDM (GI DFT-s-OFDM) [245], spectrally-precoded OFDM (SP-OFDM) [246] and orthogonal time frequency and space (OTFS) [247]. The f-OFDM is seen as a potential candidate for IoT applications [60]. Due to narrow sub-bands and thereby pure detection performance, additional processing is needed [60]. Performance of self-interference cancellation (SIC) or filtering on f-OFDMA [60] remains a topic for further study. Additionally, it is interesting to consider the balance of time and frequency dispersion in UFMC, as well as the design of an efficient prototype filter according to application scenarios [60].

5.5. Advanced Interface Management

This technological group includes receiver advances in terms of simultaneous non-unique decoding (SND) and sliding-window superposition coding (SWSC).

SND follows a rule that implies that each receiver attempts to recover the code words from intended and interfering senders [248]. The combination of advanced receivers and joint scheduling provides an improvement of over 50% in cell edge throughput without sacrificing the cell average throughput [5]. This gain demonstrates that if 5G networks incorporate advanced interference management, they will provide a virtually edgeless end-user experience [5].

SWSC [61,62] combines the theory concept from superposition coding without rate splitting [63], block Markov coding [166,167], successive cancellation decoding [63,64,168], and sliding-window decoding [65,169,249]. The sliding-window coded modulation (SWCM) aims to mitigate inter cell interference at the physical layer by achieving simultaneous decoding performance with point-to-point channel codes, low-complexity decoding, and minimal coordination overhead [170]. The realization of the theoretical concept to the practical transmission coding scheme is an important research direction in SWSC [5].

5.6. Access Architecture Related Radio Technology

This technological group includes ultra-densification, enhanced wireless backhaul, moving networks, and D2D communication.

Advanced small cell [66,123] deployment is considered to be one of the key enablers for achieving many of the requirements currently envisioned for 5G [67], with higher data rates [68,171,250] and more capacity [171–174], as most important. Higher data rates and smaller battery consumption can be achieved using short distances in the small cell [69]. Solving the capacity and data rate challenge with network densification could be very expensive in terms of equipment, maintenance,

and operations [200]. With denser cell deployment come significant challenges in the design of a high-performance backhauling system for RAN and the impact of backhaul on radio resource management (RRM) [70]. However, there are in existence many interesting topics to be further investigated which can be grouped around several problem areas [34]: user association, backhauling, interference management, energy efficiency, and propagation modelling.

Moving networks (MN) are the combination of multi-hop and vehicular communications concepts [69,71]. The MN deploys one or several moving relay node(s) (MRNs) [175,176,251] on vehicles that form their own cell(s) inside the vehicle to serve vehicular users [72]. Challenges in using MRN are efficient backhauling, design of efficient resource allocation and interference management techniques, as well as mobility management schemes to exploit the benefit of group handovers for vehicular user equipment (UE) devices served by the same MRN [72]. The main research challenges related to MN concept are associated with complexity management due to the mobility of access points and providing a high-rate wireless backhaul link from the moving cell to the fixed network [69].

Enhanced wireless backhaul is one of the main challenges in hyper-dense 5G networks [34,217]. The performance of wireless backhaul is dictated by the environment and traffic profile of the intended use case [9]. In UDN except mmWave, new approaches are needed, e.g., interface aware routing and intelligent resource allocation [9], as these links may occupy part of the spectrum used in the access network [73]. Latency and reliability of this link are important issues to be considered being prone to blocking and fading [69]. In any case, further research is necessary to explore TDD multi-flow coordination schemes to avoid bottlenecks in the downlink backhaul [9]. The guidelines for deploying future 5G wireless backhaul networks in economical and highly energy-efficient ways are provided in [74].

D2D communication is defined as a direct route of data traffic between spatially closely located mobile UE [75,177,178]. The advantages of D2D communication compared with the traditional cellular method include the reduction of transmission latency [73,75] and power consumption [75], improvements in coverage [71,76,179], spectral and energy efficiency [77], and throughput, when power control and resource allocation methods are used [78]. The use of D2D communications has an overall positive impact on system capacity in cellular environments. D2D communication brings challenges and complexities related to interference management [79,80], QoS requirements [79], and resource allocation [34,215]. The design of D2D direct communication link is still a hot topic [29].

5.7. Energy Related Technologies

IoT applications span a broad range of domains including home automation, healthcare, surveillance, transportation, smart environments, etc. One of the most important obstacles for implementing such an impressive scheme is supplying adequate energy to operate the network in a self-sufficient way without compromising QoS [180]. Since energy efficiency is of most importance to battery constrained IoT devices, researches have focused their work on the development of the device energy saving mechanisms.

Energy harvesting is a new paradigm which uses solar, thermal, wind and kinetic energy sources to power sensor nodes and consequently prolong network lifetime [181]. Among different energy harvesting methods, wireless energy harvesting (WEH) has proven to be one of the most promising solution for energy aware IoT devices, because of its simplicity, ease of implementation, and availability [180]. This concept will improve some of the 5G high network communication requirements, like reliability of IoT communications, as presented in [182]. Authors in [252] have shown that the integration of social awareness and energy harvesting in D2D communication results in higher system capacity. Network architectures proposed in [100,253] have shown better energy efficiency in 5G wireless network. Researchers could work on improving this architecture and integration with various 5G technologies in the future.

UAV implies a flying vehicle without the driving presence of a human pilot to control it on-board [113]. Drones are a possible example of UAVs, although many other robotics related

applications could be part of this application group [113]. UAVs can play a vital role in IoT scenarios where devices are unable to transmit over a long distance due to their energy constraints. In this case UAVs play the role of moving aggregators which fly toward one IoT devices, collect the data, and transmit it to other devices [81]. In [183] authors presented UAV–based floating relay (FR) for cell dynamic and coverage improvement. Deployment of unmanned aerial base stations in 5G heterogeneous architecture can improve throughput [254], coverage [183–185,254], connectivity [184,185], and 5th percentile spectral efficiency [254]. On-demand wireless systems with low-altitude UAVs are in faster to deploy, more flexibly reconfigured, and likely to have better communication channels due to the presence of short-range line-of-sight links [186] when compared to terrestrial communications or those based on high-altitude platforms. The utilization of highly mobile and energy-constrained UAVs for wireless communication introduces many new challenges [186], some of them are listed in [82]. To effectively use UAVs for IoT, several challenges must be addressed such as optimal deployment, mobility and energy-efficient use of UAVs [81].

5.8. Other Technologies

Along with the aforementioned technologies, a lot of research attention is devoted to technologies, such as mMIMO, visible light communication (VLC), SIC, vehicle-to-everything (V2X), etc.

mMIMO technology [73,123] promises significant gains in data rate and link reliability [187], reduces latency and energy [13], simplifies media access control (MAC) layer [13], shows robustness against intentional jamming [13], unintended man-made interface [83], and increases capacity [127,198] due to spatial multiplexing [123]. Reliable links are provided by benefiting from spatial diversity and the mitigating effects of fast fading, beamforming, and zero forcing caused by multi-user interference [203]. The mMIMO can be exploited to extend the coverage of higher frequency bands by relying on beamforming gains [200]. Other specific benefits of mMIMO system are: increased capacity 10 times or more with simultaneous improvement in radiated energy efficiency in the order of 100 times, the possibility to use inexpensive, low-power components, the reduction of latency on the air interface, and multiple access layer simplification [83]. The low complexity mMIMO uplink scheme for IoT lightweight devices is presented in [188]. The performance of practical mMIMO system needs to be investigated, since the research community pays attention to analyzing the performance of mMIMO in an ideal channel state information assumption [73].

VLC is a growing technology for short range, high capacity LOS optical links [189]. It uses a visible range of the electromagnetic spectrum (370–780 nm) which provides data transmission and room illumination using light emitting diodes (LEDs). Prominent features of VLC are an abundant license-free spectrum, the ability to provide multiple gigabit-per-second data rates, low energy consumption, and low implementation costs [190]. VLC is sensitive to sunlight and is not able to work long range without LOS. Since VLC coverage is LOS limited [84,191], this is known as LOS blocking [192]. With poor performance in non-line-of-sight scenarios, VLC networks fail to provide convenient UL coverage at the current state-of-the-art, and each AP illuminates only a small confined cell compared to cellular RF networks [192]. VLC applications are expected to include IoT, wireless Internet access, and vehicle-to-vehicle (V2V) communications, broadcast from LED, M2M communications, positioning systems, and navigation. The problem of how to provide mobile applications over VLC is still quite an open one [189].

SIC implementation enables low-latency applications in a cost effective manner [132]. SIC can be used to increase link capacity, spectrum virtualization, any-division duplexing, novel relay solutions, and enhanced interface coordination [132]. Practical SIC implementation is still in the investigation phase.

V2X is the communication between a vehicle and everything with which it might interact (e.g., other vehicles, traffic operators and service providers). It is used in conjunction with D2D for coverage extension and latency reduction in 5G networks [255]. V2X communication might play a vital role in terms of implementing smart and efficient traffic solutions [193], improving road safety, traffic efficiency,

and driver convenience. To reduce traffic congestion one may use an intelligent route management system based on V2X communication [7]. Since it has big potential in autonomous driving application, the localization of vehicles in dense urban areas is difficult, so several algorithms are proposed to solve the problems [194]. Many V2X applications are described in existing literature [85,195]. However, there is still a need to design vehicular mobility management strategies in next UDN networks and to find a way to enhance existing connected vehicle services with V2X [86].

These technologies are highlighted as the main 5G driver in existing literature [5–7,96,207]. Authors compare these technologies and try to implement them through prototypes, or test the combination of these technologies. However, other technologies exist, such as cloud-RAN [7], Coordinated Multi-Point (CoMP), White Space Spectrum [208], which are not in the scope of this paper.

5.9. Summary of IoT in Enabling Technologies

Performance requirements of activity-based IoT application classes have served to identify the enabling technologies in the radio access part of 5G networks, which are summarized in Table 5. Various 5G enabling technologies have been sorted into eight technological groups:

1. Wide and flexible bandwidth technology: mmWave band communication and large-scale antennas, heterogeneous multi-RAT integration, cognitive radio, and spectrum sharing;
2. Advanced modulation and coding: advanced modulation schemes, advanced channel coding;
3. Duplexing: in-band FD, dynamic TDD;
4. Multiple access and waveform: multiple access, new waveforms;
5. Advanced interface management: SND, SWSC;
6. Access architecture related radio technologies: advanced small cell, MN, enhanced wireless backhaul, D2D;
7. Energy related technologies: energy harvesting, UAV;
8. Other technologies: mMIMO, VLC, SIC, V2X.

These technologies have been discussed in terms of their possibilities to meet performance requirements of activity-based IoT application classes and identify research gaps and directions, which are summarized in Table 6.

We have highlighted technologies only used to satisfy high priority performance requirements of mMTC activity-based IoT application classes, i.e., connection density, positioning accuracy, and coverage. We have focused on these technologies from telco's perspective, since the area of mMTC activity-based IoT classes is more mature, as its development has already started within LTE, while uMTC poses new research questions to be answered in order to achieve unprecedented levels of reliability needed for new applications in 5G.

The new waveform technology may be used to fulfil the requirements of almost every activity-based IoT application class in terms of connection density. This technology affects the connection density by definition. Analysis of different modulation formats indicates that f-OFDM is the most suitable candidate for IoT applications with high connection density requirements. In this regard, a deeper and more comprehensive analysis of f-OFDM is needed in the context of different mMTC activities (i.e., ticketing, tracking, monitoring, and managing/controlling). The result of the analysis to be performed should be the discovery of an optimal waveform for each activity-based IoT class which has to be integrated with other 5G service classes.

Large scale antennas and advanced small cell technologies can be used to satisfy the requirements of ticketing-, tracking-, and uMTC managing/controlling-based IoT application classes in terms of positioning accuracy. Fulfilling these performance requirements is rather a business than a technical decision. The size of the 5G cell must be planned to meet the desired position accuracy since it is very important for future IoT applications, such as automated driving, remote surgery, robotics, taxis, etc.

Wide and flexible bandwidth technologies, in-band full duplex technologies, access architecture related radio technologies, and mMIMO can be used to achieve the high requirements of ticketing-,

tracking-, and monitoring-based IoT application classes in terms of coverage. The combination of these technologies should be tested to find the optimal solution to meet these performance requirements. Since small cell deployment has an impact on required position accuracy, they should serve as a basis for achieving the desired level of coverage. Along with small cell deployment, mMIMO and mmWave technologies are present in almost every 5G prototype.

Since this section discusses radio technologies used to accomplish performance requirements of mMTC activity-based IoT application classes, it can serve telecom operators and other interested parties depending on their interest and potential to utilize these findings towards IoT implementation and monetization. It describes each technology in terms of definition, advantages, disadvantages, and the possible impact on the performance requirements of a broad range of IoT applications that drive the deployment of 5G networks. Moreover, this section can be useful to the research community interested in this attractive field to address recognized research gaps and directions.

6. Discussion

Telecom operators have the opportunity to capture a share of the revenue that is generated by IoT implementation depending on their role in the IoT value chain. Regardless of their role, telcos have to face many technical challenges in order to meet the changing connectivity and performance requirements. Since current cellular networks limit numerous IoT applications, new technologies are being introduced leading towards 5G networks. Therefore, telcos have to focus on deploying these network technologies in order meet the changing requirements necessary to achieve success in IoT.

In this regard, writing this paper was motivated by the challenge of providing an enhanced understanding of the scope and classification of the broad range of IoT applications in order to determine and prioritize their performance requirements with the goal of specifying the enabling technologies towards 5G networks. The aim has been to propose a new classification of IoT applications, define and prioritize the performance requirements of such IoT application classes, and give insight into state-of-the-art technologies used to meet these requirements from telco's point of view. The motivation that led to the focus of this paper being on IoT applications classification, performance requirements, and 5G enabling technologies could be explained by telco's need for added value from IoT services. Hence, an analysis of IoT customer service requests inspired us to propose an activity-based classification of IoT applications as it can, according to authors' best knowledge, has allowed telcos to more precisely specify their performance requirements and 5G enabling technologies, thereby improving customer experience.

In this regard, the paper fulfilled the following four objectives: (1) the identification of activities relevant to IoT applications and their usage as a new criterion for IoT application classification; (2) the specification and prioritization of performance requirements of such IoT applications classes; (3) the analysis of the radio technologies used to accomplish IoT application requirements; and (4) the identification of the research gaps and the recommendation of new research directions.

Through fulfilling these objectives, we reviewed literature from the fields of IoT in 5G service classifications, IoT in 5G performance requirements, and IoT in 5G enabling technologies. Since the first aim of this paper was to propose a new classification of IoT applications, the existing approaches have been summarized to serve as a basis to identify their drawbacks and formulate the appropriate solution to overcome them. In this context, we proposed a new approach to IoT applications classification, which was based on the activity as a new classification criterion denoting the main function/purpose of specific IoT application. This approach enabled a clearer and more precise positioning of particular application in the IoT application spectrum, as well as the determination of performance requirements and enabling technologies from telco's point of view. The activity-based IoT application classification facilitated the specification of the performance requirements and determination of technologies which enable these requirements to be fulfilled. In this context, the proposed approach served as a basis for the simplification of the realization of particular IoT application. For example, although the monitoring- and tracking-based applications seem to be similar, they set different performance requirements on the

network, thereby allowing the proposed approach to precisely grade the IoT applications from the same IoT application domain.

Furthermore, we associated the activity-based IoT application classes with the 5G service classes, i.e., mMTC and uMTC, in order to specify and prioritize their performance requirements. It was determined that almost each activity-based IoT application class poses high requirements in terms of connection density, whereas ticketing-based and tracking-based IoT application classes additionally require high positioning accuracy and coverage. In order to analyze these performance requirements, we have summarized the radio technologies used to implement the future 5G networks. The focus was on the technologies used to meet the aforementioned performance requirements of mMTC activity-based IoT application classes, since mMTC is more mature, as its deployment has already started, while uMTC requires further research to achieve incomparable levels of reliability needed to enable new applications in 5G.

The analysis showed that new waveform technology can be used to meet the requirements in terms of connection density; large-scale antennas and advanced small cell technologies can be used for the purpose of satisfying the requirements in terms of positioning accuracy; while wide and flexible bandwidth technologies, in-band full duplexing technologies, and access architecture related radio technologies (i.e., advanced small cell, enhanced wireless backhaul, moving network, and D2D communication) can be used to achieve high requirements in terms of coverage. In addition, the conducted research study allowed us to highlight a number of open research issues that could serve the research community and other stakeholders interested in this contemporary and attractive field. In this context, we have recognized research gaps and directions which mostly relate to network redesign and optimization in order to accommodate large-scale IoT applications.

7. Conclusions

The IoT paradigm has the potential to revolutionize all areas of daily life of individuals, businesses, and society as a whole. Telcos enjoy a central role in the paradigm of IoT because of owing communication infrastructure which is exposed to the numerous technical challenges due to changing connectivity and performance requirements of various IoT applications. These requirements cannot be met with the current cellular networks which create the need to introduce new types of technologies leading toward 5G networks as the main driver for enabling numerous IoT applications. In this context, this paper proposed the activity-based classification of IoT applications and specification of their performance requirements in order to identify 5G radio technologies used to meet them, all from telco's perspective. Activity-based classification of IoT applications indirectly allowed the construction and distribution of performance, as IoT value proposition, while using 5G enabling technologies, as IoT resources in telco's internal value chain. In this context, high performance requirements of each activity-based IoT application class (i.e., connection density, positioning accuracy, coverage) served as a basis to analyze various enabling technologies in radio access part of 5G network in terms of advantages, disadvantages, and research gaps.

On the basis of the conducted analysis, we concluded that the following technologies can meet the high performance requirements of mMTC activity-based IoT application classes: new waveform technology (in terms of connection density), large scale antennas (in terms of positioning accuracy), wide and flexible bandwidth technologies, in-band full duplexing technologies, and access architecture related radio technologies (in terms of coverage). According to the identified research gaps, one may conclude that the optimal solutions for each technology are still in its infancy. This implies that any 5G enabling technology should be first implemented and tested through prototype construction before the deployment of specific IoT application. Thereafter, the technology combination that meets the performance requirements of each activity-based IoT class should first be found. Finally, the practical implementation of different technological combinations may further lead to a deep and comprehensive analysis of QoS and QoE in the context of IoT applications.

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5G VISION

DMC R&D Center, Samsung Electronics Co., Ltd.

Date : February 2015

Samsung envisions the fifth Generation (5G) mobile communication era to be the beginning of a full scale Internet of Things (IoT). Billions of connected devices autonomously interconnect with one another while ensuring personal privacy. The unprecedented latencies offered by 5G Networks will enable users to indulge in gigabit speed immersive services regardless of geographical and time dependent factors. This white paper introduces you to future services, key requirements, and enabling technologies that will herald in the 5G era that is expected to revolutionize the way we experience mobile services.

Dawn of the 5G Era

Fuelled by the unprecedented growth in the number of connected devices and mobile data, and the ever-fast approaching limits of the 4G technologies to address this enormous data demand, industry efforts and investments to define, develop and deliver the systems and specifications for the fifth-Generation (5G) mobile system and services are well under way - signaling the dawn of the 5G Era.

As shown in Figure 1, the number of connected Internet of Things (IoT) is estimated to reach 50 Billion by 2020 [1], while the mobile data traffic is expected to grow to 24.3 Exabytes per month by 2019 [2].

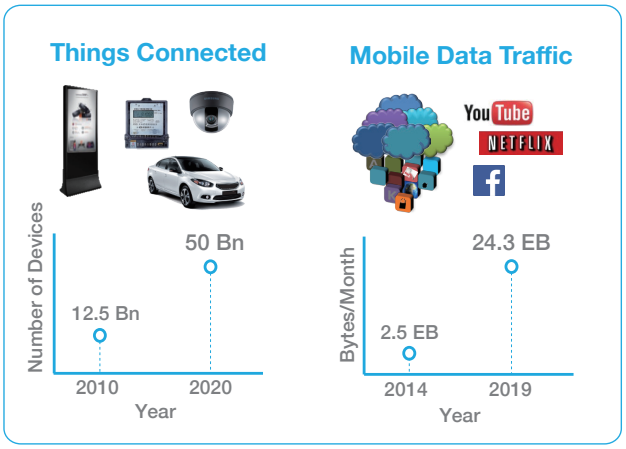

Figure 1 Growth in Mobile Traffic and Connected Devices

Add to it, the impact of higher cell capacity and end-user data rate requirements due to emerging new services such as Ultra-High-Definition (UHD) multimedia streaming and extremely low latency requirements for cloud computing and storage/retrieval, and it soon becomes evident that the current 4G systems, which are already stretched to near-breaking points (despite massive Wi-Fi offload), will be stretched too thin to deliver the quality of experience (QoE) necessary to support mobile experience that 5G is set to deliver.

5G Era can be expected to revolutionize the way we communicate by supporting immersive applications that demand exceptionally high-speed wireless connections, a fully-realized IoT, experience lower latency and promote both spectrum and energy efficiency. To realize these benefits, 5G systems will differ fundamentally from their predecessors fueling a series of groundbreaking innovations. Let's look at the services and the requirements that 5G is expected to address.

5G Service Vision

5G services have the potential to revolutionize the mobile experience. Here's how:

Internet of Things

5G will make the "Internet of Things" a reality. With 5G technology, a device will be able to maintain network connectivity regardless of time and location, and open the possibility to connect all the connected devices without human intervention. For this, the basic fabric of the 5G system design is expected to provide support for up to a million simultaneous connections per square kilometer, enabling a variety of machine-to-machine services including wireless metering, mobile payments, smart grid and critical infrastructure monitoring, connected home, smart transportation, and telemedicine. Intelligent devices will communicate with each other autonomously in the background and share information freely. This ubiquitous connectivity - a basic tenet of the 5G services, will truly enable IoT services which in turn is expected to profoundly change human lives by connecting virtually everything.

– Smart Home

Dishwashers will fix themselves using information from peers of the same model while home appliances at home and in the neighboring homes may cooperate to extinguish a fire. A smart refrigerator, recommending a recipe of cuisine to be cooked with ingredients that are already in your refrigerator, is yet another plausible scenario.

– Fitness & Healthcare

Connected Health and Fitness related wearable devices such as The Samsung Gear™ Fit will record your athletic performance while you exercise and recommend the type of exercise, its duration and frequency per day. These connected healthcare devices will also send vital signs such as brainwave, blood pressure and heartbeat to an expert system in the hospital in real-time to prevent medical emergencies before they occur. Such time critical applications put unprecedented requirements on latency.

– Smart Store

In large shopping malls, while many people walk around window shopping, vicinity to products is continuously tracked, usually by a server somewhere in the cloud. Customized alerts for low priced product can be sent to the user's device as the user is detected in the vicinity of that low-priced product, or information of other lower prices in the nearby stores can be sent to the device as the customer spends more time in the vicinity of a certain product class.

Such a system can be tailored to deliver a highly customized experience thereby greatly enhancing a user's shopping experience. To support such a scenario, massive connectivity and low latency technologies are inevitable.

– Smart Office

In smart office environments, office appliances are connected with one another and will share information. Nearby computers and input/output devices can recognize a user and change the settings using the user's preferences stored in the IoT cloud. Printers will print out the relevant documents when the user passes by the printer. Almost all the office appliances will connect wirelessly, while exchanging massive data through wireless medium without noticeable delay. Alerts on the upcoming meetings, materials and documents relevant to that meeting will instantaneously become available to the user's device, while documents and tasks that are modified will be automatically updated.

– Connected Car

Many of us use navigation services via in-car navigation systems or our smart phones to find the most efficient route to our destination. Vehicle diagnostic services are becoming attractive to obtain the information such as battery level, fuel level or engine status on our smartphones. The 'eCall' system that automatically calls emergency services in case of an emergency exemplifies such a service. By 2020 and beyond, more attractive services that wirelessly connect 'cars' around us with 'things' will emerge and make people in the vehicles very comfortable, and provide an enjoyable driving experience. For safer driving, sensor and camera data in a vehicle as well as supplementary information from the neighboring vehicles will be collected using mobile networks so that a potential emergency situation can be reliably informed to a driver in real-time and timely steps can be taken to avoid an actual emergency situation. This operation will eventually be applied to self-driving cars, which can be viewed as an important type of 'things'.

Immersive Multimedia Experience

In a 5G environment, users will experience life-like multimedia streams anytime and anywhere. Users will feel as if they are part of the scene when they watch videos on their smart devices. To provide such an immersive experience, many obstacles will need to be overcome. Agility to instantaneously respond to the user's thought and behavior will be necessary. An upcoming service that is expected to provide life-like experience in 5G system is UHD video streaming with its greatly enhanced resolution and clarity. Currently, UHD services over terrestrial broadcast are already being standardized in some countries. In addition, some smart phones in the market are now equipped with a camera module

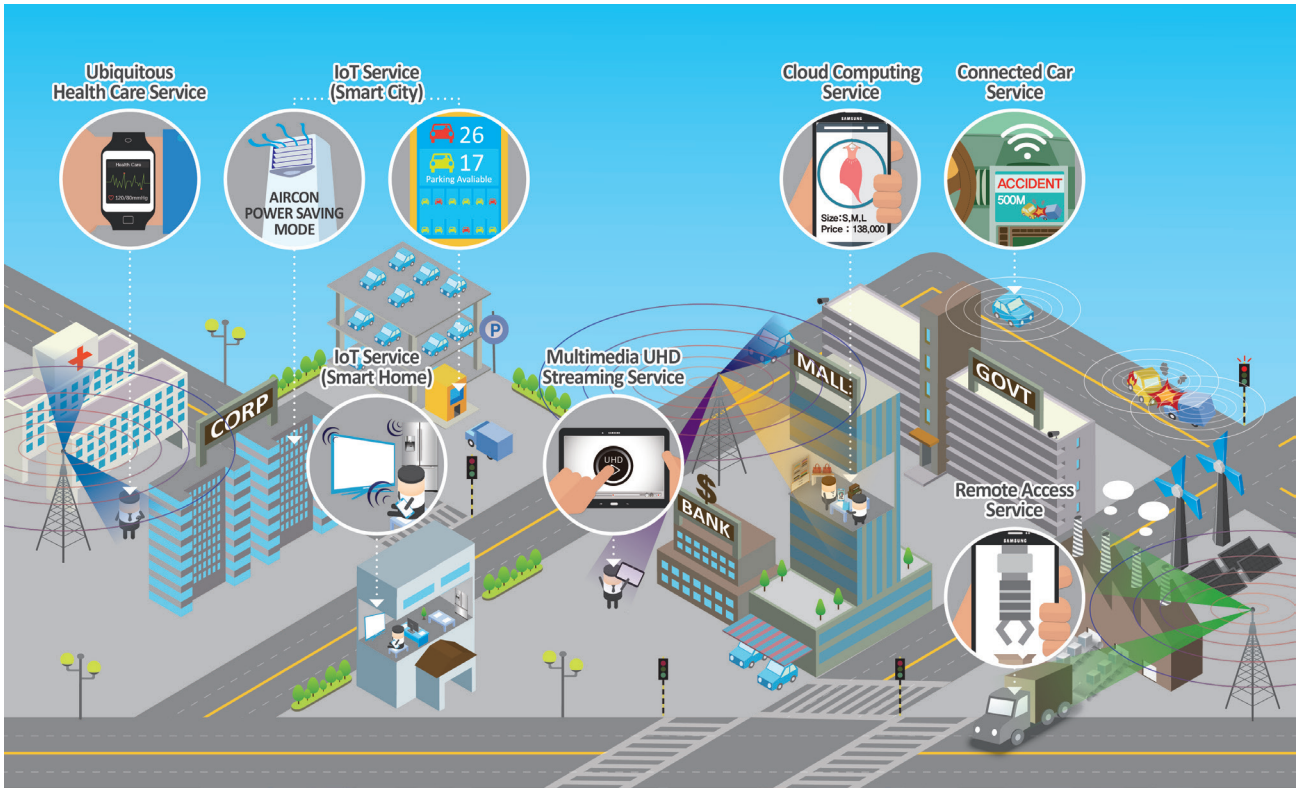

Figure 2 Major Service Scenarios with 5G

that can record video with 4K UHD quality. It is expected that UHD services are likely to go mainstream by 2020 raising an acute need for performance enhancement of cellular systems to support such services.

Other examples of "immersive" services that will fundamentally revolutionize entertainment, health, education, and other industry sectors are Virtual Reality (VR) and Augmented Reality (AR).

VR provides a world where physical presence is simulated by computer graphics, and the user can actively interact with the simulated elements, as in immersive sports broadcasting for instance (See Figure 3). Other interesting VR service scenarios are interactive 360° movies, online games, remote education, and virtual orchestra. Samsung's recently launched VR headset called (called Gear VR), virtual reality video service platform (called Milk VR) and 'Project Beyond,' (a 360° 3D camera with 17 Full HD (FHD) camera modules, optimal for generating contents for Milk VR) indicate the humble beginnings of the truly immersive experience that is to come in the 5G Era.

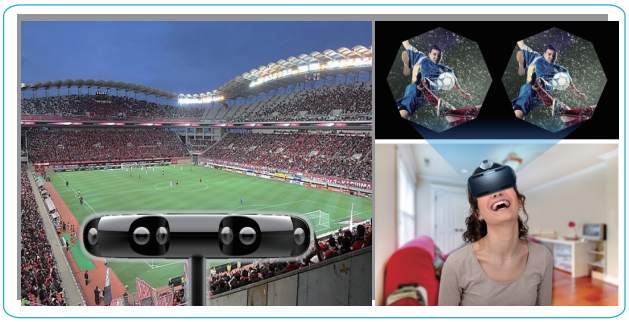

Figure 3 Watching Sport Events with VR

In an AR service scenario, computer-aided real-time information based on user context is graphically augmented to the display, delivering added value for the user. In the future the service desk attendant no longer needs to memorize the tiresome details of the products. Instead, AR services will help to inform the price, popularity, and details of a given product. Figure 4 illustrates another service scenario - AR navigation on windshield, where navigation information and other helpful notifications (refuel reminder and nearby shop location) are displayed on the windshield of a car, so that the user can continue to focus on driving while getting subtle context-aware notifications about potential services at the same time.

Samsung is actively involved in the development of 5G technologies to support these immersive VR and AR services, which will entertain users and provide a truly life-like experience on the move.

Figure 4 Driving a Car with AR Navigation

Everything on the Cloud

5G will provide users with a desktop-like experience based on cloud computing. With everything stored and processed on the cloud and immediately accessed with low latency, only simple input and output interfaces on mobile devices are needed, making them lighter, thinner, fancier, and more eco-friendly.

As an example, when you go shopping, the smart device can notify you about the arrival of new dresses that you might like, or let you know how well a dress in the newly incoming inventory matches with your liking based on your purchase history. This notification can be triggered, for instance, as you step into a shop, or take a picture of the dress, while the necessary computation to come up with the dress recommendation through crowd sourcing is done on a cloud server that is potentially half a world away.

Intuitive Remote Access

Users will be able to control remote machines and appliances as if they are right before them, even from thousands of miles away. Thanks to the reliable connections and near-zero latency of 5G, users will be able to control heavy industrial machines remotely, or access hazardous site remotely. It will also help mankind in exploring areas on the earth that are as yet unexplored, such as the Polar Regions or parts of the ocean floor.

5G Requirements

In order to realize such a demanding and unprecedented service vision, Samsung proposes the 5G rainbow requirements consisting of 7 Key Performance Indices (KPIs) as shown in Figure 5.

5G systems will be required to deliver an order of magnitude cell capacities and per-user data rate compared to its predecessors. Specially, 5G systems are expected to support data rates of 10-50 Gbps for low-mobility users. As a baseline, 5G sys-

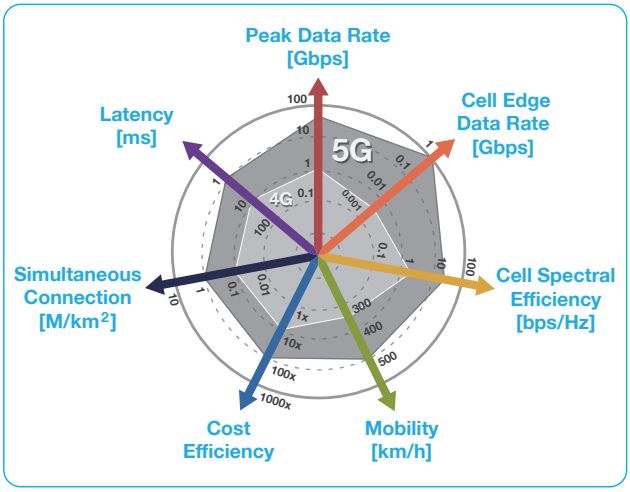

Figure 5 5G Rainbow Requirements

tems will provide gigabit-rate data services regardless of a user's location as shown in Figure 6 and Figure 7. To provide this uniform QoE, 5G network deployments are expected to be much denser compared to 4G networks, so making cost-effective deployment is a very important requisite.

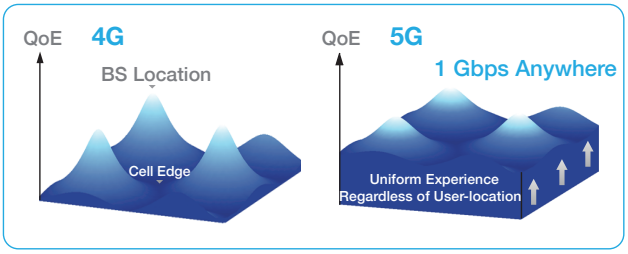

Figure 6 Edgeless RAN - 1 Gbps Anywhere

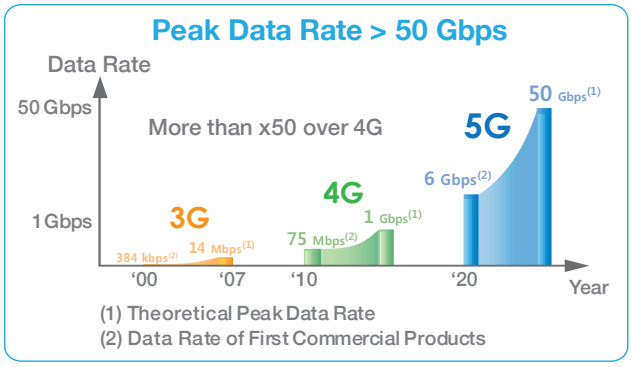

Figure 7 Data Rate Comparison of 5G with 3G and 4G

To fundamentally support the cloud storage/computing infrastructure of the future, 5G networks will deliver an end-to-end latency of less than 5 milliseconds and over-the-air latency of less than one millisecond (see Figure 8) - which is one-tenth compared to the latency of a 4G network. Critical infrastructure monitoring, for example, currently requires service levels achievable only on dedicated wireline networks while 5G technologies offer the promise of making these service levels achievable over wireless networks. Likewise, low-latency networks will allow pre-crash sensing, enabling vehicles to sense imminent collisions and exchange relevant data that could salvage the situation and/or mitigate adverse impact of the collision. Other challenging low-latency services that could be enabled by 5G could include self-driving cars, public safety communications systems, augmented reality, and "tactile internet" [3].

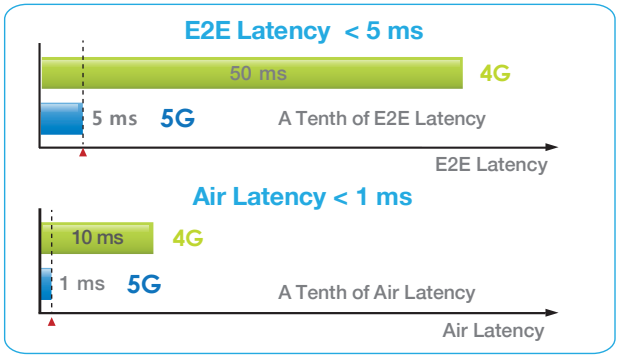

Figure 8 Ultra Low Latency of 5G

With spectral efficiency requirements set to 10 bps/Hz levels (in contrast to the 1-3 bps/Hz on 4G networks), 5G is also expected to deliver an efficient use of the spectrum by using MIMO, advanced coding and modulation schemes and new waveform design (more on this in the enabling technology section)

To address the ever-widening revenue gap that the operators and service providers are experiencing, 5G systems are targeted to be 50 times more efficient than 4G by delivering reduced cost and energy usage per bit. This sequentially requires low-cost network equipment, lower deployment costs, and enhanced power saving functionality on the network and user equipment sides.

5G technologies will be required to cope efficiently with all degrees of mobility by providing "mobility on demand" based on each device's and service's needs. On one hand, the mobility of user equipment should be guaranteed to be at least the same level as the current 4G system - that is the baseline. On the other hand, Samsung envisions that specialized 5G systems will support mobility at speeds ranging from 300 to 500 km/h.

To make the IoT Vision come true, the number of simultaneous connections in the 5G system is expected to be over 10^6 per unit square kilometer, which is much higher than that of the legacy system.

5G Key Enabling Technologies

Groundbreaking innovations will drive 5G technologies to meet the unprecedented speeds, near-wireline latencies, ubiquitous connectivity with uniform QoE, and the ability to connect massive amounts of devices with each other, all working in unison to provide the user with an immersive experience, even while the user is on the move. Future 5G systems will encompass fundamentally new designs to boost wireless capacity utilizing new frequency bands, advanced spectrum efficiency enhancement methods in the legacy band, and seamless integration of licensed and unlicensed bands.

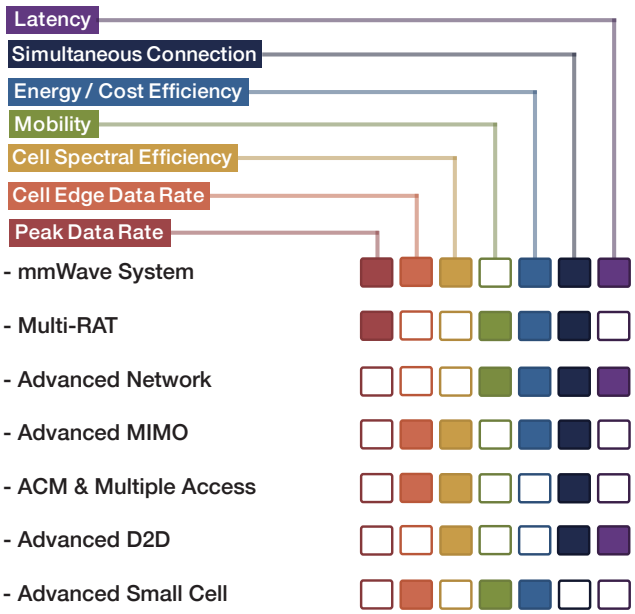

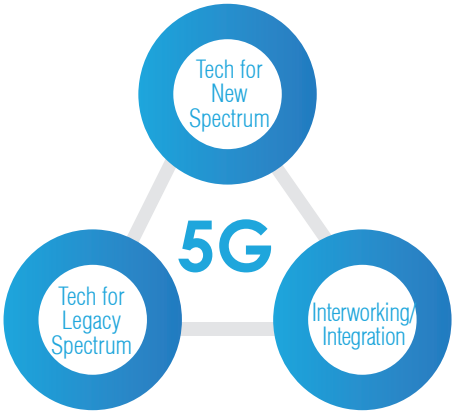

Figure 9 shows an overview of the 5G key enabling technologies. The massively higher capacity needs of the 5G systems will be addressed by new mmWave systems, high-density small cells, advanced Multiple-Input and Multiple-output (MIMO) and new multiple access schemes like Filter-Bank Multi-Carrier (FBMC). Adaptive Coding and Modulation like Frequency and Quadrature Amplitude Modulation (FQAM) can significantly improve the cell edge performance and combined with higher density deployments with multi-BS cooperation will help to deliver on the promise of "Gbps anywhere" and Uniform QoE. Multi-Radio Access Technology (Multi-RAT) integration including carrier

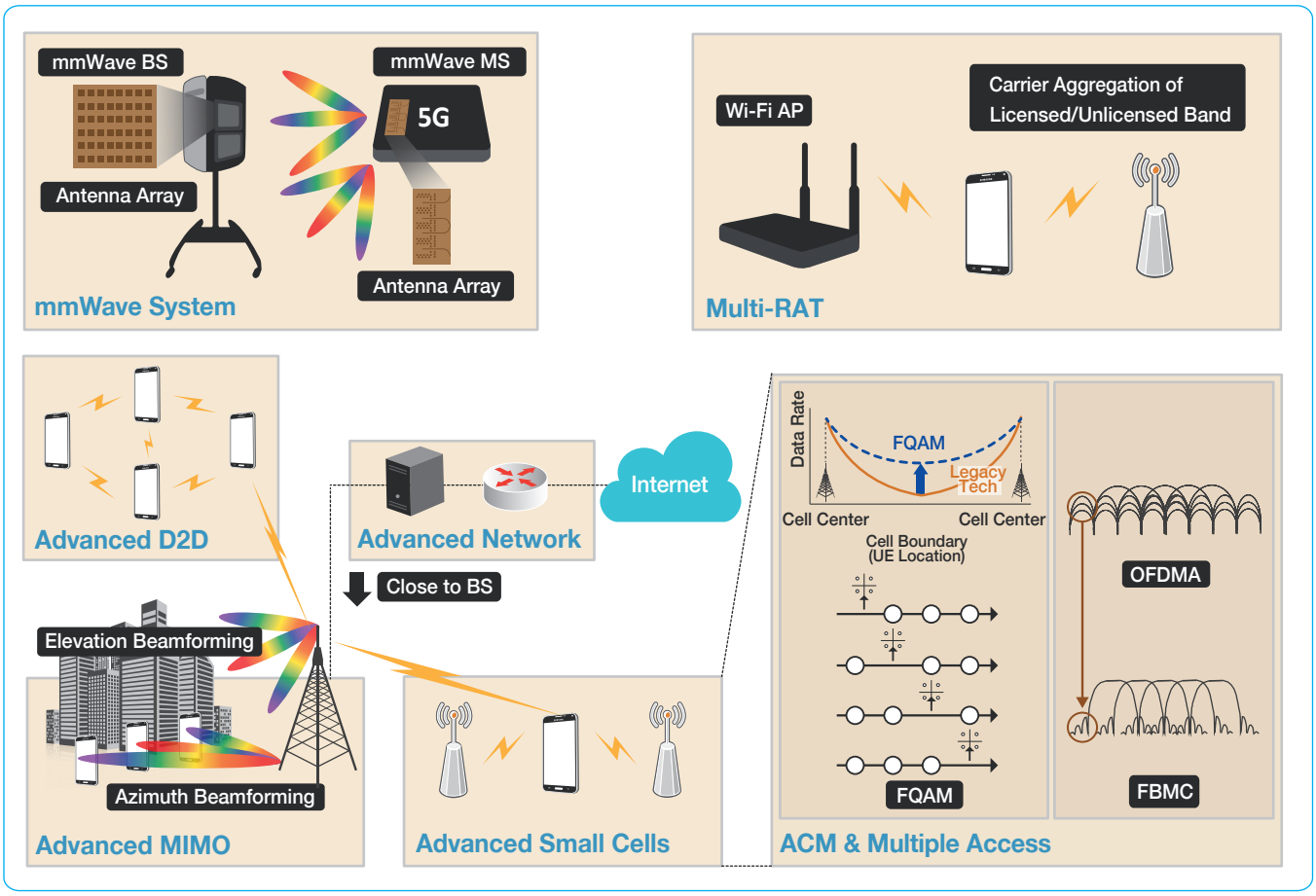

Figure 9 Overview of 5G Key Enabling Technologies

aggregation of licensed and unlicensed bands will inevitably help in increasing the available system bandwidth. On the network side, novel topologies including application servers placed closer to the network edge will contribute to significantly reducing the network latency. Advanced Device-to-Device (D2D) technology can help reduce the communications latency and support larger number of simultaneous connections in a network.

These 5G key enabling technologies are described in more detail in the following sections.

mmWave System

The mmWave bands provide 10 times more bandwidth than the 4G cellular-bands, as illustrated in Figure 10. Therefore, the mmWave bands can support the higher data rates required in future mobile broadband access networks.

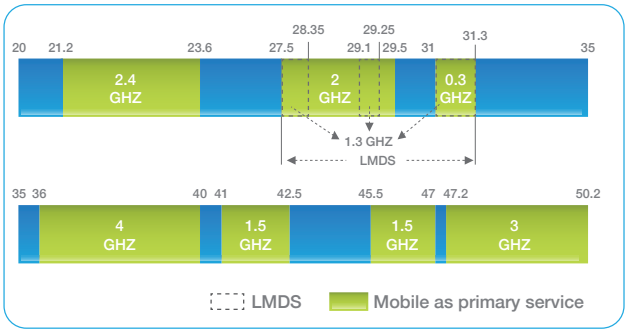

Figure 10 Potential Bands in 20-50 GHz (US)

Unlike the below 6GHz bands, in the mmWave bands we have to carefully consider the wireless conditions such as rainfalls, snowfalls, and fogs. However, the amount of loss is mild for the expected range of a 5G communication link. For example, atmospheric absorption loss due to H_2O and O_2 at 28 GHz would be around 0.02 dB at a distance of 200 meters. Intensive rainfall (110 mm/h) results in about 4 dB loss at 200 meters distance. Loss due to heavy snow (10 mm/h) or heavy fog (visibility distance under 50 meters) will be less than 0.1 dB, at all distance of 200 meters [4][5].

In Figure 11, we show mmWave channel measurements from extensive experiments in Daejeon, Korea [6][7]. These channel measurements were carried out at 28 GHz with a channel bandwidth of 250 MHz, transmission power of 29 dBm and the horn antenna gain of 24.5 dBi for both the transmitter and the receiver [6][7].

The path loss exponents (based on 8 meters distance free space path loss) is 3.53 in Non Line of Sight (NLoS) links [6]. The mild path loss exponent from measurement results strongly suggests that mmWave communication links can be supported

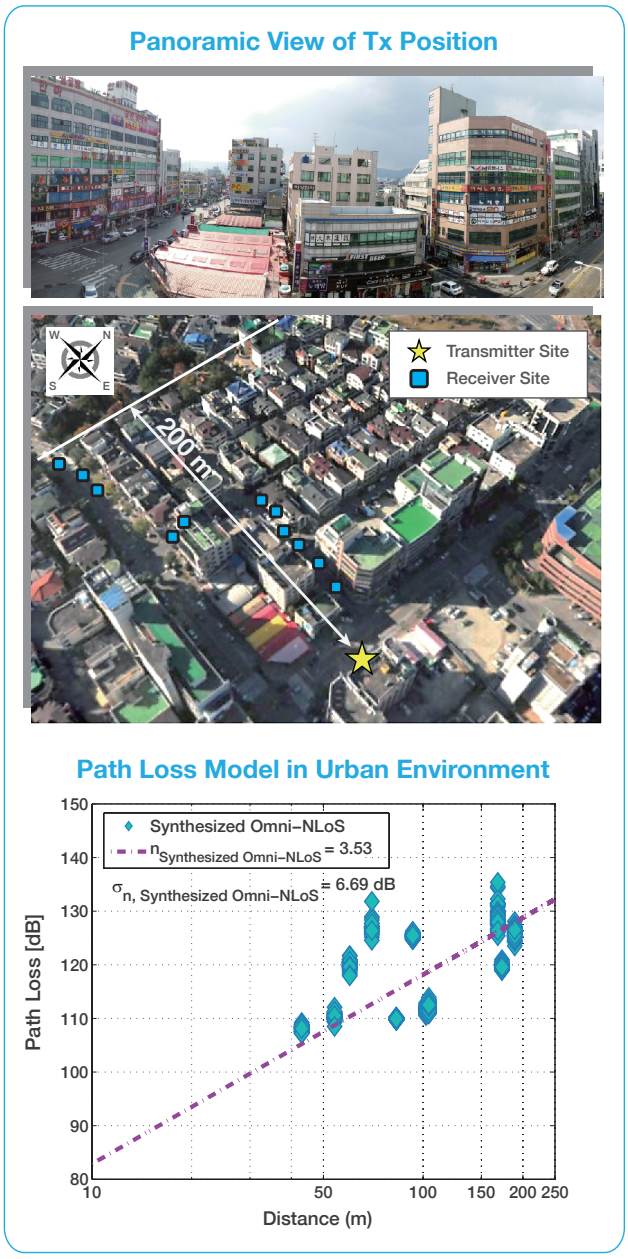

Figure 11 mmWave Channel Measurements in Urban Area, Daejeon (Korea)

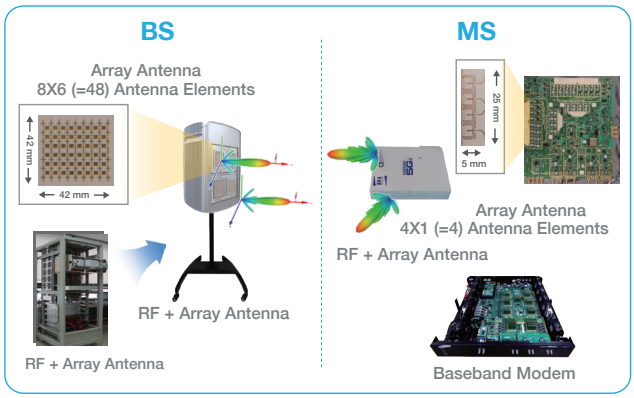

Figure 12 Adaptive Pencil Beamforming (Example)

over 200 meters of distance, even in dense urban outdoor NLoS environments. Similar results are also reported in ray-tracing-based mmWave propagation model [8], confirming the fact that mmWave

bands can be successfully utilized for future IMT systems. Moreover, based on the ray-tracing, mmWave 3D-channel model in urban scenario is proposed in [9]. Higher path-loss and the resulting fragile link is largely due to weak diffractions in the mmWave bands. We need to overcome these challenges in order to make outdoor mmWave communication a reality [10][11]. Fortunately, the small mmWave wavelength also means highly directional beamforms can be obtained using a large number of antenna elements in a smaller form factor. These adaptive directional beams with large antenna array gain are key in combating the large propagation loss in the mmWave [12][13][14][15], as illustrated in Figure 12.

We have developed a mmWave beamforming prototype at the DMC R&D Center, Samsung Electronics, Korea, in order to demonstrate the feasibility of using mmWave bands for cellular services. We showed that mmWave system can meet the two key requirements of cellular services: sufficiently large geographical coverage and support for mobility in NLoS environments.

With the prototype, we tested outdoor coverage to demonstrate the service availability in a typical outdoor environment for both LoS and NLoS sites. The tests were performed at sites surrounded by tall buildings where various channel propagation effects such as reflection, diffraction, and penetration were present, as shown in Figure 13. We observed that reliable communication links are formed even for NLoS sites that are more than 200 meters away from the base station.

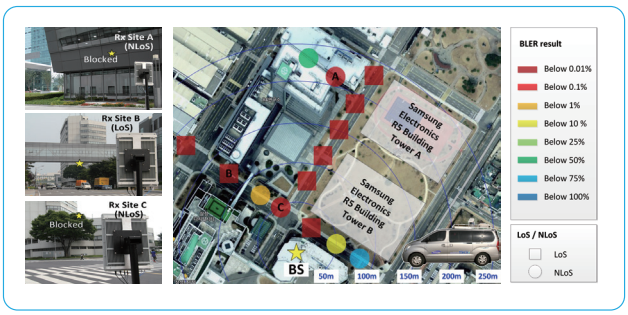

Figure 13 Exemplary Outdoor Coverage Test Results

Advances in semiconductor technology have made commercial mmWave systems readily available. Recent technologies of Silicon-based Complementary Metal Oxide Semiconductor (CMOS) processes are capable of integrating mixers, Low Noise Amplifiers (LNAs), Power Amplifiers (PAs), and Inter-Frequency (IF) amplifiers, all in a single package. A good example is the 60 GHz commercialized products with the label of Wireless Gigabit Alliance (WiGig) [16], and it is well recognized that cost effective implementations of sub-100nm CMOS process made it possible to utilize the 60 GHz bands [17].

GaAs Monolithic Microwave Integrated Circuit (MMIC) technologies are maturing fast, and they are becoming a dominant choice for components in the RF chain including PAs, LNAs, switches for digital attenuators and phase shifters, Voltage Controlled Oscillators (VCOs), and passive components from a few GHz to 100 GHz. As illustrated in Figure 14, it is projected that the Power Added Efficiency (PAE) of a 5G Front End Modules (FEM) will soon match the PAE of today's commercial 4G system. Meanwhile, a good Effective Isotropic Radiated Power (EIRP) can be achieved with the help of high antenna gains from a large number of antenna elements [18][19].

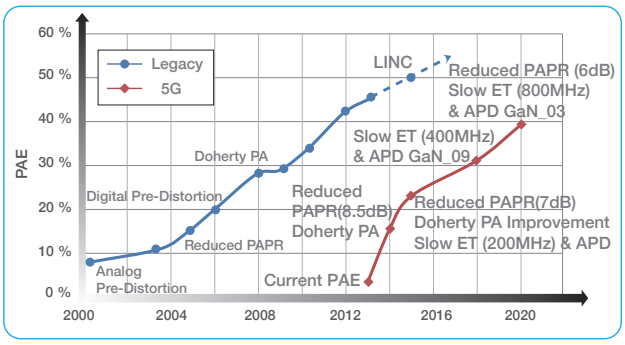

Figure 14 Projections of 5G FEM PAE

High performance antenna solution is an important piece of the 5G puzzle. The constantly varying LoS and NLoS propagation environment demands a novel antenna which exhibits high gain as well as wide spatial coverage capacity. The antenna array comprising of multiple antenna elements must fit within the small form factor of a 5G mobile handset.

Samsung has been developing innovative 5G phased array antennas that have near zero-footprint and reconfigurable antenna modes, as shown in Figure 15.

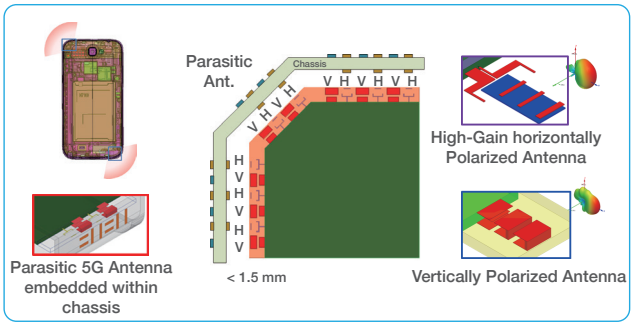

Figure 15 The Reconfigurable 5G Phased-array Antenna

Characterizing the biological implications on a user's body imposed by cellular handset devices is one of the most important aspects that need to be verified prior to its commercial release. The Signal Absorption Rate (SAR) regulated by worldwide gov-

ernmental bodies is used as a guideline to assess the effect of mmWave bands on a user's body. The SAR of an envisioned 5G (28 GHz) cellular handset is analyzed and illustrated in Figure 16.

When optimally configured, the 5G beamforming technology enables the peak radiation of the Mobile Station (MS) antenna to steer away from the user's head. As a result, the average SAR can be reduced by more than a factor of 10 compared to that of the present day 4G cellular handsets.

The maximum SAR is expected to be further minimized in the future, as 5G antenna technology continues to evolve.

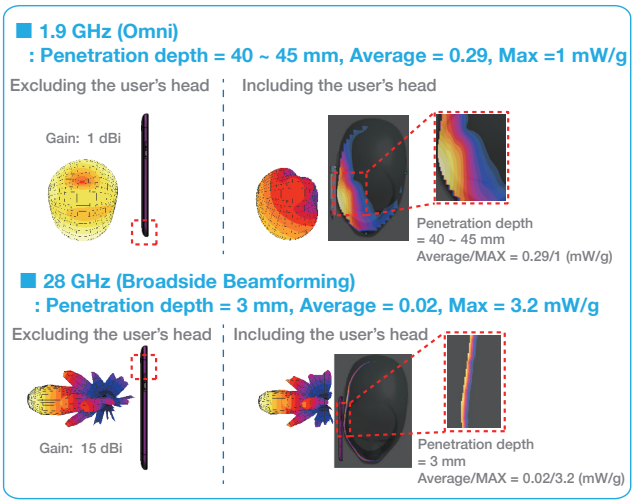

Figure 16 Biological Implications on the User's Body

Multi-RAT

To realize the envisioned 5G services, significant enhancement of per-user throughput and overall system capacity is required, compared with those of the 4G system. Such an enhancement can be achieved through advanced PHY/MAC/network technologies and efficient methods of cell deployment and spectrum management. In particular, utilizing a larger amount of system bandwidth guarantees an increase in the capacity by allocating more frequency resources to each user in the system. Therefore, utilizing the spectrum where huge bandwidth is available can be considered to be the most critical issue for the 5G system.

Currently, the 4G system specifies its operating frequency bands and some of them are assigned to cellular operators. These deployments can be beneficial since the existing 4G system will not interfere with other RATs.

However, obtaining the licensed spectrum requires not only considerable financial investment, but also a significantly long period of time spent on regulatory procedures. More importantly, a substantial portion of the licensed spectrum around 2 GHz is already being used. Therefore, finding a bandwidth that is wide enough to support the 5G system is very challenging.

The recent trend in spectrum management is to aggregate both the licensed and unlicensed spectrums to extend available system bandwidth, as shown in Figure 17.

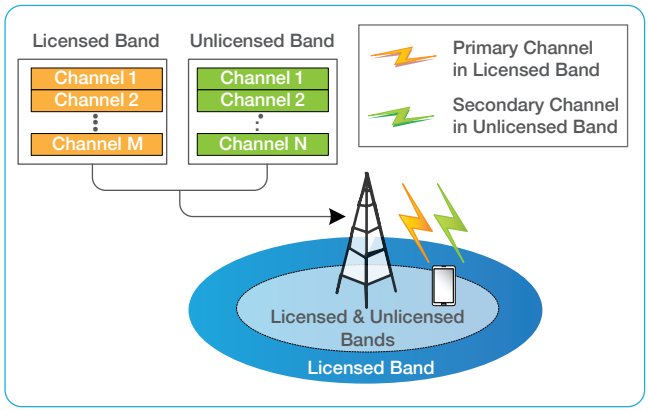

Figure 17 Integration of Licensed and Unlicensed Bands

The unlicensed spectrum has plenty of bandwidth. For instance, approximately 500 MHz and 7 GHz bandwidths are available in the 5 GHz and 60 GHz bands, respectively. In order for the 5G system to utilize the unlicensed spectrum, regulations imposed on each frequency band should be carefully reconsidered. Representative examples of the regulations are the Transmit Power Control (TPC), Dynamic Frequency Selection (DFS), and Listen Before Talk (LBT).

To efficiently utilize the unlicensed spectrum, we will develop the 5G system with the following characteristics.

First, we will design PHY/MAC/network algorithms suitable for the nature of the unlicensed spectrum. Since a wide range of frequency bands are included in the unlicensed spectrum, each frequency band has its own characteristics. Hence, band-specific solutions will be provided.

Second, efficient coexistence mechanisms that take into account other RATs (e.g., WiFi or WiGig) operating in the unlicensed spectrum will be suggested.

Finally, techniques for interworking and integrating the 5G system with other RATs will be developed. By taking advantage of multiple RATs, the 5G system will be able to take advantage of the unique characteristics of each RAT and improve the practicality of the system as a whole. For instance, the 4G system is used for exchanging the control messages to maintain the connection, to perform handover, and to provide real-time services such as VoLTE. The technology operating in mmWave unlicensed frequency band would support the gigabit data rate service. Multiple mmWave cells can be overlaid on top of the underlying 4G macro cells, as shown in Figure 18.

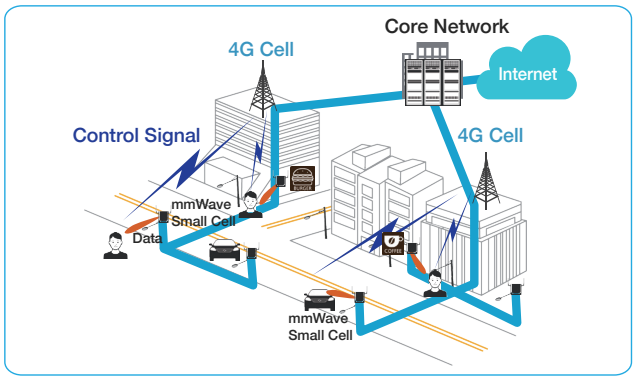

Figure 18 Overlaid Network of mmWave Small Cell Integrated with the Underlay 4G System

Advanced Network

In order to meet the 5G key requirements such as latency and the large number of simultaneous connections, and to support new business models and scenarios for operators, technologies above the radio access level should also be considered. Therefore, we need to develop technologies at the system architecture level from the network point of view. To accomplish the 5G key requirements and support the increased data rate of new 5G radio access, 5G network will have to evolve towards a distributed and flat architecture.

Current mobile network architectures designate a dedicated node in the core network (e.g., PGW - Packet Data Network Gateway in 3GPP) as a mobility anchor that allocates an IP address to the terminal, tracks terminal location in the IP topology, and ensures terminal's reachability by tunneling its traffic to wherever it goes. All terminal traffic is tunneled through the centralized node in the mobile core network. However, the undesirable consequences of this design include the following:

- Increase in end-to-end transmission latency due to elongated data paths.
- Additional load of backhauling and network processing in the core networks.
- Low network reliability due to introduction of a single point of failures.

In the 5G flat network architecture, as illustrated in Figure 19, user mobility is managed efficiently and in a dynamically scalable fashion by pushing the functionality to the edges of the network and even onto the mobile terminals [20].

The three important benefits of this approach include the followings:

First, such a distributed mobility management always provides the shortest data path between MS and the Internet without traversing the core network. This distributed mobility management leads to a significant reduction of signaling and data transmission delay. Also, low end-to-end latency requirements of 'less than 5 ms' for new 5G services such as immersive UHD video streaming, cloud gaming, and virtual reality, cannot be archived solely by reducing radio access latency but would also require a flatter network architecture design. In the flat network architecture, services which require low latency transmission can be provided by Edge Servers and they can benefit from advanced network features which utilizes network information for optimal operations.

Second, it provides a highly scalable solution compared to the centralized architecture, in which a single core network gateway maintains the whole traffic from MSs or to MSs.

Third, it easily avoids the risk of having a single point of failure. In flat network architecture, the breakdown of one network gateway would not significantly interfere with the operations of the other gateways.

Flexibility is considered as another key requirement of 5G network architecture. Software-Defined Networking (SDN) and Network Function Virtualization (NFV) provide promising examples of programmable design technologies for realizing a flexible 5G network architecture.

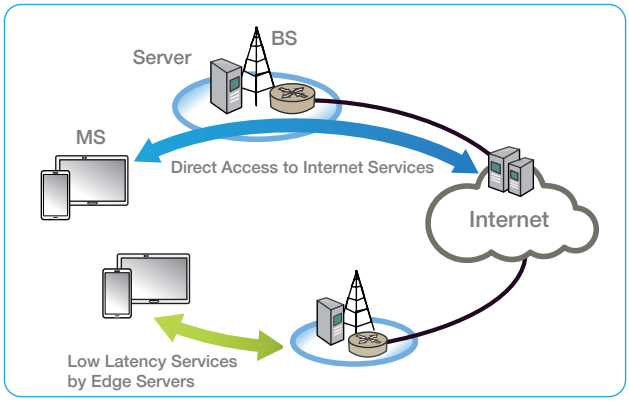

Figure 19 5G Flat Network Architecture

Advanced MIMO

One promising technology for meeting the future demands is massive MIMO transmission/reception [21]. When used with multi-user precoding schemes such as Maximum Ratio Transmission (MRT) precoding, also known as channel conjugate precoding, massive MIMO systems experience small inter-user and inter-cell interferences, and consequently achieve significantly higher throughput than the state-of-the-art MIMO systems.

One of the main challenges to build massive MIMO systems in practice is the limitation in the number of antennas that can be equipped at a BS, caused by the BS form factors and operating carrier frequencies.

For example, to horizontally install a large number of antenna elements (e.g., > 8) at the top of a BS tower operating with the lowest 4G system frequency bands of 700 MHz, eight antenna elements with 0.5 λ spacing require up to 1.7 m width, where λ is the carrier wavelength. For the typical 4G system frequency bands of 2.5 GHz, fitting 32 antenna elements with 0.5 λ spacing require up to 1.9 m width, which is still not feasible in many BSs that have only limited room on the tower. This practical limitation has motivated Full-Dimension MIMO (FD-MIMO) cellular communication systems, which place a large number of active antenna elements in a two dimensional grid at the BSs.

A typical FD-MIMO deployment scenario is illustrated in Figure 20, for a macro BS with 3 sectors equipped with 2D Active Antenna Array (AAA) panels.

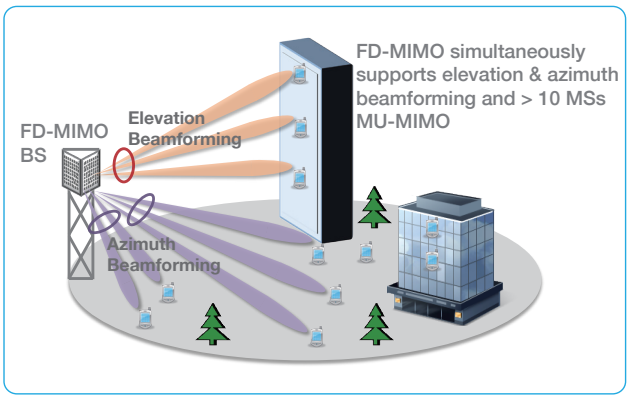

Figure 20 Example of FD-MIMO Deployment

FD-MIMO system can support high-order Multi-User MIMO (MU-MIMO), while fully exploiting the elevation as well as the azimuth dimension, thereby generating improved system throughput.

In full buffer system-level evaluations, it has been found that 64-antenna-port FD-MIMO system achieves 243% average-cell and 244% cell-edge performance gain, compared to those of the 8-antenna-port legacy MIMO system. In order to achieve the promising gain of FD-MIMO in practice, we need accurate beam steering and tracking in three Dimensions (3D).

To steer and track the MU beams toward serving MSs, FD-MIMO BS should be equipped with multiple transceivers (TRX) feeding 2D array elements, in which the number of TRX doubles or even quadruples compared to that of the conventional BS.

Having a large number of TRX poses new challenges, such as antenna calibration and complexity issues associated with Channel State Information (CSI) acquisition and precoding.

On the other hand, high-order MU-MIMO introduces another set of new challenges, such as scheduling complexity and link adaptation. Furthermore, in Frequency Division Duplex (FDD) systems, other new challenges emerge such as pilot overhead, CSI estimation complexity, CSI quantization and feedback overheads.

ACM & Multiple Access

– FBMC

As cellular IoT has been one of key driving forces to 5G, spectrally efficient support for heterogeneous services that have quite different requirements is becoming ever so important. Accordingly, several enabling methods such as multi-RAT coexistence and flexible spectrum sharing have been actively investigated.

Recently, FBMC has drawn much attention as an enabling technology for enhancing the fundamental spectral efficiency, though its theory has a long history similar to that of Orthogonal Frequency Division Multiplexing (OFDM).

Because of the well-localized time/frequency traits adopted from a pulse shaping filter per subcarrier, the FBMC system can reduce the overhead of guard band required to fit in the given spectrum bandwidth, while meeting the spectrum mask requirement.

Furthermore, the effectively increased symbol duration is suitable for handling the multi-path fading channels even without Cyclic Prefix (CP) overhead. Consequently, the FBMC system can reduce the inherent overheads such as CP and guard-bands in CP-OFDM. FBMC is also attractive in specific asynchronous scenarios, including Coordinated Multi-Point Transmission and Reception (CoMP) and Dynamic Spectrum Access (DSA) in a fragmented spectrum.

However, to maintain the transmission symbol rate, the conventional FBMC system generally doubles the lattice density either in time or in frequency compared with OFDM while adopting Offset Quadrature Amplitude Modulation (OQAM). In OQAM, in-phase and quadrature-phase modulation symbols are mapped separately with half symbol duration offset. Thus, so-called OQAM-FBMC or Staggered Multi-Tone (SMT) causes intrinsic interference that makes it difficult to apply conventional pilot designs and corresponding channel estimation algorithms as well as MIMO schemes as in CP-OFDM systems [22].

With a base-filter that takes the spectrum confinement and the orthogonality among adjacent subcarriers into consideration, the QAM-FBMC system performs comparable to the CP-OFDM system even without the CP overhead, while the guard-

band overhead reduction is also available from the well-confined spectrum. Sophisticated receiver algorithms including channel estimation and equalization can further mitigate the multi-path fading channel impact without the CP.

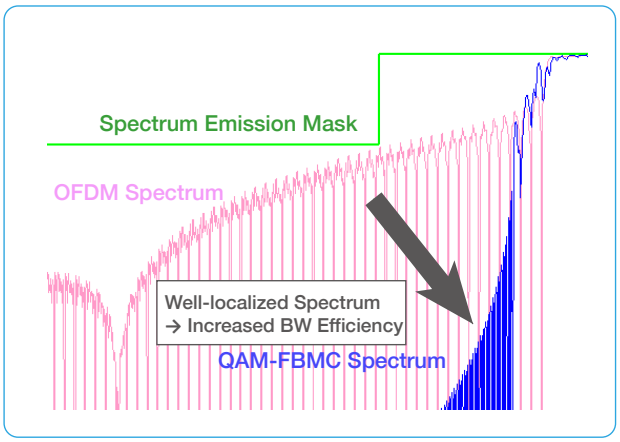

Figure 21 One QAM-FBMC Symbol Generation

– FQAM

One of key requirements for 5G is enhancement of cell-edge performance, which means that every user should be supported with Gigabit experience anywhere. Conventional approaches to enhance the cell-edge performance mainly focus on managing interference (e.g., interference cancellation, interference avoidance), by dealing with interference as a Gaussian. However, it is proved that the worst-case additive noise in wireless networks with respect to the channel capacity has a Gaussian distribution. From this observation, one can expect that the channel capacity can be increased by a non-Gaussian interference design which makes Inter-Cell Interference (ICI) non-Gaussian. The distribution of ICI depends on the modulation schemes of the interfering BSs. Therefore, an active interference design for improved cell-edge performance can be achieved by applying a new type of modulation.

FQAM, a combination of Frequency Shift Keying (FSK), and Quadrature Amplitude Modulation (QAM) can be used as an active interference design scheme. Figure 22 shows the signal constellation of 16-ary FQAM that is a combination of 4-ary FSK and 4-ary QAM.

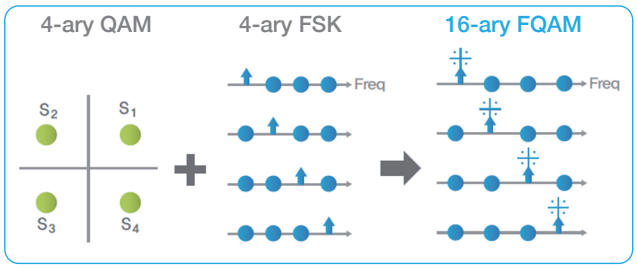

Figure 22 Example of 16-ary FQAM

With FQAM, the statistical distribution of ICI is likely to be non-Gaussian, especially for cell-edge users. As a result, the transmission rates for the cell-edge users can be significantly improved.

The statistics of ICI and the performance enhancement possibility have been proven by practical implementation of a system which uses FQAM. FQAM system environment for cellular downlink OFDMA networks is shown in Figure 23 and 24. Our experimental results show that the transmission rates for interference-limited users in FQAM-based OFDMA networks are around 300% higher than those in QAM-based OFDMA networks [23][24].

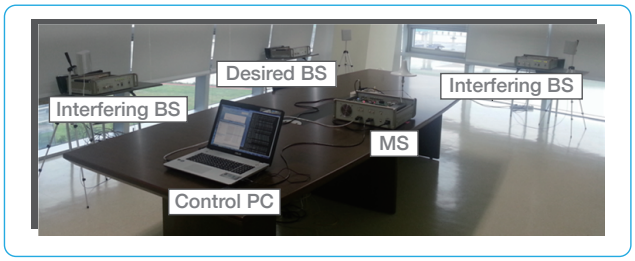

Figure 23 3 Cell Structure with MS and BSs

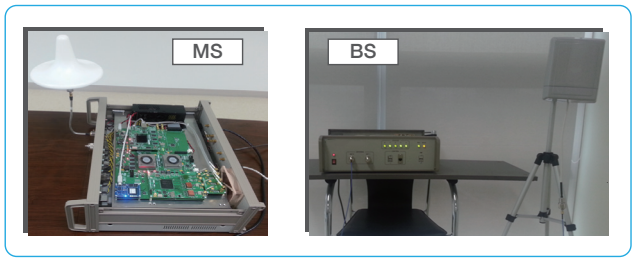

Figure 24 Implemented MS and BS

Advanced D2D

Advanced D2D communication is an attractive technology that enhances spectral efficiency and reduces end-to-end latency for 5G. Not entirely depending on the cellular network, D2D devices can communicate directly with one another when they are in close proximity. Hence, D2D communication will be used for offloading data from network so that the cost of processing those data and related signaling is minimized. Moreover, enhanced version of D2D communication was suggested lately for being used as special purpose such as Mission Critical Push-To-Talk (MCPTT) communication and Vehicle-to-Anything (V2X) communication.

In advanced D2D communication, a single radio resource can be reused among multiple groups which want to communicate with each other if the interference incurred between groups is tolerable. Hence, we can increase the spectral efficiency and the number of the simultaneous connection by utilizing D2D communication in 5G. Moreover, since the data is directly transmitted and not going through the core network, the end-to-end latency can be

considerably reduced. Therefore, advanced D2D communication is quite well aligned with IoT services as shown in Figure 25. The cars can communicate with each other to exchange the information for safety alarm and infotainment without cellular base station. The home appliances communicate with each other for home automation service. Many objects in proximity region can be connected to each other so that IoT services can be accomplished.

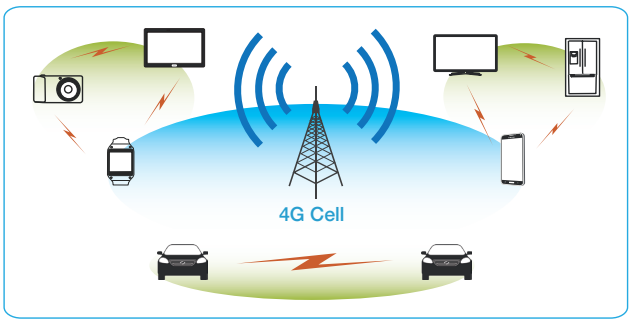

Figure 25 Advanced D2D Communications

Advanced Small Cell

To achieve significant throughput enhancement in a practical manner, it is necessary to deploy a large number of cells in a given area and to manage them intelligently. The 5G system is expected to utilize higher frequencies to take advantage of the vast bandwidth in the mmWave bands. Hence, the considerably high propagation loss of mmWave makes it suitable for dense small cell deployment, which leads to higher spatial reuse.

Moreover, Figure 26 shows the concept of a user-centric virtual cell. Conventional static network topologies with a central controller have an "edge", the reach of the central controller. However, a user-centric virtual cell that consists of a group of cooperating BSs is continuously reformed so that any user will always find himself/herself at the "center" of the cell.

Distributed and self-configuring network technologies will make it easy to deploy many small BSs in urban and suburban areas. In-band wireless backhaul can be used between BSs for cooperative communication, reducing the cost and complexity of backhaul network deployment.

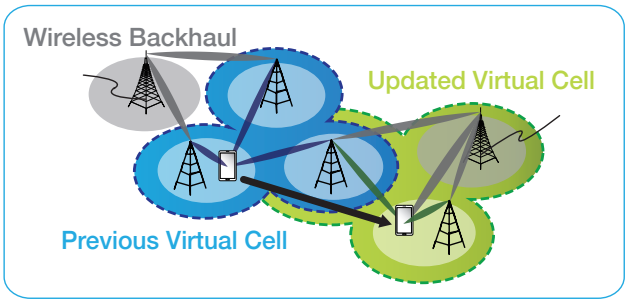

Figure 26 User Centric Virtual Cellular Network

5G Deployment Scenario

In order to provide the ubiquitous high QoE gigabit accessibility, we envision an overlaid deployment of 5G in conjunction with the existing 4G macro cells. The 5G small cells can be coupled with the overlaid 4G macro cells, and the 4G macro cells will control the operations of the associated 5G small cells, as illustrated in Figure 27. In the figure, 5G BS primarily provides multi-gigabit per second throughput with high QoE to mobile users over the legacy spectrum or higher spectrum like the 5 GHz unlicensed band and bands above 6 GHz. Meanwhile, the 4G BS can serve as a control channel to 5G MSs for supporting seamless connection anywhere over the legacy 4G spectrum.

5G system will need enhanced RAN technologies that not only utilize the legacy frequency bands assigned to IMT and IMT-Advanced systems, but also use new frequency bands. At the same time, 5G system will also need to support seamless interworking with other RATs operating in unlicensed bands.

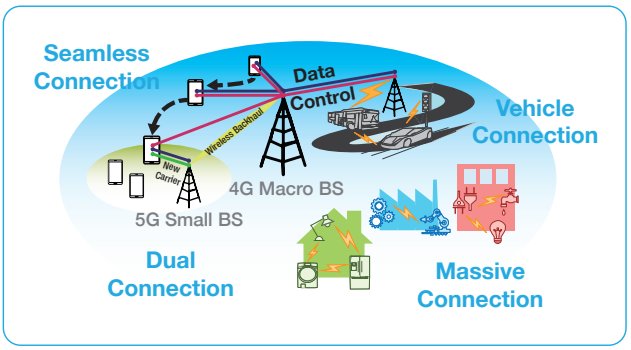

Figure 27 5G Deployment Scenario

Standardizations and Regulations

As shown in Figure 28, 5G is planned to be commercialized in year 2020. ITU-R WP 5D is preparing timelines in the vision document for standardization, spectrum allocation, and commercialization, in order to be on time. From the perspective of commercialization, standards for 5G should be ready by the year 2017 to allow 2 or 3 years for the development of 5G products. Considering average periods of previous standardization, 5G standards need to get started in 2015 to make 5G standards available by the end of 2017.

New frequency bands may be required to achieve the target performance of 5G. World Radio communication Conference (WRC)-15 agenda item 1.1 made in WRC-12 indicates consideration for additional spectrum allocations to mobile services on a primary basis and for identification of additional frequency bands for IMT purposes.

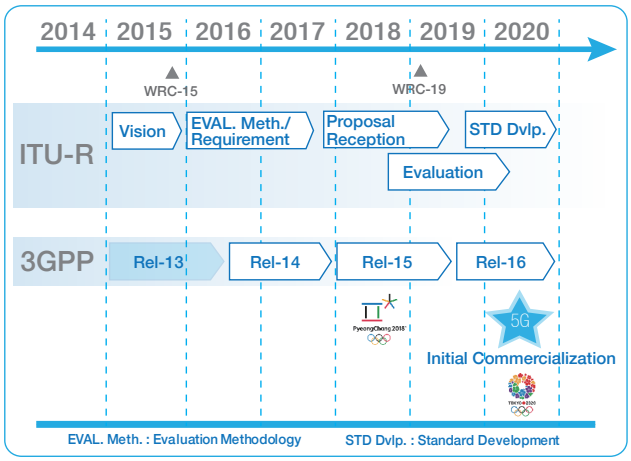

Figure 28 5G Timelines

In light of this agenda item, various frequency ranges had been proposed and discussed in ITU-R WP 5D in July 2013, and Joint Task Group (JTG) 4-5-6-7 had performed compatibility studies among various technologies in each candidate frequency band until July 2014.

Although bands above 6 GHz were not included in JTG 4-5-6-7's candidate frequency bands, WP 5D has been developing a new report on IMT systems in bands above 6 GHz, including channel characteristics and the potential usage of the bands for IMT systems.

WP 5D may also provide JTG 4-5-6-7 with the necessary information regarding bands above 6 GHz in order to be referenced as appropriate in the draft text of Conference Preparatory Meeting (CPM). The possibility and further necessity to study the bands are captured in the report from JTG 4-5-6-7 to CPM as follows:

"The demand of high bit rate, especially in densely populated area could be accommodated in higher frequency bands (e.g. above 6 GHz) than those currently being considered in studies, however the technical information required for compatibility studies has yet to be developed and these studies and proposals are being explored for future work, beyond WRC-15."

This report implies that new frequency bands can be added to the IMT frequency bands toward WRC-19, and it is likely that bands above 6 GHz can be one of candidate frequency bands.

In addition, Licensed Assisted Access (LAA) study item has been accepted in 3GPP LTE in the second half of 2014, acknowledging the use of unlicensed bands for cellular system.

Recently, as FCC relieves 5GHz band regulations for various unlicensed band usage, related coexistence technology between LTE and WLAN will be standardized in both standards.

Further, as shown in Figure 29, Samsung is actively engaging in the most of global 5G research initiatives, such as European 5G PPP projects of Horizon 2020, 5G Innovation Centre (5GIC) in UK, NYU Wireless Center in US, Giga KOREA project and Chinese 836 project.

Samsung is leading various collaborations with industries and academics over the world. In particular, Samsung has played an important role as the full member of 5G PPP Infrastructure Association, the executive board member of 5G Forum in Korea and the chair of vision sub-working group for Future IMT (5G) in ITU-R WP5D.

In order to have a consistent perspective on 5G with those of other academic institutes, we are vigorously developing 5G core technologies with several outstanding universities around the world.

Figure 29 Global 5G R&D Activities

Conclusion

5G will usher in a revolutionary generation of mobile communication that provides ubiquitous multi-Gbps data rate regardless of the user's location.

Significantly increased system capacity and real-time responsiveness of the 5G system will introduce life-changing services providing the users with a truly immersive and rich experience. The profoundly life-alternating world of billions of interconnected devices, the IoT, will require something as revolutionary as 5G to be fully realized in its fullest extent. And finally 5G promises to reverse the widening revenue gap and make it worthwhile for operators and service providers to invest again in innovative new services, and continue to propel increased productivity and efficiency.

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Samsung Demonstrates World's First 5G Data Transmission at Highway Speeds

Record-breaking 1.2Gbps data transmission at over 100km/h, and 7.5Gbps in stationary conditions using 28GHz spectrum

SEOUL, Korea – October 15, 2014 – Samsung Electronics Co., Ltd today announced the record-breaking demonstration of super-fast data transmission targeted for fifth generation (5G) mobile networks using 28 GHz spectrum. Samsung researchers confirmed the world's first data rate of 1.2 Gbps, or 150 MB per second on a vehicle cruising at over 100 km/h. This marks a significant step towards the utilization of millimeter wave frequency bands for 5G mobile networks

Figure A Achieved Data Rate in Mobile Condition (1.2Gbps)

The achievement was bolstered by another record-breaking demonstration in which Samsung achieved data transmission speed up to 7.5 Gbps, or 940 MB per second when the vehicle came to a complete stop. The peak data rate is more than thirty times faster compared to the state-of-the-art 4G LTE technology.

Back in May, 2013, Samsung revealed the world's first 28 GHz based 5G data transmission speed of 1Gbps at pedestrian speeds. Since then researches at Samsung were able to increase the maximum data rate by more than 7-fold and support mobility up to highway speeds. The continued ground breaking success underlines the company's leadership in next-generation mobile communications.

"The expectations for 5G communications will continue to grow based on the rising demands for smart devices, cloud services, smart home technology, and Internet of Things" , said ChangYeong Kim, Head of DMC R&D Center of Samsung Electronics. "We are committed to developing innovative 5G technologies and will continue to utilize our exceptional R&D capabilities as well as our diverse partnerships with leading companies and research centers around the world".

While 5G standard has yet to be ratified, 5G networks are expected to feature data rates and capacity that are hundreds times larger compared to 4G LTE.

Figure B Achieved Data Rate in Stationary Condition (7.5Gbps)

In order to achieve such high data rates, 5G networks will inevitably exploit frequencies much higher and less congested than those of which are currently used for cellular networks (typically under 3 GHz). However, difficulties such as large propagation loss at these frequency bands have prohibited the industry from utilizing these bands for cellular applications. To address these challenges, Samsung has applied 'Hybrid Adaptive Array Technology' at 28 GHz frequency bands.

In addition, Samsung has revealed its '5G Rainbow' – seven technical requirements which are pillars to ensure a truly differentiating 5G user experience. The list comprises of maximum data rate, spectral efficiency, speed of mobility, data transmission rate at the cell boundary, the number of simultaneous connections, communication delays, and cost. To meet these requirements, Samsung has been developing key technologies including transmission technologies for high frequency bands, multiple access schemes and low latency networks among others.

The company is committed to developing innovative technologies that will enable the 5G era and plans to demonstrate its capabilities at the upcoming 2018 PyeongChang and 2020 Tokyo Olympics.

Australian Government
Department of Communications and the Arts

5G—Enabling the future economy

October 2017

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Australia's 5G vision

5G is the next step in the evolution of mobile wireless communications technology, promising improved connectivity, greater network speeds and bandwidth, and very low latency. It is the fifth generation in mobile technology which, at each step, has seen significant developments in communications networks:

- 1G—The first generation of mobile phone networks were deployed in the early 1980s, providing a basic voice service using analogue transmission.
- 2G—In 1991, second generation networks were deployed, making the switch to digital standards with improved voice messaging and the introduction of the short message service (SMS).
- 3G—The third generation launched in 2001 and introduced data services in addition to voice and SMS.
- 4G—In 2009, the fourth generation protocol, Long Term Evolution (LTE), was introduced, supporting improved mobile broadband which saw increased capacity and speed for data.

New capabilities of mobile communications networks enabled by 5G technology will allow for a variety of 'use cases':

- higher quality and more video services provided to multiple users with full mobility, even at high speed
- massive scale automation delivered through widespread sensor networks and multiple connected devices
- delivery of critical communications assured by low latency and ultra-reliable networks, and
- improved productivity assisted by high quality, real time data analytics.

Unlike existing mobile communications networks, 5G networks have the potential to allow tailoring of requirements for each of these different use cases within the same network.

The Government considers that 5G is more than an incremental change for mobile communications. Instead, it provides the underlying architecture that will enable the next wave of productivity and innovation across different sectors of the Australian economy. Efficient rollout of 5G and uptake of the services it supports has the potential to produce far-reaching economic and social benefits and support growth of Australia's digital economy. This will be supported by the rollout of the National Broadband Network (NBN) allowing greater capabilities for the seamless delivery of services across high speed mobile, fixed line and fixed wireless networks.

The Government wants to create an environment that allows Australia's telecommunications industry to be at the forefront of seizing the benefits of 5G across the economy. The communications sector will lead the rollout of 5G networks in Australia. However, the Government can create the policy and regulatory environment to support a more efficient rollout, given its potential benefits to the economy.

The Government's direction will be to support the timely rollout of 5G in Australia to enable the next wave of broad-based industry productivity, and support the growth of Australia's digital economy.

This includes immediate actions by Government that enable the communications market to introduce new 5G technologies in line with international developments. These include:

- making spectrum available in a timely manner
- actively engaging in the international standardisation process
- streamlining arrangements to allow mobile carriers to deploy infrastructure more quickly, and
- reviewing existing telecommunications regulatory arrangements to ensure they are fit-for-purpose.

The Government recognises that as 5G continues to develop, other issues relating to the technology will likely emerge which may require future Government action. In particular, while there are opportunities for 5G to create economy-wide transformation, this will require a broader examination of sectoral regulatory frameworks.

To that end, the Government will work collaboratively with industry to foster an ongoing dialogue on 5G beyond the launch of this paper to identify and remove sectoral barriers to its successful and timely rollout. Through this dialogue, the Government will also look at opportunities to build on other Government activities, such as the national Digital Economy Strategy which will more broadly focus on building the productivity of sectors across the economy.

What is 5G?

The International Telecommunication Union (ITU) is the United Nations specialised agency for information and communications technologies. This body decides global spectrum allocation frameworks and harmonises international spectrum to ensure networks and connected devices can communicate seamlessly. The ITU will undertake the formal, international process to identify bands for 5G by 2020. It has developed draft technical specifications for 5G which include:[1]

- high data rates (1 Gbps for hotspots, 100 Mbps download and 50 Mbps upload for wide-area coverage)
- massive connectivity (1 million connections per square kilometre)
- ultra-low latency (1 millisecond)
- high reliability (99.999% for mission critical 'ultra-reliable' communications), and
- mobility at high speeds (up to 500 km/h i.e. high speed trains).

In working towards these specifications, 5G represents a significant leap from the capabilities of previous generations and introduces a range of new technological possibilities. The success of 5G in delivering new technologies and services will be supported by existing communications infrastructure, including the NBN. This convergence of high-speed fixed-line and mobile services will collectively produce a consistent and ubiquitous user experience.

The 5G economics case

Unlike early generations of mobile networks, 5G will represent a significant shift in the telecommunications industry's focus away from voice and more towards mobile broadband and increased industrial applications. These new use cases are expected to create benefits across a range of sectors—including transportation, health, manufacturing and agriculture—and have varying networking requirements. These use cases, as identified by the industry, can be divided into the following categories:

- enhanced Mobile Broadband
- massive Machine Type Communications, and
- critical communications.

Enhanced Mobile Broadband (eMBB)

eMBB will deliver improved capacity to a greater number of devices. This will enable higher rates and volumes of data transmission per device and improve coverage to a broader range of locations. eMBB will likely be the focus of early 5G deployments as it can immediately support the growing communications requirements for the digital economy.

An improved mobile experience for consumers

5G networks will give consumers a better mobile experience in more locations. Increased network capacity will support more users, even in crowded areas, such as large public events, and at peak times. Faster network speeds will also enable consumers to view rich content in more places, supporting the streaming of live events and high resolution media.

[1] ITU, 23 February 2017, 'Press Release: ITU agrees on key 5G performance requirements for IMT-2020'.

Massive machine type communications (mMTC)

As 5G networks mature, they will support the widespread and dense deployment of sensors and other network-connected devices by significantly reducing their power requirements and providing flexible coverage across different spectrum bands. This proliferation of the Internet of Things (IoT) across industries is expected to produce significant productivity benefits and support integration between sectors.

Supporting productivity and innovation

The term Industry 4.0 describes the next step in the advancement of the manufacturing sector (the 'fourth industrial revolution'). Industry 4.0 introduces autonomous systems supported by a combination of technologies such as IoT, artificial intelligence, continued technological improvements and digitalisation in manufacturing.

Australia stands to benefit from Industry 4.0, given our world-class manufacturing sector, which includes several high-value industries such as medical technology and aerospace. Australian manufacturers can improve their productivity and international competitiveness through Industry 4.0 processes by supporting their participation in global value chains. This is of particular benefit to SME manufacturers, opening them up to new markets and opportunities. 5G can support Industry 4.0, by providing communications infrastructure that is more accessible and flexible to suit specific industry needs.

5G can enable innovation in other sectors such as agriculture. A challenge for Australia's agricultural sector is identifying how to improve productivity while balancing environmental and commercial constraints. Precision agriculture, which focuses on improving yields and minimising economic risks, seeks to provide more control in the management of agricultural production. While precision agriculture requires a range of enablers—including data analysis, sensor networks and geographical information systems—5G can provide the supporting infrastructure for these technologies.

Critical communications

Low latency and 'ultra-reliable' communications networks will support the delivery of critical communications, i.e. to support public safety use and playing role in the technology ecosystem supporting autonomous vehicles. In addition to automation, critical communications will also help to support technological advancement in areas including robotics and artificial intelligence.

The social benefits from autonomous vehicles

5G networks are expected to play a role in the technology ecosystem supporting the development of autonomous vehicles, which will enable a number of social benefits for transportation. Traffic congestion, which is estimated to cost Australia $53 billion by 2031,[2] could be proactively reduced by smart city traffic management systems that are informed by machine-to-machine communications with autonomous vehicles.

Improved road safety is also expected to be a key outcome of autonomous vehicles, as the majority of car accidents involve human error. In the 12 months to July 2017, there were 1,235 deaths on Australian roads with road trauma costing the Australian community an estimated $27 billion annually.[3] Autonomous vehicles can have a valuable role not just in terms of financial savings, but in saving human lives.

[2] Infrastructure Australia, 2015, 'Australian Infrastructure Audit'.
[3] Bureau of Infrastructure, Transport and Regional Economics, August 2017, 'Road deaths—monthly bulletins'.

Figure 1—Outline of the relationship between the technical requirements of 5G and expected services and applications it will deliver

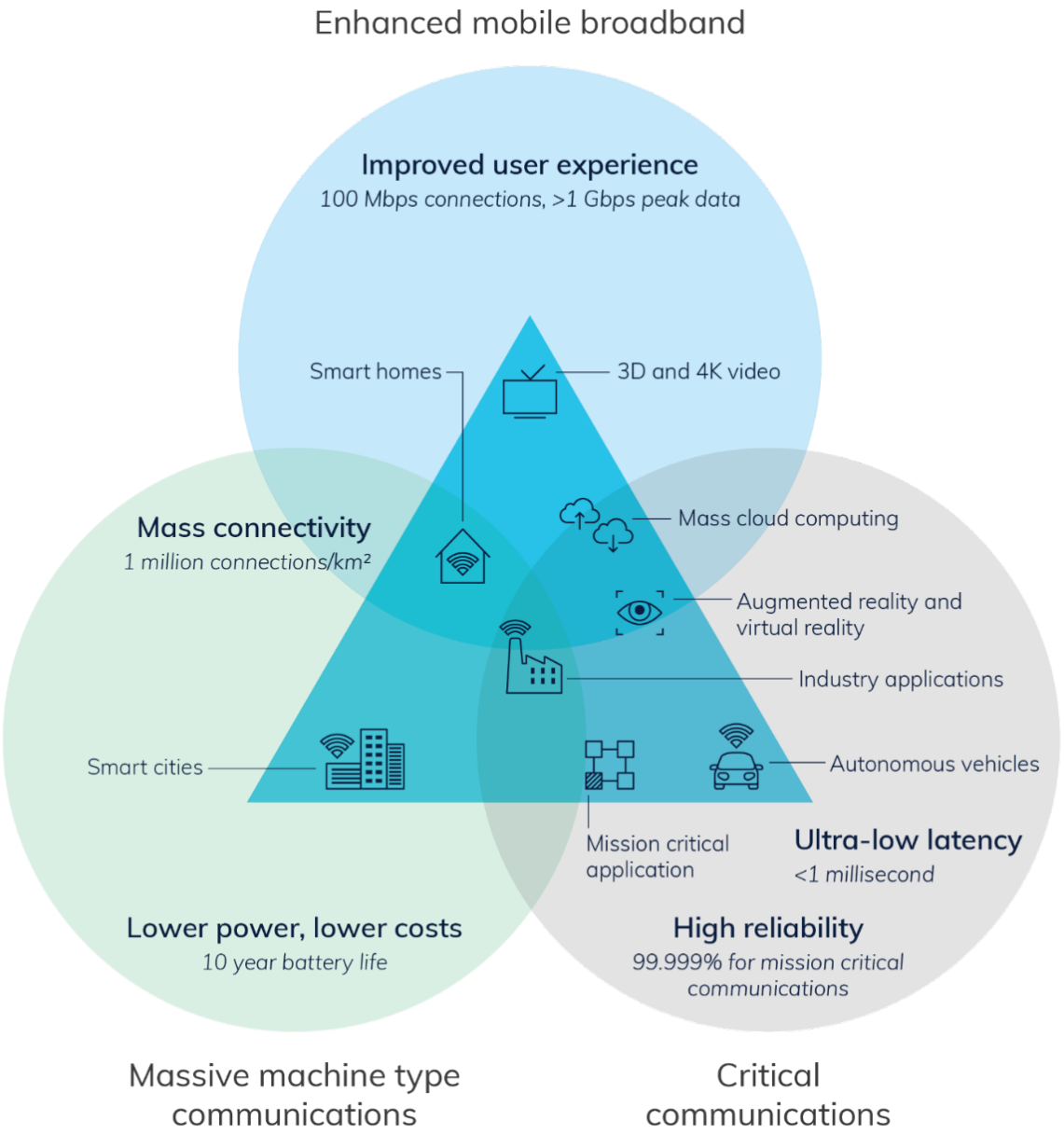

Source: Based on figure 2 from the ITU paper, '[IMT Vision—Framework and overall objectives of the future development of IMT for 2020 and beyond](#).'

What is different about 5G?

5G is expected to enable productivity outcomes across key verticals of the economy as a result of a range of characteristics, such as **network slicing** and **mesh networks**. However, it will need to overcome deployment challenges such as **spectrum acquisition** and **coverage**. This is expected to lead to new approaches for deployment to enable widespread 5G coverage in Australia. The industry will also need to develop a robust **business case** for 5G rollout, which will likely be demand driven, to support the significant capital expenditure required.

Network slicing

Network slicing allows operators to split their network into separate sub-networks (also referred to as slices), enabling them to dedicate network resources to different users and applications. Sub-networks can 'slice' the infrastructure resources from the physical network to create virtual independent networks. This is a significant development from previous mobile network generations, as it enables an operator to deliver many different capabilities by creating slices that can be tailored for the intended usage. For example, an operator could create a network slice for IoT devices, or alternatively, a network slice for higher security for a higher quality of service for government or public safety uses.

Network slicing also provides a model for infrastructure sharing between network operators. In this case, a single transmitter's network could be shared with more than one operator. Given the capital expenditure that will be associated with 5G rollout, network slicing can provide a cost effective, short-term solution for operators.

Figure 2—5G network slicing enables operators to create separate virtual networks to meet application requirements

Source: Based on figure 2 from the ITU article, '[Why end-to-end network slicing will be important for 5G](#).'

Mesh networks

Mesh networks can be utilised to increase the range of coverage, where the 'mesh' is an interconnection among a network of devices. Only one device in the mesh needs to be connected to the network, which can then relay data to other nearby devices.

Mesh networks not only provide the opportunity to support 5G deployment but also have the additional benefit of providing efficient network speeds. Through dynamic routing, devices on a mesh network are able to seek the fastest and most reliable pathway to send and receive data. As such, this architecture can provide a cost effective solution for coverage in more remote areas. For example,

primary industries would benefit from this network approach by simplifying network connections and costs associated with deploying and managing an IoT sensor network. However, the application of mesh networks is still highly speculative as the industry considers how they will operate in practice and in different environments. This may contribute to the development of new business models for 5G.

Spectrum sharing

Spectrum is a critical enabler of Australia's current and future communications infrastructure. The specific spectrum bands and quantity of spectrum required for 5G are still being considered. However, 5G will likely require a mix of low, medium and high frequency spectrum to meet different scenarios relating to coverage, connectivity, and latency:

- Low frequency (less than 1GHz)—providing widespread coverage across urban, suburban and rural areas and supporting IoT for low data rate applications.
- Medium frequency (1–6GHz)—providing good coverage and high speeds, and including the expected initial 5G range of 3.3–3.8GHz which has been identified as the most likely band for launching 5G globally.
- High frequency (above 6GHz)—providing ultra-high broadband speeds for advanced mobile broadband applications, and most suitable for applications in dense traffic hotspots.

5G technologies can be expected to deliver improvements in spectral efficiency (the data rate that can be supported per unit of spectrum). However, the use of 5G networks for applications such as widespread industrial applications is likely to require significantly more amounts of contiguous spectrum to be made available.

While some of the potential bands for 5G currently have unused spectrum, other bands would need to be 'refarmed', noting that it is likely that bands currently used for 2G, 3G and 4G in Australia will transition over time to 5G. Refarming enables spectrum to be transitioned to the highest value use as required. The refarming of spectrum already held by mobile broadband operators is a commercial decision for those operators. 5G is also expected to provide the opportunity for 'soft-refarming' where 4G and 5G technologies can both be supported simultaneously, minimising the impact to legacy devices during transition periods.

Spectrum sharing, that is spectrum accessed by numerous users on a shared basis, has also been identified as an option for 5G technology. Spectrum sharing encompasses a range of different aspects of spectrum management. Spectrum can be shared by geography, time, economic priority schemes, code modulation, polarisation, directionality or power. Access to spectrum is divided between users so it can be used without interference issues.

5G opens up new opportunities for increased spectrum sharing, through mechanisms such as network slicing. 5G technology is also designed to support shared arrangements, and allows for the sharing of the same spectrum ('unlicensed Wi-Fi' spectrum) with other technologies. Operators can augment their holdings in situations where existing exclusive holdings are insufficient to meet customer needs. Spectrum sharing in the 5G context is also supported by the expected use of highly directional antenna technology which would enable operators to operate in closer proximity without interference.

Antenna technology and network topology

5G will require radically different structures of networks if it is to achieve successful deployment in Australia. As 5G will likely utilise different frequencies, new equipment will be necessary. Additionally, the higher frequency 5G spectrum can only travel a small distance and will need more cells to ensure adequate coverage. However, antennas and equipment will be smaller, making it easier to attach these cells to existing infrastructure such as street lights and buildings.

The more dense deployment of cells will also give rise to other approaches that improve the reliability of data transmission across a 5G network. Data may be divided into individual streams and transmitted through multiple antenna segments in a process called Multiple Input Multiple Output (MIMO) which allows for more information to be transmitted simultaneously. This technique is further empowered by 'beamforming' which allows base stations to direct focused beams of energy to a specific area rather than dissipate the available power of a larger area. These developments will enable more efficient transmission and increase overall throughput.

5G is also expected to assist the adoption of IoT by further reducing power consumption through extended discontinuous reception. In this scenario, IoT devices shift between active and inactive cycles, transmitting only when required. This will allow connected devices to operate for extended periods on a single charge, reducing operational costs.

5G will also increase the support for a greater density of devices that would have otherwise been limited by the capacity on 3G and 4G networks. They will also enhance IoT deployment through the use of network slicing to create virtual network configurations that are optimised for the low power and coverage requirements of IoT networks.

Business case

For Australians to experience the benefits of 5G, the communications sector will need to explore and develop new business cases to attract investment and support the rollout of 5G services. As 5G becomes an integral part of the communications ecosystem, the sector will need to be agile to respond to the needs and expectations of other sectors which will be seeking to take advantage of these next generation networks.

While residential consumers will inevitably be attracted to the enhanced mobile broadband services offered by 5G, it is the industrial applications for 5G where industry expects to see the greatest opportunity for new business models.

Compelling industrial applications are still to be developed. For example, industry sectors can be expected to seek tailored solutions for their business needs such as enhancing their local area network or enabling autonomous systems, and small businesses will look for low cost deployments of IoT.

It is therefore expected that the model for 5G will be demand driven and will require the communications industry to foster new business opportunities.

How are countries preparing for 5G?

In preparation for 5G, many countries have been taking steps to test the technology and review their spectrum arrangements.

Examples of 5G work being undertaken by other countries

The United States is clearing the 600MHz band through an incentive auction for the potential early deployment of 5G. The United States has also identified reforms to infrastructure deployment as a priority for 5G rollout. Mobile network operators are also conducting trials of low-band spectrum for use in 5G services.

The Asia-Pacific Telecommunity (APT), the regional arm of the ITU, approved a recommendation for the use of the 700MHz band for 5G, with 26 countries in the Asia-Pacific region identifying this band for this use, including Australia, Japan, South Korea and New Zealand.

Korea and Japan have stated their intention to use some or all of the 26.5 to 29.5GHz range to trial enhanced mobile broadband applications ahead of the 2018 Winter and 2020 Summer Olympics respectively. It is expected that these trials will lead to commercial availability of 5G services.

The European Communications Commission (ECC) identified the 3.4–3.8 GHz and 26GHz band (from 24.25 to 27.5GHz) bands for the deployment of 5G in Europe. All European countries are expected to select at least part of this range to launch 5G by 2020.

In the United Kingdom, the government launched its 5G strategy in March 2017. It is funding testbeds to understand the different deployment requirements and security considerations for 5G. The United Kingdom is also working to make suitable spectrum available in the high (24.25 GHz–27.5 GHz, and other bands above 30 GHz), medium (3.4–3.8 GHz) and low frequency (700 MHz) bands.

Industry 5G preparations in Australia

Australia is well positioned to harness the opportunities of 5G. Australia has an effective and competitive mobile communications market, with voice and data coverage available to more than 99 per cent of the population.[4] It is the top performer internationally in terms of having in place effective enablers—infrastructure, affordability, consumer readiness and content availability—to support mobile internet adoption.[5]

5G trials have already commenced in Australia, with each of the main carriers working with mobile equipment suppliers in testing the application and limits of the technology. These trials will continue and will inform the communications sector on how 5G can be effectively deployed for the Australian environment.

[4] Department of Communications and the Arts, accessed 1 September 2017, 'Mobile phone towers'.
[5] GSM Association, 24 June 2016, 'Global Mobile Connectivity Index'.

The Government's direction for 5G

The Government has made significant investments to improve telecommunications infrastructure in Australia, through the NBN and the Mobile Black Spot Program. The Government is also working to create a policy and regulatory environment that supports a competitive and innovative communications market.

The Government recognises that 5G will enable innovation and productivity across industry sectors and can significantly contribute to Australian's growth and future prosperity. Therefore, the Government will focus on enabling the early deployment of this new generation of mobile networks in Australia and encourage its use in delivering new services and applications.

The Government will support the timely rollout of 5G in Australia to enable the next wave of broad-based industry productivity, and support the growth of Australia's digital economy.

Industry expects and needs to lead the deployment of 5G. However, the Government has a role in supporting network rollout by modernising policy and regulatory frameworks and removing barriers that would delay rollout and adoption unnecessarily.

In the first instance, the Government will support the early deployment of 5G in Australia by:

- making spectrum available in a timely manner
- actively engaging in international spectrum harmonisation activities
- streamlining arrangements to allow mobile carriers to deploy infrastructure more quickly, and
- reviewing existing telecommunications regulatory arrangements to ensure they are fit-for-purpose.

Making spectrum available in a timely manner

A clear, efficient and flexible regulatory framework governing spectrum access will be essential to support the timely deployment of 5G networks in Australia.

The Government is currently undertaking work to modernise Australia's spectrum management framework to ensure it remains fit-for-purpose. In May 2017, it outlined its proposed reforms to the framework which are designed to simplify and streamline the processes for spectrum allocation and provide a transparent, efficient and flexible spectrum management framework. This will be the most significant change to the Australian spectrum management framework in the last 25 years.

The reforms will remove barriers between licence types, and enable flexible licensing issue and allocation processes. This strategic approach will remove outdated processes and support the Australian Communications and Media Authority (the ACMA) to more effectively respond to market demands and new technologies, such as 5G. This will help Australia remain internationally competitive with a modern, innovative economy over the coming decades.

The Government will put in place its new spectrum management framework by 2019.

In addition, the ACMA will continue to work on making spectrum available for 5G. The ACMA has been investigating the use of 1.5GHz and 3.6GHz and high frequency mmWave bands in considering additional spectrum for mobile broadband services. The ACMA has decided to prioritise refarming of the 3.6GHz band over the 1.5GHz band, citing industry submissions noting this band is likely to be a pioneer band for early 5G deployments and the need to provide greater clarity and investment certainty for incumbents and potential new band entrants alike. The ACMA is currently engaging with industry on which parts of the 3.6GHz band should be reallocated and on what terms. This approach also follows international trends which have seen the 3.6GHz band commonly used for 5G trials.

The ACMA will work to bring 3.6GHz spectrum to auction in 2018.

Actively engaging in international spectrum harmonisation activities

There is already significant work underway globally with several countries trialling 5G, but standards for this new generation technology are yet to be finalised. The formal, international process to define 5G is led by the ITU. The ITU's Working Party 5D is responsible for shaping the standard for "futuristic mobile technologies" to support International Mobile Telecommunications (IMT) for 2020 and beyond.[6] This process is known as IMT-2020.

Stakeholders such as regulatory and policy setting bodies, hardware manufacturers and governments of countries in which they are based will be seeking to influence the international dialogue. A key body is the industry-driven 3GPP which undertakes technology standardisation. Collectively, the ITU and 3GPP will drive spectrum harmonisation activities: the ITU, led by administrations, will focus on the spectrum requirements; and the 3GPP, led by industry, will concentrate on equipment and device standards.

Industry is well-placed to lead the standardisation process particularly given its role identifying the application of 5G technologies. However, there is also an important role for the Government in these processes. This is particularly the case in the harmonisation of international spectrum arrangements which will have significant impact on the availability and cost of 5G devices in Australia and can be strongly contested.

In the past, Australia and the Asia-Pacific region have been influential in contributing to standards and spectrum plans that have been adopted across the world. This ensured that Australia was able to adopt new technologies quickly and that the Australian market could take advantage of the economies of scale and have a greater choice of mobile handset equipment.

The Government will ensure strong participation by Australian in domestic and international discussions about 5G spectrum harmonisation. Our continued involvement provides the opportunity to contribute to this dialogue and secure outcomes that will benefit the adoption of 5G in Australia.

Streamlining arrangements to allow mobile carriers to deploy infrastructure more quickly

The design and deployment of mobile networks will be radically different from those of today. 5G is expected to require additional infrastructure in new forms, including smaller cells and more densely-located antennas, particularly in the use of high-band spectrum.

Carriers have specific powers and immunities relating to telecommunications infrastructure deployment and installation. These laws help carriers to rollout telecommunications infrastructure quickly in a nationally-uniform way, rather than having to follow state, territory and local government requirements. These laws have existed in their current form since 1997.

The Government has recently consulted on proposed new arrangements that take account of technology developments and changes in operating practices as well as identifying opportunities to streamline deployment processes. Under these new proposed arrangements, mobile carriers would be able to rollout new communications technologies such as 5G more efficiently.

The Government understands that some members of the community have expressed concerns about the impact on public amenity from increased telecommunications infrastructure. The Government considers that telecommunications providers should work with local communities to address concerns about their infrastructure plans and is encouraging industry to consider consultation requirements for future 5G networks.

The Government continues to work with stakeholders and will implement the first tranche of changes to carrier powers and immunities following the conclusion of the consultation process.

[6] ITU, accessed 1 September, ITU towards "IMT for 2020 and beyond."

Reviewing existing telecommunications regulatory arrangements to ensure they are fit-for-purpose

The pace of change in the communications sector is impacting on the effectiveness of the existing telecommunications regulatory framework. In response, the Government is progressively working to modernise the regulatory architecture to ensure that the regulatory and policy settings flexibly respond to the current and future needs of the communications sector.

In undertaking reform, the Government is cognisant that the communications regulatory framework will need to be sufficiently flexible to address the emergence of new technologies and business models.

5G deployment will benefit from the Government's reform efforts, including updates to the regulatory framework for telecommunications and radio spectrum and modernising the ACMA. In these cases, the Government has been revising regulation to shift it away from the traditional vertical telecommunications sectors to principles based, flexible arrangements. This will provide the versatility necessary to account for 5G developments and services.

The Government will continue to work with industry to modernise current telecommunications regulatory arrangements to ensure they encourage competition and innovation in the sector.

As with previous mobile networks, cybersecurity will be a critical consideration as 5G is deployed. Security will be even more so a challenge for 5G, as the reliability of communications will be pivotal in the technology's ability to deliver benefits, particularly in the case of critical communications.

Additionally, in providing the architecture for automation, 5G networks will trigger an ever-increasing volume of data. While the bulk of data will be machine-to-machine communications, users will want assurance that their personal information is protected. User consent will be an area of growing complexity due to the intersection between autonomous systems and the individual.

Industry has strong incentives to address cybersecurity risks in 5G's new types of network deployments and systems. However, **the Government will continue to assess cybersecurity and privacy issues as they evolve to ensure Australians have confidence in using 5G.**

Next steps

The Government recognises the opportunities presented by 5G for economy-wide transformation, creating productivity benefits in sectors such as transportation, health, manufacturing and agriculture. However, realising the benefits of 5G in sectors other than communications will need the right sectoral regulatory settings.

The Government will work to ensure that sectoral regulatory frameworks are updated to take advantage of 5G. The communications portfolio is well-placed to facilitate an ongoing strategic dialogue on 5G that will support sectors to identify and work towards unlocking the potential benefits of the technology. This dialogue would provide a starting point for greater engagement across Government and with industry and the community.

To that end, **the Government will establish a 5G working group that will bring together representatives from across Government and industry.** The working group will create a platform for this strategic dialogue with a mandate to seek out opportunities and emerging issues on 5G. This will provide better coverage across Government of the evolving policy and regulatory challenges associated with 5G.

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Energy Efficient Switched Parasitic Array Antenna for 5G Networks and IoT

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***Abstract*—This paper includes design and implementation result of an adaptive beam forming antenna for upcoming 5G and Internet of Things (IoT). Switched parasitic array antennas are low cost, small sized and compact circular array antennas that steer beam in a desired direction by variation in switching pattern of parasitic elements. The proposed antenna design has an active center element, which is surrounded by several symmetrically placed parasitic elements. The designed antenna has a gain of 8 dB and is capable of 360 degrees beam steering in steps of 60 degrees each. Simulations are validated with results of the fabricated antenna. Antenna beam is steered by controlling parasitic elements. Future application of Electronically Steerable Parasitic Array Radiator (ESPAR) antennas and switched parasitic array antennas in next generation communication networks and methods for reducing size of the antenna are also highlighted.**

***Index Terms*—Internet of Things, 5G, circular array, reconfigurable, smart antenna, adaptive beamforming, Switched-Parasitic Array**

I. Introduction

Smart antennas are capable of adaptive beam forming in accordance with the environment. Over the last three decades wireless communication has made rapid progress due to better modulation schemes and better error correction schemes. Wireless communication systems are replacing the wired ones. Antenna is an integral part of wireless devices. To meet the ever-increasing demand of higher data rate, smart antennas capable of adaptive beam forming are introduced as a potential solution to increasing data rate and improving signal-to-noise ratio (SNR) in upcoming 5G and Internet of Things (IoT) [1]. By using smart antennas Equivalent Isotropically Radiated power (EIRP) can be increased. EIRP denotes product of the transmit power (P_t) and transmit antenna gain (G_t), i.e.

$$EIRP = P_t \times G_t \tag{1}$$

From (1), it is observed that by using a smart antenna G_t increases, which in turn leads to the increase in the EIRP. The beam of an antenna can be steered by means of mechanical movement of a directional antenna or by electronic beam steering. Electronic beam steering is resilient and provides more accurate approximation of the desired signal source. Moreover electronic beam steering antenna does not involve moving parts. Therefore, there is less wear and tear on the antenna as compared to mechanical beam steering. Generally electronic beam forming is achieved by using phase shifters coupled with an array of antenna elements. The phase of an individual phase shifter is varied such that there is net constructive interference in the intended direction of the antenna beam and destructive interference in all other directions [2]. Hence, electronic beam steering is preferred over mechanical beam steering.

Electronically Steerable Parasitic Array Radiator (ESPAR) antennas use mutual coupling between antenna elements to steer the beams instead of phase shifters. Design of parastic array radiator antennas is discussed in [3], [4] in which there is a center active element surrounded by a circular array of passive elements, where each passive element is loaded with a specific reactance. ESPAR antennas are smaller in size as compared to phase array antennas because elements have to be placed at a quarter of wavelength or less distance from each other for effective mutual coupling. Hence, ESPAR antennas are cost effective and space efficient. In such antennas we have only one active element, therefore, only one feed is required. Consequently, ESPAR antennas have lower losses (due to single feed) as compared to phase array antennas [3].

Previously designed antenna Electronically Steerable Parasitic Raidator(ESPAR) antennas have all cylindrical element, including the feed element [6], [7]. In this paper we have proposed design of seven element ESPAR antenna with conical center(active element)[1]. Length of conical element is optimized using optimetrics in HFSS. Our proposed antenna has higher bandwidth as compared to previously designed ESPAR antennas. [6], [7]. In multiple-input-multiple-output (MIMO)

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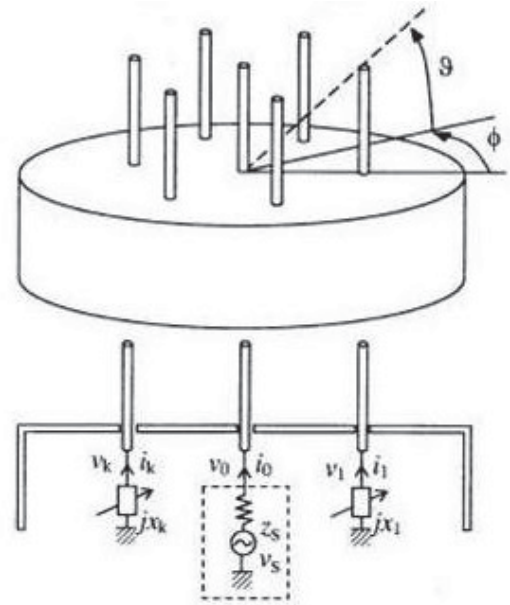

Fig. 1. Seven Element switched parasitic array antenna, ϕ is azimuth angle and θ is elevation angle.

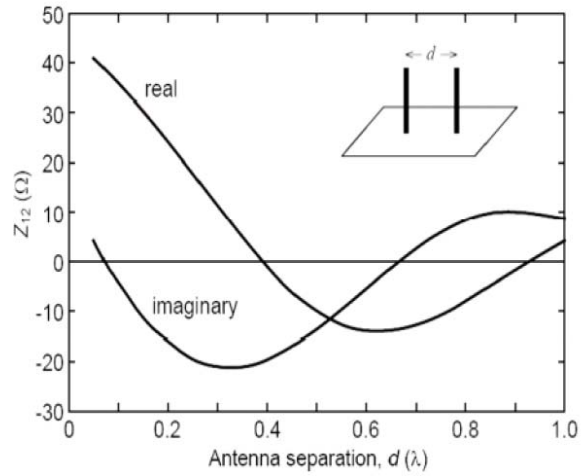

Fig. 2. Z_{21} versus separation distance.

systems there are multiple transmit and and receive antennas. Each receive antenna receives signal over different propagation channels yielding diversity gain. The MIMO technique can increase system throughput and reduce propagation losses. Similarly diversity gain can also be achieved by using smart antennas. In particular, we can transmit the same signal in multiple directions through directional beams, such that they experience different propagation channels [4]. Our proposed antenna is more suited for MIMO applications compared to previously designed model because of its higher gain and improved bandwidth efficiency.

This paper focuses on the design of a seven element switched parasitic array antenna. The antenna is first simulated and then it is fabricated. Simulation results are validated with the hardware results. Previously done work on ESPAR and switched array antennas involve cylindrical monopole elements mounted on a ground plain [8] due to cylindrical nature bandwidth of active monopole is confined, subsequently bandwidth of switched array and ESPAR antennas is limited. Instead on cylindrical monopole element we have used tapered conical monopole. Due to tapered design bandwidth is enhanced.

II. Switched Parasitic Array Antenna Concept

The conceptual overview of the switched parasitic array antenna is given in Fig. 1. We have first simulated the antenna with seven monopole elements. There is one element at center which is surrounded by a circular array. Feed is applied to the center element and it is termed as active element, whereas elements in the circular array are parasitic elements. Parasitic array antennas do not involve phase shifters, so that the manufacturing cost is less as compared to the phase array antennas. Each element is separated from other element by a quarter of wavelength, thus mutual coupling phenomena comes into account and there is a shift in phase of current in each element because of this mutual coupling phenomenon. Since switched parasitic array antennas offer adaptive beamforming solution with compact size and low cost, they are likely to be used in future communication devices to increase data-rates [6], [7]. Parasitic array antennas have vast potential for usage in laptops, cell phones, WLANs etc.

A. Mutual Coupling

Mutual Coupling is basically the interaction between antenna elements in an array. Since parasitic elements are placed closer to each other (at a distance of λ/4) there will be mutual coupling.This mutual coupling phenomenon is responsible for a shift in phase of current induced in each element [8].The current induced by one antenna element in another antenna element [9] is given by (3)

$$I_2 = \frac{Z_{21}}{Z_{22}} \times I_0 \tag{2}$$

$$Z_{21} = \left|\frac{V_2}{I_1}\right|_{I_2=0} \tag{3}$$

$$Z_{21} = \left|\frac{V_2}{I_2}\right|_{I_1=0} \tag{4}$$

Here Z_{22} is constant as it is open-circuit output impedance. Z_{21} is open-circuit transfer impedenace from port 2 to port 1 and it can be approximated by graph shown in Fig. 2. From equation (3), beam can be steered in the desired direction by varying the phase of current I_2 [10].

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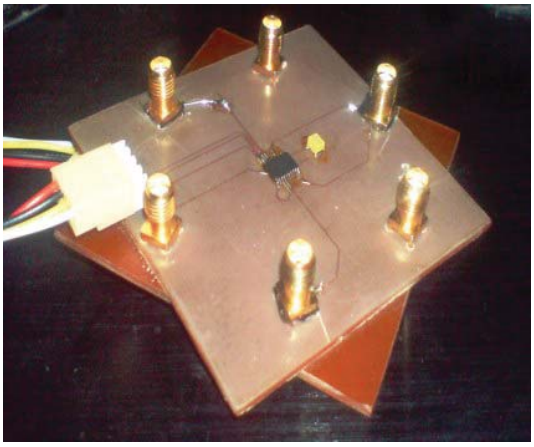

Fig. 3. RF PCB with Analog devices ADG 904 RF switches.

TABLE I
DESIGN PARAMETERS

Parameters	Values
Ground Skirt length	lambda/4
Monople Length	lambda/4
Frequency	2.45 GHz
Ground Radius	lambda/2
Monopole Radius	lambda/200
Ground Thickness	3 mm

B. Beam Steering Mechanism

In this work the designed antenna is capable of 360^0 beam steering in steps of 60^0. The beam steering is achieved by using two sets of 4:1 Analog devices multiplier switch ADG 904. Fig.3 shows RF PCB designed for beam steering. Beam is steered towards an element which is open. The open element behaves as a director and shorted elements act as reflectors. In order to achieve a maxima at 0^0, we make the element 1 open by using RF switch IC while other elements (i.e., elements 2,3,4,5 and 6) are shorted. This mechanism is similar to Yagi-Uda antenna where elements with shorter lengths in front of feed element act as directors and elements at rear of feed element acts as reflectors [11]. In Yagi-Uda antenna feed element is often a dipole or folded dipole.

III. PARASITIC ARRAY ANTENNA DESIGN

Design parameters and mechanical design of antenna is included in this section.

A. Design Parameters

Antenna design parameters are tabulated and the results are optimized using antenna simulation tools. Ground is skirted, since skirted ground provides mechanically sound model for PCB assembly to mount at back of antenna [12]. Skirt is $\lambda/4$ in length similarly each monopole element is lambda/4 in length and $\lambda/200$ is its radius.Table I shows the design parameters for the seven-element switched parasitic array antenna.

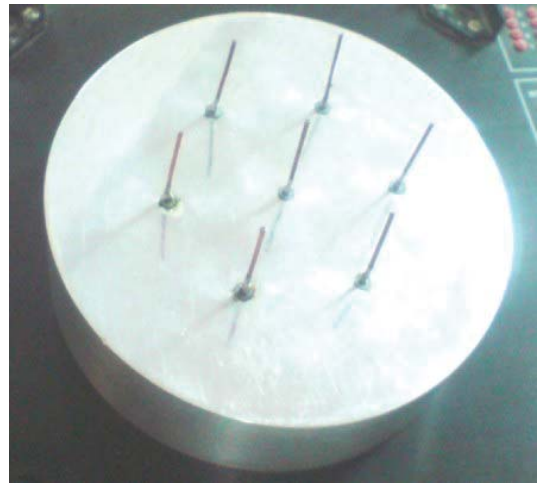

Fig. 4. Designed seven element parasitic switched array antenna.

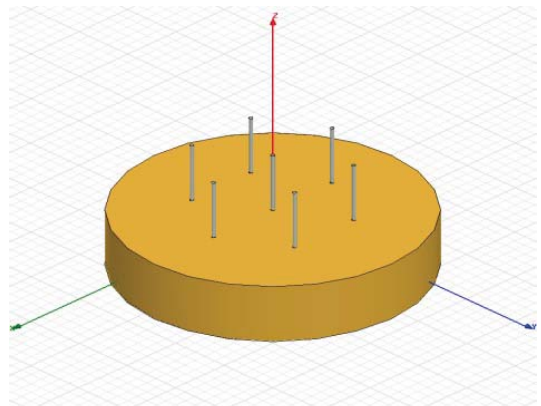

Fig. 5. Simulated antenna model.

B. Mechanical Design

Monopole elements are made by cutting copper wire of desired gauge i.e lambda/200 in radius [13] and these elements are soldered on pin of SMA connectors.Aluminum is used as ground plane. Electromagnetic waves are reflected by the ground. Instead of using seven dipole elements we have used seven monopole elements mounted on the ground plane [14]. Ground is made hollow in order to create space for mounting control circuitry [15]. Fig. 4 shows designed hardware.

IV. ANTENNA SIMULATION AND PLOTS

The antenna is first simulated and then simulated results are compared with the measured results of fabricated antenna. Simulated results were in line with the hardware results and 8 dB gain was observed in simulated results as well as in fabricated antenna. In simulation each of the parasitic element is loaded with lumped port excitation, simulating opening and shorting [16] of monopole elements. Fig. 5 shows simulated model.

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TABLE II
MAXIMA PATTERN

Azimuth Angle	Element 1	Element 2	Element 3	Element 4	Element 5	Element 6
0 degree	Open	Short	Short	Short	Short	Short
30 degree	Open	Open	Short	Short	Short	Short

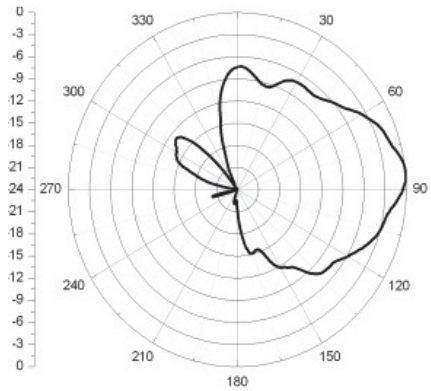

Fig. 6. Anechoic chamber results for θ=90^0 (Beam in elevated because we are using monopole elements with finite ground).

Two dimension polar plots depicts the beam steering in the direction of given elevation angle, theta (θ) and azimuth angle, phi (ϕ). Anechoic chamber results for θ=90 and ϕ=0 and 30 degrees are shown in Fig. 7 and 8 respectively. Using large ground plane angle of elevation is reduced closer to 90^0. Fig. 6 shows anechoic chamber result for θ=90 one can observe small elevation form desired x-y axis because of ground skirt [17].In simulations elevation angle of 85^0 is observed. Fig. 6(a) shows antenna simulated plot for elevation angle θ and Fig. 6(b) shows anechoic chamber results.Anechoic chamber plot of Fig. 7 shows maxima at ϕ=0^0, in order to get maxima at 0^0 elements from element number 2-6 are shorted and the element 1 is opened. Similarly Anechoic chamber plot of Fig. 8 shows maxima at ϕ=30^0, in order to get maxima at 30^0 elements from element number 3-6 are shorted and element 1 and element 2 are open.

Traditional ESPAR antenna and switched parasiric array antenna have all cylindrical elements, including the active element [3], [4]. We have made center element conical instead of cylindrical. Due to conical nature of active element response our frequency range and improved. In order to validate the gain enhancement both models were simulated and results were compared. Fig 9. (a) shows conventional design and Fig. 9(b) shows simulated antenna with conical center element. Fig. 10 shows S_{11} plot for cylindrical active element. Considering -8_{dB} as cut off point bandwidth range from 2.358 GHz to 2.51 GHz (0.152 GHz). Fig. 11 shows $S-11$ plot for centre conical element, considering 8_{dB} as cut off point bandwidth ranges from 2.36 GHz to 2.555 GHz (0.195 GHz). Therefore my making center element conical we have improved bandwidth as compared to traditional switch array

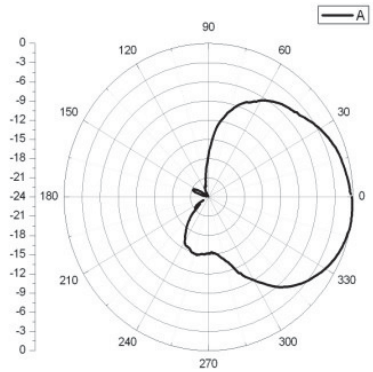

Fig. 7. Anechoic chamber results for ϕ=0^0.

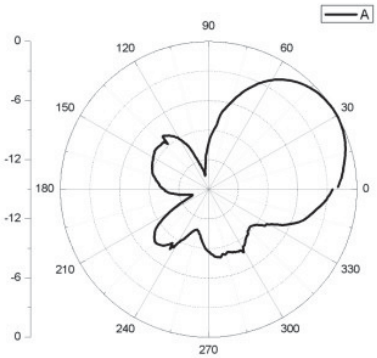

Fig. 8. Anechoic chamber results for ϕ=30^0.

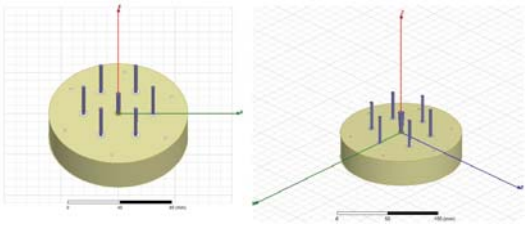

Fig. 9. (a) Conventional ESPAR antenna model with cylindrical Center Element, Fig. 9 (b) Designed ESPAR antenna with conical element for Bandwidth Enhancement.

parasitic antennas. Low profile design for switched parasitic array antennas in also highlighted in [18].

V. FUTURE WORK AND CONCLUSION

5G networks will be designed for device to device, device to human and human to human interactions. High data rates are required to meet demands of 5G systems. One of proposed bands for 5G is in mm-Waves range i.e from 30GHz to 60GHz for such high frequencies path losses are considerable and beam steering antennas are way forward to overcome path

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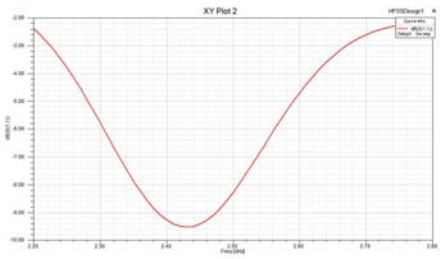

Fig. 10. S_{11} plot for conventional switched array antenna.

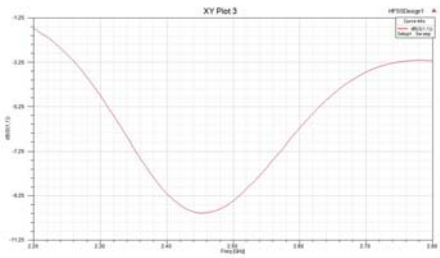

Fig. 11. S_{11} plot for center conical element switched array antenna.

losses [19]. ESPAR and switched parasitic array antennas provide a cost effective way of incorporating adaptive beamforming in future 5G and internet of Things (IoT) devices [20]. However for the efficient use of ESPAR antennas in mobile terminals the size of the antenna system must be reduced, for this further research on dielectric switched parasitic array antennas is underway. Seven element switched parasitic array antenna is designed that is capable of dynamic beam steering. Gain of 8dB is achieved practically. Simulated results are in line with the anechoic chamber results. Designed antenna increase the channel capacity by improving signal to noise ratio. Gain of 8dB was achieved in specified directions of elevation angle ,theta (θ) and azimuth angle, phi (ϕ). Antenna is optimized in terms of interference reduction for its use in wireless ad hoc networks, operating at frequency of 2.45 GHz. Bandwidth of designed antenna is 450 MHz and beam is steered in 360^0.

Acknowledgement

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Recent Antenna System Technologies for Next-generation Wireless Communications

Koichi Tsunekawa†

Abstract

This paper describes the requirements of the antennas or antenna systems in recent high-speed and high-capacity wireless communication systems and the key technologies for satisfying them. It also explains the antennas and antenna systems being researched and developed for next-generation wireless communication systems. The antenna in such a system requires high gain, high-efficiency antenna elements and a multi-antenna design. This paper introduces a high-efficiency antenna created by integrating it with a monolithic microwave integrated circuit (MMIC) in a millimeter-wave frequency-band system, a multi-antenna system for the multiple-input multiple-output (MIMO) technique that enables multiple data transmission for land mobile communication systems, and a beam-scanning antenna for satellite communication systems. It also explains the general research and development trend of antenna systems and technical problems in each wireless system as an introduction to the other selected papers in this issue.

1. Introduction

Wireless access technologies have advanced rapidly [1] and broadband wireless communication systems have become popular in our daily lives. An antenna is a very important component of a wireless system because it acts as the input and output interface for wireless equipment, as shown in **Fig. 1**. However, system performance is determined by the total performance of each component, such as the antenna and the radio-frequency (RF), intermediate-frequency (IF), and baseband (BB) units. For recent high-performance wireless systems, overall system design has been essential. Accordingly, the antenna must not

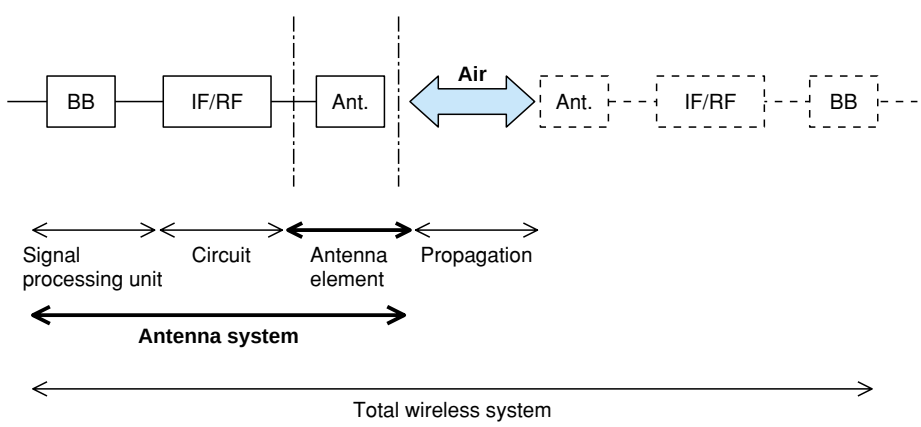

Fig. 1. Wireless and antenna system.

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only have antenna elements with high-performance characteristics, but must also perform effectively as an antenna system in conjunction with the RF, IF, and BB units. New functions can be added through antenna system design: for example, appropriate radiation pattern control provides a large system capacity by using baseband signal processing and an antenna element with an integrated RF circuit provides high gain without feeder loss.

The selected papers in this issue describe the latest antenna and antenna system technologies for achieving high performance. Two of the papers present beam-scanning antenna systems in satellite broadband communication. Beam scanning is carried out using by two methods: one [2] uses a variable active device or tunable reactance device incorporated into the antenna element, which has high-speed electronic control while the other [3] uses mechanically controlled antenna movement, which has a very precise direction control function. Another paper [4] introduces an active integrated antenna system with an RF circuit, which provides high gain and high efficiency, for a high-capacity millimeter-wave transmission system. And two papers describe a multiple-input multiple-output (MIMO) antenna system for obtaining high-speed transmission and high system capacity in the land mobile communication system from the viewpoints of beamforming techniques [5] and implementation methods [6].

As an introduction to these advanced antenna techniques, this paper provides a general explanation of the requirements of antennas and antenna systems in recent high-speed and high-capacity wireless communication systems and the key technologies for satisfying these requirements. It also describes current antenna systems and NTT's antenna research results for typical wireless systems.

2. Antenna requirements in recent wireless communication systems

The trend of wireless systems is shown in **Fig. 2**. This indicates the typical system transmission speed and number of antennas needed to achieve a particular system performance for each operating frequency. Wireless communication systems are moving towards high transmission speeds and high capacity by using higher system frequencies to enable a wide frequency

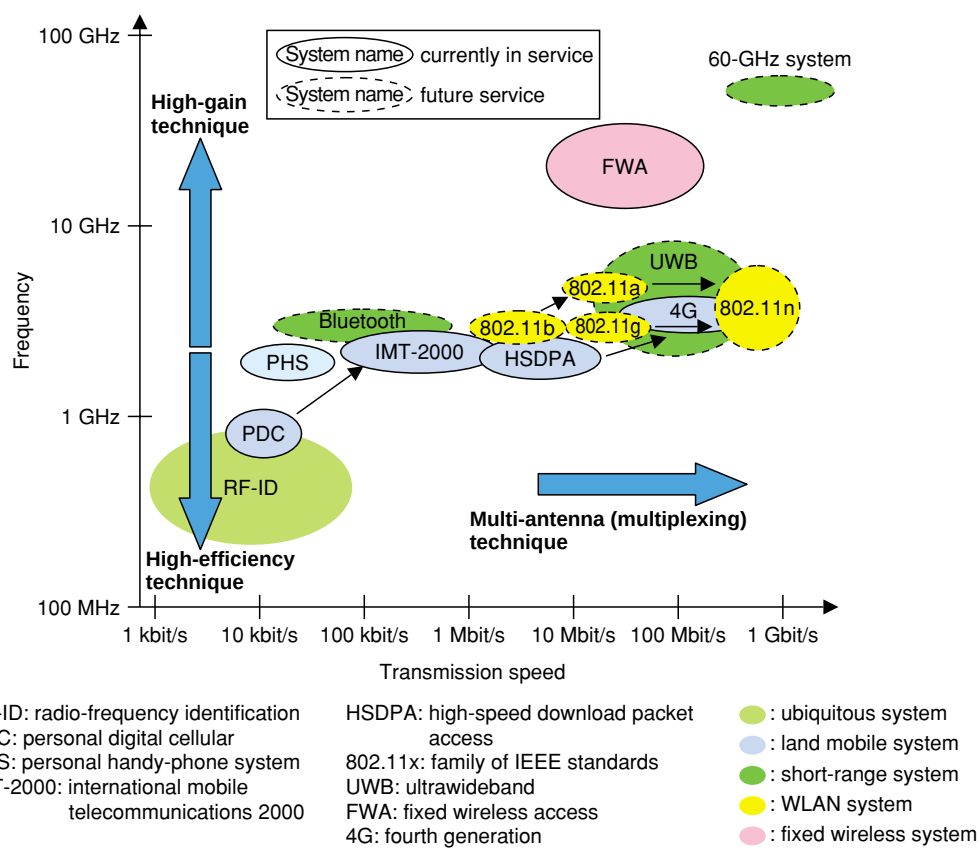

Fig. 2. Advances of terrestrial wireless communication systems and their relationship to antenna technologies.

band and using advanced system technology to achieve high quality and signal multiplexing. The antenna requirements for these system properties are:

- High-gain and high-efficiency technology
- Multi-antenna technology

Increases in the gain and efficiency of an antenna are offset by higher propagation loss at high frequencies, so the received signal level needs to be higher. High gain is an age-old problem in antenna research and development. Multi-antenna technology improves the receiving signal quality and provides multiplexed signal transmission by using an antenna system that includes RF circuits, BB units, and antenna elements.

2.1 High-gain and high-efficiency antenna

Theoretical and experimental antenna gain and efficiency characteristics are shown in **Fig. 3**. The dependences of gain and beamwidth on horn dimension L(λ) in a relatively large antenna are explained in Fig. 3(a) [7]. When L is more than 0.5 times the wavelength, the antenna's efficiency is about 100%; a larger antenna provides higher gain. However, the high-gain radiation pattern leads to a narrow beamwidth. Therefore, a mobile terminal needs to use beam-scanning or beam-tracking techniques to follow the transmitter while the terminal moves. On the other hand, the efficiency decreases if the antenna size is less than 0.5 wavelengths. The bandwidth of a linear dipole antenna versus its efficiency for various antenna sizes (D: diameter) is shown in Fig. 3(b). This graph was estimated from theoretical limits [8] and many experimental results. The antenna efficiency becomes approximately –5 dB when antenna bandwidth of 10% is provided using a linear dipole antenna with a length of 0.3 wavelengths. This figure shows that the efficiency and bandwidth have a tradeoff relationship and that the efficiency drops greatly as the antenna size decreases. Therefore, some clever ideas for the antenna element structure are needed to overcome these weak points.

2.2 Multi-antenna system

A multi-antenna system has several antenna elements, but it does not merely work as an ordinary array antenna. The performance requirements are satisfied because the antenna system includes RF circuits, BB units, and antenna elements. The antenna element technologies and the multi-antenna system are shown in **Fig. 4**. In the antenna element, a high gain can be achieved by improvements to the antenna element structure, for example, by using a new material, adding a parasitic element, or integrating an RF circuit (Figs. 4(a)–(c)). The antenna shown in Fig. 4(c) is called an integrated antenna. It can control the radiation pattern as well as provide high gain by eliminating feeder loss. In a multi-antenna system (Fig. 4(d)), the radiation pattern is controlled by baseband signal processing, so the pattern of each wireless channel can be controlled by each baseband channel. Furthermore, it is possible to get multiplexed signal transmission in the space domain by baseband signal processing. Multi-antenna systems are generally called smart antennas or active antennas [9].

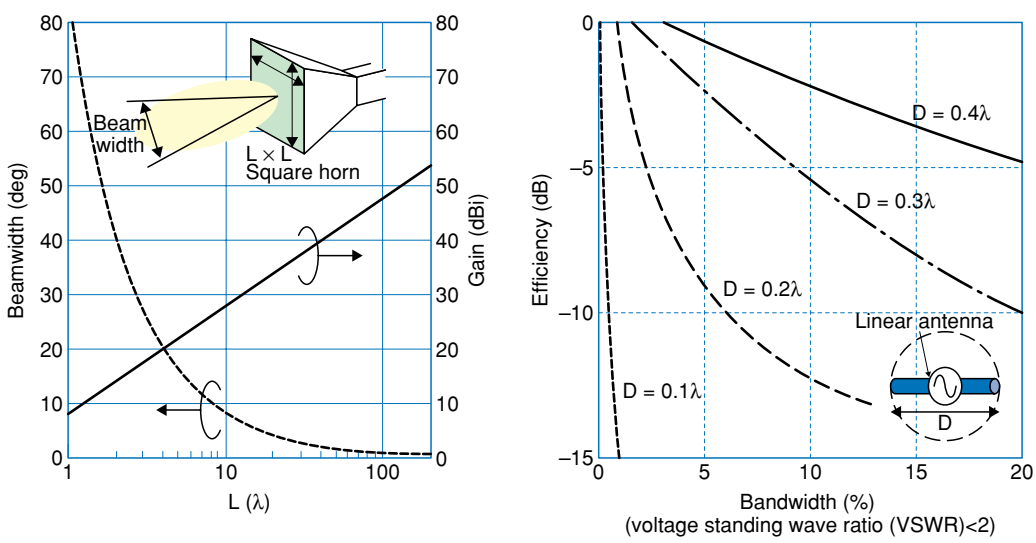

(a) Aperture antenna gain characteristics

(b) Dipole antenna efficiency characteristics

Fig. 3. Antenna gain and efficiency characteristics.

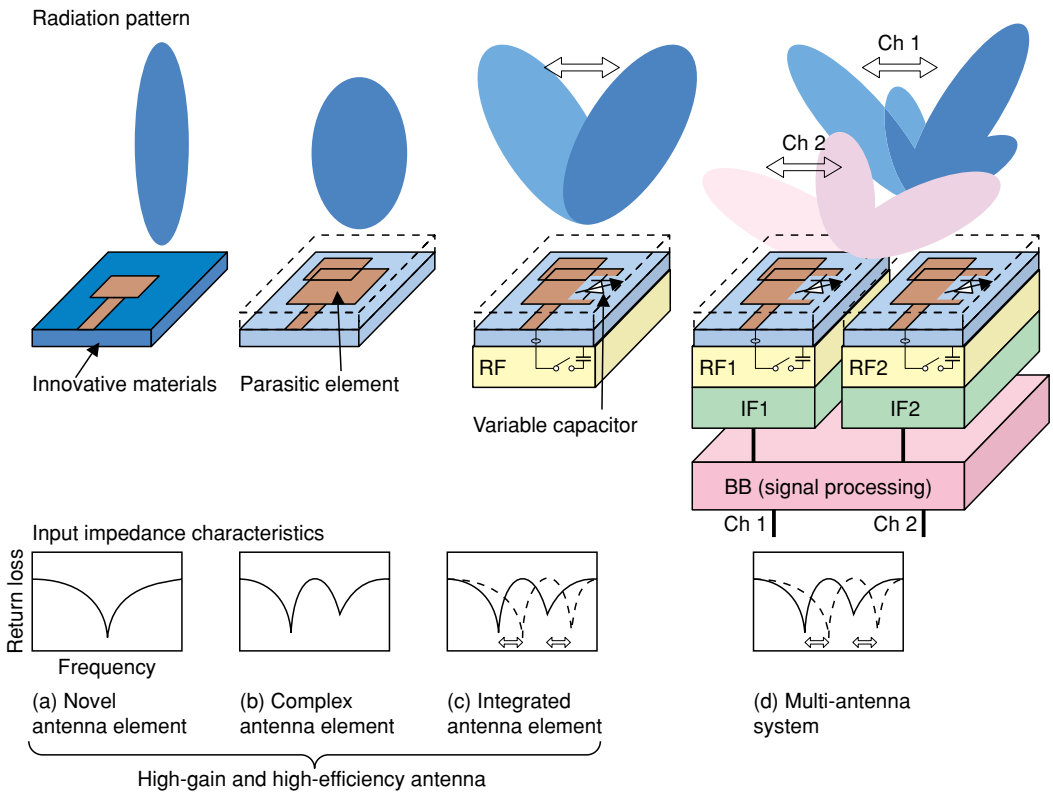

Fig. 4. Antenna elements and system.

An example of a mobile communication system using a smart antenna in the base station is shown in **Fig. 5**. Independent information can be sent to the terminals, which are spatially separated, using the same frequency at the same time because each beam is generated for a specific terminal by using the space division multiple access (SDMA) technique. Furthermore, N multiplexed transmissions can be sent to a terminal with N antennas by utilizing the slight difference in antenna locations in the terminal. MIMO is representative of this kind of technology. The latest smart antenna systems can increase the antenna gain even in a mobile system and expand the service area. The designed system capacity can be increased by using multiplexing techniques based on baseband signal processing. Multi-antenna systems can achieve very high performance with high-level functions corresponding to the wireless system requirements.

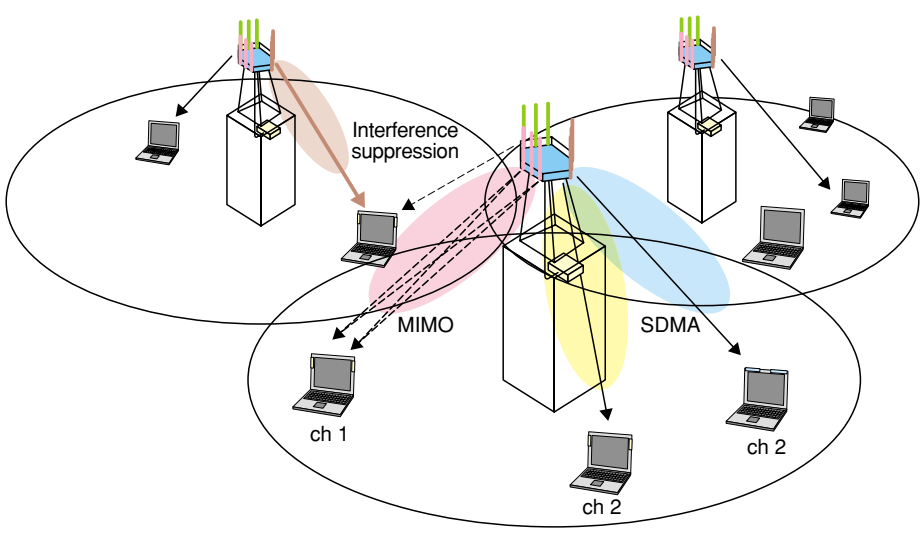

Fig. 5. Smart antenna system (land mobile telecommunication).

2.3 Key antenna technologies

The key technologies for achieving a high-gain,

high-efficiency, multi-antenna system are shown in **Table 1**. Antennas for the latest wireless communication systems are required to achieve high gain and high efficiency. The multi-antenna systems are designed to make maximum use of system resources, especially space.

3. Wireless systems and suitable antenna systems

The kinds of wireless systems that we can expect to find around us in the near future are illustrated in **Fig. 6**. RF-ID (radio-frequency identification) tags will be attached to various kinds of objects in a ubiquitous network and a large quantity of information will be gathered to provide useful knowledge to each person. High-speed data transmission ranging from a few megabits per second to 1 Gbit/s will be possible in mobile satellite systems, land mobile systems, and wireless local area network (WLAN) systems. In home networks, individual items of electronic equipment will be connected to each other at very high

Table 1. Key technologies to meet antenna requirements.

Requirements	Key technologies
1) High gain and high efficiency	a. Innovative materials (meta-material, high magnetic material, …) b. Element design (parasitic element, fractal element, …) c. Integrated antenna (antenna with RF circuit or RF device, …) d. Active antenna (antenna within variable reactance or switch, ….)
2) Multi-antenna techniques	a. Beam scanning antenna b. Sector antenna (fixed narrow multi-beam system) c. Diversity antenna d. SDMA antenna e. MIMO antenna

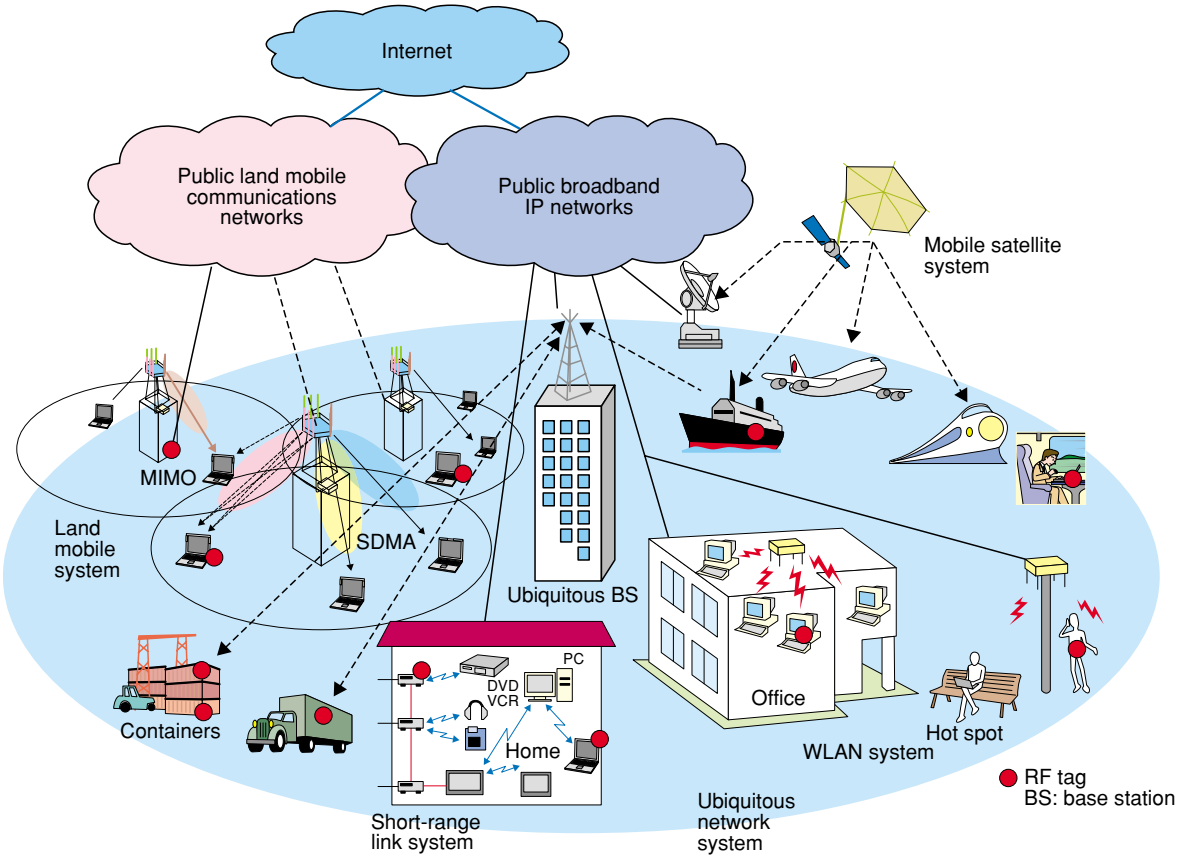

Fig. 6. Wireless communication systems.

Table 2. Wireless systems and NTT's antenna system approaches.

	System features	Main technical trends (example system, standard, or equipment)	NTT's antenna approaches (using technologies in Table 1)
Ubiquitous RF-ID	Multiple access Low rate	Active tags Sensor network Mesh network (802.15.5)	Compact high-efficiency tag antenna High-gain beam tilting base station antenna (1a, 1b, 1c)
Short-range communication	Short range Ultrahigh speed Link transmission	High frequency band (millimeter-wave system) Ultrawideband (UWB) Infrared rays (IrDA)	Active integrated antenna system (millimeter wave) (1b, 1c, 2a, 2b)
Land mobile and WLAN	Medium range High speed/capacity Many subscribers	MIMO-OFDM (802.11n,802.16a/e) MC-CDMA (4G, Beyond 3G) HSDPA (3.5G,1xEV-DO/V)	MIMO-OFDM antenna system Compact mobile terminal antenna system (1b, 1d, 2b, 2c, 2d, 2e)
Mobile satellite	Very long range Medium to high speed Various mobile stations	S/Ku band high-speed mobile comm. (N-Star/ETS-VIII) Broadband (Internet) (WINS) Millimeter wave/optical comm. (MILSTAR, GeoLITE)	Multi-beam antenna Large deployable antenna Beam-tracking antenna system (1c, 1d, 2a, 2e)

(discussed in papers in this issue)

speed (several gigabits per second) wirelessly instead of by cables. In these wireless systems, highly functional and high-performance antennas will be essential. **Table 2** explains the main features and technical trend of the systems and also shows NTT's approaches to antennas and antenna systems for each high-performance wireless system. The technologies in Table 1 that are used are indicated in parentheses. Each antenna system must satisfy severe specifications and also provide high functionality, as shown in Figs. 4(c) and (d). The antennas discussed in the selected papers in this issue are shown in blue in Table 2. The present status of each antenna system and research and development in NTT are explained below.

3.1 Ubiquitous network antenna system

Tag antenna elements have the same problems as pagers or portable telephone systems that use the LF, UHF, and VHF bands. The antenna element must be as small as possible and have high efficiency in a small volume and in the neighborhood of various objects. Most antennas for passive tags using the LF band (13 MHz) are spiral, helical, N-turn loop, or meander line antennas [10] for achieving an electromagnetic induction area and their gains are considered to be very low. Bent and spiral monopole or dipole antennas are used in personal computer card wireless communication systems or in small square film tags using UHF-band systems [11]. The approach is to design the antenna and RF-IC as one system; in other words, the connection impedance between the antenna and RF-IC is designed as a freely selectable value instead of being restricted to 50 Ω. The same kind of technique is currently being investigated in NTT in a study of active integrated antennas [12]. On the other hand, the base station antenna can be designed by applying techniques developed for pagers or land mobile antennas because it has high-gain and beam-tilting characteristics.

3.2 Millimeter-wave frequency band communication antenna system

A high-speed wireless communication system is achieved by using wideband technology, so millimeter-wave frequencies, which provide a very wide bandwidth, are attracting attention. The use of high frequencies also requires high output power to compensate for the huge propagation loss and passive circuit losses, so high-gain and high-efficiency antennas are very important in system design [13]. Millimeter-wave systems mainly use horn, reflector [14], or lens antennas [15]. Horn or reflector antennas are used in relatively long-range communication where the range is several hundred meters. A lens type antenna, which is integrated with monolithic microwave integrated circuits (MMICs) to achieve high efficiency without a feeding line, is mainly used for short-range transmission, e.g., for a home link system. Active integrated antenna technology in which an amplifier for transmitting and receiving is mounted without using a connector or cables is suitable for a high-frequency-band system [16]. Typical antenna types for millimeter-wave frequency systems are shown in **Table 3**. Horn or reflector antennas provide very high gain but cannot be integrated with MMICs. The lens antenna provides high gain and can be made into an integrated antenna but requires adjustment to correct its

Table 3. Antenna types for millimeter-wave systems.

Antenna	Gain	Integration with MMIC	Mounting adjustment
Horn or reflector	Very high (over 20 dBi)	No	(Feeder)
Lens	High (10 to 20 dBi)	Yes	Needed
Single patch	Low (2 dBi)	Yes	No
Parasitic element patch	High (10 dBi)	Yes	No

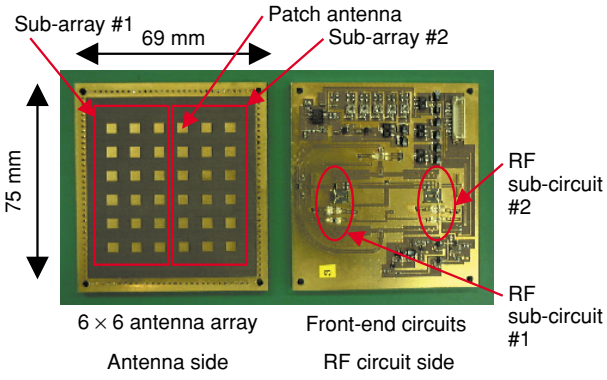

Fig. 7. Active integrated antenna for 25-GHz system.

mounting error. The patch antenna is a good element for integration with MMICs because it can be made on the same material substrates, so it does not need antenna adjustment. We have developed an active integrated antenna designed for broadband mobile wireless access systems using the 25-GHz band, as shown in **Fig. 7** [12]. It exhibited output power of 14.6 dBm and a noise figure of less than 5 dB. The only weakness of this integrated antenna is that high gains cannot be provided with one patch antenna. The third selected paper in this issue describes a high-gain integrated active antenna and high-efficiency RF circuit for the millimeter-wave frequency band for a millimeter-wave communication system [4]. A high-gain integrated patch antenna is investigated as a parasitic element to obtain a wide antenna aperture. The millimeter-wave frequency-band link system was first proposed for application to the transmission of uncompressed HDTV (high-definition television) signals in the home or in a studio.

3.3 Land mobile and WLAN antenna systems

The number of subscribers to land mobile systems, especially cellular systems, has increased rapidly, and users are now demanding high-speed transmission for broadband Internet access. To meets these demands, many improvements to the land mobile system have been proposed such as wideband code division multiple access (W-CDMA), adaptive modulation, and *ad hoc* transmission. Recently, the utilization of space has become as desirable as frequency and time utilization [17]. Space utilization is achieved using a multi-antenna system with a radiation control mechanism, which is accomplished by a smart antenna system.

3.3.1 Typical multi-antenna techniques for mobile systems

The application areas of multi-antenna techniques depend qualitatively on the system characteristics, as shown in **Fig. 8**. A fixed high-gain beam antenna does not always need antenna elements, but the other techniques are achieved through various combinations of antenna elements, so they are provided by adaptive or integrated multi-antenna systems, as shown in Figs. 4(c) and (d). A narrow-beam or high-gain antenna is used in the line-of-sight situation (where there are no obstacles between the transmitting and receiving antennas and there are few paths in the multipath transmission), so a beam-scanning mechanism is needed when a terminal moves fast, and multiple beams or sector beams are required when there are many terminals in the service area. The diversity antenna technique can provide a stable signal level in a multipath mobile environment. Beam scanning (with a sector beam or multiple beams) and diversity antenna techniques have been used fairly extensively from the early days of mobile communication service because they use only simple signal processing. However, with the rapid progress of signal processing technology, a desired signal can now be distinguished from a mixture of many signals in a multipath environment. The SDMA technique distributes signals among the terminals communicating in the service area. MIMO techniques enable very-high-data-rate communication with multiplexed transmission in each antenna of the multi-antenna system of the base station or mobile terminal. These techniques require more calculation as the movement speed of the mobile terminal increases. In these wireless systems, signal processing ability and superior algorithms are more important than the performance of antenna elements.

3.3.2 Research results and developed antenna systems

A very small and thin planar six-sector antenna using a patch Yagi-Uda array with common directors for mobile terminals has been proposed (**Fig. 9**) [18],

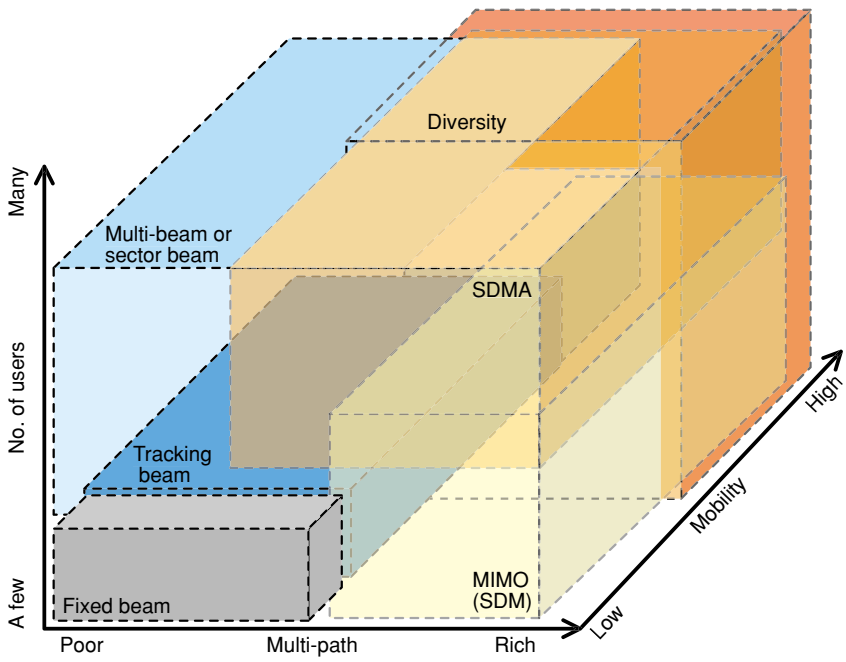

Fig. 8. Dependence of multi-antenna techniques on system characteristics.

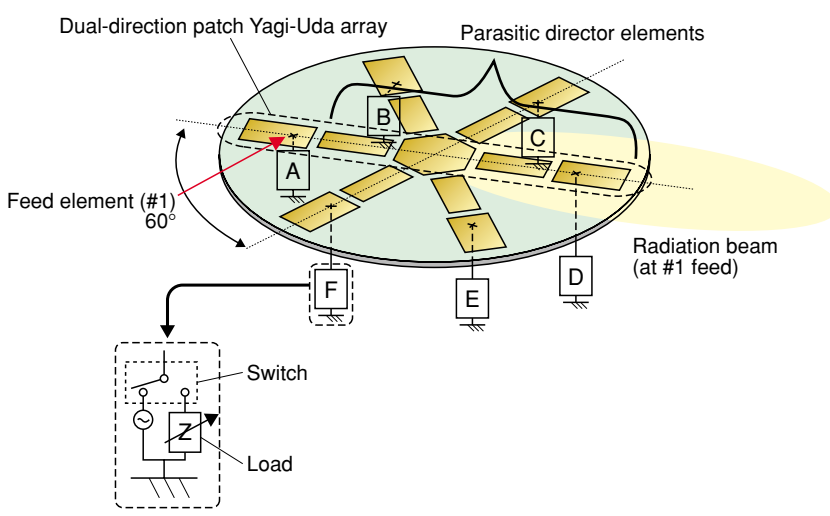

Fig. 9. Thin and small sector beam antenna.

[19]. It has square parasitic director elements that are shared by two sector arrays that face in opposite directions, and it has a hexagonal central director element that is shared by all six sectors. These elements form three line arrays, which intersect at 60°. These shared elements enable the sector antenna to be compact. Experimental results showed that the fabricated antenna had a conical plane beam width of 63° and high front-back ratio of 17 dB. The creation of adaptive (smart) antenna hardware has been investigated [20]. A novel beam combination method for wideband digital indoor communication systems such as WLANs has been proposed [21] in NTT. Crossed fan beams are used at the base station and mobile terminal. The beam combination method provides better transmission quality than the traditional pencil-beam combination and eliminates the need for complex beam control in the base station. Maximum dispersion distributions in the transmission frequency bandwidth have been calculated using a three-dimensional indoor propagation delay simulation algorithm. A method of designing adaptive antennas including an

antenna configuration that is suitable for street microcells, considering the propagation environment, has been described. An automatic calibration method at the transmitters and receivers using the transmitting signal (ACT), which enables realtime calibration, has been presented [22]. An SDMA technique using polarization has also been studied [23]. The transmission quality of an SDMA scheme that uses vertical pattern and polarization control was investigated in an actual cellular environment. For a sector cell system, this configuration was shown to be effective based on an evaluation of the spatial correlation characteristics. We also found that the output carrier-to-interference-plus-noise power ratio (CINR) of the proposed configuration was from 10 to 17 dB higher than that of the conventional SDMA configuration when the number of users was greater than four. The proposed configuration can reduce the antenna size compared with conventional SDMA. Moreover, MIMO techniques enable very-high-data-rate transmission using a limited frequency band. We have studied technologies based on the eigenmode-space division multiplexing (E-SDM) [24] scheme because it provides the theoretically maximum channel capacity and reduces the terminal's calculation load. The selected papers in this issue introduce both theoretical and practical technologies. The fourth paper describes new MIMO methods with beamforming to overcome problems of calculation complexity and low MIMO effect in the line-of-sight scenario [5]. The fifth paper describes the configuration of an 8 × 4 MIMO-OFDM transceiver and presents experimental results for the propagation characteristics, bit error rate (BER), and frequency utilization [6].

3.4 Satellite broadband communication system

If we want to create a seamless and flexible wireless network system, then a satellite communication system is very important because it provides a wide service area. However, it has the inherent problem that the distance between the transmitter and receiver is long, so the terminal needs a larger antenna than ones in the land mobile system to provide high-speed transmission. The effective solution is to make the satellite dish larger to provide high gain and multibeam transmission. We have studied multibeam communication satellite technology and onboard large deployable antennas for creating a broadband mobile satellite communication system [25]. An MMIC-based beamforming network equipment for a multibeam feeder whose weight is only 1/3 that of the conventional type was developed. We are also developing a large, highly precise deployable antenna with a diameter in the over-10-m range. The mobile terminal acting as an earth station is also an important component of a broadband mobile satellite communication system. Typical existing antennas in earth stations are shown in **Table 4**. Various mobile terminals are accommodated in the satellite communication system by different transmission rates, and these terminals use various antenna methods and locations. A comparatively large terminal antenna is required to handle high data transmission rates in a satellite system to mitigate the huge propagation loss. The high gain and narrow beam of a large antenna make a beam-scanning mechanism necessary to enable the antenna to follow the satellite direction as the terminal moves. The sixth selected paper describes a highly accurate and cost-effective auto-tracking antenna system for earth stations onboard vessels, using a novel inclinometer that is highly accurate in acceleration disturbance environments and a new systematic stabilization controller design process based on H_∞ control [3].

Table 4. Typical antennas in earth stations.

Satellite category	Typical satellite system	Current typical earth station antenna (size or length, gain)
LEO	Iridium Globalstar	Helical (0.1 m, 2 dBi) Linear whip (0.1 m, 0 dBi) Patch (0.1 m^2, 3 dBi)
MEO GEO	ICO N-STAR INMARSAT	Parabola (0.6 – 0.9 m, 18 – 21 dBi) Phased patch array (0.5 m^2, 14 dBi) Helical (0.3 m, 2 dBi) Patch array (0.3 m^2, 12 dBi) Patch (0.1 m^2, 3 dBi)

LEO: low earth orbit
MEO: medium earth orbit
GEO: geostationary earth orbit

4. Conclusion

This paper gave an overview of the requirements of antennas and antenna systems in recent high-speed and high-capacity wireless communication systems and the key technologies for satisfying these requirements to create next-generation wireless communications. It also described current antenna systems and NTT's antenna research results for typical wireless systems.

Antennas for next-generation wireless communications require high gain, high efficiency, and a multi-antenna design. A high-gain antenna can be made

using a relatively large antenna aperture, but a beam-scanning mechanism is needed for mobile communications. A high-efficiency antenna can be made using an active integrated antenna, which integrates an MMIC with the antenna element. Multi-antenna technology is the innovative technology that enables multiple data transmission in space. In MIMO-type multi-antenna systems, the most important key technologies are the beamforming algorithm and the implementation method. The solution technologies for NTT's advanced antenna systems are explained in detail in the following selected papers in this issue. The technological background and the current research and development situation are also described to make the papers easy to understand.

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The Roles of 5G Mobile Broadband in the Development of IoT, Big Data, Cloud and SDN

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Abstract

The fast technology development of 5G mobile broadband (5G), Internet of Things (IoT), Big Data Analytics (Big Data), Cloud Computing (Cloud) and Software Defined Networks (SDN) has made those technologies one after another and created strong interdependence among one another. For example, IoT applications that generate small data with large volume and fast velocity will need 5G with characteristics of high data rate and low latency to transmit such data faster and cheaper. On the other hand, those data also need Cloud to process and to store and furthermore, SDN to provide scalable network infrastructure to transport this large volume of data in an optimal way. This article explores the technical relationships among the development of IoT, Big Data, Cloud, and SDN in the coming 5G era and illustrates several ongoing programs and applications at National Chiao Tung University that are based on the converging of those technologies.

Keywords

5G, Internet of Things (IoT), Software Defined Networks (SDN), Big Data Analytics, Cloud Computing

1. Introduction

The roles of SDN, Cloud, IoT, and Big Data in 5G Networks have raised great interest recently [1]. According to the IEEE Computer Society (IEEE CS 2022 Report [2]), Cloud Computing (Cloud), Big Data Analytics (Big Data), Internet of Things (IoT), and Software Defined Networks (SDN) are among 4 of 20+ emerging technologies as illustrated in **Table 1**. In the meantime, based on the report in IEEE Communications Society (IEEE ComSoc Technology News [3]), among top 10 trends in 2015 as listed in **Table 2**, 5G, Virtualization (SDN & NFV), everywhere connectivity for IoT & IoE, and Big Data are also included. Combining both reports, we can identify 5G, Cloud, IoT/IoE, Big Data, and SDN as the five most worthwhile ICTs (information & communica-

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Table 1. IEEE computer society 2022 report.

Technology & Indexing Terms		
1. Security Cross-Cutting Issues	9. Multicore	17. 3D Printing
2. Open Intellectual Property Movement	10. Photonics	18. Big Data and Analytics
3. Sustainability	11. Networking and Interconnectivity	19. Machine Learning and Intelligent Systems
4. Massively Online Open Courses	12. Software Defined Networks	20. Life Sciences
5. Quantum Computing	13. High Performance Computing	21. Computational Biology and Bioinformatics
6. Device and Nanotechnology	14. Cloud Computing	22. Robotics
7. 3D Integrated Circuits	15. Internet of Things	
8. Universal Memory	16. Natural User Interfaces	

Table 2. IEEE communications society top 10 trends 2015.

1)	5G
2)	FIBER EVERYWHERE
3)	VIRTUALIZATION, SDN & NFV
4)	EVERYWHERE CONNECTIVITY FOR IoT & IoE
5)	BIG DATA, COGNITIVE NETWORKS
6)	CYBERSECURITY
7)	GREEN COMMUNICATIONS
8)	SMARTER SMARTPHONES, CONNECTED SENSORS
9)	NETWORK NEUTRALITY, INTERNET GOVERNANCE
10)	MOLECULAR COMMUNICATIONS

tions technologies) to watch out up to 2020 in term of their potential, convergence and applications. **Figure 1** depicts the overlapping of these five major ICT trends. It also illustrates how the infrastructure deployment of 5G mobile broadband and the architectural integration of Cloud Computing strongly impact the development of IoT, Big Data, and SDN. This paper explores the technical relationships of these five areas and discusses several ongoing programs and applications currently under development at NCTU based on these technologies.

2. The Roles of 5G, IoT, Big Data, Cloud, and SDN till 2020

Although so far the 5G mobile broadband requirements and standard specifications are not ready yet, 5G technology research & development are already started and some 5G features or subsystems are readily available. By Year 2020 the commercial 5G will be available and IoT applications will be deployed everywhere with mobile broadband technology. Moreover, the Big Data generated by IoT applications will become a norm and Cloud will be largely utilized to compute, store and virtualize network functions (NFV). Also, the underlying network infrastructure will adopt SDN to reduce both capital expense (CAPEX) and operational expense (OPEX). **Figure 2** further illustrates the roles of 5G, IoT, Big Data, Cloud and SDN and their relationships. This figure is modified based on the reference [4] by inserting 5G mobile broadband in the center.

3. Technical Relationships among IoT, Big Data, Cloud, & SDN in 5G Era

Based on **Figure 2**, we develop **Figure 3** to better explain the technical relationships among IoT, Big Data, Cloud, and SDN in the 5G mobile broadband services (5G MBS) [5]. First, IoT is capable of generating Big Data with four Vs: volume, velocity, variety and veracity. Then, Cloud is brought in for Big Data storage and processing. Finally, SDN is employed to provide more efficient and flexible networks for inter-Cloud data transport. Out of Big Data, Cloud, and SDN, advanced technologies such as machine learning analytics, Cloud

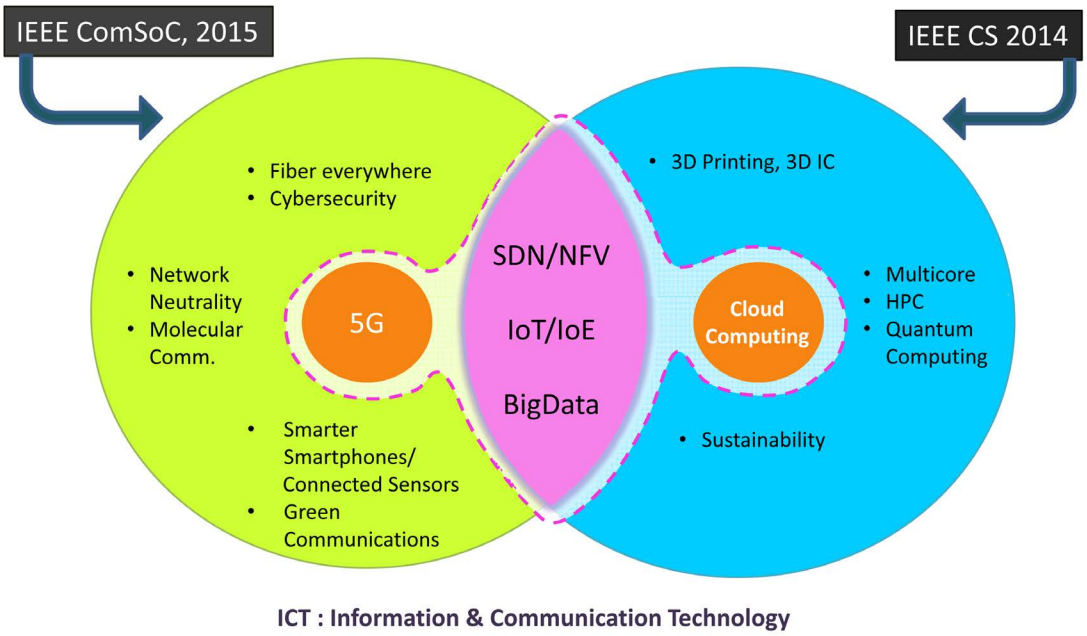

Figure 1. ICT major trends for 2015-2020.

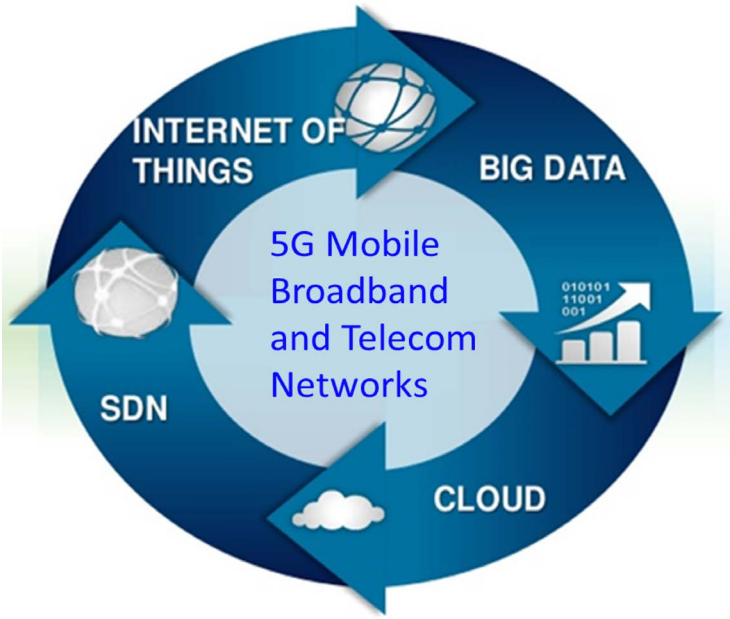

Figure 2. Relationship among 5G, IoT, Big Data, Cloud and SDN based on [4].

RAN and softwarized 5G then are developed.

As illustrated in **Figure 4**, 5G will serve as a better gateway and transport network for IoT applications so that IoT data can be delivered more efficiently and economically. In addition, IoT will become one of the major sources of Big Data by producing large volume, fast velocity, and many varieties of data [6] as illustrated in **Figure 5**.

Finally, **Figure 6** shows that Cloud can be adopted in the 5G Radio Access Network (RAN) and turns it to a Cloud-based RAN (C-RAN). Both SDN and NFV have been applied to data center in the cloud to enable better load balance and resource allocation of the cloud. SDN has also been applied to 5G mobile broadband core networks to enable smart routing, better traffic management and improve network resource utilization.

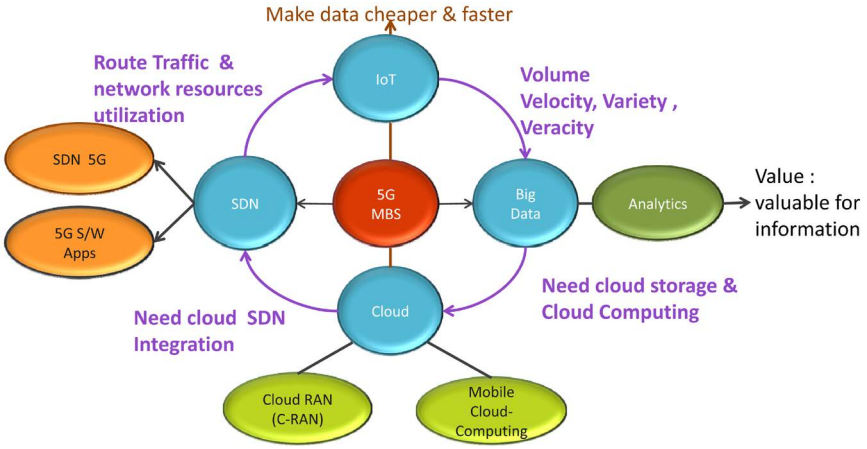

Figure 3. Technical relationships among 5G & IoT, Big Data, Cloud, and SDN.

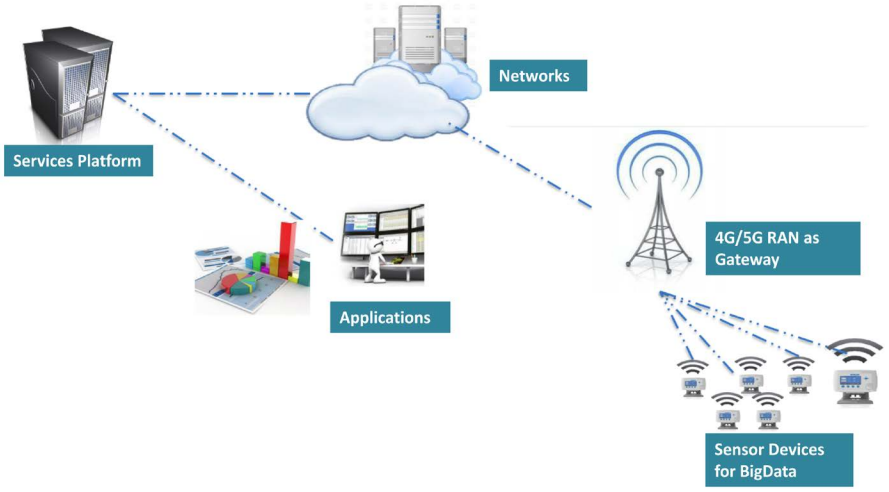

Figure 4. 4G/5G as the gateway for IoT applications.

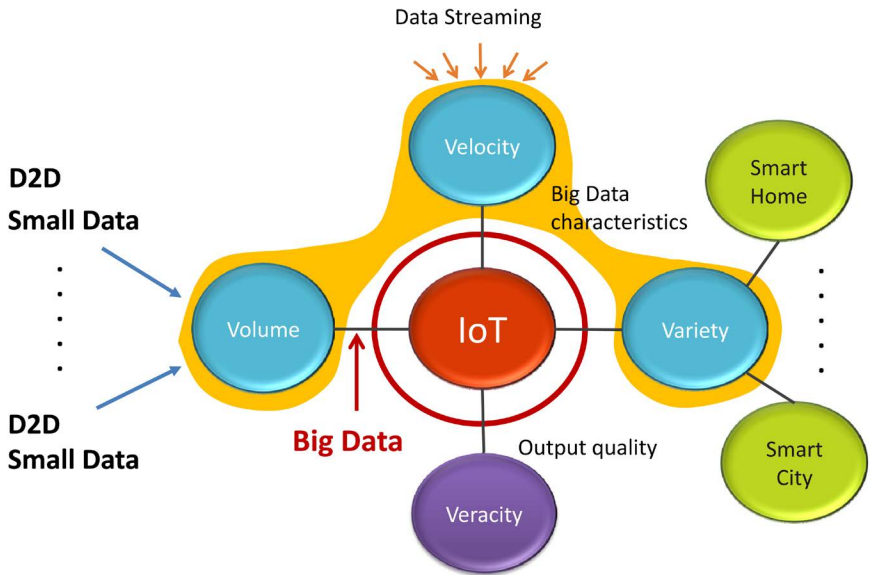

Figure 5. Relationships between IoT and Big Data.

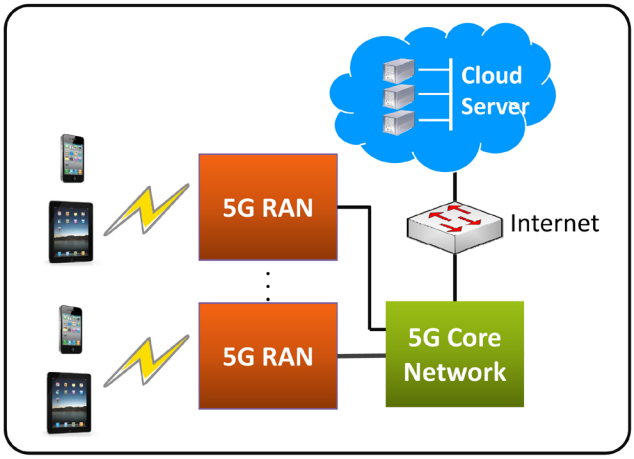

Figure 6. C-RAN architecture in 5G mobile network.

4. Ongoing Programs and Applications at National Chiao Tung University (NCTU)

In this section, we describe five ongoing programs and applications at NCTU that are closely related to the SDN, Cloud, Big Data, IoT, and 5G technologies [7]-[17].

4.1. Program on SDN-Enabled Cloud-Based Broadband and Wireless Network Technologies and Services

This program is a national program to support the SDN Industry-Academia Cooperation, led by both NCTU and CHT (Chunghwa Telecom, the largest mobile & telecom operator in Taiwan) with 5 other networking and communications companies in Taiwan. This is a multi-year program with the target to set up a testbed for end-to-end testing and to help establish an ecosystem for local SDN industry.

Figure 7 shows the scope of this program that covers mobile access, WiFi access, broadband core and data center cloud end-to-end application systems.

Figure 8 further shows both the structure of the program and its network configuration across NCTU, CHT and another university National Tsing Hwa University (NTHU).The program includes research and development involving 4G/LTE, B4G/5G, SDN, Cloud, SDN for Wi-Fi, and SDN for WAN technologies. There are five sub-programs: 1) SDN broadband network technologies and services, 2) SDN mobile/wireless network technologies and services, 3) SDN and cloud integration services and management, 4) SDN switch-related devices and systems and 5) SDN system integration and field trials.

The program is intended to construct an SDN network in NCTU, CHT and NTHU, respectively. These SDN networks then will be interconnected to form a wide area SDN network in Taiwan. Eventually, we plan to have this end-to-end system connected to the global network. The SDN switches deployed in this testbed will be mostly small or medium scale due to their experimental nature. Also included in this testbed are SDN-based Wi-Fi access points. Cloud-based data centers will be deployed in each location of NCTU, CHT and NTHU. Three types of SDN controllers including OpenDaylight, Ryu and Floodlight are currently under trial in the experimental network. Our architecture assumes the scenario of multiple SDN controllers with a hierarchical topology on which useful SDN APPs such as load balancer, network optimizer for video delivery, network coordinator (including visualization), dynamic flow configuration, end-to-end service configuration, dynamic policy-based traffic engineering, and multitenant network automation can be developed and deployed.

4.2. Program on Big Data Analytics for Network Traffic and Management Data

In this program, we address the network performance issues with two experimental networks: BML at NCTU campus and ITRINET of ITRI.

The architecture of the BML experimental network is illustrated in the lower part of **Figure 9** that consists of a 4G RAN, a 4G Core and a Cloud environment. For the 4G RAN, both indoor and outdoor environment are taken into consideration. The left upper part of **Figure 9** shows the scope of the ITRINET experimental network

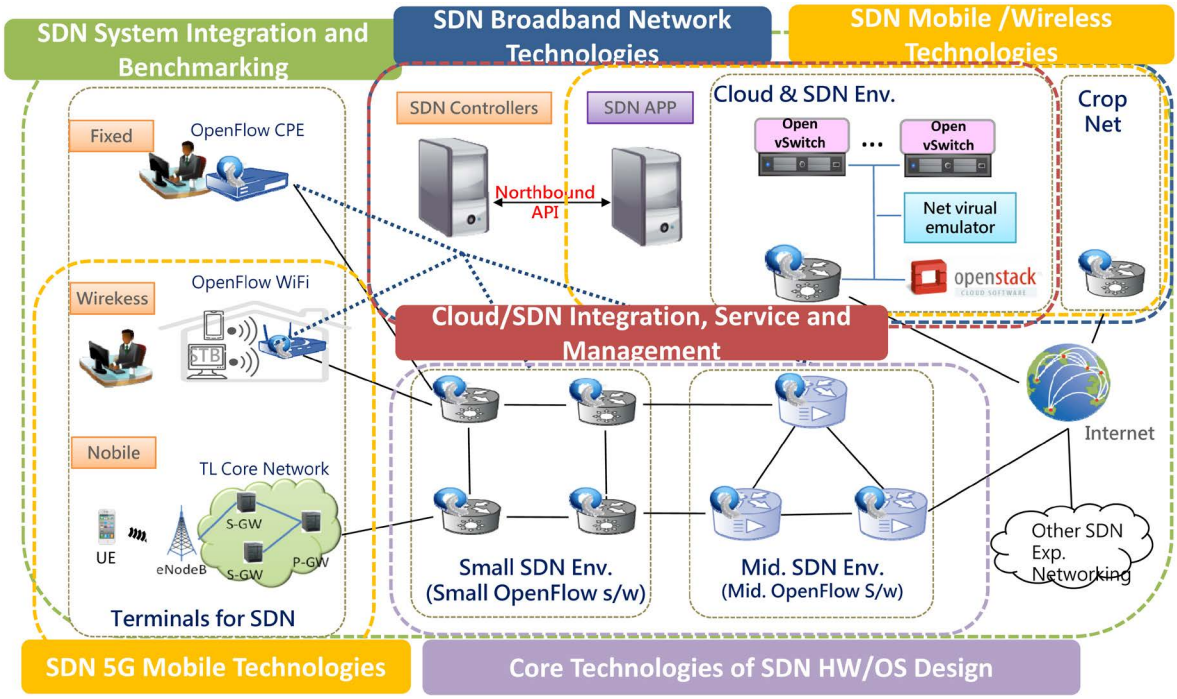

Figure 7. Applications of SDN & cloud in 4G/LTE & 5G wireless networks.

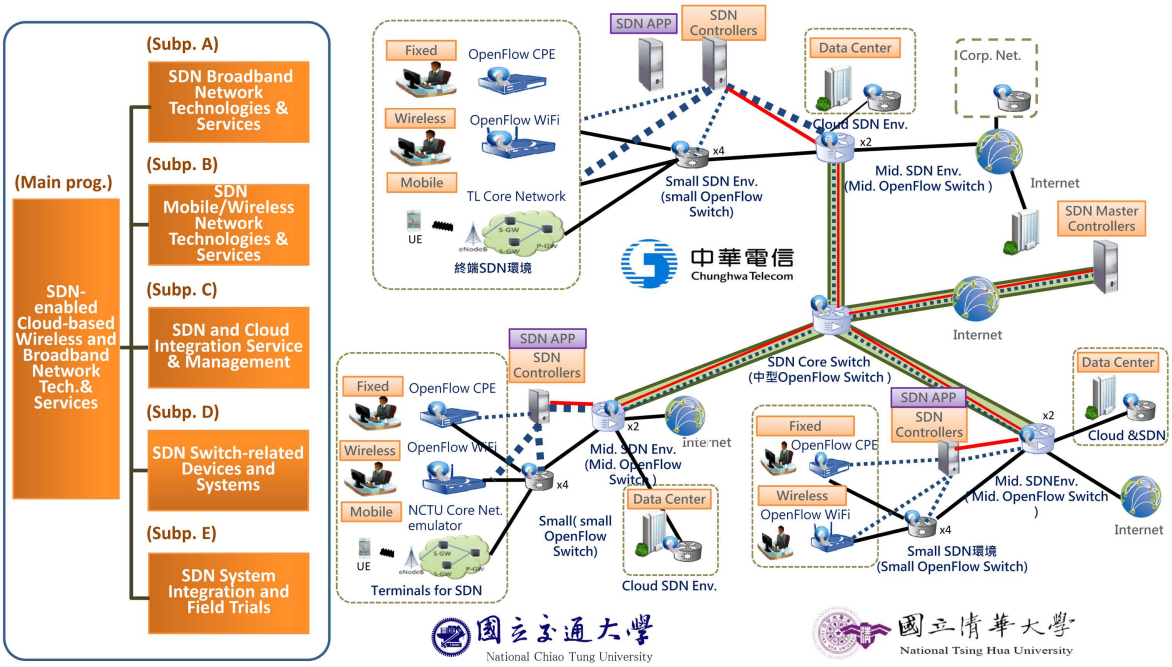

Figure 8. SDN technical R&D center and projects at NCTU.

that covers a much greater area of Hsinchu County than NCTU and includes additionally ITRI (Industrial Technologies Research Institute), HSIP (Hsinchu Science Industrial Park) and THR (Taiwan High-speed Rail, Hsinchu station). The right upper part of **Figure 9** illustrates how ITRINET covers various R&D buildings in the corporate campus of ITRI such as B11, B12, B51, etc.

Figure 10 illustrates how Big Data analytics based on InfoSphere or Spark is performed on ITRINET for the purpose of network optimization. First, network traffic measurement and network management data are collected.

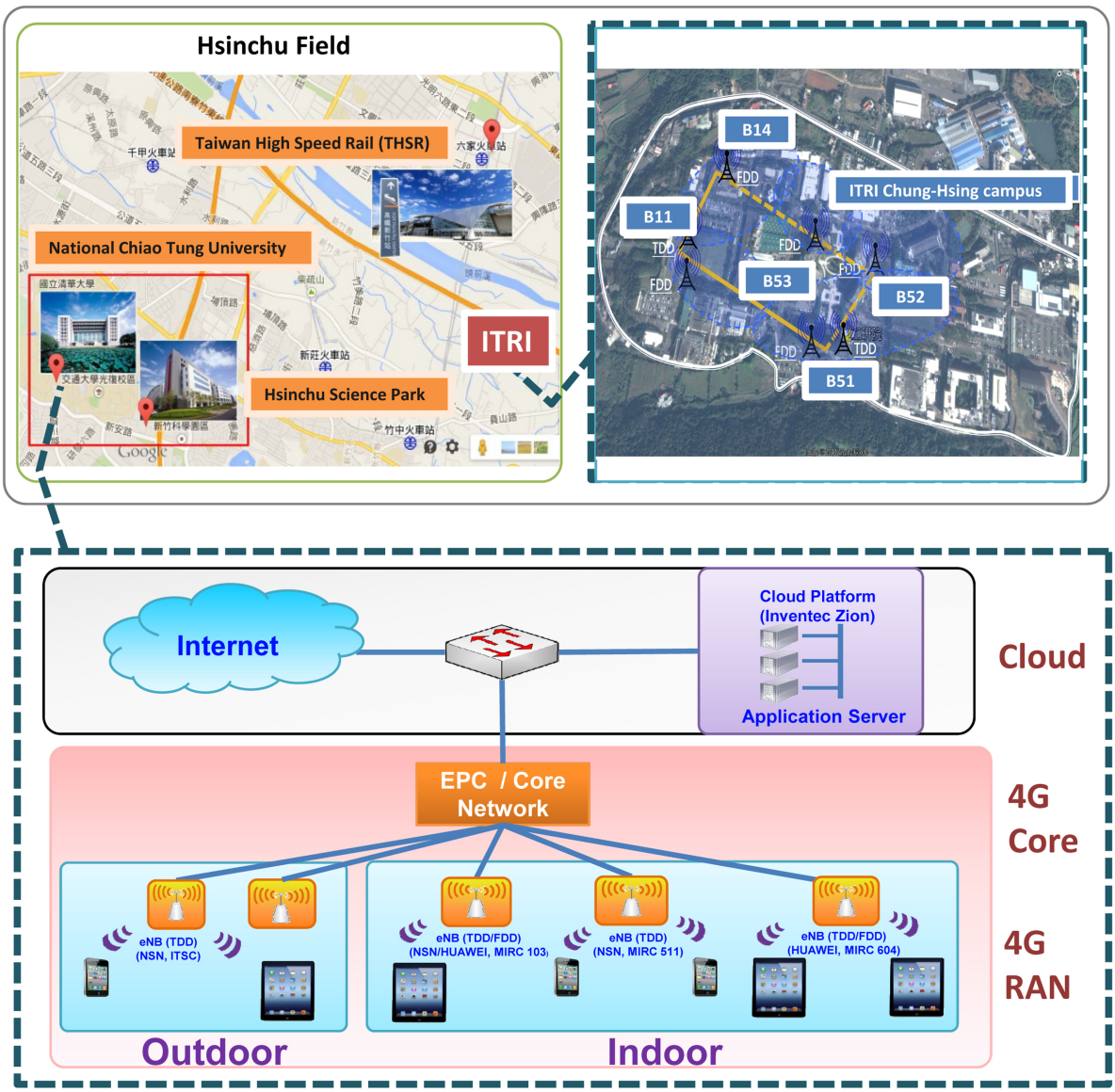

Figure 9. Greater Hsinchu 4G/LTE & Future 5G experimental network ITRINET (include ITRI, NCTU, THR & HSIP).

Then, data analytics methods based on machine learning, data mining and statistical modeling are applied to analyze the collected data. Finally, we apply the results thus generated to network performance evaluation and optimization by providing a feedback loop for system re-configuration. The whole operational cycle includes the technologies of 4G/LTE, B4G/5G, Big Data Analytics, Cloud, and Traffic Engineering.

4.3. Application on IoT Platform Integrated with Data Generation and Data Analytics

This is an application where we set up an IoT platform integrated with data generator and data analytics capabilities as illustrated in **Figure 11**. A common challenge for IoT/M2M service providers is how to test their large scale IoT/M2M applications with the near realistic data that the system will handle in a production environment. As such tests may involve not only a large number but also a large variety of sensors, deploying a testing environment that contains all the necessary sensors turns out to be an infeasible, if not impossible job. To tackle this problem, we develop a data generation method (illustrated in the lower part of **Figure 11**) based on streams generation capabilities of IBM InfoSphere and Spark to emulate data from a large number and a large variety of sensors. Such generated data will be sent into and processed by the applications residing on the IoT/M2M

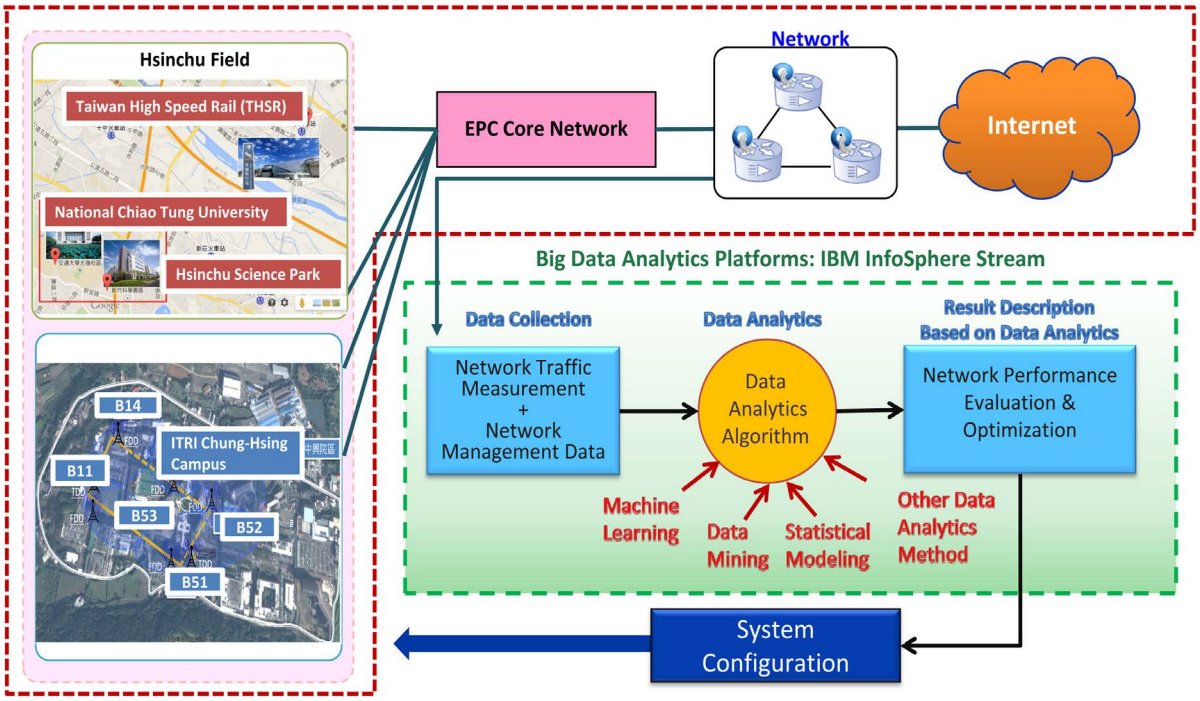

Figure 10. Big Data analytics for Traffic engineering of ITRINET.

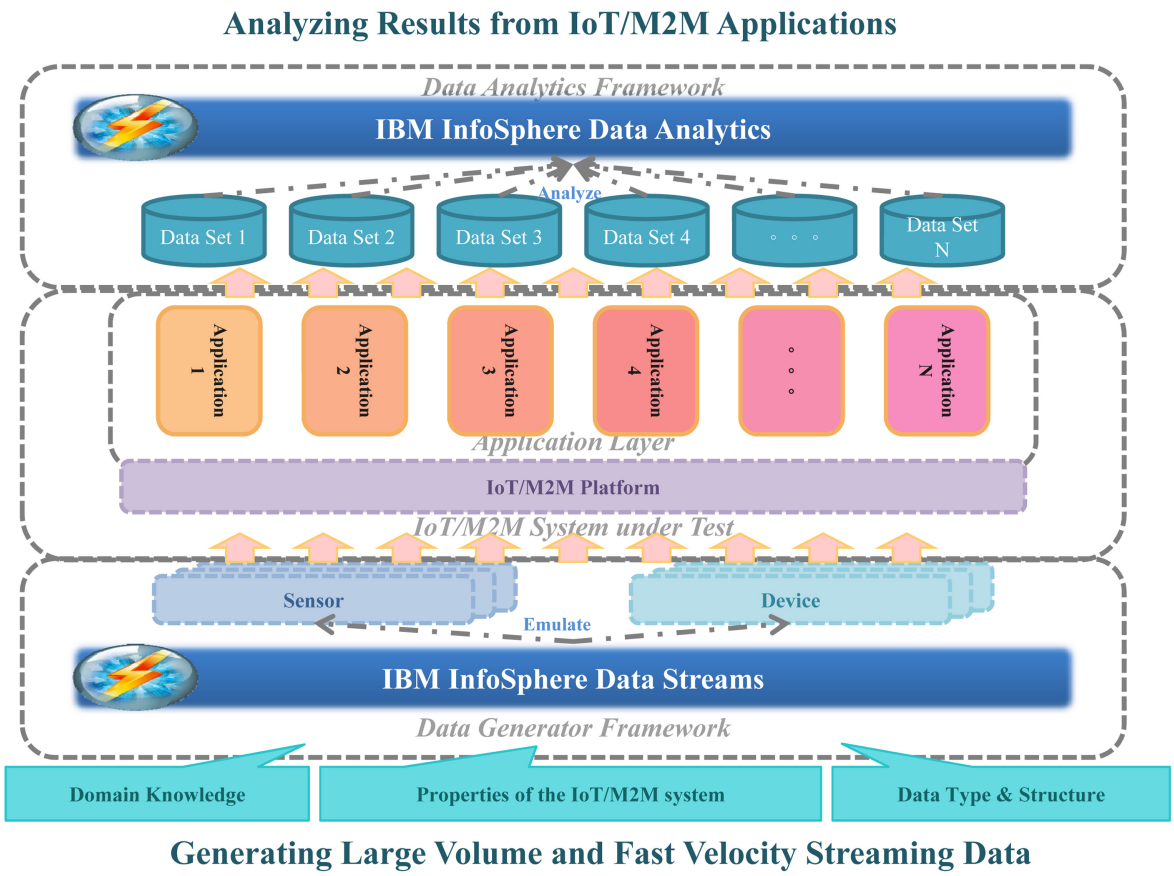

Figure 11. IoT platform integrated with data generation and data analytics.

platform (illustrated in the middle part of **Figure 11**). Finally, the data sets produced by the IoT/M2M applications are analyzed by data analytics engines in IBM InfoSphere and Spark (illustrated in the upper part of **Figure 11**).

The effectiveness of our data generation methodology is first verified in a people management system of a large factory environment. With our methodology, we are able to test our factory management IoT/M2M application more efficiently without actually deploying a large number and a large variety of sensors. This application development uses both IoT and Big Data Analytics.

4.4. Application on Data Analytics for Traffic Generated by Testing & Measurement

The automatic Testing & Measurement (T&M) of DUT (Device under Test, including 4G/LTE SD, UE/CPE) for 4-Stage (namely, conformance, interoperability, operator-IOT and field trials) testing is shown in **Figure 12**.

We apply the data analytics learning techniques for the classification of the DUT types by series numbers or id. Once the type is identified, the parameters for feature extraction can be measured by the testing and measurement equipment. An example for DUT classification is shown in **Table 3**. In this example, the DUT type relational table is a 4 × 4 table with 4 fields: 1) DUT Device Type, 2) UE capability Information (FGI), 3) DNS (TTL), and 4) HTTP (User Agent). This device relational table is created by applying multivariate statistical analytics on the network traffic flow and LTE UE connection related information. Then by extracting specific features, we are able to identify the types of DUT such as Dongle, Smartphone, CPE, etc.

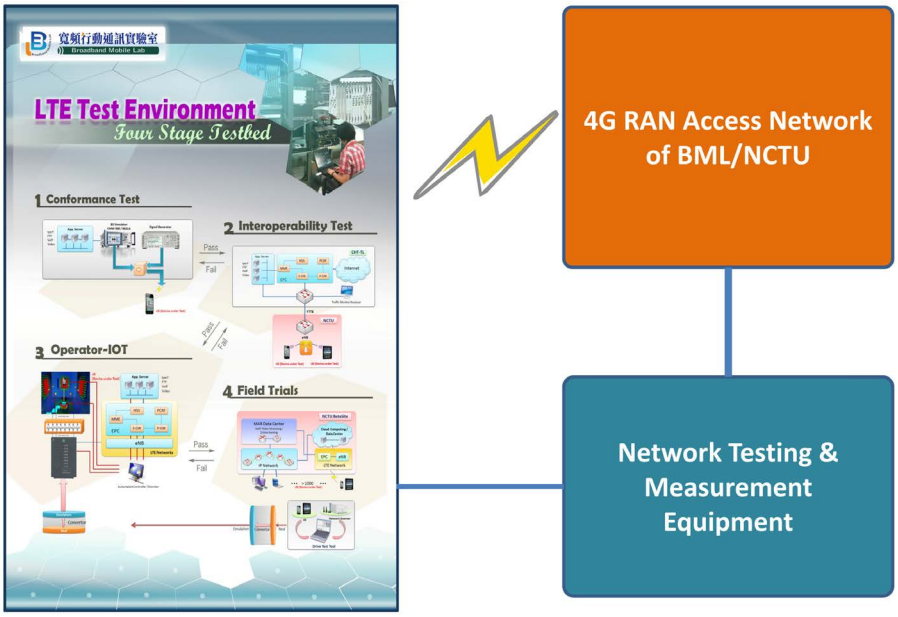

Figure 12. Data generation by endpoints from testing & measurement.

Table 3. DUT relational table.

DUT Device Type	UE FGI	DNS-TTL	HTTP-User Agent
Dongle A	0100 0110 0000 0101 0001 1000 0000 0000	128	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/43.0.2357.134 Safari/537.36\r\n
Dongle B	0101 1111 0000 1111 1111 1100 1000 0000	63	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/43.0.2357.134 Safari/537.36\r\n
Smart Phone	0101 1110 0000 1101 1101 1000 1000 0000	43	iPhone6,2/8.3 (12F70)\r\n
CPE	0101 1111 0000 1111 1111 1100 1000 0000	127	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/43.0.2357.134 Safari/537.36\r\n

Another example of applying data analytics in T&M traffic is to evaluate LTE QoS. When evaluating LTE QoS, it is required to setup testing scenarios with different QoS levels. Traffic Flow Template (TFT) (as shown in **Table 4**) is designed to filter packets into correspondent bearers, either a default bearer or dedicated bearer, in LTE network. Each bearer has its own QoS level. We can establish a dedicated bearer of guarantee bit rate (GBR) for applications such as VoIP, or a default bearer of basic QoS level for applications like file transfer.

What TFT does is to filter packets into correspondent bearers according to packets' IP address, port number, protocol, direction. The information, however, is insufficient to differentiate among web file download, FB news browsing, and Line chat. We are unable to give different QoS levels to these applications. To tackle this problem, we propose a new architecture which integrates deep packet inspection (DPI) with TFT to provide a higher granularity of QoS levels for applications. When some traffic flow has been identified as a certain application type, TFT will be informed to update rules of packet filters. With this improved method, the traffic flow can be delivered through the bearer of suitable QoS level.

4.5. Applications on Data Analytics for Traffic Flow Created by APP's of SD

To fulfill the Quality of Service (QoS) requirements from users, it is important to make effective use of the network resource. We can optimize the performance of a network by applying data analytics to traffic engineering. In particular, it is important to classify mobile applications traffic intended by the user with data analytics.

We propose a HMM-based (Hidden Markov Model) model to classify the mobile applications. By surveying related work, we have realized that there are different handshake patterns of well-known application protocols. Also, according to the observation of some specific mobile applications, we discover that every mobile Internet service has its unique negotiation process at the beginning when service starts. HMM was widely used to recognize time-dependent sequences and find out unknown patterns of data, such as speech recognition, handwriting recognition.

Table 4. Traffic Flow Template (TFT): Use to specify the packet filters associated.

UL Packet Filter ID	DRB	Packet Filter Evaluation Precedence	Protocol Number (IPv4)/ Next Header (IPv6)	Remote Address and Subnet Mask	Single Local Port (UE)	Local Port Range (UE)	Single Remote Port Range (NW)	Remote Port Range (NW)	IPSec SPI Range	Type of Service (IPv4)/ Traffic Class (IPv6) and Mask	Flow Label (IPv6)
1	DRB2	6	6 (TCP)	IPv4: 172.168.8.0 [255.255.255.0] IPv6: 2001:0ba0::[ffff:ffff::]	60051	-	-	-	-	-	-
2	DRB2	2	17 (UDP)	-	-	-	60201	-	-	-	-
3	DRB3	7	6 (TCP)	IPv4: 172.168.8.0 [255.255.255.0] IPv6: 2001:0ba0::[ffff:ffff::]	-	60100:60200	-	-	-	-	-
4	DRB3	3	17 (UDP)	-	-	-	-	60300: 60400	-	-	-
5	DRB3	5	50 IPSec (ESP)	-	-	-	-	-	0x0F80F0000	-	-
6	DRB3	1	-	-	-	-	-	-	-	00101000, Mask = 11111100	-
7	DRB3	6	-	-	-	-	-	-	-	-	-
8	DRB1 (default bearer)	255	6 (TCP)	-	-	-	-	-	-	-	-

In our method, we extract the packet size sequence and packet transmission direction sequence of the first 20 packets to train the HMM model. **Figure 13** shows our designed model structure of HMM. X_n is the hidden variable. It represents the transmission states which cannot be observed directly. Because of the unknown transmission states, we need to use observation variable O_n^1 and O_n^2 as training features to build the mobile application models. Here, "*n*" is the sequence number of packets in a traffic flow. O_n^1 is the observation symbol of packets transmission direction. O_n^2 is the observation of packet size that quantizes to a certain range of packet size. We quantize smallest packet size to number 1 and largest packet size to number 8. The rest of packet sizes are then divided into six groups.

Figure 14 shows the main process of our classification system. First, we process the collected packets by reading from original PCAP files, and extract the necessary field of packet header, including source IP, destination IP, source port number, destination port number, packet timestamp, and packet size. Second, we use packet

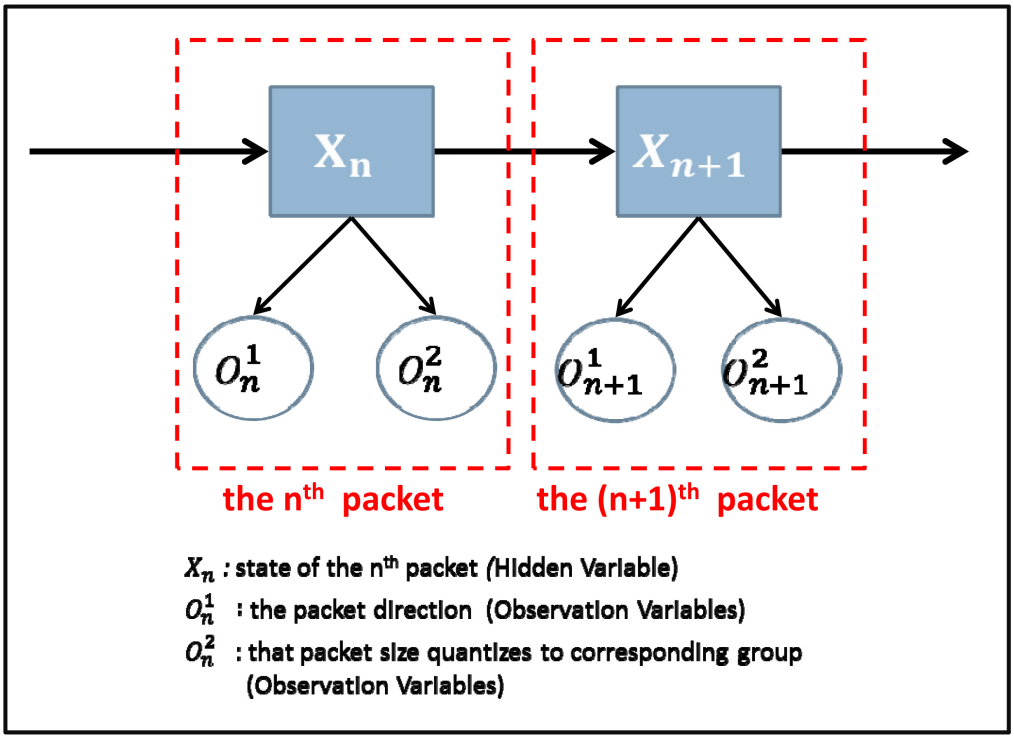

Figure 13. Classification model of Internet application traffic.

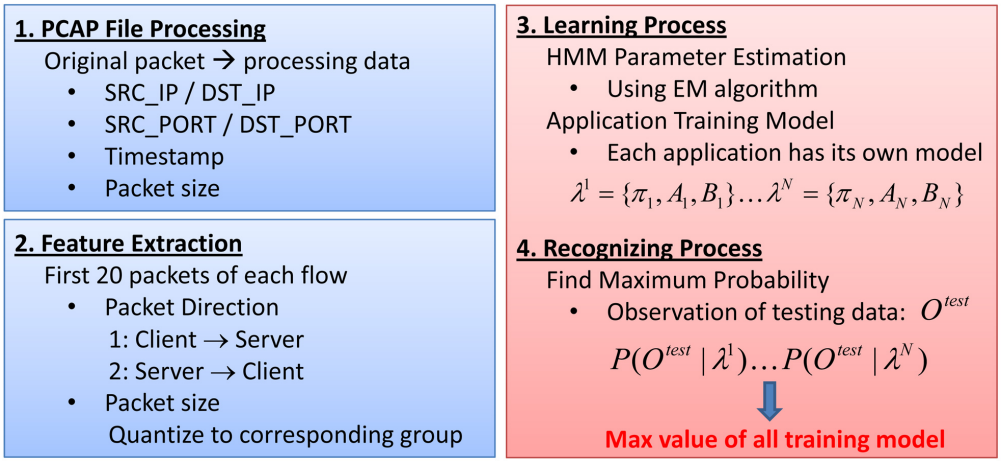

Figure 14. The process of our proposed classification system.

header information (5-tuple: source IP, destination IP, source port number, destination port number, and protocol) to process packets with the same 5-tuple information into a unit of mobile application traffic flow, and extract the features of each application flow. Third, in learning process, we use the extracted features which are quantized into corresponding symbol sequence to training the HMM-based application models for different applications. Finally, we can identify the new traffic flow by finding out the maximum value of log likelihoods derived from different application models.

5. Conclusion

This paper presents a forward looking view of the convergence of IoT, big data, cloud, SDN technologies along with the arrival of 5G mobile broadband networks. We intend to demonstrate the technical relationships of those technologies and the compelling programs and applications that can be created when two, three or more of those technologies converge. Due to the nature of fast evolution of ICT and the ongoing innovation of those five technologies, this paper should be updated on annual basis to keep the related information up to day with the ICT major trends.

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Research Article

A Model of Socially Connected Web Objects for IoT Applications

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The Internet of Things (IoT) is evolving with the connected objects at an unprecedented rate, bringing about enormous opportunities for the future IoT applications as well as challenges. One of the major challenges is to handle the complexity generated by the interconnection of billions of objects. However, Social Internet of Things (SIoT), emerging from the conglomeration of IoT and social networks, has realized an efficient way to facilitate the development of complex future IoT applications. Nevertheless, to fully utilize the benefits of SIoT, a platform that can provide efficient services using social relations among heterogeneous objects is highly required. The web objects enabled IoT environment promotes SIoT features by enabling virtualization using virtual objects and supporting the modularity with microservices. To realize SIoT services, this article proposes an architecture that provides a foundation for the development of lightweight microservices based on socially connected web objects. To efficiently discover web objects and reduce the complexity of service provisioning processes, a social relationship model is presented. To realize the interoperable service operations, a semantic ontology model has been developed. Finally, to evaluate the proposed design, a prototype has been implemented based on a use case scenario.

1. Introduction

The Internet of Things (IoT) envisions billions of objects connected to the Internet that continuously generate data about the physical environment. Several state-of-the-art applications can be built using the information and services provided by the pervasive and heterogeneous IoT objects. However, building applications based on these objects raises some challenges. Examples include how the growing number of objects will interact or coordinate to render valuable services, how the complexity generated by the coordination of objects can be handled, and how a large amount of diverse data sensed from the surroundings can be managed properly.

Numerous promising solutions have been provided to handle the complexity and the heterogeneity of IoT objects. One of the prominent approaches is to develop virtual environments to resolve the issues caused by the heterogeneous objects. Virtualization has become a key component in many IoT architectures, in the form of either virtual objects or virtual entities. A virtual object (VO) is defined as a digital representation of a real-world object [1] and provides a way for the IoT services to discover and compose features that cannot be achieved directly with a real-world object (RWO). It has been realized that issues such as heterogeneity of dissimilar objects and scalability can be effectively resolved using VOs. Hence, a crucial role of a VO is to bridge the gap between the physical world and the virtual world by hiding the physical characteristics of an IoT device and acquiring and interpreting its data and context.

Another way to reduce the complexity caused by a large number of objects is to link these objects in a social network [2], which provides a more exact solution than using a sole individual object. This principle has given birth to the concept of Social Internet of Things (SIoT), which is emerging as a new paradigm with the merger of social networks and IoT [3–7]. It has been realized as an efficient way to facilitate the development of complex future IoT applications. It supports sharing of information generated by

the people and the devices based on the social relationships. These relationships further promote efficient discovery of the objects and effective service compositions.

Let us have a glimpse of the application scenarios in which SIoT will make a profound effect on our daily life in the near future. Imagine a group of vehicles that form a mobile social network on the move when heading towards the same location or when they are bound in a common relationship. Vehicles may form diverse social communities; for example, small cars create a social network to share available parking space information or bicycles share information about the vacant paths using a network [8]. Vehicles commuting from home to office can join a social network to share traffic congestion experience, accident warnings, or other common information (e.g., a meeting plan) with colleagues by accessing their vehicles' social network. Let us analyze another SIoT use case where a user enters a public museum with an IoT environment, which incorporates smart objects that exploit social relationships to share information. At the entrance to the premises, the user's smartphone is prompted with a beacon signal to recommend a service app installation. When the user grants the permission, an app is installed and a social agent acquires his profile and friendship details. The app incorporates a microservice which uses a smartphone object to establish a social relationship with the museum visit service. The museum is equipped with a network of smart objects that monitor the user's location and provide services to enhance his/her experience such as personalizing the displays, assisting in the navigation, and recommending the relevant services.

To support the above-mentioned use cases, most of the current IoT architectural approaches are not suitable as they are based on the traditional monolithic approaches, which further hinder the development of efficient, modular, and independent services that cannot scale well with the increasing user's service demands, as already witnessed in many studies [9–12]. Using monolithic approaches, we cannot fully achieve the benefits offered by SIoT including efficient information discovery, improved scalability, and simplified interconnection of objects.

These limitations motivate the current paper to define a design for the development of SIoT based services with efficient and lightweight mechanisms to exploit SIoT features for improved service provisioning. The proposed design is based on the microservices concept which promises a more solid practice of SOA. There is no particular definition of microservices architectural style; however, it is explained in [13] by Martin Fowler as "an approach to developing a single application as a suite of small services, each running in its own process and communicating with lightweight mechanisms, often an HTTP resource API." Following the microservices based proposed design, SIoT applications can be developed, deployed, and maintained more efficiently and independently, which will promote system modularity and interoperability.

Moreover, a SIoT design needs to facilitate the efficient information discovery based on the social relationships among objects. To achieve this, incorporating the existing social relationship models in the proposed design can be useful. However, applications with intelligent service features require dynamic object selection. Therefore, objects need to acquire the ability to infer new relationships for interconnection with other objects in the system. This view further motivates the present article to develop a social relationship model based on the semantic ontology. The utilized ontology-based approach is highly useful to dynamically infer new social relationships for efficient service provisioning.

Furthermore, to fully achieve the benefits of both, the SIoT and microservices, selecting an IoT environment is necessary where not only can the social interconnection among heterogeneous objects be utilized but also the lightweight services can be developed to apply these relationships for effective IoT service provisioning. To fulfill this goal, the Web of Objects (WoO) [14] platform has been selected. According to the ITU recommendation (ITU-T Y.4452) [15], "the Web of Objects (WoO) is a realization way of the IoT services, where virtualized objects (i.e., virtual objects (VOs) and composite virtual objects (CVOs)) are connected, controlled, and incorporated with resources to facilitate the development, deployment, and operation of IoT services on the World Wide Web."

To exploit the opportunities provided by the above discussed technological advancements, the main contributions are highlighted as follows:

(i) This article contributes a novel design based on the microservices concept with lightweight and modular services to support the development of SIoT applications. The proposed design involves mechanisms to enhance object discovery and to reduce the magnitude of complexity generated due to the huge number of objects.

(ii) A social relationship ontological model is developed, which helps identify the hidden and unidentified relationships among objects with reasoning mechanisms.

(iii) A use case with the implementation prototype based on the WoO platform is developed to exploit the social relationship model, supporting the proposed design for efficient IoT service provisioning.

Further, to support the above contributions, virtual objects, serving on real-world objects, have been developed, which can be reusable in other services as well. CVOs are implemented, where each update of the information in the real-world object is reflected in the VO and propagated to the CVO. Also, the Social IoT notion is incorporated into virtual objects to provide easy discovery and efficient execution while maintaining collaboration using social connections. Moreover, an experimental analysis has been carried out to evaluate the discovery time of VOs and the time required for service execution, with or without social relationships among virtual objects.

The remainder of this article is organized as follows. In Section 2, the related work is described. Section 3 presents the proposed design of the social web objects accompanied by the social interaction model. In Section 4, an IoT environment

use case is explained with the details of the prototype implementation and discussion of the performance evaluation. Finally, Section 5 provides a conclusion of this paper.

2. Related Work

This section presents the related work with respect to the SIoT and microservices. Further, the significance of both technologies pertaining to the IoT environment has been discussed.

2.1. Social Internet of Things (SIoT). The concept behind SIoT is to enable smart objects to create a social network similar to a human social network. The objective is to exploit the social relationships among objects in an IoT environment to facilitate the effective information discovery, to promote the scalability, to enhance the interactive communication between objects that are friends, and to achieve trustworthiness [3].

The initial notion of a social network of objects was proposed by [16], which discussed how the wireless devices form social connections on the temporary bases that are controlled by the node owners. As the work was carried out before the introduction of IoT, it did not consider the SIoT concept. Later studies [5] investigated the objects' social interaction where objects formed social networks and communicated with each other based on the rules already set.

The idea of using the Web of Things in a social ecosystem was presented by [17, 18], where things were shared using the social network infrastructures, for example, Twitter, Facebook, and LinkedIn. These implementations consisted of objects that communicated either through the built-in embedded servers or through smart gateways. Further, in these settings, the web-enabled things owned by a person provided an interface to his/her social group of friends so that they can interact with the things using a social network.

Lysis [19] is another good example of Social IoT platform based on cloud infrastructure. It uses the platform as a service (PaaS) model and focuses on the deployment of applications in the cloud space. However, dynamic inferencing of new social relationships from existing relationships is not supported by this system. Moreover, making a modular interoperable design by employing concepts like microservices and semantic web technologies is not considered in this work.

Paraimpu [20] provided a social Web of Things platform to connect virtual and physical things to the web. In this system, the social concept only relates to humans by providing them with the capability to share things with each other using a human social network. Also, virtual things are not considered as VOs but rather viewed as services on other IoT platforms.

Using SIoT at the edge of the network was investigated by [21]. In this system, an approach was proposed to cope with the communication delay due to the objects being remotely located in the cloud. This approach exploits the computing resources at the network edge to deploy virtual objects.

The ThingSpeak solution was used as the basis for the implementation of an early SIoT platform [22]. This platform provided the object social behavior functions incorporated at the centralized server. In this implementation, functions such as the creation and the management of the social relationships were developed. However, VO concept was limited only to the records in the remote database.

Another featured SIoT framework was contributed by [4]. This work presented how to combine services, devices, users, and their social interaction to enable interactivity, discovery, and recommendation of services. Social relationships have also been investigated in communities [23], where a proposed framework enables the identification of communities in the social networks.

Although most of the research contributions in the SIoT domain incorporate a notion of the social association of objects, however, limited information has been provided about the social relationship model and the details on how that can be used by IoT services. Furthermore, existing approaches are lacking lightweight and modular mechanisms which can be utilized by services to exploit social relationships efficiently. In our approach, we have developed a semantic ontology-based social relationship model that provides the capability to infer new connections in a network of social objects. Another distinction of the proposed system is a microservices based design that utilizes the developed social model to provide lightweight, modular, simple, and interoperable IoT services.

2.2. Microservices. The microservices architecture is emerging as a new trend among the practices of developing distributed web applications. To develop SOA based systems, microservices have become a prominent approach in real-world settings [24]. In the microservices based architectural pattern, each application incorporates a collection of small services which execute independently and use lightweight communication mechanisms [9]. The microservices are targeted for doing one thing well at a time based on the principle of single responsibility [25], as defined by Robert C. Martine: "Gather together those things that change for the same reason and separate those things that change for different reasons" [26]. Also, the microservices are conceived as autonomous entities, which means they can be changed and deployed independently of each other without requiring their consumers to change [24].

In the last few years, several IoT architectural designs were proposed and developed. Some of these designs provided innovative features such as the European FP7 project iCore [27] which proposed a cognitive framework for IoT application development. This project provided an architecture with the concept of virtual objects and their composites. However, in iCore, services are designed using a traditional SOA based monolithic style, whereas the microservices based architecture provides a better option to develop IoT services. Furthermore, in iCore, VOs lack the mechanisms to semantically represent real-world objects (RWOs), which limits extensibility and interoperability.

To support IoT applications, microservices based architectures are being proposed in many research initiatives and applied in several research projects. In [28], microservices are used for M2M applications, realizing the fact that monolithic approaches for M2M cannot provide a real solution. Another

work [10] provided an analysis of using microservices architecture for large-scale distributed applications. This work demonstrated that significant benefits can be achieved as compared to generic SOA approaches when using microservices in an IoT platform for smart city applications.

Moreover, Almanac FP7 EU Project [29] provides smart city services based on the IoT environment. The project uses microservices to employ scalability in a horizontal and vertical fashion. Also, in the industry, microservices have become a solution for developing large-scale applications. Netflix, Pivotal [30], and Amazon use microservices in their software bases.

The increased importance of microservices for the IoT applications is due to the fact that they simplify complex systems. By dividing a system into smaller parts, higher cohesion and lower coupling can be achieved, which makes it highly scalable. In scenarios where requirements keep changing continuously, microservices can help make a system easily modifiable. Moreover, the major benefits that are envisaged when using microservices in an IoT environment are as follows: Microservices leverage scalability to provide a highly decoupled pattern and can allow scaling individually. Their usefulness can be realized as when the demand for the requirement increases the system complexity also rises. In this case, a system can be supported by creating new instances of existing services. Microservices scalability [9] fits in three-dimensional space, that is, horizontal scalability (typical scalability), vertical scalability (splitting different individual microservices), and z-axis scalability (splitting similar things, such as DB partitioning). Microservices architecture supports a plug-and-play behavior where system components become loosely coupled. To acquire new functionality or replace a failed service, pull the plug from one microservice and plug into a new microservice [31]. One of the major problems that IoT is facing today is how to deal with the heterogeneity of incompatible solutions. To harmonize the heterogeneity, semantic web technologies with microservices are leveraged to provide interoperable exchange and communication of data. Microservices realize a decentralized and autonomous behavior, operating on their own priorities and schedule. This way, they provide several benefits for being utilized in an IoT design.

3. The Proposed Design of Social Web Objects

Recently, there have been several research efforts [3–6, 17, 20, 32] for defining the Social IoT. This new aspect minimizes the complexity generated by the communication of billions of real-world objects and enables sharing of information. The social notion can be incorporated into the WoO platform to provide a semantically rich base for IoT applications that can utilize real-world object relationships for efficient information discovery. Moreover, this section provides a brief introduction of WoO reference architecture in Section 3.1. A classification of social relationships among web objects (virtual objects and composite virtual objects) is discussed in Section 3.2 and a social relationship model is presented in Section 3.3. Further, the details of functional components for the proposed architecture are explained in Section 3.4.

3.1. Web of Objects (WoO) Reference Architecture. To enable the deployment of IoT services on the World Wide Web, WoO provides a reference framework. In other words, it realizes the IoT services in such a way that virtualized objects are interwoven with resources to support the development, deployment, and operations of IoT services [33, 34]. The WoO platform provides service functionality by merging VOs and features of web applications. Moreover, the WoO platform uses semantic web technologies to enable interoperability among heterogeneous resources. This realization provides the basis for the composition and harmonization of objects to provide smart services in an IoT domain. Building services based on WoO platform using diverse technologies, including microservices [35], social networks, and semantic web, helps reduce the complexity and fosters the easy and efficient development of IoT applications.

Virtualization has become a major concept in IoT to address the heterogeneity of diverse types of physical objects. VO is a digital representation of a real-world object that can be anything, living or nonliving, mobile or stationary, concrete or immaterial. In WoO, VO is defined as domain-specific semantic ontology based on the VO information model [36]. It is uniquely identified using URI and provides information updates on the representative real-world object. On the other hand, WoO also provides a notion of CVO which aggregates one or more VOs to enable service features that satisfy the application requirements. CVOs chain semantically interoperable VOs together. The WoO platform incorporates features to efficiently reuse existing VOs and handles the complexity generated by self-management and control mechanisms [37]. In the WoO, service level decides which CVOs and VOs will take part in creating an object mashup to fulfill service objectives. The service logic is saved in the form of templates and stored in the template repository [38–40]. The domain expert or knowledge engineer defines the service templates that are used to instantiate new services.

WoO reference architecture is shown in Figure 1. In this architecture, the service layer handles requests and provides several management functions, whereas the CVO level consists of functions to manage and instantiate CVOs or reuse the existing ones based on the provided service execution logic. New objects such as sensors are registered in the WoO platform using a registration function and their templates are generated to make them digitally available in the form of VOs. Another most important aspect is the semantic representation of data at three-layered WoO architecture [23, 39]. The database at each layer is supported with semantic web technologies.

3.2. Types of Social Relationships. Previous research [3] on SIoT has derived some basic relationship types among objects. These relationships are characterized as follows. *Parental Object relationship* (POR) exists between the objects that belong to the same batch, such as objects that are created in the same production process or at the same time by a common manufacturer. *Cowork object relationship* (CWOR) is the relationship among objects that are grouped together based on some commonly shared job to be done by them. Similarly, *colocation object relationship* (CLOR) is established

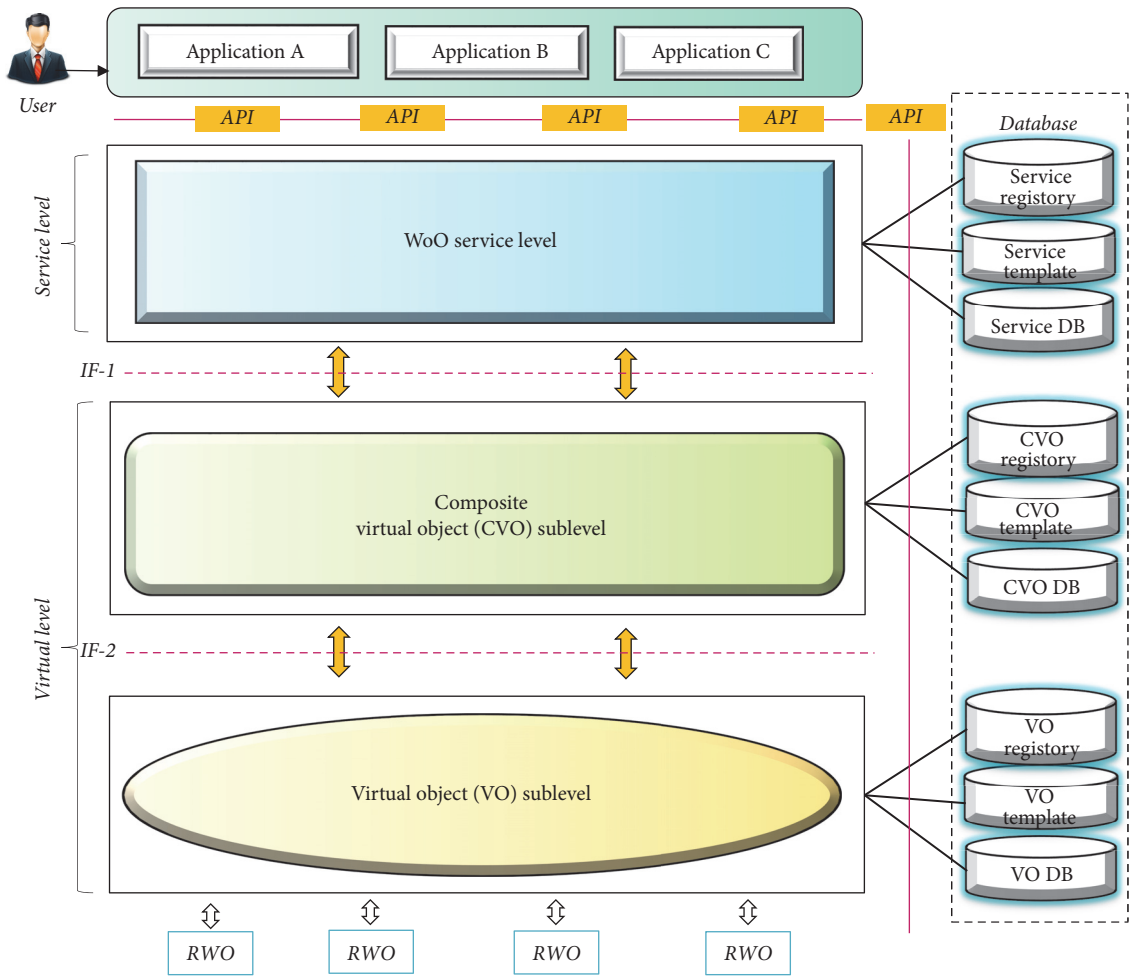

Figure 1: Web of Objects reference architecture.

between objects belonging to the same location such as home or office. Different or same types of objects can be combined based on the common location or premises. On the other hand, *Ownership Object Relationship* (OOR) is formed among objects belonging to the same owner. *Social Object Relationship* (SOR) is another kind of relationship that is created among objects when they come close to each other, either random in time or periodically. This relationship can be envisaged when the owners of objects come into contact with each other. Apart from the above relationships, in [41], the authors define the *Guardian Object Relationship* (GOR) in the Internet of Vehicles (IoV) scenario where on-board units of vehicles become children in relation to the super nodes of Road Side Units. This child and parent association gives a special meaning to a new hierarchical relationship.

In addition to the relationships defined in other studies, we have identified few more relationships suitable for some diverse scenarios. These include *Sibling Object Relationship* (SIBOR) that is created among objects that belong to a group of friends or family members. This relationship among objects extracts the property of trustworthiness based on the relationship of their owners. Another relationship type is the *guest object relationship* (GSTOR) which is formed between objects that belong to the users in the guest role, for example, when a person visits a friend's home and gets the privilege as a guest. The same can be applied to the objects that move in guest relation (GSTOR) from one place to another; they will have some privilege of accessibility of information as compared to other objects. *Stranger Object Relation* (STGOR) applies to objects that encounter the presence of each other in an anonymous environment such as on the go or in the public environment. Similar to people who meet each other sometimes regularly but are anonymous to each other or are not fully aware of each other, this relationship can be used among objects to form different trust levels or to form strict restrictions to promote secure connections. Moreover, in *service object relationship* (SVOR), objects form a relationship while coordinating in the same service composition to fulfill a service request. Generally, in the proposed scheme, service request execution generates a mashup of objects, and objects that belong to the same mashup are assumed to be in SVOR.

We believe that the above defined new social relationships are beneficial in several distinctive scenarios. For example, SIBOR is more useful in scenarios where trust is highly important for establishing a connection. Unlike the more generalized relation POR, SIBOR is established

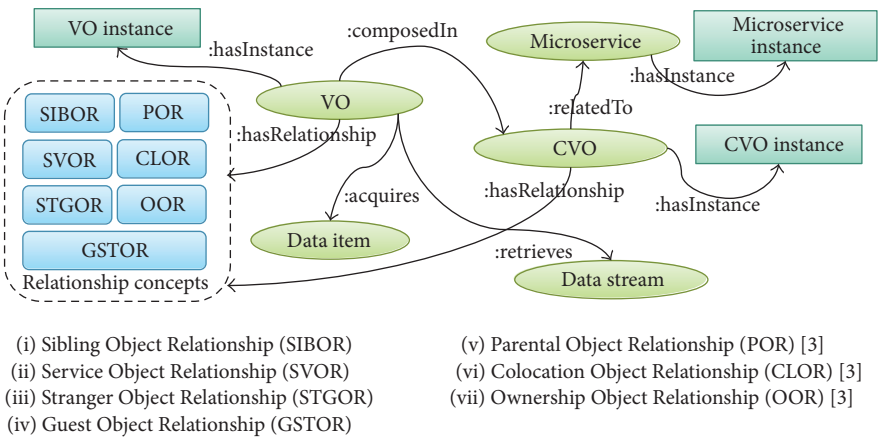

Figure 2: Ontological model representing web objects' relationships.

among objects from the same manufacturer having similar features but different behaviors. Similarly, GSTOR is suitable in scenarios where objects use relationships for privileged services. Imagine a person as a guest speaker in a conference with his smart devices, where he can connect to the network easily, and his personal devices are recognized as a guest (with GSTOR) in the venue network to avail free services like high-speed Internet, special notifications, and others. Stranger Object Relation (STGOR) is used in scenarios where objects are on the go, and to get some information, they have to compromise with a limited trust level. For instance, in a public transit system, one mobile node on the move wants to use crowdsourced information from another mobile node which is not fully trusted. Also, SVOR is useful in service composition specific scenarios, where object mashups are formed to facilitate service requirement, and it is also useful in a particular orchestration of objects.

To model information about microservices, social web objects, and their relationships, a semantic ontological model has been developed as depicted in Figure 2. Conceptualization of objects and their social relationships in semantic structures are highly beneficial to infer new connections among a network of objects with the help of reasoning techniques. The ontology facilitates the representation of objects, as well as what they measure in terms of observations, their processing, and functions. Web objects' relationship ontology contains the concepts that define each object in terms of a class. The data properties are used to represent object values and the object properties are defined to identify the link between two objects in the ontology. Major concepts in the ontology are microservices, CVOs, VOs, and their social relationships. Further, microservices have an individual instance that uniquely defines a microservice object and associated data with it. Similarly, CVOs and VOs are also instantiated and contain data properties to retain their values. With the increasing number of objects, a semantic ontology model is used to perform reasoning function that helps identify new connections. Further, to analyze the social relationship among objects (such as VOs and CVOs), their properties are provided in Table 1.

3.3. Social Relationship Model for Web Objects. At each level of service life cycle, objects form a social relationship with each other to accomplish a service task. Codifying the relationship among web objects can provide many benefits, such as efficient information discovery from related objects and better composition and reuse. To perceive social interaction between web objects, we assume every service is based on one or more microservices and other objects including CVOs and VOs. At VO level, VOs create several relationships with each other based on the RWO they represent. CVOs associated with microservices are incorporated in relationships as well.

Object-to-object associations are categorized as either vertical associations (interobject relations) or horizontal associations (intraobject relations) as shown in Figure 3. The relationships that flow from the bottom to the top in WoO based architecture are known as interobject relations (i.e., from VO to CVO or vice versa). On the other hand, relationships are known as intraobject relations if they are generated within objects at each level such as between one VO and another, or within one CVO to a relative CVO. The newly defined relationships among objects are maintained at different levels, which enables information discovery more efficiently. It is considered that not only will the relationships be maintained when two objects (i.e., VOs) are used in the same CVO or service, but also they will be maintained if objects are used in different CVOs or services.

As depicted in Figure 3, VO1 and VO2 bind in the SIBOR relationship, considering the fact that they belong to the same family of CVO1. Similarly, VO4, VO5, and VO6 are combined in a CWOR, as they are used in the same service. However, all of them do not have a common family relation that makes their trustworthiness restrictive to some level as compared to SIBOR. Moreover, though VO7 and VO8 are not used together in a service setup, still they form a STGOR relationship. This relationship also helps codify those VOs that have similarity in premises during a certain point in time regularly but they had never combined in any service scenario before. For example, if a person visits a subway regularly but stays very shortly, in such scene, the user's smartphone VO and subway station point

Table 1: Social relationship attributes.

Social object relationships types	Attributes/properties
Sibling object relation (SIBOR)	O_x *has relationship* with O_y → SIBOR, if objects' *ownership* is defined as: == SameFamily
Service object relationship (SVOR)	O_x *has relationship* with O_y → SVOR, if objects' *serviceStatus* is defined as: == SameServiceComposition
Stranger object relation (STGOR)	O_x *has relationship* with O_y → STGOR, if objects' *authentication* is defined as: == Anonymous
Guest object relationship (GSTOR)	O_x *has relationship* with O_y → GSTOR, if objects' *ownership* is defined as: !=SameFamily && == GuestFriend
Parental object relationship (POR)	O_x *has relationship* with O_y → POR, if objects' *creation* is defined as: == SameBatch ‖ == SameProduction
Colocation object relationship (CLOR)	O_x *has relationship* with O_y → CLOR, if objects' *proximity* is defined as: == Neighborhood ‖ *location* is defined as: == SameLocation
Ownership object relationship (OOR)	O_x *has relationship* with O_y → OOR, if objects' *proprietorship* is defined as: == SameOwner

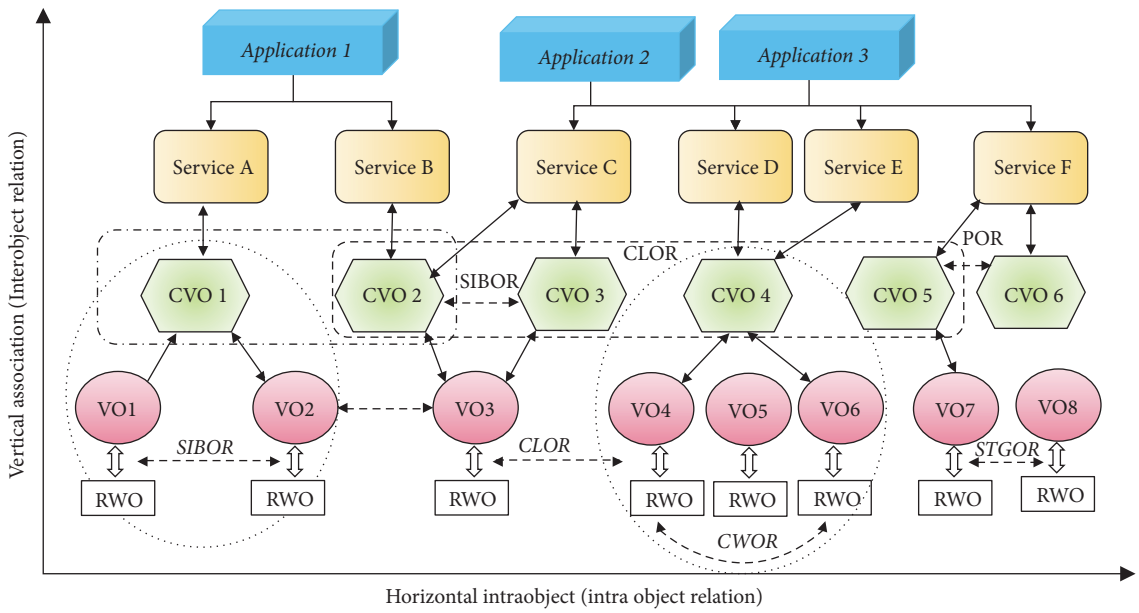

Figure 3: Hierarchical social relationships of web objects.

VO or subway security camera VO may establish STGOR. This may help reuse VOs in service scenarios where only for short duration a VO object is required. At CVO level, CVO2 forms two different relationships, which increases the level of connectivity of the CVO. CVO2 first shares a CLOR with CVO1 and CVO3, CVO4, and CVO5 together. Secondly, CVO2 is combined in a SIBOR with CVO3 and becomes in the same service family. Further, in the selected use case scenario described in Section 4, several other social interactions have also been elaborated.

3.4. Social Web Objects Architecture. SIoT envisages a system where the social framework will bring smart devices and people to interact with each other. By incorporating web technologies like SOA based microservices, IoT services can be rendered on top of the social framework. The proposed social web objects architecture (as shown in Figure 4) has been decomposed into three levels: service level, object virtualization level, and aggregated object virtualization level. At the service level, to support social relationships within web objects, several microservices have been designed, which are discussed further in the following section. Moreover, the data management function in the proposed design helps each layer to interconnect with semantic databases. The SPARQL endpoints have been defined at the service and the object virtualization levels that expose interfaces to retrieve, store, and modify RDF graphs. Several interfaces allow the knowledge engineer, domain expert, and the developer to create service templates and VOs, as well as update the RWK model, user profile, and policies.

3.4.1. Service Level Functional Components. The service level functions handle operations from the request inception to the execution of services. This level is supported by some core functions common to be used in each service life cycle. These include the management function to handle service

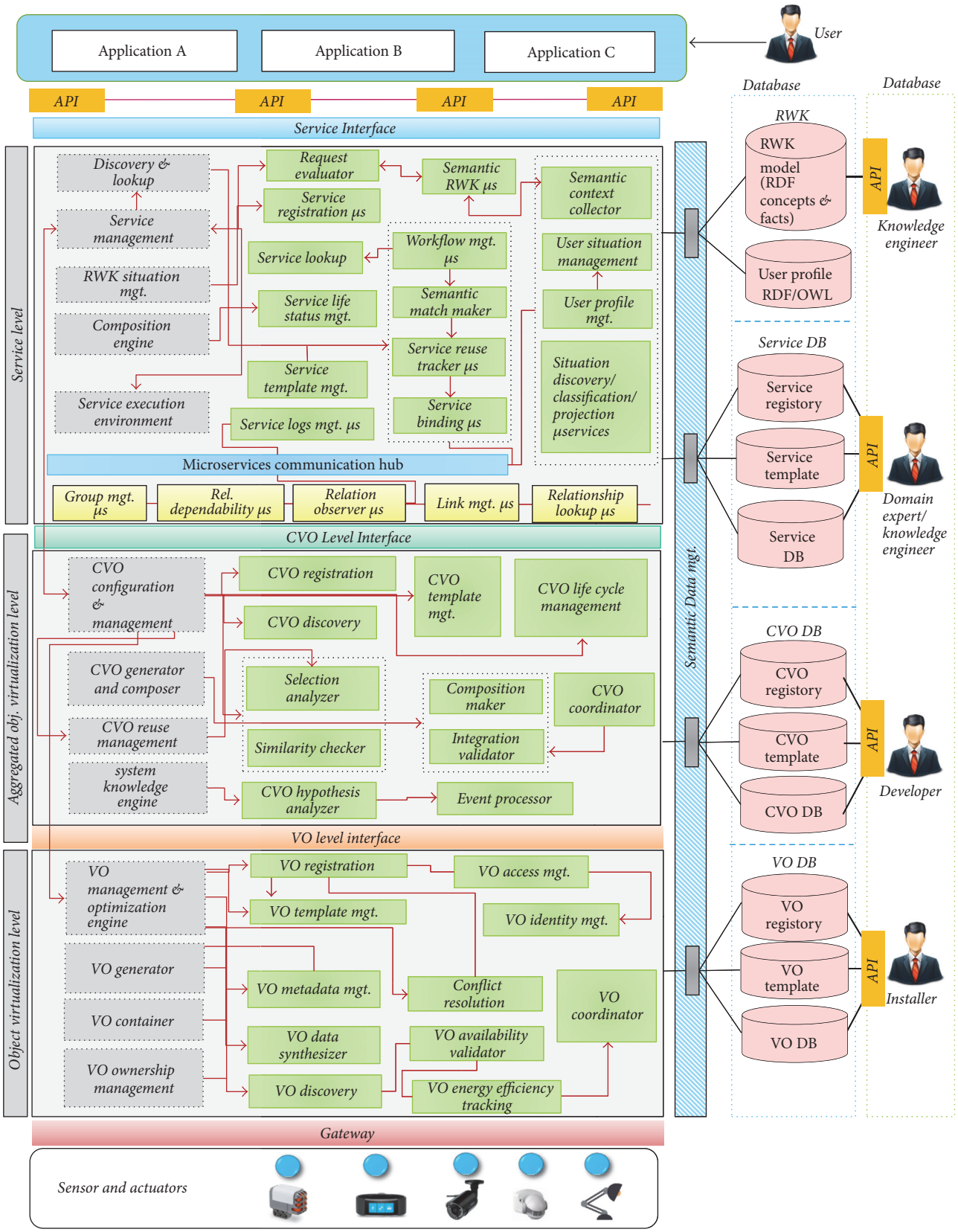

Figure 4: Social web objects functional architecture.

requests and initiate service provisioning processes, the service discovery function to select the available services, the composition engine to enable service mashups, and the Real-World Knowledge (RWK) and situation management function to acquire RWK and continuously maintain it. Besides these core functions, several microservices have been used to provide the plug-and-play feature in the proposed design; that is, in case of service failure, it is replaced with another one. These services include the Request Evaluator microservice which interprets a service request and matches a request query to the service template. The registration microservice registers newly added service objects to the registry. When a new template is instantiated, objects are put in service, and to know the existence of available service instances, they are recorded in the service registry. The lookup microservice is defined to search for the required service objects using the semantic representation. The representations available in RDF/OWL format are queried from the registry based on the request parameters. Service life cycle management keeps track of the states of service objects during their life cycle, whereas RWK management microservice is a semantic data processing service which processes facts about user preferences, profile, and situational information.

To realize service provisioning, it is always not possible to satisfy the service requirement with a single service function. Service composition and harmonization features are required to fulfill a demanding service request. Service composition is not a single operation; many microservices are used to compose the individual features. One of the major components of the composition is the Workflow Management (WFM) microservice which is responsible for decomposing the service requirement if no single service is available to satisfy the task. WFM microservice identifies the service objects using input and output interfaces. In this concern, it uses the matchmaking microservice to identify the approximate matches that can serve the required service functionality. Here, service objects are semantically represented in the form of ontologies. The semantic ontology alignment algorithm is used to match the service up to a certain threshold level that is defined by the matchmaking microservice. The reuse tracker microservice is used to identify the current service instance usage by the application; it incorporates a coordination mechanism before instantiating any new instance, and this helps in service reuse by many clients. Binding microservice enables tying of services selected by WFM; this function synchronizes input and output of services in a workflow to produce a single service output based on the generated composition plan.

Furthermore, user characterization is another important element to support the IoT services by matching user requirements more closely. The User Profile Manager microservice handles many facts related to the human user. These include user profile, preference, context, and policies. Semantic Context Collector microservice organizes the services requested by the user and the context in which these services were requested. This helps in identifying user interest with respect to the service context. User context or situation helps in service selection more efficiently if a user requests again with a similar service requirement. Some microservices have been designed to handle user situation information; these microservices include situation discovery, classification, and recognition functions. Situation discovery is used to process sensor data that is provided by CVOs to prompt a situation, whereas machine learning algorithms are applied to remove the false values and data normalization is performed in case inappropriate triggers in the data exist. Situation classification incorporates the reasoning methods and rules to generate a relationship over detected events and refine the missing knowledge between the events. Situation projection analyzes the events data with the help of machine learning methods and provides an output in the form of predicted facts that are related to the situation being detected. Moreover, all the microservices coordinate using a communication hub to share information with each other.

A flow of service inception to service execution in the proposed architecture is depicted in Figure 5 where service management is responsible for initiating the above-mentioned functionalities and instantiating the microservices. This process further results in the generation of CVO/VO mashup graphs to be handled by CVO management (discussed in Section 3.4.2). Situational information has also been used to improve request analysis and service provisioning, whereas VO management (discussed in Section 3.4.3) acquires and aggregates data from sensors and other RWOs.

Social Relationship Management Microservices. To support the social relationships among web objects at each layer of the proposed system, relationship management microservices are defined, which support the codification of relationships among web objects (VOs and CVOs) and their management. These microservices are defined as follows. Group management microservice identifies the grouping of objects into specific sets based on the type and interaction of objects; it builds a social graph of the object relationships. Link management microservice incorporates mechanisms to maintain relationships among different objects and it includes several other subfunctions. The first subfunction is object selection which involves choosing candidate objects that are likely to form a particular association. The second subfunction is matchmaking service which provides exact relationship match based on the type of objects. The third subfunction is the association life cycle manager, which maintains the relationship status between objects; it checks whether they are in active relation or not. It keeps track of relationship validity and also the duration of relationships. Relationship observer microservice enables the object activities to be observed, and it also handles the mutual sharing, which defines what information an object is allowed to share or use of another object based on the relationship among them. Relationship dependability recognizer microservice identifies, maintains, and continuously improves the level of reliability among objects. If objects A and B are frequently interacting and always perform a task together that leads to successful execution of an application to serve the requirements, then they are more likely to form a reliable relationship with each other. The consistency of the relationship allows objects to share their information with fewer constraints as compared to unpredictable association among objects. Relationship

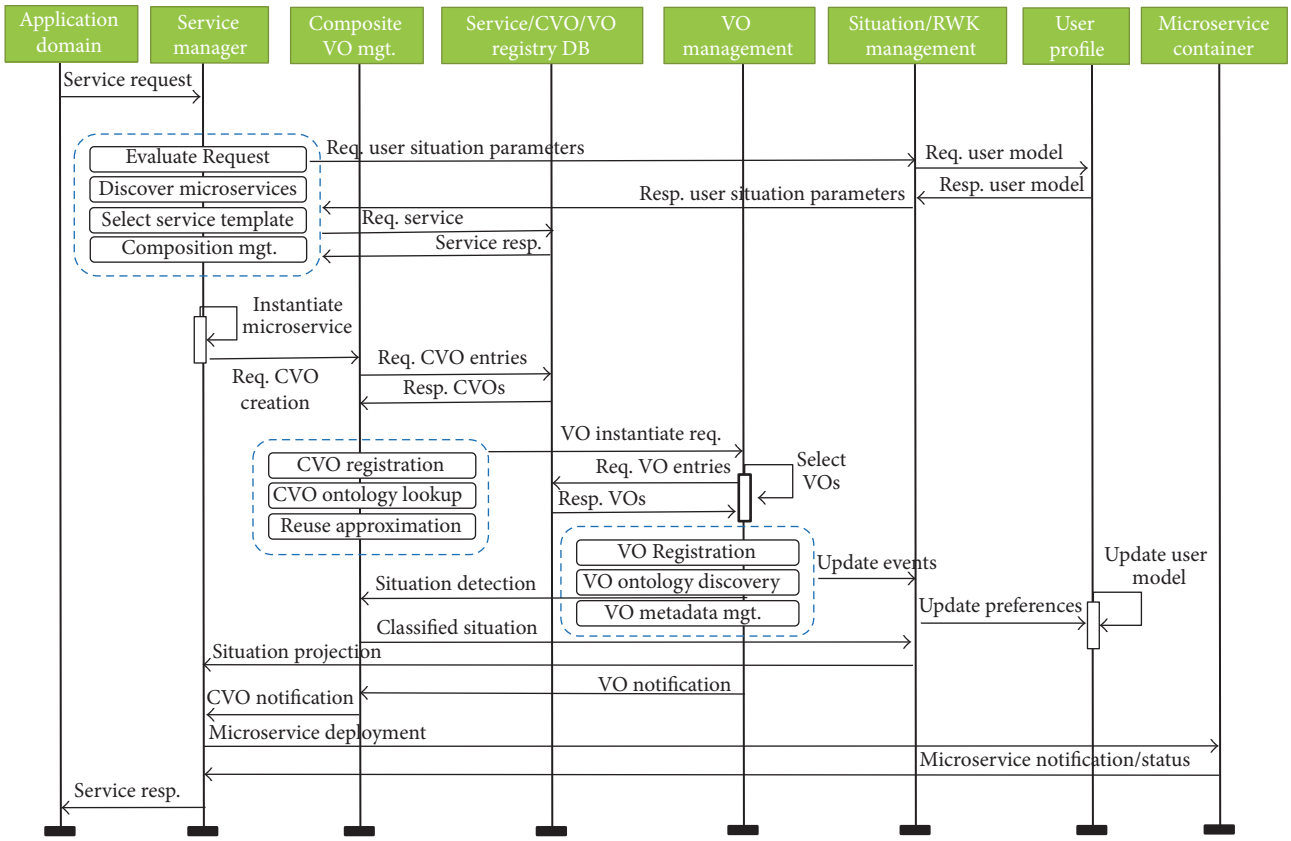

Figure 5: Request initiation and service execution flow in the proposed architecture.

lookup microservice incorporates the discovery algorithm (as given in listing of Algorithm 1) to discover the social relationships and maintains the list of all objects and their potential association rating. The rating defines the opportunity for objects to form a relationship with each other.

Moreover, the operation flow of social microservices has been illustrated in Figure 6, where VO management retrieves the social relationship among objects this is queried using link management, which uses a lookup service. Associations are maintained in a social relationship graph using semantic ontology and queried using the relation observer service. The social graph is also updated and maintained continuously with respect to changing links among objects, on the basis of which VOs are selected.

3.4.2. Functional Components in Aggregated Object Virtualization Level. Aggregated object virtualization (AOV) level involves all the necessary functions to instantiate, manage, and continuously monitor CVOs. Besides, it includes the interface required by the service level to interact with CVO components. Service level provides the mashup graphs of CVOs and VOs that are required to fulfill a service request. Aggregation level also supports some core functions; these are categorized as CVO configuration and management to decompose requests from service level and manage CVO instances, CVO generator to instantiate CVOs, composition function to form CVO and VO mashups, reuse management to select existing CVOs that approximately match service requirement, and system knowledge engine to grow knowledge for the optimal use of CVO resources. Further, other aggregation level functionalities are as follows: registration function records the CVO entry into the semantic CVO registry in the form of RDF/JSON format. CVO includes ontologies that specify conditions to be applied on the VO data. Also, at this level, templates are created by a domain expert or knowledge engineer, which consist of functionalities associated with each CVO type. Template management module provides an interface to include templates to the CVO template repository and also supports the modification mechanism. CVOs are discovered using their semantic annotation via the discovery function. CVO selection analyzer function provides estimated selection of a CVO for reuse if there is no single CVO that can exactly provide the required service. This is supported by similarity checking mechanism to analyze the level of similarity before recommending for reuse. At aggregation level, another important function is event processing; event streams generated by object virtualization level are highly valuable to infer situational awareness and building RWK that is used by high-level functions. Event processing module facilitates processing of events and provides generated facts as output. Event processing is supported by CVO hypothesis analyzer that incorporates several hypotheses which are trained over data to build system level knowledge. Aggregation level also

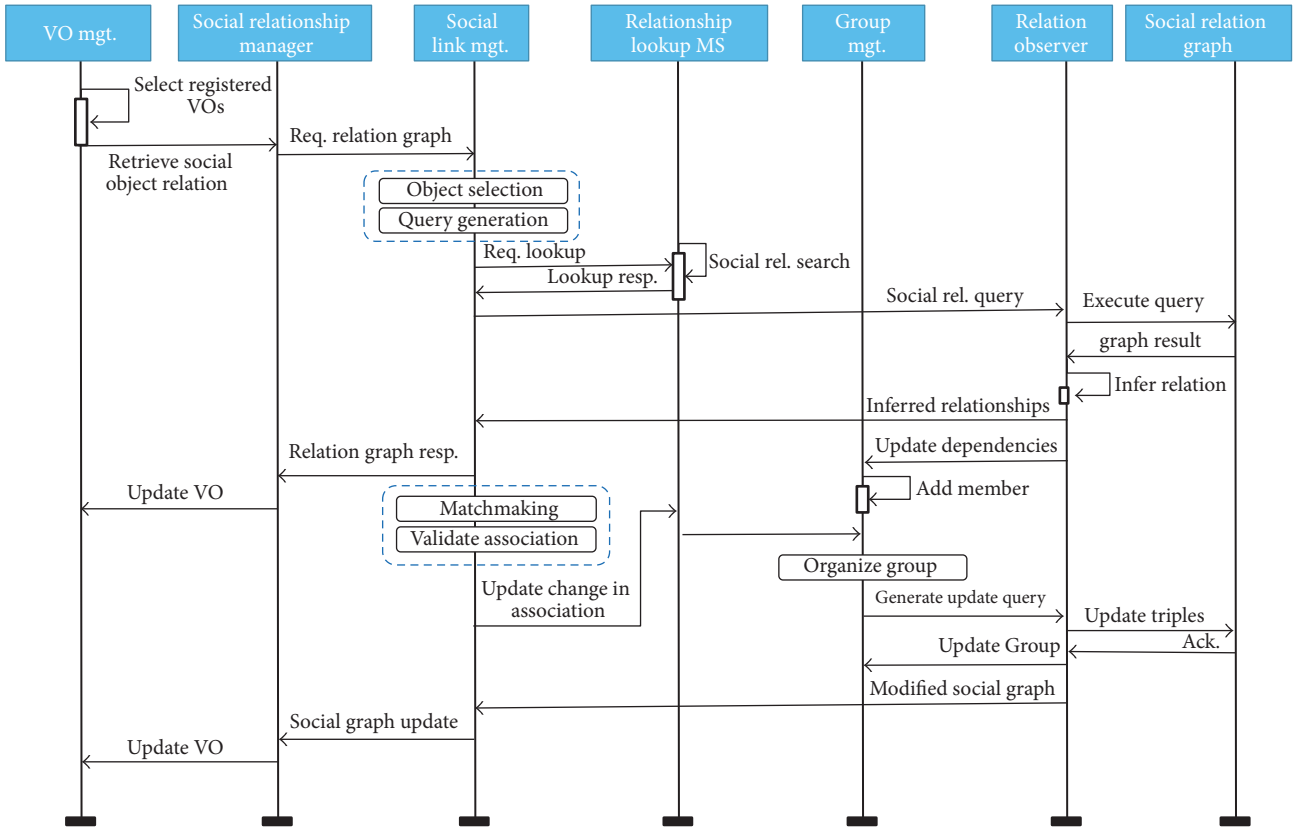

Figure 6: Sequence of operation required to establish a social relationship among objects.

provides composition function which provides the basis for merging multiple VOs to generate single service feature and validation function to validate the compositions of multiple VOs. Moreover, the coordinator helps in resolving conflicts in case of simultaneous access of single CVO by multiple services together.

3.4.3. Functional Components in Object Virtualization Level. Although IoT middleware virtualizes sensors and actuators in some form of virtual entities, however, in WoO, every living or nonliving thing can be represented in the virtual world. VOs are supported by an information model [14, 15] which includes the representation of RWO that can be ICT or non-ICT. In the proposed architecture, object virtualization level includes functions to create, maintain, and coordinate VOs such as VO generator, VO management, and optimization engine. VO registration function provides an interface to register VOs with the help of VO ownership management function where the VO ownership is maintained. Template management function handles templates or loads updated ones as provided by the domain expert. Metadata management maintains data associated with VOs; as VO is a digital representative of real-world entities, there is a high need to store metadata information to recognize the class of sensed data. Use of metadata provides the real value of the data in the form of the context stored within it. Furthermore, VO data synthesizer service handles the discrepancies if found in the data corresponding to VO; this includes data manipulation and missing value rectifications. Conflict resolution function helps in case the same VO is used by multiple service instances, to resolve the conflicts. Also, VO access management function controls access for VOs in case access right information has been defined by the VO owner, whereas identification management module maintains identification information about VOs so that each VO can be uniquely identified in the system.

3.4.4. Social Relationship Discovery and Composition. To identify associations among web objects within a social relationship graph, an algorithm is elaborated briefly. In the following algorithm, the microservices that are in execution are retrieved first, represented as $\Sigma M\mu$; next, all the CVOs associated with each of those microservices are recovered in ΣMc and, further, the corresponding VO model ΣMv is iterated. In the next step, executing the query statement routine returns the results denoted as $\overline{\mathbb{T}}$. The process of finding the relationships is carried out through lines (6)–(19) in multiple nested iterations as shown in the pseudocode of Algorithm 1 listing.

Algorithm 2 facilitates the composition of objects based on social association types. This algorithm takes as input the set of object social relationships denoted by $\mathbb{Z}$ and registry entries of the objects that are currently available in the system, represented as $\mathbb{R}e$. After the object model denoted

Require: $(\Sigma\phi)$, $(\mathbb{R}_e)$
(1) **Output:** $\hat{\mathbf{S}}$ (social relationship graph of objects)
(2) $\Sigma M_{\mu} \leftarrow$ Load Microservices in model
(3) $\Sigma M_c \leftarrow$ Load CVOs in model
(4) $\Sigma M_v \leftarrow$ Load VOs in model
(5) $\overline{\mathrm{T}} \leftarrow$ *executeQueryStatement* (M_{μ}, M_c, M_v, Q)
(6) **for All** μ in $\mu\overline{\mathrm{T}}$ **do** (iterate Microservice instance being used)
(7) **for All** $O \in \mu$ **do** (check CVO and VOs used by the Services)
(8) **if** O_i == output of C_R in a relationship set R_c **then**
(9) add C_R to $\mathbb{III}_L$
(10) **else**
(11) **if** O_i == output of V_R in relationship set R_v **then**
(12) add V_R to $\mathbb{III}_L$
(13) $\mathbb{N}_i \leftarrow$ tag (Assign relationship tag to each object entry)
(14) **else**
(15) add O_i to $\mathbb{III}_U$
(16) **end if**
(17) **end if**
(18) **end for**
(19) **end for**

Algorithm 1: Social relationship discovery.

Require: $(\Sigma\phi)$, $(\mathbb{R}_e)$, $(\mathbb{Z})$
(1) **Output:** $\mathbb{C}$ **(Composite Service)**
(2) $\Sigma M \leftarrow$ List all objects available (Microservices, CVOs, VOs) in model
(3) $\overline{\mathrm{T}} \leftarrow$ *executeQueryStatement* $(\Sigma M, Q)$
(4) $\mathbb{Z} \leftarrow$ *executeQueryStatement* $(\Sigma M, Q')$
(5) **for All** $\sigma i \in \overline{\mathrm{T}}$ **do**
(6) **for All** $\boldsymbol{\lambda} i \in \sigma$ **do**
(7) **if** $\boldsymbol{\lambda} i$ == *any* z in $\mathbb{Z}$ **then**
(8) add $\boldsymbol{\lambda} i$ to $\mathbb{III}_{\mathrm{Lm}}$
(9) store $\mathbb{III}_{\mathrm{Lm}}$
(10) **end if**
(11) **end for**
(12) **for All** $\boldsymbol{\varpi}\mathbf{i} \in \mathbb{III}_{\mathrm{Lm}}$ **do**
(13) **if** $\boldsymbol{\varpi}\mathbf{i}$ == *any* $\boldsymbol{\varpi}\mathbf{i}$ in $\mathbb{III}_{\mathrm{Lm}}$ **then**
(14) $\partial \leftarrow$ ranking (Assign rank to each service)
(15) add $\boldsymbol{\varpi}\mathbf{i}$ **to** $\mathbb{III}_{\mathrm{LR}}$
(16) store $\mathbb{III}_{\mathrm{LR}}$
(17) **end if**
(18) **end for**
(19) **for All** $\sigma j \in \mathbb{III}_{\mathrm{LR}}$ **do**
(20) **if** $\sigma j(\mathrm{R}\partial) > \kappa$ **then**
(21) add σj to Wf
(22) Pq $\leftarrow$ assign to queue
(23) Sort Pq
(24) Formulate Wf
(25) **end if**
(26) **end for**

Algorithm 2: Composition of objects based on social relationship.

as ΣM is loaded, the first step is to compose objects based on their relationship types. This way, the SPARQL queries are executed; the first query is denoted as Q to retrieve the available service templates and the second query is represented as Q' to extract the relationships associated with the services. From line (5) to (11), first, the social relationship is searched among objects and then the found relative objects are composed in groups. The design philosophy employed over here is to assign a ranking to each selected group based on the relationship type that helps in a more efficient

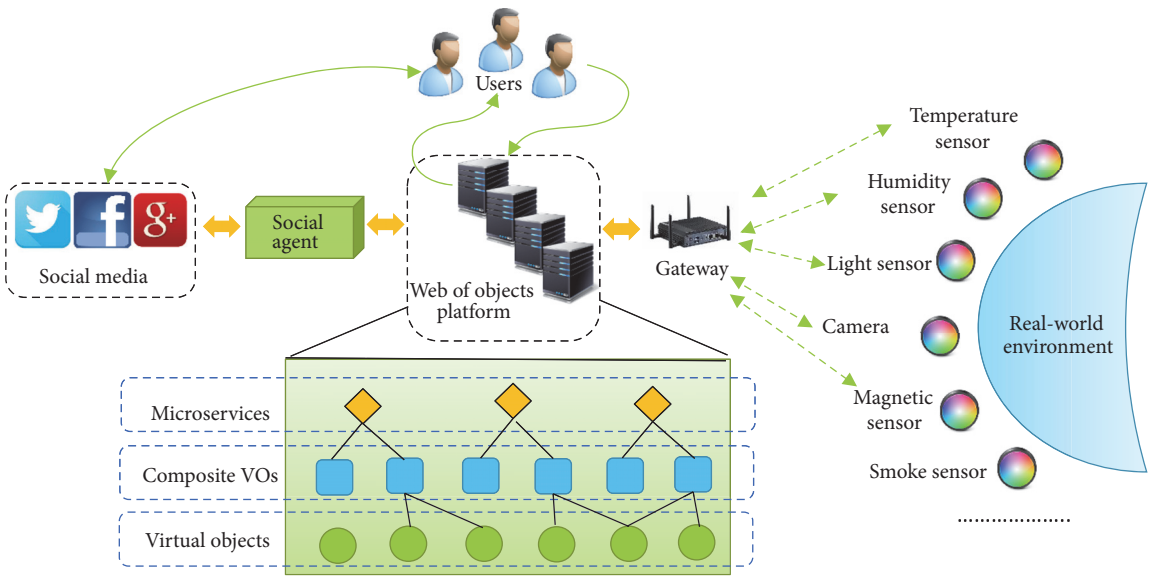

Figure 7: Use case scenario.

composition of service objects (from line (12) to (18)). The last part of Algorithm 2 will continue to iterate to compose the object composition workflow by checking first the assigned relationship ranking with the defined threshold, and then the selected composition workflow graphs are sorted and stored in queues for service execution.

4. Use Case and Prototype Implementation

In this section, first, to realize IoT service provisioning based on social web objects, a use case about IoT enabled museum environment has been presented and then the details on the prototype implementation are furnished.

4.1. Use Case Scenario. This use case is based on a user experience in a public museum where the IoT environment is already set up with the WoO platform incorporating web objects that use social relationship model and a social agent which obtains the user's profile and his friendship details from social media (as shown in Figure 7). The user enters the premises of the museum and his smartphone is prompted with a beacon signal to recommend service app installation where he accepts the request. The phone app incorporates a microservice which establishes a social relationship (GSTOR) with museum visit service objects. The system monitors the interaction of the user in the museum environment; the installed camera network and motion detectors detect the user presence and this feed is collected by the museum visit service. The user shares his current location with the system, which is used by the location navigator service to assist him in moving around the museum by providing the direction to the locations where different museum items are situated. It is worth noticing that the VOs for museum visit service and location navigator service are bound in CLOR relationship due to the same location points. The user shares his social network profile which is used to acquire the list of friends and choices for things the user is interested in. This information is acquired by the recommendation service which suggests the best things to do with respect to the user's interests, making his visit most enjoyable. Recommendation service suggests facilities available in the museum such as places a user should visit, cafeteria food menu, and prices for the day. This service also shares with the user the past experiences of his friends at the museum to help him get most out of his visit. Moreover, personalization service provides special features such as adjusting contents on displays or optimizing the luminosity, to support users with disabilities. To enable these service features, objects exploit the SVOR relationship. Also, the fire management service maintains the status of all VOs that can detect an unusual fire situation in the museum. The temperature VOs acquire readings from temperature sensors and smoke detector VOs get a feed from smoke detection sensors. These VOs form a CLOR relationship with each other in the common proximity. Fire situation monitoring CVO acquires VOs data. One or more CVOs are managed by the fire management service. In case of a fire breakout, the fire management service executes with the data from the fire detection CVOs and the temperature and smoke detector VOs. Meanwhile, services incorporate high-level functionality to react on the data provided by virtual entities in the system. It is important to notice that sharing of information based on social relationships has become easy in the proposed use case. That is because the user information and device information are communicated with social links of web objects and are utilized by the services.

4.2. Proof-of-Concept Details. To evaluate the proposed design, a proof of concept has been furnished, which realizes services based on web objects as considered in the above use case. These objects include, for instance, fire situation monitoring CVO to handle emergency fire breakout situations, location navigator CVO to find the shortest path to the user

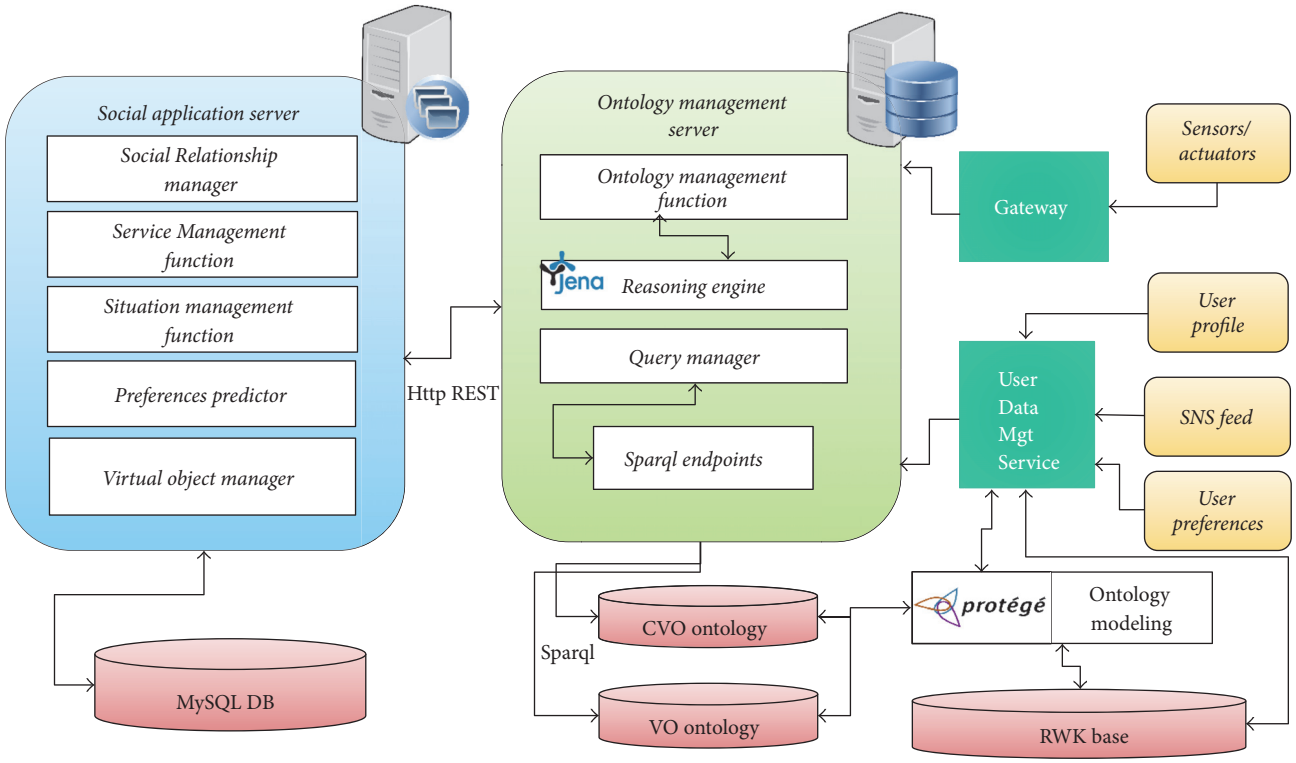

Figure 8: Prototype implementation components.

intended destinations, and user profile reader CVO which acquires user personal information from the social media profile. Several other CVOs have been developed that acquire diverse data and metadata from VOs where each represents a different RWO. These VOs include a user VO, smartphone VO, camera VO, wristband VO, motion detector VO, and others that are associated with the chosen environment (such as CO_2 sensor VO, humidity VO, temperature VO, and light VO). Each VO has several instances; for example, temperature sensor instances are represented as temperatureSesor0001 and temperatureSesor0002. Further VO data is collected and analyzed by CVOs with the rules incorporated in the ontologies. CVOs composed in microservices help analyze different situations and initiate inference over data using inference engines. Considering the system requirement, several aspects have been evaluated, including identification of web objects for effective IoT service provisioning, finding the social relationships among web objects, efficient discovery of web objects based on these relationships, and composition and harmonization of web objects.

4.3. Prototype Implementation Details. To analyze the feasibility of the proposed architecture, a prototype on the discussed use case has been implemented. Figure 8 illustrates the components of the prototype, which constitute social application server (SAS), ontology management server (OMS), and databases to hold VO and CVO graphs that are supported with SPARQL endpoints. The gateway connecting sensors and actuators has been incorporated in the implementation. Additionally, user data management services are implemented to get user profile and preferences history along with social network data.

The application server comprises five major components: social relationship manager (SRM), service management function (SMF), situation/context management function (CMF), preference predictor, and virtual object manager (VOM). The SMF is an entry point for the service request; it interprets and evaluates the service request. It is also responsible for matching the service request with the available template. SMF communicates with VOM to check the VO or CVO availability. A compiled list of VOs is provided to SMF which generates object mashups to satisfy the service request. The execution of VO mashup graph is done using microservices. The second function, VOM, maintains instances of CVOs and associated VOs and coordinates with OMS to use available ontologies in the system. It records the association of services and VOs and enables the reuse of VOs by more than one service; it also resolves conflicts using conflict resolution mechanism. VOM is implemented using RESTful web services. Further, SRM is implemented to maintain object relationships in the form of RDF concepts represented in ontologies. It also involves several microservices, each implemented for a specific task. For example, group management microservice is developed to group objects that have similar characteristics. Similarly, other tasks are distributed in different microservices; for example, link management microservice is used to identify the dependency among objects. Relationship observer microservice is implemented to monitor the objects when they change their state at runtime, whereas to search a web

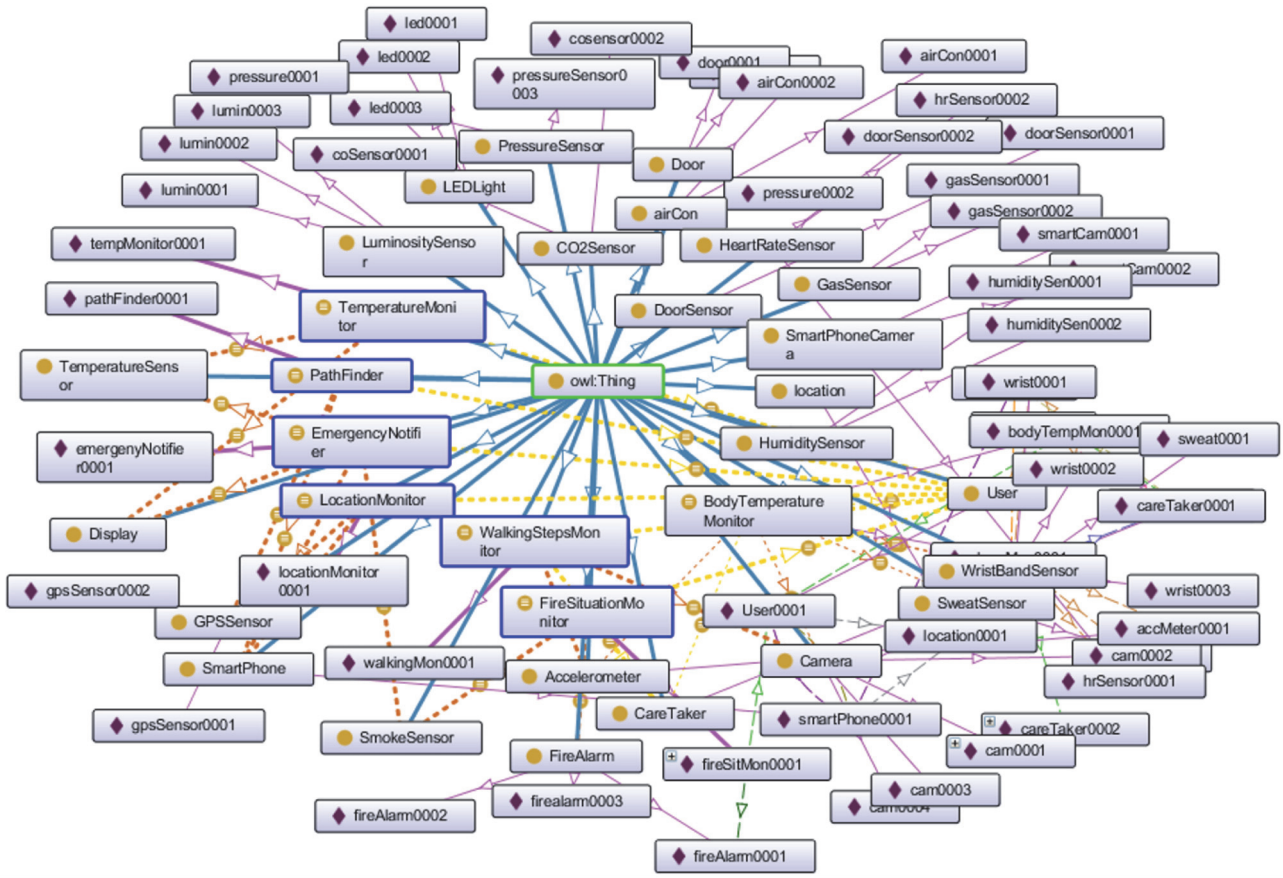

Figure 9: Ontological model of social web objects.

object relationship, the lookup microservice is used. The CMF function has been developed to process the situational information and it selects the most suitable VOs based on the context. The situational information contains the current location of the user, location of the RWOs, and the area under observation. CMF helps form a VO configuration specific to the user current situation. Additionally, to incorporate the real-world facts about the user and the situation, RWK base has been developed which is updated continuously. This also helps in adapting services according to the current situation. VOs provided data is accumulated in RWK model and the reasoning engine is used to infer new facts based on the existing data. The last function of social application server is the preference predictor which provides predictions by using machine learning methods. To implement the learning function, Weka Library [42] has been used. For the objective of demonstration, user preference patterns are collected from the social data and user preference history is used to predict the future patterns.

On the other hand, OMS deals with the semantic representation of VOs. The first functional component of OMS is the ontology management service, which is used to handle VO and CVO ontologies and provides an interface to use VO graphs. Further, to manage ontologies in the developed system, we have used Apache Jena framework [43], and to model VO and CVO ontologies, Protégé [44] has been used. Models generated in Protégé are utilized by ontology management service and stored in OWL format in semantic data stores. To take full advantage of ontology-based implementation, a reasoning engine has also been used to get extra facts related to the modeled concepts. Reasoning engine helps to grow RWK facts stored in VO and CVO ontologies. For the proof of concept, the prototype has used Apache Jena inference engine along with Jena provided reasoner. For the deployment of persistent storage of the RDF data, Jena TDB has been used in our prototype, which is the Jena native high-performance triple store with API support [43]. Query manager is another important component of OMS which provides an interface to query CVO and VO ontologies saved in RDF/XML format, using SPARQL. Also, web services are implemented for the execution of SPARQL queries such as extracting and updating RDF triples in the database. Other than SPARQL query processing, semantic matching of existing concepts is also performed.

Moreover, to achieve interoperable relationships among web objects, a semantic ontology model has been developed as shown in Figure 9. The model constitutes the VO and CVO ontologies and their relationships. Several CVOs have been instantiated, for example, the location navigator, fire situation monitor, emergency notification, and many others that are

```
<!-- http://www.webofobjects.com/hufs/smartservice#01 -->
 <owl:Class rdf:about="http://www.webofobjects.com/hufs/smartservice#01#SmartMuseumService">
     <!-- http://www.webofobjects.com/hufs/smartservice#01#fireSitMon0001 -->
     <owl:NamedIndividual rdf:about="http://www.webofobjects.com/hufs/smartservice#01#fireSitMon0001">
         <rdf:type rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#FireSituationMonitor"/>
         <smartservice:CapturedBy rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#cam0001"/>
         <smartservice:NotifyTo rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#fireAlarm0001"/>
         <smartservice:NotifyTo rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#smokeSensor0001"/>
         <smartservice:checkedBy rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#User0001"/>
     </owl:NamedIndividual>

     <!-- http://www.webofobjects.com/hufs/smartservice#01#PathFinder0001 -->
     <owl:NamedIndividual rdf:about="http://www.webofobjects.com/hufs/smartservice#01#PathFinder0001">
         <rdf:type rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#PathFinder"/>
         <smartservice:checkedBy rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#User0001"/>
         <smartservice:checkedBy rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#surveillanceSystem0001"/>
         <smartservice:notifiedBy rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#location0001"/>
         <smartservice:notifiedBy rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#smartPhone0001"/>
         <smartservice:notifiedBy rdf:resource="http://www.webofobjects.com/hufs/smartservice#01#motionDetector0002"/>
     </owl:NamedIndividual>
 </owl:Class>
```

Figure 10: CVOs and VOs used in the ontology.

```
<!-- http://www.webofobjects.com/hufs/smart-service-ontology#smartPhone0001 -->

<rdf:Description rdf:about="http://www.webofobjects.com/hufs/smart-service-ontology#smartPhone0001">
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#NamedIndividual"/>
    <rdf:type rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#SmartPhone"/>
    <hasLocation rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#location0001"/>
    <hasOwner rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#User0001"/>
    <batteryStatus rdf:datatype="http://www.w3.org/2001/XMLSchema#string">70%</batteryStatus>
    <deviceName rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Samsung-S5</deviceName>
    <modelNumber rdf:datatype="http://www.w3.org/2001/XMLSchema#string">SHV-E77OS</modelNumber>
    <networkStatus rdf:datatype="http://www.w3.org/2001/XMLSchema#string">WIFI</networkStatus>
    <osVersion rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Andriod version 5.0.1</osVersion>
    <smartPhoneId rdf:datatype="http://www.w3.org/2001/XMLSchema#string">S5-00:33:55:11:00</smartPhoneId>
    <smartPhoneManufacturer rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Samsung</smartPhoneManufacturer>
</rdf:Description>
```

Figure 11: Smartphone VO used in the ontology.

based on the composition of numerous VOs. This development has been supported by OMS and semantic web tools such as Jena. Using OMS, CRUD operations are performed like create, update, and delete on CVOs and VOs using SPARQL. In the developed semantic relationships, two CVO instances, namely, "FireSitMon0001" and "PathFinder0001," have been used in the code snippet provided in Figure 10, for fire situation monitoring and location navigation, respectively. We can see the data properties and object properties associated with each object to maintain the relationship with other objects in the system. Further, to understand the VO representation, a smartphone VO "SmartPhone0001" is shown in Figure 11 with the defined properties. A list of VOs used in our prototype has been given in OWL description as shown in Figure 12.

In the test bed environment, the sensor to the gateway connectivity is enabled using ZigBee and BLE. Another source of information that has been incorporated to provide user-centric service capability is SNS feed, which consists of Twitter and Facebook data collected using social media APIs. On the other hand, user profile and preferences are updated using data management service, and this information is used to grow RWK base.

To test the prototype, an android application has been developed. After the user logs in to the app for WoO based assisted services, the app starts the configuration of services according to the user profile. A list of services is presented on the user's screen from which the user can select any service. These services include museum visit service, location navigator service, recommendation service, and emergency notification. The selected service starts collecting information with the interaction of the user or when the devices start pushing values about any change in the observed environment. Based on these observed parameters, alerts are generated by the app; for example, the museum visit service generates alerts about the available facilities in the museum and the environmental conditions including the indoor and outdoor temperatures. On the other hand, the location navigator service helps the user to navigate around the museum by showing directions to several visitor attractions. Moreover, the emergency notification service triggers alerts when a temporary fire is created to mimic an unusual situation such as fire breakout. The resulting fire increases the temperature reading which is detected by the temperature sensor. This change in reading is forwarded through the gateway and analyzed by the fire situation monitor CVO which checks its threshold value and generates an emergency notification on the user's app screen. Also, the recommendation service is used to generate suggestions about the museum events and the places to visit.

```
<!-- http://www.webofobjects.com/hufs/smart-service-ontology#deviceName -->

<rdf:Description rdf:about="http://www.webofobjects.com/hufs/smart-service-ontology#deviceName">
    <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#DatatypeProperty"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#CO2Sensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#Camera"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#DoorSensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#FireAlarm"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#GPSSensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#GasSensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#HeartRateSensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#HumiditySensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#LEDLight"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#LuminositySensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#PressureSensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#SmartPhone"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#SmartPhoneCamera"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#SmokeSensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#SweatSensor"/>
    <rdfs:domain rdf:resource="http://www.webofobjects.com/hufs/smart-service-ontology#WristBandSensor"/>
    <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
</rdf:Description>
```

Figure 12: List of VOs used in the ontology.

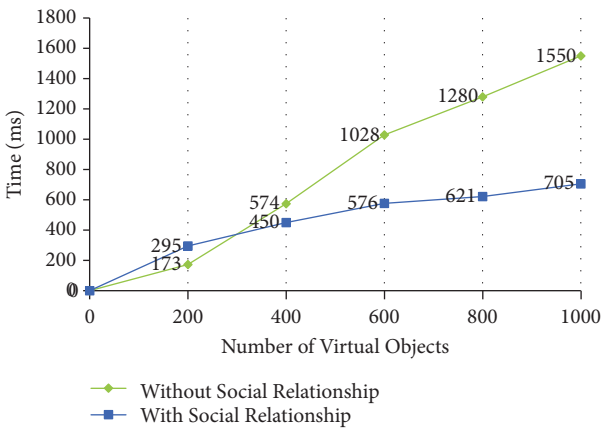

Figure 13: VO discovery time with the increasing number of virtual objects.

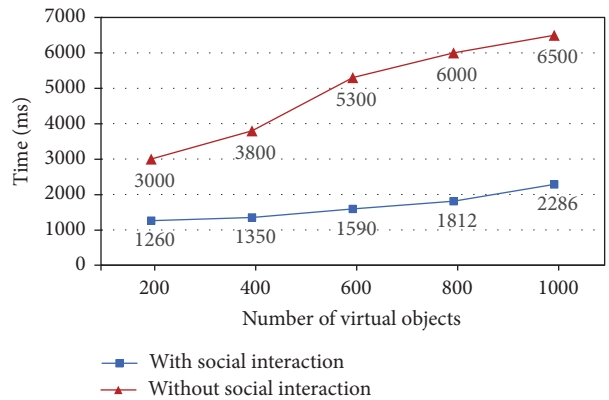

Figure 14: Service execution time with the increasing number of virtual objects.

4.4. Performance Evaluation. The proposed architecture has been analyzed from two different perspectives: system scalability and resource consumption. The results with respect to the experiments and the performance criterion are discussed in this section. The first experiment involves the analysis of the time required to discover the virtual objects in the proposed system with or without social relationship criterion as shown in Figure 13. As it is apparent from the results, initially, to form a social graph, VO discovery process incurs delay due to the communication for establishing social relationship links. However, direct lookup for VOs in the registry at the start of the discovery process comparatively requires less time, but as the number of VOs increases, the delay rises. Traversing the social links to discover objects as the number of virtual objects grows considerably reduces the total lookups in the registry database.

The second experiment provides an analysis of the execution time required for the CVOs as shown in Figure 14. To test this in a real environment, an android application has been developed. The app allows access to the parameters from the available VOs. When the app requires retrieving observations, it iterates through VOs in the repository using a query interface. This requires high CPU utilization with more execution time required to retrieve the sensor values against each app generated request. This is due to the fact that the decision for the selection of VOs has been done at runtime; it requires more time to select the VO graphs, execute them, and get the relevant data from the VOs. However, when object interaction is based on the social relationship, it requires less time for the retrieval as friends in the social network share the data on other friends' requests, which results in less computation as compared with the previous scheme.

Moreover, Figure 15 depicts the time to discover VOs in four different types of services. These services are the museum visit service, the location navigator service, the emergency notification service, and the recommendation service. The discovery time varies from one service to another depending on the number of VOs used. However, as compared with the impact of social connections, it can be

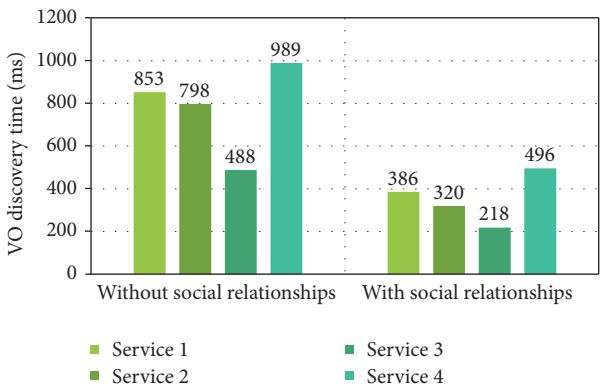

Figure 15: VO discovery time for four different services with or without social relationship utilization.

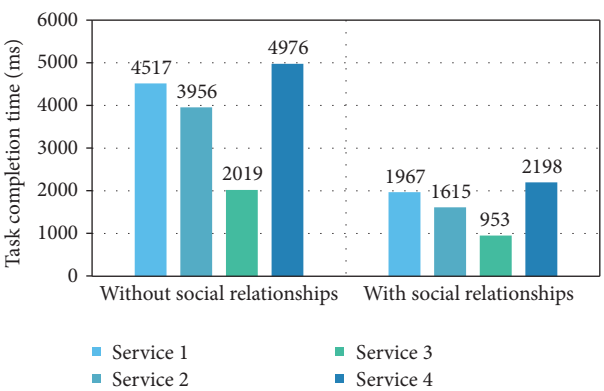

Figure 16: Task completion time required for each service with or without social relationship exploitation.

realized that the services can considerably reduce the time of object discovery and execution by using the relationship model. This is due to the fact that with social association among web objects a service does not have to query the registry for all VOs and rather VOs in the same social graph are utilized. Also, VOs collected observations are shared to save the service time for probing each VO. To view this, Figure 16 shows the overall time required for services to execute their tasks. An important factor to notice here is that the overall task completion time is also affected when social links are used to collect observations from VOs that are used in the service execution.

5. Conclusion

The Internet of Things is bringing the next technological revolution by connecting billions of objects on the earth and providing intelligent IoT services. However, it also carries two most important challenges: the first one is the complexity of handling a huge number of heterogeneous objects and the second one is how to deal with the monolithic approaches for providing services over existing IoT infrastructure. To address these challenges, we have proposed an integrated design based on the principles of SIoT, where the complexity has been handled using socially connected web objects; to overcome the monolithic approaches, microservices that can compose new service features independently have been adopted. In the proposed design, a social relationship model has been presented, which enables the efficient discovery of web objects and reduces the complexity of service provisioning process with the algorithms to discover and compose web objects. A semantic ontology model has also been developed to realize the interoperable social interaction among heterogeneous objects. Finally, a prototype implementation based on a use case scenario has been demonstrated; to evaluate the system with respect to the performance issues, experimental results pertaining to the VO discovery and service execution time have been rendered.

Details of Notations Used in Algorithms

$\mathbb{\Sigma}\phi$: Service object ontologies based on semantic representation where ϕ is a replacement for M_μ which represents microservices M_c which represents CVO and M_v are VO ontologies

$\mathbb{\Pi}_L$: Collection or list of all relationships that are retrieved from service objects

$\mathbb{\Pi}_U$: List of the objects that do not have a relationship or are not associated

$\hat{S}$: Social relationship graph of objects

U: Correlation union of templates

$\underline{\mu}\overline{\mathrm{T}}$: All service objects returned in response to the query request

$\overline{\mathrm{T}}$: All objects returned in response to the query request

μ: The single instance iterated from the collection of microservices

M: Data model based on the specified ontology, where $\mathbb{\Sigma}M_s$ represents service data model, $\mathbb{\Sigma}M_c$ represents context data model, and user profile model is represented as $\mathbb{\Sigma}M_u$

Q: SPARQL query to retrieve the available service templates for user rating

Q': SPARQL query to retrieve the relationship associated with services

$\mathbb{R}_e$: Registry entries of service objects

C_R: Relationship associated with CVO

V_R: Relationship associated with VO

R_c: All possible relationships that can be associated with CVO

R_v: All possible relationships that can be associated with VO

O_i: Iterator object instance for iterating the list of CVO and VO objects

$\mathbb{Z}$: Set of objects' social relationships

σi: Iteration item of the list of service objects

λi: An instance of iteration items in the list of service objects

$\mathbb{\Pi}_{Lm}$: List of all matched service items

ϖi: An instance of iteration items in the list of matched service items

$\mathbb{III}_{LR}$: List of all matched ranking
∂: Ranking value assigned to a service object
σj: Iterator item for the ranking list
κ: Threshold to rank a service object
Wf: Workflow for the composition of service objects
Pq: Priority queue to store ranked object instances
R∂: Assigned relationship ranking.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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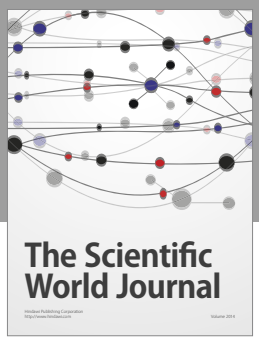

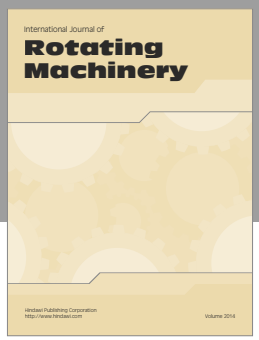

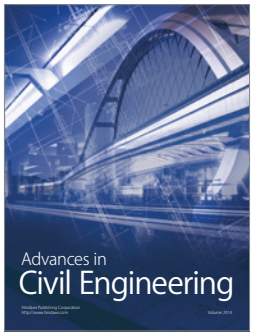

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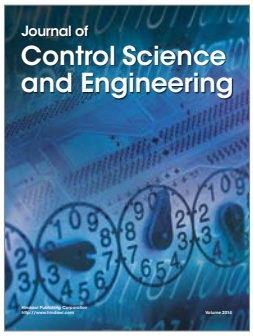

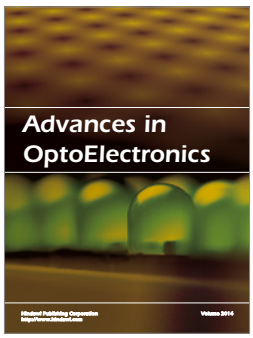

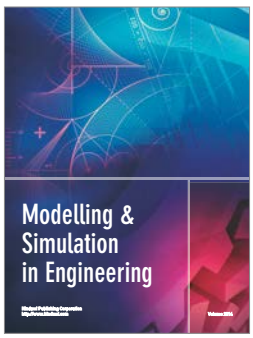

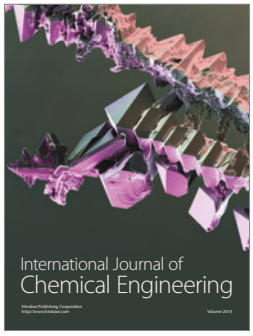

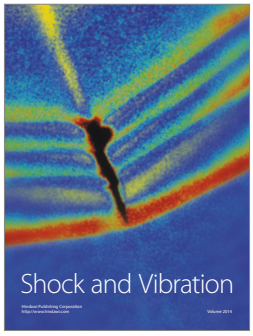

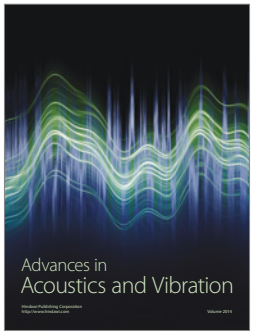

Multiple Antenna Technologies

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ABSTRACT

Multiple antenna technologies have received high attention in the last few decades for their capabilities to improve the overall system performance. Multiple-input multiple-output systems include a variety of techniques capable of not only increase the reliability of the communication but also impressively boost the channel capacity. In addition, smart antenna systems can increase the link quality and lead to appreciable interference reduction.

I. Introduction

Multiple antennas technologies proposed for communications systems have gained much attention in the last few years because of the huge gain they can introduce in the communication reliability and the channel capacity levels. Furthermore, multiple antenna systems can have a big contribution to reduce the interference both in the uplink and the downlink by employing smart antenna technology.

To increase the reliability of the communication systems, multiple antennas can be installed at the transmitter or/and at the receiver. Alamouti code is considered as the simplest transmit diversity scheme while the receive diversity includes maximum ratio, equal gain and selection combining methods. Recently, cooperative communication was deeply investigated as a mean of increasing the communication reliability by not only considering the mobile station as user but also as a base station (or relay station). The idea behind multiple antenna diversity is to supply the receiver by multiple versions of the same signal transmitted via independent channels.

On the other hand, multiple antenna systems can tremendously increase the channel capacity by sending independent signals from different transmit antennas. BLAST spatial multiplexing schemes are a good example of such category of multiple antenna technologies that boost the channel capacity.

In addition, smart antenna technique can significantly increase the data rate and improve the quality of wireless transmission, which is limited by interference, local scattering and multipath propagation. Through shaping the antenna radiation pattern and adaptively adjusting the antenna weight vector, smart antennas improve the communication link quality by increasing the received signal power and suppressing the interference.

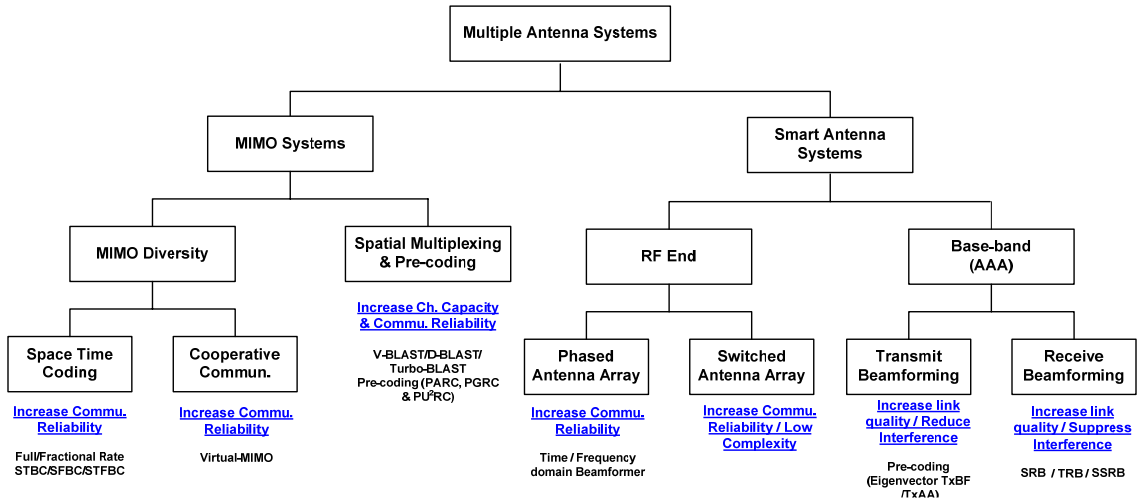

Fig. 1. Multiple antenna technologies.

Besides, on-line calibration technique is also adopted to correct the errors due to the distortions and nonlinearity of the radio frequency components in the antenna array system.

Fig. 1 summarizes the different multiple antenna technologies and gives some examples of these technologies.

This paper is organized as follows: in section II we present multiple antenna diversity schemes employed at the transmitter or/and at the receiver. Spatial multiplexing presented by BLAST schemes is detailed in section III. Section IV is dedicated to some advanced multiple input multiple-output (MIMO) systems including multi-user MIMO and cooperative communications. While techniques related to the smart antennas such as phased antenna array, switched beam antenna array, and adaptive antenna array are described in Section V. Finally, we conclude in Section VI.

II. **MIMO Diversity**

In communication systems, we have to increase the reliability of the communication operation between transmitter and receiver while maintaining a high spectral efficiency. The ultimate solution relies in the use of *diversity*, which can be viewed as a form of redundancy [1]. There are many diversity techniques that can be applied to communication systems; we mention herein time diversity, frequency diversity, and spatial diversity or any combination of these three diversities. In *time diversity*, the same information-bearing signal is transmitted in different time slots where a good gain can be achieved when the duration between the two slots, in which the same symbol is transmitted, is greater than the coherence time of the channel. In *frequency diversity*, the same information-bearing signal is transmitted on different subcarriers where a good diversity gain can be achieved when the separation between subcarriers is greater than the coherence bandwidth.

Finally, in *spatial diversity*, the same information-bearing signal is transmitted or received via different antennas where the maximum gain can be achieved when the fading occurring in the channel is independent (or low correlated). In the receiver, diversity gain can be achieved by combining the redundant signals arriving via independent (or lowly correlated) channels.

Fig. 2 shows some possible combinations of transmit diversity which can be achieved when employing multiple transmit antennas.

In the following section, we present some famous space-time block codes applied at the transmitter side. We present also the combining techniques used when different versions of the information-bearing signal are received. Finally, we present a scheme that includes transmit and receive diversities.

2.1 Space Diversity at the Transmit Side

The basic idea of the use of transmit diversity is to reduce the mobile station (MS) receiver complexity while improving the detection performance.

The pioneering work in the transmit diversity was done by Alamouti where he proposed his famous 2×1 space-time code. Alamouti scheme achieves diversity gain while requiring only a linear decoder.

Later on, Tarokh et al. proposed a generalized theory of the complex orthogonal space-time codes. Based on Tarokh work, more than two antennas can be used and the code rate can be fractional.

In the following we present the two different types of space-time codes.

2.1.1 Complex Orthogonal Space-Time Codes

For this type of space time codes, the following conditions must be satisfied

- Square transmission matrix (number of transmit antennas N_t equal to number of used time slots m)
- A unity code rate (number of used time slots m equals to number of transmitted symbols l)
- Orthogonality of the transmission matrix in the time and space domains ($SS^H = S^H S$) where S^H is the conjugate transpose of S.

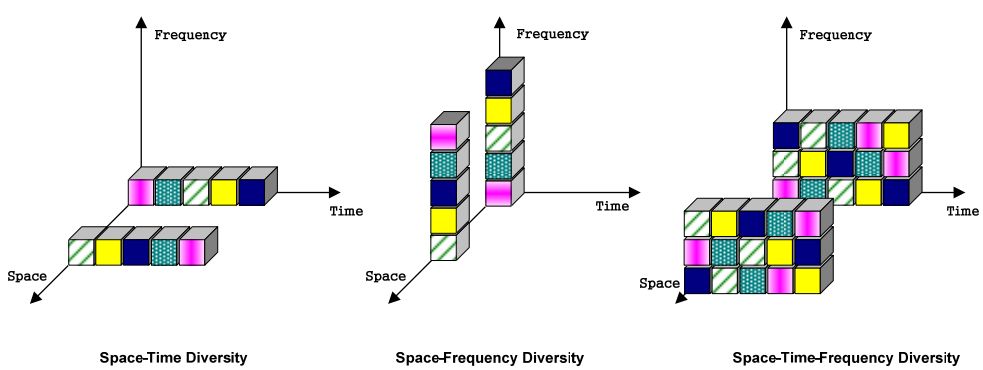

Fig. 2. Transmit diversity.

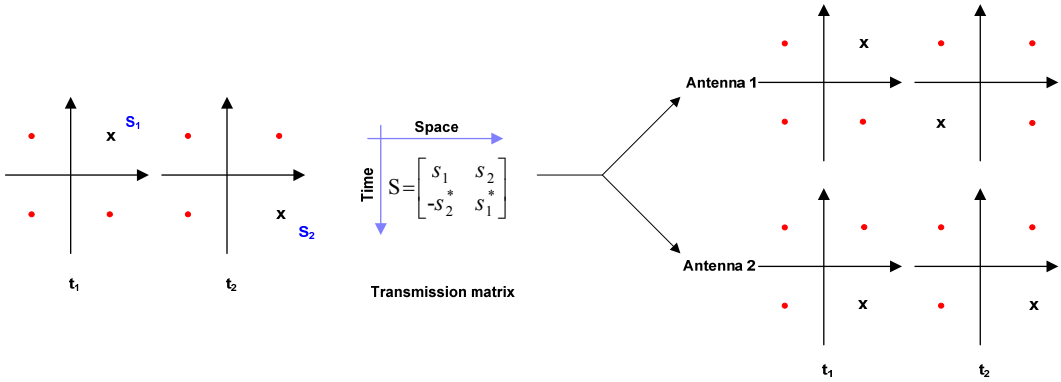

Fig. 3. Alamouti scheme example with QPSK modulation.

As said before, the simplest complex orthogonal space-time code is the Alamouti code which uses two transmit antennas and one receive antenna. Furthermore, Alamouti scheme requires that the fading channel envelope remains constant over two time slots.

Fig. 3 shows an example of the encoding process of Alamouti scheme with QPSK modulation [2], [3].

Fig. 4 shows the receiver structure used for decoding the combined received symbols.

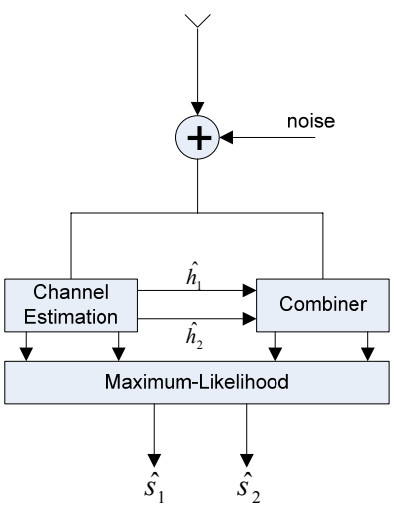

Fig. 4. Alamouti code receiver.

At the receiver the following signals are received (with applying the complex conjugate to the received signal at t_2)

$$\begin{bmatrix} y_1 \\ y_2^* \end{bmatrix} = \begin{bmatrix} h_1 & h_2 \\ h_2^* & -h_1^* \end{bmatrix} \begin{bmatrix} s_1 \\ s_2 \end{bmatrix} + \begin{bmatrix} n_1 \\ n_2^* \end{bmatrix} \qquad (1)$$

The linear combiner multiplies the received symbols by the Hermitian transpose of the channel matrix (for simplicity, we consider that channel is perfectly estimated). The output of the linear combiner is then given by

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \left[h_1^2 + h_2^2 \right] \begin{bmatrix} s_1 \\ s_2 \end{bmatrix} + \begin{bmatrix} w_1 \\ w_2 \end{bmatrix} \qquad (2)$$

Maximum-Likelihood (ML) decoder is then applied to get the transmitted symbols. As one can see, the simplicity of the receiver is due to the spatio-temporal orthogonality of the transmission matrix.

A complex orthogonal space-time code using 4 or 8 antennas was proposed by Tarokh et al. in [4].

2.1.2 Generalized Complex Orthogonal Space-Time Codes

The search for space-time codes with more than two antennas was started by Tarokh, Jafarkhani, and Calderbank. Their work

has built the basis for a theory of generalized complex orthogonal designs.

Generalized complex orthogonal designs are distinguished from Alamouti code by the following

- A non-square transmission matrix (number of used time slots ≠ number of Tx antennas)
- A fractional code rate (number of transmitted symbols < number of used time slots)
- Orthogonality of the transmission matrix is only guaranteed in the time sense.

As a consequence of these characteristics, the spectral efficiency is reduced and the number of time slots over which the channel should be constant is increased.

The transmission matrix of a generalized complex space-time code with 3 antennas, 4 transmitted symbols and 8 used time slots is given by [5]

$$\mathbf{G_3} = \begin{bmatrix} s_1 & s_2 & s_3 \\ -s_2 & s_1 & -s_4 \\ -s_3 & s_4 & s_1 \\ -s_4 & -s_3 & s_2 \\ s_1^* & s_2^* & s_3^* \\ -s_2^* & s_1^* & -s_4^* \\ -s_3^* & s_4^* & s_1^* \\ -s_4^* & -s_3^* & s_2^* \end{bmatrix} \qquad (3)$$

In the literature, more research was done to increase the rate of the space-time codes. For more details refer to [6].

Table 1 summarizes the difference between Alamouti and space-time code characterized by the transmission matrix $\mathbf{G_3}$.

These shown coding schemes can be transmitted in the space-time domains, space-frequency domains or in space-frequency-Time domains. These coding schemes are thus known as ST, SF, and STF coding, respectively [7].

2.1.3 Cyclic Delay Diversity (CDD)

CDD can be considered as a very simple transmit diversity scheme. CDD can achieve transmit artificial frequency diversity by selecting appropriate transmit delays. In this method, multiuser diversity, obtained by scheduling based on frequency domain channel response, can be improved by adjusting the delay spread (at the transmitter) which is done by controlling the delay values dependent on the channel condition [8], [9].

2.2 Space Diversity at the Receive Side

In space diversity at the receive side, multiple antennas are used in the receiver with sufficient spacing between antennas in such a way mutual correlation between antennas is reduced and as consequence diversity gain is increased [10]. To get diversity gain at the receiver, received signals from different antennas are combined. There are four combining methods, namely, select combining (SC), maximal-ratio combining (MRC), equal-gain combining (EGC), and square-law combining. The first three schemes are linear while the last requires a non-linear receiver.

Fig. 5 shows a simplified block diagram of the linear combining schemes which differ in the weighting vector **w.** In SC, the signal at the branch with maximum signal to noise ratio (SNR) is selected and other received signals are discarded.

The weighting vector $\mathbf{w} = (w_1, w_2, \ldots, w_M)$ is the Nth column of the identity matrix of size M where the Nth branch has the maximum SNR.

Table 1. Comparison between Alamouti and generalized complex space-time codes.

Space-time code	Number of Tx antennas	Number of transmitted symbols, *l*	Number of used time slots, *m*	Orthogonality of Tx matrix	Rate = *l/m*
S	2	2	2	Spatio-temporal sense	1
G_3	3	4	8	Only temporal sense	1/2

Table 2. Comparison between diversity combining schemes.

Scheme	Requiring CSI	Outage Probability F(x)	Application
SC	No	$\left[1-e^{-x/\bar{y}_c}\right]^M$	No constraints
MRC	Yes	$1-e^{-x/\bar{y}_c}\sum_{k=0}^{M-1}\frac{1}{k!}\left(\frac{x}{\bar{y}_c}\right)^k$	No constraints
EGC	Yes	No closed form for M > 2	No constraints
SLC	No	-	FSK or DS-CDMA

As one can see, the SC scheme does not require any channel information except that of SNR. On the other hand, MRC and EGC schemes require the channel state information (CSI) or a part of it (channel envelope, phase, delay). MRC scheme weights the received signals according to their reliability; a more reliable signal has a high weight while a less reliable signal has a small weight. Also, the channel phase distortion is compensated. Finally, signals are aligned then combined. On the other hand, EGC scheme can be viewed as a simplified version of MRC where signals are weighted equally (i.e. the weighting vector $\mathbf{w} = [1, 1, \ldots, 1]_M$) then aligned before being combined coherently. In practice, the phase at different branches can't be often estimated. So, EGC and MRC can't be employed. In such situations, square law combining (SLC) can be applied to obtain spatial diversity without requiring phase estimation. Unlike linear combining schemes, SLC scheme can only be applied to modulation schemes which preserve some sort of orthogonality including frequency-shift keying (FSK) or direct-sequence CDMA [5], [11].

Table 2 summarizes a comparison between combining schemes. It is known that, from a performance point of view, MRC is optimum and gives the best performance among the pre-described combining schemes.

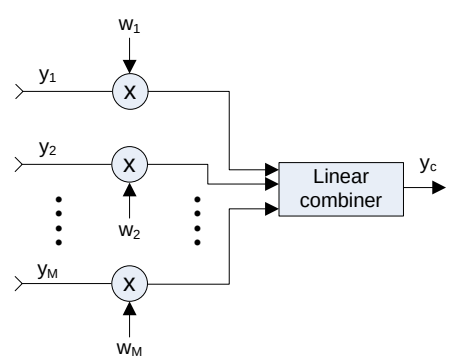

Fig. 5. Simple block diagram of linear combining schemes.

2.3 Combined Transmit/Receive Diversity

Spatial diversity schemes explained in the previous two sections can be combined together to achieve diversity at both receive and transmit sides. An example of such a hybrid spatial diversity scheme is

the 2×2 Alamouti/MRC MIMO system [12].

III. Spatial Multiplexing

As shown in the previous section, MIMO diversity can be used in the transmitter or the receiver sides or in both to increase the reliability of the communication. In this section we talk about spatial multiplexing schemes which are for goal to increase the channel capacity.

The most known spatial multiplexing schemes are the BLAST family which includes Vertical-BLAST, Diagonal-BLAST, and Turbo-BLAST. The acronym BLAST stands for "*Bell Laboratories Layered Space-Time*".

3.1 Diagonal-BLAST

D-BLAST was originally proposed by Foschini [13]. In D-BLAST, the symbols to be transmitted are arranged on the diagonals of the space-time transmission matrix where elements under the diagonal are padded with zeros. Fig. 6-a depicts the structure of the D-BLAST transmitter for four transmit antennas. At first, the bit stream is de-multiplexed into four parallel streams which are encoded and modulated independently. Encoded-modulated streams are cycled over time. Equation (4) is an example of the transmission matrix when using four transmit antennas.

$$S = \begin{bmatrix} s_{1,1} & s_{1,2} & s_{1,3} & s_{1,4} & \cdots & s_{1,K-1} & s_{1,K} & 0 & 0 & 0 \\ 0 & s_{2,1} & s_{2,3} & s_{2,4} & \cdots & s_{2,K-2} & s_{2,K-1} & s_{2,K} & 0 & 0 \\ 0 & 0 & s_{3,1} & s_{3,2} & \cdots & s_{3,K-3} & s_{3,K-2} & s_{3,K-1} & s_{3,K} & 0 \\ 0 & 0 & 0 & s_{4,1} & \cdots & s_{4,K-4} & s_{4,K-3} & s_{4,K-2} & s_{4,K-1} & s_{4,K} \end{bmatrix} \quad (4)$$

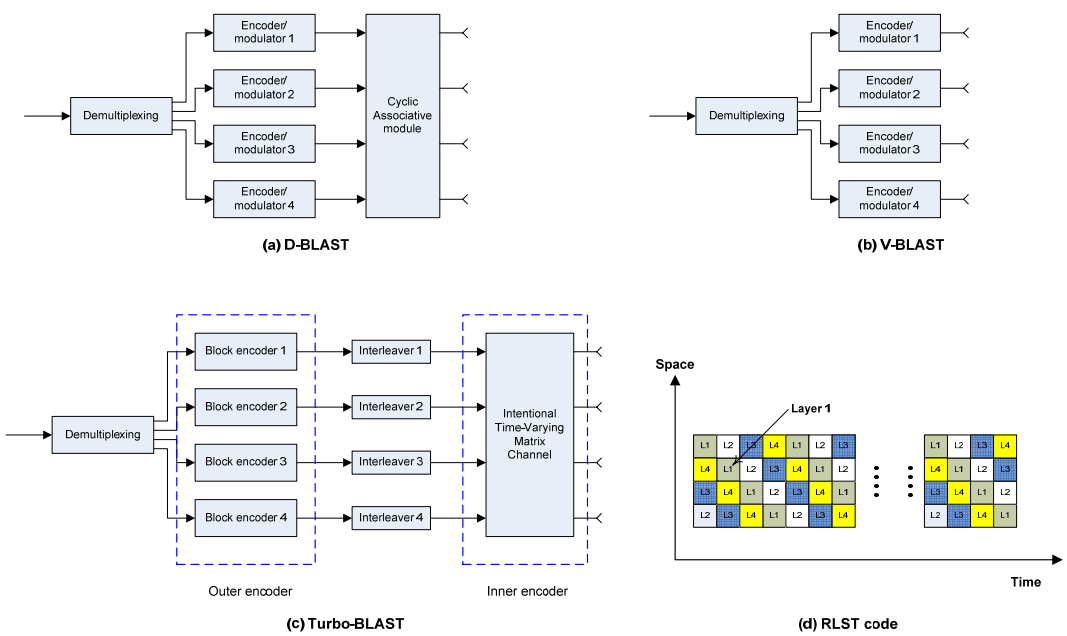

Fig. 6. Transmitter block diagrams for BLAST family using four transmit antennas.

Table 3. MIMO systems diversity orders.

MIMO Configuration	Diversity order
STBC	$N_t \times N_r$
BLAST	$N_r - N_t + 1$

The first diagonal of S is transmitted via the first antenna; the second diagonal is transmitted via antenna 2, and so on.

3.2 Vertical-BLAST

A simplified version of D-BLAST was proposed by Wolniansky known as Vertical-BLAST or V-BLAST [14]. In V-BLAST, incoming data stream is de-multiplexed into N_t streams each of which is encoded and modulated independently and sent on an antenna of its own. V-BLAST high-level diagram is depicted in Fig. 6-b where four antennas are used at the transmit side. Compared to D-BLAST, V-BLAST does not include cycling over time, the complexity is significantly reduced. In addition, unlike D-BLAST, V-BLAST does not include any space-time wastage. At the receiver, transmitted symbols can be decoded using *ordered serial interference-cancellation (OSIC) detector*. For the OSIC to work properly, the number of receive antennas N_r must be at least as large as the number of transmit antennas.

3.3 Turbo-BLAST

Turbo-BLAST was first described by Sellathurai and Haykin [15]. The Turbo-BLAST transmitter structure is depicted in Fig. 6-c. The data stream bits are firstly demultiplexed into N_t parallel streams which are encoded independently using the block encoder (outer encoder) (i.e. channel coding). The output streams of the outer encoder are interleaved independently and passed to the inner encoder. The mission of the outer encoder is to achieve *random-layered space-time* (RLST) coding.

The structure of the RLST encoder, with periodical cyclic space-time interleaving is depicted in Fig. 6-d. For optimal performance of the RLST code, the receiver should employ the *maximum a posteriori probability (MAP)* decoding algorithm. Nevertheless, the complexity of the MAP decoding algorithm is very high (increases exponentially with N_t). To decrease the complexity of the receiver, the near-optimal turbo-like receiver can be used. This near-optimal turbo-like receiver is known as *iterative detection and decoding (IDD) receiver*.

Before going further, we list in Table 3 a comparison between diversity order of the different space-time coding and the BLAST family schemes.

IV. Advanced Topics

4.1 Single and Multi CodeWord MIMO

In single codeword (SCW) MIMO, an encoded packet is distributed across many streams to form the MIMO transmission. Feedback is used to control the rank of the MIMO transmission (number of streams used) as well as the overall rate of transmission. In multiple codeword MIMO, several separately encoded packets are transmitted independently over the multiple streams. Here the rate of each stream can be controlled with feedback [16] and [17].

4.2 Single-User MIMO and Multi-User MIMO

In single-user MIMO, already explained techniques in previous sections are used where the channel capacity grows linearly with *min(Nt, Nr)* [18].

For multi-user MIMO, which is of high interest research topic, it was shown that for N_t transmitting antennas (at the base station) and N_r users, the same overall capacity can be achieved. This later work was encouraged by applying dirty paper coding [19] where results showed that if the transmitter knows the interfering signal, then the channel capacity will not be affected by the presence of the interference [20]. On the other hand, multi-user MIMO can integrate beamforming to apply spatial division multiple access (SDMA).

4.3 Cooperative Communication and Virtual MIMO

In cooperative communication, a mobile can act as both a user and relay. As consequence, mobile sends to the base station its own data bits and some of other mobiles (sometimes called partner) information bits. Fig. 7 shows a cooperative cellular system where for simplicity we consider three cooperative users and one base station [21]. As depicted in Fig. 7, user 1 cooperates with users 2 and 3 to send its own information. As a result, the overall cooperative system can be seen as virtual-MIMO (V-MIMO) and in the above example it is $3\times N_{BS}$ MIMO system (for the uplink) where N_{BS} is the base station's number of receive antennas. Users 2 and 3 can simply amplify and forward user 1 received information or detect and forward [22]. Another method of cooperation is the coded cooperation where different coded portions are sent via different fading channels [23].

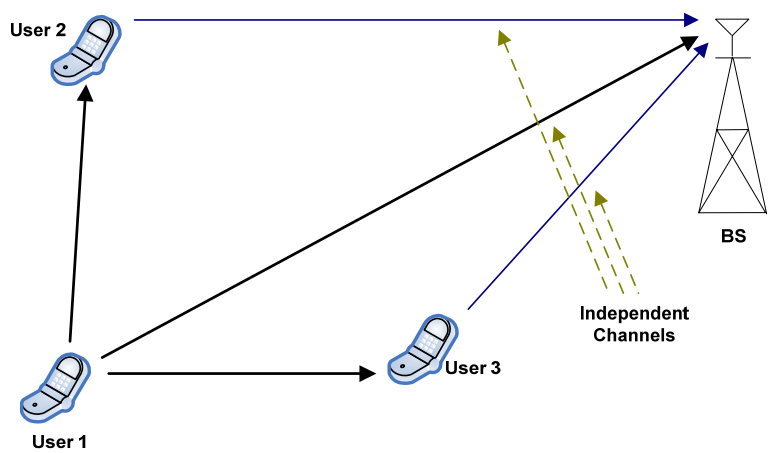

Fig. 7. Cooperative communication and virtual-MIMO.

4.4 Pre-Coded MIMO with Rank Adaptation

4.4.1 Per Antenna Rate Control (PARC)

PARC can be considered as a closed-loop MIMO system where transmitter uses *channel quality indication* (CQI) fed by the receiver to select the best modulation and coding schemes per antenna. Fig. (8) shows a general PARC transmitter structure with 4 transmit antennas [24].

4.4.2 Per Group Rate Control (PGRC)

In PARC, a CQI feedback is necessary for each transmit antenna. This increases the uplink overhead.

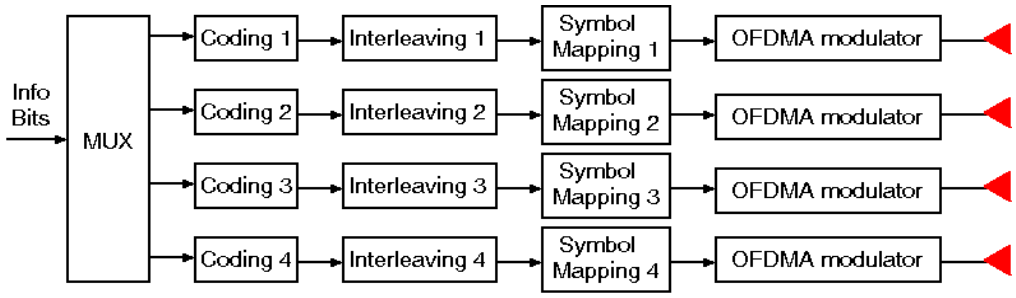

Fig. 8. Per Antenna Rate Control (PARC).

To solve this problem, PGRC is used where a feedback is required per group of antennas. This reduces the feedback information while maintaining almost the same performance of PARC [24].

4.4.3 Per User Unitary Rate Control (PU^2RC)

PU^2RC is a multi-user closed-loop MIMO system. Each user feeds back the CQI to the base station. The base station uses the CQI to determine the modulation and coding schemes per user. In addition, base station can apply unitary pre-coding and adaptively select the number of transmit antennas (rank adaption) [25].

V. Smart Antennas

5.1 Introduction

Smart antenna was born in the early 1990s when well developed adaptive antenna arrays originate from Radar system. Later, Smart antenna technique is applied in wireless communications system. Recently, Smart antenna technique has been proposed as a promising solution to the future generations of wireless communication systems, such as the Fourth-Generation mobile communication systems, broadband wireless access networks, where a wide variety of services through reliable high-data rate wireless channels are expected. Smart antenna technique can significantly increase the data rate and improve the quality of wireless transmission, which is limited by interference, local scattering and multipath propagation [26], [27]. Smart antennas offer the following main applications in high data-rate wireless communication systems [28], [29]:

- Spatial Diversity
- Co-channel interference reduction
- Angle reuse or space division multiple access (SDMA)
- Spatial multiplexing

Smart antenna system can be categorized into three main groups: Phased antenna array system, switched beam systems, and adaptive antenna array system. To match the characteristics in each radio frequency chain of the transmitter and receiver, on-line calibration is required in smart antenna systems. On-line calibration technique can compensate the errors such as the distortions of radio frequency components due to small environment changes, the nonlinear characteristics of mixer, amplifier and attenuator, I/Q imbalance errors, etc.

5.2 Phased Antenna Array System

Phased antenna array is a group of antennas in which the relative phases of the respective signals feeding the antennas are varied in such a way that the effective radiation pattern of the array is reinforced in a desired direction and suppressed in undesired directions.

Phased antenna array system is usually utilized in *radio frequency* (RF) or *intermediate frequency* (IF) with the system central frequency larger than 10 GHz, such as satellite communication system [30]. There are two main different types of phased arrays, also called beamformers. There are time domain beamformers and frequency domain beamformers.

5.3 Switched Beam System

The switched beam method is considered as an extension of the current sectorization scheme. In the switched beam approach, the sector coverage is achieved by multiple predetermined fixed beam patterns with the greater gain placed in the centre of a beam [30]. When a mobile user is in the vicinity of a beam, then the signals at the output ports will be given as in (5). This enables the switched beam system to select the signal from the output port corresponding to that beam. As the mobile moves to the coverage of another beam during the call, the system monitors the signal strength and switches to other output ports as required. A basic switched beam antenna architecture is shown in Fig. 9. And Fig. 10 illustrates the produced antenna pattern with 4 antennas.

$$y_i(t) = s_i(t)G_i(t)\sum_{l=1}^{L} I_l(t)G_{li}(\theta_l) \qquad (5)$$

where $y_i(t)$ is the total signal appearing at port i, $s_i(t)$ is the signal source, $I_l(t)$ is the interfering signal source located at arbitrary angles θ_l, G_i is the transfer function between signal source along the main beams and their corresponding output ports, G_{li} is the transfer function between interference signal l and port i.

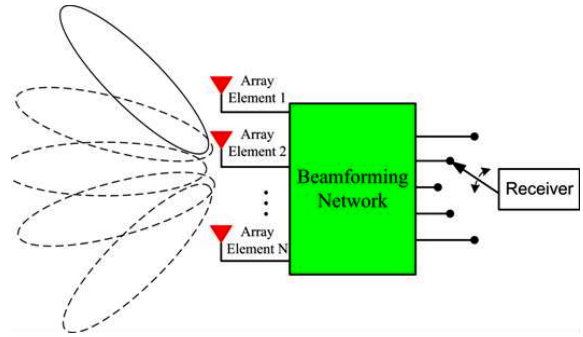

Fig.9. Functional block diagram of switched beam system.

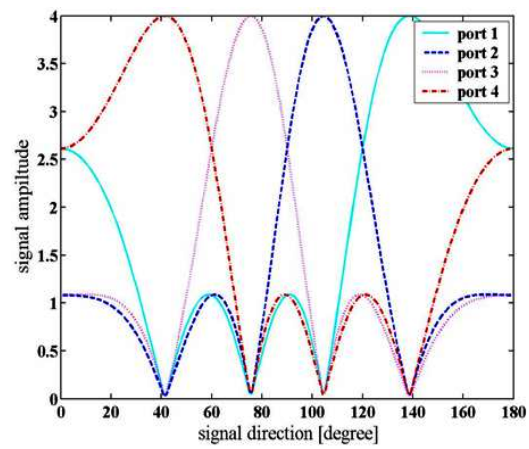

Fig.10. Produced antenna pattern of switched beam system with 4 antennas.

Switched beam systems can offer several advantages, including

- Low complexity and cost. Since switched beam system only requires a beamforming network, RF switches, and simple control logic, they are relatively easy and cheap to implement.
- Moderate interaction with base station receivers. In practice, switched beam system can simply replace conventional sector antennas without requiring significant modifications to the radio base station antenna interface or the baseband algorithms implemented at the receiver.
- Coverage extension. The antenna array aperture gain will boost the link

budget, which could be translated to a coverage extension.

5.4 Adaptive Antenna Array System (AAA)

Adaptive antennas date back to 1959. The original work was attributed to L. C. Van Atta's work, Electromagnetic Reflection. Since then, adaptive beamforming techniques have been employed to remove unwanted noise and jamming from the output, mainly in military applications. With the thriving commercial wireless communication industry and the advancing microprocessor technologies, the adaptive beamforming techniques have found their applications in commercial wireless communications. With powerful *digital signal processing* (DSP) hardware at the base-band, algorithms could control antenna beam patterns adaptively to the real signal environment, forming beams towards the desired signals while forming nulls to co-channel interferers. Thus, the system performance is optimized in terms of link quality and system capacity [31].

Adaptive antenna array can be utilized in the transmitter side, which is known as *transmit beamforming* (TxBF) or in the receiver side, which is called *receive beamforming* (RxBF).

5.4.1 Transmit Beamforming (TxBF)

The implementation of adaptive antenna array technique in a handset is difficult with today`s hardware due to its limitations in size, cost, and energy storage capability, while it is feasible to adopt antenna arrays at base stations. Transmit beamforming provides a powerful method for increasing downlink capacity [32]-[35]. The idea of TxBF is similar to the pre-coded MIMO technique but with different strategies to calculate the transmit weight vector. TxBF adjusts the antenna main lobe towards to the desired user and reduce the interference to other users. A simple illustration of TxBF is shown in Fig. 11.

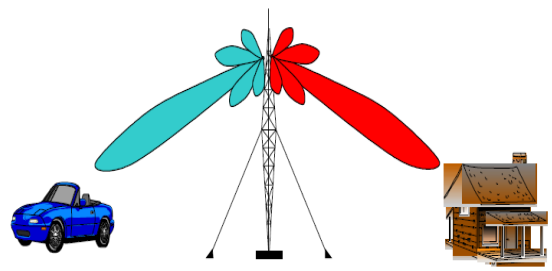

Fig.11. An illustration of TxBF.

Eigenvector TxBF Algorithm

Eignenvector TxBF algorithm is widely used for TxBF. The eigenvector of the spatial covariance channel matrix is calculated as

$$\mathbf{R}_{ss} = \boldsymbol{\lambda}\mathbf{H} \qquad (6)$$

where $\mathbf{R}_{ss}$ is the autocovariance matrix of the desired user`s signal, and $\mathbf{H}$ is the spatial covariance channel matrix. The eigenvector $\boldsymbol{\lambda}_{max}$ which corresponds to the largest eigenvalue will be selected as the weight vector [36]. One example of beam pattern for 4 uniform linear array elements is shown in Fig 12.

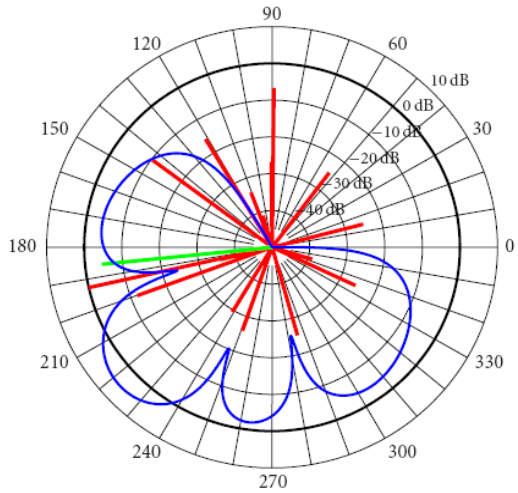

Fig. 12. Example beam pattern of 4 antenna elements in a sectorized system for a single sector (main beam direction is 240°).

Transmit Adaptive Array (TxAA) Algorithm

Transmit adaptive array (TXAA) is a technique in which the user periodically sends quantized estimates of the optimal transmit weights to the BS via a feedback channel. The transmitter weights are optimized to deliver maximum power to the user. The optimal transmit weights are given by

$$\mathbf{w} = \mathbf{H}^H / \mathbf{H}\mathbf{H}^H \qquad (7)$$

where **w** is the transmit weight vector and **H** is the channel matrix.

The weights are normalized so that the total transmitted power is not altered. In the case of multipath channels emanating from each antenna, the optimal weights will be given by the principal eigenvector of the channel correlation matrix $\mathbf{H}^H\mathbf{H}$.

5.4.2 Receive Beamforming (RxBF)

Beamforming also can be applied in the uplink to improve the link quality and suppress the co-channel interference, which is known as *receive beamforming* (RxBF). Through RxBF, smart antenna system can receive predominantly from a desired direction (direction of the desired source) compared to some undesired directions (direction of interfering sources). This implies that the digital processing has the ability to shape the radiation pattern to adaptively steer beams in the direction of the desired signals and put nulls in the direction of the interfering signals. This enable low co-channel interference and large antenna gain to the desired signal.

Based on the reference signals adopted in the beamforming algorithms, RxBF can be classified into *spatial reference beamforming* (SRB), *temporal reference beamforming* (TRB), and *signal structure reference beamforming* (SSRB).

Spatial Reference Beamforming (SRB)

Spatial reference beamforming method is sometimes referred as *direction of arrival* (DoA) method. SRB estimates the direction of arrival of the signal based on the spatial reference signal, using any of the techniques like *multiple signal classification* or *estimation of signal*

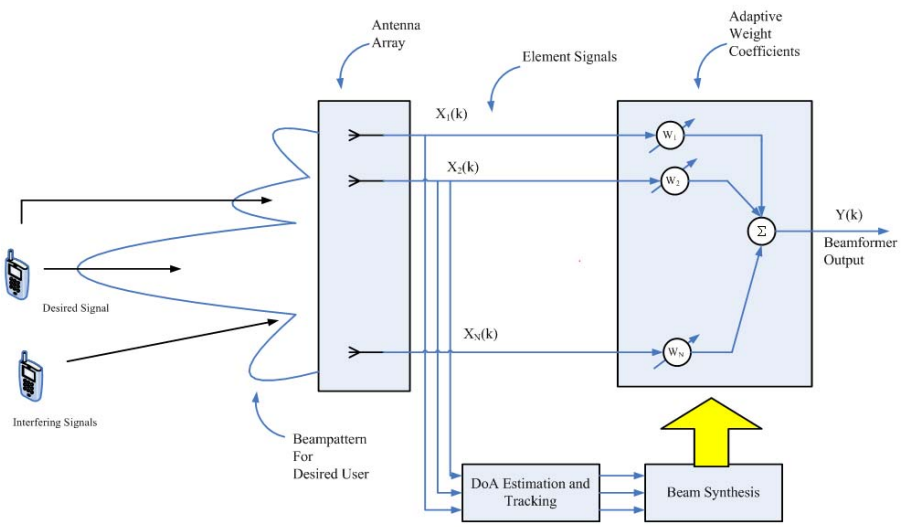

Fig. 13. A general structure of SRB.

parameters via rotational invariance techniques algorithms or their derivatives. They involve finding a spatial spectrum of the antenna/sensor array, and calculating the DoA from the peaks of this spectrum [37]. A general architecture of SRB algorithm is shown in Fig. 13. The general steps of SRB method are shown as follows:

- DoA Estimation
  - Arbitrary Array: MUSIC, etc.
  - Linear Array: ESPRIIT, etc.
- Beam Synthesis
  - Gram-Schmidt, etc.
- Combining
  - EGC, MRC, Wiener Filter, etc.

Multiple signal classification (MUSIC) algorithm estimates the DoA of the desired signal by using an eigen-space method based on a spatial reference signal. MUSIC requires intensive calculation of eigenvalues and eigenvectors of an autocorrelation matrix of the input vectors from the receiving antenna array. A general step of MUSIC algorithm is shown below:

- Collect received samples and estimate the covariance matrix of the received samples.
- Perform eigen-decomposition of the covariance matrix.
- Calculate spatial spectrum.
- Estimate DoA by locating peaks in the spectrum.

Estimation of signal parameters via rotational invariance techniques (ESPRIT) is also well known for the SRB method. In addition, ESPRIT has many important advantages over MUSIC algorithm [38]:

- No knowledge of the array geometry and element characteristics are required.
- Much less complex on computation.
- No calibration of the array is required.
- The algorithm simultaneously estimates the number of sources and DoA`s

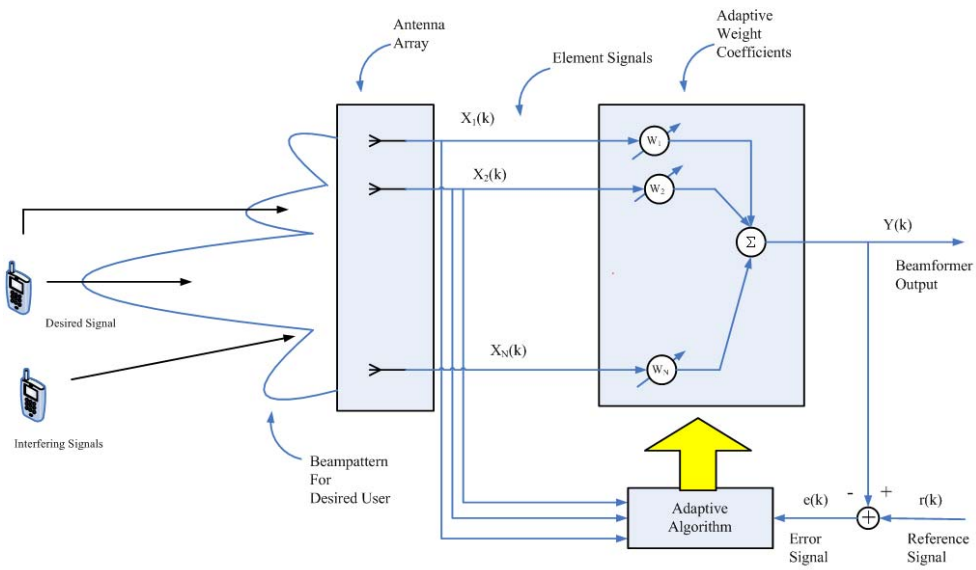

Fig. 14. A general structure of TRB.

Temporal Reference Beamforming (TRB)

Temporal Reference Beamforming shown in Fig. 14, is a method used to create the radiation patter of the antenna array by adding constructively the phases of the signals in the DoA of the desired user, and nulling the pattern of the interfering users based on the temporal reference signal [39]. Based on the temporal reference signal and some predefined adaptive weight calculation criterion, some adaptive algorithms such as LMS (Least Mean Square), RLS (Recursive Least Squares), and DSMI (Direct Sample Matrix Inverse) algorithms, are used to adjust the weight vector of the antenna array to improve the link quality. The general characteristics of TRB are as follows:

- Good performance in multipath channel environment
- Computationally inexpensive
- Requiring Training sequence
- Difficult to apply TxBF because of the absence of DoA information

Criterion of Adaptive Weight Calculation

In the *minimum mean-square error* (MMSE) criterion, the weights are chosen to minimize the *mean-square error* (MSE) between the beamformer output and the temporal reference signal. While in the *maximum signal-to-interference ratio* (MSIR) criterion, the weights are chosen to directly maximize the signal-to-interference ratio (SIR). And The *minimum variance* (MV) criterion chooses the weights that minimize the variance of the output power. All the above three criterions has the same form of

$$\mathbf{w}_{opt} = \beta \mathbf{R}_i^{-1} \mathbf{v} \qquad (8)$$

where $\mathbf{R}_i^{-1}$ is the inverse of the covariance matrix of the interference signals received in the antenna array and $\mathbf{V}$ is the antenna array propagation vector [40].

Let us assume that *d(t)* is the transmitted temporal reference signal and $\mathbf{R}_u$ is the covariance matrix of interference signals at the output of the beamformer. The calculation of β for MMSE, MSIR

Table 4. β Calculation.

Criterion	MMSE	MSIR	MV
$\boldsymbol{\beta}$	$\frac{E\{d^2(t)\}}{1+E\{d^2(t)\}\mathbf{v}^H\mathbf{R}_i^{-1}\mathbf{v}}$	$\frac{E\{d^2(t)\}}{SIR}\mathbf{v}^H\mathbf{w}_{opt}$	$\frac{g}{\mathbf{v}^H\mathbf{R}_u^{-1}\mathbf{v}}$

and MV criterions are summarized in Table 4.

Adaptive Beamforming Algorithm

The *least mean square* (LMS) algorithm uses the temporal reference signal to update the weights at each iteration. In the LMS algorithm, we are searching for the optimal weight that would make the array output either equal or as close as possible to the reference signal, which is the weight that minimizes the MSE. Since the MSE has a quadratic form, moving the weights in the negative direction of the gradient of the MSE should lead us to the minimum of the error surface. The weight update equation is shown in (9) [30].

$$\mathbf{w}(t+1)=\mathbf{w}(t)-\mu\mathbf{x}(t+1)\varepsilon^* \quad (9)$$

where μ is a constant, called the step size, which determines how close the weights approach the optimum value after each iteration and it controls the convergence speed of the algorithm. And ε is the error signal between the temporal reference signal and the received signal at the beamformer output. **x**(t+1) is the received signal vector at the antenna array at time *t+1*.

The main drawback of the LMS algorithm is that it is sensitive to the scaling of its input. This makes it very hard (if not impossible) to choose a step size μ that guarantees stability of the algorithm. The *normalized least mean square* (NLMS) algorithm is a variant of the LMS algorithm that solves this problem by normalizing with the power of the input. The weights updating function of NLMS algorithm is shown as

$$\mathbf{w}(t+1)=\mathbf{w}(t)+\frac{\hat{\mu}}{a+\|x(t)\|^2}\mathbf{x}(t)\varepsilon^* \quad (10)$$

Recursive least square (RLS) algorithm is derived to overcome the drawback of slow convergence speed in the LMS algorithm, when the eigenvalue spread of the correlation matrix R of received signal vector **x** is large. RLS algorithm replaces the step size μ with the inverse of R. The weights are then updated using (11).

$$\mathbf{w}(t+1)=\mathbf{w}(t)-\mathbf{R}^{-1}\mathbf{x}(t+1)\varepsilon^* \quad (11)$$

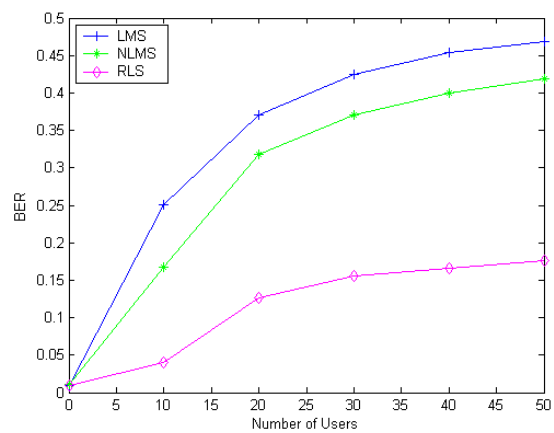

Fig. 15. Performance comparison among LMS, NLMS, and RLS algorithms.

Fig. 15 shows a simple performance comparison of the above three algorithms in OFDMA system under the Rayleigh fading channel with 8 antenna elements [41]. From this figure, we see that RLS algorithm performs best due to its faster

convergence speed than LMS and NLMS algorithms.

Signal Structure Reference Beamforming (SSRB)

SSRB method is based on inherent structure of the transmit signal of the implicit kind reference signal. Algorithms such as blind beamforming, least squares, and constant modulus algorithms, are based on the SSRB method. SSRB method is robust against different propagation conditions and does not require the array manifold knowledge. But the convergence problem becomes the main drawback of the SSRB method.

VI. Conclusions

In this paper we introduced the multi antenna technologies which can be considered as one of the most vivid area of research. Multiple antenna technologies were categorized into two main groups where in the first group we introduced some techniques related to spatial diversity and spatial multiplexing by outlining the gain achieved by these schemes. Furthermore, we introduced the smart antenna techniques and the up-to-date research progress in this field.

The advantages of multiple antenna systems make of them a very strong candidate to increase link reliability, increase channel capacity and reduce interference in both uplink and downlink.

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RÉPUBLIQUE FRANCAISE

5G: ISSUES & CHALLENGES

March 2017

The issues and challenges surrounding 5G

The telecoms industry is currently in the process of designing the technologies that are due to take over from 4G, which is still being deployed today. A great deal of work is thus underway to prepare these “5G” technologies.

To prepare for the arrival of this new generation of technologies, Arcep wanted to take a detailed look at the industry to better understand what is in the works. This report is the fruit of the interviews and research that Arcep conducted over the course of 2016, and which the Authority wanted to publish as a way to contribute to the public debate over 5G.

Its aim it to provide as objective and exhaustive an overview as possible, and deliver a concise, informative snapshot of the work that is currently underway on the future generation of mobile networks.

This report reflects the views of the stakeholders who were interviewed, but in no way represents Arcep’s positions on or roadmap for 5G. Arcep awarded in 2015 the 700 MHz band and is currently working towards licensing the 3.5 GHz band, both of which have been identified as 5G bands. Arcep is also working with the Direction générale des entreprises and the Agence nationale des fréquences towards enabling spectrum for 5G.

Arcep would like to thank all of the entities (listed on the last page) who agreed to take part in this process, and who were willing to contribute to the regulator’s investigation into the development of 4G’s successor. Arcep is dedicated to sustaining an ongoing dialogue with the market, and invites all interested parties to provide information on the matter or to share their reactions to this report, by contacting Arcep’s Mobile and Innovation Directorate at the following address: 5G@arcep.fr.

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Introduction: the vision for 5G, creating an ultra-connected society

5G wants to be the disruptive generation, the generation that no longer only caters to the needs of mobile operators and consumer communications, but which opens up new prospects and enables an extremely wide diversity of applications and use, unified within a single technology. 5G is setting itself up as an enabler of the digitisation of society and the economy.

The idea that is starting to take shape behind the notion of 5G is that it will not mean just an increase in transmission speeds, as has been the case with previous generations.

Consumer mobile communications, video downloads and the use of mobile apps account for the bulk of 4G networks' radio resources usage today. With 5G, the goal will be to enable a much broader spectrum of uses and a much greater diversity of users.

5G is targeting a wide variety of sectors, which will not necessarily have anything other than this technology in common, but which are central pillars in a society: energy, healthcare, media, industry and transportation.

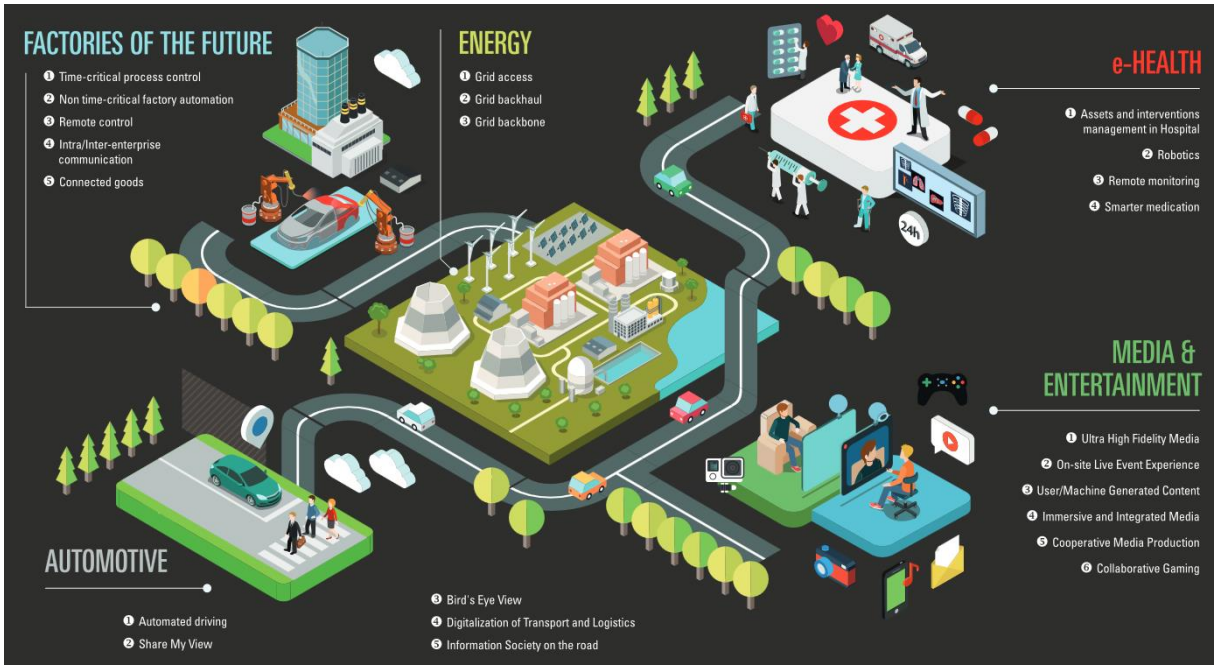

Figure 1. 5G driving industrial and societal changes[1]

The energy sector, for instance, has undergone a great many changes and developments over the past several years in terms of energy production, storage and transport. Rising fossil fuel costs, the introduction of renewable energy sources and markets being opened up to competition have all helped usher in new kinds of energy product and new stakeholders – both independent companies and ordinary citizens – to the energy marketplace. The objective with 5G will thus be to enable better management of these networks (smart grids, smart agriculture, factories of the future) and their interconnections, to achieve more efficient and more agile distribution.

[1] 5G Empowering vertical industries. White Paper, 2016, https://5g-ppp.eu/wp-content/uploads/2016/02/BROCHURE_5PPP_BAT2_PL.pdf

Healthcare, transportation and media are sectors that are bound up with our fellow citizens' daily lives: any improvements in these sectors thus have a clearly visible impact. The introduction of robots to perform specialised surgical operations, of video on demand or the advent of new connected features in cars have already improved our daily lives. 5G is promising to go several steps further in all of these areas: it would enable remote medical diagnoses and operations in real time, it would democratise streaming of 360° 3D video, it would provide users with a vast selection of video content with a picture quality better than ultra high-definition (4K, 8K…). The automotive universe could rely on these new networks to help cars make decisions without human involvement, and also communicate with one another (this is already possible, for instance, with the first experimental fleet of fully autonomous taxis being tested on the streets of Singapore by the firms nuTonomy and Grab[2]), with reaction times that are compatible with the demands of high-speed travel.

In terms of factories of the future, the improvements brought by 5G are primarily targeting the introduction of new generations of connected robots, the interconnection of production sites and the much heavier use of smart sensors to improve industrial processes. Generally speaking, the aim is to achieve ubiquitous communication between machines, a process that is already well underway.

One thing that it is crucial to understand, through the few examples listed above whose demands might seem mutually incompatible, is that depending on the sector or the application, the network properties and the functionalities required will not be the same. Service providers – whether they are today's mobile operators or other market players – will need to be capable of adapting their network to demand, occasionally in real time. 5G will thus be not so much a universal technology as a polymorphous, or multi-faceted technology, capable of adapting to any use, up to and including the most demanding ones.

[2] http://nutonomy.com/

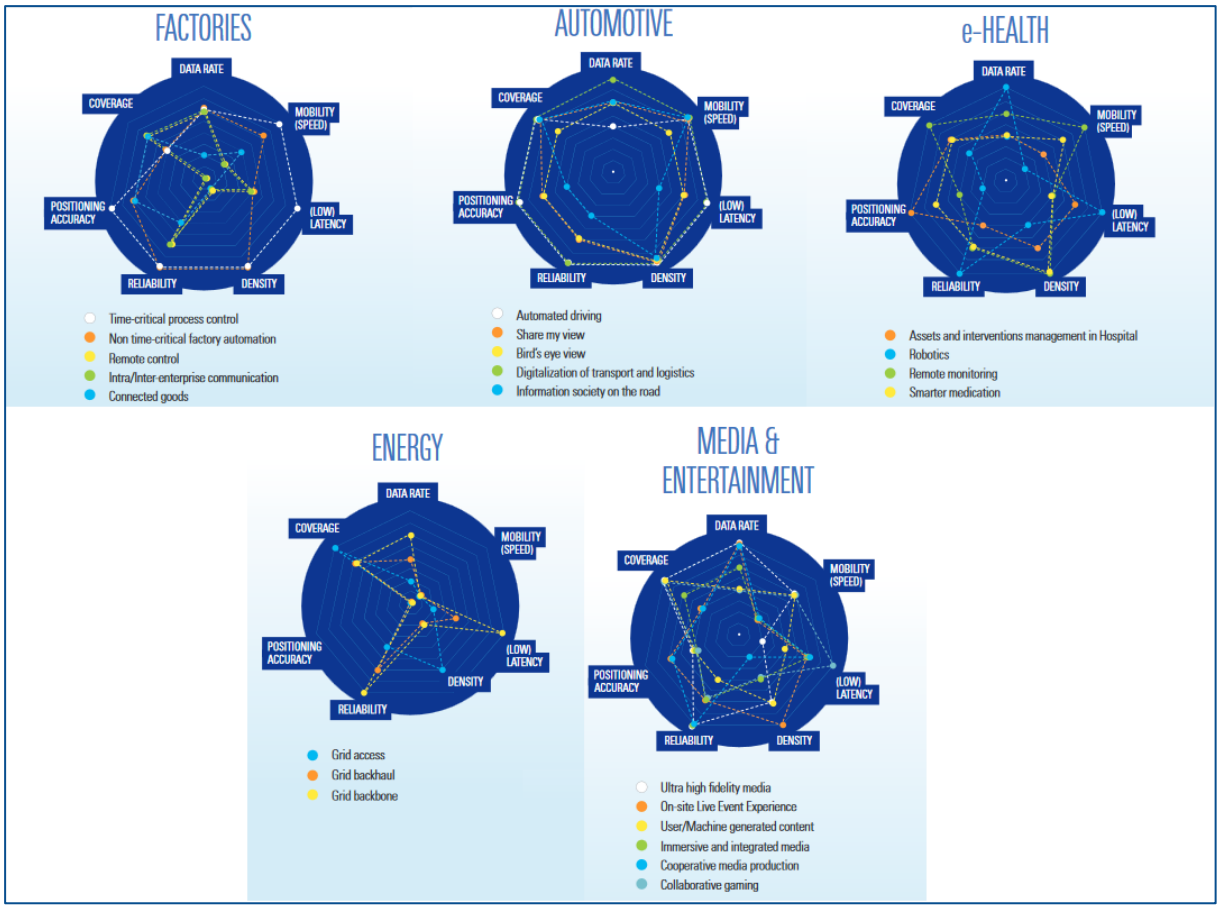

Figure 2. Performances required by vertical sectors[3]

[3] 5G Empowering vertical industries. White Paper, 2016, https://5g-ppp.eu/wp-content/uploads/2016/02/BROCHURE_5PPP_BAT2_PL.pdf

1 5G objectives

Ever since the first real mobile telephone call, 44 years ago[4], mobile technologies have been evolving steadily and their performances have improved exponentially: as mentioned earlier, calling services and later texting and finally the mobile internet and the use of multi-service mobile applications have characterised the evolution of mobile networks and the transition from one generation to the next. The birth of LTE technology and the fourth generation (4G), coupled with the widespread use of smartphones and tablets, have driven a massive increase in the amount of mobile data traffic being relayed over the networks.

The use of a mobile handset and its applications is now an integral part of our fellow citizens' daily habits. Portable connected devices are increasingly powerful: in many instances they have replaced users' landline telephones, cameras, computers and even televisions. Today, 5 million videos are watched on YouTube and 67,000 images uploaded to Instagram every minute (see Figure 3).

Figure 3. What we do over the network today in one minute[5]

The latest *Mobility Report*[6] from Ericsson indicates that traffic on mobile networks almost doubled in a single year, and that over the next five years it will have increased to 10 times what it is today. New solutions must therefore be found to meet this demand, and to optimise how resources are used.

The increase in the number of applications available, their diversification and the improved quality of mobile networks have all contributed to driving up demand, the emergence of new uses (connected objects, drones, etc.) and new users.

[4] On 3 April 1973, Motorola's Martin Cooper made a call from the corner of 56th street in New York City with the first mobile phone.

[5] https://www.ericsson.com/res/docs/2014/5g-what-is-it-for.pdf

[6] https://www.ericsson.com/assets/local/mobility-report/documents/2016/ericsson-mobility-report-november-2016.pdf

5G is at the crossroads of these news uses; it aims to better and simultaneously satisfy this tremendous variety of needs and these new demands, through a unified technology that takes this diversity into account at the design stage.

The advent of 5G could have a significant impact not only in the technical realm, but also on different countries' economic and social development. As indicated in the introduction, 5G targets a very large number of sectors and, through society's digitisation, is expected to contribute to countries' economic growth.

To give an example, according to a report produced by InterDigital Europe, Real Wireless, Tech4i2 and Connect (Trinity College Dublin)[7], this new technology will require a great deal of money and a great deal of work, but will generate €113.1 billion in profits per annum for the European economy by 2025.

1.1 Technical specifications of 5G

The specifications for a new generation of mobile telephony are set primarily by two bodies: ITU (International Telecommunication Union) and 3GPP (3rd Generation Partnership Project).

ITU is the United Nations agency devoted to information and communications technologies. It carries out research and studies through its Working Party 5D, the sub-group responsible for the overall radio system aspects of international mobile telecommunications (IMT). In 2013, this group began working on defining the characteristics of the new IMT standard, IMT-2020 (5G) (cf. 1.3), as it had done back in the early 2000s to define 4G (IMT-Advanced). Further details on the roadmap established for this work can be found in Annex 1, the objective set by ITU-R being to complete its analyses by 2020.

Parallel to the work being done by ITU are the studies being conducted by 3GPP. The 3rd Generation Partnership Project was created in 1998, and its members include seven standardisation bodies, several hundred industry players, associations and public organisations. It is responsible for developing and maintaining technical specifications for mobile telephony standards[8]. When a new standard is being defined by ITU, 3GPP works on the technical solutions that make it possible to achieve the objectives set by ITU.

Although 5G is one of the most widely debated topics inside international and European bodies today, no standard has yet been defined by 3GPP. The draft of Release 15, the first 5G standard from 3GPP, is still in the works: definition of the new architecture began in December 2016 and work on the New Radio (NR) interface is set to begin in March 2017. A first Release of the standard should be validated in September 2018 to meet the more urgent demands; a second Release (3GPP Release 16) will then be published in March 2020. All of these elements are addressed in more detail in Annex 1.

It should also be said that the transition from one generation to the next takes place gradually. LTE will continue to evolve alongside NR, and these two standards will likely be very complementary initially. In particular, for pioneer 5G rollouts LTE shall probably remain the master of the network and control the NR antennae. Moreover, some of the objectives set for 5G could be achieved thanks to functionalities or technologies introduced in 3GPP Releases 13, 14 and 15 that will not be proper to 5G, but rather evolutions of 4G (which some refer to as 4.9G or LTE Advanced Pro).

[7] http://ir.interdigital.com/file/Index?KeyFile=36051369

[8] GSM for 2G, UMTS for 3G and LTE for 4G

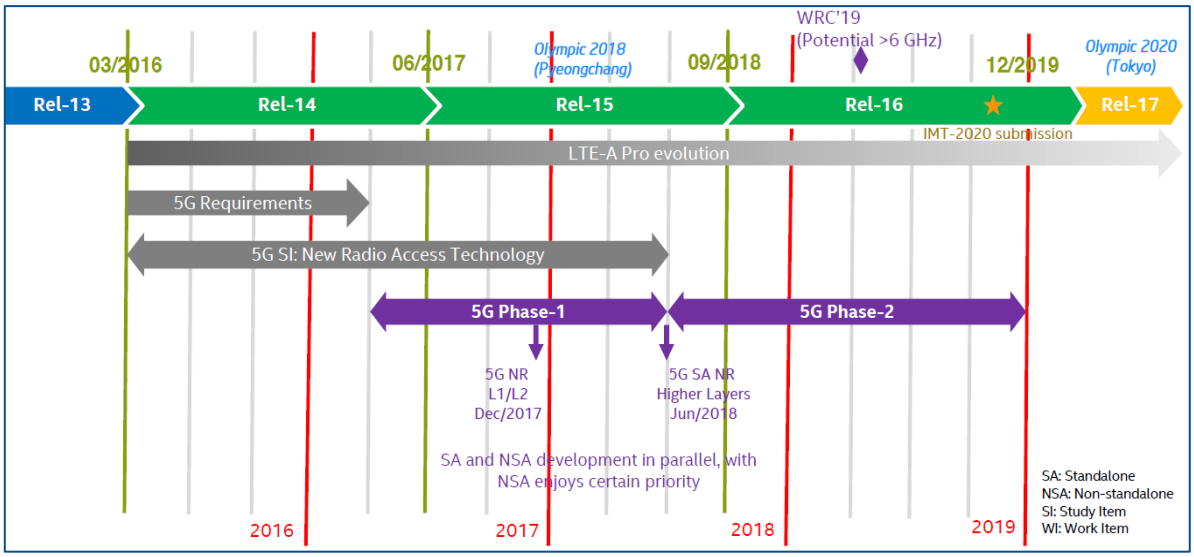

Figure 4. 3GPP timeline for 5G[9]

This same momentum occurred when making the transition from 3G (Release 4) to 4G (Release 10, first Release of IMT-Advanced): the first LTE specifications (Releases 8 & 9) do not achieve all of the ITU targets for 4G, and reprised many of the characteristics of the most advanced form of 3G at the time.

The synergies between the successive generations, the absence in most instances of a great initial jump in performances between generations, and the race between competitors to outperform one another and be the most innovative, can often lead operators and equipment suppliers to give a "commercial" name to each generation of mobile telephony. For instance, in the United States AT&T had called its HSPA network 4G, while in France it is a 3G+ network.

So in all likelihood the first 5G networks deployed on a large scale will be 4.9G systems, using carrier aggregation, massive MIMO (Multiple-Input Multiple-Output) and Network Function Virtualization, or NFV (cf. trials conducted in in France, detailed in Section 1.5.3). These technologies, which will be explored in greater detail further on, represent more of an evolution of the fourth generation than an actual transition to 5G, which will occur when disruptive technologies such as NR carriers in millimetre bands, non orthogonal multiple access (NOMA*)* and mobile edge computing (MEC) can be put into place.

In addition to this commercial race, equipment suppliers – often backed by their respective government at home, notably in the United States, Japan and South Korea – want to get a head start in defining and testing 5G technologies, in the hope of establishing themselves as the technological leaders in international standardisation bodies. Here, the precocity of the first rollouts announced in South Korea (5G deployment for the Winter Olympics in 2018 in Pyeongchang) and Japan (5G deployment for the Summer Olympics in Tokyo) would justify the supposition that only a small portion of 5G technologies will be used, and that these rollouts will be based more on 4.9G or pre-5G technologies.

[9] http://gsacom.com/paper/intel-5g-technology-mm-wave-frequencies/

1.2 5G use cases

Three main use cases (defined by ITU, under IMT-2020), with their respective – and potentially mutually incompatible – demands are in the process of taking shape, and will make it possible to meet the sector-specific needs referred to in the introduction.

1. **mMTC – Massive Machine Type Communications**: A very large number of connected devices with disparate quality of service requirements. The objective of this category is to provide a response to the exponential increase in the density of connected objects;
2. **eMBB – Enhanced Mobile Broadband**: ultra high-speed connection indoors and outdoors, with uniform quality of service, even on the edges of a cell;
3. **uRLLC – Ultra-reliable and Low Latency Communications**: this use case has stringent requirements for capabilities such as latency and packet-loss, to ensure increased reactivity.

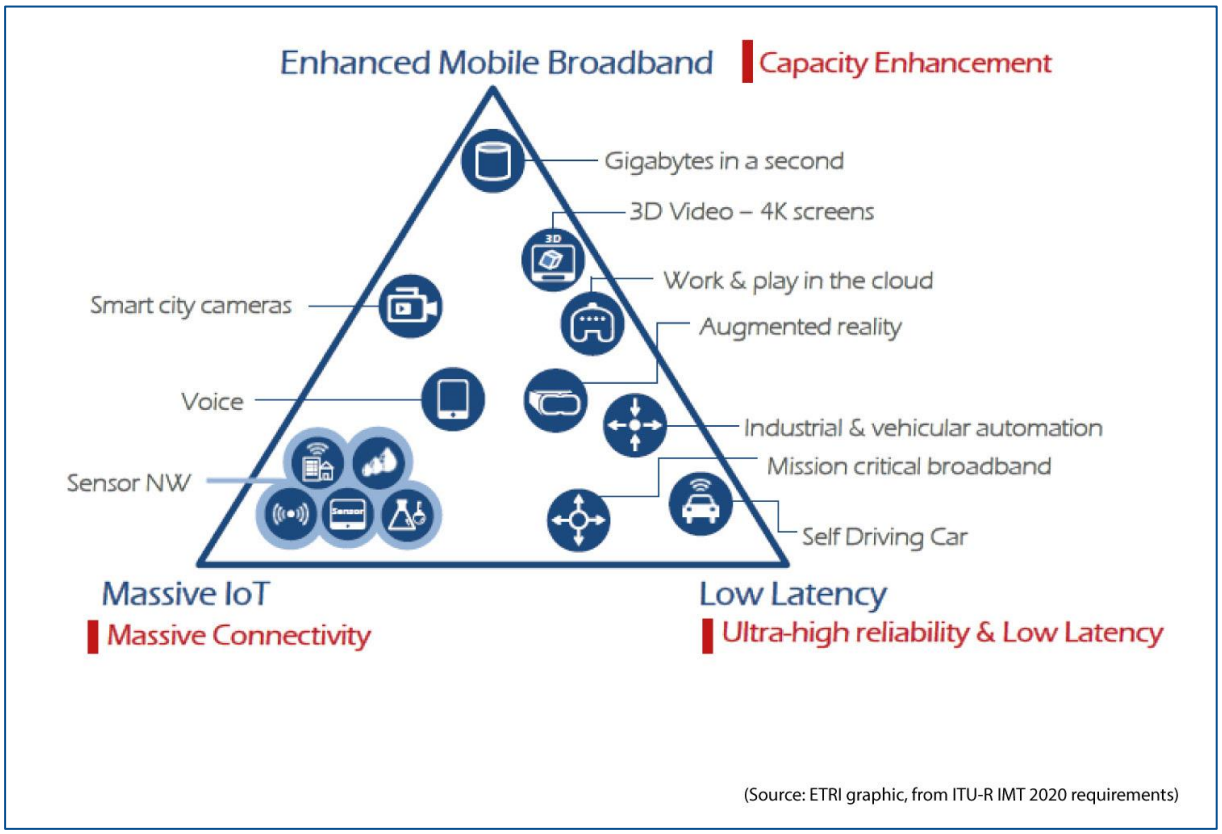

Figure 5. 5G use cases[10]

The first group (mMTC) primarily encompasses all Internet of Things related uses. These services require broad coverage, lower energy consumption and relatively slow transmission speeds. What 5G will deliver compared to existing technologies is the ability to connect objects that are spread out in a very dense fashion across a given area.

Enhanced mobile broadband (eMBB) concerns all of the applications and services that require increasingly fast connections, for instance to watch ultra high-definition (8K) videos or to stream virtual or augmented reality applications wirelessly.

[10] http://5g.ieee.org/standards

Ultra-reliable and Low Latency Communications (uRLLC) include all of the applications that require an extreme reactivity and very strong message transmission guarantees. The sectors where these requirements are particularly prevalent are transportation (reaction time when an accident occurs, for instance) and medicine (telesurgery), and when digitising manufacturing processes in general.

To implement these three use case, ITU established eight key performance indicators[11] (KPI) to specify, quantify and measure the characteristics of IMT-2020 (5G) systems:

- Peak data rate (Gbit/s);
- User experienced data rate (Mbit/s);
- Spectrum efficiency (bit/Hz);
- Device mobility (km/h);
- Latency (ms);
- Connection density (number of connected/accessible objects per km²);
- Network's energy efficiency;
- Area traffic capacity (Mbit/s/m²).

[11] Added to these eight classes, five new indicators were defined and are currently being examined: reliability, mobility interruption time, bandwidth, maximum spectrum efficiency, 5th percentile spectrum efficiency.

1.3 Jump in performance compared to 4G networks

As mentioned in Paragraph 1.1, the deployment of 5G is likely to take place in two stages:

1. The first 5G rollouts will deliver better performances, but as a continuation of what is being provided at the time by 4G systems which will continue to evolve as well (4.5G, 4.9G);
2. Performances will continue to improve with the gradual introduction of disruptive technologies, such as the use of millimetre wave frequencies.

This gradual rollout is very similar to the way in which 4G was introduced, as the performances obtained with pioneer deployments were relatively similar to those supplied by existing 3G networks.

ITU defines the 4th generation of technologies, called IMT-Advanced, by the values for the eight KPI listed above, as indicated in the following chart. The 5th generation, called IMT-2020, is represented as well. Here, it should be noted that the official ITU definition of 4G in fact corresponds to what commercial rollouts supplied later on, under the name 4G+ or LTE-Advanced.

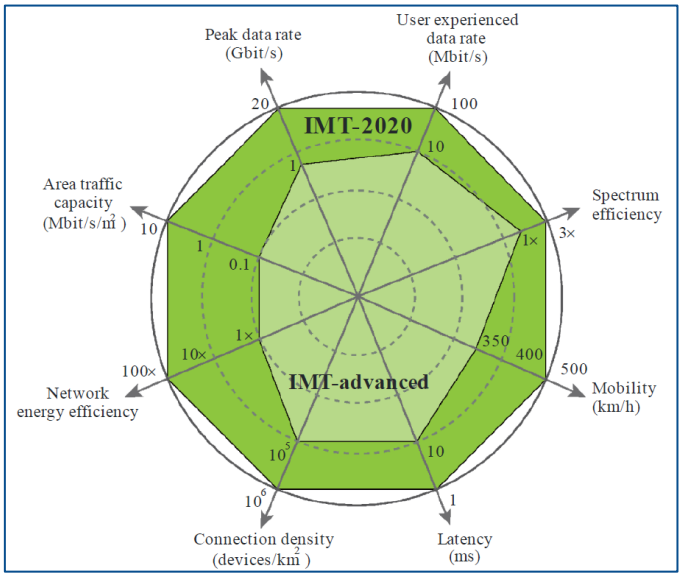

Figure 6. Comparison between 4G and 5G with respect to the eight key performance indicators[12]

According to these objectives, 5G must be able to provide a user experienced data rate and a peak data rate that is respectively 10 and 20 times higher than what is currently available. The maximum connection density will be multiplied by 10 and latency divided by at least 10 (the target point-to-point latency is 1 ms, compared to 30 to 40 ms today).

[12] Recommendation ITU-R M.2083-0 (09/2015), https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf

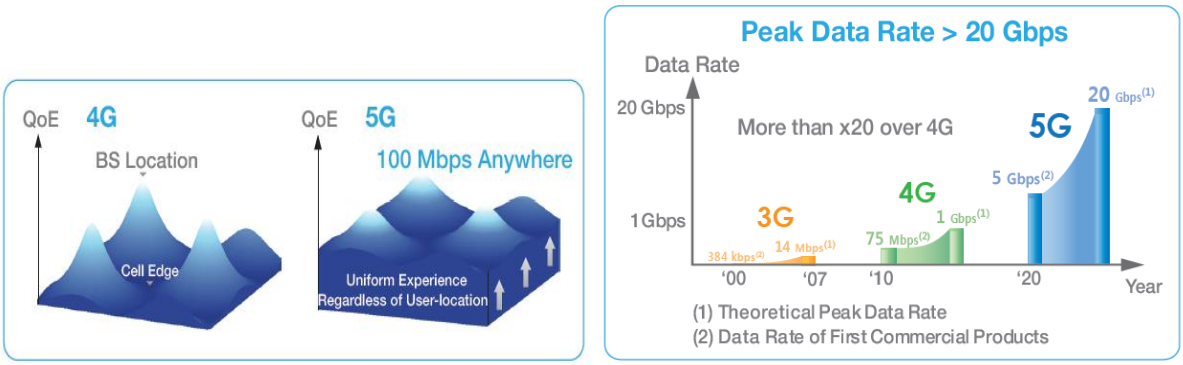

Figure 7. Representation of the "average user experience data rate" KPI for 4G and 5G and "Peak data rate" KPI for 3G, 4G and 5G[13]

As the successor to 4G, the objective for 5G will also be to provide:

- An extremely reliable network, with more consistent performances regardless of the user's position with respect to the base station;
- A stable connection, even when travelling (at speeds of up to 500 km/h);
- Greater network energy efficiency (with batteries that consume up to 100 times less power).

The following table summarises the target performances for 5G and those currently available with 4G:

Performances/Generation	4G	5G
1. Peak data rate (Gbit/s)	1	20
2. User experience data rate (Mbit/s)	10	100
3. Spectrum efficiency	1x	3x
4. Speed (km/h)	350	500
5. Latency (ms)	10	1
6. Connection density (number of objects/km²)	10^5	10^6
7. Network energy efficiency	1x	100x
8. Area traffic capacity (Mbit/s/m²)	0.1	10

Table 1. Comparisons between 4G and 5G performances

[13] http://www.samsung.com/global/business-images/insights/2015/Samsung-5G-Vision-0.pdf

1.4 Network slicing and software-defined networks

It is vital to understand that the set of indicators listed in Section 1.3 determine a set of peak performances for 5G. It will not, however, be possible to achieve all these peak values simultaneously: not every requirement or use case is compatible, so a trade-off will need to be made when defining categories of use that each have their own performance envelope, notably for the use cases described in Section 1.2 (mMTC, eMBB and uRLLC). This is the principle of network slicing: each slice has its own set of KPI, which is a trade-off tied to the target use. On a 5G system, the network properties will need to adapt to the chosen environment.

The following diagram positions the three main use cases listed in Section 1.2. with respect to the eight key performance indicators listed above.

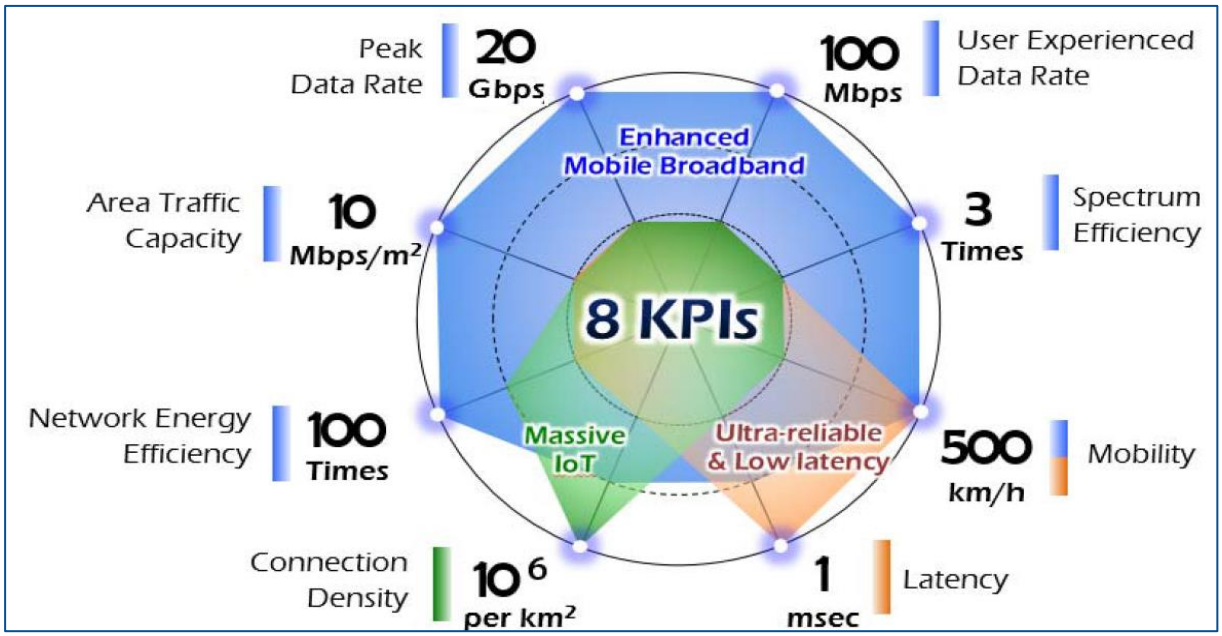

Figure 8. Key performance indicators for the three 5G use cases[14]

So for applications that require enhanced mobile broadband (eMBB), such as 4K, 8K or 3D video or virtual reality, a certain number of performance indicators, such as spectrum efficiency, peak data rate and area traffic capacity, can be reached only at the expense of others, such as latency or connection density.

On the flipside, when a massive simultaneous connection of connected objects (mMTC) needs to be managed, the network will concentrate its resources and use the technologies required to achieve this task, but will not be able, for instance, to use spectrum as efficiently or to guarantee low latency.

Lastly, when ultra-reliable and low latency communications (uRLLC) are required, the number of simultaneous connections, data rates and spectrum efficiency may be reduced.

This flexibility, or ability to adapt, that network slicing brings can only be achieved thanks to the softwarisation and virtualisation of a sizeable number of network components (cf. 1.5.2) – a process referred to as Software-Defined Networking (SDN) and Network Function Virtualisation (NFV). Behind these acronyms is a common idea, namely to use as many generic and reconfigurable components as possible, rather than bespoke ones that are permanently dedicated to very specific

[14] https://5g-ppp.eu/wp-content/uploads/2016/11/06_10-Nov_Session-3_Lee-JunHwan.pdf

tasks. This evolution towards software-based systems has been in the works for several years, but is now becoming possible thanks to improved performances from all of these reconfigurable components, including those that are the closest to the elementary tasks of wireless communications (detection, baseband coding, bitstream management, frequency handover, signal processing, etc.).

1.5 Technological building blocks to achieve the objectives

1.5.1 Air interface

Several, sometimes competing radio access technologies are currently being examined. Some have already been pre-implemented by equipment manufactures and can be used in trials, notably massive MIMO and NFV. Others, such as NOMA modulation and mobile edge computing (MEC), will no doubt take longer before they are ready to be used. In any event, a consensus – which could be painful for certain suppliers whose investments will be lost – will need to be found when defining 5G standards, to ensure the systems' interoperability.

The technologies currently being examined are the following:

- **Millimetre wave frequencies**: the use of millimetre wave frequencies constitutes one of the disruptive 5G technologies. The term refers to the frequencies above 6 GHz which have never been considered for mobile fronthaul network rollouts, for reasons of technological maturity and propagation quality. To meet the demand for ever increasing data rates and traffic volumes, new bands with very wide channels (over 100 MHz per user) will need to be employed: millimetre wave frequencies could provide this spectrum resource, and in certain cases their use would make it possible to achieve the data rates listed in Table 1. Comparisons between 4G and 5G). In exchange, to be able to use these frequencies all of the required, miniaturised low-cost technologies will need to be developed, and ensure a level of energy consumption that is compatible with portable devices (amplifiers, coders, signal processing, antennae, etc.). In particular, because of millimetre waves' poor propagation quality, each cell will have limited coverage and so require the use of beamforming (described below) to better focus the power transmitted by the antenna.
- **Massive MIMO** (Multiple Inputs – Multiple Outputs): this technology involves the use of a large number of smart micro-antennae, located on the same panel (between eight and 128 today, but the number will increase with the use of frequencies above 6 GHz). The appeal of using massive MIMO is twofold: first, the technology makes it possible to increase data rates, thanks to spatiotemporal multiplexing; second, it makes it possible to focus energy on a device to improve its link budget, thanks to beamforming.

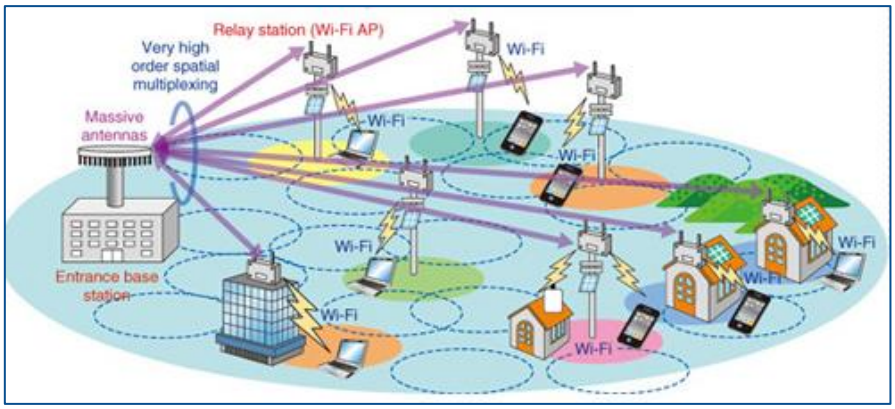

Figure 9. Example of the use of a beamforming antenna to connect Wi-Fi access points[15]

- **Full Duplex**: in classic systems, transmission and reception takes place either on different frequency bands, i.e. frequency division duplexing (FDD) used on all mobile network bands in France, or at different times: time division duplexing (TDD), the top contender for LTE wireless local loop networks in France. The full duplex is intended to enable the simultaneous transmission and reception of data, on the same frequencies, at the same time and in the same location.[16]

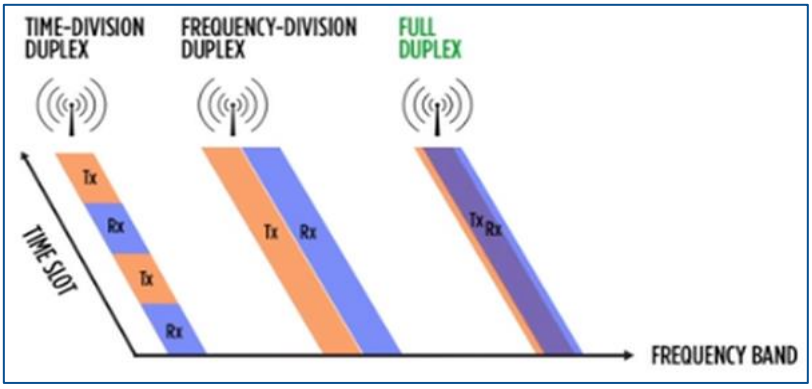

Figure 10. Illustration of full-duplex, compared to FDD and TDD[17]

- **NOMA Multiplexing** (Non Orthogonal Multiple Access): LTE uses what is referred to as orthogonal multiplexing, with each device using a portion of the resource blocks in a unique fashion at any given time. For 5G to provide improved spectrum efficiency compared to 4G, the plan is to use non-orthogonal multiplexing methods, whereby several users can use the same frequencies at the same time. A distinction can be made between several users by assigning different codes to each user – referred to as SCMA or sparse code multiple access – a combination of 3G's code division multiple access (CDMA) and 4G's orthogonal frequency

[15] https://www.slideshare.net/100001290086432/massive-mimo

[16] The basic operating principle is the following: an antenna sends a signal at the same time as it is receiving signals coming from devices in the cell. However, the signal received by the antenna is a combination of the signal sent by itself and signals coming from the devices (everyone is "talking" at once). As it knows which signal it itself has sent, the antenna can subtract it during digital processing from the ones it received. So only the signals received from the devices remain.

[17] http://compeng.columbia.edu/biggest-component-full-duplex-wi-fi-radio-antenna

division multiple access (OFDMA) or by playing on the difference in users' signal to noise ratios (power domain NOMA[18], illustrated below). These are the two methods chosen for NR.

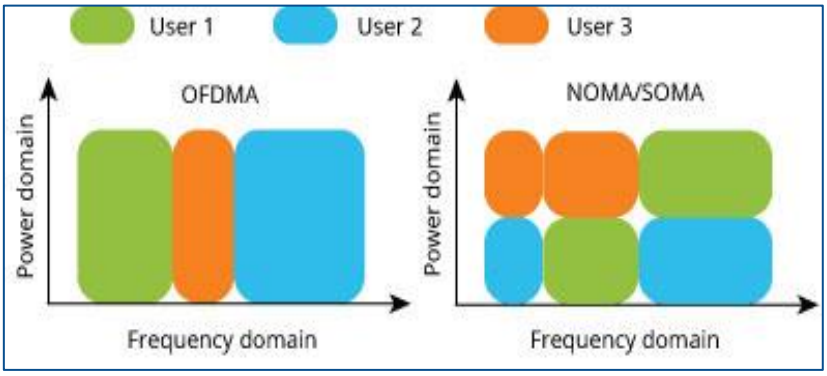

Figure 11. Illustration de multiplexing *power domain* NOMA[19]

- **QAM256**: as with many modern communication systems, 4G uses quadrature amplitude modulation (QAM). In 4G this modulation can achieve QAM64, which means that six bits of information are being transmitted ($2^6 = 64$) at any given time. On wireless systems, the main limitation on QAM order is the signal to noise ratio: when a large amount of information is sent all at once, its transmission will be very sensitive to disruptions (a bit like trying to talk in a noisy environment: it is easy to understand "yes" or "no" but harder to understand more complex sentences). Thanks to an improved link budget, via antenna or signal processing technologies, 5G modulation could reach QAM256, i.e. eight bits of information being transmitted at any given time, which translates into a 33% increase in maximum capacity under ideal conditions. This improved modulation will also be deployed on advanced 4G systems.
- **IoT waveforms**: new waveforms are being explored for the future deployment of 5G IoT in mobile bands. But although mass market IoT is one of the main challenges put forth for 5G, no concrete results have yet been made public. Operators[20] are starting to deploy new standards (EC-GSM or Extended Coverage GSM, LTE-(e)MTC or enhancements for Machine-Type Communications, NB-IoT or NarrowBand IoT) which were defined by 3GPP in Release 13 but, as they are based on 2G and 4G, they do not deliver the performance levels, notably in terms of autonomy, coverage and density, that are compatible with the targets set for future 5G networks.

1.5.2 Network architecture

As with air interfaces, new network architectures are also being explored:

- **Software-defined networking (SDN) and network functions virtualisation (NFV)**: these two functionalities extend beyond the scope of 5G networks per se. They are part of an overall

[18] The basic operating principle is the following: either User 1 (U1) with a good signal to noise ratio and User 2 (U2) with a less good signal to noise ratio. The antenna sends a high power Signal 2 to U2, and superimposes a weaker Signal 1 aimed at U1. U2 will only see S2 as S1 is drowned out by the noise. U1 will decrypt S2 then delete it from the signal received, to create a higher quality S1, thanks to a better signal to noise ratio.

[19] https://www.anritsu.com/en-AU/test-measurement/technologies/5g-everything-connected/5g-everything-connected-detail

[20] http://www.vodafone.com/content/index/what/technology-blog/nbiot-commercial-launch-spain.html

process of network upgrades taking place today and already available with 4G technology (4.9G). The nevertheless remain a key enabler of 5G:

- SDN (Software-Defined Network) is designed to disassociate the network's control plane from its data plane, these two planes traditionally being linked and distributed in a set fashion in the network (see diagram below). Controlling the network, a task previously assigned to specialised and unscalable hardware components, is centralised in the form of software on more powerful servers and, in theory, free of equipment manufacturer specifications. This enables the deployment of high value-added services (load balancing, smart routing, dynamic configuration, etc.) in disparate environments.

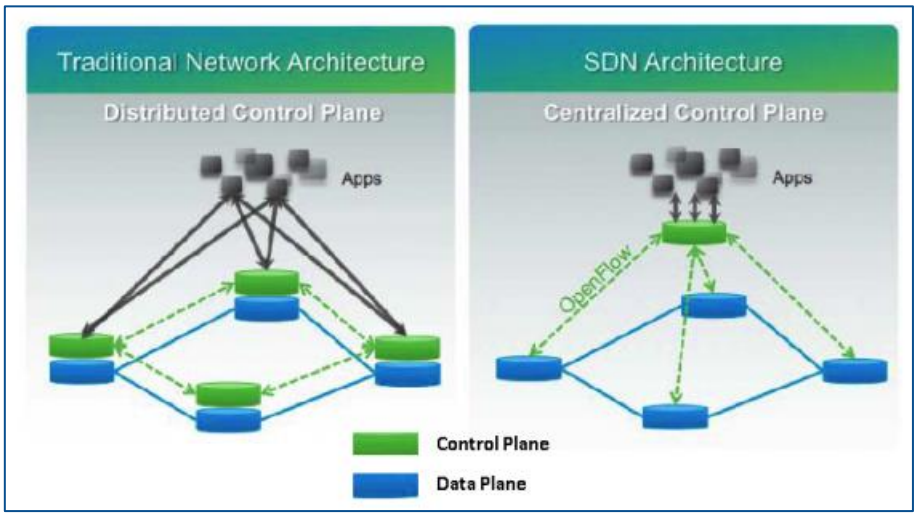

Figure 12. Centralisation of the control plane in a software-defined network[21]

- NFV, which builds upon SDN, is used to virtualise, in other words to replace hardware designed specially to perform certain key network functions (firewall, network core, interfaces between different systems…) with software on a server, to accelerate rollouts and enable rapid changes and upgrades.

- **CloudRAN**: this functionality, also know as centralized-RAN, requires a very different network architecture to what we find today. It is an evolution of SDN: the base stations' signal processing units, currently installed at the base station level, are moved to the cloud and centralised. They communicate with the network radio heads, located closer to the antenna, over an optical fibre network (Radio over fibre technology). This centralisation makes it possible to obtain a complete overview of all of the stations deployed and to coordinate signal processing and manage interference between cells and devices

[21] http://www-igm.univ-mlv.fr/~dr/XPOSE2014/software-defined_networking/sdn.html

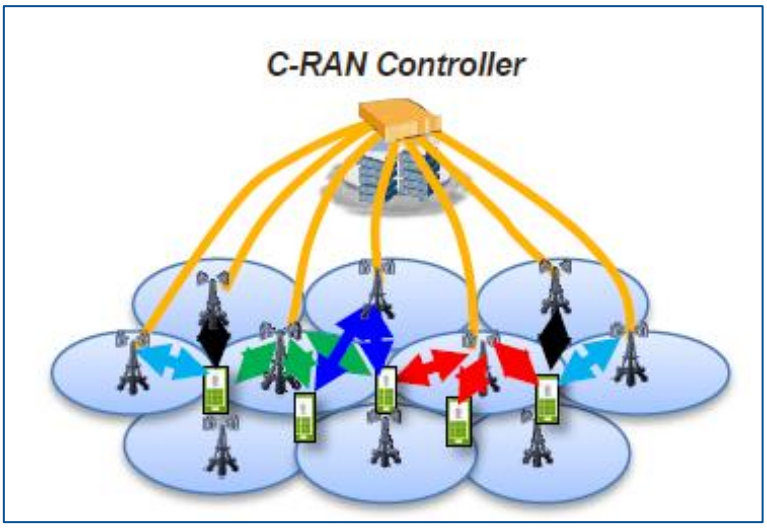

Figure 13. Illustration of CloudRAN[22] network architecture

- **Optimised content delivery, using a mobile content delivery network (mobile CDN)**: corresponds to a set of servers working together in a transparent fashion to optimise the delivery of content to end users over wireless (mobile or Wi-Fi) networks, with high availability and performance. With 5G, the objective for these CDN is to cache content close to users, notably thanks to predictive algorithms, to offload traffic from the networks and decrease latency.
- **MEC (mobile edge computing)**: MEC is an evolution of mobile CDN whose purpose, in addition to bringing data closer to devices, is to provide devices with an accessible computing power with very low latency, within a very specific area for demanding applications. This technology makes it possible to locate a portion of the network's intelligence (managing local critical applications and performance analysis) at the base station level. The "antennae" will be capable of analysing a certain number of data, and so to make decisions very quickly.
- **Device-to-device**: D2D is a direct form of communication between two nearby devices, which does not require the data to travel over the cellular network. Device-to-device communication is not new, as technologies such as Bluetooth and Wi-Fi direct already enable it. But a new mesh networking technology will be introduced with 4.9G and later 5G network rollouts: LTE-direct. Far more energy-efficient than its predecessors, this technology will have a range of up to 500 metres and geolocation capabilities to enable communications. This technology will be very useful for low latency V2V (vehicle-to-vehicle) or V2X (vehicle-to-everything) communications and for certain public-security related uses.

1.5.3 5G: a multi-technology generation cohabitating with existing networks

As stated earlier, 5G is not meant to replace 4G overnight. In practice, the devices will undoubtedly be multi-modal: still connected to the 4G network, which will provide extended coverage for pioneer rollouts, then transitioning to 5G networks when they become available.

While 4G and 5G frequencies will probably be initially segregated, in all likelihood devices will rapidly become capable of aggregating 4G and 5G carriers and, further down the road, 4G carriers will be encapsulated in 5G ones.

[22] https://5g-ppp.eu/wp-content/uploads/2016/11/04_10-Nov_Session-3_Takaharu-Nakamura.pdf

4G is still being deployed, and its technological evolution and certain building blocks will be used by both the first 5G networks and advanced 4G networks. To wit, the latest trials conducted in France are allowing 4G networks to perform better thanks to the use of pre-5G technologies:

- Bouygues Telecom, in partnership with Huawei, managed to achieve a peak data rate of 1 Gbps thanks to the simultaneous use of four-carrier aggregation (800 MHz, 1800 MHz, 2100 MHz, 2600 MHz) and more powerful modulation (256 QAM)[23];
- In the coming weeks, Orange will be launching a massive MIMO (16x16) trial with Nokia[24].

In addition to the strong integration between 4G and 5G, the new generation will no doubt also continue convergence efforts between frequency bands governed by exclusive licences – i.e. bands that are allocated exclusively to an operator, such as mobile operators – and unlicensed frequency bands, governed by a system of general authorisation (e.g. Wi-Fi bands), which already began in 4G with LTE-LAA (Long Term Evolution – License Assisted Access) and LTE-LWA (Long Term Evolution – Wi-Fi Link Aggregation).

LTE-LAA is characterised by the aggregation of one or several LTE carriers, used in licensed bands, with other LTE carriers employing unlicensed 5 GHz Wi-Fi bands. To guarantee cohabitation with very widespread Wi-Fi networks whose deployment pattern is unpredictable, it uses LBT (Listen Before Talk) technology to listen to the radio channel before transmitting, in order to determine whether or not a frequency is available.

LTE-LWA consists of an aggregation of LTE carriers in licensed bands with Wi-Fi traffic. To achieve this, the LTE cell and Wi-Fi access point need to be connected: the Wi-Fi traffic is sent to the cell which sends back the entire aggregated link on the 4G core network. This technology is particularly well suited to indoor environments with small cells, a system which, as detailed in paragraph 3.3 below, will lend itself well to 5G deployments.

[23] https://www.corporate.bouyguestelecom.fr/wp-content/uploads/2016/05/Communiqu%C3%A9-Bouygues-Telecom-et-Huawei-Technologies-r%C3%A9alisent-un-test-de-d%C3%A9bit-4G-%C3%A0-plus-de-1-Gbps-pour-la-premi%C3%A8re-fois-en-Europe-de-lOuest.pdf

[24] https://networks.orange.fr/actualites/actualites-des-networks/orange-et-nokia-partners-pour-developper-les-futurs-services-5g

2 5G development initiatives

With a view to keeping the many promises being made for 5G, a number of initiatives are currently underway around the globe to promote its development. Below, we detail the foremost initiatives put forth by the players with which Arcep met as part of its investigation.

2.1 Government initiatives

The prospect of significant socio-economic repercussions generated by 5G (possible revenue of close to $225 billion a year[25] by 2025) combined with many countries' desire to establish themselves as technological leaders and make their companies more competitive, have propelled a multitude of government initiatives around the globe, aimed at encouraging the mobile ecosystem to begin the work and make the investments required to drive the rapid construction of the first 5G networks.

A selection of the largest initiative is detailed below.

2.1.1 In Europe

5G-PPP

The 5G Public Private Partnership (5G-PPP) is dedicated to 5G research and development, created on the initiative of the European Commission in 2013, with a budget de €700 million in public funding. The main objectives set by 5G-PPP are:

- Create stronger ties between the economic players and academic bodies devoted to the telecommunications sector over R&D projects, along the entire value chain;
- Reduce technological dependence on the United States and Asia while sustaining a strong global market;
- Regain technological leadership, notably in disruptive technologies, by promoting standards in international bodies;
- Allow innovative business models to emerge;
- Facilitate large-scale experimentation.

The results of this work will help clarify the 5G action plan (see below), and fuel the standardisation work that is currently underway.

To achieve its ambitions, 5G-PPP has initiated three stages of work, financed by the European Union, whose roadmap is in sync with the main international initiatives (3GPP and ITU, cf. Figure 14):

- The first stage which is currently underway, will last until mid-2017;
- A second stage focused on systems optimisations, from the end of 2017 to mid-2019;
- And finally a full-size trial stage from 2019 to 2020.

Deploying 5G by 2020 will require Europe to develop leading edge technologies, globally approved standards and especially to achieve consensus over the most suitable frequency bands. This funding and these projects – involving a great many researchers from more than a hundred companies and the finest R&D centres in Europe – are thus vital.

[25] https://www.abiresearch.com/press/abi-research-projects-5g-worldwide-service-revenue

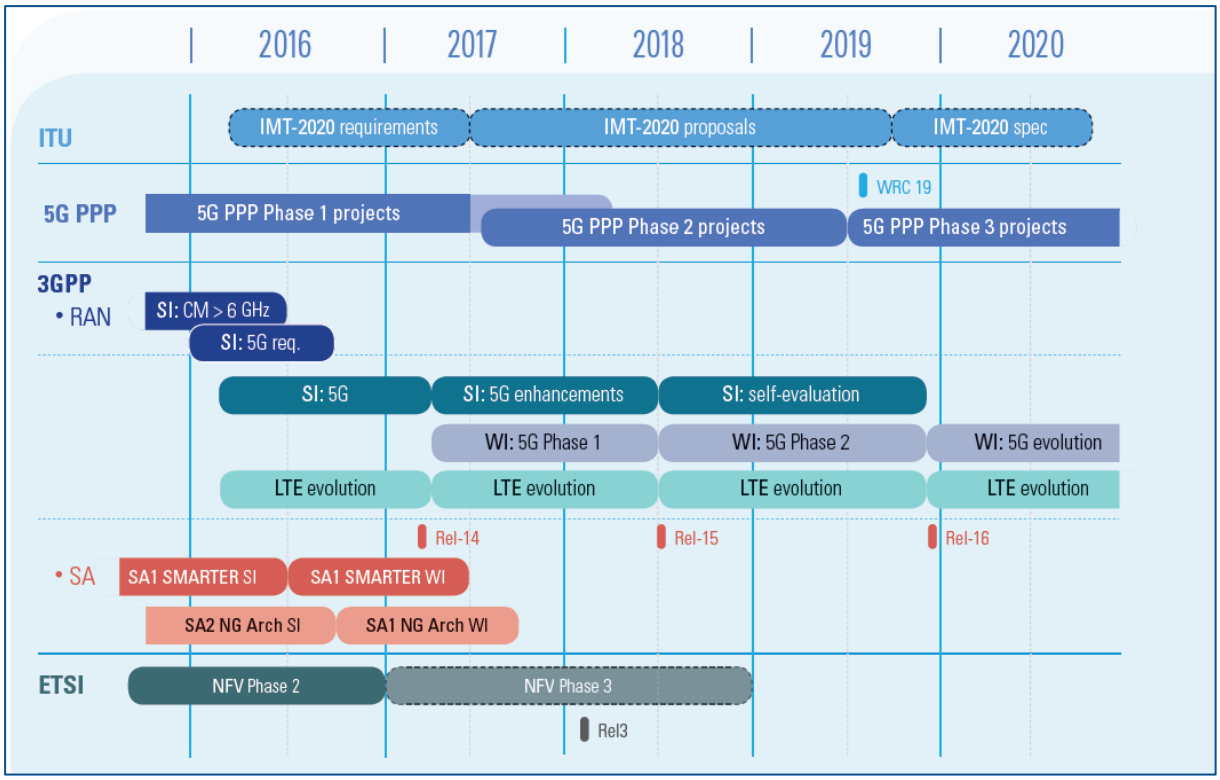

Figure 14. 5G PPP vs. 3GPP and ITU roadmaps[26]

5G action plan

As a complementary measure, on 14 September 2016 the European Commission launched its *5G for Europe Action Plan* to bolster investments in 5G infrastructure and service rollout efforts in the Digital Single Market between now and 2020. This action plan sets out a clear roadmap for public and private 5G investments inside the EU.

The Commission has proposed the following measures to achieve this plan:

- Align roadmaps and priorities for a coordinated 5G deployment across all EU Member states, targeting early network introduction by 2018, and moving towards commercial large scale introduction by the end of 2020 at the latest.
- Make provisional spectrum bands available for 5G ahead of the 2019 World Radio Communication Conference (WRC-19), to be complemented by additional bands as quickly as possible, and work towards a recommended approach for the authorisation of the specific 5G spectrum bands above 6GHz.
- Promote early deployment in major urban areas and along major transport paths.
- Promote pan-European multi-stakeholder trials as catalysts to turn technological innovation into full business solutions.
- Facilitate the implementation of an industry-led venture fund in support of 5G-based innovation.
- Unite leading actors in working towards the promotion of global standards.

[26]5G Empowering vertical industries. White Paper, 2016, https://5g-ppp.eu/wp-content/uploads/2016/02/BROCHURE_5PPP_BAT2_PL.pdf

The European Commission has given every EU country a certain number of ambitious, numerical targets. One core objective for 5G is thus to have at least one major city in every European country outfitted with this new generation mobile system by 2020, and coverage of every city, motorway and high-speed railway lines by 2025. This comes in response to announcements from South Korea and Japan which are both promising large-scale 5G demonstrations, respectively, at the Winter Olympics in Pyeongchang in 2018 and the Summer Olympics in Tokyo in 2020.

2.1.2 Worldwide (examples in the US, South Korea, Japan and China)

The race is already underway between countries to be the first to begin large-scale 5G trials, and later to introduce commercially available services, so much so that they are willing to employ pre-standard technical specifications.

Several countries are therefore working on standards and seeking to reach a consensus with one another to achieve international backing for the technical specifications that will satisfy their needs, and earn them the best possible return on the investments made thus far. This in turn is creating a certain turmoil, for instance, over the frequency bands that would be the best candidates for 5G.

The United States[27]

5G is seen as an unprecedented opportunity for economic growth, with a tremendous impact on education, job, transportation, etc. According to the US federal regulator, the FCC (Federal Communications Commission), the following three elements in particular need to be the prime focus of attention: spectrum, infrastructure and the backhaul network:

- **Spectrum**: in July 2016, the FCC voted to free up and to open up nearly 11 GHz of high frequency spectrum to be used for fixed and mobile broadband applications: 3.85 GHz of licensed spectrum in the 27.5 – 28.35 GHz and 37 - 40 GHz bands, as well 7 GHz of unlicensed spectrum from the 64 - 71 GHz band. The FCC's stated goal was to provide the assurance and clarity for investments in the telecoms sector. Verizon welcomed this decision, and plans on achieving the first rollouts in 2017, with trials already underway in several cities around the country (cf. 3.3).
- **Infrastructures**: The FCC believes that 5G must be underpinned by a robust infrastructure network capable of handling already heavy traffic that could potentially increase exponentially in the coming years. It will interact in a hybrid fashion between traditional towers with macro cells and small cell deployments, as well as distributed antenna systems. With an eye on the deployment of new towers, the FCC resolved to reduce, or eliminate in certain cases, the regulatory restrictions on installing facilities and antennae that will have very little impact "on historic properties" (tower re-use, small antennae, indoor installations, etc.)[28].
- **Backhaul network**: Because 5G systems will require very high-power backhaul networks, the FCC is in the process of reforming and updating the regulations governing data services markets, including wireless backhaul solutions. The FCC is seeking to protect this market while also creating competition, so that competitive and high quality backhaul network solutions can emerge.

[27] Forging Our 5G Future – Federal Communications Commission: https://www.fcc.gov/5G

[28] https://apps.fcc.gov/edocs_public/attachmatch/DA-16-900A1_Rcd.pdf

Japan

Japan wants to demonstrate its 5G leadership by deploying the first commercial 5G network that complies with international technical specifications, in time for the Summer Olympic Games in Tokyo in 2020.

According to the *Radio Policies Towards 2020*[29] report, published in June 2016 by Japan's Ministry of Internal affairs and Communications (MIC), the 3600 - 4200 MHz, 4400 - 4900 MHz and 27.5 – 29.5 GHz bands were selected to be the 5G candidate bands on a national scale. Although other bands are also being investigated, with a view to WRC19, 5G rollouts are already planned in the 3600 - 4100 MHz, 4405 - 4895 MHz and 27.5 - 28.28 GHz bands as early as 2017 in Tokyo, and will be built out in 2018 and 2019.

China

Like Japan, China too wants to prove its leadership with the first commercial rollouts in 2020. The first trials will be conducted that year in the 3400 – 3600 MHz band. The 3300 - 3400 MHz, 4400 - 4500 MHz and 4800 - 4990 MHz bands are also under consideration and currently being investigated. For higher speeds, the country plans on using spectrum around the 25 GHz and 40 GHz frequencies.

South Korea

South Korea, meanwhile, has set its sights on a pre-commercial 5G service that would be ready in time for the 2018 Winter Olympics in Pyeongchang. Several trials are already underway to prepare for full scale demonstrations in several South Korean cities, including Pyeongchang and Seoul. The country's three national mobile operators are hoping for spectrum in the 26.5 – 29.5 GHz bands.

South Korea's largest mobile operator, SK Telecom, has announced a plan for conducting interoperability tests with Qualcomm and Ericsson, as well as outdoor trials of the new air interface based on the 3GPP NR standards that are being developed today. These trials and experiments will be carried out in the second half of 2017.

If the goal of these trials is to help accelerate the specification of the new NR air interface, which is part of the work being done on 3GPP Release 15, it has not yet been specified which frequency bands will be used for these trials.

2.2 A host of private initiatives – a few examples

5G Open Trial Specification Alliance

In early 2016, South Korean operators KT and SK Telecom, Japanese carrier NTT DoCoMo and American carrier Verizon formed the 5G Open Trial Specification Alliance to carry out collaborative 5G trials.

Due to be conducted between 2016 and 2018, the aim for these trials is to provide a common platform for operators, for exchanging results and shared assessments of the different 5G network components and elements. One of the operators' objectives is to help accelerate the definition of standards and specs, and to enable economies of scale. The findings of these evaluations will provide input for 3GPP discussions, adding simulations to the experimental data produced by the partnership.

[29] http://www.gsma.com/spectrum/wp-content/uploads/2016/08/MIC_Spectrum-for-5G-MIC-Kuniko-OGAWA.pdf

The alliance's founders hope to attract a number of industrial partners to the platform, including other carriers, equipment suppliers, chipset makers, etc. Several of the founding operators' equipment suppliers are already involved in the scheduled trials.

The trials will cover multiple frequency bands, both above and below 6 GHz.

Verizon 5G Technical Forum

The Verizon 5G Technology Forum (V5GTF) was created in late 2015 by Verizon, in cooperation with its partners Cisco, Ericsson, Intel, LG, Nokia and Qualcomm. The goal of the collaboration is to provide a platform for testing radio interface specifications in the 28 and 39 GHz bands.

The first fruit of this collaboration, in July 2016 Verizon announced the completion of the first specifications of their 5G radio interface. These specs should enable the different parties involved to develop interoperable solutions and so to help drive forward the definition pre-standards.

Even though they run the risk of developing solutions that are not compatible with 3GPP or ITU standards, Verizon believes it has a solid enough grasp of the overall concepts being discussed in those bodies. The tests carried out in several US cities were thus able to validate substantially greater capacities than 4G.

Orange/Ericsson

Orange and Ericsson have been working together since October 2016 on developing 5G use cases and services, as well as demonstrations. The purpose is to develop technological building blocks, conduct trials and pilot projects for a range of use cases, including multi gigabits/s wireless internet access in suburban and rural environments, the Internet of Things and connected cars.

Their collaboration made it possible to achieve 15 Gb/s in a laboratory environment, notably thanks to the use of massive MIMO and beamtracking using centimetre waves. The collaboration will also focus on the transition from 4G to 5G solutions, notably in terms of reducing costs and improving energy efficiency, and on the use of SDN and NFV technologies.

Since January 2017, the partnership has included PSA (Peugeot) to carry out trials on connected cars.

5G-ConnectedMobility

5G-ConnectedMobility is a consortium formed by Ericsson, BMW, Deutsche Bahn, Germany's three mobile operators, Deutsche Telekom, Telefonica Deutschland and Vodafone, the 5G TU Dresden laboratory, the BAST research institute and BnetzA, with the goal of galvanising and accelerating 5G R&D in Germany.

5G-ConnectedMobility thus plans on supplying a digital motorway infrastructure and real application environment to be able to test V2V (vehicle-to-vehicle) technologies as well as solutions for digitising railway infrastructure.

To this end, 5G-ConnectedMobility operates with the help of an independent network infrastructure that is not connected to any commercial network. The Ericsson mobile network devoted to this project makes it possible to run live tests: Ericsson thus obtained permission from regulator BNetzA to employ spectrum in the 700 MHz band in the Nuremberg area.

3 The challenges of 5G

In this part we explore the different challenges that lie ahead for 5G, which emerged from the interviews that Arcep conducted over the past several months.

3.1 New business models focused on vertical markets

3G and especially 4G technologies were designed primarily for the superfast mobile internet. 5G continues on in this direction, but also wants to target what are known as vertical markets, which encompass several segments, including:

- Connected vehicles, not only to deliver entertainment and information to passengers, but also to guarantee safety via communications both between vehicles and between vehicles and infrastructure;
- Factories of the future;
- Smart cities with requirements in the areas of public transportation (similar to the needs of connected vehicles), the environment, managing buildings and energy consumption;
- Medicine, healthcare and robot-assisted telesurgery;
- Smart grid flow monitoring and management (electricity, gas, water, etc.).

This section will focus in particular on the connected car and factories of the future segments. Because of their current and future macro-economic context, along with the plurality and effervescence of the pioneer work being done in these areas, these two segments constitute the main avenues of 5G development in vertical markets. Smart cities and smart grids have already begun to soar through existing Internet of Things (IoT) technologies.

3.1.1 The automotive sector

The car is an extremely common form of transportation, and safe driving is a fundamental consideration: human error is the number one cause of all transport accidents. The transportation sector wants to use technological innovations to tackle this problem, and to continue to make transportation more efficient, more sustainable and safer.

There are three areas in which technological progress could help improve automotive transportation. 5G could have a role to play in all three, but particularly in the first two:

- Provide in car internet connectivity, to deliver entertainment to passengers;
- Provide access to driver assistance information, to reduce accidents and improve the fluidity of traffic;
- And, finally, the ability to make cars autonomous, thanks to artificial intelligence algorithms.

The first area is just an extension of the developments occurring today around 4G. The aim is to give passengers access to their messaging services, to the internet, to multimedia content, online gaming, etc. The increased connection speeds promised by 5G will improve the use of all of these services.

The second area aims to make cars more intelligent by using information that was not previously available to them. This in turn will help improve the safety and efficiency of the networks as well as help drivers make the right decisions, and adapt to driving conditions. Such connected vehicles could have access to information about dangers on the road (slow or stopped cars, traffic jam warnings, indications of where construction is taking place on the roads, weather conditions, emergency braking, emergency service vehicles approaching, etc.) or regarding signage (signalling/signage on-

board vehicles, speed limits on vehicles, failure to heed signage/safety precautions at crossings, request for right-of-way at traffic lights for designated vehicles, green light optimal speed advisory, etc.). Other services, such as information on refuelling or recharging stations, vulnerable road user protection, managing street parking and traffic information, and smart guidance, could also prove useful. It is still not clear whether, to achieve this, vehicles will simply exchange information with each other or if connectivity with infrastructure will be required along the roads to optimise vehicles' behaviour. In both instances, 5G could have a role to play.

Of the many initiatives that are already underway we can begin with an example from France: the SCOOP@F[30] (cooperative intelligent transport systems) project coordinated by the Ministry of the Environment, Energy and the Sea, and which unites local authorities and R&D centres. Launched in February 2014, new partners subsequently joined the initiative, including Orange and Austrian, Spanish and Portuguese partners. As it is a European project, it receives 50% of its financing from the European Commission, and cross-tests are conducted with Austria, Spain and Portugal. SCOOP@F is a pilot rollout project for cooperative intelligent transport systems; it aims to deploy 3,000 vehicles on 2,000 km of roadway spread across five locations: Ile-de-France, the A4 motorway, the Isère, and ring roads in Bordeaux and Brittany. Its main objectives are to improve road safety and the safety of roadway workers, achieve more efficient traffic management, reduce pollution, streamline infrastructure management costs and participate in defining the car of the future.

In addition, in early 2017, mobile carrier Orange, equipment supplier Ericsson and car-maker PSA Group signed a partnership agreement[31], as part of the "*Towards 5G*" initiative, to conduct technical trials relating to 5G. The aim of this alliance is to test the different paths of technological evolution from 4G to 5G to meet the needs of connected cars, notably in terms of intelligent transport systems (ITS), for safer driving and new on-board services.

The third area concerns the emergence of autonomous vehicles. A number of projects are underway in this area. The first step is to outfit vehicles with algorithms that enable it to make decisions quickly based on their environment. This requires a large number of sensors to deliver a full "understanding" of what is happening around the vehicle. Without pre-judging the technologies that will ultimately be employed to achieve this, as with a human driver (see above), the car could take advantage of connections with other vehicles on the road and with an infrastructure, to have access to all of the aforementioned information.

3.1.2 Industry 4.0

Competitiveness does not depend solely on innovation and the evolution of products, but also on modernising businesses and their means of production. According to certain studies carried out in 2015[32], the digital transition in Europe will enable enterprises to increase their revenue by more than 110 billion euros a year over a five-year period.

A great many countries have set out a strategy for modernising their manufacturing infrastructure (*l'industrie du futur* in France[33], Industry 4.0 in Germany…) of which one aspect will involve digitising processes and trade. The European Commission itself introduced measures in 2016 for strengthening

[30] http://www.scoop.developpement-durable.gouv.fr/spip.php?page=sommaire

[31] http://www.orange.com/fr/Press-Room/communiques-2017/Ericsson-Orange-et-le-groupe-PSA-partners-pour-la-voiture-connectee-en-5G

[32] PwC, "Industry 4.0: Opportunities and challenges of the industrial internet" (2015), and Boston Consulting Group, "Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries" (2015)

[33] http://www.economie.gouv.fr/files/files/PDF/industrie-du-futur_dp.pdf

competitiveness in Europe, in which 5G could play a significant role. This included earmarking 500 million euros for the Horizon-2020[34] research programme.

The advent of new technologies (4G, fibre and soon 5G) and new services (the Internet of Things, the cloud, big data) should facilitate businesses' digital transition. 5G in particular is expected to be a very versatile technology, capable of undergirding a very wide array of uses, and could go a long way in furthering companies' transition to digital technologies and solutions.

3.2 Spectrum harmonisation

5G is emerging as a technology that will use both low frequencies (f < 1 GHz), high frequencies (1 GHz < f < 6 GHz) and, for the first time ever in consumer networks, very high frequencies referred to as "millimetre wave" frequencies (f > 6 GHz).

This spectrum diversity is entirely bound up with the promises of 5G: extended coverage (low frequencies), ultra high speeds (very large channels in very high frequency bands), low power consumption. Furthermore, satellite services will also contribute to the development of this new technology, especially in areas that are difficult to cover and to provide backhaul solutions. The satellite industry is thus taking an interest in 5G, and wants to be involved in defining these new generation network.

3.2.1 Millimetre wave frequencies

The "millimetre" band, also referred to as millimetre wave spectrum, aka frequencies above 6 GHz, are essential to enabling 5G to mark a departure from 4G, for the reasons cited in Section 1.5.1.

At the latest World Radiocommunications Conference (WRC-15 in Geneva), a conference under the aegis of ITU whose objective is to change the way frequencies are allocated between users, discussions over the definition of future mobile bands made it possible to focus future 5G studies, for millimetre wave frequencies, on a certain number of bands situated between 24 GHz and 86 GHz (33.25 GHz identified in total): 24.25 - 27.5 GHz, 31.8 - 33.4 GHz, 37 – 43.5 GHz, 45.5 - 50.2 GHz, 50.4 - 52.6 GHz, 66 - 76 GHz, 81 - 86 GHz.

It is important to stress that, even if the above-listed bands have been identified as "5G bands", at this stage there is no way to know whether they can actually be used to deploy this new generation system: only the results of technical studies will make it possible to establish the constraints and rules of compliance, and to validate the feasibility of these hypotheses.

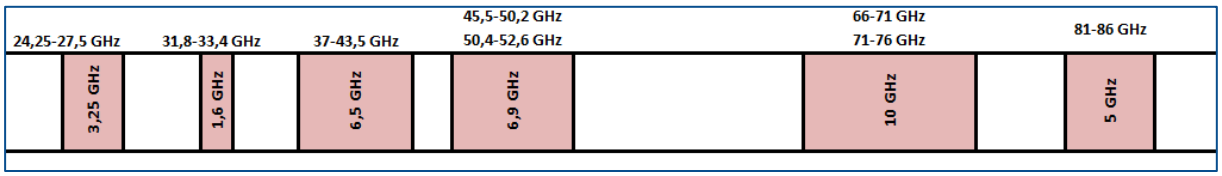

Figure 15. Millimetre wave frequencies identified at WRC-15

Contrary to the conclusions of the Conference, which reflect European recommendations, the United States and certain Asian countries (South Korea, Japan) have decided to perform 5G trials in the 28 GHz band, and equipment suppliers such as Qualcomm and Samsung, have begun manufacturing 28 GHz- band products.

[34] https://ec.europa.eu/programmes/horizon2020/en/what-horizon-2020

Meanwhile Europe, following the publication of an RSPG (Radio Spectrum Policy Group within which France is represented by ANFR) opinion[35], decided to focus its first studies on the 26 GHz band (pioneer band), then on the 32 GHz and 42 GHz bands. Later, studies will be carried out on introducing 5G in all of the other bands identified by WRC-15.

The rapid choice of the 26 GHz band as the pioneer band was made to enable economies of scale for equipment production, since it is very likely that dual-mode equipment, i.e. compatible with both the 26 GHz and 28 GHz band, will be available for pioneer rollouts[36].

In France, the 26 GHz band is already being employed for a variety of uses: mobile operators' wireless fixed links (4G infrastructure links), fixed satellite service systems and ground stations for space services. Studies will therefore need to be conducted to take these services into account, and define either the cohabitation or migration of applications to other millimetre wave frequencies.

3.2.2 Frequency bands below 6 GHz

a) The 3.4-3.8 GHz band

It will not be possible for 5G to run entirely on millimetre wave frequencies: the propagation qualities of these bands make it difficult to achieve widespread coverage, particularly in more sparsely populated areas. In addition, these bands are still lacking in technological maturity when it comes to delivering consumer market communication services. As a result, a "core" band below 6 GHz needs to be identified: one that provides sufficiently large channels to enable future 5G operators to provide innovative services and a higher quality of service than with 4G.

The 3400 - 3800 MHz band appears to be a good candidate.

First, it has already been harmonised for ultrafast mobile services inside the European Union. Initially the 3400 - 3600 MHz band and later the 3600 - 3800 MHz band were identified as the "IMT" bands (for high-speed mobile). Second, they have a great deal of available spectrum (up to 400 MHz). Lastly, technological advancements (antenna and signal processing) make these frequencies compatible with their use to establish macro cells, and not only microcells. To give an example, it emerged from the interviews conducted by Arcep that coverage with this band could be similar to coverage with the 2.6 GHz band, the core 4G frequency band.

This analysis has been confirmed by the European Commission (in its 5G mandate to RSCOM[37]) and by RSPG[38] which consider the 3.4 - 3.8 GHz band as the only credible 5G band for deployments taking place before the end of 2020.

In France, the band is assigned to Arcep, in a priority fashion, for the 3400 - 3600 MHz frequencies (and in a non-priority fashion to the Ministry of the Interior and the Ministry of Defence), and exclusively for the 3600 - 3800 MHz frequency bands. It is used for wireless local loop and satellite applications.

The compatibility of future uses with current applications is being examined by the Electromagnetic Compatibility Advisory Committee, which is chaired by the National Frequency Agency and of which

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[35] http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf

[36] The tuning range is vital here: a system capable of regulating its frequency from 26 to 28 GHz appears entirely technologically achievable within the timeframe for the first 5G millimetre wave deployments. This would have been less true if a switch between 28 and 32 GHz were required.

[37] https://circabc.europa.eu/sd/a/448dc765-51de-4fc8-b6e0-56ed6a1d0bca/RSCOM16-40rev3%205G%20draft_mandate_CEPT.pdf

[38] http://rspg-spectrum.eu/wp-content/uploads/2013/05/RPSG16-032-Opinion_5G.pdf

Arcep is a member: exclusion zones, protecting certain locations tied to long-term use of satellite solutions, need to be set up. Military radiolocation systems operating below 3.4 GHz also need to be protected.

b) Other bands below 6 GHz

The bands being used today for 2G, 3G and 4G could be used for future 5G deployments.

Refarming 2G, 3G and 4G could be a delicate undertaking, however, because of the duplexing methods they use. Most mobile communications in Europe use FDD (Frequency Division Duplexing)[39] to exchange information. Technical discussions over 5G are nevertheless anticipating that TDD (Time Division Duplexing)[40] will be the chief, if not sole, form of duplexing used for this new generation, notably because it makes it possible to adjust bandwidth to data rates and because it is particularly efficient when beamforming is used.

For 5G networks, using already harmonised mobile bands will thus require in-depth technical studies to define the terms and conditions of use and sharing with existing services. On this point, the ECC (Electronic Communications Committee[41]) decided to assess the potential of certain already harmonised bands, notably the 700 MHz and the L band (1427-1492 MHz).

In France, Arcep allocated the 700 MHz band to mobile operators in late 2015. Even if the country's four operators all obtained frequencies in this band, only Free Mobile, which has no blocks of 800 MHz spectrum, decided to begin its rollouts in the band using LTE (4G) technology.

Arcep is currently analysing the contributions to its public consultation, addressing among other the 3.5 GHz band, that ended recently.

The L band (1427 - 1518 MHz), which was defined to be used exclusively in SDL (Supplemental DownLink) mode, could be considered to meet the constant demand for ever higher data rates and the greater increase in downlink traffic, compared to uplink traffic. In France the band is used by wireless fixed links authorised by Arcep, by the Ministry of Defence for mobile services (excluding aeronautical) and by the Ministry of the Interior. Using it for 4G or 5G would therefore suppose moving the above-mentioned uses over to other bands.

3.3 Increasingly small cells

Today, mobile network rollouts are essentially based on the use of macro base stations: installations that are equipped with high-power antennae deployed to guarantee coverage for a relatively wide area, providing good quality of service. Network configurations are evolving constantly: new radio base stations are installed on a regular basis to increase the networks' capacity, to better meet users' needs in terms of indoor and outdoor coverage, and to improve quality of service.

However, this continually growing demand for capacity already requires operators to increase the density of their networks with smaller and smaller cells.

5G – which will probably bring about a sizeable increase in data traffic, and which will use millimetre wave frequencies whose propagation capabilities are weak – will no doubt require the widespread deployment of low-power base stations (small cells).

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[39] A technique that consists of sending and receiving data simultaneously, but on two different frequency bands.

[40] A technique that consists of sending and receiving data on the same frequency band but at different times.

[41] The European body that specifies the technical terms and conditions governing the use of frequency bands, which are then set by European Commission decisions.

To satisfy demand and enable the introduction of 5G, estimates indicate at least 10 small cells per macro base station in urban settings[42], where cells are already today relatively tightly meshed to handle traffic density.

Here, the players that met with Arcep raised several questions that will no doubt need to be answered when considering the ubiquitous deployment of small cells.

3.3.1 Taxation

The current regulatory framework stipulates that base stations whose power requires an opinion, an agreement or a statement from the National Frequency Agency (ANFR) are subject to a flat tax on network companies (IFER[43]). The amount of the tax varies according to transmission power, the type of installation and the deployment location. For a deployment in an urban area, the tax stands at €1,607/year/installation for a base station with an effective isotropic radiated power (EIRP) of more than 5W (a COMSIS agreement from ANFR is required to be able to transmit) and €160.70 €/ year/installation for an EIRP of between 1W and 5W (declaration to ANFR is required to be able to transmit).

5G small cells will likely use variable transmission powers of between 1W and 25W. In light of rollout density forecasts, hence the number of small cells to install, some of the stakeholders that Arcep met with raised the question of possibly adapting this tax in such a way as to enable massive small cell deployments without generating an equally massive increase in the total tax amount.

This process is already underway, notably with a view to decreasing taxes on base stations in locations that are hard to cover: Act No. 2016-1888 of 28 December 2016 on the modernisation, development and protection of mountain regions thus exonerates mobile base stations built in mountain regions between 1 January 2017 and 31 December 2020 from paying the IFER tax.

3.3.2 Access to elevated and “semi-elevated” locations

To perform their deployments successfully, mobile operators have traditionally needed to install their base stations in elevated locations (towers, rooftops, etc.). This will continue to be true with 5G networks, but will be even more challenging for two main reasons:

1. 5G antennae will probably be larger (in the m^2 range for some) than current 2G, 3G or 4G antennae, because of the above-mentioned massive MIMO processing that will require the use of a very large number of radiating elements. Moreover, additional antennae compatible with new 5G bands will no doubt also need to be deployed. So the re-use of existing masts could very well be problematic, and new (possibly collocated) transmission sites will need to be found.
2. This search for new sites will also need to be carried out to install small cells in semi-elevated locations, but with extra care as the density of these installations will undoubtedly be high: operators will thus be required to deploy their equipment on urban furniture and infrastructures such as bus shelters, lampposts, public buildings, billboards, etc.

As a result, public authorities will need to keep a close eye on the matter and, if necessary, adopt measures that will facilitate 5G rollouts.

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[42] http://www.lemag-numerique.com/wp-content/uploads/2015/10/WP_-Souverainete_Telecoms_PetitesCells_FINAL.pdf

[43] IFER = *Imposition forfaitaire sur les enterprises de réseaux*

3.3.3 5G networks' regional coverage and backhaul

Ensuring regional connectivity will be one of the challenges for this new generation of mobile networks.

The diversity of use-cases envisioned for future 5G networks, the geographical distribution of which is not yet precisely known, must be factored in when addressing coverage issues.

The higher frequency bands that are being put forth for future 5G networks, along with the potentially very substantial bandwidth consumed by these new uses, pose the question of the regional foothold of these networks. As a matter of fact, mobile networks have never before employed such high frequencies whose use will require a large number of relay antennae to be installed.

Moreover, connecting the 5G installations to the network will push to the fore the question of the cost of connecting them via optical fibre, which will no doubt be necessary in most instances to ensure the expected quality of service. The industry needs to design the technologies that will make it possible to minimise the cost of 5G rollouts in rural areas.

3.4 Net neutrality issues

European regulation on safeguarding an Open Internet[44], adopted by the European Parliament and Council on 25 November 2015, for which European regulators required an additional nine months to specify the rules governing its application, introduces the principle of net neutrality as one of the top priorities in the standardisation hierarchy.

Net neutrality is an overriding principle that guarantees equal treatment for all data traffic on the internet. In particular, it excludes any form of discrimination with respect to the source, the destination or the content of data flows.

On 30 August 2016, BEREC (the Body of European Regulators for Electronic Communications) published guidelines for national regulators on the enforcement of the European Open Internet regulation[45].

During the BEREC public consultation[46] on its draft net neutrality guidelines, several enterprises and electronic communications sector stakeholders took the opportunity to deliver a clear-cut point of view in their *"5G manifesto for timely deployment of 5G in Europe"*[47]. This manifesto aims at warning public authorities against a too restrictive approach to traffic management, and especially of the supposedly negative effects that, in their opinion, an overly strong enforcement of net neutrality could have on the 5G rollout roadmap.

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[44] Regulation (EU) 2015/2120: http://eur-lex.europa.eu/legal-content/FR/TXT/PDF/?uri=CELEX:32015R2120&from=EN

[45] Internet service providers (ISP) can employ reasonable traffic management measures for certain categories of traffic, under non-discriminatory conditions and provided they are transparent, proportionate and justified by objective technical requirements, and not used to serve their own commercial interests. ISPs can also distinguish certain services, called specialised services, from their internet access service, without them affecting the latter, provided these services have specific, objective transit requirements.

[46] http://www.berec.europa.eu/

[47] http://telecoms.com/wp-content/blogs.dir/1/files/2016/07/5GManifestofortimelydeploymentof5GinEurope.pdf

BEREC's opinion[48], in response to the contributions to the aforementioned public consultation, recalls that the rules of net neutrality are technology neutral and therefore apply to 5G networks. Moreover, BEREC guidelines clarify that network slicing which networks will need to use to respond to the different use cases (mMTC, eMBB, uRLLC) planned for this new generation (cf. 1.4) system, may be used to deliver specialised services[49].

The subject of net neutrality as it applies to future 5G networks is still very much open and unexplored, but new analyses could be performed parallel to the work being done on defining 5G. Arcep is open to discussion and will also work, within BEREC, towards bringing the required clarity to the ecosystem.

[48] http://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/6161-berec-report-on-the-outcome-of-the-publi_0.pdf

[49] http://berec.europa.eu/eng/document_register/subject_matter/berec/download/0/6160-berec-guidelines-on-the-implementation-b_0.pdf - footnote 26

Annexes

Annex 1 Definition and standardisation work

A new generation of mobile telephony is defined primarily by two bodies: ITU (International Telecommunication Union) and 3GPP (3rd Generation Partnership Project). These two, respectively public and private, organisations are dedicated to defining the objectives, standards and technical specifications of the new technology in question.

ITU

The first large-scale 5G commercial rollouts are expected to take place in 2020. As mentioned earlier, the exploratory phase – which provides an opportunity to determine demands and identify the most promising techniques and technologies for these future 5G networks – has already begun. Although a number of organisations and consortia are involved in defining 5G, 3GPP will very probably be the central standardisation body for its technical specifications.

Whatever the case may be, ITU (International Telecommunication Union) is vital to defining the technologies and standards that govern any new generation of IMT (International Mobile Telecommunications) at the global level.

These IMT standards are established with the involvement of public authorities and industry players, and have provided the framework for the evolution of mobile communication services around the world, since the beginning of IMT standardisation, with IMT-2000 (3G, UMTS), then IMT-Advanced (4G, LTE-A) and more recently IMT-2020 (5G).

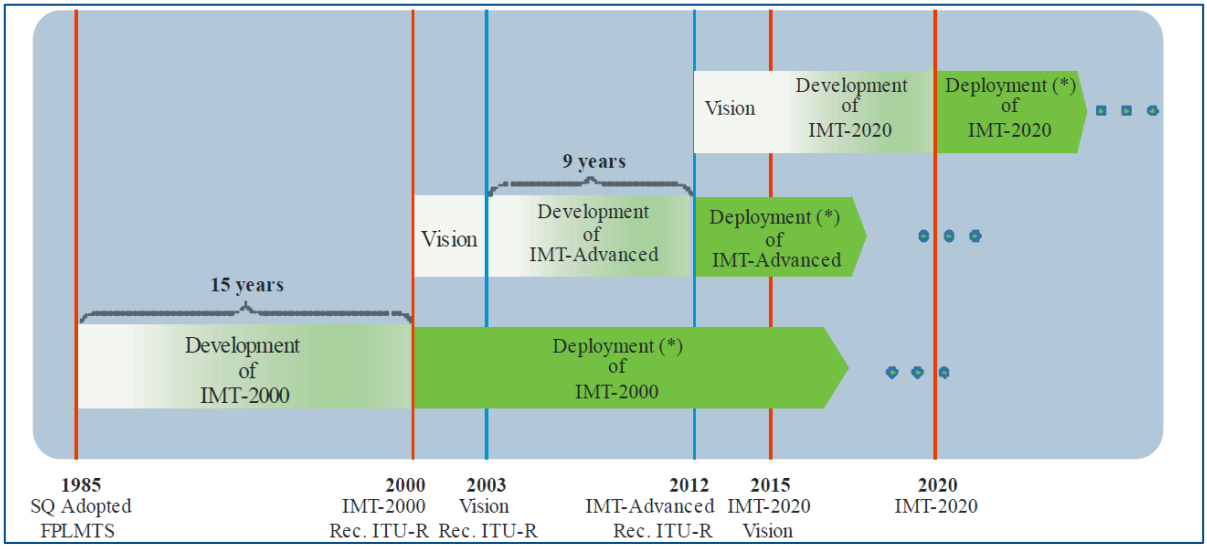

Figure 16. Timeline of IMT developments and deployments[52]

The advent of an IMT standard typically occurs in three main stages : a vision stage, a development stage and a deployment stage.

The vision stage – whose completion is marked by a document that is usually called a Vision Recommendation – is the stage during which ITU sets the framework and objectives for the future technology. The aim of this document is generally to define what the new technology will be in a more or less concrete fashion, what its characteristics will be, the uses it will enable, etc. Whether for

[52]Recommendation ITU-R M.2083-0 (09/2015), https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf

IMT-Advanced, the commonly used technical abbreviation attributed to the definition of 4G, or IMT-2020, the abbreviation attributed to definition of 5G, the vision stage lasts around three years.

Recommendation ITU-R M.2083-0 was published in September 2015, bringing to a close three years of work performed by ITU-R (Working Party 5D) on defining the framework and objectives for IMT for 2020 and beyond. It is this document that today serves as the basis of the different 5G research and standardisation work being done around the globe.

Next comes the standards development stage, based on the conclusions of the vision stage. Regarding IMT-2020, this development and standardisation work is already underway, and ITU plans on having completed it by 2020 to be able to satisfy the most pressing needs of the ITU members and organisations that want to deploy 5G as quickly as possible. This is all the more challenging as the development stage will last only five years, compared to 15 years for IMT-2000 and nine years for IMT-Advanced.

The different deadlines set for IMT-2020 within ITU can be found in Figure 17. The spectrum identification phases (indicated by the black triangles) coincide with the World Radiocommunications Conferences, of which the latest was WRC-2015 and the next is WRC-2019 (see 3.2).

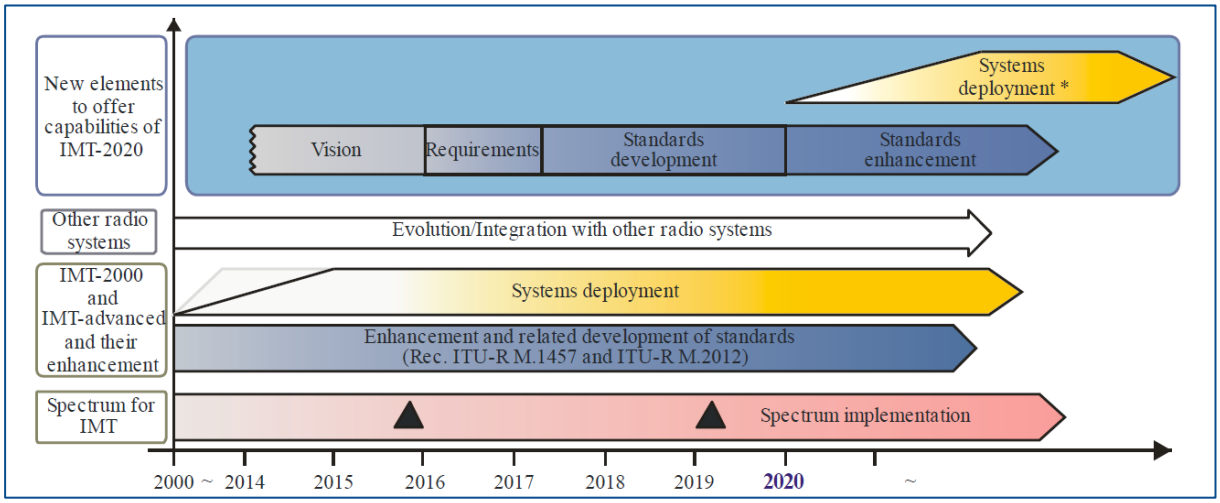

Figure 17. Stages and expected deadlines for IMT-2020[53]

All of the work that ITU is conducting on IMT-2020 is following a roadmap that is detailed in Figure 18, with the completed stages indicated in green and those to come in blue. The work that is underway today concerns 5G spectrum aspects, prerequisites and assessment criteria, along with the different technical studies and proposals, which are a prerequisite to the standardisation phase of the work.

[53]Recommendation ITU-R M.2083-0 (09/2015), https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2083-0-201509-I!!PDF-E.pdf

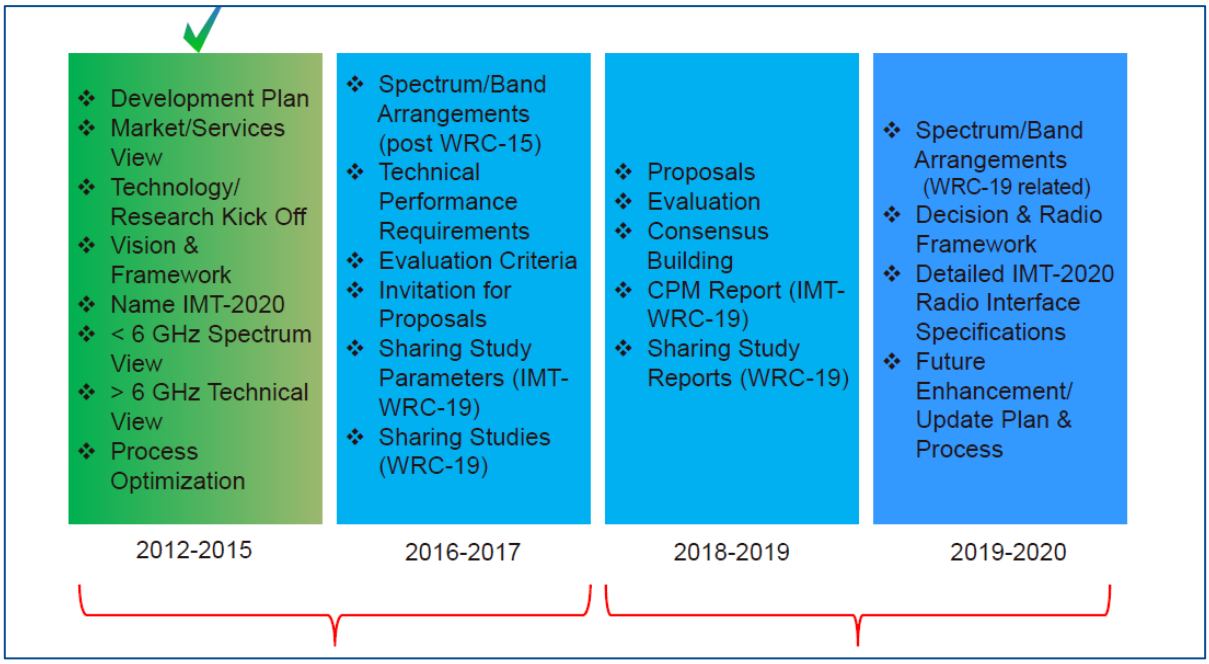

Figure 18. WP 5D[54] work programme

3GPP

Based on ITU Recommendations, 3GPP has played a major role in the success of LTE over the past several years, which has been the fastest growing cellular technology to date: never before has a new radio standard been adopted and deployed as rapidly and as widely from the finalisation of the first version of its standardisation (for LTE Release 8, in December 2008).

For the first time, under the LTE acronym, the entire mobile industry agreed on a single new technology (contrary to 3G where 3GPP and 3GPP2 co-exist, each backing their version of 3G standardisation that complies with IMT-2000 criteria), and so enabling unprecedented economies of scale and momentum in the ecosystem.

After Release 8, the work performed by 3GPP has been centred on the following strategic areas:

- Enhancing LTE radio standards to further improve capacity and performance;
- Enhancing system standards to make LTE and EPC (Evolved Packet Core, the core LTE network technology) available to new business segments;
- Introducing improvements for system robustness, especially for handing exponential smartphone traffic growth.

These areas of focus have made it possible to map out the general path of evolution from LTE to LTE-Advanced (Releases 10 to 12) and later LTE-Advanced Pro (Releases 13 and 14) while awaiting 5G.

The ambitiousness of 5G requirements, the tight timeline "imposed" by the market, along with the different national tendencies have pushed 3GPP to define two stages of specification work:

1. A first stage that will end in the second half of 2018, with the termination of Release 15, and which will address the most urgent matters with respect to commercial requirements;

[54] https://www.itu.int/en/membership/Documents/missions/GVA-mission-briefing-5G-28Sept2016.pdf

2. A second stage that will end in December 2019, which marks the end of Release 16, which will address the other use cases and prerequisites identified in the IMT-2020 Vision Recommendation.

The Work Plan for Release 15, the first set of 5G specifications, was ratified at the plenary meeting of the TSG#72 (Technical Specification Group #72) 3GPP working groups in June 2016. This plan includes a set of intermediate tasks and checkpoints to steer ongoing work in the different groups. This Work Plan sets out the transition from current studies to the standardisation phase of the work:

- Starting in December 2016: beginning of standardisation work by TSG SA2 (Technical Specification Group System Architecture);
- Starting in March 2017: specification begins for the 5G NR (New Radio) interface in the TSG RAN (Technical Specification Group Radio Access Network).

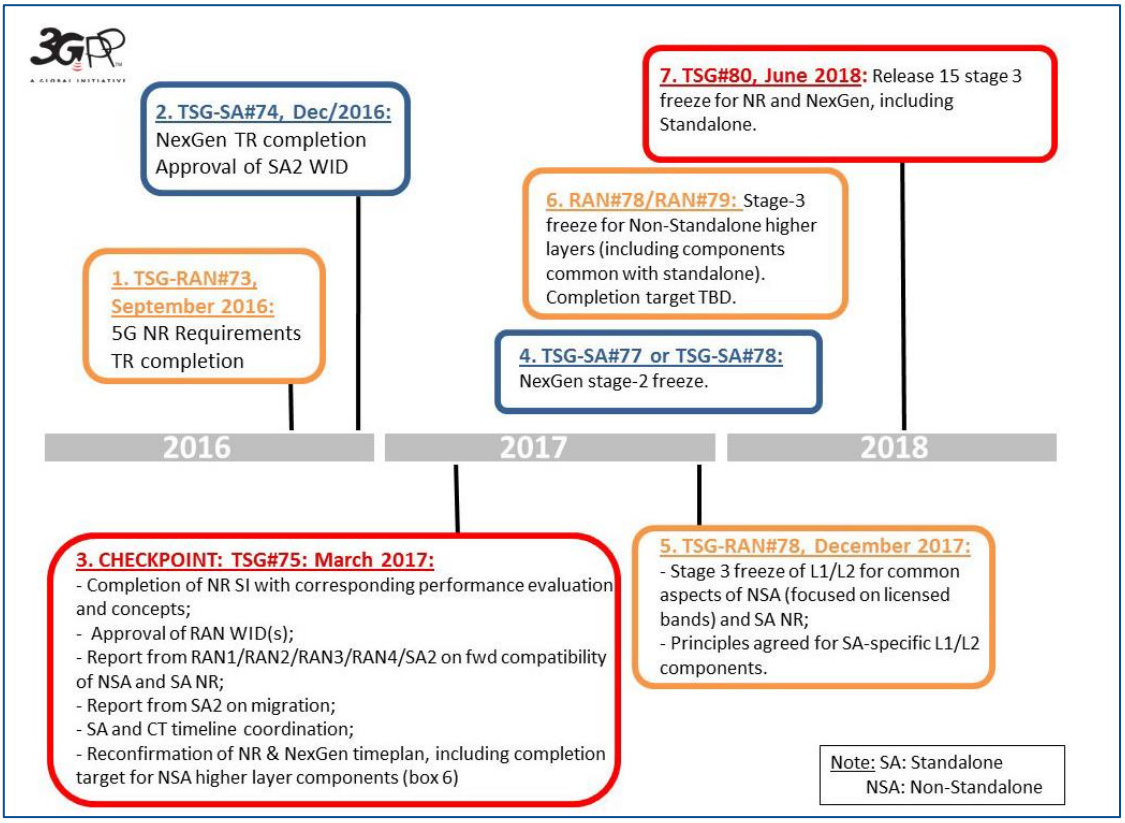

Figure 19. Roadmap for 3GPP standardisation groups[55]

If 5G is viewed as the technology capable of transforming society, and even of ushering in the next industrial revolution by impacting multiple (vertical) sectors with new business models and in a way that benefits the economy, notably in Europe, in all likelihood it will initially be driven forward by eMBB (Enhanced Mobile Broadband, cf. 1.2).

With this in mind, 3GPP defined the framework for Release 15, stage 1 specifications of 5G standardisation, as detailed earlier, whose work will focus on the following:

- Standalone and Non-Standalone NR operation: the Standalone version to work independently of LTE technology, and the Non-standalone NR being highly interoperable with LTE[56].

[55] https://5g-ppp.eu/wp-content/uploads/2016/11/01_10-Nov_Session-3_Dino-Flore.pdf

- Target use cases: starting with Enhanced Mobile Broadband (eMBB) as well as Low Latency and High Reliability to enable some URLLC (Ultra-reliable and Low Latency Communications, cf. 1.2) use cases.
- Simultaneous examination of frequency ranges below 6 GHz and above 6 GHz.

Release 16, the second phase of 5G specifications, will then focus more on other segments such as mMTC (Massive Machine Type Communications, cf. 1.2), for instance, to tackle IoT use cases that require higher quality of service than what LPWAN (Low-Power Wide-Area Network)[57] can provide.

[56] In its non-standalone version, the NR control plane is LTE's. in other words, the 4G network controls the 5G carriers and spreads users across the different bands and technologies.

[57] Sigfox and LoRa LPWAN

Annex 2 Entities Arcep met with

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White Paper

Designing 5G-Ready Mobile Core Networks

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5G Core Service & Performance Requirements

An industry "Vision for 5G" is now established and supported worldwide. Services and performance requirements have been identified, and the industry is moving into the development and implementation phases with a view to commercial launch of 5G mobile service around 2019 and fixed wireless access using mmWave radio from 2017. To meet these schedules, leading operators – especially Tier 1s with high expectations and aggressive deployment timelines – are working to make their networks 5G-ready ahead of commercial deployment.

This white paper argues that with a 5G-ready technology strategy, operators can prepare for rapid 5G service launch in a way that optimizes their investment in next-generation IP and mobile core platforms over the next three years. Specifically, it discusses 1) how 5G services drive a requirement for an IP services fabric to connect the distributed data centers that will host 5G network functions, content and applications and 2) the development of cloud-native, service-orientated core networks for advanced 4G and 5G networks.

5G Services Dimensions

Development of the 5G system architecture, and associated core network, is being led by 5G service requirements. **Figure 1** shows the output from the 3GPP SMARTER study group that has investigated the service dimensions of 5G.

Figure 1: Service Dimensions in Future 5G Networks

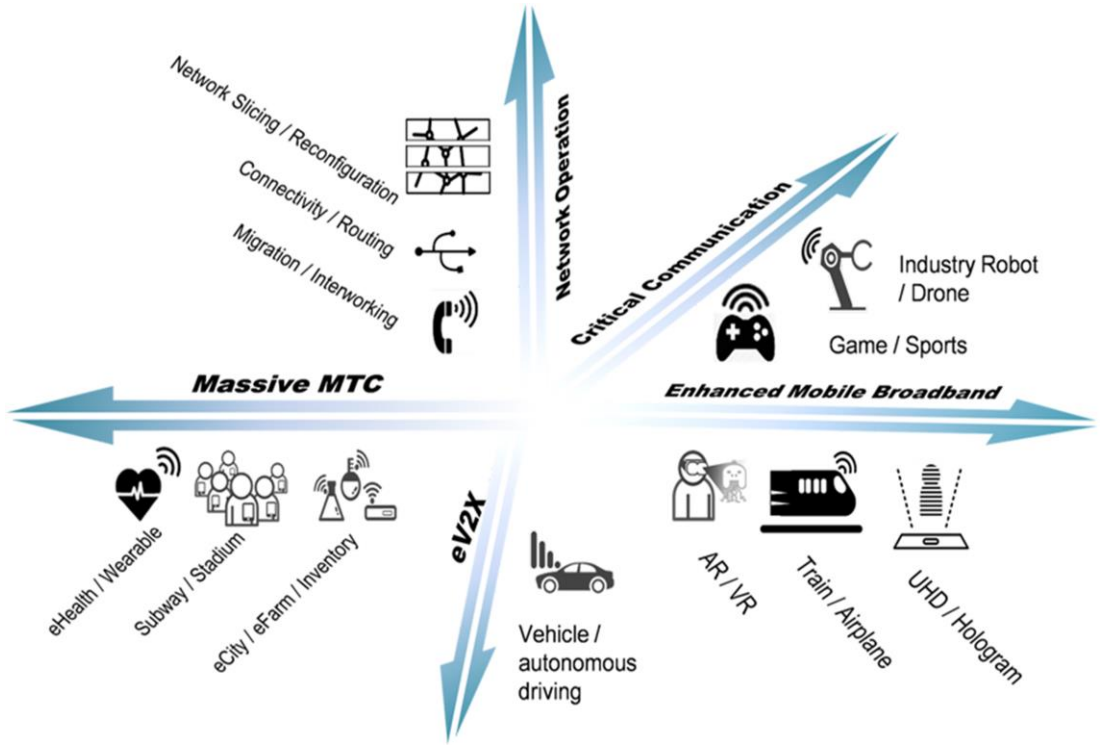

Source: 3GPP SMARTER

The chart maps closely to the now famous triangle representation of 5G services made up of enhanced mobile broadband (eMBB), low latency and mission critical communications and massive machine-type services (mMTC). However, it adds two important axes: a dedicated eV2X axis for vehicular services and, significantly, a network operations axis.

The dedicated operations axis is important because it makes explicit that automation is fundamental to 5G. To address new commercial opportunities, operators need the ability to create service-specific "network slices" that extend end to end across the infrastructure. Automating set up and management of these "network slices," including configuration of the underlying IP network, is critical to the 5G business case.

These service dimensions incorporate many different performance requirements. **Figure 2** shows IMT-2020 performance targets, developed by the ITU, for 5G. To the left, these are shown in comparison to IMT Advanced (4G). To the right, performance requirements are mapped to the three major use-case categories.

Figure 2: IMT-2020 Performance Targets

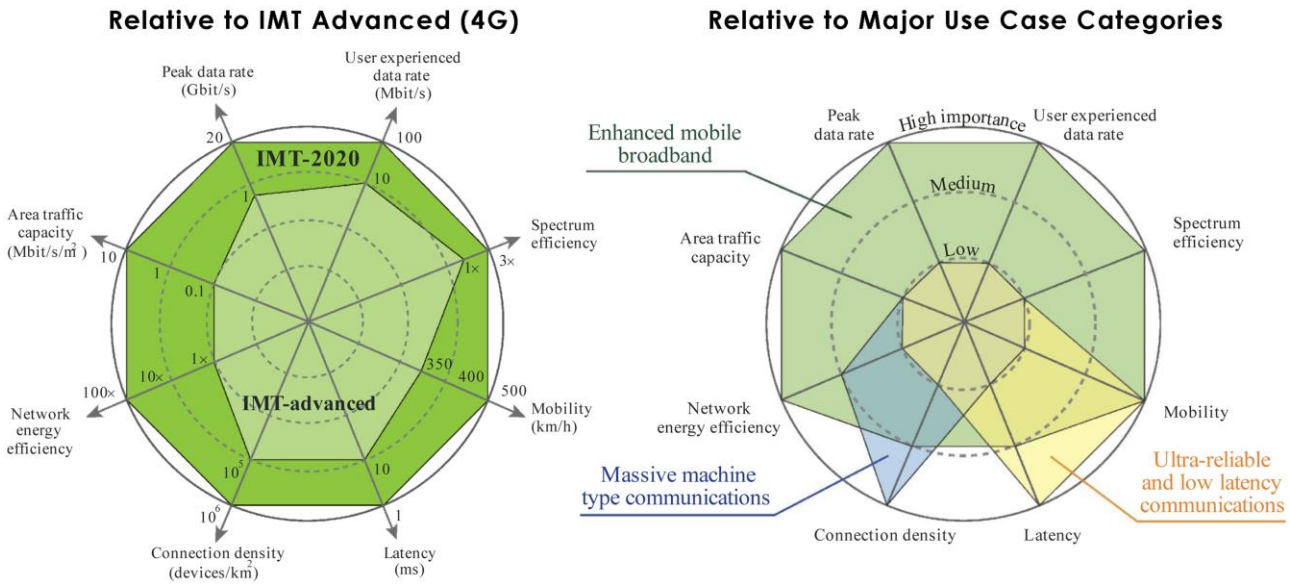

Source: ITU Recommendation ITU-R M.2083-0, September 2015

Probably the most influential factor on 5G physical network deployment will be the low-latency requirement. To deliver services over a wide-area network (WAN) with a consistent 5-10ms roundtrip time is extremely challenging and will drive a new system architecture deployed on a distributed cloud infrastructure.

A 5G-Ready Network Investment Strategy

Operators now have a good idea of what 5G will look like in scope and a reasonable view into the initial deployments models. Development of normative standards for 5G new radio (NR) and the next-generation core network (NG Core) is underway

with the first specifications – and the first "compatible" pilot deployments – expected in mid 2018. Although there is uncertainty about the details of the specifications under development, the industry has already undertaken significant R&D work on 5G candidate technologies, making it is possible for operators to pursue a 5G-ready network strategy with a reasonable degree of confidence that they will be able to rapidly deploy 5G, at scale, as the technology becomes commercially available.

From an IP and core network perspective, five tiers of a 5G-ready investment strategy are, from the ground up, as follows:

1. **Develop a distributed data center footprint**. The Central Office Re-architected as Data Center (CORD) model provides a good reference. The idea is for operators to develop physical assets located close to the edge and transform them into distributed data centers. The edge location is critical for low-latency 5G services and, as Mobile Edge Computing (MEC) shows, the edge-cloud is valuable in many networking scenarios – it is not solely a 5G investment. In time, the distributed data center will also come to support Cloud RAN (C-RAN) and Virtual RAN (V-RAN) hub sites and will host core network functions, such as distributed user-plane nodes.
2. **Create an "IP Services Fabric" for 5G with software-defined networking (SDN) control**. Edge-cloud locations running 5G network functions and services will require high-performance, secure connectivity. Investment in wide-area SDN is already underway to create an "IP services fabric" that connects centralized data centers, distributed cloud locations and cell sites. This IP services fabric provides routing, security, service chaining, redundancy and orchestration. Again, this investment is, in many aspects, not unique to 5G, but common to high-performance networking at the cloud edge.
3. **Invest in cloud-based Evolved Packet Core (EPC) and NG Core.** With a distributed cloud infrastructure, it is logical to redesign core network functions to take advantage of this asset to meet the strict latency requirements of 5G services and efficiently manage data traffic. Some aspects of NG Core are already reasonably well understood, (for example, control- and user- plane separation or "CUPS"), while others remain works in progress (for example, mobility and session management). In general, expect control-plane separation to apply across the 5G architecture, from radio to core.
4. **Use network slicing for a service-optimized core.** Network slicing is an important bridge from a 4G core to a new 5G core and is a key component of a 5G-ready network investment strategy. In this model, virtual network functions (VNFs) are created per service and data is routed via an optimized processing path across the network. By isolating services into virtual network slices, operators can offer better security, more efficient transport, optimized core network processing and appropriate service quality. A network slice created for an Internet of Things (IoT) customer, for example, may support both 4G and 5G access networks.
5. **Automation and service orchestration.** Automating network operations provides the ability to launch new services rapidly, to reach new market segments, to evaluate success/failure quickly, and then to modify, scale and repeat. Significant progress is being made in applying service orchestration to 4G-Long Term Evolution (LTE) networks, especially where software-based core networks are deployed. Network slicing is a good example of the need for automation because there will be many more logical entities to commission, provision and manage. "Automated service orchestration" is a good, tangible example of 5G-ready functionality.

The 5G Core Network

The new 5G core network is now reasonably well understood: It will be "cloud-native," it will make extensive use of network slicing, and it will operate in concert with a new model-driven service orchestration layer. The industry can therefore start to develop NG Core products that can be adapted as standards emerge and solidify.

From a practical perspective, for the initial deployment, operators can support 5G radio access on a "5G-ready" EPC and then migrate to a new NG Core over time. In both cases, the "IP services fabric" provides SDN-controlled connectivity and related IP services, across a distributed cloud infrastructure.

Virtualized & Cloud-Native Mobile Core

Operators have made good progress on virtual EPC over the past couple of years. The largest networks now support more than 15 million subscribers (AT&T has discussed this publicly); some progressive operators have started to refresh their main EPC networks using multivendor network functions virtualization (NFV) (e.g., Docomo, Etisalat); and others (e.g., Vodafone) have deployed virtual core elements for IoT services.

Figure 3 shows two migration paths to a "cloud-native" 5G core. The blue line shows a virtualized 4G core as a stepping stone to a "5G-ready" core and then a full 5G core. The grey line shows a more conservative option where the operator scales the classic EPC in the near-term and then makes a bigger leap to 5G later.

Figure 3: A Preliminary Cloud-Based 5G Architecture

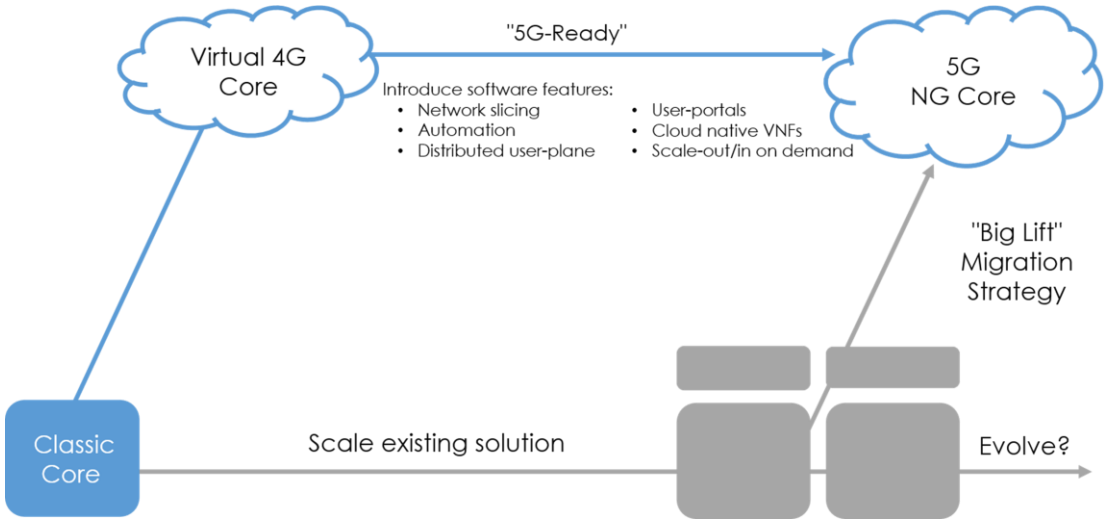

Source: Heavy Reading

There is debate about what exactly "cloud native" means, particularly in the context of stateful telecom network functions. Nevertheless, Heavy Reading's established view is that operators that deploy virtual EPC – even at small scale – gain experience in how these systems work, how to operate them, and how to evolve them, and that in turn will give them a sustainable advantage in the longer-term transition to software-centric 5G mobile networks.

Migrating 5G RAN From EPC to NG Core

A 5G-ready core strategy is determined, in part, by how the operator plans to introduce 5G radio. There are two basic possibilities: operate 5G RAN using an EPC or using a new NG Core. In practice, operators with plans to launch 5G early are likely to start with an EPC and migrate to NG Core over time, as shown in **Figure 4** below.

Figure 4: Migrating 5G RAN from EPC to NG Core

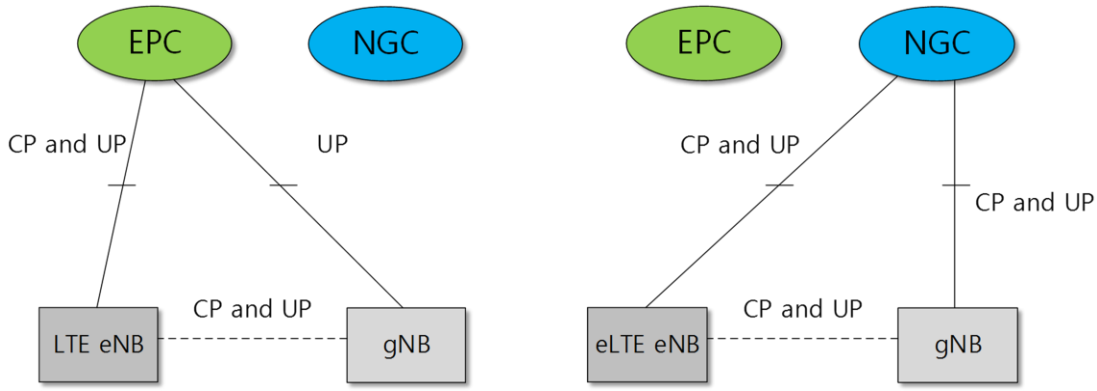

Source: 3GPP TR 38.801 v0.4.0

The diagram is taken from the most recent version of the 3GPP "Study on New Radio Access Technology" (TR 38.801), which will inform development of standards in Release 15. Several permutations of the architecture are under consideration; however, in simple terms, to the left, the new 5G base station (gNB) user-plane interface connects directly to a 4G EPC, while the control-plane functions, such as tracking, paging, etc., are provided by an evolved 4G base station (eNB), which in turn also connects to the EPC. In this scenario, the EPC requires little or no modification, making this a fast and simple way to deploy 5G radio from a core perspective.

Over time, both 4G and 5G base stations can migrate to a new NG Core, which will provide both control- and user-plane functions. At this stage, NG Core becomes the primary core network for 4G and 5G access, as shown to the right in the diagram. This is conceptually similar to how EPC supports 3G and 4G access networks.

Note that in cases where 5G radio is deployed for fixed wireless access, there is no need for an LTE RAN to provide control-plane functions to the 5G user device; a standard EPC is sufficient, although it would need to provide session management for the 5G access. Some of the first 5G deployments are expected to use this model.

Network Slicing: A Key Bridge to 5G

Network slicing is one of the key bridges between the 4G and 5G core. To support diverse service types, operators will use multiple core networks deployed as "network slices" on a common IP services infrastructure. The idea, shown in **Figure 5**, is to create virtual core network instances (or "slices") dedicated to different services. Each slice can be optimized for the traffic profile and the commercial context of the associated service – for example, IoT, public safety, mobile virtual network operator (MVNO), connected car, voice over WiFi or enterprise services. Network slices can be two dimensional in the sense that they can be both service- and customer-specific.

Figure 5: Dedicated Packet Core Network Slices

- Virtualization enables multi-tenant and single-tenant private core networks
- "Slices" configured according to service type & traffic profile
- Multiple options to steer user traffic into a core network processing path
- Mechanisms in 3G/4G include APN routing, MoCN, DECOR

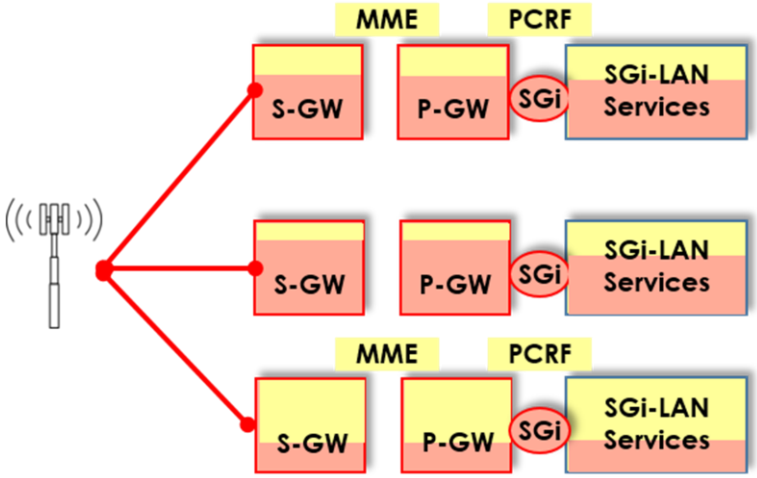

Source: Heavy Reading

IoT is an example of how operators can use "slicing" to support a 5G-ready core strategy. Since many of the core network design parameters are similar between 4G and 5G, investment in a software-based IoT core network can be made with the expectation that the same core (with software updates) will also support IoT services on 5G in future. Moreover, because devices from both access types will connect to a common IoT core, operators will be able to develop integrated 4G/5G IoT strategies that optimize investment and enable them to go to market with narrowband IoT services before 5G specifications are released and radio equipment is deployed.

5G will, naturally, bring more capabilities to network slicing. Most importantly, it is expected that the slice will run end to end across the RAN, core and transport network. Radio is typically deployed as a shared resource, which means that 5G slicing will involve advanced self-organizing network (SON) capabilities and hierarchical, slice-aware scheduling on the air interface. On the network side, the operator can use SDN to reserve resources for the network slice on the IP services fabric.

NG Core for 5G

A new core network offers important benefits, particularly for services with demanding performance requirements, and is an important part of the 5G architecture. The high-level view of the NG core network architecture, as it looks in September 2016, according to TR 23.799 (the Technical Report on the NextGen System Architecture) is shown in **Figure 6**.

The chart shows the primary elements of the new 5G system architecture, including the device (UE), the radio access network (NG-RAN) and the core network that comprises the control-plane (NG-CP) and user-plane (NG-UP) functions. The separation of control and user planes is a direct extension of the "CUPS" concept being developed for advanced EPCs in 4G networks and is another example of how operators can invest in 5G-ready core network designs in the near term.

Figure 6: High Level View of NG Core Architecture (Proposed)

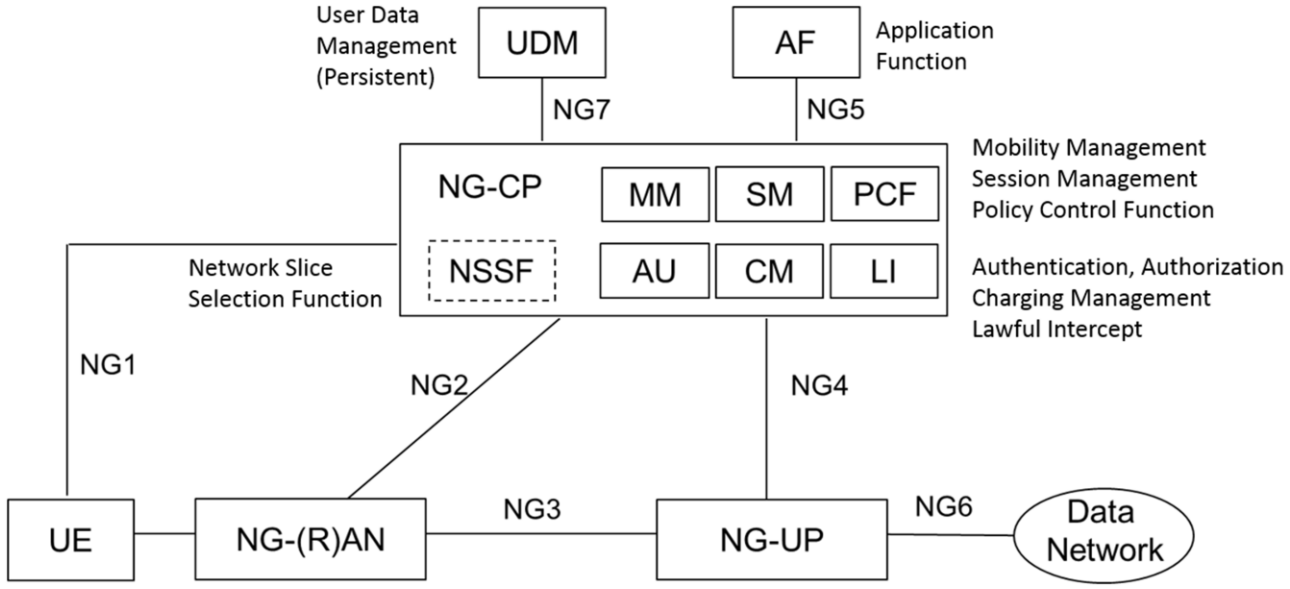

Source: 3GPP, Adapted from TR 23.799 v0.8.0, September 2016 (Figure 7.2.4-1)

It is interesting to compare this new functional architecture with the existing EPC. **Figure 7** maps the new NG Core elements to their equivalent in EPC. It shows significant overlap between the EPC and NG Core and provides confidence that today's state-of-the-art EPC is reasonably close to the next-generation core in terms of functionality, albeit that the interfaces and protocols will change/evolve.

Figure 7: Mapping NG Core & EPC Functions

NG Core Network Function	Approximate Equivalent EPC Function
UDM (User data management)	SPR
AF (Application function)	AF
NSSF (Network slice selection function)	MME (DECOR) + HSS
MM (Mobility management)	MME + SGW / MME + SGW-C
SM (Session management)	PGW/PGW-C
PCF (Policy control function)	PCRF
AU (Authentication & Authorization)	HSS/AAA
CM (Charging management)	PGW + PCRF, OCS, OFCS
LI (Lawful intercept)	LI
NG-UP (User-plane function)	SGW + PGW / SGW-U + PGW-U

Source: Heavy Reading, Affirmed, Juniper

Key Capabilities of the Next-Gen System Architecture

In addition to proposed architectures, the Technical Report provides guidance on the features and services NG Core should support. It identifies 19 key issues for the Next-Gen System Architecture, which can be grouped into four categories:

- **Flexible Deployment**: Including network slicing, user-plane network selection, network function granularity (e.g., decomposition of VNFs and service chains), interworking and migration, a policy and charging framework.
- **Flexible Access Support**: Including variable core/access splits, a flexible authentication framework (with varying credentials according to device-type, use case and policy), support for relays and multi-hopping, improved network discovery and selection mechanisms.
- **Connectivity**: Including session management, mobility management, a quality-of-service (QoS) framework and service and session continuity (e.g., across accesses).
- **Adapting Existing Capabilities**: Including network/service capability exposure, multicast and broadcast, IP Multimedia Subsystem (IMS) support, off-network communications (e.g., *ad hoc* networks for public safety).

Implementation of these capabilities is tightly linked to both the design of the NG Core and the underlying IP service infrastructure. The 3GPP specifications do not reference connectivity services, but, in practice, there is a close relationship.

A Distributed 5G Services Fabric

The infrastructure onto which 5G will be deployed should support multiple, demanding use cases. This drives a need for a high-performance wide-area IP services fabric controlled (or "orchestrated") by SDN. This IP services fabric should provide connectivity between many different distributed data centers in a meshed architecture that provides resiliency and scalability, and should be programmable such that it can support dynamic, service-specific network slices. In effect, the IP services fabric makes distributed centers act in a unified manner – i.e., behave as one integrated data center. The concept is shown in **Figure 8**.

The design of the distributed IP services fabric is formed by the variety of use cases, the requirement for low latency and high availability, and the need to scale efficiently. In tandem, the mobile network architecture will evolve to a more distributed model. To meet 5G service requirements, NG Core will be deployed using the "CUPS" model, with user-plane nodes hosted at distributed data center locations, and control-plane nodes at more centralized locations, interconnected by the IP services fabric.

Service orchestration will generally be domain specific, with SDN-controlled IP services, cloud resource management, NFV lifecycle management and end-user service orchestration, all operating quasi-independently in a layered architecture. Coordination between the layers will use "cross domain orchestration" to ensure a network slice contains all the networking components needed to deliver the service.

Depending on how the architecture evolves, there will be a need to support highly accurate, 1588v2-based timing (frequency and phase) within this IP services fabric. Virtual RAN/Cloud RAN is an example on the network side that benefits from accurate network timing. On the customer side, it is expected that some market segments, such as the financial industry, will also require timing to be incorporated into network slices.

Figure 8: IP Services Fabric for 5G Networks

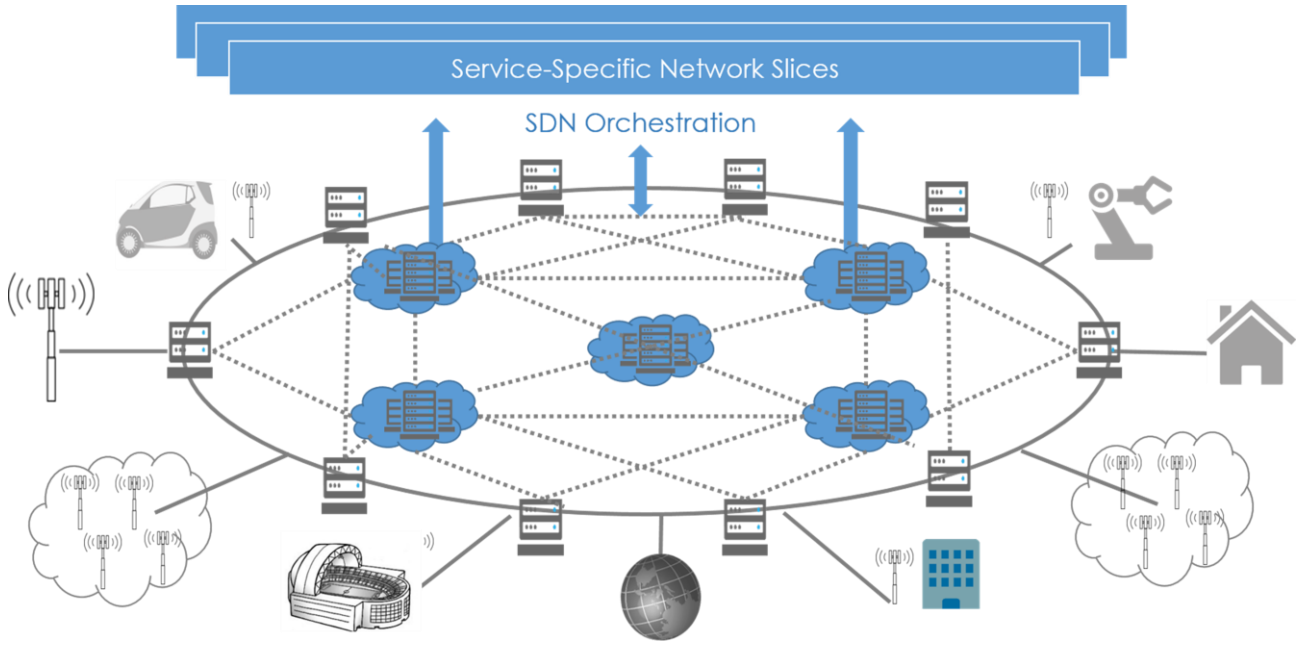

Source: Heavy Reading

Distributed Data Centers

To provide access network services, telecom operators have a physical footprint – in the form of central offices, base station controller sites and transport aggregation sites – that they can convert into distributed or micro data centers.

Depending on the service requirements, these data centers can be used to terminate access connections using virtualized edge functions and become the obvious place to host latency-sensitive content and applications. For centralized cloud providers, this capability is harder to replicate unless they build out an extensive physical footprint or partner with an access provider, and, therefore, this strategy provides operators with a potentially important and sustainable competitive advantage.

The "edge cloud" model will be critical to 5G and is the subject of detailed R&D across the industry. As an example, a preliminary architecture developed by the SuperFluidity project (a European 5G research project) is shown in **Figure 9**. Work on this particular project, which is academic in focus but contains several industrial partners, is scheduled to finish by the end of 2017.

As the name implies, the project aims to achieve superfluidity in the network: the ability to instantiate services on the fly, run them anywhere in the network (core, aggregation, edge) and shift them transparently to different locations. This is the essence of the "IP Services Fabric" for 5G. In this new network, operations will also need to move from a "red light, take action" model to an automated model where the orchestration and associated next-gen operations support system (OSS) detect and fix problems with the IP and NFV layers, and re-optimize the network accordingly.

Figure 9: A Preliminary Converged Cloud-Based 5G Architecture

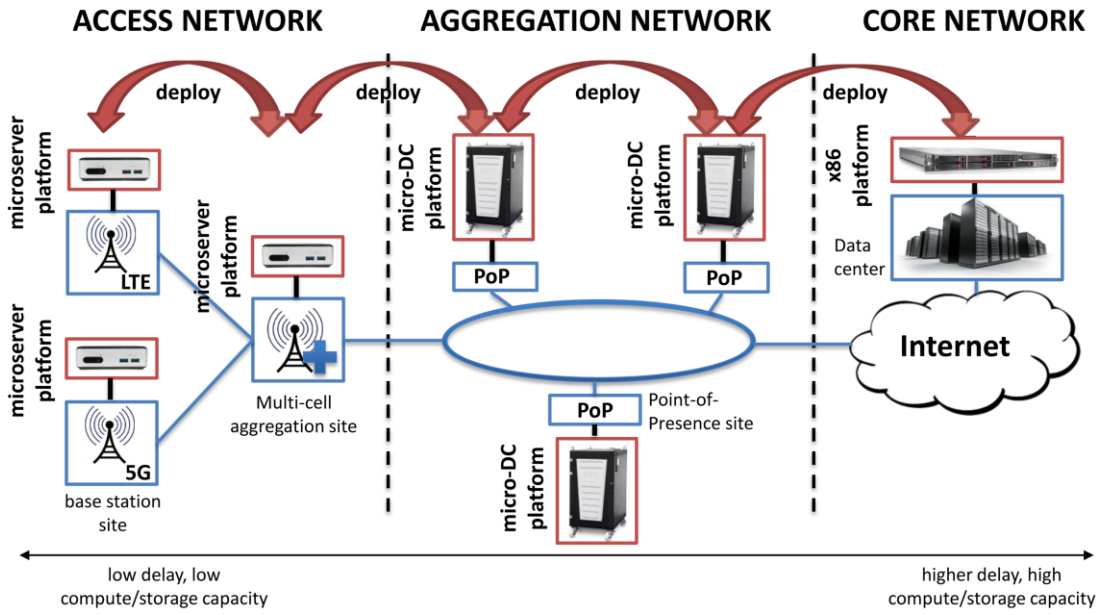

Source: SuperFluidity

Central Office Re-architected as a Data Center (CORD)

There are several industry and service provider initiatives to define the architecture for SDN-enabled distributed data centers. The Central Office Re-architected as a Data Center (CORD) initiative hosted by the Linux Foundation is one example of how operators aim to make better use of these assets.

According to the CORD initiative, AT&T alone operates 4,000 to 5,000 central offices, each serving 10,000 to 100,000 residential, enterprise and mobile customers. These central offices contain fragmented vendor hardware with multiple physical appliances installed per site (AT&T said it has 300+ unique appliances deployed in its central offices nationwide). The opportunity is to re-architect these central offices to support edge cloud infrastructure and deploy VNFs in place of appliances.

Each CORD location will be connected using an SD-WAN, making it possible to load-balance content and NFV workloads across the distributed cloud using the same SuperFluidity concepts discussed above. In the CORD case, the focus is on the ONOS controller, but in the sense that this is a generic architecture, multiple SDN controller options are viable and attractive. Note that for I/O-intensive workloads, the selection of an edge location should consider the physical transport resources available at the site. It would not make sense, for example, to deploy a 5G user-plane node for fixed wireless access in a central office that does not have a high bandwidth connection to the Internet.

In March 2016, the Linux Foundation announced the M-CORD initiative for mobile operators, backed by AT&T, SK Telecom, Verizon, China Unicom and NTT Communications. It highlighted three key aspects of the architecture, saying that it:

- Will use the same CORD principles of elastic commodity cloud and SDN to bring data center economies and cloud agility to the mobile edge.
- Will demonstrate integration of disaggregated/virtualized RAN, disaggregated/virtualized EPC and mobile edge services.
- Will partner with the SDN controller groups to accelerate adoption of open source SDN and NFV solutions and realize the benefits of the cloud.

Given the timing of the work, we expect M-CORD and similar initiatives to turn their focus toward "5G-ready" core networks as the architecture, interfaces and protocols for NG Core become more clear. A common CORD and M-CORD implementation, with the same architecture and foundational technologies, will create a good foundation for fixed-mobile network convergence, enabling access agnostic services – an important objective of many operators pursuing 5G.

Mapping Mobile Core to Distributed Cloud

The NG Core for 5G and EPC for advanced 4G networks must be mapped to the distributed cloud architecture. One approach would be to simply deploy more packet gateways (and mobility controllers) at the edge of the network to meet capacity and performance demands.

The challenge with this is that today's centralized packet core deployments are characterized by complex integration with surrounding network functions, such as policy, charging, IMS, SGi-LAN and routing services. By moving this model to the edge, the operator would, in effect, have to "distribute complexity," which is costly to deploy and, in particular, to manage. To meet 5G performance, scalability and automation requirements, a new architecture for packet core is needed that will make operation in the edge cloud infrastructure simpler and faster.

There are many aspects to this new architecture. Part of the solution is CUPS, as is currently being developed for 4G-LTE core networks. This involves extracting the control-plane functions from the gateway to leave a simpler, user-plane node. The gateway thus is "split" into S/PGW-U and S/PGW-C components that can that can scale independently, as shown in **Figure 6** above. A key benefit of the architecture is that the control plane, and all the associated complex interactions, can be centralized, while the user plane is distributed across the IP services fabric and scaled as required by the traffic load. This is shown in **Figure 10**.

Depending on the scaling needs, the S/PGW-U functions deployed at the edge data center can be implemented in several different ways: on a router, on a white box switch (potentially), on an existing PGW platform, as a virtualized function, or as part of a vRouter. Virtualized user-plane nodes can more easily be placed at the optimal location, as determined by the use case and this flexibility is a strong argument to deploy S/PGW-U nodes as VNFs rather than as hardware functions.

The S/PGW-C components would similarly be deployed as virtualized functions on a cloud platform, typically at a more centralized location. There may be an opportunity to collapse MME, SGW-C, PGW-C functions and perhaps other 3GPP control-plane functions into some form of unified "mobility controller" node. This has the potential to simplify operations and this same model is being pursued for NG Core.

In this architecture, virtualized SGi service LAN components can be placed where appropriate for the traffic coming from the distributed user-plane nodes. For example, some SGi functions could be on router-based compute blades, or on COTS x86

servers deployed at the distributed site, while others could be in the central data center or close to Internet peering points. The selection of the site for the SGi functions is carried out by the central orchestration system, which steers traffic into service chains on a per subscriber, application, bearer, device or combination basis.

Figure 10: Distributed User-Plane at Edge Data Centers

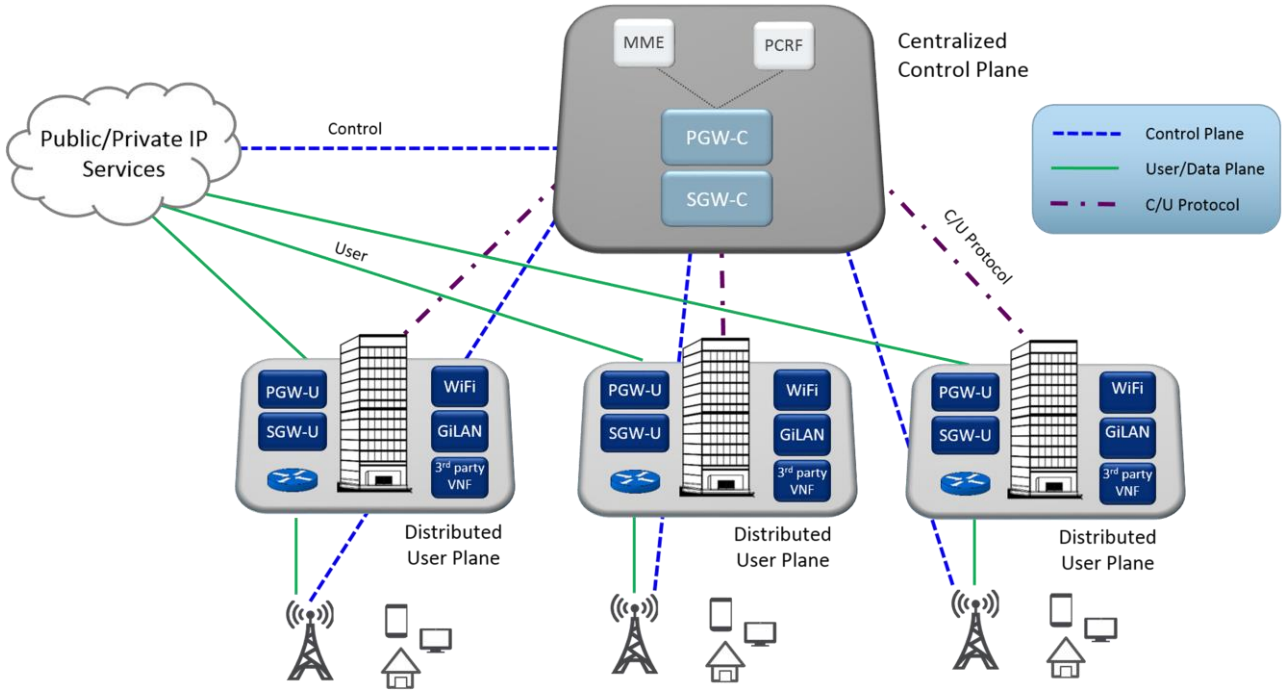

Source: Affirmed Networks

This model of discrete control- and user-plane functions is expected to be fundamental to 5G and the NG Core. In this sense, CUPS can be viewed as an important part of a 5G-ready investment strategy.

A 5G-Ready Core Is Now a Priority

The industry now has a reasonable view of 5G service requirements, and progressive operators with aggressive deployment timelines are now working to prepare their networks for rapid deployment of 5G when equipment is available. This is driving investment in the critical IP services network needed to connect the edge cloud locations that will run 5G network functions, content and services.

On the mobile core side, development of cloud-native, service-orientated core networks for advanced 4G and 5G networks is underway. Network slicing provides a conceptual bridge between 4G and 5G investment and facilitates a faster insertion of new services into the network. Similarly, CUPS provides a reference for NG Core and the new 5G network architecture. With a 5G-ready technology strategy, operators can prepare for 5G service launch in a way that optimizes their investment in next-generation IP and mobile core platforms over the next three years.

About Affirmed Networks

Affirmed Networks' NFV solution has become the standard for the world's top mobile operators, who are embracing new business models and building new revenue streams by making the transition to virtualized architectures. The company's technology portfolio includes the Affirmed Mobile Content Cloud, the Affirmed Wi-Fi Gateway (serving as a TWAG/TWAP and an ePDG), Affirmed Service Automation Platform (ASAP) and Affirmed Virtual Probe and Analytics Solution. These virtualized solutions have come to represent the present and the future of virtualized mobile networks with extreme scalability, remarkable flexibility, comprehensive network orchestration and future-proof solutions for a 5G-ready architecture. Please find more information at www.affirmednetworks.com.

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Energy harvesting power for the Internet of Things

Energy harvesting wireless technology easily interconnects thousands of individual devices in a system, opening up unlimited processing and monitoring applications.

Laurent Giai-Miniet, EnOcean, Oberhaching (Munich), Germany
09/30/2013

Share

Energy is everywhere within reach; it just needs to be harvested. This is the principle of energy harvesting. Today, energy harvesting wireless solutions are already well established in the commercial building automation sector. But the technology is just getting started. New application fields for batteryless, wireless communication will be found to further enhance the world around us.

Based on energy harvesting wireless technology, a wide range of energy-autonomous applications are currently available for connected buildings that use motion, light, or temperature differences as their energy source such as batteryless switches; intelligent window handles; temperature, moisture, and light sensors; presence detectors, heating valves; and smart home systems. However, building automation is by no means where energy harvesting wireless ends.

Multiple interconnections

Everybody's talking about the Internet of Things (IoT). But how should billions of communicating devices be powered? The answer is by energy harvesting, and the reason is simple: Liberating sensors from external power, making them energy-autonomous, opens up unlimited processing and monitoring applications where cables or batteries represent an insurmountable hurdle. These features make energy harvesting wireless technology the ideal communication standard to easily and reliably interconnect thousands of individual devices in a system, as well as network them with other wireless protocols.

Today, energy harvesting wireless technology is widespread, providing M2M solutions in the building automation sector and bridging the control of light, HVAC, and other fields of building technology to smart buildings, smart metering, and energy management systems. This is the starting point to actuate further applications that lead to the IoT in the long term. The following four categories show what this could look like.

Monitoring and control

Wireless and batteryless technology significantly eases energy monitoring and control in buildings with little intervention into the existing systems. The wireless devices are highly flexible to install so that individual components, wall switches, sensors, and relay receivers can be easily networked to form an intelligent system without complex cabling. In addition, dispensing with batteries eliminates the burden of maintaining the devices' energy supply in a regular time period, which can be up to each year.

An example for such a flexible automation system is HVAC control. Here, a thermostat, VAV (variable air volume), or fan coil controller receives information related to occupancy, temperature, humidity, window position, or CO_2 from the respective batteryless sensors and controls the opening and closing of valve actuators for radiators, or dampers for VAV systems. At the same time, the controller sends status information to a central building automation system, and receives control messages from the BAS. This enables the building to be monitored from a central location that can be remote from the building itself, and building-wide settings, such as holiday shutdown, to be implemented. Enormous progress is also being made on the product side, leveraging advancements in energy harvesting. Self-powered radiator valves generate energy from the difference in temperature between the hot water and the surrounding air. This energy powers the communication with a controller or BAS system, and turns the valve itself. Without cables or batteries, these wireless devices are especially easy to install, and they require no maintenance.

In further optimized systems, central equipment such as boilers or air handling units are integrated into the wireless communication system, enabling scalable HVAC generation, visible and controllable over the Internet on a PC, tablet, or

smartphone.

Performing tasks

Alarm systems are a second field that batteryless wireless technology is opening up, due to its specific features. Here, the reliability requirements are much more stringent than those required for lighting controls. A system failure not only means a malfunction but also can cause much more serious consequences for other systems that depend upon the equipment being monitored. It's a fact that more malfunctions are caused by battery failures than by the electronics, especially in large systems. Energy harvesting overcomes this issue.

There are already various batteryless wireless water detectors available that use miniaturized solar cells or motion energy converters to power wireless signals that report water leaks in areas such as water supply networks in spacious industrial facilities. In the AFRISO universal module, for example, the EnOcean wireless signal immediately sends the leakage information to a gateway controller or directly to a valve, causing the main water pipeline or the affected supply line to be shut off. A notification is sent to the user's smartphone or smartpad at the same time to inform the user about the incident. In addition, the water valve can be opened and closed, independent of leakage notifications, by GSM connection via smartphone or smartpad.

Embedded processing

A major requirement of today's and the future energy supply is the Smart Grid. It's intended to network centralized and decentralized energy suppliers, including private homes producing electricity by photovoltaic installations, to an intelligent system that provides energy only when needed, updating in real time. This requires continuous data flow and processing from all involved parties, which means from millions of information points.

A key component is smart metering systems. To work reliably and cost-efficiently, interoperability between the meters is supplied by different manufacturers; this is why smart metering calls for standardized technologies. Consequently, the members of the EnOcean Alliance have defined a specific device communication protocol, the Automated Meter Reading (AMR) profile for batteryless wireless devices. Smart meter systems based on this open protocol are already available from a number of manufacturers. For example, Eltako meter components read and transmit the current electricity, water, and gas consumption, including accumulated meter figures, by means of energy harvesting wireless technology located at a variety of points inside a building. BSC software monitors and displays the current meter readings and compares them against default values. This makes all relevant data available for systems processing for intelligent energy management on demand.

Bridge to the cloud

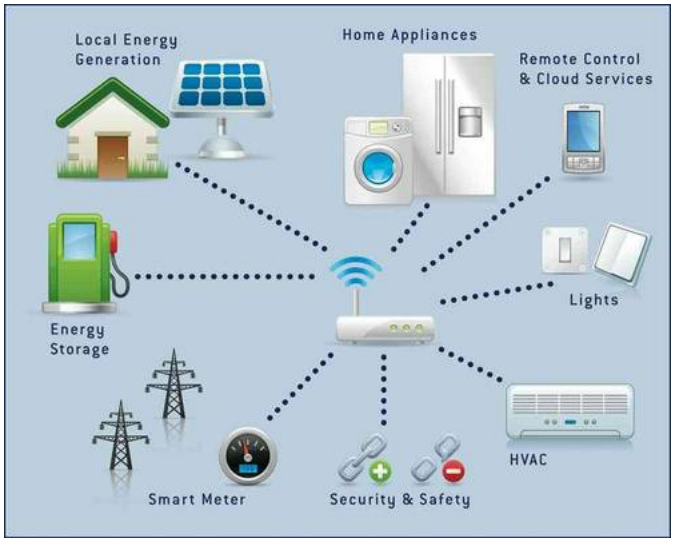

Via similar gateways, the standard-based energy harvesting technology can also communicate with Ethernet, Wi-Fi, GSM/UMTS/CDMA, and other networks for integration in cloud services. Here, all data collected by batteryless wireless sensors is encrypted and transmitted to a cloud service over the Internet. The gateways connected to a control and visualization software by TCP/IP that can be used to control all relay receivers and sensors bidirectionally. Some manufacturers have developed a cloud solution that offers energy management as a service. Therefore, facility managers, building owners, and businesses can monitor important inventory, equipment, assets, and energy-related information from anywhere at any time, via the cloud. Critical building-related data is automatically pushed to the cloud, freeing owners and managers from the often-challenging coordination and expense of hosting on-site servers.

One of the major advantages of such a cloud-based solution is that the management system arrives completely precommissioned from the manufacturer and ongoing device commissioning is expertly done on behalf of the client and pushed out from the cloud. The users are granted unlimited access to their remote, dedicated virtual server with their own IP address, accessible from a desktop or smartphone — the perfect precondition for a deeply connected world of an IoT.

The energy harvesting market is growing and multiplies on a year-by-year basis. Forecasts show that this trend will continue, especially as the next generation of energy harvesting wireless solutions is just around the corner to pave the way to the Internet of Things.

Laurent Giai-Miniet is CEO of energy harvesting wireless solutions provider EnOcean and previously spent 20 years with Texas Instruments (TI), where he held several management positions including General Manager for Low Power RF Products (LPRF).

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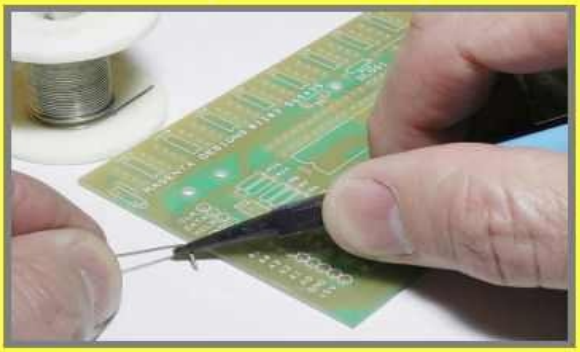

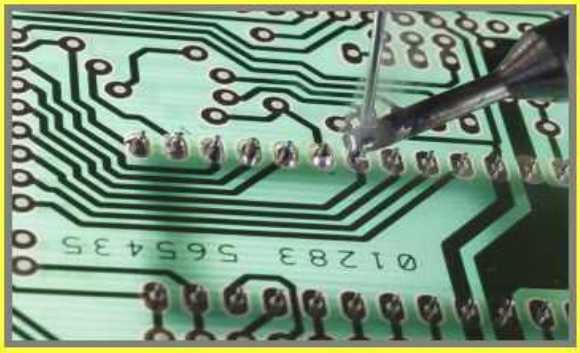

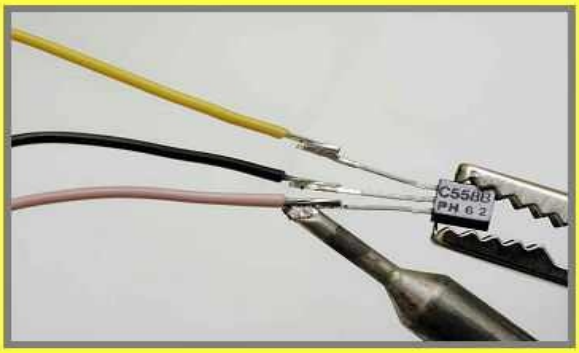

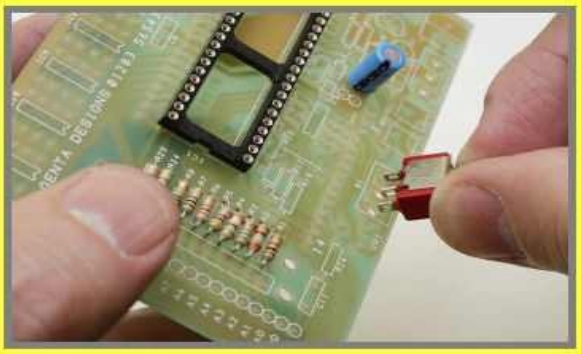

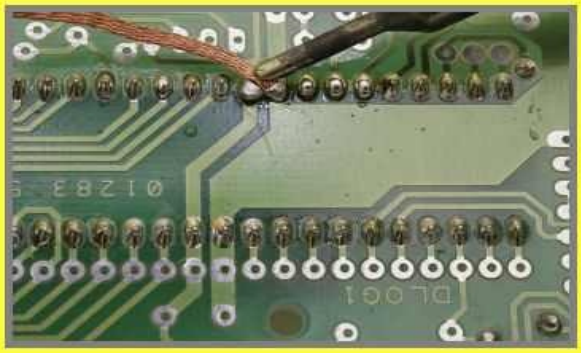

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The Basic Soldering Guide

by Alan Winstanley
***EPE Magazine* Online Editor**

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Preface

In 1996 when the world wide web was still very young, I launched the first and most detailed website ever describing the practical skills of electronic soldering, and my **Basic Soldering Guide** quickly became the #1 web site of its kind in the Google search engine.

Thanks to its in-depth reference text and the unequalled high-quality close-up photography showing soldering step by step, many quickly learned the essential stages needed to make a solder joint successfully. Even novices who had never tried soldering before, gained the skills and confidence needed to acquire this skill.

My Basic Soldering Guide became a key *go-to* online guide for soldering, and I've enjoyed receiving encouraging feedback ever since from the likes of the US Air Force, US Marines, US Coastguard, Honeywell trainers, Atomic Energy authorities, Australian aeronautical suppliers, UK colleges and universities, trainees and many more around the world.

In association with Antex (Electronics) Ltd., the leading UK manufacturer of electronic soldering equipment, I'm delighted to bring you this updated Basic Soldering Guide containing over 80 all-new colour photographs, more background, more detailed information and lots more practical hints and tips.

I've revisited various areas of the guide and refreshed them, taking onboard readers' queries and nearly 17 years of online feedback, experiences and answering reader's questions. With the help of all-new photography, I'm sure you'll master the skills needed to solder electronics successfully using this updated guide.

I welcome feedback and comments, and readers can reach me via my website **www.alanwinstanley.com** or Email me at **alan@epemag.demon.co.uk**

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Introduction

The first and most important aspect of assembling any electronic project is that of *soldering,* which is a delicate and precise skill that can be mastered with experience. Sometimes called “soft soldering”, there’s no shortcut to acquiring the necessary expertise, and producing a consistently satisfactory solder joint takes a little practice. However, like riding a bicycle, soldering is an art which once learnt is never forgotten, and the purpose of this new and updated guide is to explain the techniques of soldering and desoldering for beginners, which I hope will set the hobbyist or trainee technician firmly on the road to successful electronic assembly or repairs in the future.

Soldering is the least “aggressive” way of joining non-ferrous metals together, and is used universally in electronics, air conditioning and refrigeration circuits, household plumbing and more besides – applications where the precise joining together of components at fairly moderate temperatures is needed. Further up the scale, **brazing** involves using higher temperatures to melt brazing rods onto larger metal parts, perhaps to repair a metal chair, lawnmower or to fabricate metal components or jewellery into intricate shapes. Lastly, **welding** is a very aggressive way of fabrication using welding rods or wire; steel girders, oil rigs and ships are all welded together, or robotic spot-welding is used for the mass production of, say, washing machines or car bodyshells using sheet steel to make strong rigid assemblies.

Due to the lower temperatures used and the need to make consistently good electrically conductive and mechanically sound joints with precision, soldering is used to connect components together when manufacturing electronic circuits. Small components would quickly be destroyed by brazing or welding, although tiny spot-welding joints do appear in electronics, perhaps to weld a metal tag onto a button battery.

This guide therefore deals with the soldering techniques used in electronics at hobbyist or trainee educational level. It explains what to look for before buying a soldering iron, describes ways of making various solder joints on circuit boards and other electronic components, and also how to *desolder* – removing solder in order to repair a circuit board or replace an electronic component.

You’ll also find more details of other aspects of soldering, including an outline of typical solder types and fluxes. In short, everything you need to get started in electronics soldering is here, so let’s get started!

First steps

The principle behind soldering sounds quite simple: the idea is to join components together to form an electrical connection, by using a mixture of lead and tin solder or alternatively “lead-free” solder (an alloy of tin and copper), which is melted onto the joint using a *soldering iron*. If you have never picked up a soldering iron before, then this guide will show you everything to help you start soldering with confidence. I also hope that the guidance will help those working in other areas — computer technicians or audio enthusiasts, for example, who may be faced with electronic repairs or modifications using a soldering iron for the first time.

If you’re an electronics hobbyist or trainee, before embarking on any form of ambitious electronic project, it is recommended that you practice your soldering technique on some *brand new* components using *clean* strip board (or protoboard) or a printed circuit board, and select a simple and straightforward constructional design as a starting point. Become acquainted and comfortable with your chosen soldering iron, which likely to become as familiar to you as a favourite pen. Learn how to balance it and handle it with precision. Try soldering an assortment of resistors, capacitors, diodes, transistors and integrated circuits with it, and then try your hand at *desoldering* – removing the solder again to make a repair or modification.

A really good place to start learning is by building a simple electronics kit, such as a Velleman kit that contains a good quality printed circuit board. You’ll learn some of the basic skills of successful soldering this way, and it’ll be a great confidence booster too.

Did you know? In the USA and elsewhere, the letter L in “solder” is silent and they say “soda” or “sodder” – but here in Britain we do pronounce the L and we say “sole-der”.

Soldering iron choices

Search any electronics catalogue or website and you'll see a bewildering array of soldering equipment on sale, including irons, controllers, work stations and desoldering equipment too. A large range of soldering irons is readily obtainable - which one is suitable for you depends on your budget and how serious your interest in electronics is, but there's something for every pocket distributed by a variety of retail, industrial and mail-order outlets.

The Antex range of soldering equipment has been very popular with industry, education and the electronics hobbyist for 60 years; I grew up with an Antex iron and a trusty 15W Antex iron was an everyday part of my hobby electronics all the way through the 1980's. An industrial user or a more dedicated hobbyist – with a bigger budget! – will be interested in a soldering station instead and again Antex offers a range of British-made products for industry or home use.

A very basic mains electric soldering iron can cost from under £5 (US$ 8), but I find that these very cheap irons, as sold on auction websites, are pretty crude and imprecise. They are best suited for simple electrical repairs and DIY rather than precision electronics or printed circuit boards discussed here. They tend to be bulky and uncomfortable for extended use, and they may not have suitable "bits" or tips of various sizes to suit different tasks.

^^ *This classic Antex XS25 "pencil style" 25W mains-powered soldering iron has exchangeable tips or "bits" and is great for general hobbyist or educational use. Stands are also available to store them safely in between use.*

A quality pencil-style electric soldering iron such as the Antex XS25 (photo) will be approximately £20 (US$18 tax free) - though it's possible to spend into three figures on a

soldering iron “station” if you’re really serious about the subject! Don’t be tempted to over-spend on an elaborate workstation though, unless you are really very serious about becoming involved in electronics. You will usually obtain perfectly satisfactory results using a fairly modest “pencil” iron model, and you can upgrade to something more sophisticated should your needs change in the future.

^^ For enthusiasts or industry, this Antex 660TC soldering station has a separate mains-powered control unit and a matching low-voltage soldering iron rated at 24 Volts, 50 Watts so it’s suited to a wider range of tasks than a lower powered one.

When choosing your soldering iron, certain factors to bear in mind include:

Voltage: for the British market, “mains” electric irons run directly from the mains at 230V a.c. or will be set for other voltages (110V a.c.) depending on the country. However, **low voltage types** (e.g. 12V or 24V) usually form part of a “soldering station” for use with a matching controller made by the same manufacturer. Some low-voltage irons run off batteries (e.g. a car battery or Ni-cads) but these are uncommon.

Wattage: this is an extremely important factor to think about when choosing your iron. Typically, irons for general electronics work may have a power rating of between 15-25 watts or so, which is fine for most electronic assembly tasks, printed circuit boards and inter-wiring. It’s important to note that a higher wattage does *not* mean that the iron runs hotter - it simply means that there is more power “in reserve” for coping with larger joints. The maximum electric iron wattage generally available is about 100W, which is OK for DIY electrical repairs but is far too high for general electronics or circuit board use.

A higher wattage iron offers you more flexibility for tackling a wider range of tasks. It has a better “recovery rate” which makes it more “unstoppable” when it comes to

heavier-duty work, because it won't be drained of its heat so quickly. So check the power ratings carefully, and anything between 15–40W is fine for general electronics soldering.

Temperature Control - the simplest and cheapest types don't have any form of temperature "regulation". Simply plug them into the mains and switch them on! Thermal regulation is "designed in" (by physics, not electronics!). Sometimes they are described as "thermally balanced" as they have some degree of temperature "matching" – in other words, they warm up as quickly as they lose heat during use, so in a primitive way they maintain roughly a constant temperature. This type of iron is perfectly acceptable for hobby or less demanding professional use. It's essential to use the manufacturer's specified tips (see later) to maintain proper temperature matching, otherwise the iron may not heat up enough – or it may overshoot in temperature.

These unregulated irons form an ideal general-purpose iron for most users, and they cope reasonably well with printed circuit board soldering and general interwiring. However, most of these "miniature" types of iron will be of little use when attempting to solder large joints (e.g. very large terminals or very thick copper wires) because the components being soldered will draw or "sink" heat away from the tip of the iron, cooling it down too much and preventing solder from flowing properly. That's when a higher wattage iron is needed.

A proper **temperature-controlled iron** will be quite a lot more expensive - retailing at say £40 (US$ 60) or more - and will have some form of built-in thermostatic control, to ensure that the temperature of the "bit" (the tip of the iron) is maintained at a fixed level within reasonable limits. This is desirable during frequent use, since it helps to ensure that the temperature will be relatively stable regardless of the workload. Some irons have a bimetallic strip thermostat built into the handle which gives an audible "click" in use, and some may include an adjustable screwdriver control within the handle as well. Others may have electronic controls built in.

^^ *An Antex 660TC soldering station with matching iron and bench stand.*

More expensive still, **soldering stations** cost from £70 (US$ 115) upwards (the iron may be sold separately, so you can pick the type you prefer), and consist of a complete bench-top control unit into which a special *low-voltage* soldering iron is plugged. Some versions might have a built-in digital temperature readout, and a control knob to vary the setting. The temperature could be boosted for soldering larger joints, for example, or for using higher melting-point solders (e.g. lead-free or silver solder). These are designed for the discerning user, or for continuous production line or professional use. A thermocouple will be built into the tip or shaft, which monitors temperature.

The best soldering stations have irons which are well balanced, with comfort-grip handles which remain cool all day, and silicone-based cables which are burn proof. Antex produces a range of irons with silicone cables specially for education use, to help avoid accidents caused by careless use by students.

Anti-static protection: if you need to solder a lot of static-sensitive parts (e.g. CMOS chips or MOSFET transistors), more advanced and expensive soldering iron stations use static-dissipative materials in their construction to avoid static charges accumulating on the iron itself, which could otherwise damage or “zap” some semiconductors. Such irons are listed as “ESD safe” (electro-static discharge proof). The cheapest irons are not classed as ESD-safe but they still perform well enough in most hobby or educational applications provided you take the usual anti-static precautions when handling these components. The iron would need to be well earthed (grounded) in these circumstances, to carry away any static.

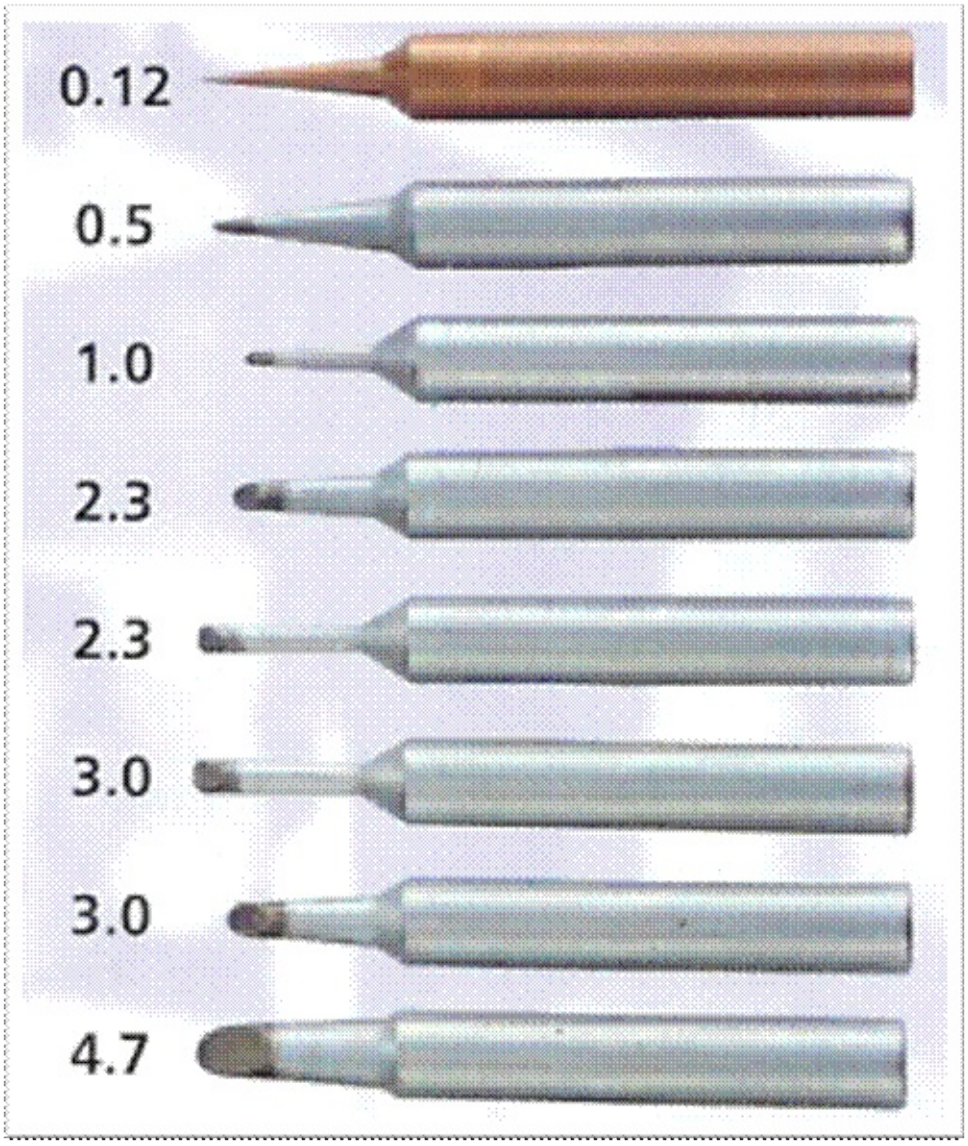

^^ *Just part of the range of spare tips or "bits" produced by Antex for their soldering irons. Use only tips intended for a particular iron, to avoid thermal matching problems.*

Tips or Bits: it's often useful to have a small selection of manufacturer's bits (soldering iron tips) available with different diameters or shapes, which can be changed depending on the type of work in hand. You will probably find that you become accustomed to, and work best with, one particular shape of tip for the majority of your work. Usually, tips are iron-coated or plated to preserve their life and to maintain good tip "hygiene". Be sure only to use tips that are specifically designed for your iron, otherwise thermal problems may arise. I show separately some typical tips, courtesy of Antex.

^^ Useful accessories from Antex including solder, tips and tip cleaner, desoldering braid and a heatshunt.

Spare parts: it's always reassuring to know that spares are available in the future if required, so if the element blows, you don't need to replace the entire iron. This is especially the case with expensive irons. Check some websites or mail-order catalogues to see whether spare parts are listed. One drawback is that you may need another soldering iron when exchanging a broken heating element!

^^ Gascat 40 gas-powered soldering iron kit by Antex, with spare tips and cleaning sponge.

Gas or electric? So far I've discussed electric soldering irons, but **gas-powered** soldering irons are sold which use butane propellant rather than mains electricity to operate. They have a flint lighter or (better still) a built-in piezo for ignition, and have a catalytic element which, once warmed up, continues to glow hot when gas passes over them. They tend to be big and bulky compared to electric pencil irons.

Field service engineers use gas-powered irons for working on repairs where there may be no power available, or where a joint is tricky to reach with a normal electric iron, so they are really for occasional “on the spot” use, rather than for mainstream construction or assembly work. I use one when I just need to do a quick repair and can’t be bothered getting the electric soldering iron going!

Gas irons can have higher power equivalents than electric ones (eg 125 watts or more) but some gas-powered irons are nothing more than miniaturised blowtorches, which may or may not be useful for occasional heavier duty soldering. In the author’s experience they can be difficult to use in confined areas. *Extreme care is needed at all times to ensure hot gas emitted from the iron’s exhaust port doesn’t damage nearby materials, plastics or wiring.* Gas irons can have useful accessories to convert them into e.g. a hot knife for sealing nylon rope, or a hot-air blower for use with heatshrink tubing. Almost every electronics constructor uses an electric-powered iron though.

A **solder gun** is a pistol-shaped iron, typically running at 100W or more, and is completely unsuitable for soldering modern electronic components: they’re too hot, heavy and unwieldy for micro-electronics use, nor are they designed for that. Plumbing or DIY, maybe..!

^^ *A heat resistant soldering iron stand with cleaning sponge. (Antex)*

Soldering irons are best used along with a **heat-resistant bench stand**, where the hot iron can be safely stored in between use (photo). It is extremely important that a hot

soldering iron is safely “parked” ready for action, and a bench stand is really a necessity. Soldering stations usually have such a feature, otherwise a separate soldering iron stand is essential, ideally one that’s supplied with a tip-cleaning sponge. You can make your own cleaning sponges using *cellulose* sponge only.

^^ *A benchtop fume extractor fan for hobbyist use. A replaceable carbon filter helps remove particles and air is vented out the back.*

Other equipment worth considering includes the use of **fume extractors**, which are compulsory in the industrial workplace. Solder fumes and flux smoke are not known to be toxic but they can cause irritation. A basic fume extractor (photo) consists of a small bench-top fan which draw fumes and irritating smoke away from the operator’s face and filters out some of the smoke particles, before exhausting the air back out through the fan. The carbon-impregnated foam filters are replaceable. Such devices are quite effective and users soon find them indispensable, even though they can be a bit noisy at close range.

Professional fume extraction systems draw the smoke and fumes directly from the work area via a clip-on tube fitted to the soldering iron, then vent the fumes away through a large filter pump. It is definitely worth considering a small bench top unit for regular hobby or occasional professional use, as having decent ventilation can only be a good thing.

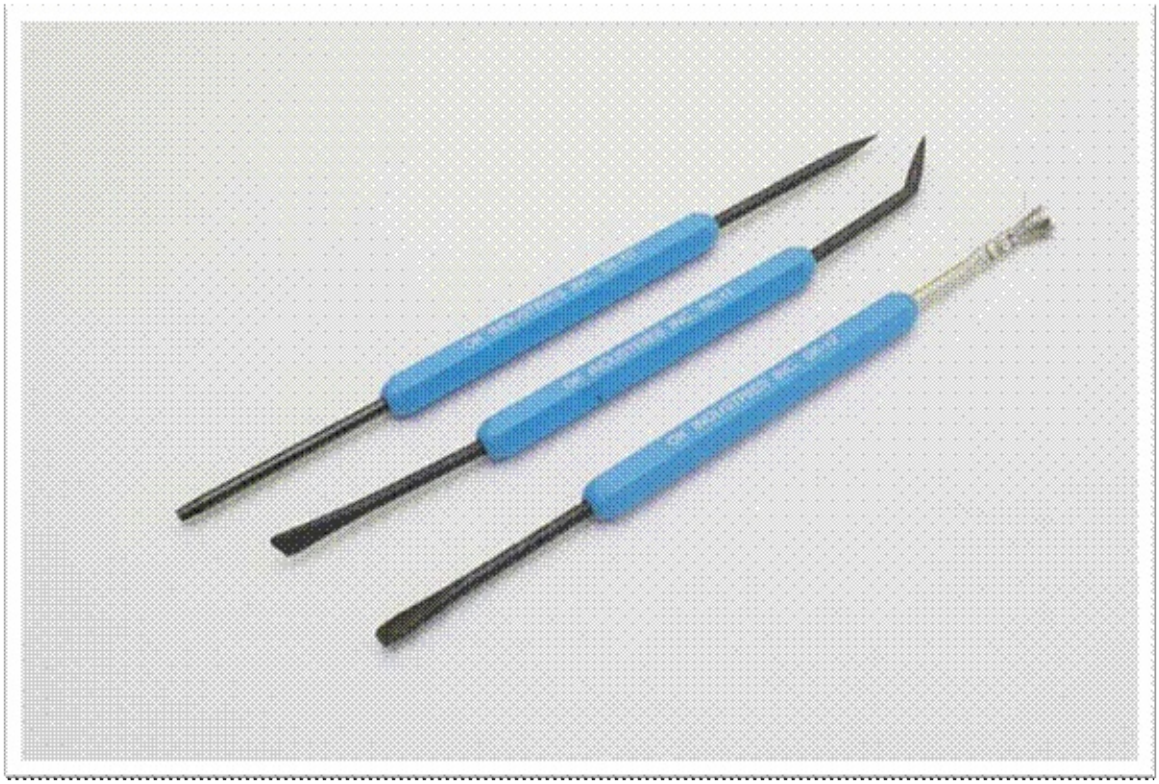

^^ *A soldering accessory toolkit by OK Industries, including probes, scrapers and wire brush*

A variety of specialist **hand tools** are available that assist with soldering, and a good supplier's catalogue will offer a range of small brushes, scrapers and cleaning tools in a handy kit, together with the usual types of wire cutters, pliers and so forth, which are necessary for handling components and tidying up as required. Some specialist service aids (aerosols etc.) are also described later.

Now let's look at how to use soldering irons properly, and later on we will describe the techniques for putting things right when a joint somehow goes wrong — and don't worry, even the experts get it wrong sometimes!

How to solder

This guide will show you step by step how to solder successfully and plenty of photographs are provided to help explain the techniques needed.As you read through the guide I'll explain all the stages in more detail, but let's look at the basics first.

First of all, successful soldering requires that the items being soldered together are held with as little movement as possible. So it's best to *secure the work* as needed, so that your accuracy isn't affected should the workpiece move accidentally.

In the case of a printed circuit board, various holding frames are useful especially when densely populated boards are being soldered: the idea is to insert all the parts on one side (a process called "stuffing the board"), hold them in place with a suitable pad to prevent them falling out again, turn the board over and then snip off the wires with cutters before soldering the joints. The frame saves an awful lot of turning the board over and back again, especially with large boards: all the soldering can be performed in one pass.

^^ The ever-popular "Helping Hands" (left) helps support sundry parts, wires etc. during soldering.
A modeller's vice (right) holds parts firmly. A vacuum base fixes it onto smooth surfaces.

Only the more serious constructor will purchase a holding frame, and hobbyists can retain parts in place by improvising in a variety of ways – the ever popular "Helping Hands" stands cost a few pounds and is widely sold. They have adjustable crocodile clips to grip parts, and maybe a magnifying glass or soldering iron stand as well. The cast iron base provides stability. Other parts could be held firm in a modeller's small vice, for example.

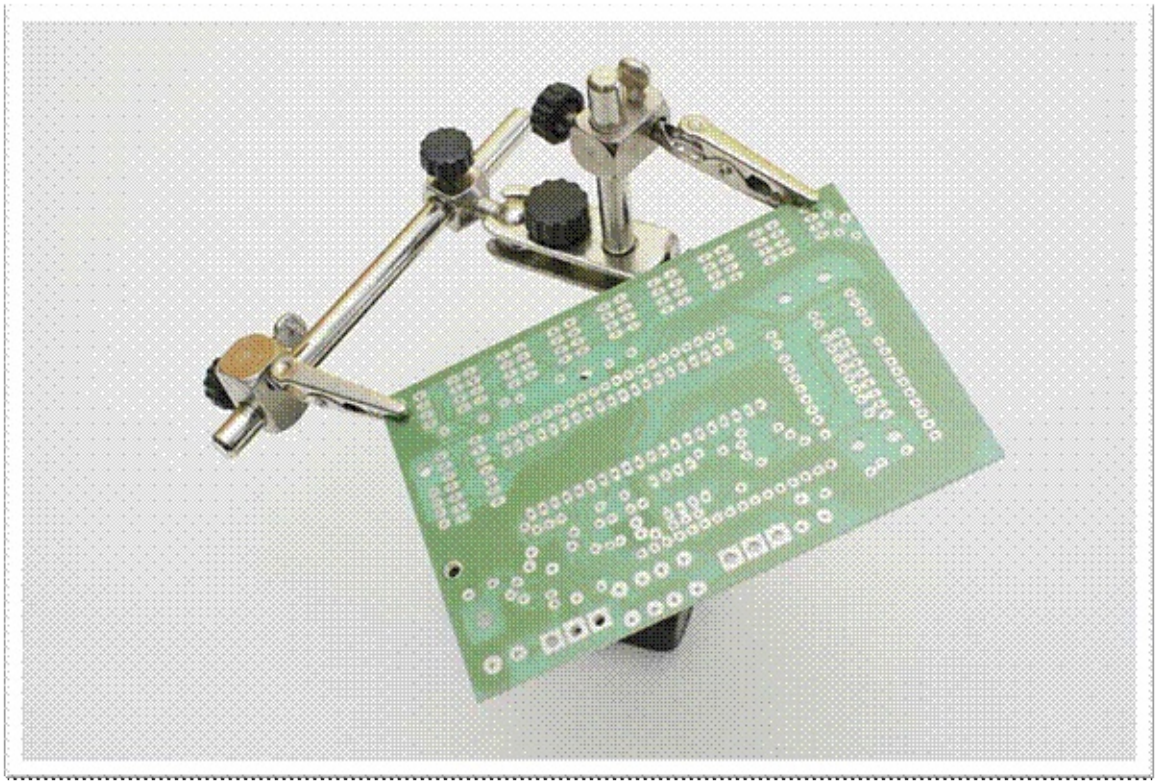

^^ *"Helping Hands" uses crocodile clips to grip parts during soldering. Or just place parts flat on the bench.*

When soldering parts onto an ordinary circuit board, components' wires can simply be bent to the correct pitch (distance apart) to fit through the board, insert the part flush down against the board's surface, splay the wires a little so that the component grips the board under spring tension, and then solder it. This technique is universally used in manual **through-hole soldering,** which is explained in full later.

In the author's view - opinions vary – it's generally better to snip off the surplus wires leads first, to make the joint and neighbouring joints more accessible and also to reduce the mechanical shock transmitted to the p.c.b. copper foil. However, in the case of diodes and transistors the author tends to leave the snipping until after the joint has been made, since the excess wire will help to "sink" heat away from the heat-sensitive semiconductor junction.

A special clip-on heatsink is available which also helps stop excess heat from reaching temperature-sensitive semiconductors like these. I've always managed without one but beginners might find them reassuring. Integrated circuits can either be soldered directly into place if you are confident enough, or better, use a dual-in-line socket to prevent heat damage. The chip can then be swapped out at a later date if needed.

Parts which become hot in operation (e.g. some power resistors), should be raised above the board slightly to allow air to circulate. Some components, especially large electrolytic capacitors, may require a mounting clip to be screwed down to the board first, otherwise the part may eventually break off due to vibration. It's a good idea to bolt such components firmly into place before soldering their terminals, in order not to strain the soldered joints or the components when fasteners are tightened.

By securing the workpiece as much as possible to prevent movement, you have a

much higher chance of producing good-quality reliable solder joints.

Next steps

Let's get to grips with actual soldering techniques in more detail. The soldering of electronics components utilises **lead/ tin** or **lead-free solder** and the process is compatible with many non-ferrous metals. You can solder copper, lead, brass, gold plate, silver, nickel, tin and tin plate, zinc and more besides but some metals such as nichrome, galvanised or stainless steel require a highly specialist "flux" (see later) to solder them and aren't discussed here. Some materials such as beryllium, chromium, magnesium and titanium are non-solderable in any case, according to solder manufacturers Multicore.

In electronics we're mainly concerned with soldering parts or wires onto printed circuit boards or terminals that are usually already "tinned" with solder or plated, ready for soldering with flux-cored solder. The key factors affecting the quality of a solder joint are:

- **Cleanliness** – dirt or impurities drastically hinder good solder coverage.
- **Temperature** – the right level to enable the solder to flow freely!
- **Time** – apply heat for just the right amount of time!
- **Adequate solder coverage** – enough to form a good joint without touching neighbouring areas.

A little effort spent now in soldering the perfect joint may save you — or somebody else —a considerable amount of time in troubleshooting a defective joint in the future. Let's discuss the basic principles outlined above in more depth.

Cleanliness and “Tinning” the bit

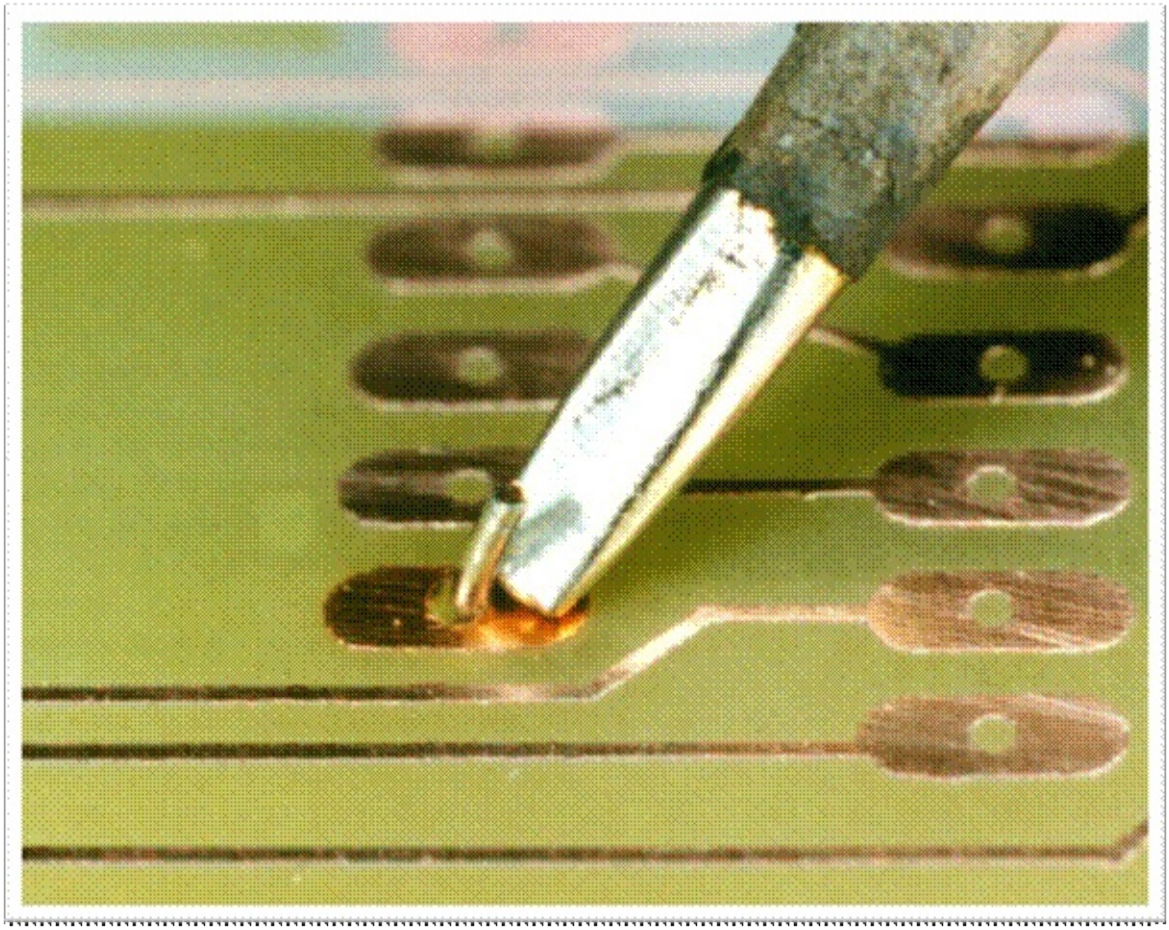

^^ A clean and shiny soldering tip or “bit” is essential for each and every solder joint you make.

Firstly, and without exception, all parts - including the soldering iron’s tip itself - must be clean and free from contamination. Fact is, solder just will not “take” to dirty parts! Old components or copper board can be impossible to solder because of oxidation that builds up on the surface of the leads. This repels the molten solder and will soon become evident because the solder will “bead” into shiny globules looking like mercury, going everywhere except where you need it. *Dirt and contamination are the enemies of a good quality soldered joint!*

When all the conditions are right for soldering, materials are said to be “wettable” and will accept molten solder, which should flow readily over their surfaces. Hence, it’s **really necessary** to ensure that parts are free from grease, oxidation and other contaminants. Note that in any case, some incompatible materials or surface finishes just cannot be soldered using ordinary lead-free solder, no matter how hard you try – e.g. aluminium parts would require special aluminium solder and fluxes (see later) to be used.

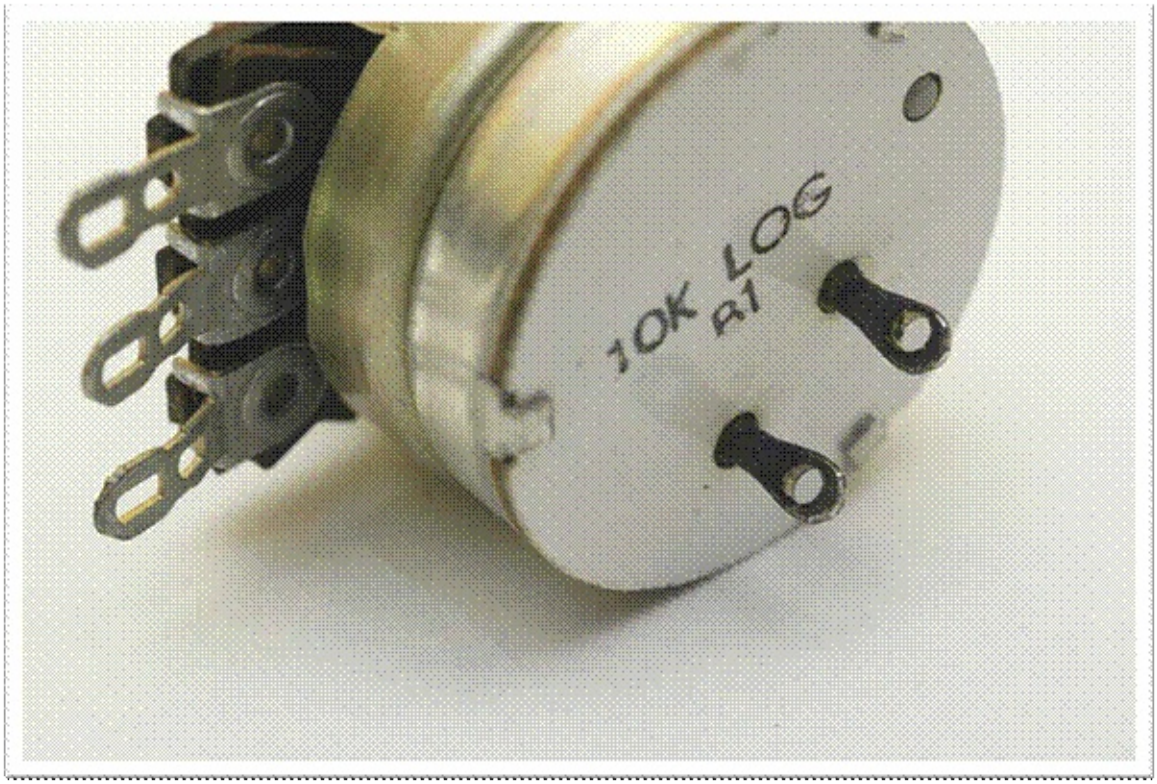

^^ *The two tags on this switched potentiometer have blackened with age and oxidation. They must be cleaned before they can be soldered…*

In the case of old components that have been stored a long time, where the leads have blackened and oxidised, use a small hand-held file or perhaps fine emery cloth to reveal fresh metal underneath. Stripboard and copper printed circuit board will generally oxidise after a few months, especially where it has tarnished due to fingerprints, so the copper strips could be cleaned using e.g. an abrasive rubber block made for the purpose. Also available is a fibre-glass filament brush (photo), which is used propelling-pencil-like to remove contamination. They're OK for general cleaning but best avoided on fine surfaces (e.g. gold plated switch contacts). These produce tiny particles which can irritate the skin, so avoid accidental contact with any debris.

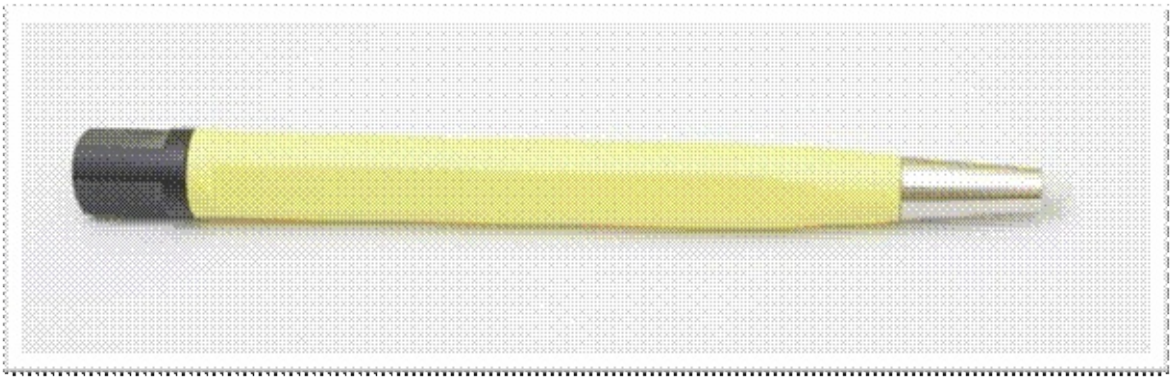

^^ *A glass-fibre filament brush like this is useful for cleaning oxidised parts.*

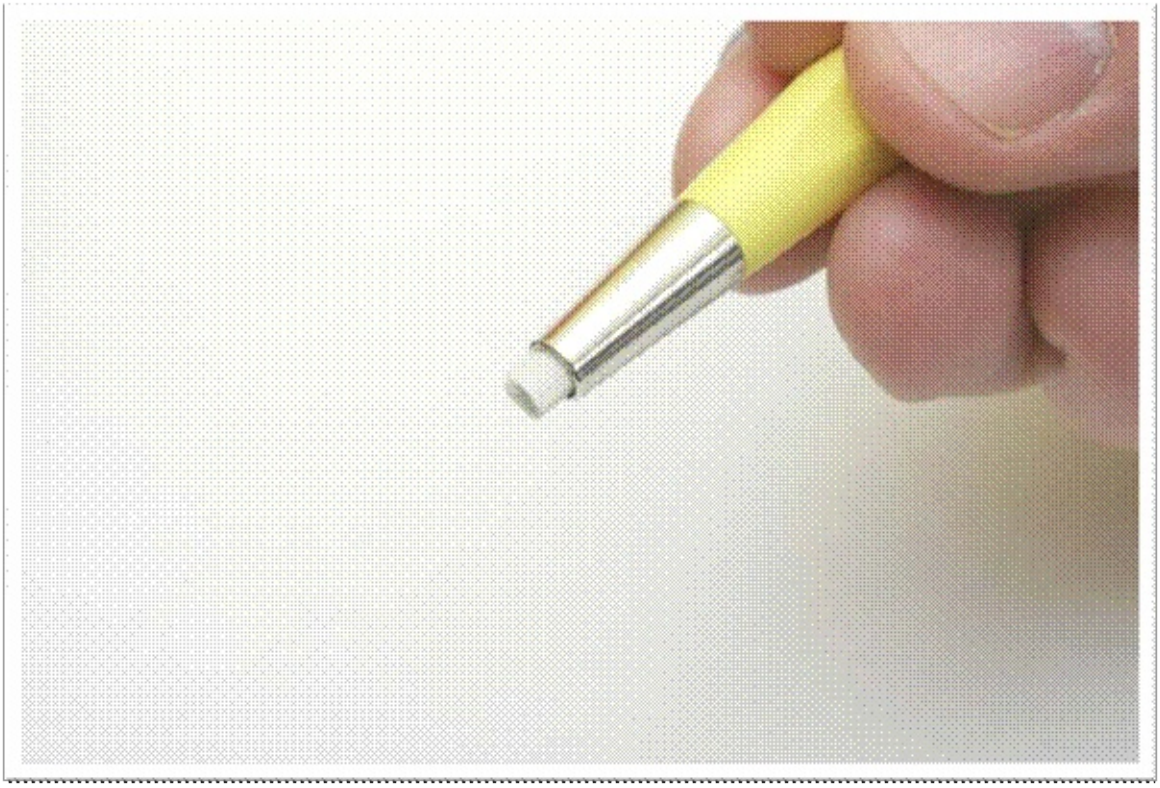

^^ *The glass-fibre brush works like a propelling pencil and produces irritating dust.*

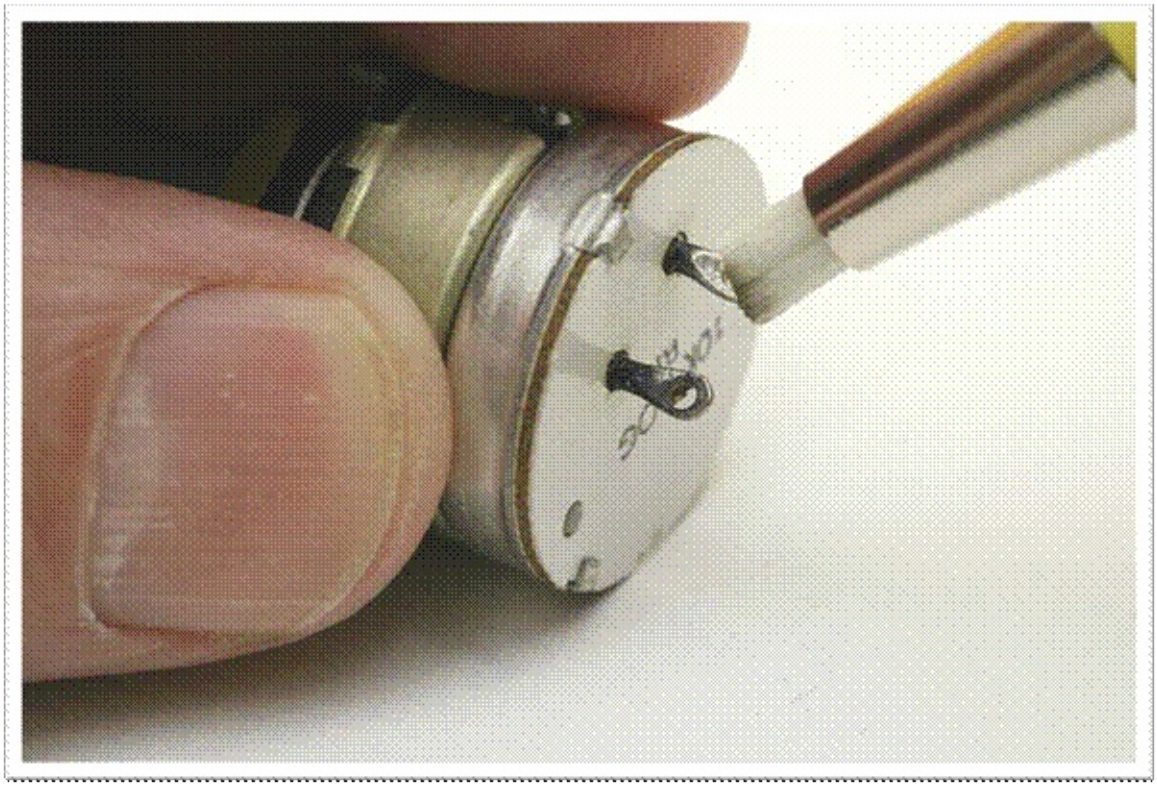

^^ *Cleaning oxidised tags with a glass fibre brush to make them nice and shiny, ready for soldering*

Afterwards, a wipe with a rag soaked in cleaning solvent will remove most grease marks and fingerprints. After preparing the surfaces, avoid touching any parts as far as possible.

Another side effect of trying to solder contaminated or incompatible materials is the tendency to apply more heat and “force the solder to take”. As the materials aren’t

wettable the molten solder won't flow where you want it to flow. This can do more harm than good, because it may be impossible to burn off any contaminants anyway, and the component or the printed circuit board may be overheated and damaged in the process. Semiconductors may be harmed by applying excessive heat for more than a few seconds, and extreme heat applied to printed circuit board tracks can cause irreparable damage, because the tracks will be lifted away from the substrate especially on a delicate or badly designed board. You can avoid trouble by ensuring the surfaces to be soldered are clean and wettable to begin with.

Getting Ready

As already explained, cleanliness in soldering is a major factor in obtaining successful results. A soldering iron stand usually has a sponge that is dampened – it wants to be quite damp but not running wet, so squeeze out any excess.

^^ *Dampen the sponge but don't soak it unduly. Note the hole, which gives an edge to wipe tip with.*

^^ *An Antex soldering iron tip. It simply slides onto the iron's heating element. Only the extreme end is wettable and will accept solder: the tip should be kept nice and shiny.*

Soldering iron bits are typically iron-plated to resist wear, then chrome-plated to prevent molten solder being deposited on them, with the extreme tip being "wettable" to work with molten solder. Before using the iron to make a joint, the hot tip must be "tinned" with a few millimetres of solder*: you should always flood a brand new tip with plenty of solder to tin it immediately, when using it for the first time*.

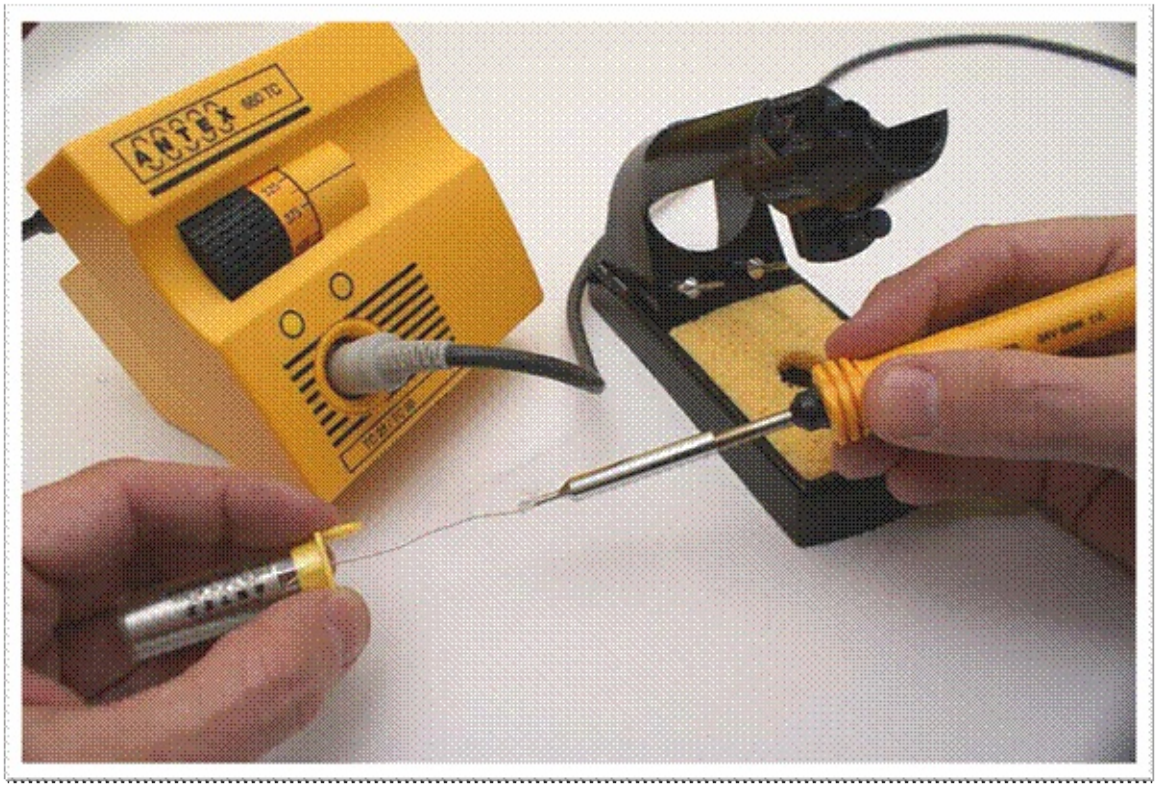

^^ *Tinning the tip ready for use: apply a few millimetres of solder to the hot tip.*

Wipe off excess solder using a damp sponge and it's ready to use. That's why sponges have a hole or well in them – the edge acts as a wiper and the hole catches excess solder.

A useful tip: after tinning the bit, just before using the iron it helps to re-apply a small amount of solder to a clean tip, to improve the thermal contact between the tip and the joint. The molten solder fills the void between the materials and the iron tip, to help transfer heat better so that the solder flows more quickly and easily.

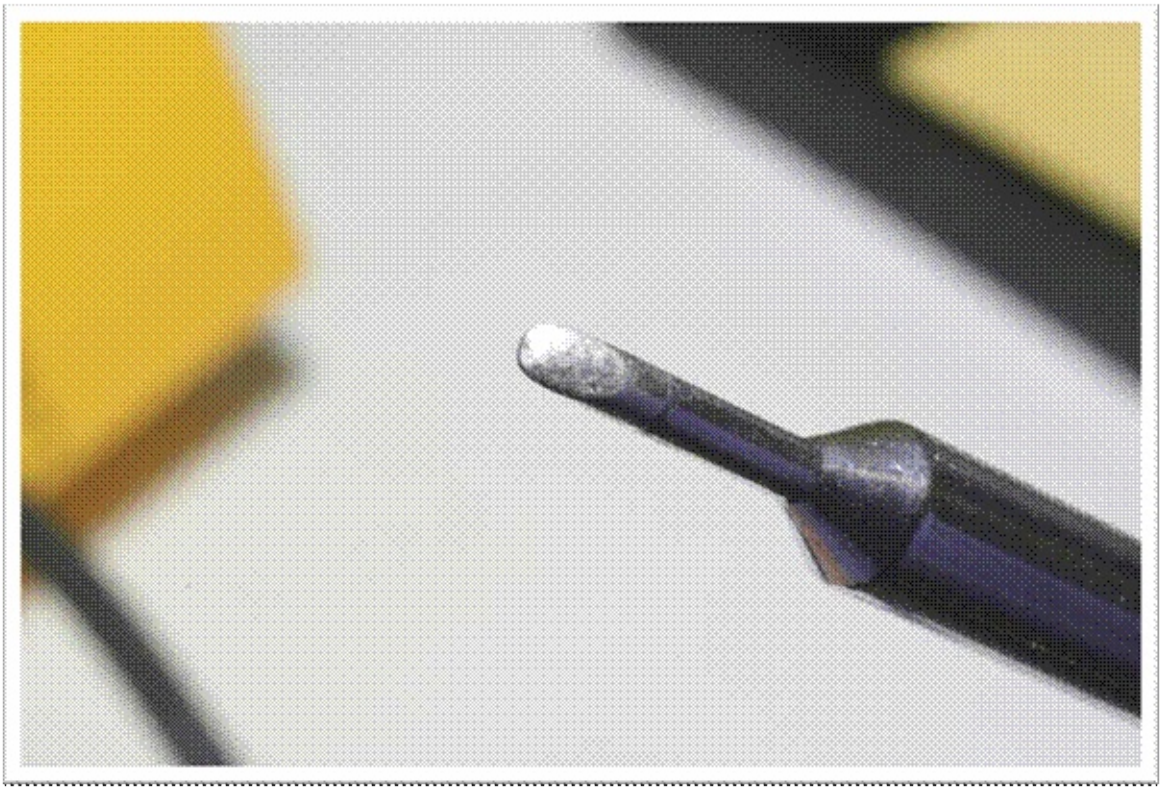

^^ *A tinned tip should look like this, ready to make the next joint.*

It's sometimes better to tin larger parts as well before making the joint itself, but this is not generally necessary with p.c.b. work. Small tinlets of special paste are available onto which you dab a hot iron - the product cleans and tins the iron ready for use. It's useful in extreme cases where the bit has some stubborn contamination.

I find special Tip Tinner &Cleaner products to be very useful: gently abrasive in action, they help to clean dirty bits and keep them in good condition. Use them for removing stubborn contaminants, but don't overdo it.

^^ Tip Tinner and Cleaner is a useful aid to maintaining a soldering iron bit …

^^ Just press the hot iron onto the solid paste and scrub it around a little. The tip will be cleaned, tinned, and made ready for use.

The move to lead-free solders (see next chapter) has had some effect on the life of soldering iron bits, with increased wear and corrosion noted due to the higher temperatures and the fluxes found in tin-based solders. You can therefore expect bits to wear out over time. Once the iron-plating is damaged due to oxidation or erosion, the bit is fast approaching its end of life. Never use an abrasive or file to sand down a tip: the iron-coating will be damaged and the iron's core exposed, so the tip will soon be made useless due to erosion.

Having prepared the soldering iron tip ready for use, in the next chapter solder and fluxes are discussed.

Solder and Fluxes

In recent years there's been a move towards using more environmentally-friendly materials in electronic products. EU legislation such as *Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment* (RoHS) aims to reduce toxic heavy metals being sent to landfill. (Look for the RoHS symbol on equipment to indicate compliance.) Due to RoHS compliance, the electronics industry had to change the type of solder it uses in electronic production.

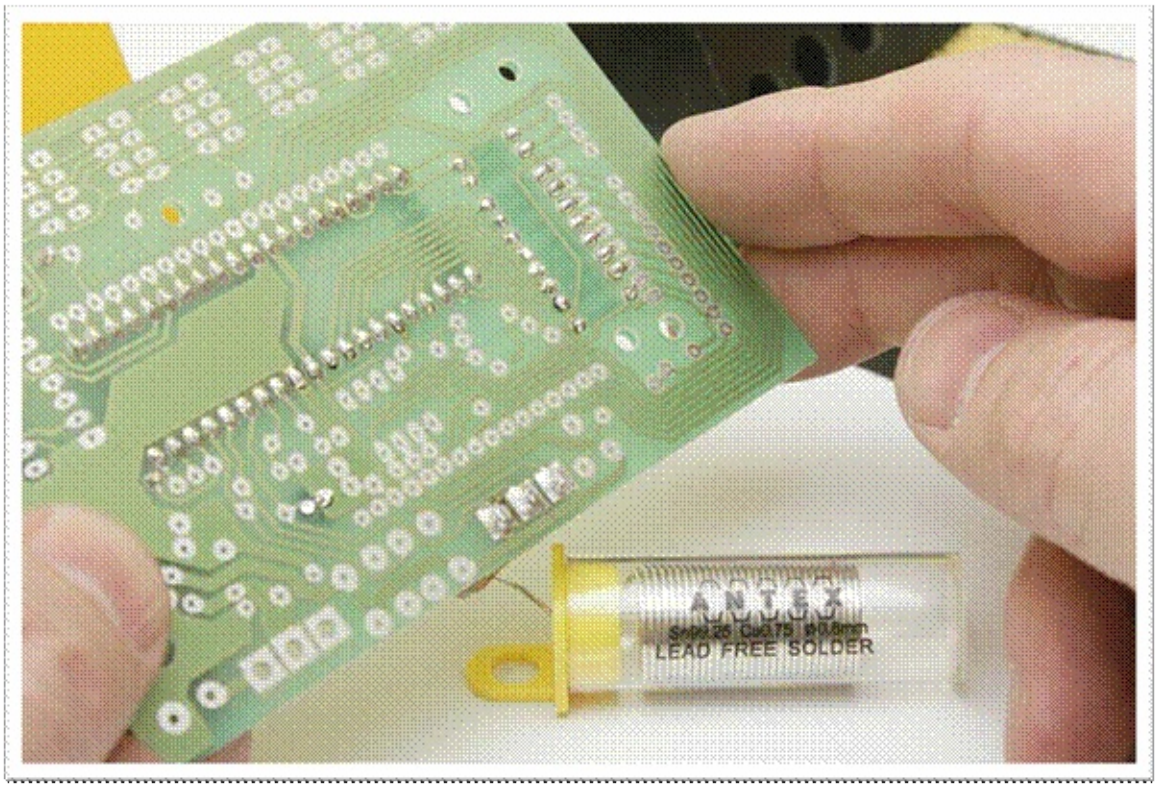

^^ *Electronics solder is supplied in reels or handy dispensers like this.*

Solder comes in various forms including solid bars or pellets for melting in small electric 'solder pots' used for treating the ends of wires with solder. Traditional general-purpose electronics-grade solder is in wire form – starting with so-called "60/40" which contains 60% tin (symbol Sn) and 40% lead (symbol Pb) and is sold in handy dispensers or reels. Although tin-lead solder is now banned in industry, there's nothing to stop the hobbyist from using it but best practice is to use lead-free solder in our work: my advice is to try both, and see which you prefer to work with. "40/60" tin-lead produces lower quality results but is slightly cheaper and perfectly acceptable in hobby circles.

Various diameters of solder wire are marketed. In the UK they're sold in Standard Width Gauge (SWG) sizes, typically as 18SWG (1.2mm) or 22SWG (0.7mm). The latter is fine for almost all hand-soldering of printed circuit boards or general electronics. For larger solder joints (e.g. larger switch or motor terminals), 18SWG solder would be better as more solder can be dispensed more quickly.

Lead-free solder is universally available and contains typically 99.7% pure tin and 0.3% copper (symbol Cu). It needs a higher melting point which makes it slightly more difficult to work with, but standard soldering irons will cope with it well. Antex lead-free

solder (Sn 99.25 / Cu 0.75) is a good compromise at 0.8mm diameter and is sold in small dispensers.

Other solders are produced for specialist work, including aluminium solder (Alu-Sol®) and another solder variant used by professionals is Multicore “Smart” wire which contains a small amount of pure silver (symbol Ag). It produces very clean results and is often associated with SMD (surface mount devices), though some engineers also use it for routine p.c.b. work for producing the best possible finish by hand. As “Smart” wire contains lead it is not RoHS compliant.

An interesting variant is **Eutectic** solder, which is 63/37 Tin/Lead. It goes instantly from solid to liquid when melted and is particularly good for hand-soldering. An almost-equivalent lead-free product would be Stannol Flowtin TC or TSC solder.

The low-down on fluxes

When melting solder with a soldering iron, oxides of metal are produced as a result of the high temperatures involved. Unfortunately, these oxides contaminate the metal surfaces being soldered, which interferes with the flow of molten metal and the production of a good quality solder joint.

All electronics-grade solder wire therefore contains an additive called “flux” which helps the molten solder to flow more easily over the joint. It does this by scrubbing away the oxides which arise naturally during heating, and it will often be seen as a pungent brown fluid bubbling away on the joint, accompanied by some fumes.

Those coming into electronics from other industries should note that flux is already contained within “cored” electronics solder and on no account should any acidic flux be applied separately before using the soldering iron. Plumbers, for example, apply flux paste to copper pipes before soldering them, but electronics-grade solder wire already contains a flux and extra flux is almost never needed. Electronics is no place for acid fluxes!

^^ *A close-up of electronics-grade multi-cored solder. Five cores of rosin flux can be seen running through it.*

For almost all electronic hand assembly, solder wire containing “Rosin flux” is used. Cores of flux run through the solder wire like letters running through seaside candy, and they prevent the hot area from being contaminated by oxides, otherwise solder would never flow properly and the result would be an incomplete and unreliable joint.

Flux dispensers and Colophony

Flux dispenser pens are sold that allows special liquid flux to be applied separately onto a work area. These might be handy for difficult or challenging jobs to help solder to flow better: adding more flux this way won't do any harm and may help a solder joint to be made more quickly and reliably. In my hobby electronics, there's hardly ever been a time when I felt the need to apply extra flux but it's useful for some very tricky or demanding jobs.

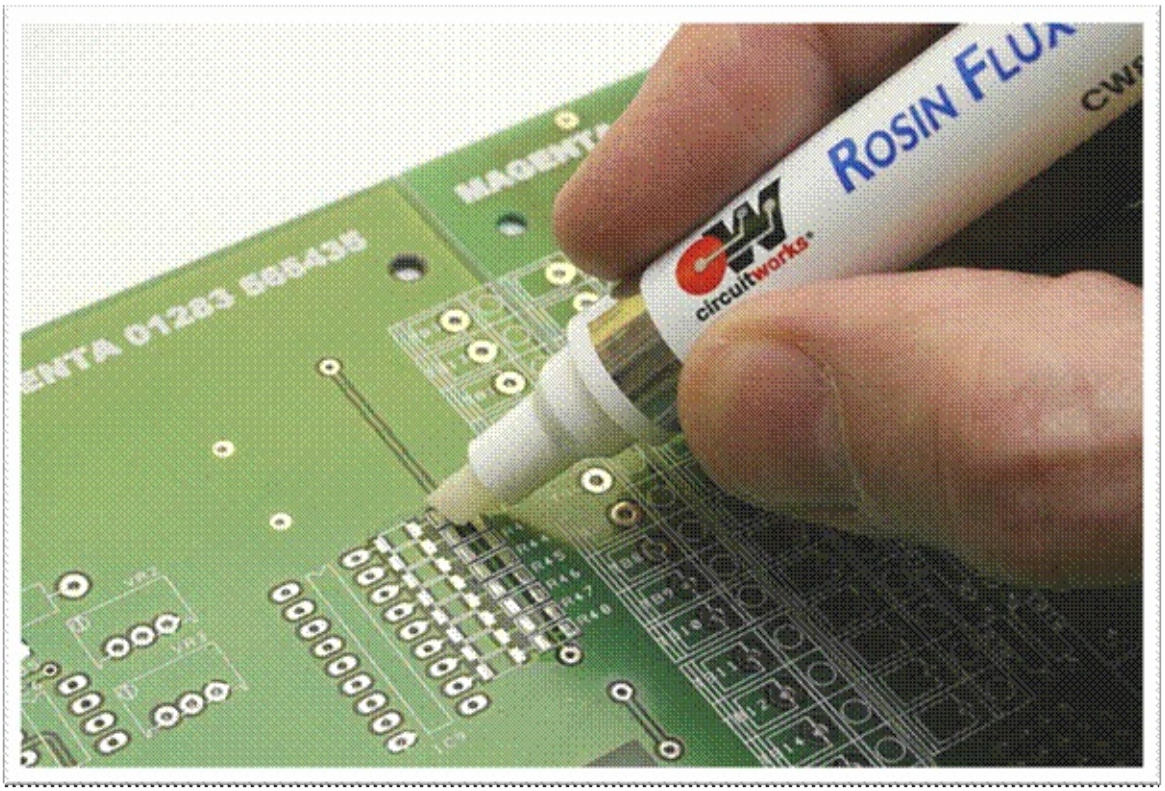

^^ *For more demanding work, a flux dispenser pen allows additional flux to be applied*

For example I've used specialist Chemtronics flux dispenser pens on tricky, extra-large solder joints involving very thick wires for lead-acid battery connections where I really struggled to make the solder flow properly. You might also use them in micro-electronic surface-mount work. The extra flux can only help, but for the rest of the time rosin-flux core solder wire contains sufficient flux and that's all that you'll need.

^^ *Colophony or rosin flux is available in small tinlets if you want to prepare your own liquid flux.*

One thing that many seasoned electronics enthusiasts will recognise is the distinctive smell of rosin flux: its intense woody pine smell is not unpleasant, and flux fumes themselves are not known to be harmful but solder smoke can be an irritant, especially if you suffer from asthma or other respiratory conditions. (I dealt with solder fume extraction earlier when soldering irons were outlined.)

Rosin flux is also known as **Colophony.** It's an amber resin that's glassy and brittle like sugar candy, distilled from the resins of conifers (mainly pine trees) and it's worth knowing about. For electronics use, Colophony is available in individual tinlets of solid resin (e.g. *Kolophonium* in 20g tins by Donau Elektronik GmbH, sold by Westfalia or Conrad).

As an aside, the resins of various trees are used in incense burners: placing a few fragments on a charcoal burner produces intense delicious fragrances of pine, frankincense or forest but you still wouldn't want to inhale the smoke or fumes directly.

Solids of Colophony can be dissolved to make a semi-liquid flux, for dipping or applying manually prior to soldering. To make your own rosin flux from solids of Colophony, chip off some fragments and crush them into a small tinfoil dish, then apply some isoproponal alcohol (start with 2 parts solvent to 1 part Colophony) and let it dissolve over about 20-30 minutes or more.

^^ *Chip off some solids of colophony and put them in a small tin foil dish*

^^ *Add e.g. x 2 volume isopropanol alcohol and allow the solids to dissolve. Experiment as needed.*

^^ *The resulting flux can be very sticky so handle with care and do not spill.*

In this form it can be applied directly with a brush or dropper to areas prior to soldering. In an open dish, after a day or two the solvent will mostly have evaporated to leave an extremely sticky resin that should be handled carefully: it's no co-incidence that Colophony is also used in adhesives and varnishes, and different grades of Colophony resins are used to treat violin or double-bass bows to add friction to bow hairs! Try experimenting with different ratios of solvent and making some up and storing it in an old nail varnish bottle with brush, or generally do what works for you.

Unused Colophony crystals can be reformed into their storage tinlet by warming carefully with a hot air gun, but don't overdo it. You can also use flux cleaners or PCB solvent cleaners if you want to remove traces of excess rosin flux after soldering: these are left behind as a brown deposit and are otherwise harmless.

The subject of using your soldering iron to raise the temperature of the materials is discussed next.

Temperature flow

This aspect takes a bit more understanding, but with practice you'll soon understand how temperature flows within a workpiece being soldered and how you have to harness it properly. After ensuring all parts are clean and the soldering iron is ready to go, the next step to successful soldering requires that the **temperature** of **all** the parts is raised to roughly the same level, before solder can be applied.

Imagine the most basic task of soldering a simple resistor onto a printed circuit board: the copper p.c.b. and the resistor lead should both be heated *together* so that the solder will flow readily over the joint. Later I'll show the precise stages step by step.

A beginner will often mistakenly just heat one part of the joint (e.g. a resistor's wire protruding through a printed circuit board) and hope that the resultant "blob" of solder will be enough to tack everything together. That's completely wrong, because the remaining metal in the joint is cold when molten solder is flooded on to it. The joint will be weak, incomplete or unreliable. Flux will not have flowed properly either, so the joint could be contaminated internally.

Another beginner's mistake is to use a soldering iron to carry blobs of molten solder over to the joint, as if to daub solder over it. The secret of success is to control the iron accurately and apply the hot tip onto the workpiece so that it's in contact with *all the parts*. Within a fraction of a second, heat will conduct from the iron and raise the temperature of the entire joint, after which solder can be melted over it. Remove the iron and let the joint cool naturally. It takes some practice with your chosen soldering iron tip to obtain the best heating action, making sure the tip is clean and tinned properly to begin with.

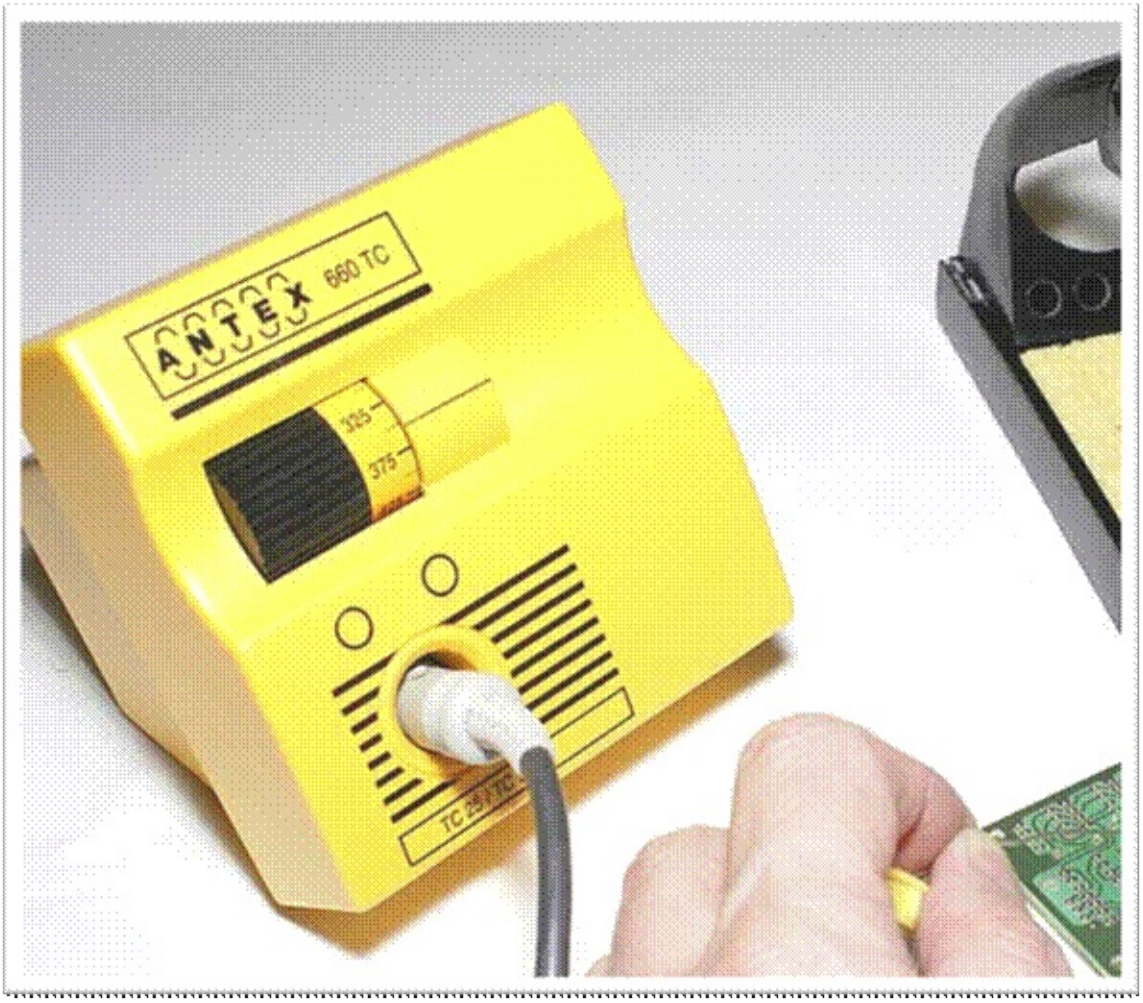

^^ Set a typical temperature of 330-350 ºC (626-662 ºF) or more, if you have a soldering station.

The melting point of traditional tin-lead solders is about 190ºC (374ºF) but lead-free tin-based solders require higher temperatures, having melting points of typically 201-227 ºC. As Antex reminds us, the melting point is *not* the temperature of the soldering iron tip: instead you should set a temperature that ensures the solder melts *instantly* onto the tip. Fixed-temperature soldering irons have no adjustability but they'll cope just fine with either type of solder. A soldering station usually has a variable control that gives more control in different circumstances. In practice the iron tip temperature should be set for typically 330-350 ºC (626-662 ºF) or maybe a little more if using lead-free solder.

Now is the time…

The next diagram shows what would happen if you applied a hot soldering iron to an imaginary metal block. In step (1) heat travels out of the iron into the cold metal block, which starts to warm up starting at the edges. Gradually (2), the whole metal block's temperature rises until the middle of the block finally rises in temperature as well. In effect heat is now travelling back "towards" the iron tip, until finally (3) the whole block is at the same temperature as the iron. At this point solder could now be applied.

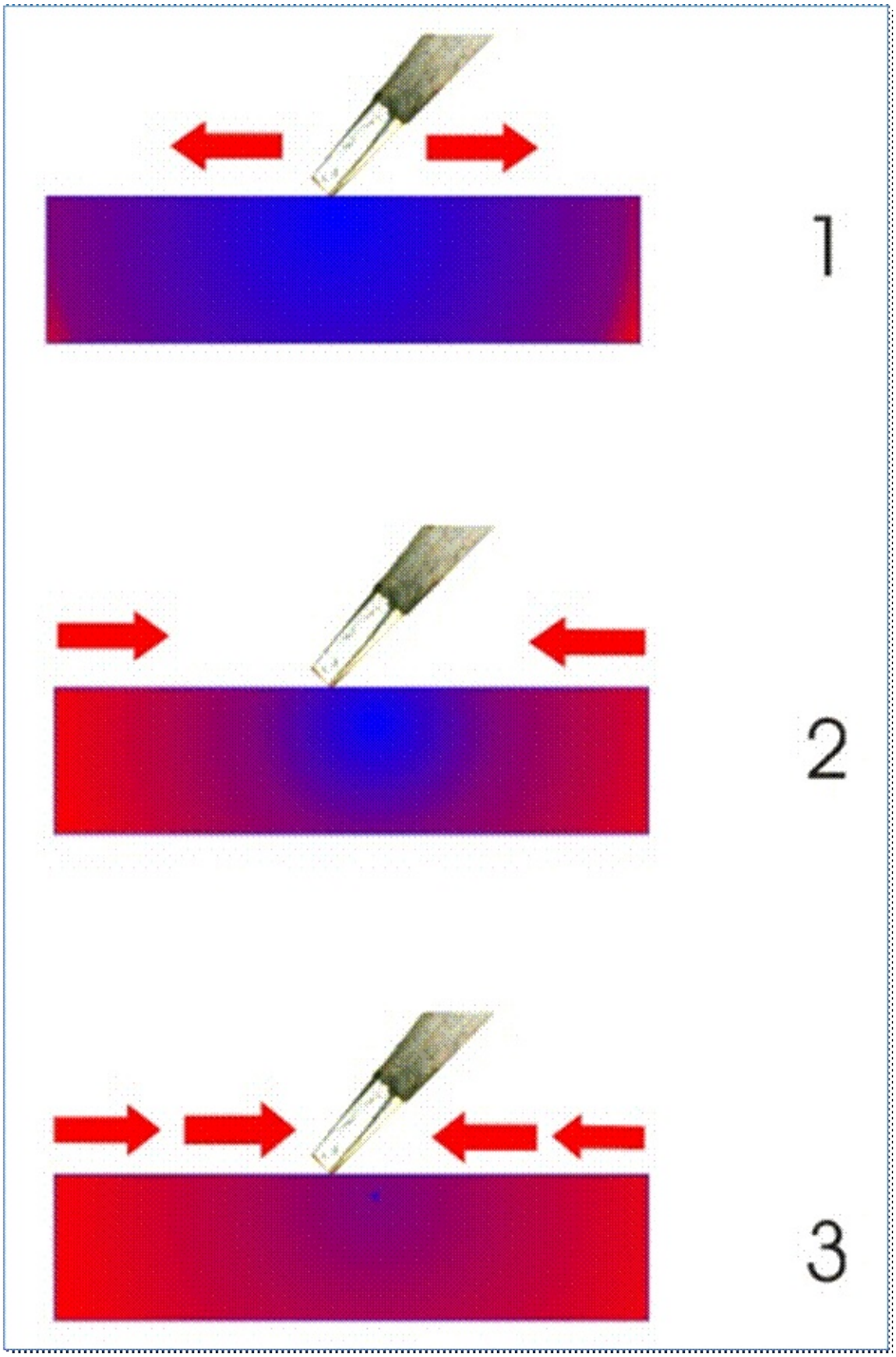

^^ How metal in the joint actually "sinks" heat away from the tip to begin with. Then heat moves back towards the tip until the solder's melting point is finally reached.

You'll notice this effect as a time delay when soldering any joint. The "working area" of the iron's tip gets **cooled** to begin with, because the metal in the rest of the joint is sinking heat away from where it's most wanted. Only after the whole joint has risen in temperature can solder be melted onto it.

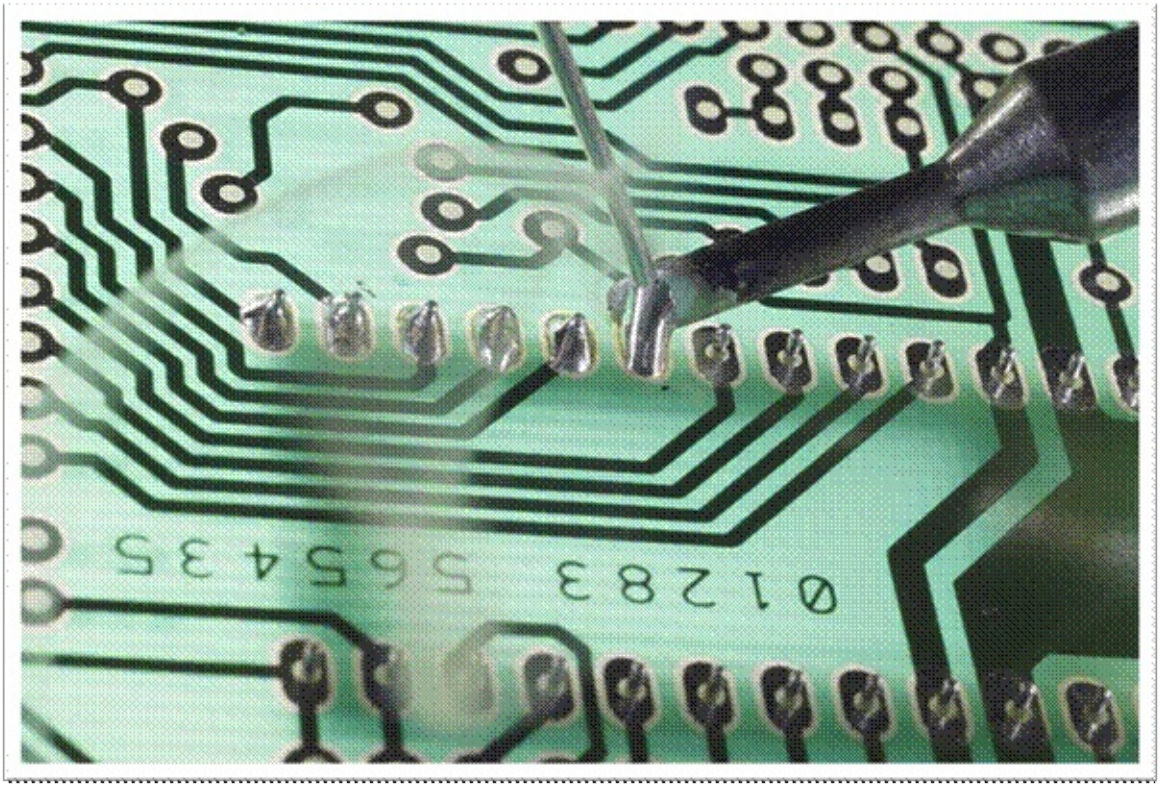

^^ *Soldering a small p.c.b. joint*

With experience, you'll get a feel for how long it takes before you can apply solder. The more metal that is present in the joint, the longer period that heat must be applied for. A small p.c.b. joint takes well under one second to complete. A large metal terminal could take quite a few seconds or more to heat up. As I explained earlier, higher power (wattage) irons cope better with larger workpieces because they recover more quickly and are more "unstoppable", making it easier for them to heat larger workpieces without cooling down so much.

If you apply solder too early, it won't melt properly and the result will be a grey, crystalline joint caused by the solder's melting point temperature not being reached and the flux not having flowed properly. Semiconductors must be soldered as rapidly as possible as they are heat-sensitive, but they're a lot more robust than they used to be.

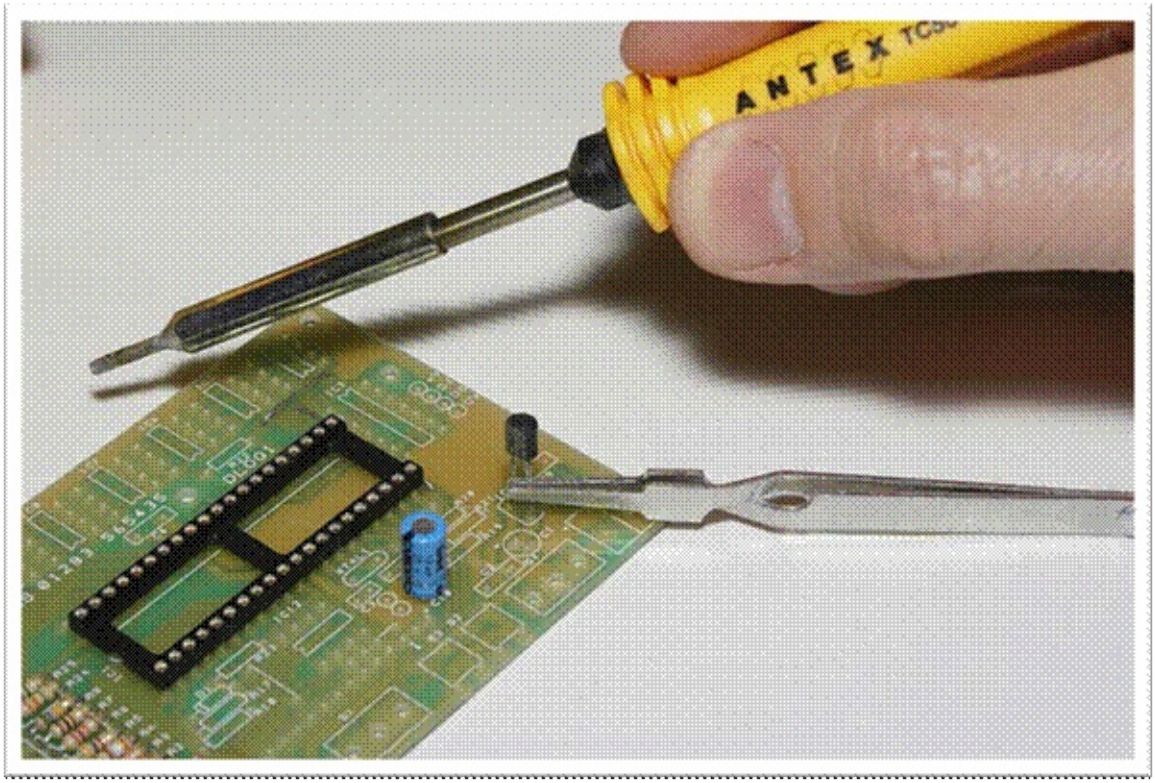

^^ *A clip-on Antex heat shunt fitted to a transistor leg, helps prevent thermal damage due to overheating when soldering it in place. Less essential these days, but beginners find them re-assuring.*

Until they have gained some practice, novices sometimes buy a small clip-on heat-shunt (photo) which resembles a pair of aluminium tweezers. In the example of, say, a transistor, the shunt is attached to one of the leads near to the transistor's body. Any excess heat then diverts up the heat shunt instead of into the transistor junction, thereby avoiding the risk of thermal damage. Applying far too much heat may destroy the part or damage the p.c.b. foil which may lift away from the board.

In due course constructors learns to judge how much solder should be applied to any particular joint. An ideal p.c.b. joint is very slightly concave in shape. If not enough solder is used, the result may be an incomplete joint which may cause an intermittent fault later on. An excess of solder – shaped like a ball bearing - is an unnecessary waste and in extreme cases may cause short circuits, especially on densely-populated boards. There is no need to add more solder "for luck". Professionally-produced p.c.b.s have a green *solder resist* coating which helps to ensure that solder does not stray onto adjacent pads. As a finishing touch, I usually spray the solder-side of a circuitboard with aerosol spray lacquer afterwards. It keeps the solder joints nice and shiny and helps prevent corrosion.

Some components can create hazards during a soldering operation:

Coin cells and button batteries are commonly used as power, clock or memory backups. If heated excessively they can explode without warning due to the build-up of internal pressure. Spot-welders are used in industry to connect tags to them, but if you need to solder wires to such a cell then it should be done as quickly as possible.

Some **memory back-up capacitors** or **electrolytic capacitors** remain energised for a while even when the circuit is powered down. Molten solder is a perfect electrical

conductor and in some cases the component's contacts could be shorted during the soldering (or desoldering) operation. If molten solder shorts it out then the arcing may cause globules of solder to be spattered outwards without warning, potentially risking eyesight damage.

Always ensure that powered components are electrically inert and discharged before soldering. Cells, batteries and battery packs should not be accidentally shorted during the soldering process, to avoid arcing and solder spatter. Note that electrolytic capacitors can also explode after a while if reverse-connected, so observe polarity closely.

Let's now consider the practical stages of soldering components and wires successfully.

Soldering Step by Step

Earlier I explained the individual factors that affect the quality of a solder joint. These are:

- **Cleanliness** – dirt or impurities drastically hinder good solder coverage.
- **Temperature** – the right level to enable the solder to flow freely!
- **Time** – apply heat for just the right amount of time!
- **Adequate solder coverage** – enough to form a good joint without touching neighbouring areas.

These rules apply whether soldering a p.c.b. or performing other tasks such as interwiring (hooking everything together with connecting wire).

We'll now summarise the stages of making a typical solder joint – soldering components onto a printed circuit board (through-hole soldering). Most people insert components into the circuit board and simply splay the wires out to hold them in place under spring tension. I find it best to snip excess wire leads off at this stage, to improve accessibility.

- All parts must be bright, clean and free from dirt and grease.
- Try to secure the work firmly to stop parts moving around.
- "Tin" the soldering iron tip with a small amount of solder. Do this immediately, with new tips being used for the first time.
- Wipe the tip of the hot soldering iron on a damp cellulose sponge to remove excess solder or contamination.
- Many people then add a tiny amount of fresh solder to the cleansed tip just before using it.
- Heat all parts of the joint with the iron typically for under a second or so, until it's heated throughout.
- While heating, then apply sufficient rosin-core solder to form an adequately-covered joint.
- It only takes a second or two at most, to solder the average p.c.b. joint this way.
- Do not move parts until the solder has cooled.
- Remove and return the iron safely to its stand.

This special photo sequence illustrates these stages. It's best to start with the smallest, fiddliest parts first when soldering a blank p.c.b., because that's when you've got the most access on the board. Accessibility will be reduced as more components are added, so we'll start with a simple wire link on a professionally designed p.c.b.

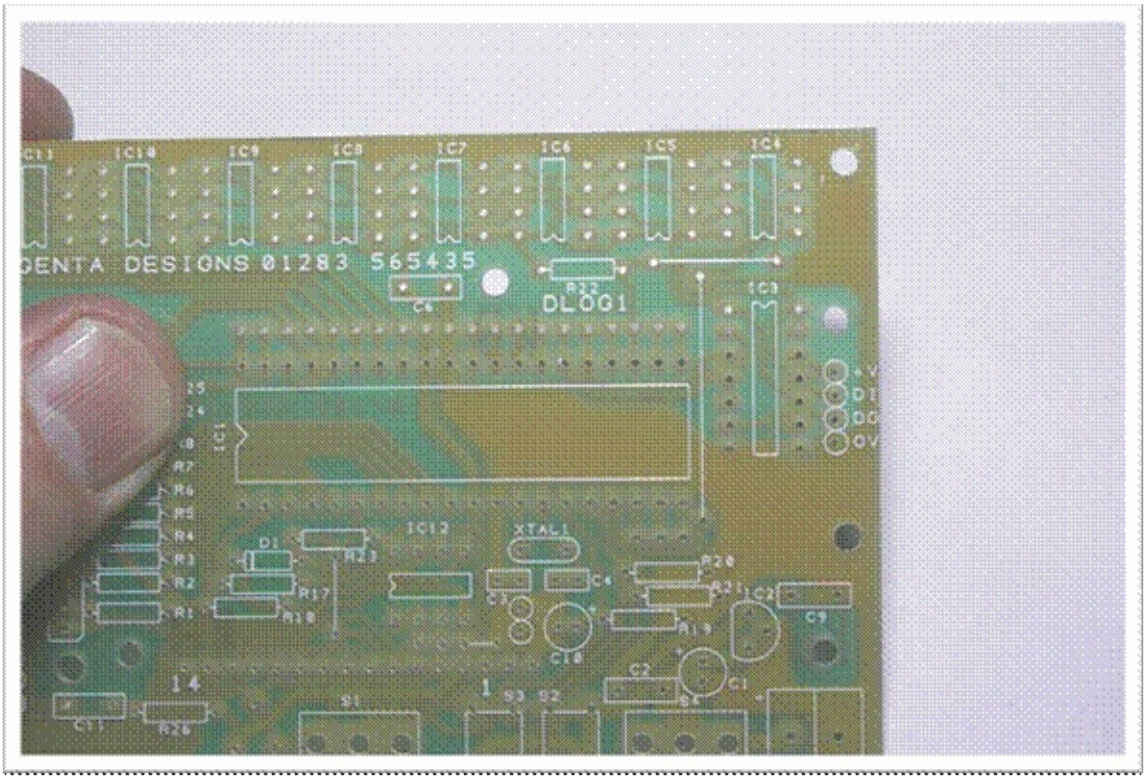

^^ *A typical professional blank p.c.b. – silk-screen printing shows what goes where. The underside has been treated with a green solder resist coating, and the solder pads are ready-tinned to help with soldering.*

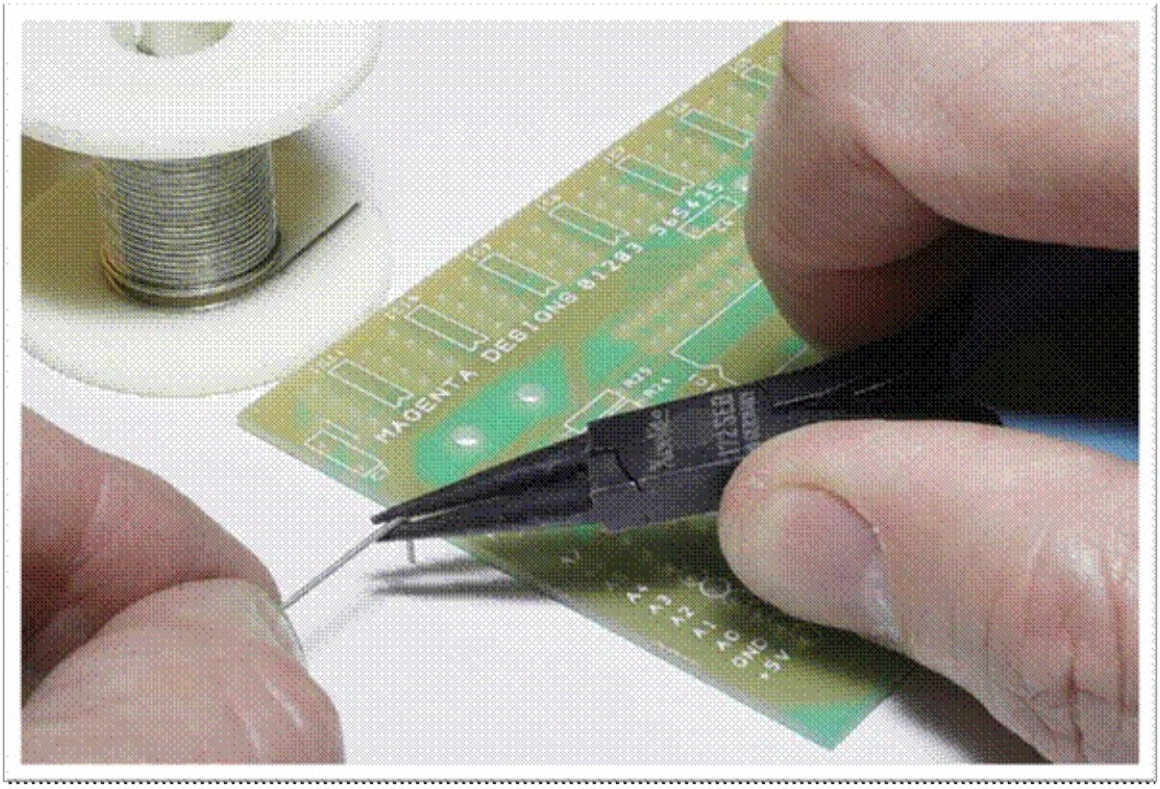

^^ *Preparing a wire link for soldering – cut off some tinned copper wire and bend the ends to fit the p.c.b. correctly. Round-nose pliers (shown) are perfect for this, but ordinary electronics or "radio" pliers will do.*

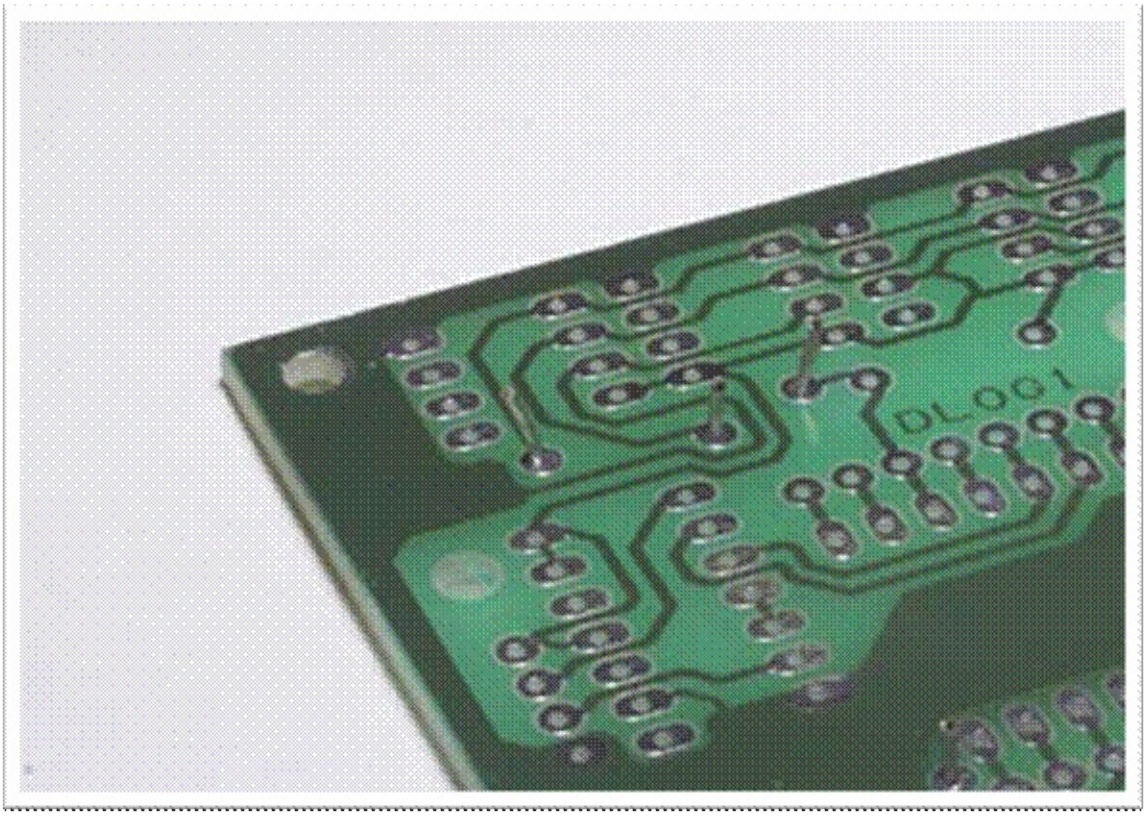

^^ *Wires are prodded through the holes in the board, then turn it upside down to view the solder side. You can then "spring" or splay the ends apart slightly, so they are held in place while you solder them.*

^^ *Wipe the hot soldering iron on the damp sponge to clean the tip. Do this periodically when contamination, flux deposits etc. build up on the iron to keep the tip nice and shiny. Tip Tinner & Cleaner helps too.*

^^ *It often helps to dab a tiny amount of solder wire onto the tip, to improve heat transfer.*

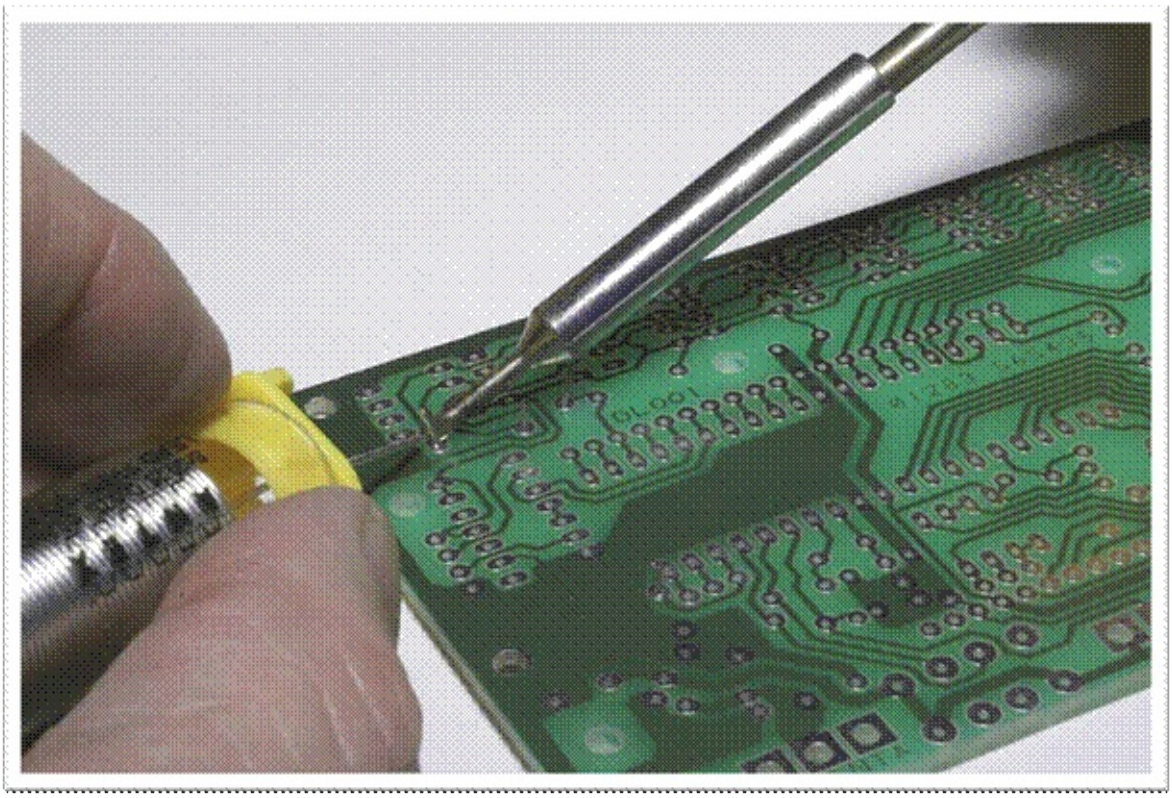

^^ *Then apply the soldering iron to heat both the solder "pad" and the wire end at the same time (say <1 second). Apply a few millimetres only, of solder. Then remove the soldering iron immediately and allow the joint to cool down by itself. The green solder-resist coating ensures solder doesn't flow onto neighbouring pads.*

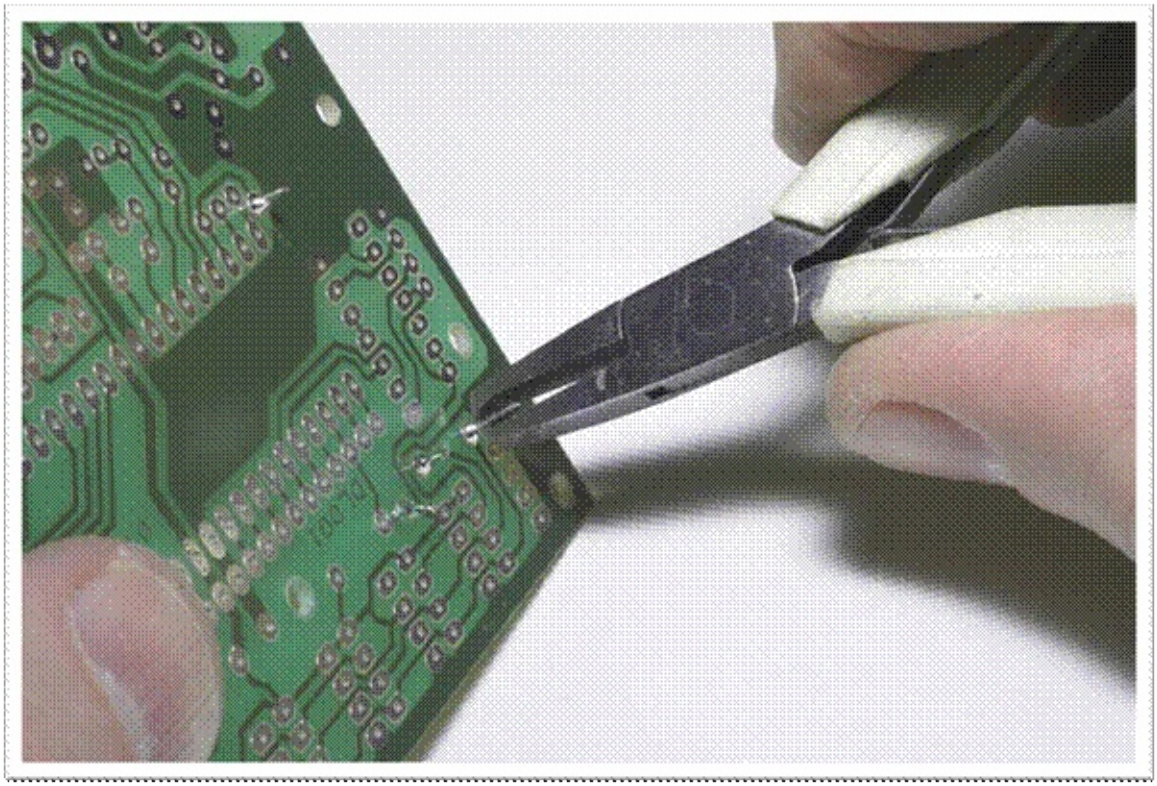

^^ *These "end cutters" can then be used to snip off excess wire after soldering….*

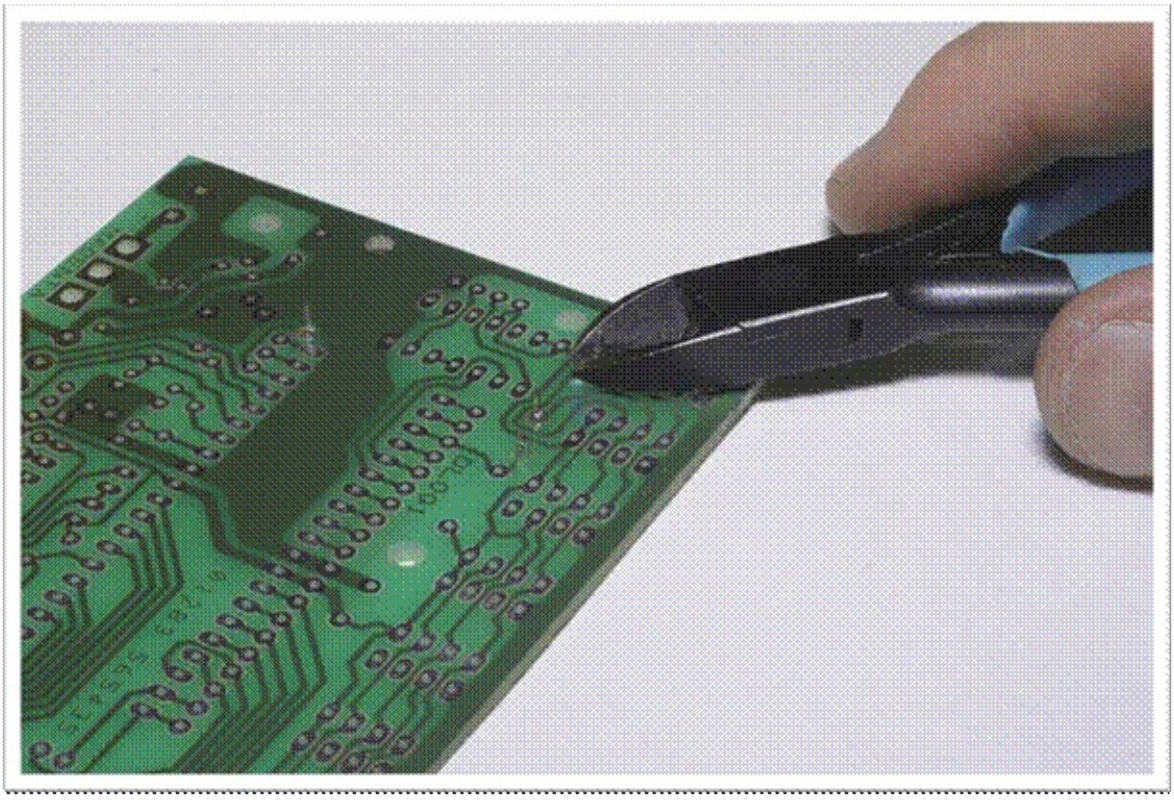

^^ *… but ordinary electronics "side cutters" are fine for trimming or snipping wires.*

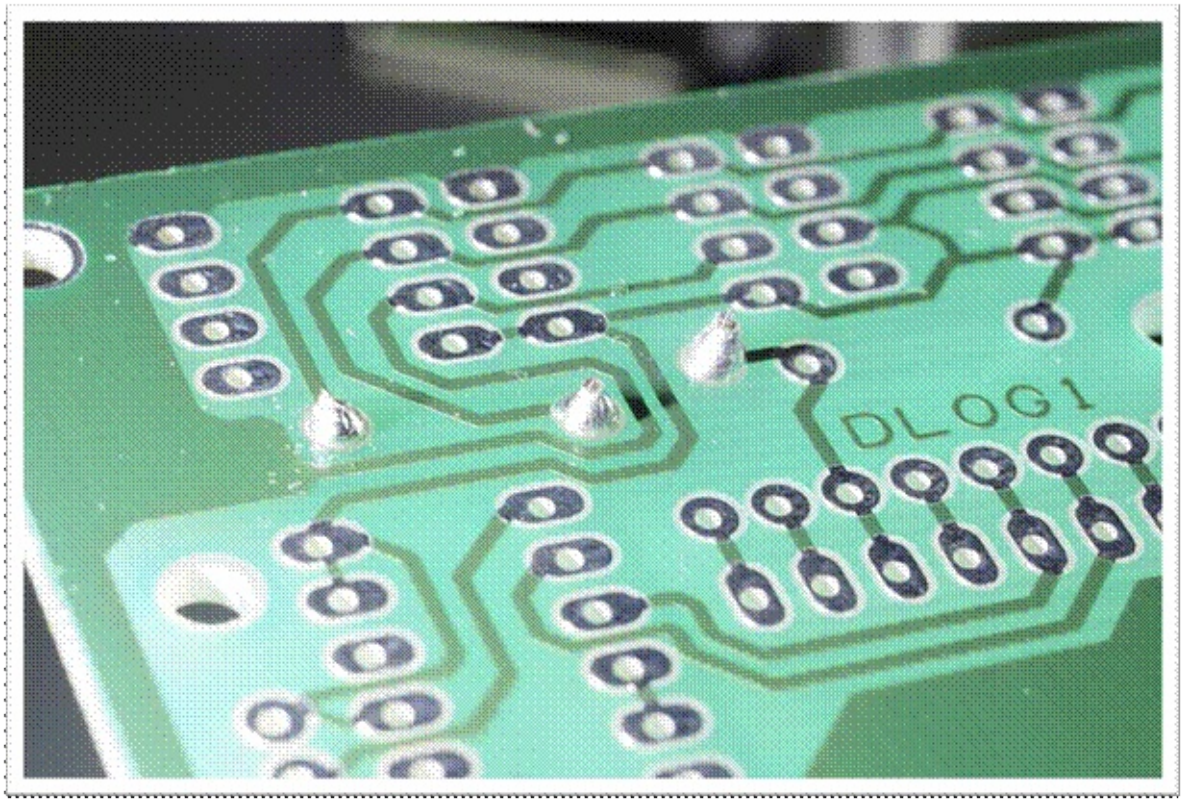

^^ *The ideal solder joint should be smooth and slightly concave, quite shiny, not dull or crystalline-looking nor ball-bearing shaped.*

Try to get consistent results in your soldering, but don't worry too much about the lack of uniformity – this is soldering by hand after all, not by precision machinery, and some slight variation is OK provided the solder coverage is good and the soldering is generally clean and effective. You'll improve with practice, that's for sure!

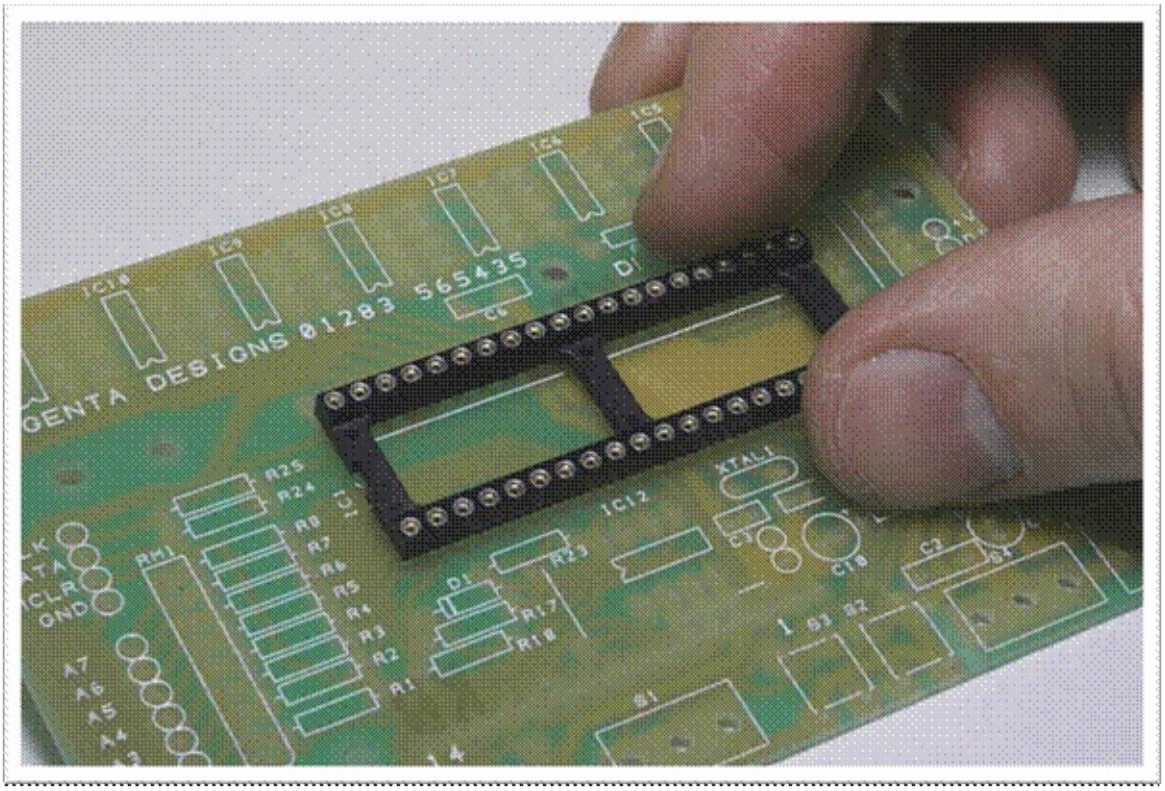

^^ *A large i.c. socket can be added next…*

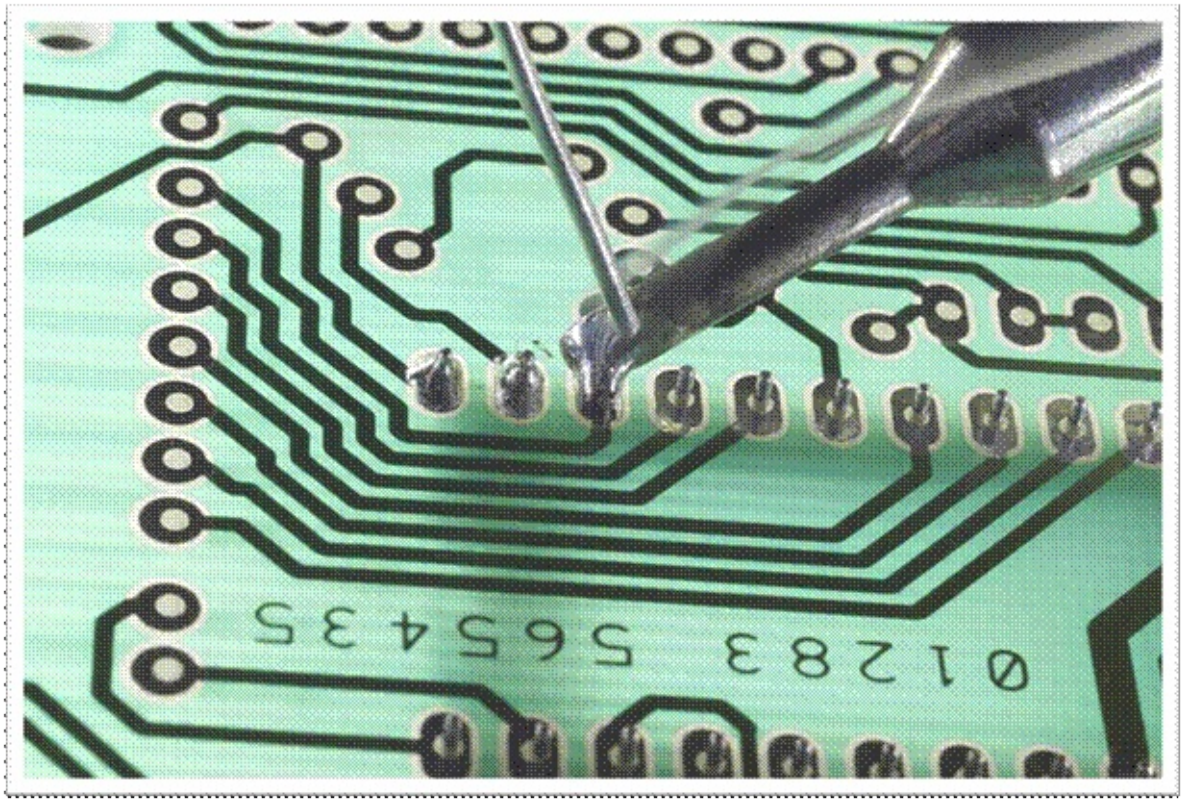

^^ Go along the rows of pins and solder them one at a time. See how simple it is! Heat both the solder pad and pin with the iron, and dab on a little solder wire to ensure full coverage. Ensure the socket is flush against the board.

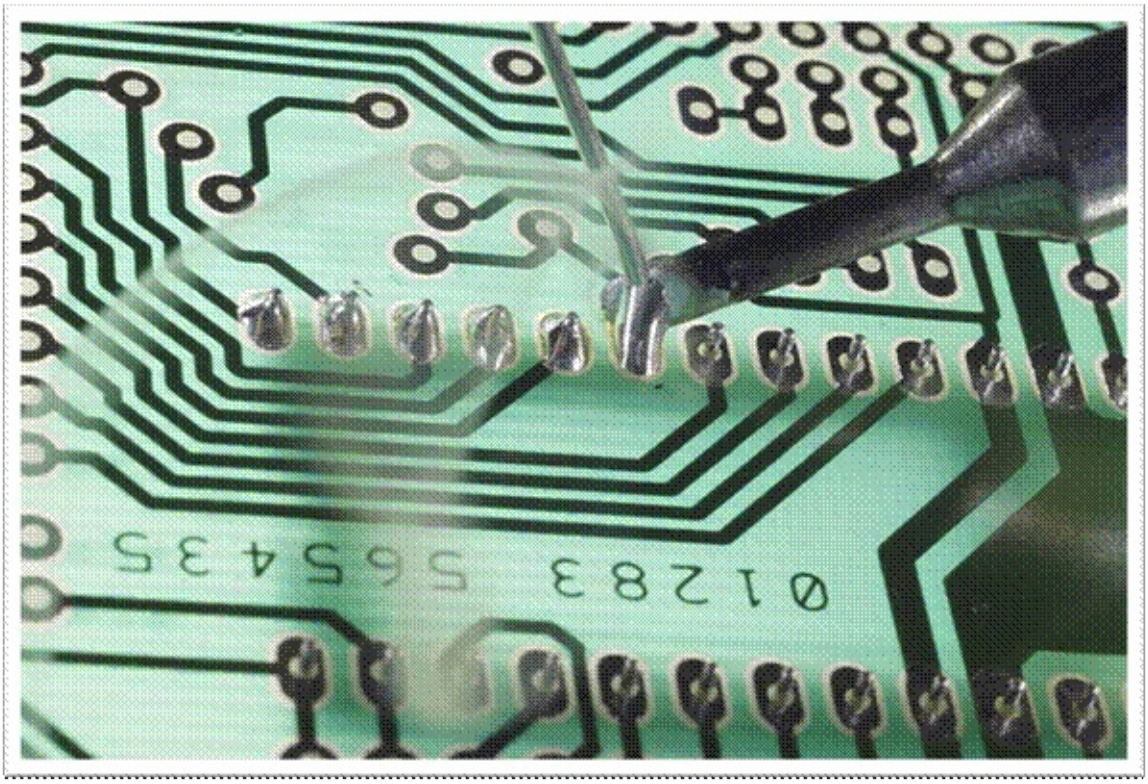

^^ As hardly any metal is involved each pin should take well under a second to solder at most.

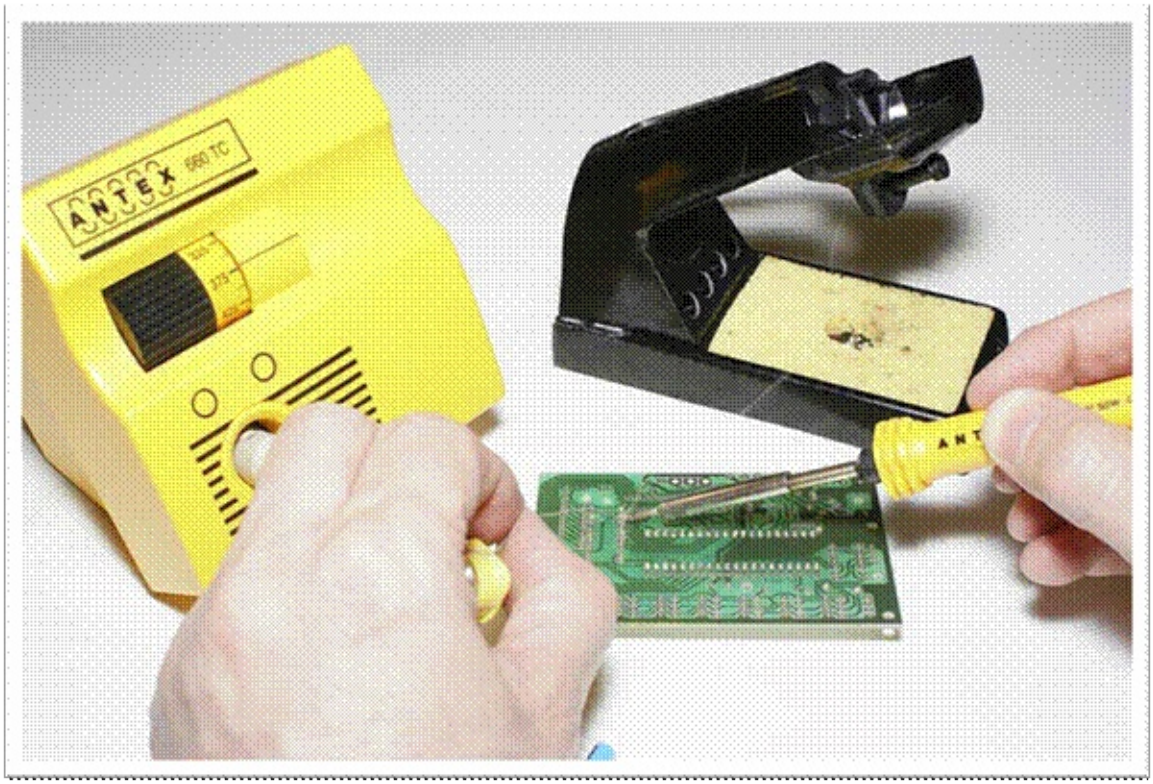

^^ *Continue until the i.c. socket is soldered.*

Once the smallest parts are soldered into place, you can continue to solder the remaining components. It's easiest to handle the smallest so-called "discrete" parts first while you still have plenty of room on the board. I usually solder resistors and capacitors next. The principle of soldering them is just the same as a simple wire link: insert them from above till they are flush on the board, then splay their wires a little to hold them in place, and preferably snip off at least some of the wire to give you more access.

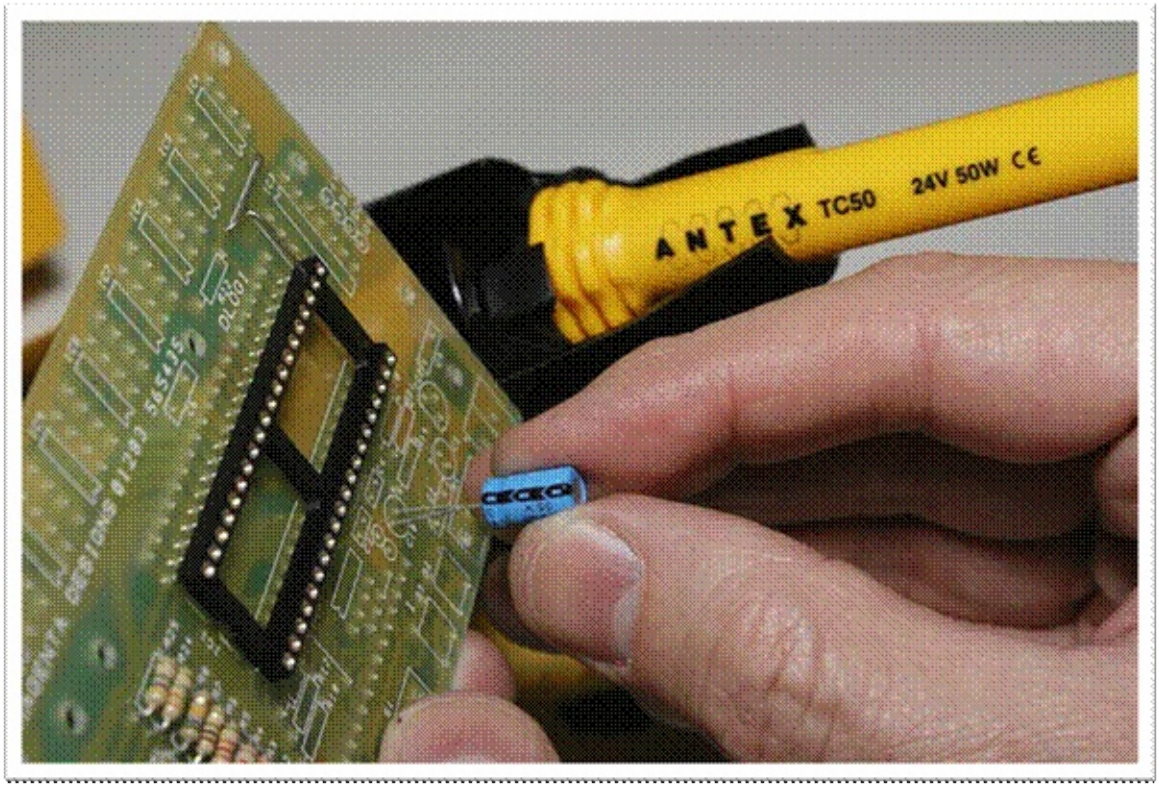

^^ *Continue by inserting "discrete" components from above, splay their wires out*

underneath to secure them in place, then snip and solder the joints exactly as before. Some parts like this blue electrolytic capacitor are polarity sensitive (note the – sign), and must be inserted the right way round. Same is true of every semiconductor.

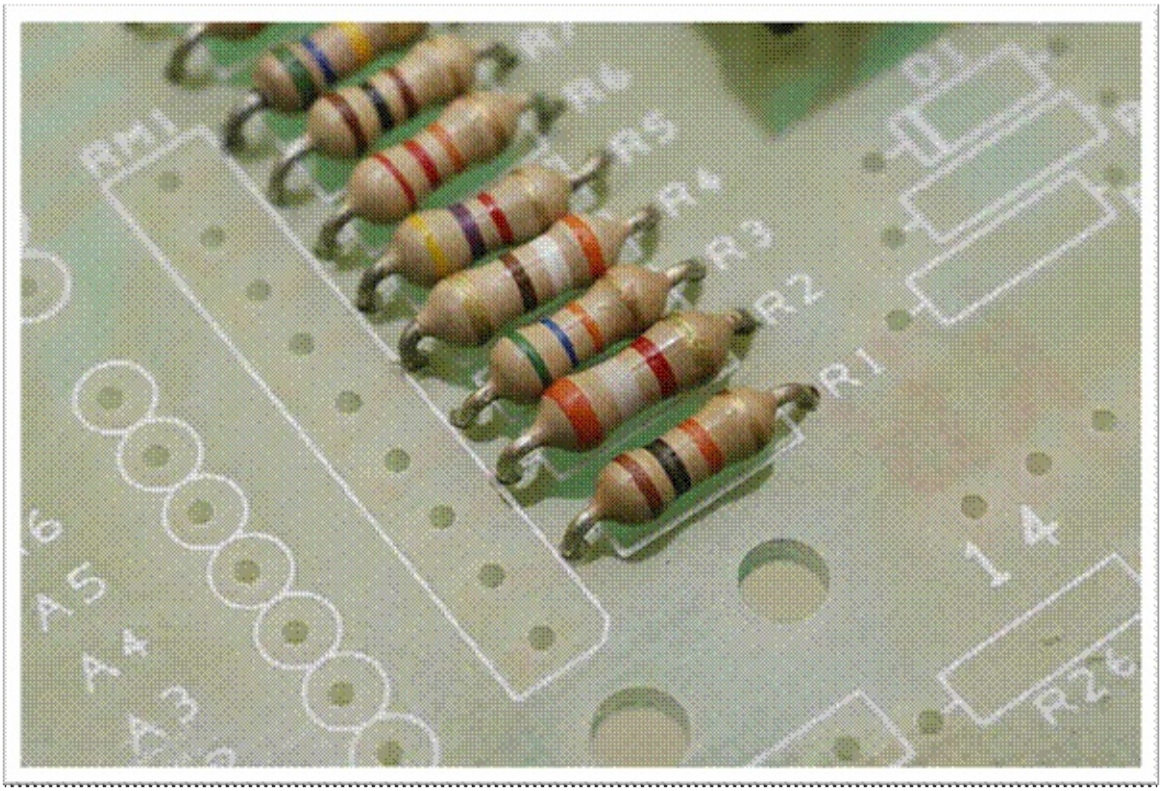

^^ This row of ¼ watt resistors was next. I like to show the colour codes all the same way round, with gold or silver (tolerance bands) on the right for consistency.

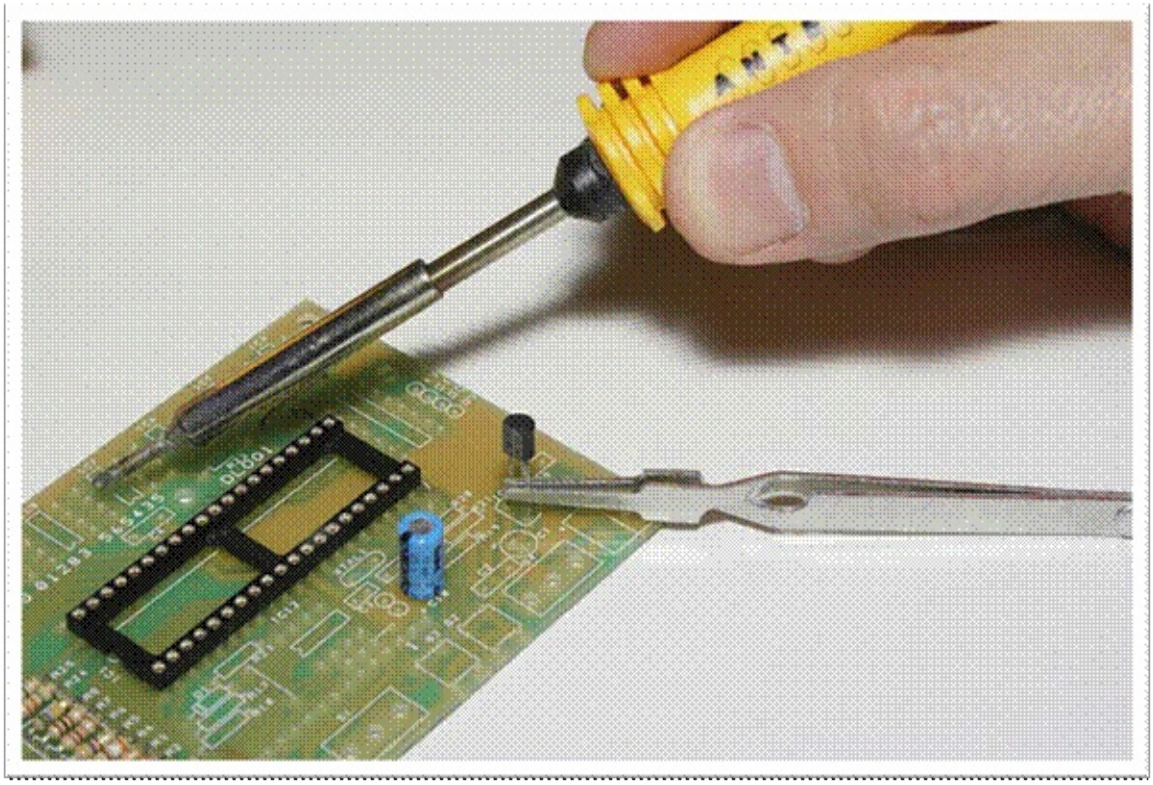

^^ This transistor was next. Solder it quickly to avoid damage, and observe polarity correctly, so it is the right way round on the p.c.b. The heatshunt is optional.

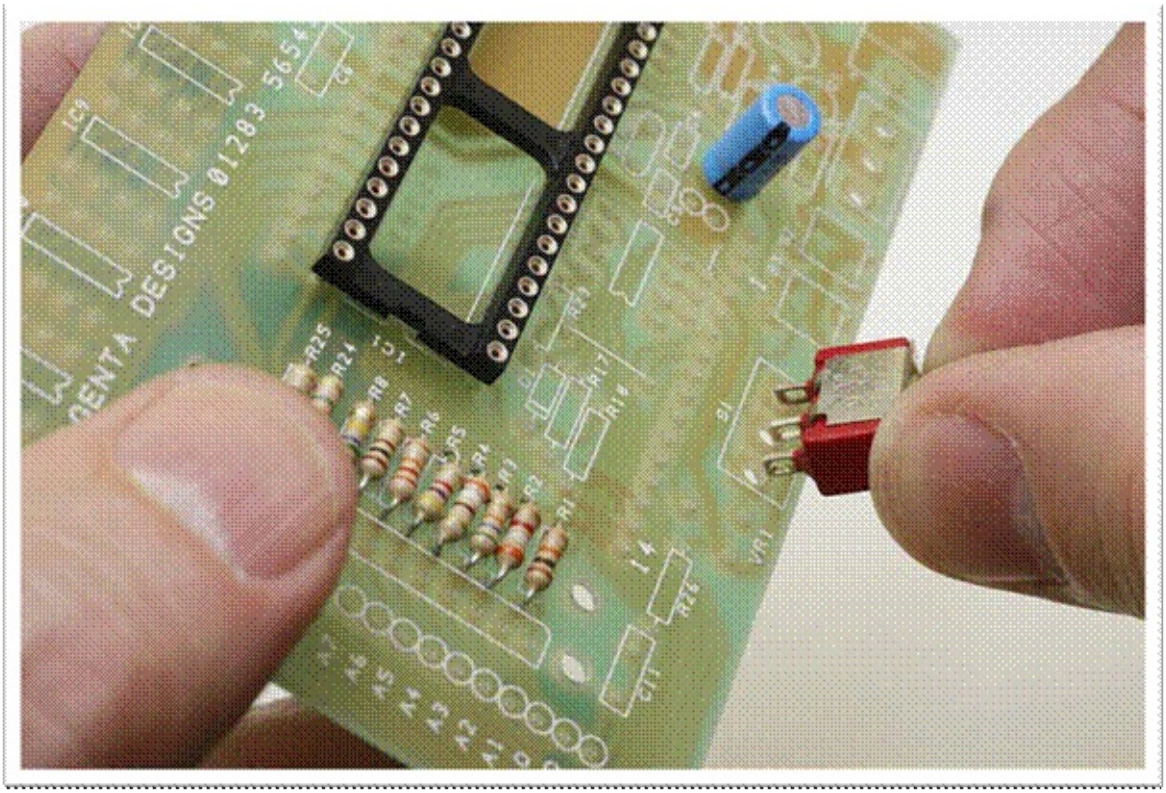

^^ Unusually, this toggle switch fitted directly onto the board as well which saved wiring it up. Neat idea!

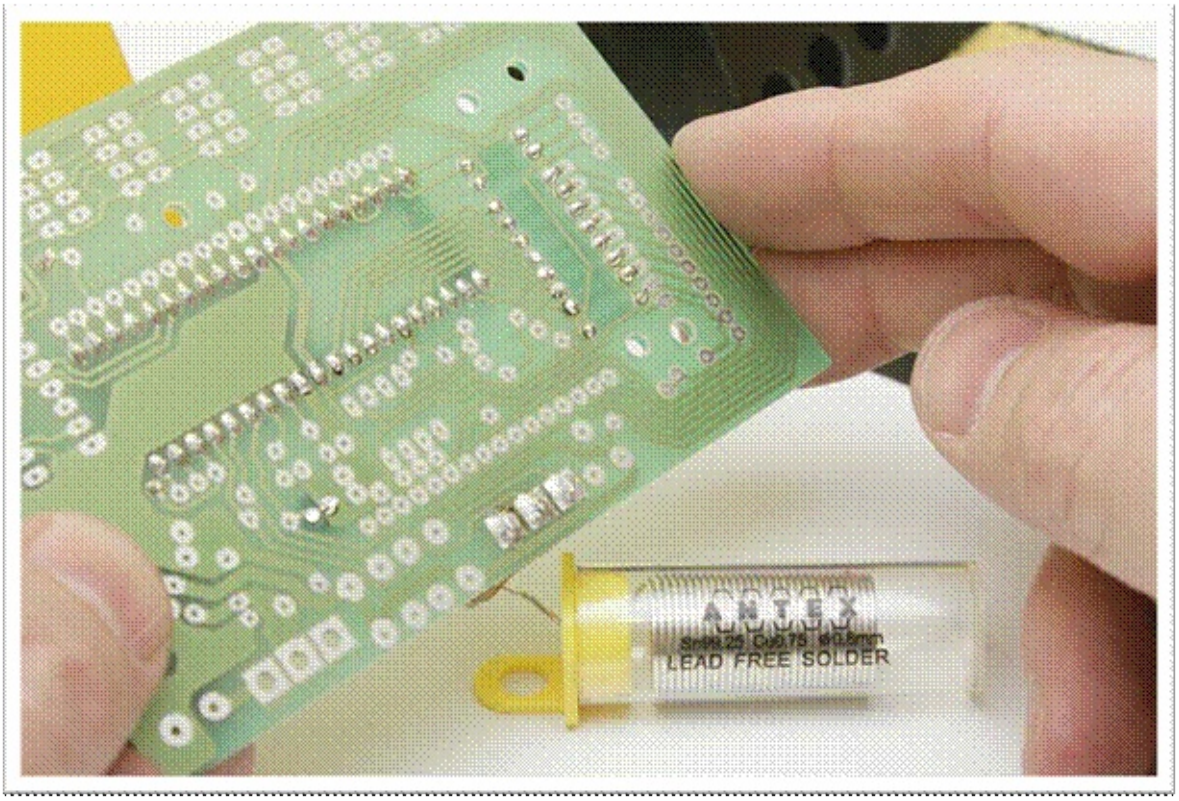

^^ As there is comparatively more metal to heat up, it'll take longer to solder the switch terminals, and you'll need more solder as well. Thicker gauge solder is useful at such times. Allow say 2-3 seconds to solder each terminal.

Don't forget to clean the soldering iron tip on its damp sponge every now and then, to ensure the bit is kept clean and shiny. Later on I'll show you how to correct any problems by desoldering using various techniques. Next, we'll move on from printed circuit board "through-hole" soldering and look at how to handle wires and leads.

Interwiring – get hooked up!

With practice, through-hole soldering of p.c.b.s will become second nature. There's no substitute for tackling some soldering jobs though, particularly trying a simple kit based on a quality p.c.b. which will boost your confidence enormously.

Most electronic devices need connecting up to external components such as battery packs, speakers, l.e.d.s or switches. Usually, multi-stranded connecting wire is used to connect circuit boards and external parts together. Unlike single solid-core wire, *multi-stranded wire* is flexible and vibration-resistant. Hobbyists mainly use 7/0.2mm wire (7 strands, each 0.2mm diameter) for low-voltage hook-ups although much Chinese equipment uses much thinner wires than this. So let's look at some aspects of soldering this type of wire.

In a separate photo sequence I show how a potentiometer (a panel-mounted variable resistor) and a light-emitting diode (l.e.d.) are connected using multi-stranded wire. The same principles of soldering apply to most other components including panel-mounted switches, loudspeakers, buzzers, audio sockets and more.

Components usually have terminals or "tags" to which wires can be soldered. Start by ensuring the component's tags are clean: otherwise solder will not wet properly and the joint will be impossible to solder, so all contamination must be removed. This is especially true of parts that have been in storage a long time. The connections often oxidise or blacken, so clean the solder tags with e.g. an abrasive glass-fibre brush, or a needle file or abrasive paper. Using a glass fibre brush was shown earlier in "Cleanliness and Tinning the Bit".

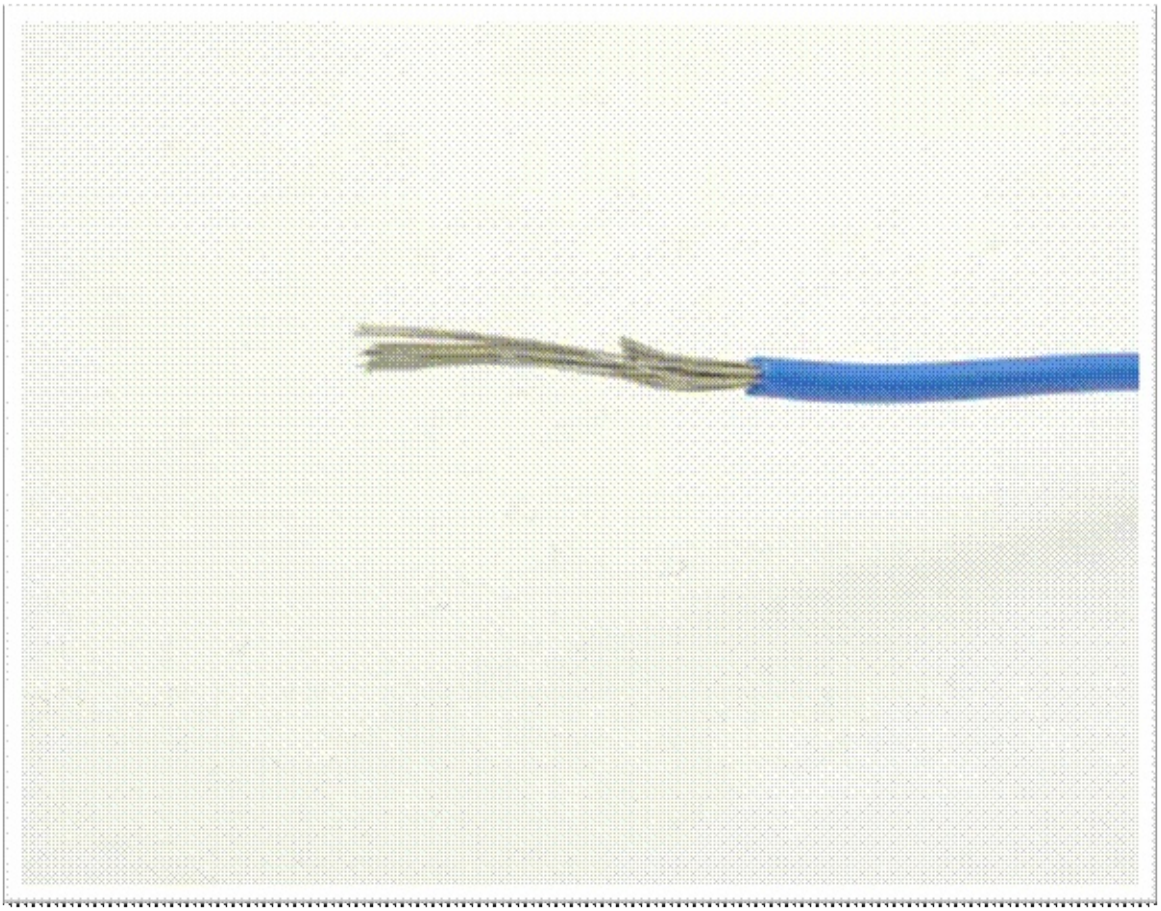

^^ How not to strip insulation off wire: some of the cores have also been cut – avoid doing this!

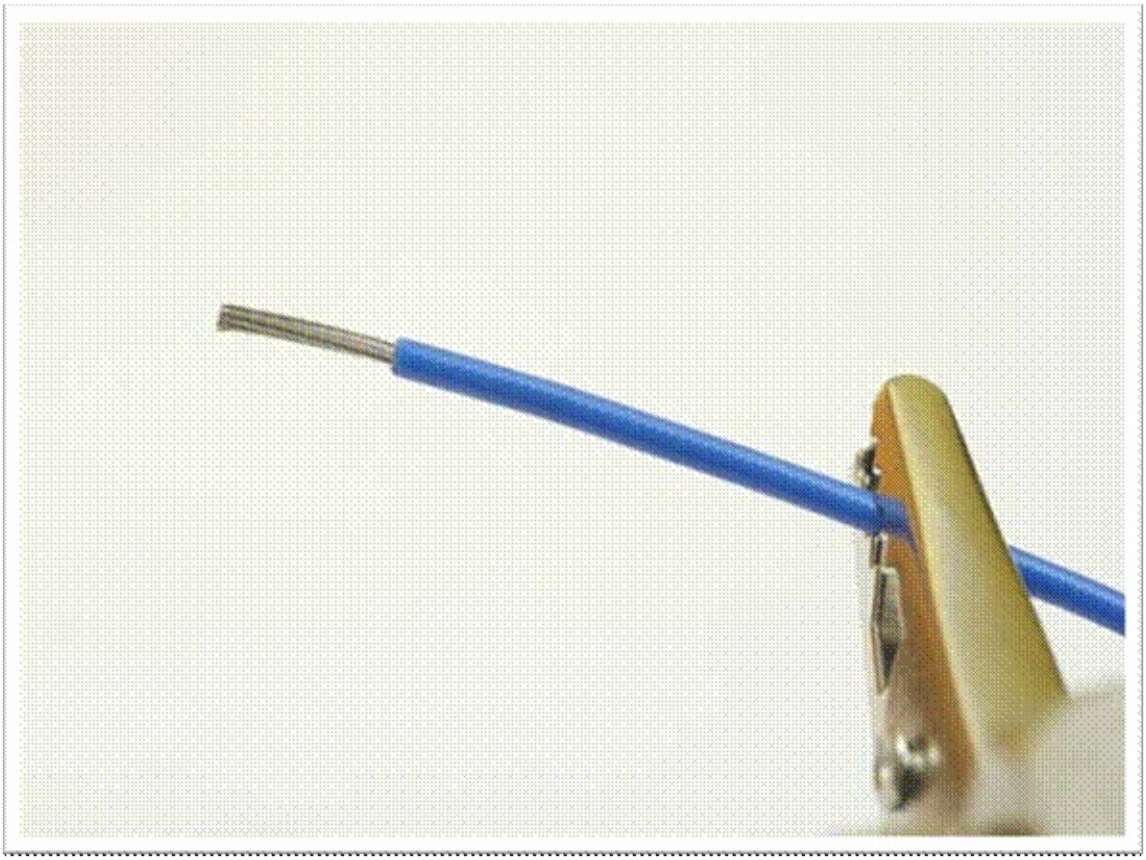

^^ Gripping a wire end in a "Helping Hand" croc clip can help with soldering.

After stripping a short length of insulation from the connecting wire, there are two ways to solder it to a component's solder tag. The first way is to "*tin" the stripped wire end to solidify it* - just heat it with the iron and melt a little solder on it, and let it cool. Poke the wire end through the solder tag, apply the hot iron to both parts and solder them together using a few millimetres of solder.

Although the assembly doesn't hold itself together so well during soldering (consider a Helping Hands jig if needed) this is quicker and easier to make and also easy to desolder again, and is perfectly adequate for most joints of this kind. The majority of commercial wire joints seem to be made this way.

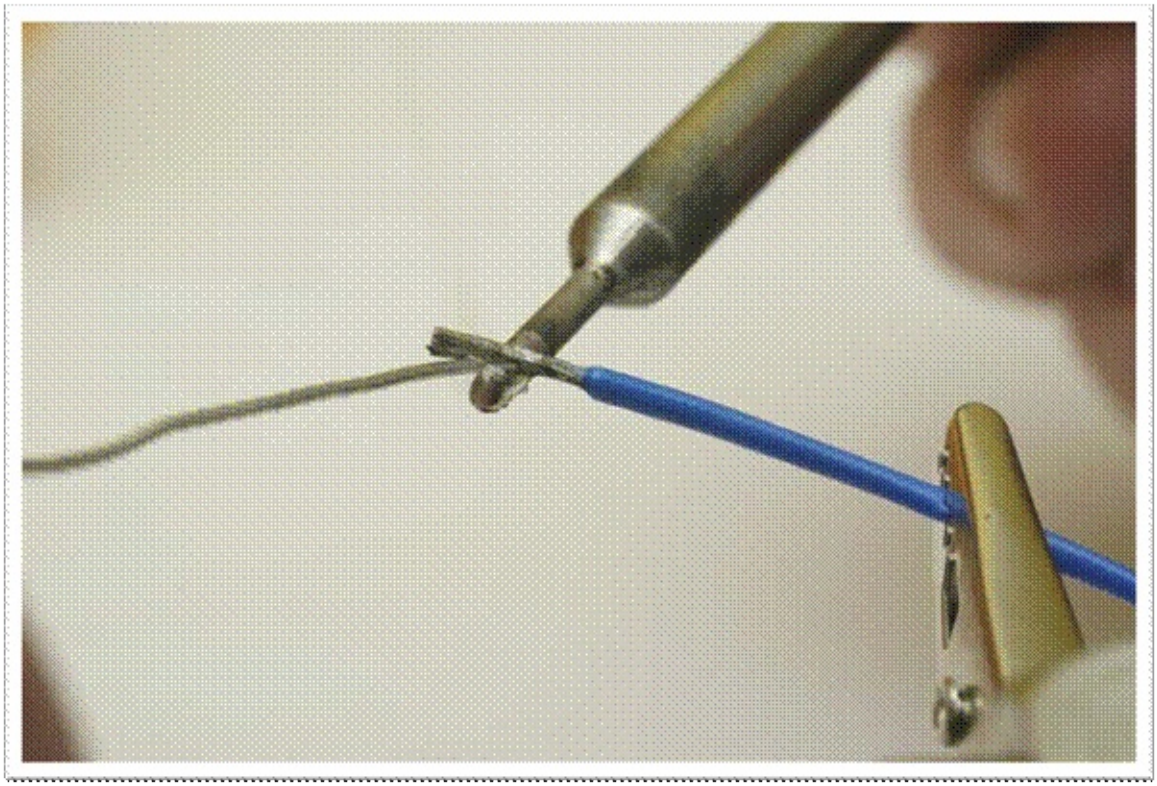

^^ *Apply a hot iron and solder, in order to "tin" the wire ends. This makes them into a solid.*

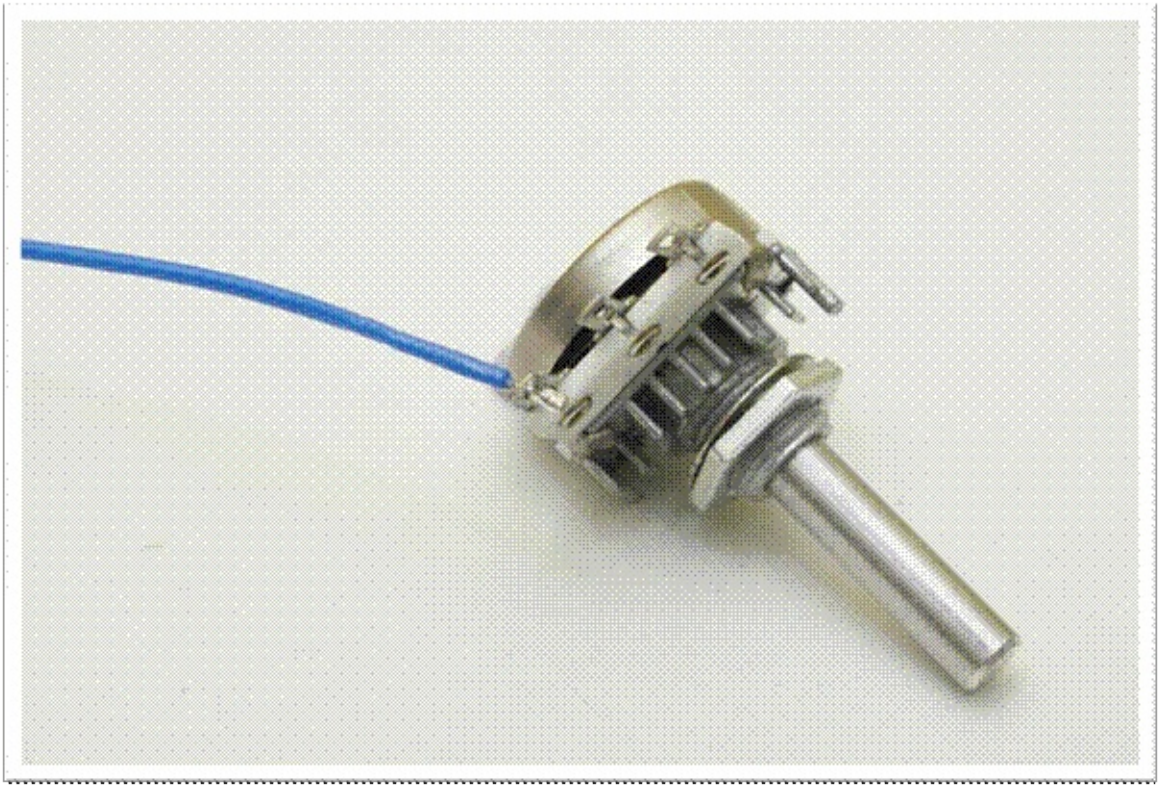

^^ *Then feed the tinned wire through the hole in the solder tag. Crop the wire with cutters if needed…*

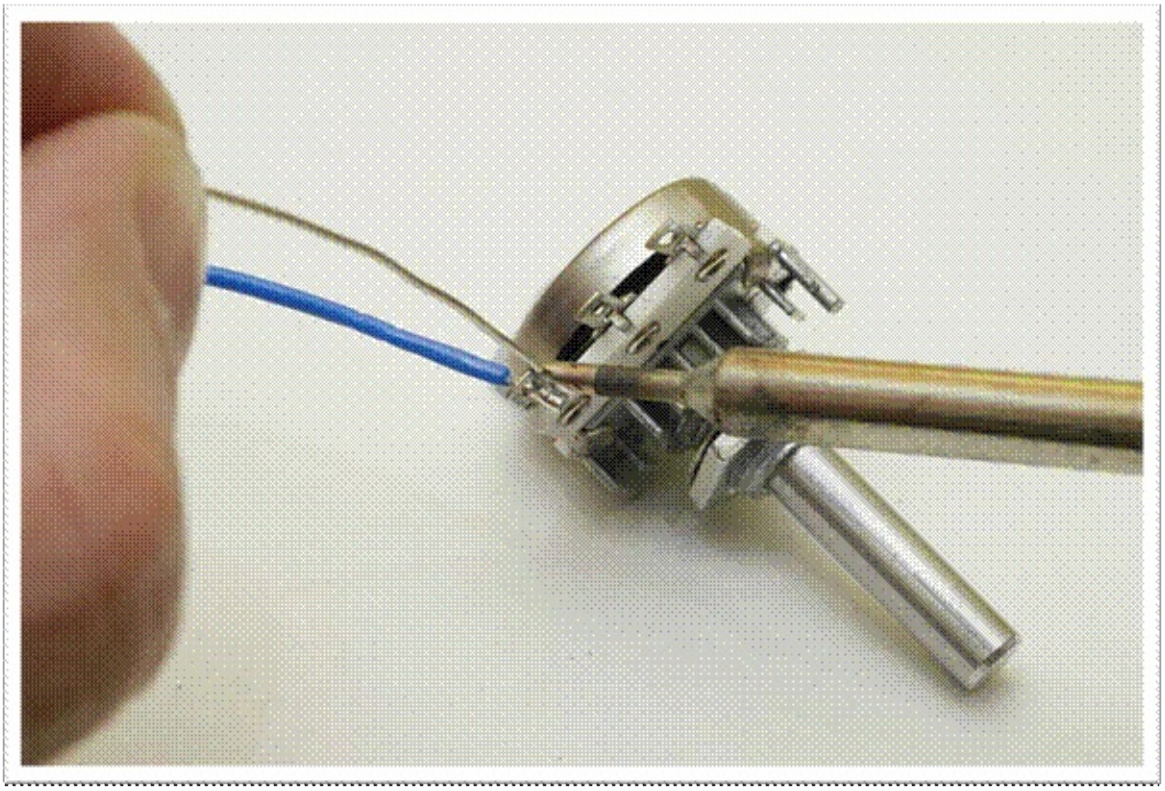

^^ *... and apply the iron to heat the joint. As there's quite a lot of metal to heat, allow several seconds to heat it up and then simply solder the wire and solder tag together with a dab of solder wire.*

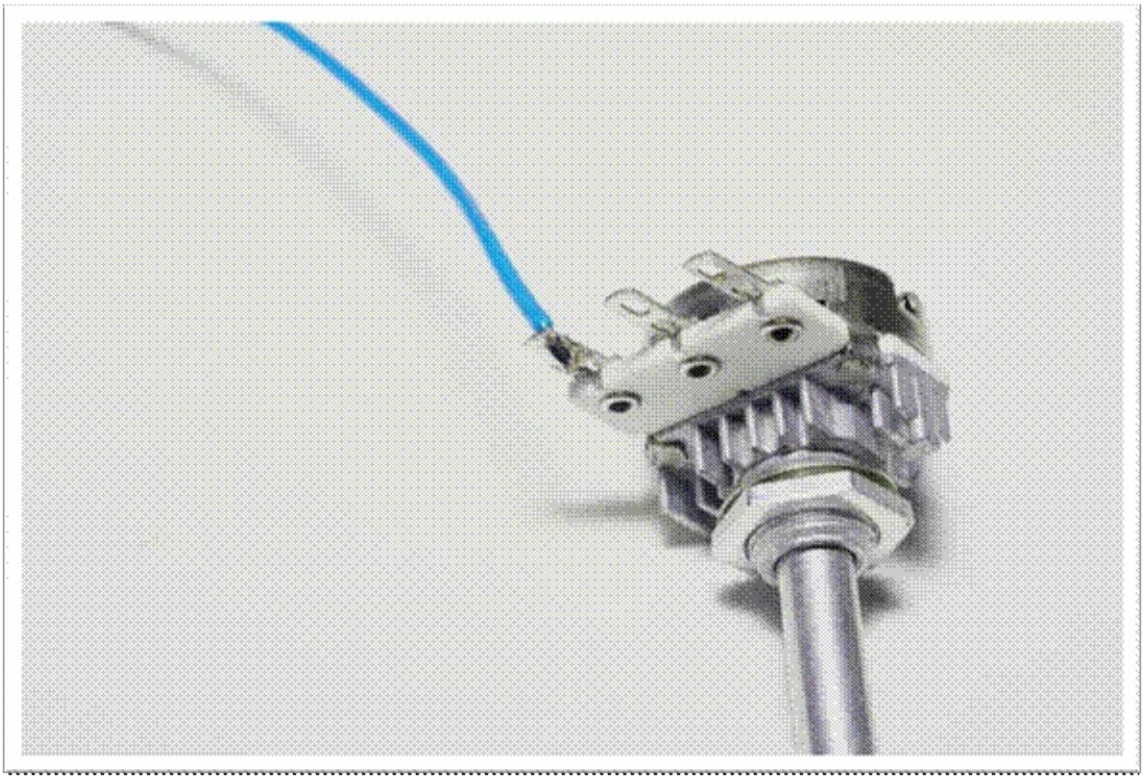

^^ *The result is a perfectly satisfactory solder joint.*

The second way is to loop the **untinned** wire through the tag a few turns and then solder it. This secures the wire during soldering, but it's messier to desolder if things go wrong (see later):

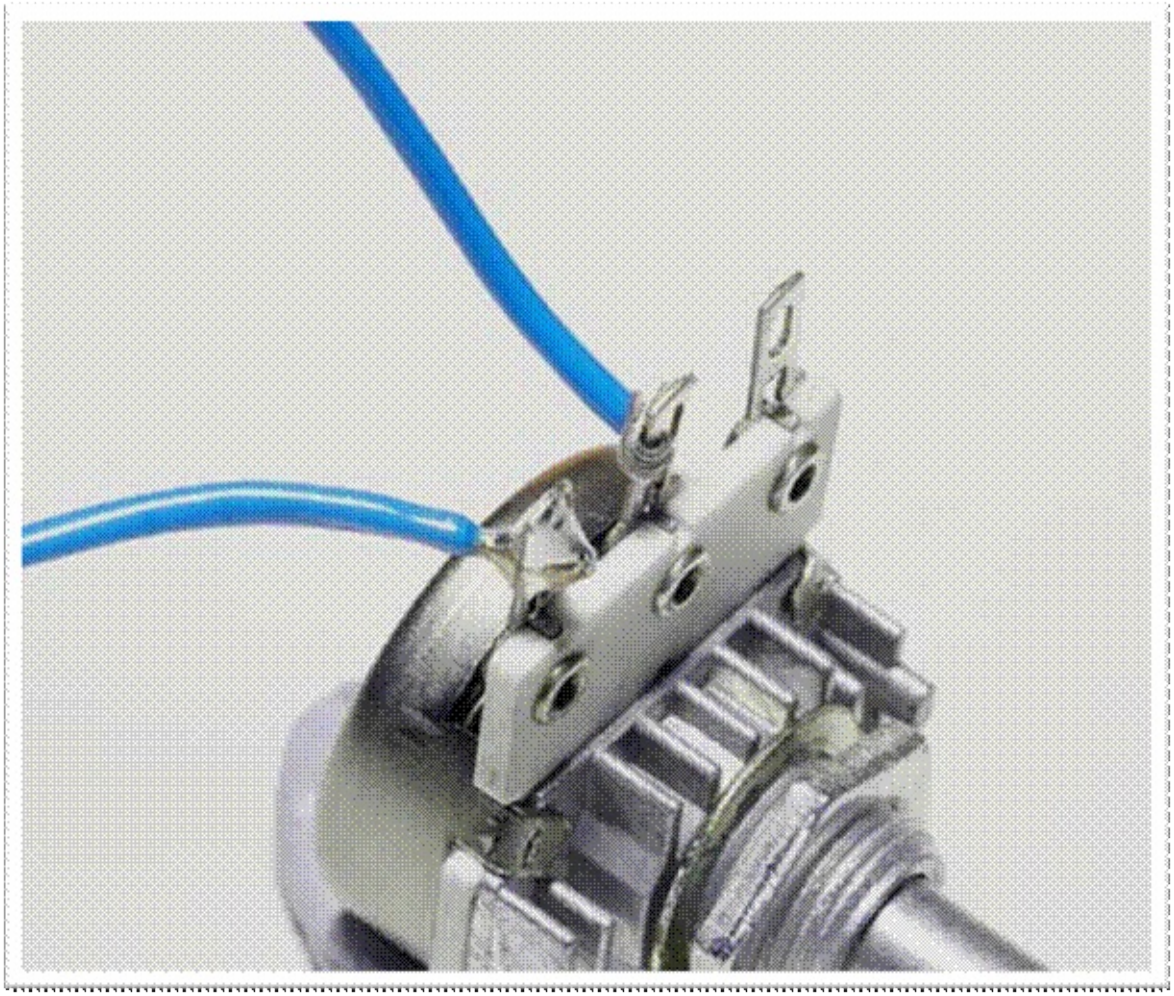

^^ *The centre wire (potentiometer wiper terminal) has been wrapped around to secure it before soldering.*

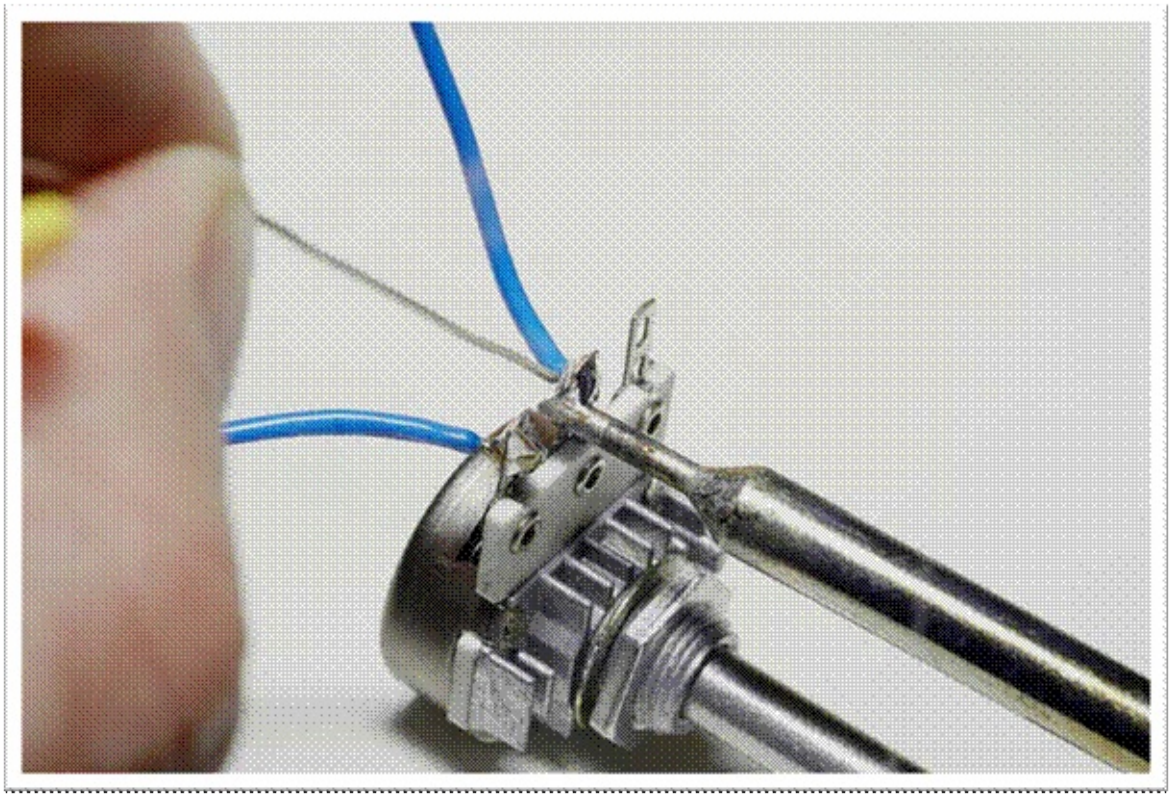

^^ *Solder the joint in just the same way – heat it up and dab on some solder wire.*

Much electronic equipment is connected or inter-wired this way and soldering everything together is a key stage in assembling any electronic project. I'll explain some refinements you can try, later.

Wire joints

Soldering isn't always the best solution to some problems, for reasons that I explain in the next section called Fatigue and Breakage. However you can solder wires together to join them simply and cheaply, and next I show a classic wire joint of this kind, sometimes called a **Western Union** joint.

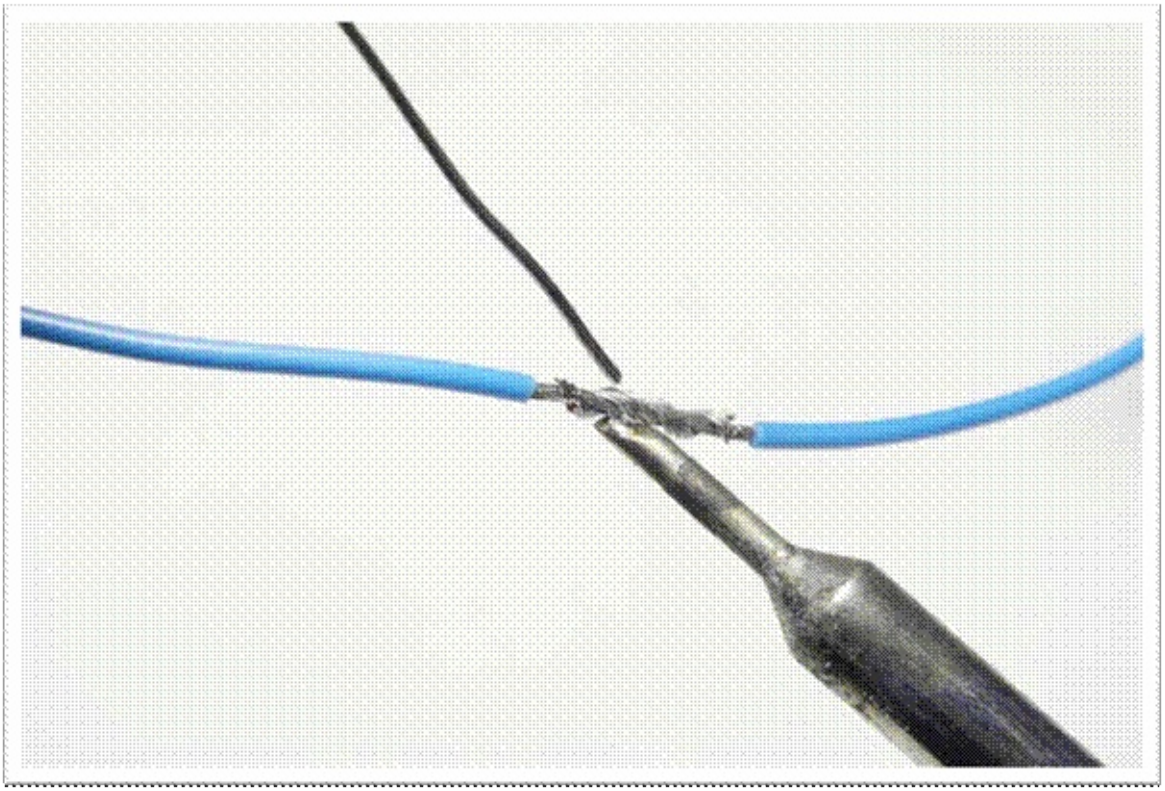

^^ *Soldering a Western Union wire joint.*

Strip the ends from each wire using wire strippers, and try not to cut any of the stranded cores or this will create a weakness. (Stray strands of wire can also be a hazard.) Then twist the wires securely together several times, ideally four or five. Apply a soldering iron to the exposed joint and dab on some solder until it flows fully over the joint, then remove the iron and allow the joint to cool.

The wire's plastic insulation may shrink back a little due to the heat, but try not to overheat it excessively. If you have the resources you can finish off by insulating the joint with some heatshrink tubing (slide it over a wire before you make the solder joint!). Otherwise use ordinary PVC tubing or insulation tape if you have any.

A solder tag can be soldered easily enough, and it's probably best to feed a stripped wire end through the tag and twist it over several times before soldering it, so it's held together when soldering.

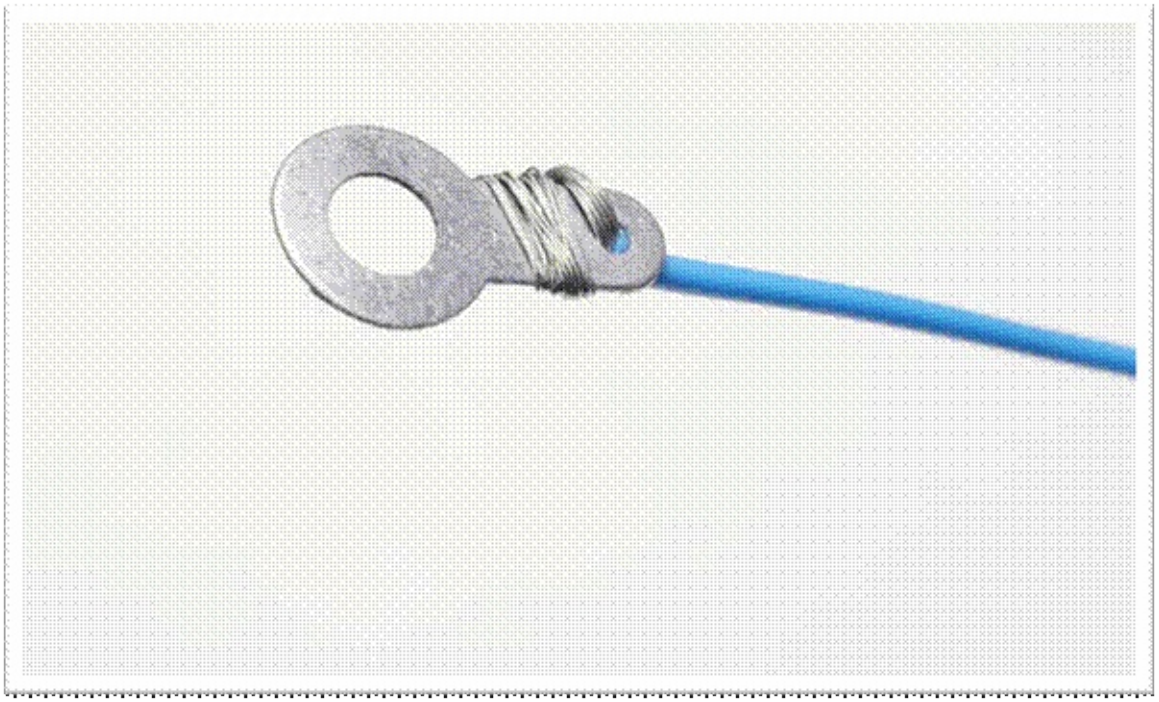

^^ *A solder tag is soldered by wrapping a stripped wire end through the hole and round again, to secure it.*

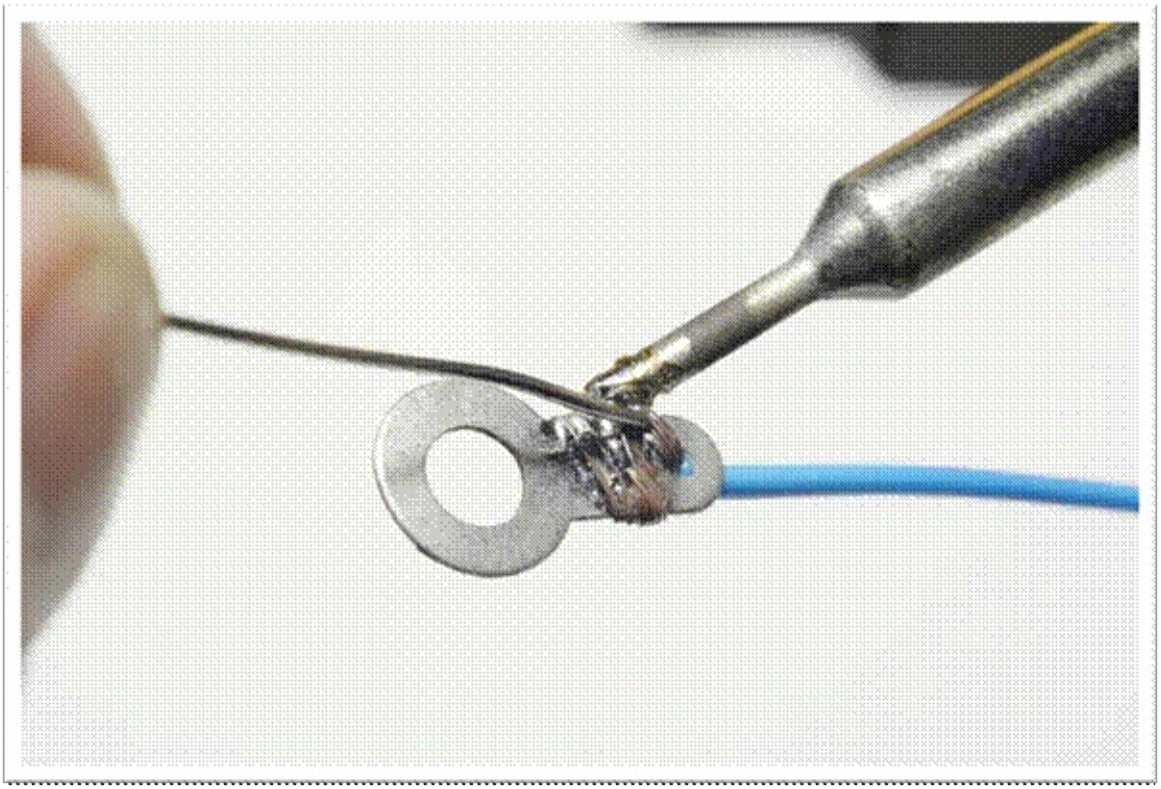

^^ *Apply plenty of heat and solder for a few seconds.*

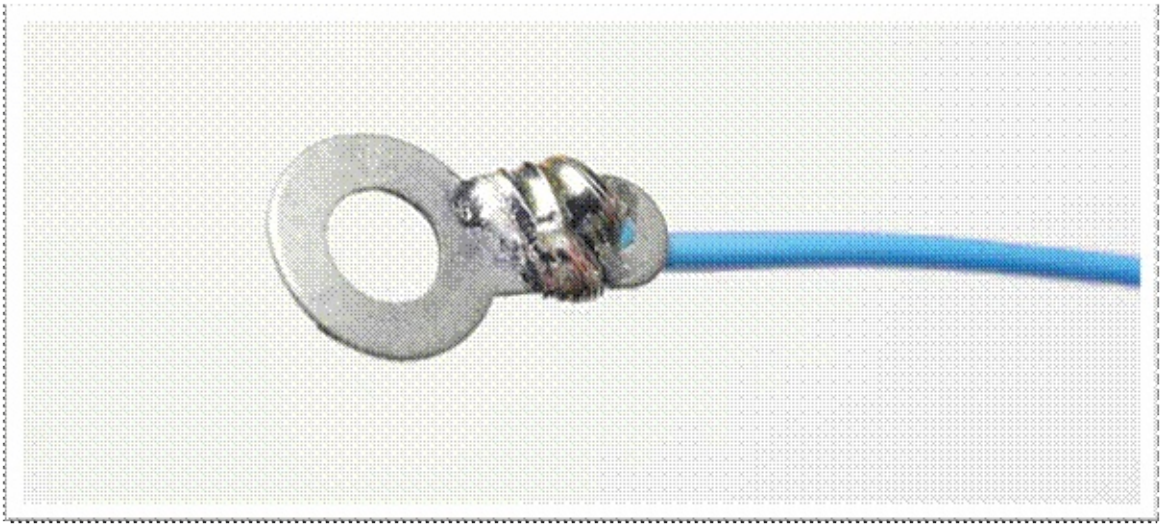

^^ *The completed solder tag*

The next sequence show how the same basic principles of soldering wires are used to connect up a device such as a panel-mounting l.e.d.. A series resistor can be wrapped around and soldered directly to one of the l.e.d. solid wires, and then two multi-stranded connecting leads are soldered to the l.e.d. and resistor. It's best to use heatshrink tubing or PVC sleeve to insulate the solder joints and prevent short circuits afterwards.

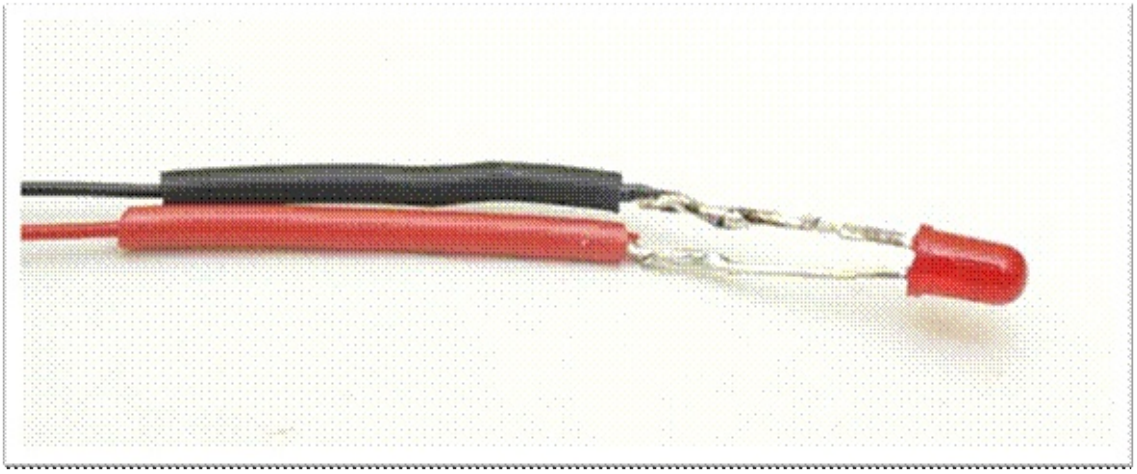

^^ *Multi-stranded wires can be soldered to the solid leads of an l.e.d.: insulate them afterwards. Different coloured wires identify the polarity of anode and cathode.*

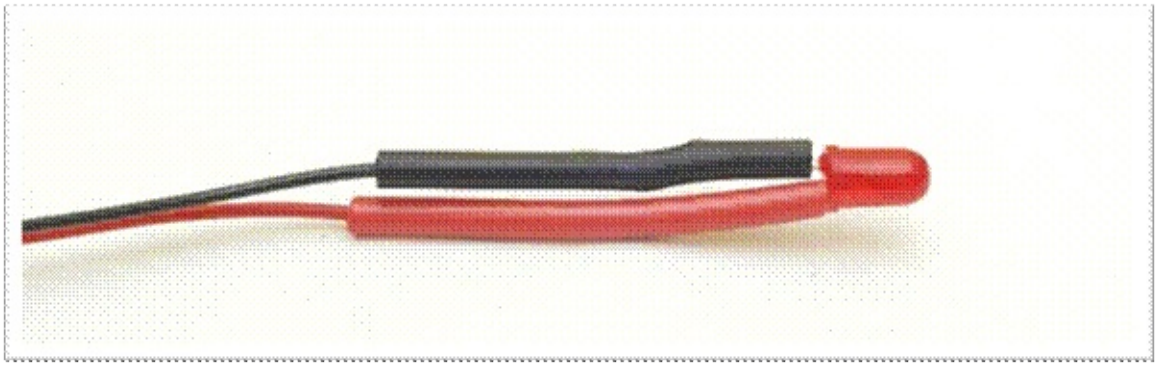

^^ *PVC sleeving or heatshrink is needed to prevent short circuits.*

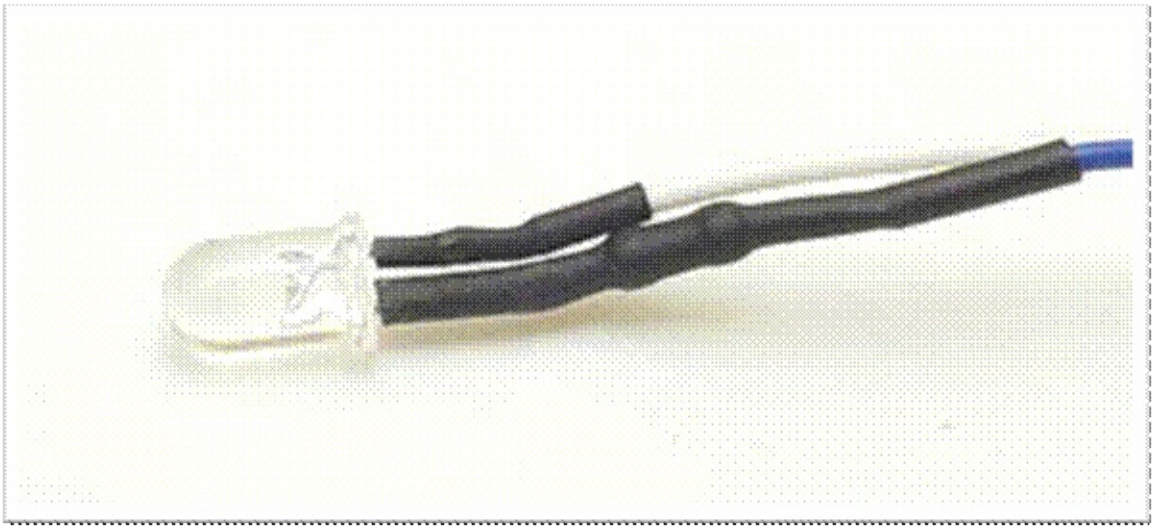

^^ *A commercial l.e.d.– the series resistor can be made out in the sleeving.*

Wires can also be soldered directly to printed circuit boards by stripping and tinning the ends, provided they fit through the holes in the p.c.b. It's a very common and cheap way of hooking up a board using "flying leads" and you'll see this all the time in consumer electronic equipment. For convenience so-called "solder pins" can be used, onto which flying leads may be soldered from the component-side instead.

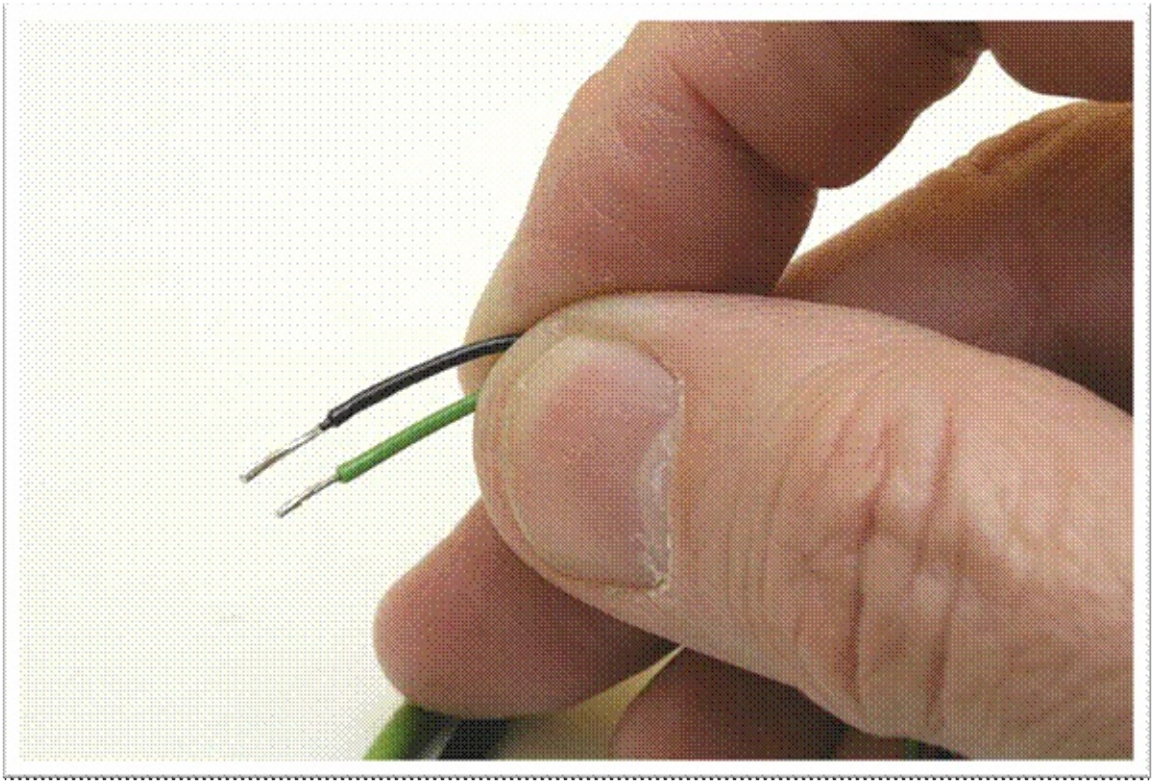

^^ *A set of l.e.d.s connecting wires, stripped, tinned and ready to be soldered to the p.c.b.*

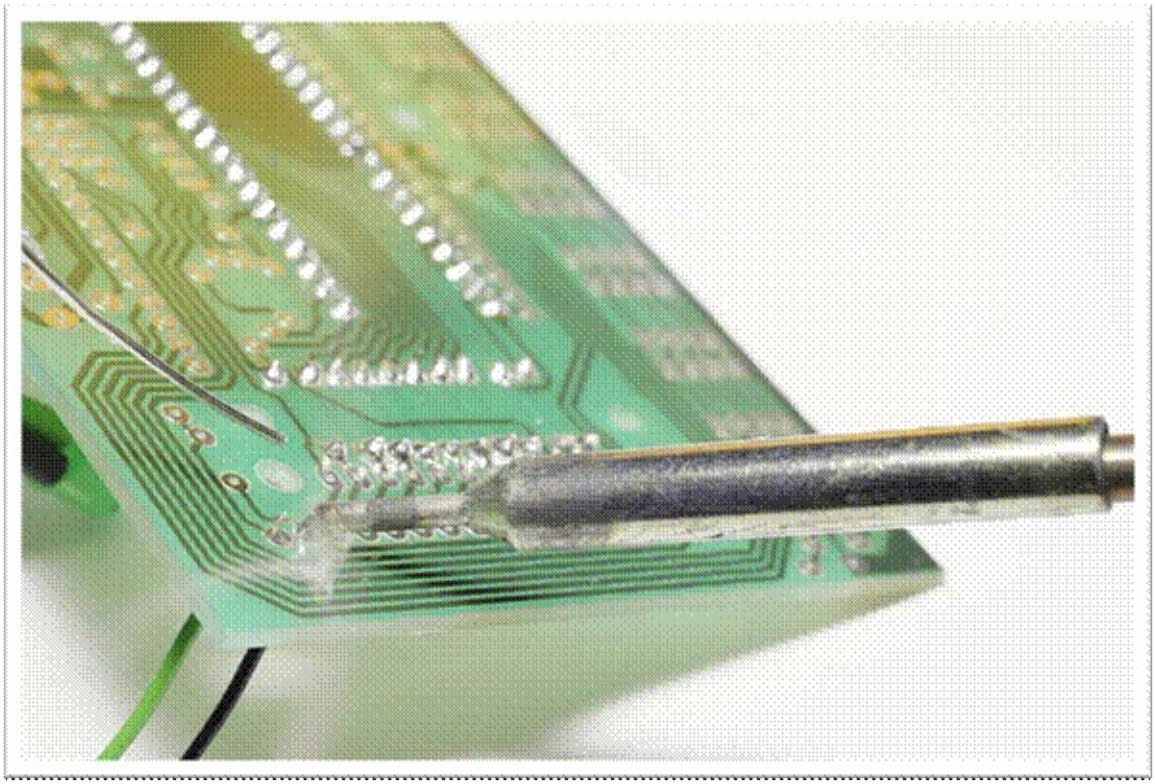

^^ Solder the two "flying leads" to the copper pads in the usual way. Hopefully the holes are big enough for the wires!

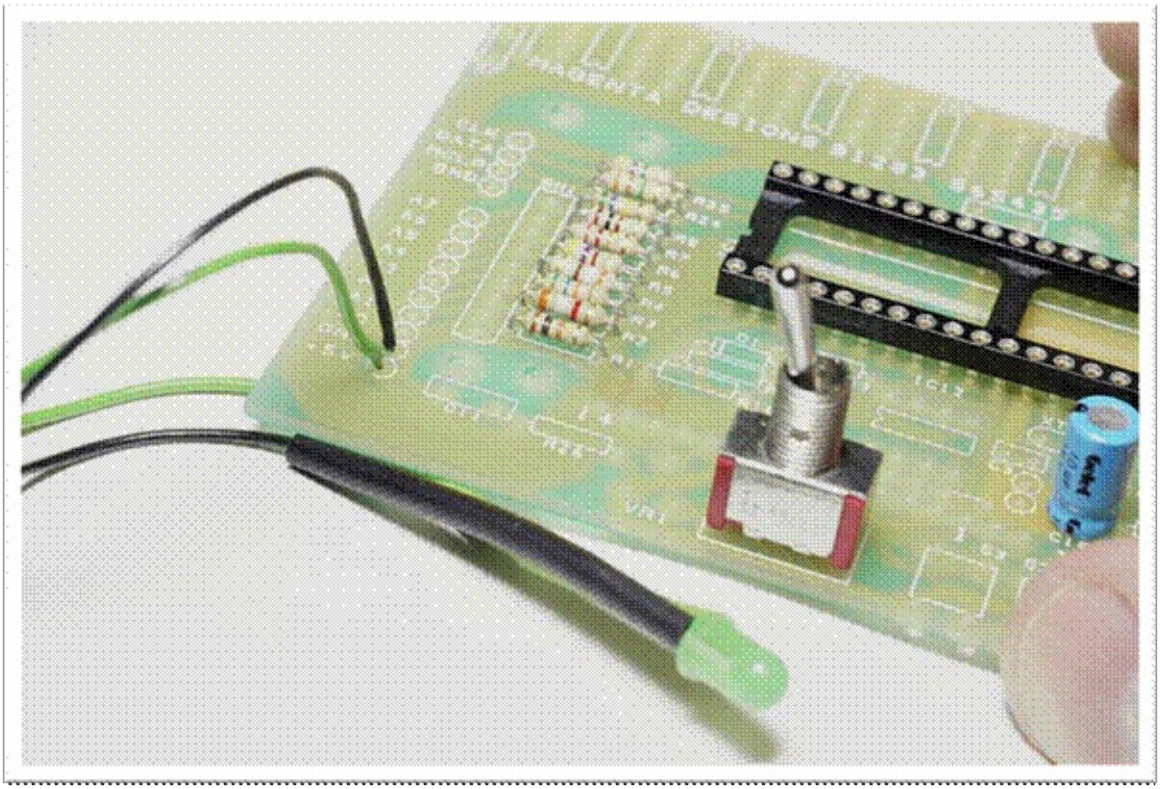

^^ Connecting an l.e.d. to a circuit board with flying leads.

Wires can also be attached to the underside (solder-side) of circuit boards, tacking them onto existing solder joints by re-melting them and absorbing the tinned wire end into it ("reflow soldering" – see later). This is a cheap and cheerful, semi-reliable way of rigging wires to a circuit board, and it's used all the time in imported consumer electronics.

Tidying up

I'll leave it to readers to decide whether they should cut off excess wire before or after soldering. After the soldering is complete, I prefer to tidy up the joint by snipping any excess wire from the joint using a pair of "end cutters" shown earlier. These expensive hand tools have specially angled blades that snip the joint neatly down to the top of the solder joint. Ordinary side cutters will do fine.

It's worth taking time out to inspect the work closely, looking for any missing solder joints, whiskers of solder or swarf shorting out any solder pads, and all such potential problem areas should be dealt with prior to testing the board. Faultfinding goes beyond the scope of this guide, but it's true to say that almost always, any problems noticed after powering up the circuit are due to soldering faults or wrong components being used.

Reflow technique

Another technique often used is “reflow” soldering. This is used to “tack” devices or wires together, especially if very small, sensitive or fiddly parts are involved. There might be no room to make a “proper” sturdy joint, or it might just not be necessary to have any mechanical strength in the joint, especially if tiny parts are used.

As an example, imagine a small temperature sensor (I used a transistor) for use in a thermometer project. It could be quite tricky to solder flying leads onto the sensor’s leadouts, so a good approach is to tin both the flying leads and the sensor’s leads, and then simply touch them together and re-melt the solder with the iron. There’s no need to add any more solder, because the solder that’s already there will re-melt and the joint will be made. Sometimes this is called a butt joint.

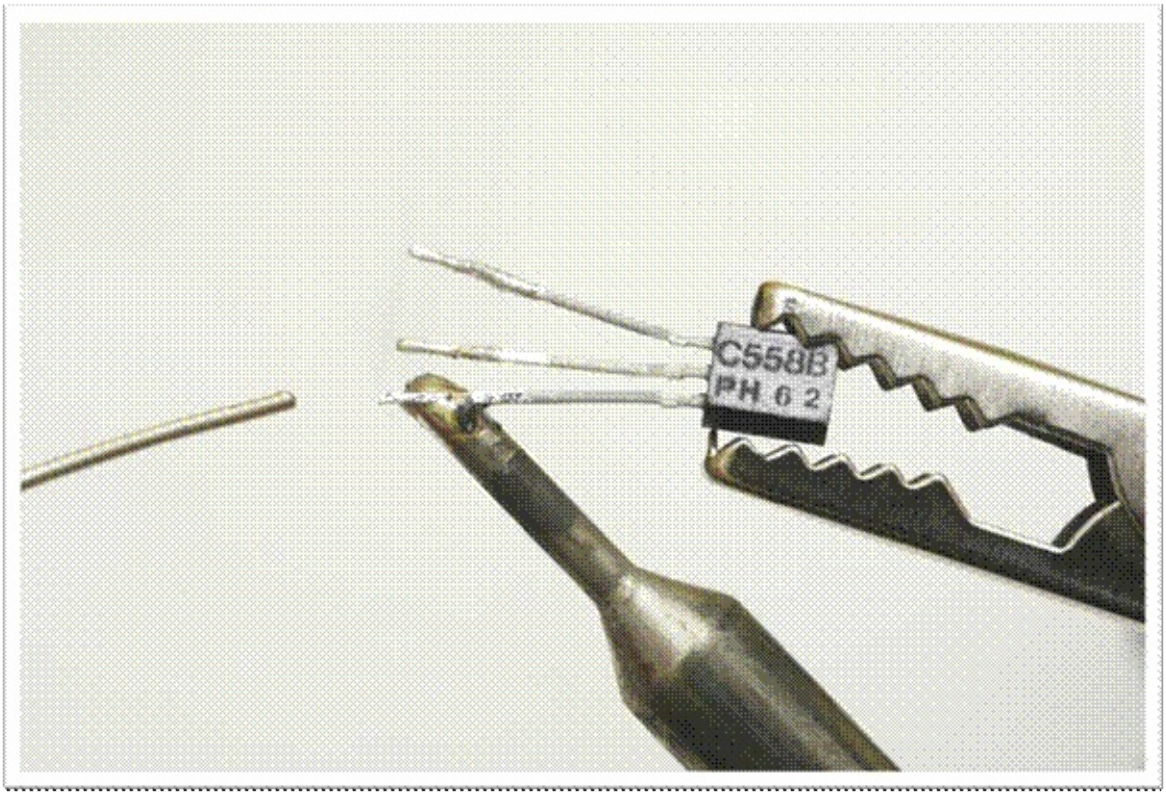

^^ The leads of this sensor (transistor) have been tinned, ready for flying leads to be tacked onto them with a reflow method. A Helping Hands jig might help!

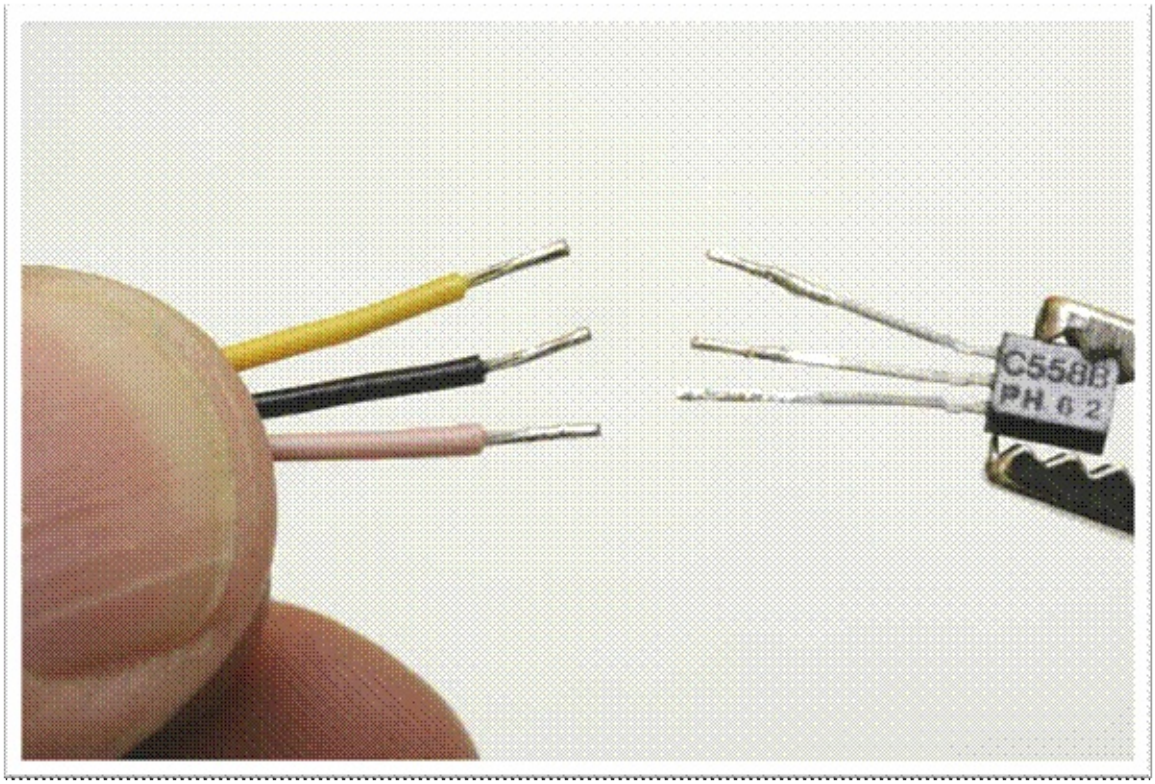

^^ *The three flying leads stripped, tinned and ready to be reflow-soldered onto the device.*

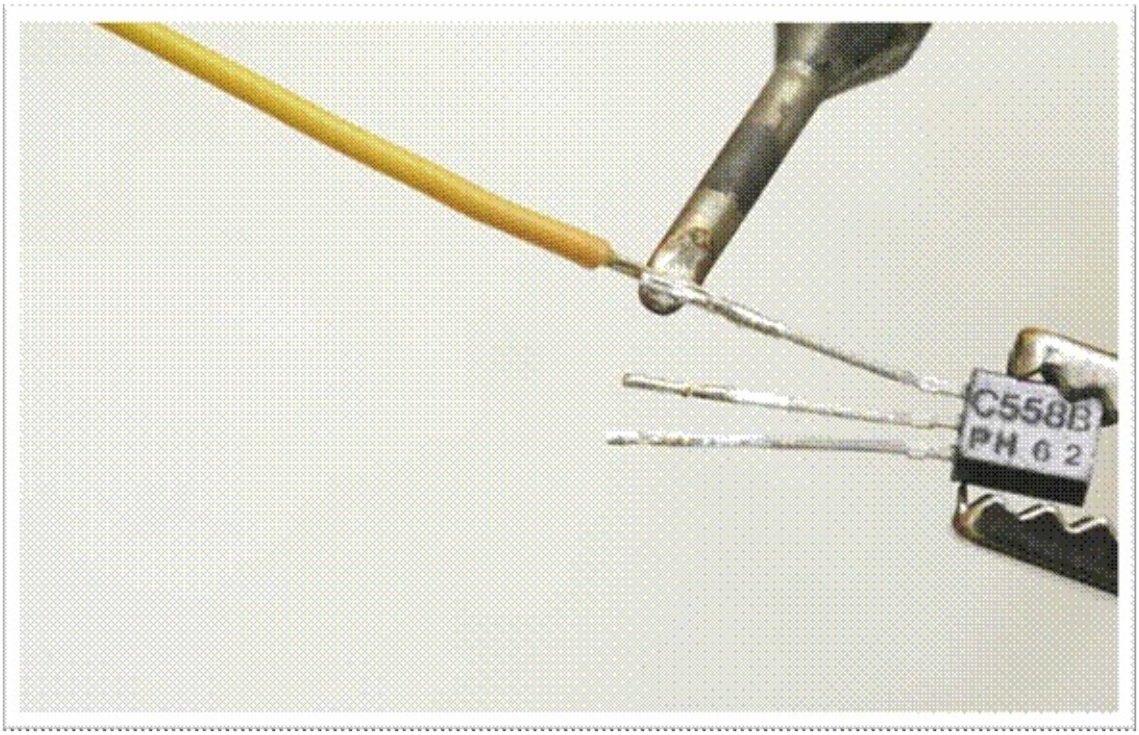

^^ *To reflow solder them, simply hold the two leads together while re-melting the solder with the iron.*

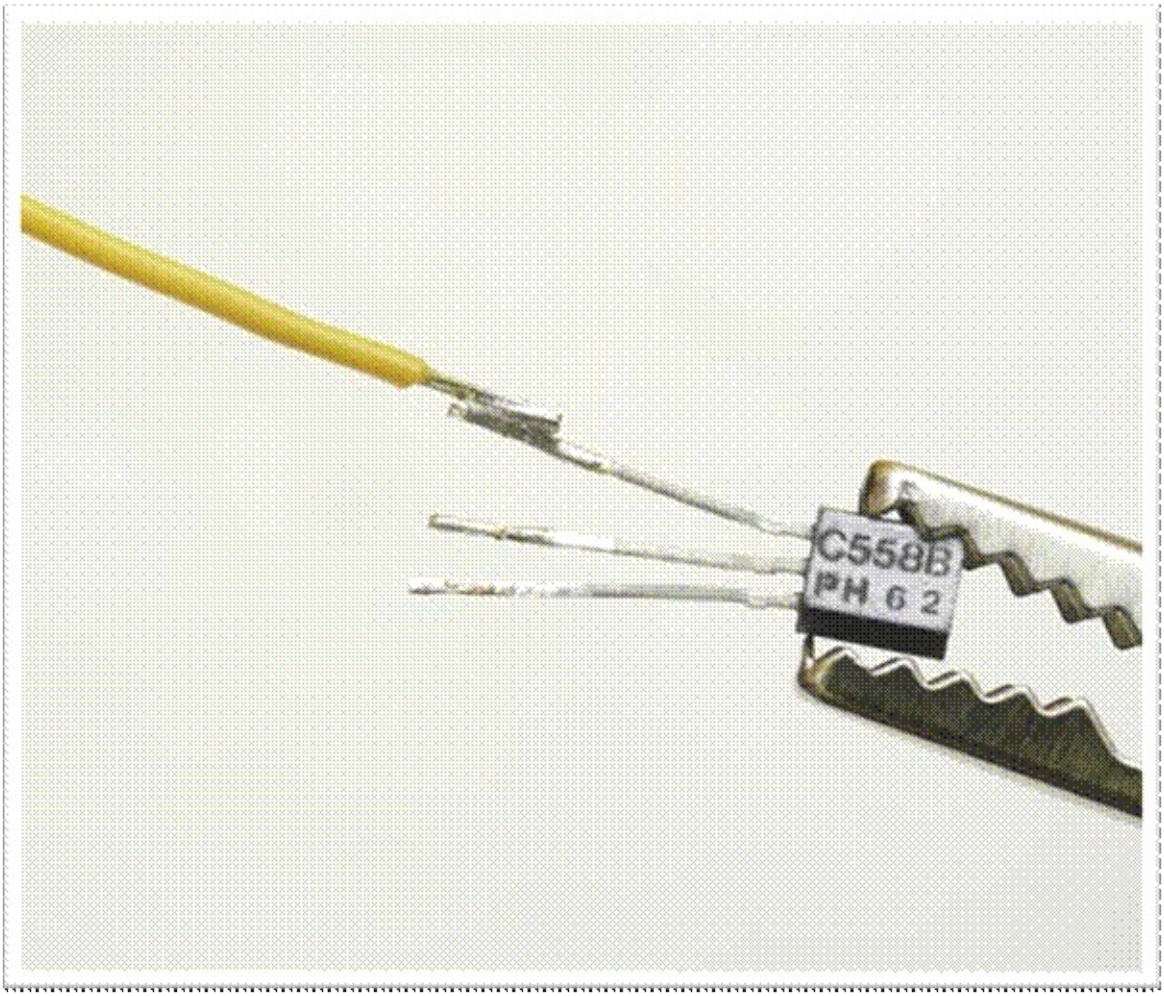

^^ *Remove the iron and let the solder cool. The wire is tacked on.*

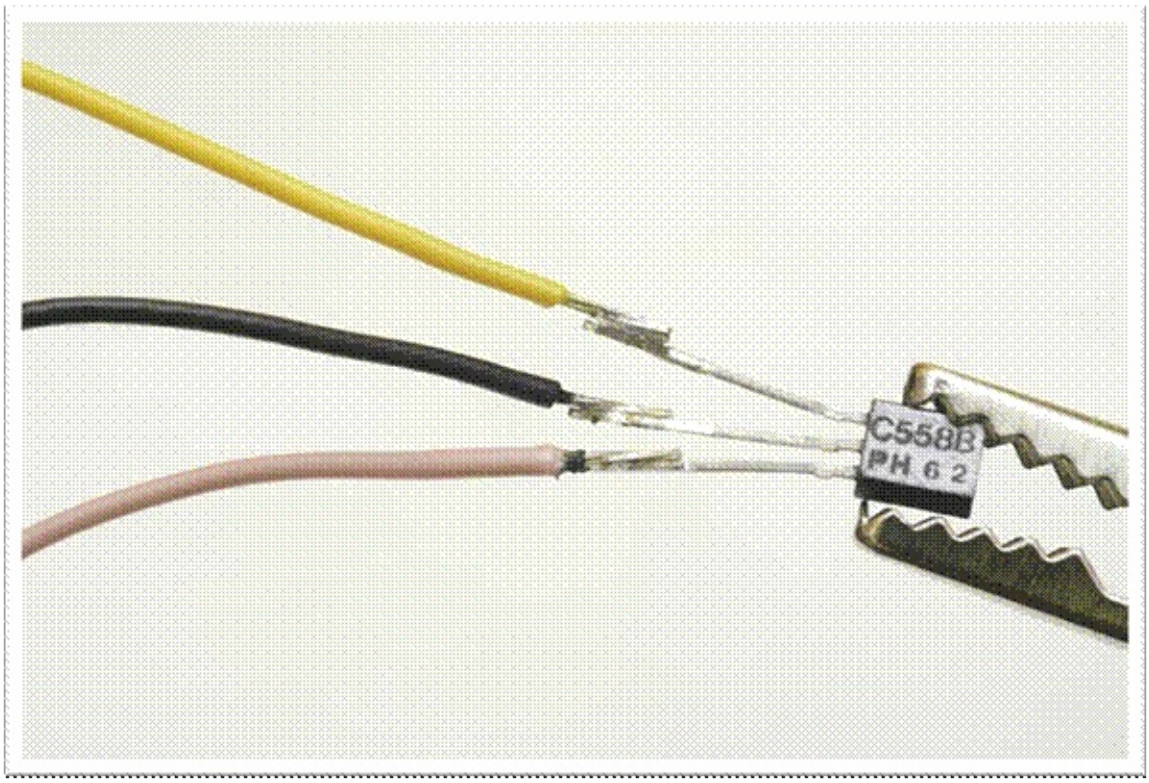

^^ *Repeat for the other leads. They just need insulating with sleeving, then job done!*

Depicted next is a typical “tag strip”, an insulated panel with metal solder tags used for making sundry connections. (Entire TVs and radios used to be hand-built with them, in

the early-mid 20th Century!) The principles of soldering are exactly the same, but more time is needed when applying the soldering iron because more metal is present, which needs more heat. You'll need more solder for bigger joints like these, so larger diameter solder makes a quicker job of it. Consider adding more flux (see earlier) to see if it helps.

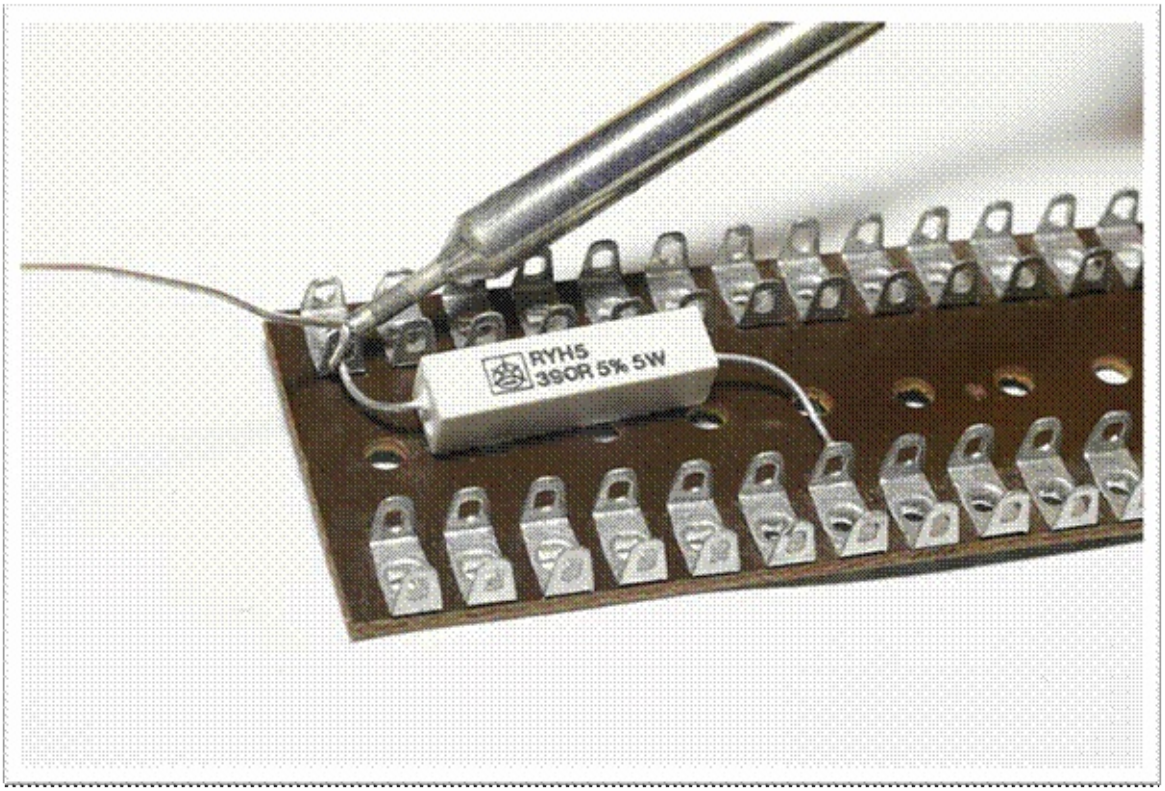

^^ *Wrap wires through the terminals and arrange everything neatly, then solder as normal.*

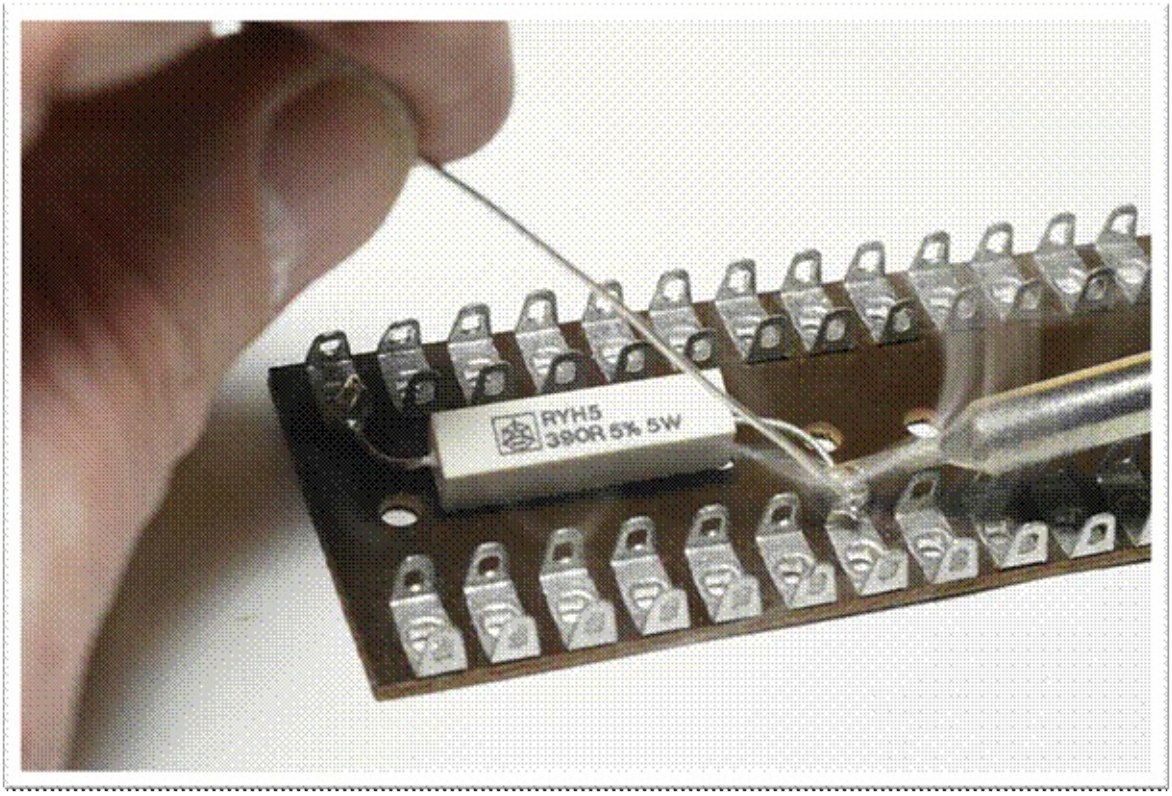

^^ *Don't be afraid to apply more heat with larger assemblies like these: they contain more metal than, say, an ordinary p.c.b so allow more time for the solder to flow over*

everything properly.

Fatigue & Breakage

Earlier I explained how multi-stranded hookup wire is flexible, which also makes it vibration proof – that's why a car's electrics are full of multi-stranded wiring, and test equipment probes use ultra-flexible multi-stranded wire for the same reason. Solid-core wire can be bent and will stay in shape (called "plate wiring") but if it's repeatedly bent or vibrated then it may eventually break somewhere due to fatigue.

The same is true of wires that have been soldered or tinned. No longer is the wire 100% multi-cored and flexible – instead it's been turned into a *single core wire* at the point where it's been soldered. This is potentially a weak spot and could eventually fracture due to fatigue, if subjected to continued vibration (e.g. in a car engine bay or in motorised equipment).

In a lot of equipment problems can be avoided by adding *strain reliefs* of some sort, to stop the wire being flexed where it's been soldered. Heatshrink tubing, or a dab of hot-melt glue, are ways of taking the pressure off the joint and ensuring soldered wires won't snap off due to vibration.

One of the reasons that higher-quality equipment and cars etc. use crimp terminals and connectors is that crimped (as opposed to soldered) connections retain all the flexibility of multi-core stranded wire from end to end, avoiding problems of wires breaking off. A *ferrule* is a very neat way of tidying wire ends and preventing stray strands of wire doing damage. Ferrules can be used to connect wires into screw terminal blocks etc. Simply clamp the terminal block down onto it and the screw will grip the ferrule.

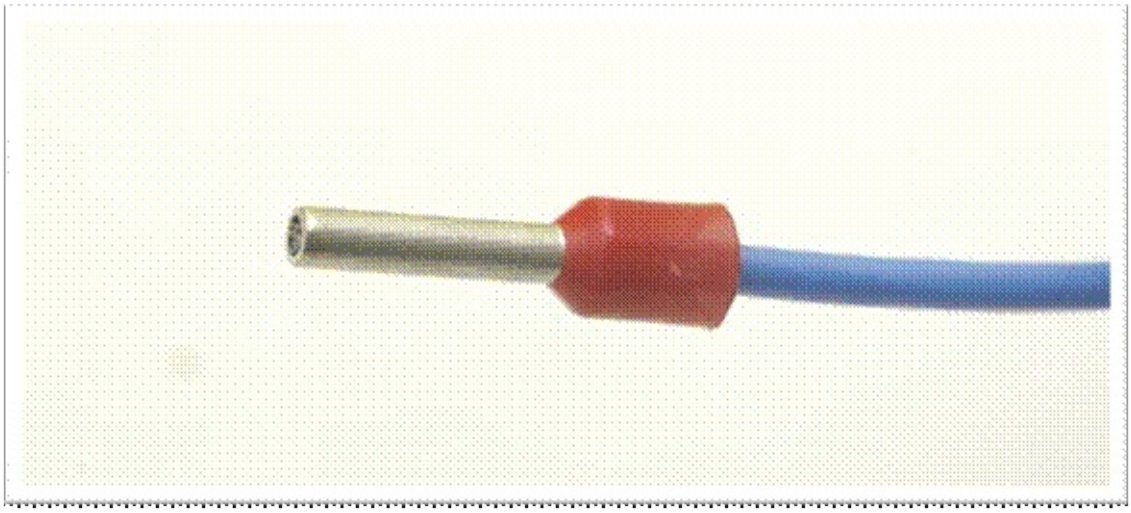

^^ *Instead of soldering them, wires can be terminated with ferrules prior to fitting to e.g. screw terminal blocks. This makes them vibration-proof and also avoids any problem of stray wires poking out.*

Faults & Desoldering techniques

By putting into practice the guidelines in my *Basic Soldering Guide* practice, there's no reason at all why you should not obtain perfect results and eliminate any potential problems. Hopefully the information gives you plenty of guidance to tackle various soldering projects with confidence. There's no substitute for getting some hands-on experience though, so I'd repeat the advice to try assembling a simple high quality electronic kit or two, such as those produced by Velleman and see how you get on. Powering up your first project successfully is a great thrill as every electronics hobbyist knows.

^^ *Popular desoldering products, a pump and various widths of desolder braid.*

Let's now look at reversing the soldering procedure – what to do if things go wrong, or maybe you have to repair a circuit by replacing a faulty component.

A solder joint which is badly made is likely to be electrically "noisy", unreliable and will probably worsen over time. Expansion and contraction of the joint due to heating and cooling can also throw up intermittent problems later down the line. The joint may look OK but underneath it may have a poor electrical connection, or could work initially and then cause the equipment to fail at a later date! These intermittent problems can be maddening to fix. TV repair technicians have an uncanny ability to go straight to a faulty solder joint because they see the same problem all the time, especially on equipment that has a "reputation".

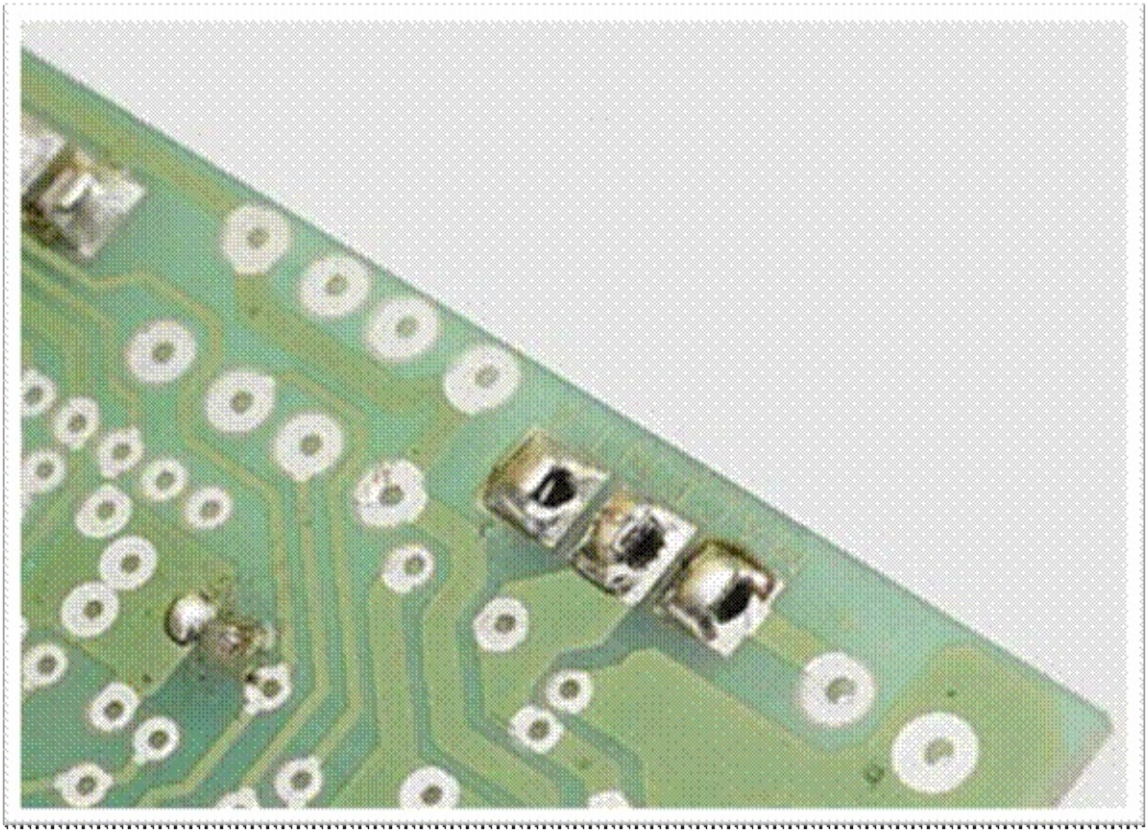

^^ *These dry or grey/ gray joints were caused by dirty parts, poor heating and inadequate solder coverage*

A solder joint that's poorly formed is called a "dry joint" or "cold joint" or a "grey/ gray" joint. Usually it results from inadequate heating, dirt or grease preventing the solder from melting onto the parts properly, and is often noticeable because the solder tends not to wet the surface properly. Instead it forms beads or globules. Alternatively, if it seems to take a very long time for the solder to wet the joint, that's another sign of contamination and that the joint may be a dry one, or the material is incompatible anyway. A matt, crystalline appearance instead of a shiny joint points to inadequate heating: the solder cooled down far too quickly and didn't flow properly.

Whether you want to replace a faulty component or fix a dry or poor-quality solder joint, it's usually necessary to remove the troublesome solder and then re-solder it afresh. Naturally, there are tools and techniques that make the job easy. It's very bad practice to simply re-melt the joint and then lash out with the board, whiplash style, hoping that the molten solder will be flicked off the board.

The usual way of removing solder from a joint is to use a *desoldering pump*. These work like a small spring-loaded bicycle pump, only in reverse! A plunger is pressed down until it locks into position. It's released by pressing a button which sucks air back through a pointed nozzle, carrying any molten solder with it. It may take one or two attempts to clean up a joint this way, but a small desoldering pump is an invaluable tool especially for p.c.b. work and they are widely available now.

^^ *A hobby desoldering pump primed for use*

Desoldering pumps often have a heatproof P.T.F.E. nozzle which may need replacing occasionally. Each time the button is pressed, a plunger clears the nozzle but sometimes solder particles and swarf will be ejected in the process; when you prime the pump, point the nozzle into a small pot or old aerosol top to catch any debris. Remove the spout and clean out the pump from time to time.

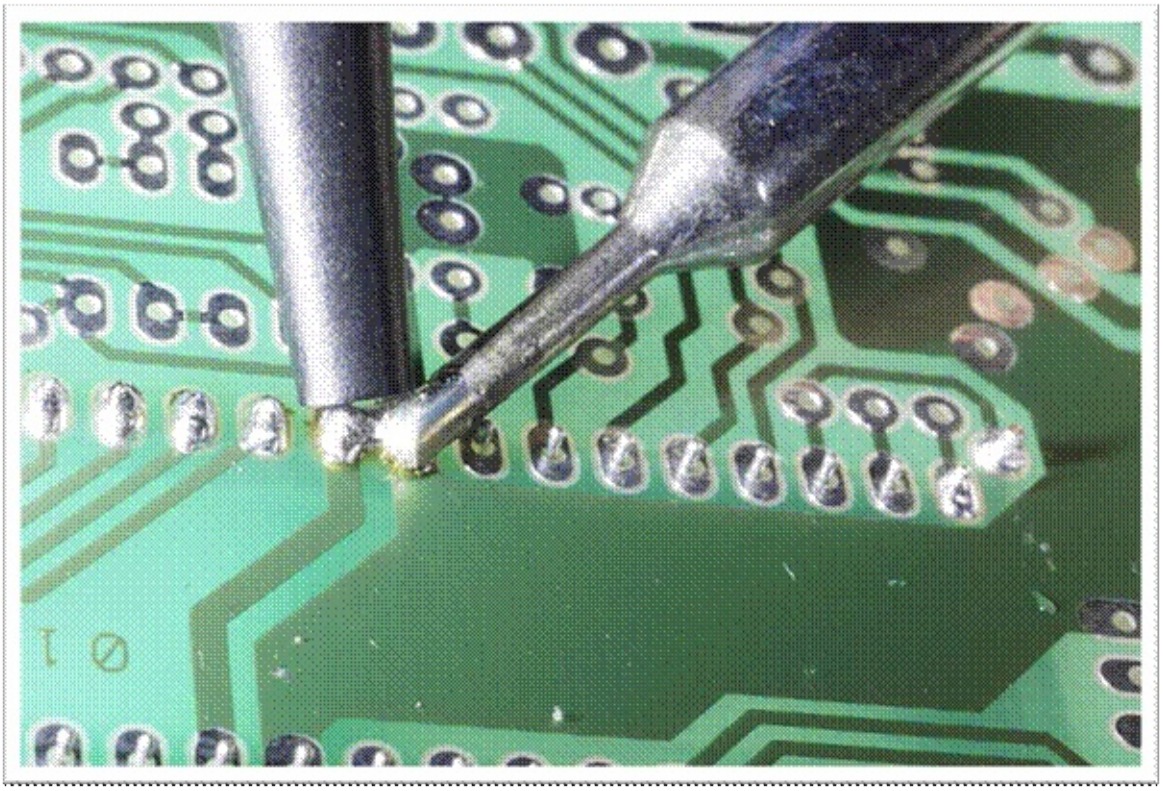

^^ *Suck up molten solder using a desoldering pump*

With very stubborn joints where the last traces of molten solder just can’t be shifted,

it sometimes helps to actually *add* more solder and then desolder the whole lot again with a pump.

Desolder Braid

An alternative to a pump is to use *desoldering braid* which arrives in small dispenser reels. It's a flux-impregnated fine copper braid which is applied to the molten joint, and the solder is then drawn up into the wick by capillary action. It's remarkably effective and for certain tasks, it can be more thorough than a pump. I recommend that a small reel is bought (start with 1.5mm width) for the toolbox, to tackle larger or difficult joints which would take several attempts with a pump.

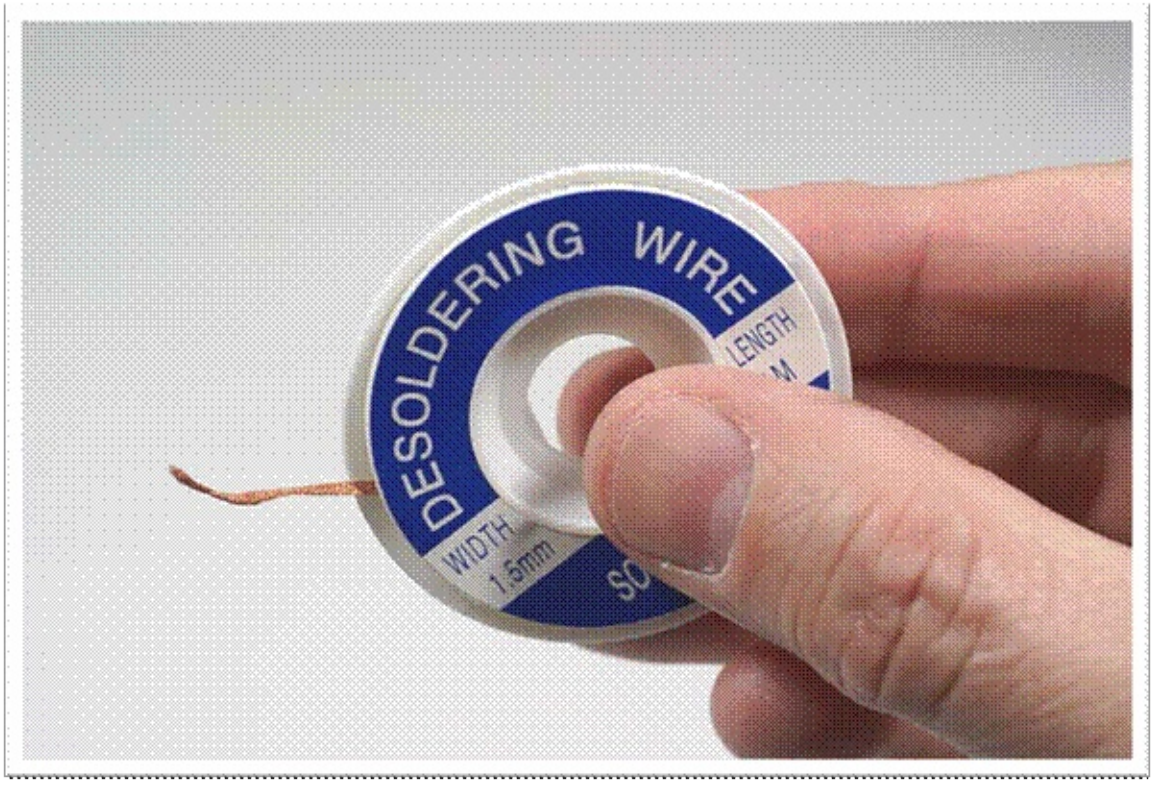

^^ *Desolder braid is also handy and can sometimes be more effective than a desolder pump. It comes in various widths to suit the scale of work being tackled.*

To use desolder braid, press the end of the braid down onto the joint using the tip of an iron, and let the solder melt underneath: the braid will then absorb the solder. The braid becomes hot so beware of burns. Once the solder's solidified on the braid, cut it off and discard.

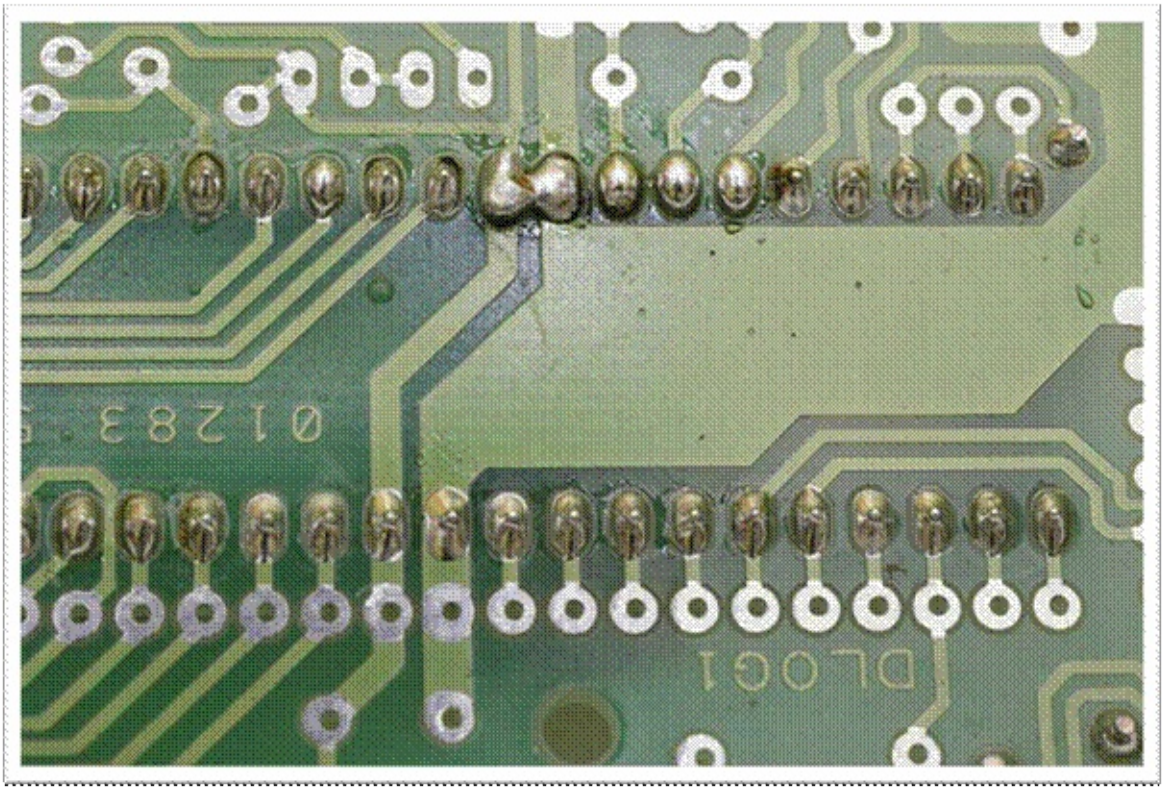

^^ Desolder braid can also be used to remove excess solder, e.g. two i.c. pins shorted together.

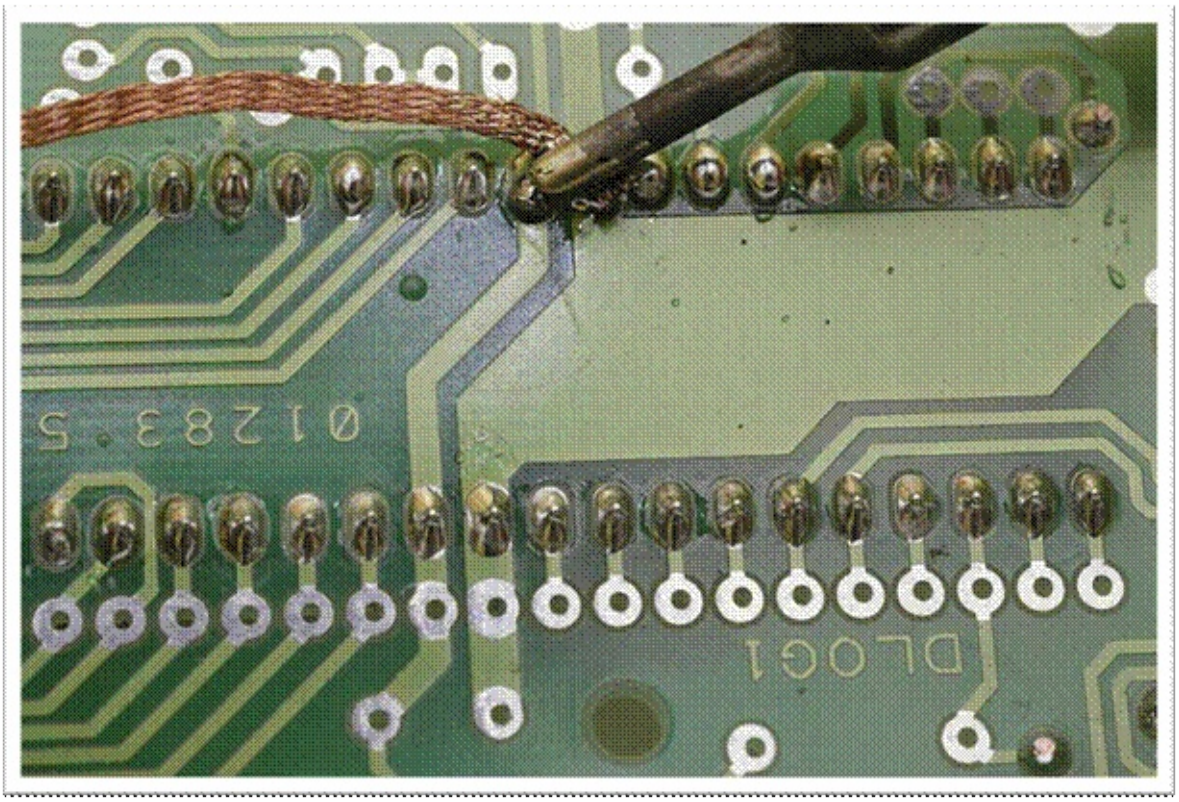

^^ Press some desolder braid over the joint, then melt it with an iron to draw molten solder up the braid.

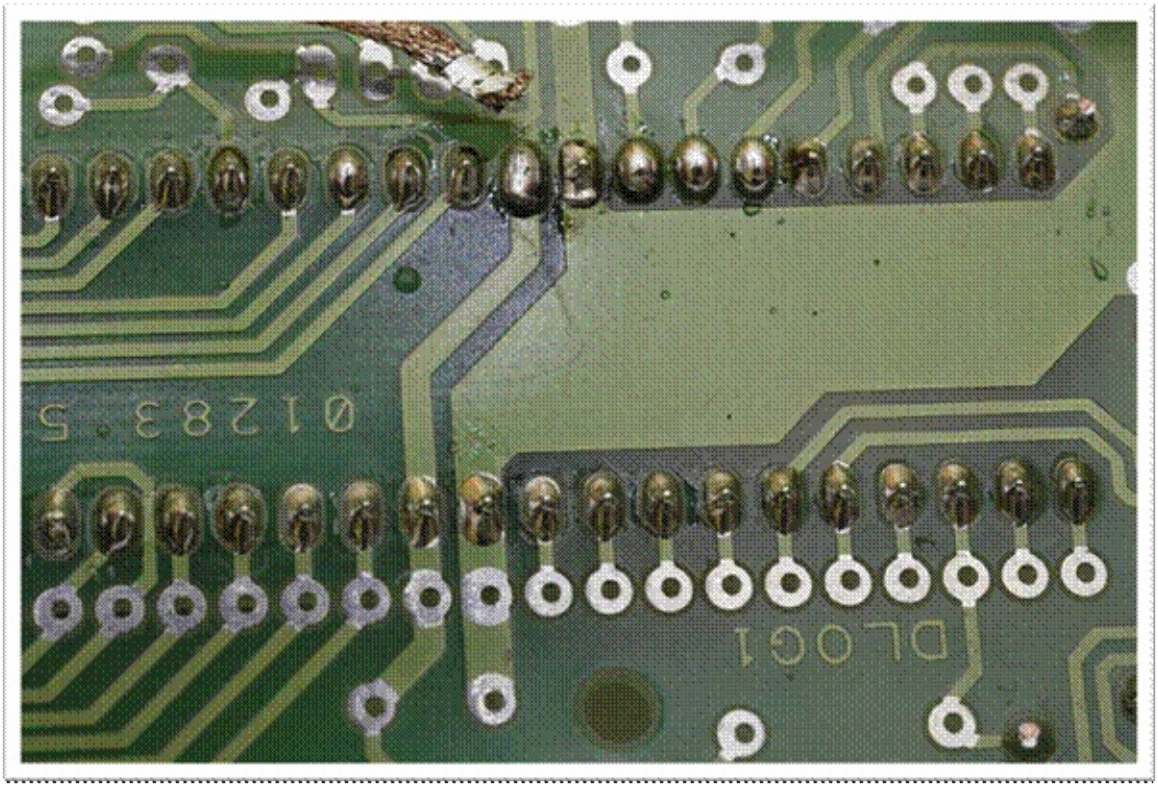

^^ *Remove the braid immediately and don't drag "whiskers" of molten solder around. The excess solder is absorbed by the braid, which is snipped off ready for the next job.*

Be aware that you can damage a printed circuit board accidentally when removing the desolder braid if it's not removed *quickly enough*. The solder will soon solidify, which effectively solders the braid to the printed circuit board! A careless tug may yank copper tracks or pads away from the board, stuck to the braid. You can also drag solder "whiskers" onto neighbouring pads unless the braid is removed cleanly. Why not practice using desolder braid with an old circuit board?

Whichever desoldering method you use, care is needed to ensure that the boards and parts are not damaged by excessive heat. It's not that difficult to apply so much heat when desoldering that the adhesive holding the copper foil tracks on the p.c.b. eventually fails, causing the copper track to lift away – everyone's worst nightmare.

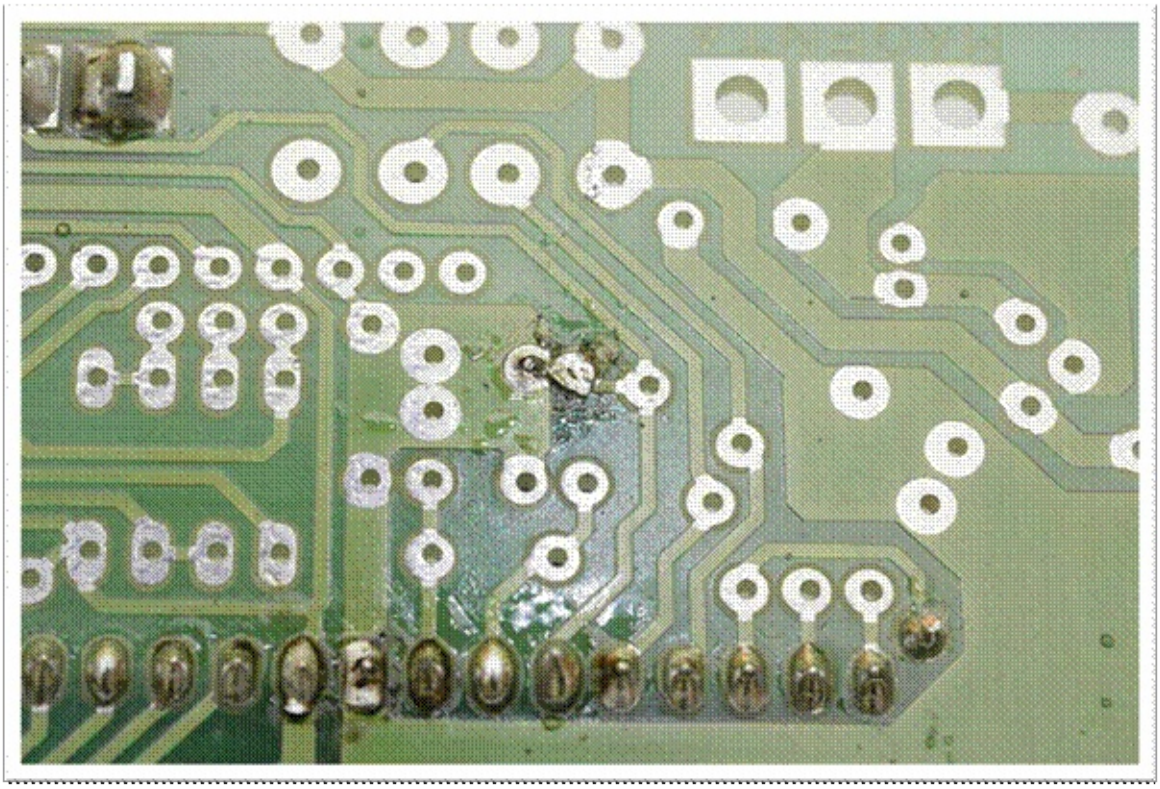

^^ *Typical copper track damage (centre) caused by overheating during soldering or desoldering. The track has lifted off, but you can try repairing it by adding extra wiring or SuperGlue it if the track isn't broken.*

If this should ever happen, remove the iron immediately and permit the area to cool (a freezer aerosol is valuable at such times). If you're lucky, you can maybe repair the lifted track using a droplet or two of Super Glue, or add "jumper wires" to bypass the damage.

^^ *A Freezer aerosol can give rapid cooling where excess heat has been applied*

during soldering. Also used in circuit faultfinding to identify overheating parts.

You now know everything you need to know about making the ideal solder joint, and desoldering it in case you need to make a repair. Just to remind you, a Quick Summary guide follows.

Quick Summary Guide

To round off the Basic Soldering Guide, let's summarise how to make the perfect solder joint.

- Ensure materials to be soldered are compatible with tin/ lead or lead-free solder.
- All parts must be clean and free from dirt and contaminants.
- Try to secure the workpiece firmly during soldering.
- Brand new soldering iron tips must be flooded with solder immediately, the first time they are used.
- Wipe the tip of the hot soldering iron on a damp cellulose sponge at frequent intervals. Then "tin" the iron tip by applying a small amount of solder.
- Aim to heat all parts of the joint with the iron for under a second or so, to bring them up to the same temperature.
- Continue heating and apply sufficient rosin-core tin/ lead or lead-free solder to form a complete joint.
- It only takes a second at most, to solder the average p.c.b. joint. It should be smooth and shiny, and through-hole joints should be slightly convex in shape.
- Remove the iron and return it safely to its stand.
- Do not move parts until the solder has cooled.
- Tin the soldering iron tip and clean it well, when switching it off, ready for next time.
- Consider using e.g. electronics flux dispenser pens or Colophony (rosin) to help with difficult joints.

Sometimes solder joints don't go quite to plan, and sooner or later everyone is faced with the need to problem-solve or troubleshoot, so a simple Troubleshooting Guide follows next.

Troubleshooting Guide

This troubleshooting guide may help fix common problems encountered with troublesome solder joints.

SYMPTOMS	LIKELY CAUSES	REMEDY
Solder won't "take" (wet) and won't flow properly over the joint — molten solder forms beads or "ball bearings" instead of flowing properly.	Grease or contaminants present; Material may not be suitable for soldering with standard lead/tin or lead-free solder, e.g chromium.	Treat contaminated parts with abrasive cleaners etc. as required to expose base metal. Some metals can't be soldered with electronics-grade solder.
Solder doesn't melt or flow very well — the joint is crystalline or grainy-looking - a grey or dry joint.	Joint has been moved before being allowed to cool naturally, or: Joint was not heated adequately. Too large a joint – too much metal present – and/ or the soldering iron temperature or power rating are too low.	Desolder and remake. Apply heat for a longer period, or use a higher power soldering iron, or check the temperature setting and raise it if possible.
Solder joint forms a "spike" and applying the iron again makes it even worse!	Probably overheated, burning away the flux. The iron, when removed, would cause the solder to stand up in a spike.	It is usually best to desolder and remake the joint freshly again.
The copper foil of my p.c.b. has lifted off the circuit board!	Excessive use of heat has damaged the adhesive. Provided the track hasn't broken, it may be repairable.	You can sometimes repair it with Super Glue, or re-wire the board with jumper wires.
Brown varnish-like deposits are left behind after I finish soldering.	These are the remains of rosin flux and are nothing to worry about.	It can be removed with PCB cleaners or some solvents, if you want to tidy up the board and inspect your work.

Possible Hazards and simple First Aid

It's extremely rare that soldering iron operators receive any burns or other injuries from the use of hot soldering irons. Soldering is perfectly safe provided that common sense precautions are taken during the soldering operation. Here are some of them:

- Components are very hot after soldering, so let them cool before handling them to avoid skin burns.
- Beware of splashes of molten solder caused by careless handling of a hot soldering iron.
- Beware of energised components (capacitors, batteries etc.) being shorted by molten solder and ejecting solder splashes due to arcing.
- Always park a hot iron safely on a stand in between use — never hang it vertically next to the bench.
- Keep a hot soldering iron away from its mains cable (silicone cables reduce the risk of accidental damage).
- Beware of wire offcuts flying off (danger to eyesight) when snipping wires to length before or after soldering.
- Avoid inhalation of solder and flux fumes as this can irritate the respiratory tracts, especially in sensitive cases (e.g. asthma).

Should you receive a more serious skin burn which requires attention, then:

- **Cool the affected area immediately.** Use plenty of cooler running water – but avoid ice cubes etc. as they can cause nerve damage after a time or inhibit the flow of blood to the affected area.
- Remove any **objects** which may be constrictive, before any swelling starts (rings, watches, bracelets).
- Do not prick blisters nor apply ointments, salves or lotions at this stage.
- Local pain relief for small burns can be obtained by spraying *Burneze* aerosol onto unbroken skin.
- Seek medical attention for more serious burns.

Eyesight problems are exceptionally rare, e.g. pieces of wire offcuts or solder splashes lodging in the eye area, and should be treated by a qualified first-aider or A&E. The best you can do is bathe the affected area with e.g. a first-aid eyewash bottle or fresh water. Then seek professional medical help straight away.

Useful resources

Details of the Antex range of soldering equipment, solder tips and spare parts can be obtained from www.antex.co.uk. UK and international distributors are also listed on the Antex (Electronics) web site.

If you're interested in hobby electronics then why not try **EPE Magazine**, the No. 1 UK magazine for hobby electronics enthusiasts, students, trainees and technicians around the world. You can buy a printed edition from newsstands, download a PDF version (for Windows) or try a tablet/ smartphone version from Pocketmags. More details at www.epemag.com

You can learn more about the writer at his website http://www.alanwinstanley.com/

Some mail order suppliers of soldering equipment and electronic parts include:

- ESR Electronic Components Ltd. (soldering equipment, Velleman kits)
- Bowood Electronics (Antex irons and spares, electronic parts)
- Rapid Electronics (components, tools, equipment)
- Cricklewood Electronics (CCTV, Antex soldering irons and spares, components)
- Maplin Electronics (UK electronics retailer and mail order)
- Farnell Electronic Components (major UK industrial supplier)
- RS (UK electronics industrial supplier)
- Brewsters Ltd (soldering equipment mail order specialists)
- Velleman UK (electronic kits)
- Quasar Electronics (Velleman kit mail order retailers)
- Kemo Kits (Germany, trade only)
- Hobbytronics (UK hobby mail order supplier)
- Multicore Solders (now a Henkel brand)

These links were correct at the time of going to press, July 2013.

Acknowledgements

Antex (Electronics) UK generously provided samples of their ever popular British-made soldering equipment, materials and accessories for use in the Basic Soldering Guide. When starting out as a 1970's teenage schoolboy electronics hobbyist, I and my trusty Antex soldering iron shared many adventures in electronics together, and it has been a pleasure to use the latest Antex soldering irons throughout this guide.

Also I would like to thank Brian Brooks of Magenta Electronics Ltd. (www.magenta2000.co.uk) for supplying me with a variety of their professionally-designed printed circuit boards and a range of components which were the subjects used in the photographs.

Photography

All photographs were taken by the author using Sony Alpha DSLRs and 50mm macro lens with extension tubes, and a Sony macro flash. High-resolution versions of these and more technical photos are available for commercial or educational royalty-free use. Please contact me with any enquiries.

Conclusion

I really hope the Basic Soldering Guide will give you the confidence to try your hand at electronic soldering. It's really a lot easier than it sounds, and armed with the guide's advice and photographs, the next thing to do is invest in a decent-quality soldering iron such as the excellent range manufactured by Antex that will serve you well for years to come.

Soldering an electronics kit together such as the professional designs produced by Velleman is a great way of testing out your new skills. Start with a small, simple kit costing a few pounds to gain confidence and experience, and avoid the temptation to tackle something too complex until you're ready to extend yourself further.

Feedback is welcomed by email to alan@epemag.demon.co.uk

You can learn more about me at www.alanwinstanley.com or read my column in EPE Magazine.

Good luck with your soldering!

Alan Winstanley

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Learn to Solder

Tools and Techniques for Assembling Electronics

Brian Jepson,
Tyler Moskowite
& Gregory Hayes

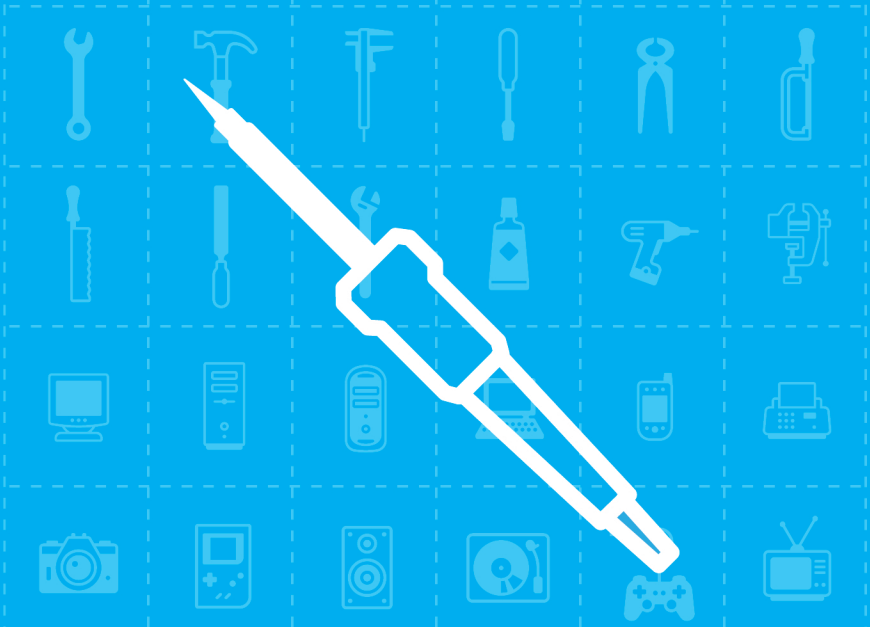

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Learn to Solder

Brian Jepson, Tyler Moskowite, and Gregory Hayes

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Learn to Solder

by Brian Jepson, Tyler Moskowite, and Gregory Hayes

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Welcome

Welcome to MAKE's Getting Started with Soldering Kit, and congratulations on taking a big step into the world of DIY electronics. Once you get the hang of soldering, you can put together some of the many great kits that are available, fix electronics that are broken, and build inventions of your own. With this kit, you'll learn how to:

- Prepare and clean your soldering iron
- Assemble electronic circuits from kits
- Transfer circuit designs from a solderless breadboard to a prototyping PCB
- Correct soldering mistakes you've made

Basic Tools

There's a lot of great stuff in the box, and before you start using it, here's a tour of what you'll find in there. Figure 0-1 shows the soldering tools you'll be using most of the time.

Figure 0-1. *Basic soldering tools*

Deluxe soldering iron
: (Top left) This soldering station includes a variable temperature controller, a cleaning sponge, soldering iron, and a ringed holder.

Crosscut pliers
: (Left) You'll use these to trim away excess leads after you solder components in place.

Solder tube
: (Bottom) This is enough solder to get you started and keep you busy over many projects.

Helping hands
: (Right) For those times when you need a third or fourth hand, the helping hands let you hold items steady while you solder.

Advanced Tools

Most of the time, you'll only need the basic tools to get things done. But when you need to replace your soldering iron tip, correct a mistake you made while soldering, or need a tool to help keep components from overheating, you'll need the items shown in Figure 0-2.

Figure 0-2. *Advanced soldering tools*

Heat sink
: (Left) Clip this to sensitive components to help dissipate heat.

Desoldering wick
: (Bottom left) Use this to wick away excess molten solder.

Desolder pump
: (Center left) This pump will suck up molten solder when you have a lot of solder to remove.

Soldering tools
: (Center right) The scrapers, brush, and slotted probe come in handy when you need to move solder around or precisely position a component.

Replacement tips
: (Right) Tips don't last forever. When you've worn out your tip, use one of these as a replacement.

Project 1: Learn to Solder Skill Badge

Our Learn to Solder Skill Badge Kit (the 2011 model is shown in Figure 0-3) has been used to teach thousands of people of all ages how to solder at Maker Faires across the country. It's a simple, fun way to learn how to solder and also how to teach others to solder. After you build the one included in the box, you can order more from *makershed.com* and teach others how to solder.

Figure 0-3. *Learn to Solder Skill Badge, 2011 model*

Blinking or Color Change LED

(Top left) This is an LED (Light-Emitting Diode) with a twist. Normal LEDs give off a single color, and keep shining as long as you give them power. Also, normal LEDs require a specific voltage to operate: don't give it enough power, it won't light at all; give it even a little too much, and you could burn it out.

This LED is different in both respects: it has three elements (red, green, and blue) that are under the control of a small integrated circuit (IC) embedded within the LED. The IC causes the elements to change color in a repeating pattern. Because the IC controls the voltage that it delivers to the individual color elements, it's more tolerant of variations in the voltage you give it. For example, even though red LED color elements typically operate at around 2 volts, you're able to use a 3 volt battery with the pin.

The 2012 model uses two self-blinking LEDs instead of one self-color changing RGB LED.

CR1220 battery

(Lower left) This "coin cell" battery supplies power to the pin.

Printed Circuit Board (PCB)

(Center) The 2011 Learn to Solder Skill Badge features a friendly robot. The 2012 model will also have a robot, every bit as friendly.

Pin and clutch

(Top right) This is what holds the pin to your clothing.

Battery holder

This keeps the battery on the PCB.

Project 2: 555 Timer Blinky

The 555 timer blinky is a simple circuit that makes two LEDs flash in an alternating pattern. When one is on, the other is off. Figure 0-4 shows the components for this project, and Figure 0-5 shows the finished project. This is a slightly more challenging project than the skill badge.

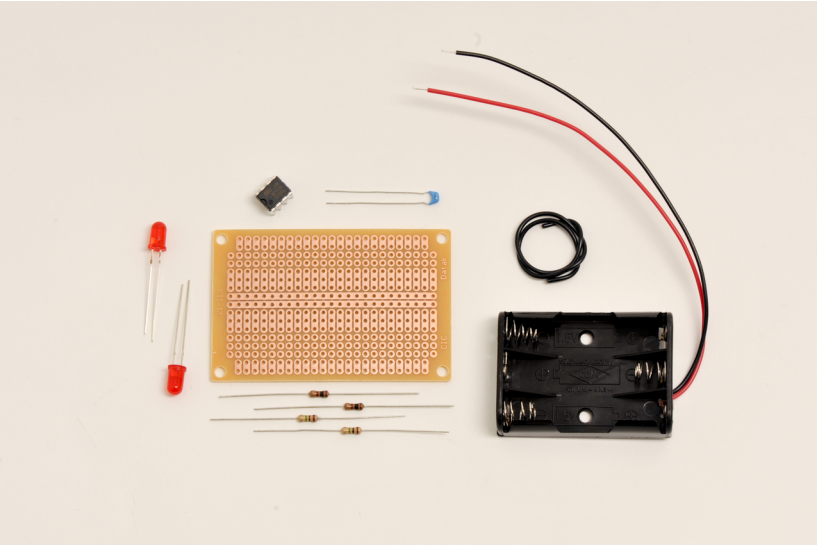

Figure 0-4. *555 blinky parts*

LEDs
: (Left) Unlike the LEDs used in the skill badge, these are your normal, run of the mill LEDs.

Protoboard
: (Center) Look back at the skill badge PCB. Notice how it was custom designed for a single purpose. Now look at this protoboard PCB: it's got a lot of different holes in convenient locations. You can build many kinds of simple electronics projects on a board like this.

555 Timer
: (Top left) The 555 timer is a special type of integrated circuit that can turn electrical current on and off in a repeating pattern. It's just what you need to blink an LED.

Capacitor
: (Top right) To customize the 555 timer, you need to connect certain components to it. The value (capacitance or resistance) of the component determines how quickly the 555 turns things on and off.

Hookup/Jumper Wire

(Top right) You'll need this to connect one thing to another.

Resistors

(Bottom) Resistors serve two purposes here: two are used to make sure the LEDs don't get too much current; the other two work with the capacitor to control the behavior of the 555 timer.

Battery Box

(Right) This holds 3 AAA batteries.

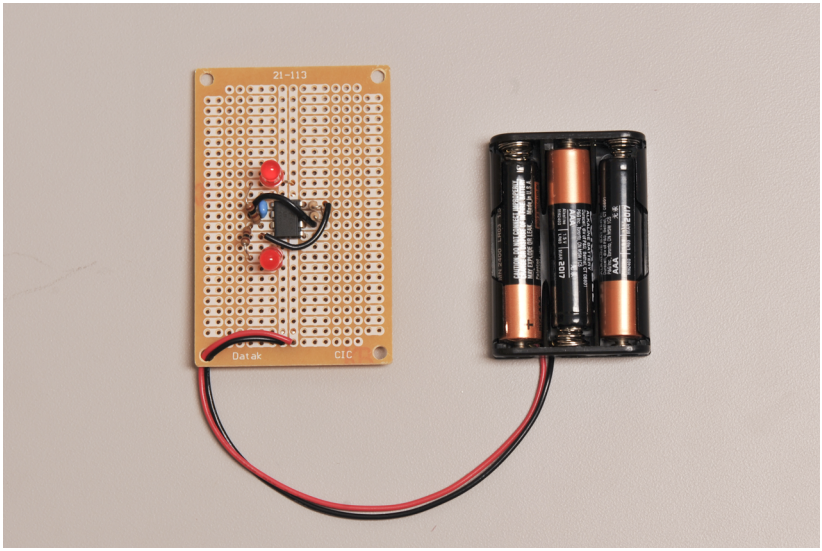

Figure 0-5. *Finished 555 blinky*

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Got a kit or product you think we should sell? Send a note to *kits@makezine.com*.

Want to carry MAKE books or kits in your store? Send a note to *resellers@makershed.com*.

1/Getting the Workspace Ready

Before you can start soldering, you need to get your iron ready. This involves a few steps. First, you'll have to attach the tip to the soldering iron. Then, you'll need to prepare the station: make sure your sponge is moistened, set the temperature, and "tin" the tip by applying some solder to it.

At the end of this chapter, your soldering iron will be assembled, clean, and hot enough to begin soldering.

Solder contains harmful chemicals. Wash your hands after soldering as well as after handling solder or the solder station sponge. Though it may be tempting to snack while you're working, keep any food or drink away from your soldering area.

1: Attach the Tip

Locate the soldering iron (make sure it's unplugged and cool), a soldering iron tip, and the tip nut that holds the tip in place. Insert the tip into the soldering iron as shown in Figure 1-1, and push it in as far as it will go. It will not require much force to insert it.

WARNING: Make sure the soldering iron is unplugged and cool.

Figure 1-1. *Inserting the tip into the tube*

2: Secure the Tip

Slide the tip nut over the tip, and screw it in place. You can use pliers to tighten it (see Figure 1-2). Be careful not to overtighten it, since you will eventually need to replace it when the tip gets worn from all the projects you'll be making with it.

Figure 1-2. *Making sure the tip stays put*

WARNING: Over time, the tip nut might become loose. Let the iron cool down before you tighten it.

3: Wet the Soldering Station Sponge

You'll need to perform this step (and the remaining ones in this chapter) at the beginning of each soldering session.

As you use the soldering iron, you're going to be wiping the tip a lot, so you need to keep the solder station sponge moist. Pour a little clean, fresh water on the sponge as shown in Figure 1-3. Don't soak it, but make sure it's completely moistened.

NOTE: If your water has a high mineral content, use distilled water for wetting the sponge.

Figure 1-3. *Wetting the sponge*

4: Set the Station's Temperature

Plug your soldering iron in, and set the heat setting to the mark shown in Figure 1-4 (pointing at the 3 o'clock position on the dial). Give the iron a couple minutes to warm up.

Figure 1-4. *Setting the temperature*

WARNING: The iron will get very hot, and certainly hot enough to burn you. Don't touch the tip and don't touch the tip to anything other than solder or components you are soldering together.

5: Wipe the Iron's Tip

Wipe the tip on the sponge as shown in Figure 1-5, being sure to turn the iron a few times as you wipe it, so you wipe all of its surfaces. It will make a sizzling sound as the water in the sponge comes into contact with the tip. The figure shows a sponge that's been used a few times. Notice the little blobs of solder that have come off the tip over time. A clean tip is critical to successful soldering. Even a small layer of oxidized material or other crud will limit the amount of heat that's transferred to the component you're soldering. Wipe the tip often, and keep the tip clean.

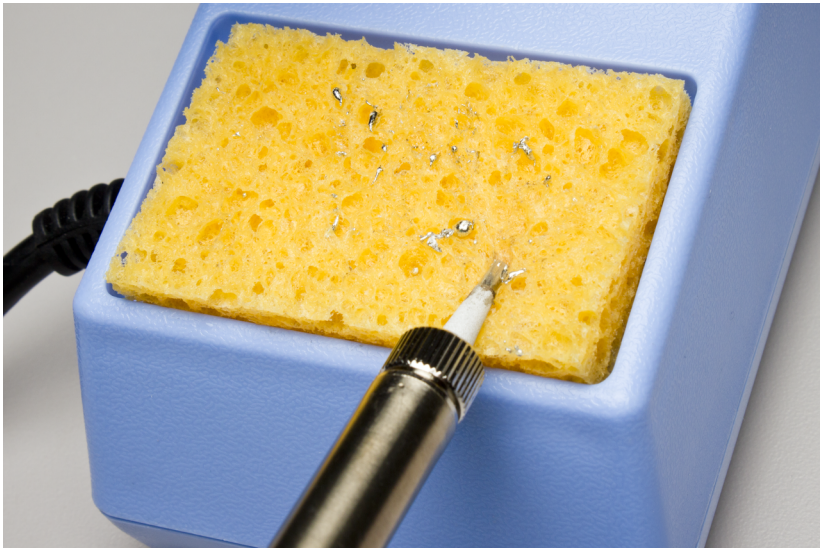

Figure 1-5. *Wiping the tip clean*

6: Tin the Iron's Tip

Before you begin soldering components, you should put a thin layer of solder on the tip as shown in Figure 1-6. This will have two effects: burning off any crud that shouldn't be there, but also providing a thin layer of liquid solder. This layer makes for a very effective heat transfer between the soldering iron and whatever you're soldering. Give the tip one more quick wipe on the iron and place the soldering iron into the holder until you need it.

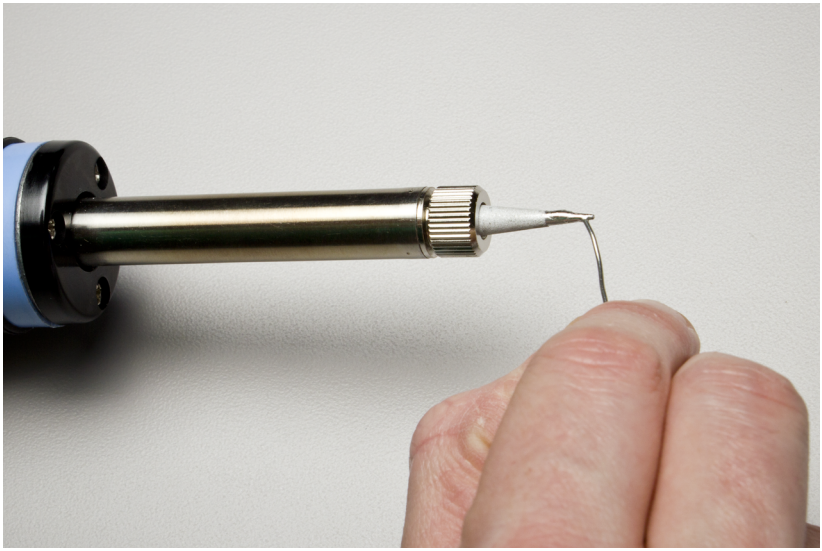

Figure 1-6. *Tinning the soldering iron tip*

NOTE: A small puff of smoke will appear as the *rosin flux* in the center of the solder is activated. The rosin serves two purposes: to clean the soldering iron (and the joint that you are soldering) and to help the solder flow freely. Avoid inhaling this smoke.

Go Make Your Learn to Solder Skill Badge

With your workstation all set up, you're ready to try your hand at soldering. The Learn to Solder Skill Badge ("Project 1: Learn to Solder Skill Badge" on page viii) is a great place to start. It's so simple, we think you can even try it before you read any more. But before you try the second project ("Project 2: 555 Timer Blinky" on page x), you should definitely give the rest of this guide a read.

2/How to Solder

With your soldering iron prepped, you're ready to begin soldering. This chapter has many helpful tips and techniques for soldering effectively, safely, and neatly.

Working with Solder

Solder is made of metal with a core that contains flux, which cleans the connection as you solder. When the metal melts, the flux begins to flow onto the joint. Some solder lead-based, but the solder in this kit is lead-free. To melt solder, heat it with the soldering iron as shown in Figure 2-1.

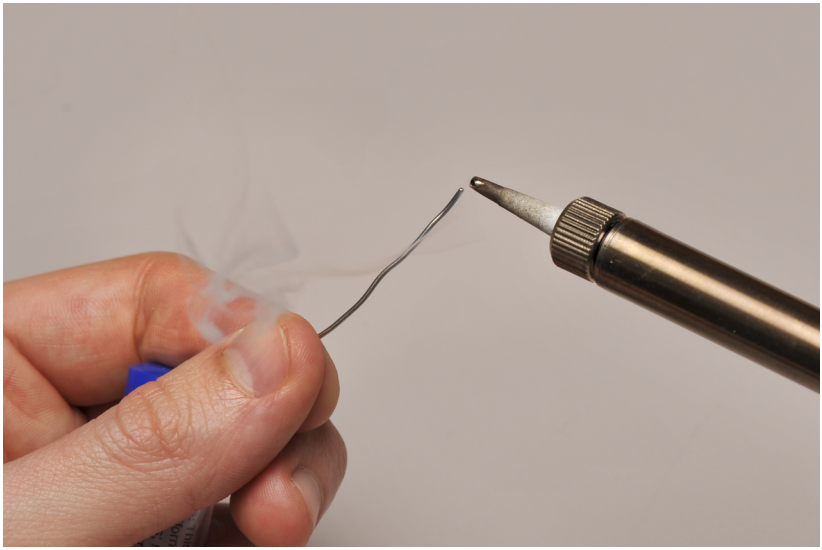

Figure 2-1. *Melting some solder*

Try melting some solder, but be careful not to drip it on yourself or anything other than a work surface. You can try pushing tiny balls of solder around on your work surface to see how it flows. If you have some bare hookup wire or similar metal, try heating it up by holding the soldering iron to it (don't hold the wire while you're heating it). Touch a piece of solder to the wire, but

choose a point that's an inch or so from where the soldering iron is touching. How close do you have to get to the soldering iron tip before it melts?

Keeping the Circuit Board from Moving

When you're soldering, you've got a lot to juggle: the soldering iron, the solder, and the two things you are connecting to each other. The helping hands let you place the items you're soldering in a stable position. Use the clips to hold the item in place as shown in Figure 2-2. But once you start inserting items into the board, you need some way to keep them from moving. "Placing a Component in the Board" on page 11 shows you how to do that.

Figure 2-2. *Holding a PCB in the helping hands*

Tinning Solder Pads

You'll sometimes come across things that need a layer of solder to work right. For example, on the Learn to Solder Skill Badge, you need to put a bump of solder in place to give the battery a snug fit. With solder pads that are this big, you need to heat the pad with the iron really well; the pad is so large that it's going to take longer to heat. It's best if you melt the solder by pushing it onto the pad rather than pushing it directly against the iron. This makes sure that the solder flows thoroughly over the pad. If the solder doesn't melt, try tinning the tip again first.

Start with a little blob as shown in Figure 2-3, and spread it around evenly. When you've got the desired thickness, first pull the solder away, then pull the soldering iron away. Doing it in this order will avoid leaving chunks of solder behind.

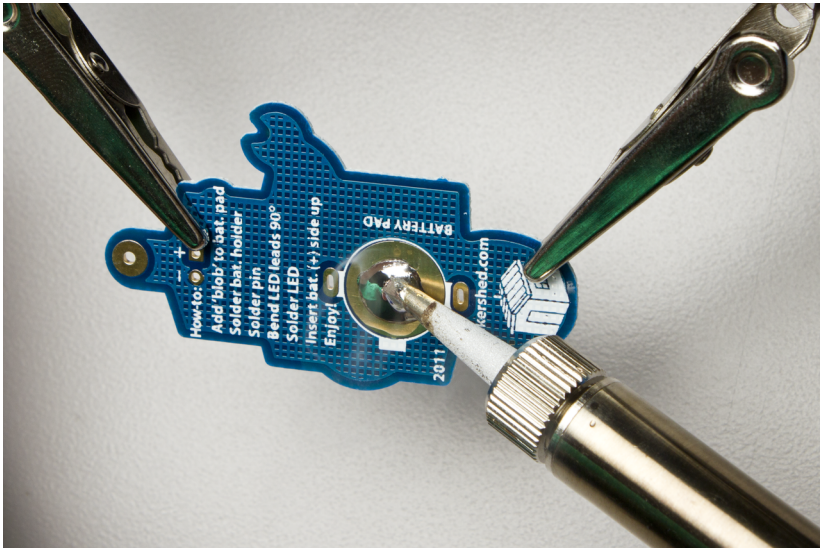

Figure 2-3. *Laying down some solder*

Placing a Component in the Board

You don't want components falling out of the board while you're soldering. In fact, you'll often insert a component with the board upside down (see Figure 2-4), then flip the board over when you put it in the helping hands. So the components have plenty of opportunity to fall out. To keep the component in place, bend the leads out as shown in Figure 2-5.

In some cases, you may need to quickly tack a component in place to keep it from moving. See "Stabilizing and Straightening Components" on page 14.

Don't try to place every component at once. Start with low-profile (shorter) components, solder them in one at a time, and move on to higher-profile components.

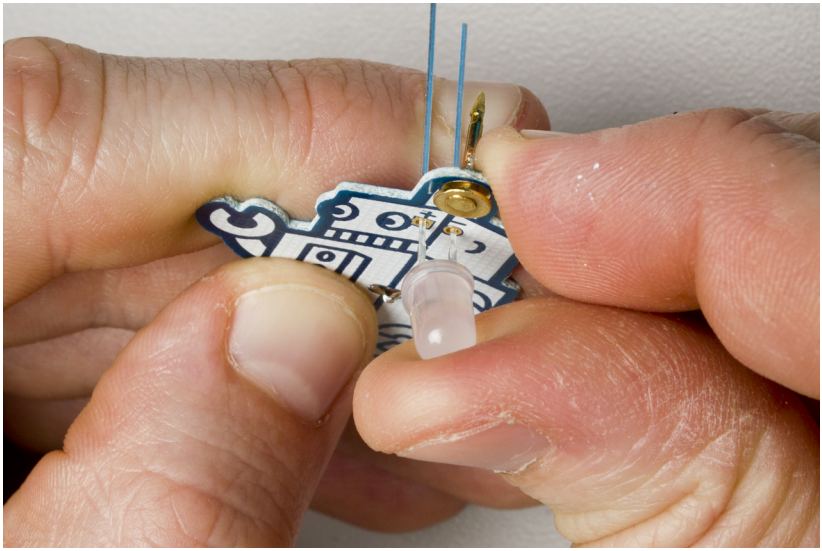

Figure 2-4. *Inserting an LED*

Figure 2-5. *Bending out the leads*

Knowing Which Way a Component Goes In

Some components don't care which way you put them in: resistors, some capacitors (such as the one that comes with this kit), and many other components fall into that category. On the other hand, LEDs are *polarized*; electrical current will only flow through them in one direction. So if you put your LED in backwards, it won't light up at all. You can determine an LED's polarity in a couple of ways: First, the longer of the two leads is the positive (+), and the shorter is negative (-).

Second, look closely at the bottom of the LED and examine the ring that bulges out around it. There is a flattened part of that ring that indicates the side of the LED that's negative (-). You can see this flattened side on the right in Figure 2-6.

With ICs, this also matters. Every pin has a specific function, and there will be one or more pins for positive (+) and one or more pins for negative (-).

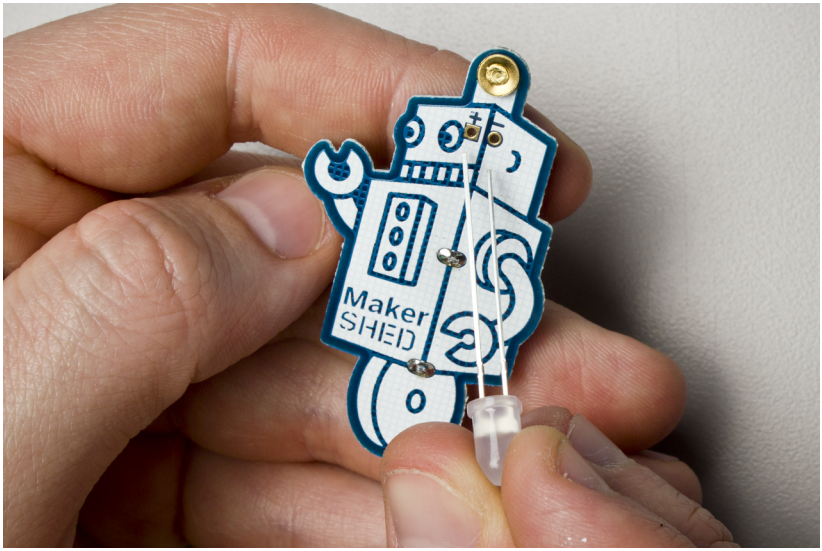

Figure 2-6. *Polarity—LEDs have it*

Stabilizing and Straightening Components

ICs present a unique problem. They don't have long enough leads for you to bend out effectively, which means they are more likely to slip and slide while you're soldering them. So do the best you can with that (see Figure 2-7), but flip the board back over after you solder the first joint. In most cases, you'll find that the IC has shifted. But since you only have one joint soldered, you can easily move the IC into the position you want. Once you've done this, flip the board over and solder the remaining connections.

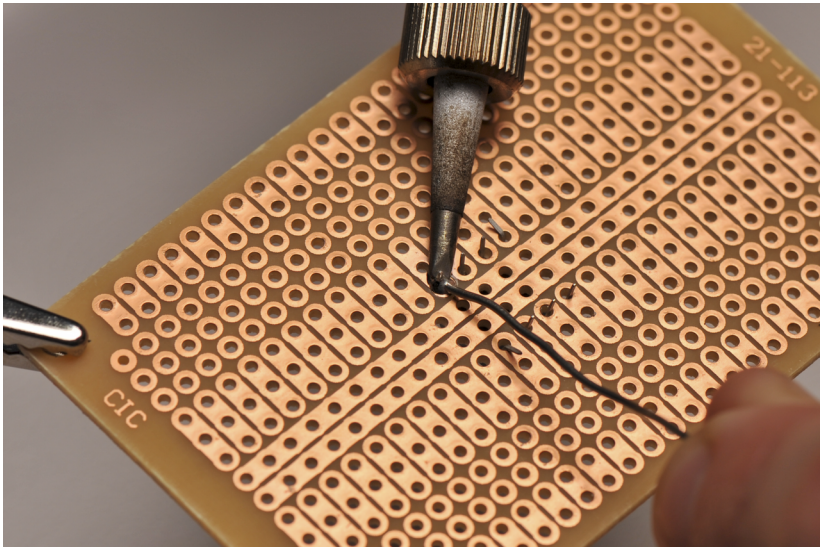

Figure 2-7. *Tacking down an IC*

Safely Soldering Sensitive Components

You need to avoid applying too much heat to a component, or you might damage it. One way to help avoid this is to clamp the heatsink to the component as shown in Figure 2-8. This will draw heat away from the component, protecting it somewhat.

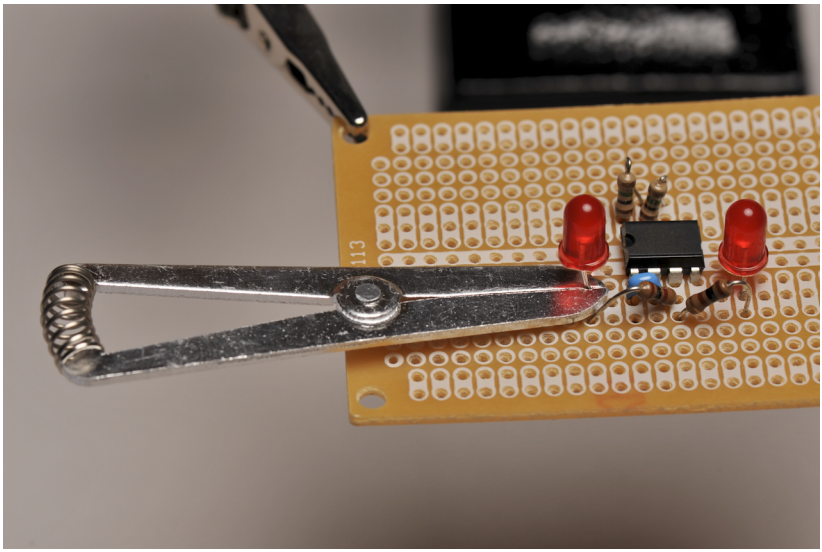

Figure 2-8. *Keeping heat away from the component*

Soldering a Component in Place

Wipe the soldering iron on the sponge and hold it so it's touching both the solder pad and the lead that protrudes through. Avoid using the soldering iron to melt the solder. Instead, heat up both the lead and the pad so that the solder melts when you touch it to them.

This must all be done quickly: within a second of touching the iron to the joint, push a small amount of solder into the joint, and let it flow around the joint as shown. Give it a second to flow, take the solder away, then wait a second, and take the iron away. With practice, you should be able to do all of this in three to four seconds per joint. Figure 2-9 shows how you'd solder the pin to the skill badge. Figure 2-10 shows an LED being soldered.

If you hold the iron to the component too long, you run the risk of damaging either the component or the solder trace on the PCB.

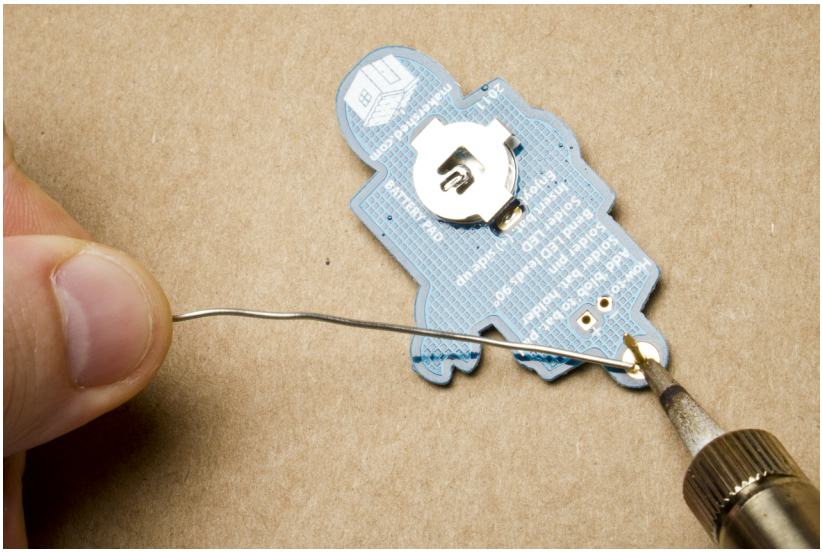

Figure 2-9. *Soldering a pin*

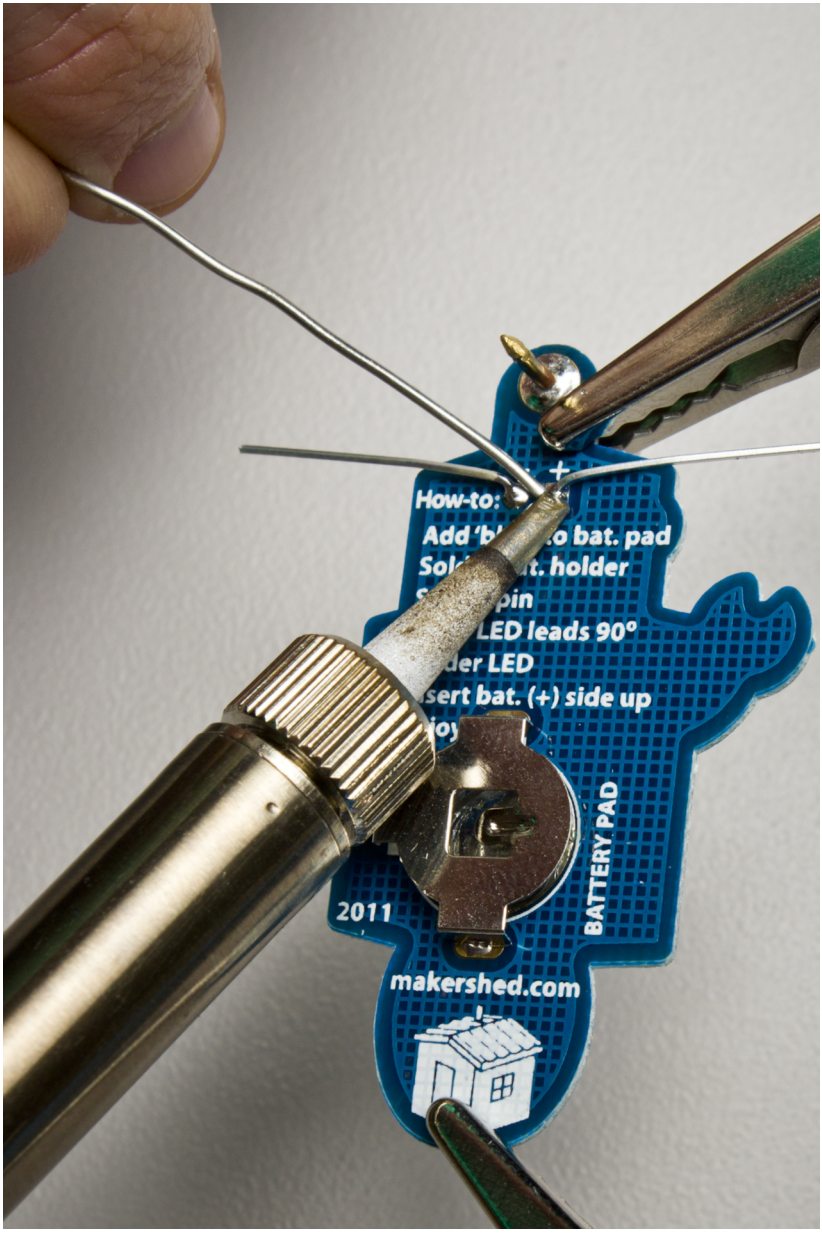

Figure 2-10. *Soldering an LED*

Trimming Your Leads

After you solder a component in place, you need to tidy things up. Grab the cutters from your kit, and trim the leads as close to the solder joint as possible (see Figure 2-11 and Figure 2-12). Don't cut into the solder joint; the idea is to trim the excess wire lead.

When you clip it, the wire lead will fly away from the clippers very fast, and could injure someone. The best way to keep this from happening is to use one or two fingers to hold the lead you're clipping. With one finger, you can put enough pressure on it to keep it from flying away.

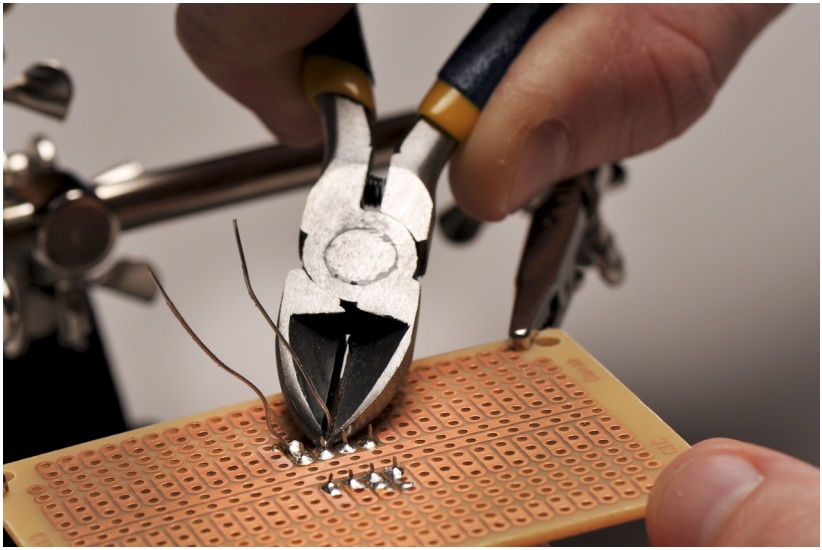

Figure 2-11. *Trimming leads on the 555 blinky*

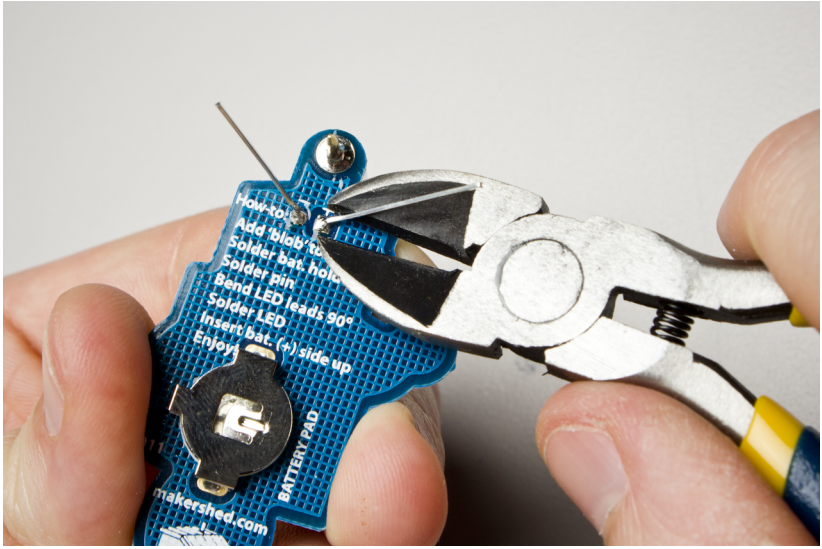

Figure 2-12. *Trimming leads on the Learn to Solder Skill Badge*

Going From Solderless Breadboard to PCB

The beauty of protoboard is that it mirrors the layout of a solderless breadboard, which is used for prototyping electronic circuits. Once you have your project laid out and working on a breadboard, you can easily transfer it to the protoboard. As with a solderless breadboard, the protoboard has rows and columns that are tied together. The layout is slightly different, though. Where the breadboard has two rails (one for positive, one for negative) on both the top and bottom as shown in Figure 2-13, the protoboard that comes with this kit has its rails in the center of the board.

Figure 2-14 shows the project from Figure 2-13, but laid out on a protoboard instead of the solderless breadboard.

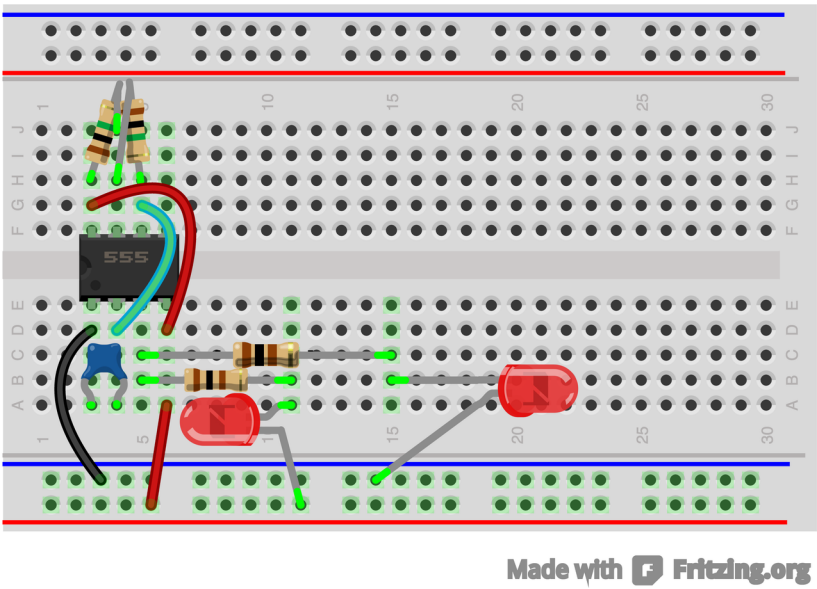

Figure 2-13. *The 555 blinky project on a breadboard*

NOTE: The breadboard diagram in Figure 2-13 was made with Fritzing, an open-source initiative to support designers, artists, researchers and hobbyists to work creatively with interactive electronics. For more information, see *http://fritzing.org/*.

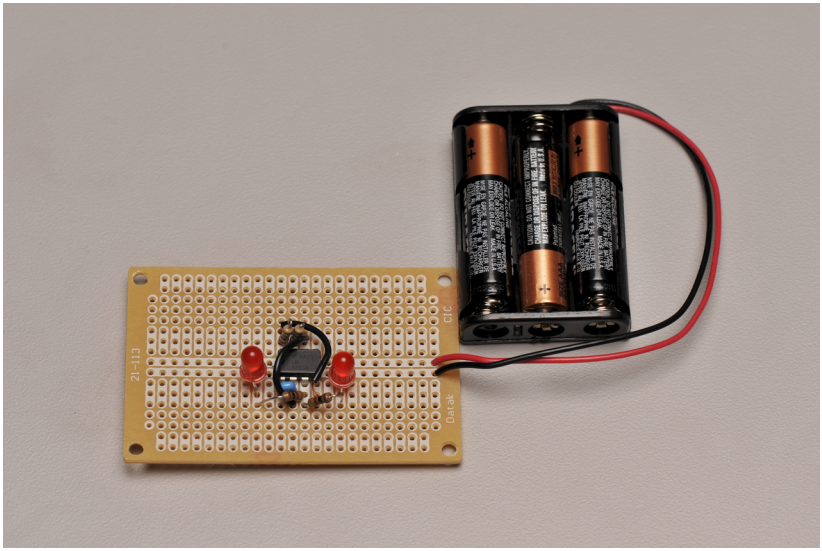

Figure 2-14. *The 555 blinky project on a protoboard*

Soldering Jumper Wire

Jumper wire can be treated a lot like other components (see "Placing a Component in the Board" on page 11): make sure there's enough bare wire poking through so you can bend it outward enough to hold it in place. The notched probe included with this kit can be helpful with placing jumper wire in the right place (see Figure 2-15).

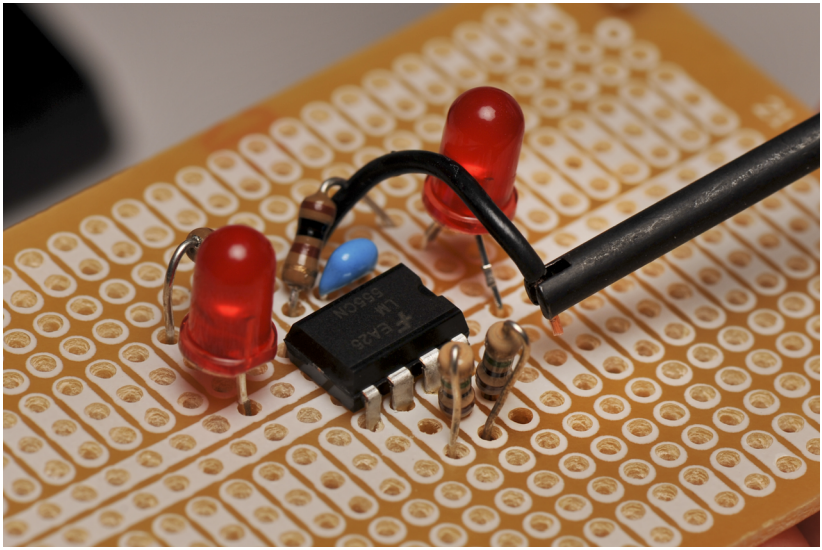

Figure 2-15. *Placing the jumper wire*

Bridging Joints with Solder

When you're working with the protoboard, you will sometimes need to bridge joints that are close to each other. This is preferable to using jumper wire since your board remains uncluttered on the top. It doesn't always look great on the bottom, though, because you end up with a lot of solder in some places. Figure 2-16 shows the start of a bridge: feeding the solder into the gap between solder joints. Figure 2-17 shows a bridge being formed.

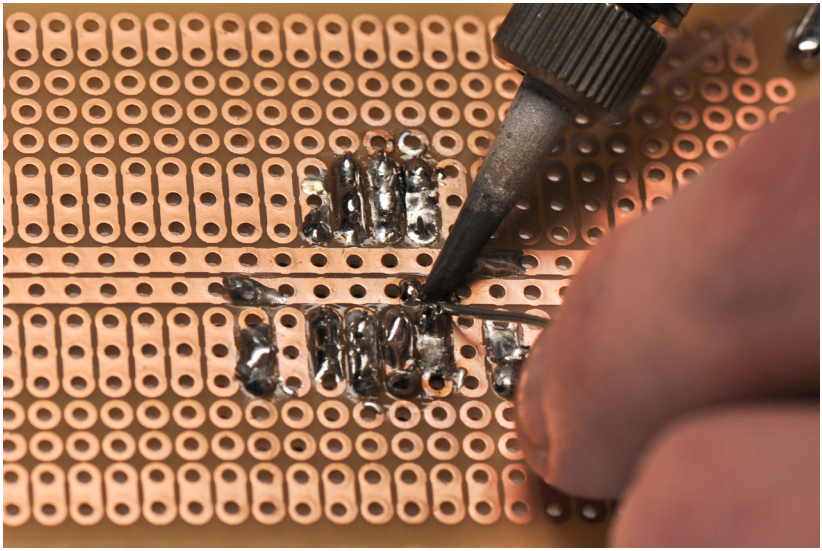

Figure 2-16. *Feeding solder into a gap*

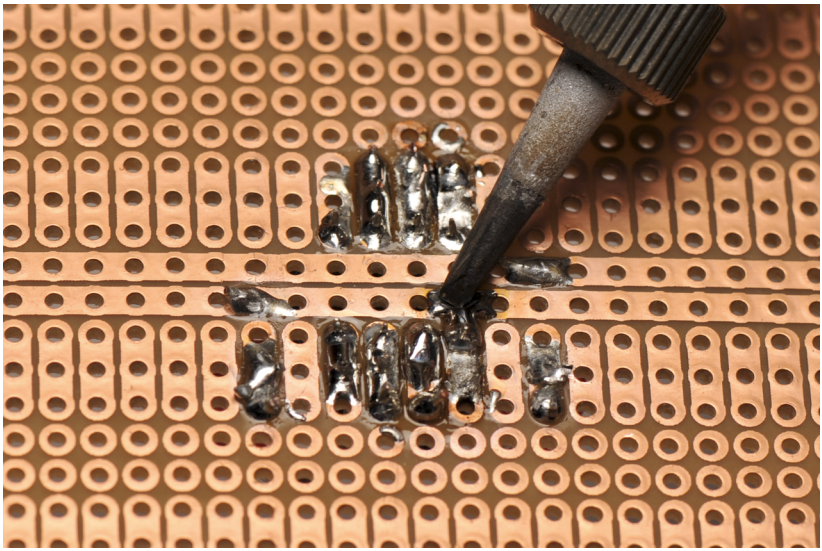

Figure 2-17. *Forming a bridge across the gap*

Relieving Strain on Cables

If you have something heavy dangling off your board, such as a battery box, it's very likely that the solder joints will come undone. If you pass the wires through the large holes on the board before soldering them down (Figure 2-18), you can add some strain relief (Figure 2-19) that will help prevent this from happening. If you have a small drill, you can also drill out a couple of holes close to where you are going to solder the connection, and loop the wire through there. This will be even more rugged than using the larger holes.

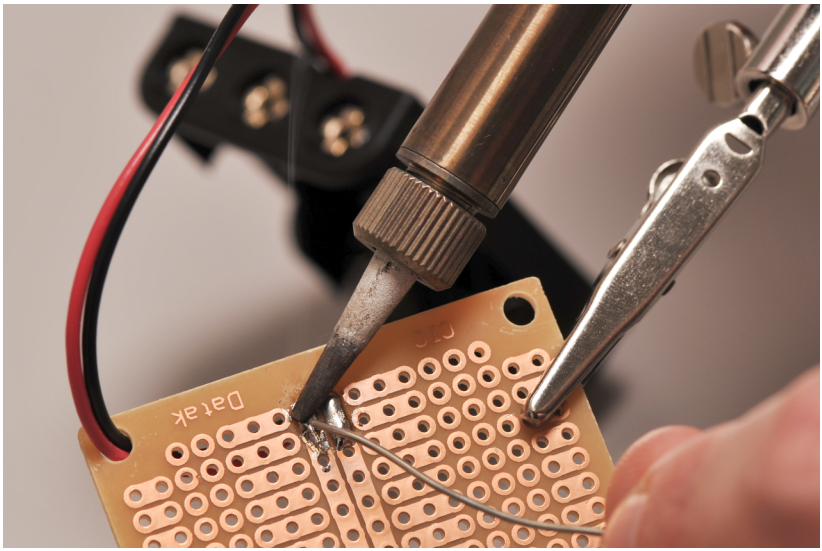

Figure 2-18. *Soldering the battery holder wires*

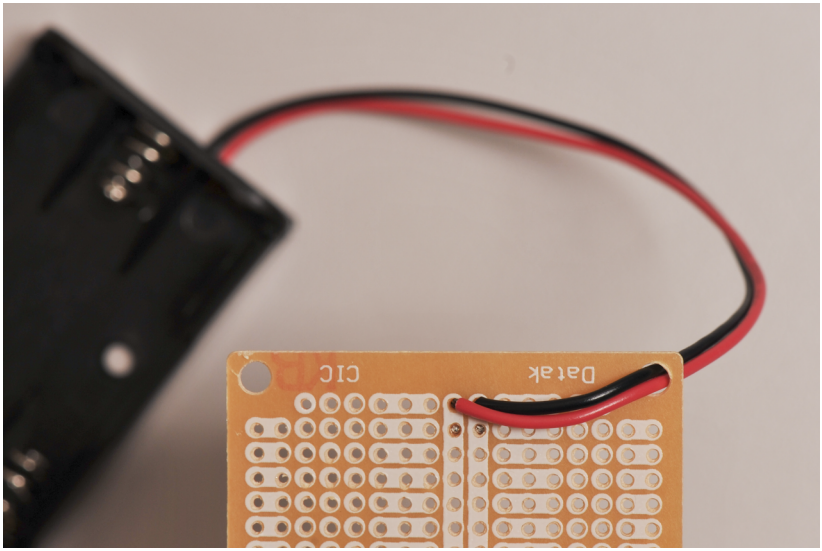

Figure 2-19. *Strain relief*

Getting the Perfect Solder Joint

It's not hard to get a great solder joint, but it's also easy to be sloppy. Here are some pictures of good and bad joints to help you out.

Figure 2-20
: Here's a good solder joint on the positive (+) pad: solder surrounds the joint and makes a little peak. This joint had just the right amount of solder and just the right amount of heat.

Figure 2-21
: The joint on the negative (-) pad is sloppy. The solder didn't flow around the joint, and some of it is spread out across the lead. You can try to fix it by holding the iron to the joint for a couple seconds; the solder should flow down the lead and onto the joint.

Figure 2-22
: The joint on the positive (+) pad has too much solder, and it's balled up. You can use the desoldering wick or solder sucker to remove the excess. After you do that, hold the iron to the joint for a couple seconds to get the solder to flow around it.

Figure 2-23
: Here are two joints for comparison: one good, one blobby.

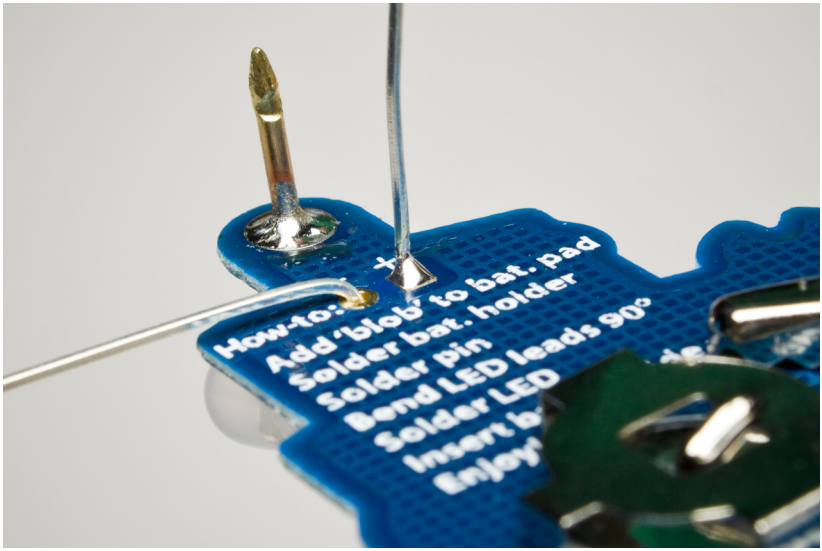

Figure 2-20. *A good solder joint*

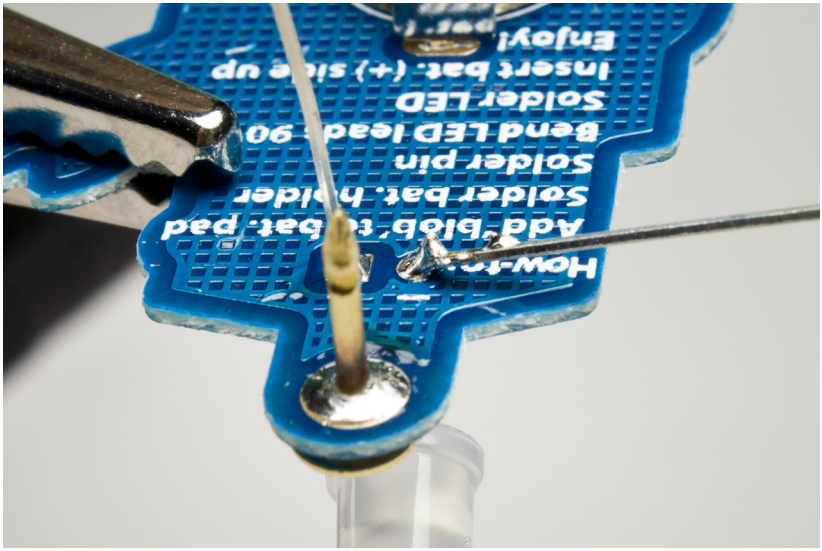

Figure 2-21. *A messy solder joint*

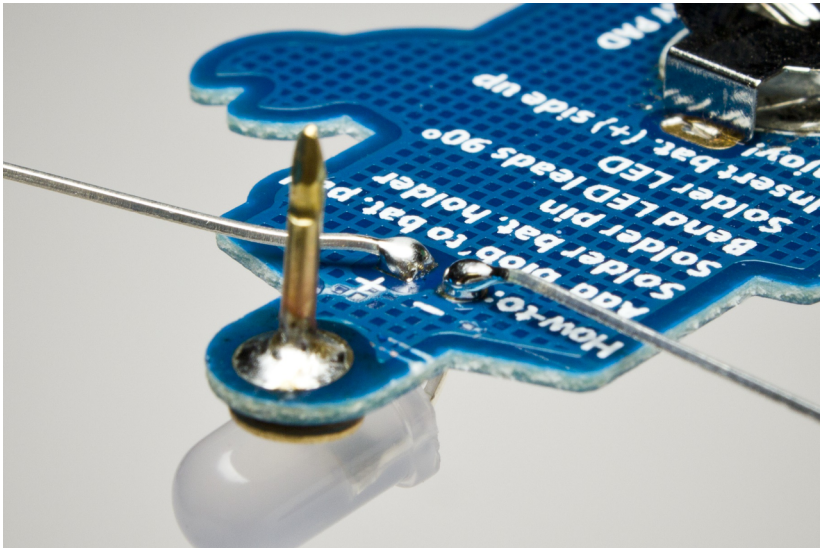

Figure 2-22. *A blobby solder joint*

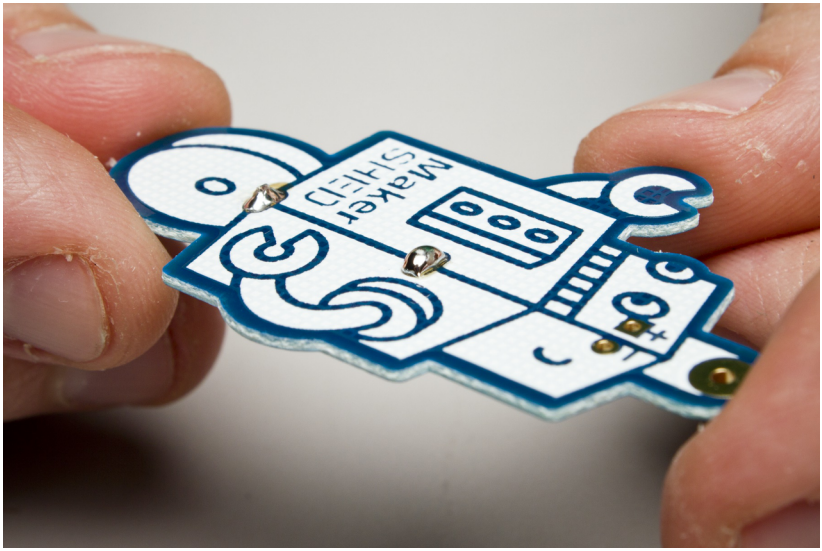

Figure 2-23. *Comparing two joints*

3/Desoldering

If everything went right the first time, you'd never learn anything. This section shows you how to recover from little soldering mistakes, and also includes a gallery of various solder joints so you can compare your work.

Desoldering is the "undo" command for soldering. With this technique, you can remove solder from a joint, allowing you to free the component so you can reorient it as needed. There are two tools for this: the *desoldering wick* (sometimes called *desoldering braid*) and the *solder sucker*.

The Desoldering Wick

Pull a small length of wick out of its spool (Figure 3-1). You don't need much, but if you don't use it all, you can wind the wick back into its spool.

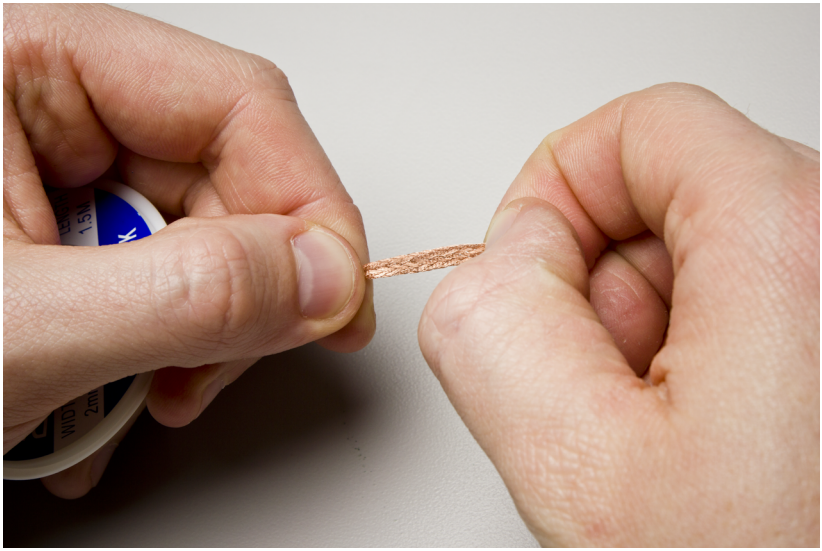

Figure 3-1. *Pulling out some wick*

Preparing the Wick

Before you use the wick, hold it as shown in Figure 3-2, and push inward. This will cause the wick to spread out, giving you more surface area to work with.

Figure 3-2. *Spreading the wick*

Desoldering with the Wick

Position the wick over the joint, and press down on the wick with the soldering iron as shown in Figure 3-3. The heat will pass through the wick and melt the solder. As this happens, the wick will soak up the solder, removing it from the joint. When you're done, you can trim off the used portion of wick with your wire snips.

Figure 3-3. *Desoldering*

WARNING: The wick will get very hot, so take your hands off it as soon as you press the soldering iron to it (the soldering iron will hold it in place).

Desoldering with the Solder Sucker

The solder sucker is another tool for removing solder. It's best for removing excess solder, and you can use it to clean things up a bit before you use the wick. To use the solder sucker, press the plunger down until it locks. Use the soldering iron to melt the solder around the joint, and quickly bring the solder sucker's nozzle to the joint (Figure 3-4). Press the button on the sucker, and it will pull the solder right up into the tube. When you press the plunger again, any solder in the tube will be ejected.

Figure 3-4. *Using the solder sucker*

4/What's Next?

Now that you've learned the ins and outs of soldering, it's time to do more. You can share this book with a friend so they can learn, or you can teach them yourself. And the world is full of wonderful things you can make now that you know how to solder.

Teach the World to Solder

Before you can teach someone to solder, you need to figure out what you want them to try making. You can purchase more Learn to Solder Skill Badge Kits from *http://makershed.com*. Here are a few tips for teaching soldering to others:

Keep Your Hands Off the Tools
: You're there to teach, not to solder. And your students will learn best if they always have their hands on the tools. If you grab the tools from them and do part of the work, they won't learn from it.

Be Patient
: Try to remember what you went through the first time you tried to solder. It takes time, and you did things incorrectly, and maybe you even made mistakes that required desoldering. Let your students learn from their mistakes, and let them take their time.

No Food or Beverages
: Even with lead-free solder, there are chemicals in the flux that aren't good for you. If you allow food or drink near the work area, it could get contaminated. Keep food and drink away from where you're working.

Make Sure There's Plenty of Light
: The components you work with while you solder are small, and hard to see. Make sure to use a well-lit workspace for teaching.

Keep Spare Parts Around
: Beginners will break things. Pick up some spare resistors, LEDs, and other common components, and have them on hand in case you need to replace a damaged component.

Make More Things

Maker Shed (*http://makershed.com*) carries many electronic kits that you can apply your newly-learned soldering skills to. Here's just a few of them:

Supercap Racer Kit

One of the latest in our popular Mintronics line of DIY kits is this tiny race car designed by George Albercook. Once assembled, this little racer (Figure 4-1) will run around getting its juice from a supercapacitor. Capacitors are like little batteries. Supercaps store and release power faster than ordinary ones, so they're great for making quick-charge gadgets and power-on-demand circuits.

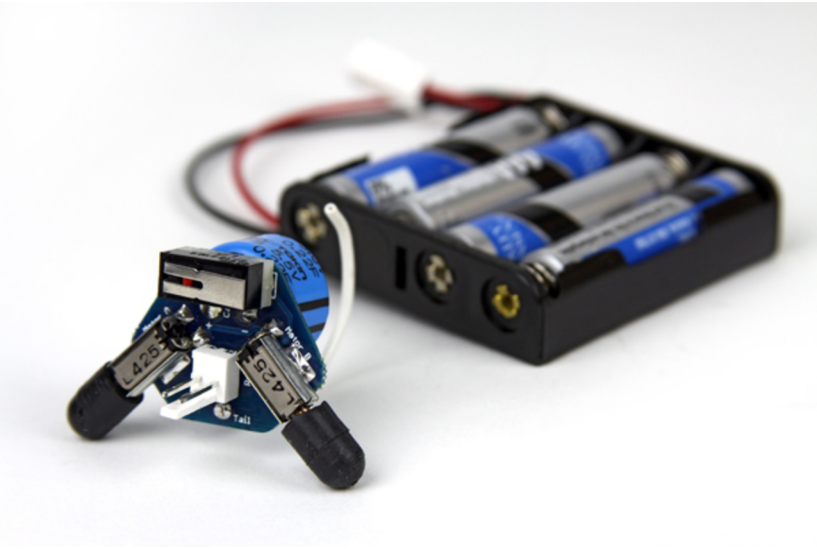

Figure 4-1. *Supercap Racer Kit*

Wee Blinky Kit

The Wee Blinky kit (Figure 4-2) is an easy-to-solder two (2) LED blinker circuit. It comes with a 9V battery snap, but will work with almost any voltage from 3V to 12V. A 9V battery is required but not included. It's tiny, it blinks, and it's a great kit to hone your soldering skills since it's cheap too!

Figure 4-2. *Wee Blinky Kit*

MintyBoost

The MintyBoost (Figure 4-3) is a small and simple USB charger for your iPod or other MP3 player, your camera, cellphone, and any other gadget you can plug into a USB port to charge.

Figure 4-3. *MintyBoost USB Charger Kit*

About the Authors

Brian Jepson is an O'Reilly editor, hacker, and co-organizer of Providence Geeks and the Rhode Island Mini Maker Faire. He's also been involved in various ways over the years with AS220, a non-profit arts center in Providence, Rhode Island. AS220 gives Rhode Island artists uncensored and unjuried forums for their work and also provides galleries, performance space, fabrication facilities, and live/work space.

Tyler Moskowite, a programmer, engineering intern at Make Magazine, and student at Santa Rosa Junior College, has been tinkering with electronics for almost half his life. He picked up Arduino, then Android, and with the release of the ADK he has found his niche.

As a photographer for Make Magazine, Gregory Hayes has ruined more clothes than he ever did as a handyman, hiked more miles with a heavier load than he did as a backpacker, done more research than he did as a writer, and gotten closer to more human hands than advised by any epidemiologist. Taught to solder at the age of seven and forced to solder for his supper at the age of nine, he's now content to let others enjoy the lion's share while he stands by watching safely from behind glass.

How to solder

This pdf refers on informations from the site: http://store.curiousinventor.com/guides/
Have also a look to the 7min. Tutorial video on: http://store.curiousinventor.com/guides/How_to_Solder

Select a Soldering Iron

A 25 or 30 Watt iron should suffice for most small electronics work.

1. Most **soldering "guns" are vastly overpowered for electronics soldering** and can easily overheat components or expose them to harmful voltages. However, some people cleverly use them to solder multiple leads on surface mount devices. Soldering "guns" are for plumbing and much heavier duty applications, and are usually over 100 Watts. The "guns" work by passing high currents through the tips, and these currents can generate voltages that damage electronic components. Also, magnetic fields from guns with transformers can damage some electronics.By forming the heating element in the shape of of the chip, a soldering gun can be used to heat many leads simultaneously.

2. **How much wattage do you need for a particular application and how does wattage relate to tip temperature?**

   A loose analogy: Imagine a car tire has a leak, but you're trying to keep it inflated by pumping air into the tire at the same time it's escaping out the leak. The bigger the leak, the more air you have to pump into it to keep the pressure up. If the tire pressure represents tip temperature and the air lost through the leak represents heat lost through the tip, then wattage represents the maximum amount of air your pump could supply. Once more air escapes through the leak than your pump can replace, the tire pressure (or tip temperature) starts to drop.

   If you had a very small leak and a huge pump (say a 100 Watt iron equivalent), you might be afraid that the pump would cause the tire to explode since so much more air is going in and so little going out. But if you have a nozzle to regulate the pump's air, you could only allow just the right amount of air in to replace what's lost through the leak. This is how "temperature controlled" soldering irons work. As long as you aren't losing more heat out of the tip than the iron can replace (up to its rated wattage), it will automatically regulate just the right amount of heat into the tip to maintain the same temperature.

   However, typical plug-in irons have no such regulation. A 15 Watt iron always delivers 15 Watts of heat to the tip, and the tip temperature stops increasing only when 15 Watts of heat escape through the air. When the tip touches a part, its temperature drops, and if the part you're soldering can dissipate enough heat, the temperature will keep dropping until it won't melt solder any more. After the iron is pulled away from the joint, the temperature will climb again. There is some amount of natural regulation: as the tip gets hotter, it dissipates more heat, and as it gets cooler, it dissipates less.

   Usually, the bigger the component the more heat it can absorb and dissipate, so the general rule is that you need more wattage for larger parts. If you're just soldering small resistors and ICs, 15 Watts will probably suffice, but you may have to wait a bit in between joints for the tip to recover. If you're soldering larger components, especially ones with heat sinks (like voltage regulators), or doing a lot of soldering, you'll probably want a 25 or 30 Watt iron. For soldering larger things like 10 gauge copper wire, motor casings, or large heat sinks, you may need upwards of a 50 Watt iron or more. The following video shows what happens to tip temperature as 15, 25, and 40 Watt irons solder various sizes of wires and components. For cheap irons, higher wattage does indeed mean higher temperatures!

- What is the difference between cheap RadioShack® irons and more expensive ones like Wellers®? What do $100+ and $400+ soldering "stations" have over the cheaper kinds that plug straight into the wall? expand Among the irons that plug straight into a wall and don't have a separate station, the dirt cheap kinds will work satisfactorily for many applications. From personal experience, the tips on RadioShack® irons often come loose and sometimes can be impossible to remove. The irons can also get uncomfortably hot to hold after several hours of use. The more professional Weller (or other) lines are made for longer, continuous use and have insulation on the handles that keeps them cooler. They

can also take a wider variety of tips.
Soldering iron "stations" usually provide some control over the heat being supplied to the iron tip. Ones that are temperature controlled automatically control the amount of heat delivered to the tip so that it remains at a set temperature. In every iron, when the tip touches a component, some heat is lost and the temperature drops. One measure of quality is the time needed for the tip to regain its temperature. A nice feature of many soldering stations is that the tip heats up in seconds after you turn it on.
Many stations also allow you to hot-swap the iron tip, which can be very helpful if you're alternating between surface mount joints and larger components.

- If standard tin-lead solder melts below 400 °F (and lead free below 500 °F), why do most soldering irons have tip temperatures between 600 and 800 °F? Just what is the right **soldering temperature**? expand The basic reason that tips are so much hotter than solder's melting point is because that difference helps to transfer heat faster to the joint. What is the "correct" temperature is a debatable topic, but a common rule of thumb is to start off at 600 °F and increase from there until acceptable results are achieved. Typical Kester (a solder manufacturer) datasheets recommend 600-700 °F for lead-based solder, and 700-800 °F for lead-free solder. "No-clean" or "low solids" fluxes will burn off before a joint can be made with higher temperatures, so low temperatures (below 700) may be essential for these fluxes.
  From Kester's hand-soldering knowledge base: "When hand soldering with a rosin flux such as the Kester #44 or the # 285 the recommended iron tip temperature is 750°F. If you are soldering with a low residue no clean solder such as the #245or # 275 we recommend a tip temperature of 600-650°F.
  What are acceptable results? The goal is to heat up the parts enough so that solder will adhere to them and form a good bond. The higher the iron temperature, the faster it will heat up the parts, so why not set it extremely high to work faster?
  Besides the obvious increased risk of overheating components and the board, higher temperatures cause the iron tip to oxidize faster and can significantly reduce its life. Some claim a 10 °C rise reduces tip life by half (ref p.33). For occasional use, though, tip life may not be much of a factor, especially if the tip is kept covered with solder at all times.

- **Tip size and shape:** a basic guide is to pick a tip that's slightly smaller than the pad you're soldering to. From there, you want a tip with a large thermal mass and short stroke (why?) In most soldering irons, the tip is not actually the heater, but sits in between your work and the heater. You can think of it like a heat bucket that empties into your work and gets filled again by the heater. Typically touching a component empties heat out of the tip much faster than the iron can replace it, and if you have a small bucket (tip), the temperature will quickly drop to an ineffective level.
  Especially if you have a small wattage iron (15 Watts or less), the temperature will drop before you can heat up a larger part, or you'll have to wait a bit in between joints for the tip temperature to recover. With a bigger bucket (tip), you can handle larger joints with smaller wattage, but eventually you'll need to step up the wattage.
  The "stroke", or length of the tip should be minimized to get the heater closer to the work; it takes some time for heat to transfer through the tip. This is balanced with the need to get into tight places where you need a longer tip.
- What do common tip shapes look like and what applications are they best for?

Screwdriver, spade, and conical are some of the more common tip shapes. Personal preference is the biggest factor when choosing a tip, but the goal is to get as much surface area contact between the tip and work as possible. Chisel and spade tips have more surface area at their ends, and also "hold" solder at their tips more readily than conical tips, which have a tendency to draw solder away. Even for fine pitch surface mount soldering, having a small flat at the end can be helpful.

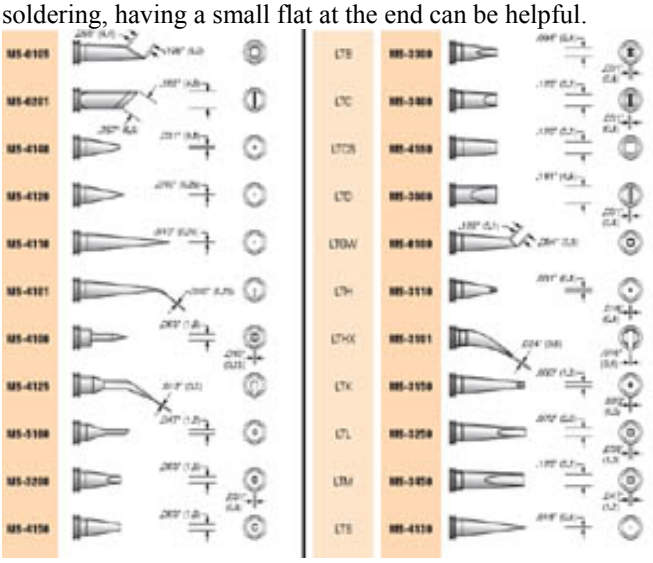

- There are myriad other tip shapes and sizes. The picture to the right shows one Plato catalog page of many. Some other non-standard shapes include a knife-blade (useful for fine pitch leads) and a surface mount desoldering tip.

desolder surface mount resistors

desoldering a surface mount soic chip © 2007 CuriousInventor.com

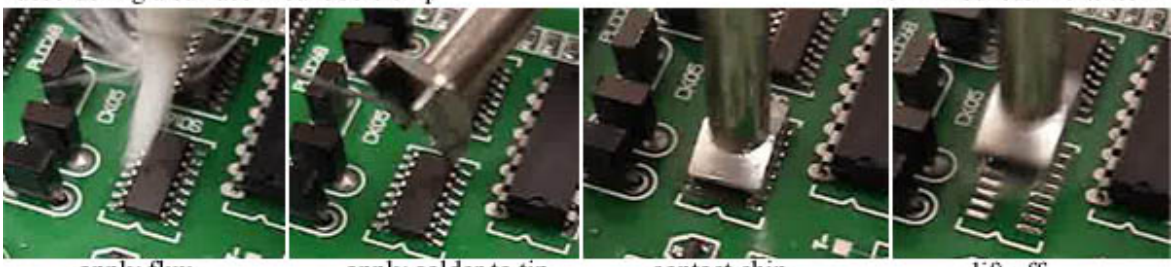

apply flux | apply solder to tip | contact chip | lift off

To preserve tip life, the number one thing you can do is reduce the tip temperature (if your iron allows this). After that, ALWAYS keep a layer of solder on the tip to prevent the tip itself from oxidizing, and clean it in between uses. Put a glob of solder whenever you put it back in the stand, and before you turn it off. When heating up a new tip for the first time, hold solder against it so the tip can be covered as soon as the iron gets hot enough.
The longer flux residues and oxides are left on the tip, the harder they are to clean off. They also can drastically reduce the tip's ability to heat up a part, and prevent solder from "wetting" the tip. Regular cleaning of the tip before use is one of the best ways to prolong tip life and make soldering easier. It's important that solder "wet" or cling to the surface of the iron--without solder in between the tip and work the tip's ability to heat is drastically reduced.

- What about gas powered irons and the Cold Heat® iron that is supposedly touchable 1 sec. after use? Butane (and other gas) powered irons are mainly used in situations where electrical power isn't

available. Weller sells some battery powered irons as well.
Everyday Practical Electronics gives a pretty damning review of the Cold Heat iron here, in addition to having one of the better how-to guides out there. To summarize, the Cold Heat® iron has a forked end that you must bridge with the work or solder to turn on the iron, so it can be hard to hold it in a place that keeps it on and also effectively heats the part. Many people complain about pushing harder to make a good connection and then having the brittle tips break. Running power through your work to heat it may not be the greatest idea with some parts. Finally, the iron doesn't get hot enough for a lot of jobs, or cool enough to do anything like throwing it in your pocket right after use. But for something that's portable and cordless, heats up and down in under a few seconds, maybe it's worth the price ($20). Weller's battery powered ($20) iron doesn't have a forked end and supposedly heats up in under 15 seconds, but I don't know about cool-down time.

What kind of solder (rosin cored, etc. lead-free)? What is flux and when is it necessary?

As a starting place, for most small electronics soldering, 1/32 inch (.03) rosin-cored, 60/40 (tin-lead) or 63/37 solder should work fine. Rosin-cored lead-free is fine, too. Unless you have reason otherwise, don't use "no-clean" solder--it's very likely that you don't need to clean the regular rosin-cored solder. The solder should be thin enough to prevent accidentally applying too much (and causing a solder bridge), but thick enough so that more doesn't have to be gathered from the coil too often.

Besides affecting your feed-rate and convenience, the solder thickness also relates to the amount of flux that is delivered. Flux is basically a weak acid that removes oxides so that solder can adhere to the metal, and is so essential to the soldering process that it's built into the core of common wire-solder. It also helps the solder spread out (reduces surface tension), transfer heat, and acts as a protective blanket to keep oxygen away from the metal until solder displaces it.

For the most part, manufacturers include a sufficient amount of flux in the wire, but if you use an extremely thin wire there may not be enough to clean the joint OR the iron tip. Consider using a thicker gauge for cleaning the tip periodically if you're using especially thin solder. Liquid flux is helpful for SMD soldering, too.

When picking a wire-solder, there are 4 features to decide on: flux type and amount (% weight), alloy (tin-lead, lead free, silver bearing, etc.), thickness and total amount (1oz, 1lb?).

- **Flux:** Just what is flux, what kinds are there, and when do I need liquid flux?

  Why it's needed: Solder doesn't just freeze on a joint, it actually forms a metallurgical bond by dissolving and chemically reacting with the base material. Unfortunately, almost all metals oxidize in air and form an oxidized layer that prevents solder from wetting and bonding to them. What is oxidation?

  Oxidation, is when Oxygen (or other oxidizing agents like sulfur) atoms combine with base materials, stripping loosely attached electrons and forming new compounds like iron(III) oxide. It is what happens when apple slices turn brown, iron rusts, copper turns black / green and unsolderable. (read references for more accurate/complete explanation)

  Results vary significantly. When iron rusts, the oxides flake off until no iron is left. Alternatively, aluminum oxidizes extremely rapidly, but is then protected from additional oxidation by the oxide layer. This layer makes Al impossible to solder without using special solder and extremely aggressive flux, or plating the surface with a solderable metal, like nickel. The chromium in stainless steel fulfills the same function, oxidizing to form a protective barrier that is difficult to solder. Gold remains shiny

because it doesn't oxidize, and is easy to solder to, but forms brittle joints. Heat, moisture, and salt all increase the rate of oxidation.

Oxidation can add a hidden cost to components and boards that may have been sitting on the shelf for long periods of time, or have been exposed to hot, humid environments. Copper pads on PCBs (printed circuit boards) are covered with solder or are plated to prevent oxidation, but given enough time, oxygen can still penetrate these barriers. Surplus parts in particular may need a bit of steel wool.

Some interesting references:
rusting chemical reaction
fairly understandable explanation of oxidation
wiki/Corrosion
wiki/Oxidation

Oxidation occurs much faster at higher temperatures, so even if you somehow had clean metals to start with, you would still need flux to prevent new oxides from forming while soldering.

The main choice to make when deciding on a flux, whether it comes in a cored wire or a liquid or paste form, is how aggressive it should be. The more aggressive or "active" the flux, the harder the oxides it can remove, and the faster it can remove them. Going from weakest to strongest, typical choices for hand soldering applications include: "no clean", RMA (Rosin Mildly Activated), RA (Rosin Activated), and water soluble. A newer classification system (J-STD-004) has recently been adopted and classifies fluxes not by rosin content, but by activity, material, and halide presence.

The new system classifies flux by material (RO=rosin, RE=resin, OR=organic, IN=inorganic), activity level (Low, Moderate, High), and halide presence (0 or 1). No-clean, rosin-based no-clean fluxes might be labeled ROL0 or ROL1. Although there is no direct translation between the old system and new, most R and RMA fluxes fall under Low activity level, RA are generally labeled as Moderate activity, and water soluble are High activity. (source IPC-HDBK-001 www.ipc.org)

The downside to choosing a more aggressive flux is that the residues left over after soldering MAY be corrosive, conductive, or enable fern-like growths called "dendrites" to grow between connections. A brief description (p.29) of dendrite growth and some great pictures at the end of this paper.

Because of the risk of corrosion and dendrite growth, most manufacturers clean off the residue from RMA and RA fluxes, and some even clean "no-clean" residues. The question of what flux to use and whether / how to clean it is quite involved.

Rosin flux is quite an interesting animal. Made from pine tree sap, at room temperature, it's an excellent insulator and non-corrosive. When it hits 226 °F it begins to turn acidic and attack oxides, but then when it cools it supposedly leaves residues that are again inert. Kester's data sheet for "44" flux (classified as RA and ROM1) claims no cleaning whatsoever is necessary. I haven't read of any manufacturers that would use a RA (or even an RMA) flux and not clean it--the military won't even use a RA flux WITH cleaning because of the risk that some will be left behind. This Chemtronics author recommends cleaning even the "no-clean" fluxes. He also points out that even if the residue is non-corrosive and non-conductive, it might be tacky and attract dust that causes a short.

To add one more piece to the puzzle, flux generally gets used up during the soldering process. This is why no-clean fluxes are oftentimes ineffectual for lead-free soldering, which can require slightly higher temperatures and longer heating because the lead-free solder "wets" slower. The no-clean flux can burn off before the joint is complete. Alternatively, if you apply liquid flux far from a joint, it may still be active (corrosive) if it never got heated.

I'm not making missile guidance electronics, I'm making a robot that pours a beer, what flux should I use and do I really need to clean? Even manufacturers of non-life critical electronics have much more stringent reliability requirements than an individual. They must ensure that tens of thousands of products will work for multiple years, not a single project.

The safe advice is to use the least aggressive flux that enables solder to quickly wet or cling to the surfaces, and then clean off the residues with alcohol and lint-free wipes (don't just spread the flux around). Try starting with a rosin-based mildly activated flux: RMA. I am inclined to trust Kester's spec sheet for "44" (RA) flux that says it does not actually require cleaning. Other flux manufacturers may have RA or RMA level fluxes that do indeed need to be cleaned, so if you don't know what you're using, cleaning is probably prudent. If you are going to clean rosin fluxes, do it soon after soldering because they quickly harden (see pics under 'Cleaning'). Finally, I would personally avoid no-clean fluxes and solder unless you have a critical application and very clean parts.

Lead-free solder generally requires a made-for-lead-free flux designed to be used under slightly higher temperatures.

Liquid flux can greatly help with surface mount soldering and desoldering components, but the flux inside cored-solder should be sufficient for through hole components. When soldering SMD components and desoldering pretty much anything, liquid flux acts as a blanket that helps to spread heat and also keep oxygen away from the metals. Finally, flux lowers the surface tension of solder, helping it to spread out and wick into connections.

A water-soluble flux may be necessary for heavily oxidized parts or difficult metals like nickel. Without question, clean these fluxes. Special fluxes and solders exist for aluminum and stainless steel and these also certainly require cleaning. Never use acid-core solder; it deposits zinc chloride into the solder that cannot be cleaned out. A final reason to clean flux residues is if you'd like to apply a conformal coating and aren't sure whether it will adhere to those residues.

Some more references:

- Never use acid-core and how to solder to stainless steel (Kester)
- White residue and all about rosin (more Kester)
- Good mini-class on fluxes: Bolton University
- To clean or not to clean and a brief history of electronics cleaning: more Bolton
- The Kester catalog provides good info on the solderability and flux requirements of various materials (see p.14).
- Flux residues and what to do about them. This explains a bit about cleaning options and the health risks of rosin and non-rosin fluxes.

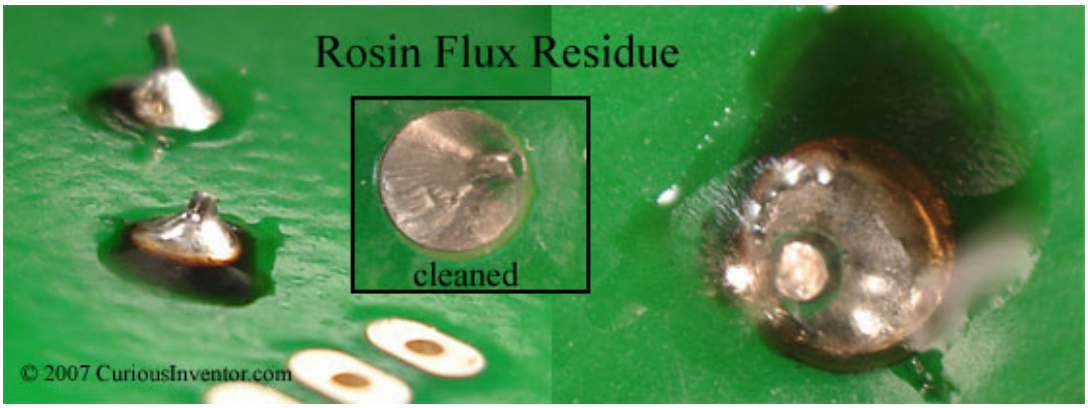

- **Alloy:** 60/40, 63/37, tin-lead, lead-free, silver bearing, RoHS, eutectic, oh my...

- **Standard lead-based solder** is made of tin and lead. When you see 60/40 or 63/37, it means 60% tin by weight, 40% lead. Either once of these alloys should be fine for typical small electronics soldering. 63/37 in bulk is slightly more expensive because of additional tin, but has the special property of being a "eutectic" alloy, which transitions from liquid to solid at one temperature (like water) instead of range of temperatures. Basically, in non-eutectic alloys like 60/40, there is a "pasty" region of temperature where portions of the solder are frozen and other portions are liquid. What does this mean for soldering and is 63/37 really that much better?

  Alloy metals have some interesting properties that are different from the metals comprising them. In tin-lead solder, the mixture has a lower melting point than either lead or tin alone, and the melting point varies depending on the portions. The mixture that yields the lowest melting point is called eutectic. This is also the only mix where all the constituents melt and freeze at the same temperature.

  If the tin-lead alloy isn't eutectic (ie, if it is not 63% tin), it will go through a "pasty" phase while it freezes. Unlike water, which freezes entirely at 0 °C, some parts of a non-eutectic mixture of tin-lead freeze at higher temperatures than other parts. For a somewhat simplified explanation, if you held the temperature of 60/40 slightly above 361 °F, the "extra lead" would solidify and be floating in a liquid 63/37 eutectic mix. For a more exact and great explanation of this process, look here.

  How is it that the mixture of two elements somehow lowers the melting point? And I quote: "increased entropy." Chew on this. (Another great phase-diagram explanation with a bonus of why ice and salt can get almost 30 °F below freezing--enough to freeze ice cream) And one last great explanation--talks a bit about grain structure and how solder isn't a simple homogeneous mixture of tin and lead.

  This compares the difference between eutectic freezing in tin-lead and eutectic freezing in more complex 3 element lead-free alloys.

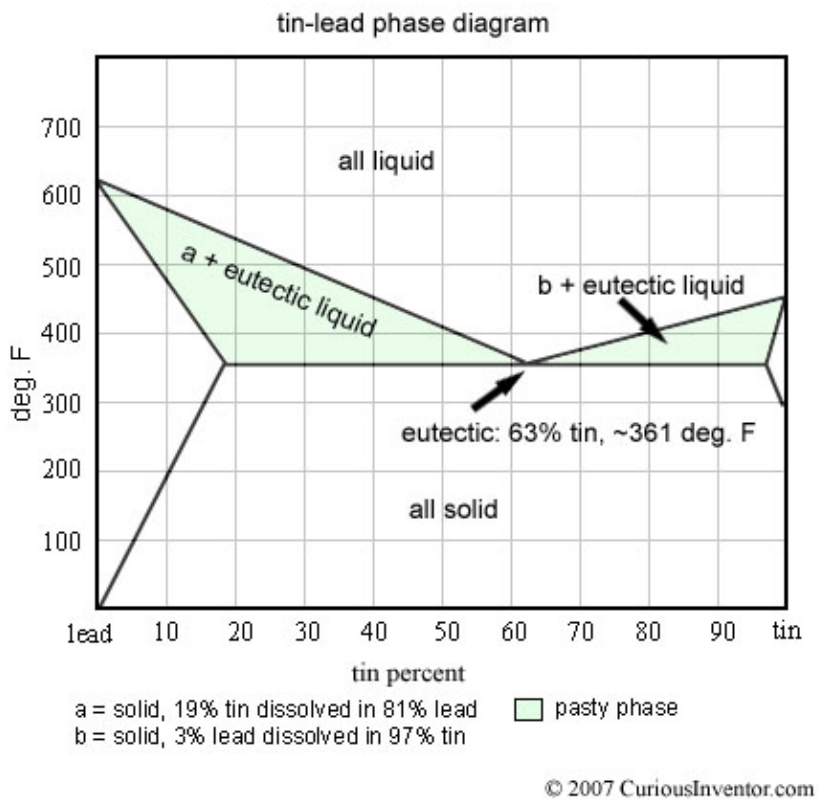

So which is better, 60/40 or 63/37? A decade or so back (before the lead-free movement), most manufacturers incurred about a 5% increase in cost to switch from 60/40 to 63/37. 63/37 flows slightly easier, makes shinier joints, and has a faster total freezing time which means there is less risk the joints will be "distrubed," which is what happens when the joint moves during solidification. This can lead to internal fractures that cause poor electrical connections and unreliable mechanical joints. Note that 63/37 doesn't freeze instantly (just like water)--it still has a window of time during which the joint can be disturbed, too.

I think most would say that the enhanced properties of 63/37 really only matter for mass soldering operations like wave or reflow soldering, and that there is little difference for hand soldering. A dull joint is more often caused by insufficient heat, dirt or oxides, or lack of flux rather than alloy makeup. (A no-clean flux may burn off before the joint is complete) Holding everything else constant, the difference in shininess between 60/40 and 63/37 is completely cosmetic. If you'd like to see a shiny 60/40 joint, try using Kester 60/40 with #44 flux.

- **Silver bearing solder:** (that is, contains silver, not for roller bearings) Silver is used in one of the leading alloys for lead free solder (An96.5% Ag3.0% Cu.5%) and also as an addition to tin-lead solder, usually in the 2-4% range (when you se 62/36/2 this means Sn64Pb36Ag2).

  People claim that it flows better, has a lower melting point, is stronger, and has a higher conductivity. According to Indium's solder wire data sheet, their 2% silver solder has an electrical conductivity that is 11.9% of Cu compared to 11.5% of 63/37 tin-lead solder, a shear strength of 7540psi vs. 6200psi, and a tensile strength of 7000psi vs. 7500psi for 63/37. So, yes, the claims are true, and also mostly insignificant. Silver was initially added to solder to prevent silver platings on component leads from dissolving into the solder ("silver migration") and forming brittle joints. Having silver in the solder reduces migration, so you may want to use it on silver joints. (Note: this logic doesn't entirely make sense to me. If silver getting in the solder caused embrittlement, how does adding *more* silver prevent this?)

  Audiophiles seem to be enamored by 4% silver bearing solder, namely some from WBT, Cardas, and WonderSolder. Are these really better for audio?

  The superior claims include things like higher purity, eutectic alloys, higher conductivity, and better flux. I haven't found any controlled studies showing that a group of people can actually hear the difference, so I'm skeptical. Although additional silver does increase conductivity, the increase is small and the joint distance over which that conductivity applies is also extremely small. For what it's worth, here's a forum discussion that discusses a bit about solder in high-end audio and also a FAQ (scroll down)concerning solder on Cardas Audio's site. Another decent discussion.

  Bad joints made with any solder can create a high-resistance connection, especially if the underlying components were heavily oxidized initially. My advice: if it makes you feel better, get it, but be wary of sellers that don't provide spec sheets.

- **Lead-free Solder:** As of July 1st, 2006, European laws mandated that new electronics be almost entirely lead free. As of yet, there are no US laws (outside CA) mandating the removal of lead, but most manufacturers are switching over for competitive reasons. More on RoHS, WEEE, and lead risks:

  The European Union passed directives in 2003 stating that no equipment sold in Europe should, by July 2006, have more than .1% lead in any homogenous component (like a solder joint). The directives are known as the WEEE (Waste Electrical and Electronic Equipment) and RoHS (Restriction of Hazardous Substances) (wiki). There are corresponding laws in China, Korea, and California. Japan manufacturers actually voluntarily begin switching to lead

free years before RoHS or WEEE for competitive reasons. IPC's informative lead-free website: here.

Although only .5% of lead used in the US gets embedded in electronics (verses 80% in batteries), there is concern that the lead from those electronics will leach into ground water supplies from landfills. Why the concern over solder joints when batteries contain so much more lead? For the most part, lead containing batteries are recycled and regulated, whereas electronics are routinely just thrown away. The EPA claims that 1% of municipal waste is electronics. Interestingly, according to this publication by IPC, no studies have found any evidence of lead getting into the ground water from landfills.

Lead health risks: Lead does not get absorbed through the skin, and is actually not present in solder fumes to any appreciable degree (fumes are still bad for you, see fumes section below). The greatest risk of hand soldering with lead comes from ingesting lead by eating or smoking without first washing. Health risks include increased blood pressure, fertility problems, nerve disorders, muscle and joint pain, irritability, and memory or concentration problems. The latest health data indicates that there is no amount of lead that will not be detrimental to health. Google lead or start with this link.

Some great lead-free joint pictures: here.

The most popular lead-free alloy seems to be Tin 96.5% Silver 3.0% Copper .5%. The wiki page on solder mentions several different lead-free varieties.
-AIM lead-free solders.
-Huge list of Indium lead-free solders and their properties.

Lead-free solder generally melts at a higher temperature, and doesn't wet as quickly to metals. (Eutectic tin-lead solder melts at 361 °F and the SnAg3Cu.5 melts at 423 °F.) Manufacturers generally recommend setting soldering iron temperatures between 700-800 °F for lead-free instead of 600-700 °F for tin-lead soldering. The 15 Watt RadioShack® iron I had operated a bit below 500 °F, so soldering should be possible with it, but maybe slow. Technique wise, since lead-free wets slower, joints will take longer (upwards of 4-7 seconds), but this doesn't mean the soldering iron temperature should be turned up excessively--patience is better than higher temperatures. If you're going to use a lead-free solder, get a flux that's designed for the higher temperatures--the regular no-clean fluxes will likely burn off before doing their job.

A quick word on reliability. Some say that lead-free joints are stronger, and while the material is indeed stronger, it's less flexible than lead-based solder, so expansion and contraction due to temperature change has been shown to break components held by lead-free solder. It seems true mechanical reliability of lead-free vs. lead depends heavily on the situation (see p.30). There is also concern of something called "tin whiskers." These are extremely thin crystalline growths that grow perpendicularly out from surfaces. These took down some space systems and NASA has a great page here. These are different from dendrites (which grow on the surface) and appear to be more likely on bright all-tin platings. Most component platings used to consist of a tin-lead mixture, and since all-tin platings are a common lead-free replacement, people are concerned. I have yet to find any literature that points to TinSilverCopper solder as a risk factor, though. I believe it is a plating issue, only.

One more link: -Why tin or silver?

- **Thickness and Amount:** As a general guide, .032" thick solder (21 gauge) should be suitable for through hole soldering and some surface mount soldering. For finer pitch surface mount devices, use .02" or .015", and if you're soldering a lot of switch terminals, or tinning thick gauge wire you may want .05". If you use .015" solder consider having some thicker solder on hand to re-tin your tip, since the amount of flux in .015" may not be enough to remove tip oxides. The picture below shows how the various thicknesses compare next to the standard .1" spaced DIP pins.

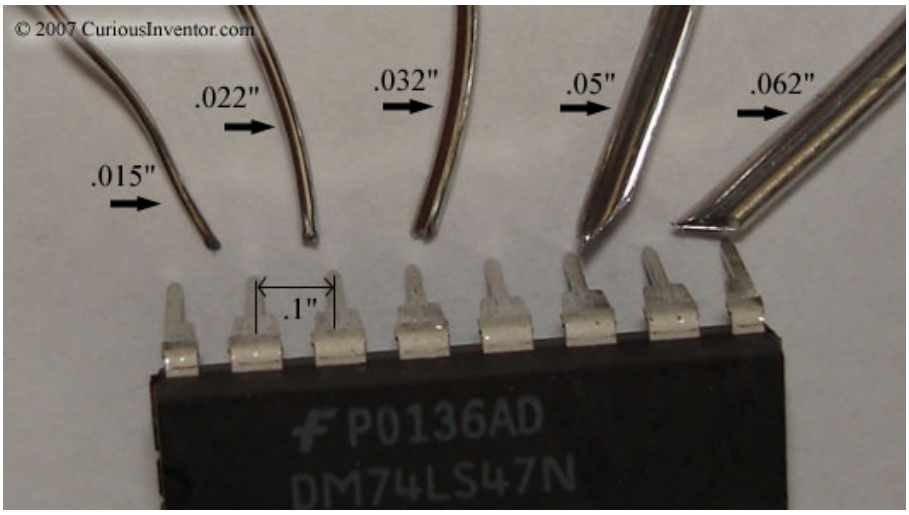

Expand to see how .032" and .015" solder compare to a SOIC surface mount chip and fine pitch (.02") device.

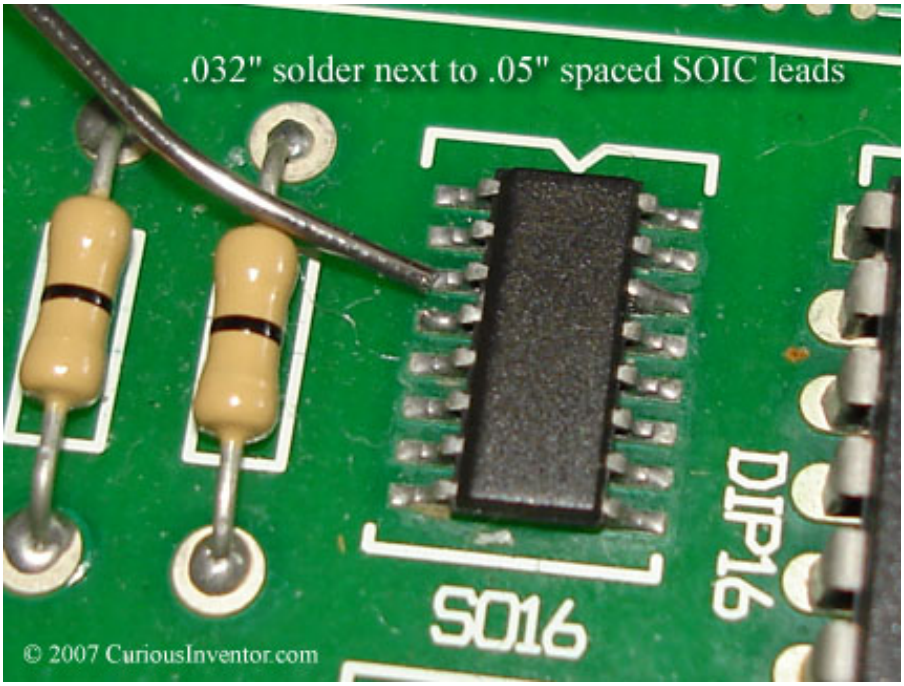

How much solder do I really need? An ounce? A pound? How long will a pound last?

To get a very approximate feel for just how much solder is in an ounce vs. a pound, I measured how much .032" solder it took to attach ten 16 pin DIPs. Trying to provide an upper bound, the soldering is excessive, and a generous glob was placed on the tip in between each chip to account for solder used to tin and protect the tip during normal use.

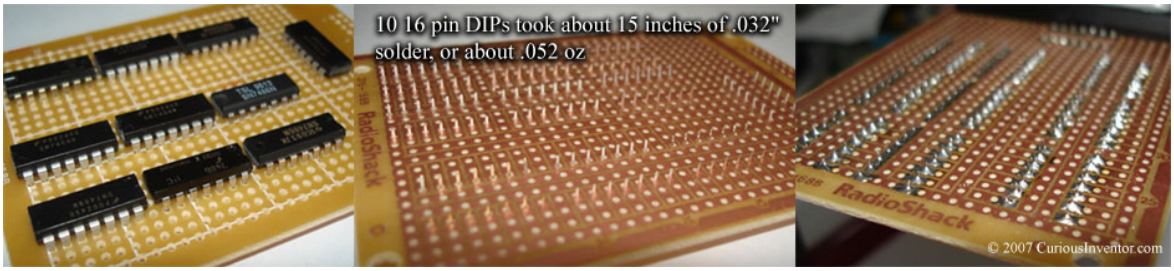

The ten chips took about 15" of generously applied .032" solder that weighed in approximately at .052oz. This particular solder weighed about .00348oz/in. At about 3.27e-4 oz/joint, a 1 oz spool should last 3060 joints, a half pound should last 25 thousand joints, and a pound should last about 50 thousand joints. Mileage will certainly vary with different sized solders, joints, tinning wires, and highway vs. city driving, but if you're not in a production environment, a half pound should last a while.

Solder Fumes:

What is exactly in solder fumes? Am I safer using lead-free solder?

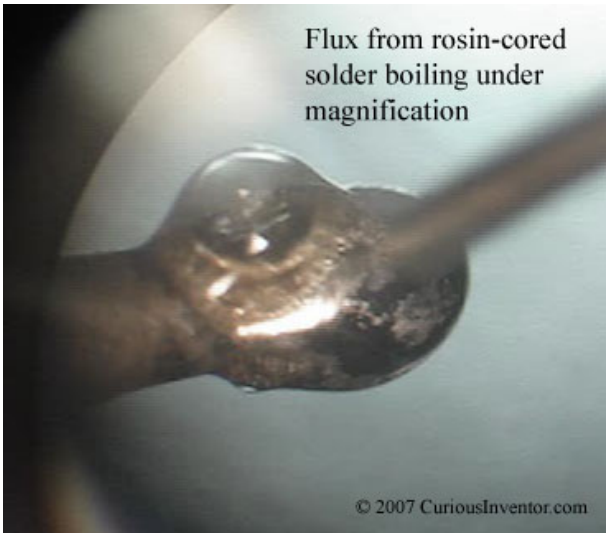

Lead boils at over 3000 °F, and in most cases soldering tips should be kept below 750 °F, so it is highly unlikely that gaseous lead is present in the fumes. The fumes are actually from the flux boiling, which still isn't great for you--many of the chemicals found in cigarette smoke are found in flux fumes: formaldehyde, toluene, alcohols, and hydrochloric acid to name a few. Most of the public health literature indicates that asthma is the major health risk from soldering fumes (not cancer or lead poisoning). When acquired, it is permanent and can cause hyper sensitivity so that even small amounts of fumes bring on attacks. Surprisingly, scientists have not been able to determine what exactly in the fumes cause the health defects, nor what amounts are harmful. Yet, the British health department has set exposure limits of .05 mg/m^3 over 8 hours and .15 mg/m^3 over 15 minutes. I believe these limits have been shown to provide a safe work environment and also one for which the necessary systems / filters are financially reasonable.

Some informative links:

- Solder Fumes and You A British health department pamphlet explaining the health hazards of rosin-based flux fumes (irritation, headaches, dermatitis, asthma) and what precautions employees and employers should take. Note the total lack of any mentioning of lead poisoning.
- Workplace Exposure to Rosin-based Solder Flux Fume During Hand Soldering A study done by the UK Health and Safety Laboratory measuring exposure levels and also the effectiveness of various exhaust, ventilation, and filter systems.
- Measurement of the Performance of Air Cleaners Against the Particulate Element of Rosin-based Solder Flux Fume Another UK Health study investigating the effectiveness of various fume extraction and filter systems. Most interesting finding: although activated carbon filters can remove gaseous hazards, they are largely ineffective for fine particulate in the fumes which they believe to cause much of the harm. Some combination of carbon and HEPA filter is needed, and even these are useless without sufficient air flow.

Returning to the topic of lead, it is widely agreed that eating, smoking and drinking without first washing is the greatest risk factor. Despite the high boiling point of lead, there is also agreement that at least a small amount of lead particles are indeed present in the fumes. The conspicuous lack of

emphasis on lead poisoning in all the research done by the UK health department implies that these particles are of little concern. Sentry Air Systems has a brief page that is one of the very few sources I found to claim that lead particles under normal soldering conditions are harmful. The company sells fume extraction technology.

The material safety data sheet for Kester #44 cored solder says under the fire fighting section: "Melted solder above 1000 °F will liberate toxic lead and/or antimony fumes."

According to IPC's DVD-11, "General Safety in Electronic Assembly," when solder is heated past 850 °F the lead can become atomized and end up in the fumes. video link (if link breaks, you may have to search for DVD-11 at www.ipc.org).

Useful comments from someone in the manufacturing world regarding lead.

It would seem that, for typical lead-based, rosin cored solder, the risks are probably not that great from the fumes if you only solder occasionally, don't use abnormally high temperatures, and are in a well ventilated area. If ventilation isn't too good, and you're soldering for long periods of time, the cheaper foam-type carbon filters may not be good enough.

But what about lead-free solder? Lead-free solder often requires higher temperatures and more active fluxes, and both of these factors lead to significantly worse fumes.

Fume Extraction Becomes More Important in a Leadfree Environment - from the Weller blog

Another excellent article on the increased risk of lead-free fumes from OK International.

Instructables has all sorts of home-made fume extractors.

Prepare the Work

- **Start with clean components:** Flux can remove small amounts of oxides, but will be of little help for heavy oxidation, grease, oil or dirt. Notice how the solder in the adjacent picture has been repelled by the heavily oxidized pin. It may be necessary to lightly use steel wool or fine grit sand paper to remove especially bad oxides. Some people say that you should not do this because it creates scratches that can promote future oxidation... sand at your own risk. Use Silicon Carbide sandpaper (black) as opposed to Garnet (brown, for woodworking) sandpaper because the Garnet paper will shatter and become embedded in the metal. An effective and gentle alternative is to use a pink eraser, especially for copper traces.
- **Clamp your work:** PanaVise makes a popular clamp that accepts several different attachments for holding different sized circuit boards. It's by far the most popular clamp and is also very sturdy. Having the work held in place is especially helpful for desoldering when it's necessary to push or pull a bit. The alligator hands are a cheap alternative.

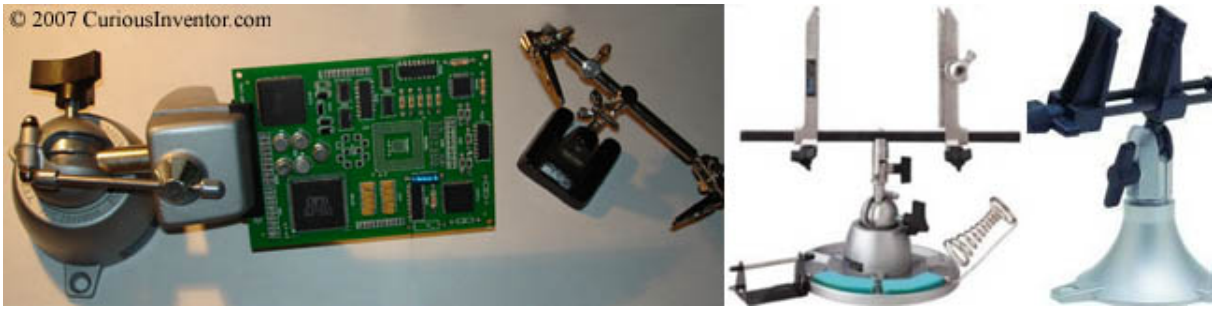

- **Wire preparation:** Tin stranded wires so they don't "bird-cage," or bend out from their original lay. Expand for instructions on the correct way to strip a wire manually, use an automatic stripper, and tin wire.

- **Manual wire stripping:** The natural way you would think to use the wire strippers is to first cut the insulation, and then use the same cutting hole to push off the insulation slug. In production environments where reliability is critical, this is not allowed because it's very easy to nick the wires this way. The pliers at the tip of the stripper are actually meant to remove the insulation slug. First score the insulation with the cutting hole, and then pull it off with either the pliers or by hand. If removing by hand, twist slightly while pulling to keep the strands in place. This is the "right" way to strip a wire, if you're careful, pulling the insulation off with the cutting hole is probably fine.

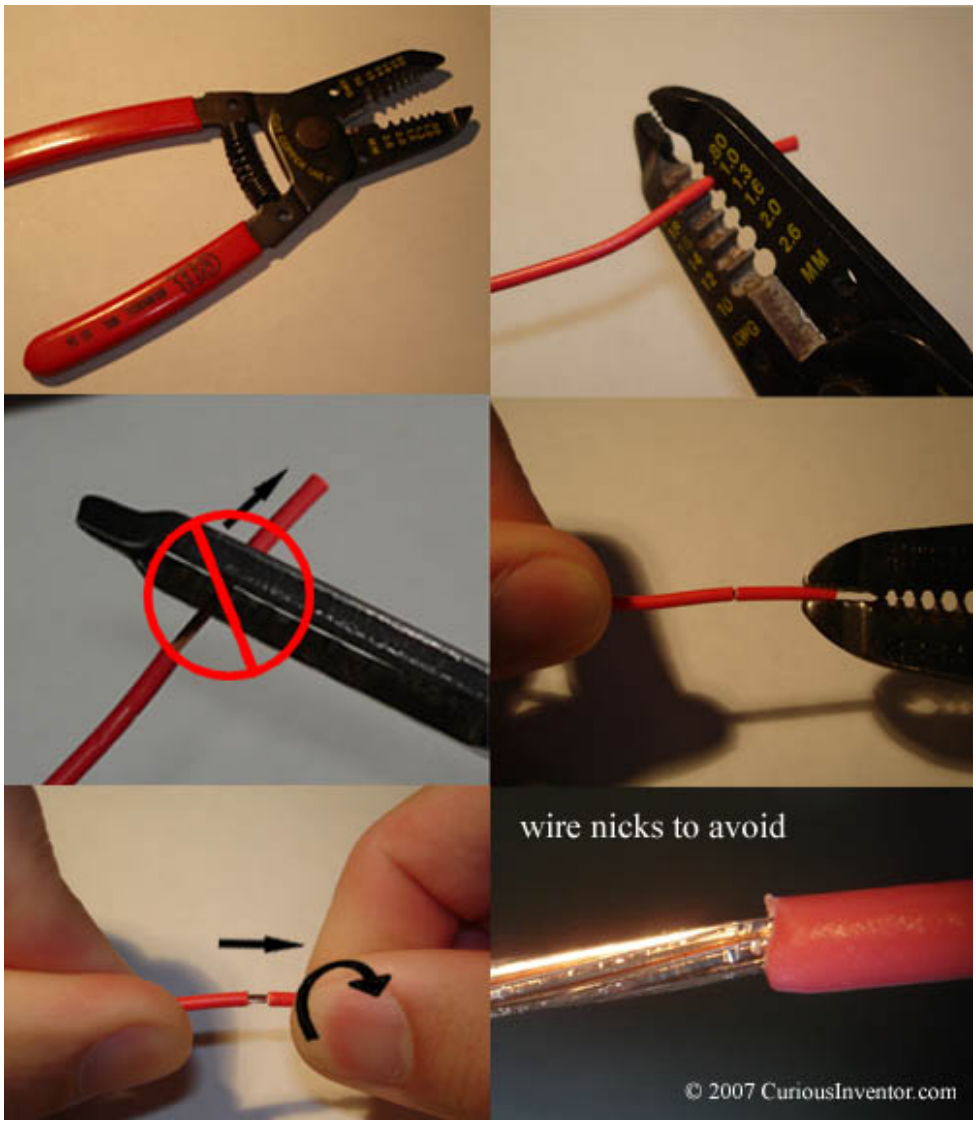

- **Automatic stripping:** With one squeeze these cut and pull off insulation.

- **Tinning:** Just like soldering a joint, the key here is to apply solder to the wire, not the iron tip. If the wire is hot enough to melt the solder directly, then it's hot enough to form a good bond with the solder. Hold the iron against one side of the wire and apply a small amount of solder in between the tip and wire to form a heat bridge (if there isn't already enough solder from tinning the tip). Now apply solder to the opposite side. The solder should wick into the strands. Move the iron and solder as necessary to coat the surfaces. You should still be able to clearly see the individual strands when it's complete.

  Don't tin wires that are going to be held in clamping terminals since the solder will slowly deform under pressure and cause the connection to come loose.

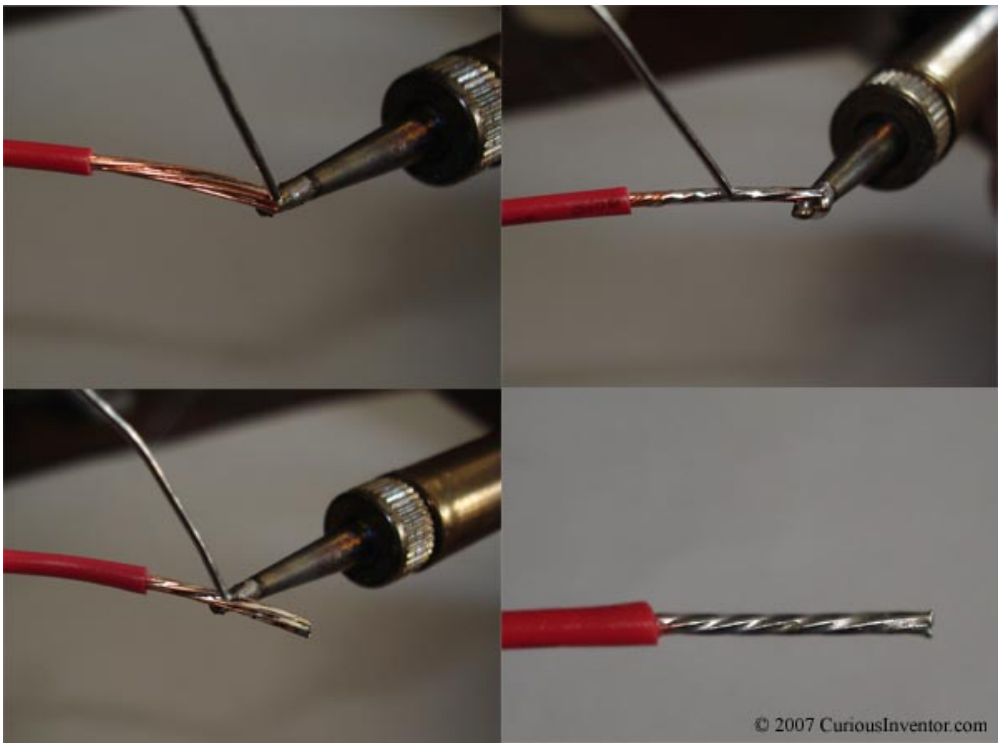

Got a lot of tinning to do? For under $300 you can get a vat of molten solder to speed up the process. The only catch is that there's no flux in the vat, so you need to dip the end of the wires in liquid flux before dunking them in the molten solder. Only dip the very end of the wire in the flux; capillary action will draw it further up the strands. If you dipped more than just the

end into the flux, the capillary action would draw flux beyond the insulation where it can't be cleaned, and would eventually corrode the wire.

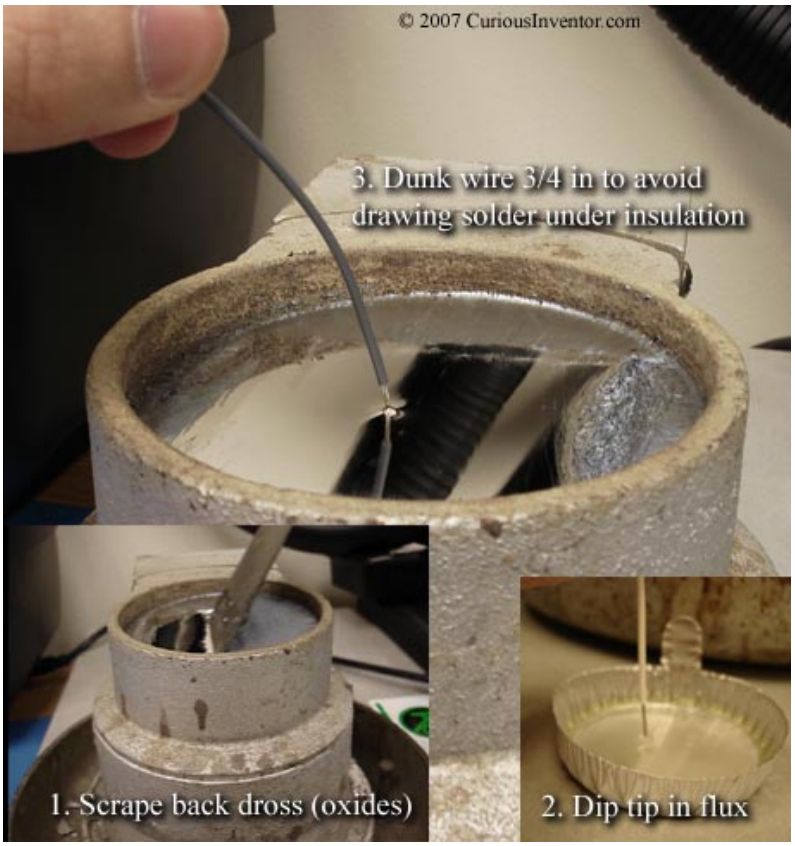

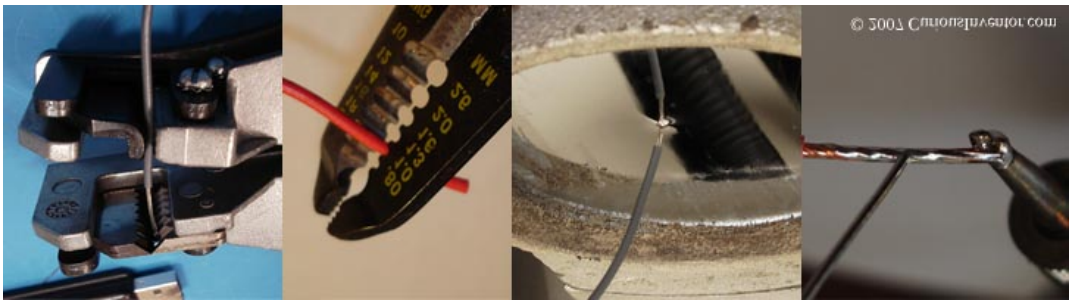

- **Insert, clinch and trim components:** First, make bends *before* inserting the components. Avoid stressing the connection between lead and component by bracing the lead with pliers while bending. Pliers with serrated tips aren't used in high-reliability production because the grooves can create nicks in the leads that eventually cause a break after a lot of vibration and thermal changes. Round nose pliers make it easy to make any sized radius.

  Unless the component has a metal casing or needs clearance for air flow to keep cool, insert it until it's flush with the board. This doesn't apply to some transistors, and also capacitors that have plastic coverings that need to be kept out of the solder joint. Clinch or bend out the leads so the component is held in place during soldering, and finally trim the leads to about the radius of the pad. Trim the leads before soldering since doing so afterwards can shock and crack the joint. Wearing safety glasses for this process is not at all excessive--those leads can get you. Everything else about proper component installation: NASA guide.

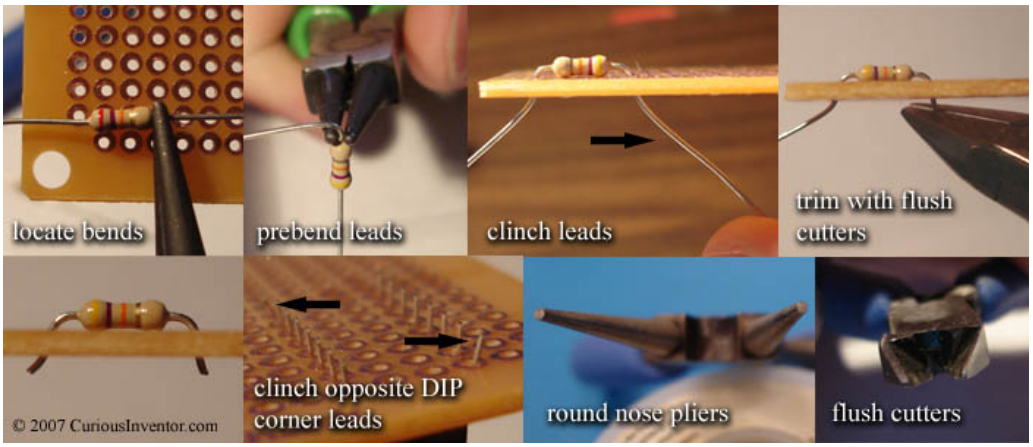

- **Add heat sink:** Some semi-conductors (some transistors and diodes) are especially heat sensitive. This clip acts a heat shunt to keep the transistor protected.

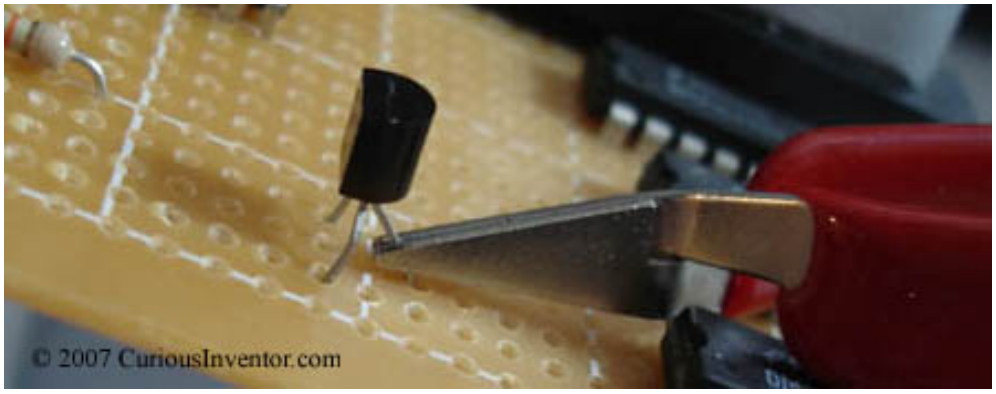

Clean and tin the Tip

· **Regular cleaning = easier soldering and longer tip life:**The iron tip's ability to transfer heat is drastically reduced when it gets covered in oxides and burnt flux residues. Not only does heat not transfer as well through this debris, but the contaminants also prevent solder from wetting or sticking to the tip. Most heat transfer actually goes through a fluid solder "heat bridge" that lies between the iron tip and components, so an iron tip that repels solder will be very ineffective.

The longer oxides and charcoaled flux residues remain on the tip, the harder they become to remove, so it's a good idea to clean the tip every time you pick up the iron.

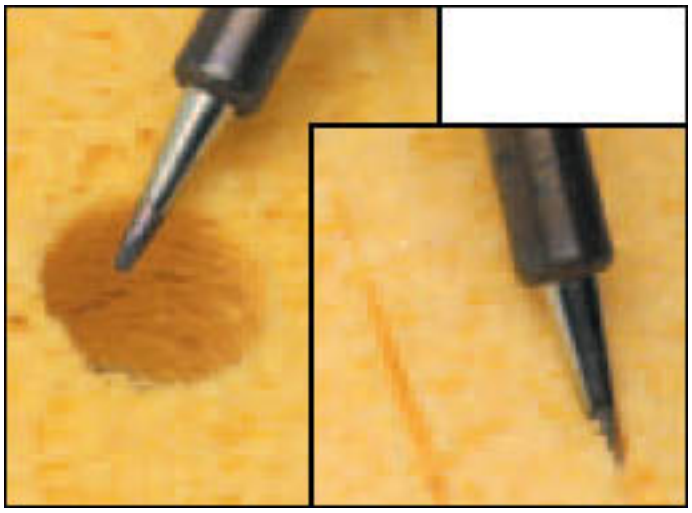

Wiping the iron on an edge of a hole cut into a sponge can help to remove oxides easier, and also allows waste to fall away. A dry cleaner can also be used. It consists of soft metal shavings that are coated with flux. You clean by thrusting the iron into the shaving a few times. By avoiding the thermal shock of touching a damp sponge, these cleaners help to increase tip life, and in our opinion, do a better, faster job.

Usually touching the tip with rosin-cored solder will supply enough flux so that oxides can be removed with a damp sponge. If this isn't sufficient, you can purchase "tip tinners and cleaners" that are a mixture of solder paste and flux. The flux is oftentimes stronger (more activated) to help remove oxides.

Finally, when that doesn't work, special polishing bars to can be used to salvage extremely bad tips. Another last resort is to gently rub the oxides off with an emery cloth or soft steel brush. Cover the tip immediately with solder after cleaning to prevent further oxidation. Never file the tip to clean it or form a different shape. The tips are mostly copper with a protective iron plating, and once that plating is pierced, the tip will die quickly. Copper is used because it's an excellent heat conductor, but if exposed to solder, it will quickly dissolve into the solder.

Tin the tip: Add a small amount of solder back onto the tip. This helps to protect the newly cleaned and exposed tip, and also helps to transfer heat to components.

Heat and Solder the Joint

- **Heat the joint:** Place the iron tip so that it touches both the component lead and pad--the goal is to get as much surface area contact between the iron tip and joint as possible. Almost no heat will travel through the point.

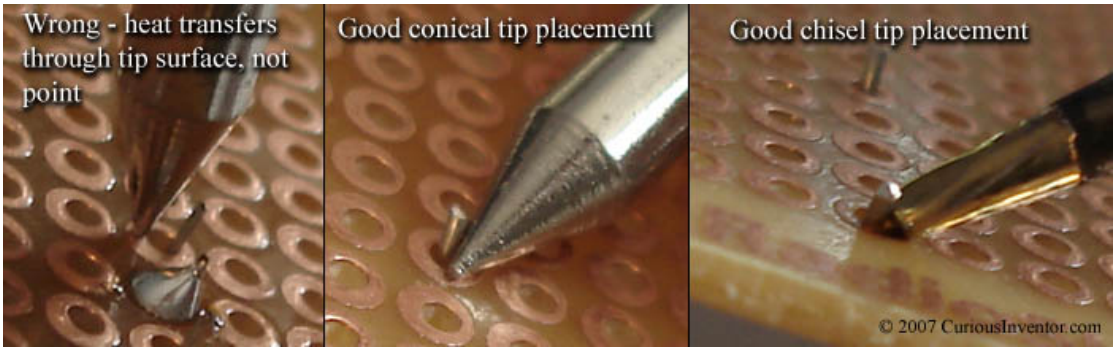

- **Make heat bridge:** Add a small amount of solder between the tip and the work--heat transfers much faster through the liquid solder than dry surface contact. This is why a tip that won't "wet" is so difficult to use. Pressing hard should not be necessary. This step may not be necessary if there's enough solder already on the tip from tinning it after cleaning.

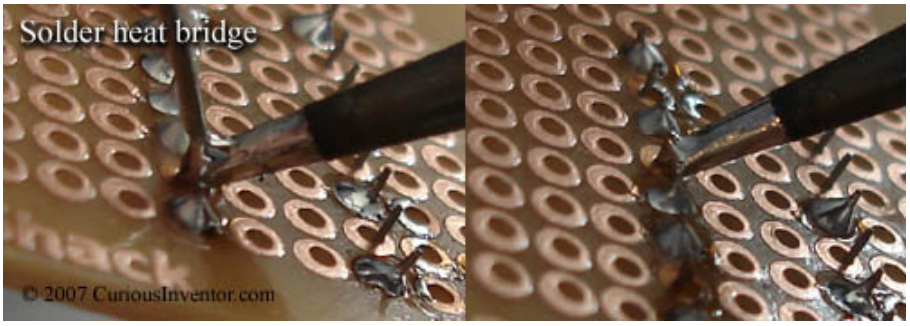

- **Apply solder to opposite side:** Apply solder to the parts, *not* the iron. By doing this, you ensure the parts are hot enough for the solder to "wet" and bond with them. Also, solder will run towards the heat source, so applying solder opposite from the iron helps to spread it out and cover the joint.

  For larger joints, rather than dumping in all the solder quickly, continuously pulse in small amounts to keep a fresh supply of active flux available.

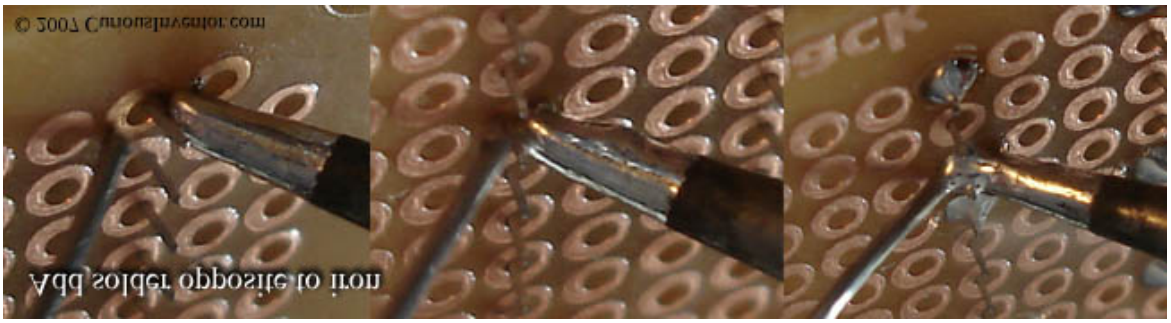

- **Time:** The joint should take about 2-5 seconds total time for standard 60/40, 63/37 lead based solder and a non- no-clean flux, and up to 7 seconds for lead-free solder. Lead-free solder just takes longer to "wet" the metal.

  Wetting is how easily and quickly solder spreads out over a surface. A water droplet on a freshly waxed car shows poor wetting, as does solder on a heavily oxidized soldering iron tip. It basically comes down

to how attracted the liquid molecules are to each other verses the surface (see surface tension). In industry, tests are done to determine the "solderability" of materials by measuring the time it takes solder to spread out over a surface, or measuring how much force a pot of liquid solder will pull down on a component partially submerged.

Good pictures and description of wetting and surface tension. Contains a video of a razor blade floating on the surface of water until a drop of soap is added.

A brochure for a solderabiliy testing station. Scroll down a few pages to see some great pictures of this machine holding one lead of a surface mount chip in a drop of solder.

Another related wiki: wiki/Surface_energy

In general, the goal is to make the joint as quickly as possible. Longer times can char and damage the board, lift pads, overheat components, burn off and polymerize flux (making it harder to remove), and finally lead to a more brittle joint. Solder doesn't just freeze on a joint, tin in the solder dissolves and chemically reacts with copper in the connection to form a new bonding material, called an "intermetallic layer". While this layer is what makes an excellent thermal and electrical bond, it is also extremely brittle; a doubling of its thickness reduces joint tensile strength by half (ref 1). Since this layer grows faster with higher temperatures, joints should be made using the coolest temperature and shortest soldering time possible. This layer is also why re-heating joints has been shown to weaken them. Having said all this, I have to admit that I don't know just how long is *too* long for projects that don't need to operate for 30 years with 100% reliability. After 10 seconds there's a good chance the flux has been used up.

- **Remove solder, then iron:** Pull the iron out fairly quickly to avoid leaving a solder spike.

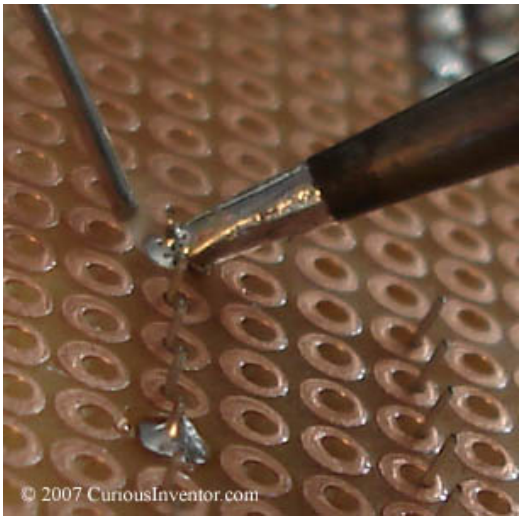

- **Good and bad joint gallery:** The solder should smoothly ramp to meet surfaces and be shiny in appearance if it's lead-based. Lead-free solder will have a duller and grainier surface, but will still be a good joint as long as there are no signs of non-wetting. The important thing to look for is any solder that looks like it didn't cling to a surface, or is just sitting on top or next to a surface.

Gallery of joints:

A NASA gallery of every possible joint / board defect you could ever imagine. Here's another great gallery of defects.

Great comparison pictures between lead-based and lead-free joints. p. 34

Good joints:

Great joints:

What's the right amount? A large amount of solder is not needed, just enough to cover the pad and lead without any gaps (actually, only 270° is required by IPC J-STD-001). The measure for too much solder is whether or not you can see the outline of the lead in the solder. This is important because you need to be able to see whether the solder adhered or "clung" to the lead (indicating a true bond), and

didn't just freeze around it. This applies to all types of joints: tinning wires, soldering to connectors, surface mount components... the solder should never completely hide the underlying wires or leads.

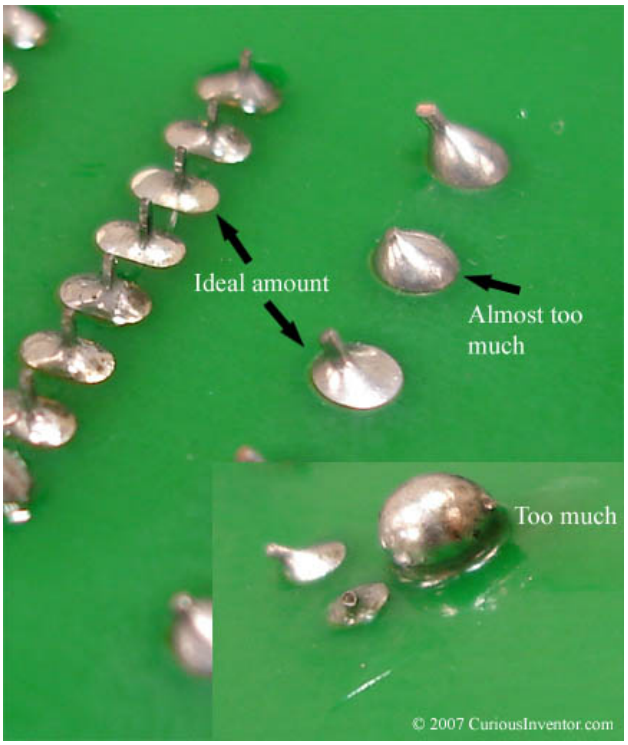

Disturbed joint (bad): If the component moves during solidification, the internal structure of the solder will have fractures, leading to a high resistance or unreliable electrical connection, as well as a fragile mechanical one. The solder also appears dull and grainy--typical signs of a "cold" joint that doesn't actually bond with the underlying surfaces.

"Cold" joints are often formed when the underlying pad or lead didn't get hot enough for the solder to wet it.

Awful joints:

© 2007 CuriousInventor.com
Extreme over-heating
and pad lifting
No adhesion to lead--oxidized lead
Resting on and not adhering to
pad--insufficient pad heating
Solder resting on pad, not adhereing
Solder was applied to iron first and
then transfered to joint

Clean Up

Most manufacturers will clean off residues from any flux that isn't labeled "no-clean," despite flux datasheets like Kester's that say even some of the more active fluxes do not need to be cleaned. For short life-span hobby projects, it probably doesn't matter unless you're using a solder/flux labeled "organic" or "water-soluble"--these fluxes leave behind very aggressive acids that will quickly eat away circuits. Cleaning may be necessary if you're applying a protective coating that won't adhere to flux residues. Finally, some rosin residues are tacky and may attract dust that can short a circuit.

The fact that a flux is made from rosin doesn't tell you much about how strong it is or whether it should be cleaned. What matters is how concentrated the mix is and how much acidic (halides) activators were added. RadioShack® doesn't supply any information on the flux in their standard rosin-cored solder, but it's probably weak enough that the residues do not need to be cleaned off.

Isopropyl alcohol works decently on rosin-based residues, but clean shortly after soldering because the residues quickly harden. Use water for water-soluble fluxes. This pump containing bottle dispenses a little alcohol when you push down on the top with a brush, and keeps the rest from evaporating. If you are going to clean, make sure you wipe up the remnants with a lint-free cloth--don't just spread them around the board with a brush and alcohol.

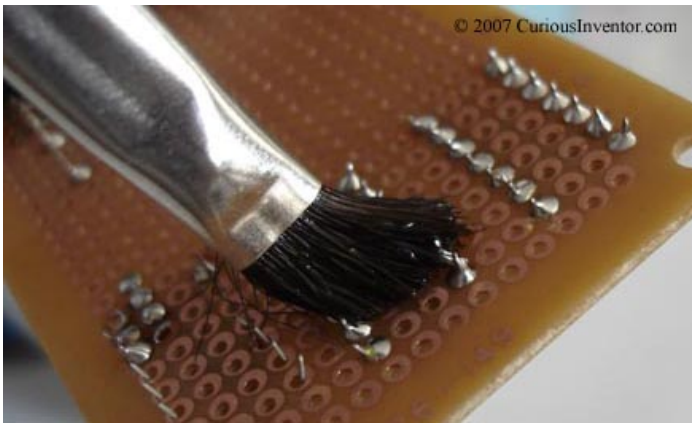

Desoldering

The three most common inexpensive ways to remove solder include a "solder sucker", solder wick, and an iron with an attached desoldering bulb.

- **Solder Sucker:** To use, press in the plunger, heat up the joint, and as quickly as possible, pull out the iron, place the sucker's nozzle over the joint and press the release button. It may take a few iterations to clean out a joint enough to wiggle free a component. On plated through holes it may actually be easier to add *more* solder to the joint before sucking, since the sucker won't be able to create a vacuum with too little solder remaining.

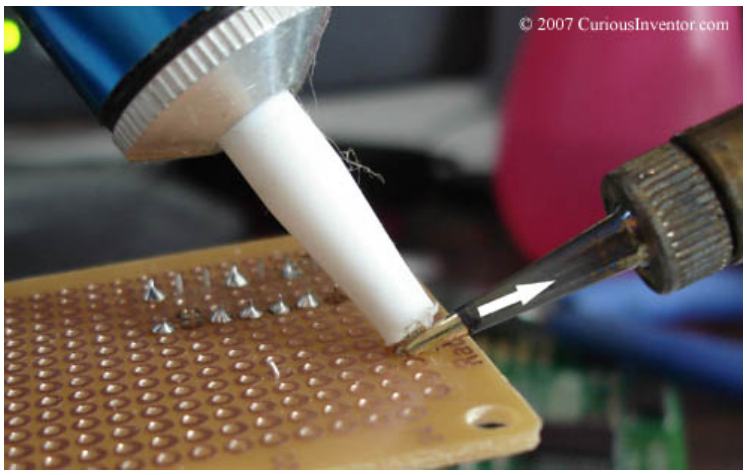

- **Desoldering Iron:** This works just like the solder sucker, but is much easier to use because there's no race to suck out the solder before it freezes, as with the "solder sucker".

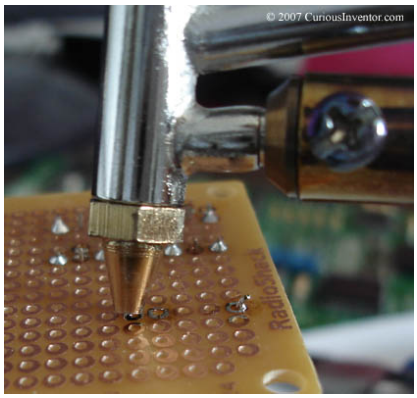

- **Solder Wick (desoldering braid):** The above two tools will often not be able to completely remove all the solder. Many people use the sucker devices above to remove most of the solder, and then get the rest with solder wick, which absorbs solder through capillary action. It's a fine weave of copper wires that are coated in flux. Place it over a joint and then heat from the opposite side with a soldering iron. It may help to have a bit of solder already on the iron's tip to speed heat transfer.

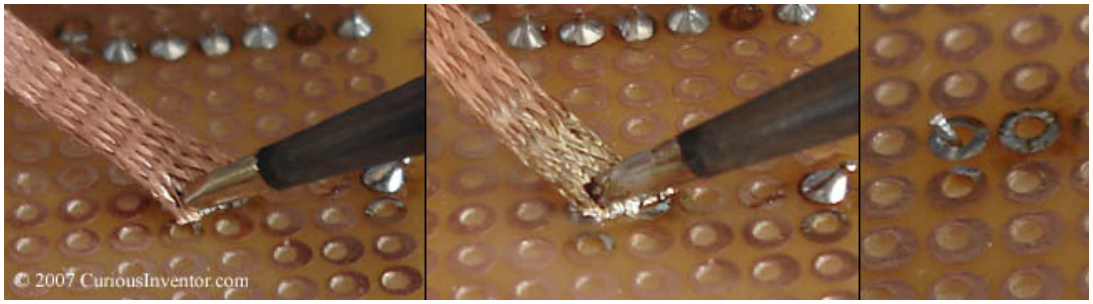

Surface mount desoldering: Surface mount chips are especially hard to desolder because it's very difficult to completely remove all the solder pin by pin, and avoid overheating the board and lifting a pad. Professional shops use expensive hot air guns or special tips (shown below) to heat all the joints at once.

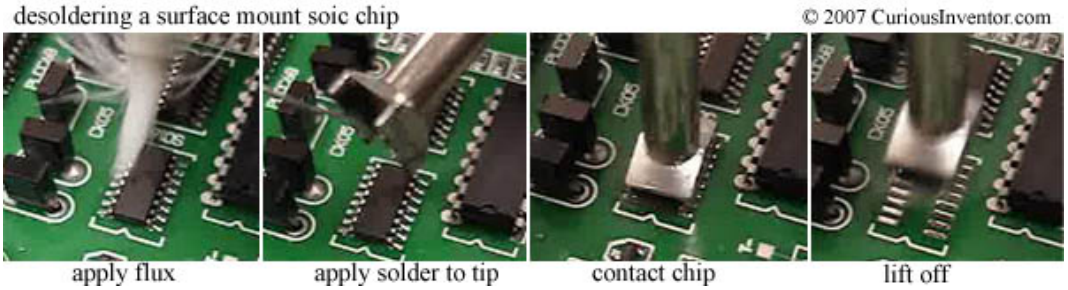

There are fortunately a few cheap ways to desolder surface mount chips.

- ChipQuik provides an interesting solder that when melted over existing joints produces a new low-melting point alloy (under 200 °F) with a much longer solidification time. The longer solidification time enables you to melt all the joints at once and then flick off the chip.
- There are many guides for making a DIY hot air gun with the RadioShack® desoldering iron and a fish tank air pump. Engadget has one of the better how-to guides. Here and here are some more plus the supposed original.

The Ersa soldering primer

Soldering made easy

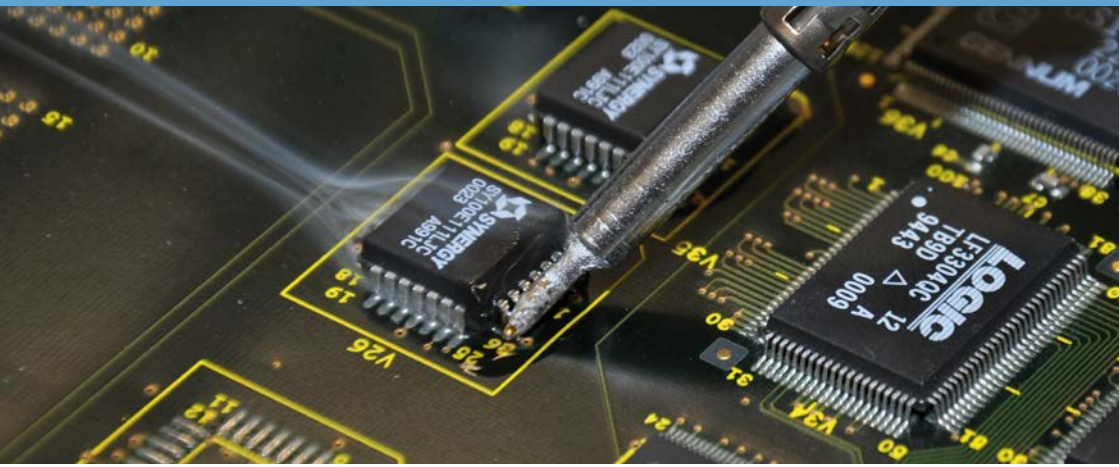

kurtz ersa

Soldering – a never-ending story

for more than 5,000 years already

Man had scarcely learned how to use metals for his purposes when the desire to join them arose in him. Many of the pieces of jewelry, tools and weapons we know from the Bronze Age owe their usefulness and beauty to the art of soldering.

Today, it is difficult to say who first discovered how to "glue" metals. One thing is certain - the goldsmiths of ancient Egypt knew how to join gold and silver already more than 5,000 years ago. Their colleagues in Troy were also master craftsmen long before the ancient Teutons could even dream of such handicraft. Soldering really "came of age" when tin was discovered

as a joining metal. And that was, after all, already 4,000 years ago!

From then on, soldering technology was on its way. It first spread around the Mediterranean. The Cretans showed it to the Etruscans who then taught it to the Romans, Tunisians, Spaniards, followed by many others, including the less developed cultures of the time – the Swiss, Bohemians, Hungarians, Teutons and Scandinavians. From culture to culture, from generation to generation, the craft of soldering was continuously improved and refined.

The ancient Romans already laid down and soldered 400 km of leaden water pipes, conjured up stoves and bathtubs from bronze sheets, not to mention the excellent craftsmanship of their armorers and goldsmiths. Apart from craftsmanship in soldering, our understanding of the science of soldering has grown and has been refined over the centuries.

Today, soft soldering in the electronics industry has developed into a full-fledged production technology, encompassing the fields of mechanics, chemistry, physics and metallurgy. Ernst Sachs, the founder of Ersa (the company name consists of the initial letters of his first and last name) contributed to this development. In 1921 he developed the first electrically operated soldering iron for the industry that was manufactured in series. Since that time, Ersa has committed itself to the further development and perfection of soldering technology with great passion and extending its full power of innovation.

Today, Ersa stands for the most comprehensive product range in the soft soldering technology worldwide and for more than 90 years of industry experience and innovation, know-how and highest product quality.

The Ersa soldering iron product range covers ultra-fine soldering tips, classical soldering irons powered from the standard power net and special soldering tools up to the 550 W hammer soldering iron. Ersa's electronically temperature-controlled soldering stations represent the industry standard, as does the extensive range of rework and

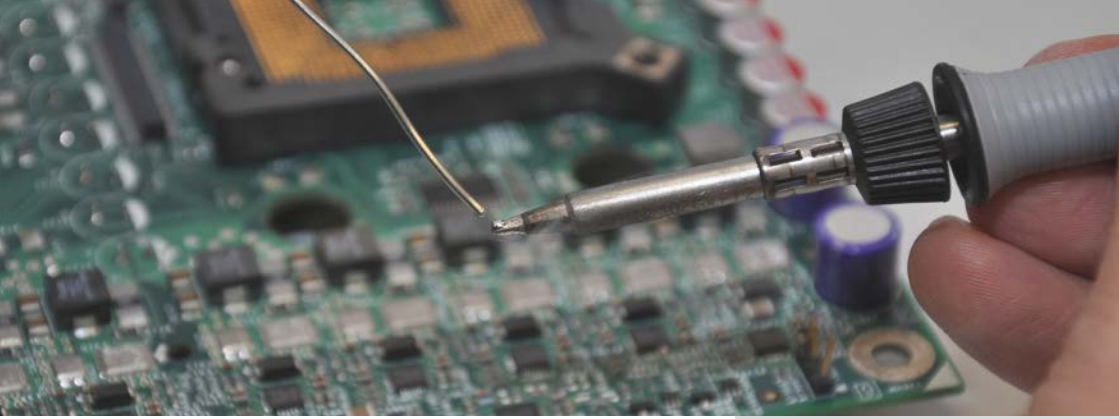

inspection systems, wave-, reflow- and selective soldering systems. The line of Ersa screen printers complements the product range.

Ersa's quality soldering tools are used in the hobby area, such as, for example, in model-making or tiffany soldering, in the craft sector, in laboratories and in industrial electronics manufacturing.

New challenges for the soldering technology were raised by the ban on certain hazardous substances (RoHS) in 2006. Since 1 July 2006 electric and electronic equipment may not contain any lead, mercury, hexavalent chromium, PBB (Polybrominated biphenyls) or PBDE (Polybrominated diphenyl ethers).

In many cases this restriction entailed having to depart from the use of the well-known soft solders based on tin and lead.

By publication of this small primer, Ersa would like to facilitate your entry into the "World of Soldering", and raise your enthusiasm for a modern technology with a long history.

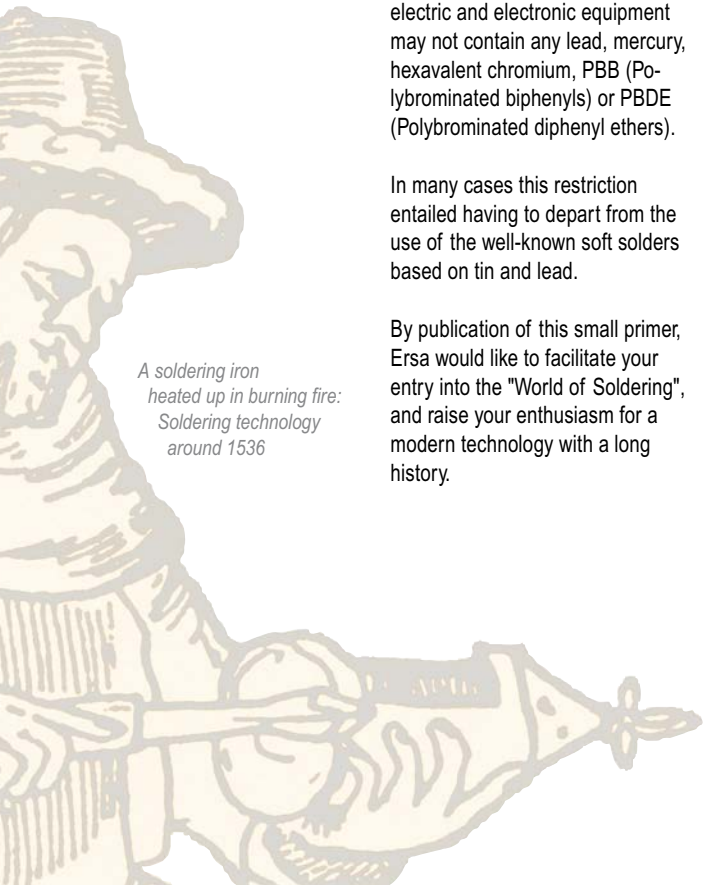

A soldering iron heated up in burning fire: Soldering technology around 1536

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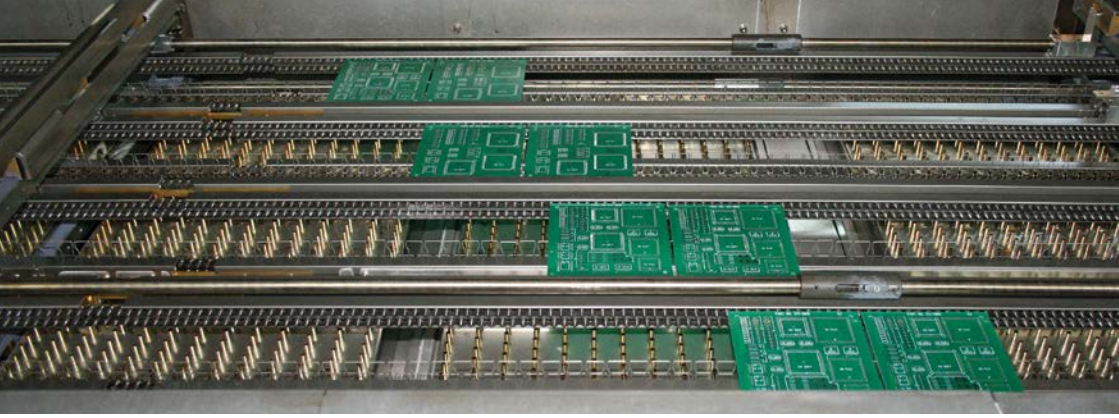

Solder joints hold the world together

Connecting pacemakers and solar parks

To imagine today's world without soft soldering is not possible. It is the means to fabricate safely functioning, electrically conducting connections. Regardless of whether we talk about power technology, drive technology, telecommunications, automation or electronic controls – in all those fields soldered connections have a decisive share that everything functions in a way as has been foreseen and planned by the developers and

visionaries of the products. Today, soft soldering is such a common place occurrence, that no one wastes any further thought on it. We take the daily use of our computers, mobile phones and play stations for granted, the modern comforts provided for by electronics found in modern automobiles is expected as a matter of course, and we fly – privately or on business – to the farthest spots in the world.

Consequential damage because of the failure of a solder joint in an iPod is relatively limited. It is a different matter altogether, though, if the electronics in an airplane full of vacationers, in a space shuttle, or in an implanted pacemaker fails.

Such failures are immanently life-threatening. But not to worry – the highest quality demands apply for those applications, and rightfully so!

Aside from soldering in consumer electronic products, there are numerous other applications such as, to name but a few, alternative power generation with wind turbines or solar parks, R&D departments and in work performed by craftsmen such as electricians and plumbers. Let us not forget the many part-time and hobby users for whom there are no limits curtailing their phantasies and artistic freedom when handling a soldering iron and solder.

The art of soldering

What's behind it?

In a soldering process two metal parts are joined by means of a molten metallic bonding agent (solder), whereby the melting point of the bonding agent is always lower than that of the metal parts to be joined. If the melting point is below 450 ºC, then it is a soft soldering process, if it is above, it is called hard soldering or brazing. Welding, on the other hand, is the process where two metals will be heated up to their melting point, at which time they will, together with a filler material, form a pool of molten material causing coalescence. In soft soldering, the seams between the metals to be joined will be filled with a tin alloy. It is important that the alloy does not simply stick to the foreign metals' surface after cooling but unites with the metal. For this purpose, a small quantity of the foreign metals must dissolve and unite with the tin alloy forming a mix of crystals – the so called diffusion zone. That is the task of the tin, whereas the alloy's other components are responsible for the solder liquefaction and the joint's mechanical stability. A solder joint consists of the following layers:

① Base metal
② Diffusion zone
③ Solidified solder
② Diffusion zone
① Base metal

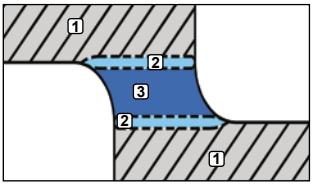

Cross section of a solder joint

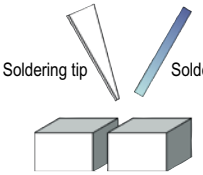

The prepared parts and the solder are heated

The liquid solder flows into the gap and fills it

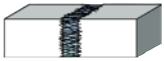

The solidified solder joins the parts together

To achieve the highest mechanical stability, i.e. to assure the durability of the solder joint, the diffusion zone may neither be too thick nor too thin. Its ideal thickness is 0.5 µm. The formation of the diffusion zone depends on the temperature, the solder time and the alloy used. If the diffusion zone is too thick, the solder joint will be brittle and porous, whereas the formation of a zone which is too thin indicates that an insufficient connection or no mechanical connection at all has been formed.

Reaction of the flux during manual soldering on a PCB using flux cored solder wire

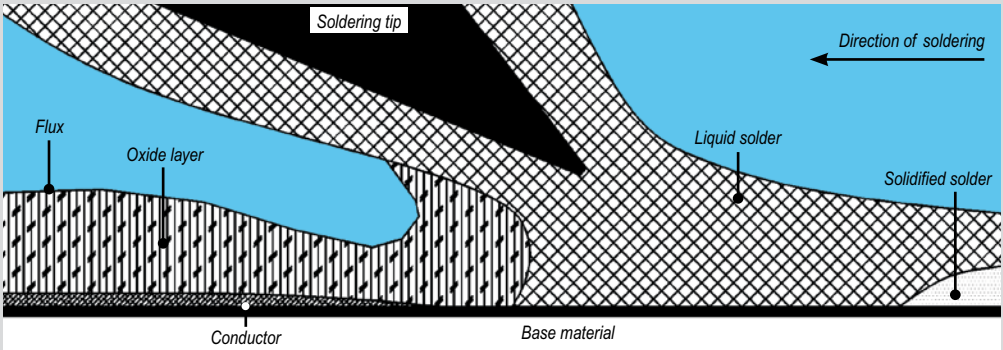

What do you need for soldering?

The basics – the 5 essential factors

1. The soldering iron

to provide the heat required

Heat is required to melt the solder. This is the soldering iron's job.

Temperatures of 200 ºC – 450 ºC are required depending on solder joint and solder alloy. In the field of electronics, the usual temperature lies between 250 ºC and 375 ºC.

In order to have the proper temperature for any soldering application, the soldering iron's thermal output and an efficient heat transfer to the solder joint to be made is decisive. One either selects a soldering iron that performs within the temperature range required, or a soldering station with temperature control is used. Temperature-controlled soldering stations enable the user to work on different applications without loss of solder joint quality, because of the precise control of the preset temperature at the soldering iron tip.

Both the soldering station's registration of the actual tip temperature should be highly precise, and the heating element should be powerful and recover quickly in order to avoid over-heated or cold solder joints.

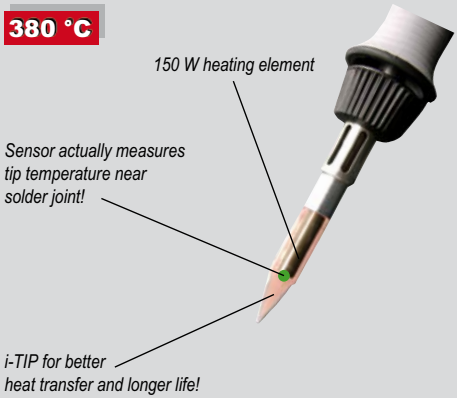

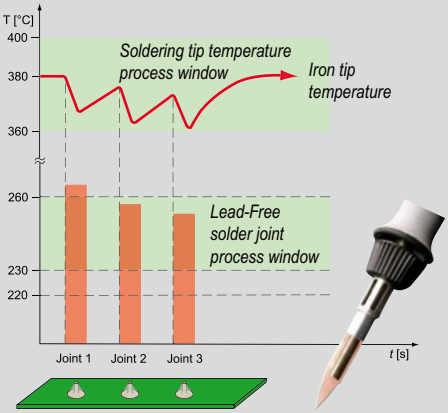

Temperature curve of controlled tip temperature when soldering multiple joints

2. The soldering tip

to transfer the heat from the heating element to the tip

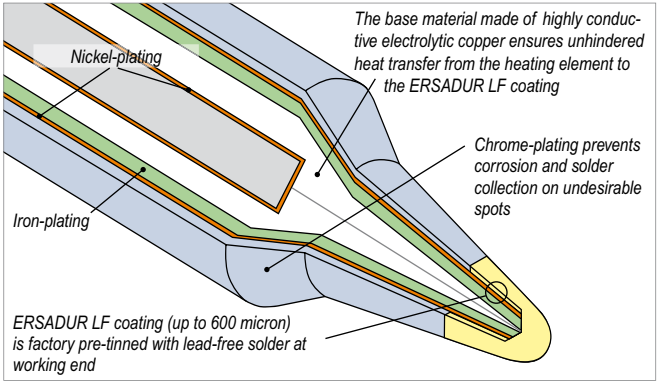

Cross-section of an ERSADUR soldering tip, non-scale representation

The soldering tip is the "heart" of the soldering iron and responsible for the heat transfer from the heating element via the solder to the solder joint. Depending on the soldering iron and the application, different types of tips are available. Prerequisites for good solder joints are the correct soldering iron tip shape, perfect heat transfer, a good condition of the tip and a reliable performance over time. In addition, the soldering tip has to convey also the necessary amount of sensitivity back to the operator.

How to take solder joint quality to its peak – ERSADUR long-life soldering tips

Traditional soldering tips are made of copper which conducts heat well and is inexpensive, but the tip oxidizes heavily when heated and releases copper particles into the solder until it has been "corroded" entirely. To maintain the tip in operational shape, it requires intensive care. Today, only coated soldering tips are used in electronics production – the largest field of application for soft soldering.

ERSADUR long-life tips have been conceived for continuous operation and for high-quality results. They are galvanically plated with an iron coating and protected against corrosion and oxidation by an additional chrome layer in a very special manufacturing process, developed and used exclusively by Ersa. And their perfect thermal conductivity protects the heating element from overheating and premature wear. Ersa offers a comprehensive range of soldering tips for the diverse requirements.

Proper tip care increases tip lifetime considerably:

- Never clean the long-life tip before putting the soldering iron into its holder, since the solder remaining on the tip prevents oxidation of the solder track.
- Always keep the long-life soldering tip covered with solder, as otherwise it becomes passive and will no longer wet properly.

Passive tips can be reactivated by the application of the lead- and halogen-free Ersa TIP REACTIVATOR. All that is needed is to wipe the hot tip on the surface of the regeneration compound. Furthermore, the hot tips should regularly be cleaned with a moist viscose sponge before soldering. Alternatively the tips can be dry cleaned using the Ersa "dry sponge", a sponge made of special metal wool. Dry cleaning has proven to be advantageous in lead-free soldering. The soldering tips are not cooled abruptly, and contaminated tips resulting from dirty sponges are avoided. Due to the slightly abrasive properties of the special wire mesh, passive layers that accumulated on the tip can easily be removed. Tip life is thus increased considerably in lead-free hand soldering.

Ersa TIP REACTIVATOR. A comprehensive range of accessories is available at ***www.ersa.com***

What do you need for soldering?

The basics – the 5 essential factors

3. The solder

for the connection

Metallic bonding agents (solders), mostly in the shape of a wire or a bar, are available as diverse alloys.

Soft solders consisted mostly of a mix of tin (Sn) and lead (Pb). Since the implementation of the RoHS directives on 01 July 2006 the use of solders containing lead is prohibited. Lead-free solders are usually alloys containing silver (Ag) and copper (Cu).

The alloy's composition determines melting temperature and physical properties of the joint. Criteria for the choice of an alloy are: production process, specification of the product, field of application, cost of the alloy.

Prerequisites for good soldering results are:

- Suitable soldering iron
- Clean surfaces of where to solder
- Sound soldering tip
- Suitable fluxes
- Suitable solder alloy
- Correct soldering time

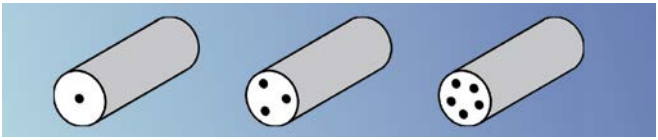

Solder wire with one or with multiple flux cores

4. The flux

for the ability to wet

Fluxes are used to attain the best possible bonding between solder and metal. They provide for metallically clean surfaces of the parts to be soldered, remove the oxides as well as other flow-inhibiting contaminations and prevent the formation of new oxides during the soldering process. A difference is made between acidic (as used in plumbing) and acid-free products (as used in electrical and electronic applications). It is most common to use solder wire with one or more flux cores in electronics production, whereas bar solder is the form of choice in plumbing as well as in the radiator and auto body work.

Examples of some common alloys

Alloy	Flux type	Melting point / range
L-Sn60Pb40	EN 29454/1.1.2 (F-SW 26/DIN 8511)	183 °C – 190 °C
L-Sn60Pb38Cu2	EN 29454/1.1.2 (F-SW 26/DIN 8511)	183 °C – 190 °C
L-Sn63Pb37	EN 29454/1.1.3 (F-SW 32/DIN 8511), free of halogen	183 °C eutectic
L-Sn62Pb36Ag2	EN 29454/1.1.3 (F-SW 32/DIN 8511), free of halogen	178 °C – 190 °C
Alloy – lead-free / complying RoHS-WEEE		
L-Sn95,5Ag3,8Cu0,7	EN 29454/1.1.2 (F-SW 26/DIN 8511)	217 °C eutectic
L-Sn96,5/Ag3,5	EN 29454/1.2.3 (F-SW 33/DIN 8511), free of halogen	221 °C eutectic
L-Sn99,3Cu0,7	EN 29454/1.2.3 (F-SW 33/DIN 8511), free of halogen	227 °C eutectic

5. A safe and clean working environment

to ensure quality and health

Safety first, especially while soldering. The VDE and GS emblems ensure the electrical safety of soldering equipment. The use of the VDE sign obligates the manufacturer to monitor production accordance with test guidelines and to conduct tests according to the regulations determined by the VDE testing institute.

Noxious gases develop in every soldering process

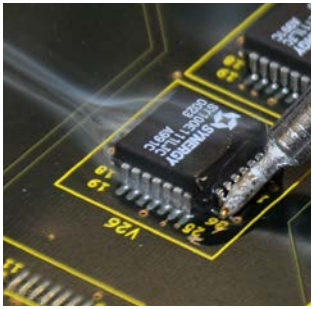

Health protection during soldering

- The breathing zone is very close to the soldering process during manual soldering, and the solder is added by hand. Thus there is the danger of contaminated air and hands or items which may have been touched
- Flux vapors can be damaging to the operator's health and should be kept out of the breathing area. Suitable devices for this purpose are solder fume extractions, which extract the smoke and associated vapors from the workplace and remove particles and gases. Modern fume extractions can be programmed to operate only when the soldering process is taking place, thus saving energy.
- One should never eat, drink or smoke in rooms where soldering is preformed. Contaminations which remain on the hands can enter the human organism through food or cigarette smoke.
- Hands should be washed thoroughly after soldering.

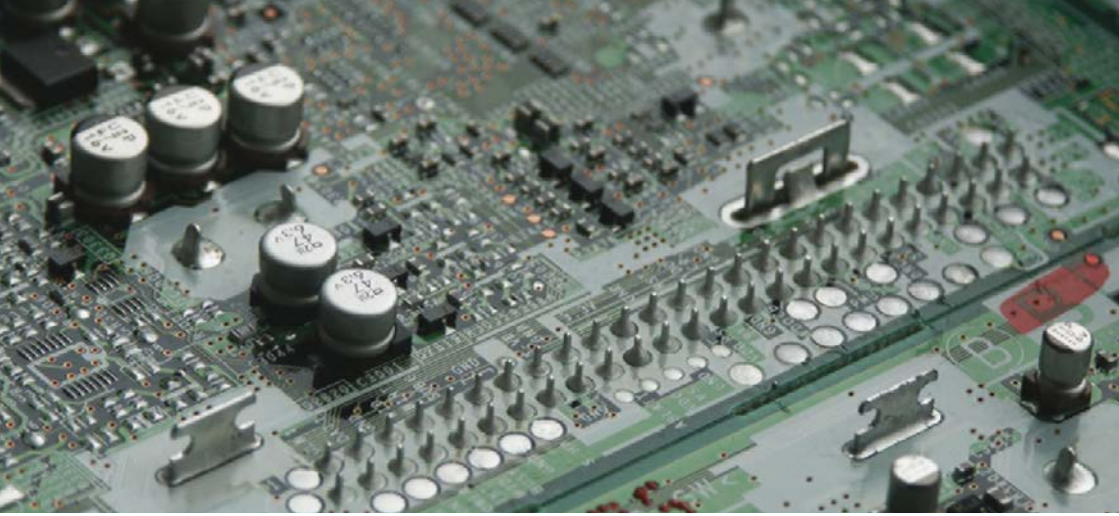

Best solder quality

due to the right preparation and correct soldering parameters

Preparation

The most important prerequisite for a good solder joint is absolute cleanliness. Conductor and component must be free of dirt, oil and oxides. They can be removed with solvents or flux.

Prior to soldering ERSADUR soldering tips should be cleaned while hot with a moist sponge or with a metallic dry sponge. Do not file the tip as you would copper tips, because this would damage the protective coating and render the tip unusable.

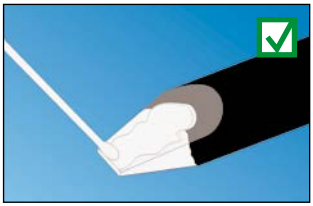

Wetting the soldering iron tip

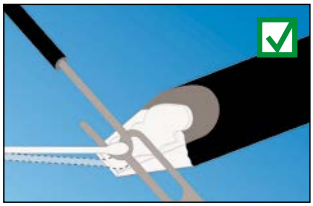

Soldering a joint

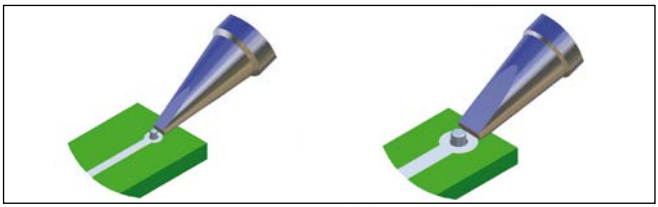

The selection of the right soldering tip is decisive for good soldering results

Soldering process

The soldering process has three phases: wetting, flowing, and bonding, whereas the working temperature is the most important criterion. It is best to work at the lowest temperature at which the three phases can progress smoothly. This requires some experience. A temperature-controlled soldering station will definitely facilitate this work. Place the tip on the joint to be soldered after cleaning and heat up the joint. Then feed the flux-cored solder wire between the soldering tip and the joint and melt as much solder as is required to wet the complete joint. Then remove the solder wire first and right after that the soldering tip to prevent overheating the solder. Allow the solder to solidify, avoiding any vibrations or jarring during this time.

Soldering time

The soldering process should be completed within 2 to maximum 5 seconds with a correctly dimensioned soldering tip. When soldering electronic components with lead-free solders, experience shows that more time is required. But even here requiring more than 5 seconds is not permissible, and it indicates that either the temperature setting is too low or the soldering iron lacks the necessary power.

Solder joint quality

When the leads of the components mounted on the board are crimped, a good solder joint has been formed when the contour of the soldered lead is still visible. This will not be the case, if an excessive amount of solder has been used to form the joint.

A further quality attribute is the wetting angle. This consideration is based on the fact that good wetting of the pad, discernible through a small wetting angle, has given rise to the formation of a diffusion zone (intermetallic zone). Wetting angles of up to 25º identify a good joint, wetting angles of up to 50º are still tolerable in manual soldering.

Another quality indicator is what the solder surface actually looks like. It should be smooth and shiny, without any porous areas visible. Grainy surfaces indicate either overheating of the solder or an excessive soldering time. Using lead-free solders, especially silver loaded alloys, matt surfaces may form.

The only absolute quality indicator for a sound and strong solder joint is the formation of the diffusion zone. In the diffusion zone, intermetallic compounds of copper and tin are formed, whose presence is the final proof of quality (mixed crystals, see page 5). Unfortunately, the only way to make this zone visible is through a destructive test (sectioning of the joint). If the diffusion zone is too thick, the solder joints have no tensile strength and become brittle. The higher the soldering temperature and the longer the soldering duration, the thicker the diffusion zone will be. Therefore the joint should be made at the lowest suitable temperature and within shortest soldering times.

As soon as the last solder joint has been made, the soldering iron is placed securely into the holder. At this time, the tip should not be cleaned, because the remaining solder on the tip prevents oxidization.

Correct!

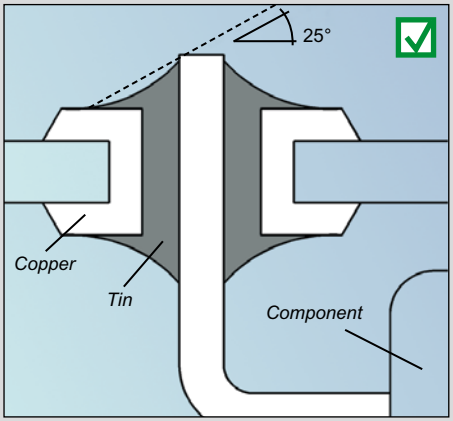

Wrong!

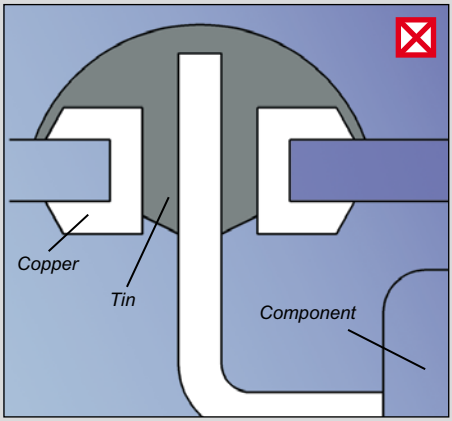

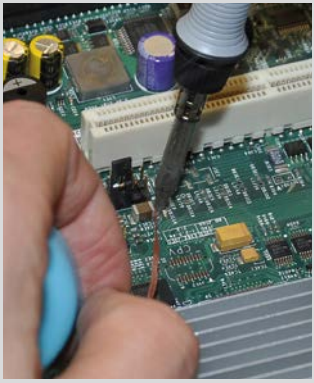

Desoldering with a solder wick

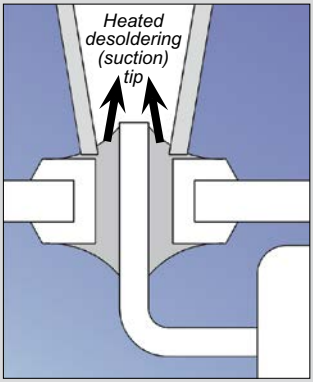

Desoldering with a temperature-controlled soldering iron

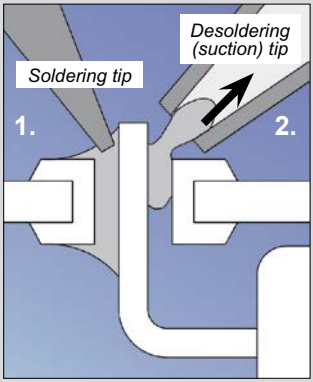

Desoldering with a desoldering pump

To achieve good results in desoldering, it is essential to select the right equipment. One can choose between desoldering wicks (desoldering using the principle of capillary action), mechanical desoldering pumps or electronically temperature-controlled desoldering systems. These are divided in desoldering systems with conductive heat or those with hot air.

Correct desoldering made easy

The right tool for each application

Desoldering

Reheating is not recommended for repairing a faulty solder joint. It is better to remove the solder and to resolder the joint. When using a desoldering pump, the solder joint has to be heated with the soldering iron until the solder has molten. Then the tip is removed and the desoldering pump is placed on the joint to extract the solder.

Using a heated desoldering tool, the hollow desoldering tip is placed on the joint to be repaired, making certain that there is good thermal contact. Once the solder has molten, it is extracted.

Desoldering is also dependent on proper tip selection. For example, the desoldering tip's inner diameter should be the same size as the diameter of the through-hole or even slightly larger (by max. 0.3 mm, see above drawing). The best desoldering results with least damage to PCB or the components can be achieved with temperature-controlled desoldering irons (also see pages 24/25). Please note that basically it has to be distinguished between the desoldering of through-hole components and the desoldering of SMD components.

Temperature-controlled desoldering iron

Sucking up the old, molten solder remnants with a mechanical solder sucker (desoldering pump)

Some examples of SMD components

C.CAPAC./MELF

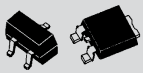

SOT&DPAK

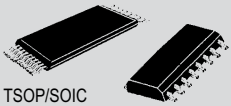

TSOP/SOIC

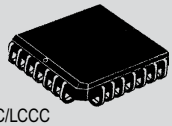

PLCC/LCCC

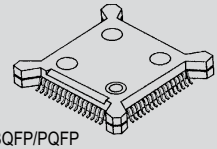

BQFP/PQFP

Ever smaller, ever finer

SMD technology, a true challenge

SMD Soldering

SMD technology (Surface Mount Device Technology) is currently the standard process in electronics manufacturing. Ever smaller and highly integrated surface mount components place growing demands on SMD soldering equipment.

Single solder joints, for example on resistors, are made with ERSADUR long-life soldering tips starting with a diameter of 0.2 mm. Fine-pitch connections with a high pin-out, i.e. IC's, are most efficiently soldered with Ersa PowerWell soldering tips.

Ersa PowerWell technology for soldering fine pitch components within seconds

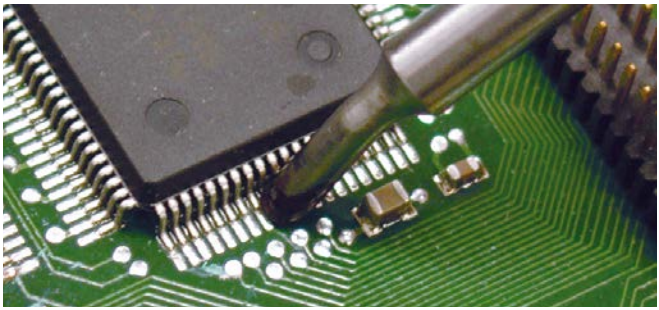

Soldering fine-pitch components

Process guide description

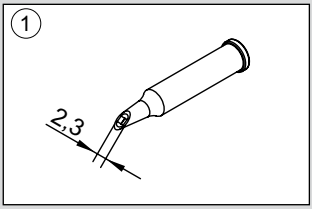

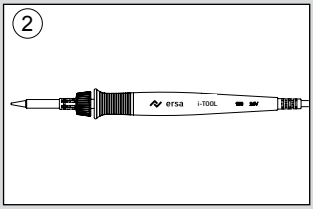

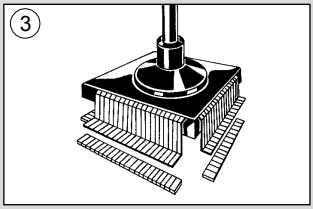

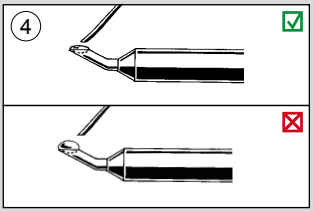

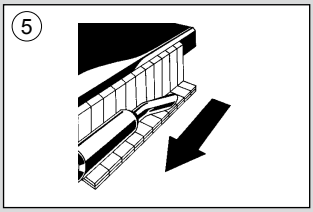

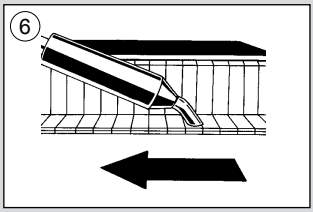

At first glance, soldering fine-pitch components by hand seems to be a tough job. Yet it is easy, with the right equipment at hand:

Insert an Ersa PowerWell i-TIP (1) into the i-TOOL soldering iron (2) and set a tip temperature of 285 ºC to 360 ºC (depending on the alloy used – tin/lead or lead-free).

Then position the component (3) and fix two corner pins.

Add flux cream (also see page 30) to the pins on all 4 sides. Clean the front and concave portion of the PowerWell tip with a damp sponge or the Ersa dry sponge.

Fill the concave portion with solder to slightly above the rim by melting the solder wire, until a small dome occurs (4). Take care not to add too much solder.

Place the i-TOOL lightly on the flat section of the pins (5), and pull the tip across the pins towards you (6) without exercising pressure.

Repeat steps (4) to (6) to solder the remaining sides.

Good solder joint, sufficient solder and good fillet

Wrong: insufficient solder

Wrong: too much solder

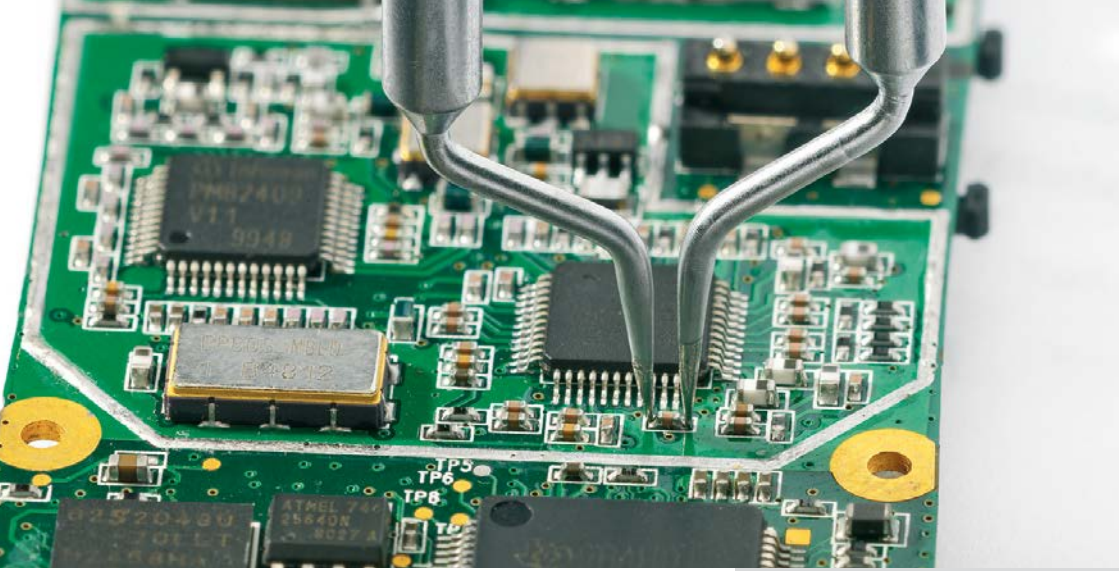

SMD desoldering in 3 seconds – with the Ersa desoldering tweezers

Some examples of different desoldering tip shapes:

to desolder and remove MELF's

to desolder and remove SOIC's

to desolder and remove QFP and PLCC components

SMD Desoldering

To desolder or rework a damaged SMD component, the suitable tools are required to remove the component from the board. When using desoldering tweezers, it is extremely important to select the proper pair of desoldering tips. After having desoldered the component, the pad has to be cleared of the residual solder (e. g. with a suitable soldering tip and a no-clean desoldering wick). Afterwards the new component can be positioned and soldered. An optional IR heating plate is a very useful addition – particularly in lead-free hand soldering applications.

More comprehensive instructions on SMD desoldering is available in the process description "SMD desoldering" on our website at www.ersa.com. For the soldering and desoldering of BGAs or other high pin-out SMDs, particularly those with hidden joints, we recommend the semi-automatic Ersa rework stations (see page 31).

Solder melting and removal with a desoldering wick

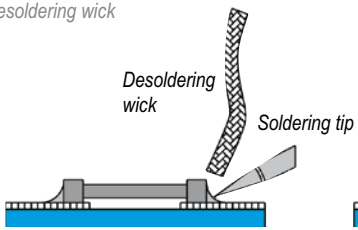

Ersa desoldering tweezers

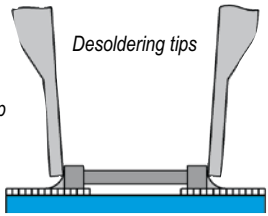

The compact CHIP TOOL VARIO desoldering tweezers are perfect for precise desoldering of very small SMDs.

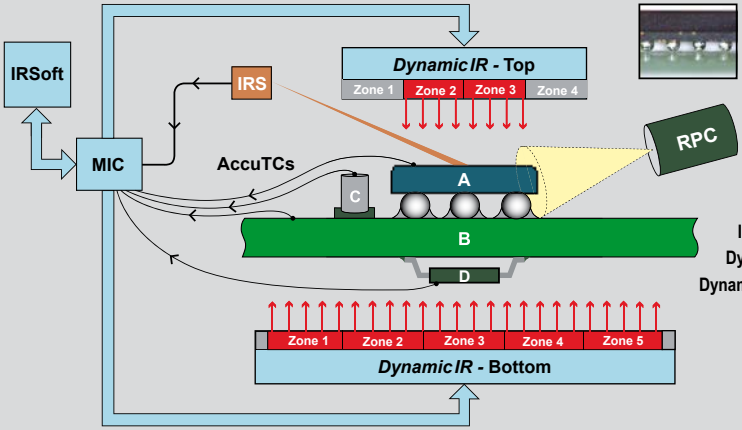

A: Component for rework
B: PCB
C: Adjacent component (top side)
D: Adjacent component (bottom side)
AccuTCs: Thermocouples (4 each)
IntelligentIRS: Non-contact infrared sensor
DynamicIR Top: Top IR radiator (4 zones)
DynamicIR Bottom: Bottom IR radiator (5 zones)
RPC: Reflow Process Camera
IRSoft: Control & documentation software
MIC: Microprocessor controls the DynamicIR heating system

Principle of a rework station

Rework or repair soldering

The rework process demonstrated on the example of a BGA (Ball Grid Array)

Rework designates the repair or touch-up of electronic components such as Ball Grid Arrays (BGAs) or SMTs. This chapter describes the process steps for BGA rework:

1. Desoldering the BGA

The rework station heats the printed circuit board from the bottom, whereas the BGA body itself is heated from the top.

The real-time temperature of the component controls the pre-set temperature curve so that all solder joints melt at the same time. Then the vacuum suction cup is placed on the BGA and once all joints have molten the BGA is lifted off.

2. Removal of residual solder, cleaning

Solder remaining on the pads is removed with a soldering iron. To do so the residual solder is coated with flux. Then a flat soldering tip (e. g. 0102ADLF40 or 0102ZDLF150) is moved over the pad without applying any force. The solder adheres to the larger surface area of the tip, thereby levelling off the remaining solder of the connection pads. Flux residues are finally cleaned off (e. g. using Ersa FLUX-REMOVER).

3. Reballing – Reusing the BGA

Desoldered BGA's can be refit with new solder balls and re-attached to the board. This process is referred to as reballing. Residual solder is removed from the BGA by means of a soldering station. Lying on its back, the component is coated with flux first. Then the new solder balls are attached, for example by means of a stencil. These solder balls are heated up to the melting point with the rework station to firmly connect with the BGA body. Now the BGA is ready to be re-attached.

4. Application of flux or solder paste

The component and the connection pads are now fluxed, or, as the case may be, solder paste is added through stencil printing. The type of technique applied depends on the application, components and the skill level of the operators. For the commonly used PBGA's the application of flux is mostly sufficient.

5. Placing the component

Once the pad has been prepared, the component has to be placed. Since all solder joints of a BGA are hidden under the component body, a component placement unit is required. Successful visual placement by hand requires an operator with extensive experience and excellent skills. If the component is placed on solder paste deposits, great care has to be taken not to squash the solder depot, since doing so may lead to shorts after soldering.

6. Resoldering the BGA

The component is heated to the melting temperature of the solder alloy used via a controlled temperature curve. The heating continues until all solder joints have melted and remained so for some seconds.

During this time durable and lasting solder joints are formed. After resoldering, the board is cooled in a similar fashion as had been done after desoldering.

These process steps are generally applicable for all surface mount components. Subject to the type of connections (wired, hidden) they may slightly vary.

Rework – Repair of high-terminal count IC's
to successfully repair SMT assemblies, the several points must be observed:

- Dimensions and properties of the assembly have an influence on its temperature requirement
- PCB holders and supports keep the assembly flat and prevent warpage
- A gentle and controlled heating process, continuously monitored, prevents damage of components or the board
- Accurate component placement is a prerequisite for a good soldering result
- Operators that are well trained will understand the process and ensure good results

Rework process steps

1. Remove BGA

2. Remove residual solder from the pads of the board

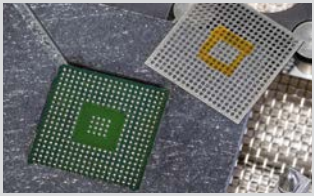

3. Reballing – addion of new solder balls

4. Application of flux or solder paste

5. Placement of the new or reballed component

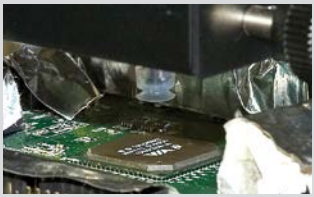

6. Resolder the BGA on the prepared surfaces of the board

Miniature soldering iron

Ersa MINOR S

MINOR S, 5 W

Ersa MINOR S (5 W), a featherweight at 6 g for ultrafine soldering applications

The **MINOR S** miniature soldering iron with a rating of 5 W and a maximum tip temperature of 440 ºC is an ideal tool for ultrafine soldering applications on micro IC's and under a microscope. It can either operate with a 6 V transformer or a 6 V battery.

Besides electronics the MINOR S can also be used in watch repair, in the photographic industry and in dental technology.

Micro soldering irons

Ersa MULTITIP Series

MULTITIP series, 15/25 W

Ersa MULTITIP (15/25 W) internally heated soldering iron for small to medium solder joints

The **MULTITIP** soldering irons are especially short, light and easy-to-handle soldering irons with minimal distance between soldering tip and the handle's front part. They are ideally suited for small solder joints. Its internally heated soldering tip provides an enhanced degree of efficiency.

The MULTITIP is available for 15 W and 25 W which makes it suitable for micro soldering joints and medium-sized joints, as for example, on distributor strips or in the hobby sector.

Universal soldering iron

ERSA 30 S, MULTI-PRO, ERSA 15+ and ERSA 25+

The proven **ERSA 30 S,** available with a 30 or 40 W rating, is a very robust and durable soldering iron. Its improved ergonomics is further enhanced by the practical stick-on rubber support disk. This universal soldering iron is designed for multi-purpose use in the crafts, service and hobby sector.

The **MULTI-PRO** with its heat-resistant power supply cord is extremely flexible, as it can be operated with a wide range of different tips. Therefore, it is suitable for almost all conventional soldering applications.

The **ERSA 15+** universal soldering iron is the ideal tool for cost-effective soldering. Internally heated soldering tips guarantee an outstanding performance. The ERSA 15+ can be operated with diverse fine tips of the 832 and 842 tip series. Its ergonomic handle assists in the safe processing of fine soldering joints.

The **ERSA 25+** is perfect for soldering applications with increased heat requirements. The internally heated, larger soldering tips of the 832 and 842 tip series ensure good heat transfer at a high thermal performance. The ergonomic handle provides a safe grip for every soldering application.

Ersa universal soldering irons – for almost all applications

Standard and hammer soldering irons

ERSA 50 S, 80 S and 150 S / ERSA 200, 300 and 550

ERSA 50 S, 80 S, 150 S, 50/80/150 W

ERSA 200/300, 200/300 W

ERSA 550, 550 W

The **ERSA 50 S/80 S** or **150 S** series is designed for applications where a large amount of heating capacity is required, as, for example, on copper conductors with cross-sections of 2.5 mm to 6 mm.

The **ERSA 200, 300** and **550** hammer soldering iron series are particularly suited for sheet metal processing and installation work and for soldering commutators and copper bus bars.
Hammer soldering irons have also proven their merit in leveling applications during body work and lead glazing.

High-speed soldering iron

Ersa MULTI-SPRINT

The **Ersa MULTI-SPRINT** is an ergonomically designed and extremely light-weight, pistol-type soldering iron with up to 150 W power which does not require a transformer. Its PTC heating element, together with the internally heated ERSADUR long-life soldering tip, ensures its exceptionally high efficiency. Due to its very short heat-up time, it is ideally suited for making quick single soldering joints. The MULTI-SPRINT is powered only as long as the button is pressed. Depending on the heat requirement of the solder joint to be made, additional energy can be supplied by periodically pressing the button. The large variety of soldering tips of the 832 / 842 series make the MULTI-SPRINT suitable for more than only the use in repair and service applications.

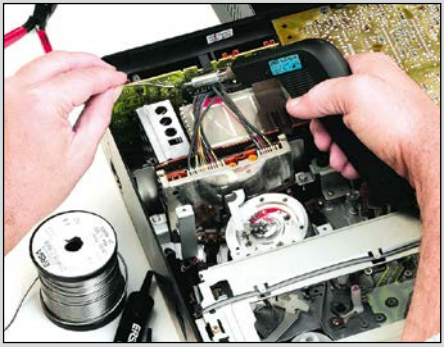

Ersa MULTI-SPRINT, 150/75 W

Power soldering iron

Ersa MULTI-TC and PTC 70

Ersa MULTI-TC, 75 W

Ersa PTC 70, 75 W

The **MULTI-TC** and **PTC 70** are powerful and robust, temperature-controlled soldering irons. Both tools offer an outstanding heat-up rating.

Due to their high thermal performance, and because of the large selection of soldering tips, the MULTI-TC and PTC 70 are suitable for fine soldering joints in electronics as well as for joints with medium heat requirements. The MULTI-TC is furthermore also used anywhere else where standard irons with 150 W power are in use, including, for example, lead glass and Tiffany soldering.

Gas soldering irons

Ersa INDEPENDENT 75 and INDEPENDENT 130

Ersa INDEPENDENT 75, 15 – 75 W

Ersa INDEPENDENT 130, 25 – 130 W

Ersa gas soldering irons are fueled with commercially available lighter gas and are fired up through the piezo ignition. Compared with electrical soldering irons, the **INDEPENDENT 75** has between 15 – 75 W, and the **INDEPENDENT 130** between 25 – 130 W performance. Both irons are available in the BASIC-SET and PROFI-SET versions.

Aside from handling the usual types of electronic components, the selection of tips available enables the INDEPENDENT to also handle SMD soldering, micro-welding, forming and cutting of synthetic materials and the processing of shrink sleeves.

The basic soldering station

Ersa ANALOG 60

The electronically temperature-controlled ANALOG 60 is Ersa's basic soldering station model. It has the tried and proven RESISTRONIC temperature control technology with the PTC heating element serving as the temperature sensor. The high heat-up rating of 190 W guarantees the immediate supply of heat and a heat-up from room temperature to 280 ºC within 60 seconds. The BASIC TOOL 60 soldering iron uses the internally heated ERSADUR long-life soldering tips of the 832/842 series and provides very high performance.

Due to the wide range of 832/842 soldering tips, the Ersa ANALOG 60, which is also available as an antistatic version, covers a wide range of applications with the most varied soldering requirements.

Digital soldering station

Ersa RDS 80 – high performance for low cost

The digital soldering station Ersa **RDS 80** offers the proven and tested Ersa RESISTRONIC temperature control technology with a strong heating power of 80 W. The ceramic PTC heating element (Positive Temperature Coefficient) acts as the temperature sensor in this control system. Due to its very high ramp-up capability of up to 190 W, the station reaches operating temperature very fast.

RT 80: sleek soldering iron with a large selection of soldering tips

Multifunctional soldering stations

Ersa i-CON NANO and i-CON PICO – small, powerful and versatile

adjustment of operating temperature as well as the setting of stand-by time and calibration value.

Further adjustments such as fixed temperatures, power level, interlock and shutdown functions are available with the free PC software and an optionally available micro smart SD card.

Micro-SD card with SD-card and USB adapter

The soldering stations **i-CON NANO** and **i-CON PICO**, two models of the i-CON product family, fulfill all the needs of today's electronics manufacturing while requiring minimal space. They are designed for continuous operation in the electronic manufacturing environment as well as for special applications in laboratories and R&D departments.

Due to the simple and user-friendly operating concept, the factory settings provide for a variable

The concept of the Ersa i-CON stations ensures that each application is processed with the optimal parameters. They stand for the highest level of process safety and quality control at low investment and operating cost.

Ersa i-CON PICO

- Small footprint (145 x 80 mm) – saves valuable space
- Antistatic as per MIL-SPEC/ESA (only i-CON NANO)
- Three fixed temperature settings or continuously adjustable temperature settings from 150 ºC to 450 ºC
- Three selectable power levels
- Ultra-light and ergonomic soldering tool with max. 80 W power
- Wide range of low-cost exchangeable long-life soldering tips
- Automatic stand-by and sleep function for low energy consumption and longer tip life
- Password interlock for maximum process control
- Calibration function for a precise tip temperature
- Complete parameterization through PC software and Micro-SD card

High-end soldering and desoldering stations

The Ersa i-CON product family for highest productivity and process safety

Ersa *i-CON2* with *i-TOOL* and CHIP TOOL

The stations of the i-CON product family are Ersa's innovative solution for intelligent manual soldering. The need to be able to cope with higher working temperatures and with progressively smaller process windows when working with lead-free solders, poses no problem whatsoever for the i-CON product family.

The i-CON is available as a single station or as double iron station. The single station **i-CON1** is delivered together with the i-TOOL soldering iron. The i-TOOL is extremely small, ultra-light and ergonomic. It is powered by a 150 W micro heating element, which realizes short heat-up times (within 9 seconds up to 350 ºC!) and rapid heat recovery.

The microprocessor which stores the temperature calibration of the iron is located in the PCB which is installed in the handle. This now allows for each individual i-TOOL to be calibrated independent of the soldering station.

In contrast to the concept followed by the cartridge-type soldering tips, only the tip itself is exchanged at the i-TOOL. The cost-intensive heating element remains.

The double iron soldering station **i-CON2** can be operated either with a second i-TOOL or with the SMD desoldering tweezers CHIP TOOL

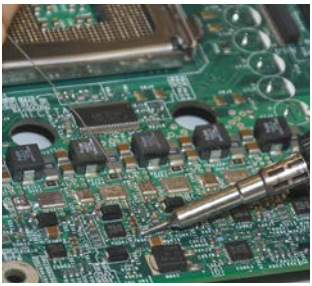

Soldering miniature and densely placed SMD components with the i-TOOL and i-TIPS, starting at a 0.2 mm diameter.

i-CON1 with i-TOOL soldering iron with high-performance micro heating element

- i-TOOL soldering iron with 150 W micro heating element technology
- Low-cost exchangeable long-life tips of the i-TIP series
- User friendly “One-Touch” operation
- Three power levels – no overshoot
- Process window and alarms
- Interface to control peripheral equipment on the workplace, such as heating plate and solder fume extraction systems
- Stand-by control for tools, heating plate and solder fume extraction system
- i-TOOL calibration
- Tools for SMT and conventional soldering applications
- Automatic tool recognition

1. *Low-cost i-TIP long-life soldering tips*
2. *i-TIP tip fastener*
3. *High-power heating element (stick-on type, long-life)*

Ersa i-TOOL: The ideal soldering iron – ultra light (only 30 g), ultra short (only 155 mm), and ultra short tip-to-grip (only 45 mm) and extremely powerful.

respectively with the desoldering irons X-TOOL or X-TOOL VARIO.

The CHIP TOOL facilitates safe and quick desoldering, of the smallest chips up to large PLCC's. To remove the residual solder and to desolder wired components – also on multilayer boards – the X-TOOL or X-TOOL VARIO desoldering iron is the right tool.

User-friendly controls: quick programming & lock, huge multi-functional display with i-Op controls, menu in 7 languages, online help

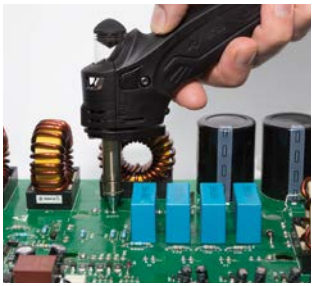

High-mass through-hole desoldering with the X-TOOL VARIO

The C-line of the i-CON stations was developed, so that peripheral equipment could be controlled or to communicate with them. Via a serial interface, the i-CON1 C or the i-CON2 C controls the Ersa IR heating plates or the Ersa solder fume extraction systems.

i-CON VARIO 4 multi-channel station with X-TOOL VARIO desoldering iron, i-TOOL soldering iron, i-TOOL AIR S hot-air iron and CHIP TOOL VARIO desoldering tweezers.

Top Tips

i-TIPS for all applications

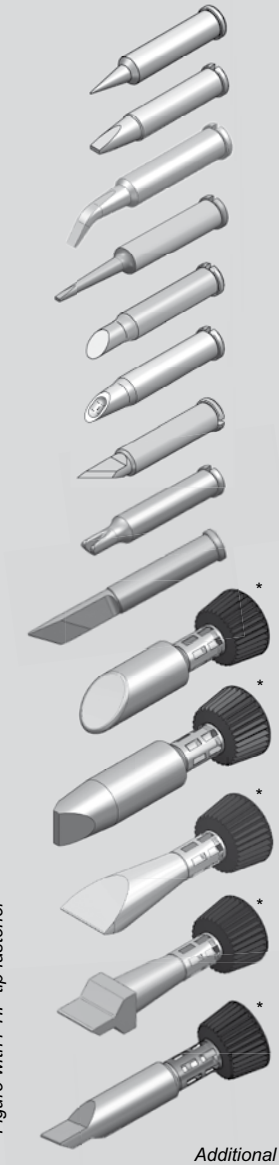

**Figure with i-TIP tip fastener*

Additional soldering tips for the i-TOOL and the i-CON soldering stations is available on our web site:
www.ersa.com

Hybrid Rework Station

Ersa HR 100 A – The innovative combination of hot air and infrared radiation

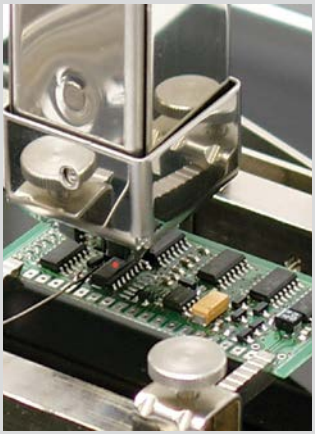

The Ersa **HR 100 A** applies the Ersa Hybrid Rework Technology for a safe desoldering and replacement of small SMD components. Its medium wave length IR radiation, combined with a safe stream of hot air ensures optimal heat transfer to the component.

The HYBRID TOOL offers a gentle and homogeneous warming of all sizes of components, from 0201 chips up to 20 x 20 mm SMD's and larger. Exchangeable hybrid adapters target the thermal energy available (up to 200 W) on to the component, all the while protecting neighboring areas and not blowing away or moving adjacent chips.

Its user-friendly handling permits even operators with little experience to safely and efficiently operate the HR 100. More experienced operators, on the other hand, can not only variably adjust the air flow as well as the heat output, but also record and run profiles. A positioning laser whose laser point makes it possible to keep track of the component worked on through the complete process is integrated in the grip of the ergonomic hybrid tool.

Complete system with HR 100 A, IR heating plate, stand for HYBRID TOOL and PCB holder.

- HYBRID TOOL with 200 W heating element, positioning laser integrated in grip
- 3 exchangeable hybrid adapters (6 x 6 mm, 10 x 10 mm and 20 x 20 mm)
- Silent rework fan (below 40 dB)
- Integrated vacuum pump and vacuum pen; tool holder and K-type thermocouple input socket; USB interface; LED display
- 2-channel temperature recording:
  TC & IRS; AccuTC and Flexpoint thermocouple holder
- Tool holder with z-axis height adjustment
- x-y PCB holder (290 mm x 250 mm)
- 800 W IR heating plate with glass cover:
  125 mm x 125 mm IR high-performance heating element
- Rework profile and documentation software Ersa IRsoft

CLEAN-AIR solder fume extractions

Ersa EASY ARM 1 and EASY ARM 2 – protecting environment, health and resources

Ersa EASY ARM 1

Ersa EASY ARM 2

The Ersa **EASY ARM 1** is a compact yet powerful filter unit to efficiently clean the process air at the workplace. Both i-CON1 C, i-CON2 C and i-CON VARIO can be connected to the EASY ARM 1 with an interface cable. The solder fume extraction has three filtration levels to remove noxious gases.

With the solder fume extraction **EASY ARM 2**, Ersa offers the user a further compact and highly efficient fume extraction unit for either one or two workplaces. One or two units i-CON1 C / i-CON2 C / i-CON VARIO can be connected to the EASY ARM 2 via interface cable.

Both EASY ARM systems are provided with a stand-by mode and operate only when the soldering stations they are connected to are being used. The EASY ARM 1 and 2 are easy to install and can be placed very flexibly. Due to their very low noise level, they can be operated in virtually all environments, be it repair shops, development facilities or laboratories.

To accommodate different working conditions and applications, a variety of extraction arms and nozzle shapes which can easily and quickly be exchanged are available to meet different working conditions.

Noxious gases develop in every soldering process.

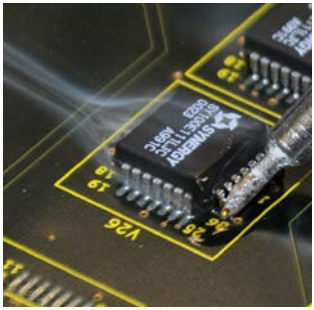

Q&A 1: So, how can you get rid of them? By using a solder fume extraction unit to clear the air from particles and gases.

Q&A 2: How does that work? Active carbon in the filters absorbs harmful gas molecules; result: a clean working environment.

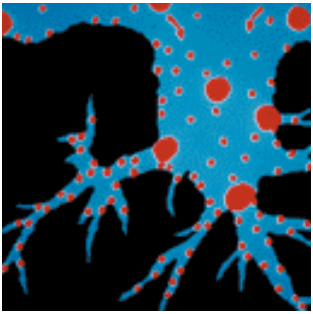

Tiffany soldering

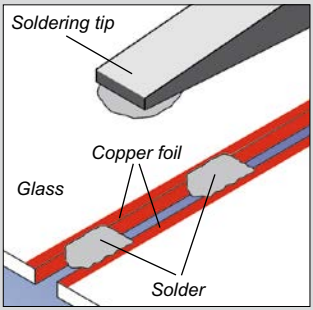

Step 1: spot soldering

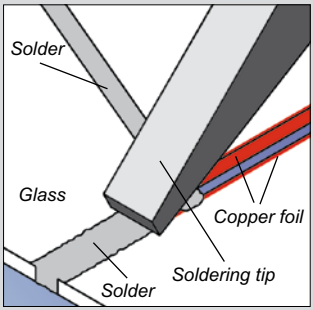

Step 2: rough soldering

Tiffany or sheet metal soldering

Soldering beyond the field of electronics

Tiffany soldering (Lead glass soldering)

Soldering a Tiffany object generally involves three individual steps:

- Spot soldering
- Rough soldering
- Finishing

Prior to the actual soldering process, copper foil is glued on the glass edges. The next step is spot soldering, i. e. the glass parts are fastened or connected by taking a drop of solder with the tip of the soldering iron and carefully applying it to the solder joint. Each spot soldering operation should only take about a second. During rough soldering the gap between the glass is filled with solder after flux has been applied. For this purpose the tip and solder are moved together along the joint. Always drag the soldering iron, never push it. Only if this procedure is accurately followed, and if a sufficient amount of solder is applied, the desired, half-round and convex seams are achieved. The lack of visual quality of the seam at this stage is optimized during the finishing soldering step, in which the soldering tip is dragged slowly and from the beginning of the seam until the end at an even speed. The seam worked on should always lie flat on the bench.

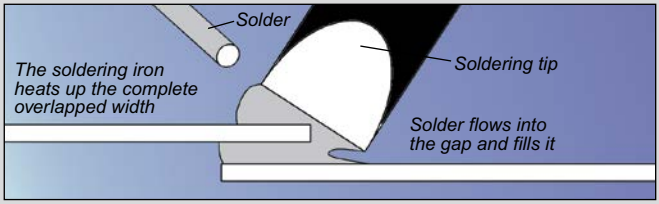

Guiding the soldering iron when soldering a broad seam

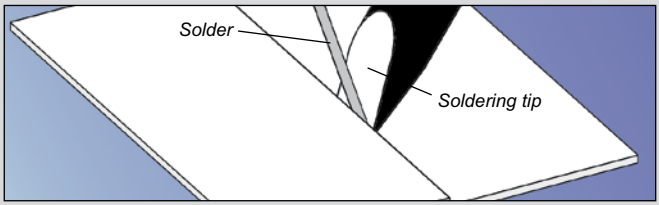

Guiding the soldering iron when soldering a narrow seam

Plumbing and tinsmith work

For the joining of sheet metal and metal pipes, the joints to be soldered have to be bare. This calls for a good prior cleaning.
After this, the flux – either solder grease or solder fluid, a zinc chloride solution – is applied. Then the area to be soldered is heated with the tip of the soldering iron.
Once the soldering area is sufficiently hot, solder is added and the solder gap is filled.
The aggressive flux residues are removed after cooling to avoid the risk of future corrosion.

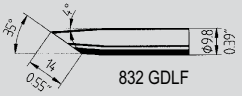

832 GDLF

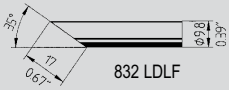

832 LDLF

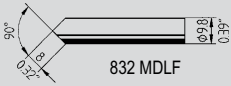

832 MDLF

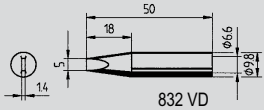

832 VD

ERSADUR Tiffany soldering tips

The types VD, GDLF, LDLF and MDLF of the comprehensive 832 tip series are particularly suited for Tiffany work. On account of their shapes and their high mass (excellent because of the ensuing heat retention capacity), the seams between the glass parts can quickly and easily be filled with solder. And the ERSADUR finish warrants a long tip lifetime.

ERSADUR Tiffany soldering tips

Ersa DIGITAL 2000A, Ersa MULTI-TC and ERSADUR soldering tips

Tiffany lamp

The **MULTI-TC** soldering iron is very light, robust and powerful. The Ersa SENSOTRONIC Control with the PT-1000 temperature sensor in the tip reacts immediately when heat is withdrawn.

The MULTI-TC is provided with a 2.2 mm wide, chisel-shaped soldering tip. Together with the Tiffany soldering tips, the slim MULTI-TC is superbly suited for the use in Tiffany work.

Due to its precise temperature control, the **DIGITAL 2000 A** soldering station completely eliminates the possibility to overheat any glass components or the copper foil, and the station has tremendous power reserves, making it comparable and putting it on an equal level with unregulated 150 W soldering irons.

The Ersa SENSOTRONIC control with its internally heated soldering tip, where the temperature sensor is mounted directly below the tip, provides for precise temperature control and ensures uniform temperature levels at the soldering joint.

The long-life ceramic PTC heating element provides up to 290 W heat-up rating which means that the powerful soldering iron is ready for use in only 60 seconds.

The DIGITAL 2000 A is provided with a 2.2 mm wide, chisel-shaped soldering tip. Particularly good results are achieved with the optionally available tip versions 832 VD, 832 GDLF, 832 CDLF and 832 MDLF, which are specifically offered for Tiffany applications.

Ersa MULTI-TC, 75 Watt

Ersa DIGITAL 2000 A with POWER TOOL

Ersa tool holders or stick-on rubber supports to safely and ergonomically put down the soldering iron during work stoppages or during heat-up.

Ersa viscose cleaning sponges for moist or special metal wool for dry cleaning of the hot soldering tip prior to the soldering process.

Auxiliary products and practical accessories

Everything for your soldering needs from one source

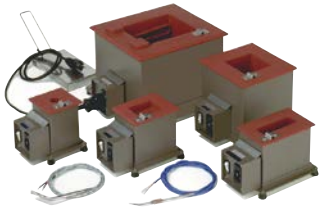

Ersa solder baths

Ersa solder wire and solder wire dispenser

Ersa DTM 100 tempera-ture measuring device

Ersa SOLDAPULLT desoldering pump

Ersa VAC X desoldering pump

Ersa SMD flux and flux cream

Ersa tip exchanger

Ersa FLUX-REMOVER

Ersa desoldering wicks

Ersa TIP-REACTIVATOR

Further peripherals and accesso-ries can be obtained from your local Ersa distributor and at **www.ersa.com**. Or just ask for our catalog!

IR rework stations

Ersa IR/PL 550, IR/PL 650 and HR 600 – from mobile phone boards up to XXL boards

Ersa HR 600

More than 5,000 customers worldwide use Ersa's patented IR-Rework technology.

Ersa rework stations deploy the DynamicIR Heating Technology, programmable top and bottom heating zones as well as the accurate, user-friendly and motorized "Auto Pick & Place" feature. System control, process documentation and visualization is handled by the Ersa rework software IRSoft/HRSoft.

Optical solder joint inspection

ERSASCOPE inspection systems – the patented original

Since its introduction over 10 years ago more than 3,000 customers worldwide profit from the possibility to non-destructively inspect hidden solder joints.

Regardless of whether the joints are under a flip-chip, or whether areas are to be inspected where other microscopes have come to their limits – the ERSASCOPE technology offers a considerable added value to any quality assurance program!

Ersa Know-How Seminars

Expert knowledge for professional users comprehensively imparted

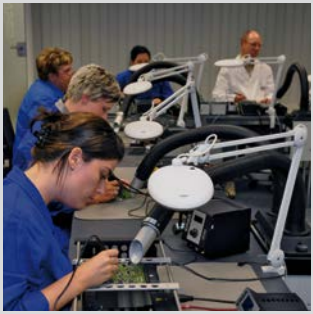

Today more than ever, cost-effective production and highest quality in the electronics manufacturing industry is the basis for profitable competitiveness. A key ingredient for being competitive is a well-qualified staff, which is up-to-date on current technology and process.

Ersa Know-How Seminars are ideal for transmitting this knowledge to those of your staff members with process responsibility in electronic manufacturing. In these seminars, theoretical and practical knowledge is presented in a neutral fashion in workshops and presentations by reputed experts in their field.

For further information go to our website **www.ersa.com** and click "Events".

Ersa Electronics Production Equipment

Technical data and further detailed information on our range of hand soldering equipment is available in our "Soldering Tools" catalog. This is available in printed form and as PDF, as are the "Rework & Inspection" catalog.

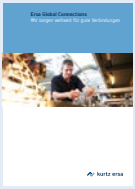

Aside from the extensive selection of hand soldering tools, rework stations and inspection systems for non-destructive inspection, Ersa, as Europe's largest manufacturer of soldering systems, also offers a complete range of selective, wave and reflow soldering systems, as well as stencil printers for the industrial electronic manufacturing industry.

Please refer to our brochures and our website **www.ersa.com** for further information.

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Soldering Guide

Safety Precautions

- **Never touch the element or tip of the soldering iron.**
  They are very hot (about 400°C) and will give you a nasty burn.
- **Take great care to avoid touching the mains flex with the tip of the iron.**
  The iron should have a heatproof flex for extra protection. Ordinary plastic flex melts immediately if touched by a hot iron and there is a risk of burns and electric shock.
- **Always return the soldering iron to its stand when not in use.**
  Never put it down on your workbench, even for a moment!
- **Allow joints a minute or so to cool down before you touch them.**
- **Work in a well-ventilated area.**
  The smoke formed as you melt solder is mostly from the flux and quite irritating. Avoid breathing it by keeping you head to the side of, not above, your work.
- **Wash your hands after using solder.**
  Solder contains lead.

Treatment for minor burns

Most burns from soldering are likely to be minor and treatment is simple:

- **Immediately cool the affected area under gently running cold water.**
  Keep the burn in the cold water for at least 5 minutes (15 minutes is recommended). If ice is readily available this can be helpful too, but do not delay the initial cooling with cold water.
- **Do not apply any creams or ointments.**
  The burn will heal better without them. A dry dressing, such as a clean handkerchief, may be applied if you wish to protect the area from dirt.
- **Seek medical attention if the burn covers an area bigger than your hand.**

Preparing the soldering iron

- **Place the soldering iron in its stand and plug in.**
  The iron will take a few minutes to reach its operating temperature of about 400°C.
- **Dampen the sponge in the stand.**
  The best way to do this is to lift it out the stand and hold it under a cold tap for a moment, then squeeze to remove excess water. It should be damp, not dripping wet.
- **Wait a few minutes for the soldering iron to warm up.**
  You can check if it is ready by trying to melt a little solder on the tip.
- **Wipe the tip of the iron on the damp sponge.**
  This will clean the tip.
- **Melt a little solder on the tip of the iron.**
  This is called 'tinning' and it will help the heat to flow from the iron’s tip to the joint. It only needs to be done when you plug in the iron, and occasionally while soldering if you need to wipe the tip clean on the sponge.
- **You are now ready to start soldering!**
  Please turn the page for further instructions...

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Making soldered joints

- **Hold the soldering iron like a pen, near the base of the handle.**
  Imagine you are going to write your name!
  Remember to never touch the hot element or tip.
- **Touch the soldering iron onto the joint to be made.**
  Make sure it touches both the component lead and the track.
  Hold the tip there for a few seconds and...
- **Feed a little solder onto the joint.**
  It should flow smoothly onto the lead and track to form a volcano shape as shown in the diagram below. Make sure you apply the solder to the joint, not the iron.
- **Remove the solder, then the iron, while keeping the joint still.**
  Allow the joint a few seconds to cool before you move the circuit board.
- **Inspect the joint closely.**
  It should look shiny and have a 'volcano' shape. If not, you will need to reheat it and feed in a little more solder. This time ensure that both the lead and track are heated fully before applying solder.

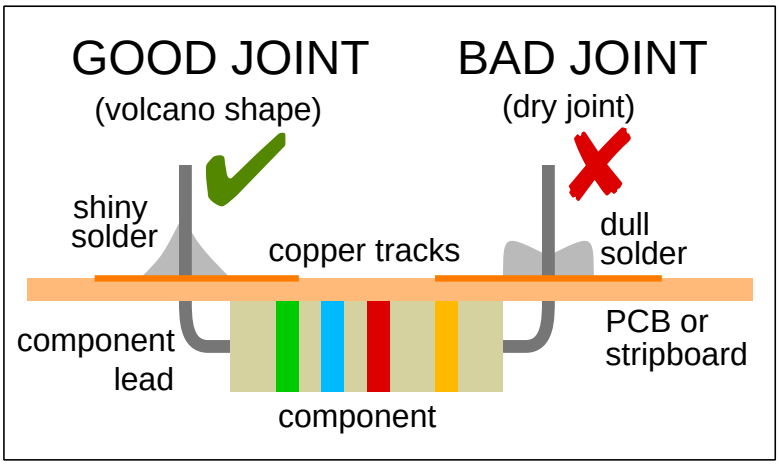

Using a heat sink

Some components, such as transistors, can be damaged by heat when soldering. It is wise to use a heat sink clipped to the lead between the joint and the component body, as shown in the picture. You can buy a special tool, but a standard crocodile clip works just as well and is cheaper!

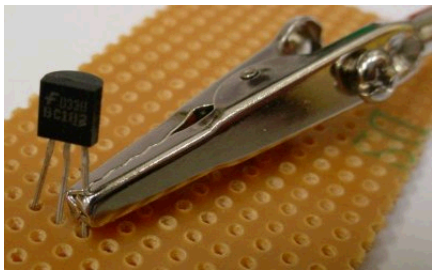

Soldering advice for components

Some components require special care when soldering. Many must be placed the correct way round and a few are easily damaged by the heat from soldering. Appropriate warnings are given in the table on the next page, together with other advice which may be useful when soldering.

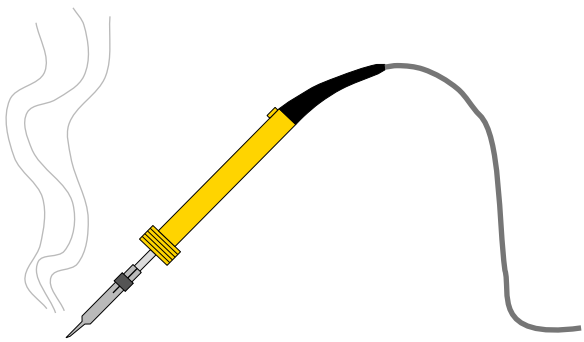

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Components	Pictures	Soldering advice
Resistors		No special precautions are required. Connect either way round.
Diodes		Diodes must be connected the correct way round: a = anode, k = cathode. Use a heat sink with germanium diodes.
IC holders (DIL sockets)	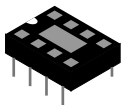	Ensure the notch is at the correct end. Do **not** insert the IC at this stage to prevent it being damaged by heat.
Presets (small variable resistors)		No special precautions are required. On stripboard take care to ensure you insert them the correct way round.
Capacitors, non-polarised (less than 1µF)	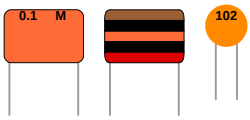	No special precautions are required. Connect either way round. Take care to identify their value.
Capacitors, electrolytic (1µF and greater)	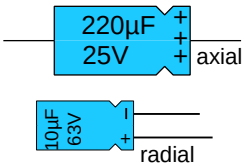	Electrolytic capacitors must be connected the correct way round, they are marked with + or - near one lead.
LEDs (Light Emitting Diodes)	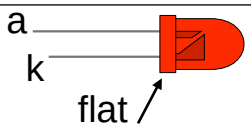	LEDs must be connected the correct way round: a = anode, k = cathode. Use a heat sink with small (3mm) LEDs.
Transistors	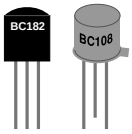	Transistors have three leads and must be connected the correct way round. Use a heat sink clipped to each lead in turn between the joint and the transistor.
Wire links between points on the board		Use tinned copper wire (such as the offcut from a resistor lead) or single-core plastic-coated wire.
Other parts mounted on the board		No special precautions are required for most parts, but make sure they are the correct way round.
Battery clips, buzzers and other parts with wires		Red (+) and black (-) wires must be connected the correct way round.
Wires to parts off the board such as switches		Use plastic-coated stranded wire which is flexible, single-core wire is likely to break at the joint.
Integrated Circuits (ICs or 'chips')	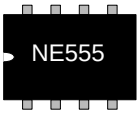	When all soldering is complete, carefully insert ICs the correct way round in their holders. Make sure all the pins are lined up before pushing in firmly.

For further information about electronic components please see: www.kpsec.freeuk.com

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Desoldering

At some stage you will probably need to desolder a joint to remove or re-position a wire or component. There are two ways to remove the solder:

1. With a desoldering pump (solder sucker)

- Set the pump by pushing the spring-loaded plunger down until it locks.
- Apply both the pump nozzle and the tip of your soldering iron to the joint.
- Wait a second or two for the solder to melt.
- Then press the button on the pump to release the plunger and suck the molten solder into the tool.
- Repeat if necessary to remove as much solder as possible.
- The pump will need emptying occasionally by unscrewing the nozzle.

2. With solder remover wick (copper braid)

- Apply both the end of the wick and the tip of your soldering iron to the joint.
- As the solder melts most of it will flow onto the wick, away from the joint.
- Remove the wick first, then the soldering iron.
- Cut off and discard the end of the wick coated with solder.

After removing most of the solder from the joint(s) you may be able to remove the wire or component lead straight away (allow a few seconds for it to cool). If the joint will not come apart easily apply your soldering iron to melt the remaining traces of solder at the same time as pulling the joint apart, taking care to avoid burning yourself.

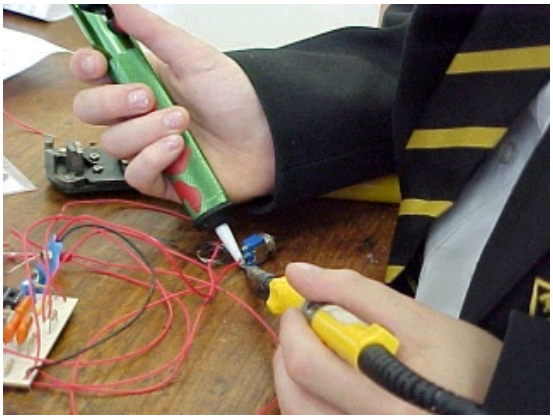

Using a desoldering pump (solder sucker)

What is solder?

Solder is an alloy (mixture) of tin and lead, typically 60% tin and 40% lead. It melts at a temperature of about 200°C. Coating a surface with solder is called ‘tinning’ because of the tin content of solder. Lead is poisonous and you should always wash your hands after using solder.

Solder for electronics use contains tiny cores of flux, like the wires inside a mains flex. The flux is corrosive, like an acid, and it cleans the metal surfaces as the solder melts. This is why you must melt the solder actually on the joint, not on the iron tip. Without flux most joints would fail because metals quickly oxidise and the solder itself will not flow properly onto a dirty, oxidised, metal surface.

The best size of solder for electronic circuit boards is 22swg (swg = standard wire gauge).

For plugs, component holders and other larger joints you may prefer to use 18swg solder.

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Safety Rules for Soldering

Department of Electrical, Computer and Biomedical Engineering, University of Rhode Island

1. Wear goggles for eye protection. When trimming off leads or excess solder dross, be careful of the flyaway that could injury yourself as well as other people nearby.
2. Work in a well-ventilated area and use a fume extractor. Do not inhale fumes from the soldering processes.
3. Always return the soldering iron to its stand when not in use. Never put it down on your workbench. The soldering iron tip is very hot (about 400°C). Avoid touching plastic, wire insulator, or any flammable material in the working area with the soldering iron. Turn the soldering station to standby or off if not used for more than few minutes. Turn unit off or unplug it when done.
4. Use a third hand, a circuit board vice, pliers, tweezers, or clamps for holding components to avoid burns. Legs and arms should be covered to avoid burns from splashed hot solder.
5. Do not have food or drink near the working area. The solder is usually a tin/lead alloy and lead is toxic. The flux is a chemical used to help metal parts soldered together. It is acidic and toxic. Clean up spilled flux immediately. Wash hands after soldering. Flux can cause acid burns to the skin or damage clothing. In case of acid burns, flush immediately with water.
6. Wash hands thoroughly after handling flux and solder containing lead. Use lead-free solder whenever possible.
7. Clean up the area when finished. Discard lead and silver solder and dross in a container with a lid. Label the container: “Lead/Silver Solder Waste for Recycling”. Used solder sponges and contaminated rags must be disposed of as hazardous waste.

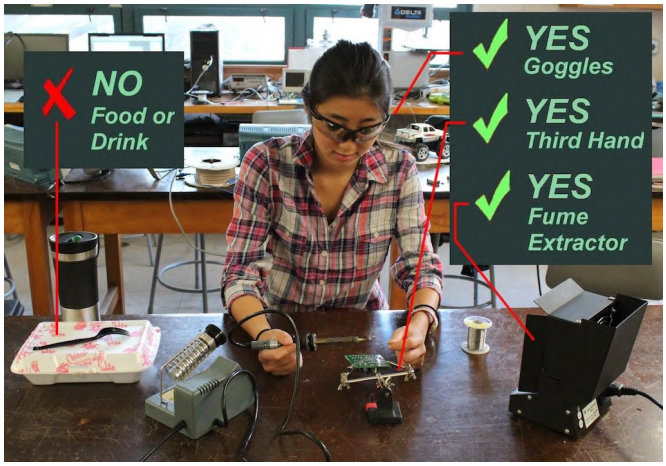

Soldering Techniques

1. Basic tools include an electric soldering station (a temperature-adjustable type preferred), solder, a pair of needle-nose pliers, a wire stripper, a flush cutter, a desoldering bulb, a utility blade, and a third hand or a vice.
2. Workspace should be as uncluttered as possible. Clear the path between the soldering station stand and the project to be soldered.
3. Prepare the soldering iron tip. Scrape off oxides with a utility blade if necessary. Adjust to an appropriate temperature. It won't work if you can't get the solder melt onto the soldering tip. Tinning the soldering tip by coating it with a thin coat of solder. This helps heat transfer between the tip and the components. The cleaning sponge should be soaking wet. Quickly run the soldering tip over the wet sponge to get rid of excess solder.
4. Clean the contact surfaces of the metal parts if necessary. Scrape off oxides with a utility blade. In some cases, it is easier to tin the individual components first before joining them.
5. Position the components using a third hand or a vice. Avoid holding the metal part of a component with your fingers.
6. Timing is important for soldering the components together. The solder needs to be completely melt at the joint to avoid a “cold solder point.” However, too much heat could damage a sensitive electronic component or melt the insulator of a wire. The required time depends on the heat transfer, which is affected by the temperature of the soldering tip, the mass of the components, the presence of flux or rosin, and how clean the contact surfaces are.
7. Start over when an attempt fails. Old solder has impurities. Remove old solder completely with a desoldering bulb or pump. Clean up flux/rosin residuals. Try again.

Examples: www.leadsdirect.co.uk/technical/perfectsolderjoint.html

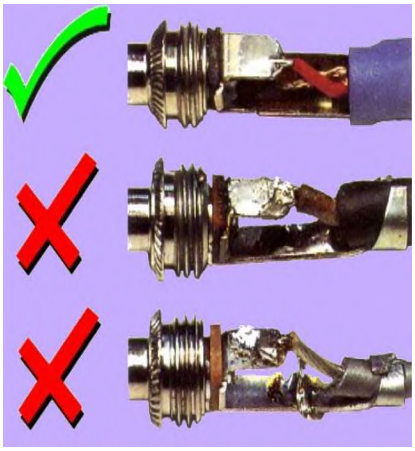

Good – clean, shiny, and just the right amount of solder.

Bad – too much solder which is uneven, has sharp points in places, and was probably overheated.

Worse – uneven texture, and the flux remaining on the joint.

Soldering

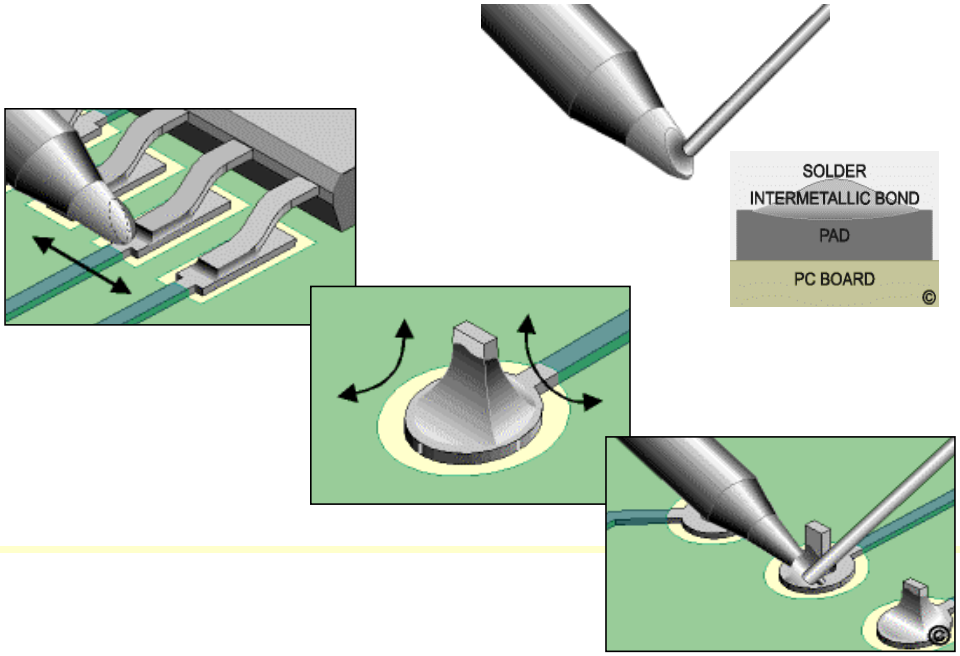

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SOLDERING

Theoretical background for technicians

1. Introduction :

Progress within the electronics industry would not have resulted in the mass production of electronic appliances as we know them today, without a similar progress in the field of soldering technology.

To be able to understand how soldering techniques are used in the electronics industry, we first have to get familiar with the materials used during the soldering process, and we have to learn how a soldering connection is created on a molecular level.

Soldering is an old technique for creating permanent electrical and mechanical connections between metals. In contrast to ordinary glueing, which makes only a physical connection between materials (although electrically conducting glue also exists) soldering causes a chemical reaction with other materials, creating a new alloy.

There are several soldering techniques, which all have a few things in common: basic metals, soldering flux, solder and heating.

2. Basic metals :

When we place electronic components on a PCB, the legs of the components and the soldering lands on the PCB, are the basic metals that will connect with the solder.
Several metals like copper, bronze, silver and some types of steel react with solder and make a strong chemical and physical connection.
Other materials like aluminium, titanium, etc. are difficult or even impossible to solder.
The fact that materials exist which can not be soldered is very important, as these materials can be used for making soldering machines and soldering irons. These materials can also be used for covering components during soldering.

There is a direct relationship between how strongly the surface of the basic metal oxidizes and how the soldering reacts on this: When there is more oxidation present, the soldering connection will be weaker.
The fact that most metals oxidize very quickly when heated, is a specific problem, because if one wants to obtain a chemical soldering reaction, a high temperature is necessary…
Flux is used to counteract this oxidation problem.

3. Soldering flux :

Although the soldering surface looks clean, there is always a thin layer of oxide on the metals. This layer always arises as soon as the metal is exposed to air. Reliable soldering connections can only be made on "clean" surfaces. "Clean" surfaces could be accomplished using cleaning product, but this would be insufficient as metal oxidizes incredibly fast when heated.
To prevent the creation of the layer of oxide, the use of soldering flux is necessary.

Using soldering flux on the basic metals before the soldering starts has various reasons and advantages:

The main reason of the use of flux is to stop the oxidation of the basic metals during heating.
The flux makes sure that the air can't reach the soldering surface, and therefore prevents the formation of oxidation during warming up.
Most of the different flux types have acid components which are used to remove the oxidation that is already present on the basic metal.
If a very strong acid is active in the flux, theoretically it would be possible to remove all the oxides.
This however is in practice not possible, as the acid would also affect the PCB and the components, which of course is not the intention.

Therefore there will always be a search for the balance between a flux that contains strong acids, and as a consequence also removes the oxidates more effectively (but also affects the PCB), and a flux that contains a less strong acid and therefore removes less oxides. (but does not affect the PCB).

Most fluxes though use types of acid. Therefore it generally is necessary to remove the flux residues after soldering.

When solder is applied, the flux needs to flow off so that the solder can make direct contact with the basic metal. During this process it is however impossible to avoid the flux mixing with the solder.
Flux developers make use of this fact to develop a flux that has the property to reduce the surface tension of the solder on contact, as a result of which better "wetting" arises.

Flux consists of natural or synthetic resin and chemical additives, called activators.
In PEM a "no clean" flux of Tamura is used (for the placement of Flat-Package-IC's). Consequently it is not necessary to remove the flux after soldering.
Furthermore it is not necessary to add extra flux when doing easy manual soldering because the soldering wire contains flux (3.3 %), like a resin core.

4. Solder :

There several existing metals and metal alloys that can be used for soldering.
The choice for using a certain metal is based on the properties of the metal:
Is the metal flexible or fragile? How well does it conduct heat?
Does it expand rapidly when heated? What is the electrical resistance of the metal?
How strong is it? Is it toxic? And not unimportant: what does it cost?
Although it is not perfect, an alloy of tin and lead is most often used traditionally.
Pure tin melts at 203°C and pure lead melts at 330°C. A mixture of both metals has a lower melting point.
By using a different mixture the melting temperature of the soldering alloy can be changed.
A alloy of tin and lead (e.g. 60/40) has a relatively low melting point (183°C) and can be produced at a relatively low price, in comparison to other alloys with similar properties.
Lead is a very cheap and can be found in a lot of places. Therefore the cost of the tin-lead alloy is mainly determined by the cost of tin.

When this alloy is warmed up, it goes through several phases:
the alloy goes from a "fixed" condition, to a "paste" condition (semi-liquid), and finally becomes totally liquid. It is difficult to solder with an alloy that is in a "paste" condition: because there is little movement or vibration during this "paste" condition, this can cause bad soldering.
If the alloy is of 50% tin and 50 % lead, it starts to melt at a temperature of 193°C, and will be totally melted at a temperature of 216°C.

To prevent bad soldering during the "paste" condition, "eutectical" solder is used.
An "eutectical" alloy is an alloy that, when heated, goes immediately from a fixed condition to a liquid condition: the "paste" stage is effectively skipped.
An "eutectical" tin-lead alloy contains 63% tin and 37% lead.
Often a tin-lead alloy with 60% tin and 40% lead is used. This alloy can be produced cheaper than the eutectical solder because it contains less tin. But because this alloy is almost "eutectical", it can effectively be used for soldering.
During soldering, be careful to make no sudden movements whilst the solder is cooling.
This can cause "interrupted connections" and therefore unreliable soldering.
An "interrupted" soldering connection has a rough and irregular surface and appears dim instead of clear and shiny.
It is also very important that no impurities get into the solder.
If small metal particles from the components get into the soldering "cup" of the soldering machine.
This can result in a serious change to surface tension, and consequently bad soldering connections.
These metal impurities could even change the melting temperature of the solder.

5. Heat, generation of soldering connection

If the solder gets in contact with a copper surface,
the solder dissolves and penetrates the copper layer.
The molecules of the solder and the copper get mixed and a new
alloy is created, consisting partially of copper and partially of solder.
This reaction is called "wetting" and has as a result an "inter-metallic" connection
between the components. "Wetting" can only take place if the surface of the copper does not contain
oxides. The solder and the surface of the copper also have to be at the right temperature before the
"wetting" can take place.

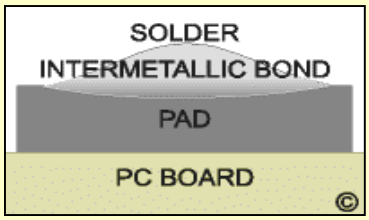

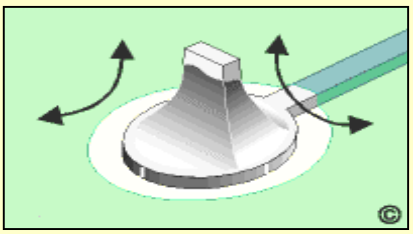

6. Soldering with a soldering iron:

The following 4 factors determine the quality of the soldering connection:

- clean surfaces
- temperature
- time
- quantity of solder

a) Clean surfaces:

"dirt is the enemy of a good soldering connection!"

It is enormously important that there are no impurities on all of the components (including the soldering bit). Soldering on "dirty" components is not possible!
Old PCB's or components sometimes can not be soldered due to a
large layer of oxide on the islands and the legs of the components.
In such cases the solder is rejected and goes to everywhere, except for where we want it to go.
In a desperate attempt to solder in such a situation, a common reaction is to raise the
soldering temperature. However, this is certainly not a solution. On the contrary!
The only correct solution is thorough cleaning. (e.g. with a brush of glass fibre)

Before the soldering iron can be used, the soldering bit first has to be coated with tin.
Some solder has to be melted onto the bit. Afterwards the bit has to be cleaned.
For cleaning the soldering bit, it is best is to use a slightly moistened sponge
(with demineralized water). The use of ordinary tap water is not reccomended, because the
silver layer on the bit gets affected by calcium in the tap water, which results in less thermal
contact. This diminished thermal contact runs the risk of cold soldering, etc.
To improve the thermal contact between the bit and the soldering surface, it is advisable
to coat the soldering bit with a little bit of solder before every soldering action.

b) Temperature & time :

The temperature of the soldering bit is not the most determining factor for successful soldering:
the heating cycle (combination of temperature of the bit and the time the heating takes) is!
How fast the soldering components warm up, how warm they get and how long they stay warm, are
the most important factors that have to be controlled to make a reliable soldering
connection.

The time soldering takes is very important. A soldering task may only take a couple of
seconds: when heated too long, the components and the soldering lands can be damaged.

It is also totally wrong to use the soldering bit to rub melted solder across the soldering surface.

Although the temperature of the bit is not the most determining factor, it is advisable to
to do soldering at the lowest possible temperature.

The first that has to be examined before the soldering starts in the 'thermal mass" of the components.

Every soldering task has its own specific "thermal mass" which is determined by the heat absorption of the components. For soldering e.g. the component pins and solder lands.
For components on a heat sink there will be a large thermal mass. In other words: the heat will be "absorbed " by the heat sink, as a result of which more warmth will have to be added than e.g. for soldering the leg of an IC.
Secondly it is very important that the temperature of all the components that will be soldered have more or less the same temperature.
An example: it is necessary that the leg and the soldering land have had at the same time the necessary warming up before the solder is added.
We have to take care that, while warming up, the soldering bit gets in contact with both the leg and the soldering land.
"Thermal contact" is therefore very important.

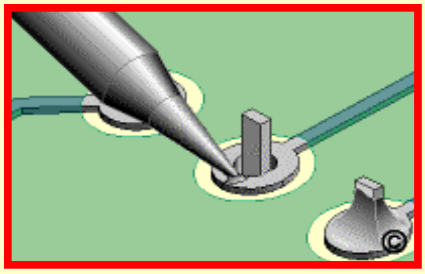

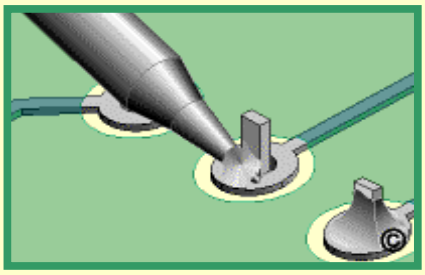

The thermal contact is low
The warmth is transmitted by means of the bit.
to the leg and the soldering land

The thermal contact is higher
by adding a bit of solder
to the point of contact

The size and the shape of the soldering bit, as well as the position of the bit, will determine whether or not it makes a good thermal contact. For being able to make a good thermal contact in all circumstances, different types of soldering bits exist (different shapes).
Normally the soldering bit has to be placed on the "largest mass point" of the soldering connection that needs to be made.
This will make fast heating possible.

c) Adding solder & quantity

The last factor necessary for a high quality soldering connection, is adding the correct quantity of solder.
Too much solder is an unnecessary waste and can aid the formation of "bridges" across legs
If not enough solder is added, this can cause an "insufficient soldering" or "dry soldering"
Adding the correct quantity of solder takes a lot of exercise and experience

Melted solder always flows from a "colder" area to a "warmer" area.
Before the solder is added, the surface temperature of the components to be soldered has to be higher than the melting temperature of the solder.
Never let the soldering wire melt by holding it against the soldering bit. This may cause the solder to fall on a surface where the temperature is lower than the melting temperature
This can result in a cold soldering, with almost no or insufficient "wetting".
If the solder is added to a clean, fluxed and sufficiently heated surface, then the solder will melt and flow nicely without direct contact with the heat source. (soldering bit)
Therefore it is advisable to put the soldering wire on the sufficiently heated surface so that the solder melts as a consequence of the contact with the heated surface

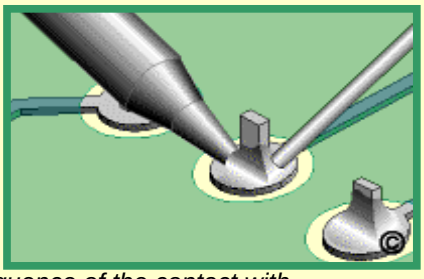

The solder is melted as a consequence of the contact with the heated surface. No contact with the soldering bit is necessary.

d) Soldering : 7 steps

1. Cleaning of the soldering bit:
For soldering to be effective, the soldering bit has to be clean: no dirt and no oxides are allowed on the soldering bit.
The soldering bit needs to be cleaned before soldering.

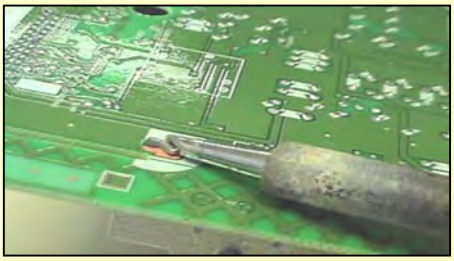

2. Heating of the components that will be soldered.
For soldering to be effective, the components which have to be connected, have to be heated (in this case the pin and the solder lands) to a temperature that at least equals the temperature of the melting point of the soldering alloy. (183 °C)
Bear in mind the "thermal mass", the type of bit and the position of the bit!

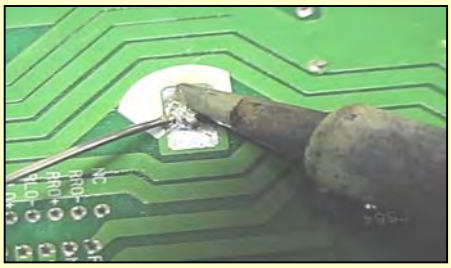

3. Adding the solder:
After both components are heated sufficiently, solder can be added.
Let the solder melt as a consequence of the contact with the heated surface. In other words: don't make any direct contact with the soldering bit.

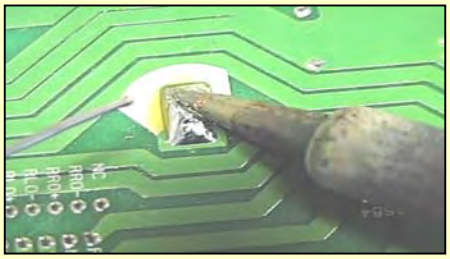

4. Quantity of the solder to be added and letting the solder flow.
Let the solder flow nicely between both components and add solder until the right quantity is reached.

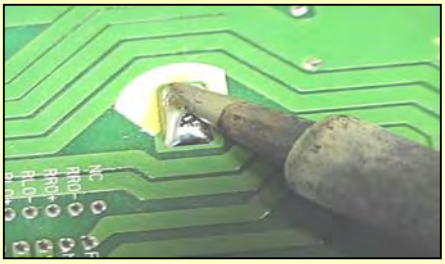

5. Remove the soldering wire
When sufficient solder is added, the soldering wire may be removed.

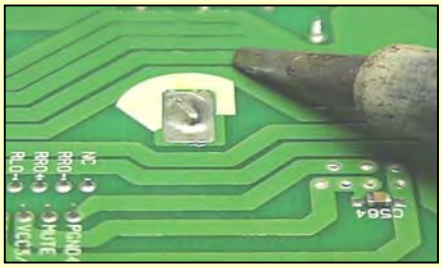

6. Remove the soldering bit.
When the solder has nicely flowed open, and there is "wetting", the soldering bit may be removed so that the solder can solidify.
Pay attention for possible sudden movements during this operation. (risk of "disturbed" soldering)

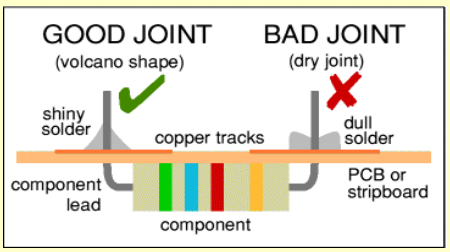

7. Check the soldering connection
Check the soldering connection.
Nicely formed soldering is shining and even. Also pay attention to the shape: a spherical shape is not good!

e) Soldering of a flatpackage IC

For soldering a "Flat-package IC" (gull wing type) one can use, beside the ordinary point soldering, (= leg by leg), a special soldering technique: the DRAGGING TECHNIQUE.
For this technique, one must use a special soldering bit that will, after filling-up, act as a kind of "mini-soldering-wave", and with which one can solder a whole row of legs in one ongoing movement

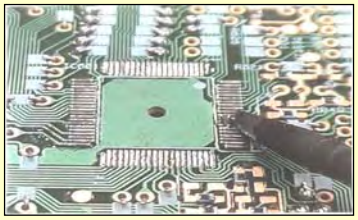

1. Cleaning of the soldering surface:
Remove all possible soldering residues (caused by desoldering) and make all the paths nicely even by going over those paths with the soldering bit. (without adding solder)

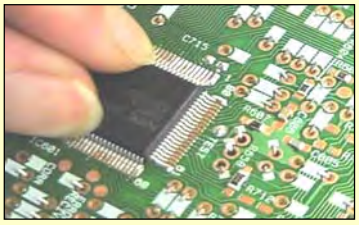

2. Positioning of the IC:
Position the IC on the patterns.
This has to be very precise.
A little movement can cause serious problems.

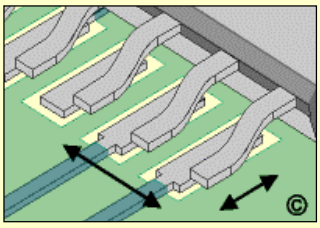

3. Fixing of the IC:
Fix the IC on the PCB, by "temporarily" soldering some legs on both sides.

4. Add sufficient flux on all sides.

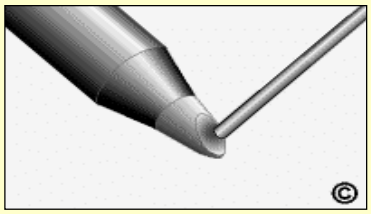

5. Filling of the bit and start of the soldering:
Fill the special (concave) soldering bit with solder.

Now start a slow dragging movement from one leg to another.
Pay attention that the solder nicely moves up on the legs of the IC.

If the PCB is equipped with a "soldering thief" (a soldering land that is positioned next to the last leg), one has to solder in the direction of the soldering thief, so that at the end the possible surplus of solder flows on this soldering thief and no short circuit is created on the last two legs of the row.

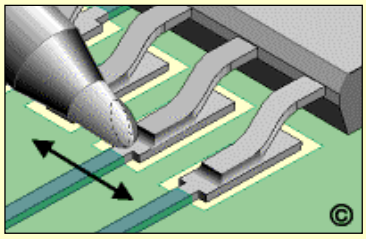

f) Incorrect soldering :

For certain soldering problems or soldering mistakes, specific terms are used:

SOLDER BRIDGE

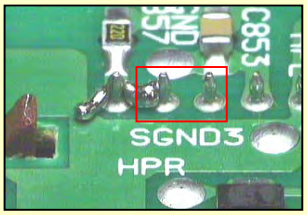

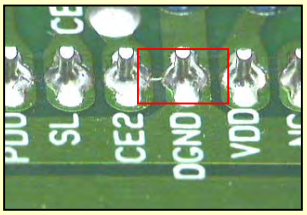

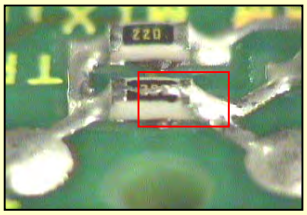

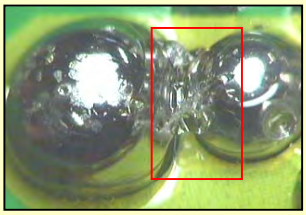

COLD SOLDERING

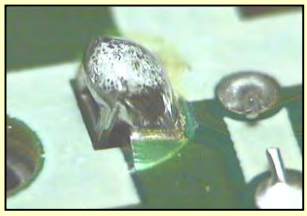

HALF SOLDERING OR DRY SOLDERING

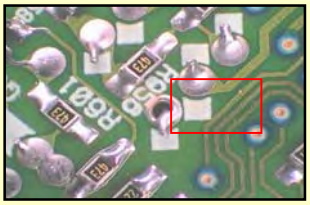

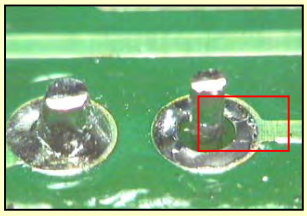

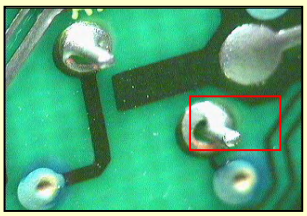

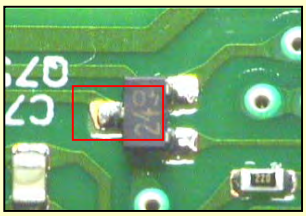

NO SOLDERING

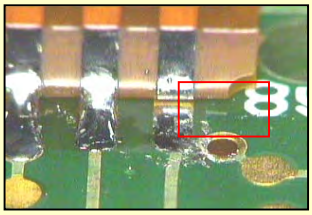

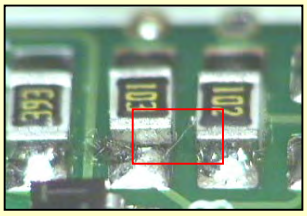

SOLDERING HORN

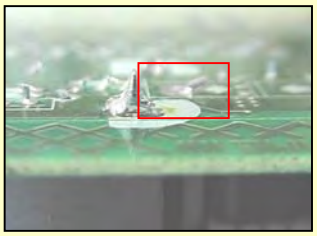

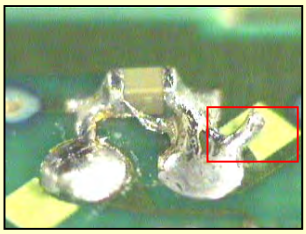

SOLDERING BALL OR SOLDERING SPLASH

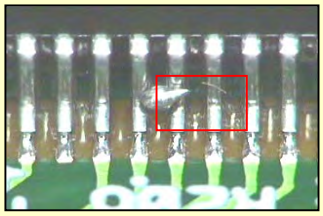

SOLDERING WIRE SHORT CIRCUIT

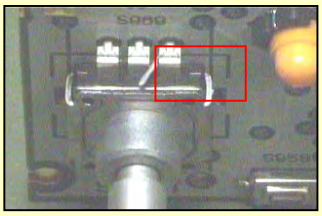

7) (De)soldering with warm air and soldering paste:

In some cases it is impossible to solder or desolder certain components with a classical soldering iron or a normal desoldering station.

This is often the case for SMT components, with contact legs (partly) underneath the component.
In such a case one has to use a (de)soldering appliance that uses warm air or infra-red heat.

SMT component with contact surfaces beneath the component

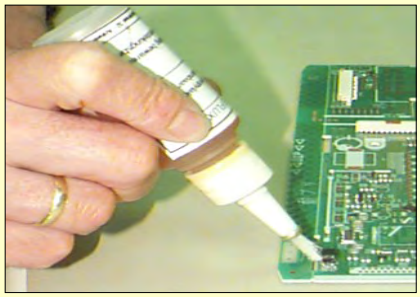

1. Fluxing of the component:
To have a good temperature conductance during warming up, the soldering surfaces need to be moistened with flux.
If these surfaces are parly underneath the component, flux can be put on the borders of the component.

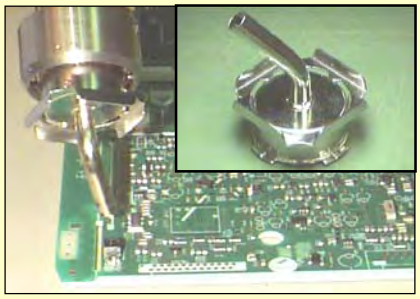

2. Warming-up of the soldered surfaces:
Use a "pointing nozzle" and point it at the component you want to remove. Keep a distance of 1 cm between the nozzle and the surface you want to warm up. Choose the temperature of the warm air e.g. +/- 340°C. (dependant on the temperature profile of the compents.)
Pay attention : if the contact surfaces are partly under the component, it is necessary to warm up the body of the component. Often the component is not useable afterwards.

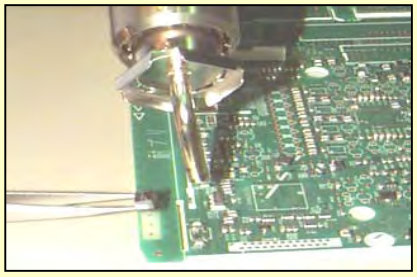

3. Removal of the component
When the solder (paste) has melted, the component can be removed with a pair of tweezers.

4. Cleaning of the soldering surfaces:
Remove all redundant soldering paste with a classical desoldering station.

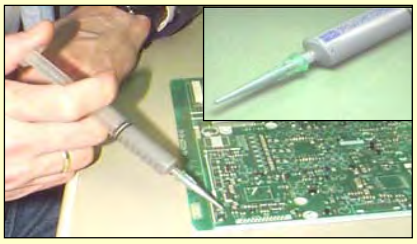

5. Adding soldering paste:
Add with a measured squirt the necessary soldering paste on the soldering lands.
Pay attention: soldering paste needs to be stored in strict circumstances. (see the instructions of the supplier)

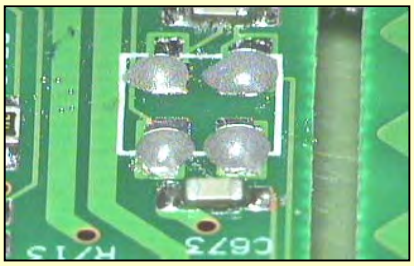

6. Checking the quantity of soldering paste:
Check the quantity of the added soldering paste.
Only the contact surfaces should be covered with soldering paste.
Too much soldering paste can cause a short circuit during "re-flowing".

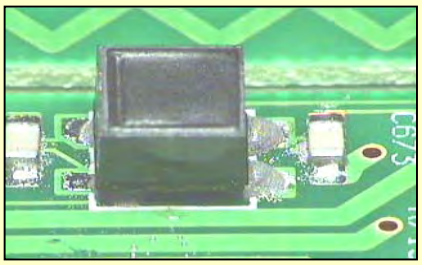

7. Positioning of the component

Position the new component carefully with the contact surfaces in the soldering paste with a pair of tweezers.
Position the component by the guide lines on the PCB.

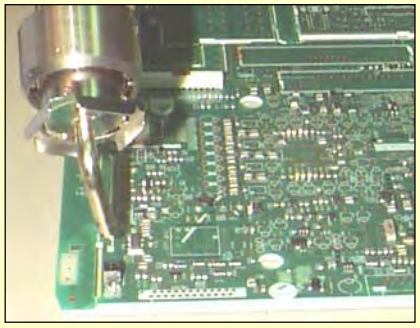

8. Reflowing of the component:

Use a "pointing nozzle" and point it on the component you want to remove. Keep a distance of 1 cm between the nozzle and the surface you want to warm up. Choose the temperature of the warm air e.g. +/- 340°C. (dependant on the temperature profile of the component.) Warm up until one sees that the soldering paste is active or flowing. The result should be a good soldered joint.
Pay attention: For most of the warm air soldering appliances one can choose the air pressure. The speed should be minimum, otherwise there is a possibility of blowing the component away.

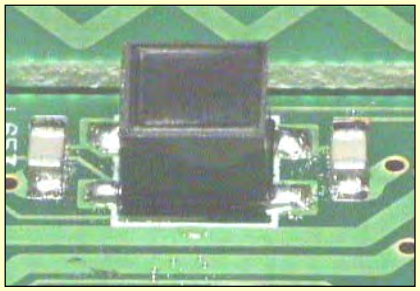

9. Checking of the soldering:

If possible, check the soldered joints.
Good soldering shines and has flowed evenly.

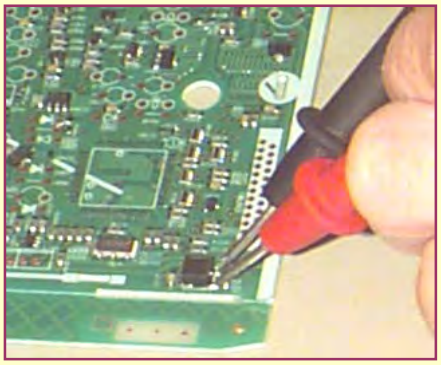

10. Checking of the electrical connection

If possible check the electrical connection with a meter.

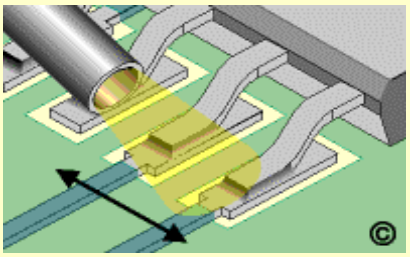

Example of a "warm air soldering appliance": PACE.

8) Lead free soldering

Introduction.

Normally all solderings (mechanical - and hand soldering) were executed with soldering material that contained lead. (40 % lead / 60 % tin)
But lead is toxic and therefore damaging for humans and for nature.
Hence European directives were made in which companies will be obliged to use soldering techniques without lead after July 2006.

Soldering without lead is relatively new in the world of electronics.

Lead-free solder:

If no lead is present in the soldering wire, this has to be replaced. The soldering wire needs to contain another metal, like SILVER & COPPER. (96,5 % tin / 3% silver / 0,5 % copper)

This new composition has the advantage that it is no longer toxic and that the soldering connections are stronger. (lead is relatively weak). But this new composition also has some negative consequences:

1) The cost is higher (silver and copper alloys are more expensive than lead)
2) The joints look different (more granular instead of shining)
3) The melting temperature is higher

One of the main points of interest is the higher melting temperature. One would think that as a consequence of the higher melting temperature of the solder, also the soldering temperature needs to be raised. This however is not always allowed! Some components are only able to handle a certain maximum temperature for a certain time.

In practice:

- You can use your original soldering station if you can reach the correct temperature at the soldertip
- The soldering bit has to be a bit larger than a soldering bit for soldering with lead.

Pay attention: **Solder with lead and solder without lead can never be mixed.**

9) Temperature specifications of the soldering bit

Solder with lead

Process	Bit Type	Solder	Min	Center	Max
Pins	ETB / ETCC/ 1121-0519	UOS-014	340°C	**380°C**	400°C
LCD	ETF / ETCC	UOS-005	320°C	**340°C**	360°C
OEL Display	ETCC	UOS-004	280°C	**290°C**	300°C
Connector	ETL / ETF	UOS-005	320°C	**340°C**	360°C
Flexible PCB	ETF	UOS-004	280°C	**300°C**	320°C
IC's & QFP IC's	1121-0490	UOS-005	280°C	**300°C**	320°C
Removal bridge	ETB / ETCC	UOS-005	320°C	**340°C**	360°C
Lights	ETF / ETB /1121-0519	UOS-005	280°C	**300°C**	320°C
SMT/SMD repair	ETL / ETF	UOS-005	280°C	**300°C**	320°C

Temp. specifications Pioneer standard ZES-A015 & ZES-B016

Solder without lead

Process	Bit Type	Solder	Min	Center	Max
Pins	LTB / LTCC	UOS-026	400°C	**410°C**	420°C
LCD	LTF / LTCC	UOS-027	320°C	**340°C**	360°C
OEL Display	LTCC	UOS-028	280°C	**300°C**	320°C
Connector	LTL / LTF	UOS-027	320°C	**340°C**	360°C
Flexible PCB	LTF	UOS-028	280°C	**300°C**	320°C
IC's & QFP IC's	1121-0490	UOS-027	280°C	**300°C**	320°C
Removal bridge	LTB / LTCC	UOS-027	320°C	**340°C**	360°C
Lights	LTF / LTB	UOS-027	280°C	**300°C**	320°C
SMT/SMD repair	LTL / LTF	UOS-027	280°C	**300°C**	320°C

Temp. specifications Pioneer standard ZES-A043

Types of soldering wire:

With lead	UOS-014 (1 mm) + UOS-005 (0.8 mm) + UOS-004 (0.5mm)
Without lead	UOS-026 (1 mm) + UOS-027 (0.8 mm) + UOS-028 (0.5 mm)

10) Types of soldering bits:

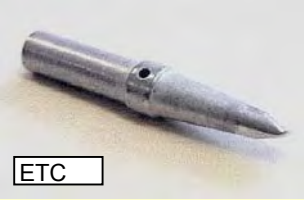

11) Soldering devices:

"Clean-o-point": for automatic cleaning of the soldering bit with 2 rotating sponges

"Flux dosing bottle": for easy adding of flux (with brush)

"Bit cleaner": for drying and cleaning of the soldering bit

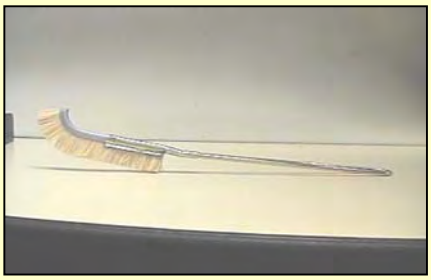

" Brush " : for removal of possible soldering residues after soldering

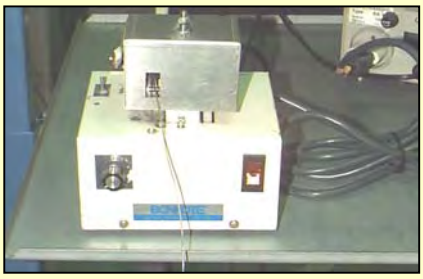

"V-cutter" : for making a cut in the soldering wire, in order to reduce the formation of little soldering balls

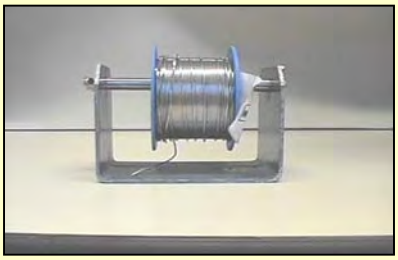

"Solder dispenser" : for a simple supply of soldering wire

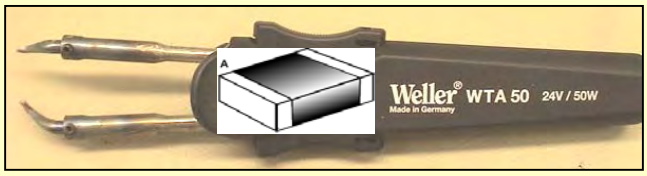

"Tweezer-copper bit": handy tool for the removal of SMD/SMT components.

"Warm air desoldering appliance": for easy desoldering of flat-package IC's

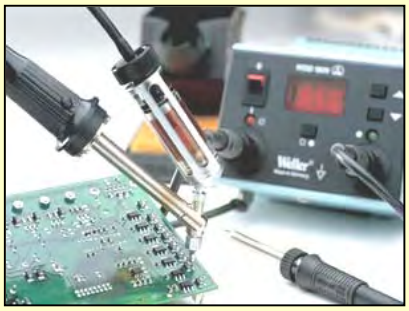

"Desoldering appliance": for easy desoldering of point solderings

"Soldering magnifying glass": for a good view during soldering

The Basic Soldering Guide

http://www.epemag.wimborne.co.uk/solderfaq.htm (for text in this document)

basics for wire (Good intro) : http://www.youtube.com/watch?v=BLfXXRfRIzY
The Happy Soldering Iron: http://www.youtube.com/watch?v=AL-_RGbyf1s
basics: http://www.youtube.com/watch?v=I_NU2ruzyc4
Watt/temp comparison http://www.youtube.com/watch?v=Vh9pWu6K6tc&NR=1
tip sizes: http://www.youtube.com/watch?v=Sfb1Ve52ztY&NR=1
types of solder: http://www.youtube.com/watch?v=COqGkYMOA44
maintenance: http://www.youtube.com/watch?v=krxTfZCFptk&NR=1

Good overview with some odd bits: http://www.youtube.com/watch?v=AOdnGUMi7lQ

Desoldering overview: http://www.youtube.com/watch?v=j-_pnc-Qqm8
2nd good overview: http://www.youtube.com/watch?v=8UN3D2-f64A
Hot air pencil/gun: http://www.youtube.com/watch?v=AxYhF6Ab2CU
Desoldering gun (short): http://www.youtube.com/watch?v=8Z6MvZz_uNc

Crazy Guy from Make Electronics: http://www.youtube.com/watch?v=3N3ApzmyjzE
Not Soldering!! – Bread board: http://www.youtube.com/watch?v=oiqNaSPTI7w

This written guide will help beginners and novices to obtain effective results when soldering **electronic components**. If you have little or no experience of using a soldering iron, then EPE *(Everyday Practical Electronics* magazine) recommends that you practice your soldering technique on some fresh surplus components and clean stripboard (protoboard), before experimenting with a proper constructional project. This will help you to avoid the risk of disappointment when you start to assemble your first prototypes. If you've never soldered before, then read on!

Soldering irons

The most fundamental skill needed to assemble any electronic project is that of ***soldering***. It takes some practice to make the perfect joint, but, like riding a bicycle, once learned is never forgotten! The idea is simple: to join electrical parts together to form an electrical connection, using a molten mixture of lead and tin (solder*) with a soldering iron. A large range of soldering irons is available - which one is suitable for you depends on your budget and how serious your interest in electronics is.

[*Note: the use of lead in solder is now increasingly prohibited in many countries. "Lead free" solder is now statutory instead.]

Electronics catalogues often include a selection of well-known brands of soldering iron. Excellent British-made ones include the universally popular Antex, Adcola and Litesold makes. Other popular brands include those made by Weller and Ungar. A very basic mains electric soldering iron can cost from under £5 (US$ 8), but expect a reasonable model to be approximately £10-£12 (US$ 16 - 20) - though it's possible to spend into three figures on a soldering iron "station" if you're really serious! Check some suppliers' catalogues for some typical types. Certain factors you need to bear in mind include:-

Voltage: most irons run from the mains at 240V. However, low voltage types (e.g. 12V or 24V) generally form part of a "soldering station" and are designed to be used with a special controller made by the same manufacturer.

Wattage: Typically, they may have a power rating of between 15-25 watts or so, which is fine for most work. A higher wattage does ***not*** mean that the iron runs hotter - it simply means that there is more power in reserve for coping with larger joints. This also depends partly on the design of the "bit" (the tip of the iron). Consider a higher wattage iron simply as being more "unstoppable" when it comes to heavier-duty work, because it won't cool down so quickly.

Temperature Control: the simplest and cheapest types don't have any form of temperature regulation. Simply plug them in and switch them on! Thermal regulation is "designed in" (by physics, not electronics!): they may be described as "thermally balanced" so that they have some degree of temperature "matching" but their output will otherwise not be controlled. Unregulated irons form an ideal general purpose iron for most users, and they generally cope well with printed circuit board soldering and general interwiring. Most of these "miniature" types of iron will be of little use when attempting to solder large joints (e.g. very large terminals or very thick wires) because the component being soldered will "sink" heat away from the tip of the iron, cooling it down too much. (This is where a higher wattage comes in useful.)

A proper temperature-controlled iron will be quite a lot more expensive - retailing at say £40 (US$ 60) or more - and will have some form of built-in thermostatic control, to ensure that the temperature of the bit (the tip of the iron) is maintained at a fixed level (within limits). This is desirable especially during more frequent use, since it helps to ensure that the temperature does not "overshoot" in between times, and also guarantees that the output will be relatively stable. Some irons have a bimetallic strip thermostat built into the handle which gives an audible "click" in use: other types use all-electronic controllers, and some may be adjustable using a screwdriver.

Yet more expensive still, ***soldering stations*** cost from £70 (US$ 115) upwards (the iron may be sold separately, so you can pick the type you prefer), and consist of a complete bench-top control unit into which a special *low-voltage* soldering iron is plugged. Some versions might have a built-in digital temperature readout, and will have a control knob to enable you to vary the setting. The temperature could be boosted for soldering larger joints, for example, or for using higher melting-point solders (e.g. silver solder). These are designed for the most discerning users, or for continuous production line/ professional

use. The best stations have irons which are well balanced, with comfort-grip handles which remain cool all day. A thermocouple will be built into the tip or shaft, which monitors temperature.

Anti-static protection: if you're interested in soldering a lot of static-sensitive parts (e.g. CMOS chips or MOSFET transistors), more advanced and expensive soldering iron stations use static-dissipative materials in their construction to ensure that static does not build up on the iron itself. You may see these listed as "ESD safe" *(electrostatic discharge proof)*. The cheapest irons won't necessarily be ESD-safe but never the less will still probably perform perfectly well in most hobby or educational applications, if you take the usual anti-static precautions when handling the components. The tip would need to be well earthed (grounded) in these circumstances.

Bits: it's useful to have a small selection of manufacturer's bits (soldering iron tips) available with different diameters or shapes, which can be changed depending on the type of work in hand. You'll probably find that you become accustomed to, and work best with, a particular shape of tip. Often, tips are *iron-coated* to preserve their life, or they may be bright-plated instead. Copper tips are seldom seen these days.

Spare parts: it's nice to know that spare parts may be available, so if the element blows, you don't need to replace the entire iron. This is especially so with expensive irons. Check through some of the larger mail-order catalogues.

A ***solder gun*** is a pistol-shaped iron, typically running at 100W or more, and is completely unsuitable for soldering modern electronic components: they're too hot, heavy and unwieldy for micro-electronics use. Plumbing, maybe..!

Soldering irons are best used along with a heat-resistant ***bench-type holder***, so that the hot iron can be safely parked in between use. Soldering stations already have this feature, otherwise a separate soldering iron stand is essential, preferably one with a holder for tip-cleaning sponges. Now let's look at how to use soldering irons properly, and how to put things right when a joint goes wrong.

The Basic Soldering Guide Photo Gallery

Soldering is a delicate manual skill which only comes with practice. Remember that your ability to solder effectively will determine directly how well the prototype or product functions during its lifespan. Poor soldering can be an expensive business - causing product failure and downtime, engineer's maintenance time and customer dissatisfaction. At hobbyist level, bad soldering technique can be a cause of major disappointment which damages your confidence. It needn't be like that: soldering is really easy to learn, and like learning to ride a bike, once mastered is never forgotten!

These photos illustrate the basic steps in making a perfect solder joint on a p.c.b. If you're a beginner, our advice is that it's best to practice your soldering technique using some clean, new parts with perhaps some new stripboard (protoboard). Be sure to avoid using old, dirty parts; these can be difficult if not impossible to solder.

(Left) Printed circuit board copper tracks must be clean to begin with, especially if they're not previously "tinned" with solder. Clean any raw p.c.b. copper tracks gently with e.g. an abrasive rubber block available from electronics suppliers. **(Right)** Clean the iron "bit" (soldering iron tip) using a damp sponge. The soldering iron featured is an Ungar Concept 2100 Soldering Station. Other popular brands of soldering equipment include Weller and Antex.

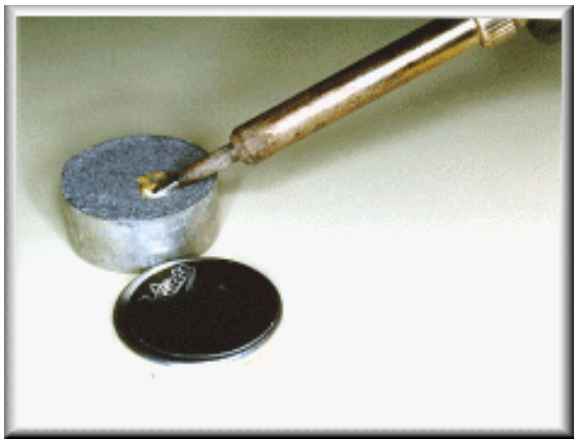

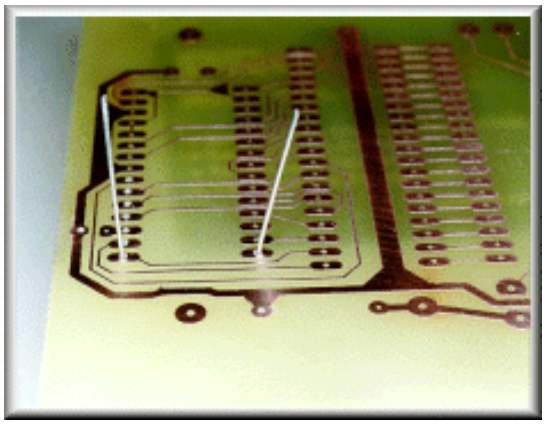

(Left) A useful product is Multicore's Tip Tinner Cleaner (TTC) - a 15 gramme tin of special paste which cleans and "tins" the soldering iron iron, in one go. New tips must be tinned **immediately** when used for the first time. **(Right)** Insert components and splay the leads so that the part is held in place.

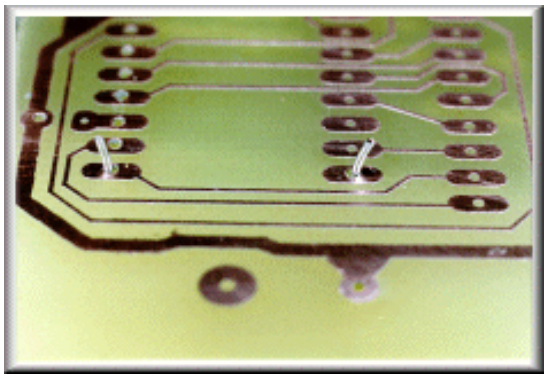
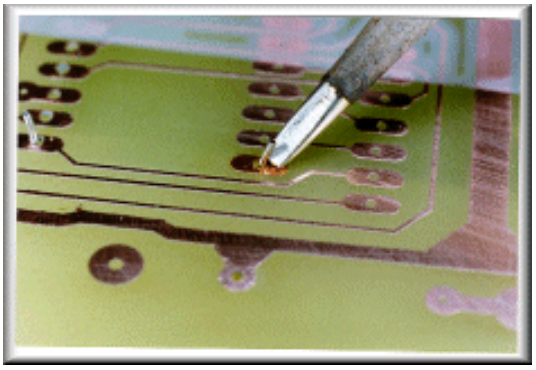

(Left) It's usually best to snip the electronic component wires to length prior to soldering. This helps prevent transmitting mechanical shocks to the copper foil.**(Right)** Apply a clean soldering iron tip to the copper solder pad and the component lead, in order to heat *both* items at the same time.

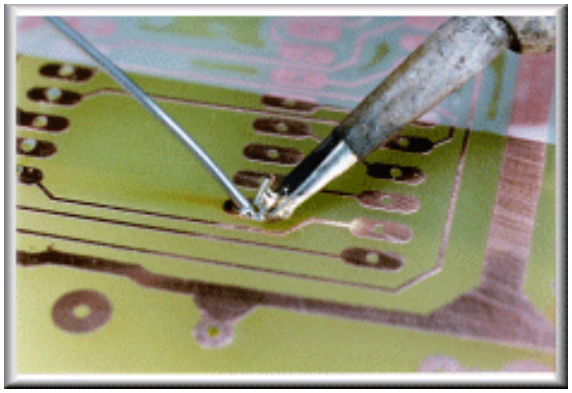
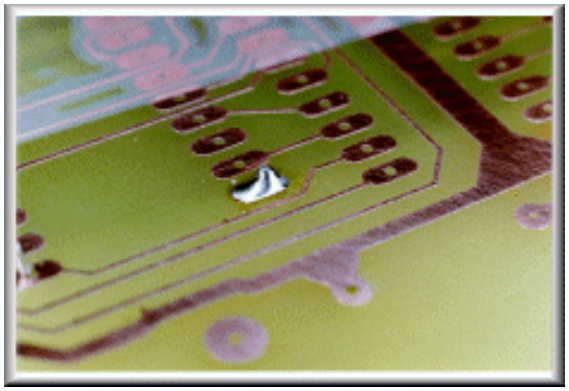

(Left) Continue heating and apply a few millimetres of solder. Remove the iron and allow the solder joint to cool naturally. **(Right)** It only takes a second or two, to make the perfect joint, which should be nice and shiny. Check the Guide for troubleshooting help.

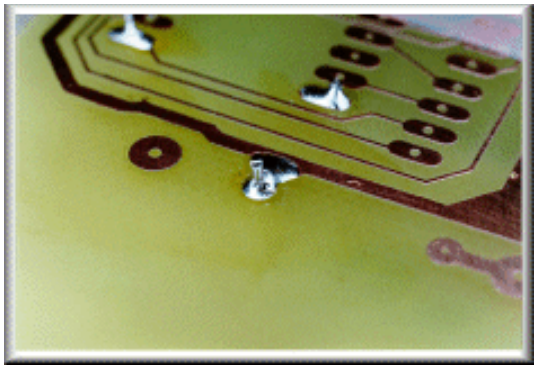

An example of a "dry" or "gray" soller joint - the solder failed to flow, and instead beaded to form globules around the wire.

How to solder

Turning to the actual techniques of soldering, firstly it's best to *secure the work* somehow so that it doesn't move during soldering and affect your accuracy. In the case of a printed circuit board, various holding frames are fairly popular especially with densely populated boards: the idea is to insert all the parts on one side ("stuffing the board"), hold them in place with a special foam pad to prevent them falling out, turn the board over and then snip off the wires with cutters before making the joints. The frame saves an awful lot of turning the board over and over, especially with large boards. Other parts could be held firm in a modeller's small vice, for example.

Solder joints may need to possess some degree of mechanical strength in some cases, especially with wires soldered to, say, potentiometer or switch tags, and this means that the wire should be looped through the tag and secured before solder is applied. The down side is that it is more difficult to *de-solder* the joint (see later) and remove the wire afterwards, if required. Otherwise, in the case of an ordinary circuit board, components' wires are bent to fit through the board, inserted flush against the board's surface, splayed outwards a little so that the part grips the board, and then soldered.

In my view - opinions vary - it's generally better to snip the surplus wires leads off *first*, to make the joint more accessible and avoid applying a mechanical shock to the p.c.b. joint. However, in the case of semiconductors, I often tend to leave the snipping until *after* the joint has been made, since the excess wire will help to sink away some of the heat from the semiconductor junction. Integrated circuits can either be soldered directly into place if you are confident enough, or better, use a dual-in-line socket to prevent heat damage. The chip can then be swapped out if needed.

Parts which become hot in operation (e.g. some resistors), are raised above the board slightly to allow air to circulate. Some components, especially large electrolytic capacitors, may require a mounting clip to be screwed down to the board first, otherwise the part may eventually break off due to vibration.

The perfectly soldered joint will be nice and shiny looking, and will prove reliable in service. I would say that:

- cleanliness
- temperature
- time
- adequate solder coverage

are the key factors affecting the quality of the joint. A little effort spent now in soldering the perfect joint may save you - or somebody else - a considerable amount of time in troubleshooting a defective joint in the future. The basic principles are as follows.

Really Clean

First, and without exception, all parts - including the iron tip itself - must be clean and free from contamination. Solder just will not "take" to dirty parts! Old components or copper board can be notoriously difficult to solder, because of the layer of oxidation which builds up on the surface of the leads. This repels the molten solder and this will soon be evident because the solder will "bead" into globules, going everywhere except where you need it. Dirt is the enemy of a good quality soldered joint!

Hence, it is an absolute necessity to ensure that parts are free from grease, oxidation and other contamination. In the case of old resistors or capacitors, for example, where the leads have started to oxidise, use a small hand-held file or perhaps scrape a knife blade or rub a fine emery cloth over them to reveal fresh metal underneath. Stripboard and copper printed circuit board will generally oxidise after a few months, especially if it has been fingerprinted, and the copper strips can be cleaned using an abrasive rubber block, like an aggressive eraser, to reveal fresh shiny copper underneath.

Also available is a fibre-glass filament brush, which is used propelling-pencil-like to remove any surface contamination. These tend to produce tiny particles which are highly irritating to skin, so avoid accidental contact with any debris. Afterwards, a wipe with a rag soaked in cleaning solvent will remove most grease marks and fingerprints. After preparing the surfaces, avoid touching the parts afterwards if at all possible.

Another side effect of having dirty surfaces is the tendency for people to want to apply *more heat* in an attempt to "force the solder to take". This will often do more harm than good because it may not be possible to burn off any contaminants anyway, and the component may be overheated. In the case of semiconductors, temperature is quite critical and they may be harmed by applying such excessive heat.

Before using the iron to make a joint, it should be "tinned" (coated with solder) by applying a few millimetres of solder, then wiped on a damp sponge preparing it for use: you should always do this immediately with a new bit, anyway. Personally, I always re-apply a very small amount of solder again, mainly to improve the thermal contact between the iron and the joint, so that the solder will flow more quickly and easily. It's sometimes better to tin larger parts as well before making the joint itself, but it isn't generally necessary with p.c.b. work. (All *EPE* printed circuit boards are "roller-tinned" to preserve their quality and to help with soldering.) A worthwhile product is Weller's *Tip Tinner & Cleaner*, a small 15 gram tinlet of paste onto which you dab a hot iron - the product cleans and tins the iron ready for use. An equivalent is Adcola *Tip-Save*.

Normal electronics grade solder is now "lead free" and typically contains Sn 97 Ag 2.5 Cu 0.5 (i.e. 97% tin, 2.5% silver and 0.5% copper). **It already contains cores of "flux"** which helps the molten solder to flow more easily over the joint. Flux removes oxides which arise during heating, and is seen as a brown fluid bubbling away on the joint. The use of separate acid flux paste (e.g. as used by plumbers) should NEVER be necessary in normal electronics applications because electronics-grade solder already contains the correct grade of flux! Other solders are available for specialist work, including

aluminium and silver-solder. Different solder diameters are produced, too; 20-22 SWG (19-21 AWG) is 0.91-0.71mm diameter and is fine for most work. Choose 18 SWG (16 AWG) for larger joints requiring more solder.

Temperature

Another step to successful soldering is to ensure that the **temperature** of *all* the parts is raised to roughly the same level before applying solder. Imagine, for instance, trying to solder a resistor into place on a printed circuit board: it's far better to heat *both* the copper p.c.b. *and* the resistor lead at the same time before applying solder, so that the solder will flow much more readily over the joint. Heating one part but not the other is far less satisfactory joint, so strive to ensure that the iron is in contact with *all* the components first, before touching the solder to it. The melting point of most solder is in the region of 188°C (370°F) and the iron tip temperature is typically 330-350°C (626°-662°F). The latest lead-free solders typically require a higher temperature.

Now is the time

Next, the joint should be heated with the bit for just the right amount of time - during which a short length of solder is applied to the joint. Do not use the iron to carry molten solder over to the joint! Excessive time will damage the component and perhaps the circuit board copper foil too! Heat the joint with the tip of the iron, then continue heating whilst applying solder, then remove the iron and allow the joint to cool. This should take only a few seconds, with experience. The heating period depends on the temperature of your iron and size of the joint - and larger parts need more heat than smaller ones - but some parts (semiconductor diodes, transistors and i.c.s), are sensitive to heat and should not be heated for more than a few seconds. Novices sometimes buy a small clip-on heat-shunt, which resembles a pair of aluminium tweezers. In the case of, say, a transistor, the shunt is attached to one of the leads near to the transistor's body. Any excess heat then diverts up the heat shunt instead of into the transistor junction, thereby saving the device from over-heating. Beginners find them reassuring until they've gained more experience.

Solder Coverage

The final key to a successful solder joint is to apply an appropriate amount of solder. Too much solder is an unnecessary waste and may cause short circuits with adjacent joints. Too little and it may not support the component properly, or may not fully form a working joint. How much to apply, only really comes with practice. A few millimetres only, is enough for an "average" p.c.b. joint, (if there is such a thing).

Here's a summary of how to make the perfect solder joint.

1. All parts must be clean and free from dirt and grease.
2. Try to secure the work firmly.
3. "Tin" the iron tip with a small amount of solder. Do this immediately, with new tips being used for the first time.
4. Clean the tip of the hot soldering iron on a damp sponge.
5. Many people then add a tiny amount of fresh solder to the cleansed tip.

6. Heat all parts of the joint with the iron for under a second or so.
7. Continue heating, then apply sufficient solder only, to form an adequate joint.
8. Remove and return the iron safely to its stand.
9. It only takes two or three seconds at most, to solder the average p.c.b. joint.
10. Do not move parts until the solder has cooled.

Troubleshooting Guide

- Solder won't "take" - grease or dirt present - desolder and clean up the parts. Or, material may not be suitable for soldering with lead/tin solder (eg aluminium).
- Joint is crystalline or grainy-looking - has been moved before being allowed to cool, or joint was not heated adequately - too small an iron/ too large a joint.
- Solder joint forms a "spike" - probably overheated, burning away the flux.

Desoldering methods

A soldered joint which is improperly made will be electrically "noisy", unreliable and is likely to get worse in time. It may even not have made any electrical connection at all, or could work initially and then cause the equipment to fail at a later date! It can be hard to judge the quality of a solder joint purely by appearances, because you cannot say how the joint actually formed on the *inside*, but by following the guidelines there is no reason why you should not obtain perfect results.

A joint which is poorly formed is often called a "dry joint". Usually it results from dirt or grease preventing the solder from melting onto the parts properly, and is often noticeable because of the tendency of the solder not to "spread" but to form beads or globules instead, perhaps partially. Alternatively, if it seems to take an inordinately long time for the solder to spread, this is another sign of possible dirt and that the joint may potentially be a dry one.

There will undoubtedly come a time when you need to *remove* the solder from a joint: possibly to replace a faulty component or fix a dry joint. The usual way is to use a ***desoldering pump*** or vacuum pump which works like a small spring-loaded bicycle pump, only in reverse! (More demanding users using CMOS devices might need a pump which is ESD safe.) A spring-loaded plunger is released at the push of a button and the molten solder is then drawn up into the pump. It may take one or two attempts to clean up a joint this way, but a small desoldering pump is an invaluable tool especially for p.c.b. work.

Sometimes, it's effective to actually *add more* solder and then desolder the whole lot with a pump, if the solder is particularly awkward to remove. Care is needed, though, to

ensure that the boards and parts are not damaged by excessive heat; the pumps themselves have a P.T.F.E. nozzle which is heat proof but may need replacing occasionally.

An excellent alternative to a pump is to use *desoldering braid*, including the famous American "Soder-Wick" (sic) or Adcola "TISA-Wick" which are packaged in small dispenser reels. This product is a specially treated fine copper braid which draws molten solder up into the braid where it solidifies. The best way is to use the tip of the hot iron to press a short length of braid down onto the joint to be de-soldered. The iron will subsequently melt the solder, which will be drawn up into the braid. Take extreme care to ensure that you don't allow the solder to cool with the braid adhering to the work, or you run the risk of damaging p.c.b. copper tracks when you attempt to pull the braid off the joint. See my photo gallery for more details.

I recommend buying a small reel of de-soldering braid, especially for larger or difficult joints which would take several attempts with a pump. It is surprisingly effective, especially on difficult joints where a desoldering pump may prove a struggle.

The Basic De-soldering Guide Photo Gallery (and Black Museum of Bad Soldering)

De-soldering is required when electronic components need to be removed from a circuit, usually because they are faulty. It may sometimes be necessary during testing or assembly, if a wrong part has been fitted or a modification has to be made. In the field, it's not uncommon for faulty electronic components to be swapped out, or poor joints (perhaps "dry" or gray joints) to need re-making properly, months or years after manufacture. Experienced engineers can often diagnose a particular faulty joint immediately, because they may have seen the same problem on similar electronic equipment before, especially if the equipment has a "reputation". A proper desoldering technique can soon be acquired with practice - all you need to do is buy some scrap boards to have a go with, and desolder to your heart's content!

The next photo sequence illustrates the basic steps for desoldering a printed circuit board, in order to remove a faulty part. Both the technique for using a desoldering suction pump as well as desolder braid are illustrated. Some real-life examples of poor soldering are shown too, in my *Black Museum of Bad Soldering*!

Remember - it costs just as much to get it right as it does to get it wrong! Practice makes perfect.

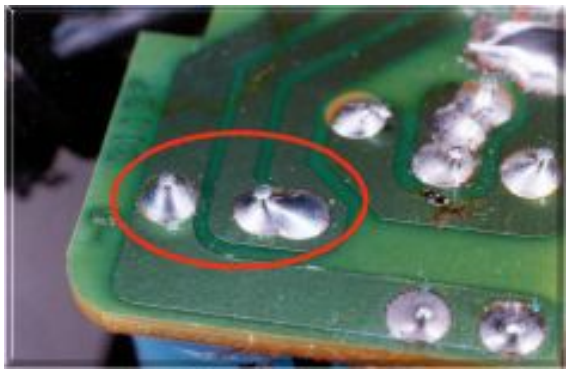

(Left) The two solder joints to be desoldered, to enable a faulty electrolytic capacitor to be removed from the printed circuit board.

(Right) If using a suction-type desoldering pump, apply the soldering iron tip first to melt the solder joint (say for 1-2 seconds). Ensure the spring-loaded desoldering pump is 'primed' and ready to go...

(Left) The PTFE nozzle of the desoldering pump is applied to the molten solder and the spring-loaded plunger is then immediately released, drawing the molten solder up into the pump. Remove the soldering iron tip. Repeat the process if needed. *Handy tip*: sometimes it helps to add some fresh solder and then desolder the whole joint.

(Right) The first p.c.b. joint, now desoldered. The second joint will be desoldered using traditional desoldering braid.

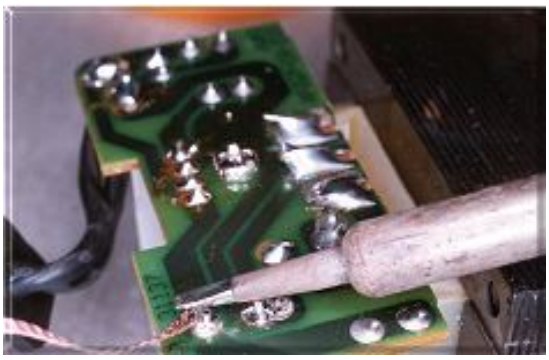

(Left) Select a suitable width of desoldering braid, and **press it down** onto the **COLD** joint using the hot tip of the iron. A flat soldering iron bit is preferable.

(Right) The molten solder is drawn up by capillary action into the desoldering braid. Take care not to overheat the board (the p.c.b. copper track may lift off), nor 'drag whiskers' of solder over the board, nor let the braid solidify onto the joint! Remove the braid while the joint is still molten.

(Left) The faulty electrolytic capacitor dropped out of the board after desoldering. Sometimes, it may need persuading with pliers.... but don't overdo this or you risk damaging the copper tracks on the p.c.b.

(Right) Close-up photograph of both joints, now desoldered and ready for the replacement component to be fitted.

The Black Museum of Bad Soldering

These are all genuine examples which have not been retouched or reworked in any way.

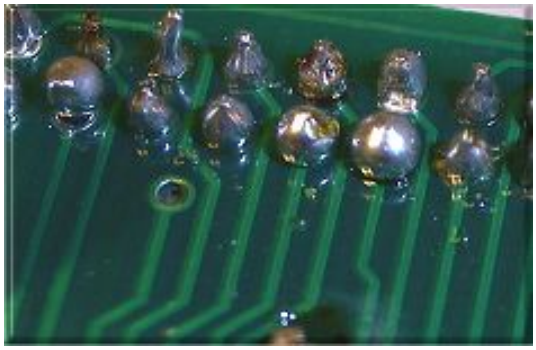

(Left) A tenfold excess of solder on this hand-soldered printed circuit board, and (extreme left) an incomplete solder joint with poor coverage. There is no need to add more solder "for luck".

(Right) An example of a dry (or gray) solder joint found inside a commercial PSU for a computer peripheral. The wire had been fed through the hole in the brass terminal, and merely tacked on with a blob of solder. This is a fire hazard (risk of arcing and overheating).

(Left) Hmmmm... this joint looks somewhat suspect as well... it's the earth (ground) wire in the same PSU

(Right) A close-up reveals the terrible standard of soldering (and quality control), with a fracture visible on this ground/ earth joint.

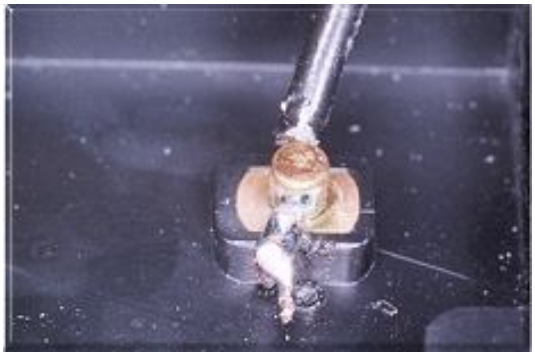

(Left) How **not** to make a mains voltage soldered joint. This solder joint went "dry" and starting arcing, nearly destroying the attached equipment. It is also a fire hazard.

(Right) The same mains connection, the wire merely being 'tacked on' with a blob of solder.

First Aid

If you are unlucky enough to receive burns which require treatment, here's what to do :-

1. Immediately cool the affected area with cold running water for several minutes.
2. Remove any rings etc. before swelling starts.
3. Apply a sterile dressing to protect against infection.
4. Do not apply lotions, ointments etc., nor prick any blisters which form later.
5. Seek professional medical advice where necessary.

A Few Hints about soldering on a Ground Plane

Before starting

- Always remove any grease and water from your hands. This will reduce the extent to which you oxidise and contaminate the board.
- Avoid touching the copper surface with your hands, always hold a board by its edges.
- Ensure all power and signal inputs are turned off (the soldering iron will short anything you touch to ground!!!)

Soldering a component

- Consider the circuit pathway from input to output in order to minimise the distance. This is especially important between ICs.
- Use the cleaning rubbers or solutions to clean away the oxidised surface where you are going to mount the component. This will help improve the electrical characteristic and improve solder flow
- Where you intend to place solder, VERY LIGHTLY scratch a cross-hatch pattern on the copper plate with a sharp tool. This will increase the friction thereby preventing your soldering iron skating across the board surface
- Apply heat to the copper surface first then add the solder so it smoothly flows on to the copper.
- Use pliers to bend the wire/chip legs to form small feet as this will increase the stability and make them much easier to solder. All wire bends should be done with pliers!
- Tin the legs before trying to mount them on the board
- When using wire, devise a colour coding system and stick to it i.e. red +ve rail, black GND rail, yellow –ve rail, blue input etc. This will make debugging so much easier
- If you are soldering an IC, two good techniques are:
    - Bend its legs with pliers so they are all horizontal and the chip can sit flat on the GND plane surface. Then place a bend just after where the pin leg narrows and bend again slightly further down so the leg it touching the ground plane (see image below). This way the IC is firmly held in place.

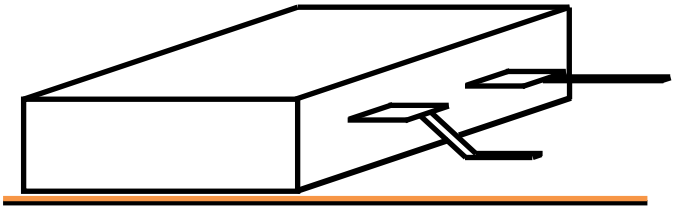

    - Bend legs touching the copper plane at the end to make small feet, then bend all other legs so that they are horizontal. This will result in the chip hovering just off the GND plane reducing the stability, but increasing the space to connect further components.
- Keep component leads as short as possible. This will reduce parasitics, improve mechanical robustness and reduce the chance of accidental shorts

These rules should be followed in conjunction with Dr Clarke's Soldering Guidelines found on the EE2 lab website.

Here is a good copper board layout. Notice the neat leads with none left loose above the circuit, and the way that the layout looks like a schematic. See the web copy (on the AMP handout page) of this picture for more detail.

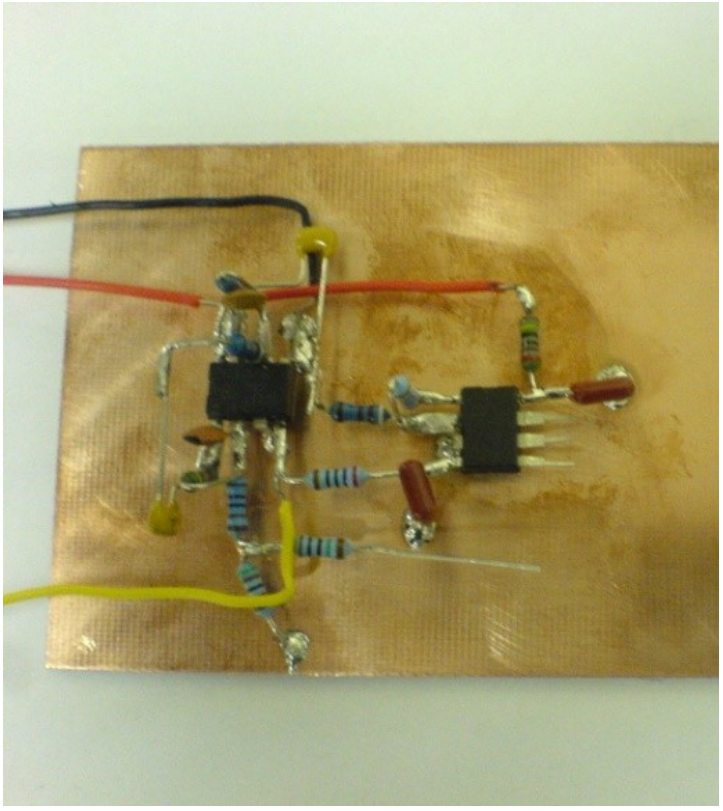

Soldering and Desoldering Instruction

Soldering is defined as "the joining of metals by a fusion of alloys which have relatively low melting points". In other words, you use a metal that has a low melting point to adhere the surfaces to be soldered together. Soldering is more like gluing with molten metal than anything else. Soldering is also a must have skill for all sorts of electrical and electronics work. It is also a skill that must be taught correctly and developed with practice.

Remember that when soldering, the rosin in the solder releases fumes. These fumes are harmful to your eyes and lungs. Therefore, always work in a well-ventilated area. Hot solder is also dangerous. Be sure not to let is splash around because it will burn you almost instantly. Eye protection is also advised.

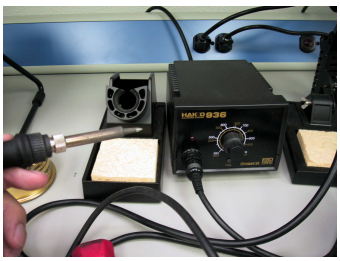

The Tools

Soldering Iron – Even the cheapest of them will do the job. They may not last as long, but they do get hot enough to melt solder and that is the goal. You only need to make sure that the one you buy has a suitable tip on it. The most typical tip is the one that is about the size of a 1/8" stereo mini-plug.

Solder – Get Rosin Core solder. Rosin will help the solder to flow onto the wires. Solder comes in different thickness. Buy what is appropriate for your job.

Desoldering Gun – This tool will make life a lot easier when you need to rework a previous solder job.
Solder Wick – Braided copper with rosin coating used to draw solder off of circuit boards.

SMD Rework station— Basically this is a high temp hair dryer with special nozzle attached. It heats up entire pins of the SMD device so you can remove them.

The Methods

Soldering – There is not art to soldering, it takes patience and practice to get it right. If you are doing it right, it will be easy and very fast. First, make sure that your soldering iron tip is clean. If it is dirtier than just a light gray color, you need to clean it. You can do this with sandpaper or a Scotch Brite pad. Next, turn your iron on and give it plenty of time to heat up. To test the heat, use a piece of solder touched to the tip. If it melts immediately, it is ready.

The most common way to mess up a solder job is to let the soldering iron stay on the parts to be soldered too long. What this does is oxidize the metal, making it too dirty to attract solder. If you are working with a circuit board, too much heat can damage the board, rendering it useless and in need of repair. You should only hold the soldering iron to the parts to be joined for no more than 10-12 seconds. Any longer and you will melt insulation on wire or damage a circuit board.

It has been said that soldering is a two-person job. You need two hands to hold the parts together, one hand to hold the iron, and another to feed the solder. The correct method for applying solder is to hold the joint perfectly still while heating with the soldering iron. After a few seconds, introduce the end of the solder at the point where the iron meets the parts

If the solder does not melt immediately and flow onto the joint, pull the solder away and try again after a couple seconds longer. If you exceed 10 seconds, pull the iron off and try again after it all cools down. You probably didn't have the iron touching enough of the parts to be soldered. Sometimes, the parts to be soldered are so big that they conduct the heat away very quickly and make it difficult to solder. In this case, it is OK to put some solder on each part individually and then put them together later by melting the solder on each one while they are touching.

Joining Two Wires - Strip off about 3/8" of insulation from the two wire ends to be joined. Place a ½" length of heat shrink tubing over one wire and push it back so that the heat from soldering won't shrink it prematurely. Fold each bare wire end back on itself so that the tip of the wire now comes back to the end of the insulation. Link both wires together using the bends like hooks. Now, twist the ends of the wires around themselves tightly. This type of connection is called a Western Union and it is the strongest method of joining two wires together. Now, heat the connection with the iron and allow solder to flow over the entire joint. Wait a few seconds for it to cool off and then slide the heat shrink tubing down over the connection and heat it with a match or heat gun.

Soldering a Wire to a Circuit Board – This is delicate work that you will do while soldering. Too much heat and your board will be damaged. If you are attaching a wire to an existing hole on the board, make sure that the hole is clean and free of any excess solder (see de-soldering for more detail). The best advice when soldering to a circuit board is to angle your soldering iron tip so that it makes good contact with the pad on the circuit board and the wire or part to be soldered at the same time. Heat the parts up and touch the solder at the point where the tip meets the part and the pad. If the solder does not flow immediately, pull everything off and wait for it to cool down and try again later.

Step 1

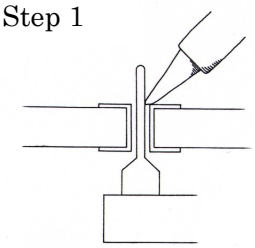

Apply heat to both pin and pad on the circuit board. Make sure tip of the soldering iron is touching both pin and pad.

Step 2

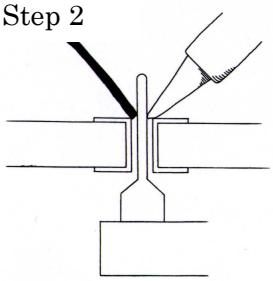

When the both pin and pad are heated enough, apply solder to the pin and pad. Solder should starts to flow.

Step 3

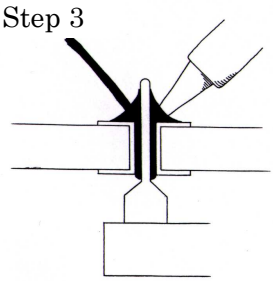

Apply enough but not too much solder. While applying the solder, do not move the tip of iron.

Step 4

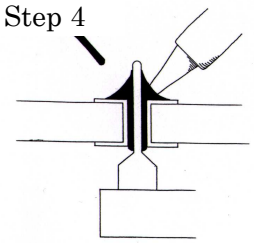

Remove solder away.

Step 5

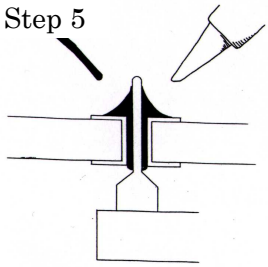

Remove tip of soldering iron also.

Step 6

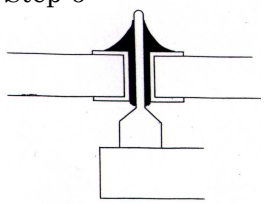

Done! Check the joint to make sure the connection.

Good soldering and Bad soldering Joints

Here are some example of Good soldering and Bad soldering joint.
For Japanese, we often say, “Good soldering joint should look like Mt. Fuji.”

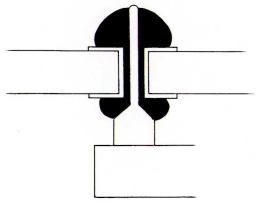

Too much soldering

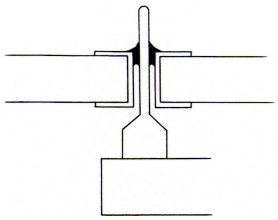

Too little soldering

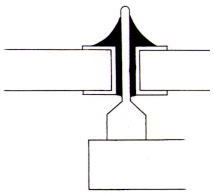

Good soldering

Cold Solder Joints

A cold joint is a joint in which the solder does not make good contact with the component lead or printed circuit board pad. Cold joints occur when the component lead or solder pad moves before the solder is completely cooled. Cold joints make a really bad electrical connection and can prevent your circuit from working.

Cold joints can be recognized by a characteristic grainy, dull gray color, and can be easily fixed. This is done by first removing the old solder with a desoldering tool or simply by heating it up and flicking it off with the iron. Once the old solder is off, you can re-solder the joint, making sure to keep it still as it cools.

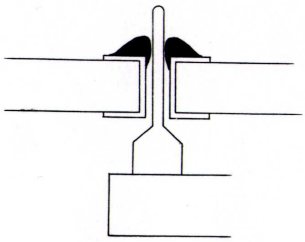

Cold soldering joints

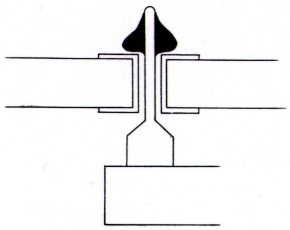

Tips and Tricks

Soldering is something that needs to be practiced. These tips should help you become successful so you can stop practicing and get down to some serious building.

1. Use heat sinks. Heat sinks are a must for the leads of sensitive components such as ICs and transistors. If you don't have a clip on heat sink, then a pair of pliers is a good substitute.

2. Keep the iron tip clean. A clean iron tip means better heat conduction and a better joint. Use a wet sponge to clean the tip between joints.

3. Double-check joints. It is a good idea to check all solder joints with an ohmmeter after they are cooled. If the joint measures any more than a few tenths of an ohm, then it may be a good idea to re-solder it.

4. Use the proper iron or temperature. Remember that bigger joints will take longer to heat up with an 30W iron than with a 150W iron. While 30W is good for printed circuit boards and the like, higher wattages are great when soldering to a heavy metal chassis.

Desoldering

Desoldering is extremely difficult compare to soldering. In the process of RomBoard installation, the parts and circuit board must be in the good shape to re-use them. The tool we use is Desoldering Gun. This device has vacuum pump built in with heater tip. Process of desoldering it self is very simple, but there are some tricks to do clean and safe desoldering job.

Step 1

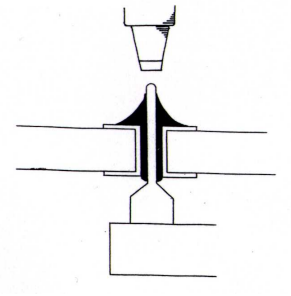

Put the desoldering gun's tip over to the soldering joint. Make sure nozzle is 90° angle from circuit board.

Step 2

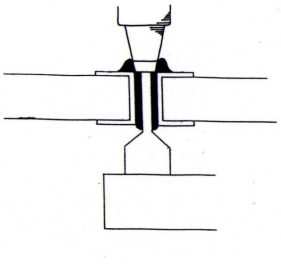

Apply the enough heat to melt entire solder. Multi-layer board or ground pin may take while to transfer heat.

Step 3

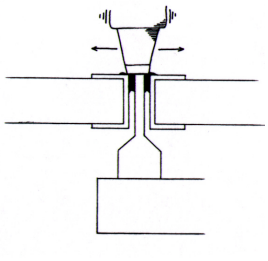

While applying vacuum, move the tip around the pin to get all the solder of around the pin out. At this time, you can also feel pin moves freely, so you know pin is free from circuit board.

Step 4

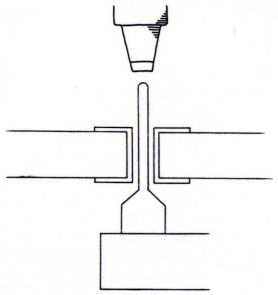

When you can hear air flow sound from hole, you should be done. Stop applying vacuum and remove the gun from the pin. Inspect hole and pin.

When you done with desoldering, the parts that you are trying to remove should move freely. If it doesn't, find which pin is still has solder left, and re-apply fresh solder to it and try desoldering process again. The multi-layer circuit board require more heat to get solder to melt. Make sure pin start to move freely by moving the tip of soldering gun before you apply vacuum to it.

SMD device soldering and removal

In the process of RomBoard installation, chance of handling SMD devices is becoming higher and higher due to ECU configuration change.
Soldering of SMD devices are not much different from regular through hole soldering.
Important thing is positioning of the device is very critical.
Start with applying little solder to two of the each corner of the pads on the circuit board.
Then, place the SMD device and re-heat a one of the solder you just applied to connect a SMD device pin to the pad. Check the position of the device, if position is right re-heat the other end of solder to secure the device completely. If you didn't get position right, re-heat the pin that you just soldered and while heating a pin, move the device to the right position.
Once you positioned the device in the right position, apply Rosin Flux to both pins and pads. This will help your soldering job by keeping solder separate from each pin.
Here is how the joint on SMD device pin should look like.

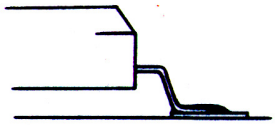

QFP and SOP chip

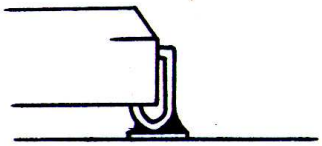

PLCC chip

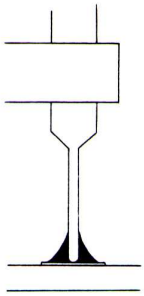

RomBoard adapter socket

Removing SMD device will be the probably the most difficult process. SMD rework station is used to do this. Make sure all the pins are completely heated otherwise you will be removing a pad from the circuit board along with device. Also, you should note, when you are applying heat to the device, some parts around the device is also heated and moves around when you touch. It is good idea to take a note of location of the devices near the target device.

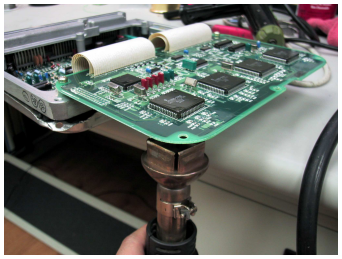

Step 1
Apply pre-heat from back side of the target device. Keep applying heat until you can't touch the chip. By this time, circuit board should have enough heat.

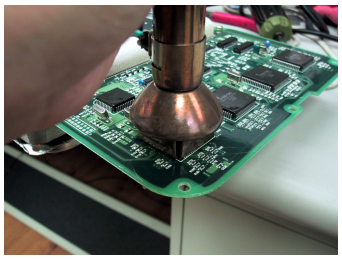

Step 2
Apply heat from top of the target device. Nozzle should cover entire chip. You can check if chip is free from solder by sliding the nozzle left and right. Make sure you don't move other parts. If the chip moves freely, it is ready to be removed.

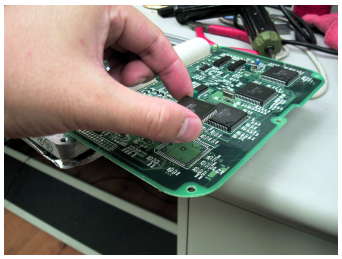

Step 3
Remove the chip straight up to avoid making solder bridge between pins. Chip is extremely hot! Unless you have skin of steel, avoid imitating the picture.

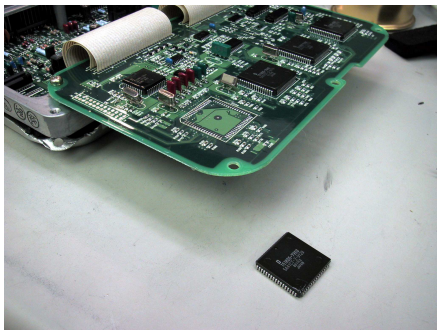

Step 4
After remove the chip, cool down both circuit board and chip.

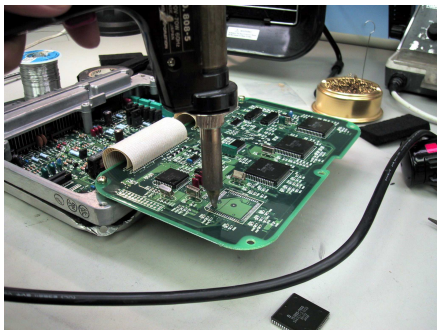

Step 5
Clean the pads on the circuit board with desoldering gun.
Do not apply too much heat to the pad. Pad might peel off from circuit board. Clean the chip by desoldering gun also.
Check for any bridge between pins. If the chip has too much protective coating on it, use solvent to clean it up.

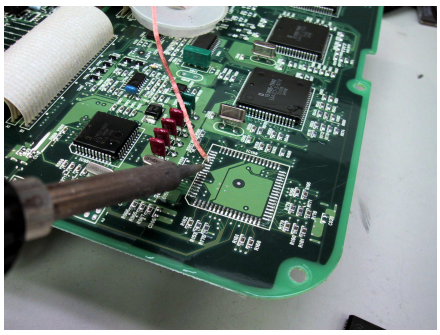

Step 6
If the pads on the circuit board is too small to use desolding gun, try cleaning by solder wick with rosin flux. This may take time but it is much better than peeling pads off.
Once again, do not apply too much heat.

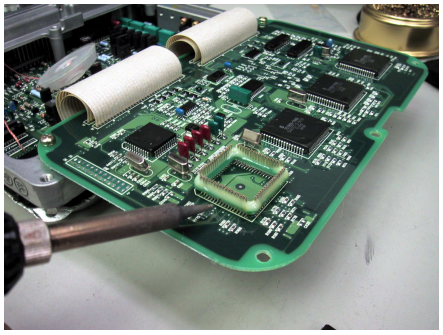

Step 7
Solder the RomBoard adapter where the chip was.
Refer SMD device soldering section for how to solder adapter.

The Final Word

Soldering, desoldering, and working with SMD device will take some effort to learn. You should be relaxed and concentrated when you work.
Keeping every thing clean (tip of iron, gun, work surface, etc) will help you also.
Once you get comfortable to work with soldering you may find your own tips and tricks.
Experience is all bout soldering.

EOF

Strain Gages and Instruments | Tech Tip TT-609

Strain Gage Soldering Techniques

Introduction

The most common method of making electrical connections in strain gage circuits is by means of soft solders, in wire form. Other methods, such as spot welding, brazing, compression bonding, paste solders, and conductive epoxies, are also available, but find only limited application. Solders have many advantages for strain gage use — they are low in cost, readily available in various alloy compositions to provide a range of melting temperatures, and are easily obtained in the form of either solid wire or wire with a core of flux. They are convenient to use, and offer an excellent combination of electrical and mechanical properties.

Although soldering is basically a simple procedure, it must be done with appropriate tools, supplies, and techniques to assure accurate strain measurement. This is particularly true when test requirements are severe in the sense of approaching the limits of the strain gage circuit capabilities; e.g., long-term stability, high-elongation measurements, fatigue endurance, etc. Use of improper materials or techniques can significantly degrade strain gage performance.

The purpose of this Tech Tip is to outline recommended procedures and materials for attaching leadwires to strain gage solder tabs or to bonded printed-circuit terminals. These reliable, experience-proven methods are based on the use of a professional quality soldering station, in conjunction with Micro-Measurements solders and installation accessories.

Soldering Station and Pencil

For precision soldering of strain gages, it is always necessary to use a temperature- or power-controlled soldering station that provides low voltage and adjustable temperature to the soldering iron tip. An unregulated soldering iron, connected directly to the power line, is not ordinarily suitable for strain gage use because the tip temperature is apt to be far too high. This tends to oxidize the tip, and to instantly vaporize the flux, making soldering much more difficult. In addition, the unnecessarily high temperature may damage the strain gage, the bonding adhesive, or even the test specimen. For these reasons, the soldering station should incorporate provision for adjusting the soldering temperature to suit varying installation conditions and requirements. The temperature must be adjusted, of course, to accommodate the melting points of the different solders commonly used for strain gage connections, but also to allow for environmental conditions such as drafts or outdoor soldering in cold weather. Moreover, the temperature controller should be carefully designed to ensure that it does not generate electrical noise that could adversely affect nearby measuring instruments when both are in use.

Design of the soldering pencil also requires special consideration. It should be light in weight, with a very flexible power cord, and with the gripping area thermally insulated from the heating element. These characteristics contribute to the comfort, ease, and precision of soldering, and minimize operator fatigue during long periods of use. The soldering tip itself should be of the flat, chisel, or screwdriver type. Pointed tips should not be used, because they tend to draw solder away from the work area, and thus make it more difficult to achieve a proper joint. In contrast, flat tips act to confine the solder, while offering greater surface area for better heat transfer and more effective soldering, generally.

Micro-Measurements soldering units incorporate all of the above features and a number of others, designed to help the user easily make consistent, reliable solder joints. These soldering units are widely used by professional strain gage installers everywhere, in both stress analysis laboratories and in transducer manufacture.

Solder Selection

The Micro-Measurements Division stocks a broad range of solder types to meet various installation and test requirements. While solders are sometimes selected to provide specific electrical or mechanical properties, the most common basis for selection is simply the melting-temperature range. Low-melting-point solders, for example, are generally used for strain gage installations on nonmetallic test parts to avoid damaging the gage, bonding adhesive, or test material due to overheating. In contrast, high-temperature solders are normally selected only when necessary to satisfy elevated-temperature testing requirements. These solders are somewhat more difficult to handle because the higher working temperature

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rapidly vaporizes the flux, and oxidizes the soldering tip, both of which tend to impede the soldering process. Specially designed soldering tips are recommended for high-temperature use.

For routine applications, where test conditions do not dictate the use of either a low- or high-temperature solder, an alloy with an intermediate melting temperature is the normal selection. The 63/37 tin-lead alloy (Type 361A-20R) is an excellent choice for general-purpose strain gage soldering. As an eutectic alloy, it has a sharply defined melting temperature — a characteristic that largely eliminates "cold" solder joints. The addition of a trace of antimony provides superior performance when the soldered connections will be exposed to very low (cryogenic) temperatures for long periods of time.

The general-purpose solders are supplied with a core of activated rosin flux. This makes soldering much more convenient, and is particularly useful in field applications where accessory liquid rosin flux (M-Flux AR) may not be available. Solid-wire solder, with externally applied acid flux (M-Flux SS), is recommended for making soldered connections to Micro-Measurements K- and D-alloy (modified Karma and isoelastic) strain gages. Rosin-core solders should not be used in conjunction with acid flux.

Silver solder (Type 1240-FPA) is available for applications where leadwire connections will be exposed to temperatures above about +550°F (*+290°C*). This solder, in paste form, is not suitable for attaching wires directly to strain gage solder tabs or to bondable terminals, but is intended for connecting instrument leads to preattached strain gage leads, as with WK-Series gages using a special resistance soldering unit. Techniques for making leadwire connections with silver solder are described in Micro-Measurements Tech Tip TT-602, *Silver Soldering Technique for Attachment of Leads to Strain Gages*.

Soldering Flux

The function of a soldering flux is to remove oxidation from the members being joined (solder tabs, terminals, leadwires), and to prevent further oxidation during soldering. For making leadwire splices, or soldering directly to constantan foil or copper terminals, the flux contained in a rosin-core solder is usually sufficient. With higher temperature solders, however, it may be necessary to supply additional flux. A liquid activated-rosin flux such as M-Flux AR is recommended for this purpose.

Acid fluxes should never be used on constantan strain gages or copper terminals, or for splicing copper leadwires; and paste fluxes, containing chlorides, should not be used under any circumstances for strain gage soldering. When tinning bare (without soldering options) solder tabs of Micro-Measurements K- and D-alloy strain gages, a liquid acid flux (M-Flux SS) is recommended. After the tinning operation, the residual flux must be completely neutralized within one to two minutes; and then the leadwire joint can be completed using the same solder and M-Flux AR rosin flux or a rosin-cored solder.

Preparation of the Soldering Tip

New soldering tips should always be tinned with solder prior to initial use. This is easily accomplished by wrapping one to two in (*25 to 50 mm*) of solder wire around the working portion of the tip while the soldering iron is cold, before applying power to the soldering station. If rosin-core solder is used, no external flux is required. With solid-wire solder, however, the wrapped tip should be dipped into liquid rosin flux (M-Flux AR) to provide sufficient flux for initial tinning. Set the control on the soldering station to the appropriate temperature range for the solder, and apply power to the unit. Allow the soldering pencil to heat until the solder wrapped around the tip melts completely. Remove excess melted solder from the tip with a dry gauze sponge. Never knock the heated soldering pencil against any object to remove excess solder, since this may result in personal injury or damage to the soldering pencil.

Note: Cross-alloying of solders can change the electrical, chemical, thermal and mechanical properties of the solder being used. To prevent cross-alloying, it is recommended that only one type of solder be used with each soldering tip. Of course, if one type of solder is incorporated in a gage with solder dots and another type is added, a mixture is produced. This mixture cannot be expected to have melting and strength properties any better than those of the lower temperature component.

Oxidation of the soldering tip seriously hinders the soldering operation. The tendency for oxidation can be minimized by ensuring that excess melted solder remains on the tip at all times when it is not actually in use. Negligent maintenance practices, or wiping the hot tip with materials that char on the surface, will produce a buildup of oxide that prevents proper soldering. If the tip does become oxidized, the following procedure is effective for cleaning and re-tinning:

1. Set the soldering station to the appropriate temperature range for the solder in use.
2. Place several drops of M-Flux SS on a glass plate. Re-tin the soldering surface by holding the heated tip in the SS flux while feeding solder onto the tip. A generous amount of solder is essential for proper tinning.

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3. Wipe the excess solder from the tinned tip with a dry gauze sponge. For severely oxidized tips, it may be necessary to repeat this operation several times to obtain a properly tinned surface. The soldering tip should never be filed or sanded, since this may remove the plating on the tip, accelerating the oxidation and leading to the early deterioration of the tip. After the cleaning operation, remove excess solder, re-tin and clean the tip several times, using rosin-core solder, or solid-wire solder withM-Flux AR.

Tinning Solder Tabs and Bondable Terminals

All strain gage solder tabs, terminals, and leadwires must be properly tinned before making soldered connections. This helps ensure active surface wetting and good heat transfer during the soldering operation. Tinning stranded leadwires to produce a formable solid conductor will also greatly simplify the leadwire attachment procedure.

Before tinning the solder tabs on open-face (unencapsulated) strain gages, the measuring grid should be protected with PDT drafting tape. The drafting tape is positioned to cover the entire grid and the upper portion of the solder tabs, as shown in Figure 1. This not only shields the grid from soldering flux and inadvertent solder splash, but also restricts the flow of solder on the tabs. The tinned area on the solder tabs should be only large enough to easily accommodate the leadwire size in use. The latter consideration is particularly important when making installations for dynamic applications or large-strain measurement.

The tinning procedure for strain gage tabs and terminals consists of first cleaning and reapplying a small amount of solder to the hot soldering iron tip. Next, apply a drop of M-Flux AR to the tab or terminal (this step can be omitted if a rosin-core solder is used). When soldering directly to bare Karma or isoelastic foil, use M-Flux SS on the gage tabs only. Hold the soldering pencil in a nearly horizontal position (<30°), with the flat surface of the tip parallel to the solder tab or terminal. Place the solder wire flat on the gage tab, and press firmly with the tinned hot soldering tip for about one to two seconds, while adding approximately 1/8 in (*3 mm*) of fresh solder at the edge of the tip. This procedure assures that there is sufficient solder and flux for effective tinning. Simultaneously lift both the soldering pencil and solder wire from the tab area.

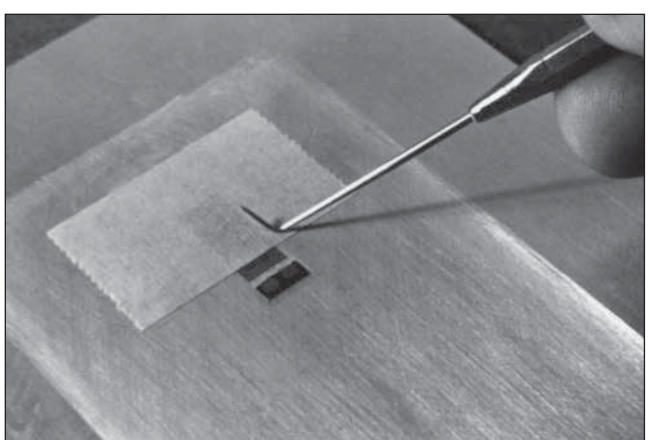

Figure 1 – Gage grid and upper portion of solder tabs masked with drafting tape.

NOTE: Lifting the soldering iron before lifting the solder may result in the end of the solder wire becoming attached to the tab; lifting them in the reverse order can leave a jagged (spike) solder deposit on the tab. When the operation is performed properly, it will produce a small, smoothly tinned area on the tab or terminal.

If M-Flux AR or a rosin-core solder is used in the tinning, it is not necessary to remove the residual soldering flux at this time. However, when M-Flux SS is employed to tin the bare solder tabs of K- or D-alloy gages, the acidic flux residue must be removed immediately following the tinning operation. To remove the residue, apply M-Prep Conditioner A liberally, and wash the area with a soft brush; then blot dry with a clean gauze sponge. Next, wash again with freely applied M-Prep Neutralizer 5A, and blot dry with a clean gauze sponge.

NOTE: Special procedures for tinning and wiring strain gages supplied with preattached solder dots are described in Micro-Measurements Tech Tip TT-606, *Soldering Techniques for Lead Attachment to Strain Gages with Solder Dots*.

Tinning and Attaching Leadwires

Of course, leadwire ends must be stripped of insulation before tinning, and this should be done with a thermal wire stripper to avoid the damage to the wire that often occurs when mechanical wire strippers are used. After the wires are stripped, the ends of stranded conductors should be twisted tightly together before tinning. The bare leadwire ends can then be tinned easily with the following procedure:

1. Remove excess solder from the soldering tip, using a dry gauze sponge. Then melt fresh solder on the hot tip to form a hemisphere of molten solder about twice the diameter of the wire to be tinned.

2. If rosin-core solder is used, slowly draw the bare wire through the molten solder while continuously adding fresh solder to the interface of the wire and soldering tip. With solid-wire solder, apply M-Flux AR to the

Strain Gage Soldering Techniques

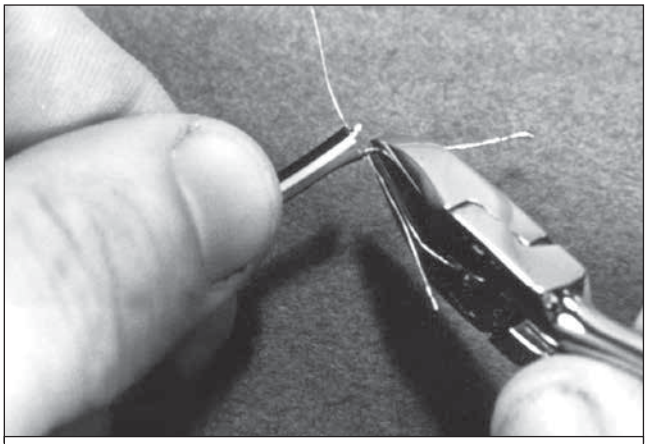

Figure 2 – Trimming leadwire ends before taping in place.

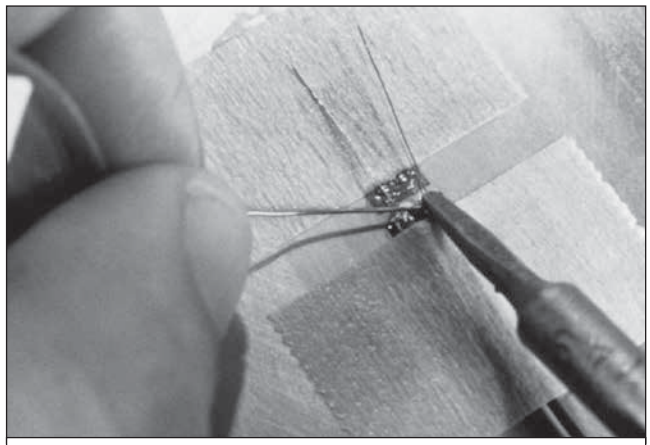

Figure 3 – Leadwire end taped to surface in preparation for soldering.

wire end before starting to tin, and proceed in the same manner. This will produce a smooth, shiny coating of solder over the bare wire.

For applications employing bondable terminal strips and stranded instrumentation wire, it may be convenient to use a single strand of the wire as a jumper between the terminal and the strain gage solder tab. In such cases, the single wire strand should be separated out before twisting and tinning the remaining strands (see Micro-Measurements Tech Tip TT-603, *The Proper Use of Bondable Terminals in Strain Gage Applications*).

Leadwires should be formed and routed to the strain gage or terminal strip, then firmly anchored to the test-part surface with drafting tape before making the soldered connection. Attempting to route the leadwires after completing the solder joint will often result in damage to the gage or terminals. Routing into the connection area should be along a minimum strain direction (such as the "Poisson" direction in a uniaxial stress field) particularly for high elongation or dynamic tests. The tinned leadwire end should be trimmed short enough so that it will not protrude through the connection area, and cannot inadvertently make electrical contact with the test-part surface or adjacent solder connections. Figure 2 illustrates this stage in the procedure. In the final preparatory step, bend the leadwire end slightly to form a spring-like loop, and tape the wire firmly in place over the connection area, using PDT drafting tape. The tape should be within about 1/8 in (*3 mm*) of the connection area, as shown in Figure 3.

Clean and re-tin the soldering iron tip with fresh solder. The temperature of the iron should be adjusted so that the solder is easily melted, without rapidly vaporizing the flux. If the iron temperature is either too low or too high, it may cause poor solder connections, or it may damage the strain gage, terminal, or bonding adhesive. Apply a small amount of M-Flux AR to the joint area and, holding the soldering pencil nearly horizontal, firmly press the flat surface of the tip on the junction for about one second; then lift the tip from the soldered joint. If needed, additional flux can be provided during the joining operation by feeding a little fresh solder into the joint from a spool of rosin-core solder. This procedure should result in a smooth, hemispherical solder joint, without any peaks or jagged areas. If the solder joints are not smooth and uniform in size, repeat the soldering procedure, using additional flux and/or solder as necessary.

Cleanup and Inspection of Soldered Joints

After completing the soldering operation, it is imperative that all traces of residual flux be completely removed with RSK Rosin Solvent. The same solvent is used to soften the mastic of the drafting tape, permitting its easy removal. Do not try to pull away the tape with tweezers or other tools, because this may result in damage to the soldered connections or the strain gage grid. Thoroughly clean the entire installation area with generously applied rosin solvent and a soft-bristled brush. Clean the solder connection area until no visible signs of residual flux remain, and blot the area dry with a clean gauze sponge. Any traces of residual flux can cause gage instability and drift, and will inhibit bonding of the installation's protective coating. Incompletely removed soldering flux is the most common cause of degraded performance in strain gage installations. Residual flux mixed with a protective coating application can completely destroy the coating objective.

Visually inspect the soldered joints for any gritty or jagged joint surfaces, and for traces of flux. Solder connections

Strain Gage Soldering Techniques

should be smooth, shiny, and uniform in appearance. Any soldered joints that look questionable should be re-soldered, and flux removed. Check the resistance-to-ground of the completed gage installation, using the Model 1300 Gage Installation Tester. Low or marginal resistance readings suggest a leakage path between the soldered connections and the test-part surface. This condition usually results from residual soldering flux, or from bare leadwire conductors partially shorting the gage tabs or terminals to the test part. Soldered joints should not be tested by pulling on the leadwire, or by probing at the joint area. These practices frequently cause lifting or tearing of the solder tab from the gage backing material.

Summary

The ability to make consistently good soldered joints is essential for precision strain gage measurements. The techniques described here are straightforward and easily mastered, but they are most effective when used with professional soldering equipment which is specially designed for making soldered connections in strain gage circuits. The soldering pencil should be lightweight, with a flat chisel or screwdriver tip, and it should be connected to the soldering station with a very flexible power cord. Requirements for the soldering station include low-voltage operation of the soldering pencil, and provision for temperature adjustment to suit the type of solder and the application conditions. The equipment should not generate electrical interference that could affect sensitive measuring instrumentation. Solder selection is based primarily on the expected operating temperature range of the strain gage installation; and all solder tabs, bondable terminals, and leadwire ends should be tinned before soldering the joints. Soldered joints should always be smooth and shiny, with no jagged or irregular edges, and all traces of residual flux must be thoroughly removed prior to the application of protective coating. Use of the recommended materials and techniques, with careful attention to detail, will result in consistently proper and reliable soldered connections.

Soldering & De-soldering

Digital Electronics

Soldering & De-soldering

This presentation will…

- Review the tools needed to solder and de-solder electronic components.
- Demonstrate how to *tin* a soldering iron tip.
- Demonstrate the soldering process.
- Show the characteristics of a good solder connection.
- Review classic soldering mistakes.
- Demonstrate the de-soldering process.

2

Soldering Tools

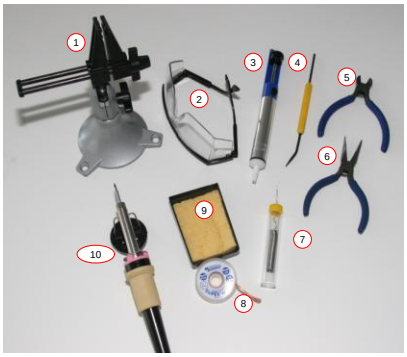

1) Vise
2) Safety glasses
3) Solder sucker
4) Solder tool
5) Diagonal cutters
6) Needle nose pliers
7) Solder
8) Solder wick
9) Damp sponge
10) Soldering iron

3

Soldering Iron

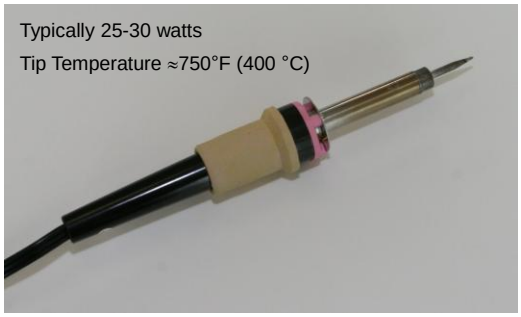

4

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Solder

- Solder is an alloy of tin and lead.
- The solder used for electronics is frequently called 60/40 solder because it is made of 63% tin and 37% lead.
- 60/40 solder melts at 361° F.
- Lead-free solder**:** As of July 1st, 2006, European laws mandated that new electronics be entirely lead-free. As of yet, no such laws exist in the United States.

5

Soldering Iron Care & Maintenance

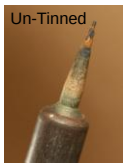

- A soldering iron must be coated with a thin coat of solder. This will allow for the transfer of heat to the work piece.
- This procedure is called tinning.
- The tip must be kept coated with a shiny layer of solder by occasional wiping and applying solder directly to the tip.

6

Tinning Process

Apply Solder to Soldering Iron Tip

Roll Tip on Damp Sponge

Properly Tinned Soldering Iron Tip

7

Solder Process

Heat both items at the same time by applying the soldering iron to the copper pad and the component lead.

Continue heating and apply a few millimeters of solder. Remove the iron and allow the solder joint to cool naturally.

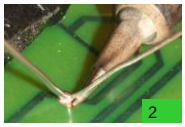

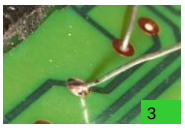

It only takes a second or two to make the perfect joint, which should appear shiny.

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A Good Solder Joint

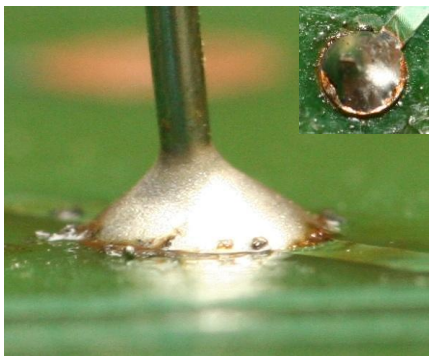

- Smooth
- Bright
- Shiny
- Clean
- Concave fillet

9

Bad Solder Connections

Too Much Solder

Too Little Solder

10

Bad Solder Connections

Cold Solder Joint

Not Soldered

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Bad Solder Connections

Solder Bridge

Lifted Trace/Pad

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De-Solder Process: *Solder Sucker*

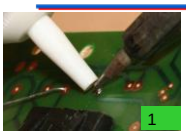

Apply heat to the connection to be de-soldered. When the solder melts, trigger the solder sucker.

Repeat de-soldering as needed until all solder is removed. Remove soldering iron & solder sucker from area.

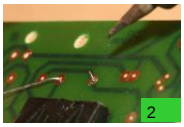

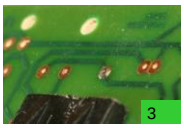

Remove component lead.

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De-Solder Process: *Solder Wick*

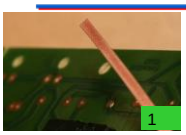

Solder wick is finely braided copper that is used to *wick away* excess solder from a de-soldered connection.

Apply the solder wick and soldering iron to the de-soldered connection. The solder wick will draw the excess solder off of the PCB pad.

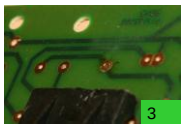

De-soldered PCB pad

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Soldering Safety

- Wear safety glasses when soldering. This includes all individuals in the vicinity of someone who is soldering.
- Place soldering iron in an approved holder when not in use. The iron is hot and can cause burns.
- Place the soldering iron so that the cord does not get caught up in your arms or on others.
- Ensure access to proper ventilation.
- Verify that the type of solder is safe to use in your working environment.
- Secure the components to be soldered before beginning the soldering process.

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Soldering Safety

- Provide plenty of space to work.
- Use a properly-sized point for the soldering job to be completed.
- Verify that the tip on the soldering iron has a sharp point and has not been damaged in any way.
- Check the power cord for burned or melted sections that show bare wires. Label those cords DO NOT USE and ask the instructor to repair or replace.
- Do not to touch molten solder - it is hot!
- Make sure that the solder strand is long enough to keep fingers away from the hot iron.

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Soldering Safety

- Tie back long hair and remove or tuck loose clothing.
- Use heat sinks for heat-sensitive parts. Provide sufficient cooling time before removing parts.
- Do not flick solder off of the iron. Flicking can cause solder to spray and hit skin or eyes.
- Hold the scrap end when cutting excess leads so that the scrap lead is not thrown into the air.
- Cut leads evenly with wire cutters.
- Make sure that leads do not short across other traces or leads.
- Thoroughly wash your hands after handling solder.

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How to Solder Like a Pro

Detailed instruction, helpful hints, safety tips, and a comprehensive troubleshooting guide

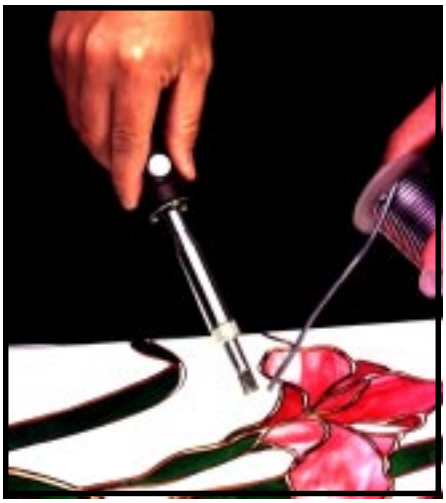

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Safety

The Importance of Safety

One of the most important aspect of soldering any stained glass project is to take the proper measures to safeguard your health. Soldering involves working with potentially hazardous materials like lead, flux and harmful fumes. By observing specific safety precautions and using informed common sense, working in stained glass can be a safe and enjoyable past time. The following is intended to serve as a general rule of thumb. Since each person and situation is unique, you should use this information as a starting point to help you make informed safety decisions concerning your soldering habits.

Fumes

Solder only in a well ventilated area, and use an exhaust device that moves solder fumes away from your face. It's preferable to exhaust outside (check local/state building codes and restrictions on venting to outside air). If you don't exhaust to the outside, use a bench top fan or intake device with a replaceable smoke/fume absorber made for stained glass artists. It should draw solder fumes into the replaceable filter. The filter should be activated charcoal and designed to remove particles smaller than 1/2 micron from the air. There are also several OSHA approved respirators available for fumes. Consider wearing one in conjunction with a venting system, especially if you plan on soldering for several hours every day.

Lead

Most popular solders used in stained glass are lead based. When you are using them, follow these precautions:

- Never eat, drink, or smoke in any area where soldering takes place.
- Always thoroughly wash your hands after soldering.
- Make sure your soldering equipment and supplies are kept out of the reach of children.
- Do not discard lead or solder scraps into the trash. Find a means or place to recycle them.
- Never use lead based solders or cames on items that will come in contact with food or children, or will be frequently handled. If you are making kaleidoscopes, jewelry or napkin holders, use lead free solder.
- Consider having your blood lead level checked by your physician on a regular basis to help you monitor your handling practices.
- If you are pregnant, or considering it, you should check with your doctor before using lead or solder.

Heat

Soldering tools operate at high temperatures, so these safeguards are important:

- Wear safety glasses! Solder and flux can "pop" and "spit."
- Solder on a fire resistant surface. Homosote, or dry wall are good .
- Never leave your iron plugged in and unattended.
- Do not overload a wall outlet with too many electric appliances.
- Never set your hot iron down on anything other than an iron stand.
- Replace the cord of your iron if it becomes worn or gets burnt.
- To prevent burning your fingers, use needle nose pliers or heat resistant gloves to hold small pieces.
- Never cut off a grounding prong on an iron plug to make it fit an ungrounded receptacle.

Soldering Irons

Choosing a Soldering Iron

There is a lot to consider when you choose an iron for stained glass. The handle should be heat resistant and comfortable for you to hold. You may be holding it for several hours at a time, so consider the weight and balance of the iron. Carefully check the wattage of the iron that you are considering. It must be able to continuously generate enough heat to melt all of the types of solder you plan to work with and be compatible with the type of construction you use (i.e.-copper, foil, lead came, rebar, etc.). You will need an iron that is at least 60 watts, with chisel type tips, and a way to control the temperature.

Types of Temperature Controls

A broad range of soldering irons are available. Most irons, which we will call "conventional irons," are made with wound wire heaters in a barrel with mica insulation. They are often inexpensive, but they do not offer the ability to control operating temperature. A separate temperature controlling device must be used with these irons to achieve the best results. There are three types of soldering irons that are easier to use for stained glass projects, because they allow you to control temperatures more effectively:

Irons with temperature controlled tips.

Irons used with temperature controlling devices.

Irons with ceramic heaters.

Irons with Temperature Controlled Tips

These irons are supplied with an internal regulator in the tip that does not allow the iron to exceed a predetermined temperature. An example would be a 600°F tip. The iron heats to that temperature then "shuts off." When heat is required, the iron "turns on" again. Tips are available in predetermined temperatures up to 800°F. These irons are easy for beginners to use, because the temperature is automatically maintained for you, however, as your skills increase, you may prefer to control the amount of heat yourself for different soldering situations. The limited amount of control may become frustrating as your soldering skills increase. With this type of iron you will likely encounter "cold spots" where the iron will not melt your solder. These cold spots occur when heat is being drawn out of the tip faster than it is being replenished. You will need an iron with a minimum of 100 watts.

Ceramic Heating Element Irons

These irons are relatively new to the stained glass trade. They are made with highly efficient ceramic heating elements. Like a ceramic room heater, they produce a consistent temperature using less electrical wattage during operation. When initially heating and when reheating during "recovery" periods, they can draw a "burst" of power exceeding 100 watts and then efficiently reduce electrical consumption, often below 60 watts, during the soldering process. The result is efficiency and economy.

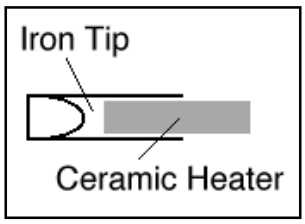

A remarkable feature of ceramic heater irons is they generally reach operating temperature in less than 60 seconds. Of the three types of noncoventional irons, the ceramic heater type best maintains consistent tip temperature over extended periods of time. Problems with slow heat recovery generally don't exist. A ceramic heater iron offers excellent flexibility and can be used with a temperature controller if you like.

Temperature Controlling Devices

A temperature controller is a device that operates similarly to a light dimmer switch. By dialing the control to a higher or lower setting, more or less electricity is fed to the iron. This increases or decreases the iron temperature, allowing the tip temperature to be controlled. You can establish the maximum temperature without changing tips.

A temperature control/iron combination offers you greater control and flexibility than a temperature controlled tip iron when working with different metals and solder mixes. Look for one that is at least 85 watts. Since the flow of electricity to the tip is consistent and never completely stops, encounters with cold spots are nearly eliminated. A temperature control/iron combination is suitable for all types of stained glass construction.

Temperature controllers are generally separate units that the iron plugs into. They are small, easy to use and relatively inexpensive. There are also irons that have controls built into the handle of the iron, which generally cost less than buying an iron and a separate control. Never plug an iron into a temperature control unless the manufacturer specifically states it is suitable for use with it.

Tip Sizes, Styles and Uses

Stained glass irons are generally sold with a "chisel" style tip. There are a variety of tip sizes and styles available for nearly every iron used in the stained glass industry. Different tips can expand the versatility of your soldering iron, so select an iron that offers more than one size replacement tip.

The standard tip size that comes with an iron is usually from 1/4" to 3/8" wide. This size works well for soldering either copper foil or lead came projects.

A smaller chisel tip, 3/16" wide, can be useful when soldering small pieces or when soldering in a tight area, such as a narrow inside part of a kaleidoscope. It is also very effective for decorative soldering.

Very small tips, 1/8" or narrower, are usually used for decorative soldering. They allow you to create very fine details and designs with the solder.

Iron and Tip Maintenance

The Importance of Proper Care

Your soldering iron may very well be one of your biggest tool investments, so you will want to do everything possible to ensure that it gives you many years of service. Well maintained soldering irons and tips perform better and make the job of soldering much easier. Always place your soldering iron in a stable iron stand whether it is being used or not.

The Cord

- Make sure you plug the iron into the correct type of outlet.
- Try not to use an extension cord. If you must, use a heavy duty one.
- Don't drop or bang the iron. Ceramic heaters are especially easy to crack or break.
- Regularly check the cord for burns or cracks and have a professional electrician replace worn cords before using the iron.
- Make sure that the cord is not hanging in such a way that it can be pulled off of the table.

The Heating Element

- Do not allow the iron to idle at operating temperatures for extended periods. This could burn out the heater element. Unplug the iron or, if you are using a rheostat, turn it down to a low "idle" setting.
- Occasionally, remove the tip and **lightly** tap the barrel of wire wound heater irons to remove debris.
- If you will not be using your iron for an extended period of time, you may want to store it (after it has fully cooled) in a zipper type bag to protect it from corrosion and humidity.

The Tips

- When you are finished using your iron, remove the tip from the barrel. Removing the tip is essential to preventing "seizing" which can occur if it is left in the iron for extended periods. (If your tip seizes, you can easily damage the heating element trying to remove it. It is best to return you iron to the manufacturer for removal.)

- When reinserting tips, make sure they are properly seated in the barrel.
- Never dip your tip into flux in order to clean it. Instead, use a clean damp sponge to wipe all sides of the tip periodically as you solder. Doing this removes impurities the tip has accumulated from the solder and the environment. It will ensure that you are receiving the maximum heat at the tip surface.
- Properly cleaned tips are bright and shiny. If your tip becomes "blackened," you can usually remove the buildup with a wet sponge, a tinning block or by gently using a brass brush. A “tinning block” (sal-amoniac) is used by placing a small amount of flux on the block and rubbing the tip of your hot iron in it. Wipe the tip on a damp sponge to remove debris. You may need to repeat this several times if your tip is very dirty.)

- Never use sandpaper or any abrasive material to clean a tip.
- The best way to minimize your tip maintenance is to find a good quality solder. Use one that has a high tin content and high metal purity.

Solder

Why Do We Use Solder?

Solder is a combination of tin and lead used to create a strong bond between other metals. Since solder won't stick to glass, we apply a copper foil tape (our metal) to the edges of the glass. This is refered to as the copper foil method of stained glass construction. Solder is melted over the copper foil, creating a structure that holds the pieces of glass together. The other option is to set the glass into channels of lead or metal, and solder the channels together. This is refered to as the lead came method.

The Advantages of Solder

Some of the advantages of soldering versus other bonding methods are:

- Solders are easy to use and relatively inexpensive.
- Low energy is required to solder.
- Properly soldered joints are highly reliable.
- Solder joints are easy to rework or repair.
- Experienced craftpersons can exercise a high degree of control over the soldering process.
- Solder joints age very well. They can last for years, decades and centuries.

Types of Solder

Stained glass solders are usually a mixture of tin and lead, designated by two numbers representing the percentages of each metal in that specific mix. The first number always refers to the percentage of tin, the second is the percentage of lead. The most commonly used solders in stained glass are 60/40, (60% tin/40% lead) 50/50 and 63/37. "Lead-free" solders have no number designation and are a mixture of tin and small amounts of other metals. Avoid solders containing antimony, a very toxic element. Instead look for lead-free solders containing silver, or copper. They are safer and easy to use. (Note they are, however, more difficult to patina.)

In North America, you will find solder is generally sold in solid core wire form on a spool. The common spool size is one pound. In Europe, you will find solders primarily sold in a bar form. Never use acid-core or rosin-core solders for stained glass work. Look for solders that are sold as "free of impurities" in the component metals. Impurities cause a "scum" on your solder bead, degrade soldering iron tips, and interfere with the proper reaction of patina chemicals resulting in undesired finishes.

An important term for solders is the "working range" or "pasty range." This is the range of temperature between which solder transitions from liquid back to solid.

Characteristics of Solder Types

60/40 Solder: Composed of 60% tin and 40% lead, this solder melts at 374°F, but doesn't become completely solid until it cools to 361°F. This means it has a "pasty range" or "working range" of 13 degrees. This solder is your best choice for copper foil work. The liquid temperature and narrow "pasty range" make it easy to form and maintain consistent high, rounded, beaded seams. Because of its relatively low melting point, "60/40" solder is easy to rework to maintain a smooth finish solder bead.

50/50 Solder: This is composed of 50% tin and 50% lead. It is liquid at 421°F, solid at 361°F and has a pasty range of 60 degrees. This solder will produce a much "flatter" bead than 60/40. Because of its higher melting point, 50/50 solder is often used on the back (or inside) of a stained glass project to protect against "melt through" when soldering the front. Because it spreads and flattens out, 50/50 solder is often used when soldering lead came joints.

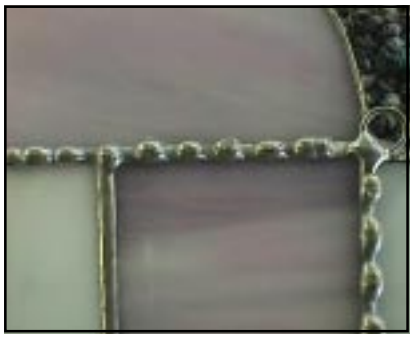

63/37 Solder: This solder is 63% tin and 37% lead. It becomes liquid at 361°F, and solid at 361°F, with a pasty or working range of 0 degrees. This solder is called a eutectic alloy which means at 361°F, you can go instantly from solid to liquid to solid just by applying or removing the heat source. You will often find "63/37" solder referred to as decorative or quick set solder. It is primarily used to create dimensional effects in the solder itself and can be "pulled" and manipulated to produce a variety of textures and designs. 63/37 solder also makes an excellent solder to bead up the outside rim of copper foiled pieces.

Lead-Free Solder: Depending on the specific mix of metals, lead free will produce differing liquid, solid, and pasty range temperatures. Check with the solder manufacturers for these specifics. Lead-free solders will perform similar to a 50/50 mix. Lead-free solders require more practice in order to obtain a smooth bead on copper foiled pieces and should not be used on lead came projects. Lead-free solder is the most expensive solder, but is the solder of choice when constructing pieces that will contact food, that will be handled frequently, or that will be used in a child's play area or room.

Solder Composition Reference Table

Alloy	Tin%	Lead%	Solid to	Liquid at	Pasty Range
50/50	50	50	361^0	421^0	60^0
60/40	60	40	361^0	374^0	13^0
63/37	63	37	361^0	361^0	0^0

Flux

Why Do We Use Flux?

Flux is a chemical compound that is used to promote the bonding of metals by removing the oxide residue simultaneously with the soldering process. Most metals left exposed to the air around us react with the air to form residue on the surface of the metal. The process is oxidization and the residues are oxides. Each mix of metals being joined has a specific flux that best promotes this bonding process. In stained glass, the metals being joined are primarily copper to tin/lead solder and lead, brass or zinc to tin/lead solder.

Types of Flux

Selecting the correct flux for your application is as critical as any other step of the soldering process. The proper flux will assure less soldering problems and a satisfactory solder bond. The best fluxes do three things:

- They remove all the residue that has formed on the surface of the metals you are going to solder.
- They prevent oxides from forming while you are soldering.
- Any post-soldering residue they leave is noncorrosive and easily cleaned off.

Fluxes are available in organic and inorganic forms. If you touch the flux and your skin seems to have a sensitivity to one type of flux, an inorganic type for example, try an organic variety. Often you will find that you are less sensitive to irritation by using the opposite type flux. Organic fluxes are generally some form of oleic (fatty) acids, while inorganic fluxes are most often zinc chloride based.

Characteristics of Fluxes

Liquid flux is the most widely used. It may or may not be water soluble. Water soluble fluxes clean up very easily, but are thinner and some have a tendency to evaporate quickly and require repeat applications. Some liquid fluxes are thinner than others and have a tendency to run or spread out from their point of application.

Gel Flux is generally water soluble and "adheres" well to the surface being soldered. Gels tend not to evaporate as readily as liquid flux, but if you apply too much, they produce more "spitting" and "popping" as you solder.

Paste Flux is very thick, stays where it's applied, and doesn't evaporate easily. It's effective when soldering 3-D forms such as lamps. Paste fluxes can be difficult to clean. Be very careful not to over apply a paste flux as it will also spit and pop, leaving pits on your solder seams.

Getting the Most From Your Flux

It is important to keep your flux clean and free of impurities. This will ensure the purest possible solder joint. One way to keep your flux clean is to avoid dipping in and out of the original container. Pour out the amount you will need for your current project into a separate, smaller container. Don't leave the flux bottle sitting around with the cover off. Never pour leftover flux back into the original container. Fluxes often will produce fumes as you solder. Make sure you are aware of and follow the precautions suggested in the health and safety section of this guide.

Soldering Basics for Copper Foil

The quality of the solder job can make or break your project, yet it is the step that takes the most practice to become good at. Soldering is more difficult than the other steps in stained glass because there are so many things that can effect it: the amount of heat, the amount of solder, the type of flux, the rate at which you move, gaps in the project, etc. The following step-by-step instructions will give you the basics of soldering. If you are just starting out, you will learn a lot. If you are experienced, you may just find the trick that makes it all come together. Great soldering takes a little bit of knowledge and a lot of practice.

Before You Start

Preparation is the key to producing a good solder bead. Here are some suggestions to help you get of to a great start!

- Make sure that the foil is seated properly over the glass.
- Trim all overlaps in the foil using a sharp craft blade.
- Assemble all the tools you will need so they are at hand.
- Wear safety glasses.
- Have a proper ventilation set up.
- Make sure the foil is well burnished and sealed smoothly to the glass surface.
- Secure the glass pieces using pins, or squaring blocks made for this purpose before soldering.

Set aside enough time to solder your entire project all at once. If you don't, dried flux and solder residues on the unfinished parts will make further soldering difficult. Flux allowed to remain on a project can compromise the strength of the solder joints.

Cleaning Before Soldering

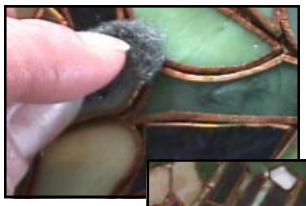

Sometimes the surface you are going to solder needs cleaning to remove visible grime, dirt, residue or oxidization. In this case, use 000 or 0000 steel wool to clean the surface of copper foil. For lead came or excessive oxidation carefully use a soft brass brush. If you won't be able to solder your project immediately after it is copper foiled, store it in a plastic bag to help reduce oxidation. If you partially solder the project and have to stop before it is complete, be sure to clean off all of the flux and store the project in a plastic bag until you are ready to continue. You will probably still need to use steel wool on the joints when you are ready to solder, but the clean up should be minor.

Getting Started

Begin the soldering process by fluxing all intersections of the glass project. Then "flat tack" solder these intersections together by using a very small amount of solder and the flat face of the iron tip. The solder should lay flat on the intersection and you shouldn't have any beads or bumps of solder on the piece. Hence the name "flat-tack" soldering.

Now, fill any gaps between the glass pieces by melting solder into them until the solder is level with the surface of the glass. If you have large gaps, you can ball up some copper foil, with the sticky sides together, and fill the gaps. This will help keep the solder from seeping out the other side.

"Tin" the entire perimeter making sure to work some solder into seams that intersect the perimeter. (Tinning is the process of coating a surface with a thin layer of solder. Apply just enough solder to turn the foil to the silver color of the solder.) This creates a "dam" that prevents solder from spilling over the edge when you solder the interior seams.

Next, flux an area you can comfortably finish soldering before the flux can evaporate. Start at the top of the piece and work down. This prevents you from dragging your sleeves and hands through the flux.

Running The Solder Bead

Hold your soldering iron in your writing hand. Position the iron comfortably so the face of the iron tip is perpendicular to the seam. If you hold your iron like a carving knife you will automatically put the tip in the best position for soldering. It will also keep you from "painting" with the iron. You will hold the solder in the opposite hand. Start soldering by placing the iron tip down on the foil seam with the wider face perpendicular to the seam and facing you. Touch the solder to the tip of the iron, just above the point where the iron tip touches the copper foil. Allow the solder to flow down the tip face onto the seam as you move the iron along the seam. Feed the solder at a continuous, even rate to create a consistent, rounded bead of solder over the seam. This takes practice!

If you apply too little solder or move too quickly, your seam will be flat. To correct this problem, allow the solder to cool, then resolder the joint applying more solder. On the other hand, be careful not to feed the solder too fast or move the iron too slowly, as this will cause the solder seam to bulge and flow out over the glass.

Fixing Imperfections

If you have too little solder, just add more, being sure to remelt the previous solder line as you apply another coat. If you applied too much solder the first time, it's easy to remove the excess with the following procedure. Clean your iron tip thoroughly on a sponge. With the iron tip positioned with the flat face down, move it across the seam, "pulling" the excess solder onto the glass. Clean your tip and repeat the process until all excess solder is removed. Another method for removing excess solder is to wait until all the seams have been soldered. Then place your project up on edge and run the tip through the seam allowing the excess to run off. Lay the piece flat, reflux, and rework the seam, adding additional solder as needed.

When you solder, work slowly enough to produce a good bead, but not so slowly that solder melts through seams to the back side of the project. Here's a hint: one way to prevent this is to put damp paper towel under your panel before you start soldering. Moving too slow also increases the likelihood of causing heat fractures on your glass.

Other Things To Consider

Always keep your tip clean by frequently wiping all sides of the tip on your damp sponge. Wait momentarily for the tip to reheat before continuing to solder. A clean tip maintains proper heat and removes impurities.

To achieve a smooth solder line, solder the longest continuous seam possible. Don't start or stop a solder seam at an intersection with another seam. As you meet an intersection, allow the solder to break or "y" out over the intersecting seam about 1/2" and then return to the original path you were soldering in one continuous motion. As you continue to solder seams, you will connect these branches, thus preventing pulling out at intersections of seams (which is a noticeable sign of a beginner). When you encounter a "v" type joint. Solder in a direction that moves up into the "v" point, instead of coming down onto the point. This keeps a nice clean "v" joint without excess solder obscuring it. Do this by soldering up one leg of the "v" and as you approach the apex, drop your iron tip down flatter on the glass, so that it crosses over both seams. Then continue soldering into and out of the point of the "v."

Avoid a "painting" motion when soldering. Visualize your iron as a magnet pulling along a metal strip. Maintain a small puddle of solder at the base of the tip as you solder. When two adjacent pieces of glass vary in thickness, ride the tip on the higher piece of glass as you solder.

Effects of using the iron like a paint brush

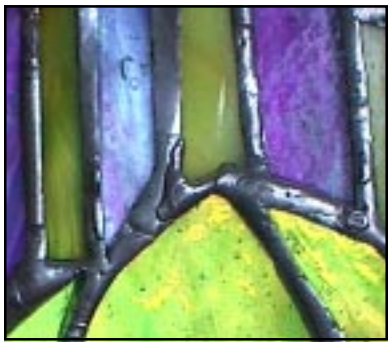

A big advantage of using copper foil is that not-so-perfect solder seams can be reworked. Allow the seam to cool, reflux it, then resolder. Be careful because reworking a seam too many times (more than 2-3) can cause the adhesive on the foil to loosen and bubble.

Solder one side of your project completely, then turn it over and repeat the process on the other side. Some of the flux from the first side you soldered will have seeped to the other side. You may encounter more "spitting," so use flux very sparingly. To achieve a smooth, beaded solder seam: practice! practice!

Ending A Bead

When you are ready to end your seam, pull off across the face of the glass making sure you are in a liquid section of the solder seam and do not lift straight up. This technique leaves a smooth exit point that is virtually unnoticeable. You may notice that this is the same photo used for removing extra solder. It’s not a mistake. The action is very much the same.

Practice!

Creating perfect solder seams takes practice. One good way is to make a practice board. Make sure to include all types of intersections and lines (curvy and straight). Foil the piece and flat solder it on the front and back. Practice each different soldering technique. When you are finished, you can hold the piece vertical and melt the solder off. Now you are ready to start again. Many people use the practice board before they start soldering each project, just to get the feel of soldering again.

Cleanup After Soldering

After soldering, you will need to remove all flux and solder residues from your solder lines and glass. The best cleaners to use are ones that neutralize the acid property of fluxes. To properly clean your project, you will need a good flux cleaner, very warm water and a soft scrub brush. Thoroughly brush the cleaner into every corner of your project, front and back. Follow this with a long rinse in clean, warm water and then towel the project dry. This step is very important because any flux that remains will continue to react with the solder, causing oxidation. If your project looks good after the initial cleaning, but the solder lines have a white or green growth on them after a few weeks, it generally means that all of the flux was not removed from the project. You can use 000 steel wool to remove the patina and finishing compound and thoroughly clean the project. Then reapply the patina and finishing compound.

A small stiff scrub brush is the best way to clean the entire project. After the initial cleaning, you may find some areas that need additional attention.

You may find small pieces of solder stuck to the glass. You can easily remove these using your fingernail, or 000 steel wool. Be careful not to scratch the glass.

An old toothbrush can be helpful for cleaning in tight intersections and right up against the solder line.

Occasionally you may find that after applying patina, certain types of glass acquire a “rainbow” effect. This is most likely to occur on hot colors, black, white and iridized glass. It is one of those things that is unpredictable and difficult or impossible to remove. You can try to remove it by using a paste made from baking soda, but it doesn’t always work. The only way to prevent this occasional problem is to be very careful not to get patina on your glass. Use a cotton swab to apply the patina only to the solder lines of the project. If you have this problem, it is a good idea to make note of it on any remaining glass, so you can be more careful the next time you use that particular glass.

Finishing

After cleaning your project you should use a finishing wax or compound to keep it looking it’s best. A good quality carnauba wax or pre-mixed wax and cleaner should be applied to all of the solder lines. A nice side effect is that the wax also enhances the color of the patina making it either rich black or shinny copper. You may find it helpful to reapply the wax after a few months. (If you would like to change the color of the solder, see the section about patina on page 16.)

Soldering Basics for Metal Cames

Lead came construction requires a different soldering technique than that used for copper foil. You can use the same iron and flux, but the preparation and actual soldering will differ. You will be soldering only the joints, instead of running an entire bead. With a little knowledge and some practice, you will be able to make perfect solder joints on lead or other metals.

Getting Started

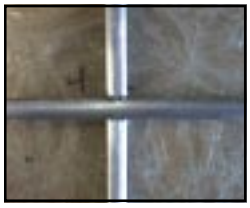

First, make sure that all joints are in line with each other and butt against each other with no gaps. Use a triangle and/or square to check the squareness of the panel and make sure that your lines run true across the panel in all directions. Make any adjustments that are needed. Thoroughly clean surface oxidation from intersections with a soft brass brush.

Soldering

The most desirable solder to use when constructing a lead project is 50/50. It flows out from the point of contact, leaving a nice joint. Do a "lead" test to check the heat of your iron. Allow the iron tip to heat for several minutes. Then, place the flat face of the tip on a scrap of lead. If the lead melts, the iron is too hot. Lower the temperature or change to a lower temperature tip. (This is where a rheostat iron is great.) Now test the tip with 50/50 solder to make sure it can melt it. If it does, your tip temperature is adjusted correctly. If not, raise tip temperature just until you melt the solder. Recheck the tip temperature and test it on the lead again. Now flux all the joints on your panel.

Begin by holding the solder on the joint. Move in to the joint across the glass, not from across the came. The wide face of the tip should be down toward the joint. Coming into the joint over the glass prevents leaving a solder trail on the lead came at one end of the solder joint. Techniques like these are the signature of an accomplished craftsperson.

Melt only a small amount of solder and move the tip in a slight circular motion allowing it to flow out over the joint a distance equal to the width of the came being used. Pull the iron tip straight up off the center of the joint. The desired end result is that intersections of the lead cames are not visible through the solder and the solder on them is smooth, not beaded. You should be able to run a fingernail over the came and into the soldered joint without it catching or clicking. Solder the joints on the front of the project. Then turn the project over and repeat the same process on the back.

Finishing

Lead projects need to be finished by applying a cement. The cement will weatherproof the project and secure the glass in the channels. This step is necessary on any came project to ensure a strong, secure panel. Cement is easily applied to the panel by using a small scrub brush to work the cement under the channels both on the front and back of the project. After the cementing process is complete, whiting sprinkled over the entire surface and allowed to absorb excess moisture for a few minutes. Using a stiff brush, vigerously brush the lead channels, removing excess cement from the glass. The brushing process allows a natural patina to form on the lead, so it is not necessary to apply patina to the project. Allow the project to dry thoroughly, usually for a few days, before installing or hanging the project.

Soldering Basics for Other Metals

Vase Caps

Vase caps are generally made from spun brass. The cap must be very clean of all dirt and oils for the solder to adhere. Use 0000 steel wool to clean the areas that you will be soldering. The cap also needs to be quite hot in order to achieve a good bond between the solder and the brass. An easy way to get the cap hot is to heat it in a hot oven for about 15 minutes. Use pliers to carefully remove the cap from the oven. Center the vase cap on the lamp. Flux all areas you will be soldering. (Paste flux is easy to use for this purpose, because it doesn't drip.) Get a small amount of solder on your iron and hold it on the vase cap for a minute or so at the area you want to make a connection to the lamp. When the cap is hot enough, the solder will spread out instead of lumping up. Add more solder to make a connection to the lamp. (Some vase caps have a lacquer finish on them. This must be removed at the areas you need to solder. Use a craft knife to gently scrape the lacquer in these areas.

Spiders

Spiders are made from brass as well. You can either cut the legs to fit, or bend them. Like a vase cap, you need to get the brass quite hot in order to create a good bond with the solder. Unlike vase caps, you can get the smaller area of the spider hot enough using just your soldering iron. Simply hold your iron tip on the area that you need to solder for a minute or so. Apply flux and a little solder, and continue to heat the spider with your iron. When it is hot enough, the solder will smooth out around the spider leg and adhere to the lamp. If the solder is globed up, the spider leg isn't hot enough. Continue in this manner for all of the legs.

Metal Outer Channels

When attaching a zinc, copper or brass edge to a project, use this solder technique: Cut the zinc, copper or brass came vertical members to overlap the horizontal members in a "butt" type joint. A butt joint provides structural stability and distributes weight. Before you solder the butt joints, you can use masking tape to contain the size of the solder joint.

Clean and flux these joints and solder them to each other using the flat tip of the iron on the metal. The metal channel will take a little longer to get hot than copper foil. If the metal is not hot enough the solder will not smooth out. The metal frame should be attached to the panel by soldering it to any lead lines that it touches.

On leaded projects, solder from the outer metal edging onto the lead came, pulling the iron tip straight up over the point of intersection when completing the solder joint. This simple technique will level the solder smoothly over the joint.

For copper foil pieces, stop your solder bead about 1/4-1/2" from the outer edge to allow room for the metal edging to fit onto the perimeter of the project. If you forget to do this initially, flatten the solder bead so the outer edging fits onto the project. After fitting the outer edging material, flux and solder the corners as outlined above. Connect the copper foil beads that intersect with the outer edging metal by continuing the solder bead into the edging making sure that the

solder adheres securely to the metal edge.

As you work more with your iron, different solders, lead came, and copper foiled projects, your skills will increase. You will quickly develop the techniques that will make you more confident in tackling increasingly complex projects.

Hanging Hardware

There are many ways to hang your project. You will want to make sure that the method you choose will support the weight of the project. You can purchase pre-made hardware from your stained glass store, or make your own using any type of solderable wire. If you are using wire look for 16 to 18 gauge.

Rings can be added to the metal border of the project if it is not too heavy. A general rule of thumb is about one square foot. Hold the ring with pliers and solder rings to the metal border of the piece wherever they allow it to hang properly. Just like soldering the channel together, if you don't allow the metal to get hot enough, the solder will not adhere well. This will result in your hanging rings failing.

A stronger type of hardware is made using wire. Twist together four strands of 16 -18 gauge wire, leaving a loop at the end. Cut the wire to about 1/2". Insert the wire into the opening of the metal channel, bending the loop the direction you need it to be. Solder the hanger to the channel and fill the opening with solder.

Another option is to make a loop from twisted wire and solder it to the front and back of the metal channel, with the loop extending above the project. Be sure to solder the hanger into an existing solder joint, not just to the channel. This will prevent the weight of the project from pulling the channel away from the glass.

By the way, the joint on the hanger at the right was painted to match the brass channel using a gold paint pen.

Patina

Solder and lead change color naturally over time, but you can change their color instantly by using patinas. There are several different formulas producing a variety of colors. Patinas are easy to use. Make sure that your project is thoroughly clean and free of solder, flux and cutting residues. Use a brush or soft rag to apply the patina to the solder until you reach the desired color. Wash the panel again to remove any patina from the glass.

- When using antique brass patina, first scrub your solder seams with fine steel wool. Apply the patina sparingly with a clean brush, using only a few strokes. Over use will produce a coppery finish.
- Never mix patinas and always use proper ventilation and skin protection.
- To get a nice black finish on brass, add a dash of table salt to a little black patina in a glass or plastic jar. Mix well, apply and allow to dry. Clean and finish a usual.

Trouble Shooting

Problem: The solder won't adhere to the foil or came.

Solutions/Explanations:

1) Did you apply any flux?
2) Did you apply enough flux?
3) Was your iron too cool?
4) Is the foil or lead came too oxidized for flux to activate the surface?
   A) Buff copper foil with 000 or 0000 steel wool.
   B) Clean lead came with brass brush.

Problem: Solder is melting through to the backside of my project.

Solutions/Explanations:

1) Your iron is too hot. Depending on what type of iron you are using, either turn the temperature controller down or change to a lower temperature tip.
2) You may be soldering too long in each area. Move on and let the solder cool. Return to those spots later.
3) The gaps between your glass are too wide. Try to fill the gaps with solder and let it cool. Then go back and solder a bead on top of the filled gaps.
4) Try placing a wet paper towel under the project to provide cooling.

Problem: My solder is "stiff." I am unable to get a smooth bead.

Solutions/Explanations:

1) Your iron is too cool. Depending on what type of iron you are using, either turn the temperature controller up or change to a higher temperature tip.
2) You may not be using enough flux.
3) Is the tip of the iron getting hot? Check to see that the tip is seated correctly down in the barrel of the iron.
4) Are you "painting" with solder, instead of running a long bead with a steady, even, one directional movement? This is one of the most common mistakes that beginners make. In order for the solder to create a bead, it has to get molten. If you are using the iron as a “paint brush”, the solder is not getting hot enough to melt thoroughly.
5) You may be soldering with just a corner of the iron tip. Check for proper positioning of your iron.
6) Try a different solder with a lower melting point.

Problem: My iron seems to be hot, but the solder isn't melting as fast as normal.

Solutions/Explanations:

1) Check your tip. Is it loose?
2) Is your tip too dirty?
   A) Clean it on a wet sponge.
   B) Clean it on a tinning block.
3) Your tip is too corroded or defective. Replace it.
4) Your rheostat may be malfunctioning.
   A) Plug the iron into the outlet you are using without the temperature controller. If the iron works, the controller is malfunctioning. If the iron doesn’t work, the problem may be with the iron itself.
   B) With some types you can check the temperature controller by plugging a lamp into it. Turn on the lamp and see if the controller dims and brightens the lamp.

Problem: My solder seams are flat.

Solutions/Explanations:

1) You are not using enough solder. Reflux your project and add more solder.
2) You are soldering too fast. Move at a speed that lets the solder bead.
3) If the bead was there, but disappeared, you may be working too long in one area causing the solder to melt through to the other side. Allow the area to cool down before trying again. Another option is to place a damp paper towel under the seam you are working on. This will help keep the glass cool, allowing you a little more time to work.
4) Check the type of solder mix you are using. For copper foil work, 60/40 will help produce a higher, more rounded bead. Don't make the mistake of buying 40/60 solder. It has an even longer pasty range than 50/50, and is not recommended for stained glass work.

Problem: My solder seam is too wide.

Solutions/Explanations:

1) Do you have large gaps between the pieces you are soldering?
   A) You may have to recut some pieces.
2) You may be using too much solder causing the seam to bulge over onto the glass. "Pull" or "bleed" the excess solder from the seam.
3) Is the copper foil too wide? This is another common mistake for beginners. Remember that the width of the solder seam is determined by the width of the foil. An attractive solder seam is accomplished by using a foil that shows about 1/16" on both sides of the glass.

Problem: My solder seams are irregular in width.

Solutions/Explanations:

1) You may have poorly fitting pieces that create different size gaps in your project. Recut these pieces.
2) Your foil may be applied unevenly on each side of the glass in some places. You may try to correct this by trimming the foil with a craft knife. If that does not work, remove the foil and start again.

Problem: My glass fractured while I was soldering.

Solutions/Explanations:

1) Your iron is too hot. Depending on what type of iron you are using, either turn the rheostat down or change to a lower temperature tip.
2) You "worked" too long in one location with the iron.
3) There could have been a small chip or crack in the glass which was expanded when it was heated by the iron.

Problem: My solder bead is not bright and shiny. It appears dull and splotchy.

Solutions/Explanations:

1) The solder was applied too cold, so it never fully reached its "liquid state." Turn up the temperature if you are using a rheostat or change to a higher temperature tip if you are using a temperature controlled tip.
2) You may not be using enough flux to "wet" your foil or lead and create a proper solder condition.
3) If you're using 50/50 solder, try 60/40. Because solder crystallizes as it cools through the pasty range, 50/50 is more prone to having a textured look on its surface because of its considerably larger pasty range.
4) The solder you are using may be of inferior quality.

Problem: My solder is "spitting" as I work. What's wrong?

Solutions/Explanations:

1) You are likely using too much flux. It is literally boiling when you apply the solder. Wipe some of the flux off with a paper towel and try soldering again. You may find areas that now need a little more flux, because you removed too much.
2) If the spitting only occurs on the back side of your project (or the second side you are soldering), the problem is still too much flux, but the cure is different. When you use too much flux on the front side of the project, the excess to flows through the panel, so the spitting isn't as bad as it could be. When you use too much flux on the back side of the project, it can't flow through to the front, because the front is already sealed. The obvious cure for this problem is to use less flux the next time. But what about now, when you already have too much and can't remove it from between the glass? The only good solution is to apply your solder, and allow the flux to boil up and out of the seam. (Keep your face as far away from the project as you can.) Once it stops spitting, you can remelt the solder and make it look as good as new.

Problem: I have gooey, glue residue along my solder seams that won't wash away.

Solutions/Explanations:

1) Adhesive from foil may be working up and out onto your glass. This can be caused by poor foiling or burnishing of the copper foil, which allowed flux to seep underneath the foil. To correct this use a cuticle stick or soft toothbrush to clean adhesive away.
2) Your iron is too hot, causing the adhesive on the back of the foil to melt and seep out onto the glass. Depending on what type of iron you are using, either turn the rheostat down or change to a lower temperature tip.
3) If you reworked a seam too often, it may have loosened the foil. Allow the seam to cool to the touch and gently press the foil back down to the glass.

Problem: Attached hooks and rings are pulling away from my project.

Solution/Explanations:

1) Hooks and rings should never be attached to just a foiled edge. Attach hooks/rings to vertical seams in the piece or at a juncture between a vertical seam and the perimeter.
2) If there is no vertical seam or intersection, then attach the ring/hook to a horizontal seam in the piece.

Problem: My solder has a white chalky growth on it. What did I do wrong?

Solution/Explanations:

1) All of the flux was not washed off of the project after it was soldered.
2)The project was not sealed with a finishing compound or wax, or it has worn off. Use 000 steel wool to remove the patina and any remaining wax. Clean the project thoroughly paying special attention to the corners and edges. Reapply the patina and wax.
3) The project has been exposed to the outside elements. Most waxes are intended for indoor use only. Others can be used outside, but must be reapplied regularly. Projects that will be exposed to the elements are better constructed using the lead came method.

Glossary of Soldering Terms

Antimony

An element used in the production of some solders. It should be avoided for use in stained glass.

Ceramic Heater

A type of heating element comprised primarily of ceramic, noted as extremely fast heating and efficient.

Chisel Tip

A soldering iron tip shaped like a chisel tool. This is the most common shape used for soldering stained glass. Chisel tips are made in a variety of sizes, the most common being 1/8”, 1/4” and 3/8”.

Heat Sink

A device used to draw or absorb heat being generated by another source. For example, an object being soldered acts as a heat sink to the soldering iron.

Decorative Soldering

Any decorative effects created in solder. These effects are created with a soldering iron, usually with a very narrow tip. Special solder, like 63/37 or QuickSet, make it easier to create special effects because it has a “zero” pasty range.

Eutectic Point

An exact single temperature point at which an alloy goes from solidus to liquidus with no pasty range. For example, the eutectic point of lead and tin is 361^0 F. This point is obtained only by 63/37 tin/lead alloy.

Flux

A chemical agent used to remove compounds from the surface of metals during the soldering process. (See organic and inorganic flux.)

Idle Temperature

A very low temperature at which the iron is on, maintaining the capability of a more rapid heat up than if the iron was off or “cold”. This is usually between 200^0F and 300^0F.

Inorganic Flux

A flux comprised of one or more inorganic salt such as zinc chloride or ammonium chloride. Inorganic fluxes are more corrosive and conductive than organic fluxes,. They are effective on all common metals.

Leaded Solder

A material used to join metals comprised of tin and lead.

Liquidus

The temperature at which a pure metal becomes completely molten or liquid.

Mica

A mineral based material used as a construction component in wire wound type heaters of soldering irons.

Organic Flux

Organic fluxes are not as corrosive as inorganic fluxes. They are often used when the surface of the glass may be effected by the flux, such as painted glass.

Oxides

Debris on the surface of a metal which is the result of the reaction with chemicals in its environment. Oxides must be removed mechanically (with steel wool or a brass brush) and chemically for proper wetting to occur.

Pasty Range of Solder

The temperature range which is the difference between the solidus and the liquidus temperatures. This is sometimes referred to a the “working range”.

QuickSet™

Another name for 63/37 solder. See decorative solder.

Recovery Time

The time required for a soldering iron to reach soldering temperature after it has hit a “cold spot”.

Rheostat

The term applied to a soldering iron control which is used to vary the temperature of the heater in the iron.

Solder

An alloy of two or more metals with a liquidus temperature of less than 800^0 F.

Solder Bead

The term used to describe the look of solder when it has been properly applied to a copper foil seam.

Solidus

The temperature at which a pure metal or alloy goes from liquid to solid (or “freezes”).

Temperature Control

An electrical or electronic device into which a soldering iron is plugged, or which is within a soldering iron. The device is used to vary the temperature of the soldering iron heater.

Tinning

Applying a thin layer of solder to a metal surface. Most commonly used in reference to the copper foil technique.

Tinning Block

A block of sal-ammoniac on which a soldering tip is cleaned and resurfaced with a layer of solder. It is not actually used for soldering.

Tip Tinning

The process of renewing a soldering iron tip using a sal-ammoniac (tinning) block.

Wetting

The term used to describe the proper flow of liquid solder, promoted by flux, on the surface of another metal. “Wetting” is necessary to form a proper soldering joint.

Wire Wound Heaters

Soldering iron heaters constructed with heating wires wound in a coil around Mica.

Soldering & Desoldering

Soldering/Desoldering Tools & Accessories

Soldering Station with LCD Display, ESD Safe 400 Series

17400

- High-quality sensor and heat exchange system guarantee precise temperature control at the soldering tip
- Soldering iron tool heats rapidly from room temperature to 350C in 30 seconds
- Suitable for general purpose soldering as well as specialized lead-free soldering applications
- Sponge and coiled brass tip cleaner ensure a clean soldering tip free from debris and corrosive material
- Strong, deluxe iron holder provides safe secure place to store heated iron between uses

Product ID	Description
17400	Soldering Station with LCD Display, ESD Safe 400 Series

Soldering Station with LCD Display, ESD Safe 405 Series

17405

- LCD temperature control display with blue backlight
- Long lasting, durable high - quality ceramic heater
- Sponge and recessed area provides a convenient method for cleaning the tip
- Suitable for general purpose soldering as well as specialized lead-free soldering applications
- Safety guard iron holder

Product ID	Description
17405	Soldering Station with LCD Display, ESD Safe 405 Series

Soldering Kit - 6pc

17501

- 40 Watt Soldering Iron heats up to 900° F
- Ideal for use on electrical/electronic components, audio equipment, etc.
- Includes desoldering pump for removing liquid solder
- Provides basic tools needed for many soldering projects
- 6 Pc kit comes complete with replaceable fine tip

Product ID	Description
17501	Soldering Kit - 6pc

Soldering Kit - 7pc

17502

- 40 Watt Soldering Iron heats up to 900° F
- Ideal for use on electrical/electronic components, audio equipment, etc.
- Includes desoldering pump for removing liquid solder
- Provides basic tools needed for many soldering projects
- 6 Pc kit comes complete with replaceable fine tip

Product ID	Description
17502	Soldering Kit - 7pc

Soldering Iron 80W with Fine Tip

17510

- Ideal for general purpose soldering applications including metal board, tube or large components
- Round, soft grip, non-slip handle
- Durable cord with a 5-foot reach
- Fitted with long life replaceable fine tip

Product ID	Description
17521	Soldering Iron 40W with Fine Tip

Soldering Iron 40W with Fine Tip

17521

- Ideal for general purpose soldering
- Round, soft grip, non-slip handle
- Durable cord with a 5-foot reach
- Fitted with long life replaceable fine tip

Product ID	Description
17521	Soldering Iron 40W with Fine Tip

N-Series Soldering Iron Tips

- Long life, lead-free soldering iron tips
- Replacement tips for soldering the different components of PCBs
- Five different sizes
- Includes two tips
- For use with 17400 & 17405 ESD Safe Soldering Stations with LCD Display

Product ID	Description
17400-N9-1	N-Series Soldering Iron Tips (N9-1)
17400-N9-2	N-Series Soldering Iron Tips (N9-2)
17400-N9-3	N-Series Soldering Iron Tips (N9-3)
17400-N9-4	N-Series Soldering Iron Tips (N9-4)
17400-N9-5	N-Series Soldering Iron Tips (N9-5)

C-Series Soldering Iron Tips

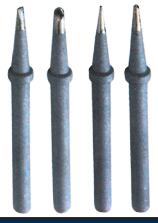

- Long life, lead-free soldering iron tips
- Replacement tips for soldering the different components of PCBs
- Four different sizes
- Includes two tips
- For use with 17521 Soldering Iron 40W

Product ID	Description
17521-C1-1	C-Series Soldering Iron Tips (C1-1)
17521-C1-2	C-Series Soldering Iron Tips (C1-2)
17521-C1-3	C-Series Soldering Iron Tips (C1-3)
17521-C1-4	C-Series Soldering Iron Tips (C1-4)

B-Series Soldering Iron Tips

- Long life, lead-free soldering iron tips
- Includes two tips
- For use with 17510 Soldering Iron 80W

Product ID	Description
17510-B5-1	B-Series Soldering Iron Tips (B5-1)

SMD Soldering

Your reference guide to soldering with surface mount devices

Edited by Lim Siong Boon, last dated 06-May-09.

email: mail@siongboon.com
website: http://www.siongboon.com

Short cut to your reference guides and charts

1. Introduction to SMD soldering
2. SMD soldering (prototyping board)
3. SMD soldering (prototyping PCB socket 2.54mm pitch)

1. Introduction to SMD soldering

SMD IC stands for surface mount device integrated circuit, or commonly known as SMT surface mount technology. Why go into SMD? Small in size, light in weight. This is the advantage of smd. Being small, engineer is able to design small electronics gadget that people can carry around. It is quite obvious that people prefer small mobile phone.

The ultimate advantage will be lower cost to consumer. Being small in size, the printed circuit board (pcb) can be small, meaning low cost. Transportation cost can be reduce because it is now lighter and more products can be packed into the same box. Space required is less, meaning cost saving on the warehouse storage. PCB board is easy to route without the through hole. Better signal integrity. Easily assembled by machine. There is too much advantages. Going SMT is certainly the way forward.

Technology evolution, from big to small.

A phone small enough to carry around.

Smaller mobile phone

Even smaller phone

Mobile phone as thin as biscuit.

I used to build circuits using dual in-line package (DIP or DIL) IC only. I hardly thought of using surface mount device/component (SMD) because I have great doubt that I can solder the fine legs of the IC chip. The pitch for the older DIP IC package are 2.54mm. Pitch is the distance between adjacent pins as illustrated in the picture. Most IC comes with a variety of packages. The IC that I know of, offer both the SMD and DIP packages. I

Through hole packages

	DIP - 8 pins

thought that I will never ever need to use smd packages until one day, I have no more choice. I managed to pick up new circuit designs, and discover more and more new IC chips. Most new IC chips design do not have DIP packages. You can hardly find one. I realised that in order to implement better circuits, I need to learn to use new IC chip. In order to use the new chip, I have to find ways to solder smd components. That's where I venture into the world of smd.

Nowadays people prefer to use smd, because they are small in size, which turns out to be cost efficient fabricating small PCB. With smaller PCB, space & weight is saved, resulting in lower cost for the transportation/distribution and storage.

Research and research, I got to know from other electronics guru that smd is in fact easier to work with than through hole. I try it out and from that day onwards, I am in love with smd components. Small to solder, but it save me the effort to cut the lead for through hole component. I managed to store my component using minimum box and space. There are many many advantage to work with smd.

Many people might think that you need special tools like a rework station or fine tip iron to solder the small smd components with small pitches. With the correct technique, you can use your soldering iron to do the soldering. In fact my 60W goot TQ-95 soldering iron has quite blunt tip. So thick that most people think that it is not possible to solder smd IC with fine pitches. Fine tip iron is easy to reach the fine lead, but I find that it is not as hot as the same iron with blunt tip. If you prefer fine tip, I will recommend hotter soldering iron or those which can allow you to adjust the temperature, they can be hot. I managed to solder smd package TQFP, SSOP QSOP with pitch as small as 0.5mm. Width of the lead of about 0.3mm.

Dealing with SMD components do not necessary requires you to fabricate a professional pcb board. You can also mount smd components on low cost prototyping board. To start off implementing smd components, you might like to try using the soic package. Quite common at this point in time, but may just phase out as what has happened to the dip packaging. SOIC has a pitch of 1.27mm, which is exactly half of DIP packages. This size is great because I can solder the IC to the same old 2.54mm pitch prototyping donut padded board. What I usually do is to cut the donut pad into half. Soldered onto each pad is two pins 1.27mm apart.

You can refer to the following article, for further illustration.

"SMD soldering (prototyping board)"

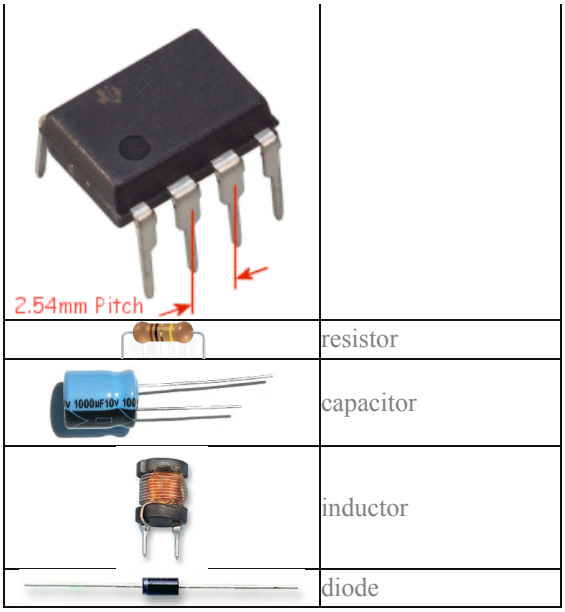

SMD packages

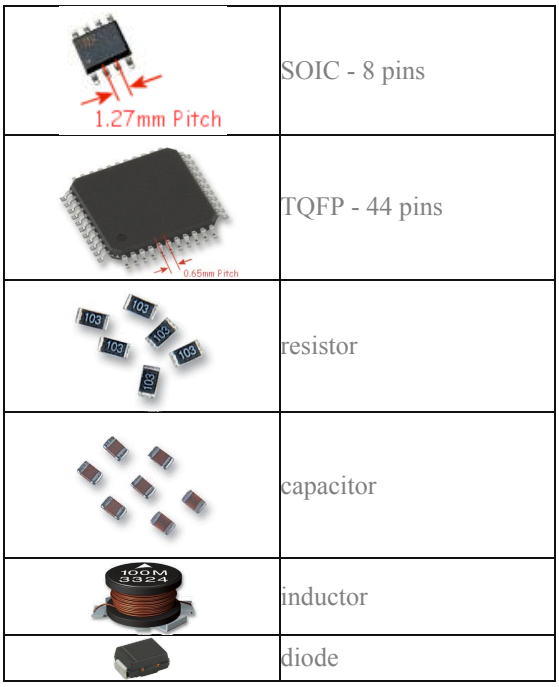

With so much advantage there is indeed a disavantage. SMD IC comes with many type of packages with different pitches. Unlike DIP IC, the pitch is typical 2.54mm. I can easy purchase a prototype board with 2.54mm, and almost all the DIP will fit to the board. SOIC package can still be mounted onto the 2.54mm prototype board. The rest of the SMD IC chip has quite a wide range of completely different packaging. This make them difficult to start with, without having to fabricate a PCB.

There are actually solution to this. Most IC company usually introduce their IC chip together with a prototype board for the IC.

Another solution will be to use a pre-fabricated prototyping board that allows mounting of various smd footprint. You can search for the various names such as

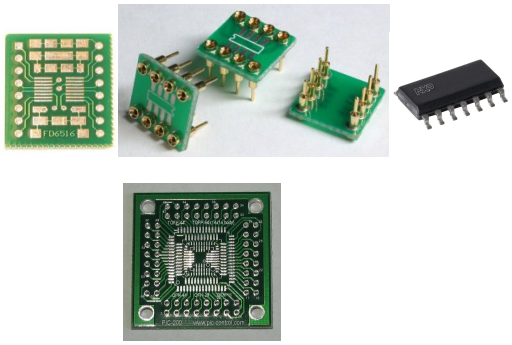

Various distributor for the prototyping adaptor

- prototype adaptor
- chip adaptor
- smd prototyping board
- smd to dip adaptor
- smd socket
- smd adaptor
- smd to 2.54mm converter
- SMD to DIP converter
- chip carrier

You can refer to the following article, for further illustration.

"SMD soldering (prototyping PCB socket 2.54mm pitch)"

In prototyping with DIL IC, pcb mount IC socket is usually used, so that the IC can be removed easily if damaged. Some sockets are designed for programming used where the chip can be inserted and remove easily for programming purpose. To remove the component, you need not have to do de-soldering. Like DIL package, smd also comes with their own IC socket. There are many variety of smd packaging, and getting the socket for your smd components is not going to come cheap & easy compare to DIL. Therefore I usually built prototype without any sockets for smd design. After numerous attempts designing and building of circuits, you will definitely attain a certain level of confident on your design without considering IC socket. Without the socket, cost and space are saved significantly.

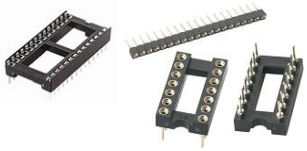

DIL IC sockets/ holder. Turn pins designs is of better quality.

Various distributor for SMD socket

SMD IC sockets:

The headache will come when you really need to removed the smd IC. How do you remove the IC from the PCB? For de-soldering of smd component more than 3 leads, you can add in more solder to connect up the IC pins heat pins on all the sides of the IC and eventually pull out the component. It is easier to use the rework station or IR heater to de-solder smd components. The rework station uses hot sir to melt down the solder on the board. You will need to aim the hot air at the solder joint.

Rework Station

If you do not have the lurxy of getting the rework station, another possible method might be to use a special solder that has lower melting point. LowMelt® DeSolder Wire. A lower melting point means that the solder will takes a longer time to cool down to a solid. This allows you more time to remove the IC after heating up the solder. The solder is flooded onto the pins of the IC. The pins are heated up together using a soldering iron and the smd IC can then be removed easily with a tweezer.

Various type of smd packaging

* SOT, SC
* SOIC, ExposedPad™
* SSOP, ExposedPad™
* TQFP, ExposedPad™
* TSOP
* TSSOP, ExposedPad™

Low melt solder wire

* PLCC

* LQFP, ExposedPad™

* LGA

* PBGA

* PSOP

* Dual Row MicroLeadFrame®

* LQFP PowerQuad®

* MicroLeadFrame® (MLF®)

* MQFP PowerQuad®

* PSvfBGA

* SuperBGA®

* TapeArray® BGA

* tsCSP

* Ultra CSP™

* CABGA, CTBGA, CVBGA

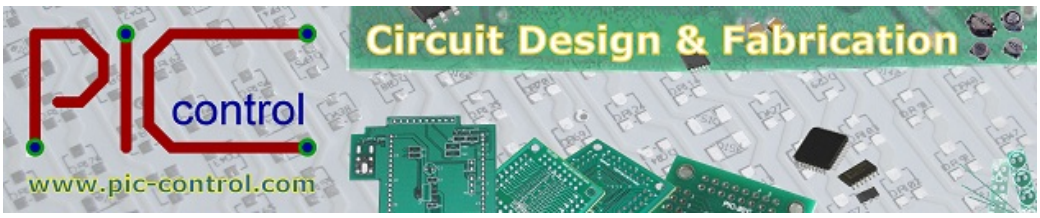

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2. SMD soldering (prototyping board)

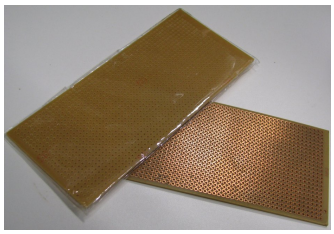

The prototype board above has pad with 2.54mm pitch and is designed for DIL and through hole components. The board is easily available from local store. Dealing with smd components on this 2.54mm pitch board is not difficult as well. I have been using this board to solder quite a number of surface mount components.
- SOIC
- DPAK
- SOT23-6, SOT-3
- TO-263
- PSOP

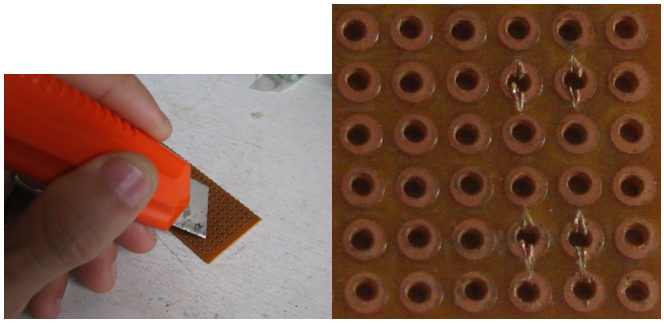

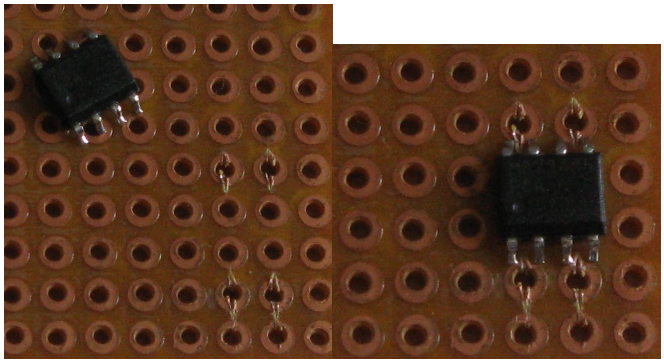

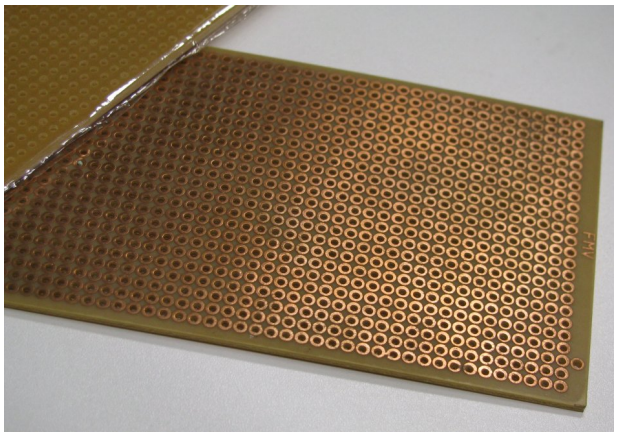

High pin count component with pitch less than 1.27mm will not be suitable to mount onto this board. For passive smd component like resistor, capacitor or inductor which only have 2 pin, mounting is simpler. Size is not an issue soldering onto the board.

Align the SMD IC to the position on the pad. Mark out the pad for the cutting to be done.

Use a penknife to cut the donut pad into half. Ensure that the half pad does not short circuit using your multi-meter. Sometimes the cut may not be deep enough or conductive reside between the gap resulting in a short circuit. Remember to ensure that each is proper cut before you start to solder.

Align the smd with your finger or tweezer and begin soldering one of the pin. Check if the IC is still properly align after soldering the first pin. If not, heat up the soldered pin and realign again. After the ICis align, solder all the rest of the pin. If the solder bridge across to the adjacent pin, use a soldering sucker to remove the excess solder.

The cut between the pad usually make the solder harder to bridge across the adjacent pin. Bridging is still possible, and it is quite easy to have it removed.

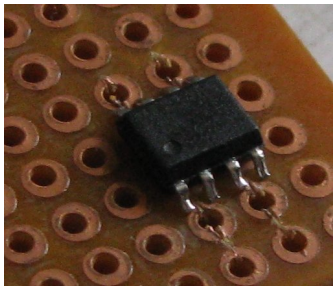

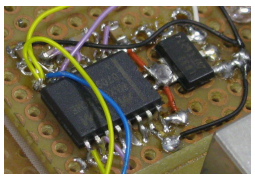

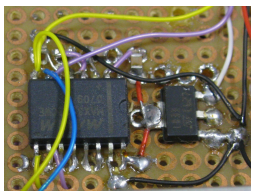

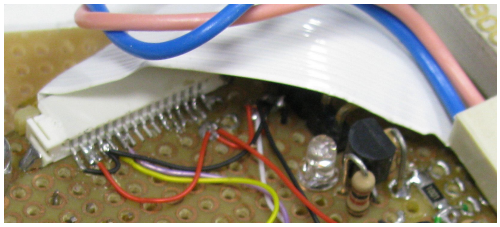

SMD ribbon cable connector being soldered onto the 2.54mm pitch prototype board.

Example of building the circuit using surface mount component on the prototyping board with 2.54mm pitch pads. As shown above, the pins are being wired by fine wire wrapping wire. The single core wire is very flexible and comes in a variety of color, making it easy to identify the type of signal being carried by the wire.

3. SMD soldering (prototyping PCB socket 2.54mm pitch)

What you need...

List of items:
- Surface IC chip (TQFP package)
- Surface mount IC adaptor or converter
- Soldering Iron
- Tweezer or Pincer
- Solder with flux core
- Soldering Flux
- Stick for coating flux
- Wiping paper
- Tinner

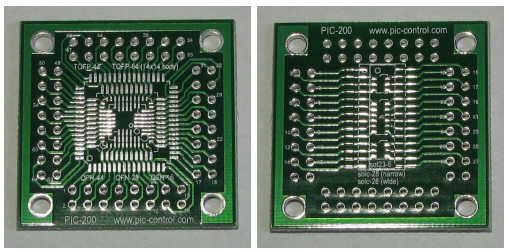

PIC-200 smd to 2.54mm pitch adaptor

from PIC control.

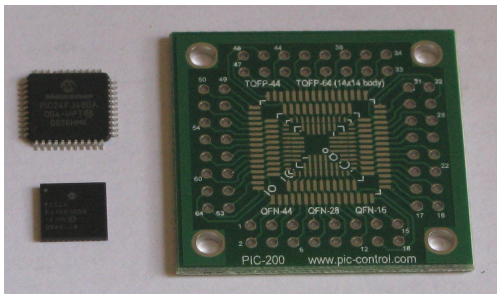

INTRODUCTION

In this setup, I am going to solder a surface mount microcontroller (TQFP 44 pins) onto a smd adaptor. The adaptor will then be used on the commonly available prototyping board, so that I can try out my new design for circuit control.

TQFP, QFN and SOIC are quite some common footprint for prototyping smd microcontroller from 18 to 64pins. This prototyping adaptor pic-200 (on the left) that I have is an ideal adaptor for my microcontroller. Converting the smd device into 2.54mm, I can easily mount the smd unit onto my 2.54mm pitch prototyping board. It is available locally.

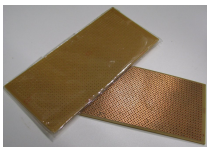

Prototyping board with 2.54mm pitch donut pads.

The pic-200 smd adaptor originate from PIC-CONTROL and is well documented. Commonly used smd footprint can be found on either the top or bottom side of the pcb adaptor. These are some of the smd packages that can be mounted onto pic-200 adaptor.

IC	Front	Back
TQFP-44		

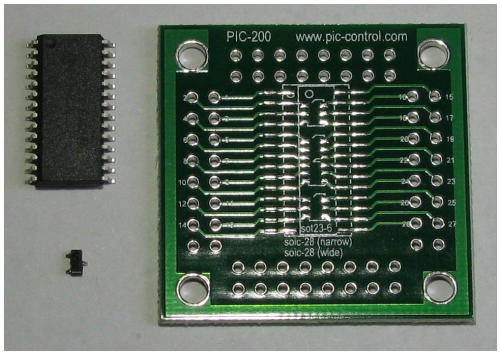

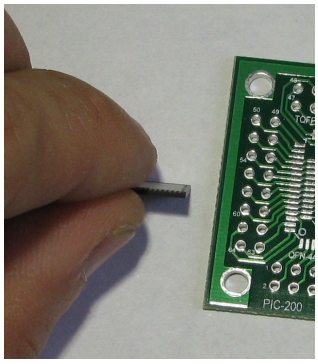

Holding onto the side view of the QFN package IC.

QFN-44

SOIC-28

SOT-3

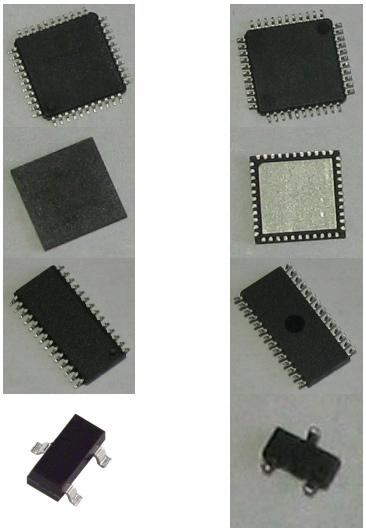

With a wide range of smd components that can be mounted, it is easier to stock up this pcb adaptor for future prototyping use.

The following article is about getting my smd microcontroller PIC24FJ64G004 soldered onto this board. After which I will be on my way to do prototyping for my new control circuit.

This smd adaptor origined from PIC-CONTROL. For other type of adaptors, you can also refer to other manufacturer as mention above.

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<Step 1>

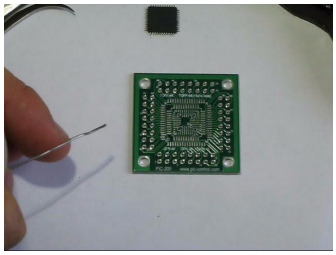

Before soldering, ensure that the soldering pad on the PCB is free of oxidation. PCB is usually tinned to protect the copper surface from oxidation. In cases where the surface is oxidized, you can try cleaning the surface with a contact cleaner. Apply the solution with tissue paper or toothbrush to clean up the contact. This solution make the PCB board rather oily, which I don't quite appreciate.

Contact cleaner.

Let us start our smd soldering here. Soldering surface mount component. The first important thing to introduce would be the solder.

There are many type of solder. Choosing the correct solder takes a bit of some knowledge too. Leaded or lead free solder? The industries is moving towards Pb free components & PCB, calling for unleaded product. Lead is toxin and not environmental friendly. I would advise ou to wash your hand after soldering or

handling pcb board. A soldering fume extractor to vacuum the smoky fume would be quite comfortable for your soldering. The smoke is quite choking and a health hazard if you breath that in.

soldering fume extractor.

Solder also comes with a variety of metal alloy combination. Nowadays it is common in solder core to contain flux. If the solder do not have the flux in the core, the flux have to be manually applied onto the metal surface before the soldering beginning. The flux cleans up the soldering surface, and also make the solder flow rather smooth like liquid. One of the important ingredient to make a good solder joint lays in the soldering flux.

Solder wire also comes in a wide range of diameter to choose from. Generally I use 0.8mm soldering wire roll with flux at the core. Smaller diameter solder wire allows you a better control of the amount of solder to apply. For soldering larger pins or connector component thicker diameter wire will be preferred. Wire too thin is rather troublesome, because you need to feed in a longer length of solder in order to solder the large surface/lead. For general purpose PCB board soldering 0.8mm wire fits somewhere in the middle. Not too thick nor too thin. For smd components, diameter smaller than 0.8mm is preferred. Using 0.8mm for smd soldering is not of any issue.

Solder wire 2mm

1.2mm

1.0mm

0.8mm

0.5mm

<Step 2>

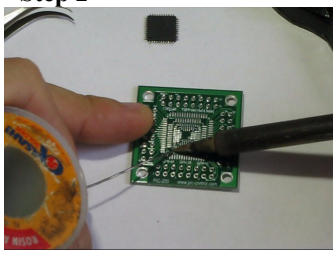
One of the pad being tinned.

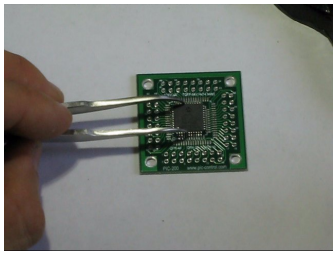
Align smd IC to the respective pad.

My microcontroller TQFP package has 44pins around the square package. To secure the package to the adaptor, I will need to solder one of the pin to the board first. It is important to solder only one pin. In case of mis-alignment, we can correct it easily. If more pins are soldered, it will be more difficult to correct any alignment.

Pin 1 of the adaptor pad is first tinned with a layer of solder. A tweezer is then used to align the IC chip on the pad. The IC is secure to the board with a slight touch from my soldering iron, soldering the IC pin to the pad.

The important factor to consider would be the heat generated by the iron. I prefer to use a 60W iron, which still works well in air-con room. A lower wattage or fine tip iron will not heat up that well in colder environment.

Goot TQ95 60W

If you prefer a fine tip, perhaps the soldering station will be more suitable. The iron temperature can be adjusted to a higher or precise temperature for the component that you want to solder. Component with thick metal contact like connector, heat sink, for thick cables should be solder with a

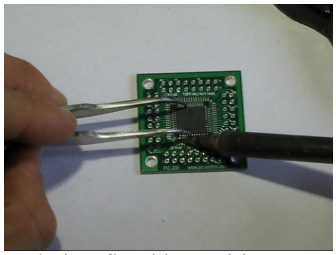
IC being fixed in position

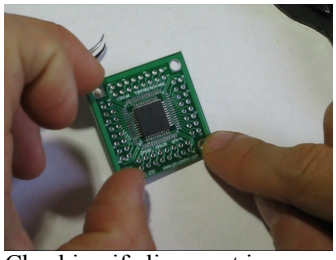
Checking if alignment is correct.

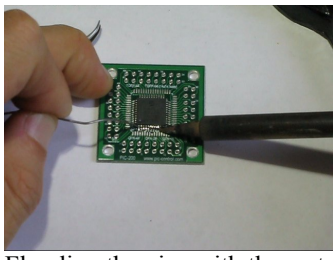
Flooding the pins with the rest of the solder.

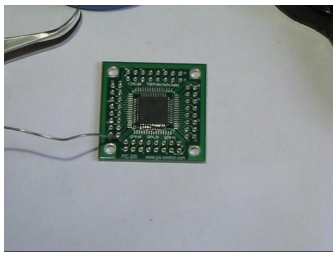
Pins flooded with solder

<Step 3>

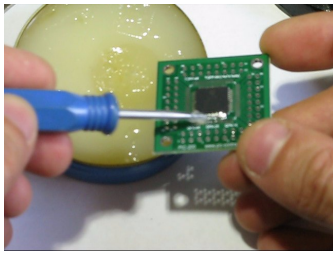

higher temperature. The iron should be held on longer, in order to have the component fully heated up before any solder is applied.

Solder Station

For soldering the IC pin to the pad, you can start off by heating up the pad. Then while heating up the pad, touch the IC pin and apply the solder wire directly to the pad or IC pin, allowing the solder to flow like liquid. The IC pin is heated last to minimize the chance of over heating the pin. If it doesn't flow very well, you can manually some flux to the joint. The solder wire should not touch the iron directly, because this will vaporize the flux, and solder flow will be restricted.

Heat up the lead and pad longer allows the solder to flow and form a good joint. Not for too long as it can also damaged your IC. You should be able to see the solder flow eventually onto the lead & pad. With a bit of practice, you will see the difference between a quick solder touch and another one with lead & pad heat up a little bit longer. It takes a number of practice to get a good joint with minimum amount of heating time.

The soldering iron that I use has rather thick tip, but that does not matter when I do soldering for the smd microcontroller. All we do is to flood the pins with solder. They can be be suck up later.

There is a technology known as ultrasonic soldering. The soldering iron tip has this micro vibration which helps the solder to flow more easy without much use of flux. It can also solderthose difficult to solder material. The following is one article that I found that describe about it. - Soldering the unsolderable.

I have applied more flux at this stage. It should have been applied before flooding the pin, but it doesn't matter too much. The flux will make the solder rather liquid so that it is easier to suck up the excess solder.

solder flux paste

Baker Soldering Fluid

<Step 4>

The flooded solder is being heated up, and the excess solder are being sucked up.

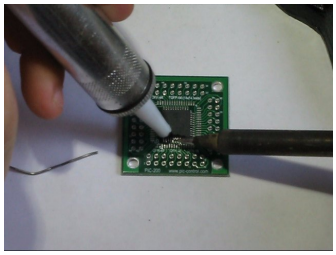

<Step 5>

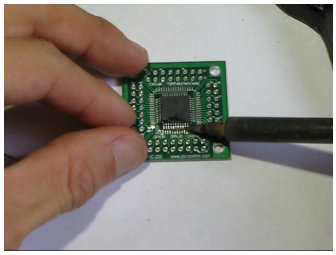

Each pins is being touch up, ensuring that the pin is solder to pad and that they are not bridged across to the adjacent pins.

Now we have got our smd component soldered onto the board.

<Step 6>

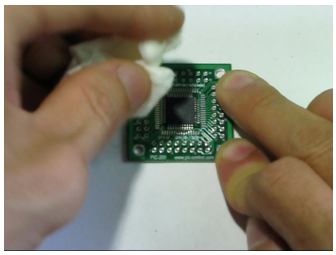

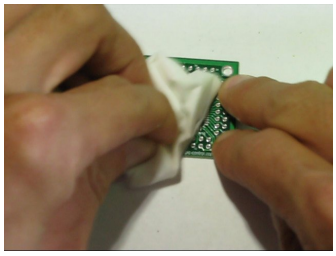

The flux helps a lot in doing a good solder but it often leaves the board with tiny dots of transparent strain, a bit sticky, also known as grease or flux residue. The board looks untidy with these tiny bits of grease.

These are the various recommended cleaning solution for pcb.
- 50% Alcohol + 50% Water
- Thinner
- Flux remover
- Multicore Prozone MCF800
- Solvent-> Bromopropane; propane, 1-bromo-; propyl bromide (Chemical Formula: C3H7Br)

Alcohol MSDS (Material Safety Data Sheet)

Thinner MSDS (Material Safety Data Sheet)

Electrolube, FLU Fluxclene Cleaning Solvent, pdf file

MG Chemicals 413B Heavy Duty Flux Remover

Brush for the crush

Flux Remover

Multicore Prozone MCF800

Besides using chemical, or after using chemical, there may still be some white blur stain. Those are flux spread dry up on the surface. Using a hot air blower, or heater on the surface can melt the dry up flux, and recover the smooth shiny PCB board surface again. Clean away the melt flux immediate after the heat.

Using alcohol is strongly recommended. Thinner is not suitable for certain plastic/material. Care is required when using thinner for cleaner. Using thinner on the PCB, copper pads and soldering joint isn't a problem. When use on plastic, you are advise to do a trial to ensure that the material is able to with stand thinner solution. Flux remover is commercially ready mixed solution. From what I learn in the manufacturer website, they are non-flammable chemical solution.

Alcohol & thinner has a lower flash point, and catch fire easily. You have to be extremely in handling and storing these flammable chemical. Do not store or work on the chemical near electrical appliances, hot area or things that can cause spark. Keep your windows open to allow air to circulate while working with these chemical. They may cause headache, dizziness and uncomfortable when inhaled.

Chemical comes in different level of grade. A slight different in the chemical concentration or purity can results in a large difference in cost. Alcohol can be expensive. For pcb cleaning purpose, request for technical grade alcohol. Higher grade alcohol is typically used for consumption or lab experiment purpose. Since we are using it for cleaning, there is not much advantage in using high quality chemical which is expensive. Dickson chemical is specialized in high graded chemical for laboratory use. They do sell lower cost technical grade alcohol. They are not suitable for consumption but is ok for cleaning application.

Dickson Chemicals Dickson Chemical selling Technical grade alcohol

You can easily buy thinner from your local hardware. Typically used for cleaning your brushes after all the wall painting works.

The Science Of Zephyrtronics Non-flammable Flux remover

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These are other recommendation in the web. After researching further, I would advise not use them. These chemical are of health hazard. Exposure will have severe adverse health effects.

- 50% isopropanol + 50% water
- Trichloroethylene
- Carbon tetrachloride

Isopropanol (true chemical name) is also known as Isopropyl alcohol or 2-propanol. 2- is refer as Iso. Other chemical may starts with 1- refer as N. These are some jargon used in the chemical industrial. I managed to learn a few of the terms from the vendor.
Trichloroethylene (true chemical name) is typically used for degreasing the metal. It is an extraction solvent for oil. Another name for Trichloroethylene is Trielin. Based on some read up, they can cause cancer.
http://www.answers.com/topic/trichloroethylene

Carbon tetrachloride can harm our environment, producing CFC which deplete the earth's ozone layer. http://en.wikipedia.org/wiki/Carbon_tetrachloride

Initially I tried using contact cleaner to clean the stain off. I use cloth or tissue but the fabric is often tear by the component sharp edges. Most corners are not easy to reach. Later on I tried using a toothbrush, the result is better.

For mass cleaning job, you can try using the ultrasonic pcb cleaner. It is a deep metal container for the solution, using micro vibration to shake off the dirt. I have never tried on it before, and I believe it is the same machine people used for cleaning their jewelry. Basically, you will need to dip the pcb board into the solution, and the ultrasonic will be activated to do it's job. The solution used is the same as manual cleaning, requiring 3-5 minutes of cleaning.

Ultrasonic cleaner

Ultrasonic jewelry cleaner

There is also a flux that does not leave residue on the PCB. I found it on the internet, and have not try it before.

INTERFLUX, IF 2005M No-Residue™ flux, pdf file

Article relating to removing flux residue:

- pcb cleaning - Aqueous Cleaning Process.pdf
- pcb cleaning - Flux Removal, nuxx.pdf
- pcb cleaning - pcb cleaning article.pdf
- pcb cleaning - PCB Cleaning, Printed Circ.pdf
- pcb cleaning - pcb washing chemical composite.txt
- pcb cleaning - remove solder flux.pdf
- pcb cleaning - Solvent washing PCB boards.pdf
- pcb cleaning - washing the board using alcohol.pdf
- pcb cleaning - PCB cleaning article Inventec_S24_03.pdf

<Step 7>

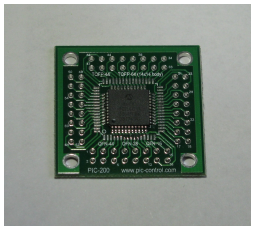
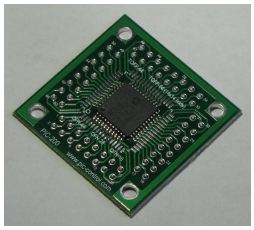

A close up view of the clean and neatly soldered surface mount IC on the prototyping adaptor. Soldering smd components is simple and fast with a bit of practice. Small and easy to clean up. There are too many advantage in working with surface mount, compared to through hole components.

This is the end of the short demonstration on smd soldering. I hope these article can provide you some insight and confident to start experimenting circuits using surface mount components.

Video available. Please click here,

smd soldering.mpg (25MB)

smd cleaning pcb.mpg (5.5MB)

Article on smd soldering.
- 2010-07 How to Solder Surface-Mount Devices.pdf

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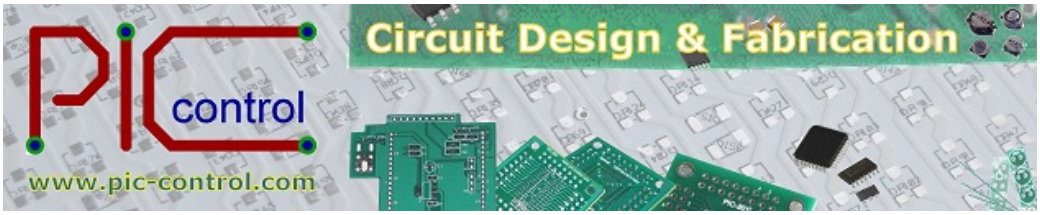

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Various Chemical Reference:

Alcohol 70% + Distill Water 30%
MDX4-4159
7MHFE-71DE

Cyclohexanone
Methylethylketone
ethylacetate,
Silicon Wacker
Wacker M4503, General purpose mould making silicon (Using Two Part Silicon Mold Putty to Make Molds)
http://www.kirkside.com.au/, Mould Material Specialist

Propanol, used to clean PCB. (close to white electric oil)
Acetone, remove away ink printed on PVC stickers
n-Hexane (white electric oil)

smd glue for surface mount component mounting / soldering use
Seal-glo NE series, NE3000S, NE8800T, more Seal-glo

email: mail@siongboon.com
website: http://www.siongboon.com

Keyword: surface mount soldering, smd adaptor, smd to 2.54mm convertor

Surface Mount Soldering Procedure

We believe that the following procedures describe the simplest way to reliably assemble surface mount components without special tools. The only tools required are a pair of fine-tip tweezers, a rosin based flux pen, rosin core solder (.025” dia. preferred), and a soldering iron with a small, clean tip. A spool of fine (0.075”) solderwick will come in handy if you need to rework connections. You will need isopropyl alcohol, cotton balls, and cotton swabs for cleanup. If you have access to hot air rework tools and the skill to use them, feel free to use them instead.

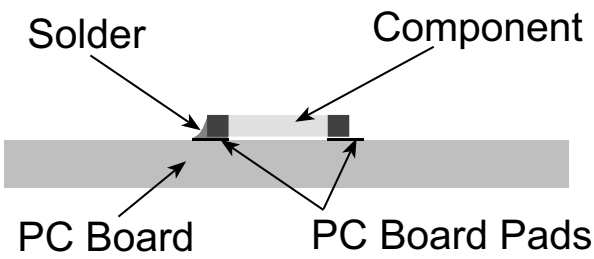

A proper solder joint with fillet

Proper joints

Poor joints

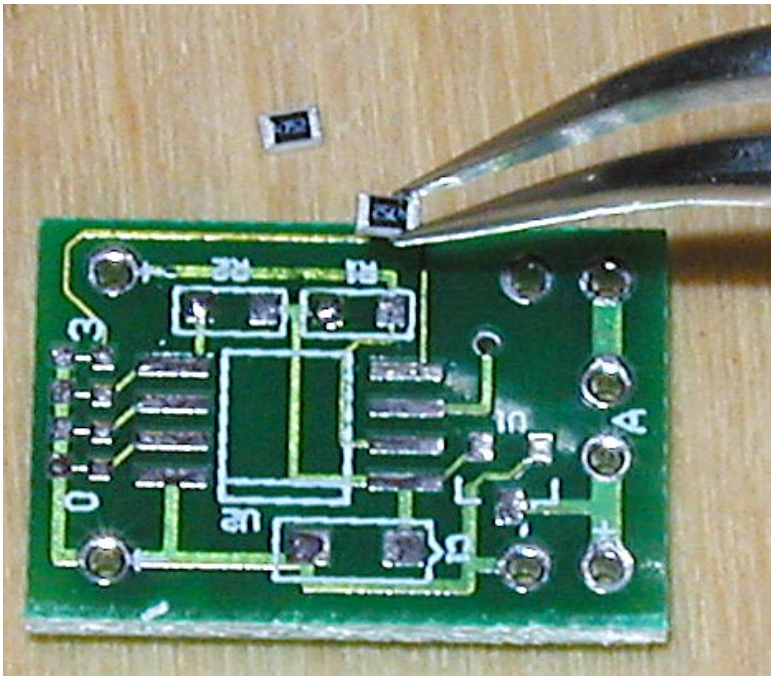

Placing the component

Soldering surface mount components is not difficult, but it does require good eyes, a steady hand, and a soldering iron with a small, clean tip. The illustrations at the left show a proper and a poor solder joint. In the proper joint, the flux has “wetted” both mating surfaces, allowing the molten solder to adhere to both the printed circuit board pad and the component lead. In the illustration of the poor connection, insufficient heat or flux has forced the solder to ball up on the end of the component, without making it to the PCB pad. The component is not attached properly, and the electrical connection will be intermittent at best. This connection can be salvaged by applying flux and heat to the PCB pad to get the solder to flow to the area between the pad and the component.

The most important characteristic of your soldering iron is that it must be equipped with a *small, clean* tip. If the tip is too large or is covered with oxidation, creating a well-flowed solder joint will be nearly impossible. Wipe your tip on a sponge before each joint - it must be shiny and well-tinned in order to transfer its heat properly.

You will find it easiest to work on your board if you clamp it in a moveable vise or stick it to a small block of wood with double-stick tape. This will allow you to rotate the board to whatever angle is most comfortable for access to the component being installed. If you try to hold the tiny parts at awkward angles, you will not have good results!

The first step is to apply a small bead of solder to <u>one</u> of the PCB pads for the component to be installed (the left-hand pads of R1 and R2 in the photo at right). The bead should be approximately 0.020” to 0.030” high (you may want to reevaluate your bead size after you have completed several joints). Apply some liquid *rosin based* flux from a flux pen to the solder bead and to the other pad(s) for the component.

Next, using a pair of tweezers, pick up the component to be installed and place it over the appropriate pads.

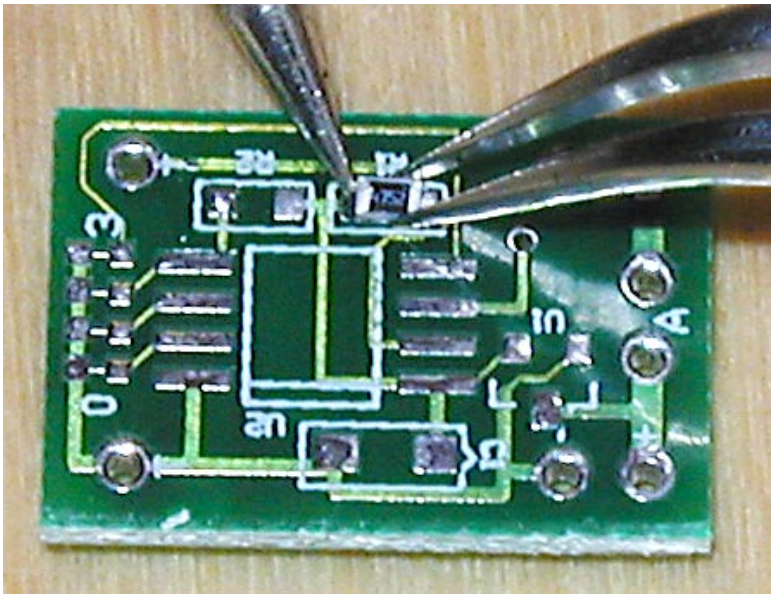

Affix the part by reflowing the first solder bead

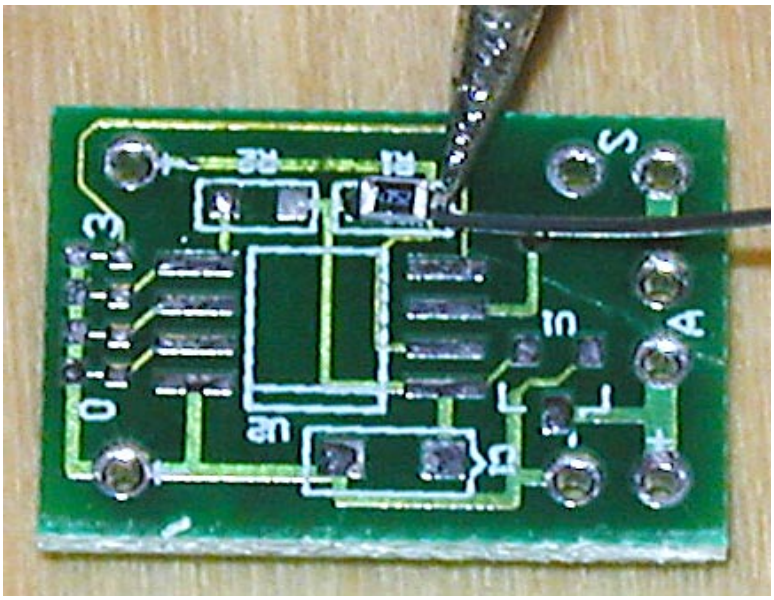

With the part in position, solder the other end

With the part in position, move the soldering iron to the solder bead on the PCB pad. Apply a small amount of heat from the iron to flow the bead, simultaneously lowering the part against the board and correcting for any rotational misalignment. Remove the iron and allow the solder to cool. Inspect the joint -- at this point you are not concerned about the quality of the actual solder joint, just the positioning of the component. The part should be flush against the PCB, with both ends properly contacting the pads. The part should be straight, and centered between the two pads.

Apply a liberal amount of liquid flux (again, a flux pen is the ideal applicator) to both ends of the component. Heat the currently unsoldered end of the component and the adjacent pad with the soldering iron, and carefully wipe on a small amount of solder. You want a small fillet as shown in the earlier illustration, not a large glob of solder. Make sure that the solder has flowed onto the pad as well as the component lead - don't be fooled by a lump of solder on the end of the component that doesn't flow under the component and onto the PCB pad.

After the second end is soldered, go back to the original solder joint and reheat the solder. The flux will allow the solder to flow freely, and a good fillet should be observed. If there seems to be insufficient solder, add a little more. If either of the ends appears to have an excessive amount of solder (a large blob sticking up above the part) it can be removed with solder wick. Apply flux to the blob and the wick, position the wick over the blob, and press lightly on the wick with your iron. As the heat is conducted through the wick the solder blob will melt and be drawn off by the wick. You may end up removing too much of the solder, in which case you can reapply a *small* amount of fresh solder to the joint.

After the joints have cooled, inspect them carefully to make sure that they are solid and make contact with the board. If you have any doubt about the quality of the connections, apply more flux and reflow the joints until you are satisfied.

The same procedure is also used for installing components with three or more leads (transistors, ICs, etc.). Start with a bead of solder on one pad, position and "tack" the part, then add more flux and solder the remaining leads. Don't forget to reflow/improve the first "tacked" connection if necessary.

Electrical Wire soldering For Beginners

by Randy Glass

DISCLAIMER- First, soldering can be dangerous. This lesson is not meant to be everything you need to know. Your safety is up to you, and you take full responsibility for any damage or injury caused by these instructions, whether as an act of omission or commission on your part or mine. Be aware that an improperly soldered wire can lead to fire, loss of vehicles, injury, and even death. By reading and/or using these instructions you take full responsibility and release me from all liability. Second, I took these photos as I did the work, pressing the remote control for my camera with one finger as I held the soldering pencil in one hand and the solder in the other. I apologize for any images that might be out of focus or poorly composed.

If Yogi Berra ever wrote a book on motorcycles he would probably say, "We seem to spend around forty percent of our time taking things apart, and the other seventy-five percent of the time putting them back together." Some things are easy to put together. We use specialized fasteners like nuts, bolts and screws to hold things together that, some day, we might want to take apart again. But there are some things that, once put together, we would like to know that, to some degree, our fastening system is permanent. One of those places is in electrical wiring. When a wire breaks or needs to be fastened to a connector or another wire in such a way as to be dependable, then the very best way is to solder.

soldering is a method to attach one metal part to another. It is part of a family that uses molten metal to do this job. At the top of the ladder is welding. This is a very high temperature method that actually melts the parts a bit where they are attached, along with some other metal, usually in the form of welding rods. Next is brazing. This melts some hard metal, usually brass, into the gap between two pieces of metal. Normally, the surface of the material being joined is not melted in this process, but it gets very, very hot. Finally there is soldering. soldering flows some molten metal between metal parts at relatively low temperatures.

For our purposes I am going to speak of the type of soldering that attaches two wires together or one wire to a connector- the sort of soldering that any backyard mechanic might need to do when working on any electrical component or the wires that connect them together in almost any type of vehicle.

WHY solder?

Although there are methods that can be used to make these connections without soldering, they are usually inferior. soldering does a lot of things:

1) It Is Strong- You are connecting two metal parts with a liquid metal that becomes solid after it fills the joint and cools. When properly done it leaves no voids so the joint is very strong and the wire is well supported.

2) It Slows or Stops Oxidation - Because solder fills the joint it excludes air and moisture so the metal in the joint will not oxidize. This maximizes electrical flow over time.

3) It Makes An Excellent Electrical Connection- because the solder is a conductor it gives the wire more area from which it can flow electrons to whatever it is connected.

4) Non-permanent - Although soldering is very strong, it can be removed and the joint taken apart in the future if necessary.

5) Connectors do Not Need to be Crimped - Those little metal connectors that are designed to be crimped have a terrible habit of coming loose as well as breaking the little copper wires in the conductor making a weak joint as well as one that does not conduct as well as it should. They easily let air and moisture in which causes corrosion and that leads to poor and broken connections.

MATERIAL LIST

It doesn't take much to set yourself up as a soldering wizard. Here is a list (numbers refer to image to the left):

*1) **soldering Pencil -** Something around 25 to 40 watts would probably be fine for most electrical work. You don't need a huge soldering gun to do electrical work. A little smaller is actually better than too big, as we shall see. Get a brand-named pencil so that down the line you will still be able to

get replacement tips for it. A chisel tip as seen in the pictures that follow is best for most work but you might also need a pointed tip for more delicate work. Those old soldering guns are nice for making battery cables, but are generally too large for what we are doing. it would be like using a sledge hammer to make a picture frame- it would have to be a REALLY big picture frame!

There are also cordless, rechargeable soldering irons available. They generally run about $35-75 or so. Although these cost substantially more than a corded iron, and the replacement tips are more expensive as well, there is no cord to get in the way when working and as they can be carried along on trips. These generally have a built-in light as well making repairs at night easier. I normally loosen the lamp so that it does not light, so the battery lasts longer in use.

There are soldering tools that are actually little, refillable, butane-powered torches with a soldering tip at the end which is heated by the flame. As they are about the size of a fat ball point pen, they are another good way to get a portable soldering tool. These generally are available for less cost than the rechargeable irons mentioned above. I have used electric irons to solder around a gas tank on an automobile- something that I would never consider with one of these.

And a **soldering Pencil Holder** - Most soldering pencils come with a holder or a rest as seen here, but if not, get one. These metal stands are very handy and will help avoid melted parts and burned hands and work surfaces.

*2) **solder** - Resin core solder is what you want. NEVER use acid core solder on electrical components. The acid will stick around and continue to eat into components and wiring well after the soldering job is over.

Resin core solder can be had in various quantities, but I buy the one pound roll for around $12-15 which will be a lifetime supply for most folks. I use Kester brand "44" Resin Core solder in the .031 diameter size. This is about the size of mechanical pencil lead and works quite well for what you will be doing.

It use to be that a standard part of a soldering kit was a little tub of flux. This paste would be spread on the joint ahead of time to help clean the joint chemically as it was heated by the iron. It was necessary as flux-core solder was unavailable. If your wires are clean and you are using a quality, resin core solder, additional flux is not necessary.

*3) A**n Old kitchen sponge** or two

* **Tools** to work on wires such as a (4) wire stripper and a (5) wire cutter, and possibly needle nosed pliers and a small vise (not shown).

* 6) A few bits of **insulated wire** and an old spade connector or two on which to practice. Two or three feet of wire will do.

*7) **Heat Shrink Tubing** - I rarely use electrical tape any more. Heat shrink is really great! I usually buy it in three foot lengths in two or three sizes. This is a sort of memory tubing that, I believe, is made by heating a special tubing and stretching it and allowing it to cool while still stretched. it maintains that size. When heat is applied once again the tubing will shrink back down to its original size.

*8) Protection for the work surface like an old piece of 1/4" plywood about 12" square or such. An old piece of counter-top lamination works also.

* Wicking material (not shown)- You can purchase some special copper wick that is used to unsolder joints. This is usually not necessary, but handy at times, and inexpensive.

* **Eye protection**

* A Ventilated workspace

SOME WARNINGS

HEAT - A soldering pencil as well as molten solder are both really hot. They will burn you and it will hurt. It can hurt a lot. It can make your skin give off smoke and that smells bad. If left unattended a hot soldering pencil can cause fires, melt carpeting, burn workbenches, and make the cat dance like never before. An unsuspecting person can pick up a hot soldering iron and get a nasty burn (trust me on this one!). Never leave a soldering tool warming or hot and unattended.

Additionally, a hot soldering iron can almost instantly melt plastic parts and upholstery in a hurry. Use care when soldering as well as when moving the iron to and from the solder joint. If the cord gets caught when moving the iron it can easily cause you to drop the hot tool onto something expensive or painful. NEVER place a soldering iron on saddles, luggage, body work, painted surfaces, or on or near any heat-sensitive surface.

LEAD and VAPORS- solder contains a good amount of lead and handling it over a long period of time may have negative health consequences. The vapors caused by soldering can, over time, cause health problems as well. Work in a well ventilated area. I usually work out doors and use a fan to blow the vapors away from me. The smoke that is given off by the flux in the solder is also not a good thing to breathe.

MOLTEN METAL - When soldering (and particularly when un-soldering) it is very possible to flick bits of melted solder about. As this stuff is quite hot, even a small drop in the eye can cause permanent damage. Wear eye protection and do not wear your good glasses, or wear them under goggles. The dripped solder can melt plastic parts and permanently damage auto carpeting as well. Be aware of other folks or critters who may be in the area as well.

ELECTRICITY - You will be soldering on wires that, if shorted out, could cause a blown fuse, damaged electrical components, or melting wires and a fire. Always disconnect the battery when soldering wires on a vehicle and remove connectors from heat-sensitive components before soldering on them.

LETS GO

I could spend a lot of time talking about how it all works, but jumping right in is the best way to learn how to solder and I will explain as I go

Begin by creating a safe work area. One free of clutter, with sufficient light, and protected from the soldering iron and melting solder. Set the soldering pencil in its stand and plug it in. be sure that the cord is placed in a way that it will not be accidently pulled or tripped on, upsetting the soldering pencil.

While that is heating up, prepare your sponge. Wet it, squeeze out the excess water, then fold it in

half and rubber band it about half-way down.

Pull out about a foot or two of solder from the roll and touch it to the tip of the soldering iron. Always apply the solder to the flat parts of the tip and not to the sides. When the solder melts fairly easily, melt an amount all over the tip. There will be some smoke from the resin in the solder.

The solder you bought is actually a bit hollow. Inside of the metal there is a channel (or in some cases, channels) that make it sort of like a little garden hose. The channel is filled with a resin. When heated it melts and some of it burns off. The action of the resin when it is heated helps clean the surface to be soldered which helps the solder stick a lot better. Unfortunately, the burned resins can also leave deposits on the soldering pencil, and over time will make it difficult to solder. That's where the sponge comes in. After you have melted some solder onto the tip (about a quarter inch or so of the thin stuff) wipe the soldering pencil's tip off on the damp sponge a few times.

If you examine the tip of the soldering pencil carefully you will see that it is now covered with a thing coat of shiny, silver metal- the solder. You have successfully "tinned" the tip of the pencil. This keeps the metal tip from oxidizing and will assist you in soldering from now on. Always do this before starting a soldering job and occasionally during a larger job.

Place the soldering pencil back into its holder and let's prepare the wires. We are going to solder two wires together, making believe they have broken or need extending.

We start by "stripping" some of the plastic insulation away from where we want to connect the wires. The thicker the wire the more insulation we remove. For most common wires on a motorcycle or in a car, removing about 3/8 to ⅛ inch works fine. You will get a

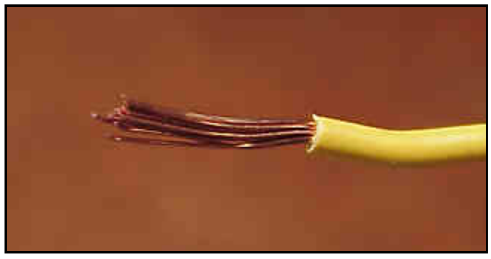

feel for how much in a short period of time. When stripping wire be very careful not to cut the strands of the conductor.

There are special tools available for stripping wire that can save a lot of time. These can be as simple as a carefully wielded razor blade to fancy and somewhat expensive automatic strippers.

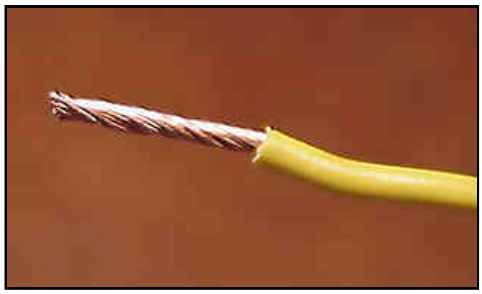

Once stripped, twist the strands together into a neat little bundle.

The exposed wires should look fairly clean and in most cases, shiny, but certainly not green or cruddy. If corroded, then the wires should be cut back and re-stripped until clean wire is found.

Now cut a length of heat shrink tubing off about an inch long. It should be of a large enough diameter that at least two of the wires you are soldering can easily fit into it at the same time. Slide the length of the tubing over one of the stripped wires- it doesn't matter which here, but in real life we would slide it over the lower wire or the one which slopes most downward away from the joint so it will tend to slide out of the way. make sure it is at least three or four inches away from the joint.

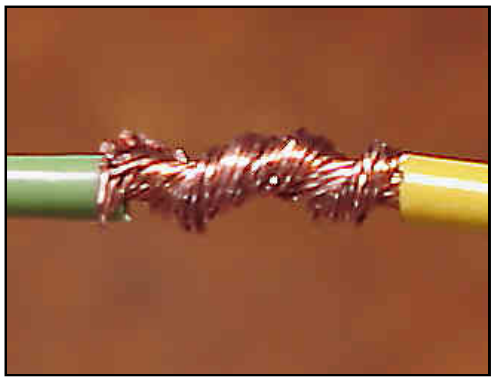

Now, twist the two wires together into a tight, neat pair. This is important because it helps create a good electrical connection. You also do not want any little wires sticking out. Start by crossing the wires about mid-strip, crossing them at about 45 degrees or so, and twisting in opposite directions. When done, the joint should be fairly strong on its own, holding the two wires together tightly. The connected pair of wires should be in line as if they are a single wire and not two joined together.

It's time to solder. Place the roll of solder on your left (if you are right handed) with a good length of solder hanging out of the roll. With the solder in your left hand and the soldering iron in your right hand, check to see that the tip is still tinned and shiny. If not, repeat the process with a bit of solder melted to the tip, then wipe the tip off on the sponge.

Melt a little ball of solder onto the iron....

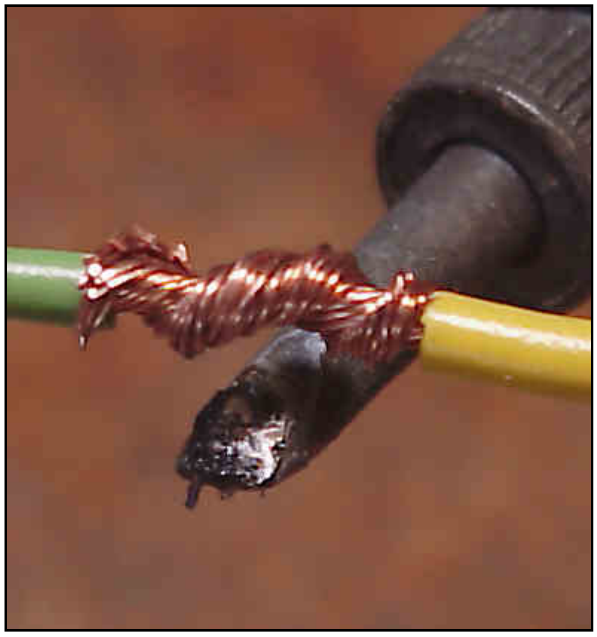

...and immediately place the soldering iron under the twisted wires (if possible) so that the little ball of solder fills much of the gap between the soldering pencil and the wire. Since heat rises, placing the iron under the joint will heat it faster. The little ball of solder works as a heat conductor and will very rapidly conduct the heat from the soldering pencil's tip into the wires. If the ball of solder does not seem like it is contacting the wire very well, without removing the pencil from the joint, melt just a bit more solder in there by feeding the end of the solder wire into the tip. This will not only increase the contact area of the solder to the wire but it will also add a bit of flux that helps the solder adhere to the wire at this time.

After about two or three seconds, start to feed solder, slowly at first, into the void between the pencil and the wire. You should soon see the solder is flowing into the twisted wires. WHen that happens, increase the feed rate of the solder into the joint, and you can now also feed a little into the top of the joint. Don't move the iron's placement, jut take the end of the solder wire and touch it to the tip of the joint. Continue to feed solder until the individual wires are almost filled with solder and the entire joint has turned silver. When that happens, stop feeding the solder in and immediately but gently remove the soldering iron.

How long do you wait until feeding in solder? One way to test how long to wait is to touch the solder on top of the joint and wait until that area is hot enough to melt the solder. The amount of time it takes varies with the size of the wires to be soldered, the size of the solder, the wattage of the iron, the size of the irons's tip, the ambient air temperature, and other factors. Experience will teach you how long this takes.

The problem comes from waiting too long and putting too much heat into the joint. When you do that it begins to melt the insulation on the wires around the joint (you can see that beginning to happen above at the end of the insulation of the green wire next to the soldered joint). That is why I like tho flow the solder in from where the iron's tip touches the wire. This is the place that will come up to soldering temperature first, and then the flowing solder will more easily flow solder into the joint as it carries heat with it. The larger the wires, the longer it takes and the more important it

becomes to feed in some solder from the top of the joint as well. Again, experience will teach you when that is necessary.

How much solder is enough? Too much? The correct amount of solder is used when the joint is fairly all silver colored but still shows the "outlines" of the individual strands of wire in the joint. If there is very much in the way of copper colored wire showing then you probably didn't use enough solder or the wires weren't clean and would not accept the solder. If there are big blobs and drips of hardened solder on the joint then you probably had either too cool of a joint or used too much solder.

After soldering, let the joint cool for about thirty seconds to a minute or so before handling. If you were successful you should have:

* A pair of wires tightly joined together

* The joint between them is very shiny, looking like polished sterling silver.

* No hardened dribbles or drops of solder hanging off the joint

* No little wires sticking out of the joint.

* A union only slightly larger than each of the wires themselves.

If you were NOT successful you might see:

* Large blobs or possibly a long, pointy finger of hardened solder hanging off the joint. Sometimes, after cleaning the iron, these can be removed by simply heating the joint until the solder melts, then removing the iron which will pull away some of the excess solder with it. This may need to be repeated a few times to remedy the situation.

* Wires that are not soldered together and has movement within it. Re-heat the joint and add some more solder.

* Melted insulation. This can be so bad that the wires are revealed with the insulation dripping off the wires. At this point you will probably need to cut the wires and begin again, or unsolder the joint and add a long piece of heat-shrink tubing to cover the exposed wires.

* Little ends of the copper wires sticking out. These can sometimes be cut off with a wire cutter and/or pressed down with a pair of smooth-jaw pliers, possibly needle nose pliers.

Now it is time to cover the joint with the heat shrink tubing. You DID remember to slide on the heat shrink tubing before beginning, didn't you? Once the joint is cool enough to touch, slide the tubing so it is centered over the joint and gently touch the meaty part of the soldering iron's heating element to the center of the tubing.

Continue this around the center of the tubing until it tightly grips the wire joint, then work outwards until the entire piece of tubing has shrunk tightly around the joint.

Attaching An Electrical Connector

Besides connecting two wires together, soldering is the best way top attach some sort of connector to the end of a wire. The connection is strong as well as fairly well sealed against the elements. It works pretty much the same way as above...

Remember when we "tinned" the tip of the soldering pencil? We did this to apply a film of solder to the tip so it wouldn't oxidize and thus be able to more easily transfer heat. Now I am going to do the same with a piece of wire.

Here I am applying a good amount of solder ahead of time to this wire because I am planning on soldering it to a fairly heavy connector. This way, the wire will be "pre-soldered" and easier to attach, and will have less of a chance of melting the insulation.

When soldering a connector to the end of a piece of wire it is very helpful to use some sort of vise to hold the connector. A small pair of locking pliers or a pair of needle nose pliers with a rubber band around the handles to hold the jaws shut works well. Here I have locked a pair of locking pliers into a small vise to work as a "hands-free" holder. This not only allows me to use both hands to work but isolates me from the heat of the soldering process.

Remember that the heavy metal pliers will work as a heat sink, pulling heat away from the soldering joint, so it might take longer to achieve the proper heat level in the joint. That is why I have gripped the connector as far away from the area to be soldered as possible,

Be careful as the pliers may get hot near the tips and you might overheat the wire as well. Be sure to slide the heat shrink tubing over then wire BEFORE beginning to solder! If you leave it off and finish soldering, you will be left with the soldering job in one hand, the heat shrink tubing in the other hand, and a stupid look on your face. We call this, "Heat Shrink Tubing Syndrome."

Additionally, if you apply too much solder, particularly with a small connector, it is very possible to fill the connector with solder and thus make it difficult or impossible for the connector to function properly. There are ways to

get the solder out, but they are generally more difficult (or dangerous) than just chucking it and starting over. To keep this from happening:

* Never touch the area of the connector where you don't want solder to flow
* Orient the connector with the part where solder shouldn't flow, upwards (or Higher than the end where solder will flow).
* Apply solder sparingly and slowly
* Use a lower wattage soldering pencil
* Use a smaller tip on the soldering pencil

I sometimes use two pieces of heat shrink, one over the other, shrunk one at a time, in areas where extra protection is needed. This is particularly useful when soldering a connector to the end of a wire. I first shrink a small diameter piece about an inch long over the wire up to where it joins the connector as shown here. This acts as a strain relief as well as insulation.

Notice the small amount of flux on the connector ring left over from the soldering process. If you use resin core solder, this stuff is harmless to the electrical device. It can be brushed off with a small wire brush if you wish.

I then shrink another larger diameter piece about ⅓ an inch long over the connector to act as an insulating cover. In the case of something like a female spade connector, the entire connector except for the opening can be covered and protected in this way. If the heat shrink interferes with the connection, simply cut the offending part away with a razor blade being careful not to damage anything else including yourself!

In areas where the joint needs to be protected from corrosion, slather the terminal with petroleum jelly, or the special grease for this application.

Following these directions you will become a "master solderer" in a short period of time. It takes some practice to get a feel of how hot for how long with how much solder it takes to create to make a good solder joint, so get some scrap wire and practice before attempting to solder on anything important.

If there are any questions or comments, please feel free to E-mail me at frcn@cncnet.com.

Note by Duane; If you appreciate articles like this, I suggest that you thank Randy at the email address above.

More BMW info

Home page

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Soldering and Desoldering Instruction

Soldering is defined as "the joining of metals by a fusion of alloys which have relatively low melting points". In other words, you use a metal that has a low melting point to adhere the surfaces to be soldered together. Soldering is more like gluing with molten metal than anything else. Soldering is also a must have skill for all sorts of electrical and electronics work. It is also a skill that must be taught correctly and developed with practice.

Remember that when soldering, the rosin in the solder releases fumes. These fumes are harmful to your eyes and lungs. Therefore, always work in a well-ventilated area. Hot solder is also dangerous. Be sure not to let is splash around because it will burn you almost instantly. Eye protection is also advised.

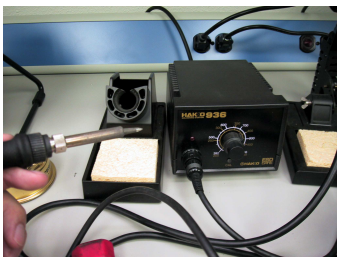

The Tools

Soldering Iron – Even the cheapest of them will do the job. They may not last as long, but they do get hot enough to melt solder and that is the goal. You only need to make sure that the one you buy has a suitable tip on it. The most typical tip is the one that is about the size of a 1/8" stereo mini-plug.

Solder – Get Rosin Core solder. Rosin will help the solder to flow onto the wires. Solder comes in different thickness. Buy what is appropriate for your job.

Desoldering Gun – This tool will make life a lot easier when you need to rework a previous solder job.
Solder Wick – Braided copper with rosin coating used to draw solder off of circuit boards.

SMD Rework station— Basically this is a high temp hair dryer with special nozzle attached. It heats up entire pins of the SMD device so you can remove them.

The Methods

Soldering – There is not art to soldering, it takes patience and practice to get it right. If you are doing it right, it will be easy and very fast. First, make sure that your soldering iron tip is clean. If it is dirtier than just a light gray color, you need to clean it. You can do this with sandpaper or a Scotch Brite pad. Next, turn your iron on and give it plenty of time to heat up. To test the heat, use a piece of solder touched to the tip. If it melts immediately, it is ready.

The most common way to mess up a solder job is to let the soldering iron stay on the parts to be soldered too long. What this does is oxidize the metal, making it too dirty to attract solder. If you are working with a circuit board, too much heat can damage the board, rendering it useless and in need of repair. You should only hold the soldering iron to the parts to be joined for no more than 10-12 seconds. Any longer and you will melt insulation on wire or damage a circuit board.

It has been said that soldering is a two-person job. You need two hands to hold the parts together, one hand to hold the iron, and another to feed the solder. The correct method for applying solder is to hold the joint perfectly still while heating with the soldering iron. After a few seconds, introduce the end of the solder at the point where the iron meets the parts

If the solder does not melt immediately and flow onto the joint, pull the solder away and try again after a couple seconds longer. If you exceed 10 seconds, pull the iron off and try again after it all cools down. You probably didn't have the iron touching enough of the parts to be soldered. Sometimes, the parts to be soldered are so big that they conduct the heat away very quickly and make it difficult to solder. In this case, it is OK to put some solder on each part individually and then put them together later by melting the solder on each one while they are touching.

Joining Two Wires - Strip off about 3/8" of insulation from the two wire ends to be joined. Place a ½" length of heat shrink tubing over one wire and push it back so that the heat from soldering won't shrink it prematurely. Fold each bare wire end back on itself so that the tip of the wire now comes back to the end of the insulation. Link both wires together using the bends like hooks. Now, twist the ends of the wires around themselves tightly. This type of connection is called a Western Union and it is the strongest method of joining two wires together. Now, heat the connection with the iron and allow solder to flow over the entire joint. Wait a few seconds for it to cool off and then slide the heat shrink tubing down over the connection and heat it with a match or heat gun.

Soldering a Wire to a Circuit Board – This is delicate work that you will do while soldering. Too much heat and your board will be damaged. If you are attaching a wire to an existing hole on the board, make sure that the hole is clean and free of any excess solder (see de-soldering for more detail). The best advice when soldering to a circuit board is to angle your soldering iron tip so that it makes good contact with the pad on the circuit board and the wire or part to be soldered at the same time. Heat the parts up and touch the solder at the point where the tip meets the part and the pad. If the solder does not flow immediately, pull everything off and wait for it to cool down and try again later.

Step 1

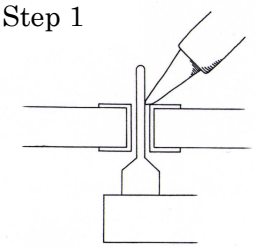

Apply heat to both pin and pad on the circuit board. Make sure tip of the soldering iron is touching both pin and pad.

Step 2

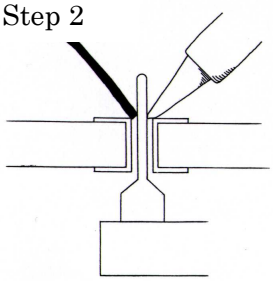

When the both pin and pad are heated enough, apply solder to the pin and pad. Solder should starts to flow.

Step 3

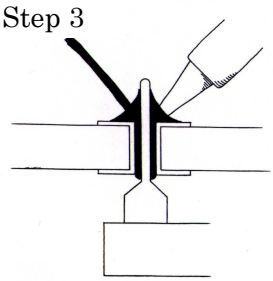

Apply enough but not too much solder. While applying the solder, do not move the tip of iron.

Step 4

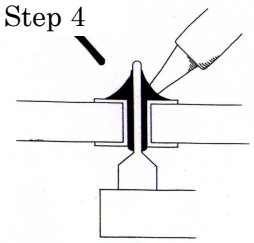

Remove solder away.

Step 5

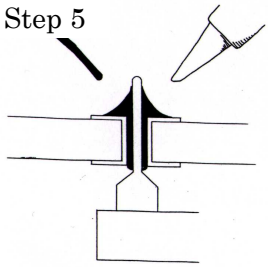

Remove tip of soldering iron also.

Step 6

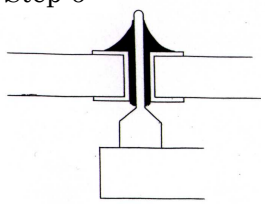

Done! Check the joint to make sure the connection.

Good soldering and Bad soldering Joints

Here are some example of Good soldering and Bad soldering joint.
For Japanese, we often say, “Good soldering joint should look like Mt. Fuji.”

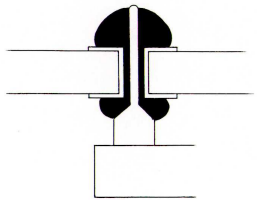

Too much soldering

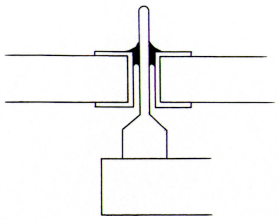

Too little soldering

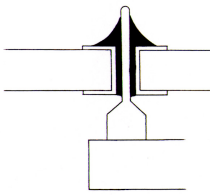

Good soldering

Cold Solder Joints

A cold joint is a joint in which the solder does not make good contact with the component lead or printed circuit board pad. Cold joints occur when the component lead or solder pad moves before the solder is completely cooled. Cold joints make a really bad electrical connection and can prevent your circuit from working.

Cold joints can be recognized by a characteristic grainy, dull gray color, and can be easily fixed. This is done by first removing the old solder with a desoldering tool or simply by heating it up and flicking it off with the iron. Once the old solder is off, you can re-solder the joint, making sure to keep it still as it cools.

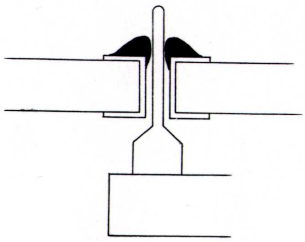

Cold soldering joints

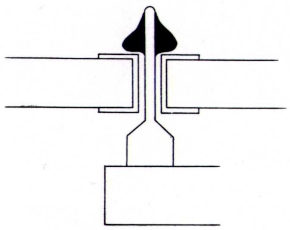

Tips and Tricks

Soldering is something that needs to be practiced. These tips should help you become successful so you can stop practicing and get down to some serious building.

1. Use heat sinks. Heat sinks are a must for the leads of sensitive components such as ICs and transistors. If you don't have a clip on heat sink, then a pair of pliers is a good substitute.

2. Keep the iron tip clean. A clean iron tip means better heat conduction and a better joint. Use a wet sponge to clean the tip between joints.

3. Double-check joints. It is a good idea to check all solder joints with an ohmmeter after they are cooled. If the joint measures any more than a few tenths of an ohm, then it may be a good idea to re-solder it.

4. Use the proper iron or temperature. Remember that bigger joints will take longer to heat up with an 30W iron than with a 150W iron. While 30W is good for printed circuit boards and the like, higher wattages are great when soldering to a heavy metal chassis.

Desoldering

Desoldering is extremely difficult compare to soldering. In the process of RomBoard installation, the parts and circuit board must be in the good shape to re-use them. The tool we use is Desoldering Gun. This device has vacuum pump built in with heater tip. Process of desoldering it self is very simple, but there are some tricks to do clean and safe desoldering job.

Step 1

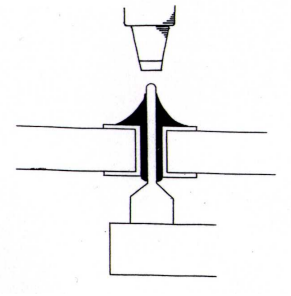

Put the desoldering gun's tip over to the soldering joint. Make sure nozzle is 90° angle from circuit board.

Step 2

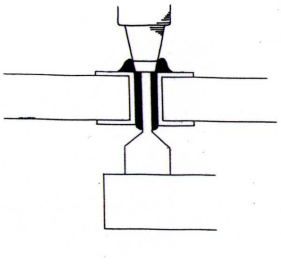

Apply the enough heat to melt entire solder. Multi-layer board or ground pin may take while to transfer heat.

Step 3

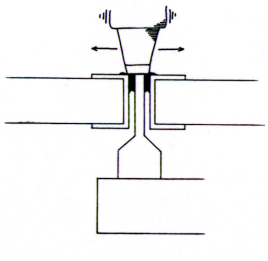

While applying vacuum, move the tip around the pin to get all the solder of around the pin out. At this time, you can also feel pin moves freely, so you know pin is free from circuit board.

Step 4

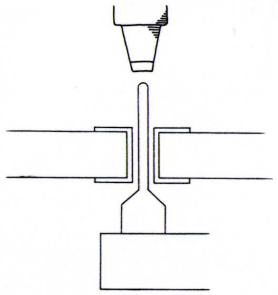

When you can hear air flow sound from hole, you should be done. Stop applying vacuum and remove the gun from the pin. Inspect hole and pin.

When you done with desoldering, the parts that you are trying to remove should move freely. If it doesn't, find which pin is still has solder left, and re-apply fresh solder to it and try desoldering process again. The multi-layer circuit board require more heat to get solder to melt. Make sure pin start to move freely by moving the tip of soldering gun before you apply vacuum to it.

SMD device soldering and removal

In the process of RomBoard installation, chance of handling SMD devices is becoming higher and higher due to ECU configuration change.
Soldering of SMD devices are not much different from regular through hole soldering.
Important thing is positioning of the device is very critical.
Start with applying little solder to two of the each corner of the pads on the circuit board.
Then, place the SMD device and re-heat a one of the solder you just applied to connect a SMD device pin to the pad. Check the position of the device, if position is right re-heat the other end of solder to secure the device completely. If you didn't get position right, re-heat the pin that you just soldered and while heating a pin, move the device to the right position.
Once you positioned the device in the right position, apply Rosin Flux to both pins and pads. This will help your soldering job by keeping solder separate from each pin.
Here is how the joint on SMD device pin should look like.

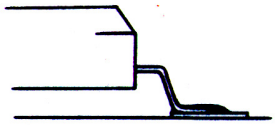

QFP and SOP chip

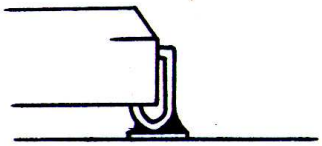

PLCC chip

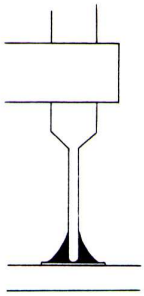

RomBoard adapter socket

Removing SMD device will be the probably the most difficult process. SMD rework station is used to do this. Make sure all the pins are completely heated otherwise you will be removing a pad from the circuit board along with device. Also, you should note, when you are applying heat to the device, some parts around the device is also heated and moves around when you touch. It is good idea to take a note of location of the devices near the target device.

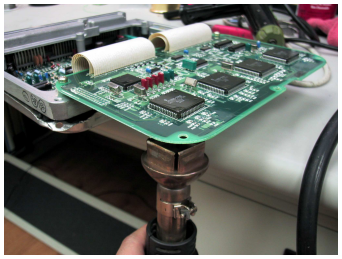

Step 1
Apply pre-heat from back side of the target device. Keep applying heat until you can't touch the chip. By this time, circuit board should have enough heat.

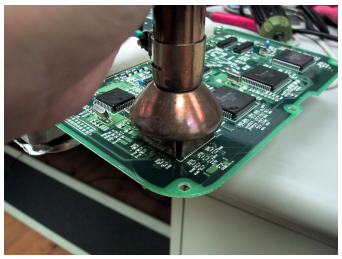

Step 2
Apply heat from top of the target device. Nozzle should cover entire chip. You can check if chip is free from solder by sliding the nozzle left and right. Make sure you don't move other parts. If the chip moves freely, it is ready to be removed.

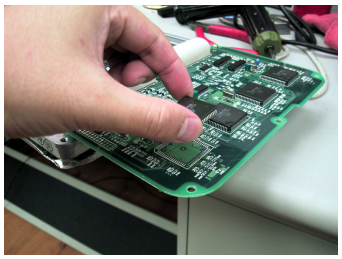

Step 3
Remove the chip straight up to avoid making solder bridge between pins. Chip is extremely hot! Unless you have skin of steel, avoid imitating the picture.

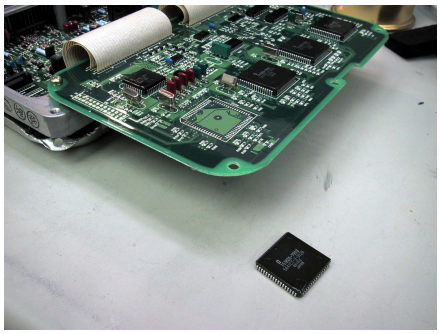

Step 4
After remove the chip, cool down both circuit board and chip.

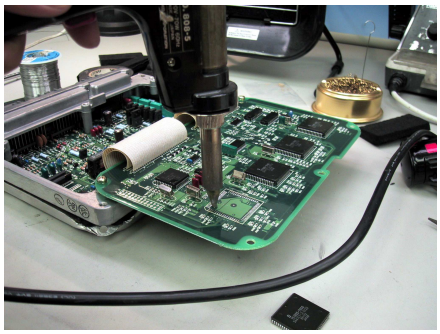

Step 5
Clean the pads on the circuit board with desoldering gun.
Do not apply too much heat to the pad. Pad might peel off from circuit board. Clean the chip by desoldering gun also.
Check for any bridge between pins. If the chip has too much protective coating on it, use solvent to clean it up.

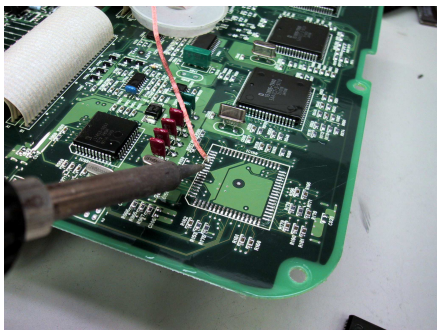

Step 6
If the pads on the circuit board is too small to use desolding gun, try cleaning by solder wick with rosin flux. This may take time but it is much better than peeling pads off.
Once again, do not apply too much heat.

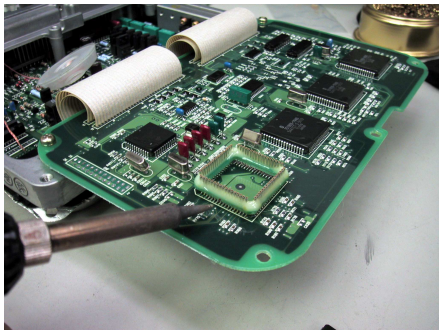

Step 7
Solder the RomBoard adapter where the chip was.
Refer SMD device soldering section for how to solder adapter.

The Final Word

Soldering, desoldering, and working with SMD device will take some effort to learn. You should be relaxed and concentrated when you work.
Keeping every thing clean (tip of iron, gun, work surface, etc) will help you also.
Once you get comfortable to work with soldering you may find your own tips and tricks.
Experience is all bout soldering.

EOF

How To Solder - Soldering Tutorial

Soldering is defined as "the joining of metals by a fusion of alloys which have relatively low melting points". In other words, you use a metal that has a low melting point to adhere the surfaces to be soldered together. Consider that soldering is more like gluing with molten metal, unlike welding where the base metals are actually melted and combined. Soldering is also a must have skill for all sorts of electrical and electronics work. It is also a skill that must be taught correctly and developed with practice. This tutorial will cover the most common types of soldering required for electronics work. This includes soldering components to printed circuit boards and soldering a spliced wire joint. This presentation came from http://www.aaroncake.net/electronics/solder.htm

Soldering Equipment

The Soldering Iron/Gun

The first thing you will need is a soldering iron, which is the heat source used to melt solder. Irons of the 15W to 30W range are good for most electronics/printed circuit board work. Anything higher in wattage and you risk damaging either the component or the board. If you intend to solder heavy components and thick wire, then you will want to invest in an iron of higher wattage (40W and above) or one of the large soldering guns. The main difference between an iron and a gun is that an iron is pencil shaped and designed with a pinpoint heat source for precise work, while a gun is in a familiar gun shape with a large high wattage tip heated by flowing electrical current directly through it.

A 30W Watt Soldering Iron

A 300W Soldering Gun

For **hobbyist electronics** use, a soldering iron is generally the tool of choice as its small tip and low heat capacity is suited for printed circuit board work (such as assembling kits). A soldering gun is generally used in heavy duty soldering such as joining heavy gauge wires, soldering brackets to a chassis or stained glass work.

You should choose a soldering iron with a 3-pronged grounding plug. The ground will help prevent stray voltage from collecting at the soldering tip and potentially damaging sensitive (such as CMOS) components. By their nature, soldering guns are quite "dirty" in this respect as the heat is generated by shorting a current (often AC) through the tip made of formed wire. Guns will have much less use in hobbyist electronics so if you have only one tool choice, an iron is what you want. For a beginner, a 15W to 30W range is the best but be aware that at the 15W end of that range, you may not have enough power to join wires or larger components. As your skill increases, a 40W iron is an excellent choice as it has the capacity for slightly larger jobs and makes joints very quickly. Be aware that it is often best

to use a more powerful iron so that you don't need to spend a lot of time heating the joint, which can damage components.

A variation of the basic gun or iron is the soldering station, where the soldering instrument is attached to a variable power supply. A soldering station can precisely control the temperature of the soldering tip unlike a standard gun or iron where the tip temperature will increase when idle and decrease when applying heat to a joint. However, the price of a soldering station is often ten to one hundred times the cost of a basic iron and thus really isn't an option for the hobby market. But if you plan to do very precise work, such as surface mount, or spend 8 hours a day behind a soldering iron, then you should consider a soldering station.

The rest of this document will assume that you are using a soldering iron as that is what the majority of electronics work requires. The techniques for using a soldering gun are basically the same with the only difference being that heat is only generated when the trigger is pressed.

Solder

The choice of solder is also important. There several kinds of solder available but only a few are suitable for electronics work. Most importantly, you will only use *rosin core solder*. *Acid* core solder is common in hardware stores and home improvement stores, but meant for soldering copper plumbing pipes and not **electronic circuits**. If acid core solder is used on electronics, the acid will destroy the traces on the printed circuit board and erode the component leads. It can also form a conductive layer leading to shorts.

For most printed circuit board work, a solder with a diameter of 0.75MM to 1.0MM is desirable. Thicker solder may be used and will allow you to solder larger joints more quickly, but will make soldering small joints difficult and increase the likelihood of creating solder bridges between closely spaced PCB pads. An alloy of 60/40 (60% tin, 40% lead) is used for most electronics work. These days, several lead-free solders are available as well. **Kester "44" Rosin Core** solder has been a staple of electronics for many years and continues to be available. It is available in several diameters and has a non-corrosive flux.

Large joints, such as soldering a bracket to a chassis using a high wattage soldering gun, will require a separate application of brush on flux and a thick diameter solder of several millimeters. Remember that when soldering, the flux in the solder will release fumes as it is heated. These fumes are harmful to your eyes and lungs. Therefore, always work in a well-ventilated area and avoid breathing the smoke created. Hot solder is also dangerous. It is surprisingly easy to splash hot solder onto yourself, which is a thoroughly unpleasant experience. Eye protection is also advised.

Preparing To Solder

Tinning the Soldering Tip

Before use, a new soldering tip, or one that is very dirty, must be tinned. "Tinning" is the process of coating a soldering tip with a thin coat of solder. This aids in heat transfer between the tip and the component you are soldering, and also gives the solder a base from which to flow from.

Step 1: Warm Up the Iron

Warm up the soldering iron or gun thoroughly. Make sure that it has fully come to temperature because you are about to melt a lot of solder on it. This is especially important if the iron is new because it may have been packed with some kind of coating to prevent corrosion.

Step 2: Prepare A Little Space

While the soldering iron is warming up, prepare a little space to work. Moisten a little sponge and place it in the base of your soldering iron stand or in a dish close by. Lay down a piece of cardboard in case you drip solder (you probably will) and make sure you have room to work comfortably.

Step 3: Thoroughly Coat the Tip in Solder

Thoroughly coat the soldering tip in solder. It is very important to cover the entire tip. You will use a considerable amount of solder during this process and it will drip, so be ready. If you leave any part of the tip uncovered it will tend to collect flux residue and will not conduct heat very well, so run the solder up and down the tip and completely around it to totally cover it in molten solder

.

Step 4: Clean the Soldering Tip

After you are certain that the tip is totally coated in solder, wipe the tip off on the wet sponge to remove all the flux residue. Do this immediately so there is no time for the flux to dry out and solidify.

Step 5: You're Done!

You have just tinned your soldering tip. This must be done anytime you replace the tip or clean it so that the iron maintains good heat transfer.

Soldering a Printed Circuit Board (PCB)

Soldering a PCB is probably the most common soldering task an electronics hobbyist will perform. The basic techniques are fairly easy to grasp but it is a skill that will take a little practice to master. The best way to practice is to buy a simple electronics kit or assemble a simple circuit (such as an **LED chaser**) on a perf-board. Don't buy that expensive kit or dive into a huge project after only soldering a few joints.

Soldering components onto a PCB involves preparing the surface, placing the components, and then soldering the joint.

Step 1: Surface Preparation:

A clean surface is very important if you want a strong, low resistance solder joint. All surfaces to be soldered should be cleaned well. **3M Scotch Brite pads** purchased from the home improvement, industrial supply store or automotive body shop are a good choice as they will quickly remove surface tarnish but will not abrade the PCB material. Note that you will want *industrial* pads and not the kitchen cleaning pads impregnated with cleaner/soap. If you have particularly tough deposits on your board, then a fine grade of steel wool is acceptable but be very cautious on boards with tight tolerances as the fine steel shavings can lodge between pads and in holes.

Once you have cleaned the board down to shiny copper you can use a solvent such as acetone to clean any bits of the cleaning pad that may remain and to remove chemical contamination from the surface of the board. Methyl hydrate is another good solvent and a bit less stinky then acetone. Be aware that both these solvents can remove ink, so if your board is silk screened, test the chemicals first before hosing down the entire board.

A few blasts with compressed air will dry out the board and remove any junk that may have built up in the holes.

Step 2: Component Placement

After the component and board have been cleaned, you are ready to place the components onto the board. Unless your circuit is simple and only contains a few components, you will probably not be placing all the components onto the board and soldering them at once. Most likely you will be soldering a few components at a time before turning the board over and placing more. In general it is best to start with the smallest and flattest components (resistors, ICs, signal diodes, etc.) and then work up to the larger components (capacitors, power transistors, transformers) after the small parts are done. This keeps the board relatively flat, making it more stable during soldering. It is also best to save sensitive components (MOSFETs, non-socketed ICs) until the end to lessen the chance of damaging them during assembly of the rest of the circuit.

Bend the leads as necessary and insert the component through the proper holes on the board. To hold the part in place while you are soldering, you may want to bend the leads on the bottom of the board at a 45 degree angle. This works well for parts with long leads such as resistors. Components with short leads such as IC sockets can be held in place with a little masking tape or you can bend the leads down to clamp onto the PC board pads.

In the image below, a resistor is ready to solder and is held in place by slightly bent leads.

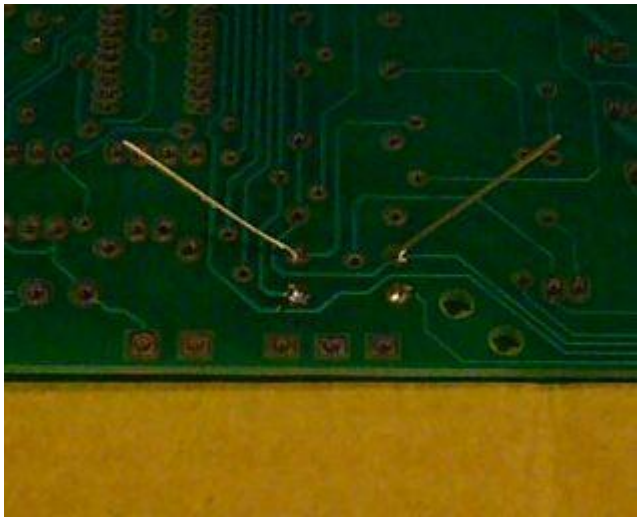

Step 3: Apply Heat

Apply a very small amount of solder to the tip of the iron. This helps conduct the heat to the component and board, but it is **not** the solder that will make up the joint. To heat the joint you will lay the tip of the iron so that it rests against both the *component lead* and the *board*. It is critical that you heat the lead and the board, otherwise the solder will simply pool and refuse to stick to the unheated item. The small amount of solder you applied to the tip before heating the joint will help make contact between the board and the lead. It normally takes a second or two to get the joint hot enough to solder, but larger components and thicker pads/traces will absorb more heat and can increase this time.

If you see the area under the pad starting to bubble, **stop** heating and remove the soldering iron because you are overheating the pad and it is in danger of lifting. Let it cool, then carefully heat it again for much less time.

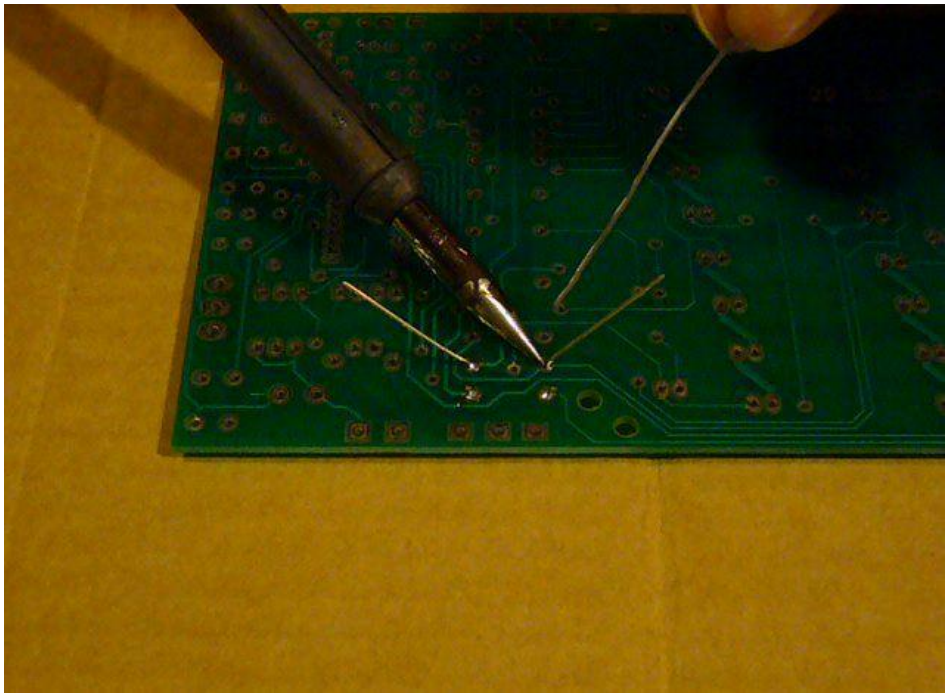

Step 4: Apply Solder to the Joint

Once the component lead and solder pad has heated up, you are ready to apply solder. Touch the tip of the strand of solder to the component lead and solder pad, but **not** the tip of the iron. If everything is hot enough, the solder should flow freely around the lead and pad. You will see the flux melt liquefy as well, bubble around the joint (this is part of its cleaning action), flow out and release smoke. Continue to add solder to the joint until the pad is completely coated and the solder forms a small mound with slightly concave sides. If it starts to ball up, you have used too much solder or the pad on the board is not hot enough.

Once the surface of the pad is completely coated, you can stop adding solder and remove the soldering iron (in that order). Don't move the joint for a few seconds as the solder needs time to cool and solidify. If you do move the joint, you will get what's called a "cold joint". This is recognized by it's characteristic dull and grainy appearance. Many cold joints can be fixed by reheating and applying a small amount of solder, then being allowed to cool without being disturbed.

Step 5: Inspect the Joint and Cleanup

Once the joint is made you should inspect it. Check for cold joints (described a little above and at length below), shorts with adjacent pads or poor flow. If the joint checks out, move on to the next. To trim the lead, use a small set of side cutters and cut at the top of the solder joint.

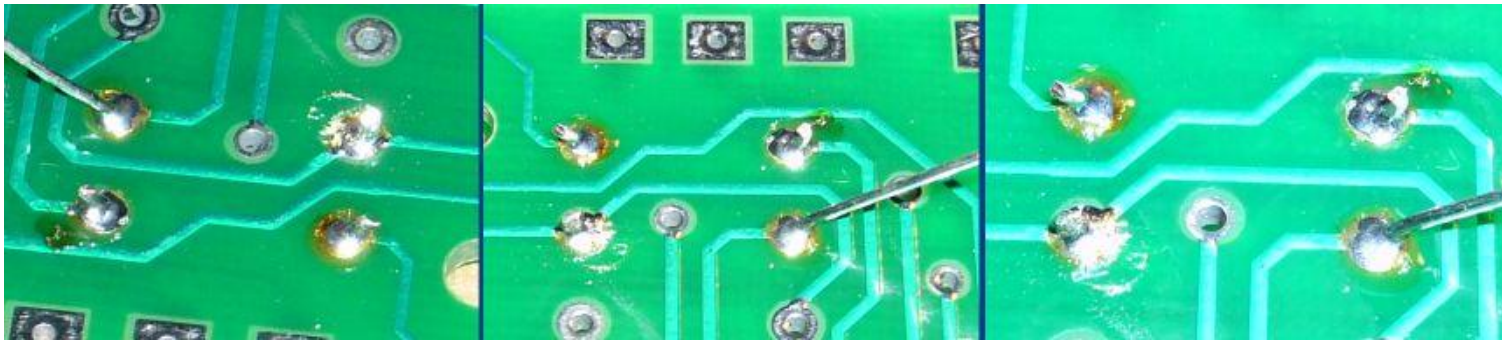

After you have made all the solder joints, it is good practice to clean all the excess flux residue from the board. Some fluxes are hydroscopic (they absorb water) and can slowly absorb enough water to become slightly conductive. This can be a significant issue in a hostile environment such as an automotive application. Most fluxes will clean up easily using methyl hydrate and a rag but some will require a stronger solvent. Use the appropriate solvent to remove the flux, then blow the board dry with compressed air.

Cold Solder Joints

A "cold solder joint" can occur when not enough heat is applied to the component, board, or both. Another common cause is a component moving before the solder has completely cooled and solidified. A cold joint is brittle and prone to physical failure. It is also generally a very high resistance connection which can affect the operation of the circuit or cause it to fail completely.

Cold joints can often be recognized by a characteristic grainy, dull gray color, but this is not always the case. A cold joint can often appear as a ball of solder sitting on the pad and surrounding the component lead. Additionally you may notice cracks in the solder and the joint may even move. Below is the shocking image of every example of a bad solder joint you will ever see. It appears that this **FM transmitter kit** was assembled using the technique of "apply solder to iron then drip onto joint". If your joints are looking like this, then **stop** and practice after rereading this page. Note that not a single of of these joints is acceptable, but amazingly, the circuit worked.

Most cold solder joints can be easily fixed. Generally all that is required is to reheat the joint and apply a little more solder. If there is already too much solder on the joint, then the joint will have to be **desoldered** and then soldered again. This is done by first removing the old solder with a desoldering tool or simply by heating it up and flicking it off with the iron. Once the old solder is off, you can resolder the joint, making sure to heat it thoroughly and keep it still as it cools.

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HOW TO SOLDER - THE QUICK, THOROUGH GUIDE

Technology (/technology/) > Soldering | by IoTalabs (/member/IoTalabs/) Follow

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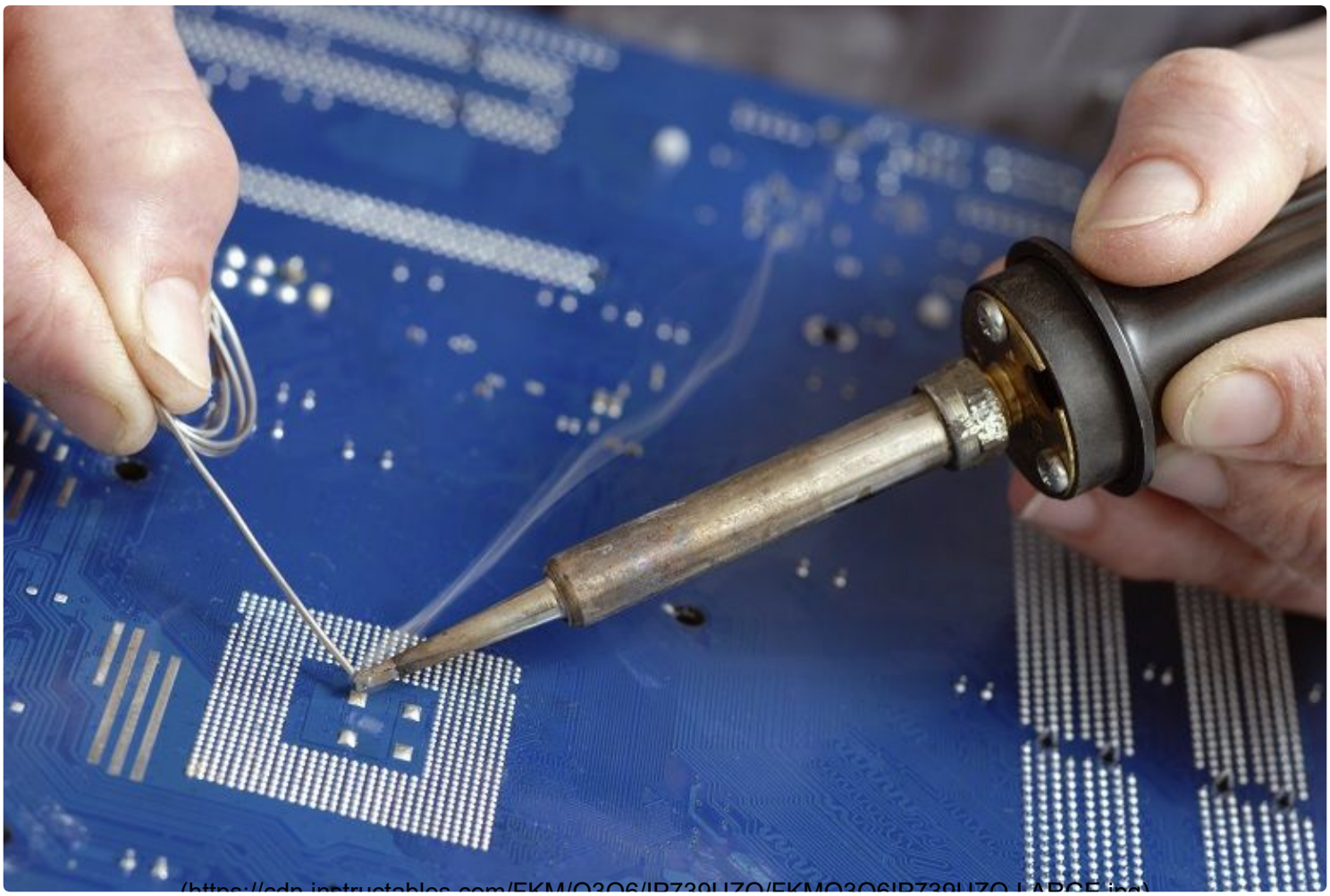

We are IoTalabs and we are a group of Internet of Things enthusiasts that love hacking together different devices. Over the past few months we have immersed ourself in the wonderful world of hardware! In our journey, we learned the best soldering practices around.

We've been working on many projects (check out our current project http://doteverything.co/) and we wanted to share our experience on safely and correctly soldering connections!

Add Tip Ask Question

Step 1: What Is Soldering?

Soldering accomplishes a strong bond between two pieces of metal by joining them together. In this procedure, a material called solder, an alloy mixture of tin and lead, flows over two pre-heated pieces of metal and holds them together. The process is similar to welding but differs because when you weld you are fusing and melting two pieces together to make one. When you solder you are essentially ‘gluing’ two parts together with molten metal. Most metals with the exception of aluminum, white metal and porous cast iron can be soldered. Below, you will find instructions and illustrations that show you how to use a soldering iron.

Add Tip Ask Question

Step 2: Materials for Soldering

Soldering Iron

Modeler’s Vise or Frame (optional)

Solder

Damp Sponge

Flux to remove oxides

Add Tip Ask Question

Step 3: Prepare Your Workspace

Make sure your table or bench top is clear and free of obstructions. You will want as much freedom as possible to move your hand around and make adjustments.

Add Tip Ask Question

Step 4: Turn on the Soldering Iron

The soldering iron needs to be warmed up properly before it can be used to ensure clean application of the solder. Some soldering irons heat up in seconds while others take minutes. Turn it on and leave it in the stand for 2-3 minutes to be safe.

Add Tip Ask Question

Step 5: (Optional) Secure the Items You Are Soldering

Because we only have two hands, it would be nice to stabilize the item we want to solder. This is where a vice or clamp that can hold your item sturdily would come in handy. This is not required, but can greatly increase the ease and quality of your solder joints.

Add Tip Ask Question

Step 6: Cleaning the Soldering Iron

(https://cdn.instructables.com/FVM/SZ4M/IPZ4QCY5/FVMSZ4MIPZ4QCY5.LARGE.jpg)

Because soldering irons get so hot, they oxidize and become dirty quickly. They key to reliable connections is clean components so make sure that your soldering tip and parts you are joining are clean. To accomplish this, pass the tip of your soldering iron on a wet sponge until it shines.

Add Tip | Ask Question

Step 7: Apply Flux

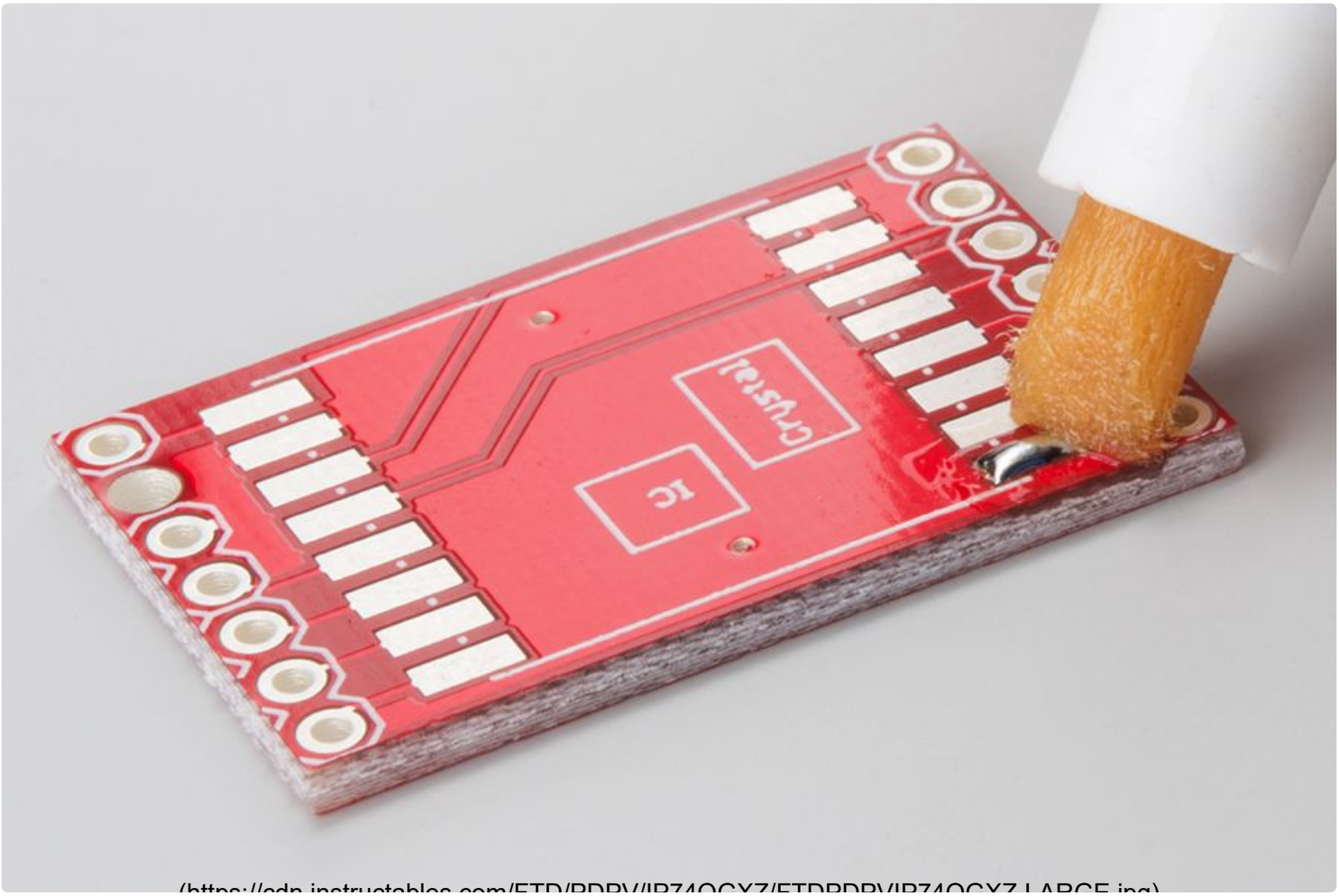

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In soldering it often becomes necessary to use materials called fluxes to help remove oxides and keep them absent while you solder. Flux needs to melt at a temperature lower than solder so that it can do its job prior to the soldering action. There are different methods to apply flux. The method you choose will be dependent on the items you are soldering.

Add Tip | Ask Question

Step 8: Tin the Soldering Iron

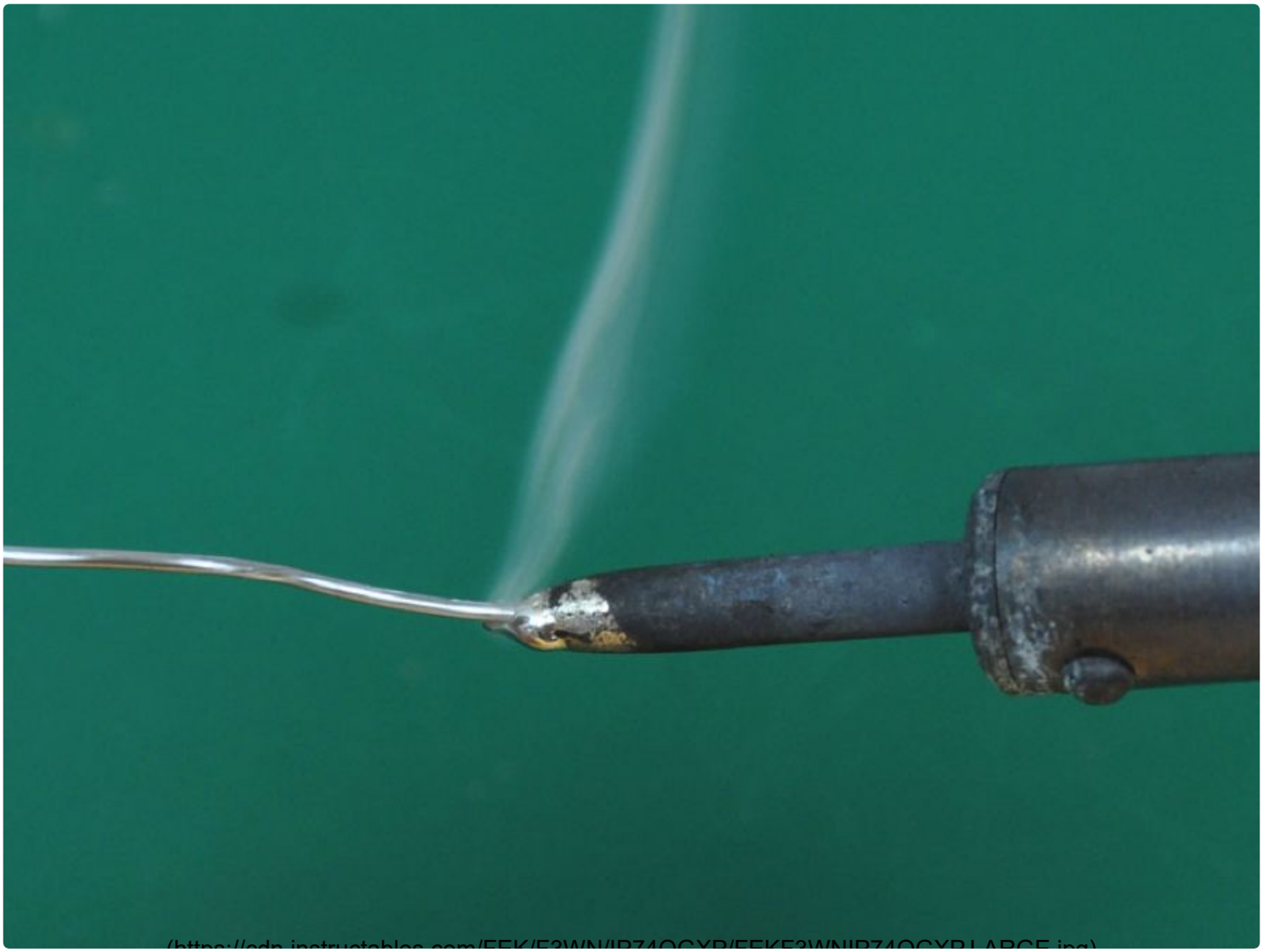

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If you want to know everything there is to know about how to use a soldering iron, you'll need to know how to tin. Tinning is the process of coating a soldering tip with a thin coat of solder. Melt a thin layer of solder on your iron's tip. This aids in heat transfer between the tip and the component you are soldering, and also gives the solder a base from which to flow from. This process may need to be repeated as you solder. You will only touch the tip of the soldering iron to the solder when you tin. Do not touch the tip of the iron to the solder while you are actually soldering.

Add Tip | Ask Question

Step 9: Start Soldering

Hold the soldering iron like you would a pen in the hand you write with and the solder in the other. Then place the tip of the soldering iron. The tip needs to touch both the wire lead and the surface so they achieve the same temperature.

Add Tip Ask Question

Step 10: Feeding the Solder

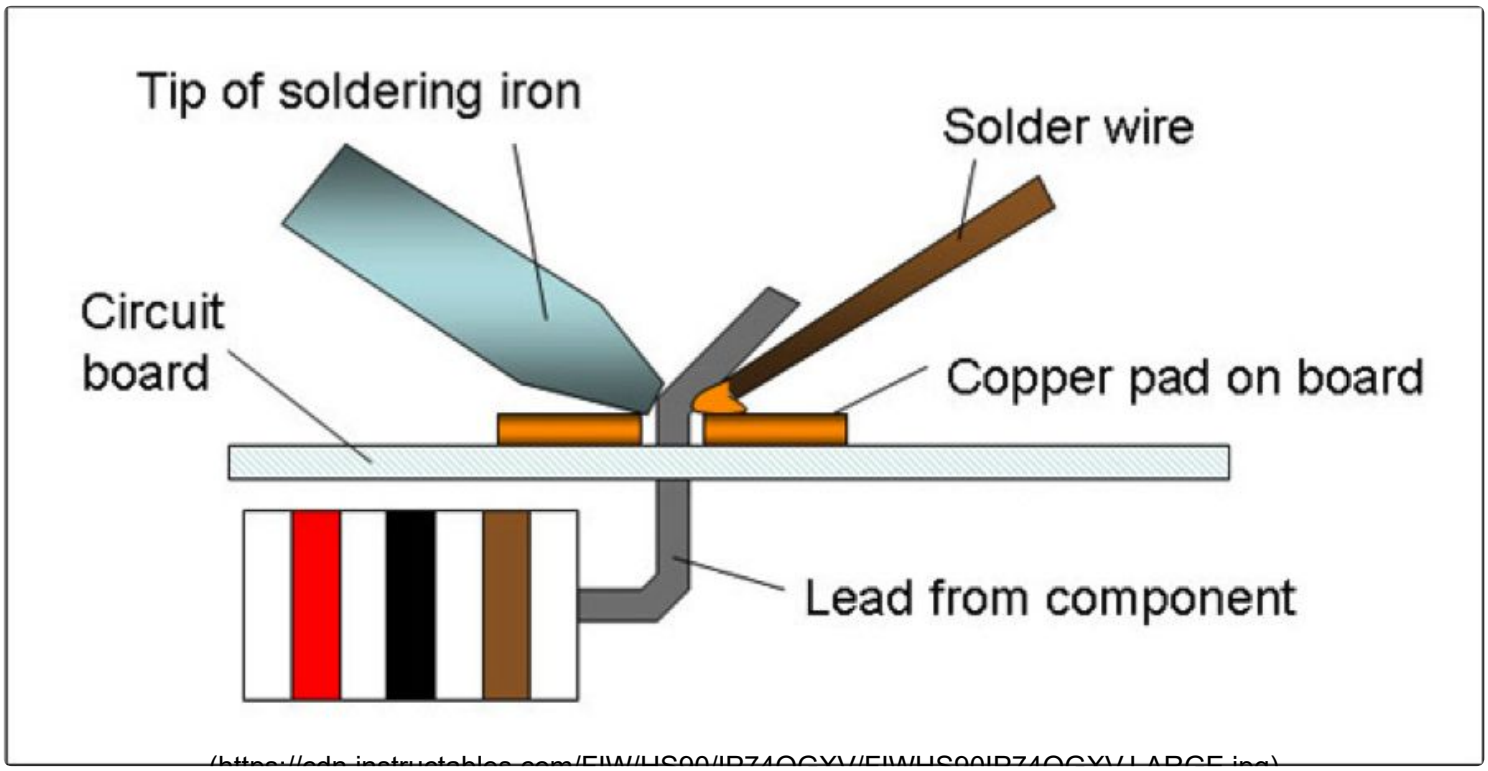

Touch the solder to the side of the connection opposite the soldering iron after heating the area for 2-3 seconds. Then, let the solder flow only until the connection is covered.

Add Tip Ask Question

Step 11: Removing the Solder

Remove the solder first, then the iron otherwise your solder will get stuck to your connection point without the appropriate heat. Make sure the joint remains stationary while it cools.

Add Tip Ask Question

Step 12: Check to See If the Connection Is Solid

A smooth, shiny and volcano shaped joint is what you are looking for. If this isn't what you see, you'll need to reheat and feed in more solder.

Add Tip Ask Question

Step 13: Warnings

- DO NOT lay a soldering iron down on any surface. A soldering iron should either be placed on a stand or sealed with a heat resistant cap after every use.
- Soldering should be completed in a well ventilated area.
- Lead is present in most solders. Be sure to wash your hands after your project, or better yet wear gloves.
- Try not to inhale any of the solder smoke that comes off the solder. This is lead and can be dangerous.
- The tip of a soldering iron is very hot. Contact with the tip of a soldering iron would result in a nasty burn.
- Your soldering iron will perform better if kept clean. A damp sponge can be used to clean residue caused by flux material. A very small skim of flux should be applied to the iron after the cleaning.

THE BASICS OF HOW TO SOLDER

Soldering Tutorial for Beginners: Five Easy Steps

Table of Contents:

- Before you begin
- Step 1: Heat your iron to the appropriate temperature
- Step 2: Make your connection mechanically stable
- Step 3: Clean the tip of your iron
- Step 4: Apply heat and solder
- Step 5: Inspect the joint
- Common mistakes

Before you begin

You will need the following equipment:

A temperature-controlled soldering iron of 25W or more
A tip cleaner such as a brass sponge or a wet sponge

Solder (leaded is easier to work with than lead-free)
(Optional) Helping hands
Safety glasses

Note: molten solder is extremely hot! Irons heat up to around twice the boiling point of water, so be extremely careful. Wear safety glasses when soldering.

Step 1: Heat your iron to the appropriate temperature

For through-hole components in a circuit board, you will want 600-700 degrees fahrenheit.

If you're soldering a larger connections, with more copper that's dissipating heat, then you may want a slightly higher temperature. With a temperature-adjustable iron you can see what works and adjust accordingly.

Step 2: Make your connection mechanically stable

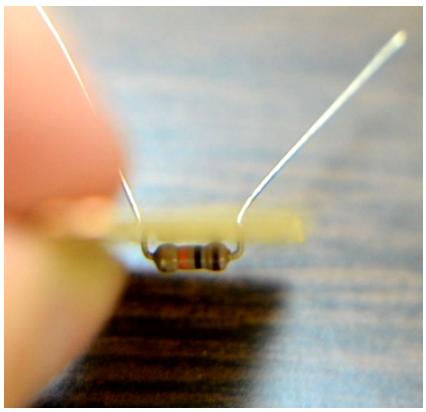

While your iron is heating up, you can work on making your components stay in place without your help. This is where your helping hands may come in handy. Use them to help you arrange your components to be stable without you needing to hold anything. If you're soldering a through-hole component in a circuit board, you can bend the leads of the component into a V-shape so that it stays in place flush against the board. For components without long leads, you can use a piece of tape to hold them in place.

Step 3: Clean the tip of your iron

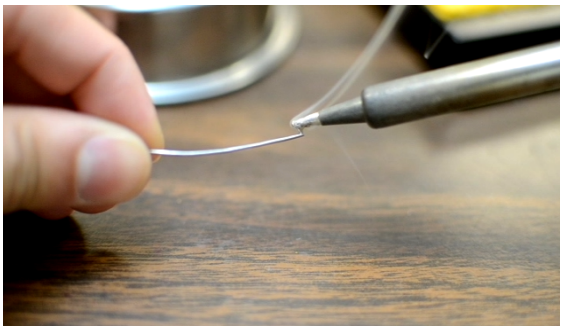

You can check whether your iron is close to its final temperature by touching your solder to the end of the iron and seeing if it melts. When you do this, you'll see some smoke come out. This is not the metal vaporizing, but rather the flux inside of it is burning. Flux is a mild acid that eats away at the oxidation layer that forms on the surface of hot metals. Without flux in the solder to clean your surfaces, you would have a very hard time getting the solder to wet.

Clean your iron using a brass sponge or a wet sponge to remove any oxidation or excess solder from the tip. Remember to always keep your tip clean while you're soldering. A dirty tip is covered in metal oxides that transfer heat badly and can result in poorly soldered joints.

Step 4: Apply heat and solder

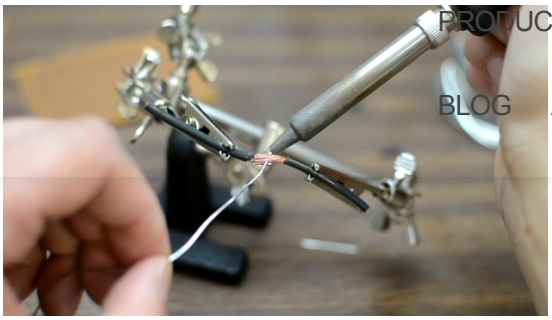

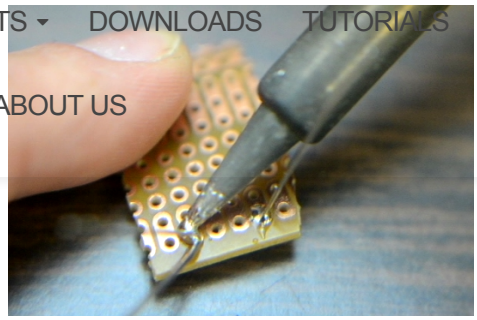

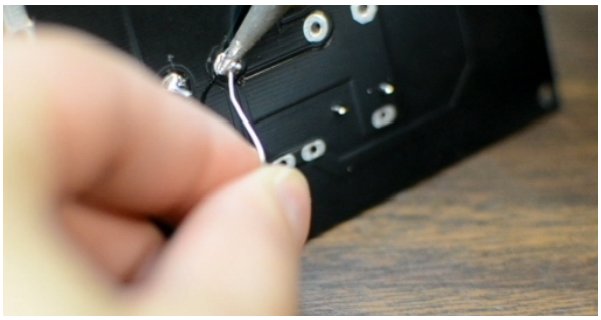

Touch the flat part of your iron's tip to one side of the joint, while feeding solder from the other side of the joint. The idea is to heat up the entire joint to the melting temperature of solder, so when you touch the solder to the surfaces it melts right on. The only way you can ensure a good electrical connection is by letting the solder flow over the components you're joining. Don't apply the solder directly to the tip of the iron. For through-hole components, hold the iron against both the lead and the pad.

Small joints can heat up within a few seconds, but larger joints can take a minute or two. Keep the joint steady for a few seconds after removing the iron, as the solder needs time to cool. Remember that the joint is hot now! don't touch it with your fingers right away.

Step 5: Inspect the joint

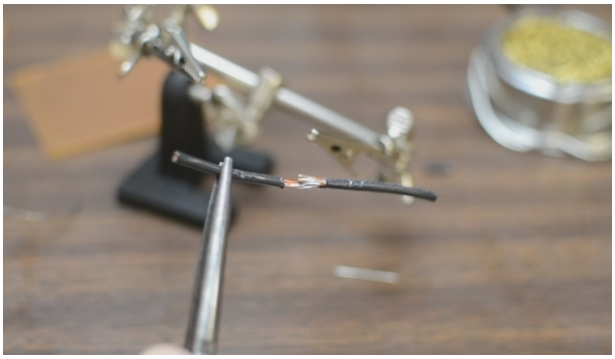

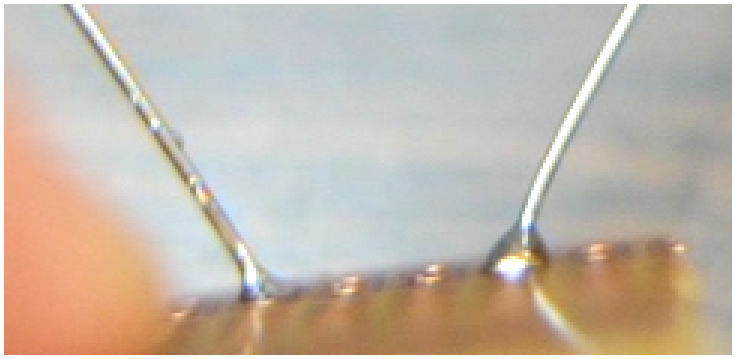

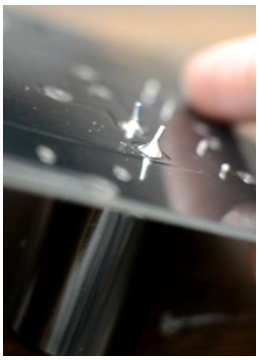

The solder should have wetted to both surfaces. On pads of a printed circuit board, the solder should be covering the entire pad, and it should make a volcano shape between the pad and the lead, indicating good adhesion. Once the joint is perfect, clip the leads of through-hole components.

Common mistakes, or what NOT to do

Now that we've gone over what to do, let me tell you what NOT to do.

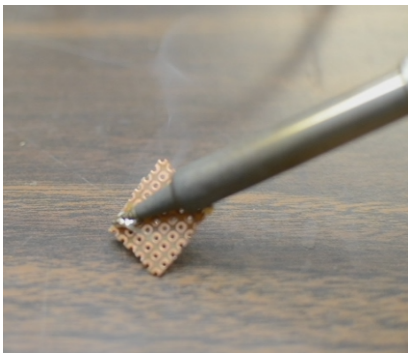

Don't put a blob of solder on the iron and then try to transfer it to your joint. This burns away all of the flux in the solder, which prevents the flux from cleaning the metal surfaces. Furthermore, it's easy to transfer the solder blob away from the iron without actually making it wet to the joint. I guarantee you that this will result in an awful electrical connection, so don't do it.

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How To Solder: A Beginner's Guide

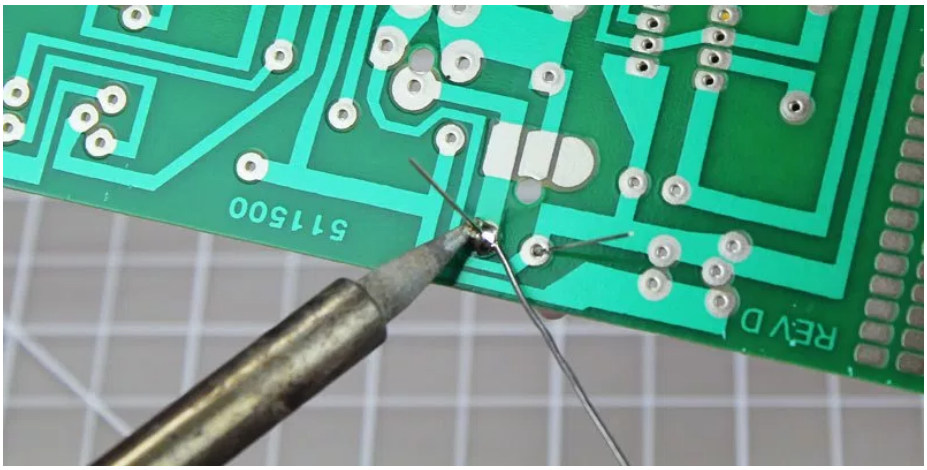

Learning how to solder w/ proper soldering techniques is a fundamental skill every maker should master. In this tutorial, we outline the basics of soldering irons, soldering stations, types of solder, desoldering and safety tips. Whether you're building a robot or working with Arduino, knowing how to solder will come in handy.

FREE EBOOK (PDF) – Learn To Solder Guide (17 pages)

What Is Soldering?

If you were to take apart any electronic device that contains a circuit board, you'll see the components are attached using soldering techniques. Soldering is the process of joining two or more electronic parts together by melting solder around the connection. Solder is a

using a desoldering tool as described below.

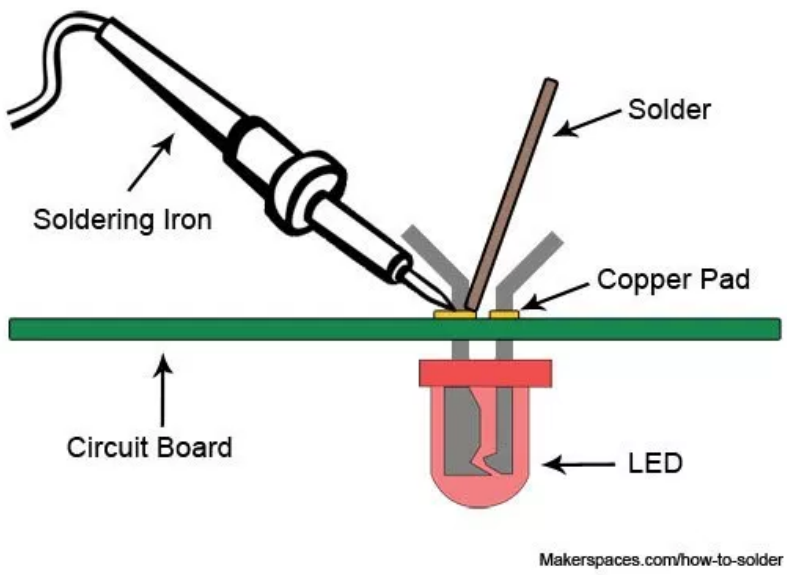

Soldering Tools

The good thing about learning how to solder is the fact that you don't need a lot to get started. Below we'll outline the basic tools and materials you will need for most of your soldering projects.

Soldering Iron

A soldering iron is a hand tool that plugs into a standard 120v AC outlet and heats up in order to melt solder around electrical connections. This is one of the most important tools used in soldering and it can come in a few variations such as pen or gun form. For beginners, it's recommended that you use the pen style soldering iron in

type of soldering iron because it can heat up to 896′ F which is extremely hot.

Soldering Station

A soldering station is a more advanced version of the basic standalone soldering pen. If you are going to be doing a lot of soldering, these are great to have as they offer more flexibility and control. The main benefit of a soldering station is the ability to precisely adjust the temperature of the soldering iron which is great for a range of projects. These stations can also create a safer workspace as some include advanced temperature sensors, alert settings and even password protection for safety.

Soldering Iron Tips

At the end of most soldering irons is an interchangeable part known as a soldering tip. There are many variations of this tip and they come in a wide variety of shapes and sizes. Each tip is used for a specific purpose and offers a distinct advantage over another. The most common tips you will use in electronics projects are the conical tip and the chisel tip.

Conical Tip – Used in precision electronics soldering because of the fine tip. Because of its pointed end, it's able to deliver heat to smaller areas without affecting its surroundings.

Chisel Tip – This tip is well-suited to soldering wires or other larger components because of its broad flat tip.

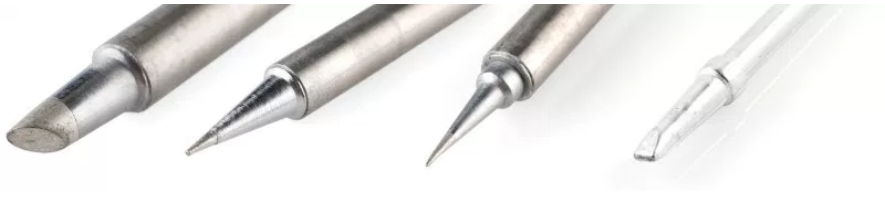

Image Credit – Sparkfun.com

Brass or Conventional Sponge

it did when it was new. You could use a conventional wet sponge but this tends to shorten the lifespan of the tip due to expansion and contraction. Also, a wet sponge will drop the temperature of the tip temporarily when wiped. A better alternative is to use a brass sponge as shown on the left.

Soldering Iron Stand

A soldering iron stand is very basic but very useful and handy to have. This stand helps prevent the hot iron tip from coming in contact with flammable materials or causing accidental injury to your hand. Most soldering stations come with this built in and also include a sponge or brass sponge for cleaning the tip.

Solder

Solder is a metal alloy material that is melted to create a permanent bond between electrical parts. It comes in both lead and lead-free variations with diameters of .032″ and .062″ being the most common. Inside the solder core is a material known as flux which helps improve electrical contact and its mechanical strength.

For electronics soldering, the most commonly used type is lead-free rosin core solder. This type of solder is usually made up of a Tin/Copper alloy. You can also use leaded 60/40 (60% tin, 40% lead) rosin core solder but it's becoming less popular due to health concerns. If you do use lead solder, make sure you have proper ventilation and that you wash your hands after use.

When buying solder, make sure NOT to use acid core solder as this will damage your circuits and components. Acid core solder is sold at home improvement stores and is mainly used for plumbing and metal working.

As mentioned earlier, solder does come in a few different diameters. The thicker diameter solder (.062″) is good for soldering larger joints more quickly but it can make soldering smaller joints difficult. For this reason, it's always a good idea to have both sizes on hand for your different projects.

Helping Hand (Third Hand)

A helping hand is a device that has 2 or more alligator clips and sometimes a magnifying glass/light attached. This clips will assist you by holding the items you are trying to solder while you use the soldering iron and solder. A very helpful tool to have in your makerspace.

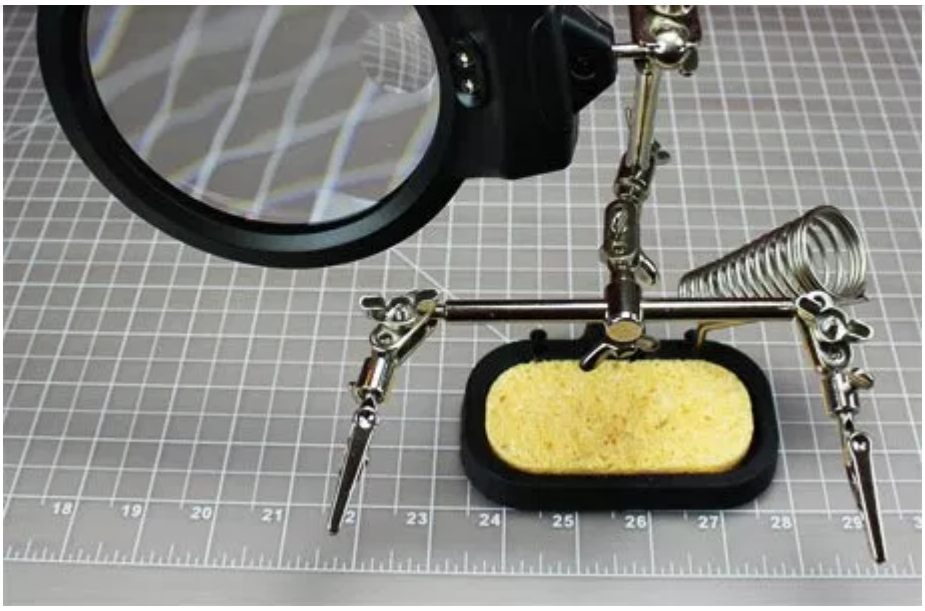

Soldering Safety

Now that you know what tools and materials are required, it's time to briefly discuss ways of staying safe while soldering.

Soldering irons can reach temperatures of 800′ F so it's very important to know where your iron is at all times. We always recommend you use a soldering iron stand to help prevent accidental burns or damage.

Make sure you are soldering in a well ventilated area. When solder is heated, there are fumes released that are harmful to your eyes and lungs. It's recommended to use a fume extractor which is a fan with a charcoal filter that absorbs the harmful solder smoke.

It's always a good idea to wear protective eye wear in case of accidental splashes of hot solder. Lastly, make sure to wash your hands when done soldering especially if using lead solder.

Tinning The Tip

Before you can start soldering, you need to prep your soldering iron by tinning the tip with solder. This process will help improve the heat transfer from the iron to the item you're soldering. Tinning will also help to protect the tip and reduce wear.

Step 1: Begin by making sure the tip is attached to the iron and screwed tightly in place.

Step 3: Wipe the tip of the soldering iron on a damp wet sponge to clean it. Wait a few seconds to let the tip heat up again before proceeding to step 4.

Step 4: Hold the soldering iron in one hand and solder in the other. Touch the solder to the tip of the iron and make sure the solder flows evenly around the tip.

You should tin the tip of your iron before and after each soldering session to extend its life. Eventually, every tip will wear out and will need replacing when it becomes rough or pitted.

How To Solder

To better explain how to solder, we're going to demonstrate it with a real world application. In this example, we're going to solder an LED to a circuit board.

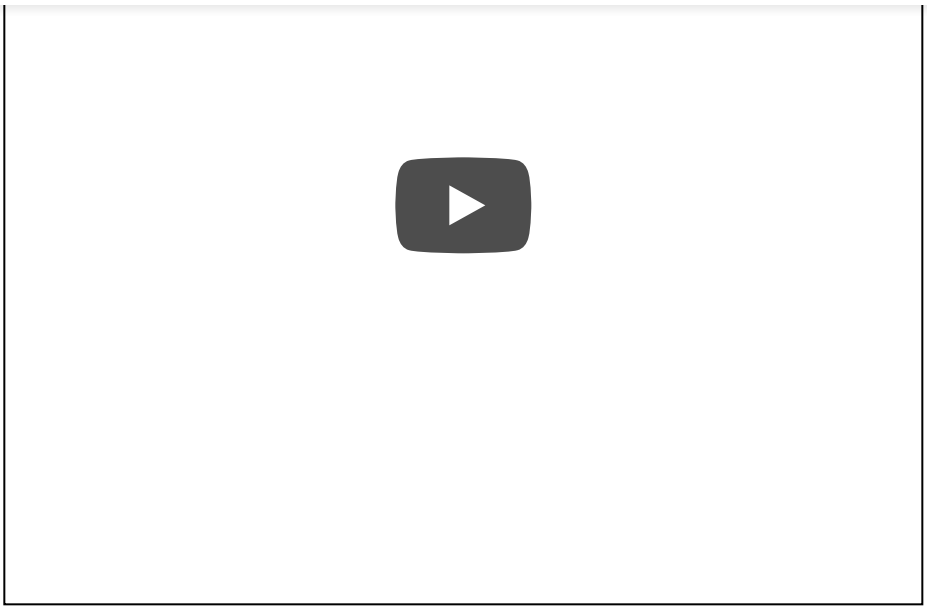

Step 1: Mount The Component – Begin by inserting the leads of the LED into the holes of the circuit board. Flip the board over and bend the leads outward at a 45′ angle. This will help the component make a better connection with the copper pad and prevent it from falling out while soldering.

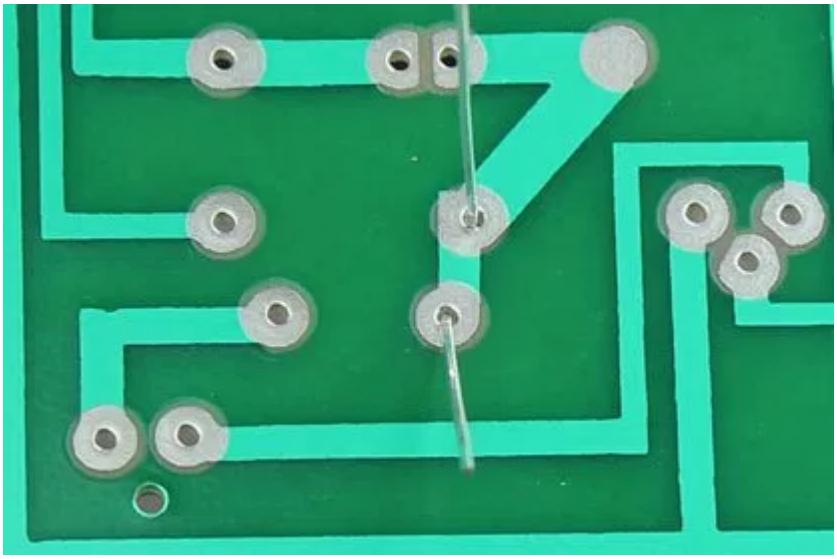

resistor lead at the same time. You need to hold the soldering iron in place for 3-4 seconds in order to heat the pad and the lead.

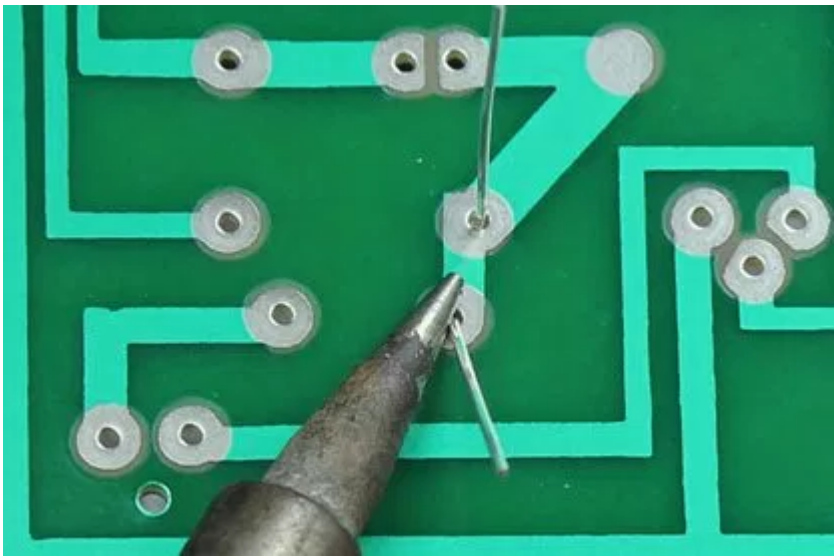

Step 3: Apply Solder To Joint – Continue holding the soldering iron on the copper pad and the lead and touch your solder to the joint. **IMPORTANT** – Don't touch the solder directly to the tip of the iron. You want the joint to be hot enough to melt the solder when it's touched. If the joint is too cold, it will form a bad connection.

Step 4: Snip The Leads – Remove the soldering iron and let the solder cool down naturally. Don't blow on the solder as this will cause a bad joint. Once cool, you can snip the extra wire from leads.

A proper solder joint is smooth, shiny and looks like a volcano or cone shape. You want just enough solder to cover the entire joint but not too much so it becomes a ball or spills to a nearby lead or joint.

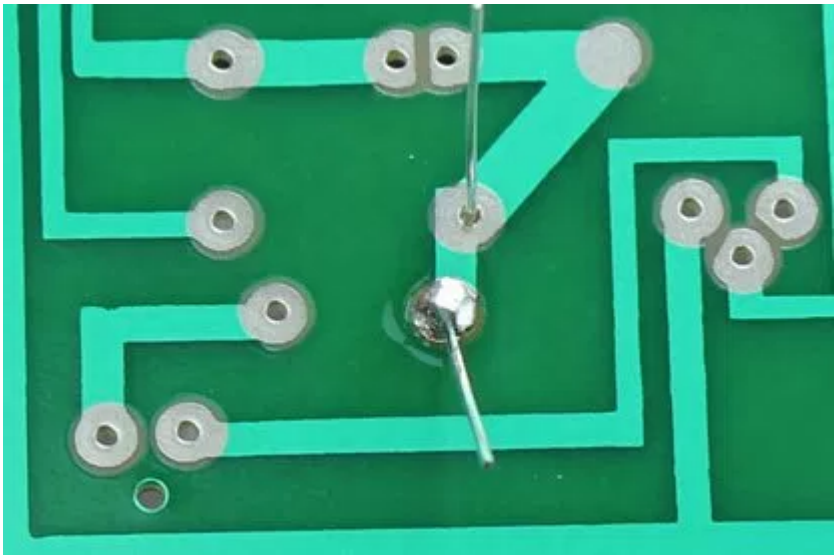

How To Solder Wires

Begin by removing the insulation from the ends of both wires you are soldering together. If the wire is stranded, twist the strands together with your fingers.

Make sure your soldering iron is fully heated and touch the tip to the end of one of the wires. Hold it on the wire for 3-4 seconds.

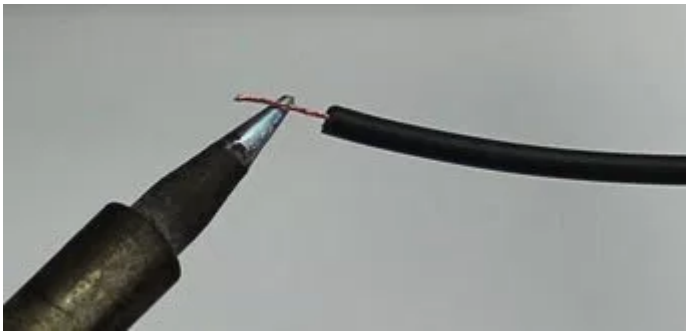

Keep the iron in place and touch the solder to the wire until it’s fully coated. Repeat this process on the other wire.

Hold the two tinned wires on top of each other and touch the soldering iron to both wires. This process should melt the solder and coat both wires evenly.

Remove the soldering iron and wait a few seconds to let the soldered connection cool and harden. Use heat shrink to cover the connection.

Desoldering

The good thing about using solder is the fact that it can be removed easily in a technique known as desoldering.

To desolder a joint, you will need solder wick which is also known as desoldering braid.

Step 1 – Place a piece of the desoldering braid on top of the joint/solder you want removed.

Step 2 – Heat your soldering iron and touch the tip to the top of the braid. This will heat the solder below which will then be absorbed into the desoldering braid. You can now remove the braid to see the solder has been extracted and removed. Be careful touching the braid when you are heating it because it will get hot.

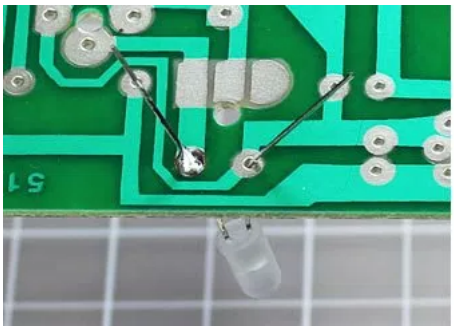

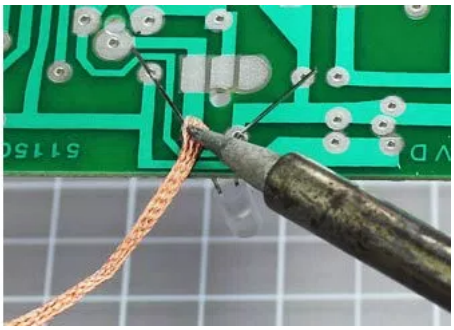

solder with a press of a button.

To use, press the plunger down at the end of the solder sucker. Heat the joint with your soldering iron and place the tip of the solder sucker over the hot solder. Press the release button to suck up the liquid solder. In order to empty the solder sucker, press down on the plunger.

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Created by Bill Earl

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Tools

Building a Soldering Toolkit

If you are just getting started in Electronics, Ladyada's Electronics Toolkit (http://adafru.it/136) (pictured above) is a great kit full of quality tools - including everything you need to make great solder joints. If you would rather build your toolkit piece-by-piece, read on:

Choosing a Soldering Iron

There are many types of soldering irons. For most Adafruit kits and projects, you will want a pencil-style soldering iron with 25 watts or more.

An under-powered iron is a poor investment. It will end up costing you more in ruined kits and damaged components.

- It will take longer to heat the joint, allowing heat to spread to the component being soldered - potentially overheating and damaging the component.
- Longer heating times will also give more time for oxides to form on the surfaces being soldered. This will prevent the solder from flowing and result in a poor joint.
- Longer recovery times between joints can result in frustration, 'cold joints' or both.

You don't need to spend a fortune to get a good iron. Advanced features such as temperature control and interchangeable tips are nice to have, but not essential for hobbiest-level work.

Basic Irons

There are many basic pencil style irons that are suitable for hobbiest use. But you will need one that is capable of heating the joints quickly enough. Choose an iron with 25 watts at a minimum.

Better Irons

An adjustable temperature iron with a little more power will give you a bit more control and allow you to work faster. The Adjustable 30W 110v Soldering Iron (http://adafru.it/180) in the store is an excellent choice.

This iron is also available as part of Ladyada's Electronics Toolkit (http://adafru.it/136), which contains many other essential soldering tools.

Best Irons

A professional-style temperature-controlled iron with interchangeable tips and 50 watts or more of power is a joy to work with. Feedback control keeps the tip temperature at precisely the level you set. The extra watts speed recovery time so that you can work faster. Interchangeable tips let you select the ideal tip shape for specialized work.

The 65 watt Hakko FX-888 (http://adafru.it/303) is an excellent professional quality soldering iron. The Weller WES51 or WESD51 are also excellent choices for serious electronics work.

Irons to avoid

In addition to underpowered irons, there are several types of irons to avoid for general circuit-board work.

For emergencies only:

These irons are handy for occasions when you have no place to plug in a regular soldering iron. But they are not the best choice for a primary soldering tool:

- **Butane Powered Irons** have plenty of power but are difficult to control.
- **Battery Powered Irons** are generally underpowered for most work.

Not for circuit board use:

These tools are not suitable for circuit board work:

- **Torches** of any kind are not suitable for electronics work and will damage your circuit boards.
- **Soldering Guns** are OK for working with heavy gauge wires, but don't have the precision necessary for soldering delicate electronics components.
- ***Cold-Heat™*** Irons inject current into the joint to heat the tip. This current can be damaging to sensitive electonic components. Avoid these irons for electronics work.

Essential Tools and Supplies:

These tools are the bare-minimum essentials required for soldering:

Stand

If your soldering iron does not have a built-in stand, you will need a safe place to rest the hot iron between uses. A Soldering Iron Stand (http://adafru.it/150) will keep your iron from rolling around and protect both you and your work surface from burns.

Most stand holders come with a sponge and tray for cleaning your soldering iron.

Solder

Standard 60/40 lead/tin Rosin Core Solder (http://adafru.it/145) is the easiest type to work with.

Diagonal Cutters

You will also need a pair of Diagonal Cutters (http://adafru.it/152) for trimming component leads after soldering.

Other Handy Tools and Supplies

These are some other tools and supplies you might find useful when working on soldering projects.

Vise

A vise holds your work steady as you solder. This is important for both safety and sound joints. The Panavise Jr (http://adafru.it/151) is an ideal size for most Adafruit kits and projects.

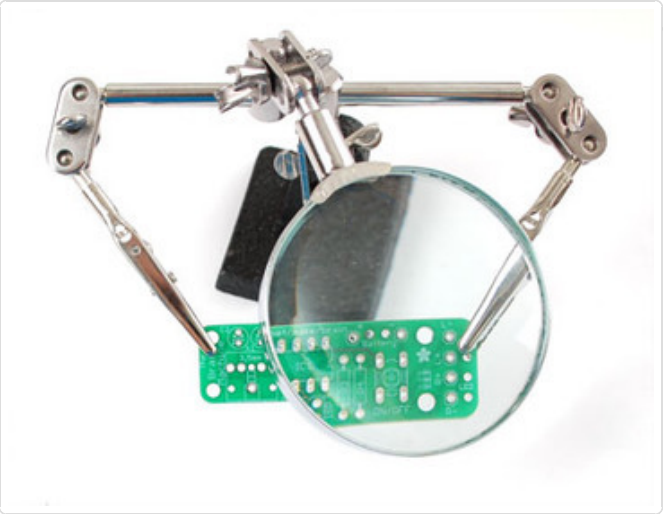

Third Hand

A Helping Third Hand (http://adafru.it/291) Tool is a good for smaller boards, or to hold things in place while terminating or splicing wires.

Solder Sucker

A Solder Sucker (http://adafru.it/148) is a very helpful tools for removing excess solder or when you need to de-solder a joint. As the name implies, this device literally sucks the solder out of the joint.

Solder Wick

Solder Wick (http://adafru.it/149) is another way to clean excess solder from a joint. Unlike the solder sucker, the wick soaks up the molten solder.

Preparation

Heat the Iron

Plug an and/or turn on your soldering iron to warm up. If you are using a temperature controlled iron, set it to 700F/370C for 60/40 or 750F/400C for lead-free solder.

While the iron is heating dampen the sponge with a little bit of water.

Clean the Iron

Wipe the tip of the hot iron on the damp sponge to clean off any oxidation.

Do not use files or abrasives to clean the tip. It will damage the plating and ruin the tip.

Tin the Tip

Apply a small amount of solder to the tip and wipe again to tin the tip. You should have a thin, shiny layer of molten solder on the tip of your iron.

If the tip is badly oxidized and difficult to tin, it can usually be reconditioned with some tip-tinning paste.

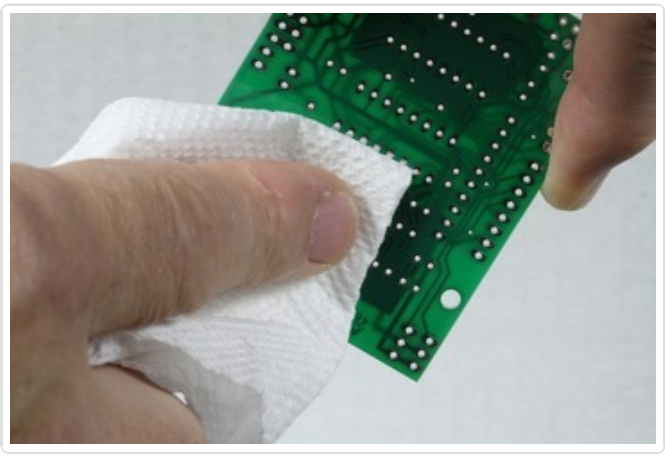

Make sure that the joint is clean

Dirt, oxidation and oily fingerprints can prevent the solder from wetting the solder-pad to create a solid joint. All Adafruit boards are plated to prevent oxidation, but if your board appears dirty from storage or handling, wipe it down with a little isopropyl alcohol.

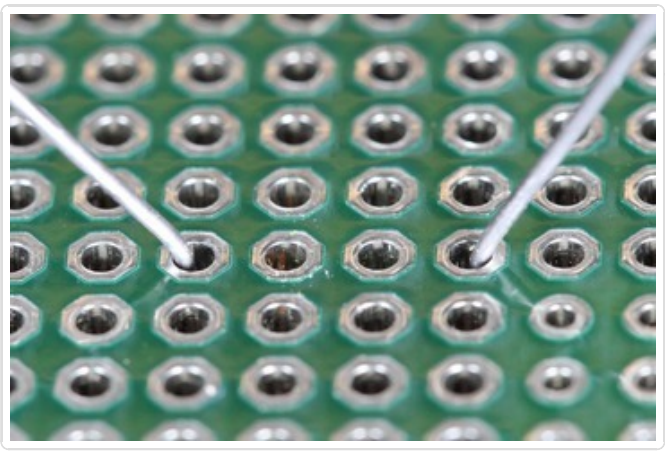

Immobilize the Joint

This is very important! The parts being joined must not move during the soldering process. If there is any movement as the molten solder is solidifying, you will end up with an unreliable 'cold joint'.

Most through-hole components can be immobilized by simply bending the leads on the solder-side of the hole.

Steady the Board

A vise is a good way to keep the board from moving around while you try to solder it.

Once the joint is clean and immobilized, you are ready to apply the solder.

Making a good solder joint

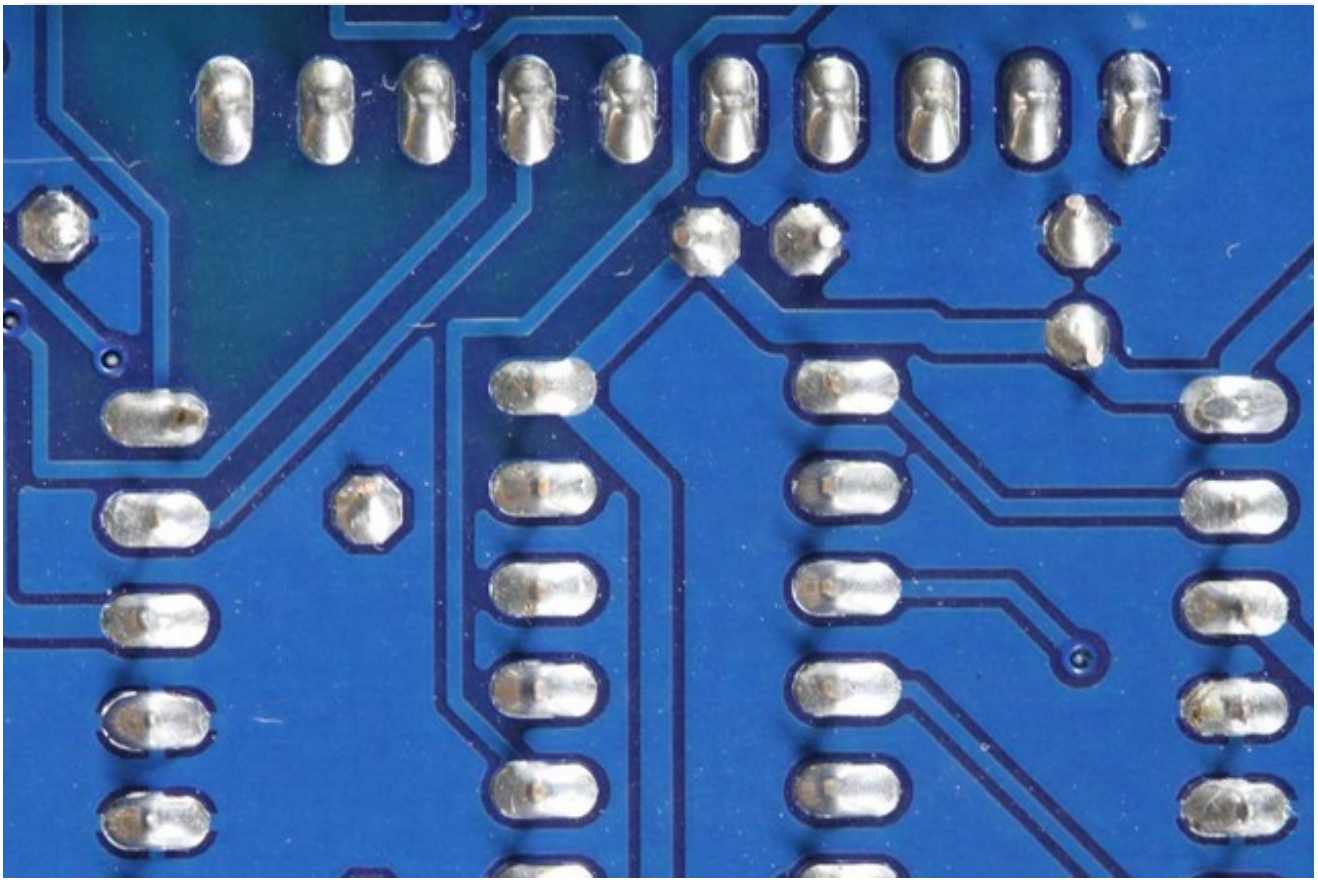

Once you have prepared the your tools and the joint to be soldered, making a good solder joint requires just a few simple steps.

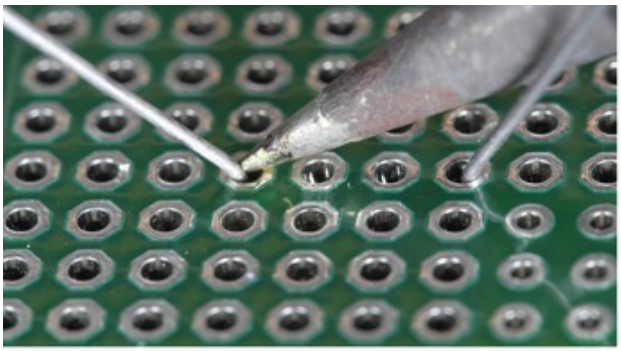

Heat the joint

Heat the joint with the tip of the iron. Be sure to heat both the solder pad and the component lead or pin. A small drop of solder on the tip will help to transfer the heat to the joint quickly.

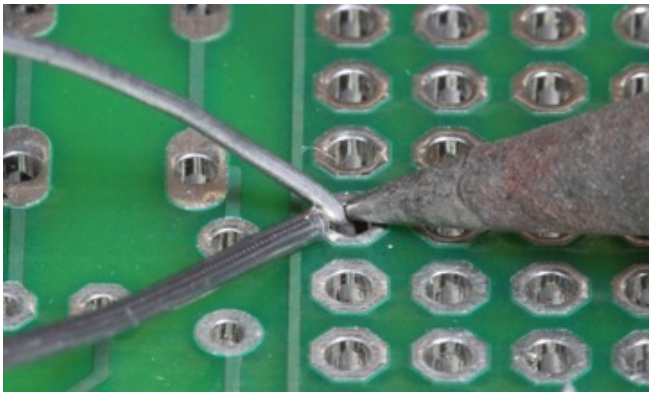

Apply the solder

Touch the end of the solder to the joint so that it contacts both the solder pad and the component lead or pin. It should melt and flow smoothly onto both the pin and the pad. If the solder does not flow, heat the joint for another second or two and try again.

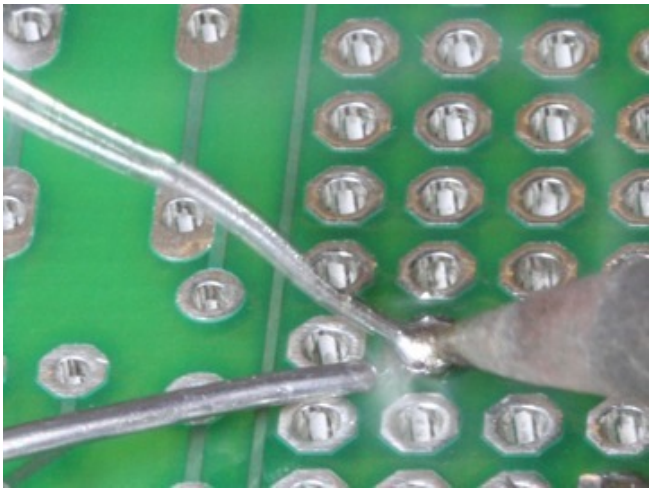

Let It Flow

Keep heating the solder and allow it to flow into the joint. It should fill the hole and flow smoothly onto both the solder pad and the pin or component lead.

Let It Cool

Once enough solder has been added to the joint and it has flowed well onto both the component lead and the solder pad, remove the iron from the joint and allow it to cool undisturbed.

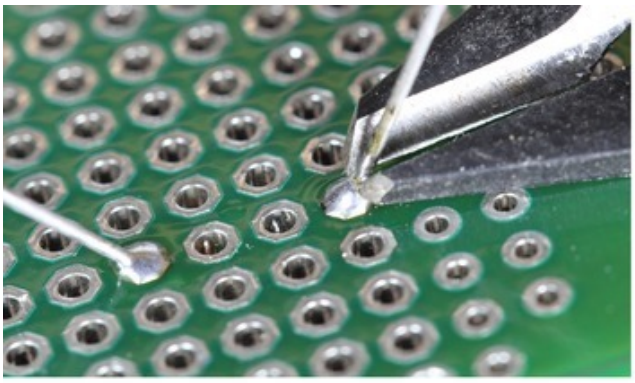

Trim the Lead

Use your diagonal cutters to trim the lead close to the board.

Note: This step applies only to components with wire leads. It is not necessary to trim the pins on Integrated circuit chips or sockets.

Congratulations!

Reward yourself with a Soldering Badge (http://adafru.it/465).

Problems?

The last page of this guide illustrates a number of common soldering problems with advice on prevention and repair.

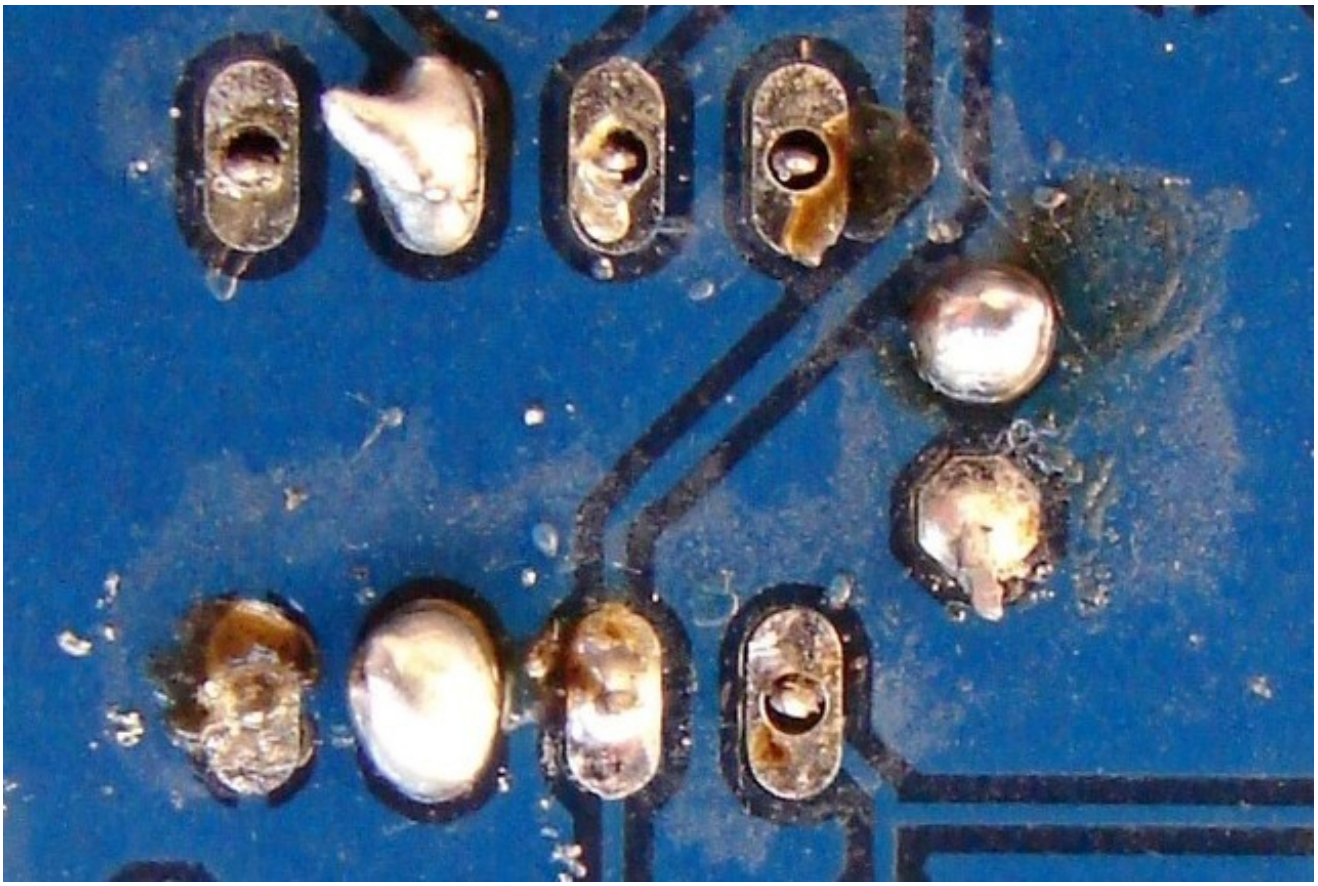

Surface Mount Components

The previous page showed how to make a good through-hole joint. But more and more components are only available in surface mount form these days. Not all surface mount packages are easily worked by hand, but there are plenty that can be managed with the same basic tools used for through-hole soldering.

Let's start with a surface-mount part common to several Adafruit kits: The SD Card Holder:

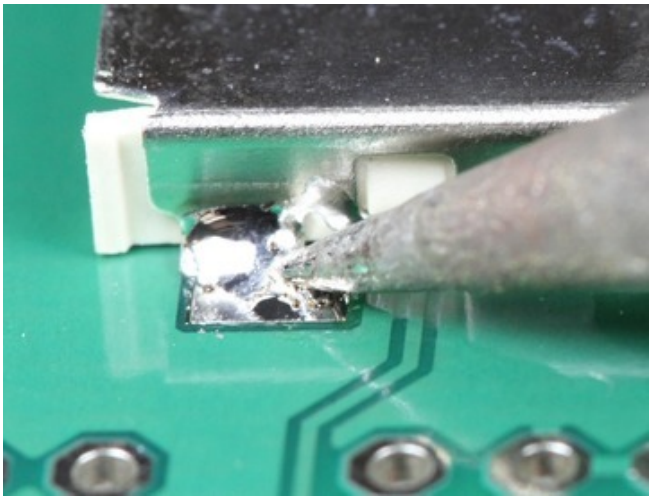

Immobilize the Joint

Unlike many surface mount components, immobilizing the SD card holder is relatively easy. There are small pegs on the back that fit into positioning holes in the board. Once it is in place, solder the four small corner tabs to make it permanent.

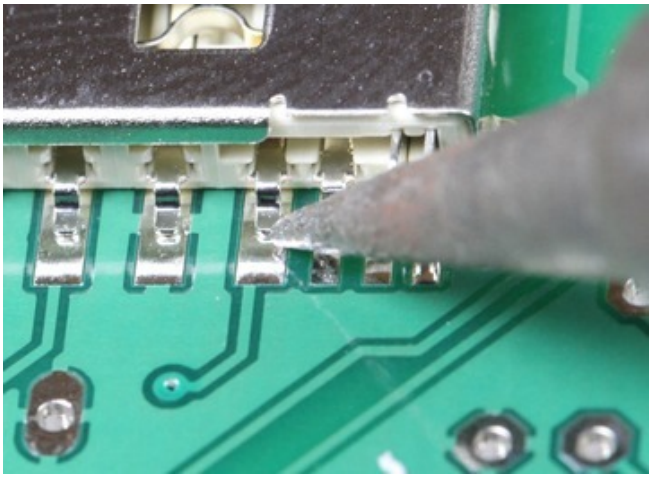

Heat the Joint

Start by putting the tip of the hot iron on the solder pad adjacent to the pin. The pad will take longer to heat, so we apply most of the heat to the pad to start.

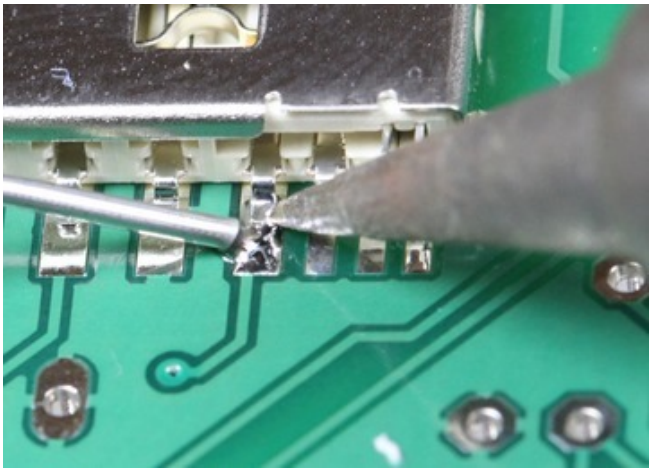

Apply the Solder

When the joint is hot, apply solder to the side opposite the iron. The solder should melt and start to flow into the joint.

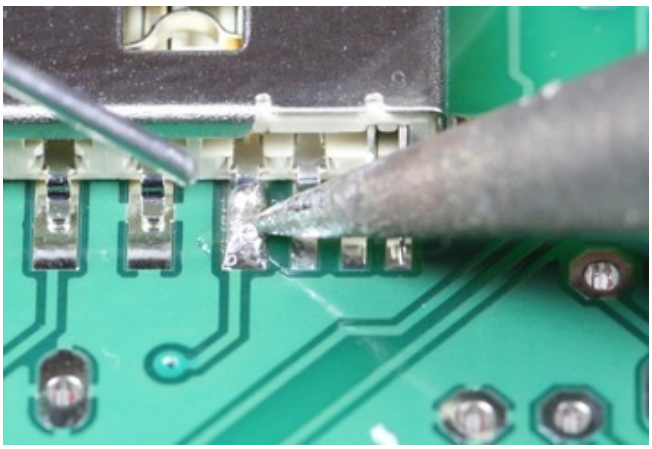

Let it Flow

Apply just enough solder to ensure a good joint, then keep the heat on while the solder wicks up between the pin and the pad to make a good electrical bond.

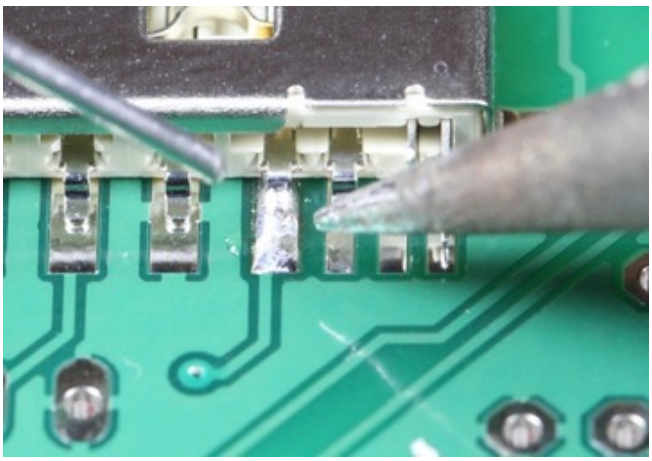

Let it Cool

Remove the iron and allow the joint to cool undisturbed.

Problems?

The last page of this guide illustrates a number of common soldering problems with advice

on prevention and repair.

Common Soldering Problems

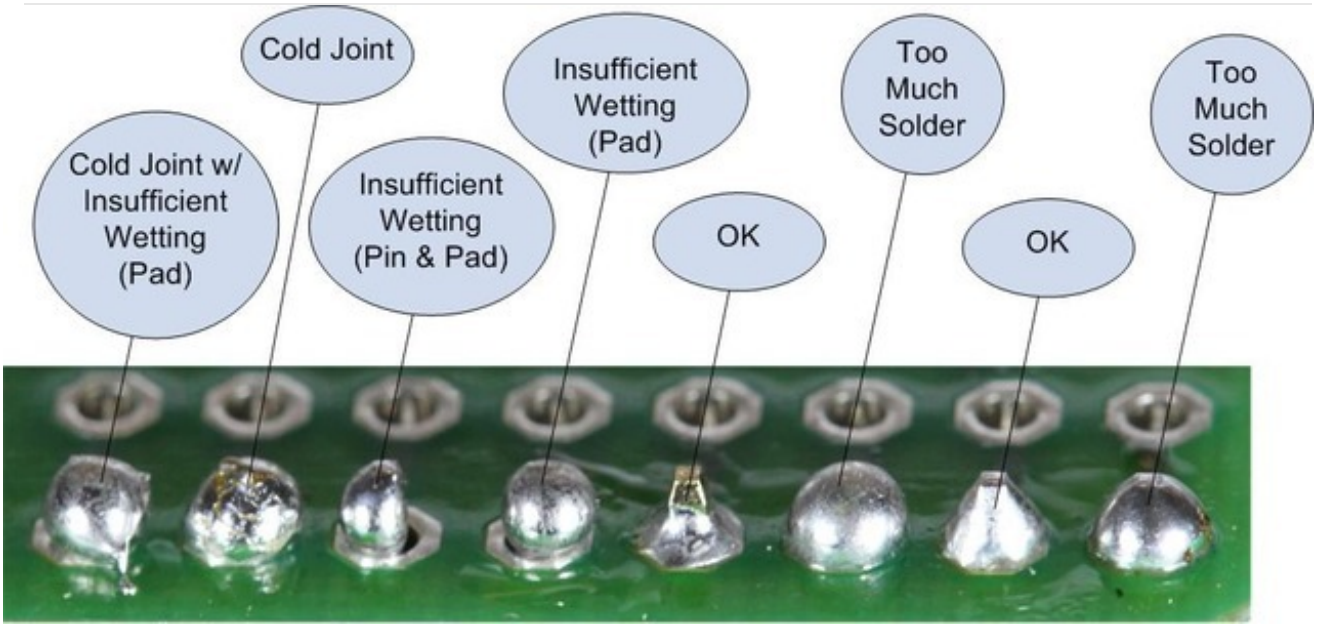

The Ideal Solder Joint

The ideal solder joint for through-hole components should resemble the diagram below.

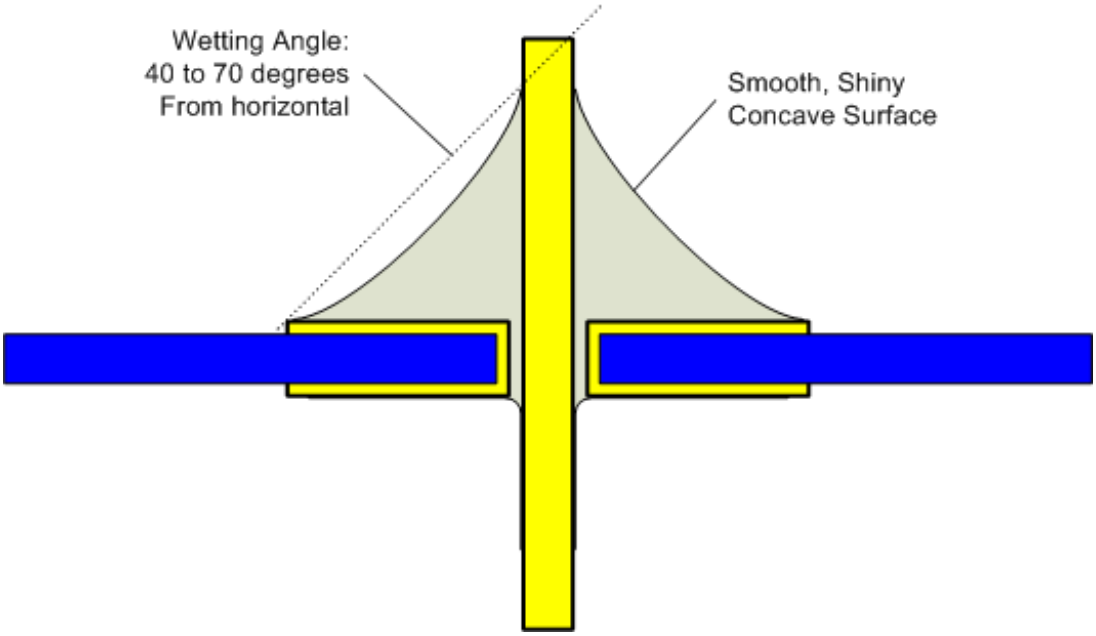

The photos that follow show some common soldering problems, with suggestions for repair and prevention:

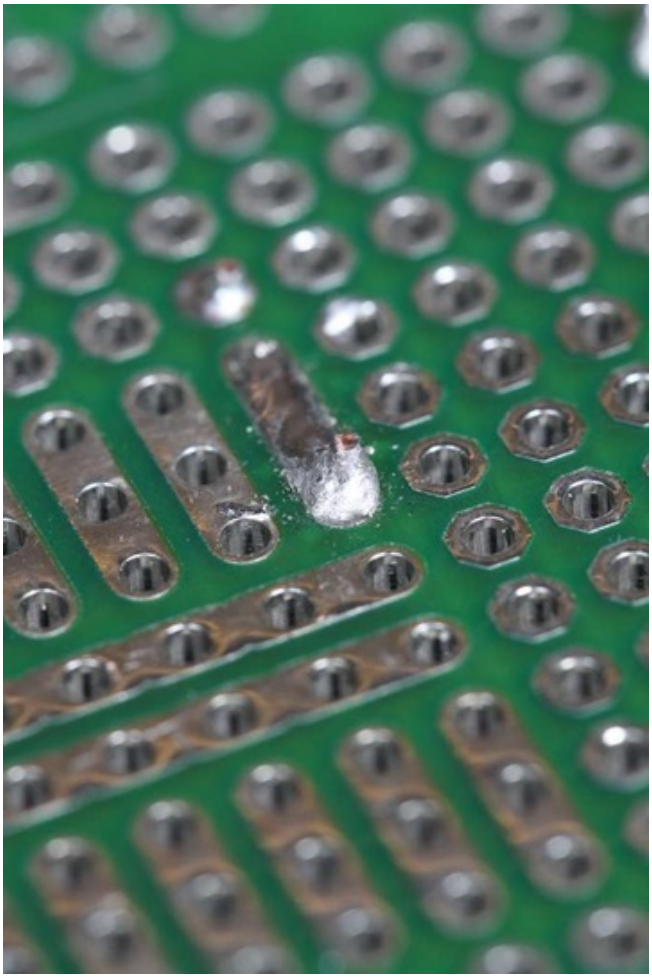

Disturbed Joint

A Disturbed joint is one that has been subjected to movement as the solder was solidifying. The surface of the joint may appear frosted, crystalline or rough.

Often called a 'Cold Joint'. They can look similar to a true cold joint, but the cause is different.

Repair: This joint can be repaired by reheating and allowing it to cool undisturbed.

Prevention: Proper preparation, including immobilizing the joint and stabilizing the work in a vise can prevent disturbed joints.

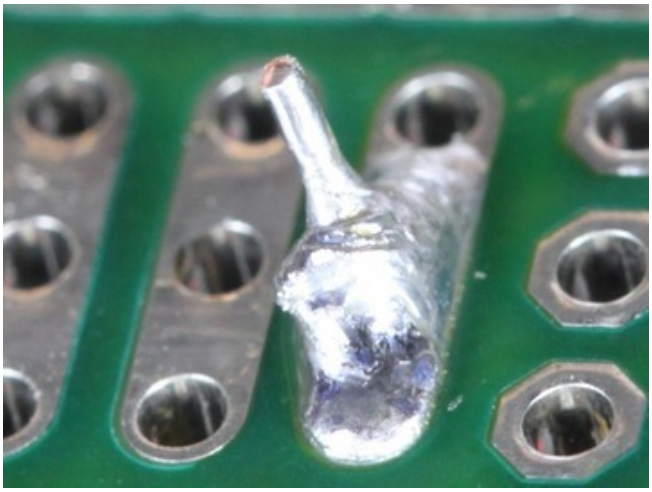

Cold Joint

A 'Cold Joint' is one where the solder did not melt completely. It is often characterized by a rough or lumpy surface. Cold joints are unreliable. The solder bond will be poor and the cracks may develop in the joint over time.

Repair: Cold joints can usually be repaired by simply re-heating the joint with a hot iron until the solder flows. Many cold joints (such as the one pictured) also suffer from too much solder. The excess solder can usually be drawn-off with the tip of the iron.

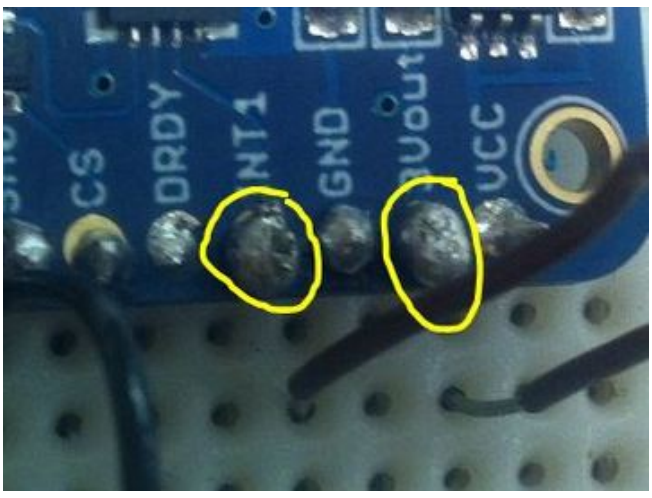

Prevention: A properly pre-heated soldering iron with sufficient power will help prevent cold joints.

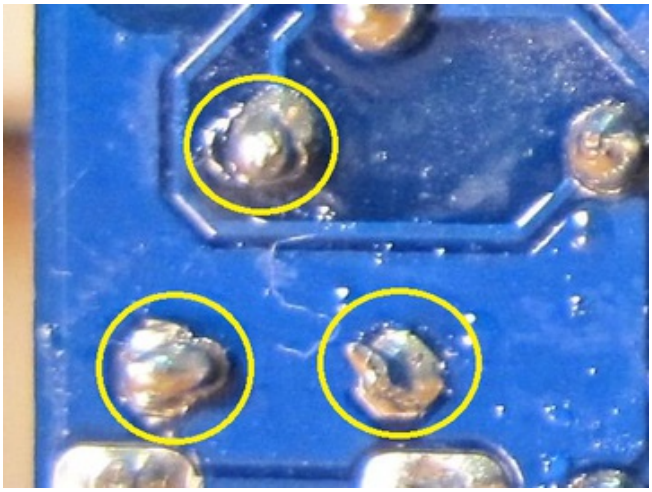

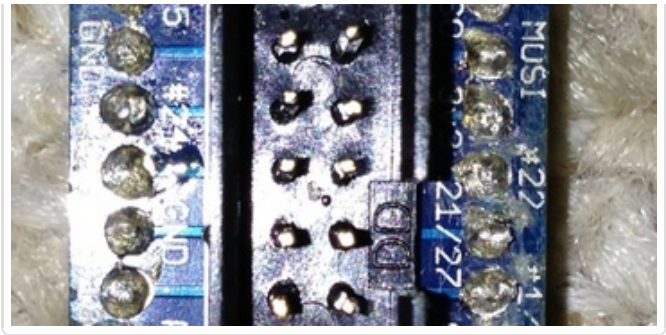
MUSI #22 #1
21/27
5 #41 clp
GND

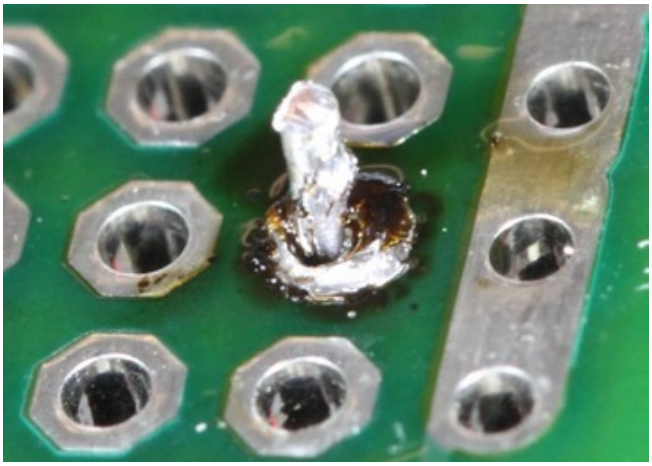

Overheated Joint

At the other extreme, we have the overheated joint. The solder has not yet flowed well and the residue of burnt flux will make fixing this joint difficult.

Repair: An overheated joint can usually be repaired after cleaning. Careful scraping with the tip of a knife, or little isopropyl alcohol & a toothbrush will remove the burnt flux.

Prevention: A clean, hot soldering iron, proper preparation and cleaning of the joint will help prevent overheated joints.

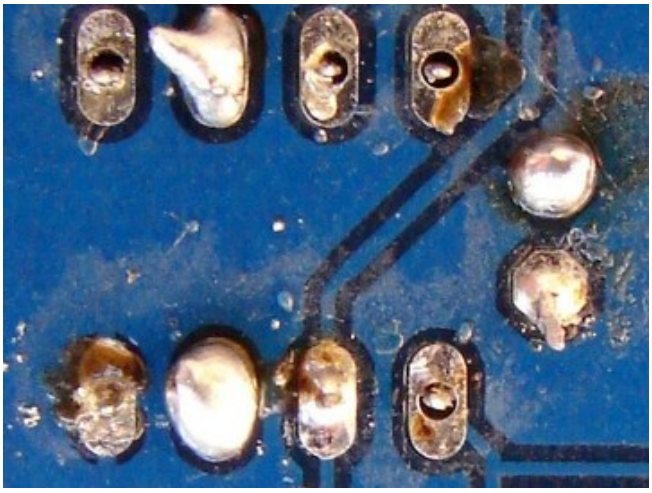

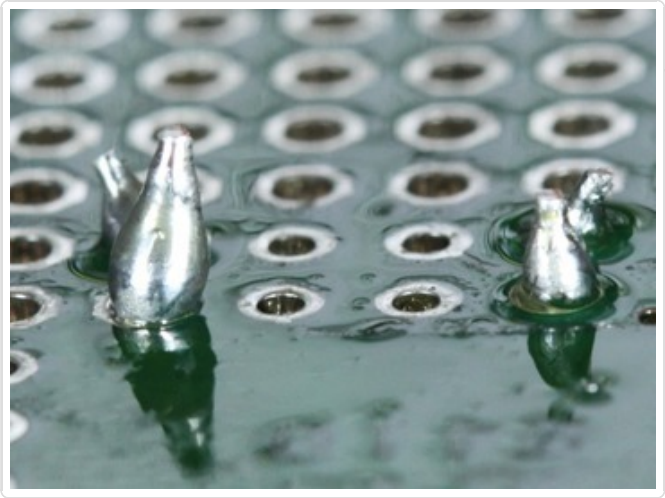

Insufficient Wetting (Pad)

These two joints both show signs of insufficient wetting of the solder pad. The solder has wetted the leads nicely, but it has not formed a good bond with the pad. This can be caused by a dirty circuit board, or by failing to apply heat to the pad as well as the pin.

Repair: This condition can usually be repaired by placing the tip of the hot iron at the base of the joint until the solder flows to cover the pad.

Prevention: Cleaning the board and even heating of both the pad and the pin will prevent this problem.

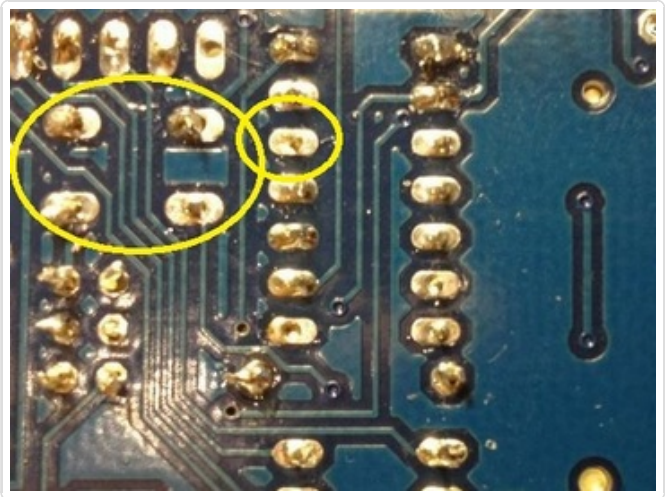

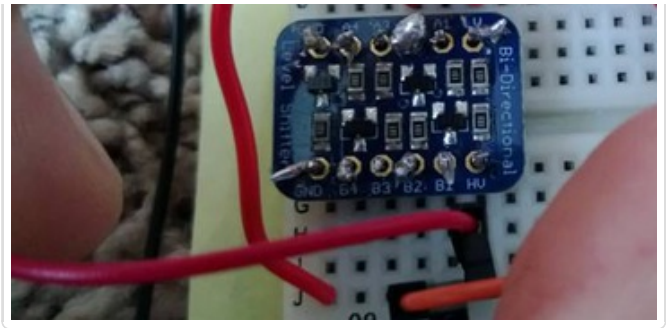
Bi-Directional
GND B4 B3 B2 B1 HV

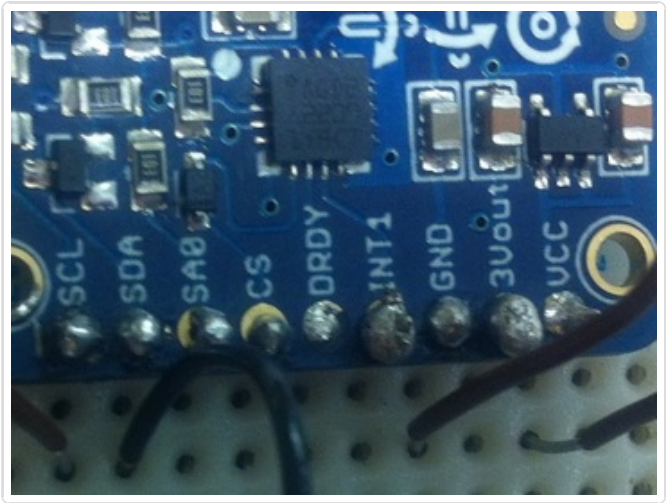
SCL
SDA
SA0
CS
DRDY
INT1
GND
3VOUT
VCC

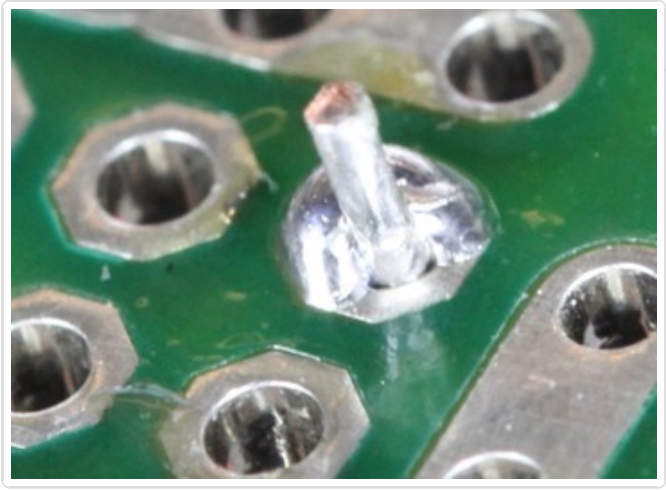

Insufficient Wetting (Pin)

This solder in this joint has not wetted the pin at all and has only partially wetted the pad. In this case, heat was not applied to the pin and the solder was not given adequate time to flow.

Repair: This joint can be repaired by re-heating and applying more solder. Be sure that the tip of the hot iron is touching both the pin and the pad.

Prevention: Even heating of both the pin and the pad will prevent this problem.

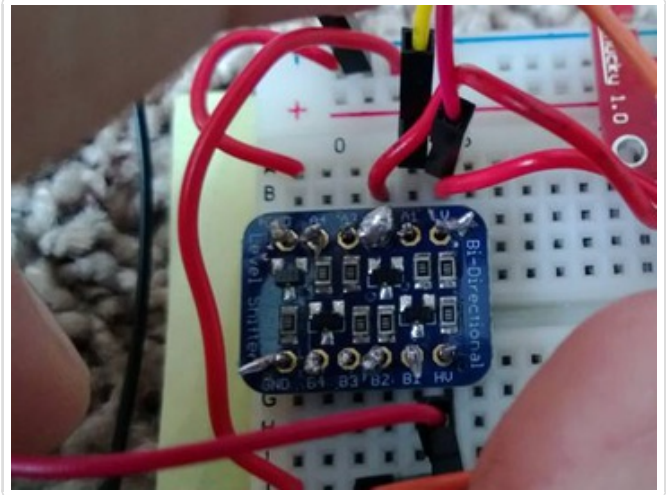

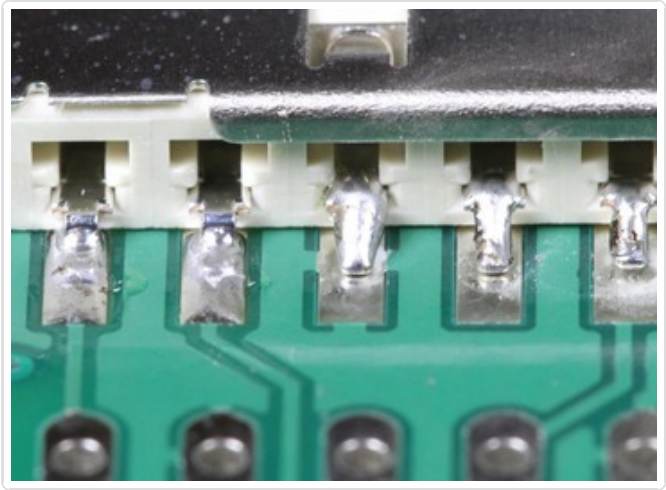

Insufficient Wetting (Surface Mount)

Here we have three pins of a surface mount component where the solder has not flowed onto the solder pad. This is caused by heating the pin instead of the pad.

Repair: This is easily repaired by heating the solder pad with the tip of the iron, then applying solder until it flows and melts together with the solder already on the pin.

Prevention: Heat the pad first.

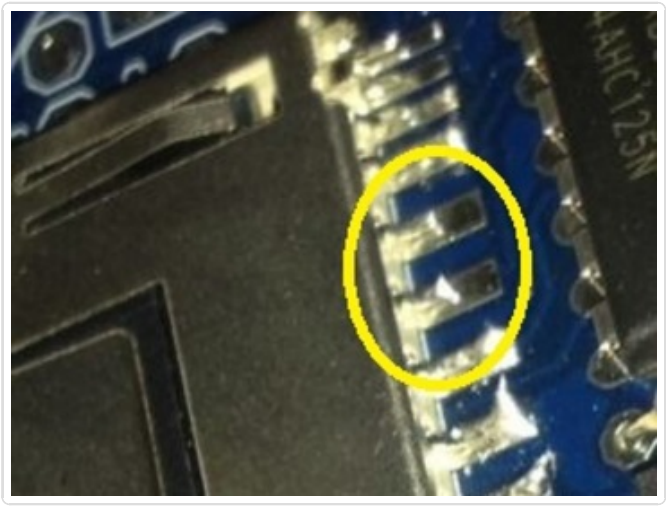

Solder Starved

A solder starved joint simply does not have enough solder. It may make good electrical contact, but it is hard to verify by inspection. In any case, it is not a strong joint and may develop stress cracks and fail over time.

Repair: Re-heat the joint and add more solder to make a good strong joint.

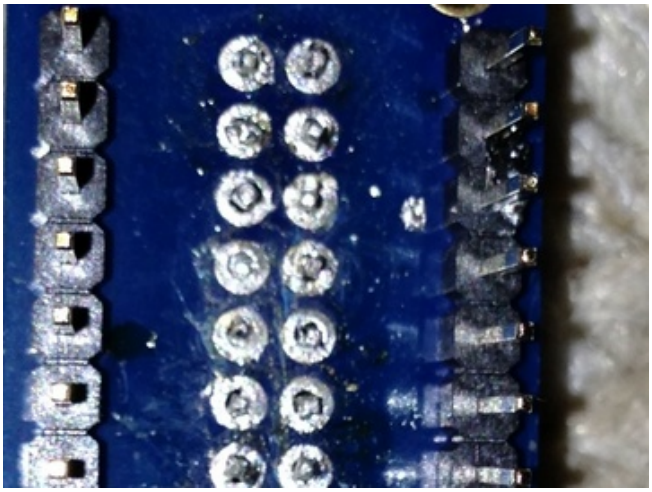

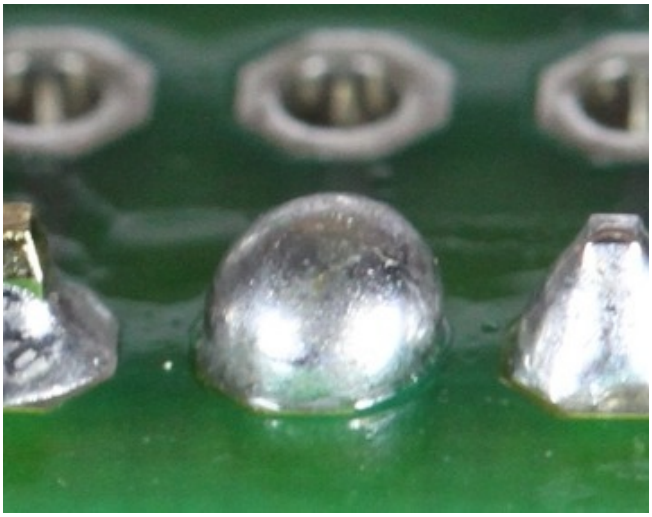

Too Much Solder

This might be a perfectly good joint, but we can't tell for sure. It is entirely possible that this blob of solder wets neither the pin nor the pad and is not a reliable electrical connection. The best evidence of proper wetting (and good electrical contact) is a nice concave surface as on the joint on the far left.

Repair: It is usually possible to draw off some of the excess solder with the tip of a hot iron. In extreme cases, a solder-sucker or some solder wick can be helpful as well.

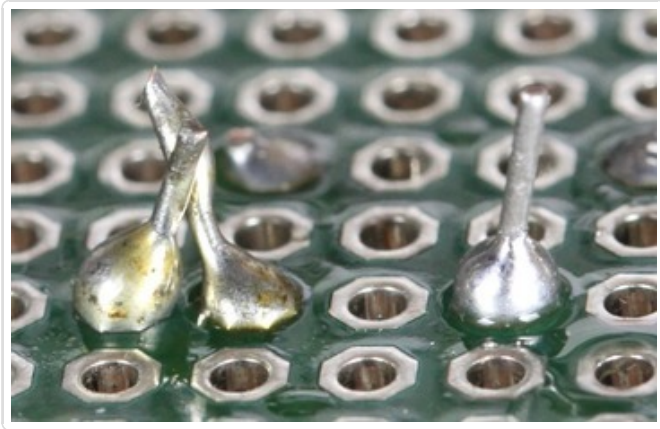

Untrimmed Leads

Leads that are too long are potential short circuits. The two joints on the left are an obvious danger of touching. But the one on the right is long enough to be dangerous as well. It would not take much force to bend that lead over to touch an adjacent trace.

Repair: Trim all leads just at the top of the solder joint.

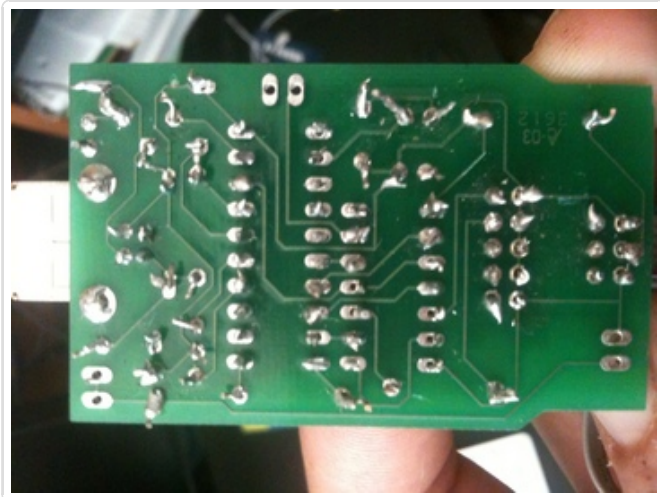

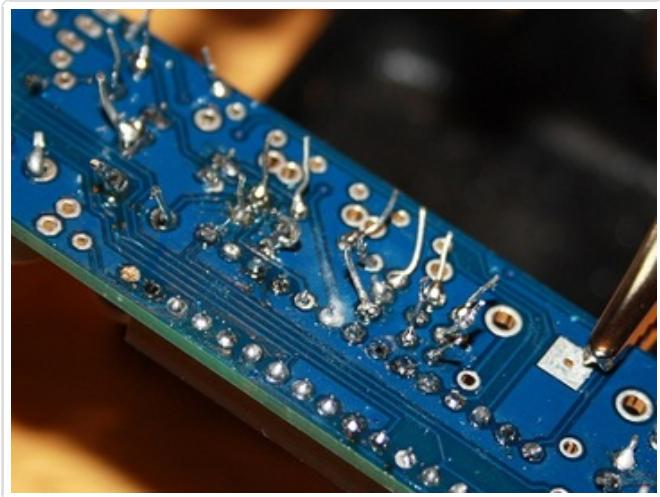

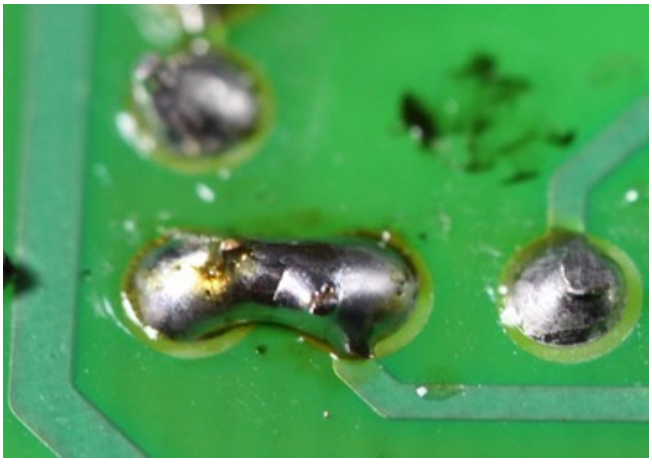

Solder Bridge

The left two solder joints have melted together, forming an unintended connection between the two.

Repair: Sometimes the excess solder can be drawn off by dragging the tip of a hot iron between the two solder joints. If there is too much solder, a solder sucker or solder wick can help get rid of the excess.

Prevention: Solder bridges most often happen between joints with too much solder to begin with. Use only enough solder to make a good joint.

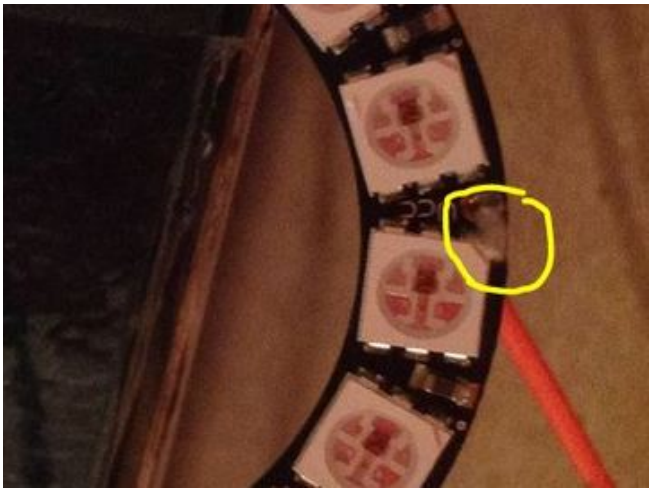

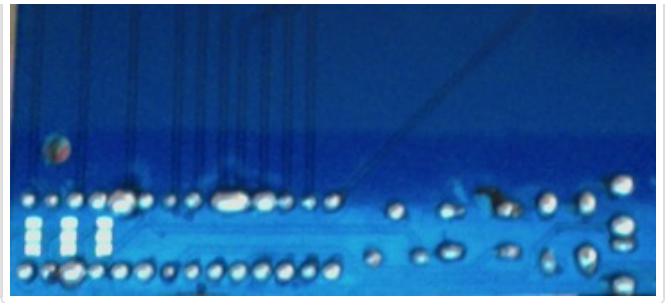

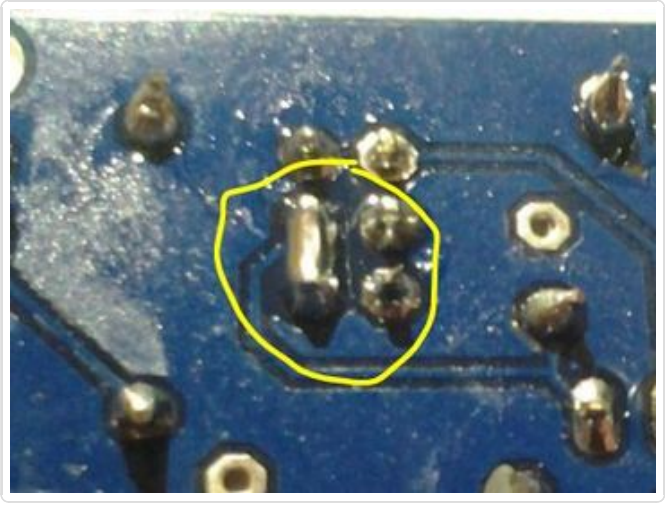

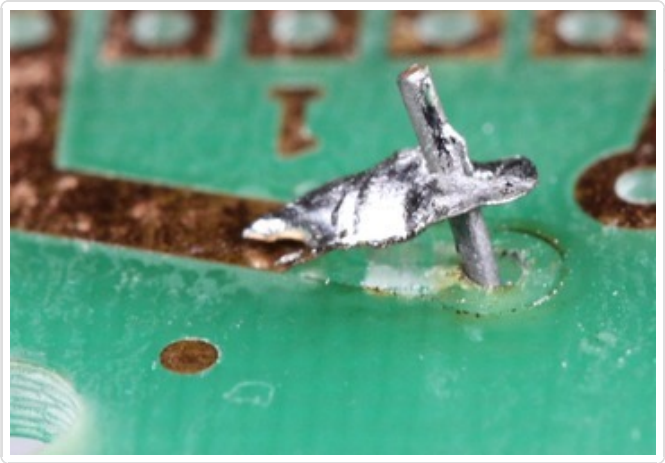

Lifted Pad

This photo shows a solder pad that has become detached from the surface of the circuit board. This most often occurs when trying to de-solder components from the board. But it can result simply from overworking the joint to the point where the adhesive bond between copper and the board is destroyed.

Lifted pads are especially common on boards with thin copper layers and/or no through-plating on the holes.

Repairing a Lifted Pad

It may not be pretty, but a lifted pad can usually be repaired. The simplest repair is to fold the lead over to a still-attached copper trace and solder it as shown to the left. If your board has a solder-mask, you will need to carefully scrape off enough to expose the bare copper.

Other alternatives are to follow the trace to the next via and run a jumper to there. Or, in the worst case, follow the trace to the nearest component and solder your jumper to the leg of that. Not exactly pretty, but functional.

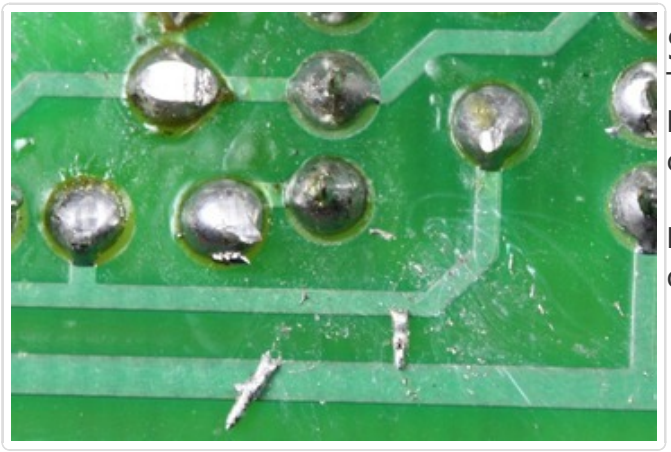

Stray Solder Spatters

These bits of solder are held to the board only by sticky flux residue. If they work loose, they can easily cause a short circuit on the board.

Repair: These are easy to remove with the tip of a knife or tweezers.

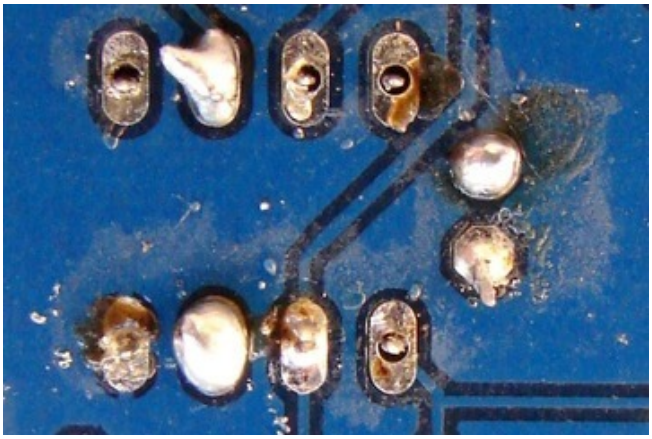

All of the Above!

Don't panic. Take your time. Most joints can be repaired with patience. If the solder refuses to flow the way you want it to:

1. Stop and let the joint cool.
2. Clean and tin your iron.
3. Clean off any burnt flux from the joint.
4. Let the iron come back up to temperature.
5. Then reheat the joint and try again.

HAND SOLDERING TUTORIAL FOR FINE PITCH QFP DEVICES

Scope

This document is intended to help designers create their initial prototype systems using Silicon Lab's TQFP and LQFP devices where surface mount assembly equipment is not readily available. This application note assumes that the reader has at least basic hand soldering skills for through-hole soldering. The example presented will be the removal, cleanup and replacement of a TQFP with 48 leads and 0.5 mm lead pitch.

Safety

Work should be done in a well-ventilated area. Prolonged exposure to solder fumes and solvents can be hazardous. There should be no presence of sparks or flames when solvents are in use.

Materials

The right materials are key to a good solder job. The list below are the recommendations from Silicon Labs. Other materials may work, so the user should feel free to substitute and experiment. The use of organic solder is highly recommended.

Required

1. Wire wrap wire (30 gauge) *
2. Wire strippers for wire wrap wire *
3. Soldering station - variable temperature, ESD-safe. Should support temperatures 800°F (425°C). This example uses a Weller model EC1201A. The soldering wand should have a fine tip no more than 1 mm wide.
4. Solder - 10/18 organic core; 0.2" (0.5 mm) diameter
5. Solder flux - liquid type in dispenser
6. Solder wick - size C 0.075" (1.9 mm)
7. Magnifier - 4X minimum. An inexpensive headset OptiVISOR by Donegan Optical Co. is used for this example.
8. ESD mat or tabletop and ESD wrist strap - both grounded
9. Tweezers with pointed (not flat) tips
10. Isopropyl Alcohol
11. Small stiff bristle brush for cleaning (nylon or other non-metallic material). Cut off hair to approximately 0.25" (6 mm)

* Required for device removal only.

Optional

1. Board vise to hold printed circuit board
2. Dental pick (90 degree bend)
3. Compressed dry air or nitrogen to dry boards

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4. Optical inspection stereo microscope 30-40X

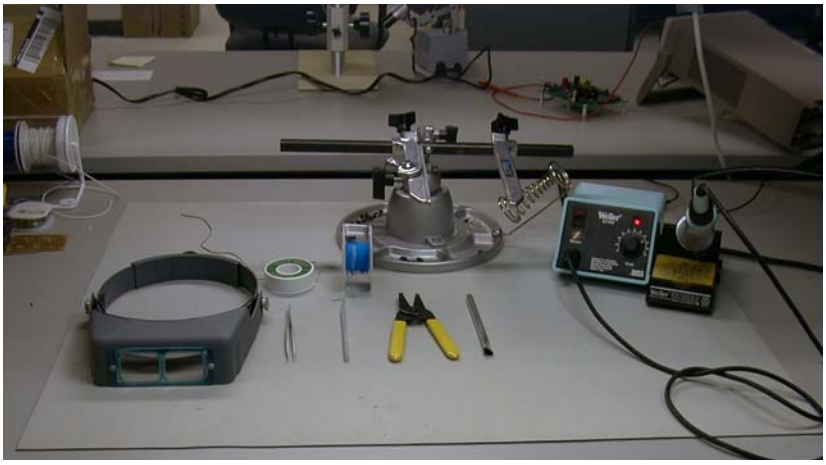

Figure 1. Some of the materials to get started...

Figure 2. clock-wise from left: 4X magnifying headset, solder wick, wire wrap wire, stiff cleaning brush, wire strippers, and pointed tweezers

Figure 3. Solder wick and wire wrap wire

Figure 3. Isopropyl Alcohol

Figure 4. ESD safe soldering station with fine tip wand. This one is Weller model EC1201A

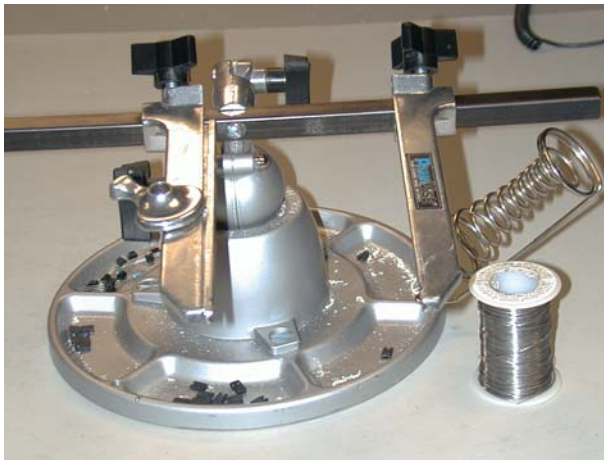

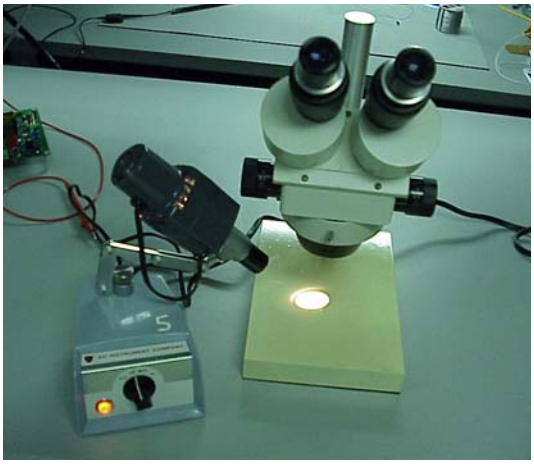

Figure 5. Optional equipment includes a PCB vise and an inspection microscope 7-40X

Procedure

The following procedures cover the replacement of a TQFP 48 pin device with 0.5 mm lead pitch. The lead shape is the standard gullwing associated with JEDEC standard QFPs. This procedure section is divided into three parts:

A. Part Removal

B. Board Cleanup

C. Soldering a new device.

If you are soldering parts to a new printed circuit board, skip part A and refer to the new board cleanup section in part B.

A. Part Removal

Preparation:

- Board with IC to be removed is mounted in a holder or vise. A PCB holder/vise is optional but it is required that the PCB is held steady for the part removal.
- The soldering station is warmed up to 800°F (422°C) and the solder tip is clean.
- ESD precautions have been taken.

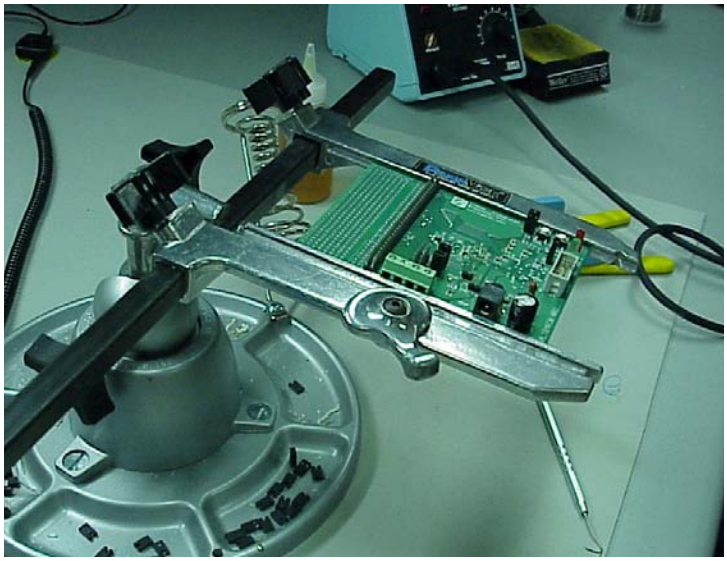

Figure 6. Ready to get started

Begin by wetting all the leads with flux to enhance the initial solder wicking cleanup. Wick up solder as much as possible from the QFP leads. Be careful not to scorch the PCB board with prolonged solder heat.

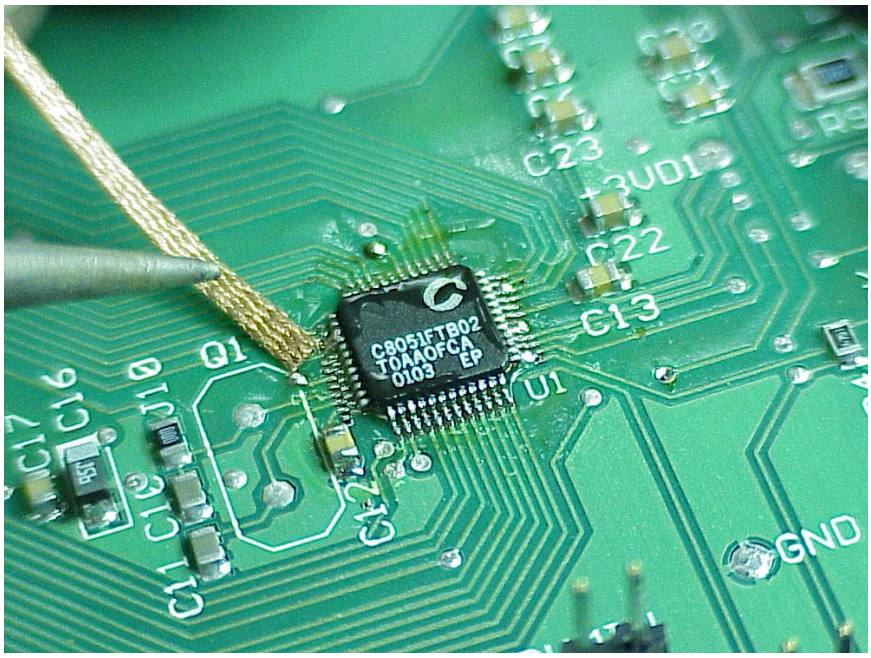

Figure 7. Apply flux; wick excess solder from pins

Next, strip off approximately 3 inches of insulation from a piece of the 30 gauge wire wrap wire. Cut the wire at a comfortable 12 inch length or so.

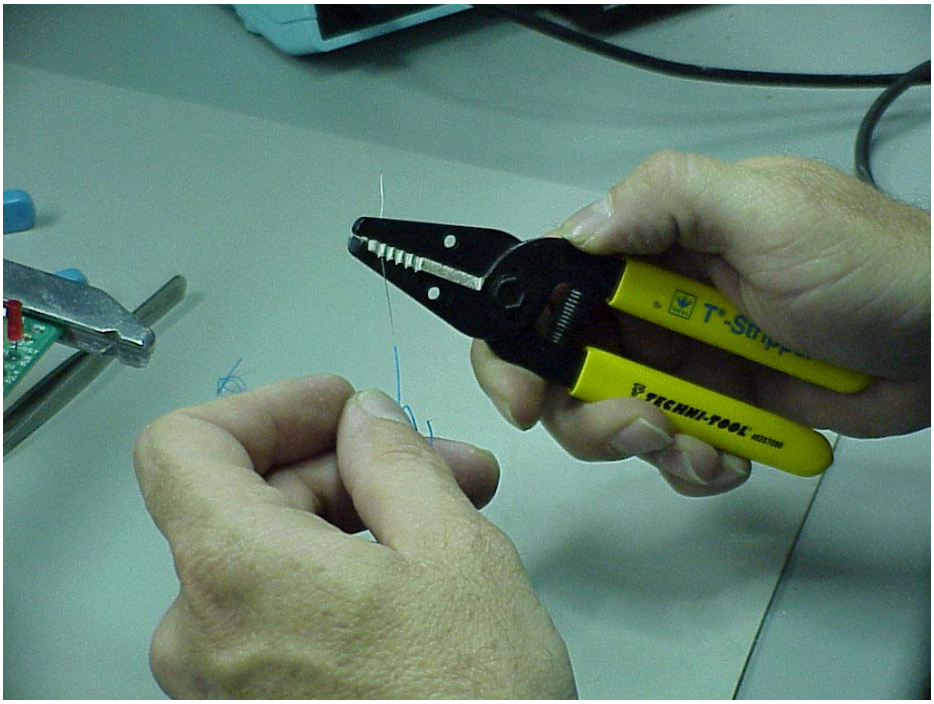

Figure 8. Wire stripping

Feed the wire behind and under the leads on one side of the IC as shown in Figure 9.

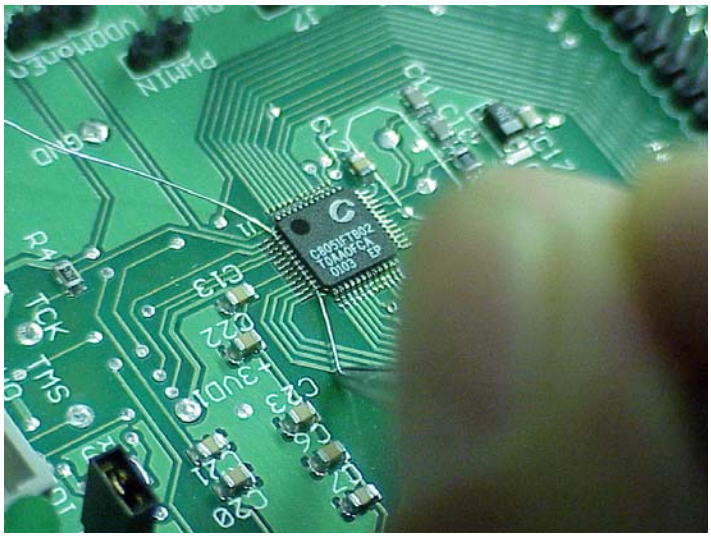

Figure 9. Feeding wire under QFP leads

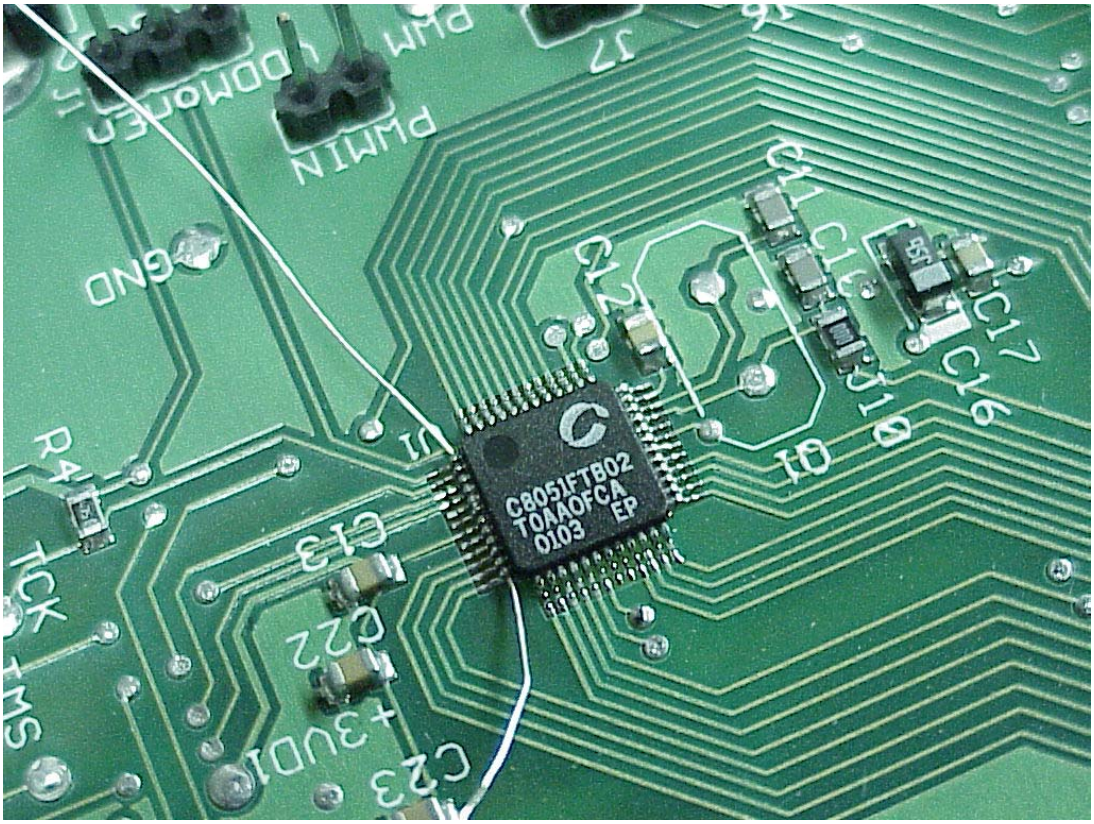

Figure 9. Wire with one side anchored to nearby component

Solder tack (anchor) one end of the 3 inch wire to a nearby via or component on the PCB. The anchor point should be in a location similar to that should in Figure 10.

Dispense a small amount of liquid flux across the leads.

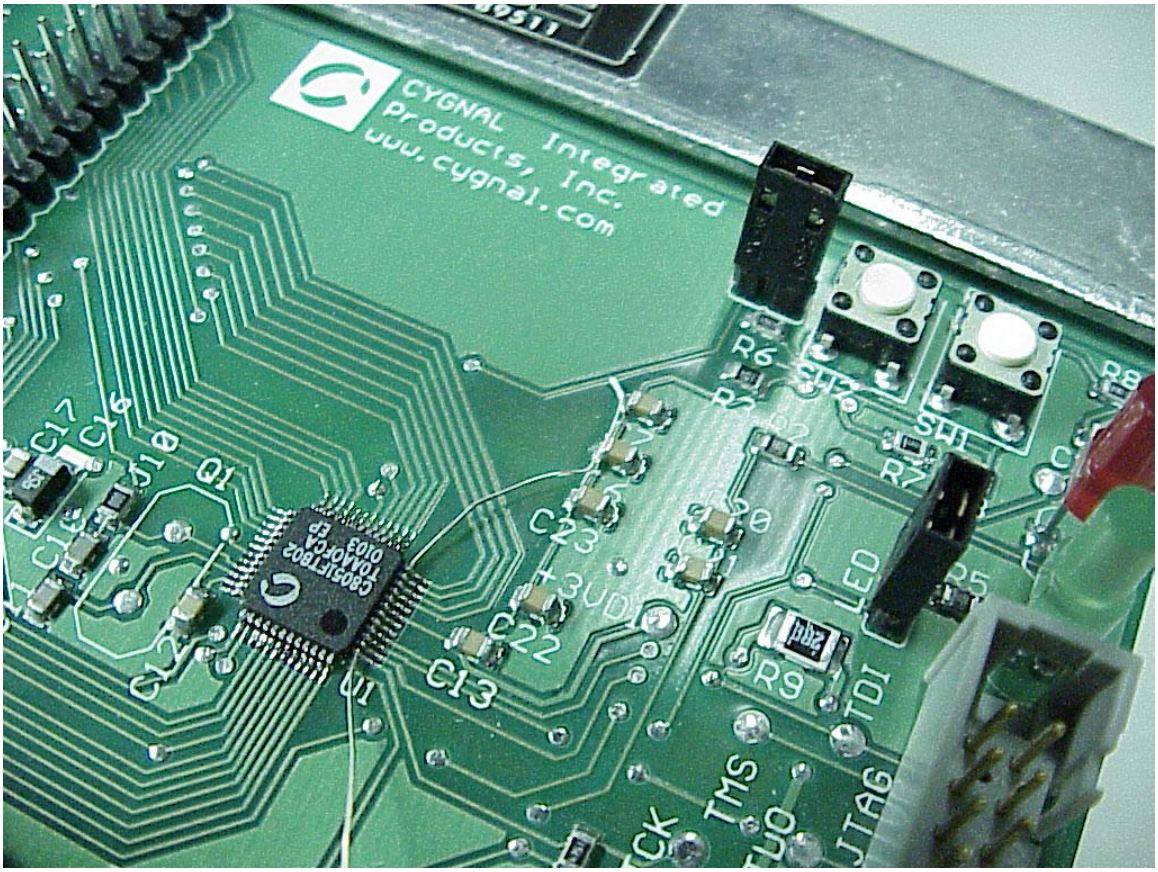

Figure 10. Bus wire is anchored on C6

Hold the loose (non-anchored) end of the wire with tweezers in close proximity to the device as shown in Figure 11.

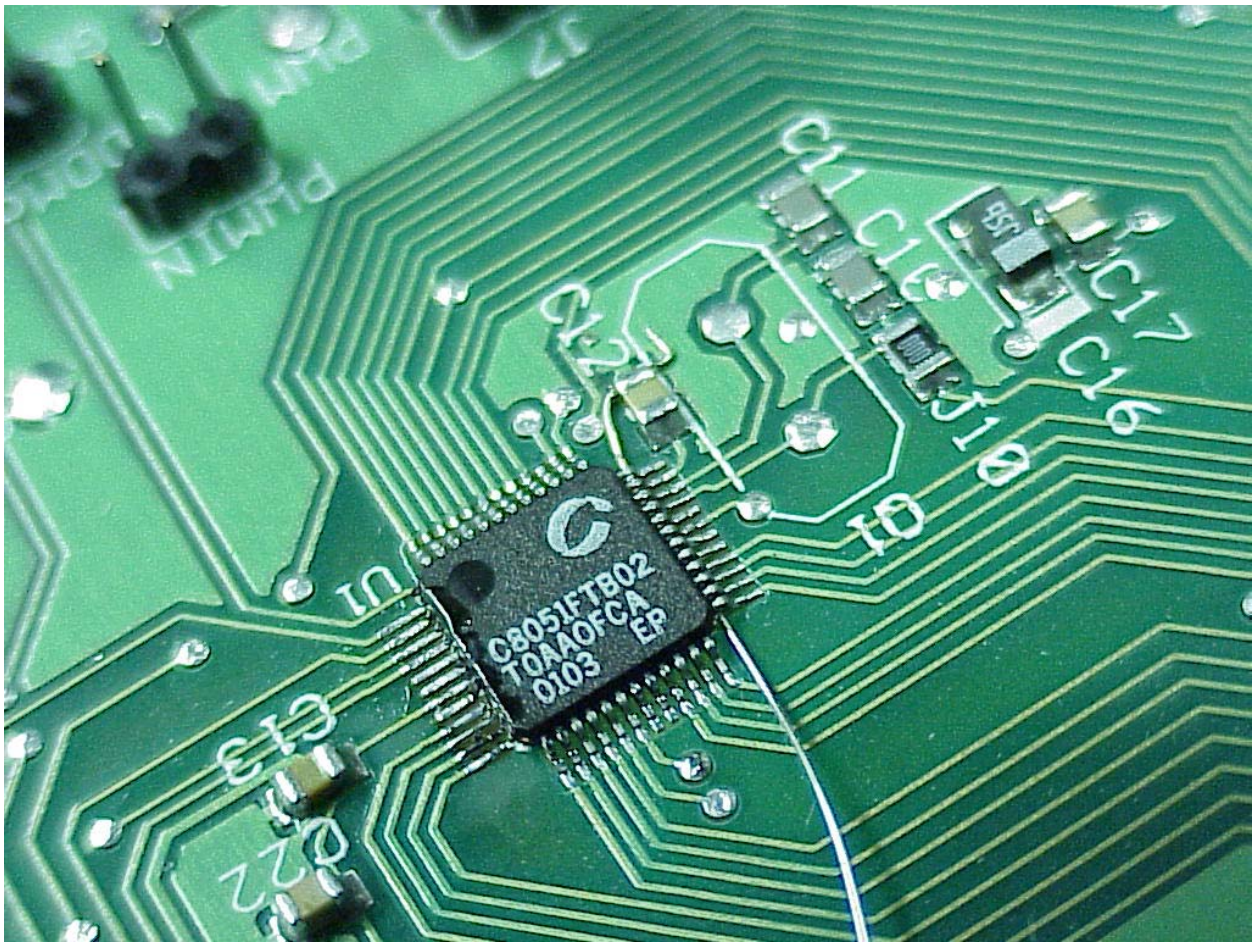

Figure 11. Side 2 anchored and ready for solder heat

You will now need to simultaneously apply solder heat and pull the wire away from the QFP, pulling at a slight upward angle from the board surface. Apply solder heat beginning at the lead closest to your tweezers. As the solder melts, gently pull the wire away from the QFP while continuing to move the solder heat from pin to pin to the right. You should not pull very hard. Pull as the solder melts. Do not leave the solder heat on any lead for more than necessary. The first lead will take the longest to heat, and after the wire gets hot, solder on the other leads will melt quickly. Excessive heat will damage the IC device and the PCB pad. The removal of 12 pins from a 48TQFP should take about 5 seconds total. Signs of excessive heat are:

- Melted plastic on the IC device
- PCB pads that lift off
- Brown scorch marks on the PCB

With one side of the QFP completed, repeat the same procedure on the other three sides of the QFP. Cut off the dirty part of the wire wrap wire or use a new piece for each side. Dispense flux again for each side.

Note that in the following pictures, the old IC device is not being saved. There is slightly more heat being applied here than necessary to speed up the process. This result is some melted plastic and missing gull-wing leads. These are visible in the pictures that follow. If you are trying to save the IC being removed, then you must be very careful to apply as little heat as possible during the removal process such that the QFP leads remain intact in the plastic QFP body. This will require some experimentation with solder heat settings and timing.

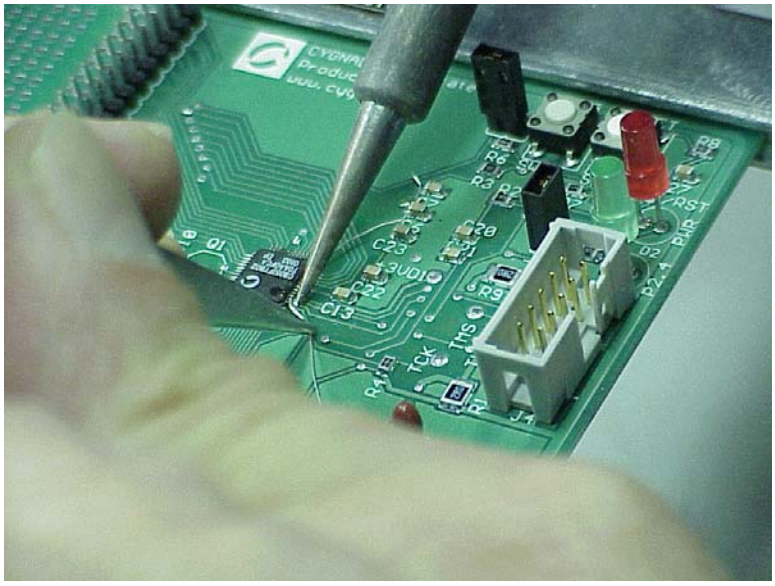

Figure 12. Hold tweezers close to device

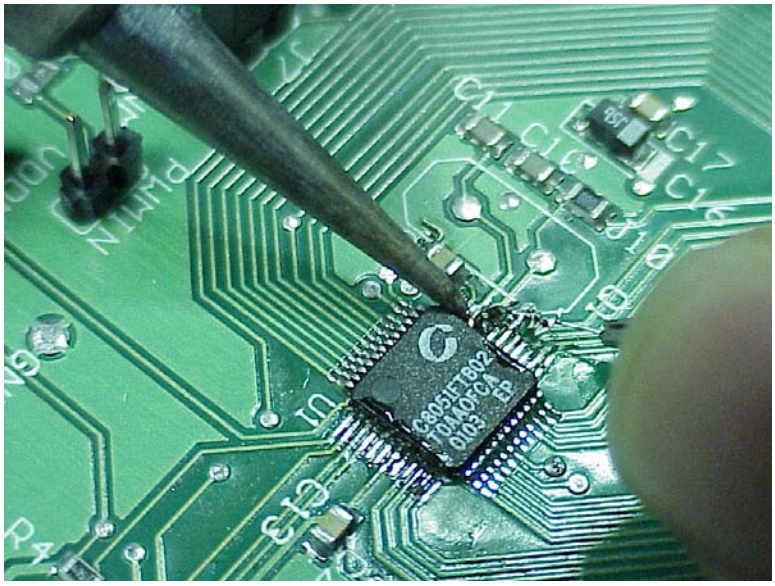

Figure 14. Side 2 almost complete

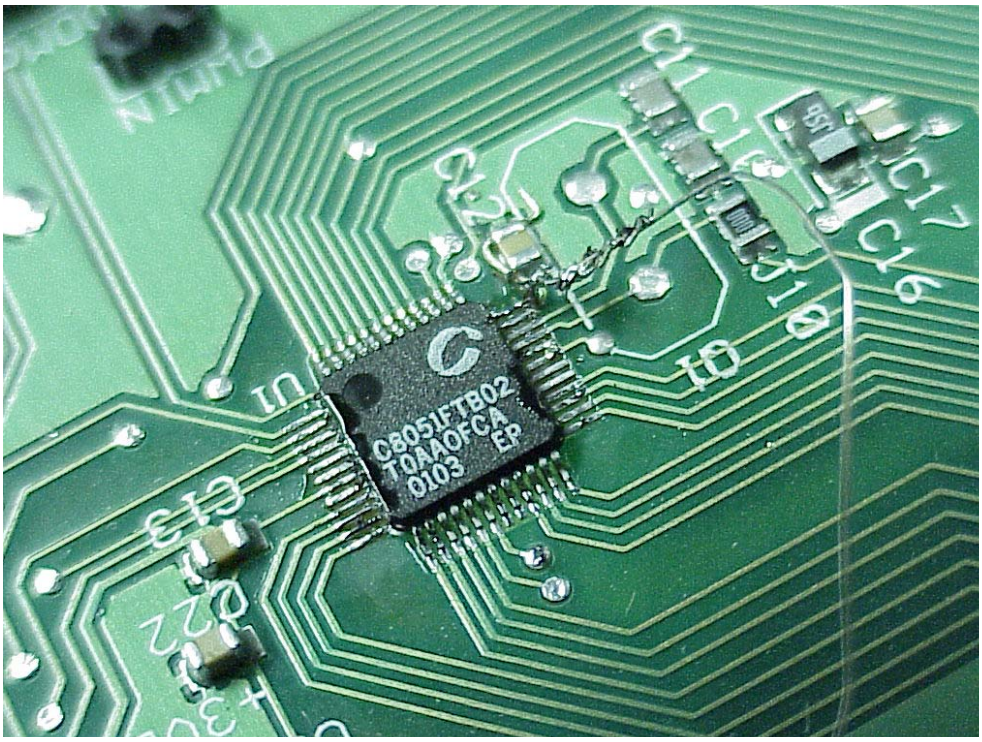

Figure 15. Side 2 is done

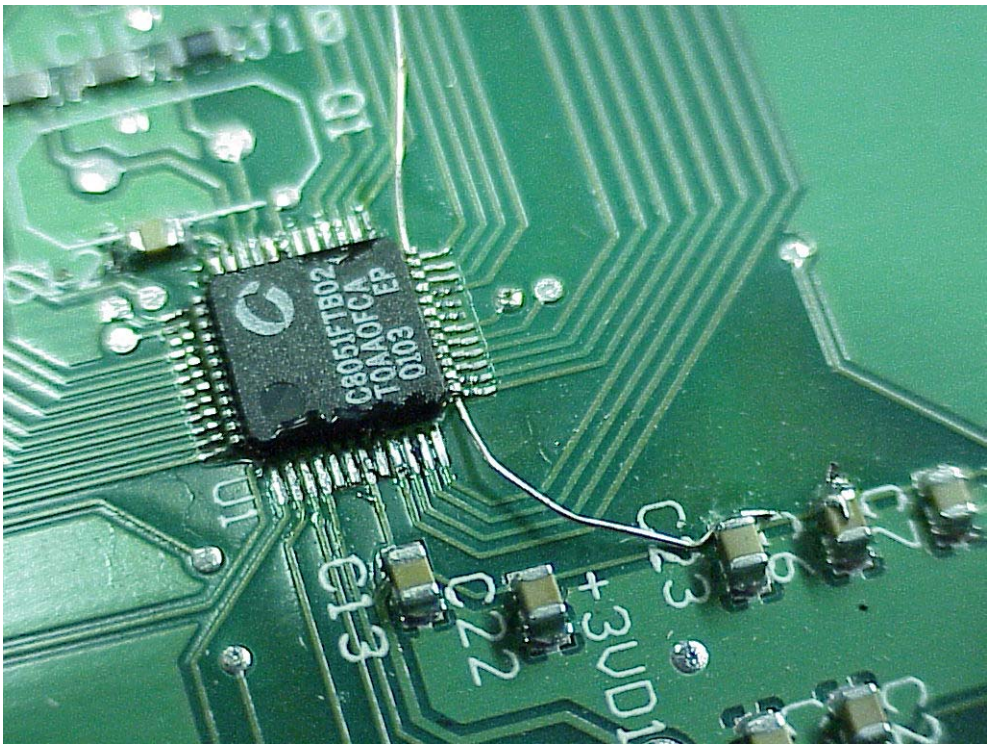

Figure 16. Side 3 anchored and ready

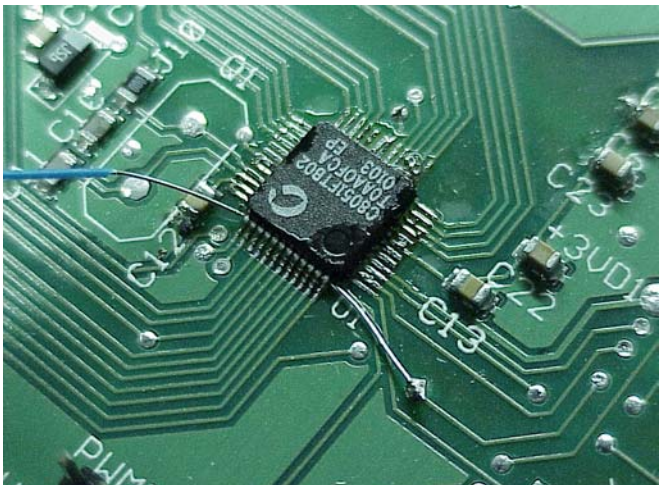

Figure 17. Side 4 anchored to a via

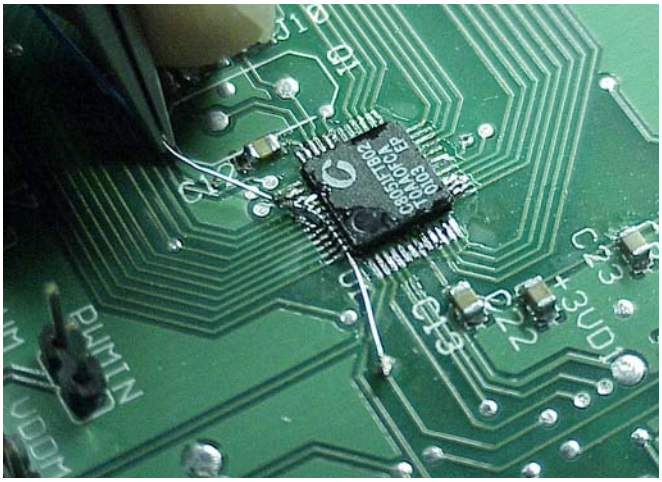

Figure 18. Side 4 removal started

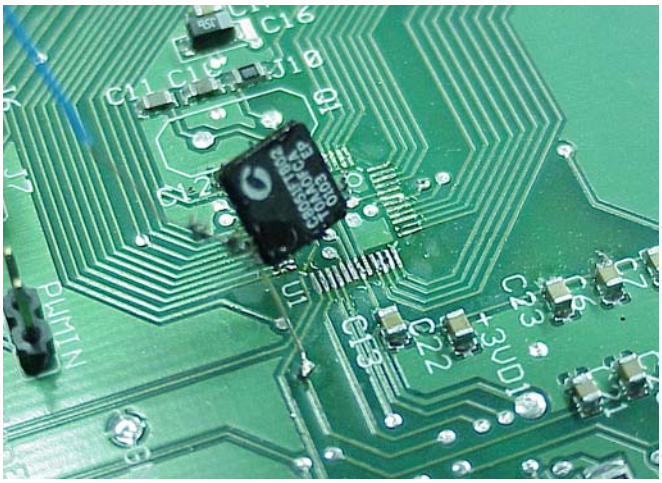

Figure 19. QFP removal a second before completion

B. Board Cleanup

New PCBs

For mounting a device to a new PCB, the amount of cleanup should be minimal. On a new PCB, there should be no solder on the pads. Brushing the pads with isopropyl alcohol (Figure 33) and drying the board should be enough preparation to begin the mounting procedure.

Reworked PCBs

The following section is the cleanup sequence that follows the QFP removal in the previous section. After removing the device, the solder pads will need cleanup. The idea is to clean the pads so that they are flat and free or solder and flux. Solder wick the pads until they are flat and dull. A clean pad appearance should be a dull silver color.

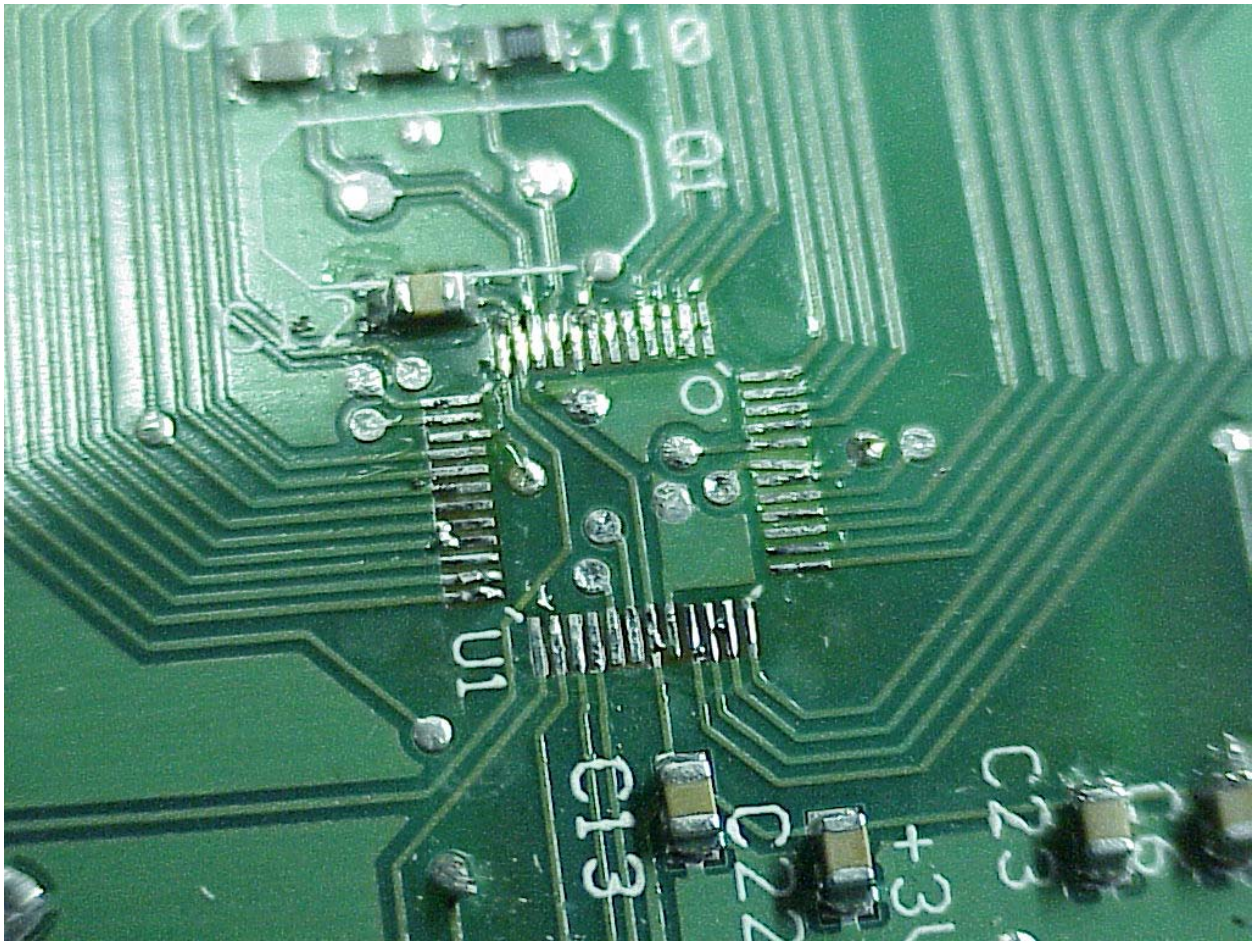

Figure 20. Pads after QFP removal procedure

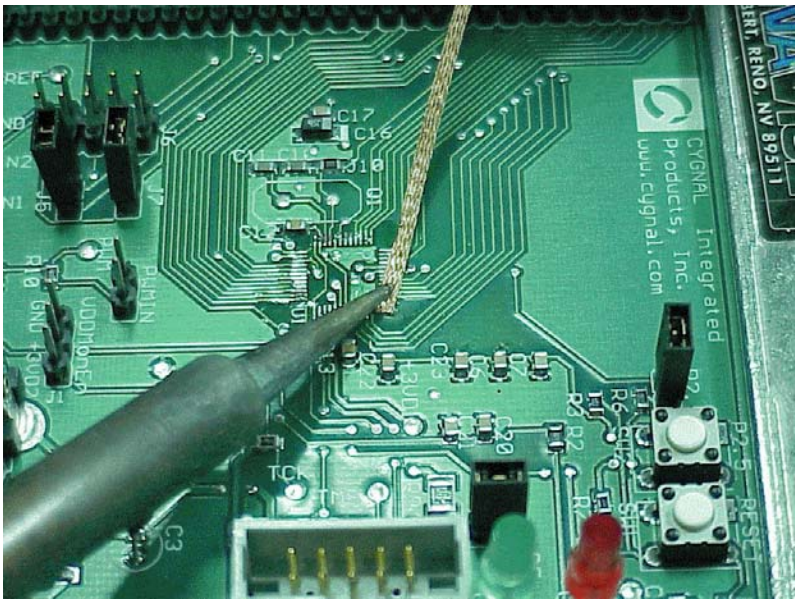

Figure 21. Solder wick to remove solder on the pads

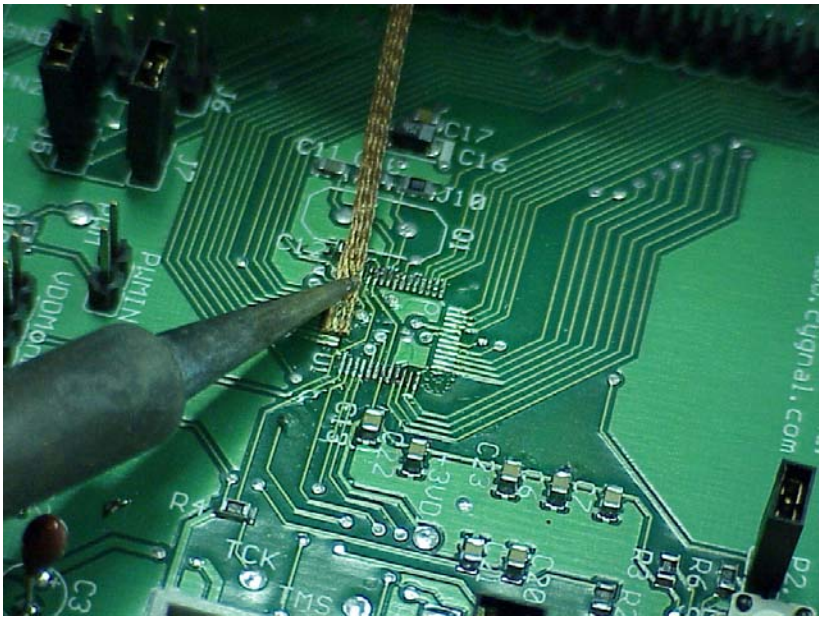

Figure 22. Repeat for all pads

If any pads become loose from the PCB, use a dental pick or other pointed object to re-align the pad (Figure 23 and Figure 24).

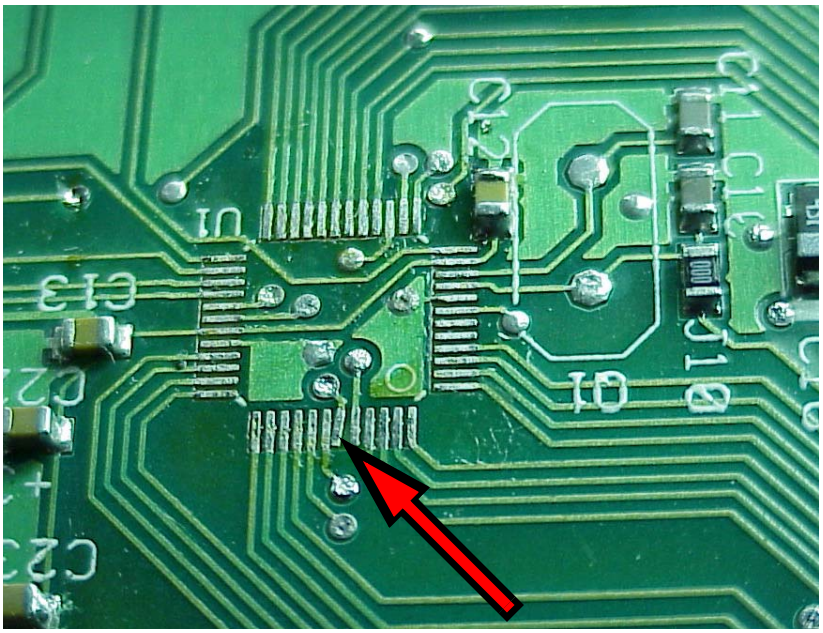

Figure 23. Clean pads but one pad is slightly crooked

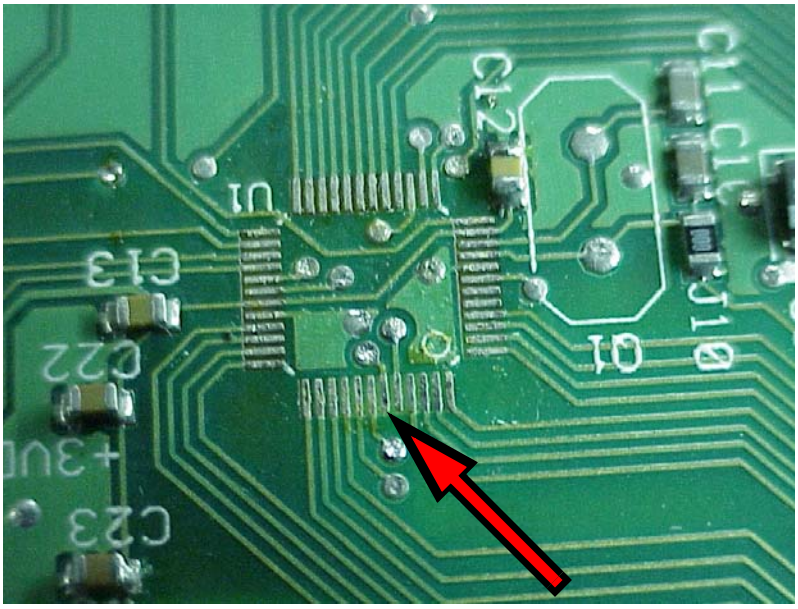

Figure 24. Pad straightened out

B. Soldering a new QFP

The pads on the PCB should be clean and free of any solder.

Carefully place the new QFP device on the PCB using tweezers or another safe method. Make sure the part is not dropped as the leads can be easily damaged.

Align the part over the pads using a small pick or similar tool to push the part. Get the alignment as accurate as you can. Also, make sure that the part is oriented correctly (pin 1 orientation).

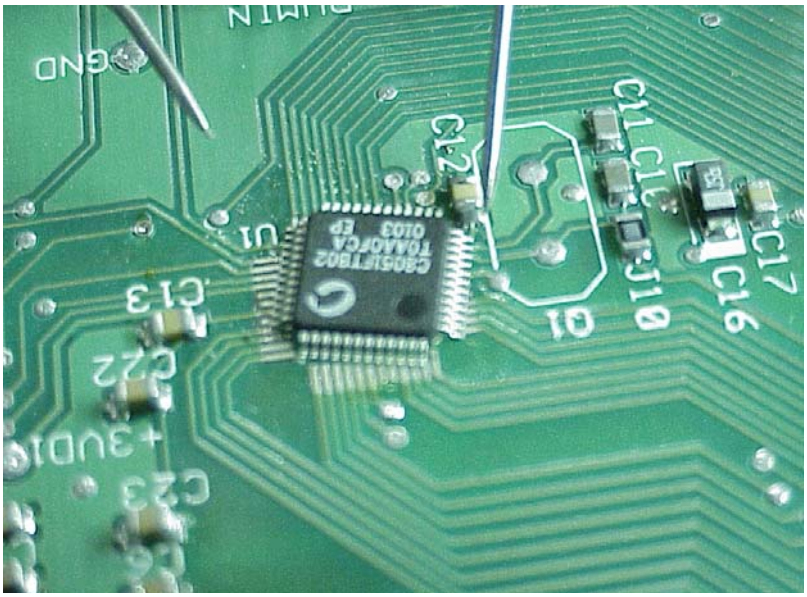

Figure 25. New QFP near pads, ready for alignment

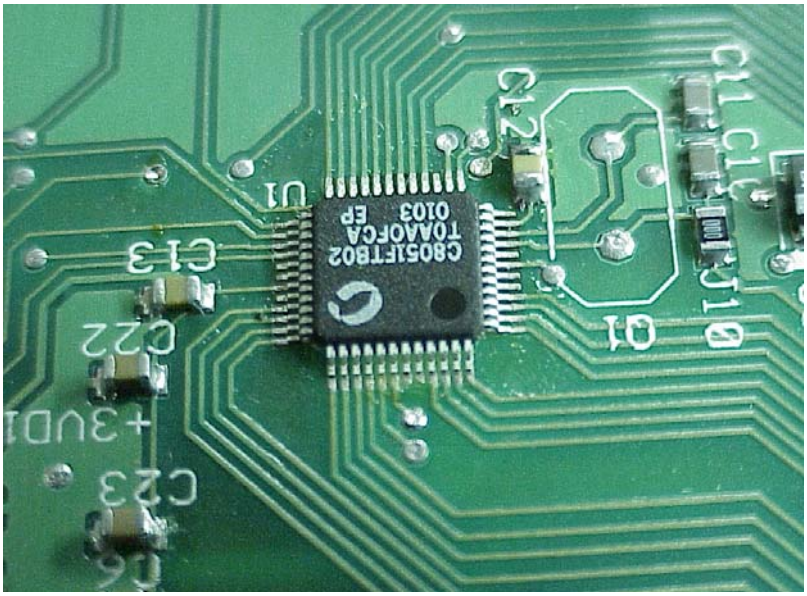

Figure 26. QFP aligned

Adjust the soldering station temperature to 725°F (385°C). Put a small amount of solder on the tip of the solder iron. While holding down the aligned QFP with a pick or other pointed tool, add a small amount of solder flux to the corner leads in two opposite corners. While still holding the part down with the pick, solder down two opposite corner leads on the QFP. Do not worry about excess solder or shorts between adjacent leads at this time. The idea is to anchor down the aligned QFP with solder so it does not move.

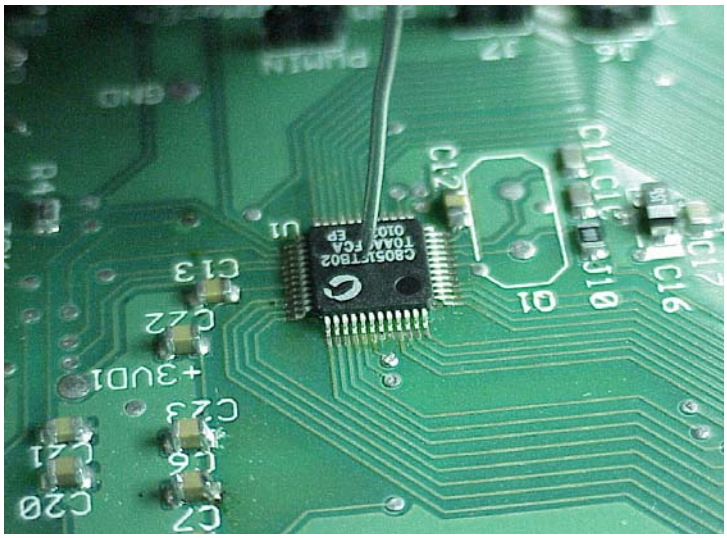

Figure 27. Aligned QFP ready for solder anchoring

Re-check the QFP alignment after soldering the corners. If necessary, make adjustments or remove and start over to get good QFP to PCB alignment.

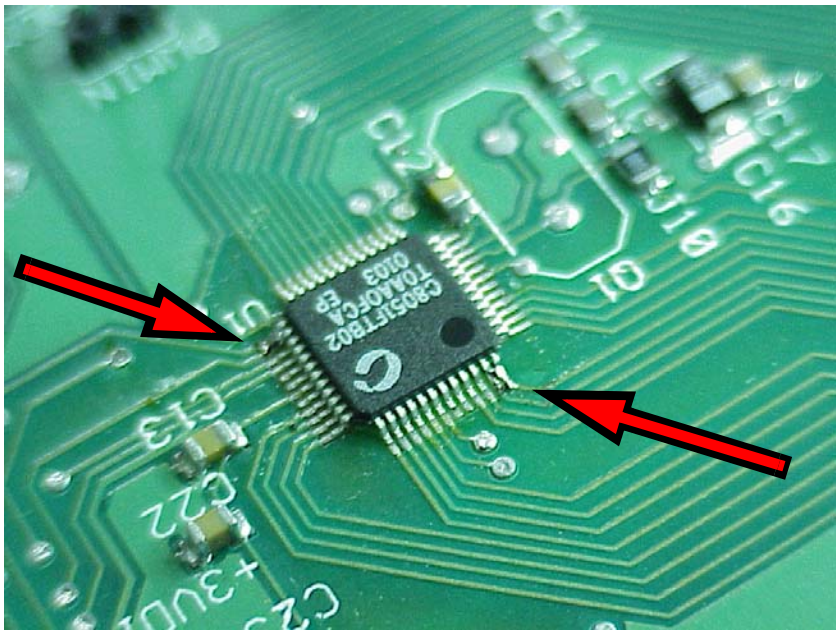

Figure 28. Aligned QFP with corners soldered down

Now you are ready to solder all the leads. Add solder to the tip of the soldering iron. Dispense flux over all the leads to keep them wet.

Touch the solder iron tip to the end of each QFP lead until the solder is seen running up the lead. Repeat for all the leads. Add small amounts of solder as needed to the soldering iron tip. Again, do not worry if you see some solder bridging as you will clean that up in the next step.

When soldering, keep the soldering iron tip parallel with the pins being soldered to prevent excessive solder shorts.

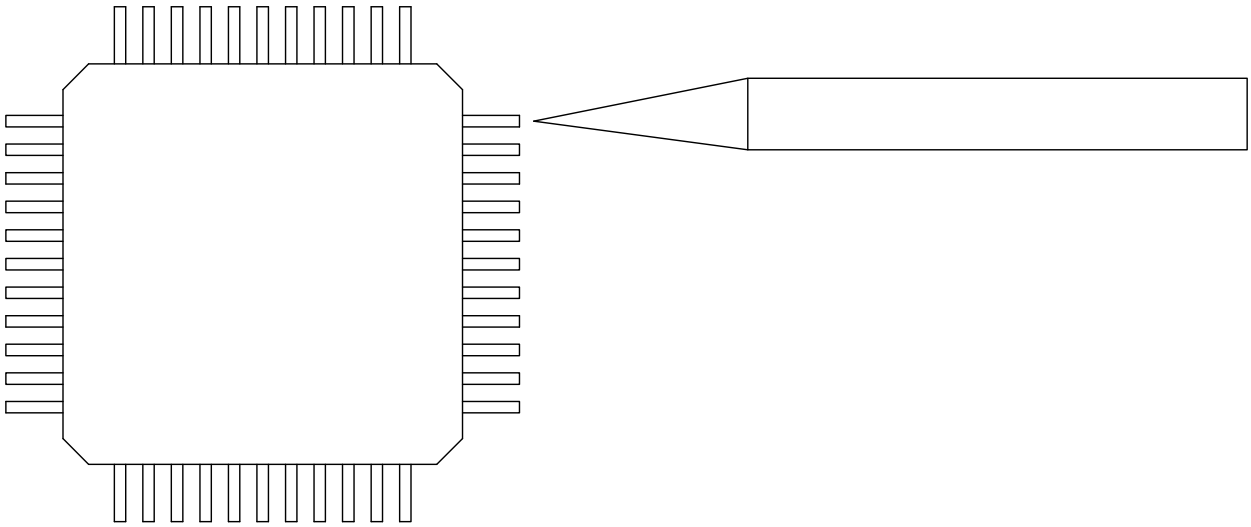

Figure 29. Keep iron tip parallel to pins being soldered

After soldering all the leads, wet all the leads with flux to enhance the solder wicking cleanup. Wick up solder where needed to eliminate any shorts/bridging.

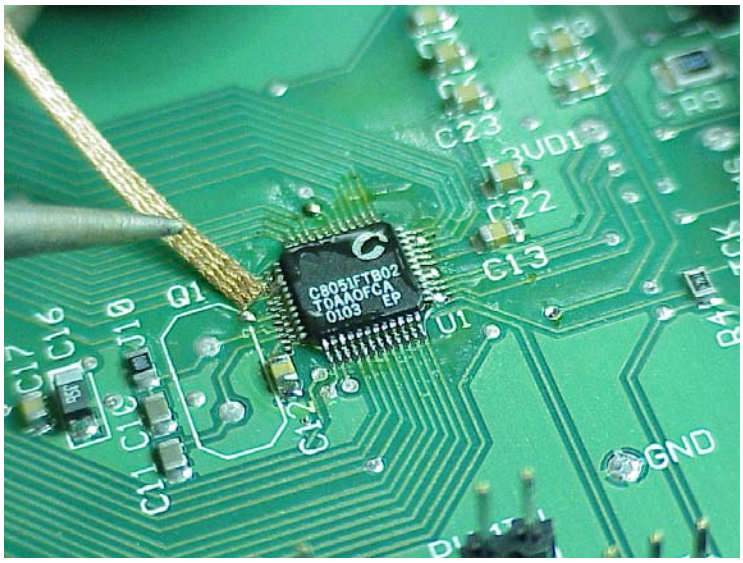

Figure 30. Wicking Solder #1

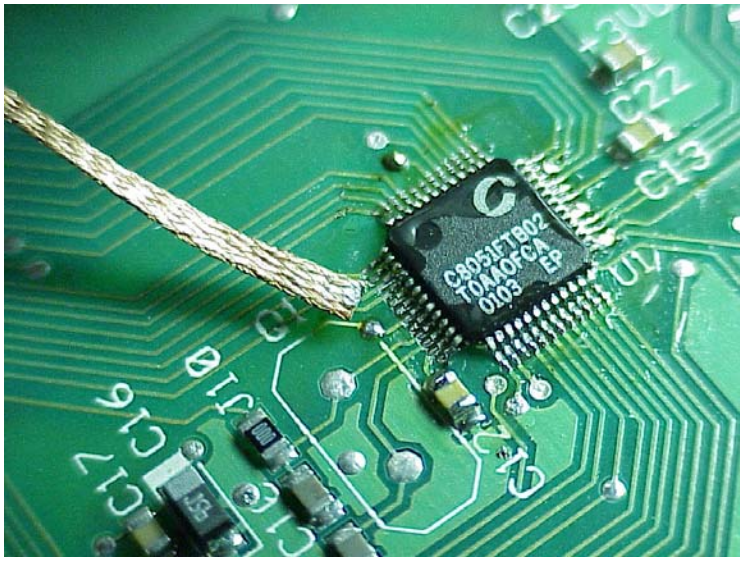

Figure 31. Wicking Solder #2

Hand inspect the board using 4X magnification (or higher) for shorts or marginal solder joints. Solder joints should have a smooth melt transition between each device pin and the PCB. Rework any pins as needed

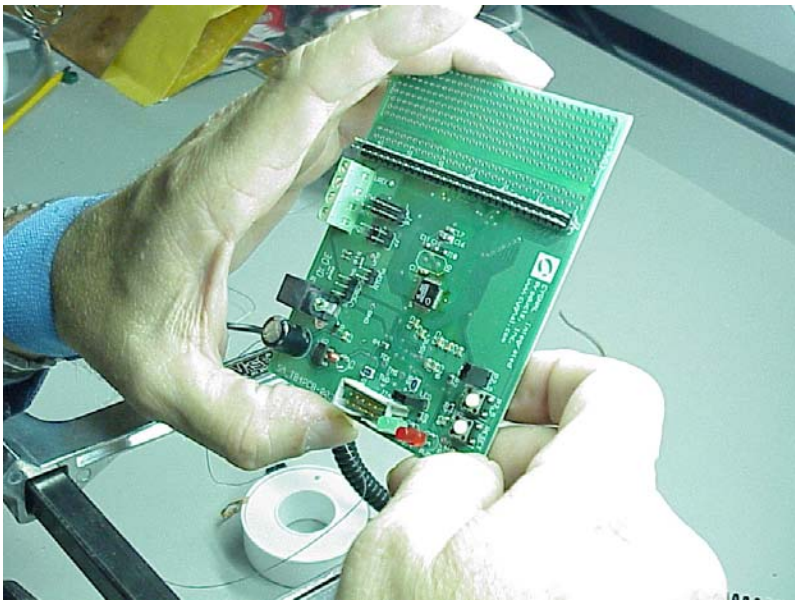

Figure 32. Visual Inspection

After the inspection passes, it is time to clean the flux off the board. Dip the stiff bristle brush into alcohol and wipe in the direction of the leads. Use moderate, but not excessive pressure. Use liberal amounts of alcohol and brush well between the QFP leads until the flux disappears.

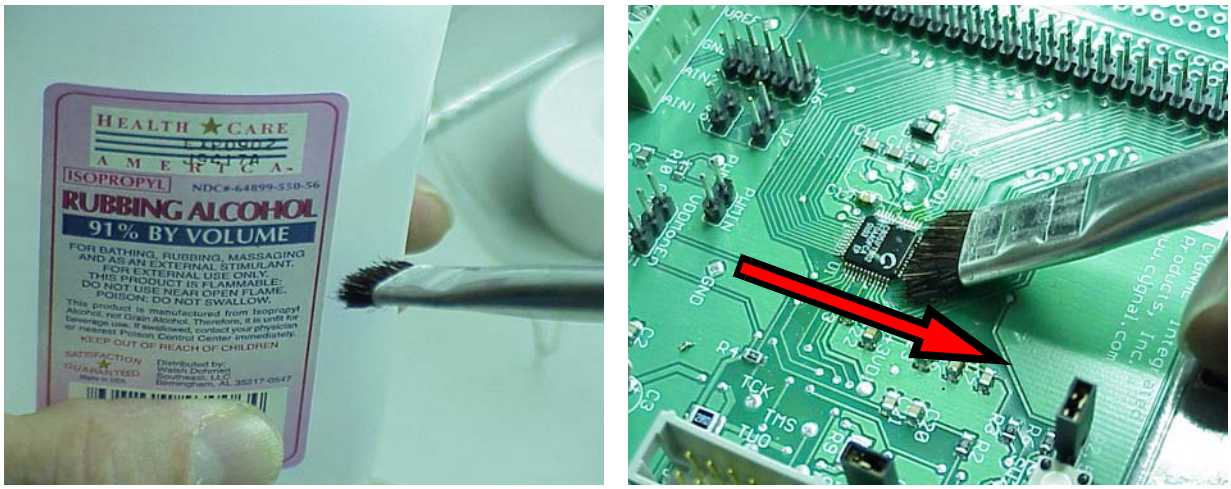

Figure 33. Isopropyl Alcohol and stiff brush used for cleanup. Brush only in direction of leads

Dry the board with compressed dry air or nitrogen. If this is not available, let the board dry for 30 minutes or more to let the alcohol evaporate under the QFP. The QFP leads should look bright and there should be no flux residue.

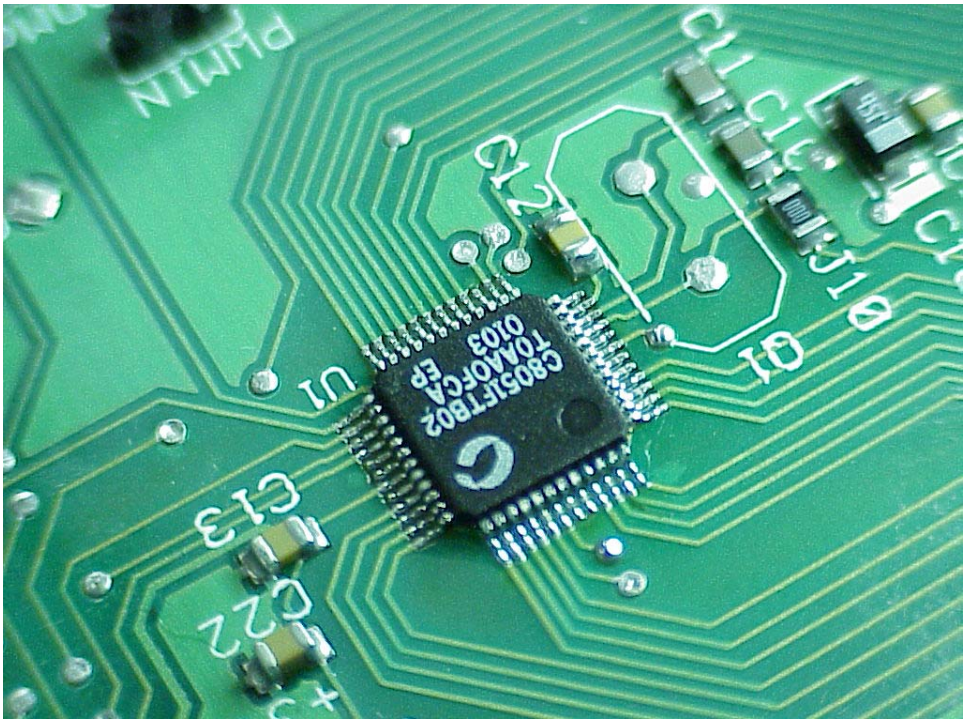

Figure 34. Clean and Pristine

Re-inspect the board for workmanship. Rework any leads if needed.

Figure 35. Stereo zoom inspection station (7X to 40X magnification) helps to inspect solder joint workmanship

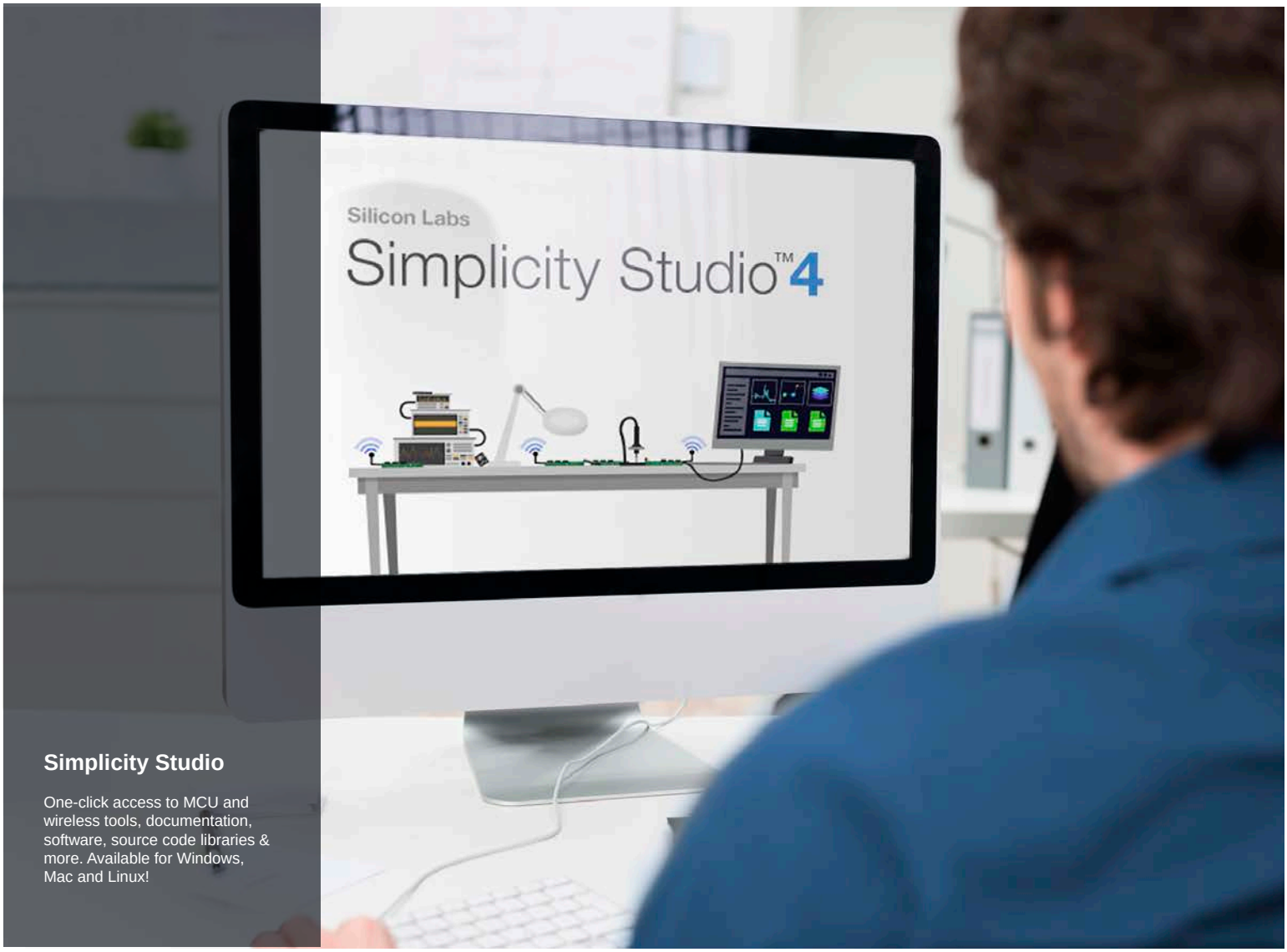

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Soldering Guidelines

Solder0 R0.1

EE400/1
Design

Revision History

Rev.	Date	Contributor	
0.1	September 2005	L. Wyard-Scott	Updates to reflect changed Capstone Design Course format and new de/soldering equipment.
0.0	January 2004	V.J. Sieben, L. Wyard-Scott, E. Tiong	Creation.

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Chapter 1

Soldering Technique

This guide is intended to give an introduction to basic soldering technique. If the reader desires to pursue advanced soldering techniques, there are several books as well as technical institutions that offer detailed courses in the area of soldering.

1.1 Required Tools

Before discussing soldering techniques, one should must set up a "soldering work station". The following is a list of tools for a typical soldering station. See Appendix A for pictures of the various parts listed below.

1. **Variable temperature soldering iron:** used for applying heat to joints during the soldering process.
2. **Damp sponge:** for cleaning soldering iron tip.
3. **Rosin-core solder:** to electrically and mechanically bond a component to the PCB.
4. **Wire cutters or side cutter:** for trimming component leads and stripping insulation from wires.
5. **Needle nose pliers:** for holding, placing and shaping components.
6. **Desoldering pump and/or desoldering braid:** for removing solder.
7. **Scotch tape and/or a "Third Hand":** for securing components.

8. **Safety glasses:** for eye protection. These are mandatory in the lab.
9. **Magnifier:** to provide more detail during intricate work. A magnifying glass is convenient, but an illuminated magnifier is better.
10. **Light source:** to prevent eye-strain.
11. **Ventilation:** to extract and dispel fumes generated during the soldering process.
12. **Flux:** to clean components and PCB pads.
13. **Acid brush:** to assist in the removal of flux residue.

Prior to soldering it is a good idea to have all components organized as it will make populating the PCB more efficient. Make a BOM (bill of materials) for the PCB, and ensure before soldering that the components have been collected. The schematic and PCB layout will also be referred to when populating the board.

1.2 Important Soldering Tips

The following tips provide a quick guideline on how to make proper joints.

Cleanliness: All parts, including the soldering iron tip, must be clean and free from grease, oxidation and contamination. Solder does not flow over contaminated areas; moreover, solder is repelled by dirt. Severe contamination is evident when solder begins to "bead". A common source of contamination is oxidation. Old components and copper boards will often have an oxide layer that prevents a good solder joint. Ensure all components have shiny leads and the PCB has clean traces. An abrasive such as a blue or pink eraser, emery paper, or stell wool can be used to remove the oxidized layer from the PCB board and components.

Tinning: In addition to being clean, the soldering iron tip must also be tinned (coated with solder). Tinning the tip allows solder to flow on the components more quickly rather than the soldering iron tip itself. Tinning involves adding a few millimetres of solder to the tip and then wiping and rotating the tip on the damp sponge to reveal a shiny surface on the tip of the soldering iron: a thin layer of solder will coat or "tin" the tip of the soldering iron. **When done soldering,**

tinning the iron is required to protect the tip from oxidation thereby dramatically increasing its life.

Temperature: Ensure that both the component leads and the PCB's copper layer are heated at the same time. The soldering iron tip should contact both the component and the PCB pad. This will ensure that each surface is relatively close in temperature resulting in a good joint. If there is a temperature difference between the two surfaces, the solder will form a "dry" joint. Soldering irons are typically set around 650 Fahrenheit, depending on the lead-tin ratio of the solder being used. Too much heat causes excessive "sputtering" of flux, and too little doesn't melt the solder in a timely manner.

Duration: The duration that the iron is in contact with the component and PCB is dependent on the size of the joint and your soldering iron temperature. For the typical PCB through-hole joint, it should take a few seconds to heat the joint and apply the solder. This will require practice, so don't expect to be fast if you are a beginner. Excessive heat (several seconds in duration) will damage sensitive semiconductors. If this is a concern, use a heat sink attached to the component leads: sometimes as simple as an alligator clip. These concerns can sometimes be avoided by soldering sockets instead of the semiconductor itself.

Adequate solder coverage: If too little solder is applied, the joint will not make a secure connection and will cause erratic behaviour. However, if too much solder is applied, the joint may bridge with adjacent joints resulting in electrical shorts. How much solder to apply comes with experience. Figs. 1.4 through 1.7 show good and bad solder joints.

Handling: Most modern electronics systems contain static-sensitive devices. Use proper handling procedures to minimize the likelihood of damage: grounding wrist-straps, grounded soldering irons, grounding mats, etc.

1.3 Precautions

Soldering Irons get very hot (600-800^{0}F, 315-425^{0}C), please ensure you follow precautions during use. Basic safety precautions are listed below.

- Never leave your iron turned on while unattended.

- Turn the soldering iron off when it is not being used. If the iron is left on for long periods of idle time, the soldering iron tip will be destroyed through oxidation.
- Eye protection must always be worn when soldering. Hot flux can spit up and into an unprotected eye. **In the Capstone Design Lab, use of eye protection is mandatory.**
- If the cord of the soldering iron is damaged, inform the lab staff who will ensure it is replaced.
- Never set the soldering iron down on anything other than an iron stand.
- To prevent burning your fingers, use needle nose pliers, heat resistant gloves, or a third hand tool to hold small pieces.
- Familiarize yourself with the safe handling of all materials used during the soldering process. This includes solder, flux, alcohol, and desoldering braid. Each has a Material Safety Data Sheet (MSDS) and can be found in the lab or online. "Safe Operating Procedures" are found posted on the wall close to the soldering facilities.

1.4 How to Solder Through-Hole Components

Most of the soldering done in the Capstone Design Lab is through-hole. A through-hole joint is a type of soldering joint in which the component joins with the PCB pad through a physical hole in the board. The following steps will illustrate how to make a proper through hole solder joint on a PCB.

1. Ensure that the printed circuit board and all components are clean. Cleaning can be achieved with a mild abrasive and/or the application of flux.
2. Plug in the soldering iron, turn it on, and let it warm up for 2–3 minutes.
3. Wet the soldering station sponge with the water provided in the lab. Do not wet the sponge in the bathroom or the water fountain.
4. Clean the tip of the soldering iron and tin it with solder.

5. Insert the component into the holes. Ensure that the component is secure by taping the component or by using a third hand. Optionally, the component leads can be clinched as shown in Fig. 1.1. This technique, however, is not recommended for two-sided boards as the flow of solder to the component side is restricted.

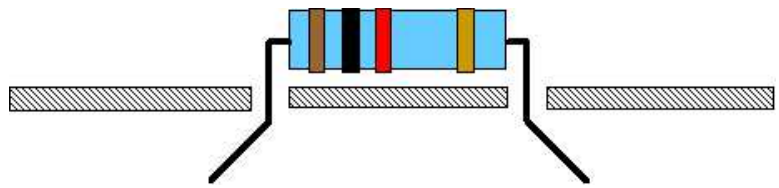

Figure 1.1: Clinched Component Leads

6. Apply the soldering iron tip to one side of joint making contact with the component lead and the board copper foil, ensuring that both are heated up to the same temperature as shown in Fig. 1.2 and Fig 1.3. Notice the tinned tip in Fig. 1.3.

7. Slowly add a few millimetres of solder to the other side of the joint. DO NOT apply solder to the soldering iron tip. If enough heat was applied to the PCB pad and component wire, the solder will flow freely onto the joint.

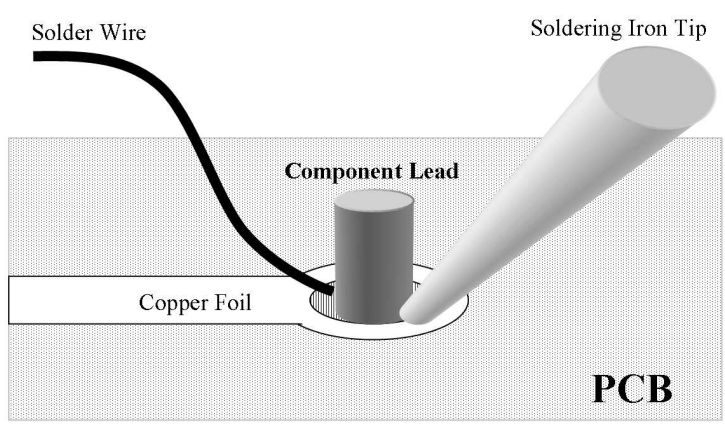

Figure 1.2: Method of Soldering Through Hole Joints

8. Remove the solder when the joint is suitably covered as shown in

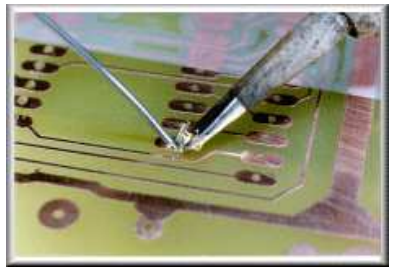

Figure 1.3: Method of Soldering Through Hole Joints, [8]

Fig. 1.4. The goal is to get the joint to be a "fillet": a curve as shown in Fig. 1.4.

9. If the PCB is double-sided, the solder should flow through the hole around the component lead and make a bond on the component side of the board (opposite to the side that the solder was applied). If this "wicking" does not occur, the hole may be undersized, clinching could be blocking the solder's path, or the component lead is not clean.

10. Remove the soldering iron and allow the joint to cool naturally.

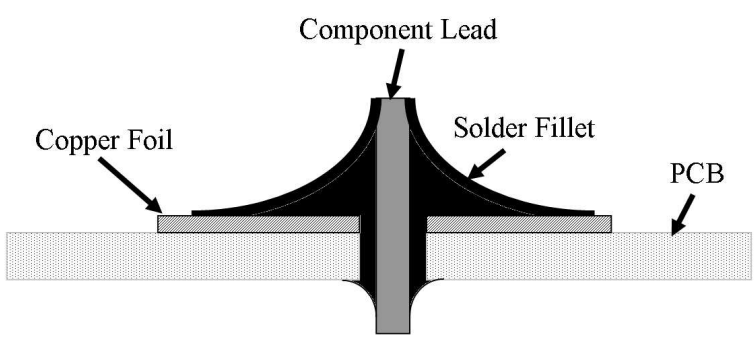

Figure 1.4: Good Solder Joint - Solder Fillet

11. Cut the lead of the component, if necessary.

Fig. 1.6 and Fig. 1.7 below are pictures showing good and bad solder joints.

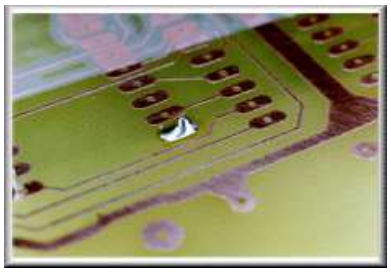

Figure 1.5: Good Solder Joint, [8]

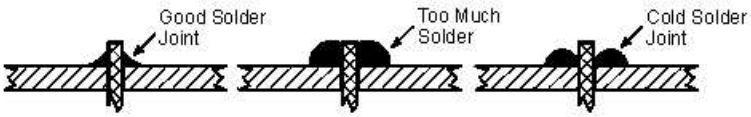

Figure 1.6: Joint Examples, [3]

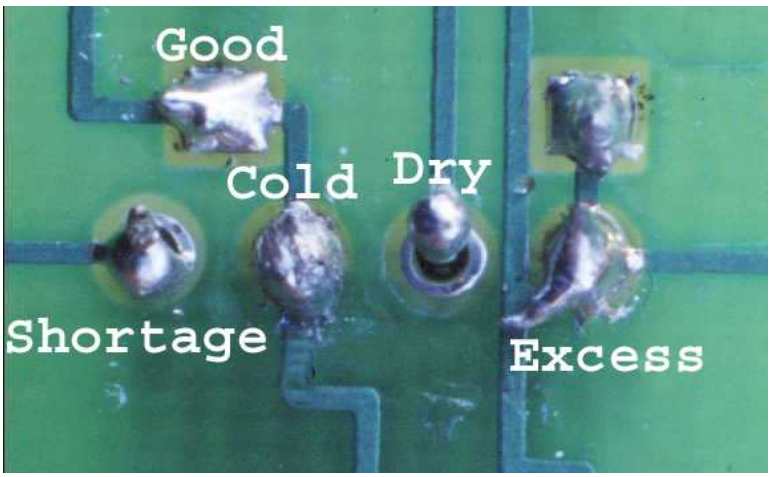

Figure 1.7: Joint Examples, [2]

1.5 How to Solder Surface-Mount Components

Surface mount soldering requires more experience and skill than through hole. It is recommended that one practices with through-hole prior to attempting any surface mount soldering. As the name suggests, surface mount involves soldering a component to either the top or bottom surface of a PCB. Depending on the footprint, the pads are usually a spaced closer together (finer pitch), making the soldering more susceptible to solder bridges, etc.

Figs. 1.8 and 1.9 show examples of good surface-mount solder joints.

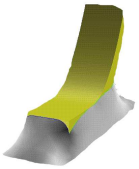

Figure 1.8: Surface Mount Good Solder Joint, [6]

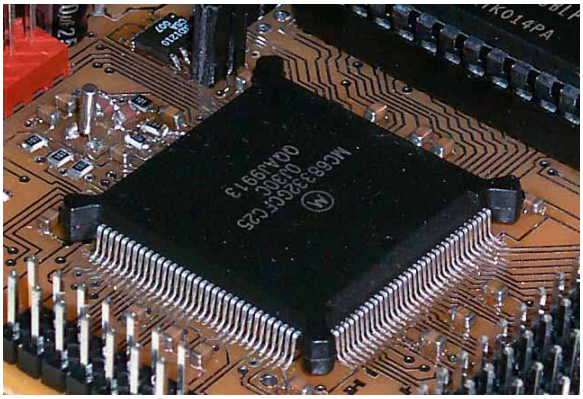

Figure 1.9: Surface Mount IC with Good Solder Joints, [5]

The actual soldering of the joints is similiar to the through-hole method. One difficulty, however, is maintaining the part's alignment on the PCB pads. A good technique is outlined here:

1. Align the component on the PCB pads. This can be aided with the use of tweezers and dental picks.

2. Secure the component to the PCB by applying a small amount of pressure onto the top of the component using a small slot screwdriver.

An index finger resting on the end of the screwdriver provides enough force to secure the device.

3. Solder one of the corner component leads to the PCB pad.
4. Align the remaining pads and solder the opposite corner PCB pad.
5. Solder the remaining pads in a pattern that does not build-up too much heat in the device.

1.6 Wire Connectors and Headers

When PCBs are manufactured they often have connectors to peripheral devices. These connectors are like other components in how they are soldered onto the PCB. However, the plug that matches the connector usually also requires some soldering. **Please note that with very few exceptions, the wire used for cabling is stranded (rather than solid-core) due to its higher strength and flexibility.** Below are procedures for a few of the more common plug types.

1.6.1 Crimp Connectors and Pins

1. Strip off about 1cm of the wire insulation.
2. Place the exposed wire into the crimp-style connector or pin. The wire should just barely show coming out the other side. Some crimp pins have two crimping areas – one for the stripped wire, and the other for the wire *with* the insulation.
3. Crimp the connector with the appropriate crimping tool. Note that the connectors are colour coded to settings on the crimping tool, try and match the correct colour.
4. As added insurance, apply solder to the joint to solidify the connection.

Before crimping all pins destined for a connector housing, start with one and ensure that it fits successfully into the housing. If the crimp is made too tightly, or otherwise mis-shaped, the pin may no longer fit.

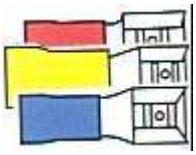

Figure 1.10: Colour Coded Crimp Connectors

Figure 1.11: Crimp connector without shrink wrap, [1]

1.6.2 DB Connectors (Solder Cup Type)

1. Strip off about 5mm of the wire insulation.
2. Tin the wire.
3. Slide shrink wrap on the wire.
4. Place the wire into the DB - connector solder end.
5. Apply the soldering iron tip to the connector and wire.
6. Apply a few millimetres of solder until the joint is adequately covered.
7. Let the joint cool.
8. Slide the shrink wrap over the joint and heat the shrink wrap with a heat gun (or other heat source) until the wrap shrinks around the joint.

1.6.3 Joining Two Wires

1. Slide shrink wrap on one of the wires.
2. Tin or coat each wire with some solder.
3. Join the wires in a way that provides a good mechanical connection (such as twisting together) and apply the soldering iron tip and some solder.

Figure 1.12: DB Connector with shrink wrap, [7]

4. Let the joint cool.
5. Slide shrink wrap over the joint and heat the shrink wrap with a heating gun or a heat source until it the the wrap shrinks around the joint.

Figure 1.13: Two wire joint insulated by shrink wrap, [4]

1.7 Testing Connections

After completely soldering a component to a PCB, it is good practice to ensure connectivity between the component wire leads and the PCB pads they are soldered to. A DMM (Digital Multi-Meter) is sufficient to deter-

mine connectivity; many DMMs include an audible connectivity setting, but failing this, measure the joint resistance.

1.8 Milled Board Soldering

In-lab manufacture of PCBs uses a technique known as "milling". The milling technique involves cutting out the PCB tracks and pads from the copper-clad board.

Due to its construction, a milled PCB is susceptible to solder-bridging across the milled grooves, particularly when an excess of solder is used. Finding a short caused by a bridge is a difficult task, particularly when many solder joints exist. To this end, make a limited number of solder connections and then test for bridges using a multimeter.

1.9 Post-Soldering Cleanup

1.9.1 PCB Cleanup

The flux left behind by rosin-core solders, or perhaps as part of the cleaning process, needs to be removed from the PCB. Due to the flux's sticky nature, dirt gathers and contributes to short-circuiting problems. The most frustrating part of this situation is that a short does not necessarily occur immediately. Weeks, or even years later, a short can develop.

To remove flux, alcohol is used. Apply the alcohol liberally and then brush away with an acid brush, starting at the center of the PCB and working out toward the edges. This is a time-consuming task, but a clean board is well-worth the effort.

1.9.2 Work Area Cleanup

The importance of keeping your work area clean cannot be emphasized enough. When clear of obstructions and garbage, handling a hot soldering iron is safer. The soldering process itself involves chemicals and substances which are known to have ill-effects in humans. Wiping-down the work-area surfaces with a moist paper towel will help reduce some contamination. When you are done soldering, **wash your hands with soap and water** to get rid of contamination. The primary concern here is accidental ingestion of the chemicals. For more information, please refer to the Safe Operating Procedures, posted in the lab's soldering area.

Chapter 2

Desoldering Technique

Desoldering may be required for several reasons:

- a component may have failed
- a wrong part was installed;
- a design modification necessitates a change; or
- if a board contains expensive components that can be salvaged.

Whatever the reason, there are three common techniques to remove solder from a joint: using a desoldering pump, a desoldering wick, or desoldering iron.

Regardless of the method used, if it is permissible to destroy the part during removal, then a lot of time and effort can be saved. For instance, using wire cutters to trim off all the pins of a through-hole IC so they can be removed individually makes the removal process much easier. In most cases, avoiding damage to the PCB is of paramount importance.

2.1 Solder Pump/Sucker

A desoldering pump is exactly what it sounds like: a pump that sucks up solder. Usually the pump is spring-loaded and provides a recoil when released. The four steps below outline how to desolder a joint using a desoldering pump.

1. Prime the desoldering pump. This involves depressing the desoldering pump spring. The pump will click when correctly depressed.

2. Heat the joint from one side with the soldering iron tip. Wait 1-2 seconds until the solder begins to melt from the soldering iron heat.

3. Put the pump tip on the other side of the joint. Don't be afraid to actually touch the joint.

Figure 2.1: Desoldering with a Solder Pump, [8]

4. Press the desoldering pump spring-release button to suck up the solder.

This procedure should be repeated if the joint has a significant amount of solder. If done correctly the joint should eventually look as shown in Fig. 2.2 shown below.

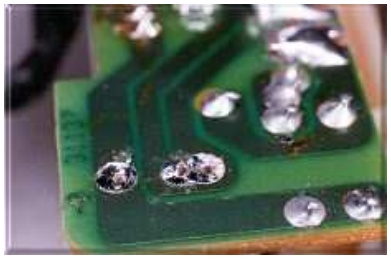

Figure 2.2: Clean Joint from Desoldering with a Solder Pump, [8]

2.2 Desoldering Braid/Wick

A desoldering braid removes solder from a joint using a technique known as "wicking". Desolder braid is a piece of material that sponges up molten solder by capillary action that draws solder away from the joint the braid. The following procedure outlines the basic steps involved in desoldering a joint using desoldering braid.

1. Place the desoldering braid over the joint.
2. Press the desoldering braid onto the joint with the soldering iron tip. This will apply heat to the desoldering braid and the joint allowing the molten solder to flow.
3. Wait for the solder to melt. The solder should flow onto the braid and away from the joint.

Figure 2.3: Desoldering with a Solder Wick, [8]

4. Cut off the solder coated portion of the desoldering braid. **There should be no copper visible in the portion that is removed: braid is very expensive.**

2.3 Desoldering Iron

Using a desoldering iron, available with higher-end soldering stations, is similar to using a solder sucker. The desoldering iron is essentially a soldering iron with a built-in vacuum.

1. Make contact between the iron and the joint to be desoldered, ensuring the vacuum opening is not blocked.
2. Once the solder on the joint has become molten, depress the button on the iron to activate the vacuum.

It is very important for the life of the desoldering iron that the vacuum assembly be cleaned after every session of use. Please ask the lab personnel for a description of the cleaning procedure.

As with a normal soldering iron, the desoldering iron tip should be tinned before and after every use.

2.4 Removing Components Effectively

To remove a component with little or no damage to the PCB or component takes practice and **patience**. Often when removing a component, PCB pads and tracks may be damaged by "lifting" off the board. Below are some tips that may be useful when removing components from a PCB.

- Desolder all joints pertaining to a component prior to removal. It may be necessary to go over the joints several times before all the solder is removed. Practice patience.
- Use pliers and *gently* pull on components while applying heat to the joints. The assistance of a friend can help with this.
- Do not pull with force, because the PCB pads and tracks will be damaged.
- Do not try and remove components by prying them.
- Do not try to push the component out of the holes with the soldering tip. This will certainly lift the copper pad off of the PCB and ruin the iron tip.
- In order to get better thermal conductivity between the iron and the solder joint, it is sometimes effective to *add* a small amount of solder.

Chapter 3

Glossary

BOM: Bill of Materials, which contains a list of all components and values contained on a particular PCB. Used as a "shopping list".

Desoldering Braid: A material used to remove solder with capillary action.

Desoldering Pump: A device used to remove solder with a swift vacuum action.

Flux: Cleans the surfaces that are being heated by bringing contaminants to the surface. Most solders include flux in their core. For excessive contamination use a flux pen.

Footprint: The spacing pattern or layout of pads for a particular component or integrated chip, as used on a PCB.

PCB (Printed Circuit Board): A fibreglass board upon which copper traces are laminated to make connections between various components. The copper traces serve as flat wires connecting various components.

Shrink Wrap: A tube that fits over a wire, that when heated shrinks to provide insulation and support for the joints.

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Appendix A

Pictures of Tools

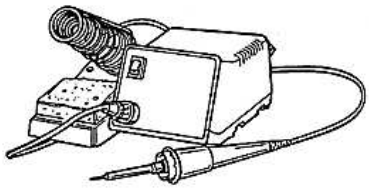

Figure A.1: Soldering Iron

Figure A.2: Solder Wire

Figure A.3: Desolder Pump

Figure A.4: Desolder Braid

Figure A.5: Third Man

Soldering

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Introduction

Soldering is a process used for joining metal parts to form a mechanical or electrical bond. It typically uses a low melting point metal alloy (solder) which is melted and applied to the metal parts to be joined and this bonds to the metal parts and forms a connection when the solder solidifies. It is different to welding in that the parts being joined are not melted and are usually not the same material as the solder.

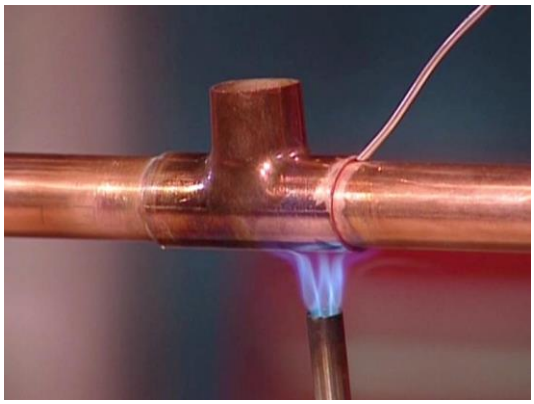	
Soldering copper pipe	Sheet metal fabrication

Figure 1 – Different Types of Soldering

Soldering is a common practice for assembling electrical components and wiring. Although it can be used for plumbing, sheet metal fabrication or automotive radiator repair the techniques and materials used are different to those used for electrical work. This document is intended to provide guidance on the safe working methods and proper tools and techniques for soldering of electrical components.

1 Soldering Printed Circuit Boards

Soldering may be used to join wires or attached components to a printed circuit board (PCB). Wires, component leads and tracks on circuit boards are mostly made of copper. The copper is usually covered with a thin layer of tin to prevent oxidization and to promote better bonding to other parts with solder. When soldering bare copper wires they are often “tinned” by applying molten solder before making a joint.

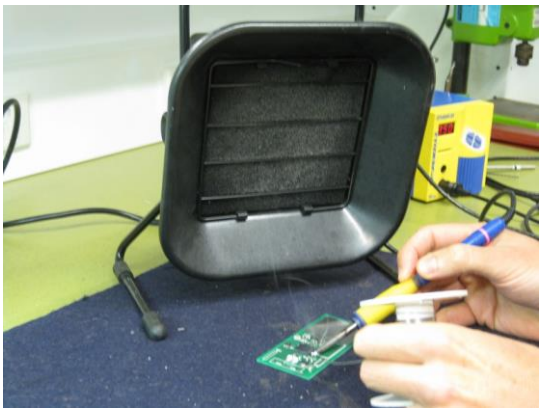	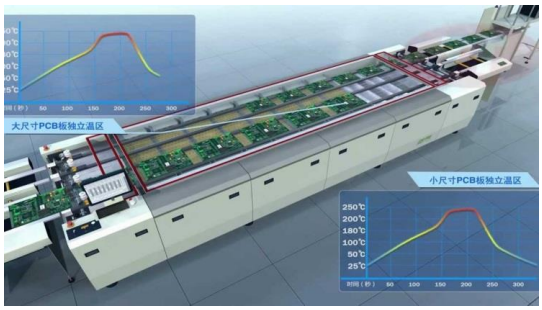
Hand soldering components on PCB	Industrial oven for surface mount

Figure 2 – Different Types of PCB Soldering

2 Types of Solder

There are different types of solder used for electrical work. They are broadly classified as tin/lead solders or lead free solders. Tin/lead solders have been used for many years because of their ease of use however they have been phased out of commercial use due to the harmful effects on humans and the environment. Tin/lead solder is still available and is used by “hobbyists” and other non-commercial users as it is still easier to use than lead free types. When using tin/lead (or leaded) solder there are additional safety precautions that must be observed.

Different gauges of solder wire	Solder composition is labelled (Lead free on left)

Figure 3 – Different Types of Solder

3 Types of PCB

Printed circuit boards (PCBs) are populated by electronic components and these may be “surface mount” or “through-hole” types.

3.1 Through-Hole Components

As the description “through-hole” suggests, the leads of the component are passed through holes in the PCB and then soldered to a “pad” on the reverse side of the PCB. Soldering is accomplished by heating the component lead and PCB pad with a soldering iron and melting solder wire into the joint. This type of construction was common from the 1960’s until early 2000’s and is still used by hobbyists and in small scale production where manual assembly is preferred.

3.2 Surface Mount Components

Commercial circuits are mostly of the surface mount type as these are cheaper to make, more compact and easier to automate assembly. For surface mount construction the component’s pads are on the same side of the PCB as the component and the component connections sit onto these pads. Soldering is accomplished by applying solder paste onto component pads on the PCB, placing the component onto the paste and then heating the entire assembly to melt the solder. Commercial assembly uses ovens to heat the boards. Hobbyists can also use surface mount components and soldering can be accomplished by applying solder paste and melting with a hot plate, small oven or soldering iron. Some surface mount joints can be soldered using a soldering iron and solder wire.

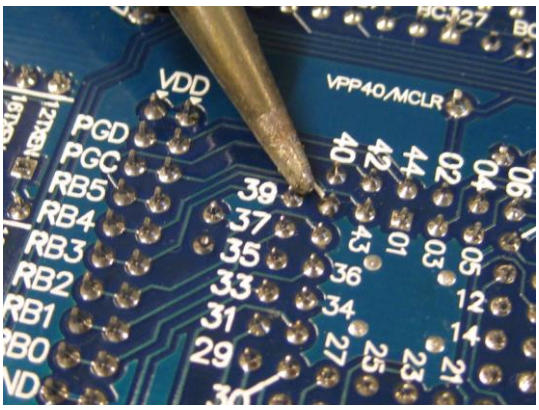	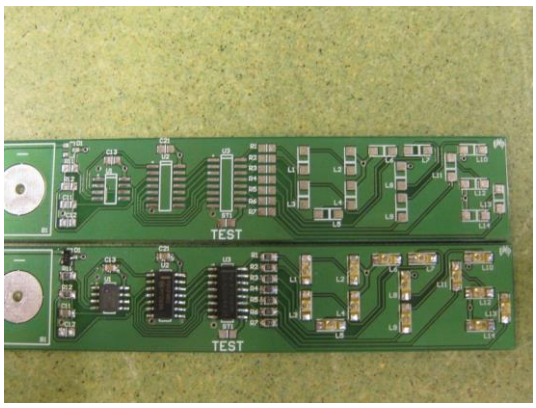
Through-hole PCB (non-component side)	Surface mount PCB (component side)

Figure 4 – Different Types of PCB

4 Flux

For electrical soldering both solder wire and solder paste contain flux. This helps to clean the surfaces being soldered and prevent oxidization of the hot solder. The composition of the flux will vary depending on whether it is in a paste or wire, leaded or unleaded solder. Solder wire usually contains a flux called “rosin”. Most fluxes will produce fumes when the solder is heated and these fumes are likely harmful to your health. For occasional soldering it may be sufficient to have a well-ventilated workspace but for longer or repeated exposure a fume extractor should be used. Solder flux can also cause solder to spatter and eye protection should be worn when soldering.

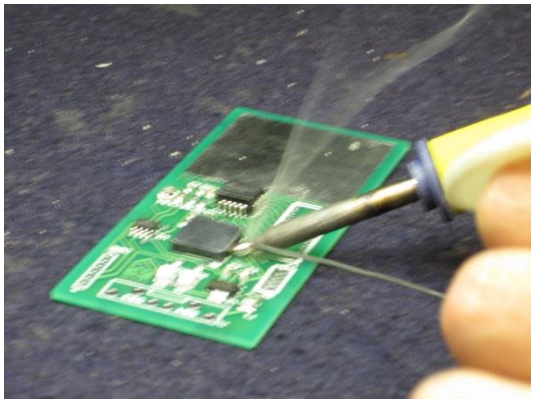	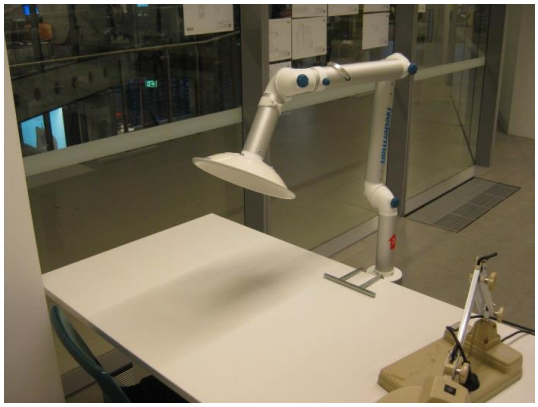
Fumes produced when soldering	Workstation with fume extraction system

Figure 5 – Fumes and Fume Extraction Systems

5 Soldering Irons

Soldering irons come in many varieties and sizes. Soldering irons may be electric, gas powered or externally heated. Most common types are electric. Simple electric soldering irons have no controls and you simply plug them in and wait for them to heat up. Their temperature is regulated by the power of the heating element and heat loss to the environment. Some soldering irons have temperature controls which allow the user to set a desired operating temperature for the soldering iron. This is useful if the soldering iron is being used for different types of solders which have different melting points or if the soldering iron is being used for other purposes such as heating heatshrink. It also introduces a problem if the user does not set an appropriate temperature for the work, solder can be overheated and decompose. Hotter is not better! A temperature of around 320 °C works well for 60/40 leaded solder. Some temperature controlled soldering irons use interchangeable tips to change the temperature at which they operate.

	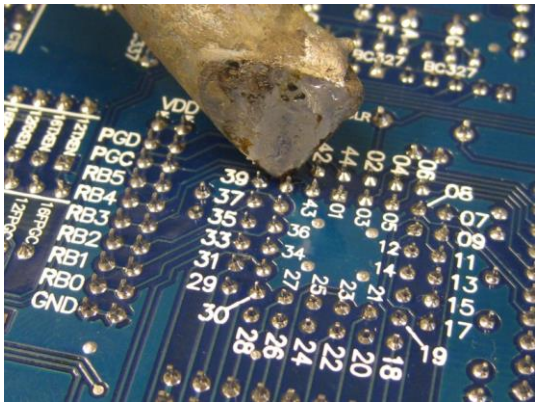
A range of electric soldering irons	Choose an iron appropriate for your task!

Figure 6 – Types of soldering irons

Adjustable temperature soldering stations	Different tips set the temperature for this station

Figure 7 – Types of soldering stations

5.1 Tips

Heat is transferred from the tip of the soldering iron to the joint by thermal conduction enabled by metal to metal contact between the tip and joint. The tips of soldering irons come in various shapes and sizes to enable the best contact to be made. Most tips are either conical or chisel shapes. The shape is largely a personal preference and you can use whichever type works best for you. The size of the tip should be selected to allow the tip to be placed against the joint being soldered without interfering with adjacent parts. The tip should be large enough to conduct sufficient heat into the joint to allow the solder to melt and flow properly. The choice of tip size is not a precise calculation and a “normal” size tip will work for most joints on a PCB.

5.2 Tip Contamination and Cleaning

The thermal conduction from the tip to the joint may be inhibited by contamination on the tip. This contamination can be formed by burnt solder flux or oxidized solder. To make best thermal contact the tip should be cleaned using a tip cleaner(!). Two types are a wet sponge or a brass wire wool. The wet sponge removes the contaminated material when the tip is wiped across it, the water in the sponge cools the solder and the mechanical abrasion removes the contamination leaving a thin coating of clean solder on the tip. This method can cause the tip temperature to dip momentarily. The brass wire wool type removes the contamination by mechanical abrasion and bonding contaminated solder to the brass. The tip is pushed into the brass wool and when it is withdrawn the tip is clean with a thin coating of solder. You must not “wipe” the tip on the brass wool type because the springiness of the brass wool may flick molten solder which may cause burns to people or objects. You should never “flick” excess solder from the soldering iron as this may also cause burns or damage.

Tip contaminated with old solder and burnt flux	Brass wool type tip cleaner

Figure 8 – Dirty tip and brass wool cleaner

6 Ovens and Hot Plates

For surface mount soldering the heat is usually applied to the whole PCB and all components soldered at the same time. For commercial work this is done in large ovens, often with conveyors to move the boards through the oven. For small scale work simple infrared ovens are available. Another technique uses a hotplate. The same considerations for temperature apply, although because the heat source does not come into contact with the solder or flux, contamination is less likely. Time and temperature are considerations with these methods as the components are exposed to the high temperature for the period required for the solder paste to melt and flow.

	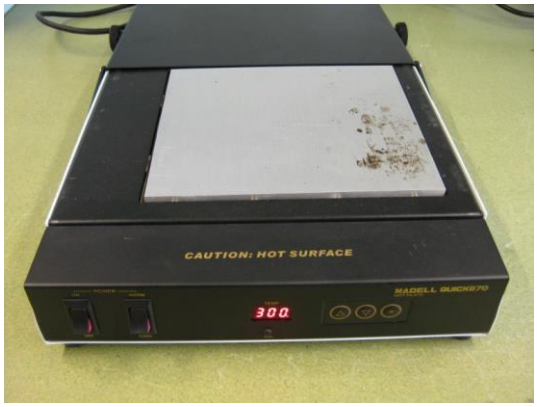
Infrared oven for surface mount soldering	Hotplate for surface mount soldering

Figure 9 – Oven and hot plate used for surface mount soldering

7 Desoldering

If a part that has been soldered needs to be replaced it needs to be “de-soldered”. Depending on the part and type of joint it may be possible to simply re-melt the solder and remove the part, or it may be necessary to remove the solder from the joint so the part can be freed. Some methods for removing solder are solder wick, solder sucker or de-soldering tool. Solder wick is a copper braid which is applied to the joint and heated with a soldering iron. As the solder in the joint is melted it is drawn into the solder wick like a sponge and is removed from the joint. A solder sucker is a spring loaded syringe or rubber bulb. The tip of the solder sucker is placed near the joint as the joint is melted by a soldering iron. When the sucker is operated a vacuum is created which draws the molten solder from the joint into the body of the sucker. A de-soldering tool is a type of soldering iron with a hollow tip and is connected to a pump or vacuum source. The tip of the de-soldering tool is placed onto the joint, typically over a component lead, and once the solder has melted the pump is operated to draw the molten solder away.

Solder wick, syringe type sucker, vacuum de-soldering tool	Hot tweezers or Hot air nozzle are options for SMDs

Figure 10 – Desoldering tools and tweezers for surface mount devices

8 Hazards involved in soldering

8.1 Heat

Although solder has a relatively low melting point this temperature is more than high enough to cause serious burns to people or objects. It is important to hold the soldering iron only by the insulated handle, never touch the heating element or tip when the soldering iron is on. The soldering iron will remain hot for some time after it is turned off so always check that it has cooled down before touching it, e.g. if changing the tip. When you are not soldering always keep the soldering iron in a proper holder so that you don't touch it accidently and it doesn't heat or burn other objects such as the benchtop. Don't hold parts being soldered with your hands as these will also be heated when being soldered. Don't flick molten solder from the soldering iron or wipe the tip on brass wool type tip cleaners.

If using a hot plate for surface mount soldering do not touch the hot plate. Use utensils such as pliers to place and remove PCB's from the hotplate. If using hot air tools for soldering, de-soldering or rework, do not direct the hot air stream onto yourself or other people. If using an oven allow the PCB to cool before handling or use utensils. Don't place hot PCB's on temperature sensitive surfaces.

If burns occur they should be treated by holding under cold running water for several minutes and assistance sought if burns are severe. Incidents should be reported.

8.2 Toxic materials

Leaded solder contains lead which is a harmful material. Use of this type of solder will probably involve handling it and your skin may become contaminated by it. Although it is unlikely that the lead can be absorbed directly through your skin it may be ingested indirectly if it is transferred by handling food whilst your skin is contaminated. Always wash your hands thoroughly before eating or handling food.

Solder flux creates fumes when heated during soldering which may be harmful if inhaled. Use a fume extractor to avoid inhaling fumes.

8.3 Spattering

Solder and flux can spit or spatter when heated. Always wear eye protection (safety glasses) when soldering.

8.4 Electrical Safety

Electric soldering irons are plugin appliances and must have a current safety test tag. The test will confirm that the soldering iron conforms to electrical safety standards and has not been damaged at the time of the test. Before use you should visually check that the soldering iron does not have damage such as melted insulation on the lead, broken or cracked handle or exposed conductors. Don’t use damaged equipment and report the damage.

For electrical safety the exposed metal parts such as the tip and heating element are earthed. Don’t solder on any live equipment as contact with the earthed tip may cause damage to the equipment or soldering iron.

SMD Soldering

Information & Instructions

This is a walkthrough of a SMD Soldering Workshop. The following information and instructions can be used as a simple method for soldering SMD components. The recipient of this information should acknowledge the danger of soldering *(written on the back page of this pamphlet)* before attempting to solder.

Recommended Tools:

- Soldering Iron
- Solder
- Tweezers
- Solder Wick
- Flux Pen

1 Add solder to one pad.

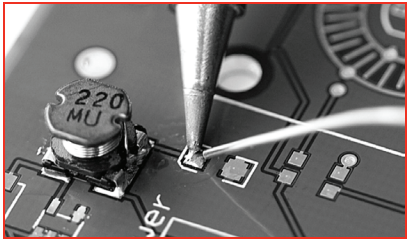

2 While that pad is molten, slide the component into place. Do not push down from the top - slide the component into the blob of solder horizontally.

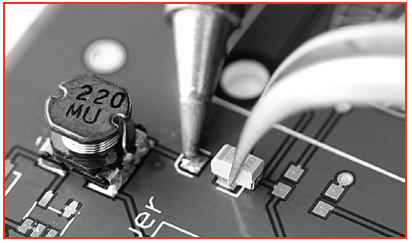

3 Align the component while connection is still molten.

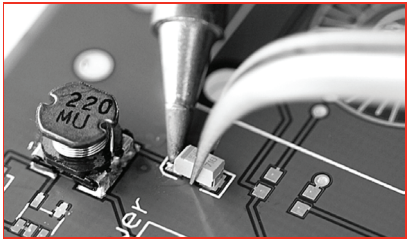

4 Once you have good alignment, continue to hold the component in place, and remove your iron. Continue to hold component for 1-2 seconds while the solder joint solidifies.

5 From above, the alignment looked good. From the side, you can see the rear pad is hovering slightly above the PCB. This can lead to problems on multi-pin components (open connections). Be sure the component is flush up against the PCB before soldering more connections. Re-grip the component, re-heat pad 1 and push the component flush against the PCB.

6 This is how a tantalum capacitor should look after making both solder connections.

7 If alignment is not good, do not solder more than 1 pad! Re-heat the joint, re-adjust component until aligned correctly, then move on to soldering other connections.

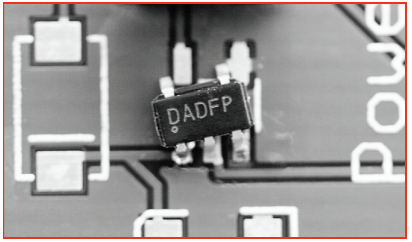

8 This is bad. It would be nearly impossible to finish the connections on this part. Make sure you have the component flush against the PCB.

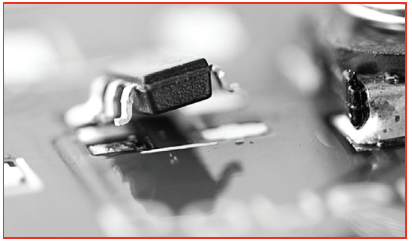

9 If you solder multiple pins together, don't worry about it! It can be easily fixed. Do not worry about jumpers! There are actually three pins under that blob.

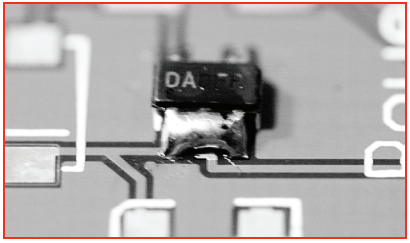

10 Pull out some solder wick. Put a small amount of solder on the end of your iron (this will transfer heat from iron to wick to the jumper). Sandwich the wick in between the iron and the solder jumper.

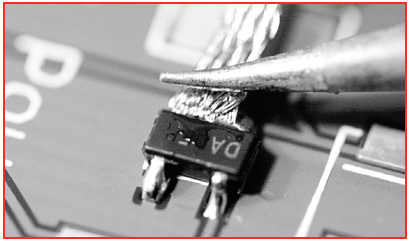

11 Hold still for 2-3 seconds. You will see solder start to flow up the wick. Once the excess solder has flowed into the wick, carefully lift up the wick and your iron in one fluid motion.

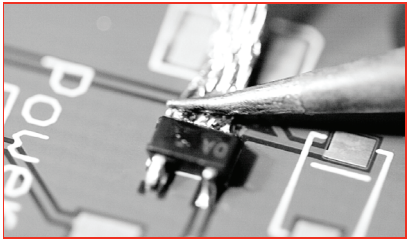

12 Nice and clean!

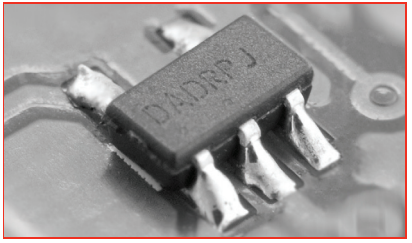

13 Bad bad bad. There was not enough solder for the connection on the left. Middle pin is lacking solder and should have been heated for longer. Right pin has had solder applied by an iron rather than applied to two metal contacts (the board and the pin).

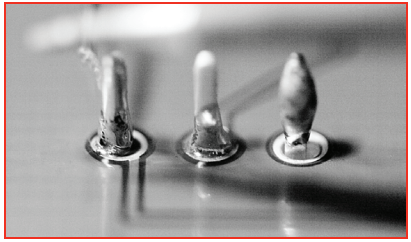

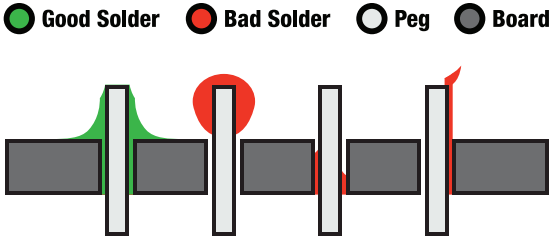

TIPS & TRICKS

A Solder flows smooth all the way to the bottom.

B Error: Solder balls up on top of pad, not connecting pin to pad.
Solution: Flux then wick. If you wick too much add solder.

C Error: Too little solder makes for weak connection.
Solution: Flux then add solder.

D Error: Bad Connection... and ugly... oh so ugly.
Solution: Flux then add solder.

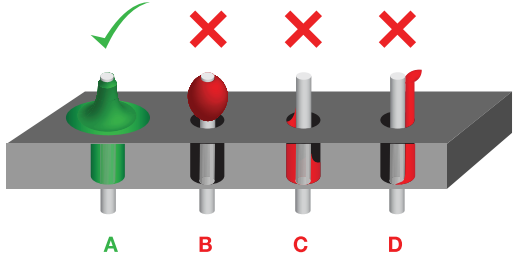

Safety Issues

Soldering

The tip of the iron is normally 700 °F, hot enough to melt metal. It is normal for the handle of the soldering iron to heat up a bit. Hold it like a pencil and move your hand further away from the tip if the heat is uncomfortable. The solder smokes because the rosin inside the solder is burning off - it's not harmful.

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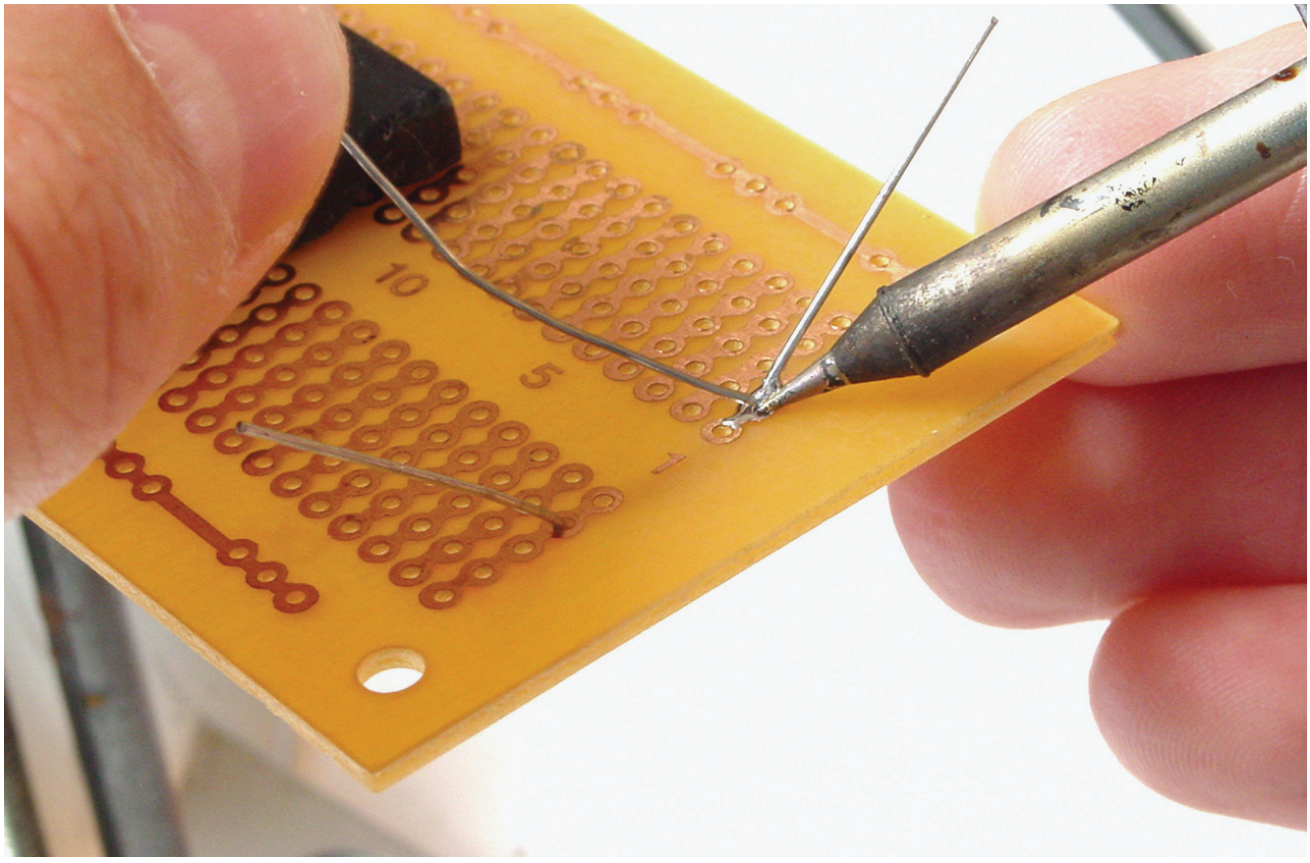

Soldering and Desoldering

Step-by-step instructions for making (and unmaking) the perfect solder joint.

By Joe Grand

The two key parts of soldering are good heat distribution and cleanliness of the soldering surface and component. With practice, you'll become comfortable and experienced with the process.

In this primer, I'll explain how to solder a component onto a printed circuit board (PCB). I'll also provide desoldering tips and show you how to remove a surface-mount component from a printed circuit board using a Chip Quik kit. And I'll show you how to remove a component by removing the solder in a way that won't damage the components or the circuit board.

Photography by Joe Grand

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Tools of the Trade

Soldering iron You could pay as little as $10 or as much as $1,000 for a soldering iron. I recommend a fine-tip, 700°F, 50W soldering stick iron. A good general-purpose iron for hardware hacking is the Weller W60P Controlled-Output Soldering Iron, which sells for under $70.

Solder Should be thin gauge (0.032" or 0.025" diameter) 60/40 rosin core.

Desoldering tool (aka solder sucker) A manual vacuum device that pulls up hot solder, useful for removing components from circuit boards. I like the one RadioShack sells (#64-2098, $10).

IC extraction tool Helps lift integrated circuits from the board during removal/desoldering.

Chip Quik SMD Removal Kit Allows you to remove surface mount components quickly and easily. Chipquik.com offers the kit for $16.

Sandpaper A very fine-grit sandpaper is useful for removing oxidation from component and circuit board surfaces.

Desoldering braid Woven metal material used to wick up melted solder.

Small, flat-tip screwdriver Comes in handy for removing some types of components.

Needlenose pliers, wire cutters, and vise These common tools will make your job easier.

The Chip Quik SMD Removal Kit

The Chip Quik SMD Removal Kit allows you to quickly and easily remove surface-mount components such as PLCC, SOIC, TSOP, QFP, and discrete packages. The main component of the kit is a low-melting-temperature solder (requiring less than 300°F) that reduces the overall melting temperature of the solder on the SMD pads. Essentially, this enables you to just lift the part right off the PCB.

INCLUDES

- Alcohol pads for cleaning the circuit board after device removal
- A special low-melting-temperature alloy
- Standard no-clean flux
- Application syringe

Desoldering Tips

FOR STANDARD THROUGH-HOLE COMPONENTS

- First grasp the component with a pair of needlenose pliers. Heat the pad beneath the lead you intend to extract and pull gently. The lead should come out. Repeat for the other lead.
- If solder fills in behind the lead as you extract it, use a spring-loaded solder sucker to remove the excess solder.

FOR THROUGH-HOLE ICs OR MULTI-PIN PARTS

- Use a solder sucker or desoldering braid to remove excess from the hole before attempting to extract the part.
- You can use a small, flat-tip screwdriver or IC extraction tool to help loosen the device from the holes.
- Be careful to not overheat components, since they can become damaged and may fail during operation.

BEFORE YOU START

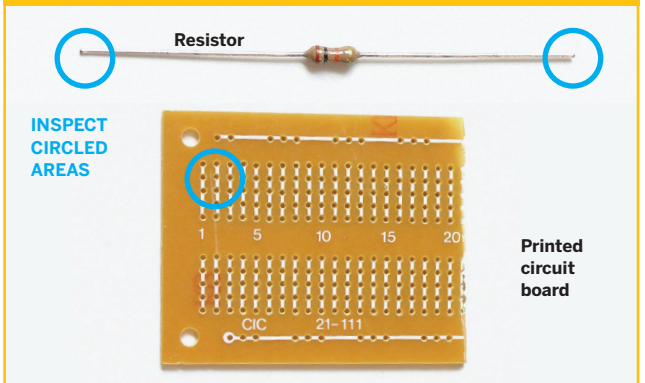

Joe Grand is the president of Grand Idea Studio, Inc. (joe@grandideastudio.com), a product-development and intellectual-property licensing firm. He specializes in embedded system design, computer security research, and inventing new concepts and technologies. He is also a host on The Discovery Channel's *Prototype This*.

SOLDERING A RESISTOR TO A CIRCUIT BOARD

BEFORE YOU START

Inspect the leads or pins for oxidation. If the metal surface is dull, sand with fine sandpaper until shiny. In addition, use the sandpaper to clean the oxidation and excess solder from the soldering iron tip to ensure maximum heat transfer.

This simple example shows the step-by-step process to solder a through-hole component to a printed circuit board (PCB). I used a piece of prototype PCB and a single resistor.

DANGER: It's important to consider safety precautions. Improper handling of the soldering iron can lead to burns or other physical injuries. Wear safety goggles and other protective clothing when working with solder tools. With temperatures hovering around 700°F, the tip of the soldering iron, molten solder, and flux can quickly sear through clothing and skin. Keep all soldering equipment away from flammable materials and objects. Be sure to turn off the iron when it's not in use and store it properly in its stand.

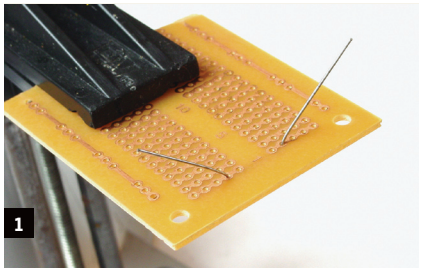

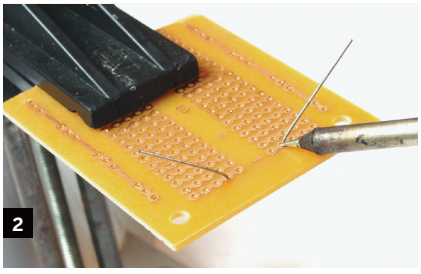

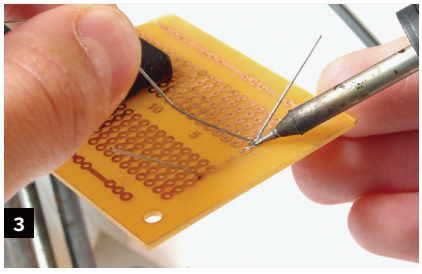

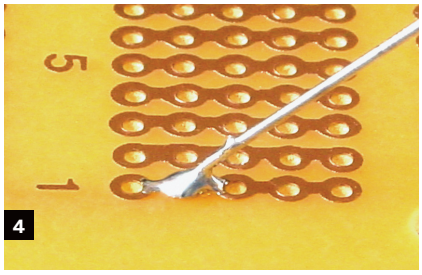

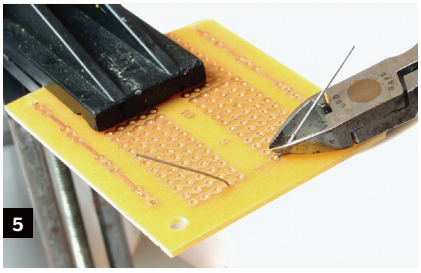

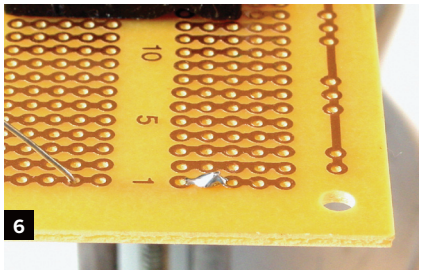

1. Bend and insert the component leads into the desired holes on the PCB. Flip the board to the other side. Slightly bend the lead you'll be soldering to prevent the component from falling out when the board is turned upside down.

2. To begin the actual soldering process, allow the tip of your iron to contact both the component lead and the pad on the circuit board for about 1 second before feeding solder to the connection. This will allow the surface to become hot enough for solder to flow smoothly.

3. Next, apply solder sparingly and hold the iron in place until solder has evenly coated the surface. Ensure that the solder flows all around the 2 pieces (component lead and PCB pad) that you're fastening together.

Don't put solder directly onto the hot iron tip before it has made contact with the lead or pad; doing so can cause a cold-solder joint (a common mistake that can prevent your hack from working properly). Soldering is a function of heat, and if the pieces aren't heated uniformly, solder may not spread as desired. A cold-solder joint will loosen over time and can build up corrosion.

4. When it appears that the solder has flowed properly, remove the iron from the area and wait a few seconds for the solder to cool and harden. Do not attempt to move the component during this time.

The solder joint should appear smooth and shiny, resembling the image above. If your solder joint has a dull finish, reheat the connection and add more solder.

5. Once the solder joint is in place, snip the lead to the desired length. Usually, you'll simply cut the remaining portion of the lead that isn't part of the actual solder joint. This prevents any risk of short circuits between leftover component leads on the board.

6. Here's a completed soldering example.

BEFORE YOU START

Use a rubbing alcohol pad to remove any residue from the solder pads. Verify that the solder pads are clean and free of cuts or solder jumps before proceeding. Desoldering, or removing a soldered component from a circuit board, is typically trickier than soldering because you can easily damage the device, the circuit board, or surrounding components. For surface mount devices (SMDs) with more than a few pins, the easiest method to remove the part is the Chip Quik SMD Removal Kit, as shown in the following step-by-step example.

PLEASE READ through this example completely before attempting SMD removal on an actual device. When removing the device, be careful not to scratch or damage any of the surrounding components or pull up any PCB traces.

THREE PRIMARY FUNCTIONS OF FLUX

- **Cleans metal surfaces to assist the flow of *filler metals* (solder) over *base metals* (device pins).**
- **Assists with heat transfer from heat source (soldering iron) to metal surface (device pins).**
- **Helps in the removal of *surface metal oxides* (created by oxygen in the air when the metal reaches high temperatures).**

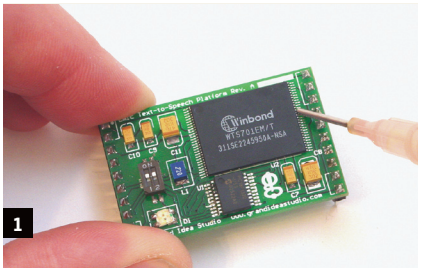

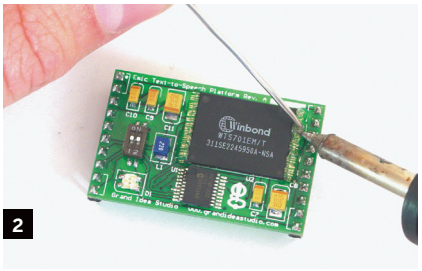

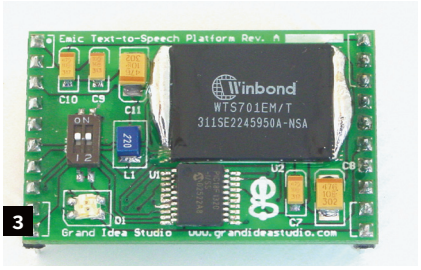

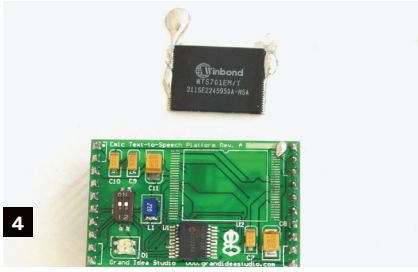

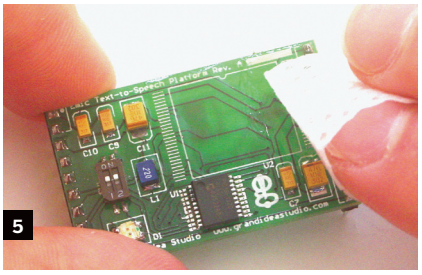

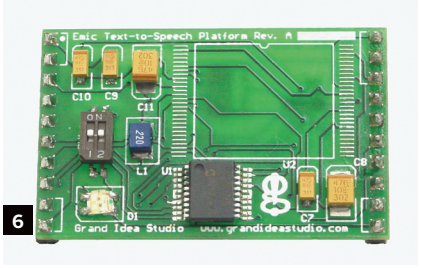

1. The first step is to assemble the syringe, which contains the no-clean flux. Simply insert the plunger into the syringe and push down to dispense the compound. The flux should be applied evenly across all the pins on the package you'll be removing. (Flux is a chemical compound used to assist in the soldering or removal of electronic components or other metals.)

2. Once the flux is evenly spread over the pins of the target device, the next step is to apply the special Chip Quik alloy to the device. This step is just like soldering: apply heat to the pins of the device and the alloy at the same time. The alloy has a melting point of approximately 300°F, which is quite low. You shouldn't have to heat the alloy with the soldering iron for very long before it begins to melt. The molten alloy should flow around and under the device pins. Starting at one end of the device, simply heat and apply the alloy. Repeat for the other side(s) of the device.

3. Flux will help ensure a nice flow of the alloy onto the device pins. Make sure the alloy has come in contact with every single pin by gently moving the soldering iron around the edges of the device. Avoid touching nearby components on the PCB with the soldering iron.

4. Now that the alloy has been properly applied to all pins of the device, it's time to remove the device from the board. After making sure that the alloy is still molten by reheating all of it with the soldering iron, gently slide the component off the board. You can use a small, jeweler's flat-tip screwdriver to help with the task. If the device is stuck, reheat the alloy and wiggle the part back and forth to help the alloy flow underneath the pads of the device and loosen the connections.

5. The final step in the desoldering process is to clean the circuit board. This step is important because it will remove any impurities left behind from the Chip Quik kit and get you ready for the next step.

First, use the soldering iron to remove any stray alloy left on the device pads or anywhere else on the circuit board. Next, apply a thin, even layer of flux to all of the pads that the device was just soldered to. Use the included alcohol swab or a flux-remover spray to remove the flux and clean the area.

6. The desoldering process is now complete. The surface-mount device has been removed and the circuit board cleaned.

TECHNOLOGY IN ACTION™

Building Your Own Electronics Lab

A Guide to Setting Up Your Own Gadget Workshop

Dale Wheat

For your convenience Apress has placed some of the front matter material after the index. Please use the Bookmarks and Contents at a Glance links to access them.

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Introduction

We're surrounded by electronics these days. Did you ever wonder how it all worked? Do you know just enough about electricity to be dangerous? Would you like to learn more? Then this book is for you.

There are many excellent textbooks on how electricity works. This is not one of them. This book helps you get started learning about electricity and electronics by showing you how to set up your own electronics laboratory. You might have guessed that from the title.

Along the way, several simple exercises are presented to show you some basic concepts about how electricity works in the real world—not just in a lecture hall. By the time you get done reading this short book, you'll have a good idea of where to begin and what kinds of tools and components you might need, and you'll have some excellent advice about how to keep it all organized.

Once you've got your own space set up to perform your electronic experiments, the sky is the limit.

Here's what you have to look forward to in this book, one chapter at a time.

Chapter 1: Planning Your Electronics Workshop

Your very own electronics laboratory is a great place to build, repair, invent, and learn more about electronics. We seem to be surrounded by electronics more and more every day. We can easily become dependent upon them, without even understanding how they work. Having your own electronics lab can help you gain some control over your electronic minions. Here you can learn about their inner mysteries, including how to repair them when possible or, better yet, improve them with your own custom modifications. You can also turn your own ideas into reality by building electronic circuits from scratch.

What will you need to plan your lab? What if you already have a basic understanding of electronics and the beginnings of a workshop at your disposal? This chapter helps get you going in the right direction.

Chapter 2: Building Your Tool Chest

You're going to need some tools in your lab, as well as the skills to use them effectively. This chapter will get you started.

If you're starting from scratch, don't worry. There's not a whole lot you absolutely *must* have to get started. Some basic hand tools and a place to keep them organized is all you will need. You don't even have to spend a lot of money at first. As you progress in your hobby, you will most likely want to add to your tool chest and upgrade some of those tools. Electronics can be the perfect hobby because it can take up (1) all your spare time and (2) all your discretionary income. What more could you ask for?

Chapter 3: Components

You're going to need some components to play with, as well as the knowledge to use them effectively. This chapter will introduce you to some of the bits and pieces that make up modern electric and electronic circuits. You'll also learn a little bit about how to identify components from their appearance and markings, when available.

Once you've got an idea about what these parts do in a circuit, you'll learn a little more about how to measure their electrical properties and put them to use. You'll also be shown what *not* to do, in some select examples.

Chapter 4: A Portable Mini-Lab

Having a portable (or at least (*trans*portable) electronics lab comes in handy in several circumstances. Maybe you don't have a place (yet) for a permanent home for all that equipment. Maybe you need to bounce at a moment's notice, heading off on electronic adventures at the drop of a hat. Or maybe you like to keep everything where you can find it in a hurry, without having to rummage through shelves and boxes, looking for just the right tool or component.

Whatever your motivation for wanting a portable lab at your disposal, this chapter should help you get started.

Chapter 5: The Cozy Corner Lab

You don't need an entire garage or extra office for a functional laboratory for your electronic endeavors. It's certainly nice if these areas are available to you, but you might be surprised at how much you can do in just a small space, if you set it up properly and maintain it with determination.

Chapter 6: The Small Group Lab and Classroom

The first part of this book deals with how to get along with electrons and make them do your bidding. In this chapter, you'll explore a completely different topic: other people, and how to get along with them.

You might not ever figure out how to get *them* to do your bidding, but at least you can keep them from stealing your tools. Maybe.

Appendix A: Getting Started with Tool Building

Once you've become comfortable in your lab and had time to play with a few circuits, you might start to notice that some of the "tools" you've been using are just simple electronic circuits themselves. Good examples are power supplies and meters. These are great tool-building projects because you can see useful results early.

This appendix takes a look at building a couple of simple electronic tools that might be of use in your lab. Hopefully you will develop a better understanding of how these tools work. Ideally, you will progress from the basic question of "Does it work?" to the more involved questions of "How well does it work and what can I do to improve it?"

CHAPTER 1

Planning Your Electronics Workshop

Are you interested in electronics? Would you like to set up your own "electro lab" to conduct amazing experiments, build crazy gizmos, and repair or modify your existing electronics? Then this book is for you!

Your very own electronics laboratory is a great place to build, repair, invent, and learn more about electronics. We seem to be surrounded by electronics more and more every day. We can easily become dependent upon them, without even understanding how they work. Having your own electronics lab can help you gain some control over your electronic minions. Here you can learn about their inner mysteries, including how to repair them when possible or, better yet, improve them with your own custom modifications. You can also turn your own ideas into reality by building electronic circuits from scratch.

What will you need to plan your lab? What if you already have a basic understanding of electronics and the beginnings of a workshop at your disposal? This chapter helps get you going in the right direction.

What to Expect

This book can't teach you everything about electronics, and it doesn't try. That would take several lifetimes. What it can do is introduce you to the tools and the skills you will need to set up your own electronics lab. This will include a very basic introduction to electricity, a little bit of theory, some safety tips, and a whole lot of example projects. It's a great starting place. Where it will lead you is mostly determined by you and what you're wanting to do with electronics.

If you're already familiar with electricity and electronic concepts, there is still plenty of fun and interesting stuff waiting for you to explore. The field of electronics itself is constantly expanding. From the time this book was written to the time that you've finished reading this sentence, many advances will have occurred in both our understanding of electronics as well as the development of new applications and electronic devices. This is one of the many things that makes the study of electronics so interesting and exciting.

Every lab is different. Your lab will reflect not only your immediate electronics goals but also your personality. Feel free to pick and choose from all the ideas presented in this book and add in some of your own. The repair shop and the design studio are necessarily going to be arranged differently. There really is no right or wrong way to go.

Even the best laid plans, so the saying goes, end up somewhere unexpected. When planning your electronics lab for the first time, or for the tenth time, keep in mind that your interests, resources, and reasons for wanting to work on electronics are going to change over time. Please feel free to reinvent yourself and your lab as conditions permit. You might also be forced to reconsider your priorities when

other factors in your life exert themselves. That being said, stay tuned for "A Cautionary Tale" at the end of this chapter.

Some configurations are more appropriate for certain endeavors, and nothing replaces the right tool for the job. This book should at least give you an idea of what is involved and get you pointed down the right road.

It Starts with a Plan

Most of the decisions you'll make when planning your laboratory will depend on what *you're* interested in doing there. Having a good plan at the beginning is like having a clear map when taking a long journey. It helps you from getting lost and also is handy for figuring out when you've arrived.

■ **Note** If you fail to plan, you plan to fail.

Remember, at this point in the game, you don't have to make any final decisions about what you want to be able to do in your lab. This book is all about illustrating possibilities and giving you the information and advice necessary to branch out into the areas that hold the most interest for *you*.

A Broad Outline

Here's what you need to get started: a little time, a small amount of space, some basic tools, and a few components. Those are the boring parts. The fun stuff includes your ideas, goals, and inspiration. Combine all that with some fundamental information about how electricity and electronics work, and you're in business.

A Little Time

Like any good hobby, setting up your electronics lab and conducting experiments there is going to take up some of your time. For some, this is the *main reason* for getting started in electronics and building a lab: a place to escape, unwind, and tinker with ideas, prototypes, and complex systems. Maybe it's your job. Maybe it's your passion. Perhaps it's a bit of both.

You're going to need time to plan and build your lab. This book will spell out several specific arrangements for various-sized labs, but they are just examples and not hard-and-fast rules. More time will be required for obtaining the proper tools and materials that you will use there. Time will be spent not only *doing* things in your lab, but also in just *thinking* about doing things in your lab. For example, you might build a clever little gizmo that ought to do a simple task, only to find out that it refuses to work. You might need to spend a little bit of time thinking of ways of testing it to find out where the problem lies. This is sometimes called *troubleshooting* or *debugging*.

This is the basis of the scientific method. To help understand how something works, you first form a theory that would explain its behavior. Next you prepare one or more experiments that will demonstrate the accuracy of your theory. The experiments are conducted and their results are analyzed. If the results are in agreement with your theory's predictions, then your theory is more than likely correct. If not, you may need to modify or extend your theory to accommodate the behavior observed. All of these things take time, which helps explain why we don't have jet packs or time machines yet.

A Little Space

You don't have to start out with a cavernous underground bunker for your electronics lab. If you already have one, that's great. You might have an extra classroom available, some unused warehouse space, or an empty bench in a garage.

Then again, you might only have a corner of the dining-room table, and then only between mealtimes. That's plenty of room when you're just getting started! Once you learn more about electronics, and especially when you learn more about what it is that *you* want to do with electronics, then you can start looking for a more permanent home for your toys, tools, and spare parts.

The main points that will be stressed throughout this book when planning and working in your space are safety, good lighting, and organization, in that order.

- Your lab needs to be relatively safe for you, and *very* safe for your visitors and neighbors. The "Go Away!" sign on the door does not guarantee that you will be free from curious visitors, pesky and otherwise. People are naturally attracted to the creative and mysterious activities going on in your lab.
- Be prepared to buy, build, or borrow more lighting, because you're going to need it. Proper lighting improves the quality of your doodlings and tinkering enormously. You might think you already have enough light, and unless you were a photographer in a previous life, you don't. (Photographers understand that you can never have too much light.)
- An organized lab is a productive lab. Don't waste time looking for parts or tools when it would have only taken mere moments to put them in their proper places in the first place. A place for everything, and everything in its place. You get to decide where all these tools and bits get to live, so spend some time and do it wisely.

These three tenets will be repeated throughout the book, so you might as well get used to hearing about them.

Basic Tools

You really don't need a lot of tools to get started. There is a tendency to want to be a bit overprepared before tackling any new project, but it really isn't necessary when it comes to planning and building a new electronics lab. This is also true when sorting out a lab that's gone badly out of control.

You're going to be working with wire quite often. Claude Debussy has been quoted as saying that music is the space between the notes. It's the connections between the various electronic components that make the magic happen in an electronic circuit, in the same way that it's the relationships between people that make their lives so interesting.

The connections between all the various imaginable electronic components almost always start out as bits of wire. These connections can then be optimized into copper traces etched on a printed circuit board or even as metallization links in an integrated circuit. You're going to be working with a lot of wires in this hobby, and that usually boils down to two basic hand tools: *wire cutters* and *wire strippers*.

A wire cutter does what it says and says what it does: it cuts wire. A wire stripper is a more specialized tool that helps remove the outer layer of insulation from a wire. Ever more specialized versions of both tools abound. Some tools aim to perform both tasks at once, while never perfecting the art of either.

Resist the temptation to use your teeth for cutting and stripping wire. If you're caught in a situation without proper tools, use your fingernails. They grow back faster than teeth.

■ **Tip** Use the right tool for the job. Knowing which tool is the right tool is half the battle.

If you're performing detailed work on smaller circuits, you might benefit from having some small needle-nosed pliers, a small vise, clip, or helping-hands jig, and possibly a magnifying glass.

A popular and handy skill in the electronic arena is *soldering*. Soldering is the process of making electrical and mechanical connections. This is done by heating the items to be joined together and adding solder. The solder melts and fills in all the gaps between the items being joined. Once cooled, the solder forms a solid, conductive link.

■ **Note** Soldering is similar to welding, with the exception that welding actually melts the parts being joined.

A suitably sized soldering iron and the right kind of solder are indispensible for many projects, including repair, prototyping, and production. Picking up the skill to make quality connections is obtained in the same way as all worthwhile skills: with lots of practice.

Besides these basic fabrication tools, you will also want some *test and measurement equipment*. These are devices used to measure various aspects of electrical circuit behavior. These range from the very simple, such as voltage meters, current meters, and continuity testers, to the very exotic (and sometimes expensive), which include oscilloscopes and various logic, network, and signal analyzers. See the Appendix for information about building your own simple test equipment for your lab.

This is just a quick summary of the kinds of tools you might want in your electronics lab. Chapter 2 goes into much more detail about the tools you will probably need or want in your lab, as well as the skills needed to operate them safely and effectively.

Fundamental Components

As mentioned in the previous section, you're more than likely going to be wiring up various contraptions and rewiring others. This is probably going to involve a lot of wire.

For small voltages and currents, small-gauge insulated copper wire is often used. It's easy to handle, cut, and splice. This can be done with mechanical connectors such as wire-nuts or screw terminals, as well as with soldering.

Back in the day when computers were all connected using fat cables, lots of tiny wires were bundled up into cables and snaked all over a typical desktop computer installation. With the increasing popularity of wireless devices, those fat, juicy cables are lying around, discarded, unwanted, and just waiting to be harvested for their valuable conductors. You can also buy various kinds of wire in all colors and sizes from most hardware stores and from online suppliers.

Now consider the types of projects you'll be working on:

- If you're most interested in building your own lighting, you're going to want some lightbulbs, sockets, and LEDs, or whatever lighting technology appeals most to you. Don't forget that you're also going to need switches, knobs, dimmers, housings, plugs, and *more wire*.

- If you like to work with things that move, you're going to need motors, relays, solenoids, servos, and fans. You'll probably be needing some gears, pulleys, chains, belts, shafts, and couplings, along with connectors, switches, controllers, position sensors, and *more wire*.
- If you're into making lots and lots of sound, you'll be needing speakers, headphones, microphones, pickups, transducers, transformers, amplifiers, connectors, jacks, plugs, and, you guessed it, *more wire*.
- Are computers and digital devices more to your liking? Be thinking about getting yourself a wide variety of chips, microcontrollers, software, cables, sockets, connectors, and still *more wire*.

Now you've got an idea of some of the different components you might want to have on hand, depending on what kind of inspiration happens to strike. You're going to need a place to keep all these different parts sorted. This will play a big part in the overall planning phase of your lab. Maybe your old fishing tackle box has enough room for your basic hand tools and enough secret compartments to hold an interesting variety of components. On the other end of the spectrum, maybe you need to start thinking about some industrial-grade shelving units or pallet racks. Now is the time to think about all these factors and start making the right kind of plans to help make your lab a successful one.

Again, this is just a quick summary of some of the types of components you might want to work on in your lab. Chapter 3 is going to take you much farther into understanding many of the more common electrical and electronic components that you are likely to encounter in your lab.

Ideas

Admit it: you've already got some ideas for cool projects that you'd like to be working on in your own electronics lab. That's great! You're well on your way to making those dreams a reality.

The best possible thing you could do with your ideas is to write them down somewhere. It can be as simple as a sketch on a piece of scrap paper or as formal as a complete set of project documentation. The important thing is that you actually get the idea across using either words or pictures in a form that you will be able to revisit in the future. This will be of immense benefit to you, as well as anyone else that might be interested in your ideas.

It's also a great idea to keep a log as you work on your projects. That's the perfect place to jot down those ideas as they come popping out of your brain. Be as detailed as you can be. You will thank yourself later.

Even if you don't already have a backlog of ideas jostling for your attention in the lab, it's still a good idea to keep a log and explore the things that interest you. Leonardo da Vinci kept detailed notebooks on almost every possible subject. Anything that interested him got written down, sketched, or diagrammed in his notes. Even today, people are still getting inspiration from his doodles (see Figure 1-1).

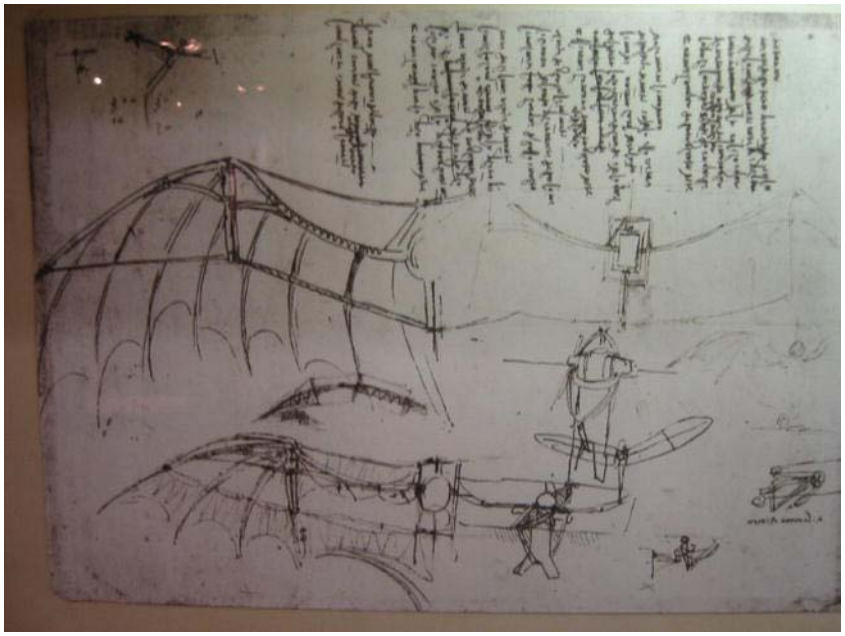

Figure 1-1. *Sketches and notes for a "flying machine" by Leonardo da Vinci. Photograph by Arnaud 25 (public domain), via Wikimedia Commons.*

Writing down your ideas also helps you pick which projects you want to work on first. It just isn't possible to work on all of them at the same time! Narrowing down the list helps get you focused and lets you concentrate all of your talents and energies on the most important projects.

When you're just beginning, the "most important projects" are the ones that provide the most positive reinforcement in the shortest amount of time. Plan a few simple, straightforward projects with a high probability of success at first. You can become more ambitious and take greater risks when you've built up a good reserve of self-confidence and techniques. Remember, the only experiments that fail are the ones from which you don't learn anything. Sometimes learning how *not* to do something is just as important as learning how to do it correctly.

Goals

The best way to turn great ideas into spectacular projects is to have a plan. Set some achievable goals for yourself. When you're first starting, don't be afraid to take those baby steps. You have to crawl before you can teleport.

Project planning is its own art form, and a dark and mysterious art it can be sometimes. It really helps to have clearly defined goals and expectations early in a project. Otherwise, how will you know when you're finished?

Any large, complex problem or project can be broken down into smaller, more manageable subprojects. Unfortunately, this can be carried too far. You don't need to reinvent the wheel every time you start a new project. There's a saying that suggests, "Don't build anything you can buy." The counterpoint to this wisdom is the equally ancient saying, "Don't buy what you can build." You'll have to be the judge as to which one applies best to you and your situation.

Do you have lots of time and very little money? This is good news! This helps simplify the decision-making process enormously. Design and build everything yourself, from scratch. This can include your own tools as well as custom-made components. The trick to this approach is not get lost in all the inevitable details that will arise.

No time to spare, but there's a bit of a budget available? This is likewise good news. With few exceptions, there's someone out there that's willing to part with just what you need for a reasonable price. The trick here is to find them and make that connection.

Inspiration!

Remind yourself what your inspiration is. What initially prompted you to start thinking about building your own electronics lab? Why did you want to get into electronics as a hobby or a career in the first place? Do you even remember?

It really helps to have a firm grasp on what your underlying motives are (or were) when faced with the challenges that regularly present themselves along the way. While it's true that some things just need doing, does it really have to be *you* that does them? Could you farm out some of the work and still feel a sense of satisfaction in the completion of the project? Or do you feel the need to take the do-it-yourself mind frame to its utmost limit?

Whatever your inspiration is, or wherever it came from, do your best to keep it in your sights while pursuing your dreams and goals. It makes it that much more satisfying when you eventually attain them.

How Electricity Works

There are two ways to go about learning how electricity actually works. The first involves just a whole bunch of *fascinating* theoretical information about atoms, electrons, fairies, and dragons. The second way is to just assume that it does indeed work, and spend some time actually putting it to work.

You don't need to know everything about electricity to have fun with it. A passing understanding is sufficient to get you started. As your technical requirements grow more elaborate, you will find yourself going back to revisit some of the basic concepts, until your comprehension is sufficient to carry you forward.

The Theoretical Approach

The prevailing theories about how electricity works center around the orbits of negatively charged subatomic particles called *electrons*. Electrons are quite small, even when compared to individual atoms. Electrons normally whiz around the *nucleus* of the atom, which is usually made up of other subatomic particles called *protons* and *neutrons*. The exception is hydrogen, whose most common isotope has only a single proton and no neutrons. Protons have a positive electrical charge and neutrons have no electrical charge.

When an atom has a balance of protons and electrons, it is said to be electrically neutral. If an atom has more electrons than protons, it has a negative electrical charge. Conversely, if there are more protons than electrons, the atom has a positive charge. An atom that has either a positive or negative electrical charge is called an *ion*.

While flying round and round the nucleus, electrons tend to cluster into well-defined orbits, or *shells*. The innermost shell of an atom can hold as many as 2 electrons. Once this orbit is "full," up to 8 more electrons can be accommodated in the next larger shell. The next shell holds up to 18 electrons, and the one after that can contain up to 32 electrons. After that, the shells get smaller again, stepping back down symmetrically from 18 to 8 to 2.

Each unique combination of electrons and protons represents one of the chemically distinct *elements*. Each element has its own particular chemical characteristics, and cannot be further subdivided by conventional chemical or mechanical means. Toward the end of the *periodic table*, which arranges all the known elements into meaningful rows and columns, you'll start to find some exceptions to the shell symmetry. These heavier elements, however, don't usually turn up in most electronics labs, so we'll not be spending a lot of time there.

Individual atoms can combine into more complex structures called *molecules*. One popular molecule is water, which is made up of two hydrogen atoms and one oxygen atom. Each of the hydrogen atoms has a single electron. The oxygen atom has eight electrons. The first two electrons in the oxygen atom occupy the first shell, leaving six electrons in the next outer shell. That leaves two "open" places in the second shell, which is where the two electrons from the two hydrogen atoms come into play. The electrons are shared by the three atoms, linking them all together and forming a *covalent bond*. Water has vastly different physical properties than either hydrogen or oxygen.

It's also possible to bump an electron out of orbit around a nucleus. When this happens, the atom becomes an ion and is electrically positive. This makes it especially attractive to any loose electrons that happen to be in the vicinity. This is because electrons are negatively charged, and in the case of electrical charges, opposites attract. This movement of electrons is how an electric charge flows through a substance.

Some materials are very good at slinging those electrons around, and as such are called good *conductors* of electrical energy. Examples of good conductors are copper and silver. Some materials resist the flow of electrical charge, and can be used as *insulators*.

An important concept to understand about the flow of electricity is that it is based on the movements of tiny, *negatively charged particles*. This is referred to as the flow of *electron current*, but this term is rarely used. For some reason, the more popular, or conventional, idea of electric current flow is from the more positive point to the more negative point in a circuit. This is referred to as *conventional current* and is the standard used throughout this book.

The fairies and the dragons come into the picture when you start to look any deeper into how the building blocks of matter are actually (or allegedly) constituted. The previous quick summary of how electricity works covers less than 1 percent of the physics needed to understand even how basic atomic principles operate. Even then there are various schools of thought as to how, *exactly*, all that tiny stuff works together to produce rainbows and cousins and moon rocks. A proton, once thought to be an indivisible *elementary particle*, is now thought to be built out of a "down" quark and two "up" quarks. There are also "strange" and "charmed" quarks flitting about, along with an entire pantheon of mythological particles. Go figure.

Now all of that *fascinating* information only scratched the surface of how *electricity* works. Electricity does a lot of work for us. We use it for lighting, heating, motion; just all kinds of things. *Electronics* is where we start to get into some really bizarre physics involving semiconductors, transistors, computer chips, and other miracles of the modern age. Explaining even the basic ideas about how *electronics* works is way beyond the scope of this little book. It's certainly possible to learn and understand it, but for the purposes of setting up a lab and building some example projects, we can just assume that it does indeed work. We can start from there and have some fun with it.

If your curious mind just can't stand *not knowing* how electronics works, the interwebs are your friends, and so are the helpful folks at your local library.

A Practical Approach

An easier way to think about electricity is to skip over *why* it flows and concentrate on *how* it flows. That's what we'll be doing in the remainder of this book, for the most part.

■ **Note** Electricity flows in a circle.

Any continuous flow of electrical current travels in a circle. There are exceptions to this broad generalization, but most of the example circuits encountered in this book will have a definite circular arrangement, if you know how to look for it.

Here are some technical terms that will be used throughout this book. You don't have to memorize any of them right now (there will *not* be a test), but you should at least take a glance at them so you know where to come back when you want to know more.

Circuit: A circuit is anything that forms a continuous loop or circle. The term *circuit* is formed from the same Latin word that means *circle* or *wheel*.

Amps: The *intensity* of an electrical current is measured in units called *amperes*, named after André-Marie Ampère. This is usually shortened to *amp* in popular usage. The symbol for amperage in a circuit is *I* (for intensity), while the unit is abbreviated *A*. For example, you could say that the intensity of the electrical current (I) in a circuit was measured to be 3.75A (amperes). Electrical current is measured with an *ammeter*.

Volts: The voltage in a circuit is the measure of the difference in electrical *potential*, or how much work it *could* do. The unit of voltage is the volt (V), named after Alessandro Volta. This is sometimes referred to as pressure or tension. For example, a "high-tension wire" means a high-voltage line, not necessarily one that has been pulled really, really tight. Voltage is, not surprisingly, measured with a *voltmeter*.

Watts: Electrical power is measured in watts (W), named after James Watt. The easy way to calculate watts, or the amount of energy that is converted into work (either useful or not) is to multiply the voltage across the circuit by the current flowing through the circuit. For example, if a 12V battery is connected to a lightbulb that draws 2A, the bulb converts the electrical energy into both light and heat (mostly heat) to the tune of 24W (12V × 2A = 24W).

Ohms: The resistance to the flow of electrical current is measured in *ohms*, named after Georg Ohm. A *resistor* is a simple electronic component that exhibits a fixed resistance to the flow of electrical current. The symbol for resistance is *R* and the unit of measure is the capital Greek letter omega, Ω.

Safety

Make no mistake: electricity can kill you. It bears repeating, as well as emphasis.

■ **Warning** Electricity can kill you.

Working safely with electricity is like working safely with a sharp knife, for example. A good knife is a useful tool. Life would be cumbersome and crude (not to mention short) without good tools. However, when using *any* tools it's important to understand their proper use and operation. The same goes for electricity.

The point here is not to be overdramatic about the dangers of electricity. Billions of people are safely and peacefully coexisting with electricity, largely due to wise safety rules and well-designed electrical appliances. However, there are three major ways that you can be harmed when working around electricity, and it is important that you be aware of them:

- Your body uses tiny amounts of electricity to send nerve impulses to and from your brain. Sending relatively giant shocks of electricity through your body is a good way to stop your heart from beating or your lungs from breathing. You need to keep doing both of those things, so be careful.
- Since your body is not a very good conductor of electricity, it converts the electrical current into heat, which can produce very damaging burns, both on the inside and the outside of your body.
- Additionally, many electrically related injuries are sustained while trying to *get away* (i.e., your body's involuntary reflex when exposed to dangerous voltages).

Yet working safely with electricity is easy. Observe the following rules and you'll be relatively safe, both in your lab and outside of it:

- Always assume a circuit is "live." Electrical devices can retain lethal voltages even when completely disconnected from power.
- Don't work with high voltage (more than 36 volts) unless you're specifically trained. Reading this book does *not* mean you're "specifically trained," even if you read it *twice*.
- Don't short-circuit batteries (i.e., deliberately connect the positive and negative terminals together). Even very small batteries can hold dangerous amounts of power and can produce enough heat to burn you. Even worse, it can start a fire, which is yet another unpleasant way to die.
- Be careful when using metal (conductive) tools around battery terminals so that you don't accidentally short the terminals together or to other circuitry.
- Don't assume other people are aware of these dangers.

Lighten Up!

Now it's time to have a little fun with electricity, don't you think? While it's important to keep safety in mind, it's just as important to be curious and willing to try new things. Don't let the (important) safety rules immobilize your creativity. Use these rules, like any tool, to leverage your enjoyment of this fun and exciting hobby.

Let's start with a simple circuit that is almost guaranteed to lighten things up. Let's take apart a flashlight (or *torch* for you metric types) and see how it works.

First, find a typical household flashlight. The flashlight in Figure 1-2 was purchased for $3, and it included two new D-cell batteries. Put the batteries in the flashlight and make sure it lights up when you turn on the switch. If the bulb is burned out or the batteries are dead, then this experiment is not going to be much fun at all.

Figure 1-2. *A typical household flashlight will be the ~~victim~~ subject of our first electrical experiment.*

Once we've established that the flashlight works as intended, we can begin the experiment.

DISSECTING A FLASHLIGHT

We don't need most of the pieces of the flashlight body. Let's take it apart and have a look inside.

1. Open the flashlight be unscrewing the end with the lightbulb in it.
2. Remove the batteries. Set them aside for the moment. We'll use them in a bit.
3. Remove the plastic retainer that holds the bulb in the reflector.
4. Take out the bulb.
5. We'll need to replace the wiring that was contained within the flashlight's body. Find a short piece of wire 8" to 12" long. A specialized jumper wire with alligator clips on the end was used in the photos for this exercise, but almost any kind of wire will do. See Figure 1-3.

Figure 1-3. *All the pieces you'll need to light up the bulb.*

6. If you're using plain, insulated wire, you'll need to remove a small bit of it from both ends of the wire to expose the *conductor*, or metal wire part inside.
7. This step can be tricky. Try to hold both batteries in one hand, along with the bulb. The batteries need to be pointed in the same direction. If this is too hard to do, try it with just one battery.

8. The positive end of the battery has a small cap on it. Touch the bottom point of the bulb to the top of the battery.
9. Now, using your other hand, connect the wire from the bottom of the battery to the metal base of the bulb.
10. The lightbulb should start to glow. See Figure 1-4.

■ **Caution** If you have a super-bright bulb, it can get hot. Don't burn yourself!

Figure 1-4. *The completed circuit, showing the glowing bulb. Electricity is flowing!*

Several important things are going on in this very simple circuit. Electrical current is flowing, producing useful work (in this case, light). Can you see the "circle"? When you *break* the circuit, the bulb stops glowing. This is exactly how the switch in the flashlight body works. Peek inside the flashlight and see if you can tell how it works. By connecting and disconnecting the wire, you can make the bulb flash. If you only use one battery, the bulb turns on, but is not as bright. Why do you think that happens?

Environmental Impact

You affect your environment every day, and your environment affects you, as well. As you learn more about electronics and all the interesting and wonderful things it can teach you, be mindful of what kind of trail you're leaving behind for others to clean up.

A good way to get a feel for your environmental impact is to take a look at your garbage. It doesn't sound that interesting or fun, but it *will* teach you a lot about yourself and your habits. What are you throwing away? Could you have found either another use for it, or perhaps another home? Is it going to be a nuisance to someone else, or even worse, a hazard?

A good example is the use of "disposable" batteries. We used batteries (technically *cells*, but that distinction will be spelled out in more detail in Chapter 3) in our very first experiment. We buy new batteries and plug them into our devices, and when they run out of power we take them out and throw them away. Where do they go? How do they then interact with the environment? They don't just "go away."

Disposable batteries are very convenient. They are generally inexpensive, compact, self-contained, and reliable. This *convenience*, however, comes with a price all its own. Consider using *rechargeable* batteries whenever possible in your lab. They cost a little more than their disposable counterparts, but can easily and cheaply be refilled with electrical goodness over and over again.

You should also be aware of any hazardous materials that you use or store in your lab. For example, lead is a very common material used in many electrical devices, even though its use is being reduced worldwide. It is found in older-technology rechargeable batteries, solder, and printed circuit boards.

Some of the chemicals used to etch printed circuit boards can be dangerous if not used, stored, and disposed of properly. Take the time to understand what, exactly, you're working with when you're conducting your experiments in your laboratory.

Just like the captain of a seagoing vessel, you're in charge of what happens in *your* lab. With this authority come important responsibilities that rest squarely upon your shoulders. Please take these responsibilities seriously.

Budgeting

How much is all this stuff going to cost? A lot of it depends on how creative you want to be in stocking your lab with tools and parts.

If your budget is small, then start small. If your budget is nonexistent, then you'll just have to start even smaller. You should generally approach acquisitions for your lab under one of these three headings:

- Buying new
- Finding used
- Harvesting or recycling

Buying New

Buying everything new is obviously the most expensive approach, at least from the *money* side of it. What a lot of people fail to take into account is that their *time* is also a very valuable commodity. Try to balance the one with the other, as befits your particular situation.

Except for the folks in the most *dreadful* of hurries, it always makes sense to shop around for the tools, equipment, and components that you are going to need in your lab. You'll find that a lot of "professional-grade" equipment carries an enormous price premium compared with "consumer-" or

"hobby-grade" alternatives. This is generally to be blamed on the fact that there is a correspondingly enormous amount of money to be made in the field of electronics.

New components are almost always more desirable to use, especially when you're looking at a production environment and you need to make sure everything produced is of the highest possible quality and reliability. New, unused components are also more appropriate when conducting complex experiments, as this helps to reduce, if not eliminate, many variables in the testing and analysis phases. You don't have to worry that someone (probably you) might have "borrowed" some parts for a quick fix or some other temporary usage and then surreptitiously replaced them back in inventory, having possibly compromised them in some unseen way.

Finding Used

A prudent way to fill up a new lab, especially when first starting out, is to look for bargains on used tools and components. This is especially true of the fixtures, shelves, cabinets, benches, and other furniture that belongs in a lab.

Tools wear out. Tools are replaced. This is a fact of life when you're in the business of working with tools. The good news is that "one man's trash is another man's treasure." If we consider the possibility of women participating, we get three more potential combinations, all of which can end up in a win-win situation.

Many used tools can be retrofitted and placed back into service in your lab. On the other hand, there are a lot of tools that are simply used up and can not feasibly be brought back into useful service. Either their repair is cost prohibitive or they are no longer supported by their original manufacturers.

Another factor working in favor of the patient and observant collector of discarded tools is the inevitable march of progress. What was shiny and top-of-the-line a year ago might be intolerable or insufficient next year, from the standpoint of the original purchaser. Many bargain opportunities arise from this simple understanding.

This can sometimes be applied to the purchase of components that have never been used, but have been sitting somewhere waiting for their chance. A commonly used phrase to describe these parts, which are often sold at a discount, is *new old stock (NOS)*. Sometimes these parts are sold this way because of overstock or because a manufacturing run was cancelled or cut short.

Harvesting or Recycling

There's an absurdly large amount of perfectly good equipment, tooling, fixtures, and components sitting out there, looking for a new home. A lot of companies, as well as individuals, either outgrow their present fittings or turn toward other interests and endeavors. This can be an excellent opportunity to acquire the furnishings you need to populate your lab.

On the other hand, please don't go crazy. You don't have to pick up every discarded appliance or chair you see sitting by the roadside. Why pay rent for something you can easily and cheaply obtain when you actually need it? Are you really wanting to pay the heating and air-conditioning bill for that box full of odd-sized capacitors that are probably past their prime? Don't fall into the trap of the *false economy* when it comes to bargain-hunting for your lab. The most important ingredient in your lab is *you*. Leave a little room to move around a bit.

Another factor to keep in mind is *shelf life*. Not all parts (or tools) last forever, especially when not being used. Batteries are the worst. You can prolong the shelf life of nonrechargeable batteries by storing them in your refrigerator, as this slows down the electrochemical processes within them that produce the electricity. Even solar panels will wear out with either constant use or constant disuse, although this can take years to happen.

Some Example Workshops

Here's a little peek into some actual electronic laboratories, each with its own personality and history. Each one grew from something small into something, well, not so small.

A Fresh Start

Harold Timmis is an electronic engineer, software developer, and author. His curiosity about how things worked started as a small child, which led him from taking apart everything in his parents' house to studying engineering at the Florida Institute of Technology.

Harold keeps a lab in his home where he can work on gadgets in his spare time. Harold recently moved, and used the opportunity to "clean house" and set up everything in his lab exactly the way he wanted things.

He took this photo of his new lab after working on a couple of projects (see Figure 1-5). Note that everything is within easy reach when sitting at the desk. It's still quite tidy, as you can see.

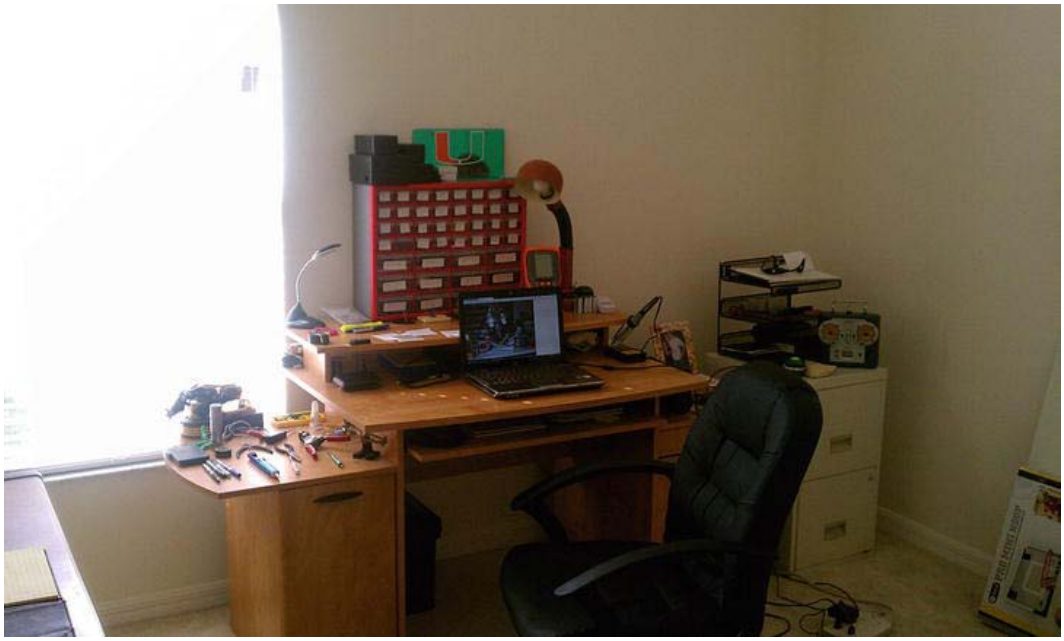

Figure 1-5. *The reorganized home lab of Harold Timmis (photo by Harold Timmis)*

The Robot Clubhouse

The Dallas Personal Robotics Group (`http://dprg.org`) is the world's oldest personal robotics group known to man. From 2002 to 2009, Mike Dodson of Modern Assemblies donated the use of a portion of one of his warehouses to DPRG. This gave DPRG a permanent home for meetings, contests, and social gatherings.

Robot builders enjoyed a spacious and comfortable area for working on robot projects, among other pursuits. Over the years, members contributed time, equipment, and lots of hard work to improving the space. The photo in Figure 1-6 shows one end of the available space, after an extensive remodeling. Several workstations along the wall are in the process of being set up. That good-looking fellow seated at the table is the author.

When Mike retired in 2009, DPRG began a search for another home.

Figure 1-6. *DPRG's world headquarters from 2002 to 2009 (photo by R. Steve Rainwater)*

A Cautionary Tale

It's relatively easy to go from a well-designed and effective lab to something, let's say, less desirable. This doesn't happen overnight, but it can happen. Let this be a warning to you about how even the best of intentions can still produce embarrassing and unproductive confusion (see Figure 1-7).

Unfinished projects and leftover parts and tools compete for the limited space available in this photo. Not only is a lot of time wasted in searching for both components and tools, but the limited space restricts the scale of projects that can be entertained.

Don't let this happen to you.

Figure 1-7. *It's not safe. It's not pretty. It's not even properly "eccentric." You have been warned.*

Summary

So now you know a little something about electricity and electronics. Hopefully this chapter has covered your very basic questions about how all this magic stuff actually works.

Now you're ready to start poking around some circuits. You're going to need the right tools for the job. Chapter 2 will get you started. You'll learn about some basic hand tools that are very useful in the lab, as well as some fairly high-tech machines that you might require in the future.

CHAPTER 2

Building Your Tool Chest

You're going to need some tools in your lab, as well as the skills to use them effectively. This chapter will get you started. If you're starting from scratch, don't worry. There's not a whole lot you absolutely *must* have to get started. Some basic hand tools and a place to keep them organized is all you will need. You don't even have to spend a lot of money at first. As you progress in your hobby, you will most likely want to add to your tool chest and upgrade some of those tools. Electronics can be the perfect hobby because it can take up (1) all your spare time and (2) all of your discretionary income. What more could you ask?

The very basic hand tools, such as screwdrivers and tweezers, are mostly self-evident in their usage. Try not to poke yourself in the eye. Where some helpful advice is appropriate, it will be given.

Here's an excellent example of a simple safety rule that will absolutely improve and extend your life: when using any kind of cutting tool, always direct the cutting motion away from yourself. For example, you might receive a package in the mail, and get all excited about opening it. You then discover it's sealed up with indestructible packing tape and can't simply be ripped open with your bare hands. Use a small knife or box cutter and make a single cut at a time, starting from the point closest to you on the package and cutting outward. Using this method, should the knife slip for any reason, the blade will travel away from you. This allows your blood and other bits to stay inside you, where they can do the most good. Never cut toward yourself.

If you've already got some tools (or even a *lot* of tools), it never hurts to review their proper usage. Also, if you're suffering from an *overabundance* of tools, to the point where you can no longer keep them organized, this chapter might help you to prioritize them, at least as far as permanent residency in your lab is concerned.

■ **Tip** Every tool in your shop must *earn* its place there. It must *deserve* to be there. *No exceptions*.

The Most Important Tool Ever

The most important tool you'll ever use is your mind. Every other tool you will ever work with depends on the correct and proper functioning of your mind. If you're careful with it, you won't misplace it, neglect it, damage it, or use it for the wrong job. Your mind is a wonderful asset when cared for properly, and a terrible liability when ill-treated.

Your mind is in many ways like a muscle. The more you use it, the stronger it gets. Learning new things does not "push out" the old things you've already learned. Your brain is capable of forging new neural pathways when challenged, and there's plenty of extra capacity in that old noggin of yours to handle whatever may arise.

■ **Tip** Try to learn something new every day.

Take care of that brain of yours. Just like you wouldn't use a dull drill bit or a rusty saw, don't try to work on electrical or electronic projects when your mind is not in the right place. Ideally, you should never try to get any work done in your lab when you are sleepy, distracted, angry, upset, medicated, or overly tired. Deal with whatever problems you're facing in a responsible manner and then get back to work in the lab.

- Are you sleepy? Take a nap or head off to bed for the night. Really bad mistakes are made when the brain does not get enough sleep. Sleep deprivation is notorious for being obvious (and obnoxious!) to everyone else except you. "Really bad mistakes" made while working with electrical or electronic projects can produce very hazardous conditions for you and everyone around you, such as fire, damaged equipment, injuries, and even death.
- Are you angry or upset? Then your mind is not going to be adequately focused on what you need to do in the lab. "Fools! I'll destroy them all!" are famous last words *for a reason*. Give yourself some time to calm down from whatever has angered or upset you. Also, it's OK for you to give yourself permission to admit that you are angry or upset about something in the first place. Ignoring it probably won't make it go away, and probably won't make your feelings about it go away, either. Walk away, count to ten, or whatever works for you.
- Feeling distracted? Then now is *not* the time to be conducting electronic experiments in the lab. You need to be *present* in the lab, both bodily and mentally. There are just too many ways to make simple blunders that have far-reaching and sometimes overly expensive consequences.
- Have your cognitive functions been compromised? This can happen from taking certain medicines or even recreational intoxicants. If the little bottle says, "Don't operate machinery or drive an automobile," then you probably shouldn't be making important decisions or working with dangerous circuits in your lab, either. Wait until you're clear-headed enough to proceed with your plan for world domination, adding blinking eyes to a plush doll, or what have you.

The worst thing about cognitive impairment is that the first thing that gets impaired is the ability to judge the level of your cognitive impairment!

Care and Feeding of Your Brain

Here are a few tips to keep your brain (and the rest of you) in good working order:

- Stay hydrated. Drink more water than you think you need. This might result in more trips to the bathroom, but this is much more desirable than the alternative. A good flow of water through your systems helps your body feed and repair itself, as well as aiding in the elimination of toxins. Drink more water.
- Avoid excess consumption of coffee, tea, sodas, and especially "energy" drinks. These contain ingredients that stress both your body and your mental capacity. They do not contain energy, but trick your body into going into overdrive by triggering a stress reaction.
- Take frequent breaks. Get up and walk around, if possible. Raise your arms over your head and hold them there as you count to ten. This redirects blood flow and helps restore a balance within your peripherals.

All Those Other Bits, Too

Just as your mind is the most important tool you'll ever use, the rest of your bodily bits and personal pieces are vital and important in your work in the lab. For the most part, there are no spare parts laying around for things like your eyes, your ears, your hands, or your skin.

Should you wear eye protection in the lab? Yes, you should. Are you always going to do so? Probably not. It's true, it can be inconvenient or perhaps a tad uncomfortable. Consider the cost, however. Even the tiniest scratch on your eyeball can take weeks to heal and leave you susceptible to infection or vision loss. It's just not worth it to be lazy. Ask the next one-eyed person you see. If you're a bit uncomfortable asking one-eyed people, "Hey, what's with the one eye?" then perhaps you can just try to imagine them advocating or encouraging you along the same path they took, whether intentionally or accidentally. They won't do it.

Invest in quality eye protection that is comfortable and properly sized for you. Provide eye protection for visitors to your lab as well, if they will be present when soldering, welding, machine tooling, or wire clipping is being performed. Then invest in the habit of wearing your eye protection whenever it is appropriate.

■ **Note** Don't pretend that your prescription glasses with polycarbonate lenses are "safety glasses." They aren't. They do not protect either your eyes or your face from impact or objects entering from the side, as proper safety glasses should. If you usually wear glasses, use safety glasses that comfortably accommodate your glasses when worn.

Will you be working with really loud noises? These could be from powerful audio amplifiers ("it goes to 11") or power tools. Hearing loss from exposure to excessively loud noises is cumulative. This means it slowly (or suddenly) chips away at your hearing, bit by bit. Why do you think old people turn up the TV so loud?

Hearing protection is both affordable and comfortable. For temporary protection, you can use disposable earplugs. If you need protection all day, consider earmuffs designed for hearing protection. Don't let "Hey, y'all, check this out" be the last thing you ever hear.

It's hard to work with hand tools with no hands. It's possible; just really hard. Take care of your hands. There are a hundred ways to burn, tear, cut, or otherwise mangle those mitten-fittings of yours. Have a variety of work gloves on hand to handle the different needs of your lab. The choice will be ultimately determined by the particular hazards present in your lab. Are you working with chemicals as well as electronics? How about sharp edges or glassware? Normally, you won't need to wear gloves for soldering small electronics, but if you start working with really large-scale projects, such as sculptures or plumbing, you might.

Make sure you are still "handy" when wearing the proper gloves for the job. Make sure the gloves fit you properly and allow you the adequate dexterity you need.

■ **Tip** Be safe. Don't be lazy.

Basic Hand Tools

Assuming that you're going to start small and build toward bigger things, you should also start small with some small hand tools. These tools will make it much easier to work on small parts and wires.

Good hand tools increase your effective strength and improve the accuracy and precision of your motions. They allow you to focus a great deal of your strength on exactly the part that needs it, without wasting a lot of effort. Good hand tools also insulate you from sharp, hot, or otherwise unpleasant objects when you work on them.

Take care of your hand tools. Put them up when you're done with them. Make sure they are clean and ready to be used again the next time you need them. Few things are more frustrating than attempting to start a quick repair job and finding out that you need to spend twice as much time preparing your tools for use.

Have some sort of methodical plan or reasoning involved with the storage of your tools. They need a safe and comfortable home, just like you do. You need to be able to find them quickly when you want them. Try out different organizational strategies until you find one that works for you and your lab. This is an easy task when you have just a few tools to organize. Once you've accumulated a large collection of hand tools, this is no longer optional. You *must* know what tools are available and where they are located.

Frequently used tools should be within easy reach of your primary workstation. If your tools need any sort of adjustment or setup before use, make sure you've got all the proper bits handy. For example, a drill press will often have a chuck key used to tighten and loosen the chuck that holds a drill bit in place. That key needs to be in the immediate vicinity of the drill press, as well as easy to locate. Don't spend a lot of time needlessly hunting for tools. Decide for yourself on some safe and practical policies for where you keep your tools.

■ **Tip** Don't waste time guessing where your tools are located. *Decide* where they are located.

Just like everything else, hand tools have a limited useful lifetime. While some tools can easily outlast you, it's up to you to keep track of exactly how much utility you can continue to expect from your tools. This doesn't mean that you have to trash your hand tools once they develop some tiny flaw. If it's beyond your capabilities to repair the tool, then consider replacing it and reassigning it to the second string or backup tool chest. Having a spare tool, even a slightly imperfect one, on hand when you need it can make the difference between success and failure in a project.

Bear in mind, however, that some tools are simply too dangerous to keep around once they've outlived their useful life span. A dull cutting tool that cannot be reasonably resharpened is a good example of a tool that has lost its honored place among your other tools. Thank it for its service, wipe away that little tear, and then figure out a good way to recycle any of its bits that are still functional.

Wire Cutters and Wire Strippers

As you might have picked up from Chapter 1, you can spend a lot of time working with wire in this hobby. Understanding a little bit about how wire is made and how it functions in a circuit will aid you in your experiments.

How Wire is Made—The Very Short Version

Most wire is made of copper or a copper alloy. Some wire used for electrical wiring in houses is made of aluminum. The wire itself starts out as a fairly thick strand and is stretched and pulled—a process called *drawing*—until the desired diameter is obtained. This strand is then wrapped up on spools or bobbins.

- Some wire is made of a single strand of copper (or aluminum). This is called *solid-core* or *single-strand* wire. It is a single strand of wire, usually circular in cross-section.
- Multiple, thinner strands of wire are often bundled or twisted together to make larger-diameter wire. Stranded wire is much more flexible than solid-core wire, but is more expensive to produce because of the extra manufacturing steps required. Because stranded wire has a larger surface area per unit of length, it is more susceptible to environmental hazards such as corrosion.

Most electrical wire is covered with an insulating jacket, usually made of plastic or rubber. This sheathing must be removed to make electrical connections. There is sometimes more than one layer of insulation on a wire, depending on what its final application is destined to be.

More information about wire as a *component* will be presented in Chapter 3. For now, the emphasis is on the characteristics of wire that help determine the best tools to use when working with wire.

Selecting the Correct Tool

Both copper and the aluminum alloys used for electrical wiring are fairly soft metals and can be easily cut or formed with simple hand tools. Wire *cutters* are specialized tools made to make a clean cut through the wire's strand or stands. Wire *strippers* are another kind of specialized tool used to remove the insulation from a wire.

Figure 2-1 shows two rows of commonly available wire cutters.

Figure 2-1. *Commonly available wire-cutting tools. The top row shows three styles of diagonal cutters, which are the preferred tools for cutting small-gauge copper wire. The bottom row shows some tools that offer wire cutting as a secondary facility, and should only be used when proper wire cutters are not available.*

The top row of cutting implements in Figure 2-1 are various forms of what are known as diagonal cutters, side cutters, or flush cutters. These cutters have beveled cutting edges that meet in the middle of the wire being cut. One side of the cutters is flat, or *flush*, allowing wires to be cut with some precision. These are the preferred cutters for small-gauge copper wire, as well as for clipping excess component leads from a printed circuit board (PCB). See Figure 2-2.

Compare the cutting action of the side cutters to the other, less optimized wire cutters in the second row of cutters in Figure 2-1. These cutters either use a shearing action to cut the wire or include a flush-cutting area as a secondary feature.

Figure 2-2. *A close-up look at the business end of a pair of side cutters. When the two cutting edges meet in the middle, the bottom side is flat, or flush, allowing the user to get quite close to where a wire or component lead emerges from a solder joint.*

Use caution when clipping component leads or small wires with any wire cutters. The cut lead can easily fly away at sufficient velocity to poke you right in the eye or other sensitive area. If possible, hold *both* ends of a wire being cut or direct the cut leads *away* from your face.

■ **Caution** Use eye protection when clipping leads. Don't say you weren't warned about this hazard.

Wire Strippers

Wire strippers are tools that allow you to easily strip the nonconductive insulation from wires. You can try chewing it off with your remaining teeth, but this is not recommended.

Wire strippers usually consist of a pair of hinged blades with some sort of machined notch. The notch allows the blades to cut the insulation around the wire without cutting or nicking the underlying conductor. A good example is shown in Figure 2-3.

Figure 2-3. *The popular T-Stripper combination wire cutter and stripper tool from Ideal Industries has been around for over half a century. Note the wire gauge sizes stamped into the face of the cutter blade. New models feature laser-engraved text.*

The wire strippers in Figure 2-3 can easily strip the insulation from wires with a conductor diameter, or *gauge*, between 16 (0.0508" or 1.291 mm) and 26 (0.0159" or 0.405 mm). The higher-numbered wire gauges represent *smaller*-diameter wires. Once upon a time, the gauge number represented the number of *drawing* operations that were performed on a wire when being manufactured. The more times it was drawn through the processing equipment, the thinner the wire became. Today, the wire-manufacturing industry in the United States and Canada has adopted the American Wire Gauge standard (AWG). See Table 2-1.

Table 2-1. *The AWG. A more complete listing is available at http://en.wikipedia.org/wiki/American_wire_gauge, from which this partial list was obtained.*

AWG	Diameter Area			Copper Resistance	
	Inch mm		mm^2	Ω/km mΩ/m	Ω/1000 ft mΩ/ft
0000 (4/0) 0.46 00		11.684 107		0.1608	0.04901
000 (3/0)	0.4096	10.404	85.0 0.20	28	0.06180
00 (2/0)	0.3648	9.266	67.4 0.25	57	0.07793
0 (1/0)	0.3249	8.252	53.5 0.32	24	0.09827
1 0.28	93	7.348	42.4 0.40	66	0.1239
2 0.25	76	6.544	33.6 0.51	27	0.1563
3 0.22	94	5.827	26.7 0.64	65	0.1970
4 0.20	43	5.189	21.2 0.81	52	0.2485
5 0.18	19	4.621	16.8 1.02	8	0.3133
6 0.16	20	4.115	13.3 1.29	6	0.3951
7 0.14	43	3.665	10.5 1.63	4	0.4982
8 0.12	85	3.264	8.37 2.06	1	0.6282
10 0.10	19	2.588	5.26 3.27	7	0.9989
12 0.08	08	2.053	3.31 5.21	1	1.588
14 0.06	41	1.628	2.08 8.28	6	2.525
16 0.05	08	1.291	1.31 13.1	7	4.016
18 0.04	03	1.024	0.823 20.9	5	6.385
20 0.03	20	0.812	0.518 33.3	1	10.15

22 0.02	53	0.644	0.326 52.9	6	16.14
24 0.02	01	0.511	0.205 84.2	2	25.67
26 0.01	59	0.405	0.129	133.9	40.81
28	0.0126 0.32	1	0.0810 212.	9	64.90
30	0.0100 0.25	5	0.0509 338.	6	103.2

We'll return to this table again in Chapter 3 when the electrical properties of wire are discussed. For now, note that as the wire gauge number goes *up*, the wire's physical diameter goes *down*. Similarly, as a conductor's physical size goes down, its ability to carry current also goes down, and its electrical *resistance* goes up.

■ **Note** Other standards exist throughout the world. Steel-wire manufacturers use a different scale, as their interest is more on the tensile strength of the wire, not its electrical properties.

Note that the AWG is for single-strand copper wire. Equivalent gauges in stranded wire are physically a bit larger, although they have the same effective cross-sectional area and can carry the same amount of current.

When using wire strippers, keep in mind that your goal is to cut and remove only the nonconductive insulation from the wire, leaving the internal conductor intact. Even a small nick can result in a weak point in the wire, both electrically and mechanically.

Practice Makes Perfect

The best way to attain proficiency with a new tool is with practice—lots and lots of practice. This is true for working with your hands as well as with that big brain of yours. Ideally, any task worth doing will involve at least a little bit of both manual dexterity and focused brain power.

Cutting and stripping wires is an excellent example. For your first practice assignment, spend some time turning long, beautiful lengths of wire into little bits of wire with stripped ends.

CUTTING AND STRIPPING WIRE

For this exercise, you're going to need the following:

- Wire cutters
- Wire strippers
- Much wire
- A comfortable, well-lit location

Cut the Wire into Segments

Don't watch TV or be otherwise distracted. Pay attention to what you are doing.

Begin by cutting the wire into various-sized segments from 2" to 6" in length. Accuracy in length is not critical at this point. You need to get a good feel for your wire cutters and how much force is needed to cut the wire, without cutting yourself or others.

Collect the cut wire segments into a bowl or small container for the next step.

Strip the Wire Segments

Using your wire strippers, remove about 1/4" (6 mm) of insulation from both ends of each wire. Try not to cut or nick the wire core. The insulation that you remove can either be discarded or collected for use in some sort of art or craft project.

Once you've completed the cutting and stripping portion of this exercise, sort the wires according to their length, or their color if you used different colors of wire. Compare the quality and consistency of your work by looking at the first few wires and the last ones you did. Do you see any improvements in your work?

If you spend about an hour working on your wire-cutting and wire-stripping technique, you will perhaps master a skill that will prove useful for the rest of your life, as well as prepare a big pile of wires that you can use in many of the sample projects illustrated in this book.

Pliers and Tweezers

Every day, the size of the "typical" electronic component gets smaller and smaller. This miniaturization process has brought about a world where you can carry a phenomenally powerful computer in your pocket, and sometimes even make phone calls with it. The individual transistors, resistors, capacitors, and other components inside such modern marvels are literally microscopic in size. You need a fairly powerful microscope to be able to see them at all.

In your typical home electronics lab, and even in many professional labs, you will not be dealing with these tiny things, except as large clumps all tied together inside a chip or other framework. Still, the typical components you will use are often a bit too small for all but the tiniest of fingers. That's where pliers and tweezers come into play. They are an extension of your own hands and fingers, increasing your precision and allowing you to perform delicate tasks with tiny parts.

There are several types of pliers and tweezers that you may use on a daily basis in your lab. See Figure 2-4.

Figure 2-4. *Pliers and tweezers aid in working with small parts. On the left is a pair of needle-nosed pliers with cushioned grips and leaf springs. In the center is a pair of slip-joint pliers that can be adjusted to accommodate two different ranges of gripping action. On the right is a pair of needle-sharp tweezers, which can be used to pick up and place even the tiniest of electronic components—if your hand is steady enough!*

Screwdrivers, Nut Drivers, Wrenches, and Ratchets

A lot of electrical connections can be made using only a screwdriver. Figure 2-5 shows an electrical connection using a *barrier strip*. A specialized connector is crimped onto the end of the wire and held in place with a screw. A variety of crimp-on connectors are available and should be installed using the appropriate tool, as indicated by the connector's manufacturer. Just smashing the connector onto the wire with some pliers is not recommended.

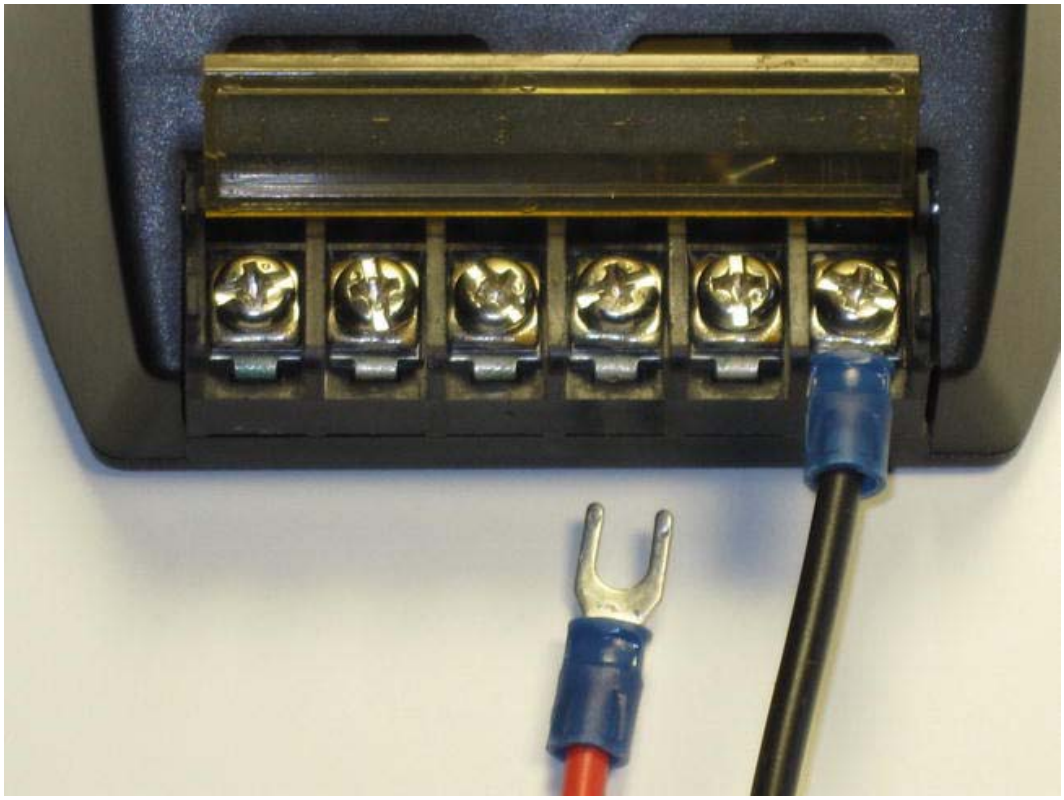

Figure 2-5. *A barrier strip on a low-cost solar-charge controller. No soldering required! The specialized connector is held in place with a screw. The connector is affixed to the end of the wire by deformation using a specially designed crimping tool. You can see the indentations in the insulating collar around the connector.*

Another type of connector that is tightened with a screw is called a *terminal block*. Unlike a barrier strip, no specialized connector is required on the wire. You can simply insert a stripped wire into the terminal block and tighten the connector using a screwdriver. Try to strip the wire only enough to allow the bare conductor to enter the terminal block, without leaving any noninsulated wire exposed that could accidentally short out against another wire. See Figure 2-6.

Figure 2-6. *A terminal block uses a screw for tightening the connection with a bare wire.*

Besides being useful for making electrical connections using barrier strips and terminal blocks, screwdrivers are also quite handy in their original function, which is to tighten and loosen mechanical fastening devices such as screws and bolts. See Figure 2-7.

Figure 2-7. *A variety of screwdrivers. The four on the left are standard, or straight-bladed, screwdrivers. The three on the right are Phillips-style screwdrivers. Other specialty bits are also available.*

You should only use screwdrivers to drive screws and bolts. Don't try to use them as levers, pry bars, chisels, punches, or other tools. When you need a chisel, use a chisel. Keep your screwdrivers clean and dry. Put them back where they belong when you're done with them. You get to decide where they belong.

Screws, Bolts, and Nuts

There are a *very* large number of different kinds of screws and bolts. Some screws, such as wood screws, are made to be driven directly into wood and create their own threads in the material as they are installed. Other screws, largely referred to as machine screws, mate with a premachined or tapped hole, or a machine nut.

Nuts are often shaped with four or six sides that allow them to be held in place while the screw is turned. Alternately, the nuts themselves are turned while the screw is held in place. Some screws and bolts have a similarly shaped head that allows them to be turned with a wrench or nut driver instead of a traditional screwdriver.

Please resist the urge to overtighten screws and bolts. The mechanical advantage gained by the inclined plane of the screw thread multiplies the force used to turn the screw into a terrific amount of pressure on the screw itself. You can easily damage either the screw or the threads in the material to be fastened by overtightening a screw.

More Specialized Hand Tools

A good set of wire tools, pliers, and screwdrivers will go a long way when working with electronics. However, sometimes you need a more specialized tool for more specialized work.

Here are some of the more common tools that are a little more focused on a particular task than they are for general-purpose usage.

Wire Crimpers

As mentioned previously in this chapter, you can make solid electrical and mechanical connections using barrier strips and specially terminated wires. The optimized connectors used for this purpose require optimized tools for best performance.

Figure 2-8 depicts some examples of specialized crimp tools for electrical connections.

Figure 2-8. *Some common crimping tools for affixing electrical connectors to wire*

Referring again to Figure 2-8, the crimpers on the left are for crimping tiny pins to the ends of tiny wires that are then inserted into plastic connector bodies. The center crimp tool is for crimping modular jacks onto telephone cables. It also includes a wire-cutter blade (bottom) and a pair of controlled-depth stripper blades for removing only the outside layer of insulation from silver-satin flat telephone cord, without disturbing the individually insulated wires contained within. The crimp tool on the right features a ratcheting action that increases the crimping force applied to the connectors. This is the tool used to crimp the connectors show previously in Figure 2-5.

Computers

You might not think about computers as being "power tools" in your toolbox. As the size of computers, laptops, tablets, and smart phones decreases, and their computing power, networking ability, and storage capacities increase, they become much better candidates for use in the lab.

Traditional "desktop" personal computers (PCs), laptops, netbooks, and tablets can perform multiple roles in your laboratory setting. If you are lucky enough to have Internet access on your computer, it can become a conduit for all types of useful electronics information, in addition to its more accepted role as a source of funny cat videos. See Figure 2-9.

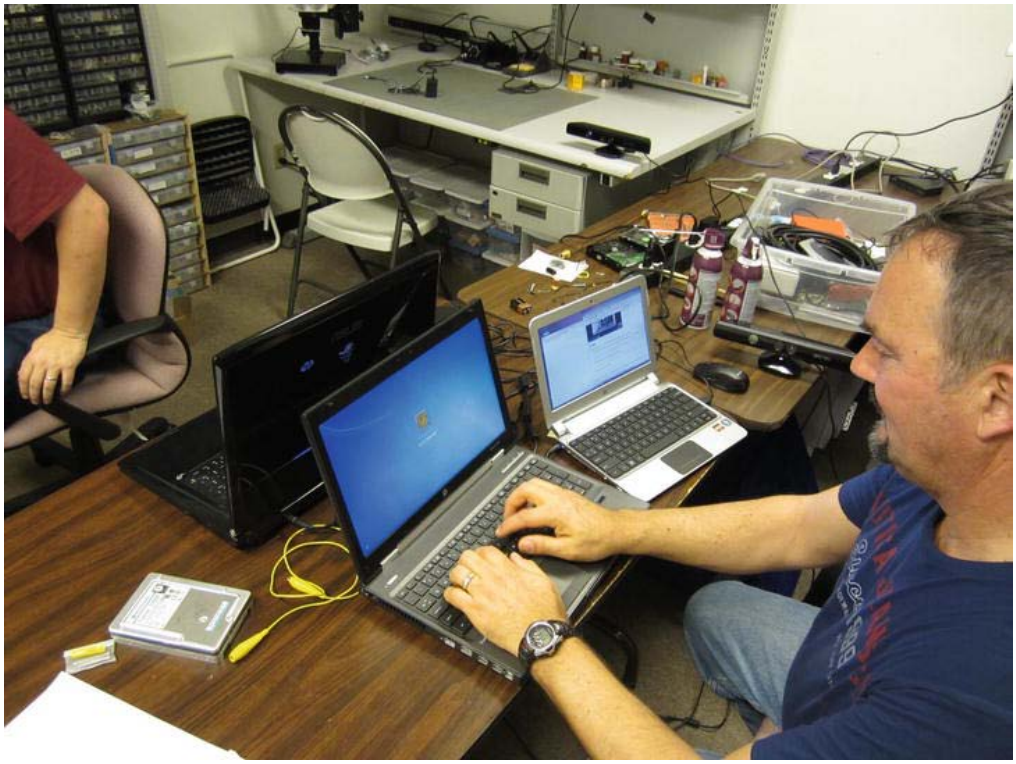

Figure 2-9. *Computers being used in the lab. Paul Bouchier of DPRG uses two laptops at once when testing new robot software with the Microsoft Kinect (just to the right of his mouse).*

Here are just a few of the many possible areas of practical knowledge, learning opportunities, and bits of interesting information that you can access using your computer:

Data sheets: Almost all electronics manufacturers provide online access to a library of technical data sheets and application notes for their products. These should be your first choice for information about how and when to use their products. These sources also contain important product *errata*, which contains corrections and updates for products that have been made since their first publication.

Online tutorials: The Web abounds with detailed and thought-provoking tutorials and background information on every topic imaginable, including, not surprisingly, mountains of information on computers and electronics.

User forums: People tend to cluster around others with similar interests. Once upon a time when people where geographically limited and unable to communicate or interact with folks around the world, this severely restricted a lot of the more specialized areas of knowledge. Today, you can find user groups centered on every conceivable human endeavor (and some inconceivable ones, too) that are filled with helpful, knowledgeable members that are more than happy to answer questions and share experiences with you. Do try to be courteous, respectful, and fair when asking for help with your projects, and always try to repay in kind by helping those with similar questions that you've had to master.

Sharing/collaboration web sites: As the cost and complexity of publishing your work on the Internet becomes more manageable, it becomes faster and easier to let others know about your progress, as well as your problems. You can easily set up your own web page for little or no cash, or join many of the available user groups that allow their members to post, browse, and otherwise benefit from the works of other similarly minded individuals.

Design tools: You can find many free or reasonably priced electronic design and simulation tools online. Some manufacturers also provide free tools specifically for optimizing designs for their products.

Online suppliers: Where you once had to walk (or drive) down to the store and see what was available in your area as far as electronic components and tools went, now you can browse through the catalogs of suppliers from all over the world, from the comfort of your own lab. Not only does this provide a much larger field from which to choose, it also levels the playing field, so to speak, forcing worldwide competition for your hard-earned cash. Bonus: Some manufacturers offer a limited numbers of free samples. Yip!

This list only scratches the surface of the kinds of information you can access using a computer. You can also use a computer as part of your electronic projects, and several examples of doing this are included later in the book.

Tools for Soldering

You don't have to learn how to solder to work with electronics, but it helps. It really does. It opens a whole new world of possible projects, repairs, and custom modifications to existing equipment. Just remember, as always, to keep your work area clean and safe. See Figure 2-10.

Figure 2-10. *A Weller controlled-temperature soldering station. What a mess!*

Like any worthwhile skill, soldering is best mastered with lots and lots of practice. The best way to learn this useful skill is to have someone show you how it's done. It's difficult, but not impossible, to learn proper soldering techniques from a book. That being said, have a look at Figure 2-11.

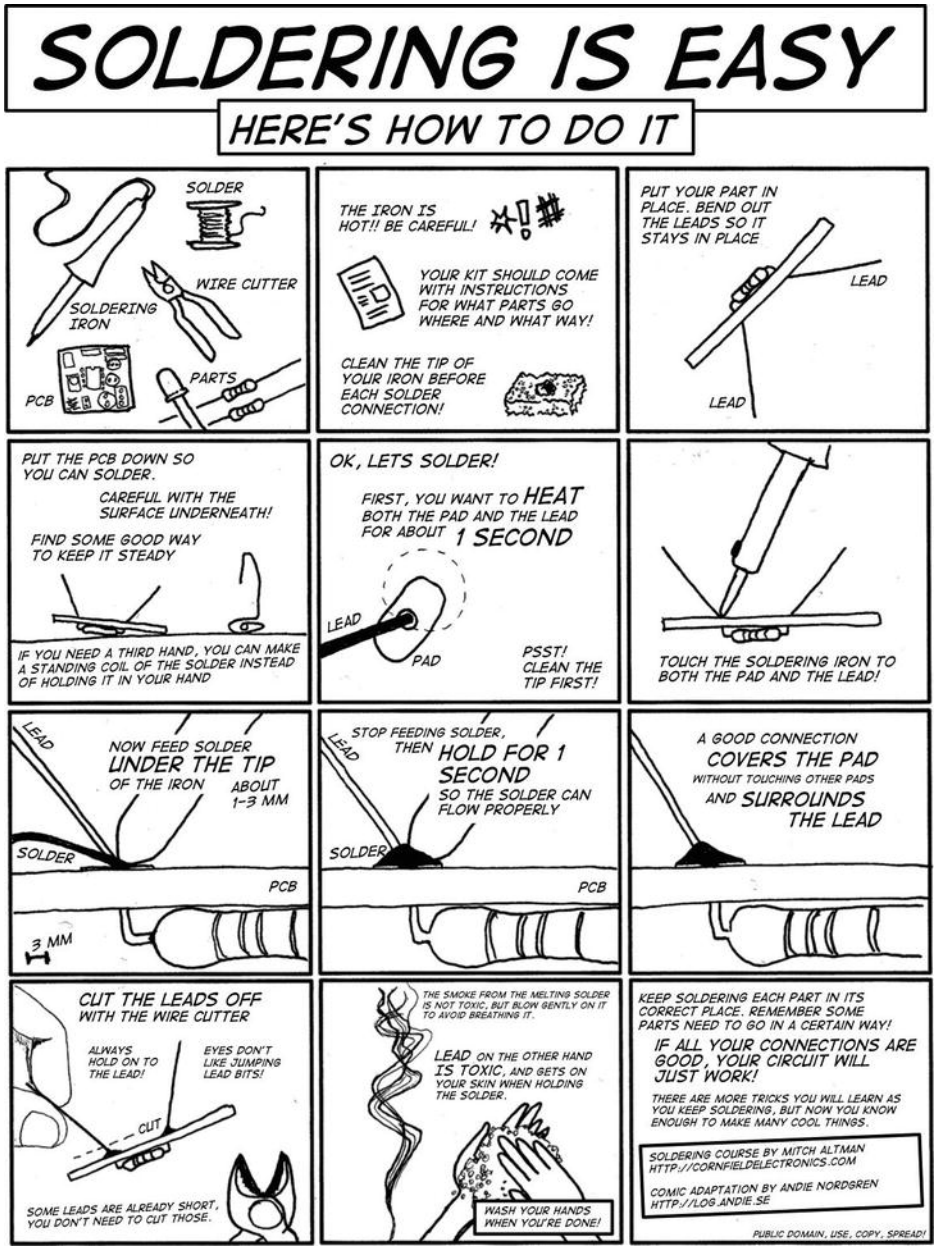

Figure 2-11. *Instructions for soldering. This delightful illustration by Andie Nordgren captures the basics of soldering as taught by soldering guru Mitch Altman (http://log.andie.se/post/397677855/soldering-is-easy).*

To solder, you will need a soldering iron. You will also need some solder and probably some wire cutters. That's just the tip of the iceberg, however. Like any good tool, your soldering station will soon accumulate many *accessories* to enhance your soldering prowess.

To begin your soldering adventure, you will need a *small* soldering iron, some solder, and a damp sponge. The big, pistol-grip style of soldering irons are for much larger projects, such as plumbing. Ideally you want something in the 15W to 50W range. See Figure 2-12.

Figure 2-12. *The pencil-grip style of soldering irons is better suited for working on small electronics projects.*

The soldering iron in Figure 2-12 has a replaceable, conical tip. These tips are generally interchangeable for a particular model of soldering iron, but unfortunately not interchangeable between different models or manufacturers. Different tip shapes are also available, depending on what types of things you're wanting to solder.

The tip is usually made of copper, which is an excellent conductor of heat. Since copper really likes to combine with other metals at high temperatures (which is exactly what happens when soldering), most tips are coated in a thin layer of steel to give them much longer useful lifetimes. Tips still wear out, however, and should be replaced.

In this particular soldering iron, the next part of the iron is the removable barrel that holds the tip in place. This barrel is where the heating element is housed, so remember that it is just as hot as the tip! Try not to touch it. You will probably not want to make that mistake more than once.

The next section is the padded and insulated handle of the soldering iron, which is made of dense plastic foam. A quality soldering iron will be comfortable in your hand and won't produce excessive fatigue, even after hours of use. Lower-quality and lower-priced models will more rapidly take their toll on your hands.

Not shown in Figure 2-12 is the flexible power cord running back to the soldering iron's base. This cord supplies the electrical power that is converted to heat in the barrel, as well as some wires for a

temperature sensor. This allows the unit to control the temperature of the tip with great accuracy. Note the temperature dial in Figure 2-10. Lower-cost units omit the temperature control features and run at a constant power output.

It will take some amount of time for the soldering iron tip to reach a working temperature. Likewise, it will also take some time to cool off once you've turned off the soldering iron.

■ **Caution** Soldering irons are very hot in use and can cause painful burns. Always treat them with respect!

The solder you use will be determined by what kind of soldering you want to do. For most small, electronics-related soldering projects, a small-gauge tin-lead or lead-free solder can be used. Bear in mind that lead is a poisonous material that slowly accumulates in your system, should you come into contact with it, as your body has no good way of eliminating it. Wash your hands before and after soldering, just to be safe.

Soldering works best when everything being soldered is sparklingly clean. To help facilitate this cleanliness, chemical compounds known as soldering rosin are used. These compounds chemically clean the surfaces being soldered when exposed to high levels of heat. Some types of solder have rosin incorporated into them. You can also obtain rosin as a paste into which you can dip wires and component leads before soldering. Other types can be applied with a dispensing pen.

■ **Caution** Don't breathe the smoke emitted during the soldering process. If possible, use a fan or fume extractor to redirect the soldering fumes away from you.

Once your soldering iron is up to its proper operating temperature, clean the tip by wiping it gently on a damp sponge. Your tips will last longer if you resist the urge to clean them before replacing the soldering iron in its holder. Even though it seems counterintuitive to "put it up dirty," this will more than double the life of your soldering iron tips. Just be sure to clean the tip *before* you solder anything.

Power Tools

Everybody loves power tools, don't they? Sometimes it's enough to just *imagine* that you might need one to justify a trip to the store and subsequent purchase. While this may be human nature (or perhaps only the nature of one particular gender), it doesn't fully justify having one of each in the lab, *just in case*.

Drills and Drill Bits

You will, however, find a few particular tools to be especially useful in your lab. A good hand drill or drill press is one of those tools. There seems to be no end of things electronical that need a few more holes drilled into them. Electronic enclosures and control panels need good, clean holes drilled into them. If you make your own PCBs at home, you will find that they need *lots* of holes drilled into them.

Like any power tool, an electric drill needs and deserves your respect. You'd be surprised how much unintentional damage you can cause with such a simple device. Observe these simple safety rules when operating a power drill:

- Keep your work area clean and well illuminated.
- Remove any watches or jewelry you might be wearing.
- If you have long hair, keep it pulled back and tied out of the way.
- Always clamp down any work to be drilled on a drill press.
- Always remove drill bits from the drill chuck after use.
- Discard dull or rusted drill bits that cannot be resharpened.
- Always wear safety glasses when operating power tools.

Hand drills come in all shapes, sizes, and price ranges. Some are powered by hand cranks and some are electric. Rechargeable batteries make for very portable drills that you can carry almost anywhere. See Figure 2-13. The only drawback is their limited charge time. That's why you should always have at least one spare battery charged up and ready to go. Electric drills with wires attached don't have this problem. Just don't trip over the cord!

Figure 2-13. *A rechargeable hand drill. This model is both variable speed and reversible, which are two very desirable features in a hand drill.*

■ **Note** Power drills are also very handy when used with screwdriver bits. They can save you time and many blisters!

Drill bits likewise come in all sizes and shapes. You can buy sets with a variety of sizes, and these will usually come with a handy storage container that conveniently labels all the sizes for you. This only works, however, if you take the time to return the drill bits to their proper location once you've finished working with them.

A drill press has a large frame that facilitates drilling a precisely aligned hole, over and over again. You can make spindle-speed adjustments to drill presses (even small ones, such as the one pictured in Figure 2-14) either through an electronic speed control or by changing up the belts and pulleys that drive the spindle. There are even small frames for mounting handheld drills or rotary tools, such as the Dremel brand of tools. You can often, however, find actual, dedicated drill presses on sale for about the same price as the daintier Dremel tools.

Figure 2-14. *A small tabletop drill press*

■ **Caution** When working with drills and presses, always keep your work area clear. Always wear safety glasses when using power tools. Try to keep the chuck key handy. Don't leave drill bits mounted in the chuck when not in use. Many chuck keys have built-in springs that prevent them from remaining in the chuck. Those that don't risk being accidentally left in the chuck when the drill its turned on, which can either fling the chuck across the workshop or make a big mess of your favorite hands.

Laser Cutters and 3D Printers

While not everyone can afford some of the more expensive and esoteric tools that are available, some of these tools are getting more popular than others; excellent examples are laser cutters and 3D printers. See Figures 2-15 and 2-16.

Laser cutters and engravers use a powerful carbon-dioxide laser to cut through wood and non-chlorine-based plastics. The laser beam is focused onto the work surface using mirrors that are mounted in an XY gantry, allowing the cutting area to be controlled by a computer. Typical installations require venting to the outside because of the various aromas produced in the process, as well as a water-cooling system for the laser tube itself.

There are also some newer laser cutters being built by hobbyists from scratch.

Figure 2-15. *A laser cutter. A powerful 40W carbon-dioxide laser is used to cut through wood and non-chlorine-based plastic, all under computer control. It can also be used as an engraver. This model is manufactured by Full Spectrum Engineering.*

3D printers seem to be all the rage these days. We're all pretty accustomed to the idea of printing on paper with a computer, although it's still a pretty recent innovation, as far as the history of printing goes. The idea of printing a solid object, on the other hand, is considered to be something of a game-changer.

The simplest 3D printers use a plastic extrusion and a motorized gantry to operate as a kind of a robotic glue gun. A plastic filament is fed into a heated fixture that is moved around a print bed, leaving a trail of cooling, gooey plastic. Either the extruder or the print bed is moved using motors under computer control to build up a layer at a time of the desired object.

Higher-technology 3D printers use this and other techniques to produce tangible, solid objects. Some use layers of fine powder that is glued together with a binder dispensed from a print head, similar to an inkjet printer. As each layer is printed, the object is lowered and another layer is deposited. This can even be done with sugar, as in the case of the CandyFab 4000, designed by the clever folks at Evil Mad Scientist Laboratories (`www.evilmadscientist.com/article.php/candyfab`). A stream of heated air is used to fuse a layer of sugar into a single solid structure, and an object is built up of successive layers.

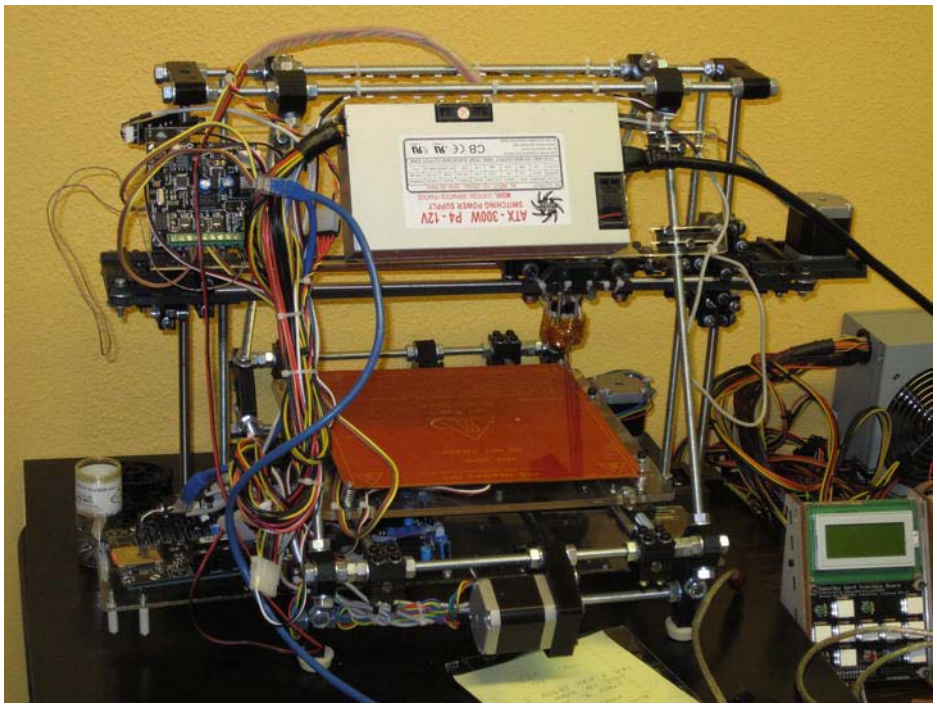

Figure 2-16. *A 3D printer at Dallas Makerspace. This machine uses a heated extruder to build 3D objects out of plastic.*

Basic Test and Measurement Equipment

When it is behaving itself, electricity is generally invisible. To "see" what it is doing, or not doing, you will need some specialized tools. These fall into the two general categories of *test* and *measurement* equipment.

The line between testing and measuring is sometimes blurry. One possible distinction might be that testing verifies proper operation within acceptable parameters, while measurement actually assigns

values to those parameters. An example of testing is, Does that flashlight work? The answer is yes or no, arrived at by the simple expedient of turning it on and observing the results. An example of measurement is, How much current does that flashlight draw? The answer might be 0.78A, and this would be determined using the appropriate measurement device, which in this case could be an ammeter.

Inspection Equipment

Sometimes, however, measuring things isn't hard at all, especially when the things being measured are actual, tangible items that you can hold in your hand. What you will need are some basic tools, primarily to be able to *see* what it is that you are measuring, and secondarily to take accurate measurements of them, at least in regard to their physical dimension. This comes in very handy when trying to identify components during repair or equipment upgrades, when the original technical documentation is not at hand.

Even the youngest and finest of eyeballs will need help with the teeny-tiny components that are available nowadays. You should try to find at least a small magnifying glass to examine fine details. If your budget allows, you might want to consider a microscope of modest power to look at your handiwork. Careful shopping will result in finding some older microscopes at bargain prices. Expect to pay a premium price for the shiny, new stuff. See Figure 2-17.

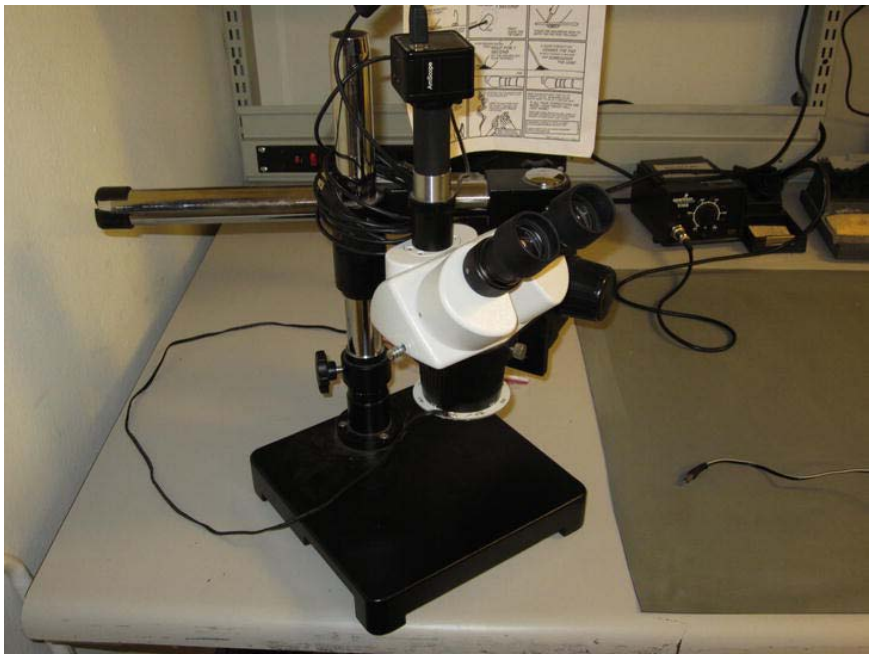

Figure 2-17. *A very nice stereo microscope. The power cord running to the white ring (partially hidden) supplies power to a ring of white LEDs that help illuminate the field of view. The base is very heavy to help stabilize the microscope.*

Even a humble magnifying lens can be very helpful in the lab, especially if it has a built-in light. See Figure 2-18.

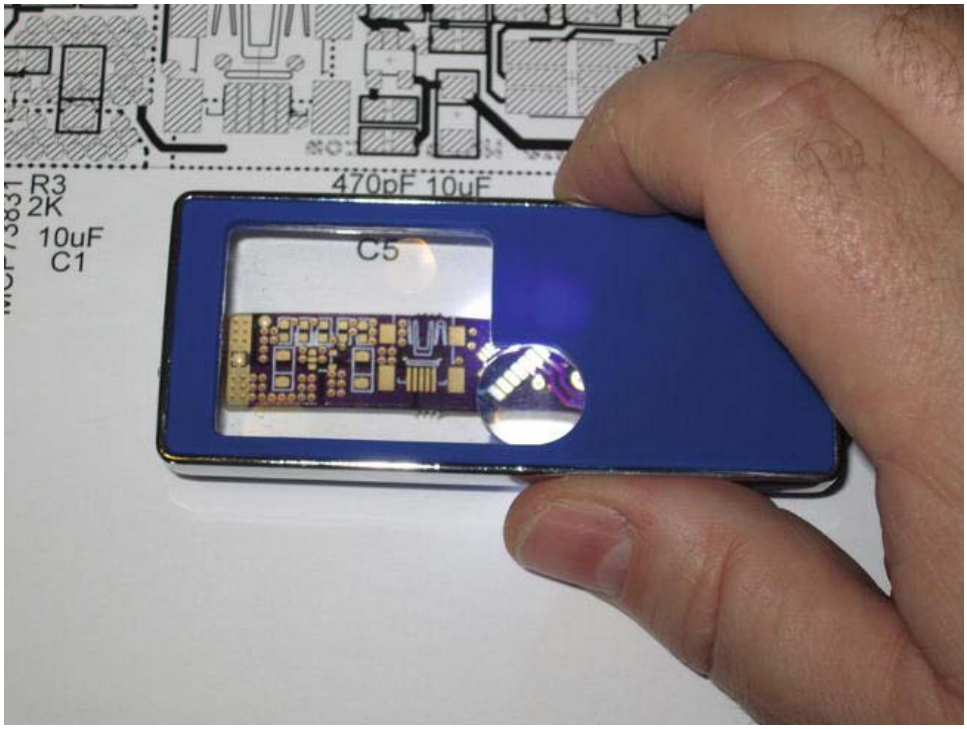

Figure 2-18. *A small, handheld magnifier with a built-in LED light is very handy for examining small features and details, such as are found on many PCBs.*

Physical Measurement Devices

Once you know what something looks like, at extreme close-ups, can you describe in absolute terms how big it is?

Take a look at Figure 2-19. Here we have, from the top to the bottom, a traditional tape measure, marked in both English and metric units (fractional inches and decimal centimeters), a digital caliper that can render measurements in either system at the touch of a button, and an architect's scale. While it may not be evident in the top-down view, the architect's scale is triangular in cross-section, resulting in not two but *six* different measurement options. This is mostly due to architects liking to draw things to scale, instead of full-sized.

The digital caliper is interesting in that it also provides a computer interface so that its readings can be pulled in by a computing device of some sort. These devices used to be quite expensive, but mass production has brought their prices down significantly.

Figure 2-19. *From top to bottom, a tape measure, a set of digital calipers, and an architect's scale.*

Simple Electronic Measurement Tools

Now that you've got the tools to examine what these things look like and how big or small they are, let's move on to the more mysterious art of measuring their electrical properties.

Voltmeters

Voltage is a measure of electromotive force, and the standard unit of measure is the *volt*, named after Alessandro Volta, an Italian physicist. Voltage is sometimes compared to the pressure of water flowing through a garden hose, while amperage is compared to the amount of water flowing through the hose at any given time. It's not particularly useful to push this water analogy too far, but it's helpful in the beginning.

Voltage can be accurately measured with, you guessed it, a voltmeter. See Figure 2-20.

Figure 2-20. *A panel-mount analog voltmeter (left) and a digital version (right)*

A voltmeter measures the voltage, or *potential difference*, in a circuit across two points. Sometimes one of the points is a fixed reference point, such as the electrical *ground* mentioned in many circuits. This is often just a convenience for the purpose of measuring things, as the ground in an electrical circuit may or may not be connected to the ground under your feet.

A voltmeter will have two terminals, labeled positive (+) and negative (–). Looking at the analog voltmeter in Figure 2-20 (the one on the left), we see a needle that can swing from 0 on the left to 30 on the right. The prominent capital *V* on the dial indicates that the unit of measure is the volt. This indicates that you can use this meter to directly read from 0 to 30 volts, just by placing its terminals across a voltage. The meter itself is electromechanical in design, and creates a magnetic field that works against a spring and a fixed magnet. This action causes the needle to move to a point generally corresponding to the labeled voltage on the dial. These needles are not especially accurate, but can be corrected using the screwdriver adjustment at the bottom of the meter.

An analog panel meter such as this one does not require a separate power supply for proper operation. It draws all the power it needs from the signal being measured. This makes it unsuitable for measuring low-power circuits, where the current draw from the meter would unduly influence the reading.

The panel meter on the right is a digital circuit that measures the voltage and displays it on the built-in liquid crystal display (LCD). It requires a separate power supply for normal operation.

Ammeters

An *ammeter* looks and operates just like a voltmeter, except that it measures electrical current flow instead of voltage. The flow of electrical current is measured in units called *amperes* (A). The basic mechanism is almost identical to a voltmeter. To convert a current flow into a voltage, an electrical device known as a *shunt* is used. The shunt is simply a fixed-value resistor that produces a voltage across its terminals in relation to the amount of current that is flowing through it and its inherent resistance to the flow of current.

This relationship between voltage, current, and resistance is elegantly expressed in *Ohm's Law*. If you know two of the measurements in a circuit, you can calculate the third, based on their fixed and proportional relationship to each other. You will find this law to be exceedingly helpful to you when designing, repairing, and upgrading electronics.

To avoid using fractions, which seem to terrify so many people for no good reason, you can use Ohm's Law thusly:

- Voltage (volts) = current (amps) × resistance (ohms)
- Current (amps) = voltage (volts) ÷ resistance (ohms)
- Resistance (ohms) = voltage (volts) ÷ current (amps)

That's all there is to it, if you're just working with volts, amps, and ohms. Things can get weird, however, when you start to work with alternating current (AC), which is the kind of electricity you find in wall outlets and audio circuits.

Ohmmeters

An excellent application of Ohm's Law is found in building a resistance meter, also called an ohmmeter, because it measures resistance. Resistance is measured in units called ohms, often abbreviated with the capital Greek letter omega (Ω).

There are two ways to do measure resistance. One is to pass a known voltage though the unknown resistance and measure the current that is flowing in the circuit. The other is to pass a fixed current though an unknown resistance and measure the voltage across it. This second method is the one most commonly used.

You're most likely going to use a multimeter to measure resistance, as this is one of the more common functions of these handy devices. Mutlimeters are covered in the very next section.

Advanced Test and Measurement Equipment

It would seem that for simple circuits, having just a voltmeter, an ammeter, and an ohmmeter would be all you need. For the most part, this is correct. However, have you considered what would happen if you applied 100V to the 30V meter shown in Figure 2-20? What if you simply reversed the polarity of the signal by accident? Something bad for the meter, that's for sure. It might not actually catch on fire *right away*, but it would certainly damage the delicate, spring-loaded mechanism, possibly rendering it useless as a reliable measuring instrument.

The same can be said for an unprotected ammeter or ohmmeter. Luckily, the nice people that make good test equipment stay up late at night, thinking of the stupid things we might do with their products, and protect them accordingly. Let's look at some meters that measure multiple electrical characteristics, which strangely enough are called *multimeters*.

Multimeters

Multimeters will almost always allow you to measure various ranges of DC (direct current) volts, AC volts, current, and resistance. More advanced meters also measure things like frequency and duty cycle or even temperature. Some meters will even directly measure capacitors, inductors, and transistors using specialized connectors.

As with most tools, you generally get what you pay for with multimeters. The meter on the left in Figure 2-21 was purchased for under $3, including shipping from China. It arrived DOA (dead on arrival) and was not deemed important enough to return. It will make an interesting clock or fake lie detector someday. The unit on the right was purchased new for nearly $400 and has provided over a decade of useful service. The unit in the center is modeled after the unit on the right, it would seem, but can be bought new for between $10 and $20. The unit in the photo was bought wholesale for $4, because sometimes you get lucky. It's often handy to have a second meter in the lab—for example, when you need to measure the voltage *and* the current flowing in a circuit simultaneously, which you just can't do with a single meter.

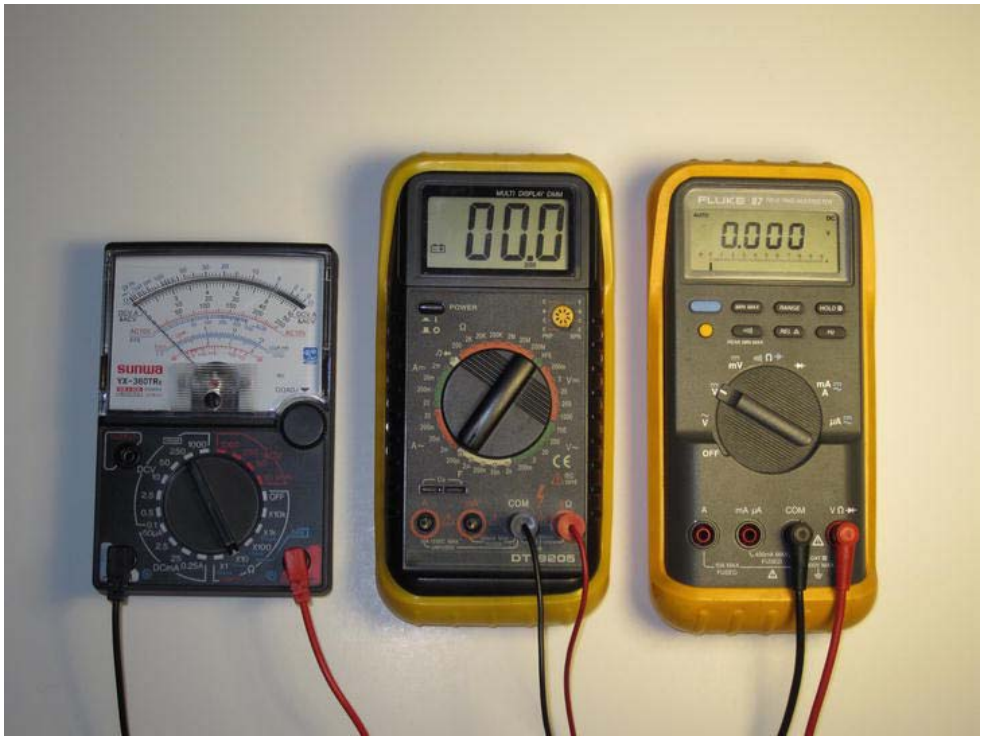

Figure 2-21. *Examples of some multimeters. The meter on the left features an analog display that is easy to read and acommodates several readout scales simultaneously. The remaining two meters have digital readouts and offer more accuracy. All the meters use a large rotary knob for selecting the proper function. The higher-cost unit on the right features auto-ranging, intellignetly deciding what range to use. The right two units also have high-impact boots to help protect them in the event of a fall.*

Your present budget will help determine what level of multimeter you might want to obtain. If you're wanting to sink less cash into a multimeter right now, consider looking for used equipment in good shape. As with any good tool, you can spend as much as you like on these. The sky really is the limit here.

Most all-in-one meters protect their inputs using fuses. You will have to disassemble your meter to replace these fuses, so think twice and measure once (to paraphrase the old carpenter's saying, "Measure twice and cut once").

■ **Tip** Be sure to set up your meter for the proper function and range *before* taking measurements.

Oscilloscopes

Once you've gone beyond measuring simple DC and AC voltages and move on to more complex signals and waveforms, you'll have to lay aside your trusty meter and fire up your favorite oscilloscope. This instrument is more complex than your traditional multimeter, and offers a different perspective on what's going on in your circuit.

While many modern oscilloscopes have many modes of operation, their basic function is to draw a picture of your signal on a small screen. In the olden days, this was done with a moving dot that was swept across a phosphorescent screen, leaving a residual, fading line of light. If this pattern was repeated over time, a visual representation of the signal could be seen on the screen. See Figure 2-22.

Modern oscilloscopes use a computer monitor or built-in screen display to draw the signal. This saves space, weight, and power requirements.

When purchasing an oscilloscope, the features you pay most for are the number of available channels and the bandwidth. The least expensive oscilloscopes will have a single channel. Having multiple channels allows you to "see" multiple signals simultaneously, which is often helpful in understanding what is going on in a circuit.

Bandwidth refers to the range of frequencies that can accurately be measured by the oscilloscope. Lower bandwidth scopes require much simpler electronics, and are thus cheaper to produce.

Figure 2-22. *A Tektronix 475A oscilloscope. This piece of vintage test equipment is considered by some to be the best analog oscilloscope ever made. It also has a digital multimeter built in along the top edge.*

The Golden Age

Once upon a time, not so long ago, a quality oscilloscope weighed 40 pounds and had a folding handle to make it, if not portable, at least *transportable*. It also had its own line of furniture to place it on, so that you could wheel it around the lab as you needed. Oh, and it also cost about three months' salary, and that's if you had a *good* job.

The good news? That same scope still works today. It can be repaired or calibrated to the exact same standards as when it was brand new, *plus* you can buy it on eBay for a few hundred dollars, sometimes less. That's because when these devices were designed back in the 1970s, they were made to be the best in the world, and cost was not a factor.

Modern Oscilloscopes

Today you can buy a quality oscilloscope for a few hundred to a few thousand dollars. These scopes not only display your signal on a large, colorful screen, but they can also analyze the signal and tell you all kinds of interesting things about it. For an example of such an oscilloscope, see Figure 2-23.

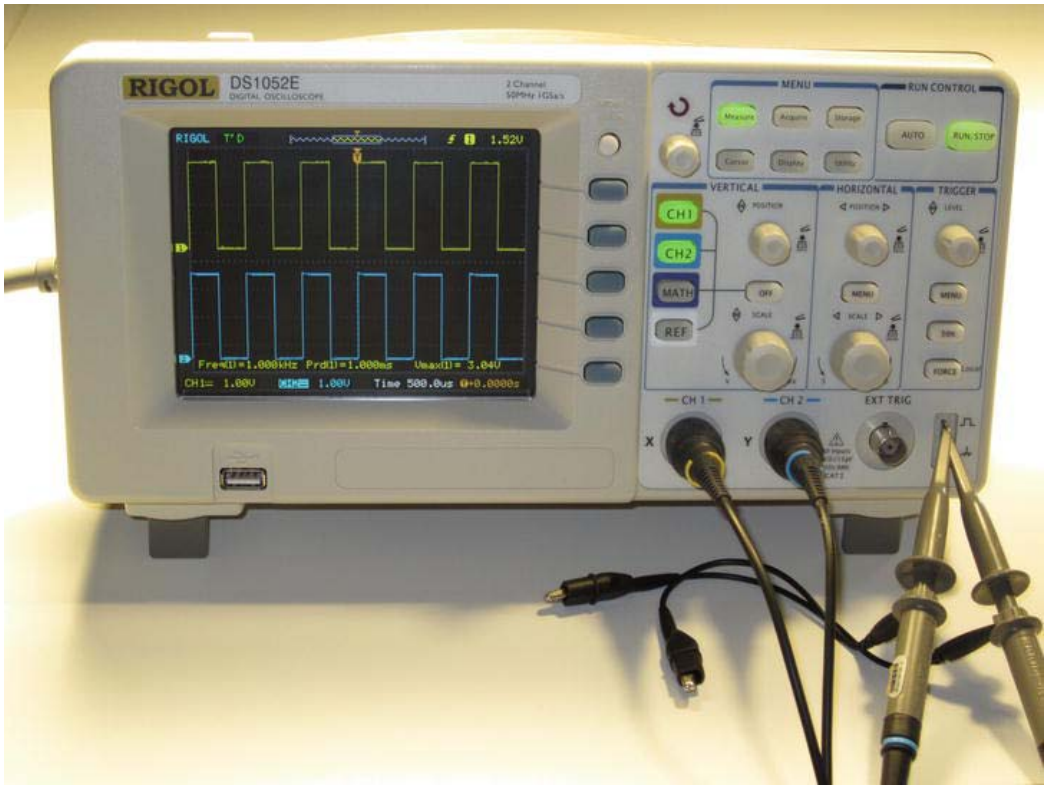

Figure 2-23. *A modern digital storage oscilloscope. The RIGOL DS1052E is an affordable scope that will handle most troubleshooting and design challenges that you might encounter in your lab.*

This new breed of digital storage oscilloscope (DSO) can even connect to your PC to be remotely operated and allow you to capture screen shots that can then be pasted into books about how to build your own electronics lab. It's true. See Figure 2-24.

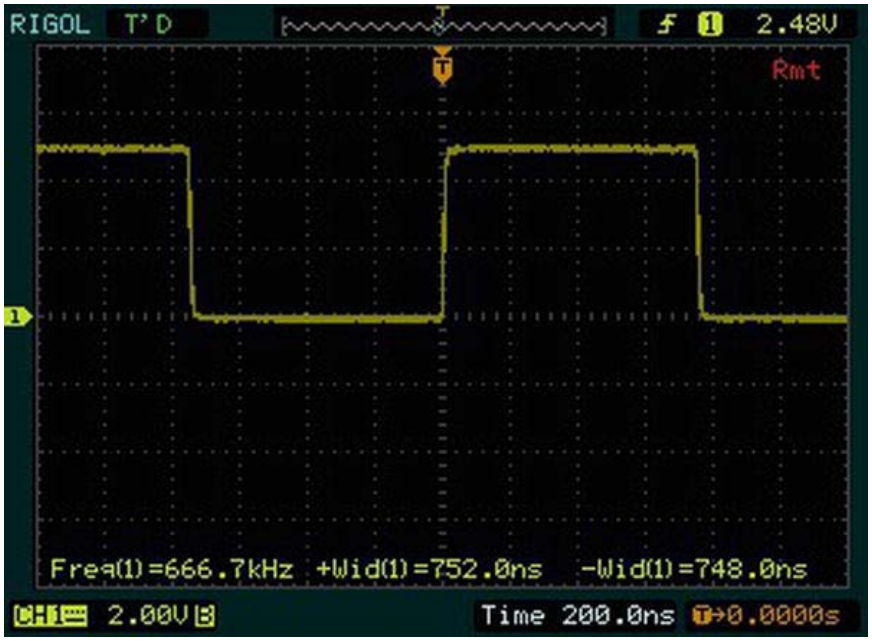

Figure 2-24. *A screen capture made with the RIGOL DS1052E oscilloscope.*

Tiny Oscilloscopes

The march of electronic miniaturization never stops, and so it is with oscilloscopes. If both your needs and your budget are modest enough, perhaps you can get by with something like the pocket-sized wonder shown in Figure 2-25.

While little scopes like this lack the accuracy and bandwidth of their larger relatives, they are definitely handy to have when you need to look at a signal. If you can keep your expectations in check when it comes to the user interface, you can get a lot of utility from such a small package.

Additionally, one of the benefits of a device such as this is that the hardware and internal software (yes, there's a little computer in there, somewhere) is all open source. This means that you have access to all the schematics and source code. And what does that mean? It means that if you have the skills and the right equipment, you can redesign the entire apparatus to fit your own requirements, assuming that you understand the basic limitations of the electronics. The sky is the limit. You are empowered.

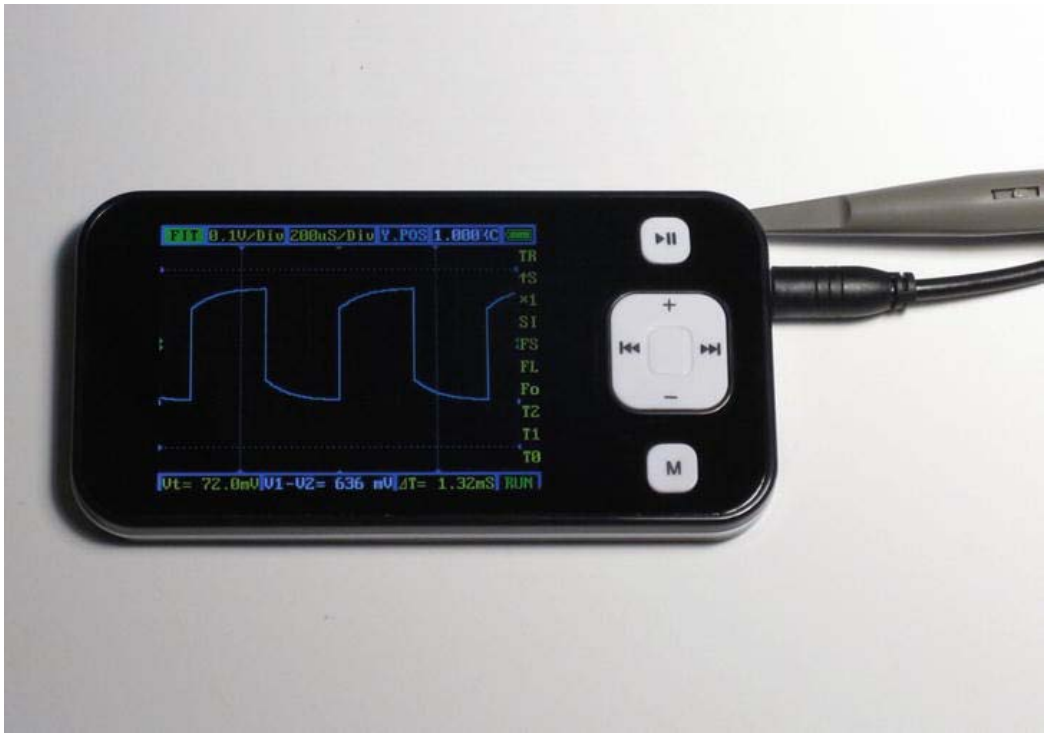

Figure 2-25. *A handheld oscilloscope, which can also fit in your pocket. This is the DSO201, which has been discontinued by the manufacturer, but can still be snapped up for a song from various online distributors, as well as eBay. This unit was purchased new for $60 and features a single channel with a bandwidth of 1 MHz.*

Power Supplies

One of the most important pieces of test equipment in your lab is a reliable power supply. Building a good bench power supply is an excellent first or second electronics project (see Chapter 5 for more on adding power supply to your lab and Appendix A for more on building your own). This is because the basic design is very simple and easy to build, yet allows you to add any number of additional features later.

Once you get tired of throwing away spent 9V batteries and grow weary of waiting for the red light on the battery charger to go out, it's time to invest (either time or money or both) in a decent bench power supply.

It doesn't have to be fancy. In fact, the simpler the better at first. What you're aiming for primarily at this point is reliability. You want to know that when you turn on your 5V supply, it's putting out 5 volts, not 2 or 11, no matter what you do to it. If it's overloaded, it needs to deal with it and not be catching on fire. If it's underloaded, or not loaded at all, it still needs to maintain a nice, clean output.

Want a cheap or free power supply? Do you have any dead or discarded electrical gizmos that came with a charger? These make excellent starter supplies for the new lab. Do you have any extra USB

chargers? These are even better, because they supply up to 2.5W (and sometimes more) of *regulated* 5V. We'll use some of these in experiments in Chapter 3.

Organizing Your Tools

So now you have an idea about some of the tools you want (or already have) for your lab. Where are they all going to live? This is a big question, and deserves a big answer.

One way to look at this book is that the entire latter half is dedicated to answering this question. There are, obviously, many possible arrangements that will work for most people. But we're talking about *your* lab, with *your* tools, arranged and ordered to meet, specifically, *your* needs.

As you progress through Chapter 3 (the very next chapter in this book), you'll get a chance to play with both your tools and some interesting electronic components, all in the interest of getting you familiar with some basic concepts. These concepts and ideas are not new, but they may be new to you. The good news is that time invested today and in the very near future should pay off big dividends to you later in life. Who knows what you'll devise in that electronics lab of yours?

Summary

Starting with your brain and working outward, this chapter has covered some of the tools and devices you might use in your electronics lab. These include basic hand tools, computers, tools for soldering, some common power tools you might find handy, as well as some fancy-schmancy tools you might only find in a hackerspace, school, or electronics clubs, such as laser cutters and 3D printers.

You also learned about some of the basic test and measurement tools you'll be needing when working on electronic circuits in your lab. These include magnifying glasses, measuring tapes, and meters (oh my!), as well as oscilloscopes and power supplies.

Additionally, *lots* of advice on safety was presented. These topics were learned the hard way. Do try to learn from the mistakes of others, won't you?

Just a hint was given about how you might want to organize your tools within your lab. Take care of your tools and they will most certainly take care of you. The details about possible organizational scenarios is left for the second half of the book, where you will learn about setting up labs big and small, as befits your needs, budget, and interests.

Chapter 3 ties in much that you have learned here in Chapter 2 by introducing you to not only some of the basic electronics components and their uses and characteristics, but also how to use a good number of the tools described in this chapter. Hopefully this chapter has whetted your appetite and readied you to dive into some circuits and see what kind of mischief you can wreak on the world.

CHAPTER 3

Components

You're going to need some components to play with, as well as the knowledge to use them effectively. This chapter will introduce you to some of the bits and pieces that make up modern electric and electronic circuits. It will also teach you a little bit about how to identify components from their appearance and markings, when available.

Once you've got an idea about what these parts do in a circuit, you'll learn a little more about how to measure their electrical properties and put them to use. You'll also be shown what *not* to do, in some select examples.

There are an enormous number of both manufacturers and vendors of electronic components these days. Trying to list even a few of them here in print doesn't really make much sense, as a good percentage of that information will be incorrect or obsolete as soon as the ink dries on the page.

Having a variety of basic components readily available is convenient, until your collection grows beyond your ability to house or organize it. This happens far too often, in reality. Most common electronic parts can be obtained within a day or two from local sources, unless you live in a really secluded part of the planet. Also, most of the more common parts will typically cost only a few pennies apiece, so there aren't a lot of reasons to stockpile random parts. Keep a few of each on hand for experimentation, but hold off on pointless hoarding . . . if you can.

Conductors and Interconnects

In any electrical or electronic circuit, there are just as many connections between components as there are components. These include wires, cables, connectors, plugs, sockets, and all those other pieces that help the little electrons zip around the circuit.

First, let's take a look at wires and interconnects in a very abstract way. We can think of wires as connections between other components, without having to get into a lot of detail about the wire itself. We just want a way to indicate that there is an electrical connection among all the bits, and using an electrical schematic diagram is an easy and effective way to do this.

Electrical Schematics

A *schematic* diagram is any kind of stylized drawing that represents a simplified view of something. Usually some sorts of symbols are used to represent the parts that make up the whole, as well as the connections or relationships that exist between them and possibly the outside world. You can have schematics for plumbing, hiking trails, or tribbles, a well as electrical and electronic circuits. Let's talk about electronic schematics for a little bit.

The electrical symbol for a wire is almost always just a plain, solid line. If there's something really special about the wire that needs to be used, it is usually indicated in a note somewhere on the schematic. This can be used to indicate what color the wire needs to be, what size is appropriate,

whether there are any special requirements for the insulation, and so forth. Most of the time it's just a plain, solid line. For an example of just how simple it can be to draw a wire in a schematic, see Figure 3-1.

Figure 3-1. *A very simple electrical schematic diagram, showing how to get from point A to point B with a single wire. Drawing wires in schematics is easy!*

If a wire starts in just one place and ends in just one place, everything stays nice and easy. If multiple wires need to converge on a single point, or one signal wire needs to split up to go to more than one destination, it gets just a little more complicated, but not too much. See Figure 3-2.

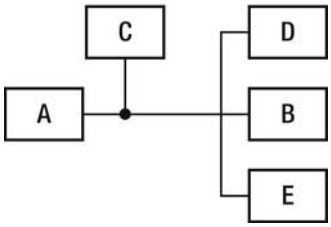

Figure 3-2. *Wires that are connected to each other usually have a dot at their intersection. If there is no dot, there is no connection between overlapping wires.*

In the figure, points A, B, and C are connected together. Points D and E are connected together, but are not connected to points A, B or C, even though the wires look like they are crossing. In a professional schematic, a careful draftsperson would route the wire from point D to point E on the right side of the components to avoid any possible confusion.

Some folks like to draw a little bump, or bridge, when two unconnected wires cross in a schematic, just to make sure that everyone knows that the wires aren't connected. This gets to be a bit tedious once you've got more than two or three components in your schematic, and it can look a bit unsightly. Feel free, however, to draw your schematics however you see fit. Just remember that others might not share your particular drafting sensibilities.

Wire and Cables

Chapter 2 took a quick look at wire and how it is made to help you pick out the best wire-cutting and wire-stripping tools. Now it is time to consider wire as an electrical component within your circuits. Knowing what a wire can and cannot do will help you pick the right kind of wire to use. Yes, wire has limits! This is important both for building new circuits from scratch as well as repairing, replacing, or upgrading wiring in existing circuits.

Wire can be used for all sorts of artsy and craftsy purposes. Copper wire is the most common wire used in electronics. Sometimes the copper conductor is *tinned* with another conductive metal with a low melting point to make it easier to solder. When you cut this wire, you can see the copper on the inside.

Pure copper wire is getting very expensive these days. Unscrupulous people try to pass off copper alloy with inferior electrical properties as the real deal. A quick way to test is with a magnet. Copper is not attracted to magnets.

As mentioned in Chapter 2, wire comes in two major categories: solid core and stranded. Solid core wire is just a single piece of copper wire, while stranded wire is made up of many smaller strands of copper wire, usually twisted together. Stranded wire is generally more flexible than solid core wire.

Copper wire is measured using a gauge system. Different systems exist around the world. A common system used in the United States and Canada is the American Wire Gauge (AWG) standard. It uses a series of single numbers to denote the relative size of the wire, with larger numbers representing smaller-diameter wires. These numbers go all the way down to zero (0 gauge), but they don't stop there. Larger wires than 0 gauge are called 00 gauge, double-ought, or sometimes 2/0. There are also three- and four-digit versions, but after that, those giant wires are specified with their actual cross-sectional diameter.

Using Wire: The Very Short Version

Fatter wires carry more current with less heat being generated due to resistance. The wire's insulation is rated for a maximum voltage and temperature. If this temperature is exceeded, the insulation will soften, melt, or catch on fire. Avoid this by using the right sized wire for the job. Exceeding the maximum voltage can cause more problems if the current arcs through the insulation. This can cause a short circuit and may even cause a fire. It is also likely to give off noxious fumes. Choose wisely!

For low voltages (under 36V) and small current loads (under 1A), you can use whatever you want. It doesn't matter. Pick something pretty. A thing of beauty is a joy forever.

For higher-voltage applications, make sure the wire's insulation is rated *far in excess* of what you anticipate. The rating should be visibly printed on the insulation itself. See Figure 3-3.

Figure 3-3. *The wire's insulation only works up to a point. That point is usually printed on the insulation itself, but you may need to put on your good reading glasses to see it. This wire states, "LL33911 CSA TEW 105°C 600V FTT 14AWG," which translates to the manufacturer's part number, Canadian Standards Association certified thermoplastic equipment wire, maximum temperature of 105°C, 600V insulation dialectric strength, 14 gauge.*

For higher-current applications, you really need to use the highest-gauge wire that is necessary to carry the required current. Hot wires cause fires.

Using Wire: The Longer Version

If you will spend some time learning about the properties of wire, you will be able to make *much* better decisions regarding its use and application. Assuming that the overall shape of the cross section of the wire is round, the gauge of the wire determines how much resistance to the flow of electrical current the wire will exhibit over a given distance. This resistance, in turn, helps determine the amount of electrical current that the wire can safely carry.

When electric current meets resistance, the electrical power is converted into some other form of energy. Usually this energy is given off as heat, or thermal energy. It can also produce magnetic fields, sound, light, and radio waves.

A good example of this is demonstrated by the heater coils on an electric stovetop. When the stove's switch is turned on, current flows through the coil. Most of the current is converted directly into heat. Electric heaters are very efficient this way. A small amount of the electrical power is converted into light. You can see this as a red glow coming from the heater coil when it is hot. The coil also creates a magnetic field.

If you know the gauge of a wire, you can look up the wire's characteristic resistance. These numbers will be close but perhaps not exact, as there will always be small variations in wire diameter, conductor purity, and other factors. Generally, however, the numbers are pretty close.

Let's take another look at the AWG table (see Table 3-1), and look at a few simple examples to help understand what these wires can do for us. (A more complete listing is available at `http://en.wikipedia.org/wiki/American wire gauge`, from which this partial list was obtained.)

Table 3-1. *The AWG*

AWG	Diameter Area			Copper Resistance	
	Inch mm		mm^2	Ω/km mΩ/m	Ω/1000 ft mΩ/ft
0000 (4/0) 0.46 00 11.6 84			107	0.1608	0.04901
000 (3/0)	0.4096	10.404	85.0 0.20	28	0.06180
00 (2/0)	0.3648	9.266	67.4 0.25	57	0.07793
0 (1/0)	0.3249	8.252	53.5 0.32	24	0.09827
1 0.28	93	7.348	42.4 0.40	66	0.1239
2 0.25	76	6.544	33.6 0.51	27	0.1563
3 0.22	94	5.827	26.7 0.64	65	0.1970
4 0.20	43	5.189	21.2 0.81	52	0.2485
5 0.18	19	4.621	16.8 1.02	8	0.3133
6 0.16	20	4.115	13.3 1.29	6	0.3951
7 0.14	43	3.665	10.5 1.63	4	0.4982

8 0.12	85	3.264	8.37 2.06	1	0.6282
10 0.10	19	2.588	5.26 3.27	7	0.9989
12 0.08	08	2.053	3.31 5.21	1	1.588
14 0.06	41	1.628	2.08 8.28	6	2.525
16 0.05	08	1.291	1.31 13.1	7	4.016
18 0.04	03	1.024	0.823 20.9	5	6.385
20 0.03	20	0.812	0.518 33.3	1	10.15
22 0.02	53	0.644	0.326 52.9	6	16.14
24 0.02	01	0.511	0.205 84.2	2	25.67
26 0.01	59	0.405	0.129	133.9	40.81
28	0.0126 0.32	1 0	08 10	212.9	64.90
30	0.0100 0.25	5 0	05 09	338.6	103.2

Conductivity

The first thing you need to know is that copper wire really, really wants to conduct electricity. It wants to conduct electricity more than it wants to *resist* the flow of electrical current. Even so, copper is not a perfect conductor, and it has a certain amount of inherent resistance. This resistance causes the energy carried by the electrical current to be sidetracked, or converted into heat and other forms of energy. The higher the resistance in the wire, the more heat will be produced.

Normally this heat is a very small thing and is easily dissipated into the surrounding air. You usually can't even tell by touching that a wire is a fraction of a degree warmer than its surroundings—but this is only true when the amount of energy is relatively small, like in our rewired flashlight example. When you start to push a *lot* of power through a wire, the heat buildup can outpace the cooling-off provided by the surrounding air, and the temperature of the wire increases.

Again, this is no big deal as long as that temperature stays within a comfortable range. But what happens when the temperature gets really high?

First, the insulation will get soft, melt, or even catch on fire. After the insulation, if any, has burned off, the wire will glow red hot and eventually melt. This is known as *catastrophic wire failure*, which can result in what electrical engineers refer to as an unauthorized thermal event, which we call a fire. Yikes!

But look around you. You're probably sitting right next to some wires right now, very few of which (hopefully) are on fire, even though they are carrying variously large loads. How do they keep from burning up? The answer is in the proper selection of the right *size* of wire for the job. Bigger wires have less resistance to the flow of electricity, so they are able to carry more power with less heat being produced.

Now, you don't want to have to wire up all of your electronic circuits using jumper cables from your car's trunk, as that gets to be cumbersome after a while. Let's look at some good guidelines for what size wire to use for your projects.

In Chapter 2 you learned about (or were reminded of) Ohm's Law, which illustrates the relationships between voltage, current, and resistance in any electrical circuit. In summary, $V = I \times R$, where V is volts, I is current in amps, and R is resistance in ohms. It's not just a good idea, it's the law!

So how much electricity will we lose going through a foot or so of 16-gauge wire? If we know that one foot of 16-gauge wire has a resistance of 4mΩ (and we know this from looking it up in the chart), and we build a circuit that pushes 1A of current through this wire, we can figure out a couple of interesting things using Ohm's Law and a calculator.

Applying Ohm's Law

If you know two of the three variables used in Ohm's Law, you can calculate the third variable. Since we know R and I, we can calculate V. Since V = I × R, we can substitute our values of 1A and 4mΩ (0.004Ω) into the equation, and get 0.004V, or 4 millivolts.

That's not very many volts at all! In this case, that's a good thing. The voltage we just calculated is the *voltage drop* across the length of the wire. Those millivolts never make it from one end of the wire to the other—they're lost. Poor millivolts, they never had a chance.

OK, let's not let their heroic sacrifice be in vain. If we know volts, and we know amps, we can also calculate power, which is the rate at which energy is converted to work. The unit of measure for electrical power is *watts*, and is also the same as Joules per second (J/s), but that's another story. We usually use the capital letter *W* to abbreviate wattage, but we use the capital letter *P* to represent the *value* in equations.

Calculating power is simple if you know the volts and the amps. Just multiply them together: P = V × I. Easy.

So in our example so far, we have 4mV, 1A, and 4mΩ. How much power is being dissipated (wasted) in this circuit? P = 0.004V × 1A = 0.004W, or 4 milliwatts, which is just four-thousandths of a watt. That's just about enough power to light up a dim LED, and not much else. So you're not going to be starting any fires with these numbers. You most likely would not even be able to measure the rise in temperature that is occurring in the wire (oh yes, it's occurring, but it's very, very small).

Let's put 10A through a foot of 30-gauge wire. On second thought, let's not, and just do the math instead. The voltage drop will be V = I × R, or 10A × 0.1032Ω = 1.032V. The power dissipated would be P = V × I, or 1.032V × 10A = 10.32W. That wire would be a crispy critter in no time. Ten watts doesn't sound like much when you're talking about a home stereo or a lightbulb or a hair dryer, but that skinny little wire has almost no surface area with which to dissipate the generated heat. This means that the temperature goes up, quickly. Bye-bye, little piece of wire.

As a side note, you just learned how most current-limiting fuses operate. The conductor within the fuse literally *fuses*, or evaporates, when the internally generated heat produced from an "overcurrent" situation rises beyond its melting point. Poof, the circuit is opened, and property and lives are saved.

■ **Warning** Never circumvent the protection afforded by a fuse.

Ideally what you want is the smallest wire that will carry the required amount of current with an acceptable rise in temperature. Remember that any rise in temperature is in addition to the *ambient* temperature. If you're sitting in a room that is "room temperature," which is assumed to be 25°C or 77°F (the same thing, if you want to check it), and you're expecting a 50°C rise in temperature due to waste heat, your wire is going to be 75°C, which is far too hot to touch. Remember that 100°C is the boiling point of (pure) water (at sea level). Hot!

One more thing that complicates the thermal calculations is that copper, as a conductor, has a *positive thermal coefficient*, meaning that the characteristic resistance of a piece of wire (which we can look up in the AWG table) goes *up* by a known amount as the temperature increases. You need to

consider this when you build circuits that are *supposed* to get hot, such as electric heaters. In most other cases, it's best to keep the heat to a minimum, as it represents wasted power, plain and simple.

Testing Your Wires

Can something as simple as a wire go bad? Yes, it most certainly can. How can you tell? Usually, it's because something doesn't work the way you think it should, or *worse*, it works sometimes and not others. A great deal of time, the problem is right at the end of the wire, where it is trying to make a connection with something else. However, it's possible for a wire to develop a problem right in the middle. This can be caused by a tiny nick in the insulation that lets in nasty elements such as rain and dirt, allowing the inner conductor to corrode. This type of problem takes time to make itself apparent, but it can certainly happen, especially in equipment that is exposed to the outside world for any length of time.

A quick way to test a wire is with a piece of test equipment called a *continuity tester*. This simple device usually is battery powered and has two probes. When you connect the probes together, the tester makes a noise, lights up a light, or maybe does both. Make sure your continuity tester's batteries are fresh and that the probes, if they are removable, are firmly seated in their sockets. Even test equipment needs testing from time to time.

■ **Note** A continuity tester is one of the easiest pieces of test equipment to cobble together yourself. See Appendix A for more information about building your own tools.

As mentioned previously, the problem is almost always at the very end of the wire. This is a good thing to know, so you can start looking in the most likely places first, saving valuable troubleshooting time.

A much better way to test a wire is with an ohmmeter. Using an ohmmeter, you can determine the *exact* amount of resistance in a wire, which under ideal circumstances should be very low. One ohm or less is typical for most normal-sized wires that you are likely to encounter. Super-long wires can have higher resistance, and that's where you can consult the handy AWG table to find out what the resistance is *supposed* to be.

When testing wires, especially wires with attached connectors, it's a good idea to wiggle the wire about vigorously, as this will reveal some intermittent connections for you.

Storing Your Wire

If you're buying new wire, it will probably come on a reel. It's often handy to keep common sizes and colors on your bench, if you have room. A paper towel–holder makes an excellent wire dispenser rack, although you can also spend more time or money buying a prebuilt one or designing and fabricating your own.

A custom red-and-black wire dispenser is shown in Figure 3-4. You might use a fixture like this if many pairs of identical-length wires are needed for a project. Not having to chase the wire spools all over the bench really saves a lot of time. This structure was built using a MicroRax miniature slotted aluminum extrusion (*http://www.microrax.com*), which is perhaps a bit of overkill, but was a lot of fun to plan and build. A coat hanger, artfully bent, would have also done the trick.

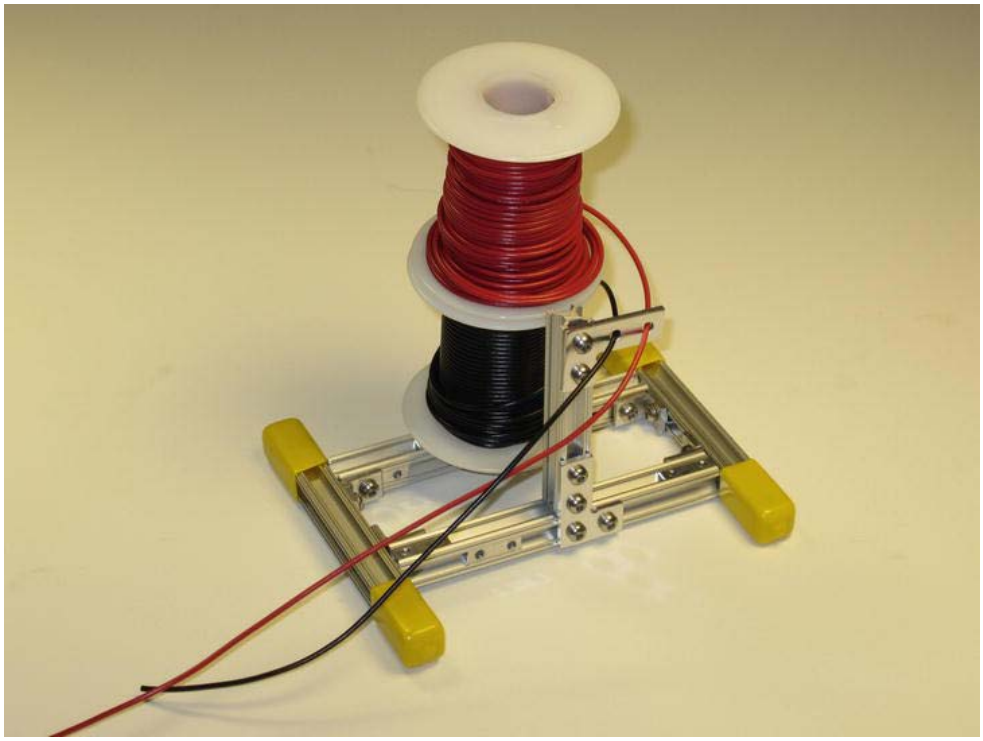

Figure 3-4. *A custom wire-dispensing frame made from modular aluminum extrusion. This kind of fixture makes it easier to cut both a red and a black wire to almost exactly the same length, which happens a lot when you use red and black wire for positive and negative power connections, respectively.*

Connectors

Connectors make life easier for the casual wiring enthusiast. The hardcore types solder everything together, but that is not always practical or even the right thing to do in every circumstance.

Keep in mind that every connector, just like every wire, has some sort of electrical limits. These limits must be respected.

Clip Leads

Also called *alligator clips* or *test leads*, you can buy ready-made wires or build your own from individual connectors. The flexible rubber or plastic boot extends the insulation of the wire. A spring-loaded jaw, often with serrated teeth, is used to clamp down on the wire, lead, or electrical terminal desired (see Figure 3-5).

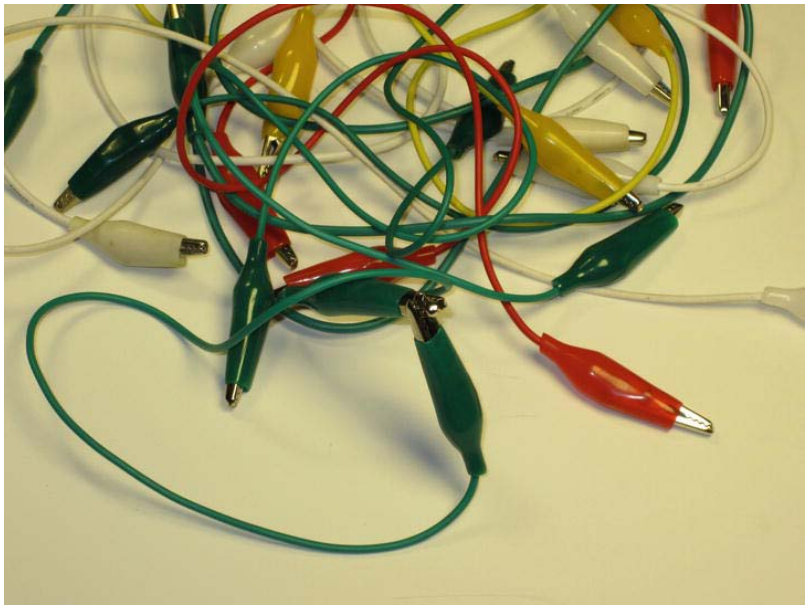

Figure 3-5. *Clip leads come in all sizes, gauges, colors, and terminal types. They are handy for making quick electrical connections.*

Clip leads are quite handy to have around your bench, if you've got the room for them. They tend to get tangled up, so some people hang them from a specially slotted rack, making them easier to pluck at a moment's notice.

Keep in mind that clip leads are generally for *temporary* electrical connections, such as when you're testing something or trying out a prototype circuit. They don't make very good long-term solutions to your electrical connection needs for a variety of reasons.

The first problem is that even when the spring-loaded jaws make a solid, low-impedance connection when first attached, this electrical connection will deteriorate over time as oxidation inevitably forms on the contacts.

Another problem is that many mass-produced clip leads are inexpertly smashed onto the ends of wires, without taking advantage of the alligator clips' built-in features, such as strain reliefs and soldering points. This leads to additional resistance in your circuit at both ends of the clip lead, where you would probably never think to look. The next time you buy some brand-new clip leads, hook them up to your ohmmeter and see just how conductive they really are. A good practice is to carefully remove the insulating boot and make a proper electrical connection yourself, so that you've got one less thing to worry about.

Solderless Breadboards

A very versatile prototyping platform is the solderless breadboard. Once upon a time, people would tack together simple electrical circuits using wires, small nails, and a hammer, utilizing a wooden plank or small board as the substrate. The kitchen breadboard was often just right in size and weight and would mysteriously disappear into the workshop. You can still cobble together simple circuits using this technique.

The solderless breadboard is a miracle of modern manufacturing techniques. A body made of precision-molded plastic has an array of small openings built in, and within each opening is a row of small spring clips that are just the right size to grasp and hold a small-gauge (22–26 AWG) wire. Adjacent points within the array are electrically connected together, which lets you easily connect small components into a circuit using your bare hands, with no soldering required. About all you would normally need would be some solid-core wire (preferably), some wire cutters, and some wire strippers. You can even buy precut jumper wires specifically made for use with solderless breadboards. They're terrifically handy! See Figure 3-6.

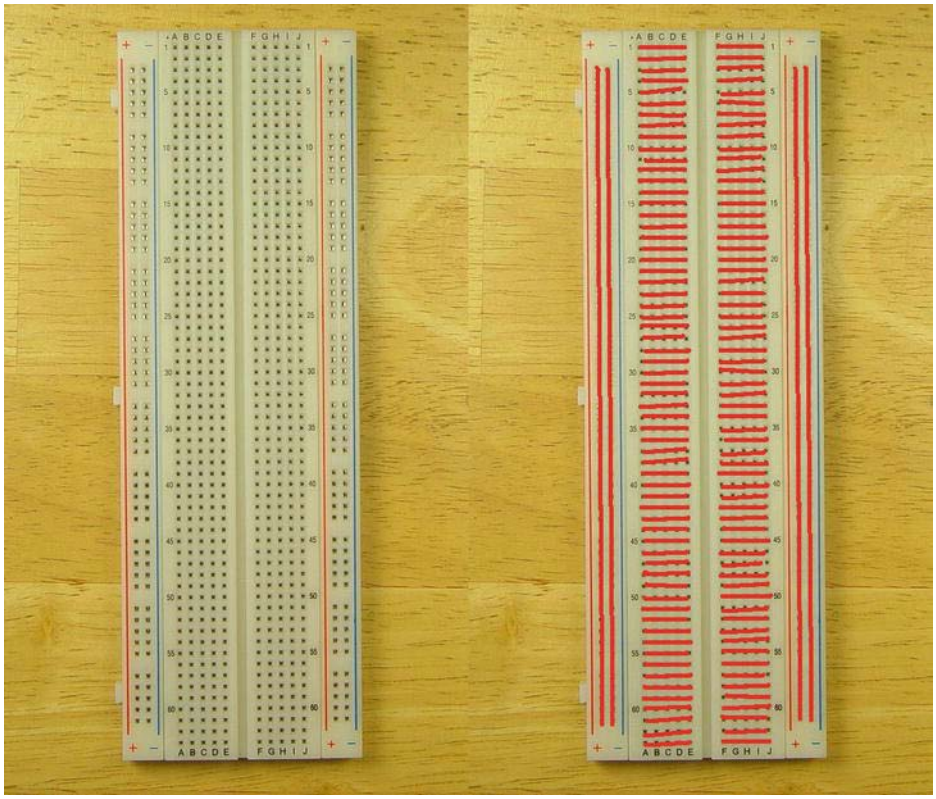

Figure 3-6. *On the left is a solderless breadboard with 830 tie points. Each hole has a spring clip inside that can hold a small wire or component lead. On the right, the underlying electrical connections between the tie points are illustrated.*

The spacing between adjacent tie points is exactly 0.1", which corresponds to many common “footprints” for electronic components. You can easily build simple circuits in just a few minutes. You can even build fairly complex circuits using integrated circuits and other components. Figure 3-7 shows a complete Arduino-compatible microcomputer that you can build with your bare hands and then program using your PC and the free Arduino software.

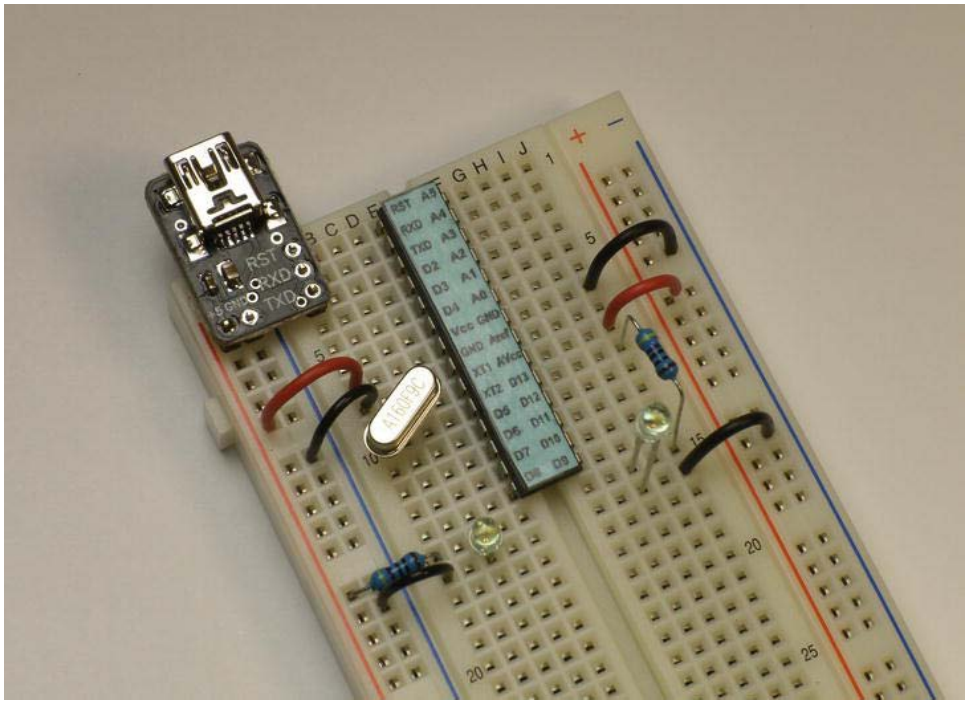

Figure 3-7. *A breadboard Arduino, which is compatible with the popular Arduino Duemilanove microcontroller, can be built using just a handful of components on a solderless breadboard, leaving plenty of room for more experimentation. The black, rectangular component in the upper-left corner is a miniature USB adapter that supplies power, and provides communication and control signals for the microcontroller.*

You’ll find that projects tend to expand to fill the available area (and budget). See Figure 3-8.

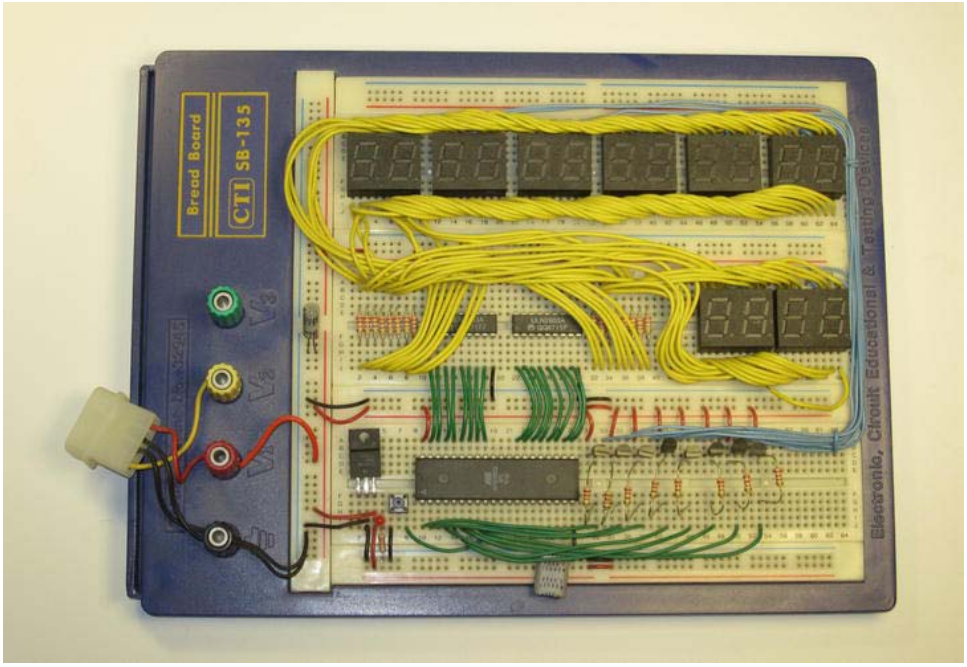

Figure 3-8. *A prototype LED display with computer control, built on a solderless breadboard. That's a lot of wires!*

Passive Components

Most electronic components fall into one of two different categories: *passive* and *active*. There are a few different ideas floating around as to what, exactly, is the difference between passive and active components. For the purposes of this book, we will use the simple definition that an *active* component requires a power source to work properly, while a *passive* component does not.

Resistors

A good example of a passive component is a *resistor*. You've already learned a lot about resistance in an electronic circuit. Resistance is measured in ohms, and it converts electricity into heat. When you're working with wires, cables, and other conductors, resistance is usually a *bad thing*. You want the least amount of resistance possible. However, there are times when you both want and need resistance in a circuit.

One example of when you would want resistance in a circuit is when you want to light up an LED. Unlike an incandescent lightbulb, an LED has no built-in current-limiting ability. Without a fixed amount of external resistance added to the circuit, an LED would self-destruct in a very short time, because it would overheat from excessive current flowing through it. A resistor would limit the amount of current flowing and control the brightness of the LED.

The exception to this dire prediction is when the power source that is lighting up the LED has insufficient gumption to blow up anything, such as with a small coin-cell battery. Anything bigger than

that normally has no trouble convincing the LED to release its magic smoke, without which it can no longer function.

A typical resistor has a fixed resistance and a maximum power rating. The resistance is determined by the material from which the resistor is made. The value of a resistor, as you already know, is measured in ohms, and can range from just a fraction of an ohm (often expressed as milliohms) up to millions of ohms.

Through-Hole and Surface-Mount Resistors

Resistors come in all shapes and sizes. Generally speaking, the larger the surface area of the resistor, the more power it can safely dissipate. A typical resistor that you might work with on a solderless breadboard or on an older PCB is shown in Figure 3-9. These are called *through-hole* components because their extended leads are meant to be formed and threaded through holes that are drilled into PCBs. Also in Figure 3-9, for comparison, are some teensy-weensy *surface-mount* resistors. Surface-mount resistors have no leads and are meant to be soldered directly to pads laid out on the surface of the PCB.

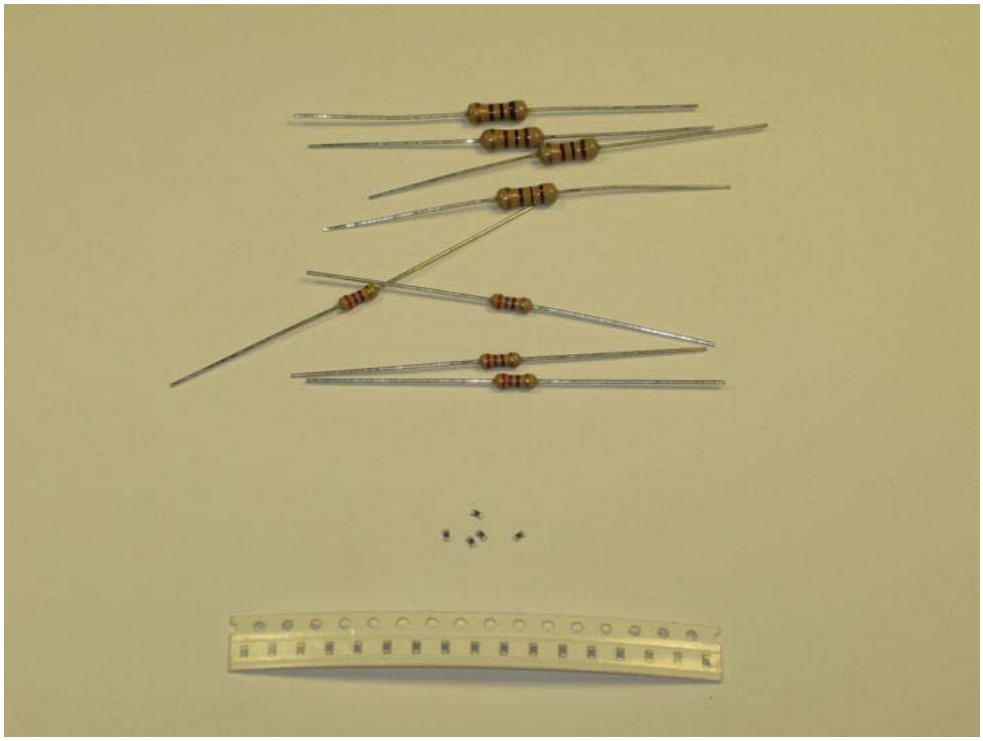

Figure 3-9. *Some through-hole resistors (top) and surface mount resistors (bottom). The surface mount resistors are so small that they are shipped packaged in tape, which is usually wound on reels for automated placement in PCB assembly.*

You can easily form the leads of through-hole resistors by hand or by using a *lead-bending jig*, a small tool with accurately spaced notches. Traditionally, these resistors have their leads formed so as to be threaded through holes in a PCB, and then soldered to the PCB. The extra lead length on the bottom of the PCB is then clipped off. See Figure 3-10.

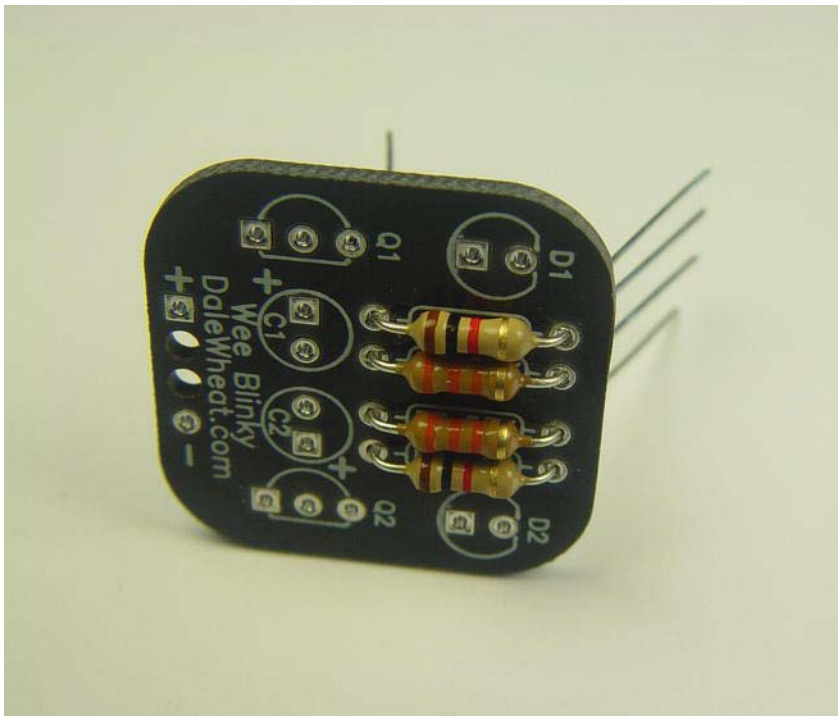

Figure 3-10. *Resistor leads are bent at right angles and inserted into holes in the PCB to be soldered.*

Schematic Symbols and Reference Designators

The schematic symbol for a fixed-value resistor is a zigzag line. See Figure 3-11. Every component in your circuit should have a name, which is also called a *reference designator*. Typically, most reference designators will have a short letter abbreviation to describe what kind of part it is (*R* is for *resistor*) and a sequential number assigned as more parts are added to the schematic. R1 would be the first resistor, R2 would be the second resistor, and so on.

If there is only one resistor in your circuit, then you don't have to number them, do you? You can just called it *R*, or *Galactic Emperor R the Mighty*, or whatever strikes your fancy. Most people stick to simple numbers.

Your numbering scheme depends a lot on the complexity of your schematic. If you only have a few resistors in your circuit, you can start at one and go up as needed. If you have a complex circuit with many subcircuits, you might allocate R101, R102, R103, and so on, to the first subcircuit (e.g., a power supply), and then assigned R201, R202, and so on, to a different section, such as a display. It's entirely up to you. Use a system that helps *you* keep track of things.

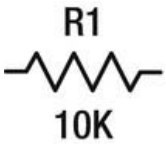

Figure 3-11. *The schematic symbol for a fixed-value resistor is a zigzag. The reference designator for this resistor is R1 and its value is 10,000 ohms, or 10KΩ. A simple rectangle symbol is also used to represent resistors, although many components are available in this physical form factor. Use the symbol you like best.*

Standard Resistor Values and Tolerances

Remember how wires have their own peculiar numbering scheme to describe their basic characteristics (i.e., the AWG, which uses *smaller* numbers to represent *larger* wires)? Well, resistors have their own peculiar numbering system as well to describe their electrical properties, or *value*. Even though the *value* of a resistor is measured in ohms and succinctly describes its characteristic resistance, not every possible value is readily available.

Some smart cookies at the Electronics Industries Alliance (EIA; see `http://www.ecaus.org/eia/site/index.html#`) have come up with some standard values that fill in most of the commonly used values for resistors and other components. Their scale is not linear but logarithmic, meaning that it takes larger steps as the values go up. This makes a little more sense once you understand how component value *tolerances* work.

You can buy, for example, a 1Ω resistor and expect it to be pretty close to being 1Ω at room temperature, but it's not going to be *exactly* 1Ω. It's going to be pretty close. How close? Well, that mostly depends on how much money you're willing to spend on this single resistor. If the answer is "not that much," then "pretty close" is going to mean within 5 percent of the stated value. That means your 1Ω resistor could actually measure as little as 0.95Ω or as much as 1.05Ω and still be "within tolerance." Five-percent resistors cost only a few cents even in small quantities.

Given that there's a little wiggle room for each resistor value, people who can tolerate their resistor values being off by as much as 5 percent don't need to be ordering 50 resistors of 0.99Ω and another 50 of 1.01Ω when they could just as easily (and certainly less expensively) order 100 resistors of 1Ω with a 5 percent tolerance.

This overlap in the values of the resistors allows us to skip from 1.0Ω to 1.1Ω without having to keep track of all the little resistors in between. This is because a 1.1Ω resistor could measure as little as 1.05Ω or as much as 1.15Ω and still be in tolerance.

With a standard resistor tolerance of 5 percent, we can use just 24 values to cover the range between 1Ω and 10Ω. The same multiples can then be used to cover the range between 10Ω and 100Ω, and so on. Aren't logarithms fun? See Table 3-2.

Table 3-2. *The E24 Standard Values for 5 Percent Resistor Value Tolerances (Higher and Lower Decades Are Also Available)*

1.0 10		100	1.0K	10K	100K	1.0M
1.1 11		110	1.1K	11K	110K	1.1M
1.2 12		120	1.2K	12K	120K	1.2M
1.3 13		130	1.3K	13K	130K	1.3M
1.5 15		150	1.5K	15K	150K	1.5M

1.6	16	160	1.6K	16K	160K	1.6M
1.8	18	180	1.8K	18K	180K	1.8M
2.0	20	200	2.0K	20K	200K	2.0M
2.2	22	220	2.2K	22K	220K	2.2M
2.4	24	240	2.4K	24K	240K	2.4M
2.7	27	270	2.7K	27K	270K	2.7M
3.0	30	300	3.0K	30K	300K	3.0M
3.3	33	330	3.3K	33K	330K	3.3M
3.6	36	360	3.6K	36K	360K	3.6M
3.9	39	390	3.9K	39K	390K	3.9M
4.3	43	430	4.3K	43K	430K	4.3M
4.7	47	470	4.7K	47K	470K	4.7M
5.1	51	510	5.1K	51K	510K	5.1M
5.6	56	560	5.6K	56K	560K	5.6M
6.2	62	620	6.2K	62K	620K	6.2M
6.8	68	680	6.8K	68K	680K	6.8M
7.5	75	750	7.5K	75K	750K	7.5M
8.2	82	820	8.2K	82K	820K	8.2M
9.1	91	910	9.1K	91K	910K	9.1M

Color Codes

Even the old-fashioned through-hole parts are a bit too small to legibly label with a numeric value and tolerance factor. A system of color codes was developed to designate resistor values, using colors to represent both single digits, a power-of-ten multiple, and the resistor's tolerance. These colors are painted on the resistors in bands. A little memorization and careful practice will have you reading resistor color codes in no time.

For 5 percent tolerance resistors, only four bands are needed to completely specify the resistor's value and tolerance. The first two bands represent the first two significant digits of the value. The next value is the multiplier. The final value is a special case to tell the resistor's tolerance.

The first two bands, as well as the multiplier value, use the color codes shown in Table 3-3 to represent the digits 0 through 9. (Unfortunately, these colors were chosen before the subtleties of colorblindness were widely understood.)

Table 3-3. *The Resistor Color Codes for the Significant Digits and Multiplier Digit of the Resistor's Value*

Digit	Color
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White

The last band indicates the tolerance of the resistor using a different set of colors, as shown in Table 3-4. The most common are 5 percent (gold) and 1 percent (brown). There is supposed to be a slightly larger gap between the digits and the tolerance bands, but this is sometimes hard to see.

Table 3-4. *Resistor Color Codes for the Final Color Band*

Tolerance	Color
0.05%	Orange
0.25%	Blue
0.5%	Green
1%	Brown
2%	Red
5%	Gold
10%	Silver
20%	None

The multiplier digit can be thought of as either the number of 0s after the specified digits or as the exponent to which the number 10 is raised, as in scientific notation. Some examples make this easy to understand and remember.

A resistor marked with brown, black, red, and gold stripes has a resistance of 1KΩ with a tolerance of 5 percent. An easy way to decipher this code is to do a simple substitution for the first two digits (brown is 1 and black is 0, so we have 10 so far). Next decipher the multiplier band and write down that many 0s after the first two digits. Red is 2, so write down two 0s. That gives us 1000 so far. The final band is gold, and that means a 5 percent tolerance; 1,000 ohms is usually abbreviated as 1.0KΩ or simply 1KΩ.

■ **Note** *K* stands for *kilo*, the Greek prefix for 1,000. Likewise, *M* stands for *mega*, the prefix for 1 million.

This method works for most values from 10Ω to 10MΩ. A problem occurs, however, when we need to specify a value less than 10, as a negative multiplier value must be used to get an exponent of less than 0. For the value 1 and those less than 10Ω, a gold band is used for the multiplier. For values less than 1Ω, a silver band is used.

To save even more precious space on our schematics, another convention is to replace the decimal point with the multiplier. For example, 4.7KΩ would be written as just 4K7. 1.8MΩ would become 1M8 and 1.5Ω would be 1E5. 10KΩ would still be 10K using this method. If it is clearly understood that the unit of measure is the ohm, then even the Ω can be omitted.

Resistor Power Ratings

Any resistor has a maximum power-handling capability. This rating is usually expressed in watts or fractions of a watt. The larger through-hole resistors shown previously in Figure 3-9, for example, have a power rating of 1/2W (or 0.5W, if you prefer). This means that if you attempt to dissipate more than half a watt of power through the resistor, it is most likely going to quickly overheat and fail.

Thermal failure in a resistor starts with a thin curl of smoke, and then results in the discoloration of the resistor itself and sometimes actual flames. In any case, it gets dangerously hot, so do try to avoid this situation.

If you know the voltage across the resistor, as well as the current, you can easily calculate the power being dissipated using the simple formula P = V × I. Remember that P is the power value in watts, V is the voltage in volts, and I is the current in amps. One volt at one amp is one watt, which is way more than enough to smoke our little resistors. Be careful! Any time you calculate the correct value for a resistor in ohms, be sure to also calculate the required power-handling capability.

Variable Resistors

So far we've only looked at *fixed*-value resistors. They usually exhibit the same resistance day in and day out. That's what we love about them. But what if you need to vary the resistance in a circuit? We have resistors for that, too! A good example is a volume control on an amplifier. Turn it to the left (down), and the volume goes down. Turn it to the right (up), and the volume goes up. How does that work?

One kind of variable resistor is called a *potentiometer*. Potentiometers are sometimes abbreviated as *pots*. Pots usually have three terminals instead of two. Two of the terminals connect to the fixed resistor that is inside the potentiometer. Instead of being all sealed up like the fixed resistors you've been studying, the internal, resistive conductor is exposed along a track or groove. The third terminal, which is often physically in the center, between the two other terminals, is called the *wiper*, and can be moved from one end of the fixed resistor to the other end, making electrical connection to the inner part of the fixed resistor as it goes. As the wiper moves along the length of the resistive element, it taps into the resistor at a different point, varying the resistance. This is how a potentiometer can be used as a variable resistor.

Figure 3-12 shows a typical three-terminal potentiometer with a round body. The shaft can be turned to adjust the resistance. There are many variations on this basic design.

Figure 3-12. *A typical potentiometer, or variable resistor. Image by BG Micro (http://bgmicro.com).*

The schematic symbol for a potentiometer looks suspiciously like a resistor with an extra terminal, which happens to be exactly what it is. The extra terminal is the wiper, shown as the upward-pointing arrow. See Figure 3-13.

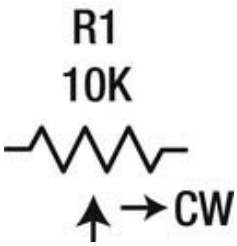

Figure 3-13. *The schematic symbol for a potentiometer is a fixed resistor with a wiper terminal. The "CW" arrow indicates which way the wiper goes when the shaft is rotated clockwise.*

Potentiometers generally come with two distinctive *response curves*, or *tapers*:

- A *linear* curve means that every equal step of rotation about the axis changes the resistance by the same amount. For example, if you were to center the shaft in the middle of its rotation, the resistance from the wiper contact to either of the end contacts would be nearly exactly half of the total resistance between the two end contacts. This is quite useful for when you need to adjust a voltage up or down in a relatively straight line. This is sometimes indicated by adding a capital *B* to the end of the resistance value (e.g., 10KΩB).
- In many audio circuits, however, it has been discovered that the human ear is anything *but* linear. A special response curve that more accurately describes this sensitivity is called an *audio* curve or taper. An *A* is used as a suffix to indicate that an audio taper is used for a potentiometer.

Note that linear and audio tapers are *not* interchangeable. If you find some random potentiometers in a parts bin, you can get a quick idea of what you've got by centering the shafts and seeing if the resistance is "symmetrical" or not, using an ohmmeter. Equal resistance to either end terminal indicates a linear taper, and anything else is mostly probably an audio taper.

Just like any other resistor, a potentiometer has a maximum power rating as well as a tolerance. These are usually either printed on the body of the potentiometer, if there is room, or hidden away in a product data sheet somewhere.

Specialty Resistors

There are many different kinds of resistors made for many special kinds of applications. High-power resistors are built out of sturdier materials that can take the thermal stress required to dissipate large amounts of heat. See Figure 13-14.

Figure 13-14. *A power resistor can handle much more heat dissipation than the smaller though-hole or surface-mount varieties. They are often so big that they need special mounting hardware. Image by BG Micro (http://bgmicro.com).*

Another popular option is the *multiturn* potentiometer. These potentiometers have an internal gear system that allows their shafts or wipers to be moved slowly across their internal resistive tracks by multiple turns of the control element. Increasing the number of turns allows the user much finer control of the resistance adjustment. It also takes the user longer to get from one point to another along the scale.

Capacitors

The basic definition of a *capacitor* is two conductors separated by an insulator. By itself, it doesn't sound like that would be a very interesting configuration at all. It turns out, however, that there's a lot more to it.

When a voltage is applied across a capacitor, no steady current flows through it. Remember, there is an *insulator* in the middle of that capacitor. Any insulator, just like the insulation on a piece of wire, *does not conduct electricity*.

What happens is that an *electric field* is created between the two conductors, or *plates*, as they are called when they are part of a capacitor. Now we get back to the fairies and dragons and molecules and so forth, way down deep at the heart of the problem. This electric field is a form of energy. Once it is built up by the difference in voltage, or *potential*, between the two conductors, it has nowhere to go, so there it stays . . . at least until something else in the circuit changes.

For this reason, capacitors are sometimes used as *reservoirs* of electrical energy in a circuit, holding a bit of spark here and there as needed. Just as it takes electrical energy to build up this electric field, a certain amount of electrical energy will be released when the field collapses. This will happen when the voltage between the two conductors drops.

Using capacitors as tiny electric batteries in a circuit is only one of many applications for this versatile part. While a capacitor will not conduct a *steady* flow of electric current between its terminals, it will often *appear* to conduct *alternating current* (as opposed to *direct current*), which is why you see them so often in audio circuits. As a charge builds up on one plate within the capacitor, it then attracts electrons from the other side, pulling them in from the other side. Even though they don't "jump the gap" of the central insulator, it looks like a tug-of-war is going on from both sides.

This behavior can also be used to send the higher-frequency components of a signal one way in a circuit and the lower-frequency components of a signal in another direction. This is one way that analog filters are built, and it has all kinds of useful and interesting applications.

Capacitors come in all shapes and sizes. They are made of many different materials, depending on what particular characteristics are needed. See Figure 3-15.

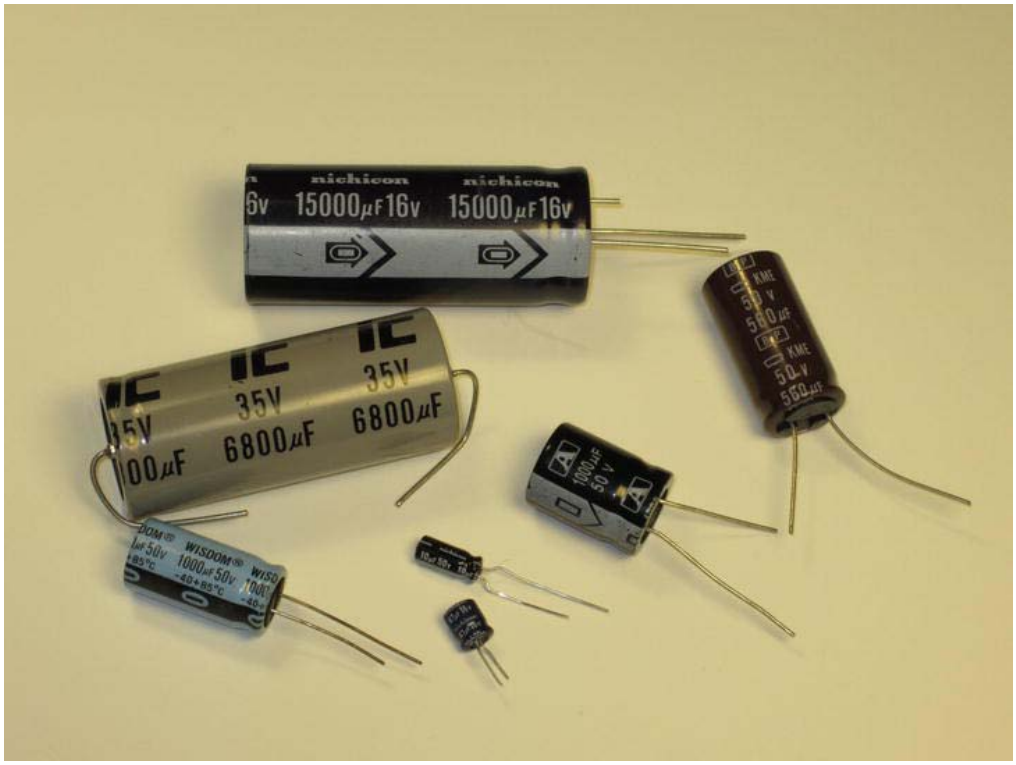

Figure 3-15. *Some electrolytic capacitors of various sizes and capacities. Both much larger and much smaller capacitors exist and are very common in electronics.*

Schematic Symbols

While there are a large number of special-purpose capacitors that are custom made for certain applications, a very large number of capacitors fall into two broad categories: polarized and nonpolarized. The schematic symbols for both types of capacitors display the fundamental construction of two conducting plates separated by an insulator. See Figure 3-16.

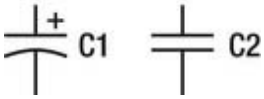

Figure 3-16. *The schematic symbols for polarized capacitors (left) and nonpolarized capacitors (right)*

C1 is a *polarized* capacitor, meaning one terminal is more positive than the other. In practice, this is indicated on the part itself in a variety of ways. One convention is that the *anode*, or more positive lead, is physically a little bit longer than the *cathode*, or negative lead. There is generally some sort of mark made on the capacitor body itself. Usually this is a stripe on the *negative* side of the capacitor.

What's really odd and potentially confusing is that one type of capacitor, specifically that made primarily of tantalum, has a stripe that indicates the *positive* lead of the polarized capacitor. Know your capacitors!

A polarized capacitor that is installed backward will experience terrible physical and thermal stresses and can sometimes explode, sending bits of itself all over the place.

C2 in Figure 3-16 illustrates a *nonpolarized* capacitor. It doesn't matter which way it is installed in a circuit. It is electrically symmetrical and works just as well in either orientation.

Inductors

An inductor is almost always made out of coils of wire. Sometimes inductors are quite large, as with transformers, while other times they are as small as a speck. An inductor would appear, electrically, as a simple short-circuit if it weren't configured to take advantage of certain principles of *electromagnetism*, or the tendency for the flow of electric current in a conductor to form a *magnetic field* around the conductor. The shape and orientation of the loops of wire that compose the inductor determine its electrical characteristics.

In many ways, an inductor is the opposite or complement of the capacitor. While a capacitor does not conduct direct current from one terminal to another, an inductor will happily do so, at least for a time. While a capacitor will resist a change in voltage across its terminal as it builds up its electric field, an inductor will resist a change in current flow across its terminal once it has established a magnetic field.

Because of their complementary natures, the two components can be used together to form a *tuned circuit*—one that resonates at a particular frequency, or allows the passage of only a certain range of frequencies, with the capacitor shuffling the high-frequency portions and blocking the low-frequency portions, while the inductor does the opposite, blocking the high-frequency components and passing the low-frequency ones. This is how many older radios and televisions worked before the advent of low-cost solid-state electronics.

Once an inductor has built up a magnetic field, any drop in the current flow across its terminals will result in the collapse of the field and the generation of a very-high-voltage spike. This is the basic electrical circuit that was used in automobile engines to create the high-voltage spark needed to ignite the fuel-and-air mixture in the combustion chamber.

Inductors can also be used to efficiently pass alternating current via a magnetic field from one inductor to another. This is how the primary windings of a power transformer *induce* a current in the neighboring secondary coil, which, depending on the ratio of windings and a few other factors, determines if the transformer *steps up* the voltage or *steps down* the voltage. It can even keep the voltage the same, for when electrical isolation is needed between two different systems.

Most electric motors employ some sort of inductor that alternately attracts and repels another electromagnet or permanent magnet. The most basic direct-current (DC) motors require a fairly complex mechanical arrangement to perform the necessary switch-swap to alternate the fields. This process is called *commutation*. In other types of electric motors, such as brushless motors and stepper motors, this commutation process is done electronically, externally to the motor itself, and requires more complex circuitry to control the speed and direction of the motors. See Figure 3-17.

Figure 3-17. *Some simple DC motors. When direct current is applied to their terminals, they spin. The magic happens with an electrical and mechanical arrangement inside that performs the necessary commutation of the magnetic fields.*

Switches

The most basic way to control the flow of electric current in a circuit it to literally *break* the circuit. This means that instead of forming a conductive loop from power source to components and back again, a gap is introduced somewhere in the loop.

This gap can come anywhere in the loop. It can be right next to the battery, for example, or somewhere off in the middle—as long as the circle is broken, no current will flow.

If you perform the lightbulb experiment in Chapter 1, you can see how this works. When everything is lined up properly and the final connection is made, the lightbulb lights up. When any of the connections are broken, the light goes out. It's really as simple as that.

Most of the electrical switches that you operate every day are really mechanical in nature. Their main function is to physically move two conductors either together or apart.

In the lightbulb experiment, you could use the wire as a switch, by physically touching either the battery terminal or the lightbulb (depending on how you were holding everything together). With a little practice, you could probably send Morse code, or at least a variation on "one if by land, two if by sea."

There are many kinds of switches for many kinds of switching tasks. The most basic are *momentary action* switches. These are usually push buttons, and only conduct electricity when pressed. Alternately, they can be built so that they conduct electricity all the time, *except* when pressed:

- The first option is called *normally open*. When a circuit is open, it is not conducting electricity. When you *close* the circuit, by completing the loop, electricity can flow. A normally open switch would be welcome in a doorbell circuit. When no one is pressing the button, no bells are ringing. It would be annoying the other way around.
- A *normally closed* switch acts like a solid piece of wire (being a conductor of electricity) until it is activated, when it ceases to provide a path for the electricity to follow. This type of switch can be used as a *kill switch* on a gasoline-powered engine, such as a lawn mower, for example. By interrupting the flow of electricity generated by the magneto and powering the spark plug, you interrupt the internal combustion cycle, which will eventually cause the engine to slow down and then stop.

This type of switch is called a *single-throw* switch. It's either on or it's off—conducting electricity or not conducting electricity.

■ **Note** For almost every possible configuration of switches, there is a corresponding *opposite* configuration that is almost as popular.

Another useful configuration for a switch is to switch from one circuit to another circuit, and not just on and off. This is referred to as a *double-throw* circuit. A switch like this normally has three terminals. A *common* terminal is usually, but not always, in the center. At any rate, the common terminal is electrically connected to the moving part of the switch that is going to make contact with one or the other two remaining contacts. The *normally closed* contact is the one that will be making contact with the common terminal when the switch is not activated, or at rest. The *normally open* contact is simply the other terminal. This assumes that the switch has some sort of bias or mechanical spring action that returns it to a certain orientation when no one is activating it.

Some double-throw switches can remain in either state indefinitely. A typical light switch used in indoor lighting is a good example. It's just as happy to stay on as off.

Switches can have more than one circuit built into them. These switches are called *double pole*, *triple pole*, and so forth. They're like two or more single-pole switches physically taped together, so that when one is switched, they all are switched. Usually these poles are electrically isolated from each other.

We'll play with switches again in Chapter 5, where you'll learn some interesting ways to wire them up.

Active Components

While it could truthfully be said that *all* electronic components require some electricity to do anything, the distinction made in this book between *passive* and *active* components is that *active* components need a little more power to be really interesting.

First we'll look at sources of this magical electricity, and then we'll move on to some of the fascinating and complex components that will happily use it all up for you.

Power Supplies

You're going to need some sort of power source for any electric or electronic circuit you run across. If it doesn't use electricity in some structured form, it's not really electronics, now is it?

Batteries

You can use regular batteries to power a lot of your circuits, but they eventually wear out, and then you have no real recourse other than to throw them away or recycle them, if possible. If you're going to be using batteries, at least get some good ones. Many of the bargain brands are terribly inferior in their manufacture and are only providing you with a false economy. Spend a little more and get higher-quality parts, and you will be rewarded with longer life and more reliable operation.

A great way to work with batteries is to use the appropriate battery connectors or battery holders. Sometimes you can remove these from obsolete electronic devices that have outlived their useful lifetime. Always observe the proper orientation and polarity of batteries. Even smaller batteries contain an annoying amount of power, especially when it all decides to come out at once, such as when you accidentally plug something in backward or short something out. This can result in damaged parts, burns, or even fires. Be careful with batteries.

Having a fuse holder wired inline with your battery-powered supply is an excellent and cheap way to prevent such "unauthorized thermal events." Keep several spare fuses on hand as well. Fuses cost little and save much.

Rechargeable batteries are becoming more common, and they keep coming down in price while improving in longevity and power capacity, and decreasing in size and weight. Any rechargeable battery technology beats any kind of primary, or nonrechargeable, battery in the long run.

■ **Caution** The same warnings about battery polarity and fuses apply to rechargeable batteries as well.

Since there's no easy way to "turn off" a battery, it would be a good idea to include a power switch in your supply, if possible. Just make sure that whatever switch you select can stand up to the maximum current you will want to be extracting from your power supply. You should also make your switch large and easy to see, so that you can find it quickly when you need it. An obvious power-on indicator is also a great plus for a homemade power supply. This can be as simple as a green LED (with appropriate current-limiting resistor—see below) or as complex as a voltage meter indicating how much juice is left.

Transformers

Another great power supply that you probably already own is a power adapter or transformer from another electronic appliance. You should use caution, of course, with anything that plugs into the wall for power, especially if you're planning on monkeying around with the other end of it.

Almost all commercially produced power adapters have a slew of certifications plastered on them. Somewhere in there should be the basic data concerning what type of power input it expects, what it is going to try to produce, and what the maximum limits are on the output. Make sure that whatever it is that you're going to plug into your wall is specifically designed to plug into *your* wall, as electrical power standards vary from one location to another.

Make sure that any repurposed power supply you use does not get overly warm when in use. This is an indication that it is presently or has been overloaded in the past. Such a device is a fire-starter waiting for its magic moment.

You need to know how much voltage is coming out of your power supply. Even if it is clearly printed on the device itself, if you have access to a voltmeter, you need to verify the output voltage before connecting it to anything. Many lower-cost power adapters are *unregulated* and will produce an output voltage that will vary wildly depending on the load applied to it. A *regulated* voltage output, on the other hand, will provide consistent voltage levels on the output, even with varying loads.

USB adapters and chargers are becoming quite common and can provide *regulated* +5V at up to 1/2A and sometimes more. These are great devices to use for small electronic experiments. They are generally small, lightweight, and reliable.

A dedicated bench power supply is a very handy piece of test and measurement gear to have available in your lab. A good supply will have a variable voltage and a readout to show you what's going on (or coming out). A step up and you get to set the maximum current that it will supply (to keep things from getting out of control too fast). Additional desirable features include multiple outputs and remote control from your PC.

No matter what kind of power supply you use, use it responsibly. Don't leave equipment powered up if you're not using it. Don't attempt to bypass safety measures that are in place for *your* protection.

Diodes

A diode is a semiconductor device that will conduct current in one direction only. That's the simple story. Of course, the reality is much more complex. A typical diode is composed of two pieces of a semiconductor material, usually silicon, but sometimes germanium or some other exotic substance. The diode action occurs in the *junction* between the two types of semiconductors, which have been specially manufactured to contain the exact right balance of impurities required. This is generally not the kind of thing you can build in your lab, unless you're Jeri Ellsworth.

These two bits of semiconductor, called the *N region* and the *P region* (for negative and positive, respectively), are sealed up in either a glass or plastic enclosure. A standard diode has two terminals—an *anode* and a *cathode*—which represent the positive and negative leads, again respectively. Conventional current (i.e., current flowing from the more positive voltage to the more negative voltage) can flow through the diode from the anode to the cathode, but not the other way around. It's magic! Well, technically it's semiconductor physics, but either answer will serve for our purposes.

Diodes come in all sizes. Generally speaking, the more power a diode is expected to handle, the larger it is going to be. *Small-signal* diodes are the same size or smaller than typical resistors. Power diodes, often called *rectifiers*, depending on their application, can be so large they have to be mounted with large bolts.

The two most important electrical characteristics for the happy care and feeding of diodes are their maximum reverse voltage and forward current capability. You don't want to exceed either one.

Since a diode is, at best, only ever going to have a cryptic part number written on it, you'll need to consult the manufacturer's data sheet to find out all the necessary information. Many semiconductor producers offer "commodity" parts that conform to standard part numbering schemes. That way, you know that a 2N4148 diode from one manufacturer is going to be pretty close to a 2N4148 diode from any other manufacturer, but you should always check to make sure.

Diodes typically have a *forward voltage* that must be exceeded before current will flow. This voltage is essentially lost and is dissipated as waste heat from the device. Silicon diodes will have an average forward voltage around 0.7V and up. Germanium diodes will have a smaller forward voltage, in the area of 0.3V. Schottky diodes use a metal-to-semiconductor interface region and achieve substantially lower voltage drops, making them much more suitable for higher-power applications.

LEDs

One special kind of diode is the popular *light-emitting diode*. You see these little guys everywhere these days. In fact, some folks go around with black tape, just trying to cover them all up so they can get their darkness back at night.

The reason that they are everywhere is that they are cheap, reliable, and easy to use. They don't take up much room, don't take up much power, and don't generate that much heat. The exceptions to these admirable qualities, of course, are in the newer generation of LED lighting products that emit tremendous amounts of light and produce tremendous amounts of heat. Every month it seems that a new record is set for efficiency. Let's hope that trend continues.

Being essentially diodes, LEDs have both an anode and a cathode. LEDs only conduct current in a single direction. You'll need to make sure you limit the amount of current flowing through your LEDs, because the LEDs themselves sure aren't going to do it.

LEDs designed to be indicator lights can be powered with as little as 1mA. High-efficiency LEDs can be used for illumination purposes and still only draw 20–30mA each. These very modest power requirements make LEDs a favorite for microcontroller projects, as these output power levels are easily handled by most popular chips.

The forward voltage drop across LEDs is typically much higher than for a rectifier or signal diode. In fact, the voltage goes up as the emitted color of the LED goes from the infrared and red end of the spectrum (1.2–2V) up to the blue and ultraviolet end of the spectrum (3–3.6V).

Transistors

A true modern miracle, the semiconductor transistor ushered in the age of solid-state electronics. More than a million individual transistors can be used to build modern computer processors, all on a single chip.

The first types of transistors to be built and used were called *bipolar junction transistors (BJTs)*. This type of transistor is similar in construction to the diode, except that there are two semiconductor junction areas inside.

This arrangement of magic beans allows a small amount of electrical current to be applied to one of the three terminals of the transistor, called the *base*, which in turn allows a much greater amount of electrical current to flow between the remaining two terminals, known as the *collector* and *emitter*.

Two complementary types of BJTs are made, depending on the way that the positive and negative semiconductors are sandwiched together. NPN transistors will conduct conventional current from the collector to the emitter when current flows from the base to the emitter. The opposite variety, called the PNP transistor, does precisely the opposite, conducting conventional current from the emitter to the collector when the base is negatively biased.

Transistors can be used to make amplifiers, switches, current limiters, voltage regulators, oscillators, and any number of other useful circuits. They are generally very low cost, lightweight, and reliable.

As with any other electrical components, you need to be aware of the electrical limitations of your transistors. Even when a transistor is fully saturated and conducting very efficiently, it's still dissipating a certain amount of its energy as heat. Too much heat and say goodbye to your transistor.

A newer type of transistor is becoming quite popular in power circuit applications, and uses a different type of semiconductor property to accomplish its mission. The *MOSFET (metal-oxide–semiconductor field-effect transistor)* has three terminals, just like the BJT. Each terminal performs a similar job, but does it in a different way. The *gate* of a MOSFET is electrically isolated from the conduction *channel* between the *drain* and *source* terminals. However, when a proper voltage is applied to the gate, it creates an electrical field that influences the conductivity of the channel between the drain and the source.

The important differences between BJTs and MOSFETs lie in the type of signal needed to drive each of the transistors and how much power is wasted by being converted to heat. A BJT is a current-controlled device, where more current into (or out of) the base results in more current flow through the device. The MOSFET is a voltage-controlled device, where more voltage applied to the gate increases the current flowing through the channel.

Additionally, MOSFETs typically have much lower on-state resistance than BJTs, meaning they can more efficiently switch higher currents. Finally, MOSFETs have a *positive temperature coefficient*, meaning that they conduct less power as they heat up—which is a good thing. BJTs are subject to *thermal runaway*—conducting more current as they heat up, which in turn generates more heat, and so on, until something snaps, crackles, or pops.

Integrated Circuits

As parts get more specialized, they become less fun. There are a hundred ways to wire up some transistors, resistors, and capacitors, but there's generally only one way to hook up a thermocouple interface chip.

The good news is that it has become much easier for companies to design and build vastly complex chips that can do things for us that, honestly, most people cannot comprehend. And that's OK. We need airplanes that can, mostly, fly themselves. If we had to depend on humans to get everything done, you can imagine what kind of world we'd live in. Humans are notoriously sleepy, hungry, distracted, and forgetful. A voltage comparator chip does nothing but compare two voltages, all day, every day, perfectly, all the time.

Integrated circuits come in an unbelievably wide range of functions, packages, and capabilities. The first integrated circuits were amplifiers. Integrated circuits allowed manufacturers to make chips that have dozens or hundreds of transistors and other parts *all at once*. Just plop that little silicon chip into a plastic package with legs on it, and you're done.

What kind of chips do you need in your lab? Well, that's going to depend heavily on what kind of circuits you're wanting to design, build, or repair.

Many older chips had a standard 0.1" pin spacing that made them easy to plug into a solderless breadboard for prototyping purposes. Most newer chips have been considerably shrunk, because phones and tablet computers are all the rage these days. It's still possible to work with these newer chips, but it almost always requires mounting them to some sort of breakout board or expander that brings out their tiny leads to a more reasonable, and reachable, size.

Acquiring Components

Where do components come from? The same place as everything else—the store—just like food, just like money.

The electronic component manufacturing industry spans the globe. If someone's not putting something electronic together, they're taking something electronic apart.

Once upon a time it took some hunting to find sources for electronic parts. Swap meets and "ham fests" were great places to find components, assemblies, and entire appliances just ready to be hacked, studied, improved, or rebuilt. Now you have to spend time looking for places to *get away* from all the electronic hustle and bustle.

One of the great things about today's Internet is that it takes almost no effort to find both electronic parts and the information needed to use them. The real trick these days is finding the best deal.

If you're strictly a hobbyist, looking to spend some quality time alone or with your kids, learning about electronics and building fun projects, then it just about doesn't matter if you get the absolute, rock-bottom price on every component and tool. Even if you're a budding entrepreneur, you're still in a much better position today to leverage those brilliant ideas floating around in that noggin of yours than you would have been even ten years ago, all because of the ubiquitous nature of electronics and technology saturating our lives. Not only can you get the right tools and the best parts shipped right to your door for a song, you can easily network with knowledgeable folk from all over the globe, contributing ideas and brainstorming across time zones and borders.

Buying New Components

It would be more than a full-time job just keeping up with all of the new tools, parts, software, and hardware that are available today. Even if you could, it would take many lifetimes to make and grow the connections and relationships you need to successfully compete in the global economy.

That being said, a good place to start is in your own backyard. If at all possible, you should deal locally for the things you need. When what you want or need cannot be obtained locally, expand outward until you find it.

While it's certainly nice to be able to find all your needs met close to home, it's also good to know that the world is shrinking every day. The sort of deals and relationships that couldn't possibly have existed in your parents' time are happening right now.

If you are in a position to spend some money on quality tools and components, then by all means do so. You will not regret it. Buying questionable items is like buying your groceries out of some guy's van in a parking lot. Maybe he'll be there next week and maybe he won't.

Even the small fry can get treated like an honored guest when dealing with the right people. The trick is finding the right people. The best way to find them is to ask your friends and others with similar interest where they trade. Ask them how they feel about their relationships with their vendors. Are they just a number? Or are they a partner?

Recycling Used Components

It's really a bad idea to waste anything. In a more perfect world, there'd be no "other" category at the recyclers. Everything would have an exit strategy, especially the complex and fragile toys we're so addicted to these days.

Until that day, try to look at your trash with new eyes. Is it conceivable that someone else might be able to use this equipment, or is it truly past its useful life? Or are you just being lazy?

You can do your part, and you should believe that others are doing their part as well. Take the time to find them, find out what they can offer you, and find out what you have that they might be able to use. You won't know until you ask.

Be careful when harvesting components with which you are unfamiliar. Novice recyclers should give yesterday's cathode ray tube (CRT) TVs and monitors a wide berth. They can retain *lethal* voltages for considerable periods of time after being retired from service. Just leave them on the side of the road. The same goes for microwave ovens, or any equipment that has refrigerant in it. The stuff they use nowadays is quite toxic.

There is a growing surplus of both components and "last year's models" available to the student of electronics these days. Sometimes it's worth your time and money just to take something apart to see how it works. Then sometimes you find some useful parts inside that you can use in projects of your own.

Component Data Sheets

Every component ever manufactured has a data sheet. This data sheet contains everything you ever wanted or needed to know about this particular component. It's probably available right now on the manufacturer's web site, along with a dozen application notes. If not, then it's probably available on a university's computer system in a project folder.

This isn't always the case, sadly. Past a certain point, it doesn't make sense to allocate resources to information that no one wants or needs anymore. That point varies with each company, with some diligently archiving their information and others tossing it out the window at the end of the quarter.

When possible, collect and maintain your own private set of data sheets. When you acquire a new piece of equipment, get everything you can find in electronic form and stash it away somewhere where you can find it when you need it. If you're experimenting with some new components, squirrel away those data sheets, just in case you strike gold.

Have you built something cool? Write up your own data sheet for it! Pretend that you're still going to be interested in this project next year. Better yet, imagine that *someone else* could take an interest in your work. You'll be pleasantly surprised at how useful you'll find this information in the future, after you've slept a bit.

Summary

This chapter has covered a lot of different types of electronic components, but it has only scratched the surface of what is presently available.

It's perfectly possible to spend a lifetime pleasantly tinkering with electronics and never have a clue how any of the underlying principles work. Sometimes all you need is a *practical* understanding of what the different components do in a circuit. Hopefully this chapter has given you a rough outline of what is involved. Ideally, your interest has been sparked enough to pursue more detailed study elsewhere. Good luck and happy discovering!

Now that you're armed with some basic tools and some ideas about some of the available components, it's time to get busy building your own lab, one experiment at a time.

The remainder of this book will take you on a journey of trial, error, and experimentation that will help you build the best possible lab for your needs, both for now and in the future.

CHAPTER 4

A Portable Mini-Lab

Having a portable (or at least (*trans*portable) electronics lab comes in handy in several circumstances. Maybe you don't have a place (yet) for a permanent home for all that equipment. Maybe you need to bounce at a moment's notice, heading off on electronic adventures at the drop of a hat. Or maybe you like to keep everything where you can find it in a hurry, without having to rummage through shelves and boxes, looking for just the right tool or component.

Whatever your motivation for wanting a portable lab at your disposal, this chapter should help you get started.

Have Lab, Will Travel

First, a note or two is in order concerning *travelling* with your electronics lab. Nothing makes security screeners at an airport or customs inspectors at border crossings more nervous than a bunch of mysterious devices, especially devices that are tangled up in a rat's nest of wires.

Do what you can to keep your collection of tools and components tidy and in working order. You will most likely be asked to at least turn on any questionable items and demonstrate that they are not hollowed-out shells for transporting questionable items. It also doesn't hurt to clearly label equipment as to its function and ownership, which makes sense in any case, not just travel scenarios.

The Compact Executive Model

"A full mongoose is a slow mongoose." This is an important lesson learned from Rudyard Kipling's *Rikki-Tikki-Tavi*. Rikki, a mongoose, has to stay fast on his feet to be able to combat Nag the cobra and hope to win. Therefore, Rikki learns to only take a few bites at a time when eating and never gorge himself.

Although hopefully not in a life-or-death situation like Rikki's, you can learn a thing or two from this simple philosophy. Only take what you absolutely need when travelling, and never take something you can obtain at your destination. These things will only slow you down. Don't be a slow mongoose.

■ **Tip** Travel light.

A slim and lightweight briefcase or attaché can hold many of the tools and components you might need for your mobile electronic experimentations. The main advantage is that you will only need one hand to carry it (leaving one hand free to open doors, bribe guards, or fend off ninja—assuming you have two hands to begin with). See Figure 4-1.

Figure 4-1. *The compact executive mobile electronics laboratory. There's plenty of room for lots of tiny things, but not much else. Also handy for transporting big stacks of cash, should the situation arise.*

Let's take a look at what all you can take with you without a lot of heavy lifting. Starting on the left and moving to the right, we have

- Netbook PC with AC charger and USB mouse (it might be hard to see in Figure 4-1 because it's upside down and covered by other stuff)
- Arduino Uno programmable microcontroller (or *physical computing platform*)
- Folding multitool
- Lighted magnifier
- Digital camera
- Solderless breadboard with lots of precut jumper wires
- Digital multimeter and probes
- Compact single-channel oscilloscope with probe
- AC-powered USB charger—can also be used as a stand-alone regulated 5V power supply
- USB cable
- A variety of LEDs in all shapes and sizes
- Additional passive components
- A variety of batteries, both rechargeable and otherwise, and various battery holders (not shown)
- Static-sensitive integrated circuits and modules stored in antistatic bags
- Notebooks, writing implements, blank media, and documentation
- Your contact information in case of loss

One of the interesting features of this lab is that it is completely self-contained, power-wise. While it's nice to have access to AC power, it's not strictly required, at least for a while. The Arduino and the attached breadboard are powered by the battery in the netbook, via the USB cable. The multimeter has its own 9V battery, while the mini-oscilloscope can be recharged from a spare USB connector. With an extended-life battery, you can expect four to five hours of on-location electronic experimentation.

If your netbook or PC has Wi-Fi or other connectivity to the Internet, you can browse tutorials, data sheets, user forums, and even this book, unless you've already downloaded these items to the internal hard drive.

Have a look at this particular lab deployed and ready for action in Figure 4-2.

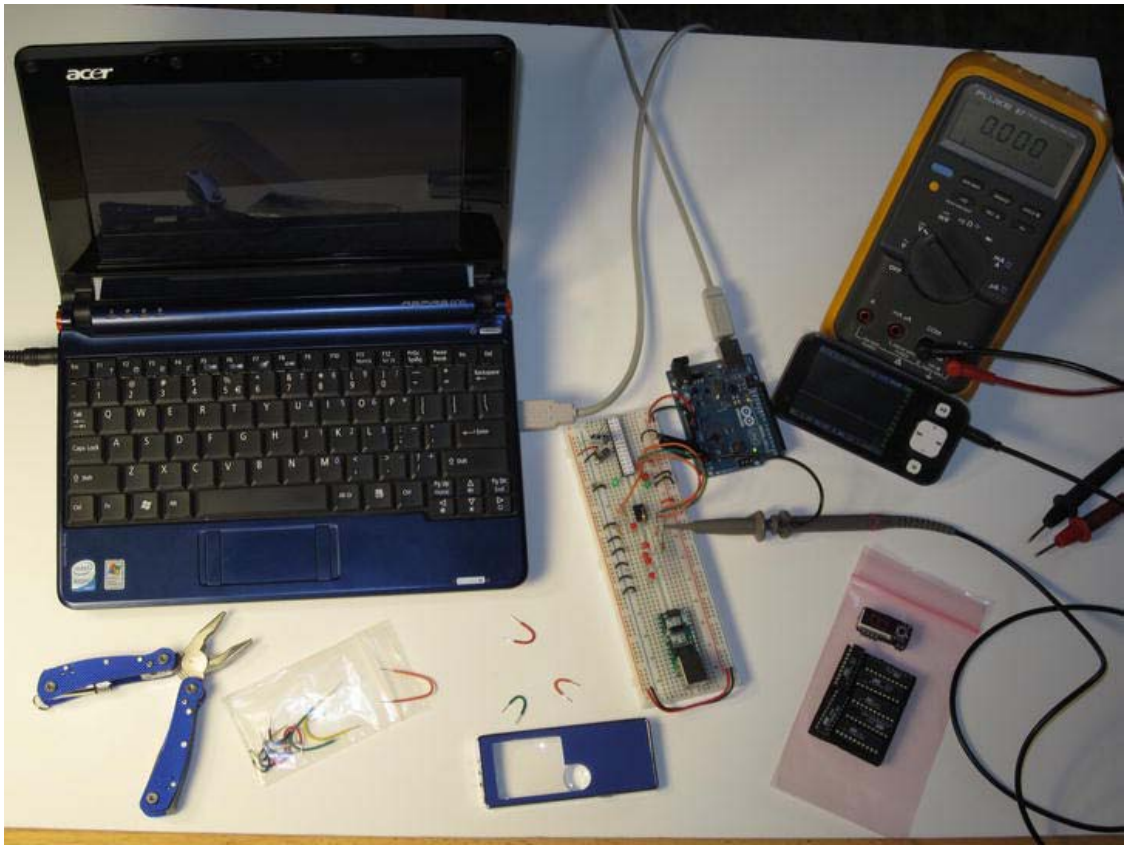

Figure 4-2. *The compact executive lab is deployed on a desktop. You have access to lots of electronic building and debugging capabilities in a small area. Using a solderless breadboard helps reduce the number of fabrication tools that you need to carry with you on your adventures.*

The Arduino was included for its small size, popularity, and ease of use. There's a whole world waiting for you inside that little board, waiting to be explored, but that's a story for another day.

You can use the USB cable to extract a regulated +5V supply from your PC for your low-voltage-experimenting pleasure. You can also use an inexpensive USB charger to do the same thing, if you don't feel like hauling a whole PC around with you. Just don't try to draw more than half an amp of current, which is the "official" USB limit for supplying power to USB devices. Technically, *unenumerated* devices (i.e., just a USB cable with nothing intelligent enough to identify itself to your computer) can only draw up to 100 mA (0.1A) of current. A USB charger, on the other hand, is not so picky.

No Soldering Required

One notable omission from this particular configuration is any sort of soldering tool. You could certainly add a small soldering iron, some solder, and a few more hand tools. You'll either need to boot out some of the bulkier items, such as the PC or the full-sized multimeter, or get a slightly bigger carrying case.

The Ever-Shrinking Computing Device

One option that will be gaining momentum in the very near future is the use of tablet computers or smart phones instead of the physically larger laptops or netbooks. They already have a lot of the computing capabilities of reasonably powered portable computers. Also, you can look forward to innovative hardware and software interfaces that will make them more useful in the lab as programmable test and measurement devices. While name-brand products still command a premium price, many no-name or OEM (original equipment manufacturer) products are being sold for a fraction of the cost.

Electrical Experiments You Can Perform

Here are some simple electronic experiments that you can perform using only the tools and components found in the compact executive mobile electronics lab. Start out with something simple and incrementally build on your success. Don't try the most complex problems first. What you want is to build up both your knowledge *and* your confidence at the same time.

Lighten Up, 20th Century Style

Here's an easy experiment that will teach you several interesting things about electronics, believe it or not. You can light up a typical LED using only a lithium coin cell. It needs to be a lithium coin cell that produces at least three volts (marked "3V"), not one of the smaller batteries that only supplies 1.5V, such as a watch or hearing-aid battery, as these will not produce enough voltage to light up a typical LED.

Slide the coin cell between the leads of your LED. There are four possible outcomes, three of which are "nothing interesting happens." Let's start with the least likely possibility, in which the LED lights up. Sometimes you just get lucky.

First Possible Outcome: The LED Lights Up When Attached to the Coin Cell

Figure 4-3 shows the results of this outcome. Notice that the longer lead of the sLED (the positive, or anode, lead) is touching the side of the coin cell marked with a +. No current-limiting resistor is required in this circuit because the battery's internal resistance is sufficient to keep from blowing up the LED. It just happens to work out that way, this time. Most other times, you will need to add a current-limiting resistor to the circuit.

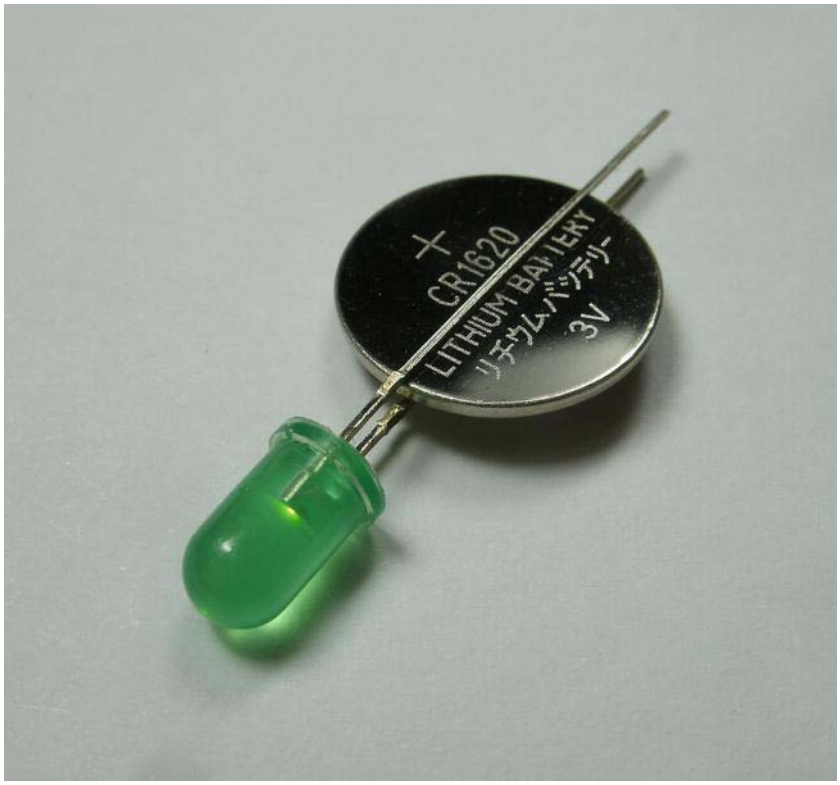

Figure 4-3. *A typical LED lights up when attached to a lithium coin cell. No extra wires needed!*

The other three scenarios? Let's look at them one at a time.

Second Possible Outcome: Nothing Interesting Happens

Why? Because the LED has been installed backward. Alternatively, the coin cell has been installed backward. Remember from Chapter 2 that LEDs are light-emitting diodes, and diodes only carry current in one direction. Therefore, when connected backward, they block the flow of electric current, preventing anything interesting from happening in the rest of the circuit.

Typical lithium coin cells have one broad, flat side that usually has something printed or etched on it, almost always with a + to indicate the positive polarity of the cell. The other side is often textured or rippled in some way to help make better electrical contact when installed in a device. This other side is the negative terminal of the battery.

The LED, being a diode, is *polarized*. It will only work when installed in the proper orientation inside the circuit. Most LEDs will offer one or more ways of easily identifying which lead is which (see Figure 4-4).

- Brand-new LEDs will have extended leads about an inch or so long. One lead will be slightly longer than the other one. The longer lead is the *anode*, or positive lead. The shorter lead is the *cathode*, or negative lead. This information is lost when the leads of the LED are trimmed—for example, after being installed in a PCB.
- Another industry standard for identifying the polarity of an LED is to look at the small ridge or shoulder at the base of the LED body. There will be a flat portion molded into the otherwise circular outline. This flat spot marks the cathode, or negative terminal of the LED.

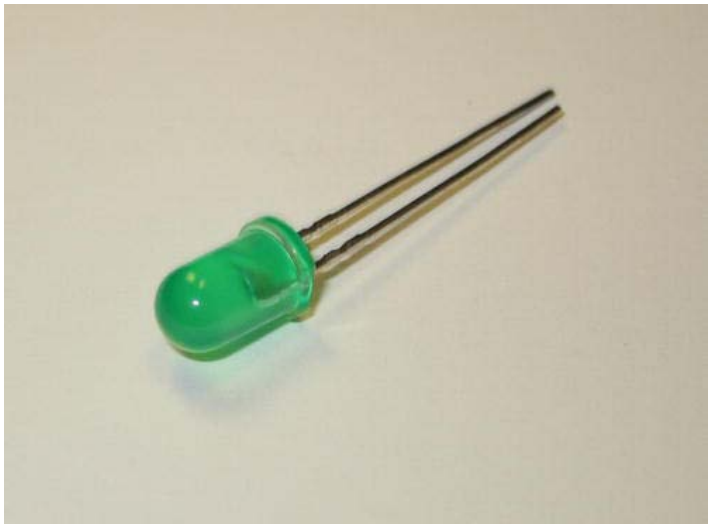

Figure 4-4. *Typical LEDs in the 3mm, 5mm, 8mm, and 10mm sizes almost always have two polarity indicators. The first is that the longer lead is the positive lead, or anode (top). The second is that the flat side on the base indicates the negative lead, or cathode (bottom).*

On really tiny LEDs, there may be an even tinier mark printed or etched onto the LED to indicate the cathode. You will sometimes need a magnifying glass just to see it!

The quick and easy fix for this problem is to swap the direction of either the LED or the battery. If this still produces no good results, we have to consider some more possibilities.

Third Possible Outcome: Nothing Interesting Happens

This time, after establishing that the LED has been properly oriented with respect to the polarity of the battery, we must entertain the possibility that the battery has been previously depleted. Coin cells have a limited amount of energy stored within them, and this can be easily drained in normal use over time.

A quick way to measure a battery's electrical goodness is to use a voltmeter. See Figure 4-5.

Figure 4-5. *Measuring a coin cell's electrical goodness using a digital multimeter. This one is chock-full of goodness!*

If you have a multimeter, be sure to set it to read DC voltage, in the appropriate voltage range (unless you have a fancy "autoranging" meter). Touch one of the meter's probes to one side of the battery and the other probe to the other side of the battery, and see how much voltage is measured. Anything below 3V should be considered depleted and of no further use, as far as electronic-type projects are concerned. The batteries are shiny and round, so they may have a second career in some sort of art project, but otherwise they should be disposed of in a responsible manner.

Also, perhaps because of their very shininess and roundness, they like to be eaten by small children. Don't let this happen! Take whatever steps are necessary to prevent small children from handling or even touching your electronic tools and components. Use extra care when your lab is mobilized.

■ **Caution** No unsupervised children, no matter how adorable, are allowed in the lab!

Fourth Possible Outcome: Nothing Interesting Happens Because the LED Is Defective

This can happen when an LED is subjected to too much current and the tiny, tiny wires within the plastic body overheat and fail. It can also occur when the LED has been exposed to the elements and moisture has penetrated the casing, allowing the internal connections to oxidize. This scenario, while within the realm of possibility, is certainly the least likely of the four, unless you are habitually cruel to your LEDs. It's also easy to test, if you have a known-good lithium coin cell handy.

Where's the Resistor?

You might be wondering where the current-limiting resistor can be found in this circuit. It's in there, all right, but it's hidden within the battery, so to speak. Coin cells are designed to provide tiny amounts of current over a long period of time. You're not going to arc-weld or start your car with one. As such, they have a much higher *internal resistance* than most any other kind of battery. We use this "feature" to our advantage when testing LEDs using just a coin cell, as the maximum amount of current that will normally flow out of the battery is below that necessary to destroy the LED.

A Slightly More Permanent Circuit

You can build a more permanent circuit for the coin cell and LED using a solderless breadboard. If you recall from the "Solderless Breadboards" section of Chapter 3 (see Figure 3-6), a solderless breadboard is an array of spring-loaded tie points, which serve to both physically hold electronic components and provide electrical connections between certain points. Let's build an LED circuit on a solderless breadboard using an LED, a coin cell, a resistor, a jumper wire, and a custom battery holder (see Figure 4-6). Later on, in Figure 4-7, you can see details of the custom battery holder.

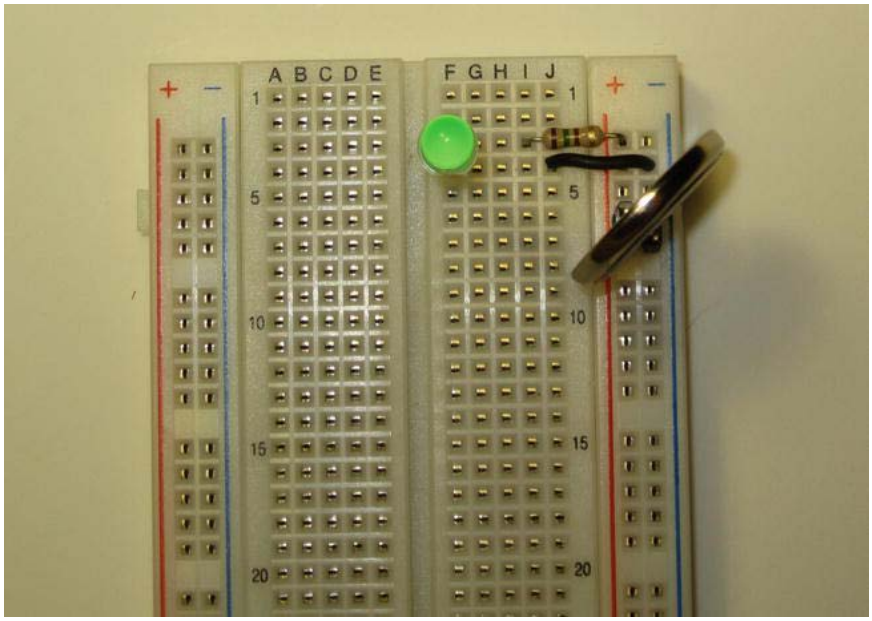

Figure 4-6. *A slightly more permanent LED circuit, built on a solderless breadboard. The tie points on the breadboard are labeled left to right with the letters A–E and F–J for the columns. The rows are numbered starting at 1 at the top. The LED's anode, for example, is installed in tie point F3. The power rails on either side are simply marked with + for positive and – for negative.*

Referring again to Figure 4-6, you can see the overall layout of the LEDcircuit. The power rails along both sides of the breadboard are just longer versions of the electrical connections that connect each of the groups of five tie points together. In this example, the right-hand power rails are used, but the left-hand side is not.

The schematic diagram of this circuit shows how simple it is, at least in principle (see Figure 4-7). Can you see the circle?

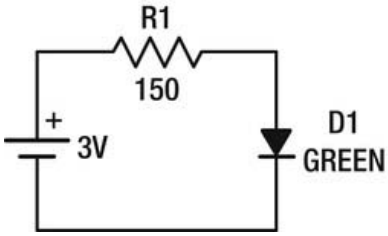

Figure 4-7. *The schematic diagram of the LED circuit as built on the solderless breadboard. Schematics are intentionally simpler than reality (most of the time) in order to help convey the very basic idea of how things are to be wired and the relationships between the components, without bogging you down in all the inevitable details that are involved.*

The Battery

The symbol for the battery actually looks like the battery in this case. The same symbol is used for most single-cell batteries, even when they are of completely different shapes or proportions. Multicell batteries are usually represented with repeated stacks of long and short lines.

The battery symbol's long line represents the positive terminal of the battery, and the short line represents the negative terminal. Again, it's just a coincidence that the wide side of the lithium coin cell is the positive terminal. The addition of the + sign in the schematic is redundant, but you'd be surprised how many people accidentally reverse this symbol. Better safe than sorry when it comes to electricity!

The Resistor

The battery's positive terminal is connected via a wire (drawn as a simple, solid line) to one side of the resistor. The schematic symbol for the resistor is a zigzag line.

The resistor is labeled "R1" (resistor 1) in this schematic, even though it's the only resistor and could just as well have been labeled "RESISTOR #1," or just plain "resistor." The numeric value underneath the resistor is the component's primary electrical characteristic, at least as far as we're concerned when looking at the schematic. In this case, it indicates a resistor whose *value* is 150Ω. In this simple example, the value of the resistor is quite flexible. A larger value, such as 1KΩ (1,000 ohms) or more, would also work, except that the LED would not shine as brightly. This is because *more* resistance results in *less* current flow, and it's the current flow that makes the LED shine. More current, more shiny.

We haven't specified any of the other important characteristics of the resistor, such as the tolerance or the power-handling capacity. Because this is such a low-power circuit, almost anything will do. When you start to work with really big LEDs that require correspondingly really big power supplies, this becomes a much more critical issue. For now, we start simply.

The LED

The other side of the resistor is connected, again, with a simple, solid line, to the anode of the LED, whose *reference designator* in this schematic is D1 (for diode 1). You could have called it "LED," and future generations would probably have understood your intentions, which should be your overriding goal. Its characteristic "value" in this case is "green." Of course, any color will do, as long as you have the eyes to see it.

The LED's schematic diagram effectively communicates its polarized nature. The arrow indicates the flow of *conventional current*. The flat bar indicates the cathode, or negative terminal of the LED. This corresponds to the flat side of the LED body in this example. The cathode is connected via a wire back to the negative terminal of the battery, completing the circuit.

Can you see the circle yet? Hint: It's disguised as a rectangle. The important point is that it forms a complete loop.

Building the Actual Circuit

Comparing the schematic to the photograph of the completed circuit might not immediately click in your head. Take a look at Figure 4-8 for a slightly different angle, where you can see some more details, such as how the battery is being mounted.

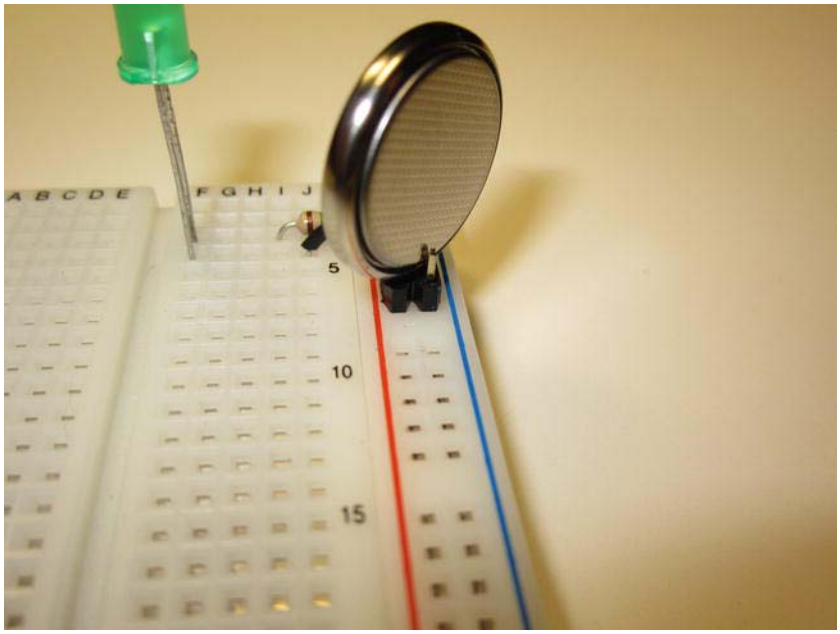

Figure 4-8. *Another view of the LED circuit as built on a solderless breadboard. The battery holder is a modified pin block that has had a couple of its pins removed, allowing the coin cell to fit in on the diagonal. A thinner coin cell could have fit without your having to remove the corner pins. A proper coin cell holder is inexpensive and would provide a much more robust solution to the problem.*

Looking at Figure 4-8, you can see how the positive side of the battery is making physical and electrical contact with the gold-plated pin of the pin block. The remainder of the pin emerges underneath the black plastic molding to make contact with the spring-loaded tie point within the body of the solderless breadboard, which in this case is the negative power rail. The positive terminal, in a similar fashion, makes contact with the positive power rail.

By attaching the battery directly to the right-side power rails, you ensure that your circuits are only a short jumper away from power, no matter where along the breadboard you decide to build them. Handy!

Note that the left-side and right-side power rails are not connected at this time. If you would like them to be, you can easily attach them using jumper wires. See Figure 4-9.

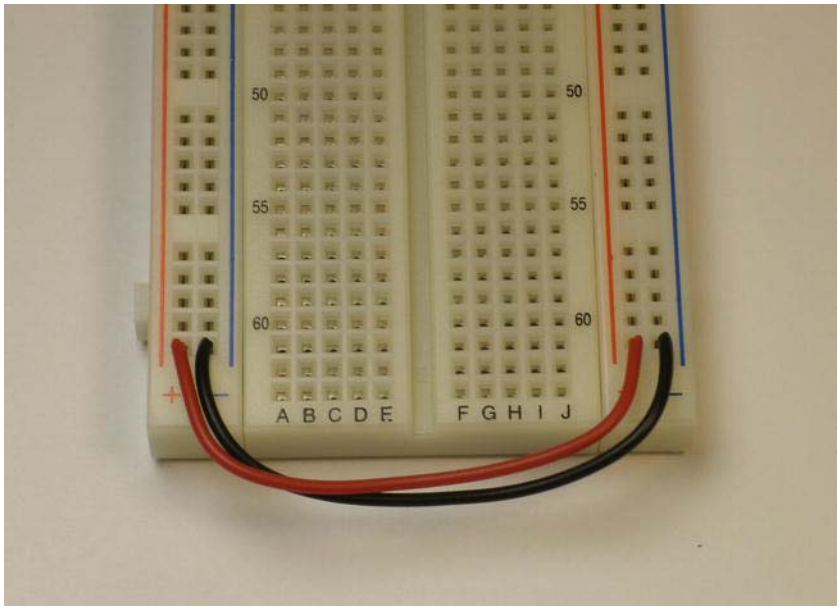

Figure 4-9. *Attaching the left- and right-side power rails using jumpers. By default, the power rails are not connected. There are some situations where you need them to not be connected, such as when using multiple supply voltages within a single circuit. These things happen.*

Now, referring *all the way back* to Figure 4-6 (sorry about that), you should be able to see how the positive terminal of the battery is indeed connected to one side of the resistor. The other side of the resistor, then, makes an electrical connection with the anode of the LED (the non-flat side, when seen from above). The cathode is connected to the negative power rail using a short jumper wire. The negative power rail then completes the circuit back to the battery. The circle is complete.

Note that the resistor could have been placed either before the LED in the circuit (as shown in the photographs) or after the LED. The only important points are that it is in the same circuit, or circle, and that the current must flow through *both* the LED and the resistor. It really doesn't matter which one comes first, especially in this simple circuit. It will only make a difference when you start to do fancy stuff, like adding switches and such to complicate things.

If you're using a different kind of solderless breadboard (and there are a few distinct varieties), you may or may not have power rails available. If so, fret not. You can still make point-to-point connections using more jumper wires. Now you're starting to understand why you were assigned to cut and strip so many jumper wires back in Chapter 2! They should start to be coming in handy just about now.

Multiple Uses for the LED

Now we've moved from the 19th century incandescent bulb to the 20th century LED. What kind of lighting devices will we encounter in the centuries ahead?

One of the nice features of LEDs is that they don't typically require a great deal of power to operate. This is certainly true of indicator-style LEDs, whose only purpose is to be seen as either on or off. We can leave this LED installed right where it is and use it as a handy power-on indicator for future projects. You might be surprised how many heads get scratched in puzzlement, wondering why a newly wired prototype isn't working, only to find out after exhaustive investigation that the power wasn't turned on! Then again, you might not be surprised by this.

Now let's take this perfectly working circuit and break it—on purpose. If we interrupt the circuit, for example, by removing any of the components or their connections, the circuit stops working. To that end, remove the short jumper wire and replace it with two longer jumper wires. Plug in each of the new, longer jumper wires where the two ends of the short jumper were installed. See Figure 4-10.

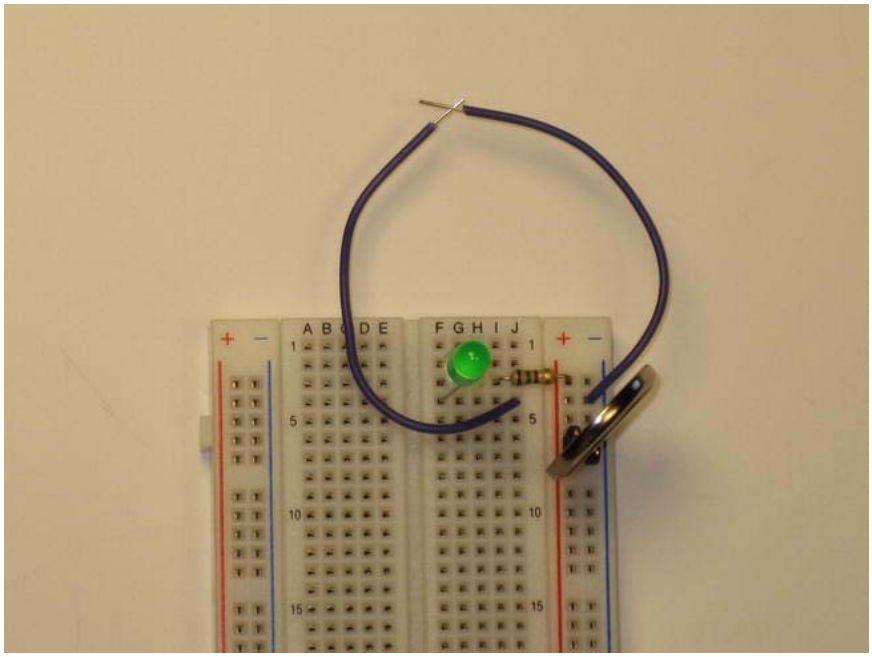

Figure 4-10. *By intentionally breaking the circuit, we stop the flow of electricity through the components, extinguishing the LED. By reconnecting the longer jumpers (or just touching them together), we reestablish the circuit, and the LED should light back up again. We can use this mechanism to test whether there is continuity in another circuit.*

Now, by touching the two probe wires together, you recomplete the circuit, and the LED should glow in happiness. This is exactly how a switch works. You can use this basic idea to build a continuity tester that lights up the LED when the current flows in the circuit. This is very handy for testing cables and wiring in a more complex assembly.

More electronic experiments, including how to both calculate and measure what's happening in a circuit, can be found in Chapter 5.

The Special Project Portable Laboratory

When you move past the simple joys of lighting LEDs and wiring up tutorial circuits, where do you go and what do you build? How about a robot?

Doug Paradis is an award-winning writer and robot builder. When Doug wants to work on one of his robots, he packs up a small kit of tools and heads over the local robot club, which in Doug's case is the Dallas Personal Robotics Group (DPRG). They meet every Tuesday at the Dallas Makerspace for an informal evening of robot building and socializing. See Figure 4-11.

Figure 4-11. *Doug Paradis of DPRG, arriving at the Dallas Makerspace for an evening of robot building. Doug uses the club's laser cutter and other specialized tools to give his robots that winning edge. He brings his own set of hand-picked tools along with him.*

Figure 4-12 shows what Doug brings with him to work on his robots.

Figure 4-12. *The contents of Doug's portable workshop. A variety of hand tools, precison measurement devices, and fasteners (including tape, tie wraps, and super glue) are easily stored in a small tool bag for easy transport. The comparmentalized storage containers at the upper right contain a large assortment of screws, washers, and nuts.*

Doug has learned the lesson of travelling light. The electronic portions of his robotic creations evolve slowly over time, but the mechanical aspects get a lot of tweaking along the way.

Not everyone has perfected the art of light travelling. See Figure 4-13.

Figure 4-13. *A sort-of-portable robotics lab, with lots of tools and spare parts. One way of looking at this bounteous splendor is "three trips to the car."*

This caravan of tools, parts, and miscellaneous supplies forms the entourage of Kyle the Robot. Kyle is very much a work-in-progress. The basic framework is made of hand-tooled aluminum. The large wheels use O-rings for tires and are driven by 24V gear motors. The 24V supply is made up of two 12V, 5Ah rechargeable lead-acid batteries. Ah stands for amp hours, and represents the capacity of the battery. In this case, it can deliver an amp of current for five hours, or five amps for one hour. The custom PCB holds the electronics for the drive motors and will be controlled by a separate microcontroller that has yet to be added. See Figure 4-14.

Figure 4-14. *Kyle the Robot is a work-in-progress who requires a wide range of specialized tools and components. Some new components are being fitted, including dedicated battery voltmeters, fuses, a circuit breaker, and a master power switch. Once the sharp corners are filed off, Kyle will be able to roll around the house, looking for chores to do.*

Summary

As we come to the end of this chapter, you should have some good ideas bouncing around in your head about how you want to pack your mobile electronics lab, what tools and components you *absolutely* must have with you, and how you want them organized. The best way to find out for sure what works for you is to make a few field trips, paying careful attention to what was actually used compared to what you anticipated needing. This will help you whittle down your cargo to the bare essentials, which is what you want. Remember, travel light. Excess baggage is a purely optional curse.

In the next chapter, we'll look at some suggestions for organizing and working in a more permanent setting. This could be a domain as small as the corner of a desk or as large as a warehouse. You will soon discover, if you haven't already, that this hobby, like many other projects, will quickly expand to fill the space available. Try to keep in mind that *you* are the one that ultimately makes the decisions. Effort spent planning ahead of time will help keep the sprawl to a minimum, while helping you stay focused on what you wanted to be able to do in the first place.

CHAPTER 5

The Cozy Corner Lab

Chapter 4 focused on the needs of the travelling electronic adept. Here in Chapter 5 you can come home to a lab that is always ready and waiting for some electrical fun and doodling. Nice!

You don't need an entire garage or extra office for a functional laboratory for your electronic endeavors. It's certainly nice if these areas are available to you, but you might be surprised at how much you can do in just a small space, if you set it up properly and maintain it with determination.

The first part of this chapter will deal with the task of rehabilitating a small, dedicated work area that has succumbed to years of poor organizational habits. These things happen. The second half of the chapter explores the possibilities of starting afresh with a nice, clean space—either something brand new or just newly cleaned. Some more projects help break in your new work area, as well as familiarize you with more interesting information about some of the basic electronic components reviewed in Chapter 3.

The Rehabilitation of a Small but Useful Area

Let's perform a little magic, in the form of a complete makeover for a small workstation. Have a look at Figure 5-1. Don't let this happen to you!

Figure 5-1. *A workstation that has been in continuous use for several years. Not much planning went into the original organization of this work area. Such a space can often accumulate flotsam and jetsam that might have at one time seemed appropriate, but now just competes for precious space. The effective work area is down to only a few dozen square inches! This limits the scope of projects that can be comfortably undertaken. It also causes unnecessary delays in rooting around for tools and parts. It's not pretty and it's not safe.*

Where to begin? Like any other project, this big project is made up of many smaller projects, none of which are especially difficult, if approached in the right order and with the right attitude.

If you're starting from scratch with your electronics lab and don't want to wade through this mess, jump on over to the "Adding a Power Source" section of this chapter.

Science to the Rescue!

Let's use the science of *taxonomy* to help break down this task into smaller, more manageable jobs. Taxonomy comes from the Greek words for "arrangement" (*taxis*) and "method" (*nomia*). That sound like *exactly* what is needed here! An "arrangement method" would assist in building up a plan for attacking this project.

■ **Tip** Method plus rigor equals success! Have a plan, pursue it with determination, and you will succeed.

Let's break down the overall category of "big mess on table" into two major *taxa* (singular: *taxon*), or categories. Ideally, what we will find here are *tools* and *components*. There will be other bits and pieces that don't easily fit into one category or the other (or will maybe fit into both), but it gives us a place to start.

Organization

Divide and *conquer*! These are the two words that will help us through the ordeal of rehabilitating this workspace. We'll get to do a lot of dividing here, and end up as conquerors. The spoils will be a useful (and tidy!) work area that will encourage you to begin new electronic adventures, instead of scaring small children.

The Great Divide

It would be possible to reorganize this workspace *in situ* (i.e., in place), but it would require a great deal of inner peace and lots of patience. Lacking these, a complete reboot is in order. Let's clear off the entire table and start afresh. This will provide the excellent opportunity to arrange things in exactly the best possible order.

First, get two big containers. These can be cardboard boxes or plastic storage bins—it really doesn't matter. We'll just be using them as temporary staging areas as we make like an embryo (and divide and divide again). See Figure 5-2.

Figure 5-2. *Two large cardboard boxes are enlisted to help with the initial organization of the contents of the tabletop. One will be for tools and the other one for components. Further subdivisions will be made later.*

Now, the first thing you will want to do is remove any items that really don't belong in the lab at all, such as coffee cups, personal effects, and any obvious trash. Everything that is about to go into one of the two boxes should eventually find its way back to the work area, so now is the time to omit the things just don't belong here.

Is it a tool? Is it a component? How do we tell? Ask five people and you will get five different answers. For the purposes of this little endeavor, a *component* is something that will become a part of a project, while a *tool* is something that is used to modify or manipulate a component. Another way of looking at it is that components get used up quickly, while tools get used up slowly. If you build enough projects, you will be lucky enough to see exceptions to these guidelines.

Here are some examples. Wire is a component. Wire cutters are tools. That was easy. A flashlight is a "visual inspection aid," so it goes under the category of tools. Batteries for the flashlight are consumable, so they are components. There's no real need to be ultra-precise at this point. Use your best judgment and make up policies that make sense to *you*.

It might help, from a physical logistics standpoint, to use smaller subcontainers to hold the really small bits as you're lumping them into the two broad categories. Folding cardboard bin boxes are handy both on the tabletop as well as on shelves, if you have them. The cardboard bin boxes shown in Figure 5-3 are from Uline (`http://uline.com`), part numbers S-16268 (4" wide) and S-16269 (6" wide).

Figure 5-3. *Folding cardboard bin boxes help contain some of the smaller bits and pieces during the Big Sort. You can use whatever happens to be available. Some preliminary subsubdivision is going on here. For the most part, the tools are on the left and the components are on the right.*

After everything is removed from the table and the cardboard boxes are nearly full, the table itself should get a good washing. Behold the *tabula rasa* (blank slate) depicted in Figure 5-4.

Figure 5-4. *The tabletop has been cleared of tools, components, and various bits of debris. A good washing with soap and water completes the cleansing. A burned spot (the result of a poorly supervised thermal test) is covered with a small sticker (see inset).*

Adding a Power Source

Here's where a bit of planning will save you a lot of headaches in the future. What you never seem to have enough of in any laboratory, especially electronics labs, are lots of conveniently located power outlets. Let's take care of that issue right away, before building anything else onto the tabletop. See Figure 5-5.

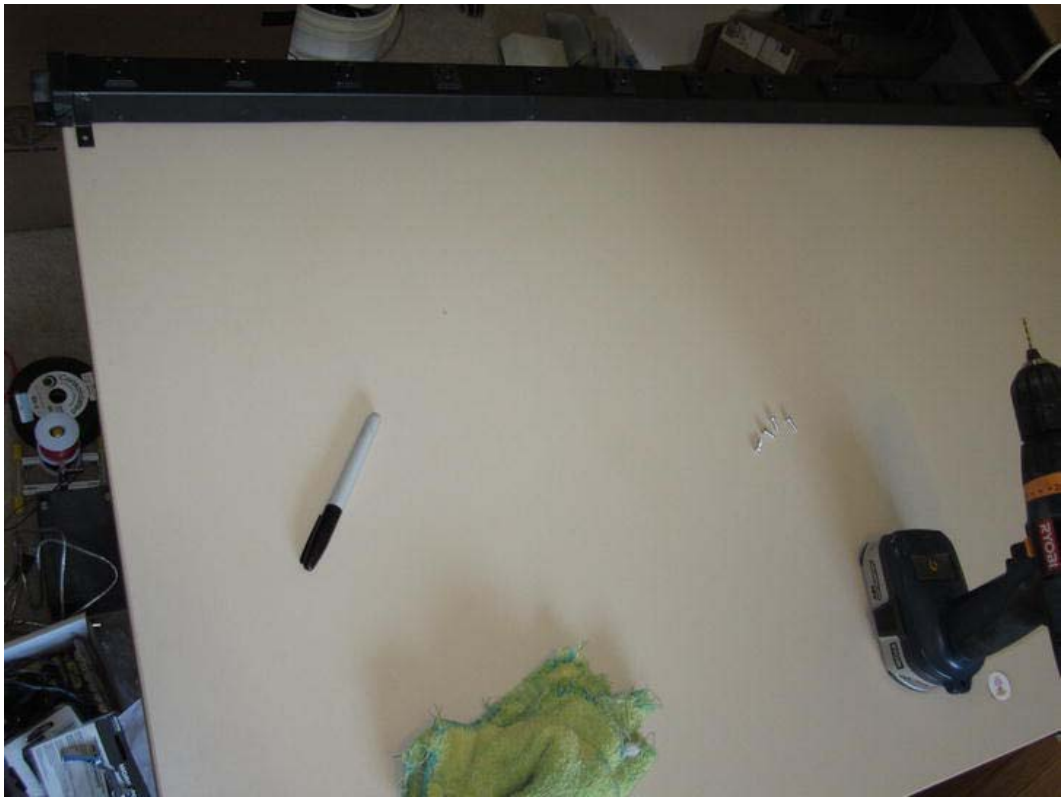

Figure 5-5. *A 12-outlet power strip is attached to the back edge of the tabletop. This will provide a safe and convenient source of power for all those gadgets you'll eventually want on your bench. Tools needed for the job include a drill motor to drill out some small pilot holes for the brackets, a small drill bit, and a felt-tipped marker. Before drilling the pilot holes, align the brackets where you want them to go and use the marker to put a dot where the pilot hole should be drilled. Make sure the power strip is not plugged in when you're drilling right next to it!*

Having lots of extra power outlets is a nice bonus, but is not absolutely required. What you want to avoid, however, is excessive daisy-chaining of power strips and extension cords. This is a fire hazard. Remember from Chapter 3 that every conductor has a certain amount of resistance. This resistance turns electricity into heat. Enough heat makes things catch on fire.

If you do have the luxury of being able to mount a permanent power strip (which, technically, remains a temporary power tap as far as the manufacturer is concerned), then be sure to install it securely using the hardware provided. See Figure 5-6.

Figure 5-6. *The power strip is fastened securely to the table using the provided hardware. You do not want your power strip wiggling around, or worse yet, falling off the table, dragging all of your power tools with it!*

■ **Tip** Test every outlet of your power strip before permanently mounting it to your workbench.

A Clean, Well-Lighted Space

You can never have enough light, it seems. What passes for normal room illumination might be sufficient for such adventurous undertakings as finding your way to the door or looking for the remote control for the television. For anything more demanding, you're going to have to add some more lighting, and probably lots of it.

At a minimum, you are going to want some *task lighting*, which helps illuminate the immediate area of your focus. In this case, where a small table is being used as a workbench, an articulated fluorescent lamp with a built-in magnifier will do a great job, at least until more lighting can be strung up. See Figure 5-7.

Figure 5-7. *You will need some task lighting for your bench. This desk lamp also includes a handy magnifier for really close work.*

Tools

Now we're ready to bring some of the tools back in to the lab. Here's where you get to decide which tools get a *permanent* home on the bench and which ones get put up and stored when not in use.

The permanently deployed tools on your workbench should be the ones that you find that you are using the most. The ones that get put up after every use are the ones that either only get used infrequently or pose some sort of hazard, such as sharp edges or hot surfaces. Again, you get to decide. It's your lab.

Tools for Soldering

An activity that is practiced frequently in many electronics labs is soldering. If you haven't learned how to solder yet, you are strongly encouraged to do so. Here's a handy setup for soldering, sitting in one corner of the newly refurbished workbench. See Figure 5-8.

Figure 5-8. *A temperature-controlled soldering station with a stand for the soldering iron, a water bottle to wet the tip-wiping sponge, and some different kinds of solder. Some people prefer to have the soldering station nearer to the front edge of the table. Use whatever configuation makes the most sense in your lab.*

■ **Caution** Soldering irons are hot and can cause serious burns. Do not place a soldering iron where you might accidentally knock it off the work table or brush against it.

Hand Tools and Some Test Equipment

No matter what you work on at the bench, you will most likely discover the need for some common hand tools. When working with electronics, especially, you will often need wire cutters, wire strippers, and small pliers. These tools have been laid out conveniently (for a right-handed person) at the lower-right-hand side of the bench, while the less-often-used hand tools can reside in a box.

A regulated, adjustable bench power supply is also very handy when working with electronics of all kinds. A good, reliable multimeter can also claim a permanent home on the bench, as these will get a lot of use. See Figure 5-9.

Figure 5-9. *A clean bench with just enough tools to have some fun. Extra soldering supplies, including more kinds of solder , extra soldering iron tips, soldering flux, and an emergency backup soldering iron, sit in a box adjacent to the soldering station. Hand tools and basic test-and-measurement equipment complete the set of "most-useful tools." There's still room for a few more, when you need them.*

Under the Desk

If your workbench has the luxury of drawers, by all means use them! Try to keep your under-desk environment as free of clutter as possible. It's not really a very convenient place to store unused tools or components. You're going to drop the occasional item from time to time, so having to dig out a bunch of junk just to find it is just going to be more frustrating for you. Keep it clean!

You *should* keep a medium-sized trash can under or near your work area, as you will inevitably generate some waste products in this hobby. By minimizing the amount of food-related garbage deposited in your laboratory trash receptacle, you can postpone the invasion of little critters looking for a free meal. Also, bits of wire and old components don't tend to stink after a few days, but a half-eaten sandwich might.

■ **Tip** Copper easily recycles at a premium price. Collect your copper wire snippings and cash them in someday.

A nice addition to the under-the-table accessories you might consider is some low-wattage strip lighting. LEDs are especially good for this. You will appreciate this more once you conduct your first search-and-rescue mission for that teensy-tiny component that dropped off the edge of your table and into the carpet.

Components

Most of our tools are now ready to go. The most frequently used tools are permanently set up, ready for action. The less frequently used tools are carefully stored where we can get to them when we need them, but are not in the way the rest of the time. This is a big improvement over the situation you saw back in Figure 5-1.

Now we need some components with which to work, using our scientifically arrayed tools. Have a look at Figure 5-10 to see one example of how to keep your parts organized yet within easy reach.

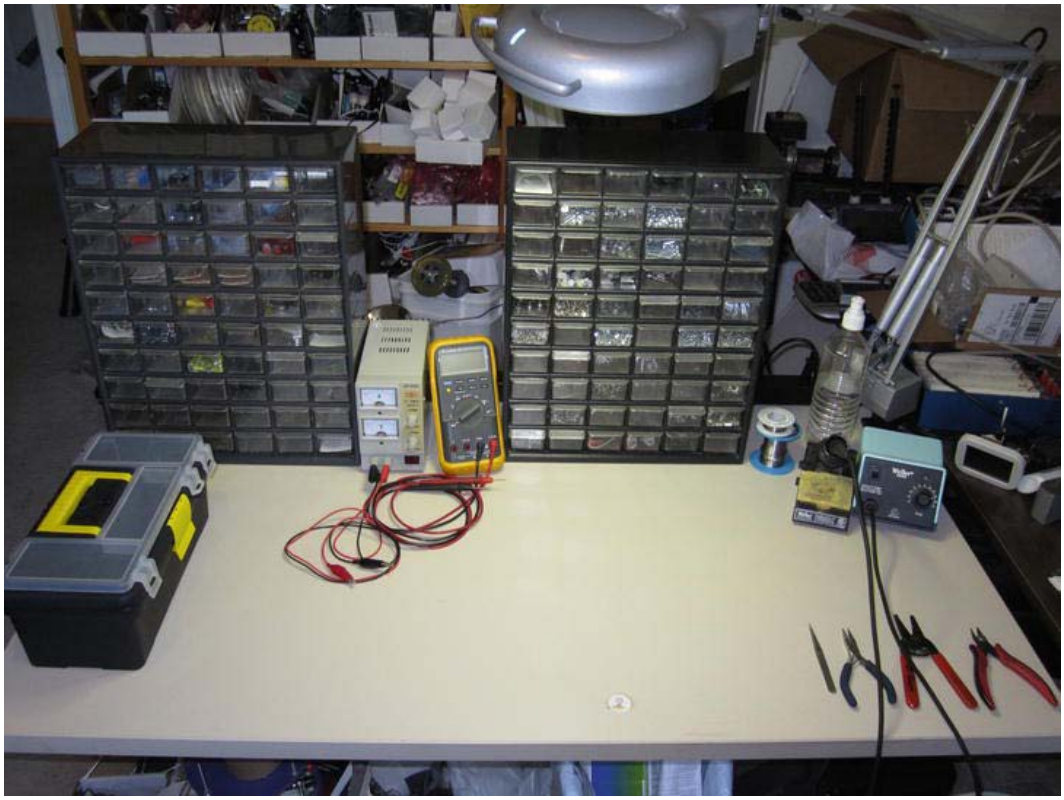

Figure 5-10. *Parts bins are used to organize components. This style of container is available in many sizes with different numbers and sizes of drawers. Even more parts are stored on a shelf behind the work area. The most commonly used hand tools are laid out on the right. The other hand tools are collected in a small toolbox on the left.*

Where to Go from Here

This work space could be further augmented with shelving, both above the work surface and underneath. More lighting wouldn't hurt, either. However, this is plenty to get started. Let's build some electronics projects on this squeaky-clean table and see if we can dirty it up a bit.

Projects

Let's look at a few smaller circuits you can easily build on your tidy, new work area using a solderless breadboard. Expanding on the LED-and-coin-cell experiments in Chapter 4, we'll add a few more components and hopefully start to see how they all interact.

There are any number of different types of solderless breadboards available today. A range of them is shown in Figure 5-11.

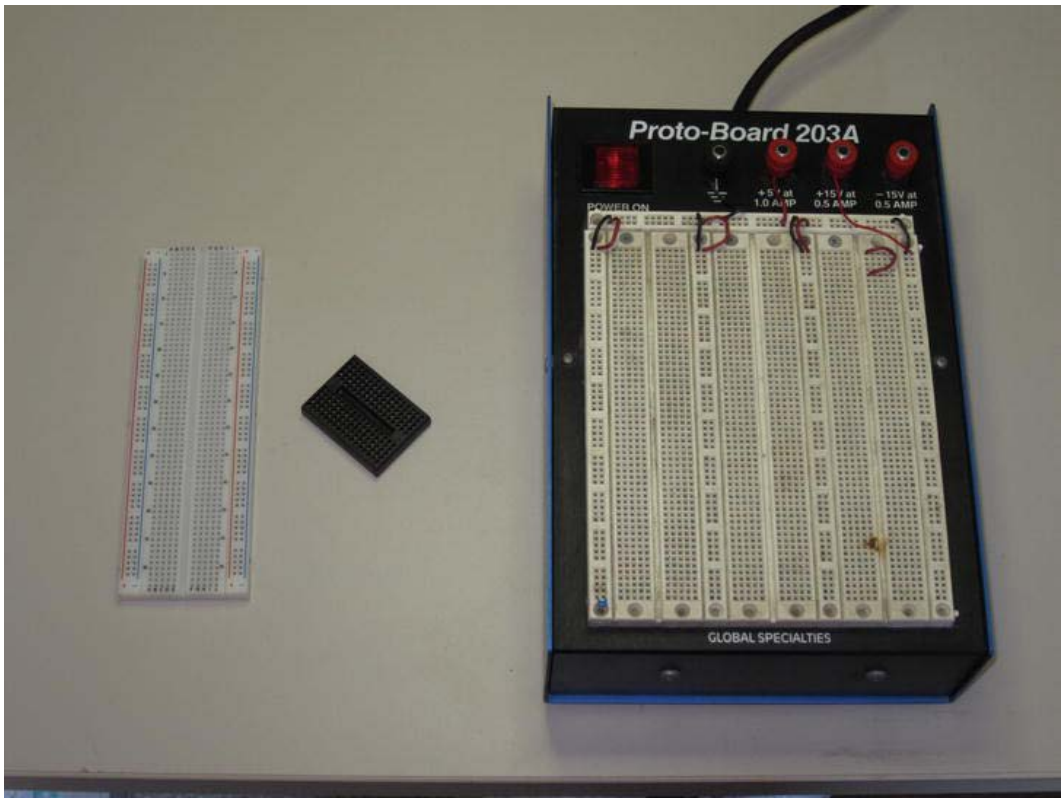

Figure 5-11. *Different sizes of solderless breadboards, all with the same lead pitch and internal connections. The small black unit in the center is perfect for little circuits with only a few small components. The white unit on the left has more tie points and offers power rails along each side. The deluxe, powered unit on the right adds even more space, as well as multiple regulated power supplies for all your tinkering requirements.*

Parallel and Series Circuits

The circuits presented so far have all illustrated the "loop" characteristic of electrical circuits. Electricity generally flows in a circle. It's possible to have more than one path through a circuit, however. What happens then?

Like most good questions, the answer is, "It depends." Let's hook up *two* LEDs at once and try to figure out exactly what's going on. Figure 5-12 shows how it's put together. See Figure 5-13 for the schematic diagram.

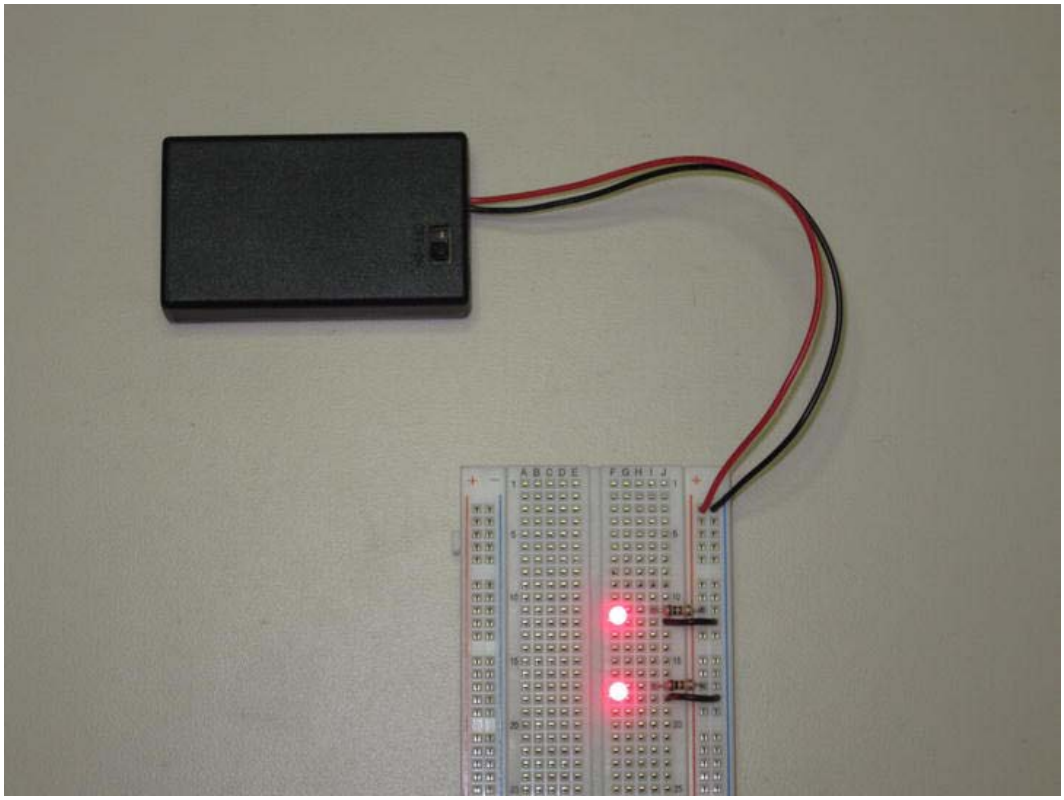

Figure 5-12. *Two LEDs are illuminated at the same time. This simple circuit demonstrates both parallel and series electrical circuits. A 3×AAA battery holder with an integrated power switch is used to provide power to the circuit.*

To build this circuit as shown, you will need the following components:

- A solderless breadboard with power rails
- A 3×AAA battery holder (which holds three AAA cells) and three fresh AAA cells—rechargeable cells are better
- Two LEDs (any visible color will do
- Two 100Ω 1/4W resistors
- Two short jumper wires

Using the letters printed on the breadboard to find the columns across the top and the numbers to find the rows, we can describe each of the tie points using a single letter and a number, such as A-1 or B-2. The following exercise shows how to put it all together.

ASSEMBLY INSTRUCTIONS

1. Install the top LED with its anode (longer lead) in tie point F-11 and the cathode in tie point F-12.
2. Insert one of the resistors from the red power rail on the right at row 11 across to tie point I-11.
3. Connect the right-hand blue power rail at row 12 to tie point J-12 using a short jumper wire.
4. Install another LED just below the top LED, with its anode in tie point F-17 and the cathode in F-18.
5. Install the other resistor from the right-hand power rail at row 17 across to tie point I-17.
6. Use another short jumper wire to connect the blue power rail on the right at row 18 to tie point J-18.
7. Install three fresh AAA cells into the battery holder.
8. Insert the red wire (positive) coming from the battery holder to the red power rail on the right at row 3 (the top).
9. Insert the black wire (negative) from the battery holder to the blue power rail on the right at row 3.
10. If your battery holder has a power switch, turn it on now.

The circuit is now complete. Please verify that both LEDs are illuminated, as shown in Figure 5-12.

Troubleshooting

If both LEDs are not shining at this point, you're going to have to do some troubleshooting.

- The first thing to do is double-check your wiring. Does your breadboard look like the one in Figure 5-12?
- Next, make sure you're using good batteries. If you have a voltmeter, you can test the batteries by measuring their voltage. New alkaline or carbon zinc cells should read 1.5V or more. Rechargeable nickel-cadmium (NiCd) or nickel–metal hydride (NiMH) batteries should read around 1.2V each when completely charged.
- Are the cells properly installed in the holder? Are they in the proper orientation and firmly seated?

- Is the power switch (if available) not in the On position? This happens more frequently than anyone would like to admit. Wiggle the switch back and forth and see if it's only making intermittent connection.
- Check the orientation of the LEDs. They will only work if installed in the correct orientation. It only takes a second to unplug them, swap them around, and try them the other way. At these low voltages, it won't hurt them to be installed backward.
- Are your resistors the right value? The 100Ω value is not critical. Anything from 100Ω to 1KΩ will do nicely. Don't use smaller values, as this will allow too much current to flow through the circuit, perhaps damaging the LEDs. How much current? We'll figure that out in just a bit. Larger-value resistors will decrease the amount of light emitted by the LEDs, down to the point where you can't see them anymore.
- Are you sure your LEDs emit visible light? Millions of infrared LEDs are manufactured every month for use in remote controls and night-vision gear. This light is not visible with the human eye, although some digital cameras can see it. Just because it looks like an LED doesn't mean it *is* an LED.

A Different View of the Same Thing

Your version of the circuit in Figure 5-12 might look a little different, and that's just fine. The important point is that both LEDs are lit up at the same time when you apply power.

Let's look at the traditional schematic for this circuit to get an idea of what's going on here. See Figure 5-13.

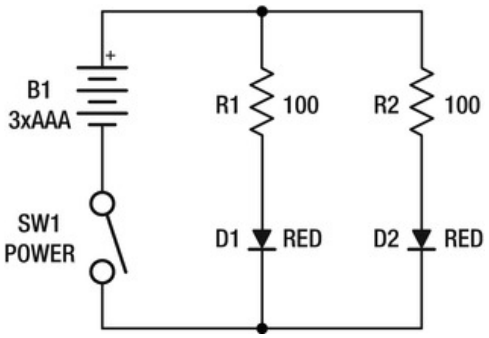

Figure 5-13. *The traditional schematic diagram of the two-LED circuit. This diagram should convey the very basic information needed to build the circuit, as well as understand the important aspects of how the circuit is supposed to work, without going into much detail at all about the actual implementation or assembly of the components.*

By now you should be able to look at the schematic and see the loop formed by the circuit. The only new twist is that there are *two* paths along which the electricity can flow, either through R1 and D1 (the top LED on the breadboard) or through R2 and D2 (the bottom LED, or the initials of a certain adorable robot from the movies).

The three AAA cells in the battery holder are shown as B1 in the diagram. The power switch, labeled SW1, is shown as a separate component to remind us that the circuit can easily be broken, halting the flow of electricity, which is something we want to happen from time to time. The connections between the two resistors and the two LEDs should be somewhat obvious. I'll discuss the details for the parallel and series connections momentarily.

Remember that an electronic schematic diagram is an abstract representation, boiled down to only the essential items involved and the relationships among them. As such, it doesn't need to resemble the final product, but it could. See Figure 5-14.

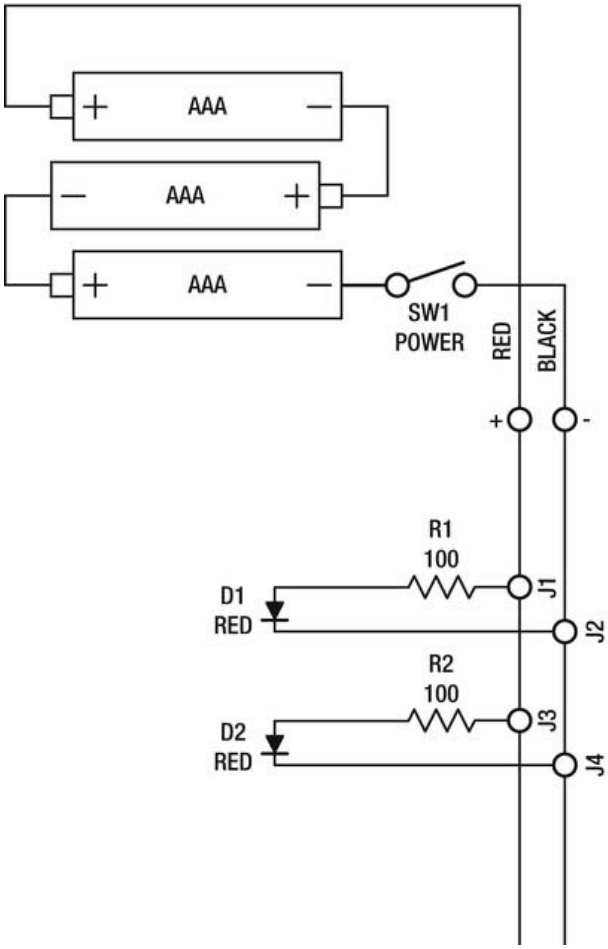

Figure 5-14. *Another schematic diagram of the two-LED circuit, showing the approximate physical layout of the components on the solderless breadboard. This style of schematic is often used when describing how to actually build a circuit, showing the constraints of the actual, physical components and the connections between them. It conveys more specific information than the previous example in Figure 5-13.*

Batteries in Series and Parallel

Let's look at the batteries first. Technically, as mentioned in Chapter 1, there is one *battery* in this circuit, and it happens to be composed of three *cells*. The term *battery* is very often used interchangeably with *cells*, and the distinction is minor. It's better to avoid confusion than it is to be exactly, precisely *correct*—usually.

We see three cells sitting side by side in both the schematic in Figure 5-14 and the actual battery holder shown in Figure 5-12. The cells are connected *in series*, meaning that one connects to another that connects to another, and so forth. They are like beads on a single wire. You should be able to trace the wiring (the solid lines) that connects the individual cells in the schematic.

Note the polarity of each of the cells within the battery. The positive terminal of the bottom-most cell is wired to the negative terminal of the center cell. The positive terminal of the center cell is connected to the negative terminal of the topmost cell.

The negative terminal of the bottom-most cell is connected to one side of an *SPST (single-pole, single-throw)* switch. The other side of the switch emerges from the battery holder's body as the black, or negative, lead from the battery pack. The positive terminal of the topmost cell connects directly to the red, or positive, lead coming out of the battery pack.

The switch could have just as easily been installed in the positive lead, and it would have worked exactly the same. The battery holder used in the photograph happens to switch the negative lead, as was revealed by examining the internal wiring using a multimeter as a continuity tester.

When the switch is *open* (i.e., in the Off position), the circle is broken and no electricity is going to flow. When the switch is *closed*, the circuit is complete and power is made available to the remainder of the LED circuit, assuming that it is wired up correctly.

The amount of *voltage* being supplied by the battery holder depends on the electrical characteristics of the individual cells. If alkaline batteries are used, each cell will provide 1.5V, assuming that the cells are relatively fresh. Rechargeable NiCd or NiMH cells will provide around 1.2V when fully charged.

When batteries like these are connected in series, the total voltage available is the sum of each of the cells. Just add all the voltages together. For example, using fresh alkaline batteries, the total voltage would be 3 × 1.5V = 4.5V. Rechargeable cells would provide 3 × 1.2V = 3.6V when fully charged.

If the cells were wired *in parallel*, with all of the positive terminals being connected together and all of the negative terminals wired together, the total output voltage would only be 1.5V for alkaline cells. The total output *current*, however, would be triple the capacity of each individual cell. See Figure 5-15 for a comparison of series, parallel, and combination circuits using batteries.

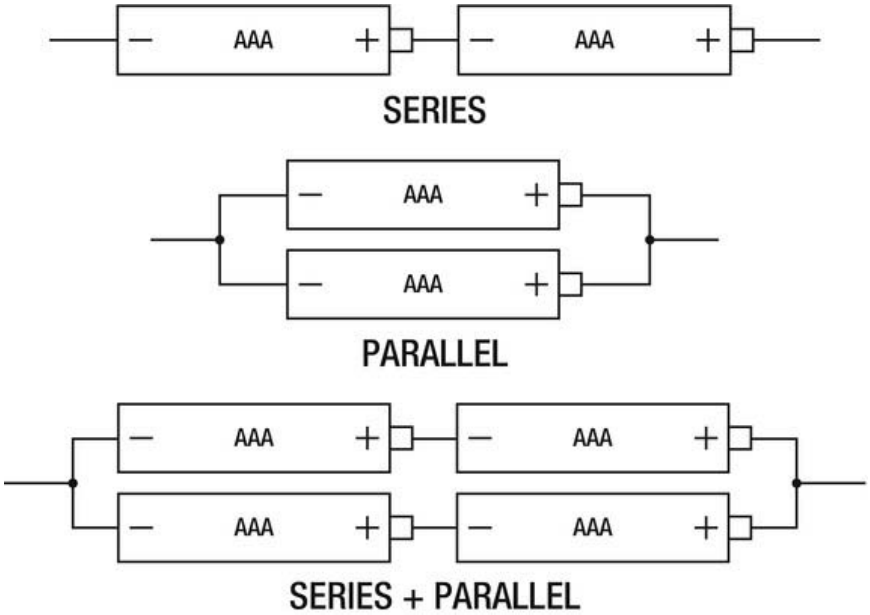

Figure 5-15. *Different arrangements of the wiring of the batteries produce different results. The top two cells are arranged in series. Their respective voltages are added together. The center circuit consists of two cells arranged in parallel. This configuration doubles the current that can be delivered. The bottom drawing shows a combination of both series and parallel circuits, doubling both the voltage and the current.*

When connected in series, the total current output is the same as the current capacity of each individual cell.

In summary, if you need more voltage, stack the cells end to end. If you need more current, stack them side by side. Even more complex arrangements are possible, using both parallel and series circuits to achieve the desired power output characteristics. This practice is very common in hobby model aircraft and battery-powered vehicles. A designation such as 3S2P means that there are two parallel circuits (2P) of three cells in series (3S).

Looking back at the circuit in Figures 5-13 and 5-14, we see that the "battery" used in this circuit consists of three cells in series. This means that if alkaline batteries of 1.5V each are used, the total voltage available to the circuit is 4.5V. If typical rechargeable cells (NiCd or NiMH) are used, we can expect 3.6V to flow through the circuit.

Switches in Series

The power switch, labeled SW1 in the schematic, is *in series* with the rest of the circuit. As mentioned in the previous section, when this switch is open, no current flows through the circuit at all. The switch is intentionally placed at this location in this circuit to act as a bottleneck. When the power switch is turned off, no power flows through the circuit. That seems like a good idea, considering the desired operational goal.

The schematic symbol for SW1 shows a pretty good likeness to the internal wiring of any simple SPST switch. There are two terminals, and a conductor that can be moved to either electrically connect them or electrically isolate them. As drawn, the switch is in the open position.

If we added another identical switch in series with the existing switch, what would happen? Take a look at Figure 5-16.

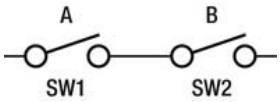

Figure 5-16. *Two switches in series. Both switches must be closed for electricity to flow through this part of the circuit. If either switch is open, the circuit is broken and no current will flow.*

Both switch A (SW1) and switch B (SW2) must be moved to the closed position for any electricity to flow through the circuit. If either switch is opened, then no current will flow. This is sometimes referred to as an *AND* circuit. Both A *and* B must be on for the circuit to operate.

A circuit just like this is often used in security systems. Switches are attached to doors and windows. All of the switches are wired in series, forming a large loop. The switches are all configured to be closed when the doors and windows are closed, and to open when doors or windows are opened.

If all the doors and windows are closed, then the loop of switches will allow the flow of electricity. Although it sounds exactly *backward*, when electricity is flowing in the circuit, this keeps the security alarm *turned off*. When any one of the switches is opened, the circuit is broken. The alarm then sounds.

Most real security systems are more complex than this, of course. The main advantage of this particular configuration is that it is easy to install and requires the least amount of wiring. The chief disadvantage is that when the alarm is triggered, you have no idea exactly *which switch* caused it.

Switches in Parallel

Just like with batteries, switches behave differently when configured in a different manner. Let's connect two switches *in parallel* this time and see what happens. See Figure 5-17.

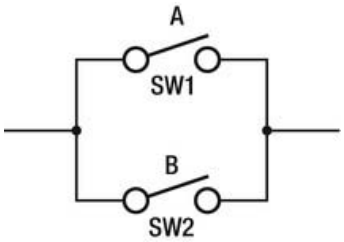

Figure 5-17. *Two SPST switches in parallel. If either one of the switches is closed, then power can flow through this part of the circuit. Both switches must be opened to stop the flow of current.*

The circuit in Figure 5-17 will conduct electricity if switch A (SW1) *or* switch B (SW2) are closed. To stop the flow of current, you have to open both switches. This can be used as a simple *OR* circuit. If switch A *or* switch B is closed, then power can flow through the circuit.

Looking back at the schematics in Figures 5-13 and 5-14, we see that SW1 is in series with the rest of the circuit. This makes it a very effective way to turn power on and off from a single location. Handy!

The Three-Way Switch

You might think that the circuit shown in Figure 5-17 could be used to turn lights on and off from two different locations. You would be partly correct. You could turn lights *on* from either switch location, since flipping either switch to On will cause current to flow and lights (or other appliances) to operate.

Unfortunately, you would not be able to turn *off* the light from either switch if the other switch were on. So this configuration is good for turning lights on but not off. A slightly more complex arrangement is required to do both.

We will need two switches, as before, but they will need to have a little more functionality to accomplish what we've set out to do. Instead of a switch that's either open or closed, we need a switch that alternates between two different routes, depending on how it is positioned. This type of switch is called a *double-throw* switch, as it connects a *common* terminal to either one of two different terminals. It can be *thrown* in two different directions. This should be much easier to understand when looking at a schematic symbol. See Figure 5-18.

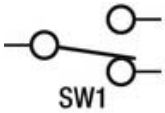

Figure 5-18. *A single-pole, double-throw (SPDT) switch. The common terminal on the left side is connected to either the top or bottom terminal on the right. Variations of this type of switch have a neutral position in the middle. Push-button (i.e., momentary contact) versions of this switch will label the two right-side terminals as either "normally open" or "normally closed," depending on the physical configuration of the switch.*

Now comes the clever bit. We'll connect a pair of these switches together by tying the two non-common terminals on one switch to their counterparts on the other switch. This results in four possible combinations of switch positions (both down, one up, the other up, and both up). Two possibilities turn the light on, and the other two turn the light off. The important point is that the "on" or "off" state of the entire circuit can be changed from either location, independently of the state of the other switch. Problem solved! Again, this should be easier to see when presented as a diagram. See Figure 5-19.

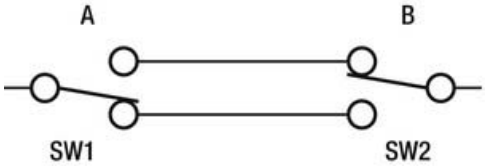

Figure 5-19. *A three-way switch circuit built using two SPDT switches. Power is either carried by the upper wire or the lower wire, as long as both switches are in the same position. If not, then no power flows across this part of the circuit. As shown, the three-way switch is effectively off. Flip either switch to turn it on.*

If you ask a real electrician how to wire a three-way switch, you'll get several answers, or more likely, you'll get, "It depends." That's because *it really does* depend on the actual wiring situation. Sometimes the power is routed through one or the other of the two switches, and sometimes the power is routed through the load. Each of these scenarios requires a different routing of wires and connections.

You are strongly advised to consult a real electrician concerning wiring in your house, where your family, pets, and all your stuff live. Less-than-perfect wiring causes fires or electrocution, which are both very unpleasant ways to die.

■ **Caution** This book does *not* teach you how to wire electricity in your home. Consult a professional.

Resistors in Series

Just like batteries and switches, resistors perform different functions in a circuit depending on their configuration. Let's look at using resistors *in series* first, and then consider using them in parallel later. Both combinations have their uses, as you will see.

Let's look at just a small part of the schematic that we've been working with so far in this chapter. See Figure 5-20.

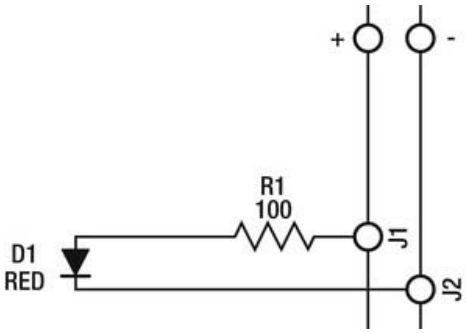

Figure 5-20. *One part of the circuit showing an LED, a resistor, and the power rails from our solderless breadboard. The resistor and LED are connected in series. The battery and power switch are not shown.*

LED Curiosities

D1 is an LED. It is a polarized component and will only work when installed in the proper orientation. The schematic indicates a red LED should be used, but feel free to use whatever color LED you like or happen to have available. The triangle shape of the schematic symbol helps remind us of the direction of *conventional current* through the device. The actual flow of electrons is the other way, but that's only because electrons are negatively charged particles and do everything backward. Apparently this was not well understood when electricity was first being tamed for our use.

LEDs are fascinating devices, emitting light in a wide range of colors, coming in an astounding array of shapes and sizes, and generally requiring very little power to operate. They are almost as easy to use as incandescent bulbs and are certainly more power efficient.

Being semiconductors, however (which leads to their being semimagical in their inner workings), LEDs generally only operate correctly within tightly bounded parameters. For example, a typical LED will only need between 2 and 3V to shine quite brightly. Incandescent lightbulbs, on the other hand, can operate from less than 1V to many hundreds of volts, depending on their construction and intended purpose.

While LEDs have a minimum *forward voltage* requirement that must be met for them to work at all, the brightness of an LED is determined solely by the amount of current flowing through it.

LEDs Have No Self-Control

In addition, LEDs have no internal, inherent mechanism to limit the amount of current flowing through them. Incandescent bulbs, when cold, have a low internal resistance, allowing much current to flow through them when connected to the right power supply. Remember that less resistance means more current can flow, and vice versa. This resistance almost instantly goes way up as the filament of the bulb glows white hot. The filament itself then becomes the limiting factor in how much current flows through the bulb, usually stabilizing at the proper power level.

LEDs have no such sense of self-control. They will conduct as much current though themselves as you are willing to provide, up to and beyond the point where the internal heat generated by the small amount of resistance they do possess causes them to literally burn up. In general, it's usually the tiny, almost microscopic internal bond wires that fizzle out, not the actual LED chip itself. However, dead is dead, and LEDs are generally considered to be "unrepairable" subassemblies. (Believe it or not, that's the correct technical term, even though it's not the correct English word—*irreparable* is the correct term when speaking of non-electrical things).

Care and Feeding of LEDs

The simplest possible solution to this ~~problem~~ opportunity for excellence is the use of a *current-limiting resistor* in series with the LED. Recall that a resistor will resist the flow of current in a circuit. The resistor used in this circuit, R1, is indicated to exhibit a resistance of 100Ω.

Let's say that D1, the red LED in our circuit, requires 2V in normal operation. This is pretty common for red LEDs. Generally speaking, the forward voltage requirement for LEDs goes up as you get farther up the color spectrum. Blue LEDs, for example, often require 3.0V to 3.6V to operate.

If we're using rechargeable cells in our prototype (and we really should be, you know), we can expect 3.6V to be made available to the resistor-plus-LED loop within our circuit. If 2V is needed for the LED, where are the rest of those volts going?

The answer is that they are being used to heat up the current-limiting resistor R1. Resistors turn current into heat. That's what they do. They do it, however, in a very precise and predictable way, which makes it easy for us to calculate how much current, voltage, and heat will be churning around in our circuits.

■ **Caution** Third-grade arithmetic ahead: Addition, subtraction, multiplication, and (shudder) division. You have been warned.

If we started with 3.6V, and two of those volts are being used by the LED, then our good friend Subtraction tells us that we've got 1.6V flowing through R1. For a thorough explanation of why this happens the way it does, feel free to look up Kirchhoff's Voltage Law. It basically says that all the voltages in a circuit end up being equal. The voltage across the resistor and LED will equal the battery voltage. The voltages within the LED-in-series-with-resistor circuit add up, just like battery voltages add up in series.

If we know the voltage across R1 (1.6V) and the resistance of R1 (100Ω), then we can use Ohm's Law to calculate the current flowing through R1. Reviewing what you learned in Chapter 3 about the predictable and inviolable relationships between voltage, resistance, and current, you can see that I = E / R (i.e., current equals voltage divided by resistance), where I is the current in amps, E is the voltage in volts. and R is the resistance in ohms.

It's not that hard! It sounds much worse than it actually is. The answer is 0.016A, or 16mA (1.6V/100Ω). That's the teeny-tiny amount of current needed to light up a typical red LED. Most small LEDs can handle up to 25mA safely, and some can handle much more than that, especially if they are intended for illumination purposes.

One quick side trip to multiplication land and we'll know everything we need to know about R1 in this circuit. While the schematic specified the resistance of R1 as 100Ω (the primary characteristic or component *value*), nothing was said about the power-handling capability of this component.

Power is calculated as voltage multiplied by current. That's all there is to it. We know the voltage: 1.6V. We know the current: 16mA. We multiply them together to get 0.0256W (watts), or almost 26mW. Remember that you have to enter the current as 0.016 because the formula calls for the number of *amps*, not milliamps.

Not quite 26mA is not quite much of anything. You will not be able to tell that the resistor is shedding all those extra volts as heat with your fingertip. It might not even register with a sensitive thermometer. It's just a really tiny amount of power. A typical small resistor (a 1/4W resistor) will handle 250mW of power, which is almost ten times what is needed in this application.

■ **Tip** It's always a good idea to calculate the power requirements of your components, just so you're not *too* surprised when the magic smoke leaves the circuit, rendering it crispy and nonfunctional.

OK, we're back from the frightening land of multiplication. It wasn't *that* bad was it? The remainder of understanding resistors in series depends only upon the science of addition. Counting on your fingers will be good enough.

We can change the brightness of the LED by changing the amount of current flowing through it. We can change the amount of current flowing through the LED by either raising the supply voltage or by changing the resistance of R1. Since we can easily substitute any other value of resistor for the 100Ω resistor with which we began, this is easy to do. Just don't go *too low* in resistor value, as this will allow *too much* current to flow through the LED, possibly damaging it permanently.

Adding resistors in series adds their resistances together. For example, if you placed two 100Ω resistors end to end, the total resistance across them would be 200Ω. That's really all there is to it: 100Ω + 100Ω = 200Ω.

If you perform this experiment with the LED circuit we built on the breadboard, you can see that the LED will not shine as brightly as it did before. This is because the resistance has doubled, which means, all other factors remaining the same, that the current through the LED has been cut in half. Half the current results in half the brightness, since LEDs are controlled by the amount of current flowing through them.

What's interesting about this arrangement is that the power-handling capacity of the two resistors is *also* double what it was when only one resistor was in the circuit. This is because each resistor is now dissipating half the power when compared with the previous scenario. If two 1/4W resistors are used in series, they can together safely dissipate up to 1/2W of power, although pushing any component to 100 percent of its capacity is just asking for trouble, especially when heat is concerned.

By connecting resistors end to end, you add their resistances together, as well as their power-handling capabilities. By keeping a small variety of basic values on hand (e.g., 1Ω, 10Ω, 100Ω, 1KΩ, 10KΩ, etc.), you can easily stack up the right combination needed for almost any electronic application. This is the method used in the very handy device known as a *decade resistor* or *decade box*, which has dials for each digit in the desired resistance, allowing you to dial up any value of resistor needed.

Extra credit: If you've followed along this far, consider researching voltage dividers built using only resistors.

Resistors in Parallel

What happens when resistors are connected side by side instead of end to end? That's where things get interesting, at least from a mathematical point of view.

An easy way to look at parallel resistors is to think about the amount of current flowing through each one, and then add them all up. See Figure 5-21.

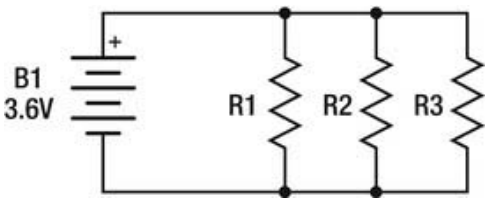

Figure 5-21. *Parallel resistors each conduct a portion of the total current flow through the circuit. Each resistor allows a certain amount of current to flow. The sum of their currents can be calculated if their individual resistances are known.*

Let's assume that R1, R2, and R3 have resistances of 100Ω, 200Ω, and 300Ω, respectively. The total resistance of the circuit across the battery terminals is *not* 600Ω, as would be the case if they were in series instead of parallel. The total resistance is less than 100Ω, which is the least of the resistors. How can this be?

First, let's think in terms of how much current is flowing in each of the three parallel pathways within this circuit. If B1 is putting out 3.6V, and R1 is 100Ω, then we know to use Ohm's Law to calculate the current, with I = E / R. In this case, I = 3.6V / 100Ω = 0.036A, or 36mA. *In addition*, the path through R2 is drawing half that (because R2 is double the value of R1—get it?), or 18 mA. *In addition*, the final pathway is drawing one-third as much current as the first one, or 12 mA. Just to verify: I = 3.6 / 300Ω = 0.012A, or 12mA. Everything checks out.

Now add all those currents together: 36mA + 18mA + 12mA = 66mA. That's the total current, using this method. Again, since we know both the voltage and the current, we can find the *effective* or *equivalent resistance* of all three resistors in parallel, as if they were one single resistor. Rearranging the formula for Ohm's Law, we find that R = E / I. In our case, R = 3.6 / 0.066A = ~54.55Ω. See? Smaller than 100Ω, somehow.

Thinking about the individual *currents* flowing through each resistor is the same as adding the current-supplying capacity of battery cells together when arrayed in parallel. Just add them together. However, we had to calculate each current separately and then add them together. There is a more direct way, depending upon how you look at things, but beware: it involves not only *fractions*, but *fractions upon fractions*. Oh, the horror.

■ **Note** Some people don't dig math. Weird, but true.

Here is the equation for calculating the total resistance (R_T) of three resistors in parallel (R_1, R_2, R_3):

$$R_T = \frac{1}{\left(\frac{1}{R_1}\right) + \left(\frac{1}{R_2}\right) + \left(\frac{1}{R_3}\right)}$$

The good thing about this equation is that you don't need to know what the supply voltage is to get the correct answer. All you need to know are the values of the resistors. If you need to use more resistors, just add more terms to the equation.

Calculating the value of parallel resistors occurs quite frequently when designing electronics. Some special cases are simple enough to do in your head. For example, if two identical-value resistors are placed in parallel, their combined resistance is half the value of each individual resistor. That is, if you placed two 100Ω ohm resistors in parallel, their effective resistance would be 50Ω. Similarly, if you have three identical resistors, the net resistance is one-third the value of each constituent resistor. Make sense? These are special cases of the general equation just shown.

This happens so much that an alternate notation method has been developed: $R_T = R_1|R_2|R_3$. This is not often used for hobby electronics, however.

The power-handling ratings of resistors are added together, so if you have two 10W resistors in parallel, the net power-handling capacity is now 20W. At least that part was easy.

Capacitors in Series and Parallel

Capacitors are completely different from resistors. When calculating their values in series and in parallel, you have to use *exactly the opposite* methods. Isn't electronics interesting?

The values of capacitors *in parallel* are added together. This makes them much more like batteries in parallel than resistors. However, you still have to use the fractions-upon-fractions method to calculate the value of capacitors in series.

Again, some shortcuts are available. Two identical capacitors in series have *half* the capacitance of each individual capacitor, but *double* the working voltage, which is the maximum voltage they were designed to withstand before failing.

Inductors in Series and Parallel

It gets more interesting, believe it or not. Inductors act like resistors as far as adding their values together in series and taking the reciprocal of the sum of the reciprocals of their values in parallel, but *only* when the magnetic fields of all of the inductors involved do not interfere with each other. If the magnetic fields generated when current flows though the inductors overlap, then you have to factor in their *mutual inductance*, which starts to get complicated.

Extra credit: Figure out how all that works and let me know.

LEDs in Series and Parallel

You learned (or were reminded of) a few of the basic characteristics of LEDs in the previous section, although it was really to help illustrate the operation of resistors in series and parallel. A couple of major oversimplifications were introduced to help concentrate on the resistor. We'll address a couple of these issues here.

Lighting up a single LED using a battery and a fixed current-limiting resistor is fun, but it's pretty basic stuff. Lighting up a *lot* of LEDs is where it gets to be a *lot* of fun. To do so, you need to learn a little more about the weirdness that is *semiconductor*.

LEDs are diodes (*LED* stands for *light-emitting diode*, after all). Diodes are semiconductors and are made by elves in a hollow tree. Semiconductors do not have nice linear voltage-to-current curves.

For the purposes of simplicity, in the previous section, it was suggested that LEDs have a certain minimum voltage that they need to operate. This is called their *forward voltage*, and is sometimes referred to as their *voltage drop* within a circuit. So far, this is all true. You can find an LED's forward voltage specification in the data sheet published by the manufacturer.

What you'll find, when you look, is that every manufacturer only publishes a *range* of voltages, such as 1.8V–2.2V, giving a minimum and a maximum voltage. This is what they are contractually obligated to deliver in their product. Anything outside of this range is considered *defective*, or at least out of tolerance. You might get a good deal on "rejects" that fall outside these parameters but still light up quite nicely. Such is the provenance of many of the penny LEDs available from overseas. Yes, they exist. And yes, you get what you pay for.

There are two reasons why LED manufacturers are being so deliberately vague in their specifications. The first is that process variations are going to produce a certain randomness to these values. One batch might be identical to the next batch, but then the third batch might be all over the place. Such things happen.

The second reason is where the real weirdness begins. Forward voltage is not a fixed value in any given device, but instead increases as the current increases. Again, this increase is *nonlinear* and cannot be calculated with a simple formula.

The best way to demonstrate this to yourself is to connect an LED to a power source via a variable resistor, such as a potentiometer. For the protection of your LED, add a fixed resistor in series with the potentiometer so that you establish a maximum current level, even when the potentiometer is turned all the way up (i.e., has almost zero resistance).

Now apply power and adjust the potentiometer until the LED just barely lights up. Now measure the voltage across the terminals of the LED, using a voltmeter. It should be in the neighborhood of 2V–3V. For extra credit, measure the current flowing *through* the LED, using an ammeter. This measurement will most likely be less than 1mA.

Compare these readings to what you find when the LED is at full brightness. The forward voltage across the LED goes up as the current goes up. To map the nonlinearity of this function, you would need to record many readings of both voltage and current, and then plot them in a graph.

Just as you can wire resistors, capacitors, and inductors in series and in parallel, you can do the same with LEDs. As with resistors, the forward voltage of the LEDs are added together when arranged in a series circuit. This raises the minimum voltage required to light up a string of LEDs in series. This means that you can't light up ten LEDs in a single string using a 9V battery. You have to first overcome the minimum forward voltage just to get any current at all flowing. Then you have to up the current to get the desired brightness, which simultaneously raises the total forward voltage through the circuit. You still need a current-limiting resistor in this circuit—but only one is needed. You don't have to have one for each LED.

The amount of current flowing through the string of LEDs is determined by the supply voltage, the cumulative forward voltage of all the LEDs, and the resistance of the current-limiting resistor. The same

amount of current is flowing in every part of the circuit. If 25mA is being drawn from the power supply to light up your single string of LEDs, that means that each and every LED has 25mA of juice flowing through it—more than enough to light them up quite nicely.

If you have a 12V power supply (or a car battery), you could string up to five or maybe six red LEDs in series, with a small current-limiting resistor. That's because each red LED will typically have a forward voltage between 1.8V and 2.2V. Other colors higher up the rainbow might need more voltage per LED, meaning fewer can be lit at once using a single string of LEDs in series.

But don't fret. You can light up as many LEDs as you want by placing multiple strings of LEDs in parallel with each other. Each additional string of LEDs adds to the total current draw, so you will eventually find a limit along that dimension as well. For an example of a small LED array using both parallel and series circuits, see Figure 5-22. The schematic is shown in Figure 5-23.

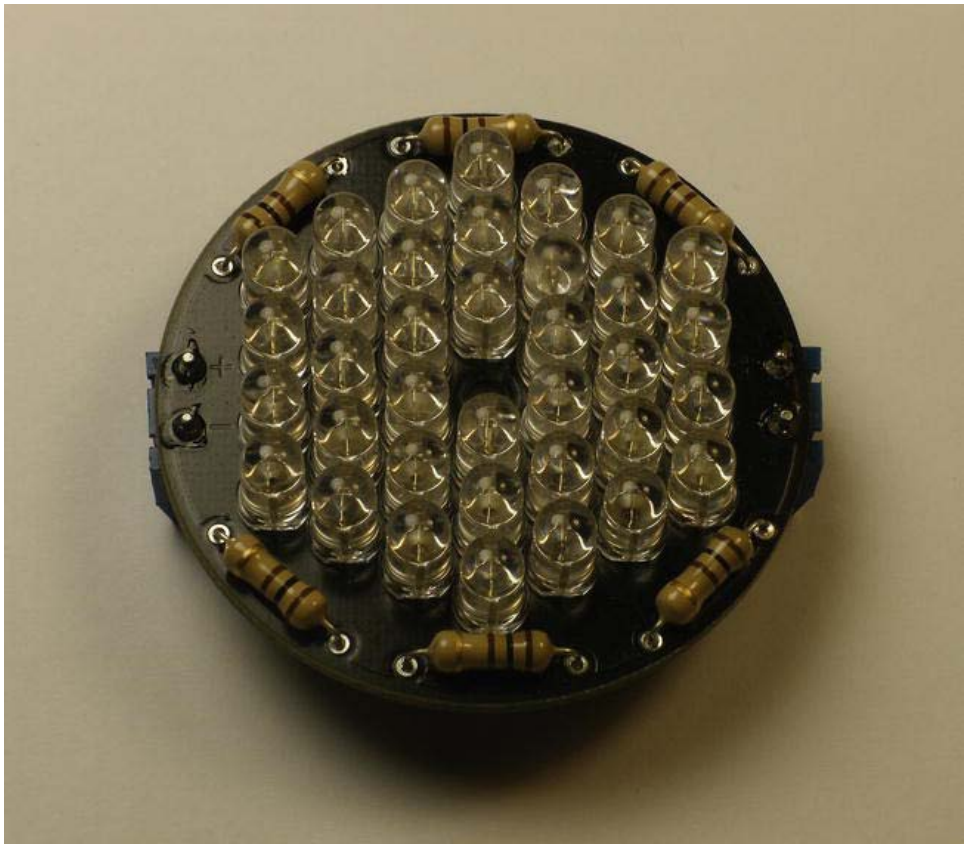

Figure 5-22. *An array of six parallel strings of six infrared LEDs in series. These infrared spotlights are used for covert surveillance and security applications.*

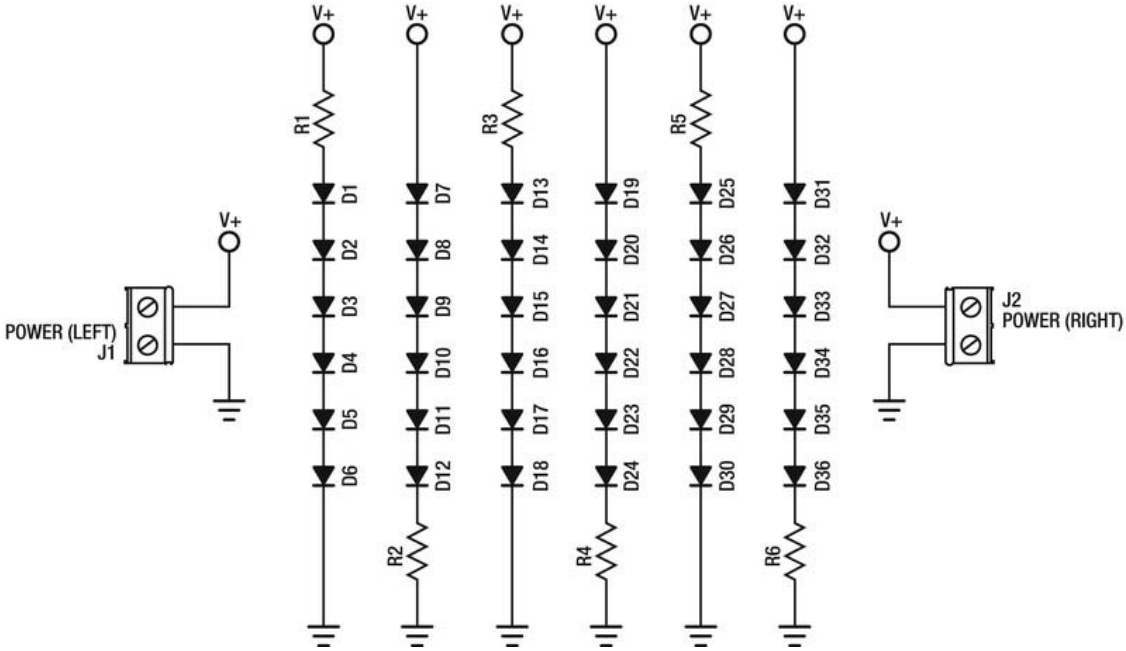

Figure 5-23. *The schematic of the LED array, showing both parallel and series circuits. The circuit offers two power connectors to make it easy to wire multiple LED arrays using the same power supply.*

Summary

Even if your workbench doesn't look as bad as the one presented at the beginning of this chapter (or even if it looks *worse*), hopefully you've learned a thing or two about the importance of they saying, "A place for everything and everything in its place." Since *you* get to decide where everything goes, you can either make it easy or hard on yourself as the years go by.

The workspace in this chapter extended to a total of 10 square feet. If this is what you have to work with, you can certainly set up a comfortable, safe, and productive area for your electronic projects. If you have even more space available (adding a shelf either above or below the desk is a great way to do this), then even better.

Hopefully some of the more detailed descriptions of how electronic components can be wired up have given you some ideas for projects of your own. The very best possible way to learn more about electronics is to think up some simple experiments and try to build them in your lab. Have a goal, take lots of notes, and have some fun—even your failures can be used as stepping stones to more ambitious and creative projects in the future.

Have a *lot* more room? Then perhaps you should be thinking about setting up a group lab or classroom. Chapter 6 will give you some helpful advice about what you are going to need to get started. See you there!

CHAPTER 6

The Small Group Lab and Classroom

The first part of this book covered what you need to know to build your own personal electronics lab. Now it's time to share the love with your fellow electronics enthusiasts. Where to begin?

Like most important questions, the answer remains, "It depends." What resources are available to you and your group? How many folks will likely want to be working together, and for how long? How well do you really know these people? And these are just a few of the questions you're going to encounter along the way.

Take the time to understand exactly who "you" (plural; in Texas, *y'all*) are and what your requirements and goals could be. By doing so, you map out the future of your successful facility. Likewise, *not* planning ahead or making reasonable assumptions about your needs is simply an invitation to problems, problems, and more problems. Who wants *more* problems?

■ **Tip** If you fail to plan, you plan to fail.

Know Yourself

The ancient Greek maxim "know thyself" has as many definitions as it has authors, it seems. Plato indicated in several of his dialogues that Socrates would use this phrase to admonish his students to learn more about themselves and their own characters and capabilities before attempting to figure out the rest of the universe. Wise advice then and now.

As far as knowing yourself in relation to setting up a shared electronics lab, you should first think about what role *you* are going to play in this endeavor. Yes, *you*. Here are some of the major ones, and you might end up being all of them at some point.

Facilitator or Coordinator

In the role of the facilitator, you plan on providing an environment for others to use for their projects and explorations in electronics. You may or may not partake in these activities yourself, but have been tasked with (or volunteered for) the organization and coordination of the lab.

It's critically important to understand the needs of your intended ~~lab monkeys~~ users. See the "Know Your Group" section later in the chapter for more information on this topic.

As the lab facilitator, lab workers will come to you with questions, requests, comments, and complaints. Be prepared to address their needs in a responsive and professional manner—even if they're just your cousin.

Your responsibilities will include

- Communicating the scope of the lab (i.e., deciding what *is* and what *is not* acceptable or expected)
- Publishing any important information or updates regarding location, available times, features, rules, and possibly ongoing projects
- Crafting policies involving safety, proper tool usage and training, and participant conduct
- Maintaining supplies of commonly used materials
- Inspecting and repairing tools as the need arises

To balance out your responsibilities, you should be granted adequate authority in the following areas:

- Characterizing the scope of the lab, based on present and anticipated future needs
- Enforcing the policies of the lab
- Budgetary discretion in acquiring, provisioning, and maintaining lab assets
- Granting or revoking access to the lab based on established parameters

If you're going to be the Keeper of the Lab, then you should have both a personal interest in keeping it in good shape as well as the wherewithal to decide how things should be done.

Good luck finding the right balance there.

Teacher or Presenter

Let's assume that your lab has already been set up (or can be set up in a jiffy), and your main goal is to present information or teach classes there. Again, it should be apparent that a good knowledge of your intended audience will play a vital part in your success. See the "Know Your Group" section for more information.

Once you understand the needs of your class and the goals of your presentation, the next step is to leverage the existing facilities to your best advantage. Will you need specialized presentation equipment or materials? If so, see what is already available, and then make a shopping list of everything else you will need. Examples include lighting, a projector, specialized power distribution, and test equipment.

Are you making an interactive presentation? If so, what materials will you need to provide for your students to be able to fully participate in your presentation?

What will be your optimum teacher-to-student ratio? If you have a simple message that's easily communicated and reinforced, a single speaker can effectively address a rather large crowd. Once you start adding layers of complexity to the subject matter, you're going to have to be prepared to backtrack and explain things in more detail from time to time. If you're leading a group through a technical exercise, it's often profitable to have assistants available to help just those individuals that need a little more help, without having to stop the class in its tracks. These assistants need to be up to speed on the subject matter as well as have good communication and troubleshooting skills.

Remember that students look to the teacher for leadership, not only as a subject-matter expert. Take the lead, set a good example, and share your enthusiasm for your topic with your students.

A successful teacher leads a class on a journey of discovery. Make sure you don't lose too many along the way.

Participant

Your goal as primarily a group lab participant is to make effective use of the facilities at hand, making the most of your time and energy. Having access to a well-stocked lab with a good array of tools can be a decided advantage for both your immediate project goals, and it can be an excellent opportunity to accelerate your knowledge of electronics and other mysterious arts.

Imagining yourself as an active participant is the best perspective when laying out the flow of your lab. Set up workstations that have almost everything you need, leaving room for the complex or specialized stuff elsewhere. There are more suggestions about specific workstation configurations in the "Workstations" section of this chapter.

While the active-participant model helps you squeeze out the maximum utilization of your lab, be sure to consider the sort-of-working-but-also-sort-of-goofing-off model. Not everyone wants to be working full-tilt all of the time. Leave room for a certain amount of idleness, contemplation, and whimsy. You might be surprised at the results.

Observer

You want to be in on the action, but not necessarily working on anything in particular. That's great! Don't underestimate the importance of the purely social aspects of technical gatherings.

Some people just like to hang out with other like-minded individuals. This is a good thing—when resources and circumstances allow it. Watching creative, talented, and driven folks working on projects with passion is very often the best kind of inspiration. Let your kids see you having fun and making cool stuff in your lab, and the next thing you know, they are going to want to be there whenever you are. Pretty soon, they are going to want to start working on projects of their own—and that is its own special reward.

Know Your Group

Now you know a little bit about who you are and what your expectations of your lab may be. Now it's time to get to know the group of people who will most benefit from access to the lab.

Identify the needs and requirements of your group by first identifying *precisely* who your intended audience is going to be. Knowing this one item, up front, before any big plans are laid, is the best way to ensure success down the road.

There are several broad categories for which you might need to prepare. The more you know about your particular group, the better. Let's start fairly close to home and expand outward.

Your Family

Once you've established your own electronics lab at home, it's great to be able to share some of the fun with those that are closest to you. This might be your children, parents, siblings, or extended family. A well-planned and well-maintained electronics lab is going to generate some interest, or at least some curiosity. Here's how you can carve out some room for them, while still being able to get things done yourself.

It's very natural to want to share your hobbies and interest with others, and a safe and well-stocked electronics lab is a great place to do so. This is an especially ripe opportunity for parents to pass on their knowledge, skills, values, and work ethic to the next generation.

The family lab can be a logical extension of the family home. Everything is shared, including responsibilities and privileges. In more agrarian societies, this is already well understood at an early age, where chores around the farm and in the fields and a respect for the tools being used help enhance a sense of group belonging and worth. Everyone has a stake in the prosperity of the family endeavor.

Do you want your kids to appreciate what you give them? Then give them chores before you give them presents. Let them clean up the lab, put away tools, inventory parts, and take out the trash before spoiling them with all the fun stuff you get to do in the lab. This will help foster a sense of ownership in the long-term success of the lab, whether you're there to supervise or not.

It bears repeating (from Chapter 4) that no unsupervised children, no matter how adorable, should be allowed in the lab. Would you allow unsupervised cooking in the kitchen? It's the same basic scenario. When everything goes well, everyone has a good time. It only takes a split-second distraction to go from a good time to a trip to the emergency room in either case. Have rules and enforce them, even if it's your elders that you are protecting by doing so.

Sometimes having a resource like a shared electronic laboratory is the first opportunity people have to assert some sort of control over their relationships. Use the opportunity to make friends with your relatives, while you still can.

Your Friends

Unlike your family, as the saying goes, you get to *pick* your friends. Now you have the opportunity to provide a cool place to hang out as well as build all manner of awesome gizmos. It's only natural to want to share some of the fun with your like-minded friends.

The basic framework of rules and accountability apply to the friendly lab as well as any other group endeavor. Let your friends know up front what your expectations of them are in regard to use of the lab. Can they use your tools? Can they store artwork-in-progress at your place? When is it cool to come over to tinker, and when is it not? These kinds of questions should be dealt with early in the game; otherwise, these issues can flare up and become trouble spots. There's no substitute for good communication.

Once you extend your laboratory's hospitality to those outside your immediate family, it's a good idea to clearly designate what is your personal property and what belongs to the lab and all its participants. This can be as simple as putting name tags on all your tools and marking shared resources appropriately.

This is where *trust* really factors into the success or failure of a group lab. Just like in math, you want to eliminate as many variables as possible to ensure that a good time is had by all, and to ensure the long-term safety and viability of the facility itself. Which of your friends do you *trust* in your lab? Think about these things at length before opening the doors to just anybody.

Coworkers and Fellow Students

So you've been tasked with organizing or supervising a lab for a school class or university department. You may or may not have any choice in who will be granted access, or even when they can avail themselves to the facilities.

The balance of responsibility and authority is crucial in this scenario, just like in most other situations in life. Hopefully you will be in a position to enforce whatever rules are already in place. Ideally, you will have some say in crafting new rules as they become necessary, or adjust existing rules when they need it. In either case, it's just not fair for someone to expect you to do a good job, yet not provide you the tools to get it done.

Positions like this become available from time to time in most schools. Sometimes there's an opportunity for a small paycheck, and other times all you are going to get are points with the administration. Hopefully, at least you will also enjoy lab privileges. That's got to be worth something, yes?

If you are helping to run an existing lab, there are probably others you can consult who have had this particular honor in the past. Try to find out who these folks might be and see if you can get any helpful advice from them about your lab and its care and feeding.

If you're starting from scratch, you will enjoy the double-edged sword of setting things up the way you want, as well as setting things up the way everyone else wants it. You *get* to establish whatever level of functionality you want, with the caveat that you then must maintain that level. It's a freedom, like most freedoms, that comes with a price.

Special-Interest Groups

Are you a member of club that has a special interest in electronics? Several popular interests, such as ham radio operators, remote-control model flyers or drivers, robot builders, and computer users, have a love-hate relationship with electronics. Having a dedicated electronics lab available to the membership is a great way to build up the love as well as work out the hate.

Given a highly specialized crowd, such as the members of a university or trade school, you might even find people organized into an electronics club, especially these days when almost every aspect of our lives is touched by this technology in one way or another.

The specialized nature of your group helps focus what areas of electronics are of most practical interest, at least from a lab point of view. This cascades into easier choices when it comes to stocking the lab with workstations, tools, and components.

The Dallas Personal Robotics Group (DPRG; see `http://dprg.org`), for example, had the use of an 1,800-square-foot warehouse for over six years, rent free, due to the generosity of one of the members, Mike Dodson of Modern Assemblies. Having access to an excellent industrial setting allowed the club members to dream of and then realize much more ambitious robot projects than could be attempted at home. After Mike's retirement, the DPRG went into a nomadic phase and finally spun off a dedicated workshop and meeting area, now called the Dallas Makerspace.

The General Public

A lot of people see the popularity of do-it-yourself (DIY) and *maker-movement* projects and envision themselves as entrepreneurs, seeing a need and being able to meet it. Unfortunately, most of these people are wrong.

Building a lab dedicated to public use sounds like a great and noble aim. The realities of such an undertaking, including the financial, logistical, and business related, are not to be underestimated. While it seems to work well in certain areas and at certain times, it's almost always the result of the right combination of people coming together at the right time.

Hackerspaces (a terribly unfortunately chosen label) are springing up all over the world. The term *hacker*, while understood within some technical communities to mean a person of respectable skills, has a decidedly *unrespectable* taint to it when viewed from the outside. To the vast majority of the English-speaking world, a hacker is a rogue computer jockey, a criminal intent on breaking and entering into computer systems for nefarious purposes.

The term *maker*, on the other hand, leaves a more positive first impression. The Dallas Makerspace members deliberately made this decision when naming themselves, while they were still just a subcommittee within the board of directors of the nomadic DPRG, looking for a new home. It was important to them to maintain the very positive image that the DPRG had established and built over its long history, while still looking to the future.

If you're going to set up a lab for use by the general public, whether you decide to call it a hackerspace, a makerspace, or something entirely different, you get to make almost *no* assumptions about the good intentions of your membership. It's a sad state of affairs, to be sure, but it seems to be the prevailing wisdom of the day.

Some popular and successful organizations—such as Noisebridge (`www.noisebridge.net`), in San Francisco, California, which was incorporated in the state as a "non-profit educational corporation for public benefit"—operate almost entirely on a "consensus basis," sometimes known as "anarchic chaos." Noisebridge's overriding motto is "Be excellent to each other," very often shortened to just "Be excellent." Its very real success and sense of community among members is based on what seems to be a very local tolerance that is not to be found in many parts of the globe. If you ever get a chance, do stop by and prepare to be impressed. It's an amazing place.

A good parallel would be to visit your local public library. In the areas that still maintain libraries (shockingly, they are on the decline), you will find a finely tuned machine that meshes well with the surrounding locality. Are there bars on the windows? If so, you're going to need some bars on your windows. Are there metal detectors at the entrance? Oh, dear. Do you see any uniformed security forces present? These are not good signs.

Don't be completely discouraged, however. Sometimes a community in decline needs a little boost of energy and an injection of esprit de corps. This can often be accomplished by introducing some new alternatives for people's spare time. An ancient Muslim saying reads, "Trust in Allah, but tie your camel."

A Shared Resource

Do you have a dedicated space available? If so, you are way ahead of the game. Finding a good location is half the battle. If your space is truly dedicated to your pursuits and activities (i.e., a private home, club, or makerspace), you have the advantage of being able to leave tools, components, and projects in place, returning to them (and finding them still there!) when the opportunity arises. "Truly dedicated" in this sense can be equated with having your own key to the door and reasonably free access. While a 24-hour facility sounds like a great idea, there are a lot of logistical problems associated, such as security, utility costs, scheduling, and parking, just to name a few.

If your space is not-so-dedicated, such as a school lab or friend's garage, you can still make it a home away from home if you are able to arrange for secure storage of all your shiny toys. This could take the form of individual lockers or a storage closet.

No matter what the logistical arrangements, the main challenge to providing a versatile and effective setting for electronic and other kinds of tinkers is basically a social one. Once it's more than just you, it can start to get complicated.

Luckily, there are some time-tested methods for making these types of things run smoothly.

Be a Hospitable Host

If you are taking the lead in arranging a shared work space, please remember that you are responsible for extending the appropriate hospitality to your present and future guests. This single factor will greatly determine the vibe, feeling, or ambiance of the facility, even more than having the latest and greatest tools and gizmos on hand.

This task may or may not fall entirely on your shoulders. Many hands make light work. If you are able to delegate some of the duties of a hospitable host to other members of your group, consider doing so.

Think of your task in the same light as planning a successful party, even if it's one that you anticipate will last for days on end. These basic ideas are as old as civilized living. Think about fabulous parties or memorable events that you have been privileged to attend in the past, and then plan on taking it up a notch.

Try to anticipate the human needs of your attendees as well as their technological expectations. People have what seems like an endless list of requirements, some of which you can address, some not.

Make your location known. Make this information easy to find to those interested, and easy to update when the venue changes. A web site is trivial to set up these days, and even a post to a popular

forum will tend to be accessible via Internet search engines, in time. There's a new social media outlet popping up every third Tuesday, so avail yourself to what makes sense for your audience. Word of mouth only goes so far these days.

Once you've gone to the trouble of publishing your location, go the extra mile and put out some sort of actual sign or indicator that your arriving guests have found the right spot. If you have an identifiable logo or symbol associated with your group, be sure to proudly wave that flag. People don't like feeling lost, or unsure whether they're entering a welcoming space or about to trespass on private property.

Let everyone know when they are expected as well as when they are *not* expected. Post your regular meeting times, if you have them. Alternatively, make known the appropriate hours of operation. It's disappointing to be turned away at the door just because it's 1:00 a.m. on a school night.

When possible, welcome your guests. This makes a big impression on both newcomers as well as the regulars. Being part of a group is supposed to *enhance* a feeling of inclusiveness and belonging. We are social animals at heart, and even a simple hello is often the prelude to an interesting and productive time together.

Have rules. Make these rules known. A sign on the front door is not out of place, as long as it's not too negative or off-putting. Rules should *prevent* problems from occurring, and not be enacted as a spontaneous reaction when problems inevitably occur.

Ensure your guests' comfort when attending. Is there enough room for the largest (and the smallest) participant to safely enter and exit the facilities? Is there adequate lighting in the common areas, if they exist? Is there a place for everyone to sit? Who has dominion over the thermostat?

Do you plan on making refreshments available? Will this duty rotate among the membership? Keep track of such things, if only to keep from overextending yourself in all the myriad details of hosting a successful meeting. While massive banqueting and consumption of yummies make for a festive and enjoyable association, these activities are not always aligned with maintaining an effective laboratory. Separate the feeding trough from the work areas. Stay focused on what you're trying to accomplish here.

Will everyone have access to restrooms, and whose job is it to keep these areas tidy?

And the most important question of all: Who takes out the trash?

Be a Courteous Guest

Just as it's important to play the role of the hospitable host, it is likewise critical to be a courteous guest when visiting a facility, whether you are a paid-up member in good standing or an invited guest. Again, these guidelines will vary according to the intents and purposes of your lab, but the basics will always remain the same.

If possible, and when appropriate, let your host know if you are planning on attending. This won't apply in a causal, drop-in type of laboratory. Even so, by making your intentions of attending known ahead of time, you might influence (one way or the other) the attendance of other potential participants. Nothing succeeds like success. A well-attended party has a better potential for awesomeness than a sparsely peopled event.

Arrive on time or within the established time frames set forth by your host. Similarly, unless you have been granted special access, plan on leaving at a reasonable time as well. Benjamin Franklin wrote in his *Poor Richard's Almanack* (1736) that "Fish & Visitors stink in 3 days." Don't be a stinker.

Try to contribute something. Don't show up empty-handed, expecting to be fed, entertained, and enlightened.

Workstations

Now it's time to talk about your workstations. Even if it's just you in the lab, having a separate workstation for each type of activity is a great idea. For example, you might have one workstation set up for programming a computer, another for soldering electronics, and another for working with power tools, such as a drill press or a saw.

Workstations dedicated to a particular task should have everything within easy reach, including tooling, supplies, power, and lighting. Don't waste time by forcing people to wander around the lab looking for the right drill bit or magnifying glass. Keep everything close so you can find what you need, when you need it.

Having a place for everything ahead of time is the best way to follow the wise adage, "A place for everything and everything in its place." You get to decide where everything lives. It doesn't hurt to go ahead and label everything conspicuously so that others can find their way around the lab.

If you have several people wanting to work on the same kinds of projects at the same time, you're going to need multiple, nearly identical workstations. The exact number depends on your available space and the number of people you expect to want to participate simultaneously, as well as your budget.

Most indoor-oriented work can often be performed at a work table. Exceptions include giant-scale mechatronics, pyrotechnics, and underwater robotics. Some of their constituent bits and pieces, however, can be crafted on an adequately prepared work table.

Make sure each work area has plenty of power outlets available. You're almost guaranteed to run short at some point. Take care not to overload your circuits, however. If you anticipate needing a lot more power than is presently provisioned, you're going to have to consider the real possibility of having your facility expanded by qualified, *licensed* professionals. These requirements will vary from one location to the next. Check with your local building codes to be sure.

As repeated often in previous chapters, you can never have *too much* lighting available, especially for the more detail-oriented chores. Typical indoor room lighting is just about adequate for finding your way out of the room, and that's about all. You'll need area lighting for each workstation, and possible additional task lighting, depending on your particular requirements.

Providing network access to each workstation can be challenging. Wireless networking is a good way to accommodate a relatively small number of users at once. More than a handful of computers trying to access the Internet at the same time can bring many wireless routers to a slow crawl. Dedicated high-speed Ethernet connectivity is more expensive and takes more effort to deploy, but offers much greater bandwidth to your lab-folk.

If you're especially cramped (or *dimensionally constrained*) in your lab, you'll need to get inventive. For example, a table placed in the center of the room can be approached from multiple sides. There's no reason all the workbenches have to be pushed up against a wall, allowing access from only a single side. Get creative!

Safety Planning

While it's tempting to fill up all the available space in a lab with workstations, especially when the budget permits it, do try to leave a bit of common area here and there. You always want to be able to walk *away* from a workstation with the same (or sometimes even more) rapidity you approached it with. Fire is an excellent example of such a motivator.

■ **Tip** Keep a properly selected and maintained fire extinguisher at each workstation, if possible.

Post emergency procedures prominently, where everyone, including visitors, can see. Have an evacuation plan, complete with map and "You are here" indicator posted at each workstation. Hopefully you will never need it.

Presentations

Are you excited about your latest project? Have you just learned a great new skill? Setting up your lab for group presentations is an excellent way to communicate these ideas to your friends, family, and coworkers.

Make your ~~victims~~ guests comfortable. Have adequate seating for everyone, with plenty of room between the rows (if you have more than one row of chairs). Ensure that everyone has a good view of what you intend to present.

Will the attendees be expected to take notes? Then perhaps you should set up tables where they can comfortably jot down some of the more spectacular aspects of your presentation. If you will be providing a handout or other documentation packages, make sure you have enough for the anticipated demand. Will you be entertaining questions or comments either during the presentation or afterward? Then make sure that not only can your audience see *you*, but that *you* can see *them*.

If you're going to be using some sort of projector for your presentation, by all means set aside some time to get to know the equipment ahead of time. Nothing ever seems to work just exactly as you imagined that it should. This seems to be an invariant law of presentation physics. No one is really sure why.

Your audience's time is just as valuable as your own. In fact, if there are only two people attending, then their collective time is worth approximately *twice* as much as yours. Think about it. Have all your ducks in a row, so to speak. Wasting time figuring out which cable goes where is not a good use of your time together.

Summary

Wow! You can really go crazy setting up a shared electronics lab, can't you?

Before you even flip on the light in your shiny new group lab, you should already have an insightful idea of who is going to be using it and why. You should also have some honest expectations of what your own expectations are going to be, and how you would like to interact with both the lab itself and its population.

The details, of course, are always going to be specific to your particular situation. Be on guard, however, for the future. It's going to sneak up on you, someday. Not too long ago, for example, it took a fairly hefty desk to keep a modern personal computer up off the floor. That kind of computing power now fits in a pocket. Think of what better uses you could dream up for that space these days!

That kind of forward thinking is exactly what turns the dreams of today into the reality of tomorrow. It's forward-thinking people like you, dear reader, that help map out those realities. Take the opportunity you have right now to spend some quality time daydreaming about how things *could* be. Then take those steps necessary to make it happen. Your family, your society, and your world expect great things from you. You can do it!

APPENDIX A

Getting Started with Tool Building

Once you've become comfortable in your lab and have had time to play with a few circuits, you might start to notice that some of the "tools" you've been using are just simple electronic circuits themselves. Good examples are power supplies and meters. These are great tool-building projects because you can see useful results early.

Let's take a look at building a couple of simple electronic tools that might be of use in your lab. Hopefully you will develop a better understanding of how these tools work. Ideally, you will progress from the basic question of "Does it work?" to the more involved questions of "How well does it work and what can I do to improve it?"

Please bear in mind that these exercises, while hopefully useful, are to illustrate what needs to go into the building of practical, reliable tools. At every stage you should be thinking about what design choices you have and which choices will enhance the usefulness of your tool-building process.

A Very Simple Power Supply

Almost all electronic projects need electricity to work. Having a good, dependable power supply at your disposal on your bench will get you started faster on new projects. You won't have to worry about dead batteries and flaky power adapters. See Figure A-1.

Figure A-1. *A professional bench power supply. This device allows both the voltage and the maximum current to be adjusted. It provides two dedicated meters to show how much power is flowing: one for voltage and the other for current. It also provides a modular set of plugs (banana plugs) for easily connecting and disconnecting power leads.*

A bench power supply such as the one shown in Figure A-1 has many features and includes extra circuitry to make it safe and easy to use. It will also set you back a good chunk of change (i.e., cost money). We're going to build something a bit simpler to start. Feel free to add more bells and whistles as your needs arise.

■ **Caution** Anything plugged into the wall has the potential to shock, burn, or kill you. Do not defeat their safety features!

An Easy 2.5 Watts

You probably have a spare USB charger lying around somewhere. If you don't already, you more than likely will at some point in the near future, as these are becoming more common with smaller electronic devices. If not, you can obtain one relatively cheaply if you do some smart shopping. The USB charger shown in Figure A-2 was obtained from overseas via eBay for less than $1. You will also need a USB cable about 3 or 4 feet long. Again, don't spend a lot of money on a new cable. If you don't already have one floating around in a drawer somewhere, you probably know someone that does.

Figure A-2. *A USB charger that plugs into the wall and provides a regulated +5V supply. This plug is intended for US wiring, but will operate from 110AC to 240VAC at 50 or 60Hz, which pretty much covers the whole world, if you have the right adapter plug.*

It doesn't matter what type of USB cable you find, because we're going to cut off the smaller end and use the bare wires inside the cable. It just has to have the USB A–style plug shown on the left side of Figure A-2. The plug will fit into the socket of the charger. You do not need to open or modify the USB charger at all, and you are seriously advised not to do so for any reason.

Let's take a closer look at the label on the charger to find out exactly what it's supposed to be doing for us. See Figure A-3.

Figure A-3. *The label of the USB charger tells us that it accepts anything from 110VAC to 240VAC at either 50Hz or 60Hz. This wide range of input power allows the same internal electronic design to be used worldwide. Only the prongs that plug into the wall vary from location to location. The label also tells us that the USB charger will output +5V at up to 500mA. That's 2.5W!*

The "OUTPUT: 5.0V ⎓ 500mA" marking tells us what we need to know about the flavor of the power coming out of the adapter. The "5.0V" is the measure of the voltage. This is a very useful voltage level for small projects. Many digital chips require a 5V supply, although 3.3V is also becoming quite popular.

The ⎓ symbol represents *direct current (DC)* voltage. The symbol for *AC (alternating current)* voltage is the tilde, or wavy line symbol ~. The "500mA" is the maximum current that can be supplied by this charger (500 milliamps, or 0.5A), although you are cautioned not to expect a low-cost item such as this one to produce 100 percent of its rated power 100 percent of the time.

While this USB charger will most likely work for our intended purposes, it's best to keep those expectations in check. Note that "Model:" is misspelled ("Mode:"); and also note the absence of the magic letters *USB* or the USB logo. Also, there is a complete lack of any safety certifications present on this humble device, as befits its ~~cheap~~ economically optimized provenance. Compare this with the veritable constellation of safety certifications on the name-brand laptop charger shown in Figure A-4.

Figure A-4. *A name-brand laptop charger with several international safety certifications. Every one of these certifications costs money to obtain, and shows that the device was demonstrated to be safe for use in a typical home or business application.*

Next we adapt the USB cable to our needs. In the words of the Red Queen, "Off with his head!"

■ **Caution** Make sure the USB charger is not plugged into the wall or a power strip when making modifications to the cable.

First, plug the USB cable into the USB charger. Now cut off the *other* end of the cable. See Figure A-5.

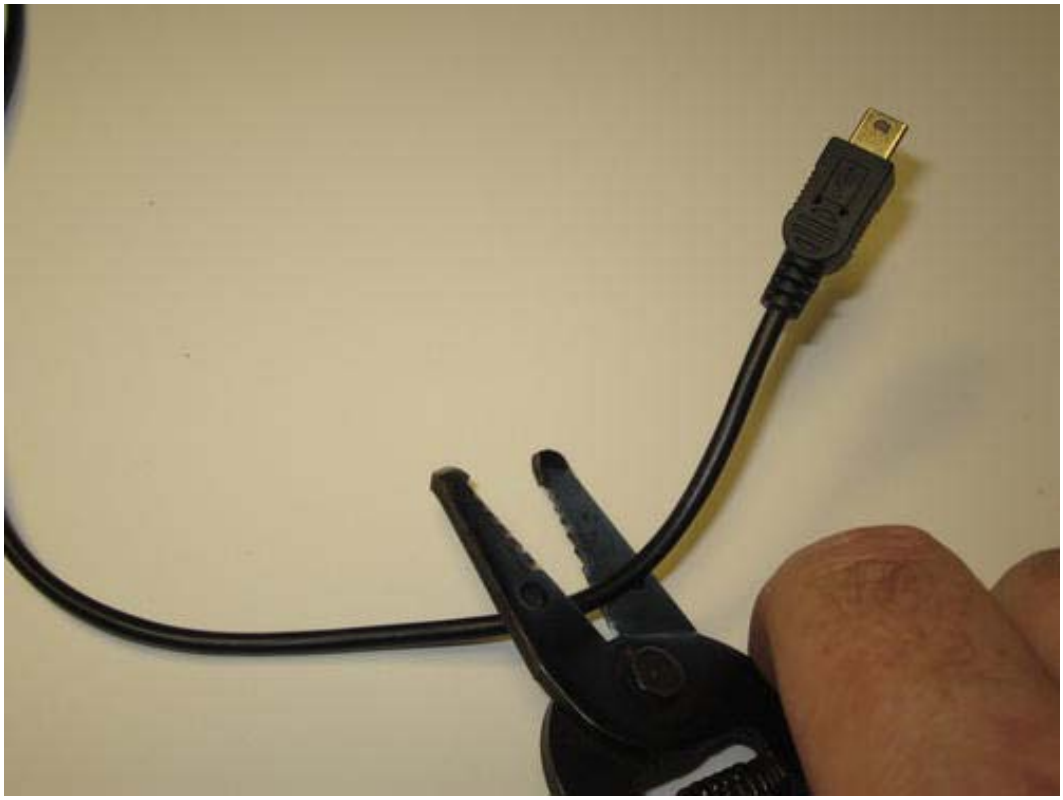

Figure A-5. *Cut off the device end of the USB cable. If you cut off the wrong end, you're not going to be able to plug it back into the charger, at least not without a considerable amount of effort. To ensure you cut the correct end, plug the host end of the cable into the USB charger before snipping, and then cut off the other end.*

Now carefully strip off about an inch of the cable's insulating jacket. Do your best to not nick the insulation on the wires inside. Within the jacket you should find four wires. Two of these wires carry the +5V and ground from the power supply. The other two wires carry the data on the USB connection. Since we're only interested in the power, we can ignore the other two wires for now. See Figure A-6.

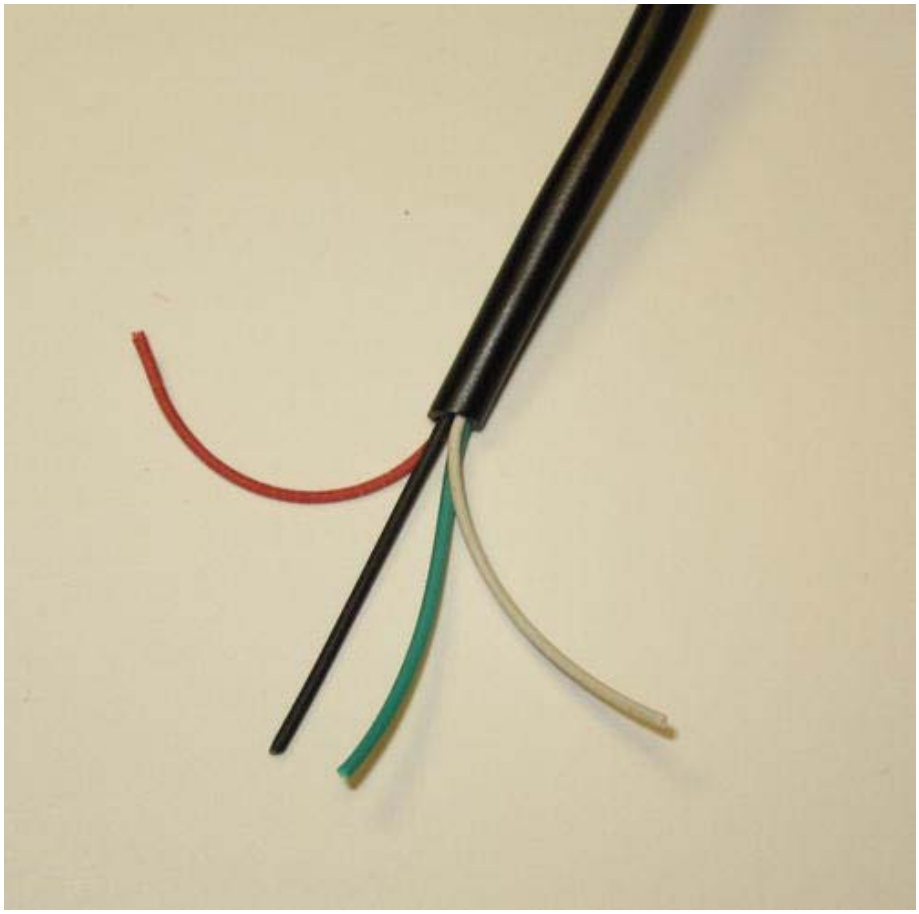

Figure A-6. *The four internal wires within the USB cable. From left to right they are red (VBUS or +5V), black (ground), green (USB D+), and white (USB D–). Use the red and black wires to pull a regulated +5V from the charger.*

The USB standard specifies every little detail about how to build and mark USB cables, even down to the colors of the internal wires in the cable that you're not ever supposed to see! That's dedication.

■ **Note** Apple violates the USB standard by not having a raised USB symbol molded into its cables.

However, sometimes cable manufacturers fudge a bit and use whatever four-conductor cable they happen to have lying around. A very common substitute cable uses red, blue, yellow, and brown wires internally. See Table A-1 for a list of which wires go where.

Table A-1. *Standard USB Wire Colors and Their Functions, Along with Popular Alternate Colors*

Function	Pin Number	Standard USB Color	Alternate Color
VBUS (+5V)	1	Red	Red
D– 2		White	Blue
D+ 3		Green	Yellow
GND 4		Black	Brown

Now is the time to verify the wiring before we get much further. Even if your cable has the official wire colors within the insulating jacket, you are strongly advised to double-check both the voltage and the polarity coming out of the charger before connecting it to your tender, sensitive circuits. Minimize your assumptions about the compliance of others. Testing proves testing works!

Strip about 1/4 inch of the insulation from the ends of the red and black wires. Get out your meter and set it up to read voltage at or above the 5V range. If your fancy meter has autoranging, then just set it to read DC voltage. Plug the USB cable into the charger, if it's not already installed. Make sure the red and black wires are not touching, and then plug the charger into the wall or a convenient power strip.

Now measure the voltage between the red and black wires. Hopefully you should see a reading at or near 5.0V. The USB standard specifies a tolerance of ±10 percent, so anything between 4.5V and 5.5V is considered OK. See Figure A-7.

Figure A-7. *Measure the voltage coming from the USB charger before connecting it to any of your circuits. This one reads 5V on the dot! This is a much safer method than trial by fire (i.e., plugging it into your circuit and looking for a fire).*

Now that you've confirmed that the red and black wires do indeed carry the regulated +5V from the USB charger, you can clip off the unused green and white wires. At this point you can either use the bare, stripped wires of the USB cable or solder on a more robust connector. Since this power supply is destined to be used with a solderless breadboard, a small, two-pin connector with the appropriate spacing will be attached. See Figure A-8.

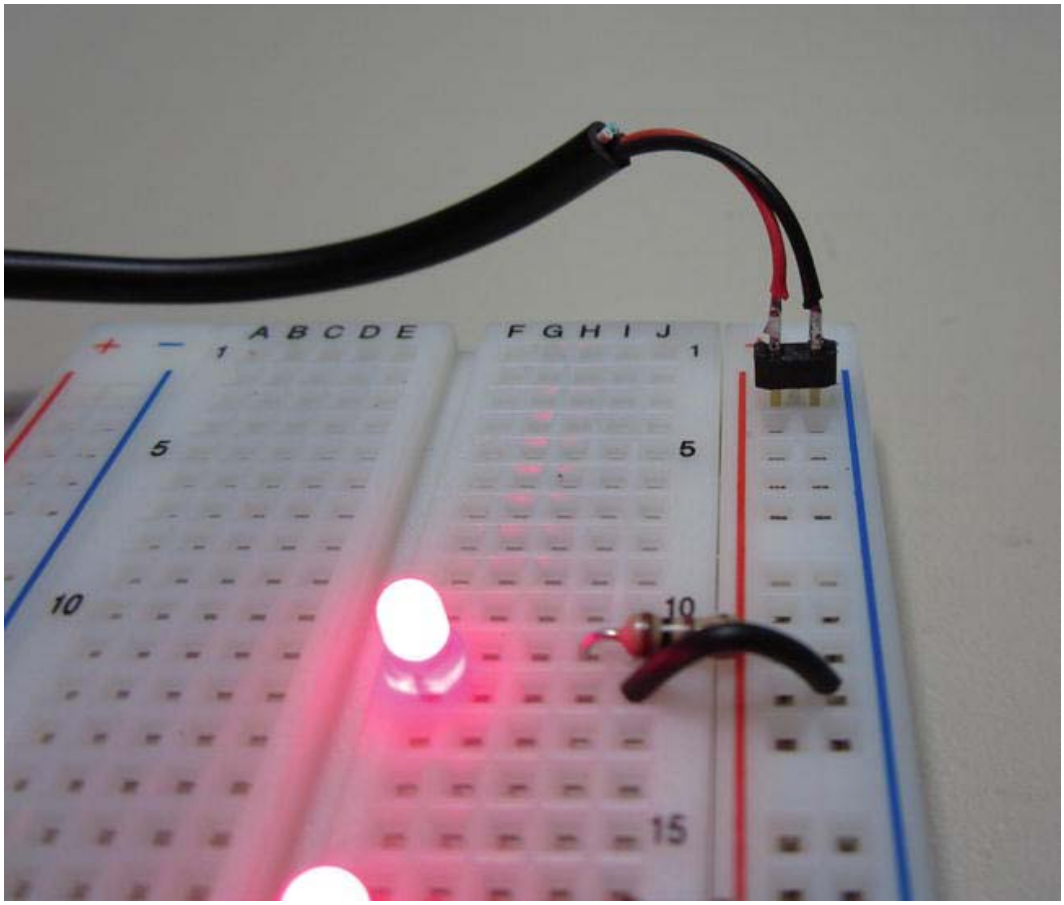

Figure A-8. *A gold-plated pin connector is soldered to the modified USB cable. The red and black insulation is left visible to be a polarity indicator when installing the cable to the solderless breadboard. Another happy LED!*

Adding Features

This power supply works just fine for most projects. If your requirements are, "Translate AC power from the wall into regulated DC power I can use for small projects, without spending a lot of money," then this contraption fits the bill precisely.

You can see for yourself in Figure A-8 that it does indeed work as advertised. Looking back at Figure A-7, you can see that the charger itself has a power-on indicator LED built into the housing. What it doesn't have is a power control or a switch. The power to the circuit is controlled by the switch on the power strip. This works just fine as long as you don't mind turning on and off everything else that happens to be plugged into the same power strip.

Various Indicators

Not all USB chargers have a power indicator, however. Some have both a power indicator LED as well as a *charge status indicator*, which can tell you at a glance if your USB device is fully charged or still charging. A charge status indicator is usually implemented by measuring the amount of current being drawn from the supply. If more than a preset current is flowing, the power supply assumes a battery is still being charged. When that current drops below a certain level, it assumes that the battery has been completely (or maybe just mostly) charged. Some chargers use a red or orange LED to indicate charging, and a green or blue LED to show that the battery is finished charging. Again, this type of charge status display is provided to give the user a quick status update with a single glance. You don't need to consult the product manual to interpret the status code, if you can remember that red means "charging" and green means "charged."

Let's rearrange some of the parts on the solderless breadboard to make room for some new features. See Figure A-9.

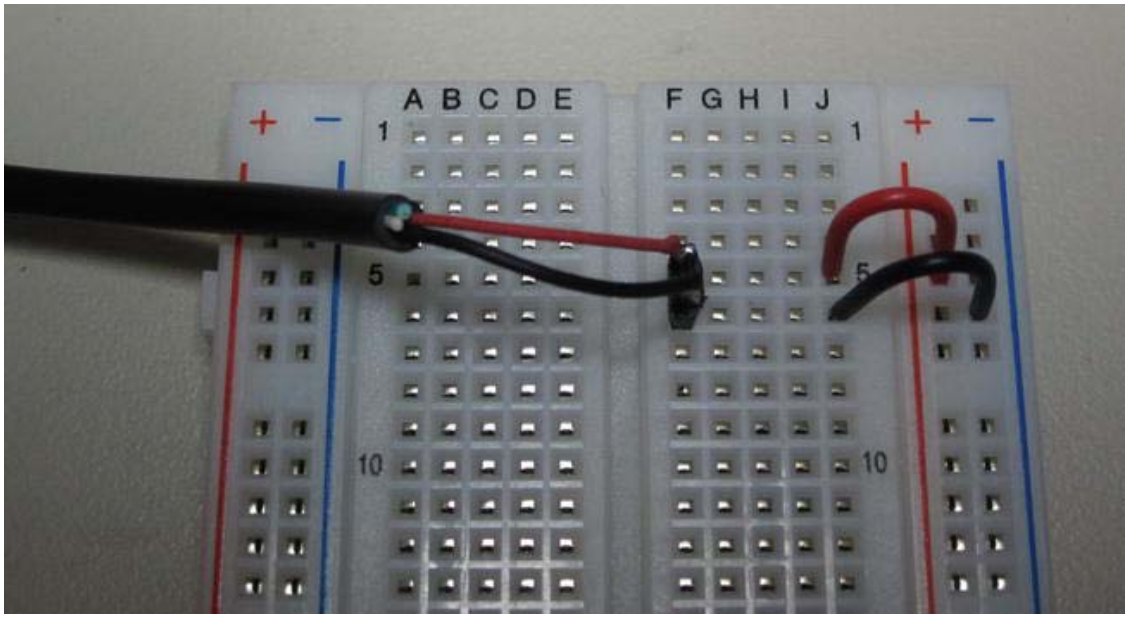

Figure A-9. *The regulated power coming from the USB charger is no longer directly connected to the breadboard's power rails. Instead, it is routed to some internal tie points and then connected to the power rails via two short jumpers.*

Power-On Indicator

First, we add a local power-on indicator by reinstalling the LED and current-limiting resistor used in the previous experiments. While this duplicates the function of any LEDs that might be present on the USB charger itself, it brings the indicator closer to the area of interest, which in this case is the circuitry onboard the solderless breadboard.

The anode of the LED goes into tie point F-3, with the cathode being installed at tie point F-4. The current-limiting resistor spans the gap between tie point I-3 and the right-hand positive (red) power rail. A short jumper connects tie point J-4 and the right-hand negative power rail. See Figure A-10.

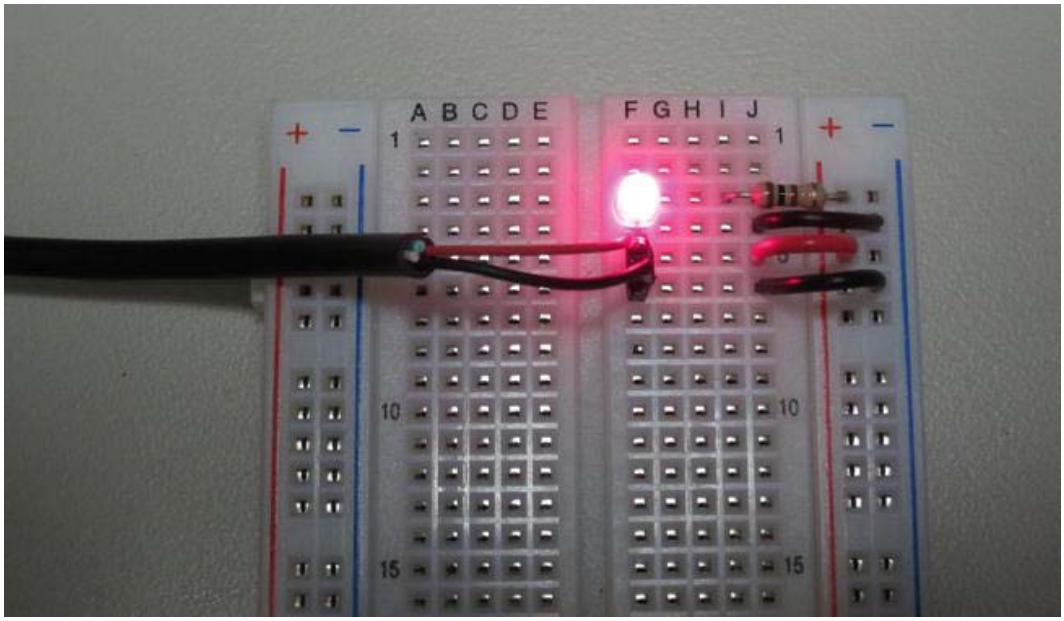

Figure A-10. *Add an LED and a current-limiting resistor across the power rails of the solderless breadboard to give an at-a-glance power indicator, right where the action is taking place.*

Now we have a good power-on indicator, right where we need it. It may or may not be redundant, depending on the features of your USB charger. This type of indicator is digital in the sense that it tells us that the circuit is either on or off, without giving us a lot of precise information about anything in between. For a lot of applications, however, this is more than enough information.

Power Supply Voltage

What if you *did* either want or need more precise information about the power supply? One method would be to permanently connect your multimeter to the circuit so that you can see how many volts are being delivered. That method assumes that you're not going to need your multimeter for anything else, ever.

A practical variation of that method, however, it to provide convenient *test points* in your circuit so that you can quickly and easily take a voltage reading when the need arises. Be sure to position the test points so that they are easy to access. Having a nice, big, readable label wouldn't hurt, either. Also, try to arrange things so that it's not likely that contact with a metal object, such as a tool or your wristwatch, will accidentally short out the power supply by touching both test points at the same time. Even simple "features" get complicated quickly, it seems!

If you want an accurate (and permanent) voltage reading on your circuit, consider adding a voltmeter. Small panel meters are relatively inexpensive and reasonably accurate. A DC voltmeter has two leads, positive and negative, that are attached across the voltage to be measured. See Figure A-11.

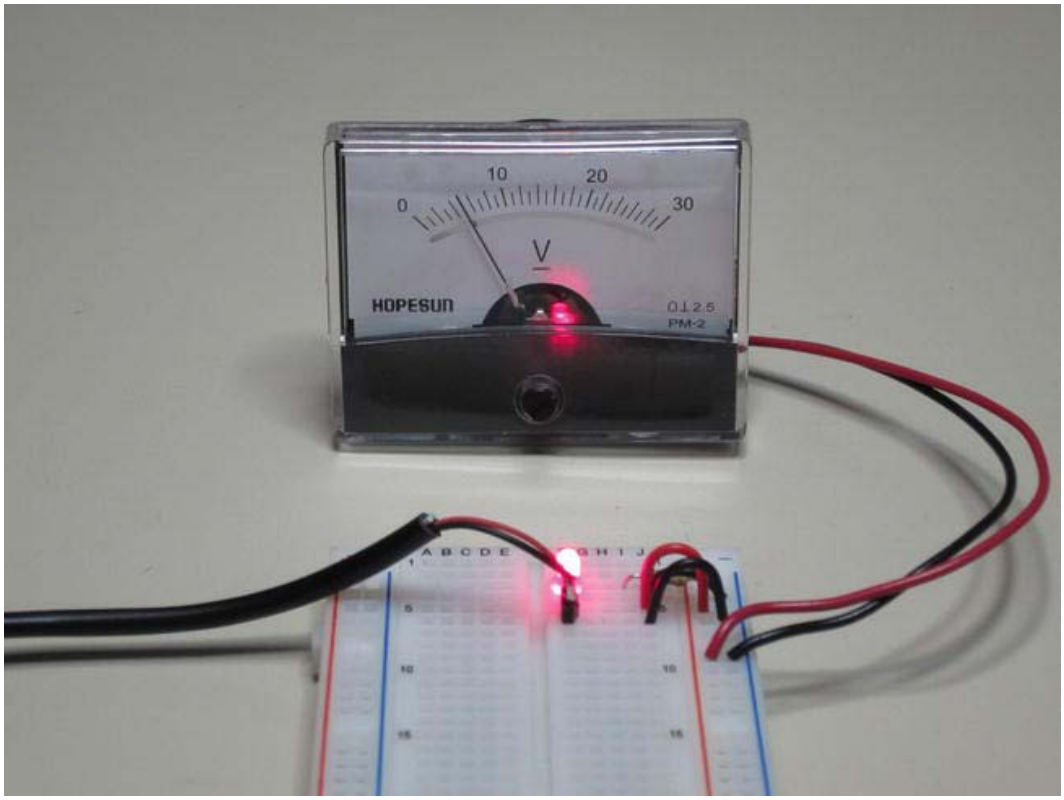

Figure A-11. *A DC voltmeter is attached to the circuit to accurately measure the supply voltage. The V on the meter's legend stands for voltage. The underline beneath the V indicates that it is designed to measure DC voltages, as opposed to AC voltages.*

The panel meter shown in Figure A-11 has a range of 0–30VDC. That's a bit more than we need, since our little power supply is only supposed to produce 5.0VDC ±10 percent. Since the meter's range does not accurately match the expected range of supply voltages, we lose a bit of precision when attempting to read the display. All the action is crowded together on the left side of the meter.

It might seem that a 0–5VDC meter would be preferable, but that would not allow for any overvoltage conditions at all. Remember, the USB standard allows for up to 5.5VDC to be delivered over the cable. A 0–6VDC meter, if available, would be more suitable. The meter introduced in Figure A-11, however, would be perfect when used with the laptop supply shown in Figure A-4, because its output voltage is 19.0V. That leaves a bit of room for overvoltage conditions and gives a wide enough swing of the needle to produce fine detail.

Power Supply Current

Measuring the *voltage* at any point in a circuit is easy. Just put a voltmeter between two points and voilà! In our previous example, we measured the VBUS power supply voltage with reference to GND, the ground potential of the circuit. Many voltage measurements are made with respect to ground.

To measure the current flowing through a circuit, we have two options. The first option is the most direct route. Install an ammeter (a meter that measures *amps* of current) inline with the circuit you want to measure. This requires that you *break* the circuit to make room for the meter. Once installed, the current flowing in the circuit actually flows through the ammeter as well.

The second option involves using a bit of trickery and some math. Instead of installing an ammeter directly inline with the current flow to be measured, we install a resistor of known resistance and measure the *voltage* that develops across the resistor.

Since we know that the values of volts, ohms, and amps are always related in any circuit, we can use Ohm's Law to determine how much current is flowing through a circuit by measuring the voltage across a known resistance.

To make things very easy, let's use a 1Ω resistor in series with the power supply, inserted in the circuit between where the positive lead of the power supply arrives at the circuit and where it is connected to the rest of the circuitry.

Unlike our previous use of Ohm's Law to calculate the missing value based on two known values, we only use *one* known value (the value of the resistor, called a *shunt resistor* when used in this manner). This one known value (resistance) then establishes the relationship between the two other values, voltage and current. As the current increases in the circuit, so does the voltage across the resistor. The two values will mirror each other—as one increases or decreases, the other will follow.

Since we used a 1Ω resistor in the circuit, this sets the relationship between current through the circuit and voltage across the resistor at a 1:1 ratio. For every ampere of current through the circuit, for example, 1V will be measured across the resistor.

Our power supply is only supposed to be able to deliver 0.5A of current, maximum, so we'll be dealing with voltages of less than 0.5V, unless something terribly unexpected happens.

Again, we could permanently attach a multimeter across the leads of a 1Ω resistor inserted into the circuit, or we could attach a voltmeter that is sensitive enough to give accurately readable information in the range we need. The 0–30VDC meter used before is much too large in range to do us any good here. We might see a tiny wiggle in the needle, but that's all.

Instead, we'll use a different kind of meter entirely. A digital voltmeter contains its own dedicated measurement circuitry and a numeric display to indicate the voltage reading. It also requires its own separate power supply. See Figure A-12.

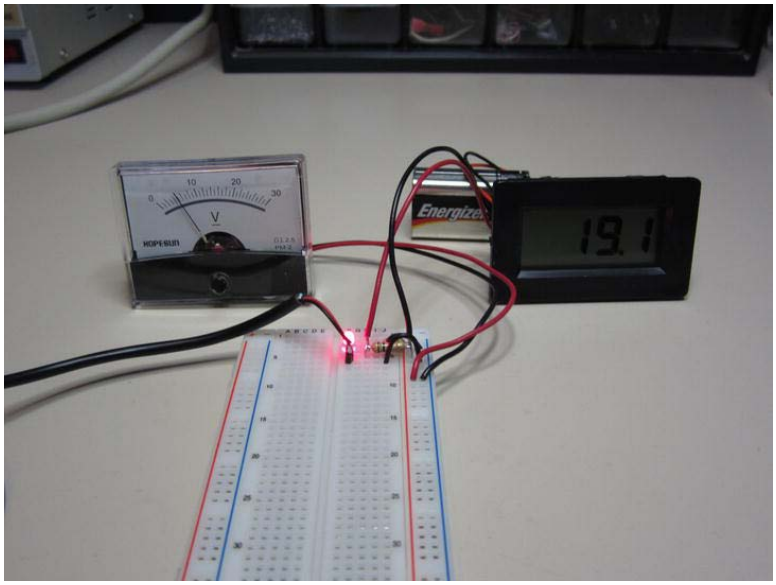

Figure A-12. *A digital voltage meter is used to read the voltage across the shunt resistor installed in the circuit. Because the shunt resistor has a 1.0Ω value, Ohm's Law dictates that the reading in millivolts on the digital meter correspond exactly to the number of milliamps flowing through the circuit. Math is useful, sometimes.*

The jumper wire connecting the incoming power supply directly to the power rail has been replaced with a 1Ω resistor. Leads from both ends of the resistor have been connected to the input terminals of the digital voltage meter on the right. The digital meter, unlike the analog meter on the left, requires an independent power supply to operate, in this case a 9V battery.

So now we've added some features to our simple power supply, including a power-on indicator, a supply voltage reading, and a supply current reading.

These are very useful features to have on any power supply. However, at this point in the prototyping stage, we've just barely covered what the added circuitry is supposed to do. Packaging all this up into an easy-to-use and reliable device takes as much if not more thought and effort.

First, you have to rebuild this entire circuit in a more permanent fashion. Next, you will have to wedge all that clever gadgetry into some sort of enclosure to protect the delicate bits while still permitting access to the inputs, outputs, and controls, if any. Then you get to label everything so that you can remember how to use it in the future.

Summary

So now you just might be developing a certain respect for how much work goes into building even the simplest tools—tools that are useful, accurate, reliable, and an asset to your toolbox. Remember, every tool on your workbench has to earn its place there. This applies to tools you design and build yourself, as well.

Good luck with your tool-building projects. Sometimes it's just as much fun to work on your tools as it is to work *with* your tools.

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Workshop. *See* Electronics lab

Building Your Own Electronics Lab

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To my father, John H. Wheat, who patiently taught me about electricity and electronics over 40 years ago. To this day, I remain fascinated by it. My life has been enriched in so many ways by the many things that I learned from my father.

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VOL. 1

Charles Platt

Encyclopedia of Electronic Components

Power Sources & Conversion

Resistors ▪ Capacitors ▪ Inductors
Switches ▪ Encoders ▪ Relays ▪ Transistors

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Encyclopedia of Electronic Components Volume 1

Charles Platt

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Encyclopedia of Electronic Components Volume 1

by Charles Platt

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[TI]

To Mark Frauenfelder, who reacquainted me with the pleasures of Making.

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Preface

At a time when information is widely and freely available in greater quantities than ever before, the reader may wonder whether *The Encyclopedia of Electronic Components* is really necessary. Surely, anything you want to know can be found online?

Well, yes and no. Let's consider the available resources.

1. Datasheets

Datasheets are indispensable, but they have limitations. Some are detailed; others are skimpy. Some show you sample schematics as a guide to using a component; many don't. None of them tells you much about how a component works, because that's not their purpose. Often they don't mention other components that must be added. Some datasheets for DC-DC converters, for instance, say nothing at all about bypass capacitors, even though the capacitors may be essential. A datasheet for an optocoupler says nothing about the pullup resistor required by the open-collector output.

Datasheets don't facilitate comparison shopping. A datasheet from one manufacturer will not compare its products with those from another manufacturer, and may not even provide much guidance about alternatives that are available from the same manufacturer. For example, a datasheet for a linear voltage regulator won't suggest that you might do better to use a DC-DC converter in an application where high efficiency is important.

Most of all, datasheets don't tell you how to avoid common mistakes. What actually happens if you connect that tantalum capacitor the wrong way around? A datasheet gives you the customary list of absolute maximum values, and after that, you are on your own, burning things out, encountering mysterious electronic behavior, and discovering limitations that are so well known, the datasheet didn't bother to mention them. In my experience, relying on datasheets creates a significant risk of reinventing the wheel.

2. Wikipedia

Wikipedia's coverage of electronics is impressive but inconsistent. Some entries are elementary, while others are extremely technical. Some are shallow, while others are deep. Some are well organized, while others run off into obscure topics that may have interested one of the contributors but are of little practical value to most readers. Many topics are distributed over multiple entries, forcing you to hunt through several URLs. Overall, Wikipedia tends to be good if you want theory, but not-so-good if you want hands-on practicality.

3. Manufacturers' Tutorials

A few helpful and enlightened manufacturers have compiled highly authoritative, instructional overviews of the components that they sell. Littelfuse, for instance, publishes an excellent series of documents telling you everything you could possibly want to know about fuses. But now you encounter a different problem: There is so much information, you'll need a couple of hours to dig through it all. Also, because the tutorials tend not to receive high page rankings on Google, they can be hard to find. And if a manufacturer has gaps in its product line, its tutorial is unlikely to mention them. Consequently, you won't know what's missing.

4. Personal Guides

It is a well-known attribute of the Web that many individuals feel the impulse to share everything they know (or think they know) about a particular topic. These personal guides can present surprisingly thorough online coverage of relatively obscure issues, such as the types of capacitors most suitable for loudspeaker crossover circuits, or the correct derivation of amp-hour numbers for lead-acid batteries. Unfortunately, on some sites you can also find errors, unsubstantiated opinions, plagiarism, and eccentricity. My general rule is that three or more guides generally have to agree with each other before their statements can be trusted—and even then, I have a small residue of doubt. The search-inspect-and-verify process can take a while.

So—yes, the information that you want usually does exist somewhere online, but no, it may not be easy to find. The vastness of the Web is not organized like an encyclopedia.

What about books? Generally speaking, they tend to be entry-level, or they specialize in narrow areas. A few broad-ranging books are truly excellent, but they are primarily educational, organized in an instructional sequence. They are not reference books.

The Encyclopedic Solution

Scarcity or inaccessibility of information ceased to be a problem many years ago. Its vast quantity, inconsistency, and dispersal have become the new barriers to acquiring knowledge. If you have to go hunting among datasheets, Wikipedia, manufacturers' tutorials (which may or may not exist), personal guides (which may have unrevealed bias), and multiple educational books, the process will be inconvenient and time-consuming. If you plan to revisit the topic in the future, you'll have to remember which URLs were useful and which ones weren't—and you may find that many of them are not even there anymore.

When I considered these issues during my own work as an electronics columnist for *Make* magazine, I saw a real need for a fact-checked, cross-referenced encyclopedia that would compile the basic information about components concisely, in an organized, consistent format, with informative photographs, schematics, and diagrams. It might save many people a lot of search time if it could summarize how components work, how to use them, what the alternatives are, and what the common errors and problems may be.

That is the modest ambition of *The Encyclopedia of Electronic Components*.

The Audience

Like any reference work, this one hopes to serve two categories of readers: The informed and the not-yet-informed.

Perhaps you are learning electronics, and you see a part listed in a catalog. It looks interesting, but the catalog doesn't tell you exactly what the part does or how it is commonly used. You need to look it up either by function or by name, but you're not sure where to start. An encyclopedic reference can simplify the fact-finding process, can save you from ordering a part that may be inappropriate, and can tell you how it should be used.

Perhaps, instead, you are an electronics engineer or hobbyist, thinking about a new circuit. You remember using a component three or four years ago, but your recollection may not be reliable. You need to refresh your memory with a quick summary—and so, you open the encyclopedia, just to make sure.

Completeness

Obviously, this book cannot include every component that exists. Mouser Electronics claims to have more than 2 million products listed in its online database. *The Encyclopedia of Electronic Components* only has room for a fraction of that number—but still, it can refer you to the primary types. The electronic edition of this book should allow easy insertions and updates. My hope is that it can become an ever-expanding resource.

Acknowledgments

Any reference work draws inspiration from many sources, and this one is no exception. Three were of special importance:

Practical Electronics for Inventors by Paul Scherz (second edition) McGraw-Hill, 2007

Electronic Devices and Circuit Theory by Robert L. Boylestad and Louis Nashelsky (ninth edition) Pearson Education Inc., 2006

The Art of Electronics by Paul Horowitz and Winfield Hill (second edition) Cambridge University Press, 2006

I also made extensive use of information gleaned through Mouser Electronics and Jameco Electronics. And where would any of us be without *Getting Started in Electronics* by Forrest M. Mims III, or *The TTL Cookbook* by Don Lancaster?

In addition, there were individuals who provided special assistance. My editor, Brian Jepson, was immensely helpful in the development of the project. Michael Butler contributed greatly to the early concept and its structure. Josh Gates did resourceful research. My publishers, O'Reilly Media, demonstrated their faith in my work. Kevin Kelly unwittingly influenced me with his legendary interest in "access to tools."

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Lastly I should mention my school friends from decades ago: Hugh Levinson, Patrick Fagg, Graham Rogers, William Edmondson, and John Witty, who helped me to feel that it was okay to be a nerdy kid building my own audio equipment, long before the word "nerd" existed.

—Charles Platt, 2012

How to Use This Book

1

To avoid misunderstandings regarding the purpose and method of this book, here is a quick guide regarding the way in which it has been conceived and organized.

Reference vs. Tutorial

As its title suggests, this is a reference book, not a tutorial. In other words, it does not begin with elementary concepts and build sequentially toward concepts that are more advanced.

You should be able to dip into the text at any point, locate the topic that interests you, learn what you need to know, and then put the book aside. If you choose to read it straight through from beginning to end, you will not find concepts being introduced in a sequential, cumulative manner.

My book *Make:Electronics* follows the tutorial approach. Its range, however, is more circumscribed than that of this encyclopedia, because a tutorial inevitably allocates a lot of space to step-by-step explanations and instructions.

Theory and Practice

This book is oriented toward practicality rather than theory. I am assuming that the reader mostly wants to know how to use electronic components, rather than why they work the way they do. Consequently I have not included any proofs of formulae, any definitions rooted in electrical theory, or any historical background. Units are defined only to the extent that is necessary to avoid confusion.

Many books on electronics theory already exist, if theory is of interest to you.

Organization

The encyclopedia is divided into entries, each entry being devoted to one broad type of component. Two rules determine whether a component has an entry all to itself, or is subsumed into another entry:

1. A component merits its own entry if it is (a) widely used or (b) not-so-widely used but has a unique identity and maybe some historical status. A widely used component would be a **bipolar transistor**, while a not-so-widely-used component with a unique identity would be a **unijunction transistor**.
2. A component does not merit its own entry if it is (a) seldom used or (b) very similar in function to another component that is more widely used. For example, the *rheostat* is sub-

sumed into the **potentiometer** section, while *silicon diode*, *Zener diode*, and *germanium diode* are combined together in the **diode** entry.

Inevitably, these guidelines required judgment calls that in some cases may seem arbitrary. My ultimate decision was based on where I would expect to find a component if I was looking for it myself.

Subject Paths

Entries are not organized alphabetically. Instead they are grouped by subject, in much the same way that books in the nonfiction section of a library are organized by the Dewey Decimal System. This is convenient if you don't know exactly what you are looking for, or if you don't know all the options that may be available to perform a task that you have in mind.

Each primary category is divided into subcategories, and the subcategories are divided into component types. This hierarchy is shown in Figure 1-1. It is also apparent when you look at the top of the first page of each entry, where you will find the path that leads to it. The **capacitor** entry, for instance, is headed with this path:

power > moderation > capacitor

Any classification scheme tends to run into exceptions. You can buy a chip containing a *resistor array*, for instance. Technically, this is an *analog integrated circuit*, but should it really be included with solid-state relays and comparators? A decision was made to put it in the **resistor** section, because this seemed more useful.

Some components have hybrid functions. In Volume 2, in the *integrated circuit* subcategory, we will distinguish between those that are *analog* and those that are *digital*. So where should an **analog-digital converter** be listed? It will be found under *analog*, because that category seems better associated with its primary function, and people may be more likely to look for it there.

Primary Category	Secondary Category	Component Type
power	source	battery
	connection	jumper
		fuse
		pushbutton
		switch
		rotary switch
		rotational encoder
	moderation	relay
		resistor
		potentiometer
		capacitor
		variable capacitor
	conversion	inductor
		AC-AC transformer
		AC-DC power supply
		DC-DC converter
		DC-AC inverter
	regulation	voltage regulator
electro-magnetism	linear output	electromagnet
		solenoid
	rotational output	DC motor
		AC motor
		servo motor
		stepper motor
discrete semi-conductor	single junction	diode
		unijunction transistor
	multi-junction	bipolar transistor
		field-effect transistor

Figure 1-1. *The subject-oriented organization of categories and entries in this encyclopedia.*

Inclusions and Exclusions

There is also the question of what is, and what is not, a component. Is wire a component? Not for

the purposes of this encyclopedia. How about a **DC-DC converter**? Because converters are now sold in small packages by component suppliers, they have been included as components.

Many similar decisions had to be made on a case-by-case basis. Undoubtedly, some readers will disagree with the outcome, but reconciling all the disagreements would have been impossible. Speaking personally, the best I could do was create a book that is organized in the way that would suit me best if I were using it myself.

Typographical Conventions

Throughout this encyclopedia, the names of components that have their own entries are presented in **bold type.** Other important electronics terms or component names are presented in *italics* where they first appear in any one section.

The names of components, and the categories to which they belong, are all set in lower-case type, except where a term is normally capitalized because it is an acronym or a trademark. *Trimpot*, for instance, is trademarked by Bourns, but *trimmer* is not. **LED** is an acronym, but *cap* (abbreviation for **capacitor**) is not.

Where formulae are used, they are expressed in a format that will be familiar to computer programmers but may be unfamiliar to others. The * (asterisk) symbol is used in place of a multiplication sign, while the / (slash symbol) is used to indicate division. Where pairs of parentheses are nested, the most deeply nested pair identifies the operations that should be performed first.

Volume Contents

Practical considerations relating to book length influenced the decision to divide *The Encyclopedia of Electronic Components* into three volumes. Each volume deals with broad subject areas as follows.

Volume 1

Power, electromagnetism, and discrete semiconductors.

The *power* category includes sources of power and methods to distribute, store, interrupt, and modify power. The *electromagnetism* category includes devices that exert force linearly, and others that create a turning force. *Discrete semiconductors* include the main types of diodes and transistors.

Volume 2

Integrated circuits, light sources, sound sources, heat sources, and high-frequency sources.

Integrated circuits are divided into analog and digital components. *Light sources* range from incandescent bulbs to LEDs and small display screens; some reflective components, such as liquid-crystal displays and e-ink, are also included. *Sound sources* are primarily electromagnetic.

Volume 3

Sensing devices.

The field of sensors has become so extensive, they easily merit a volume to themselves. *Sensing devices* include those that detect light, sound, heat, motion, pressure, gas, humidity, orientation, electricity, proximity, force, and radiation.

At the time of writing, volumes 2 and 3 are still in preparation, but their contents are expected to be as described above.

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battery

2

This entry covers electrochemical power sources. Electricity is most often generated electromagnetically, but since these sources cannot be classified as components, they are outside the scope of the encyclopedia. Electrostatic sources are excluded for similar reasons.

A battery is sometimes referred to as a *cell* or *power cell*, but can actually contain multiple cells, as defined in this entry. It used to be called an *accumulator* or a *pile*, but those terms are now archaic.

OTHER RELATED COMPONENTS

- **capacitor** (see Chapter 12)

What It Does

A battery contains one or more *electrochemical cells* in which chemical reactions create an electrical potential between two immersed terminals. This potential can be discharged as *current* passing through a *load*.

An electrochemical cell should not be confused with an *electrolytic cell*, which is powered by an external source of electricity to promote *electrolysis*, whereby chemical compounds are broken down to their constituent elements. An electrolytic cell thus consumes electricity, while an electrochemical cell produces electricity.

Batteries range in size from *button cells* to large *lead-acid* units that store power generated by solar panels or windmills in locations that can be off the grid. Arrays of large batteries can provide bridging power for businesses or even small communities where conventional power is unreliable. Figure 2-1 shows a 60KW, 480VDC self-watering battery array installed in a corporate data center, supplementing wind and solar sources and providing time-of-day peak shaving of energy usage. Each lead-acid battery in this array measures approximately 28″ × 24″ × 12″ and weighs about 1,000 lb.

Figure 2-1. *A battery array providing 60KW at 480VDC as backup for a corporate data center. (Photo by permission of Hybridyne Power Systems, Canada, Inc., and the Hybridyne group of companies. Copyright by Hybridyne, an internationally registered trademark of Hybridyne Power Systems Canada Inc. No right of further reproduction unless specifically granted by Hybridyne.)*

Schematic symbols for a battery are shown in Figure 2-2. The longer of the two lines represents the positive side of the battery, in each case. One way to remember this is by imagining that the longer line can be snipped in half so that the two segments can combine to form a + sign. Traditionally, multiple connected battery symbols indicate multiple cells inside a battery; thus the center symbols in the figure could indicate a 3V battery, while those on the right would indicate a voltage greater than 3V. In practice, this convention is not followed conscientiously.

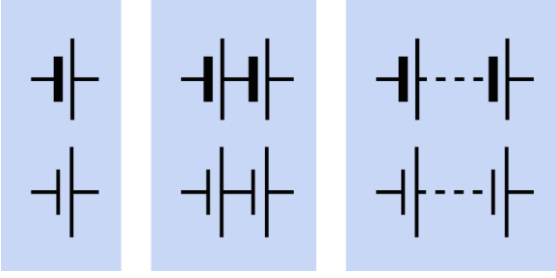

Figure 2-2. *Schematic symbols for a battery. Each pair of symbols within a blue rectangle is functionally identical.*

How It Works

In a basic battery design often used for demonstration purposes, a piece of copper serves as an *electrode*, partially immersed in a solution of copper sulfate, while a piece of zinc forms a second electrode, partially immersed in a solution of zinc sulfate. Each sulfate solution is known as an *electrolyte*, the complete battery may be referred to as a *cell*, and each half of it may be termed a *half-cell*.

A simplified cross-section view is shown in Figure 2-3. Blue arrows show the movement of electrons from the zinc terminal (the *anode*), through an external load, and into a copper terminal (the *cathode*). A *membrane separator* allows the electrons to circulate back through the battery, while preventing electrolyte mixing.

Orange arrows represent positive copper *ions*. White arrows represent positive zinc ions. (An ion is an atom with an excess or deficit of electrons.) The zinc ions are attracted into the zinc sulfate electrolyte, resulting in a net loss of mass from the zinc electrode.

Meanwhile, electrons passing into the copper electrode tend to attract positive copper ions, shown as orange arrows in the diagram. The copper ions are drawn out of the copper sulfate electrolyte, and result in a net accumulation of copper atoms on the copper electrode.

This process is energized partially by the fact that zinc tends to lose electrons more easily than copper.

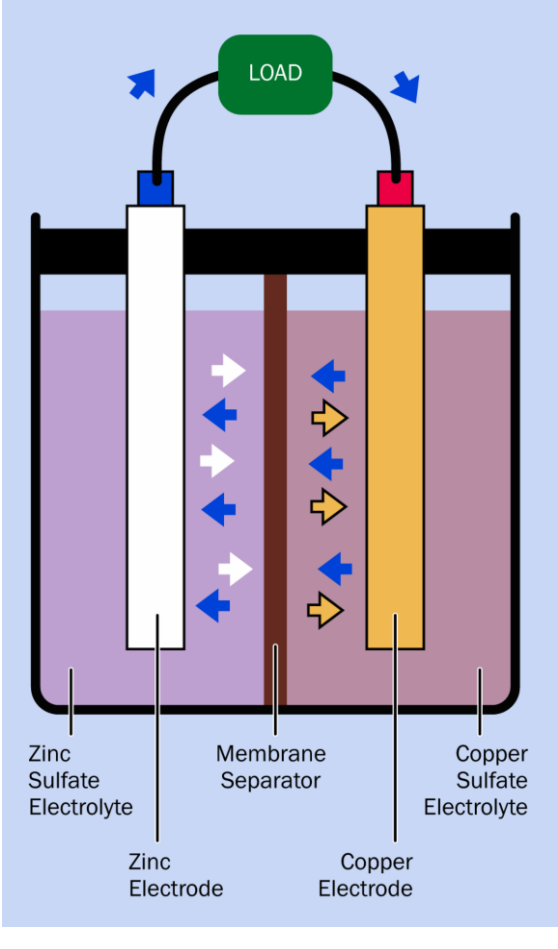

Figure 2-3. *A classically simple electrochemical cell. See text for additional details.*

Batteries for use in consumer electronics typically use a paste instead of a liquid as an electrolyte, and have been referred to as *dry cells*, although this term is becoming obsolete. The two half-cells may be combined concentrically, as in a typical 1.5-volt C, D, AA, or AAA alkaline battery (see Figure 2-4).

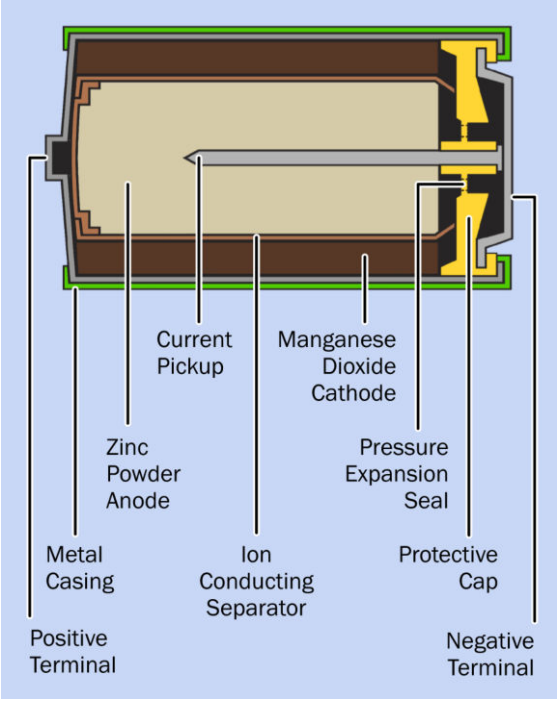

Figure 2-4. *Cross-section view of a typical 1.5-volt alkaline battery.*

A 1.5V battery contains one cell, while a 6V or 9V battery will contain multiple cells connected in series. The total voltage of the battery is the sum of the voltages of its cells.

Electrode Terminology

The electrodes of a cell are often referred to as the *anode* and the *cathode*. These terms are confusing because the electrons enter the anode inside the cell and leave it outside the cell, while electrons enter the cathode from outside the cell and leave it inside the cell. Thus, the anode is an electron emitter if you look at it externally, but the cathode is an electron emitter if you look at it internally.

Conventional current is imagined to flow in the opposite direction to electrons, and therefore, outside the cell, this current flows from the cathode to the anode, and from this perspective, the cathode can be thought of as being "more positive" than the anode. To remember this, think of the letter t in "cathode" as being a + sign, thus: ca+hode. In larger batteries, the cathode is often painted or tagged red, while the anode may be painted or tagged black or blue.

When a reusable battery is recharged, the flow of electrons reverses and the anode and the cathode effectively trade places. Recognizing this, the manufacturers of rechargeable batteries may refer to the more-positive terminal as the anode. This creates additional confusion, exacerbated further still by electronics manufacturers using the term "cathode" to identify the end of a **diode** which must be "more negative"(i.e., at a lower potential) than the opposite end.

To minimize the risk of errors, it is easiest to avoid the terms "anode" and "cathode" when referring to batteries, and speak instead of the negative and positive terminals. This encyclopedia uses the common convention of reserving the term "cathode" to identify the "more negative" end of any type of diode.

Variants

Three types of batteries exist.

1. *Disposable batteries*, properly (but infrequently) referred to as *primary cells*. They are not reliably rechargeable because their chemical reactions are not easily reversible.
2. *Rechargeable batteries*, properly (but infrequently) known as *secondary cells*. They can be recharged by applying a voltage between

the terminals from an external source such as a *battery charger*. The materials used in the battery, and the care with which the battery is maintained, will affect the rate at which chemical degradation of the electrodes gradually occurs as it is recharged repeatedly. Either way, the number of charge/discharge cycles is limited.

3. *Fuel Cells* require an inflow of a reactive gas such as hydrogen to maintain an electrochemical reaction over a long period. They are beyond the scope of this encyclopedia.

A large **capacitor** may be substituted for a battery for some applications, although it has a lower energy density and will be more expensive to manufacture than a battery of equivalent power storage. A capacitor charges and discharges much more rapidly than a battery because no chemical reactions are involved, but a battery sustains its voltage much more successfully during the discharge cycle. See Figure 2-5.

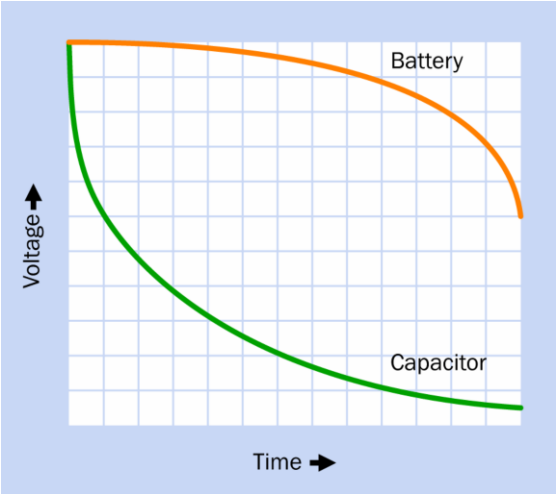

Figure 2-5. *The voltage drop of a discharging capacitor is much steeper initially than that of a battery, making capacitors unsuitable as a battery substitute in many applications. However, the ability of a capacitor to discharge very rapidly at high amperage can sometimes be a significant advantage.*

Capacitors that can store a very large amount of energy are often referred to as *supercapacitors.*

Disposable Batteries

The energy density of any disposable battery is higher than that of any type of rechargeable battery, and it will have a much longer shelf life because it loses its charge more slowly during storage (this is known as the *self-discharge rate*). Disposable batteries may have a useful life of five years or more, making them ideal for applications such as smoke detectors, handheld remotes for consumer electronics, or emergency flashlights.

Disposable batteries are not well suited to delivering high currents through loads below 75Ω. Rechargeable batteries are preferable for higher-current applications. The bar chart in Figure 2-6 shows the rated and actual capabilities of an alkaline battery relative to the three most commonly used rechargeable types, when the battery is connected with a resistance that is low enough to assure complete discharge in 1 hour.

The manufacturer's rating of watt hours per kilo is typically established by testing a battery with a relatively high-resistance load and slow rate of discharge. This rating will not apply in practice if a battery is discharged with a C-rate of 1, meaning complete discharge during 1 hour.

Common types of disposable batteries are *zinc-carbon cells* and *alkaline cells*. In a zinc-carbon cell, the negative electrode is made of zinc while the positive electrode is made of carbon. The limited power capacity of this type of battery has reduced its popularity, but because it is the cheapest to manufacture, it may still be found where a company sells a product with "batteries included." The electrolyte is usually ammonium chloride or zinc chloride. The 9V battery in Figure 2-7 is actually a zinc-carbon battery according to its supplier, while the smaller one beside it is a 12V alkaline battery designed for use in burglar alarms. These examples show that batteries cannot always be identified correctly by a casual assessment of their appearance.

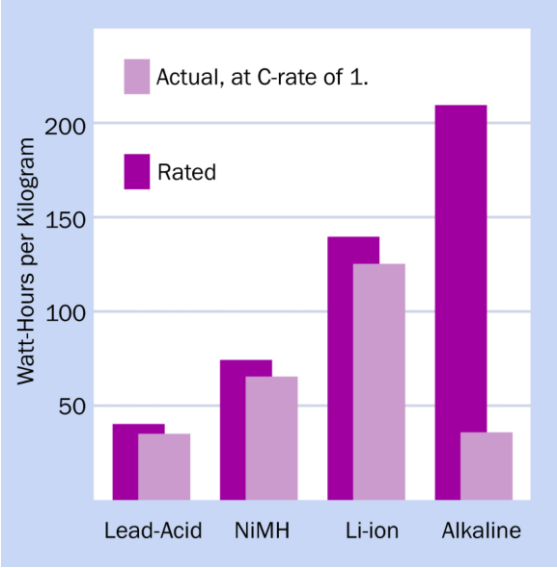

Figure 2-6. *Because of their relatively high internal resistance, alkaline batteries are especially unsuited to high discharge rates, and should be reserved for applications where a small current is required over a long period. (Chart derived from http://batteryuniversity.com.)*

Figure 2-7. *At left, a cheap carbon-zinc battery; at right, a 12V alkaline burglar-alarm battery. See text for additional details.*

In an alkaline cell, the negative electrode is made of zinc powder, the positive electrode is manganese dioxide, and the electrolyte is potassium hydroxide. An alkaline cell may provide between three to five times the power capacity of an equal size of zinc-carbon cell and is less susceptible to voltage drop during the discharge cycle.

Extremely long shelf life is necessary in some military applications. This may be achieved by using a *reserve battery*, in which the internal chemical compounds are separated from each other but can be recombined prior to use.

Rechargeable Batteries

Commonly used types are *lead-acid*, *nickel cadmium* (abbreviated *NiCad* or *NiCd*), *nickel-metal hydride* (abbreviated *NiMH*), *lithium-ion* (abbreviated *Li-ion*), and *lithium-ion polymer*.

Lead-acid batteries have existed for more than a century and are still widely used in vehicles, burglar alarms, emergency lighting, and large power backup systems. The early design was described as *flooded*; it used a solution of sulfuric acid (generically referred to as *battery acid*) as its electrolyte, required the addition of distilled water periodically, and was vented to allow gas to escape. The venting also allowed acid to spill if the battery was tipped over.

The *valve-regulated lead-acid* battery (*VRLA*) has become widely used, requiring no addition of water to the cells. A pressure relief valve is included, but will not leak electrolyte, regardless of the position of the battery. VRLA batteries are preferred for *uninterruptible power supplies* for data-processing equipment, and are found in automobiles and in electric wheelchairs, as their low gas output and security from spillage increases their safety factor.

VRLA batteries can be divided into two types: absorbed glass mat (AGM) and gel batteries. The electrolyte in an AGM is absorbed in a fiber-glass mat separator. In a gel cell, the electrolyte is mixed with silica dust to form an immobilized gel.

The term *deep cycle battery* may be applied to a lead-acid battery and indicates that it should be more tolerant of discharge to a low level—perhaps 20 percent of its full charge (although manufacturers may claim a lower number). The plates in a standard lead-acid battery are composed of a lead *sponge*, which maximizes the surface area available to acid in the battery but can be phys-

ically abraded by deep discharge. In a deep cycle battery, the plates are solid. This means they are more robust, but are less able to supply high amperage. If a deep-discharge battery is used to start an internal combustion engine, the battery should be larger than a regular lead-acid battery used for this purpose.

A sealed lead-acid battery intended to power an external light activated by a motion detector is shown in Figure 2-8. This unit weighs several pounds and is trickle-charged during the daytime by a 6″ × 6″ solar panel.

Figure 2-8. *A lead-acid battery from an external light activated by a motion sensor.*

Nickel-cadmium (*NiCad*) batteries can withstand extremely high currents, but have been banned in Europe because of the toxicity of metallic cadmium. They are being replaced in the United States by *nickel-metal hydride* (*NiMH*) types, which are free from the *memory effect* that can prevent a NiCad cell from fully recharging if it has been left for weeks or months in a partially discharged state.

Lithium-ion and lithium-ion polymer batteries have a better energy-to-mass ratio than NiMH batteries, and are widely used with electronic devices such as laptop computers, media players, digital cameras, and cellular phones. Large arrays of lithium batteries have also been used in some electric vehicles.

Various small rechargeable batteries are shown in Figure 2-9. The NiCad pack at top-left was manufactured for a cordless phone and is rapidly becoming obsolete. The 3V lithium battery at top-right was intended for a digital camera. The three batteries in the lower half of the photograph are all rechargeable NiMH substitutes for 9V, AA, and AAA batteries. The NiMH chemistry results in the AA and AAA single-cell batteries being rated for 1.2V rather than 1.5V, but the manufacturer claims they can be substituted for 1.5V alkaline cells because NiMH units sustain their rated voltage more consistently over time. Thus, the output from a fresh NiMH battery may be comparable to that of an alkaline battery that is part-way through its discharge cycle.

Figure 2-9. *Top left: NiCad battery pack for a cordless phone. Top right: Lithium battery for a digital camera. The other batteries are rechargeable NiMH substitutes for everyday alkaline cells.*

NiMH battery packs are available to deliver substantial power while being smaller and lighter than lead-acid equivalents. The NiMH package in Figure 2-10 is rated for 10Ah, and consists of ten

D-size NiMH batteries wired in series to deliver 12VDC. This type of battery pack is useful in robotics and other applications where a small motor-driven device must have free mobility.

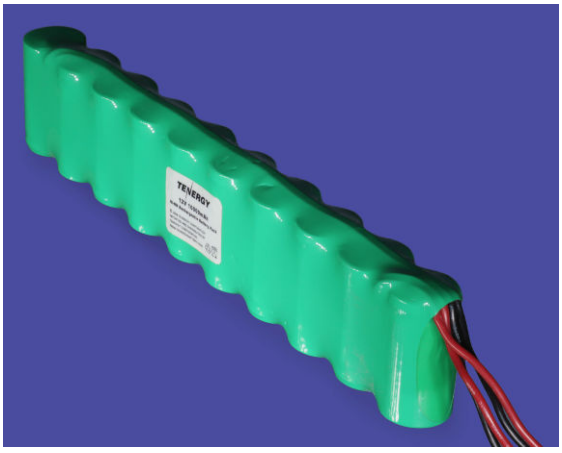

Figure 2-10. *This NiMH battery pack is rated at 10Ah and delivers 12 volts from ten D-size cells wired in series.*

Values

Amperage

The current delivered by a battery will be largely determined by the resistance of the external load placed between its terminals. However, because ion transfer must occur inside the battery to complete the circuit, the current will also be limited by the *internal resistance* of the battery. This should be thought of as an active part of the circuit.

Since a battery will deliver no current if there is no load, current must be measured while a load is attached, and cannot be measured by a meter alone. The meter will be immediately overloaded, with destructive results, if it is connected directly between the terminals of a battery, or in parallel with the load. Current must always be measured with the meter in series with the load, and the polarity of the meter must correspond with the polarity of the battery. See Figure 2-11.

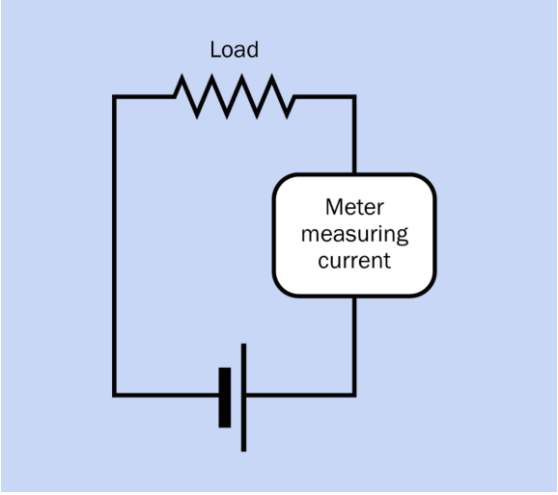

Figure 2-11. *When measuring current using an ammeter (or a multimeter configured to measure amps), the meter must be placed in series with the battery and a load. To avoid damaging the meter, it must never be applied directly across the terminals of the battery, or in parallel with a load. Be careful to observe the polarity of the meter.*

Capacity

The *electrical capacity* of a battery is measured in *amp-hours*, abbreviated *Ah*, *AH*, or (rarely) *A/H*. Smaller values are measured in *milliamp-hours*, usually abbreviated *mAh*. If I is the current being drawn from a battery (in amps) and T is the time for which the battery can deliver that current (in hours), the amp-hour capacity is given by the formula:

```
Ah = I * T
```

By turning the formula around, if we know the amp-hour rating that a manufacturer has determined for a battery, we can calculate the time in hours for which a battery can deliver a particular current:

```
T = Ah / I
```

Theoretically, Ah is a constant value for any given battery. Thus a battery rated for 4Ah should provide 1 amp for 4 hours, 4 amps for 1 hour, 5 amps for 0.8 hours (48 minutes), and so on.

In reality, this conveniently linear relationship does not exist. It quickly breaks down as the

current rises, especially when using lead-acid batteries, which do not perform well when required to deliver high current. Some of the current is lost as heat, and the battery may be electrochemically incapable of keeping up with demand.

The *Peukert number* (named after its German originator in 1897) is a fudge factor to obtain a more realistic value for T at higher currents. If n is the Peukert number for a particular battery, then the previous formula can be modified thus:

$$T = Ah / I^n$$

Manufacturers usually (but not always) supply Peukert's number in their specification for a battery. So, if a battery has been rated at 4Ah, and its Peukert number is 1.2 (which is typical for lead-acid batteries), and I=5 (in other words, we want to know for how long a time, T, the battery can deliver 5 amps):

$$T = 4 / 5^{1.2} = \text{approximately } 4 / 6.9$$

This is about 0.58 hours, or 35 minutes—much less than the 48 minutes that the original formula suggested.

Unfortunately, there is a major problem with this calculation. In Peukert's era, the amp-hour rating for a battery was established by a manufacturer by drawing 1A and measuring the time during which the battery was capable of delivering that current. If it took 4 hours, the battery was rated at 4Ah.

Today, this measurement process is reversed. Instead of specifying the current to be drawn from the battery, a manufacturer specifies the time for which the test will run, then finds the maximum current the battery can deliver for that time. Often, the time period is 20 hours. Therefore, if a battery has a modern 4Ah rating, testing has probably determined that it delivered 0.2A for 20 hours, not 1A for 4 hours, which would have been the case in Peukert's era.

This is a significant distinction, because the same battery that can deliver 0.2A for 20 hours will not be able to satisfy the greater demand of 1A for 4 hours. Therefore the old amp-hour rating and the modern amp-hour rating mean different things and are incompatible. If the modern Ah rating is inserted into the old Peukert formula (as it was above), the answer will be misleadingly optimistic. Unfortunately, this fact is widely disregarded. Peukert's formula is still being used, and the performance of many batteries is being evaluated incorrectly.

The formula has been revised (initially by Chris Gibson of SmartGauge Electronics) to take into account the way in which Ah ratings are established today. Suppose that AhM is the modern rating for the battery's capacity in amp-hours, H is the duration in hours for which the battery was tested when the manufacturer calibrated it, n is Peukert's number (supplied by the manufacturer) as before, and I is the current you hope to draw from the battery. This is the revised formula to determine T:

$$T = H * (AhM / (I * H)^n)$$

How do we know the value for H? Most (not all) manufacturers will supply this number in their battery specification. Alternatively, and confusingly, they may use the term *C-rate*, which can be defined as 1/H. This means you can easily get the value for H if you know the C-rate:

$$H = 1 / \text{C-rate}$$

We can now use the revised formula to rework the original calculation. Going back to the example, if the battery was rated for 4Ah using the modern system, in a discharge test that lasted 20 hours (which is the same as a C-rate of 0.05), and the manufacturer still states that it has a Peukert number of 1.2, and we want to know for how long we can draw 5A from it:

$$T = 20 * (4/(5 * 20)^{1.2}) = \text{approximately } 20 * 0.021$$

This is about 0.42 hours, or 25 minutes—quite different from the 35 minutes obtained with the old version of the formula, which should never be used when calculating the probable dis-

charge time based on a modern Ah rating. These issues may seem arcane, but they are of great importance when assessing the likely performance of battery-powered equipment such as electric vehicles.

Figure 2-12 shows the probable actual performance of batteries with Peukert numbers of 1.1, 1.2, and 1.3. The curves were derived from the revised version of Peukert's formula and show how the number of amp-hours that you can expect diminishes for each battery as the current increases. For example, if a battery that the manufacturer has assigned a Peukert number of 1.2 is rated at 100Ah using the modern 20-hour test, but we draw 30A from it, the battery can actually deliver only 70Ah.

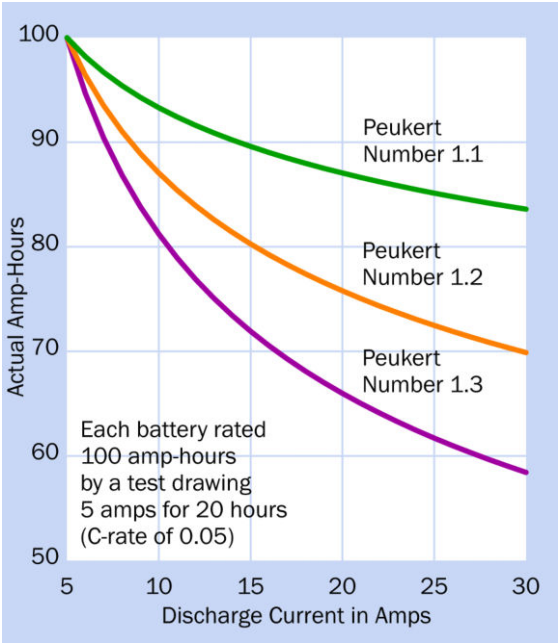

Figure 2-12. *Actual amp-hour performance that should be expected from three batteries of Peukert numbers 1.1, 1.2, and 1.3 when they discharge currents ranging from 5 to 30 amps, assuming that the manufacturer has rated each battery at 100Ah using the modern system, which usually entails a 20-hour test (a C-rate of 0.05).*

One additional factor: For any rechargeable battery, the Peukert number gradually increases with age, as the battery deteriorates chemically.

Voltage

The rated voltage of a fully charged battery is known as the *open circuit voltage* (abbreviated *OCV* or V_{oc}), defined as the potential that exists when no load is imposed between the terminals. Because the internal resistance of a volt meter (or a multimeter, when it is used to measure DC volts) is very high, it can be connected directly between the battery terminals with no other load present, and will show the OCV quite accurately, without risk of damage to the meter. A fully charged 12-volt car battery may have an OCV of about 12.6 volts, while a fresh 9-volt alkaline battery typically has an OCV of about 9.5 volts. Be extremely careful to set a multimeter to measure DC volts before connecting it across the battery. Usually this entails plugging the wire from the red probe into a socket separately reserved for measuring voltage, not amperage.

The voltage delivered by a battery will be pulled down significantly when a load is applied to it, and will decrease further as time passes during a discharge cycle. For these reasons, a **voltage regulator** is required when a battery powers components such as digital integrated circuit chips, which do not tolerate a wide variation in voltage.

To measure voltage while a load is applied to the battery, the meter must be connected in parallel with the load. See Figure 2-13. This type of measurement will give a reasonably accurate reading for the potential applied to the load, so long as the resistance of the load is relatively low compared with the internal resistance of the meter.

Figure 2-14 shows the performance of five commonly used sizes of alkaline batteries. The ratings in this chart were derived for alkaline batteries under favorable conditions, passing a small current through a relatively high-ohm load for long periods (40 to 400 hours, depending on battery type). The test continued until the final voltage for each 1.5V battery was 0.8V, and the final voltage for the 9V battery was a mere 4.8V. These voltages were considered acceptable when the

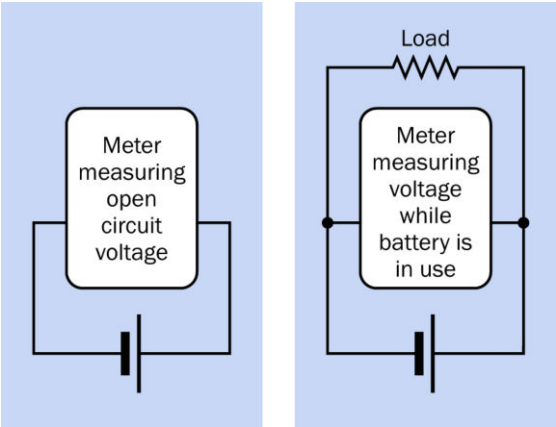

Figure 2-13. *When using a volt meter (or a multimeter configured to measure voltage), the meter can be applied directly between the battery terminals to determine the open-circuit voltage (OCV), or in parallel with a load to determine the voltage actually supplied during use. A multimeter must be set to measure DC volts before connecting it across a battery. Any other setting may damage the meter.*

Ah ratings for the batteries were calculated by the manufacturer, but in real-world situations, a final voltage of 4.8V from a 9V battery is likely to be unacceptable in many electronics applications.

Battery type	Rating (Ah)	Final voltage	Load (ohms)	Current (mA)
AAA	1.15	0.8	75	20
AA	2.87	0.8	75	20
C	7.8	0.8	39	40
D	17	0.8	39	40
9V	0.57	4.8	620	14

Figure 2-14. *The voltage delivered by a battery may drop to a low level while a manufacturer is establishing an amp-hour rating. Values for current, shown in the chart, were calculated subsequently as estimated averages, and should be considered approximate. (Derived from a chart published by Panasonic.)*

As a general rule of thumb, if an application does not tolerate a significant voltage drop, the manufacturer's amp-hour rating for a small battery may be divided by 2 to obtain a realistic number.

How to Use it

When choosing a battery to power a circuit, considerations will include the intended shelf life, maximum and typical current drain, and battery weight. The amp-hour rating of a battery can be used as a very approximate guide to determine its suitability. For 5V circuits that impose a drain of 100mA or less, it is common to use a 9V battery, or six 1.5V batteries in series, passing current through a **voltage regulator** such as the LM7805. Note that the voltage regulator requires energy to function, and thus it imposes a voltage drop that will be dissipated as heat. The minimum drop will vary depending on the type of regulator used.

Batteries or cells may be used in series or in parallel. In series, the total voltage of the chain of cells is found by summing their individual voltages, while their amp-hour rating remains the same as for a single cell, assuming that all the cells are identical. Wired in parallel, the total voltage of the cells remains the same as for a single cell, while the combined amp-hour value is found by summing their individual amp-hour ratings, assuming that all the batteries are identical. See Figure 2-15.

In addition to their obvious advantage of portability, batteries have an additional advantage of being generally free from power spikes and noise that can cause sensitive components to misbehave. Consequently, the need for smoothing will depend only on possible noise created by other components in the circuit.

Motors or other inductive loads draw an initial surge that can be many times the current that they use after they start running. A battery must be chosen that will tolerate this surge without damage.

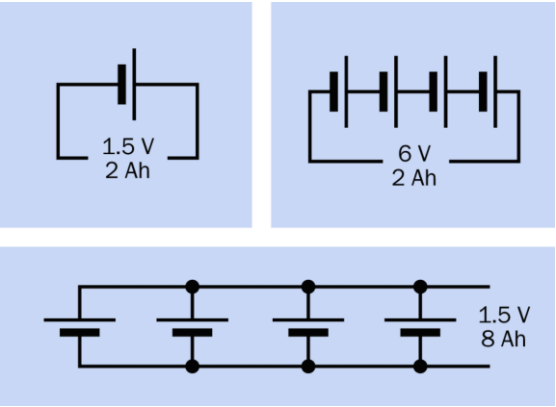

Figure 2-15. *Theoretical results of using 1.5V cells in series or in parallel, assuming a 2Ah rating for one cell.*

Because of the risk of fire, United States airline regulations limit the amp-hour capacity of lithium-ion batteries in any electronic device in carry-on or checked passenger baggage. If a device may be carried frequently as passenger baggage (for example, emergency medical equipment), NiMH batteries are preferred.

What Can Go Wrong

Short Circuits: Overheating and Fire

A battery capable of delivering significant current can overheat, catch fire, or even explode if it is short-circuited. Dropping a wrench across the terminals of a car battery will result in a bright flash, a loud noise, and some molten metal. Even a 1.5-volt alkaline AA battery can become too hot to touch if its terminals are shorted together. (Never try this with a rechargeable battery, which has a much lower internal resistance, allowing much higher flow of current.) Lithium-ion batteries are particularly dangerous, and almost always are packaged with a current-limiting component that should not be disabled. A short-circuited lithium battery can explode.

If a battery pack is used as a cheap and simple workbench DC power supply, a **fuse** or circuit breaker should be included. Any device that uses significant battery power should be fused.

Diminished Performance Caused by Improper Recharging

Many types of batteries require a precisely measured charging voltage and a cycle that ends automatically when the battery is fully charged. Failure to observe this protocol can result in chemical damage that may not be reversible. A charger should be used that is specifically intended for the type of battery. A detailed comparison of chargers and batteries is outside the scope of this encyclopedia.

Complete Discharge of Lead-Acid Battery

Complete or near-complete discharge of a lead-acid battery will significantly shorten its life (unless it is specifically designed for deep-cycle use —although even then, more than an 80% discharge is not generally recommended).

Inadequate Current

Chemical reactions inside a battery occur more slowly at low temperatures. Consequently, a cold battery cannot deliver as much current as a warm battery. For this reason, in winter weather, a car battery is less able to deliver high current. At the same time, because engine oil becomes more viscous as the temperature falls, the starter motor will demand more current to turn the engine. This combination of factors explains the tendency of car batteries to fail on cold winter mornings.

Incorrect Polarity

If a battery charger or generator is connected with a battery with incorrect polarity, the battery may experience permanent damage. The **fuse** or *circuit breaker* in a charger may prevent this from occurring and may also prevent damage to the charger, but this cannot be guaranteed.

If two high-capacity batteries are connected with opposite polarity (as may happen when a clumsy attempt is made to start a stalled car with jumper cables), the results may be explosive. Never lean over a car battery when attaching cables to it, and ideally, wear eye protection.

Reverse Charging

Reverse charging can occur when a battery becomes completely discharged while it is wired (correctly) in series with other batteries that are still delivering current. In the upper section of the schematic at Figure 2-16 two healthy 6V batteries, in series, are powering a resistive load. The battery on the left applies a potential of 6 volts to the battery on the right, which adds its own 6 volts to create a full 12 volts across the load. The red and blue lines indicate volt meter leads, and the numbers show the reading that should be observed on the meter.

In the second schematic, the battery on the left has become exhausted and is now a "dead weight" in the circuit, indicated by its gray color. The battery on the right still sustains a 6-volt potential. If the internal resistance of the dead battery is approximately 1 ohm and the resistance of the load is approximately 20 ohms, the potential across the dead battery will be about 0.3 volts, in the opposite direction to its normal charged voltage. Reverse charging will result and can damage the battery. To avoid this problem, a battery pack containing multiple cells should never be fully discharged.

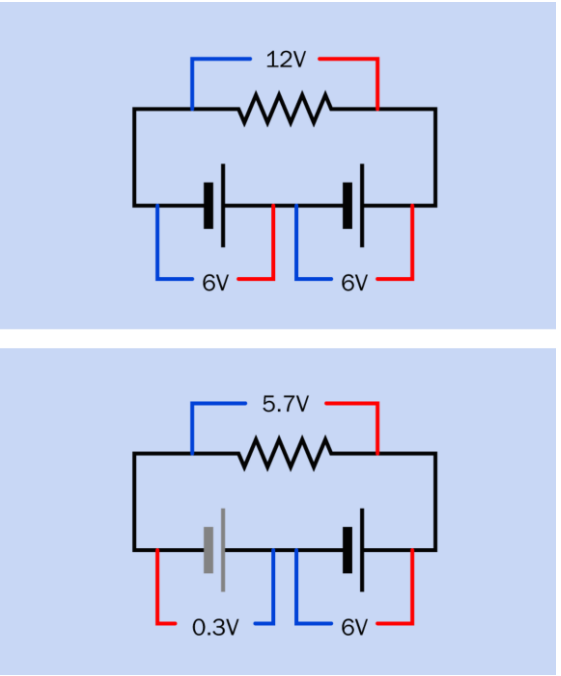

Figure 2-16. *When a pair of 6V batteries is placed in series to power a resistive load, if one of the batteries discharges completely, it becomes a load instead of a power source, and will be subjected to reverse charging, which may cause permanent damage.*

Sulfurization

When a lead-acid battery is partially or completely discharged and is allowed to remain in that state, sulfur tends to build up on its metal plates. The sulfur gradually tends to harden, forming a barrier against the electrochemical reactions that are necessary to recharge the battery. For this reason, lead-acid batteries should not be allowed to sit for long periods in a discharged condition. Anecdotal evidence suggests that even a very small trickle-charging current can prevent sulfurization, which is why some people recommend attaching a small solar panel to a battery that is seldom used—for example, on a sail boat, where the sole function of the battery is to start an auxiliary engine when there is insufficient wind.

High Current Flow Between Parallel Batteries

If two batteries are connected in parallel, with correct polarity, but one of them is fully charged while the other is not, the charged battery will attempt to recharge its neighbor. Because the batteries are wired directly together, the current will be limited only by their internal resistance and the resistance of the cables connecting them. This may lead to overheating and possible damage. The risk becomes more significant when linking batteries that have high Ah ratings. Ideally they should be protected from one another by high-current **fuses.**

jumper

3

A jumper may also be referred to as a *jumper socket* or a *shunt*. A jumper should not be confused with *jumper wires*, which are not considered components for the purposes of this encyclopedia.

OTHER RELATED COMPONENTS

- **switch** (See Chapter 6)

What It Does

A jumper is a low-cost substitute for a **switch,** where a connection has to be made (or unmade) only a few times during the lifetime of a product. Typically it allows a function or feature on a circuit board to be set on a semipermanent basis, often at the time of manufacture. A *DIP switch* performs the same function more conveniently. See "DIP" (page 43).

There is no standardized schematic symbol to represent a jumper.

How It Works

A jumper is a very small rectangular plastic tab containing two (or sometimes more) metal sockets usually spaced either 0.1″ or 2mm apart. The sockets are connected electrically inside the tab, so that when they are pushed over two (or more) pins that have been installed on a circuit board for this purpose, the jumper shorts the pins together. The pins are usually 0.025″ square and are often part of a *header* that is soldered into the board. In a parts catalogue, jumpers may be found in a section titled "Headers and Wire Housings" or similar.

Three jumpers are shown in Figure 3-1. The blue one contains two sockets spaced 0.1″ and is deep enough to enclose the pins completely. The red one contains two sockets spaced 2mm and may allow the tips of the pins to emerge from its opposite end. The black one contains four sockets, each pair spaced 0.1″ apart.

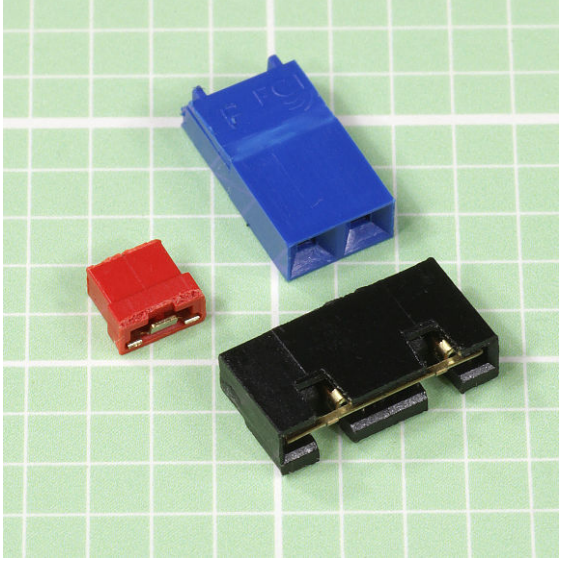

Figure 3-1. *Three jumpers containing two sockets spaced 2mm (left), two sockets spaced 0.1″ (top right), and four sockets, each pair spaced 0.1″ (bottom right).*

The set of pins with which a jumper is used is often referred to as a *header*. Headers are available with pins in single or dual rows. Some headers are designed to be snapped off to provide the desired number of pins. A dual 28-pin header is shown in Figure 3-2 with a black jumper pushed onto a pair of pins near the midpoint.

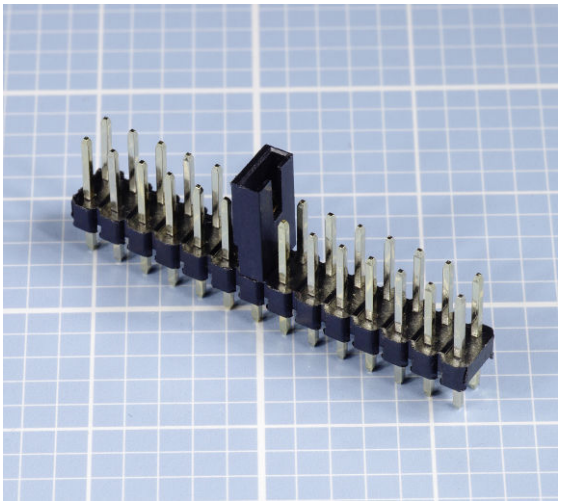

Figure 3-2. *A jumper pushed onto a pair of pins midway along a dual 28-pin header.*

Variants

A *jumper assembly* may be a kit containing not only the jumper but also the array of pins with which it is intended to be used. Check the manufacturer's datasheet to find out exactly what is included.

The most common types of jumpers have two sockets only, but variants are available with as many as 12 sockets, which may be arranged in one or two rows. *Header sockets* may be used as a substitute for purpose-made jumpers, with the advantage that they are often sold in long strips that can be snapped off to provide as many sockets as needed. However, the pins attached to header sockets must be manually connected by soldering small lengths of wire between them.

In some jumpers, the plastic tab extends upward for about half an inch and functions as a finger grip, making the jumper much easier to hold during insertion and removal. This is a desirable feature if there is room to accommodate it.

The sockets inside a jumper are often made from phosphor-bronze, copper-nickel alloy, tin alloy, or brass alloy. They are usually gold-plated, but in some instances are tin-plated.

Rarely, a jumper may consist of a metal strip with U-shaped connections suitable for being used in conjunction with screw terminals. Two jumpers of this type are shown in Figure 3-3. They should not be confused with high-amperage fuses that look superficially similar.

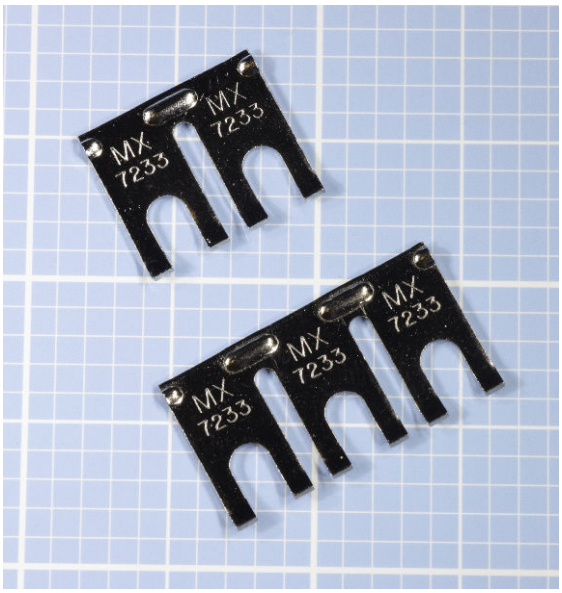

Figure 3-3. *These jumpers are designed to short together two or three screw terminals.*

Values

The spacing between the sockets in a jumper is referred to as its *pitch*. As previously noted, 0.1" and 2mm are the most popular values.

A typical maximum rating for a jumper of 0.1" pitch is 2A or 2.5A at 250V.

How to Use it

A jumper may activate a "set it and forget it" circuit function. An example would be the factory configuration of a product to work with 115VAC or 230VAC power input. End users were expected to set jumpers in some computer equipment sold during the 1980s, but this is no longer the case.

What Can Go Wrong

Jumpers are easily dropped, easily lost, and easily placed incorrectly. When purchasing jumpers, buy extras to compensate for their fragility and the ease of losing them.

Any location where a jumper may be used should be clearly labelled to define the function of each setting.

Cheap, poorly made jumpers may self-destruct from mechanical stresses when removed from their pins. The plastic casing can come away, leaving the sockets clinging naked to the pins protruding from the circuit board. This is another reason why it is a good idea to have a small stock of spare jumpers for emergencies.

Oxidation in jumpers where the contacts are not gold- or silver-plated can create electrical resistance or unreliable connections.

fuse

4

The alternate spelling *fuze* is seldom used.

OTHER RELATED COMPONENTS

- None

What It Does

A fuse protects an electrical circuit or device from excessive current when a metal element inside it melts to create an open circuit. With the exception of *resettable fuses* (discussed separately in "Resettable Fuses" (page 24)), a fuse must be discarded and replaced after it has fulfilled its function.

When high current melts a fuse, it is said to *blow* or *trip* the fuse. (In the case of a resettable fuse, only the word *trip* is used.)

A fuse can work with either AC or DC voltage, and can be designed for almost any current. In residential and commercial buildings, *circuit breakers* have become common, but a large cartridge fuse may still be used to protect the whole system from short-circuits or from overcurrent caused by lightning strikes on exposed power lines.

In electronic devices, the **power supply** is almost always fused.

Schematic symbols for a fuse are shown in Figure 4-1. Those at the right and second from right are most frequently used. The one in the center is approved by ANSI, IEC, and IEEE but is seldom seen. To the left of that is the fuse symbol understood by electrical contractors in architectural plans. The symbol at far left used to be common but has fallen into disuse.

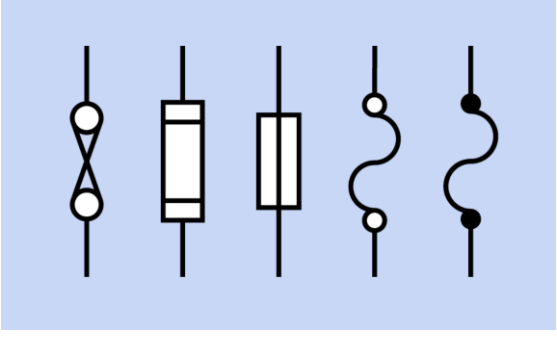

Figure 4-1. *Alternate schematic symbols for a fuse. See text for explanation.*

How It Works

The *element* in a fuse is usually a wire or thin metal strip mounted between two terminals. In a cartridge fuse, it is enclosed in a glass or ceramic cylinder with a contact at each end, or in a small metallic can. (Old-style, large, high-amperage fuses may be packaged in a paper or cardboard tube.) The traditional glass cartridge allows visual inspection to confirm that the fuse has blown.

A fuse responds only to current, not to voltage. When choosing a fuse that will be reliable in conditions of steady current consumption, a safe rule is to figure the maximum amperage when all components are functioning and add 50%. However, if current surges or spikes are likely, their duration will be relevant. If I is the current surge

in amps and t is its duration in seconds, the surge sensitivity of a fuse—which is often referred to verbally or in printed format as I2t—is given by the formula:

$$I2t = I^2 * t$$

Some semiconductors also have an I2t rating, and should be protected with a similarly rated fuse.

Any fuse will present some resistance to the current flowing through it. Otherwise, the current would not generate the heat that blows the fuse. Manufacturer datasheets list the voltage drop that the internal resistance of a fuse is likely to introduce into a circuit.

Values

The *current rating* or *rated current* of a fuse is usually printed or stamped on its casing, and is the maximum flow that it should withstand on a continuous basis, at the ambient temperature specified by the manufacturer (usually 25 degrees Centigrade). The ambient temperature refers to the immediate environment of the fuse, not the larger area in which it may be located. Note that in an enclosure containing other components, the temperature is usually significantly higher than outside the enclosure.

Ideally a fuse should function reliably and indefinitely at its rated maximum amperage, but should blow just as reliably if the current rises by approximately 20% beyond the maximum. In reality, manufacturers recommend that continuous loading of a fuse should not exceed 75% of its rating at 25 degrees Centigrade.

The *voltage rating* or *rated voltage* of a fuse is the maximum voltage at which its element can be counted on to melt in a safe and predictable manner when it is overloaded by excess current. This is sometimes known as the *breaking capacity*. Above that rating, the remaining pieces of the fuse element may form an arc that sustains some electrical conduction.

A fuse can always be used at a lower voltage than its rating. If it has a breaking capacity of 250V, it will still provide the same protection if it is used at 5V.

Four differently rated glass cartridge fuses are shown in Figure 4-2. The one at the top is a slow-blowing type, rated at 15A. Its element is designed to absorb heat before melting. Below it is a 0.5A fuse with a correspondingly thinner element. The two smaller fuses are rated at 5A each. The center two fuses have a maximum voltage rating of 250V, while the one at the top is rated at 32V and the one at the bottom is rated at 350V. Clearly, the size of a fuse should never be used as a guide to its ratings.

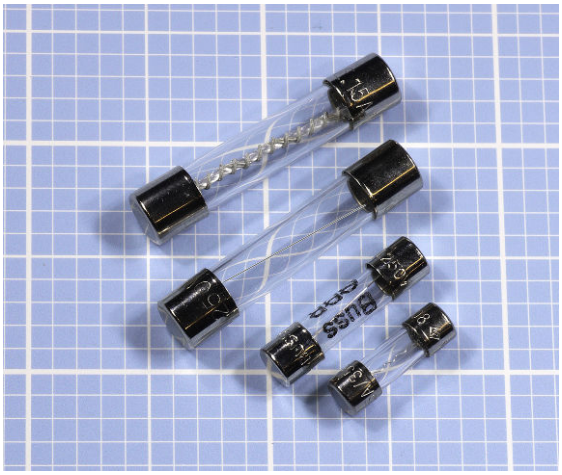

Figure 4-2. *Four glass cartridge fuses. See text for details.*

Variants

Early power fuses in residential buildings consisted of bare nichrome wire wrapped around a porcelain holder. In the 1890s, Edison developed *plug fuses* in which the fuse was contained in a porcelain module with a screw thread, compatible with the base of an incandescent bulb. This design persisted in some U.S. urban areas for more than 70 years, is still found in old buildings, and is still being manufactured.

Small Cartridge Fuses

Small cartridge fuses for appliances and electronics equipment—such as those shown in Figure 4-2--are available in sizes tabulated in Figure 4-3. With the exception of the 4.5mm diameter fuse (a European addition), these sizes were originally measured in inches; today, they are often described only with the equivalent metric measurement. Any cartridge fuse is usually available with the option of a lead attached to it at each end, so that it can be used as a through-hole component.

Fuse type	Diameter (inches)	Diameter (metric)	Length (inches)	Length (metric)
1AG	1/4"	6mm	5/8"	16mm
2AG	0.177"	4.5mm	0.588"	15mm
3AG	1/4"	6mm	1-1/4"	32mm
4AG	9/32"	7mm	1-1/4"	32mm
5AG	13/32"	10mm	1-1/2"	38mm
7AG	1/4"	6mm	7/8"	22mm
8AG	1/4"	6mm	1"	25mm

Figure 4-3. *The approximate physical sizes of commonly used small glass or ceramic cartridge fuses are shown here with the codes that are often used to identify them.*

Fuses may be fast acting, medium acting, or slow-blowing, the last of which may alternatively be referred to as *delay fuses*. Extra-fast–acting fuses are available from some manufacturers. The term *Slo-Blo* is often used but is actually a trademark of Littelfuse. None of the terms describing the speed of action of a fuse has been standardized with a specific time or time range.

Some cartridge fuses are available in a ceramic format as an alternative to the more common glass cylinder. If accidental application of extremely high current is possible (for example, in a multimeter that can be set to measure amps, and may be accidentally connected across a powerful battery), a ceramic cartridge is preferable because it contains a filler that will help to stop an arc from forming. Also, if a fuse is physically destroyed by application of very high current, ceramic fragments may be preferable to glass fragments.

Automotive Fuses

Automotive fuses are identifiable by their use of blades designed for insertion in flat sockets where the fuse is unlikely to loosen as a result of vibration or temperature changes. The fuses come in various sizes, and are uniformly color-coded for easy identification.

A selection of automotive fuses is shown in Figure 4-4. The type at the top is typically described as a "maxi-fuse" while the type at bottom-left is a "mini-fuse." Here again, size is irrelevant to function, as all three of those pictured are rated 30A at 32V.

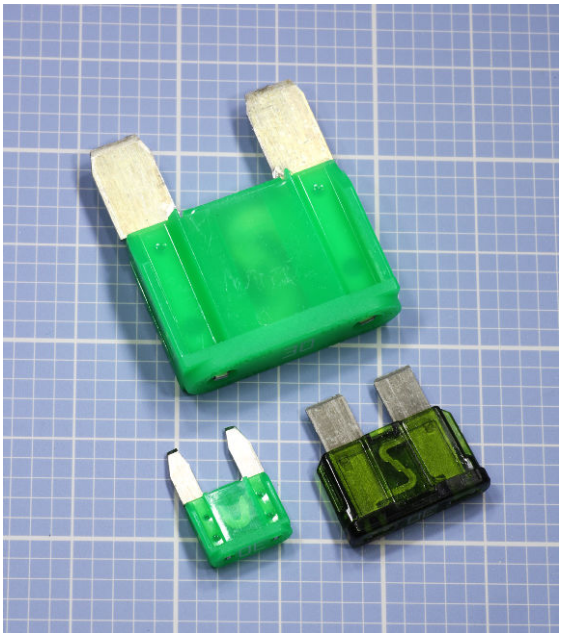

Figure 4-4. *Three automotive fuses. All have the same rating: 30A at 32V.*

In Figure 4-5, the largest of the fuses from Figure 4-4 has been cut open to reveal its element.

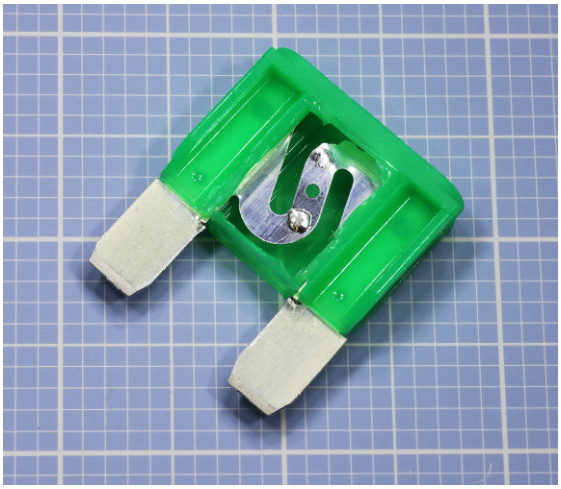

Figure 4-5. *The largest fuse from the previous figure, cut open to reveal its element.*

Usually automotive fuses are mounted together in a block, but if aftermarket accessory equipment is added, it may be protected by an inline fuse in a holder that terminates in two wires. This is shown with two sample fuses in Figure 4-6. Similar inline fuse holders are manufactured for other types of fuses.

Strip Fuses

High-amperage fuses for vehicles may be sold in "strip fuse" format, also known as a *fusible link*, designed to be clamped between two screw-down terminals. Since some **jumpers** may look very similar, it is important to keep them separate. A strip fuse is shown in Figure 4-7.

Through-Hole Fuses

Small fuses with radial leads, which seem appropriate for through-hole insertion in printed circuit boards, are actually often used in conjunction with appropriate sockets, so that they can be easily replaced. They are described in catalogues as "subminiature fuses" and are typically found in laptop computers and their power supplies, also televisions, battery chargers, and air conditioners. Three examples are shown in Figure 4-8. All have slow-blowing characteristics.

Figure 4-6. *Two blade-type fuses, commonly used for automotive applications, shown with an inline fuse holder. The plastic cap, at right, is closed over the holder when a fuse has been installed.*

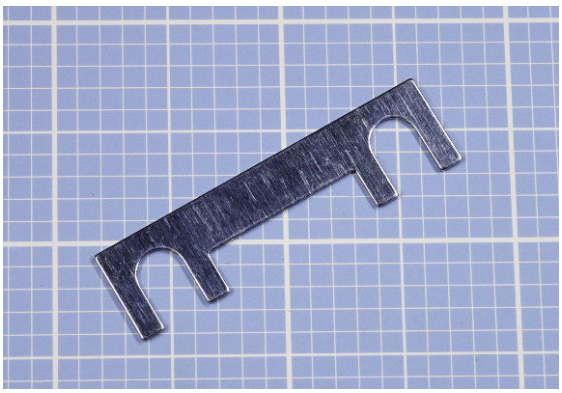

Figure 4-7. *This strip fuse is intended for use in diesel vehicles. The example shown is rated 100A at 36V.*

Resettable Fuses

Properly known as a *polymeric positive temperature coefficient* fuse (often abbreviated *PTC* or *PPTC*), a *resettable fuse* is a solid-state, encapsulated component that greatly increases its resistance in response to a current overload, but gradually returns to its original condition when the flow of current is discontinued. It can be thought

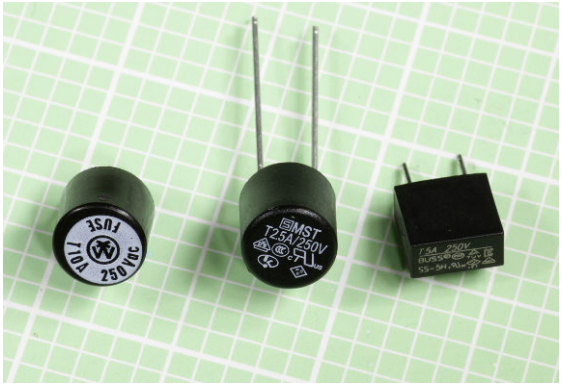

Figure 4-8. *Three subminiature fuses terminating in wire leads. From left to right: 10A at 250V, 2.5A at 250V, and 5A at 250V.*

of as a **thermistor** that has a nonlinear response. Three through-hole examples are shown in Figure 4-9. While different sizes of cartridge fuse may share the same ratings, differently rated resettable fuses may be identical in size. The one on the left is rated 40A at 30V, while the one on the right is rated 2.5A at 30V. (Note that the codes printed on the fuses are not the same as their manufacturer part numbers.) The fuse at the top is rated 1A at 135V.

When more than the maximum current passes through the fuse, its internal resistance increases suddenly from a few ohms to hundreds of thousands of ohms. This is known as *tripping* the fuse. This inevitably entails a small delay, but is comparable to the time taken for a slow-blowing fuse to respond.

A resettable fuse contains a polymer whose crystalline structure is loaded with graphite particles that conduct electricity. As current flowing through the fuse induces heat, the polymer transitions to an amorphous state, separating the graphite particles and interrupting the conductive pathways. A small current still passes through the component, sufficient to maintain its amorphous state until power is disconnected.

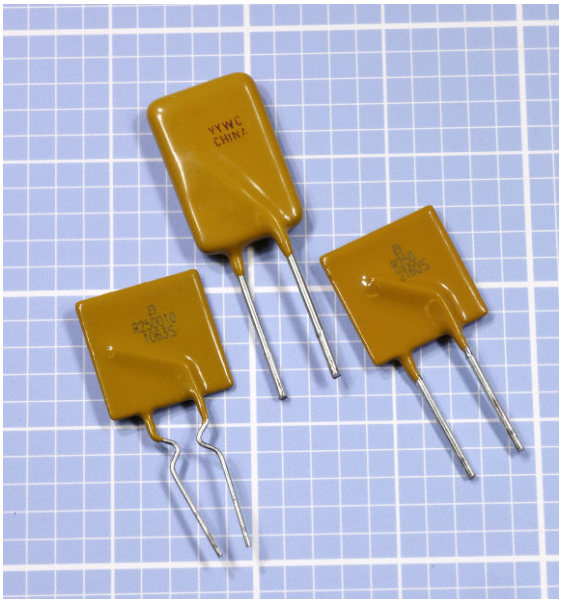

Figure 4-9. *Some through-hole resettable fuses. See text for details.*

After the resettable fuse cools, it gradually recrystallizes, although its resistance does not fall back completely to its original value for more than an hour.

The maximum safe level of current for a resettable fuse is known as the *hold current*, while the current that triggers its response is termed the *trip current*. Resettable fuses are available with trip-current ratings from 20mA to 100A. While conventional appliance and electronics fuses may be rated as high as 600V, resettable fuses are seldom rated above 100V.

Typical cartridge fuses are affected only to a minor extent by temperature, but the current rating of a resettable fuse may diminish to 75% of its normal value at 50 degrees Centigrade and may drop to 50% of its normal value at 80 degrees Centigrade. In other words, a fuse that is rated for 4A at 25 degrees may tolerate a maximum of only 3A when it operates at twice that temperature. See Figure 4-10.

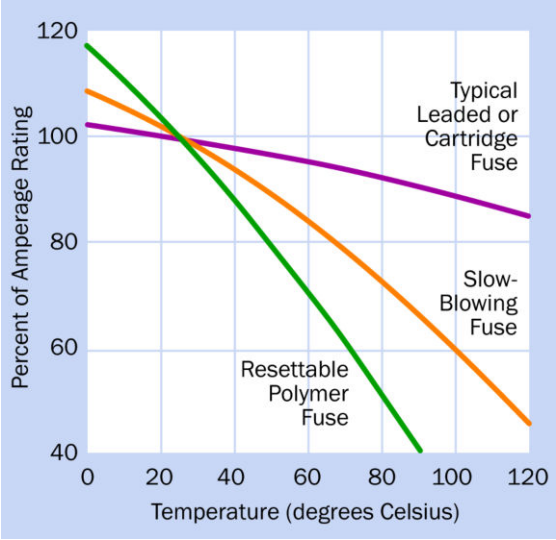

Figure 4-10. *The three curves give a very approximate idea of the temperature sensitivity of three types of fuses commonly used to protect electronic equipment. The left-hand scale provides an approximate value for the amperage which will trip the fuse.*

Conventional slow-blowing fuses are temperature-sensitive, but to a lesser degree than resettable fuses.

Resettable fuses are used in computer power supplies, USB power sources, and loudspeaker enclosures, where they protect the speaker coils from being overdriven. They are appropriate in situations where a fuse may be tripped relatively often, or where technically unsophisticated users may feel unable to replace a fuse or reset a circuit breaker.

Brand names for resettable fuses include PolySwitch, OptiReset, Everfuse, Polyfuse, and Multifuse. They are available in *surface-mount* (SMT) packages or as *through-hole* components, but not in cartridge format.

Surface Mount Fuses

Because surface-mount fuses are difficult or impossible to replace after they have been soldered onto the board, they are often resettable.

A surface-mount resettable fuse approximately 0.3" square is shown in Figure 4-11. It is rated for 230V and has an internal resistance of 50 ohms. Its hold current is 0.09A and its trip current is 0.19A.

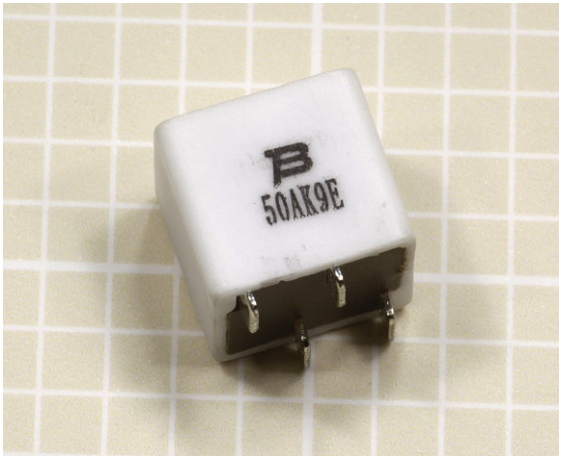

Figure 4-11. *A surface-mount resettable fuse. See text for details.*

How to Use it

Any equipment that may be plugged into a wall outlet should be fused, not only to protect its components but also to protect users who may open the box and start investigating with a screwdriver.

Equipment that contains powerful motors, pumps, or other inductive loads should be protected with slow-blowing fuses, as the initial surge of current when the equipment is switched on is likely to rise well above the rating of the fuse. A slow-blowing fuse will tolerate a surge for a couple of seconds. Other fuses will not.

Conversely, fast-acting fuses should be used with electronic equipment, especially integrated circuits that are quickly and easily damaged.

Any device using substantial **battery** power should be fused because of the unpredictable and generally bad behavior of batteries when they are short-circuited. Parallel connections between multiple large batteries should be fused

to avoid the possibility that a highly charged battery may attempt to recharge its neighbor(s). Large "J size" fuses rated from 125A to 450A have become common in the solar power community, where banks of lead-acid batteries are often used. These fuses have a thick brass tab at each end, drilled so that they can be bolted into place. Alternatively, they will push-fit into an appropriate *fuseholder*.

For cartridge fuses up to 1/4" in diameter that don't have leads attached, appropriately sized fuseholders are available in several formats:

Panel mounted fuse enclosure is probably the most common, consisting of a plastic tube with a spring-contact at the bottom, and a plastic cap with a second contact inside. The cap either screws onto the tube of the fuse, or is pushed down and turned to hold it in place. A nut is provided to secure the fuseholder after it has been inserted into a hole drilled in the panel. The fuse is dropped into the tube, and the cap is applied. This type of holder is available in full-length or shorter, "low profile" formats. A low-profile holder is shown in Figure 4-12. It is shown assembled at right, with its component parts disassembled alongside.

Figure 4-12. *A low-profile panel-mounted fuse holder shown disassembled (left) and assembled (right).*

Circuit board mounted fuse enclosure is basically the same as the panel-mounted version, but with through-hole solder pins attached.

Fuse block is a small plastic block with two clips on its upper surface for insertion of a cartridge fuse.

Fuse clips can be bought individually, with solder pins for through-hole mounting.

Inline fuse holder is designed to be inserted in a length of wire. Usually made of plastic, it will either terminate it, wires or will have metal contacts to crimp or solder at each end. See Figure 4-6.

Through-hole fuse holders are available for subminiature fuses.

What Can Go Wrong

Repeated Failure

When a fuse in a circuit blows frequently, this is known as *nuisance opening*. Often it can result from failure to take into account all the aspects of the circuit, such as a large filtering capacitor in a power supply that draws a major surge of current when the power supply is switched on. The formally correct procedure to address this problem is to measure the power surge, properly known as *peak inrush current*, with an oscilloscope, calculate the $I^2 * t$ of the wave form, and select a fuse with a rating at least 5 times that value.

A fuse should never be replaced with an equivalent length of wire or any other conductor.

Soldering Damage

When a through-hole or surface-mount fuse is soldered into place, heat from the soldering process can cause the soft metal element inside the fuse to melt partially and reflow. This is likely to change the rating of the fuse. Generally, fuses should be treated with the same caution as semiconductors when they are fixed in place with solder.

Placement

A fuse should be placed close to the power source or power input point in a circuit, so that it protects as much of the circuit as possible.

pushbutton

5

Often referred to as a *pushbutton switch* and sometimes as a *momentary switch*. In this encyclopedia, a pushbutton is considered separately from a **switch**, which generally uses a lever-shaped actuator rather than a button, and has at least one *pole* contact where a pushbutton generally has contacts that are not distinguishable from each other.

OTHER RELATED COMPONENTS

- **switch** (See Chapter 6)
- **rotary switch** (See Chapter 7)

What It Does

A pushbutton contains at least two contacts, which close or open when the button is pressed. Usually a spring restores the button to its original position when external pressure is released. Figure 5-1 shows schematic symbols for pushbuttons. The symbols that share each blue rectangle are functionally identical. At top is a normally-open single-throw pushbutton. At center is a normally-closed single-throw pushbutton. At bottom is a double-throw pushbutton.

Unlike a **switch**, a basic pushbutton does not have a primary contact that can be identified as the *pole*. However, a single pushbutton may close or open two separate pairs of contacts, in which case it can be referred to, a little misleadingly, as a double-pole pushbutton. See Figure 5-2. Different symbols are used for slider pushbuttons with multiple contact pairs; see "Slider" (page 31).

A generic full-size, two-contact pushbutton is shown in Figure 5-3.

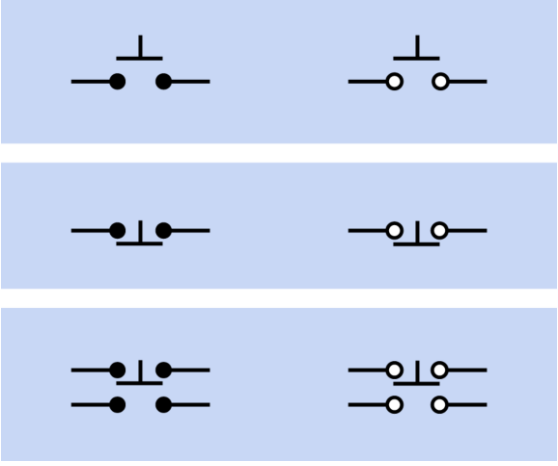

Figure 5-1. *Commonly used schematic symbols to represent a simple pushbutton. See text for details.*

How It Works

Figure 5-4 shows a cross-section of a pushbutton that has a single steel return spring, to create resistance to downward force on the button, and a pair of springs above a pair of contacts, to hold each contact in place and make a firm connection when the button is pressed. The two upper contacts are electrically linked, although this feature is not shown.

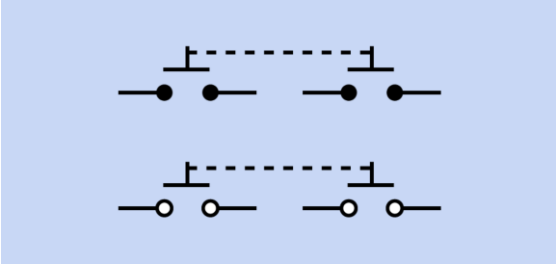

Figure 5-2. *Commonly used schematic symbols to represent a double-pole pushbutton.*

Figure 5-4. *Cross-section of a pushbutton showing two spring-loaded contacts and a single return spring.*

Variants

Poles and Throws

Abbreviations that identify the number of poles and contacts inside a pushbutton are the same as the abbreviations that identify those attributes in a **switch**. A few examples will make this clear:

SPST, also known as 1P1T
: Single pole, single throw

DPST also known as 2P1T
: Double pole, single throw

Figure 5-3. *The simplest, traditional form of pushbutton, in which pressing the button creates a connection between two contacts.*

SPDT also known as 1P2T
: Single pole, double throw

3PST also known as 3P1T
: Three pole, single throw

While a switch may have an additional center position, pushbuttons generally do not.

On-Off Behavior

Parentheses are used to indicate the momentary state of the pushbutton while it is pressed. It will return to the other state by default.

OFF-(ON) or (ON)-OFF
: Contacts are normally open by default, and are closed only while the button is pressed. This is sometimes described as a *make-to-make* connection, or as a *Form A* pushbutton.

ON-(OFF) or (OFF)-ON
: Contacts are normally closed by default, and are open only while the button is pressed. This is sometimes described as a *make-to-break* connection, or as a *Form B* pushbutton.

ON-(ON) or (ON)-ON
: This is a double-throw pushbutton in which one set of contacts is normally closed. When the button is pressed, the first set of contacts

is opened and the other set of contacts is closed, until the button is released. This is sometimes described as a *Form C* pushbutton.

For a single-throw pushbutton, the terms NC or NO may be used to describe it as *normally closed* or *normally open*.

Slider

This type, also known as a *slide* pushbutton, contains a thin bar or rod that slides in and out of a long, narrow enclosure. Contacts on the rod rub across secondary contacts inside the enclosure. Closely resembling a slider switch, it is cheap, compact, and well adapted for multiple connections (up to 8 separate poles in some models). However, it can only tolerate low currents, has limited durability, and is vulnerable to contamination.

A four-pole, double-throw pushbutton is shown in Figure 5-5. A variety of plastic caps can be obtained to press-fit onto the end of the white nylon actuator.

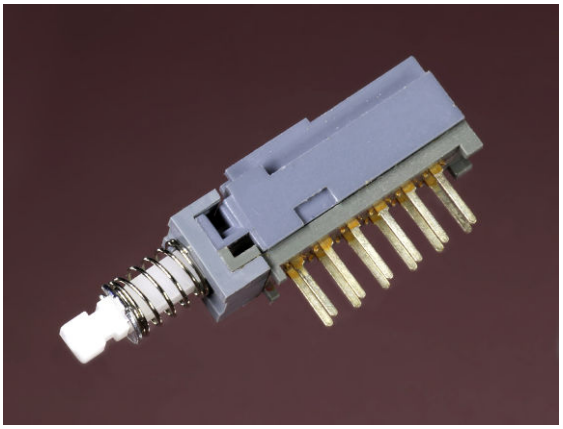

Figure 5-5. *A 4PDT slider pushbutton, shown without the cap that can be snapped onto the end of the actuator.*

Figure 5-6 shows schematic symbols for two possible slide pushbuttons, with a black rectangle indicating each sliding contact. The lead that functions as a pole is marked with a P in each case. Standardization for slide pushbutton schematic symbols does not really exist, but these examples are fairly typical. An insulating section that connects the sliding contacts internally is shown here as a gray rectangle, but in some datasheets may appear as a line or an open rectangle.

Since the symbols for a slide pushbutton may be identical to the symbols for a slide switch, care must be taken when examining a schematic, to determine which type of component is intended.

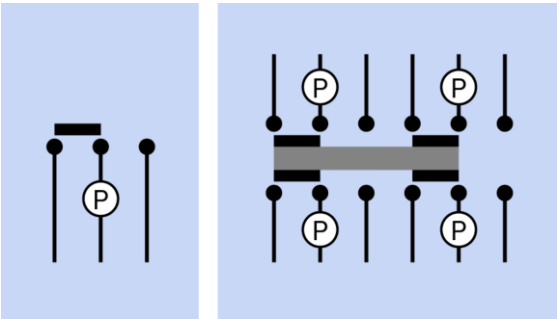

Figure 5-6. *Left: schematic symbol for a simple SPDT slide pushbutton, where a movable contact shorts together either the left pair or right pair of fixed contacts. Right: A 4PDT pushbutton in which the same principle has been extended. The movable contacts are attached to each other mechanically by an insulator. Each pole terminal is marked with a P.*

Styles

Many pushbutton switches are sold without caps attached. This allows the user to choose from a selection of styles and colors. Typically the cap is a push-fit onto the end of the rod or bar that activates the internal contacts. Some sample caps are shown in Figure 5-7, alongside a DPDT pushbutton. Any of the caps will snap-fit onto its actuator.

An *illuminated* pushbutton contains a small *incandescent bulb*, *neon bulb*, or **LED** (*light-emitting diode*). The light source almost always has its own two terminals, which are isolated from the other terminals on the button housing and can be wired to activate the light when the button is pressed, when it is released, or on some other basis. Pushbuttons containing LEDs usually

Figure 5-7. *Caps (buttons or knobs) that may be sold as separate accessories for some pushbuttons, shown here alongside a compatible pushbutton switch.*

require external series resistors, which should be chosen according to the voltage that will be used. See the **LED** entry in Volume 2 for additional commentary on appropriate series resistors. An example of an illuminated pushbutton is shown in Figure 5-8. This is a DPDT component, designed to be mounted on a printed circuit board, with an additional lead at each end connecting with an internal LED underneath the translucent white button.

Termination and Contact Plating

These options are the same as for a **switch** and are described in that entry.

Mounting Style

The traditional panel-mounted button is usually secured through a hole in the panel by tightening a nut that engages with a thread on the bushing of the pushbutton. Alternatively, a push-

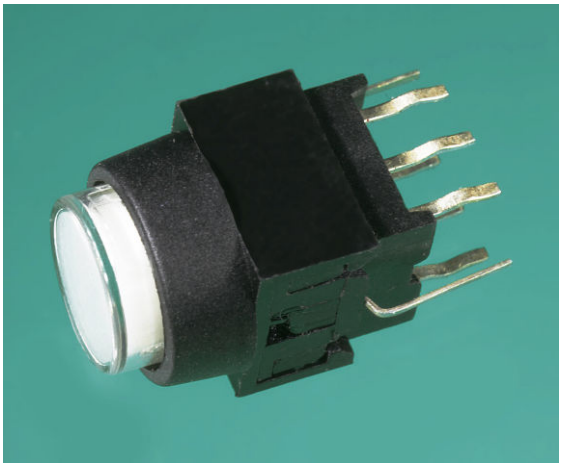

Figure 5-8. *This pushbutton contains an LED underneath the white translucent button.*

button housing can have flexible plastic protrusions on either side, allowing it to be snapped into place in an appropriate-sized panel cutout. This style is shown in Figure 5-4.

PC pushbuttons (pushbuttons mounted in a printed circuit board, or PCB) are a common variant. After the component has been installed in the circuit board, either the button must align with a cutout in the front panel and poke through it when the device is assembled, or an external (non-electrical) button that is part of the product enclosure must press on the actuator of the pushbutton after assembly.

Surface-mount pushbuttons that allow direct fingertip access are uncommon. However, about one-quarter of tactile switches are designed for surface mount at the time of writing. They are typically found beneath membranes that the user presses to activate the switch beneath—for example, in remotes that are used to operate electronic devices.

Sealed or Unsealed

A sealed pushbutton will include protection against water, dust, dirt, and other environmental hazards, at some additional cost.

Latching

This variant, also known as a *press-twice* pushbutton, contains a mechanical ratchet, which is rotated each time the button is pressed. The first press causes contacts to latch in the closed state. The second press returns the contacts to the open state, after which, the process repeats. This press-twice design is typically found on flashlights, audio equipment, and in automotive applications. While *latching* is the most commonly used term, it is also known as *push-push*, *locking*, *push-lock push-release*, *push-on push-off*, and *alternate*.

In a latching pushbutton with *lockdown*, the button is visibly lower in the latched state than in the unlatched state. However, buttons that behave this way are not always identified as doing so on their datasheets.

A six-pole double-throw pushbutton that latches and then unlatches each time it is pressed is shown in Figure 5-9.

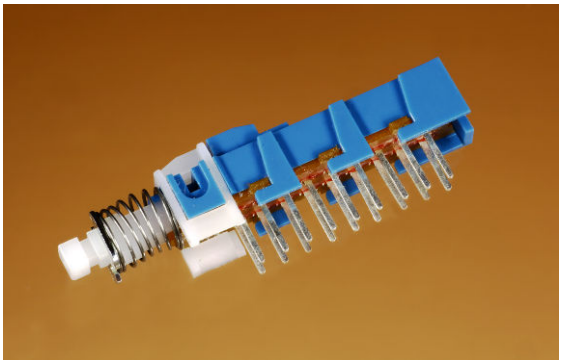

Figure 5-9. *This 6PDT pushbutton latches and then unlatches, each time it is pressed.*

Two more variants are shown in Figure 5-10. On the right is a simple DPDT latching pushbutton with lockdown. On the left is a latching pushbutton that cycles through four states, beginning with one "off" state, the remaining three connecting a different pair of its wires in turn.

A simple OFF-(ON) button may appear to have a latching output if it sends a pulse to a **microcontroller** in which software inside the microcontroller toggles an output between two states. The microcontroller can step through an unlimited number of options in response to each button press. Examples are found on cellular phones or portable media players.

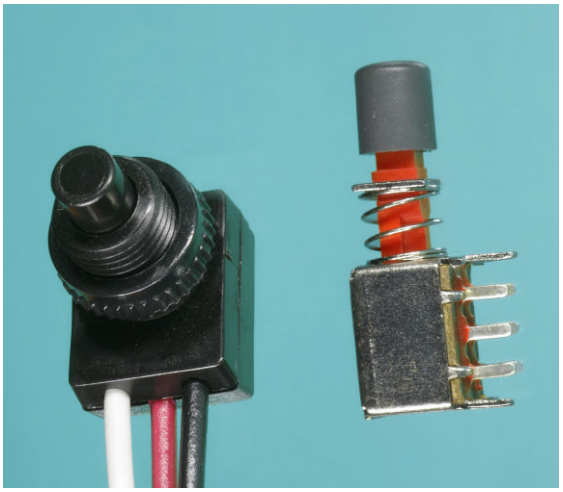

Figure 5-10. *At right, a simple DPDT latching pushbutton with lockdown. At left, this pushbutton cycles through four states, one of them an "off" state, the others connecting a different pair of its wires in turn.*

A mechanically latching pushbutton has a higher failure rate than a simple OFF-(ON) button, as a result of its internal mechanism, but has the advantage of requiring no additional microcontroller to create its output. Microcontrollers are discussed in Volume 2.

Foot Pedal

Foot pedal pushbuttons generally require more actuation force than those intended for manual use. They are ruggedly built and are commonly found in vacuum cleaners, audio-transcription foot pedals, and "stomp boxes" used by musicians.

Keypad

A keypad is a rectangular array of usually 12 or 16 OFF-(ON) buttons. Their contacts are accessed via a *header* suitable for connection with a ribbon cable or insertion into a printed circuit board. In some keypads, each button connects with a

separate contact in the header, while all the buttons share a common ground. More often, the buttons are *matrix encoded*, meaning that each of them bridges a unique pair of conductors in a matrix. A 16-button matrix is shown in Figure 5-11. This configuration is suitable for polling by a **microcontroller**, which can be programmed to send an output pulse to each of the four horizontal wires in turn. During each pulse, it checks the remaining four vertical wires in sequence, to determine which one, if any, is carrying a signal. Pullup or pulldown resistors should be added to the input wires to prevent the inputs of the microcontroller from behaving unpredictably when no signal is present. The external appearance of two keypads is shown in Figure 5-12.

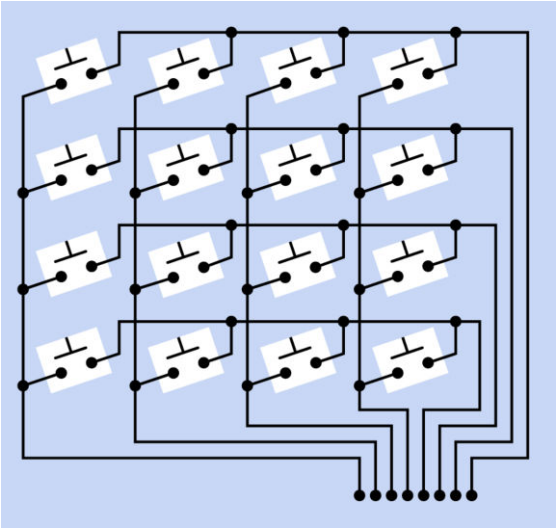

Figure 5-11. *Buttons in a numeric keypad are usually wired as a matrix, where each button makes a connection between a unique pair of wires. This system is suitable for being polled by a microcontroller.*

Tactile Switch

Despite being called a switch, this is a miniature pushbutton, less than 0.4" square, designed for insertion in a printed-circuit board or in a solderless breadboard. It is almost always a SPST device but may have four pins, one pair connected to each contact. Tactile switches may be PC-mounted behind membrane pads. An example is shown in Figure 5-13.

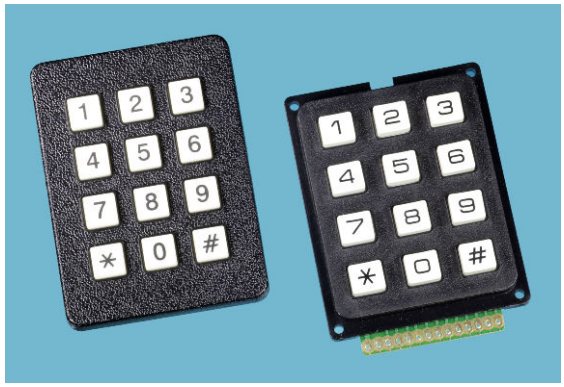

Figure 5-12. *The keypad on the left is matrix-encoded, and is polled via seven through-hole pins that protrude behind it. The keypad on the right assigns each button to a separate contact in its header. See the text for details about matrix encoding.*

Figure 5-13. *A typical tactile switch.*

Membrane Pad

Typically found on devices such as microwave ovens where contacts must be sealed against particles and liquids. Finger pressure on a membrane pad closes hidden or internal pushbuttons. They are usually custom-designed for specific product applications and are not generally available as generic off-the-shelf components. Some surplus pads may be found for sale on auction websites.

Radio Buttons

The term *radio buttons* is sometimes used to identify a set of pushbuttons that are mechanically interlinked so that only one of them can make an electrical connection at a time. If one button is pressed, it latches. If a second button is pressed, it latches while unlatching the first button. The buttons can be pressed in any sequence. This system is useful for applications such as component selection in a stereo system, where only one input can be permitted at a time. However, its use is becoming less common.

Snap-Action Switches

A snap-action switch (described in detail in the **switch** section of this encyclopedia) can be fitted with a pushbutton, as shown in Figure 5-14. This provides a pleasingly precise action, high reliability, and capability of switching currents of around 5A. However, snap-action switches are almost always single-pole devices.

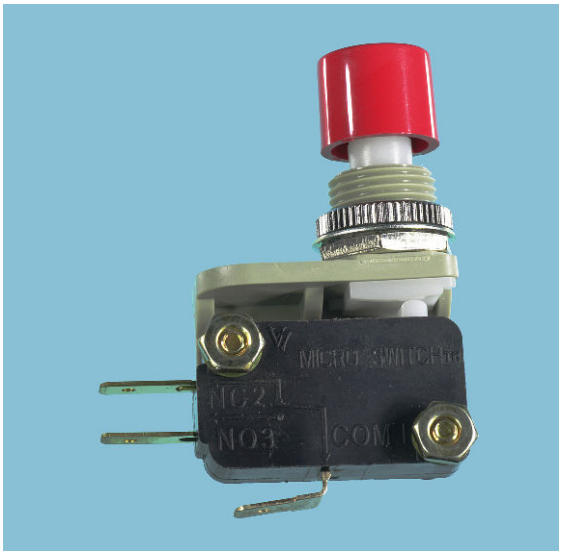

Figure 5-14. *A pushbutton mounted on top of a SPDT snap-action switch.*

Emergency Switch

An emergency switch is a normally-closed device, usually consisting of a large pushbutton that clicks firmly into its "off" position when pressed, and does not spring back. A flange around the button allows it to be grasped and pulled outward to restore it to its "on" position.

Values

Pushbutton current ratings range from a few mA to 20A or more. Many pushbuttons have their current ratings printed on them but some do not. Current ratings are usually specified for a particular voltage, and may differ for AC versus DC.

How to Use it

Issues such as appearance, tactile feel, physical size, and ease of product assembly tend to dictate the choice of a pushbutton, after the fundamental requirements of voltage, current, and durability have been satisfied. Like any electromechanical component, a pushbutton is vulnerable to dirt and moisture. The ways in which a device may be used or abused should be taken into account when deciding whether the extra expense of a sealed component is justified.

When a pushbutton controls a device that has a high inductive load, a *snubber* can be added to minimize arcing. See "Arcing" (page 47) in the **switch** entry of this encyclopedia, for additional information.

What Can Go Wrong

No Button

When ordering a pushbutton switch, read datasheets carefully to determine whether a cap is included. Caps are often sold separately and may not be interchangeable between switches from different manufacturers.

Mounting Problems

In a panel-mount pushbutton that is secured by turning a nut, the nut may loosen with use, allowing the component to fall inside its enclosure when the button is pressed. Conversely, overtightening the nut may strip the threads on the

pushbutton bushing, especially in cheaper components where the threads are molded into plastic. Consider applying a drop of Loc-Tite or similar adhesive before completely tightening the nut. Nut sizes vary widely, and finding a replacement may be time-consuming.

LED Issues

When using a pushbutton containing an LED, be careful to distinguish the LED power terminals from the switched terminals. The manufacturer's datasheet should clarify this distinction, but the polarity of the LED terminals may not be clearly indicated. If a diode-testing meter function is unavailable, a sample of the switch should be tested with a source of 3 to 5VDC and a 2K series resistor. Briefly touching the power to the LED terminals, through the resistor, should cause the LED to flash dimly if the polarity is correct, but should not be sufficient to burn out the LED if the polarity is incorrect.

Other Problems

Problems such as arcing, overload, short circuits, wrong terminal type, and contact bounce are generally the same as those associated with a **switch**, and are summarized in that entry in this encyclopedia.

switch

The term **switch** refers here to a physically operated mechanical switch, controlled by flipping a lever or sliding a knob. Although there is some overlap of function, **rotary switches** and **pushbuttons** have their own separate entries. Solid-state switching components are described in entries for **bipolar transistor**, **unijunction transistor**, and **field-effect transistor**. Integrated-circuit switching devices will be found in Volume 2. *Coaxial switches* are used for high-frequency signals, and are not included in this encyclopedia. *Multidirectional switches* differentiate up, down, left, right, diagonal, rotational, and other finger inputs, and are not included in this encyclopedia.

OTHER RELATED COMPONENTS

- **pushbutton** (See Chapter 5)
- **rotary switch** (See Chapter 7)

What It Does

A switch contains at least two contacts, which close or open when an external lever or knob is flipped or moved. Schematic symbols for the most basic type of on-off switch are shown in Figure 6-1.

The most fundamental type of switch is a *knife switch*, illustrated in Figure 6-2. Although it was common in the earliest days of electrical discovery, today it is restricted to educational purposes in schools, and (in a more robust format) to AC electrical supply panels, where the large contact area makes it appropriate for conducting high amperages, and it can be used for "hot switching" a substantial load.

How It Works

The *pole* of a switch is generally connected with a movable contact that makes or breaks a connection with a secondary contact. If there is only one pole, this is a *single-pole* switch. If there is an additional pole, electrically isolated from the first, with its own contact or set of contacts, this is a *two-pole* switch, also known as a *double-pole* switch. Switches with more than 4 poles are uncommon.

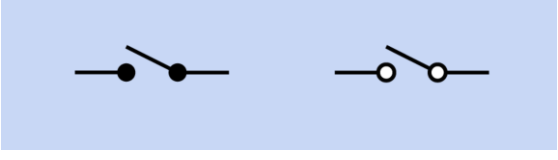

Figure 6-1. *The two most common schematic symbols for a SPST switch, also known as an on-off switch. The symbols are functionally identical.*

If there is only one secondary contact per pole, this is a *single-throw* or *ST* switch, which may also be described as an *on-off* or *off-on* switch. If there is an additional secondary contact per pole, and the pole of the switch connects with the second contact while disconnecting from the first, this is a *double-throw* or *DT* switch, also known as a *two-way* switch.

Figure 6-2. *A DPST knife switch intended for the educational environment.*

A double-throw switch may have an additional center position. This position may have no connection (it is an "off" position) or in some cases it connects with a third contact.

Where a switch is spring-loaded to return to one of its positions when manual pressure is released, it functions like a **pushbutton** even though its physical appearance may be indistinguishable from a switch.

Variants

Float switch, *mercury switch*, *reed switch*, *pressure switch*, and *Hall-effect switch* are considered as sensing devices, and will be found in Volume 3.

Terminology

Many different types of switches contain parts that serve the same common functions. The *actuator* is the lever, knob, or toggle that the user turns or pushes. A *bushing* surrounds the actuator on a toggle-type switch. The *common contact* inside a switch is connected with the *pole* of the switch. Usually a *movable contact* is attached to it internally, to touch the secondary contact, also known as a *stationary contact* when the movable contact is flipped to and fro.

Poles and Throws

Abbreviations identify the number of poles and contacts inside a switch. A few examples will make this clear:

SPST also known as 1P1T
: Single pole, single throw

DPST also known as 2P1T
: Double pole, single throw

SPDT also known as 1P2T
: Single pole, double throw

3PST also known as 3P1T
: Three pole, single throw

Other combinations are possible.

In Figure 6-3, schematic symbols are shown for double-throw switches with 1, 2, and 3 poles. The dashed lines indicate a mechanical connection, so that all sections of the switch move together when the switch is turned. No electrical connection exists between the poles.

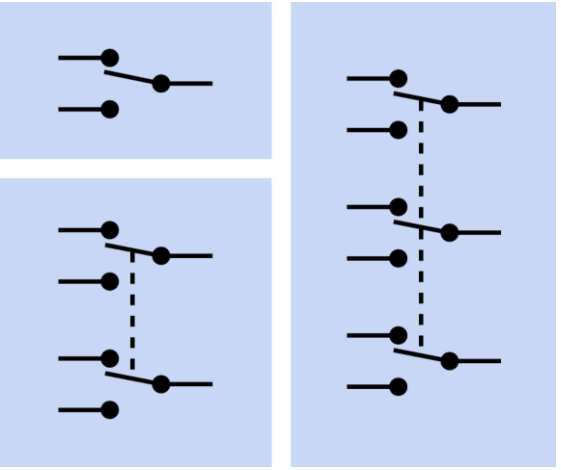

Figure 6-3. *Schematic symbols to represent three types of double-throw switch. Top left: Single-pole. Bottom left: Double-pole. Right: Triple-pole, more commonly known as 3-pole.*

On-Off Behavior

The words ON and OFF are used to indicate the possible states of a switch. The additional word NONE is used by some manufacturers to indicate that a switch does not have a center position. Some manufacturers don't bother with the word NONE, assuming that if the word is omitted, a center position does not exist.

ON-OFF or ON-NONE-OFF
: A basic on-off SPST switch with no center position.

ON-ON or ON-NONE-ON
: A basic SPDT switch with no center position.

ON-OFF-ON
: A double-throw switch with center-off position (no connection when the switch is centered).

ON-ON-ON
: A triple-throw switch where the center position connects with its own set of terminals.

Parentheses are used in descriptions of spring-loaded switches to indicate a momentary state that lasts only as long as pressure is applied to the actuator.

(ON)-OFF or OFF-(ON)
: A spring-loaded switch that is normally off and returns to that position when pressure is released. Also known as *NO* (normally open), and sometimes described as *FORM A*. Its performance is similar to that of a push-button and is sometimes described as a *make-to-make* connection.

ON-(OFF) or (OFF)-ON
: A spring-loaded switch that is normally on and returns to that position when pressure is released. This is sometimes described as a *make-to-break* connection. Also known as *NC* (normally closed), and sometimes described as *FORM B*.

(ON)-OFF-(ON)
: A spring-loaded double-throw switch with a no-connection center position to which it returns when pressure on its actuator is released.

Other combinations of these terms are possible.

Most double-throw switches break the connection with one contact (or set of contacts) before making the connection with the second contact (or set of contacts). This is known as a *break before make* switch. Much less common is a *make before break* switch, also known as a *shorting switch*, which establishes the second connection a moment before the first connection is broken. Use of a shorting switch may cause unforeseen consequences in electronic components attached to it, as both sides of the switch will be briefly connected when the switch is turned.

Snap-Action

Also known as a *limit switch* and sometimes as a *microswitch* or *basic switch*. This utilitarian design is often intended to be triggered mechanically rather than with finger pressure, for example in 3D printers. It is generally cheap but reliable.

Two snap-action switches are shown in Figure 6-4. A sectional view of a snap-action ON-(ON) limit switch is shown in Figure 6-5. The pole contacts are mounted on a flexible strip which can move up and down in the center of the switch. The strip has a cutout which allows an inverted U-shaped spring to flip to and fro. It keeps the contacts pressed together in either of the switch states.

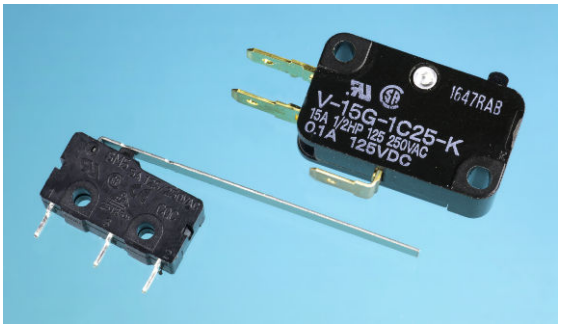

Figure 6-4. *Two SPDT snap-action switches, also known as limit switches. The one on the right is full-size. The one on the left is miniature, with an actuator arm to provide additional leverage. The arm may be trimmed to the required length.*

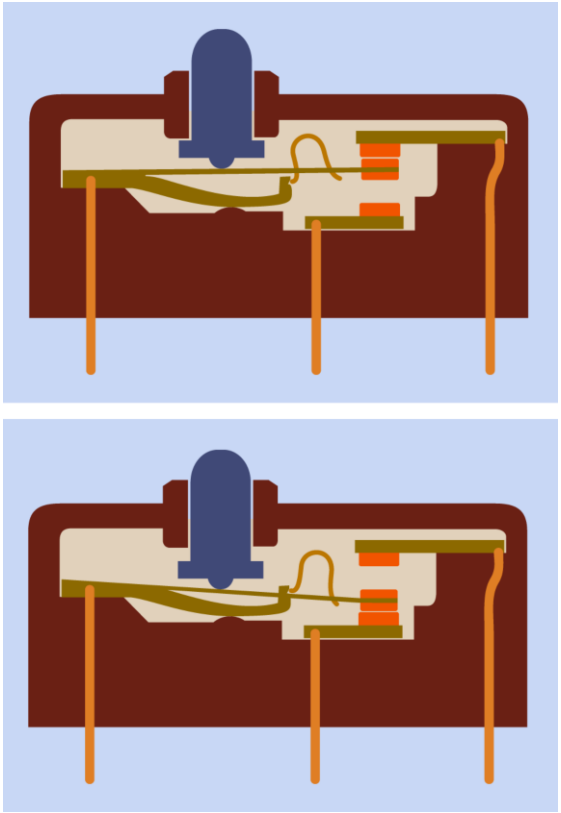

Figure 6-5. *Top: Two contacts inside this limit switch are touching by default. Bottom: When the external button is pressed, it pushes a flexible metal strip downward until it connects with the lower contact. The inverted-U–shaped component is a spring that rests inside a cutout in the flexible strip and resists motion through the central part of its travel.*

The term *snap action* refers to a spring-loaded internal mechanism which snaps to and fro between its two positions. This type of switch is usually SPDT and has a momentary action; in other words, it functions in ON-(ON) mode, although OFF-(ON) and (less often) ON-(OFF) versions are available. The body of the switch is sealed, with a small button protruding through a hole. A thin metal arm may provide additional leverage to press the button. A roller may be mounted at the end of the arm so that the switch can be activated as it slides against a moving mechanical component such as a cam or a wheel. The switch is commonly used to limit the travel or rotation of such a component. Literally thousands of variants are available, in different sizes, requiring different amounts of force for activation. Subminiature snap-action switches can often be actuated by a pressure of only a few grams.

Rocker

Three rocker switches are shown in Figure 6-6. A sectional view of a rocker switch is shown in Figure 6-7. In this design, a spring-loaded ball bearing rolls to either end of a central rocker arm when the switch is turned. Rocker switches are often used as power on-off switches.

Slider

Many types of slider switch (also known as *slide switch*) are widely used as a low-cost but versatile way to control small electronic devices, from clock-radios to stereos. The switch is usually mounted on a circuit board, and its knob or cap protrudes through a slot in the panel. This design is more vulnerable to dirt and moisture than other types of switch. It is usually cheaper than a toggle switch but is seldom designed for use with a high current.

Most slide switches have two positions, and function as SPDT or DPDT switches, but other configurations are less commonly available with more poles and/or positions. A subminiature slide switch is shown in Figure 6-8, while some schematic representations are shown in Figure 6-9,

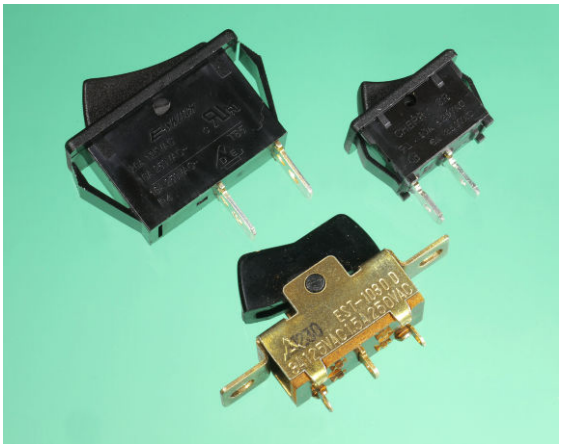

Figure 6-6. *Three rocker switches, the upper two designed for push-insertion into a suitably sized rectangular hole in a panel. The switch at front-center is intended to be screwed in place, and is more than 20 years old, showing that while the choice of materials has changed, the basic design has not.*

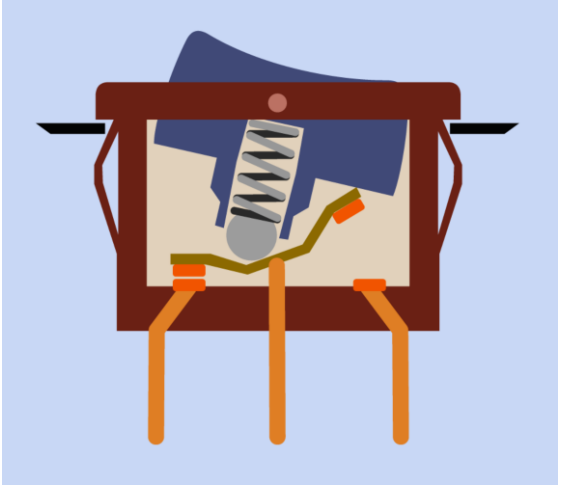

Figure 6-7. *This sectional view of a rocker switch shows a spring-loaded ball-bearing that rolls to and fro along a rocker arm, connecting either pair of contacts when the switch is turned.*

where a black rectangle indicates a sliding internal contact, and a terminal that functions as a pole is identified with letter P in each case. Top left: A SPDT switch using a two-position slider. Top right: A 4PDT slide switch. Bottom left: There are no poles in this switch, as such. The slider can short together any of four pairs of contacts. Bottom right: The slider shorts together three possible pairs of contacts out of four. Here again, there is no pole.

Note that the schematic representation of a slide switch may be identical to that of a slide **push-button**. A schematic should be inspected carefully to determine which type is intended.

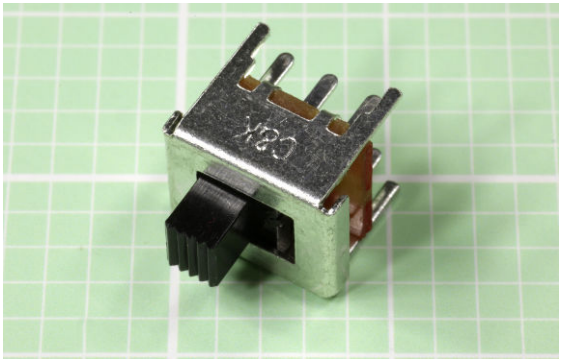

Figure 6-8. *This subminiature slide switch is less than half an inch long, rated 0.3A at 30VDC. Larger versions look almost identical, but can handle only slightly more current.*

The representation of sliders in schematics has not been standardized, but the samples shown are common.

Toggle

A *toggle switch* provides a firm and precise action via a lever (the *toggle*) that is usually tear-drop shaped and nickel plated, although plastic toggles are common in cheaper variants. Formerly used to control almost all electronic components (including early computers), the toggle has declined in popularity but is still used in applications such as automobile accessory kits, motorboat instrument panels, and industrial controls.

Three miniature DPDT toggle switches are shown in Figure 6-10. Two full-size, heavy-duty toggle switches are shown in Figure 6-11. A full-size, four-pole, double-throw heavy-duty toggle switch is shown in Figure 6-12. Toggle switches with more poles are extremely rare.

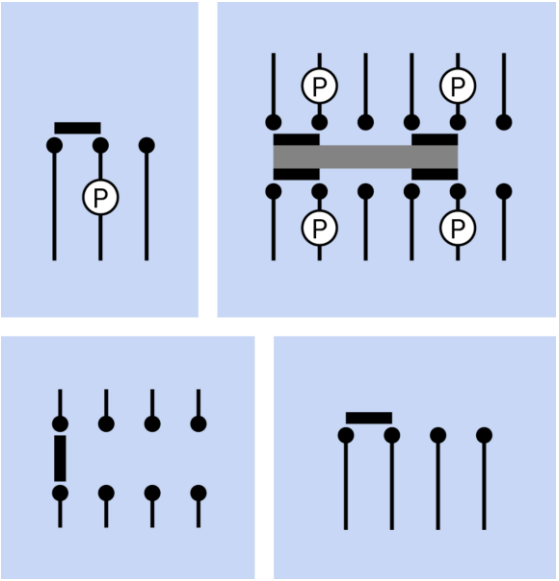

Figure 6-9. *Slide switch schematics. Each black rectangle represents a movable contact that connects two pairs of fixed contacts at a time. Detailed commentary on these variants will be found in the body of the text. Manufacturers may use variants of these symbols in their datasheets (for example, the gray rectangle indicating an insulating contact carrier, at top right, may be represented as a single line, or a black outline with a white center).*

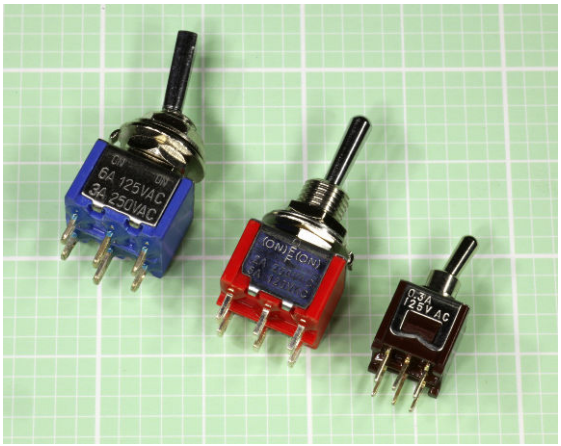

Figure 6-10. *Three miniature toggle switches with current ratings ranging from 0.3A to 6A at 125VAC. Each small square in the background grid measures 0.1" x 0.1".*

An automotive toggle switch is shown in Figure 6-13. Its plastic toggle is extended to minimize operating error.

Figure 6-11. *Two full-size toggle switches capable of handling significant current. At left, the switch terminates in quick-connect terminals. At right, the switch has solder terminals (some of them containing residual traces of solder).*

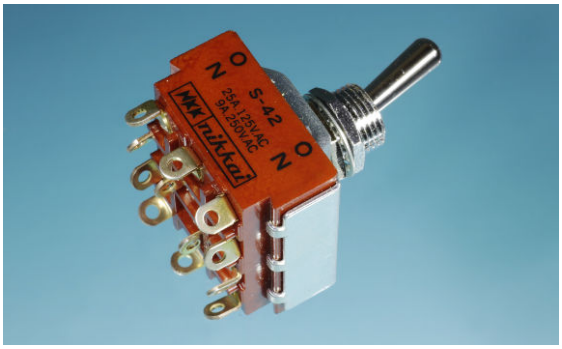

Figure 6-12. *A 4PDT full-size toggle switch with solder terminals, capable of switching 25A at 125VAC. Four-pole switches are relatively unusual.*

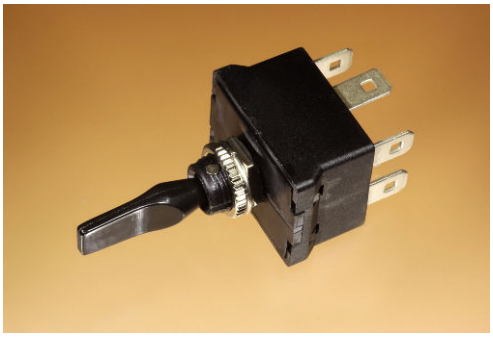

Figure 6-13. *A toggle switch intended for control of automotive accessories.*

High-end toggle switches are extremely durable and can be sealed from environmental

contamination with a thin *boot* made from molded rubber or vinyl, which screws in place over the toggle, using the thread on the switch bushing. See Figure 6-14.

Figure 6-14. *A rubber or vinyl boot can be used to protect a toggle switch from contamination with dirt or water. Each boot contains a nut that screws onto the threads of a toggle switch, as shown at left.*

A *locking toggle switch* has a toggle that must be pulled out against the force of a retaining spring, before the toggle can be moved from one position to another. The toggle then snaps back into place, usually engaging in a small slot in the bushing of the switch.

DIP

A DIP switch is an array of very small, separate switches, designed for mounting directly on a circuit board, either in through-hole or surface-mount format. Through-hole DIP switches have two rows of pins with a 0.1" pitch, the rows being spaced 0.3" apart to fit a standard DIP (dual-inline package) socket or comparable configuration of holes in the board. Surface-mount DIP switches may have 0.1" or 0.05" pitch.

Most DIP arrays consist of SPST switches, each of which can close or open a connection between two pins on opposite sides of the switch body. The switch positions are usually labelled ON and OFF. Figure 6-15 shows a selection of DIP switches. Figure 6-16 shows the internal connections in a DIP switch.

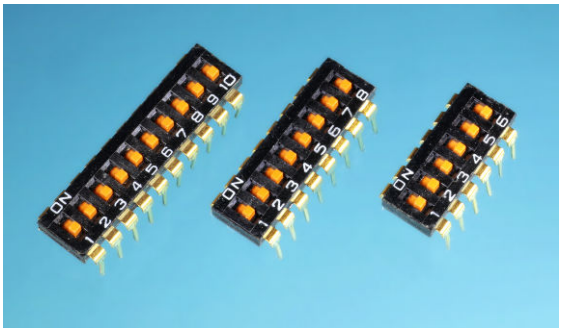

Figure 6-15. *As shown here, DIP switches are available with a variety of "positions," meaning the number of switches, not the number of switch states.*

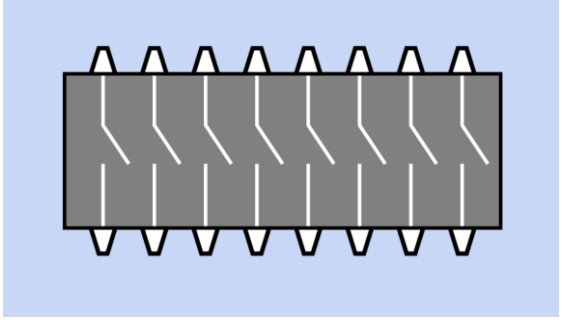

Figure 6-16. *The interior connections of a 16-pin DIP switch.*

The number of switches in a DIP array is usually referred to as its number of "positions." This should not be confused with the two positions of each physical switch lever. SPST DIP switches are made with 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, and 16 positions.

Early IBM-compatible desktop computers often required the user to set the position of an internal DIP switch when making routine upgrades such as installing an additional disk drive. While this feature is now obsolete, DIP switches are still used in scientific equipment where the user is expected to be sufficiently competent to open a cabinet and poke around inside it. Because of the 0.1" spacing, a small screwdriver or the tip of a pen is more appropriate than a finger to flip individual levers to and fro.

DIP switches may also be used during prototype development, as they allow a convenient way to test a circuit in numerous different modes of operation.

Most DIP switches have wire terminals which are just long enough for insertion into a standard breaboard.

DIP switch package options include standard, low-profile, right-angle (standing at 90 degrees relative to the circuit board), and piano (with switch levers designed to be pressed, like tiny rocker switches, instead of being flipped to and fro).

Some SPDT, DPST, DPDT, 3PST, and 4PST variants exist, but are uncommon. Multiple external pins connect with the additional internal switch contacts, and a manufacturer's datasheet should be consulted to confirm the pattern of internal connections. A surface-mount, 0.1" pitch, DPST DIP switch is shown in Figure 6-17, with a plastic cover to protect the switches from contamination during wave soldering (at left), and with the cover peeled off (at right).

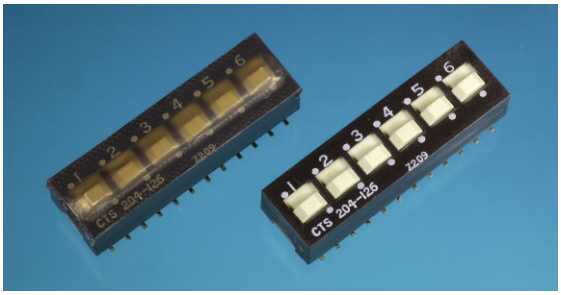

Figure 6-17. *A SPDT surface-mount double-throw DIP switch, sold with a plastic cover (shown at left) to protect it during wave soldering. The cover has been removed at right.*

SIP

A SIP switch is an array of small, separate switches, identical in concept to a DIP switch, but using only one row of pins instead of a double row. The applications for SIP switches are the same as DIP switches; the primary difference is simply that the SIP switch occupies a little less space, while being perhaps slightly less convenient to use.

One terminal of each switch usually shares a common bus. The internal connections in a typical 8-pin SIP array are shown in Figure 6-18. Pin spacing is 0.1", as in a typical DIP switch.

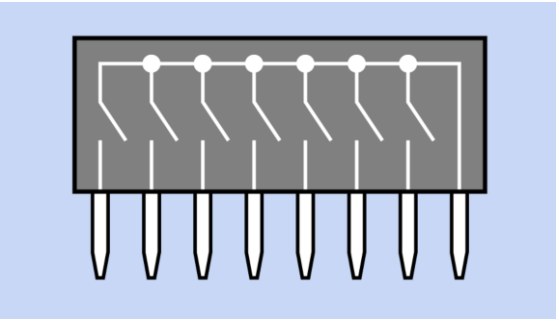

Figure 6-18. *The interior connections of an 8-pin SIP switch incorporating a common bus.*

Paddle

A paddle switch has a flat-sided tab-shaped plastic actuator, relatively large to allow a firm, error-free grip. Internally it is often comparable with a rocker switch, and is generally used with AC power. Some toggle-switch bodies are also sold with paddle-shaped actuators. A subminiature paddle switch is shown in Figure 6-19.

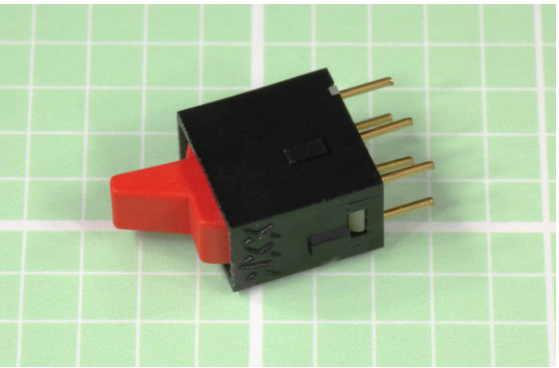

Figure 6-19. *A subminiature paddle switch. Full-size versions are often used as power switches.*

Vandal Resistant Switch

Typically fabricated from stainless steel, this is designed to withstand most types of abuse and is also weather-proof. The pushbuttons that allow pedestrians to trigger a traffic signal are a form of vandal-resistant switch.

Tactile Switch

This is considered to be a **pushbutton**, and is described in that entry. See "Tactile Switch" (page 34).

Mounting Options

A *panel mount* switch generally has a threaded bushing that is inserted from behind the front panel of a product, through a hole of appropriate size. It is supplied with a lockwasher and a nut (often, two nuts) that fit the thread on the switch bushing.

Front panel mount usually means that screws visible from the front of the panel are attached to a bracket on the switch behind the panel. The actuator of the switch is accessible through a cutout in the panel. This mounting style is mostly used for rocker switches and sometimes for slide switches.

Subpanel mount means that the switch is attached to a separate plate or chassis behind the control panel. The actuator of the switch is accessible through a cutout.

Snap-in mount requires a switch with flexible plastic or metal tabs each side, designed to push through a cutout in the panel, at which point the tabs spring out and retain the switch.

PC mount switches have pins that are soldered into a printed circuit board. They may have additional solderable lugs to provide mechanical support.

Surface mount switches are attached to a board in the same manner as other surface-mount components.

Termination

Switches (and pushbuttons) are available with a variety of terminals.

Solder lugs are small tabs, each usually perforated with a hole through which the end of a wire can be inserted prior to soldering.

PC terminals are pins that protrude from the bottom of the switch, suitable for insertion in a printed circuit board. This style is also known as a *through-hole*. The terminals may have a right-angle bend to allow the component to be mounted flat against the board, with the switch actuator sticking out at the side. This termination style is known as *right-angle PC*. Many manufacturers offer a choice of straight or bent pin terminals, but the component may be listed in a catalog under either of those options, with no indication that other options exist. Check manufacturer datasheets carefully.

Quick connect terminals are spade-shaped to accept push-on connectors, commonly used in automotive applications. Hybrid quick-connect terminals that can also function as solder lugs are sometimes offered as an option.

Screw terminals have screws premounted in flat terminals, for solderless attachment of wires.

Wire leads are flexible insulated wires, often with stripped and tinned ends, protruding at least an inch from the body of the component. This option is becoming uncommon.

Contact Plating Options

The internal electrical contacts of a switch are usually plated with silver or gold. Nickel, tin, and silver alloys are cheaper but less common. Other types are relatively rare.

Values

Switches designed for electronic devices vary widely in power capability, depending on their purpose. Rocker switches, paddle switches, and toggle switches are often used to turn power on and off, and are typically rated for 10A at 125VAC,

although some toggle switches go as high as 30A. Snap-action or limit switches may be similarly rated, although miniature versions will have reduced capability. Slide switches cannot handle significant power, and are often rated around 0.5A (or less) at 30VDC. DIP and SIP switches have a typical maximum rating of 100mA at 50V and are not designed for frequent use. Generally they are used only when the power to the device is off.

How to Use it

Power Switches

When a simple SPST switch is used to turn DC power on and off, it conventionally switches the positive side of the power supply, also sometimes known as the *high side*. The primary reason for following this convention is that it is widely used; thus, following it will reduce confusion.

More importantly, an on-off switch that controls AC power must be used on the "live" side of the supply, not the "neutral" side. If you have any doubts about these concepts (which go beyond the scope of this book), consult a reference guide on this subject. Using a DPST component to switch both sides of an AC supply may be a worthwhile additional precaution in some applications. The ground wire of an AC supply should never be switched, because the device should always be grounded when it is plugged into an electric outlet.

Limit Switches

An application for two limit switches with a DC motor and two rectifier **diodes** is shown in Figure 6-20. This diagram assumes that the motor turns clockwise when its lower terminal is positive, and counter-clockwise when its upper terminal is positive. Only two terminals are used (and shown) in each limit switch; they are chosen to be normally-closed. Other terminals inside a switch may exist, may be normally-open, and can be ignored.

The motor is driven through a dual-coil, DPDT latching **relay**, which will remain in either position indefinitely without drawing power. When the upper coil of the relay receives a pulse from a pushbutton or some other source, the relay flips to its upper position, which conducts positive current through the lower limit switch, to the lower terminal of the motor. The motor turns clockwise until the arm attached to its shaft hits the lower limit switch and opens it. Positive current is blocked by the lower diode, so the motor stops.

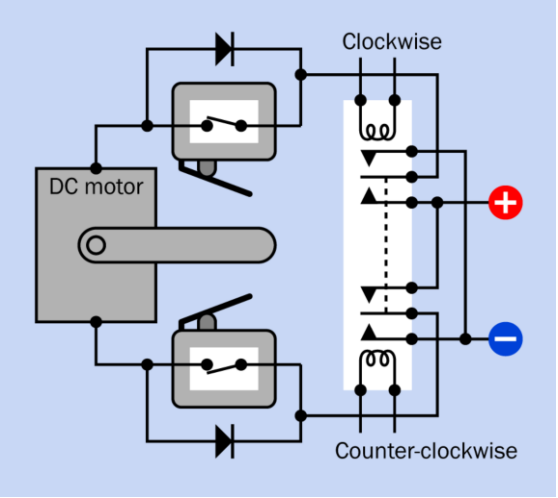

Figure 6-20. *In this schematic, normally-closed limit switches are opened by pressure from an arm attached to a motor, thus switching off its power at each end of its permitted travel and preventing overload and burnout. A two-coil latching relay activates the motor. Rectifier diodes allow power to reach the motor to reverse its rotation when a limit switch is open.*

When the lower coil of the relay is activated, the relay flips to its lower position. Positive current can now reach the upper side of the motor through the upper limit switch. The motor runs counter-clockwise until its arm opens the upper limit switch, at which point the motor stops again. This simple system allows a DC motor to be run in either direction by a button-press of any duration, without risk of burnout when the motor reaches the end of its travel. It has been used for applications such as raising and lowering powered windows in an automobile.

A DPDT pushbutton could be substituted for the latching relay if manual control, only, is acceptable. However, in this scenario, sustained pressure on the pushbutton would be necessary to move the motor arm all the way to the opposite end of its travel. A DPDT switch might be more appropriate than a pushbutton.

Logic Circuits

Logic circuits that depend purely on switches can be constructed (for example, to add binary numbers) but are rare and have no practical applications. The most familiar and simplest example of manually switched logic is a pair of SPDT switches in house wiring, one positioned at the top of a flight of stairs and the other at the bottom, as shown in Figure 6-21. Either switch will turn the light on if it is currently off, or off if it is currently on. To extend this circuit by incorporating a third switch that has the same function as the other two, a DPDT switch must be inserted. See Figure 6-22.

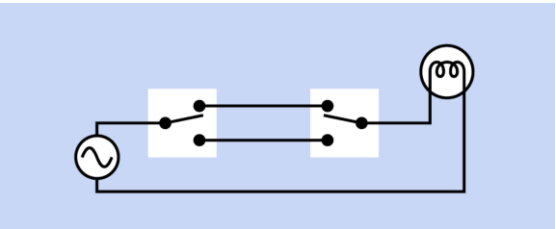

Figure 6-21. *SPDT switches are commonly used in house wiring so that either of them will turn a shared light on if it is off, or off it is on.*

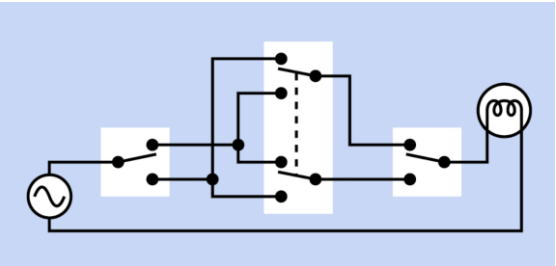

Figure 6-22. *A DPDT switch must be inserted if three switches must have identical function to control the on-off state of a single light bulb.*

Alternatives

As **microcontrollers** have become cheaper and more ubiquitous, they have taken over many functions in electronic products that used to be served by switches. A menuing system driven by a microcontroller can use one **rotational encoder** with a SPST pushbutton built into it to select and adjust numerous parameters in a device such as a car stereo, where functions were once selected and adjusted by individual switches and potentiometers. The rotational-encoder option takes up less space, is cheaper to build (assuming a microcontroller is going to be used in the device for other purposes anyway), and can be more reliable, as it reduces the number of electromechanical parts. Whether it is easier to use is a matter of taste. Cost and ergonomics may be the primary factors to consider when choosing where and how to use switches.

What Can Go Wrong

Arcing

The contacts inside a switch will be rapidly eroded if *arcing* (pronounced "arking") occurs. An electric arc is a spark that tends to form when a switch is opened while conducting a high current or high voltage (typically 10A or more and 100V or more). The most common cause is an inductive load that generates back-EMF when it is switched on and forward-EMF when it is switched off. The surge can be many times the amperage that the load draws during continuous operation. In DC circuits, arcing can be reduced by using a rectifier **diode** in parallel with the load (with its polarity blocking normal current flow). This is often referred to as a *flyback diode* or *freewheeling diode*. In AC circuits, where a diode cannot be used in this way, a *snubber* (a simple combination of capacitor and resistor) may be placed around the load. A snubber can also be used around the switch itself, in DC circuits. See "Snubber" (page 108).

When switching an inductive load, it is generally prudent to use switches rated for twice as much current as the circuit will normally draw.

Dry Joints

Switches that control significant current will have substantial terminals, and these terminals will be attached to heavy-gauge wire. When using solder to make this type of connection, the combined heat capacity of the wire and the terminal will sink a lot more heat than a small component on a circuit board. At least a 30W soldering iron should be used. Lower-wattage irons may be incapable of melting the solder completely (even though they seem to), and a "dry joint" will result, which can have a relatively high electrical resistance and will be mechanically weak, liable to break later. Any good solder joint should withstand flexing of the wire attached to it.

Short Circuits

Because many switches are still wired in with solder tabs, screw terminals, or quick-connect terminals, wires that become accidentally detached can be a significant hazard. Heat-shrink tubing should be applied to enclose wires and terminals at the rear of a power switch, as an additional precaution. Power switches should always be used in conjunction with appropriate **fuses**.

Contact Contamination

Sealed switches should be used in any environment where dirt or water may be present. Slide switches are especially vulnerable to contamination, and are difficult to seal. Switches used in audio components will create "scratchy" sounds if their contacts deteriorate.

Wrong Terminal Type

Because switches are available with a wide variety of terminal types, it's easy to order the wrong type. Switches may be supplied with pins for through-hole insertion in circuit boards; screw terminals; quick-disconnect terminals; or solder lugs. Variants may also be available for surface mount. If a project requires, for example, the insertion of pins in a printed circuit board, and a switch is supplied with solder lugs, it will be unusable.

Part numbers generally include codes to identify each terminal variant, and should be studied carefully.

Contact Bounce

Also known as *switch bounce*. When two contacts snap together, extremely rapid, microscopic vibrations occur that cause brief interruptions before the contacts settle. While this phenomenon is not perceptible to human senses, it can be perceived as a series of multiple pulses by a **logic chip**. For this reason, various strategies are used to *debounce* a switch that drives a logic input. This issue is explored in detail in the entry on logic chips in Volume 2 of the encyclopedia.

Mechanical Wear

Any toggle or rocker switch contains a mechanical pivot, which tend to deteriorate in harsh environments. Friction is also an issue inside these switches, as the design often entails the rounded tip of a lever rubbing to and fro across the center of a movable contact.

The spring inside a snap switch or limit switch may fail as a result of metal fatigue, although this is rare. A slide switch is far less durable, as its contacts rub across each other every time the switch changes position.

In any application that entails frequent switching, or where switch failure is a critical issue, the most sensible practice is to avoid using cheap switches.

Mounting Problems

In a panel-mount switch that is secured by turning a nut, the nut may loosen with use, allowing the component to fall inside its enclosure. Conversely, overtightening the nut may strip the threads on the switch body, especially in cheaper components where the threads are molded into

plastic. Consider applying a drop of Loc-Tite or similar adhesive after moderately tightening the nut. Note that nut sizes vary widely, and finding a replacement may be time-consuming.

Cryptic Schematics

In some circuit schematics, the poles of a multi-pole switch may be visually separated from each other, even at opposite sides of the page, for convenience in drawing the schematic. Dotted lines usually, but not always, link the poles. In the absence of dotted lines, switch segments are often coded to indicate their commonality. For example, SW1(a) and SW1(b) are almost certainly different parts of the same switch, with linked poles.

rotary switch

7

Not to be confused with **rotational encoder**, which has its own entry in this encyclopedia.

OTHER RELATED COMPONENTS

- **switch** (See Chapter 6)
- **rotational encoder** (See Chapter 8)

What It Does

A rotary switch makes an electrical connection between a *rotor*, mounted on a shaft that is turned by a knob, and one of two or more stationary contacts. Traditionally, it was the component of choice to select wavebands on a radio receiver, broadcast channels on a television or inputs on a stereo preamplifier. Since the 1990s, it has been substantially superceded by the **rotational encoder**. However it still has applications in military equipment, field equipment, industrial control systems, and other applications requiring a rugged component that will withstand heavy use and a possibly harsh environment. Also, while the output from a rotational encoder must be decoded and interpreted by a device such as a microcontroller, a rotary switch is an entirely passive component that does not require any additional electronics for its functionality.

Two typical schematic symbols for a rotary switch are shown in Figure 7-1. They are functionally identical. A simplified rendering of the interior of a traditional-style rotary switch is shown in Figure 7-2. A separate contact (not shown) connects with the rotor, which connects with each of the stationary contacts in turn. The colors were chosen to differentiate the parts more clearly, and do not correspond with colors in an actual switch.

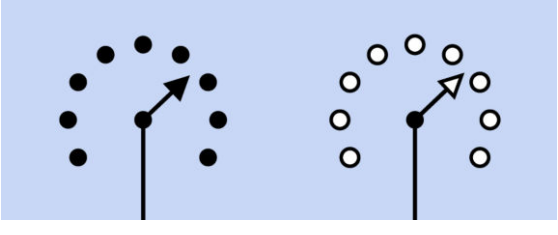

Figure 7-1. *Typical schematic symbols for a rotary switch. The two symbols are functionally identical. The number of contacts will vary depending on the switch.*

A selection of rotary switches is shown in Figure 7-3. At top-left is an *open frame* switch, providing no protection to its contacts from contaminants. This type of component is now rare. At top-right is a twelve-position, single-pole switch rated 2.5A at 125VAC. At front-left is a four-position, single-pole switch rated 0.3A at 16VDC or 100VAC. At front right is a two-position, two-pole switch with the same rating as the one beside it. All the sealed switches allow a choice of panel mounting or through-hole printed circuit board mounting.

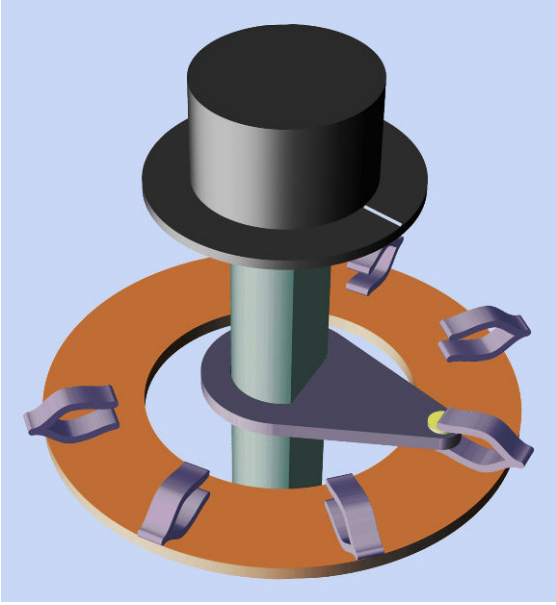

Figure 7-2. *A simplified rendering of interior parts in a basic SP6T rotary switch. Arbitrary colors have been added for clarity.*

How It Works

A switch may have multiple poles, each connecting with its own rotor. The rotors are likely to be on separate *decks* of the switch, but two, three, or four rotors, pointing in different directions, may be combined on a single deck if the switch has only a small number of positions.

Rotary switches are usually made with a maximum of twelve positions, but include provision for limiting the number of positions with a *stop*. This is typically a pin, which may be attached to a washer that fits around the bushing of the switch. The pin is inserted into a choice of holes to prevent the switch from turning past that point. For example, an eight-position rotary switch can be configured so that it has only seven (or as few as two) available positions.

A specification for a rotary switch usually includes the angle through which the switch turns between one position and the next. A twelve-position switch usually has a 30-degree turn angle.

Figure 7-3. *A selection of rotary switches. See text for details.*

Variants

Conventional

The traditional style of rotary switch is designed to be panel-mounted, with a body that ranges from 1″ to 1.5″ in diameter. If there is more than one deck, they are spaced from each other by about 0.5″. The switch makes an audible and tactile "click" as it is turned from one position to the next.

A rugged sealed five-deck rotary switch is shown in Figure 7-4. It has five poles (one per deck), and a maximum of 12 positions. The contacts are rated 0.5A at 28VDC. This type of heavy-duty component is becoming relatively rare.

If the rotor in a switch establishes a connection with the next contact a moment before breaking the connection with the previous contact, this is known as a *shorting* switch, which may also be described as a *make-before-break* switch. In a *nonshorting* or *break-before-make* switch, a tiny

Figure 7-4. *A five-pole, twelve-position rotary switch.*

interval separates one connection from the next. This can be of significant importance, depending on the components that are connected with the switch.

The shaft may be round, splined, or D-shaped in section. A knob is seldom supplied with a switch and must be chosen to match the shaft. Some shaft dimensions are metric, while others are measured in inches, with 1/4" diameter being the oldest standard. Some switches with a splined shaft are supplied with an adapter for a knob of D-shaped internal section; the adapter can be slipped onto the shaft in any of 12 or more positions, to minimize the inconvenience of positioning the body of the switch itself so that the knob is correctly oriented in relation to positions printed on the face of the panel.

Miniature rotary switches may be as small as 0.5" diameter, and usually terminate in pins for through-hole mounting on a PC board. Miniature switches usually have lower current ratings than full-size switches.

Rotary switches must be securely anchored to resist the high turning forces that can be inflicted upon them by users. In a panel-mount design, a nut is tightened around a thread on the bushing of the switch. Through-hole versions can be secured to the PC board with the shaft protruding loosely through a cutout in the panel. To minimize mechanical stress on the circuit board, the detents in a PC-board switch are usually weaker than in a full-size switch, and the knob is usually smaller, allowing less leverage.

Rotary DIP

A conventional *DIP switch* is a linear array of miniature SPST switches designed to fit a standard DIP (dual-inline package) layout of holes in a circuit board. It is described in the **switch** entry of this encyclopedia. A *rotary DIP* switch (also known as an *encoded output rotary switch* or a *coded rotary switch*) does not conform with a DIP layout, despite its name. It is approximately 0.4" square and usually has five pins, one of which can be considered the input or common pin while the other four can function as outputs. The pins are spaced at 0.1" pitch from one another. Pin function and layout are not standardized.

A dial on top of the switch has either 10 positions (numbered 0 through 9) or 16 positions (0 through 9 followed by letters A through F). One switch of each type is shown in Figure 7-5.

Each position of the dial closes pairs of contacts inside the component to create a unique binary-coded decimal pattern (in a 10-position switch) or binary-coded hexadecimal pattern (in the 16-position switch) on the four output pins. The pin states are shown in Figure 7-6. A rotary DIP switch is a relatively flimsy device, and is not designed for frequent or heavy use. It is more likely to be a "set it and forget it" device whose state is established when it is installed in a circuit board.

Because each position of the switch is identified with a unique binary pattern, this is an example of *absolute encoding*. By contrast, a typical **rotational encoder** uses *relative encoding*, as it merely generates a series of undifferentiated pulses when the shaft is turned.

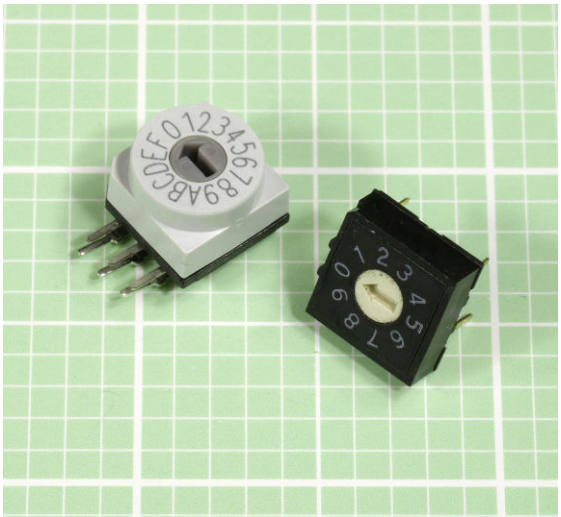

Figure 7-5. *A rotary DIP switch, also known as an encoded output rotary switch, may be used as a substitute for a DIP switch in some applications.*

A *real-coded* rotary DIP makes a connection between input and output pins wherever a binary 1 would exist. In the *complement-coded* version, the output is inverted. The switch is primarily intended for use with a **microcontroller**, enabling only four binary input pins on the microcontroller to sense up to sixteen different switch positions.

A six-pin rotary DIP variant is available from some manufacturers, with two rows of three pins, the two center pins in each row being tied together internally, and serving as the pole of the switch.

Rotary DIPs are available with a screw slot, small knurled knob, or larger knob. The screw-slot version minimizes the height of the component, which can be relevant where circuit boards will be stacked close together. A *right-angle PC* variant stands at 90 degrees to the circuit board, with pins occupying a narrower footprint. The switch on the left in Figure 7-5 is of this type.

While most rotary DIPs are through-hole components, surface-mount versions are available.

Most rotary DIPs are sealed to protect their internal components during wave-soldering of circuit boards.

Switch Position	Pin 1	Pin 2	Pin 3	Pin 4
0	●	●	●	●
1	●	●	●	●
2	●	●	●	●
3	●	●	●	●
4	●	●	●	●
5	●	●	●	●
6	●	●	●	●
7	●	●	●	●
8	●	●	●	●
9	●	●	●	●
A	●	●	●	●
B	●	●	●	●
C	●	●	●	●
D	●	●	●	●
E	●	●	●	●
F	●	●	●	●

Figure 7-6. *Positive and negative states of the four output pins of a real-coded 16-position rotary DIP switch, assuming that the common pin of the switch is connected with a positive supply voltage. A ten-position rotary DIP switch would use only the states from 0 through 9. In a complement-coded switch, the positive and negative states would be reversed.*

Gray Code

A Gray code (named after its originator, Frank Gray) is a system of absolute encoding of a switch output, using a series of nonsequential binary numbers that are chosen in such a way that each number differs by only one digit from the preceding number. Such a series is useful because it eliminates the risk that when a switch turns, some bits in the output will change before others, creating the risk of erroneous interpretation. A minority of rotary switches or rotational en-

coders are available with Gray-coded outputs. Typically, a microcontroller must use a lookup table to convert each binary output to an angular switch position.

PC Board Rotary Switch

Miniature switches with a conventional, non-encoded output are available for printed-circuit board mounting, sometimes requiring a screwdriver or hex wrench to select a position. A single-pole eight-position switch of this type is shown in Figure 7-7. Its contacts are rated to carry 0.5A at 30VDC, but it is not designed to switch this current actively.

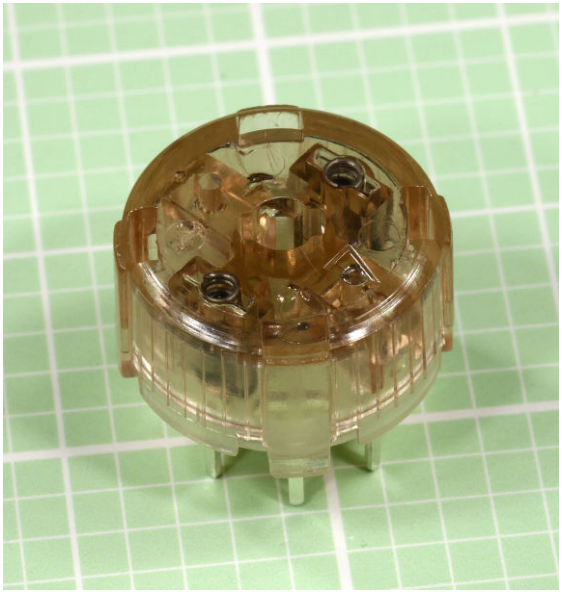

Figure 7-7. *This miniature switch is designed for insertion on a printed circuit board. It can be used to make a setting before a device is shipped to the end user.*

Mechanical Encoder

A *mechanical encoder* functions similarly to a rotary DIP switch but is intended for much heavier use. It outputs a binary-coded-decimal value corresponding with its shaft position, is typically the size of a miniature rotary switch, and is designed for panel mounting. The Grayhill Series 51 allows 12 positions, each generating a code among four terminals. The Bourns EAW provides 128 positions, each generating a code among 8 terminals.

Pushwheel and Thumbwheel

A *pushwheel switch* is a simple electromechanical device that enables an operator to provide a code number as input to data processing equipment, often in industrial process control. The decimal version contains a wheel on which numbers are printed, usually in white on black, from 0 through 9, visible one at a time through a window in the face of the switch. A button above the wheel, marked with a minus sign, rotates it to the next lower number, while a button below the wheel, marked with a plus sign, rotates it to the next higher number. A connector at the rear of the unit includes a common (input) pin and four output pins with values 1, 2, 4, and 8. An additional set of pins with values 1, 2, 3, and 4 is often provided. The states of the output pins sum to the value that is currently being displayed by the wheel. Often two, three, or four pushwheels (each with an independent set of connector pins) are combined in one unit, although individual pushwheels are available and can be stacked in a row.

A *thumbwheel switch* operates like a pushwheel switch, except that it uses a thumbwheel instead of two buttons. Miniaturized thumbwheel switches are available for through-hole mounting on PC boards.

Hexadecimal versions are also available, with numbers from 0 through 9 followed by letters A through F, although they are less common than decimal versions.

Keylock

A *keylock switch* is generally a two-position rotary switch that can be turned only after insertion of a key in a lock attached to the top of the shaft. This type of switch almost always has an OFF-(ON) configuration and is used to control power.

Keylock switches are found in locations such as elevators, for fire-department access; in cash registers; or on data-processing equipment where switching power on or off is reserved for a system administrator.

Values

A full-size rotary switch may be rated from 0.5A at 30VDC to 5A at 125VAC, depending on its purpose. A very few switches are rated 30A at 125VAC; these are high-quality, durable, expensive items.

A typical rotary DIP switch is rated 30mA at 30VDC and has a carrying current rating (continuous current when no switching occurs) of no more than 100mA at 50VDC.

How to Use it

In addition to its traditional purpose as a mode or option selector, a rotary switch provides a user-friendly way to input data values. Three ten-position switches, for instance, can allow user input of a decimal number ranging from 000 to 999.

When used with a **microcontroller**, a rotary switch can have a *resistor ladder* mounted around its contacts, like a multi-point *voltage divider*, so that each position of the rotor provides a unique potential ranging between the positive supply voltage and negative ground. This concept is illustrated in Figure 7-8, where all the resistors have the same value. The voltage can be used as an input to the microcontroller, so long as the microcontroller shares a common ground with the switch. An analog-digital converter inside the microcontroller translates the voltage into a digital value. The advantage of this scheme is that it allows very rapid control by the user, while requiring only one pin on the microcontroller to sense as many as twelve input states.

For a ladder consisting of 8 resistors, as shown, each resistor could have a value of 250Ω. (The specifications for a particular microcontroller

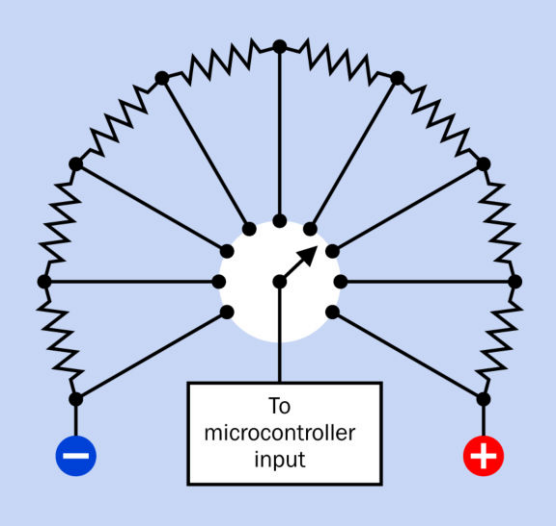

Figure 7-8. *A resistor ladder can be formed around the contacts of a rotary switch, with the pole of the switch connected to a microcontroller that has an analog-digital converter built in. The microcontroller converts the voltage input to an internal digital value. Thus, one pin can sense as many as twelve input states.*

might require other values.) To avoid ambiguous inputs, a nonshorting rotary switch should be used in this scheme. A *pullup resistor* of perhaps 10K should be added to the microcontroller input, so that there is no risk of it "floating" when the switch rotor is moving from one contact to the next. The code that controls the microcontroller can also include a blanking interval during which the microcontroller is instructed to ignore the switch.

Because the rotary switch is an electromechanical device, it has typical vulnerabilities to dirt and moisture, in addition to being bulkier, heavier, and more expensive than a **rotational encoder**. Rotary switches have also been partially replaced by pushbuttons wired to a microcontroller. This option is found on devices ranging from digital alarm clocks to cellular phones. In addition to being cheaper, the pushbutton alternative is preferable where space on a control panel, and behind it, is limited.

What Can Go Wrong

Vulnerable Contacts

Most modern rotary switches are sealed, but some are not. Any switch with exposed contacts will be especially vulnerable to dirt and moisture, leading to unreliable connections. This was an issue in old-fashioned TV sets, where periodic contact cleaning of the channel selector switch was needed.

Exposed contacts are also more vulnerable to side-effects from temperature cycling (when a device warms up and then cools down).

Contact Overload

The contacts on a cheap rotary switch are especially vulnerable to arcing, as the user may turn the switch slowly, causing gradual engagement and disengagement of contacts instead of the snap-action that is characteristic of a well-made toggle switch. If a rotary switch may control significant currents or current surges, it must be appropriately rated, regardless of the extra expense. For more information on arc suppression in switches, see "Arcing" (page 47).

Misalignment

Most knobs for rotary switches consist of a pointer, or have a white line engraved to provide clear visual indication of the position of the switch. If this does not align precisely with indications printed on the panel, confusion will result. For hand-built equipment, the switch can be installed first, after which the control-panel indications can be glued or riveted in place on a separate piece of laminated card, plastic, or metal for precise alignment. If the switch is not secured tightly, its body may turn slightly under repeated stress, leading to erroneous interpretation of the knob position.

Misidentified Shorting Switch

If a shorting switch is used where a nonshorting switch was intended, the results can be disconcerting or even destructive, as one terminal will be briefly connected with the adjacent terminal while the switch is being turned. Multiple functions of a circuit may be activated simultaneously, and in a worst case scenario, adjacent terminals may be connected to opposite sides of the same power supply.

User Abuse

The turning force that must be applied to a full-size conventional rotary switch is significantly greater than the force that is applied to most other types of panel-mounted switches. This encourages aggressive treatment, and the turning motion is especially likely to loosen a nut holding the switch in place. The lighter action characteristic of miniature rotary switches does not necessarily solve this problem, as users who are accustomed to older-style switches may still apply the same force anyway.

Rotary switches should be mounted in expectation of rough use. It is prudent to use Loc-Tite or a similar compound to prevent nuts from loosening, and a switch should not be mounted in a thin or flimsy panel. When using a miniature rotary switch that has through-hole mounting in a circuit board, the board must be sufficiently robust and properly secured.

Wrong Shaft, Wrong Knobs, Nuts That Get Lost, Too Big to Fit

These problems are identical to those that can be encountered with a **potentiometer**, which are discussed in that entry in this encyclopedia.

rotational encoder

The term *rotational encoder* used to be reserved for high-quality components, often using optical methods to measure rotation with precision (more than 100 intervals in 360 degrees). Cheaper, simpler, electromechanical devices were properly referred to as *control shaft encoders*. However, the term *rotational encoder* is now applied to almost any device capable of converting rotational position to a digital output via opening and closing internal mechanical contacts; this is the sense in which the term is used here. It is sometimes distinguished from other types of encoder with the term *mechanical rotary encoder*. Magnetic and optical rotary encoders do not contain mechanical switches, are classified as *sensors* by this encyclopedia, and will appear in Volume 3. They are found in a device such as an *optical mouse*.

OTHER RELATED COMPONENTS

- **rotary switch** (See Chapter 7)

What It Does

A rotational encoder has a knob that a user can turn to display a series of prompts on an LCD screen, or to adjust the input or output on a product such as a stereo receiver. The component is almost always connected to inputs on a **microcontroller** and is usually fitted with *detents* that provide tactile feedback suggesting many closely spaced positions. The encoder often allows the user to make a selection by pushing the knob in, which closes an internal momentary switch. Thus, this type of encoder functions as a pushbutton as well as a switch.

A rotational encoder is an *incremental* or *relative* device, meaning that it merely creates and breaks internal switch connections when rotation occurs, without providing a unique code to identify each absolute rotational position. An *absolute* encoder is discussed in the **rotary switch** entry of this encyclopedia.

No schematic symbol exists to represent a rotational encoder.

How It Works

An encoder contains two pairs of contacts, which open and close out of phase with each other when the shaft rotates. In a clockwise direction, the A pair of contacts may be activated momentarily before the B pair; in a counter-clockwise direction, the B pair may be activated before the A pair. (Some encoders reverse this phase difference.) Thus if one contact from each pair is connected with two inputs of an appropriately programmed microcontroller, and if the other contact of each pair is connected with negative ground, the microcontroller can deduce which way the knob is turning by sensing which pair of contacts closes first. The microcontroller can then count the number of pulses from the contacts and interpret this to adjust an output or update a display.

A simplified schematic is shown in Figure 8-1. The two buttons inside the dashed line represent the two pairs of contacts inside the encoder, while the chip is a microcontroller. The knob and shaft that activate the internal switches are not shown. The schematic assumes that when a contact closes, it pulls the chip input to a low state. A pullup resistor is added to each input of the chip to prevent the pins from "floating" when either pair of contacts is open.

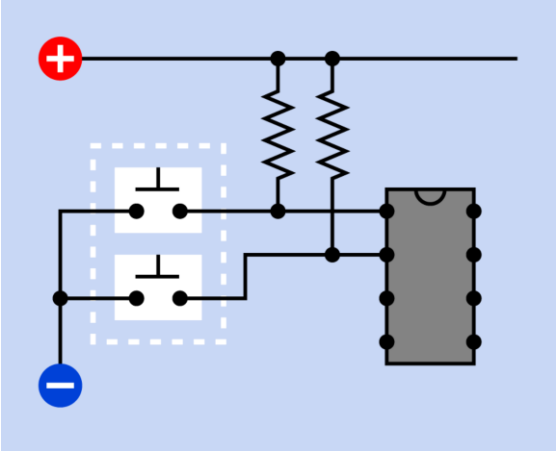

Figure 8-1. *Simplified schematic showing the typical set-up for a rotational encoder. The pushbuttons inside the dashed line represent the contacts inside the encoder. The chip is a microcontroller.*

Figure 8-2 gives a conceptual view of the outputs of an encoder that is turned clockwise (top) and then counter-clockwise (bottom). Some encoders may reverse this phase sequence. Red and black colors have been assigned to the pin states on the assumption that the terminals that are common to both pairs of contacts are connected with negative ground. Thus a "high" pulse in the graphical representation actually indicates that the encoder is grounding its output.

Microcontrollers have become so ubiquitous, and rotational encoders are so cheap, they have displaced rotary switches in many applications where a low current is being switched. The combination of a rotational encoder and a microcontroller is very versatile, allowing display and control of an almost unlimited number of menus and options.

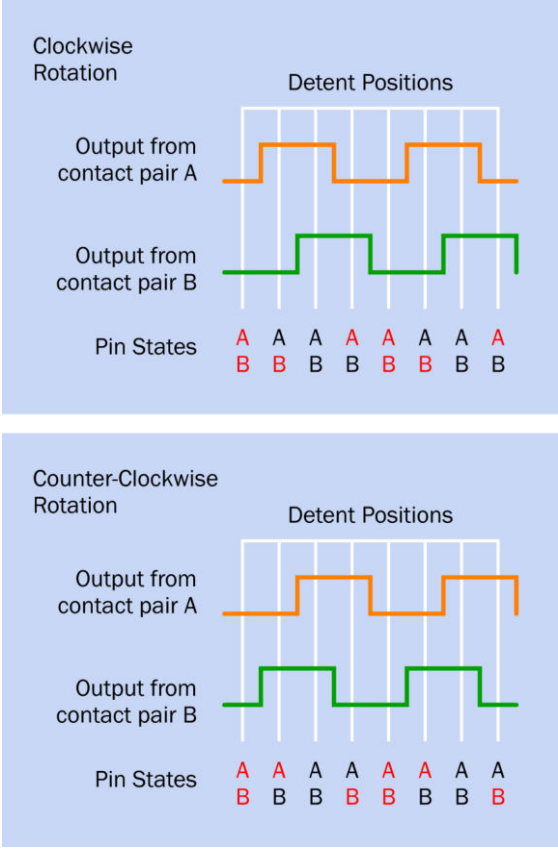

Figure 8-2. *Hypothetical outputs from a rotational encoder, assuming that the common terminals of the contact pairs are connected to negative ground. A high pulse in the graphical representation therefore indicates that the contact pair is grounded. The number of detents relative to the number of pulses per rotation varies from one type of encoder to another.*

Variants

There are two types of rotational encoders containing mechanical contacts: absolute and relative. An absolute encoder generates a code corresponding with each specific rotational position. The code is usually a binary output among

four or more pins. It is discussed under *mechanical encoder* in the **rotary switch** section of this encyclopedia. The variants listed here are all relative encoders.

Pulses and Detents

Rotational encoders from different manufacturers may have as few as 4 or as many as 24 pulses per rotation (PPR), with 12 to 36 detents (or no detents at all, in a few models.) The relationship between pulses and detents shown in Figure 8-2 is typical but is far from being universal. The number of detents may be equal to, greater than, or less than the number of pulses per rotation.

Format

Rotational encoders are generally panel-mounted or through-hole devices. In the latter category, most are horizontally mounted, with a minority being at 90 degrees to the board.

Output

In an encoder containing two switches, four switch-state combinations are possible: OFF-OFF, ON-OFF, OFF-ON, and ON-ON. This is known as a *quadrature* output. All of the rotational encoders discussed here conform with that system.

Rotational Resistance

Rotational encoders vary widely in the resistance that they offer when the user turns the knob. This is largely a function of the detents, if they are included. Still, all rotational encoders generally offer less rotational resistance than a rotary switch, and do not have the kind of heavy-duty knobs that are typically used with rotary switches. Since an encoder creates only a stream of pulses without any absolute positional information, a knob with any kind of pointer on it is inappropriate.

Values

Virtually all rotational encoders are designed to work with a low-voltage supply, 12VDC or less. All of them are intended for low currents, reflecting their purpose to drive microcontroller inputs. Some sample rotational encoders are pictured in Figure 8-3. At rear: nine pulses per rotation (PPR), 36 detents, 10mA at 10VDC. Far left: 20PPR, 20 detents, with switch. Far right: 24PPR, no detents, 1mA at 5VDC. Center (blue): 16PPR, no detents, 1mA at 5VDC. Front: 12PPR, 24 detents, 1mA at 10VDC, requires Allen wrench or similar hexagonal shaft to engage with the rotor.

Figure 8-3. *Rotational encoders with a variety of specifications. See text for details.*

Contact Bounce

Any mechanical switch will suffer some degree of *contact bounce* when its contacts close. Datasheets for rotational encoders may include a specification for bounce duration ranging from around 2ms to 5ms, which is sometimes known as the *settling time*. Naturally, a lower value is preferred. The microcontroller that interprets the positional information from the encoder can include a debouncing routine that simply disregards any signals during the bounce period following switch closure.

Sliding Noise

Sliding noise is the opposite of contact bounce. When two contacts have made a connection and then rub across each other (as occurs inside a rotational encoder while the knob is being turned), the connection may suffer momentary lapses. Datasheets for rotational encoders generally do not supply ratings for this.

How to Use it

As noted above, a rotational encoder can only be used in conjunction with a microcontroller or similar device that is capable of interpreting the phase difference between the pairs of contacts, and is capable of counting the number of opening/closing events while the knob is being turned. (Some dedicated chips are designed for this specific purpose.)

It can be adapted to be driven by a **stepper motor**, to provide feedback regarding the rotation of the motor shaft, and its output can also be interpreted to calculate angular acceleration.

Programming the microcontroller is the most significant obstacle. Generally the program should follow a sequence suggested by this pseudocode:

Check:

- If the encoder contains a pushbutton switch, check it. If the pushbutton is being pressed, go to an appropriate subroutine.
- The status of contacts A.
- The status of contacts B.

Compare their status with previously saved states for A and B. If the status has not changed, repeat from Check.

Debounce:

- Recheck the contacts status rapidly and repeatedly for 50ms, and count the states for contacts A and B. (The 50ms duration may be adjusted for different encoders, as an encoder with a higher number of pulses per rotation will tend to create shorter pulses.)
- Compare the total number of changed states with unchanged states.

If the changed states are in a small minority, probably the signal was erroneous, caused by bounce or sliding noise. Go back to Check and start over.

Interpret:

- Deduce the rotational direction from these four possibilities:
  - — Contacts A were open and have closed.
  - — Contacts A were closed and have opened.
  - — Contacts B were open and have closed.
  - — Contacts B were closed and have opened. (The specific type of encoder will determine how these transitions are interpreted.)
- Revise the variable storing the direction of rotation if necessary.
- Depending on the direction of rotation, increment or decrement a variable that counts pulses.
- Take action that is appropriate to the direction of rotation and the cumulative number of pulses.
- Go back to Check again.

What Can Go Wrong

Switch Bounce

In addition to a debouncing algorithm in the microcontroller, a 0.1µF bypass capacitor can be used with each of the output terminals from the encoder, to help reduce the problem of switch bounce.

Contact Burnout

Rotational encoders are TTL-compatible. They are not generally designed to drive even a small output device, such as an LED. The contacts are extremely delicate and will be easily damaged by any attempt to switch a significant current.

relay

Properly known as an *electromagnetic armature relay* to distinguish it from a *solid-state relay*. However, the full term is very rarely used. It may also be described as an *electromechanical relay*, but the term **relay** is normally understood to mean a device that is not solid state.

OTHER RELATED COMPONENTS

- **solid state relay** (Volume 2)
- **switch** (See Chapter 6)

What It Does

A relay enables a signal or pulse of electricity to switch on (or switch off) a separate flow of electricity. Often, a relay uses a low voltage or low current to control a higher voltage and/or higher current. The low voltage/low current signal can be initiated by a relatively small, economical switch, and can be carried to the relay by relatively cheap, small-gauge wire, at which point the relay controls a larger current near to the load. In a car, for example, turning the ignition switch sends a signal to a relay positioned close to the starter motor.

While solid-state switching devices are faster and more reliable, relays retain some advantages. They can handle double-throw and/or multiple-pole switching and can be cheaper when high voltages or currents are involved. A comparison of their advantages relative to **solid state relays** and **transistors** is tabulated in the entry on **bipolar transistor** in Figure 28-15.

Common schematic symbols for single-throw relays are shown in Figure 9-1 and for double-throw relays in Figure 9-2. The appearance and orientation of the coil and contacts in the symbols may vary significantly, but the functionality remains the same.

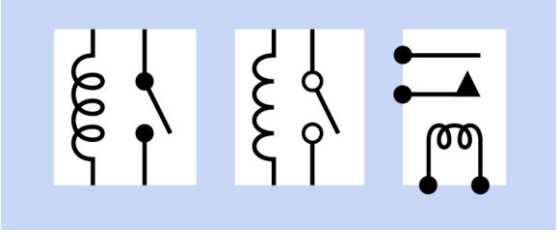

Figure 9-1. *Commonly used schematic symbols for a SPST relay. The symbols are functionally identical.*

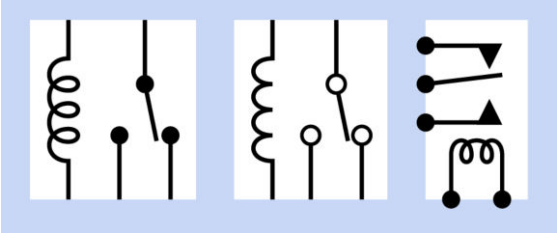

Figure 9-2. *Commonly used schematic symbols for a SPDT relay. The symbols are functionally identical.*

How It Works

A relay contains a *coil*, an *armature*, and at least one pair of *contacts*. Current flows through the coil, which functions as an **electromagnet** and generates a magnetic field. This pulls the armature, which is often shaped as a pivoting bracket that closes (or opens) the contacts. These parts are visible in the simplified rendering of a DPST relay in Figure 9-3. For purposes of identification, the armature is colored green, while the coil is red and the contacts are orange. The two blue blocks are made of an insulating material, the one on the left supporting the contact strips, the one on the right pressing the contacts together when the armature pivots in response to a magnetic field from the coil. Electrical connections to the contacts and the coil have been omitted for simplicity.

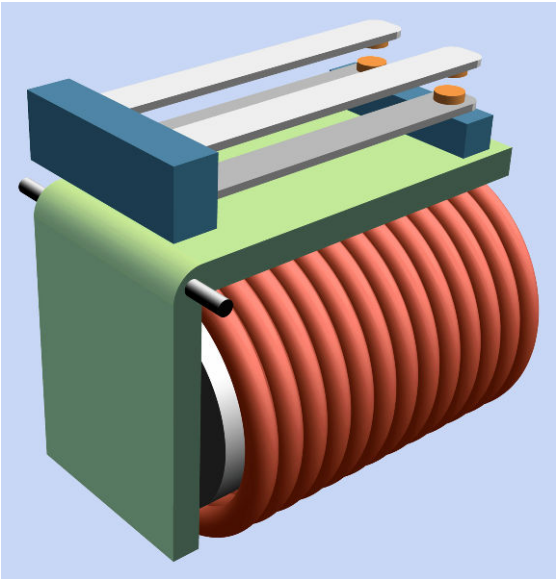

Figure 9-3. *This simplified rendering shows the primary parts of a DPST relay. See text for details.*

Various small relays, capable of handling a variety of voltages and currents, are pictured in Figure 9-4. At top-left is a 12VDC automotive relay, which plugs into a suitable socket shown immediately below it. At top-right is a 24VDC SPDT relay with exposed coil and contacts, making it suitable only for use in a very clean, dry environment. Continuing downward, the four sealed relays in colored plastic cases are designed to switch currents of 5A at 250VAC, 10A at 120VAC, 0.6A at 125VAC, and 2A at 30VDC, respectively. The two blue relays have 12VDC coils, while the red and yellow relays have 5V coils. All are nonlatching, except for the yellow relay, which is a latching type with two coils. At bottom-left is a 12VDC relay in a transparent case, rated to switch up to 5A at 240VAC or 30VDC.

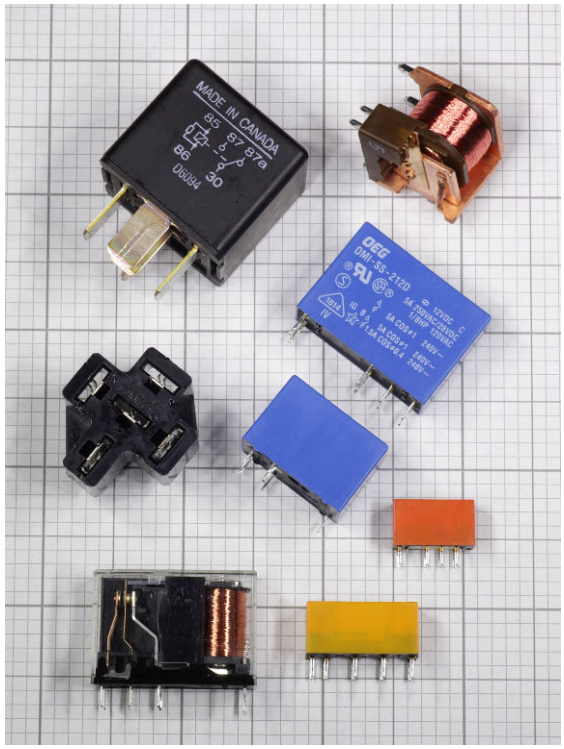

Figure 9-4. *An assortment of small DC-powered relays. See text for details.*

The configuration of a relay is specified using the same abbreviations that apply to a **switch**. SP, DP, 3P, and 4P indicate 1, 2, 3, or 4 poles (relays with more than 4 poles are rare). ST and DT indicate single-throw or double-throw switching. These abbreviations are usually concatenated, as in 3PST or SPDT. In addition, the terminology Form

A (meaning normally open), Form B (normally closed), and Form C (double-throw) may be used, preceded by a number that indicates the number of poles. Thus "2 Form C" means a DPDT relay.

Variants

Latching

There are two basic types of relay: *latching* and *nonlatching*. A nonlatching relay, also known as a *single side stable* type, is the most common, and resembles a *momentary switch* or **pushbutton** in that its contacts spring back to their default state when power to the relay is interrupted. This can be important in an application where the relay should return to a known state if power is lost. By contrast, a latching relay has no default state. Latching relays almost always have double-throw contacts, which remain in either position without drawing power. The relay only requires a short pulse to change its status. In semiconductor terms, its behavior is similar to that of a *flip-flop*.

In a *single-coil* latching relay, the polarity of voltage applied to the coil determines which pair of contacts will close. In a *dual-coil* latching relay, a second coil moves the armature between each of its two states.

Schematic symbols for a dual-coil latching relay are shown in Figure 9-5. Some symbol styles do not make it clear which switch position each coil induces. It may be necessary to read the manufacturer's datasheet or test the relay by applying its rated voltage to randomly selected terminal pairs while testing for continuity between other terminal pairs.

Polarity

There are three types of DC relay. In a *neutral relay*, polarity of DC current through the coil is irrelevant. The relay functions equally well either way. A *polarized relay* contains a diode in series with the coil to block current in one direction. A *biased relay* contains a permanent magnet near the armature, which boosts performance when

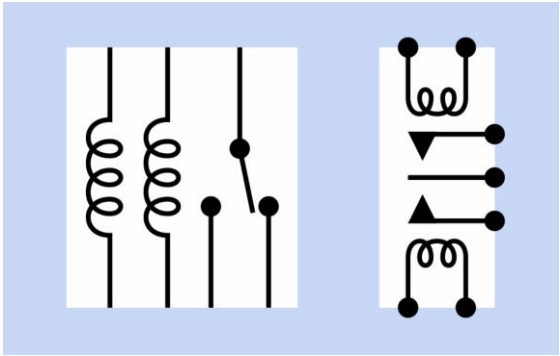

Figure 9-5. *Schematic symbols for a two-coil latching relay. The symbols are functionally identical.*

current flows through the coil in one direction, but blocks a response when the current flows through the coil in the opposite direction. Manufacturers' datasheets may not use this terminology, but will state whether the relay coil is sensitive to the polarity of a DC voltage.

All relays can switch AC current, but only an *AC relay* is designed to use AC as its coil current.

Pinout Variations

The layout and function of relay pins or quick connects is not standardized among manufacturers. Often the component will have some indication of pin functions printed on it, but should always be checked against the manufacturer's datasheet and/or tested for continuity with a meter.

Figure 9-6 shows four sample pin configurations, adapted from a manufacturer's datasheet. These configurations are functionally quite different, although all of them happen to be for DPDT relays. In each schematic, the coil of the relay is shown as a rectangle, while the pins are circles, black indicating an energized state and white indicating a non-energized state. The bent lines show the possible connections between the poles and other contacts inside the relay. The contacts are shown as arrows. Thus, pole 4 can connect with either contact 3 or contact 5, while pole 9 can connect with either contact 8 or contact 10.

Top-left: Polarized nonlatching relay in its resting condition, with no power applied. Top right: Single-coil latching relay showing energized contacts (black circles) when the coil is powered with the polarity indicated. If the polarity is reversed, the relay flips to its opposite state. Some manufacturers indicate the option to reverse polarity by placing a minus sign alongside a plus sign, and a plus sign alongside a minus sign. Bottom-left and bottom-right: Polarized latching relays with two coils, with different pinouts.

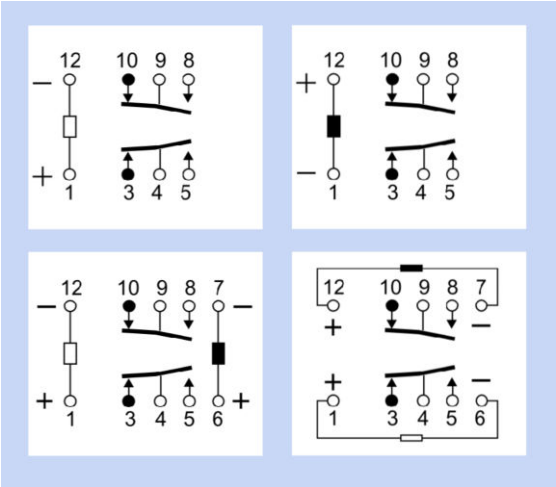

Figure 9-6. *Relay pinouts depicted in the style commonly found in manufacturers' datasheets, showing different relay types. Top-left: Single coil, nonlatching. Top-right: Single coil, latching. Bottom left: Two-coil, latching. Bottom right: Two-coil, latching, alternate pinouts. (Adapted from a Panasonic datasheet.)*

In these diagrams, the relay is seen from above. Some datasheets show the relay seen from below, and some show both views. Some manufacturers use slightly different symbols to indicate interior functions and features. When in doubt, use a meter for verification.

Reed Relay

A *reed relay* is the smallest type of electromechanical relay with applications primarily in test equipment and telecommunications. With a coil resistance ranging from 500 to 2000 ohms, these relays consume very little power. The design consists of a *reed switch* with a coil wrapped around it. Figure 9-7 shows a simplified rendering. The two black contacts are enclosed in a glass or plastic envelope and magnetized in such a way that a magnetic field from the surrounding coil bends them together, creating a connection. When power to the coil is disconnected, the magnetic field collapses and the contacts spring apart.

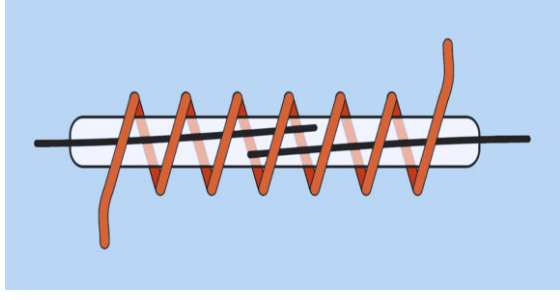

Figure 9-7. *This simplified rendering shows a reed relay, consisting of a magnetized reed switch inside a glass or plastic pod, activated by a coil wrapped around it.*

In Figure 9-8, two reed relays are shown, at top-left and center-right. At bottom-left, the type of relay on the right has been opened by a belt sander to reveal its copper coil and inside that, a capsule in which the relay contacts are visible.

Surface-mount reed relays can be smaller than 0.5″ × 0.2″. Through-hole versions are often around 0.7″ × 0.3″ with pins in two rows, though some are available in SIP packages.

Reed relays have limited current switching capacity and are not suitable to switch inductive loads.

Small Signal Relay

A *small signal relay* is also known as a *low signal relay*. This type may have a footprint as small as a reed relay but generally stands slightly taller, requires slightly more coil current, and is available in versions that can switch slightly higher

Figure 9-8. *Three reed relays, one of which has had its packaging partially removed by a belt sander to reveal its copper coil and internal contacts.*

voltages and currents. There are usually two rows of pins, spaced either 0.2″ or 0.3″ apart. The red and orange relays in Figure 9-4 are small signal relays.

Automotive Relays

An *automotive relay* is typically packaged in a cube-shaped black plastic case with quick-connect terminals at the bottom, typically plugged into a socket. Naturally they are designed to switch, and be switched by, a 12VDC supply.

General Purpose/Industrial

These relays cover a very wide range and are usually built without significant concern for size. They may be capable of switching high currents at high voltages. Typically they are designed to plug into a socket such as an *octal base* of the type that was once used for **vacuum tubes**. The base, in turn, terminates in solder tabs, screws, or quick connects and is designed to be screwed to a chassis. It allows the relay to be unplugged and swapped without resoldering.

Two industrial relays are shown in Figure 9-9. Both are DPDT type with 12VDC coils and rated to switch up to 10A at 240VAC. The one on the left has an octal base. An octal socket that fits an octal base is shown in Figure 9-10.

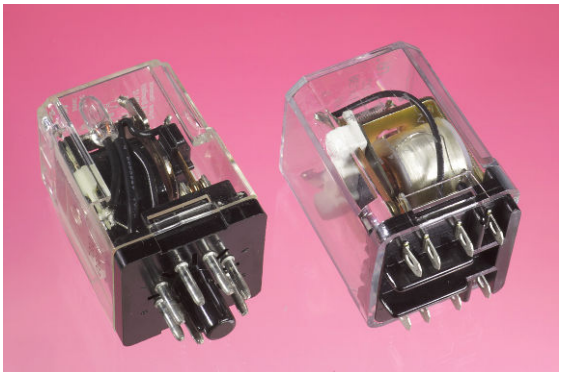

Figure 9-9. *Two relays powered by 12VDC, capable of switching up to 10A at 240VAC.*

Figure 9-10. *An octal socket with screw terminals, designed to accept a relay with an octal base.*

Time Delay Relay

Generally used to control industrial processes, a *time delay relay* switches an output on and off at

preset time intervals that can be programmed to repeat. The example in Figure 9-11 has a 12VDC coil and is rated to switch up at 10A at 240VAC. It has an octal base.

Figure 9-11. *The control switches on a time-delay relay, allowing separately configured "on" and "off" intervals.*

Contactor

A contactor functions just like a relay but is designed to switch higher currents (up to thousands of amperes) at higher voltages (up to many kilovolts). It may range from being palm-sized to measuring more than one foot in diameter, and may be used to control heavy loads such as very large motors, banks of high-wattage lights, and heavy-duty power supplies.

Values

Datasheets usually specify maximum voltage and current for the contacts, and nominal voltage and current for the coil, although in some cases the coil resistance is stated instead of nominal coil current. The approximate current consumption can be estimated, if necessary, by using Ohm's Law. The minimum voltage that the relay needs for activation is sometimes described as the *Must Operate By* voltage, while the *Must Release By* voltage is the maximum coil voltage that the relay will ignore. Relays are rated on the assumption that the coil may remain energized for long periods, unless otherwise stated.

While the contact rating may suggest that a relay can switch a large load, this is not necessarily true if the load has significant inductance.

Reed relays

Usually use a coil voltage of 5VDC and have a contact rating of up to 0.25A at 100V. Through-hole (PCB) versions may have a coil voltage of 5VDC, 6VDC, 12VDC, or 24VDC and in some cases claim to switch 0.5A to 1A at up to 100V, although this rating is strictly for a noninductive load.

Small signal/low signal relays

Usually use a coil voltage ranging from 5VDC to 24VDC, drawing about 20mA. Maximum switching current for noninductive loads ranges from 1A to 3A.

Industrial/general purpose relays

A very wide range of possible values, with coil voltages ranging up to 48VDC or 125VAC to 250VAC. Contact rating is typically 5A to 30A.

Automotive relays

Coil voltage of 12VDC, and contact rating often 5A at up to 24VDC.

Timer relays

Usually these specify a coil voltage of 12VDC, 24VDC, 24VAC, 125VAC, or 230VAC. The timed interval can range from 0.1 sec to 9999 hours in some cases. Common values for contact ratings are 5A up to 20A, with a voltage of 125V to 250V, AC or DC.

How to Use it

Relays are found in home appliances such as dishwashers, washing machines, refrigerators, air conditioners, photocopy machines, and other products where a substantial load (such as a motor or compressor) has to be switched on and off by a control switch, a thermostat, or an electronic circuit.

Figure 9-12 shows a common small-scale application in which a signal from a microcontroller (a few mA at 5VDC) is applied to the base of a transistor, which controls the relay. In this way, a logic output can switch 10A at 125VAC. Note the rectifier diode wired in parallel with the relay coil.

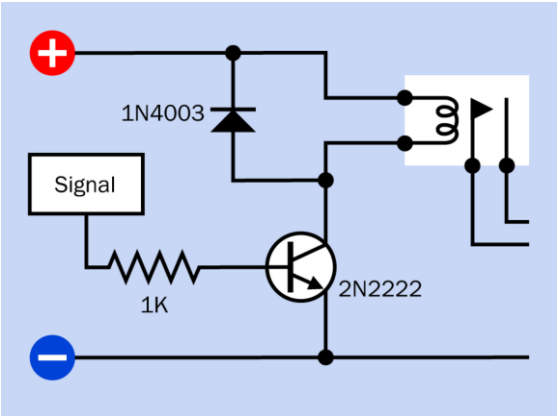

Figure 9-12. *A signal from a digital source such as a microcontroller can switch substantial voltage and current if it is applied to the base of a transistor that activates a relay.*

A latching relay is useful wherever a connection should persist when power is switched off or interrupted, or if power consumption must be minimized. Security devices are one common application. However, the circuit may require a "power reset" function to restore known default settings of latched relays.

A circuit including every possible protection against voltage spikes is shown in Figure 9-13, including a snubber to protect the relay contacts, a rectifier diode to suppress back-EMF generated by the relay coil, and another rectifier diode to protect the relay from EMF generated by a motor when the relay switches it on and off. The snubber can be omitted if the motor draws a relatively low current (below 5A) or if the relay is switching a noninductive load. The diode around the relay coil can be omitted if there are no semiconductors or other components in the circuit that are vulnerable to voltage spikes. However, a spike can affect components in adjacent circuits that appear to be electrically isolated. A severe spike can even be transmitted back into 125VAC house wiring. For information on using a resistor-capacitor combination to form a snubber, see "Snubber" (page 108).

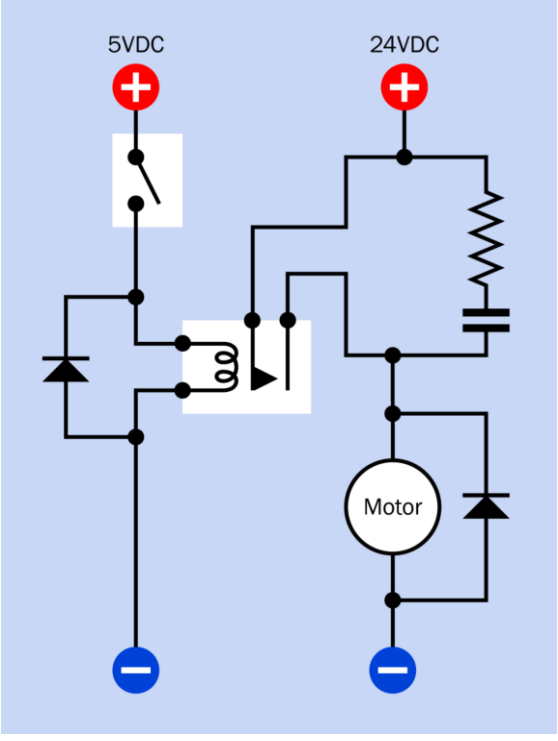

Figure 9-13. *This hypothetical schematic shows three types of protection against voltage spikes induced by an inductive load (a motor, in this instance) and the coil of the relay.*

What Can Go Wrong

Wrong Pinouts

The lack of standardization of relay pinouts can cause errors if one relay is replaced with another that appears to be the same, but isn't. In particular, the pins that connect with normally-closed contacts may trade places with pins connected with normally-open contacts, in relays from different manufacturers.

Pinouts are also confusing in that some datasheets depict them from above, some from below, and some from both perspectives.

Wrong Orientation

Small relays of through-hole type usually have pins spaced in multiples of 0.1". This allows them to be inserted the wrong way around in a perforated board. Almost all relays have an identification mark molded into one end or one corner of the plastic shell. Manufacturers do not standardize the position and meaning of these marks, but they are usually replicated in datasheets. When using a relay of a type that you have not used before, it is a sensible precaution to test it with a meter to verify the functions of its terminals before installing it.

Wrong Type

A latching relay may have exactly the same appearance as a nonlatching relay from the same manufacturer, and the same two pins may energize the coil. However, in a latching relay, the contacts won't spring back to their non-energized position, causing functional errors that may be difficult to diagnose. The part numbers printed on latching and nonlatching versions of the same relay may differ by only one letter or numeral and should be checked carefully.

Wrong Polarity

A relay with a DC-energized coil may require power to be applied with correct polarity and may malfunction otherwise.

AC and DC

A relay coil designed to be powered by DC will not work from AC and vice-versa. The contact rating of a relay is likely to be different depending whether it is switching AC or DC.

Chatter

This is the noise created by relay contacts when they make rapid intermittent connection. Chatter is potentially damaging to relay contacts and should be avoided. It can also create electrical noise that interferes with other components. Likely correctible causes of chatter include insufficient voltage or power fluctuations.

Relay Coil Voltage Spike

A relay coil is an inductive device. Merely switching a large relay on and off can create voltage spikes. To address this problem, a rectifier diode should be placed across the coil terminals with polarity opposing the energizing voltage.

Arcing

This problem is discussed in the **switch** entry of this encyclopedia. See "Arcing" (page 47). Note that because the contacts inside a *reed relay* are so tiny, they are especially susceptible to arcing and may actually melt and weld themselves together if they are used to control excessive current or an inductive load.

Magnetic Fields

Relays generate magnetic fields during operation and should not be placed near components that are susceptible.

The reed switch inside a reed relay can be unexpectedly activated by an external magnetic field. This type of relay may be enclosed in a metal shell to provide some protection. The adequacy of this protection should be verified by testing the relay under real-world conditions.

Environmental Hazards

Dirt, oxidation, or moisture on relay contacts is a significant problem. Most relays are sealed and should remain sealed.

Relays are susceptible to vibration, which can affect the contacts and can accelerate wear on moving parts. Severe vibration can even damage a relay permanently. **Solid-state relays** (discussed in Volume 2) should be used in harsh environments.

resistor

10

OTHER RELATED COMPONENTS

- **potentiometer** (See Chapter 11)

What It Does

A resistor is one of the most fundamental components in electronics. Its purpose is to impede a flow of current and impose a voltage reduction. It consists of two wires or conductors attached at opposite ends or sides of a relatively poor electrical conductor, the resistance of which is measured in ohms, universally represented by the Greek omega symbol, Ω.

Schematic symbols that represent a resistor are shown in Figure 10-1 (Left: The traditional schematic symbol. Right: The more recent European equivalent). The US symbol is still sometimes used in European schematics, and the European symbol is sometimes used in US schematics. Letters K or M indicate that the value shown for the resistor is in thousands of ohms or millions of ohms, respectively. Where these letters are used in Europe, and sometimes in the US, they are substituted for a decimal point. Thus, a 4.7K resistor may be identified as 4K7, a 3.3M resistor may be identified as 3M3, and so on. (The numeric value in Figure 10-1 was chosen arbitrarily.)

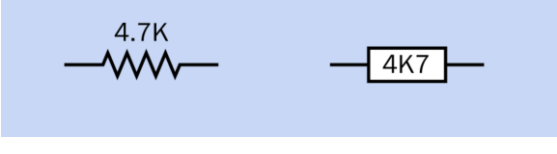

Figure 10-1. *Resistor symbols. The left one is more common in the United States, while the right one is widely used in Europe. The 4.7K value was chosen arbitrarily.*

A resistor is commonly used for purposes such as limiting the charging rate of a **capacitor**; providing appropriate control voltage to semiconductors such as **bipolar transistors**; protecting **LED**s or other semiconductors from excessive current; adjusting or limiting the frequency response in an audio circuit (in conjunction with other components); pulling up or pulling down the voltage at the input pin of a digital logic chip; or controlling a voltage at a point in a circuit. In this last application, two resistors may be placed in series to create a *voltage divider*.

A **potentiometer** may be used instead of a resistor where variable resistance is required.

Sample resistors of various values are shown in Figure 10-2. From top to bottom, their power dissipation ratings are 3W, 1W, 1/2W, 1/4W, 1/4W, 1/4W, and 1/8W. The accuracy (tolerance) of each resistor, from top to bottom, is plus-or-minus 5%, 5%, 5%, 1%, 1%, 5%, and 1%. The beige-colored body of a resistor is often an indication that its tolerance is 5%, while a blue-colored body often indicates a tolerance of 1% or 2%. The blue-bodied resistors and the dark brown resistor contain metal-oxide film elements, while the beige-bodied resistors and the green resistor contain carbon film. For more information on resistor values, see the upcoming *Values* section.

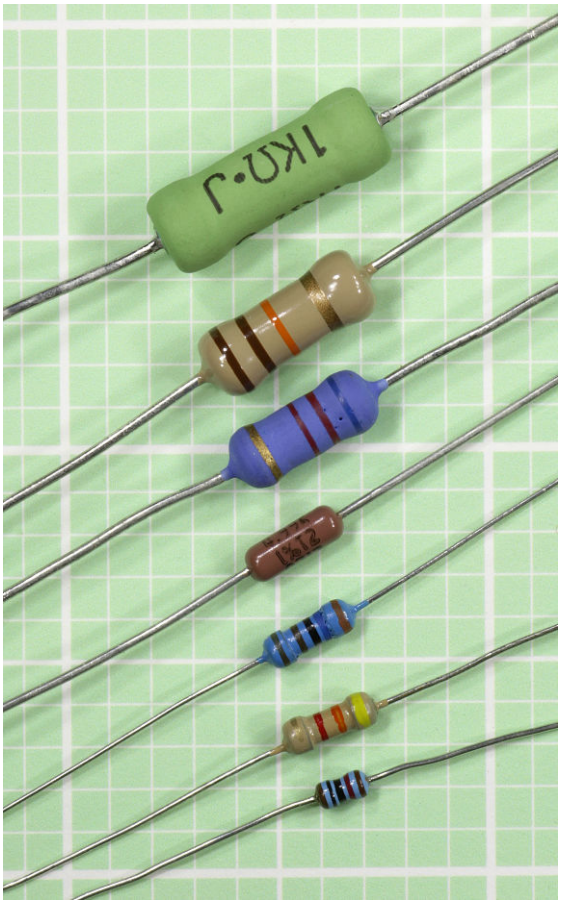

Figure 10-2. *A range of typical resistors. See text for details.*

How It Works

In the process of impeding the flow of current and reducing voltage, a resistor absorbs electrical energy, which it must dissipate as heat. In most modern electronic circuits, the heat dissipation is typically a fraction of a watt.

If R is the resistance in ohms, I is the current flowing through the resistor in amperes, and V is the voltage drop imposed by the resistor (the difference in electrical potential between the two contacts that are attached to it), Ohm's law states:

$$V = I / R$$

This is another way of saying that a resistor of 1Ω will allow a current of 1 amp when the potential difference between the ends of the resistor is 1 volt.

If W is the power in watts dissipated by the resistor, in a DC circuit:

$$W = V * I$$

By substitution in Ohm's law, we can express watts in terms of current and resistance:

$$W = I^2 / R$$

We can also express watts in terms of voltage and resistance:

$$W = V^2 * R$$

These alternates may be useful in situations where you do not know the voltage drop or the current, respectively.

Approximately similar relationships exist when using alternating current, although the power will be a more complex function.

Variants

Axial resistors have two leads that emerge from opposite ends of a usually cylindrical body. *Radial resistors* have parallel leads emerging from one side of the body and are unusual.

Precision resistors are generally defined as having a tolerance of no more than plus-or-minus 1%.

General-purpose resistors are less stable, and their value is less precise.

Power resistors are generally defined as dissipating 1 or 2 watts or more, particularly in power supplies or power amplifiers. They are physically larger and may require *heat sinks* or fan cooling.

Wire-wound resistors are used where the component must withstand substantial heat. A wire-wound resistor often consists of an insulating tube or core that is flat or cylindrical, with multi-

ple turns of resistive wire wrapped around it. The wire is usually a nickel-chromium alloy known as *nichrome* (sometimes written as *Ni-chrome*) and is dipped in a protecting coating.

The heat created by current passing through resistive wire is a potential problem in electronic circuits where temperature must be limited. However, in household appliances such as hair dryers, toaster ovens, and fan heaters, a nichrome element is used specifically to generate heat. Wire-wound resistors are also used in 3D printers to melt plastic (or some other compound) that forms the solid output of the device.

Thick film resistors are sometimes manufactured in a flat, square format. A sample is shown in Figure 10-3, rated to dissipate 10W from its flat surface. The resistance of this component is 1K.

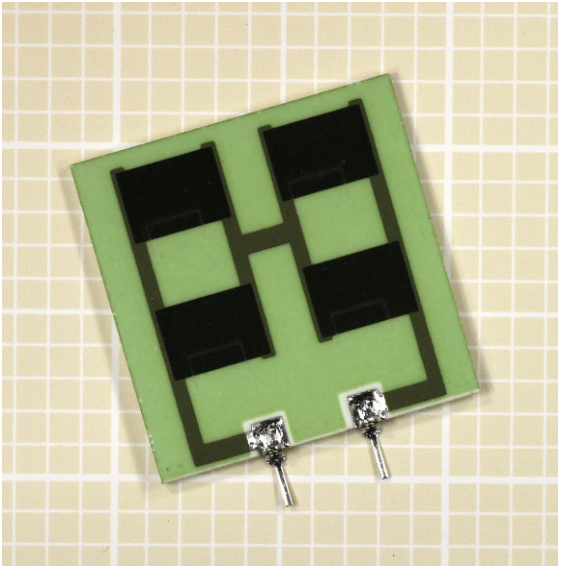

Figure 10-3. *A thick-film resistor measuring about 1" square and 0.03" thick.*

Surface-mount resistors generally consist of a resistive ink film printed on top of a tablet of aluminum oxide ceramic compound, often approximately 6mm long, known as a 2512 form factor. Each surface-mount resistor has two nickel-plated terminations coated in solder, which melts when the resistor is attached to the circuit board. The upper surface is coated, usually with black epoxy, to protect the resistive element.

Resistor Array

This is also known as a *resistor network* or *resistor ladder*, and consists of a chip containing multiple equal-valued resistors.

A resistor array in a *single-inline package* (or *SIP*) may have three possible internal configurations: isolated, common bus, and dual terminator. These options are shown at top, center, and bottom, respectively, in Figure 10-4. The isolated variant is commonly available in SIPs with 6, 8, or 10 pins. The common-bus and dual-terminator configurations generally have 8, 9, 10, or 11 pins.

In the isolated configuration, each resistor is electrically independent of the others and is accessed via its own pair of pins. On a common bus, one end of each resistor shares a bus accessed by a single pin, while the other ends of the resistors are accessed by their own separate pins. A dual-terminator configuration is more complex, consisting of pairs of resistors connected between ground and an internal bus, with the midpoint of each resistor pair accessible via a separate pin. The resistor pairs this function as voltage dividers and are commonly used in emitter-coupled logic circuits that require termination with -2 volts.

A *dual-inline package* (*DIP*) allows a similar range of internal configurations, as shown in Figure 10-5. At top, isolated resistors are commonly available in DIPs with 4, 7, 8, 9, or 10 pins. At center, the common bus configuration is available in DIPs with 8, 14, 16, 18, or 20 pins. At bottom, the dual-terminator configuration usually has 8, 14, 16, 18, or 20 pins.

The external appearance of SIP and DIP resistor arrays is shown in Figure 10-6. From left to right, the packages contain seven 120Ω resistors in

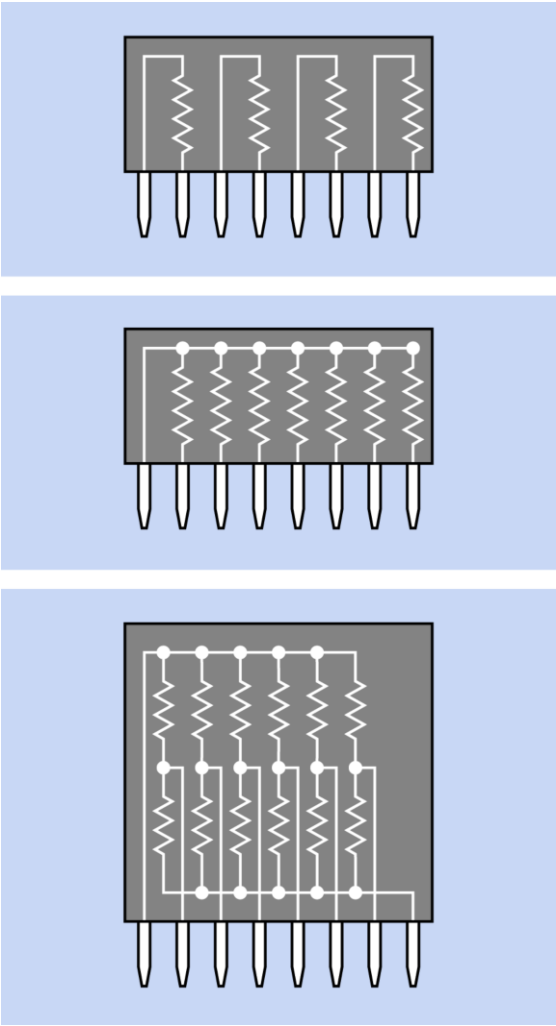

Figure 10-4. *Multiple resistors can be embedded in a single-inline package (SIP) in a variety of formats. See text for additional details.*

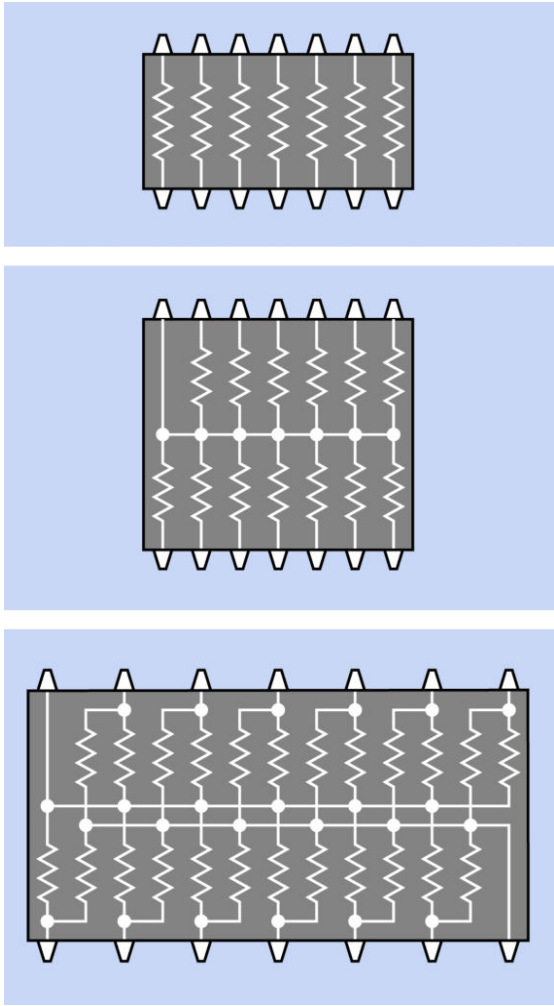

Figure 10-5. *Multiple resistors can be obtained embedded in a dual-inline package (DIP). See text for additional details.*

isolated configuration; thirteen 120Ω resistors in bussed configuration; seven 5.6K resistors in bussed configuration; and six 1K resistors in bussed configuration.

Resistor arrays with isolated or common-bus configurations are a convenient way to reduce the component count in circuits where pullup, pulldown, or terminating resistors are required for multiple chips. The common-bus configuration is also useful in conjunction with a 7-segment **LED display**, where each segment must be terminated by a series resistor and all the resistors share a common ground or common voltage source.

Surface-mount chips are available containing a pair of resistors configured as a single voltage divider.

Chips containing multiple *RC circuits* (each consisting of a capacitor and a resistor in series) are available, although uncommon. A package containing a single RC circuit may be sold as a

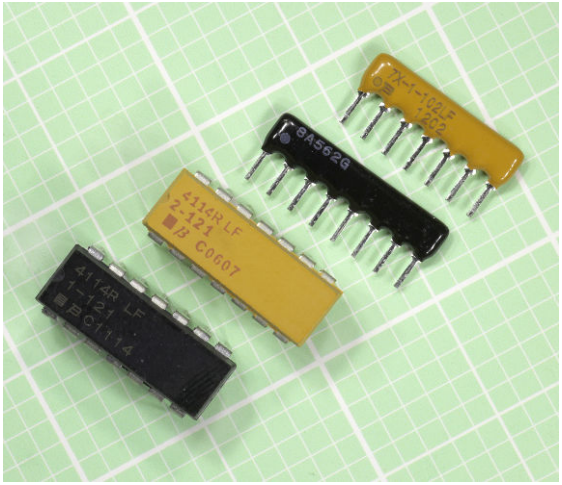

Figure 10-6. *Resistor arrays in DIP and SIP packages. See text for values.*

snubber to protect contacts in a **switch** or **relay** that switches a large inductive load. More information on snubber circuits is in the **capacitor** entry of this encyclopedia; see "Snubber" (page 108).

Values

1 *kilohm,* usually written as 1K, is 1,000Ω. 1 *megohm,* usually written as 1M or 1 meg, is 1,000K. 1 *gigaohm* is 1,000 megs, although the unit is rarely used. Resistances of less than 1Ω are uncommon and are usually expressed as a decimal number followed by the Ω symbol. The term *milliohms* (thousandths of an ohm) is used in special applications. Equivalent resistor values are shown in Figure 10-7.

A resistance value remains unchanged in DC and AC circuits, except where the AC reaches an extremely high frequency.

In common electronics applications, resistances usually range from 100Ω to 10M. Power ratings may vary from 1/16 watt to 1000 watts, but usually range from 1/8 watt to 1/2 watt in most electronic circuits (less in surface-mount applications).

Ohms	Kilohms	Megohms
1	0.001	0.000001
10	0.01	0.00001
100	0.1	0.0001
1,000	1	0.001
10,000	10	0.01
100,000	100	0.1
1,000,000	1,000	1

Figure 10-7. *Equivalent values in ohms, kilohms, and megohms.*

Tolerance

The tolerance, or precision, of a resistor may range from plus-or-minus 0.001% up to plus-or-minus 20%, but is most commonly plus-or-minus 1%, 2%, 5%, or 10%.

The traditional range of resistor values was established when a tolerance of 20% was the norm. The values were spaced to allow minimum risk of a resistor at one end of its tolerance range having the same value as another resistor at the opposite end of its tolerance range. The values were rounded to 10, 15, 22, 33, 47, 68, and 100, as illustrated in Figure 10-8 where each blue diamond represents the possible range of actual values of a 20% resistor with a theoretical value shown by the white horizontal line at the center of the diamond.

Resistor factors repeat themselves in multiples of 10. Thus, for example, beginning with a resistor of 100Ω, subsequent increasing values will be 150, 220, 330, 470, 680, and 1K, whereas the range of resistors beginning with 1Ω will be 1.5, 2.2, 3.3, 4.7, 6.8, and 10Ω.

Resistance multiplication factors are now expressed as a list of preferred values by the International Electrotechnical Commission (IEC) in their 60063 standard. Intermediate factors have been added to the basic sequence to

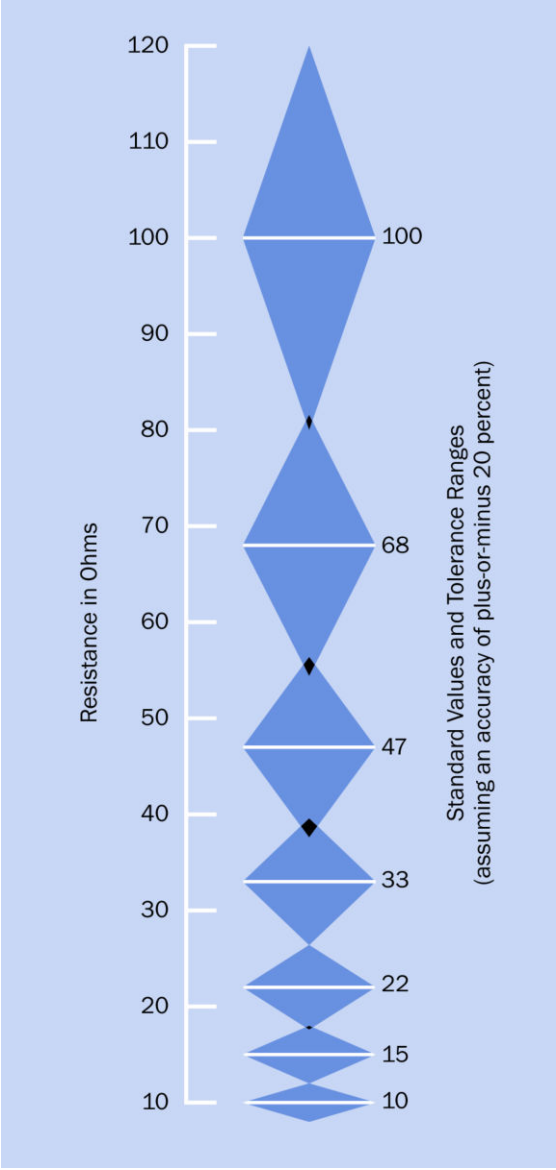

Figure 10-8. *Graphical representation of standard resistor values (white lines) established by the International Electrotechnical Commission, showing the acceptable range of actual values (dark blue areas) assuming precision of plus-or-minus 20%. The overlap, if any, between each range and the next is shown in black.*

Standard Resistor Values	Resistor Tolerances (plus or minus) 20%	10%	5%
	100	100	100
			91
		82	82
			75
	68	68	68
			62
		56	56
			51
	47	47	47
			43
		39	39
			36
	33	33	33
			30
		27	27
			24
	22	22	22
			20
		18	18
			16
	15	15	15
			13
		12	12
			11
	10	10	10

Figure 10-9. *Standard values for resistors of different precisions. For resistors outside the range shown, values can be found by multiplying or dividing (repeatedly, if necessary) by a factor of 10.*

accommodate better tolerances. A table showing resistor values for tolerances of plus-or-minus 20%, 10%, and 5% appears in Figure 10-9. Resistors with a tolerance of 5% have become increasingly common.

The IEC has established 3-digit preferred values for resistors with values accurate to plus-or-minus 0.5%.

Because many capacitors still have a tolerance no better than 20%, their values also conform with

the old original set of resistance values, although the units are expressed in farads or fractions of a farad. See the **capacitors** entry in this encyclopedia for additional information.

Value Coding

Through-hole axial resistors are traditionally printed with a sequence of three colored bands to express the value of the component, each of the first two bands representing a digit from 0 through 9, while the third band indicates the decimal multiplier (the number of zeroes, from 0 to 9, which should be appended to the digits). A fourth band of silver or gold indicates 10% or 5% tolerance respectively. No fourth band would indicate 20% tolerance, although this has become very rare.

Many resistors now have five color bands, to enable the representation of intermediate or fractional values. In this scheme, the first three bands have numeric values (using the same color system as before) while the fourth band is the multiplier. A fifth band, at the opposite end of the resistor, indicates its tolerance.

In Figure 10-10 the numeric or multiplier value of each color is shown as a "spectrum" at the top of the figure. The tolerance, or precision of a resistor, expressed as a plus-or-minus percentage, is shown using silver, gold, and various colors, at the bottom of the figure.

Two sample resistors are shown. The upper one has a value of 1K, indicated by the brown and black bands on the left (representing numeral 1 followed by a numeral 0) and the third red band (indicating two additional zeroes). The gold band at right indicates a precision of 5%. The lower one has a value of 1.05K, indicated by the brown, black, and green bands on the left (representing numeral 1 followed by numeral 0 followed by a numeral 5) and the fourth band brown (indicating one additional zero). The brown band at right indicates a precision of 1%.

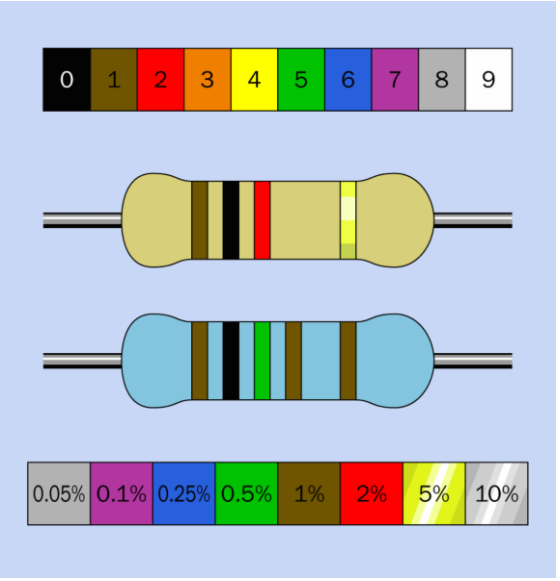

Figure 10-10. *Color coding of through-hole resistors. See text for details.*

In extremely old equipment, resistors may be coded with the body-tip-dot scheme, in which the body color represents the initial digit, the end color represents the second digit, and a dot represents the multiplier. The numeric identities of the colors is the same as in the current color scheme.

In all modern schemes, the three or four bands that show the resistance value are spaced close together, while a larger gap separates them from the band that shows the tolerance. The resistor value should be read while holding the resistor so that the group of closely-spaced numeric bands is on the left.

Confusingly, some resistors may be found where the first three bands define the value, using the old three-band convention; the fourth band indicates tolerance; and a fifth band at the opposite end of the component indicates reliability. However, this color scheme is uncommon.

Other color-coding conventions may be found in special applications, such as military equipment.

It is common for through-hole carbon-film resistors to have a beige body color, while through-hole metal-film resistors often have a blue body color. However, in relatively rare instances, a blue body color may also indicate a *fusible* resistor (designed to burn out harmlessly like a fuse, if it is overloaded) while a white body may indicate a *non-flammable* resistor. Use caution when replacing these special types.

Some modern resistors may have their values printed on them numerically. Surface-mount resistors also have digits printed on them, but they are a code, not a direct representation of resistance. The last digit indicates the number of zeroes in the resistor value, while the preceding two or three numbers define the value itself. Letter R is used to indicate a decimal point. Thus a 3R3 surface-mount resistor has a value of 3.3Ω, while 330 would indicate 33Ω, and 332 indicates 3,300Ω. A 2152 surface-mount resistor would have a value of 21,500Ω.

A surface-mount resistor with a single zero printed on it is a *zero ohm* component that has the same function as a **jumper** wire. It is used for convenience, as it is easily inserted by automated production-line equipment. It functions merely as a bridge between traces on the circuit board.

When resistor values are printed on paper in schematics, poor reproduction may result in omission of decimal points or introduction of specks that look like decimal points. Europeans have addressed this issue by using the letter as a substitute for a decimal point so that a 5.6K resistor will be shown as 5K6, or a 3.3M resistor will be shown as 3M3. This practice is followed infrequently in the United States.

Stability

This term describes the ability of a resistor to maintain an accurate value despite factors such as temperature, humidity, vibration, load cycling, current, and voltage. The *temperature coefficient* of a resistor (often referred to as T_{cr} or T_c, not to be confused with the time constant of a charging capacitor) is expressed in parts per million change in resistance for each degree centigrade deviation from room temperature (usually assumed to be 25 degrees Centigrade). T_c may be a positive or a negative value.

The *voltage coefficient* of resistance—often expressed as V_c—describes the change of a resistor's value that may occur as a function of changes in voltage. This is usually significant only where the resistive element is carbon-based. If V1 is the rated voltage of the resistor, R1 is its rated resistance at that voltage, V2 is 10% of the rated voltage, and R2 is the actual resistance at that voltage, the voltage coefficient, V_c, is given by this formula:

$$V_c = (100 * (R1 - R2)) / (R2 * (V1 - V2))$$

Materials

Resistors are formed from a variety of materials.

Carbon composite. Particles of carbon are mixed with a binder. The density of the carbon determines the end-to-end resistance, which typically ranges from 5Ω to 10M. The disadvantages of this system are low precision (a 10% tolerance is common), relatively high voltage coefficient of resistance, and introduction of noise in sensitive circuits. However, carbon-composite resistors have low inductance and are relatively tolerant of overload conditions.

Carbon film. A cheap and popular type, made by coating a ceramic substrate with a film of carbon compound. They are available in both through-hole and surface-mount formats. The range of resistor values is comparable with carbon-composite types, but the precision is increased, typically to 5%, by cutting a spiral groove in the carbon-compound coating during the manufacturing process. The carbon film suffers the same disadvantages of carbon composite resistors, but to a lesser extent. Carbon film resistors generally should not be substituted for metal film resistors in applications where accuracy is important.

Metal film. A metallic film is deposited on a ceramic substrate, and has generally superior char-

acteristics to carbon-film resistors. During manufacture, a groove may be cut in the metal film to adjust the end-to-end resistance. This may cause the resistor to have higher inductance than carbon-composite types, though it has lower noise. Tolerances of 5%, 2%, and 1% are available. This type of resistor was originally more expensive than carbon-film equivalents, but the difference is now fractional. They are available in both through-hole and surface-mount formats. They are available in lower-wattage variants (1/8 watt is common).

Thick-film resistors are spray-coated, whereas thin-film resistors are sputtered nichrome. Thin-films enjoy a flatter temperature coefficient and are typically used in environments that have a huge operational temperature range, such as satellites.

Bulk metal foil. The type of foil used in metal film resistors is applied to a ceramic wafer and etched to achieve the desired overall resistance. Typically these resistors have axial leads. They can be extremely accurate and stable, but have a limited maximum resistance.

Precision wire-wound. Formerly used in applications requiring great accuracy, but now largely replaced by precision metal foil.

Power wire-wound. Generally used when 1 or 2 watts or more power dissipation is required. Resistive wire is wrapped around a core that is often ceramic. This can cause the resistor to be referred to, inaccurately, as "ceramic." The core may alternatively be fiberglass or some other electrically insulating compound that actively sinks heat. The component is either dipped (typically in vitreous enamel or cement) or is mounted in an aluminum shell that can be clamped to a heat sink. It almost always has the ohm value printed on it in plain numerals (not codes).

Two typical wire-wound resistors are shown in Figure 10-11. The upper resistor is rated at 12W and 180Ω while the lower resistor is rated at 13W and 15K.

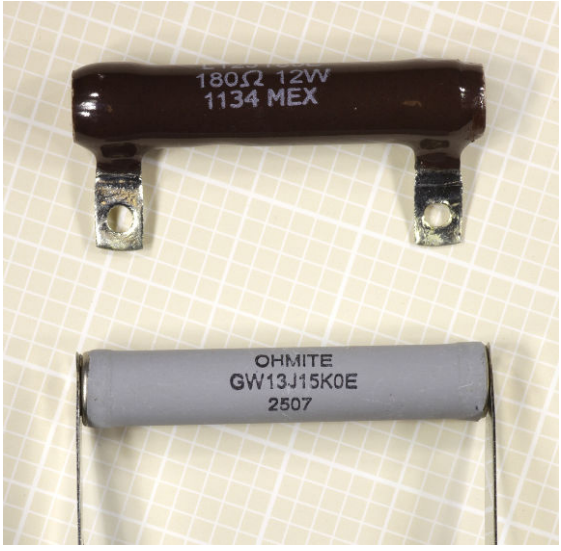

Figure 10-11. *Two wire-wound resistors of greatly differing resistance but similar power dissipation capability.*

A larger wire-wound resistor is shown in Figure 10-12, rated for 25W and 10Ω.

Figure 10-12. *A large wirewound resistor rated to dissipate 25W.*

In Figure 10-13, two resistors encapsulated in cement coatings are shown with the coatings removed to expose the elements. At left is a 1.5Ω 5W resistor, which uses a wire-wound element. At right is a very low-value 0.03Ω 10W resistor.

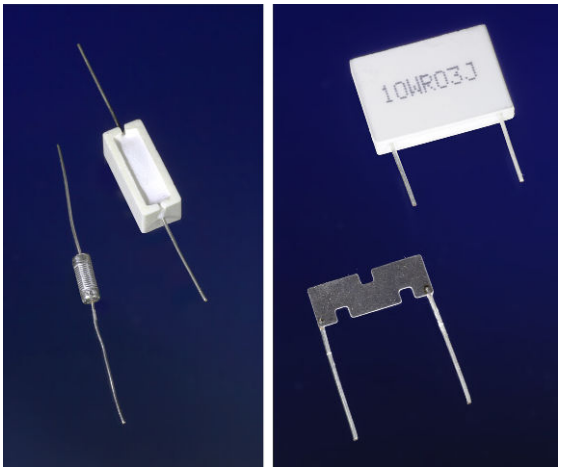

Figure 10-13. *Two low-value resistors with their cement coatings removed to show the resistive elements.*

In Figure 10-14, the resistor at right has an exposed 30Ω element while the resistor at left is rated 10W and 6.5Ω, enclosed in an anodized aluminum shell to promote heat dissipation.

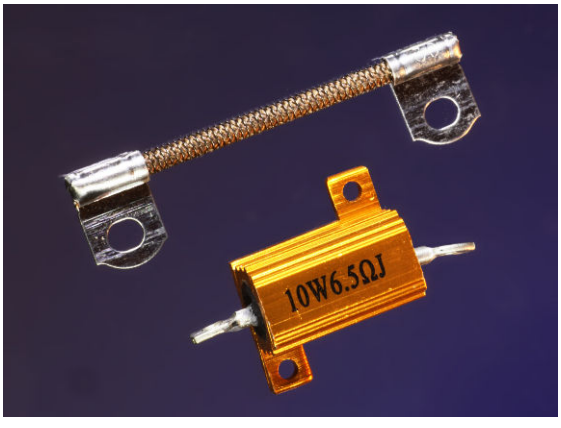

Figure 10-14. *A 30Ω resistor (right) and 6.5Ω resistor (left).*

In power resistors, heat dissipation becomes an important consideration. If other factors (such as voltage) remain the same, a lower-value resistor will tend to pass more current than a higher-value resistor, and heat dissipation is proportional to the square of the current. Therefore power wire-wound resistors are more likely to be needed where low resistance values are required. Their coiled-wire format creates significant inductance, making them unsuitable to pass high frequencies or pulses.

How to Use it

Some of the most common applications for a resistor are listed here.

In Series with LED

To protect an LED from damage caused by excessive current, a *series resistor* is chosen to allow a current that does not exceed the manufacturer's specification. In the case of a single through-hole LED (often referred to as an *indicator*), the forward current is often limited to around 20mA, and the value of the resistor will depend on the voltage being used. (See Figure 10-15.)

When using high-output LEDs (which may contain multiple elements in a single 5mm or 10mm package), or LED arrays that are now being used for domestic lighting, the acceptable current may be much greater, and the LED unit may contain its own current-limiting electronics. A datasheet should be consulted for details.

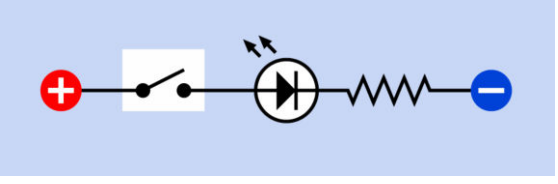

Figure 10-15. *A series resistor is necessary to limit the current that passes through an LED.*

Current Limiting with a Transistor

In Figure 10-16, a transistor is switching or amplifying current flowing from B to C. A resistor is used to protect the base of the transistor from excessive current flowing from point A. Resistors are also commonly used to prevent excessive current from flowing between B and C.

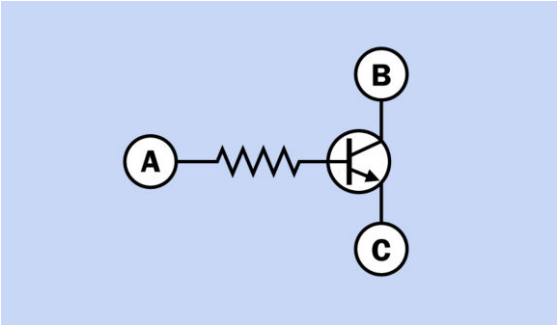

Figure 10-16. *A resistor is typically necessary to protect the base of a transistor from excessive current.*

Pullup and Pulldown Resistors

When a mechanical switch or pushbutton is attached to the input of a logic chip or **microcontroller**, a *pullup* or *pulldown* resistor is used, applying positive voltage or grounding the pin, respectively, to prevent it from "floating" in an indeterminate state when the switch is open. In Figure 10-17, the upper schematic shows a pulldown resistor, whereas the lower schematic shows a pullup resistor. A common value for either of them is 10K. When the pushbutton is pressed, its direct connection to positive voltage or to ground easily overwhelms the effect of the resistor. The choice of pullup or pulldown resistor may depend on the type of chip being used.

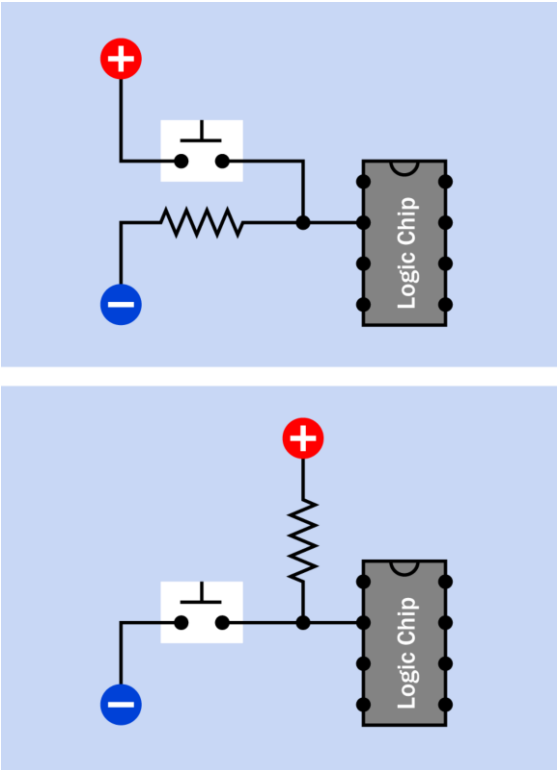

Figure 10-17. *A pulldown resistor (top) or pullup resistor (bottom) prevents an input pin on a logic chip or microcontroller from "floating" in an indeterminate state when the button is not being pressed.*

Audio Tone Control

A resistor-capacitor combination can limit the high-frequency in a simple audio tone-control circuit, as shown in Figure 10-18. Beneath a signal travelling from A to B, a resistor is placed in series with a capacitor that passes high frequencies to ground. This is known as a low-pass filter.

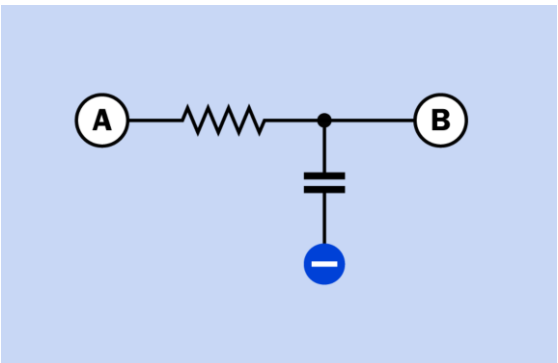

Figure 10-18. *This configuration may be used to remove high frequencies from an audio signal. It is known as a low-pass filter because low frequencies are passed from A to B.*

RC Network

A resistor will adjust the charge/discharge time when placed in series with a capacitor, as in Figure 10-19. When the switch closes, the resistor limits the rate at which the capacitor will charge itself from the power supply. Because a capacitor has an ideally infinite resistance to DC current, the voltage measured at point A will rise until it

is close to the supply voltage. This is often referred to as an *RC* (*resistor-capacitor*) network and is discussed in greater detail in the **capacitor** section of this encyclopedia.

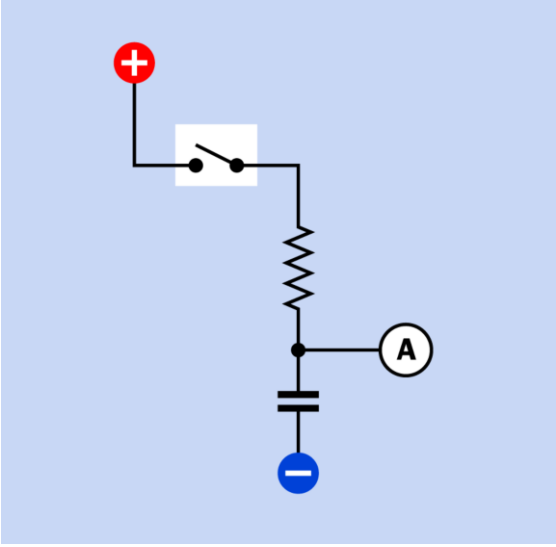

Figure 10-19. *In an RC (resistor-capacitor) network, a resistor limits the rate of increase in potential of the capacitor, measured at A, when the switch is closed.*

Voltage Divider

Two resistors may be used to create a voltage divider (see Figure 10-20). If V_{in} is the supply voltage, the output voltage, V_{out}, measured at point A, is found by the formula:

$$V_{out} = V_{in} * (R2 / (R1 + R2))$$

In reality, the actual value of V_{out} is likely to be affected by how heavily the output is loaded.

If the output node has a high impedance, such as the input to a logic chip or comparator, it will be more susceptible to electrical noise, and lower-value resistors may be needed in the voltage divider to maintain a higher current flow and maintain stability in the attached device.

Resistors in Series

If resistors in series have values R1, R2, R3 . . . the total resistance, R, is found by summing the individual resistances:

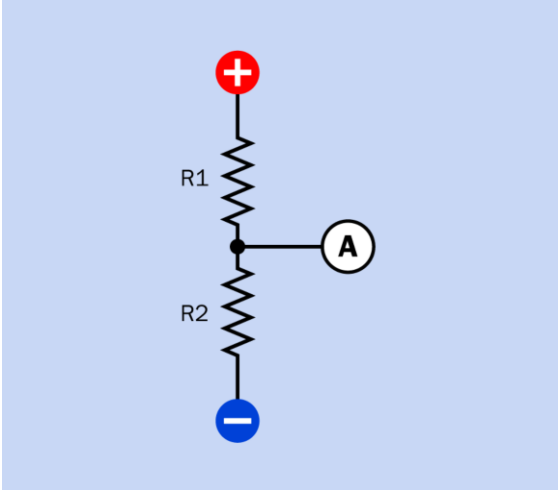

Figure 10-20. *In a DC circuit, a pair of resistors may be placed in series to function as a voltage divider. The voltage measured at A will be lower than the supply voltage, but above ground potential.*

$$R = R1 + R2 + R3. . .$$

The current through each of the resistors will be the same, whereas the voltage across each of them will vary proportionately with its resistance. If the supply voltage across the series of resistors is VS, and the total of all the resistor values is RT, and the resistance of one resistor is R1, the voltage across that resistor, V1, will be given by the formula:

$$V1 = VS * (R1 / RT)$$

Resistors in Parallel

Where two or more resistors (R1, R2, R3 . . .) are wired in parallel, their total resistance, R, is found from the formula:

$$1/R = (1/R1) + (1/R2) + (1/R3). . .$$

Suppose that R1, R2, R3 . . . all have the same individual resistance, represented by RI, and the number of resistors is N. Their total resistance, RT, when wired in parallel, will be:

$$RT = RI / N$$

If each resistor has an equal resistance and also has an equal individual rating in watts (represented by WI), the total wattage (WT) that they can handle when wired in parallel to share the power will be:

```
WT = WI * N
```

Therefore, if an application requires high-wattage resistors, multiple lower-wattage, higher-value resistors may be substituted if they are wired in parallel—and may even be cheaper than a single high-wattage wire-wound resistor. For example, if a 5W, 50Ω resistor is specified, 10 resistors can be substituted, each rated at 0.5W and 500Ω. Bear in mind that if they are tightly bundled, this will interfere with heat dissipation.

What Can Go Wrong

Heat

Resistors are probably the most robust of all electronic components, with high reliability and a long life. It is difficult to damage a resistor by overheating it with a soldering iron.

The wattage rating of a resistor does not necessarily mean that it should be used to dissipate that amount of power on a constant basis. Small resistors (1/4 watt or less) can overheat just as easily as big ones. Generally speaking, it is safe practice not to exceed 75% of a resistor's power rating on a constant basis.

Overheating is predictably more of a problem for power resistors, where provision must be made for heat dissipation. Issues such as component crowding should be considered when deciding how big a heat sink to use and how much ventilation. Some power resistors may function reliably at temperatures as high as 250 degrees Centigrade, but components near them are likely to be less tolerant and plastic enclosures may soften or melt.

Noise

The electrical *noise* introduced by a resistor in a circuit will vary according to the composition of the resistor, but for any given component, it will be proportional to voltage and current. Low-noise circuits (such as those at the input stage of a high-gain amplifier) should use low-wattage resistors at a low voltage where possible.

Inductance

The coiled wire of a wire-wound resistor will be significantly inductive at low frequencies. This is known as *parasitic inductance*. It will also have a resonant frequency. This type of resistor is unsuitable for applications where frequency exceeds 50KHz.

Inaccuracy

When using resistors with 10% tolerance, imprecise values may cause greater problems in some applications than in others. In a voltage divider, for instance, if one resistor happens to be at the high end of its tolerance range while the other happens to be at the low end, the voltage obtained at the intersection of the resistors will vary from its expected value. Using the schematic shown in Figure 10-20, if R1 is rated for 1K and R2 is rated for 5K, and the power supply is rated at 12VDC, the voltage at point A should be:

```
V = 12 * (( 5 / (5 + 1)) = 10
```

However, if R1 has an actual value of 1.1K and R2 has an actual value of 4.5K, the actual voltage obtained at point A will be:

```
V = 12 * (( 4.5 / (4.5 + 1.1)) = 9.6
```

If the resistors are at opposite ends of their respective tolerance ranges, so that R1 has an actual value of 900Ω while the lower resistor has an actual value of 5.5K, the actual voltage obtained will be:

```
V = 12 * (( 5.5 / (5.5 + 0.9)) = 10.3
```

The situation becomes worse if the two resistors are chosen to be of equal value, to provide half of the supply voltage (6 volts, in this example) at their intersection. If two 5K resistors are used, and the upper one is actually 4.5K while the lower one is 5.5K, the actual voltage will be:

```
V = 12 * (( 5.5 / (4.5 + 5.5)) = 6.6
```

Whether this variation is significant will depend on the particular circuit in which the voltage divider is being used.

Common through-hole resistors may occasionally turn out to have values that are outside their specified tolerance range, as a result of poor manufacturing processes. Checking each resistor with a meter before placing it in a circuit should be a standard procedure.

When measuring the voltage drop introduced by a resistor in an active circuit, the meter has its own internal resistance that will take a proportion of the current. This is known as *meter loading* and will result in an artificially low reading for the potential difference between the ends of a resistor. This problem becomes significant only when dealing with resistors that have a high value (such as 1M), comparable with the internal resistance of the meter (likely to be 10M or more).

Wrong Values

When resistors are sorted into small bins by the user, errors may be made, and different values may be mixed together. This is another reason for checking the values of components before using them. Identification errors may be nontrivial and easily overlooked: the visible difference between a 1 megohm resistor and a 100Ω resistor is just one thin color band.

potentiometer

11

Also known as a *variable resistor*; may be substituted for a *rheostat*.

OTHER RELATED COMPONENTS

- **rotational encoder** (see Chapter 8)
- **resistor** (see Chapter 10)

What It Does

When a voltage is applied across a potentiometer, it can deliver a variable fraction of that voltage. It is often used to adjust sensitivity, balance, input, or output, especially in audio equipment and sensors such as motion detectors.

A potentiometer can also be used to insert a variable resistance in a circuit, in which case it should really be referred to as a *variable resistor,* although most people will still call it a potentiometer.

It can be used to adjust the power supplied to a circuit, in which case it is properly known as a *rheostat*, although this term is becoming obsolete. Massive rheostats were once used for purposes such as dimming theatrical lighting, but solid-state components have taken their place in most high-wattage applications.

A full-size, classic-style potentiometer is shown in Figure 11-1.

Figure 11-1. *A generic or classic-style potentiometer, approximately one inch in diameter.*

Schematic symbols for a potentiometer and other associated components are shown in Figure 11-2, with American versions on the left and European versions on the right in each case. The symbols for a potentiometer are at the top. The correct symbols for a variable resistor or rheostat are shown at center, although a potentiometer symbol may often be used instead. A preset variable resistor is shown at the bottom, often referred to as a *trimmer* or *Trimpot*. In these examples, each has an arbitrary rated resistance of 4,700Ω. Note the European substitution of K for a decimal point.

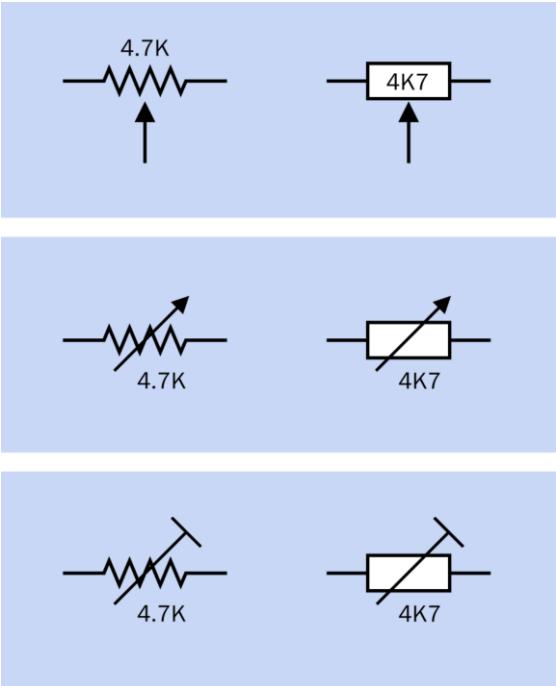

Figure 11-2. *American (left) and European (right) symbols for a potentiometer, a rheostat, and a trimmer potentiometer, reading from top to bottom. The 4.7K value was chosen arbitrarily.*

How It Works

A potentiometer has three terminals. The outer pair connect with the opposite ends of an internal resistive element, such as a strip of conductive plastic, sometimes known as the *track*. The third center terminal connects internally with a contact known as the *wiper* (or rarely, the *pick-off*), which touches the strip and can be moved from one end of it to the other by turning a shaft or screw, or by moving a slider.

If an electrical potential is applied between opposite ends of the resistive element, the voltage "picked off" by the wiper will vary as it moves. In this mode, the potentiometer works as a resistive voltage divider. For example, in a potentiometer with a linear taper (see "Variants," coming up), if you attach the negative side of a 12V battery to the right-hand end terminal and the positive side to the left-hand end terminal, you will find an 8V potential at the center terminal when the potentiometer has rotated clockwise through one-third of its range. In Figure 11-3, the base of the shaft (shown in black) is attached to an arm (shown in green) that moves a wiper (orange) along a resistive element (brown). The voltages shown assume that the resistive element has a linear taper and will vary slightly depending on wire resistance and other factors.

Because a potentiometer imposes a voltage reduction, it also reduces current flowing through it, and therefore creates waste heat which must be dissipated. In an application such as an audio circuit, small currents and low voltages generate negligible heat. If a potentiometer is used for heavier applications, it must be appropriately rated to handle the wattage and must be vented to allow heat to disperse.

To use a potentiometer as a *variable resistor* or *rheostat*, one of its end terminals may be tied to the center terminal. If the unused end terminal is left unconnected, this raises the risk of picking up stray voltages or "noise" in sensitive circuits. In Figure 11-4, a potentiometer is shown adjusting a series resistance for an *LED* for demonstration purposes. More typically, a trimmer would be used in this kind of application, since a user is unlikely to need to reset it.

Variants

Linear and Log Taper

If the resistive element in a potentiometer is of constant width and thickness, the electrical potential at the wiper will change in ratio with the rotation of the wiper and shaft (or with movement of a slider). This type of potentiometer is said to have a linear taper even though its element does not actually taper.

For audio applications, because human hearing responds nonlinearly to sound pressure, a potentiometer that has a linear taper may seem to have a very slow action at one end of its scale and an abrupt effect at the other. This problem used to be solved with a non-uniform or tapered re-

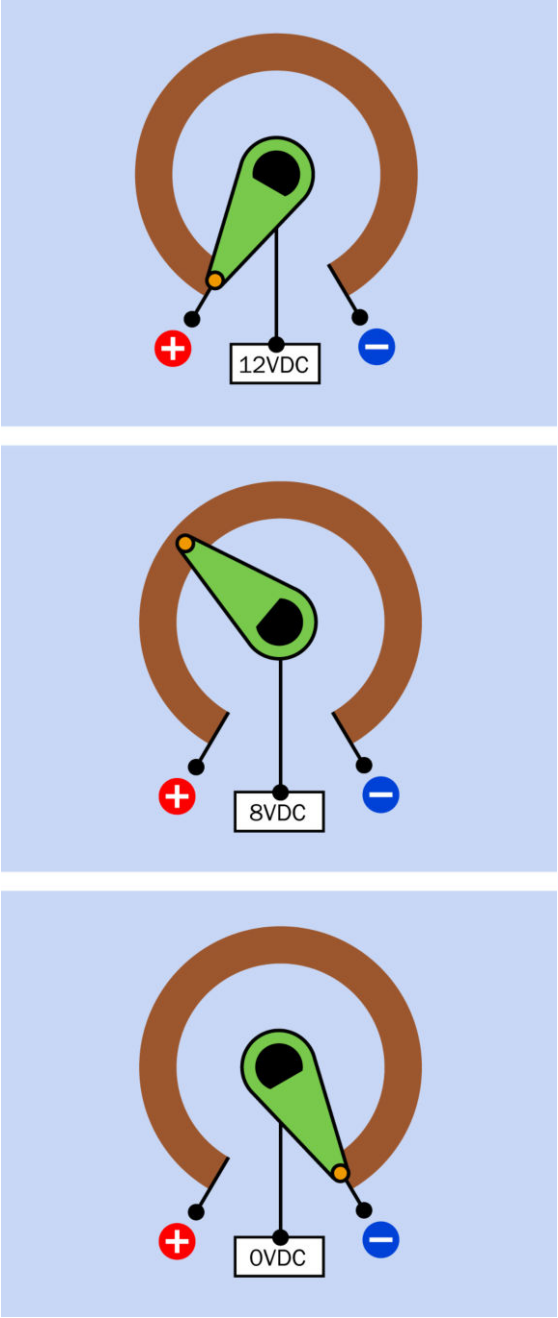

Figure 11-3. *Inside a potentiometer. See text for details.*

sistive element. More recently, a combination of resistive elements has been used as a cheaper option. Such a potentiometer is said to have an audio taper or a log taper (since the resistance

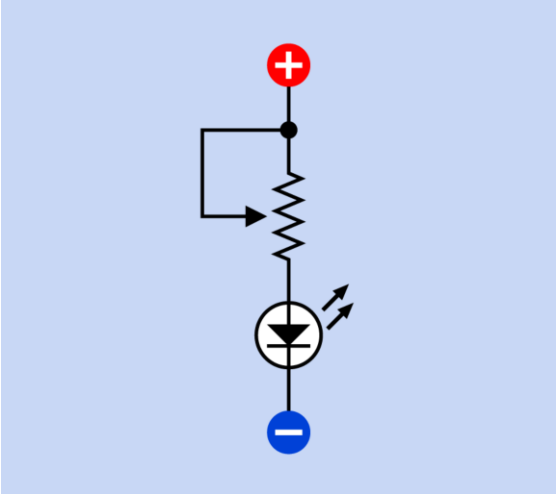

Figure 11-4. *A potentiometer can be used to adjust a series resistance, as shown in this schematic. Tying the wiper to one of the end terminals reduces the risk of picking up electrical noise.*

may vary as a logarithm of the angle of rotation). A reverse audio taper or antilog taper varies in the opposite direction, but this type has become very uncommon.

Classic-style Potentiometer

This consists of a sealed circular can, usually between 0.5″ and 1″ in diameter, containing a resistive strip that is shaped as a segment of a circle. A typical example is shown in Figure 11-1, although miniaturized versions have become more common. A shaft mounted on the can turns the internal wiper that presses against the strip. For panel-mount applications, a threaded bushing at the base of the shaft is inserted through a hole in the front panel of the electronics enclosure, and a nut is tightened on the bushing to hold the potentiometer in place. Often there is also a small offset index pin that, when paired with a corresponding front panel hole, will keep the pot from spinning freely.

Many modern potentiometers are miniaturized, and may be packaged in a box-shaped plastic

enclosure rather than a circular can. Their power ratings are likely to be lower, but their principle of operation is unchanged. Two variants are shown in Figure 11-5.

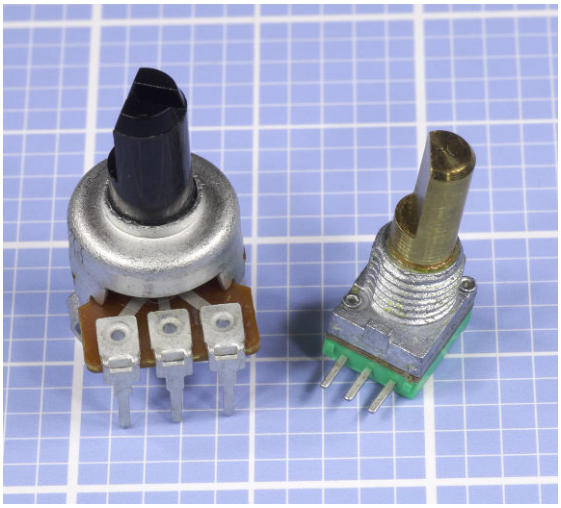

Figure 11-5. *Two modern miniaturized potentiometers. At left: 5K. At right: 10K. Both are rated to dissipate up to 50mW.*

The three terminals on the outside of a potentiometer may be solder lugs, screw terminals, or pins for direct mounting on a circuit board. The pins may be straight or angled at 90 degrees.

The resistive element may use carbon film, plastic, cermet (a ceramic-metal mixture), or resistive wire wound around an insulator. Carbon-film potentiometers are generally the cheapest, whereas wire-wound potentiometers are generally the most expensive.

Wire-wound potentiometers may handle more power than the other variants, but as the wiper makes a transition from one turn of the internal wire element to the next, the output will tend to change in discrete steps instead of varying more smoothly.

In a potentiometer with detents, typically a spring-loaded lever in contact with notched internal wheel causes the shaft to turn in discrete steps that create a stepped output even if the resistive element is continuous.

The shaft may be made of metal or plastic, with its length and width varying from one component to another. A control knob can be fitted to the end of the shaft. Some control knobs are push-on, others have a set screw to secure them. Shafts may be splined and split, or round and smooth, or round with a flat surface that matches the shape of a socket in a control knob and reduces the risk of a knob becoming loose and turning freely. Some shafts have a slotted tip to enable screwdriver adjustment.

Some shaft options for full-size potentiometers are shown in Figure 11-6.

Figure 11-6. *Three shaft options for potentiometers.*

Multiple-Turn Potentiometer

To achieve greater precision, a track inside a potentiometer may be manufactured in the form of a helix, allowing the wiper to make multiple turns on its journey from one end of the track to the other. Such multiple-turn potentiometers typically allow 3, 5, or 10 turns to move the wiper from end to end. Other multiple-turn potentiometers may use a screw thread that advances a wiper along a linear or circular track. The latter is com-

parable with a trimmer where multiple turns of a screwdriver are used to rotate a worm gear that rotates a wiper between opposite ends of a circular track.

Ganged Potentiometer

Two (or rarely, more) potentiometers can be stacked or combined so that their resistive elements and wipers share the same shaft but can use different voltages or have different taper. Each resistance-wiper assembly is known as a *cup*, and the potentiometers are said to be *ganged*.

Flat ganged potentiometers combine two resistive elements in one enclosure. Some *dual ganged* potentiometers are concentric, meaning that the pots are controlled separately by two shafts, one inside the other. Suitable concentric knobs must be used. You are unlikely to find these potentiometers sold as components in limited quantities.

Switched Potentiometer

In this variant, when the shaft is turned clockwise from an initial position that is fully counterclockwise, it flips an internal switch connected to external terminals. This can be used to power-up associated components (for example, an audio amplifier). Alternatively, a switch inside a potentiometer may be configured so that it is activated by pulling or pushing the shaft.

Slider Potentiometer

Also known as a *slide potentiometer*. This uses a straight resistive strip and a wiper that is moved to and fro linearly by a tab or lug fitted with a plastic knob or finger-grip. Sliders are still found on some audio equipment. The principle of operation, and the number of terminals, are identical to the classic-style potentiometer. Sliders typically have solder tabs or PC pins. In Figure 11-7, the large one is about 3.5" long, designed for mounting behind a panel that has a slot to allow the sliding lug to poke through. Threaded holes at either end will accept screws to fix the slider behind the panel. A removable plastic finger-grip (sold separately, in a variety of styles) has been pushed into place. Solder tabs underneath the slider are hidden in this photo. The smaller slider is designed for through-hole mounting on a circuit board.

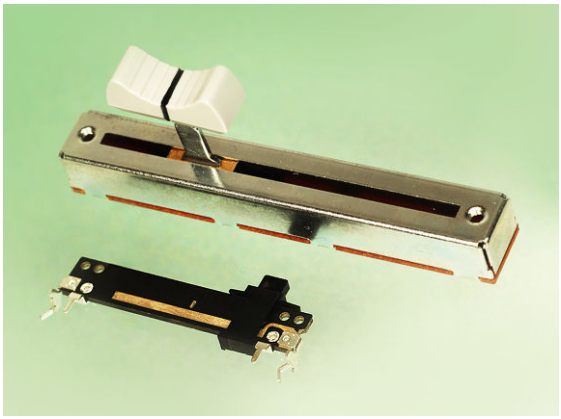

Figure 11-7. *Slider potentiometers.*

Trimmer Potentiometer

Often referred to as Trimpots, this is actually a proprietary brand name of Bourns. They are usually mounted directly on circuit boards to allow fine adjustment or trimming during manufacturing and testing to compensate for variations in other components. Trimmers may be single-turn or multi-turn, the latter containing a worm gear that engages with another gear to which the wiper is attached. Trimmers always have linear taper. They may be designed for screwdriver adjustment or may have a small knurled shaft, a thumb wheel, or a knob. They are not usually accessible by the end user of the equipment, and their setting may be sealed or fixed when the equipment is assembled. In Figure 11-8, the beige Spectrol trimmer is a single-turn design, whereas the blue trimmer is multi-turn. A worm gear inside the package, beneath the screw head, engages with an interior gear wheel that rotates the wiper.

In Figure 11-9, a 2K trimmer potentiometer has a knurled dial attached to allow easy finger adjustment, although the dial also contains a slot for a flat-blade screwdriver.

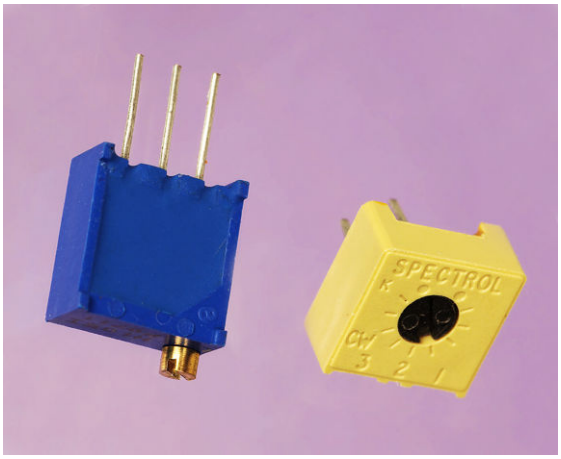

Figure 11-8. *Like most trimmers, these are designed for through-hole mounting on a circuit board.*

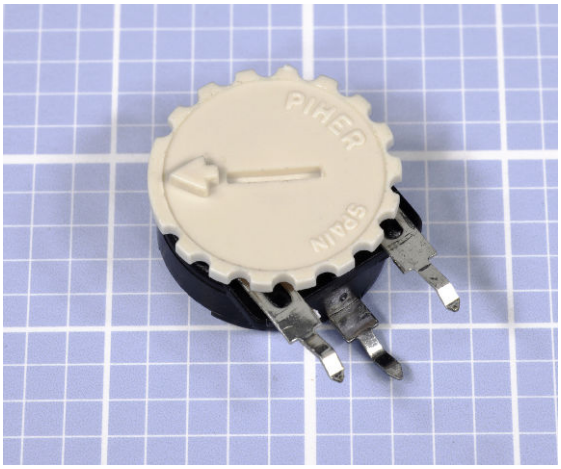

Figure 11-9. *A trimmer potentiometer with a knurled dial to facilitate finger adjustment.*

How to Use it

The classic-style potentiometer was once used universally to control volume, bass, and treble on audio equipment but has been replaced increasingly by digital input devices such as **tactile switches** (see "Tactile Switch" (page 34)) or **rotational encoders** (see Chapter 8), which are more reliable and may be cheaper, especially when assembly costs are considered.

Potentiometers are widely used in lamp dimmers and on cooking stoves (see Figure 11-10). In these applications, a solid-state switching device such as a **triac** (described in Volume 2) does the actual work of moderating the power to the lamp or the stove by interrupting it very rapidly. The potentiometer adjusts the duty cycle of the power interruptions. This system wastes far less power than if the potentiometer controlled the lighting or heating element directly as a rheostat. Since less power is involved, the potentiometer can be small and cheap, and will not generate significant heat.

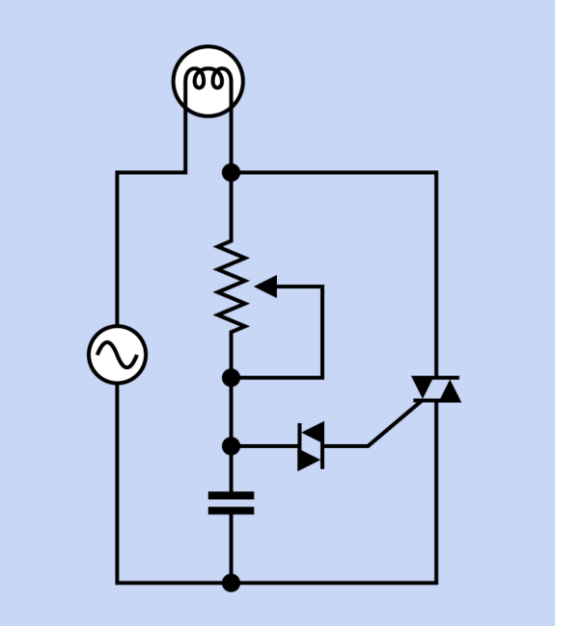

Figure 11-10. *Typical usage of a potentiometer in conjunction with a diac, triac, and capacitor to control the brightness of an incandescent bulb, using an AC power supply. Diacs and triacs are discussed in Volume 2.*

Because true logarithmic potentiometers have become decreasingly common, a linear potentiometer in conjunction with a fixed resistor can be used as a substitute, to control audio input. See Figure 11-11.

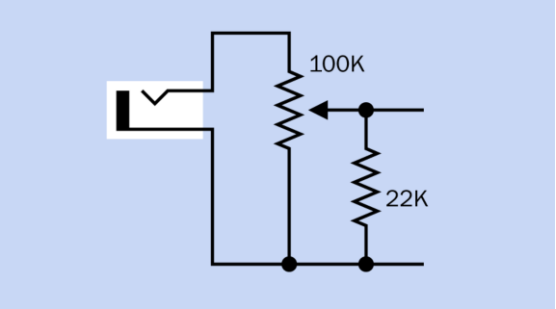

Figure 11-11. *In this circuit, a 100K linear potentiometer is used in conjunction with a 22K resistor to create an approximately logarithmic volume control for an audio system with input coming from a mono jack socket at left.*

A potentiometer may be used to match a sensor or analog input device to an analog-digital converter, or it can calibrate a device such as a temperature or motion sensor.

What Can Go Wrong

Wear and Tear

Since classic-style potentiometers are electromechanical devices, their performance will deteriorate as one part rubs against another. The long open slot of a slider potentiometer makes it especially vulnerable to contamination with dirt, water, or grease. Contact-cleaner solvent, lubricant-carrying sprays, or pressurized "duster" gas may be squirted into a potentiometer to try to extend its life. Carbon-film potentiometers are the least durable and in audio applications will eventually create a "scratchy" sound when they are turned, as the resistive element deteriorates.

If the wiper deteriorates to the point where it no longer makes electrical contact with the track, and if the potentiometer is being used as a variable resistor, two failure modes are possible, shown in Figure 11-12. Clearly the right-hand schematic is a better outcome. This is an argument for always tying the wiper to the "unused" end of the track.

If you are designing a circuit board that will go through a production process, temperature variations during wave soldering, and subsequent washing to remove flux residues, create hostile conditions for potentiometers, especially sliders where the internal parts are easily contaminated. It will be safer to hand-mount potentiometers after the automated process.

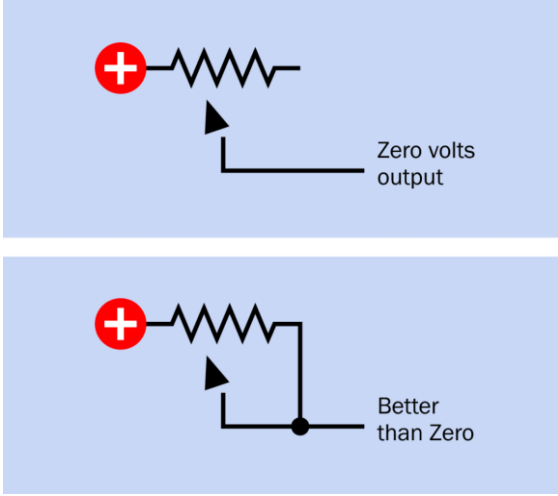

Figure 11-12. *If the wiper of a potentiometer breaks (indicated by the loose arrow head) as a result of wear and tear, and the potentiometer is being used as a variable resistor, the voltage from it will drop to zero (top schematic) unless the wiper has been tied to one end of the track (bottom schematic).*

Knobs that Don't Fit

Control knobs are almost always sold separately from potentiometers. Make sure the shaft of the potentiometer (which may be round, round-with-flat, or knurled) matches the knob of your choice. Note that some shaft diameters are expressed in inches, while others are metric.

Nuts that Get Lost

For panel-mounted potentiometers, a nut that fits the thread on the bushing is almost always included with the potentiometer; an additional nut and lock washer may also be supplied. Because there is no standardization of threads on potentiometers, if you lose a nut, you may have some difficulty finding an exact replacement.

A Shaft that Isn't Long Enough

When choosing a shaft length, if in doubt, buy a potentiometer with a long shaft that you can cut to the desired length.

Sliders with No Finger Grip

Slider potentiometers are often sold without a knob or plastic finger-grip, which must be ordered separately and may be available in different styles. The finger-grip usually push-fits onto the metal or plastic tab or lug that moves the slider to and fro.

Too Big to Fit

Check the manufacturer's datasheet if you need to know the physical size of the potentiometer. Photographs may be misleading, as a traditional-style potentiometer that is 0.5" in diameter looks much the same as one that is 1" in diameter. High-wattage potentiometers will be more costly and physically large (2 to 3 inches in diameter). See Figure 11-13.

Overheating

Be sure to leave sufficient air space around a high-wattage potentiometer. Carefully calculate the maximum voltage drop and current that you may be using, and choose a component that is appropriately rated. Note that if you use the potentiometer as a rheostat, it will have to handle more current when its wiper moves to reduce its resistance. For example, if 12VDC are applied through a 10-ohm rheostat to a component that has a resistance of 20 ohms, current in the circuit will vary from 0.4 amps to 0.6 amps depending on the position of the rheostat. At its maximum setting, the rheostat will impose a 4V voltage drop and will therefore dissipate 1.6 watts from the full length of its resistive element. If the rheostat is reset to impose only a 4-ohm resistance, the voltage drop that it imposes will be 2V, the current in the circuit will be 0.5 amps, and the rheostat will therefore dissipate 1 watt from 4/10ths of the length of its resistive element. A wire-wound potentiometer will be better able to handle high dissipation from a short segment of its element than other types of rheostat. Add a fixed resistor in series with a rheostat if necessary to impose a limit on the current.

Figure 11-13. *The large potentiometer is approximately 3" in diameter, rated at 5 ohms, and able to handle more than 4 amps. The small potentiometer is 5/8" diameter, rated at 2K and 1/4 watt, with pins designed for through-hole insertion in a circuit board, and a grooved shaft that accepts a push-on knob. Despite the disparity in size, the principle of operation and the basic features are identical.*

When using a trimmer potentiometer, limit the current through the wiper to 100mA as an absolute maximum value.

The Wrong Taper

When buying a potentiometer, remember to check the specification to find out whether it has linear or audio/log taper. If necessary, attach a meter, with the potentiometer set to its center position, to verify which kind of taper you have. While holding the meter probes in place, rotate the potentiometer shaft to determine which way an audio/log taper is oriented.

capacitor

12

Quite often referred to as a *cap*. Formerly known (primarily in the United Kingdom) as a *condenser*, but that term has become obsolete.

OTHER RELATED COMPONENTS

- **variable capacitor** (See Chapter 13)
- **battery** (See Chapter 2)

What It Does

A capacitor connected across a DC power source will accumulate a charge, which then persists after the source is disconnected. In this way, the capacitor stores (and can then discharge) energy like a small rechargeable battery. The charge/discharge rate is extremely fast but can be limited by a series resistor, which enables the capacitor to be used as a timing component in many electronic circuits.

A capacitor can also be used to block DC current while it passes pulses, or electrical "noise," or alternating current, or audio signals, or other wave forms. This capability enables it to smooth the output voltage provided by **power supplies**; to remove spikes from signals that would otherwise tend to cause spurious triggering of components in digital circuits; to adjust the frequency response of an audio circuit; or to couple separate components or circuit elements that must be protected from transmission of DC current.

Schematic symbols for capacitors are shown in Figure 12-1. At top-left is a nonpolarized capacitor, while the other two indicate that a polarized capacitor must be used, and must be oriented as shown. The variant at the bottom is most commonly used in Europe. Confusingly, the nonpolarized symbol may also be used to identify a polarized capacitor, if a + sign is added. The polarized symbols are sometimes printed without + signs, but the symbols still indicate that polarity must be observed.

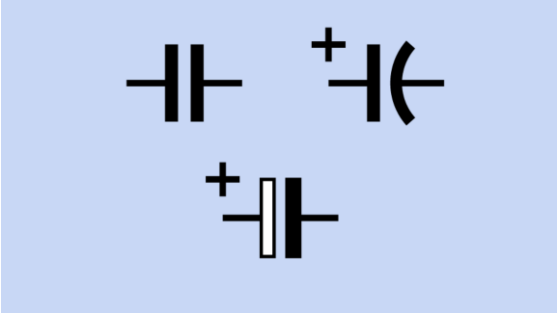

Figure 12-1. *Schematic symbols for polarized and nonpolarized capacitors. See text for details.*

How It Works

In its simplest form, a capacitor consists of two plates, each with a lead attached to it for connection with a DC power source. The plates are separated by a thin, insulating layer known as the *dielectric*, which is usually a solid or a paste but may be liquid, gel, gaseous, or vacuum.

The plates in most capacitors are made from thin metal film or metallized plastic film. To minimize the size of the component, the film may be rolled up to form a compact cylindrical package, or multiple flat sections may be interleaved.

Electrons from the power source will migrate onto the plate attached to the negative side of the source, and will tend to repel electrons from the other plate. This may be thought of as creating *electron holes* in the other plate or as attracting *positive charges*, as shown in Figure 12-2. When the capacitor is disconnected from the power source, the opposite charges on its plates will persist in equilibrium as a result of their mutual attraction, although the voltage will gradually dissipate as a result of *leakage,* either through the dielectric or via other pathways.

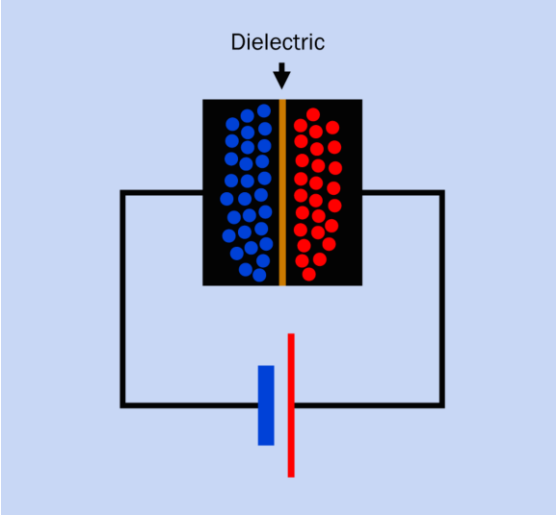

Figure 12-2. *Because the plates of a capacitor are electrically conductive, they will become populated with positive and negative charges when connected with a DC power source. As opposite charges attract each other, they will tend to congregate on either side of the dielectric, which is an insulating layer. The battery symbol is shown here colored for clarity.*

When a **resistor** is placed across the leads of a charged capacitor, the capacitor will discharge itself through the resistor at a rate limited by the resistance. Conversely, if a capacitor is charged through a resistor, the resistor will limit the charging rate.

A resistor in series with a capacitor is known as an *RC network* (Resistor-Capacitor network). In Figure 12-3, an RC circuit is shown with a SPDT switch that charges or discharges the capacitor via a series resistor. The voltage at point A increases nonlinearly (relative to the negative side of the power supply) while the capacitor is charging, and decreases nonlinearly while the capacitor is discharging, as suggested by the graphs. At any moment, the time that the capacitor takes to acquire 63% of the difference between its current charge and the voltage being supplied to it is known as the *time constant* for the circuit. See "The Time Constant" (page 105) for additional information.

When a capacitor is connected across an AC voltage source, each surge of electrons to one plate induces an equal and opposite positive surge to the other plate, and when polarity of the power supply reverses, the charges on the plates switch places. These surges may make it seem that the capacitor is conducting AC current, even though the dielectric that separates the plates is an insulator. See Figure 12-4. Often a capacitor is said to "pass" AC, even though this is not really happening. For convenience, and because the concept is widely established, this encyclopedia refers to capacitors as "passing" AC.

Depending on the size of the capacitor, it will block some AC frequencies while passing others. Generally speaking, a smaller capacitor will pass high frequencies relatively efficiently, as each little surge of current fills each plate. However, the situation is complicated by the *inductive reactance* (which creates the *effective series resistance*) of a capacitor, as discussed below. See "Alternating Current and Capacitive Reactance" (page 106).

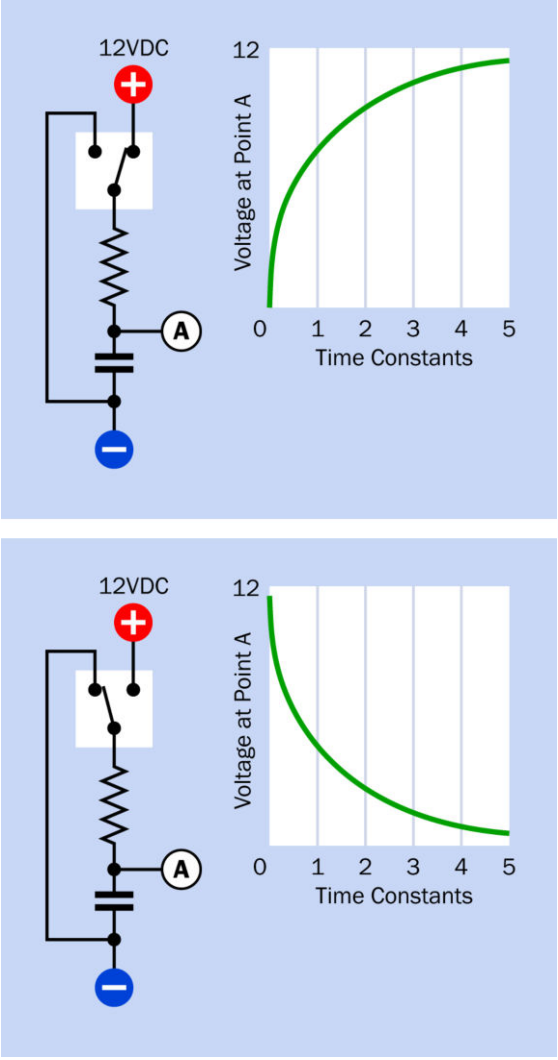

Figure 12-3. *An RC (Resistor-Capacitor) network with a switch to control charge and discharge of a capacitor. At top, the curve gives an approximate idea of the charging behavior of the capacitor. At bottom, the curve illustrates its discharging behavior.*

Variants

Format

The three most common packages for capacitors are cylindrical, disc, and rectangular tablet.

A *cylindrical capacitor* may have *axial leads* (a wire attached to each end) or *radial leads* (both wires emerging from one end). Radial capacitors are more widely used as they allow easy insertion into a circuit board. The capacitor is usually packaged in a small aluminum can, closed at one end, capped with an insulating disc at the other end, and wrapped in a thin layer of insulating plastic. Some samples are shown in Figure 12-5 and Figure 12-6.

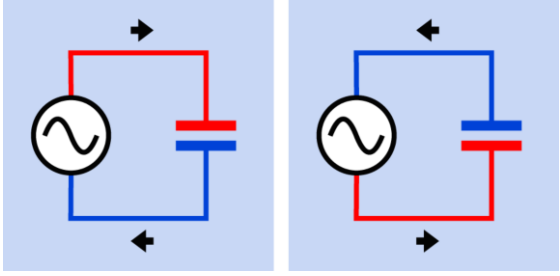

Figure 12-4. *In the left diagram, a source of alternating current charges the upper plate of a capacitor positively and the lower plate negatively. This process entails a flow of conventional current shown by the arrows. A moment later, when the AC current flow reverses, the flow also reverses, creating the impression that the capacitor "passes" AC current.*

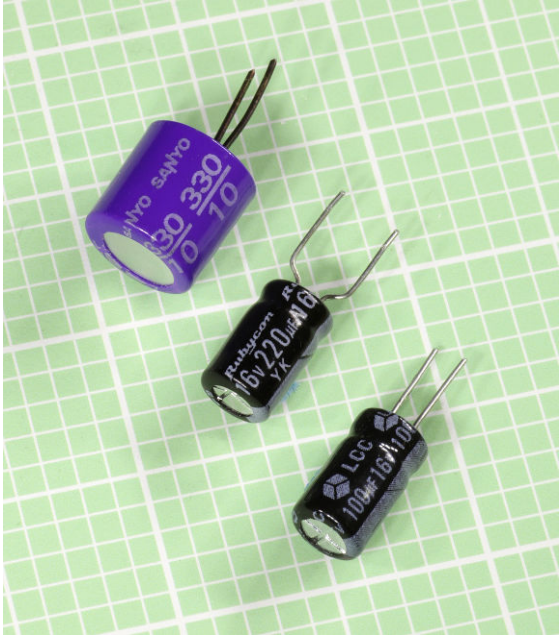

Figure 12-5. *Cylindrical capacitors with radial leads. All are electrolytic.*

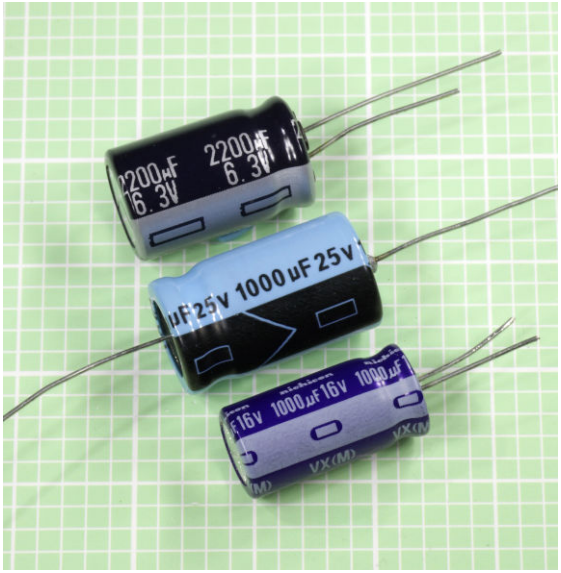

Figure 12-6. *Cylindrical capacitors with radial leads (top and bottom) and axial leads (center). All are electrolytic.*

A *disc capacitor* (sometimes referred to as a *button capacitor*) is usually encased in an insulating ceramic compound, and has radial leads. Modern small-value ceramic capacitors are more likely to be dipped in epoxy, or to be square tablets. Some samples are shown in Figure 12-7.

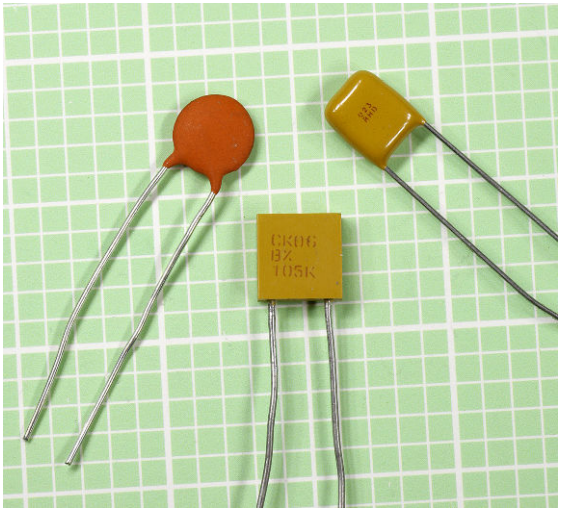

Figure 12-7. *Generic ceramic capacitors. Left: rated for 0.1µF at 50V. Center: 1µF at 50V. Right: 1µF at 50V.*

A *surface-mount capacitor* is square or rectangular, usually a few millimeters in each dimension, with two conductive pads or contacts at opposite ends. It appears almost identical to a surface-mount resistor. Larger-value capacitors are inevitably bigger but can still be designed for surface-mount applications. See Figure 12-8.

Figure 12-8. *Most surface-mount capacitors are as tiny as other surface-mount components, but this 4,700µF electrolytic (at 10V) has a base approximately 0.6" square. A solder tab is visible at the center of the nearest edge.*

Many capacitors are nonpolarized, meaning that they are insensitive to polarity. However, electrolytic and tantalum capacitors must be connected "the right way around" to any DC voltage source. If one lead is longer than the other, it must be the "more positive" lead. A mark or band at one end of the capacitor indicates the "more negative" end. Tantalum capacitors are likely to indicate the positive lead by using a + sign on the body of the component.

An arrow printed on the side of a capacitor usually points to the "more negative" terminal. In an aluminum can with axial leads, the lead at one end will have an insulating disc around it while the other lead will be integral with the rounded end of the can. The wire at the insulated end must be "more positive" than the wire at the other end.

A *capacitor array* contains two or more capacitors that are isolated from each other internally and accessed by external contacts. They are sold in surface-mount format and also in *through-hole* chips of DIP (dual-inline package) or SIP (single-inline package) format. The internal components may be connected in one of three configurations: isolated, common-bus, or dual-ended common bus. Technically the isolated configuration should be referred to as a capacitor array, but in practice, all three configurations are usually referred to as *capacitor networks*. See Figure 12-9 and Figure 12-10.

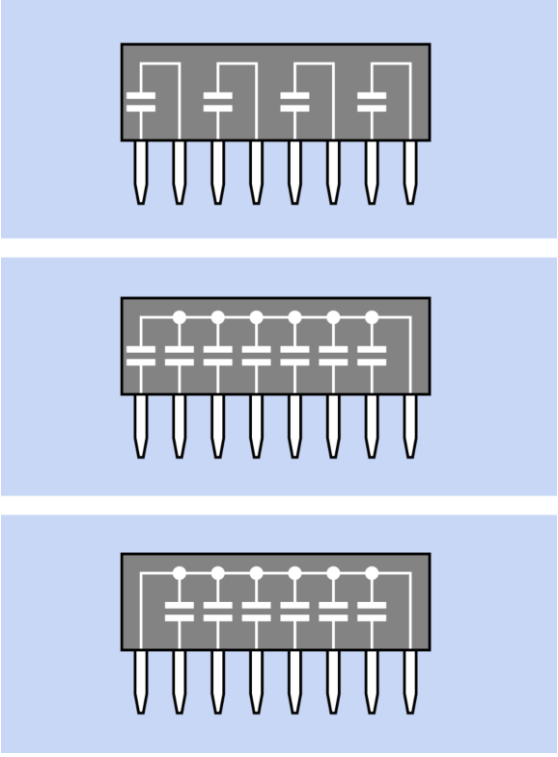

Figure 12-9. *A capacitor network most often consists of a single-inline package (SIP) chip containing multiple capacitors in one of three configurations shown here. Top: Isolated. Center: Common bus. Bottom: Dual-ended common bus. Individual capacitor values ranging from 0.001µF to 0.1µF are common.*

Capacitor networks can reduce the component count in circuits where digital logic chips require bypass capacitors. They are comparable in concept to *resistor arrays*.

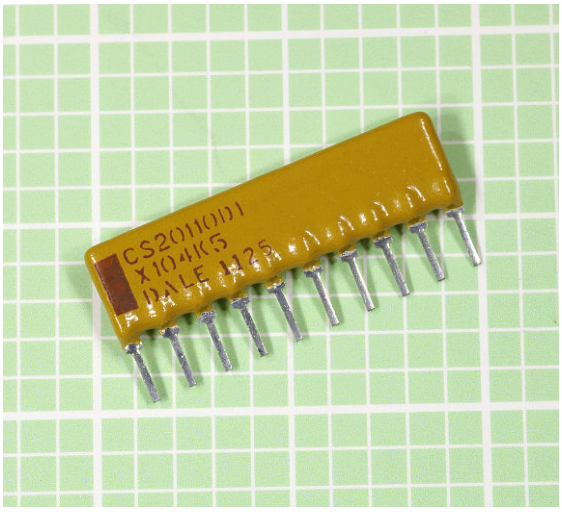

Figure 12-10. *A capacitor array in through-hole, SIP format.*

Chips containing *RC circuits* (multiple resistor-capacitor pairs) are available, although uncommon.

Principal Types

Electrolytic capacitors are relatively cheap, compact, and available in large values. These attributes have made them a popular choice in consumer electronics, especially for power supplies. The capacitive capability of an electrolytic is refreshed by periodic application of voltage. A moist paste inside the capacitor is intended to improve the dielectric performance when voltage is applied, but can dry out during a period of years. If an electrolytic is stored for 10 years or so, it may allow a short circuit between its leads when power is applied to it. The capacitors in Figure 12-5 and Figure 12-6 are all electrolytic. The capacitor in Figure 12-11 is at the high end of the scale.

A *bipolar electrolytic* is a single package containing two electrolytic capacitors in series, end-to-end, with opposed polarities, so that the combination can be used where the voltage of a signal fluctuates above and below 0VDC. See Figure 12-12 and Figure 12-13. This type of component is likely to have "BP" (bipolar) or "NP"

Figure 12-11. *This 13,000µF electrolytic capacitor is larger than would be required in most everyday applications.*

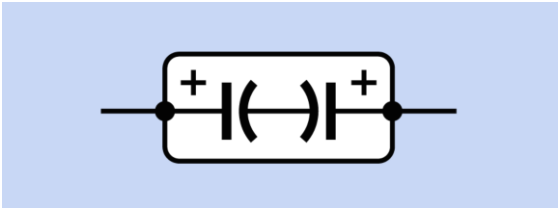

Figure 12-12. *Schematic view of the internal configuration of a bipolar electrolytic capacitor, also known as nonpolarized electrolytic capacitor. It consists of two electrolytics in series, with opposing polarities.*

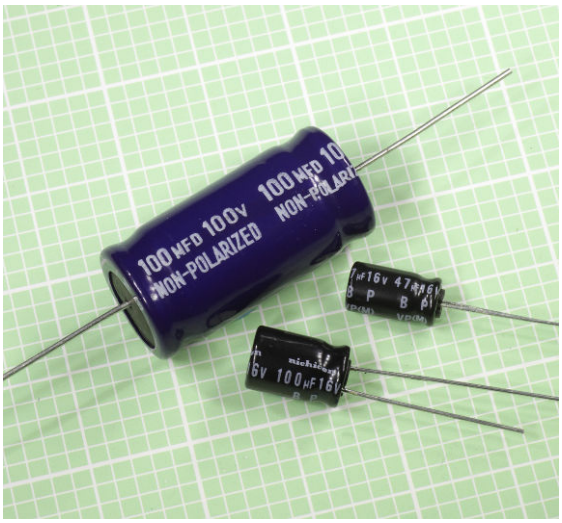

Figure 12-13. *Bipolar electrolytic capacitors. The larger size of the one at top-left is a consequence of its higher voltage rating. "BP" on the other two capacitors is an acronym for "bipolar," meaning that they have no polarity, even though one lead may be shorter than the other.*

(nonpolarized) printed on its shell. It may be used in audio circuits where polarized capacitors are normally unsuitable, and is likely to be cheaper than non-electrolytic alternatives. However, it suffers from the same weaknesses as all electrolytics.

Tantalum capacitors are compact but relatively expensive, and can be vulnerable to voltage spikes. They are sensitive to application of the wrong polarity. Typically they are epoxy-dipped rather than mounted inside a small aluminum can like electrolytics, and consequently the electrolyte may be less likely to evaporate and dry out. In Figure 12-14, two tantalum capacitors (rated 330µF at 6.3V, left, and 100µF at 20V, right) are shown above a polyester film capacitor (rated 10µF at 100V). Surface-mount tantalum capacitors are decreasing in popularity as large-value ceramic capacitors are becoming available, with smaller dimensions and lower equivalent series resistance.

Plastic-film capacitors are discussed in the following section.

Single-layer *ceramic* capacitors are often used for bypass, and are suitable for high-frequency or audio applications. Their value is not very stable with temperature, although the "NPO" variants are more stable. Multilayer ceramic capacitors are more compact than single-layer ceramic, and

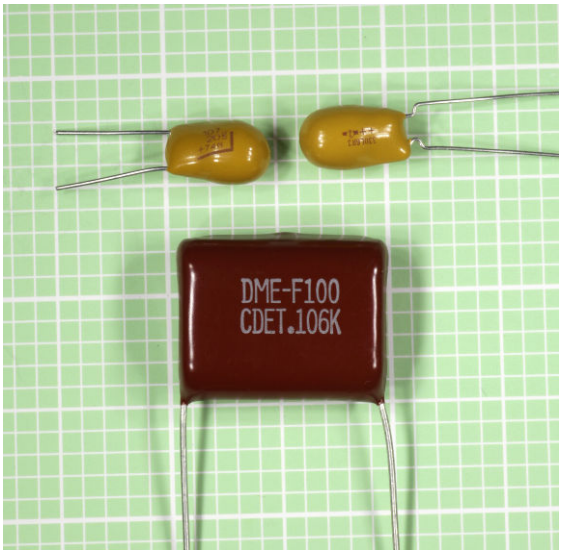

Figure 12-14. *Two tantalum capacitors are shown above a polyester film capacitor. The polarity of the tantalum capacitors is indicated by the plus signs adjacent to the longer lead, in each case. The polyester capacitor is nonpolarized.*

consequently are becoming increasingly popular. Three multilayer ceramic capacitors are shown in Figure 12-15. At bottom-right, even the largest (rated at 47µF at 16V) is only 0.2" square.

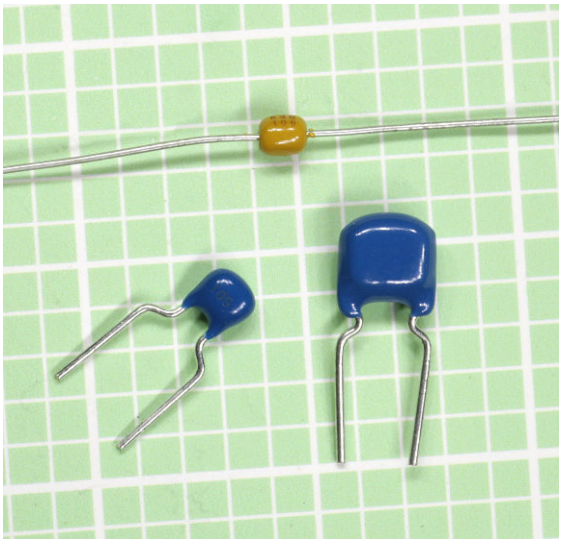

Figure 12-15. *Multilayer ceramic capacitors are extremely compact, and are nonpolarized. Top: 1,000pF (i.e. 1nF) at 100V. Bottom left: 1µF at 25V. Bottom right: 47µF at 16V.*

Dielectrics

The dielectric used in a capacitor most often consists of an electrolytic layer, a ceramic compound, a plastic film (polycarbonate, polypropylene, or polystyrene), or paper.

An *electrolytic layer* in an electrolytic capacitor traditionally consists of paper soaked in an electrolyte. It is interleaved with a thin film of aluminum on which is deposited a layer of aluminum oxide. The layers are rolled up to create a cylindrical component. The functioning dielectric is created when voltage is applied.

Polyester

This is the most common type of plastic film, with the highest dielectric constant, enabling highest capacitance per unit volume. Widely used in DC applications, but the rolled layers create parasitic inductance. Often used in decoupling, coupling, and bypass, but not so suitable for situations requiring stability and low leakage. May not be suitable for high current.

Polycarbonate

Thermally very stable, often specified for filters and timing circuits that require a fixed frequency. An excellent type of capacitor, compatible for mil-spec applications, but expensive.

Mylar, Polyester, and other plastic-film types are often used in audio circuits, where their voltage limitation (typically less than 100VDC) is not a problem, and their nonpolarized attribute is an advantage.

Polypropylene

Vulnerable to heat (a maximum of 85 degrees Centigrade is common), and less thermally stable than polycarbonate. A very low power dissipation factor allows it to handle higher power at higher frequencies. Available with tolerances down to 1%. These capacitors are a popular choice in crossover

networks for loudspeaker combinations, and are used in switching power supplies. They tend to be physically larger than other capacitors using film dielectric.

Values

Farads

The electrical storage capacity of a capacitor is measured in *farads,* universally represented by the letter F. A capacitor that can be charged with a potential difference between its plates of 1 volt, in a time of 1 second, during which it draws 1 amp, has a capacitance of 1 farad.

Because the farad is a large unit, capacitors in electronic circuits almost always have fractional values: *microfarads* (µF), *nanofarads* (nF), and *picofarads* (pF). The Greek letter µ (mu) should be used in the µF abbreviation, but a lowercase letter u is often substituted. Thus, for example, 10uF means the same as 10µF.

1F = 1,000,000µF, and 1µF = 1,000,000pF. Therefore, 1 farad is equivalent to 1 trillion picofarads —a very wide range of possible values. See Figure 12-16 and Figure 12-17 for charts showing equivalent values in different units.

pF	nF	µF
1	0.001	0.000001
10	0.01	0.00001
100	0.1	0.0001
1,000	1	0.001
10,000	10	0.01
100,000	100	0.1
1,000,000	1,000	1

Figure 12-16. *Equivalent values for picofards, nanofarads, and microfarads. The nF unit is used primarily in Europe.*

µF	F
1	0.000001
10	0.00001
100	0.0001
1,000	0.001
10,000	0.01
100,000	0.1
1,000,000	1

Figure 12-17. *Equivalent values for microfarads and farads. Because the farad is such a large unit, electronic circuits almost always use fractional values.*

The nF unit is more common in Europe than in the United States. A 1nF capacitance is often expressed in the US as 0.001µF or 1,000pF. Similarly, a 10nF capacitance is almost always expressed as a 0.01µF, and a 0.1nF capacitance is more likely to be expressed as 100pF.

European schematics may use value-symbols as a substitute for decimal points. For example, a 4.7pF capacitor may be shown as 4p7, a 6.8nF capacitor may be shown as 6n8, and a 3.3µF capacitor may be shown as 3µ3.

Commonly Used Values

The traditional range of capacitor values was established on the same basis as the traditional range of resistor values, by assuming an accuracy of plus-or-minus 20% and choosing factors that would minimize the possible overlap between adjacent tolerance ranges. The factors 1.0, 1.5, 2.2, 3.3, 4.7, 6.8, and 10 satisfy this requirement. See Chapter 10 for a more detailed explanation, including a graphical representation of values and overlaps in Figure 10-8. While many resistors are now manufactured with high precision, 20%

tolerance is still common for electrolytic capacitors. Other types of capacitors are available with an accuracy of 10% or 5%, but are more expensive.

While large-value capacitors are likely to have their actual value printed on them, smaller capacitors are identified by a variety of different codes. These codes are not standardized among manufacturers, and exist in various colors and abbreviations. A multimeter that can measure capacitance is a quicker, easier, and more reliable method of determining the value of a component than trying to interpret the codes.

In addition to capacitance, a large capacitor is likely to have its working voltage printed on it. Exceeding this value increases the risk of damaging the dielectric. In the case of electrolytic capacitors, a voltage that is much lower than the rated value should also be avoided, because these capacitors require an electrical potential to maintain their performance.

In common electronics applications, values larger than 4,700µF or smaller than 10pF are unusual.

Electrolytics are available at a moderate price in a wider range of values than other commonly used capacitors. They range from 1µF to 4,700µF and sometimes beyond. Working voltages typically range from 6.3VDC to 100VDC, but can be as high as 450VDC.

Tantalum capacitors are usually unavailable in sizes above 150µF or for voltages above 35VDC.

Single-layer ceramic capacitors have small values ranging from 0.01µF to 0.22µF, with working voltages usually not exceeding 50VDC, although very small-value capacitors may be rated much higher for special applications. Poor tolerances of +80% to -20% are common.

Some variants of multi-layer ceramic capacitors are capable of storing up to 47µF, although 10µF is a more common upper limit. They are seldom rated above 100VDC. Some are accurate to plus-or-minus 5%.

Dielectric Constant

If A is the area of each plate in a capacitor (measured in square centimeters), and T is the thickness of the dielectric (measured in centimeters), and K is the *dielectric constant* of the capacitor, the capacitance, C (measured in farads) will be obtained from the formula:

```
C = (0.0885 * K * A) / T
```

The dielectric constant of air is 1. Other dielectrics have different standard values. Polyethylene, for instance, has a constant of approximately 2.3. Thus a capacitor of 1 square centimeter plate area and polyethylene dielectric 0.01 centimeters thick would have a capacitance of about 20pF. A tantalum capacitor of equal plate area and dielectric thickness would have capacitance closer to 100pF, since the dielectric constant of tantalum oxide is much higher than that of polyethylene.

The Time Constant

When a capacitor is charged in series through a resistor (it is used in an RC network), and it begins with no charge on its plates, the *time constant* is the time, in seconds, required to charge the capacitor to 63% of the supply voltage. After an additional, identical interval of time, the capacitor will acquire 63% of the remaining difference between itself and the power supply. In theory the capacitor gets closer and closer to a full charge, but never quite reaches 100%. However, five time constants are sufficient for the capacitor to reach 99%, which is regarded as close enough to being fully charged for all practical purposes.

Refer to Figure 12-3 for a schematic of an RC network.

The time constant is a simple function of the resistance and the capacitance. If R is the value of the resistor (in ohms), and C is the value of the capacitor (in farads), the time constant, TC, will be obtained by the formula:

```
TC = R * C
```

If we multiply the R value by 1,000 while dividing the C value by 1,000, the time constant remains the same, and we can use the more convenient values of kilohms for the resistance and µF for the capacitance. In other words, the formula tells us that a 1K resistor in series with a 1,000µF capacitor has a time constant of 1 second.

The formula suggests that if the value of R diminishes to zero, the capacitor will charge instantly. In reality, the charging time will be rapid but finite, limited by factors such as the electrical resistance of the materials used.

Multiple Capacitors

When two or more capacitors are wired in parallel, their total capacitance is the sum of their separate capacitances. When two or more capacitors are wired in series, the relationship between their total capacitance © and their individual capacitances (C1, C2, C3 . . .) is given by this formula:

```
1 / C = (1/C1) + (1/C2) + (1/C3). . .
```

The formula to calculate the total capacitance of capacitors connected in series resembles the one used to calculate the total resistance of resistors connected in parallel. See Chapter 10.

Alternating Current and Capacitive Reactance

The apparent resistance of a capacitor to AC is properly known as *capacitive reactance*. In the following formula, capacitive reactance (X_C, in ohms) is derived as a function of capacitance (C, in farads) and AC frequency (f, measured in hertz):

$$X_C = 1 / (2 * \pi * f * C)$$

The formula shows that when frequency becomes zero, capacitive reactance becomes infinite; in other words, a capacitor has theoretically infinite resistance when DC current tries to flow through it. In reality, a dielectric has a finite resistance, and thus always allows some leakage.

The formula also shows that capacitive reactance diminishes when the size of the capacitor increases and/or the frequency being applied to it increases. From this it appears that an AC signal will be attenuated less at higher frequencies, especially if we use a small capacitor. However, a real-world capacitor also exhibits some degree of *inductive reactance*. This value will depend on its configuration (cylindrical vs. multiple flat plates), its physical length, the materials from which it is fabricated, the lengths of its leads, and other factors. Inductive reactance tends to *increase* with frequency, and since capacitive reactance tends to *decrease* with frequency, at some point the curves for the two functions intersect. This point represents the capacitor's *self-resonant frequency*, which is often referred to simply as its *resonant frequency*. See Figure 12-18.

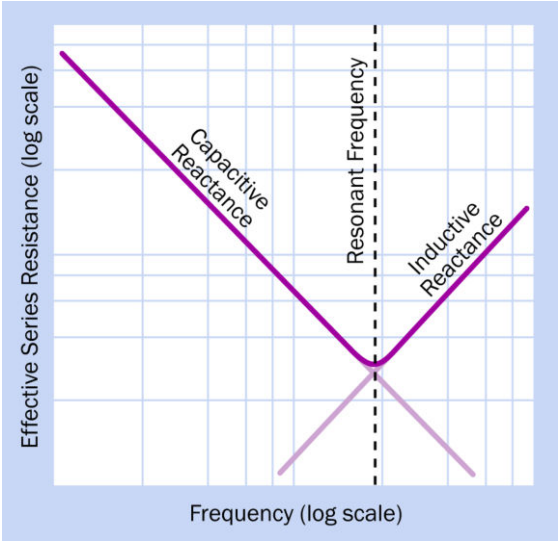

Figure 12-18. *As an AC current applied to a capacitor increases in frequency, the capacitive reactance of the component decreases, while its inductive reactance increases. The resonant frequency of the capacitor is found where the two functions intersect.*

Equivalent Series Resistance

A theoretically ideal capacitor would be purely reactive, without any resistance. In reality, capacitors are not ideal, and they have *equivalent series resistance,* or *ESR*. This is defined as the resistor

that you would have to place in series with an ideal version of the capacitor, so that the combination would behave like the real version of the capacitor on its own.

If X_c is the reactance of the capacitor, then its Q factor (which means its *quality factor*) is given by the simple formula:

$$Q = X_c \ / \ ESR$$

Thus, the quality factor is higher if the ESR is relatively low. However, the reactance of the capacitor will vary significantly with frequency, and this simple formula is only an approximate guide.

The Q-factor for capacitors should not be confused with the Q-factor for inductors, which is calculated quite differently.

How to Use it

The figures illustrate some simplified schematics for common applications.

Bypass Capacitor

In Figure 12-19, a low-value capacitor (often 0.1µF) is placed near the power input pin of a sensitive digital chip to divert high-frequency spikes or noise to negative ground. This *bypass capacitor* may also be described as a *decoupling capacitor*.

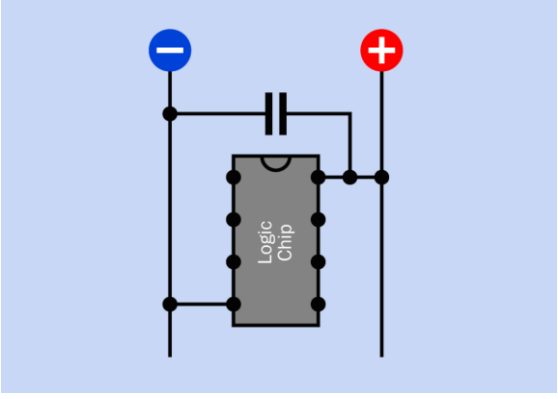

Figure 12-19. *A bypass capacitor (typically 0.1µF) configured to protect an integrated circuit logic chip from voltage spikes and noise in the power supply.*

Coupling Capacitor

In Figure 12-20, a 1µF *coupling capacitor* transmits a pulse from one section of a circuit to another, while blocking the DC voltage. Some reshaping of the waveform may occur.

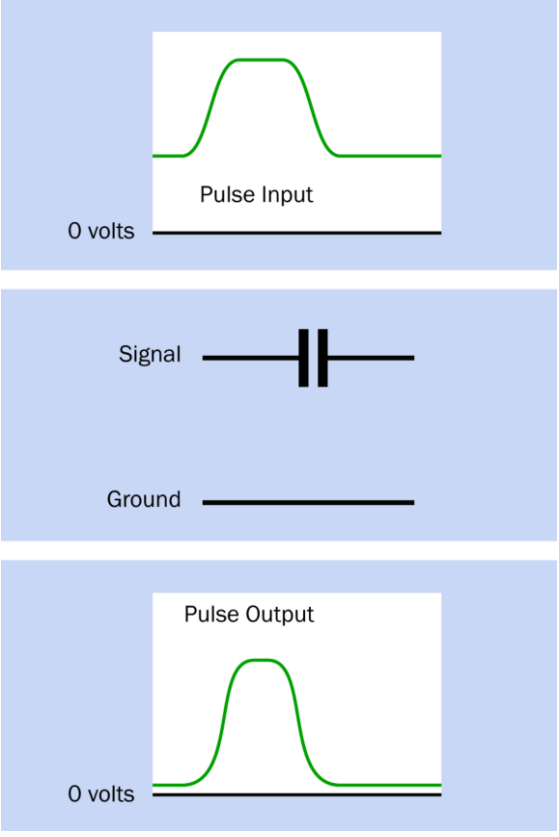

Figure 12-20. *A coupling capacitor (typically around 1µF) preserves DC isolation of one section of a circuit from another, while allowing a pulse to be transmitted.*

High-Pass Filter

In Figure 12-21, a 0.1µF capacitor blocks the low-frequency component of a complex waveform and transmits only the higher frequency that was superimposed on the low frequency.

Low-Pass Filter

In Figure 12-22, a 0.1µF decoupling capacitor diverts the higher frequency component of a complex waveform to negative ground, allowing only

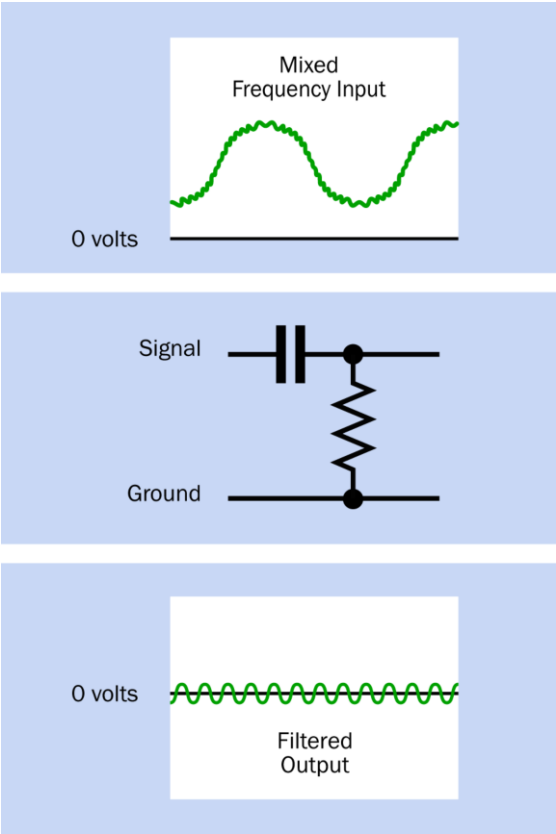

Figure 12-21. *A small capacitor (typically 0.1µF) can be used to create a high-pass filter, passing high frequencies while blocking low frequencies.*

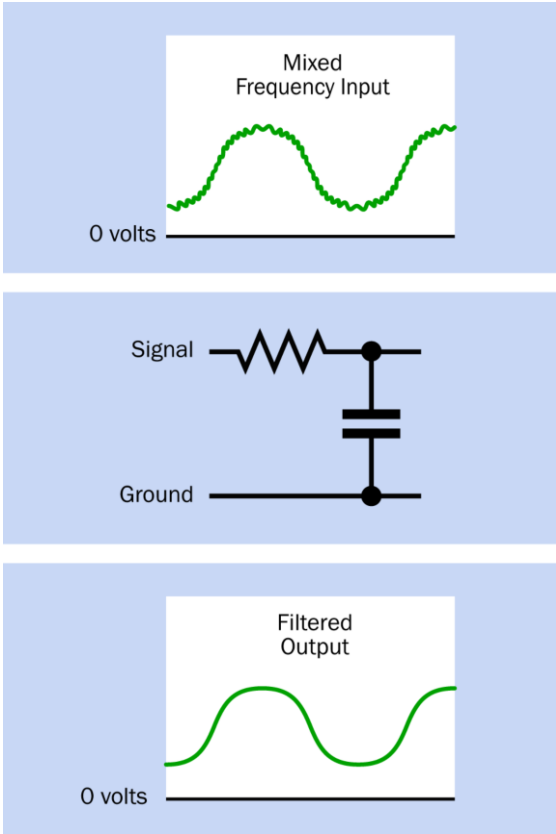

Figure 12-22. *A small capacitor (typically 0.1µF) in this configuration routes high frequencies to negative ground, filtering them out of an analog signal.*

the lower frequency to be preserved. A lower-value capacitor (such as 0.001µF) will bleed away high-frequency noise from an AM radio source without affecting audio frequencies.

Smoothing Capacitor

In Figure 12-23, a 100µF capacitor charges and discharges to smooth an AC signal after a diode has removed the negative portion.

Snubber

In Figure 12-24, an RC network (inside a white dashed line) is known as a *snubber* when used to protect a switch from the problem of *arcing* (pronounced "arking")—that is, a sustained spark that can quickly erode the switch contacts. Arcing may occur in switches, pushbuttons, or relays that control an inductive load, such as a large motor. This problem can become significant at high DC currents (10A or more) or relatively high AC or DC voltages (100V or more).

When the switch is opened, the magnetic field that has been sustained by the inductive load collapses, causing a surge of current, or *forward EMF*. The capacitor in the snubber absorbs this surge, thus protecting the switch contacts. When the switch is closed again, the capacitor discharges itself, but the resistor limits the outrush of current—again, protecting the switch.

A snubber placed around the switch in a DC circuit could typically use a 0.1µF capacitor (polypropylene or polyester) rated for 125VAC/200VDC, and a 100-ohm carbon resistor rated 0.5

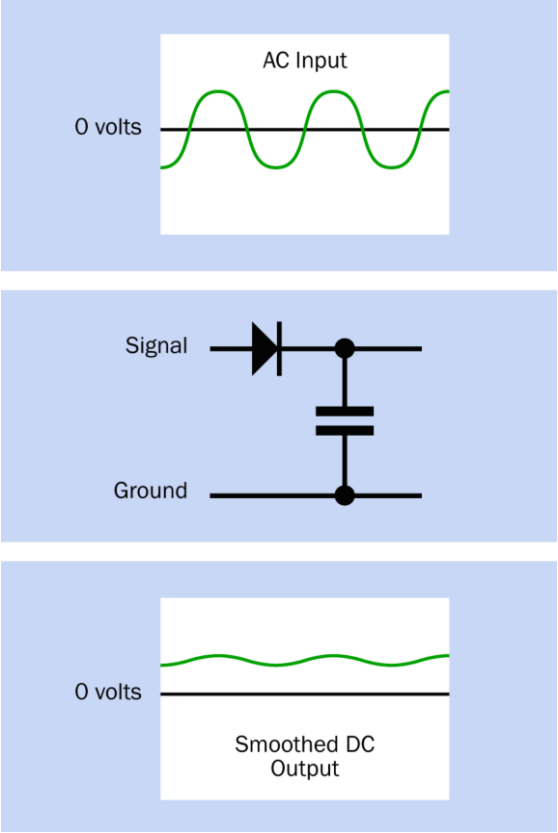

Figure 12-23. *A capacitor of 100µF or more smooths the upper half of an AC signal that has passed through a diode. The capacitor charges during each positive pulse and discharges to "fill the gaps" between them.*

watt or higher. Prepackaged snubbers containing appropriate capacitor-resistor pairs are available from some parts suppliers, primarily for industrial use.

In an AC circuit, a snubber can be placed around the inductive load itself. Although a **diode** is often used this way in a DC circuit, it cannot be used with AC.

Although solid-state switching devices such as a **solid state relay** contain no mechanical contacts, they may still be damaged by substantial pulses of back-EMF, and can be protected by a snubber where they are controlling inductive loads that take 10A or more at 100V or more.

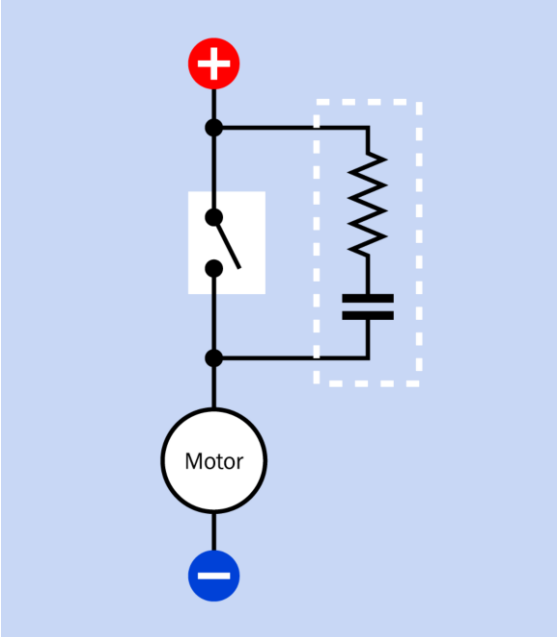

Figure 12-24. *An RC network (outlined with a white dashed line) protects a switch that controls a high inductive load. Used in this way, the RC network is known as a snubber.*

Capacitor as a Battery Substitute

A capacitor may be substituted for a battery for some applications, although it has a lower energy density and will be more expensive to manufacture. A capacitor charges and discharges much more rapidly than a battery because no chemical reactions are involved, but a battery sustains its voltage much more successfully during the discharge cycle.

Capacitors that can store a very large amount of energy are often referred to as *supercapacitors.*

What Can Go Wrong

Common problems associated with capacitors are age-related deterioration (especially in electrolytics), inductive reactance (especially in cylindrical formats), nonlinear response, resistivity, excessive current leakage, and dielectric memory. Some of these problems are discussed below. A manufacturer's datasheet should be consulted

carefully in conjunction with the notes regarding compositions in the preceding Variants section before making a commitment to a particular type of capacitor.

Wrong Polarity

A polarized capacitor may offer virtually no resistance if it is connected the wrong way around to a DC power source. A very high current can result, damaging the capacitor and probably other components in the circuit. Failing to observe the polarity of a tantalum capacitor can have destructive or even explosive consequences, depending on the amperage.

Voltage Overload

If the DC working voltage of a capacitor is exceeded, there is a risk of breaking down the dielectric and allowing a spark, or arc, that will form a short circuit. Note that the DC rating of a capacitor does not mean that it can be used safely with an equivalent AC voltage. The maximum AC voltage should be no greater than approximately 0.7 times the DC rated voltage. If a DC-rated capacitor is used directly across an AC power line, it will create an effective short circuit.

If capacitors are connected in series or in parallel, ideally the voltage rating for each capacitor should be the same, and certainly no less than the supply voltage.

Tantalum capacitors are easily damaged by current spikes that exceed their maximum working voltage, and are unsuitable for high-frequency coupling because of their inductance.

Leakage

Charge leakage is a problem especially associated with electrolytic capacitors, which are not suitable for storing a charge over a significant interval. Polypropalene or polystyrene film capacitors are a better choice.

Dielectric Memory

Also known as *dielectric absorption*, this is a phenomenon in which a capacitor's electrolyte displays some percentage of its former voltage after the capacitor has been discharged and then disconnected from the circuit. Single-layer ceramic capacitors especially tend to suffer from this problem.

Specific Electrolytic Issues

Electrolytic capacitors have high inductive reactance, are not manufactured to close tolerances, and deteriorate significantly with age. While other components may be stockpiled and used over a period of years, this is not a sensible policy with electrolytics.

The "capacitor plague" affecting many of these capacitors manufactured from 1999 onward provided a salutary lesson regarding their potential weaknesses. Faulty composition of the dielectric allowed it to deteriorate, liberating hydrogen gas, which eventually caused the aluminum shells of the capacitors to bulge and burst. Circuit boards from major manufacturers were affected. Because the problem took two years to become apparent, literally millions of boards with faulty capacitors had been sold before the fault was diagnosed and eventually corrected.

Unfortunately electrolytics cannot be easily replaced with other types of capacitors in applications such as power supplies, because substitutes will be considerably larger and more expensive.

Heat

The equivalent series resistance (ESR) of a large capacitor inevitably means that it must dissipate some power as heat during use. Ripple current can also create heat. Capacitor performance will change as the temperature increases. A common maximum component temperature for electrolytic capacitors is 85 degrees Centigrade.

Vibration

In a high-vibration environment, electrolytics should be protected by clamping them mechanically in place, using a *capacitor clamp*, also known as a *c-clamp*.

Misleading Nomenclature

Rarely, in the United States, the term "mF" may be used as a probable alternative to µF. This can be a source of confusion and risk because mF is properly (but very rarely) used to mean "millifarads." The term should always be avoided.

variable capacitor

13

Formerly known (primarily in the United Kingdom) as a *variable condenser*. The term is now obsolete.

OTHER RELATED COMPONENTS

- **capacitor** (See Chapter 12)

What It Does

A variable capacitor allows adjustment of capacitance in much the same way that a **potentiometer** allows adjustment of resistance.

Large variable capacitors were developed primarily to tune radio receivers, in which they were known as *tuning capacitors*. Cheaper, simpler, and more reliable substitutes gradually displaced them, beginning in the 1970s. Today, they are still used in semiconductor fabrication, in RF plastic welding equipment, in surgical and dental tools, and in ham radio equipment.

Small *trimmer capacitors* are widely available and are mostly used to adjust high-frequency circuits. Many of them look almost indistinguishable from *trimmer potentiometers*.

The schematic symbols commonly used to represent a variable capacitor and a trimmer capacitor are shown in Figure 13-1.

A *varactor* is a form of diode with variable capacitance, controlled by reverse voltage. See "Varactor Diode" (page 225) for this component.

How It Works

The traditional form of variable capacitor consists of two rigid semicircular plates separated by an air gap of 1mm to 2mm. To create more capacitance, additional interleaved plates are added to form a stack. One set of plates is known as the *rotor*, and is mounted on a shaft that can be turned, usually by an externally accessible knob. The other set of plates, known as the *stator*, is mounted on the frame of the unit with ceramic insulators. When the sets of plates completely overlap, the capacitance between them is maximized. As the rotor is turned, the sets of plates gradually disengage, and the capacitance diminishes to near zero. See Figure 13-2.

Figure 13-1. *Typical schematic symbols for variable capacitor (left) and trimmer capacitor (right).*

The air gaps between the sets of plates are the *dielectric*. Air has a dielectric constant of approximately 1, which does not vary significantly with temperature.

The most common shape of plate is a semicircle, which provides a linear relationship between capacitance and the angle of rotation. Other shapes have been used to create a nonlinear response.

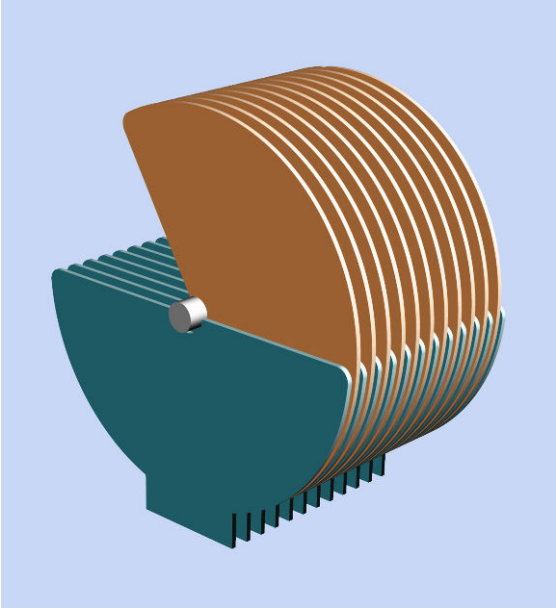

Figure 13-2. *In this simplified view of a variable capacitor, the brown plates constitute the rotor, attached to a central shaft, while the blue plates are the stator. The colors have no electrical significance and are added merely for clarity. The area of overlap between rotor and stator determines the capacitance.*

Reduction gears may be used to enable fine tuning of a variable capacitor, which means multiple turns of a knob can produce very small adjustments of the capacitor. At the peak of variable capacitor design, units were manufactured with high mechanical precision and included *anti-backlash gears*. These consisted of a pair of equal-sized gears mounted flat against each other with a spring between them that attempted to turn the gears in opposite directions from each other. The pair of gears meshed with a single pinion, eliminating the looseness, or backlash, that normally exists when gear teeth interlock. A vintage capacitor with a spring creating anti-backlash gearing (circled) is shown in Figure 13-3. This is a two-gang capacitor—it is divided into two sections, one rated 0 to 35pF, the other rated 0 to 160pF.

Figure 13-3. *A "traditional style" variable capacitor of the type designed to tune radio frequencies. The spring, circled, enables anti-backlash gearing.*

Variants

The traditional variable capacitor, with exposed, air-spaced, rigid, rotating vanes, is becoming hard to find. Small, modern variable capacitors are entirely enclosed, and their plates, or vanes, are not visible. Some capacitors use a pair of concentric cylinders instead of plates or vanes, with an external thumb screw that moves one cylinder up or down to adjust its overlap with the other. The overlap determines the capacitance.

Trimmer capacitors are available with a variety of dielectrics such as mica, thin slices of ceramic, or plastic.

Values

A large traditional capacitor can be adjusted down to a near-zero value; its maximum will be no greater than 500pF, limited by mechanical factors. (See Chapter 12 for an explanation of capacitance units.)

A maximum value for a trimmer capacitor is seldom greater than 150pF. Trimmers may have their values printed on them or may be color-coded, but there is no universal set of codes. Brown, for example, may indicate either a maximum value around 2pF or 40pF, depending on the manufacturer. Check datasheets for details.

The upper limit of a trimmer's rated capacitance is usually no less than the rated value, but can often be 50% higher.

Formats

All trimmer capacitors are designed for mounting on circuit boards. Many are surface-mount, with a minority being through-hole. Surface-mount units may be 4mm × 4mm or smaller. Through-hole are typically 5mm × 5mm or larger. Superficially, trimmer capacitors resemble single-turn trimmer potentiometers with a screw head in the center of a square package. A through-hole example is shown in Figure 13-4.

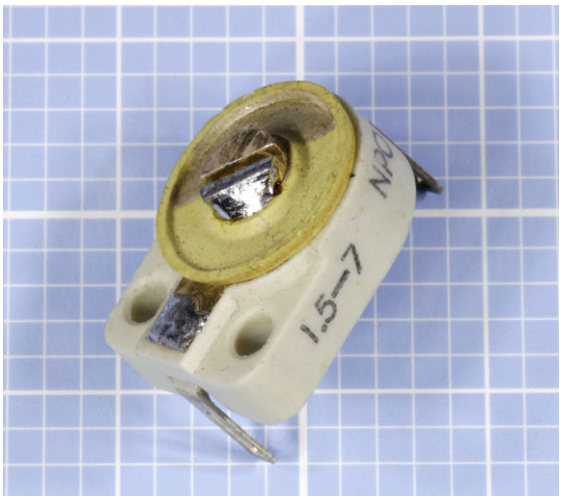

Figure 13-4. *A trimmer capacitor rated 1.5pF to 7.0pF.*

How to Use it

A variable capacitor is often used to tune an *LC circuit,* so called because a coil (with reactance customarily represented by letter L) is wired in parallel with a variable capacitor (represented by letter C). The schematic in Figure 13-5 shows an imaginary circuit to illustrate the principle. When the switch is flipped upward, it causes a large fixed-value capacitor to be charged from a DC power source. When the switch is flipped down, the capacitor tries to pass current through the coil—but the coil's *reactance* blocks the current and converts the energy into a magnetic field. After the capacitor discharges, the magnetic field collapses and converts its energy back into electricity. This flows back to the capacitor, but with inverted polarity. The cycle now repeats with current flowing in the opposite direction. A low-current **LED** across the circuit would flash as the voltage oscillates, until the energy is exhausted.

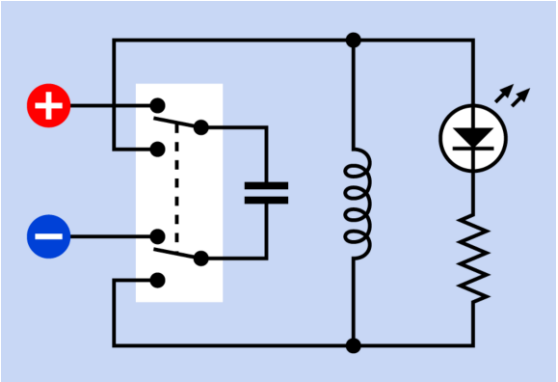

Figure 13-5. *In this imaginary circuit, the capacitor is charged through the double-pole switch in its upper position. When the switch is turned, the capacitor forms an LC (inductance-capacitance) circuit with the coil, and resonates at a frequency determined by their values. In reality, extremely high values would be needed to obtain a visible result from the LED.*

Because the oscillation resembles water sloshing from side to side in a tank, an LC circuit is sometimes referred to as a *tank circuit.*

In reality, unrealistically large values would be required to make the circuit function as described. This can be deduced from the following formula, where f is the frequency in Hz, L is inductance in Henrys, and C is capacitance in Farads:

$$f = 1 / (2\pi * \sqrt{(L * C)})$$

For a frequency of 1Hz, a massive coil opposite a very large capacitor of at least 0.1F would be needed.

However, an LC circuit is well-suited to very high frequencies (up to 1,000MHz) by using a very small coil and variable capacitor. The schematic in Figure 13-6 shows a high-impedance earphone and a diode (right) substituted for the LED and the resistor in the imaginary circuit, while a variable capacitor takes the place of the fixed capacitor. With the addition of an antenna at the top and a ground wire at the bottom, this LC circuit is now capable of receiving a radio signal, using the signal itself as the source of power. The resonant frequency of the circuit is tuned by the variable capacitor. The impedance peaks at the resonant frequency, causing other frequences to be rejected by passing them to ground. With suitable refinement and amplification, the basic principle of an LC circuit is used in AM radios and transmitters.

Because variable capacitors are so limited in size, they are unsuitable for most timing circuits.

Trimmer capacitors are typically found in high-power transmitters, cable-TV transponders, cellular base stations, and similar industrial applications.

They can be used to fine-tune the resonant frequency of an oscillator circuit, as shown in Figure 13-7.

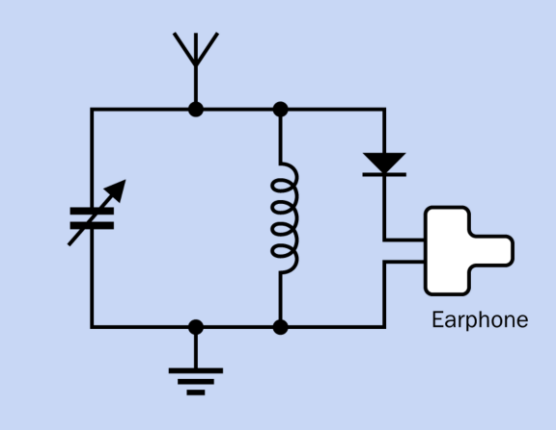

Figure 13-6. *The principle of an LC circuit is used here in a basic circuit that can tune in to a radio station and create barely audible sound through the earphone at right, using only the broadcast signal for power. The variable capacitor adjusts the frequency of the circuit to resonate with the carrier wave of the radio signal.*

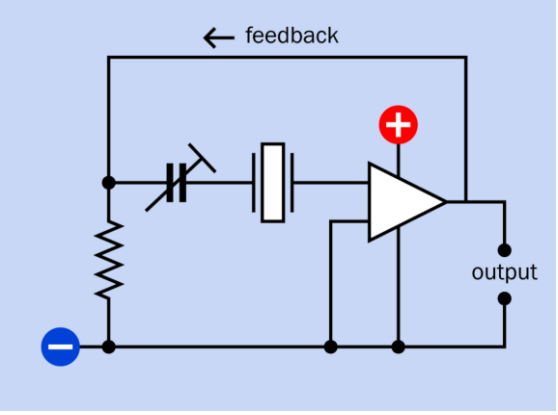

Figure 13-7. *A trimmer capacitor in series with a crystal fine-tunes the frequency of this basic circuit using an op-amp.*

In addition to tuning a circuit frequency, a trimmer capacitor can be used to compensate for changes in capacitance or inductance in a circuit that are caused by the relocation of wires or rerouting of traces during the development process. Readjusting a trimmer is easier than swapping fixed-value capacitors. A trimmer may also be used to compensate for capacitance in a circuit that gradually drifts with age.

What Can Go Wrong

Failure to Ground Trimmer Capacitor While Adjusting it

Although trimmer capacitors are not polarized, the manufacturer may mark one terminal with a plus sign and/or the other with a minus sign. If the capacitor is adjusted while its negative terminal is floating or ungrounded, a metal screwdriver blade will create erroneous readings. Always ground the appropriate side of a trimmer capacitor before fine-tuning it, and preferably use a plastic-bladed screwdriver.

Application of Overcoat Material or "Lock Paint"

Overcoat material is a rubbery adhesive that may be spread over assembled components to immunize them against moisture or vibration. *Lock paint* is a dab of paint that prevents a screw adjustment from turning after it has been set. Most manufacturers advise against applying these materials to a trimmer capacitor, because if penetration occurs, the capacitor can fail.

Lack of Shielding

Variable capacitors should be shielded during use, to protect them from external capacitive effects. Merely holding one's hand close to a variable capacitor will change its value.

inductor

14

The term **inductor** is used here to describe a coil that has the purpose of creating *self-inductance* in an electronic circuit, often while passing alternating current in combination with resistors and/or capacitors. A *choke* is a form of inductor. By comparison, the **electromagnet** entry in this encyclopedia describes a coil containing a center component of ferromagnetic material that does not move relative to the coil, and has the purpose of attracting or repelling other parts that respond to a magnetic field. A coil containing a center component of ferromagnetic material that moves as a result of current passing through the coil is considered to be a **solenoid** in this encyclopedia, even though that term is sometimes more broadly applied.

OTHER RELATED COMPONENTS

- **solenoid** (See Chapter 21)
- **electromagnet** (See Chapter 20)

What It Does

An inductor is a coil that induces a magnetic field in itself or in a *core* as a result of current passing through the coil. It may be used in circuits to block or reshape AC current or a range of AC frequencies, and in this role can "tune" a simple radio receiver or various types of oscillators. It can also protect sensitive equipment from destructive voltage spikes.

The schematic symbol for an inductor includes a coil that can be drawn in two basic styles, shown at the top and at the bottom of Figure 14-1. The style at the bottom has become more common. In each vertical section of the diagram, the functionality of the symbols is identical.

One or two parallel lines alongside the coil indicate that it is wound around a solid core of material that can be magnetized, while one or two dotted lines indicate that it is wound around a core containing metal particles, such as iron filings. Where no core is shown, this indicates an air core.

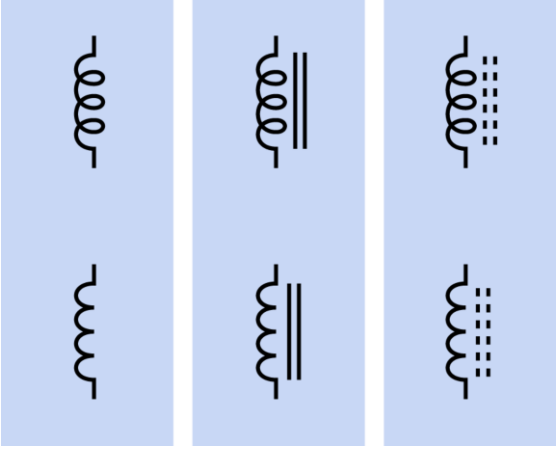

Figure 14-1. *The coil symbol for an inductor may be drawn in two styles which are functionally identical. Line(s) beside the coil indicate a solid core. Dotted line(s) indicate a core containing metal particles.*

A selection of inductors designed for through-hole mounting is shown in Figure 14-2.

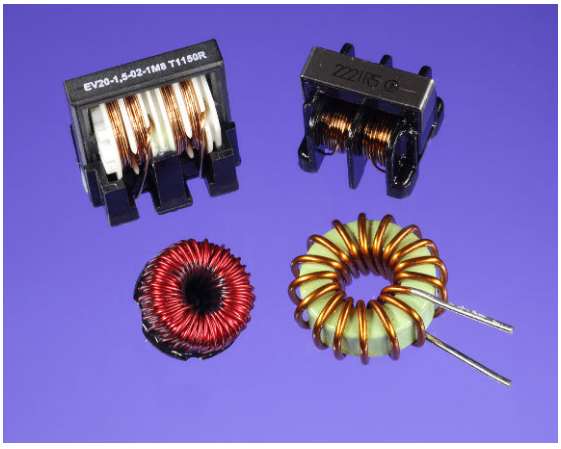

Figure 14-2. *Four inductors designed for through-hole insertion into printed circuit boards.*

How It Works

Direct current passing through an electrical conductor, such as a wire, creates a magnetic field around the conductor. In Figure 14-3, *conventional current* (flowing from positive to negative) is passing through a straight wire from left to right, as indicated by the red/blue arrow. The resulting magnetic field is indicated by the green arrows. If the wire is now bent into a curve, as shown in Figure 14-4, the magnetic field exerts an aggregate force downward through the curve. This magnetic force is conventionally said to flow from *south* to *north*.

If direct current could be induced to circulate through an unbroken circle of wire, the resulting magnetic field could exert a force through the circle as shown in Figure 14-5, assuming clockwise circulation of conventional current as suggested by the red/blue arrows.

Conversely, if a magnet was pushed through the center of the circle, it would induce a pulse of electric current in the circle. Thus, electricity passing through a wire can induce a magnetic field around the wire, and conversely, a magnet moving near a wire can induce an electric current

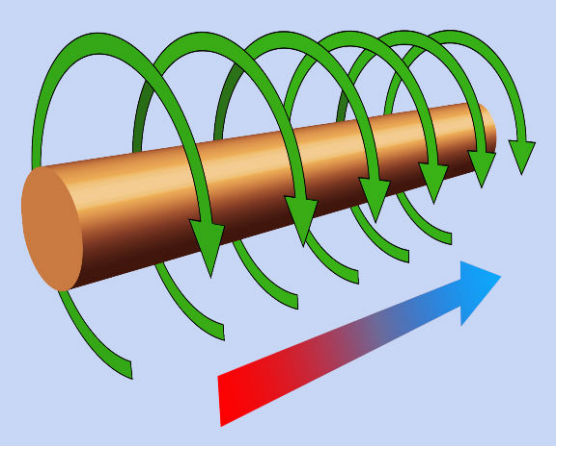

Figure 14-3. *Conventional current passing through a wire from left to right (as indicated by the red/blue arrow) induces a magnetic field around the wire (shown by the green arrows).*

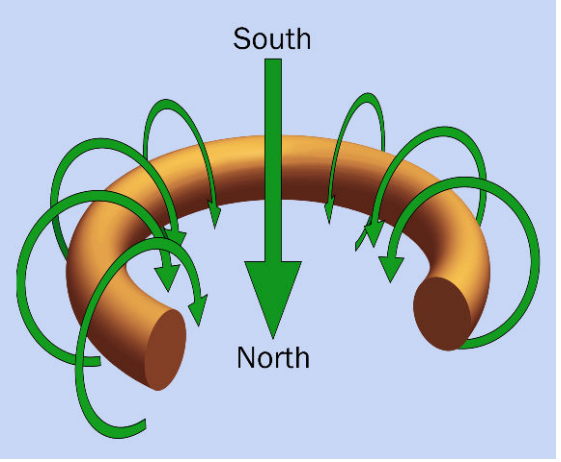

Figure 14-4. *If the wire is bent into a curve, the magnetic fields can create a net force shown by the large green arrow.*

in the wire. This principle is used in an electrical *generator*, and also in a **transformer**, where alternating current in the primary coil induces a fluctuating magnetic field in the core, and the field in the core is turned back into alternating current in the secondary coil.

Note that a static or unchanging magnetic field will not induce a flow of electricity.

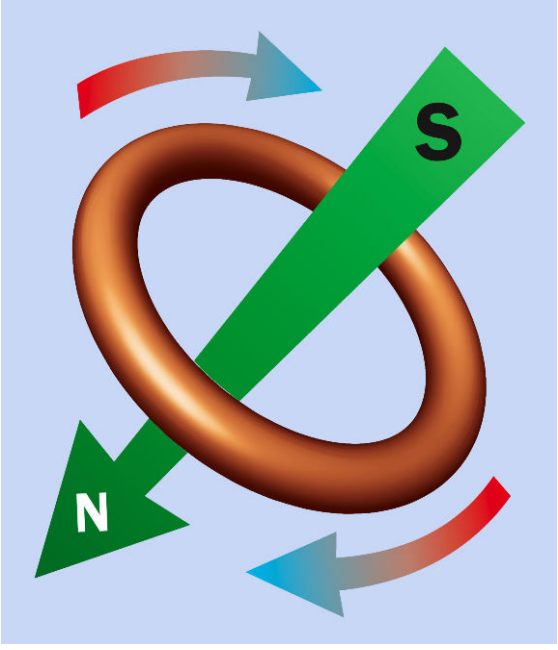

Figure 14-5. *Hypothetically, if conventional current flows around a circular conductor (as suggested by the red/blue arrows), it will create a magnetic field that can create a force as shown by the green arrow.*

DC Through a Coil

If the wire is formed into a helix (a series of approximate circles) as shown in Figure 14-6, and if DC current is passed through the wire, the aggregate of the magnetic fields can create a force in the direction of the green arrow in each example, depending whether the wire is wound clockwise or counter-clockwise, and depending on the direction of the current. The helix is usually referred to as a *coil* or a *winding*.

In actuality, a magnetic field is not open-ended, and its lines of force are completed by circling around outside the inductor, to complete a *magnetic circuit*. This completion of the field can be demonstrated by the traditional high-school experiment of positioning a compass or scattering iron filings on a sheet of paper above a magnet. A simplified depiction of lines of force completing a magnetic circuit is shown in Figure 14-7,

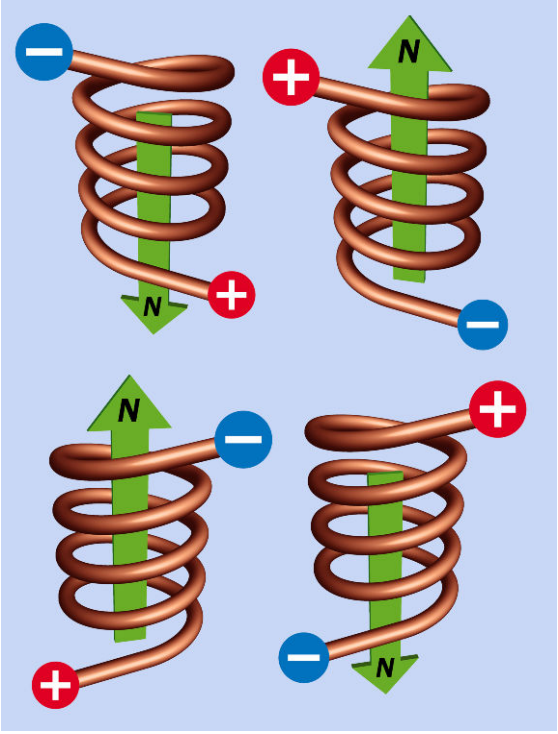

Figure 14-6. *When DC current flows through a coil, it creates magnetic fields that will exert a force whose direction depends on the direction of the current and on whether the coil is wound clockwise or counterclockwise. The force is shown by the green arrow in each case.*

where a coil is inducing the magnetic field. Note that throughout this encyclopedia, the color green is used to indicate the presence of magnetic force.

The completion of a magnetic field is not relevant to the primary function of the inductor. In fact the external part of the magnetic field is mostly a source of trouble in electronics applications, since it can interact with other components, and may necessitate the use of magnetic shielding. In addition, the field is weakened by completing itself through air, as air presents much greater *reluctance* (the magnetic equivalent of resistance) than the core of an electromagnet.

The polarity of a magnetic field created by a coil can be demonstrated by moving a small permanent magnet toward the coil, as shown in

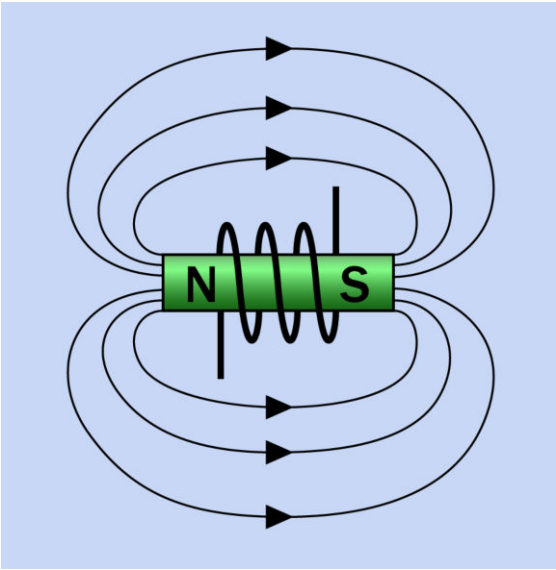

Figure 14-7. *A magnetic field in reality is not open-ended, and each line of force traveling through a rod-shaped magnet or electromagnet is completed outside of the magnet. The completion of magnetic fields has been omitted from other diagrams here for clarity.*

Figure 14-8. If the magnet has opposite polarity to the coil, it will tend to be repelled, as like poles repel. If it has the same polarity, it will tend to be attracted, because opposite poles attract. This principle may be used in **solenoids**.

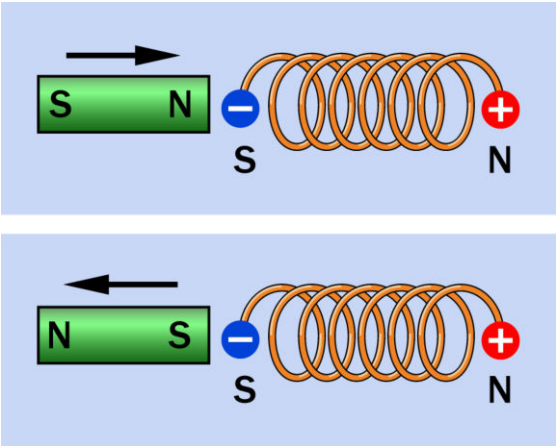

Figure 14-8. *A permanent magnet (left) will either be drawn toward a DC-energized coil or repelled from it, depending on the polarity of the two magnetic fields.*

Magnetic Core

The inductive power of a coil will be enhanced, and the saturation point will be reduced, by using a *magnetic core*. The term "magnetic" in this context does not mean that the core is a permanent magnet; it means that the core can be magnetized briefly by a transient pulse of electricity through the surrounding coil.

A core enhances the effectiveness of an inductor because it has a lower reluctance than that of air. In other words, magnetic flux will flow much more readily through the core than through air.

Roughly speaking, the *permeability* of a magnetic circuit is the opposite of reluctance; it is a measure of how easily a magnetic field can be induced, and is usually expressed relative to the permeability of air, which is approximately 1. The permeability of different core types is discussed in the following "Values" section.

The core of the coil contains *magnetic domains* that behave as tiny magnets, with north and south poles. In the absence of a polarizing magnetic field, the domains are randomly aligned. As a magnetic field is introduced around them and grows stronger, the domains align themselves with it, increasing the total magnetic force. When the domains are almost all uniformly aligned, the core approaches *magnetic saturation* and ceases adding to the net magnetic field. At this point the current in the inductor is said to be *continuous*.

When power to the coil is disconnected, the domains revert partially to their previous random orientation. Thus the core remains a weak permanent magnet. This effect is known as *hysteresis*, while the weak residual field is known as *remanent magnetism*.

EMF and Back-EMF

When DC current is connected through an inductor, the creation of a magnetic field takes a brief but measurable period of time. The field induces an *EMF* (*electro-motive force*) in the wire. Since this force opposes the supplied current, it

is referred to as *back-EMF*. It lasts only so long as the field is increasing to its full strength. After the field reaches a steady state, current flows through the coil normally.

This transient resistive effect is caused by the *self-inductance* of the coil, and is opposite to the behavior of a capacitor, which encourages an initial inrush of direct current until it is fully charged, at which point it blocks subsequent current flow.

When high-frequency alternating current attempts to flow through an inductor, if each pulse is too brief to overcome the back-EMF, the coil will block the current. A coil can thus be designed to block some frequencies but not others.

Even a simple electrical circuit that does not contain a coil will still have some self-inductance, simply because the circuit consists of wires, and even a straight length of wire induces a magnetic field when the power is switched on. However, these inductive effects are so small, they can generally be ignored in practical applications.

The transient electrical resistance to alternating current caused by either an inductor or a capacitor is known as *reactance*, although it occurs under opposite electrical conditions, as the coil impedes an initial pulse of DC current and then gradually allows it to pass, while a capacitor allows an initial pulse of DC current and then impedes it.

When a flow of DC current through a coil is switched off, the magnetic field that was created by the coil collapses and releases its stored energy. This can cause a pulse of forward EMF, and like back-EMF, it can interfere with other components in a circuit. Devices such as motors and large relays that contain substantial coils can create problematic spikes of back-EMF and forward-EMF. The forward-EMF that occurs when power to the coil is interrupted is typically dealt with by putting a diode in parallel with the coil, allowing current to circulate through it. This is known as *clamping* the voltage transient. A diode-capacitor combination known as a *snubber* is also commonly used. For a schematic and additional information on this topic, see "Snubber" (page 108).

A schematic to demonstrate EMF and back-EMF is shown in Figure 14-9. The coil can be a 100-foot spool of 26-gauge (or smaller) hookup wire, or magnet wire. It will function more effectively if a piece of iron or steel, such as half-inch galvanized pipe, is inserted through its center. When the button is pressed, current is briefly impeded by the back-EMF created by the coil, and is diverted through D1, making it flash briefly. Then the coil's reactance diminishes, allowing the current to flow through the coil and bypass the LED. When the pushbutton is released, the coil's magnetic field collapses, and the consequent forward-EMF circulates through D2, causing it to flash briefly. Note that the polarity of back-EMF and forward-EMF are opposite, which is why the LEDs in the circuit are oriented with opposite polarities.

The 220Ω resistor should be rated at 1/4 watt minimum, and the button should not be held down for long, as the electrical resistance of the coil is relatively low. The LEDs ideally should be rated for a minimal forward current of no more than 5mA.

Electrical and Magnetic Polarity

Various mnemonics and images have been created to assist in memorizing the polarity or direction of the magnetic field that will be created by a flow of electricity. The *right-hand rule* suggests that if the fingers of the right hand are curled around a coil in the same direction in which the turns of the coil were wound, and if conventional DC current also flows in this direction, the extended thumb will point in the direction of the principal force that can be created by the magnetic field.

By convention, the magnetic field is oriented from *south* to *north*, which can be remembered since the north end of the magnetic field will be

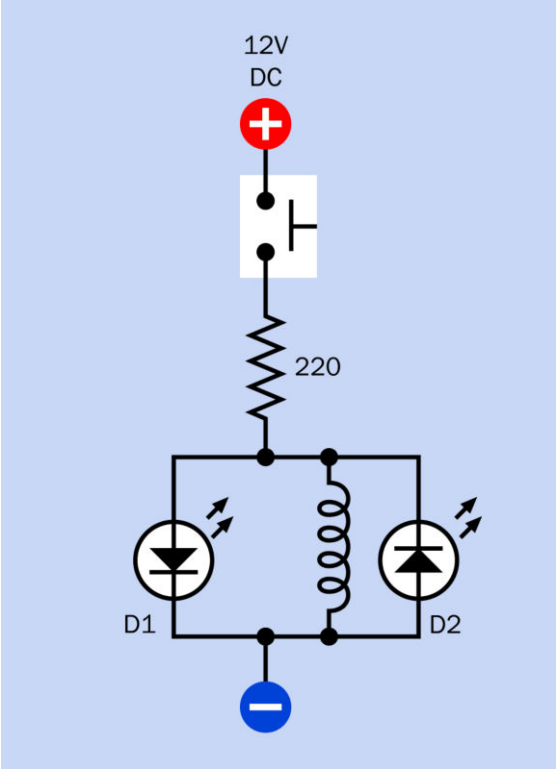

Figure 14-9. *A test circuit to demonstrate the EMF and back-EMF created when DC current starts and stops passing through a coil. See text for details.*

the negative end of the coil (north and negative both beginning with letter N). This mnemonic only works if conventional (positive) current flows through a coil that is wound clockwise.

Another model is the "corkscrew rule" in which we imagine conventional DC current flowing from the handle of a corkscrew, down through its metal section, toward the pointed end. If the corkscrew is turned clockwise, in the same direction as the electricity, the corkscrew will sink into the cork in the same as the direction as the resulting magnetic force.

Variants

Variants include core materials, core shapes, termination style (for through-hole mounting in perforated board, or for surface-mount), and external finish (some inductors are dipped in insulating material, while others allow their copper magnet wire to be exposed).

In addition there are two functional variants: variable inductors and ferrite beads. Their schematic symbols are shown in Figure 14-10.

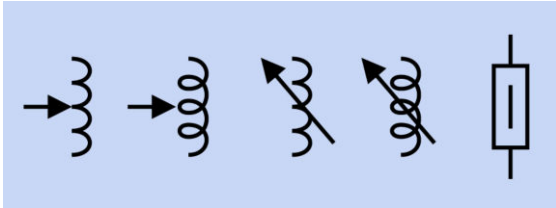

Figure 14-10. *Schematic symbols for a ferrite bead (farthest right) and variable inductors (all other symbols, which are functionally identical).*

Magnetic Cores

A magnetic core may be made from solid iron, plates of iron or steel separated by thin insulating material, powdered iron mixed with a binder, or a ferrite compound derived from nickel, zinc, manganese, or a combination. An iron core has at least 1,000 times the permeability of air, while some ferrites are 10,000 times as permeable.

One major disadvantage of a magnetic core is *hysteresis*, which in this context refers to the tendency of the core to retain some magnetic "memory" as a cycle of alternating current changes from positive to negative. This residual magnetism must be overcome by the next positive pulse of AC. The tendency of the core to retain magnetic polarity is known as its *retentivity*. Iron cores are especially retentive.

Another disadvantage of some magnetic cores is that they may host eddy currents induced by the magnetic field of the coil. These electrical currents tend to circulate through the core, reducing efficiency by generating waste heat, especially if coil currents are high. Forming a core from iron or steel plates, separated by thin layers of insulation, will inhibit these currents. Powdered iron

inhibits eddy currents because the particles have limited contact. Ferrites are nonconductive, and are therefore immune to eddy currents. They are widely used.

Hysteresis and eddy currents both incur energy losses with each AC cycle. Therefore, the losses increase linearly as the AC frequency increases. Consequently, inductor cores that suffer either of these problems are not well-suited to high frequencies.

Nonmagnetic Cores

The problems associated with magnetic cores may be avoided by winding the coil around a nonmagnetic core that may be hollow, ceramic, or plastic. A hollow core is referred to as an *air core*. The permeability of ceramic and plastic cores is close to that of air.

An inductor with a nonmagnetic core will be immune to eddy currents and retentivity, but will have to be significantly larger than a magnetic-cored coil with comparable inductance. In the case of a very primitive radio receiver, such as a crystal set, the air-cored coil that selects a radio frequency may be several inches in diameter. A basic circuit diagram for a crystal set (so-called because it uses a diode containing a germanium crystal) is shown in Figure 14-11. The antenna, at top, receives signals broadcast from radio stations. The coil can be tapped (as indicated by the black dots) as a simple way to select different inductance values, blocking all but a narrow range of frequencies. The T-shaped white component at right is a high-impedance earphone. The diode blocks the lower half of the alternating current in a radio signal, and since the signal is *amplitude-modulated*, the earphone responds to variations in intensity in the signal and reproduces the sound encoded in it.

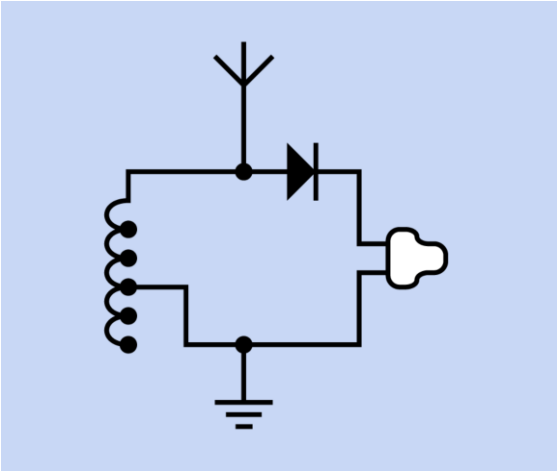

Figure 14-11. *An early and basic application for an inductor is to select radio-station frequencies, as in this schematic for a crystal set. See text for details.*

Variable Inductors

A *variable inductor*, also known as an *adjustable inductor*, is relatively uncommon but can be fabricated by using a magnetic core that penetrates the center of the inductor on an adjustable screw thread. The inductance of the assembly will increase as a larger proportion of the magnetic core penetrates into the open center of the coil. A photograph of a variable inductor is at Figure 14-12.

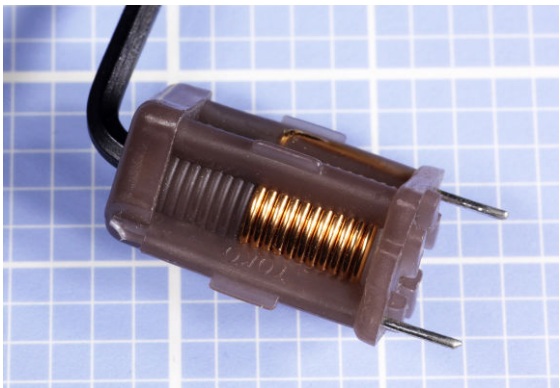

Figure 14-12. *A variable inductor. Its inductance is adjusted via a screw thread that varies the insertion of the core in the coil. In this component the core is turned by inserting a hex wrench, as shown. It is rated from 0.09μH to 0.12μH.*

Ferrite Beads

A *ferrite bead* inverts the design of a typical inductor by running a wire through a hole in the center of the bead, instead of coiling the wire around the core. Two ferrite beads are shown in Figure 14-13. At top, the bead is divided into two sections, each mounted in one-half of a plastic clam shell, which can be closed around a wire. At bottom, the bead must be threaded onto a wire. The purpose is either to limit radio-frequency radiation from a wire by absorbing it into the bead (where it is transformed into heat), or to protect a wire from external sources of radio-frequency radiation. Computer cabling to external devices; lamp dimmers; and some types of motors can be sources of radio frequency.

Figure 14-13. *Two examples of ferrite beads. They can inhibit radio-frequency radiation from a wire, or protect the wire from interference.*

Toroidal Cores

The magnetic circuit created by a rod-shaped core must be completed by the lines of force traveling back around from one end of the rod to the other, through the surrounding air. Since air has low permeability, this is a major source of inefficiency. By comparison, a torus (a geometrical shape resembling a donut) completes the entire magnetic circuit inside its core. This significantly increases its efficiency. Also, because its field is better contained, a toroidal inductor needs little or no shielding to protect other components from stray magnetic effects.

Two through-hole toroidal inductors are shown in Figure 14-2. Bottom left: Rated at 345µH. Bottom right: Rated at 15µH. The one at bottom-left has pins beneath it for insertion into a printed circuit board.

Surface-mount inductors often are toroidal to maximize the efficiency of a component that has to function on a very small scale. Examples are shown in Figure 14-14, Figure 14-15, and Figure 14-16.

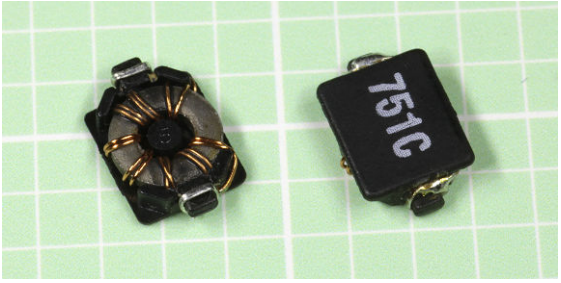

Figure 14-14. *In a typical toroidal inductor, the coil is wrapped around a magnetic core shaped as a torus. This surface-mount component (viewed from the bottom, at left, and from the top, at right) is at the low end of the range of component sizes. It is rated at 750nH.*

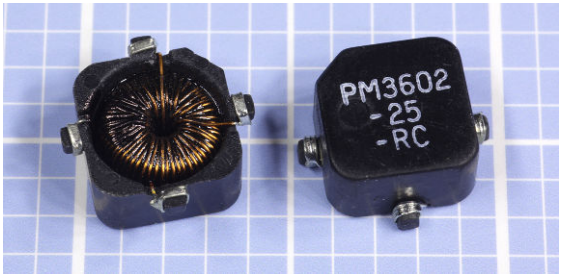

Figure 14-15. *A medium-sized surface-mount toroidal inductor (viewed from the bottom, at left, and from the top, at right). It is rated at 25µH.*

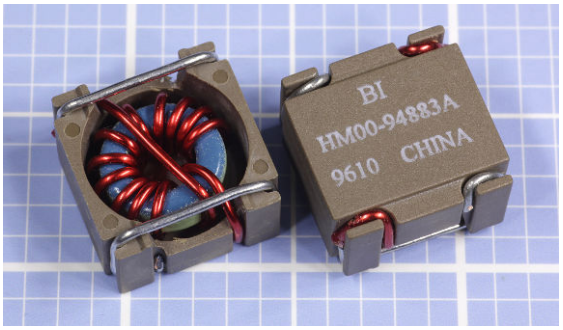

Figure 14-16. *A larger-sized surface-mount toroidal inductor (viewed from the bottom, at left, and from the top, at right). It is rated at 3.8μH.*

A chart showing some types of inductor cores, their commonly available inductances, and their maximum frequencies is shown in Figure 14-17.

Gyrator

A *gyrator* is a small network, sometimes encapsulated in a silicon chip, using **resistors**, a semiconductor, and a **capacitor** to simulate some but not all of the behavior of a coil-based inductor. The semiconductor may be a transistor or a capacitor, depending on the specific circuit. A sample schematic is shown in Figure 14-18. Because no magnetic effects are induced, the gyrator is completely free from the problems of saturation and hysteresis, which affect coils with cores, and also produces no back-EMF. It simply attenuates a signal initially, and then gradually lowers its reactance, thus imitating this aspect of an inductor.

A gyrator may be used where a coil may be unacceptably large (as in a cellular phone) or where signal quality is of paramount importance—for example, in a graphic equalizer or other audio components that perform signal processing at input stages, such as preamplifiers.

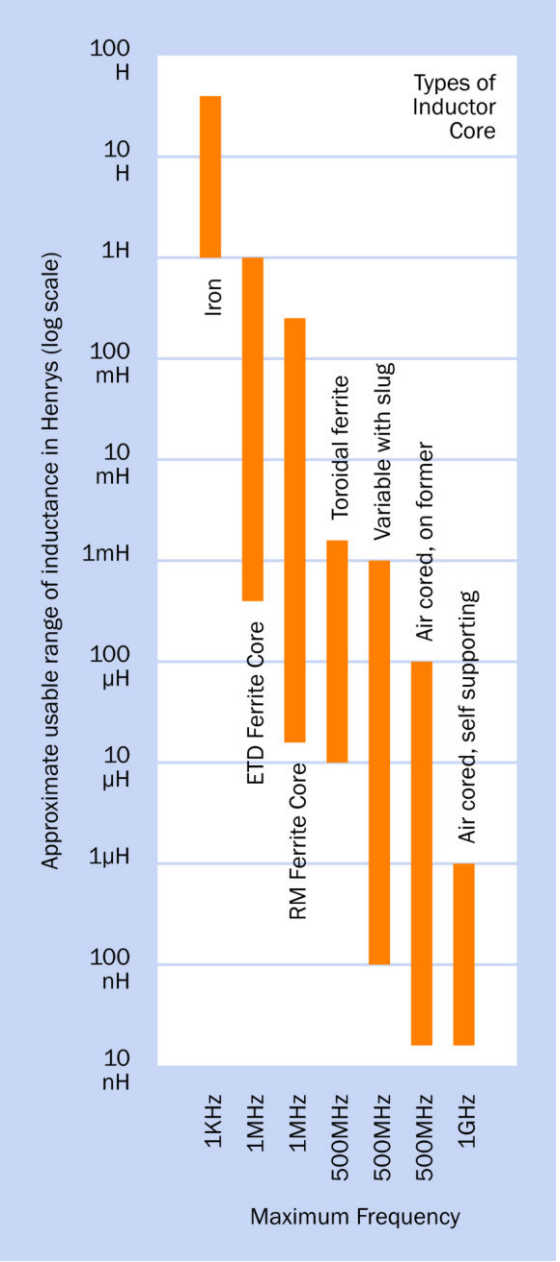

Figure 14-17. *Some commonly used inductor cores and their characteristics. Adapted from "Producing wound components" by R.Clark@surrey.ac.uk.*

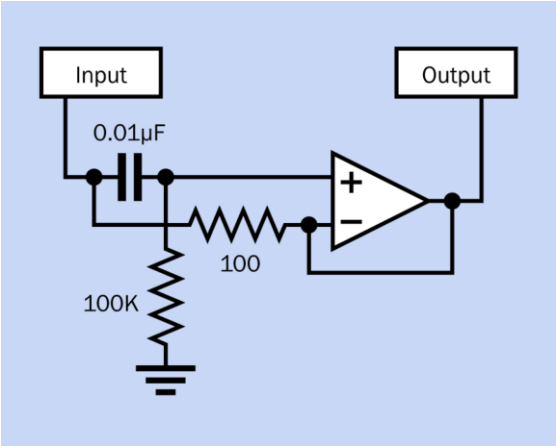

Figure 14-18. *A possible schematic for a coil substitute known as a gyrator, which may be used where a conventional coil would be unacceptably bulky.*

A gyrator does impose some limits on circuit design. While neither side of a real inductor needs to be at ground potential, a gyrator does require a ground connection. However, the performance advantages of gyrators are significant, as they can emulate high inductance without parasitic effects, can be more accurately calibrated (leading to more predictable performance), and do not create magnetic fields that can interfere with other components.

Values

Calculating Inductance

The magnetic inductance of a coil is measured with a unit known as the Henry, named after Joseph Henry, a pioneer in electromagnetism. It is defined by imagining a coil in which current is fluctuating, causing the creation of EMF. If the rate of fluctuation is 1 amp per second and the induced EMF is 1 volt, the inductance of the coil is 1 Henry.

The letter L is commonly used to represent inductance. To derive a useful formula, L will be expressed in microhenrys. If D is the diameter of a coil, N is the number of turns of wire, and W is the width of coil (when the windings are viewed from the side, as shown in Figure 14-19), the precise relationship of the variables is complex but can be reduced to an approximate formula:

$$L = \text{approx } (D^2 * N^2) / 18 * D) + (40 * W$$

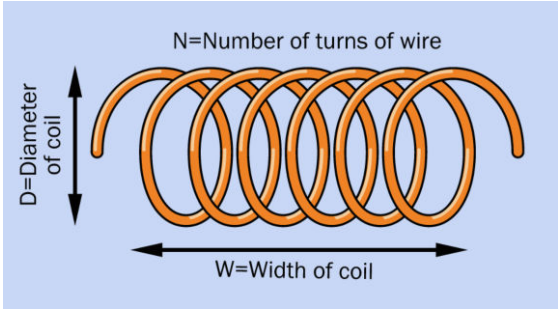

Figure 14-19. *Dimensions of a coil, referenced by a formula to calculate its approximate inductance. See text for details.*

From this, it is clear that inductance tends to increase with coil diameter, and also increases (more significantly) with the square of the number of turns. If the number of turns remains constant, inductance will be higher for a coil that is short and fat than for a coil that is narrow and long.

Because the Henry is a large unit, inductors in electronics circuits typically have their inductances measured in millihenrys (mH), microhenrys (µH), and nanohenrys (nH), where 1H = 1,000mH, 1 mH = 1,000µH, and 1µH = 1,000 nH. This relationship is shown in Figure 14-20.

Calculating Reactance

The reactance of an inductor (that is, its dynamic resistance to alternating current) varies with the frequency of the current. If f is the AC frequency (in Hertz), and L is the inductance (in Henrys), the reactance, X_L in ohms, is given by the formula:

$$X_L = 2 * \pi * f * L$$

From this equation, it's apparent that as the frequency tends toward zero (DC current), or if the inductance tends toward zero (a short piece of

nH	µH	mH
1	0.001	0.000001
10	0.01	0.00001
100	0.1	0.0001
1,000	1	0.001
10,000	10	0.01
100,000	100	0.1
1,000,000	1,000	1

Figure 14-20. *Inductance is typically measured in nanohenrys (nH), microhenrys (µH), and millihenrys (mH). Equivalent values in these units are shown here.*

straight wire), the reactance will tend toward zero. Conversely, the inductor will impede current increasingly as the frequency and/or the inductance increases.

Calculating Reluctance

The letter S is often used to represent reluctance, while Greek letter µ customarily represents permeability (not to be confused with the use of µ as a multiplication factor of 1/1,000,000, as in µF, meaning "microfarad"). If A is the area of cross-section of the magnetic circuit and L is its length:

```
S = L / µ * A
```

Datasheet Terminology

A typical manufacturer's datasheet should include an *inductance index* for an inductor, expressed in µH per 100 turns of wire (assuming the wire is in a single layer) for inductors with a powdered iron core, and mH per 1,000 turns of wire for inductors with ferrite cores.

The *DCR* is the DC resistance of an inductor, derived purely from the wire diameter and its length.

The *SRF* is the *self-resonant frequency*. An inductor should be chosen so that AC current passing through it will never get close to that frequency.

ISAT (or I_{sat}) is the saturation current, which results in a magnetic core losing its function as a result of magnetic saturation. When this occurs, inductance drops and the charge current rate increases drastically.

Series and Parallel Configurations

Because the inductance of a coil conducting DC current is proportional to the current, the calculations to derive the total inductance of coils in series or in parallel are identical to the calculations used for resistors.

In series, all the coils inevitably pass the same current, and the total inductance is therefore found by summing the individual inductances. When coils are wired in parallel, the current distributes itself according to the inductances; therefore, if L1 is the reluctance of the first coil, L2 is the reluctance of the second coil, and so on, the total reluctance L of the network is found from the formula:

```
1/L = 1/L1 + 1/L2 + 1/L3. . .
```

This is shown in Figure 14-21. In reality, differences between the coils (such as their electrical resistance), and magnetic interaction between the coils, will complicate this simple relationship.

Time Constant

Just as the *time constant* of a capacitor defines the rate at which it accumulates voltage when power is applied through a resistor, the time constant of an inductor defines the rate at which it gradually allows amperage to pass through it, overcoming the EMF generated by the coil. In both cases, the time constant is the number of seconds that the component requires to acquire approximately 63% of the difference between its current value and its maximum value. In the case of an inductor, suppose we assume zero internal resistance in the power source, zero resistance in

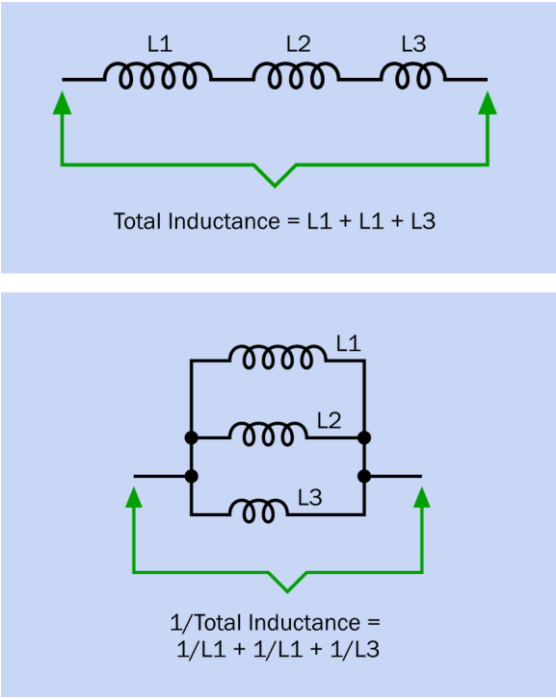

Figure 14-21. *Calculating the total inductance of inductors in parallel (top) and series (bottom).*

the coil windings, and an initial current of zero. If L is the inductance of the coil and R is the value of the series resistor, then the time constant—TC—is given in seconds by the formula

$$TC = L / R$$

Therefore a coil of 10 millihenrys (0.01 Henry) in series with a 100-ohm resistor will pass 63% of the full current in 0.0001 seconds, or 1/10 of a millisecond; it will take an equal additional amount of time for the current to rise by another 63% of the remaining difference between its charge and the maximum amperage of the circuit. In theory, the reactance of a coil can never diminish to zero, but in practice, five time constants are considered adequate to allow maximum current flow.

How to Use it

Because the inductance of an inductor peaks as current increases, and then gradually diminishes, an inductor can be used to block or attenuate high frequencies. A circuit that does this is often referred to as a *low-pass filter*. The schematic and a graph suggesting its performance are shown in Figure 14-22. A basic application could be the *crossover network* in a loudspeaker system, where high-frequency signals are blocked from a low-frequency driver and are diverted to a high-frequency driver.

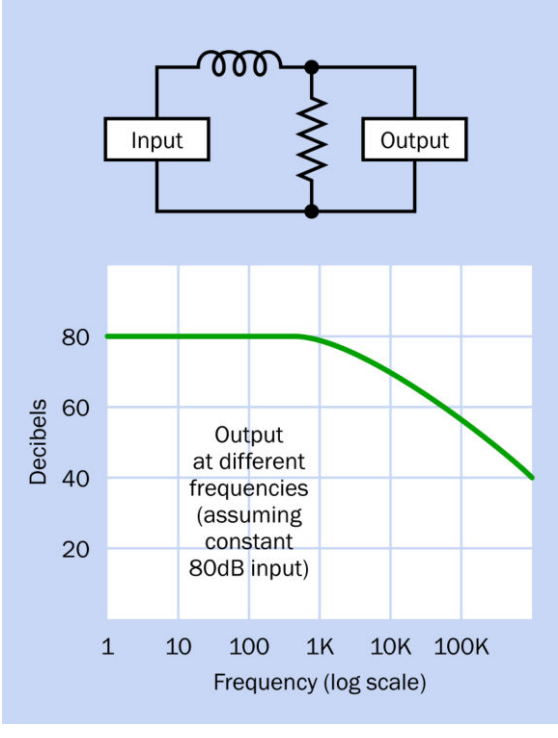

Figure 14-22. *By using the ability of an inductor to block a range of frequencies, a low-pass filter blocks higher frequencies.*

If the location of the inductor is shifted so that it shunts the signal away from the output, the results are reversed, and the circuit becomes a *high-pass filter*. The schematic and a graph suggesting its performance are shown in Figure 14-23.

Note that **capacitors** may also be used to create frequency filters, but because their function is roughly inverse to that of inductors, the place-

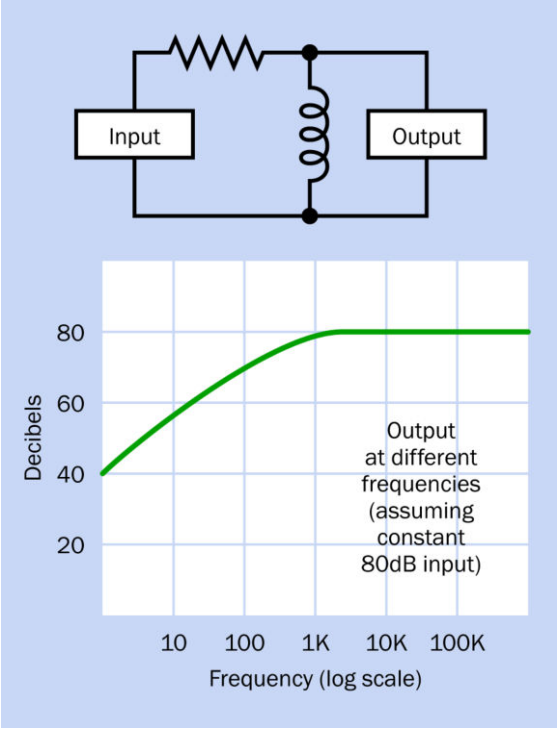

Figure 14-23. *Here the inductor diverts low frequencies away from the output, allowing high frequencies to pass through.*

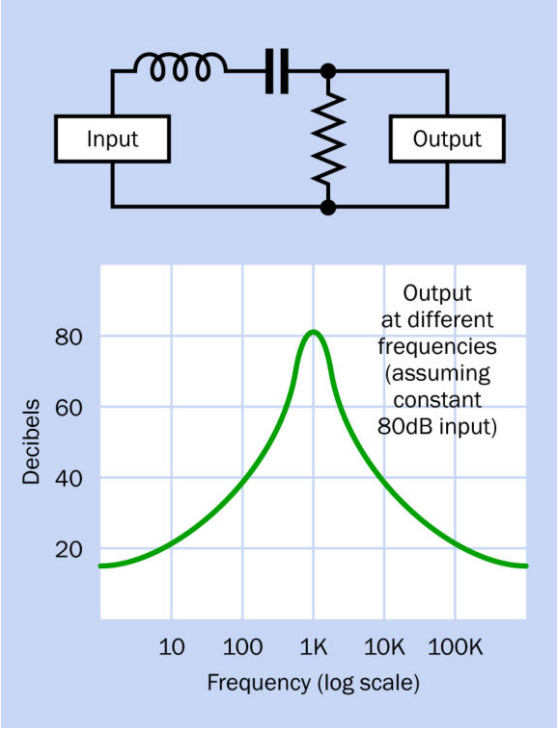

Figure 14-24. *If the values of a capacitor and an inductor are correctly chosen, and the components are placed in series, the inductor blocks high frequencies while the capacitor blocks low frequencies, creating a bandpass filter, in which only a narrow band of frequencies can get through.*

ment of a capacitor in a circuit would be opposite to the placement of the inductor. Examples of filter circuits using capacitors are found in the entry for that component in this encyclopedia.

An inductor can be combined with a capacitor to form a *bandpass filter*, as shown in Figure 14-24. In this configuration, the inductor blocks the high frequencies while the capacitor blocks the low frequencies, allowing only a limited band of frequencies to get through.

Once again if the location of the components is shifted to shunt the signal away from the output, the results are reversed, as shown in Figure 14-25. This is known as a *notch filter*.

The performance of these filters will depend on the component values, and in most applications, additional components will be necessary. Sophisticated filter circuits are outside the scope of this encyclopedia.

Inductors are of great importance in **DC-DC converters** and **AC-DC power supplies** where voltage changes are enabled by rapid switching. See the relevant entries of this encyclopedia for additional details.

Generally, as electronic equipment has become increasingly miniaturized, the unavoidable bulk of inductors has limited their application. However they may still be used to tune oscillators, to block sudden spikes in power supplies, and to protect equipment from sudden voltage spikes (they are used, for example, in surge suppressors for computing equipment).

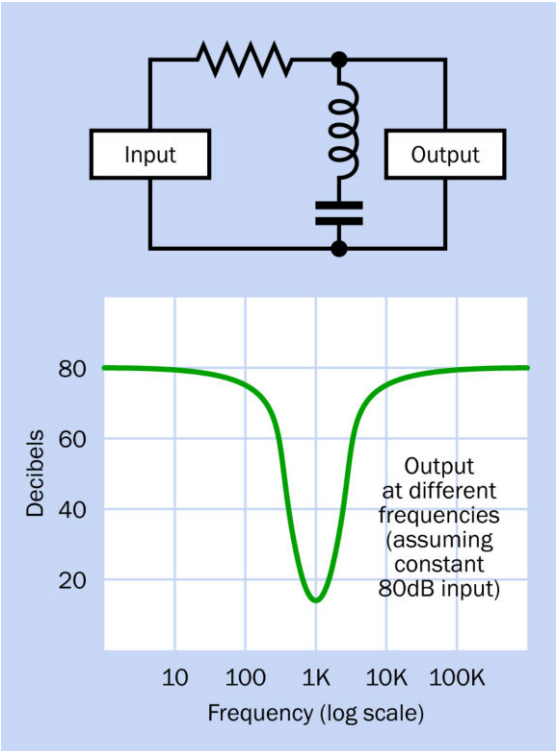

Figure 14-25. *Here the capacitor and inductor block all frequencies except a narrow band, which they divert from the output. The result is a notch filter.*

Core Choices

Air-cored inductors have relatively low inductance, because of their low permeability. However, they can be operated at very high frequencies up to the gigahertz range, and can tolerate higher peak currents.

Inductors with an iron core suffer increasing power losses due to hysteresis and eddy currents as the AC frequency passing through the inductor increases. Consequently, iron-cored inductors are not suitable for frequencies much above 10KHz.

Miniaturization

A low-value inductor can be formed by etching a spiral onto a circuit board, in applications where size must be minimized. They may also be incorporated in integrated circuit chips. However, in small devices such as cellular phones, it is more common to use a coil substitute such as a *gyrator*, as described previously.

What Can Go Wrong

Real-World Defects

The theoretically ideal inductor has no resistance or capacitance and suffers no energy losses. In reality, an inductor possesses both resistance and capacitance, also creates electrical noise, and may pick up electrical noise. It tends to create stray magnetic fields, and generally is more troublesome to deal with than its two cousins, the **resistor** and the **capacitor**.

Parasitic capacitance occurs between adjacent turns of wire. This capacitance becomes more significant at higher frequencies, leading ultimately to a situation where the coil becomes *self resonant*.

The workarounds for these problems involve coil geometries and choices of core material that go beyond the scope of this encyclopedia.

A *gyrator* should be considered as a possible substitute where inductors are troublesome or excessively expensive.

Saturation

Inductance increases as the current passing through a coil increases, but if a magnetic core is used, its contribution to inductance will stop abruptly when the core becomes magnetically *saturated*. In other words, when all of the randomly distributed *magnetic domains* in the core have been induced to align themselves with the pervasive magnetic field, the core cannot become more highly magnetized, and ceases to contribute to the inductance. Note that as a core approaches saturation levels, its hysteresis increases because reversing its magnetization requires greater energy. Antidotes to saturation would include a larger core, a lower current, a smaller number of turns in the coil, and using a core with lower permeability (such as air).

RF Problems

Radio frequencies (*RF*) introduce various problems affecting the efficiency of inductors. The *skin effect* is the tendency of high-frequency AC current to flow primarily on the surface of a strand of wire. The *proximity effect* refers to the tendency of the magnetic fields caused by adjacent wires to introduce eddy currents in the coil. Both of these effects increase the effective resistance of the coil. Various coil geometries have been developed to minimize these effects, but are outside the scope of this encyclopedia. The fundamental lesson is that coils specifically designed for RF are the only ones that should be used with RF.

AC-AC transformer

15

OTHER RELATED COMPONENTS

- **AC-DC power supply** (See Chapter 16)
- **DC-DC converter** (See Chapter 17)
- **DC-AC inverter** (See Chapter 18)

What It Does

A transformer requires an input of *alternating current* (AC). It transforms the input voltage to one or more output voltages that can be higher or lower.

Transformers range in size from tiny impedance-matching units in audio equipment such as microphones, to multi-ton behemoths that supply high voltage through the national power grids. Almost all electronic equipment that is designed to be powered by municipal AC in homes or businesses requires the inclusion of a transformer.

Two small power transformers are shown in Figure 15-1. The one at the rear is rated to provide 36VAC at 0.8A when connected with a source of 125VAC. At front, the miniature transformer is a Radio Shack product designed to provide approximately 12VAC at 300mA, although its voltage will be more than 16VAC when it is not passing current through a load.

Figure 15-1. *Two small power transformers. The one at the rear measures approximately 1" × 2" × 2" and is rated to provide 36VAC at 0.8A. The term "sec" on the smaller unit is an abbreviation for "secondary," referring to the rating for its secondary winding.*

Transformer schematic symbols are shown in Figure 15-2. The different coil styles at left and right are functionally identical. Top: A transformer with a magnetic core—a core that can be magnetized. Bottom: A transformer with an air core. (This type of transformer is rare, as it tends to be less efficient.) The input for the transformer is almost always assumed to be on the left, through the *primary* coil, while the output is on the right, through the *secondary* coil. Often the two coils will show differing numbers of turns to indicate whether the transformer is delivering a reduced voltage (in which case there will be fewer turns in the secondary coil) or an increased voltage (in which case there will be fewer turns in the primary coil).

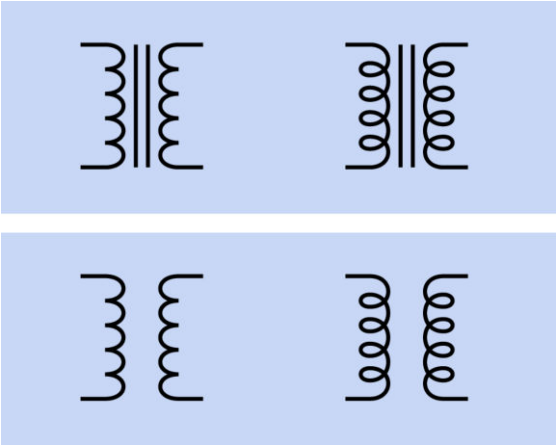

Figure 15-2. *Alternate symbols for a transformer with a ferromagnetic core (top) and air core (bottom). The differing coil symbols at left and right are functionally identical.*

How It Works

A simplified view of a transformer is shown in Figure 15-3. Alternating current flowing through the primary winding (orange) induces magnetic flux in a laminated core formed from multiple steel plates. The changing flux induces current in the secondary winding (green), which provides the output from the transformer. (In reality, the windings usually consist of thousands of turns of thin magnet wire, also known as enameled wire; and various different core configurations are used.)

The process is known as *mutual induction*. If a load is applied across the secondary winding, it will draw current from the primary winding, even though there is no electrical connection between them.

In an ideal, lossless transformer, the ratio of turns between the two windings determines whether the output voltage is higher, lower, or the same as the input voltage. If V_p and V_s are the voltages across the primary and secondary windings respectively, and N_p and N_s are the number of turns of wire in the primary and secondary windings, their relationship is given by this formula:

$$V_p / V_s = N_p / N_s$$

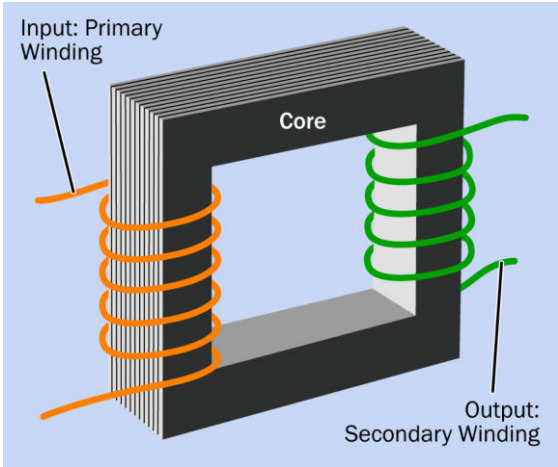

Figure 15-3. *Three basic parts of a transformer, shown in simplified form.*

A simple rule to remember is that fewer turns = lower voltage while more turns = higher voltage.

A *step-up transformer* has a higher voltage at its output than at its input, while a *step-down transformer* has a higher voltage at its input than at its output. See Figure 15-4.

In an ideal, lossless transformer, the power input would be equal to the power output. If V_{in} and V_{out} are the input and output voltages, and I_{in} and I_{out} are the input and output currents, their relationship is given by this formula:

$$V_{in} * I_{in} = V_{out} * I_{out}$$

Therefore, if the transformer doubles the voltage, it allows only half as much current to be drawn from the secondary winding; and if the voltage is cut in half, the available current will double.

Transformers are not 100% efficient, but they can be more than 98% efficient, and relationships between voltage, current, and the number of turns in the windings are reasonably realistic.

When the transformer is not loaded, the primary winding behaves like a simple inductor with reactance that inhibits the flow of current. Therefore a power transformer will consume relatively

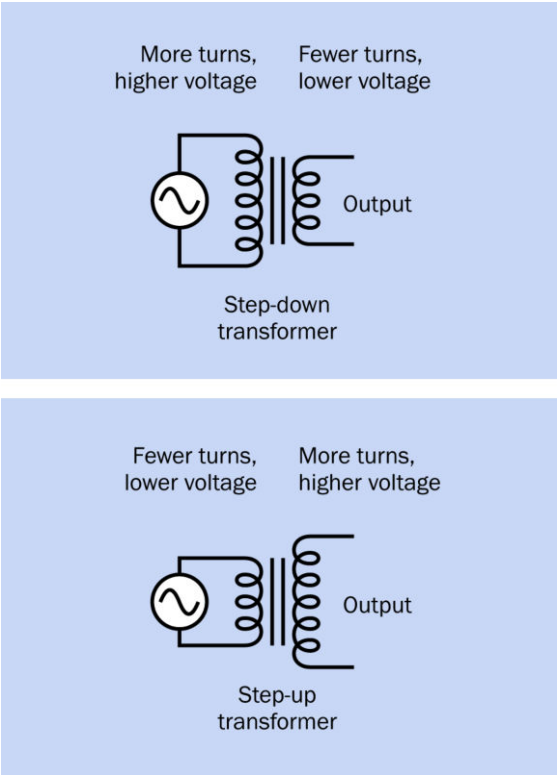

Figure 15-4. *The ratio of input voltage to output voltage is equal to the ratio of primary turns to secondary turns in the transformer windings, assuming a transformer of 100% efficiency.*

little electricity if it is left plugged in to an electrical outlet without any load connected to its output side. The power that it does consume will be wasted as heat.

The Core

The ferromagnetic core is often described as being made of iron, but in reality is more often fabricated from high permeability silicon steel. To reduce losses caused by eddy currents, the core is usually laminated—assembled from a stack of plates separated from each other by thin layers of varnish or a similar insulator. Eddy currents tend to be constrained within the thickness of each plate.

Because a DC voltage would cause magnetic saturation of the core, all transformers must operate with alternating current or pulses of current. The windings and geometry of a transformer are optimized for the frequency range, voltage, and current at which it is designed to operate. Deviating significantly from these values can damage the transformer.

Taps

A *tap* on a transformer is a connection part-way through the primary or (more often) the secondary coil. On the primary side, applying an input between the start of a coil and a tap part-way through the coil will reduce the number of turns to which the voltage is applied, therefore increasing the ratio of output turns to input turns, and increasing the output voltage. On the secondary side, taking an output between the start of a coil and a tap part-way through the coil will reduce the number of turns from which the voltage is taken, therefore decreasing the ratio of output turns to input turns, and decreasing the output voltage. This can be summarized:

- A tap on the primary side can increase output voltage.
- A tap on the secondary side can provide a decreased output voltage.

In international power adapters, a choice of input voltages may be allowed by using a double-throw switch to select either the whole primary winding, or a tapped subsection of the winding. See Figure 15-5. Modern electronics equipment often does not require a voltage adapter, because a **voltage regulator** or **DC-DC converter** inside the equipment will tolerate a wide range of input voltages while providing a relatively constant output voltage.

A transformer's secondary winding is often tapped to provide a choice of output voltages. In fact, most power transformers have at least two outputs, since the cost of adding taps to the secondary winding is relatively small. As an

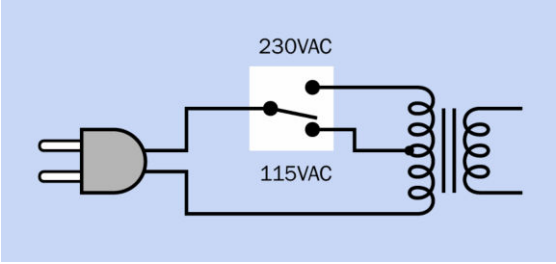

Figure 15-5. *An international power adapter can provide a fixed output voltage by using a double-throw switch to apply 230VAC voltage across a transformer's primary winding, or 115VAC to a tapped midpoint of the primary winding.*

alternative to tapped outputs, two or more separate secondary windings may be used, allowing the outputs to be electrically isolated from each other. See Figure 15-6.

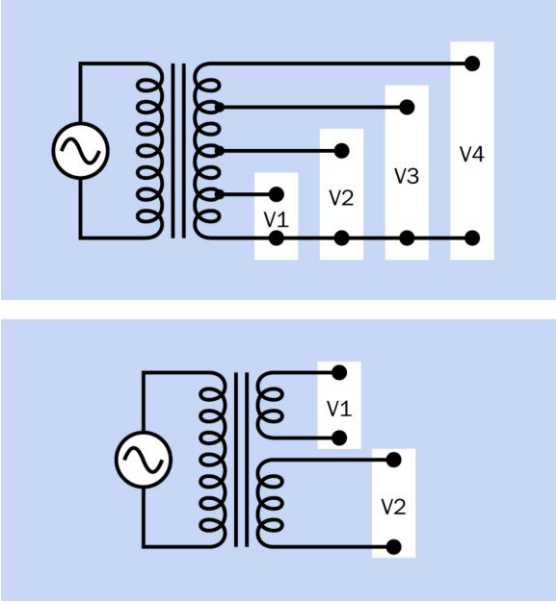

Figure 15-6. *Multiple output voltages may be obtained from a transformer by tapping into the secondary winding (top) or using two or more separate secondary windings (bottom), in which case the outputs will be electrically isolated from each other.*

If the winding on the primary side of a transformer is coiled in the same direction as the winding on the secondary side, the output voltage will be 180 degrees out of phase with the input voltage. In schematics, a dot is often placed at one end of a transformer coil to indicate where the coil begins. If the dots on the primary and secondary sides are at the same ends of the coils, there will be a 180 degree phase difference between input and output. For many applications (especially where the output from a power transformer is going to be converted to DC), this is immaterial.

If there is a center tap on the secondary winding, and it will be referenced as ground, the voltages relative to it, at opposite ends of the secondary winding, will be out of phase. See Figure 15-7.

Variants

Core Shapes

The *shell core* is a closed rectangle, as shown in Figure 15-3. This is the most efficient but most costly to manufacture. A C-shaped core is another option (three sides of the rectangle) and an E-I core is popular, consisting of a stack of E-shaped plates with two coils wound around the top and bottom legs of the E, or wound concentrically around the center leg of the E. An additional stack of straight plates is added to close the gaps in the E and form a magnetic circuit.

In Figure 15-8, the small transformer from Figure 15-1 has been sliced open with a band saw and a belt sander to reveal a cross-section of its windings. This clearly shows that its primary and secondary windings are concentric. It also reveals the configuration of its core, which is in the E-I format. In Figure 15-9, the E-I configuration is highlighted to show it more clearly.

Power Transformer

Typically designed to be bolted onto a chassis or secured inside the case or cabinet housing a piece of electrical equipment with solder tabs or connectors allowing wires to connect the transformer to the power cord, on one side, and a cir-

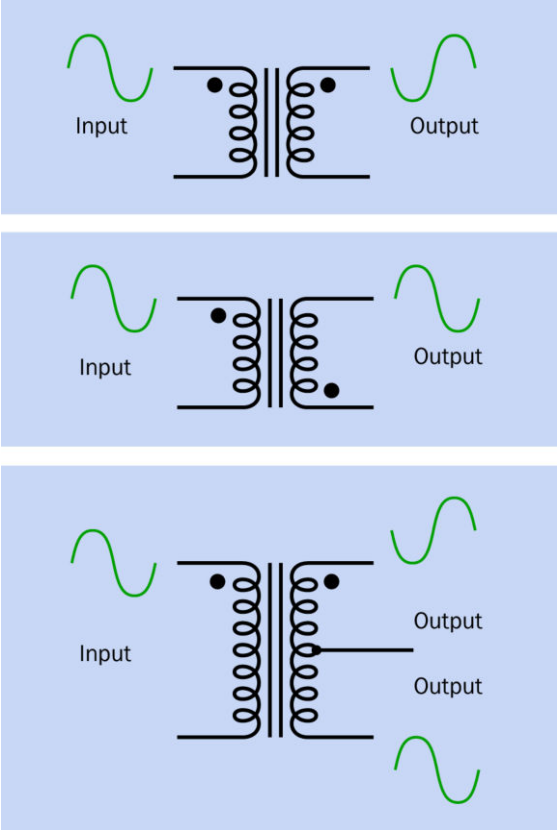

Figure 15-7. *A dot indicates the start of each winding. Where primary and secondary windings are in the same direction, the voltage output will be 180 degrees out of phase with the input. Where the dots indicate windings in opposite directions, the voltage output will have the same phase as the input. Where a center tap on the secondary winding serves as a common ground, the voltages at opposite ends of the secondary winding will be opposite to each other in phase.*

cuit board, on the other side. Smaller power transformers such as the one in Figure 15-1 have "through-hole" design with pins allowing them to be inserted directly onto circuit boards.

Plug-in Transformer

Usually sealed in a plastic housing that can be plugged directly into a wall power outlet. They are visually identical to **AC adapters** but have an AC output instead of a DC output.

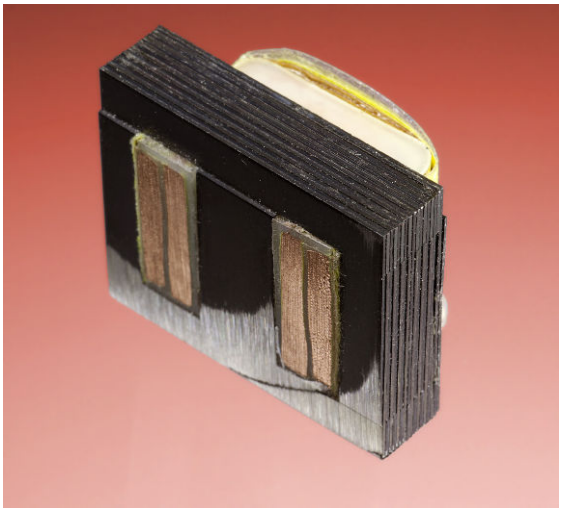

Figure 15-8. *The small transformer from the first figure in this entry is shown sliced open to reveal its internal configuration.*

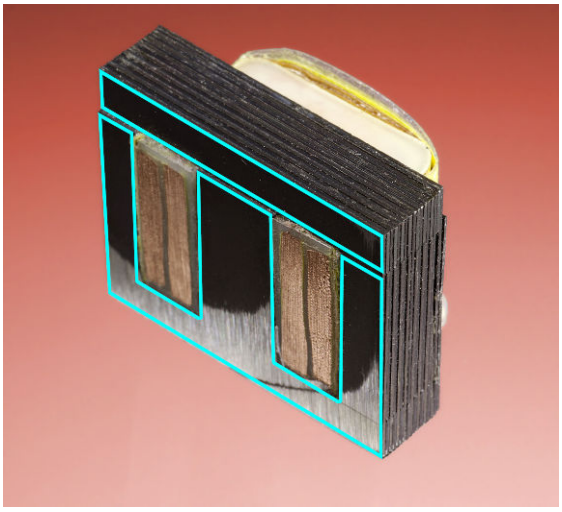

Figure 15-9. *The "EI" shaped plates that form the core of the transformer are outlined to show their edges.*

Isolation Transformer

Also known as a *1:1 transformer* because it has a 1:1 ratio between primary and secondary windings, so that the output voltage will be the same as the input voltage. When electrical equipment is plugged into the isolation transformer, it is separated from the electrical ground of AC power wiring. This reduces risk when working on

"live" equipment, as there will be negligible electrical potential between itself and ground. Consequently, touching a grounded object while also touching a live wire in the equipment should not result in potentially lethal current passing through the body.

Autotransformer

This variant uses only one coil that is tapped to provide output voltage. Mutual induction occurs between the sections of the coil. An autotransformer entails a common connection between its input and output, unlike a two-coil transformer, which allows the output to be electrically isolated from the input. See Figure 15-10. Autotransformers are often used for impedance matching in audio circuits, and to provide output voltages that differ only slightly from input voltages.

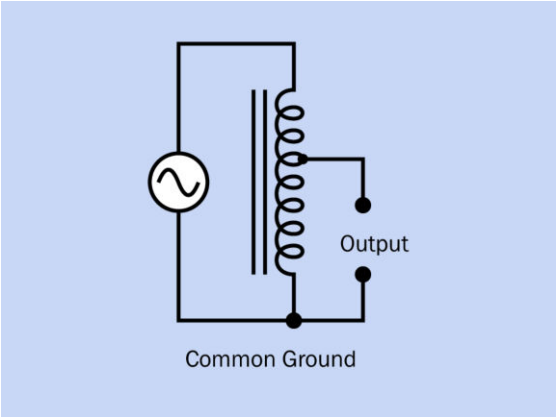

Figure 15-10. *An autotransformer contains only one coil and core. A reduced output voltage can be obtained by tapping into the coil. A common connection prevents the output from being electrically isolated from the input.*

Variable Transformer

A variable transformer, also known as a *variac*, resembles a wire-wound **potentiometer**. Only one winding is used. A *wiper* can be turned to contact the winding at any point, and serves as a movable tap. Like an autotransformer, a variable transformer entails a common connection between input and output.

Audio Transformer

When a signal is transmitted between two stages of a circuit that have different impedance, the signal may be partially reflected or attenuated. (Impedance is measured in ohms but is different from DC electrical resistance because it takes into account reactance and capacitance. It therefore varies with frequency.)

A device of low input impedance will try to draw significant current from a source, and if the source has high output impedance, its voltage will drop significantly as a result. Generally, the input impedance of a device should be at least 10 times the output impedance of the device that is trying to drive it. Passive components (resistors, and/or capacitors, and/or coils) can be used for impedance matching, but in some situations a small transformer is preferable.

If N_p and N_s are the number of turns of wire in the transformer primary and secondary windings, and Z_p is the impedance of a device (such as an audio amplifier) driving the transformer on its primary side, and Z_s is the impedance of a device (such as a loudspeaker) receiving power from the secondary side:

$$N_p / N_s = \sqrt{(Z_p / Z_s)}$$

Suppose that an audio amplifier with rated output impedance of 640Ω is driving a loudspeaker with 8Ω impedance. A matching transformer would be chosen with a ratio of primary turns to secondary turns give by:

$$\sqrt{(640/8)} = \sqrt{80} = \text{approximately } 9:1$$

The two transformers in Figure 15-11 are through-hole components designed for telecommunications purposes, but are capable of passing audio frequencies and can be used for impedance matching in applications such as a preamplifier.

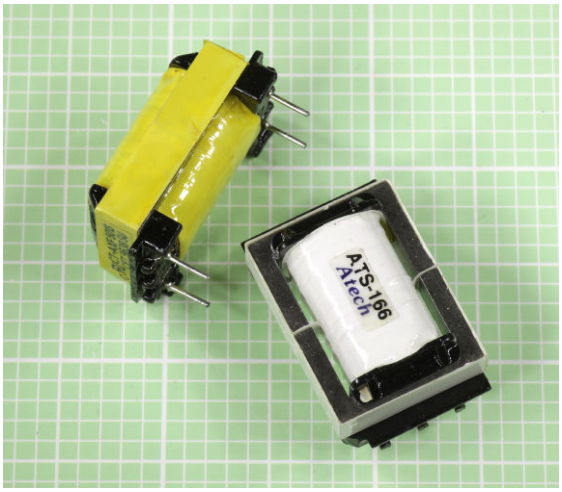

Figure 15-11. *Through-hole transformers. See text for details.*

In Figure 15-12, the transformers are designed for audio coupling. The one on the right has impedances of 500 ohms (primary) and 8 ohms (secondary). On the left is a fully encapsulated line matching transformer with a 1:1 turns ratio.

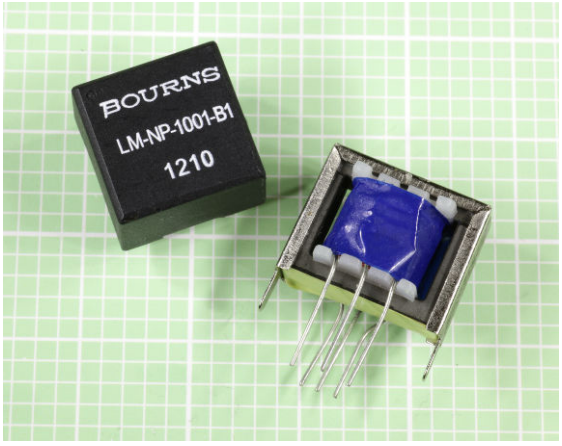

Figure 15-12. *Through-hole transformers. See text for details.*

Split-Bobbin Transformer

This variant has primary and secondary coils mounted side by side to minimize capacitive coupling.

Surface-Mount Transformer

May be less than 0.2" square and is used for impedance matching, line coupling, and filtering. Two surface-mount transformers are shown in Figure 15-13.

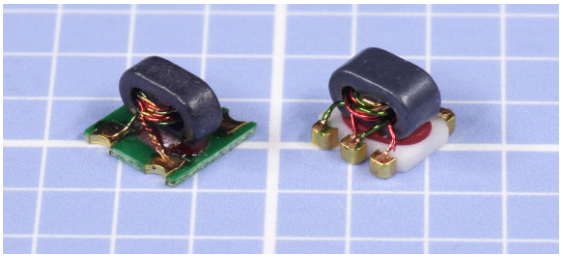

Figure 15-13. *Two surface-mount transformers, each measuring less than 0.2" square, typically used in communications equipment and suited for frequencies higher than 5 MHz.*

Values

When selecting a power transformer, its power handling capability is the value of primary interest. It is properly expressed by the term VA, derived from "volts times amps." VA should not be confused with watts because watts are measured instantaneously in a DC circuit, whereas in an AC circuit, voltage and current are fluctuating constantly. VA is actually the *apparent power*, taking reactance into account.

The relationship between VA and watts will vary depending on the device under consideration. In a worst-case scenario:

```
W = 0.65 VA (approximately)
```

In other words, the averaged power you can draw from a transformer should be no less than two-thirds of its VA value.

Transformer specifications often include input voltage, output voltage, and weight of the component, all of which are self-explanatory. Coupling transformers may also specify input and output impedances.

How to Use it

For most electronic circuits, a power transformer will be followed by a *rectifier* to convert AC to DC, and **capacitors** to smooth fluctuations in the supply. Using a prepackaged **power supply** or *AC adapter* that already contains all the necessary components will be more time-effective and probably more cost-effective than building a power supply from the ground up. See Chapter 16.

What Can Go Wrong

Reversal of Input and Output

Suppose a transformer is designed to provide an output voltage of 10 volts from domestic AC power of 115 volts. If the wrong side of the transformer is connected with 115VAC by mistake, the output will now be more than 1,000 volts—easily enough to cause death, quite apart from destroying components that are connected with it. Reversing the transformer in this way may also destroy it. Extreme caution is advisable when making connections with power transformers. A meter should be used to check output voltage. All devices containing transformers should be fused on the live side and grounded.

Shock Hazard from Common Ground

When working on equipment that uses an autotransformer, the chassis will be connected through the transformer to one side of 115VAC power. So long as a plug is used that prevents reversed polarity, the chassis should be "neutral." However, if an inappropriate power cord is used, or if the power outlet has been wired incorrectly, the chassis can become live. For protection, before working on any device that uses 115VAC power with an autotransformer, plug the device into an isolation transformer, and plug the isolation transformer into the wall outlet.

Accidental DC Input

If DC current is applied to the input side of a transformer, the relatively low resistance of the primary coil will allow high current that can destroy the component. Transformers should only be used with alternating current.

Overload

If a transformer is overloaded, heat will be generated that may be sufficient to destroy the thin layers of insulation between coil windings. Consequently, input voltage can appear unexpectedly on the output side. Transformers with a toroidal (circular) core are especially hazardous in this respect, as their primary and secondary windings usually overlap.

Some (not all) power transformers contain a thermal fuse that melts when it exceeds a temperature threshold. If the fuse is destroyed, the transformer must be discarded.

The consequences of moderate overloading may not be obvious, and can be cumulative over time. Ventilation or heat sinkage should be taken into account when designing equipment around a power transformer.

Incorrect AC Frequency

Single-phase AC power in the United States fluctuates at 60Hz, but Great Britain and some other countries use AC power at 50Hz. Many power transformers are rated to be compatible with either frequency, but if a transformer is specifically designed for 60Hz, it may eventually fail by overheating if it is used with a 50Hz supply. (A 50Hz transformer can be used safely with 60Hz AC.)

AC-DC power supply

16

Also known as an *AC adapter*. When packaged as a palm-sized plastic package that plugs directly into a power outlet, it is occasionally known colloquially as a *wall-wart*.

OTHER RELATED COMPONENTS

- **transformer** (See Chapter 15)
- **DC-DC converter** (See Chapter 17)
- **DC-AC inverter** (See Chapter 18)

What It Does

An AC-DC power supply converts *alternating current* (*AC*) into the *direct current* (*DC*) that most electronic devices require, usually at a lower voltage. Thus, despite its name, a power supply actually requires an external supply of power to operate.

Larger products, such as computers or stereo equipment, generally have a power supply contained within the device, enabling it to plug directly into a wall outlet. Smaller battery-powered devices, such as cellular phones or media players, generally use an external power supply in the form of a small plastic pod or box that plugs into a wall outlet and delivers DC via a wire terminating in a miniature connector. The external type of power supply is often, but not always, referred to as an *AC adapter*.

Although an AC-DC power supply is not a single component, it is often sold as a preassembled modular unit from component suppliers.

Variants

The two primary variants are a *linear regulated power supply* and *switching power supply*.

Linear Regulated Power Supply

A linear regulated power supply converts AC to DC in three stages:

1. A power **transformer** reduces the AC input to lower-voltage AC.
2. A *rectifier* converts the AC to unsmoothed DC. Rectifiers are discussed in the entry on **diodes** in this encyclopedia.
3. A **voltage regulator**, in conjunction with one or more **capacitors**, controls the DC voltage, smooths it, and removes *transients*. The regulator is properly known as a *linear voltage regulator* because it contains one or more **transistors**, which are functioning in linear mode—that is, responding linearly to fluctuations in base current, at less than their saturation level. The linear voltage regulator gives the linear regulated power supply its name.

A simplified schematic of a linear regulated power supply is shown in Figure 16-1.

This type of power supply may be described as *transformer-based*, since its first stage consists of a transformer to drop the AC input voltage before it is rectified.

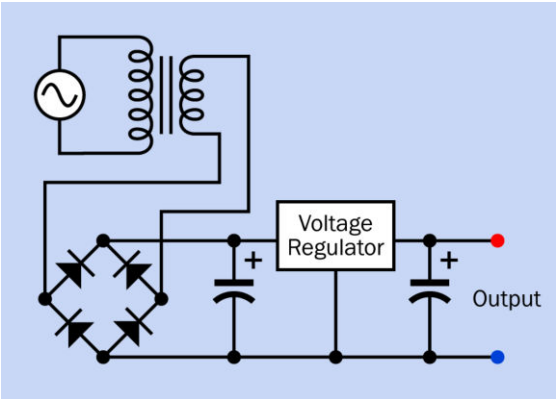

Figure 16-1. *A basic linear regulated power supply.*

Because the rectifier in a power supply generally passes each pulse of AC through a pair of silicon diodes, it will impose a voltage drop of about 1.2V at peak current. A smoothing capacitor will drop the voltage by about 3V as it removes ripple from the current, whereas a voltage regulator typically requires a difference of at least 2V between its input and its output. Bearing in mind also that the AC input voltage may fluctuate below its rated level, the output from the power transformer should be at least 8VAC higher than the ultimate desired DC output. This excess power will be dissipated as heat.

The basic principle of the linear regulated power supply originated in the early days of electronic devices such as radio receivers. A transistorized version of this type of power supply remained in widespread use through the 1990s. Switching power supplies then became an increasingly attractive option as the cost of semiconductors and their assembly decreased, and high-voltage transistors became available, allowing the circuit to run directly from rectified line voltage with no step-down power transformer required.

Some external AC adapters are still transformer-based, but are becoming a minority, easily identified by their relatively greater bulk and weight. An example is shown in Figure 16-2.

Figure 16-3 shows the handful of components inside a cheap, relatively old AC adapter. The output from a power transformer is connected directly to four diodes (the small black cylinders), which are wired as a full-wave rectifier. A single electrolytic capacitor provides some smoothing, but because there is no voltage regulator, the output will vary widely depending on the load. This type of AC adapter is not suitable for powering any sensitive electronic equipment.

Figure 16-2. *A simple transformer-based power supply can be encapsulated in a plastic shell, ready to plug into a power outlet. However, today this format more typically contains a switching power supply, which is usually lighter, smaller, and cheaper.*

Switching Power Supply

Also known as a *switched-mode power supply*, an *SMPS,* or *switcher*, it converts AC to DC in two stages.

1. A *rectifier* changes the AC input to unsmoothed DC, without a power transformer.
2. A DC-DC **converter** switches the DC on and off at a very high frequency using *pulse-width modulation* to reduce its average effective voltage. Often the converter will be the *flyback* type, containing a transformer, but the high-frequency switching allows the transformer to be much smaller than the power transformer required in a linear regulated power supply. See the DC-DC **converter** entry in this encyclopedia for an explanation of the working principles.

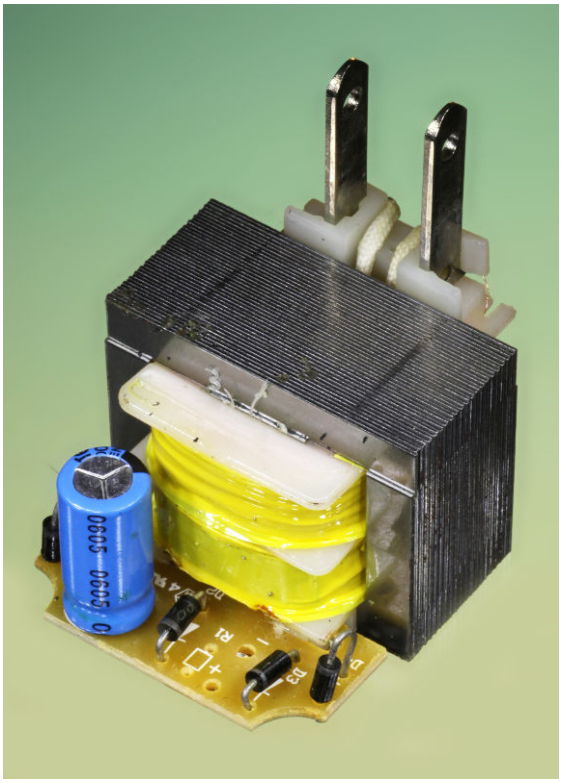

Figure 16-3. *A relatively old, cheap AC adapter contains only the most rudimentary set of components, and does not supply the kind of properly regulated DC power required by electronic equipment.*

A simplified schematic of a switching power supply is shown in Figure 16-4.

The interior of a relatively early switching power supply designed to deliver 12VDC at up to 4A is shown in Figure 16-5. This supply generated considerable waste heat, necessitating well-spaced components and a ventilated enclosure.

The type of small switching power supply that is now almost universally used to power laptop computers is shown in Figure 16-6. Note the smaller enclosure and the higher component count than in the older power supply shown in Figure 16-5. The modern unit also delivers considerably more power, and generates less waste heat. Although this example is rated at 5A, the

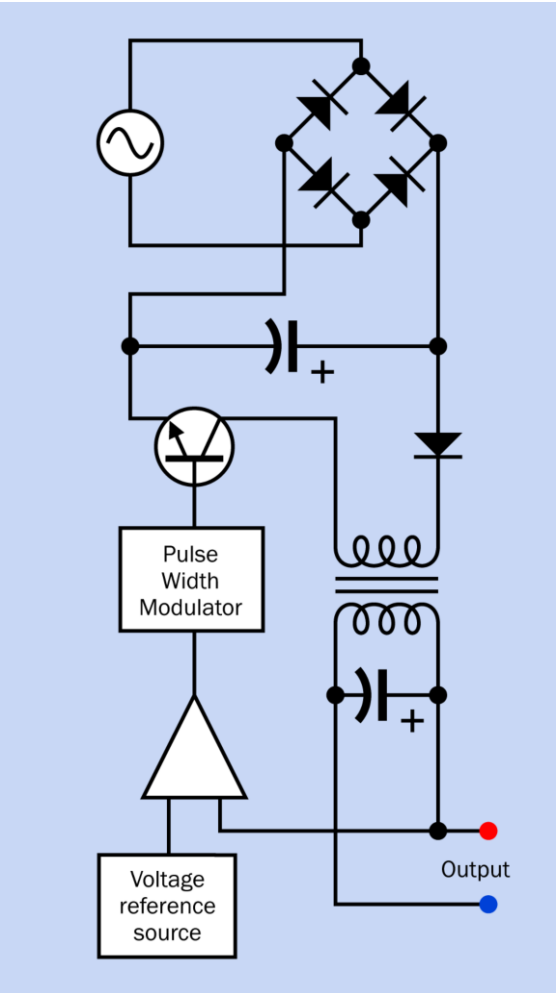

Figure 16-4. *Greatly simplified schematic showing the principal components of a switching power supply. Note the absence of a 115VAC power transformer. The transformer that is inserted subsequently in the circuit functions in conjunction with the high switching frequency, which allows it to be very much smaller, cheaper, and lighter.*

transformer (hidden under the yellow wrapper at the center of the unit) is smaller than the power transformer that would have been found in an old-style AC adapter delivering just 500mA.

The modern power supply is completely sealed, where earlier versions required ventilation. On

Figure 16-5. *The interior of an early switching power supply.*

the downside, the plastic case of the switching supply requires a metal liner (removed for this photograph) to contain high-frequency electromagnetic radiation.

Unregulated Power Supply

Typically this consists of a transformer and rectifying diodes with little or no smoothing or voltage control of the output.

Adjustable Power Supply

This is usually a linear power supply incorporating an adjustable **voltage regulator**. This type of supply has laboratory applications and is found as a benchtop item to power electronics design projects during their development.

Figure 16-6. *The interior of the type of switching power supply that powers a laptop computer.*

Voltage Multiplier

Devices such as photocopiers and laser printers, televisions, cathode-ray tubes, and microwave ovens require voltages significantly higher than those supplied by domestic AC power outlets. A voltage multiplier usually contains a step-up transformer followed by DC conversion components, but detailed consideration is outside the scope of this encyclopedia.

Formats

An *open frame* power supply consists of components on a circuit board, usually mounted on a metal chassis, with no enclosure or fan cooling.

A *covered* power supply is enclosed in a protective perforated metal box with a cooling fan if needed. Power supplies sold for desktop computers are usually in this format.

Power supplies are also available in rack-mount and DIN-rail formats.

How to Use it

Because a switching power supply contains no power transformer, it is lighter and smaller, and may be cheaper than a linear power supply. It is also more efficient and generates less waste heat. These advantages have made switching power supplies the most popular option to provide DC power for electronics devices. However, the high-frequency switching tends to create *electromagnetic interference* (*EMI*), which must be filtered to protect the output of the device and also to minimize the risk of this interference feeding back into AC power wiring. The high-frequency switched power may also generate harmonics, which must be suppressed.

High-quality linear regulated power supplies still find application in laboratory equipment, low-noise signal processing, and other niches where excellent regulation and low-ripple output are necessary. They are relatively heavy, bulky, and inefficient.

See Figure 16-7 for a chart comparing the advantages and disadvantages of linear and switching power supplies.

What Can Go Wrong

High Voltage Shock

One or more capacitors in a power supply may retain a relatively high voltage for some time after the unit has been unplugged. If the power supply is opened for inspection or repairs, caution is necessary when touching components.

Capacitor Failure

If *electrolytic capacitors* fail in a switching power supply (as a result of manufacturing defects, disuse, or age), allowing straight-through conduction of alternating current, the high-frequency switching semiconductor can also fail, allowing input voltage to be coupled unexpectedly to the output. Capacitor failure is also a potential problem in linear power supplies. For additional information on capacitor failure modes, see Chapter 12.

	Switching power supply	Linear power supply
Component count	High	Medium
Load regulation	0.05% to 0.5%	0.005% to 0.2%
Line regulation	0.05% to 0.2%	0.005% to 0.05%
Ripple (RMS)	10mV to 25mV	0.25mV to 1.5mV
Efficiency	70% to 85%	40% to 60%
EMI	High	Very low
Leakage	High	Low
Physical size	Small	Large
Weight	Light	Heavy
Heat management	Usually fan-cooled	Usually cooled by convection

Figure 16-7. *Comparison of attributes of linear regulated power supplies and switching power supplies. (Adapted from Acopian Technical Company.)*

Electrical Noise

If *electrolytic capacitors* are used, their gradual deterioration over time will permit more electrical noise associated with high-frequency switching in a switching power supply.

Peak Inrush

A switching power supply allows an initial inrush or surge of current as its capacitors accumulate their charge. This can affect other components in the circuit, and requires fusing that tolerates brief but large deviations from normal power consumption.

DC-DC converter

17

Often referred to as a *switching regulator*, and sometimes as a *switcher*, not to be confused with a *switching power supply*.

OTHER RELATED COMPONENTS

- **AC-DC power supply** (See Chapter 16)
- **voltage regulator** (See Chapter 19)
- **DC-AC inverter** (See Chapter 18)

What It Does

A DC-DC converter, often referred to simply as a *converter*, receives a DC voltage as its input and converts it to a regulated DC voltage as its output. The output voltage may be higher or lower than the input voltage, may be user-adjustable by adding an external resistor, and may be completely electrically isolated from the input, depending on the type of converter that is used. The overall efficiency is not greatly affected by the difference between input and output voltage, and can exceed 90%, minimizing waste heat and enabling the unit to be extremely compact.

A DC-DC converter is an integrated circuit package that includes a high-speed switching device (almost always, a *MOSFET*) in conjunction with an oscillator circuit, an inductor, and a diode. By comparison, a **linear regulator** is usually based around bipolar transistors. Its input must always be at a higher voltage than its output, and its efficiency will be inversely proportional with the voltage drop that it imposes. See the **voltage regulator** entry in this encyclopedia for additional information.

There is no single symbol to represent a DC-DC converter. Some simplified schematics showing the principles of operation of commonly used converters are referenced under the following Variants section.

A DC-DC converter is also typically found in the output stage of a switching **AC-DC power supply**.

How It Works

An internal oscillator controls a *MOSFET* semiconductor that switches the DC input on and off at a high frequency, usually from 50KHz to 1MHz. Output voltage is adjusted by varying the *duty cycle* of the oscillator—the length of each "on" pulse relative to each "off" interval. This is known as *pulse-width modulation*, or *PWM*. The duty cycle is controlled by sampling the output of the converter and using a comparator to subtract the output voltage from a reference voltage, to establish an error value. This is passed to another comparator, which subtracts the error voltage from an oscillator ramp signal. If the error increases, the oscillator signal is more heavily clipped, thus changing the effective ratio of on/off pulse

lengths. A simplified schematic of the PWM circuit is shown in Figure 17-1, which omits other components for clarity. The system of subtracting an error voltage from a ramp oscillator voltage to obtain a pulse-width modulated signal is illustrated in Figure 17-2.

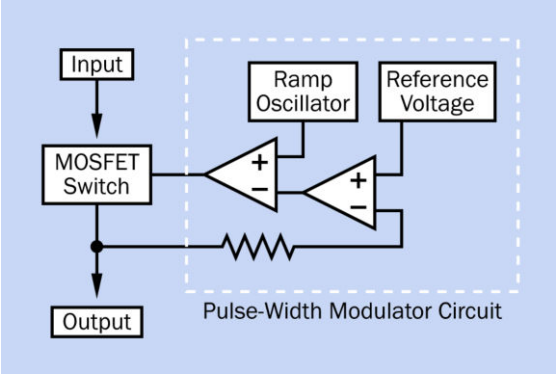

Figure 17-1. *The heart of a DC-DC converter is a MOSFET switch, which operates at a high frequency with pulse-width modulation used to create an adjustable DC output.*

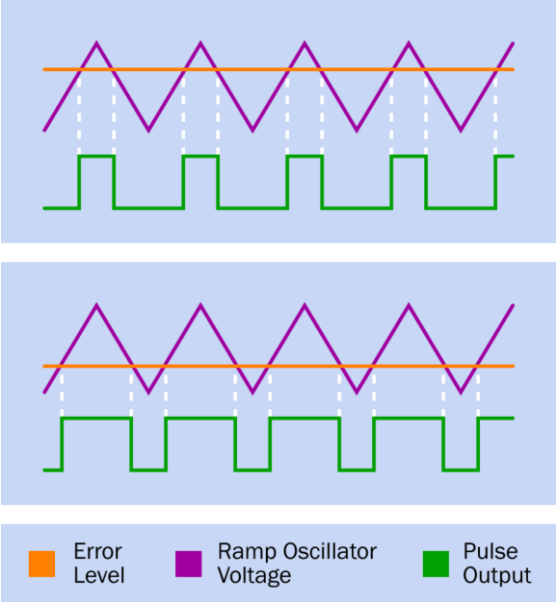

Figure 17-2. *To achieve pulse-width modulation, an error-level voltage is established by comparing the output from the converter with a reference voltage. The error level, shown as an orange line, is then subtracted from the output from a ramp oscillator. The pulse width varies accordingly.*

The key to the efficiency of a DC-DC converter is an inductor, which stores energy in its magnetic field during "on" pulse and releases it in the discharge phase. Thus, the inductor is used as a temporary reservoir and minimizes the ripple current. All converter variants use a coil for this purpose, although its placement varies in relation to the diode and capacitor that complete the basic circuit.

Variants

Four basic switching circuits are used in DC-DC converters and are defined in the coming sections, with a formula to determine the ratio between input voltage (V_{in}) and output voltage (V_{out}) in each case. In these formulae, variable D is the duty cycle in the pulse train generated through an internal MOSFET switch. The duty cycle is the fraction of the total on-off cycle that is occupied by each "on" pulse. In other words, if T_{on} is the duration of an "on" pulse and T_{off} is the "off" time:

$$D = T_{on} / (T_{on} + T_{off})$$

Buck Converter

See Figure 17-3. The output voltage is lower than the input voltage. The input and output share a common ground. For this circuit:

$$V_{out} = V_{in} * D$$

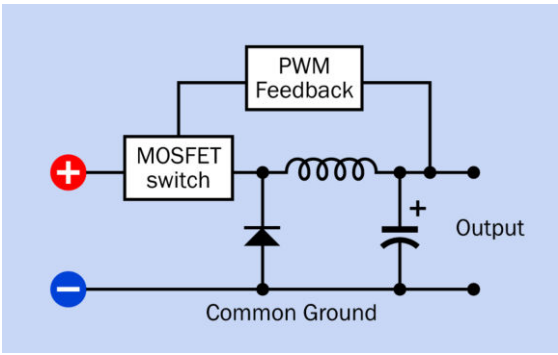

Figure 17-3. *Basic topology of a buck-type DC-DC converter.*

Boost Converter

See Figure 17-4. The output voltage is greater than the input voltage. The input and output share a common ground. For this circuit:

$$V_{out} = V_{in} / (1-D)$$

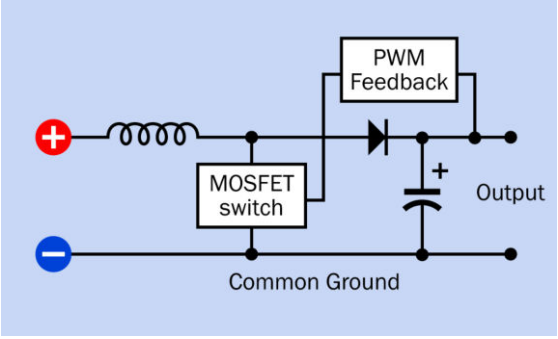

Figure 17-4. *Basic topology of a boost-type DC-DC converter.*

Flyback Converter with Inductor

Commonly known as a *buck-boost converter*. See Figure 17-5. The output voltage can be less than or greater than the input voltage. The input and output share a common ground. For this circuit:

$$V_{out} = V_{in} * (D / (1-D))$$

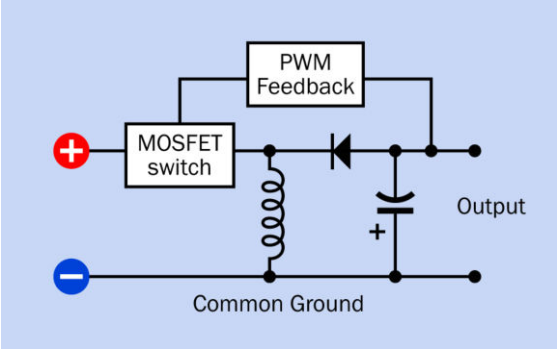

Figure 17-5. *Basic topology of a flyback-type DC-DC converter.*

Flyback Converter with Transformer

See Figure 17-6. The output voltage can be less than or greater than the input voltage. The input and output are isolated from one another. For this circuit:

$$V_{out} = V_{in} * (D / (1-D))$$

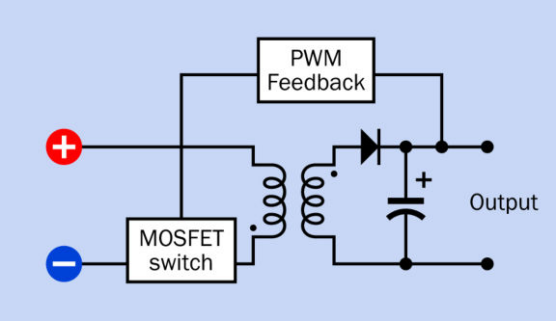

Figure 17-6. *Basic topology of a flyback-type DC-DC converter. (Buck, boost, and flyback topologies adapted from Maxim Integrated Products.)*

Using a transformer in the converter allows multiple outputs with different voltages, supplied through multiple transformer windings.

Formats

A converter may be packaged in a flat rectangular box that requires no additional heat sink and has pins for through-hole insertion into a PC board. Sizes usually range up to to 2″ × 2″. Power handling can range from 5 to 30 watts. Converters of this type are shown in Figure 17-7. (Top: Input range of 9 to 18VDC, fixed output of 5VDC at 3A completely isolated from the input. Typical efficiency of approximately 80%. The case is made of copper, providing good heat dissipation with electrical shielding. Center: Input range of 9 to 18VDC, fixed output of 5VDC at 500mA completely isolated from the input. Typical efficiency of approximately 75%. The manufacturer claims that external capacitors are only needed in critical applications. Bottom: SIP format, fixed input

of 12VDC, fixed output of 5VDC at 600mA completely isolated from the input. Typical efficiency of approximately 75%. Requires external capacitors for ripple rejection.)

Figure 17-7. *A selection of sealed DC-DC converters.*

Lower-power converters are also available as surface-mount devices.

Some adjustable-output converters are supplied as multiple surface-mounted components pre-installed on a mini-board that has pins for through-hole insertion in a printed circuit board. Their high efficiency enables them to handle a lot of power for their size. In Figure 17-8, the converter accepts a 4.5 to 14VDC input range and has an adjustable output of 0.6 to 6VDC. It is rated at a surprising 10A or 50W and is more than 90% efficient. However, it draws 80mA in a no-load state, causing it to become quite hot. A thermal cutout or automatic shutdown may be used if the converter will not be driving a consistent load.

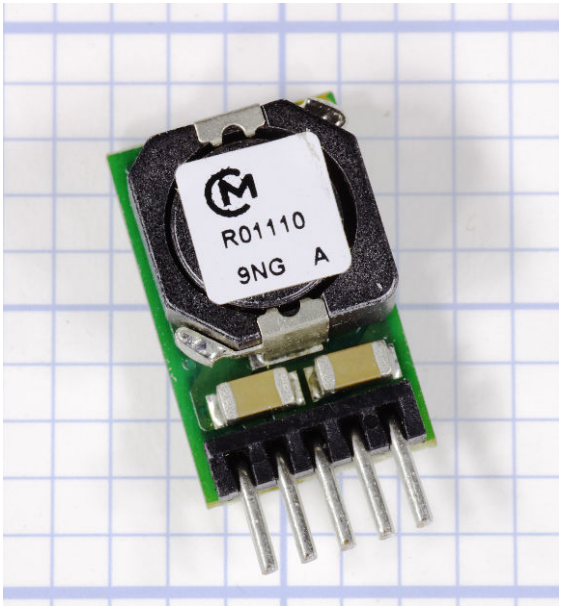

Figure 17-8. *An adjustable DC-DC converter rated for 10A or 50W. The output voltage is determined by adding an external resistor or trimmer potentiometer. External smoothing capacitors are required, as shown in the component's datasheet.*

The miniboard in Figure 17-9 accepts an input voltage from 7 to 36VDC and has an adjustable output ranging from 2.5 to 12.6VDC, at up to 6A. It is non-isolated (has a common negative bus) and claims to be more than 95% efficient at full load.

The miniboard in Figure 17-10 accepts an input voltage from 4.5 to 14VDC and has an adjustable output ranging from 0.6 to 6VDC at up to 20A. It is non-isolated (has a common negative bus) and claims to be more than 90% efficient at full load.

Values

Relevant values include:

Nominal Input Voltage and Frequency

A wide range of input voltages is often acceptable, as the PWM can vary accordingly. Converters

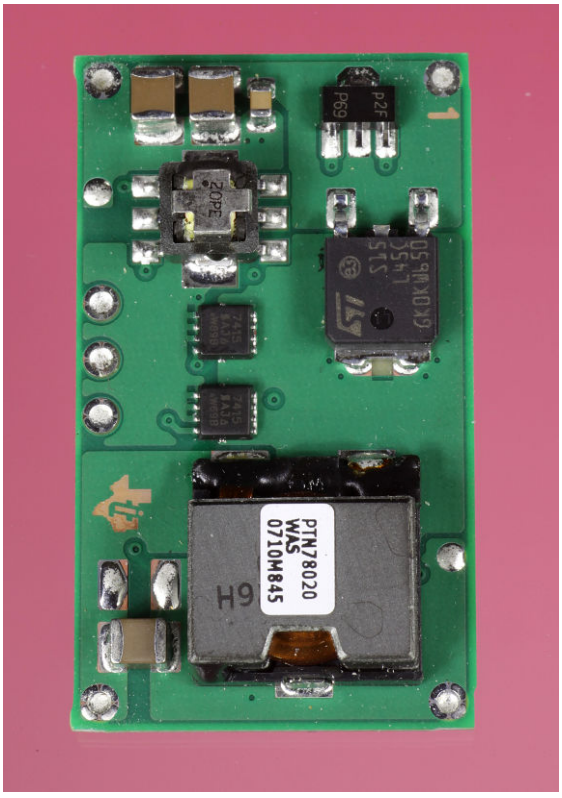

Figure 17-9. *Another adjustable DC-DC converter. The output voltage is determined by adding an external resistor or trimmer potentiometer. External smoothing capacitors are required, as shown in the component's datasheet.*

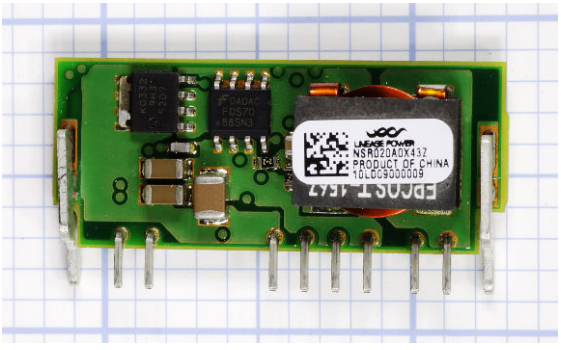

Figure 17-10. *Another adjustable DC-DC converter. The output voltage is determined by adding an external resistor or trimmer potentiometer. External smoothing capacitors are required, as shown in the component's datasheet.*

often allow equipment to be usable internationally, on any voltage ranging from 100VAC to 250VAC, at a fequency of 50Hz or 60Hz, without any adaptation.

Output Voltage

As previously noted, many converters allow the output voltage to be adjusted by adding an external resistor or potentiometer. Alternatively, there may be multiple fixed output voltages, accessible via different pins on the package. They may also provide a positive voltage and equally opposite negative voltage relative to a ground pin.

Input Current and Output Current

Because input voltage and output voltage are likely to be different, the current alone is not a reliable guide to power handling.

A datasheet should specify input current with no load (open circuit on the output side). This current will have to be entirely dissipated as heat.

Load Regulation

This is usually expressed as a percentage and suggests the extent to which output voltage may be pulled down when the load on a DC-DC converter increases. If V_{nil} is the measured output voltage with no load, and V_{max} is the measured output voltage with the maximum rated load:

$$\text{Load regulation} = 100 * (V_{nil} - V_{max})/V_{max}$$

However, note that some converters are designed with the expectation that they will never be used with zero load across the output. In these cases, V_{nil} will be the voltage at minimum rated load.

Efficiency

This is a measure of how much input current must be dissipated as heat. A converter with a 12-volt input, drawing a maximum 300mA input current, will consume 3.6 watts (3,600mW). If it is 80% efficient, it will have to dissipate roughly 20% of its power as heat, or 720mW.

Ripple and Noise

Sometimes abbreviated R/N, this may be measured in mV or as a percentage. Check the specification carefully to determine whether the ripple-and-noise values require use of external smoothing capacitors. Often, this is the case.

Isolated or Non-Isolated

This crucial piece of information is often found near the top of a datasheet, not in the detailed specifications.

How to Use it

Because a converter creates electrical noise, it should be prevented from affecting other components by adding substantial *bypass capacitors* as close as possible to its input and output pins. For most converters, external capacitors are mandatory, and their *effective series resistance* (ESR) should be as low as possible (see the **capacitor** entry in this encyclopedia for an explanation of ESR). Tantalum capacitors are preferable to electrolytics for this reason, and are also more durable. Some manufacturers recommend placing a tantalum capacitor in parallel with an electrolytic. A small ceramic capacitor, typically 0.1µF, is often recommended in an addition to larger-value capacitors on the output side.

The voltage rating of each capacitor should be twice the voltage at the point in the circuit where it is used. The capacitance value will usually be higher for higher-current converters. Values of 100µF are common, but for high amperage, a value may be as high as 1,000µF.

While datasheets are often inadequate for some types of components, datasheets for DC-DC converters usually include detailed instructions regarding bypass capacitors. Following these instructions is essential. In the relatively rare instances that a datasheet makes no mention of bypass capacitors for a converter, this does not necessarily mean that the capacitors are unnecessary. The manufacturer may assume that they will be used as a matter of course.

Converters are used in a very wide range of devices, supplying power ranging from a few milliamps to tens of amps. At the lower end of the scale, devices such as cellular telephones, portable computers, and tablets contain subcircuits that require different voltages, some of which may be higher than the voltage of a single battery or battery pack that powers the device. A converter can satisfy this requirement. Because a converter can be designed to maintain a fixed output in response to a range of input voltages, it can also compensate for the gradual decline in voltage that occurs during battery usage.

A boost-type converter can be used to double the voltage from a single 1.5V battery in an LED flashlight where 3 volts are required to power the LED. Similarly, a boost-type converter can provide the necessary voltage to run a cold-cathode fluorescent tube that provides backlighting in an LCD computer display.

On a circuit board that is primarily populated with 5VDC components and is fed by a single 5VDC power supply, a converter can be used to supply 12VDC for one special purpose, such as an analog-digital converter or a serial data connection.

If electromechanical **relays** or other inductive loads share a common ground with components ,such as *logic chips* or **microcontrollers**, it may be difficult to protect the sensitive components from voltage spikes. A A flyback converter with a transformer separating the output from the input can allow the "noisy" section of the circuit to be segregated, so long as the converter itself does not introduce noise. Since the electromagnetic interference (EMI) introduced by converters varies widely from one model to another, specifications should be checked carefully.

Very low-power components can pick up EMI from the wires or traces leading into and out of a converter. In this type of circuit, adequate noise suppression may be impossible, and a converter may not be appropriate.

What Can Go Wrong

Electrical Noise in Output

Electrolytic capacitors may be inadequate to smooth the high frequencies used. Multilayer ceramic capacitors or tantalum capacitors may be necessary. Check the manufacturer's datasheet for minimum and maximum values. Also check the datasheet for advice regarding placement of capacitors on the input side as well as across the output.

Excess Heat with No Load

Some converters generate substantial heat while they are powered without a load. The manufacturer's datasheet may not discuss this potential problem very prominently or in any detail. Check the input rating, usually expressed in mA, specified for a no-load condition. All of this current will have to be dissipated as heat, and the very small size of many converters can result in high localized temperatures, especially since many of them allow no provision for a heat sink.

Inaccurate Voltage Output with Low Load

Some converters are designed to operate with at least 10% of full rated load across their output at all times. Below this threshold, output voltage can be grossly inaccurate. Read datasheets carefully for statements such as this: "Lower than 10% loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%." Always use a meter to verify the output voltage from a converter at a variety of different loads, and perform this test before installing the converter in a circuit.

DC-AC inverter

18

A power inverter must not be confused with a *logic inverter*, which functions as a digital component in *logic circuits* to invert the state of a low-voltage DC input from high to low or low to high. Logic inverters are discussed in Volume 2.

OTHER RELATED COMPONENTS

- **AC-DC power supply** (See Chapter 16)
- **DC-DC converter** (See Chapter 17)

What It Does

A power inverter is included here as counterpoint to a **power supply** or *AC adapter*, since it has the opposite function. The inverter receives an input of *direct current* (typically 12VDC from a car battery) and delivers an output of *alternating current* (AC) in the range 110VAC-120VAC or 220VAC-240VAC, suitable to power many low-wattage appliances and devices. The interior of a low-cost inverter is shown in Figure 18-1.

Figure 18-1. *The interior components in a 175-watt inverter.*

How It Works

The first stage of an inverter typically raises a 12VDC input to a higher DC voltage via an internal **DC-DC converter**, then uses a switching circuit to create an approximation of the sinusoidal profile that is characteristic of AC voltage.

Digital switching components naturally tend to create square waves, whose simple appearance conceals the presence of higher frequencies, or *harmonics*, that are ignored by some devices (especially those that convert electricity into heat) but can be troublesome in consumer electronics equipment. A primary objective of inverter design is to adapt or combine square waves to emulate a classic AC sine wave with reasonable fidelity. Generally speaking, the more accurately an inverter emulates a sine wave, the more expensive it tends to be.

The most primitive inverter would create a plain square wave such as that shown in red in Figure 18-2, superimposed on a comparable sine wave (in green). Note that alternating current rated at 115 volts actually peaks at around 163 volts because the number 115 is the approximate *root mean square* (*RMS*) of all the voltage values during a single positive cycle. In other words, if the voltage is sampled x times during a cycle, an

RMS value can be derived by squaring each sample, adding all the samples, dividing by x, and then taking the square root of the result. The RMS value is important as a means to calculate actual power delivered because it can be multiplied by the current to obtain an approximate value in watts.

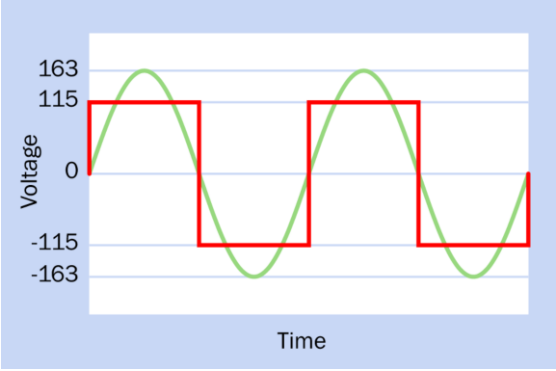

Figure 18-2. *Comparison of an AC voltage sine wave (green) and a square wave of the same frequency (red), both delivering a roughly similar amount of power.*

Variants

As a first step toward a better approximation of a sine wave, gaps of zero voltage can be inserted between square-wave pulses. This "gapped" square wave is shown in Figure 18-3.

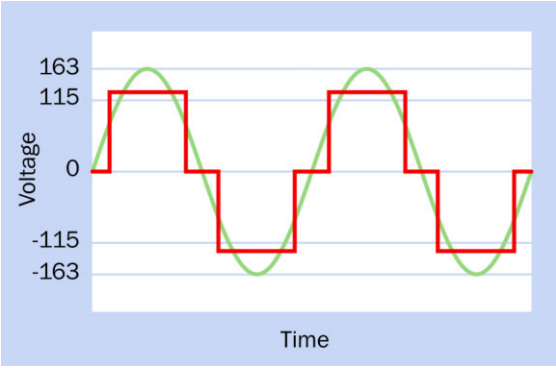

Figure 18-3. *Introducing pauses or gaps of zero voltage between square-wave pulses can produce slightly improved resemblance to a sine wave.*

A further improvement can be achieved if an additional, shorter pulse of higher voltage is added to each primary pulse, as shown in Figure 18-4. Outputs of this kind are referred to as *modified sine wave*, although they are actually square waves modified to emulate a sine wave. Their inaccuracy is expressed as *total harmonic distortion* (*THD*). Some authorities estimate that the THD of gapped square-wave output is around 25%, whereas the addition of shorter square waves reduces this to around 6.5%. This is a topic on which few people agree, but there is no doubt that a "stacked" sequence of square waves provides a closer emulation of a sine wave.

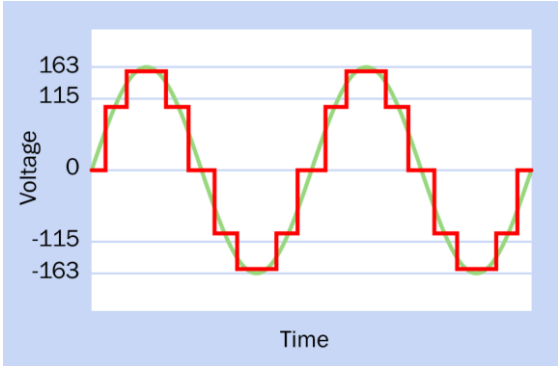

Figure 18-4. *A secondary stream of narrower square-wave pulses can improve the fidelity of an inverter's output.*

A *true sinewave inverter* typically uses *pulse-width modulation* (*PWM*) to achieve THD of less than 1%. It generates a stream of pulses much higher in frequency than that of the AC output, and varies their widths in such a way that their averaged voltage closely approximates the voltage variations in a sine wave. A simplified representation of this principle is shown in Figure 18-5.

Values

Small inverters are typically rated to deliver up to 100 watts and may be fitted with a 12VDC plug for insertion in a vehicle's cigarette lighter. Since a cheap inverter may be only 80% efficient, 100 watts at 135VAC will entail drawing as much as

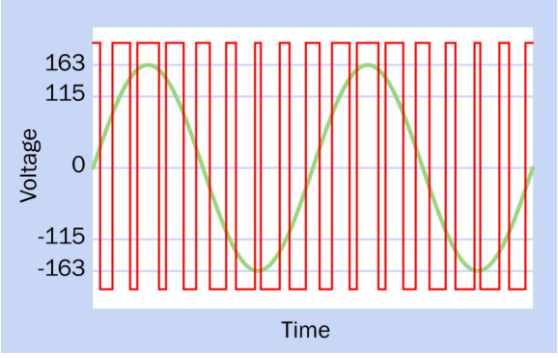

Figure 18-5. *Pulse-width modulation adjusts the widths of pulses delivered at a high frequency. The pulse widths can be averaged to generate voltage that follows a close approximation of a sine wave.*

10 amps at 12VDC. Cigarette lighters are usually fused at 15 or 20 amps, so 100 watts is a reasonable value. Inverters that are rated above 150 watts usually have cables terminating in oversize alligator clips for direct connection to the terminals of a 12V battery.

While the *cold cranking* rating of a car battery may be 100 amps or more, the battery is only designed to deliver that power for up to 30 seconds at a time. Inverters rated for as much as 500 watts will exceed the normal capacity of a single car battery, although if the battery is mounted in a vehicle, it can be supplemented by running the engine so that the alternator shares some of the load. A 500-watt inverter is better supplied by two or more 12-volt car batteries wired in parallel.

How to Use it

Small inverters are typically used in vehicles to run cellphone chargers, music players, or laptop computers. Large inverters are an integral part of off-the-grid solar and wind-powered systems, where battery power must be converted to AC house current. Uninterruptible power supplies contain batteries and inverters capable of running computer equipment for a brief period. Battery-driven electric vehicles with AC motors use inverters with an exceptionally high current rating.

There is a lack of consensus regarding possible harmful effects of powering electronics equipment with a low-cost modified sine wave inverter. Anecdotal evidence suggests that where the equipment uses its own *switching power supply* or uses an *AC adapter* (either mounted internally or as an external plug-in package), the filtering built into the power supply will block harmonics from the inverter.

Other evidence suggests that cheap inverters may have adverse effects on devices containing synchronous motors that run direct from AC. There are reports that fluorescent lighting and photographic electronic flash systems may be unsuitable for use even with modified sine wave inverters. However, differences in product design and component quality make it impossible to generalize. A cheaply made inverter may generate a wave form that is not even a close approximation of a square wave. See Figure 18-6.

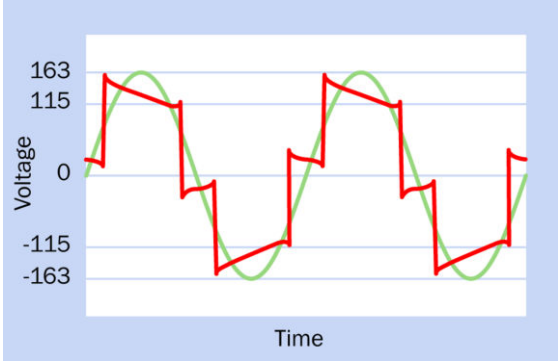

Figure 18-6. *A cheaply made inverter can generate a distorted wave form that is even higher in noise than a pure square wave. This sample is adapted from an actual oscilloscope trace.*

What Can Go Wrong

If multiple batteries are connected in parallel, using suitably heavy-gauge wire to power a large inverter, the batteries must be identical in specification and age, and must all be equally charged to prevent high and potentially dangerous flows of current among the batteries as they attempt to reach an equilibrium among themselves. Interconnections must be firmly clamped to clean battery terminals. For additional information, see the **battery** entry in this encyclopedia.

Problems associated with inverters are likely to be mundane. A 12V wiring to the inverter can overheat if items such as clothes or bedding are left on top of it; a high-wattage fan-cooled inverter can overheat if the fan is obstructed by poor placement or impaired by accumulated dirt; alligator clips may become dislodged from battery terminals; and power surges drawn by inductive loads such as motors may trigger the inverter's *breaker*, especially if they are used in conjunction with other equipment.

As always, high amperage should be treated with caution and respect, regardless of it being delivered at "only 12 volts."

voltage regulator

19

Correctly known as a *linear voltage regulator* to distinguish it from a *switching regulator* or **DC-DC converter**. However, the full term is not generally used, and "voltage regulator" is normally understood to mean a linear voltage regulator.

OTHER RELATED COMPONENTS

- **DC-DC converter** (See Chapter 17)
- **AC-DC power supply** (See Chapter 16)

What It Does

A linear voltage regulator provides a tightly controlled DC output, which it derives from an unregulated or poorly regulated DC input. The DC output remains constant regardless of the load on the regulator (within specified limits). It is a cheap, simple, and extremely robust component.

There is no single schematic symbol for a linear voltage regulator.

The general physical appearance of a commonly used type of regulator, rated for an output of around 1A DC, is shown at Figure 19-1. The LM7805, LM7806, LM7812, and similar regulators in the LM78xx series are encapsulated in this type of package, with pins that are spaced at 0.1" and have functions as shown. Other types of regulator may differ in appearance, or may look identical to this one but have different pin functions. Always check datasheets to be sure.

How It Works

All linear regulators function by taking some feedback from the output, deriving an error value by comparing the output with a reference voltage (most simply provided by a zener diode), and using the error value to control the base of a *pass transistor* that is placed between the input and the output of the regulator. Because the transistor operates below saturation level, its output current varies linearly with the current applied to its base, and this behavior gives the linear regulator is name. Figure 19-2 shows the relationship of these functions in simplified form; Figure 19-3 shows a little more detail, with a *Darlington pair* being used as the pass transistor. The base of the pair is controlled by two other transistors and a comparator that delivers the error voltage. This version of a voltage regulator is known as the *standard type*.

The voltage difference required between the base and emitter of an NPN transistor is a minimum of 0.6V. Because multiple transistors are used inside a standard-type voltage regulator, it requires a minimum total voltage difference, between its input and its output, of 2VDC. This voltage difference is known as the *dropout voltage*. If the voltage difference falls below this minimum, the regulator ceases to deliver a reliable output voltage until the input voltage rises again. *Low dropout regulators* allow a lower voltage difference, but are more expensive and less commonly used. They are described under the following Variants section.

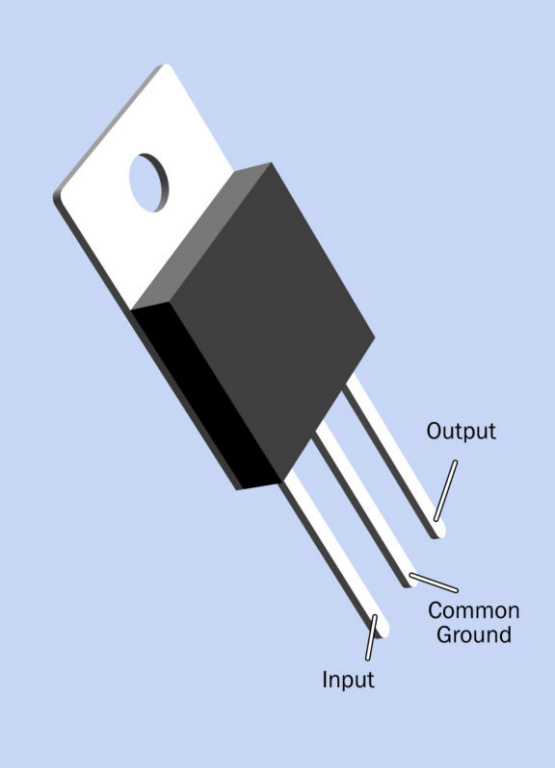

Figure 19-1. *The package design of a commonly used voltage regulator. Others may be significantly different, and the pin functions may vary. Check manufacturer datasheets for details.*

Discrete components could in theory be used to build a voltage regulator, but this ceased to be cost-effective several decades ago. The term is now understood to mean one small integrated package containing the basic circuit augmented with additional, desirable features, such as automatic protection against overload and excessive heat. Instead of burning out if it is overloaded, the component simply shuts down. Most voltage regulators also tolerate accidentally reversed power connection (as when batteries are inserted the wrong way around) and accidentally reversed insertion of the regulator in a circuit board.

Other components can satisfy the requirement to deliver power at a reduced voltage. Most simply, if two resistors in series are placed across a

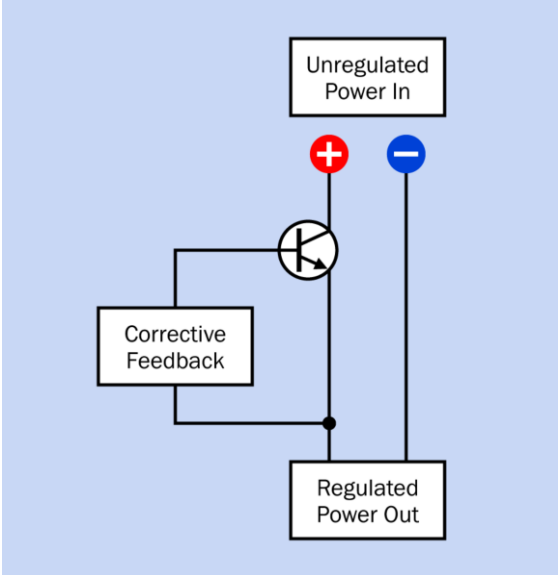

Figure 19-2. *A linear voltage regulator basically consists of a transistor whose base is controlled by corrective feedback derived from the output.*

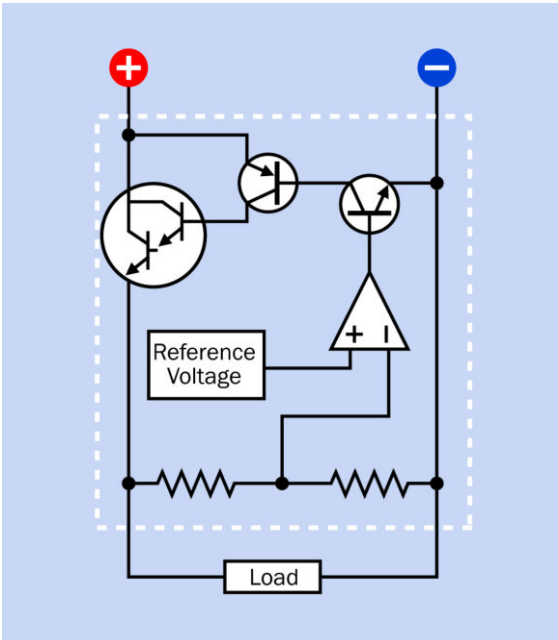

Figure 19-3. *The fundamental internal features of a standard-type voltage regulator, including a Darlington pair, two transistors, a voltage divider, comparator, and reference voltage source, shown inside the dashed white line.*

power source, they form a *voltage divider*, which provides an intermediate voltage at the connection between them. However, this voltage will vary depending on fluctuations in the input voltage and/or load impedance. A voltage regulator is the simplest way to supply a voltage that remains stable regardless of excursions in the input or fluctuations in power consumed by the load.

The disadvantage of a standard-type voltage regulator is that it is inefficient, especially when a relatively high input voltage is used to deliver a relatively low output voltage. If V_{in} is the input voltage, V_{out} is the output voltage, and I_{out} is the output current, the average power loss, P, is given by the formula:

$$P = I_{out} * (V_{in} - V_{out})$$

For example, if the output current is 1A, the input voltage is 9VDC, and the output is 5VDC, 44% of the input power will be wasted, and the component will be only 56% efficient. The wasted power (about 4 watts, in this case) will be dissipated as heat. Even when a standard-type regulator runs at its minimum 2VDC dropout voltage, it must dissipate 1W when delivering 0.5A.

Variants

Packaging

The package for the LM78xx series of regulators, shown in Figure 19-1, incorporates an aluminum plate drilled with a hole so that it can be bolted to a heat sink. Voltage regulators with a lower rated maximum output current (typically, 100mA) do not have the same need for a heat sink, and are available in a package that resembles a small transistor.

Some integrated circuits are available containing two voltage regulators, electrically isolated from each other.

Popular Varieties

In the LM78xx series, the last two digits in the part number specify the output voltage, which is fixed. Thus the LM7805 delivers 5VDC, the LM7806 delivers 6VDC, and so on. For regulators with a fractional voltage output (3.3VDC being common), an additional letter may be inserted in the part number, as in the 78M33.

Many copies of the LM78xx series are made by different manufacturers, the copies being functionally identical, regardless of additional letters that are added to the part number to identify its source or other attributes.

The LM78xx regulators are mostly rated to be accurate within 4%, although actual samples almost always deliver voltages that are more precise than this range suggests.

Adjustable Regulators

While the majority of regulators have a fixed output, some allow the user to set the output by adding one or more resistors. The LM317 is a popular example. Its output voltage can range from 1.25VDC to 37VDC and is set via a resistor and a trimmer potentiometer, as illustrated in Figure 19-4. If R1 is the fixed-value resistor and R2 is the trimmer, as shown in the schematic, the output voltage, V_{out}, is given by the formula

$$V_{out} = 1.25 * (1 + (R2 / R1))$$

Typical values for R1 and R2 would be 240Ω and 5K, respectively. With the trimmer at the middle of its range, V_{out} would be 1.25 * (1 + (2500 / 240)) = approximately 15VDC, requiring an input of at least 17VDC. However, if the trimmer is reduced to 720Ω, the output would be 5VDC. In practice, the value of a trimmer should be chosen so that a mid-range setting provides approximately the desired output. This will enable fine adjustment of the output voltage.

While the versatility of an adjustable regulator is desirable, its overall power dissipation is still proportional to the difference between the input voltage and the output voltage. To minimize heat loss, this difference should not exceed the dropout voltage by a larger amount than is absolutely necessary.

An adjustable regulator may require larger bypass capacitors than a regulator with a fixed output. A manufacturer's recommendations for the LM317 are shown in Figure 19-4.

Negative and Positive Regulators

While most linear voltage regulators are designed for "positive input" (conventional current flow from input to output), some are intended for "negative input." In this variant, the common terminal is positive, and the input and output are negative in relation to it.

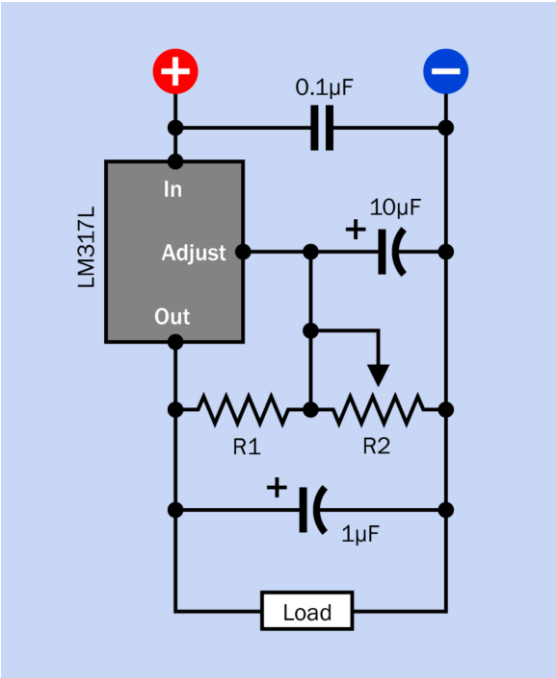

Figure 19-4. *Schematic for the LM317L adjustable voltage regulator, based on a circuit recommended by National Semiconductor, with bypass capacitors added for ripple rejection.*

Low-Dropout Linear Regulators

Low-dropout regulators (sometimes referred to as *LDO* regulators) allow a much lower dropout voltage by using a single PNP or MOSFET transistor. LDO regulators are popularly used in battery-powered devices where efficiency should be maximized and heat dissipation should be minimized. For example, the LM330 is a regulator with a 5VDC output, tolerating a dropout voltage of 0.6V, allowing it to be used with four AAA cells. In an LDO regulator the dropout voltage actually varies with load current and may diminish to as little as one-tenth of its rated value when the output current is minimal.

The majority of low-dropout regulators are sold in surface-mount packages, and are designed for maximum output of 100mA to 500mA. Only a few exceptions exist. They tend to be slightly more expensive than regulators with the typical 2V dropout rating.

Three voltage regulators are shown in Figure 19-5. From left to right, they are rated 5VDC at 1A, 12VDC at 1A, and 5VDC at 7.5A. The two smaller regulators are of the LM78xx series. The larger regulator claims a low maximum dropout voltage of 1.5VDC, and its output voltage can be adjusted with an external potentiometer and resistor.

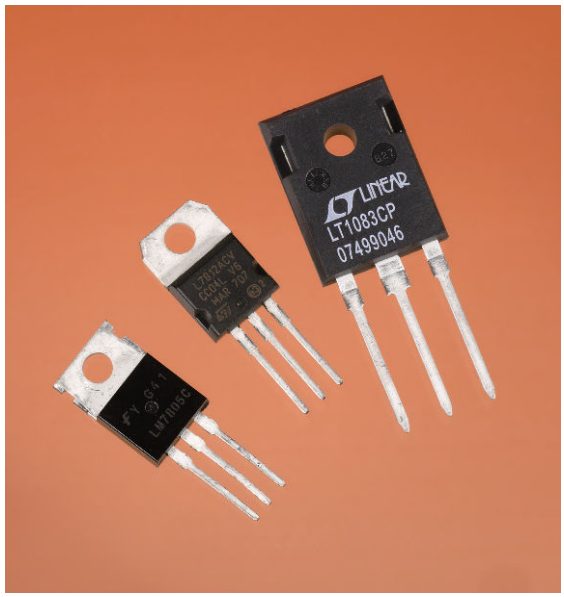

Figure 19-5. *Two voltage regulators from the LM78xx series, and a third high-current, low-dropout, adjustable regulator rated 5VDC (adjustable upward) at 7.5A.*

Quasi-Low-Dropout Linear Regulators

Where a standard regulator uses a Darlington pair as the pass transistor and an LDO uses a single PNP transistor, the so-called Quasi-LDO uses a combination of NPN and PNP transistors and has an intermediate dropout voltage, typically a maximum of 1.5VDC. However, the terms LDO and Quasi-LDO are not used uniformly in the industry. One manufacturer markets Quasi-LDO regulators as LDO regulators, and describes its LDO regulators as *Very Low Dropout* regulators. Consult datasheets to determine the actual specification of the product, regardless of its classification.

Additional Pin Functions

Some voltage regulators include an extra pin, typically known as an *enable pin*, which switches off the device in response to a signal from a microcontroller or logic gate.

Some regulators offer another option, an additional *status pin* that can signal a microcontroller that an error mode exists if the regulator output falls significantly below its rated value.

In battery-powered devices, a low-battery sensor is a desirable feature, since a regulator may simply shut down without warning if the input voltage is insufficient. A few regulators, such as the LP2953, provide a low-battery warning output via an extra pin.

Values

Linear voltage regulators with a single, fixed output are commonly available to supply DC outputs of 3.3, 5, 6, 8, 9, 10, 12, 15, 18, and 24 volts, with a few variants offering fractional values in between. The most commonly used values are 5, 6, 9, 12, and 15 volts. The input voltage may be as high as 35VDC.

Maximum output current is typically 1A or 1.5A, in the traditional three-pin, through-hole, TO-220 format. A surface-mount version is available. Other surface-mount formats have lower power limits.

Accuracy may be expressed as a percentage or as a figure for load regulation in mV. A typical load regulation value would be 50mV, while voltage regulation accuracy ranges from 1% to 4%, depending on the manufacturer and the component. While low-dropout regulators are generally more efficient, they do require more ground-pin current. This is not usually a significant factor.

How to Use it

Some components, such as many old-design CMOS chips or the traditional TTL version of the 555 timer, allow a wide range of acceptable input voltages, but most modern logic chips and microcontrollers must have a properly controlled power supply. Regulators such as the LM7805 are traditionally used to provide this, especially in small and relatively simple devices that draw a moderate amount of current, have a low component count, and are powered via a battery or an **AC adapter**. A fully fledged switching power supply is overkill in this kind of application.

A linear voltage regulator cannot respond instantly to changes in input voltage. Therefore, if the input supply contains voltage spikes, these spikes may pass through the regulator. Bypass capacitors should be applied preventively. A sample schematic showing an LM7805 regulator with bypass capacitors recommended by a manufacturer is shown in Figure 19-6.

In a battery-powered device where standby power is required for long periods and full power is only needed intermittently, the *quiescent current* drawn by a minimally loaded voltage regulator is important. Modern LDO regulators may draw as little as 100µA when they are very lightly loaded. Other types may consume significantly more. Check datasheets to find the most appropriate component for a particular application.

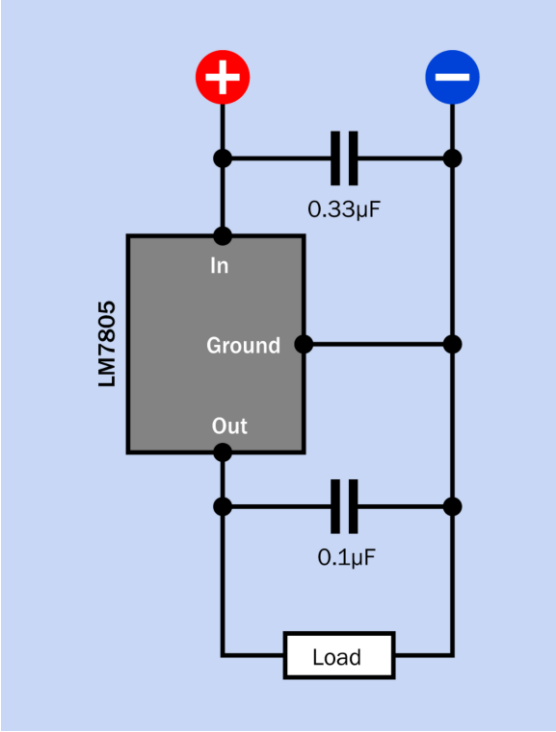

Figure 19-6. *Typical schematic for use of an LM7805 regulator, with capacitor values based on recommendations from Fairchild Semiconductor.*

Note that DC-DC power **converters** may draw a lot of current when they are lightly loaded, and will dissipate large amounts of heat as a result. An LDO is therefore preferable in this situation.

What Can Go Wrong

Inadequate Heat Management

The ability to "dial up" a wide range of voltages from an adjustable regulator such as the LM317 can be a temptation to use it on a "one size fits all" basis, to deliver any output ranging from 5VDC to 18VDC from a uniform 24VDC input. Assuming 1A output current, the worst-case power dissipation in this scenario would be almost 20W. To achieve reasonable efficiency and maintain waste heat at a manageable level, the input voltage should not exceed the output voltage by much more than the dropout voltage.

Even when a voltage regulator is used correctly, it can generate more heat than was expected if the requirements of a circuit are altered during development. An initial handful of components may draw only 100mA, but as more capabilities are requested and more parts are added (especially relays or LED displays) the power consumption can quickly add up, generating an unexpected amount of waste heat and raising the possibility of a sudden (and mysterious) shutdown if the regulator does not have an adequate heat sink.

Transient Response

When there is a major fluctuation in the demand by the load (for example, if an inductive device is switched on elsewhere in the circuit), the voltage regulator requires a finite time to adjust itself and maintain its specified output voltage. This time lag is known as its *transient response*. If a momentary fluctuation is likely, and other components may be sensitive to it, a larger capacitor should be used between the output of the voltage regulator and ground.

The transient response time may also be insufficient to block sudden, brief spikes in input voltage. This may occur, for example, when a low-cost AC adapter that does not have a properly smoothed output is used as the power source. Additional 1µF bypass capacitors may be added at the input and output of a regulator to provide better protection from power fluctuations.

Misidentified Parts

Many types of linear voltage regulators appear physically identical. Care is needed to distinguish those which have fixed output from those that allow a variable output. When using the LM78xx series, double-check the last pair of digits in the part number, which provide the only guide regarding the output. Using an LM7808 instead of an LM7805 may be sufficient to destroy all the 5VDC chips in a logic circuit. It is advisable to use a meter to check the output of any power supply before connecting it with a circuit.

Misidentified Pins

The LM78xx series of voltage regulators uses a very intuitively obvious and consistent scheme for the functions of its pins: input on the left, ground in the center, and output on the right, when looking at the regulator from the front, with its pins facing downward. Unfortunately the consistency of this scheme can encourage an unthinking habit for making connections. The LM79xx series of negative voltage regulators swaps the identity of the input and ground pins, whereas adjustable regulators use yet another different scheme. Good practice suggests checking a component against the manufacturer's datasheet before connecting it.

Dropout Caused by Low Battery

If a regulator rated to deliver 6VDC has a 2VDC dropout voltage and is powered from a 9V battery, the battery can easily drop below the minimum acceptable 8VDC if it becomes old or depleted. When this happens, the output from the regulator will tend to fall, or may oscillate.

Inaccurate Delivered Voltage

A voltage regulator maintains its output voltage between its output pin and ground pin. Thin traces on a circuit board, or a long run of very small-gauge wiring, can impose some electrical resistance, reducing the actual voltage delivered to a component. Ohm's Law tells us that the voltage drop imposed by a trace (or thin wire) will be proportional to the current flowing through it. For example, if the resistance between the output pin of a voltage regulator and a component is 0.5Ω and the current is 0.1A, the voltage drop will be only 0.05V. But if the current increases to 1A, the voltage drop is now 0.5V. Bearing this in mind, a linear voltage regulator should be positioned close to voltage-sensitive components. In printed circuit designs, the traces that deliver power should not have significant resistance.

When using linear voltage regulators with adjustable output, there may be a temptation to connect adjustment resistor R1 to the positive end of the load, to obtain a "more accurate" delivered voltage. This configuration will not produce the desired result. R1 should always be connected as closely as possible between the output pin and the adjustment pin of the voltage regulator, while R2 should connect between the adjustment pin and the negative end of the load. This is illustrated in Figure 19-7, where the gray wire in each schematic indicates that it possesses significant resistance.

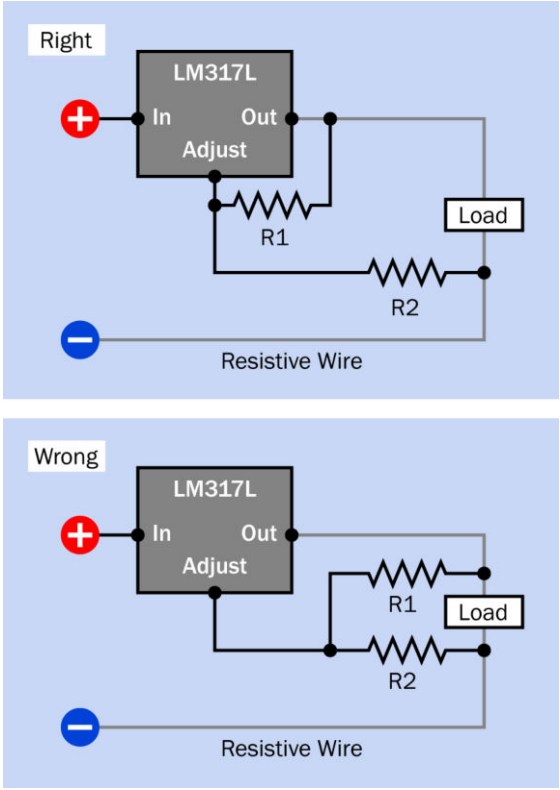

Figure 19-7. *When the connection between an adjustable-output voltage regulator and load components has a significant resistance (shown here as a gray "resistive wire"), R1 should always be connected as closely as possible to the pins of the regulator, as shown in the upper schematic. (Derived from schematics prepared by National Semiconductor.)*

electromagnet

20

The term **electromagnet** is used here to mean a coil containing a core of ferromagnetic material that does not move relative to the coil. The core is used solely to create a magnetic field that attracts or repels other parts that have appropriate inherent magnetic properties. Where a center component moves in response to the magnetic force created by current through a coil, this is discussed in the **solenoid** entry. By comparison, the **inductor** entry describes a coil that may or may not have a ferromagnetic core, and is used for the specific purpose of creating reactance, or self-inductance, in an electronic circuit, often in association with alternating current and in combination with resistors and/or capacitors. The **inductor** entry contains a basic discussion and explanation of magnetic force created by electricity.

OTHER RELATED COMPONENTS

- **solenoid** (See Chapter 21)
- **electromagnet** (See Chapter 20)
- **DC motor** (See Chapter 22)
- **AC motor** (See Chapter 23)

What It Does

An electromagnet consists of a coil that creates a magnetic field in response to an electric current. The field is channeled and reinforced by a core of magnetic material (that is, material that can be magnetized). Electromagnets are incorporated in motors, generators, loudspeakers, microphones, and industrial-sized applications such as mag-lev trains. On their own, they provide a means for electric current to hold, lift, or move objects in which a magnetic field can be induced.

A very small, basic electromagnet about 1 inch in diameter is shown in Figure 20-1. No specific schematic symbol for an electromagnet exists, and the symbol for an induction coil with a solid core is often used instead, as shown in Figure 14-1 (the center variant of each of the three) in the **inductor** entry of this encyclopedia.

Figure 20-1. *An electromagnet approximately 1 inch in diameter, rated to draw 0.25A at 12VDC.*

How It Works

Electric current flowing through a circle of wire (or a series of connected loops that form a helix

or *coil*) will induce a magnetic field through the center. This is illustrated in the **inductor** entry of this encyclopedia, specifically in diagrams Figure 14-3, Figure 14-4, Figure 14-5, and Figure 14-6.

If a stationary piece of ferromagnetic material is placed in the center of the circle or coil, it enhances the magnetic force because the *reluctance* (magnetic resistance) of the material is much lower than the reluctance of air. The combination of the coil and the core is an electromagnet. This is illustrated in Figure 20-2. For a lengthier discussion of this effect, see "Magnetic Core" (page 122).

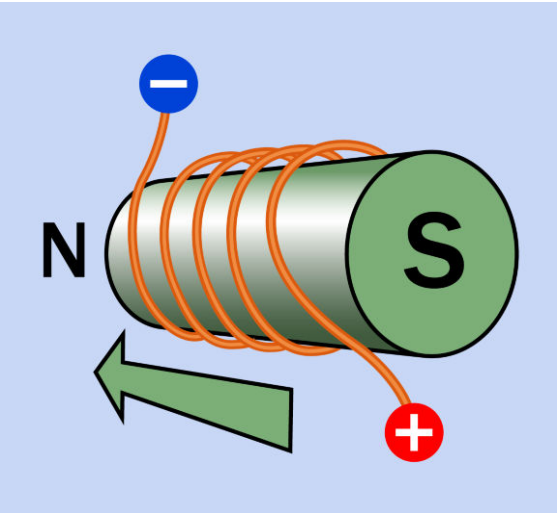

Figure 20-2. *Direct conventional current flowing through a wire coiled around a ferromagnetic rod induces a magnetic force in the rod, conventionally considered to flow from south to north.*

The magnitude of the electromagnetic *flux density* will be proportional to the current flowing through the coil, assuming a DC power source.

Variants

Electromagnet designs vary according to their application. The simplest design consists of a single coil wound around a rod which may terminate in a plate for applications such as lifting scrap metal. This design is relatively inefficient because the magnetic circuit is completed through air surrounding the electromagnet.

A more efficient, traditional design consists of a U-shaped core around which are wound one or two coils. If the U-shaped core is smoothly curved, it resembles a *horse-shoe magnet*, as shown in Figure 20-3. This design has become relatively uncommon, as it is cheaper to make windings across two separate, straight vertical cores and bridge them. However, the horseshoe configuration is extremely efficient, as the coils induce north and south magnetic polarities in the open ends of the U-shaped core, and the magnetic circuit is completed through any object that is attracted toward the open ends and links them. The attracted object is shown as a rectangular plate in Figure 20-3. Because a magnetic circuit will naturally attempt to limit its extent, and because this goal will be achieved when the circuit is completed, the attractive force of the U-shaped magnet is maximized.

An electromagnet powered by direct current naturally produces a consistently polarized, stable magnetic field. When AC current is applied, an electromagnet may still be used to exert an attractive force on a passive object that is not magnetized but is capable of being magnetized. The electromagnet will change its polarity at almost the same frequency as the AC, and will induce equal and opposite fluctuating polarity in the target, causing mutual attraction. The core of the magnet will be composed of plates separated by thin layers of insulation to inhibit the eddy currents induced by the AC, but still an AC-powered electromagnet will be less efficient than a comparable DC-powered electromagnet because it will also suffer from *hysteresis* as power is consumed by repeatedly reversing the polarity of the *magnetic domains* in the core.

Some electromagnets that are described as suitable for AC power actually contain *rectifiers* that convert the AC to DC.

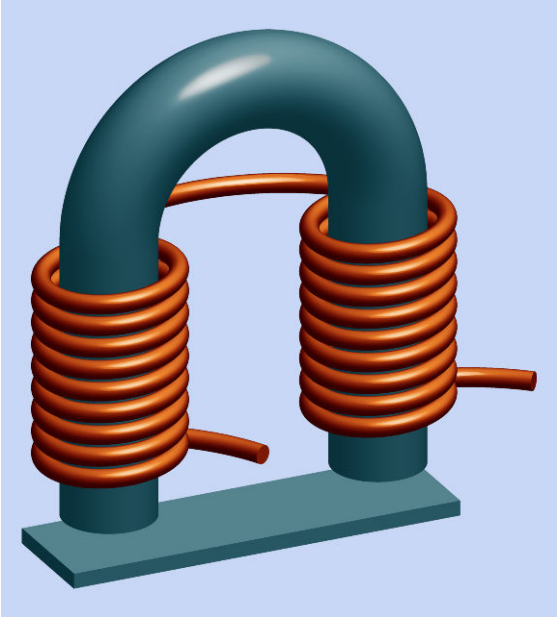

Figure 20-3. *This traditional design for an electromagnet has a pedigree stretching back for more than a century. It maximizes efficiency by completing a magnetic circuit through any object that the magnet attracts.*

Values

Electromagnets are typically calibrated in terms of their power consumption and retaining force (the weight of an iron target that they can support). The retaining force is usually measured in grams or kilograms.

How to Use it

Electromagnets are used mostly as subassemblies in other components, such as motors and generators, relays, loudspeakers, and disk drives. They have also been used in audio (and video) tape recorders to magnetize ferric oxide on tape, using a magnetic field of varying strength to record an audio signal. In this application, a form of horseshoe magnet with an extremely narrow gap is used, the width of the gap determining the highest frequency that the electromagnet can record, in conjunction with the speed of the tape moving past the head.

The tape recording process can be reversed when the electromagnet "reads" the tape and turns the signal back into a weak alternating current that can be amplified and reproduced through a loudspeaker.

A simple application for an electromagnet is in a traditional-style doorbell, where one or two coils attract a spring-loaded lever, at the top of which is a knob that hits a bell. When the lever is pulled toward the bell, it breaks a contact that supplies power to the electromagnet. This allows the lever to spring back to its original position, which re-establishes the circuit, repeating the process for as long as power is applied to the bell. The bulk and weight of the component parts in this type of doorbell are making it obsolete, as electronic versions containing small loudspeakers become relatively cheaper. However, a **solenoid** may still be used in the type of bell that creates a single chime or pair of chimes.

In any device using a *cathode-ray tube*, electromagnetic coils are used to form a *yoke* around the neck of the tube, to deflect the beam of electrons on its way to the screen. A similar principle is used in electron microscopes. In some cases, electrostatically charged plates are used to achieve the same purpose.

An electromagnet may be used to activate a *reed switch* (the diagram in Figure 9-7 shows such a switch). In this application, the combination of the electromagnet and the switch are functioning as a **relay**.

When an electromagnet is energized by alternating current, it can be used to *degauss* (in other words, to demagnetize) other objects. The AC is either applied with diminishing current, so that the alternating magnetic polarities gradually subside to zero, or the electromagnet is gradually moved away from the target, again reducing the magnetic influence to (virtually) zero. This latter procedure may be used periodically to demagnetize record and replay heads on tape recorders, which otherwise tend to acquire residual magnetism, inducing background hiss on the tape.

Traditional large-scale applications for electromagnets tend to involve lifting and moving heavy objects or scrap metal, such as junked cars. A more modern application is in magnetic resonance imaging (MRI), which has revolutionized some areas of medicine.

Very large-scale applications for electromagnets include particle accelerators, in which multiple magnetic coils are energized sequentially, and fusion-power generators, where high-temperature plasma is contained by a magnetic field.

What Can Go Wrong

Because an electromagnet requires constant power to maintain its magnetic force, yet it is not doing any actual work so long as its target remains stationary (in contact with the core of the magnet), the current running through the coil of the magnet must be dissipated entirely as heat. Further discussion of this issue will be found at "Heat" (page 177) in the **solenoid** section of this encyclopedia.

solenoid

21

The term **solenoid** was historically used to describe any coil without a magnetic core. More recently and more commonly it describes a coil inside of which a cylindrical plunger moves in response to the magnetic field generated by the coil. In this encyclopedia, the term **electromagnet** has its own entry, and describes a coil with a center component of ferromagnetic material that does not move relative to the coil. It is used solely to attract or repel other parts that have inherent magnetic properties. By comparison, the **inductor** entry describes a coil that is used for the specific purpose of creating reactance, or self-inductance, in an electronic circuit, often in association with alternating current and in combination with resistors and/or capacitors. The **inductor** entry contains a basic discussion and explanation of magnetic force created by electricity.

OTHER RELATED COMPONENTS

- **inductor** (See Chapter 14)
- **solenoid** (See Chapter 21)

What It Does

A typical solenoid consists of a hollow coil inside a *frame*, which may be a sealed cylinder or box-shaped with open sides. In the case of a cylinder, its opposite ends may be referred to as *pole faces*.

At least one of the pole faces has a hole through which a *plunger* (also known as an *armature*) is pulled or pushed by the solenoid. Thus, the solenoid is a device for applying a linear mechanical force in response to current passing through it. In most solenoids, current must be maintained in order to maintain the mechanical force.

A small open-frame solenoid is pictured in Figure 21-1. The upper section of the figure shows the three basic parts: frame, compression spring, and plunger. The lower part of the figure shows the parts assembled.

A larger, closed, cynlindrical solenoid is shown in Figure 21-2, with the plunger and spring removed.

A 3D rendering showing a simplified, imaginary, cylindrical solenoid cut in half appears in Figure 21-3. The diagram includes a gray cylindrical shell, often described as the frame; the coil, shown in orange; the plunger, which is pulled into the coil by its magnetic field; and the triangular stop, which limits the plunger's upward travel. The frame of the solenoid exists not merely to protect the coil, but to provide a magnetic circuit, which is completed through the plunger.

The lower end of the plunger is often fitted with a nonmagnetic yoke or perforated plate for connection with other components. Stainless steel can be used for this purpose. The stop may be fitted with a thrust rod (also fabricated from stainless steel) if the solenoid is intended to "push" as well as "pull." Springs to adjust the force of the plunger, or to return it to its initial position when the current through the coil is interrupted, are not shown in the rendering.

Figure 21-1. *A small 12VDC solenoid.*

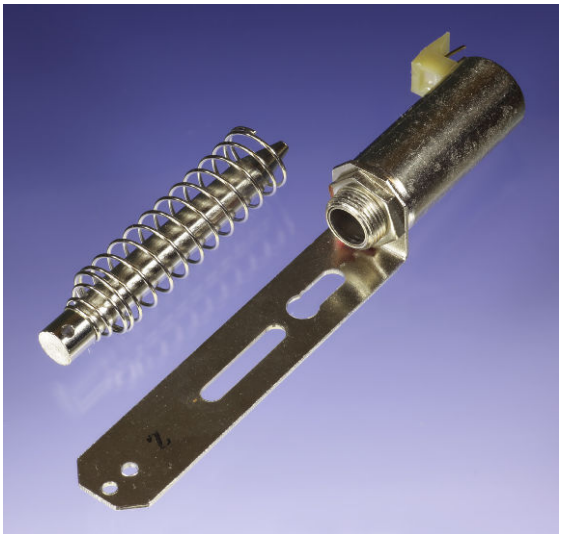

Figure 21-2. *A larger solenoid rated for 24VDC.*

Because there is no standardized schematic symbol for a solenoid, and because this type of component is so widely used in conjunction with valves, any diagram involving solenoids is more likely to emphasize fluid or gas flow with symbols that have been developed for that purpose. In such circuits, a solenoid may be represented simply by a rectangle. However, the symbols shown in Figure 21-4 may occasionally be found.

How It Works

Current flowing through the coil creates a magnetic force. This is explained in the **inductor** entry of this encyclopedia, using diagrams in Figure 14-3, Figure 14-4, Figure 14-5, and Figure 14-6.

If the plunger is fabricated from a material such as soft iron, the coil will induce an equal and opposite magnetic polarity in the plunger. Consequently the plunger will attempt to occupy a position inside the coil where the ends of the plunger are equal distances from the ends of the coil. If a collar is added to the free end of the plunger, this can increase the pulling force on the plunger when it is near the end of its throw because of the additional magnetic pull distributed between the collar and the frame of the solenoid.

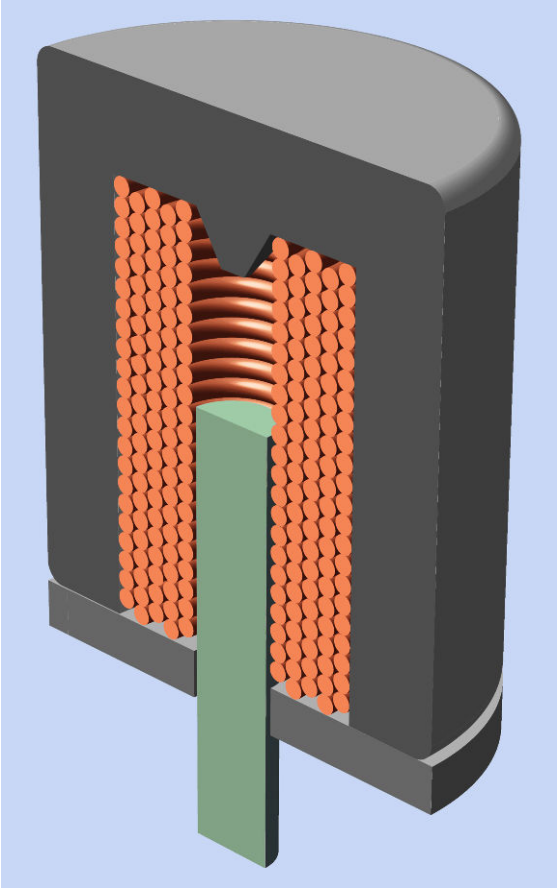

Figure 21-3. *A simplified view of a solenoid cut in half, showing the primary parts.*

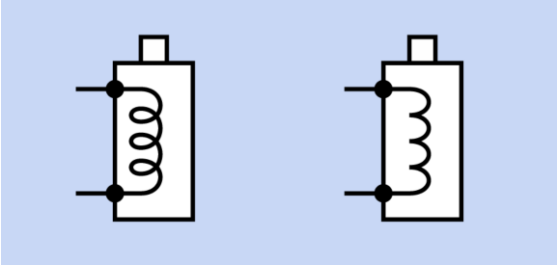

Figure 21-4. *Although no standard schematic symbol for a solenoid exists, these symbols may sometimes be found.*

A spring can be inserted to apply some resistive force to compensate for the increase in pulling force that occurs as a larger proportion of the plunger enters the coil. A spring may also be used to eject the plunger, partially at least, when current to the coil is interrupted.

If the plunger is a permanent magnet, reversing DC current to the coil will reverse the action of the plunger.

A solenoid with a nonmagnetized plunger may be energized by AC current, since polarity reversals in the magnetic field generated by the coil will induce equal and opposite reversals in the polarity of the plunger. However, the force curve of an AC-powered solenoid will be different from the force curve of a DC-powered solenoid. See Figure 21-5. The alternating current is likely to induce humming, buzzing, and vibration.

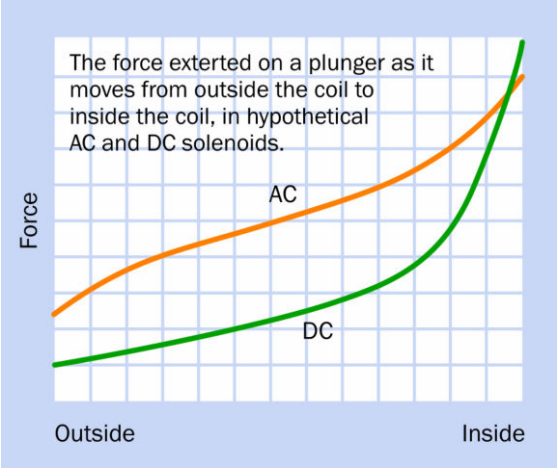

Figure 21-5. *A comparison of the force exerted on a plunger, relative to its position as it enters the coil, in hypothetical AC and DC solenoids.*

The frame of the solenoid increases the magnetic power that the coil can exert by providing a magnetic circuit of much lower *reluctance* than that of air (reluctance being the magnetic equivalent of electrical resistance). For a lengthier discussion of this effect, see "Magnetic Core" (page 122) in the **inductor** entry of this

encyclopedia. If current flowing through the coil increases to the point where the frame becomes magnetically *saturated*, the pulling power of the solenoid will level off abruptly.

The heat generated by a solenoid when it is maintained in its energized state may be reduced if the manufacturer includes a series resistor and a switch that functions as a *bypass switch*. The switch is normally closed, but is opened mechanically when the plunger reaches the end of its throw, thus diverting electricity through the series resistor. This itself will generate some heat as a result of the current flowing through it, but by increasing the total resistance of the system, the total heat output will be reduced. The resistor value is chosen to provide the minimum power needed to retain the plunger at the end of its throw.

Variants

The most common variant is tubular, with open-frame as a secondary option. A tubular solenoid has been shown in Figure 21-2.

Additional variants include:

Low Profile

A shorter, fatter solenoid which may be used if a short throw is acceptable.

Latching

A permanent magnet holds the plunger when it reaches the end of its travel, and continues to hold it after power to the solenoid is disconnected. The plunger itself is also a permanent magnet, and is released by running current of reverse polarity through the coil.

Rotary

This variant is similar in principle to a brushless DC motor and causes the armature to rotate through a fixed angle (typically ranging from 25 to 90 degrees) instead of moving linearly. It is used as a mechanical indicator in control panels, although it is being displaced by purely electronic indicators.

Hinged Clapper

Instead of a plunger, a small hinged panel (the "clapper") moves in when the solenoid is active, and springs back when the power is interrupted.

Values

The stroke length, duty cycle, and holding force are the most significant values found in solenoid datasheets.

Holding forces for DC solenoids can range from a few grams to hundreds of kilograms. The holding force will be inversely proportional to the length of the solenoid, if all other variables are equal. The force that the solenoid can exert on its plunger also varies depending on the position of the plunger in the length of its throw.

Duty cycle is of special importance because the solenoid continues to draw power and create heat so long as it is holding the plunger at the end of its throw (assuming the solenoid is not the latching type). The initial current surge in an AC solenoid generates additional heat.

The duty cycle is simply calculated. If T1 is the time for which the solenoid is on and T2 is the time for which the solenoid is off, the duty cycle, D, is derived as a percentage from the formula

```
D = 100 * (T1 / (T1 + T2))
```

Some solenoids are designed to withstand a 100% duty cycle, but many are not, and in those cases, there is a maximum value not only for D but for the peak "on" time, regardless of the duty cycle. Suppose a solenoid is rated for a 25% duty cycle. If the solenoid is appropriately switched on for one second and off for three seconds, the heat will be allowed to dissipate before it has time to reach overload levels. If the solenoid is switched

on for one minute and off for three minutes, the duty cycle is still 25%, but the heat that may accumulate during a one-minute "on" cycle may overload the component before the "off" cycle can allow it to dissipate.

Coil Size vs. Power

Because additional windings in a coil will induce a greater magnetic force, a larger solenoid tends to be more powerful than a smaller solenoid. However this means that if a larger and a smaller solenoid are both designed to generate the same force over the same distance, the smaller solenoid will probably draw more current (and will therefore generate more heat) because of its fewer coil windings.

How to Use it

Solenoids are primarily used to operate valves in fluid and gas circuits. Such circuits are found in laboratory and industrial process control, fuel injectors, aircraft systems, military applications, medical devices, and space vehicles. Solenoids may also be used in some electronic locks, in pinball machines, and in robotics.

What Can Go Wrong

Heat

Overheating is the principal concern when using solenoids, especially if the maximum "on" time is exceeded, or the duty cycle is exceeded. If the plunger is prevented from reaching the end of its throw, this can be another cause of overheating.

Because coil resistance increases with heat, a hot solenoid passes less current and therefore develops less power. This effect is more pronounced in a DC solenoid than an AC solenoid. A manufacturer's force curve should show the solenoid performance at its maximum rated temperature, which is typically around 75 degrees Centigrade, in a hypothetical ambient temperature of 25 degrees Centigrade. Exceeding these values may result in the solenoid failing to perform. As in all coils using magnet wire, there is the risk of excessive heat melting the insulation separating the coil windings, effectively shortening the coil, which will then pass more current, generating more heat.

AC Inrush

When an AC solenoid reaches the end of its travel, the sudden stop of the plunger results in forward *EMF* that generates additional heat. Generally speaking, a longer stroke creates a greater surge. Rapid cycling will therefore exacerbate coil heating.

Unwanted EMF

Like any device containing a coil, a solenoid creates back EMF when power is connected, and forward EMF when the power is disconnected. A protection diode may be necessary to suppress power spikes that can affect other components.

Loose Plunger

The plunger in many solenoids is not anchored or retained inside the frame and may fall out if the solenoid is tilted or subjected to extreme vibration.

DC motor

22

In this section, the term "traditional DC motor" is used to describe the oldest and simplest design, which consists of two *brushes* delivering power via a rotating, sectioned *commutator* to two or more electromagnetic coils mounted on the motor shaft. *Brushless* DC motors (in which DC is actually converted to a pulse train) are also described here because "brushless DC" has become a commonly used phrase, and the motor is powered by direct current, even though this is modified internally via *pulse-width modulation*.

OTHER RELATED COMPONENTS

- **AC motor** (See Chapter 23)
- **stepper motor** (See Chapter 25)
- **servo motor** (See Chapter 24)

What It Does

A traditional DC motor uses direct current to create magnetic force, which turns an output shaft. When the polarity of the DC voltage is reversed, the motor reverses its direction of rotation. Usually, the force created by the motor is equal in either direction.

How It Works

Current passes through two or more coils that are mounted on the motor shaft and rotate with it. This assembly is referred to as the *rotor*. The magnetic force produced by the current is concentrated via cores or poles of soft iron or high-silicon steel, and interacts with fields created by permanent magnets arrayed around the rotor in a fixed assembly known as the *stator*.

Power to the coils is delivered through a pair of *brushes*, often made from a graphite compound. Springs press the brushes against a sleeve that rotates with the shaft and is divided into sections, connected with the coils. The sleeve assembly is known as the *commutator*. As the commutator rotates, its sections apply power from the brushes to the motor coils sequentially, in a simple mechanical switching action.

The most elementary configuration for a traditional DC motor is shown in Figure 22-1.

In reality, small DC motors typically have three or more coils in the rotor, to provide smoother operation. The operation of a three-coil motor is shown in Figure 22-2. The three panels in this figure should be seen as successive snapshots of one motor in which the rotor turns progressively counter-clockwise. The brushes are colored red and blue to indicate positive and negative voltage supply, respectively. The coils are wired in series, with power being applied through the commutator to points between each pair of coils. The direction of current through each coil determines its magnetic polarity, shown as N for north or S for south. When two coils are energized in series without any power applied to their midpoint, each develops a smaller magnetic field than an individually energized coil. This is

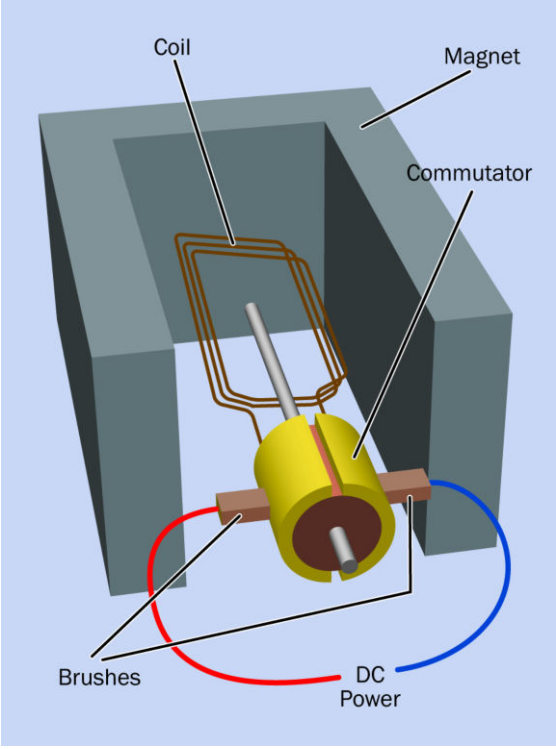

Figure 22-1. *The simplest traditional DC motor contains these parts. The combination of coil, shaft, and commutator is the rotor. The fixed magnetic structure in which it rotates is the stator.*

indicated in the diagram with a smaller white lowercase n and s. When two ends of a coil are at equal potential, the coil produces no magnetic field at all.

The stator consists of a cylindrical permanent magnet, which has two poles—shown in the figure as two black semicircles separated by a vertical gap for clarity—although in practice the magnet may be made in one piece. Opposite magnetic poles on the rotor and stator attract each other, whereas the same magnetic poles repel each other.

DC motors may be quite compact, as shown in Figure 22-3, where the frame of the motor measures about 0.7″ square. They can also be very powerful for their size; the motor that is shown disassembled in Figure 22-4 is from a 12VDC bilge pump rated at 500 gallons per hour. Its output was delivered by the small impeller attached to the rotor at right, and was achieved by using

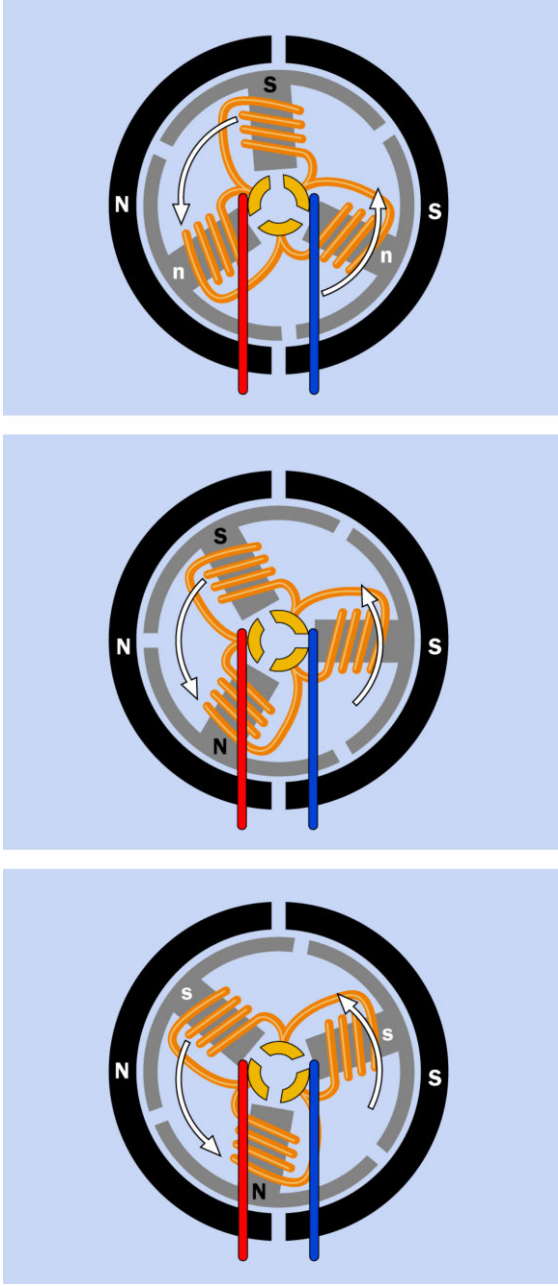

Figure 22-2. *Three sequential views of a typical three-coil DC motor viewed from the end of its shaft (the shaft itself is not shown). Magnetic effects cause the rotor to turn, which switches the current to the coils via the commutator at the center.*

two extremely powerful neodymium magnets, just visible on the inside of the motor's casing (at top-left) in conjunction with five coils on the rotor.

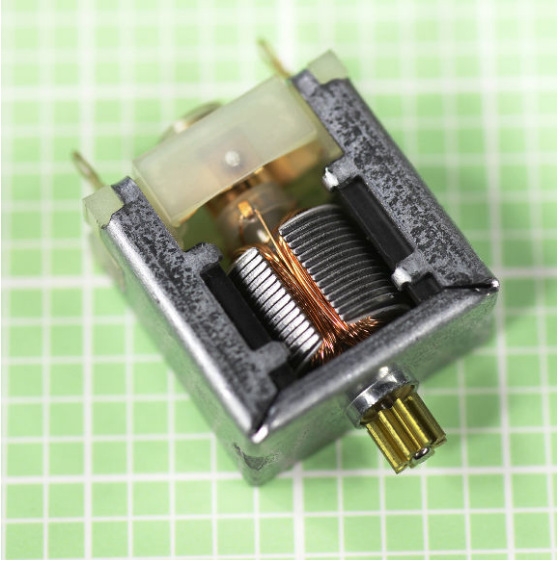

Figure 22-3. *A miniature 1.5VDC motor measuring about 0.7" square.*

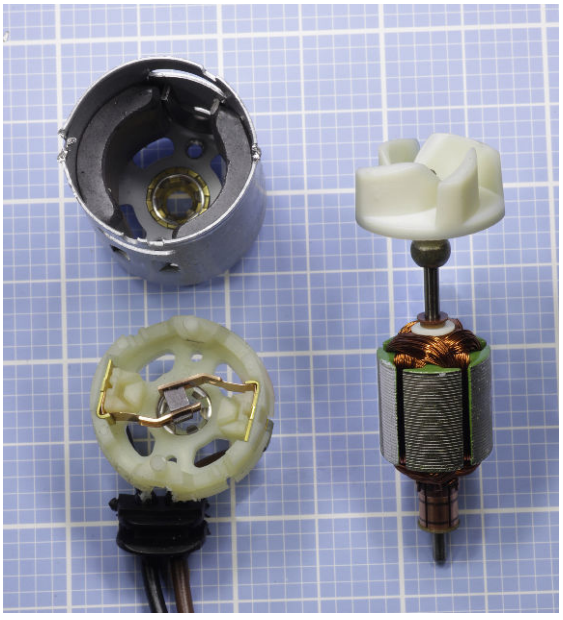

Figure 22-4. *A traditional DC motor removed from its cylindrical casing. The brushes of the motor are attached to the white plastic end piece at bottom-left. Large squares on the graph paper in the background are 1" × 1", divided in 0.1" increments. The motor was used in a small bilge pump.*

Variants

Coil Configurations

The series connection of coils used in Figure 22-2 is known as the *delta configuration*. The alternative is the *wye configuration* (or *Y configuration*, or *star configuration*). Simplified schematics are shown in Figure 22-5. Generally speaking, the delta configuration is best suited to high-speed applications, but provides relatively low torque at low speed. The wye configuration provides higher torque at low speed, but its top speed is limited.

Gearhead Motor

A *gearhead motor* (also often known as a *gear motor*) incorporates a set of reduction gears that increase the torque available from the output shaft while reducing its speed of rotation. This is often desirable as an efficient speed for a traditional DC motor may range from 3,000 to 8,000 RPM, which is too fast for most applications. The gears and the motor are often contained in a single sealed cylindrical package. Two examples are shown in Figure 22-6. A disassembled motor, revealing half of its gear train under the cap and the other half still attached to a separate circular plate, appears in Figure 22-7. When the motor is assembled, the gears engage. As in the case of the bilge-pump motor, the stator magnets are mounted inside the cylindrical casing. Note that the brushes, inside the circular plate of white plastic, have a resistor and capacitor wired to suppress voltage spikes.

Spur gears are widely used for speed reduction. *Planetary gears* (also known as *epicyclic gears*) are a slightly more expensive option. Spur gears such as those in Figure 22-8 may require three or more pairs in series. The total speed reduction is

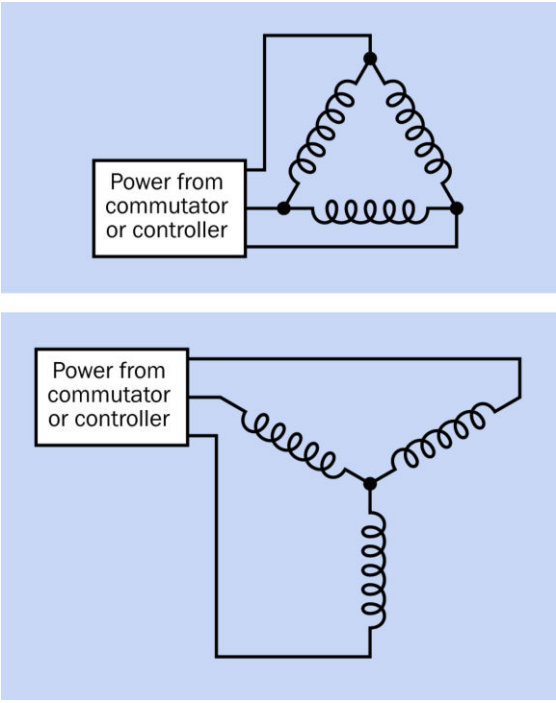

Figure 22-5. *Coils on the rotor of a traditional DC motor may be connected in delta configuration (top) or wye configuration (bottom).*

Figure 22-6. *Two typical small gearhead motors.*

found by multiplying the individual ratios. Thus, if three pairs of gears have ratios of 37 : 13, 31 : 15, and 39 : 17, the total speed reduction ® is obtained by:

```
R = ( 37 * 31 * 39 ) / ( 13 * 15 * 17 )
```

Figure 22-7. *Spur gears from a gearhead motor provide speed reduction and increased torque.*

Therefore:

```
R = 44733 / 3315 = about 13.5 : 1
```

Datasheets almost always express R as an integer. For example, the gear train shown in Figure 22-7 is rated by the manufacturer as having an overall reduction of 50:1. In reality, the reduction can be expected to have a fractional component. This is because if two gears have an integer ratio, their operating life will be shortened, as a manufacturing defect in a tooth in the smaller gear will hit the same spots in the larger gear each time it rotates. For this reason, the numbers of teeth in two spur gears usually do not have any common factors (as in the example above), and if a motor rotates at 500 RPM, a gear ratio stated as 50:1 is very unlikely to produce an output of exactly 10

RPM. Since traditional DC motors are seldom used for applications requiring high precision, this is not usually a significant issue, but it should be kept in mind.

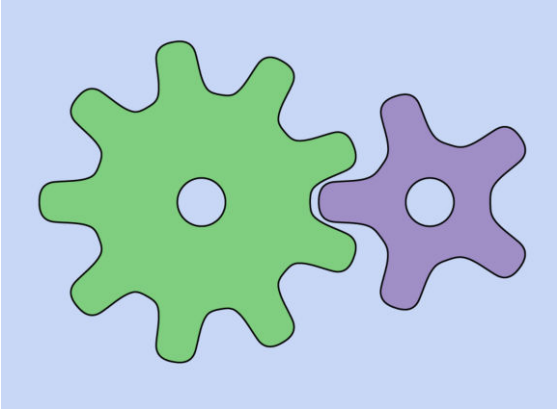

Figure 22-8. *A pair of spur gears.*

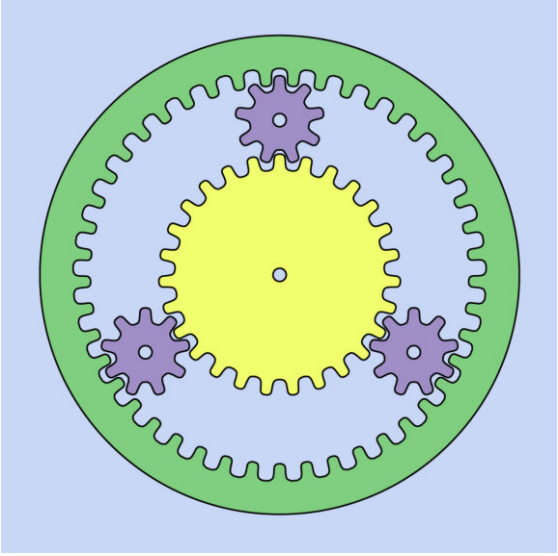

Figure 22-9. *Planetary gears, also known as epicyclic gears, share the torque from a motor among more teeth than simple spur gears.*

Figure 22-9 shows *planetary gears*, also known as *epicyclic gears*. The outer ring gear is properly referred to as the *annulus*, while the *sun gear* is at the center, and the intermediate *planet gears* may be mounted on a *carrier*. The greatest speed reduction will be achieved by driving the sun gear while the annulus is kept in a stationary position and the output is taken from the carrier of the planet gears. If A is the number of teeth in the annulus and S is the number of teeth in the sun gear, the total speed reduction, R, is given by the following formula:

```
R = (S + A) / S
```

Note that in this drive configuration, the number of teeth in each planet gear is irrelevant to the speed reduction. In Figure 22-9, the sun gear has 27 teeth whereas the annulus has 45 teeth. Therefore, the reduction is found by:

```
R = (27 + 45) / 27 = about 2.7 : 1
```

Successive reductions can be achieved by stacking planetary gear sets, using the carrier of one set to drive the sun gear in the next set.

Planetary gears are used primarily if a motor drives a heavy load, as the force is divided among more gear pairs, reducing wear and tear on gear teeth and minimizing the breakdown of lubrication. A planetary gear train may also be more compact than a train of spur gears. These advantages must be evaluated against the higher price and slightly increased friction resulting from the larger number of gears interacting with each other.

Brushless DC Motor

In a *brushless* DC motor, sometimes referred to as a *BLDC motor*, the coils are located in the stator and the permanent magnets are relocated in the rotor. The great advantage of this design is that power can be applied directly to the coils, eliminating the need for brushes, which are the primary source of failure in DC motors as a result of wear and tear. However, since there is no rotating commutator to switch the DC current to the coils, the current must be switched by electronic components, which add to the cost of the motor.

In the *inrunner* configuration the stator surrounds the rotor, whereas in the *outrunner* configuration the stator is located in the center of the motor while the rotor takes the form of a ring or

cup that spins around the stator. This is a common design for small cooling fans, where the blades are attached to the outer circumference of a cup that is lined with permanent magnets. An example is shown in Figure 22-10. In this picture, the stator coils are normally hidden from view, being fixed to the fan housing (shown at the top of the picture). Power is controlled by the surface-mount components on the green circular circuit board. The cup attached to the fan blades contains permanent magnets.

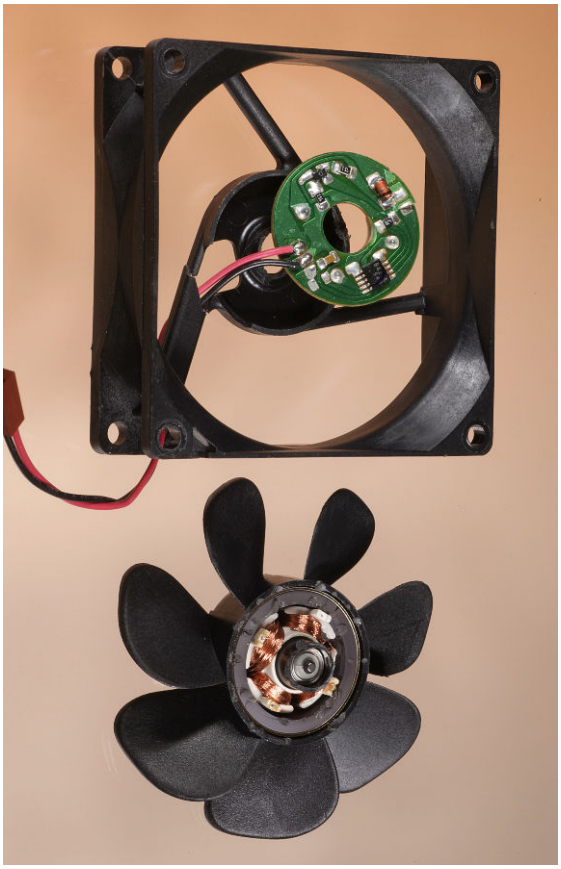

Figure 22-10. *A typical brushless DC cooling fan uses stationary coils, with permanent magnets rotating around them.*

The use of a solid-state switching system to energize the coils sequentially is known as *electronic commutation*. *Hall effect* sensors may be used to detect the position of the rotor and feed this information back to the frequency control circuit, so that it stays "one step ahead" of the rotor (when bringing it up to speed) or is synchronized with the rotor (for a constant running speed). The system is comparable to a *reluctance motor* or *synchronous motor.* These variants are described in the **AC motor** section of this encyclopedia.

While traditional DC motors have been commercially available since the late 1800s, brushless DC motors were not introduced until the 1960s, when the availability of solid-state control electronics began to make the motor design economically viable.

Linear Actuator

Linear actuator is a generic term for any device that can exert a pushing or pulling force in a straight line. In industrial applications, actuators may be powered pneumatically or hydraulically, but smaller-scale units are usually driven by a traditional DC motor. These are more properly (but not often) referred to as *electromechanical linear actuators*.

The rotational force of the motor is typically converted to linear motion by using a threaded motor shaft in conjunction with a nut or collar. The unit is often mounted in an enclosure containing *limit switches* that stop the motor automatically at the limits of travel. For an explanation of limit switches, see "Limit Switches" (page 46) in the **switch** entry in this encyclopedia.

Values

A manufacturer's datasheet should list the maximum operating voltage and typical current consumption when a motor is moderately loaded, along with the *stall current* that a motor draws when it is so heavily loaded that it stops turning. If stall current is not listed, it can be determined empirically by inserting an ammeter (or multimeter set to measure amperes) in series with the motor and applying a braking force until the motor stops. Motors should generally be protected with slow-blowing **fuses** to allow for the power fluctuations that occur when the motor starts running or experiences a change in load.

In addition, the *torque* that a motor can deliver should be specified. In the United States, torque is often expressed in *pound-feet* (or *ounce-inches* for smaller motors). Torque can be visualized by imagining an arm pivoted at one end with a weight hung on the other end. The torque exerted at the pivot is found by multiplying the weight by the length of the arm.

In the metric system, torque can be expressed as gram-centimeters, Newton-meters, or dyne-meters. A Newton is 100,000 dynes. A dyne is defined as the force required to accelerate a mass of 1 gram, increasing its velocity by 1 centimeter per second each second. 1 Newton-meter is equivalent to approximately 0.738 pound-feet.

The speed of a traditional DC motor can be adjusted by varying the voltage to it. However, if the voltage drops below 50% of the rated value, the motor may simply stop.

The power delivered by a motor is defined as its speed multiplied by its torque at that speed. The greatest power will be delivered when the motor is running at half its *unloaded speed* while delivering half the *stall torque*. However, running a motor under these conditions will usually create unacceptable amounts of heat, and will shorten its life.

Small DC motors should be run at 70% to 90% of their unloaded speed, and at 10% to 30% of the stall torque. This is also the range at which the motor is most efficient.

Ideally, DC motors that are used with reduction gearing should be driven with less than their rated voltage. This will prolong the life of the motor.

When choosing a motor, it is also important to consider the *axial loading* (the weight or force that will be imposed along the axis or shaft of the motor) and *radial loading* (the weight or force that will be imposed perpendicularly to the axis). Maximum values should be found in motor datasheets.

In the hobby field, motors for model aircraft are typically rated in watts-per-pound of motor weight (abbreviated w/lb). Values range from 50 to 250 w/lb, with higher values enabling better performance.

Relationships between torque, speed, voltage, and amperage in a traditional DC motor can be described easily, assuming a hypothetical motor that is 100% efficient:

If the amperage is constant, the torque will also be constant, regardless of the motor speed.

If the load applied to the motor remains constant (thus forcing the motor to apply a constant torque), the speed of the motor will be determined by the voltage applied to it.

If the voltage to the motor remains constant, the torque will be inversely proportional with the speed.

How to Use it

A traditional DC motor has the advantages of cheapness and simplicity, but is only suitable for intermittent use, as its brushes and commutator will tend to limit its lifetime. Its running speed will be approximate, making it unsuitable for precise applications.

As the cost of control electronics has diminished, brushless DC motors have replaced traditional DC motors. Their longevity and controllability provide obvious advantages in applications such as hard disk drives, variable-speed computer fans, CD players, and some workshop tools. Their wide variety of available sizes, and good power-to-weight ratio, have encouraged their adoption in toys and small vehicles, ranging from remote-controlled model cars, airplanes, and helicopters to personal transportation devices such as the Segway. They are also used in direct-drive audio turntables.

Where an application requires the rotation of a motor shaft to be converted to linear motion, a prepackaged *linear actuator* is usually more reliable and simpler than building a crank and

connecting rod, or cam follower, from scratch. Large linear actuators are used in industrial automation, while smaller units are popular with robotics hobbyists and can also be used to control small systems in the home, such as a remote-controlled access door to a home entertainment center.

Speed Control

A *rheostat* or **potentiometer** may be placed in series with a traditional DC motor to adjust its speed, but will be inefficient, as it will achieve a voltage drop by generating heat. Any rheostat must be rated appropriately, and should probably be wire-wound. The voltage drop between the wiper and the input terminal of the rheostat should be measured under a variety of operating conditions, along with the amperage in the circuit, to verify that the wattage rating is appropriate.

Pulse-width modulation (*PWM*) is preferable as a means of speed control for a traditional DC motor. A circuit that serves this purpose is sometimes referred to as a *chopper*, as it chops a steady flow of current into discrete pulses. Usually the pulses have constant frequency while varying in duration. The pulse width determines the average delivered power, and the frequency is sufficiently high that it does not affect smoothness of operation of the motor.

A **programmable unijunction transistor** or PUT can be used to generate a train of pulses, adjustable with a potentiometer attached to its emitter. Output from the transistor goes to a *silicon-controlled rectifier* (*SCR*), which is placed in series with the motor, or can be connected directly to the motor if the motor is small. See Figure 27-7.

Alternatively, a *555 timer* can be used to create the pulse train, controlling a *MOSFET* in series with the motor.

A **microcontroller** can also be used as a pulse source. Many microcontrollers have PWM capability built in. The microcontroller will require its own regulated power supply (typically 5VDC, 3.3VDC, or sometimes less) and a switching component such as an *insulated-gate bipolar transistor* (*IGBT*) to deliver sufficient power to the motor and to handle the flyback voltage. These components will all add to the cost of the system, but many modern devices incorporate microcontrollers anyway, merely to process user input. Another advantage of using a microcontroller is that its output can be varied by rewriting software, for example if a motor is replaced with a new version that has different characteristics, or if requirements change for other reasons. Additionally, a microcontroller enables sophisticated features such as pre-programmed speed sequences, stored memory of user preferences, and/or responses to conditions such as excessive current consumption or heat in the motor.

A PWM schematic using a microcontroller and IGBT is shown in Figure 22-11.

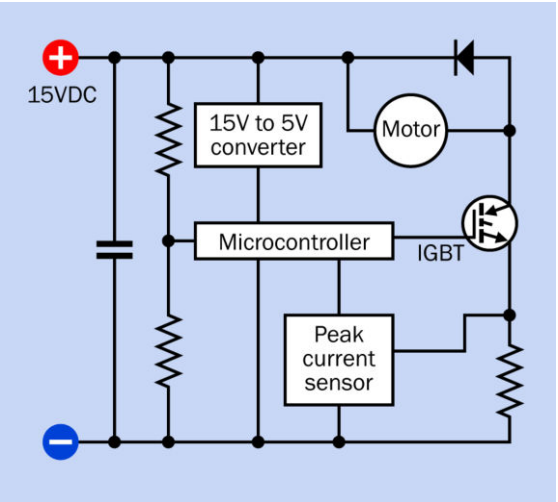

Figure 22-11. *A sample schematic for control of a DC motor via pulse-width modulation, using a microcontroller and an insulated-gate bipolar transistor.*

Direction Control

The *H bridge* is a very early system for reversing the direction of a DC motor simply by swapping the polarity of its power supply. This is shown in Figure 22-12. The switches diagonally opposite

each other are closed, leaving the other two switches open; and then to reverse the motor, the switch states are reversed. This is obviously a primitive scheme, but the term "H bridge" is still used when prepackaged in a single chip such as the LMD18200 H bridge motor controller from National Semiconductor.

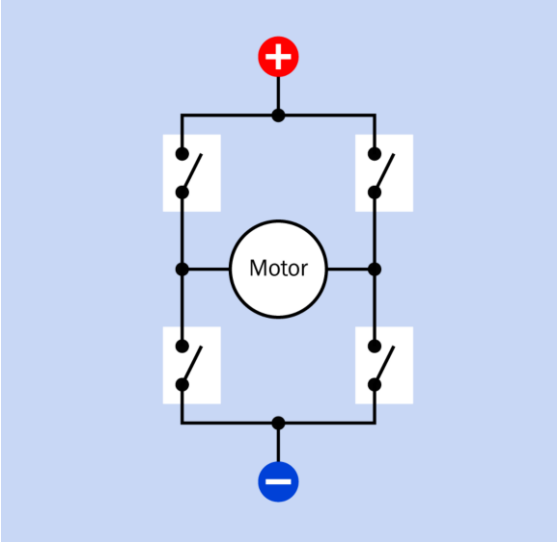

Figure 22-12. *A DC motor can be reversed by this very basic circuit, known as an H bridge, by opening and closing pairs of switches that are diagonally opposite each other.*

A double-throw, double-pole **switch** or **relay** can achieve the same purpose, as shown in Figure 22-13.

Limit Switches

When a traditional DC motor is used reversibly within a restricted range of motion, it can be fitted with *limit switches* to prevent the motor from stalling and burning out at either end of its permitted travel. Limit switches are explained in "Limit Switches" (page 46) in the **switch** entry in this encyclopedia.

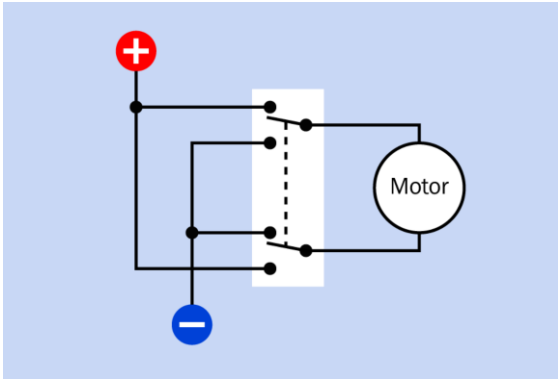

Figure 22-13. *A DPDT switch or relay can reverse the direction of a traditional DC motor simply by swapping the polarity of the power supply.*

What Can Go Wrong

Brushes and Commutator

The primary cause of failure in DC motors is abrasion of the brushes and wear and tear, oxidation, and/or accumulation of dirt on the commutator. Some motors are designed to allow replacement of the brushes; sealed motors and gearhead motors generally are not. High current and high speed will both tend to accelerate wear in the areas where the brushes meet the commutator.

Electrical Noise

The intermittent contact between the brushes and sections of the commutator of a traditional DC motor can induce voltage spikes that may travel back into the power supply for the motor and cause seemingly random effects in other components. Sparking in the commutator can be a significant source of *electromagnetic interference* (*EMI*), especially where cheap or poorly fitted brushes are used. Even if the commutator is running cleanly, the rapid creation of a magnetic field in a motor winding, following by collapse of the field, can create spikes that feed back into the power supply.

Wires that power a motor should be in twisted-pair configuration, so that their radiated EMI tends to cancel itself out. They should be routed

away from data lines or encoder outputs, and may be shielded if necessary. Data lines from sensors in brushless motors may also be shielded.

Installing a capacitor across the motor terminals can significantly reduce EMI. Some motors have capacitors preinstalled. If the motor is in a sealed casing, it may have to be disassembled to reveal whether a capacitor is present.

Heat effects

Since all motors in the real world are less than 100% efficient, some power is lost by the motor during normal operation, and will be dissipated as heat. The resistance of motor windings, and consequently the magnetic force that they generate, will decrease as the temperature rises. The motor becomes less efficient, and will try to draw more current, worsening the situation. A manufacturer's rating for maximum temperature should be taken seriously.

The insulation of the coil windings is usually the most vulnerable part of a motor if excess heat persists. Short circuits between adjacent coils as a result of insulation breakdown will degrade the performance of the motor while increasing its power consumption, which will create even more heat.

Where motor casings have protruding ridges, these cooling fins should be exposed to ambient air.

Frequent starting, stopping, and reversing will tend to generate heat as a result of power surges, and will reduce the lifetime of the motor.

Ambient Conditions

A warm, dry environment will tend to dry out bearing lubricants and graphite brushes. Conversely, a very cold environment will tend to thicken the bearing lubricants. If a motor will be used in unusual environmental conditions, the manufacturer should be consulted.

Wrong Shaft Type or Diameter

Motors have a variety of possible output shaft diameters, some measured in inches and others in millimeters, and shafts may be long or short, or may have a D-shaped cross section or splines to mate with appropriate accessories such as gears, pulleys, or couplings. Careful examination of datasheets and part numbers is necessary to determine compatibility. In the hobby-electronics world, retailers may offer purpose-built discs or arms for specific motor shafts.

Incompatible Motor Mounts

Mounting lugs or flanges may or may not be provided, and may be incompatible with the application for which the motor is intended. The same motor may be available with a variety of mount options, differentiated only by one letter or digit in the motor's part number. A mount option that was available in the past may become obsolete or may simply be out of stock. Again, examination of datasheets is necessary.

Backlash

Backlash is the looseness or "slack" in a gear train that results from small gaps between meshing gear teeth. Because backlash is cumulative when gears are assembled in series, it can become significant in a slow-output gearhead motor. When measured at the output shaft, it is generally in the range of 1 to 7 degrees, tending to increase as the load increases. If a geared motor is used as a positioning device, and is fitted with an encoder to count rotations of the motor shaft, control electronics may cause the motor to hunt to and fro in an attempt to overcome the hysteresis allowed by the backlash. A **stepper motor** or **servo motor** is probably better suited to this kind of application.

Bearings

When using a motor that is not rated for significant axial loading, the bearings may be damaged by applying excessive force to push-fit an output

gear or pulley onto the motor shaft. Even minor damage to bearings can cause significant noise (see the following section) and a reduced lifetime for the component.

In brushless DC motors, the most common cause of failure is the deterioration of bearings. Attempting to revive the bearings by unsealing them and adding lubricant is usually not worth the trouble.

Audible Noise

While electric motors are not generally thought of as being noisy devices, an enclosure can act as a sounding board, and bearing noise is likely to increase over time. Ball bearings become noisy over time, and gears are inherently noisy.

If a device will contain multiple motors, or will be used in close proximity to people who are likely to be sensitive to noise (for example, in a medical environment), care should be taken to insure that motor shafts are properly balanced, while the motors may be mounted on rubber bushings or in sleeves that will absorb vibration.

AC motor

23

The distinction between AC and DC motors has become blurred as controllers for DC motors make increasing use of *pulse-width modulation*, which can be viewed as a form of alternating current. All motors that consume DC power are referenced in the **DC motor** section of this encyclopedia, regardless of whether they modulate the power internally. **Stepper motors** and **servo motors** are considered as special cases, each with its own entry. AC motors, described here, are those that consume alternating current, usually in the form of a sine wave with a fixed frequency.

OTHER RELATED COMPONENTS

- **DC motor** (see Chapter 22)
- **stepper motor** (see Chapter 25)
- **servo motor** (see Chapter 24)

What It Does

An AC motor uses a power supply of alternating current to generate a fluctuating magnetic field that turns a shaft.

How It Works

The motor consists primarily of two parts: the *stator*, which remains stationary, and the *rotor*, which rotates inside the stator. Alternating current energizes one or more coils in the stator, creating fluctuating magnetic fields that interact with the rotor. A simplified representation is shown in Figure 23-1, where the coils create magnetic forces indicated by the green arrows, N representing North and S representing South.

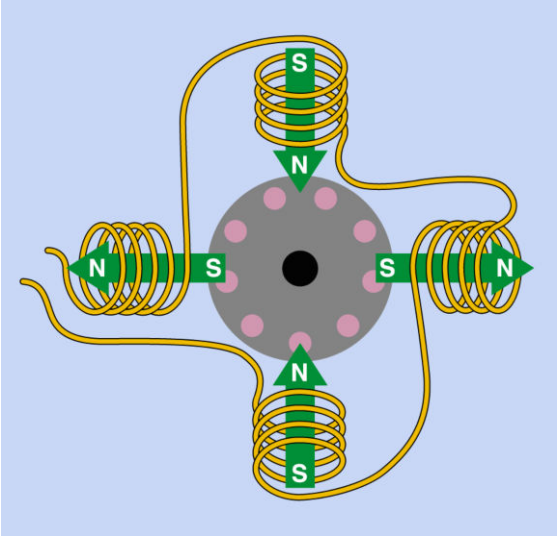

Figure 23-1. *A simplified representation of a basic AC motor. The green arrows indicate magnetic force.*

Stator Design

Plug-in electric fans typically use AC motors. The stator from a large electric fan is shown in Figure 23-2, where the large diameter of each coil maximizes its magnetic effect. The stator from a smaller electric fan is shown in Figure 23-3, in which only one coil is used. (The coil is wrapped in black electrical tape.)

Figure 23-2. *The stator from a large electric fan. Each coil of copper wire is centered on a lug pointing inward to the hole at the center, where the rotor would normally be mounted. The coils overlap because their diameter is maximized to increase their magnetic effect. Each coil is tapped to allow speed selection in steps via an external rotary switch.*

The core of a stator resembles the core of a **transformer** in that it usually consists of a stack of wafers of high-silicon steel (or sometimes aluminum or cast iron). The layers are insulated from one another by thin layers of shellac (or a similar compound) to prevent eddy currents that would otherwise circulate through the entire thickness of the stator, reducing its efficiency.

The coil(s) wound around the stator are often referred to as *field windings*, as they create the magnetic field that runs the motor.

Rotor Design

In most AC motors, the rotor does not contain any coils and does not make any electrical connection with the rest of the motor. It is powered entirely by induced magnetic effects, causing this type of motor to be known generally as an *induction motor*.

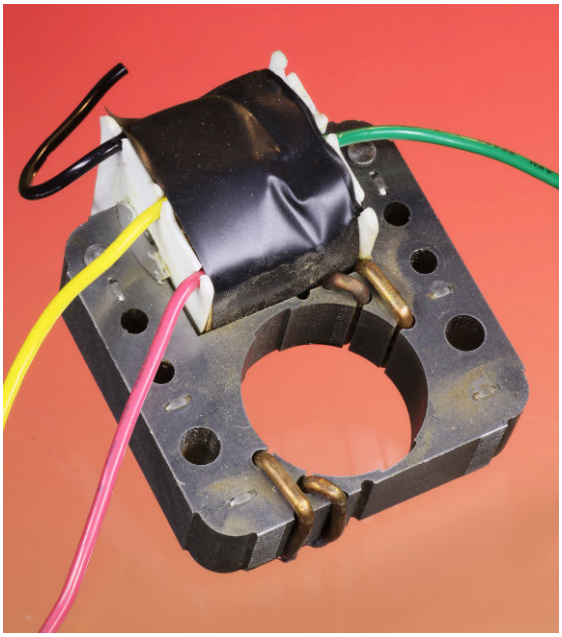

Figure 23-3. *This stator from a smaller electric fan uses only a single coil, wrapped in black tape. It is sufficient to induce a magnetic field but is generally less efficient than a motor using multiple coils.*

As the AC voltage changes from positive to negative, the magnetic force induced in the stator collapses and a new field of opposite polarity is created. Because the stator is designed to create an asymmetrical field, it induces a rotating magnetic field in the rotor. The concept of a rotating magnetic field is fundamental in AC motors.

Like the stator, the rotor is fabricated from wafers of high-silicon steel; embedded in the wafers are nonmagnetic rods, usually fabricated from aluminum but sometimes from copper, oriented approximately parallel to the axis of rotation. The rods are shorted together by a ring at each end of the rotor, forming a conductive "cage," which explains why this device is often referred to colloquially as a *squirrel cage* motor.

Figure 23-4 shows the configuration of a rotor cage with the surrounding steel wafers removed for clarity. In reality, the rods in the cage are almost always angled slightly, as shown in Figure 23-5, to promote smooth running and reduce *cogging*, or fluctuations in torque, which would otherwise occur.

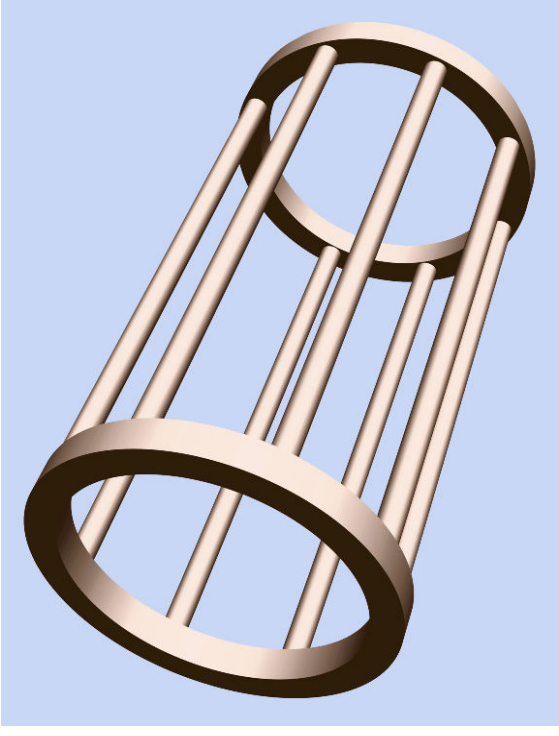

Figure 23-4. *The rotor of a typical AC motor contains a cage of aluminum (or sometimes copper) in which eddy currents occur, as a result of the rotating magnetic field inside the steel body of the rotor (which is omitted here for clarity). These currents cause their own magnetic fields, which interact with the fields generated by coils in the stator.*

In Figure 23-6, the steel wafers of a rotor are shown, with channels to accommodate an angled aluminum cage. Figure 23-7 shows a cross-section of a rotor with the cage elements in pale red and the steel wafer in gray.

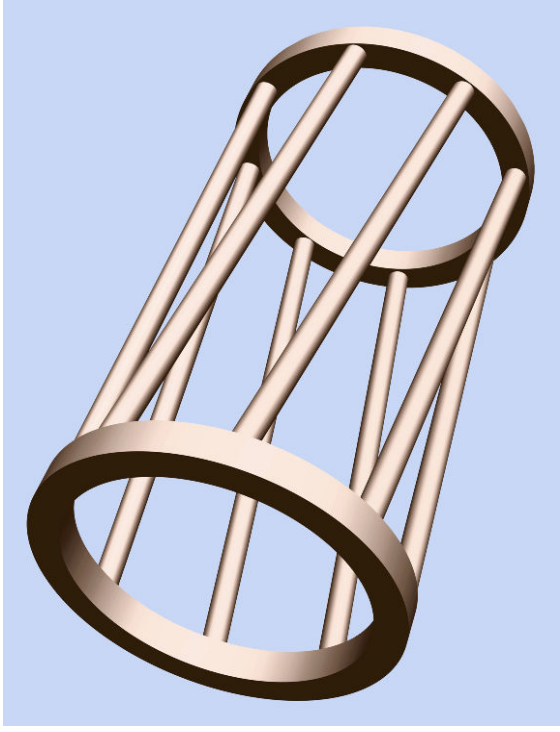

Figure 23-5. *To promote smooth running of the motor, the longitudinal elements of the cage are typically angled, as suggested in this rendering.*

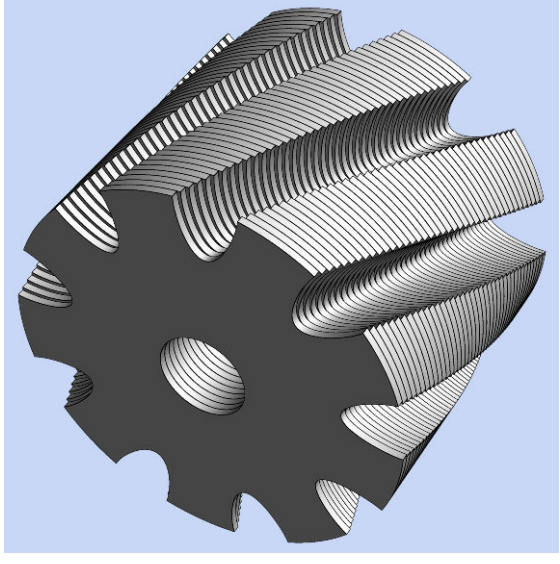

Figure 23-6. *The steel wafers in the rotor of an AC motor are typically offset as shown here. The channels are to accommodate a cage of aluminum or copper conductors.*

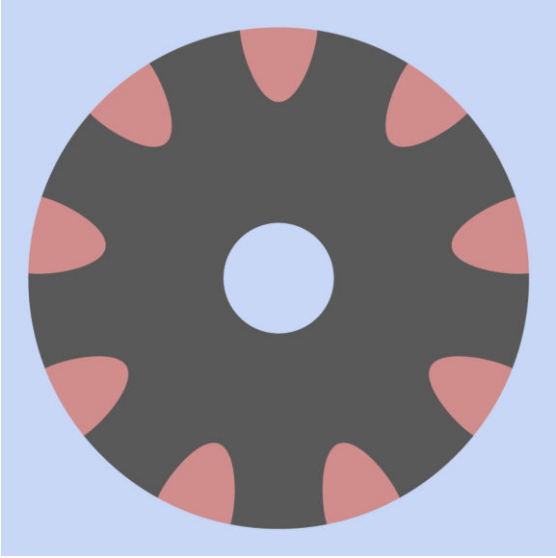

Figure 23-7. *Cross-section of a rotor with steel shown in gray and embedded elements of an aluminum cage shown in pale red.*

The actual rotor from an induction motor is shown in Figure 23-8. This rotor was removed from the stator shown in Figure 23-3. The bearings at either end of the rotor were bolted to the stator until disassembly.

Although the cage is nonmagnetic, it is electrically conductive. Therefore the rotating magnetic field that is induced in the steel part of the rotor generates substantial secondary electric current in the cage, so long as the magnetic field inside the rotor is turning faster than the rotor itself. The current in the longitudinal elements of the cage creates its own magnetic field, which interacts with the fields created by coils in the stator. Attraction and repulsion between these fields causes the rotor to turn.

Note that if the turning speed of the rotor rises to match the frequency of the alternating current powering the coils in the stator, the cage in the rotor is no longer turning through magnetic lines of force, and ceases to derive any power from

Figure 23-8. *The rotor from a small fan motor. The aluminum cage and its end pieces are the pale gray sections, steel plates are the darker sections.*

them. In an ideal, frictionless motor, its unloaded operating speed would be in equilibrium with the AC frequency. In reality, an induction motor never quite attains that speed.

When power is applied while the rotor is at rest, the induction motor draws a heavy surge of current, much like a short-circuited **transformer**. Electrically, the coils in the stator are comparable to the primary winding of a transformer, while the cage in the rotor resembles the secondary winding. The turning force induced in the stationary rotor is known as *locked-rotor torque*. As the motor picks up speed, its power consumption diminishes. See Figure 23-9.

When the motor is running and a mechanical load is applied to it, the motor speed will drop. As the speed diminishes, the cage of conductors embedded in the rotor will derive more power, as they are turning more slowly than the rotating magnetic field. The speed of rotation of the field is determined by the frequency of the AC power, and is therefore constant. The difference in rota-

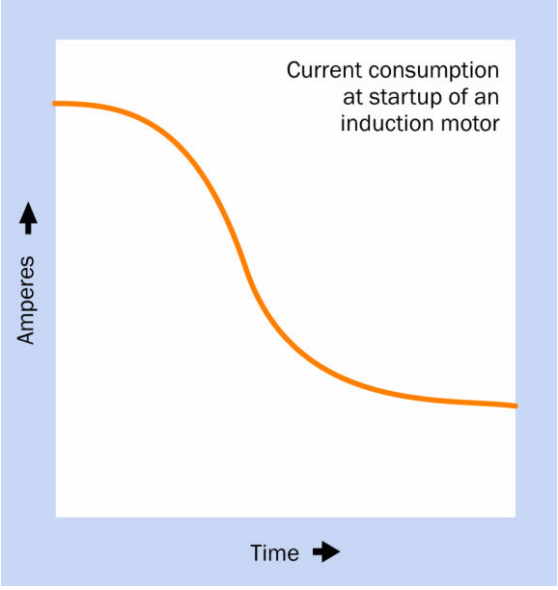

Figure 23-9. *An approximated graph showing the typical current consumption of an AC induction motor as it starts from rest and gains speed over a period of time.*

tional speed between the magnetic field and the rotor is known as *slip*. Higher levels of slip induce greater power, and therefore the induction motor will automatically find an equilibrium for any load within its designed range.

When running under full load, a small induction motor may have a slip value from 4 to 6 percent. In larger motors, this value will be lower.

Variants

Variants of the generic induction motor described above are generally designed to take advantage of either *single-phase* or *three-phase* alternating current.

A *synchronous motor* is a variant in which the rotor maintains a constant speed of rotation regardless of small fluctuations in load.

Some AC motors incorporate a *commutator*, which allows an external connection to coils mounted on the rotor, and can enable variable speed control.

A *linear motor* may consist of two rows of coils, energized by a sequence of pulses that can move a permanent magnet or electromagnet between the coils. Alternatively, the linear motor's coils may move as a result of magnetic interaction with a segmented fixed rail. Detailed description of linear motors is outside the scope of this encyclopedia.

Single-Phase Induction Motor

The majority of induction motors run on single-phase alternating current (typically, from domestic wall outlets). This type of motor is not innately self-starting because the stator coils and rotor are symmetrical. This tends to result in vibration rather than rotation.

To initiate rotation, the stator design is modified so that it induces an asymmetrical magnetic field, which is more powerful in one direction than the other. The simplest way to achieve this is by adding one or more *shorting coils* to the stator. Each shorting coil is often just a circle of heavy-gauge copper wire. This ploy reduces the efficiency of the motor and impairs its starting torque, and is generally used in small devices such as electric fans, where low-end torque is unimportant. Because the shorting coil obstructs some of the magnetic field, this configuration is often known as a *shaded pole* motor.

Copper shorting coils are visible in the fan motor shown in Figure 23-3.

A **capacitor** is a higher-cost but more efficient alternative to a shorting coil. If power is supplied to one or more of the stator coils through a capacitor, it will create a phase difference between these coils and the others in the motor, inducing an asymmetrical magnetic field. When the motor reaches approximately 80% of its designed running speed, a centrifugal switch may be included to take the capacitor out of the circuit, since it is no longer necessary. Switching out the capacitor and substituting a direct connection to the stator coils will improve the efficiency of the motor.

A third option to initiate rotation is to add a second winding in the stator, using fewer turns of smaller-gauge wire, which have a higher resistance than the main winding. Consequently the magnetic field will be angled to encourage the motor to start turning. This configuration is known as a *split-phase* induction motor, in which the starter winding is often referred to as the *auxilliary winding* and consists of about 30% of the total stator windings in the motor. Here again, a centrifugal switch can be incorporated, to eliminate the secondary winding from the circuit when the motor has reached 75 to 80 percent of its designed running speed.

The relationship between motor speed and torque of the three types of motors described above is shown in Figure 23-10. These curves are simplified and do not show the effect that would be produced by introducing a centrifugal switch.

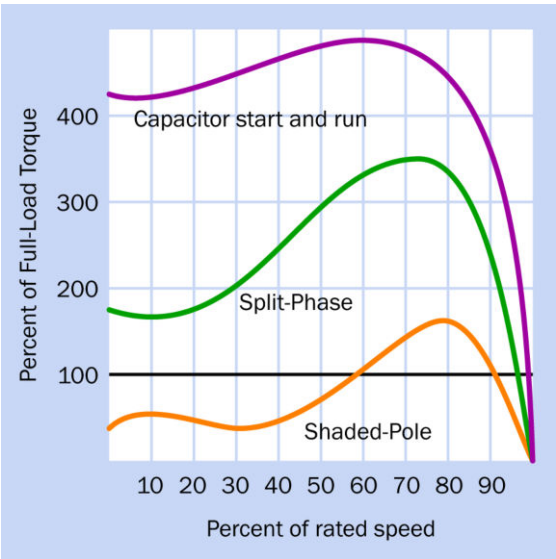

Figure 23-10. *Approximate curves showing the relationship between speed and torque for three types of single-phase induction motor. (Graph derived from AC Induction Motor Fundamentals published by Microchip Technology Inc.)*

Three-Phase Induction Motor

Larger induction motors are often *three-phase* devices. Three-phase AC (which is by far the most common form of *polyphase* AC) is delivered by a power utility company or generator via three wires, each of which carries alternating current with a phase difference of 120 degrees relative to the other two, usually for industrial applications. A common configuration of stator coils for a three-phase motor is shown in Figure 23-11. Since the three wires take it in turns to deliver their peak voltage, they are ideally suited to turn the stator of a motor via induction, and no shorting coil or capacitor is needed for startup. Heavy-duty 3-phase induction motors are extremely reliable, being brushless and generally maintenance-free.

Synchronous Motor

A synchronous motor is a form of induction motor that is designed to reach and maintain equilibrium when the rotor is turning in perfect synchronization with the AC power supply. The speed of the motor will depend on the number of poles (magnetic coils) in the stator, and the number of phases in the power supply. If R is the RPM of a synchronous motor, f is the frequency of the AC current in Hz, and p is the number of poles per phase:

```
R = (120 * f) / p
```

This formula assumes 60Hz AC current. In nations where 50Hz AC is used, the number 120 should be replaced with the number 100.

Two basic types of synchronous motors exist: *direct current excited*, which require external power to start turning, and *non-excited*, which are self-starting. Since non-excited synchronous motors are more common in electronic applications, this encyclopedia will not deal with direct current excited variants.

A *hysteresis motor* is a synchronous motor containing a solid rotor cast from cobalt steel, which has high coercivity, meaning that once it is magnetized, a substantial field is required to reverse the magnetic polarity. Consequently the polarity of the rotor lags behind the constantly changing

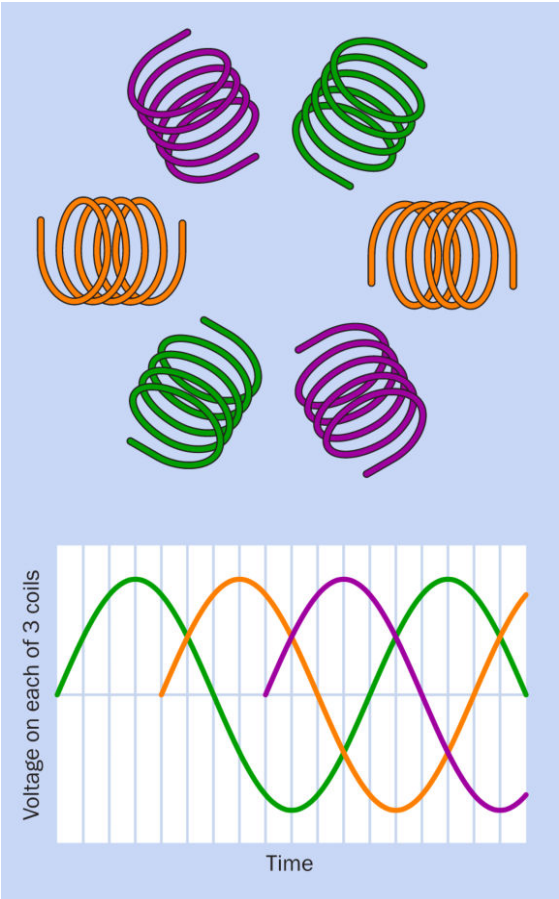

Figure 23-11. *The graph shows voltage delivered via three wires constituting a three-phase power supply. (The curve colors are arbitrary.) A three-phase motor contains a multiple of three coils—often six, as shown here diagrammatically. The three wires of the power supply are connected directly to the coils, which induce a rotating magnetic field.*

polarity of the stator, creating an attracting force that turns the rotor. Because the lag angle is independent of motor speed, this motor delivers constant torque from startup.

Reluctance Motor

Reluctance is the magnetic equivalent to electrical resistance. If a piece of iron is free to move in a magnetic field, it will tend to align itself with the field to reduce the reluctance of the magnetic circuit. This principle was used in very early reluctance motors designed to work from AC and has been revived as electronics to control variable frequency drives have become cheaper.

The simplest reluctance motor consists of a soft iron rotor with projecting lugs, rotating within a stator that is magnetically energized with its own set of inwardly projecting poles. The rotor tends to turn until its lugs are aligned with the poles of the stator, thus minimizing the reluctance.

A basic reluctance motor design is shown in Figure 25-2. It is located in the **stepper motor** section of this encyclopedia, as stepper motors are a primary application of the reluctance principle.

Although a reluctance motor can be used with polyphase fixed-frequency AC power, a variable frequency drive greatly enhances its usefulness. The timing of the frequency is adjusted by the speed of the motor, which is detected by a sensor. Thus the energizing pulses can remain "one step ahead" of the rotor. Since the rotor is not a magnet, it generates no back-EMF, allowing it to reach very high speeds.

The simplicity of the motor itself is a compensating factor for the cost of the electronics, as it requires no commutator, brushes, permanent magnets, or rotor windings. Characteristics of reluctance motors include:

- Cheap parts, easily manufactured, and high reliability.
- Compact size and low weight.
- Efficiencies greater than 90% possible.
- Capable of high start-up torque and high speed operation.

Disadvantages include noise, cogging, and tight manufacturing tolerances, as the air gap between the rotor and stator must be minimized.

A reluctance motor can function synchronously, if it is designed for that purpose.

Variable Frequency Drive

A basic induction motor suffers from significant problems. The surge of power that it draws when starting from rest can pull down the supply voltage enough to affect other devices that share the AC power supply. (Hence, the brief dimming of lights that may occur when the compressor in an air conditioner or refrigerator starts running.) While the motor is turning, it can introduce electrical noise, which feeds back into the power supply, once again causing potential problems for other devices. In addition, the narrow range of speed of an AC induction motor is a great disadvantage.

The advent of cheap solid-state technology encouraged the development of *variable-frequency power supplies* for induction motors. Because the impedance of the motor will diminish as the frequency diminishes, the current drawn by the motor will tend to increase. To prevent this, a variable frequency supply also varies the voltage that it delivers.

Wound-Rotor AC Induction Motor

The stator of this variant is basically the same as that of a single-phase induction motor, but the rotor contains its own set of coils. These are electrically accessible via a *commutator* and *brushes*, as in a **DC motor**. Because the maximum torque (also known as *pull-out* torque) will be proportional to the electrical resistance of the coils in the rotor, the characteristics of the motor can be adjusted by adding or removing resistance externally, via the commutator. A higher resistance will enable greater torque at low speed when the slip between the rotor speed and rotation of the magnetic field induced by the stator is greatest. This is especially useful in corded power tools such as electric drills, where high torque at low speed is desirable, yet the motor can accelerate to full speed quickly when the external resistance is reduced. Typically, the resistance is adjusted via the trigger of the drill.

Figure 23-12 shows a wound-rotor AC induction motor. The disadvantage of this configuration is the brushes that supply power to the rotor will eventually require maintenance. Much larger wound-rotor motors are also used in industrial applications such as printing presses and elevators, where the need for variable speed makes a simple three-phase motor unsuitable.

Figure 23-12. *A motor in a corded electric drill uses coils in a brushed rotor to enable variable speed output. In most AC motors, the speed is not adjustable and the rotor does not make any electrical connection with the rest of the motor.*

Universal Motor

A wound-rotor motor may also be described as a *universal motor* if its rotor and stator coils are connected in series. This configuration allows it to be powered by either AC or DC.

DC supplied to the rotor and the stator will cause mutual magnetic repulsion. When the rotor

turns, the brushes touching the split commutator reverse the polarity of voltage in the rotor coils, and the process repeats. This configuration is very similar to that of a conventional DC motor, except that the stator in a universal motor uses electromagnets instead of the permanent magnets that are characteristic of a **DC motor**.

When powered by AC, the series connection between stator and rotor coils insures that each pulse to the stator will be duplicated in the rotor, causing mutual repulsion. The addition of a shorting coil in the stator provides the necessary asymmetry in the magnetic field to make the motor start turning.

Universal motors are not limited by AC frequency, and are capable of extremely high-speed operation. They have high starting torque, are compact, and are cheap to manufacture. Applications include food blenders, vacuum cleaners, and hair dryers. In a workshop, they are found in routers and miniature power tools such as the Dremel series.

Because a universal motor requires commutator and brushes, it is only suitable for intermittent use.

Inverted AC Motors

Some modern domestic appliances may seem to contain an AC motor, but in fact the AC current is *rectified* to DC and is then processed with pulse-width modulation to allow variable speed control. The motor is really a **DC motor**; see the entry on this type of motor for additional information.

Values

Because a basic AC induction motor is governed by the frequency of the power supply, the speed of a typical four-pole motor is limited to less than 1,800 RPM (1,500 RPM in nations where 50Hz AC is the norm).

Variable-frequency, universal, and wound-rotor motors overcome this limitation, and can reach speeds of 10,000 to 30,000 RPM. Synchronous motors typically run at 1,800 or 1,200 RPM, depending on the number of poles in the motor. (They run at 1,500 or 1,000 RPM in locations where the frequency of AC is 50Hz rather than 60Hz).

For a discussion of the torque that can be created by a motor, see "Values" (page 184) in the **DC motor** entry in this encyclopedia.

How to Use It

Old-fashioned record players (where a turntable supports a vinyl disc that must rotate at a fixed speed) and electric clocks (of the analogue type) were major applications for synchronous motors, which used the frequency of the AC power supply to control motor speed. These applications have been superceded by CD players (usually powered by brushless DC motors) and digital clocks (which use crystal oscillators).

Many home appliances continue to use AC-powered induction motors. Small cooling fans for use in electronic equipment are sometimes AC-powered, reducing the current that must be provided by the DC power supply. An induction motor generally tends to be heavier and less efficient than other types, and its speed limit imposed by the frequency of the AC power supply is a significant disadvantage.

A simple induction motor cannot provide the sophisticated control that is necessary in modern devices such as CD or DVD players, ink-jet printers, and scanners. A **stepper motor**, **servo motor**, and **DC motors** controlled with *pulse-width modulation* are preferable in these applications.

A *reluctance motor* may find applications in high-speed, high-end equipment including vacuum cleaners, fans, and pumps. Large variable reluctance motors, with high amperage ratings, may be used to power vehicles. Smaller variants are being used for power steering systems and windshield wipers in some automobiles.

What Can Go Wrong

Compared with other devices that have moving parts, the brushless induction motor is one of the most reliable and efficient devices ever invented. However, there are many ways it can be damaged. General problems affecting all types of motors are listed at "Heat effects" (page 188). Issues relating specifically to AC motors are listed below.

Premature Restart

Large industrial three-phase induction motors can be damaged if power is reapplied before the motor has stopped rotating.

Frequent Restart

If a motor is stopped and started repeatedly, the heat that is generated during the initial surge of current is likely to be cumulative.

Undervoltage or Voltage Imbalance

A voltage drop can cause the motor to draw more current than it is rated to handle. If this situation persists, overheating will result. Problems also are caused in a three-phase motor where one phase is not voltage-balanced with the others. The most common cause of this problem is an open circuit-breaker, wiring fault, or blown fuse affecting just one of the three conductors. The motor will try to run using the two conductors that are still providing power, but the result is likely to be destructive.

Stalled Motor

When power is applied to an induction motor, if the motor is prevented from turning, the conductors in the rotor will carry a large current that is entirely dissipated as heat. This current surge will either burn out the motor or blow a fuse or circuit breaker. Care should be taken, in equipment design, to minimize the risk that an induction motor may stall or jam.

Protective Relays

Sophisticated protective relays are available for industrial 3-phase motors, and can guard against all of the faults itemized above. Their details are outside the scope of this encyclopedia.

Excess Torque

As has been previously noted, the torque of an induction motor increases with the slip (speed difference) between the rotation of the magnetic field and the rotation of the rotor. Consequently, if the motor is overloaded and forced to run more slowly, it can deliver more rotational force. This can destroy other parts attached to the motor, such as drive belts.

Internal Breakage

An overloaded induction motor may suffer some cracking or breakage of its rotor. This may be obvious because of reduced power output or vibration, but can also be detected if the motor's power consumption changes significantly.

servo motor

24

Should be referred to as an *RC servo* if it is intended for use in small devices that are remote-controlled and battery powered. However, in practice, the RC acronym is often omitted.

OTHER RELATED COMPONENTS

- **AC motor** (See Chapter 23)
- **DC motor** (See Chapter 22)
- **stepper motor** (See Chapter 25)

What It Does

A servo motor is actually a combination of a motor, reduction gearing, and miniaturized control electronics, usually packaged together inside a very compact sealed plastic case. The motor itself may be AC or DC, and if DC, it may be brushed or brushless. What distinguishes a servo from other types of motor is that it is not designed for continuous rotation. It is a position-seeking device. Its rotational range may be more than 180 degrees but will be significantly less than 360 degrees. Two typical RC servos are shown in Figure 24-1. A side view of a motor is shown in Figure 24-2.

The electronics inside the motor enclosure interpret commands from an external controller. The command code specifies the desired turn angle measured as an offset either side of the center position of the motor's range. The motor turns quickly to the specified position and stops there. So long as the command signal continues and power to the motor is sustained, the motor will hold its position and "push back" against any external turning force. In the absence of such a force, while the motor is stationary, it will use very little current.

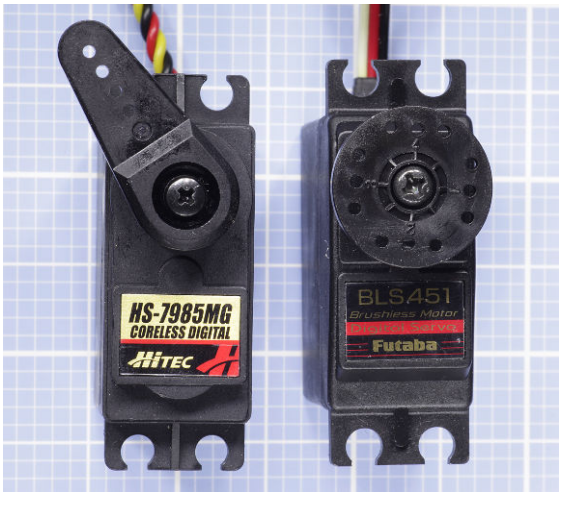

Figure 24-1. *A typical RC servo motor is capable of more than 50 inch-ounces of torque yet can be driven by three or four AA alkaline cells in series, and weighs under 2 ounces.*

The electronics inside a typical RC servo motor are shown in Figure 24-3.

How It Works

Servo motors are generally controlled via *pulse-width modulation* (*PWM*).

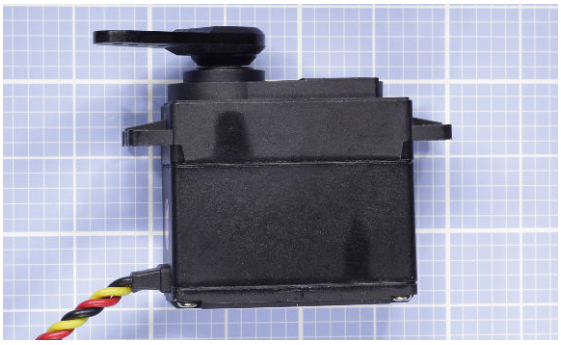

Figure 24-2. *RC servo motors are mostly similar in size. This is a typical side view.*

An industrial servo typically requires a controller that is an off-the-shelf item sold by the manufacturer of the motor. The encoding scheme of the control signals may be proprietary. A heavy-duty servo may be designed to run from three-phase power at a relatively high voltage, and may be used in applications such as production-line automation.

The remainder of this encyclopedia entry will focus primarily on small RC servos rather than industrial servos.

For small RC servos, the stream of control pulses is at a constant frequency of 20ms, with the positive durations of each pulse being interpreted as a positioning command to the motor, and the gaps between the pulses being disregarded. A typical range of pulse widths for a small motor is 1ms to 2ms, specifying a range of -90 to +90 degrees either side of a center location. Many modern motors are capable of excursions beyond these limits, and can be calibrated to establish the precise relationship between pulse width and turn angle. The motor can then be controlled by a lookup table in microcontroller software, or by using a conversion factor between degree-angle and pulse width.

Figure 24-4 shows the typical range of pulse widths within the fixed 20ms period (a frequency of 50Hz) between the start of one pulse and the start of the next, and the meaning of each pulse width to the servo motor. Intermediate pulse widths are interpreted as instructions to rotate to intermediate positions.

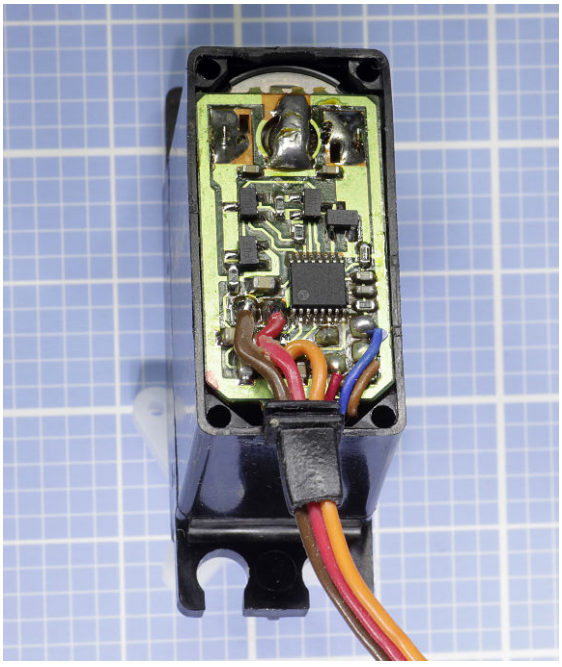

Figure 24-3. *The electronics inside a servo motor decode a stream of pulses that specify the turn angle of the motor.*

Small servo motors require the user to provide a controller that will conform with the above specification. This is often achieved by programming a *microcontroller*, and some microcontroller chips make this especially easy by providing a PWM output specifically tailored to the requirements of an RC servo. Either way, the microcontroller can be directly connected to the servo, enabling an extremely simple and flexible way to manage a positioning device.

Alternatively, a simple pulse generator such as a *555 timer chip* can be used, or controller boards are available from hobbyist supply sources. Some controller boards have USB connections enabling a servo to be governed by computer software.

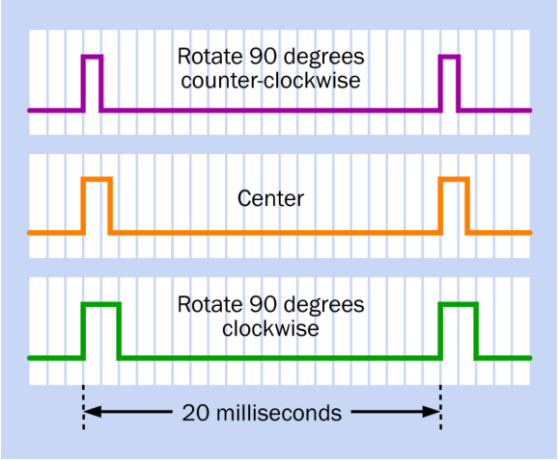

Figure 24-4. *The turn angle of a small RC servo motor is determined by a pulse width from a controller ranging from 1ms to 2ms in duration. The frequency of the pulses is constant at 50Hz.*

In Figure 24-5, a schematic illustrates the connection of a 555 timer with an RC servo, with component values to create a constant frequency of about 48Hz (slightly more than 20ms from peak to peak). The 1µF capacitor in the circuit charges through the 2.2K resistor in series with the diode, which bypasses the 28K resistor. This charging time represents the "on" cycle of the timer chip. The capacitor discharges through the 28K resistor, representing the "off" cycle. The 1K potentiometer, in series with the 5K resistors, acts as a voltage divider applied to the control pin of the timer, adjusting the timer's charge and discharge thresholds. Turning the potentiometer will lengthen or shorten the "on" time of each cycle, without changing the frequency. In practice, because capacitors are manufactured with wide tolerances, the frequency of the timer output cannot be guaranteed. Fortunately most servos will tolerate some inaccuracy.

Since the motor shares the power supply of the timer in this circuit, a protection diode and capacitor have been added between the power supply to the motor and negative ground, to suppress noise and back-EMF.

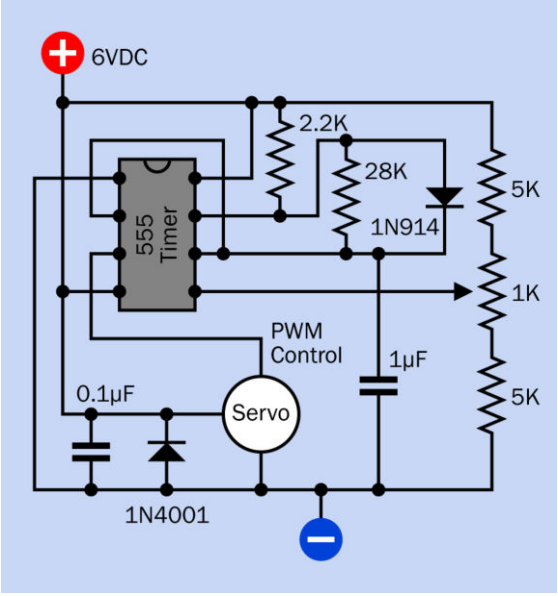

Figure 24-5. *An RC servo can be controlled via a 555 timer with appropriate component values. The potentiometer determines the angular position of the servo.*

Inside a servo motor's casing, the electronics include a **potentiometer** that turns with the output shaft, to provide feedback confirming the motor's position. The limited turning range of the potentiometer determines the turn limits of the motor output shaft.

Variants

Small servos may contain brushed or brushless DC motors. Naturally the brushless motors have greater longevity and create less electrical noise. See the **DC motor** entry in this encyclopedia for a discussion of brushed versus brushless motors.

Servos may use nylon, "Karbonite," or metal reduction gearing. The nylon gears inside a cheaper RC servo are shown in Figure 24-6.

Brushless motors and metal gears add slightly to the price of the motor. Metal gears are stronger than nylon (which can crack under load) but may wear faster, leading to *backlash* and inaccuracy in the gear train. The friction between nylon-to-nylon surfaces is very low, and nylon is certainly

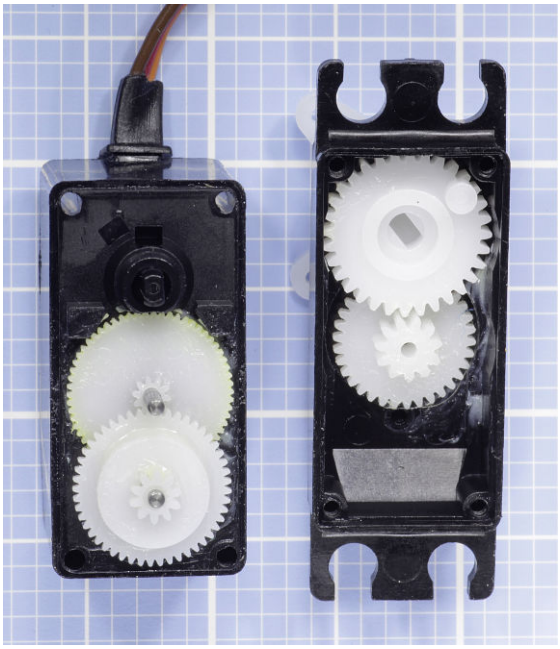

Figure 24-6. *Nylon gearing inside a servo motor.*

adequate and may be preferable if a servo will not be heavily loaded. "Karbonite" is claimed to be five times stronger than nylon and may be a satisfactory compromise. If a gear set experiences a failure (for example, teeth can be stripped as a result of excessive load), manufacturers usually will sell a replacement set to be installed by the user. Installation requires manual dexterity and patience, and some skill.

Servos may have roller bearings or plain sintered bearings, the latter being cheaper but much less durable under side loading.

So-called *digital servos* use faster internal electronics than the older, so-called *analog servos*, and because they sample the incoming pulse stream at a higher frequency, they are more responsive to small, rapid commands from the controller. For this reason they are preferred by hobbyists using servos to control the flight of model airplanes. Externally, the control protocol for digital and analog servos is the same, although a digital servo can be reprogrammed with new code values establishing the limits to its range. A standalone programming unit must be purchased to achieve this.

The most popular manufacturers of small servo motors are Futaba and Hitec. While their control protocols are virtually identical, the motor output shafts differ. The shaft is typically known as the *spline*, and is grooved to fit push-on attachments. The spline of a Futaba motor has 25 grooves, while Hitec uses 24 grooves. Attachments must be appropriate for the brand of motor that has been chosen.

Values

A small servo typically weighs 1 to 2 ounces, has a rotation time of 1 to 2 seconds from one end of its travel to the other, and can exert a surprisingly robust torque of 50 ounce-inches or greater.

Voltage

Small servos were originally designed to run from 4.8V rechargeable batteries in model aircraft. They can be driven with 5VDC to 6VDC on a routine basis. A few servos are designed for higher voltages.

Amperage

The datasheets provided by most manufacturers often fail to specify the power that a servo will draw when it is exerting maximum torque (or indeed, any torque at all). Since small servos are often driven by three or four AA alkaline batteries in series, the maximum current draw is unlikely to be much greater than 1 amp. When the motor is energized but not turning, and is not resisting a turning force, its power consumption is negligible. This feature makes servos especially desirable for remote-controlled battery-powered devices.

Some motors that have a turning range exceeding 180 degrees will respond to pulses of less than 1ms or greater than 2ms. A newly acquired motor should be tested with a microcontroller

that steps through a wide range of pulse durations, to determine the limits empirically. Pulses that are outside the motor's designed range will generally be ignored and will not cause damage.

The *turn rate* or *transit time* specified in a datasheet is the time a servo takes to rotate through 60 degrees, with no load on the output shaft. A high-torque servo generally achieves its greater turning force by using a higher reduction gear ratio, which tends to result in a longer transit time.

How to Use it

Typical applications for a small servo include rotating the flaps or rudder of a model aircraft, steering a model boat, model car, or wheeled robot, and turning robotic arms.

A servo generally has three wires, colored red (power supply), black or brown (ground), and orange, yellow, or white (for the pulse train from the controller). The ground wire to the motor must be common with the ground of the controller, and consequently a ceramic bypass **capacitor** of 0.1µF or 0.01µF should be placed between the (red) power wire to the motor and ground. A protection **diode** should also be used. Neither a diode nor a capacitor should be attached to the wire carrying control signals, as it will interfere with the pulse train.

When powering the motor, an AC adapter should only be used with some caution, as its power output may be inadequately smoothed. A voltage regulator is not necessary, but bypass **capacitors** are mandatory. Figure 24-7 shows two hypothetical schematics. The upper section of the figure shows a battery-driven system, possibly using four 1.2V NiMH rechargeable batteries. Since batteries do not generally create voltage spikes, no capacitors are used, but a diode is included to protect the microcontroller from EMF when the servo stops and starts. The lower section of the figure shows the additional precautions that may be necessary when using DC power from an **AC adapter**. The DC-DC **converter**, which derives 6VDC for the motor requires smoothing capacitors (this should be specified in its datasheet), and so does the **voltage regulator**, which delivers regulated 5VDC power to the microcontroller. Once again, the protection diode is included. In both diagrams, the orange wire represents the control wire transmitting pulses to the servo motor.

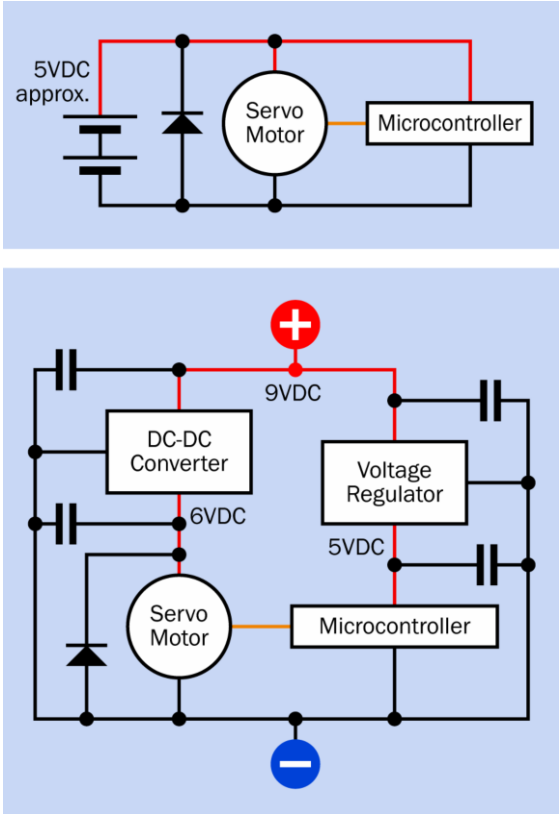

Figure 24-7. *Two possible schematics to run a small servo motor, the upper example using battery power (for example, from four 1.2V NiMH cells) and the lower example using a 9VDC AC adapter. See text for additional explanation.*

Various shaft attachments are available from the same online hobby-electronics suppliers that sell servos. The attachments include discs, single arms, double arms, and four arms in a cross-shaped configuration. A single-arm attachment is often known as a *horn*, and this term may be applied loosely to any kind of attachment. The

horn is usually perforated so that other components can be fixed to it by using small screws or nuts and bolts. Figure 24-8 shows a variety of horns.

Figure 24-8. *Various shaft attachments, known as horns, are available from motor manufacturers. The blue one is metallic; the others are plastic.*

After the horn is pushed onto the spline (the motor shaft), it is held in place with one central screw. As previously noted, the two major manufacturers of small servos, Futaba and Hitec, have incompatible splines.

Modification for Continuous Rotation

It is possible to modify a small servo motor so that it will rotate continuously.

First the motor case must be opened, and the potentiometer must be centered by using a controller to send some 1.5ms pulses. The potentiometer must then be glued or otherwise secured with its wiper in this precise center position, after which the potentiometer is disconnected from the drive train.

Mechanical stops that would limit the rotation of the motor shaft must be cut away, after which the motor is reassembled. Because the potentiometer has been immobilized, the motor's internal electronics will now "see" the shaft as being in its center position at all times. If the controller sends a pulse instructing the motor to seek a position clockwise or counter-clockwise from center, the motor will rotate in an effort to reach that position. Because the potentiometer will not provide feedback to signal that the motor has achieved its goal, the shaft will continue to rotate indefinitely.

In this mode, the primary distinguishing characteristic of the servo has been disabled, in that it can no longer turn to a specific angle. Also, stopping the servo may be problematic, as it must receive a command that precisely matches the fixed position of the potentiometer. Since the potentiometer may have moved fractionally during the process in which it was immobilized, some trial and error may be needed to determine the pulse width that corresponds with the potentiometer position.

The purpose of modifying a servo for continuous rotation is to take advantage of its high torque, small size, light weight, and the ease of controlling it with a microcontroller.

In response to the interest shown by hobbyists in modifying servos for continuous rotation, some manufacturers now market servos with continuous rotation as a built-in feature. Typically they include a trimmer potentiometer to calibrate the motor, to establish its center-off position.

What Can Go Wrong

Incorrect Wiring

The manufacturer's datasheet should be checked to confirm the color coding of the wires. While a simple DC motor can be reversed by inverting the polarity of its power supply, this is totally inappropriate for a servo motor.

Shaft/Horn Mismatch

Attachments for the spline of one brand of motor may not fit the spline of another brand, and cannot be forced to fit.

Unrealistically Rapid Software Commands

Microcontroller software that positions a servo must allow sufficient time for the servo to respond before the software specifies a new position. It may be necessary to insert delay loops or other wait times in the software.

Jitter

A servo arm that twitches unpredictably usually indicates that the pulse train is being corrupted by external electrical noise. The control wire to the servo should be as short as possible, and should not run closely adjacent to conductors carrying AC or high frequency current switching, or control wires for other servo motors.

Motor Overload

A servo capable of delivering 2 lbs of force 1 inch from its shaft can easily generate enough torque, when it stalls, to break itself free from its mounts, or bend or break any arm or linkage attached to its shaft. Ideally, a relatively "weak link" should be included so that if breakage occurs, it will be predictable and will be relatively easy and cheap to repair.

Unrealistic Duty Cycle

Small servos are designed for intermittent use. Constant cycling will cause wear and tear, especially if the motor has a brushed commutator or metal reduction gears.

Electrical Noise

Brushed motors are always a source of electrical interference, and any servo will also tend to create a voltage dip or surge when it starts and stops. A protection diode may be insufficient to isolate sensitive microcontrollers and other integrated circuit chips. To minimize problems, the servo can be driven by a source of positive voltage that is separate from the regulated power supply used by the chips, and larger filter capacitors may be added to the voltage supply of the microcontroller. A common ground between the motor and the chips is unfortunately unavoidable.

stepper motor

25

Also often referred to as a *stepping motor*, and sometimes known as a *step motor*. It is a type of *induction motor* but merits its own entry in this encyclopedia as it has acquired significant and unique importance in electronics equipment where precise positioning of a moving part is needed and digital control is available.

OTHER RELATED COMPONENTS

- **DC motor** (See Chapter 22)
- **AC motor** (See Chapter 23)
- **servo motor** (See Chapter 24)

What It Does

A stepper motor rotates its drive shaft in precise steps in response to a timed sequence of pulses (usually one step per pulse). The pulses are delivered to a series of coils or *windings* in the *stator*, which is the stationary section of the motor, usually forming a ring around the *rotor*, which is the part of the motor that rotates. Steps may also be referred to as *phases*, and a motor that rotates in small steps may be referred to as having a high *phase count*.

A stepper motor theoretically draws power for its stator coils at a constant level that does not vary with speed. Consequently the torque tends to decrease as the speed increases, and conversely, it is greatest when the motor is stationary or locked.

The motor requires a suitable control system to provide the sequence of pulses. The control system may consist of a small dedicated circuit, or a microcontroller or computer with the addition of suitable driver transistors capable of handling the necessary current. The torque curve of a motor can be extended by using a controller that increases the voltage as the speed of the control pulses increases.

Because the behavior of the motor is controlled by external electronics, and its interior is usually symmetrical, a stepper motor can be driven backward and forward with equal torque, and can also be held in a stationary position, although the stator coils will continue to consume power in this mode.

How It Works

The stator has multiple poles made from soft iron or other magnetic material. Each pole is either energized by its own coil, or more commonly, several poles share a single, large coil. In all types of stepper motor, sets of stator poles are magnetized sequentially to turn the rotor and can remain energized in one configuration to hold the rotor stationary.

The rotor may contain one or more permanent magnets, which interact with the magnetic fields

generated in the stator. Note that this is different from a *squirrel-cage* **AC motor** in which a "cage" is embedded in the rotor and interacts with a rotating magnetic field, but does not consist of permanent magnets.

Three small stepper motors are shown in Figure 25-1. Clockwise from the top-left, they are four-wire, five-wire, and six-wire types (this distinction is explained in the following section). The motor at top-left has a threaded shaft that can engage with a collar, so that as the motor shaft rotates counter-clockwise and clockwise, the collar will be moved down and up.

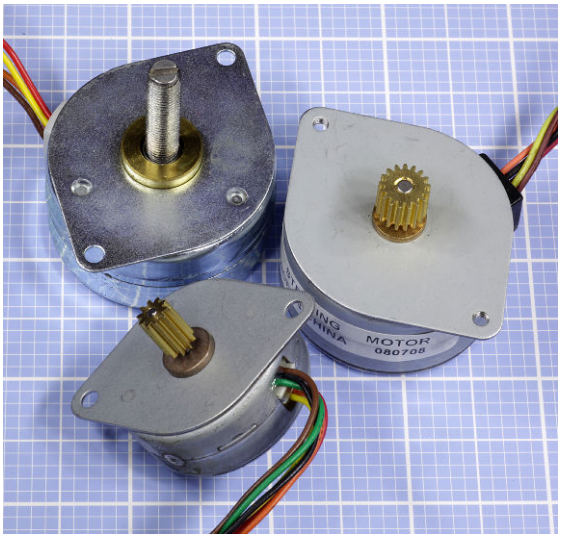

Figure 25-1. *Three small stepper motors.*

Reluctance Stepper Motors

The simplest form of stepper motor uses a rotor that does not contain permanent magnets. It relies on the principle of *variable reluctance*, reluctance being the magnetic equivalent of electrical *resistance*. The rotor will tend to align its protruding parts with the exterior source(s) of the magnetic field, as this will reduce the reluctance in the system. Additional information about variable reluctance is included in "Reluctance Motor" (page 197) in the section of this encyclopedia dealing with the **AC motor**.

A variable reluctance motor requires an external controller that simply energizes the stator coils sequentially. This is shown in Figure 25-2, where six poles (energized in pairs) are arrayed symmetrically around a rotor with four protrusions, usually referred to as *teeth*. Six stator poles and four teeth are the minimum numbers for reliable performance of a reluctance stepper motor.

In the diagram, the core of each pole is tinted green when it is magnetized, and is gray when it is not magnetized. In each section of this diagram, the stator coils are shown when they have just been energized, and the rotor has not yet had time to respond. External switching to energize the coils has been omitted for simplicity. In a real motor, the rotor would have numerous ridges, and the clearance between them and the stator would be extremely narrow to maximize the magnetic effect.

In a 6-pole reluctance motor where the rotor has four teeth, each time the controller energizes a new pair of poles, the rotor turns by 30 degrees counter-clockwise. This is known as the *step angle*, and means that the motor makes 12 steps in each full 360-degree rotation of its shaft. This configuration is very similar to that of a 3-phase AC *induction motor*, as shown in Figure 23-11 in the **AC motor** section of this encyclopedia. However, the AC motor is designed to be plugged into a power source with a constant frequency, and is intended to run smoothly and continuously, not in discrete steps.

Generally, reluctance motors tend to be larger than those with magnetized rotors, and often require feedback from a sensor that monitors shaft angle and provides this information to control electronics. This is known as a *closed loop* system. Most smaller stepper motors operate in an *open loop* system, where positional feedback is considered unnecessary if the number of pulses to the motor is counted as a means of tracking its position.

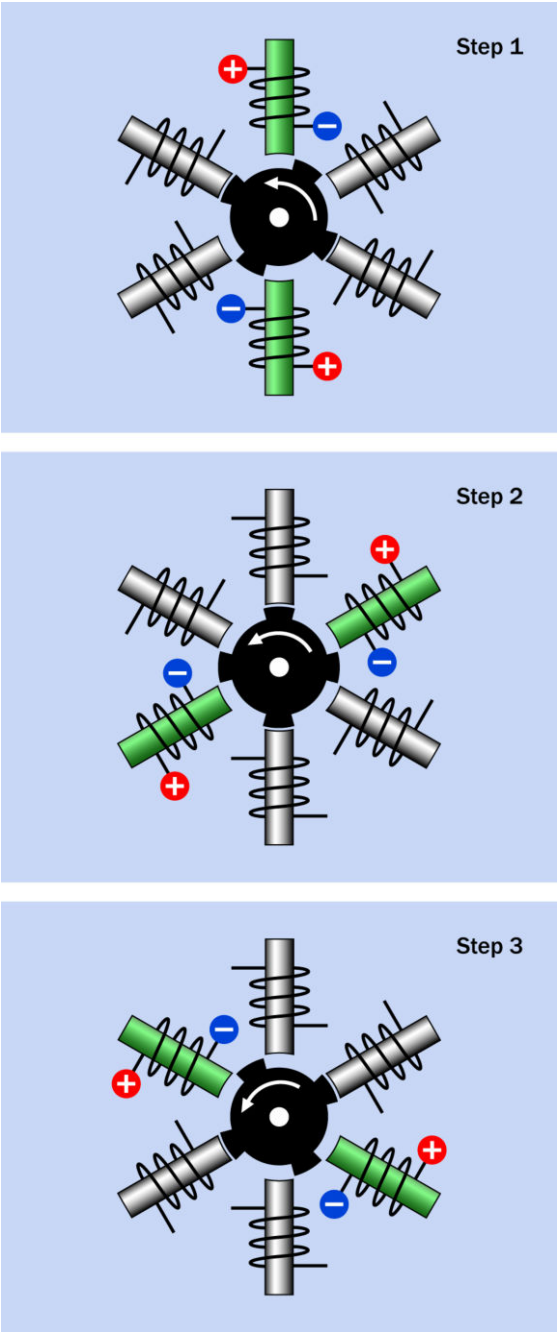

Figure 25-2. *In a variable reluctance stepper motor, the rotor moves to minimize magnetic reluctance each time the next pair of coils is energized. At each step, the coils have been energized a moment before the rotor has had time to respond.*

Permanent Magnet Stepper Motors

More commonly, the rotor of a stepper motor contains permanent magnets, which require the controller to be capable of reversing the magnetic field created by each of the stator coils, so that they alternately attract and repel the rotor magnets.

In a *bipolar* motor, the magnetic field generated by a coil is reversed simply by reversing the current through it. This is shown diagrammatically in Figure 25-3. In a *unipolar* motor, the magnetic field is reversed by applying positive voltage to the center tap of a coil, and grounding one end or the other. This is shown diagrammatically in Figure 25-4.

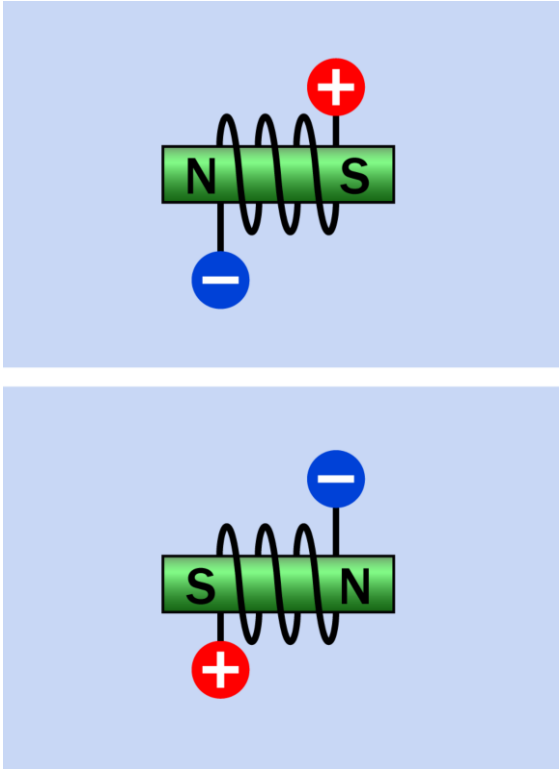

Figure 25-3. *In a bipolar motor, the magnetic field generated by each stator coil is reversed simply by reversing the current through the coil.*

Either type of motor is often designed with an upper and lower deck surrounding a single rotor,

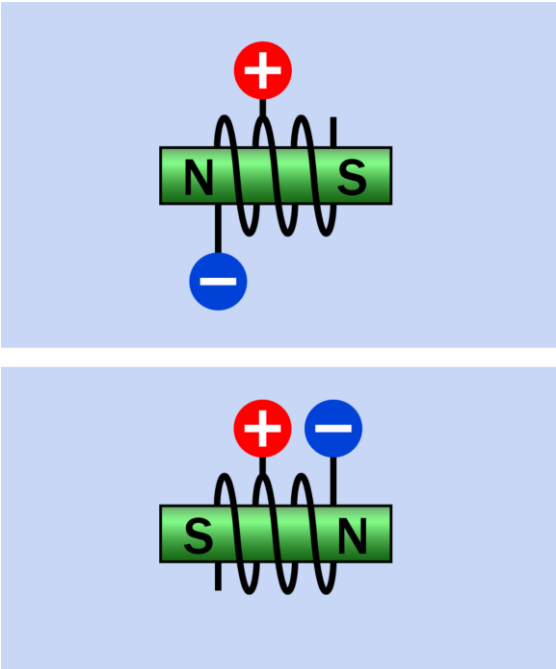

Figure 25-4. *The magnetic field of this coil is reversed by applying positive voltage constantly to a center tap and grounding one end of the coil or the other.*

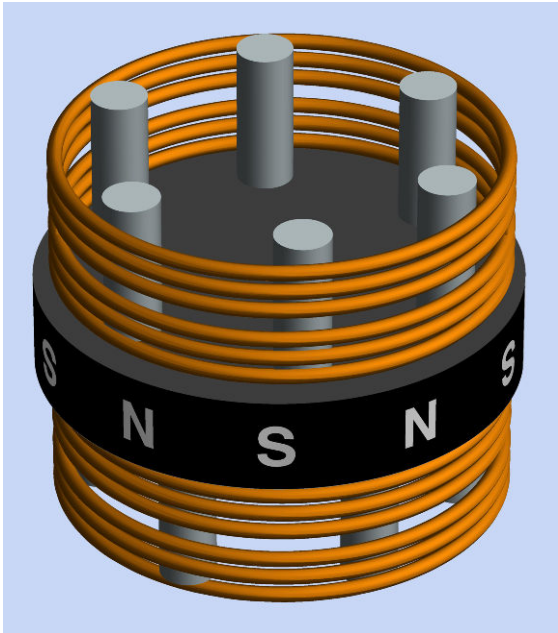

Figure 25-5. *A simplified rendering of the common "two deck" type of motor. See text for details.*

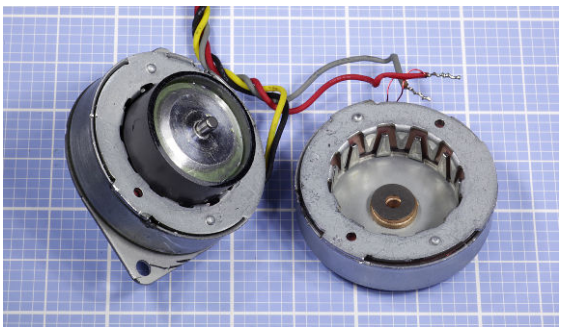

Figure 25-6. *A two-deck stepper motor split open to reveal its rotor (left) and one of the stators (right) encircled by a coil.*

as suggested in Figure 25-5. A large single coil, or center-tapped coil, induces a magnetic field in multiple poles in the top deck, out of phase by one step with a second set of poles, energized by their own coil, in the bottom deck. (All three motors shown in Figure 25-1 are of this type.) The rotor of the motor is tall enough to span both decks, and is rotated by each of them in turn.

In Figure 25-6, the decks of a two-deck four-wire motor have been split apart. The rotor remains in the left-hand section. It is enclosed within a black cylinder that is a permanent magnet divided into multiple poles. In the right-hand section, a coil is visible surrounding metal "teeth" that function as stator poles when the coil is energized.

In Figure 25-7, the same motor has been further disassembled. The coil was secured with a length of tape around its periphery, which has been removed to make the coil visible. The remaining half of the motor, at top-right, contains a second, concealed but identical coil with its own set of poles, one step out of phase with those in the first deck.

Because the field effects in a two-deck stepper motor are difficult to visualize, the remaining diagrams show simplified configurations with a minimum number of stator poles, each with its own coil.

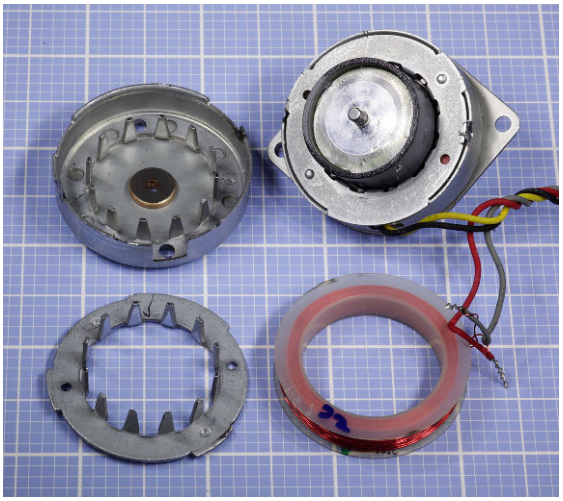

Figure 25-7. *The stepper motor from the previous figure, further disassembled.*

Bipolar Stepper Motors

The most basic way to reverse the current in a coil is by using an *H-bridge* configuration of switches, as shown in Figure 25-8, where the green arrow indicates the direction of the magnetic field. In actual applications, the switches are solid-state. Integrated circuits are available containing all the necessary components to control a bipolar stepper motor.

Four sequential steps of a bipolar motor are shown in Figure 25-9, Figure 25-10, Figure 25-11, and Figure 25-12. The H-bridge control electronics for each coil are omitted for clarity. As before, energized coils are shown with the pole inside the coil tinted green, while non-energized coils are gray, and the rotor is shown before it has had time to respond to the magnetic field in each step.

Unipolar Motors

The control electronics for a unipolar motor can be simpler than those for a bipolar motor, as off-the-shelf switching transistors can ground one end of the coil or the other. The classic five-wire unipolar stepper motor, often sold to hobbyists and used in robotics projects and similar applications, can be driven by nothing more elaborate

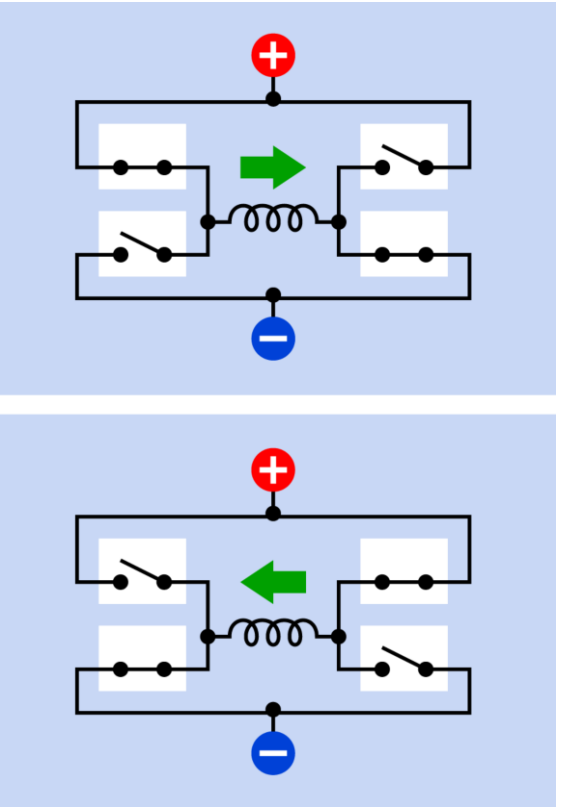

Figure 25-8. *The simplest and most basic way to reverse the current through a coil is via an H-bridge circuit. In practice, the switches are replaced by solid-state components.*

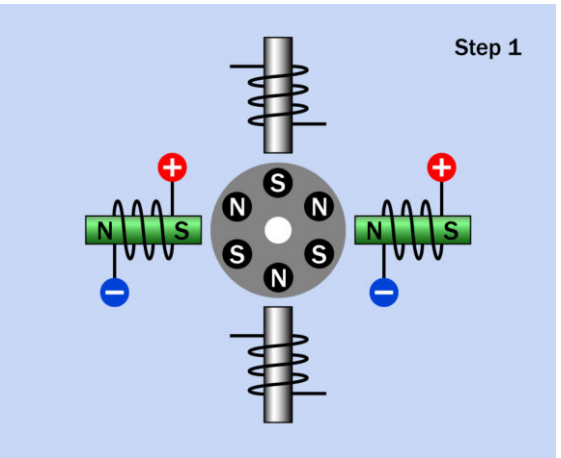

Figure 25-9. *A bipolar stepper motor depicted a moment before the rotor has had time to make its first step in response to magnetic fields created by the stator coils.*

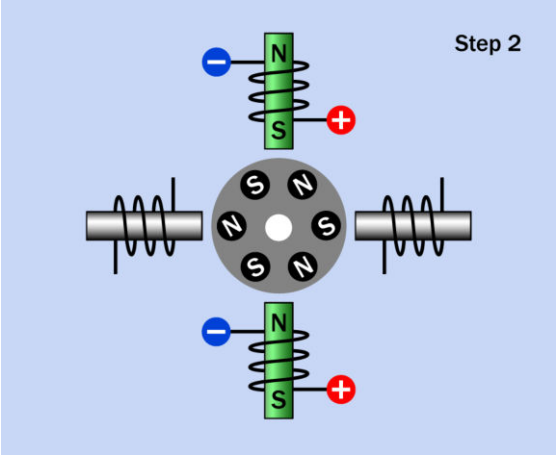

Figure 25-10. *The bipolar stepper motor from the previous figure is shown with its rotor having advanced by one step, and coil polarity changed to induce it to make a second step.*

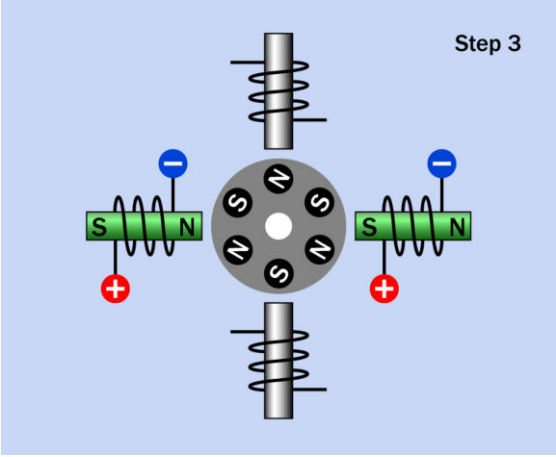

Figure 25-11. *The bipolar stepper motor after taking its second step, immediately before making its third step.*

than a set of *555 timer* chips. However, this type of motor is less powerful for its size and weight because only half of each coil is energized at a time.

In Figure 25-13, Figure 25-14, Figure 25-15, and Figure 25-16, the simplest configuration of a unipolar system is shown in diagrammatic form using four stator coils and a rotor containing six magnetic poles. Each figure shows the stator coils when they have just been energized, a moment before the rotor has had time to move in response to them. Coils that are energized are shown with the metal cores tinted green. Wires that are not conducting current are shown in gray. The open and closed positions of switches a, b, c, and d suggest the path that current is taking along the wires that are colored black.

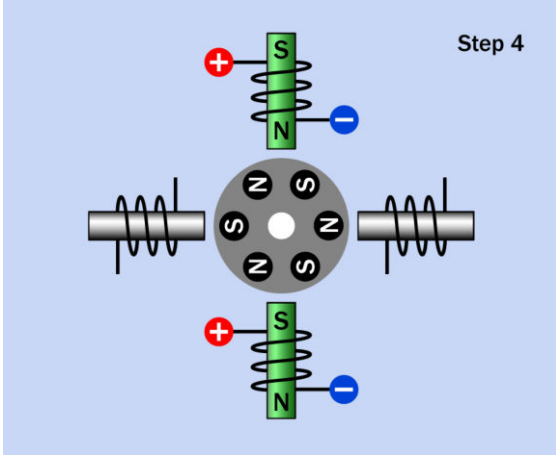

Figure 25-12. *The bipolar stepper motor after taking its third step. When the rotor responds to the new pattern of magnetic fields, its orientation will be functionally identical with that shown in the first step.*

Note that coils on opposite sides of the motor are energized simultaneously, while the other pair of coils is de-energized. Adjusting the controller so that it overlaps the "on" cycles of the coils can generate more torque, while consuming more power.

A motor containing more stator poles can advance in smaller steps, if the poles are separately energized. However, if the coils have individual windings, this will increase the cost of the motor.

Variants

In addition to bipolar and unipolar variants, previously described, three others are available.

High Phase Count

This term describes any type of stepper motor in which additional poles reduce the step size. The advantages of a high phase count include

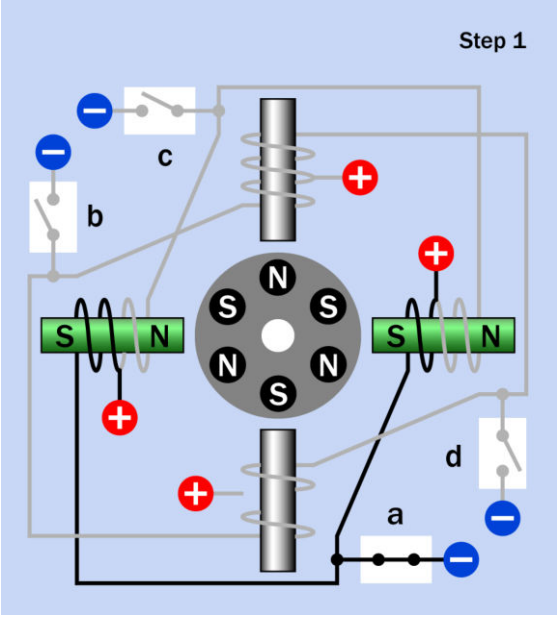

Figure 25-13. *The coils of this unipolar stepper motor are shown an instant after they have been energized, before the rotor has had time to respond by making its first step.*

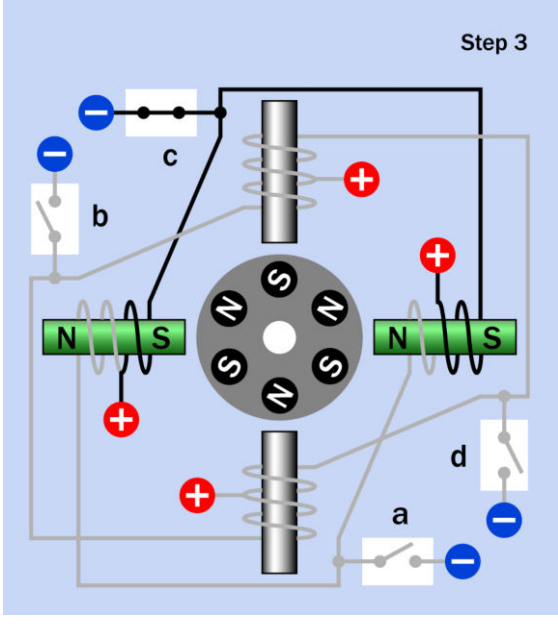

Figure 25-15. *The same motor from the previous figure is shown with coils energized to induce the rotor to make its third step.*

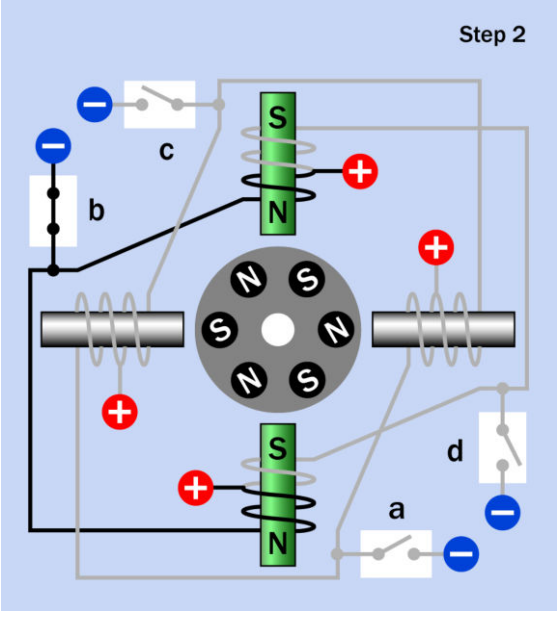

Figure 25-14. *The same motor from the previous figure is shown with coils energized to induce the rotor to make its second step.*

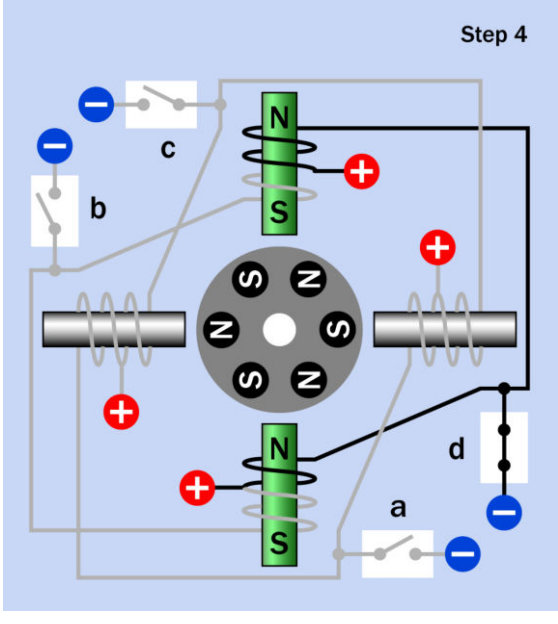

Figure 25-16. *When the rotor makes its fourth step, it will be back in an orientation that is functionally identical with the first figure in this series.*

smoother running at high speed and greater precision when selecting a desired motor position. The additional coils also enable higher power density, but naturally tend to add to the cost of the motor.

Hybrid

This type of motor uses a toothed rotor that provides variable reluctance while also containing permanent magnets. It has become relatively common, as the addition of teeth to the rotor enables greater precision and efficiency. From a control point of view, the motor behaves like a regular permanent-magnet stepper motor.

Bifilar

In this type of motor, also sometimes known as a *universal* stepper motor, two coils are wound in parallel for each stator pole. If there are two poles or sets of poles, and both ends of each winding are accessible via wires that are run out of the motor, there will be eight wires in total. Consequently this type is often referred to as an *8-wire motor*.

The advantage of this scheme is that it allows three possible configurations for the internal coils. By shorting together the wires selectively, the motor can be made to function either in unipolar or bipolar mode.

In Figure 25-17, the upper pair of simplified diagrams depicts one end of one coil connected to the beginning of the other, while positive voltage is applied at the midpoint, as in a unipolar motor. The magnetic polarity of the coil is determined by grounding either end of the coil. The section of each coil that is not conducting current is shown in gray.

The center pair of diagrams shows the adjacent ends of the coils tied together, so that they are now energized in parallel, with the magnetic polarity being determined by the polarity of the voltage, as in a bipolar motor.

The coils may also be connected in series, as shown in the lower pair of diagrams. This will provide greater torque at low speed and lower torque at high speed, while enabling higher-voltage, lower-current operation.

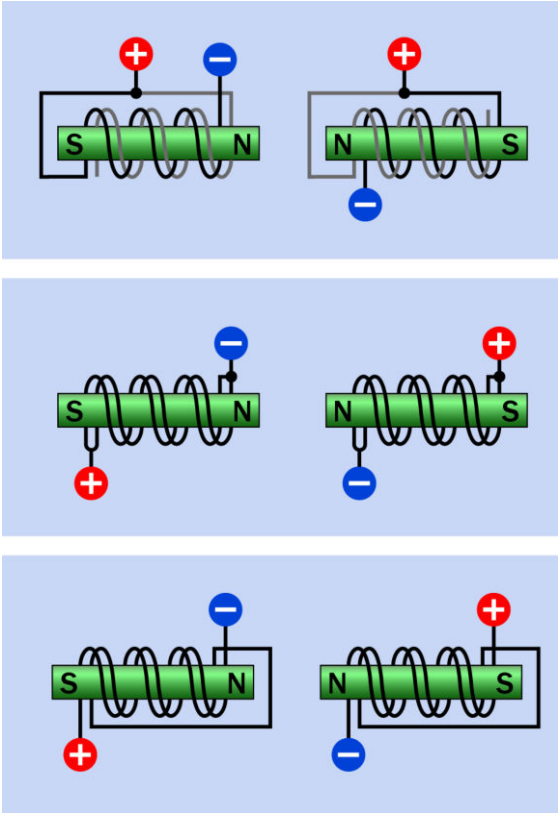

Figure 25-17. *In a bifilar motor, two coils are wound in parallel around each stator pole and can be connected with a center tap to emulate a unipolar motor (upper diagrams), or can be energized in parallel (middle diagrams) or series (lower diagrams) to emulate a bipolar motor.*

Multiphase

In a multiphase motor, multiple stator coils are usually connected in series, with a center tap applied between each pair. A possible configuration is shown in Figure 25-18, where the two diagrams show two consecutive steps in rotation, although the step angle could be halved by changing the voltage polarity in only one location at a time. The way in which the motor is wired

enables only one stator coil to be unpowered during any step, because its two ends are at equal potential. Therefore this type of motor is capable of high torque in a relatively small format.

In some multiphase motors, additional wires allow access to both ends of each coil, and the coils are not connected internally. This allows control of the motor to be customized.

Microstepping

An appropriately designed stepper motor can be induced to make very small, intermediate steps if the control voltage is modulated to intermediate levels. Step angles as low as 0.007 degrees are claimed by some manufacturers. However, a motor running in this mode is less able to generate torque.

The simplest form of microstepping is half-stepping. To achieve this in a unipolar motor, each coil passes through an "off" state before its magnetic polarity is reversed.

Sensing and Feedback

So long as the series of pulses to the motor allows the rotor ample time to respond, no feedback mechanism from the rotor is necessary to confirm its position, and an open-loop system is sufficient. If sudden acceleration, deceleration, load fluctuations, and/or rotation reversal will occur, or if high speeds are involved, a *closed loop system*, in which a sensor provides positional feedback, may be necessary.

Voltage Control

Rapid stepping of a motor requires rapid creation and collapse of magnetic fields in the stator windings. Therefore, self-inductance of the windings can limit the motor speed. One way to overcome this is to use a higher voltage. A more sophisticated solution is to use a controller that provides a high initial voltage, which is reduced or briefly interrupted when a sensor indicates that coil current has increased sufficiently to overcome the self-inductance of the windings and has reached its imposed limit. This type of controller may be referred to as a *chopper drive* as the voltage is "chopped," usually by power transistors. It is a form of *pulse width modulation*.

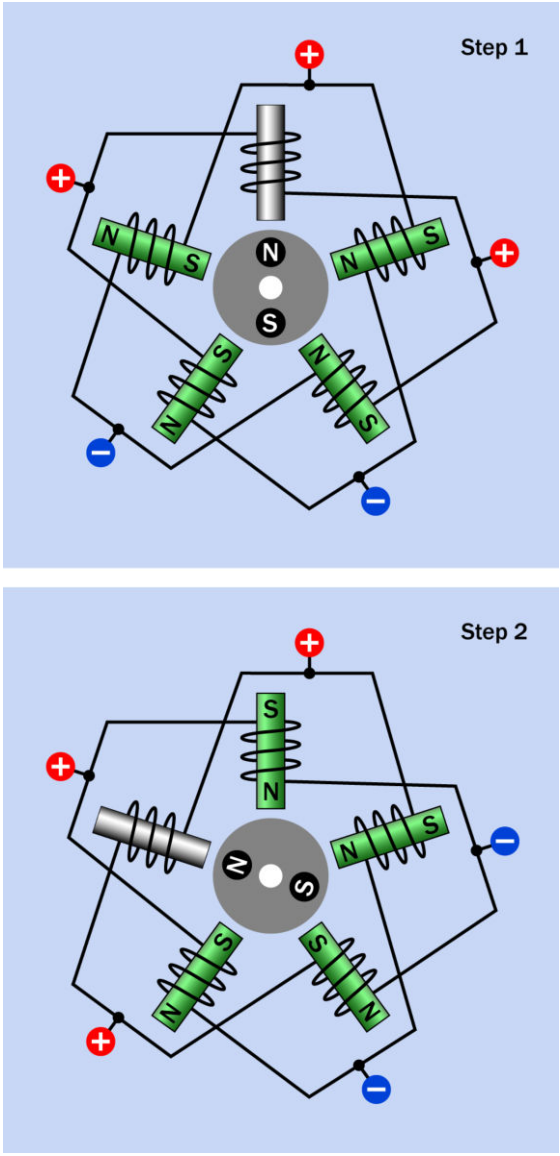

Figure 25-18. *A multiphase stepper motor. By applying voltage in the pattern shown, only one coil is not energized during each step. This enables high torque compared with the size of the motor.*

Values

The *step angle* of a stepper motor is the angular rotation of its shaft, in degrees, for each full step. This will be determined by the physical construction of the motor. The coarsest step angle is 90 degrees, while sophisticated motors may be capable of 1.8 degrees (without microstepping).

The maximum torque that a motor can deliver is discussed in "Values" (page 184) in the **DC motor** entry of this encyclopedia.

Motor weight and size, shaft length, and shaft diameter are the principal passive values of a stepper motor, which should be checked before it is selected for use.

How to Use it

Stepper motors are used to control the seek action in disk drives, the print-head movement and paper advance in computer printers, and the scanning motion in document scanners and copiers.

Industrial and laboratory applications include the adjustment of optical devices (modern telescopes are often oriented with stepper motors), and valve control in fluid systems.

A stepper motor may be used to power a *linear actuator*, usually via a screw thread (properly known as a lead screw) or worm gear. For more on linear actuators, see "Linear Actuator" (page 184). While the stepper motor will enable greater accuracy than a traditional DC motor, the gearing inevitably will introduce some imprecision.

Advantages of stepper motors include:

- Precise positioning, typically within 3 percent to 5 percent per step. The percentage step error does not accumulate as the motor rotates
- Able to run at a wide range of speeds, including very slow speeds without reduction gearing
- Trouble-free start, stop, and reverse action
- Cheap controller hardware where open-loop applications are acceptable
- High reliability, since no brushes or commutator are involved

Disadvantages include:

- Noise and vibration
- Resonance at low speeds
- Progressive loss of torque at high speeds

Protection Diodes

While a small stepper motor may be driven directly from power transistors, *darlington pairs*, or even *555 timers*, larger motors will create *back-EMF* when the magnetic field of each stator coil is induced or forward EMF when the field is allowed to collapse, and bipolar motors will also induce voltage spikes when the current reverses. In a unipolar motor, while only one-half of the coil is actually energized via its center tap, the other half will have an induced voltage, as the coil acts like a *linear transformer*.

A simplified schematic illustrating diode placement for a bipolar motor is shown in Figure 25-19.

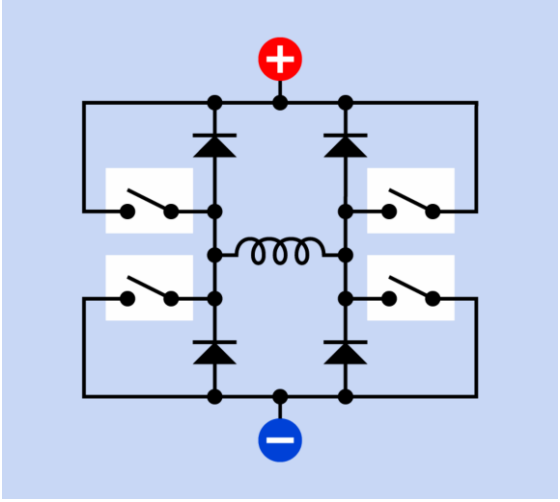

Figure 25-19. *The H-bridge circuit must be augmented with protection diodes to guard against back-EMF created by fluctuating current in the stator coil.*

Integrated circuit chips are available taht incorporate protection diodes, in addition to the necessary power transistors. Stepper motors may also have protection diodes built in. Consult the manufacturer's datasheet for details before attaching a motor to a power source.

Positional Control

The built-in control electronics of a **servo motor** typically turn the shaft to a precisely known position in response to pulse-width modulation from an exterior source such as a **microcontroller**, whereas the angle of rotation of a stepper motor in an open-loop system must be calculated by counting the number of steps from an initial, home position. This limitation of a stepper motor can be overcome by using a closed-loop system, but that will require monitoring the motor, adding complexity to the external controller. The choice between stepper and servo motors should be evaluated on a case-by-case basis.

What Can Go Wrong

General problems affecting all types of motors are listed in "Heat effects" (page 188). Issues relating more specifically to stepper motors are listed in the following sections.

Incorrect Wiring

Because a stepper motor is driven via multiple conductors, there is a significant risk of wiring errors, especially since many motors are not identified with part numbers. The first challenge, then, may be to determine what type of motor it is. When the motor is disconnected from any power, and the shaft is rotated with finger and thumb, a magnetized-rotor motor will not spin as freely as a reluctance motor, because the magnets in the rotor will provide intermittent turning resistance.

If a unipolar motor is relatively small and is fitted with five wires, almost certainly the motor contains two coils, each with a center tap, and their function can be determined by applying positive voltage to the red wire and grounding each of the other wires in turn. Attaching a small piece of tape to the motor shaft will assist in viewing its orientation.

A multimeter set to measure ohms can also be useful in deducing the internal coil connections of the motor, since the end-to-end resistance of a coil should be approximately twice the resistance between the center tap and either end of the coil.

A multiphase motor may have five wires, but in this case, the resistance between any two non-adjacent wires will be 1.5 times the resistance between any two adjacent wires.

Step Loss

In an open-loop system, if the motor skips or misses pulses from the controller, the controller no longer has an accurate assessment of the shaft angle. This is known as *step loss*. Since this can be caused by sudden changes in control frequency, the frequency should be increased (or decreased) gradually. This is known as *ramping* the motor speed. Stepper motors cannot respond instantly to changes in speed, because of inertia in the rotor or in the device that the motor is driving.

Where the motor turns one or more steps beyond its commanded stopping point, this is known as *overshoot*.

Step loss may also occur if the motor continues turning after power has been interrupted (either intentionally or because of an external fault). In an open-loop system, the controller should be designed to reset the motor position when power is initiated.

Excessive Torque

When the motor is stationary and not powered, *detent torque* is the maximum turning force that can be applied without causing the shaft to turn. When the motor is stationary and the controller does deliver power to it, *holding torque* is the maximum turning force that can be applied

without causing the shaft to turn, and *pull-in torque* is the maximum torque which the motor can apply to overcome resistance and reach full speed. When the motor is running, *pull-out torque* is the maximum torque the motor can deliver without suffering step loss (pulling it out of sync with its controller). Some or all of these values should be specified on the motor's datasheet. Exceeding any of them will result in step loss.

Hysteresis

When a controller directs a stepper motor to seek a specified position, the term *hysteresis* is often used to mean the total error between the actual position it reaches when turning clockwise, and the actual position it reaches when turning counter-clockwise. This difference may occur because a stepper motor tends to stop a fraction short of its intended position, especially under significant load. Any design that requires precision should be tested under real-world conditions to assess the hysteresis of the motor.

Resonance

A motor has a natural resonant frequency. If it is stepped near that frequency, vibration will tend to be amplified, which can cause positional errors, gear wear (if gears are attached), bearing wear, noise, and other issues. A good datasheet should specify the resonant frequency of the motor, and the motor should run above that frequency if possible. The problem can be addressed by rubber motor mounts or by using a resilient component, such as a drive belt, in conjunction with the drive shaft. *Damping* the vibration may be attempted by adding weight to the motor mount.

Note that if the motor has any significant weight attached directly to its shaft, this will lower its resonant frequency, and should be taken into account.

Resonance may also cause *step loss* (see preceding sections).

Hunting

In a closed-loop system, a sensor on the motor reports its rotational position to the controller, and if necessary, the controller responds by adjusting the position of the motor. Like any feedback system, this entails some lag time, and at certain speeds the motor may start *hunting* or *oscillating* as the controller over-corrects and must then correct its correction. Some closed-loop controllers avoid this issue by running mostly in open-loop mode, using correction only when the motor experiences conditions (such as sudden speed changes), which are likely to cause step loss.

Saturation

While it may be tempting to increase the torque from a stepper motor by upping the voltage (which will increase the current through the stator coils), in practice motors are usually designed so that the cores of the coils will be close to saturation at the rated voltage. Therefore, increasing the voltage may achieve very little increase in power, while causing a significant increase in heat.

Rotor Demagnetization

The permanent magnets in a rotor can be partially demagnetized by excessive heat. Demagnetization can also occur if the magnets are exposed to high-frequency alternating current when the rotor is stationary. Therefore, attempting to run a stepper motor at high speed when the rotor is stalled can cause irrevocable loss of performance.

diode

26

The term **diode** almost always means a semiconductor device, properly known as a *PN junction diode*, although the full term is not often used. It was formerly known as a *crystal diode*. Before that, **diode** usually meant a type of *vacuum tube*, which is now rarely used outside of high-wattage RF transmitters and some high-end audio equipment.

OTHER RELATED COMPONENTS

- **rectifier** (See "Rectification" (page 227))
- **unijunction transistor** (See Chapter 27)
- **LED** (light-emitting diode) (Volume 2)

What It Does

A diode is a two-terminal device that allows current to flow in one direction, known as the *forward direction,* when the *anode* of the diode has a higher positive potential than the *cathode*. In this state, the diode is said to be *forward biased*. If the polarity of the voltage is reversed, the diode is now *reverse biased*, and it will attempt to block current flow, within its rated limits.

Diodes are often used as *rectifiers* to convert alternating current into direct current. They may also be used to suppress voltage spikes or protect components that would be vulnerable to reversed voltage, and they have specialized applications in high-frequency circuits.

A *Zener diode* can regulate voltage, a *varactor diode* can control a high-frequency oscillator, and *tunnel diodes*, *Gunn diodes*, and *PIN diodes* have high-frequency applications appropriate to their rapid switching capability. An **LED** (*light-emitting diode*) is a highly efficient light source, which is discussed in Volume 2 of this encyclopedia. A **photosensitive diode** will adjust its ability to pass current depending on the light that falls upon it, and is included as a *sensor* in Volume 3.

See Figure 26-1 for schematic symbols representing a generic diode.

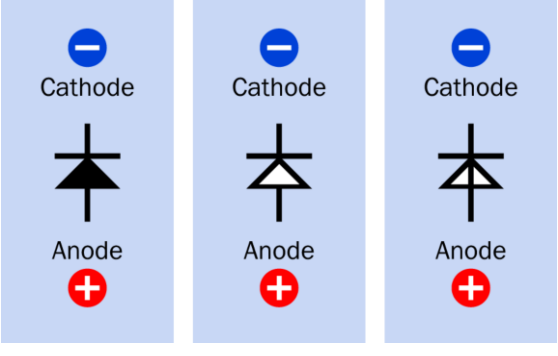

Figure 26-1. *Commonly used schematic symbols for a generic diode. All the symbols are functionally identical. The direction of the arrow formed by the triangle indicates the direction of conventional current (from positive to negative) when the diode is forward-biased.*

The basic diode symbol is modified in various ways to represent variants, as shown in Figure 26-2.

At top

Each symbol in the group of six indicates a Zener diode. All are functionally identical.

Bottom-left
Tunnel diode.

Bottom-center
Schottky diode.

Bottom-right
Varactor.

A triangle with an open center does not indicate any different function from a triangle with a solid center. The direction of the arrow always indicates the direction of conventional current, from positive to negative, when the diode is forward-biased, although the functionality of Zener diodes and varactors depends on them being reverse-biased, and thus they are used with current flowing opposite to the arrow symbol. The bent line used in the Zener symbol can be thought of as an opened letter Z, while the curled line used in the Schottky diode symbol can be thought of as a letter S, although these lines are sometimes drawn flipped left-to-right.

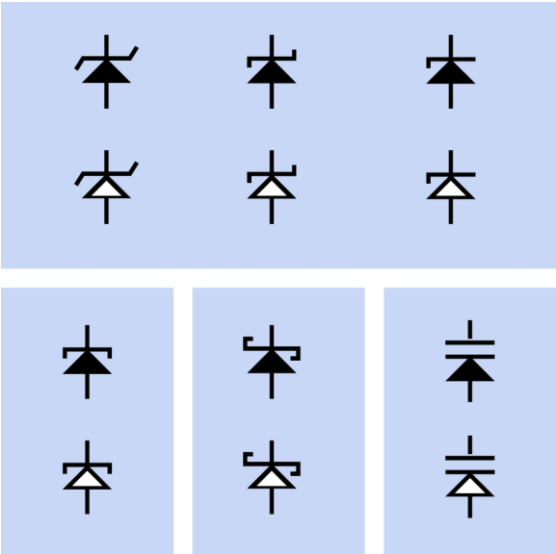

Figure 26-2. *Commonly used schematic symbols for specialized types of diodes. See text for details.*

A range of rectifier and signal diodes is shown in Figure 26-3. (Top: Rectifier diode rated 7.5A at 35VDC. Second from top: Rectifier diode rated 5A at 35VDC. Center: Rectifier diode rated 3A at 35VDC. Second from bottom: 1N4001 Rectifier diode rated 1A at 35VDC. Bottom: 1N4148 signal switching diode rated at 300mA.) All values are for forward continuous current and RMS voltage. Each cylindrical diode is marked with a silver stripe (a black stripe on the 1N4148) to identify its *cathode*, or the end of the diode that should be "more negative" when the component is forward biased. Peak current can greatly exceed continuous current without damaging the component. Datasheets will provide additional information.

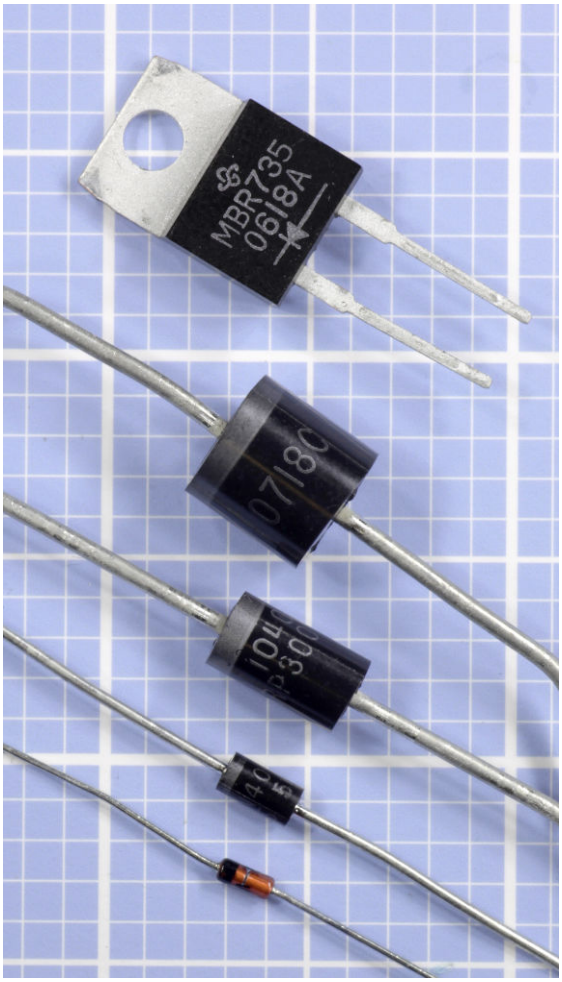

Figure 26-3. *Diodes ranging in continuous forward-current capability from 7.5A (top) to 300mA (bottom). See text for additional details.*

How It Works

A PN diode is a two-layer *semiconductor*, usually fabricated from silicon, sometimes from germanium, and rarely from other materials. The layers are doped with impurities to adjust their electrical characteristics (this concept is explained in more detail in Chapter 28). The *N layer* (on the negative, cathode side) has a surplus of electrons, creating a net negative charge. The *P layer* (on the positive, anode side) has a deficit of electrons, creating a net positive charge. The deficit of electrons can also be thought of as a surplus of "positive charges," or more accurately, a surplus of *electron holes*, which can be considered as spaces that electrons can fill.

When the negative side of an external voltage source is connected with the cathode of a diode, and the positive side is connected with the anode, the diode is forward-biased, and electrons and electron holes are forced by mutual repulsion toward the junction between the n and p layers (see Figure 26-4). In a silicon diode, if the potential difference is greater than approximately 0.6 volts, this is known as the *junction threshold voltage*, and the charges start to pass through the junction. The threshold is only about 0.2 volts in a germanium diode, while in a Schottky diode it is about 0.4 volts.

If the negative side of an external voltage source is connected with the anode of a diode and positive side is connected with the cathode, the diode is now reverse-biased, and electrons and electron holes are attracted away from the junction between the n and p layers. The junction is now a *depletion region*, which blocks current.

Like any electronic component, a diode is not 100% efficient. When it is forward-biased and is passing current, it imposes a small voltage drop of around 0.7V for a silicon-based diode (Schottky diodes can impose a drop of as little as 0.2V, germanium diodes 0.3V, and some LEDs between 1.4V and 4V). This energy is dissipated as heat. When the diode is reverse-biased, it is still not 100% efficient, this time in its task of blocking

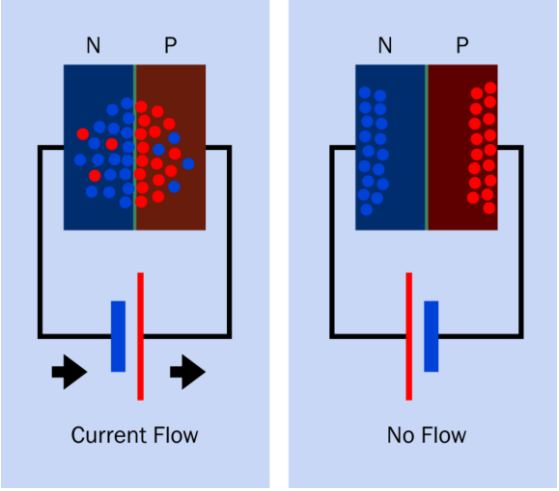

Figure 26-4. *Inside a PN junction diode. Left: in forward-biased mode, voltage from a battery (bottom, with plates colored for clarity) forces charges in the N and P layers toward the central junction of the diode. Current begins to flow. Right: in reverse-biased mode, charges in the N and P layers are attracted away from the central junction, which becomes a depletion region, unable to pass significant current.*

current. The very small amount of current that manages to get through is known as *leakage*. This is almost always less than 1mA and may be just a few µA, depending on the type of diode.

The performance of a theoretical generic PN diode is illustrated in Figure 26-5. The right-hand side of the graph shows that if a diode is forward-biased with a gradually increasing potential, no current passes until the diode reaches its junction threshold voltage, after which the current rises very steeply, as the *dynamic resistance* of the diode diminishes to near zero. The left-hand side of the graph shows that when the diode is reverse-biased with a gradually increasing potential, initially a very small amount of current passes as leakage (the graph exaggerates this for clarity). Eventually, if the potential is high enough, the diode reaches its intrinsic *breakdown voltage*, and once again its effective resistance diminishes to near zero. At either end of the curve, the diode will be easily and permanently

damaged by excessive current. With the exception of Zener diodes and varactors, reverse bias on a diode should not be allowed to reach the breakdown voltage level.

The graph in Figure 26-5 does not have a consistent scale on its Y axis, and in many diodes the magnitude of the (reverse-biased) breakdown voltage will be as much as 100 times the magnitude of the (forward-biased) threshold voltage. The graph has been simplified for clarity.

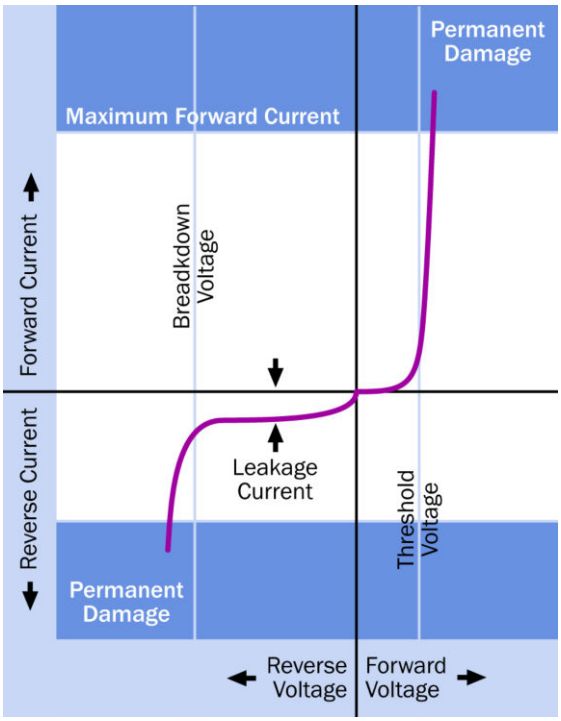

Figure 26-5. *As the forward voltage across a diode reaches the junction threshold, the diode begins passing current. If the voltage across the diode is reversed, initially a small amount of current leakeage occurs. Excessive forward or reverse voltage will create sufficient current to destroy the component.*

Variants

Packaging

Some diodes have no information at all printed on them, while others may have a part number. Any additional information is rare. No convention exists for indicating the electrical characteristics of the component by colors or abbreviations. If one terminal is marked in any way, almost certainly it is the cathode. One way to remember the meaning of a stripe on the cathode end of a rectifier diode or signal diode is by thinking of it as resembling the line in the diode schematic symbol.

Signal Diodes

Also known as *switching diodes* and *high-speed diodes*, their small size provides a low junction capacitance, enabling fast response times. They are not designed to withstand high currents. Signal diodes traditionally were packaged with axial leads for through-hole installation (like traditional-style resistors). Although this format still exists, signal diodes are now more commonly available in surface-mount formats.

Rectifier Diodes

Physically larger than signal diodes, and capable of handling higher currents. Their higher junction capacitance makes them unsuitable for fast switching. Rectifier diodes often have axial leads, although different package formats are used where higher currents are involved, and may include a heat sink, or may have provision for being attached to a heat sink.

There are no generally agreed maximum or minimum ratings to distinguish signal diodes from rectifier diodes.

Zener Diode

A Zener diode generally behaves very similarly to a signal or rectifier diode, except that its breakdown voltage is lower.

The Zener is intended to be reverse-biased; that is, conventional current is applied through it "in the wrong direction" compared with conventional diodes. As the current increases, the *dynamic resistance* of the Zener diode decreases. This relationship is shown in Figure 26-6, where the two colored curves represent the performance of different possible Zener diodes. (The curves are adapted from a manufacturer's data-

sheet.) This behavior allows the Zener to be used in simple voltage-regulator circuits, as it can allow a reverse current to flow at a voltage limited by the diode's breakdown voltage. Other applications for Zener diodes are described in "DC Voltage Regulation and Noise Suppression" (page 230). A typical Zener diode is shown in Figure 26-7.

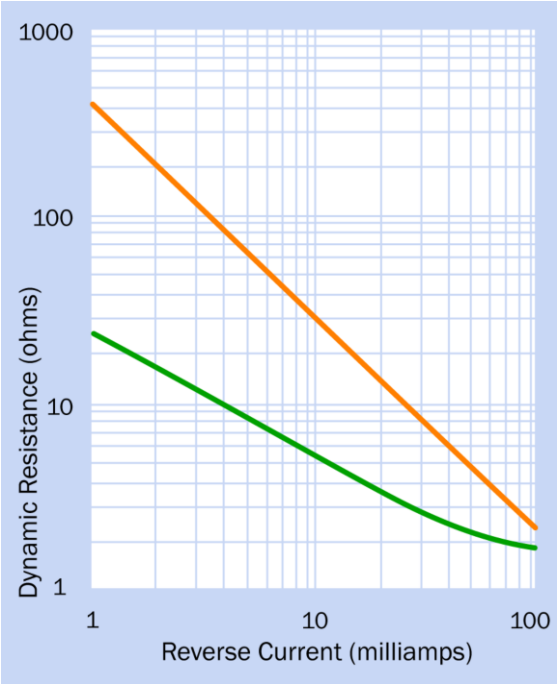

Figure 26-6. *A manufacturer's datasheet may include graphs of this kind, showing the variation in dynamic resistance of two reverse-biased Zener diodes in response to changes in current.*

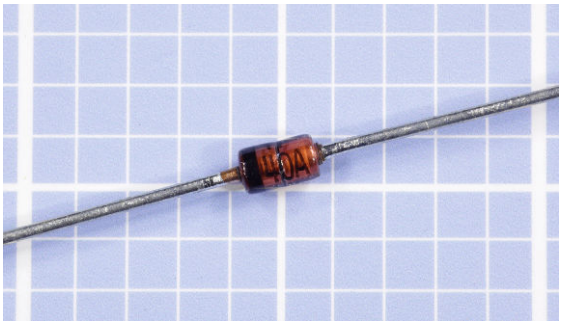

Figure 26-7. *A 1N4740 Zener diode.*

Transient Voltage Suppressor (TVS)

A form of Zener diode designed to protect sensitive devices from transient voltage spikes by clamping them—in other words, diverting the energy to ground. A TVS can absorb as much as 30,000 volts from a lightning strike or static discharge. Typically the Zener diode is incorporated in a network of other diodes in a surface-mount integrated circuit chip.

Zener diodes can also be used in circuits to handle electrostatic discharge (ESD), which can occur when a person unknowingly accumulates an electrostatic potential and then grounds it by touching an electronic device.

Schottky Diode

This type has a low junction capacitance, enabling faster switching than comparable generic silicon diodes. It also imposes a lower forward voltage drop, which can be desirable in low-voltage applications, and allows less power dissipation when a diode is necessary to control current flow. The Schottky diode is fabricated with a semiconductor-to-metal junction, and tends to be slightly more expensive than generic silicon diodes with similar voltage and current specifications.

Varactor Diode

Also known as a *varicap*, this type of diode has variable capacitance controlled by reverse voltage. While other diodes may exhibit this same phenomenon, the varactor is specifically designed to exploit it at very high frequencies. The voltage expands or contracts the depletion region in the junction between the P and N regions, which can be thought of as analogous to moving the plates of a capacitor nearer together or farther apart.

Because the capacitance of a varactor has a low maximum of about 100pF, its uses are limited. It is used extensively in RF applications where its voltage-controlled variable capacitance provides a uniquely useful way to control the

frequency of an oscillator circuit. In almost all radio, cellular, and wireless receivers, a varactor controls a phase-locked loop oscillator. In ham radio receivers, it can be used to adjust the tuning of a filter that tracks an incoming radio frequency.

A varactor is always reverse-biased below its breakdown voltage, so that there is no direct conduction. The voltage that controls a varactor must be absolutely free from random fluctuations that would affect its resonant frequency.

Tunnel Diode, Gunn Diode, PIN Diode

Mostly used in very high frequency or microwave applications, where ordinary diodes are unacceptable because they have insufficiently high switching speeds.

Diode Array

Two or more diodes may be encapsulated in a single DIP or (more commonly) surface-mount integrated circuit chip. The internal configuration and the pinouts of the chip will vary from one device to another. Diode arrays may be used for termination of data lines to reduce reflection noise.

Bridge Rectifier

Although this is a diode array, it is commonly indexed in parts catalogues under the term *bridge rectifier*. Numerous through-hole versions are available with ratings as high as 25A, some designed for single-phase input while others process three-phase AC. Screw-terminal components can rectify more than 1,000 volts at 1,000 amps. The package does not usually include any provision for smoothing or filtering the output. See "Rectification" (page 227) for more information on the behavior of a bridge rectifier.

Values

A manufacturer's datasheet for a typical generic diode should define the following values, using abbreviations that may include those in the following list.

- Maximum sustained forward current: I_f or I_o or I_{Omax}
- Forward voltage (the voltage drop imposed by the diode): V_f
- Peak inverse DC voltage (may be referred to as maximum blocking voltage or breakdown voltage): P_{iv} or V_{dc} or V_{br}
- Maximum reverse current (also referred to as leakage): I_r

Datasheets may include additional values when the diode is used with alternating current, and will also include information on peak forward surge current and acceptable operating temperatures.

A typical signal diode is the 1N4148 (included at the bottom of Figure 26-3), which is limited to about 300mA forward current while imposing a voltage drop of about 1V. The component can tolerate a 75V peak inverse voltage. These values may vary slightly among different manufacturers.

Rectifier diodes in the 1N4001/1N4002/1N4003 series have a maximum forward current of 1A and will impose a voltage drop of slightly more than 1V. They can withstand 50V to 1,000V of inverse voltage, depending on the component. Here again, the values may vary slightly among different manufacturers.

Zener diodes have a different specification, as they are used with reverse bias as voltage-regulating devices rather than rectification devices. Manufacturers' data sheets are likely to contain the following terminology:

- Zener voltage (the potential at which the diode begins to allow reverse current flow when it is reverse-biased, similar to breakdown voltage): V_z
- Zener impedance or dynamic resistance (the effective resistance of the diode, specified when it is reverse-biased at the Zener voltage): Z_z

- Maximum or admissible Zener current (or reverse current): I_z or I_{zm}
- Maximum or total power dissipation: P_d or P_{tot}

Zener voltage may be defined within a minimum and maximum range, or as a simple maximum value.

Limits on forward current are often not specified, as the component is not intended to be forward-biased.

How to Use it

Rectification

A *rectifier diode*, as its name implies, is commonly used to rectify alternating current—that is, to turn AC into DC. A half-wave rectifier uses a single diode to block one-half of the AC sinewave. The basic circuit for a half-wave rectifier is shown in Figure 26-8. At top, the diode allows current to circulate counter-clockwise through the load. At bottom, the diode blocks current that attempts to circulate clockwise. Although the output has "gaps" between the pulses, it is usable for simple tasks such as lighting an LED, and with the addition of a smoothing capacitor, can power the coil of a DC relay.

A full-wave bridge rectifier employs four diodes to provide a more efficient output, usually filtered and smoothed with appropriate **capacitors**. The basic circuit is shown in Figure 26-9. A comparison of input and output waveforms for half-wave and full-wave rectifiers appears in Figure 26-10.

Discrete components are seldom used for this purpose, as off-the-shelf bridge rectifiers are available in a single integrated package. Rectifier diodes as discrete components are more likely to be used to suppress *back-EMF* pulses, as described below.

An old but widely used design for a full-wave bridge rectifier is shown in Figure 26-11. This unit measured approximately 2″ × 2″ × 1.5″ and was divided into four sections (as indicated by the solder terminals on the right-hand side), each

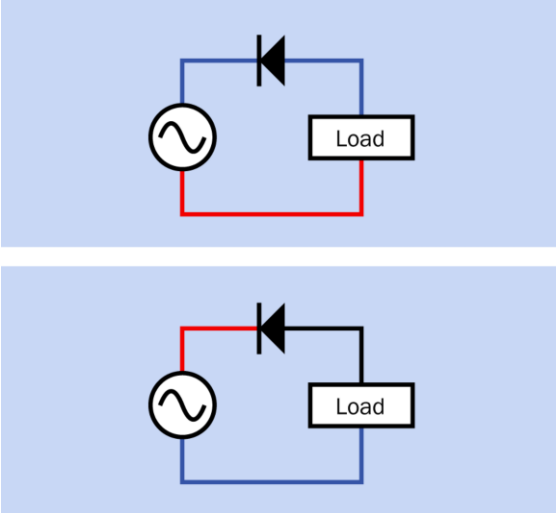

Figure 26-8. *A half-wave rectifier. In this configuration the diode allows AC current to circulate counter-clockwise but blocks it clockwise.*

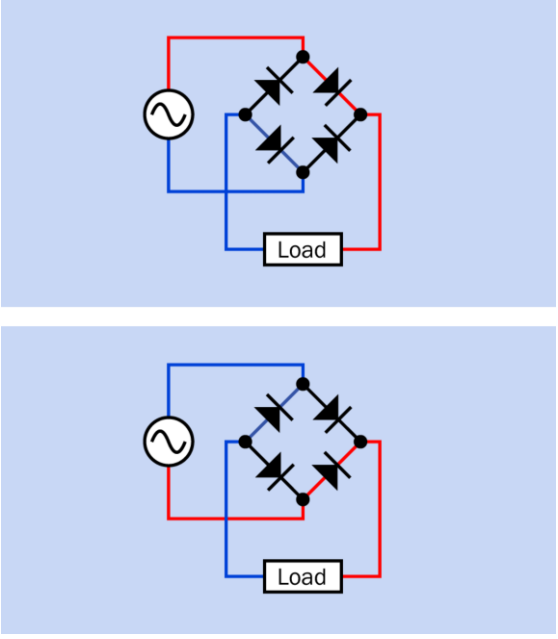

Figure 26-9. *The basic circuit commonly used to form a bridge rectifier, with color added to indicate polarity. Wires shown in black are not passing current because diodes are blocking it. Note that the polarity at the load remains constant.*

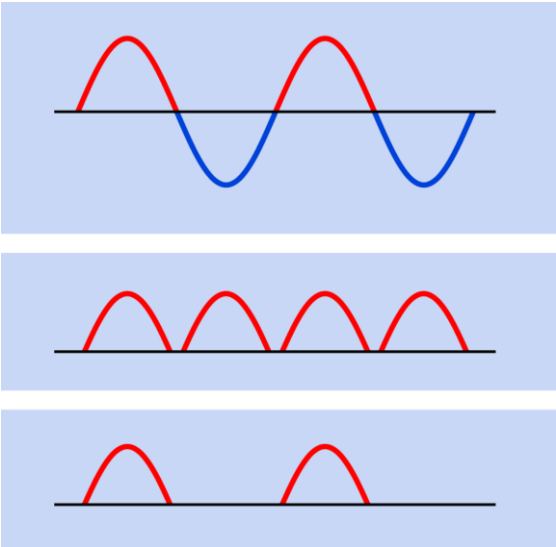

Figure 26-10. *Top: The voltage-amplitude sinewave of an alternating current source that fluctuates between positive voltage (shown red) and negative voltage (shown blue) relative to a neutral (black) baseline. Center: AC current converted by a full-wave rectifier. Because the diodes do not conduct below their threshold voltage, small gaps appear between pulses. Bottom: Output from a half-wave rectifier.*

section corresponding with the functionality of one modern diode. Figure 26-12 shows relatively modern rectifier packages, the one on the left rated at 20A continuous at 800V RMS, the one on the right rated 4A continuous at 200V RMS. In Figure 26-13, the one on the left is rated 4A continuous at 50V RMS, whereas the one on the right is rated 1.5A at 200V RMS.

DC output from rectifier packages is usually supplied via the outermost pins, while the two pins near the center receive AC current. The positive DC pin may be longer than the other three, and is usually marked with a + symbol.

Full-wave bridge rectifiers are also available in surface-mount format. The one in Figure 26-14 is rated for half an amp continuous current.

Back-EMF Suppression

A relay coil, motor, or other device with significant inductance will typically create a spike of voltage when it is turned on or off. This *EMF* can

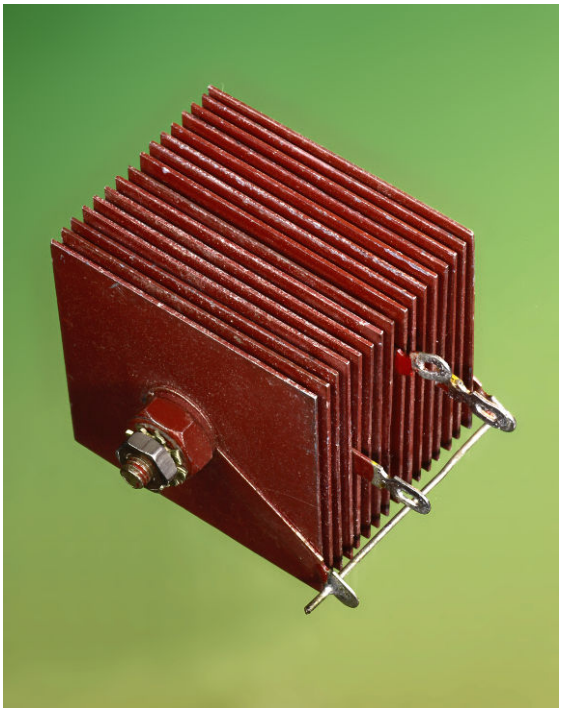

Figure 26-11. *Prior to the perfection of chip fabrication in the late 1960s, it was common to find silicon rectifiers of this type, measuring about 2" square.*

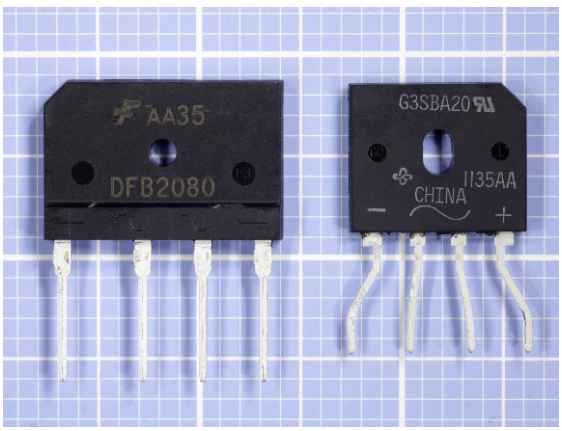

Figure 26-12. *Full-wave bridge rectifies are commonly available in packages such as these. See text for details.*

be shunted through a rectifier diode to safeguard other components in the circuit. A diode in this configuration may be referred to as a *protection diode*, a *clamp diode*, or *transient suppressor*. See Figure 26-15.

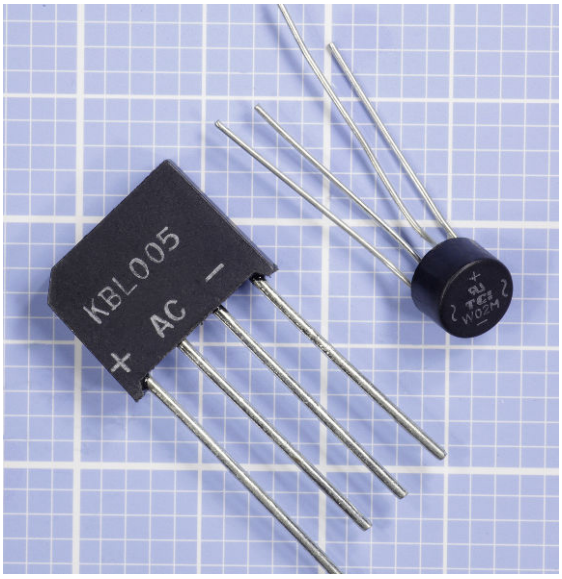

Figure 26-13. *Smaller full-wave bridge rectifiers capable of 1.5A to 4A continuous current.*

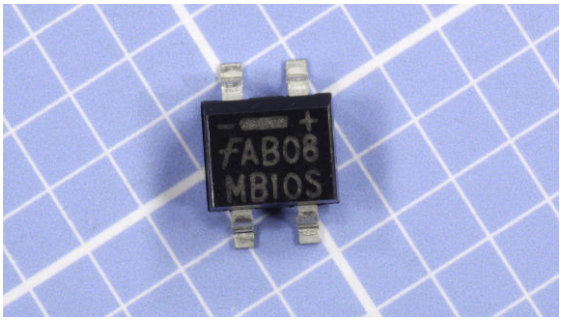

Figure 26-14. *This surface-mount component contains four diodes forming a full-wave bridge rectifier circuit, and can pass 0.5A continuous current. It measures approximately 0.2" square.*

Voltage Selection

A diode is sensitive to the relative voltage between its anode and cathode terminals. In other words, if the cathode is at 9V relative to the ground in the circuit, and the anode is at 12V, the 3V difference will easily exceed the threshold voltage, and the diode will pass current. (Actual tolerable values will depend on the forward voltage capability of the diode.) If the voltages are reversed, the diode will block the current.

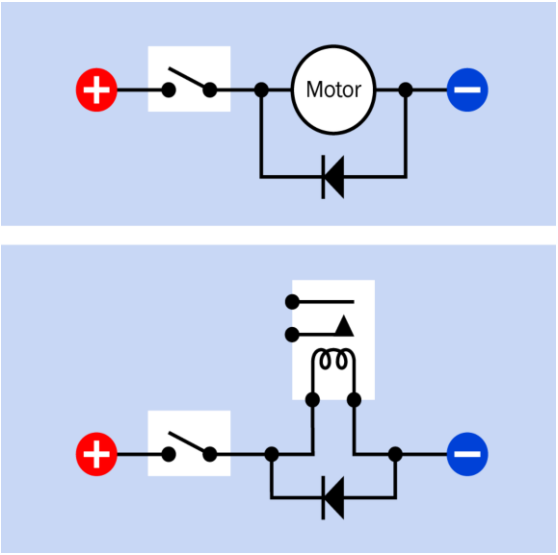

Figure 26-15. *A rectifier diode is very often placed across a motor (top), relay (bottom), or other device with significant inductance that creates a spike of reverse voltage when switched on or off. The surge is shunted through the diode, protecting other components in the circuit.*

This attribute can be used to make a device choose automatically between an AC adapter and a 9V battery. The schematic is shown in Figure 26-16. When an AC adapter that delivers 12VDC is plugged into a wall outlet, the adapter competes with the battery to provide power to a voltage regulator. The battery delivers 9VDC through the lower diode to the cathode side of the upper diode, but the AC adapter trumps it with 12VDC through the upper diode. Consequently, the battery ceases to power the circuit until the AC adapter is unplugged, at which point the battery takes over, and the upper diode now prevents the battery from trying to pass any current back through the AC adapter.

The voltage regulator in this schematic accepts either 12VDC or 9VDC and converts it to 5VDC. (In the case of 12VDC, the regulator will waste more power, which will be dissipated as waste heat.)

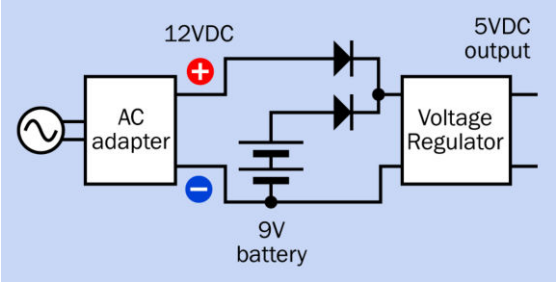

Figure 26-16. *Two diodes with their cathodes tied together will choose automatically between an AC adapter that delivers 12VDC and an internal 9V battery.*

Voltage Clamping

A diode can be used to *clamp* a voltage to a desired value. If an input to a 5V CMOS semiconductor or similarly sensitive device must be prevented from rising out of range, the anode of a diode can be connected to the input and the cathode to a 5V voltage source. If the input rises much above 5.6V, the potential difference exceeds the diode's junction threshold, and the diode diverts the excess energy. See Figure 26-17.

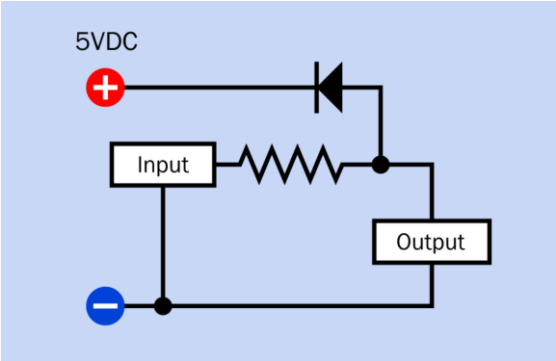

Figure 26-17. *A clamping diode can limit output voltage—in this example, to about 5.6V. If the input rises above that value relative to the common ground, the potential difference across the diode feeds the excess voltage back through it to the 5V source.*

Logic Gate

A signal diode is less than ideal as a logic gate, because it imposes a typical 0.6V voltage reduction, which can be significant in a 5V circuit and is probably unacceptable in a 3.3V circuit. Still, it can be useful on the output side—for example, if two or more outputs from a logic chip or microcontroller are intended to drive, or share, another device such as a single **LED**, as shown in Figure 26-18. In this role, the diodes wired in parallel behave similarly to an OR gate, while preventing either output from the chip from feeding current back into the other output.

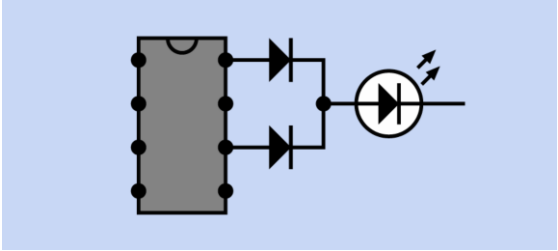

Figure 26-18. *Two or more outputs from a logic chip or microcontroller may be coupled with diodes to power another device, such as an LED, while protecting the chip from backflow of current. The diodes form a logical OR gate.*

DC Voltage Regulation and Noise Suppression

As previously noted, the dynamic resistance of a reverse-biased Zener diode will diminish as the current increases. This relationship begins at the point where breakdown in the diode begins—at its *Zener voltage*--and is approximately linear over a limited range.

The unique behavior of the Zener makes it usable as a very simple voltage controller when placed in series with a resistor as shown in Figure 26-19. It is helpful to imagine the diode and the resistor as forming a kind of voltage divider, with power being taken out at point A in the schematic. If a supply fluctuation increases the input voltage, this will tend to increase the current flowing through the Zener, and its dynamic resistance will diminish accordingly. A lower resistance in its position in the voltage divider will reduce the output voltage at point A, thus tending to compensate for the surge in input voltage.

Conversely, if the load in the circuit increases, and tends to pull down the input voltage, the current

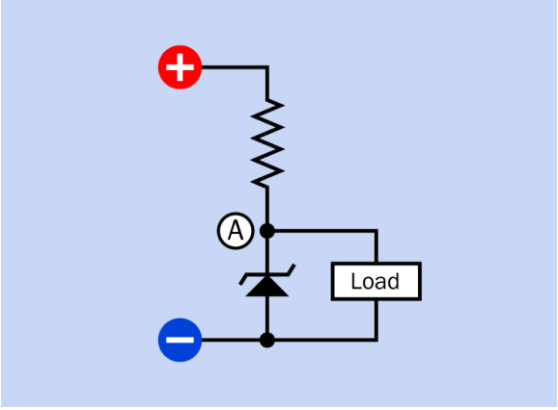

Figure 26-19. *A simplified, basic circuit illustrating the ability of a Zener diode to compensate for variations in the power supply or load in a circuit, creating an approximately constant voltage at point A.*

flowing through the Zener will diminish, and the voltage at point A will tend to increase, once again compensating for the fluctuation in the circuit.

As the series resistor would be a source of heat, a transistor could be added to drive the load, as shown in Figure 26-20.

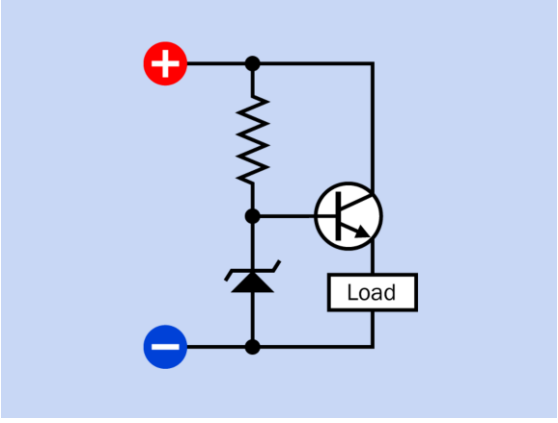

Figure 26-20. *A transistor could be added to the circuit in the previous figure to reduce power waste through the resistor.*

A manufacturer's datasheet may provide guidance regarding the dynamic resistance of a Zener diode in response to current, as previously shown in Figure 26-6. In practice, a packaged **voltage regulator** such as the LM7805 would most likely be used instead of discrete components, since it includes self-calibrating features, requires no series resistor, and is relatively unaffected by temperature. However, the LM7805 contains its own Zener diode, and the principle of operation is still the same.

AC Voltage Control and Signal Clipping

A more practical Zener application would be to limit AC voltage and/or impose clipping on an AC sinewave, using two diodes wired in series with opposed polarities. The basic schematic is shown in Figure 26-21, while clipping of the AC sinewave is illustrated in Figure 26-22. In this application, when one diode is reverse-biased, the other is forward-biased. A forward-biased Zener diode works like any other diode: it allows current to pass relatively freely, so long as the voltage exceeds its threshold. When the AC current reverses, the Zeners trade their functions, so that the first one merely passes current while the second one limits the voltage. Thus, the diodes divert peak voltage away from the load. The Zener voltage of each diode would be chosen to be a small margin above the AC voltage for voltage control, and below the AC voltage for signal clipping.

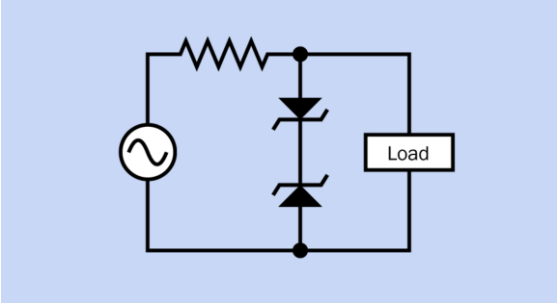

Figure 26-21. *Two Zener diodes placed in series, with opposite polarities, can clip or limit the voltage sinewave of an AC signal.*

Voltage Sensing

A Zener diode can be used to sense a small shift in voltage and provide a switched output in response.

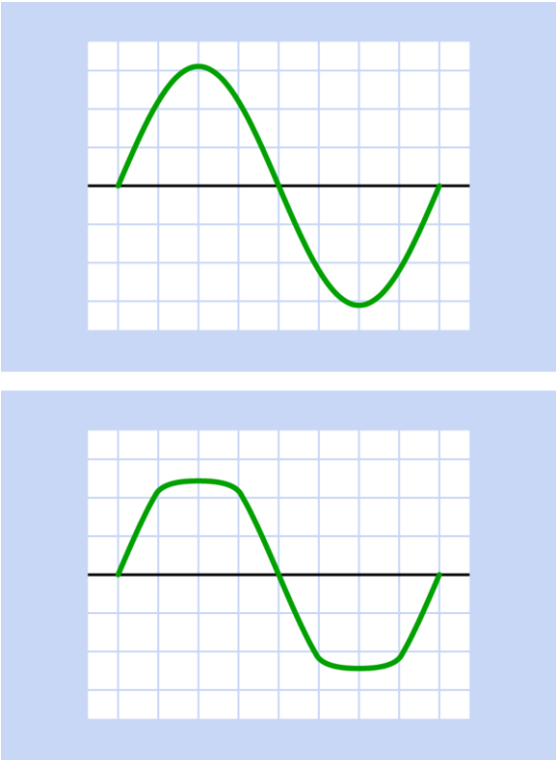

Figure 26-22. *AC input showing a pure sinewave (left) and a clipped version (right) created by Zener diodes wired in series, as in the previous figure.*

In Figure 26-23, the upper schematic shows a Zener diode preventing voltage from reaching the emitter of a PNP transistor while the divided input signal is below the Zener (breakdown) voltage of the diode. In this mode, the transistor is relatively non-conductive, very little current flows through it, and the output is now at near-zero voltage. As soon as the input signal rises above the Zener voltage, the transistor switches on and power is supplied to the output. The input is thus replicated in the output, as shown in the upper portion of Figure 26-24.

In Figure 26-23, the lower schematic shows a Zener diode preventing voltage from reaching the base of an NPN transistor while the input signal is below the Zener (breakdown) voltage of the diode. In this mode, the transistor is relatively non-conductive, and power is supplied to the output. As soon as the input signal rises above the Zener voltage, the transistor is activated, diverting the current to ground and bypassing the output, which is now at near-zero voltage. The input is thus inverted, as shown in the lower portion of Figure 26-24 (provided there is enough current to drive the transistor into saturation).

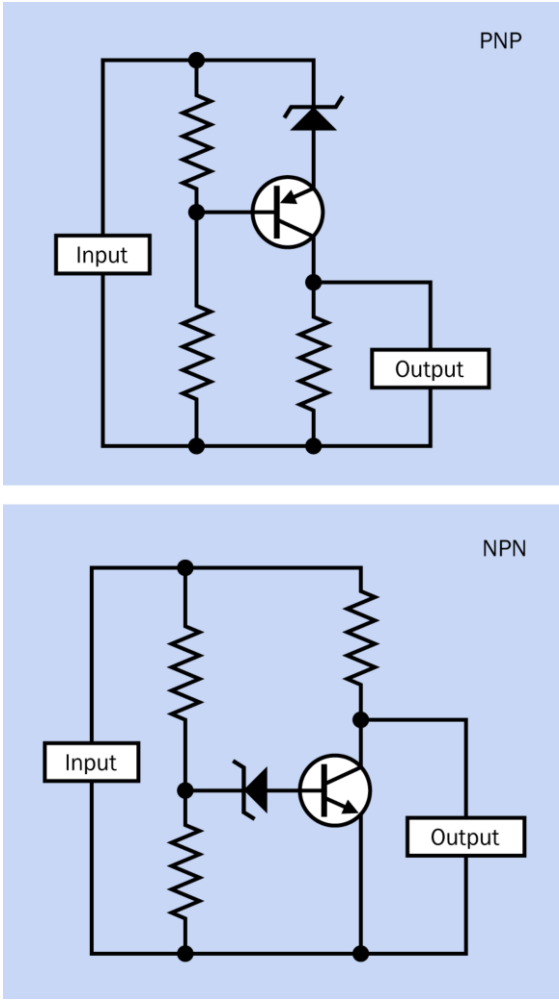

Figure 26-23. *A Zener diode can be used in conjunction with a PNP transistor. See text for details.*

What Can Go Wrong

Overload

If maximum forward current is exceeded, the heat generated is likely to destroy the diode. If the diode is reverse-biased beyond its peak in-

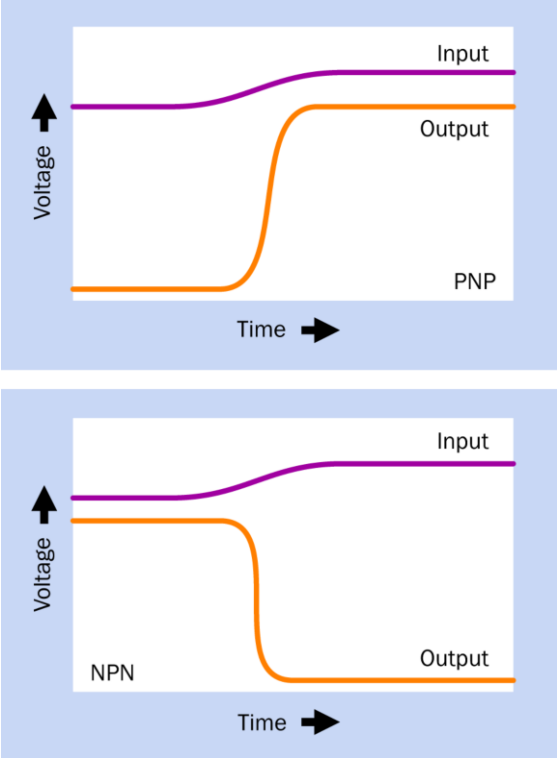

Figure 26-24. *Theoretical output from the transistors in the two previous schematics.*

verse voltage limit, the current will overwhelm the diode's ability to block it, and an *avalanche breakdown* will occur, once again probably destroying the component. The graph in Figure 26-5 illustrates the performance range of a hypothetical generic diode.

Reversed Polarity

Zener diodes look almost identical to other types, and all diodes share the same convention of marking the cathode for identification. Yet Zeners must be reverse-biased while others are forward-biased. This creates a significant risk of installing a diode "the wrong way around," with potentially destructive or at least confusing results, especially when used in a power supply. The very low resistance of a diode to forward current makes it especially vulnerable to burnout if installed incorrectly.

Wrong Type of Diode

If a Zener diode is used accidentally where a signal or rectifier diode is appropriate, the circuit will malfunction, as the Zener will probably have a much lower breakdown voltage, and therefore will not block reverse current. Conversely, if a signal or rectifier diode is used where the circuit calls for a Zener diode, reverse voltage will be clamped (or regulated at the diode's forward voltage value). Since diodes are often poorly marked, a sensible precaution is to store Zener diodes separately from all other types.

unijunction transistor

27

The unijunction transistor (UJT) and programmable unijunction transistor (PUT) are different internally, but are sufficiently similar in function to be combined in this entry.

OTHER RELATED COMPONENTS

- **diode** (See Chapter 26)
- **bipolar transistor** (See Chapter 28)
- **field-effect transistor** (See Chapter 29)

What It Does

Despite their names, the unijunction transistor (UJT) and programmable unijunction transistor (PUT) are not current-amplification devices like bipolar transistors. They are switching components that are more similar to diodes than to transistors.

The UJT can be used to build low- to mid-frequency oscillator circuits, while the PUT provides similar capability with the addition of more sophisticated control, and is capable of functioning at lower currents. The UJT declined in popularity during the 1980s after introduction of components such as the *555 timer*, which offered more flexibility and a more stable output frequency, eventually at a competitive price. UJTs are now uncommon, but PUTs are still available in quantity as through-hole discrete components. Whereas an integrated circuit such as a 555 timer generates a square wave, unijunction transistors in oscillator circuits generate a series of voltage spikes.

The PUT is often used to trigger a **thyristor** (described in Volume 2) and has applications in low-power circuits, where it can draw as little as a few microamps.

Schematic symbols for the two components are shown in Figure 27-1 and Figure 27-2. Although the symbol for the UJT is very similar to the symbol for a field-effect transistor (FET), its behavior is quite different. The bent arrow identifies the UJT, while a straight arrow identifies the FET. This difference is of significant importance.

The schematic symbol for a PUT indicates its function, as it resembles a diode with the addition of a gate connection.

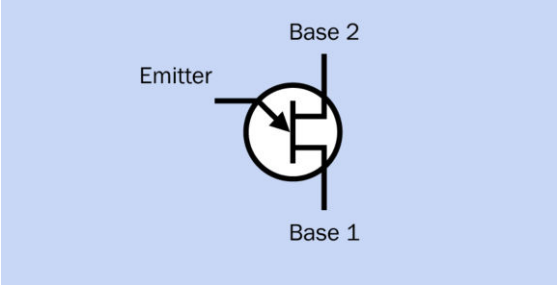

Figure 27-1. *Schematic symbol for a unijunction transistor (UJT). Note the bent arrow. The symbol for a field-effect transistor looks similar, but has a straight arrow. The functionality of the two components is very different.*

In Figure 27-3, the transistors at left and center are old-original unijunction transistors, while the one at right is a programmable unijunction transistor. (Left: Maximum 300mW, 35V interbase voltage. Center: 450mW, 35V interbase voltage. Right: 300mW, 40V gate-cathode forward voltage, 40V anode-cathode voltage.)

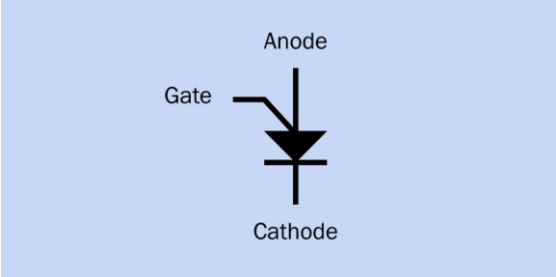

Figure 27-2. *Schematic symbol for a programmable unijunction transistor (PUT). The symbol accurately suggests the similarity in function to a diode, with the addition of a gate to adjust the threshold voltage.*

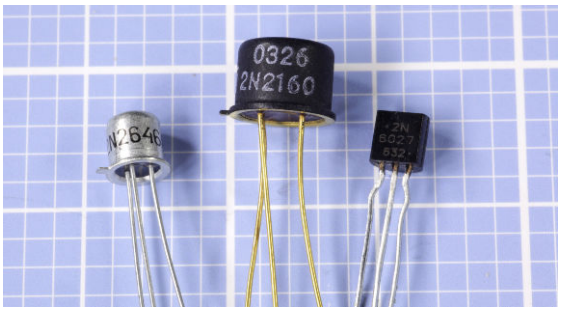

Figure 27-3. *The unijunction transistors at left and center are becoming obsolete; the one at the right is a programmable unijunction transistor (PUT), still readily available and widely used as a thyristor trigger.*

How It Works

The UJT is a three-terminal semiconductor device, but contains only two sections sharing a single junction—hence its name. Leads attached to opposite ends of a single channel of N-type semiconductor are referred to as base 1 and base 2, with base 2 requiring a slightly higher potential than base 1. A smaller P-type insert, midway between base 1 and base 2, is known as the emitter.

The diagram in Figure 27-4 gives an approximate idea of internal function.

When no voltage is applied to the emitter, a relatively high resistance (usually more than 5K) prevents significant current flow from base 2 to base 1. When the positive potential at the emitter increases to a *triggering voltage* (similar to the *junction threshold voltage* of a forward-biased diode), the internal resistance of the UJT drops very rapidly, allowing current to enter the component via both the emitter and base 2, exiting at base 1. (The term "current" refers, here, to conventional current; electron flow is opposite.) Current flowing from base 2 to base 1 is significantly greater than current flowing from the emitter to base 1.

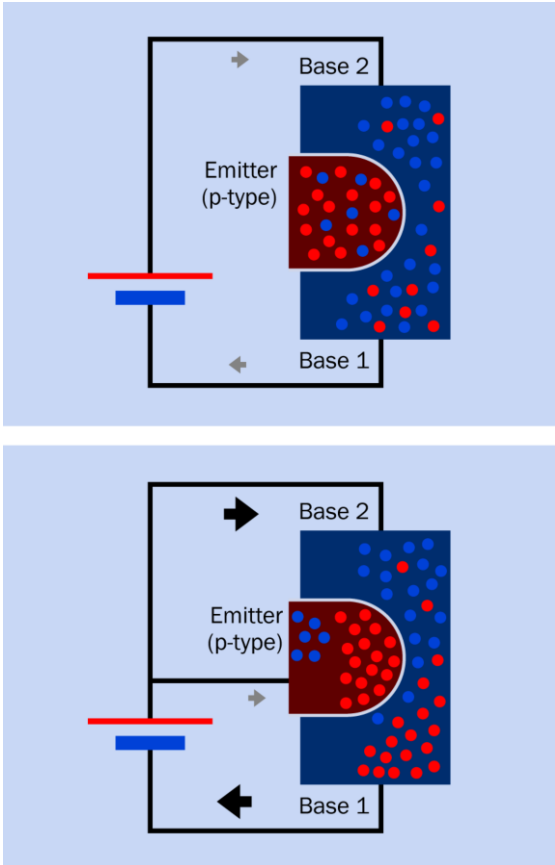

Figure 27-4. *Internal workings of a unijunction transistor.*

The graph in Figure 27-5 outlines the behavior of a UJT. As the voltage applied to the emitter increases, current flowing into the component from the emitter increases slightly, until the triggering voltage is reached. The component's internal resistance now drops rapidly. This pulls down the voltage at the emitter, while the current continues to increase significantly. Because of the drop in resistance, this is referred to as a *negative resistance* region. The resistance actually cannot fall below zero, but its change is negative. After emitter voltage drops to a minimum known as the *valley voltage*, the current continues to increase with a small increase in voltage. On datasheets, the peak current is often referred to as I_p while valley current is I_v.

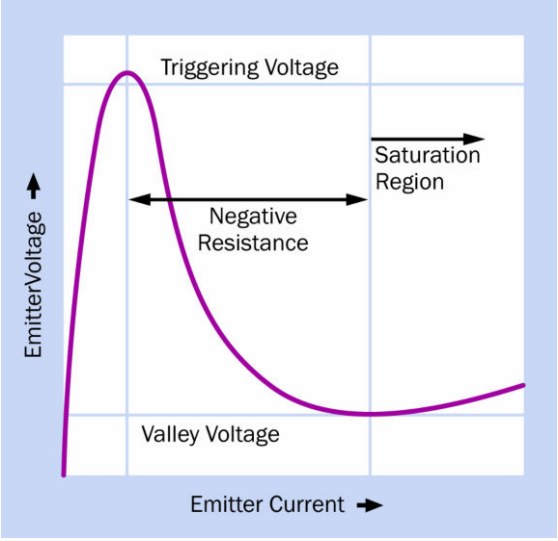

Figure 27-5. *Response curve of a unijunction transistor (UJT). When positive potential at the emitter reaches the triggering voltage, internal resistance drops radically and the component goes through a phase known as "negative resistance" as current increases.*

Figure 27-6 shows a test circuit to demonstrate the function of a UJT, with a volt meter indicating its status. A typical supply voltage would range from 9VDC to 20VDC.

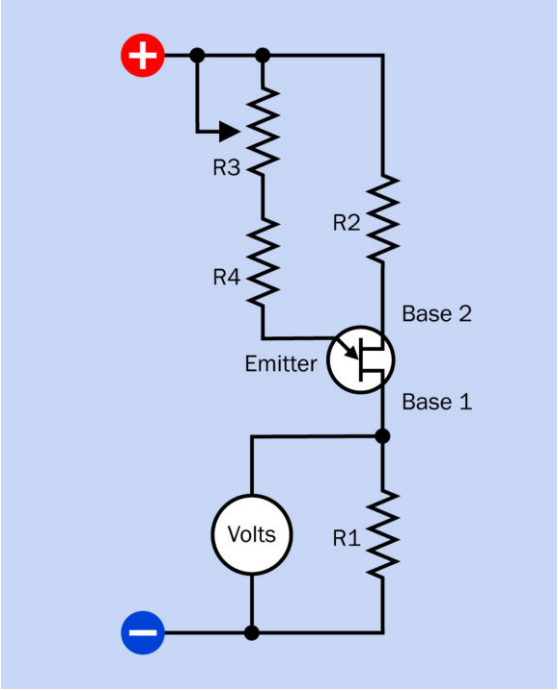

Figure 27-6. *A test circuit for a unijunction transistor (UJT) using a volt meter to show its response as a potentiometer increases the voltage applied to its emitter.*

A PUT behaves similarly in many ways to a UJT but is internally quite different, consisting of four semiconducting layers and functioning similarly to a thyristor.

The PUT is triggered by increasing the voltage on the anode. Figure 27-7 shows a test circuit for a PUT. This component is triggered when the voltage at its anode exceeds a threshold level, while the gate sets the threshold where this occurs. When the PUT is triggered, its internal resistance drops, and current flows from anode to cathode, with a smaller amount of current entering through the gate. This behavior is almost identical to that of a forward-biased diode, except that the threshold level can be controlled, or "programmed," according to the value of the positive potential applied at the gate, with R1 and R2 establishing that potential by functioning as a voltage divider.

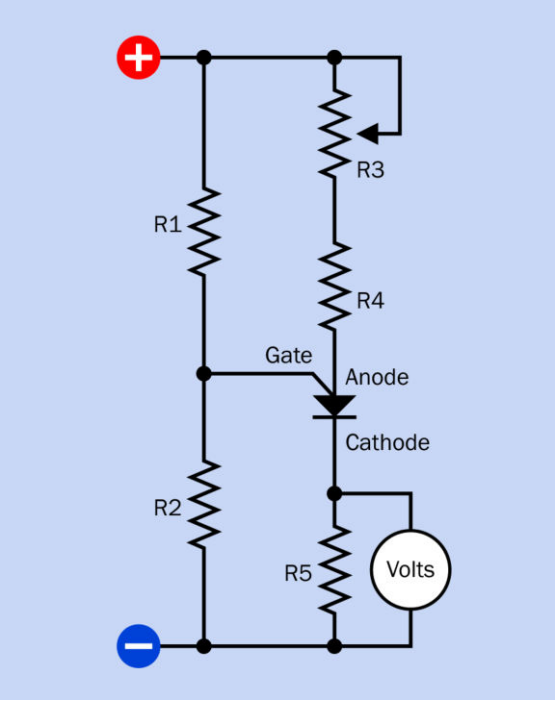

Figure 27-7. *A test circuit for a programmable unijunction transistor (PUT) using a volt meter to show its response as a potentiometer increases the voltage applied to its anode.*

The voltage output of a PUT follows a curve that is very similar to that shown in Figure 27-5, although current and voltage would be measured at the cathode.

Variants

PUTs and UJTs are not made as surface-mount components.

UJTs are usually packaged in black plastic, although older variants were manufactured in cans. PUTs are almost all packaged in black plastic. With the leads pointing downward and the flat side facing toward the viewer, the lead functions of a PUT are usually anode, gate, and cathode, reading from left to right.

Values

The triggering voltage of a UJT can be calculated from the values of R1 and R2 in Figure 27-7 and the voltage at base 1. The term R_{bb} is often used to represent the sum of R1 + R2, with V_{bb} representing the total voltage across the two resistors (this is the same as the supply voltage in Figure 27-6). V_t, the triggering voltage, is given by:

$$V_t = V_{bb} * (R1 / R_{bb})$$

The term ($R1/R_{bb}$) is known as the *standoff ratio*, often represented by the Greek letter ϱ.

Typically the standoff ratio in a UJT is at least 0.7, as R1 is chosen to be larger than R2. Typical values for R1 and R2 could be 180Ω and 100Ω, respectively. If R4 is 50K and a 100K linear potentiometer is used for R3, the PUT should be triggered when the potentiometer is near the center of its range. The emitter saturation voltage is typically from 2V to 4V.

If using a PUT, typical values in the test circuit could be supply voltage ranging from 9VDC to 20VDC, with resistances 28K for R1 and 16K for R2, 20Ω for R5, 280K for R4, and a 500K linear potentiometer for R3. The PUT should be triggered when the potentiometer is near the center of its range.

Sustained forward current from anode to cathode is usually a maximum of 150mA, while from gate to cathode the maximum is usually 50mA. Power dissipation should not exceed 300mW. These values should be lower at temperatures above 25 degrees Centigrade.

Depending on the PUT being used, power consumption can be radically decreased by upping the resistor values by a multiple of 100, while supply voltage can be decreased to 5V. The cathode output from the PUT would then be connected with the base of an NPN transistor for amplification.

How to Use it

Figure 27-8 shows a simple oscillator circuit built around a UJT, Figure 27-9 shows a comparable circuit for a PUT. Initially the supply voltage charges the capacitor, until the potential at the emitter of the UJT or the gate of the PUT reaches the threshold voltage, at which point the capacitor discharges through the emitter and the cycle repeats. Resistor values would be similar to those used in the test circuits previously described, while a capacitor value of 2.2µF would provide a visible pulse of the LED. Smaller capacitor values would enable faster oscillation. In the PUT circuit, adjusting the values of R1 and R2 would allow fine control of triggering the semiconductor.

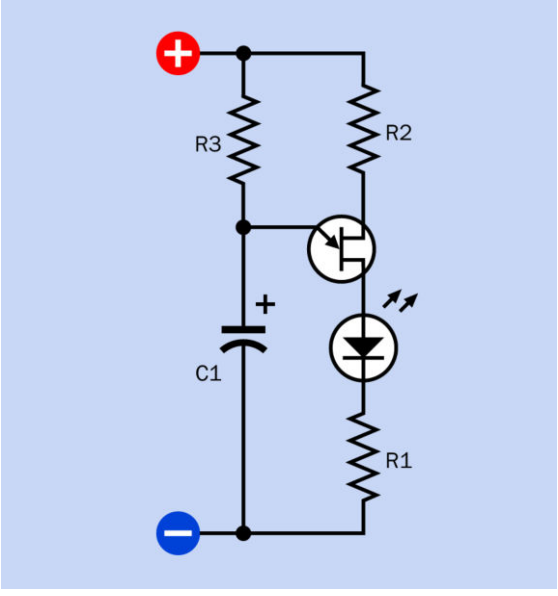

Figure 27-8. *A basic oscillator circuit using a unijunction transistor (UJT). As the capacitor accumulates charge, the voltage on the emitter increases until it triggers the UJT, at which point the capacitor discharges through the emitter.*

Probably the most common use for a PUT at this time is to trigger a **thyristor**.

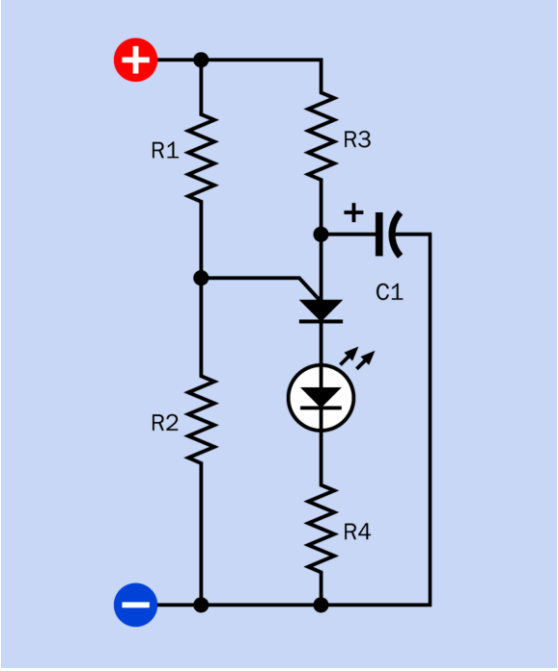

Figure 27-9. *A basic oscillator circuit using a programmable unijunction transistor (PUT). As the capacitor accumulates charge, the voltage on the anode increases until it triggers the PUT, at which point the capacitor discharges through the anode. The gate voltage is preset by R1 and R2 to adjust the triggering voltage.*

What Can Go Wrong

Name Confusion

A programmable unijunction transistor (PUT) is sometimes referred to simply as a "unijunction transistor" (UJT). Bearing in mind the totally different modes of operation of UJT and PUT, the PUT should always be identified by its acronym or by its full name. A circuit will not function if a UJT is substituted for a PUT, or a PUT is substituted for a UJT.

Incorrect Bias

Neither the UJT nor the PUT is designed to operate with reverse bias. In the UJT, a small forward bias should be applied from base 2 to base 1 (that is, base 2 should be at a higher potential relative to base 1) regardless of the voltage on the emitter. The emitter voltage may vary from 0 volts

upward. The PUT must be forward biased between its anode and cathode (the anode must have a higher potential relative to the cathode), with an intermediate positive voltage at the gate established by resistors R1 and R2 functioning as a voltage divider (see Figure 27-7). Failure to observe correct biasing will result in unpredictable behavior and possible damage to the component.

Overload

Like any semiconductor, the UJT and the PUT must be protected from excessive current, which can burn out the component. Never connect either of these components directly across a power source without appropriate resistances to limit current flow. Maximum continuous power dissipation for UJTs and PUTs is usually 300mW.

bipolar transistor

28

The word *transistor*, on its own, is often used to mean *bipolar transistor*, as this was the type that became most widely used in the field of discrete semiconductors. However, *bipolar transistor* is the correct term. It is sometimes referred to as a *bipolar junction transistor* or *BJT*.

OTHER RELATED COMPONENTS

- **unijunction transistor** (See Chapter 27)
- **field-effect transistor** (See Chapter 29)
- **diac** (Volume 2)
- **triac** (Volume 2)
- **relay** (Volume 2)
- **solid-state relay** (Volume 2)

What It Does

A bipolar transistor amplifies fluctuations in current or can be used to switch current on and off. In its amplifying mode, it replaced the *vacuum tubes* that were formerly used in the amplification of audio signals and many other applications. In its switching mode it resembles a **relay**, although in its "off" state the transistor still allows a very small amount of current flow, known as *leakage*.

A bipolar transistor is described as a *discrete* semiconductor device when it is individually packaged, with three leads or contacts. A package containing multiple transistors is an *integrated circuit*. A Darlington pair actually contains two transistors, but is included here as a discrete component because it is packaged similarly and functions like a single transistor. Most integrated circuits will be found in Volume 2 of this encyclopedia.

How It Works

Although the earliest transistors were fabricated from germanium, silicon has become the most commonly used material. Silicon behaves like an insulator, in its pure state at room temperature, but can be "doped" (carefully contaminated) with impurities that introduce a surplus of electrons unbonded from individual atoms. The result is an *N-type semiconductor* that can be induced to allow the movement of electrons through it, if it is *biased* with an external voltage. *Forward bias* means the application of a positive voltage, while *reverse bias* means reversing that voltage.

Other dopants can create a deficit of electrons, which can be thought of as a surplus of "holes" that can be filled by electrons. The result is a *P-type semiconductor*.

A bipolar NPN transistor consists of a thin central P-type layer sandwiched between two thicker N-type layers. The three layers are referred to as *collector*, *base*, and *emitter*, with a wire or contact

attached to each of them. When a negative charge is applied to the emitter, electrons are forced by mutual repulsion toward the central base layer. If a forward bias (positive potential) is applied to the base, electrons will tend to be attracted out through the base. However, because the base layer is so thin, the electrons are now close to the collector. If the base voltage increases, the additional energy encourages the electrons to jump into the collector, from which they will make their way to the positive current source, which can be thought of as having an even greater deficit of electrons.

Thus, the emitter of an NPN bipolar transistor emits electrons into the transistor, while the collector collects them from the base and moves them out of the transistor. It is important to remember that since electrons carry a negative charge, the flow of electrons moves from negative to positive. The concept of positive-to-negative current is a fiction that exists only for historical reasons. Nevertheless, the arrow in a transistor schematic symbol points in the direction of conventional (positive-to-negative) current.

In a PNP transistor, a thin N-type layer is sandwiched between two thicker P-type layers, the base is negatively biased relative to the emitter, and the function of an NPN transistor is reversed, as the terms "emitter" and "collector" now refer to the movement of electron-holes rather than electrons. The collector is negative relative to the base, and the resulting positive-to-negative current flow moves from emitter to base to collector. The arrow in the schematic symbol for a PNP transistor still indicates the direction of positive current flow.

Symbols for NPN and PNP transistors are shown in Figure 28-1. The most common symbol for an NPN transistor is shown at top-left, with letters C, B, and E identifying collector, base, and emitter. In some schematics the circle in the symbols is omitted, as at top-right.

A PNP transistor is shown in the center. This is the most common orientation of the symbol, since its collector must be at a lower potential than its emitter, and ground (negative) is usually at the bottom of a schematic. At bottom, the PNP symbol is inverted, allowing the positions of emitter and collector to remain the same as in the symbol for the NPN transistor at the top. Other orientations of transistor symbols are often found, merely to facilitate simpler schematics with fewer conductor crossovers. The direction of the arrow in the symbol (pointing out or pointing in) always differentiates NPN from PNP transistors, respectively, and indicates current flowing from positive to negative.

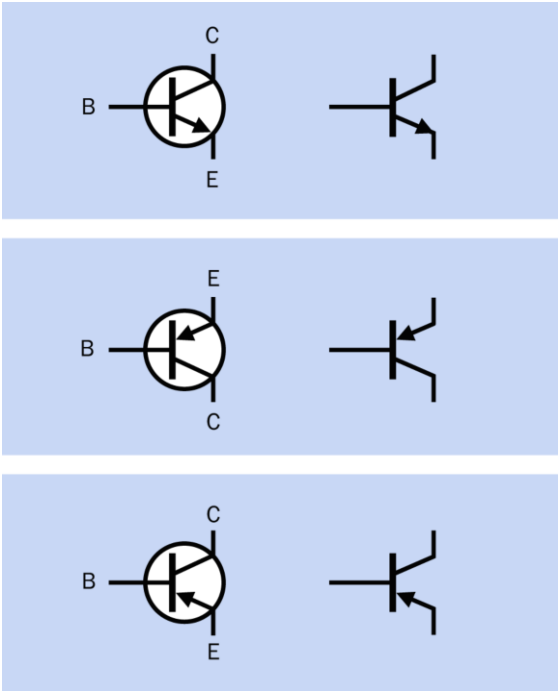

Figure 28-1. *Symbols for an NPN transistor (top) and a PNP transistor (center and bottom). Depending on the schematic in which the symbol appears, it may be rotated or inverted. The circle may be omitted, but the function of the component remains the same.*

NPN transistors are much more commonly used than PNP transistors. The PNP type was more difficult and expensive to manufacture initially, and

circuit design evolved around the NPN type. In addition, NPN transistors enable faster switching, because electrons have greater mobility than electron-holes.

To remember the functions of the collector and the emitter in an NPN transistor, you may prefer to think in terms of the collector collecting positive current *into* the transistor, and the emitter emitting positive current *out of* the transistor. To remember that the emitter is always the terminal with an arrow attached to it (both in NPN and PNP schematic symbols), consider that "emitter" and "arrow" both begin with a vowel, while "base" and "collector" begin with consonants. To remember that an NPN transistor symbol has its arrow pointing outward, you can use the mnemonic "N/ever P/ointing i/N."

Current flow for NPN and PNP transistors is illustrated in Figure 28-2. At top-left, an NPN transistor passes no current (other than a small amount of leakage) from its collector to its emitter so long as its base is held at, or near, the potential of its emitter, which in this case is tied to negative or ground. At bottom-left, the purple positive symbol indicates that the base is now being held at a *relatively* positive voltage, at least 0.6 volts higher than the emitter (for a silicon-based transistor). This enables electrons to move from the emitter to the collector, in the direction of the blue arrows, while the red arrows indicate the conventional concept of current flowing from positive to negative. The smaller arrows indicate a smaller flow of current. A resistor is included to protect the transistor from excessive current, and can be thought of as the load in these circuits.

At top-right, a PNP transistor passes no current (other than a small amount of leakage) from its emitter to its collector so long as its base is held at, or near, the potential of the emitter, which in this case is tied to the positive power supply. At bottom-right, the purple negative symbol indicates that the base is now being held at a *relatively* negative voltage, at least 0.6 volts lower than the emitter. This enables electrons and current to flow as shown. Note that current flows into the base in the NPN transistor, but out from the base in the PNP transistor, to enable conductivity. In both diagrams, the resistor that would normally be included to protect the base has been omitted for the sake of simplicity.

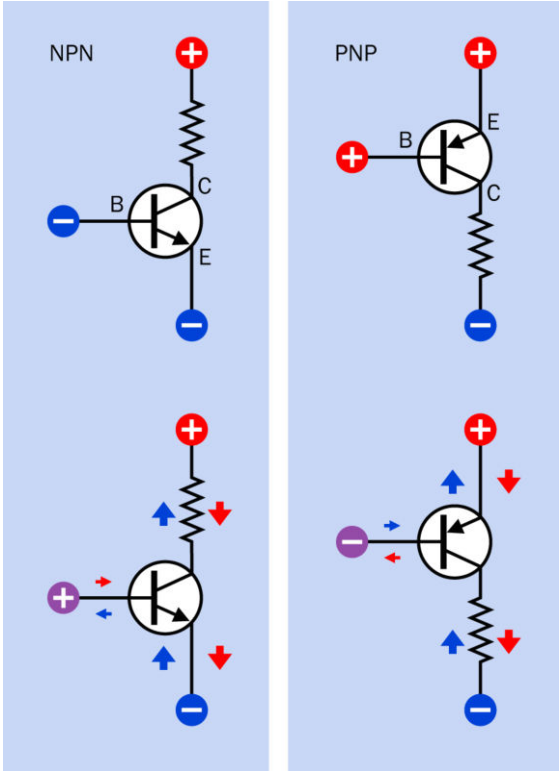

Figure 28-2. *Current flow through NPN and PNP transistors. See text for details.*

An NPN transistor amplifies its base current only so long as the positive potential applied to the collector is greater than the potential applied to the base, and the potential at the base must be greater than the potential at the emitter by at least 0.6 volts. So long as the transistor is biased in this way, and so long as the current values remain within the manufacturer's specified limits, a small fluctuation in current applied to the base will induce a much larger fluctuation in current between the collector and the emitter. This is why a transistor may be described as a *current amplifier*.

A *voltage divider* is often used to control the base potential and ensure that it remains less than the potential on the collector and greater than the potential at the emitter (in an NPN transistor). See Figure 28-3.

See Chapter 10 for additional information about the function of a voltage divider.

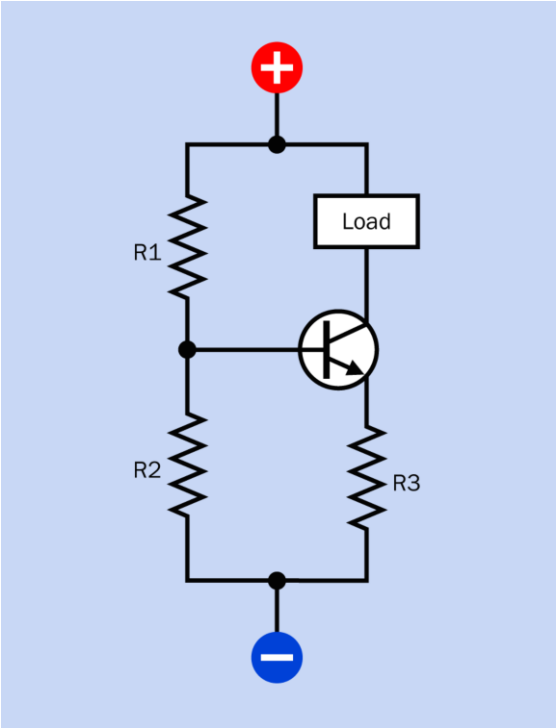

Figure 28-3. *Resistors R1 and R2 establish a voltage divider to apply acceptable bias to the base of an NPN transistor.*

Current Gain

The amplification of current by a transistor is known as its *current gain* or *beta value*, which can be expressed as the ratio of an increase in collector current divided by the increase in base current that enables it. Greek letter β is customarily used to represent this ratio. The formula looks like this:

$$\beta = \Delta I_c \ / \ \Delta I_b$$

where I_c is the collector current and I_b is the base current, and the Δ symbol represents a small change in the value of the variable that follows it.

Current gain is also represented by the term h_{FE}, where E is for the common Emitter, F is for Forward current, and lowercase letter h refers to the transistor as a "hybrid" device.

The beta value will always be greater than 1 and is often around 100, although it will vary from one type of transistor to another. It will also be affected by temperature, voltage applied to the transistor, collector current, and manufacturing inaccuracies. When the transistor is used outside of its design parameters, the formula to determine the beta value no longer directly applies.

There are only two connections at which current can enter an NPN transistor and one connection where it can leave. Therefore, if I_e is the current from the emitter, I_c is the current entering the collector, and I_b is the current entering the base:

$$I_e = I_c + I_b$$

If the potential applied to the base of an NPN transistor diminishes to the point where it is less than 0.6V above the potential at the emitter, the transistor will not conduct, and is in an "off" state, although a very small amount of leakage from collector to emitter will still occur.

When the current flowing into the base of the transistor rises to the point where the transistor cannot amplify the current any further, it becomes *saturated*, at which point its internal impedance has fallen to a minimal value. Theoretically this will allow a large flow of current; in practice, the transistor should be protected by resistors from being damaged by high current resulting from saturation.

Any transistor has maximum values for the collector current, base current, and the potential

difference between collector and emitter. These values should be provided in a datasheet. Exceeding them is likely to damage the component.

Terminology

In its *saturated mode*, a transistor's base is saturated with electrons (with no room for more) and the internal impedance between collector and emitter drops as low as it can go.

The *cutoff mode* of an NPN transistor is the state where a low base voltage eliminates all current flow from collector to emitter other than a small amount of leakage.

The *active mode*, or *linear mode*, is the intermediate condition between cutoff and saturated, where the beta value or h_{FE} (ratio of collector current to base current) remains approximately constant. That is, the collector current is almost linearly proportional to the base current. This linear relationship breaks down when the transistor nears its saturation point.

Variants

Small signal transistors are defined as having a maximum collector current of 500 mA and maximum collector power dissipation of 1 watt. They can be used for audio amplification of low-level inputs and for switching of small currents. When determining whether a small-signal transistor can control an inductive load such as a motor or relay coil, bear in mind that the initial current surge will be greater than the rated current draw during sustained operation.

Small switching transistors have some overlap in specification with small signal transistors, but generally have a faster response time, lower beta value, and may be more limited in their tolerance for collector current. Check the manufacturer's datasheet for details.

High frequency transistors are primarily used in video amplifiers and oscillators, are physically small, and have a maximum frequency rating as high as 2,000 MHz.

Power transistors are defined as being capable of handling at least 1 watt, with upper limits that can be as high as 500 watts and 150 amps. They are physically larger than the other types, and may be used in the output stages of audio amplifiers, and in switching **power supplies** (see Chapter 16). Typically they have a much lower current gain than smaller transistors (20 or 30 as opposed to 100 or more).

Sample transistors are shown in Figure 28-4. Top: A 2N3055 NPN power transistor. This type was originally introduced in the late 1960s, and versions are still being manufactured. It is often found in power supplies and in push-pull power amplifiers, and has a total power dissipation rating of 115W. Second row, far left: general purpose switching-amplification PNP power transistor rated for up to 50W power dissipation. Second row, far right: A high-frequency switching transistor for use in lighting ballast, converters, inverters, switching regulators, and motor control systems. It tolerates relatively high voltages (up to 700V collector-emitter peak) and is rated for up to 80W total power dissipation. Second row, center-left and center-right: Two variants of the 2N2222 NPN small signal switching transistor, first introduced in the 1960s, and still very widely used. The metal can is the TO-19 package, capable of slightly higher power dissipation than the cheaper plastic TO-92 package (1.8W vs. 1.5W with a collector temperature no greater than 25 degrees Centigrade).

Packaging

Traditionally, small-signal transistors were packaged in small aluminum "cans" about 1/4" in diameter, and are still sometimes found in this form. More commonly they are embedded in buds of black plastic. Power transistors are packaged either in a rectangular module of black

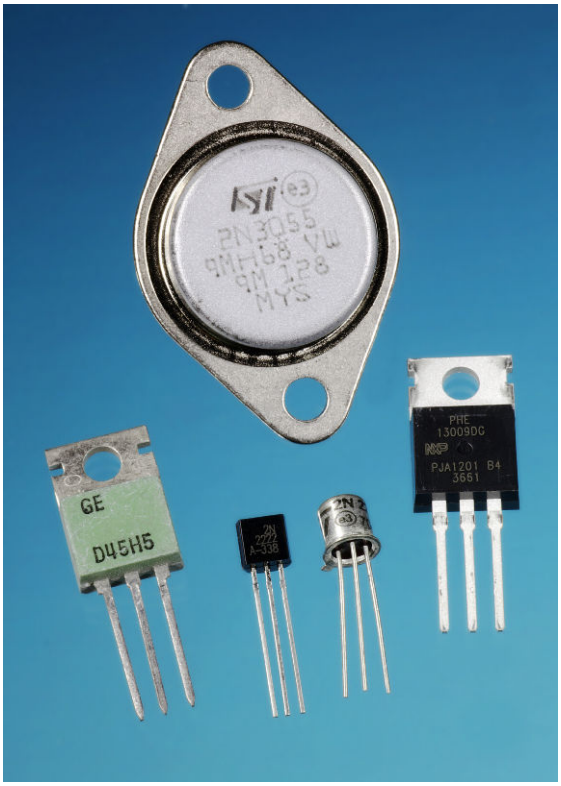

Figure 28-4. *Samples of commonly used transistors. See text for details.*

plastic with a metal back, or in a round metal "button." Both of these forms are designed to dissipate heat by being screw-clamped to a *heat sink*.

Connections

Often a transistor package provides no clue as to which lead is the emitter, which lead is the base, and which lead is the collector. Old can-style packaging includes a protruding tab that usually points toward the emitter, but not always. Where power transistors are packaged in a metal enclosure, it is typically connected internally with the collector. In the case of surface-mount transistors, look for a dot or marker that should identify the base of a bipolar transistor or the gate of a field-effect transistor.

A through-hole transistor usually has its part number printed or engraved on its package, although a magnifying glass may be necessary to see this. The component's datasheet may then be checked online. If a datasheet is unavailable, meter-testing will be necessary to confirm the functions of the three transistor leads. Some multimeters include a transistor-test function, which may validate the functionality of a transistor while also displaying its beta value. Otherwise, a meter can be put in diode-testing mode, and an unpowered NPN transistor should behave as if diodes are connected between its leads as shown in Figure 28-5. Where the identities of the transistor's leads are unknown, this test will be sufficient to identify the base, after which the collector and emitter may be determined empirically by testing the transistor in a simple low-voltage circuit such as that shown in Figure 28-6.

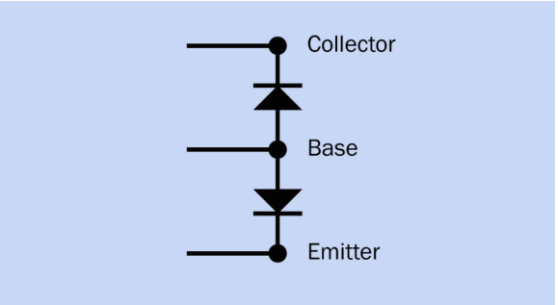

Figure 28-5. *An NPN transistor can behave as if it contains two diodes connected as shown. Where the functions of the leads of the transistor are unknown, the base can be identified by testing for conductivity.*

How to Use it

The following abbreviations and acronyms are common in transistor datasheets. Some or all of the letters following the initial letter are usually, but not always, formatted as subscripts:

h_{FE}
: Forward current gain

β
: Same as hFE

V_{CEO}
: Voltage between collector and emitter (no connection at base)

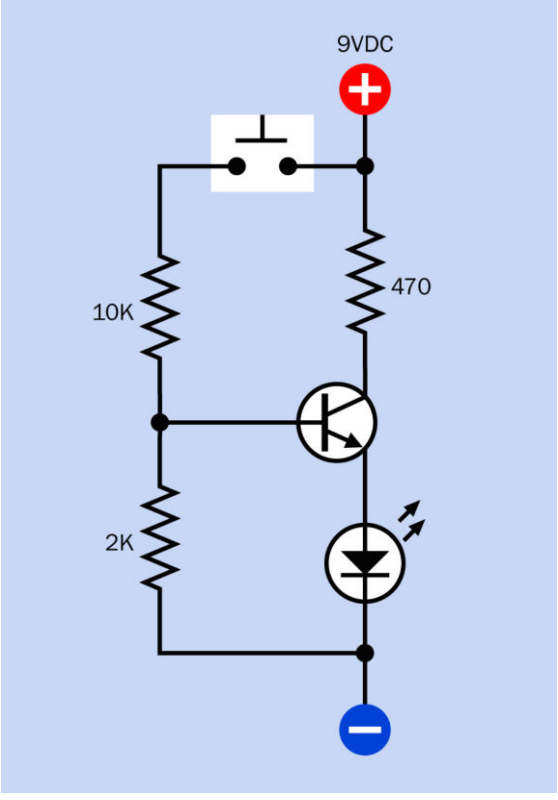

Figure 28-6. *This simple schematic can be used to breadboard-test a transistor empirically, determining its functionality and the identities of its collector and emitter leads.*

V_{CBO}
: Voltage between collector and base (no connection at emitter)

V_{EBO}
: Voltage between emitter and base (no connection at collector)

V_{CEsat}
: Saturation voltage between collector and emitter

V_{BEsat}
: Saturation voltage between base and emitter

I_c
: Current measured at collector

I_{CM}
: Maximum peak current at collector

I_{BM}
: Maximum peak current at base

P_{TOT}
: Total maximum power dissipation at room temperature

T_J
: Maximum junction temperature to avoid damage

Often these terms are used to define "absolute maximum values" for a component. If these maximums are exceeded, damage may occur.

A manufacturer's datasheet may include a graph showing the *safe operating area* (SOA) for a transistor. This is more common where power transistors are involved, as heat becomes more of an issue. The graph in Figure 28-7 has been adapted from a datasheet for a silicon diffused power transistor manufactured by Philips. The safe operating area is bounded at the top by a horizontal segment representing the maximum safe current, and at the right by a vertical segment representing the maximum safe voltage. However, the rectangular area enclosed by these lines is reduced by two diagonal segments representing the *total power limit* and the *second breakdown limit*. The latter refers to the tendency of a transistor to develop internal localized "hot spots" that tend to conduct more current, which makes them hotter, and able to conduct better—ultimately melting the silicon and causing a short circuit. The total power limit and the second breakdown limit reduce the safe operating area, which would otherwise be defined purely by maximum safe current and maximum safe voltage.

Uses for discrete transistors began to diminish when integrated circuits became cheaper and started to subsume multi-transistor circuits. For instance, an entire 5-watt audio amplifier, which used to be constructed from multiple components can now be bought on a chip, requiring just

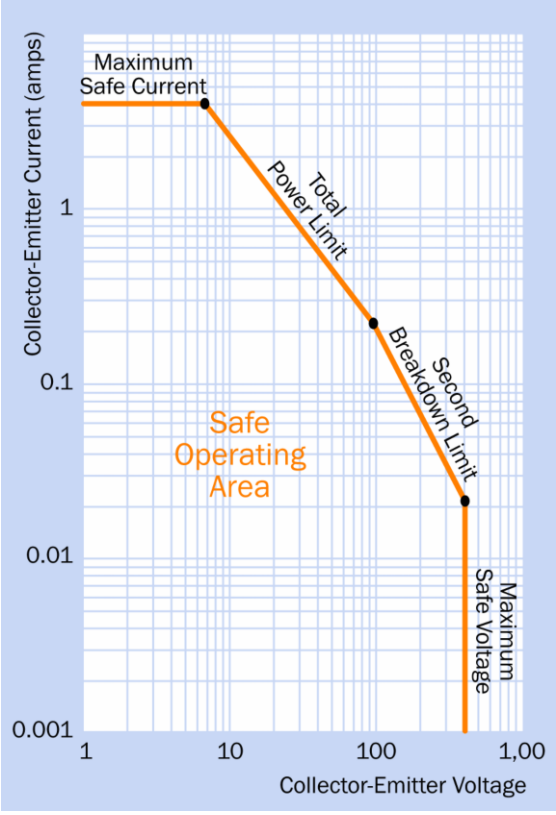

Figure 28-7. *Adapted from a Philips datasheet for a power transistor, this graph defines a safe operating area (SOA) for the component. See text for details.*

a few external capacitors. More powerful audio equipment typically uses integrated circuits to process inputs, but will use individual power transistors to handle high-wattage output.

Darlington Pairs

Discrete transistors are useful in situations where current amplification or switching is required at just one location in a circuit. An example would be where one output pin from a **microcontroller** must switch a small motor on and off. The motor may run on the same voltage as the microcontroller, but requires considerably more current than the typical 20mA maximum available from a microcontroller output. A *Darlington pair* of transistors may be used in this application. The overall gain of the pair can be 100,000 or more. See Figure 28-8. If a power source feeding through a potentiometer is substituted for the microcontroller chip, the circuit can function as a motor speed control (assuming that a generic DC motor is being used).

In the application shown here, the microcontroller chip must share a common ground (not shown) with the transistors. The optional resistor may be necessary to prevent leakage from the first transistor (when in its "off" state) from triggering the second. The diode protects the transistors from voltage transients that are likely when the motor stops and starts.

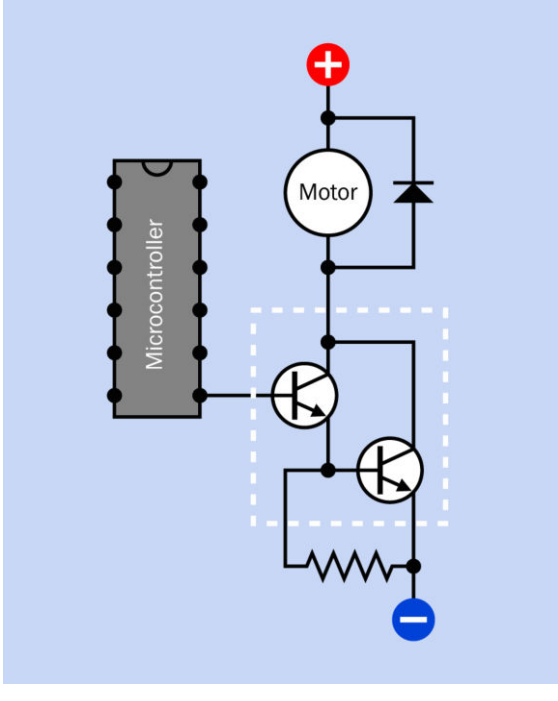

Figure 28-8. *Where the emitter of one NPN transistor is coupled to the base of another, they form a Darlington pair (identified by the dashed rectangle in this schematic). Multiplying the gain of the first transistor by the gain of the second gives the total gain of the pair.*

A Darlington pair can be obtained in a single transistor-like package, and may be represented by the schematic symbol shown in Figure 28-9.

Various through-hole Darlington packages are shown in Figure 28-10.

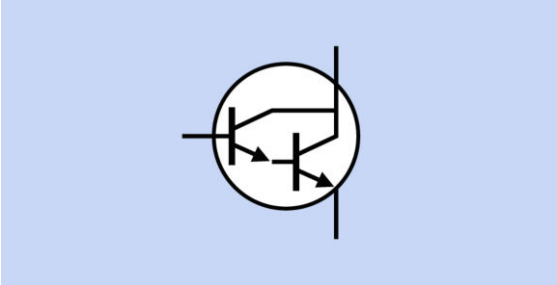

Figure 28-9. *When a Darlington pair is embedded in a single transistor-like package, it may be represented by this schematic symbol. The leads attached to the package can be used as if they are the emitter, base, and collector of a single NPN transistor.*

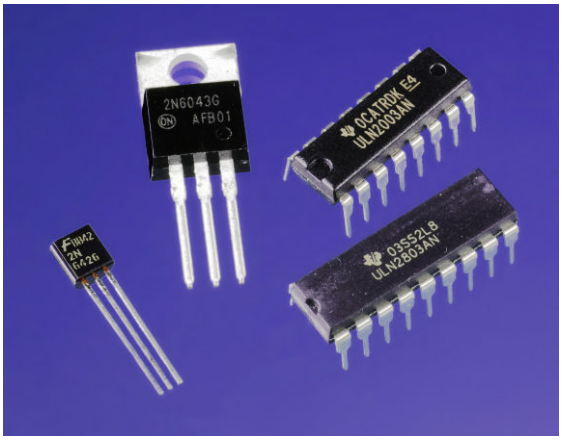

Figure 28-10. *Various packaging options for Darlington pairs. From left to right: The 2N6426 contains a Darlington pair rated to pass up to 500mA continuous collector current. The 2N6043 is rated for 8A continuous. The ULN2003 and ULN2083 chips contain seven and eight Darlington pairs, respectively.*

Seven or eight Darlington pairs can be obtained in a single integrated chip. Each transistor pair in these chips is typically rated at 500mA, but they can be connected in parallel to allow higher currents. The chip usually includes protection diodes to allow it to drive inductive loads directly.

A typical schematic is shown in Figure 28-11. In this figure, the microcontroller connections are hypothetical and do not correspond with any actual chip. The Darlington chip is a ULN2003 or similar, containing seven transistor pairs, each with an "input" pin on the left and an "output" pin opposite it on the right. Any of pins 1 through 7 down the left side of the chip can be used to control a device connected to a pin on the opposite side.

A high input can be thought of as creating a negative output, although in reality the transistors inside the chip are sinking current via an external device—a motor, in this example. The device can have its own positive supply voltage, shown here as 12VDC, but must share a common ground with the microcontroller, or with any other component which is being used on the input side. The lower-right pin of the chip shares the 12VDC supply because this pin is attached internally to clamp diodes (one for each Darlington pair), which protect against surges caused by inductive loads. For this reason, the motor does not have a clamp diode around it in the schematic.

The Darlington chip does not have a separate pin for connection with positive supply voltage, because the transistors inside it are sinking power from the devices attached to it.

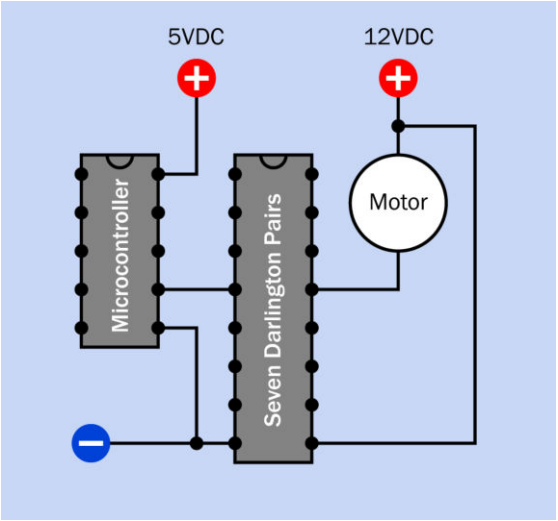

Figure 28-11. *A chip such as the ULN2003 contains seven Darlington pairs. It will sink current from the device it is driving. See text for details.*

A surface-mount Darlington pair is shown in Figure 28-12. This measures just slightly more

than 0.1″ long but is still rated for up to 500mA collector current or 250mW total power dissipation (at a component temperature no higher than 25 degrees Centigrade).

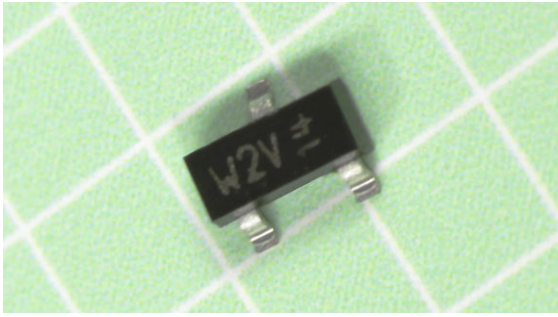

Figure 28-12. *A surface-mount package for a Darlington pair. Each square in the background grid measures 0.1″. See text for additional details.*

Amplifiers

Two basic types of transistor amplifiers are shown in Figure 28-13 and Figure 28-14. The *common-collector* configuration has current gain but no voltage gain. The capacitor on the input side blocks DC current from entering the amplifier circuit, and the two resistors forming a voltage divider on the base of the transistor establish a voltage midpoint (known as the *quiescent point* or *operating point*) from which the signal to be amplified may deviate above and below.

The *common-emitter* amplifier provides voltage gain instead of current gain, but inverts the phase of the input signal. Additional discussion of amplifier design is outside the scope of this encyclopedia.

In switching applications, modern transistors have been developed to handle a lot of current compared with earlier versions, but still have some limitations. Few power transistors can handle more than 50A flowing from collector to emitter, and 1,000V is typically a maximum value. Electromechanical relays continue to exist because they retain some advantages, as shown in the table in Figure 28-15, which compares switching capabilities of transistors, **solid-state relays**, and electromechanical **relays**.

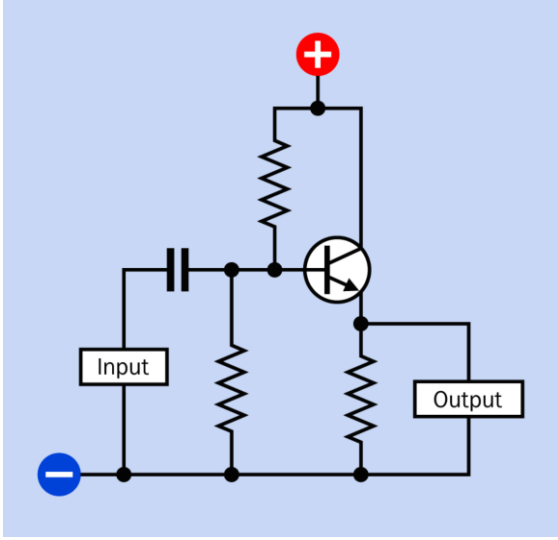

Figure 28-13. *The basic schematic for a common-collector amplifier. See text for details.*

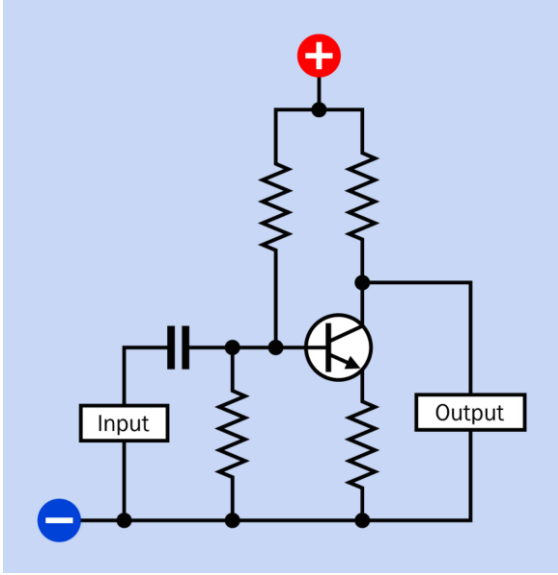

Figure 28-14. *The basic schematic for a common-emitter amplifier. See text for details.*

	Transistor	Solid-State Relay	Electro-Mechanical Relay
Long-term reliability	Excellent	Excellent	Limited
NC contacts?	No	Yes	Yes
DT contacts?	No	No	Yes
Ability to switch large current	Limited	Some	Good
Ability to switch AC	No	Yes	Yes
Can be triggered by AC voltage?	No	Yes	Yes
Suitability for miniaturization	Excellent	Poor	Poor
Vulnerable to heat	Yes	Yes	Not very
Vulnerable to corrosion	No	No	Yes
OK at high speed	Excellent	Good	Poor
Price advantage for low-voltage low-current	Yes	No	No
Price advantage for high-voltage high-current	No	No	Yes
Current leakage when "off"	Yes	Yes	No
Trigger circuit isolated from switched circuit	No	Yes	Yes

Figure 28-15. *A comparison of characteristics of switching devices.*

What Can Go Wrong

Wrong Connections on a Bipolar Transistor

Failing to identify a transistor's leads or contacts correctly can obviously be a potential source of damage, but swapping the collector and emitter accidentally will not necessarily destroy the transistor. Because of the inherent symmetry of the device, it will in fact function with collector and emitter connections reversed. Rohm, a large semiconductor manufacturer, has included this scenario in its general information pages and concludes that the primary indicator of transposed connections is that the β value, or h_{FE}, drops to about 1/10th of specification. If you are using a transistor that works but provides much less amplification than you expect, check that the emitter and collector leads are not transposed.

Wrong Connections on a Darlington Pair Chip

While a single-component package for a Darlington pair functions almost indistinguishably from a single transistor, multiple Darlington pairs in a DIP package may create confusion because the component behaves differently from most other chips, such as logic chips.

A frequent error is to ground the output device instead of applying positive power to it. See Figure 28-11 and imagine an erroneous connection of negative power instead of the 12VDC positive power.

Additional confusion may be caused by reading a manufacturer's datasheet for a Darlington pair chip such as the ULN2003. The datasheet depicts the internal function of the chip as if it contains logic inverters. While the chip can be imagined as behaving this way, in fact it contains bipolar transistors that amplify the current applied to the base of each pair. The datasheet also typically will not show the positive connection that should be made to the common-diode pin (usually at bottom-right), to provide protection from surges caused by inductive loads. This pin must be distinguished carefully from the common-ground pin (usually at bottom-left). The positive connection to the common-diode pin is optional; the common-ground connection is mandatory.

Soldering Damage

Like any semiconductor, transistors are vulnerable to heat and can be damaged while soldering, although this seldom happens if a low-wattage iron is used. A copper alligator clip can be applied as a heat sink to each lead before it is soldered.

Excessive Current or Voltage

During use, a transistor will be damaged if it is subjected to current or voltage outside of its rated range. Passing current through a transistor without any series resistance to protect it will almost certainly burn it out, and the same thing can happen if incorrect resistor values are used.

The maximum wattage that a transistor can dissipate will be shown in its datasheet. Suppose, for example, this figure is 200mW, and you are using a 12VDC supply. Ignoring the base current, the maximum collector current will be 200 / 12 = approximately 15mA. If the transistor's emitter is connected to ground, and the load applied to the transistor output has a high impedance, and if we ignore the transresistance, Ohm's Law suggests that a resistor that you place between the collector and the supply voltage should have a resistance of at least 12 / 0.015 = 800 ohms.

When transistors are used in switching applications, it is customary for the base current to be 1/5th of the collector current. In the example discussed here, a 4.7K resistor might be appropriate. A meter should be used to verify actual current and voltage values.

Excessive Leakage

In a Darlington pair, or any other configuration where the output from one transistor is connected with the base of another, leakage from the first transistor while in its "off" state can be amplified by the second transistor. If this is unacceptable, a bypass resistor can be used to divert some of the leakage from the base of the second transistor to ground. Of course the resistor will also steal some of the base current when the first transistor is active, but the resistor value is typically chosen so that it takes no more than 10% of the active current. See Figure 28-8 for an example of a bypass resistor added to a Darlington pair.

field effect transistor

29

The term **field-effect transistor** encompasses a family primarily consisting of the *junction field-effect transistor* (or *JFET*, which is the simplest generic type) and the *metal-oxide semiconductor field-effect transistor* (or *MOSFET*, also sometimes known as an *insulated-gate field-effect transistor*, or *IGFET*). Because the principles of operation overlap considerably, the entire -FET family is grouped in this entry.

OTHER RELATED COMPONENTS

- **bipolar transitor** (See Chapter 28)
- **unijunction transistor** (See Chapter 27)
- **diode** (See Chapter 26)

What It Does

A field-effect transistor creates an electric field to control current flowing through a channel in a semiconductor. MOSFETs of microscopic size form the basis of complementary metal oxide semiconductor (CMOS) *integrated circuit chips*, while large discrete MOSFETs are capable of switching substantial currents, in lamp dimmers, audio amplifiers, and motor controllers. FETs have become indispensable in computer electronics.

A **bipolar transistor** is generally thought of as a *current amplifier* because the current passing through it is controlled by a smaller amount of current passing through the base. By contrast, all FETs are considered to be *voltage amplifiers*, as the control voltage establishes field intensity, which requires little or no current. The negligible leakage through the gate of an FET makes it ideal for use in low-power applications such as portable hand-held devices.

How It Works

This section is divided into two subsections, describing the most widely used FETs: JFETs and MOSFETs.

JFETs

A *junction field-effect transistor* (or *JFET*) is the simplest form of FET. Just as a bipolar transistor can be of NPN or PNP type, a JFET can have an *N-channel* or *P-channel*, depending whether the channel that transmits current through the device is negatively or positively *doped*. A detailed explanation of semiconductor doping will be found in the **bipolar transistor** entry.

Because negative charges have greater mobility, the N-channel type allows faster switching and is more commonly used than the P-channel type. A schematic symbol for it is shown in Figure 29-1 alongside the schematic for an NPN transistor. These symbols suggest the similarity of the devices as amplifiers or switches, but it is important to remember that the FET is a primarily a voltage amplifier while the bipolar transistor is a current amplifier.

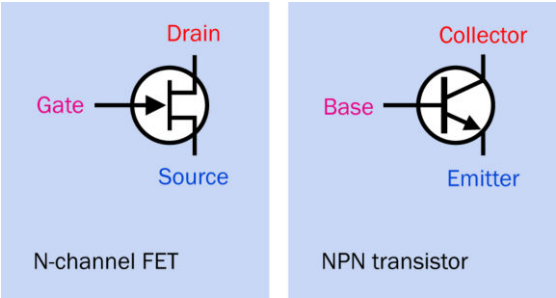

Figure 29-1. *A comparison between schematic symbols for N-channel JFET (left) and NPN bipolar transistor (right) suggests their functional similarity as switches or amplifiers, although their behavior is markedly different.*

Three JFETs are shown in Figure 29-2. The N-channel J112 type is supplied by several manufacturers, the figure showing two samples, one from Fairchild Semiconductor (left) and the other from On Semiconductor (right). Although the full part numbers are different, the specifications are almost identical, including a drain-gate voltage of 35V, a drain-source voltage of 35V, and a gate current of 50mA. The metal-clad 2N4392 in the center has similar values but is three times the price, with a much higher power dissipation of 1.8W, compared with 300mW and 350mW for the other two transistors respectively.

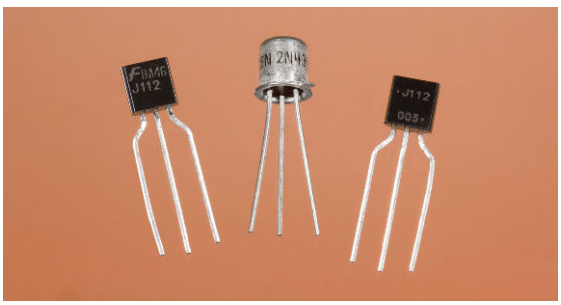

Figure 29-2. *Junction Field Effect Transistors (JFETs). See text for details.*

Schematic symbols for N-channel and P-channel JFETs are shown in Figure 29-3, N-channel being on the left while P-channel is on the right. The upper-left and lower-left symbol variants are both widely used and are functionally identical. The upper-right and lower-right variants likewise mean the same thing. Because the upper variants are symmetrical, an S should be added to clarify which terminal is the source. In practice, the S is often omitted, allowing some ambiguity. While the source and drain of some JFETs are in fact interchangeable, this does not apply to all types.

The circle around each symbol is occasionally omitted when representing discrete components, and is almost always omitted when multiple FETs are shown connected to form an integrated circuit.

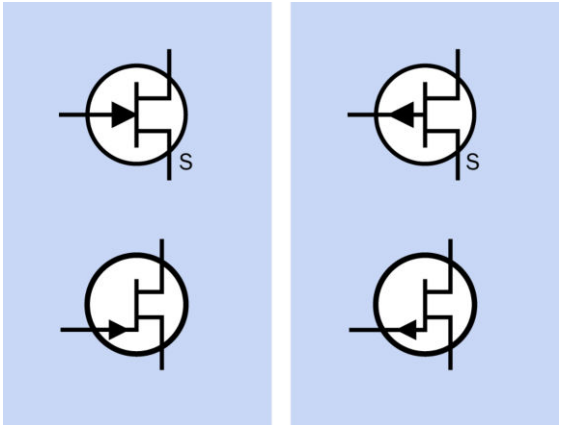

Figure 29-3. *Schematic symbols for junction field-effect transistors (JFETs). Left: N-channel. Right: P-channel. The symbols at top and bottom on each side are functionally identical. Circles may be omitted. Letter S may be omitted from the symmetrical symbol variants, even though this creates some ambiguity.*

The internal function of an N-channel JFET is shown diagrammatically in Figure 29-4. In this component, the source terminal is a source of electrons, flowing relatively freely through the N-doped channel and emerging through the drain. Thus, conventional current flows nonintuitively from the drain terminal, to the source terminal, which will be of lower potential.

The JFET is like a normally-closed switch. It has a low resistance so long as the gate is at the same potential as the source. However, if the potential of the gate is reduced below the potential of the source—that is, the gate acquires a more rela-

tively negative voltage than the source—the current flow is *pinched off* as a result of the field created by the gate. This is suggested by the lower diagram in Figure 29-4.

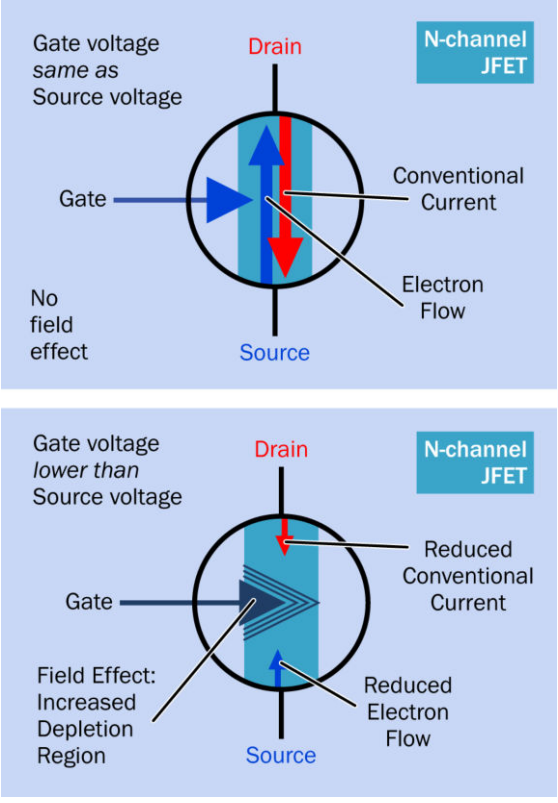

Figure 29-4. *At top, conventional current flows freely from drain to source through the channel of an N-doped JFET. At bottom, the lowered voltage of the gate relative to the source creates a field effect that pinches off the flow of current.*

The situation for a P-channel JFET is reversed, as shown in Figure 29-5. The source is now positive (but is still referred to as the source), while the drain can be grounded. Conventional current now flows freely from source to drain, so long as the gate is at the same positive potential as the source. If the gate voltage rises above the source voltage, the flow is pinched off.

A bipolar transistor tends to block current flow by default, but becomes less resistive when its base is forward-biased. Therefore it can be referred to as an *enhancement device*. By contrast, an N-channel JFET allows current to flow by default, and becomes more resistive when its base is reverse-biased, which widens the *depletion layer* at the base junction. Consequently it can be referred to as a *depletion device*.

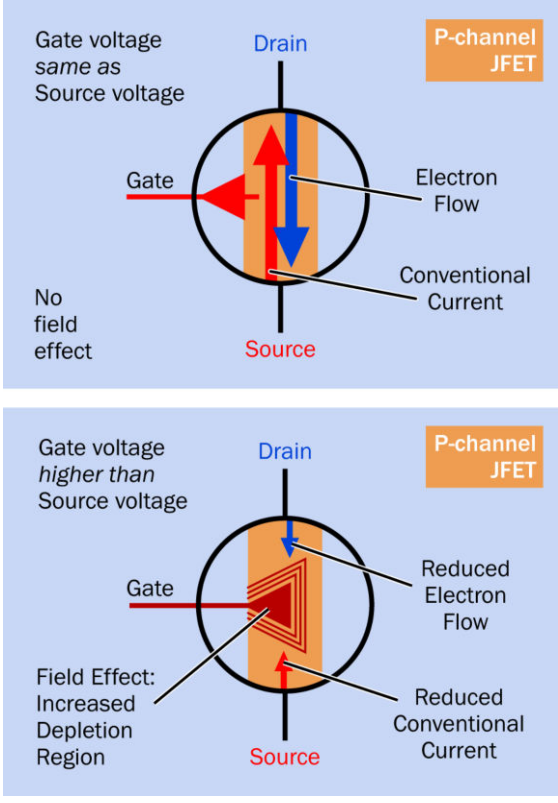

Figure 29-5. *At top, conventional current flows freely from source to drain through the channel of a P-doped JFET. At bottom, the higher voltage of the gate relative to the source creates a field effect that pinches off the flow of current.*

The primary characteristics of a junction field-effect transistor relative to an NPN bipolar transistor are summarized in the table in Figure 29-6.

JFET Behavior

The voltage difference between gate and source of a JFET is usually referred to as V_{gs} while the voltage difference between drain and source is referred to as V_{ds}.

	NPN Bipolar Transistor	N-Channel JFET
Type of amplifier	Current	Voltage
Active bias	Positive	Negative
Unbiased state	Nonconductive	Conductive
Biased state	More conductive	Less conductive

Figure 29-6. *This table contrasts the characteristics of an N-channel JFET with those of an NPN bipolar transistor.*

Suppose the gate of an N-channel JFET is connected with the source, so that V_{gs}=0. Now if V_{ds} increases, the current flowing through the channel of the JFET also increases, approximately linearly with V_{ds}. In other words, initially the JFET behaves like a low-value resistor in which the voltage across it, divided by the amperage flowing through it, is approximately constant. This phase of the JFET's behavior is known as its *ohmic region*. While the unbiased resistance of the channel in a JFET depends on the component type, it is generally somewhere between 10Ω and 1K.

If V_{ds} increases still further, eventually no additional flow of current occurs. At this point the channel has become *saturated*, and this plateau zone is referred to as the *saturation region*, often abbreviated I_{dss}, meaning "the saturated drain current at zero bias." Although this is a nearly constant value for any particular JFET, it may vary somewhat from one sample of a component to another, as a result of manufacturing variations.

If V_{ds} continues to increase, the component finally enters a *breakdown* state, sometimes referred to by its full formal terminology as *drain-source breakdown*. The current passing through the JFET will now be limited only by capabilities of the external power source. This breakdown state can be destructive to the component, and is comparable to the breakdown state of a typical **diode**.

What if the voltage at the gate is reduced below the voltage at the source—such as V_{gs} becomes negative? In its ohmic region, the component now behaves as if it has a higher resistance, and it will reach its saturation region at a lower current value (although around the same value for V_{ds}). Therefore, by reducing the voltage on the gate relative to the voltage at the source, the effective resistance of the component increases, and in fact it can behave as a *voltage-controlled resistor*.

The upper diagram in Figure 29-7 shows this graphically. Below it, the corresponding graph for a P-channel JFET looks almost identical, except that the current flow is reversed and is pinched off as the gate voltage rises above the source voltage. Also, the breakdown region is reached more quickly with a P-channel JFET than with an N-channel JFET.

MOSFETs

MOSFETs have become one of the most widely used components in electronics, everywhere from computer memory to high-amperage switching power supplies. The name is an acronym for *metal-oxide semiconductor field-effect transistor*. A simplified cross-section of an N-channel MOSFET is shown in Figure 29-8.

Two MOSFETs are shown in Figure 29-9.

Like a JFET, a MOSFET has three terminals, identified as drain, gate, and source, and it functions by creating a field effect that controls current flowing through a channel. (Some MOSFETS have a fourth terminal, described later). However, it has a metal source and drain making contact with each end of the channel (hence the term "metal" in its acronym) and also has a thin layer of silicon dioxide (hence the term "oxide" in its acronym) separating the gate from the channel, thus raising the impedance at the gate to at least

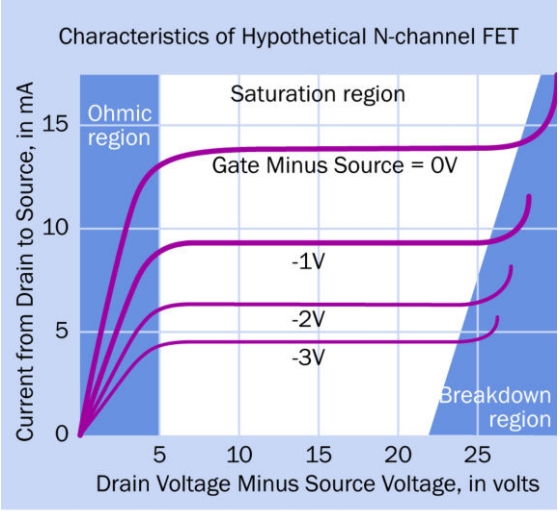

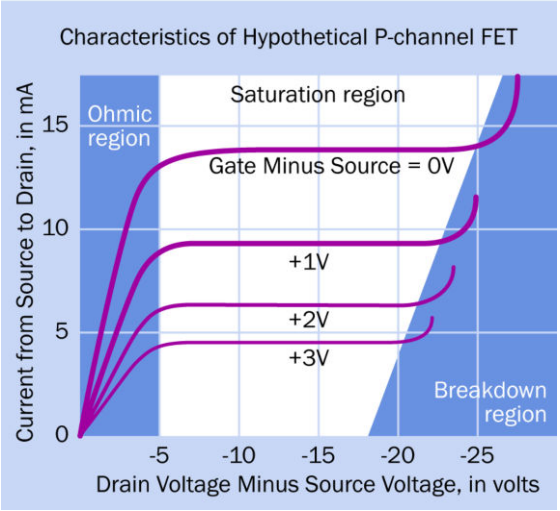

Figure 29-7. *The top graph shows current passing through the channel of an N-channel JFET, depending on gate voltage and source voltage. The lower graph is for a P-channel JFET.*

100,000 gigaohms and reducing gate current essentially to zero. The high gate impedance of a MOSFET allows it to be connected directly to the output of a digital integrated circuit. The layer of silicon dioxide is a *dielectric*, meaning that a field appled to one side creates an opposite field on the other side. The gate attached to the surface of the layer functions in the same way as one plate of a capacitor.

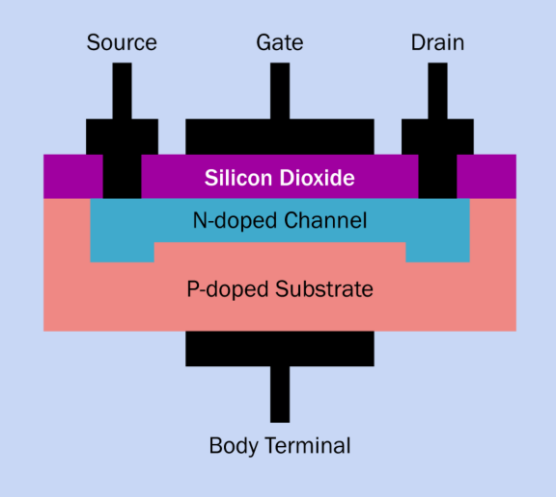

Figure 29-8. *Simplified diagram of an N-channel MOSFET. The thickness of the silicon dioxide layer has been greatly exaggerated for clarity. The black terminals are metallic.*

Figure 29-9. *Two MOSFETs. At left, the TO-220 package claims a drain current of up to 65A continuous, and a drain-to-source breakdown voltage 100V. At right, the smaller package offers a drain current of 175mA continuous, and a drain-to-source breakdown voltage of 300V.*

The silicon dioxide also has the highly desirable property of insulating the gate from the channel, thus preventing unwanted reverse current. In a JFET, which lacks a dielectric layer, if source voltage is allowed to rise more than about 0.6V higher than gate voltage, the direct internal connection between gate and channel allows negative

charges to flow freely from source to gate, and as the internal resistance will be very low, the resulting current can be destructive. This is why the JFET must always be reverse-biased.

A MOSFET is freed from these restrictions, and the gate voltage can be higher or lower than the source voltage. This property enables an N-channel MOSFET to be designed not only as a depletion device, but alternatively as an *enhancement device*, which is "normally off" and can be switched on by being forward-biased. The primary difference is the extent to which the channel in the MOSFET is N-doped with charge carriers, and therefore will or will not conduct without some help from the gate bias.

In a depletion device, the channel conducts, but applying negative voltage to the gate can pinch off the current.

In an enhancement device, the channel does not conduct, but applying positive voltage to the gate can make it start to do so.

In either case, a shift of bias from negative to positive encourages channel conduction; the depletion and enhancement versions simply start from different points.

This is clarified in Figure 29-10. The vertical (logarithmic) scale suggests the current being conducted through the channel of the MOSFET, while the green curve describes the behavior of a depletion version of the device. Where this curve crosses the center line representing 0 volts bias, the channel is naturally conductive, like a JFET. Moving left down the curve, as reverse bias is applied (shown on the horizontal axis), the component becomes less conductive until finally its conductivity reaches zero.

Meanwhile on the same graph, the orange curve represents an enhancement MOSFET, which is nonconductive at 0 volts bias. As forward bias increases, the current also increases—similar to a bipolar transistor.

To make things more confusing, a MOSFET, like a JFET, can have a P-doped channel; and once

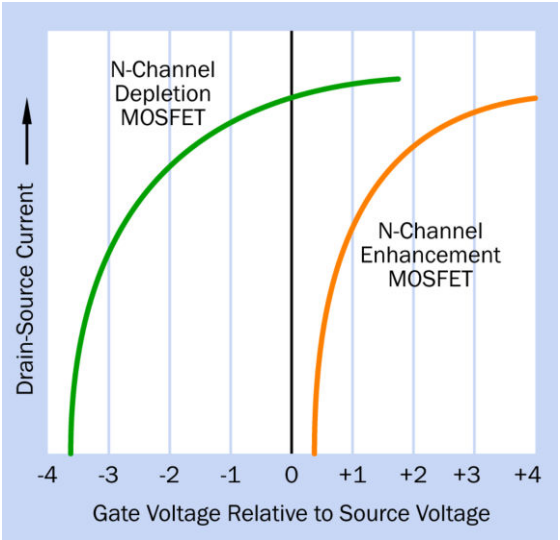

Figure 29-10. *The current conduction of depletion and enhancement N-channel MOSFETs. See text for details. (Influenced by The Art of Electronics by Horowitz and Hill.)*

again it can function in depletion or enhancement mode. The behavior of this variant is shown in Figure 29-11. As before, the green curve shows the behavior of a depletion MOSFET, while the orange curve refers to the enhancement version. The horizontal axis now shows the voltage difference between the gate and the drain terminal. The depletion component is naturally conductive at zero bias, until the gate voltage increases above the drain voltage, pinching off the current flow. The enhancement component is not conductive until reverse bias is applied.

Figure 29-12 shows schematic symbols that represent depletion MOSFETs. The two symbols on the left are functionally identical, representing N-channel versions, while the two symbols on the right represent P-channel versions. As in the case of JFETs, the letter "S" should be (but often is not) added to the symmetrical versions of the symbols, to clarify which is the source terminal. The left-pointing arrow identifies the components as N-channel, while in the symbols on the right, the right-pointing arrows indicate P-channel MOS-

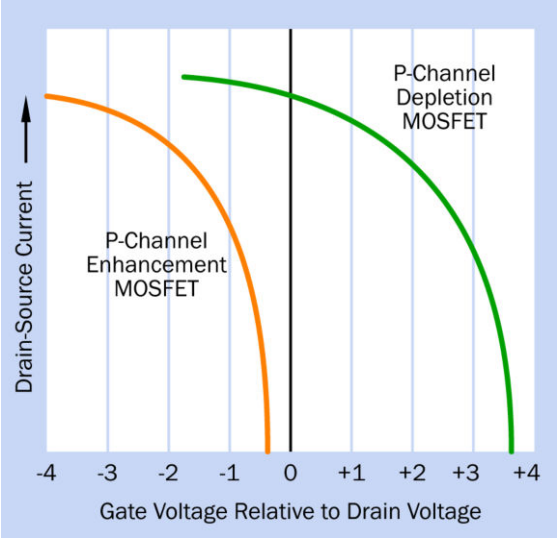

Figure 29-11. *The current conduction of depletion and enhancement P-channel MOSFETs. See text for details.*

FETs. The gap between the two vertical lines in each symbol suggests the silicon dioxide dielectric. The right-hand vertical line represents the channel.

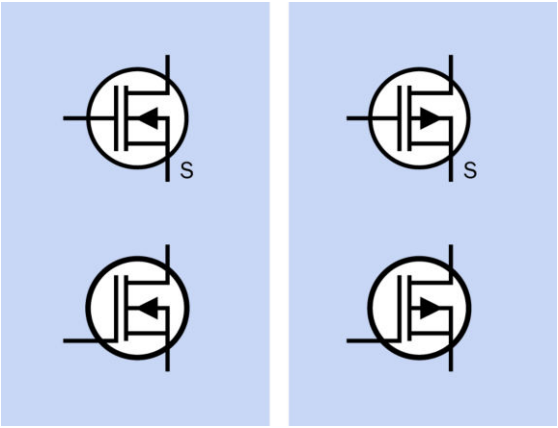

Figure 29-12. *Schematic symbols for depletion MOSFETs. These function similarly to JFETs. The two symbols on the left are functionally identical, and represent N-channel depletion MOSFETs. The two symbols on the right are both widely used to represent P-channel depletion MOSFETs.*

For enhancement MOSFETs, a slightly different symbol uses a broken line between the source and drain (as shown in Figure 29-13) to remind us that these components are "normally off" when zero-biased, instead of "normally on." Here again a left-pointing arrow represents an N-channel MOSFET, while a right-pointing arrow represents a P-channel MOSFET.

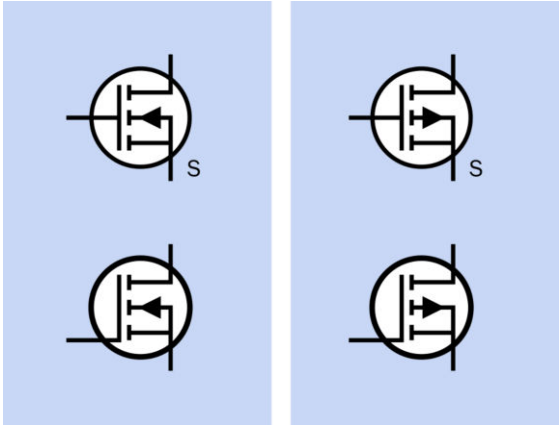

Figure 29-13. *Schematic symbols for enhancement MOSFETs. The two on the left are functionally identical, and represent N-channel enhancement MOSFETs. The two on the right represent P-channel enhancement MOSFETs.*

Because there is so much room for confusion regarding MOSFETs, a summary is presented in Figure 29-14 and Figure 29-15. In these figures, the relevant parts of each schematic symbol are shown disassembled alongside text explaining their meaning. Either of the symbols in Figure 29-14 can be superimposed on either of the symbols in Figure 29-15, to combine their functions. So, for instance, if the upper symbol in Figure 29-14 is superimposed on the lower symbol in Figure 29-15, we get an N-channel MOSFET of the enhancement type.

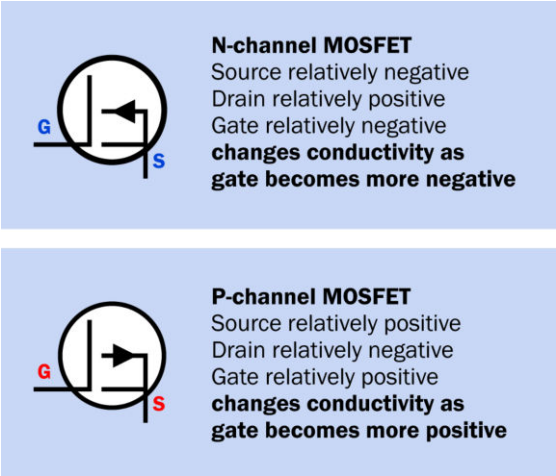

Figure 29-14. *Either of the two symbols can be combined with either of the two symbols in the next figure, to create one of the four symbols for a MOSFET. See text for details.*

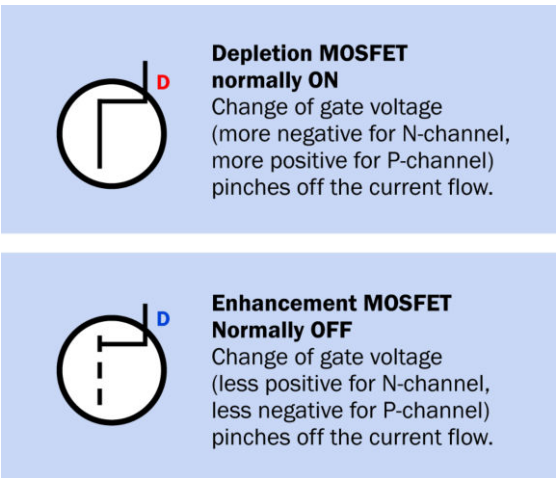

Figure 29-15. *Either of the two symbols can be combined with either of the two symbols from the previous figure, to create one of the four symbols for a MOSFET. See text for details.*

In an additional attempt to clarify MOSFET behavior, four graphs are provided in Figure 29-16, Figure 29-17, Figure 29-18, and Figure 29-19. Like JFETs, MOSFETs have an initial ohmic region, followed by a saturation region where current flows relatively freely through the device. The gate-to-source voltage will determine how much flow is permitted. However, it is important to pay close attention to the graph scales, which differ for each of the four types of MOSFET.

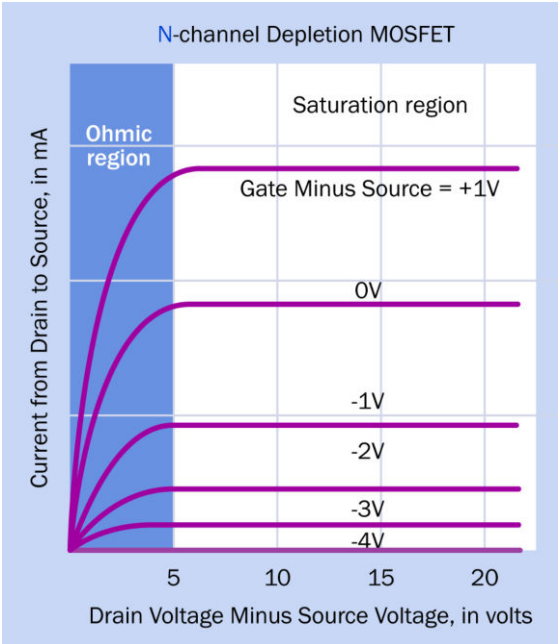

Figure 29-16. *Current flow through a depletion-type, N-channel MOSFET.*

In all of these graphs, a bias voltage exists, which allows zero current to flow (represented by the graph line superimposed on the horizontal axis). In other words, the MOSFET can operate as a switch. The actual voltages where this occurs will vary with the particular component under consideration.

The N-channel, enhancement-type MOSFET is especially useful as a switch because in its normally-off state (with zero bias) it presents a very high resistance to current flow. It requires a relatively low positive voltage at the gate, and effectively no gate current, to begin conducting conventional current from its drain terminal to its source terminal. Thus it can be driven directly by typical 5-volt logic chips.

Depletion-type MOSFETs are now less commonly used than the enhancement-type.

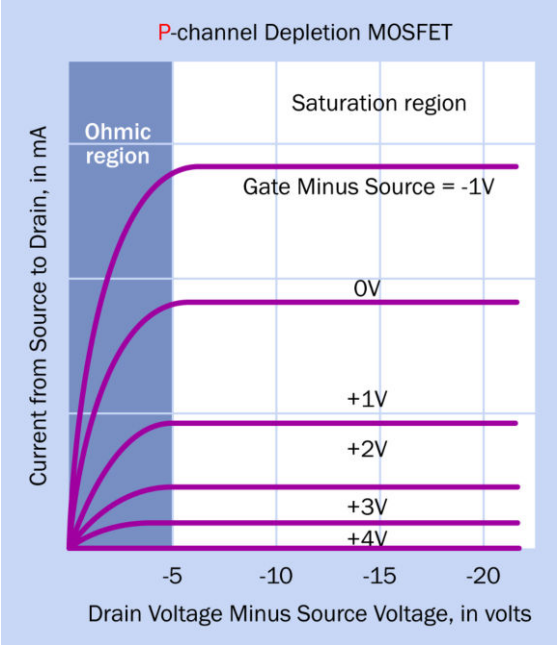

Figure 29-17. *Current flow through a depletion-type, P-channel MOSFET.*

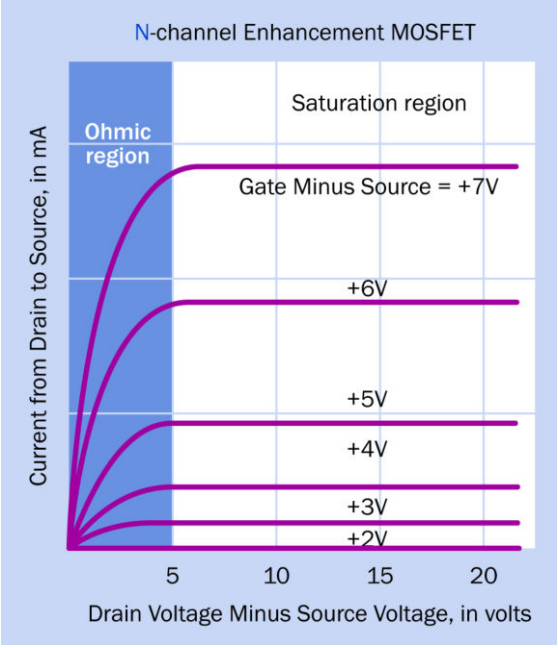

Figure 29-18. *Current flow through an enhancement-type, N-channel MOSFET.*

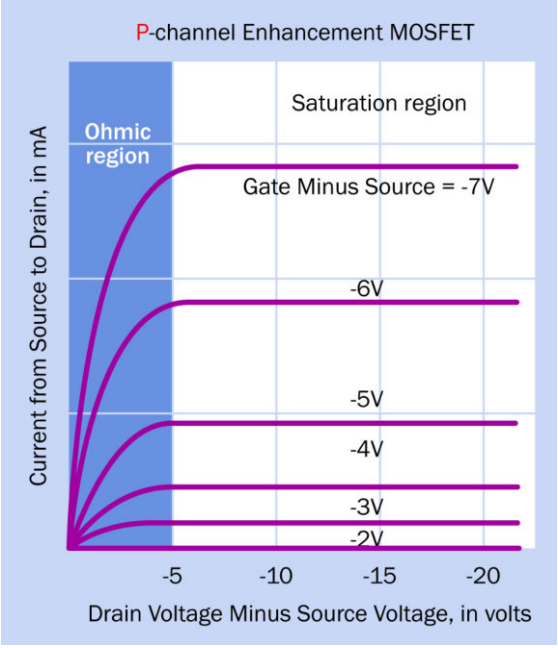

Figure 29-19. *Current flow through an enhancement-type, P-channel MOSFET.*

The Substrate Connection

Up to this point, nothing has been said about a fourth connection available on many MOSFETs, known as the *body terminal*. This is connected to the substrate on which the rest of the component is mounted, and acts as a diode junction with the channel. It is typically shorted to the source terminal, and in fact this is indicated by the schematic symbols that have been used so far. It is possible, however, to use the body terminal to shift the threshold gate voltage of the MOSFET, either by making the body terminal more negative than the source terminal (in an N-channel MOSFET) or more positive (in a P-channel MOSFET). Variants of the MOSFET schematic symbols showing the body terminal are shown in Figure 29-20 (for depletion MOSFETS) and Figure 29-21 (for enhancement MOSFETS).

A detailed discussion of the use of the body terminal to adjust characteristics of the gate is beyond the scope of this encyclopedia.

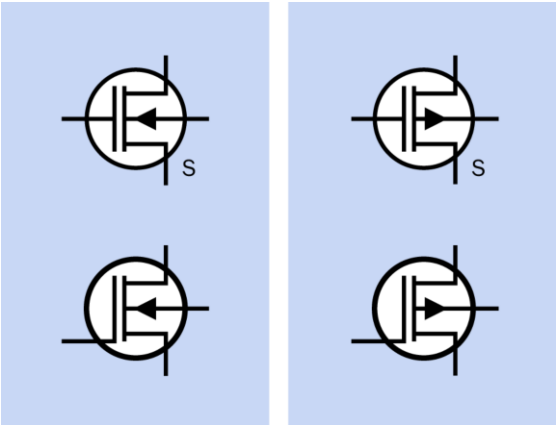

Figure 29-20. *Schematic symbol variants for depletion MOSFETs, showing the body terminal separately accessible instead of being tied to the source terminal.*

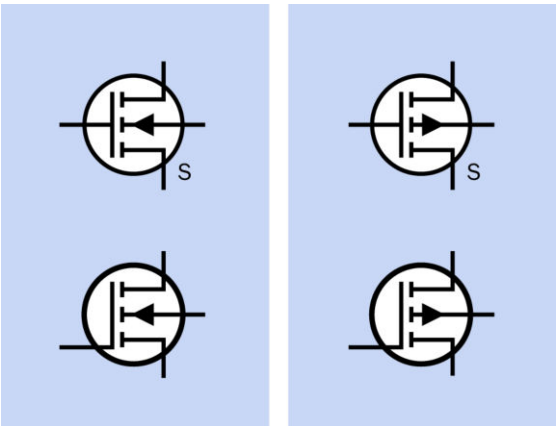

Figure 29-21. *Schematic symbol variants for enhancement MOSFETs, showing the body terminal separately accessible instead of being tied to the source terminal.*

Variants

A few FET variants exist in addition to the two previously discussed.

MESFET

The acronym stands for *MEtal-Semiconductor Field Effect Transistor*. This FET variant is fabricated from gallium arsenide and is used primarily in radio frequency amplification, which is outside the scope of this encyclopedia.

V-Channel MOSFET

Whereas most FET devices are capable of handling only small currents, the *V-channel MOSFET* (which is often abbreviated as a *VMOS FET* and has a V-shaped channel as its name implies) is capable of sustained currents of at least 50A and voltages as high as 1,000V. It is able to pass the high current because its channel resistance is well under 1Ω. These devices, commonly referred to as *power MOSFETs*, are available from all primary semiconductor manufacturers and are commonly used in switching power supplies.

Trench MOS

The TrenchMOS or Trenchgate MOS is a MOSFET variant that encourages current to flow vertically rather than horizontally, and includes other innovations that enable an even lower channel resistance, allowing high currents with minimal heat generation. This device is finding applications in the automobile industry as a replacement for electromechanical **relays**.

Values

The maximum values for JFETs, commonly found listed in datasheets, will specify V_{ds} (the drain-source voltage, meaning the potential difference between drain and source); V_{dg} (the drain-gate voltage, meaning the potential difference between drain and gate); V_{gsr} (the reverse gate-source voltage); gate current; and total device dissipation in mW. Note that the voltage differences are relative, not absolute. Thus a voltage of 50V on the drain and 25V on the source might be acceptable in a component with a V_{ds} of 25V. Similarly, while a JFET's "pinch-off" effect begins as the gate becomes "more negative" than the source, this can be achieved if, for example, the source has a potential of 6V and the gate has a potential of 3V.

JFETs and MOSFETs designed for low-current switching applications have a typical channel resistance of just a few ohms, and a maximum switching speed around 10Mhz.

The datasheet for a MOSFET will typically include values such as gate threshold voltage, which may be abbreviated V_{gs} (or V_{th}) and establishes the relative voltage at which the gate starts to play an active role; and the maximum on-state drain current, which may be abbreviated $I_{d(on)}$ and establishes the maximum limiting current (usually at 25 degree Centigrade) between source and gate.

How to Use it

The combination of a very high gate impedance, very low noise, very low quiescent power consumption in its off state, and very fast switching capability makes the MOSFET suitable for many applications.

P-Channel Disadvantage

P-channel MOSFETs are generally less popular than N-channel MOSFETS because of the higher resistivity of P-type silicon, resulting from its lower carrier mobility, putting it at a relative disadvantage.

Bipolar Substitution

In many instances, an appropriate enhancement-type MOSFET can be substituted for a bipolar transistor with better results (lower noise, faster action, much higher impedance, and probably less power dissipation).

Amplifier Front Ends

While MOSFETs are well-suited for use in the front end of an audio amplifier, chips containing MOSFETs are now available for this specific purpose.

Voltage-Controlled Resistor

A simple voltage-controlled resistor can be built around a JFET or MOSFET, so long as its performance remains limited to the linear or ohmic region.

Compatibility with Digital Devices

A JFET may commonly use power supplies in the range of 25VDC. However, it can accept the high/low output from a 5V digital device to control its gate. A 4.7K pullup resistor is an appropriate value to be used if the FET is to be used in conjunction with a TTL digital chip that may have a voltage swing of only approximately 2.5V between its low and high thresholds.

What Can Go Wrong

Static Electricity

Because the gate of a MOSFET is insulated from the rest of the component, and functions much like a plate of a capacitor, it is especially likely to accumulate static electricity. This static charge may then discharge itself into the body of the component, destroying it. A MOSFET is particularly vulnerable to electrostatic discharge because its oxide layer is so thin. Special care should be taken either when handling the component, or when it is in use. Always touch a grounded object or wear a grounded wrist band when handling MOSFETs, and be sure that any circuit using MOSFETs includes appropriate protection from static and voltage spikes.

A MOSFET should not be inserted or removed while the circuit in which it performs is switched on or contains residual voltage from undischarged capacitors.

Heat

Failure because of overheating is of special concern when using power MOSFETs. A Vishay Application Note ("Current Power Rating of Power Semiconductors") suggests that this kind of component is unlikely to operate at less than 90 degrees Centigrade in real-world conditions, yet the power handling capability listed in a datasheet usually assumes an industry standard of 25 degrees Centigrade.

On the other hand, ratings for continuous power are of little relevance to switching devices that have duty cycles well below 100%. Other factors also play a part, such as the possibility of power surges, the switching frequency, and the integrity of the connection between the component

and its heat sink. The heat sink itself creates uncertainty by tending to average the temperature of the component, and of course there is no simple way to know the actual junction temperature, moment by moment, inside a MOSFET.

Bearing in mind the accumulation of unknown factors, power MOSFETs should be chosen on an extremely conservative basis. According to a tutorial in the *EE Times*, actual current switched by a MOSFET should be less than half of its rated current at 25 degrees, while one-fourth to one-third are common. Figure 29-22 shows the real-world recommended maximum drain current at various temperatures. Exceeding this recommendation can create additional heat, which cannot be dissipated, leading to further accumulation of heat, and a thermal runaway condition, causing eventual failure of the component.

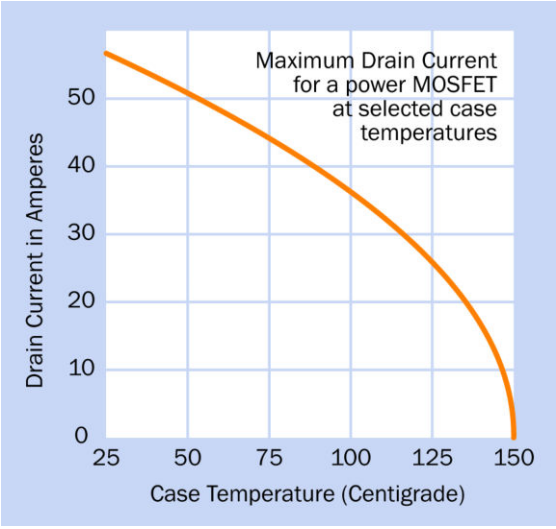

Figure 29-22. *Maximum advised drain current through a power MOSFET, related to case temperature of the component. Derived from EE Times Power MOSFET Tutorial.*

Wrong Bias

As previously noted, applying forward bias to a JFET can result in the junction between the gate and the source starting to behave like a forward-biased diode, when the voltage at the gate is greater than the voltage at the source by approximately 0.6V or more (in an N-channel JFET). The junction will present relatively little resistance, encouraging excessive current and destructive consequences. It is important to design devices that allow user input in such a way that user error can never result in this eventuality.

Schematic Symbols

A

This section contains a compilation of schematic symbols for components that have been described in this volume. They are sequenced primarily in alphabetical order, as this section is intended for use as an index. However, symbols that have a strong similarity are grouped together; thus **potentiometer** is found adjacent to **resistor**, and all types of transistors are in the same group.

The symbol variants shown in each blue rectangle are functionally identical.

Where a component has mandatory polarity or is commonly used with a certain polarity, a red plus sign (+) has been added for guidance. This sign is not part of the symbol. In the case of polarized capacitors, where a plus sign is normally shown (or should be shown) with the symbol, the plus sign is a part of the symbol and appears in black.

This is not intended to be an exhaustive compilation of symbol variants. Some uncommon ones may not be here. However, the list should be sufficient to enable identification of components in this volume.

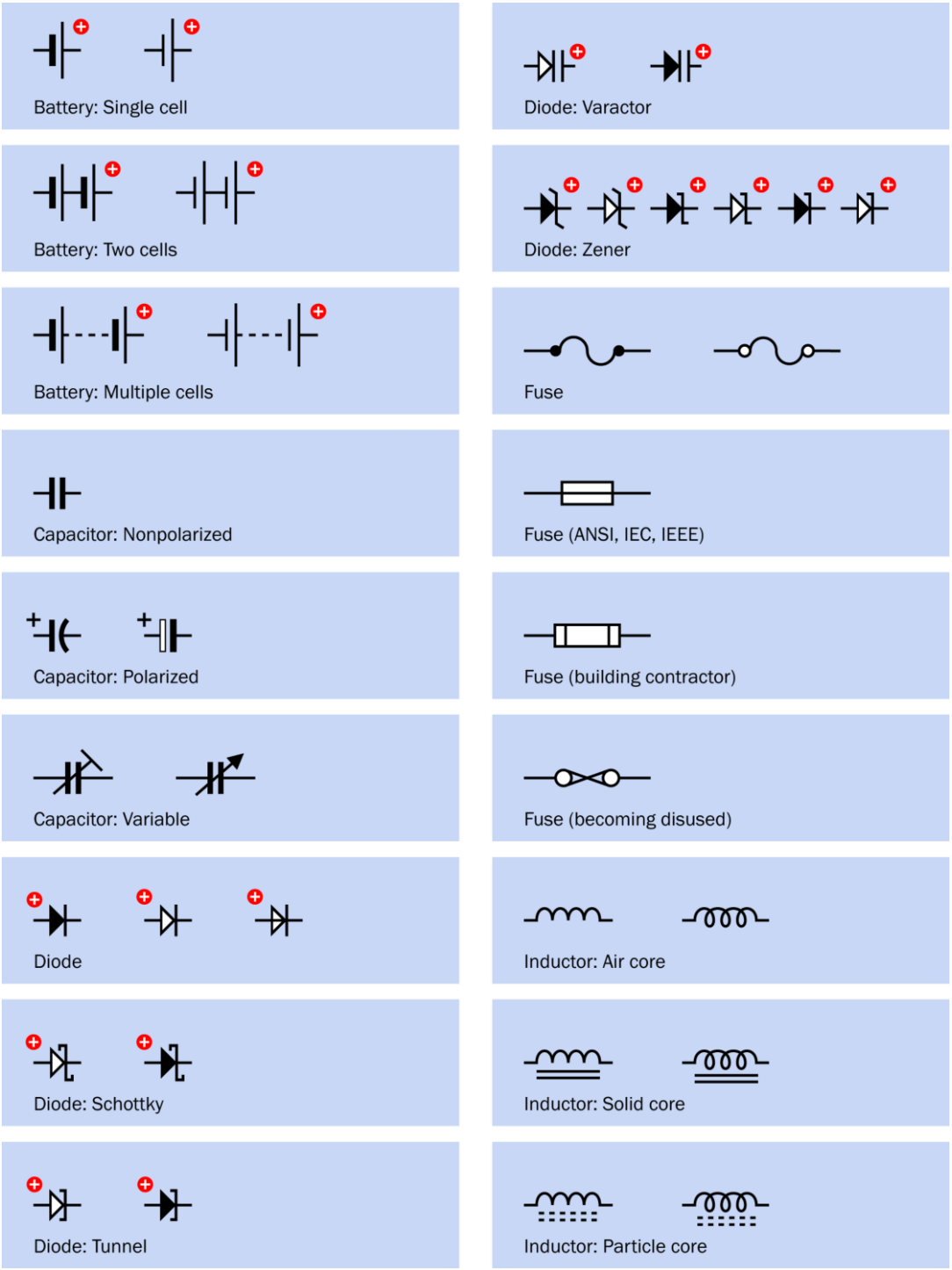

Figure A-1. *Schematic symbols*

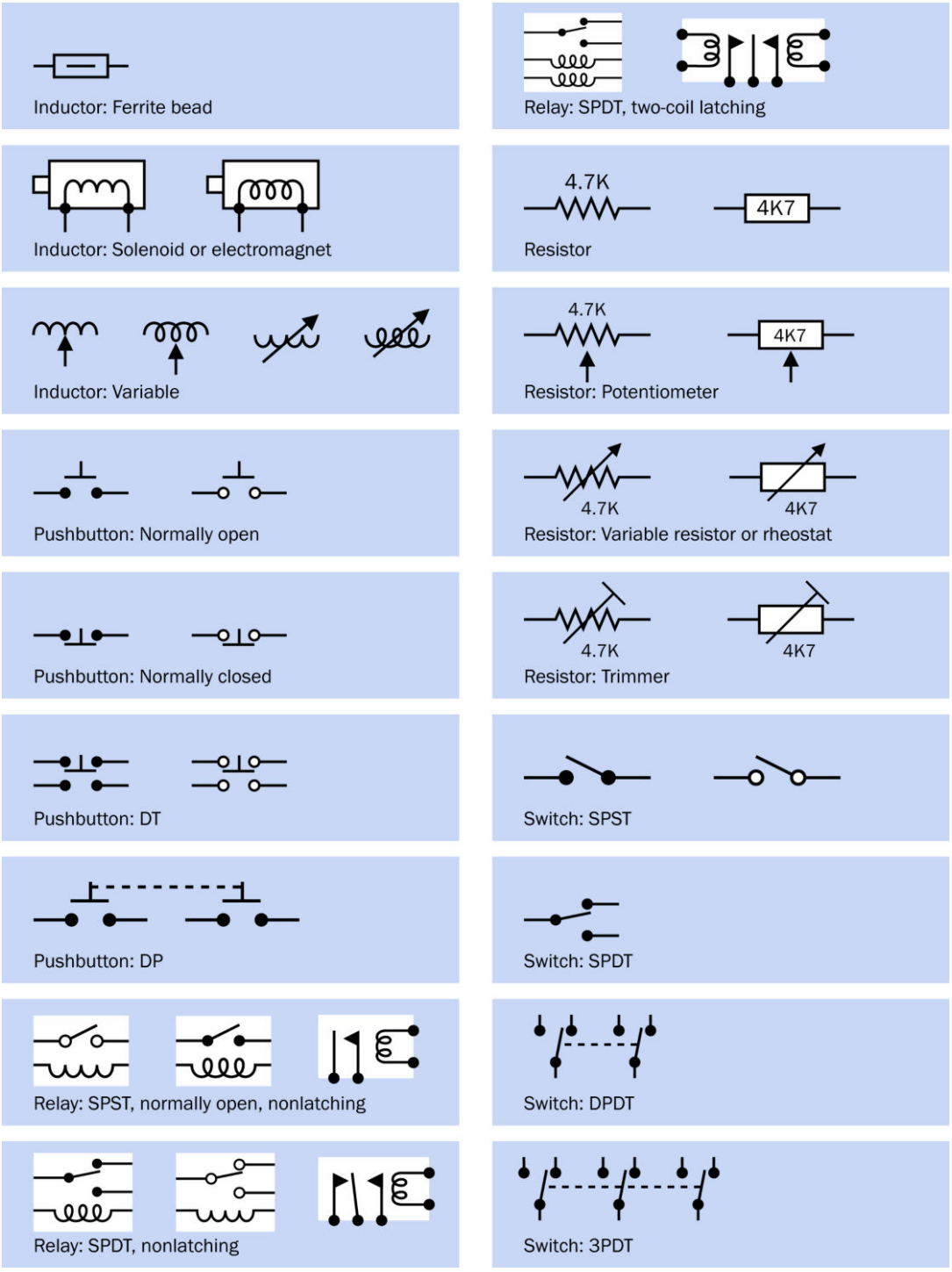

Figure A-2. *Schematic symbols, continued*

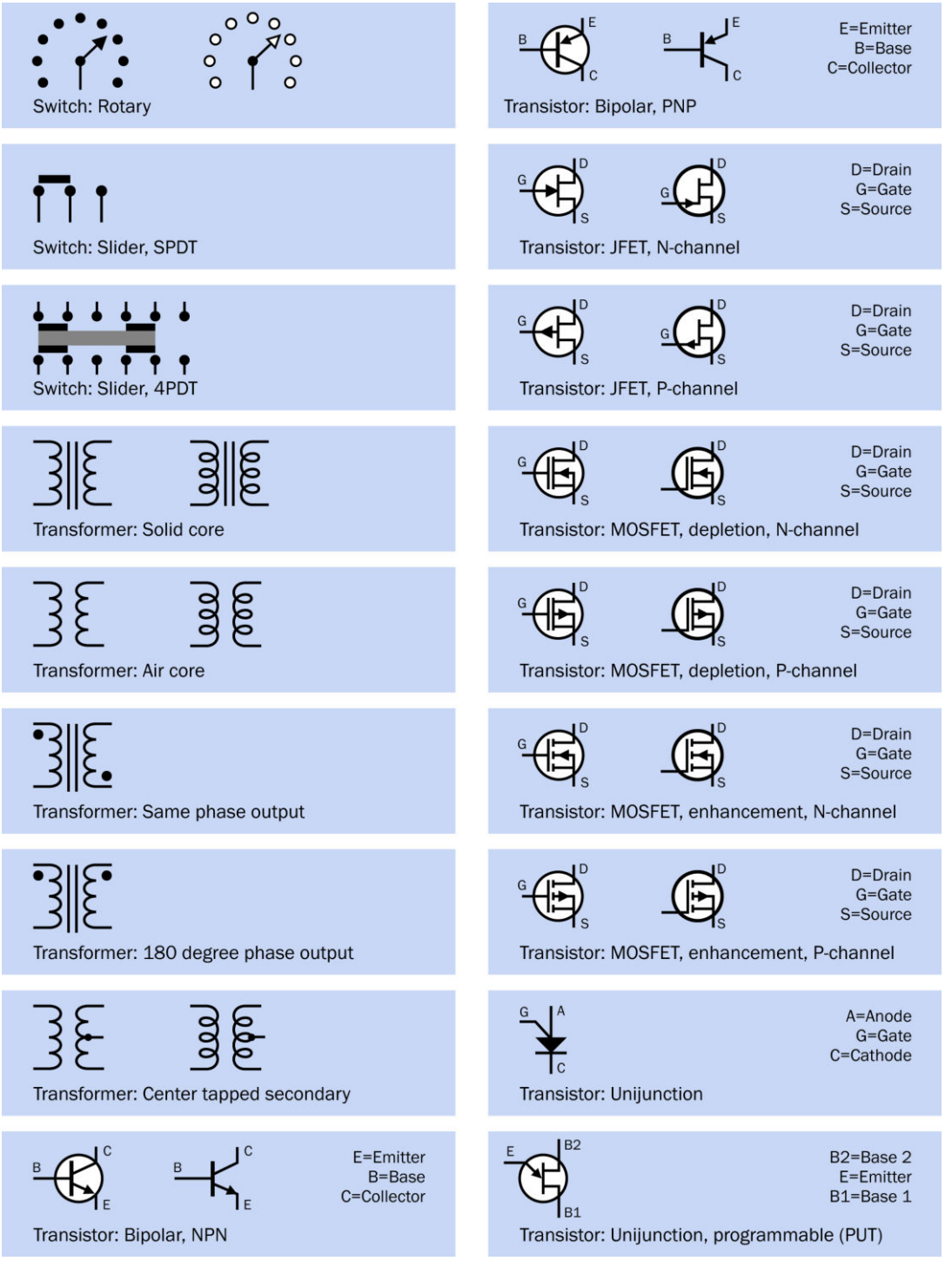

Figure A-3. *Schematic symbols, continued*

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Charles Platt with Fredrik Jansson

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Charles Platt

Charles Platt's lifelong love of electronics began when he built a telephone answering machine at age 15. A contributing editor to *Make:* magazine, he wrote the widely acclaimed *Make: Electronics*. He's also a science-fiction writer (author of *The Silicon Man*), and a former senior writer at *Wired* magazine.

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[TI]

In fond memory of my father, Maurice Platt

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How to Use This Book

This is the second of three volumes. Its purpose is to provide an overview of the most commonly used electronic components, for reference by students, engineers, hobbyists, and instructors. While you can find much of this information dispersed among datasheets, introductory books, websites, and technical resources maintained by manufacturers, the *Encyclopedia of Electronic Components* gathers all the relevant facts in one place, properly organized and verified, including details that may be hard to find elsewhere. Each entry includes typical applications, possible substitutions, cross-references to similar devices, sample schematics, and a list of common problems and errors.

You can find a more detailed rationale for this encyclopedia in the Preface to Volume 1.

Volume Contents

Practical considerations influenced the decision to divide this encyclopedia into three volumes. Each deals with broad subject areas as follows.

Volume 1

Power; electromagnetic devices; discrete semiconductors

The *power* category includes sources of electricity and methods to distribute, store, interrupt, convert, and regulate power. The *electromagnetic devices* category includes devices that exert force linearly, and others that create a turning force. *Discrete semiconductors* include the primary types of diodes and transistors. A contents listing for Volume 1 appears in Figure P-1.

Volume 2

Thyristors (SCRs, diacs, and triacs); integrated circuits; light sources, indicators, and displays; and sound sources

Integrated circuits are divided into analog and digital components. *Light sources, indicators, and displays* are divided into reflective displays, single sources of light, and displays that emit light. *Sound sources* are divided into those that create sound, and those that reproduce sound. A contents listing for Volume 2 appears in Figure P-2.

Volume 3

Sensing devices

The field of sensors has become so extensive, they easily merit a volume to themselves. *Sensing devices* include those that detect light, sound, heat, motion, pressure, gas, humidity, orientation, electricity, proximity, force, and radiation.

At the time of writing, Volume 3 is still in preparation, while Volume 1 is complete and is available in a variety of formats.

Primary Category	Secondary Category	Component Type
power	source	battery
	connection	jumper
		fuse
		pushbutton
		switch
		rotary switch
		rotational encoder
	moderation	relay
		resistor
		potentiometer
		capacitor
		variable capacitor
	conversion	inductor
		AC-AC transformer
		AC-DC power supply
		DC-DC converter
		DC-AC inverter
	regulation	voltage regulator
electro-magnetism	linear output	electromagnet
		solenoid
	rotational output	DC motor
		AC motor
		servo motor
		stepper motor
discrete semi-conductor	single junction	diode
		unijunction transistor
	multi-junction	bipolar transistor
		field-effect transistor

Figure P-1. *The subject-oriented organization of categories and entries in Volume 1.*

Primary Category	Secondary Category	Component Type
discrete semi-conductor	thyristor	SCR
		diac
		triac
integrated circuit	analog	solid-state relay
		optocoupler
		comparator
		op-amp
		digital potentiometer
		timer
	digital	logic gate
		flip-flop
		shift register
		counter
		encoder
		decoder
		multiplexer
light source, indicator or display	reflective	LCD
	single source	incandescent lamp
		neon bulb
		fluorescent light
		laser
		LED indicator
		LED area lighting
	multi-source or panel	LED display
		vacuum-fluorescent
		electroluminescence
sound source	audio alert	transducer
		audio indicator
	reproducer	headphone
		speaker

Figure P-2. *The subject-oriented organization of categories and entries in Volume 2.*

Organization

Reference versus Tutorial

As its title suggests, this is a reference book, not a tutorial. A tutorial begins with elementary concepts and builds sequentially toward concepts that are more advanced. A reference book assumes that you may dip into the text at any point, learn what you need to know, and then put the book aside. If you choose to read it straight through from beginning to end, you will find some repetition, as each entry is intended to be self-sufficient, requiring minimal reference to other entries.

My books *Make: Electronics* and *Make: More Electronics* follow a tutorial approach. They don't go into as much depth as this Encyclopedia, because a tutorial inevitably allocates a lot of space to step-by-step explanations and instructions.

Theory and Practice

This book is oriented toward practicality rather than theory. I assume that the reader mostly wants to know how to use electronic components, rather than why they work the way they do. Consequently, I have not included proofs of formulae or definitions rooted in electrical theory. Units are defined only to the extent necessary to avoid confusion.

Many books on electronics theory already exist, if theory is of interest to you.

Entries

This encyclopedia is divided into entries, each entry being devoted to one broad type of component. Two rules determine whether a component has an entry all to itself, or is subsumed into another entry:

Rule 1

A component merits its own entry if it is (a) widely used, or (b) not so widely used but has a unique identity and maybe some historical status. The **bipolar transistor** entry is an example of a widely used component, whereas the **unijunction transistor** entry is an example of a not so widely used component with a unique identity.

Rule 2

A component does not merit its own entry if it is (a) seldom used, or (b) very similar in function to another component that is more widely used. For example, a *rheostat* is subsumed into the **potentiometer** section, while *silicon diode*, *Zener diode*, and *germanium diode* are combined together in the **diode** entry.

Inevitably, these guidelines required judgment calls which in some cases may seem arbitrary. My ultimate decision was based on where I would expect to find a component if I was looking for it myself.

Subject Paths

Entries are not organized alphabetically. They are grouped by subject, in much the same way that books in the nonfiction section of some libraries are organized by the Dewey Decimal System. This is convenient if you don't know exactly what you are looking for, or if you don't know all the options that may be available to perform a task that you have in mind.

Each primary category is divided into subcategories, and the subcategories are divided into component types. This hierarchy is shown in Figure P-2. It is also apparent when you look at the top of the first page of each entry, where you will find the path that leads to it. The **diac** entry, for instance, is headed with this path:

discrete semiconductor > thyristor > diac

Any classification scheme will run into exceptions. You can buy a chip containing a *resistor array*, for instance. Technically, this is an *analog integrated circuit*, but a decision was made to put it in the **resistor** section of Volume 1, because it can be directly substituted for a group of resistors.

Some components have hybrid functions. A **multiplexer**, for instance, may pass analog signals and may have "analog" in its name. However, it is digitally controlled and is mostly used in conjunction with other digital integrated circuits. This seemed to justify placing it in the digital category.

Inclusions and Exclusions

There is also the question of what is, and is not, a component. Is wire a component? Not for the purposes of this encyclopedia. How about a **DC-DC converter**? Because converters are now sold in small packages by component suppliers, they are included in Volume 1 as components.

Many similar decisions had to be made on a case-by-case basis. Some readers will disagree with the outcome, but reconciling all the disagreements would have been impossible. The best I could do was to create a book which is organized in the way that would suit me best if I were using it myself.

Typographical Conventions

Within each entry, **bold type** is used for the first occurrence of the name of a component that has its own entry elsewhere. Other important electronics terms or component names may be presented in *italics*.

The names of components, and the categories to which they belong, are all set in lowercase type, except where a term is normally capitalized because it is an acronym or a trademark. The term *Trimpot*, for instance, is trademarked by Bourns, but *trimmer* is not. **LED** is an acronym, but *cap* (abbreviation for **capacitor**) is not.

The European convention for representing fractional component values eliminates decimal points. Thus, values such as 3.3K and 4.7K are expressed as 3K3 and 4K7. This style has not been adopted to a significant degree in the United States, and is not used in this encyclopedia.

In mathematical formulae, I have used the style that is common in programming languages. The * (asterisk) is used as a multiplication symbol, while the / (forward slash) is used as a division symbol. Where some terms are in parentheses, they must be dealt with first. Where parentheses are inside parentheses, the innermost ones must be dealt with first. So, in this example:

```
A = 30 / (7 + (4 * 2) )
```

You would begin by multiplying 4 times 2, to get 8; then add 7, to get 15; then divide that into 30, to get the value for A, which is 2.

Visual Conventions

Figure P-3 shows the conventions that are used in the schematics in this book. A black dot always indicates a connection, except that to minimize ambiguity, the configuration at top right is avoided, and the configuration at top center is used instead. Conductors that cross each other without a black dot do not make a connection. The styles at bottom right are sometimes seen elsewhere, but are not used here.

All the schematics are formatted with pale blue backgrounds. This enables components such as switches, transistors, and LEDs to be highlighted in white, drawing attention to them and clarifying the boundary of the component. The white areas have no other meaning.

Photographic Backgrounds

All photographs of components include a background grid that is divided into squares measuring 0.1". Although the grid is virtual, it is equivalent in scale to physical graph paper placed immediately behind the component. If the component is photographed at an angle, the grid may be reproduced at a similar angle, creating perspective on the squares.

Background colors in photographs were chosen for contrast with the colors of the components, or for visual variety. They have no other significance.

Component Availability

Because there is no way of knowing if a component may have a long production run, this encyclopedia is cautious about listing specific part numbers. To find a specific part that has a narrow function, searching the websites maintained by suppliers will be necessary. The following suppliers were checked frequently during the preparation of the book:

- Mouser Electronics
- Jameco Electronics

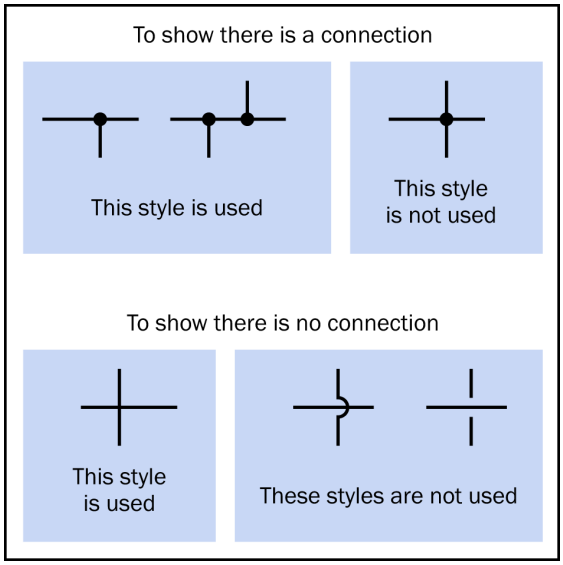

Figure P-3. *Visual conventions that are used in the schematics in this book.*

When seeking obsolete parts, or those that are nearing the end of their commercial life, eBay can be very useful.

Issues and Errata

If you believe you have found an error in this book, you will find guidance on how to report it here: *http://bit.ly/eec_v2_errata*.

Before posting your own erratum, please check those that have been submitted previously, to see if someone else already reported it.

I value and encourage reader feedback. However, before you post feedback publicly to a site such as Amazon, I have a request. Please be aware of the power that you have as a reader, and use it fairly. A single negative review can create a bigger effect than you may realize. It can certainly outweigh half-a-dozen positive reviews. If you feel you have not received a prompt or adequate response from the O'Reilly errata site mentioned here, you can email me personally at:

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We have a web page for this book, where we list errata, examples, and any additional information. You can access this page at: *http://bit.ly/encyclopedia_of_electronic_components_v2*.

Acknowledgments

Any reference work draws inspiration from many sources. Datasheets and tutorials maintained by component manufacturers were considered the most trustworthy sources of information online. In addition, component retailers, college texts, crowd-sourced reference works, and hobbyist sites were used. The following books provided useful information:

Boylestad, Robert L. and Nashelsky, Louis: *Electronic Devices and Circuit Theory*, 9th edition. Pearson Education, 2006.

Braga, Newton C.: *CMOS Sourcebook*. Sams Technical Publishing, 2001.

Hoenig, Stuart A.: *How to Build and Use Electronic Devices Without Frustration, Panic, Mountains of Money, or an Engineering Degree*, 2nd edition. Little, Brown, 1980.

Horn, Delton T.: *Electronic Components*. Tab Books, 1992.

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Lancaster, Don: *TTL Cookbook*. Howard W. Sams & Co, 1974.

Lenk, Ron and Lenk, Carol: *Practical Lighting Design with LEDs*. John Wiley & Sons, 2011.

Lowe, Doug: *Electronics All-in-One for Dummies*. John Wiley & Sons, 2012.

Mims III, Forrest M.: *Getting Started in Electronics*. Master Publishing, 2000.

Mims III, Forrest M.: *Electronic Sensor Circuits & Projects*. Master Publishing, 2007.

Mims III, Forrest M.: *Timer, Op Amp, & Optelectronic Circuits and Projects*. Master Publishing, 2007.

Predko, Mike: *123 Robotics Experiments for the Evil Genius*. McGraw-Hill, 2004.

Scherz, Paul: *Practical Electronics for Inventors*, 2nd edition. McGraw-Hill, 2007.

Williams, Tim: *The Circuit Designer's Companion*, 2nd edition. Newnes, 2005.

I also made extensive use of information on vendor sites, especially:

- Mouser Electronics
- Jameco Electronics
- All Electronics
- sparkfun
- Electronic Goldmine
- Adafruit
- Parallax, Inc.

In addition, some individuals provided special assistance. My editor, Brian Jepson, was immensely helpful in the development of this book. Philipp Marek and Steve Conklin reviewed the text for errors. My publisher demonstrated faith in my work. Kevin Kelly unwittingly influenced me with his legendary interest in "access to tools." It was Mark Frauenfelder who originally brought me back to the pleasures of building things, and Gareth Branwyn who revived my interest in electronics.

Lastly, I should mention my school friends from decades ago: Patrick Fagg, Hugh Levinson, Graham Rogers, William Edmondson, and John Witty, who helped me to feel that it was OK to be a nerd building my own audio equipment, long before the word "nerd" actually existed.

—Charles Platt, 2014

SCR

1

The acronym **SCR** is derived from *silicon-controlled rectifier*, which is a gate-triggered type of *thyristor*. A thyristor is defined here as a semiconductor having four or more alternating layers of p-type and n-type silicon. Because it predated integrated circuits, and in its basic form consists of a single multilayer semiconductor, a thyristor is considered to be a discrete component in this encyclopedia. When a thyristor is combined with other components in one package (as in a **solid-state relay**), it is considered to be an integrated circuit.

Other types of thyristor are the **diac** and **triac**, each of which has its own entry.

Thyristor variants that are not so widely used, such as the *gate turn-off thyristor (GTO)* and *silicon-controlled switch (SCS)*, do not have entries here.

OTHER RELATED COMPONENTS

- **diac** (see Chapter 2)
- **triac** (see Chapter 3)

What It Does

In the 1920s, the *thyratron* was a gas-filled tube that functioned as a switch and a rectifier. In 1956, General Electric introduced a solid-state version of it under the name *thyristor*. In both cases, the names were derived from the thyroid gland in the human body, which controls the rate of consumption of energy. The thyratron and, subsequently, the thyristor enabled control of large flows of current.

The **SCR** (silicon-controlled rectifier) is a type of thyristor, although the two terms are often used as if they are synonymous. Text that refers loosely to a thyristor may actually be discussing an SCR, and vice versa. In this encyclopedia, the **SCR**, **diac**, and **triac** are all considered to be variant types of thyristor.

An SCR is a solid-state switch that in many instances can pass high currents at high voltages. Like a **bipolar transistor**, it is triggered by voltage applied to a gate. Unlike the transistor, it allows the flow of current to continue even when the gate voltage diminishes to zero.

How It Works

This component is designed to pass current in one direction only. It can be forced to conduct in the opposite direction if the reversed potential exceeds its *breakdown voltage*, but this mistreatment is likely to cause damage.

By comparison, the diac and triac are designed to be bidirectional.

The SCR has three leads, identified as anode, cathode, and gate. Two functionally identical versions of the schematic symbol are shown in Figure 1-1. Early versions sometimes included a circle drawn around them, but this style has become obsolete. Care must be taken to distinguish

between the SCR symbol and the symbol that represents a **programmable unijunction transistor** (PUT), shown in Figure 1-2.

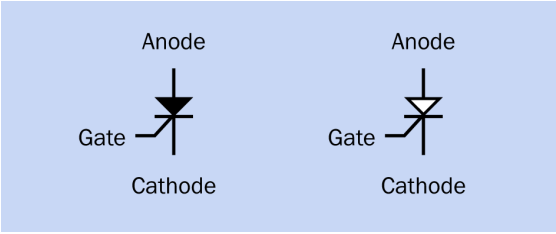

Figure 1-1. *Two functionally identical schematic symbols for an SCR (silicon-controlled rectifier). The symbol on the left is more common.*

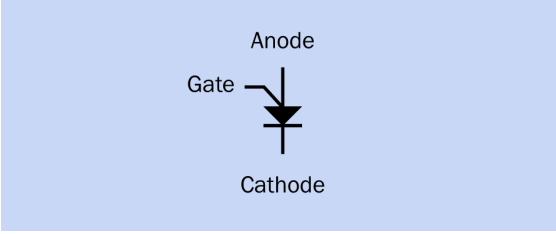

Figure 1-2. *The symbol shown here is for a programmable unijunction transistor (PUT). Care must be taken to distinguish it from the symbol for an SCR.*

Switching Behavior

When the SCR is in its passive or nonconductive state, it will block current in either direction between anode and cathode, although a very small amount of *leakage* typically occurs. When the SCR is activated by a positive voltage at the gate, current can now flow from anode to cathode, although it is still blocked from cathode to anode. When the flow reaches a level known as the *latching current*, the flow will continue even after the triggering voltage drops to zero. This behavior causes it to be known as a *regenerative* device.

If the current between anode and cathode starts to diminish while the gate voltage remains zero, the current flow will continue below the latching level until it falls below the value known as the *holding current*. The flow now ceases. Thus, the only way to end a flow of current that has been initiated through an SCR is by reducing the flow or attempting to reverse it.

Note that the self-sustaining flow is a function of current rather than voltage.

Unlike a transistor, an SCR is either "on" or "off" and does not function as a *current amplifier*. Like a diode, it is designed to conduct current in one direction; hence the term *rectifier* in its full name. When it has been triggered, the impedance between its anode and cathode is sufficiently low that heat dissipation can be managed even at high power levels.

The ability of SCRs to pass relatively large amounts of current makes them suitable for controlling the power supplied to motors and resistive heating elements. The fast switching response also enables an SCR to interrupt and abbreviate each positive phase of an AC waveform, to reduce the average power supplied. This is known as *phase control*.

SCRs are also used to provide *overvoltage protection*.

SCR packages reflect their design for a wide range of voltages and currents. Figure 1-3 shows an SCR designed for on-state current of 4A RMS (i.e., measured as the root mean square of the alternating current). Among its applications are small-engine ignition and *crowbar* overvoltage protection, so named because it shorts a power supply directly to ground, much like a crowbar being dropped across the terminals of a car battery (but hopefully with a less dramatic outcome). See Figure 1-15.

In Figure 1-4, the SCR can handle up to 800V repetitive peak off-state voltage and 55A RMS. Possible applications include AC rectification, crowbar protection, welding, and battery charging. The component in Figure 1-5 is rated for 25A and 50V repetitive peak off-state voltage. To assess the component sizes, bear in mind that the graph line spacing is 0.1".

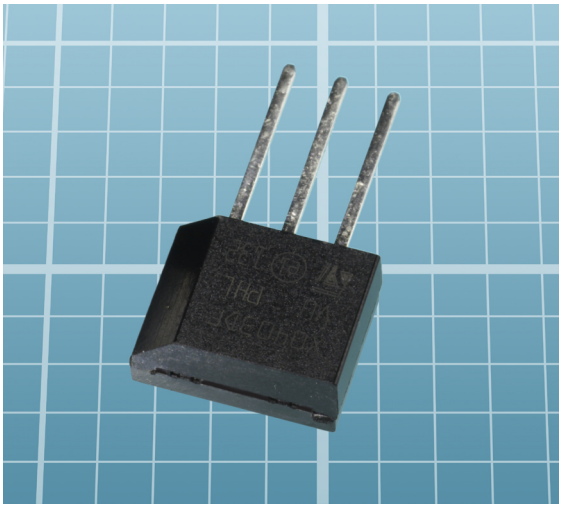

Figure 1-3. *SCR rated for 400V repetitive off-state voltage, no greater than 4A RMS.*

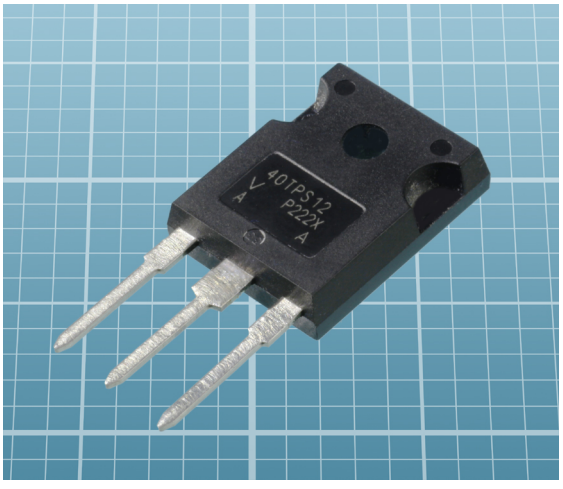

Figure 1-4. *SCR rated for 800V repetitive off-state voltage, no greater than 55A RMS.*

Internal Configuration

The function of an SCR can be imagined as being similar to that of a PNP transistor paired with an NPN transistor, as shown in Figure 1-6. In this simplified schematic, so long as zero voltage is applied to the "gate" wire, the lower (NPN) transistor remains nonconductive. Consequently, the upper (PNP) transistor cannot sink current, and this transistor also remains nonconductive.

When voltage is applied to the "gate," the lower transistor starts to sink current from the upper transistor. This switches it on. The two transistors now continue to conduct even if power to the "gate" is disconnected, because they have created a positive feedback loop.

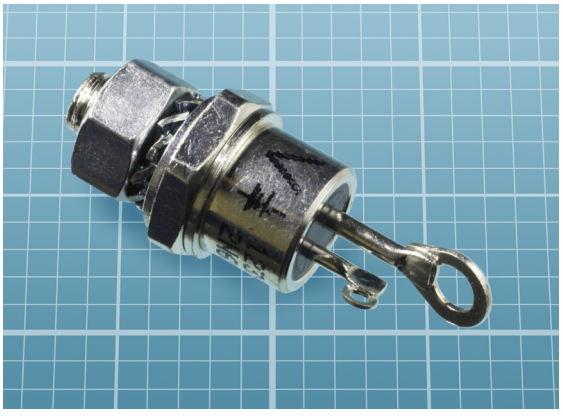

Figure 1-5. *Stud-packaged SCR rated for 50V repetitive off-state voltage, no greater than 25A RMS.*

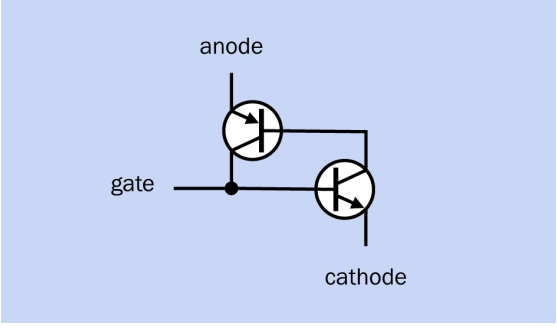

Figure 1-6. *An SCR behaves similarly to an NPN and a PNP transistor coupled together.*

Figure 1-7 shows the same two transistors in simplified form as sandwiches of p-type and n-type silicon layers (on the left), and their combination in an SCR (on the right). Although the actual configuration of silicon segments is not as simple or as linear as this diagram suggests, the SCR can be described correctly as a *PNPN device*.

An SCR is comparable with an electromagnetic **latching relay**, except that it works much faster and more reliably.

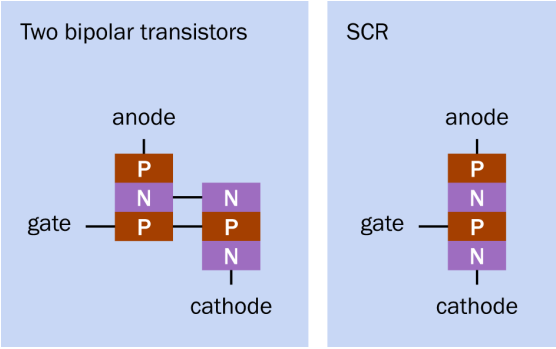

Figure 1-7. *The two transistors from the previous figure are shown here in simplified form as two stacks of p-type and n-type silicon layers. These layers are combined in an SCR, on the right.*

Breakdown and Breakover Voltage

The curves in Figure 1-8 illustrate the behavior of a hypothetical SCR, and can be compared with the curves shown for a diac in Figure 2-5 and a triac in Figure 3-10. Beginning with zero voltage applied between anode and cathode, and zero current flowing (i.e., at the center origin of the graph), if we apply a voltage at the anode that is increasingly negative relative to the cathode (i.e., we attempt to force the SCR to allow negative current flow), we see a small amount of leakage, indicated by the darker blue area (which is not drawn to scale). Finally the *breakdown voltage* is reached, at which point the negative potential overcomes the SCR and its impedance drops rapidly, allowing a surge of current to flow, probably damaging it.

Alternatively, starting once again from the center, if we apply a voltage at the anode that is increasingly positive relative to the cathode, two consequences are possible. The dashed curve assumes that there is zero voltage at the gate, and shows that some leakage occurs until the applied potential at the anode reaches the *breakover voltage*, at which point the SCR allows a large current flow, which continues even when the voltage decreases.

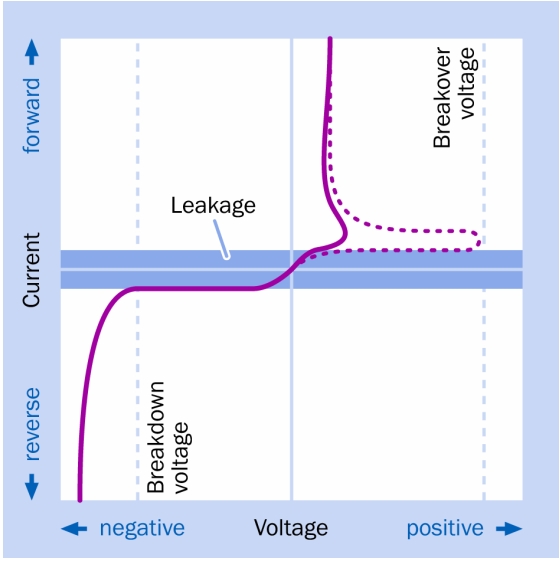

Figure 1-8. *The solid curve shows current passing between the anode and cathode of a hypothetical SCR for varying voltages, while a triggering voltage is applied to the gate. The dashed curve assumes that no triggering voltage is applied to the gate.*

In practice, the SCR is intended to respond to a positive gate voltage. Under these circumstances, its behavior is shown by the solid curve in the top-right quadrant in Figure 1-8. The SCR begins to conduct current without having to reach the breakover voltage at the anode.

- When used as it is intended, the SCR should not reach breakdown or breakover voltage levels.

SCR Concept Demo

In Figure 1-9, pushbutton S1 applies voltage to the gate of the SCR, which puts the SCR in self-sustaining conductive mode. When S1 is released, the meter will show that current continues to pass between the anode and the cathode. The X0403DF SCR suggested for this circuit has a holding current of 5mA, which a 5VDC supply should be able to provide with the 1K resistor in

the circuit. If necessary, this resistor can be reduced to 680Ω.

Now if pushbutton S2 is pressed, the flow is interrupted. When S2 is released, the flow will not resume. Alternatively, if pushbutton S3 is pressed while the SCR is conducting current, the flow is diverted around the SCR, and when the pushbutton is released, the flow through the SCR will not resume. Thus, the SCR can be shut down either by a normally closed pushbutton in series with it (which will interrupt the current), or a normally open pushbutton in parallel with it (which will divert the current).

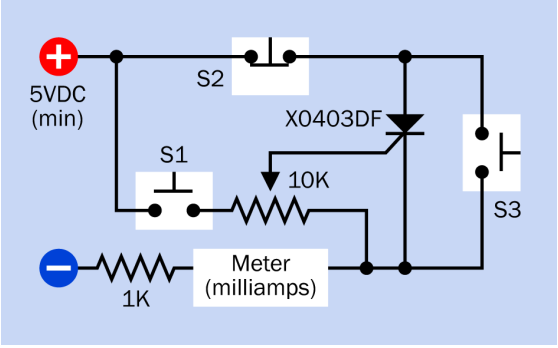

Figure 1-9. *In this test circuit, S1 triggers the SCR, while S2 or S3 will stop it. See text for additional details.*

The test circuit is shown installed on a breadboard in Figure 1-10. In this photograph, the red and blue wires supply a minimum of 5VDC. The two red buttons are tactile switches, the one at top left being S1 in the schematic while the one at bottom right is S3. The large switch with a rectangular button is S2; this is normally closed, and opens when pressed. The X0403DF SCR is just below it and to the right. The square blue trimmer is set to the midpoint of its range.

AC Current Applications

If the SCR is used with alternating current, it stops conducting during each negative cycle, and is retriggered in each positive cycle. This suggests one of its primary applications, as a controllable rectifier that can switch rapidly enough to limit the amount of current that passes through it during each cycle.

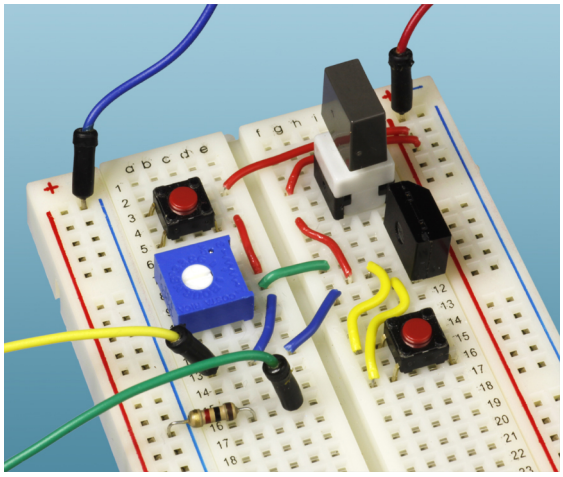

Figure 1-10. *A breadboarded version of the SCR test circuit. The two red buttons correspond with S1 and S3 in the schematic, while the large rectangular button at top right opens S2. See text for details.*

Variants

SCRs are available in surface-mount, through-hole, and stud packages, to handle increasing currents and voltages. Some special-purpose SCRs can control currents of hundreds of amps, while high-power SCRs are used to switch thousands of amps at more than 10,000V in power distribution systems. They are too specialized for inclusion in this encyclopedia.

Typical power ratings for SCRs in general use are summarized in the next section.

Values

Any SCR will impose a forward voltage drop, which typically ranges from around 1V to 2V, depending on the component.

Because SCRs are often used to modify AC waveforms, the current that the component can pass is usually expressed as the root mean square (RMS) of its peak value.

Commonly Used Abbreviations

- V_{DRM} Maximum repetitive forward voltage that may be applied to the anode while no voltage is applied to the gate (i.e., when the SCR is not in conductive mode).
- V_{RRM} Maximum repetitive reverse voltage that may be applied to the anode while no voltage is applied to the gate (i.e., when the SCR is not in conductive mode).
- V_{TM} Maximum on-state voltage while the SCR is in conductive mode. T indicates that this value changes with temperature.
- V_{GM} Forward maximum gate voltage.
- V_{GT} Minimum gate voltage required to trigger.
- V_{GD} Maximum gate voltage that will not trigger.
- I_{DRM} Peak repetitive forward blocking current (i.e., maximum leakage).
- I_{RRM} Peak repetitive reverse blocking current (i.e., leakage in the off state).
- I_{GM} Maximum forward gate current.
- $I_{T(RMS)}$ Maximum RMS current between anode and cathode while the SCR is in conductive mode. T indicates that this value changes with temperature.
- $I_{T(AV)}$ Maximum average current between anode and cathode while the SCR is in conductive mode. T indicates that this value changes with temperature.
- I_{GT} Maximum gate current required to trigger.
- I_H Typical holding current.
- I_L Maximum latching current.
- T_C Case temperature, usually expressed as an acceptable range.
- T_J Operating junction temperature, usually expressed as an acceptable range.

Surface-mount variants may tolerate maximum anode-cathode currents that typically range from 1A to 10A. Maximum voltages as high as 500V are allowed in some cases. Leakage in the "off" state may be as high as 0.5mA or as low as 5µA. Gate trigger voltage is likely to range from 0.8V to 1.5V, and trigger current of 0.2mA to 15mA is typical.

Through-hole variants may be packaged in TO-92 format (like discrete transistors) or, more commonly, in TO-220 format (like a typical 1A voltage regulator). They may be rated for a maximum of 5A up to 50A, depending on the component, with maximum voltages ranging from 50V to 500V. Leakage is similar to surface-mount variants. The gate trigger voltage is typically around 1.5V, and trigger current ranges from 25–50mA.

A stud-type SCR may have a maximum 50A to 500A current rating, although some components are capable of tolerating even higher values. Maximum voltages of 50V to 500V are possible. Leakage is likely to be higher than in other formats, with 5mA to 30mA being common. The gate trigger voltage is typically 1.5 to 3V, and trigger current may range from around 50mA to 200mA.

How to Use It

Although other applications are possible, in practice SCRs have two main applications:

- Phase control, which interrupts each positive phase of an AC power supply. It can moderate the speed of a motor or the heat generated by a resistive load.
- Overvoltage protection. This can safeguard sensitive components in a circuit where there is a DC power supply.

SCRs are often incorporated in ground-fault circuit interruptors (although not usually as discrete components) and in automotive ignition systems.

Phase Control

Phase control is a convenient way to control or limit the AC power delivered to a load by abbreviating each pulse in the AC waveform. This is done by adjusting the gate voltage so that the SCR blocks the first part of each positive phase, then conducts the remainder, and then stops conducting below its holding level. The SCR will then block the reversed flow in the negative phase of the AC waveform, but an additional SCR with opposite polarity can be added.

This is a form of *pulse-width modulation*. It is highly efficient, as the effective internal resistance of the SCR is either very high or very low, and the component does not waste significant energy in the form of heat.

On a graph showing the fluctuating voltage of an AC waveform, a single cycle is customarily divided into four stages: (1) zero voltage, (2) maximum positive voltage, (3) zero voltage, (4) minimum negative voltage, all measurements being made between the live side of the supply and the neutral side of the supply.

The cycle then repeats. Its transitions are often referred to as *phase angles* of 0 degrees, 90 degrees, 180 degrees, and 270 degrees, as shown in Figure 1-11.

The fluctuating voltage in an AC power supply is proportional with the sine of the phase angle. This concept is illustrated in Figure 1-12. If an imaginary point (shown as a purple dot) is moving in a circular path counterclockwise at a constant speed, its vertical distance (shown in green) above or below the X axis (horizontal centerline) can represent an AC voltage corresponding with the angle (shown as purple arcs) of the circle radius to the point, each angle being measured from at the center relative to a start position at right on the X axis.

When an SCR is used for phase control, the point at which it starts to conduct may be anywhere from 0 to almost 180 degrees. This is achieved by diverting a small amount of the AC power into an RC network attached to the gate of the SCR, as shown in Figure 1-13. The capacitor in this schematic introduces a delay that can be varied by the potentiometer. This enables the SCR to be triggered even after the peak of the AC power signal. In Figure 1-14, the AC power is shown by the center (green) curve, and the slightly delayed, reduced voltage at the gate is shown by the upper, purple curve. When the gate voltage rises to the trigger level, it causes the SCR to begin conducting current, creating an abbreviated output shown in the bottom curve. In this way, triggering from an AC phase angle of 0 degrees to almost 180 degrees is possible. The phase angle where the SCR begins to allow conduction is known as the *conduction angle*.

If two SCRs with opposite polarity are placed in parallel with each other, they can be used to provide phase control on both the positive-going and negative-going sections of an AC cycle. This configuration is used in high-powered devices. A **triac** is used for the same purpose with lower current.

Six SCRs may be used to control three-phase power.

Overvoltage Protection

The tolerance of an SCR for high current makes it suitable for use in a crowbar voltage limiting circuit.

In Figure 1-15, the SCR does not conduct current (other than a small amount of leakage) until the Zener diode senses a voltage above the maximum level considered safe. The diode then allows power to reach the gate of the SCR. Its impedance drops immediately, and the resulting surge of current trips the fuse. After the cause of the overvoltage condition is corrected, the fuse can be replaced and the circuit may resume functioning.

A capacitor is included so brief spikes in the power supply will be passed to ground without triggering the SCR. A resistor of around 100Ω ensures that the gate voltage of the SCR remains near zero during normal operation. When the Zener

diode starts to conduct current, the resistor acts as a voltage divider with the diode, so that sufficient voltage reaches the SCR to activate it.

This circuit may be unsuitable for low-voltage power supplies, because the Zener diode has to be chosen with a high enough rating to prevent small power fluctuations from tripping it. Bearing in mind that the real triggering voltage of the diode may be at least plus-or-minus 5% of its rated voltage, the diode may have to be chosen with at least a 6V rating in a 5V circuit, and it may not be activated until the voltage is actually 6.5V. This may be insufficient to protect the components being used with the power supply.

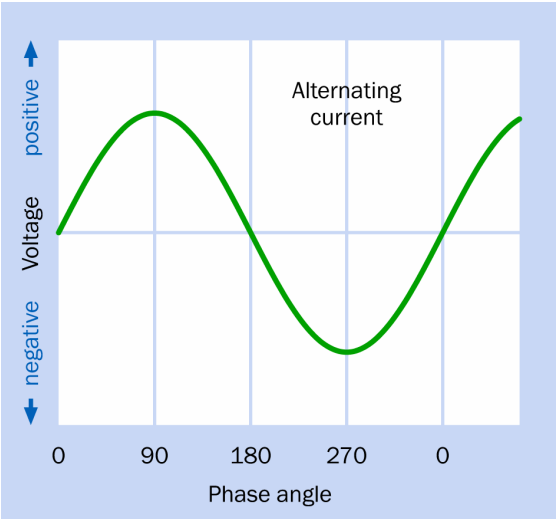

Figure 1-11. *An AC waveform is customarily measured in degrees of phase angle.*

What Can Go Wrong

Like other semiconductors, an SCR can be adversely affected by excessive heat. Usual precautions should be taken to allow sufficient ventilation and heat sinking, especially when components are moved from an open prototyping board to an enclosure in which crowding is likely.

Unexpected Triggering Caused by Heat

On a datasheet, the values for triggering current and holding current are valid only within a recommended temperature range. A buildup of heat can provoke unexpected triggering.

Unexpected Triggering Caused by Voltage

A very rapid increase in forward voltage at the anode can induce a triggering voltage in the gate by capacitive coupling. As a result, the SCR can trigger itself without any external application of gate voltage. This is sometimes known as *dv/dt triggering*. If necessary, a snubber circuit can be added across the anode input to prevent sudden voltage transitions.

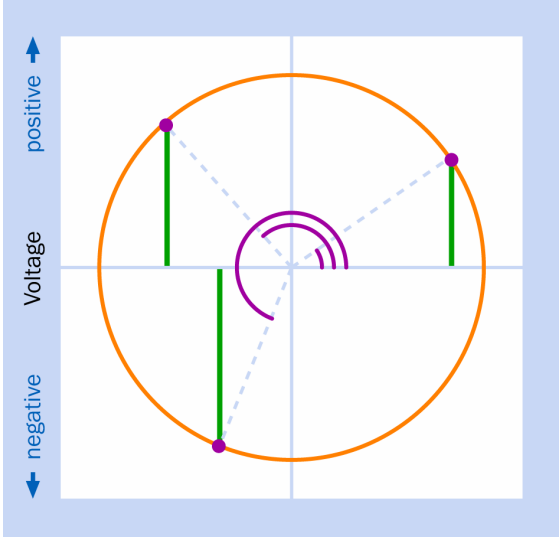

Figure 1-12. *The fluctuating voltage of an AC power supply (shown as vertical green lines) is proportional with the sines of the angles (purple arcs) in this diagram. The angles are referred to as phase angles.*

Confusion of AC and DC Ratings

The on-state current for an SCR is averaged only over the width of each pulse that the SCR actually conducts. It is not time-averaged over an entire AC cycle, and it will be different again from a DC rating. Care must be taken to match the current

rating with the way in which the component will actually be used.

Maximum Current versus Conduction Angle

Current-carrying capability will be very significantly affected by the length of the duty cycle when the SCR is being used to abbreviate each positive AC pulse. When the SCR imposes a 120-degree conduction angle, it may be able to handle twice the average on-state current as when it is imposing a 30-degree conduction angle. The manufacturer's datasheet should include a graphical illustration of this relationship. If an SCR is chosen for a high conduction angle, and the angle is later reduced, overheating will result, and damage is likely.

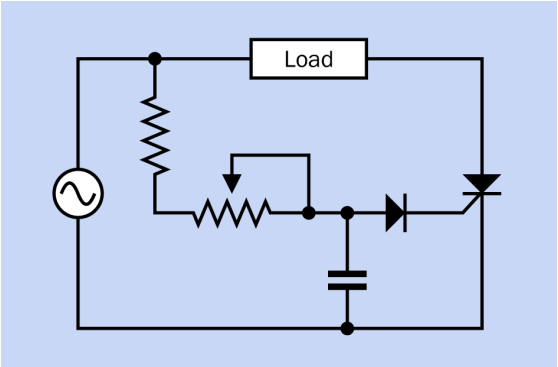

Figure 1-13. *In this schematic, an SCR is used to apply phase control, adjusting the power that passes through a load.*

Confusing Symbols

When reading a schematic, unfortunate errors can result from failure to distinguish between the symbol for a **programmable unijunction transistor (PUT)** and the symbol for an SCR. The characteristics of a PUT are described in Volume 1 of this encyclopedia.

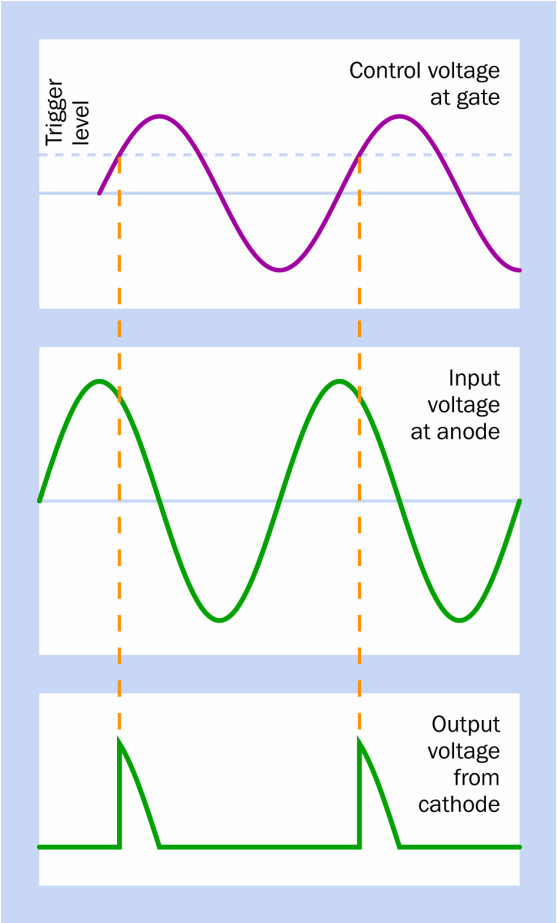

Figure 1-14. *If the AC power applied to the anode of an SCR (center) is reduced in voltage and delayed slightly by an RC network, it can trigger the SCR (top), causing it to pass only an abbreviated segment of each positive AC pulse (bottom).*

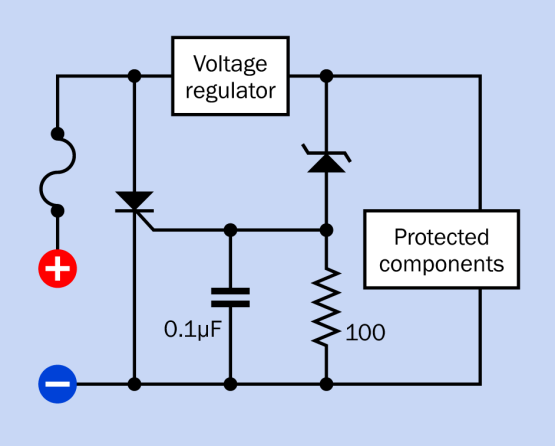

Figure 1-15. *In this schematic, an SCR is used to provide crowbar overvoltage protection for sensitive components.*

diac

2

A **diac** is a self-triggering type of *thyristor*. Its name is said to be derived from the phrase "diode for AC," and because it is not an acronym, it is not usually capitalized.

A thyristor is defined here as a semiconductor having four or more layers of p-type and n-type silicon. Because the thyristor predated integrated circuits, and in its basic form consists of a single multilayer semiconductor, it is categorized as a discrete component in this encyclopedia. When a thyristor is combined with other components in one package (as in a **solid-state relay**) it is considered to be an integrated circuit.

Other types of thyristor are the **SCR** (silicon-controlled rectifier) and the **triac**, each of which has its own entry in this encyclopedia.

Thyristor variants that are not so widely used, such as the *gate turn-off thyristor (GTO)* and *silicon-controlled switch (SCS)*, do not have entries here.

OTHER RELATED COMPONENTS

- **SCR** (see Chapter 1)
- **triac** (see Chapter 3)

What It Does

The **diac** is a bidirectional thyristor with only two terminals. It blocks current until it is subjected to sufficient voltage, at which point its impedance drops very rapidly. It is primarily used to trigger a **triac** for purposes of moderating AC power to an **incandescent lamp**, a resistive heating element, or an AC **motor**. The two leads on a diac have identical function and are interchangeable.

By comparison, a **triac** and an **SCR** are thyristors with three leads, one of them being referred to as the gate, which determines whether the component becomes conductive. A triac and a diac allow current to flow in either direction, while an SCR always blocks current in one direction.

Symbol Variants

The schematic symbol for a diac, shown in Figure 2-1, resembles two diodes joined together, one of them inverted relative to the other. Functionally, the diac is comparable with a pair of Zener diodes, as it is intended to be driven beyond the point where it becomes saturated. Because its two leads are functionally identical, they do not require names to differentiate them. They are sometimes referred to as A1 and A2, in recognition that either of them may function as an anode; or they may be identified as MT1 and MT2, MT being an acronym for "main terminal."

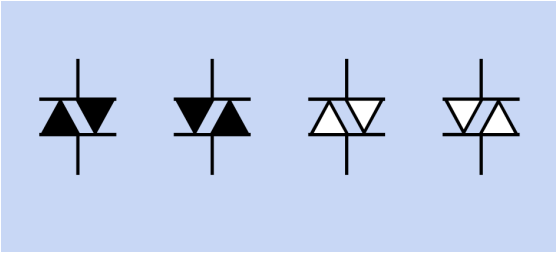

Figure 2-1. *Symbol variants to represent a diac. All four are functionally identical.*

The symbol may be reflected left to right, and the black triangles may have open centers. All of these variants mean the same thing. Occasionally the symbol has a circle around it, but this style is now rare.

When only a moderate voltage is applied (usually less than 30V) the diac remains in a passive state and will block current in either direction, although a very small amount of *leakage* typically occurs. When the voltage exceeds a threshold known as its *breakover level*, current can flow, and the diac will continue to conduct until the current falls below its *holding level*.

A sample diac is shown in Figure 2-2.

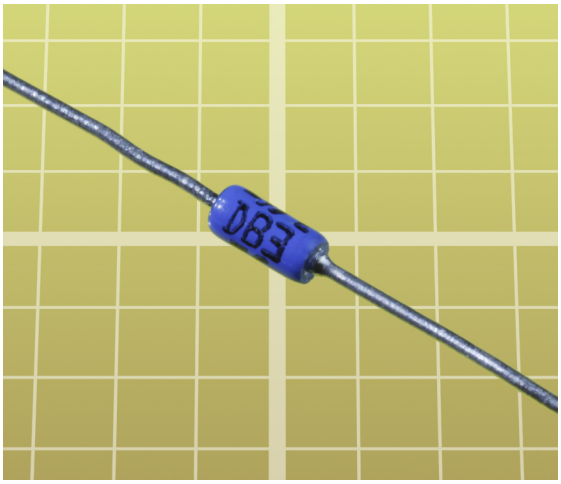

Figure 2-2. *Because a diac is not intended to pass significant current, it is typically packaged in a small format. The graph squares in the photograph each measure 0.1".*

How It Works

Figure 2-3 shows a circuit that demonstrates the conductive behavior of a diac.

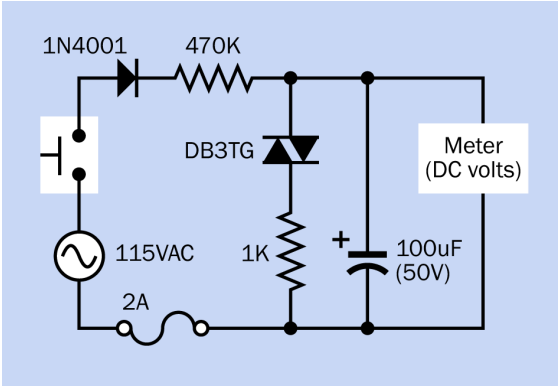

Figure 2-3. *A test circuit to demonstrate the behavior of a diac. See text for details.*

When the pushbutton is held down, current from the positive side of the AC supply flows through the diode and the 470K resistor to the capacitor. The diac is not yet conductive, so the capacitor accumulates a potential that can be monitored with the volt meter. After about 30 seconds, the charge on the capacitor reaches 32V. This is the breakover voltage for this particular diac, so it becomes conductive. The positive side of the capacitor can now discharge through the diac and the 1K series resistor to ground.

If the pushbutton is released at this moment, the meter will show that the capacitor discharges to a potential below the holding level of the diac. The capacitor now stops discharging because the diac has ceased being conductive.

If the pushbutton is held down constantly, the meter will show the capacitor charging and then discharging through the diac repeatedly, so that the circuit behaves as a *relaxation oscillator*. The 1K series resistor is included to protect the diac from excessive current. If a standard quarter-watt resistor is used, it should not become unduly warm because current passes through it only intermittently.

- Because this circuit uses 115VAC, basic precautions should be taken. The fuse should not be omitted, the capacitor should be rated for at least 50V, and the circuit should not be touched while it is connected to the power source. Breadboarding a circuit using this voltage requires caution and experience, as wires can easily come loose, and components can be touched accidentally while they are live.

Figure 2-4 shows the test circuit on a breadboard. The red and blue leads at the top of the photograph are from a fused 115VAC power supply. The live side of the supply passes through a diode to a pushbutton switch that has a rectangular black cap. A 470K resistor connects the other side of the switch to the positive side of a 100µF electrolytic capacitor, and also to the diac (small blue component). A 1K resistor connects the other end of the diac back to the negative side of the capacitor, which is grounded. The yellow and blue wires leaving the photograph at the left are connected with a volt meter, which is not shown.

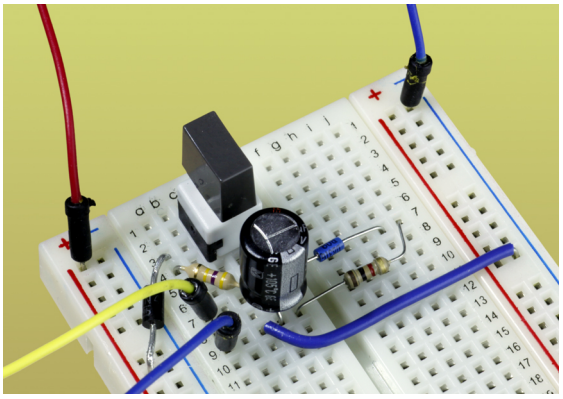

Figure 2-4. *A breadboarded version of the diac test circuit. See text for details.*

The behavior of a diac is also illustrated in Figure 2-5, which can be compared with the curves in Figures 3-10 and 1-8, depicting the behavior of a triac and an SCR respectively.

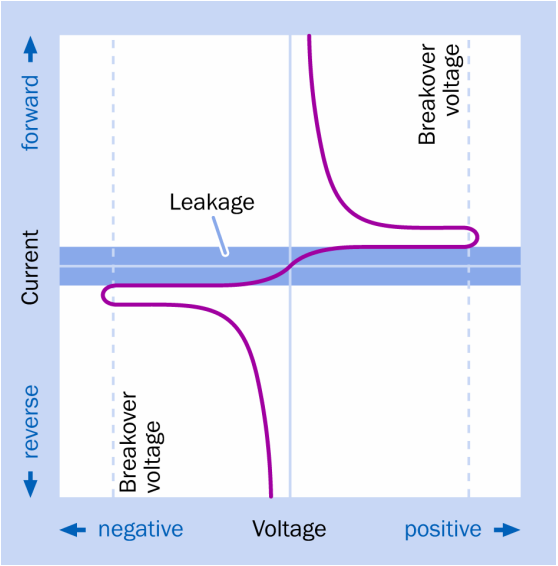

Figure 2-5. *The curve shows current passing through a diac when various voltages are applied.*

Switching AC

The diac cannot function as a switch, because it lacks the third terminal which is found in a triac, an SCR, or a bipolar transistor. However, it is well suited to drive the gate of a triac, because the behavior of a diac is symmetrical in response to opposite voltages, while the triac is not. If an AC voltage applied to a diac is adjusted with a potentiometer in an RC circuit, the diac will pass along a portion of each positive or negative pulse, and will delay it by a brief amount of time determined by the value of the capacitor in the RC circuit and the setting of the potentiometer. This is known as *phase control*, as it controls the *phase angle* at which the diac allows current to flow.

See Figure 3-13 for a schematic showing a diac driving a triac. See Figures 1-14 and 3-11 for graphs illustrating phase control. See "Phase Control" for a discussion of phase in AC waveforms.

Variants

Diacs are available in through-hole and surface-mount formats. Because they are not intended

to handle significant current, no heat sink is included.

A *sidac* behaves very similarly to a diac, its name being derived from "silicon diode for alternating current." Its primary difference from generic diacs is that it is designed to reach its breakover voltage at a higher value, typically 120VAC or 240VAC.

Values

When performing its function to trigger a triac, a diac is unlikely to pass more than 100mA.

The breakover voltage of a diac is usually between 30V and 40V, with a few versions designed for up to 70V. When the diac starts to conduct, its on-state impedance is sufficient to reduce the voltage significantly, with 5V being a typical minimum output voltage.

Although the rise time when a diac responds is very brief (around 1µs), the component is not expected to run at a high frequency. It will normally be used with 50Hz or 60Hz AC to trigger a triac. For this reason, its repetitive peak on-state current is usually specified at no more than 120Hz.

Abbreviations in datasheets are likely to include:

- V_{BO} Breakover voltage (sometimes may be specified as latching voltage, which for a diac is the same thing).
- V_{BO1} - V_{BO2} Breakover voltage symmetry. The hyphen is intended as a minus sign, so that this value is the maximum difference between breakover voltage in each direction.
- V_O Minimum output voltage.
- I_{TRM} Repetitive peak on-state current.
- I_{BO} Breakover current, usually the maximum required, and less than 20µA.
- I_R Maximum leakage current, usually less than 20µA.
- T_J Operating junction temperature, usually expressed as an acceptable range.

What Can Go Wrong

Like other semiconductors, a diac is heat sensitive. Usual precautions should be taken to allow sufficient ventilation and heat sinking, especially when components are moved from an open prototyping board to an enclosure in which crowding is likely.

Unexpected Triggering Caused by Heat

On a datasheet, a value for breakover current is valid only within a recommended temperature range. A buildup of heat can provoke unexpected triggering.

Low-Temperature Effects

A higher breakover voltage will be required by a diac operating at low temperatures, although the variation is unlikely to be greater than plus-or-minus 2% within a normal operating range. Temperature has a much more significant effect on a triac.

Manufacturing Tolerances

The breakover voltage for a diac is not adjustable, and may vary significantly between samples of the component that are supposed to be identical. The diac is not intended to be used as a precision component. In addition, while its breakover voltage should be the same in either direction, a difference of plus-or-minus 2% is possible (1% in some components).

triac

3

A **triac** is a gate-triggered type of *thyristor*. Its name was probably derived from the phrase "triode for AC," and because it is not an acronym, it is not usually capitalized.

A thyristor is defined here as a semiconductor having four or more layers of p-type and n-type silicon. Because the thyristor predated integrated circuits, and in its basic form consists of a single multilayer semiconductor, it is categorized as a discrete component in this encyclopedia. When a thyristor is combined with other components in one package (as in a **solid-state relay**) it is considered to be an integrated circuit.

Other types of thyristor are the **SCR** (silicon-controlled rectifier) and the **diac**, each of which has its own entry in this encyclopedia.

Thyristor variants that are not so widely used, such as the *gate turn-off thyristor (GTO)* and *silicon-controlled switch (SCS)*, do not have entries here.

OTHER RELATED COMPONENTS

- **SCR** (see Chapter 1)
- **diac** (see Chapter 2)

What It Does

The **triac** is ubiquitous in AC dimmers for **incandescent lamps**. It is also used to control the speed of AC motors and the output of resistive heating elements. It is a type of *thyristor* which contains five segments of p-type and n-type silicon and has three leads, one of them attached to a gate that can switch a bidirectional flow of current between the other two. Its name was originally a trademark, generally thought to be derived from the phrase "triode for AC." A triode was a common type of vacuum tube when thyristors were first introduced in the 1950s.

By comparison, a **diac** is a thyristor with only two leads, allowing current to flow in either direction when the component reaches a *breakover voltage*. Its name was probably derived from the phrase "diode for AC." It is often used in conjunction with a triac.

An **SCR** (silicon-controlled rectifier) is a thyristor that resembles a triac, as it has three leads, one of them a gate. However, it only allows current to flow in one direction.

Symbol Variants

The schematic symbol for a triac, shown in Figure 3-1, resembles two diodes joined together, one of them inverted relative to the other. While a triac does not actually consist of two diodes, it is functionally similar, and can pass current in either direction.

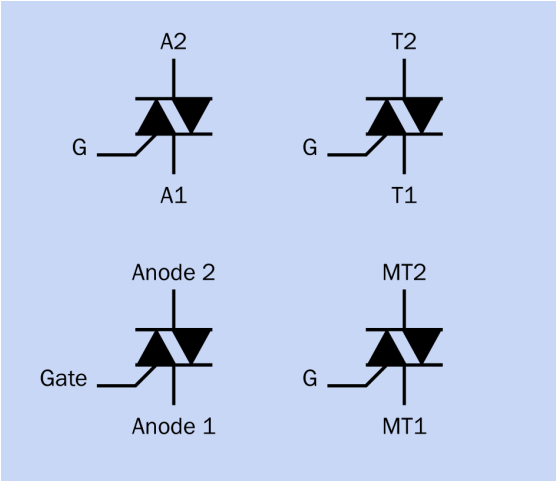

Figure 3-1. *The schematic symbol for a triac, with four naming conventions that are used for its leads. The different conventions do not indicate any functional difference.*

An appended bent line represents the gate. The labels for the other two leads are not standardized, and can be referred to as A1 and A2 (for Anode 1 and Anode 2), or T1 and T2 (for Terminal 1 and Terminal 2), or MT1 and MT2 (for Main Terminal 1 and Main Terminal 2). The choice of terms does not indicate any functional difference. In this encyclopedia entry, A1 and A2 are used.

The A1 terminal (or T1, or MT1) is always shown closer to the gate than A2 (or T2, or MT2). This distinction is important because although the triac can pass current in either direction, its behavior is somewhat asymmetrical.

- Voltages are expressed relative to terminal A1 (or T1, or MT1, if those terms are used).

The schematic symbol may be reflected or rotated, the black triangles may have open centers, and the placement of the bent line representing the gate may vary. However, terminal A1 is always nearer to the gate than terminal A2.

Figure 3-2 shows 12 of the 16 theoretical possibilities. All of these variants are functionally identical. Occasionally the symbol has a circle around it, but this style is now rare.

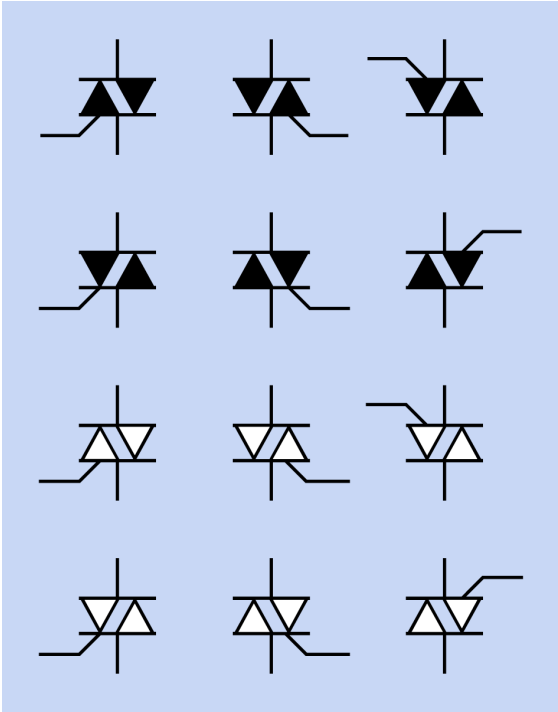

Figure 3-2. *Interchangeable variants of the schematic symbol for a triac.*

Triacs with various characteristics are shown in Figures 3-3, 3-4, and 3-5.

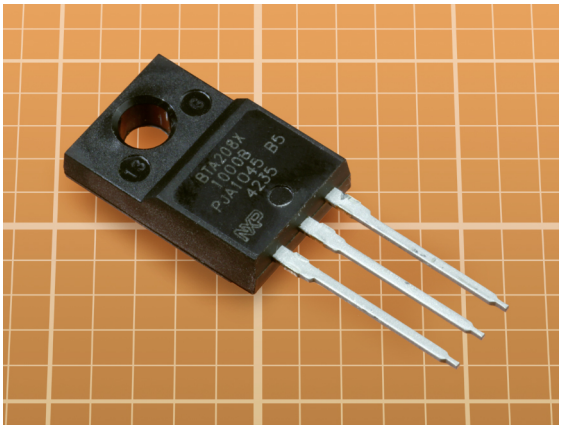

Figure 3-3. *The BTA208X-1000B triac can conduct 8A continuous on-state current RMS, and withstands peak off-state voltage of up to 1,000V. This is a "snubberless" triac.*

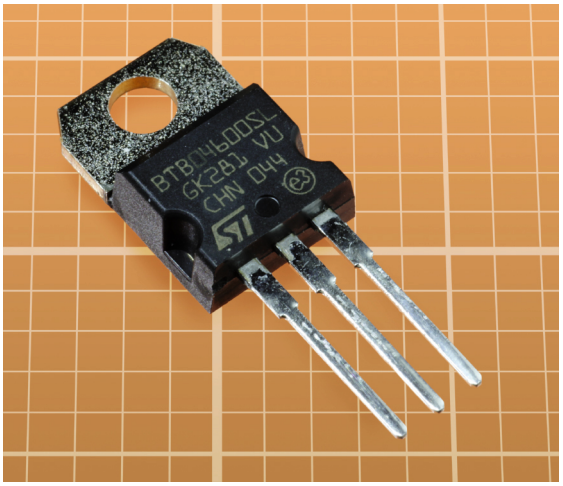

Figure 3-4. *The BTB04-600SL triac can conduct 4A continuous on-state current RMS, and withstands peak off-state voltage of up to 600V.*

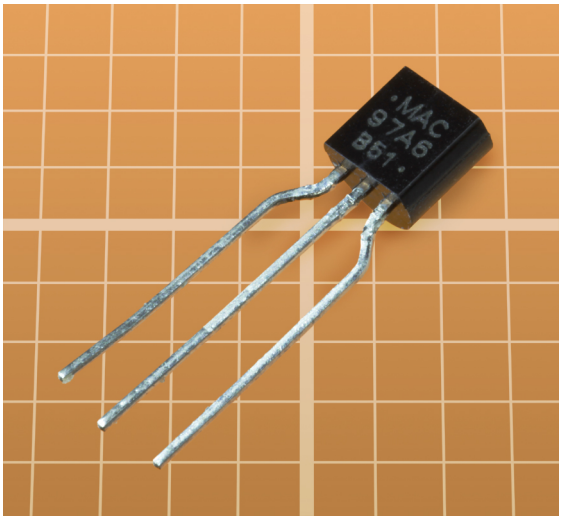

Figure 3-5. *The MAC97A6 triac can conduct 0.8A continuous on-state current RMS, and withstands peak off-state voltage of up to 400V.*

How It Works

When no gate voltage is applied, the triac remains in a passive state and will block current in either direction between A1 and A2, although a very small amount of *leakage* typically occurs. If the gate potential becomes sufficiently positive *or* negative relative to terminal A1, current can begin to flow between A1 and A2 in *either* direction. This makes the triac ideal for controlling AC.

Quadrants

While a gate voltage is applied, four operating modes are possible. In each case, A1 is the reference (which can be thought of as being held at a neutral ground value). Because the triac is conducting AC, voltages above and below ground will occur. The four modes of operation are often referred to as four *quadrants*, and are typically arranged as shown in Figure 3-6.

In some reference sources (especially educational text books), current is shown with an arrow indicating a flow of electrons moving from negative to positive. Because the type of current flow is often undefined, diagrams should be interpreted carefully. In this encyclopedia, current is always shown flowing from a more-positive location to a more-negative location.

Quadrant 1 (upper right)
: A2 is more positive than A1, and the gate is more positive than A1. Conventional current (positive to negative) will flow from A2 to A1. (This behavior is very similar to that of an **SCR**.)

Quadrant 2 (upper left)
: A2 is more positive than A1, and the gate is more negative than A1. Once again, conventional current (positive to negative) will flow from A2 to A1.

Quadrant 3 (lower left)
: A2 is more negative than A1, and the gate is more negative than A1. Conventional current is reversed from A1 to A2.

Quadrant 4 (lower right)
: A2 is more negative than A1, but the gate is more positive than A1. Conventional current is reversed from A1 to A2.

- Note that two positive symbols or two negative symbols in Figure 3-6 do not mean that both locations are of equal voltage. They simply mean that these

locations are at potentials that are significantly different from A1.

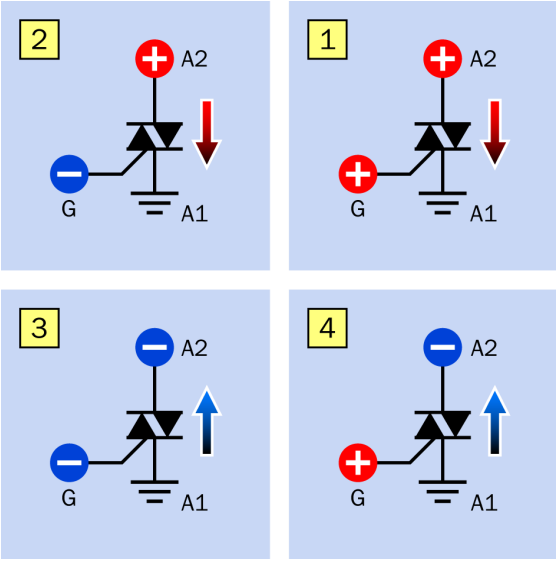

Figure 3-6. *The "quadrants" of triac behavior. Positive and negative symbols indicate which terminal is "more positive" or "more negative" than A1. The ground symbol represents a potential midway between positive and negative. See text for details.*

Suppose that gate current increases gradually. When it reaches the *gate threshold current* of the triac, the component starts conducting between A1 and A2. If the current between A1 and A2 rises above the value known as the *latching current*, it will continue to flow, even if gate current disappears completely.

If the self-sustaining current through the triac gradually diminishes, while there is no voltage applied to the gate, conduction between the main terminals will stop spontaneously when it falls below a level known as the *holding current*. This behavior is similar to that of an SCR. The triac now returns to its original state, blocking current until the gate triggers it again.

The triac is sufficiently sensitive to respond to rapid fluctuations, as in 50Hz or 60Hz AC.

Threshold, Latching, and Holding Current

Figure 3-7 shows the relationship between the gate threshold current, the latching current, and holding current. In the upper half of the figure, gate current is shown fluctuating until it crosses the threshold level. This establishes current flow between the main terminals, shown in the lower half of the figure. Prior to this moment, a very small amount of leakage current occurred (shown in the figure, but not to scale).

In this hypothetical scenario, the triac starts passing current between external components—and the current exceeds the latching level. Consequently, gate current can diminish to zero, and the triac remains conductive. However, when external factors cause the current between the main terminals to diminish below the holding level, the triac abruptly ceases to be conductive, and current falls back to the leakage level.

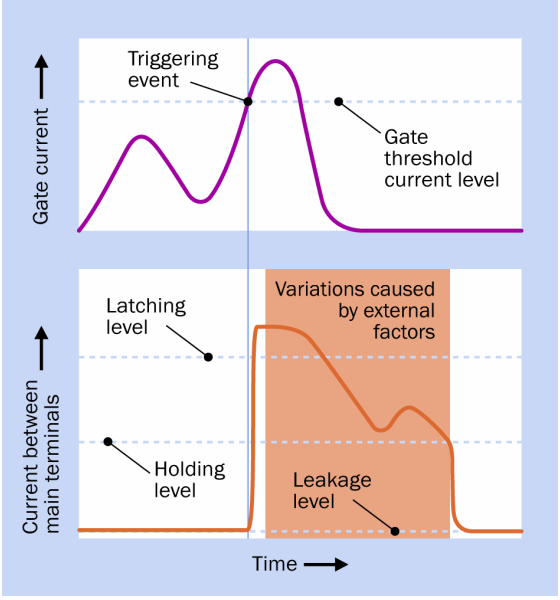

Figure 3-7. *The relationship between gate current of a triac and the current between its main terminals. See text for details.*

Unlike a **bipolar transistor**, a triac is either "on" or "off" and does not function as a *current ampli-*

fier. When it has been triggered, the impedance between A1 and A2 is low enough for heat dissipation to be manageable even at relatively high power levels.

Triac Testing

Figure 3-8 shows a circuit which can demonstrate the conductive behavior of a triac. For simplicity, this circuit is DC powered. In a real application, the triac is almost always used with AC.

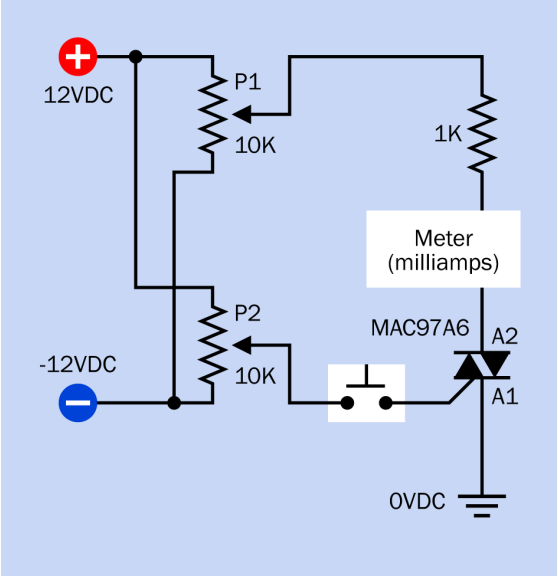

Figure 3-8. *A test circuit to show the behavior of a triac when varying positive and negative potentials are applied to the gate and to the A2 terminal, relative to A1.*

Note that this circuit requires at least a +12VDC and -12VDC power supply (higher values may also be used). The ground symbol represents a midpoint voltage of 0VDC, applied to terminal A1 of the triac, which is an MAC97A6 or similar. If a dual-voltage power supply is unavailable, the gate of the triac can be connected directly to +12VDC, omitting potentiometer P2; but in this case, only two operating modes of the triac can be demonstrated by turning potentiometer P1.

Each potentiometer functions as a voltage divider between the positive and negative sides of the power supply. P1 applies a positive or negative voltage to A2, relative to A1. P2 applies a positive or negative voltage to the gate, relative to A1.

If the test begins with both potentiometers at the top ends of their range, A1 and G both have a positive potential relative to A1, so that the triac is now in quadrant 1 of its operating modes. Pressing the pushbutton should cause it to start conducting current limited by the 1K resistor, and the meter should change from measuring 0mA to around 12mA. If the pushbutton is released, the triac should continue to conduct current, because 12mA is above this triac's latching level. If P1 is slowly moved toward the center of its range, the current diminishes, ceasing when it falls below the holding level. If P1 is now moved back to the top of its range, the current will not resume until the triac is retriggered with the pushbutton.

The test can be repeated with P1 at the top of its range and P2 at the bottom of its range, to operate the triac in quadrant 2; P1 at the bottom of its range and P2 at the bottom of its range, to operate the triac in quadrant 3; and P1 at the bottom of its range and P2 at the top of its range, to operate the triac in quadrant 4. The functionality should be the same in each case. The pushbutton will initiate a flow of current, which will diminish when P1 is turned toward the center of its range.

In any of these quadrants, P2 can be turned slowly toward the center of its range while the pushbutton is pressed repeatedly. This will allow empirical determination of the gate threshold current for this triac. The meter, measuring milliamps, will measure the current if it is inserted between the wiper of the potentiometer and the gate of the triac.

The test circuit is shown installed on a breadboard in Figure 3-9. In this photograph, the red and blue wires at left supply +12VDC and -12VDC relative to the black ground wire at top right. The yellow and green wires connect with a meter set to measure milliamps. The red button is a tactile switch, while the MAC97A6 triac is just above it

and to the left. The square blue 10K trimmers are set to opposite ends of their scales, so that the meter will show current flowing when the tactile switch is pressed.

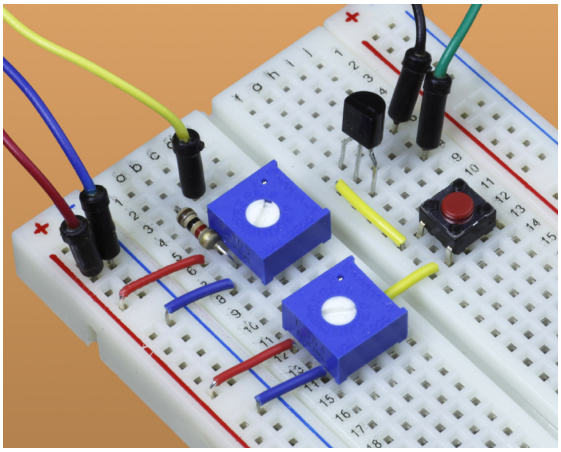

Figure 3-9. *A breadboarded triac test circuit.*

Breakover Voltage

If a much higher voltage is applied to A2, the triac can be forced to conduct current without any triggering voltage being applied to the gate. This occurs when the potential between A1 and A2 reaches the triac's *breakover voltage*, although the component is not designed to be used this way. The concept is illustrated in Figure 3-10, which can be compared with the behavior of an SCR illustrated in Figure 1-8 and the behavior of a diac shown in Figure 2-5. While the term *breakdown voltage* defines the minimum reverse voltage required to force a diode to conduct, *breakover voltage* refers to the minimum forward voltage that has this effect. Because a triac is designed to conduct in both directions, it can be thought of as having a breakover voltage in both directions.

In Figure 3-10, the numbers in yellow squares are the quadrants referred to in Figure 3-6. The solid curve represents current flow if a triggering voltage is applied to the gate while a positive or negative potential is applied to A2, relative to A1. If the gate is not triggered while the voltage between A1 and A2 gradually increases, the dashed section of the curve illustrates the outcome when the component reaches breakover voltage. Although this may not damage the triac, the component becomes uncontrollable.

- In normal usage, the voltage between A1 and A2 should not be allowed to reach breakover level.

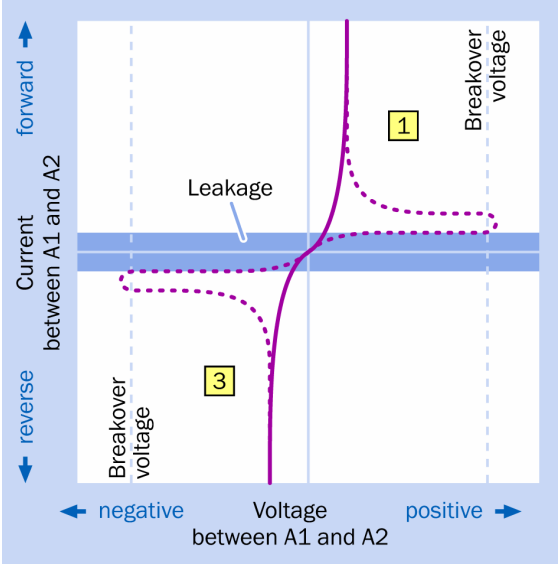

Figure 3-10. *The solid curve shows current passing between A1 and A2 in a hypothetical triac, for varying voltages, while triggering voltage is applied to the gate. The dashed curve assumes that no triggering voltage is applied to the gate. The numbers in yellow squares are the quadrants of triac operation.*

Switching AC

"Switching" AC with a triac means interrupting each pulse of current so that only a portion of it is conducted through to the load. Usually this is done with the triac functioning in quadrants 1 and 3. In quadrant 3, the polarity of the flow between A1 and A2 is opposite to that in quadrant 1, and the gate voltage is also reversed. This enables a relatively simple circuit to control the duration of each half-cycle passing through the triac. The theory of this circuit is shown in Figure 3-11.

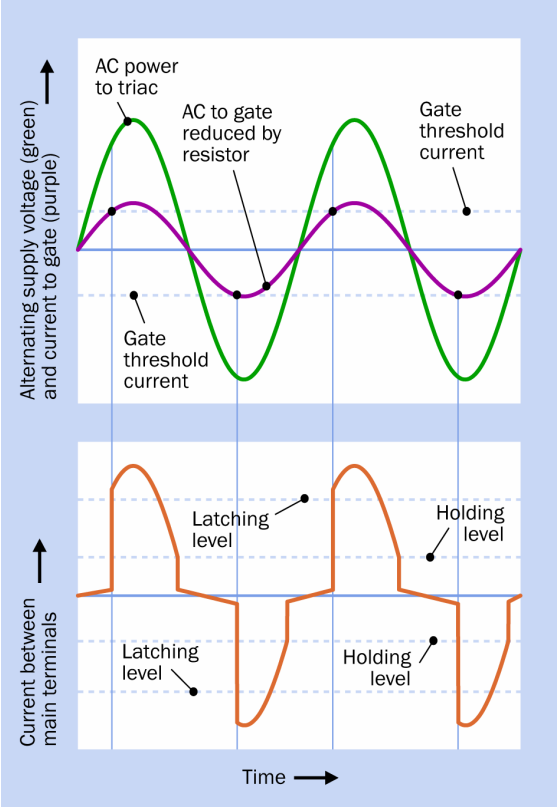

Figure 3-11. *To moderate the power of AC current, a triac can block a section of each AC pulse.*

The upper section of Figure 3-11 shows alternating voltage to the triac in green. The purple curve represents the gate current of the triac, reduced by a variable resistor. (The figure is for conceptual purposes only; the alternating power supply voltage and the fluctuating gate current cannot actually share the same vertical scale of a graph.)

Figure 3-11 can be compared with Figure 3-7, except that the negative threshold level for the gate is now shown as well as the positive threshold level. Remember, either a positive or negative voltage can activate the gate.

In Figure 3-11, initially the triac is nonconductive. As time passes, the gate current reaches the threshold level, and this triggering event enables current to flow between the main terminals of the triac, as shown in the lower part of the figure. This current exceeds the latching level, so it continues to flow, even though the gate current diminishes below its threshold level. Finally the current between the main terminals falls below the holding level, at which point the triac stops conducting. It waits for the next triggering event, which occurs as the power supply swings to negative.

This simple system blocks a section of each AC pulse, which will vary in length depending how much current is allowed to flow through the gate. Because the blocking process occurs rapidly, we notice only the reduced overall power passing through the triac (in terms of the brightness of a light, the heat emitted by a resistive element, or the speed of a motor).

Unfortunately, there is a problem in this scenario: the triac does not quite behave symmetrically. Its gate threshold level for positive current is not exactly equal and opposite to its gate threshold level for negative current. The upper part of Figure 3-11 shows this flaw in the differing vertical offsets of the positive and negative thresholds from the central zero line.

The result is that negative AC pulses through the triac are shorter than positive pulses. This asymmetry produces harmonics and noise that can feed back into power supply wiring, interfering with other electronic equipment. The actual disparities in gate response, in each quadrant of operation for two triacs, are shown in Figure 3-12.

Current capacity of triac	Ratio of gate current required to conduct, relative to quadrant 1		
	Quadrant 2	Quadrant 3	Quadrant 4
4 amp	1.6	2.5	2.7
10 amp	1.5	1.4	3.1

Figure 3-12. *Because the internal structure of a triac is asymmetrical, it requires a different trigger current in each of its operating quadrants. This table, derived from a Littelfuse technical briefing document, shows the ratio of the minimum trigger current in quadrants 2, 3, and 4 relative to quadrant 1.*

See Figure 1-14 for a graph illustrating phase control in the SCR. See "Phase Control" for a discussion of phase in AC waveforms generally.

Triac Triggered by a Diac

The problem of asymmetrical triggering can be overcome if the triac is triggered with a voltage pulse generated by another component that does behave symmetrically. The other component is almost always a diac, which is another type of thyristor. Unlike an SCR or a triac, it has no gate. It is designed to be pushed beyond its breakover voltage, at which point it latches and will continue to conduct until current flowing through it diminishes below its holding level. See Chapter 2 for more information about the diac.

In Figure 3-13, the diac is shown to the right of the triac, and is driven by a simple RC network consisting of a fixed resistor, a potentiometer, and a capacitor. (In an actual application, the RC network may be slightly more complex.) The capacitor takes a small amount of time to charge during each half-cycle of AC. The length of this delay is adjusted by the potentiometer, and determines the point in each AC half-cycle when the voltage to the diac reaches breakover level. Because the delay affects the phase of the AC, this adjustment is known as *phase control*.

As the voltage exceeds breakover level, the diac starts to pass current through to the gate of the triac, and triggers it. The holding level of the diac is lower than its latching level, so it continues to pass current while the capacitor discharges and the voltage diminishes. When the current falls below the holding level, the diac stops conducting, ready for the next cycle. Meanwhile, the triac continues to pass current until the AC voltage dips below its holding level. At this point, the triac becomes nonconductive until it is triggered again.

This chopped waveform will still create some harmonics, which are suppressed by the coil and capacitor at the left side of the circuit in Figure 3-13.

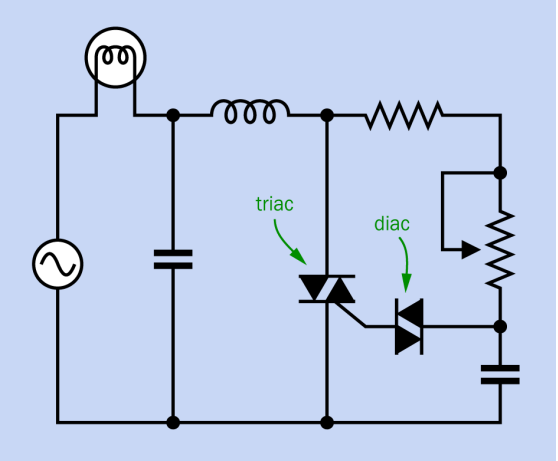

Figure 3-13. *A minimal schematic showing typical operation of a triac, with a diac supplying pulses to the triac gate. The potentiometer adjusts the delay created by the capacitor.*

Other Triac Drivers

It is possible, although unusual, to drive a triac from a source other than a diac.

Simple on-off control can be achieved by using a special optocoupler such as the MOC3162 by Fairchild Semiconductor. This emits a switching signal to a triac only when the AC voltage passes through zero. A *zero cross* circuit is desirable because it creates much less interference. The use of an optocoupler helps to isolate the triac from other components.(((“zero cross circuit”))

Phase control can be achieved using an optocoupler such as the H11L1, which can be driven by rectified but unsmoothed AC after it passes through a Zener diode to limit the voltage. The output from the optocoupler is logic-compatible and can be connected with the input to a timer such as the 555, set to one-shot mode. Each pulse from the timer passes through another optocoupler such as the MOC3023, which uses an internal LED to trigger the gate of a triac.

Yet another possibility is to use the programmed output from a microcontroller, through an optocoupler, to control the gate of a triac. An online

search for the terms "microcontroller" and "triac" will provide some additional suggestions.

Charge Storage

While switching AC, the internal charge between A1 and A2 inside the triac requires time to dissipate before the reverse voltage is applied; otherwise, *charge storage* occurs, and the component may start to conduct continuously. For this reason, the triac is normally restricted to relatively low frequencies such as domestic 60Hz AC power.

When a triac controls a motor, the phase lag between voltage and current associated with an inductive load can interfere with the triac's need for a transitional moment between a positive and negative voltage cycle. In a datasheet, the term *commutating dv/dt* defines the rate of rise of opposite polarity voltage that the triac can withstand without locking into a continuous-on state.

An RC *snubber network* is often wired in parallel with A1 and A2 to control the rise time of voltage to the triac, as shown within the darker blue rectangle in Figure 3-14, where a resistor and capacitor have been added just to the left of the triac. The highest resistance and lowest capacitance, consistent with trouble-free operation, should be chosen. Typical values are 47Ω to 100Ω for the resistor, and 0.01µF to 0.1µF for the capacitor.

Variants

Triacs are available in through-hole and surface-mount packages.

Some components that are referred to as triacs actually contain two SCR components of opposite polarity. The "alternistor" range from Littelfuse is an example. The SCR will tolerate faster voltage rise times than a conventional triac, and is more suitable for driving inductive loads such as large motors.

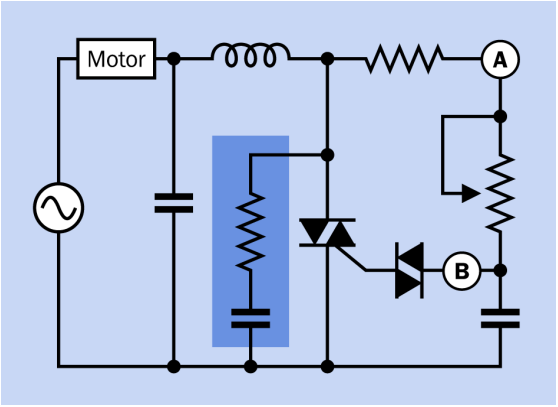

Figure 3-14. *To prevent a triac from locking itself into a continuous-on state while driving an inductive load such as a motor, a snubber circuit can be added (shown here as a resistor and capacitor in the darker blue rectangle to the left of the triac).*

A *snubberless triac*, as its name implies, is designed to drive an inductive load without need for a snubber circuit. An example is the STMicroelectronics BTA24. Datasheets for this type of component impose some limits that may be stricter than for a generic triac.

Values

Surface-mount triacs are typically rated between 2A to 25A of switched AC current (RMS), the higher-current versions being as large as 10mm square. The necessary gate trigger voltage may range from 0.7V to 1.5V. Through-hole packages may be capable of slightly higher currents (up to 40A), with gate trigger voltages of 1V to 2.5V being common.

As noted previously, the majority of triacs are restricted to relatively low frequency switching, 60Hz being very common.

Abbreviations in datasheets are likely to include:

- V_{DRM} or V_{RRM} Peak repetitive reverse off-state voltage. The maximum reverse voltage that the component will withstand in its "off" state without experiencing damage or allowing current to pass.

- V_{TM} The maximum voltage difference between A1 and A2, measured with a short pulse width and low duty cycle.
- V_{GT} Gate trigger voltage necessary to produce the gate trigger current.
- I_{DRM} Peak repetitive blocking current (i.e., maximum leakage).
- I_{GM} Maximum gate current.
- I_{GT} Minimum gate trigger current.
- I_H Holding current.
- I_L Latching current.
- $I_{T(RMS)}$ On-state RMS current. The maximum value passing through the component on a continuous basis.
- I_{TSM} Maximum non-repetitive surge current. Specified at a stated pulse width, usually 60 Hz.
- T_C Case temperature, usually expressed as an acceptable range.
- T_J Operating junction temperature, usually expressed as an acceptable range.

What Can Go Wrong

Like other semiconductors, a triac is heat sensitive. Usual precautions should be taken to allow sufficient ventilation and heat sinking, especially when components are moved from an open prototyping board to an enclosure in which crowding is likely.

Unexpected Triggering Caused by Heat

On a datasheet, a value for triggering current is valid only within a recommended temperature range. A buildup of heat can provoke unexpected triggering.

Low-Temperature Effects

Significantly higher gate current will be required by a triac operating at low temperatures. It is quite possible that the component will need twice as much current at 25° C compared with 100° C, junction temperature. If the triac receives insufficient current, it will not turn on.

Wrong Type of Load

If an **incandescent lamp** is replaced with a **fluorescent light** or **LED area lighting**, a pre-existing triac may no longer work as a dimmer. Fluorescent lamps will have some inductance, and may also provide a capacitive load, either of which will interfere with the normal behavior of a triac.

The light output of an LED varies very differently compared with the light output of an incandescent bulb, in response to reduction in power. Therefore an LED should be dimmed using pulse-width modulation that is appropriate for its output characteristics. A triac is generally not suitable.

Wrongly Identified Terminals

A triac is often thought of as a symmetrical device, because it is designed to switch AC current using either positive or negative voltage at the gate. In reality, its behavior is asymmetrical, and if it is installed "the wrong way around" it may function erratically or not at all.

Failure to Switch Off

As already noted (see "Charge Storage" on page 23), a triac will tend to suffer from *charge storage* if there is insufficient time between the end of one half-cycle and the beginning of the next. A component that works with a resistive load may cease to function if it is used, instead, to power an inductive load.

solid-state relay

4

A **solid-state relay** is less-commonly referred to by its acronym, *SSR*. It is sometimes regarded as an **optocoupler**, but in this encyclopedia the two components have separate entries. An optocoupler is a relatively simple device consisting of a light source (usually an **LED**) and a light sensor, in one package. It is used primarily for isolation rather than to switch a high current. A solid-state relay can be thought of as a substitute for an electromagnetic **relay**, usually has additional components in its package, and is intended to switch currents of at least 1A.

A component that works like a solid-state relay but only switches a 5V (or lower) logic signal may be referred to as a *switch*, even though it is entirely solid-state. This type of component is included in this entry because it functions so similarly to a solid-state relay.

OTHER RELATED COMPONENTS

- **electromagnetic relay** (see Volume 1)
- **optocoupler** (see Chapter 5)

What It Does

A **solid-state relay** (SSR) is a semiconductor package that emulates an electromagnetic **relay** (see Volume 1). It switches power on or off between its output terminals in response to a smaller current and voltage between its input terminals. Variants can switch AC or DC and may be controlled by AC or DC. An SSR functions as a *SPST switch*, and is available in normally open or normally closed versions. SSRs that function as an SPDT switch are relatively unusual and actually contain more than one SSR.

No single schematic symbol has been adopted to represent a solid-state relay, but some alternatives are shown in Figure 4-1:

Top
: An unusually detailed depiction of an SSR that switches DC current using MOSFETS. Symbols for this device often omit the diodes on the output side and may simplify the MOSFET symbols.

Bottom left
: An SSR that uses an internal **triac** to switch AC. The box labeled 0x indicates that this is a *zero-crossing* relay, meaning that it switches when alternating voltage crosses the 0V level from positive to negative or negative to positive.

Bottom right
: A generic SSR, showing a symbol for a normally open relay, although whether it is designed for AC or DC is unclear.

Advantages

- Great reliability and long life.
- No physical contacts that are vulnerable to arcing and erosion or (under extreme conditions) that could weld themselves together.

- Very fast response, typically 1µs on and 0.5µs off.
- Very low power consumption on the input side, as low as 5mA at 5VDC. Many solid-state relays can be driven directly from logic chips.
- Lack of mechanical noise.
- No contact bounce; a clean output signal.
- No coil that would introduce back EMF into the circuit.
- Safe with flammable vapors, as there is no sparking of contacts.
- Often smaller than a comparable electromagnetic relay.
- Insensitive to vibration.
- Safer for switching high voltages, as there is complete internal separation between input and output.
- Some variants work with input control voltages as low as 1.5VDC. Electromagnetic relays typically require at least 3VDC (or more, where larger relays are required to switch higher currents).

Disadvantages

- Less efficient; its internal impedance introduces a fixed-value voltage drop on the output side (although this may be negligible when switching higher voltages).
- Generates waste heat in its "on" mode, in accordance with the voltage drop.
- Passes some *leakage* current (usually measured in microamps) on the output side when the relay is supposed to be "off."
- A DC solid-state relay usually requires observation of polarity on the output side. An electromagnetic relay does not.
- Brief voltage spikes on the input side, which would be ignored by a slower electromagnetic relay, may trigger a solid-state relay.
- More vulnerable than an electromagnetic relay to surges and spikes in the current that is switched on the output side.

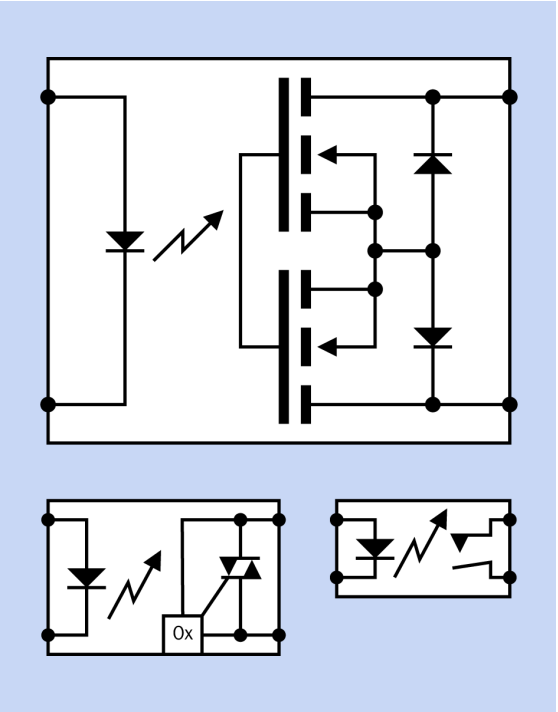

Figure 4-1. *Schematic symbols for solid-state relays have not been standardized. See text for details.*

How It Works

Almost all modern SSRs contain an internal **LED** (light-emitting diode, see Chapter 22) which is switched on by the control input. Infrared light from the LED is detected by a sensor consisting of one or more **phototransistors** or **photodiodes**. In a relay that controls DC current, the sensor usually switches a **MOSFET** (see Volume 1) or an **SCR** (silicon-controlled rectifier—see Chapter 1). In relays that control AC current, a **triac** (see Chapter 3) controls the output. Because the input side and the output side of the SSR are linked only by a light signal, they are electrically isolated from each other.

The MOSFETs require so little power, it can be provided entirely by light falling on an array of 20 or more photodiodes inside the SSR package.

Typical solid-state relays are shown in Figures 4-2 and 4-3.

Figure 4-2. *A solid-state relay capable of switching up to 7A DC. See text for a detailed description.*

The Crydom DC60S7 accepts a control voltage ranging from 3.5VDC to 32VDC, with a typical input current of less than 3mA. Maximum turn-on time is 0.1ms and maximum turn-off time is 0.3ms. This relay can switch up to 7A and tolerates a surge of up to twice that current. It imposes a voltage drop of as much as 1.7VDC, which can become a drawback when switching voltages that are significantly lower than its maximum 60VDC. The electronics are sealed in thermally conductive epoxy, mounted on a metal plate approximately 1/8" thick which can be screwed down onto an additional heat sink.

The Crydom CMX60D10 tolerates a more limited range of control voltages (3VDC to 10VDC) and requires a higher input current of 15mA at 5VDC. However, its very low maximum on-state resistance of 0.018Ω imposes a much smaller voltage drop of less than 0.2 volts when passing 10A. This results in less waste heat and enables a *single-inline package* (SIP) without a heat sink. The CMX60D10 weighs 0.4 ounces, as opposed to the 3 ounces of the DC60S7. Relays from other manufacturers use similar packaging and have similar specifications.

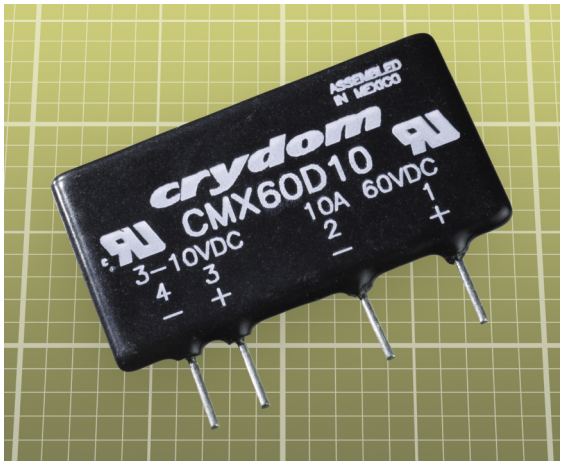

Figure 4-3. *A solid-state relay capable of switching up to 10A. Its lower internal resistance results in less waste heat and enables a smaller package. See text for a detailed description.*

Variants

Many solid-state relays have protective components built into the package, such as a varistor on the output side to absorb transients. Check datasheets carefully to determine how much protection from external components may be necessary when switching an inductive load.

Instantaneous versus Zero Crossing

A *zero crossing* SSR is one that (a) switches AC current and (b) will not switch "on" until the instant when the AC voltage crosses through 0V. The advantages of this type are that it does not have to be built to switch such a high current, and creates minimal voltage spike when the switching occurs.

All SSRs that are designed to switch AC will wait for the next voltage zero crossing before switching to their "off" state.

NC and NO Modes

Solid-state relays are SPST devices, but different models may have a normally closed or normally open output. If you require double-throw operation, two relays can be combined, one normally closed, the other normally open. See Figure 4-4. A few manufacturers combine a normally closed relay and a normally open relay in one package, to emulate a SPDT relay.

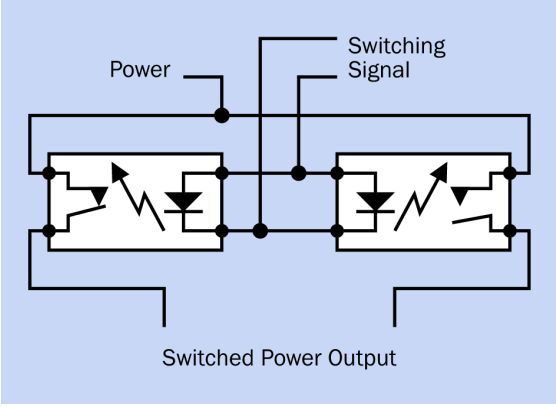

Figure 4-4. *A normally closed solid-state relay can be paired with a normally open solid-state relay to emulate a SPDT switch. This combination is available in a single package from some manufacturers.*

Packaging

High-current solid-state relays are often packaged with screw terminals and a metal base that is appropriate for mating with a *heat sink*. Some are sold with heat sinks integrated. Spade terminals and crimp terminals may be optional. The Crydom DC60S7 shown in Figure 4-2 is an example. This type of package may be referred to as *industrial mount.*

Lower-current solid-state relays (5A or less), and those with a very low output resistance, may be packaged with single-inline pins for through-hole mounting in circuit boards.

Solid-State Analog Switch

DIP packaging may be used for solid-state relays that are designed for compatibility with the low voltages and currents of logic chips. This type of component may be referred to simply as a *switch*. The 74HC4316 is an example, pictured in Figure 4-5.

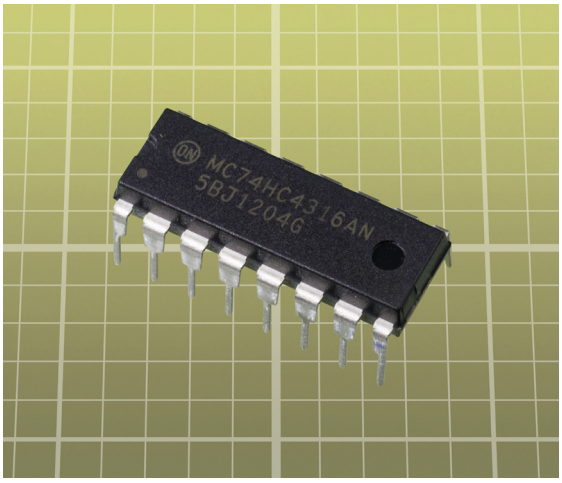

Figure 4-5. *This DIP package contains four "switches" that function as solid-state relays but are restricted to low voltages and currents, compatible with logic chips. See text for details.*

Typically the control voltage and the switched voltage are limited between +7V and –7V, with a maximum output current of 25mA. Each internal switch has its own Control pin, while an additional Enable pin forces all switches into an "off" state if its logic state is high. The simplified functionality of this component is illustrated in Figure 4-6, without showing internal optical isolation.

The "on" resistance of each internal pathway will be approximately 200Ω when the component is powered with +5VDC on the positive side and 0VDC on the negative side. This resistance drops to 100Ω if the negative power supply is -5VDC.

If all of the outputs from the chip are shorted together, it functions as a **multiplexer** (see Chapter 16). In fact, this type of switch component is often listed in catalogs as a multiplexer, even though it has other applications.

Because the component tolerates equal and opposite input voltages, it is capable of switching AC.

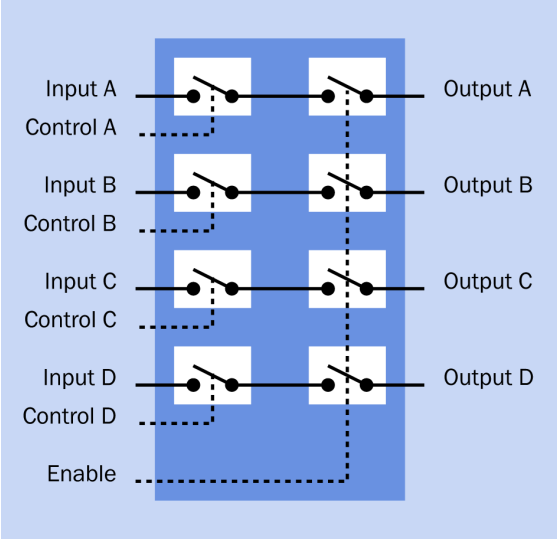

Figure 4-6. *The functionality of a chip containing four solid-state analog switches. A high state on a Control pin closes its associated switch. The Enable pin must be held low for normal operation; a high Enable state forces all the switches into the "off" position. If the outputs are tied together, this component can function as a multiplexer.*

Values

Industrial-mount solid-state relays typically can switch currents ranging from 5A to 500A, with 50A being very common. The higher-current relays mostly require DC control voltage; 4V to 32V are typical, although some versions can go much higher. They contain an SCR or triac to switch AC.

Smaller solid-state relays in SIP, DIP, or surface-mount packages often use MOSFETs on the output side, and are often capable of switching up to 2A or 3A. Some can switch either AC or DC, depending on the way the output is wired. The LED on the input side may require as little as 3mA to 5mA for triggering.

How to Use It

Solid-state relays find their primary uses in telecommunications equipment, industrial control systems and signalling, and security systems.

The component is very simple externally. Power on the input side can come from any source capable of delivering the voltage and current specified by the manufacturer, and any device that doesn't exceed maximum current rating can be connected to the output side, so long as provision is made for suppressing back-EMF from an inductive load, as shown in Figure 4-7. Often a solid-state relay can be substituted directly for an electromagnetic relay, without modifying the circuit.

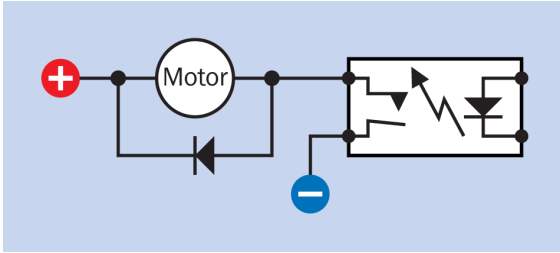

Figure 4-7. *Use of a diode around an inductive load, to protect a solid-state relay from back-EMF.*

Solid-state relays are heat sensitive, and their rating for switching current will diminish as their temperature increases. Manufacturer datasheets will provide specific guidance. Using a heat sink will greatly improve the performance. Bear in mind that the relay generates heat continuously while it is in its "on" mode—about 1 watt per ampere.

Because it requires so little current on the input side (typically no more than 15mA), a solid-state relay can usually be driven directly by chips such as *microcontrollers* that would not be able to activate an equivalent electromagnetic relay.

Applications may take advantage of the solid-state relay's reliability, immunity to vibration, lack of contact sparking, freedom from coil-induced surges on the input side, and lack of contact bounce on the output side. A solid-state relay is ideal within digital equipment that is sensitive to power spikes. It may switch a fuel pump that handles volatile, flammable liquids, or a wastewater pump in a basement subject to

flooding (where long-term zero-maintenance reliability is necessary, and contact corrosion could be a risk in electromagnetic relays). Small solid-state relays can switch motors in robots or appliances where vibration is common, and are often used in arcade games.

What Can Go Wrong

Overheating Caused by Overloading

Relays must be *derated* when used at operating temperatures above the typical 20 or 25° C for which their specification applies. In other words, the sustained operating current must be reduced, usually by an amount such as 20% to 30% for each 10-degree increase in ambient temperature. Failure to observe this rule may result in failure of the component. Burnout may also occur if a high-current solid-state relay is used without a heat sink, or the heat sink isn't big enough, or *thermal compound* is not applied between the solid-state relay and the heat sink.

Overheating Caused by Bad Terminal Contact

If the screw terminals on the output side of a high-current solid-state relay are not tightened sufficiently, or if there is a loose spade terminal, or if a crimped connection isn't crimped tightly enough, the poor contact will create electrical resistance, and at high currents, the resistance will create heat, which can cause the solid-state relay to overheat and burn out.

Overheating Caused by Changing Duty Cycle

If a high-current solid-state relay is chosen for an application where it is in its "on" state only half the time, but the application changes during product development so that the solid-state relay is in its "on" state almost all the time, it will have to dissippate almost twice as much heat. Any time the duty cycle is changed, heat should be considered. The possibility of the relay being used in an unconventional or unexpected manner should also be considered.

Overheating Caused by Component Crowding

Overheating increases dramatically when components are tightly crowded. At least 2cm (3/4") should be allowed between components.

Overheating in Dual Packaging

When a package contains two solid-state relays, the additive effects of the heat created by each of them must be considered.

Reverse-Voltage Burnout

Because a solid-state relay is more sensitive to *back-EMF* than an electromagnetic relay, greater care should be used to protect it from reverse voltage when switching inductive loads. A *protection diode* should be used, and a *snubber* can be added between its output terminals, if it is not included inside the relay package.

Low Voltage Output Current May Not Work

Unlike electromagnetic relays, solid-state relays require some voltage on the output side to enable their internal operation. If there is no voltage, or only a very low voltage, the SSR may not respond to an input. The minimum voltage required on the output side is usually specified in a datasheet.

To test a solid-state relay, apply actual voltages on input and output sides and use a load such as an incandescent light bulb. Merely applying a meter on the output side, set to measure continuity, may not provide sufficient voltage to enable the relay to function, creating the erroneous impression that it has failed.

Inability to Measure AC Output

When a multimeter is used to test continuity across the output of an AC-switching solid-state relay of zero-crossing specification, the meter will generate enough voltage to prevent the

solid-state relay from finding zero voltage across its output terminals, and consequently the solid-state relay won't switch its output.

Relay Turns On but Won't Turn Off

When a solid-state relay controls a relatively high-impedance load such as a small **solenoid** (see Volume 1) or a **neon bulb** (see Chapter 19), the relay may switch the device on but will seem unable to switch it off. This is because the leakage current of the solid-state relay, in its "off" state, may be just enough to maintain the load in its "on" state.

If an SSR containing a triac is used erroneously to switch DC, it will not be able to switch off the current.

Relays in Parallel Won't Work

Two solid-state relays usually cannot be used in parallel to switch twice as much current. Because of small manufacturing variances, one relay will switch on a moment before the other. When the first relay is on, it will divert the load current away from the second relay. The second relay needs a small amount of current on its output side, to function. Without any current, it will not switch on. This means the first relay will pass the total current without any help from the second relay, and will probably burn out, while the second relay does nothing.

Output Device Doesn't Run at Full Power

A solid-state relay imposes a voltage reduction on its output side. This will be a fixed amount, not a percentage. When switching 110V, this difference may be negligible; when switching 12V, it may deliver only 10.5V, which represents enough of a drop to cause a motor or a pump to run noticeably more slowly. The internal switching device inside the relay (MOSFET, triac, SSR, or bipolar transistor) will largely determine the voltage drop. Check the manufacturer's datasheet before using the relay.

Solid-State Relays and Safety Disconnects

Because a solid-state relay always allows some leakage in its "off" state, it can still deliver a shock when used to switch high voltages. For this reason, it may not be suitable in a safety disconnect.

optocoupler

5

Sometimes known as an *optoelectronic coupler*, *opto-isolator*, *photocoupler*, or *optical isolator*.

A **solid-state relay** is sometimes referred to as an **optocoupler**, but in this encyclopedia it has a separate entry. An optocoupler is a relatively simple device consisting of a light source (usually an LED) and a light sensor, both embedded in one package. It is used primarily for isolation rather than to switch a high current. A solid-state relay can be thought of as a substitute for an electromagnetic **relay**, usually has additional components in its package, and is intended to switch currents of at least 1A.

OTHER RELATED COMPONENTS

- **electromagnetic relay** (see Volume 1)
- **solid-state relay** (see Chapter 4)

What It Does

An optocoupler allows one section of a circuit to be electrically isolated from another. It protects sensitive components, such as logic chips or a microcontroller, from voltage spikes or incompatible voltages in other sections of a circuit. Optocouplers are also used in medical devices where a patient has to be protected from any risk of electric shock, and are used in devices which conform with the MIDI standard for digital control of music components.

In Figure 5-1, three possible applications for an optocoupler are suggested:

Top
: The output from a logic chip passes through an optocoupler to an inductive load such as a relay coil, which may create voltage spikes that would be hazardous to the chip.

Center
: The noisy signal from an electromagnetic switch passes through an optocoupler to the input of a logic chip.

Bottom
: The low-voltage output from a sensing device on a human patient passes through an optocoupler to some medical equipment, such as an EEG machine, where higher voltages are used.

Internally, an optocoupler works on the same principle as a **solid-state relay**. An LED is embedded on the input side, shining light through an interior channel or transparent window to a sensing component that is embedded on the output side. Because the only internal connection is a light beam, the input and output of the optocoupler are isolated from each other.

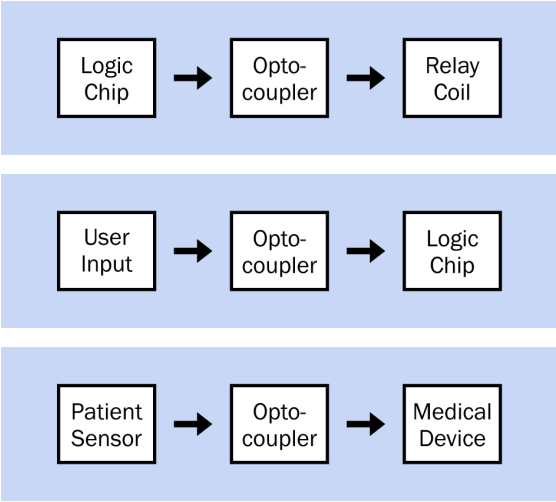

Figure 5-1. *Possible applications for a photocoupler. See text for details.*

Isolation transformers were traditionally used for this purpose prior to the 1970s, when optocouplers became competitive. In addition to being smaller and cheaper, an optocoupler can also pass slow-changing signals or on-off DC states which a transformer would ignore.

More recently, inductive and capacitive coupling components have become available in surface-mount packages that are competitive with optocouplers for high-speed data transfer. They also claim to be more durable. Because of the gradual reduction in output from an LED, the performance of an optocoupler degrades over time, and is typically rated for up to 10 years.

How It Works

The LED in an optocoupler almost always emits light in the near-infrared part of the spectrum, and is matched to the sensitivity of a **phototransistor**, or a **photodiode**, or (less often) a **photoresistor** that provides the output. Photosensitive **triacs** and **SCRs** are also sometimes used.

The most common type of optocoupler uses a bipolar phototransistor with an open-collector output. Schematic symbols for this type are shown in Figure 5-2:

Top left
: The most common generic form.

Top right
: Two diodes on the input side allow the use of alternating current.

Center left
: An additional terminal allows addition of bias to the photosensitive base of the output transistor, to reduce its sensitivity.

Center right
: An Enable signal can be used as the input to the NAND, suppressing or enabling the output.

Bottom left
: A *photodarlington* allows higher emitter current.

Bottom right
: Relatively uncommon, and is also used for a **solid-state relay**.

In each symbol, the diode is an LED, and the zigzag arrow indicates light that is emitted from it. A pair of straight arrows, or wavy arrows, may alternatively be used.

An optocoupler in through-hole DIP format is shown in Figure 5-3.

An *optical switch* can be thought of as a form of optocoupler, as it contains an LED opposite a sensor. However, the LED and the sensor are separated by an open slot, to allow a thin moving object to pass through, interrupting the light beam as a means of detecting the event. It is categorized as a *sensor* in this encyclopedia, and will be found in Volume 3.

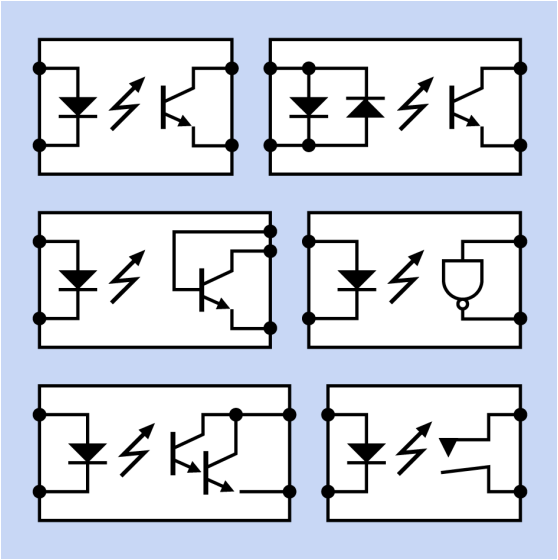

Figure 5-2. *Six variants of schematic symbols that may be used to represent an optocoupler. See text for details.*

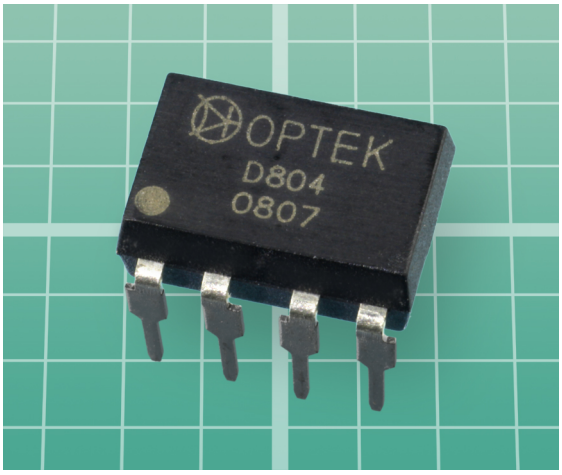

Figure 5-3. *An optocoupler in through-hole 8-pin DIP format.*

Variants

Internal Sensors

Historically, a photoresistor (often referred to as a *photocell*) was the first type of sensor to be used. It has a more linear response than other sensor types, but its response is much slower. It is still found in audio applications. "Stomp box" pedals used by guitarists typically contain an optocoupler that employs a photoresistor, and are valued for their linearity and their immunity from the mechanical wear, contamination, and "scratchiness" that builds up over time in a **potentiometer**. Optocouplers also eliminate *ground loops*, which tend to be induced by small differences in ground potential, introducing hum or buzz in audio applications when two or more power supplies are tied together.

The type of optocoupler that contains a photoresistor and is commonly used by musicians was initially trademarked as a *Vactrol*, and that term is still used generically. Vactrols have also been used to provide audio compression in telephone voice networks, and were used in photocopiers and photographic exposure meters, but these applications are now obsolete.

Photoresistors are becoming uncommon because of their cadmium content, which is unlawful in many countries (especially in Europe) because of its environmental toxicity.

A photodiode provides the fastest response time in an optocoupler, limited primarily by the characteristics of the LED that shines light upon it. A *PIN diode* can respond in less than a nanosecond; its acronym is derived from its fabrication from p-type and n-type semiconductor layers with an *intrinsic* layer connecting them. This additional layer can be responsive to light. When the diode is slightly reverse-biased, a photon entering the intrinsic layer can dislodge an electron, enabling current to flow. The reverse bias enlarges the active area and enhances the effect. In this mode, the PIN acts like a photoresistor, appearing to reduce its resistance in response to light.

When the PIN is used in *photovoltaic* mode, no bias is applied, and the component actually generates a small voltage (less than 1VDC), like a solar cell, in response to incoming light. Where an optocoupler uses a MOSFET on its output side, as many as 30 photodiodes may be connected in series to develop the necessary threshold volt-

age to trigger the transistor. This arrangement is common in **solid-state relays**.

A bipolar phototransistor is a slower-speed device but is still usually capable of a 5µs response time or better. Its open collector requires external voltage and a *pull-up resistor* to deliver a positive output so long as the phototransistor is nonconductive. When the LED turns on, the phototransistor sinks current, effectively creating a low output. In this way, the optocoupler functions like an *inverter*, although some variants include a noninverting output.

Basic Optocoupler Types

An optocoupler with *high linearity* will respond more proportionally to variations in current to its LED. *High Speed* optocouplers are used for high-frequency data transfer. *Logic-output* optocouplers have a clean high/low output transition, rather than an *analog output*, which varies with fluctuations in the input. Linearity is of importance only where an optocoupler is being used to transmit an analog signal with some fidelity. Some logic-output optocouplers provide the function of a Schmitt trigger on their output side.

While optocouplers are available in various package formats, the DIP style with six or eight pins remains popular, providing sufficient physical space for the LED, the sensor, and a light channel, while providing good electrical isolation.

Variants may have two or four optocouplers combined in one package. A *bidirectional* optocoupler may consist of two optocouplers in parallel, inverted with respect to each other.

Values

In a datasheet, the characteristics of primary importance in an optocoupler are:

- CTR is the Current Transfer Ratio, the ratio of maximum output current to input current, expressed as a percentage. With a bipolar phototransistor output, 20% is a typical minimum CTR. With a photodarlington output, the CTR may be 1,000% but the bandwidth is much lower—the response time may be measured in microseconds rather than nanoseconds. Optocouplers with a photodiode output have a very low CTR, and their output is in microamps. However, they provide the most linear response.
- $V_{CE(MAX)}$ is the maximum collector-emitter voltage difference (in an optocoupler with a bipolar phototransistor output). Values from 20 to 80 volts are common.
- V_{ISO} is the maximum potential difference, in VDC, between the two sides of the optocoupler.
- I_{MAX} is the maximum current the transistor can handle, generally in mA.
- Bandwidth is the maximum transmittable signal frequency, often in the range of 20kHz to 500kHz.

The LED in an optocoupler typically requires 5mA at a forward voltage of 1.5V to 1.6V.

The maximum collector current on the output side of an optocoupler is unlikely to be higher than 200mA. For higher output currents, a solid-state relay should be considered. It provides photo-isolation on the same basis as an optocoupler, but high-current versions tend to be considerably more expensive.

How to Use It

The primary purpose of an optocoupler is to provide protection against excessive voltage—from transients, incompatible power supplies, or equipment with unknown characteristics. If a device is designed to be plugged into a USB port on a computer, for instance, the computer may be isolated via an optocoupler.

A series resistor for the LED is not built into most optocouplers, because the value of the resistor will depend on the input voltage that is used. Care must be taken to determine what the maximum voltage on the input side will be, and a

series resistor should be chosen to reduce current appropriately. Allowance should be made for some degradation in the performance of the LED over time.

For an optocoupler with an open-collector output, a pull-up resistor is necessary in most applications. The voltage from the optocoupler must be matched to the input requirements of other components, and the collector current must remain within the specified limits. Some trial and error in resistor selection may be necessary.

In Figure 5-4, a schematic shows typical component values in a test circuit using a pushbutton as input. The separation of the two power supplies is emphasized by the different color shades used for the positive and negative symbols. Although the input side and the output side of an optocoupler may be used with a common ground, this defeats its purpose in providing complete isolation between the sections of the circuit.

The pinouts for an optocoupler must be checked carefully in the manufacturer's datasheet. While the input for an 8-pin DIP chip is usually applied to pins 2 and 3, the output pin functions are not standardized and will vary depending on the internal configuration of the chip. An optocoupler such as the Optek D804, with an enable function using an internal NAND gate, requires its own power supply.

Where an optocoupler allows an external connection to the base of its internal bipolar output phototransistor, reverse bias applied to this pin will decrease the sensitivity of the optocoupler but can increase its immunity to noise on the input side.

What Can Go Wrong

Overload conditions on the input or the output side of an optocoupler will be the most likely cause of failure.

Age

Because optocouplers are typically rated for only 10 years of average use, the age of a component may cause it to fail.

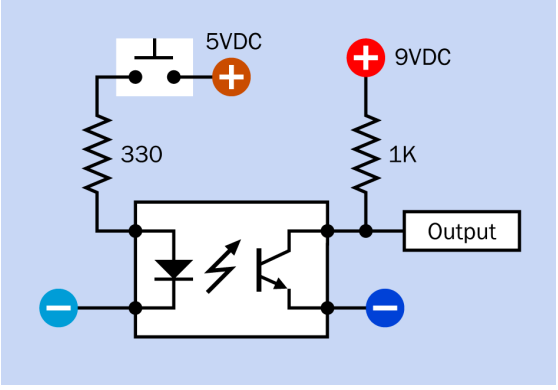

Figure 5-4. *Typical values for a series resistor (to protect the LED) and pull-up resistor (to control current and voltage on the output side) in an optocoupler test circuit.*

LED Burnout

Because the LED is hidden inside the component, there is no immediate indication of its performance. A meter can be inserted into the circuit on the input side to determine if current is passing through the LED. A meter set to measure volts can be used to discover whether the LED is imposing a normal voltage drop. While significant overload will cause immediate burnout, slightly exceeding the current rating of the LED may have more pernicious consequences, as the LED may not fail until days or weeks have passed without any sign of trouble. The failure of the optocoupler will be unexpected and difficult to determine.

Transistor Burnout

Here again the damage caused by excessive current may be progressive, occurring over a prolonged period. The easiest way to test an optocoupler that may have failed is by removing it from the circuit. A socketed DIP package is preferable for this purpose.

comparator

Although a **comparator** has the same schematic symbol as an **op-amp**, their applications differ and they are described in separate sections of this encyclopedia.

This entry describes an analog comparator. A *digital comparator* is very different, being a logic chip that compares two binary numbers that can be referred to as A and B. Outputs from the chip indicate whether A>B or A<B or A=B. The digital comparator does not have an entry in this encyclopedia.

OTHER RELATED COMPONENTS

- **op-amp** (see Chapter 7)

What It Does

A **comparator** is an integrated circuit chip that compares a variable voltage on one input pin with a fixed, reference voltage on a second input pin. Depending which voltage is higher, the output from the comparator will be high or low.

The output will make a clean transition between two fixed values, even if the input is infinitely variable. Thus the comparator can function as an *analog-digital converter*, as shown in Figure 6-1.

Because the output voltage range can be adjusted up or down independently of the input range, a comparator can also function as a *voltage converter*.

Hysteresis

If positive feedback is added through external resistors, *hysteresis* can be introduced. We may imagine a *hysteresis zone* extending above and below the reference voltage level. Small input variations that occur within the zone will be ignored. The comparator only reacts when the input signal emerges above or below the hysteresis zone. When the input signal returns into the hysteresis zone, this event also will be ignored. The concept is illustrated graphically in Figure 6-2. A circuit to create hysteresis is shown in Figure 6-10.

How It Works

The schematic symbol for a comparator is shown in Figure 6-3. This seems identical to the symbol for an op-amp, described in Chapter 7, but an op-amp is traditionally a *dual-voltage* device using positive and negative power sources that are equal and opposite, in addition to a zero value midway between the two. Modern comparators mostly use a conventional single voltage, and therefore the negative symbol used in comparator schematics throughout this section of the encyclopedia represents 0 volts. It has the same meaning as the ground symbol found in many schematics elsewhere.

The two inputs to a comparator are described as *inverting* and *noninverting* (for reasons explained later). Confusingly, these are identified with plus and minus symbols inside the triangle that represents the component. These plain black-and-

white symbols have nothing to do with the power supply.

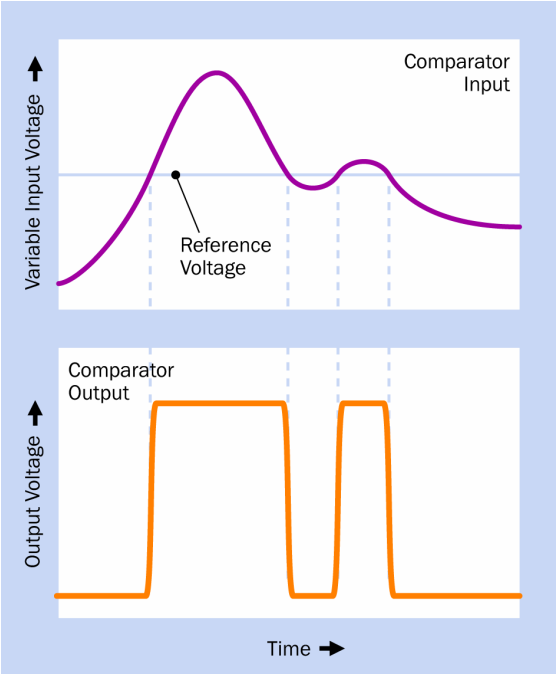

Figure 6-1. *The basic behavior of a simple comparator is shown here.*

Often, in schematics, the power supply is not shown, because it is assumed to be present. However, all comparators require a power supply in order to function.

The basic internal and external connections used in conjunction with a typical comparator are shown in Figure 6-4.

The potentiometer at top left is often a *trimmer*, to fine-tune a reference voltage. The variable input can come from a sensor or any other device capable of delivering a voltage up to the limit set by V1.

The output is often an *open collector* from an internal bipolar transistor, as shown in the figure.

Note that as many as three different voltages can be used, as indicated by the different colors associated with V1, V2, and V3. However, they must share a common ground to enable the comparator to make valid comparisons.

When the noninverting input exceeds the voltage of the inverting input, the output transistor goes into its "off" state, and blocks current from an external *pullup resistor*. Because the current from the resistor now has nowhere else to go, it is available to drive other devices attached to the comparator output, and the output appears to be high.

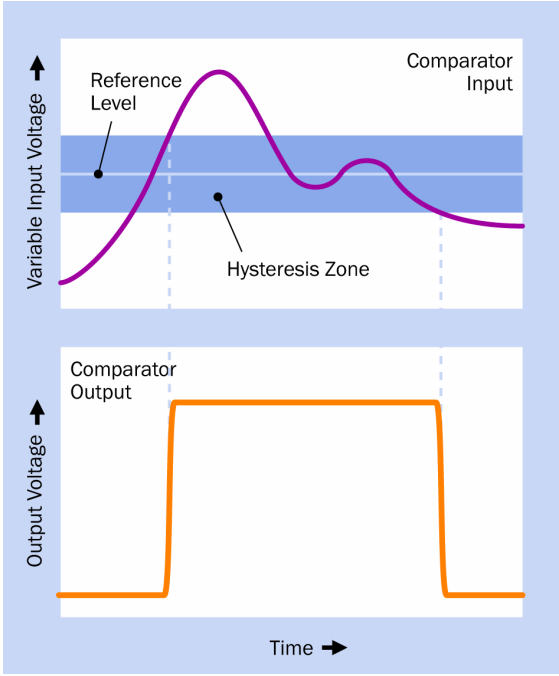

Figure 6-2. *The performance of a comparator shown in the previous figure can be modified by the addition of hysteresis. Small variations that occur within the hysteresis zone are ignored.*

When the noninverting input falls below the voltage of the inverting input, the transistor becomes conductive, and sinks almost all the current from the pullup resistor, assuming other devices attached to the output have a relatively high impedance. The output from the comparator now appears to be low.

This can be summed up as follows:

- When a variable voltage is applied to the noninverting input, and it rises *above* the reference voltage applied to the *inverting input*, the output transistor turns off, and the comparator delivers a *high* output.
- When a variable voltage is applied to the noninverting input, and it falls *below* the reference voltage applied to the *inverting input*, the output transistor turns on, and the comparator delivers a *low* output.

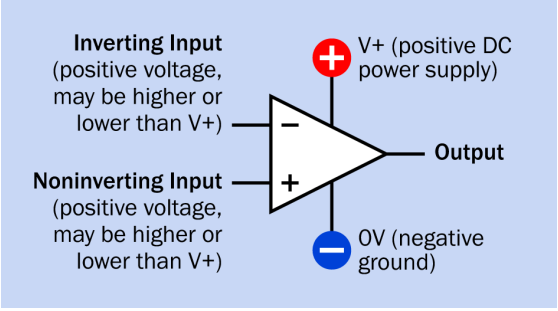

Figure 6-3. *The symbol for a comparator is the same as the symbol for an op-amp, even though they often require different types of power supply and their functions are significantly different.*

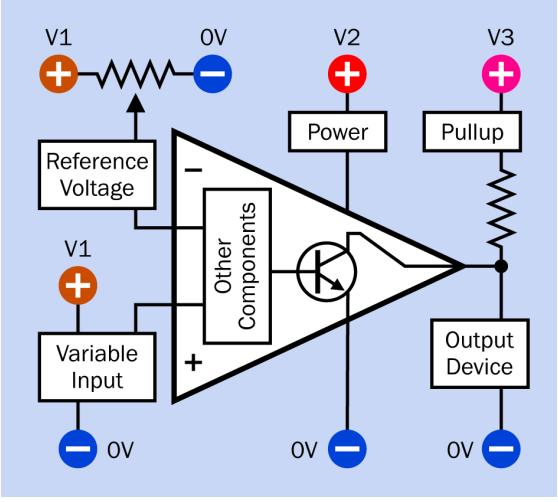

Figure 6-4. *Connections to a comparator, and their functions.*

If the reference voltage and the variable voltage are swapped between the input pins, the behavior of the comparator is reversed. This relationship is illustrated in Figure 6-5. When a voltage transition is applied to the *inverting* input, the transition is *inverted* at the output.

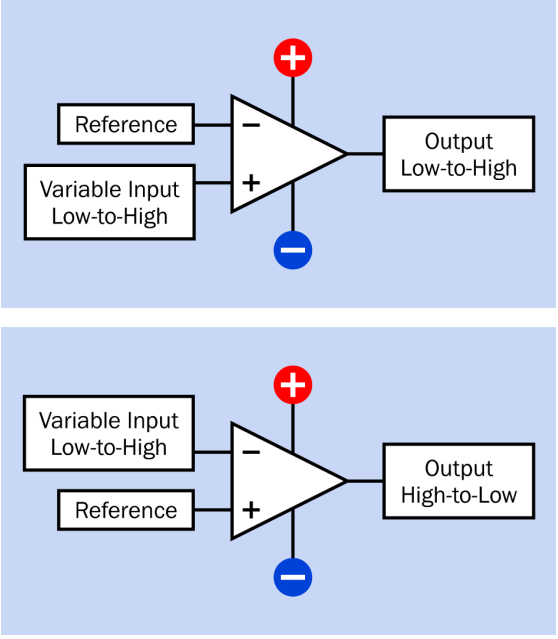

Figure 6-5. *Depending which input pin is used for the reference voltage, and which input carries a variable voltage, the comparator output either follows the variable voltage or inverts it.*

Placement of the plus and minus signs inside the comparator symbol may vary. Most often, the minus sign is above the plus sign, as shown in all the schematics here. Sometimes, however, for convenience in drawing a schematic, the plus sign may be shown above the minus sign. Regardless of their placement, the plus sign always identifies the noninverting input, and the minus sign always identifies the inverting input. To avoid misinterpretations, schematics should be inspected carefully.

Where a power supply for the comparator is shown, the positive side is always attached to the upper edge of the symbol, while 0V ground is always attached to the lower edge.

Differences from an Op-Amp

Saturation versus linearity

The output of a comparator is optimized for saturation (high or low, without intermediate levels, using positive feedback). The output of an op-amp is optimized for linearity (faithful reproduction of nuances in the input, using negative feedback).

Output mode

The majority of comparators have open-collector outputs (or open-drain outputs in CMOS devices) where the voltage is established by a pullup resistor. This can be adjusted for compatibility with other components, especially 5VDC logic. Only a minority have push-pull amplifier outputs that require no pullup resistor. By comparison, among op-amps, a push-pull output that functions as a voltage source is the traditional default.

Faster response

A comparator responds more quickly than an op-amp to changes in input voltage, if the op-amp is used in the role of a comparator. The comparator is primarily a switching device, not an amplifier.

Hysteresis

This is generally desirable in a comparator, for reasons already explained, and some components are designed with hysteresis built in. This feature is undesirable in an op-amp, as it degrades sensitivity.

Open-loop operation

(i.e., without feedback) this can be used with a comparator. An op-amp is intended for use in closed-loop circuits (i.e., with feedback), and manufacturers will not specify its performance in an open loop.

As previously noted, a comparator usually requires a single-voltage power supply, while an op-amp often requires a dual-voltage power supply.

Variants

Where a comparator uses a MOSFET output transistor, it may have an open-drain output, which requires a pullup resistor, as with an open-collector output.

Some comparators have a *push-pull* output, capable of supplying output current (usually a small amount). In these instances, no pullup resistor is necessary or desirable. The output voltage range will be closest to *rail-to-rail* values (i.e., the range of the power supply) where MOSFETs are used for the output, as MOSFETs impose a smaller voltage drop than bipolar transistors.

The advantage of an open collector (or open drain) relative to a push-pull output is that it allows the output voltage to be set independently of the power supply voltage. Another advantage is that multiple outputs can be connected in parallel, as in a *window comparator* circuit (described below).

Some comparators incorporate a reference voltage on the chip, based on the power supply to the chip. In this case, a separate reference voltage does not have to be supplied, and the component will draw less current.

Many chips are available containing two or more comparators. This is often expressed as the number of *channels* in the component. A *dual comparator* typically allows two different voltage sources for the outputs of the comparators. They will share the same 0V ground, however. Chips such as the LM139 and LM339 contain four comparators, and are available in through-hole or surface-mount formats. They have become a generic choice, costing less than $1 apiece.

An LM339 comparator chip is shown in Figure 6-6. This is a quad chip, meaning that it contains four comparators. They share a common power supply. The chip is TTL and CMOS compatible, is typically powered by 5VDC, but can be driven by up to 36VDC. The input differential voltage range also extends up to 36V.

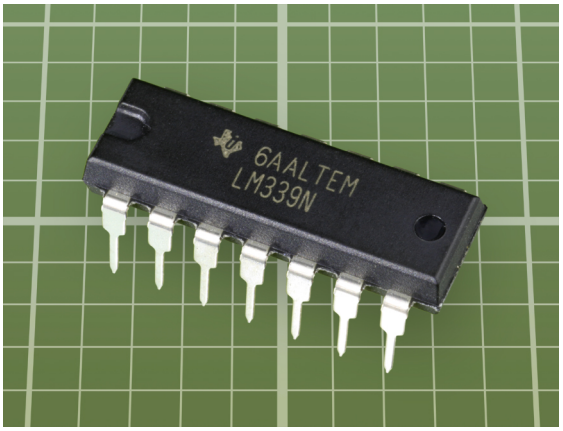

Figure 6-6. *The LM339 quad comparator chip, shown here, was introduced long ago but remains widely used.*

Some comparators have an internal *latch* function that is accessed by a dedicated pin. The latch-enable signal forces the comparator to assess its inputs and hold an appropriate output which can then be checked by other components.

Values

In a datasheet, V_{IO} (also referred to as V_{OS}) is the *input offset voltage*. This is a small voltage, in addition to the reference voltage, which the comparator will require to *toggle* its output in either direction, up or down. Figure 6-7 shows this graphically. V_{IO} sets the limit of *resolution* of the comparator, which will not respond unless the input voltage exceeds the reference voltage by this amount. A smaller value for V_{IO} is better than a larger value. Common values for V_{IO} range from 1mV to 15mV. The actual offset voltage tends to vary between one sample of a component and another. V_{IO} is the maximum allowed value for a component.

Because the comparator will not respond until the reference voltage is exceeded by V_{IO}, the output pulse width will be narrower than if the comparator reacted at the point where the variable voltage input was precisely the same as the reference voltage.

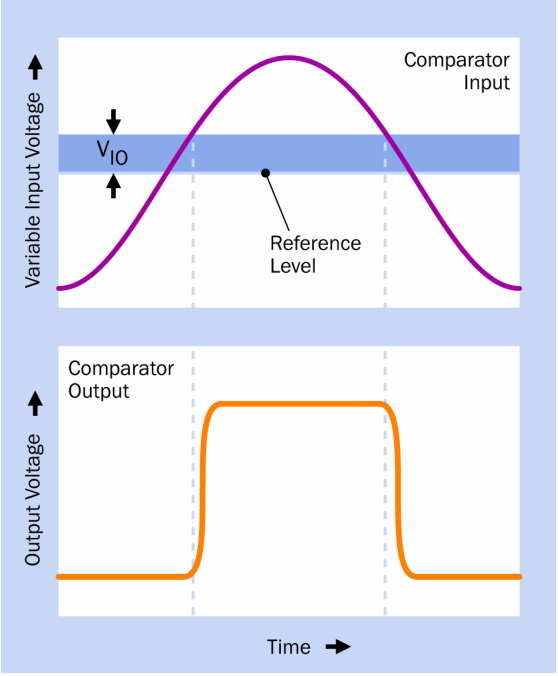

Figure 6-7. *The input offset voltage is the very small voltage that a comparator requires, additional to the reference input voltage, before it will toggle its output from low to high or high to low.*

V_{TRIP+} and V_{TRIP-} are the *rising* and *falling voltages*, respectively, that will trip the comparator output where the comparator exhibits some innate hysteresis without an external feedback loop. They are also referred to as *Lower State Transition Voltage* (LSTV) and *Upper State Transition Voltage* (USTV).

V_{HYST} is the *hysteresis range* defined as V_{TRIP+} minus V_{TRIP-}. The relationship is shown graphically in Figure 6-8.

A_{VD} is the *voltage gain* of a comparator, in which the letter "A" can be thought of as meaning "amplification." The gain is measured as a maximum ratio of output voltage to input voltage. Typically it ranges from 40 to 200.

Supply voltage for modern comparators is often low, as the components are used in surface-mount format for battery-powered devices where low power consumption is a primary con-

cern. Thus, 3VDC is common as a power requirement, and 1.5VDC comparators are available. Still, older chips can use as much as 35VDC.

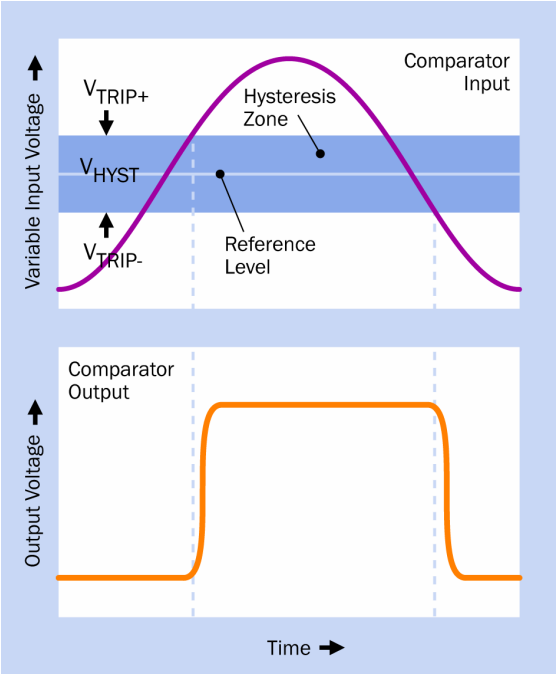

Figure 6-8. *The value of V_{TRIP} shows the hysteresis in a comparator—the range of input voltages, relative to the reference voltage, in which it will not respond.*

Supply current can range from 7mA down to below 1µA.

I_{SINK} is the recommended typical or maximum *sink current* that the component will tolerate, if it has an open-collector output. This value should be considered in relation to the power dissipation, P_D.

The *propagation delay* in a comparator is measured from the moment when an input (usually a square wave) reaches the triggering value, to the time when the consequent output reaches 50% of its final value.

When a comparator is driving CMOS logic using a 5VDC power supply, a typical value for a pullup resistor is 100K. It does not have to be lower, because CMOS has such a high input impedance.

How to Use It

In Figure 6-1, a hypothetical comparator responds immediately when the input voltage equals the reference voltage value. However, this is an idealized scenario. A magnified view, in Figure 6-9, suggests that the comparator is likely to respond with *jitter* when the input signal is very close to the reference voltage, because of tiny variations in heat, current, and other variables. This jitter will cause significant problems if the comparator is driving a device such as a relay, directly or indirectly.

Hysteresis eliminates this uncertainty around the transition level of the input, by telling the comparator to ignore small irregularities in the input voltage. Hysteresis is also useful in many situations where larger variations in a sensor input should be ignored. In Figure 6-2, for instance, suppose that the input voltage comes from a temperature sensor. The small bump in the right-hand section of the curve is probably unimportant; it could be caused by someone opening a door, or a person's body heat in brief proximity to the sensor. There's no point in responding to every little event of this type. In this application, the larger, longer-term temperature trend is what matters, and significant hysteresis is appropriate.

Also, if a comparator is being used as a thermostat, to switch a heating system on and off, we do not want the comparator to respond as soon as the temperature rises just a small amount. The heating system should run for a while before it elevates the temperature beyond the hysteresis zone.

The usual way to create hysteresis is with *positive feedback*. In Figure 6-10, a connection from the output of the comparator runs back through a 1M potentiometer to the variable (noninverting) input. The effect that this has is to reinforce the input voltage with the output voltage, as soon as the comparator input goes high. Now the input can diminish slightly without switching off the comparator. But if the input declines significant-

ly, even the feedback from the output voltage won't be sufficient to maintain the variable input at a higher level than the reference voltage. (Remember, the "high" output voltage from the comparator is a fixed value; it does not change in proportion with the input voltage.) Consequently, the output toggles to low. Now the variable input is deprived of help from the comparator output, so it will be low enough that it has to rise considerably to toggle the comparator back on again. During that period, once again, small variations will be ignored.

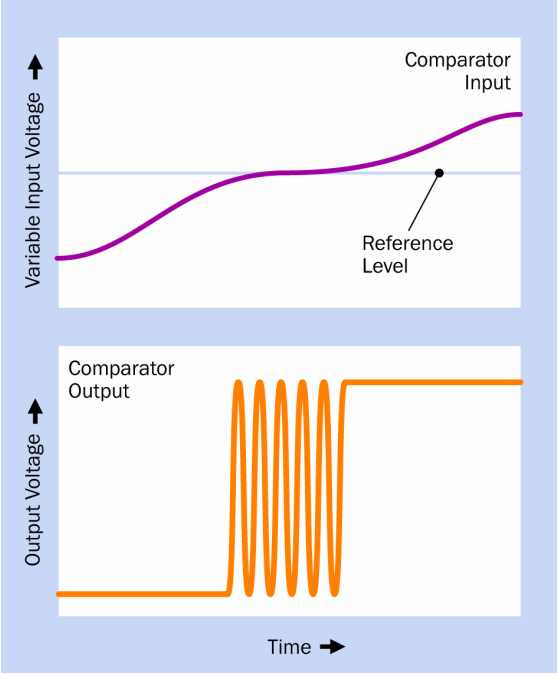

Figure 6-9. *In real-world applications, tiny variations where the variable input voltage crosses the reference voltage can induce jitter in the output from a comparator that has no hysteresis.*

In the schematic, a **phototransistor** (PT1, at left) is in series with a 3.3K resistor to adjust its voltage output to a suitable range. A 1M potentiometer at upper-left is wired as a voltage divider, so that it can establish a reference level that matches the light level that we wish to detect with the phototransistor.

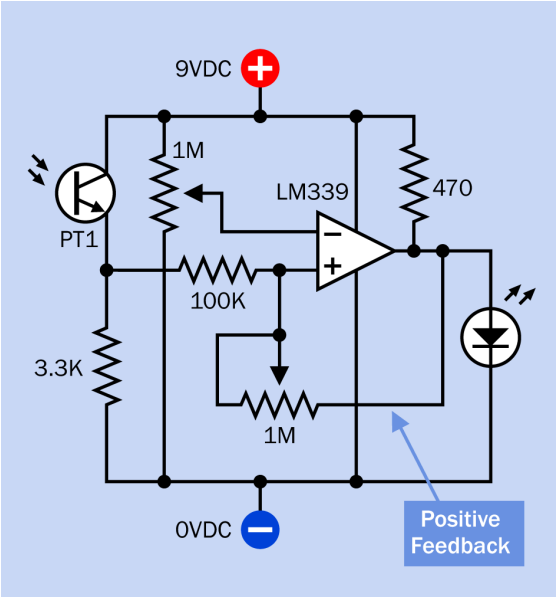

Figure 6-10. *A simple circuit to achieve hysteresis with positive feedback to the variable input of a comparator.*

The 470Ω resistor is the pullup resistor, which protects the LED from excessive current. The lower 1M resistor adjusts the amount of positive feedback, which determines the width of the hysteresis zone.

Values for components may have to be adjusted depending on the supply voltage, the variable input voltage, and other factors. But the principle will remain the same. Note that in the example shown, all the positive voltage sources are identical. In practice, different voltages could be used, so long as they share a common ground.

AND gate

A set of open-collector comparators can function jointly as an AND gate, when their outputs are tied together with one pullup resistor. So long as all the output transistors are nonconductive, the output will be high. If just one comparator toggles into conductive mode, the output will be low. See Figure 6-11.

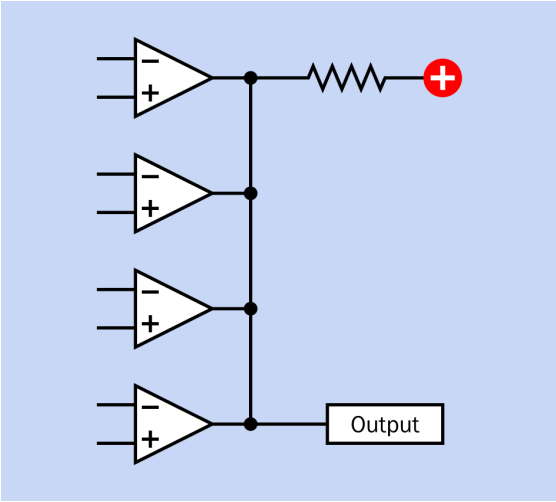

Figure 6-11. *If the outputs of multiple open-collector comparators are tied together with a suitable pullup resistor, they will function as an AND gate.*

Bistable Multivibrator

If positive feedback to the noninverting input of the comparator is sufficiently high, a voltage almost at 0V ground will be required to counter the high output from the comparator—after which, a voltage almost equal to the supply voltage will be needed to turn it back on. In other words, the comparator is behaving like a *bistable multivibrator*, or **flip-flop**.

Relaxation Oscillator

A *relaxation oscillator*, which is a form of *astable multivibrator,* can be created using direct positive feedback in combination with delayed negative feedback. In Figure 6-12, positive feedback goes to the noninverting input, as before, but negative feedback also passes through a 220K resistor to the inverting input of the comparator. A 0.47µF capacitor initially holds the inverting input low, while the capacitor charges. Gradually the capacitor reaches and exceeds the charge on the noninverting input, so the output from the comparator toggles to its low state. This means that its internal transistor is now sinking current, and it discharges the capacitor. Because the noninverting input is being held at a voltage midway between supply and ground by the two 100K resistors forming a voltage divider, eventually the voltage on the inverting input controlled by the capacitor falls below the noninverting voltage, so the cycle begins again.

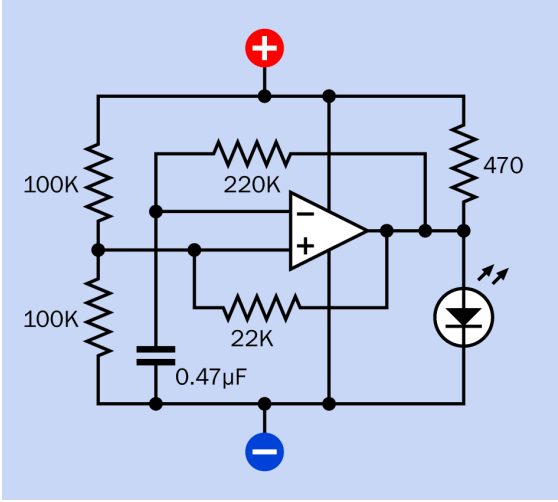

Figure 6-12. *A comparator can be used to create a relaxation oscillator.*

Level Shifter

Where a comparator is used simply to change the level of an input voltage, it can be referred to as a *level shifter*. An example of a level shifter is shown in Figure 6-13, in which a high/low 3VDC logic input is converted to a high/low logic output at 5VDC.

Window Comparator

A *window comparator* is a circuit (not a single component) that will respond to input voltages that deviate outside an acceptable "window" of values. In other words, the circuit responds anytime the variable input is either unacceptably low or unacceptably high.

An example could be an alarm that will sound if a temperature is either too low or too high. In Figure 6-14, two comparators are used to create a window comparator circuit, both sharing a variable voltage input from a sensor. A voltage divider is necessary to establish a higher voltage limit at the noninverting input of the upper com-

parator, while a separate voltage divider would establish a lower limit at the inverting input of the lower comparator. If an alarm has an appropriate resistance, it can be used instead of a pull-up resistor. The alarm will sound when the output from either comparator is low, which happens if the inverting input has a higher voltage than the non-inverting input.

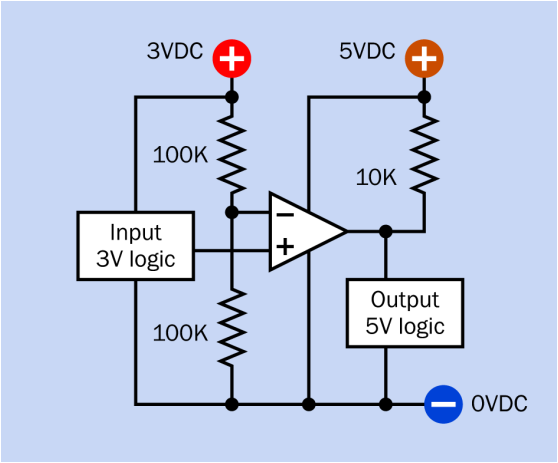

Figure 6-13. *A comparator can be used to convert high and low 3V logic inputs into high and low 5V logic outputs.*

Other Applications

As previously noted, a comparator can be used as a simple *analog-digital converter*. It has "one bit" accuracy (i.e., its output is either high or low).

A comparator can be used as a *zero point finder* when its variable voltage input is attached to an AC signal. The output from the comparator will be toggled whenever the AC signal passes through zero volts. The output will be a square wave (approximately) instead of a sine wave.

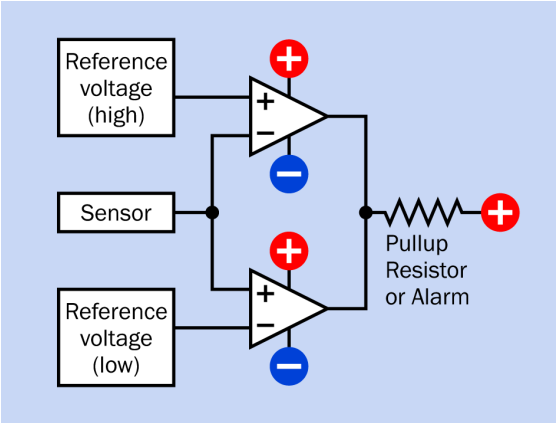

Figure 6-14. *A basic, simplified circuit for a window comparator. See text for details.*

A *continuous converter* changes its output promptly in response to a change in input. This requires continuous current consumption. Because many applications only need to check the output from a comparator at intervals, power can be saved by using a *clocked* or *latched* comparator.

What Can Go Wrong

Oscillating Output

The high input impedance of a comparator is vulnerable to stray electromagnetic fields. If the conductors leading to and from the comparator are relatively long, the output can couple capacitively with the input during voltage transitions, causing unwanted oscillations.

The commonly recommended solution to this problem is to add 1µF bypass capacitors to the power supply on either side of the comparator. However, some manufacturers recommend alternatives such as introducing just a small amount of hysteresis, or reducing the value of input resistors to below 10K.

If a chip contains multiple comparators, and one of them is unused, one of its input pins should be tied to the positive side of the voltage supply while the other should be tied to 0V ground, to eliminate the possibility of an oscillating output.

Confused Inputs

A comparator will function if its two inputs are swapped accidentally, but its high and low output states will be the inverse of what is expected. Also, if positive feedback is used, transposed inputs can create oscillations. Because the comparator symbol may appear in a schematic with the noninverting input either below or above the inverting input, the inputs are easily transposed by accident.

One way to remember which way the inputs should be connected is to use the mnemonic: "plus, high, positive." The *plus* input creates a *high* output when the input becomes *more positive* than the reference voltage on the other input. The opposite is less intuitively obvious: the *minus* input creates a *high* output when the input becomes *more negative* than the reference voltage on the other input.

Wrong Chip Type

Different comparators offer different outputs: open collector, open drain, and push-pull. While open collector and open drain function similarly, the pullup resistor value is likely to be different in each case. If a push-pull output is mistakenly connected as if it is open collector or open drain, it will not work correctly, if at all. Different types of comparators must be sorted and stored in clearly labeled bins.

Omitted Pullup Resistor

It is relatively easy to forget to include the pullup resistor on an open-collector output. In this case, when the transistor inside the comparator is in its nonconductive state, the output pin will be floating, with an indeterminate voltage that will create confusing or random results.

CMOS Issues

As usual when using CMOS chips, it is bad practice to allow unconnected, floating inputs. This is an issue where a chip contains multiple comparators, some of which are not being used. The solution recommended by some manufacturers is to tie one input of an unused comparator to the supply voltage, and the other input of the same comparator to ground.

Erratic Output

If positive feedback is insufficient, the comparator output may show signs of *jitter*. Conversely, if the positive feedback is excessive, the comparator may get stuck in an on state or an off state. Feedback must be chosen carefully.

Swapped Voltages

A comparator is often capable of controlling an output voltage that is much higher than that of its power supply. Because both voltages are applied to different pins on the same chip, mistakes can be made quite easily. The chip is likely to be damaged if the voltages are swapped accidentally between the relevant pins.

Heat-Dependent Hysteresis

Remember that the voltages at which the comparator turns on and off will vary slightly with the temperature of the component. This *drift* should be tested by running the comparator at higher temperatures.

op-amp

7

Although a comparator has the same schematic symbol as an **op-amp**, their applications differ and they are described in separate sections of this encyclopedia.

The unabbreviated name for an op-amp is an *operational amplifier*, but this term is seldom used.

OTHER RELATED COMPONENTS

- **comparator** (see Chapter 6)

What It Does

An op-amp is an *operational amplifier* consisting of multiple transistors packaged in an integrated circuit chip. It senses the fluctuating voltage difference between two inputs, uses power from an external supply to amplify that difference, and uses *negative feedback* to ensure that the output is an accurate replica of the input. Its amplification can be adjusted by changing the values of two external resistors.

Op-amps were developed originally using vacuum tubes, for use in analog computers, before the era of digital computing. Their implementation in integrated circuits dates from the late 1960s, when chips such as the LM741 were introduced (lower-noise versions of it still being widely used today). Multiple op-amps in a single package were introduced in the 1970s.

An LM741 is shown in Figure 7-1. Inside the 8-pin, DIP package is a single op-amp.

How It Works

In alternating current, voltages deviate above and below a zero value, which is sometimes referred to as the *neutral* value. This occurs in domestic power supplies and in audio signals, to name two very common examples. A *voltage amplifier* multiplies the positive and negative voltage excursions, using an external power source to achieve this. Most op-amps are voltage amplifiers.

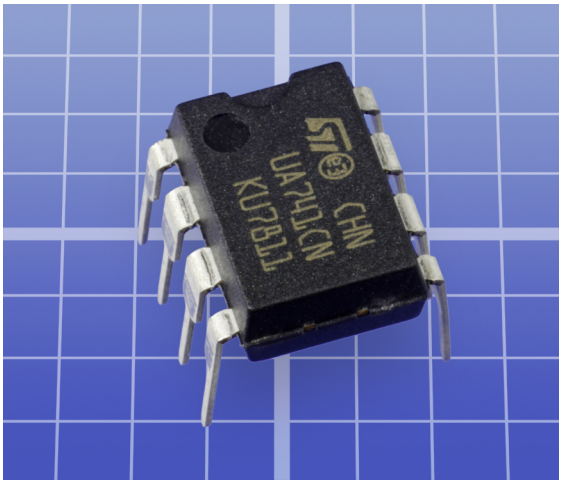

Figure 7-1. *The LM741, shown here, is still one of the most widely used op-amps.*

An ideal amplifier maintains a *linear relationship* between its input and its output, meaning that the output voltage values are a constant multiple of the input voltages over a wide range. This is

illustrated in Figure 7-2, where the lower curve is a duplicate of the upper curve, the only difference being that its amplitude is multiplied by a fixed amount (usually much greater than shown here). The ratio is properly known as the *gain* of the amplifier, usually represented with letter A (for amplification).

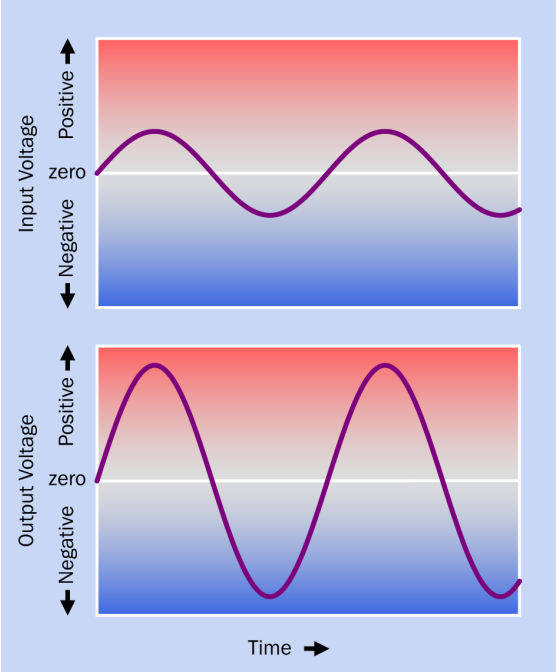

Figure 7-2. *In an ideal voltage amplifier, the output voltage will be a duplicate of the fluctuating input voltage, the only difference being that the amplitude of the output is multiplied by a fixed amount. This ratio is known as the gain of the amplifier.*

Figure 7-3 shows the triangular symbol for a generic single-input amplifier (not an op-amp). It may contain any number of components. The triangle almost always points from left to right, with its input on the left and its output on the right, and power attached above and below. This is often a *dual voltage* power supply, which is convenient for amplifying a signal that fluctuates above and below 0V. In some schematics, the power supply connections may not be shown, as they are assumed to exist.

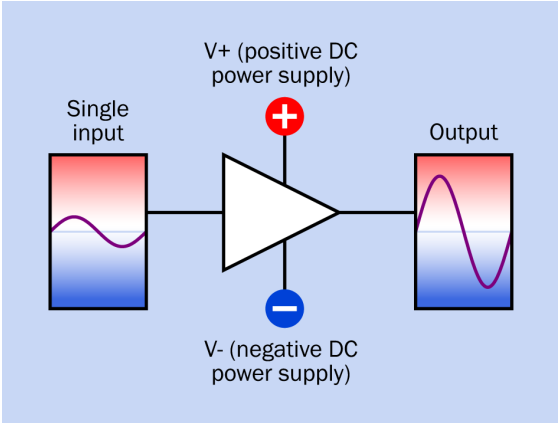

Figure 7-3. *The generic symbol for a single-input amplifier (not an op-amp), with the positive side of its power supply being equal and opposite in value to the negative side, and 0V being at the midpoint between them.*

- While the blue negative symbol is generally used throughout this encyclopedia to indicate 0V ground, it represents a voltage identified as V– in a dual voltage power supply, being equal in value but opposite in polarity to the positive side of the supply, V+. (Sometimes these voltages are indicated as V– and V+.)

The output from this imaginary generic amplifier is shown in the figure as a linear amplification of the input.

Dual Inputs

An op-amp has two inputs instead of one, and amplifies the voltage difference between them. Its symbol is shown in Figure 7-4. The upper input in this figure is held at 0V, midway between V+ and V–. Because the op-amp has so much gain, an accurate reproduction of its input would create an output exceeding the voltage of the power supply. Because this is not possible, the output tends to become saturated and consequently is *clipped* when it reaches its maximum value, as shown in the figure. The thumbnail graphs give only an approximate impression, as they are not drawn to the same scale.

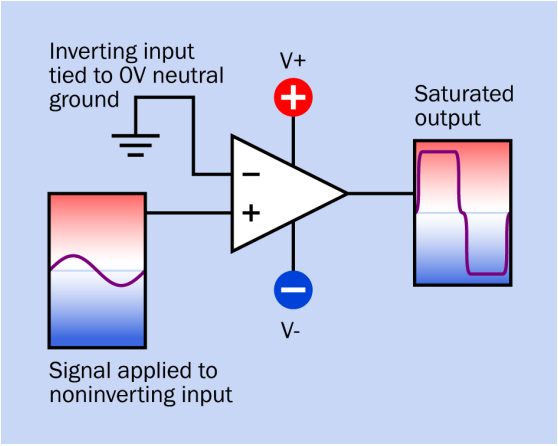

Figure 7-4. *An op-amp has so much gain, its output will tend to saturate, producing a square wave regardless of the shape of the input.*

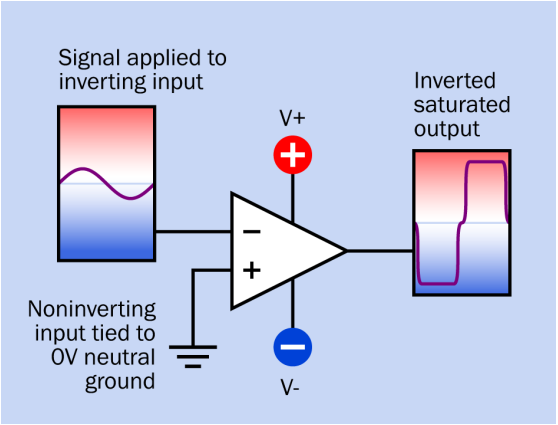

Figure 7-5. *When the incoming signal is applied to the inverting input of an op-amp while its noninverting input is held at 0V ground, the output is inverted.*

The small black plus and minus signs alongside the two inputs to the op-amp have nothing to do with the voltage supplied to the component. The "minus" input is properly referred to as the *inverting input* while the "plus" input is the *noninverting input*, in recognition of their functions.

The inputs are sometimes arranged with the minus above the plus, and sometimes with the plus above the minus. Schematics should be inspected carefully to note which arrangement is being used.

The positive and negative power connections to the op-amp may be omitted, but if shown, they always place V+ at the top, regardless of which way around the inputs are presented.

If a signal is applied to the noninverting input, while the inverting input is held at 0V ground, the op-amp provides an output in which the voltage is not inverted relative to the input.

If the input connections are swapped, so that the inverting input receives the incoming signal while the noninverting input is tied to 0V ground, the output from the op-amp is inverted (the gain remains the same). See Figure 7-5.

- An op-amp that is being used without any other components to moderate its output is functioning in *open loop* mode.

Negative Feedback

To create an output that is an accurate replica of the input, the op-amp must be brought under control with *negative feedback* to the input signal. This is illustrated in Figure 7-6. A resistor connects the output back to the inverting input, so that the input is automatically reduced to the point where the output is no longer saturated. The values of R1 and R2 will determine the gain of the op-amp, as explained in "How to Use It" on page 53. The op-amp is now functioning in its intended *closed loop* mode, meaning that the output is being tapped for feedback.

To obtain a linear output that is noninverted, connections are made as shown in Figure 7-7. The resistors form a voltage divider between the output and 0V ground, effectively increasing the comparison value on the inverting input.

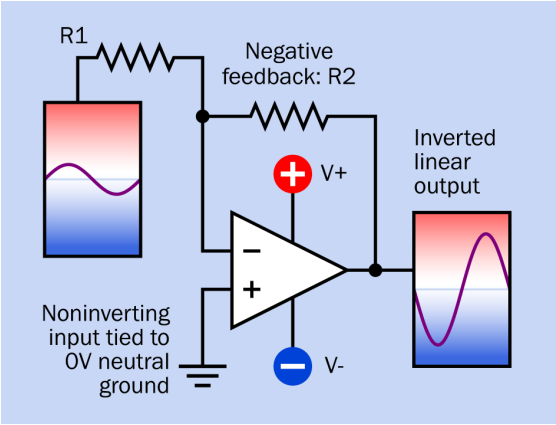

Figure 7-6. *A resistor applies negative feedback to the inverting input of an op-amp, and creates a linear output.*

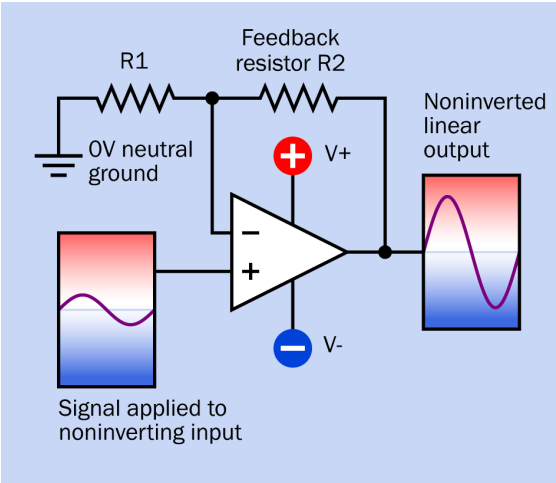

Figure 7-7. *Where the incoming signal is applied to the noninverting input, negative feedback is created by using a pair of resistors forming a voltage divider between the output and 0V ground.*

- Note that the gain of an op-amp is specific to a particular frequency range of AC signal. This is discussed in "How to Use It" on page 53.

Op-Amps and Comparators

A **comparator** can be regarded as a type of op-amp, and in fact an op-amp can be used as a comparator, comparing a variable DC voltage on one input with a reference voltage on another input. However, the two types of components have diverged in design to the point where they should be considered separately. The distinction is sufficiently important to have prompted Texas Instruments to issue an Application Report in 2001 titled "Op Amp and Comparators—Don't Confuse Them!".

Differences in function are summarized in the previous entry discussing comparators (see "Differences from an Op-Amp" on page 42).

Variants

Because op-amps are mostly low-current devices, they are widely available in very small surface-mount formats, in addition to the through-hole DIP packages which used to be more common.

Many chips are available containing two or more op-amps. This is often expressed as the number of *channels* in the component. A dual chip contains two op-amps, while a quad chip contains four op-amps. Usually all the op-amps in a chip share the same power supply. Bipolar or CMOS transistors may be used.

Because op-amps are widely available in dual and quad packages, it's quite common for a circuit designer to have one op-amp in a chip "left over." The designer may be tempted to use that spare unit as a comparator instead of installing an additional chip. To address this situation, some manufacturers offer hybrid op-amp chips containing an additional comparator. The Texas Instruments TLV2303 and TLV2304 are examples.

Values

The op-amps derived from 1970s designs often tolerate a wide range of power-supply voltages. Plus-or-minus 5VDC to plus-or-minus 15VDC is a common range. Modern op-amps are available that run from as little as 1VDC to as much as 1,000VDC.

Op-amps are available for frequencies ranging from 5KHz all the way up to 1GHz.

A "classic" op-amp such as the LM741, which is still widely used, will operate with a power supply ranging from plus-or-minus 5VDC to plus-or-minus 22VDC. Its output is rated for up to 25mA, and its input impedance is at least 2MΩ. The most current it will draw from an input is around 0.5µA.

V_{IO} is the *input offset voltage*. In an ideal component, the output from an op-amp should be 0V when its inputs have a voltage difference of 0V. In practice, the output will be 0V when the inputs differ by the offset voltage. V_{IO} is likely to be no greater than a couple of mV, and negative feedback can compensate for the offset.

V_{ICR} is the *common mode voltage range*. This is the range of input voltages that the op-amp will tolerate. This can never be more than the positive power supply voltage and will often be less, depending on the types of transistors that are used on the input side. If an input voltage goes outside the common mode voltage range, the op-amp will stop functioning.

V_{IDR} is the *input differential voltage range*—the maximum permissible difference between peak positive and peak negative input voltages. This is often expressed as plus-or-minus the power supply voltage, or slightly less. Exceeding the range can have destructive consequences.

I_B is the *input bias current*, averaged over the two inputs. Most op-amps have extremely high input impedance and consequently use very low input currents.

Slew rate at unity gain is the rate of change of the output voltage caused by an instantaneous change on the input side, when the output of the op-amp is connected directly back to the inverting input (during operation in noninverting mode).

How to Use It

In addition to being an amplifier for AC signals, an op-amp can serve as an oscillator, filter, signal conditioner, actuator driver, current source, and voltage source. Many applications require some understanding of the complexities of mathematics describing alternating current, which are not included this encyclopedia. Almost all the applications have a common starting point, however, which is to establish and control the gain of the feedback circuit.

Controlling the Gain

"A_{VOL} is the *open-loop voltage gain*, defined as the maximum voltage amplification that can be achieved when no feedback is applied from the output to an input. This remains constant until the AC frequency rises to a point known as the *breakover frequency*. If the frequency continues to rise, the maximum gain diminishes quite rapidly, until finally it terminates in 1:1 amplification at the *unity gain frequency*. This transition is shown by the orange line in Figure 7-8. The length of each purple line shows the frequencies which can be tolerated when the op-amp is used in closed-loop mode, and a negative feedback loop limits the gain. For example, where the gain is just 10:1, it can remain constant to just above 10KHz.

Note that both of the scales in this graph are logarithmic.

Calculating Amplification

So long as an op-amp is used within the boundaries of the graph, its voltage amplification can be controlled by choosing appropriate feedback and input resistors. If the op-amp is being used in noninverting mode, and R1 and R2 are placed as shown in Figure 7-7, the amplification ratio, A, is found approximately by the formula:

```
A = (approximately) 1 + (R2 / R1)
```

From this it can be seen that when R1 is very large compared with R2, the gain diminishes to near unity. If R1 becomes infinite and R2 is zero, the gain is exactly 1:1. This can be achieved by replacing R2 with a section of wire (theoretically of zero resistance) and omitting R1 entirely, as in Figure 7-9. In this configuration, the output from the op-amp should be identical with its input.

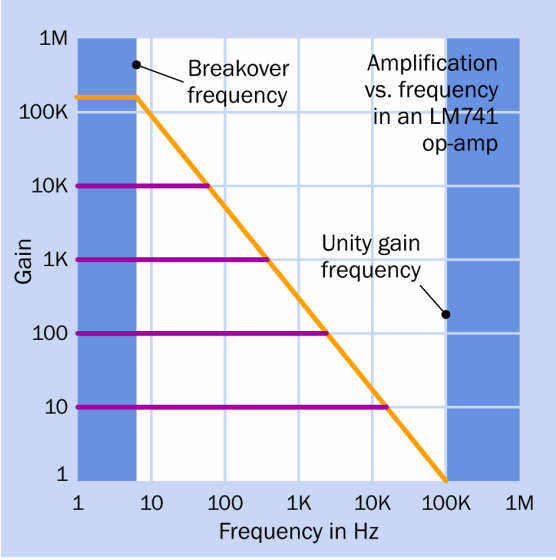

Figure 7-8. *Where each horizontal purple line meets the diagonal orange line, this is the maximum frequency that can be used without reduction in the maximum gain of an op-amp.*

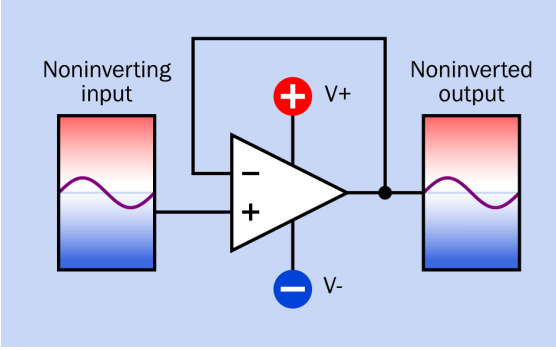

Figure 7-9. *While an op-amp is in noninverting mode, if the feedback resistor is replaced with a section of wire and the 0V ground connection is omitted entirely, the gain of the op-amp diminishes theoretically to 1:1.*

If the op-amp is being used in inverting mode, and R1 and R2 are placed as shown in Figure 7-6, then the voltage amplification ratio, A, is found approximately by the formula:

```
A = (approximately) -(R2 / R1)
```

- Note the minus sign. In inverting mode, gain is expressed as a negative number.
- In a practical circuit, at the expected frequency, the amplification factor established by choice of resistors should be no more than 20.
- An inverting circuit has a relatively low input impedance. For this reason, in most applications, a noninverting circuit is preferred.

Unintentional DC Voltage Amplification

Although the op-amp is intended primarily as an AC signal voltage amplifier, it will also amplify a DC difference between the voltages on its inputs. In the upper section of Figure 7-10, a positive DC offset is inverted and amplified to the point where the output is forced to its negative limit, and the signal is lost, because its fluctuations have been overwhelmed by the positive offset. A coupling capacitor (shown in the lower section of the figure) removes the DC voltage while passing the AC signal. The appropriate capacitor value will depend on the frequency of the signal.

Low-Pass Filter

An op-amp can facilitate a very simple low-pass audio filter, just by adding a capacitor to the basic inverting circuit previously shown in Figure 7-6. The filter schematic is shown in Figure 7-11. Capacitor C1 is chosen with a value that passes higher audio frequencies and blocks lower audio frequencies. Because the gain of the basic inverting circuit is approximately –(R2 / R1), the op-amp functions normally when the impedance of C1 is blocking the low frequencies, forcing them to pass through R2. Higher frequencies, however, are able to bypass R2 through C1, lowering the effective resistance of the feedback section of the circuit, thus reducing its gain. This way, the power of the op-amp is greatly reduced for higher frequencies compared with lower frequencies. A passive RC circuit could achieve the same effect, but would attenuate the signal, while the op-amp circuit boosts part of it.

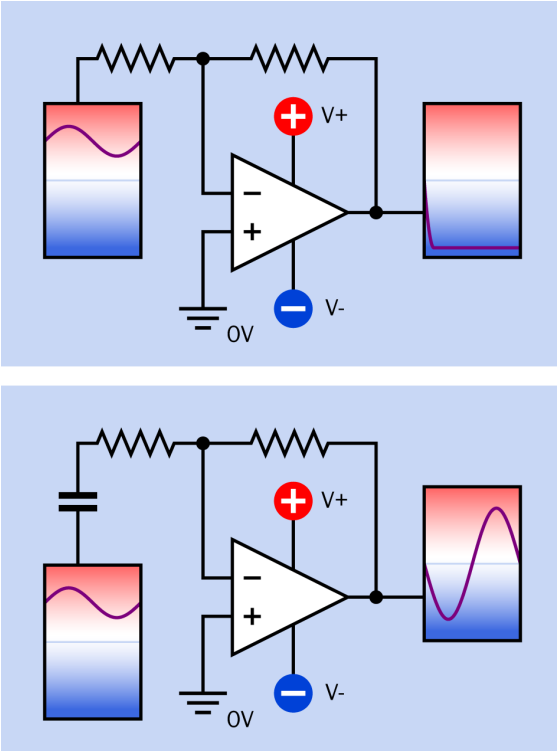

Figure 7-10. *The addition of a capacitor at the input of an op-amp is often necessary to prevent any DC voltage offset being amplified. In the upper section of this figure, a DC offset is large enough to force the inverted output to its negative limit, and the signal is completely lost.*

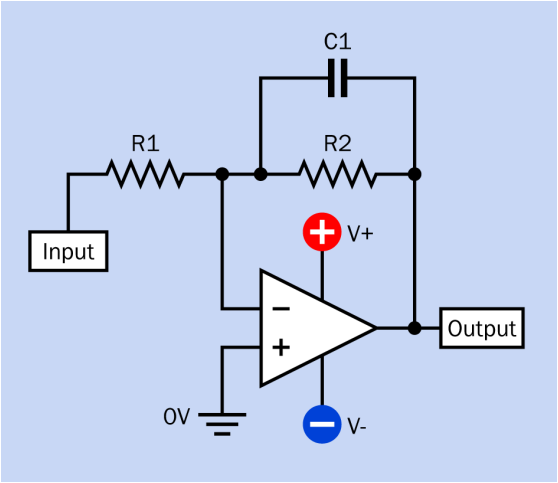

Figure 7-11. *A very basic low-pass filter, which works by allowing capacitor C1 to bypass resistor R2 at higher audio frequencies.*

High-Pass Filter

A simple high-pass filter can be created by adding a capacitor to the basic noninverting circuit previously shown in Figure 7-7. The filter schematic is shown in Figure 7-12. Once again capacitor C1 is chosen with a value that passes higher audio frequencies and blocks lower audio frequencies. Because the gain of the basic noninverting circuit is approximately 1 + (R2 / R1), the op-amp functions normally when the impedance of C1 is blocking the low frequencies, forcing them to pass through R1. Higher frequencies, however, are able to bypass R1 through C1, lowering the effective resistance of that section of the circuit, thus reducing the negative feedback and increasing the gain. This way, the power of the op-amp is increased for higher frequencies compared with lower frequencies. A passive RC circuit could achieve the same effect, but would attenuate the signal, while the op-amp circuit boosts part of it.

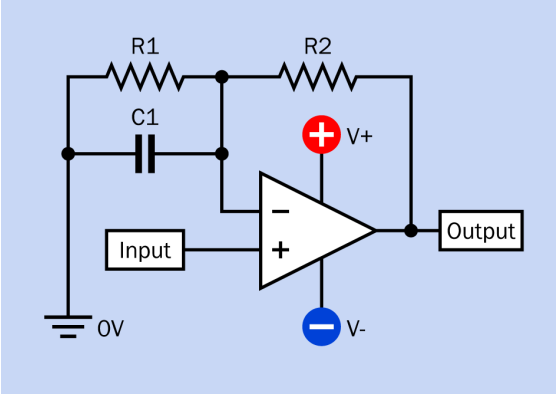

Figure 7-12. *A very basic high-pass filter, which works by allowing capacitor C1 to bypass resistor R1 at higher audio frequencies.*

Relaxation Oscillator

The schematic in Figure 7-13 is similar to the circuit shown in Figure 6-12 using a comparator. It functions as a *relaxation oscillator*, which is a form of *astable multivibrator*. The lower half of the circuit is a positive feedback loop that reinforces the output while the upper half of the circuit is charging the capacitor. Eventually the charge on the

capacitor exceeds the voltage on the noninverting input of the op-amp, creating negative feedback that exceeds the positive feedback. The capacitor discharges and the cycle repeats. The component values in the figure should generate an output that runs at around 2Hz. Reducing the value of the capacitor will increase the frequency.

Single Power Source

A few op-amps are designed to work from single voltages, but they are a relatively small minority, and will clip the output signal if the input goes negative. Power supplies are readily available that provide multiple voltages such as +15VDC, 0V, and -15VDC. They are ideal for driving an op-amp—but may not be useful for any other components in the circuit. Can an op-amp that is designed for dual voltages be made to run from a single supply, such as 30VDC?

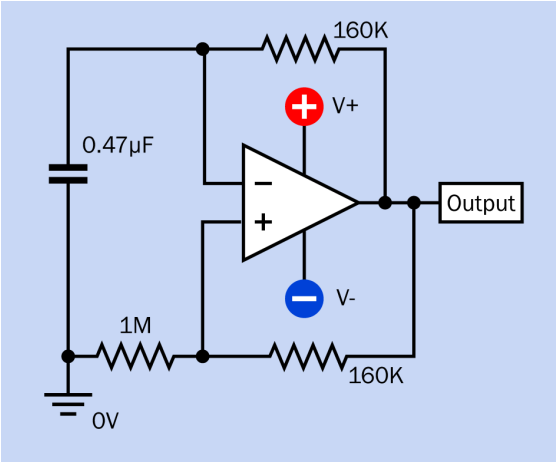

Figure 7-13. *A relaxation oscillator.*

This is relatively easy to do. The op-amp simply needs a potential difference to power its internal transistors, and 30VDC on the V+ pin with 0VDC on the V– pin will work just as well as +15VDC and -15VDC. However, referring back to Figure 7-6, if the op-amp is used in inverting mode, an intermediate voltage must be supplied to the noninverting input. Likewise, in noninverting mode, an intermediate voltage is necessary for one of the inputs, and must be half-way between the extremes of the power supply. If the supply is +15VDC and -15VDC, the midpoint is 0V. If the supply is 30VDC and 0V, the midpoint is 15VDC.

Because the inputs of an op-amp have a very high impedance and draw negligible current, the intermediate voltage can be provided with a simple voltage divider, as shown in Figure 7-14, where R3 and R4 should be no greater than 100K each. Their exact values are not important, so long as they are equal.

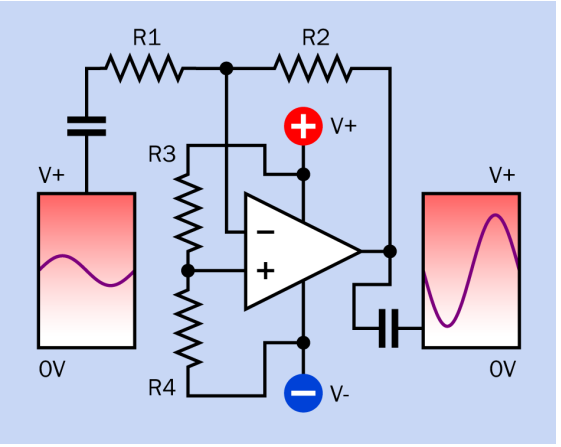

Figure 7-14. *A voltage divider, comprised of R3 and R4 in this schematic, can provide a voltage halfway between V+ and negative ground, enabling the op-amp to use just one power supply instead of two.*

A coupling capacitor should still be used on the input side, as shown, because there is no guarantee that the input signal will be centered precisely on 15V, and any offset will be amplified, potentially causing clipping of the signal. For similar reasons, a coupling capacitor is also added on the output side.

Offset Null Adjustment

Some op-amps provide two pins for *offset null adjustment*, which is a setup process to ensure that identical voltage on the two inputs will produce a null output. This is a way of compensating for any internal inconsistencies introduced during the manufacturing process.

To perform offset null adjustment, both input pins are connected directly to 0V ground, and the ends of a trimmer potentiometer (typically, 10K) are connected with the offset null pins, while the wiper of the potentiometer is centered and then connected with the negative power supply. The probes of a meter that is set to measure DC volts are placed between the output of the op-amp and 0V ground. The potentiometer is then adjusted until the meter shows a reading of 0VDC. A schematic is shown in Figure 7-15.

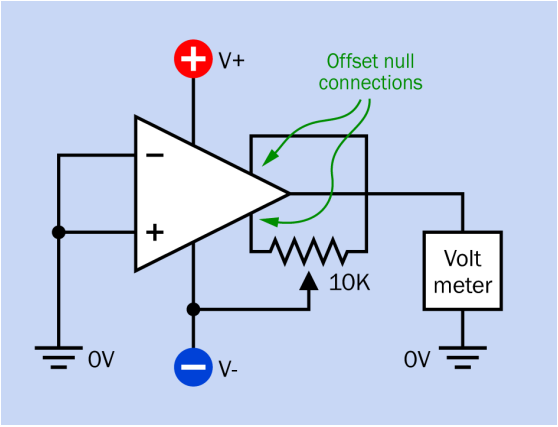

Figure 7-15. *Connections for making an offset null adjustment to an op-amp that allows this procedure.*

What Can Go Wrong

Power Supply Problems

Op-amps are especially vulnerable to reversed polarity in a power supply. If there is even a remote possibility of this occurring, a diode in series with one side of the supply can provide protection.

A more realistic concern is the destructive consequence of an input signal that exceeds the power supply voltage(s) of the op-amp. Even if the input is within the acceptable range, it can still cause permanent damage if it is applied before the op-amp powers up.

Bad Connection of Unused Sections

Multiple op-amps are often combined in a single package. If some of these "sections" remain unused, they will still receive power from the shared supply, and will attempt to function. If the inputs are left unconnected, they will pick up small stray voltages by capacitance or induction, and in the absence of negative feedback, the op-amp will create unpredictable outputs, consuming power and possibly interacting with other sections of the same chip. Figure 7-16 shows three incorrect options for addressing this problem, and one recommended option (derived from Texas Instruments Application Report SLOA067).

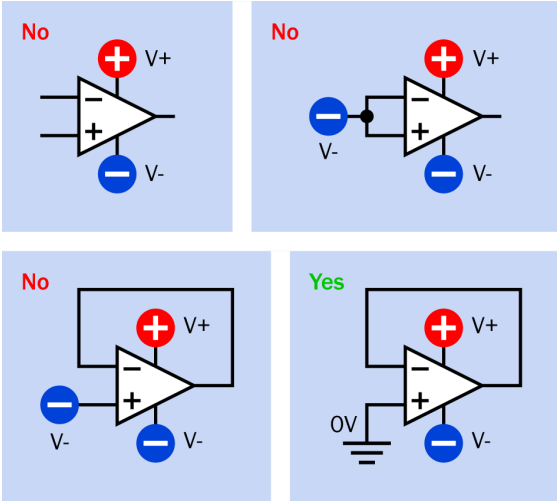

Figure 7-16. *When multiple op-amps share a chip, one that is unused will still receive power from the shared supply. Its inputs must not be allowed to float, and must be connected to minimize activity and power consumption. Three common errors are shown here, with one recommended option. Note the distinction between 0V ground (0V) and negative power (V–).*

Oscillating Output

The inputs of an op-amp are vulnerable to stray electromagnetic fields. If the conductors leading to and from the op-amp are relatively long, the output can couple capacitively with the input during voltage transitions, causing unwanted oscillations.

The commonly recommended solution to this problem is to add a 1µF bypass capacitor between the power supply and 0V ground. However, some manufacturers recommend alternatives such as introducing a very small amount of hysteresis, or reducing the value of input resistors to below 10K.

Confused Inputs

A schematic may show an op-amp with the noninverting input above the inverting input, or vice versa. The only indication of this will be the plus and minus signs inside the chip, which can be extremely small and easily overlooked. For convenience in drawing a diagram, two op-amps in the same circuit may have their inputs shown in opposite configurations. Special care must be taken to verify that the inverting and noninverting input pins on a chip are correctly assigned.

digital potentiometer

A **digital potentiometer** is also known as a *digitally adjustable potentiometer*, a *digitally controlled potentiometer*, a *digitally programmed potentiometer* (with acronym *DPP*), a *digpot*, or a *digipot*. The terms are functionally interchangeable. Because the abbreviation *pot* is often used to describe an analog potentiometer, some people refer to digital potentiometers colloquially as *digital pots*. In printed documentation, the letters in *pot* may be capitalized. Because it is an abbreviation, not an acronym, it is not capitalized here.

Because this component enables digital control of a variable voltage, it is a *mixed signal device*. It is classified here as an analog chip because it primarily emulates the function of an analog device. It may be thought of as a form of *digital-analog converter*, although this encyclopedia does not have a section devoted to that type of component or to *analog-digital converters*, as their application is relatively specialized.

OTHER RELATED COMPONENTS

- **potentiometer** (see Volume 1)

What It Does

This component is an integrated circuit chip that emulates the function of an analog **potentiometer**. It is often described as being *programmable*, meaning that its internal resistance can be changed via a control input.

Digital potentiometers are particularly suited for use in conjunction with a *microcontroller*, which can control the internal resistance of the component. Possible applications include adjustment of the pulse width of an oscillator or multistable multivibrator (e.g., using the Control pin of a 555 **timer** chip); adjustment of the gain in an **op-amp**; specification of voltage delivered by a *voltage regulator*; and adjustment of a *band-pass filter*.

A digital potentiometer in combination with a microcontroller may also be used in conjunction with a pair of external buttons or a rotational encoder, to adjust the gain of an audio amplifier and for similar applications.

Advantages

A digital potentiometer offers significant advantages over an analog potentiometer:

- Reliability. The digital component may be rated for as many as a million cycles (each storing the wiper position in an internal memory location). An analog component may be capable of just a few thousand adjustment cycles.
- Digital interface.
- Elimination of long signal paths or cable runs. The digital potentiometer can be placed close to other chips, whereas an analog potentiometer often has to be some distance away to enable control by the end user. Reduction in the length of signal paths can reduce capacitive effects, while elimina-

tion of cable runs will reduce manufacturing costs.

- Reduction in size and weight compared with a manual potentiometer.

A digital potentiometer also has some disadvantages:

- Its internal resistance is somewhat affected by temperature.
- It is not usually capable of passing significant current. Few chips can sink or source more than 20mA at the output, and 1mA is common. The output is primarily intended for connection with other solid-state components that have high impedance.
- Users may prefer the immediacy and tactile feel of a knob attached to an analog potentiometer, rather than a pair of buttons or a rotational encoder.

How It Works

A digital potentiometer changes the point at which a connection is made along a *ladder* of many fixed resistors connected in series inside the chip. Each end of the ladder, and each intersection between two adjacent resistors, is known as a *tap*. The pin that can connect with any of the taps is referred to as the *wiper*, because it emulates the function of a wiper in an analog potentiometer. In reality, a digital potentiometer does not contain a wiper or any other moving parts.

A fully featured digital potentiometer allows access to each end of the ladder through two pins that are often labeled "high" and "low," even though they are functionally interchangeable (except in the case of a component that simulates a logarithmic taper, as described later). The "low" end of the ladder is sometimes numbered 0. In this case, if there are *n* resistors, the "high" end of the ladder will be numbered *n*. Alternatively, if the "low" end of the ladder is numbered 1, and there are *n* resistors, the "high" end will be numbered *n+1*. This principle is illustrated in Figure 8-1.

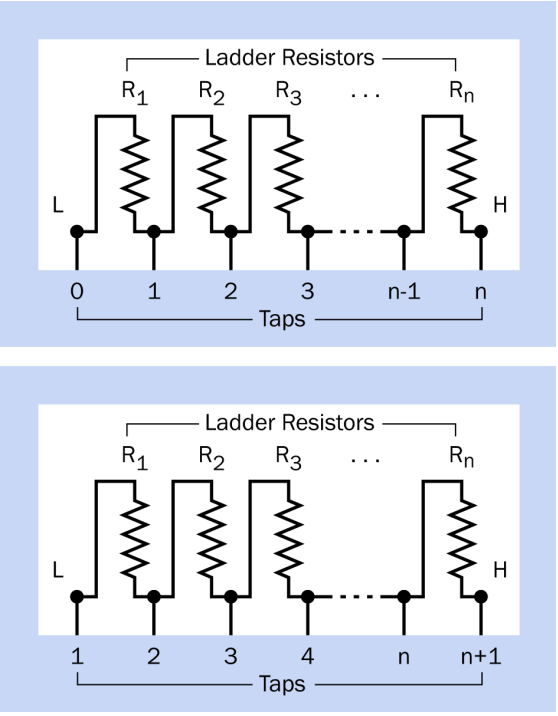

Figure 8-1. *Available wiper connections to a resistor ladder inside a digital potentiometer, showing two numbering systems that may be used.*

The "low" pin on a digital potentiometer may be identified as L, or A, or R_L, or P_A in a datasheet, while the "high" pin may be identified as H, or B, or R_H, or P_B and the pin that accesses the wiper is typically identified as W, or R_W, or P_W. Letters L, H, and W are used below. Although the L and H pins are functionally interchangeable, their labels are useful to identify which direction the W connection will move in response to an external signal.

Digital potentiometers are available with as few as 4 or as many as 1,024 taps, but common values are 32, 64, 128, or 256 taps, with 256 being the most common.

No specific schematic symbol represents a digital potentiometer. Often the component is shown as an analog potentiometer symbol inside a box that has a part number, as suggested in

Figure 8-2. Control pins and the power supply may be omitted if the schematic is just intended to show logical connections. Alternatively, if the digital potentiometer is depicted in a schematic where it is connected with other components such as a microcontroller, multiple pins and functions may be included, as shown in Figure 8-3. The pins additional to L, H, and W are explained below.

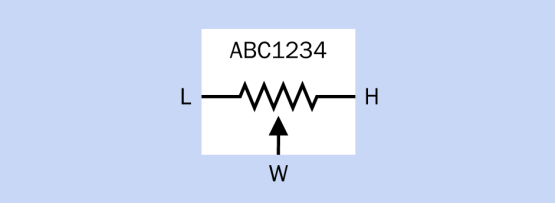

Figure 8-2. *There is no single specific symbol to represent a digital potentiometer. It may be shown using an analog potentiometer symbol in a box with a part number, as suggested here, where power connections and additional pins are omitted for clarity.*

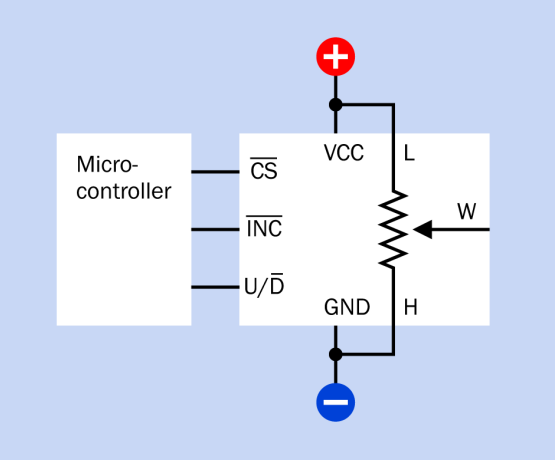

Figure 8-3. *If a digital potentiometer appears in a schematic where it is connected with other components such as a microcontroller, additional pins and functions may be indicated. This generic representation of a digital potentiometer shows some of the functions that can be included.*

Variants

A *dual* digital potentiometer contains two complete units, while a *quad* contains four. Triples exist but are relatively uncommon. A few chips contain six potentiometers. Multiple digital potentiometers in a chip can be used as the digital equivalent of *ganged* analog potentiometers, for simultaneous synchronized adjustment of multiple inputs in an audio system (two channels in a stereo amplifier, or more in a surround-sound system).

The pinouts of a sophisticated quad digital potentiometer chip are shown in Figure 8-4. Other quad chips have different pinouts and capabilities; there is no standardized format as there is with digital logic chips. In this example, the high/low states of Address 0 and Address 1 select one of the four internal resistor ladders, numbered 0 through 3. The Chip Select pin makes the whole chip either active or inactive. The Write Protect pin disables writing to the internal wiper memory. The Serial Clock pin inputs a reference pulse stream to which the serial input data must be synchronized. The Hold pin pauses the chip while data is being transmitted, allowing the data transmission to be resumed subsequently. The NC pins have no connection.

Volatile and Nonvolatile Memory

Any type of digital potentiometer requires memory to store its current wiper position, and this memory may be volatile or nonvolatile. Nonvolatile memory may be indicated in a datasheet by the term *NV*.

A digital potentiometer with volatile memory will typically reset its wiper to a center-tap position if power is disconnected and then restored. A digital potentiometer with nonvolatile memory will usually restore the most recently used wiper position, provided the chip is fully powered down and then fully powered up without glitches in the supply. If a microcontroller is being used to control the digital potentiometer, it can store the most recent resistance value in its own nonvolatile memory, in which case the type of memory in the potentiometer becomes irrelevant.

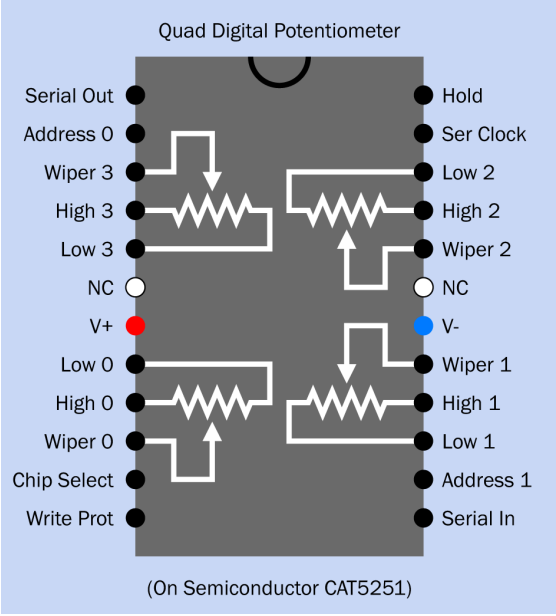

Figure 8-4. *Pinouts of a sophisticated quad digital potentiometer chip. Other chips will have different pinouts and capabilities. This example is available in surface-mount formats only. See text for details.*

Taper

Digital potentiometers are available with *linear taper* or *logarithmic taper*. In the former, each resistor in the ladder has the same value. In the latter, values are chosen so that the cumulative resistance between the wiper and the L end of the ladder increases geometrically as the wiper steps toward the H end of the ladder. This is useful in audio applications where sound intensity that increases exponentially may seem to increase linearly when perceived by the human ear.

A microcontroller can emulate logarithmic steps by skipping some taps in the ladder in a digital potentiometer, but this will result in fewer increments and lower precision.

Data Transfer

Digital potentiometers are mostly designed to use one of three serial protocols:

- *SPI*. This acronym is derived from *serial peripheral interface*, a term trademarked by Motorola but now used generically. The standard is adapted in various radically different ways among digital potentiometers.
- *I2C*. More correctly printed as *I²C* and properly pronounced "I squared C," this acronym is derived from the term *inter-integrated circuit*. Developed by Philips in the 1990s, it is a relatively slow-speed bus-communication protocol (up to 400kbps or 1Mbps in its basic form). It is built into some microcontrollers. The standard is more uniformly and rigorously defined than SPI.
- *Up/down*, also sometimes known as *push-button* or *increment/decrement* protocol.

Both SPI and I2C are supported by many microcontrollers, including the Atmel AVR at the heart of the Arduino.

These three systems for controlling a digital potentiometer are described in more detail in the following sections.

SPI

This is the most widely used protocol, but when reading datasheets, a lot of care must be taken to determine how it varies in each case.

The Microchip 4131-503, shown in Figure 8-5, uses SPI protocol. It contains 128 resistors and can be powered by 1.8VDC to 5.5VDC.

The one feature that all versions of SPI have in common is that a series of high/low pulses is interpreted by the chip as a set of bits whose value defines a tap point in the resistor ladder. In computer terminology, every tap point has an *address*. The incoming bits define the address, after which the status of an additional input pin can tell the chip to move the wiper to that location.

Typically, there will be a chip select pin, identified as CS; a serial data input pin, identified as SDA, SI, DIN, or a similar acronym; and a serial clock pin, identified as SCL, SCLK, or SCK, which must receive a stream of pulses to which the high/low data input pulses must be synchronized. In addition, the SPI protocol allows bidirectional (duplex) serial communication. Only a minority of

digital potentiometers make use of this capability, but where it exists, a serial data output pin may be labeled SDO. Alternatively, one pin may be multiplexed to enable both input and output, in which case it may be labeled SDI/SDO.

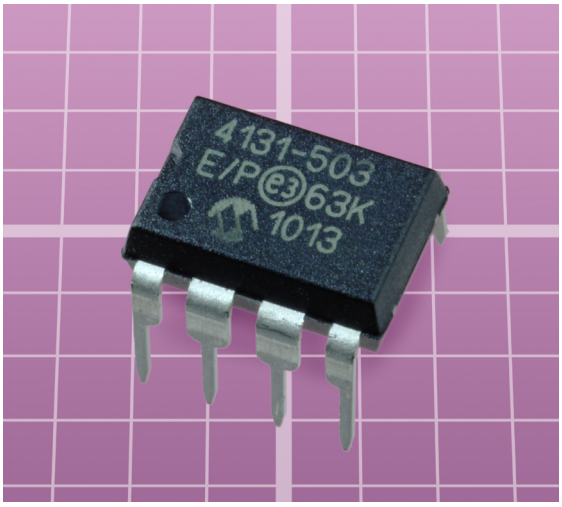

Figure 8-5. *This digital potentiometer uses SPI protocol. See text for details.*

If a pin is active-low, a bar (a horizontal line) will be printed above its acronym.

The most common type of digital potentiometer has 255 resistors and therefore 256 tap points, which have addresses numbered 0 through 255, each of which can be specified by a sequence of eight data bits constituting one byte. However, a different coding system will be applied in chips that have a different number of taps. In a 32-tap component, for instance, data is still sent in groups of eight bits, but only the first five bits define a *tap address*, while the remaining three are interpreted as commands to the chip.

Most 256-tap chips use an SPI protocol in which two eight-bit bytes are sent, the first being interpreted by the chip as a command, while the second specifies a tap address. Each manufacturer may use a different set of command codes, and these will vary among chips even from the same manufacturer.

Most commonly, three wires are used for data transmission and control (causing these chips to be described as *3-wire* programmable potentiometers).

CS is usually, but not always, pulled low to activate the digital potentiometer for input. A series of low or high states is then applied to the data-input pin. Each time the clock input changes state (usually on the rising edge of the clock pulse) the state of the data input is copied to a **shift register** inside the chip. After all the bits have been clocked in, CS can change from low to high, causing the contents of the shift register to be copied into a decoder section of the chip. The first bit received becomes the most significant bit in the decoder. The value of the eight bits is decoded, and the chip connects the W pin directly to the corresponding tap along the ladder of 255 internal resistors.

I2C Protocol

The I2C specification is controlled by NXP Semiconductors (formerly Philips), but can be used in commercial products without paying licensing fees. Only two transmission lines are required: one carrying a clock signal, the other allowing bidirectional data transfer synchronized with the clock (although many digital potentiometers use the I2C connection only to receive data). The pins are likely to be identified by the same acronyms as the pins on a chip that uses SPI protocol.

As in SPI, a command byte is followed by a data byte, although the command set differs from that of SPI and will also differ among various I2C chips. Full implementation of I2C allows multiple devices to share a single bus, but this capability may remain unused.

Up/Down Protocol

This simpler, asynchronous protocol does not require a clock input. The chip will respond to data pulses that are received at any speed (up to its maximum speed), and the pulse widths can be inconsistent.

Each pulse moves the wiper connection one step up or down the ladder. While this has the advantage of simplicity, the taps are not addressable, and consequently the wiper cannot skip to any tap without passing through intervening taps incrementally. This is not an inconvenience when the potentiometer controls audio gain, which is a primary application.

In some chips, an increment pin, usually labeled INC, receives pulses while the high or low state of a second pin, usually labeled U/D, determines whether each pulse will step the wiper up the ladder or down the ladder.

In other chips, pulses to an Up pin will step the wiper up the ladder, while pulses to a Down pin will step the wiper down the ladder.

Either of these chip designs can be referred to as a *two-wire* type. If an additional chip-select pin is included (labeled CS on datasheets), this type of digital potentiometer can be referred to as a *three-wire* type. The chip select pin is likely to be active-low, meaning that so long as it has a high state, the chip will ignore incoming signals.

The CAT5114 shown in Figure 8-6 uses an U/D pin. It contains 31 resistors, is available in 8-pin DIP or surface-mount formats, and can be powered by 2.5VDC to 6VDC. Each of its logic inputs draws only 10µA.

In six-pin chips the INC pin is omitted, one of the H, L, or W pins will be omitted, and the U/D pin will function differently. When CS is pulled low, the chip checks the state of the U/D pin. If it is high, the chip goes into increment mode; if it is low, the chip goes into decrement mode. So long as CS remains low, each transition of the U/D pin from low to high will either increment or decrement the wiper position, depending on the mode that was sensed initially. When CS goes high, further transitions on the U/D pin will be ignored until CS goes low again, at which point the procedure repeats.

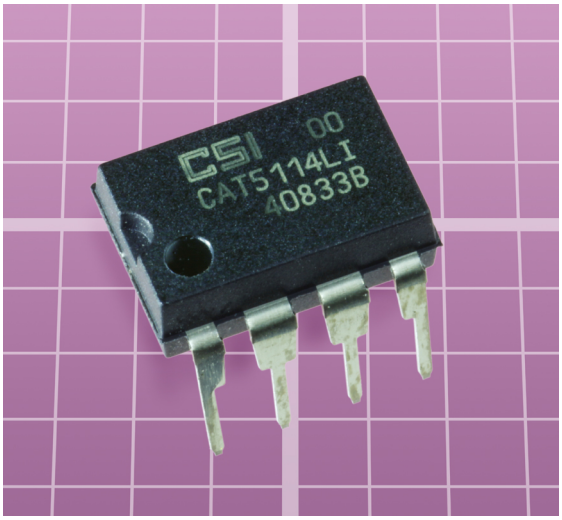

Figure 8-6. *This digital potentiometer contains 31 resistors and uses the simplest up/down protocol to step from one tap to the next.*

The chip does not provide any feedback regarding the position of its wiper, and consequently a control device such as a microcontroller cannot know the current wiper position. If the chip has nonvolatile memory (as is the case in many up/down digital potentiometers), it will resume its previous wiper location at power-up, but here again a control device will have difficulty determining what that position is. Therefore, in its basic form, an up/down chip is only appropriate for simple tasks, especially in response to up/down pushbuttons.

Other Control Systems

A few digital potentiometers use a parallel interface. Because they are relatively uncommon, they are not included here.

Connections and Modes

Some variants of digital potentiometers minimize the chip size and number of connections by limiting accessibility to the internal resistor ladder. In a chip designed to function in *rheostat mode*, the W pin is eliminated and the chip moves an internal connection point to change the resistance between the H and L pins.

In some variants, the low end of the ladder is permanently, internally connected with ground, and the L pin is omitted. In other variants, one end of the ladder is unconnected inside the chip.

A chip designed to function in *voltage divider mode* will include all three pins—H, L, and W—except in some instances where the low end of the ladder is grounded internally.

Variants are shown in Figures 8-7, 8-8, 8-9, and 8-10. Because some pins may be omitted, and there is no standardization of function among the pins that do exist, circuits and chips must be examined carefully prior to use.

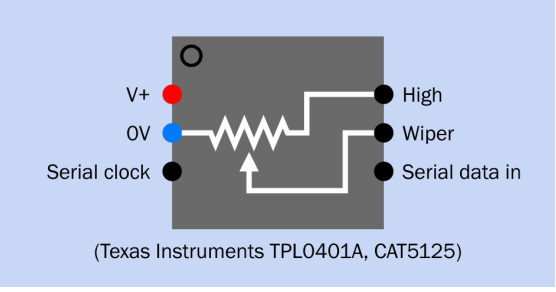

Figure 8-7. *Some digital potentiometers minimize chip size and provide specialized functionality by eliminating pins. In the variant shown here, the W pin provides a voltage between H and an internal ground connection. The chip is controlled via I2C serial protocol.*

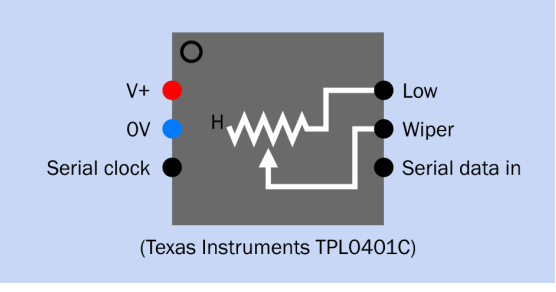

Figure 8-8. *In this variant, the H end of the internal resistor ladder is allowed to float inside the chip, and the digital potentiometer functions as a rheostat. The chip is controlled via I2C serial protocol.*

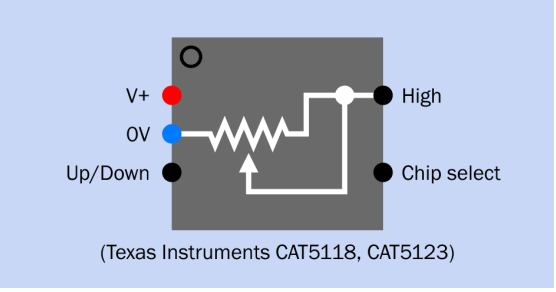

Figure 8-9. *This variant provides a variable resistance between the H pin and an internal connection with negative ground. Pin 5 is omitted. The chip is controlled by up/down pulses.*

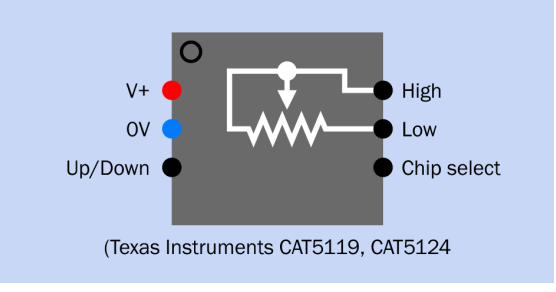

Figure 8-10. *This variant provides a variable resistance between H and L pins, without allowing either end of the resistor ladder to float. The W pin is omitted, as the wiper is tied internally to the H pin. The chips listed are controlled by up/down pulses.*

Values

A primary limitation of digital potentiometers is that they cannot withstand significant current. This may prevent them from being substituted for an analog potentiometer unless changes are made in the circuit. H, L, and W pins are usually unable to source or sink continuous, sustained current exceeding 20mA.

Wiper resistance is the resistance that is added internally by the wiper. This is nontrivial; it is often around 100Ω, and can be as high as 200Ω.

Typical end-to-end resistance of the ladder of internal resistors may range from 1K to 100K. Values of 1K, 10K, and 100K are common.

While the number of taps is likely to be a power of two in chips where the taps are addressable, up/down chips are not so constrained and may contain, for example, 100 taps.

The end-to-end resistance of a whole ladder may vary by as much as 20% from one sample of a chip to the next. Among resistor ladders in digital potentiometers sharing the same chip (i.e., in dual or quad chips) the variation will be much smaller.

Almost all digital potentiometers are designed for a supply voltage of 5V or less. The H and L pins are not sensitive to polarity, but the voltage applied to either of them must not exceed the supply voltage.

How to Use It

While most microcontrollers contain one or more analog-digital converters that change an analog *input* to an internal numeric value, a microcontroller cannot create an analog *output*. A digital potentiometer adds this functionality, although applications will be restricted by its limitation on current.

An up/down digital potentiometer can be controlled directly by a pair of **pushbuttons**, one of which will increase the resistance value while the other will reduce it. The pushbuttons must be *debounced* when used in this way. An alternative to pushbuttons is a **rotational encoder**, which emits a stream of pulses when its shaft is turned. In this case, an intermediate component (probably a microcontroller) will usually interpret the pulse stream and change it to a format that the digital potentiometer can understand.

Where a digital potentiometer is used in audio applications, it should be of the type that moves the wiper connection from one tap to another during a *zero crossing* of the audio signal (i.e., that is, at the moment when the AC input signal passes through 0V on its way from positive to negative or negative to positive). This suppresses the "click" that otherwise tends to occur during switching. Potentiometers with this feature may include phrases such as "glitch free" in their datasheets.

Digital potentiometers that are intended primarily for audio applications often have 32 taps spaced at intervals of 2dB. This will be sufficient to satisfy most listeners.

Achieving Higher Resolution

For sensitive applications where a resolution with more than 1,024 steps is required, multiple digital potentiometers with different step values can be combined. One way of doing this is shown in Figure 8-11. In this circuit, the wipers of P2 and P3 must be moved in identical steps, so that the total resistance between the positive power supply and negative ground remains constant. These two potentiometers could be contained in a dual chip, and would receive identical up/down commands. P1 is at the center of the voltage divider formed by P2 and P3, and is adjusted separately to "fine tune" the output voltage that is sensed at point A.

If all three of the potentiometers in this circuit contain 100 taps, a combined total of 10,000 resistance steps will be possible.

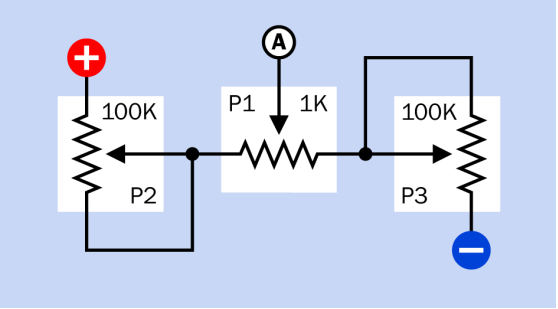

Figure 8-11. *If all three digital potentiometers in this schematic have 100 taps, and the wipers of P2 and P3 are moved in synchronization, the voltage measured at point A can have a high resolution of up to 10,000 steps.*

What Can Go Wrong

Noise and Bad Inputs

Because a digital potentiometer is capable of receiving data at speeds as high as 1MHz, it is sensitive to brief input or power fluctuations, and can misinterpret them as instructions to move the wiper—or can misinterpret them as command codes, in a component using SPI or I2C serial protocol.

To minimize noise in the power supply, some manufacturers recommend installing a 0.1µF capacitor as close as possible to the power supply pin of the component. In addition, it is obviously important to provide clean input signals. This means thorough debouncing of any electromechanical switch or pushbutton inputs.

Wrong Chip

The wide diversity of input protocols and pinouts creates many opportunities for installation error.

Up/down, SPI, and I2C protocol require totally different pulse streams. Many manufacturers offer components that are distinguished from each other by just one or two digits in their part numbers, yet have radically different functionality.

If more than one specific type of digital potentiometer may be used during circuit development, they should be stored carefully to avoid inadvertant substitutions. Using the wrong chip may be particularly confusing in that an inappropriate input protocol will still produce some results, although not those which were intended.

Controller and Chip Out of Sync

As noted in the discussion of data transmission protocols, most digital potentiometers are not capable of providing feedback to confirm the position of the internal wiper. A designer may wish to include a power-up routine which establishes the state of the digital potentiometer by resetting it to a known position, at one end of its scale or the other.

Nonlinear Effects

While the end-to-end resistance of the resistor ladder inside a digital potentiometer is not likely to be affected significantly by changes in temperature, the resistance at the wiper is more heat sensitive.

In an up/down chip, there can be differential errors between incremental and decremental modes. In other words, if a tap is reached by stepping up to it incrementally, the resistance between the W pin and H or L may not be quite the same as if the same tap is reached by stepping down to it decrementally. The difference may not be significant, but may be puzzling for those who are unfamiliar with this phenomenon.

Some differences may be found among resistors in a ladder. That is, in a supposedly linear digital potentiometer, each resistor may differ in value slightly from the next.

Data Transfer Too Fast

When using a microcontroller to send data to a digital potentiometer, a small delay may be necessary between pulses, depending on the microcontroller's clock speed. A digital potentiometer may require a minimum pulse duration of 500ns. Check the manufacturer's datasheet for details.

timer

A device that creates a single timed pulse, or a series of timed pulses with timed intervals between them, is properly known as a *multivibrator*, although the generic term **timer** has become much more common and is used here.

Three types of multivibrator exist: *astable*, *monostable*, and *bistable*. The behavior of *astable multivibrators* and *monostable multivibrators* is described in detail in this entry. A timer chip can also be made to function as a bistable multivibrator. This is described briefly below, but it is not a designed function of a timer. The primary discussion of bistable multivibrators will be found in the entry of this encyclopedia dealing with **flip-flops**.

OTHER RELATED COMPONENTS

- **flip-flop** (See Chapter 11)

What It Does

A *monostable* timer emits a single timed pulse of fixed length in response to a triggering input that is usually of shorter duration. Many monostable timers are also capable of running in *astable* mode, in which the timer spontaneously emits an ongoing stream of timed pulses with timed gaps between them. A dual-mode timer can run in either mode, determined either by external components attached to it, or (less commonly) by changing the status of a mode selection pin.

Monostable Mode

In monostable mode, the timer emits a pulse in response to a change from high to low voltage (or, less commonly, from low to high voltage) at a *trigger pin*. Most timers respond to a *voltage level* at the trigger pin, but some are insensitive to any persistent pin state and only respond to a *voltage transition*. This is known as *edge triggering*.

The pulse generated by the timer may consist of a change from low to high (or, less commonly, from high to low) at an output pin. The length of the pulse will be determined by external components, and is independent of the duration of the triggering event, although in some cases, an output pulse may be prolonged by *retriggering* the timer prematurely. This is discussed below.

At the end of the output pulse, the timer reverts to its quiescent state, and remains inactive until it is triggered again.

A monostable timer can control the duration of an event, such as the time for which a light remains on after it has been triggered by a motion sensor. Alternatively, the timer can impose a delay, such as the interval during which a paper towel dispenser refuses to respond after a towel has been dispensed. A timer can also be useful to generate a clean pulse in response to an unstable or noisy input, as from a manually operated pushbutton.

Astable Mode

In astable mode, a timer will generally trigger itself as soon as power is connected, without any need for an external stimulus. However, the output can be suppressed by applying an appropriate voltage to a *reset pin*.

External components will determine the duration of each pulse and the gap between it and the next pulse. The pulse stream can be slow enough to control the flashing of a turn signal in a 1980s automobile, or fast enough to control the bit rate in a data stream from a computer.

Modern timer circuits are often incorporated in chips that have other purposes. The flashing of a turn signal in a modern car, for instance, is now likely to be timed by a microcontroller that manages many other functions. Still, chips that are purely designed as timers remain widely used and are very commonly available in numerous through-hole and surface-mount formats.

How It Works

The duration of a single pulse in monostable mode, or the frequency of pulses in astable mode, is most commonly determined by an external *RC network* consisting of a resistor in series with a capacitor. The charging time of the capacitor is determined by its own size and by the value of the resistor. The discharge time will be determined in the same way. A **comparator** inside the timer is often used to detect when the potential on the capacitor reaches a *reference voltage* that is established by a voltage divider inside the chip.

Variants

The 555 Timer

An eight-pin integrated circuit manufactured by Signetics under part number 555 was the world's first fully functioned timer chip, introduced in 1972. It combined two comparators with a **flip-flop** (see Chapter 11) to enable great versatility while maintaining excellent stability over a wide range of supply voltages and operating temperatures. Subsequent timers have been heavily influenced by this design. A typical 555 timer chip is shown in Figure 9-1.

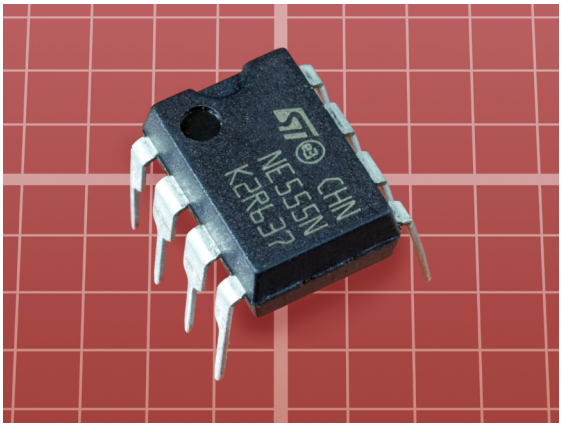

Figure 9-1. *A typical 555 timer chip. Functionally identical versions in which the "555" identifier is preceded or followed by different letter combinations are available from many different manufacturers.*

The 555 was designed by one individual, Hans Camenzind, working as an independent consultant for Signetics. According to a transcript of an interview with Camenzind maintained online at the Transistor Museum, "There was nothing like it at the time. You had to use quite a few discrete components—a comparator, a Zener diode or even two. It was not a simple circuit."

The 555 timer quickly became the most widely used chip in the world, and was still selling an annual estimated 1 billion units three decades after its introduction. It has been used in spacecraft, in intermittent windshield wiper controllers, in the early Apple II (to flash the cursor), and in children's toys. Like many chips of its era, its design was unprotected by patents, allowing it to be copied by numerous manufacturers.

The initial version was built around **bipolar transistors**, and consequently is referred to as the *bipolar version* or (more often) the *TTL version*, this being a reference to *transistor-transistor logic* protocol. Within a few years, CMOS versions based around **MOSFETs** were developed. They reduced the ability of the chip to sink or source

current at its output pin, but consumed far less power, making them better suited to battery-operated products. The CMOS versions were and still are pin-compatible with the original bipolar version, both in through-hole and surface-mount formats. Their timing parameters are usually the same.

555 Monostable Operation

The internal functionality of a 555 timer wired to run in monostable mode is illustrated in Figure 9-2 with the chip seen from above. The pins are identified in datasheets by the names shown. To assist in visualizing the behavior of the chip, this figure represents the internal flip-flop as a switch which can be moved by either of two internal comparators, or by an input from the Reset pin.

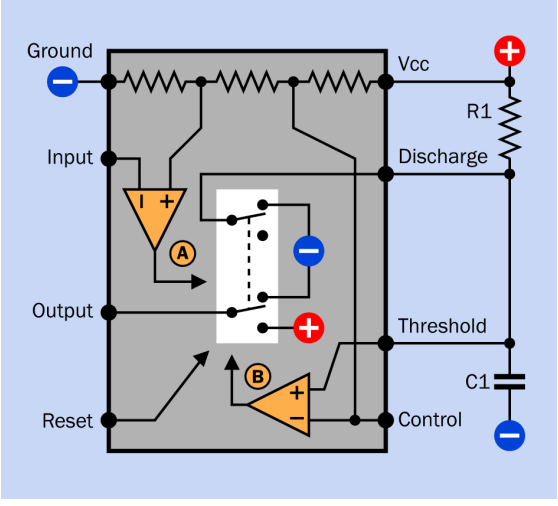

Figure 9-2. *The internal functions of a 555 chip, with its flip-flop represented as a switch that can be moved by either of two comparators, or by a low voltage on the Reset pin. An external resistor and capacitor, shown as R1 and C1, cause the timer to run in monostable (one-shot) mode, generating a single high pulse when the state of the Input pin is pulled from high to low.*

Inside the chip, three resistances of 5K each are connected between V+ (positive supply voltage) and negative ground. It has been suggested that the part number of the 555 chip was derived from these three 5K resistors, but Hans Camenzind has pointed out that Signetics was already using three-digit part numbers beginning with the number 5, and probably chose the 555 part number because the sales department had high expectations for the chip and wanted its number to be easily memorable. (A similar rationale explains the part number of the 2N2222 transistor.)

The resistances inside the timer function as a *voltage divider*, providing a reference of 1/3 of V+ to the noninverting pin of Comparator A and 2/3 of V+ to the inverting pin of Comparator B. (See Chapter 6 for an explanation of the functioning of comparators.)

When power is initially supplied to the timer, if the Input pin is at a high state, Comparator A has a low output, and the flip-flop remains in its "up" position, allowing the Output pin to remain in a low state. The flip-flop also grounds the lower end of R1, which prevents any charge from accumulating on capacitor C1.

If the state of the Input pin is pulled down externally to a voltage less than 1/3 of V+, Comparator A now creates a high output that changes the flip-flop to its "down" position, sending a high signal out through the Output pin. At the same time, C1 is no longer grounded, and begins to charge at a rate determined by its own size and by the value of R1. When the charge on the capacitor exceeds 2/3 of V+, it activates Comparator B, which forces the flip-flop into its "up" position. The Output pin goes low, C1 discharges itself into the Discharge pin, and the timer's cycle is at an end.

The low voltage on the Input pin of the timer must end before the end of the output cycle. If the voltage on the Input pin remains low, it will re-trigger the timer, prolonging the output pulse.

A pullup resistor may be used on the Input pin to avoid false triggering, especially if an external electromechanical **switch** or **pushbutton** is used to pull down the Input pin voltage.

The Reset pin should normally be held high, either by being connected directly to positive supply voltage (if the reset function will not be needed) or by using a pullup resistor. If the Reset pin is pulled low, this will always interrupt an output pulse regardless of the timer's current status.

If a voltage higher or lower than 2/3 of V+ is applied to the Control pin, this will change the reference voltage on Comparator B, which determines when the charging cycle of C1 ends and the discharge cycle begins. A lower reference voltage will shorten each output pulse by allowing a lower charge limit for C1. If the control voltage drops to 1/3 of V+ (or less), the capacitor will not charge at all, and the pulse length will diminish to zero. If the control voltage rises to become equal to V+, the capacitor will never quite reach that level, and the pulse length will become infinite. A workable range for the control voltage is therefore 40% to 90% of V+.

Because the Control pin is an input to the chip, it should be grounded through a 0.01µF ceramic capacitor if it will not be used. This is especially important in CMOS versions of the timer.

A defect of the bipolar 555 is that it creates a *voltage spike* when its Output pin changes state. If it will be sharing a circuit with sensitive components, a 0.01µF bypass capacitor should be added as closely as possible between the V+ pin and negative ground. The voltage-spike problem was largely resolved by the CMOS 555.

555 Astable Operation

In Figure 9-3, the 555 timer chip is shown with external components and connections to run it in astable mode. The pin names remain the same but have been omitted from this diagram because of limited space. The labeling of the two external resistors and capacitor as R1, R2, and C1 is universal in datasheets and manufacturers' documentation.

When the timer is powered up initially, capacitor C1 has not yet accumulated any charge. Consequently, the state of the Threshold pin is low. But the Threshold pin is connected externally with the Input pin, for astable operation. Consequently, the Input pin is low, which forces the flip-flop into its "down" state, creating a high output. This happens almost instantaneously.

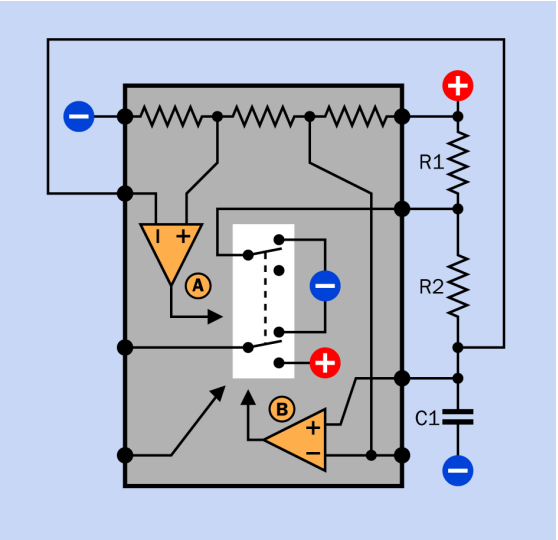

Figure 9-3. *The internal functions of a 555 chip, with two external resistors and a capacitor wired to run the timer in astable (free-running) mode.*

While the flip-flop is "down," the Discharge pin is not grounded, and current flowing through R1 and R2 begins to charge the capacitor. When the charge exceeds 2/3 of positive supply voltage, Comparator B forces the flip-flop into its "up" position. This ends the high pulse on the Output pin, and starts to drain the charge from the capacitor through R2, into the Discharge pin. However, the voltage on the capacitor is still being shared by the Input pin, and when it diminishes to 1/3 of V+, the Input pin reactivates Comparator A, starting the cycle over again.

The functions of the Reset and Control pins are the same as in monostable mode. Because voltage applied to the Control pin changes the length of each pulse and the gaps between pulses, it has the effect of adjusting the frequency of the output in astable mode.

When power is first connected to the timer, C1 must initially charge from an assumed state of zero potential to 2/3 V+. Because subsequent cycles will begin when the capacitor is at 1/3 V+, the first high output pulse from the timer will be slightly longer than subsequent output pulses. This is unimportant in most applications, especially because the rate at which a capacitor accumulates charge is greater when beginning from 0V than when it has reached 1/3 V+. Still, the longer initial pulse can be noticeable when the timer is running slowly.

Because the capacitor charges through R1 and R2 in series, but discharges only through R2, the length of each positive output pulse in astable mode is always greater than the gap between pulses. Two strategies have been used to overcome this limitation. See "Separate Control of High and Low Output Times" on page 80.

556 Timer

The 556 consists of two 555 bipolar-type timers in one package. An example of the chip is shown in Figure 9-4. The pinouts are shown in Figure 9-5. Although 556 timers have become relatively uncommon compared with the 555, they are still being manufactured in through-hole and surface-mount versions by companies such as Texas Instruments and STMicroelectronics, under part numbers such as NA556, NE556, SA556, and SE556 (with various letters or letter pairs appended). Each timer in the chip has its own set of inputs and outputs, but the timers share the same V+ and ground voltages.

558 Timer

This 16-pin chip is now uncommon, and many versions have become obsolete. It has been identified by a part number such as NE558 although different prefix letters may be used. The NTE926, shown in Figure 9-6, is actually a 558 timer.

The chip contains four 555 timers sharing a common power supply, common ground, and common control-pin input. For each internal timer, the Threshold and Discharge functions are connected internally, so that the timers can only be used in one-shot mode. However, one timer can trigger another at the end of its cycle, and the second timer can then retrigger the first, to create an astable effect.

Each timer is edge-triggered by a voltage transition (from high to low), instead of being sensitive to a voltage level, as is the case with a 555 timer. Consequently the timers in the 558 chip are insensitive to a constant (DC) voltage.

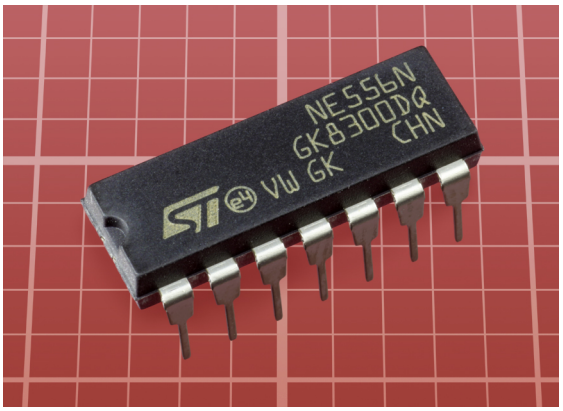

Figure 9-4. *An example of the 556 timer chip.*

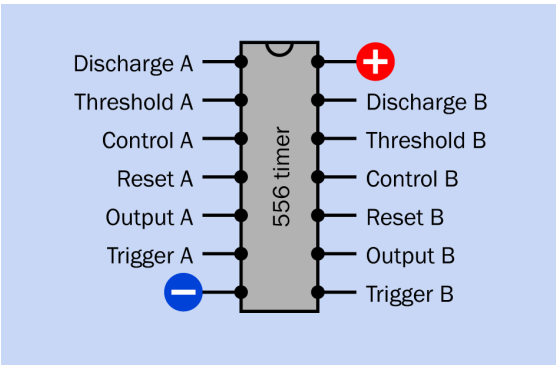

Figure 9-5. *The 556 timer contains two separate 555 timers sharing the same power supply and ground. The pin functions for timer A and timer B are shown here.*

The output from each timer is an open collector, and therefore requires an external pullup resistor. Each output is capable of sinking up to 100mA.

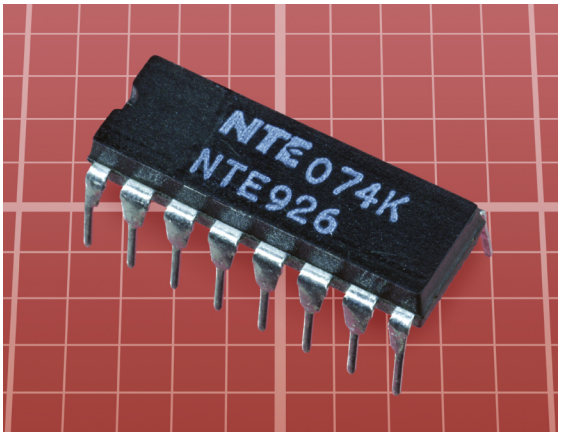

Figure 9-6. *The NTE926 is a 558 timer chip.*

CMOS 555 Timer

While the part numbers of many CMOS versions are significantly different from part numbers of the bipolar versions, in some instances the CMOS numbers are only distinguished by a couple of initial letters. The ST Microelectronics TS555 series and Texas Instruments TLC555 series, for example, use MOSFETs internally. The ST Microelectronics SE555 series and Texas Instruments SA555 series use bipolar transistors internally.

One way to distinguish between the two types, when searching a website maintained by a parts supplier, is to begin by looking generically for a "555 timer" and then add a search filter to show chips either with a minimum power supply of 3VDC (which will be CMOS) or with a minimum power suply of 4.5VDC (which will be bipolar).

CMOS versions of the 555 timer do not create the power spike that is characteristic of the bipolar versions during output transitions. The CMOS chips can also be powered by a lower voltage (3VDC, or 2VDC in some cases), and will draw significantly less current in their quiescent state. They also require very little current for threshold, trigger, and reset functions.

The wiring of external resistors and capacitors to the CMOS version of the chip, and the internal voltage levels as a fraction of V+, are identical to the original 555 timer. Pin functions are likewise identical. The only disadvantages of CMOS versions are their greater vulnerability to static discharge, and their lower output currents. The TLC555, for instance, will source only 15mA (although it can sink 10 times that amount). Other manufacturers have different specifications, and datasheets should be checked carefully.

5555 Timer

The 5555 contains a digital **counter** that enables it to time very long periods. Its full part number is 74HC5555 or 74HCT5555, although these numbers may be preceded or followed by letter combinations identifying the manufacturer. It is not pin-compatible with a 555 timer.

Two input pins are provided, one to trigger the timer on a rising edge, the other on a falling edge, of the input pulse. The inputs are Schmitt-triggered.

The timer is rated for 1Hz to 1MHz (using an external resistor and external capacitor). The counter section can divide the pulse frequency by values ranging from 2 to 256. For longer timed periods, different settings on the digital control pins will divide the frequency by values ranging from 2^{17} through 2^{24} (131,072 through 16,777,216). This enables the timer to achieve a theoretical pulse length lasting for more than 190 days. The timer will accept a clock input from an external oscillator to achieve better accuracy than is available with a resistor-capacitor timing circuit.

7555 Timer

This 8-pin chip is a CMOS version of the 555 timer, manufactured by companies such as Maxim Integrated Products and Advanced Linear Devices. Its characteristics are similar to those of CMOS 555 timers listed above, and the pinouts are the same.

7556 Timer

This 14-pin chip contains two 7555 timers, sharing common power supply and ground connec-

tions. Pinouts are the same as for the original 556 timer, as shown in Figure 9-5.

4047B Timer

This 14-pin CMOS chip was introduced in an effort to address some of the quirks of the 555 timer while also providing additional features. It runs in either monostable or astable mode, selectable by holding one input pin high or another input pin low. In astable mode, its duty cycle is fixed at approximately 50%, a single resistor being used for both charging and discharging the timing capacitor. An additional "oscillator" output runs twice as fast as the regular output.

In monostable mode, the 4047B can be triggered by a positive or negative transition (depending on which of two input pins is used). It ignores steady input states and will also ignore additional trigger pulses that occur during the output pulse. However, a retrigger pin is provided to extend the output pulse if desired.

Complementary output pins are provided, one being active-high while the other is active-low.

To time very long periods, the 4047B was designed to facilitate connection with an external counter.

The power supply for the 4047B can be as low as 3VDC. Its maximum source or sink output current is only 1mA when powered at 5VDC, but up to 6.8mA when powered at 15VDC.

The chip is still available from manufacturers such as Texas Instruments (which markets it as the CD4047B) in through-hole and surface-mount formats. However, despite its versatility, the 4047B is less popular than dual monostable timers, described in the next section.

Dual Monostable Timers

Various timers that run only in monostable mode are available in dual format (i.e., two timers in one chip). This format became popular partly because two monostable timers can trigger each other to create an astable output, in which the pulse width, and the gap between pulses, can be set by a separate resistor-capacitor pair on each timer. This allows greater flexibility than is available when using a 555 timer.

Most dual monostable timer chips are edge-triggered by a change in input voltage, and will ignore a steady DC voltage. Consequently, the output from one timer can be connected directly to the input of another, and no coupling capacitors are necessary.

As in the 4047B, the user has a choice of two input pins for each timer, one triggered by a transition from low to high, the other triggered by a transition from high to low. Similarly, each timer has two outputs, one shifting from low to high at the start of the output cycle, the other shifting from high to low.

The values of a single resistor and capacitor determine the pulse duration of each timer.

Dual monostable timers often have the numeric sequence 4528 or 4538 in their part numbers. Examples include the HEF4528B from NXP, the M74HC4538 from STMicroelectronics, and the MC14538B from On Semiconductor. The 74123 numeric sequence identifies chips that have a very similar specification, with chip-family identifiers such as HC or LS inserted, as in the 74HC123 and 74LS123, and additional letters added as prefix or suffix. The pinouts of almost all these chips are identical, as shown in Figure 9-7. However, Texas Instruments uses its own numbering system, and datasheets should always be consulted for verification before any connections are made.

Many chips of this type are described as "retriggerable," meaning that if an additional trigger pulse is applied to the input before an output pulse has ended, the current output pulse will be extended in duration. Check datasheets carefully to determine whether a chip is "retriggerable" or will ignore new inputs during the output pulse.

The 74HC221 dual monostable vibrator (pictured in Figure 9-8) functions very similarly to the

components cited above, but has slightly different pinouts.

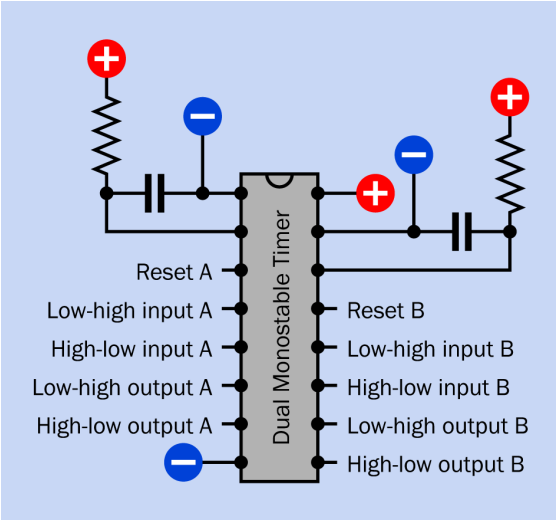

Figure 9-7. *Pin functions for most 4528, 4538, and 74123 series of dual monostable timer chips. An RC network is shown connected for each timer. Note that Texas Instruments uses different pinouts on its versions.*

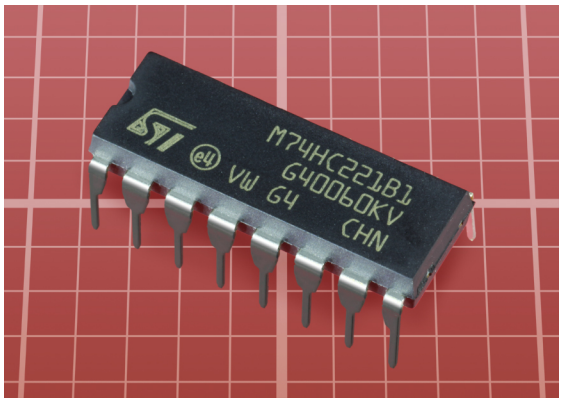

Figure 9-8. *A dual-timer chip containing two monostable multivibrators that can function in astable mode if they are connected externally to trigger each other.*

Values

555 Timer Values

The original bipolar version of the 555 timer was designed to operate using a wide range of positive supply voltages, from 4.5VDC to 16VDC. CMOS versions vary in their recommended V+ values, and datasheets must be consulted for verification.

The output of a bipolar 555 is rated to source or sink up to 200mA. In practice, the maximum current will be lower when the timer is powered at the low end of its range, around 5VDC. Attempting to source more than 50mA will pull down the voltage internally, affecting operation of the timer.

CMOS versions all impose restrictions on output current, allowing higher values for sinking than sourcing. Again, datasheets must be consulted for the values, which vary widely from one component to another.

The voltage measured on the output pin, when it is used for sourcing current, will always be lower than the power supply voltage, and a 1.7V drop is commonly specified for bipolar versions. In practice, the voltage drop that is actually measured may be less, and will vary according to the load on the output.

The voltage drop does not increase significantly with a higher supply voltage, and because it is a relatively constant value, it becomes less significant when a higher value for V+ is used.

CMOS versions of the 555 timer achieve a claimed output source voltage that is only 0.2V less than the power supply.

When choosing values for R1 and R2, a minimum for each resistor is 5K, although 10K is preferred. Lower values will increase power consumption, and may also allow overload of the internal electronics when the chip sinks current from C1. A typical maximum value for each resistor is 10M.

A high-value capacitor may cause the timer to function less accurately and predictably, because large capacitors generally allow more *leakage*. This means that the capacitor will be losing charge at the same time that it is being charged through R1 + R2. If these resistors have high values, and the capacitor has a value of 100µF or more, the rate of charge may be so low that it is

comparable with the rate of leakage. For this reason, a 555 timer is not a good choice for timing intervals much greater than a minute. If a large-value capacitor is used, tantalum is preferable to electrolytic.

The minimum practical value for a timing capacitor is around 100pF. Below this, performance may not be reliable.

Although some CMOS versions may enable fast switching, the shortest practical output pulse for a 555 timer is around 10 microseconds. On the input pin, a triggering pulse of at least 1 microsecond should be used.

Time Calculation in Monostable Mode

If R1 is measured in kilohms and C1 is measured in microfarads, the pulse duration, T, in seconds, of a 555 timer running in monostable mode can be found from this simple formula:

```
T = 0.0011 * R1 * C1
```

This relationship is the same in all versions of the 555. Figure 9-9 provides a quick and convenient way to find the pulse value using some common values for R1 and C1. Resistors can be obtained with tolerances below plus-or-minus 1%, but capacitors are often rated with an accuracy of only plus-or-minus 20%. This will limit the accuracy of the pulse values shown in the chart.

Time Calculation in Astable Mode

If R1 and R2 are measured in kilohms and C1 is measured in microfarads, the frequency of pulses, F (measured in Hz) of a 555 timer running in astable mode can be found from this simple formula:

```
F = 1440 / ( ( R1 + (2 * R2) ) * C1)
```

This relationship is found in all versions of the 555. Figure 9-10 shows the frequency for common values of R2 and C1, assuming that the value of R1 is 10K. In Figure 9-11, a value of 100K is assumed for R1.

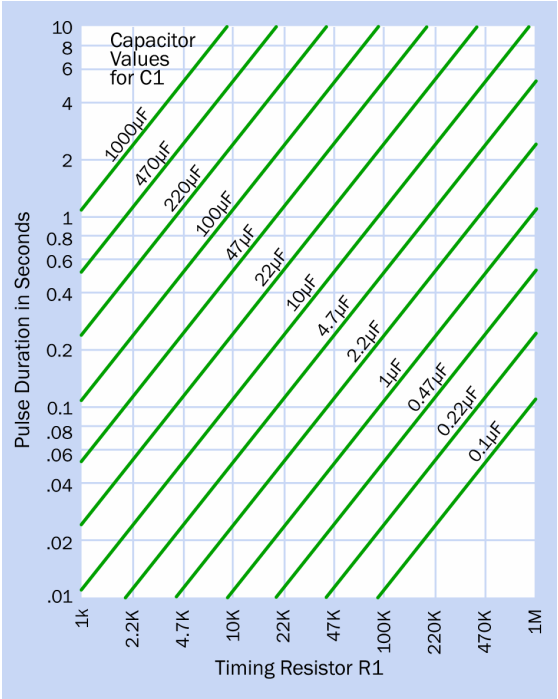

Figure 9-9. *To determine the pulse duration of a 555 timer running in monostable mode: find the value of R1 on the horizontal scale, follow its vertical grid line upward to the intersection with a green line which corresponds with the value of capacitor C1, and read across to the vertical scale providing the duration in seconds. Both axes are logarithmic.*

Dual Monostable Timers

Dual chips such as the HEF4528B from NXP, the M74HC4538 from STMicroelectronics, the MC14538B from On Semiconductor, and the 74HC123 from Texas Instruments have widely varying requirements for power supply. Some accept a limited range from 3VDC to 6VDC, while others tolerate a range of 3VDC to 20VDC. When powered with 5VDC their required input and output states are compatible with those of 5V logic chips.

Output pins of these chips source and sink no more than 25mA (much less in some instances). Because there are so many variants, they cannot be summarized here, and datasheets must be consulted for details.

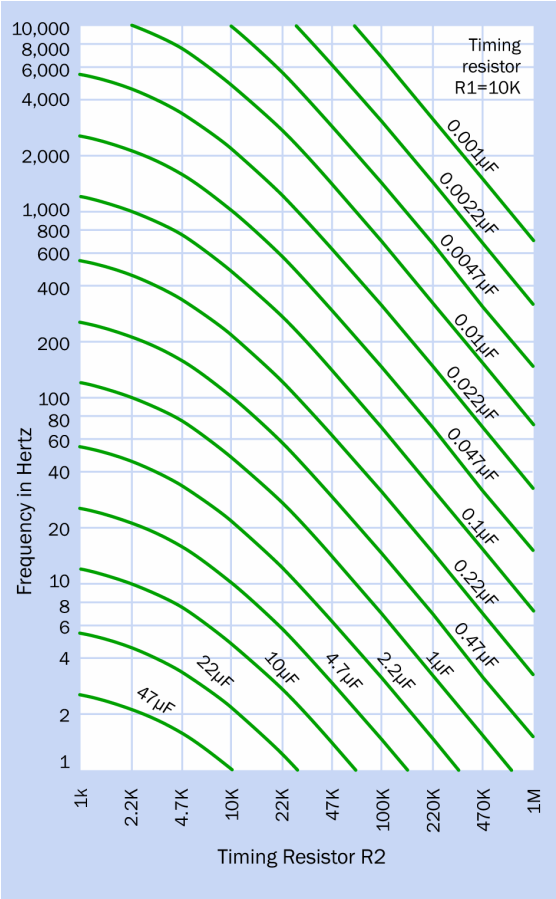

Figure 9-10. *To obtain the frequency of a 555 timer running in astable mode, when R1 has a value of 10K: find the value of R2 on the horizontal scale, follow its vertical grid line upward to the intersection with a green curve which corresponds with the value of capacitor C1, and read across to the vertical scale providing the frequency in Hertz. Both axes are logarithmic.*

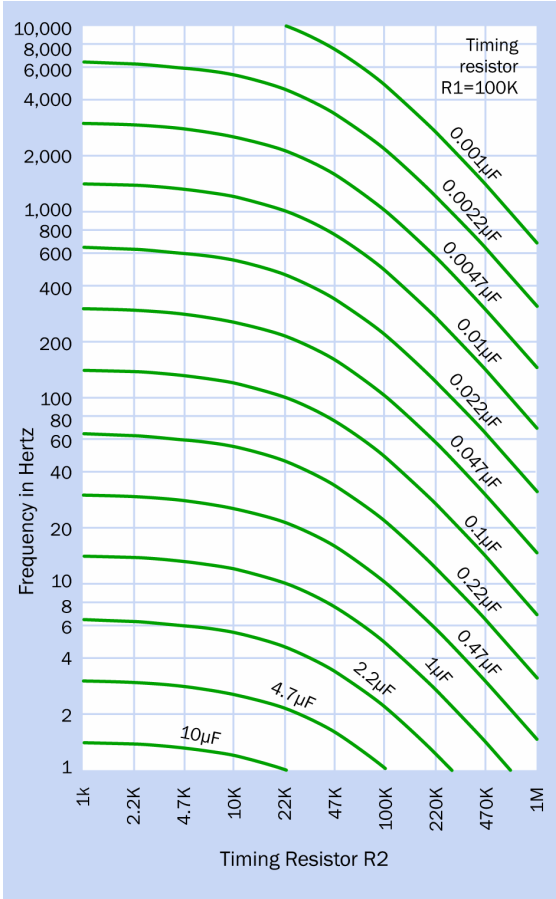

Figure 9-11. *To obtain the frequency of a 555 timer running in astable mode, when R1 has a value of 100K: find the value of R2 on the horizontal scale, follow its vertical grid line upward to the intersection with a green curve which corresponds with the value of capacitor C1, and read across to the vertical scale providing the frequency in Hertz. Both axes are logarithmic.*

As these timers are all monostable, and each timer uses just one resistor and one capacitor, the only formula required is to give the pulse time as a function of these two variables. If R is the resistor value in ohms, and F is the capacitor value in farads, and K is a constant supplied by the manufacturer, the pulse time T, in seconds, is found from the formula:

$$T = R * F * K$$

K ranges between 0.3 and 0.7 depending on the manufacturer and also on the voltage being used. Its value should be found in the manufacturer's datasheet. If R is measured in megohms and F is measured in microfarads, the formula is still valid, as the multipliers cancel each other out.

Generally speaking, these dual monostable CMOS timers are not intended for pulse duration exceeding 1 minute.

The timing capacitor should be no larger than 10µF, as it discharges directly and rapidly through the chip.

How to Use It

Where a timer is required to drive a load such as a relay coil or small motor directly, the original TTL version of the 555 timer will be the only choice. Even in this instance, a protection diode must be used across the inductive device.

For smaller loads and applications in chip-to-chip circuits, CMOS versions of the 555, including the 7555, use less power, cause less electrical interference, and are pin-compatible while using the same formulae to calculate frequency in astable mode or pulse duration in monostable mode. They are of course more vulnerable to static discharge, and care must be taken to make a connection to every pin (the capacitor that grounds the Control pin, if Control is not going to be used, is mandatory).

In dual monostable timers, unused rising-edge trigger inputs should be tied to V+ while unused falling-edge trigger inputs should be tied to ground. A Reset pin that will not be used should be tied to V+, unless that entire timer section of the chip will be unused, in which case the pin should be grounded.

To measure durations longer than a few minutes, a timer which incorporates a programmable counter to divide the clock frequency is the sensible choice. See the description of the 5555 timer that was included earlier in this entry.

The original bipolar version of the 555 remains a robust choice in hobby applications such as robotics, and its design allows some versatile variations which may even be used in logic circuits. A variety of configurations are shown in the schematics below.

555 Monostable Mode

The basic schematic for a 555 timer running in monostable mode is shown in Figure 9-12. In this particular example, a pushbutton that is liable to suffer from *switch bounce* is connected to the Input pin of the timer, which responds to the very first connection made by the pushbutton and ignores the subsequent "bounces," thus producing a "clean" output. To avoid retriggering, which results in a prolonged output pulse, the timer's output should exceed the time for which the button is likely to be pressed. The output should also exceed the duration of any possible switch bounce, which can otherwise create multiple output pulses. In the schematic, an LED is attached to the timer output for demonstration purposes.

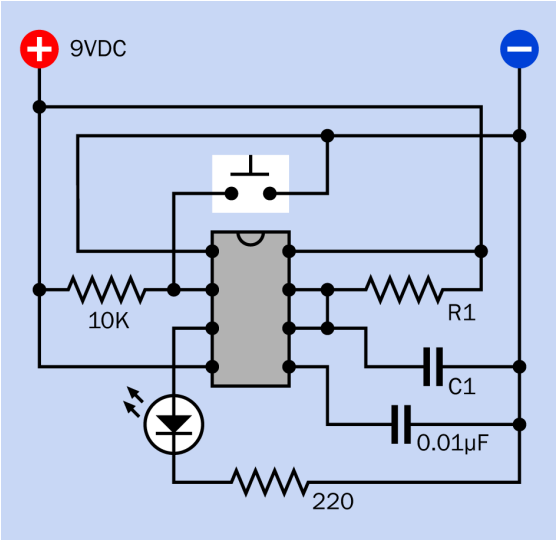

Figure 9-12. *The basic monostable configuration of a 555 timer. This particular circuit debounces an input from a pushbutton switch and converts it to a clean pulse of fixed duration, powering an LED for demonstration purposes.*

This circuit is shown on a breadboard in Figure 9-13. The red and blue wires, at the top of the photograph, supply 9VDC to the board. R1 is 1M, while C1 is 1µF, creating a pulse of just over 1 second. A tactile switch, just above the timer, provides the input.

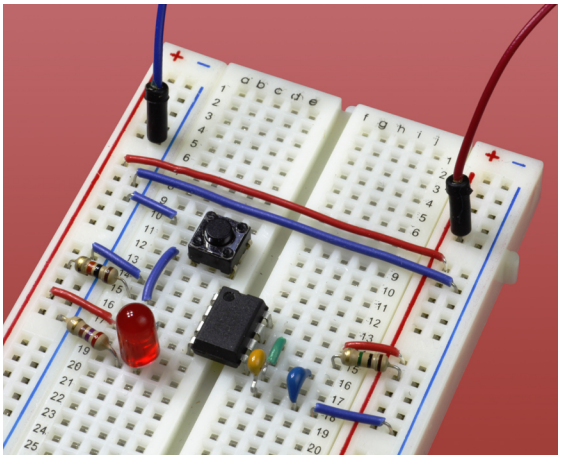

Figure 9-13. *The basic monostable configuration for a 555 timer, mounted on a breadboard.*

555 Astable Mode

A basic schematic for a 555 timer running in astable mode is shown in Figure 9-14. Once again, an LED is attached to the output for demonstration purposes. If the pulse rate exceeds the persistence of vision, a small loudspeaker can be used instead, in series with a 47Ω resistor and a 100µF capacitor.

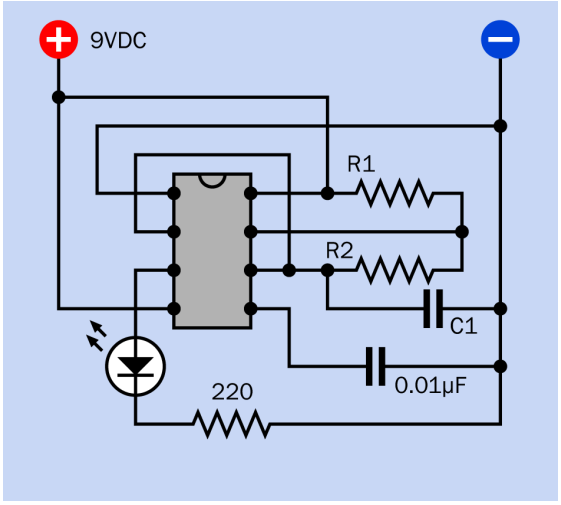

Figure 9-14. *A 555 timer with external connections and components causing it to run in astable (free-running) mode.*

Separate Control of High and Low Output Times

In Figure 9-15, a bypass diode has been added around R2. The capacitor now charges primarily through R1, as the diode has a much lower effective resistance than R2. It discharges only through R2, as the diode blocks current in that direction. Consequently, the length of the high output pulse can be adjusted with the value of R1 only, while the length of the low output pulse can be adjusted with the value of R2 only. The duration of the high output can be lower than, or equal to, the duration of the low output, which is not possible with the basic configuration of components in Figure 9-14.

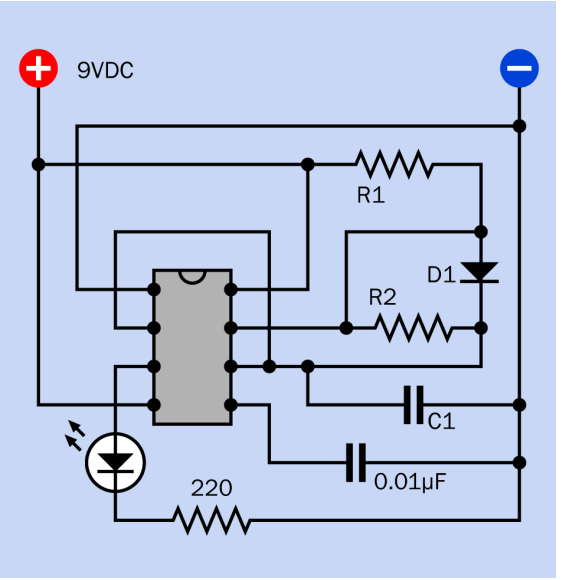

Figure 9-15. *In this circuit, a diode bypasses R2, so that the "on" time and the "off" time of the 555 timer can be set independently of each other, with R1 and R2, respectively.*

555 Fifty Percent Astable Duty Cycle: 1

In Figure 9-16, the circuit enables a fixed astable output duration of approximately 50% high and 50% low. Initially, C1 has no charge, pulling the Input of the timer low, and causing it to begin a cycle with a high pulse from the Output pin, as

usual. In this demonstration circuit, the output illuminates an LED. At the same time, resistor R1 is attached to the output and charges C1. When the voltage on C1 reaches 2/3 of V+, this is communicated to the timer Input pin, which ends the "high" cycle and initiates low status on the Output pin. This starts to sink the charge from C1, through R1. When the voltage drops to 1/3 V+, this initiates a new cycle. Because only one resistor is used to charge and discharge the capacitor, we may imagine that the charge and discharge times should be identical. However, a higher load on the output will probably pull down the output voltage to some extent, lengthening the charge time. Conversely, a load on the Output pin that has low resistance will probably sink at least some of the charge from the capacitor, shortening the discharge cycle.

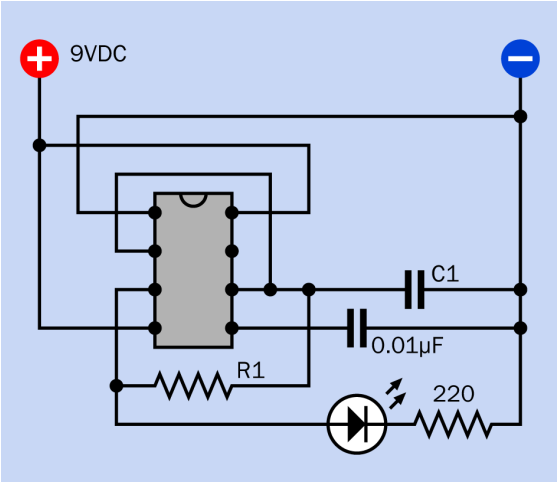

Figure 9-16. *This configuration provides an approximate 50-50 on-off duty cycle at the output pin, although the precise duration will depend on the load.*

555 Fifty Percent Astable Duty Cycle: 2

In Figure 9-17, a small modification of the basic astable circuit shown in Figure 9-14 provides another way to enable a 50% duty cycle. Compare the two schematics, and you will see that just the connection between R1 and R2 has been altered so that C1 now charges only through R1, and discharges only through R2. However, in this configuration the capacitor is discharging into a voltage divider created by the two resistors. Empirical adjustment of the resistor values may be necessary before the duty cycle is precisely 50%.

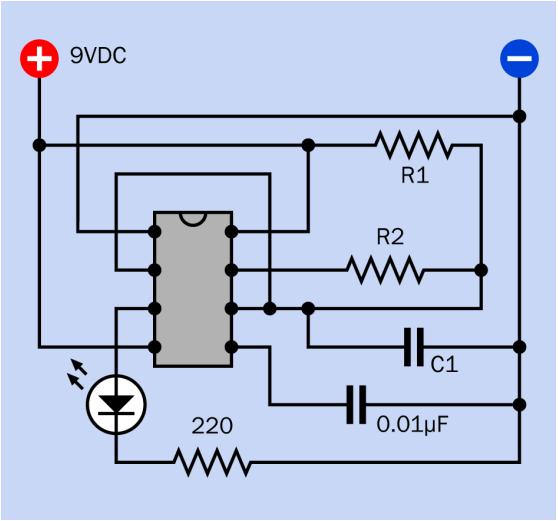

Figure 9-17. *An alternative configuration to provide an approximate 50-50 on-off duty cycle in a 555 timer.*

Use of the 555 Control Pin

In Figure 9-18, a potentiometer and two series resistors allow a varying voltage to be applied to the Control Pin. This will lengthen or reduce both the charge and the discharge times of the timing capacitor. If values for the capacitor and its associated resistors are chosen to create a frequency of approximately 700Hz, a 10K potentiometer should demonstrate more than an octave of audible tones through the loudspeaker. Other components can be substituted for a potentiometer, creating possibilities for producing pulse-width modulation. Alternatively, if a large capacitor is added between the Control pin and ground while a second 555 timer, running slowly in astable mode, applies its output to the Control pin, the charging and discharging of the capacitor will apply a smoothly rising and falling voltage. If the first 555 timer is running at an audio frequency, the output will have a "wailing siren" effect.

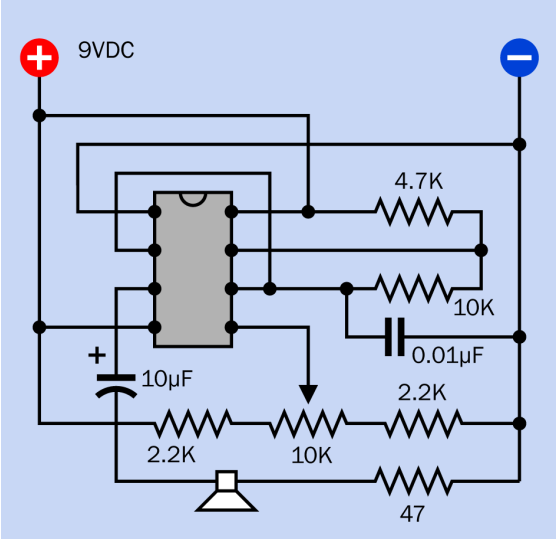

Figure 9-18. *A circuit that allows adjustment of the astable 555 frequency by increasing or lowering the voltage on the Control pin.*

Figure 9-19 shows the components specified in Figure 9-18 mounted on a breadboard.

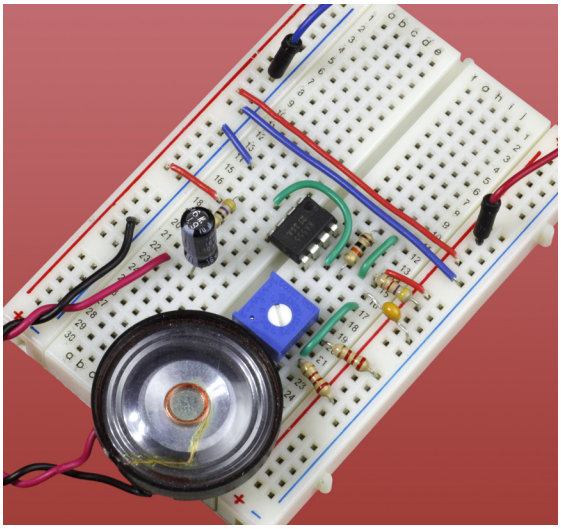

Figure 9-19. *The components in the previous schematic are shown here mounted on a breadboard. They will generate an audio output ranging between approximately 425Hz and 1,075Hz. A lower value for the timing capacitor will shift the audio range higher in frequency.*

555 Flip-Flop Emulation

The flip-flop inside a 555 timer can be accessed to control the timer's outputs. In Figure 9-20, pushbutton switch S1 applies a negative pulse to the Input pin, creating a high output from the timer, which illuminates LED D1. Normally the pulse length would be limited by the charge time of a capacitor attached to the Threshold pin, but in this circuit there is no capacitor, and the Threshold pin is hard-wired to negative ground. So, it never rises to 2/3 of positive power, and the output from the timer remains high indefinitely.

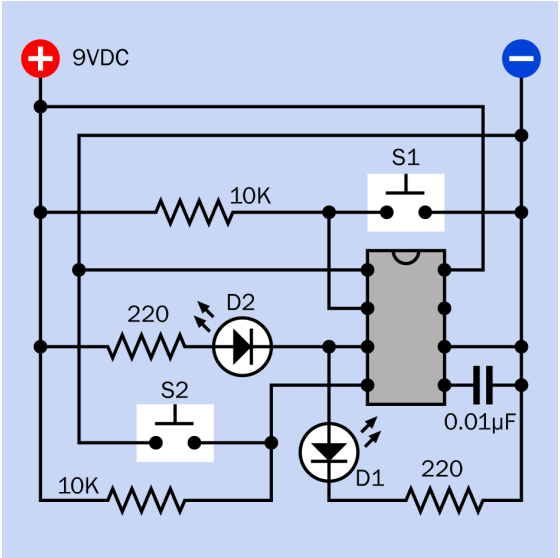

Figure 9-20. *A 555 timer can have its timing features disabled so that it functions as a flip-flop.*

However, if S2 is pressed, it grounds the Reset pin of the timer, which ends the high output and pulls the Output pin down to a low state. D1 goes out and D2 lights up, as the timer is now sinking current through it. When S2 is released, the timer output remains low and D2 remains illuminated, because the Input pin is held high by a pullup resistor. Therefore, the timer now functions in bistable mode, as a flip-flop. While this may be seen as an inappropriate use of the chip, because its full functionality is being disabled, its ability to deliver substantial current and to tolerate a wide range of supply voltages may make it more con-

venient to use than a digital flip-flop. See Chapter 11 for more information about flip-flops.

A 555 timer emulating a flip-flop is shown on a breadboard in Figure 9-21.

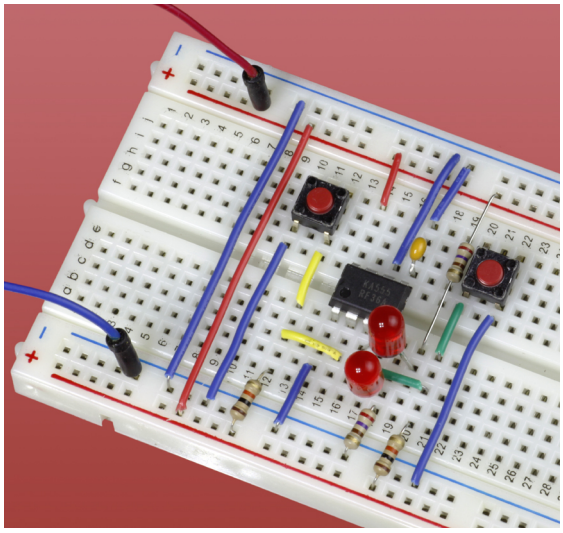

Figure 9-21. *The schematic in which a 555 timer acts as a flip-flop is shown here adapted for a breadboard.*

555 Hysteresis

The comparators inside a 555 timer enable the chip to produce hysteresis. In Figure 9-22, the Input pin and the Threshold pin are shorted together, and C1, the timing capacitor, is omitted. A 10K potentiometer, wired as a voltage divider, delivers a voltage to the Input pin ranging smoothly from V+ to negative ground. As the input dips below 1/3 V+, the Output pin goes high, lighting LED D1. Now if the input voltage gradually rises, the output remains high, even as the input rises above 1/3 V+. The output state is "sticky" because the timer does not end an output pulse until the Threshold pin tells it to, by reaching 2/3 V+. When this finally occurs, the Output pin goes low, D1 goes out, and D2 comes on, sinking current into the Output pin.

Suppose, now, the input voltage starts to go down again. Once again the output state is "sticky" because it remains low until the Input pin drops below the 1/3 level. When that happens, the output finally flips back to a high state, D2 goes out, and D1 comes on.

In the "dead zone" between 1/3 and 2/3 of supply voltage, the timer remains in its current mode, waiting for the input to stray outside of those limits. This behavior is known as *hysteresis*, and is of special importance when processing a varying signal, such as the voltage from a temperature sensor, to control an on/off device such as a thermostat. In fact the 10K potentiometer in this demo could be replaced with a thermistor or a phototransistor, wired in series with a resistor to create a voltage divider which will have an input range compatible with the 555 timer. The hysteresis can then be adjusted by varying the supply voltage that powers the timer, as this will change the values of 1/3 V+ and 2/3 V+. Alternatively, varying the voltage on the Control pin will affect the hysteresis.

A **comparator** can provide much more versatile control of hysteresis by using positive feedback (see Chapter 6 for additional details). But the 555 timer provides a quick-and-simple substitute, and its greater ability to source or sink current enables it to be connected with a wider range of other components.

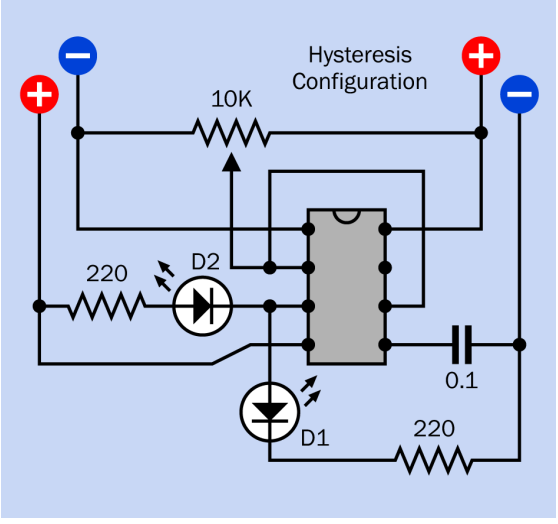

Figure 9-22. *A 555 timer wired so that it creates hysteresis, when supplied by a variable input voltage.*

555 and Coupling Capacitors

As previously noted, when a basic bipolar 555 timer (and some of its variants) is wired in monostable mode, it will retrigger itself indefinitely if its input remains low. One way to avoid this is by using a coupling capacitor. This will pass a transition from high to low, but will then block a steady subsequent voltage. In Figure 9-23, a phototransistor in series with a resistor provides a variable voltage to the noninverting input of a comparator. The reference voltage of the comparator is adjusted with a potentiometer, and resistor R3 provides positive feedback, ensuring that the output from the comparator will be quick and clean. The output from the 555 timer goes through a transistor to the relay, shown at the bottom.

It is important to see the function of the coupling capacitor, C3, with the pullup resistor, R2, which holds the Input pin of the 555 timer high by default. When the output from the comparator drops from high to low, C3 passes this transition to the Input pin of the timer, momentarily overcoming the positive potential, and triggering the timer. After the timer responds, however, C3 blocks any continuation of low voltage from the comparator. Pullup resistor R2 resumes its function of holding the input high, and prevents the timer from being retriggered.

555 Loudspeaker Connection

A small 8-ohm loudspeaker can be driven from the output of a bipolar 555 timer running in astable mode, but should be isolated from it with a 10µF to 100µF capacitor. A series resistor of 47Ω (minimum) should be used. See Figure 9-24.

Burst Mode

It is sometimes useful to create a short beep of fixed length in response to a button-press. The beep should terminate even if the button is held down. This "burst mode" can be achieved with the circuit in Figure 9-25, where the button connects power to a bipolar-type 555 timer running in astable mode, and an RC network applies a decreasing potential to a 47µF capacitor, which is wired to the Reset pin of the timer. The resistor in series with the capacitor will vary the length of the beep. When voltage to the pin drops below approximately 0.3V, output from the timer stops and cannot restart until the button is released.

A resistor of greater than 1.5K may not allow the input value at the reset pin to fall below the voltage, which is necessary to enable a reset. If a lower power supply voltage than 9VDC is used, the resistor value should be higher—for example, a 5VDC power supply works well with a 1.5K to 2K resistor.

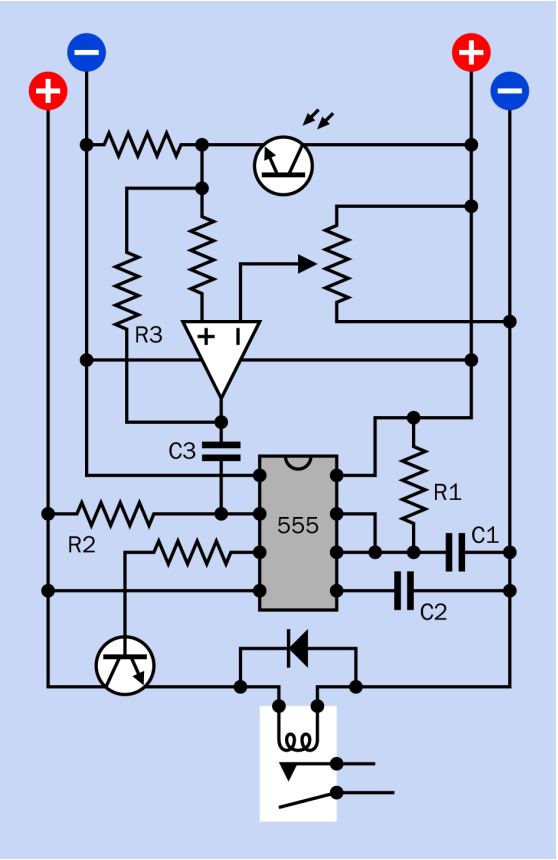

Figure 9-23. *A coupling capacitor (C3) is used in this circuit to isolate the 555 timer from a sustained low input from the comparator. The capacitor only passes a transition from high to low. The rest of the time, the pullup resistor (R3) holds the input high.*

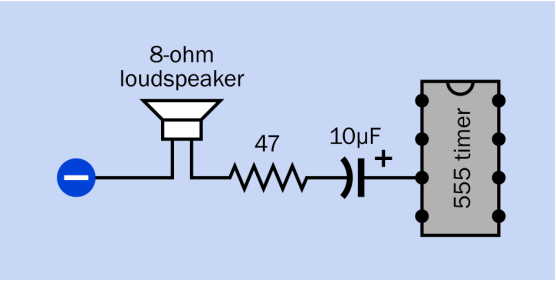

Figure 9-24. *A small 8-ohm loudspeaker can be attached through a capacitor and a resistor to the output of a bipolar 555 timer.*

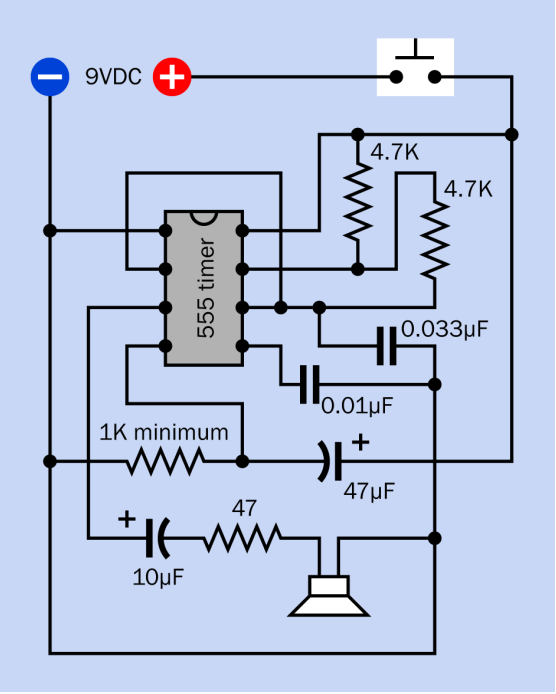

Figure 9-25. *An RC circuit, wired to apply a decreasing voltage on the Reset pin of a bipolar 555 timer, will shut off the timer shortly after it is powered up. This can be used to create a fixed-length beep in response to a button press of any duration.*

Figure 9-26 shows the components installed on a breadboard.

"You Lose" Game Sound

A timer is a simple, cheap way to create a variety of simple game sounds. The schematic in Figure 9-27 makes a groaning sound as the 100µF capacitor wired to the Control pin of a bipolar-type 555 gradually charges through the 1K resistor. Note that if a larger resistor is paired with a smaller capacitor, the effect will differ. The 150K resistor is included to discharge the capacitor reasonably quickly in time for the next cycle.

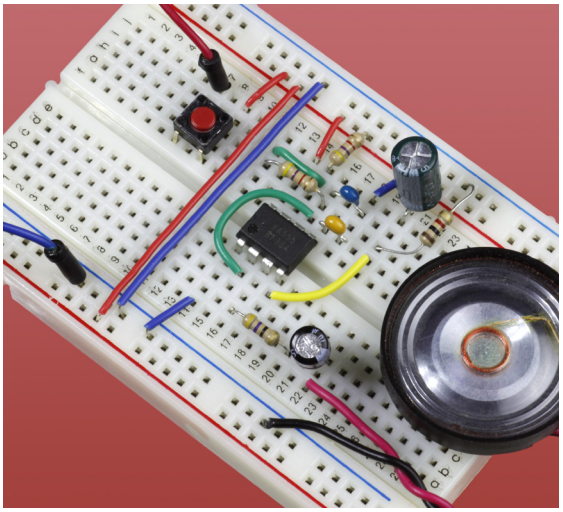

Figure 9-26. *The "burst mode" circuit installed on a breadboard with a miniature loudspeaker.*

What Can Go Wrong

Dead Timer

Like any chip, the 555 can be damaged by overvoltage, excessive source current or sinking current, static electricity, incorrectly applied polarity of power supply, and other forms of abuse. The TTL version of the timer is fairly robust, but the CMOS type much less so. Check for obvious errors such as lack of supply voltage, incorrect or ambiguous input voltages, and unusual current draw (too high, or none at all, at the V+ pin). Use the meter probes on the actual pins of the chip, in case there is a break in the wiring that feeds them. Because timer chips are cheap, a reserve supply of them should be maintained.

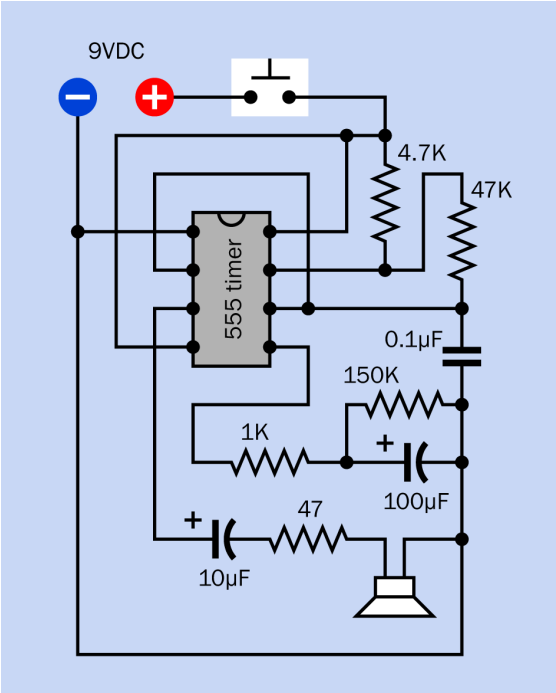

Figure 9-27. *An RC circuit, wired to apply an increasingly positive voltage to the Control pin of a bipolar timer running in astable mode, will gradually pull down the frequency at the Output pin, creating a sound that may be useful in simple game applications.*

CMOS Confused with Bipolar

The part numbers of some bipolar chips are very similar to those of some CMOS versions, and the chips look physically identical. But the CMOS version is easily overloaded, as it may source only 10mA to 20mA maximum while the TTL version is capable of 200mA. Make sure that your chips are carefully labeled when they are stored.

The Pulse that Never Ends

If a 555 timer responds correctly to a high-to-low transition on the input pin, but the output pulse continues indefinitely, check the voltage on pin 6 to see if the timing capacitor is charging above 2/3 of V+. While a 555 can run from 5VDC, a high-current device on the Output pin can pull down the voltage inside the chip to the point where the capacitor never charges sufficiently to end the cycle.

Also check that the input transition from high to low lasts for a shorter time than the pulse. A persistent low input can retrigger the timer.

Erratic Chip Behavior

Possible causes include:

- Floating pins. The Input pin, in particular, should always be connected with a defined voltage (via a 10K pullup resistor, if necessary), and must not be allowed to float at an indeterminate potential.
- Voltage spikes. A timer can be triggered by transients from other components, especially inductive loads. If the input to a monostable timer dips for even a fraction of a second, the timer will initiate a new cycle. A *protection diode* should be used in conjunction with an inductive load.
- Voltage spikes can also introduce variations in the pulse train from an astable timer.
- TTL versions of the 555 timer will tolerate a wide range of supply voltage, but if a voltage regulator is not used, fluctuations in voltage can have unpredictable consequences.

Interference with Other Components

Because the bipolar version of a 555 timer creates a voltage spike when its output changes state, it can interfere with the normal function of other components, especially CMOS chips. A 0.1µF bypass capacitor can be applied between the timer's V+ pin and ground.

Erratic Behavior of Output Devices

If a 555 timer powers an output device such as a relay, and the relay is not opening or closing in a reliable manner, first check that it is receiving sufficient voltage. If the 555 timer is powered with 5VDC, its output will be only around 4VDC.

This problem can be avoided by using the output from the timer to control the voltage on the base

of a transistor which switches a separate source of power to the relay coil.

Fatal Damage Caused by Inductive Loads

While it is possible to drive an inductive load such as a small motor or relay directly from a TTL 555 timer, two precautions should be taken. First, the motor or the coil of the relay should have a clamping diode added around it, as is standard practice. Second, because the output of the timer is capable of sinking current as well as sourcing current, it can be protected from sinking back-EMF by inserting a diode in series with the load. This is illustrated in Figure 9-28.

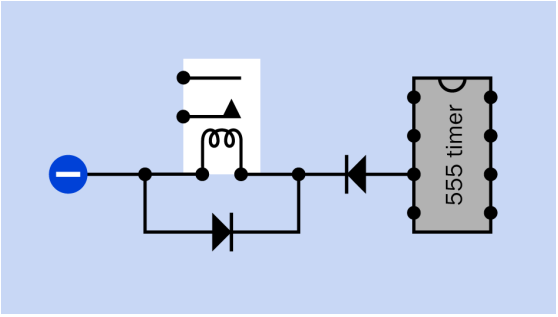

Figure 9-28. *In addition to a standard protection diode clamped around an inductive load such as a relay coil, the 555 timer can be protected from back-EMF by adding a diode in series. The series diode must of course be rated to carry sufficient current through the coil. When choosing a relay, allowance must be made for the voltage drop that will be imposed by the series diode.*

logic gate

10

Only basic **logic gates** are included in this entry—that is, components that perform a Boolean logic operation on two to eight inputs (or one input, in the case of an inverter) to create a single high or low logical output.

OTHER RELATED COMPONENTS

- **flip-flop** (see Chapter 11)

What It Does

A **logic gate** is a circuit that delivers an output, either high or low, depending on the states of its two inputs, either or both of which can be high or low.

Some gates may have more than two inputs, and an *inverter* only has one input, but the basic gates all conform with the two-input, one-output model. The components that constitute a logic gate are almost always etched into a wafer inside a silicon chip.

In a digital computer, a *high logic state* is traditionally close to 5VDC and represents a value of 1 in *binary arithmetic*, while a *low logic state* is traditionally close to 0VDC and represents a binary 0. Modern devices may use a lower voltage for the high state, but the principle is still the same.

A small network of logic gates can perform binary addition, and all other operations in a digital computer are built upon this foundation.

Origins

The concept of digital logic originated in 1894, when English mathematician George Boole announced his invention of a form of algebra (now referred to as *Boolean algebra*) to analyze combinations of two logical states that could be interpreted as "true" and "false." This concept had few practical applications until the 1930s, when Claude Shannon saw that because a basic switch has two states, Boolean algebra could enable analysis of complex networks of switches that were being used in telephone systems.

Because the state of a switch could also be used to represent the values 0 or 1 in binary arithmetic, and because a transistor could function as a switch, Boolean algebra was implemented in solid-state digital computing equipment.

How It Works

While conventional arithmetic uses *arithmetical operators* to represent procedures such as addition or multiplication, Boolean algebra uses *Boolean operators*. The operators of special interest in digital electronics are named AND, NAND, OR, NOR, XOR, and XNOR.

Although each gate actually contains multiple transistors, it is represented by a single logic symbol, as shown in Figure 10-1. The names of the Boolean operators are customarily printed all in caps. A gate requires a power supply and a connection with negative ground, separate from its inputs, but these connections are omitted from

gate schematics because they are assumed to exist.

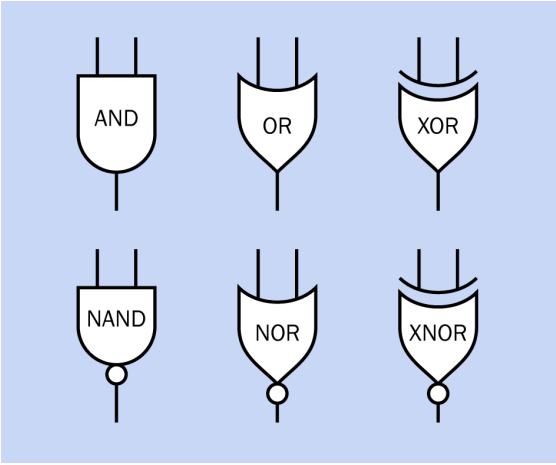

Figure 10-1. *Six types of two-input logic gates are used in digital electronics, although the XNOR gate is rare, as it has few applications. The names are customarily printed in uppercase letters.*

The functions of the gates with two inputs can be defined in electrical terms. In Figure 10-2, the four possible combinations of inputs are tabulated in the left column, with red indicating a high input and black indicating a low input. The corresponding output from each gate is shown beneath its name. This kind of tabulation is known as a *truth table*, as it is derived from Boolean algebra which originally concerned itself with "true" and "false" states.

Input states of a two-input gate	Gate Outputs					
	AND	NAND	OR	NOR	XOR	XNOR
● ●	●	●	●	●	●	●
● ●	●	●	●	●	●	●
● ●	●	●	●	●	●	●
● ●	●	●	●	●	●	●

Figure 10-2. *The four possible combinations of input states in a 2-input logic gate are shown at left. The corresponding output from each gate is shown beneath its name. Red indicates a high state, while black indicates a low state.*

The truth table assumes that *positive logic* is being used. Negative logic is very uncommon, but if it were used, the red dots in the truth table would correspond with low inputs and outputs, while the black dots would correspond with high inputs and outputs.

Inversion

The small circles appended to the outputs of NAND, NOR, and XNOR gates mean that the output of each gate is inverted compared with the AND, OR, and XOR gates. This can be seen by inspection of the output states shown in Figure 10-2. The circles are known as *bubbles*.

Sometimes logic symbols are shown with a bubble applied to one input, as in Figure 10-3. In these cases, the circle indicates that an input must be inverted. More than one gate may be needed to achieve this logic function in an actual circuit. The style is often used to show the inner workings of an IC, using a minimum number of logic symbols.

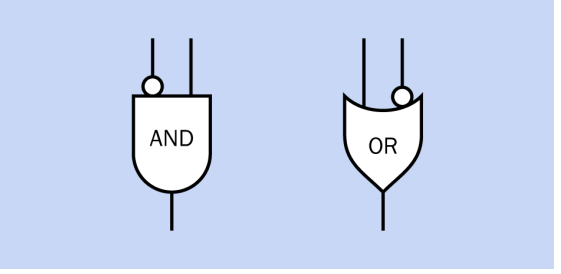

Figure 10-3. *The circle in a logic gate symbol indicates that a signal is being inverted. Circles can be inserted at gate inputs, but in a real circuit a separate inverter is likely to be needed to create this effect.*

Single-Input Gates

Two gates exist that have a single input and a single output, shown in Figure 10-4. The *buffer* should not be confused with the symbol for an **op-amp** or a **comparator**. (Those components always have two inputs.) The output state of a buffer is the same as its input state, but the component may be useful to deliver more current or to isolate one section of a circuit from another.

When a bubble is appended to a buffer, it becomes a NOT gate, more commonly known as an *inverter*. Its function is to create an output state that is opposite to its input state.

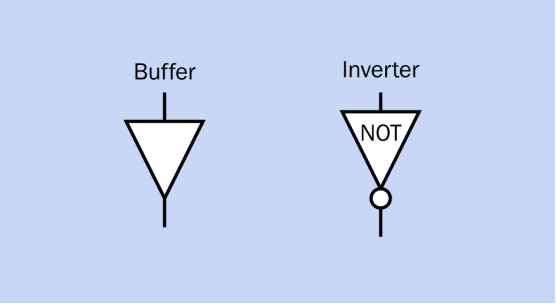

Figure 10-4. *The two logic gates that have only one input and one output. Note that in some schematics showing internal logic of ICs, the bubble on an inverter may be found on the input side instead of the output side.*

Gates with More than Two Inputs

AND, NAND, OR, and NOR gates can have any number of inputs, as suggested in Figure 10-5, although practical factors usually limit the inputs to a maximum of eight.

Input states of a gate with more than two inputs	Gate Outputs			
	AND	NAND	OR	NOR
All low	●	●	●	●
All high	●	●	●	●
At least 1 low and at least 1 high	●	●	●	●

Figure 10-5. *The previous table has been modified to show the outputs from logic gates that have more than two inputs. XOR and XNOR gates are not included in the table, because a strict interpretation of their logic requires that a unique output state exists if one input is high while the other is low.*

The rules can be summarized like this:

- Output from an AND gate: Low if any of its inputs is low, high if all of its inputs are high.
- Output from a NAND gate: High if any of its inputs is low, low if all of its inputs are high.
- Output from an OR gate: High if any of its inputs is high, low if all of its inputs are low.
- Output from a NOR gate: Low if any of its inputs is high, high if all of its inputs are low.

In the case of XOR and XNOR gates, their logic requires that a unique output state must exist if one input is high while the other input is low.

In fact, so-called three-input XOR gates do exist, an example being the 74LVC1G386 chip, in which the output is high if all three inputs are high, or if one input is high, but not if two inputs are high or no inputs are high. Further discussion of more-than-two-input XORs is outside the scope of this encyclopedia.

Boolean Notation

For reference, the original written notation for Boolean operators is shown in Figure 10-6. Unfortunately, the notation for these operators was never properly standardized, and in more than one instance, multiple symbols acquired the same meaning. The letters P and Q are often, but not always, used to represent two input states that can be true or false.

- The use of a horizontal line above a symbol, to indicate that its state has been reversed, has carried over to datasheets where this notation can show that an output state from any digital chip is inverted. The line is known as a *bar*.

Arithmetical Operations

Suppose we wish to sum two binary numbers, each containing two digits. There are four digits altogether, and depending on their values, there are 16 different possible addition sums, as shown in Figure 10-7.

If A0 and B0 represent the rightmost digits of the two numbers being added, and S0 is the sum of those two digits, inspection of the figure shows that the sum can be derived using just three rules:

1. If A0 = 0 and B0 = 0, then S = 0.
2. If A0 and B0 have opposite states, then S0 = 1.
3. If A0 = 1 and B0 = 1, then S0 = 0, and carry 1 to the next place left.

If A0 and B0 are the two inputs to an XOR logic gate, the output of the gate satisfies all three rules, except the need to carry 1 to the next place left. This last function can be satisfied with an AND gate. The function of two gates is known as a *half adder*, and is shown in the top section of Figure 10-8.

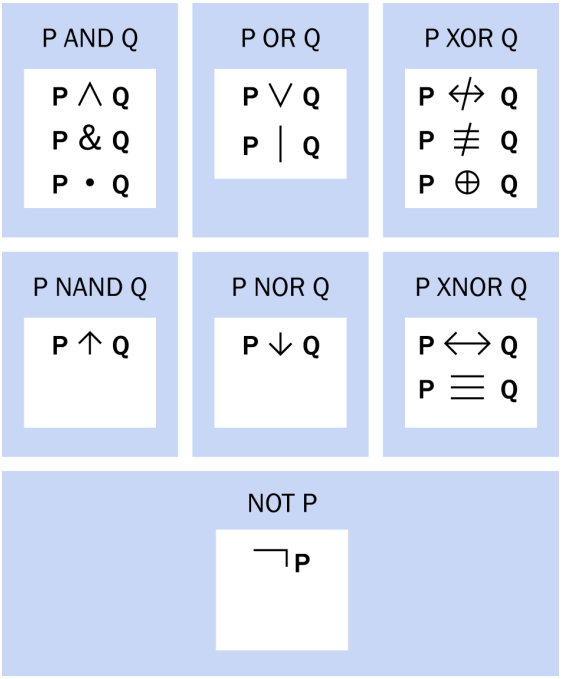

Figure 10-6. *Boolean operators as they have been expressed in written notation. Lack of standardization has resulted in more than one symbol representing some of the operators.*

When we consider the next pair of binary digits to the left, the situation now becomes more complicated, because we may be carrying 1 into this addition sum from the previous stage, and we still need to be able to to carry 1 out (if necessary) to the next stage. An assembly of five logic gates can deal with this, and their combination is known as a *full adder*. This is shown in the bottom section of Figure 10-8.

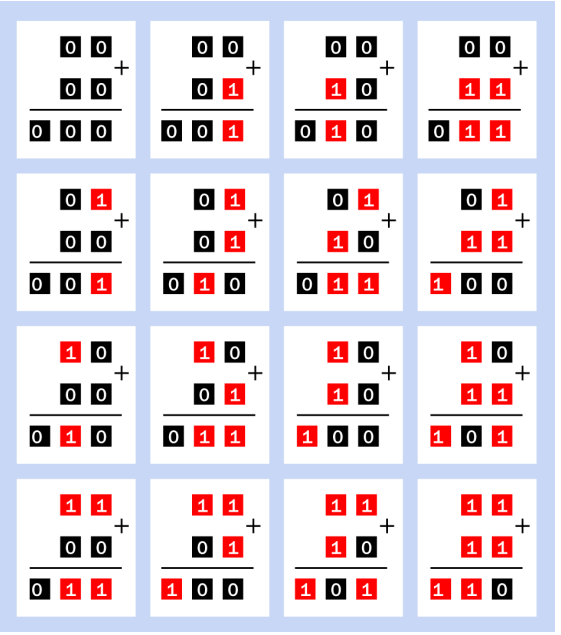

Figure 10-7. *Sixteen different addition sums are possible, when summing two binary numbers of two digits each.*

The combination of XOR and AND gates shown in Figure 10-8 is not the only one that works to add binary numbers. However, it may be the most intuitively obvious.

Other Operations

Binary arithmetic remains the most important application of logic gates, but individually packaged gates are seldom used for that purpose anymore. They were long since subsumed into large multifunction computing chips.

Single gates still have application in small systems, or to modify the inputs and outputs of microcontrollers, or to convert the output from one complex digital chip to make it compatible with the input of another. This last application is often referred to as *glue logic*.

Applications for single gates are discussed in "How to Use It" on page 103.

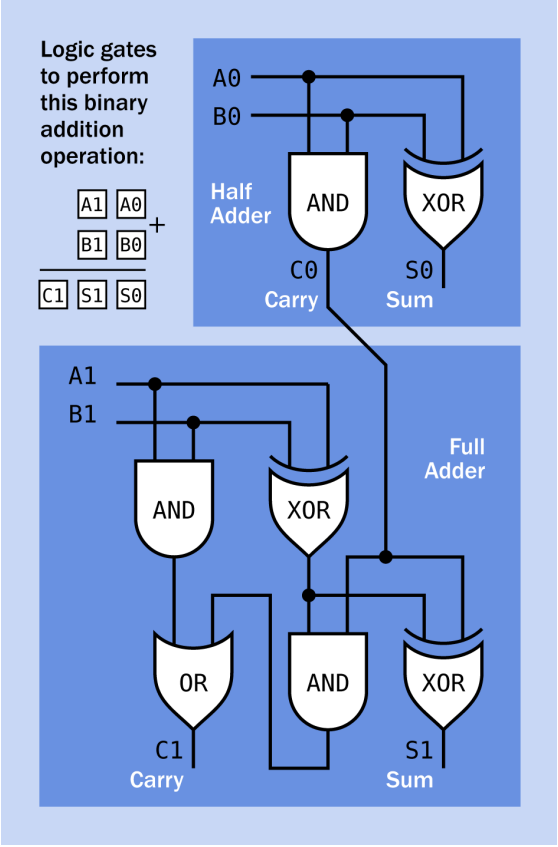

Figure 10-8. *Logic gates can be used to add binary numbers, using a high input or output to represent a binary 1 and a low input or output to represent a binary 0. This schematic shows one possible way for gates to add two two-digit binary numbers.*

Variants

Chips containing logic gates were introduced in the 1960s. The 7400 NAND chip, from Texas Instruments, was the first of a series that became so influential, the same basic part numbers (with letters added before, after, and among the digits) are still used today. An example of a currently available through-hole 7400 chip is shown in Figure 10-9.

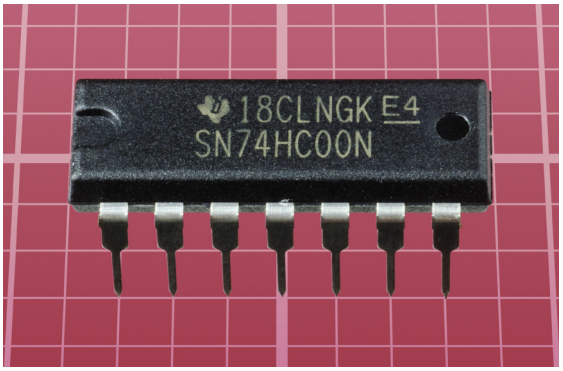

Figure 10-9. *A modern version of a 7400 chip containing four NAND gates.*

Initially, these chips conformed with a *transistor-transistor logic* (*TTL*) standard that had been invented at TRW in 1961 and introduced in commercial products by Sylvania in 1963. It established the now-familiar standard of 5VDC for the power supply. Many logic chips now use other voltages, but the term "high" still means an input or output that is near to the supply voltage, while "low" means an input or output that is near to negative ground. The exact definition of "near" will be found in datasheets for the chips.

The *7400 series* was successful partly because it was engineered for compatibility. The output from one gate could be connected directly to the input of another gate, with a few bypass capacitors added on a circuit board to suppress voltage spikes caused by rapid switching. Earlier components had not been so easy to interface with each other. The new standard dominated the industry to the point where dozens of manufacturers started making chips that conformed with it, and a single board could mix-and-match chips from multiple vendors.

Because many logic chips acquired part numbers that began with 74, they are often referred to as the 74xx series, where other digits (sometimes more than two) can be substituted for xx. This avoids ambiguity, as the very first chip in this format was a NAND gate that had 7400 as its actual part number. In the text below, 7400 will refer to

that specific chip, whereas 74xx will refer to the whole series of chips.

RCA introduced a competing family of logic gates in 1968, using CMOS transistors. As each part number began with a 4 and contained four digits, this was referred to as the *4000 series*. The CMOS chips were slower and more expensive, but tolerated a wider range of power supply voltages (3V to 12V, initially). Their biggest advantage was that they used much less current. This was important, as TTL chips created a lot of waste heat. The lower power consumption of CMOS also enabled one chip to control the inputs of many others, which simplified circuit design. This one-to-many relationship is known as *fanout*.

Ultimately, CMOS chips transcended their early limitations. While they were reserved initially for battery-powered devices in which very low power consumption was more important than speed, CMOS is now used almost everywhere, still maintaining its advantage of low current (almost zero, in fact, while a chip is quiescent) while equalling the speed of TTL. However, CMOS logic chips are very often pin-compatible with the old TTL components, and modern CMOS part numbers are often derived from the old 74xx series.

Most CMOS logic chips in the old 4000 series are still available, and may be used in situations where a power supply greater than 5VDC is convenient.

Part Numbers

As the performance of semiconductors gradually improved, successive *families* of logic chips were introduced, identified by one-letter, two-letter, or three-letter acronyms. The acronym was inserted into the part number, so that a 7400 NAND gate in the HC (high-speed CMOS) family became a 74HC00 NAND gate.

Because these chips were available from multiple sources, the part number was also preceded with one or more letters indicating the manufacturer. And because each chip was manufactured in different versions (for example, some complied with military specifications, while others didn't), letters were also appended to the end of the part number. Today, the appended letters may indicate whether the chip is of the old through-hole format, or conforms with a more recent surface-mount format.

Summing up:

- Prefix: manufacturer ID.
- Numerals, omitting any letters in the middle: Chip functionality.
- Middle letters: Chip family.
- Suffix letters: Package format.

Thus, for example, the actual part number for a 74HC00 NAND chip could be SN74HC00N, where the SN prefix indicates that it is manufactured by Texas Instruments and the N suffix means that it is in plastic dual-inline-pin (DIP) format. (The SN prefix was introduced by Texas Instruments in the earliest days of integrated circuits as an acronym for "semiconductor network," meaning that multiple transistors were "networked" on a wafer of silicon. Other manufacturers used their own schemes for part numbering, and so SN became exclusively identified with Texas Instruments.)

The system of augmenting part numbers has been further extended by inserting 1G, 2G, or 3G immediately after the family identifier, to indicate surface-mount chips that contain one, two, or three logic gates. If the "G" identifier is missing, the chip usually has four logic gates, which was the standard used in the original 74xx series. This rule applies even in surface-mount formats, where the surface-mount pads of four-gate chips have the same functions as the pinouts of the original TTL versions (except in the case of square-format surface-mount chips, which are not discussed here).

When searching a catalog to find a chip by its part number, it helps to remember that searching for a 7400 chip may not find any hits, but searching for a 74HC00 (or any other valid number con-

taining a family identifier) is much more likely to be understood.

A key to understanding part numbers is shown in Figure 10-10. The upper part of the figure is a guide to interpreting numbers on a generic basis, while the lower part interprets the specific part number shown.

Families

As of 2013, the HC family in the 74xx series has become so widely used, it can be considered the default in the traditional DIP 14-pin format. Incremental improvements are still being made, and new families are being introduced, primarily in surface-mount formats which use lower power-supply voltages (down to around 1VDC).

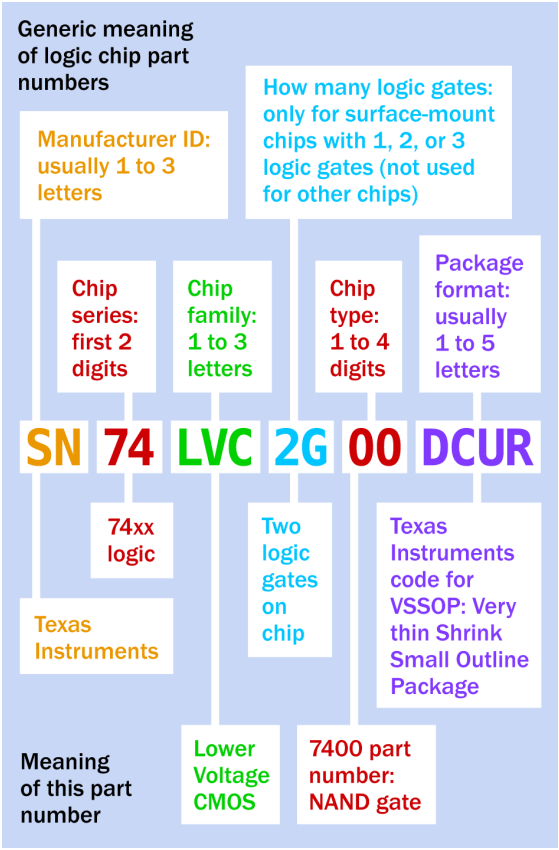

Figure 10-10. *How to interpret the segments of a logic chip part number in the 74xx family (in this case, a 7400 NAND gate).*

Here is an historical summary of the most important chip families.

- 74xx: Original series of bipolar TTL chips.
- 74Hxx: Bipolar TTL, high speed, about twice as fast as the original 74xx chips, but twice the power consumption.
- 74Lxx: Bipolar TTL, lower power consumption than the original TTL, but also much lower speed.
- 74LSxx: Bipolar TTL, lower power with Schottky input stages, faster than original TTL. Some LS chips are still being manufactured.
- 74ASxx: Bipolar TTL, Advanced Schottky, intended to supercede the 74Lxx.
- 74ALSxx: Bipolar TTL, Advanced Low Power Schottky, intended to supercede the 74LSxx.
- 74Fxx: Bipolar TTL, Faster.
- 74HCxx: CMOS high-speed emulation of 74LSxx.
- 74HCTxx: CMOS but with similar high-state input voltage threshold to bipolar TTL chips, for compatibility.
- 74ACxx: Advanced CMOS.
- 74ACTxx: Advanced CMOS emulation of TTL with similar high-state input voltage threshold to TTL, for compatibility.
- 74AHCxx: Advanced Higher-Speed CMOS, three times as fast as HC.
- 74VHCxx: Very High Speed CMOS.
- 74AUCxx, 74FCxx, 74LCXxx, 74LVCxx, 74ALVCxx, 74LVQxx, 74LVXxx: Various specifications, many using power supply voltages of 3.3V or below.

In the 4000 series, an early significant improvement was the 4000B family, which allowed a higher power supply limit (18V instead of 12V) and was much less susceptible to damage by static discharge. The 4000B family almost totally replaced the old 4000 family, and most 4000B

chips are still available, as they are useful in situations where a power supply delivers more than 5VDC.

- When it is referenced casually, the B at the end of a chip number in the 4000 series may be omitted. When the number is listed in a catalog, the B is included.

Chips with 45 as their first two digits were introduced as a new generation, but were not widely adopted. After that, the 4000 series ceased to evolve, and CMOS chips adopted 74xx part numbers, distinguishing themselves by the insertion of letter groups in the center of the number.

To add to the confusion, some 4000 series part numbers were appended to 74xx part numbers, so that, for example, the 74HCT4060 is designed to be compatible with the old 4060B chip.

Family Interoperability

One of the most important issues relating to chip families is their differing specifications for a low-state voltage and a high-state voltage in inputs and outputs.

The original 74xx TTL series, using a 5VDC power supply, used these approximate specifications:

- Output: 74xx voltage representing a low state (at most 0.4V to 0.5V)
- Input: 74xx input voltage interpreted as a low state (maximum 0.8V)
- Output: 74xx voltage representing a high state (at least 2.4V to 2.7V)
- Input: 74xx input voltage interpreted as a high state (minimum 2V)

This provided a safe margin of error of at least 0.4V when chips were communicating with each other.

In the CMOS 4000 family, however, logic chips required a minimum input of 3V to 3.5V to be interpreted as a high state. The minimum acceptable output from a TTL chip was below this level, creating problems if anyone should try to use the output from a TTL chip to communicate with an input on a CMOS chip.

One solution is to add a 4.7K pullup resistor to the TTL output, guaranteeing that it won't fall too low. But this wastes power, and the need for the resistor is easily forgotten. Another option is to use the HCT or ACT family of CMOS logic. The "T" in these family names indicates that they have been engineered to share the input standards of the old TTL chips. They still deliver the same high output as other types of CMOS, making them seem to be the best possible solution. Unfortunately, it does entail a compromise: the "T" chips are more sensitive to noise, among other factors.

- Ideally, chip families should not be intermingled.

Gates per Chip

Each of the original 74xx chips contained multiple gates within the limits of a uniform 14-pin through-hole format. The gates that were most commonly used had two inputs, and there were four of these gates per chip.

However, the desire for miniaturization, and the use of automatic chip-placement and soldering equipment, made one-gate and two-gate logic chips desirable and practical in surface-mount format. (Three-gate surface-mount chips exist, but are sufficiently unusual that they are not described in this encyclopedia.)

Two Inputs, Single Gate

Where a chip contains just one logic gate, it is almost always a surface-mount component, and the part number has 1G in the middle to indicate "one gate." Pad functions are shown in Figure 10-11. The layout is standardized for all logic gates, with the exception of XNOR gates, which are not manufactured in surface-mount format.

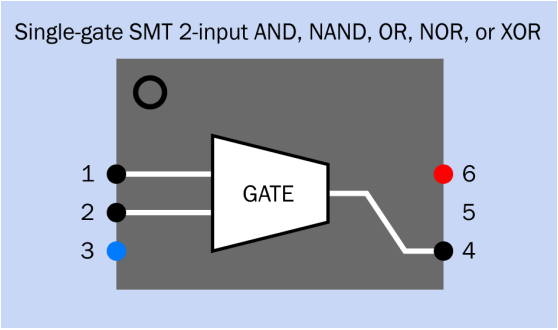

Figure 10-11. *Internal configuration and solder-pad functions for a two-input surface-mount single-gate logic chip that can contain an AND, NAND, OR, NOR, or XOR gate. XNOR gates are not manufactured in this format.*

In the figure, a gate is shown in generic form, indicating that it may be an AND, NAND, OR, NOR, or XOR gate, depending on the part number of the chip. Inputs are on the left of the gate, while its output is on the right. The chip does not have a solder pad in position 5, but the pad at top right is identified as pin 6 for consistency with the numbering pattern in other surface-mount components where six pads are common.

The generic part numbers for single-gate surface-mount two-input logic chips are shown here, with letter x indicating that letter sequences are likely to be inserted to indicate manufacturer, logic family, and chip format:

- AND gate: x74x1G08x
- OR gate: x74x1G32x
- NAND gate: x74x1G00x
- NOR gate: x74x1G02x
- XOR gate: x74x1G86x

Three Inputs, Single Gate

AND, NAND, OR, and NOR single gates are available with more than two inputs. Their output is determined by rules shown in Figure 10-5. XOR and XNOR gates are not included in the table, because a strict interpretation of their logic requires that a unique output state exists if one input is high while the other is low.

The pad functions for a surface-mount single-gate logic chip with three inputs are shown in Figure 10-12. The generic part numbers for these chips are shown below. Again, each x indicates that letter sequences are likely to be inserted to indicate manufacturer, logic family, and chip format.

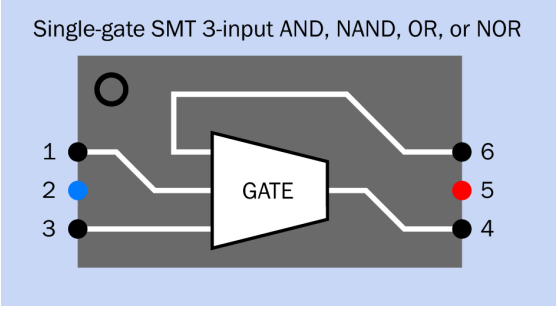

Figure 10-12. *Internal configuration and solder-pad functions for a three-input surface-mount single-gate logic chip that can contain an AND, NAND, OR, or NOR gate.*

The generic part numbers for single-gate surface-mount three-input logic chips are shown here, with each x indicating that letter sequences are likely to be inserted to indicate manufacturer, logic family, and chip format:

- AND: x74x1G11x
- NAND: x74x1G10x
- OR: x74x1G32x
- NOR: x74x1G27x

Single Gate, Selectable Function

A few surface-mount chips can emulate a variety of two-input gates, by using appropriate external connections. The internal logic of one example, with generic part number x74x1G97x (an actual example would be Texas Instruments SN74LVC1G97), is shown in Figure 10-13. Depending which pin is grounded and which other pins are used as inputs, the chip can emulate all five of the most commonly used gates. To achieve this, however, some inputs have to be inverted.

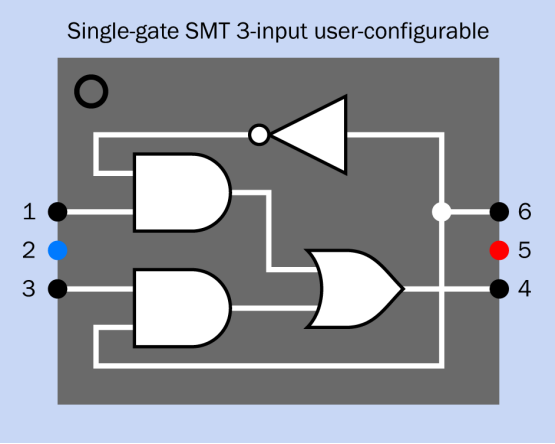

Figure 10-13. *Internal configuration for a configurable surface-mount chip that can emulate various two-input logic gates, depending which inputs are used and which are grounded. Some inputs have to be inverted to emulate some gates.*

Two Inputs, Dual Gate

Two-input surface-mount AND, NAND, OR, NOR, and XOR gates are available in dual layout (two gates per chip). The internal logic and pad functions are shown in Figure 10-14. The generic part numbers for these chips are shown here. Again, each x indicates that letter sequences are likely to be inserted to indicate manufacturer, logic family, and chip format.

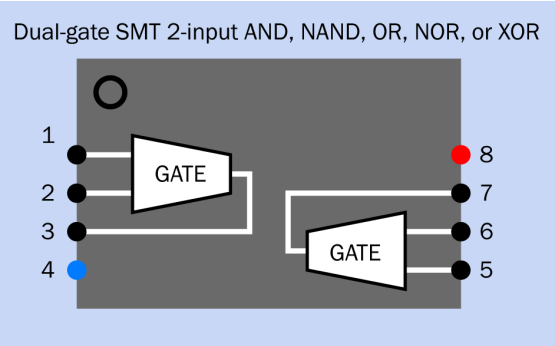

Figure 10-14. *Internal configuration and solder-pad functions for a two-input surface-mount dual-gate logic chip that can contain two AND, NAND, OR, NOR, or XOR gates. XNOR chips are not manufactured in this format.*

The generic part numbers for dual-gate surface-mount two-input logic chips are shown below, with each x indicating that letter sequences are likely to be inserted to indicate manufacturer, logic family, and chip format:

- AND: x74x2G08x
- NAND: x74x2G00x
- OR: x74x2G32x
- NOR: x74x2G02x
- XOR: x74x2G86x

Original 74xx 14-Pin Format

Each of the original 74xx TTL chips contained multiple gates within the limits of a uniform 14-pin chip format. The available options were, and still are:

- Quad 2-input: Four gates with two inputs each
- Triple 3-input: Three gates with three inputs each
- Dual 4-input: Two gates with four inputs each
- Dual 5-input: Two gates with five inputs each
- Single 8-input: One gate with eight inputs

The five-input chips have become so uncommon that they are not described in this encyclopedia.

Quad Two-Input 74xx Pinouts

14-pin DIP 74xx quad two-input logic chips are available in AND, NAND, NOR, XOR, or XNOR versions, all of which have an internal layout shown in Figure 10-15. The layout is unchanged in surface-mount format. The gates are shown in generic form, as the layout remains the same regardless of which type of gate is in the chip. All the gates in any one chip are of the same type. The four connections leading to a gate are its inputs, while the single connection from a gate is its output.

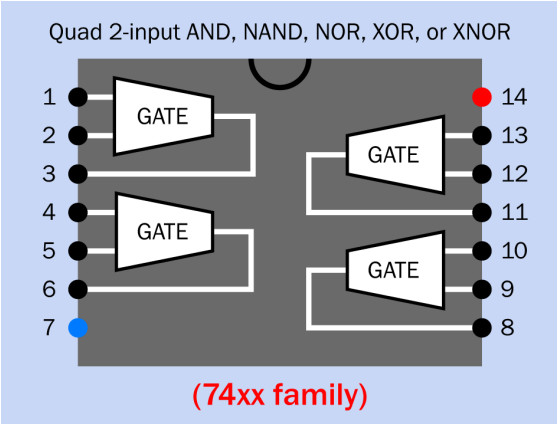

Figure 10-15. *In a 14-pin quad two-input 74xx logic chip, the AND, NAND, NOR, XOR, and XNOR versions all share this generic layout.*

- The 14-pin quad two-input OR chip has different pinouts from all the other 74xx logic chips. It is shown in Figure 10-16.

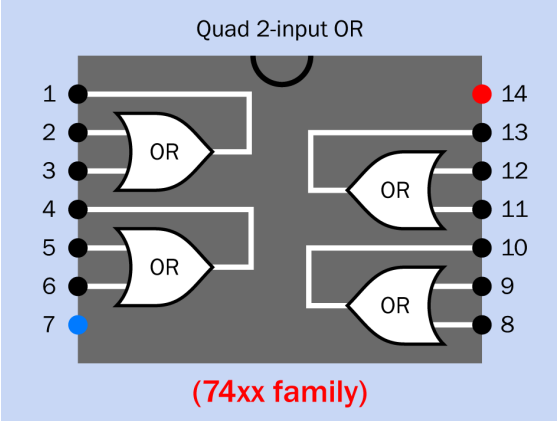

Figure 10-16. *In a quad two-input 74xx OR chip, this layout is used, which is different from that used in all the other quad two-input logic gates.*

Triple Three-Input 74xx Pinouts

The AND, NAND, and NOR versions of a 14-pin DIP 74xx triple three-input logic chip all have an internal layout shown in Figure 10-17. The layout is unchanged in surface-mount format. The gates are shown in generic form, as the layout remains the same regardless of which type of gate is in the chip. All the gates in any one chip are of the same type. Three connections leading to a gate are its inputs, while a single connection from a gate is its output.

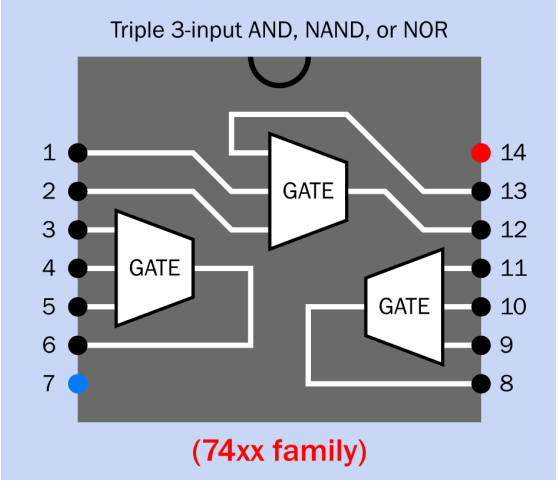

Figure 10-17. *In a 14-pin triple three-input 74xx logic chip, the AND, NAND, and NOR versions all share this generic layout.*

- The 14-pin triple three-input OR chip has different pinouts from all the other 74xx logic chips. It is shown in Figure 10-18.

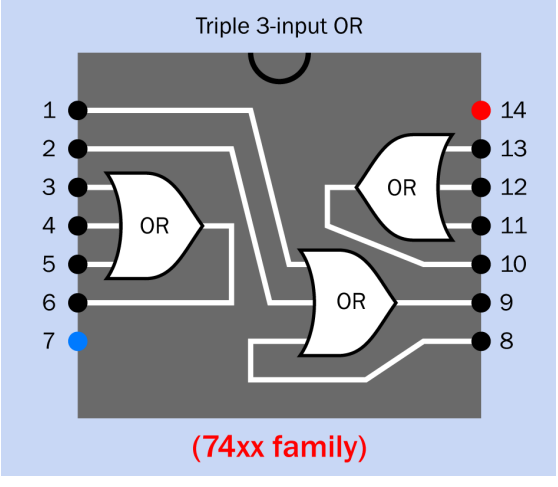

Figure 10-18. *In a triple three-input 74xx OR chip, this layout is used, which is different from that used for all the other triple three-input logic gates.*

Dual Four-Input 74xx Pinouts

A 14-pin DIP 74xx dual four-input logic chip contains two four-input gates. The AND, NAND, and NOR versions all have an internal layout shown in Figure 10-19. The layout is unchanged in surface-mount format. The gates are shown in generic form, as the layout remains the same regardless of which type of gate is in the chip. All the gates in any one chip are of the same type.

- There is no OR chip of the 14-pin dual four-input type.

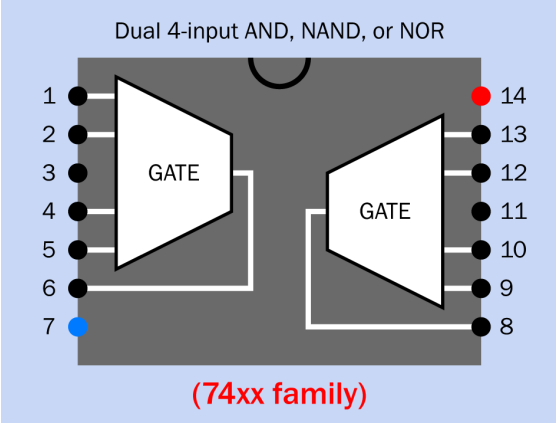

Figure 10-19. *In a 14-pin dual four-input 74xx logic chip, the AND, NAND, and NOR versions all share this generic layout. There is no 74xx OR chip with four inputs per gate.*

Single Eight-Input 74xx Pinouts

A 14-pin DIP 74xx single eight-input NAND chip contains one eight-input gate, as shown in Figure 10-20. The layout is unchanged in surface-mount format.

- There is no AND chip of the 14-pin single eight-input type.

A 14-pin eight-input logic chip in the 74xx series, able to function as both an OR and a NOR, is shown in Figure 10-21. The output from the NOR gate is connected with pin 13, but also passes through an inverter to create an OR output at pin 1. (Because a NOR gate is equivalent to an inverted-OR, when its output is inverted again, it returns to being an OR.)

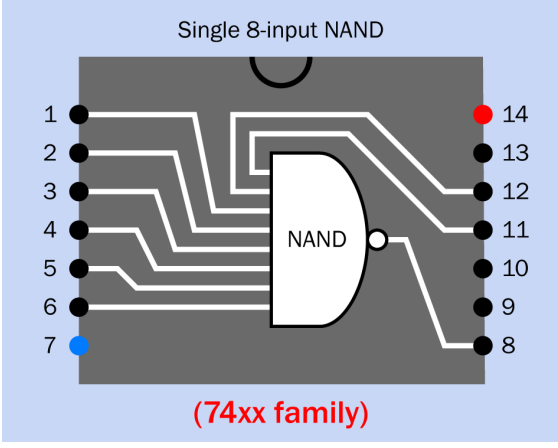

Figure 10-20. *The internal layout of single eight-input NAND chip in the 14-pin 74xx series. There is no 74xx AND chip with eight inputs per gate.*

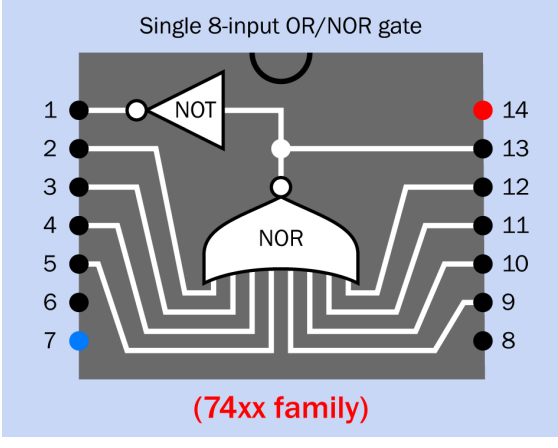

Figure 10-21. *The internal layout of single eight-input OR/NOR chip in the 14-pin 74xx series. Pin 13 has the NOR output, while pin 1 has the OR output.*

The following list shows the generic part numbers for DIP and surface-mount versions of 14-pin logic chips in the 74xx series that have two or more inputs per gate. As before, an x indicates that letter sequences are likely to be inserted to indicate manufacturer, logic family, and chip format.

- Quad 2-input AND: x74x08x
- Quad 2-input NAND: x74x00x
- Quad 2-input OR: x74x32x
- Quad 2-input NOR: x74x02x
- Quad 2-input XOR: x74x86x
- Quad 2-input XNOR: x74x266x
- Triple 3-input AND: x74x11x
- Triple 3-input NAND: x74x10x
- Triple 3-input OR: x74x4075x
- Triple 3-input NOR: x74x27x
- Dual 4-input AND: x74x21x
- Dual 4-input NAND: x74x20x
- Dual 4-input NOR: x74x4002x
- Single 8-input NAND: x74x30x
- Single 8-input OR/NOR: x74x4078x

74xx Inverters

Single, dual, and triple inverter packages in the 74xx series are available in surface-mount format only. Their internal arrangement is shown in Figures 10-22, 10-23, and 10-24.

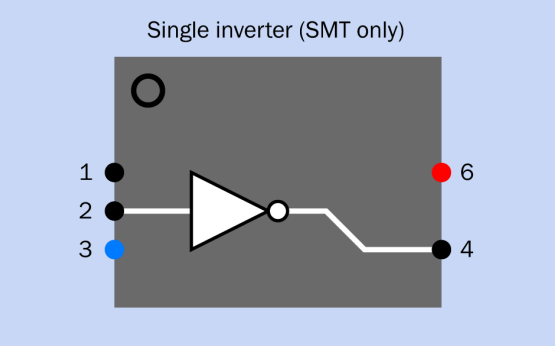

Figure 10-22. *The internal layout of a 74xx series logic chip containing one inverter. This is available in surface-mount format only. Pin 5 is absent. Pin 1 is not connected.*

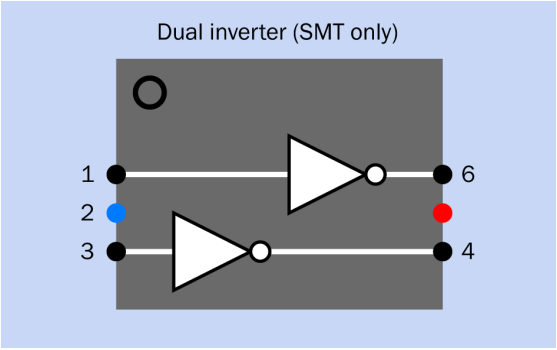

Figure 10-23. *The internal layout of a 74xx series logic chip containing two inverters. This is available in surface-mount format only.*

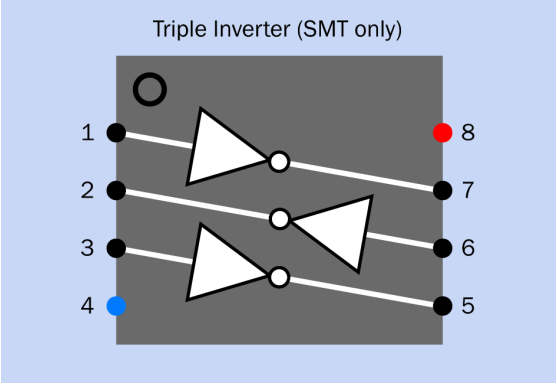

Figure 10-24. *The internal layout of a 74xx series logic chip containing three inverters. This is available in surface-mount format only.*

In the 14-pin format, a hex inverter chip (containing six inverters) is available, as shown in Figure 10-25. The layout is the same for DIP and surface-mount formats.

Generic part numbers for inverter chips are as follows:

- Single inverter: x74x1G04x
- Dual inverter: x74x2G04x
- Triple inverter: x74x3G14x
- Hex inverter: x74x04x

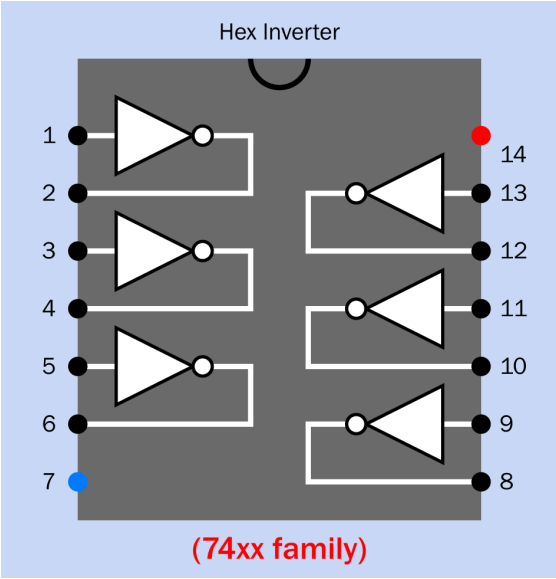

Figure 10-25. *The internal layout of a 14-pin 74xx hex inverter logic chip, containing six inverters. This layout is the same for DIP and surface-mount versions.*

Additional Variations

Some chips in the 74xx series (both DIP and surface mount versions) have variants with open drain or open collector outputs, while others have inputs that are configured as Schmitt triggers. These variants will be found as hits when searching supplier websites for logic chips by gate name and number of inputs.

Pinouts in the Original 4000 Series

Each of the original 4000 CMOS chips contained multiple gates within the limits of a uniform 14-pin chip format. The available options were, and still are:

- Quad 2-input: Four gates of two inputs each
- Triple 3-input: Three gates of three inputs each
- Dual 4-input: Two gates of four inputs each
- Single 8-input: One gate of eight inputs

In the 4000 family, 14-pin quad two-input logic chips are available in AND, OR, NAND, NOR, XOR, or XNOR versions, all of which have an internal layout shown in Figure 10-26. The gates are shown in generic form, as the layout remains the same regardless of which type of gate is in the chip. All the gates in any one chip are of the same type. The four connections leading to a gate are its inputs, while the single connection from a gate is its output.

Unlike the 74xx family, the quad two-input OR chip in the 4000 family has the same pinouts as the other types of quad two-input logic chips.

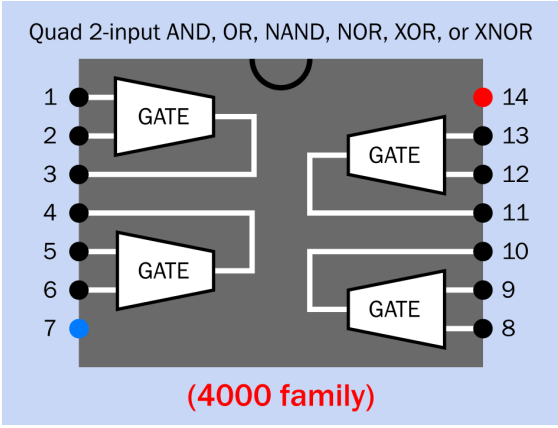

Figure 10-26. *In the 4000 family, the AND, OR, NAND, NOR, XOR, and XNOR versions of a quad two-input logic chip all share this generic layout.*

In the 4000 family, a 14-pin triple three-input logic chip contains three three-input gates. The AND, OR, NAND, and NOR versions all have an internal layout shown in Figure 10-27. The gates are shown in generic form, as the layout remains the same regardless of which type of gate is in the chip. All the gates in any one chip are of the same type. The three connections leading to a gate are its inputs, while a single connection from a gate is its output.

Unlike the 74xx family, the triple three-input OR chip in the 4000 family has the same pinouts as the other types of triple three-input logic chips.

In the 4000 family, a 14-pin dual four-input logic chip contains two four-input gates. The AND, NAND, OR, and NOR versions all have an internal

layout shown in Figure 10-28. The gates are shown in generic form, as the layout remains the same regardless of which type of gate is in the chip. All the gates in any one chip are of the same type. Each pair of connections leading to a gate are its inputs, while the single connection from a gate is its output.

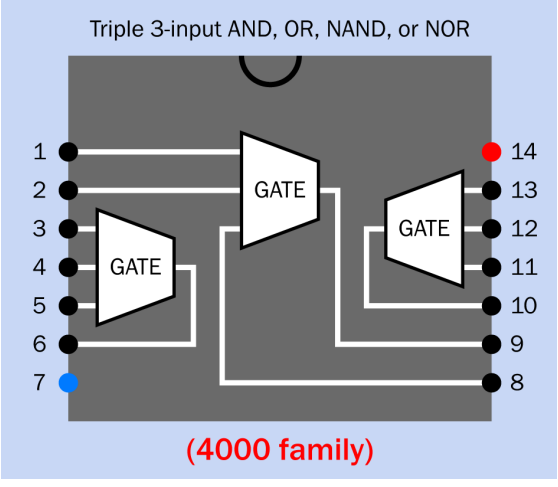

Figure 10-27. *In the 4000 family, the AND, OR, NAND, and NOR versions of a triple three-input logic chip all share this generic layout.*

Note that the 4000 family does have a dual four-input OR chip, whereas the 74xx family does not.

In the 4000 family, a 14-pin eight-input logic chip with AND and NAND outputs is available, as shown in Figure 10-29.

The following list shows the generic part numbers for 14-pin logic chips in the 4000 family that have two or more inputs per gate (in actual part numbers, letters will be substituted where an x appears):

- Quad 2-input AND: x4081x
- Quad 2-input NAND: x4011x
- Quad 2-input OR: x4071x
- Quad 2-input NOR: x4001x
- Quad 2-input XOR: x4070x
- Quad 2-input XNOR: x4077x
- Triple 3-input AND: x4073x
- Triple 3-input NAND: x4023x
- Triple 3-input OR: x4075x
- Triple 3-input NOR: x4025x
- Dual 4-input AND: x4082x
- Dual 4-input NAND: x4012x
- Dual 4-input OR: x4072x
- Dual 4-input NOR: x4002x
- Single 8-input AND/NAND: x4068x

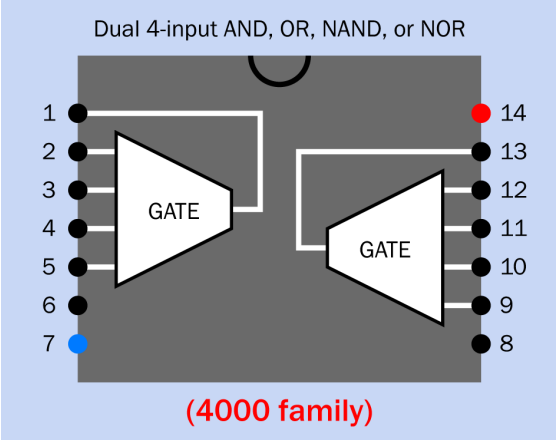

Figure 10-28. *In the 4000 family, the AND, OR, NAND, and NOR versions of a dual four-input logic chip all share this generic layout.*

4000 Series Inverters

In the 4000 family, the 4069B is a 14-pin hex inverter chip (containing six inverters), as shown in Figure 10-30. This has the same pinouts as the x74x04x chip.

How to Use It

Which Family

In DIP format, the HC family has existed for more than 30 years, and has become established as a widely used default choice.

In surface-mount formats, the choice of family will largely be determined by the choice of supply voltage.

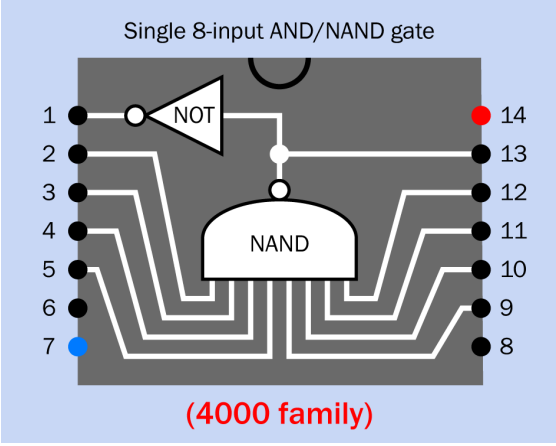

Figure 10-29. *In the 4000 family, a single eight-input AND/NAND chip has this internal layout. The inverted output from the NAND gate becomes an AND output from pin 1 of the chip.*

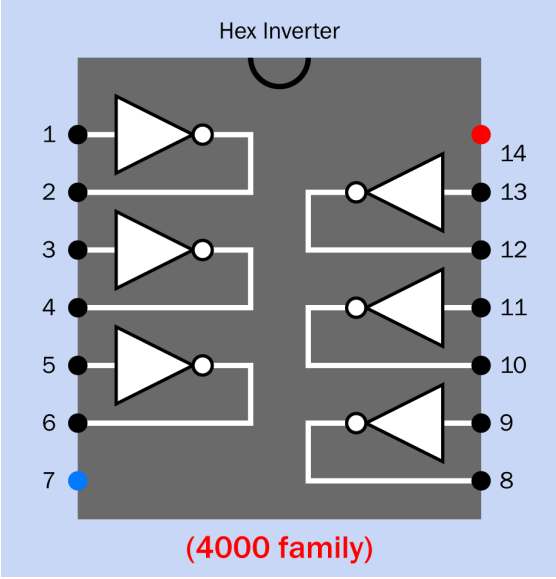

Figure 10-30. *The internal layout of a 14-pin 4069B hex inverter logic chip, containing six inverters. This layout is the same as for the x74x04x chip.*

Although the 4000 series is now more than 40 years old, it may still be useful where a 5VDC power supply is not required for other reasons in a circuit and would be added purely to power a 74xx series logic gate or other digital chip. If a circuit contains a 9VDC or 12VDC relay, for instance, a Darlington pair may be used with that voltage to drive the relay, and an old-school 4000 series logic chip could share the same supply. The relay coil would need a clamping diode to protect the logic chip from transients.

Applications

The output from a logic chip may be used as an input for a microcontroller, to enable multiple inputs to share one pin. An eight-input NAND gate, for instance, could combine the inputs from eight normally on motion sensors. If just one sensor responds to an intrusion, the gate output would change from high to low.

Logic gates may be useful in any simple device that has to respond to a single, specific combination of inputs. A digital combination lock is one example; games of chance are another. Most simple dice simulations use logic gates to convert the output from a counter to drive a dice-pattern of LEDs.

A logic gate may be used as an interface between an electromechanical **switch** and a circuit containing digital chips. A 10K pullup or pulldown resistor prevents the gate input from floating when the switch is open. A buffer can be used for this purpose, or an inverter, or any "spare" gate on a logic chip that is already in the circuit. One input of the chip can be tied to the positive power supply or negative ground, to create an appropriate input from the chip when the switch, attached to the other input, is opened or closed.

A jam-type **flip-flop** can be used to *debounce* a switch input. See Chapter 11 for details. If two NOR or two NAND gates are unused in a circuit, they can form a flip-flop.

In the original CMOS 4000 family, a positive output may be capable of driving an LED if the current does not exceed 5mA with a power supply of 5VDC or 10mA with a power supply of 10VDC. Note that the output voltage will be pulled down significantly by these loads. In the 74HCxx family, chips can source or sink as much as 20mA, but

here again the output voltage will be pulled down. Note that the total limit for all outputs from a 74HCxx chip is around 70mA.

The output from a logic chip can be passed through a buffer such as the 7407, which has an open-collector output capable of sinking as much as 200mA. This enables direct drive of modest loads, so long as they are not inductive.

Solid-state relays and **optocouplers** can be driven directly from logic chips, as they draw very little current. A solid-state relay can switch 50A or more.

What Can Go Wrong

Two problems are common when using CMOS digital chips: damage from *static electricity*, and erratic behavior caused by *floating pins*.

Static

The early 4000 series CMOS chips were especially vulnerable, but more recent CMOS designs generally include diodes at the inputs, which reduces the risk. Still, logic chips should be protected by inserting them into anti-static foam or enclosing them in conductive wrappers until they are installed in a board. While handling chips, it is good practice to be grounded, ideally using a wrist-mounted ground wire.

Floating Pins

Any pin which is unconnected in a logic chip is considered to be "floating," and can pick up signals by capacitive coupling, possibly disrupting the behavior of the chip and also causing power consumption, as the ambiguous pin state will tend to prevent that gate in the chip from entering quiescent mode.

Generally speaking, input pins in a TTL logic chip that are not being used for any purpose should be tied to the positive voltage supply, while unused CMOS pins should be tied to negative ground.

Family Incompatibilities

As previously noted, older TTL logic chips may deliver a "high" output voltage that is lower than the minimum expected by newer CMOS logic chips. The best option is not to mix families, but if chips are stored carelessly, some intermingling can occur. Part numbers should be checked if one chip appears to be ignoring output from another.

Overloaded Outputs

If a circuit calls for a logic chip with an open-collector output, and a regular chip is used by mistake, it will almost certainly be damaged.

Output Pulled Down

If the output from one logic chip is connected with the input of another logic chip, and if the output from the first chip is also connected to an **LED**, the LED may pull down the output voltage so that the second chip will not recognize it as a high state. As a general rule, a logic output can drive an LED, or can drive another logic chip, but not both. Very-low-current LEDs, which draw as little as 2mA, may be acceptable.

Incorrect Polarity and Voltages

Logic chips can be knocked out by applying incorrect polarity, or voltage to the wrong pin, or the wrong voltage. Modern logic chips tolerate a very limited voltage range, and a 74xx series chip will be irrevocably damaged if it is used where a 4000 series chip was specified for a power supply higher than 6VDC.

If a chip is inserted upside-down, it will probably be damaged when voltage is applied.

Bent Pins

Like all through-hole chips, DIP logic chips can be inserted accidentally with one or more pins bent underneath the chip. This error is very easy to miss. The bent pins will not make contact with any socket that is used, and the chip will behave unpredictably. Check for proper pin insertion with a magnifying glass if necessary.

Unclean Input

Logic chips expect a clean input without voltage spikes. A 555 timer of TTL type generates spikes in its output which can be misinterpreted as multiple pulses by the input of a logic chip. A CMOS-type 555 timer is more suitable for connection with logic chips.

If a pushbutton, rotational encoder, or electromechanical switch provides a high or low input, the input must be debounced. In hardware, this is traditionally done with a **flip-flop**. It can also be done with code in a microcontroller.

Analog Input

The input of a logic chip can be connected directly with a thermistor, phototransistor, or similar analog component, but only if there is some certainty that the voltage at the input pin will remain within the range that is acceptable to the chip. In the case of a phototransistor, for example, it should be exposed to a limited, known range of light intensity.

In general, it is best to avoid applying intermediate-voltage signals to a digital logic input, as they can create unpredictable output, or output of an intermediate voltage. A **comparator** can be placed between the analog source and the digital logic chip, or a logic chip with a Schmitt-trigger input can be used.

flip-flop

11

The term **flip-flop** is sometimes printed with a space instead of a hyphen, but the hyphenated form seems to predominate in the United States. Therefore, the hyphen is included here. The term *flipflop* (with neither a hyphen nor a space) is sometimes seen, but is unusual. The acronym *FF* is confined mostly to logic diagrams or schematics.

The term *latch* is sometimes used interchangeably with *flip-flop* but is assumed here to describe a minimal asynchronous circuit that responds immediately and transparently to an input. A flip-flop can function as a latch and also as a synchronous device which is opaque, meaning that the input does not flow directly through to the output.

OTHER RELATED COMPONENTS

- **counter** (see Chapter 13)
- **shift register** (see Chapter 12)

What It Does

Transistors enable logic gates; logic gates enable flip-flops; and flip-flops enable many mathematical, storage, and retrieval functions in digital computing. Most flip-flops today are embedded in much larger integrated circuits that have complex functions. However, they are still available as separate components in chip form, and will be discussed on that basis here.

A flip-flop is the smallest possible unit of memory. It can store a single bit of data, represented by either a high or low *logic state*. (A full explanation of logic states is included in the **logic gate** entry. See Chapter 10.) Flip-flops are especially useful in **counters**, **shift registers**, and *serial-to-parallel converters*.

A flip-flop circuit can be classified as a form of *bistable multivibrator*, as each of its outputs is stable in one of two states until an external trigger stimulates it to "flip" from one state and "flop" into the other. (For a comprehensive discussion of monostable and astable multivibrators, see the **timer** entry in Chapter 9.)

An *asynchronous* flip-flop will respond immediately to a change of input, and can be used for applications such as debouncing the signal from an electromechanical **switch** or building a *ripple* **counter**. More often, a flip-flop is *synchronous*, meaning that a change in input state will be unrecognized until it is enabled by a low-to-high or high-to-low transition in a stream of pulses from an external *clock*.

How It Works

Every flip-flop has two outputs, each of which may have a high or low state. When the flip-flop is functioning normally, the outputs will be in opposite logical states, one being high while the other is low. These outputs are typically identified as Q and NOT-Q (the latter term meaning a letter Q with bar printed above it, sometimes referred to verbally as "Q-bar"). In datasheets and other documents where a bar symbol cannot be

represented easily above a letter, the NOT-Q output may be represented as letter Q with an apostrophe after it, as in Q′.

Almost always, in a schematic diagram, a flip-flop is represented by a simple rectangle, with inputs and outputs identified by letters and other marks. Because a description of the inner workings is necessary before the different types of flip-flop can be understood, schematic symbols for various flip-flops will not be introduced until "Variants" on page 116.

The simplest flip-flop contains two logic gates whose function can be most easily understood if the inputs are controlled by a SPDT switch. It can be created from two NAND gates or two NOR gates, as described next. This type of component can be described as:

- *asynchronous*: Will accept data on an impromptu basis, as it is not synchronized with a clock.
- *jam-type*: Colloquial equivalent of *asynchronous*. The input is jammed in at any time, forcing an immediate change of output.
- *transparent*: The input state flows straight through to the output.

NAND-Based SR Flip-Flop

Figure 11-1 shows two NAND gates attached to a SPDT switch, with two pullup resistors. When either of the NANDs has a floating input from the switch, the pullup resistor attached to that input will maintain it in a high state. The data inputs for the NAND gates are labeled S and R, meaning Set and Reset, giving this component its name as an *SR* flip-flop:

- In a NAND-based SR flip-flop, a low state is considered an active logic input, as indicated by the bar placed above each letter.
- A high state is considered an inactive logic output.

The schematic style in this figure, with diagonally crossing conductors, is universally used and easily recognizable. The equivalent schematic in Figure 11-2, which might be created by circuit-drawing software, has the same functionality but would not be immediately recognizable as a flip-flop. The "classic" crossed-conductor representation is preferable.

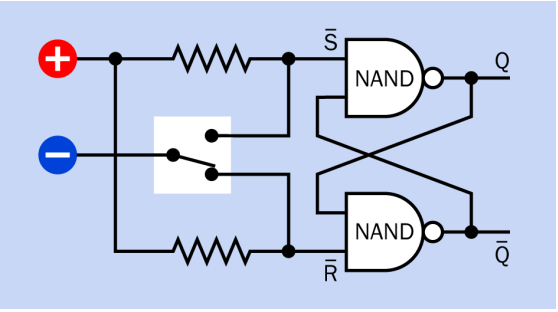

Figure 11-1. *The schematic for a simple NAND-based SR-type flip-flop, with a switch and pullup resistors added to control two inputs.*

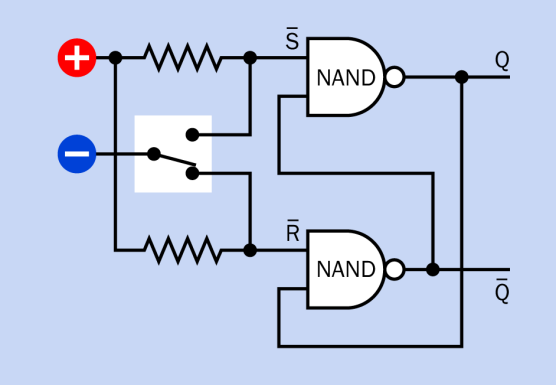

Figure 11-2. *An alternative component layout for an SR flip-flop, functionally identical to the previous schematic, but not so easily recognizable. The layout with a pair of diagonally crossing conductors has become so ubiquitous, it should be considered to be a standard.*

The first step toward understanding the behavior of flip-flops is to recall the relationship between the two inputs and the output of NAND or NOR gates. This is shown in Figure 11-3, where red indicates a high logic state and black indicates a low logic state.

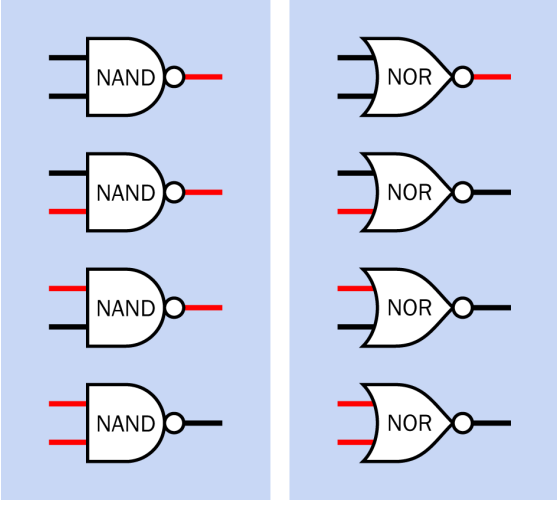

Figure 11-3. *The four possible input combinations for a NAND gate and a NOR gate, with the corresponding logical outputs. A flip-flop can be built from two NANDs or two NORs.*

The behavior of a NAND gate can be summarized:

- Both inputs high: Output low.
- Other input combinations: Output high.

Figure 11-4 shows a series of snapshots of the SR flip-flop circuit as the switch moves from one position, through an intermediate state where it makes no connection, to the other position. Remember that in this circuit, the active logical input state is low, and the active logical output state is high.

In the top panel, the pullup resistor of the lower NAND is overwhelmed by the direct connection to negative ground, which holds the R input in a low state. The other input of this gate is irrelevant, because the output from a NAND will be high if either of its inputs is low. So, the lower NAND has a high output, which feeds back to the secondary input of the upper NAND gate. The S input of this gate is high, because of the pullup resistor. Because both inputs of this gate are now high, its output is low, which feeds back to the lower gate. The lower gate doesn't change its output, because either of its low inputs is enough to keep its output high. So, the circuit is in equilibrium. A high state on the NOT-Q output is known as the *Reset* state for a NAND-based flip-flop.

The second panel shows what happens if the switch now moves up into a neutral, disconnected position. The R input of the lower NAND now becomes high, because of the pullup resistor. But this NAND still has one low input, supplied by the output of the upper gate, so its output remains high, and the circuit is still in equilibrium. This is known as the *Hold* state for the NAND circuit.

Suppose the switch bounces to and fro between the states shown in the first two panels. The output from the circuit won't change. This shows that the circuit provides a method for eliminating *switch bounce*—the very fast, momentary spikes that occur when the mechanical contacts of a switch open and close.

The third panel shows what happens if the switch now moves to its upper position. The top input of the upper NAND gate is now pulled low. Consequently, its output goes high. This feeds back to the lower gate. Its other input is high because of the pullup resistor. With both of its inputs high, its output goes low. The gate outputs have flipped and swapped values. A high state on the Q output is known as the *Set* state for a NAND-based flip-flop.

The circuit still remains in equilibrium even if the switch returns to its central, disconnected position shown in the bottom panel. Therefore, the debouncing capability of the circuit works equally well for both positions of the switch.

NOR-Based SR Flip-Flop

Figure 11-5 shows a similar circuit using two NOR gates attached to an SPDT switch. Because the NOR gates function differently, this circuit uses active-high input logic, and pulldown resistors are needed instead of pullup resistors. The output from the circuit still uses active-high logic, and is identical with the NAND-based circuit in

this respect, although the relative positions of the Q and NOT-Q outputs have been swapped.

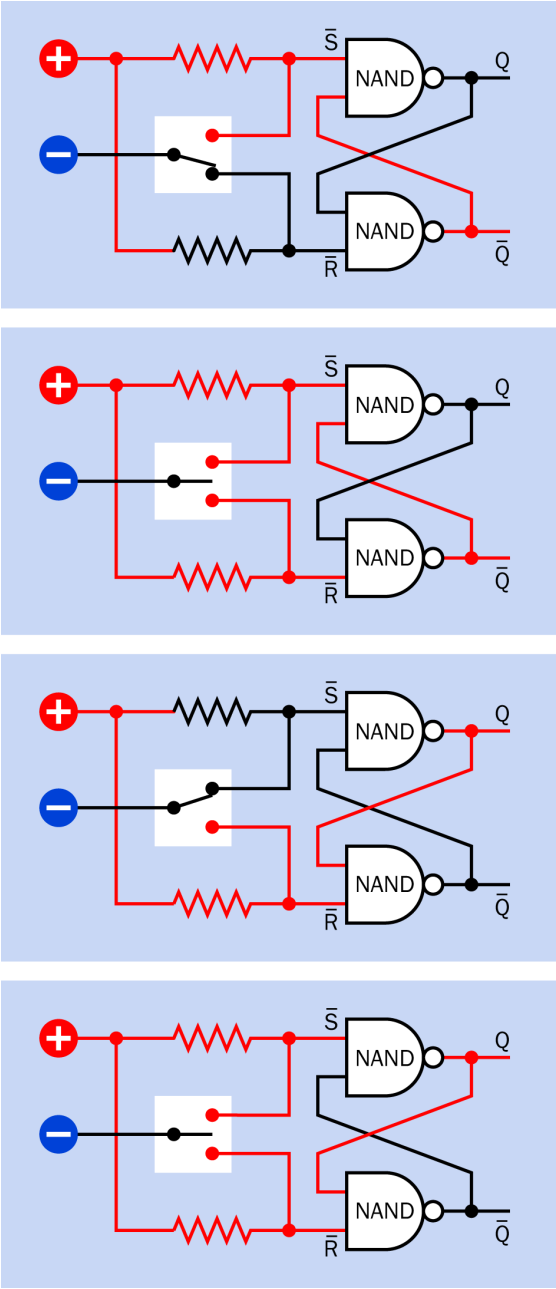

Figure 11-4. *Four snapshots of transitions in a NAND-based SR flip-flop as the switch moves down and up through an intermediate no-connection zone. See text for details.*

- In a NOR-based SR flip-flop, a high state is considered an active logic input, as indicated by the absence of a bar placed above the letters S and R.
- A high state is considered an active logic output.

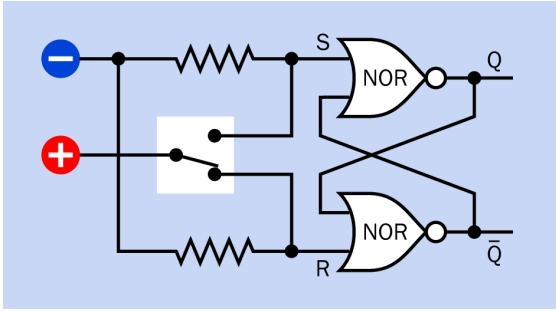

Figure 11-5. *The schematic for a simple SR flip-flop using NOR gates instead of NANDs.*

In the case of the NOR gate:

- Both inputs low: Output high.
- Other input combinations: Output low.

Figure 11-6 shows a series of snapshots as the switch moves from one position to the other, through intermediate states where it makes no connection. Remember that in this circuit, the active logical state is high at both the inputs and the outputs.

In this circuit, as in the previous circuit using NAND gates, it will ignore switch bounce, allowing the gate outputs to remain stable.

Forbidden States

Either of the circuits described so far depicts an SR flip-flop, regardless of whether it is NAND-based or NOR-based. Its input and output states are summarized in Figure 11-7. However, as this table suggests, there are some input states that create problems.

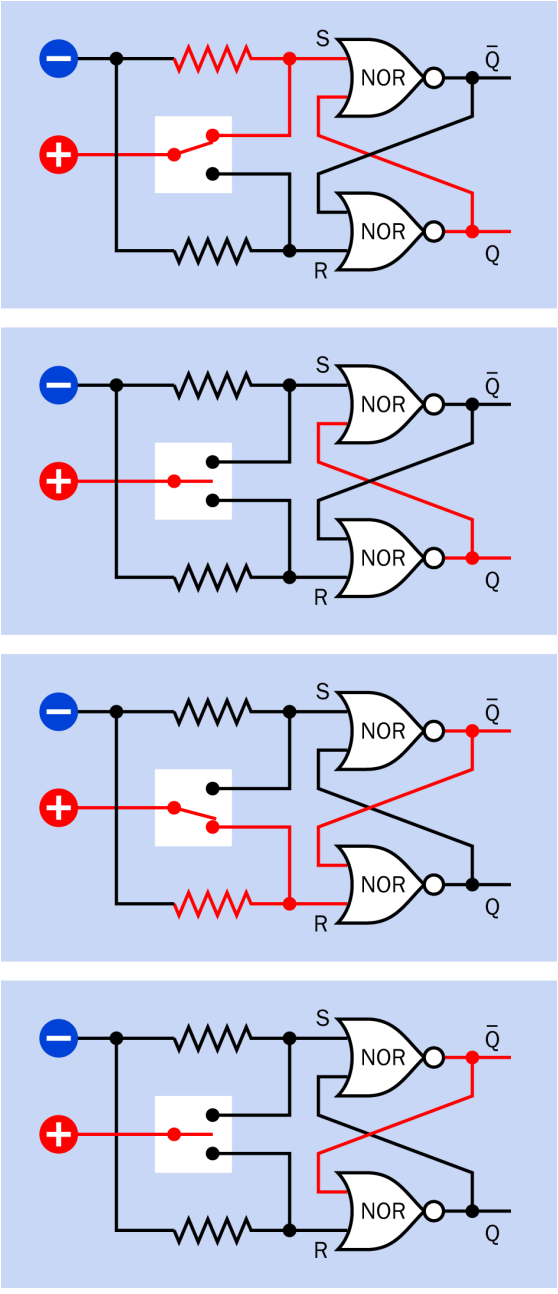

Figure 11-6. *Four snapshots of a NOR-based SR flip-flop, showing the consequence of changing switch positions, comparable with the NAND-based flip-flop.*

Flip-Flop Inputs		Flip-Flop Outputs			
		NAND-based		NOR-based	
S	R	Q	Q̄	Q	Q̄
●	●	● Problem ●		Same as Previous	
●	●	●	●	●	●
●	●	●	●	●	●
●	●	Same as Previous		● Problem ●	

Figure 11-7. *A table of input states and the consequent output states for NAND-based and NOR-based SR flip-flops.*

In either the NAND-based flip-flop or the NOR-based flip-flop, the output when the switch is in its unconnected center position will remain the same as when the switch was in its previous position. This is the usefulness of the flip-flop: it remembers the previous state. These situations are identified as "Same as Previous" in the table.

The pullup resistors (in a NAND-based flip-flop) and pulldown resistors (in a NOR-based flip-flop) are intended to guarantee that both inputs will be high (NAND) or both inputs will be low (NOR) even when the switch makes no connection. Therefore, it should be impossible for both inputs to be low (NAND) or high (NOR).

But what happens if the circuit is powered up with the switch in the unconnected position? One input of each gate is controlled by the output of the other gate. But what will those outputs be?

In the NAND-based version, the outputs from the NANDs will be low while the chips are powering up. As soon as the NAND chips are functioning, each of them will sense that it has one input high and one input low, so it will change its output to high.

But now that each chip has a high output, it will feed back to the secondary input of the other chip. Now both chips have both inputs high. This will cause them both to change their outputs to low—but this will feed back again, flipping the outputs back to high again. In fact, if the gates

are absolutely identical, the circuit will oscillate very rapidly. This is sometimes known as *ringing*.

In real life, the gates will not be absolutely identical, and eventually one of them will respond fractionally ahead of the other, tipping the circuit into the state shown either in the second panel or the fourth panel in Figure 11-4. But which chip will win? There is no way of knowing. This is known as a *race condition*, and the winner is unpredictable.

A similar but opposite situation occurs in the NOR-based flip-flop if it is powered up with the switch in the disconnected position, and the S and R outputs are both low, because of the pulldown resistors. Here again it will be a race condition.

We can address the problem by making a rule that the switch must always be in one position or the other when the flip-flop is powered up. But what if there is a faulty switch? Or what if a power interruption occurs while the switch is changing position?

Another problem occurs if the switch makes one contact a fraction before it breaks the other contact. This would result in both S and R inputs being low, in a NAND flip-flop. The same state could occur if a separate logic circuit is driving the S and R inputs, and an error causes it to make S and R both low. This is shown in Figure 11-8. Because the output from a NAND gate is always high if at least one of its inputs is low, both gates now have a high output, and the circuit is stable.

The problem is, the states of the outputs from a flip-flop should always be opposite to each other. If both of them are high, this can create logic problems in the rest of the circuit attached to the flip-flop.

- In a NAND-based SR flip-flop, if S and R are both low, this is known as a *forbidden state* or a *restricted combination*.

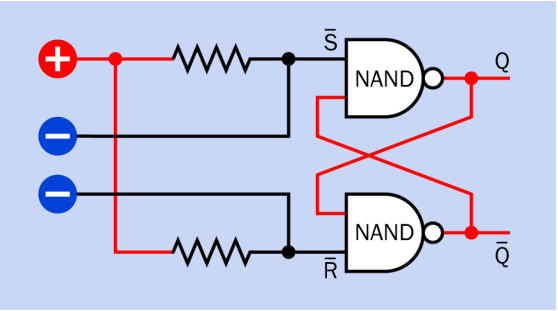

Figure 11-8. *What happens when both S and R inputs to a NAND flip-flop are low as a result of an error in a separate control circuit.*

A similar problem afflicts a NOR-based SR flip-flop, except that the forbidden state will occur when the S and R inputs are both high.

- In a NOR-based SR flip-flop, if S and R are both high, this is a *forbidden state* or a *restricted combination*.

The SR flip-flop is useful as a switch debouncer, but for computing applications, it is vulnerable to errors.

The JK Flip-Flop

Because the name of the JK flip-flop shares the initials of Jack Kilby, who won a Nobel prize for his fabrication of the world's first integrated circuit, some people speculate that this type of flip-flop was named after him. The attribution seems implausible, and may have gained currency simply because a flip-flop was the first device that Kilby happened to build when he was developing an integrated circuit.

Regardless of how it came to be named, the JK design is shown in Figure 11-9. This is commonly referred to as a JK *latch*. The electromechanical switches that were shown driving the SR flip-flop, along with pullup or pulldown resistors, are no longer included, because the inputs at positions J and K are assumed to come from other devices that have properly defined high and low states. Their behavior may be unpredictable, but neither of them will ever have a floating state.

This is a *gated* circuit, meaning that an additional input stage blocks direct access to the output stage, and it is also a *synchronous* circuit, as it uses a train of pulses at a clock input. Two three-input NAND gates are placed in front of a NAND-based SR flip-flop, and they address the problem of simultaneous identical inputs by using crossover feedback from the second stage to the first stage (via the conductors at top and bottom of the schematic).

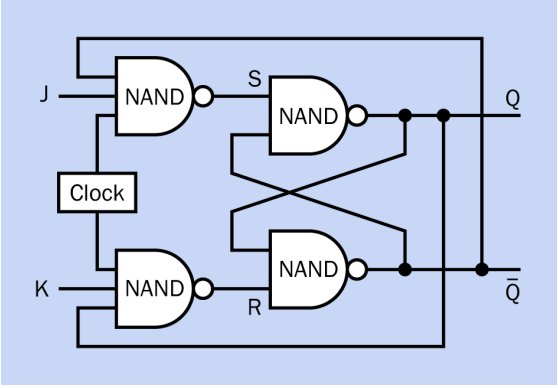

Figure 11-9. *The basic circuit for a clocked JK flip-flop, using two additional NAND gates prepended to an SR flip-flop.*

Versions of a JK flip-flop are possible using NOR gates, but are less common. Only the NAND-based version will be considered here.

In the case of a three-input NAND gate:

- All three inputs high: Output low.
- Other input combinations: Output high.

Because of the additional pair of NANDs, the circuit now recognizes a high input as logically active, instead of the low-active input in the previous SR flip-flop using NAND gates. Consequently, two simultaneous high inputs might be expected to create the type of forbidden state that was caused by two simultaneous low inputs previously. However, in Figure 11-10, the top and bottom panels show that simultaneous high inputs at J and K will support two possible valid outputs, where the state at Q is always opposite to the state at NOT-Q. In fact, when both inputs are high, a positive pulse on the clock input will *toggle* the outputs (i.e., they will switch places). In fact, the toggling will continue so long as the clock input is high. Consequently, this type of flip-flop is intended for use with short clock pulses.

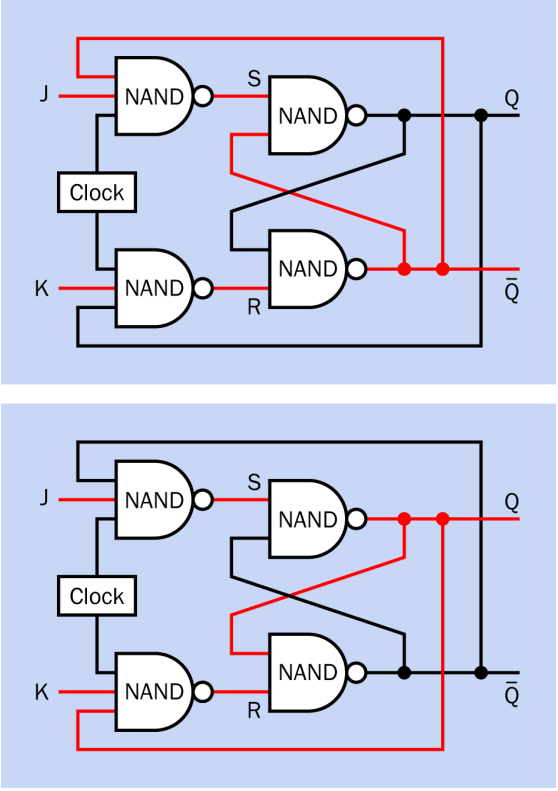

Figure 11-10. *When the J input and the K input are both high, this no longer causes a forbidden state. The combination will toggle the outputs of the flip-flop between the two states shown here.*

Master-Slave Flip-Flop

A more stable form is shown in Figure 11-11 where yet another stage has been added, this one being a "master" to the first. In fact, this configuration is known as a *master-slave* flip-flop, the slave stage being driven by the master stage but remaining inactive until a low clock input at the master stage passes through an *inverter* to become a high clock input at the slave stage. The master and slave stages thus take turns, one be-

ing activated by a high clock pulse while the other is activated by the low part of the pulse cycle. The output from the slave stage cannot feed back to the master stage while the clock pulse is still high, and thus the timing issue in the single-stage JK latch is eliminated. Because the master-slave version of the JK configuration is not *transparent*, it is correctly known as a flip-flop rather than a latch.

In addition, Preset and Clear inputs may be added to override the clock to Set or Reset the outputs. These inputs are active-low.

Figure 11-12 summarizes the behavior of a JK master-slave flip-flop that is triggered by the falling edge of each clock pulse (shown as a downward-pointing arrow in the Clock column of the table). Note that the output will be delayed while the slave stage waits for the second part of each clock cycle.

The letter X in the table indicates that the state in that cell is irrelevant.

When J and K are both low, the states of Q and NOT-Q will remain the same as in the previous cycle, and this is still referred to as a *Hold* state. When J and K are both high, the outputs toggle, meaning that their new states will be opposite to the previous states.

D-Type Flip-Flops

A D-type flip-flop places an inverter between two inputs to guarantee that they will always be in opposite states, and uses a clock signal to copy their states to a pair of logic gates.

When an inverter is added between the inputs in this way, either an SR flip-flop or a JK flip-flop can become a D-type flip-flop. Figure 11-13 shows the simplest possible D-type circuit, added to a basic SR flip-flop. Only one data input is now required (customarily labeled D), because it drives the other through the inverter.

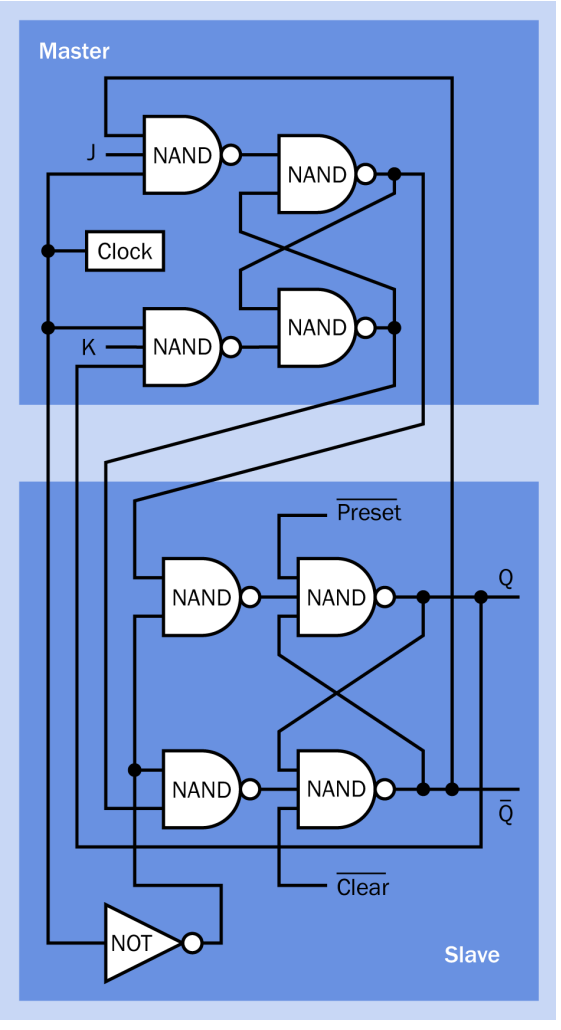

Figure 11-11. *A master-slave circuit that drives one flip-flop with another.*

Flip-Flop Inputs					Outputs	
Clock	Preset	Clear	J	K	Q	Q̄
X	●	●	X	X	●	●
X	●	●	X	X	●	●
↓	●	●	●	●	Same as Prev	
↓	●	●	●	●	●	●
↓	●	●	●	●	●	●
↓	●	●	●	●	Toggle	

Figure 11-12. *A table showing inputs and outputs for a JK master-slave flip-flop.*

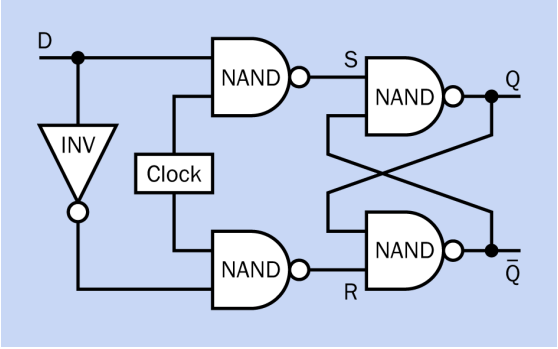

Figure 11-13. *A simple D-type flip-flop. The inverter guarantees that the state of one input will always be opposite to the state of the other.*

Figure 11-14 uses snapshots to show how the circuit responds to changing input and clock conditions. Initially, in the top panel, the data input is high, the clock input is high, and the Q output is high. In the second panel, the clock goes low, causing the output from the upper NAND gate in the input stage to change from low to high. But the upper NAND gate in the output stage still has one low input, so its state remains unchanged. In fact, the S and R inputs of the output NANDs are now both high, which creates the hold condition.

In the third panel, the D input changes from high to low, but this has no effect so long as the clock is low. The D input can fluctuate repeatedly, and nothing will happen until the clock goes high, as shown in the fourth panel. Now the clock copies the new D input state through to the output.

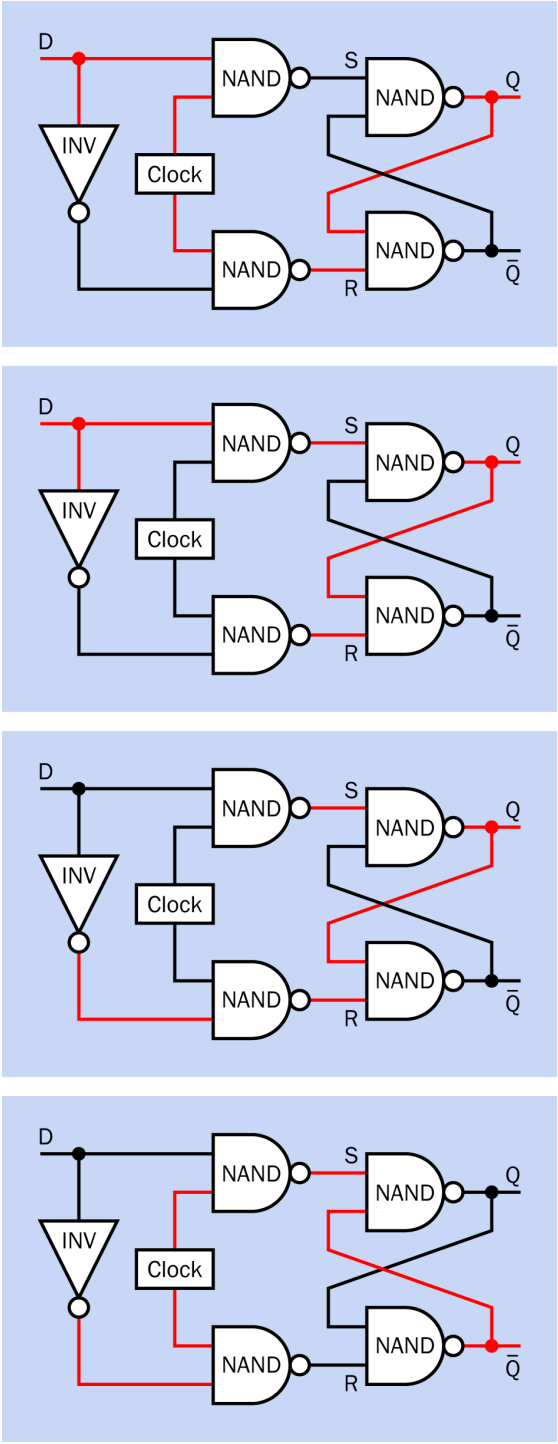

Figure 11-14. *Four snapshots showing the behavior of a D-type flip-flop.*

Summary

- An SR flip-flop can be used for switch debouncing, but in other applications it can enter an unacceptable race condition if its inputs and power supply are not carefully controlled.
- A JK flip-flop is gated, meaning that an SR circuit is preceded with an input stage and a clock input. This eliminates the race condition, adds the ability to toggle the outputs, but requires a very brief clock input. The circuit is edge-triggered.
- A master-slave flip-flop consists of two flip-flops, one driving the other. They can be JK type or SR type. The first flip-flop is activated by a positive clock state, while the second is activated by the subsequent negative clock state. Timing issues are resolved.
- A D-type flip-flop is gated with an inverter between the inputs, so that they cannot be simultaneously high or low. Consequently, only one input, labeled D, is needed. A high state on the D input causes a Set condition, while a low input causes a Reset condition, but only when the clock copies the status of the inputs through to the outputs. The status of the outputs remains stable (the flip-flop enters a hold condition) after the clock goes low.
- The JK circuit used to be widely used, because of its versatility. The D-type circuit now predominates.
- A T-type (toggling) flip-flop exists but is uncommon, and is not included in this encyclopedia.
- Many flip-flop circuits exist in addition to the ones that have been illustrated here. Only the most commonly cited circuits have been included.

A chip containing two positive-edge triggered D-type flip-flops is shown in Figure 11-15. Each flip-flop in this component has its own data, set, and reset input and complementary outputs.

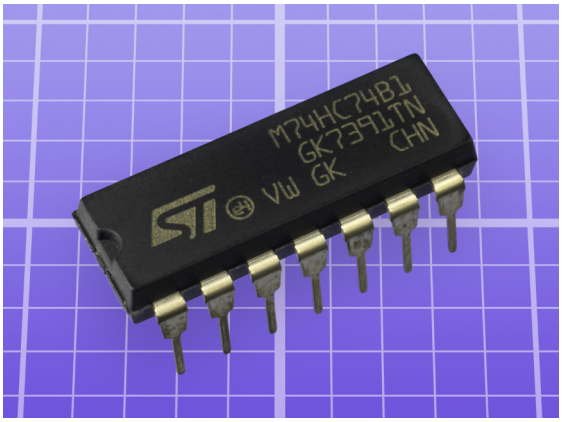

Figure 11-15. *This chip contains two positive-edge triggered D-type flip-flops.*

Variants

A selection of schematic symbols representing flip-flops is shown in Figure 11-16. Letters S, R, J, K, or D define the type of flip-flop. Q and NOT-Q are the outputs. CLK is the clock input but may alternatively be identified with letter E, meaning *Enable*. SRCK or SCLK may also identify it, the abbreviations being intended to mean "serial clock.

A triangle preceding CLK indicates that the flip-flop is positive-edge triggered. A circle, properly termed a *bubble*, preceding the triangle, indicates that the flip-flop is negative-edge triggered. In other locations, the bubble indicates that the input (or output) is inverted; it means the same thing as a bar printed above the text abbreviation, and indicates active-low logic. Synchronous inputs are shown on the left side of the flip-flop with the CLK input, while asynchronous inputs (if any) are shown above and below the flip-flop rectangle.

Using these guidelines, the examples in Figure 11-16 can be decoded:

1. An unclocked SR flip-flop with active-low inputs (probably NAND-based).
2. An unclocked SR flip-flop with active-high inputs (probably NOR-based).

3. An SR flip-flop with active-high inputs, pulse-triggered by an active-high clock input.
4. A JK flip-flop with active-high inputs, edge-triggered by a rising-edge clock input. The bubble on the lower Q output means the same thing as a letter Q with a bar printed above it.
5. A D-type flip-flop pulse-triggered by an active-low clock input.
6. A D-type flip-flop edge-triggered by a falling-edge clock input.
7. A JK flip-flop with active-high inputs, edge-triggered by a rising-edge clock input, with asynchronous active-low Preset and Clear inputs.

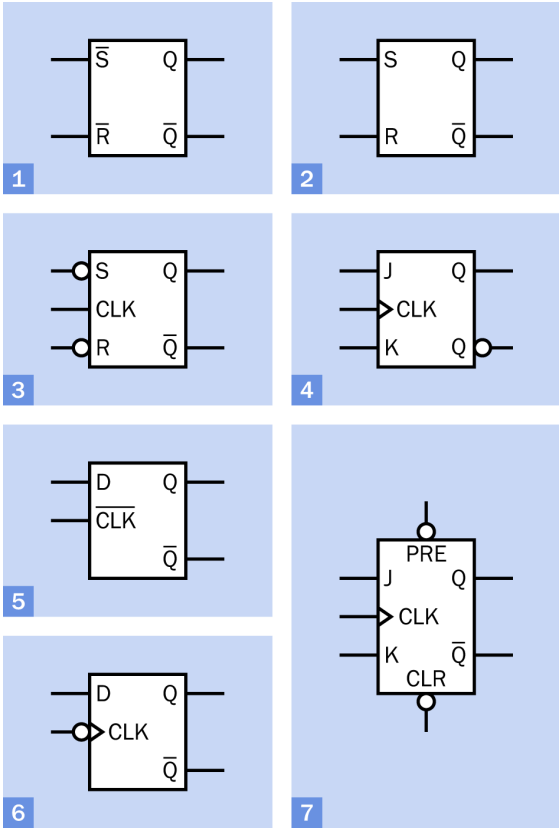

Figure 11-16. *The schematic symbol for a flip-flop is an annotated rectangle. See text for an explanation of the letters and marks.*

Packaging

Only about 10% of the flip-flops listed by a typical parts warehouse are through-hole chips. The rest are now surface-mount. Still, even if the search is narrowed further to through-hole packages in the 74xx and 4000 series, at least 100 types still exist. They provide opportunities in education and prototyping work, even though they are less often used as standalone components.

A package often contains more than one flip-flop. Dual and quad arrays are common. The flip-flops may be independently clocked, or may share a single clock input; datasheets should be checked carefully for details. Octal flip-flops, such as the D-type 74x273, are intended for use as eight-bit registers.

Many of the older flip-flops are numbered in the 74xx series of logic chips. See Chapter 10 for a detailed guide to this numbering system and the various logic families. D-type flip-flops include 74x74, 74x75, 74x174, and 74x175, where an acronym for the logic family is substituted for the x. Old-style CMOS flip-flops include the 4042B D-type latch, the 4043B quad NOR SR flip-flop, and the 4044B quad NAND SR flip-flop. The last two are synchronous, and both allow two Set inputs, labeled S1 and S2 in the datasheet.

Examples of JK flip-flops include the 74x73, 74x76, and 74x109.

Values

As is the case with other logic chips, most flip-flops in the through-hole 74xx series are intended for 5VDC power supply while the older 4000 series may tolerate up to 18VDC. Surface-mount versions may use voltages as low as 2VDC.

See "Variants" on page 93 for a discussion of acceptable high and low logic input voltages. On the output side, the 4000 series chips are able to source less than 1mA at 5VDC, but the 74HCxx series can manage around 20mA.

If a flip-flop is used for high-speed operation, the following values must be considered:

- t_S Setup time: The minimum time in nanoseconds for an input to be constant before the next clock pulse can process it.
- t_H Hold time: The minimum time in nanoseconds for an input to persist after the active edge of a clock pulse that has processed it. The interaction between a clock pulse and an input state takes a brief but measurable amount of time; errors may occur if the clock is given less than that amount of time to do its job.
- t_{CO} Clock-to-output: The elapsed time after an active clock edge, before the output changes. This is a function of the internal workings of the chip, and may be broken down into low-to-high and high-to-low output transitions, as follows.
- T_{PLH} Propagation to Low-to-High: The elapsed time after an active clock edge, before a low-to-high swing occurs at an output. This may not be identical to T_{PHL}.
- T_{PHL} Propagation to High-to-Low: The elapsed time after an active clock edge, before a high-to-low swing occurs at an output. This may not be identical to T_{PLH}.
- f_{MAX} Maximum clock frequency for reliable operation.
- $t_{W(H)}$ The minimum high clock pulse width in nanoseconds.
- $t_{W(L)}$ The minimum low clock pulse width in nanoseconds.

In a shift register or counter, where multiple flip-flops are cascaded but they share the same clock, the t_{CO} of one flip-flop must be shorter than the hold time of the next flip-flop, to allow the input of data to be complete before the window of opportunity is over.

How to Use It

The asynchronous SR flip-flop is of primary use in debouncing switches. Examples are the single MAX6816, dual MAX6817, and octal MAX6818.

D-type flip-flops are widely incorporated in frequency dividers, which are used to count pulses and display a binary output. If the NOT-Q output is wired back to the D input, the pulse stream to the clock input will have the following effect:

1. Suppose the initial D state is low and the initial state of the NOT-Q output is low.
2. The first high clock pulse propagates the low D state into the flip-flop.
3. The next low clock state forces the NOT-Q output high. This feeds back and creates a high D input.
4. The second clock pulse propagates the high D state into the flip-flop.
5. The next low clock state pulls the NOT-Q output low. This feeds back and creates a low D input.

The sequence then repeats. Only one high output is generated at NOT-Q (or at Q) for every two clock pulses; thus the circuit can become a divide-by-two **counter**. If the Q output is tapped to serve as the clock input for another flip-flop, that circuit now has a divide-by-four output. A series of many flip-flops can be chained together, so long as the propagation of signals along the chain is fast enough to occur before the next clock pulse. This is known as an *asynchronous counter*.

For more information on the use of counters, see Chapter 13.

While flip-flops have tended to be integrated with other components in digital computing, they are still used as registers where 8 or 16 bits of serial data must be assembled at a time, prior to being disseminated as parallel data.

What Can Go Wrong

Ambiguous Documentation

For reasons which are unclear, instructional texts and tutorials can be erratic when describing flip-flops:

- A truth table may fail to clarify whether the circuit uses active-high or active-low logic.
- Truth tables from different sources are often inconsistent in their representation of current and future output states, and may even fail to include the clock status in a clocked flip-flop.
- Tutorials may include logic diagrams for some types of circuit, but not others.
- NOR gates may be used, without any mention that NAND gates can also be used (and may be more common or convenient).
- The active-low or active-high status of inputs in an SR flip-flop may not be shown.

Bearing this in mind, manufacturer datasheets should be consulted whenever possible as the primary source of information.

Faulty Triggering

In many cases, a flip-flop designed for edge triggering can give erroneous results if it is level-triggered, and vice versa. Rising-edge-triggered flip-flops must be distinguished from falling-edge-triggered flip-flops. As always, it is important for similar parts that have similar functions to be stored separately.

Metastability

The behavior of flip-flops has been described in this entry under ideal conditions, where they are operating well within parameters established by the manufacturer. In reality, non-ideal scenarios may occur, especially where inputs such as data and clock, or clock and reset, are almost simultaneous. This may be difficult to avoid if a signal is received from an external source such as a sensor, with no way to control its arrival time. If the input occurs within the setup time or the hold time of a clock pulse, the flip-flop may be unable to determine whether the input precedes or follows the clock.

This may lead to *metastability*, meaning an unpredictable output and/or oscillations that take several clock cycles to settle into a stable state. If the output from a flip-flop may be used by two separate components with slightly different response times, one may interpret the oscillating output as a high state while the other interprets it as low. In a computing circuit, metastability can lead to calculation errors or a system crash. To avoid these issues, limits in datasheets should be observed. Attention should be paid to the manufacturer specifications for minimum setup time and hold time, so that the circuit has sufficient opportunity to recognize a signal and respond.

One solution to metastability is to connect multiple flip-flops in series, all sharing a common clock signal. This will tend to filter out irregularities, at the expense of requiring additional clock cycles if the flip-flops are not transparent.

Metastable-hardened flip-flops minimize metastability but cannot eliminate it completely.

Other Issues

Problems that tend to affect digital chips generally are listed in the section of the entry on logic gates (see "What Can Go Wrong" on page 105).

shift register

12

The term **shift register** is rarely hyphenated. In this encyclopedia, no hyphen is used.

A shift register can function as a *queue*, but this term is more usually applied to software. When the output from the last stage of a shift register is connected back to its input, it can function as a *ring counter*, but that application is described in the **counter** entry of this encyclopedia.

Component catalogs sometimes list shift registers as binary ripple **counters**, instead of giving them their own section. In this encyclopedia, a binary counter is considered to have binary-weighted outputs (with values 1, 2, 4, 8…. in decimal notation) and is described in the **counter** entry. A shift register has outputs that are not necessarily binary-weighted.

OTHER RELATED COMPONENTS

- **flip-flop** (see Chapter 11)
- **counter** (see Chapter 13)
- **multiplexer** (see Chapter 16)

What It Does

A *register* is a component (or a small section of computer memory) that stores information. The smallest unit of information is one *bit* (i.e., one *binary digit*) with a value 1 or 0 that can be represented by a high or low logic state. A **shift register** most commonly is designed to store eight bits, although some store four.

Each bit is memorized by the status of a **flip-flop** inside the register. For a detailed description of flip-flops, see Chapter 11. When a pulse from an external *clock* is received by the shift register, all of the bits in storage are moved along one step, from each flip-flop to the next. The high or low status of an input pin at that moment is *clocked in* to the first flip-flop, while the bit in the last flip-flop is overwritten by the bit preceding it. A diagram representing the function of a basic four-bit shift register is shown in Figure 12-1. Note that the status of the input pin is ignored until the moment when a clock pulse copies it into the first flip-flop. In the figure, when the input pin has a brief high state that ends immediately before clock pulse three, the high state is ignored.

A shift-register chip is shown in Figure 12-2.

Because the functionality of a shift register is now often incorporated in much larger logic chips, it is less widely used as a stand-alone component than it used to be. It is still useful for purposes of serial-parallel or parallel-serial conversion, and for small tasks such as scanning a matrix-encoded keyboard or keypad. It also has educational applications and can be used in conjunction with a microcontroller.

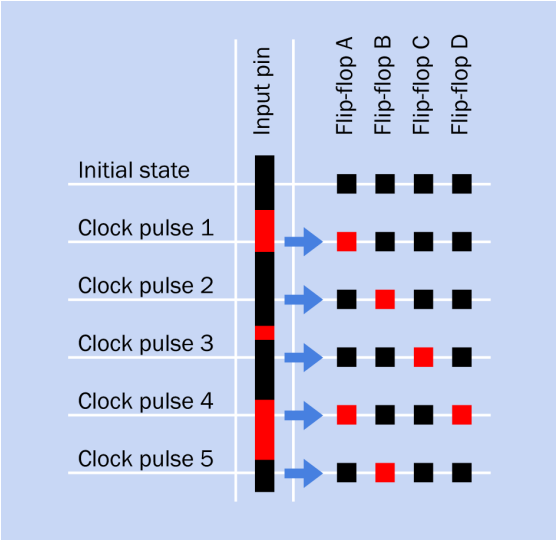

Figure 12-1. *The function of a four-bit shift register in which each flip-flop may be set to a high or a low state, represented here with red or black squares. After a high bit is clocked into the chip, it is moved one space along by each subsequent clock pulse.*

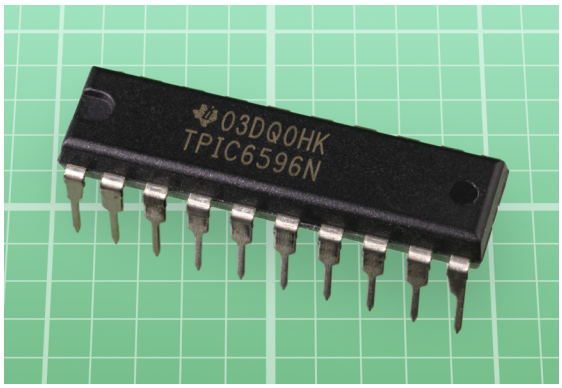

Figure 12-2. *This 8-bit shift-register chip is unusual in that it uses "power logic," in which open-drain outputs enable it to drive relatively high-current devices. It can sink up to 250mA at each of its output pins, at up to 45VDC.*

Schematic Representation

No specific symbol exists for a shift register. It is represented in a schematic by a simple rectangle, often (but not always) with control inputs on the left, data inputs arrayed along the upper edge, and data outputs along the lower edge. An example is shown in Figure 12-3, along with a diagram showing the physical chip and its pinouts. The meaning of the abbreviations identifying the inputs, outputs, and control functions will be described in "How It Works" on page 122.

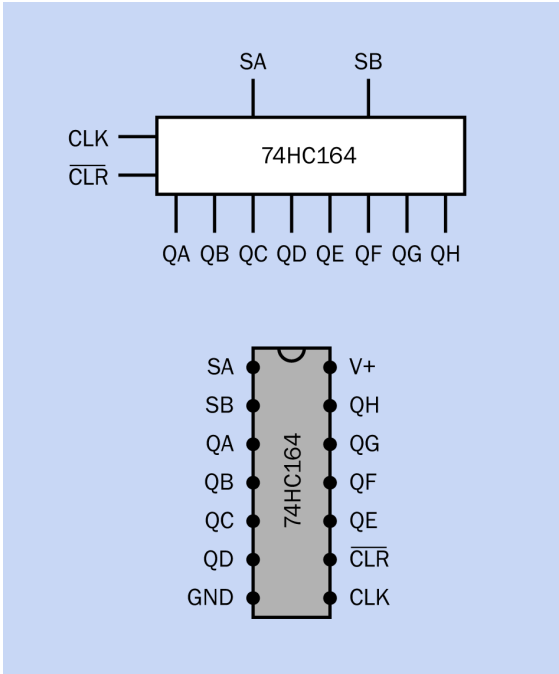

Figure 12-3. *Typical schematic representation of a shift register, compared with the pinouts of the actual component.*

The schematic symbol representing a shift register may appear superficially similar to the physical form of the chip which contains it, but the physical layout of the pins is unlikely to be the same.

How It Works

A shift register generally consists of a chain of D-type flip-flops. See the entry describing **flip-flops** in Chapter 11 for a detailed explanation of this component.

The simplest shift register functions as a *serial-in, serial-out* device, abbreviated with the acronym *SISO*. Because the first bit that enters it will be the first to leave at the opposite end, it can also be

described as a *first-in, first-out* data storage device, using the acronym *FIFO*.

The basic connections between flip-flops in a four-bit SISO shift-register are shown in Figure 12-4. The D input in each section refers to the fact that it is a D-type flip-flop. The primary output from each flip-flop is identified with letter Q.

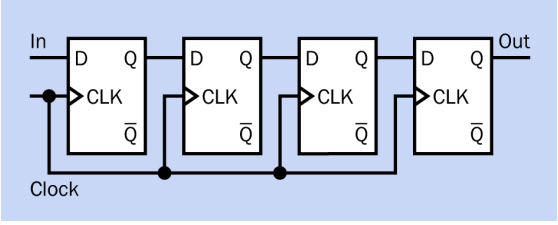

Figure 12-4. *The simplest shift register is a serial-in, serial-out (SISO) device. This example contains four D-type flip-flops.*

Each clock input is labeled CLK. When the output of each flip-flop is coupled to the input of the next flip-flop, and both share the same clock signal, the clock signal will cause the state of the third flip-flop to be sent to the fourth, the output of the second to be copied to the third, the output of the first to the second, and the input state will be copied to the first.

Abbreviations and Acronyms

The shift register will usually have an additional input that forces an immediate "clear" of all the registers, regardless of the clock state at that moment. This input is usually labeled CLR and will have a bar printed above it if it is active-low (which is the usual convention). If there is a pin labeled MR (meaning "Master Reset"), it will have the same function as CLR.

Because its effect is independent of the clock state, the clear signal is described as an *asynchronous* input.

While the abbreviation CLK is frequently used to identify the clock input, SCLK is also used (meaning "serial clock"), and occasionally the abbreviation CP may be found, meaning "clock pulse" input. If the shift register contains two stages, one to clock data in and the second to clock data out, they may be separately clocked, in which case they will be identified with different abbreviations. These are not standardized, but should be explained in the manufacturer's datasheet. No matter which abbreviation is used for a clock input, it will have a bar printed above it if the input is active-low.

Shift registers are generally *edge triggered*, meaning that the rising or falling edge of a clock pulse triggers the bit-shifting operation. If the component responds to a clock transition from low to high, it is *rising-edge triggered*. If it responds to a transition from high to low, it is *falling-edge triggered*, and this may be indicated in the schematic by a small circle, properly known as a *bubble*, preceding the triangle which indicates that this is an edge-triggered device.

Most shift registers are positive-edge triggered.

Parallel Outputs and Inputs

In many shift registers, data may be read out in parallel (from all flip-flops simultaneously), using pins provided for this purpose. In this mode, the shift register can function as a *serial-parallel converter* (*serial in, parallel out*, represented by the acronym *SIPO*). A simplified schematic of the internal connections is shown in Figure 12-5.

Where parallel outputs are provided, they are often identified as QA, QB, QC, and so on (moving from left to right) but may alternatively be described as Q1, Q2, Q3, Q4, and so on.

In a schematic, the input pin is conventionally shown as being at the left end of the component. Often two inputs are provided, connected internally as inputs to a NAND gate. The inputs are likely to be labeled A and B, but may alternatively be named SA and SB, indicating that they are serial inputs. S1 and S2 are alternative classifications. If parallel inputs exist, they may be identified as PA, PB, PC, and so on.

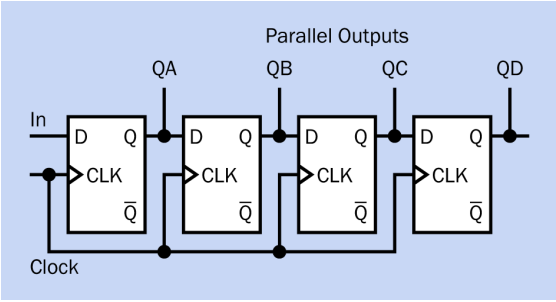

Figure 12-5. *Many shift registers have pins connected to points along the chain of flip-flops. These connections enable data to be read from the shift register in parallel.*

If serial data is supplied asynchronously, as in the illustration in Figure 12-1, it will be ignored until the shift register is triggered by the next clock pulse. The input state at that moment will then be copied into the first flip-flop, while the data that is already being stored in the shift register will be moved along the chain. In datasheets, this is customarily represented by a diagram such as the one in Figure 12-6. This diagram assumes that the shift-register is rising-edge triggered. Note that a brief fluctuation in the input which does not coincide with a clock-trigger event will be ignored.

Variants

Serial In, Serial Out

A basic SISO shift register allows only for serial input (at one end of the chain of flip-flops) and serial output (at the other end of the chain). No pins are available for parallel output of data.

This type of component usually permits 64-bit storage, where parallel output is simply impractical, as too many pins would be required. An example is the 4031B chip. This includes provision for recirculation of bits, so that it will also function as a ring counter (see Chapter 13 for a discussion of this function). As is always the case with logic chips, the part number will be preceded by letter(s) identifying the manufacturer, and a suffix will distinguish variants of the chip.

Another type of SISO shift register is programmable. It will store any number of bits from 1 through 64, determined by a binary number applied in the form of high/low states to five pins reserved for this purpose. An example is the 4557B.

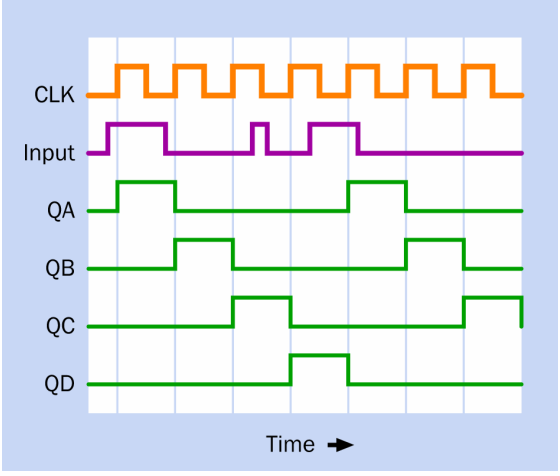

Figure 12-6. *In a rising-edge-triggered shift register, the high or low state of an asynchronous input (purple line) is copied into the first flip-flop of a shift register by each clock pulse (orange line). Brief fluctuations that do not coincide with a rising clock pulse are ignored. Existing data in the register is shifted from one flip-flop to the next.*

Serial In, Parallel Out

The majority of serial-input shift registers allow parallel output from points along the chain in addition to serial output at the end of the chain. These chips almost all are 8-bit registers. Typically two inputs are provided, one of which can be used to receive bits that recirculate from the end of the chain, back to the beginning. Widely used examples are the 4094B and the 74x164, where an acronym identifying the logic family will be substituted for the x.

Parallel In, Serial Out

A minority of shift registers are able to function as *parallel-serial converters* (*parallel in, serial out*, represented by the acronym *PISO*). Typically this type of chip allows *jam-type* parallel data input, meaning that the data is forced into the flip-flops

via a separate pin for each of them. Parallel input is enabled by the status of a serial/parallel control pin. When the control pin reverts to its opposite status, each clock pulse will now shift data along the chain of flip-flops, allowing it to be read from the final output one bit at a time. Thus, data can be entered into the chip in parallel and read out of it serially. Examples are the 4014B and 4021B. Both are 8-bit.

Parallel In, Parallel Out

Shift registers that permit parallel output in addition to parallel input are almost all of the *universal* type, described in the next section.

Universal

A *universal* shift register is capable of all four modes of operation: SISO, SIPO, PISO, and PIPO. The four modes of the component are selected by the high or low status of two *mode select* pins. In addition, this component may have the ability to shift the register states either left or right. A *bidirectional* shift register has this same capability, and may also have PISO and PIPO capability, depending on the chip. Examples are the 74x195 and 74x299, where an acronym identifying the logic family will be substituted for the x in the number.

Universal shift registers are almost all 4-bit or 8-bit. They often have relatively complicated features, such as access to internal JK flip-flops, or pins that are multiplexed to provide different functionality depending whether an enable pin is held high or low. Datasheets must be checked carefully to ensure correct use.

Dedicated shift registers of SIPO or PISO type will be easier to use.

Values

As is the case with other logic chips, most flip-flops in the through-hole 74xx series are intended for 5VDC power supply while the older 4000 series may tolerate up to 18VDC. Surface-mount versions may use voltages as low as 2VDC.

See the section on logic gates in Chapter 10 for a discussion of acceptable high and low logic-input states. On the output side, the 4000 series chips are able to source less than 1mA at 5VDC, but the 74HCxx series can usually manage around 20mA.

If a shift register is used for high-speed operation, the following values must be considered (identical notation, and similar values, are found in specifications for flip-flops):

- t_S Setup time: The input state of a shift register must exist for a very brief period before the clock trigger that processes it. This period is known as the *setup time*. In the 4000 series of chips, recommended setup may be as long as 120ns. The value will be much lower in 74xx chips.
- t_H Hold time: The minimum time in nanoseconds for an input to persist after the active edge of a clock pulse that has processed it. In many shift registers, no hold time is necessary, as the chip has already been activated by the rising edge of the clock pulse.
- t_{CO} Clock-to-output: The elapsed time after a clock trigger, before the output changes. This is a function of the internal workings of the chip, and may be broken down into low-to-high and high-to-low output transitions, as follows.
- T_{PLH} Propagation to Low-to-High: The elapsed time after an active clock trigger, before a low-to-high swing occurs at an output. This may not be identical to T_{PHL}.
- T_{PHL} Propagation to High-to-Low: The elapsed time after an active clock trigger, before a high-to-low swing occurs at an output. This may not be identical to T_{PLH}.
- f_{MAX} Maximum clock frequency for reliable operation. In the older design of 4000 series chips, 3MHz may be recommended with a power supply of 5VDC. Higher frequencies are possible with a higher voltage power

supply. Frequencies as high as 20MHz are possible in the 5VDC 74HC00 series.

- $t_{W(H)}$ The minimum high clock pulse width in nanoseconds. In the older design of 4000 series chips, 180ns may be recommended with a power supply of 5VDC. Shorter pulses are possible with higher voltage power supply. Pulses as short as 20ns are possible in the 5VDC 74HC00 series.
- $t_{W(L)}$ The minimum low clock pulse width in nanoseconds. This is likely to be the same as $t_{W(H)}$.

Power Considerations

Shift registers conform with the usual power-supply requirements for logic families. These are described in detail in the **logic gate** entry in Chapter 10. Likewise, the ability of a shift register to source or sink current is usually determined by its logic family. In a few cases, however, shift registers have an additional *open-drain* output stage for each register, capable of sinking currents as high as 250mA. The Texas Instruments TPIC6596 shown in Figure 12-2 is an example. When an open-drain output is connected with a logic device whose input cannot be allowed to float indeterminately, a *pullup resistor* must be added.

Three-State Output

A chip may have a *three-state output* (also known as *tri-state output*, a term which was trademarked but is now used generically). This means it will be capable of changing its outputs so that instead of sourcing or sinking current in a logical high or low state, they can have a high impedance. The chip then becomes "invisible" to others which may be sharing the same output bus. The high-impedance state is usually applied to all outputs from the shift register simultaneously when enabled by a separate pin, often identified as *OE*, meaning *output-enable*. Examples of three-state shift registers are the 74x595 or the 4094B chip.

The high-impedance state can be thought of as being almost equivalent to switching the outputs of the shift register out of the circuit. Consequently, if other components sharing the bus are also in high-impedance output mode, the state of the bus will "float," with uncertain results. To avoid this, a pullup resistor of 10K to 100K can be used on each bus-line.

Where the internal components of a shift register are shown in a datasheet, a three-state output is usually represented with a buffer symbol or inverter symbol that has an additional control input located on its upper edge, as shown in Figure 12-7. This should not be confused with the similar placement of a positive power supply input to an amplifier or op-amp. (Schematics showing the interior elements of a logic chip almost never include power-supply connections.)

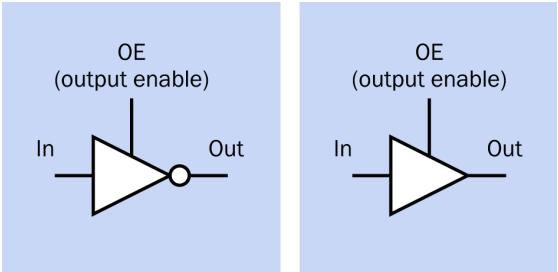

Figure 12-7. *A shift register may be capable of a three-state output, where high impedance is an option additional to the usual high or low logic state. An output enable pin allows this. It is typically shown as an additional input to an inverter (left) or buffer (right) inside the shift-register chip.*

How to Use It

The SISO application of a shift register can be used simply to delay the transmission of data by storing it and moving it from one flip-flop to the next before it is read out of the end of the chain.

The SIPO application of a shift register (serial in, parallel out) may be useful where a microcontroller has insufficient outputs to control multiple devices. Serial data can be sent from a single microcontroller output to the input of a shift register. The chip can then drive a separate device from each of its parallel output pins. If there are eight devices, the microcontroller can send a se-

quence of eight bits, each of which will control the on/off status of one device when the bits are read out of the shift register in parallel. If more devices are used, an additional shift-register can be daisy-chained to the output from the first.

Clock signals can be supplied from the microcontroller, along with a signal to the clear input of the shift register, if desired. Alternatively, the old bit states in the shift register can simply be "clocked out" and replaced with a new set of serial data. During the process of "bit banging," the parallel outputs of the shift register can remain connected directly with the output devices if the clock speed from the microcontroller is fast enough, as devices such as relays will not respond to extremely brief pulses.

For generic shift registers that do not have open-drain outputs, a buffer will be needed to provide sufficient current for any device using more current than an LED.

If a shift register is configured for PISO mode (parallel in, serial out) it can be placed on the input side of a microcontroller, polling a variety of devices and feeding their states into the microcontroller serially.

Dual Inputs

Where a shift register has two serial inputs (as is often the case), they are almost always linked as inputs to an internal NAND gate. This allows the output from the end of the chain of flip-flops to be connected back to the beginning of the chain, if the shift register is to function as a ring counter. However, if this function is not used and a single input is required, the two inputs to the shift register can be tied together. In this configuration, the input becomes active-low. The two possible configurations are shown in Figure 12-8. It is important never to leave an input *floating*, or unconnected.

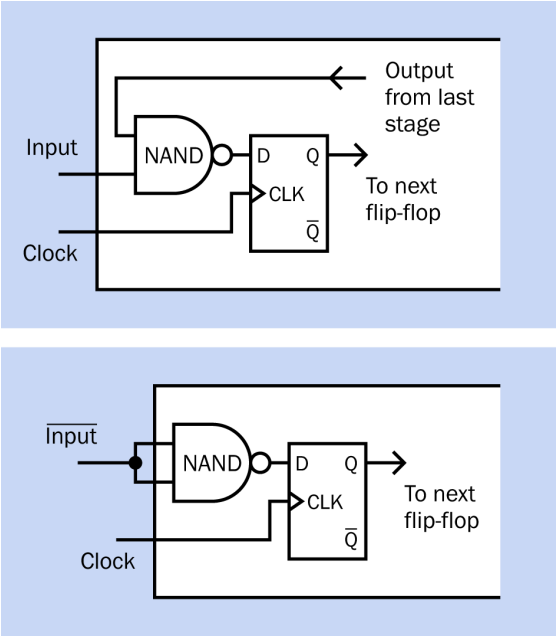

Figure 12-8. *Two possible configurations where a shift register allows two inputs linked with an internal NAND gate.*

Preloading the Shift Register

Where a shift register will be used to output a single recirculating bit (or in similar applications), the component must be preloaded with a high state in its first register. This may require a one-shot (monostable) timer which is activated only when the circuit is powered up.

Polling a Keyboard

Two shift registers can be used to scan the data lines in a matrix-encoded keyboard or keypad. This is often known as *polling* the keyboard. Provided the scan rate is sufficiently fast, the user experiences a seemingly immediate response to a key-press.

While the full schematic is too large and complex to be included here, many examples can be found online.

Arithmetical Operations

Shift registers were traditionally used to perform arithmetical operations on binary numbers. If the

number is represented by eight bits (i.e., one byte) with the most significant digit on the left, shifting the bits one space to the right will have the effect of dividing the byte value by 2. If the bits are shifted one space to the left, the byte value will be multiplied by 2 (provided an additional register is available to store the most significant bit after it has been shifted). This concept is illustrated in Figure 12-9.

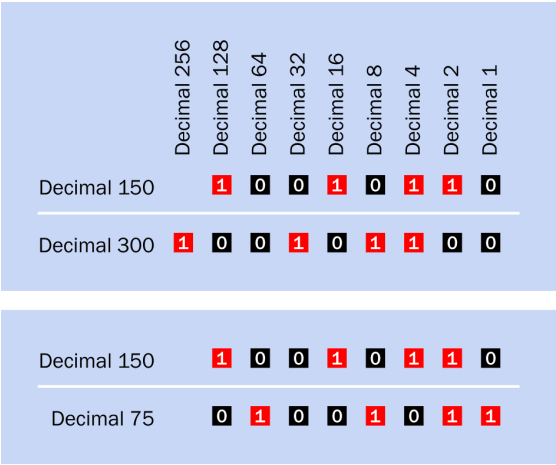

Figure 12-9. *In the upper section of this diagram, a binary number represented by eight bits in a shift register is multiplied by 2 by shifting all the bits one space to the left. In the lower section, the same binary number is divided by 2 by shifting all the bits one space to the right. The binary values are shown in decimal notation to the left.*

In the upper section of the figure, the binary number 10010110 (chosen arbitrarily) is represented in the eight flip-flops of a shift register. The decimal place value of each digit is indicated. Adding up the place values of the 1s in the number, the total is 128 + 16 + 4 + 2 = 150. Below the white line, the digits have been shifted one place to the left, with the leftmost digit carried over to an additional location, while a zero is inserted in the rightmost location. Assuming that the additional place at the leftmost location has a place value of 256, the total is now 256 + 32 + 8 + 4 = 300.

In the lower section of the figure, the same binary number has been shifted one space to the right, with a 0 introduced in the leftmost location. The decimal value is now 64 + 8 + 2 + 1 = 75.

While this application for shift registers was common during development of digital computing in the 1960s and 1970s, the shift register as a separate component became less common subsequently, as its functionality was acquired by modern CPU chips.

Buffering

A shift register may also be used as a *buffer* between two circuits where the clock speeds are different. Digits are clocked in by the first circuit, then clocked out by the second. Some shift registers allow two clock inputs and can be used for this purpose.

What Can Go Wrong

Problems that tend to affect digital chips generally are listed in the entry on logic gates (see "What Can Go Wrong" on page 105).

Confusing Classification

Because of the functional similarity to a binary ripple **counter**, a shift register is sometimes listed by component suppliers as a counter. In fact, a binary counter will almost always have outputs that have place values 1, 2, 4, 8…. and upward, while the outputs from a shift register will not have place values.

When searching for a shift register, it can be found by specifying a "counting sequence" of serial to parallel, serial to serial, parallel to serial, or parallel to parallel. If the "counting sequence" is simply up or down, the component is a counter, not a shift register.

Inadequate Setup Time

Each flip-flop in a shift register must have a stable input state before the next triggering event shifts the data. If this setup time is reduced below the minimum specified in the datasheet, results will be unpredictable.

Unconnected Input

Because many shift registers have a choice of two inputs to the same chain of internal flip-flops, it is easy to leave one of them unconnected by accident. A floating input will be vulnerable to any stray electromagnetic fields, and is almost certain to create random effects.

Output Enable Issues

The output enable pin on a shift register that has three-state logic outputs is usually active-low. Consequently, if the pin is left unconnected, the logic outputs may go into high-impedance mode, or will fluctuate unpredictably. Where three-state outputs are not required, a safe course of action will be to avoid using three-state chips.

Floating Output Bus

If a pullup resistor is omitted from a bus that is shared by three-state chips, the results will be unpredictable. Even if the circuit design seems to guarantee that at least one chip will have a high or low output on the bus, a pullup resistor should still be included.

counter

13

The term **counter** is used here to mean a digital-logic chip. A counter could be built from discrete transistors, but this approach is obsolete. Counters may also be devised from parts such as multiple relays, or a solenoid advancing a ratchet wheel, but such electromechanical devices are not included in this encyclopedia.

In this encyclopedia, a counter by definition has binary-weighted outputs with values 1, 2, 4, 8…. in decimal notation. The exception to this rule is a *ring counter*, which does not have binary-weighted outputs but is included here because its name identifies it as a counter. A **shift register** may be used as a ring counter, but is more versatile and has many other functions; hence it has a separate entry.

Gray code counters, in which successive outputs differ by only one binary digit, are not described in this encyclopedia.

OTHER RELATED COMPONENTS

- **flip-flop** (see Chapter 11)
- **shift register** (see Chapter 12)

What It Does

A counter can be used to count events, or can measure time in convenient intervals if it is connected with a component such as a *quartz crystal* that operates at a precise and reliable frequency. The counter receives input pulses (usually referred to as a *clock input*) and counts a predetermined number of them before restarting from the beginning. It will repeat in this fashion so long as power is connected, and the clock pulses continue, and a reset signal is not supplied.

Almost all counters create some form of output during the count. Most commonly, the output is a pattern of high and low states expressing the number of clock pulses in binary code. Where a counter counts to a very high number before recycling, some intermediate binary digits may be omitted.

While standalone counter chips are not as widely used now as in the early days of computing, they still find application in industrial processes, small devices, and education, and can be used to control incremental devices such as stepper motors. They can be used in conjunction with microcontrollers.

Schematic Representation

No specific logic symbol exists for a counter. It is most often shown in a schematic as a rectangle with clock input(s) and clear input(s) on the left and outputs on the right. An example appears in Figure 13-1, above a representation of the physical chip and its pinouts. The meaning of the abbreviations identifying the inputs, outputs, and control functions will be found in "How It Works" on page 132. Because the two MR inputs for this particular counter are ANDed inside the chip,

the AND symbol is included with the counter symbol.

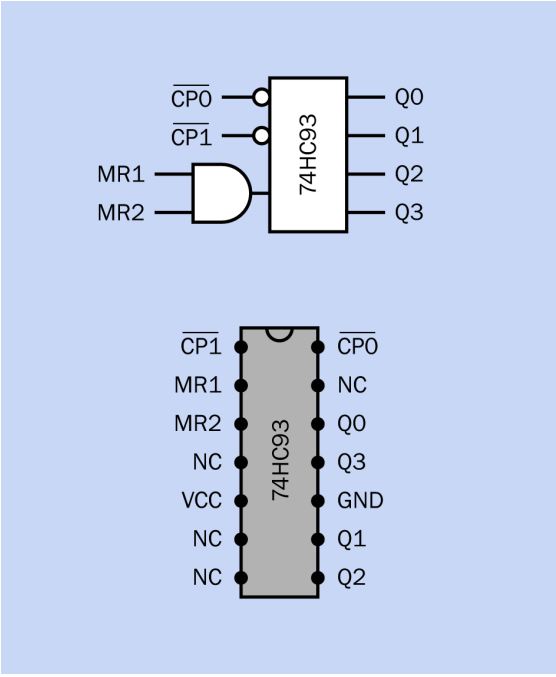

Figure 13-1. *Typical schematic representation of a counter, compared with the pinouts of the actual component.*

A counter chip is shown in Figure 13-2.

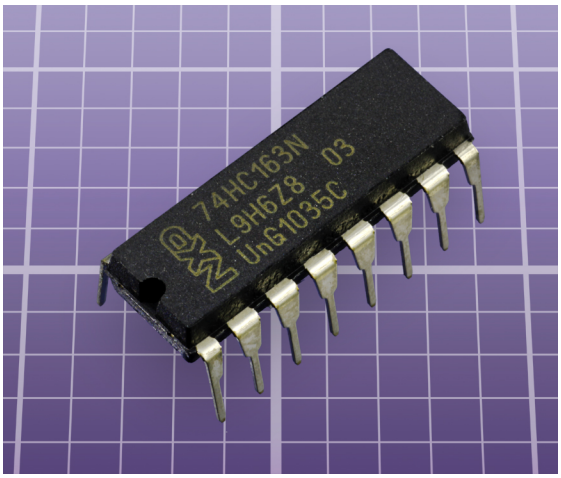

Figure 13-2. *The 74HC163 shown in this photograph is a 4-bit synchronous counter capable of being preloaded with a starting value, and able to do a synchronous reset.*

How It Works

A counter is built from a chain of **flip-flops**, with each one triggering the next. JK, T-type, or D-type flip-flops may be used. For a thorough description of a flip-flop, see Chapter 11. In Figure 13-3, a D-type flip-flop is shown, triggered by each rising clock pulse.

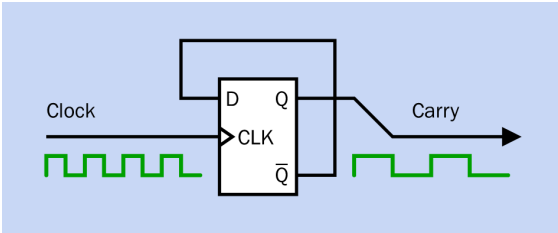

Figure 13-3. *When the complementary (NOT-Q) output from a D-type flip-flop is connected back to its input, the Q output frequency is half of the clock input frequency. See text for additional details.*

Initially the Q output of the flip-flop is low, so its NOT-Q output (identified by Q with a bar above it) is high. This feeds back to the D input, but has no effect until the rising edge of the next clock pulse copies the high D input to the Q output. The Q output is now latched high while the NOT-Q output is latched low and feeds back to the D input. The triggering event has passed, so the low D input does not have any immediate effect. The rising edge of the next clock pulse copies the low state of the D input to the output, and changes the NOT-Q output to high, causing the cycle to repeat. As a result, the output frequency of the flip-flop is one-half of the input frequency from the clock. If the output is carried to the next flip-flop to become its clock input, once again the frequency will be divided by two.

Modulus and Modulo

The *modulus* of a counter is the number it will count up to, before it repeats. This is sometimes written incorrectly as *modulo*.

In fact, *modulo* is the name of an arithmetical operation, often abbreviated as *MOD* (usually capitalized, even though it is not an acronym). This

operation consists of a division sum in which the *remainder* from the division is the result of the operation. Thus 100 modulo 5 gives a result of 0, because there is no remainder when 100 is divided by 5. But 100 modulo 7 gives a result of 2, because 2 is the remainder of the division operation.

To exacerbate the confusion, *MOD* is also used as an adjective referring to the modulus of a counter. Thus a MOD-4 counter has a modulus of 4, and a MOD-16 counter has a modulus of 16. As a general rule, when a counter is being described, *modulo* and *MOD* will mean the same thing as *modulus*. This may be confusing to people such as computer programmers who are already familiar with the correct usage of MOD as an arithmetical operator.

In a counter, to obtain a modulus that is not a power of two, logic gates inside the chip can intercept a particular value (such as 1010 binary, which is 10 decimal) and use this as a signal to restart the count at zero. External connections to the chip can achieve the same purpose.

Pin Identifiers

Abbreviations and acronyms are used in datasheets to identify pin functions. These identifiers have not been standardized, and many variants exist.

CLK is the abbreviation most commonly used for the clock input, sometimes alternatively shown as CK or CP. If it is active-low, or if its falling edge will be active, a bar will be printed above it. Where a printed font does not permit an underscore to be placed in this way, CLK' (the abbreviation followed by an apostrophe) may be used instead. Often two or more stages of a counter can be separately clocked, and the input pins will be identified with abbreviations such as CLK1 and CLK2, or 1CLK and 2CLK, or CKA and CKB, or CP1 and CP2, or similar.

Where a clock input is edge-triggered, this is indicated by a small triangle. The triangle can be seen in Figure 13-3.

CLR designates a pin which will clear the count and reset it back to zero. This signal is often active-low, indicated by a bar printed above the abbreviation.

In a schematic, a small circle, properly known as a *bubble*, may be placed at any input which is active-low. On a clock input, the circle indicates that it is falling-edge triggered. See Figure 11-16 for various implementations of symbols with flip-flop schematics.

The CLR operation may be *synchronous* (the pin state will not be recognized until the next clock pulse) or *asynchronous* (in which case the pin state overrides the clock and resets the counter immediately). MR stands for "Master Reset," and has the same function as CLR.

Where two or more counters (or multiple stages within one counter) can be reset separately, more than one clear input will be shown, and may be identified with abbreviations such as CLR1 and CLR2, or MR1 and MR2.

Output pins will almost always be identified as Q0, Q1, Q2 … or QA, QB, QC … up to the maximum necessary to express the modulus. If two or more counters are included in one chip, outputs may be prefixed with an appropriate number. Thus 2Q3 would be the third output in the second counter. Multiple counters in one chip are identified with numbers starting from 1.

Where internal flip-flops are shown, they will have identifiers such as FF1 or FF2. Each flip-flop will have its own clear function, identified as C or CD (the latter meaning "clear data"), and may have inputs labeled D1, D2, D3… in a D-type flip-flop or J and K in a JK flip-flop. See Chapter 11 for an explanation of flip-flop inputs and outputs.

The input to a counter is always imagined to begin from the left, and consequently the leftmost flip-flop shown in an internal schematic will express the least significant bit of the current value of the count, even though a binary number is written with the least significant bit in the rightmost place.

If a counter is capable of receiving parallel data as an input (explained below) it will have a pin labeled PE for parallel enable. It may also have a CE or CET pin, for count enable.

As is generally the case in logic chips, VCC or V+ are typically used to identify the positive power supply pin, while GND or V- will identify the negative-ground pin. NC means that a pin has no internal connection at all, and consequently requires no external connection.

Variants

All counter chips use binary code internally, and the number of *bits* (*binary digits*) in the counter's modulus will be the same as the number of internal flip-flops. A 4-bit counter (the usual minimum) will have a modulus of 2^4 which is 16. A 21-bit counter (the maximum typically available) will have a modulus of 2^{21} which is 2,097,152. For higher moduli, counters can be chained together, each sending a carry signal to the next. This is known as a *cascade*.

Multiple counters, with different moduli, may be chained in a single chip. For example, in a digital clock that displays hours and minutes using the 60Hz frequency of an American domestic power supply as its timebase, the initial counting stage will have a modulus of 60, to count individual seconds. The next counting stages will have moduli of 60, 10, and 6, so that they can count from 00 to 59 minutes. Additional stages in the chip will tally hours.

A counter with a *parallel input* can be preloaded with an initial value (in binary code) from which it may count up or down. A *parallel-enable* pin may put the counter into a mode where the number can be *jam loaded*, meaning that it is jammed into the counter regardless of the clock state. Other types of counter are loaded synchronously.

Ripple versus Synchronous

In a *ripple counter* each internal flip-flop triggers the clock input of the next, so that their states change in a rapid but incremental sequence from the input to the output. This is also known as an *asynchronous* counter. Because the final state will not be valid until the clock pulse has rippled all the way through the counter (and through additional counters if they are cascaded together), a ripple counter will tend to suffer from a *propagation delay* of up to a microsecond. Ripple counters may also create output spikes or momentary transient count values that are invalid. Therefore, they are more suitable for applications such as driving a numeric display than for interfacing at high speed with other logic chips.

In a *synchronous counter*, all the flip-flops are clocked simultaneously. A synchronous counter is better suited to operation at high speed.

Of the counter chips available today, about half are synchronous and half are asynchronous.

Ring, Binary, and BCD

A counter that activates output pins one at a time sequentially is said to have a *decoded output*. It is often referred to as a *ring counter*. It has the same number of output pins as its modulus. An example is the 4017B chip.

A *binary counter* is more common and has an *encoded output*, meaning that it will express the running total of the count in binary code through *weighted outputs* that typically have (decimal) values of 1, 2, 4, 8, and so on. A modulus-8 counter (often referred to as an *octal counter*) will require three outputs which represent the binary numbers 000, 001, 010, 011, 100, 101, 110, and 111 (decimal 0 through 7) before going back to 000 and repeating.

A *modulus-16* counter, also known as a *hexadecimal counter* or a *divide-by-16 counter*, will have a binary output represented by four output pins, counting from 0000 through 1111 (decimal 0 through 15). Four-digit binary counters are very common, and their outputs are compatible with other components such as a **decoder**, which converts a binary-number input into a ring-counter-style output.

A *decade counter* is a modulus-10 binary counter. It is described as having a *binary-coded decimal* output (often expressed with the acronym *BCD*), using four weighted output pins which represent the numbers 0000, 0001, 0010, 0011, 0100, 0101, 0110, 0111, 1000, and 1001 (decimal 0 through 9) before repeating. Because this counter skips binary outputs from 1010 through 1111 (decimal 10 through 15), it is said to have a *shortened modulus*.

Figure 13-4 shows a schematic diagram of JK flip-flops in a decade ripple counter. The J and K inputs are all tied to the positive power supply, as this causes the clock input to toggle the output high and low. Note that because the primary input is always shown at the left end of the component, the least significant output bit (Q0) is in the leftmost position.

To intercept binary 1010 (decimal 10), an internal NAND gate is used. Its output goes low when its two inputs, from Q1 and Q3, go high. The output from the NAND immediately activates the CLR function on all the flip-flops, so that as soon as the decade counter reaches 1010 (decimal 10), it resets itself to 0.

In this particular chip, the preload for each flip-flop is tied to the positive power supply, so that it is always inactive. In some counters, the preload feature of each flip-flop is accessible via pins outside the chip. This creates the potential hazard of preloading the counter with one of the numbers that it normally skips (for instance, 11 decimal in a decade counter). This is referred to as an *invalid number* or *disallowed state*. (This use of the term "state" refers only to the binary number stored in the counter's flip-flops. It has nothing to do with the high-state or low-state voltages used to represent binary 0 or 1.)

The counter's datasheet should include a *state diagram* showing how the counter will deal with this situation. It may reset itself to a valid value after a maximum of two steps, but this can still cause confusion, depending on the application.

The state diagram for a 74HC192 counter is shown in Figure 13-5.

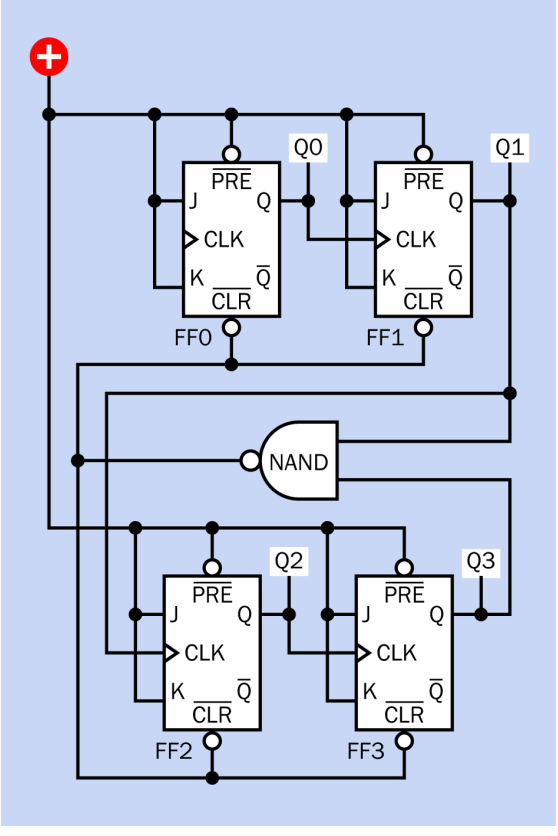

Figure 13-4. *The internal logic of a synchronous decade counter that uses JK flip-flops.*

Clock Sources

The clock input may be provided by a **timer** chip or by an *RC network*, which has the advantage of being able to run at a relatively low speed for purposes where this is desirable. It may alternatively be provided by a *quartz crystal* oscillating at a much higher frequency such as 1MHz. Successive counters may be necessary to reduce this value, depending on the application.

In some counters, the clock is built into the chip. More commonly, a resistor and capacitor may be used externally to establish a clock rate in conjunction with logic gates inside the chip. The datasheet for this type of component will include

a formula for calculating the clock frequency from the resistor and capacitor values. The 4060B chip is an example.

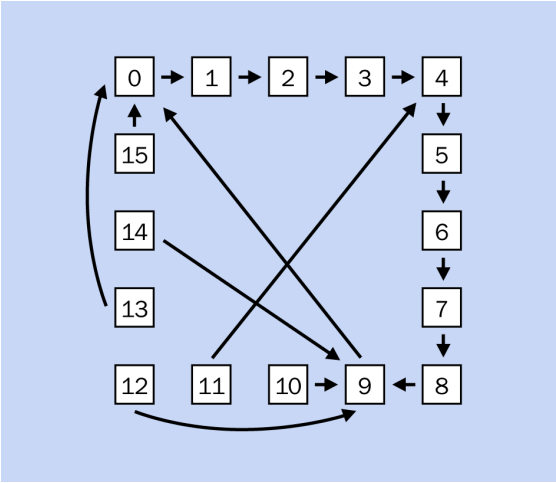

Figure 13-5. *A state diagram shows the transitions that a counter will make from each number to the next (in decimal notation), including the transitions which enable it to exit from disallowed states. This example is for a 74HC192 chip.*

Rising Edge and Falling Edge

A counter may be designed to be triggered either by the rising edge or the falling edge of the clock input, or by its high or low logic state. Generally speaking, ripple counters use the falling edge, so that the final output from one counter can become the clock input of the next. In other words, when the most significant digit of the first counter changes from a high to low logic state, this transition toggles the least significant bit of the second counter.

Synchronous counters generally use the rising edge of the clock input. If multiple synchronous counters are cascaded, they must all share the same clock signal, and will all change their flip-flop states simultaneously.

Multiple Stages

It is common for a counter chip to contain two or more *stages* with differing moduli. To take a common example, a divide-by-2 stage and a divide-by-5 stage that are both present in a single chip can be used to create a decade counter by connecting external pins. The extra stages provide a choice of moduli if they are used individually.

Single and Dual

Counter chips may contain two counters of the same modulus. This is known as a *dual* counter. Dual 4-bit counter chips are common. Each counter can be used separately, or they can be cascaded, in which case the total modulus will be found by multiplying the individual moduli together.

High-State, Low-State, and Three-State

Almost all counters use positive logic where a 1 is represented by a high state and 0 by a low state. Some counters allow an additional output state which has a high impedance and is equivalent to an open circuit. This feature is useful when two or more chips share the same output bus. It is discussed in the entry for **shift registers** in "Three-State Output" on page 126.

Descending Output

Most components only create an ascending count. The output can be converted to a descending count by passing each binary state through an inverter, but this will only work properly if the modulus is equal to the number of states. In a BCD counter, its inverted outputs will count from decimal 15 to decimal 6, not from decimal 9 to decimal 0.

A few counters are available which are designed to create a correct descending count. Other counters are available which allow the user to set the mode to ascending or descending. Examples are the 74x190 or 74x192 (where an acronym for the chip family will be substituted for the letter x).

A descending output is useful in combination with a parallel input, where a user may set an initial value from which the counter will descend

to 0. With suitable logic, this can enable a user-specified delay period.

Programmable Counters

A programmable counter can usually allow a modulus ranging from 2 to more than 10,000. The counter counts down by dividing an initial number repeatedly with a value that is preset with binary inputs. An example is the 4059B chip.

Examples

Many counter specifications date back to the 4000 family of logic chips. Versions of them subsequently became available in the 74xx series, often with the old 4000 part number preceded by 74x (where x is replaced by a designation of the logic family). For example, a version of the 4518B dual BCD chip can be obtained as the 74HC4518. As is the case with all logic chips, this part number will be preceded by letter(s) designating the particular manufacturer, with a suffix added to differentiate minor variants of the chip. The 74xx series has the advantage of higher speed and a greater ability to source or sink current at its output pins.

Most of the original CMOS chips, such as the 4518B, are still available, even in surface-mount versions. These offer the possible advantage of being able to use a higher power supply voltage.

Many counters offer multiple options such as different modulus values that can be selected by external pin connections. Some chips are tolerant of slow clock frequencies; others are not. Most are edge-triggered, but a few are level triggered. Some, such as the 4518B mentioned above, allow a choice of a rising-edge clock input and falling-edge clock input on different pins. For a specific application, it is really necessary to read a variety of datasheets to select the chip that is most suitable.

Values

As is the case with other logic chips, most counters in the through-hole 74xx series are intended for 5VDC power supply while the older 4000 series may tolerate up to 18VDC. Surface-mount 74xx versions may use voltages as low as 2VDC.

See the section on logic gates in Chapter 10 for a discussion of acceptable high and low logic-input states. On the output side, the 4000 series chips are able to source or sink less than 1mA at 5VDC, but the 74HCxx series can usually manage around 20mA.

A few counters are capable of delivering more power through additional output stages that can drive LEDs. The 4026B decade counter is still being manufactured, capable of powering modest 7-segment displays. The 4033B has the additional option of blanking any leading zeros in a multi-digit display. Other chips that were designed for direct connection to LED numerals have become obsolete as the need for this application has diminished. The 74C925, 74C926, 74C927, and 74C928 are examples. They may still be found from surplus outlets, but should not be specified in new circuit designs.

What Can Go Wrong

The entry that deals with problems affecting shift registers (see "What Can Go Wrong" on page 128), describes issues which also affect counters. The entry that deals with logic chips (see "What Can Go Wrong" on page 105), describes problems affecting all types of logic chips. In addition, the potential problems listed below are specific to counters.

Lock-Out

This is the condition which occurs if a counter with a shortened modulus is loaded with a binary state that is out of its range. Consult the datasheet and study its state diagram to determine the most likely outcome if this problem occurs.

Asynchronous Artifacts

Because the flip-flops in an asynchronous (ripple) counter do not change simultaneously, they create very brief false outputs while the ripple

process is taking place. In a 4-bit counter, the binary number 0111 (decimal 7) should be followed by 1000 (decimal 8). However, the rightmost digit (i.e., the least significant bit) will change to a 0 initially, creating 0110 as a momentary binary output (decimal 6). The carry operation will then change the next digit to a 0, creating 0100 (decimal 4). The carry operation continues, changing the next digit to a 0, creating 0000. Finally the operation completes by creating 1000 as the correct output.

These intermediate states on the output pins are often referred to as *glitches*. Because they are extremely brief, they will be indetectable when a counter is used to drive a display. They can cause significant issues, however, if the outputs of the counter are connected with other logic chips.

Another type of asynchronous problem will occur if the clock speed is sufficiently high that a new pulse is received at the first flip-flop before the ripple of changing states has passed all the way through to the final flip-flop. This will result in a different brief invalid value on the output pins.

Noise

Old TTL-type counters, such as the 74LSxx series, are especially noise-sensitive. Adding a 0.1µF or 0.047µF bypass capacitor as close to the power supply pin as possible is recommended. Breadboarding counters of this type may result in errors if a high-frequency clock is used, because conductors such as patch-cords are liable to pick up noise. Modern 74HCxx counters are preferable.

encoder

14

In this encyclopedia, an **encoder** is a digital chip that converts a decimal-valued input into a binary-coded output.

The term "encoder" may alternatively refer to a **rotational encoder** (also known as a *rotary encoder*) which has a separate entry in Volume 1 of this encyclopedia. The term may also describe a *code hopping encoder*, which is an encryption device used in keyless entry systems for automobiles.

OTHER RELATED COMPONENTS

- **decoder** (see Chapter 15)
- **multiplexer** (see Chapter 16)

What It Does

An encoder is a *logic chip* that receives an input consisting of an active logical state on one of at least four input pins, which have decimal values from 0 upward in increments of 1. The encoder converts the active pin number into a binary value represented by logic states on at least two output pins. This behavior is opposite to that of a **decoder**.

Encoders are identified in terms of their inputs and outputs. For example:

- 4-to-2 encoder (four input pins, two output pins)
- 8-to-3 encoder (eight input pins, three output pins)
- 16-to-4 encoder (sixteen input pins, four output pins)

In the early days of computing, encoders processed interrupts. This application is now rare, and relatively few encoder chips are still being manufactured. However, they are still useful in small devices—for example, if a large number of inputs must be handled by a microcontroller that has insufficient pins to receive data from each individually.

Schematic Symbol

Like other logic-based components, the encoder does not have a specific schematic symbol and can be represented by a plain rectangle as in Figure 14-1, with inputs on the left and outputs on the right. The bars printed above some of the abbreviations indicate that an input or output is active-low. In this chip, the 74LS148, all inputs and outputs are active-low.

Generally speaking, inputs labeled D0, D1, D2… are used for data input, although they may simply be numbered, with no identifying letter. The encoded outputs are typically identified as Q0, Q1, Q2… or A0, A1, A2… with Q0 or A0 designating the least significant bit in the binary number.

Pins labeled E and GS are explained in the following section.

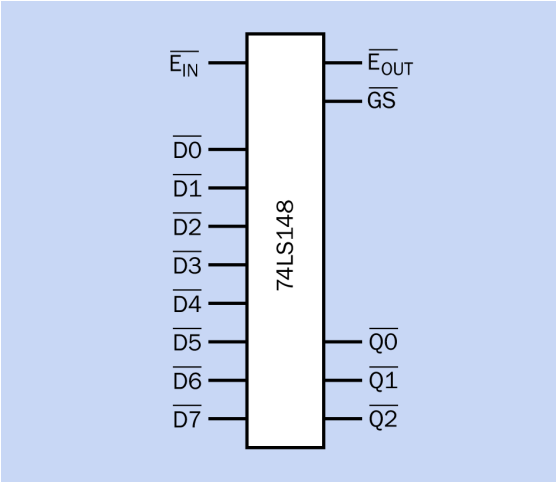

Figure 14-1. *While no specific schematic symbol exists for an encoder chip, this style is commonly used. Shown here is a 16–to–4 encoder with active-low inputs and outputs.*

Similar Devices

The similarities and differences between encoder, decoder, multiplexer, and demultiplexer can cause confusion.

- In an **encoder**, an active logic state is applied to one of four or more input pins, while the rest remain in an inactive logic state. The input pin number is converted to a binary code which is expressed as a pattern of logic states on two or more output pins.
- In a **decoder**, a binary number is applied as a pattern of logic states on two or more input pins. This value determines which one of four or more output pins will have an active logic state, while the rest remain in an inactive logic state.
- A **multiplexer** can connect a choice of multiple inputs to a single output, for data transfer. The logic state of an enable pin, or a binary number applied as a pattern of logic states to multiple control pins, chooses which input should be connected with the output pin. The alternative term *data selector* evokes the function of this device more clearly.
- An analog multiplexer may allow its inputs and outputs to be swapped, in which case it becomes a **demultiplexer**. It can connect a single input to one of multiple outputs, for data transfer. The logic state of an enable pin, or a binary number applied as a pattern of logic states to multiple control pins, chooses which output should be used. The alternative term *data distributor* evokes the function of this device more clearly.

How It Works

An encoder contains **logic gates**. The internal logic of an 8-to-3 encoder is shown in Figure 14-2, where the darker blue rectangle represents the chip. The switches in this figure are external and are included only to clarify the concept. An open switch is imagined to provide an inactive logic input, while a single closed switch provides an active logic input. (Multiple active inputs can be handled by a *priority encoder*, described below).

Each input switch has a numeric status from 1 to 7. The switch with value 0 does not make an internal connection, because the output from the OR gates is 000 by default.

The logic state of each OR output represents a binary number, weighted with decimal values 1, 2, and 4, as shown at the bottom of the figure. Thus, if switch 5 is pressed, by tracing the connections it is clear that the outputs of OR gates 4 and 1 become active, while the output from gate 2 remains inactive. The values of the active outputs thus sum to 5 decimal.

Figure 14-3 shows the outputs for all possible input states of a 4-to-2 encoder. Figure 14-4 shows the outputs for all possible input states of an 8-to-3 encoder. These diagrams assume that a high logic state is an active logic state, on input or output. This is usually the case.

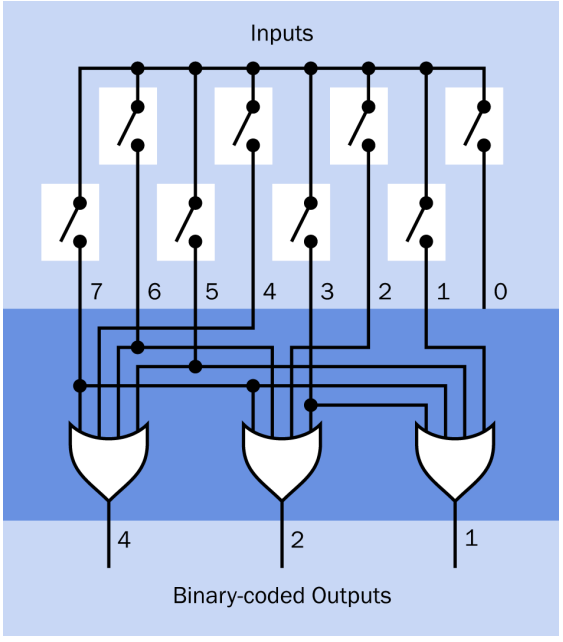

Figure 14-2. *A simplified simulation of the internal logic of an 8-to-3 encoder. The dark blue rectangle indicates the space inside the chip. The external switches are included only to clarify the concept. An encoder chip would have an Enable line to create an active output.*

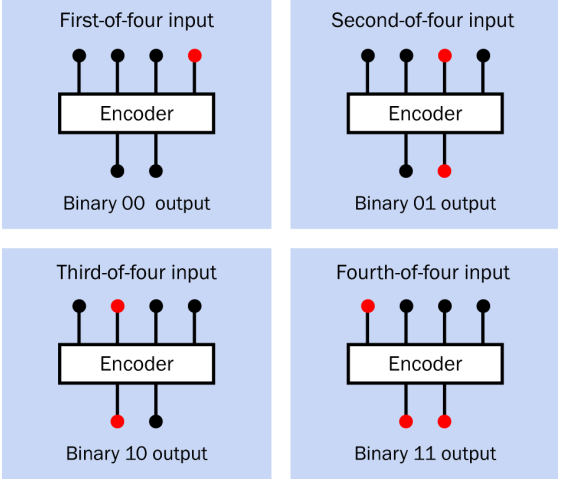

Figure 14-3. *The four possible inputs of a 4-to-2 encoder (top of each panel) and the encoded outputs (below).*

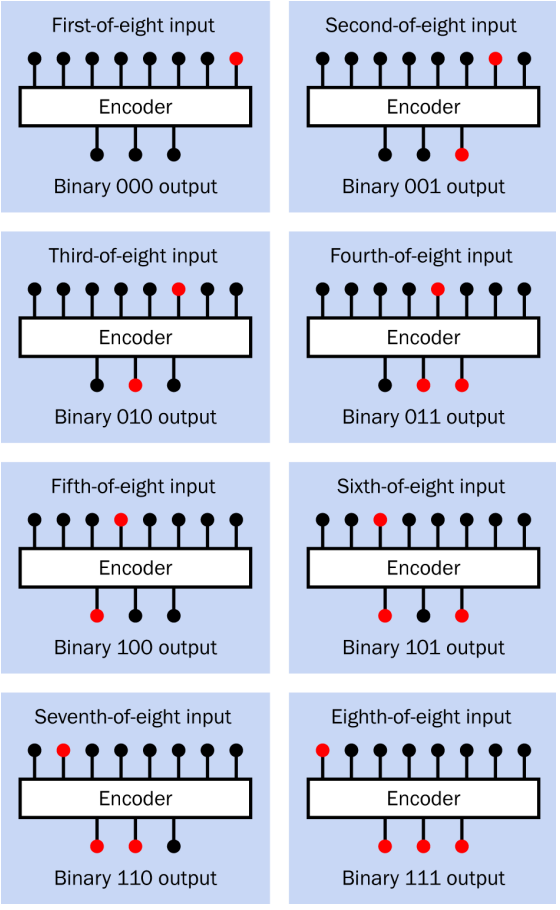

Figure 14-4. *The eight possible inputs of an 8-to-3 encoder (at the top of each panel), and the encoded outputs (below). Note that one input of an encoder must always be logic-high. All logic-low inputs are not a valid state.*

Unlike ripple counters, where propagation delays can reduce the overall response time of the component, decoders respond within two or three nanoseconds.

Variants

A *simple encoder* assumes that only one input pin can be logically active at a time. A *priority encoder* assigns priority to the highest-value input pin if more than one happens to receive an active input. It ignores any lower-value inputs. An example is the 74LS148, which is an 8-to-3 chip.

A few encoders feature *three-state* outputs (also known as *tri-state*), in which a high-impedance or "floating" output state is available in addition to the usual high and low logic states. The high-impedance state allows multiple chips to share an output bus, as those that are in high-impedance mode appear to be disconnected. This is useful if two or more encoders are cascaded to handle a larger number of inputs.

Values

As is the case with other logic chips, most encoders in the through-hole 74xx series are intended for 5VDC power supply while the older 4000 series may tolerate up to 18VDC. Surface-mount versions may use voltages as low as 2VDC.

See the section on logic gates in Chapter 10 for a discussion of acceptable high and low input states. On the output side, the 4000 series chips are able to source less than 1mA at 5VDC, but the 74HCxx series can manage around 20mA.

How to Use It

Suppose that a microcontroller should respond to an eight-position rotary switch. Because the switch cannot be turned to more than one position at a time, all of its eight contacts can be connected with the inputs on an encoder, which will deliver a 3-bit binary number to three inputs of the microcontroller. Code inside the microcontroller then interprets the pin states.

This is shown in Figure 14-5. Pulldown resistors would be needed on the input pins of the encoder, to prevent them from floating when they are not connected by the rotary switch. They have been omitted from this diagram for simplicity. Debouncing the switch would be handled by the microcontroller.

Other forms of input may be used instead of a rotary switch. For example, the outputs from eight comparators or eight phototransistors could be passed through an encoder.

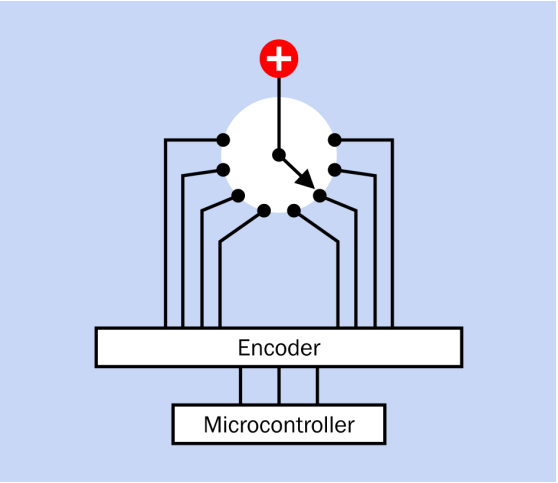

Figure 14-5. *Output from an eight-input rotary switch could be connected through an 8-to-3 encoder to provide input to a microcontroller using a reduced number of pins. Pulldown resistors have been omitted for simplicity.*

Cascaded Encoders

Encoders are often provided with features to facilitate handling additional inputs via multiple chips. Typically, a second Enable pin is provided, as an output that connects with the Enable input of the preceding chip. This preserves the priority function, so that an input on the second chip prevents any additional input to the first chip from affecting the output. In a datasheet, the enable pins may be labeled E_{IN} and E_{OUT}, or E_I and E_O.

In addition, a GS pin will be included, meaning "Group Select." It is logically active only when the encoder is enabled and at least one input is active. The GS pin of the most-significant encoder provides an additional binary digit.

The outputs from two encoders can be linked via OR gates, as shown in Figure 14-6, where the lower chip's GS output provides the most significant bit of a four-bit binary number.

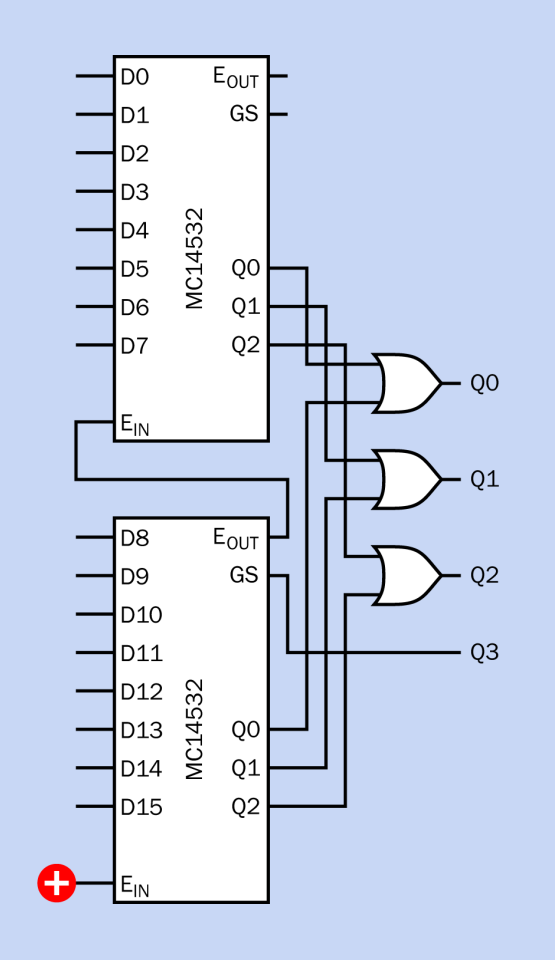

Figure 14-6. *Two eight-bit encoders can be cascaded to handle 16 separate inputs. In this example, the encoders use active-high logic.*

What Can Go Wrong

Problems that are common to all digital chips are summarized in the section on logic gates in "What Can Go Wrong" on page 105.

See "What Can Go Wrong" on page 149 in the entry describing **decoders** for a list of more specific problems that also afflict encoders.

decoder

15

In this Encyclopedia, a **decoder** is a digital chip that receives a binary-coded input and converts it to a decimal output by applying a logic state to one of a sequence of pins, each of which is assigned an integer value from 0 upward.

The term "decoder" also refers to components and devices that have other functions, such as decoding audio or video formats. These functions are not included here.

OTHER RELATED COMPONENTS

- **encoder** (see Chapter 14)
- **multiplexer** (see Chapter 16)

What it Does

A decoder receives a binary-coded number on two or more input pins. It *decodes* that number and expresses it by activating one of at least four output pins.

The behavior of a decoder with a two-bit binary input is shown in four sequential snapshots in Figure 15-1, where the least significant bit of the input is on the right in each diagram, and the output moves from right to left.

Figure 15-2 shows a similar sequence in a decoder where various values of a three-bit input are decoded to create an eight-pin output.

One sample state of a four-bit decoder is shown in Figure 15-3.

All of these figures assume that a high state represents an active input or output. In a few chips, a low state is used to represent an active output.

Decoders with 2, 3, or 4 input pins are common. To handle a binary input greater than 1111 (decimal 15), decoders can be chained together, as described below.

Manufacturers' datasheets often describe decoders in terms of their inputs and outputs. Typical examples would include:

- 2-to-4 decoder (two input pins, four output pins)
- 3-to-8 decoder (three input pins, eight output pins)
- 4-to-10 decoder (for converting *binary-coded decimal* to decimal output)
- 4-to-16 decoder (also known as a *hex decoder*).

Input Devices

The input pins of a decoder can be driven by a counter that has a binary-coded output. A decoder can also be driven by a microcontroller, which may have an insufficient number of output pins to control a variety of devices. Two, three, or four of the outputs can be used to represent a binary number which is passed through the decoder to activate the devices one at a time, perhaps with transistors or Darlington arrays introduced to handle the load. This is suggested in Figure 15-4.

A **shift register** can be used for a similar purpose, but often has only one pin for input. This pin must be supplied sequentially with a serial pattern of bits that will match the desired high/low states of the output pins. The relative advantage of this system is that a shift register can generate any pattern of output states. A one-of-many decoder can activate only one output at a time.

LED Driver

A special case is a *seven-segment decoder* designed to drive a seven-segment **LED display** numeral. A binary-coded decimal number on four input pins is converted to a pattern of outputs appropriate for lighting the segments of the display that will form a number from decimal 0 through 9.

Schematic Symbol

Like other logic-based components, the decoder does not have a specific schematic symbol and is represented by a plain rectangle as in Figure 15-5, with inputs on the left and outputs on the right. The bars printed above the E and LE abbreviations (which stand for Enable and Latch Enable, respectively) indicate that they are active-low. In this chip, the 74HC4514, all outputs are active-high, but in a related 4-to-16 decoder, the 74HC4515, all outputs are active-low. In both of these chips, the Enable pin is held low to activate the outputs. The Latch Enable pin freezes the current state of the outputs (i.e., it latches them) when it is held low.

Generally speaking, pins labeled A0, A1, A2… in a datasheet are often the binary inputs (although A, B, C… may be used), with A0 designating the least significant bit. Outputs are usually labeled Y, and are activated in sequence from Y0 when the binary input starts counting upward.

Similar Devices

The similarities and differences between encoder, decoder, multiplexer, and demultiplexer can cause confusion.

- In a **decoder**, a binary number is applied as a pattern of logic states on two or more input pins. This value determines which one of four or more output pins will have an active logic state, while the rest remain in an inactive logic state.
- A **multiplexer** can connect a choice of multiple inputs to a single output, for data transfer. The logic state of an enable pin, or a binary number applied as a pattern of logic states to multiple control pins, chooses which input should be connected with the output pin. The alternative term *data selector* evokes the function of this device more clearly.
- An analog multiplexer may allow its inputs and outputs to be reversed, in which case it becomes a **demultiplexer**. It can connect a single input to one of multiple outputs, for data transfer. The logic state of an enable pin, or a binary number applied as a pattern of logic states to multiple control pins, chooses which output should be used. The alternative term *data distributor* evokes the function of this device more clearly.

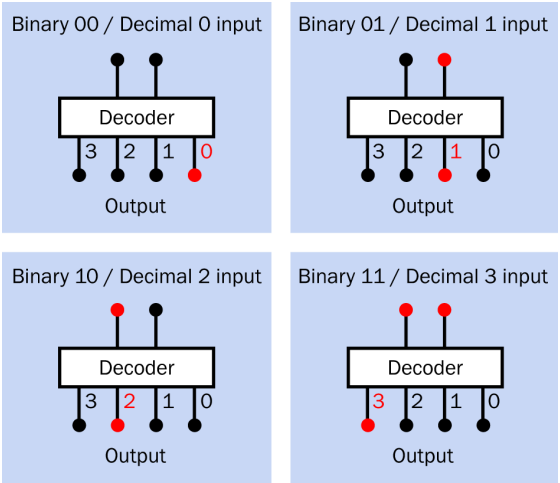

Figure 15-1. *A decoder with two input pins can interpret their binary-number representation to create an active logic state on one of four output pins.*

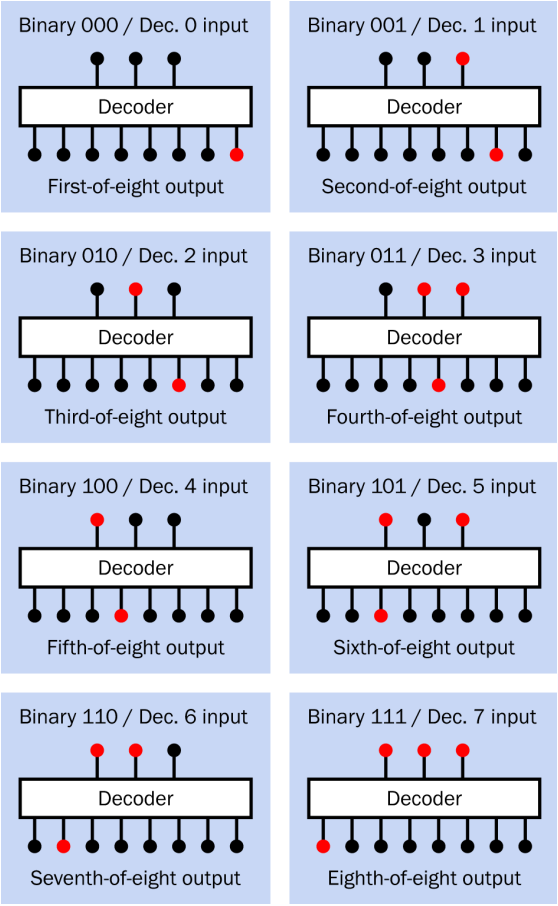

Figure 15-2. *A decoder with three input pins can interpret their binary-number representation to create a high logic state on one of eight output pins.*

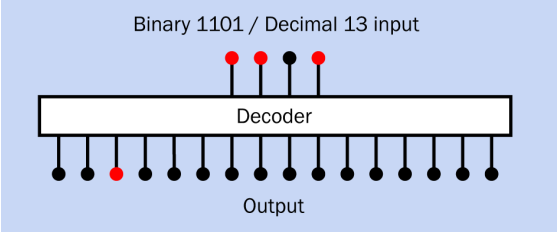

Figure 15-3. *A decoder with four input pins can interpret their binary-number representation to create a high logic state on one of 16 output pins. Only one of the 16 possible states is shown here.*

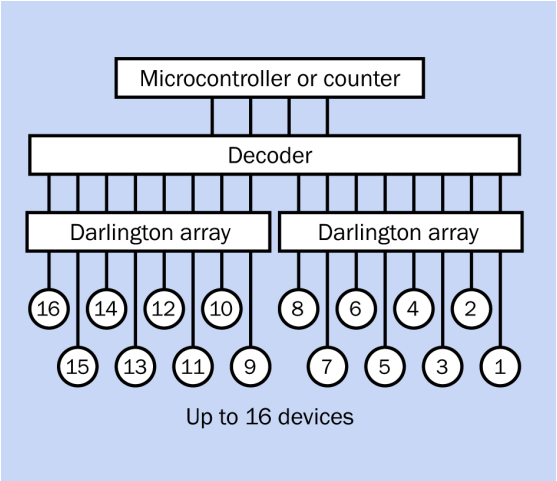

Figure 15-4. *Four outputs from a binary counter or microcontroller can be used by a decoder to activate one of up to 16 output devices.*

A photograph of a 74HC4514 decoder chip appears in Figure 15-6.

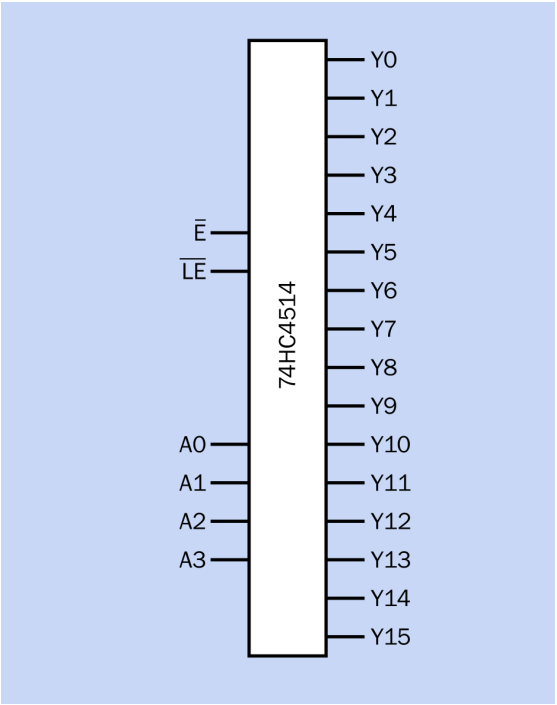

Figure 15-5. *While no specific schematic symbol exists for a decoder chip, this style is commonly used. Shown here is a 4-to-16 decoder.*

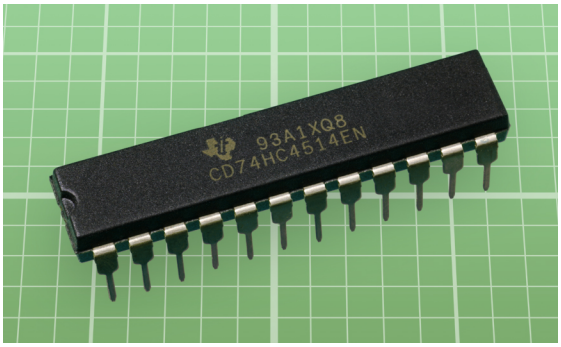

Figure 15-6. *The 24-pin 74HC4514 decoder chip processes a 4-bit input and represents it by making one of its 16 output pins active-high.*

How It Works

A decoder contains logic gates, each of which is wired to respond to a unique binary pattern of inputs. (In the case of a seven-segment decoder, the internal logic is more complicated.) Figure 15-7 shows the logic of a 2-to-4 decoder. The darker blue area contains the components inside the chip. The external switches are included only to clarify the function of the decoder. An open switch is imagined to provide a low logic input, while each closed switch provides a high logic input.

Unlike ripple counters, where propagation delays can reduce the overall response time of the component, decoders function within two or three nanoseconds.

Variants

Decoder variants have not proliferated with time, and relatively few are available. Most are 3-to-8, 4-to-16, and binary-coded-decimal types.

The 7447 and 74LS47 are seven-segment decoders that have an open-collector output capable of driving a 7-segment display directly. The 7448 is similar but also contains built-in resistors and a capability to blank out leading zeros in a display. However, some suppliers now list the 74LS48 as obsolete. It may be still available from old stock, but should not be specified in new circuits.

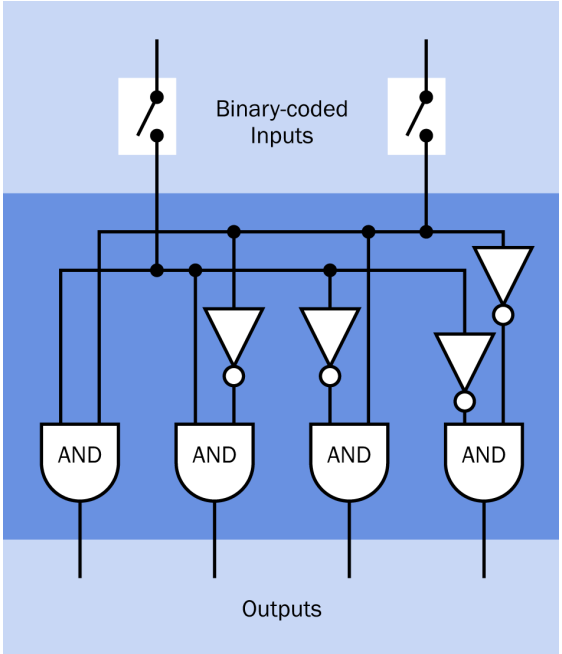

Figure 15-7. *A simplified simulation of the logic in a decoder. An actual chip would have an Enable line to activate the output. The dark blue rectangle indicates the space inside the chip.*

Although 74LS47 is still being manufactured, and is available in surface-mount as well as through-hole format, a version is not available in the widely used HC family of 74xx chips. Care must be taken to satisfy the input voltage requirements of the 74LS47 when driving it with 74HCxx chips.

Values

As is the case with other logic chips, most decoders in the through-hole 74xx series are intended for 5VDC power supply while the older 4000 series may tolerate up to 18VDC. Surface-mount versions may use voltages as low as 2VDC.

See the section on logic gates in Chapter 10 for a discussion of acceptable high and low input states. On the output side, the 4000 series chips

are able to source or sink less than 1mA at 5VDC, but the 74HCxx series can manage around 20mA.

How to Use It

The original applications for decoders in computer circuits have become uncommon, but the chips can still be useful in small appliances and gadgets where multiple outputs are controlled by a **counter** or microcontroller.

Although 16 is usually the maximum number of outputs, some chips are designed to allow expansion. The 74x138 (where a chip family identifier such as LS or HC can be substituted for the letter x) is a 3-to-8 decoder with two logic-low Enable pins and one logic-high Enable. If a value-8 binary line is applied to the low-enable of one chip and the high-enable of another, the first chip will be disabled when the line goes high to indicate that the binary number 1000 has been reached, and the second chip can continue upward from there by sharing the same three less-significant-bit inputs. As many as four chips can be chained in this way.

What Can Go Wrong

Problems that are common to all digital chips are summarized in the section on logic gates in "What Can Go Wrong" on page 105.

Glitches

Although a decoder typically functions faster than a ripple counter, it suffers the same tendency to introduce brief *glitches* in its output. These are momentary invalid states which occur while processes inside the chip that are slightly slower are catching up with other processes that reach completion slightly faster. A brief *settling time* is necessary to ensure that the output is stable and valid. This will be irrelevant when powering a device such as an **LED indicator**, which will not display such brief transients. The problem may be more important if the output from the decoder is used as an input to other logic chips.

If the input to a decoder is derived from a ripple counter, the input may also contain glitches, which can cause erroneous outputs from the decoder. It is better to use a synchronous counter on the input side of a decoder.

Unhelpful Classification

Online parts suppliers tend to list decoders under the same category heading as encoders, multiplexers, and demultiplexers, making it difficult to find what you want. Under this broad subject heading (which will include thousands of chips), if you search by selecting the number of inputs relative to the number of outputs that you have in mind, this will narrow the search considerably.

Active-Low and Active-High

Chips with identical appearance and similar part numbers may have outputs that are either active-low or active-high. Some may offer a latch-enable pin, while others have enable pins that must be pulled low or forced high to produce an output. Accidental chip substitution is a common cause of confusion.

multiplexer

16

May be abbreviated as a *mux* (this term is sometimes printed all in caps), and may be referred to alternatively as a *data selector*. Some sources maintain that a multiplexer has no more than two channels, whereas a data selector has more, but there is no consensus on this, and datasheets continue to use the term "multiplexer" predominantly.

Analog multiplexers are usually bidirectional, and thus will function equally well as *demultiplexers*. Consequently, this encyclopedia does not contain a separate entry for demultiplexers.

OTHER RELATED COMPONENTS

- **encoder** (see Chapter 14)
- **decoder** (see Chapter 15)

What It Does

A multiplexer can select one of two or more input pins, and connect it internally with an output pin. Although it is an entirely solid-state device, it behaves as if it contains a **rotary switch** in series with a SPST switch, as shown in Figure 16-1. A binary code applied to one or more Select pins chooses the input, and an Enable pin establishes the connection with the output. The Select and Enable functions are processed via an internal section referred to as a *decoder*, not to be confused with a **decoder** chip, which has its own entry in this encyclopedia.

All multiplexers are digitally controlled devices, but may be described as either *digital* or *analog* depending how they process the input signal. A digital multiplexer creates an output that is adjusted to logic-high or logic-low within the limits of its logic family. An analog multiplexer does not impose any processing on the voltage, and passes along any fluctuations. Thus, it can be used with alternating current.

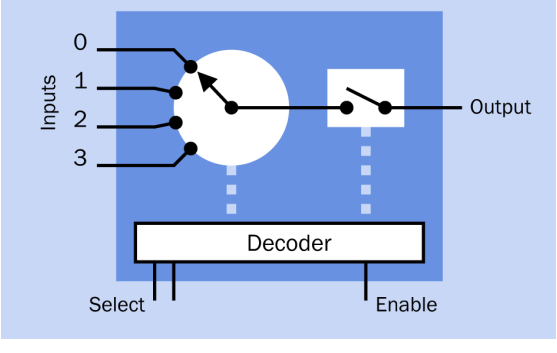

Figure 16-1. *A multiplexer functions as if it contains a rotary switch. The switch position is determined by a binary number applied to external Select pins. The internal connection is completed by applying a signal to an Enable pin.*

Because an analog multiplexer merely switches a flow of current, it can be *bidirectional*; in other words, it can function as a *demultiplexer*, in which case the input is applied to the pole of the (imaginary) internal switch and outputs are taken from the terminals.

Differential Multiplexer

A *differential* multiplexer contains multiple switches that are differentiated from one another (i.e., they are electrically isolated, although they are controlled by the same set of select pins). A differential multiplexer is conceptually similar to a rotary switch with two or more decks controlled by a single shaft. See Figure 16-2.

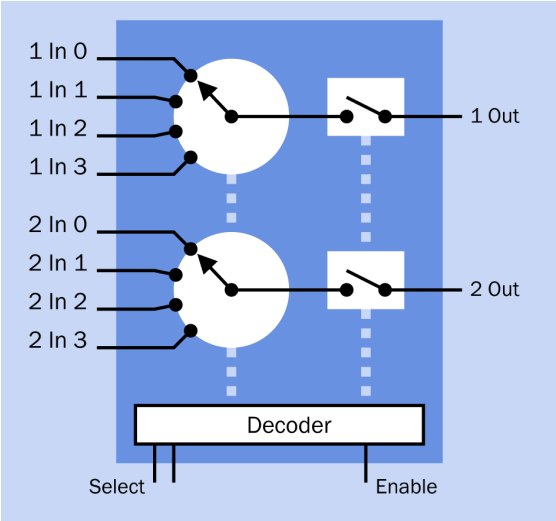

Figure 16-2. *A differential multiplexer contains two or more electronic switches that are differentiated from one another, similarly to the decks on a rotary switch. Although the channels into each switch are typically numbered from 0 upward, the switches are numbered from 1 upward.*

A bidirectional dual 4-channel differential analog multiplexer is shown in Figure 16-3.

Modern multiplexers are often found switching high-frequency data streams in audio, telecommunications, or video applications.

Similar Devices

The similarities and differences between multiplexer, demultiplexer, encoder, and decoder can cause confusion:

- A **multiplexer** can connect a choice of multiple inputs to a single output, for data transfer. The logic state of an enable pin, or a binary number applied as a pattern of logic states to multiple control pins, chooses which input should be connected with the output pin. The alternative term *data selector* evokes the function of this device more clearly.
- An *analog* multiplexer may allow its inputs and outputs to be reversed, allowing it to become a **demultiplexer**, connecting a single input to one of multiple outputs, for data transfer. The logic state of an enable pin, or a binary number applied as a pattern of logic states to multiple control pins, chooses which output should be used. The alternative term *data distributor* evokes the function of this device more clearly.

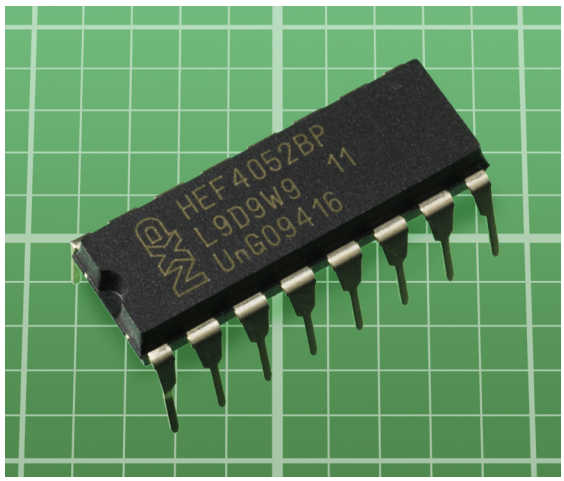

Figure 16-3. *This CMOS chip contains two four-channel differential analog multiplexers.*

- In an **encoder**, an active logic state is applied to one of four or more input pins, while the rest remain in an inactive logic state. The input pin number is converted to a binary code which is expressed as a pattern of logic states on two or more output pins.
- In a **decoder**, a binary number is applied as a pattern of logic states on two or more input pins. This value determines which one of four or more output pins will have an active logic state, while the rest remain in an inactive

logic state. A digital multiplexer does not allow reversal of its inputs and outputs, but a decoder functions as if it were a digital demultiplexer.

How It Works

The multiple inputs to a multiplexer are referred to as *channels*. Almost always, the number of channels is 1, 2, 4, 8, or 16. A 1-channel component is only capable of "on" or "off" modes and functions similarly to a SPST switch.

If there are more than two channels, a binary number will determine which channel is connected internally. The number of channels is usually the maximum that can be identified by the number of select pins, so that 2 pins will control 4 channels, 3 pins will control 8 channels, and 4 pins (the usual maximum) will control 16 channels.

In multiplexers with three or more channels, an enable pin is usually still present to activate or deactivate all the channels simultaneously. The enable feature may be described alternatively as a *strobe*, or may have an inverse function as an *inhibit* pin.

Although a rotary switch is helpful in conceptualizing the function of a multiplexer, a more common representation (sometimes in datasheets) is an array of SPST switches, each of which can be opened or closed by the decoder circuit. A typical example, depicting a dual differential multiplexer, is shown in Figure 16-4. Note that the internal decoder can only close one switch in each channel at a time.

The switch analogy is appropriate in that when an output from a multiplexer is not connected internally (i.e., its switch is "open") it is effectively an open circuit. However, some multiplexers contain *pullup resistors* to give each output a defined state. This can be an important factor in determining whether the multiplexer is suitable for a particular application.

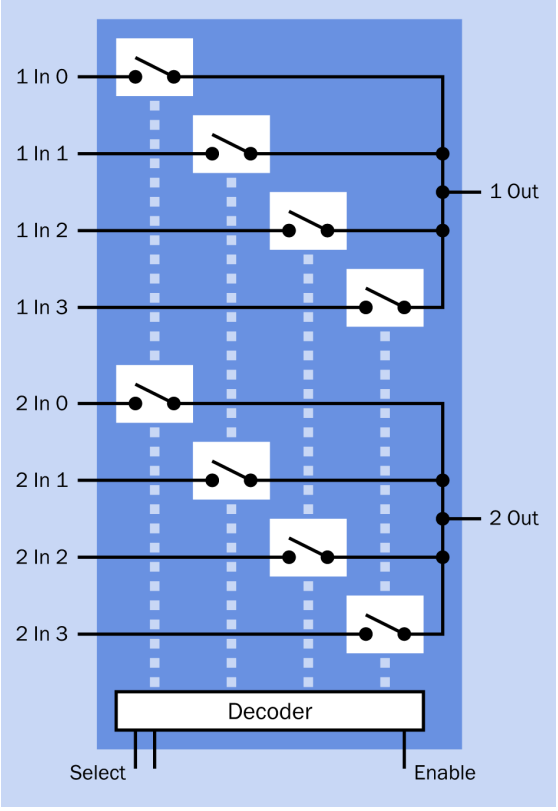

Figure 16-4. *The internal function of a dual multiplexer is commonly represented as a network of SPST switches, each of which is controlled by decoder logic.*

A digital multiplexer actually contains a network of logic gates, shown in simplified form in Figure 16-5.

A demultiplexer has internal logic shown in simplifier form in Figure 16-6.

Schematic Symbol

In a schematic, a multiplexer and demultiplexer may be represented by a trapezoid with its longer vertical side oriented toward the larger number of connections. This is shown in Figure 16-7. However, this symbol is falling into disuse.

More often, as is the case with most logic components, a multiplexer or demultiplexer is represented by a rectangle with inputs on the left and

outputs on the right, as shown in Figure 16-8. The distinction between inputs and outputs is problematic, however, in an analog multiplexer which will allow data flow to be reversed.

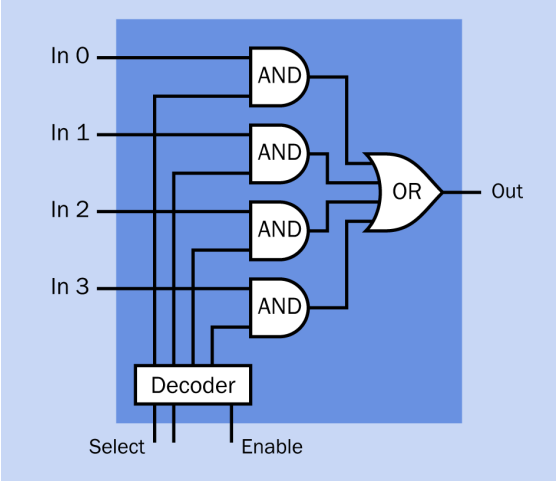

Figure 16-5. *A simplified representation of the logic gates in a digital multiplexer.*

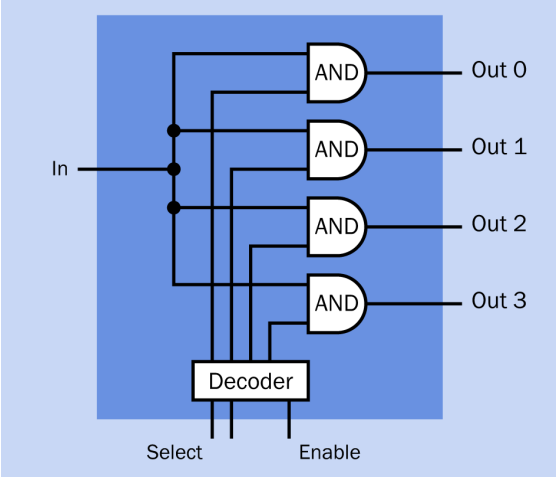

Figure 16-6. *A simplifier representation of the logic gates in a digital demultiplexer.*

Pin Identifiers

The lack of standardization in the identification of pin functions is perhaps more extreme in the case of multiplexers than for other types of logic chips.

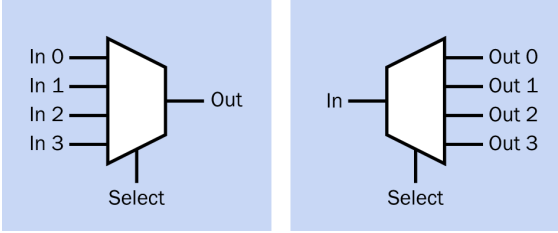

Figure 16-7. *The traditional symbol for a multiplexer (left) and demultiplexer (right). The trapezoid is oriented with its longer vertical side facing the larger number of connections. This symbol is falling into disuse.*

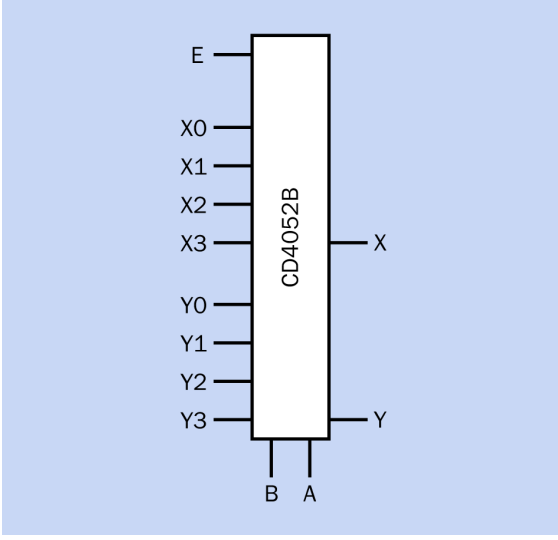

Figure 16-8. *A simple rectangle is most often used as a schematic symbol for a multiplexer, but the abbreviations assigned to pin functions are not standardized. See text for details.*

An output enable pin will be shown as E or EN, or occasionally OE. It may alternatively be described as an inhibit pin, labeled INH, or sometimes will be called a strobe. The function is the same in each case: one of its logic states will enable the internal switches, while its other logic state will prevent any internal switches from closing.

Switch inputs may be labeled S0, S1, S2… or X0, X1, X2… or may simply be numbered, almost always counting up from 0. Where two or more sets of switches coexist in one package, each set of

inputs may be distinguished from the others by preceding each identifier with a numeral or letter to designate the switch, as in 1S0, 1S1, 1S2… or 1X0, 1X1, 1X2… (Switches are generally numbered from 1 upward, even though their inputs are numbered from 0 upward.) Outputs may be identified using the same coding scheme as inputs, bearing in mind that the inputs and outputs of an analog multiplexer usually are interchangeable. Some manufacturers, however, prefer to identify each multiplexer output by preceding it with letter Y. Alternatively, Z1, Z2, Z3… may identify the outputs from switches 1, 2, 3… Fortunately, datasheets usually include some kind of key to this grab-bag of abbreviations.

Control pins are often identified as A, B, C… with letter A representing the least significant bit in the binary number that is applied to the pins.

Voltages can be confusing in multiplexers. Components intended for use with digital inputs are straightforward enough, as the supply voltage will be identified as V_{CC} and is typically 5VDC for through-hole packages (often lower for surface-mount), while negative ground is assumed to be 0VDC. However, where a multiplexer may be used with AC inputs in which the voltage varies above and below 0V, supply voltages above and below 0VDC are also possible—such as +7.5VDC and −7.5VDC, to take a random example. Three power-supply pins may be provided for this purpose. The positive supply will usually be identified as V_{DD} (the D refers to the Drain in the internal MOSFETs). A V_{EE} pin may be at 0VDC or at a negative value equal and opposite to V_{DD}. The E in this abbreviation is derived from Emitter voltage, even though the component may not contain a bipolar transistor with an emitter. Customarily, a V_{SS} pin (the S being derived from the Source in the internal MOSFETs) will be at 0VDC, and other voltages will be measured above and below this baseline. This ground pin may alternatively be labeled GND.

As is customary in logic chips, low-active control pins will have a bar printed above their identifiers, or an apostrophe will be placed after an identifier if the font does not permit printing the bar. Alternatively, low-active pins may be represented by showing a small circle, properly referred to as a *bubble*, at the input or output point of the symbol for the multiplexer. Note that analog inputs and outputs are neither high-active nor low-active; they merely pass voltages through.

Variants

Most multiplexers are "break before make" devices, where one input is disconnected before the next input is connected. However, some exceptions exist, and datasheets should be checked for this. It can be a significant issue, because make-before-break switching will briefly connect external devices with each other, through the chip.

Many multiplexers can tolerate control voltages above the usual high value in a logic circuit—as high as 15VDC in some cases. The voltage that is switched by the multiplexer may be the same as the control voltage, or may be higher.

Some analog multiplexers have *overvoltage protection* that allows them to withstand input voltages that are twice or three times the recommended maximum.

Datasheets may mention "internal address decoding," meaning that the binary number input, specifying a channel to be switched, is decoded inside the chip. In fact, virtually all multiplexers now have on-chip address decoding, and this feature should be assumed to exist, regardless of whether it is mentioned.

Values

The voltage to be switched will usually be referred to as the *input voltage*, V_{IN}.

An analog multiplexer should not be subjected to current exceeding the value that it is designed to switch. This is known as the maximum *channel current*. A typical value would be 10mA, although many modern surface-mount components are designed for currents in the microamp range.

The *on-resistance* is the resistance imposed by the analog multiplexer on the signal flowing through it. While modern, specialized analog multiplexers may have an on-resistance as low as 5Ω, these are relatively unusual. An on-resistance of 100Ω to 200Ω is more common. This value will vary within a component depending on the power supply voltage and the voltage being switched. It will increase slightly as V_{IN} deviates above (or below) 0V, will increase substantially for lower values of supply voltage, and will increase significantly with temperature.

The curves in Figure 16-9 show on-resistance of an analog multiplexer varying with input voltage, with three different power supplies: plus-and-minus 2.5VDC (described in the graph as a "spread" of 5VDC), plus-and-minus 5VDC (a "spread" of 10VDC), and plus-and-minus 7.5VDC (a "spread" of 15VDC). These curves were derived from a datasheet for the MC14067B analog multiplexer; curves for other chips will be different, although the basic principles remain the same.

Switching time is an important consideration in high-speed applications. The "on" and "off" times specified in a datasheet (often as t_{ON} and t_{OFF}) are a function of the propagation delay from the control input to the toggling of the switch, and are generally measured from the halfway point of the rising or falling edge of the control input, to the 90% point of the output signal level.

Leakage current is the small amount of current (often measured in picoamperes) that the solid-state switch will pass when it is in its "off" state. This should be insignificant except when very high-impedance loads are used.

Separate switches inside a multiplexer may have characteristics that differ slightly from one another. Differences in on-resistance between adjacent switches can be important when switching parallel analog signals. A datasheet should mention the extent to which switches have matched characteristics, and may define the maximum deviation from one another using the abbreviation R_{ON} even though this same term may be used, confusingly, to denote the on-resistance of each individual switch.

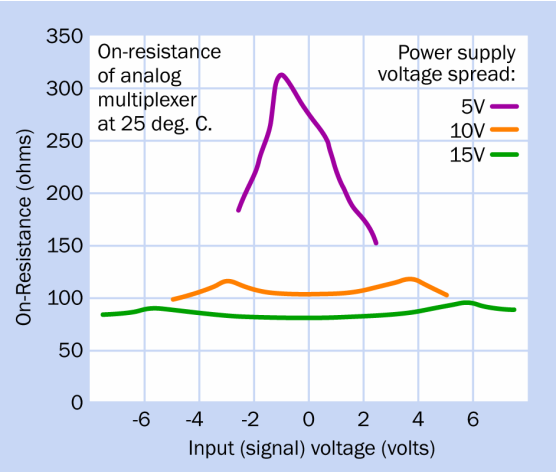

Figure 16-9. *Variations in on-resistance in an analog multiplexer. Each voltage "spread" is the difference between positive supply voltage and an equal-and-opposite negative ground voltage. Thus a "spread" of 10VDC means plus and minus voltages of 5VDC. (Curves derived from On Semiconductor datasheet for MC14067B analog multiplexer.)*

How to Use It

A multiplexer may be used as a simple switch to choose one of multiple inputs, such as a choice of input jacks on a stereo system. A dual differential multiplexer is useful in this application, as it can use a single select signal to switch two signal paths simultaneously.

A multiplexer can also be used as a digital volume control by switching an audio signal among a variety of resistances, similar to a **digital potentiometer**. In this application, the possible presence of pullup resistors inside the multiplexer must be considered.

Where a microcontroller must monitor a large number of inputs (for example, a range of temperature sensors or motion sensors), a multiplexer can reduce the number of input pins required. Its data-select pins will be cycled through all the possible binary states by the microcontroller, to select each data input in turn, while its single-

wire output will carry the analog data to a separate pin on the microcontroller which performs an analog-digital conversion.

Conversely, a demultiplexer (i.e., an analog multiplexer such as the 4067B chip which can be used in demultiplexer mode) can be used by a microcontroller to switch multiple components on and off. Four outputs from the microcontroller can connect with the control pins of a 16-channel demultiplexer, counting from binary 0000 through binary 1111 to select output pins 0 through 15. After selecting each pin, the microcontroller can send a high or low pulse through it. The process then repeats. (A **decoder** can be used in the same way.)

Other Application Notes

Multiplexers may be *cascaded* to increase the inputs-to-outputs ratio.

Modern multiplexers are found on computer boards where they choose among video output ports, or as PCI express channel switches.

A multiplexer may be used as a parallel-to-serial converter, as it samples multiple channels and converts them into a serial data stream.

In telecommunications, a multiplexer can sample voice signals from multiple separate inputs and combine them into a digital stream that can be transmitted at a faster bit rate over a single channel. However, this application goes far beyond the simple uses for multiplexers described here.

What Can Go Wrong

Problems that are common to all digital chips are summarized in the section on logic gates (see "What Can Go Wrong" on page 105).

Pullup Resistors

While they are often necessary to prevent connections from floating, pullup resistors built into a multiplexer may have unexpected consequences if the user is unaware of them.

Break Before Make

For most applications, it is desirable for each internal solid-state switch to break one connection before making a new one. This avoids the possibility of separate external components being briefly connected with each other through the multiplexer. Datasheets should be checked to verify that a multiplexer functions in break-before-make mode. If it doesn't, the enable pin can be used momentarily to disable all connections before a new connection is established.

Signal Distortion

Where a multiplexer is passing analog signals, signal distortion can result if the on-resistance of multiple internal switches varies significantly at different voltages. A datasheet for an analog multiplexer should usually include a graph showing on-resistance over the full signal range. The flatter the graph is, the less distortion the component will create. This is often described in datasheets as R_{ON} Flatness.

Limits of CMOS Switching

Although most multiplexers are built around CMOS transistors, their switching speed may be insufficient for video signals, and their on-resistance may vary enough to introduce distortion. Multiplexers are available with complementary bipolar switching for very high-speed applications. They impose some penalties in cost and power consumption.

Transients

Switch capacitance inside a multiplexer can cause transients in the output when the switch changes state. An allowance for *settling time* may be necessary. This will be additional to the switching speed claimed by the datasheet.

LCD

17

The full term *liquid-crystal display* is seldom used. Its acronym, **LCD**, is much more common. Sometimes the redundant combination **LCD display** is found. All three terms refer to the same device. In this encyclopedia, the first two words in *liquid-crystal display* are hyphenated because they are an adjectival phrase. Other sources often omit the hyphen.

The acronym **LED** (for **light-emitting diode**) is easily confused with **LCD**. While both devices display information, their mode of action is completely different.

OTHER RELATED COMPONENTS

- **LED display** (see Chapter 24)

What It Does

An LCD presents information on a small display panel or screen by using one or more segments that change their appearance in response to an AC voltage. The display may contain alphanumeric characters and/or symbols, icons, dots, or pixels in a *bitmap*.

Because of its very low power consumption, a basic monochrome LCD is often used to display numerals in battery-powered devices such as digital watches and calculators. A small liquid-crystal display of this type is shown in Figure 17-1.

Color-enabled, backlit LCDs are now frequently used in almost all forms of video displays, including those in cellular telephones, computer monitors, game-playing devices, TV screens, and aircraft cockpit displays.

How It Works

Light consists of electromagnetic waves that possess an electric field and a magnetic field. The fields are perpendicular to each other and to the direction in which the light is traveling, but the field polarities are randomly mixed in most visible radiation. This type of light is referred to as *incoherent*.

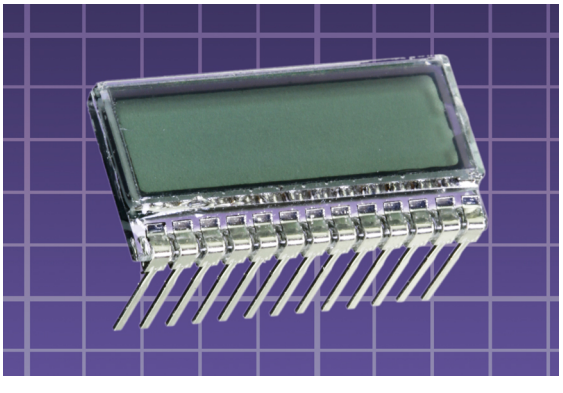

Figure 17-1. *A small, basic monochrome LCD.*

Figure 17-2 shows a simplified view of an LCD that uses a backlight. Incoherent light emerges from the backlight panel (A) and enters a vertical polarizing filter (B) that limits the electric field vector. The polarized light then enters a liquid crystal (C) which is a liquid composed of molecules organized in a regular helical structure that rotates the polarity by 90 degrees when no voltage is applied to it. The light now passes through

a horizontal polarizing filter (D) and is visible to the user.

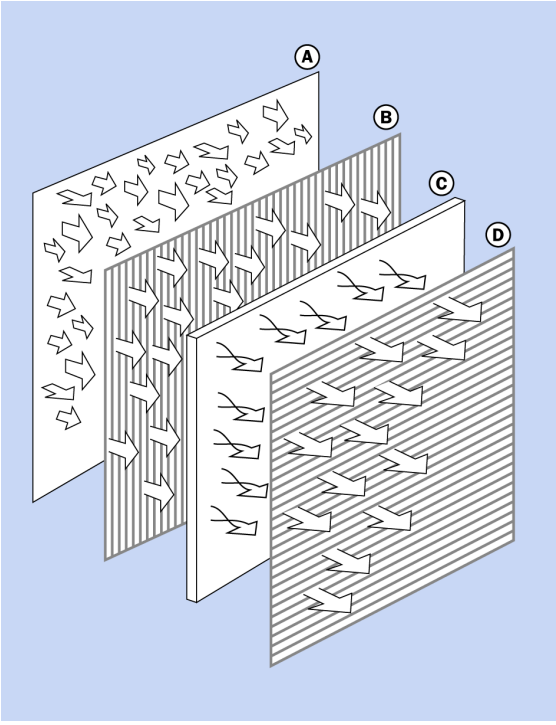

Figure 17-2. *The combination of two polarizers and a liquid crystal appears transparent when voltage is not applied. See text for details.*

- A liquid crystal itself does not emit light. It can only modify light that passes through it.

Figure 17-3 shows what happens when voltage is applied to the liquid crystal via transparent electrodes (not included in the figure). The molecules reorganize themselves in response to the electric potential and allow light to pass without changing its polarity. Consequently, the vertically polarized light is now blocked by the front, horizontally polarized filter, and the display becomes dark.

A liquid crystal contains ionic compounds that will be attracted to the electrodes if a DC voltage is applied for a significant period of time. This can degrade the display permanently. Therefore, AC voltage must be used. An AC frequency of 50Hz to 100Hz is common.

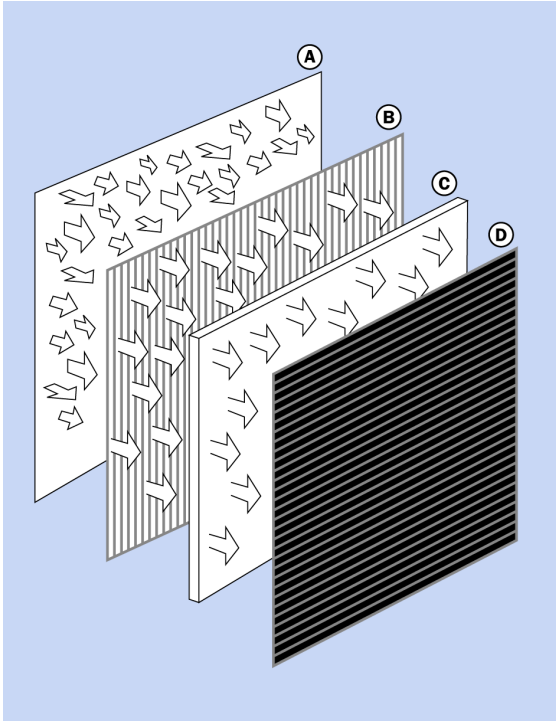

Figure 17-3. *The LCD appears dark when voltage is applied. See text for details.*

Variants

A *transmissive LCD* requires a backlight to be visible, and is the type illustrated in Figure 17-2. In its simplest form, it is a monochrome device, but is often enhanced to display full color by adding red, green, and blue filters. Alternatively, instead of a white backlight, an array of pixel-sized red, green, and blue **LEDs** may be used, in which case filters are unnecessary.

Backlit color LCDs have displaced *cathode-ray tubes*, which used to be the default system in almost all video monitors and TVs. LCDs are not only cheaper but can be fabricated in larger sizes. They do not suffer from *burn in*, where a persistent unchanging image creates a permanent scar in the phosphors on the inside of a tube. However, large LCDs may suffer from dead pixels or

stuck pixels as manufacturing defects. Different manufacturers and vendors have varying policies regarding the maximum acceptable number of pixel defects.

In a *reflective LCD*, the structure is basically the same as that shown in Figure 17-2 except that a reflective surface is substituted for the backlight. Ambient light enters from the front of the display, and is either blocked by the liquid crystal in combination with the polarizing filters, or is allowed to reach the reflective surface at the rear, from which it reflects back through the liquid crystal to the eye of the user. This type of display is very easily readable in a bright environment, but will be difficult to see in dim conditions and will be invisible in darkness. Therefore, it may be augmented with a user-activated light source mounted at the side of the display.

A *transreflective LCD* contains a translucent rear polarizer that will reflect some ambient light, and is also transparent to enable a backlight. While this type of LCD is not as bright as a reflective LCD and has less contrast, it is more versatile and can be more energy efficient, as the backlight can be switched off automatically when ambient light is bright enough to make the display visible.

Active and Passive Types

An *active matrix* LCD adds a matrix of thin-film transistors to the basic liquid-crystal array, to store the state of each segment or pixel actively while the energizing AC voltage transitions from positive to negative. This enables a brighter, sharper display as *crosstalk* between adjacent pixels is reduced. Because *thin-film transistors* are used, this is often described as a *TFT* display; but the term is interchangable with *active matrix*.

A *passive matrix* LCD is cheaper to fabricate but responds sluggishly in large displays and is not so well suited to fine gradations in intensity. This type of component is used primarily in simple monochrome displays lacking intermediate shades of gray.

Crystal Types

Twisted Nematic (TN) are the cheapest, simplest type of LCD, allowing only a small viewing angle and average contrast. The appearance is limited to black on gray. The response rate is relatively slow.

Super Twisted Nematic (STN) displays were developed in the 1980s for passive LCDs, enabling better detail, wider view angle, and a faster response. The natural appearance is dark violet or black on green, or dark blue on silver-gray.

Film-compensated Super Twisted Nematic (FSTN) uses an extra coating of film that enables a pure black on white display.

Double Super Twisted Nematic provides further enhancement of contrast and response times, and automatic contrast compensation in response to ambient temperature. The appearance is black on white. This display requires backlighting.

Color Super Twisted Nematic (CSTN) is an STN display with filters added for full color reproduction.

Seven-Segment Displays

The earliest monochrome LCDs in devices such as watches and calculators used seven segments to display each numeral from 0 through 9. This type of LCD is still used in low-cost applications. A separate control line, or electrode, connects to each segment, while a *backplane* is shared by all the segments, connecting with a *common* pin to complete the circuit.

Figure 17-4 shows a typical seven-segment display. The lowercase letters *a* through *g* that identify each segment are universally used in datasheets. The decimal point, customarily referred to as "dp," may be omitted from some displays. The array of segments is slanted forward to enable more acceptable representation of the diagonal stroke in numeral 7.

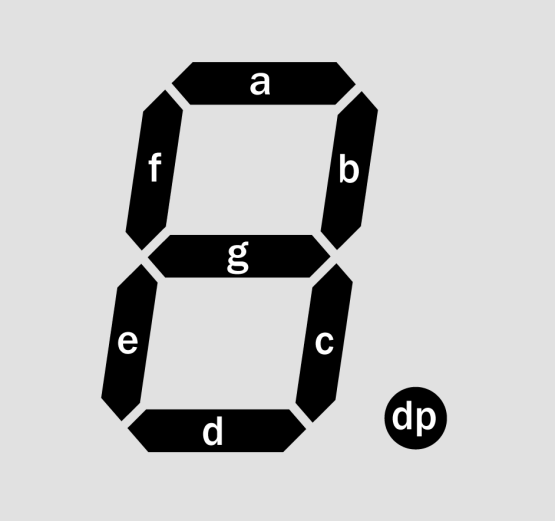

Figure 17-4. *Basic numeric display format for LCD numeric displays (the same layout is used with LEDs). To identify each segment, lowercase letters are universally used.*

Seven-segment displays are not elegant but are functional and are reasonably easy to read, as shown in Figure 17-5. Letters A, B, C, D, E, and F (displayed as A, b, c, d, E, F because of the restrictions imposed by the small number of segments) may be added to enable display of hexadecimal values.

In appliances such as microwave ovens, very basic text messages can be displayed to the user within the limitations of 7-segment displays, as suggested in Figure 17-6.

The advantage of this system is low cost, as 7-segment displays are cheap to fabricate, entail the fewest connections, and require minimal decoding to create each alphanumeric character. However, numbers 0, 1, and 5 cannot be distinguished from letters O, I, and S, while letters containing diagonal strokes, such as K, M, N, W, X, and Z, cannot be displayed at all.

Figure 17-5. *Numerals and the first six letters of the alphabet created with a 7-segment display.*

Additional Segments

Alphanumeric LCDs were developed using 14 or 16 segments to enable better representation of letters of the alphabet. Sometimes these displays were slanted forward, like the 7-segment displays, perhaps because the style had become familiar, even though the addition of diagonal segments made it unnecessary. In other cases, the 14 or 16 segments were arrayed in a rectangle. See Figure 17-7.

The same words represented in Figure 17-6 are shown in Figure 17-8, using 16-segment LCDs. Clearly, the advantage gained by enabling diagonal strokes entailed the disadvantage of larger gaps in the letters, making made them ugly and difficult to read.

Figure 17-6. *Basic text messages can be generated with 7-segment displays, although they cannot contain alphabetical letters that use diagonal strokes.*

A full character set using 16-segment LCDs is shown in Figure 17-9. This conforms partially with the ASCII coding system, in which each character has an identifying numeric code ranging from 20 hexadecimal for a letter-space to 7A hexadecimal for letter z (although this character set does not attempt to represent lowercase letters differently from uppercase). The ASCII acronym stands for *American Standard Code for Information Interchange*.

Because backlit LCDs had become common by the time 16-segment displays were introduced, the characters were often displayed in light-on-dark or "negative" format, as suggested in this figure. LEDs, of course, have always used the light-on-dark format, as an LED is a light-emitting component.

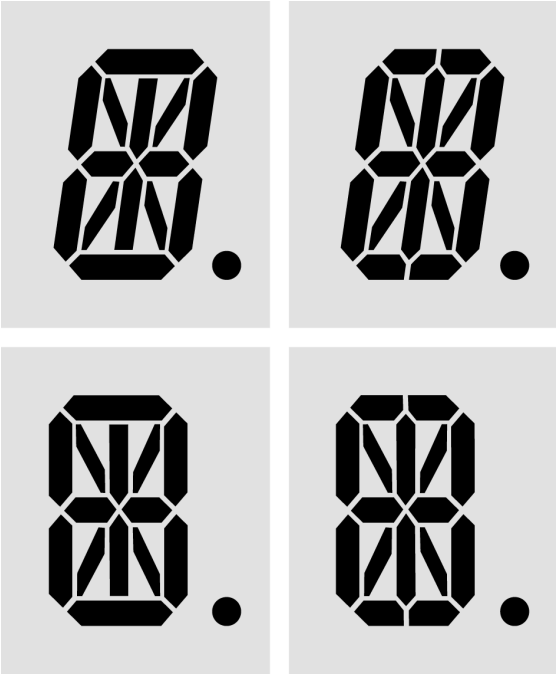

Figure 17-7. *LCDs using 14 segments (left) and 16 segments (right) were introduced to represent a full alphabet in addition to numerals. Sometimes these displays were slanted forward, like the previous 7-segment type, even though this was no longer necessary to represent the number 7.*

Dot-Matrix Displays

The 16-segment displays were never widely popular, and the declining cost of microprocessors, LCD fabrication, and ROM storage made it economic to produce displays using the more easily legible 5x7 dot-matrix alphabet that had been common among early microcomputers. Figure 17-10 shows a dot-matrix character set that is typical of many LCDs.

Because the original ASCII codes were not standardized below 20 hexadecimal or above 7A hexadecimal, manufacturers have represented a variety of foreign-language characters, Greek letters, Japanese characters, accented letters, or symbols using codes 00 through 1F and 7B through FF. The lower codes are often left blank, allowing user installation of custom symbols. Codes 00 through 0F are often reserved for control functions, such as a command to start a new

line of text. There is no standardization in this area, and the user must examine a datasheet for guidance.

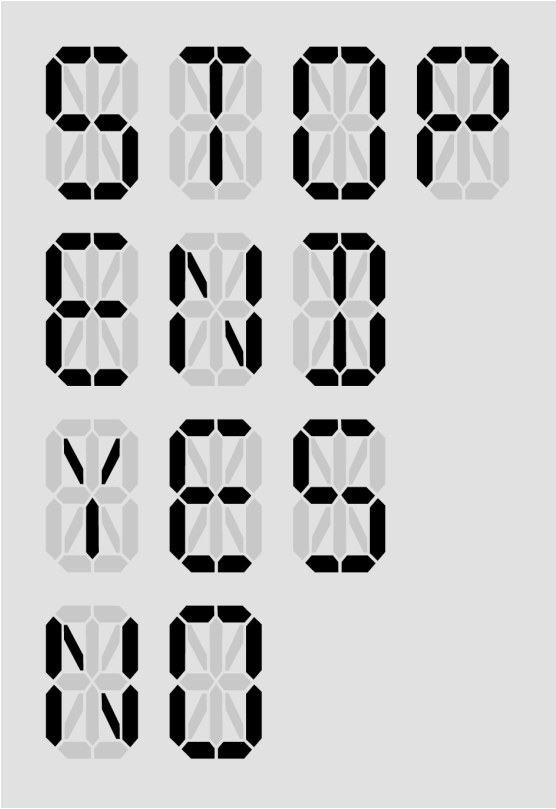

Figure 17-8. *The same text messages shown previously using 7-segment LCDs are shown here using 16-segment displays.*

Dot-matrix LCDs are usually packaged in arrays consisting of eight or more columns and two or more rows of characters. The number of columns is always stated before the number of rows, so that a typical 8 x 2 display contains eight alphanumeric characters in two horizontal rows. An array of characters is properly referred to as a *display module*, but may be described, confusingly, as a *display*, even though a single seven-segment LCD is itself a display. A 16x2 display module is shown from the front in Figure 17-11 and from the rear in Figure 17-12.

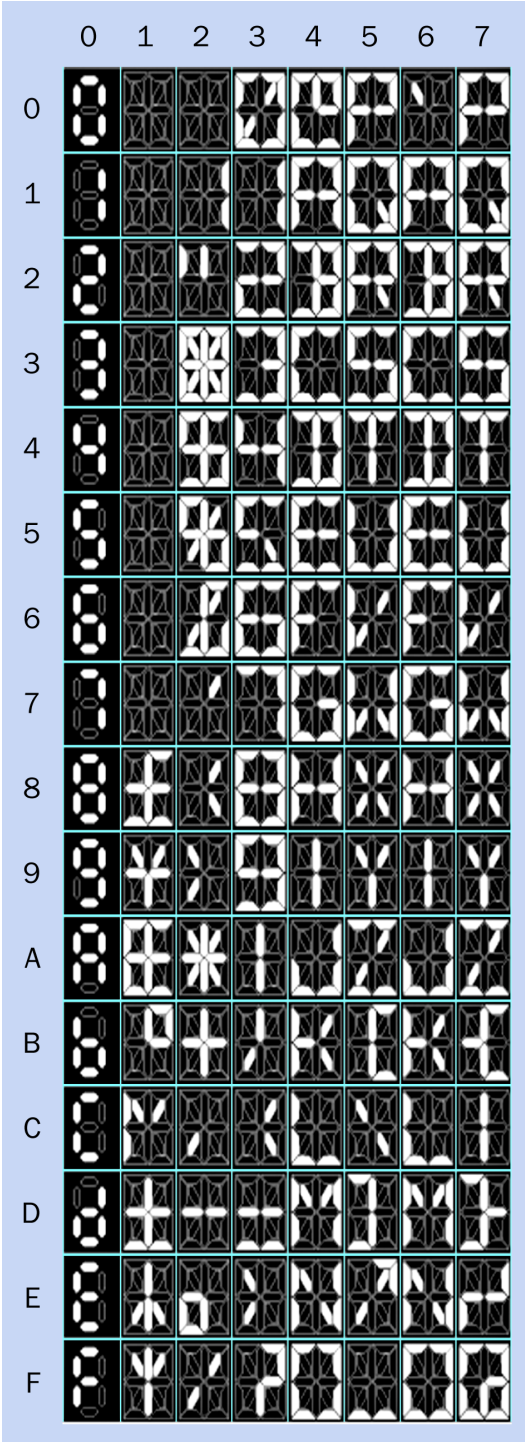

Figure 17-9. *A full character set using 16-segment LCDs.*

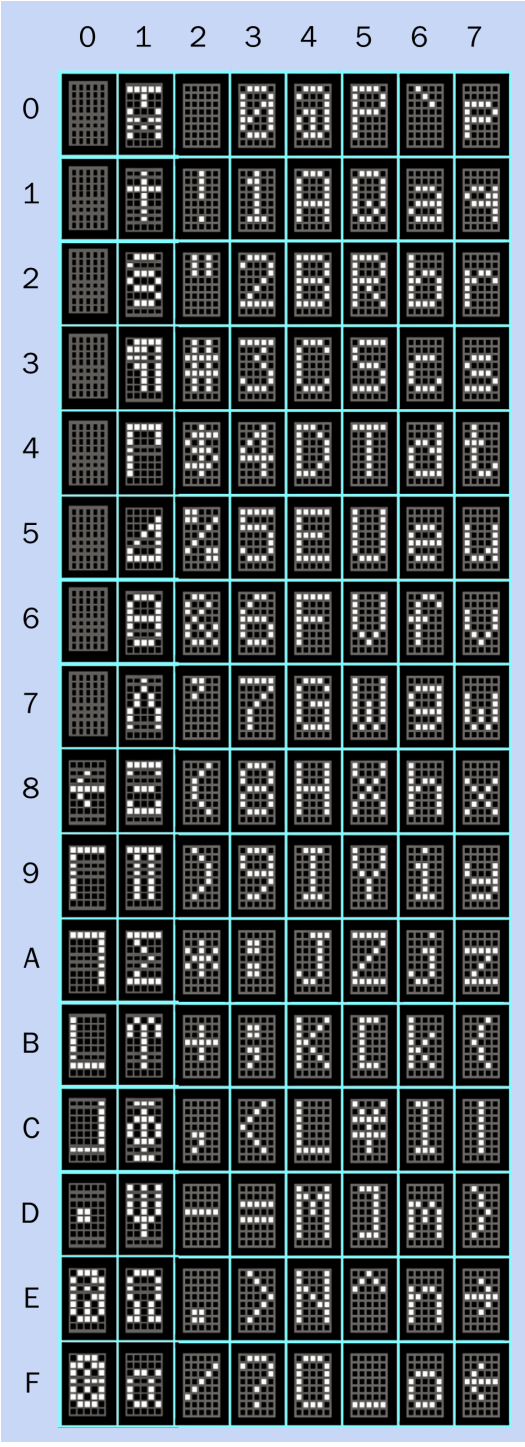

Figure 17-10. *A dot-matrix character set typical of LCDs capable of displaying a matrix of 5×7 dots.*

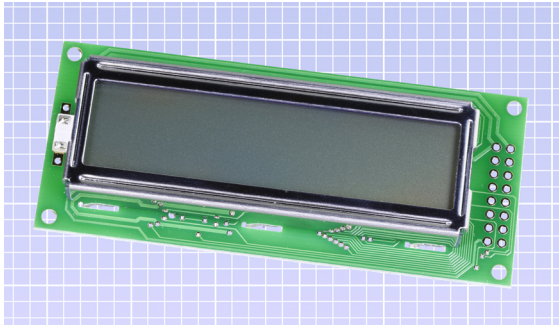

Figure 17-11. *A 16x2 LCD display module seen from the front.*

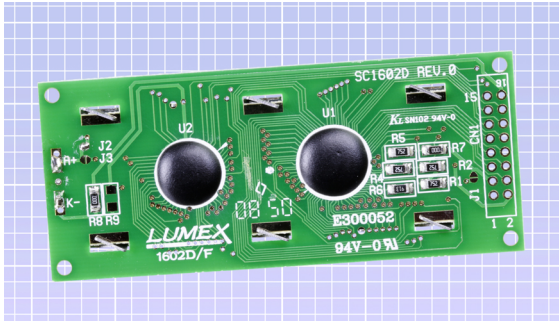

Figure 17-12. *The same 16x2 LCD display module from the previous figure, seen from the rear.*

Multiple-character display modules have been widely used in consumer electronics products such as audio components and automobiles where simple status messages and prompts are necessary—for example, to show the volume setting or broadcast frequency on a stereo receiver. Backlighting is almost always used.

Because the cost of small, full-color, high-resolution LCD screens has been driven down rapidly by the mass production of cellular phones, color displays are likely to displace monochrome dot-matrix LCD display modules in many applications. Similarly, touchscreens will tend to displace pushbuttons and tactile switches. Touchscreens are outside the scope of this encyclopedia.

Color

The addition of filters to create a full color display is shown in simplified form in Figure 17-13.

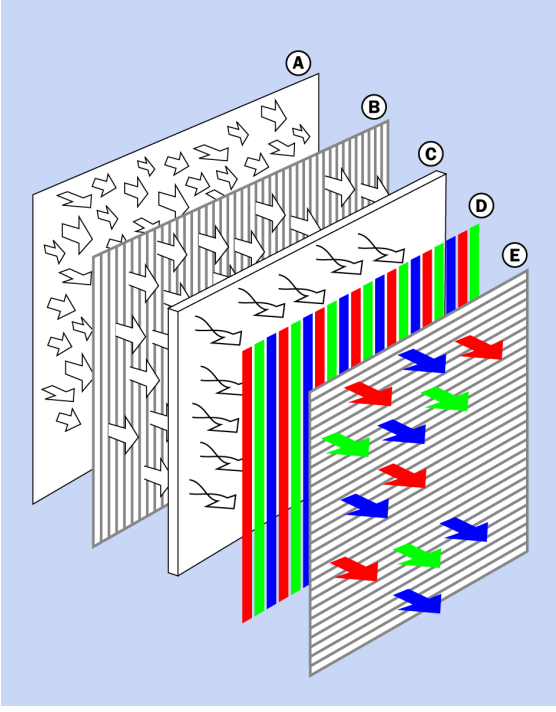

Figure 17-13. *The addition of red, green, and blue color filters, in conjunction with variable density liquid crystal pixels, enables an LCD full-color display.*

Red, green, and blue are almost always used as primary colors for transmitted light, because the combination of different intensities of these *RGB* primaries can create the appearance of many colors throughout the visible spectrum. They are said to be *additive* primaries, as they create brighter colors when they are combined. The principle is illustrated in Figure 17-14.

The use of the word "primaries" to refer to red, green, and blue can cause confusion, as full-color printed materials use a different set of *reflective* primaries, typically cyan, magenta, and yellow, often with the addition of black. In this *CMYK* system, additional layers of pigment will absorb, or subtract, more visible frequences. See Figure 17-15.

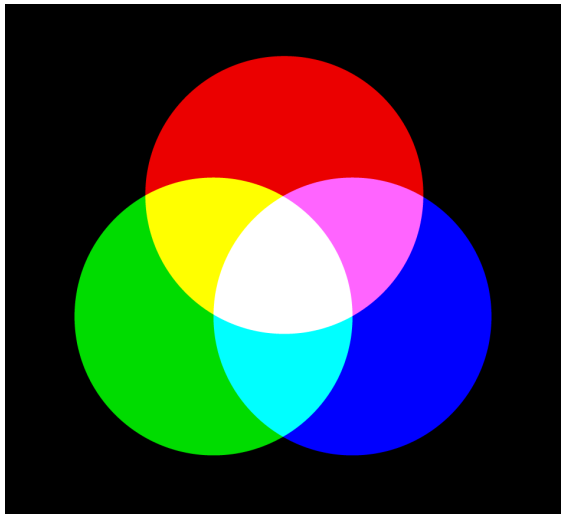

Figure 17-14. *When colors red, green, and blue are transmitted directly to the eye, pairs of these additive primaries create secondary colors cyan, magenta, and yellow. Combining all three additive primaries creates an approximation of white light. This can be verified by viewing a color monitor with a magnifying glass.*

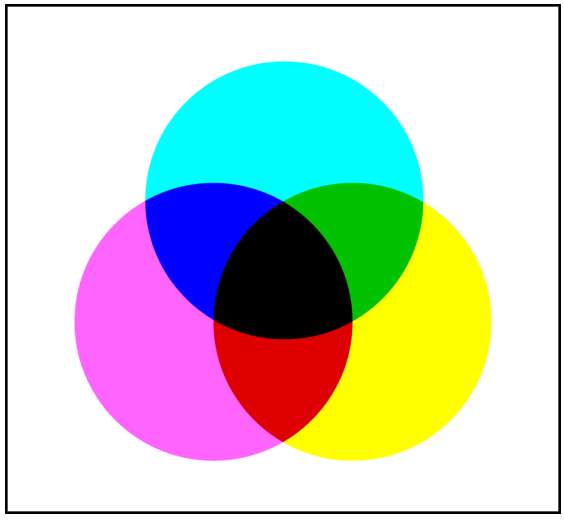

Figure 17-15. *When ink colors cyan, magenta, and yellow are superimposed on white paper and are viewed in white light, pairs of these subtractive primaries create secondary colors red, green, and blue. Overprinting all three subtractive primaries creates an approximation of black, limited by the reflective properties of available pigments. Black ink is usually added to provide additional contrast.*

The complete range of colors that can be created as a combination of primaries is known as the *gamut*. Many different RGB color standards have been developed, the two most widely used being *sRGB* (almost universal in web applications) and *Adobe 1998* (introduced by Adobe Systems for Photoshop, providing a wider gamut). None of the available systems for color reproduction comes close to creating the full gamut that can be perceived by the human eye.

Backlighting Options

For monochrome LCDs, **electroluminescent** backlighting may be used. It requires very low current, generates very little heat, and has a uniform output. However, its brightness is severely limited, and it requires an inverter that adds significantly to the current consumption.

For full-color LCDs, **fluorescent** lights were originally used. They have a long lifetime, generate little heat, and have low power consumption. However, they require a relatively high voltage, and do not work well at low temperatures. Early flat screens for laptop computers and desktop monitors used *cold-cathode fluorescent panels.*

Subsequently, white light-emitting diodes (**LED**s) were refined to the point where they generated a range of frequencies that was considered acceptable. Light from the LEDs passes through a diffuser to provide reasonably consistent illumination across the entire screen. LEDs are cheaper than fluorescent panels, and allow a thinner screen.

High-end video monitors use individual red, green, and blue LEDs instead of a white backlight. This eliminates the need for colored filters and produces a wider gamut. So-called *RGB* LCD monitors are more expensive but are preferred for professional applications in video and print media where accurate color reproduction is essential.

Zero-Power Displays

Some techniques exist to create LCDs that require power only to flip them to and fro between their transparent and opaque states. These are also known as *bistable* displays, but have not become as widely used. They are similar in concept to *e-ink* or *electronic paper* displays, but the principle of operation is different.

How to Use It

So long as an LCD consists of just one numeral, it can be driven by just one decoder chip that translates a binary-coded input into the outputs required to activate the appropriate segments of the LCD. The evolution of multi-digit displays, alphanumeric displays, dot-matrix displays, and graphical displays has complicated this situation.

Numeric Display Modules

An LCD consisting of a single digit is now a rare item, as few circuits require only one numeral for output. More commonly, two to eight numerals are mounted together in a small rectangular panel, three or four numerals being most common. A typical digital alarm clock uses a four-digit numeric display module, incorporating a colon and indicators showing AM/PM and alarm on/off. Other numeric display modules may include a minus sign.

Modules that are described as having 3.5 or 4.5 digits contain three full digits preceded by a numeral 1 composed of two segments. Thus, a 3-digit module can display numbers from 000 through 999, while a 3.5-digit display can display numbers from 000 through 1999, approximately doubling the range.

Numeric display modules of the type described here do not contain any decoder logic or drivers. An external device, such as a microcontroller, must contain a lookup table to translate a numeric value into outputs that will activate the appropriate segments in the numbers in a display, with or without decimal points and a minus sign. To avoid reinventing the wheel, a programmer may download code libraries for microcontrollers to drive commonly used numeric display modules. It is important to remember, though,

that segments in monochrome LCDs must be activated by AC, typically a square wave with a frequency of 30Hz to 90Hz.

An alternative is to use a decoder chip such as the 4543B or 4056B, which receives a binary-coded decimal input (i.e., 0000 through 1001 binary, on four input puts) and translates it into an output on seven pins suitable for connection with the seven segments of a 7-segment display. The 4543B requires a square-wave input to its "phase" pin. The square-wave must also be applied simultaneously to the backplane of the LCD, often identified as the "common" pin on datasheets. Pinouts for the 4543B are shown in Figure 17-16.

The 4543B includes provision for "display blanking," which can be used to suppress leading zeros in a multidigit number. However, the lack of outputs to control a minus sign or decimal point limits the decoder to displaying positive integers.

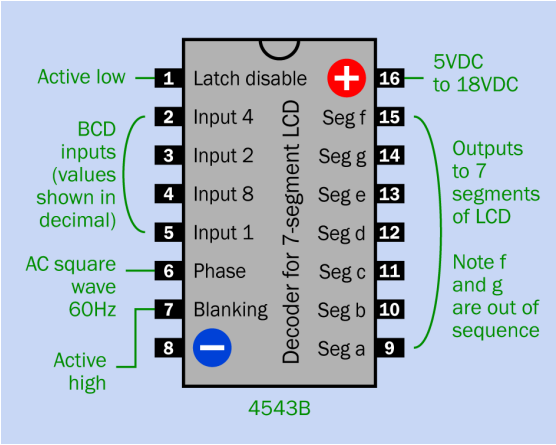

Figure 17-16. *Pinouts for the 4543B decoder chip, which is designed to drive a seven-segment numeric LCD.*

The power supply for a 4543B can range from 5VDC to 18VDC, but because the logic-high output voltage will be almost the same as that of the power supply, it must be chosen to match the power requirements of the LCD (very often 5VAC).(((

To drive a three-digit numeric display module, a separate decoder chip can be used to control each digit. The disadvantage of this system is that each decoder requires three inputs, so that a three-digit display will require nine outputs from the microcontroller.

To deal with this issue, it is common to *multiplex* a multi-digit display. This means that each output from the decoder is shared among the same segments of all the LCD numerals. Each LCD numeral is then activated in sequence by applying AC voltage to its common pin. Simultaneously, the decoder sends the data appropriate to that LCD. This process must be fast enough so that all the digits appear to be active simultaneously, and is best managed with a microcontroller. A simplified schematic is shown in Figure 17-17. It can be compared with a similar circuit to drive LED displays, shown in Figure 24-13.

Alphanumeric Display Module

Arrays of dot-matrix LCDs that can display alphabetical characters as well as numerals require preset character patterns (usually stored in ROM) and a command interpreter to process instructions that are embedded in the data stream. These capabilities are often built into the LCD module itself.

While there is no formal or de facto standard, the command set used by the Hitachi HD44780 controller is installed in many displays, and code libraries for this set are available for download from sites dedicated to the Arduino and other microcontrollers. Writing code from scratch to control all aspects of an alphanumeric display is not a trivial chore. The Hamtronix HDM08216L-3-L30S is a display that incorporates the HD44780.

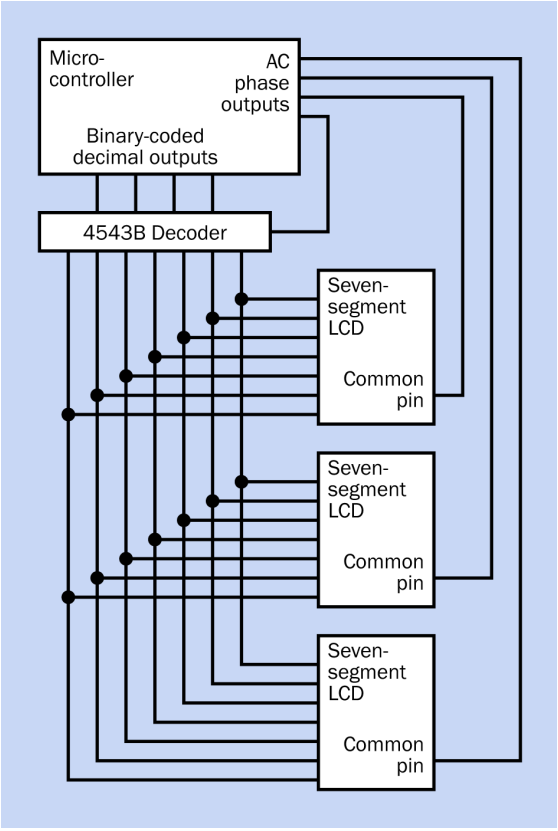

Figure 17-17. *When two or more numeric displays are multiplexed, a control device (typically, a microcontroller) activates each of them in turn via its backplane (common terminal) while sending appropriate data over a shared bus.*

Regardless of which standard is used, some features of alphanumeric display modules are almost universal:

- Register select pin. Tells the display whether the incoming data is an instruction, or a code identifying a displayable character.
- Read/write pin. Tells the display whether to receive characters from a microcontroller or send them to a microcontroller.
- Enable/disable pin.
- Character data input pins. There will be eight pins to receive the 8-bit ASCII code for each displayable character in parallel. Often there is an option to use only four of these pins, to reduce the number of microcontroller outputs necessary to drive the display. Where four pins are used, each 8-bit character is sent in two segments.
- LED backlight pin. Two may be provided, one connected to the anode(s) of the LED backlight, the other to the cathode(s).
- Reset pin.

Embedded instruction codes can be complex, including commands to reposition the cursor at a specific screen location, backspace-and-erase, scroll the display, and erase all characters on the screen. Codes may be included to adjust screen brightness and to switch the display between light-on-dark (negative) and dark-on-light (positive) characters.

Some display modules also have graphics capability, allowing the user to address any individual pixel on the screen.

Because of the lack of standardization in control codes, manufacturer's datasheets must be consulted to learn the usage of a particular alphanumeric display module. In addition to datasheets, online user forums are a valuable source of information regarding quirks and undocumented features.

What Can Go Wrong

Temperature Sensitivity

Liquid crystals vary in their tolerance for low and high temperatures, but generally speaking, a higher voltage may be necessary to create a sufficiently dense image at a low temperature. Conversely, a lower voltage may be necessary to avoid "ghosting" at a high temperature. An absolutely safe operating temperature range is likely to be 0 through 50 degrees Celsius, but check the manufacturer's datasheet for confirmation. Special-purpose LCDs are available for extreme temperatures.

Excessive Multiplexing

A twisted nematic display is likely to perform poorly if its duty cycle is greater than 1:4. In other words, more than four displays should not be multiplexed by the same controller.

DC Damage

An LCD can be damaged quickly and permanently if it is subjected to DC current. This can occur by accident if, for example, a timer chip is being used to generate the AC pulse stream, and the timer is accidentally disconnected, or has an incorrect connection in its RC network. Check timer output with a meter set to measure AC volts before allowing any connection to the common pin of an LCD.

Bad Communications Protocol

Many alphanumeric display modules do not use a formal communications protocol. Duplex serial or I2C connection may not be available. Care must be taken to allow pauses of a few milliseconds after execution of embedded commands, to give the display sufficient time to complete the instruction. This is especially likely where a command to clear all characters from the screen has to be executed. If garbage characters appear on the screen, incorrect data transfer speed or lack of pause times may be to blame.

Wiring Errors

This is often cited by manufacturers as the most common cause of failure to display characters correctly, or lack of any screen image at all.

incandescent lamp

18

The terms *incandescent light*, *incandescent bulb*, and *incandescent light bulb* are often used interchangeably with **incandescent lamp**. Because the term "lamp" seems to be most common, it is used here. A *panel-mounted indicator lamp* is considered to be an assembly containing an incandescent lamp.

A *carbon arc*, which generates light as a self-sustaining spark between two carbon electrodes, can be thought of as a form of incandescent lamp, but is now rare and is not included in this encyclopedia.

OTHER RELATED COMPONENTS

- **LED area lighting** (see Chapter 23)
- **LED indicator** (see Chapter 22)
- **neon bulb** (see Chapter 19)
- **fluorescent light** (see Chapter 20)

What It Does

The term *incandescent* describes an object that emits visible light purely as a consequence of being hot. This principle is used in an **incandescent lamp** where a wire *filament* glows as a result of electric current passing through it and raising it to a high temperature. To prevent oxidation of the filament, it is contained within a sealed bulb or tube containing an inert gas under low pressure or (less often) a vacuum.

Because incandescent lamps are relatively inefficient, they are not considered a wise environmental choice for area lighting and have been prohibited for that purpose in some areas. However, small, low-voltage, panel-mount versions are still widely available. For a summary of advantages of miniature incandescent lamps relative to **light-emitting diodes** (LEDs) see "Relative Advantages" on page 179.

Schematic symbols representing an incandescent lamp are shown in Figure 18-1. The symbols are all functionally identical except that the one at bottom right is more likely to be used to represent small panel-mounted indicators.

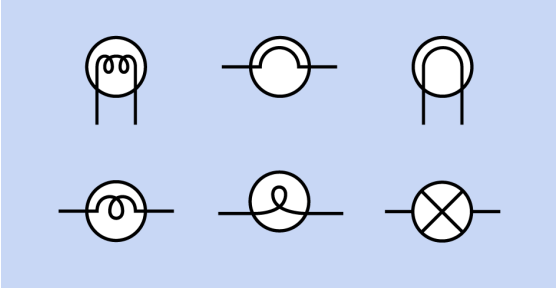

Figure 18-1. *A variety of symbols can represent an incandescent lamp. The one at bottom right may be more commonly used for small panel-mounted indicators.*

The parts of a generic incandescent light bulb are identified in Figure 18-2:

A: Glass bulb.

B: Inert gas at low pressure.

C: Tungsten filament.

D: Contact wires (connecting internally with brass base and center contact, below).

E: Wires to support the filament.

F: Internal glass stem.

G: Brass base or cap.

H: Vitreous insulation.

I: Center contact.

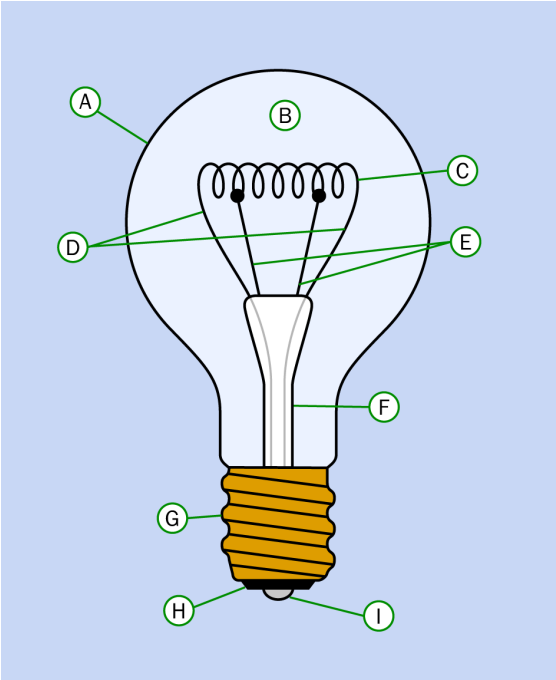

Figure 18-2. *The parts of a typical incandescent lamp (see text for details).*

History

The concept of generating light by using electricity to heat a metal originated with Englishman Humphrey Davy, who demonstrated it with a large battery and a strip of platinum in 1802. Platinum was thought to be suitable because it has a relatively high melting point. The lamp worked but was not practical, being insufficiently bright and having a short lifespan. In addition, the platinum was prohibitively expensive.

The first patent for an incandescent lamp was issued in England in 1841, but it still used platinum. Subsequently, British physicist and chemist Joseph Swan spent many years attempting to develop practical carbon filaments, and obtained a patent in 1880 for *parchmentized thread*. His house was the first in the world to be illuminated by light bulbs.

Thomas Edison began work to refine the electric lamp in 1878, and achieved a successful test with a carbonized filament in October 1879. The bulb lasted slightly more than 13 hours. Lawsuits over patent rights ensued. Carbonized filaments were used until a tungsten filament was patented in 1904 by the German/Hungarian inventor Just Sándor Frigyes and the Croatian inventor Franjo Hanaman. This type of bulb was filled with an inert gas, instead of using a vacuum.

Many other pioneers participated in the effort to develop electric light on a practical basis. Thus it is incorrect to state that "Thomas Edison invented the light bulb." The device went through a very lengthy process of gradual refinement, and one of Edison's most significant achievements was the development of a power distribution system that could run multiple lamps in parallel, using filaments that had a relatively high resistance. His error was insisting on using *direct current* (DC) while his rival Westinghouse pioneered *alternating currrent* (AC), enabling power transmission over longer distances through the use of **transformers**. The use of AC also enabled Tesla's brushless induction motor.

By the mid-1900s, most incandescent bulbs used tungsten filaments.

How It Works

All objects emit electromagnetic radiation as a function of their temperature. This is known as *black body radiation*, based on the concept of an object that absorbs all incoming light, and thus does not reflect any sources from outside itself. As its temperature increases, the intensity of the

radiation increases while the wavelength of the radiation tends to decrease.

If the temperature is high enough, the wavelength of the radiation enters the visible spectrum, between 380 and 740 nanometers. (A nanometer is one-billionth of a meter.)

The melting point of tungsten is 3,442 degrees Celsius, but a lamp filament typically operates between 2,000 and 3,000 degrees. At the higher end of this scale, evaporation of metal from the filament tends to cause deposition of a dark residue on the inside of the bulb, and erodes the filament more rapidly, to the point where it eventually breaks. At the lower end of this scale, the light will be yellow and the intensity will be reduced.

Spectrum

The color of black-body radiation is measured using the Kelvin temperature scale. The increment of 1 degree Kelvin is the same as 1 degree Celsius, but the Kelvin scale has a zero value at *absolute zero*. This is the theoretical lowest conceivable temperature, at which there is complete absence of heat. It is approximately –273 degrees Celsius.

From this it is evident that if K is a temperature in degrees Kelvin and C is a temperature in degrees Celsius:

$$K = C + 273 \text{ (approximately)}$$

Calibration of light sources in degrees Kelvin is common in photography. Many digital cameras allow the user to specify the *color temperature* of lights that are illuminating an indoor scene, and the camera will compensate so that the light source appears to be pure white with all colors in the visible spectrum being represented equally.

Some computer monitors also allow the user to specify a white value in degrees Kelvin.

Color temperature is used in astronomy, because the spectrum of many stars is comparable with that of a theoretical black body.

A color temperature of 1,000 degrees K will have a dark orange hue, while 15,000 degrees K or higher will have a blue hue comparable to that of a pale blue sky. The color temperature of the sun is approximately 5,800 K. Interior lighting is often around 3,000 K, which many people find acceptable because it creates pleasant flesh tones. An incandescent bulb described by the manufacturer as "soft white" or "warm" will have a lower color temperature than one which is sold as "pure white" or "paper white."

Graphs showing the emission of wavelengths at various color temperatures are shown in Figure 18-3. The rainbow section indicates the approximate range of visible wavelengths between ultraviolet, on the left, and infrared, on the right. For purposes of clarity, the peak intensity for each color temperature has been equalized. In reality, increasing the temperature also increases the light output.

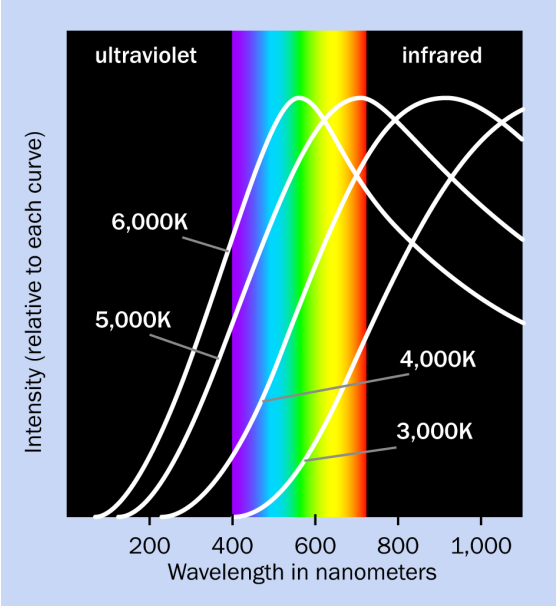

Figure 18-3. *Approximate peak wavelengths for black-body radiation at various color temperatures in degrees Kelvin. The curves have been adjusted so that their peak values are equalized. Adapted from an illustration in the reference book Light Emitting Diodes by E. Fred Schubert.*

Non-Incandescent Sources

So long as light is generated by heating a filament, plotting the intensity against wavelength will result in a smooth curve without irregularities. A higher Kelvin value will simply displace and compress the curve laterally without changing its basic shape to a significant degree.

The introduction of **fluorescent** sources and, subsequently, light-emitting diodes (**LEDs**) has complicated this scenario. Because they are *luminescent* rather than *incandescent*, they do not generate an evenly weighted, continuous range of wavelengths.

LEDs tend to emit monochromatic light, meaning that it is tightly centered around just one color. A "white" LED is really a blue LED in which a phosphor coating on the semiconductor die is excited to create light over a broader range. A fluorescent light tends to create *spectral lines* which show up as sharp peaks at a few wavelengths determined by the mercury inside the bulb. Figure 18-4 illustrates these problems.

The human eye tends to compensate for the yellow emphasis of incandescent lamps and for the irregularities in spectra emitted by other light sources. Also, the eye is often unable to distinguish between "white" light created as a mix of all the visible wavelengths, and light that appears white even though it is dominated by a few isolated wavelengths from a fluorescent source.

However, when the eye views colors that are illuminated by a source that has gaps in its spectrum, some of the colors will appear unnaturally dull or dark. This is true also if an imperfect source is used as a backlight to create colors on a video monitor. Colors rendered by different light sources are shown in Figure 23-7 and subsequent figures.

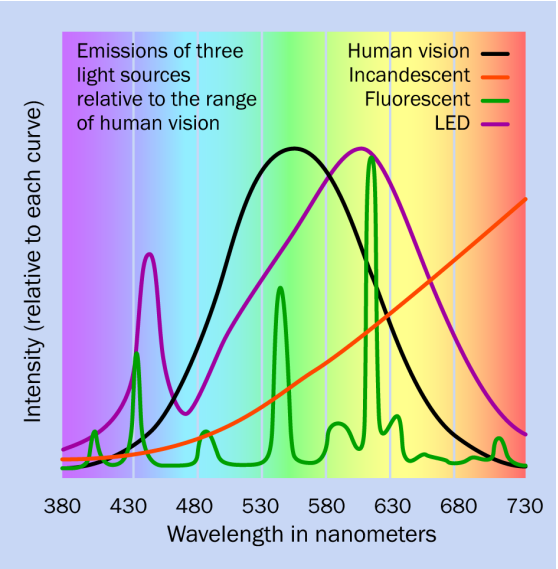

Figure 18-4. *The relative performance of three light sources compared with sensitivity of the human eye to the visible spectrum. Note that the range of wavelengths on the horizontal scale in this figure is not the same as the range in the previous figure. The color assigned to each curve is arbitrary. Adapted from VU1 Corporation.*

Photography is adversely affected by the use of LEDs or fluorescents as a light source. Reds, for example, can seem dark when lit by white LEDs, while blues can be inappropriately intense. Because the source does not have an emission curve comparable to that of an incandescent light, the auto-white balance feature of a digital camera may be unable to address this problem, and it cannot be resolved by entering a different Kelvin number manually.

The fidelity with which a light source is capable of displaying the full visible spectrum is known as the *color rendering index* (CRI), ranging from a perfect score of 100 down to 0 or even lower (sodium-vapor street lighting has a negative value). Computing the index requires standard reference color samples and has been criticized for generating scores that do not correlate well with subjective assessments.

Incandescent bulbs can have a CRI of 100, while an uncorrected "white" LED may score as low as 80.

Power Consumption

Approximately 95% of the power consumed by an incandescent lamp generates heat instead of visible light. This wastage of power in room lighting is compounded by the power consumption of air conditioning to remove the heat from enclosed spaces in hot climates. While the heat from incandescent lamps does reduce the need for space heating in cold environments, heat is delivered more efficiently by using systems designed for that purpose. Consequently, greater energy efficiency can be achieved with a light source that generates less heat, regardless of ambient air temperature.

Variants

Miniature Lamps

Prior to the development of **LED**s, all light-emitting panel-mounted indicators were either **neon bulbs** or **incandescent lamps**. The use of neon is limited by its need for a relatively high voltage.

Miniature incandescents were the traditional choice for battery-powered light sources, and at the time of writing are still used in cheap flashlights. Variants are available that are as small as a 5mm LED, with a claimed life expectancy that is comparable, although they draw more current to generate an equivalent light intensity, because much of their power is wasted in infrared wavelengths.

The photograph in Figure 18-5 is of a miniature lamp terminating in pins spaced 0.05" apart. The total height of the lamp, including its ceramic base, is less than 0.4," while its diameter is just over 0.1". It draws 60mA at 5V and is rated for 25,000 hours.

The photograph in Figure 18-6 is of a lamp of similar size and power consumption, but terminating in wire leads and rated for 100,000 hours. It emits 0.63 lumens.

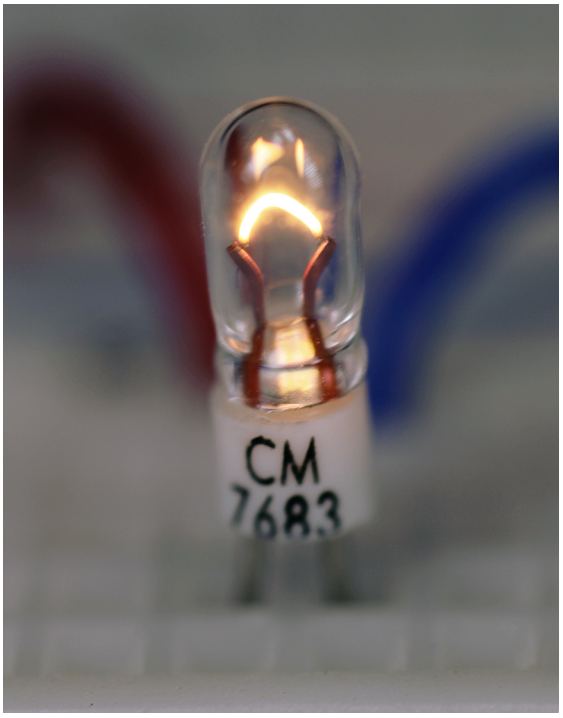

Figure 18-5. *A miniature lamp less than 0.4" high, terminating in pins spaced 0.05" apart.*

Figure 18-6. *This lamp is 0.25" high and terminates in wire leads.*

The lamp pictured in Figure 18-7 is slightly larger, with a glass envelope about 0.25" diameter. It is rated for less than half the lifetime of the lamp in Figure 18-6 but emits three times as much light —a typical tradeoff. Various base styles are available.

Figure 18-7. *This lamp has a glass envelope about 0.35" high. Its screw-in base makes it easier to replace than an LED.*

In the United States, the light output from miniature incandescent lamps may be measured in lumens, but is more often rated in *mean spherical candlepower* (MSCP). An explanation of light measurement is included in "MSCP" on page 178.

Lamp lenses provide a quick and simple way to add color to a miniature incandescent lamp. Usually the lens is cylindrical with a hemispherical end cap, and is designed to push-fit or snap-fit over a small lamp. Even when the cap is translucent, it may still be referred to as a lens.

Panel-Mount Indicator Lamps

This term often refers to a tubular assembly containing a miniature lamp, ready for installation.

The enclosure is often designed to snap-fit into a hole drilled in the panel. If the incandescent bulb inside the enclosure cannot be replaced, the component is said to be "non-relampable." Figure 18-8 shows a 12-volt panel-mount indicator lamp.

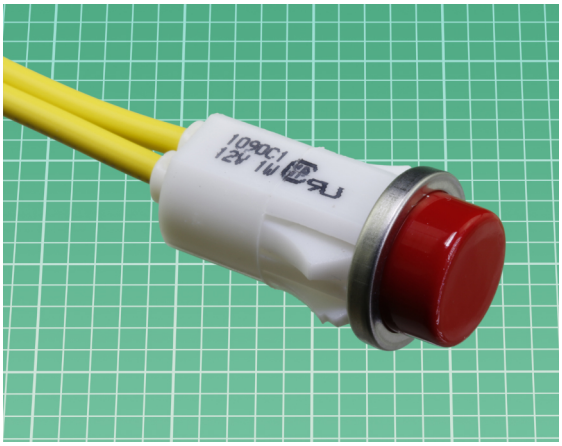

Figure 18-8. *This panel-mount indicator lamp is designed to push-fit into a hole 1/2" in diameter. The bulb inside it is not replacable, causing the assembly to be classified as "non-relampable."*

Halogen or Quartz-Halogen

This is a type of incandescent lamp containing gases under pressure in which halogens such as iodine or bromine cause evaporated tungsten atoms to be redeposited on the filament. A halogen lamp can therefore operate at a higher temperature, creating a light that is less yellow and brighter than that from a comparable incandescent lamp. It also enables a smaller bulb, but requires an envelope of borosilicate-halide glass (often termed *fused quartz*) instead of regular glass. A halogen lamp will be slightly more efficient than an incandescent bulb of the same wattage, and will last longer.

Halogens are available in a variety of formats. The small bulb pictured in Figure 18-9 consumes 75W, emitting 1,500 lumens at 3,000 degrees Kelvin. The light intensity is claimed to be equivalent to that of a 100W incandescent bulb. It has a mini-candelabra base.

Oven Lamps

Oven lamps are designed to withstand the high temperature in an oven. Typically they are usable with ambient temperatures up to 300 degrees C. A common power rating is 15W.

Figure 18-9. *A halogen bulb slightly more than 2" in length, designed for 115VAC.*

Base Variants

Miniature lamps are available with a wide variety of connection options, including wire terminals, single-contact bayonet, double-contact bayonet, miniature screw base, and fuse style. Most of these options require a matching socket.

Screw-in lamps for room illumination are common in household lighting in the United States and many other countries (but not in the UK, where bayonet fittings are used). The US socket size is designated by letter E followed by a number that gives the socket diameter in millimeters. Common sizes are E10, E14 and E27.

A *bayonet base* is fitted with two small lugs protruding on opposite sides. The lamp is secured by pushing it in and twisting it to engage the lugs in slots in the socket. The advantage of a bayonet base is that the bulb is less likely to become loose as a result of vibration.

A *pin base* consists simply of a pair of pins that will push-fit into small holes in a socket.

A *flange base* has a flange that engages in a socket where flexible segments will retain it.

A *wedge base* is forced between two contacts which retain the bulb by friction.

Some indicator lamps terminate simply in long, thin leads that can be soldered.

Values

While the power consumption of full-size incandescent lamps is rated in watts, small indicator lamps are rated in milliamps at the voltage for which they are designed. Miniature lamps may require specific voltages ranging from as low as 2V to 24V. A higher voltage generally necessitates a longer filament, which may entail a larger bulb.

The light that a lamp will emit can be measured in two ways: either as the power of the lamp (not its power consumption, but its radiating power), or as the light delivered to a specific area at a specific distance. These two measurements may differ because a lamp may concentrate its light in a beam, as in the case of a reflector bulb or an LED.

Power

Flux, in watts, is a measurement of energy flow in joules per second. The total radiating power of a lamp, in all wavelengths, in all directions, is known as its *radiant flux*. Because invisible wavelengths are of little interest when assessing the brightness of a lamp, the term *luminous flux* is used to describe the apparent brightness of the lamp in the visible spectrum. The unit for luminous flux is the *lumen*.

The human eye is most responsive to yellow-green hues in the center of the spectrum. Consequently, the measurement of luminous flux is

weighted toward green at a wavelength of 555 nanometers. Red and violet are considered to have low luminous flux, while infrared and ultraviolet have a zero value.

When considering a value expressed in lumens, remember:

- Lumens are a measure of the total radiated power output of a light source, in all directions, in the visible spectrum only, weighted toward the characteristics of the human eye.
- The number of lumens of a light source does not define the direction in which the light is shining, or its uniformity.
- The abbreviation for lumen is *lm*.

A conventional incandescent lamp that consumes 100W of electricity is likely to have a light output of about 1,500 lumens. A 40W fluorescent tube can have a light output of about 2,600 lumens.

Illuminance

The *illuminance* of a light source is defined as the luminous flux per unit of area. This can be thought of as the brightness of a surface illuminated by the source.

Illuminance is measured in *lux*, where 1 lux = 1 lumen per square meter. For accurate calibration, the illuminated surface should be spherical in shape, and must be located 1 meter from the light source, with the source at the geometrical center of the sphere.

Illuminance used to be measured in *foot-candles*, where 1 foot-candle was 1 lumen per square foot.

- The number of lumens per square meter (lux) does not define the size of the illuminated area, only the brightness per unit of area.
- A lamp that has a tightly focused beam can achieve a high lux rating. When selecting a lamp for an application, the angle of dispersion of the beam must be considered in conjunction with its lux rating.

Intensity

A *candela* measures the luminous flux within an angle of dispersion. The angle is three-dimensional, and can be imagined as the sharpness of a point of a cone, where the light source is at the point and the cone represents the dispersion of light.

The three-dimensional angle of dispersion is measured in *steradians*. If a light source is at the center of a sphere that has a radius of 1 meter, and is illuminating one square meter of the surface of the sphere, the angle of dispersion is 1 steradian.

- A source of 1 lumen which projects all its light through a dispersion angle of 1 steradian is rated at 1 candela.
- The number of candelas does not define the angle of dispersion, only the intensity within that angle.
- A light source rated for 1,000 candelas could have a power of 10 lumens concentrated within an angle of 0.01 steradians, or could have a power of only 1 lumen concentrated within an angle of 0.001 steradians.
- There are 1,000 millicandelas in 1 candela. The abbreviation for candela is *cd* while the abbreviation for a millicandela is *mcd*.
- LEDs are often rated in mcd. The number describes the intensity of light within its angle of dispersion.

MSCP

Although the term *candlepower* is obsolete, it has been redefined as being equal to 1 candela. *Mean spherical candlepower* (MSCP) is a measurement of all the light emitted from a lamp in all directions. Because the light is assumed to be omnidirectional, it fills 4 * π (about 12.57) steradians. Therefore 1 MSCP = approximately 12.57

lumens. In the United States, MSCP is still the most common method of rating the total light output of a miniature lamp.

Efficacy

The *radiant luminous efficacy* (abbreviated *LER*) assesses how effective a lamp is at channeling its output within the visible spectrum, instead of wasting it in other wavelengths, especially infrared. LER is calculated by dividing the power emitted in the visible spectrum (the *luminous flux*) by the power emitted over all wavelengths.

Thus, if VP is the power emitted in the visible spectrum, and AP is the power emitted in all wavelengths:

```
LER = VP / AP
```

LER is expressed in *lumens per watt*. It can range from a low value of around 12 lm/W for a 40W incandescent bulb to 24 lm/W for a quartz halogen lamp. Fluorescent lamps may average 50 lm/W. LEDs vary, but can achieve 100 lm/W.

Efficiency

The *radiant luminous efficiency* (abbreviated *LFR*) of a lamp measures how good its radiant luminous efficacy is, compared with an imaginary ideal lamp. (Note the difference between the words "efficiency" and "efficacy.") LFR is determined by dividing the radiant luminous efficacy (LER) by the maximum theoretical LER value of 683 lm/W, and multiplying by 100 to express the result as a percentage. Thus:

```
LFR = 100 * ( LER / 683 )
```

The LFR ranges from around 2% for a 40W bulb to 3.5% for a quartz halogen lamp. LEDs may be around 15% while fluorescents are closer to 10%.

How to Use It

When first introduced, LEDs were limited by their higher price, lower maximum light output, and inability to display blue or white. The price difference has disappeared for small indicators, while gaps in the color range have been filled (although the color rendering index of LEDs is still inferior).

Brightness remains an advantage for large incandescents relative to LEDs, as they are more upwardly scalable. However, fluorescents and vapor lamps have an advantage for very high light output, as in the lighting of big-box stores or parking lots. Thus the range of applications for incandescent bulbs is diminishing, especially because common types are now illegal for domestic light fixtures in many parts of the world.

Relative Advantages

When choosing whether to use an incandescent lamp or an LED, these advantages of an incandescent lamp should be considered:

- The intensity can be adjusted with a **triac**-based dimmer. Regular fluorescents cannot be dimmed, while LEDs often require different dimmer circuitry.
- The intensity can also be adjusted with a rheostat. The output from fluorescents cannot.
- Easy white-balance correction. LEDs and fluorescents do not naturally produce a consistent output over the visible spectrum.
- Can be designed to operate directly from a wide range of voltages (down to around 2V and up to around 300V). A higher voltage entails a longer filament wire, which may require a larger bulb. LEDs require additional components and circuitry to use higher voltages.
- Incandescent bulbs are more tolerant of voltage fluctuations than LEDs. With battery operation, the incandescent will still provide some reduced light output when the voltage has diminished radically. LEDs will not perform at all at currents lower than their threshold.
- An incandescent is nonpolarized and may be socketed, which simplifies user replacement.

LEDs are polarized and are usually soldered in.

- Can be powered by AC or DC without any modification or additional circuitry. LEDs require DC, which must be provided through a transformer and rectifier, or similar electronics, if AC power is the primary source.
- Can be equally visible from a wide range of viewing angles. LEDs have restricted viewing angles.
- The heat output from an incandescent bulb may occasionally be useful (for example in a terrarium, or in incubators for poultry).
- Trouble-free switching. Fluorescents tend to hesitate and blink when power is applied, and they require a *ballast* to energize them. The lifespan of fluorescents is reduced by frequent switching.
- No low-temperature problems. Incandescent lamps are not significantly affected by low temperatures. Fluorescents may not start easily in a cold environment, and may flicker or glow dimly for 10 minutes (or more) until they are warm enough to function properly.
- Easy disposal. Fluorescent lights contain small quantities of mercury that are an environmental hazard. They should not be mixed with ordinary trash. Compact fluorescent lamps (CFLs) and LEDs used for room lighting will be packaged with electronics that should ideally be recycled, although this is not very practical. Incandescent bulbs impose the least burden on the environment when they are thrown away.

However, the incandescent lamp has some obvious disadvantages:

- Relatively inefficient.
- More susceptible to vibration.
- More fragile.
- Likely to have a shorter natural life expectancy than LEDs, fluorescents, or neon bulbs, although the lifetime of a small panel indicator can be equal to that of an LED if a low color temperature is acceptable.
- Requires a filter or tinted glass envelope to generate colored light. This further reduces the lamp's efficiency.
- Cannot be miniaturized to the same degree as an LED indicator.

Derating

The lifespan of a lamp can be greatly extended by choosing one with a higher current rating or using it at a lower voltage. The light output will be reduced, and the color temperature will be at a lower Kelvin number, but in some situations this tradeoff may be acceptable.

The graphs in Figure 18-10 suggest that if the voltage of a hypothetical miniature lamp is reduced to 80% of the manufacturer's recommended value, this can make the lamp last 20 times as long. Note, however, that this will cut the light intensity to 50% of its normal value.

Conversely, using 130% normal voltage will give 250% of the normal light output, while shortening the life of the lamp to 1/20 of its normal value. Naturally these figures are approximations that may not apply precisely to a specific lamp.

What Can Go Wrong

High Temperature Environment

If an incandescent lamp is used in an environment hotter than 100 degrees Celsius, the life of the lamp is likely to be reduced by the "water cycle." Any water molecules inside the glass envelope will break down, allowing oxygen to combine with the tungsten filament to form tungsten oxide. The tungsten is deposited on the inside of the glass while the oxygen is liberated and begins a new cycle.

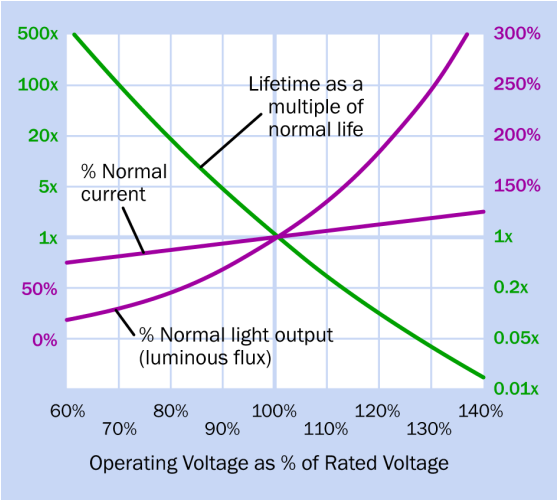

Figure 18-10. *The life expectancy of a hypothetical miniature lamp is very strongly influenced by voltage. Applying only 60% of the rated voltage can make a lamp last 500 times its normal lifespan, although it will greatly reduce light output. Note that the vertical axes apply to curves of the same color. Adapted from "Characteristics of Miniature Lamps" from Toshiba Lighting and Technology Corporation.*

Fire Risk

The partially evacuated bulb of an incandescent lamp provides some separation and protection from the heat in the filament, but if the bulb cannot disperse heat by radiation or convection, its temperature can rise to the point where it ignites flammable materials.

Halogen lamps have an elevated fire risk because they operate at a higher temperature and are smaller, providing less surface area to disperse the heat. They also contain gases under seven to eight atmospheres of pressure. Thermal stress can cause a halogen bulb to shatter, and fingerprints on the glass can increase this risk.

Current Inrush

When an incandescent lamp is first switched on, its filament has one-tenth the resistance that it will exhibit when it becomes hot. Consequently, the lamp will take a large initial surge of current, which stabilizes after about 50 milliseconds. This should be considered if one or more small lamps shares a DC power supply with components such as logic chips that may be sensitive to voltage fluctuations.

Replacement Problems

Because of the limited life of incandescent lamps, they should be installed in such a way that they are easy to replace. This can be an issue with panel indicators, where disassembly of a device may be necessary to reach the lamp.

The range of small incandescent lamps is diminishing, and may continue to diminish in the future. Future availability of replacement lamps should be considered when designing a circuit. When building equipment in small quantities, spare lamps should be purchased for future use.

neon bulb

19

The terms **neon bulb**, *neon indicator*, and *neon lamp* tend to be used interchangeably. In this encyclopedia, a neon *bulb* is defined as a glass capsule containing two electrodes in neon gas (or a combination of gases in which neon is present). A neon *lamp* is an assembly containing a neon bulb, usually using a plastic tube with a tinted transparent cap at one end. A neon *indicator* is a miniature neon lamp that is usually panel-mounted.

Large-scale neon tubes used in signage are not included in this encyclopedia.

OTHER RELATED COMPONENTS

- **incandescent lamp** (see Chapter 18)
- **fluorescent light** (see Chapter 20)
- **LED indicator** (see Chapter 22)

What It Does

When voltage is applied between two electrodes inside a neon bulb, the inert gas inside the bulb emits a soft red or orange glow. This color may be modified by using a tinted transparent plastic cap, known as a *lens*, in a *neon lamp* assembly.

A neon bulb is usually designed for a power supply of 110V or higher. It functions equally well with alternating or direct current.

The schematic symbols in Figure 19-1 are commonly used to represent either a neon bulb or a neon lamp. They are all functionally identical. The black dot that appears inside two of the symbols indicates that the component is gas filled. The position of the dot inside the circle is arbitrary. Even though all neon bulbs are gas filled, the dot is often omitted.

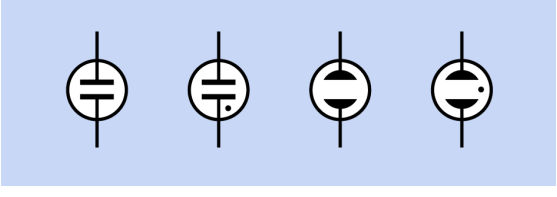

Figure 19-1. *Any of these symbols may represent a neon bulb or a neon lamp. The dot in two of the symbols indicates that the component is gas filled. All neon bulbs are gas filled, but the dot is often omitted.*

The photograph in Figure 19-2 shows a neon bulb with a series resistor preattached to one lead. Many bulbs are sold in this configuration, because a resistor must be used to limit current through the bulb. The bulb has no polarity and can be used on an AC or DC power supply. The same bulb is shown in its energized state in Figure 19-3.

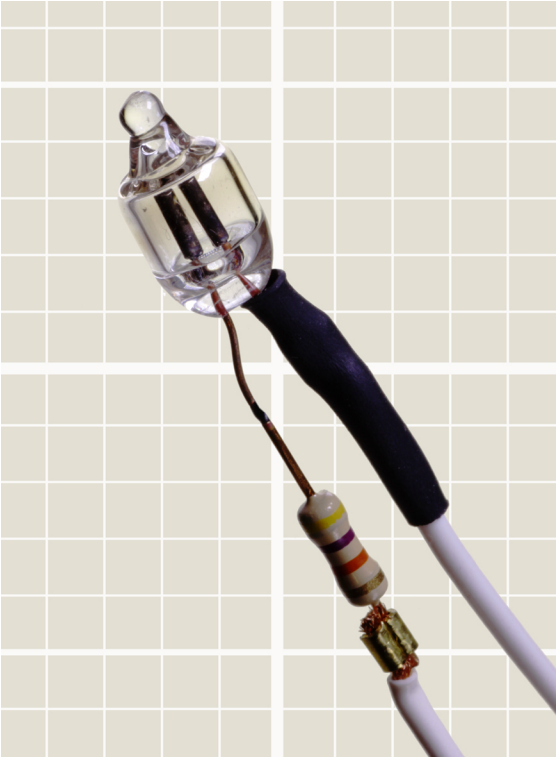

Figure 19-2. *A typical neon bulb with series resistor attached to one lead.*

How It Works

Construction

The parts of a neon bulb are illustrated in Figure 19-4. When the bulb is fabricated, it begins as a glass tube. The leads are made of *dumet*, consisting of a copper sheath around a nickel iron core. This has the same coefficient of expansion as glass, so that when the glass is heated and melted around the leads, it forms a seal that should be unaffected by subsequent temperature fluctuations. This area is known as the *pinch* in the tube.

Nickel electrodes are welded onto the leads before the leads are inserted into the tube. The electrodes have an emissive coating that reduces the minimum operating voltage. The glass tube is filled with a combination of neon and argon gases, or pure neon for higher light output (which reduces the life of the component). The top end of the glass tube is heated until it melts, and is pinched off. This creates a distinctive protrusion known as the *pip*.

Figure 19-3. *The same bulb from the previous photograph, energized with 115VAC.*

Ionization

When a voltage is applied between the leads to the bulb, the gas becomes ionized, and electrons and ions are accelerated by the electric field. When they hit other atoms, these are ionized as well, maintaining the ionization level. Atoms are excited by collisions, moving their electrons to higher energy levels. When an electron returns from a higher level to a ground state, a photon is emitted.

This process begins at the *starting voltage* (also known as the *striking voltage*, the *ignition voltage*, or the *breakdown voltage*) usually between 45V and 65V for standard types of bulb, or between 70V and 95V for high-brightness types.

When the bulb is operating, it emits a soft radiance known as a *glow discharge* with a wavelength ranging from 600 to 700 nanometers.

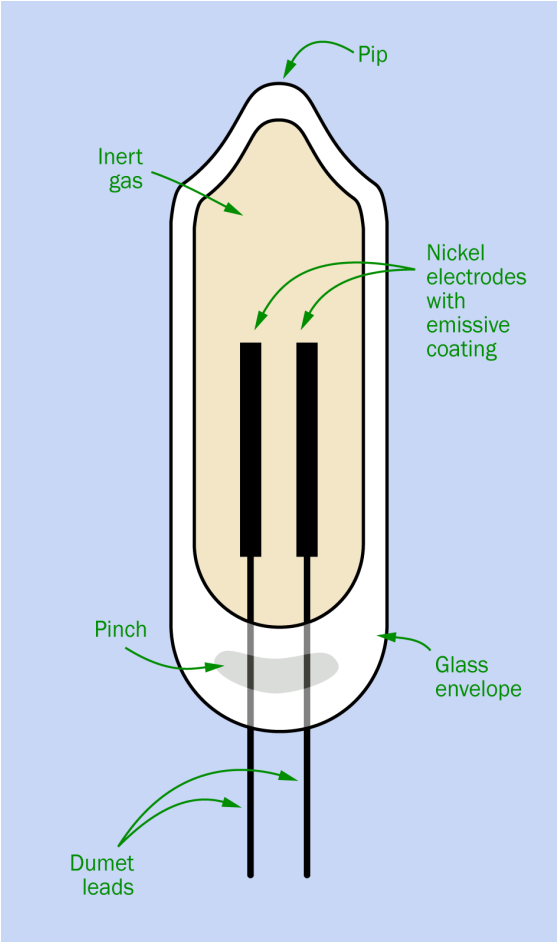

Figure 19-4. *The parts of a neon bulb. See text for details.*

The ionization of the gas allows current to flow through it. This will continue even if the power supply is reduced by 10 to 20 volts to a level known as the *maintaining voltage*.

Negative Resistance

When the glow discharge persists below the starting voltage, this is a form of *hysteresis*, meaning that the neon bulb tends to "stick" in its on state. It remains on while its power supply decreases to the maintaining voltage, but once it switches off, it will "stick" in its off state until the power supply increases again above the maintaining voltage to the starting voltage. The concept of hysteresis is discussed in the entry on **comparators**. See Figure 6-2.

A neon bulb is said to have *negative resistance*. If the current is allowed to increase without restraint, the resistance eventually decreases while the current increases further. If this runaway behavior is not controlled, the bulb will destroy itself.

This behavior is characteristic of gas-discharge tubes generally. A graph showing this appears in Figure 19-5. Note that both scales are logarithmic. Also note that the curve shows how current will be measured in response to voltage. If the voltage is reduced after it has increased, the transitional events shown by the graph will not recur in reverse order. This is especially true if arcing is allowed to begin, as it will almost certainly destroy the component.

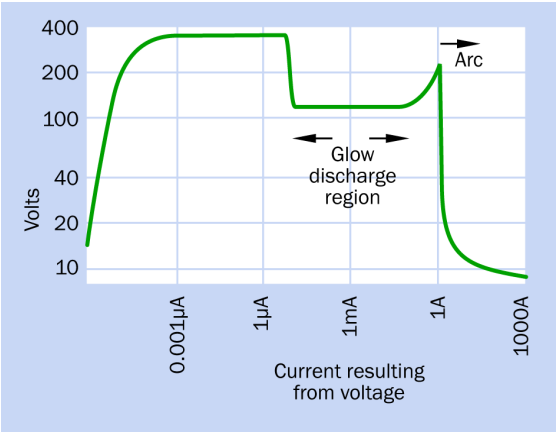

Figure 19-5. *A gas discharge tube, such as a neon bulb, is said to have a negative resistance, as current passing through it tends to increase uncontrollably after the gas is ionized and becomes conductive. (Derived from measurements made by David Knight, on a web page named after his radio ham call sign, G3YNH.)*

A neon bulb can be controlled very simply with a series resistor that maintains it in gas-discharge mode. To understand the operation of the resistor, consider the combination of the lamp and

the resistor as a voltage divider, as shown in Figure 19-6. Before the lamp begins to pass current, it has an almost infinite resistance. Therefore, the voltage on both sides of the resistor will be approximately equal, the bulb passes almost no current, and it remains dark.

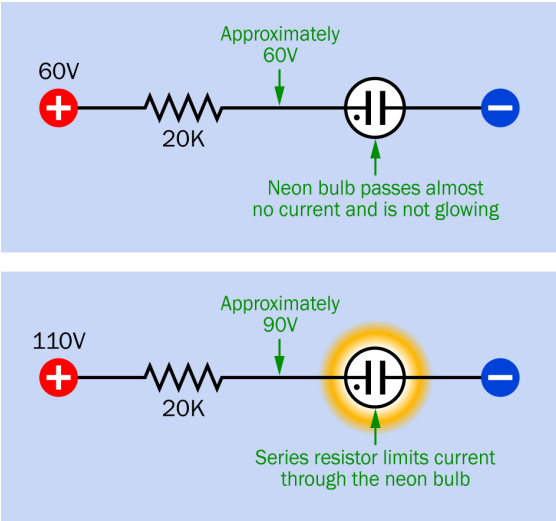

Figure 19-6. *A series resistor is essential to limit the current through a neon bulb.*

After the lamp begins to pass current, the requirement now is for the series resistor to reduce the voltage from the supply level (probably around 110V) to the maintaining level (probably around 90V). This means that the desired voltage drop is 20V, and if the manufacturer's specification tells us that the lamp should pass 1mA (i.e., 0.001 amps), R, the value of the series resistor, is given by Ohm's Law:

```
R = 20 / 0.001
```

Thus, the value for R is 20K. In fact, the value of a resistor supplied with a neon bulb may range from 10K to 220K, depending on the characteristics of the bulb and the supply voltage that will be used.

Now if the bulb's effective internal resistance falls radically, the resistor still limits the currrent. In a hypothetical worst-case scenario, if the bulb's resistance drops all the way to zero, the resistor must now impose the full voltage drop of 110V, and the current, I, will be found by Ohm's law:

```
I = 110 / 20,000
```

That is, about 5mA, or 0.005A.

Neon tubes used in signage require a more sophisticated voltage control circuit which is not included in this encyclopedia.

How to Use It

The use of a neon bulb for an indicator lamp is primarily limited to situations where domestic supply voltage (115VAC or 220VAC) is readily available. "Power on" lights are the obvious application, especially as neon indicators can accept AC. The switch shown in Figure 19-7 is illuminated by an internal neon bulb. The rectangular indicator in Figure 19-8 is designed to run on domestic supply voltage, and its internal bulb and resistor can be clearly seen through the green plastic. The assembly in Figure 19-9 is about 0.5" in diameter, which is the lower limit for neon indicators.

Figure 19-7. *This power switch is illuminated by an internal neon bulb.*

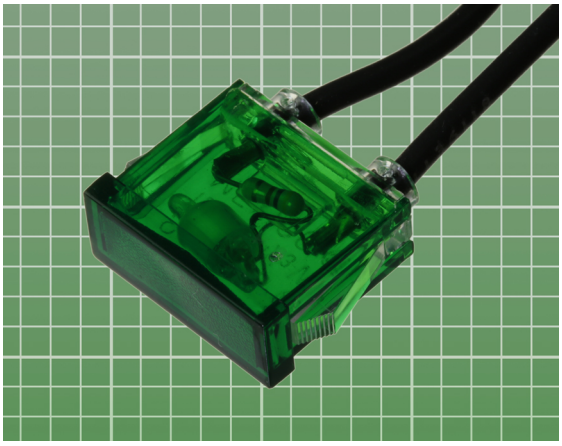

Figure 19-8. *The neon bulb and its series resistor are visible inside this indicator.*

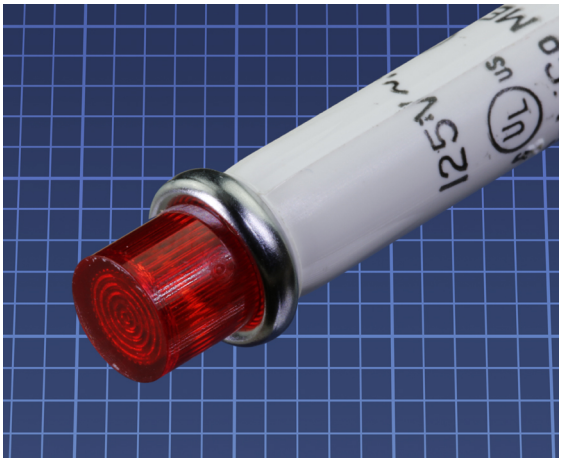

Figure 19-9. *A relatively small neon indicator lamp, designed for insertion in a hole 0.5" diameter.*

Limited Light Output

Neon bulbs have a light output of around 0.06 lumens per milliamp of consumed power (standard brightness type) or 0.15 lumens per milliamp of consumed power (high brightness type).

Comparing this value with the intensity of **LED** indicators is difficult. Their light output is customarily measured in *millicandelas* (mcd), because LED indicators almost always include a lens that focuses the light, and the candela is a measurement of luminous flux within an angle of dispersion. Moreover, because the intensity of neon indicators is not of great interest in most applications, datasheets usually do not supply an intensity value.

One way around the problem of comparisons is to use the standard of *radiant luminous efficacy* (LER), which is defined in the entry on incandescent lamps (see "Efficacy" on page 179). A standard-brightness neon bulb has an LER of about 50 lumens per emitted watt of luminous flux. A light-emitting diode may reach an LER of 100 lm/W. However, a neon bulb operates typically around 1mA while an LED indicator may use 20mA. Therefore, a typical LED indicator may appear to be 30 to 50 times brighter than a typical neon bulb.

Consequently, neon may be an inferior choice in a location where there is a high level of ambient light. Direct sunlight may render the glow of a neon indicator completely invisible.

Efficiency

Because a neon bulb does not use a lot of power and generates negligible heat, it is a good choice where current consumption is a consideration (for example, if an indicator is likely to be on for long periods). The durability and low wattage of neon bulbs, and their convenient compatibility with domestic power-supply voltage, made them a favorite for night-lights and novelty lamps in the past. Figure 19-10 shows an antique bulb containing an ornamental electrode, while Figure 19-11 is a piece of folk art, approximately 1" in diameter, mounted on a plug-in plastic capsule containing a neon bulb.

Ruggedness

Neon bulbs are a good choice in difficult environments, as they are not affected by vibration, sudden mechanical shock, voltage transients, or frequent power cycling. Their operating temperature range is typically from -40 to +150 degrees Celsius, although temperatures above 100 degrees will reduce the life of the lamp.

Figure 19-10. *In bygone decades, ornamental neon bulbs with specially shaped electrodes were popular.*

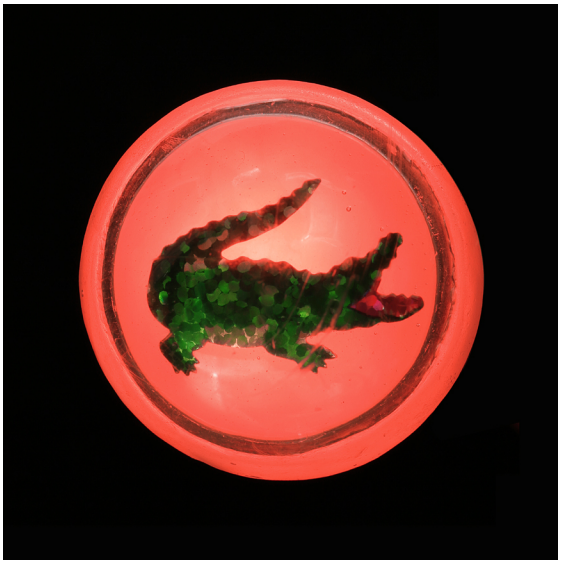

Figure 19-11. *Neon folk art survives in this hand-painted night-light sold in a Florida tourist shop.*

Power-Supply Testing

When driven by DC current, only the negative electrode (the *cathode*) of a neon bulb will glow. When AC current passes through the bulb, both terminals will glow.

If a bulb (with series resistor) is placed between the "hot" side of a domestic AC power supply and ground, the bulb will glow. If it is placed between the neutral side of the supply and ground, it will not glow.

These features enable a neon bulb to be used for simple power-supply testing.

Life Expectancy

The metal of the electrodes gradually vaporizes during everyday use of a neon bulb. This is known as *sputtering* and can be observed as the glass capsule becomes darkened by deposition of vaporized metal. The electrodes will have a more limited life in a lamp used with DC voltage, where sputtering affects only the cathode. Using AC, the electrodes take turns functioning as the cathode, and vaporization is distributed between both of them.

Failure of a neon lamp can occur as sputtering erodes the electrodes to the point where the maintaining voltage will increase until it almost reaches the level of the power supply. At this point, the bulb will flicker erratically.

Failure can also be defined as a gradual reduction in brightness to 50% of rated light output, caused by accumulated deposition in the glass capsule. Because deposition occurs more heavily on the sides of the bulb, a longer apparent life is possible if the bulb is mounted so that it is viewed from the end.

Typically, neon bulbs are rated for 15,000 to 25,000 hours (two to three years of constant operation). However, the life can be greatly increased by a slight reduction in voltage, which may be achieved by substituting a series resistor with a slightly higher value.

The relationship between operating life and resistor value is shown below. If LA is the normal operating life, LB is the extended operating life,

RA is the normal resistor value, and RB is a higher resistor value:

$$LB = LA * (RB / RA)^{3.3}$$

For example, if a normal resistor value is 20K, and it is increased to 22K, the life of the lamp should increase by a factor of slightly more than 1.4.

Variants

A typical neon bulb terminates in leads, and a lamp assembly often has solder tabs, although it may have a base with a screw thread, flange, or bayonet pins for insertion into a compatible socket. A lamp assembly that does not use a base will either snap-fit into a hole of appropriate size and shape, or may be retained with a nut that engages with a plastic thread on the cylinder of the lamp.

Some neon bulbs or lamp assemblies terminate in pins for direct insertion into a printed circuit board.

Almost all neon bulbs operate either in the 100V to 120V range or in the 220V to 240V range.

Light intensity is expressed either as "standard" or "extra-bright," although datasheets usually do not define those terms.

Nixie Tubes

Nixie tubes, first marketed in 1955, were used to display numerals from 0 through 9 in the days before LEDs took over this capability. They are no longer being manufactured.

Each numeral was physically formed from metal and functioned as an electrode inside a tube filled with a neon-based gas mixture. The typographical elegance of the digits and their aesthetically pleasing glow made Nixies enduringly popular. With a long lifespan, vintage tubes are still usable and can be purchased cheaply from sources such as eBay. Many originate in Russia, where Nixie-type displays were manufactured into the 1980s. The Russian tubes can be identified by their use of a numeral 5 that is a numeral 2 turned upside-down.

Nixie tubes typically require 170VDC. This creates a challenge for a power supply and switching, and can be a safety hazard.

Figure 19-12 shows six Nixie-type tubes repurposed for use as a 24-hour digital clock.

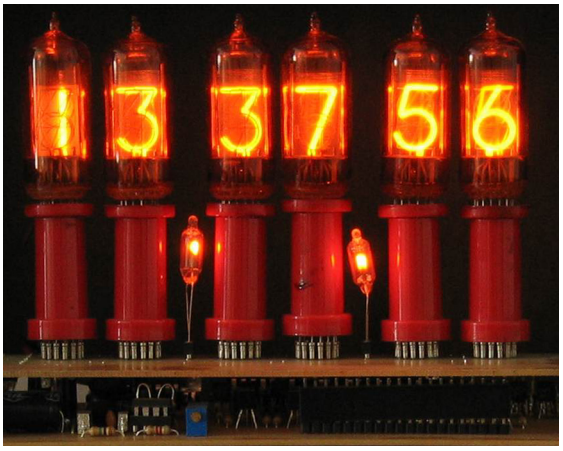

Figure 19-12. *A 24-hour clock using Nixie-type tubes. Source: Wikipedia, public domain.*

What Can Go Wrong

False Indication

Because a neon bulb requires so little power, it may be energized by induced voltages from elsewhere in a circuit, especially if inductive components such as transformers are used. To prevent this, a high-value resistor can be placed in parallel with the bulb, in addition to the series resistor that must always be used.

Failure in a Dark Environment

Because a neon bulb requires a minimal amount of light to initiate its own photon emissions, it may take time to start glowing in a very dim environment, and may not light at all in total darkness. A few bulbs include a small amount of radioactive material that enables them to self-start in complete absence of ambient light.

Premature Failure with DC

The life expectancy quoted in datasheets for neon bulbs usually assumes that they are powered by AC. Because DC results in faster vaporization of the electrodes, the expected lifetime should be reduced by 50% if DC power will be used.

Premature Failure through Voltage Fluctuations

Because the deterioration of a neon bulb accelerates rapidly with current, a sustained voltage that passes slightly more current can radically reduce the expected lifespan.

Replacement

Replacement can be an issue with panel indicators, where disassembly of a device may be necessary to reach the bulb. Bear in mind, however, that an easily removable bulb becomes vulnerable to tampering.

fluorescent light

20

This entry deals primarily with *fluorescent tubes* (infrequently but sometimes described as *fluorescent lamps*), and *compact fluorescent lamps* (CFLs) that are marketed as a substitute for **incandescent lamps**. *Cold-cathode fluorescent lamps* (CCFLs) are also mentioned.

Vacuum fluorescent devices have a separate entry in this encyclopedia. A fluorescent tube or CFL does not contain a vacuum.

Although the diode(s) in a white **LED area lighting** unit are coated with a layer of fluorescent phosphors, they are not categorized here as fluorescent lights, and have their own entry.

A **neon bulb** resembles a fluorescent light in that it is a *gas-discharge* device, but the interior of its glass envelope is usually not coated with fluorescent phosphors, and therefore it has its own entry.

OTHER RELATED COMPONENTS

- **incandescent lamp** (see Chapter 18)
- **LED area lighting** (see Chapter 23)
- **vacuum fluorescent** devices (see Chapter 25)
- **neon bulb** (see Chapter 19)

What It Does

Fluorescent tubes or *compact fluorescent lamps* (CFLs) are primarily used for area lighting. A partially disassembled CFL appears in Figure 20-1, showing the control electronics that are normally hidden inside the base.

There is no standardized schematic symbol to represent a fluorescent light. Figure 20-2 shows three commonly used symbols for a fluorescent tube on the left, and three symbols for a CFL on the right. Note that two of the symbols for a CFL are the same as those for an **incandescent lamp**, shown in Figure 18-1.

How It Works

Luminescence is the emission of light as a result of a process that does not require heat. (The opposite phenomenon is *incandescence*, in which heating causes an object to emit light; see Chapter 18 for a description of **incandescent lamps**.)

Fluorescence is a form of luminescence. It occurs when electrons in a material are energized and then make a transition back to ground level, at which point they radiate their energy as visible light. The incoming energy can consist of other light at a higher frequency. Some creatures, including species of arachnids and fish, will fluoresce when they are lit with ultraviolet light.

Figure 20-1. *A compact fluorescent lamp with its base cut away to reveal the control electronics.*

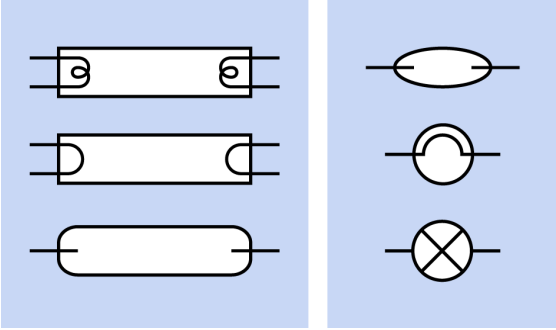

Figure 20-2. *Schematic symbols to represent fluorescent tubes and bulbs are not standardized. See text for details.*

A *fluorescent tube or lamp* contains a very small amount of mercury vapor that can be stimulated to emit ultraviolet light. This encounters a thin layer of *phosphors* coating the inner surface of the glass enclosure. The light causes the phosphors to *fluoresce*, emitting a diffuse radiance in the visible spectrum.

The tube or lamp also contains one or more inert gases such as argon, xenon, neon, or krypton at about 0.3% of normal atmospheric pressure. Two electrodes inside the glass enclosure are made primarily from tungsten, which can be preheated to initiate ionization of the gas. Confusingly, both electrodes are often referred to as *cathodes*.

The function of the gas is not to emit light, but to conduct electric current, so that free electrons may encounter mercury atoms, raising their electrons briefly to a higher energy level. When one of these electrons reverts from its unstable energized state to its previous energy level, it emits a photon at an ultraviolet wavelength.

Figure 20-3 provides a diagram showing the interior of a fluorescent tube.

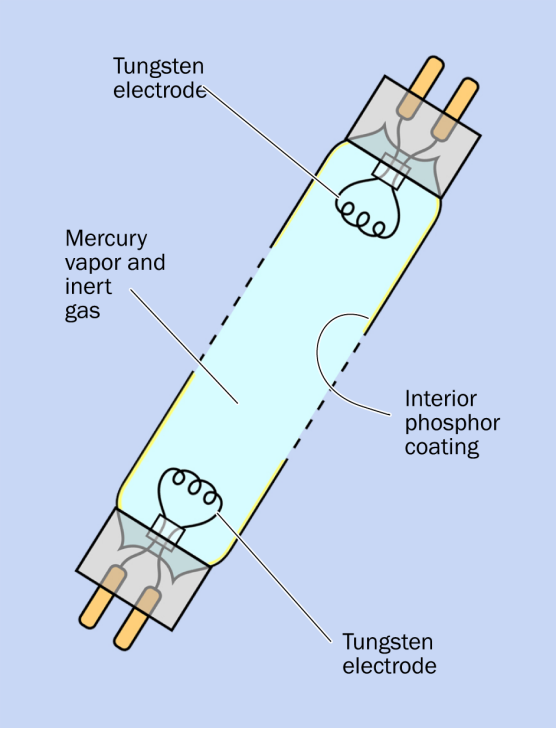

Figure 20-3. *The basic parts of a fluorescent tube.*

Ballast and Starter

Heating the tungsten electrodes is necessary but not sufficient to trigger ionization. A high-voltage pulse is also needed when the light is switched on. In a typical 48" tube, the pulse may range from 200V to 300V.

After current flow has been established, the gas, which is now a plasma, enters a phase of negative

resistance. Current passing through it will tend to increase even if the voltage decreases. This process must be controlled to prevent the formation of an *arc*, which will destroy the electrodes. (A similar process occurs in any gas discharge tube, such as a **neon bulb**, and is described in a graph in Figure 19-5.)

To heat the electrodes, ionize the gas, and then control the current, the fixture for a fluorescent tube contains components that are separate from the tube. In their simplest, traditional form, these components consist of a *starter* and a *ballast*. The starter is a neon bulb that contains a bimetallic strip serving as a normally closed switch. It allows current to flow through the electrodes in series, to heat them. The basic circuit is shown in Figure 20-4.

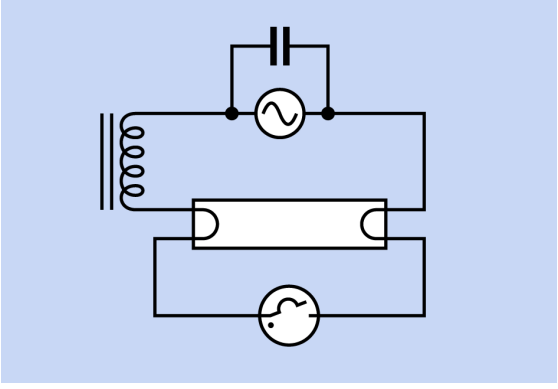

Figure 20-4. *The traditional circuit to trigger ionization of the gas in a fluorescent tube uses a starter (shown at the bottom as a neon tube containing a bimetallic strip, which serves as a switch) and ballast (an inductive load, shown at left).*

The starting process may not be immediately successful, in which case the starter may repeat several times in succession, causing the tube to flicker before its discharge becomes stable. In a cold environment, the tube will have more difficulty starting.

After the tube becomes conductive, current between the electrodes bypasses the starter. At this point, the *ballast* limits the current to prevent an arc from forming. The simplest form of ballast is a coil that functions as an **inductor**.

In a more modern system, an *electronic ballast* replaces the starter-ballast combination. It not only applies the initial surge of high current but also raises the 50Hz or 60Hz frequency of the power supply to 10KHz or more. This increases the efficiency of the tube and eliminates any visible flickering of the light.

All compact fluorescent bulbs (CFLs) contain electronic ballasts. The small components visible in Figure 20-1 are the ballast.

Flicker

When a fluorescent tube uses a conventional ballast and is illuminated with 50Hz or 60Hz AC, the glow discharge stops each time the current flow passes through the zero point in its cycle. In fact, the ionized gas in the tube cannot conduct until it is close to the maximum voltage, and stops conducting when the voltage rolls off. Consequently, the voltage across the tube fluctuates in an approximate square wave, and the light output begins and ends very abruptly. Although this occurs 100 times per second on a 50Hz supply and 120 times per second on a 60Hz supply, some people complain that the flicker is noticeable and can induce headaches.

The rapid on-off discharge is hazardous when it illuminates rotating parts in machinery, as a stroboscopic effect can make the parts seem to be stationary. To mitigate this effect, adjacent tubes in a fixture are powered by separate supplies that are out of phase. This is done either by using a three-phase power supply or by adding an LC circuit to the supply for one of the tubes.

Variants

The traditional type of ballast is also known as a *rapid-start ballast*. By preheating the electrodes, it reduces damage to them that otherwise tends to occur during the starting process. A tube designed for use with a rapid-start ballast has two

contacts at each end, and is referred to as a *bi-pin* tube.

An electronic ballast is also known as an *instant-start ballast*. It does not preheat the electrodes, and a tube designed to work with it has only one pin at each end.

CCFLs

A *cold cathode fluorescent lamp* (CCFL) may resemble a miniature fluorescent tube, typically measuring 2mm to 5mm in diameter. The tube may be straight or bent into a variety of shapes. It works on the same principle as a full-size fluorescent tube, containing mercury vapor and one or more inert gases, with an interior coating of phosphors to enable fluorescence. CCFLs are available in many colors and many shades of white.

As its name implies, the electrodes in a CCFL are not heated to establish ionization. Instead, a very high voltage (1,000VAC or more) is applied, dropping to 500VAC to 600VAC after the flow of current has been established. Because CCFLs have been often used to backlight laptop computer screens, inverter circuits are commonly available that create a high-frequency output at a high voltage from an input that can range from 3VDC to 20VDC. The inverter also includes provision to dim the CCFL by using *pulse-width modulation*.

Some CCFLs are designed for illumination of small spaces—for example, the interior of a display case. A few CCFLs look exactly like CFLs and can be used in light fixtures. Some may be compatible with the type of dimmer designed for incandescent lamps.

A CCFL usually has a limited light output compared with that of a conventional fluorescent tube, but has the advantage of working better at low temperatures. Some are designed for signage and exterior lighting in cold-weather locations.

They have a relatively long lifetime of up to 60,000 hours. A hot-cathode fluorescent lamp may fail between 3,000 and 15,000 hours.

Any tube or bulb that uses unheated electrodes to ionize a gas is technically a cold-cathode device, but will not be identified as a CCFL unless it also has an inner layer of phosphors to achieve fluorescence.

It is important to match a tube with the type of ballast installed in a fixture. This is not an issue with CFLs, as they have the appropriate ballast built in.

Sizes

Straight bi-pin tubes are sold in the United States in the following standard sizes:

- T5: 5/8″ diameter. A more modern tube, but still with tungsten electrodes that serve to heat it.
- T8: 1″ diameter. Very often 24″ or 48″ in length, consuming 18W or 36W respectively.
- T12: 1-1/2″ diameter.
- T17: 2-1/8″ diameter.

CFLs are sold in a very wide variety of configurations.

Comparisons

Fluorescent lights have significant advantages and disadvantages. On the plus side:

- After the fixture containing the ballast has been paid for, a tube is relatively cheap. A CFL or an LED light does not have this advantage, as the electronics are built in and will be discarded when the light fails.
- Fluorescent lights have a longer life than incandescent bulbs.
- Fluorescent lights are available in a wide range of shades of white.
- Fluorescent tubes create a diffuse radiance that is ideal for general lighting using ceiling-mounted fixtures. They do not cast harsh shadows.

On the minus side:

- Fluorescents were traditionally more energy-efficient than any other light source, but **LED area lighting** is now more efficient in some designs. LEDs are expected to become more efficient in the future.
- A fluorescent tube with a traditional type of ballast may cause complaints of flickering. By comparison, an LED light uses DC, and an incandescent bulb retains sufficient heat between power cycles so that it does not appear to flicker.
- Fluorescent flicker creates problems when shooting video.
- The fluorescent emission spectrum has sharp peaks that give the lighting an unnatural look.
- In applications that require a defined beam of light, a fluorescent source cannot be used.
- Conventional ballasts can create radio interference, especially in the AM band.
- Because fluorescent tubes and bulbs contain mercury, they require proper disposal, which can incur fees.
- Even an instant-on fluorescent light tends to hesitate briefly when it is switched on.
- The lifespan of a fluorescent light is greatly reduced if it is cycled on and off frequently. An incandescent bulb is less severely affected by cycling, and an LED light is not affected at all.
- Fluorescent lights have difficulty starting at low temperatures.

Values

Brightness

The intensity of a fluorescent light is measured in *lumens per watt*. Because invisible wavelengths are of little interest when assessing brightness, *luminous flux* is used to describe apparent brightness in the visible spectrum. The unit for luminous flux is the *lumen*. Additional information about light measurement is included in the entry describing incandescent lamps (see "Power" on page 177).

Spectrum

The spectrum of photons emitted from mercury vapor in a fluorescent light has wavelengths that peak at 253.7 nanometers and 185 nanometers. (A *nanometer*, customarily abbreviated as nm, is one-billionth of a meter.) These wavelengths are invisible, being in the ultraviolet range, but when the light is transposed into the visible spectrum by the layer of phosphors, "spikes" in the range of wavelengths are still present. For a comparison of output curves for incandescent, fluorescent, and LED lights, see the graph in Figure 18-4.

Various formulations for the phosphors in a tube or CFL attempt to modify the character of the light to suit the human eye, but none of them looks as "natural" as the radiance from an incandescent bulb, probably because the characteristics of incandescent light are very similar to those of sunlight.

What Can Go Wrong

Unreliable Starting

At a low temperature, the mercury inside a fluorescent tube may be slow to vaporize. At very low temperatures, vaporization may not be possible at all. Until the mercury vaporizes, fluorescence will not occur.

Terminal Flicker

As a tube ages, it may start to conduct current only in one direction, causing it to flicker visibly. As it ages more, the gas discharge becomes even less reliable, and the flicker becomes erratic. Eventually, the gas discharge fails completely. In this state, a tube may show only a dim light at each end, in proximity to the tungsten electrodes.

Cannot Dim

Neither the older style of "conventional" ballast nor a modern electronic ballast will respond appropriately to a dimmer of the type designed for incandescent bulbs. This may be an important factor when an incandescent bulb is swapped out for a CFL.

Burned Out Electrodes

Like the tungsten filament in an **incandescent lamp**, the tungsten electrodes in a fluorescent tube suffer progressive erosion. This is evident when a black tungsten deposit forms on the inside of the tube at one or both ends.

Ultraviolet Hazard

Some critics of CFLs maintain that the complex shape of a coiled or zig-zag tube tends to permit small imperfections in the internal phosphor coating, potentially allowing ultraviolet light to escape. If this occurs, and if a CFL is used in a desk fixture in close proximity to the user, ultraviolet light could elevate the risk of skin cancer.

laser

21

The term *maser* was coined in the 1950s to describe a device that used stimulated emission to amplify microwaves. When a device using similar principles amplified visible light in 1960, it was termed an *optical maser*. However, that term is now obsolete, having been replaced with **laser**. This term is always printed in lowercase letters, even though it is an acronym for Light Amplification by Stimulated Emission of Radiation.

The invented verb *to lase* is derived from *laser* and is used to describe the process of generating laser light, with the past participle *lased* and present participle *lasing* sometimes being used.

Thousands of laser variants exist. Because of space limitations, this entry will concentrate primarily on *laser diodes*, which are the smallest, most common, and most affordable type.

OTHER RELATED COMPONENTS

- **LED indicator** (see Chapter 22)

What It Does

A **laser** generally emits a thin beam of intense light, often in the visible spectrum, and usually in such a narrow range of wavelengths, it can be considered *monochromatic*. The light is also *coherent*, as explained below.

Light output from a laser has three important attributes:

- Intensity. A high-powered laser can deliver energy to a very small, well-defined area, where it may be capable of burning, cutting, welding, or drilling. Large lasers may also be used as weapons, or for power transmission.
- Collimation. This term describes a beam of light that has parallel boundaries, and therefore does not disperse significantly when passing through a transparent medium such as air, glass, or a vacuum. A laser beam can have such excellent collimation, it can be used in precision measuring devices, and has been transmitted over very long distances, even from the Earth to the Moon, where astronauts placed reflectors during the Apollo missions.
- Controllability. Because the beam can be generated with eletrical power, its intensity can be modulated rapidly with relatively simple electronic circuits, enabling applications such as burning microscopic pits in the plastic of a CD-ROM or DVD.

Laser diodes are now more common than all other forms of lasers. They are found in pointers, printers, barcode readers, scanners, computer mice, fiber-optic communications, surveying tools, weapon sights, and directional lighting sources. They are also used as a light source to trigger more powerful lasers.

No generic symbol is used for a laser, but a laser diode is often represented with the same symbol

that is used for a light-emitting diode. See Figure 22-2 in the entry for **LED indicators**.

How It Works

A laser is built around a *gain medium*, which is a material that can amplify light. The medium can be a solid, liquid, gas, or plasma, depending on the type of laser.

Initially, an input of energy provides stimulation for some atoms in the gain medium. This is known as *pumping* the laser. The energy input can come from a powerful external light source, or from an electric current.

Stimulation of an atom raises the quantum energy level of an electron associated with the atom. When the electron collapses back to its former energy state, it releases a photon. This is known as *spontaneous emission*.

If one of the photons encounters an atom that has just been excited by the external energy source, the atom may release two photons. This is known as *stimulated emission*. Beyond a threshold level, the number of released photons can increase at an exponential rate.

If two parallel reflectors are mounted at opposite ends of the gain medium, they form a *resonant cavity*. Light bounces to and fro between the reflectors, while pumping and stimulated emission amplifies the light during each pass. If one of the mirrors is partially transparent, some of the light will escape through it in the form of a laser beam. The partially transparent mirror is known as the *output coupler*.

Laser Diode

A laser diode contains an **LED**. (See "How It Works" on page 207 for a more detailed description of the function of an LED.) The p-n junction of the diode functions as the resonant cavity of the laser. Forward bias injects charges into the junction, causing spontaneous emission of photons. The photons, in turn, cause other electrons and electron-holes to combine, creating more photons in the process of stimulated emission. When this process crosses a threshold level, current passing through the diode causes it to *lase*.

The original patent for a laser diode was filed by Robert N. Hall of General Electric in 1962, and the diagram in Figure 21-1 is derived from the drawing in that patent, with color added for clarity.

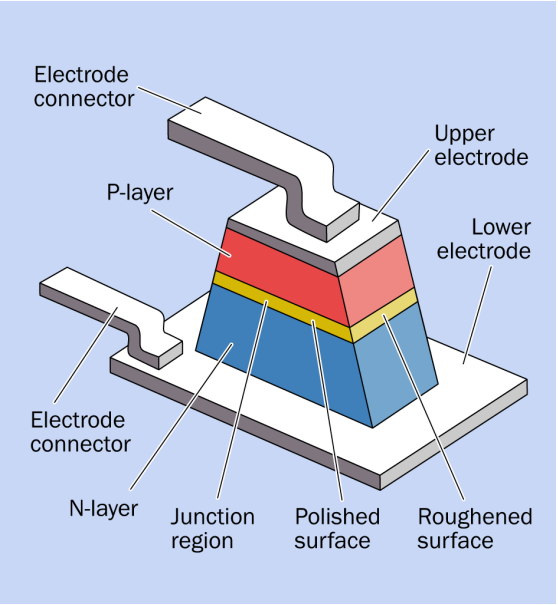

Figure 21-1. *The original design for a laser diode, from the patent filed in 1962.*

In the figure, the junction shown as a yellow layer forms the resonant cavity in which lasing occurs. It measures only 0.1 microns thick (the diagram is not drawn to scale). Its vertical front side is highly polished, and is parallel to the back side, which is also highly polished. Thus, photons reflect between these two vertical sides. The slanted face visible in the figure, and the other slanted face opposite it, are oriented and roughened to minimize internal reflection between them.

Figure 21-2 shows a simplified cross-section of the laser diode.

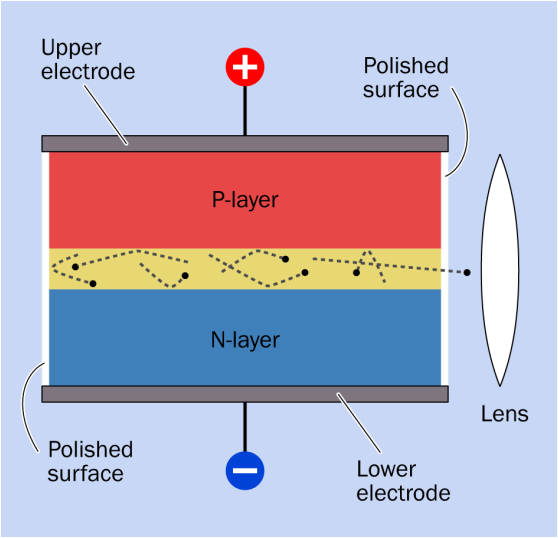

Figure 21-2. *Simplified cross-section of a laser diode.*

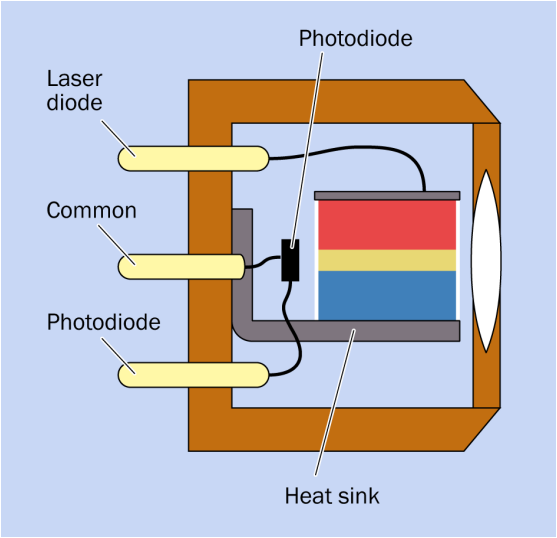

Figure 21-3. *A laser diode is typically mounted with a photodiode to provide feedback for a driver circuit, to control the current consumed by the laser.*

Figure 21-3 shows a cross-section of the diode installed in a component sold as a laser. It includes a photodiode to sense the intensity of light emerging through the polished rear end of the laser diode. External electronics are necessary to control the intensity of the laser, using feedback from the photodiode.

The component has three pins (shown pale yellow in the figure), one connecting to the photodiode, another connecting to the p-type layer of the laser diode, and the third being common to the n-type layer of the laser diode and the ground side of the photodiode.

A photograph of a laser diode is shown in Figure 21-4. Note the three pins, comparable to the pins shown in Figure 21-3, indicating that this component requires external control electronics.

In Figure 21-5, a laser is shown with a surface-mount chip adjacent to the solder pad connecting the blue wire. The presence of this chip, with only two wires, indicates that this component has its own control electronics and requires only a DC power supply.

Figure 21-4. *Lite-On 505T laser diode that emits light at 650nm. Power consumption 5mW at 2.6VDC. As indicated by the graph squares, this component is only about 0.2" in diameter.*

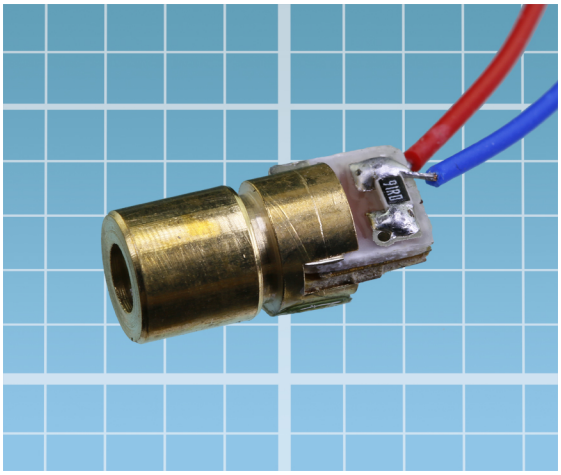

Figure 21-5. *This laser incorporates its own control electronics and requires only a 5VDC power supply. It draws 30mA and generates an output up to 5mW.*

Coherent Light

The emission of *coherent light* by a laser is often explained by suggesting that wavelengths are synchronized with each other. In fact, there are two forms of coherence that can be described approximately as *spatial coherence* and *wavelength coherence*.

If an observer looks up at a cloudy sky, the eye will perceive light radiating chaotically from many distances and directions. Thus, the light is not spatially coherent. The light also consists of many wavelengths, and thus it is not wavelength-coherent.

The filament of an incandescent lamp is a much smaller source of light, but still large enough to generate a profusion of light emissions that are spatially incoherent. The light also includes many different wavelengths.

Suppose a barrier containing a very tiny hole is placed in front of the **incandescent lamp**. If the aperture is very small, an observer on the far side will see the light as a point source. Consequently, the light that emerges from it is now spatially coherent, and will not have chaotically overlapping waves. If the light then passes through a filter, its wavelengths also will become coherent. This is suggested in Figure 21-6 where the light source is an incandescent lamp emitting a wide range of wavelengths.

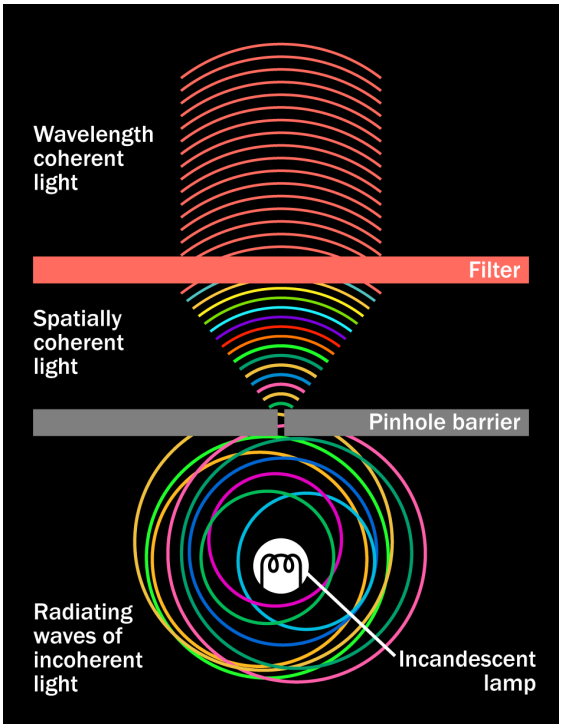

Figure 21-6. *An incandescent lamp, at the bottom of the figure, emits incoherent light at many wavelengths (exaggerated here for clarity). When it passes through a pinhole, it becomes spatially coherent. When it then passes through a colored filter, it becomes wavelength coherent.*

The small amount of light emerging through a pinhole is inevitably much dimmer than light from the original source. A laser, however, amplifies its light output, as well as tending to behave like a point source. The "hall of mirrors" effect of the parallel reflective surfaces in the resonant cavity causes much of the light to shuttle to and fro over a long distance before it emerges through the output coupler. Any light that deviates significantly from the axis of the laser will not escape at all, because the deviations will be cumulative with each reflection. Thus, the light from a laser appears to come from a point source at an almost infinite distance.

Because of the particular geometry of a light-emitting diode, the output from a laser diode is not naturally collimated, and tends to spread by an angle of around 20 degrees. A lens must be used to focus the beam.

Variants

Lasers are sold generally as fully assembled tools for a specific purpose. A very brief summary of CO2, fiber, and crystal lasers is included here.

CO2 Lasers

The gain medium is primarily carbon dioxide but also contains helium and nitrogen, with sometimes hydrogen, water vapor, and/or xenon. The laser is electrically pumped, causing a gas discharge. Nitrogen molecules are excited by the discharge and transfer their energy to the CO2 molecules when colliding with them. Helium helps to return the nitrogen to base energy state and transfer heat from the gas mixture.

CO2 lasers are infrared, and are commonly used in surgical procedures, including ophthalmology. Higher powered versions have industrial applications in cutting a very wide range of materials.

Fiber Lasers

Light is pumped via diodes and amplified in purpose-built glass fibers. The resulting beam has a very small diameter, providing a greater intensity than CO2 lasers. It can be used for metal engraving and annealing, and also for working with plastics.

Crystal Lasers

Like fiber lasers, they are pumped by diodes. These compact lasers are available in a very wide variety of wavelengths, covering the whole visible spectrum, infrared, and ultraviolet. They find applications in holography, biomedicine, interferometry, semiconductor inspection, and material processing.

Values

The output power of a laser is measured in watts (or milliwatts). This should not be confused with the power consumed by the device.

In the United States, any device sold as a laser pointer is limited to a power output of 5mW. However, laser diodes packaged similarly to laser pointers can be mail-ordered with an output of 200mW or more. The legal status of these lasers may be affected by regulations that vary state by state.

In a CD-RW drive that is capable of burning a disc, the diode may have a power of around 30mW. A laser mounted in a CD-ROM assembly is shown in Figure 21-7.

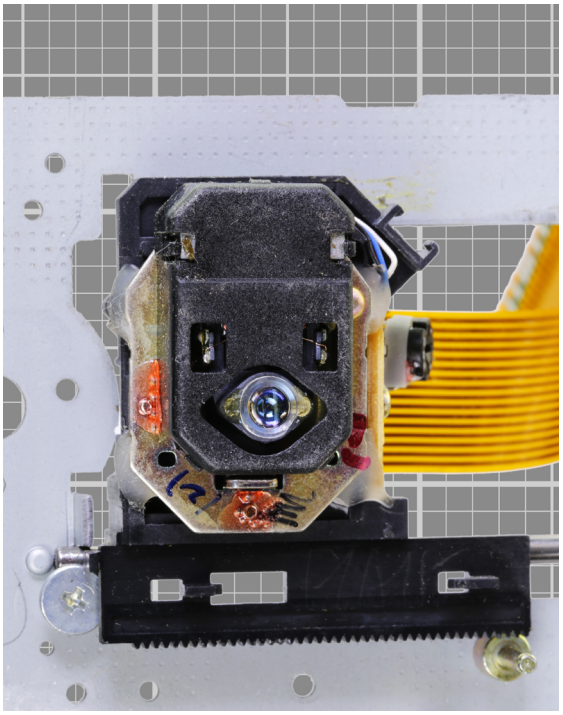

Figure 21-7. *An assembly incorporating a laser for reading a CD-ROM.*

Lasers have such a narrow range of wavelengths, they are given specific output values in nanometers. A laser in an optical mouse may have a wavelength of 848nm; in a CD drive, 785nm; in a

bar-code reader, 670nm; in a modern laser pointer, 640nm; in a Blu-ray disc player, 405nm.

How to Use It

While powerful lasers in a laboratory setting have exotic applications, a typical low-power laser diode has become so affordable (costing less than $5 in some instances, at the time of writing) it can be considered merely as a useful source of a clearly defined light beam, ideal for detecting the position of a movable mechanical component or the presence of an intruder.

Generic light-emitting diodes are made with a view angle (i.e., a dispersion angle) as low as 3 degrees, but the beam is soft-edged compared with the precise boundary of a laser beam, and cannot be used reliably in conjunction with sensors at a distance of more than a few inches.

Laser diodes that are sold as components may or may not have current-limiting control electronics built in. Applying power to the laser diode directly will result in thermal runaway and rapid destruction of the component. Drivers for laser diodes are available separately as small, preassembled circuits on breakout boards.

For many applications, it may be simpler and cheaper to buy a laser diode as an off-the-shelf product. A laser pointer provides an easy way to get a source of laser light, and if it would normally be driven by two 1.5V batteries, it can be adapted to run off a 5V supply by using a 3.3V voltage regulator.

Common Applications

In addition to being used with PowerPoint presentations and in conjunction with position sensors, laser pointers have other applications:

- Astronomy. A high-powered laser beam is visible even in clear air as a result of interaction with air molecules. This is known as *Rayleigh scattering*. The phenomenon allows one person to point out a star (or planet) for another person. Because celestial objects are so far away, parallax error is not detectable by two people viewing the beam while standing next to each other. A laser pointer may also be mounted on a telescope to assist in aiming the telescope at an object of interest. This is easier than searching for an object through an eyepiece.
- Target acquisition. Lasers are commonly used on firearms to assist in targeting, especially in low-light conditions. Infrared lasers can be used in conjunction with infrared viewing goggles.
- Survival. A small laser can be included in emergency supplies to signal search teams. A laser can also be used to repel predatory animals.

What Can Go Wrong

Risk of Injury

Lasers are potentially dangerous. Those that have an infrared or ultraviolet output are more dangerous than those with a visible beam, as there is no visual warning that the laser is active. A laser is capable of scarring the retina, although controversy exists regarding the power output that should be considered a high risk.

If a project incorporates a laser, it should be switched off while building or testing the device. It may be advisable to wear protective glasses that block laser light even when an experimenter feels confident that a laser is switched off.

Active lasers should never be pointed at people, vehicles, animals (other than dangerous animals), or oneself.

Inadequate Heat Sink

Lasers may be designed and rated for intermittent use. The burner assembly for a CD-ROM drive, for instance, will be rated for pulsed power, not continuous power. Read datasheets carefully, and provide an adequate heat sink.

Uncontrolled Power Supply

A diode laser that does not have a feedback system in place to control the flow of current can self-destruct.

Polarity

Both the light-emitting diode and the photodiode in a three-pin laser package can be damaged by incorrect polarity of applied power. Pin functions should be checked carefully against datasheets.

LED indicator

22

In this encyclopedia, an **LED indicator** is defined as a component usually 10mm or smaller in diameter, made of transparent or translucent epoxy or silicone, most often containing one *light-emitting diode*. It is purposed as a status indicator in a device, rather than as a source of illumination, and is sometimes referred to as a *standard LED*.

LED indicators that emit infrared and ultraviolet light are included in this entry. LEDs that are designed to illuminate large interior or exterior areas are discussed in a separate entry as **LED area lighting**. They are sometimes described as *high-brightness LEDs* and almost always emit white light.

The term **light-emitting diode** is becoming less common, as the acronym **LED** has become ubiquitous. The acronym does not usually include periods between the letters.

The words "light emitting" are hyphenated here, as they form an adjectival phrase, but in everyday usage the hyphen is often omitted, and no definitive rule seems to exist.

Originally, a standard LED contained only one diode, but may now include multiple diodes, either to emit additional light or to provide a range of colors. In this encyclopedia, a single epoxy or silicone capsule is still considered to be an **LED indicator** regardless of how many diodes it contains. By contrast, any component consisting of multiple separately discernible light-emitting diodes, as in a seven-segment numeral, a 14- or 16-segment alphanumeric character, a dot-matrix character, or a display of multiple characters, is listed in a separate entry as an **LED display**.

OTHER RELATED COMPONENTS

- **LED area lighting** (see Chapter 23)
- **LED display** (see Chapter 24)
- **incandescent lamp** (see Chapter 18)
- **neon bulb** (see Chapter 19)
- **laser** (see Chapter 21)

What It Does

An **LED indicator** emits light in response to a small current, typically around 20mA (but sometimes much less), at a voltage lower than 5VDC. It is usually molded from epoxy or silicone that may be colorless and transparent (often referred to as *water clear*), or colorless but translucent, or tinted and transparent, or tinted and translucent.

The color of the light is initially determined by the chemical compounds used internally, and by their dopants; therefore, a water-clear LED may emit colored light.

Ultraviolet LEDs are usually water-clear. Infrared LEDs often appear to be black, because they are opaque to the visible spectrum while being transparent to infrared.

When an LED indicator is described as being *through hole,* it has leads for insertion into holes in a circuit board. The term does not mean that the indicator itself is meant to be pushed through a hole in a panel, although this may also be done. The LED is cylindrical with a hemispherical top that acts as a lens. The leads are relatively thick, to conduct heat away from the component. A dimensioned diagram of a typical LED measuring 5mm in diameter is shown in Figure 22-1.

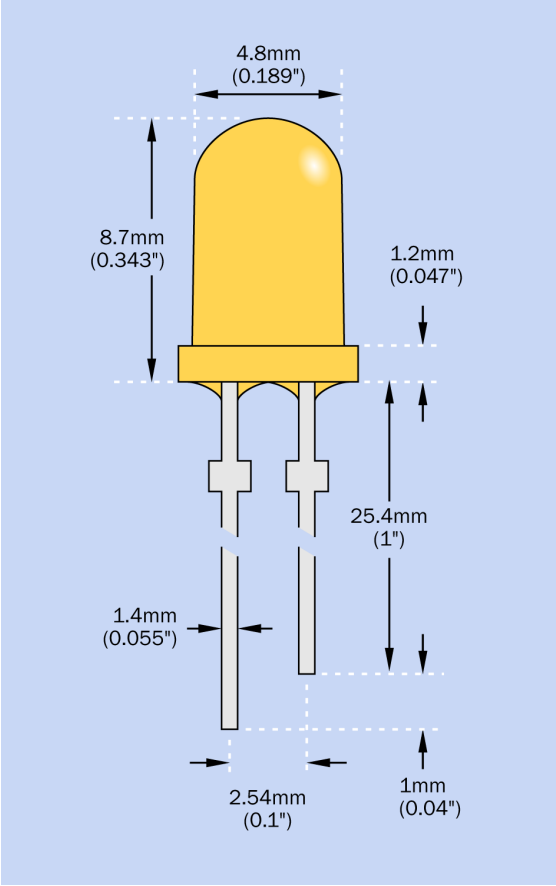

Figure 22-1. *Dimensions of a typical 5mm LED. The longer wire connects with the anode, while the shorter wire connects with the cathode. Adapted from a datasheet published by Lite-On Technology Corporation.*

An LED indicator that is not the through-hole type is usually a surface-mount component. LEDs for surface mounting are mostly rectangular and can be as small as 1mm x 0.5mm. They may require a *heat sink*.

Schematic Symbols

Figure 22-2 shows a variety of symbols that are commonly used to represent an LED. The triangle at the center of each symbol points in the direction of conventional (positive-to-negative) current flow—from the anode to the cathode. Each pair of arrows radiating away from the diode indicates emitted light. Wavy arrows are sometimes used to represent infrared (thermal) radiation. Often, however, an infrared LED is represented in exactly the same style as an LED that emits visible light. With the exception of the wavy arrows, the various styles of schematic symbol are functionally identical and do not identify different attributes of the component such as size or color.

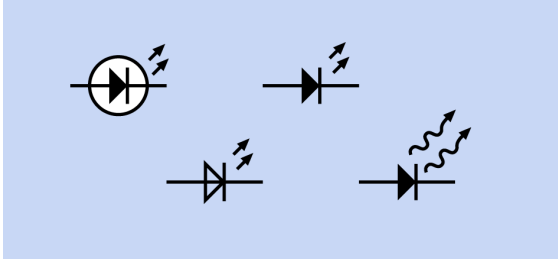

Figure 22-2. *Various symbols may be used to represent an LED. See text for details.*

Common Usage

LED indicators have mostly displaced **neon bulbs** and miniature **incandescent lamps** for the purpose of showing the status of a device. They are found in industrial control panels, home audio systems, battery chargers, washer/dryers, and many other consumer-electronics products. Higher output variants are used in flashlights, traffic signals, taillights on automobiles, and for illumination of subjects that are being photographed. LED indicators may be assembled in large numbers in attention-getting displays such as Christmas lights.

Red, orange, yellow, green, and blue are the basic standard colors. LEDs that appear to generate white light are common, but they do not emit an evenly weighted spectrum of wavelengths. See "Non-Incandescent Sources" on page 174 for a discussion of this topic.

How It Works

An LED, like any **diode**, contains a semiconductor *PN junction* that conducts current only in the forward direction (i.e., from the more-positive side of a power supply to the more-negative side). The diode becomes conductive above a *threshold voltage* sufficient to force electrons in the n-type region and holes in the p-type region to combine with each other. Each time this occurs, energy is released. The energy liberated by one electron-hole combination creates a *photon*, or one quantum of light.

The amount of energy released depends on the *band gap*, which is a property of the semiconductor material. The band gap is the smallest energy that can create an electron-hole pair. The energy determines the light's wavelength, and thus the color.

The band gap also determines the threshold voltage of the LED. For this reason, LEDs of different colors have widely different threshold voltages.

Because an LED will often be used in devices where the DC power supply exceeds the maximum forward voltage, a *series resistor* is customarily used as a simple way to restrict current through the diode.

The light emitted by a colored LED indicator tends to include only a narrow range of wavelengths. However, the addition of a phosphor coating to the diode can broaden the output. This technique is used to make the light from a blue LED appear white, as shown in Figure 22-3. Most white LEDs are actually blue LEDs with a colored phosphor layer added. See the section on **LED area lighting** in Chapter 23 for a more detailed discussion of this topic.

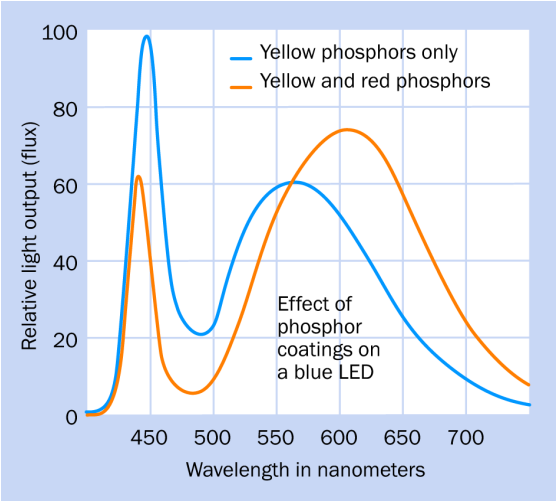

Figure 22-3. *Increasing the range of emitted wavelengths by adding phosphors to a blue LED. Source: Philips Gardco Lighting.*

Multicolor LEDs and Color Mixing

If red, green, and blue light sources are mounted extremely close together, the eye perceives them as a single source, of a color determined by their combined relative intensities. This system of additive color mixing is shown in Figure 17-14 in the entry dealing with LCDs. It is used in LED indicators that contain red, green, and blue light-emitting diodes in a single epoxy or silicone capsule.

While most video monitors use white LEDs or **fluorescent lights** to form a backlight for an **LCD** video screen, some high-end monitors use a matrix of very tiny red, green, and blue LEDs, because the combination of these separate colors generates a wider *gamut* of color wavelengths. The concept of gamut is discussed in "Color" in the **LCD** entry. The tiny LEDs in a backlight cannot be considered as indicators, but indicators are used for this purpose in billboard-sized video displays.

Variants

LED indicators vary widely in size, shape, intensity, view angle, diffusion of light, wavelength of light, minimum and maximum forward voltage, and minimum and maximum forward current.

Size and Shape

The original sizes for round LED indicators were 3mm, 5mm, or (more rarely) 10mm in diameter. Today, through-hole LEDs are sold in many intermediate sizes, although 3mm and 5mm are still most widely used.

The traditional round LED indicator is now augmented with square and rectangular shapes. In a parts catalog, a pair of dimensions such as 1mm × 5mm suggests that the LED is rectangular.

Intensity

The light intensity of an LED is usually expressed in *millicandelas*, abbreviated *mcd*. There are 1,000 mcd in a candela. For more information about units for measurement of light, see "Intensity" on page 178.

The candela measures the *luminous flux*, or visible radiant power, contained within a specified angle of dispersion, usually referred to as the *view angle*. This can be imagined as the rotated angle at the apex of a cone, where the cone defines the "spread" of the light, and the source is at the apex.

If a diode is emitting a fixed amount of luminous flux, the rating in mcd will increase with the inverse square of the view angle. This is because the light delivered to an area in front of the LED will become more intense as the angle becomes smaller. The use of mcd to rate the brightness of an LED can be misleading if it is not considered in comparison with the view angle.

For example, suppose an LED is rated at 1,000 mcd and has a view angle of 20 degrees. Now suppose the same diode is embedded in a different epoxy or silicone capsule with a lens that creates a view angle of only 10 degrees. The LED will now be rated at 4,000 mcd, even though its total power output is unchanged.

- To compare the brightness of two LED indicators meaningfully, they should share the same view angle.

Four through-hole LED indicators with a wide range of specifications are shown in Figure 22-4. From left to right: water-clear white generic, 10mm; Vishay TLCR5800 5mm (emitting red, even though the capsule is water-clear), rated for 35,000mcd with 4 degrees view angle; Everlight HLMPK150 5mm red diffused, rated for 2mcd with 60 degrees view angle; and Chicago 4302F5-5V 3mm green, rated for 8mcd at 60 degrees view angle, containing its own series resistor to allow direct connection with a 5VDC power supply.

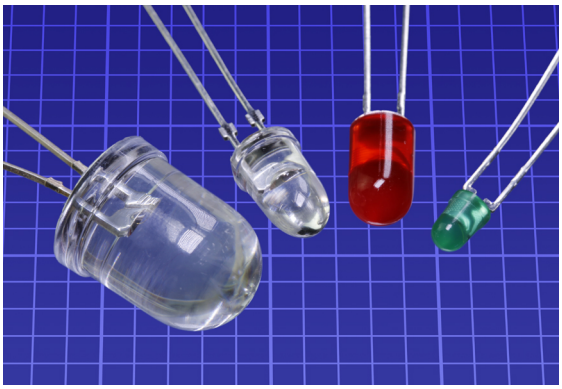

Figure 22-4. *Four assorted LED indicators with very different specifications. See text for details.*

Efficacy

The *radiant luminous efficacy* (LER) of an incandescent light source compares how effective it is at channeling its output within the visible spectrum, instead of wasting it in other wavelengths, especially infrared. Note that the word *efficacy* has a different meaning from *efficiency*. The LER acronym may help to avoid confusion.

LER is expressed in lumens per watt, and in an incandescent bulb it is calculated by dividing the power emitted in the visible spectrum (the *lumi-*

nous flux) by the power emitted over all wavelengths. This is described in detail on "Efficacy" on page 179 in the entry dealing with incandescent lamps.

In an LED indicator, almost all the radiation can be within the visible spectrum, but some power is wasted by generating heat internally. The efficacy varies depending on the type of LED; thus a red-orange indicator can have an efficacy of 98% while a blue LED will be probably below 40%.

Diffusion

Some LED indicators use epoxy or silicone that is formulated to be translucent or "cloudy" instead of transparent. They diffuse the light so that it is not projected in a defined beam, has a softer look, and has an approximately equal intensity when viewed from a wider range of angles.

"Clear" and "diffused" are options that must be taken into account when choosing LEDs from an online catalog, unless the user is willing to turn a clear LED into a diffuse LED by applying some sandpaper.

Wavelength and Color Temperature

The wavelength of light is measured in *nanometers* (abbreviated *nm*), a nanometer being 1 billionth of a meter. The visible spectrum extends from approximately 380nm to 740nm. Longer wavelengths are at the red end of the spectrum, while shorter wavelengths are at the blue end.

A typical LED emits a very narrow range of wavelengths. For example, Figure 22-5 shows the emission from a standard red LED indicator manufactured by Lite-On. Graphs of this type are typically included in manufacturers' datasheets.

Because a red LED stimulates the cones in the eye that respond to red light, it "looks red" even though the color is not comparable with the natural red that is seen, for instance, in a sunset. That natural color actually contains an additional spread of wavelengths.

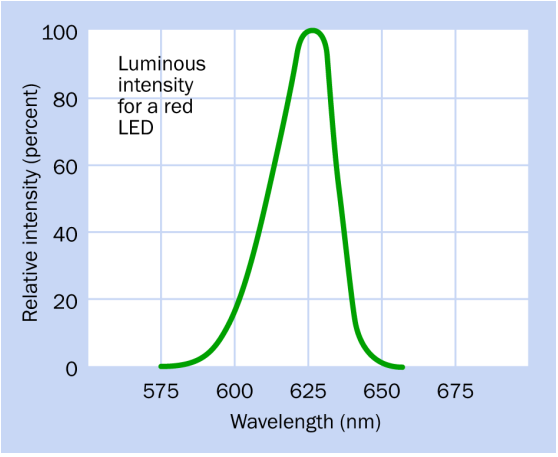

Figure 22-5. *The narrow range of wavelengths emitted by a typical red LED indicator.*

The following list shows the ranges of peak output values, in nanometers, for the most commonly available basic LED indicators (LEDs that emit other wavelengths are available, but they are less common):

- Infrared LED: 850 to 950
- Red LED: 621 to 700
- Orange LED: 605 to 620
- Amber LED: 590 to 591
- Yellow LED: 585 to 590
- Green LED: 527 to 570
- Blue LED: 470 to 475
- Ultraviolet LED: 385 to 405

Figure 22-6 shows this list graphically, omitting infrared and ultraviolet LEDs.

For almost 30 years, blue LEDs were a laboratory curiosity of little practical value, as efficiencies were stuck around 0.03%. An efficiency of more than 10% was finally achieved in 1995. Blue LEDs were marketed soon afterward.

However, when yellow phosphors are added to create the impression of white light by spreading the output over the whole visible spectrum, the wavelengths around 500nm are still not well represented, as suggested in Figure 22-3.

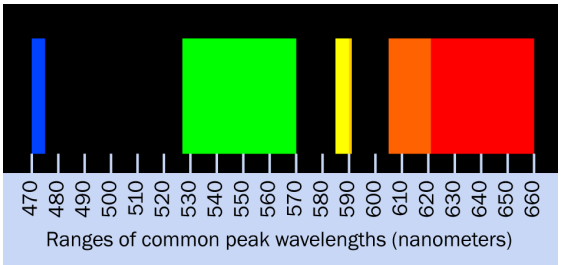

Figure 22-6. *Ranges for peak wavelengths of the most commonly used LEDs. (Source: Survey of approximately 6,000 through-hole LEDs stocked at www.mouser.com.)*

Fluorescent lights perform even more poorly than white LEDs, as can be seen in Figure 18-4 in the entry describing **incandescent lamps**.

Because white LEDs do not emit a single peak of wavelengths, their color is expressed in color temperature rather than nanometers. The concept of color temperature is explained in "Spectrum" on page 173. White LEDs are available rated from 2,800 to 9,000 degrees Kelvin, and are discussed in more detail in the **LED area lighting** entry in this encyclopedia.

Internal Resistor

To eliminate the chore of adding a series resistor to limit current through an LED, some indicators are sold with a series resistor built in. They may be rated for use with 5VDC or 12VDC, but are externally indistinguishable from each other. They are also externally indistinguishable from LEDs that do not contain series resistors. Figure 22-7 shows two 3mm LEDs, the one on the right containing its own series resistor, the one on the left being a generic LED without a series resistor.

Because of the nonlinear response of a diode, LEDs with or without internal resistors cannot be distinguished from each other reliably with a multimeter. If the meter is set to measure ohms, typically it will give an "out of range" error to all types of LED. If it is set to identify a diode, the reading will not tell you if the LED contains a resistor.

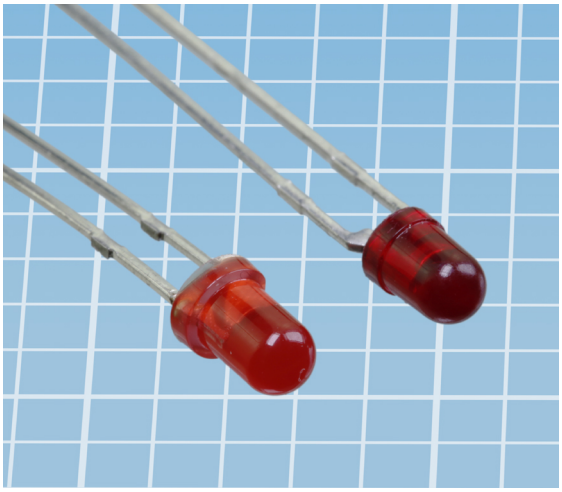

Figure 22-7. *An LED (left) that does not contain its own series resistor is usually indistinguishable from one that does (right).*

One way to determine whether an LED contains an internal series resistor would be to connect it with a variable power supply through a multimeter set to measure mA. Carefully increase the supply voltage from zero until the meter shows a current of 20mA. If the LED does not contain a series resistor, the supply voltage will be close to the recommended forward voltage for that type of LED (no lower than 1.6V for a red LED, and no higher than 3.6V for a white LED). If the LED does contain a series resistor, the supply voltage will be higher. This procedure is time consuming, but may be worthwhile to evaluate multiple LEDs that are known to be identical.

Multicolored

The leads for an LED indicator containing two or more diodes can be configured in several ways:

- Two leads, two colors. Two diodes are mounted internally in parallel, but with opposite polarity.
- Three leads, two colors. Two diodes share a common anode or common cathode.
- Four leads, three colors (RGB). Three diodes share a common anode or common cathode.

- Six leads, three colors. Three diodes, each with its own pair of leads, separate from the others.

Infrared

Most infrared emitters are LEDs that generate wavelengths longer than 800nm. They are found in handheld remotes to control consumer-electronics devices such as televisions and stereo systems, and are also used in some security systems, although *passive infrared motion detectors*, which assess infrared radiation from sources such as people or vehicles, are more commonly used for this purpose.

In conjunction with an infrared emitter, an infrared sensor is necessary, and must be sensitive to the same wavelength. To prevent false positives, the emitter modulates its output, typically with a carrier frequency between 10 and 100kHz. Remotes often use carrier frequencies of 30 to 56kHz. At the receiving end, the signal is processed with a band-pass filter matching the modulation frequency. Many different pulse-coding schemes are used, and no particular standard is dominant.

Ultraviolet

Because ultraviolet radiation can damage the eyes, LED indicators that emit ultraviolet light are potentially dangerous and should be used with caution. A yellow eyeshield can be worn to block the short wavelengths.

Ultraviolet light can be used to cure some adhesives and dental filling material. It can also kill bacteria, and can detect fluorescent print on bank notes, to check for counterfeiting. Ultraviolet flashlights are sold to detect some species of pests, such as scorpions, which fluoresce in response to ultraviolet light.

Values

The specification for an LED will include the wavelength of emitted light, luminous intensity, maximum forward voltage and current, maximum reverse voltage and current, and working values for voltage and current. All these values are important when choosing an indicator for a specific function.

White LEDs for room lighting or external use are calibrated differently. See the entry for **LED area lighting** in Chapter 23.

Forward Current

About half of all the thousands of available types of LED indicators are rated for a typical forward current of 20mA to 25mA. Absolute maximum ratings may be twice as high, but should not generally be applied.

The light intensity of a typical 5mm red LED indicator is plotted against its forward current in Figure 22-8. Note that current and light intensity have an approximately linear relationship up to the typical working current of 20mA. Even above this point, to the absolute maximum of 50mA, the light intensity rolls off only a very small amount.

Although an LED indicator can be dimmed by controlling the current passing through it, the current does not have a linear relationship with the applied voltage, and the indicator will stop functioning completely when the voltage drops below the threshold required by the diode. Consequently, LEDs are commonly dimmed by using *pulse-width modulation*.

Because of the nonlinear response of a diode, LEDs with or without internal resistors cannot be distinguished from each other reliably with a multimeter. If the meter is set to measure ohms, typically it will give an “out of range” error to all types of LED. If it is set to identify a diode, the reading will not tell you if the LED contains a resistor.

Low-Current LEDs

Indicators that require a very low forward current are convenient for direct connection to output pins of logic chips and other integrated circuits. Although a single output from an HC family chip

is capable of supplying 20mA without damaging the chip, the current will pull down the output voltage, so that it cannot be used reliably as an input to another chip while also lighting the LED.

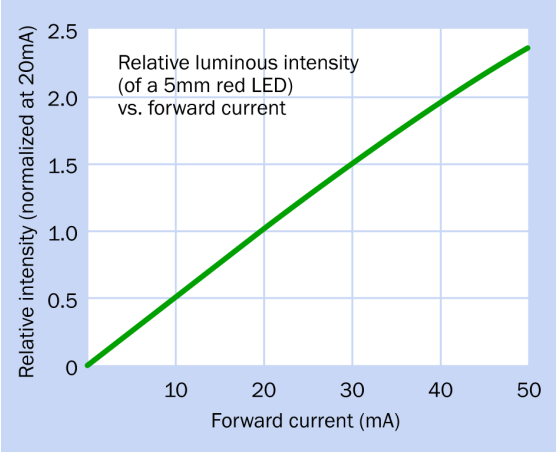

Figure 22-8. *The relationship between forward current and light intensity of a typical 5mm LED indicator is approximately linear up to the 20mA operating current, and almost linear up to the absolute maximum of 50mA.*

Various LED indicators drawing 2mA or 1mA are available, with intensities typically ranging between 1.5mcd and 2.5mcd. This low light output is still bright enough for viewing in a lab-bench environment. Low-current blue LEDs are not available. The only LEDs that draw as little as 1mA are red, as this is the most efficient type.

Using a higher value series resistor with a generic LED will of course reduce its current consumption, and some light will be visible so long as the forward voltage across the LED remains at its minimum level or above.

Forward Voltage

Red is the color that requires not only the least forward current, but the lowest forward voltage. In the range of 1.6VDC to 1.7VDC, all the LEDs are red. Typical forward voltages for various colors are shown here:

- Infrared LED: 1.6V to 2V
- Red LED: 1.6V to 2.1V
- Orange LED: 1.9V to 2.1V
- Amber LED: 2V to 2.1V
- Yellow LED: 2V to 2.4V
- Green LED: 2.4V to 3.4V
- Blue LED: 3.2V to 3.4V
- Ultraviolet LED: 3.3V to 3.7V
- White LED: 3.2V to 3.6V

Color Rendering Index

The *color rendering index* (CRI) evaluates the fidelity with which a light source is capable of displaying the full visible spectrum. It ranges from a perfect score of 100 down to 0 or even lower (sodium-vapor street lighting has a negative value). Computing the index requires standard reference color samples and has been criticized for generating scores that do not correlate well with subjective assessments.

Incandescent bulbs can have a CRI of 100, while an uncorrected white LED may score as low as 80.

Life Expectancy

Because the light output from an LED tends to decrease very gradually with time, the life expectancy is often defined as the number of hours required for the output to diminish to 70% of its output when new. Life expectancy is commonly stated on datasheets for high-brightness white LEDs, but is often omitted from datasheets for LED indicators.

Unlike incandescent lamps and fluorescent lights, LEDs do not have a shorter lifespan if they are frequently cycled on and off.

Light Output and Heat

The light intensity of an LED, measured in mcd, can vary from a few mcd to a maximum of 40,000mcd. Intensities above 30,000mcd generally are achieved by limiting the view angle to 15 degrees or less. Because the candela is weighted toward the central, green segment of the visible spectrum, green LEDs are likely to have a rela-

tively high mcd rating. LEDs rated between 20,000mcd and 30,000mcd, with a view angle of 30 degrees, are almost all green.

Datasheets may often include a *derating curve* showing the lower limit that should be placed on forward current through an LED indicator when its temperature increases. In Figure 22-9, the LED should be operated only within the boundary established by the green line.

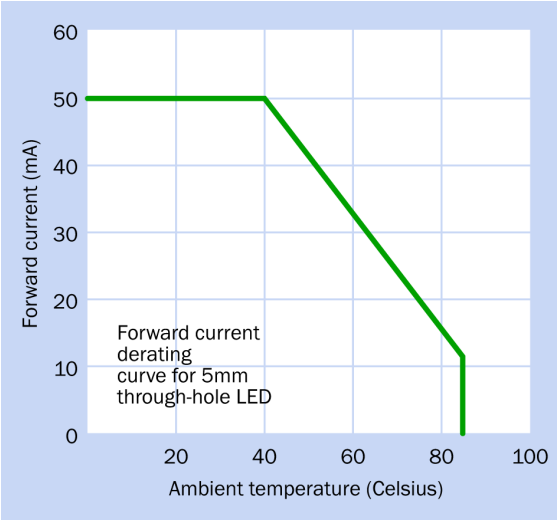

Figure 22-9. *Safe operation of an LED entails limiting the forward current if the temperature increases. The green line shows the boundary for operation of this particular component.*

View Angle

An LED formed from transparent epoxy or silicone (either water-clear or tinted) will create a well-defined beam with a view angle as narrow as 4 degrees or as wide as 160 degrees (in a few instances). The most common view angles for LED indicators are 30 degrees and 60 degrees.

Datasheets for LED indicators often include a *spatial distribution* graph showing the relative intensity of the light when viewed at various angles from the axis of the LED. The spatial distribution graph in Figure 22-10 is for an LED with a view angle defined as 40 degrees. This is the angle at which the relative luminous intensity diminishes to 50%.

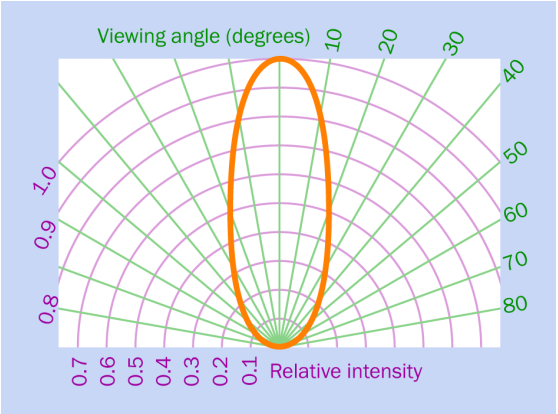

Figure 22-10. *A spatial distribution graph shows the relative intensity of light from an LED at various view angles.*

The view angle is of special concern in devices such as flashlights, where the spread of the beam affects the functionality.

How to Use It

Like all semiconductor devices, LEDs can be impaired by excess forward current and may break down irreversibly if subjected to excess reverse voltage. Their limits for reverse voltage are much lower than those of a rectifier diode. They are also vulnerable to heat, but are not particularly vulnerable to static electricity.

Polarity

A through-hole LED will have two leads of unequal length. The longer lead connects internally with the *anode* of the diode, and should be wired externally to the "more positive" side of a power source. The shorter lead connects internally with the *cathode* of the diode, and should be wired externally to the "more negative" side of a power source.

To remember the functions of the leads, consider that the plus sign would be twice as long as a minus sign if its horizontal and vertical stroke were disassembled and placed end to end.

If a round LED has a flange around its base, a flat spot in the flange will be closest to the cathode side of the component.

Series Resistor Value

Because the effective internal resistance of a diode is not a constant value at different voltages, a trial-and-error approach may be necessary to determine the ideal value for a series resistor with an LED indicator. For this purpose, a trimmer potentiometer can be used with a sample LED while measuring the current through it and the voltage drop across it. A fixed-value resistor can then be substituted. If the choice is between a resistor value that is a little too high and a value that is a little too low, the higher value resistor should be used.

An approximate value can be found using a very simple formula in which R is the resistor value, V_{CC} is the supply voltage, V_F is the forward voltage specified for the LED, and I is the desired current:

$$R = (V_{CC} - V_F) / I$$

Normally a series resistor rated at 1/4 watt will be acceptable, and 1/8 watt may be used in 5VDC circuits. However, care should be taken with a power supply of 9V or higher. Suppose an LED is rated for 1.8V forward voltage at 20mA. In a 5V circuit, the voltage drop across the series resistor will be:

$$V = 5 - 1.8 = 3.2$$

Therefore, the resistor must dissipate 3.2V * 20mA = 64mW. This is comfortably below the 125mW rating of a 1/8 watt resistor. However, with a 9V power supply, the voltage drop across the series resistor will be:

$$V = 9 - 1.8 = 7.2$$

Now the resistor must dissipate 7.2V * 20mA = 144mW. This exceeds the 125mW limit for a 1/8 watt resistor.

LEDs in Parallel

If multiple LEDs are to be driven in parallel, and none of them has to be switched individually, it is naturally tempting to save time by using a single series resistor for all of them. In these circumstances, assess the maximum current carefully and multiply by the voltage drop imposed by each of the LEDs, to determine the wattage of a series resistor.

Linking dissimilar LEDs in parallel is not recommended, because the threshold voltage decreases with increasing temperature. The hottest LED will therefore receive the largest current, and thus become even hotter. Thermal runaway can result.

LEDs containing their own series resistors can safely be wired in parallel.

Multiple Series LEDs

A series resistor wastes current by dissipating it as heat. In an application where two or more LED indicators will be illuminated simultaneously, the LEDs can be connected in series with a lower-value resistor, and three LEDs in series may eliminate the need for a resistor completely, depending on the voltage of the power supply. Here again a trimmer potentiometer should be used to determine an ideal value for any series resistor that may be necessary.

Comparisons with Other Light Emitters

Because LED indicators have largely replaced neon bulbs and miniature incandescent lamps, comparisons are of limited importance at this point. The situation regarding **LED area lighting** is different in that it is still competing actively with fluorescent lights and, in some instances, halogen. A list of advantages and disadvantages for high-intensity white LEDs is given in "Comparisons" on page 223. The advantages of incandescent lamps are listed in "Relative Advantages" on page 179.

Other Applications

LEDs are used in **optocouplers** and in **solid-state relays**. Usually an infrared LED is embedded inside a chip or a plastic module, and emits light through an interior channel to activate a phototransistor. This arrangement provides electrical isolation between the switching signal and the switched current.

Some sensors use an LED paired with a phototransistor at opposite sides of a U-shaped plastic mount. A sensor of this type can monitor industrial processes or may be found inside a photocopy machine, to detect the presence of a sheet of paper.

What Can Go Wrong

Excessive Forward Voltage

Like any diode, the LED has a *threshold voltage* in the forward direction. If this threshold is exceeded, the effective internal resistance of the LED falls very rapidly. Current rises equally rapidly, and quickly damages the component, unless it is protected by an appropriate series resistor.

Excessive Current and Heat

Exceeding the recommended value for forward current, or allowing an LED to overheat, will shorten its lifetime and cause a premature dimming of light output. LEDs generally require some current limiting or regulation (most commonly with a series resistor). They should not be connected directly to a voltage source such as a battery, even if the battery voltage matches the voltage of the diode. The exception to this rule is if the internal resistance of the battery is high enough to limit the current, as in the case of button-cell batteries.

Storage Issues

LEDs of different types are often indistinguishable from each other. They can also be indistinguishable from photodiodes and phototransistors. Careful storage is mandatory, and reusing LEDs that have been breadboarded may cause future problems if they are wrongly identified.

Polarity

If the leads on an LED indicator are trimmed, and if the indicator lacks a flange in which a flat spot will identify the cathode, the component is easily misused with reversed polarity. If it is connected with a component that has limited current sourcing capability (for instance, the output pin of a digital chip), the LED will probably survive this treatment. However, maximum reverse voltage is often as low as 5VDC. To minimize the risk of errors, the anode lead can be left slightly longer than the cathode lead when they are trimmed for insertion in a breadboard or perforated board.

Internal Resistors

As previously noted, it is difficult to distinguish an LED that contains its own series resistor from another LED that does not. The two types should be stored separately, and should be reused circumspectly.

LED area lighting

23

The term **LED area lighting** is used in this encyclopedia to describe a white LED source that is bright enough to illuminate rooms, offices, or outdoor areas. It may also be used in desk lamps or table lamps as *task lighting*. LEDs for these purposes may be categorized as *high-brightness*, *high-power*, *high-output*, or *high-intensity*. A complete fixture containing at least one light source is properly known as a *luminaire*, although the term is not uniformly applied and is sometimes written incorrectly as a *luminary*.

The full term *light-emitting diode* is not normally applied to an LED used for area lighting. For this purpose, the LED acronym has become universal. Periods are not normally placed between the letters.

While an LED area-lighting package may contain more than one diode, it is still categorized here as a single source. By contrast, any component consisting of multiple separately discernible light-emitting diodes, as in a seven-segment numeral, a 14- and 16-segment alphanumeric character, a dot-matrix character, or a display of multiple characters, is listed in a separate entry as an **LED display**.

The term *OLED* is an acronym for *Organic Light-Emitting Diode*, a thin panel in which an organic compound is contained between two flat electrodes. Despite its functionality as a form of LED, its design is similar to that of thin-film electroluminiscent light sources. Therefore it is discussed in the entry on **electroluminescence**.

OTHER RELATED COMPONENTS

- **LED indicator** (see Chapter 22)
- **incandescent lamp** (see Chapter 18)
- **fluorescent light** (see Chapter 20)
- **neon bulb** (see Chapter 19)
- **electroluminescence** (see Chapter 26)

What It Does

High-brightness white LEDs provide a plug-compatible alternative to **incandescent lamps**, *halogen lighting*, and **fluorescent lights** for work spaces and the home.

At the time of writing, products are still evolving rapidly in the field of LED area lighting. A shared goal of manufacturers is to increase efficiency while reducing retail price to the point where high-brightness LEDs will displace fluorescent tubes for most low-cost lighting applications.

A wall-mounted LED reflector-bulb that emulates a halogen fixture is shown in Figure 23-1. A small LED floodlight for exterior use is shown in Figure 23-2. An early attempt to package an LED area light in a traditional-style bulb is shown in Figure 23-3. Within a decade, as LED area lighting continues to evolve, some of these examples

may look quaint. Configurations are evolving, with final results that remain to be seen.

Figure 23-1. *A small LED reflector-light emulating a halogen fixture. Note the square of yellow phosphors mounted on the diode.*

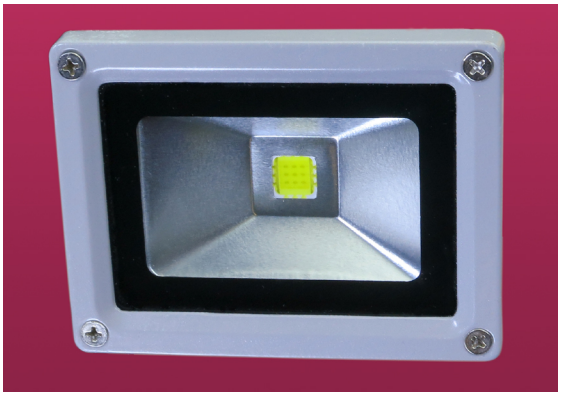

Figure 23-2. *A floodlight for exterior use. Nine LEDs are assembled behind the yellow phosphors. The steel frame measures about 4" by 3".*

Trends in Cost and Efficiency

The *luminous flux* of a source is the total power that it radiates in all directions, within the visible spectrum. The unit that measures luminous flux is the *lumen*. For a more detailed discussion of this topic, see "Power" on page 177. Since 1965, the cost per lumen of light from a given color of LED has decreased by about a factor of 10, while the maximum number of lumens emitted by an LED package has increased by a factor of 20, during each decade. This is known as Haitz's Law, named after Dr. Roland Haitz of Agilent Technologies. Figure 23-4 illustrates it graphically.

Figure 23-3. *An LED light bulb. Unlike an incandescent bulb, it focuses the illumination in one direction, like a reflector-light. Consuming only 6W, it is claimed to be equivalent to a 40W incandescent bulb.*

Schematic Symbol

Schematic symbols that are commonly used to represent an LED are shown in Figure 23-5. The symbol remains the same regardless of the size or power of the component, but architectural plans may represent any type of light using the circle-and-X symbol at bottom right.

How It Works

A high-brighteness LED functions on the same basis explained in the entry describing **LED indicators**. Photons are emitted when electrons are sufficiently energized to cross a PN junction and combine with electron-holes.

An LED that appears white, or off-white, actually emits blue light that is re-radiated over a wide range of wavelengths by adding a layer of yellow phosphors to the chip. A cutaway diagram of an

LED chip (properly known as a *die*), mounted under a silicone lens, is shown in Figure 23-6.

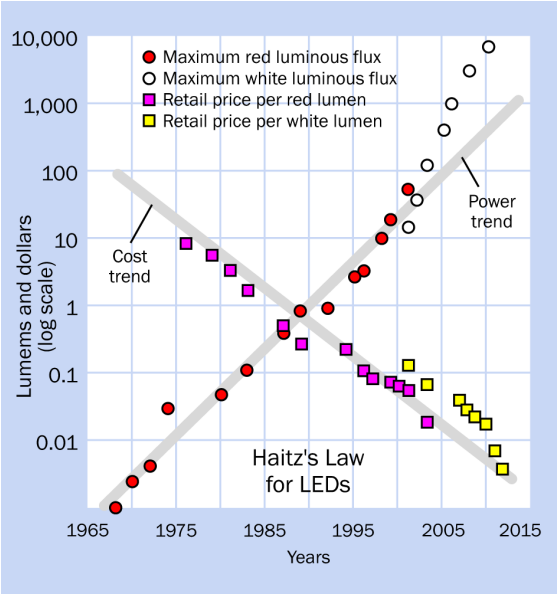

Figure 23-4. *The increase in light output (luminous flux, in lumens) of a single LED compared with the decrease in cost-per-lumen during the years since 1965. The vertical logarithmic scale measures both dollars and lumens. Source: Philips Gardco site-lighting fact sheet with additional data from a "Strategies in Light Report" published by Semiconductor Equipment and Materials International in 2013.*

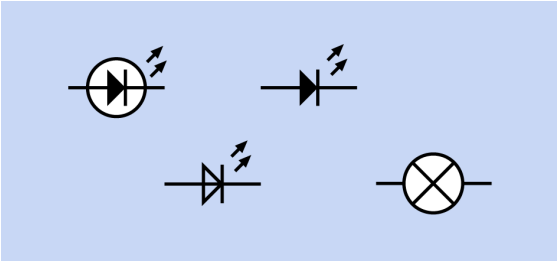

Figure 23-5. *The symbol for an LED remains the same regardless of its size and power, but architectural plans may use the circle-and-X symbol at bottom right for any type of light fixture.*

LEDs are mass-produced by etching them into crystals that are then cut into *wafers* before being subdivided into *dies*, like silicon chips. Most of the blue LEDs that form the basis of white lighting use sapphire crystals as their substrate. The crystal may range in diameter from two inches to six inches. Large sapphire wafers are also finding potential applications in camera lens covers and scratch-resistant cover plates for cellular phones.

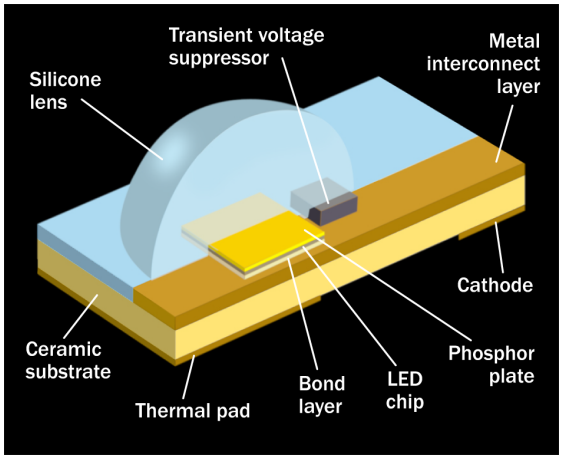

Figure 23-6. *Cutaway diagram of a high-brightness white LED. Adapted from Philips Lumileds Technical Reference document.*

While a die for an LED indicator may be 0.3mm x 0.3mm, a die in a high-brightness LED is often 1mm x 1mm. The size is limited by technical issues involving total internal reflection of the generated light.

The precise color of the light is adjusted by adding red phosphors to the yellow phosphors. This reduces the overall efficiency of the LED by around 10% but creates a "warmer" radiance. A graphical illustration of this principle is shown in Figure 22-3, in the entry on LED indicators.

The *color temperature* of white or offwhite light is measured in degrees Kelvin, typically ranging from 2,500K to 6,500K, where a lower number represents a light with more red in it and a higher number represents a light with more blue in it. This system of measurement was originally used with **incandescent bulbs** to define the temperature of the filament, which determined its color. See "Spectrum" on page 173 for a detailed explanation.

Visible Differences

The effects of different types of illumination are compared in Figure 23-7. To create this figure, first a color chart was prepared in Photoshop and printed on high-gloss photo-grade paper with a Canon Pro9000 Mark II inkjet printer, which has separate colors for red and green in addition to cyan, pale cyan, magenta, pale magenta, yellow, and black.

The color chart was then photographed twice with a Canon 5D Mark II, using a fixed white balance of 4000K. The first exposure was made with "daylight spectrum" LED lighting (claimed color temperature of 6500K) while the second was made with halogen lighting (claimed color temperature of 2900K). The photographs were adjusted in Photoshop for levels only, to fill the available range of 256 values. The two exposures show how the same chart would appear when viewed under the different lights, if the human eye did not adjust itself at all. Note the large area of the LED exposure which is rendered in shades of blue or purple. Also note the dullness of the reds. This confirms the everyday belief that "daylight spectrum" LEDs tend to have a cold, purplish cast while incandescents have a warmer, yellow look.

The same camera was then used to make two more exposures, this time with the white balance set to 6500 for LED lighting and 2900 for halogen lighting, which would be the recommended standard procedure, suggesting the kind of compensation that the human eye also tends to make for different ambient lighting. The result is shown at Figure 23-8. The LED version has improved, but the reds and yellows are still muted. The halogen version also looks better than before, but the magenta end of the spectrum has too much yellow in it. These images show the limits of white-balance correction for indoor photography.

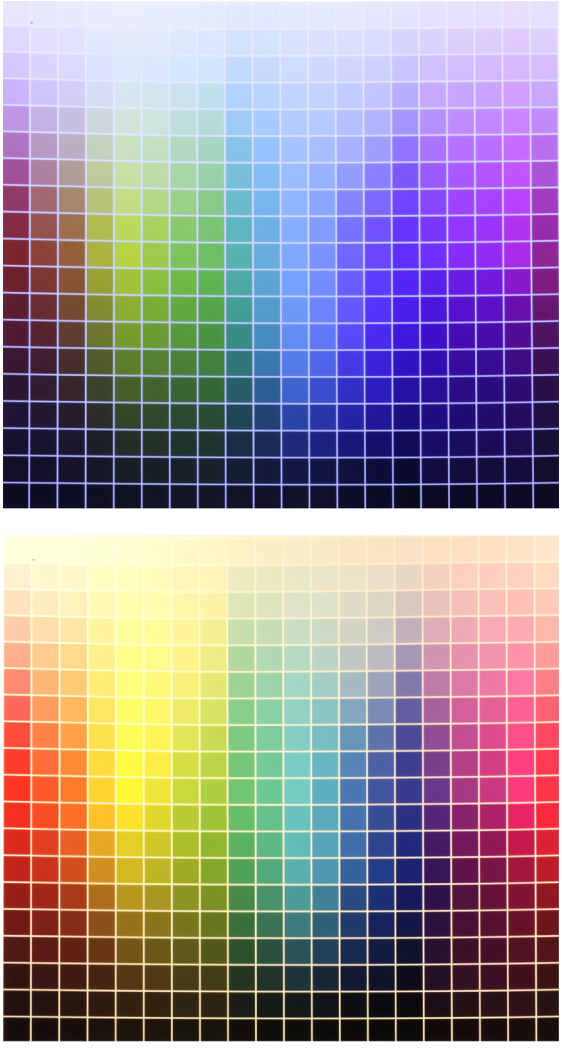

Figure 23-7. *The same printed color chart viewed with "daylight white" LEDs (top) and halogen lighting (bottom), without any compensation to allow for the different light spectra. A fixed white balance of 4000K was used for both pictures.*

Side-by-Side Comparison

Because the human eye is much better at comparing colors when they are adjacent to each other, another color chart was prepared using just six color bars of fully saturated red, yellow, green, cyan, blue, and magenta, with paler and darker versions above and below. The bars were separated with large white gaps. The chart was photographed first with the white balance set to

6500 under "daylight white" LED lighting and then again with the white balance at 2900 for halogen lighting. In Photoshop, the bars from the halogen version were copied and pasted beside the bars from the LED version to facilitate an A-B comparison. The result is shown in Figure 23-9.

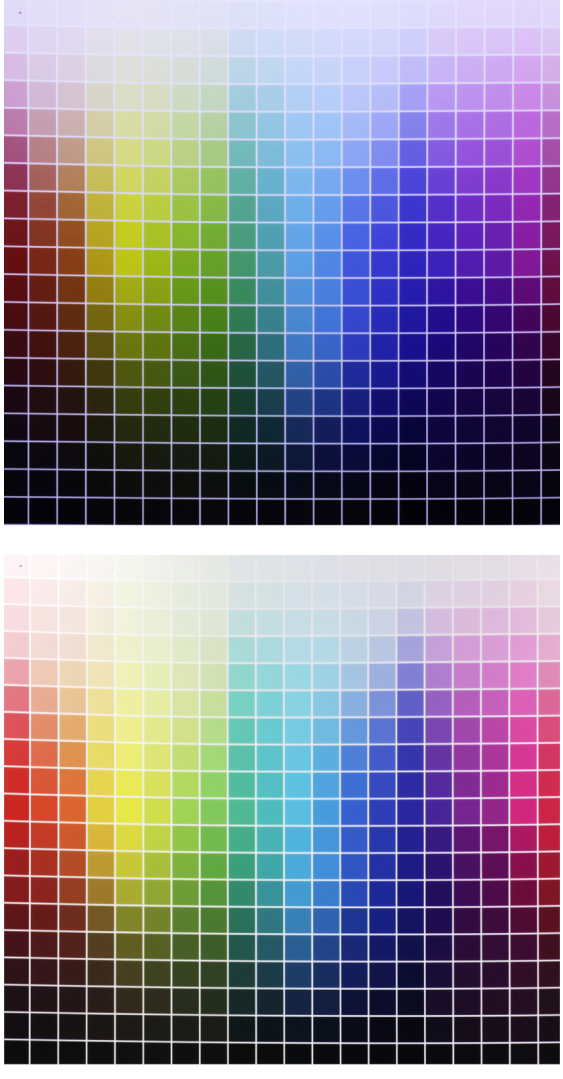

Figure 23-8. *The same color chart as before, photographed with appropriate color temperature settings of 6500K (top, using "daylight-spectrum" LEDs) and 2900K (bottom, using halogen).*

In each pair of colors, LEDs lit the one on the left, and halogen lights lit the one on the right. This figure shows the dramatic difference at the red end of the spectrum, and the poor reproduction of yellows by LED lighting. However, the LED rendering of green is better, and likewise the rendering of magenta, except where its darker version is concerned. Among the pale versions of the colors, the LED lights produce much less density (i.e., they have a brighter look) in the blues, greens, and cyans. The low densities will show up as pale highlights in a photograph of an object, and the picture will tend to have excessive contrast. This will also contribute to the "harsh" look of "daylight white" LED lighting which may be perceived by the eye.

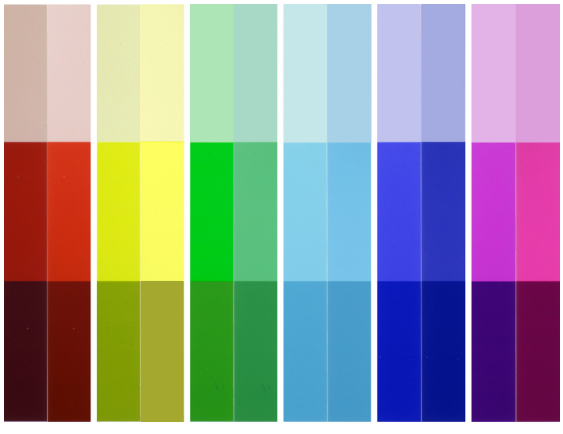

Figure 23-9. *A range of six fully saturated colors, with lighter and darker shades added above and below, photographed first with "daylight spectrum" LEDs and then with halogen lights, after which the two sets of colors were paired for easy comparison. The LED version is on the left in each pair.*

Halogen is deficient at the blue-violet end of the spectrum, even when the camera has an appropriate white-balance setting. Photographers can correct this using image-editing software. LED "daylight spectrum" lights are more difficult to correct. LEDs classified as "warm" should reproduce reds better, but may not do so well with blues.

Diffuse light from a uniformly cloudy sky may be the most ideal form of lighting for photographing objects, but this is of little help for people who work (or take photographs) under artificial lights.

LED lights that contain separate red, green, and blue emitters may perform better, but create a different problem, in that shadows will tend to have color fringes caused by the small offsets between the colored emitters.

Heat Dissipation

An LED is less than 100% efficient because not all electrons mate with electron holes. Some manage to bypass the semiconductor junction; some recombine without generating light; and some transfer their energy to other atoms. In each instance, waste heat is created. While the heat in an incandescent bulb is mostly dissipated by radiation, an LED must get rid of the heat almost entirely by conduction, typically through a *heat sink*. This complicates the design of a fixture, because the integrity of the pathway to dispose of the heat must be retained when the LED bulb or tube is replaced.

Efficacy

The *radiant luminous efficacy* (LER) of an incandescent light source measures how effective it is at channeling its output within the visible spectrum instead of wasting it in infrared radiation. LER is expressed in lumens per watt, and in an incandescent bulb, it is calculated by dividing the power emitted in the visible spectrum (the *luminous flux*) by the power emitted over all wavelengths. This is described in detail in "Efficacy" on page 179 in the entry dealing with incandescent lamps.

In an LED indicator, almost all the radiation can be contained within the visible spectrum, which suggests that its efficacy should be 100%. However, because some waste heat is still created internally, the efficacy is calculated by dividing the light output, in lumens, by the power input, in watts, at the voltage required by the LED. (Lumens can be converted directly to watts, and therefore this division makes a comparison between similar units).

In an LED lighting fixture that contains its own electronics to convert higher voltage AC to lower voltage DC, the power consumption of the fixture is measured not at the diode, but at the input side of the electronics. Therefore, the inefficiency of the electronics reduces the efficacy value of the lighting unit.

Dimming

An incandescent bulb is very sensitive to reduction in power. It becomes radically inefficient, emitting perhaps 1% of its normal light output if the power is reduced to 40%.

LEDs have an almost linear response to the supplied power. Usually a triac-based dimmer will not work well with LED area lighting, and a dimmer designed for LEDs must be substituted, using pulse-width modulation.

Ultraviolet Output

The gas plasma in a fluorescent light generates ultraviolet wavelengths that are shifted to the visible spectrum by the phosphor coating inside the glass envelope. Imperfections in the phosphor coating can potentially allow leakage of ultraviolet light, causing some researchers to claim that the use of CFLs (compact fluorescent lighting) for close-up work with desk lamps can increase the risk of developing some forms of skin cancer. (This claim remains controversial.)

LED manufacturers are quick to point out that white LEDs do not emit any ultraviolet radiation. Figure 23-10 shows spectral power distribution curves derived from measurements of three high-brightness Color Kinetics LEDs manufactured by Philips. The manufacturer states categorically that "The LED-based color and white light products made by Color Kinetics do not emit outside the visible spectrum." Infrared radiation is also negligible.

Color Variation

The *correlated color temperature* (CCT) is determined by finding the conventional incandescent color temperature which looks most similar to the light from a white LED. Unfortunately, because the CCT standard is insufficiently precise,

and because small manufacturing inaccuracies can occur, two LED sources with the same CCT number may still appear different when they are side by side. While the human eye adjusts itself to overall color temperature, it is sensitive to differences between adjacent sources. If two or more white LEDs in a lighting fixture do not have identical spectra, the difference will be noticeable.

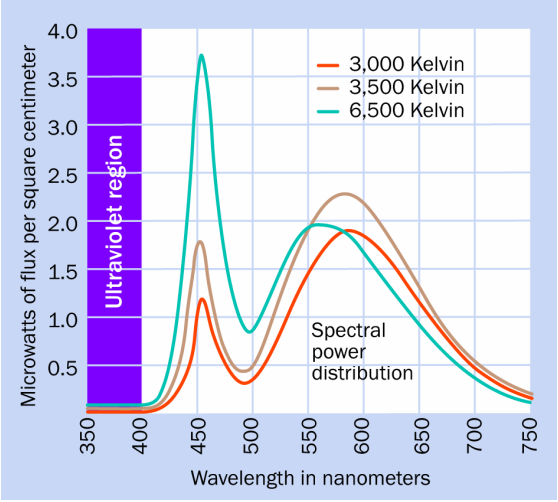

Figure 23-10. *Spectral power distribution curves for three high-brightness white LED lamps showing no ultraviolet emissions. (Adapted from a graph in a white paper published by Color Kinetics Incorporated.)*

To address the issue, manufacturers introduced the concept of "binning," in which lights are subclassified to tighter specifications and are assigned bin numbers based on their measured characteristics. The Philips Optibin system, for instance, assesses the light from various angles, as well as perpendicularly to the source. This is especially important where a large area such as a building lobby is painted white and is lit by high-brightness LEDs that must appear uniform in color temperature.

Variants

LED area lighting products are often designed to emulate the form factors of incandescent bulbs, halogen reflector bulbs, or fluorescent tubes. The standard screw-in base of an LED light bulb, the pin-base of a miniature 12V LED reflector bulb, and the pins on an LED tube enable easy migration to the newer technology.

Strip lights are unique to LED lighting systems. They are thick, flexible plastic ribbons in which are embedded a series of LEDs. For area lighting, the LEDs are white, and the strips can contain necessary control electronics for conversion of AC power. The strips can be placed behind ledges or moldings to provide soft, even illumination of the ceiling above.

Strip lights are also available for 12VDC power, to create lighting effects in customized automobiles and trucks. These strip lights are available in various colors in addition to white. Many have multicolor capability and can be controlled with a handheld remote.

Comparisons

The advantages of an **incandescent lamp** are listed in "Relative Advantages" on page 179, while advantages of **fluorescent lights** are listed in "Comparisons" on page 194. These lists can be compared with the following advantages for LED area lighting:

- While the life of an incandescent lamp for room lighting can be as little as 1,000 hours, LED area lighting typically claims up to 50,000 hours.
- The lifetime of an incandescent bulb is the average time it can emit light before catastrophic failure. The lifetime of an LED is the average time it can emit light before gradually dimming to 70% of its rated output. This is a much gentler, less inconvenient failure mode that does not require immediate replacement.
- Unlike a fluorescent light or incandescent bulb, the LED does not contain hot tungsten that fails as a result of erosion.

- Unlike a fluorescent light, an LED does not contain mercury, and therefore does not require special recycling arrangements that entail associated fees.
- While fluorescents can have difficulty starting in low temperatures, an LED is not sensitive to a cold environment.
- Bright LEDs are available in a wide range of colors that do not require filtering. Filters greatly reduce the efficiency of incandescent bulbs when they are used in applications such as traffic signals or rear lights on automobiles.
- High-brightness LEDs can be dimmable. Fluorescent lights are usually not dimmable, or perform poorly in this role.
- LEDs are inherently directional, because the die radiates light at an angle of 90 degrees to its plane. This makes it ideal for ceiling mounting, where as much light as possible should be directed downward. A fluorescent tube or incandescent bulb often requires a reflector which reduces the overall efficiency.
- LEDs are insensitive to cycling. The life expectancy of an incandescent bulb or (especially) a fluorescent tube is reduced by cycling it on and off.
- No flickering. Fluorescent tubes may start to flicker as they age.
- No electrical interference. Fluorescent tubes can interfere with AM radio reception and some audio devices.
- Safe from breakage. LED area lighting does not necessarily use any glass.

However, high-brightness LEDs still have some barriers to overcome:

- Cost. In the United States, before 60W incandescent bulbs were legislated out of existence, they could be sold profitably for less than $1 each. A T8 fluorescent tube, measuring 1″ diameter and 48″ long, currently costs between $5 and $6 (retail) but has a life expectancy in the region of 25,000 hours, and uses only 20% of the power of an incandescent bulb to generate two to three times as much light. Clearly the fluorescent tube is a more economical choice, despite the price of the electronics that must be included in the fixture to start the tube. By comparison, currently the purchase price of an LED tube is three times that of a fluorescent tube. It may last twice as long, but is not significantly more efficient, generating perhaps 100 lumens per watt while a fluorescent is typically capable of 90 lumens per watt. Prototype high-brightness LEDs have exceeded 200 lumens per watt, and should be competitive with fluorescents by 2020, but even then, migration will take time.
- Heat sensitivity. Heat reduces the light output and the lifespan of LED fixtures.
- Placement issues. Because LEDs are heat sensitive, they must be installed in locations that do not become excessively hot, their heat sinks must be correctly oriented, and they must have adequate ventilation.
- Color shift. Heat and age may cause the color temperature of an LED to shift slightly, as the color is usually derived from two types of phosphors.
- Nonuniformity. Manufacturing inconsistencies can cause LEDs of the same type to display slightly different color temperatures. Fluorescents and incandescents are more uniform.
- Lower heat output than incandescents. While this is an advantage from the point of view of efficiency, it can be a disadvantage in applications such as traffic signals or airport runway lighting where waste heat can help to keep the lights free from snow or ice.

Values

Although the output from an LED area light is directional, while the output from an incandescent bulb or a fluorescent light is omnidirectional, the intensity is measured the same way in each instance, using *lumens*. This unit expresses the total light emission, without taking directionality into account. (The intensity of **LED indicators** is calibrated in candelas, which measure the power within an angle of dispersion; but candelas are not used for area lighting.)

Typical values for incandescent bulbs are 450 lumens for a power consumption of 40 watts, 800 lumens for a consumption of 60 watts, 1,100 lumens for a consumption of 75 watts, and 1,600 lumens for a consumption of 100 watts. Because much of the output from an incandescent bulb may be wasted by using inefficient reflectors or allowing the light to shine in directions where it is not needed, a high-brightness LED rated at 1,000 lumens may actually appear brighter than a 75-watt incandescent bulb.

A T8 fluorescent tube measuring 48″ long by 1″ in diameter consumes only 32 watts but emits almost 3,000 lumens—when it is new. This output gradually diminishes by as much as 40% over the lifetime of the tube.

Incandescent bulbs deliver between 10 and 15 lumens per watt, approximately. A new fluorescent tube produces around 80 to 90 lumens per watt, and LED area lighting at the time of writing can provide 100 lumens per watt, under real-world conditions.

What Can Go Wrong

Wrong Voltage

Many high-brightness LED lighting units can be used with either 115VAC or 230VAC. There are exceptions, however. Check the specifications to make sure. Also, it is important to avoid applying domestic supply voltage to 12V LED miniature reflector-bulbs that are intended to replace 12VAC halogen bulbs of the same size.

Overheating

If a high-brightness LED fixture is equipped with a heat sink, this must be exposed to freely flowing air. Any vanes on the heat sink should be oriented vertically to encourage convection, and the fixture must not be placed in an enclosure. Overheating will radically shorten LED life.

Fluorescent Ballast Issues

A fluorescent fixture contains a *ballast* to limit the tendency of the tube to draw excessive current. The ballast is contained in a plastic box attached to the back of the frame in which the tube is mounted.

A *magnetic ballast* contains a coil, and is bypassed by an additional *starter* that applies unlimited current for one second when the power is switched on, preheating the tube to initiate plasma discharge.

An *electronic ballast* performs the same function without a separate starter.

Some LED tubes designed as substitutes for fluorescent tubes may allow a magnetic ballast to remain in the circuit, but may not tolerate an electronic ballast. Other LED tubes require any type of ballast to be unwired from the circuit. The unwiring operation will require disconnection of a couple of wires by removing wire nuts (assuming that the fixture has been designed to comply with U.S. building codes). The wires are then reconnected to apply power directly to the tube, and the wire nuts are reapplied to complete the new connection. The ballast can remain passively in the fixture.

Failing to remove the ballast and/or the starter from a fluorescent fixture before installing an LED tube that requires direct connection to the power supply can damage the tube. Connecting the power incorrectly to the LED tube may result in it failing to light up. Documentation supplied with the LED tube should provide guidance for disconnecting the ballast and connecting the tube. Note that the pin functions on LED tubes are not standardized at this time.

Misleading Color Representation

Because the spectrum of a white LED is not evenly weighted across all wavelengths, it will fail to represent some colors accurately, as shown previously. This can be important if LEDs are used to illuminate full-color printing or artwork, or if they are installed in stores selling merchandise such as clothes, furnishings, or food.

LED display

24

In this encyclopedia, a component consisting of multiple separately discernible light-emitting diodes, such as a seven-segment numeral, 14- or 16-segment alphanumeric character, a dot-matrix character, or a display module containing multiple characters, is categorized as an **LED display**. The term *light-emitting diode* is hardly ever used to describe an LED display, as the LED acronym has become ubiquitous. The acronym does not usually include periods between the letters.

An **LED indicator** is defined here as a component usually 5mm or smaller in diameter, made of transparent or translucent epoxy or silicone, most often containing one *light-emitting diode*. It is purposed as a status indicator in a device, rather than as a source of illumination, and is sometimes referred to as a *standard LED.*

LEDs that are designed to illuminate large living or working areas are discussed in a separate entry as **LED area lighting**. They are sometimes referred to as *high-brightness LEDs* and almost always emit white light.

The term *OLED* is an acronym for *Organic Light-Emitting Diode*, a thin panel in which an organic compound is contained between two flat electrodes. Despite its functionality as a form of LED, its design is similar to that of thin-film electroluminiscent light sources. Therefore it is discussed in the entry on **electroluminescence**.

OTHER RELATED COMPONENTS

- **LED indicator** (see Chapter 22)
- **LED area lighting** (see Chapter 23)
- **vacuum-fluorescent** (see Chapter 25)
- **electroluminescence** (see Chapter 26)
- **LCD** (see Chapter 17)

What It Does

An LED display presents information on a panel or screen by using multiple segments that emit light in response to a DC current, almost always at a voltage ranging between 2VDC and 5VDC. The display may contain alphanumeric characters and/or symbols; simple geometrical shapes; dots; or pixels that constitute a *bitmap*.

A *liquid-crystal display*, or **LCD**, serves the same purpose as an LED display and may appear very similar, except that a liquid crystal reflects incident light while an LED emits light. The increasing use of backlighting with LCDs has made them appear more similar to LED displays.

There is no schematic symbol to represent an LED display. Where a segmented display is used, often the segments are represented with drawn outlines.

The simplest, most basic, and probably the best-known example of an LED display is the *seven-*

segment numeral, one of which is shown in Figure 24-1. This is a Kingbright HDSP-313E with a character height of 0.4".

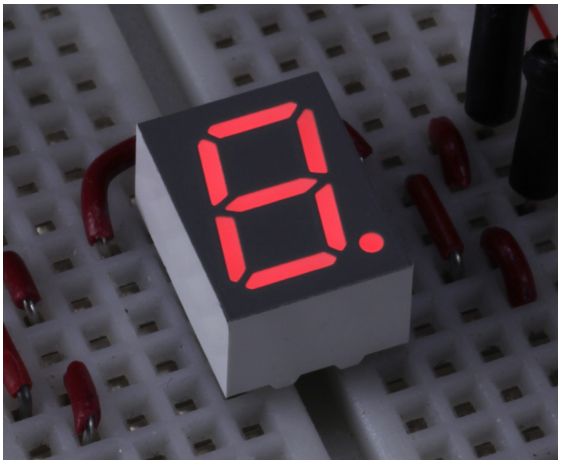

Figure 24-1. *The most basic LED display, able to create numerals from 0 through 9 using seven light-emitting segments that can be illuminated individually. An eighth segment forms the decimal point.*

How It Works

The process by which an LED generates light is explained in "How It Works" on page 207, in the entry dealing with **LED indicators**. Each light-emitting diode in an LED display is functionally the same as the diode in an LED indicator.

LEDs must be driven with DC. This is a primary distinction between an LED display and an LCD, which requires AC.

Variants

LCD comparisons

LCDs and LED displays can look very similar. This raises the obvious question: which is appropriate for a particular application?

LCDs (without backlighting) are more appropriate for applications such as digital watches and solar-powered calculators where power consumption must be minimized. They are capable of running for years from a single button cell.

LCDs are easily visible in bright ambient light, where LED displays are not. LCDs can also be designed to display complex pictographic shapes and symbols, while the segments of an LED display are more constrained to be simple in shape.

An LCD is more likely to be affected by temperature than an LED, and powering it entails some slight inconvenience, because it requires an AC source that is unlikely to be useful elsewhere in a circuit. If the LCD uses LED backlighting, it will also require a low-voltage DC power source for the backlight. An LED display is easier to use in that it can be driven directly from a microcontroller or logic chip, with only some series resistors to limit the current, and the addition of transistors to provide additional power where necessary.

Seven-Segment Displays

Early seven-segment LED displays were used in digital calculators, before LCDs became an affordable, practical alternative that greatly extended battery life. Initially, the size of the diodes was limited, sometimes requiring magnifying lenses to make them legible.

Seven-segment displays are still used in some low-cost applications, although LCDs have become more common.

Figure 24-2 shows how the segments are identified with letters *a* through *g*. This scheme is used universally in datasheets, and is also used for LCDs. The decimal point, customarily referred to as "dp," is omitted from some displays. The segments are slanted forward to enable more acceptable reproduction of the diagonal stroke in numeral 7.

Although seven-segment displays are not elegant in appearance, they are functional and are reasonably easy to read. They also enable the representation of hexadecimal numbers using letters A, B, C, D, E, and F (displayed as A, b, c, d, E, F because of the restrictions imposed by the small number of segments), as shown in Figure 24-3.

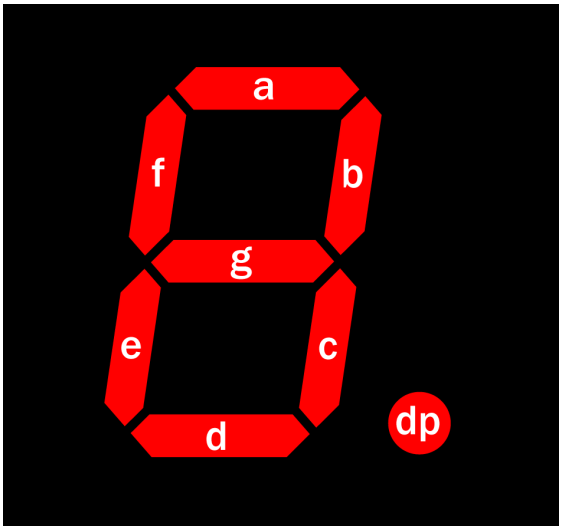

Figure 24-2. *A seven-segment LED display. The lowercase identifying letters are universally used in datasheets.*

In appliances such as microwave ovens, very basic text messages can be displayed to the user within the limitations of seven-segment displays, as suggested in Figure 24-4.

Numbers 0, 1, and 5 cannot be distinguished from letters O, I, and S, while letters containing diagonal strokes, such as K, M, N, V, W, X, and Z, cannot be displayed at all.

Multiple Numerals

Displays consisting of a single numeral are now rare, as few applications require only one digit. Displays of two, three, and four digits are more common, as shown in Figure 24-5.

Additional Segments

Displays with 14 or 16 segments were introduced in an effort to enable the representation of all the letters of the alphabet. The segment layout of these LED displays is identical to that of comparable LCDs. The differences between 14-segment and 16-segment displays are shown in Figure 24-6. Some are angled forward like seven-segment displays, even though the addition of diagonal segments makes this unnecessary for display of characters such as numeral 7.

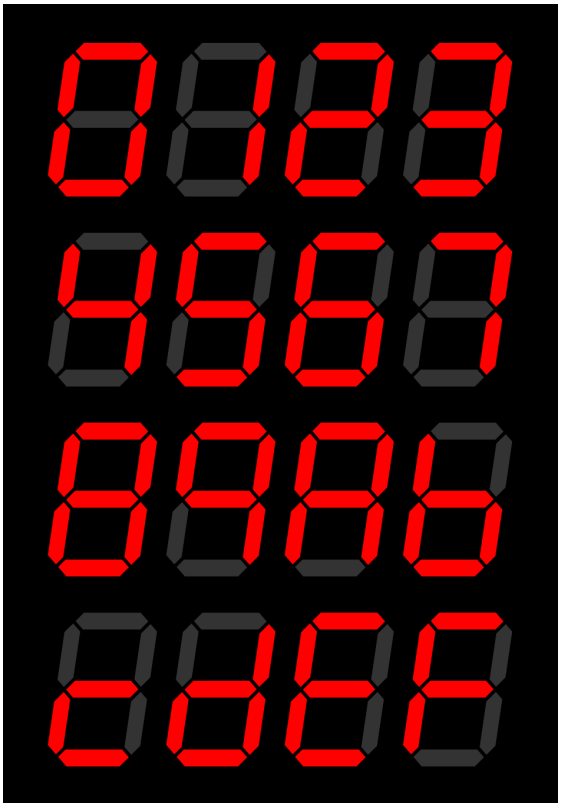

Figure 24-3. *Numerals and the first six letters of the alphabet created with seven-segment displays.*

Figure 24-7 shows the scheme for identifying the segments of a 16-segment display. This naming convention is used in all datasheets. The lowercase letters that were customary with seven-segment displays are usually abandoned in favor of uppercase, perhaps to avoid confusion with the letter L. Note that letter I is omitted from the sequence.

For a complete alphanumeric character set enabled by a 16-segment display, see Figure 17-9 in the entry discussing LCDs.

An example of a 16-segment alphanumeric LED display is shown in Figure 24-8, mounted on a breadboard and wired to show the letter N. This is a Lumex LDS-F8002RI with a character height of 0.8″. The component is still available at the time of writing, but in limited quantities.

Generally speaking, 16-segment displays were never very popular, because the gaps between adjacent segments impaired legibility. LED versions remain more readily available than LCD versions, but dot-matrix displays allow a better-looking, more easily legible alphabet, with the added possibility of simple graphics.

Dot-Matrix Displays

In the 1980s, some personal computers used a video character set in which each letter, numeral, punctuation mark, and special character was formed on a video screen from a fixed-size matrix of dots. A similar alphabet is now used in LED dot-matrix displays (and LCDs, as shown in Figure 17-10).

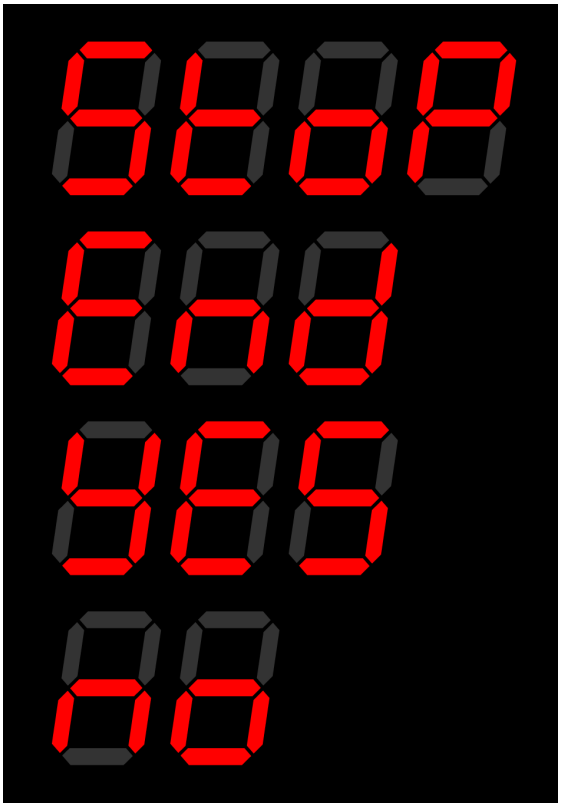

Figure 24-4. *Basic text messages can be generated with seven-segment displays, although they cannot represent alphabetical letters containing diagonal strokes.*

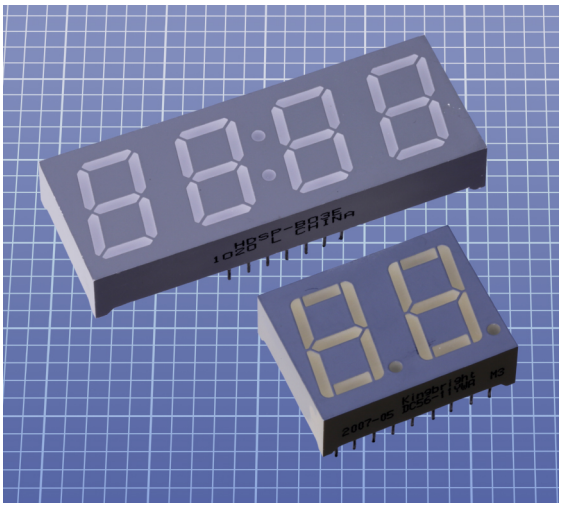

Figure 24-5. *Multiple seven-segment LED displays are often combined in a single component. Top: An Avago 2.05VDC 20mA display designed for a clock. Bottom: A Kingbright two-digit display which draws 20mA at 2.1VDC. The unlit outlines of the numerals would normally be hidden behind panels that are tinted to the same colors emitted by the LED segments when lit.*

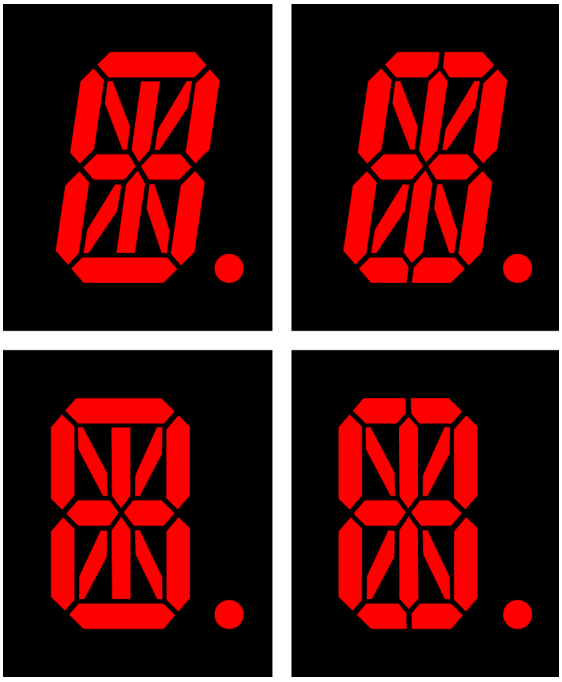

Figure 24-6. *Layouts for 14-segment and 16-segment alphanumeric LEDs are identical to those of LCDs.*

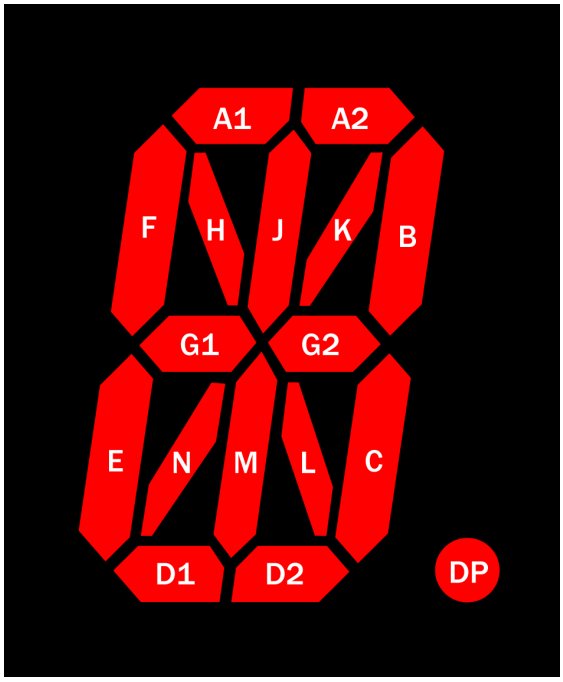

Figure 24-7. *The scheme for identification of segments in a 16-segment alphanumeric LED display.*

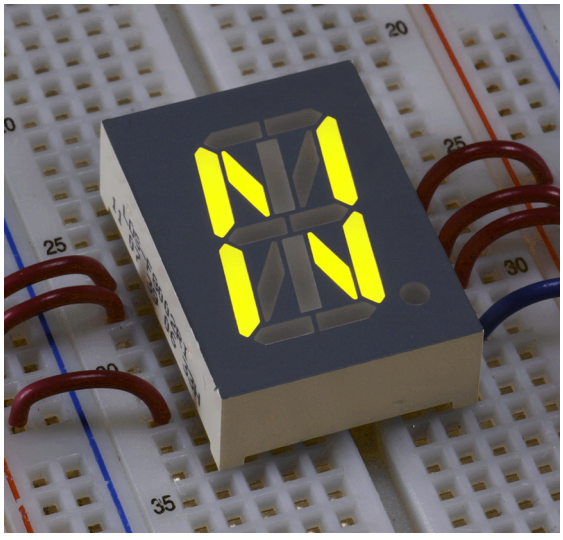

Figure 24-8. *A 16-segment alphanumeric LED display showing the letter N.*

Alphanumeric dot-matrix characters are often grouped in two or more rows with eight or more characters per row. The number of characters is always listed before the number of rows, so that an 8x2 display would contain eight alphanumeric characters in two horizontal rows. This type of component is properly described as a *display module*.

Display modules are used in consumer electronics products such as a stereo receiver where simple status messages and prompts are necessary —for example, to show the tone control settings or the frequency of a radio station. Because the cost of small, full-color, high-resolution LCD screens has been driven down rapidly by the mass production of cellular phones, and because these high-resolution screens are much more versatile, they have already displaced dot-matrix display modules in many automobiles and are likely to follow a similar path in other devices.

Pixel Arrays

The 8x8 pixel array of LED dots shown in Figure 24-9 measures 60mm square (slightly more than 2") and contains 64 LEDs, each approximately 5mm in diameter. Similar arrays are available in other sizes and with different numbers of dots. Displays of the same type may be assembled edge-to-edge to enable scrolling text or simple graphics.

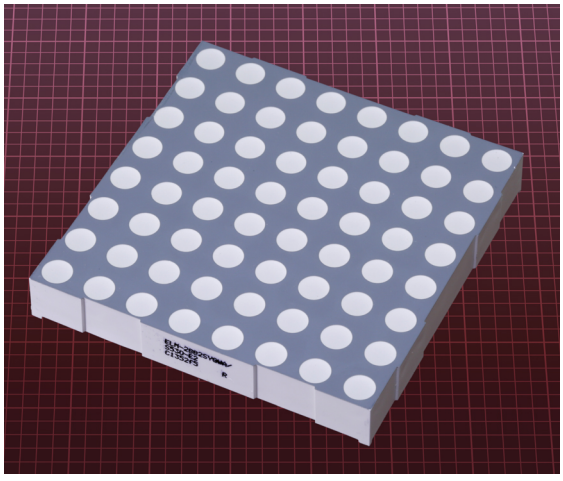

Figure 24-9. *An 8x8 matrix of LED dots measuring more than two inches square.*

Multiple Bar Display

A bar display is a row of small rectangular LEDs in a single component. It may be used for digital representation of an analog signal. The higher the voltage of the signal, the more bars will be illuminated. A typical application would be to show the signal strength of an input to an audio recorder. Ten bars are often used, as in the display shown in Figure 24-10, but multiple components can be combined end to end.

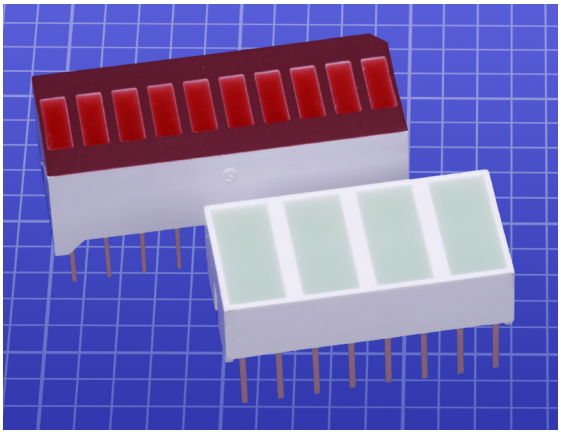

Figure 24-10. *Two LED bar displays in which segments can be lit individually.*

Single Light Bar

A light bar can be thought of as a single-source LED, as it is configured as a single square or rectangle. It is mentioned here, rather than in the entry for single-source LED indicators, because variants may be subdivided into two, three, four, or (sometimes) more discrete sections. These variants are often included in the same datasheet as the monolithic version.

A light bar contains multiple LEDs (often, four in number) behind a translucent panel that provides evenly diffused radiance.

Values

The values for most LED displays are basically the same as for LED indicators, in terms of color, brightness, current consumption, and voltage. See "Values" on page 211 for information.

Multiple-character dot-matrix LED display modules may have different requirements for forward voltage and forward current, depending on drivers that are incorporated in the module. Because there is no standardization for these modules, it will be necessary to consult the manufacturer's datasheet.

How to Use It

Seven-Segment Basics

The diodes in a seven-segment LED display share either a *common anode* or a *common cathode*, the latter being more frequently used. The two types of internal wiring are provided for convenience only. Externally, the displays function identically.

A schematic suggesting the internal wiring and pinouts of a typical ten-pin common-cathode display is shown in Figure 24-11. The pins are numbered as seen from above. Appended to each number is the identity of the segment to which it is connected. Pins 3 and 8 are connected with the cathodes of all the internal LEDs. Both of these pins should be used, to serve as heat sinks for the display.

Note that series resistors are not included inside the display and must be added externally. Their value will be determined by the power supply, to limit the forward current and forward voltage through the LEDs to the extent specified by the manufacturer.

An encapsulated *resistor array* containing either seven or eight resistors in an SIP or DIP chip can be used instead of individual resistors. A seven-segment LED display would require the type of resistor array in which both ends of each resistor are accessible.

Where two or more numerals are combined in a single component, this type of display is likely to have two horizontal lines of pins. In this case, pin 1 will be at the bottom-left corner, seen from

above. As always, the pins are numbered counterclockwise, seen from above.

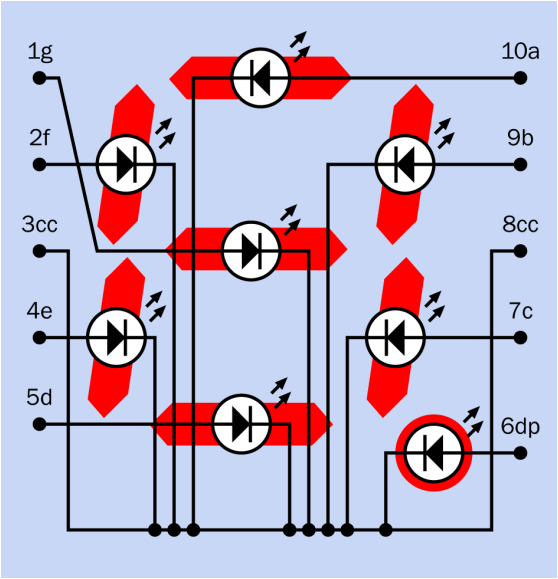

Figure 24-11. *A schematic view of internal connections and pinouts of a seven-segment common-cathode LED display. The numbers refer to the pins of the component, seen from above. The 1 pin may also have a mark beside it on the component, for identification. The orientation of the display can be deduced if there is a decimal point, as this should be at the bottom-right corner.*

Where three or more numerals are combined in a single component, the pinouts may be designed for multiplexing rather than individual access to every segment of each numeral. A four-digit clock display, for instance, may have seven pins that connect in parallel to respective segments in all of the numerals, and four additional pins that can ground each numeral in turn, so that they can be selected sequentially.

Driver Chips and Multiplexing

Illuminating the appropriate segments in a single numeral can be done directly from a microcontroller, or through a driver chip such as the well-known and widely used 4543B that converts a binary-coded decimal input into appropriate segment output patterns. The chip can source sufficient current to drive each segment through a series resistor. Its pinouts are shown at Figure 24-12.

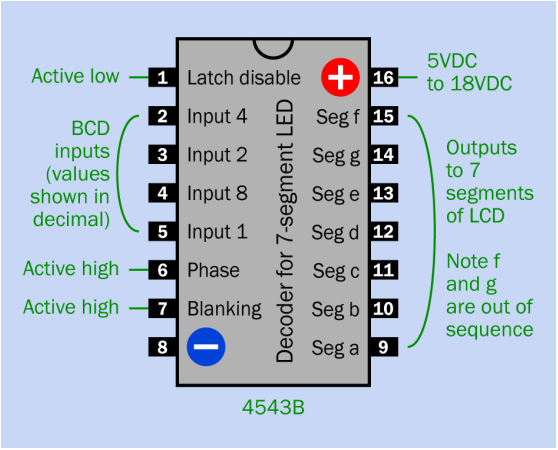

Figure 24-12. *Pinouts of the 4543B seven-segment LED driver chip.*

When used in conjunction with a microcontroller, the 4543B can drive several seven-segment displays by multiplexing them. The basic schematic to achieve this is shown in Figure 24-13, omitting optional features such as leading-zero blanking or connections for a decimal point. The microcontroller sends the binary code for the first numeral and simultaneously grounds the common cathode of that numeral through a transistor, which is needed because as many as seven segments of the numeral may be passing current in parallel. The microcontroller then sends the binary code for the second numeral, and grounds it; then sends the binary code for the third numeral, and grounds it; and the cycle repeats. So long as this process is performed at sufficient speed (at least 50Hz), persistence of vision will create the illusion that all the numerals are active simultaneously. The circuit can be compared with a similar circuit to drive LCDs, shown in Figure 17-17.

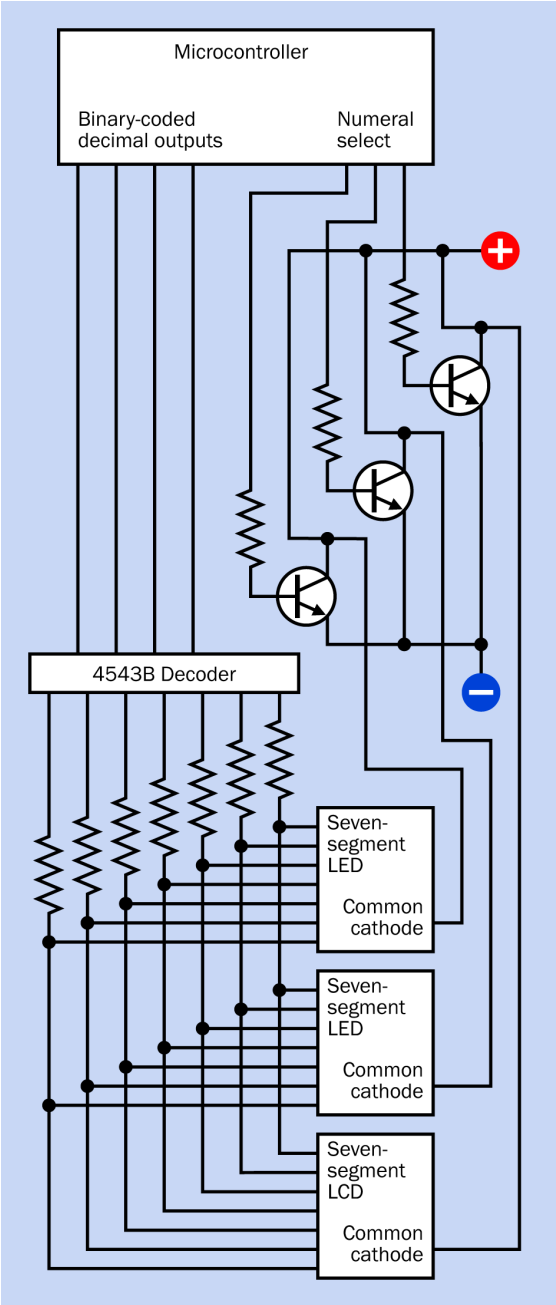

Figure 24-13. *A basic, simplified circuit for driving multiple seven-segment LED displays by multiplexing them.*

The disadvantage of this system is that the microcontroller must update the numerals constantly while performing other duties. To reduce this burden, a "smarter" driver such as the MC14489 can be used, controlling up to five 7-segment digits, or the Intersil ICM7218, which can control up to eight 7-segment digits.

The MC14489 controller receives data serially, using SPI protocol, and handles the details of addressing the LEDs. Because it contains latches to sustain the displayed data, a microcontroller only needs to communicate with the driver when the displayed information needs to be updated.

The ICM7218 is a more sophisticated chip, available in several variants, one of which can receive data on an 8-bit bus and run the seven-segment displays in hexadecimal mode.

Sixteen-Segment Driver Chip

The MAX6954 by Maxim can drive up to eight 16-segment alphanumeric LED displays using a scheme known as Charlieplexing, named after a Maxim employee named Charlie Allen who came up with the concept as a way of reducing the pin count required for multiplexing. Other Maxim controllers use this same protocol, which is transparent to the user.

A microcontroller sends data serially via I2C protocol to the MAX6954, which contains a variety of features. It can drive 14-segment and 7-segment displays as well as 16-segment displays, and contains a 104-character alphabet for each of them. Setting up a microcontroller to send the various necessary command codes to the MAX6954 is not a trivial matter, and bearing in mind the probably impending end-of-life of 16-segment displays, a better option may be to use dot-matrix LED display modules that have controller logic built in.

Dot-Matrix LED Display Modules

A dot-matrix LED display module requires data to define a character set, and a command interpreter to process instructions that will be embedded in a serial data stream. These capabilities are provided either by separate chips or (more often) are incorporated into the LED display module itself.

The SSD1306 is a monochrome graphical controller capable of I2C or SPI serial communication, or parallel communication. When this capability is built into a display module, only one of these types of communication may be activated.

The SSD1331 is a color graphical controller with similar communication capabilities.

The WS0010 is a monochrome controller, compatible with HD44780, which is designed to control LCDs.

Typical controller functions are summarized in "Alphanumeric Display Module" on page 168. Because there is no standardization in this field, precise details must be found in manufacturers' datasheets.

Pixel Arrays

The connections inside an 8x8 pixel array are shown in Figure 24-14, where the schematic symbols for LEDs have been replaced by gray circles for space reasons. To illuminate one LED, power is supplied to the intersection where it resides. In the figure, each vertical conductor (identified as A1, A2 . . . A8) can power the anodes of a column of eight LEDs, while each horizontal conductor (identified as C1, C2 . . . C8) can ground the cathodes of a row of eight LEDs. If only one vertical conductor is connected with positive power while one horizontal conductor is grounded, only one LED will light up, at the intersection of the active conductors.

A problem occurs if we wish to illuminate two LEDs. Suppose they are located at (A3,C2) and (A6,C5). Unfortunately, providing power to them will also result in activating LEDs at (A3,C5) and (A6,C2), as shown in Figure 24-15, where the yellow circles represent LEDs that have been switched on.

The answer to this problem is to rasterize the process. In other words, data is supplied on the array one line at a time, as in the process by which a TV picture is generated. If this is done quickly enough, persistence of vision will create the illusion that the LEDs are illuminated simultaneously.

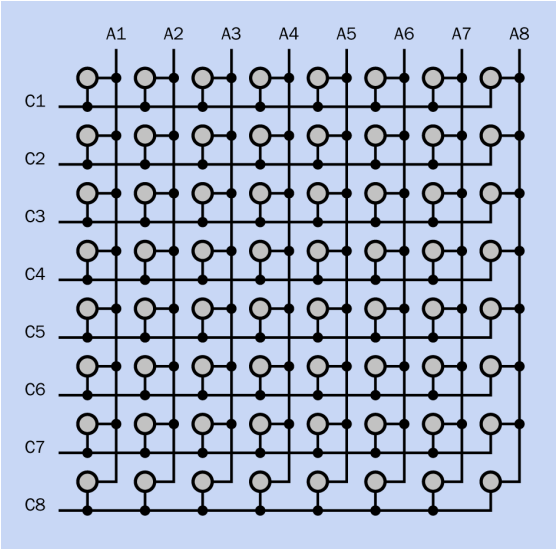

Figure 24-14. *Internal connections in the 8x8 matrix. Each gray circle represents an LED.*

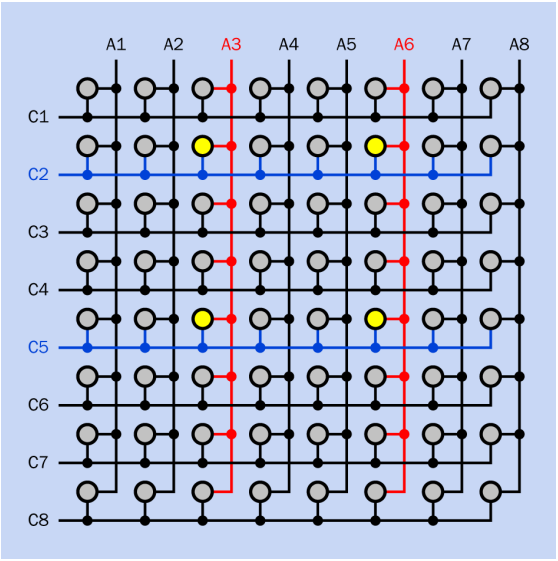

Figure 24-15. *An attempt to illuminate LEDs at (A3,C2) and (A6,C5) will also activate the LEDs at (A3,C5) and (A6,C2).*

A form of multiplexing is used to achieve this. One row of LEDs is connected to negative ground

for a brief interval. During this interval, the anodes of selected LEDs are powered momentarily. Then the next row is grounded, and selected LEDs along that row are powered momentarily. This process is repeated for all eight rows before being repeated.

If several 8x8 matrices are assembled edge to edge, their horizontal conductors can be common to all of them. A horizontally scrollable display (sometimes referred to by the archaic term, *electric newspaper*) would then be possible, although the circuit design would be nontrivial.

Multiple Bar Display Driver

The LM3914 is a driver for a bar display that compares an analog input with a reference voltage and provides power to the segments of a multiple bar display, ranging from 2mA to 30mA, adjustable to match the specification of the display that is being used. The chip can generate either a "thermometer" effect, as more outputs are activated when the analog input increases, or a "moving dot" effect, in which only one output is on at a time.

One-Digit Hexadecimal Dot Matrix

While multi-character dot-matrix LED display modules are a versatile way to display prompts and numbers, a simpler component is sometimes sufficient. The Texas Instruments TIL311 is a minimal dot-matrix LED display that receives a binary value from 0000 through 1111 on its four input pins and generates the output in hexadecimal form, using numerals 0 through 9 and letters A through F. The sixteen possible outputs in the dot-matrix display are shown in Figure 24-16. Although this component is no longer being manufactured, it is widely available from many sources, especially in Asia. It eliminates the series resistors and controller chip that are customary for a seven-segment display, and has a better-looking output.

Figure 24-16. *Sixteen possible outputs that can be displayed by the Texas Instruments TIL311 to show a hexadecimal value in response to a four-digit binary input.*

A sample of the TIL311 is shown in Figure 24-17 displaying the number 2.

If two or more of these chips are put together, they can be multiplexed to display multi-digit decimal or hexadecimal integers.

The chip features two decimal points, one to the left of the displayed numeral, and one to the right. If they are activated, they require their own series resistors to limit the current.

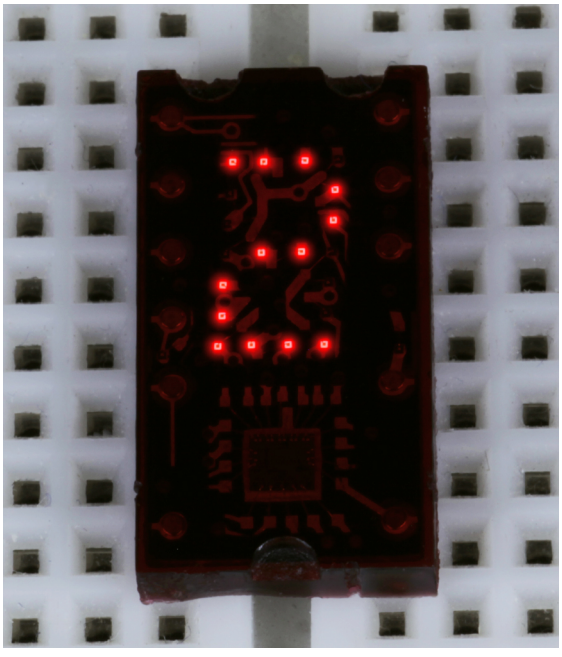

Figure 24-17. *The Texas Instruments TIL311 can be driven directly by a microcontroller or counter chip, with no series resistors necessary. It can generate a hexadecimal output.*

What Can Go Wrong

Common Anode versus Common Cathode

An LED display containing a common cathode is usually identical in appearance to a display containing a common anode, and the two versions will be distinguished by only one digit or letter in their part numbers. Because LED displays have a limited tolerance for reverse voltage, part numbers should be double-checked before applying power.

Incorrect Series Resistance

A common error is to assume that only one series resistor is necessary for a seven-segment LED display, either between the common cathode pin and ground, or, if there is a common anode, between that and the positive power supply. The problem is that if the resistor is suitable for a single LED, its value will be too high when several segments of the display are sinking current or drawing current through it. If its value is reduced, it will be too low when only two segments are using it (as when generating the number 1).

To provide equal illumination of all the segments, each must have its own series resistor.

Multiplexing Issues

When several displays are multiplexed, they naturally appear dimmer, creating a temptation to compensate by upping the current. Because current is only being applied to each display intermittently, a natural assumption is that a higher current can be safely used.

This may or may not be true. When running an LED device with pulsed current, the peak junction temperature, not the average junction temperature, determines the performance. At refresh rates below 1kHz, the peak junction temperature is higher than the average junction temperature, and the average current must therefore be reduced.

Datasheets must be checked to determine whether a device is designed with multiplexing in mind and, if so, what the recommended peak current is. Very often this value will be accompanied by a maximum duration in milliseconds, and a calculation may be necessary to determine the refresh rate, bearing in mind how many other LED displays are being multiplexed in the same circuit at the same time.

Irresponsible multiplexing will shorten the life of an LED display or burn it out.

vacuum-fluorescent display

25

The term **vacuum-fluorescent display** is seldom hyphenated, but the first two words are hyphenated here as they constitute an adjectival phrase. The acronym *VFD* is becoming increasingly popular, although it is ambiguous, being also used to identify a *variable frequency drive*. In both instances, the acronym is printed without periods between the letters.

The entry in this encyclopedia dealing with **fluorescent lights** does not include VFDs, because their purpose and design are very different. A VFD is an informational display, often showing numerals and letters, while a fluorescent light merely illuminates a room or work area. Although a VFD does use fluorescent phosphors, they are printed onto light-emitting segments of the display instead of being applied to the inside surfaces of a glass envelope.

OTHER RELATED COMPONENTS

- **LED indicator** (see Chapter 22)
- **LCD display** (see Chapter 17)
- **electroluminescence** (see Chapter 26)

What It Does

A **vacuum-fluorescent display** or *VFD* superficially resembles a backlit monochrome **LCD** or an **LED display**, as it can represent alphanumeric characters by using *segments* or a *dot matrix*, and can also display simple shapes. It is often brighter than the other information display systems, and can emit an intense green phosphorescent glow that some people find aesthetically pleasing, even though a grid of very fine wires is superimposed internally over the displayed image.

There is no specific schematic symbol to represent a vacuum-fluorescent display.

How It Works

The display is mounted inside a sealed capsule containing a high vacuum. A widely spaced series of very fine wires, primarily made of tungsten, functions as a *cathode*, moderately heated to encourage electron emission. The wires are often referred to as *filaments*.

A **fluorescent light** uses AC, and both of its electrodes are often confusingly referred to as cathodes. A VFD uses DC, and its cathode array has the function that one would expect, being connected with the negative side of the DC power supply.

Opposite the cathode, just a few millimeters away, is an anode that is subdivided into visible alphanumeric segments, symbols, or dots in a matrix. Each segment of the anode is coated with *phosphors*, and individual segments can be sep-

arately energized via a substrate. When electrons strike a positively charged anode segment, it emits visible light in a process of *fluorescence*. This behavior can be compared with that of a *cathode-ray tube*. However, the cathodes in a VFD are efficient electron emitters at a relatively low temperature, while the cathodes in a cathode-ray tube require substantial heaters.

Anode, Cathode, and Grid

A *grid* consisting of a mesh of very fine wires is mounted in the thin gap between the filaments of the cathode and the segments of the anode. A simplified view of this arrangement is shown in Figure 25-1.

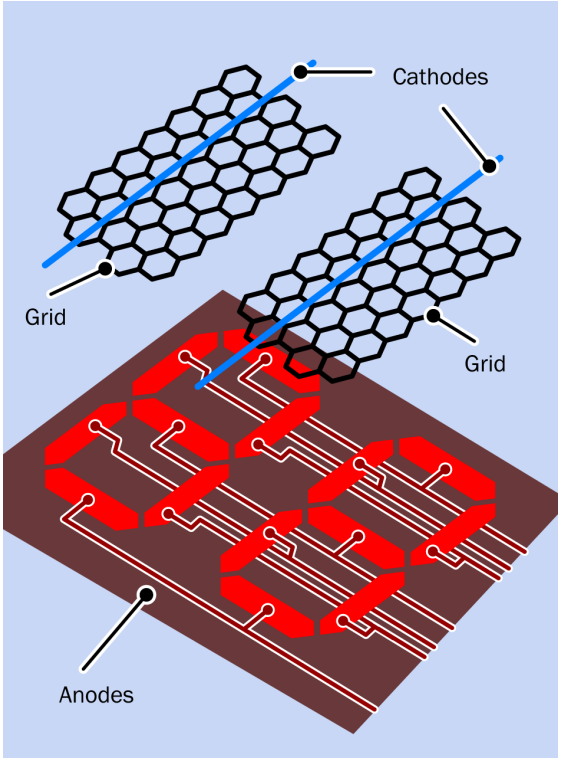

Figure 25-1. *The basic elements of a vacuum-fluorescent display.*

The polarity of the charge on the grid controls and diffuses electrons emitted by the cathode. If a grid section is negatively charged, it repels electrons and prevents them from reaching the sections of the anode beneath it. If the grid section is positively charged, it encourages electrons to reach the anode. Thus, the grid functions in the same way as the grid in a triode vacuum tube, but its conductors are so thin, they are barely visible.

How to Use It

Electronic calculators used vacuum-fluorescent displays during the 1970s, before LED displays and LCDs became more competitive. Purely numeric VFD modules are still available as strings of digits, although they are becoming uncommon and have been replaced by alphanumeric dot-matrix modules where each VFD character is mounted in its own glass module on a separate substrate.

Figure 25-2 shows the interior of a Commodore calculator from the 1970s, with its nine-digit vacuum-fluorescent display enclosed in one glass capsule.

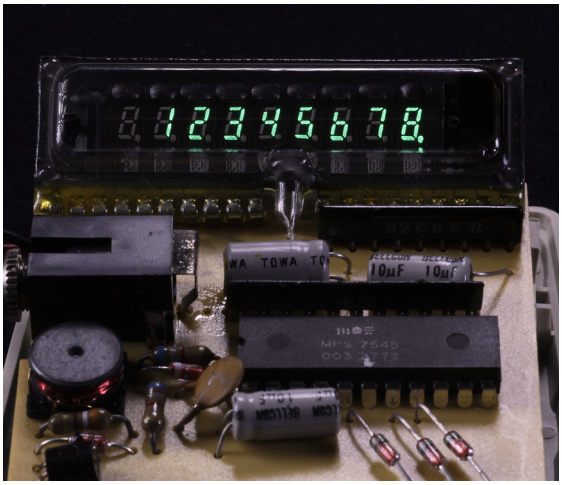

Figure 25-2. *The vacuum-fluorescent display from a 1970s Commodore calculator.*

A closeup of three digits from the previous figure appears in Figure 25-3, showing the grid superimposed above each numeral.

Figure 25-3. *Three digits from the previous figure, showing the grid that controls their illumination.*

A tinted filter of the same color as the display is usually placed in front of it, to conceal some of its workings. Thus, the Commodore calculator used a green filter in front of its green numerals. Figure 25-4 shows two seven-segment numerals from another device, with the filter removed. This reveals not only the grid but also the horizontal wires that function as the cathode. Connections between the segments of the numerals and a backplane are also visible.

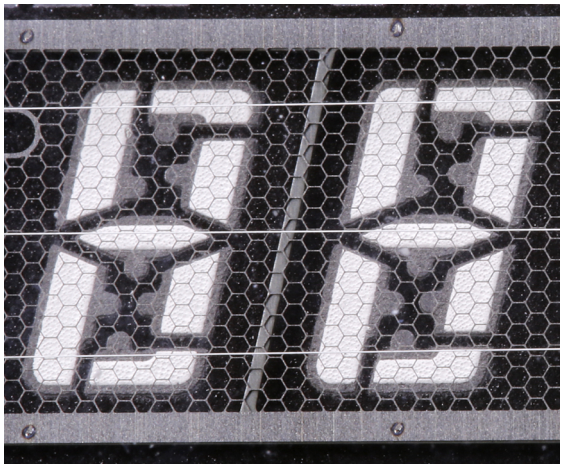

Figure 25-4. *Seven-segment numerals viewed without a colored filter, revealing the cathode (horizontal wires) and the grid (wire mesh).*

Modern Application

A modern VFD module is likely to be mated with a driver that converts 5VDC to the higher voltage (typically 50VDC to 60VDC) required for the display. Built-in logic may offer the option to receive data via an 8-bit parallel bus or with SPI serial protocol, and will contain a character set. A typical display resolution is 128 x 64 pixels.

The combination of a grid and a segmented anode enables a VFD to be controlled by *multiplexing*. For instance, in a display of four seven-segment numerals, the same equivalent segments in all four numerals can be connected in parallel while a separate grid covers each numeral. When each grid is positively energized, it selects the corresponding numeral, and the on-off segment patterns appropriate to that numeral are supplied. This procedure is repeated for each numeral in turn. Persistence of vision makes it appear that they are all active simultaneously.

Variants

Color

Although a VFD cannot provide a full-color display, selected anode segments can be coated with different phosphor colors, which can fluoresce simultaneously. Two or three individual colors are typically used, as in the display for a CD player where color helps to distinguish a variety of different functions. A closeup of a portion of the display from a CD player (with color filter removed) appears in Figure 25-5.

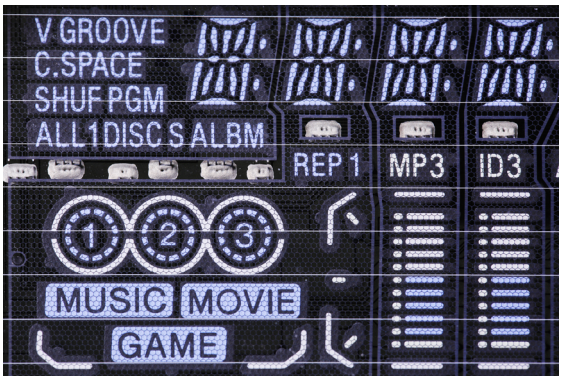

Figure 25-5. *The lefthand section of a vacuum-fluorescent display from a CD player.*

Character Sets and Pictorial Design

In the past, VFDs have combined seven-segment numerals in the same display as custom-shaped anodes. Solid-state gain meters in an audio amplifier, for instance, have used numerals beside a pictorial representation of gain levels resembling analog meters. The look and layout of a display of this type has been unique to a particular product.

Modern VFDs tend to use a generic dot-matrix display in which a character set in firmware dictates how patterns of dots are grouped to form numbers, letters, symbols, or icons.

The appearance of character sets generated with generic segments and dot-matrix arrays is thoroughly discussed and illustrated in the entry describing liquid-crystal displays in Chapter 17. VFD alphanumeric modules are identical in visual design to LCD modules, even though the internal electronics are different.

Comparisons

Two advantages of a VFD are that it functions well at low temperatures (unlike an LCD) and has sufficient brightness and contrast to be usable in sunlight (unlike many LED displays). It can be viewed from almost any angle.

Typical applications have included digital instrumentation in automobiles, information displays in audio and video consumer-electronics equipment, and numerical readouts in vending machines, medical devices, and some digital clocks.

Because a VFD requires a relatively high voltage, has significant power consumption, can show only a limited range of fixed colors, and is more expensive than LED displays or LCDs, its popularity has declined since the end of the 1990s.

What Can Go Wrong

Fading

VFDs gradually fade with age, as a result of reduced electron emission from the electrodes or diminishing performance of the phosphor coatings. Increasing the working voltage can prolong the life of a display.

electroluminescence

28

The field of **electroluminescent** devices is sometimes referred to as *EL*. The same acronym can also be applied as an adjective to an individual electroluminescent device, as in, for example, "an EL panel."

An *organic light-emitting diode*, more commonly known by its acronym *OLED*, is included in this entry because it is technically an electroluminescent device and its design concept is similar to that of an electroluminescent panel. Generic LEDs are also technically electroluminescent, but are not commonly described as such, and have their own entries in this encyclopedia under the subject categories **LED indicator**, **LED area lighting**, and **LED display**.

OTHER RELATED COMPONENTS

- **LED indicator** (see Chapter 22)
- **LCD display** (see Chapter 17)
- **fluorescent light** (see Chapter 20)
- **vacuum-fluorescent** display (see Chapter 25)

What It Does

An electroluminescent device configured as a *panel*, *ribbon*, or *rope-light* contains phosphors that emit light in response to a flow of electricity.

Panels can be used as backlights for LCD displays or, more often, as always-on low-power devices such as exit signs and night lights. Ribbons and rope lights (the latter being also known, more accurately, as *light wires*) are used mainly as recreational novelties. They can be battery powered through a suitable voltage converter. A battery-powered rope light can be wearable.

Thin-film OLED electroluminescent panels are used in small video screens in handheld devices. At the time of writing, OLED TV screens measuring 50" or more have been demonstrated, but are not yet economic for mass production.

No specific schematic symbol exists to represent any electroluminescent device or component.

How It Works

Luminescence is the emission of light as a result of a process that does not require heat. (The opposite phenomenon is *incandescence*, in which heating causes an object to emit light; see Chapter 18 for a description of **incandescent lamps**.)

Electroluminescence is luminescence resulting from stimulation by electricity. This very broad definition really includes devices such as **LED**s, although they are hardly ever described in those terms. Electroluminescence generally refers to panels, films, or wires where electrodes are in direct contact with light emitters such as phosphors.

The exception is an *organic LED*, usually known by its acronym *OLED*, which is frequently de-

scribed as an electroluminescent device, perhaps because its configuration as a sandwich of thin, flat layers resembles an electroluminescent panel. Two of the layers are semiconductors, and they interact as light-emitting diodes.

Phosphors

A *phosphor* is a compound such as zinc sulfide that will emit light when it receives an energy input from another light source or from electricity. Typically the compound must be mixed with an *activator* such as copper or silver.

For many decades, TV sets and video monitors were built around *cathode-ray tubes* in which the interior of the screen, at the front of the tube, was coated with phosphors. A beam of electrons that fluctuated in intensity generated a picture on the screen by drawing it as a series of lines.

Derivation

The term *phosphor* is derived from *phosphorescence*, which in turn comes from the name of the element *phosphorous*, which will glow when it oxidizes in moist air. (These terms were established before other forms of luminescence were discovered and understood. The behavior of phosphorous is really an example of *chemiluminscence*.)

For our purposes, a phosphor is a compound that is capable of fluorescence or electroluminescence.

Variants

Panels

Electroluminescent panels using phosphor powder, sometimes referred to as *thick phosphor*, are a popular choice where a constant, uniform, low light output is acceptable.

An electric potential is established between two films that act as electrodes, separated by a layer of phosphor crystals. Some manufacturers refer to this configuration as a *light-emitting capacitor* because the structure resembles a capacitor, even though that is not its purpose. The front film is transparent, allowing light to escape.

An electroluminescent panel can be powered by AC or DC but requires at least 75V. Its power consumption is self-limiting, so that no control electronics are required other than a voltage converter if battery power is used.

The phosphors generate a constant, evenly distributed luminescence over the entire area, although the output is not very intense. Applications include night-lights, exit signs, and backlighting for wristwatches.

Panelescent electroluminescent lighting by Sylvania was used for instrument panel displays in some car models such as the Chrysler Saratoga (1960 through 1963) and Dodge Charger (1966 through 1967). It is still used for night-lights. *Indiglo* electroluminiscent displays are still widely used in wristwatches.

The interior components of a disassembled electroluminescent night-light are shown in Figure 26-1. The panel emits a natural pale green glow. A separate blue or green filter passes the glow while blocking other colors of incident light that would otherwise reflect off the panel.

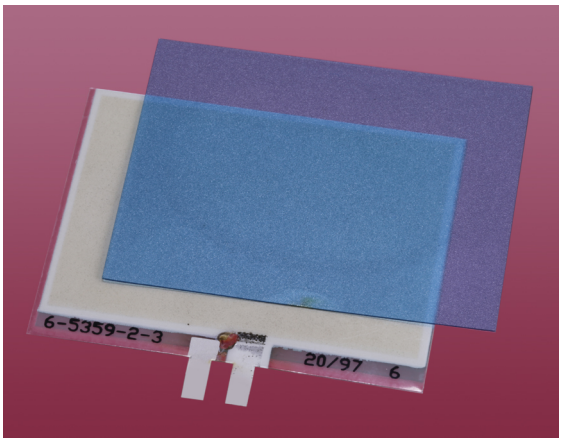

Figure 26-1. *The two interior components of an electroluminiscent night-light: the luminescent panel, and a separate translucent filter.*

Electroluminescent night-lights were popular in the 1970s and 1980s, often featuring cartoon characters to appeal to children. Figures 26-2 and 26-3 show the same night-light in its daytime off-state and its night-time on-state, respectively.

Figure 26-2. *A vintage Panelescent brand night-light, several decades old, in its off-state.*

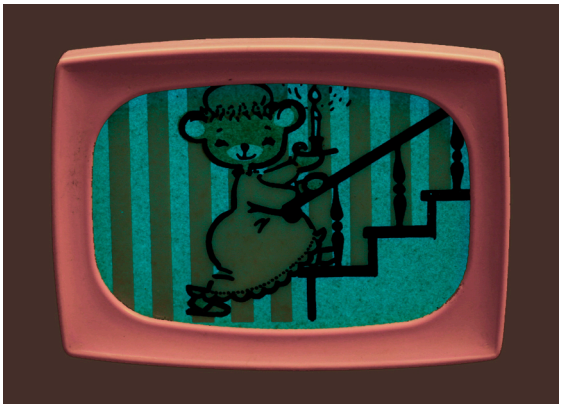

Figure 26-3. *The same night-light, with its green radiance visible under conditions of low ambient light.*

Advantages of electroluminescent panels include the following:

- Low current consumption. One US manufacturer claims that a single exit sign will use electricity costing less than 20 cents per year, while the annual cost of a night-light will be less than 3 cents per year.
- Long life, up to 50,000 hours.
- Self-regulating; no control circuitry required.
- Omnidirectional light output.
- Very wide operational temperature range, between approximately -60 and +90 degrees Celsius.
- Can be plugged directly into a wall outlet.

Disadvantages include:

- Limited light output.
- Very limited choice of colors.
- Not very efficient, 2 to 6 lumens per watt (although the low light output naturally entails low power consumption).
- Gradual reduction in phosphor performance over time.
- High voltage required: 60V to 600V. Ideal for plugging into a wall outlet, but requires a converter when used with battery-powered devices.

Flexible Ribbons

The light-emitting layers inside a night-light are somewhat flexible, and can be made more flexible by reducing their thickness. The result is an electroluminescent ribbon that has some novelty value, and may be used for customizing automobiles. Figure 26-4 shows a ribbon about 1.5" wide and 12" long, designed for 12VDC power applied through an inverter.

Rope Light

A rope light or wire light may resemble a *glowstick*. However, a glowstick generates light from chemiluminescence (chemical reactions that release photons), while a rope light uses electricity.

Figure 26-5 shows a rope light powered by two AA batteries connected through an inverter.

At the center of the rope light is a conductor that serves as one electrode. It is coated in phosphors, and the layer of phosphors is protected by a transparent sheath. One or more thin wires is wrapped around the sheath in a spiral, with large

gaps between one turn and the next. These wires serve as the second electrode. The wires are enclosed in transparent insulation that forms an outer sheath.

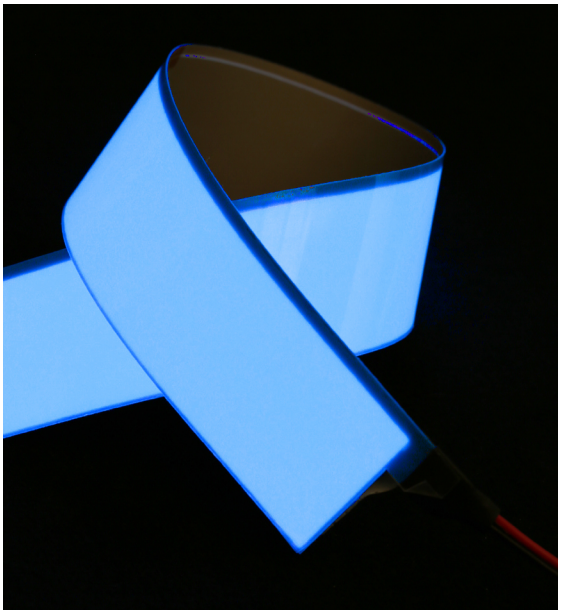

Figure 26-4. *A 12" length of electroluminescent ribbon.*

When AC is applied between the electrodes, the layer of phosphors emits light that radiates out in the gaps between the thin wires. The color of the light can be modified by using tinted outer insulation.

OLED

An OLED uses two thin, flat electrodes, somewhat like a thick-phosphor electroluminescent panel, except that it contains more layers and is capable of generating more light. The layers in an OLED are "organic" in that they consist of chemically organic molecules containing carbon and hydrogen atoms and generally do not contain heavy metals.

While an LCD video monitor or TV screen must have a separate backlight, an OLED generates its own light. This reduces the thickness of the display to a few millimeters and makes it potentially more efficient.

The semiconductor layers are subdivided into pixels, each functioning as a light-emitting diode, while additional layers carry a matrix of conductors for pixel addressing. In an AMOLED, the conductors form an active matrix, while in a PMOLED, they form a passive matrix.

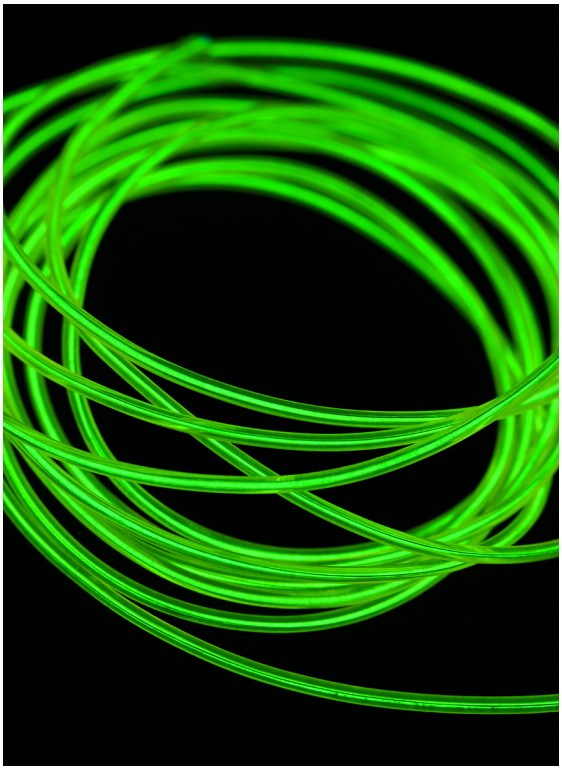

Figure 26-5. *A length of glowing rope light, also known as a light wire.*

In an active matrix, each pixel is backed with a *thin-film transistor* to store its state while the energizing voltage transitions. This is often described as a *TFT* display; but the term is interchangable with "active matrix."

In a passive matrix, each pair of conductors simply supplies current to a pixel. This is cheaper and easier to fabricate but is less responsive.

The terms "active matrix" and "passive matrix" have the same meaning as when used to describe a **liquid-crystal display**.

Monochrome OLED display modules with dot-matrix characters are currently available from China for just a few dollars. Although they appear superficially similar to LCD modules, they generate pure white-on-black characters.

Small full-color OLED screens are used in smartphones and on camera backs, but at the time of writing, large OLED screens are not a mature technology, partly because of production costs. A great variety of chemicals and layer configurations have been tried, and the application of pixels to a substrate has been attempted with vacuum deposition through a shadow mask and with a system similar to inkjet printing. Pixels that emit red, green, and blue light have also been used. Filtered pixels have been used. One dominant process has not yet emerged.

Longevity and brightness have been problems. Where red, green, and blue diodes have been used, the different colors deteriorate at different rates. While the human eye tolerates an overall reduction in brightness, it does not tolerate a slight color shift caused by blue pixels, for instance, losing brightness more rapidly than red pixels.

Because OLED screens promise to be thinner, lighter, and brighter, and may eliminate the need for a fragile glass substrate, there is a strong incentive to develop this technology, which seems likely to gain dominance in the future.

OLED panels may also become a source of diffuse, shadowless room lighting or office lighting when practical problems have been solved and costs have fallen significantly.

transducer

27

The term **transducer** is used here to describe a *noise-creating device* that is driven by external electronics. By comparison, an **audio indicator** (discussed in the next entry) contains its own internal electronics and only requires a DC power supply. Either of these components is often described as a *beeper* or *buzzer*.

A **speaker**, more properly termed a *loudspeaker*, is an electromagnetic transducer but is seldom described in those terms. It has a separate entry in this encyclopedia and is defined here as a *sound reproduction device* that is larger and more powerful than a typical transducer and has a more linear frequency response.

While piezoelectric transducers formerly used crystals, only the more modern piezoelectric type that uses a ceramic wafer will be considered here.

Some transducers convert sound into electricity, but these are categorized as *sensors*, and will be discussed in Volume 3. The only transducers discussed in this entry are those that convert electricity into sound.

OTHER RELATED COMPONENTS

- **audio indicator** (see Chapter 28)
- **headphone** (see Chapter 29)
- **speaker** (see Chapter 30)

What It Does

An audio **transducer** is a device that can create an *alert*. It requires an AC signal that is supplied by external electronics, and in its simplest form may be referred to as a *buzzer* or a *beeper*.

Audio alerts are used in microwave ovens, washer/dryers, automobiles, gasoline pumps, security devices, toys, phones, and many other consumer products. They are often used in conjunction with touch pads, to provide audio confirmation that a tactile switch has been pressed.

The schematic symbols in Figure 27-1 can be used to represent any kind of audio alert, including **indicators**, which contain their own electronics to generate a simple tone or series of tones. Type A is probably the most popular symbol. Types B and C often appear with the word "buzzer" printed beside them for clarification. D and E are really symbols for a **speaker**, but are often used for an alert. F is the symbol for a *crystal*, now sometimes used to indicate a piezoelectric noise maker. G specifically represents an electromagnetic transducer, but is seldom used.

How It Works

A circular diaphragm is glued at its edges inside a cylindrical plastic enclosure, usually measuring from around 0.5" to 1.5" in diameter. The enclosure is sealed at the bottom but has an opening at the top, so that sound can emerge from the upper side of the diaphragm without being par-

tially cancelled by sound of opposite phase that is emitted from the underside of the diaphragm. The enclosure also amplifies the sound by resonating with it, in the same way that the body of a guitar or violin amplifies a note being played on the strings.

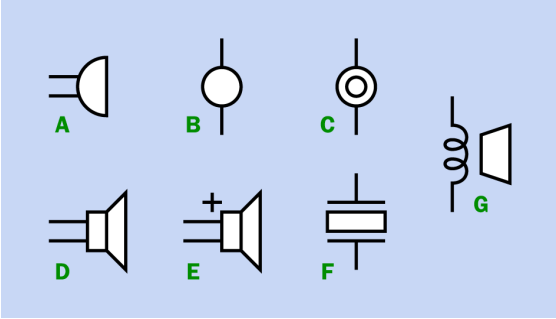

Figure 27-1. *An assortment of symbols which can represent a transducer or an indicator. See text for details.*

The diaphragm is activated either electromagnetically or piezoelectrically, as described next.

Externally, a transducer may be indistinguishable from an audio indicator such as the one pictured at Figure 28-1.

Variants

Electromagnetic

An electromagnetic transducer contains a diaphragm that is usually made of plastic. Mounted on it is a smaller *ferromagnetic disc* that responds to the fluctuating field from AC passing through a coil. When the diaphragm vibrates, it creates pressure waves that are perceived by the human ear as sound.

A car horn is a particularly loud form of electromagnetic transducer.

Piezoelectric

A piezoelectric transducer contains a diaphragm consisting of a thin brass disc on which is mounted a *ceramic wafer*. When an AC signal is applied between the piezoelectric wafer and the disc, the disc flexes at that frequency.

The term *piezo* is derived from the Greek *piezein*, which means "to squeeze or press."

Ultrasonic Transducer

The diaphragm in an *ultrasonic transducer* vibrates at a frequency above the range of human hearing. This component may be electromagnetic, piezoelectric, or crystal-based. Often it is used in conjunction with an ultrasonic receiver as a distance measuring device. The two components can be sold pre-mounted on a breakout board. An output from the board can consist of a pulse train where the pulse duration is proportional to the distance between the transducer and the nearest sound-reflecting object.

An ultrasonic transducer is pictured in Figure 27-2. Its internal components are shown in Figure 27-3.

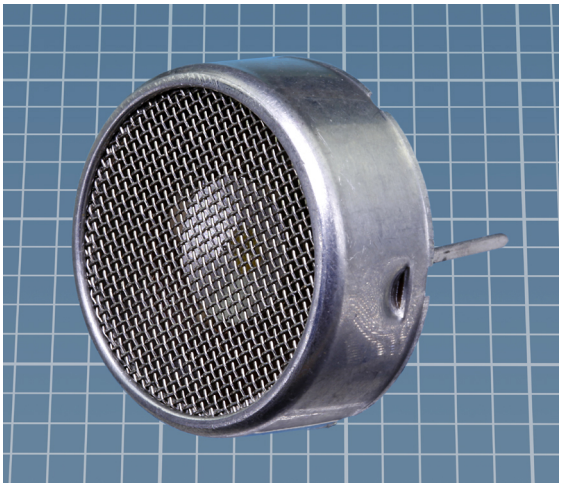

Figure 27-2. *The exterior of an ultrasonic transducer.*

Submersible ultrasonic transducers may be used in cleaning systems, where they agitate a liquid that dislodges dirt or debris. Ultrasonic transducers are also used in echo-sounding and sonar equipment with marine applications.

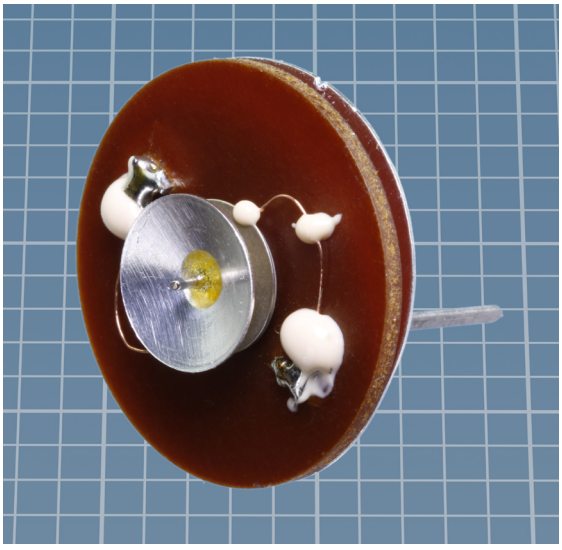

Figure 27-3. *Inside an ultrasonic transducer, a small aluminum cone is the sound radiating element. The white blobs are adhesive to secure the thin wires.*

Formats

Some transducers are available in surface-mount format, measuring about 0.5" square or less. Because the resonant frequency is related to the size of the component, surface-mount transducers usually generate a high-pitched beep.

Values

Frequency Range

Audio frequency is measured in Hertz, abbreviated Hz, named after Heinrich Rudolf Hertz, the first scientist to prove the existence of electromagnetic waves. The H in Hz is capitalized because it refers to a real name. One thousand Hertz can be written as 1 kiloHertz, almost always abbreviated as 1kHz (note that the k is lowercase).

The human ear is often described as being able to detect sounds between 20Hz and 20kHz, although the ability to hear sounds above 15kHz is relatively unusual and diminishes naturally with age. Sensitivity to all frequencies can be impaired by long-term exposure to loud noise.

The most common frequencies applied to audio transducers range between 3kHz and 3.5kHz. Piezoelectric elements are inefficient for generating sounds below 1kHz, but electromagnetic transducers are better able to generate lower frequencies. Their response curve can be approximately flat to frequencies as low as 100Hz.

Sound Pressure

Sound pressure can be measured in Newtons per square meter, often abbreviated as Pa. Newtons are units of force, while Pa is an abbreviation of Pascals.

The *sound pressure level* (SPL) of a sound is not the same as its sound pressure. SPL is a logarithmic value, to base 10, in units of decibels (dB), derived from the pressure of a sound wave relative to an arbitrary reference value, which is 20 micro-Pascals (20µPa). This is the agreed minimum threshold of human hearing, comparable to a mosquito at a distance of three meters. It is assigned the level of 0dB.

Because the decibel scale is logarithmic, a linear increase in the decibel level of a sound does not correspond with a linear increase in actual sound pressure:

- For each additional 6dB in the SPL, the actual sound pressure approximately doubles.
- For each additional 20dB in the SPL, the actual sound pressure is multipled by 10.

Bearing in mind that 0dB corresponds with the reference sound pressure of 20µPa, an SPL of 20dB represents a sound pressure of 200µPa (that is 0.0002Pa), and so on.

Many tables show an estimated decibel level for various noise sources. Unfortunately, these tables may contradict each other, or may fail to mention the distance at which a sound is measured. Figure 27-4 shows estimates derived by averaging eight similar tables. It should be viewed as an approximate guide.

Decibels	Noise Example
140	Jet engine at 50 meters
130	Threshold of pain
120	Loud rock concert
110	Automobile horn at 1 meter
100	Jackhammer at 1 meter
90	Propeller plane 300 meters above
80	Freight train at 15 meters
70	Vacuum cleaner
60	Business office
50	Conversation
40	Library
30	Quiet bedroom
20	Leaves rustling
10	Calm breathing at 1 meter
0	Auditory threshold

Figure 27-4. *Approximate decibel values for some sound sources (averaged from a selection of eight similar charts).*

Sometimes the claim is made that an increase of +10 on the decibel scale will correspond with a subjective experience that the noise is "twice as loud." Unfortunately, this statement cannot be quantified.

Weighted Sound Values

Subjective assessment of sound is complicated by the nonlinear frequency response of the human ear, which causes some frequencies to seem "louder" than others, even though their sound pressure is the same. The frequency weighting of the ear can be determined by playing a reference tone of 1kHz at 20dB and then doing an A-B comparison with a secondary tone at another frequency, asking the subject to adjust the gain of the secondary tone up or down until the two tones seem equally loud.

This procedure is performed for a range of frequencies. The test is then repeated with a louder 1kHz reference tone, at 30dB. Repetitions continue to a final reference tone of 90dB.

The resulting curves are known as *equal-loudness contours*. An averaged set, from multiple sources, has become an international standard with ISO number 226:2003. The curves shown in Figure 27-5 are derived from that standard. The curves show that the sound pressure of lower frequencies must be boosted by a significant amount to sound as loud as a 1kHz frequency, while a frequency around 3kHz must be reduced slightly, because it tends to sound louder than all others.

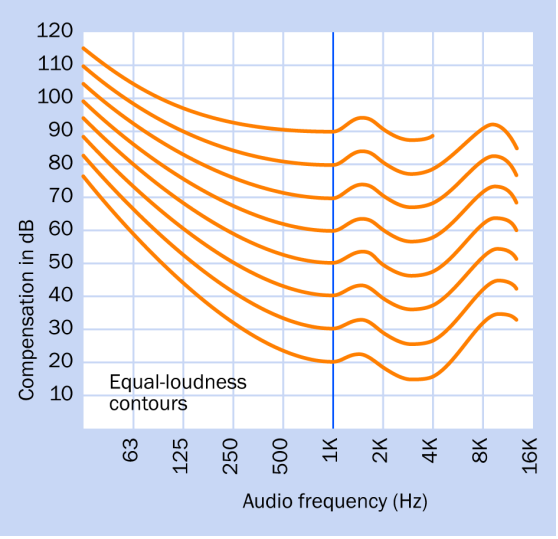

Figure 27-5. *Equal loudness contours derived from ISO 226:2003. See text for details.*

Although the accuracy of equal-loudness contours is controversial, they have been the basis of a widely used weighting system to adjust dB values to represent subjective perceptions of loudness. This *A-weighting* system remains the best-known and most widely applied audio standard in the United States, even though it has been criticized for assigning too little value to sounds that are brief in duration. If a sound level is expressed in dBA, it is A-weighted, meaning that the sounds to which the ear is least sensitive are assigned a value that is lower than their measured value. Thus, a tone of 100Hz has a dBA value about 20dB lower than its dB value, because the human ear is relatively insensitive to

low-pitched sounds. dBA values are used in regulations that limit noise in the work place and other environments.

Unweighted Values

If sound intensity is expressed in dBSPL, it is a measurement of the actual Sound Pressure Level and has not been adjusted with the A-weighting system. A graph of unadjusted dbSPL values will display low frequencies as if they are more intense than the ear will perceive. In practical terms, subjective perception of low-end rolloff will be even more severe than the graph makes it appear.

If sound intensity is expressed merely in dB, probably it is unweighted and should be considered as dBSPL.

From a practical point of view, when choosing a tone for a transducer, a 500Hz tone may sound relatively mellow and not subjectively loud. A 3.5kHz tone can be a good attention-getting signal, as the ear is most sensitive in that range.

Transducers generally have a sound pressure rating in dBSPL ranging between 65dBSPL to 95dBSPL, with just a few products that can make more or less noise.

Measurement Location

The sound pressure from an audio alert will naturally diminish if the measurement point moves farther away. Therefore, any rating in decibels should be expressed with reference to the distance at which the measurement is made.

Measurement locations may be expressed in centimeters or inches, and may vary from 10cm to 1 meter, even in datasheets for different devices from the same manufacturer. If the measurement distance doubles, the SPL diminishes by approximately 6dB.

Limitations

A piezoelectric transducer is not intended as a sound reproducer, and does not have a smooth or flat frequency response. The curve for the Mallory PT-2040PQ is not unusual, reproduced in Figure 27-6. This component measures about 3/4" in diameter, is rated for 5VDC, and uses only 1.5mA to generate 90dB (measured at a distance of 10cm). Like many piezoelectric audio devices, its response peaks around 3500kHz and diminishes above and below that value, especially toward the low end. While it is perfectly adequate as a "beeper," it will not reproduce music successfully.

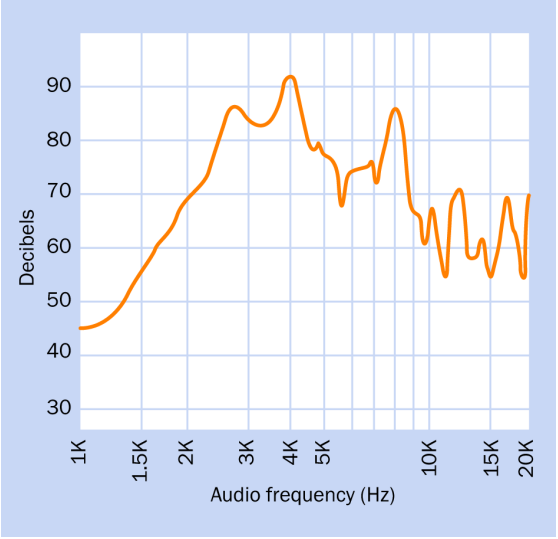

Figure 27-6. *The frequency response from a typical small piezoelectric transducer.*

An electromagnetic transducer is better able to generate low frequencies than a piezoelectric transducer. It has a low impedance that may be suitable in some circuits. However, it is slightly heavier than a comparable piezoelectric transducer, uses much more power, and as an AC device containing a coil, it can create electromagetic interference or may cause fluctuations in the circuit as an inductive load. It is also vulnerable to magnetic interference from elsewhere, while a piezoelectric transducer is not.

While an electromagnetic transducer can be used to reproduce speech or music, and will do a better job than a piezoelectric transducer, its

performance will still be dissatisfying. A miniature speaker is more appropriate for the task.

Voltage

Transducers are typically designed to work with voltages ranging from 5VAC to 24VAC. The ceramic wafer in a piezoelectric transducer usually cannot withstand voltages much above 40VAC, and its sound output will not increase significantly above 30VAC.

Current

Typical piezoelectric transducers use less than 10mA and generate negligible heat. An electromagnetic transducer may draw as much as 60mA.

How to Use It

Appropriate Sound Intensity

An alert should be chosen with reference to the environment in which it will be used. To be easily heard, it should be at least 10 dB louder than ambient background noise.

Volume Control

Sound pressure can be lowered by reducing the voltage. Because a transducer does not consume much current, a *trimmer* can serve as a volume control. Alternatively, a rotary switch with a set of fixed-value resistors can select preset sound values.

AC Supply

Although a transducer is an AC device, it is unlikely to be designed for voltage that fluctuates positively and negatively either side of a neutral value. Typically it is intended for voltage that fluctuates between 0V (ground) and the rated positive value of the power supply, and its pins, wires, or terminals are usually marked accordingly. If it has wire leads, the red lead should be connected to the more-positive side of the supply. If it has pins, the longer pin should be more positive.

The alternating signal for a transducer can be supplied by any simple oscillator or astable multivibrator circuit. For a given peak voltage, a square wave will generate a louder signal than a sinusoidal wave. A simple 555 timer circuit can be used, with a second monostable timer to limit the duration of the beep if necessary. An astable 555 can be used to test the transducer and select the audio frequency that sounds best.

Self-Drive Transducer Circuit

If a transducer has three wires or pins, it is probably a *self-drive* type. The datasheet may identify its inputs as M, G, and F, meaning Main, Ground, and Feedback. The Feedback terminal is connected with a section of the diaphragm which vibrates 180 degrees out of phase with the Main terminal. This facilitates a very simple external drive circuit, such as that in Figure 27-7, where the frequency is determined by the transducer's resonant frequency.

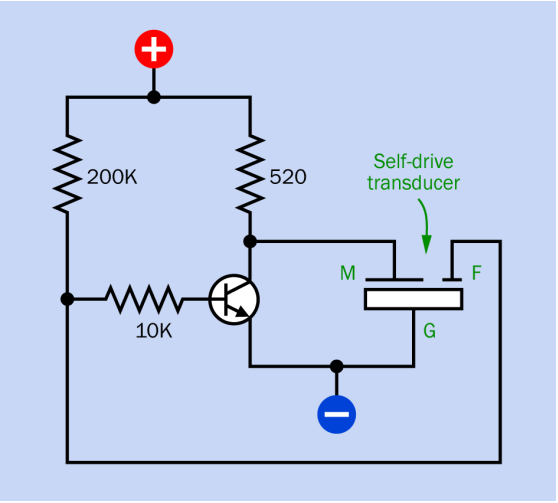

Figure 27-7. *A circuit to control a self-drive type of piezoelectric transducer.*

What Can Go Wrong

Overvoltage

Mallory Sonalerts, one of the largest producer of piezoelectric alerts, states that in the "vast ma-

jority" of returned products, the failure was caused by excessive voltage, often in the form of a transient voltage spike.

Leakage

If an alert makes a small, low-volume sound when it is supposed to be off, some current is leaking through it. Less than 1mA may be enough to cause this problem. According to one manufacturer, it can be fixed by placing a 30V Zener transient voltage suppressor diode in series with the alert, or by wiring a small **incandescent lamp** in parallel with the alert.

Note that when the alert is activated, the full supply voltage will be seen at the lamp.

Component Mounting Problems

Some alerts are packaged with mounting holes, but many are not. Those with pins can be soldered into a board, but those without must be glued in place or inserted into a cavity from which they cannot shake loose. Silicone adhesive is recommended, but care must be taken to avoid any of it dripping into the alert before it sets.

Moisture

If an alert will be used in a location where it is vulnerable to moisture, it should be of a type that is sealed against the environment. Even a sealed unit should ideally be oriented so that it faces slightly downward.

Transducer-Indicator Confusion

Externally, a transducer and an indicator often look identical, and some of them are not marked with a manufacturer's part number. Damage can be caused by applying DC to a transducer or AC to an indicator. If both types of parts are kept in inventory, they should be carefully labeled.

Connection with a Microcontroller

A piezoelectric transducer can be driven by a microcontroller, but an electromagnetic transducer is not appropriate in that role, because of its relatively higher current consumption and its behavior as an inductive load.

audio indicator

28

An **audio indicator** is defined here as a noise-creation device that generates a simple tone or series of tones. Unlike a **transducer**, which requires an external source of AC to determine its audio frequency, an indicator contains its own electronics and requires only a DC power supply. Either of these components is often described as a *beeper* or *buzzer*.

While piezoelectric alerts formerly used crystals, only the more modern piezoelectric type that uses a ceramic wafer will be considered here.

OTHER RELATED COMPONENTS

- **transducer** (see Chapter 27)
- **headphone** (see Chapter 29)
- **speaker** (see Chapter 30)

What It Does

When DC power is applied to an **audio indicator**, in its simplest form it creates a continuous or intermittent tone of a fixed frequency. This is called an *alert*.

Audio alerts are used in microwave ovens, washer/dryers, automobiles, gasoline pumps, security devices, toys, phones, and many other consumer products. They are often applied with touch pads, to provide audio confirmation that a tactile switch has been pressed.

A few indicators are programmed to create a two-tone sound, or multiple-tone sequences.

See Figure 27-1 in the previous entry for an assortment of schematic symbols that may be used to represent either an alert or a transducer.

How It Works

A circular diaphragm is glued at its edges inside a cylindrical plastic enclosure, usually measuring from around 0.5″ to 1.5″ in diameter. The enclosure is sealed at the bottom but has a small hole at the top, so that sound can emerge from the upper side of the diaphragm without being partially cancelled by sound of opposite phase that is emitted from the underside of the diaphragm. The enclosure also contains electronics to generate one or more audio tones, and amplifies the sound by resonating with it, in the same way that the body of a guitar or violin amplifies a note being played on the strings.

A PUI XL453 piezoelectric audio indicator is pictured in Figure 28-1, fully assembled on the right, and with its circuit board and diaphragm removed on the left. This indicator creates a pulsed tone at 3.5kHz with a sound pressure of 96dB. It draws 6mA at 12VDC and measures approximately 1″ in diameter.

For more information about the measurement of sound frequency and pressure, see "Frequency Range" on page 251 and "Sound Pressure" on page 251 in the previous entry.

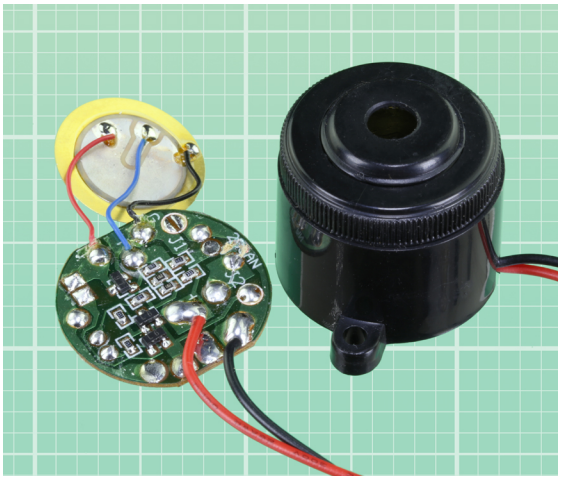

Figure 28-1. *A typical piezoelectric audio indicator.*

Externally, an audio indicator may be indistinguishable from a transducer. However, internally, an indicator is almost always a piezoelectric device, in which a *ceramic wafer* is mounted on a thin brass diaphragm. The term *piezo* is derived from the Greek *piezein*, which means to squeeze or press.

A transducer (described in the previous entry) is a piezoelectric or electromagnetic alert that does not usually contain its own circuitry and must be driven by an external source of AC, which establishes the audio frequency.

The distinction between an indicator and a transducer is often unclear in parts catalogs, where all alerts may be identified as *buzzers*, even though they mostly beep rather than buzz.

Audio Frequency

For a discussion of audio frequency, see "Frequency Range" on page 251 in the previous entry.

History

Probably the earliest form of electrically activated alert was the door bell, in which a 6VDC battery-powered solenoid pulled a spring-loaded lever terminating in a small hammer. The hammer struck the bell, but the motion of the lever also opened a pair of contacts, cutting off power to the solenoid. The lever sprang back to its rest position, which closed the contacts and repeated the cycle so long as power was supplied through an external pushbutton.

Subsequent systems used a small loudspeaker powered by AC house current through a step-down transformer. This created a buzzing sound and may have been the origin of the term "buzzer."

Small components that made a beeping sound only became common when digital equipment required a simple, cheap way to confirm user input or attract attention to the status of a device.

Variants

Sound Patterns

Because an audio indicator contains its own electronics, the manufacturer has the freedom to create various patterns of sound output.

The default is a steady tone. Other common variants include an intermittent tone and a dual tone that fluctuates rapidly between two frequencies. This is sometimes referred to as a *siren*. A few variants can generate an output pattern consisting of several tones in sequence, or effects such as warbling or whooping sounds, which are used mainly in alarm systems.

Formats

Some audio indicators are available in surface-mount format, measuring 1/2" square or less. Because the resonant frequency is related to the size of the component, surface-mount alerts usually make a high-pitched beep.

Panel-mount and board-mount formats range from about 1/2" to 1.5" in diameter. A small audio alert designed to be mounted on a circuit board is shown in Figure 28-2, with its top removed on the right to expose the brass diaphragm glued around the edges. The same component is shown with its plastic enclosure removed completely in Figure 28-3.

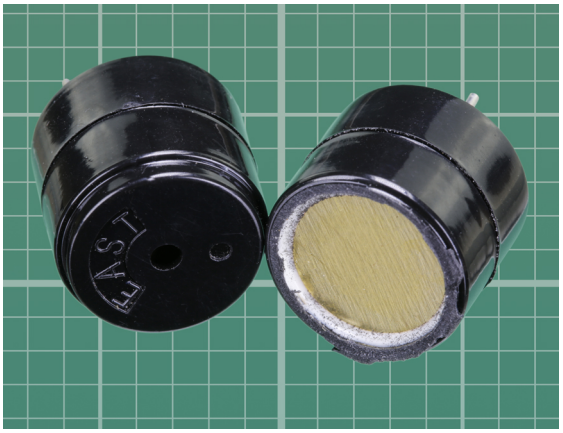

Figure 28-2. *An audio indicator approximately 0.5" in diameter, partially disassembled on the right, revealing its brass diaphragm.*

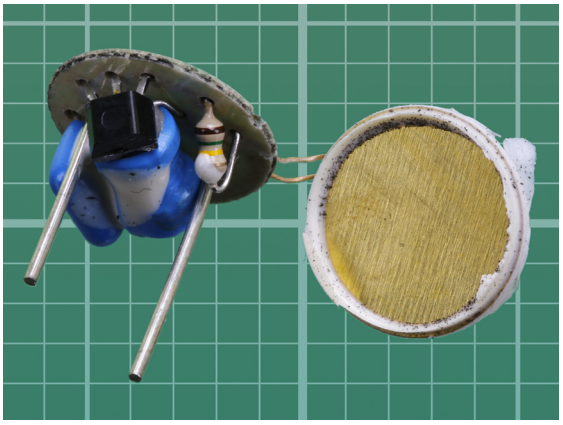

Figure 28-3. *The same indicator from the previous photograph, with its enclosure completely removed.*

Values

For an explanation and discussion of sound pressure and its measurement in decibels, see "Sound Pressure" on page 251 in the previous entry.

Audio indicators generally have a sound pressure rating in dBSPL ranging between 65dBSPL to 95dBSPL, with just a few products that make more or less noise. At 120dB and above, most products are packaged as alarm sirens ready for installation, often with a small horn attached. Their power consumption can be 200mA or more, and they are many times the price of a simple indicator designed for circuit-board mounting.

Voltage

An audio indicator containing its own electronics will almost always be rated somewhere in the range from 5VDC to 24VDC. Sirens intended for use with burglar alarms are often designed for 12VDC or 24VDC, as these are popular values for security systems with battery backup. However, in addition to a rated voltage, a datasheet may specify a wide range of acceptable operating voltages. For example, an indicator with a *rated* voltage of 12VDC may have an *operating* voltage of 3VDC to 24VDC. Naturally, the sound intensity will vary with the voltage, but not as much as one might assume. The graph at Figure 28-4 shows that the sound output from an alarm, measured in decibels, increases by only 8dB when voltage increases by almost a factor of five. Of course, the decibel scale is not linear, but human perception of sound is not linear, either.

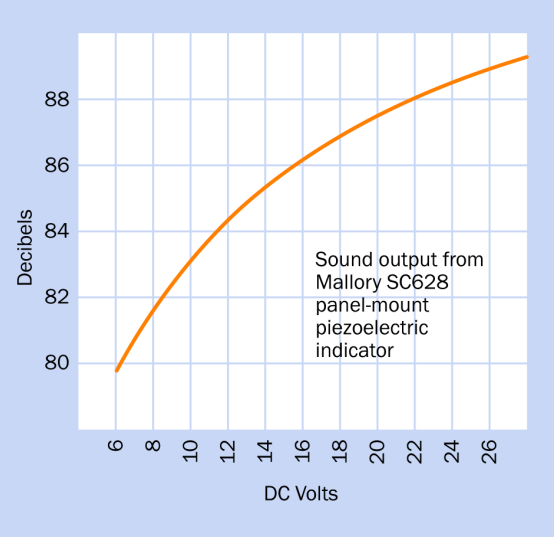

Figure 28-4. *Variation of sound output relative to voltage, in a commonly used piezoelectric indicator.*

Current

Typical piezoelectric indicators use less than 10mA (often as little as 5mA) and generate negligible heat.

Frequency

The most common frequencies for indicators range between 3kHz and 3.5kHz. Piezoelectric elements are inefficient for generating sounds below 1kHz.

Duty Cycle

Piezoelectric alerts generate very little heat and can be run on a 100% duty cycle.

If an alert will be pulsed briefly, the minimum pulse time is 50ms. A shorter duration will merely generate a clicking sound.

How to Use It

Appropriate Sound Intensity

An indicator should be chosen with reference to the environment in which it will be used. To be easily heard, it should be at least 10 dB louder than the ambient background noise.

Volume Control

Sound intensity can be reduced by reducing the voltage. Because an indicator does not consume much current, a trimmer can serve as a volume control. Alternatively, a rotary switch with a set of fixed-value resistors can select preset sound values.

However, in many indicators, variations in voltage may have relatively little effect on sound output, as shown in Figure 28-4.

Wiring

An indicator requires DC voltage. Because the indicator contains a transistor, polarity of the power supply is important. If the indicator has leads attached, the one intended for connection to the positive side of the power supply will be red. If it has pins, the longer pin will be for the positive connection.

What Can Go Wrong

The potential problems in an indicator are the same as those for a transducer. See "What Can Go Wrong" on page 254 in the previous entry.

headphone

29

The term **headphone** is used here to include almost any device that fits into or over the ear for the purpose of sound reproduction. (*Hearing aids* are not included.) Because headphones are used in pairs, the term is usually pluralized.

The term *phones* is fairly common as a colloquial diminution of *headphones* but is not used here.

An *earphone* used to be a single sound reproduction device designed for insertion into the ear, but has become rare. Pairs of *earbuds* are now common.

Because this encyclopedia assigns more emphasis to electronic components than to consumer products, this entry provides only a superficial overview of fully assembled headphones, and deals more with the drivers inside them, their principles of operation, and the general topic of sound reproduction.

OTHER RELATED COMPONENTS

- **transducer** (see Chapter 27)
- **speaker** (see Chapter 30)

What It Does

A headphone converts fluctuations of an electric signal into pressure waves that the human ear perceives as sound. It can be used for reproduction of music for entertainment purposes, or for speech in telecommunications, broadcasting, and audio recording.

Two symbols for headphones are shown in Figure 29-1. The symbol on the left shows a single headphone or earphone; when this symbol is flipped horizontally, it can represent a microphone. The pictographic symbol on the right has been used for many decades, but is still often found in schematics.

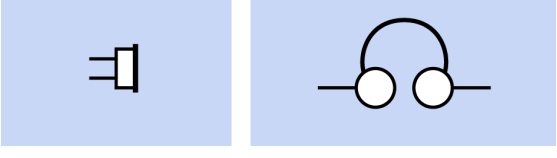

Figure 29-1. *Schematic symbols for a single earphone or headphone (left) and a pair of headphones (right).*

How It Works

Audio Basics

Sound is transmitted as pressure waves through a medium that is usually air but can be a gas, fluid, or solid. The speed of transmission will vary with the density and other attributes of the medium. Small hairs in the inner ears, known as *cilia*, vibrate in sympathy with pressure waves and transmit nerve impulses to the brain, which interprets the impulses as sound.

Three quantities describe the propagation of any type of wave, including a sound wave: its frequency (customarily represented with letter f), its speed of propagation (represented with letter v, for velocity), and its wavelength from peak-to-peak (represented by the Greek letter lambda, which appears as this λ symbol).

The relationship is defined by a very simple equation:

$$v = \lambda * f$$

Velocity is usually measured in meters per second, wavelength in meters, and frequency in Hertz, abbreviated Hz. One cycle per second is 1Hz. The H is always capitalized, as it refers to the name of Heinrich Rudolf Hertz, the first scientist to prove the existence of electromagnetic waves. One thousand Hertz can be written as 1 kilo-Hertz, almost always abbreviated as 1kHz (note that the k is lowercase).

The human ear is often described as being able to detect sounds between 20Hz and 20kHz, although the ability to hear sounds above 15kHz is relatively unusual and diminishes naturally with age. Sensitivity to all frequencies can be impaired by long-term exposure to loud noise.

Naturally occurring sounds can be converted to fluctuations in voltage by a **microphone**, which will be found listed as a *sensor* in Volume 3 of this encyclopedia. Artificial sounds can be generated as voltage fluctuations by oscillators and other electronic circuits. In either case, the output fluctuations can range between an upper limit set by a positive supply voltage and a lower limit established by electrical ground (which is assumed to be 0 volts). Alternatively, the fluctuations can range between the positive supply voltage and an equal and opposite negative supply voltage, with 0V lying midway between the two. This option can be less convenient electrically but is a more direct representation of sound, because sound waves fluctuate above and below ambient air pressure, which can be considered analogous to a ground state.

The concept of positive and negative sound waves is illustrated in Figure 29-2 (originally published in the book *Make: More Electronics*).

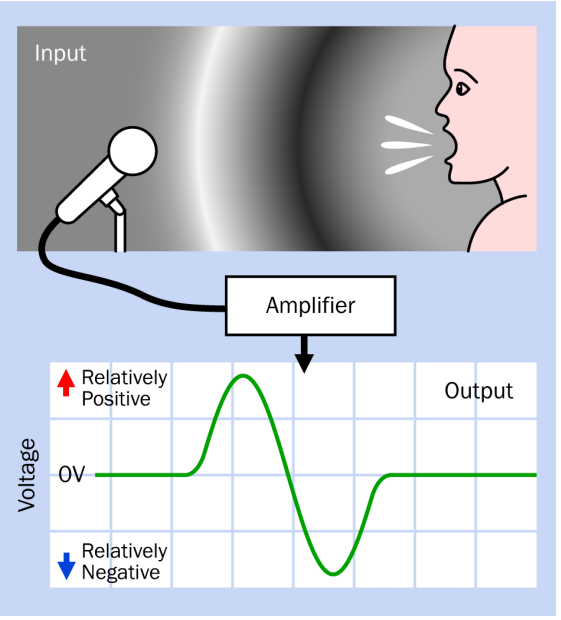

Figure 29-2. *The use of positive and negative voltages to represent a wave of high sound pressure followed by a trough of lower pressure.*

The topic of sound amplification is explored in detail in the entry on *op-amps* in Chapter 7.

A headphone inverts the function of a microphone by converting electricity back into air-pressure waves. This is done electromagnetically (moving a diaphragm in response to an electromagnet) or electrostatically (moving a membrane in response to electrostatic force between two charged electrodes).

Variants

Moving Coil

The most enduringly popular type of headphone uses a coil attached to a *diaphragm*. This is known as a *moving-coil* headphone, as the coil moves with the diaphragm. It can also be referred to as having a *dynamic driver* or *dynamic transducer*, "dynamic" referring to the movement of the coil.

The moving-coil concept is illustrated in Figure 29-3. The coil slides into a deep, narrow, circular slot in a magnet that is attached to the plastic frame of the headphone. The diaphragm is supported at its edges by a flexible rim. Variations in current passing through the coil create a fluctuating magnetic field that interacts with the field of the fixed magnet, causing the diaphragm to move in and out. A very similar configuration is used in many **loudspeakers**. Detail modifications may be made to increase efficiency, reduce production costs, or enhance sound quality, but the principle remains the same.

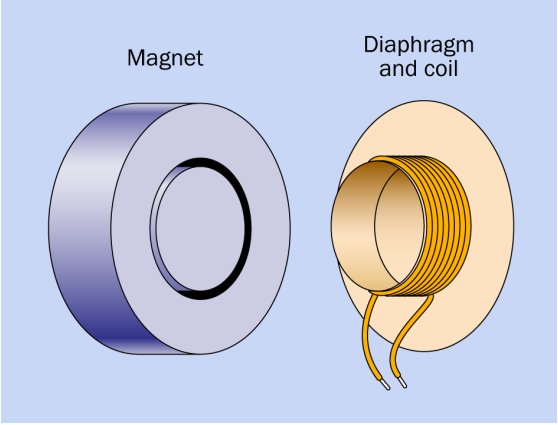

Figure 29-3. *The basic elements of a moving-coil headphone.*

The internal element of a headphone is shown in Figure 29-4. A plastic diaphragm is visible, measuring slightly less than 2″ in diameter. The magnet and coil are concealed underneath.

The element in the previous figure is normally enclosed in an assembly such as the one in Figure 29-5, which incorporates a soft padded rim to rest upon the ear.

In an effort to achieve a more balanced frequency response, some designs use two moving-coil drivers in each headphone, optimized for low frequencies and high frequencies, respectively.

Earbuds, described after the next section, often use a miniaturized version of the moving-coil design.

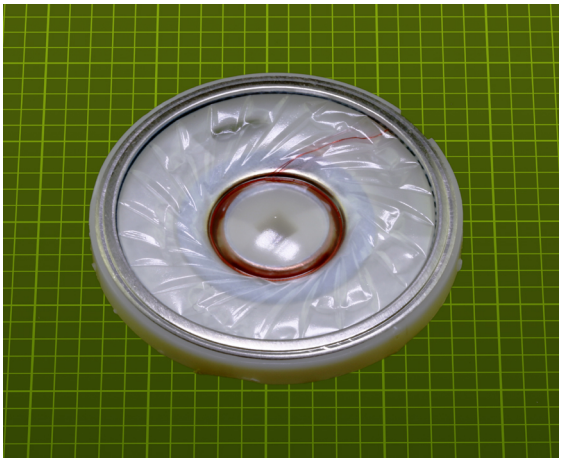

Figure 29-4. *The sound reproducing element removed from a headphone.*

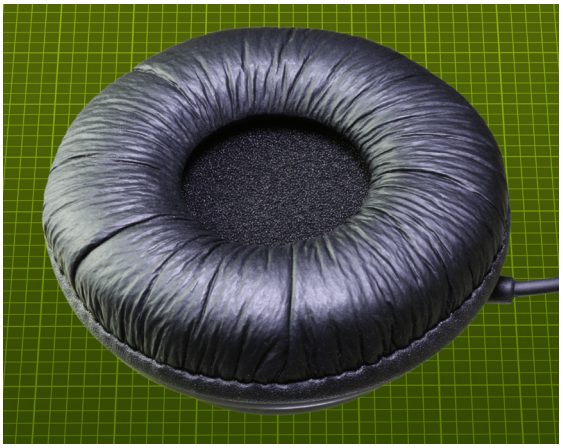

Figure 29-5. *The sound reproducing element from the previous figure is normally packaged inside this enclosure.*

Other Types

Electrostatic headphones use a thin, flat diaphragm suspended between two grids that function as electrodes. A fluctuating potential between the grids, coupled with a reverse-phase voltage on the diaphragm, will vibrate the diaphragm, generating pressure waves. A relatively high voltage is necessary to achieve this, anywhere from 100V to 1,000V, supplied through a conversion unit between the headphones and an amplifier. Electrostatic headphones are

known for low distortion and an excellent high frequency response, at some extra cost.

Electret headphones work on a similar principle, except that the membrane is permanently charged, and a high voltage is not required. Electret headphones tend to be small, inexpensive, and not of high sound quality.

A *balanced armature* design, often referred to by the acronym *BA*, uses a pivoting magnet that is claimed to increase efficiency while reducing stress on a diaphragm. BA drivers can be extremely compact, contained within a sealed metal enclosure measuring less than 10mm x 10mm x 5mm. They are commonly used in conjunction with *in-ear* earphones, described in the next section.

Mechanical Design

Circumaural headphones use large soft pads to encircle the ear and block external noise. Their size tends to make them heavy, requiring a well-designed headband to provide comfortable support. *Supra-aural* headphones are smaller and lighter, resting on the ears instead of enclosing them. They cannot exclude ambient noise, and may have inferior bass response compared with the circumaural type.

Open-back headphones, also known as *acoustically transparent*, are favored by some audiophiles because their vented outer surfaces are thought to create a more natural sound, similar to that of a **speaker**. The open backs naturally allow ambient noise to intrude, but also allow the sound generated by the headphones to be heard by others in a room. *Closed-back* headphones contain their sound and provide more insulation against ambient noise.

Earbuds rest just within the outer folds of the ear, facing inward like a pair of tiny **speakers**. They are easily dislodged and provide very little insulation against ambient noise. Their use became common after the introduction of Apple's iPod. A pair of earbuds, one of them with its plastic cover removed, is shown in Figure 29-6.

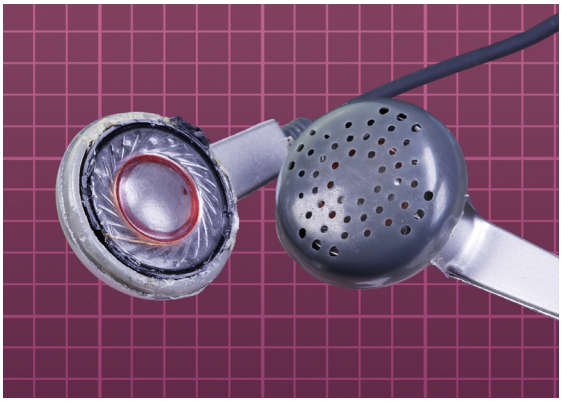

Figure 29-6. *A pair of earbuds, one with its cover removed to show the sound reproducing element, which closely resembles the diaphragm in a full-sized headphone.*

In-ear headphones are designed for insertion into the ear canal, often using a soft sheath that conforms with the ear like an earplug. This sheath is disposable for hygienic reasons, and because it may lose some of its plasticity with use. It excludes most ambient noise, and by minimizing the air gap between the driver of the headphone and the ear drum enables a high quality of sound reproduction.

In-ear headphones are also known as *in-ear monitors*, *IEMs*, *ear canal headphones*, *earphones*, and *canalphones*. A pair of in-ear headphones is shown in Figure 29-7, one of them with its foam sheath removed. The rectangular silver-colored object in the headphone on the left contains a transducer to create sound pressure.

A *headset* consists of one or two headphones plus a flexible microphone that extends to the promiximity of the mouth of the user.

Noise-cancelling headphones, popularized by Bose, monitor external noise with a built-in microphone and generate sound of opposite phase, to provide some cancellation. They are particularly effective on jet aircraft, where background noise tends to be consistent.

Figure 29-7. *A pair of in-ear headphones, supplied with disposable foam plugs that conform flexibly with the ear canal. The headphone on the left is shown with its plug removed.*

Although an *earphone* is almost obsolete, it is still obtainable from specialty suppliers. It has a high impedance, making it suitable for use with a *crystal-set radio*. An earphone is pictured in Figure 29-8.

Figure 29-8. *A vintage earphone of the type suitable for use with a crystal-set radio.*

Values

Intensity

Sound pressure is measured in decibels. For a complete explanation and discussion of weighted and unweighted decibel scales, see "Sound Pressure" on page 251 in the **transducer** entry.

Frequency Response

A plot of sound pressure as a function of frequency shows the *frequency response* of a headphone. Measuring the sound pressure meaningfully is a challenge, because the ear canal will add coloration to the sound and can amplify some frequencies while masking others. Ideally, measurement should be done at the ear drum, but this is not feasible. Consequently, high-end headphones are evaluated by making sound measurements inside simulated ear canals in a dummy human head.

A comparison between a high-quality $500 audio product and a transducer that is sold as a component for less than $1 illustrates the difference in frequency response; see Figure 29-9. The Sennheiser headphones have a smooth response that rises toward the low end, compensating for the lack of bass response that tends to be a problem in headphones, and the relative insensitivity of the human ear to low frequencies. The fluctuations at the high end are within about 5dB.

By comparison, the Kobitone emphasizes the range between 3kHz and 4kHz because its primary task is to be heard, and these are the frequencies where human hearing is most sensitive. Its low-frequency response trails off (although is still much better than that of a piezoelectric transducer, where the low response typically diminishes by 40dB to 50dB). The low-frequency output of the Kobitone is actually impressive bearing in mind that the component is only 9mm in diameter. It draws 60mA at 5VAC.

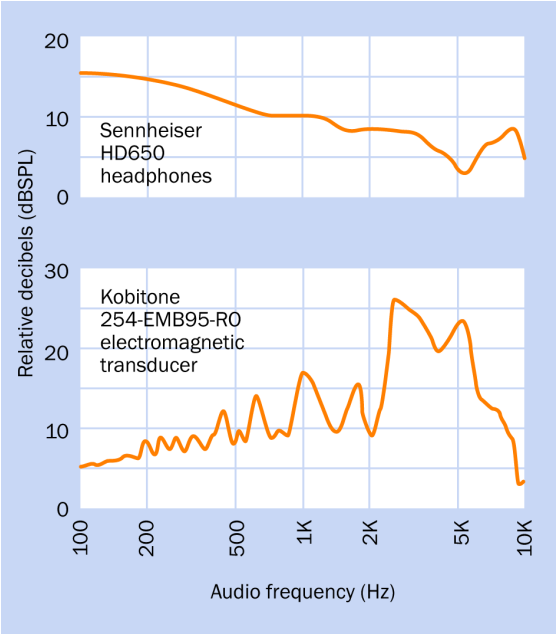

Figure 29-9. *Comparison between frequency responses of a $1 electromagnetic transducer intended as an audio alert and a $500 pair of headphones intended for sound reproduction. The upper graph is derived from a review online at headroom.com; the lower graph is from the manufacturer's datasheet.*

Some manufacturers of audio reproduction equipment prefer not to supply frequency response curves. Instead they may claim, for example, that the frequency response of a product ranges from 100Hz to 20kHz. This claim means very little unless it is accompanied by a range of sound pressure levels. If the frequency response is consistent within a range of, say, plus-or-minus 5dB, this may be acceptable. If the range is plus-or-minus 20dB, it is not acceptable. The ability to reproduce a high note or a low note is not useful if the sound is too faint to hear.

Distortion

The *total harmonic distortion* (THD) of any audio equipment measures its tendency to add spurious *harmonics* of a single frequency. If headphones are required to reproduce a pure 1kHz sinewave, they will also tend to create an additional 3kHz tone that is an artifact. This can be caused by the mechanical behavior of a vibrating diaphragm. The human ear recognizes distortion as a fuzzy or rasping sound. A square wave theoretically contains all the harmonics that are odd multiples of its fundamental frequency, and sounds extremely distorted.

THD should be less than 1% in good-quality audio devices.

Impedance

The electrical impedance of headphones is relevant in that it should match the output specification of the amplifier that drives them.

What Can Go Wrong

Overdriving

Headphones can be damaged by overdriving them. Because a low frequency requires larger excursions of a diaphragm to transmit the same energy as a high frequency, headphones are especially vulnerable to being damaged by bass at high volume.

Hearing Damage

Human hearing can be damaged by prolonged listening to headphones at a high volume. Some controversy remains regarding an acceptable limit for sound pressure.

Mismatched Impedance

If the impedance of headphones does not match the output of the amplifier driving them, distortion or a skewed frequency response can result. This is known as *mismatching*.

Incorrect Wiring

In most consumer products, a pair of headphones will share a common ground. While the connections in a typical three-layer jack plug have been standardized, hand-wired repairs or extensions should be tested carefully. Incorrect wiring will cause unpredictable results.

speaker

30

The term **speaker** is a diminution of *loudspeaker*. The full word is now so rarely used, some catalogs do not recognize it as a search term. This encyclopedia acknowledges contemporary usage by using **speaker** rather than *loudspeaker*.

A fully assembled consumer product can be referred to as a "speaker," but it also contains one or more individual components that are described as "speakers." To resolve this ambiguity, referring to the components as *drivers* is helpful, but this practice can create more ambiguity because other types of components are also called "drivers." The only real guide to the meaning of *speaker* is the context in which it is used.

For the purposes of this entry, a speaker is a *sound reproduction device*, distinguished from a typical electromagnetic **transducer** by being larger and more powerful, with a more linear frequency response. A transducer may be used as a *noise-creating device* to provide an alert, informing the user of the status of a piece of equipment. Because some speakers have been miniaturized for use in handheld products, they may be used as transducers, allowing some overlap between the two categories.

Because this encyclopedia assigns more emphasis to electronic components than to consumer products, this entry provides only a superficial overview of fully assembled speakers, and deals more with the drivers inside them, their principles of operation, and the general topic of sound reproduction.

OTHER RELATED COMPONENTS

- **headphone** (see Chapter 29)
- **transducer** (see Chapter 27)

What It Does

A speaker converts fluctuations of an electric signal into pressure waves that the human ear perceives as sound. It can be used for entertainment purposes or to provide information in the form of spoken words or distinctive sounds (as in the case of a miniature speaker in a cellular phone, playing a ring tone).

The internationally accepted schematic symbol for a speaker is shown in Figure 30-1.

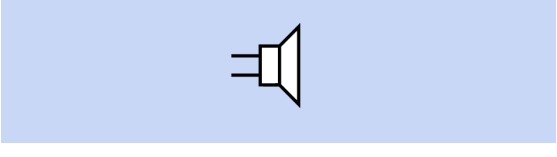

Figure 30-1. *Only one symbol exists to represent a speaker. This is it.*

How It Works

For a summary of basic concepts and terminology relating to sound and its reproduction, see "Audio Basics" on page 261 in the previous entry.

Construction

A speaker contains a *diaphragm* or *cone* with a coil attached to it. Fluctuations of current through the coil interact with a permanent magnet, causing the speaker to emit pressure waves that are proportionate with the current. The design is similar in concept to that of a headphone, shown diagrammatically in Figure 29-3. The primary difference is that a speaker of around 2″ or more will use a cone rather than a flat diaphragm. The cone shape is more rigid and creates a more directional sound.

A 2″ speaker rated for 1/4W with a 63Ω coil is shown in Figure 30-2, undamaged on the left but with its cone cut out on the right. The neck of the cone, which is normally inserted in the circular groove in the speaker magnet, is shown with the inductive coil wrapped around it.

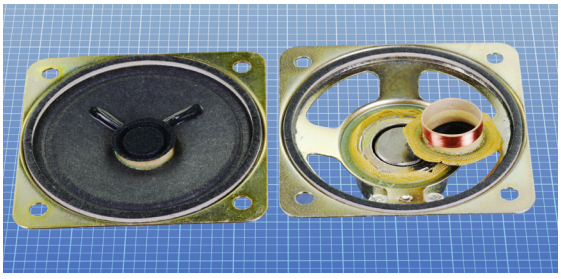

Figure 30-2. *On the left is a 2″ speaker. On the right, its cone has been cut away to reveal the magnet, with a circular groove in it. The neck of the cone, which normally slides into the groove, is shown removed.*

A speaker with a cone 4″ in diameter is shown from the rear in Figure 30-3.

A miniature surface-mount speaker is shown from the front and from the rear in Figures 30-4 and 30-5. It measures just under 0.4″ diameter and was made for Motorola. Its power rating is 50mW.

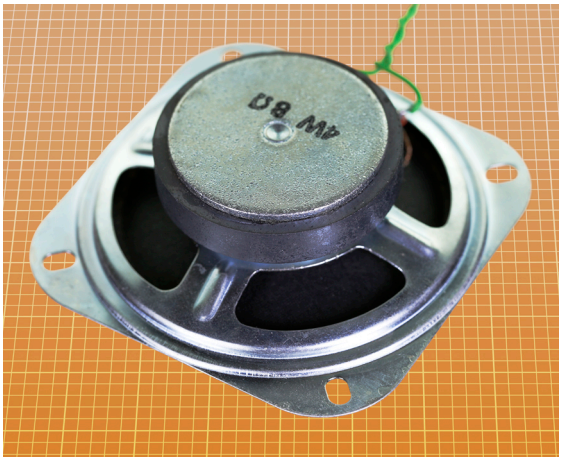

Figure 30-3. *The back side of a speaker with a cone measuring approximately 4″ in diameter. Its magnet is the large round section that is uppermost. This unit is rated for 4W and has an impedance of 8Ω.*

A speaker designed for a cellular phone is shown in Figure 30-6. Note the close resemblance in design to the driver used in an earbud, shown in Figure 29-6 in the previous entry.

In the past, speaker cones were made from tough, fibrous paper. Modern cones are more likely to be plastic, especially in small sizes.

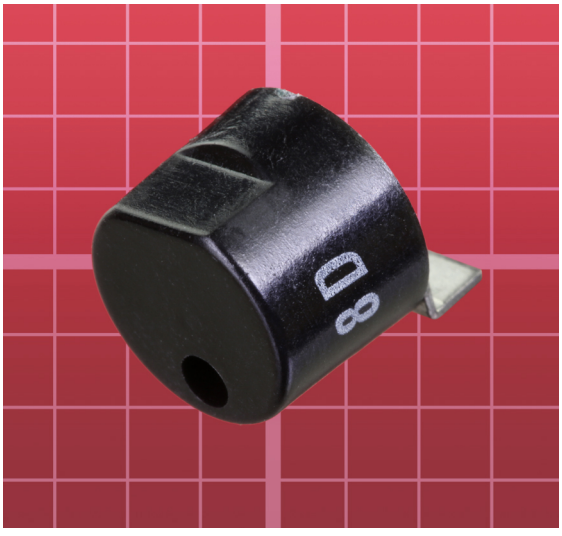

Figure 30-4. *Front view of a surface-mount speaker measuring less than 0.4″ diameter.*

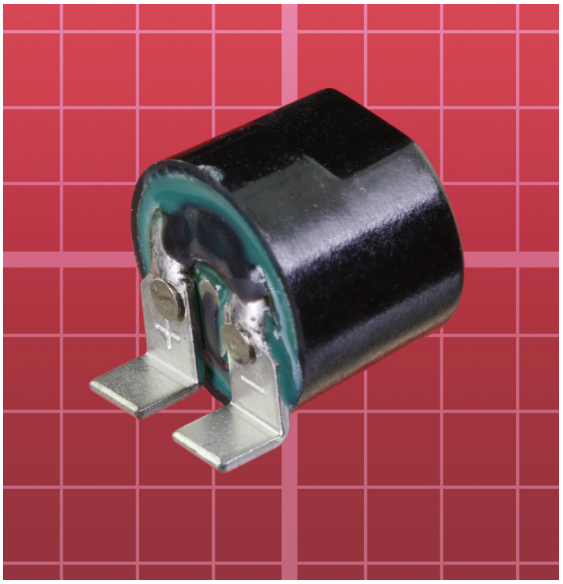

Figure 30-5. *Rear view of the speaker shown in the previous figure.*

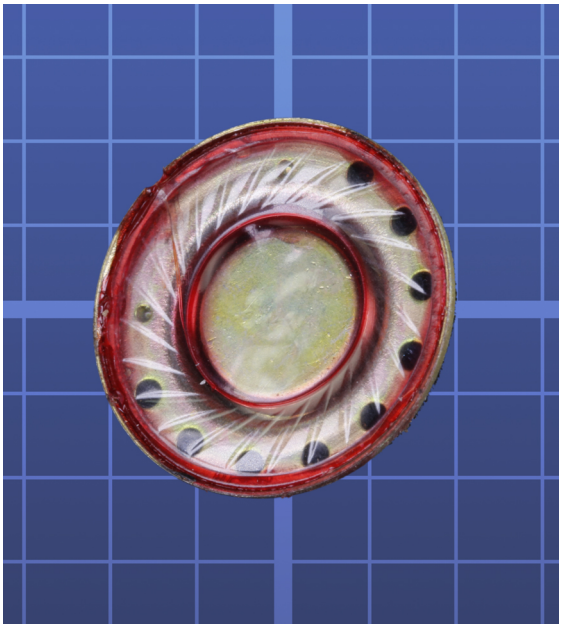

Figure 30-6. *A miniature speaker measuring slightly more than 1/2" diameter and only 0.13" thick, designed for use in a cellular phone. It has an impedance of 150Ω.*

Multiple Drivers

Generally speaking, a large-diameter speaker cone is more effective than a small cone at moving the greater volumes of air associated with reproduction of bass notes. However, the inertia of a large cone impairs its ability to vibrate at high frequencies.

To address this problem, a large speaker and a small speaker often share a single enclosure. A *crossover network* using coils and capacitors prevents low frequencies from reaching the small speaker and high frequencies from reaching the large speaker. The basic principle is shown in the simplified schematic in Figure 30-7.

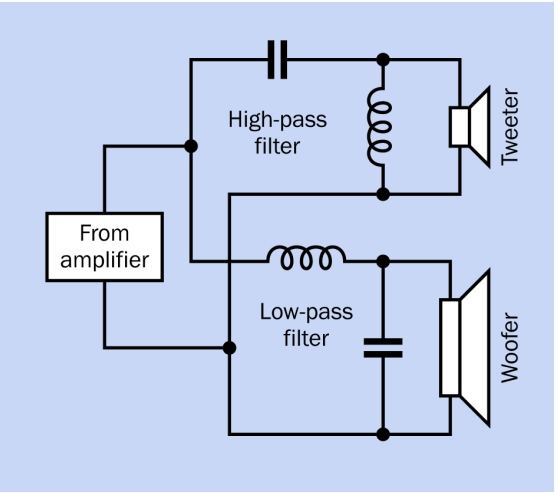

Figure 30-7. *The basic principle of a crossover network.*

Because the crossover network must be "tuned" to match the characteristics of the speakers, and because the combined sound pressure of the speakers must be relatively consistent over a wide range of frequencies, an actual network usually includes additional components.

Because the audio output from an amplifier consists of alternating current, polarized capacitors cannot be used. Polyester capacitors are common.

The small speaker in a pair is known as a *tweeter* while the large speaker is a *woofer*. Although

these appellations were whimsically coined, they have endured.

More than two speakers may be combined in an enclosure, in a wide variety of configurations.

Venting

A speaker radiates pressure waves from the back side of its cone as well as from the front, and because the waves from front and back are opposite in phase, they will tend to cancel each other out.

In a miniature speaker, this problem can be addressed simply by sealing the section of the enclosure at the rear. For larger components, a more efficient enclosure can be designed with a *vent* or *reflex port* at the front. Pressure waves from the back of the speaker are diverted over a sufficient distance inside the cabinet so that by the time they emerge through the port, they are approximately in phase with low frequencies from the front of the speaker, although the back wave will lag the front wave by one wavelength.

This design is referred to as a *bass-reflex enclosure*, and was almost universal in high-fidelity components until amplifiers became increasingly powerful during the 1960s. At that point, Acoustic Research, located in Massachusetts, marketed a product line in which speaker enclosures were sealed, the argument being that when an amplifier can deliver 100W per channel, efficiency is no longer an issue, and a sealed enclosure can eliminate compromises associated with a bass-reflex design.

Acoustic Research referred to their concept as "air suspension," as the cushion of air in the sealed cavity helped to protect the speaker by limiting its excursion. This configuration is now often referred to as a *closed-box speaker*. Some audiophiles argue that it must always be inherently superior to a bass-reflex design, partly because of the one-wavelength lag time associated with a reflex port. However, as in many aspects of sound reproduction, the debate is inconclusive.

Resonance

The enclosure for a speaker will tend to have a dominant resonant frequency. This should be lower than the lowest frequency that the speaker will reproduce; otherwise, the resonance will emphasize some frequencies relative to others, creating unwanted peaks in the response.

One reason why high-quality speakers tend to be physically heavy is to reduce their resonant frequency. A modern Thiel speaker assembly, for instance, uses a front panel of particle board that is a full 2" thick. However, heavy enclosures are expensive to transport and inconvenient to locate or relocate in the home.

To address this problem, a tweeter and a woofer can be mounted in separate boxes. The enclosure for the tweeter can be very small, lightweight, and suitable for placement on a shelf, while the heavy box for the woofer can go on the floor. Human senses have difficulty locating the source of low-frequency sound, so the woofer can be located almost anywhere in a room. In fact, its single speaker can serve both stereo channels.

This configuration has become the default for computer speakers. It is also used in home-theater systems, where the woofer has now become a subwoofer capable of very low frequency reproduction.

Miniature Speakers

If an electronics project has an audio output, and the circuit board will be sharing an enclosure with a small speaker, the size of the box and the material from which it is fabricated will affect the sound quality significantly. A box made from thin hardwood may add resonance that sounds pleasing, if the speaker is being used just for simple electronic tones. By comparison, a metal box may sound "tinny." A box fabricated from a plastic such as ABS will be relatively neutral, provided the plastic is reasonably thick (1/4" being preferable).

Variants

Electrostatic Speaker

The principle of an electrostatic speaker is the same as that of an electrostatic headphone. A charged membrane is stretched between two grids in front of it and behind it that act as electrodes. Because the membrane is so light, it responds with very little latency, and its large surface area creates a diffused sound that many audiophiles find pleasing. However, a high voltage is required to drive electrostatic speakers, and they are not cheap.

Powered Speakers

A unit containing its own driver electronics is referred to as a *powered speaker*, and is used almost universally with desktop computers, because the computer itself does not contain a power amplifier. Powered speakers may also enable a more versatile crossover network.

A subwoofer may have its own amplifier allowing control of the cutoff frequency above which the speaker will not attempt to reproduce sound. The electronics can include protection for a speaker against being overdriven.

Wireless Speakers

A wireless link between a stereo receiver and its speakers will eliminate the speaker wires that are normally necessary. However, the speakers themselves must be powered, and will have to be wired to electric outlets.

Innovative Designs

The need for small speakers in consumer products such as laptop computers has encouraged innovative designs. The speaker in Figure 30-8 is just 1″ square, and its shape is easier to accommodate in a small product than the traditional circular speaker. In Figure 30-9, the interior of the same speaker shows that inductive coils are applied to a square plastic diaphragm.

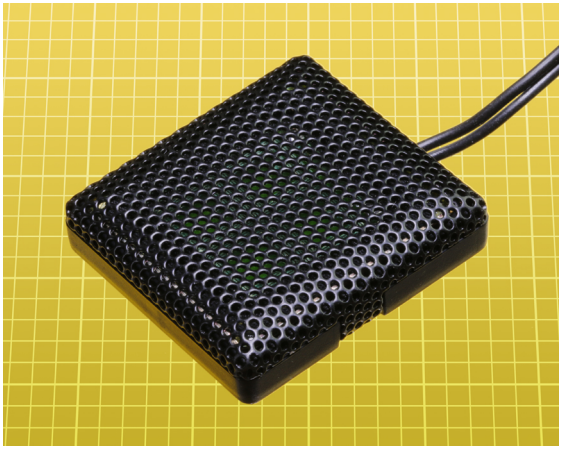

Figure 30-8. *A speaker 1″ square, suitable for use with a small electronic device.*

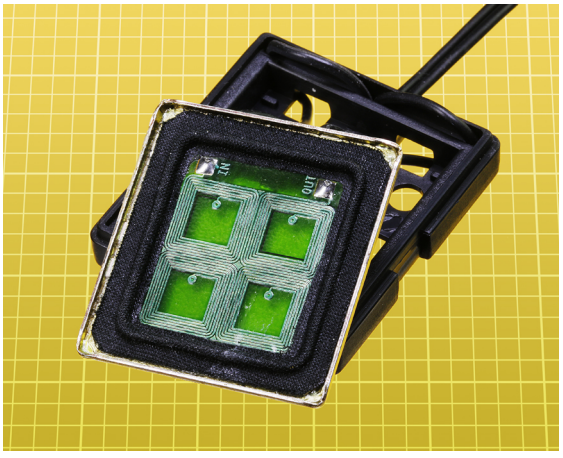

Figure 30-9. *The speaker from the previous figure, opened to show its inductive coils applied to a square plastic diaphragm.*

Values

The typical *impedance* for speakers in audio systems is 8Ω. Small speakers may have a higher impedance, which can be useful when driving them from devices that have limited power, such as a TTL-type 555 timer.

In the United States, the diameter of a circular speaker is usually expressed in inches. Speakers larger than 12″ are rare for domestic use. A 4″ speaker used to be considered minimal because

of its limited low-end frequency response, but much smaller speakers have become common in portable devices.

The low-end frequency response of a miniature loudspeaker designed to be surface-mounted on a circuit board will be very poor. The graph in Figure 30-10 was derived from data supplied by the manufacturer.

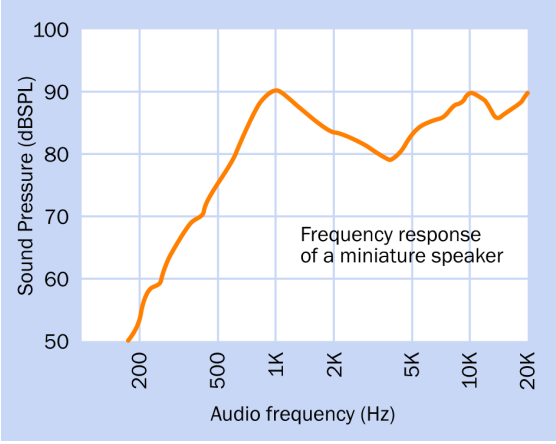

Figure 30-10. *Frequency response for a speaker measuring 15mm x 15mm x 5mm. Small dimensions and lack of an enclosure result in a negligible low-end response.*

Power rating for speakers is in watts, measured on a root-mean-square (RMS) basis.

Sensitivity is measured in decibels, at a distance of one meter, while a speaker is reproducing a single constant tone with a power input of 1W. A speaker assembly designed for undemanding home use may be rated at 85dB to 95dB.

Efficiency is a measure of sound power output divided by electrical power input. A value of 1% is typical.

What Can Go Wrong

Damage

As is the case with headphones, the most common problem affecting a speaker is damage caused by overdriving it. Because a low frequency requires larger excursions of a speaker cone to transmit an amount of energy comparable to that of a high frequency, loud bass notes can be hazardous to the cone. On the other hand, if an amplifier generates distortion (perhaps because it, too, is being overdriven), the harmonics created by the distortion can damage high-frequency speakers.

Magnetic Field

Even a small speaker (measuring 2″ or less) contains a magnet that is sufficiently powerful to cause problems if it is in close proximity to other components, especially if sensors such as reed switches or Hall-effect switches are being used. Initial circuit testing should be done with the speaker as far away as possible, to eliminate it as a source of interference.

Vibration

Solder joints will be stressed if they are subjected to low-frequency vibration from a speaker. Loose parts may rattle, and parts that are bolted into place may become unbolted. The speaker itself may become loose. Thread-locker such as Loc-Tite should be applied to nuts before they are tightened.

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Charles Platt and Fredrik Jansson

Encyclopedia of Electronic Components

Sensors

Location ▪ Presence ▪ Proximity ▪ Orientation ▪ Oscillation ▪ Force ▪ Load ▪ Human Input ▪ Liquid and Gas Properties ▪ Light ▪ Heat ▪ Sound ▪ Electricity

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Charles Platt is the author of *Make: Electronics* and *Make: More Electronics*. He is a former senior writer for *Wired* magazine, and is a contributing editor to *Make:* magazine, for which he writes a column on electronics.

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To Brian Jepson

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Preface

This third and final volume of the *Encyclopedia of Electronic Components* is devoted entirely to sensors.

Two factors have caused very significant changes in the field of sensors since the 1980s. First, features such as antilock braking, airbags, and emissions controls stimulated the development of low-priced sensors for automotive applications. Many of these sensors were fabricated in silicon as MEMS (microelectromechanical) devices.

The second wave began in 2007 when MEMS sensors were installed in the iPhone. A modern phone may contain almost a dozen different types of sensors, and their size and price have been driven down to a point that would have been unimaginable 20 years previously.

Many MEMS sensors are now as cheap as basic semiconductor components such as a voltage regulator or a logic chip, and they are easy to use in conjunction with microcontrollers. In this Encyclopedia, we have allocated significant space to this segment of the market, hoping that the specific products that we have chosen will remain popular and available for at least the next decade.

In addition, we have devoted space to older components where durability has been proven.

Purpose

While much of the information in this volume can be found dispersed among datasheets, introductory texts, Internet sites, and technical briefings published by manufacturers, we believe there is a real need for a durable resource that assembles all the relevant data in one place, properly organized and verified, including details that may be hard to find elsewhere.

This volume may also serve a useful purpose by attempting to categorize and classify components in a field that is remarkably chaotic. For example, is an *object presence sensor* different from a *proximity sensor*? Some manufacturers seem to think so; others disagree. Understanding the distinctions and the underlying principles can be important if you are trying to decide which sensor to use.

Sensor terminology can also be confusing. To take another example, what is the difference between a *reflective interrupter*, a *reflective object sensor*, a *reflective optical sensor*, a *reflective photointerrupter*, and an *opt-pass sensor*? These terms are used in various datasheets to describe components that are all *retroreflective sensors*. Understanding the proliferating variety of terminology can be essential if you simply want to find something in a product index.

Organization

As in volumes 1 and 2, this volume is organized by subject. For example, if you want to measure temperature, you'll find the entries for a thermistor and a thermocouple next to each other, in an entire section devoted to the sensing of heat. This will help you to compare capabilities and choose the component that best suits your application.

The subject path leading to each sensor is shown at the top of the first page of each entry. For gas flow rate, for instance, you would follow this path:

```
fluid > gas > flow rate
```

Note that the word "fluid" is properly used to include gases as well as liquids.

Exceptions and Conflicts

Unfortunately, some sensors are not easily categorized. There are four problems in this area.

1. What Does a Sensor Really Sense?

A GPS chip is a radio receiver, picking up transmissions from satellites. Does this mean it should be categorized as a sensor of radio waves? No, its purpose is to tell you your location. Therefore, it is categorized as a location sensor. This leads to the first general rule: sensors are categorized by their primary purpose. Secondary purposes may be found in the index.

2. How Many Sensors Are in a Sensor?

Many surface-mount chips perform more than one sensing function. For example, an inertial measurement unit (often identified by its acronym, *IMU*) can contain three gyroscope sensors and three accelerometers—and may contain three magnetometers, too. How should it be categorized?

The answer is that an IMU will be mentioned in more than one entry in the Encyclopedia, because it performs more than one function; but it will not have its own separate entry, because each entry in the Encyclopedia is for a single primary sensing function.

The names of multisensor chips are, of course, included in the index.

3. How Many Stimuli Can One Sensor Sense?

A single sensing element may be used in multiple different types of sensors. The most notable example is the Hall-effect sensor, which can be found in magnetometers, object presence sensors, speed sensors, current sensors, and dozens more. Modern automobiles can contain Hall-effect sensors everywhere from the ignition system to the trunk-locking mechanism. If you are using a hard drive with rotating platters, it probably contains a Hall-effect sensor to monitor the speed of rotation. If you have a generic computer keyboard, each keypress is probably detected with a Hall-effect sensor.

Bearing this in mind, how should a Hall-effect sensor be classified? And where should you expect to find an explanation of how it works?

The answer is that where different types of components contain the same type of sensing element, the entry for each component will include a cross-reference to one location where the sensing element is explained in detail.

This location will be chosen for its relevance. Thus, Hall-effect sensors are explained in the entry for **object presence** sensors, because this is their primary function. While it is true that a Hall-effect sensor works by detecting a magnetic field, that is not its most common application.

4. Too Many Sensors!

Wikipedia lists more than 100 general types of sensors, and even that list is probably not complete. Consequently, we had to pick and choose. Some of the decisions may seem arbitrary, but all of them were made on the grounds of practicality. There were three principles for deciding what to include and what to leave out.

1. Is it a component? We are more interested in board-mounted components than in packaged products that happen to contain sensors. For instance, a thermocouple is often enclosed in a tubular steel probe, and its wire is often plugged in to a specially designed meter that displays temperature. While we do include a photograph of a probe, we are primarily interested in the welded wires of the thermocouple inside it.
2. How much does it cost? An industrial ultrasonic sensor to check items on a factory conveyor belt will be sealed into a module with a waterproof grommet around a shielded cable—which is all very nice, but will not be very affordable. This Encyclopedia is more interested in board-mountable components for one-tenth of the price.
3. How many people are likely to want it? The stock of each type of sensor was checked on component vendor sites. If a sensor wasn't in the inventory, or if only a couple of variants were stocked, we concluded that the limited demand probably didn't justify including it here. For example, a Ferraris acceleration sensor responds to eddy currents in a rotating motor shaft, as a way of measuring vibration in the shaft. This is a really interesting device, but is unlikely to be on most people's shopping lists.

Volume Contents

Having explained the organization of this book and our decisions to include or omit various components, we now present a summary of the contents of all three Encyclopedia volumes:

Volume 1

Power; electromagnetic devices; discrete semiconductors.

The *power* category includes sources of electricity and methods to distribute, store, interrupt, convert, and regulate power. The *electromagnetism* category includes devices that exert force linearly, and others that create a turning force. *Discrete semiconductors* include the primary types of diodes and transistors. See Figure P-1 for a contents listing.

Primary Category	Secondary Category	Component Type
power	source	battery
	connection	jumper
		fuse
		pushbutton
		switch
		rotary switch
		rotational encoder
	moderation	relay
		resistor
		potentiometer
		capacitor
		variable capacitor
	conversion	inductor
		AC-AC transformer
		AC-DC power supply
		DC-DC converter
		DC-AC inverter
	regulation	voltage regulator
electro-magnetism	linear output	electromagnet
		solenoid
	rotational output	DC motor
		AC motor
		servo motor
		stepper motor
discrete semi-conductor	single junction	diode
		unijunction transistor
	multi-junction	bipolar transistor
		field-effect transistor

Figure P-1 *The subject-oriented organization of categories and entries in Volume 1 of this Encyclopedia.*

Volume 2

Thyristors (SCRs, diacs, and triacs); integrated circuits; light sources, indicators, and displays; and sound sources.

Integrated circuits are divided into analog and digital components. *Light sources, indicators, and displays* are divided into reflective displays, single sources of light, and displays that emit light. *Sound sources* are divided into those that create sound, and those that reproduce sound. A contents listing for Volume 2 appears in Figure P-2.

Volume 3

All the most common types of sensing devices, including those that detect location, presence, proximity, orientation, oscillation, force, load, human input, liquid properties, gas types and concentrations, pressure, flow rate, light, heat, sound, and electricity. A contents listing for Volume 3 appears in Figure P-3.

Method

Reference Versus Tutorial

As its title suggests, this is a reference book, not a tutorial. A tutorial such as *Make: Electronics* begins with elementary concepts and builds sequentially toward concepts that are more advanced. A reference book assumes that you may dip into the text at any point, learn what you need to know, and then put the book aside. If you choose to read it straight through from beginning to end, you will find some repetition, as each entry is intended to be self-sufficient, requiring minimal reference to other entries.

Theory and Practice

This book is oriented toward practicality rather than theory. We assume that the reader mostly wants to know how to use electronic components, rather than why they work the way they do. Consequently we do not include detailed proofs of formulae or definitions rooted in electrical theory.

Primary Category	Secondary Category	Component Type
discrete semi-conductor	thyristor	SCR
		diac
		triac
integrated circuit	analog	solid-state relay
		optocoupler
		comparator
		op-amp
		digital potentiometer
		timer
	digital	logic gate
		flip-flop
		shift register
		counter
		encoder
		decoder
		multiplexer
light source, indicator or display	reflective	LCD
	single source	incandescent lamp
		neon bulb
		fluorescent light
		laser
		LED indicator
		LED area lighting
	multi-source or panel	LED display
		vacuum-fluorescent
		electroluminescence
sound source	audio alert	transducer
		audio indicator
	reproducer	headphone
		speaker

Figure P-2 *The subject-oriented organization of categories and entries in Volume 2.*

Primary Category	Attribute to be Sensed	Type of Sensor
spatial	location	GPS
		magnetometer
	presence	object presence
		passive infrared
	distance	object proximity
		linear position
	orientation	rotary position
		tilt
		gyroscope
		accelerometer
mechanical	oscillation	vibration
	force	force
	human input	single touch
		touch screen
fluid	liquid	liquid level
		liquid flow rate
	gas/liquid	pressure
	gas	gas concentration
		gas flow rate
radiation	light	photoresistor
		photodiode
		phototransistor
	heat	NTC thermistor
		PTC thermistor
		thermocouple
		RTD
		semiconductor
		infrared temperature
	sound	microphone
electricity	metering	current
		voltage

Figure P-3 *The subject-oriented organization of categories and entries in Volume 3.*

Sensor Output

In Volumes 1 and 2 of the *Encyclopedia*, each entry included hints on how to use a component. However, many sensors have identical forms of output, which are processed in a similar way. To avoid repetition, general guidance for using nine principal types of sensor outputs has been placed in Appendix A at the back of this volume.

For example, many sensors provide an analog voltage output that varies with the phenomenon that is being sensed. In Appendix A, you will find suggestions on how to adjust the range of the output, if necessary, or how to digitize it with an analog-to-digital converter.

You will also find a comparison between serial protocols such as I2C and SPI, both of which are commonly used when a microcontroller communicates with a digital sensor via a bus.

Glossary

In the world of sensors, many terms tend to recur. *Hysteresis* is one; *MEMS* is another. Rather than define these terms repeatedly, some quick definitions are gathered in a Glossary. Please remember the existence of the glossary if you encounter a term that is unfamiliar. See Glossary.

In many instances, terms that are italicized in the text are defined in the glossary.

Typographical Conventions

Within each entry, **bold type** is used for the first occurrence in each entry of the name of a component that has its own entry elsewhere. Other important electronics terms or component names may be presented in *italics*.

The names of components, and the categories to which they belong, are all set in lowercase type, except where a term is normally capitalized because it is an acronym or a trademark, or contains a proper noun. The term *Hall effect*, for instance, has an initial cap because it is named after a person named Hall. The term *GPS* is all in caps, because it is an acronym; but *psi* (meaning pounds per square inch) remains in lowercase, because even though it is an acronym, the lowercase form is more common.

The situation is different when specifying units that are named after electrical pioneers. All of these units should be lowercased when spelled out. Thus, when referring to the SI unit of force, it is "the newton." However, where a unit named after a person is abbreviated, the abbreviation is capitalized, as in N for newtons, Hz for hertz, Pa for pascals, and A for amperes.

Mathematical Syntax

In mathematical formulae, we have used the style that is common in programming languages. The * (asterisk) is used as a multiplication symbol, while the / (forward slash) is used as a division symbol. Where some terms are in parentheses, they must be dealt with first. Where parentheses are inside parentheses, the innermost ones must be dealt with first. Consider this example:

```
A = 30 / (7 + (4 * 2) )
```

You would begin by multiplying 4 times 2, to get 8; then add 7, to get 15; then divide that into 30, to get the value for A, which is 2.

Visual Conventions

Figure P-4 shows the conventions that are used in the schematics in this book. A black dot always indicates a connection, except that to minimize ambiguity, the configuration at top-right is avoided, and the configuration at top-center is used instead. Conductors that cross each other without a black dot do not make a connection. The styles at bottom right are sometimes seen elsewhere, but are not used here.

All the schematics are formatted with pale blue backgrounds. This enables components such as switches, transistors, and LEDs to be highlighted in white, drawing attention to them and clarifying the boundary of the component. The white areas have no other meaning.

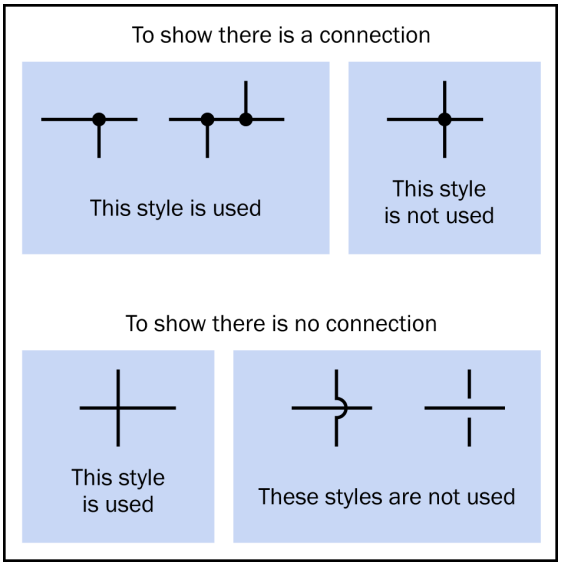

Figure P-4 *Visual conventions that are used in the schematics in this book.*

Units and Backgrounds

So long as the United States clings stubbornly to the habit of expressing dimensions in inches, there is a good argument to follow this custom in books intended for an American audience. With this in mind, Volumes 1 and 2 mostly avoided metric units of length. However, as time passed, the books were translated for use in many parts of the world where the inch is regarded as an anachronism.

Recognizing that we now have an international audience, we have used the metric system throughout this volume (with very few exceptions, such as a photograph of an American plumbing fixture that is designed to fit 3/4" pipe). For readers who are metrically impaired, here are some units of length, and their abbreviations:

- 1 nanometer (nm)
- 1 micrometer (µm) = 1,000nm
- 1 millimeter (mm) = 1,000µm
- 1 centimeter (cm) = 10mm
- 1 meter (m) = 100cm = 1,000mm

A micrometer is also known as a *micron*.

The basic conversion factor from meters to inches is 0.0254. Thus:

- 1 inch = 2.54cm = 25.4mm
- 1/1000 inch = 25.4µm

Sometimes 1/1000 inch is called a *mil*.

In many of the component photographs, a graph-paper background is included. Each square in these backgrounds is 1mm.

To avoid confusion, please remember that a few of these same component photographs appeared in books such as *Make: More Electronics*, where the background grid was in tenths of an inch. Captions to photographs in this volume will remind you that millimeters are now used.

Background colors in the photographs were chosen for contrast with the colors of the components, or for visual variety. They have no other significance.

Component Availability

The world of sensors is changing rapidly, and we have no way of knowing if a component will enjoy a long production run. We recommend checking availability at the following suppliers, which we used frequently during the preparation of the book:

- *http://www.mouser.com*
- *http://www.jameco.com*
- *http://www.sparkfun.com*
- *http://www.adafruit.com*

For obsolete parts, or those that are nearing the end of their commercial life, eBay can be very useful. Alternatively, new substitutions for old parts are often listed at *http://www.mouser.com*.

Issues and Errata

There are three situations where the reader and the writer may want to communicate with each other.

- We may want to tell you if the book contains a mistake of some significance. This is *us-informing-you* feedback.
- You may want to tell us if you think you found an error in the book. This is *you-informing-us* feedback.
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Responses in the past have been generally positive, but in a couple of cases people have been annoyed over small issues such as being unable to find a part online. Help is available on this kind of topic, if you need it. All you have to do is send a request to *make.electronics@gmail.com*.

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To comment or ask technical questions about this book, send email to:

bookquestions@oreilly.com.

Acknowledgments

Datasheets and tutorials maintained by component manufacturers were considered the most trustworthy sources of information online. In addition, component retailers, college texts, crowd-sourced reference works, and hobbyist sites were used. The following books provided useful information:

Boylestad, Robert L. and Nashelsky, Louis: *Electronic Devices and Circuit Theory*, 9th edition. Pearson Education, 2006.

Braga, Newton C.: *CMOS Sourcebook*. Sams Technical Publishing, 2001.

Hoenig, Stuart A.: *How to Build and Use Electronic Devices Without Frustration, Panic, Mountains of Money, or an Engineering Degree*, 2nd edition. Little, Brown, 1980.

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In addition, three individuals provided special assistance. Our editor, Brian Jepson, was immensely helpful in the development of this book. Philipp Marek reviewed the text for errors, and Erico Narita collaborated on the Photoshop work.

GPS

1

The acronym **GPS** properly refers to the entire Global Positioning System, including satellites and ground-based control installations. However, a *GPS sensor* consists of a surface-mount chip that processes signals from GPS satellites using a small rectangular antenna, often mounted on top of a *GPS chip*.

A *GPS module* is usually a small board on which a GPS sensor is mounted with additional components. A *GPS receiver* is a device including a data display and other features, such as memory, in addition to a GPS module. In casual colloquial usage, someone who refers to "a GPS" usually means a GPS receiver.

GPS is almost always capitalized without periods.

OTHER RELATED COMPONENTS

- **magnetometer** (see Chapter 2)

What It Does

The Global Positioning System is a navigational aid jointly funded by the U.S. Department of Defense and the U.S. Department of Transportation, while being maintained by the U.S. Air Force. Signals from GPS satellites can be received and processed by modules in a wide variety of equipment ranging from aircraft to wristwatches. The signals provide location data, and may also be used as an accurate time reference.

Schematic Symbol

There is no specific schematic symbol for a GPS chip. It is likely to be shown as a box containing abbreviations that define pin functions, similar to any integrated circuit chip.

GPS Segments

The Global Positioning System consists of three segments:

The space segment

This originally required 24 communications satellites, but was revised in 2011 to require 27, to provide better global coverage. As of August 2015, there were actually 31 satellites in service, with additional "spares" that can be activated if necessary. The satellites occupy orbits 12,500 miles above the Earth, allowing each of them to circle the planet twice in 24 hours. Specifications are maintained online.

The control segment

This includes a master ground-based control station, an alternate master control station, 12 command and control antennas, and 16 monitoring sites, all maintained by the U.S. Air Force.

The user segment

This consists of receiving devices, including those that are government-owned and those that are privately owned.

How It Works

Each satellite carries multiple atomic clocks that maintain precise time, and a pseudo-random number generator in the form of a linear-feedback **shift register** (see Volume 2).

A GPS receiver can distinguish the signals from at least four satellites by comparing their received pseudo-random bit sequences, and can compute the receiver's distance to each satellite by comparing the arrival times of satellite signals.

When a satellite appears above the horizon, it approaches a receiver. After passing overhead, it moves away. This relative motion causes a *Doppler shift* in the received frequency, which the receiver circuit must take into account.

GPS satellites transmit on several frequencies simultaneously. The one for civilian use is 1575.42 MHz, called L1. Another one, 1227.6 MHz, called L2, is reserved for military use.

Variants

A GPS chip generally processes input from an antenna and provides output through solder pads. The antenna is often integrated as a ceramic square or rectangle mounted above the chip, but many chips can also process input from an external antenna. Figure 1-1 shows a GPS chip with a metal shield that is easily mistaken for an antenna. In Figure 1-2, the GPS sensor does incorporate a ceramic antenna.

Some GPS chips contain flash memory for internal data logging, although this is not a standard feature.

Suppliers such as Adafruit and Sparkfun offer GPS modules mounted on breakout boards for easier connection with other components, as shown in Figure 1-2. Some breakout boards also include provision for battery backup with a button cell.

Figure 1-1 *A GPS sensor. This surface-mount chip is hidden beneath a metal shield.*

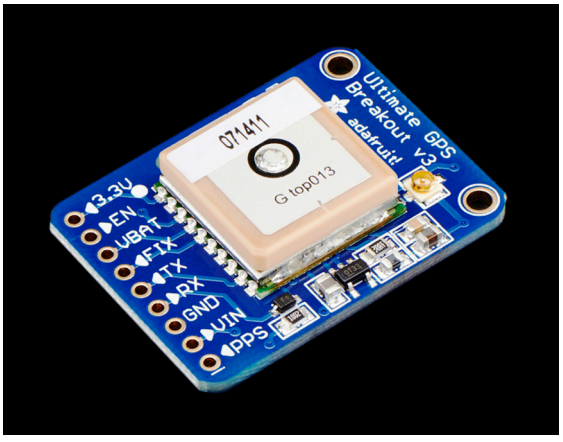

Figure 1-2 *A breakout board offered by Adafruit, incorporating a GPS sensor.*

GPS capability is almost always included in modern smartphones and tablets. It is used in handheld devices for navigation on foot, and in devices designed to be mounted in motor vehicles. Cars offer GPS capability as an option accessed via a built-in screen.

A *GPS tracker* is a device that may lack a display and simply logs its position to internal memory, from which data can be downloaded to a com-

puter later. Many (older) handheld GPS receivers have a connector giving access to a serial or USB port, and provide data in the same NMEA format as the GPS modules described below.

After the Global Positioning System became widely used, other competing systems were introduced. These include the European Galileo, the Russian GLONASS (an acronym for Global Navigation Satellite System), and the Chinese Beidou. As of 2015, GLONASS had become fully operational. Some receivers, including those in cellular phones, compare signals from GPS and GLONASS satellites to achieve higher accuracy.

Values

Sensitivity is expressed usually in dBm, meaning the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).

Time to First Fix (TTFF) is the time required to obtain an initial fix from a satellite.

Number of channels is the number of satellites that a GPS receiver can track simultaneously. Early GPS receivers could sense only four channels. Modern units may be able to deal with 22.

Power consumption may be measured in milliwatts. For example, the FGPMMOPA6H GPS standalone module by G.top claims power consumption of 82mW during acquisition of satellite signals and 66mW while tracking subsequently. At a typical voltage of 4VDC, the chipset consumes about 20mA and approximately 17mA, respectively.

Form factor. This is the size of a chip, often determined by the dimensions of the ceramic antenna on top of it. Dimensions may be 15mm x 15mm or larger.

Update rate. The number of position measurements per second. While 1 update per second is often sufficient, some chips generate updates more rapidly. The frequency of updates is expressed in hertz.

Output type. This is often TTL-level serial providing NMEA data. The baud rate can vary and is often selectable.

Supply voltage. Often below 5VDC.

Current consumption. Higher during satellite acquisition.

How to Use It

A GPS module requires only a DC power supply, and will start outputting data as soon as it has identified satellites that are currently within range.

Data provided by a GPS module uses a rather slow and primitive plain-ASCII protocol known as NMEA, developed by the National Marine Electronics Association. Each block of data is known as a *sentence*, and can be parsed independently of previous and subsequent sentences. The default transmission rate is 4,800 bits per second, using 8 bits to identify an ASCII character, no parity, and 1 stop bit. However, some GPS modules use a serial rate of 9,600 bps or faster.

A sentence begins with a two-letter abbreviation defining the type of device employing the sentence. For a GPS device, the abbreviation is GP. The sentence continues with another abbreviation of three characters or more, describing the type of data being transmitted, so that numeric values in the sentence can be interpreted correctly.

The remainder of a sentence consists of letters and numerals in plain ASCII, with values separated by commas. A sentence cannot contain more than 80 characters. A sentence will specify the latitude, longitude, and altitude of the GPS, and a value defining the time when the readings were derived from satellite signals. Some sentence data structures are proprietary, established by the device manufacturer, and will begin with the letter P.

A GPS device may send a variety of different sentence types in succession, to overcome the 80-character sentence length limit. Each sentence will be preceded with an identifier. Sentence types and data contents will be defined in a manufacturer's datasheet.

Output from GPS chips may be compatible with a microcontroller. Output from a GPS breakout board will almost certainly be compatible, and the board is likely to have its own voltage regulator. The microcontroller can receive serial data from the GPS chip, can stop the GPS chip via its enable pin, and can start and stop internal logging of data in flash memory on the GPS chip if this feature is available.

Code libraries are available online for a microcontroller, to enable it to receive and interpret serial data from a GPS device.

Pulse per Second Output

As the GPS positioning depends on calculating distances from the time it takes for a radio signal to travel, accurate timekeeping is needed. When a GPS receiver obtains a fix for its position, it will get a value for the current time as well. This makes GPS receivers usable to supply time and frequency standards. Most receiver modules report the time together with the position. Many also provide a special PPS output, which produces one pulse per second, precisely synchronized with the satellites in view.

The accurate time provided by the GPS receiver can be used to *discipline* a crystal oscillator. This means measuring the crystal oscillator frequency relative to a GPS-provided reference, and continuously adjusting the crystal frequency to keep it stable.

What Can Go Wrong

Problems generally affect chips and modules rather than devices.

Electrostatic Discharge

The patch antenna on a GPS chip connects with the chip via an RF input. If the antenna is subjected to an electrostatic discharge, the chip can be permanently damaged. Likewise, damage will result if a discharge is applied to the RF input, for example through a soldering iron. The chip must be grounded before any work is done involving the RF input.

Failure to Ground Properly

The ground solder pad on a chip, or the ground pin on a breakout board, must make contact before voltage is applied to other pads or pins.

Cold Joints

The patch antenna on a GPS chip can function as a heat sink, increasing the risk of cold solder joints when the chip is being mounted on a board.

Restricted Availability

U.S. regulations limit the export of some GPS devices capable of rapid positional updates that could be usable in military aircraft or missiles. Other restrictions also apply. Suppliers may be inconsistent in their refusal to allow purchase of restricted items outside of the United States.

Inability to Detect Satellites

Any GPS device may fail to detect satellite signals if its view of the sky is obstructed. Reception is usually possible through window glass, but may not be available through walls, a roof, heavy tree cover, and other natural obstructions.

Exceeding Maximum Velocity or Altitude

Security regulations limit the capability of GPS devices to function above 60,000 feet or at greater than 1,200 miles per hour. Outside of these limits, the GPS device will not provide data. This may affect applications in amateur rocketry or high-altitude balloons.

magnetometer

2

This entry deals only with magnetic sensors that respond to the Earth's magnetic field. Small magnetic sensors such as the ubiquitous *Hall sensor* may be used for many other purposes, such as determining the position or rotational speed of mechanical components. These applications involve **object presence** sensing; see Chapter 3. In that entry, Hall sensors are discussed at "Hall-Effect Sensor".

In the past, a **magnetometer** was a bulky measurement device incorporating knobs or other controls and some form of display. While that use of the word is still common, this entry deals only with chip-based magnetic sensors.

OTHER RELATED COMPONENTS

- **accelerometer** (see Chapter 10)
- **gyroscope** (see Chapter 9)
- **GPS** (see Chapter 1)

What It Does

A traditional compass consists of a thin magnetized strip of metal balanced on a pivot. It aligns itself with the Earth's magnetic field.

A *scalar magnetometer* measures the total strength of a magnetic field. A *vector magnetometer* can measure the strength in a specified direction. In particular, it can provide a numeric output describing the angle between the orientation of the measuring device and the Earth's magnetic poles.

Chip-based magnetometers are usually vector-type, containing three sensors mounted orthogonally—that is, each of them at 90 degrees to the other two. Suitable software can interpret the analog readings from the sensors to calculate magnetic north or south regardless of the angle at which the instrument is being held, relative to the ground.

Schematic Symbol

There is no specific schematic symbol for a magnetometer.

IMU

A **gyroscope** measures the rate of rotation of the enclosure in which it is mounted. This is properly known as the *angular velocity*. A gyroscope will also respond to changes in the rate of rotation. It does not measure linear motion or a static angle of orientation.

An **accelerometer** measures variations in linear motion and will also measure its own static orientation relative to the force of gravity. If an accelerometer rotates around its own axis, it will not measure angular velocity.

When an accelerometer and a gyroscope are contained in the same package, optionally with a magnetometer, they may be described as an *IMU* (inertial measurement unit), which can pro-

vide necessary data to maneuver aircraft, spacecraft, and watercraft, especially when **GPS** signals are unavailable.

Applications

Magnetometers are found in handheld equipment such as digital compasses, cameras, and cellular phones. They are usually surface-mount chips that are manufactured in large quantities and may be used in conjunction with microcontrollers. For the hobby-electronics community, or for experimental product development, a magnetometer may be mounted on a breakout board for ease of use. A board using a Honeywell HMC5883L is shown in Figure 2-1.

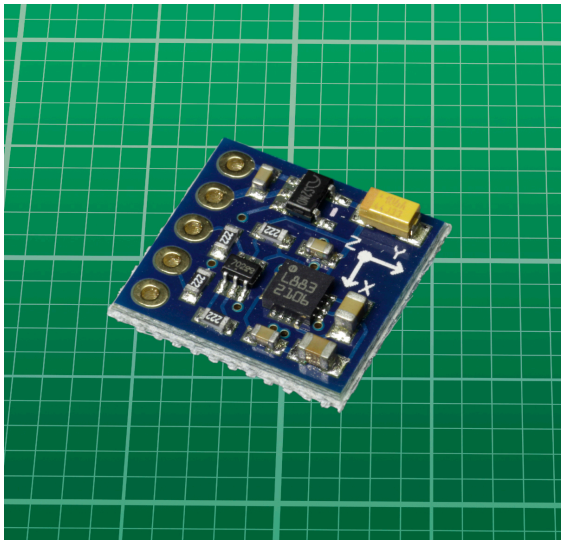

Figure 2-1 *The Honeywell HMC5883L 3-axis magnetometer mounted on a breakout board. The background grid is in millimeters.*

How It Works

An explanation of magnetometers requires an understanding of the fundamentals of magnetism.

Magnetic Fields

A magnetic field is often represented by *field lines* that show the strength and vector of the field. Field lines associated with a simple permanent magnet are shown in Figure 2-2, where the strength, or *flux density*, at any point, is indicated by the spacing the lines, while the angle tangential to a line indicates its vector. (For an extended discussion of magnetism, see **electromagnet** in Volume 1.)

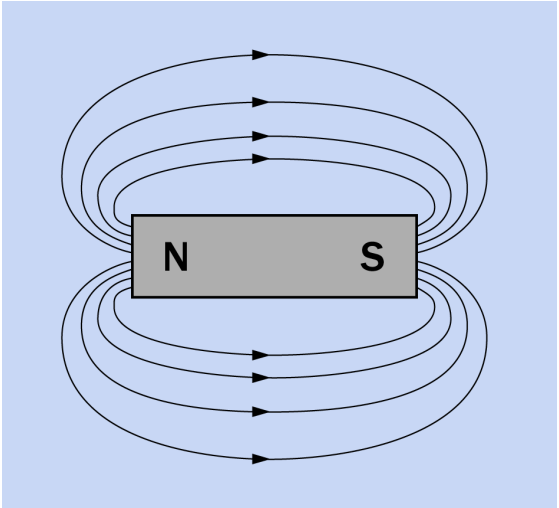

Figure 2-2 *Field lines representing magnetic flux created by a bar magnet. Space between the field lines is inversely proportional to flux density. In reality this is a three-dimensional effect, and a more accurate representation would show the magnet and field lines revolved around the axis of the magnet.*

The flux density of a magnetic field is usually represented by the letter B, and is measured in *newton-meters per ampere*, more commonly referred to as *teslas* (T). An older unit of measurement was gauss (G), 1 tesla being equivalent to 10,000 gauss. Some datasheets still refer to gauss.

The Earth's magnetic field is believed to result from convection currents in the outer liquid of the Earth's core. The strength of this field varies from 25 to 65 microteslas (0.25 to 0.65 gauss) depending on the location where it is measured. To a very rough approximation, the Earth behaves as if a giant bar magnet connects the magnetic north pole and the magnetic south pole. See Figure 2-3.

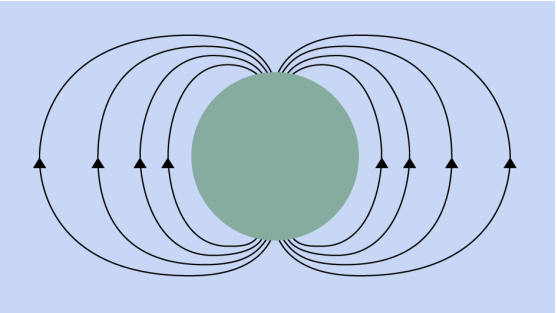

Figure 2-3 *The magnetic field of the Earth approximately resembles the field around a bar magnet.*

Note that in northern and southern latitudes, the field lines angle steeply down toward the surface, while the lines are approximately parallel with the surface near the equator. Consequently a magnetometer held tangentially to the surface of the Earth will tend to measure a stronger horizontal field near the equator than near the poles.

The varying angle of the field lines tangential to the Earth is known as their *inclination*. Variations in field strength can be used to determine an approximate location, although the **GPS** (Global Positioning System, using satellites) enables this much more accurately.

Confusion results from the fact that the nothern magnetic pole of the Earth actually behaves as a south pole, while the southern magnetic pole behaves as a north pole. That is, when a permanent magnet is free to rotate, its north pole will orient itself toward the so-called northern magnetic pole of the Earth, even though opposite poles attract. The northern pole of the Earth should therefore be thought of as the pole that attracts the north end of a compass.

Earth's Axes

Planet Earth revolves around an imaginary line referred to as the *axis of rotation*. This line is close to, but not quite coincident with, the *magnetic axis* connecting the magnetic north pole and magnetic south pole, as shown in Figure 2-4.

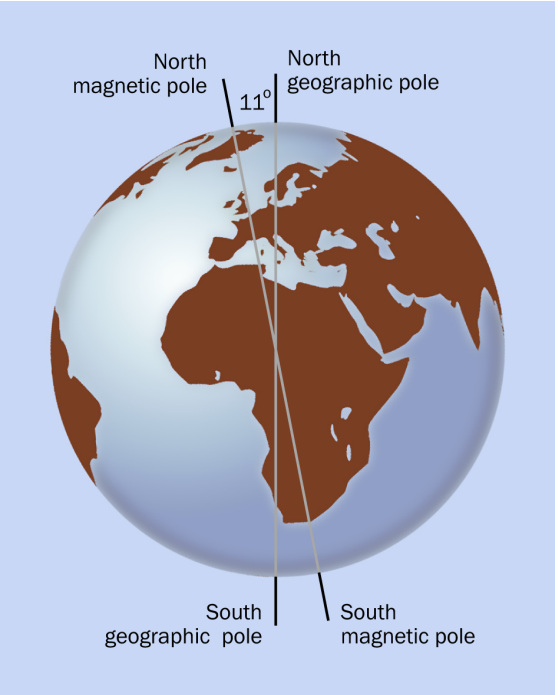

Figure 2-4 *The angle between the magnetic axis and the rotational axis of the Earth is approximately 11 degrees.*

Magnetic declination is the angle between the magnetic north pole and the geographical north pole, as perceived by an observer. This angle will vary depending on the observer's location on the surface.

Because of declination, the direction of magnetic force at points on the surface of the planet will vary with latitude and longitude, as shown in Figure 2-5. In this figure, the *magnetic meridians* are shown in red, superimposed on the *geographical meridians* shown in green. Magnetic meridians show the direction of magnetic force, while geographic meridians are drawn between the ends of the axis of rotation of the Earth. While there is an approximate correlation between the two, in some areas, especially near the north and south poles, the discrepancy can be more than 40 degrees.

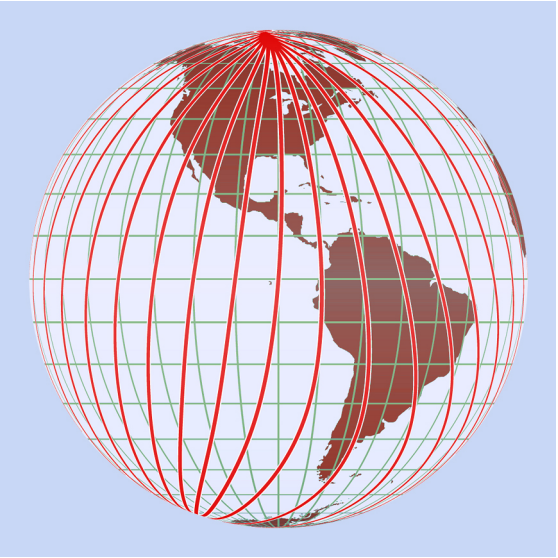

Figure 2-5 *The red lines indicate the direction in which a compass would be likely to point to magnetic north. The green lines connect the geographical poles of the planet. (From Wikimedia Commons.)*

Standard declination tables for locations on the Earth are available, and these values must be added to, or subtracted from, the reading from a compass or magnetometer to determine the direction of geographical north. Navigational systems customarily express the heading of a vehicle or vessel relative to geographical north, as shown in Figure 2-6.

Coil Magnetometer

Current flowing through a wire creates a magnetic field with flux density that is directly proportional to the current in amperes. Conversely, a changing magnetic field will induce current in a wire. This principle is used in a *coil magnetometer*, which can detect buried objects when the coil moves above them. A *rotating coil magnetometer* can determine magnetic field strength while remaining in a stationary position. However, the coil in a coil magnetometer must be relatively large.

Hall Effect and Magnetoresistance

In modern handheld devices, a magnetometer will generally use either the *Hall effect* (see "Hall-Effect Sensor") or *magnetoresistance*, described here.

Figure 2-6 *Heading is an angle usually calculated relative to geographical north, sometimes referred to as "true north."*

Magnetoresistance is a phenomenon where the resistance of a material changes fractionally when it is exposed to a magnetic field. This is capable of yielding greater accuracy than Hall-effect sensors, but has tended to be more expensive.

Orthogonally oriented sensors contained in a surface-mount chip are aligned with axes identified with letters X, Y, and Z. These sensors are analog devices whose values are converted to digital values by an onboard *analog-to-digital converter* (ADC). The values are stored in *registers* that are available to other devices, often via the *I2C* protocol, which is widely used by microcontrollers.

Typically there will be two eight-bit registers for each axis, one defining the high byte and the other defining the low byte for the digital value. In reality the ADC is likely to use 10 to 13 bits, with the remaining 6 to 3 bits being unused.

Variants

The Freescale Semiconductor FXMS3110 is a typical low-cost chip containing a 3-axis magnetometer sensor. Many chips now additionally include a 3-axis accelerometer sensor. An example is the LSM303 by STMicroelectronics, which is sold on a breakout board by Adafruit. See Figure 2-7.

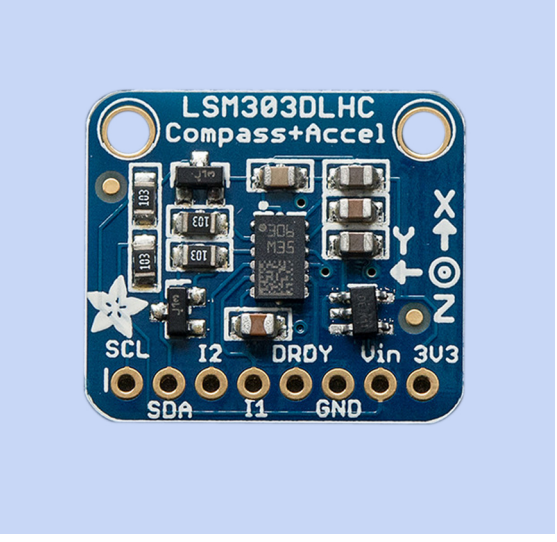

Figure 2-7 *The LSM303 is a chip manufactured by STMicroelectronics. It is shown here on a breakout board from Adafruit.*

See Chapter 10 for an explanation of the function of accelerometers.

The InvenSense MPU-9250 is a highly sophisticated IMU, including a 3-axis **gyroscope** in addition to a 3-axis magnetometer and 3-axis accelerometer.

A processing unit in the MPU-9250 reconciles the nine variables, and the digital output can be accessed via I2C or SPI protocol at speeds up to 1MHz. All functions of the chip are contained within a package measuring less than 3mm square.

See Chapter 9 for additional details about the functioning of a gyroscope.

How to Use It

A basic 3-axis magnetometer sensor such as the HMC5883L can be tested with a microcontroller that can receive data from its registers via I2C protocol. This is relatively easy with an Arduino, which was designed to be I2C-capable.

Several breakout boards are available with the HMC5883L mounted on them. Many of these boards contain a voltage regulator, allowing a 5VDC power supply to be used even though the chip is designed for a typical supply of 2.5VDC.

In addition to the power supply, the breakout board only requires two connections for I2C communication, to its SCL pin (serial clock input) and SDA pin (serial data input/output). If basic I2C software is installed on the microcontroller, it will read digital values from the magnetometer registers. If additional software is used, it will convert the values to magnetic flux densities in microteslas for the X, Y, and Z axes. Code libraries to achieve these goals are widely available online.

A more sophisticated chip such as the InvenSense MPU-9250 can be used similarly, but yields additional data for conversion. Here again, code libraries can be found online. The slightly older MPU-9150 is sold on a breakout board with downloadable code from Sparkfun.

What Can Go Wrong

Bias

Magnetometers are sensitive to their environment, which can induce *magnetometer bias* of two types.

Hard-iron bias is primarily caused by magnetized material inside the device containing the magnetometer. Because this effect is usually unvarying, compensating for it is relatively easy. *Soft-iron bias* is caused by interaction between variations in the Earth's magnetic field and

materials inside a magnetometer that can be magnetized.

A common example of soft-iron bias would be power lines, generating a magnetic field that can affect model aircraft and drones using magnetometers for navigation.

Mounting Errors

Placement of a chip-based magnetometer on a circuit board is critical. The field effects of transformers or relays must be taken into account, and even the low voltage and low current in a circuit trace can create a magnetic field sufficient to disturb a chip. No traces on any layer of the board should pass across the footprint of the chip. A magnetometer should not be mounted within a ferromagnetic case.

object presence sensor

3

An **object presence** sensor may also be described as an *object detector* or *detection sensor*.

The term **proximity** sensor may be applied to this component. However, in this Encyclopedia a proximity sensor has the capability of estimating the distance to a target. See Chapter 5. An object presence sensor merely detects whether an object is within a preset range, and does not provide additional information.

Optical and *magnetic* object-presence sensors are described and compared in this entry. *Ultrasonic sensors* are described in the entry dealing with proximity sensors, because they tend to be used for distance measurement rather than just for detection. Other methods of object presence sensing, including *capacitive*, *doppler*, *inductive*, *radar*, and *sonar*, are not included in this Encyclopedia.

A sensor that detects an object by receiving light reflected from it is categorized as a *reflective* sensor, and is included in this entry. (If a module includes a light source as well as a light sensor, it is properly categorized as *retroreflective*, although that term is not always used.)

A sensor that detects an object when it interrupts a beam of light is a *transmissive* sensor, and is included in this entry. It may also be described as a *through-beam* sensor or as an *optical switch*.

A sensor that responds to the motion of an object that emits infrared radiation is a **passive infrared** motion sensor, also described by its acronym, PIR, and often referred to simply as a *motion sensor*. It has its own separate entry. See Chapter 4.

Phototransistors and **photodiodes** may be used as sensing elements in presence sensors. These components have their own entries as light sensors. See Chapter 22 and Chapter 21.

OTHER RELATED COMPONENTS

- **proximity** sensor (see Chapter 5)
- **passive infrared** sensor (see Chapter 4)

What It Does

An **object presence** sensor verifies the presence or absence of an object within a predetermined range, without necessarily measuring how far away it is or how fast it is moving. The object may be described as a *target*.

Object presence sensing is often used to verify the correct function of an automated system—for example, the placement of objects on a conveyor belt. It can also be used to count objects as they pass a sensor.

Some types of security systems use presence sensors to sound an alarm if an intruder interrupts a beam of light. They can verify that a door or window is closed. They may also function as a limit switch to control the operation of a motor.

Schematic Symbol

In schematics, an optical presence sensor may be indicated with the symbol for an LED, plus the symbol for a **phototransistor**, with one or two arrows connecting them, as shown at top-left in Figure 3-1. Wavy-line arrows may indicate an infrared connection.

A **photodiode** may be substituted for a phototransistor, as shown at top-right in the figure.

A magnetic sensor may be shown with the symbol for a *Hall-effect sensor*, as in the lower half of Figure 3-1.

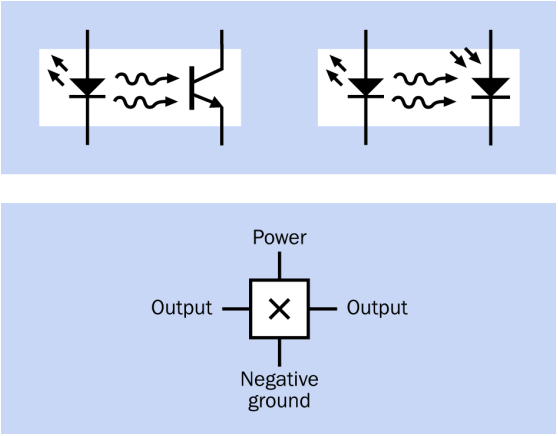

Figure 3-1 *Top: two possible schematic symbols for an optical presence sensor, using a phototransistor (left) or photodiode (right). Other variants are possible. Bottom: the schematic symbol for a Hall-effect sensor, commonly used in a magnetic sensor.*

Variants

To assist the reader in comparing different options for detecting the presence of an object, this entry includes two primary variants: *optical* and *magnetic*.

The optical sensors are divided into *transmissive* and *reflective* (including *retroreflective*). The magnetic sensors are *reed switches* and *Hall-effect sensors*. A chart showing the categories and subcategories is shown in Figure 3-2.

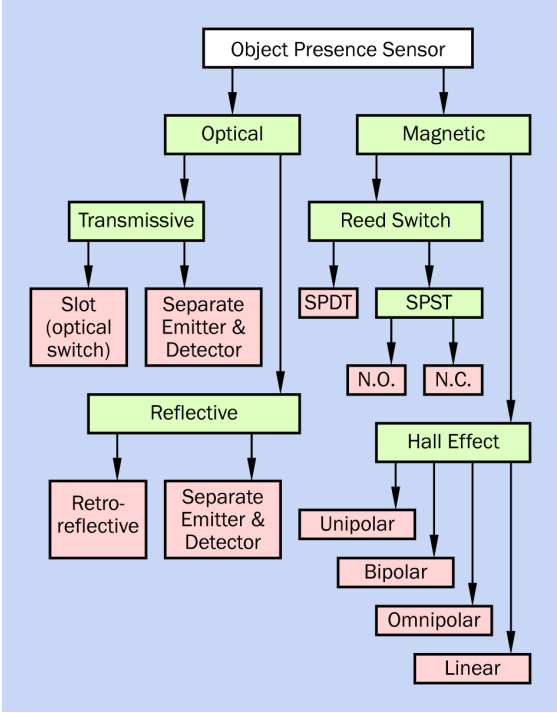

Figure 3-2 *Categories of object presence sensors discussed in this entry. Other types of object presence sensors exist, but are less common, and are not included here.*

Optical Detection

A *transmissive optical sensor*, also known as a *through-beam sensor*, is really a pair of components, one emitting light and the other receiving it. The sensor is triggered if an object

interrupts or reflects the light beam, as shown in Figure 3-3.

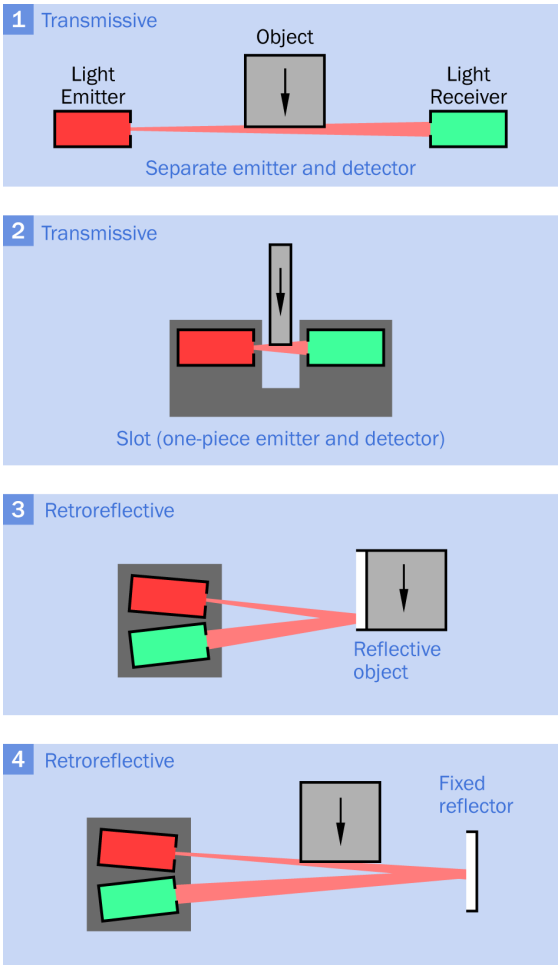

Figure 3-3 *Various configurations of optically activated object presence sensors. See text for details.*

If the light emitter and the light detector face each other across a small gap, they may be contained in a single module (usually with a slot in it) as shown in section 2 of Figure 3-3. This is often referred to as an *optical switch* (not to be confused with the solid-state switching devices used in telecommunications). It is sometimes described as a *photointerruptor* or *photointerrupter*.

A *reflective optical sensor* also consists of a light emitter and a light detector, but they are placed adjacent to each other, facing in the same general direction. When they are mounted in one module, as is often the case, the arrangement is properly known as a *retroreflective sensor*. Either way, the combination may be triggered in one of two ways:

- An object passing in front of the light beam reflects it back to the detector. The object must be naturally reflective (for example, glass containers or white boxes on a conveyor), or must have a reflective patch applied to it, or the light source must be bright enough to reflect from an object that is not highly reflective. This configuration is shown in section 3 of Figure 3-3.
- A stationary reflector can be mounted opposite the light emitter, in which case a detector beside the light emitter is triggered when an object interrupts the reflected light beam. This configuration is shown in section 4 of Figure 3-3.

Transmissive Optical Sensors

A light source and light detector may be sold as separate components in a matched pair. An example is the Vishay TCZT8020, shown in Figure 3-4. These components are small, each measuring no more than 5mm x 3mm. They are designed to be placed just a few millimeters apart. The light source is an infrared LED, while the detector is a **phototransistor** (see Chapter 22 for information about phototransistors).

The source and detector are both designed to use 5VDC. Output from the phototransistor is an open collector. Current through the collector must not exceed 50mA, and must be limited by a pullup resistor of 100 ohms or more. Current through the source must not exceed 60mA, and must be limited by an appropriate series resistor.

Details on using an open-collector output will be found in the Appendix. See Figure A-4.

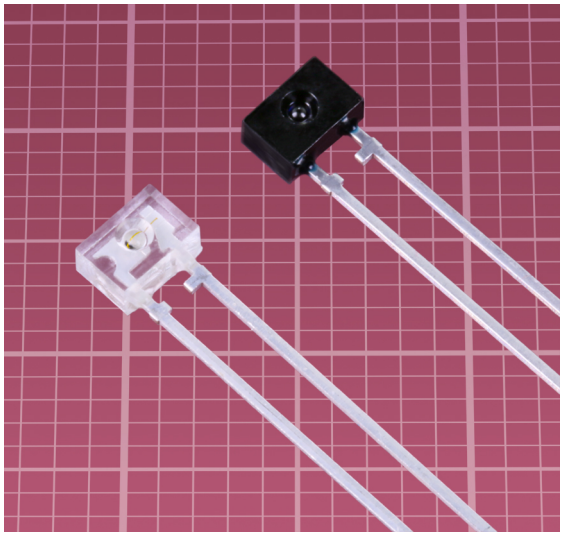

Figure 3-4 *A matched light source and light detector, for use as a transmissive optical sensor. The background grid is in millimeters.*

The Omron EE-SX range includes a variety of configurations of light source and detector separated by a 5mm slot in one module. The source is an infrared LED, and the detector is a phototransistor.

The Omron components tolerate a wide range of supply voltages, from 5VDC to 24VDC, with no series resistor necessary for the LED. Open-collector output from the phototransistor can tolerate 50mA to 100mA, depending on the particular version of the sensor. A red indicator LED is illuminated when an object blocks the slot in the sensor. Some versions have a high output when the slot is open, while others have a high output when the slot is closed. Because of their various features, these sensors are relatively expensive.

A much cheaper optical switch is the Everlight ITR9606 (described by the manufacturer as an "opto interrupter"). It is pictured in Figure 3-5. This is intended as a 5V device and has an open-collector output. It requires a series resistor for the LED and a pullup resistor for the open-collector output. Many similar detectors are available.

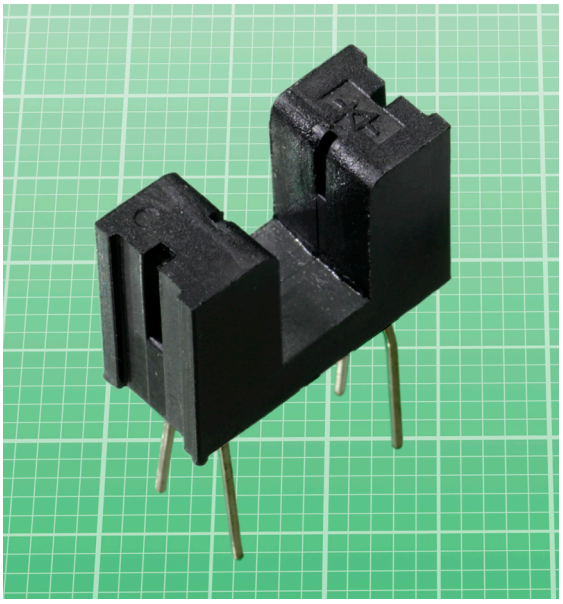

Figure 3-5 *A low-cost transmissive sensor, more commonly known as an optical switch. The background grid is in millimeters. The slot in the sensor is about 5mm wide.*

For longer-distance detection, an infrared receiver can be mounted separately from an infrared LED. The TSSP77038 from Vishay detects infrared light from as far away as 50cm, and pulls its open collector output low in response. The light must be modulated at 38kHz.

Polulo Robotics and Electronics sells a very affordable breakout board containing a TSSP77038 receiver paired with an infrared LED modulated by a 555 timer. It is shown in Figure 3-6. Because this board contains a light source as well as a light detector, it is really a retroreflective sensor.

Where distances exceeding 1 meter are involved, a laser coupled with a phototransistor that is shielded from ambient light may be necessary.

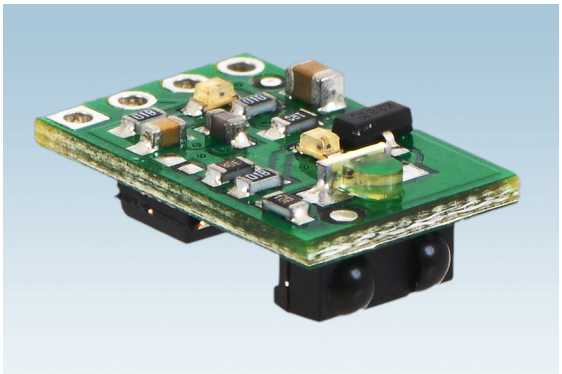

Figure 3-6 *The Vishay TSSP77038 installed with an appropriate light source on a breakout board from Polulo Robotics and Electronics.*

Retroreflective Optical Sensors

As is the case with a transmissive object detector, the retroreflective type may be listed by vendors as an *optical switch*. Other terms used in datasheets include *reflective interrupter*, *reflective object sensor*, *reflective optical sensor*, *reflective photointerrupter*, *opt-pass sensor*, and *photomicrosensor (reflective)*. The remarkable lack of standardization in terminology creates a problem when searching online for these devices. Why so many different names evolved for the exact same component is unclear.

Many retroreflective object-detection sensors are available in packages ranging from 5mm x 5mm to 10mm x 10mm in size. Almost all of these modules are analog devices using an infrared LED as the light source and a phototransistor as the sensor, with an open-collector output. (For more information about phototransistors, see Chapter 22.)

With a suitable pullup resistor, the output voltage will be proportional with the inverse of the distance. If V is the voltage, d is the distance, and k is a conversion factor:

```
V = k * ( 1 / d)
```

While many of the smaller modules are surface-mount, some have leads, as shown in Figure 3-7. A major limitation of these small components is that they have a very limited range, typically less than 5mm. They can only be used in applications such as process control where the position of a target is controlled and predictable.

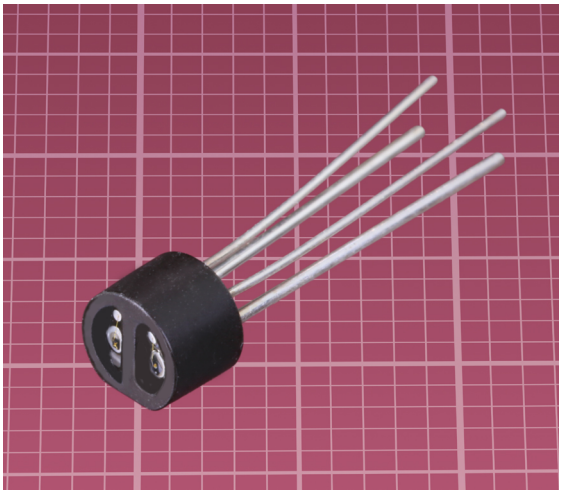

Figure 3-7 *The Rodan RT-530 is a small object-presence sensor with a limited range typical of this type of retroreflective component. The background grid is in millimeters.*

Another example of a retroreflective sensor in a small package is the Optek OPB606A shown in Figure 3-8. The background grid is in millimeters.

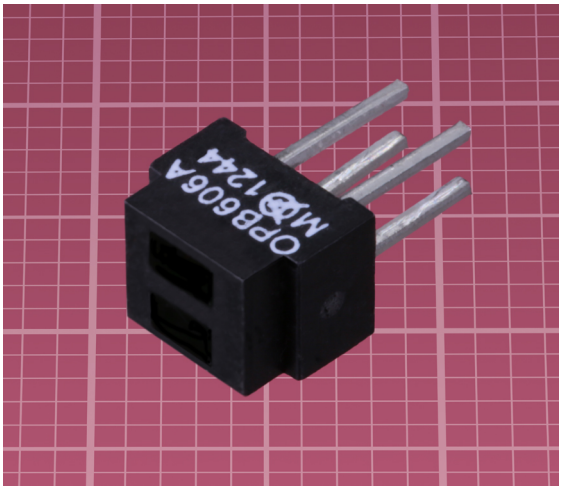

Figure 3-8 *The Optek OPB606A. The background scale is in millimeters.*

A retroreflective module, with a lensed LED and lensed phototransistor to focus the outgoing and reflected beams, is the Vishay TCRT5000 shown in Figure 3-9.

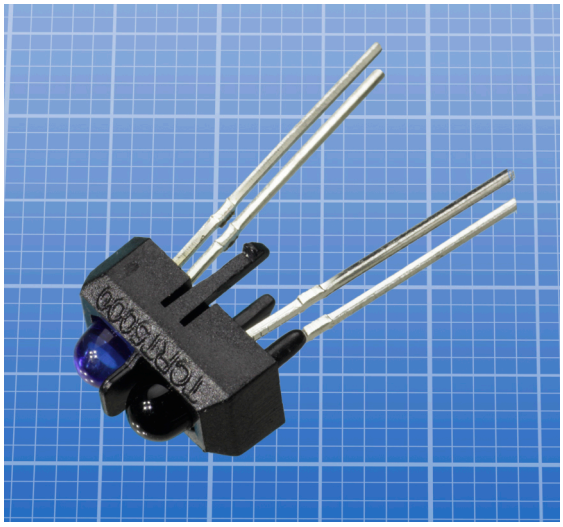

Figure 3-9 *The Vishay TCRT5000 retroreflective sensor. The background grid is in millimeters.*

Retroreflective modules that have a greater range tend to be physically larger, less common, and more expensive. Sharp makes a popular series. Some part numbers and distance sensing limits are: GP2Y0D805Z0F (5mm to 5cm), GP2Y0D810Z0F (2cm to 10cm), and GP2Y0D815Z0F (5mm to 15cm). Figure 3-10 shows the GP2Y0D810Z0F mounted on a small breakout board from Polulo Robotics and Electronics. The board is useful, as the pins on the sensor are spaced only 1.5mm apart. The size of the board is approximately 8mm x 20mm.

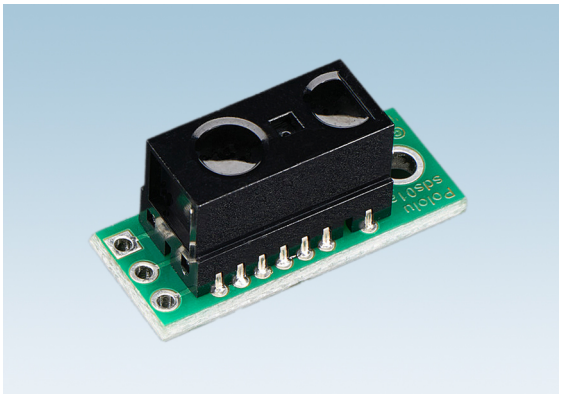

Figure 3-10 *The Sharp GP2Y0D810Z0F detection sensor mounted on a board from Polulo Robotics and Electronics. From a photograph by Adafruit Industries.*

Each of the detection sensors in this series is described in Sharp datasheets as a "Distance Measuring Sensor Unit," but in fact they do not measure distance. A single output is normally logic-high and drops to logic-low when a target is within range. Sharp refers to this as a "digital" output, but in fact it is binary, and should not be confused with the digital buffer on a more sophisticated proximity sensor that contains an analog-to-digital converter and provides a numeric output.

It is important to distinguish the Sharp object-presence sensors listed above from the range of Sharp **proximity** sensors described in the entry in Chapter 5. The proximity sensors are physically larger, and most have an analog output that varies with the distance of a target.

Magnetic Sensors

Prepackaged magnetic sensing units are sold in many configurations for industrial and military applications. Although they may be referred to as "magnetic sensors," they are outside the scope of this Encyclopedia. Here we discuss board-mounted components. Almost always, they use a *reed switch* or a *Hall-effect* sensor as their sensing elements.

Reed Switch

A reed switch is a magnetically activated mechanical switch. It consists of two metallic contacts in a small enclosure that is usually a glass capsule. The contacts are magnetic, and move in response to a magnetic field. A permanent magnet is used to activate the switch. Two reed switches are shown in Figure 3-11.

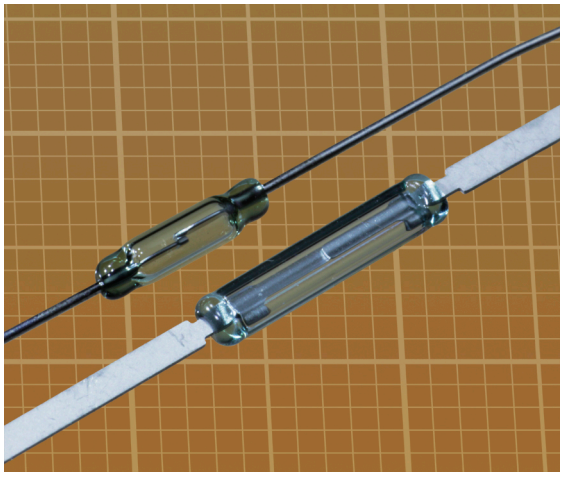

Figure 3-11 *Two SPST reed switches. Although the contacts may seem to be touching, in fact they are separated by a tiny gap, and these switches are the normally open type. The background grid is in millimeters.*

A reed switch exhibits a small amount of *hysteresis*, because the magnetic field strength required to overcome the mechanical resistance of the springy contacts is greater than the field strength required to keep them closed.

Very small electromagnetic relays that only switch a very low current may use a coil-activated reed switch. For purposes of this Encyclopedia, such a component is considered to be a relay, not a sensor. For more information about **relays**, see the entry in Volume 1.

The most common everyday application for a reed switch is in an alarm system that is triggered by an intruder entering a building. A magnet in a sealed plastic enclosure is attached to a door or window, while a reed switch, in another sealed plastic enclosure, is attached to the frame, very close to the magnet. Typical components of this type are shown in Figure 3-12. A diagram illustrating the mode of operation appears in Figure 3-13.

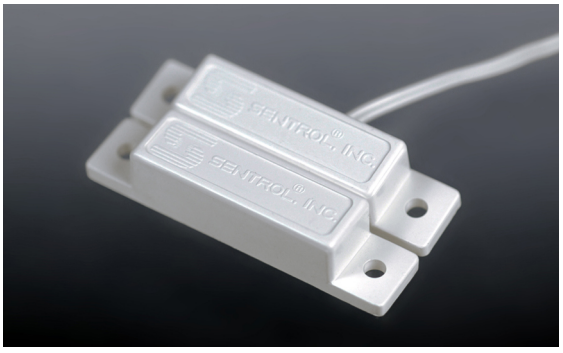

Figure 3-12 *A typical alarm sensor to detect the opening of a door or window. The nearer module contains a magnet, while the module behind it contains a reed switch.*

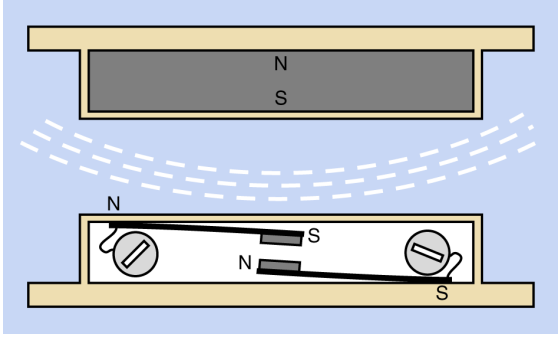

Figure 3-13 *The dashed white lines suggest the magnetic field that closes the contacts of a reed switch.*

So long as the alarmed door or window remains closed, the magnet activates the reed switch. If the door or window is opened, the magnet moves away from the reed switch, and its contacts relax. Usually in this application the reed switch is the normally open type, and is held in its closed state by the magnet. This allows multiple switches to be wired in series, completing a circuit. If a single switch opens, the circuit is broken, and an alarm is triggered.

Reed Switch Variants

Most reed switches are SPST, either normally open or normally closed, although normally

open variants are more common. Some switches are SPDT, although this variant is relatively rare. An example of a SPDT reed switch is shown in Figure 3-14.

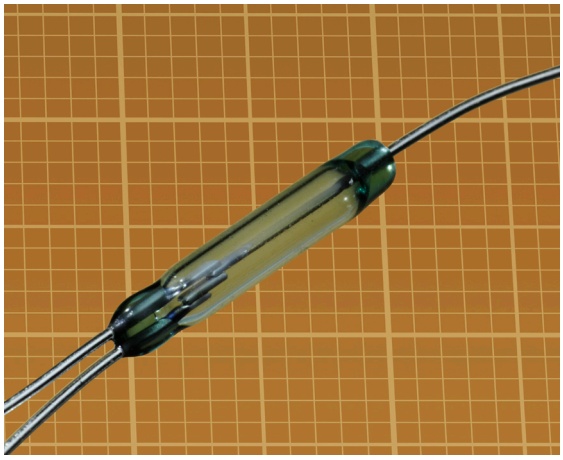

Figure 3-14 *A SPDT reed switch. The background grid is in millimeters.*

The physical size of a reed switch tends to vary roughly in proportion with its current-switching capability.

Reed switches are most commonly supplied with axial leads. A minority are available for surface-mount applications.

Some reed switches are packaged in a plastic pod to provide physical protection for the glass capsule.

Reed Switch Values

The datasheet for a reed switch is likely to contain the following values:

Pull-in: The minimum magnetic field strength required to activate the switch, often measured in ampere-turns.

Drop-out: The maximum magnetic field strength that allows the contacts of the switch to relax, often measured in ampere-turns. Pull-in will be a higher value than drop-out.

Maximum switching current: While a few industrial reed switches can switch as much as 100A, they are uncommon and expensive. A common value for a reed switch about 15mm long is 500mA.

Maximum carry current: If specified, it will be higher than the switching current.

Maximum switched power: Because a reed switch can be used with alternating current, its switching capability may be expressed in watts, or as VA (volts multiplied by amps). 10VA is a common value.

Maximum voltage: While reed switches are most often used with low voltages, some are rated to switch up to 200V.

How to Use a Reed Switch

While an optical object presence sensor may be supplied in a single package containing a light emitter and a light detector, a reed switch always requires an activating magnet that is mounted separately. For reliable operation, the maximum distance between the switch and the magnet is usually restricted to a few millimeters.

The orientation of a magnet that activates a reed switch is not crucial, but will affect the sensitivity of the switch. A manufacturer's datasheet should be consulted for information about optimal magnetic polarity.

As in other mechanical switches, the contacts in reed switches vibrate very briefly when opening or closing. This is known as *contact bounce*, and can be misintepreted as a series of separate signals by digital logic or a microcontroller. *Debouncing* with hardware designed for that purpose, or software (in a microcontroller), may be necessary. See the entry on **switches** in Volume 1.

Hall-Effect Sensor

A Hall-effect sensor responds to a magnetic field by generating a small voltage, usually amplified by a transistor included in the package with the sensor.

When a Hall sensor is in its "off" state (i.e., not triggered by a magnetic field), the sensor creates high resistance between the collector of an internal NPN transistor and negative ground. Consequently, if voltage through a pullup resistor is applied to the collector, the voltage on the collector will be high.

When the sensor is in its "on" state, the resistance drops, the voltage supplied to the collector from the pullup resistor is shunted to ground, and the output voltage appears to go low. As a general rule:

- Activated Hall sensors appear to have a low output.
- Inactive Hall sensors appear to have a high output.

Information about using open-collector outputs is contained in the Appendix. See Figure A-4.

The clean output, reliability, small size, and cheapness of Hall sensors have encouraged their use in devices as different such as hard drives, cameras, keyboards, and automobiles. They are useful in almost any situation where a sensor must detect a mechanical operation at close range. Three through-hole Hall sensors are shown in Figure 3-15. Surface-mount versions are much smaller.

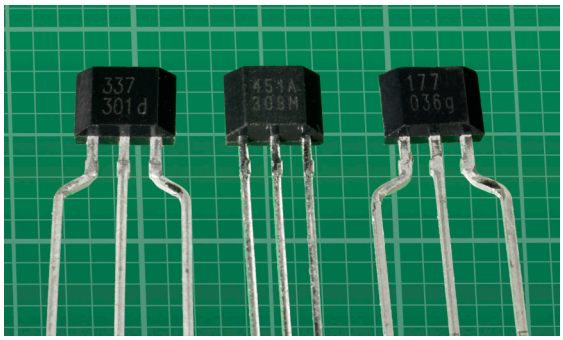

Figure 3-15 *Three through-hole Hall-effect sensors. The background grid is in millimeters.*

How a Hall-Effect Sensor Works

When current is flowing through the length of a conductor, and a magnetic field is applied across the width of the conductor, the field generates a force causing electrons and electron holes to accumulate asymmetrically on opposite sides. This is known as the *Hall effect*.

The voltage difference between the electron-rich and electron-depleted zones is known as the *Hall voltage*. It is proportional to the magnetic field, and inversely proportional to the density of free electrons in the material. For this reason, the Hall effect is easiest to observe in semiconductors, where the density of electrons or electron holes is low.

Hall sensor components contain amplifier circuitry in addition to the sensing element itself. Typically there is an open-collector output, and a comparator or Schmitt trigger to provide some hysteresis.

Hall-Effect Sensor Variants

Four primary variants of Hall sensors are widely used.

Unipolar Hall Sensor

This is activated when an external magnetic field exceeds a threshold value. When the field diminishes, the sensor switches off. Unipolar sensors are available in versions activated by the north magnetic pole or south magnetic pole.

Bipolar Hall Sensor

Proximity to one magnetic pole will switch it on. Proximity to the opposite magnetic pole will switch it off. The sensor remains in its current state (on or off) in the absence of a magnetic field.

Omnipolar Hall Sensor

Proximity to a strong magnetic field of either polarity will switch it on. Removal of the magnetic field will switch it off. An omnipolar sensor can be thought of as a pair of unipolar sensors mounted in opposite directions and

with their (open-collector) outputs wired together. This component functions similarly to a reed switch, although of course it still requires a power supply.

Linear Hall Sensor

Also known as an *analog* Hall sensor, its output voltage varies in proportion to an external magnetic field instead of switching cleanly between high and low states. When no magnetic field is detected, the output is half of the sensor's supply voltage. In response to one magnetic polarity, the output can drop almost to zero. The opposite polarity can increase the output almost to supply voltage.

The output from a linear sensor usually is supplied from the emitter of an internal NPN transistor, not the collector. A minimum 2.2K resistor should be connected between output and ground.

The variable output can be interpreted as a measurement of distance between the sensor and a magnet. In this mode, a Hall sensor functions as a **proximity** sensor. However, it is not usually capable of measuring a distance of more than 10mm.

Other Applications

Hall sensors are incorporated in other types of components. A **magnetometer**, for example, may contain Hall sensors.

Additional discussion of Hall-effect sensors, with test circuits, will be found in the book *Make: More Electronics*, from which some of the figures here have been excerpted.

Values

Magnetic field at operating point is the minimum field necessary for the output to switch on. It is measured in tesla or gauss, and the abbreviation B_{OP} is used.

Magnetic field at release point is the maximum field that allows the output to switch off. It is measured in tesla or gauss, and the abbreviation B_{RP} is used.

Magnetic field range may be specified for linear (analog) Hall sensors.

Supply voltage may range as widely as 3VDC to 20VDC, or may be restricted between 3VDC to 5.5VDC. Check datasheets carefully.

Sourcing or sinking capability for the open-collector output is typically 20mA.

How to Use a Hall-Effect Sensor

Hall sensors are often made in 3-pin packages. Through-hole variants are usually made of black plastic and look like TO-92 transistors, but are slightly smaller.

Surface-mounted variants are common.

A typical through-hole Hall sensor has one bevelled face and a flat face on the opposite side. The bevelled face may be referred to as the "front" of the component in a datasheet. The sensor responds when an appropriate magnetic pole is brought close to the front face of the sensor.

The part number printed on the front of the sensor may be abbreviated as three digits. The code below this usually refers to the date of manufacture.

A simple circuit for a Hall sensor resembles a typical circuit for a phototransistor. Positive supply voltage and negative ground are applied to two of the three leads. Positive voltage is also applied, through a pullup resistor, to the third lead, which is the open-collector output (except in the case of a linear Hall sensor, described previously). The output pin is then tapped as the output from the sensor, to be applied to a component that will not draw more than 20mA.

Configuration of Object Presence Sensors

While most of the following suggestions relate specifically to Hall-effect sensors, some general principles may be applied to optical sensors.

Linear Motion

A presence sensor can be activated when the triggering source (such as light or a magnet) approaches it directly. This is sometimes referred to as *head-on mode*. Alternatively, triggering can be arranged when the source moves past the sensor. This is sometimes referred to as *slide-by mode*. The two modes are illustrated in sections 1 and 2 of Figure 3-16.

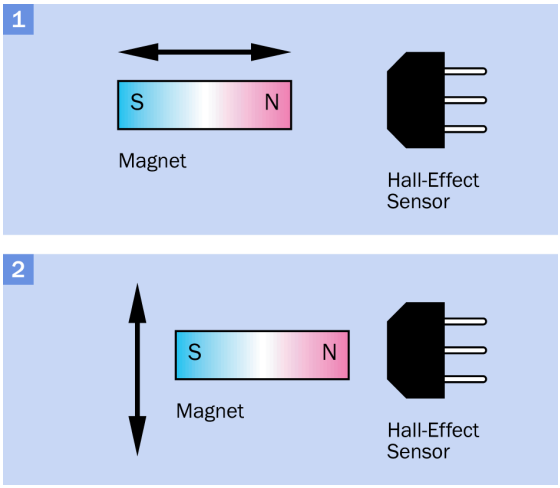

Figure 3-16 *Section 1 of this figure illustrates a presence sensor being used in head-on mode, while section 2 illustrates slide-by mode.*

Slide-by mode may be preferred because it eliminates the risk of damage to the sensor if overshoot occurs in head-on mode.

In slide-by mode, using a bipolar Hall-effect sensor, two magnets can be placed together with opposite polarity, creating a very steep transition in the overall magnetic field. This minimizes the risk of imprecise triggering. Using neodymium magnets, the triggering point can be adjusted with a precision of 0.01mm or better. See Figure 3-17.

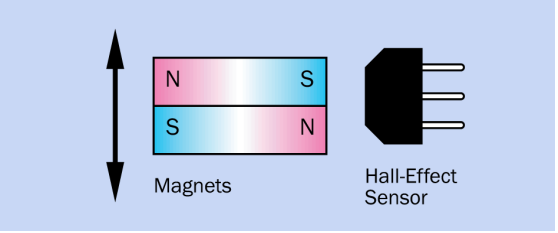

Figure 3-17 *In slide-by mode, two magnets with opposite polarity can be put together to create a very precise transition in a bipolar Hall-effect sensor.*

Sensing by Interruption

An *optointerrupter* is sensitive to an object passing between the light source and the light sensor. A comparable arrangement can be used with a Hall-effect sensor or a reed switch, but only if the interrupting object is thin and ferrous. This configuration is known as a *ferrous vane interruptor*.

Note that the magnet will exert significant force on the ferrous vane. This becomes an issue in sensors where the mechanical force is limited—for example, in paper-path sensors in a photocopy machine.

Additional information about the detection and measurement of moving objects will be found in the entry describing **linear position** sensors. See Chapter 6.

Angular Motion

One or more magnets can be used with a Hall-effect sensor to detect the angular motion, relative angular position, or absolute angular position of a rotating part. This data can be used to determine its speed of rotation. Some techniques to achieve this are described in the entry describing **rotary position** sensors. See Chapter 7.

Sensor Comparisons

Advantages of Optical Presence Sensors

- Not affected significantly by magnetic fields that can interfere with operation of a Hall-effect sensor or a reed switch.
- May be contained in a small, all-in-one package.
- Some optical sensors can operate over a distance of 50cm.
- Very well suited to sensing an object that blocks the light source (the *optointerrupter* configuration).

Disadvantages of Optical Presence Sensors

- Must have clear line-of-sight with the object and/or a reflector.
- Performance will be degraded by accumulation of dust or dirt.
- Limited lifetime of LED light source, if used continuously.
- May be accidentally triggered or impaired by some types of ambient light.
- Often requires a load resistor for the LED as well as a pullup resistor for the open-collector output.
- Range of acceptable voltage is usually narrow.

Advantages of a Reed Switch

- No polarity.
- No additional components required, other than a magnet.
- Able to switch AC or DC.
- Able to switch to voltages as high as 200V in some cases.
- Can be maintained by a magnet in open or closed state indefinitely without any power consumption.
- Many variants are capable of switching 500mA, and higher-current types are available.
- Can be activated through nonmagnetic materials (plastic, paper).
- Not significantly affected by dust or dirt that can degrade performance of an optical switch.

Disadvantages of a Reed Switch

- Requires a separate magnet (which must be placed carefully to avoid affecting other components).
- Cannot be miniaturized to the same extent as a surface-mount chip.
- Glass envelope is easily damaged.
- Arcing may occur between contacts.
- Will not work reliably when the activating magnet is more than a few millimeters from the switch.
- Can be activated accidentally by other magnetic fields.
- When sensing an object that comes between the switch and a magnet, only a ferrous object can be used.
- Must be debounced when connected with a logic chip or controller.

Advantages of a Hall Effect Sensor

- Robust solid-state component.
- Can be miniaturized for surface-mount applications.
- Very low cost.
- Fast response.
- No contact bounce.

- Extremely durable, with an almost unlimited lifetime.
- Not significantly affected by dust or dirt that can degrade performance of an optical switch.
- Low cost.

Disadvantages of a Hall Effect Sensor

- Requires a separate magnet (which must be placed carefully to avoid affecting other components).
- Open-collector output typically limited to 20mA or less.
- May be vulnerable to magnetic fields.
- When sensing an object that comes between the switch and a magnet, only a ferrous object can be used.

What Can Go Wrong

Optical Sensor Issues

Deterioration of LEDs

Most object presence sensors depend on infrared LEDs as a light source. An LED has many virtues (discussed in Volume 2), but does tend to suffer from gradual reduction in light output over a period of years. In a device such as a photocopy machine, which is used intermittently and may have an "economy" or "sleep" mode in which most of its components are powered down, LED-based detectors should last almost indefinitely. In other applications where an LED is powered continuously, its light output will diminish signicantly in 3 to 5 years. Bearing this in mind, an optical sensor should be chosen to operate well below its light-detection limits.

Object Too Close

Some optical and ultrasonic detectors triangulate on an object; that is, the light emitter and light sensor are angled slightly toward each other (as shown in sections 3 and 4 of Figure 3-3). The signal output from the sensor will peak at the distance where the emitter and sensor focus at a point. Consequently the output voltage will diminish when the object comes closer, which may create the misleading impression that the object is moving further away. To avoid spurious readings, detectors should not be used with objects that are closer than the minimum distance specified by the manufacturer.

Reed Switch Issues

Mechanical Damage

Bending the axial leads on a reed switch can easily fracture the glass envelope. Reed switches must be handled with care.

Contact Bounce

If the switch is wired to the input of a logic chip or microcontroller, contact bounce when the switch opens or closes is likely to be misinterpreted as multiple switching events. Debouncing will be necessary, either by additional components or by insertion of a momentary delay in the code embedded in a microcontroller.

Arcing

When switching high voltages or currents, an arc may be created briefly between the switch contacts, most often when they are moving from the closed to the open state. The arc erodes the contacts of the switch. Inductive loads make the arcing problem worse. If the switched voltage is kept below 5V arcing generally does not occur, extending the life of the switch.

passive infrared sensor

4

In coloquial speech, the term *motion sensor* is usually understood to mean a **passive infrared** motion sensor.

The acronym *PIR* is often used for a passive infrared sensor. It is always capitalized, without periods.

Object presence sensors and **proximity** sensors require an active source of a magnetic field, ultrasound, or infrared radiation. A passive infrared sensor does not require any such source, and responds passively to heat radiated from the object that is being detected.

OTHER RELATED COMPONENTS

- **object presence** sensor (see Chapter 3)
- **proximity** sensor (see Chapter 5)

What It Does

A **passive infrared** motion sensor, often described as a *PIR*, detects *black-body radiation*, which all objects emit as a function of their temperature relative to absolute zero. The sensor responds to infrared radiation centered around a wavelength of 10µm (10 microns, or 10,000nm). This is the approximate body temperature of people and animals.

The word "passive" in the term "passive infrared" refers to the behavior of the detector, which receives infrared radiation passively. **Proximity** sensors must generate their own infrared radiation actively, which is interrupted or reflected by nearby objects. See Chapter 5.

Schematic Symbols

Schematic symbols that are sometimes used to represent a passive infrared motion sensor are shown in Figure 4-1.

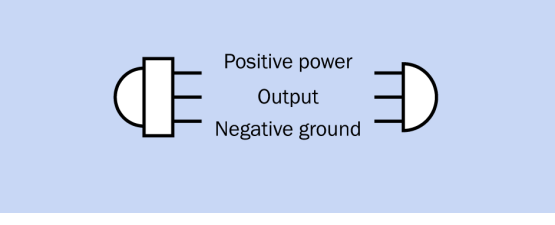

Figure 4-1 *Schematic symbols that may represent a passive infrared motion sensor. The orientation (pointing left or right) is arbitary. The pin sequence may vary.*

Applications

Motion-sensitive outdoor lighting almost always is based around a PIR. Similarly, a security system may sound an alarm or activate a video camera when a PIR indicates human activity.

Wildlife monitoring systems use PIRs to start a video camera that can then run for a preset interval.

Warning systems for automobiles have been developed that use a rear-facing PIR to detect pedestrians.

Industrial indoor lighting may use PIRs that switch the lights on automatically when people enter a room, and then switch the lights off (after a timed delay) when people are no longer detected in the room. The goal is to prevent wastage of energy as a result of employees forgetting to switch the lights off.

How It Works

A PIR module contains multiple components. Most visible is an array of at least 15 small lenses that focus infrared light from zones in the environment onto a *pyroelectric detector*, also known as a *pyroelectric sensor*. The response of the detector is processed by an amplifier, so that the signal can trigger an electromechanical **relay** or **solid-state relay** (see Volume 2). The relay operates an external device such as a light or an alarm.

Additional circuitry may allow the user to control the sensitivity of the PIR module and the length of time that the relay remains closed. The user may also be able to set the time of day when the PIR is active, or an additional **phototransistor** can shut down the PIR during daylight hours. If a phototransistor is included, its sensitivity is adjustable. For more information about phototransistors, see Chapter 22.

Pyroelectric Detector

The pyroelectric detector is actually a type of *piezoelectric* device. It is based around a wafer of lithium tantalate, which generates a small voltage in response to incident thermal radiation. However, like other piezoelectric components, it does not respond to a steady-state input, and must be activated by a transition. This distinguishes it from other types of light sensors, such as an infrared **photodiode**, in which the response is consistently related to a temperature input.

The response of a pyroelectric detector is suggested by the graphs in Figure 4-2.

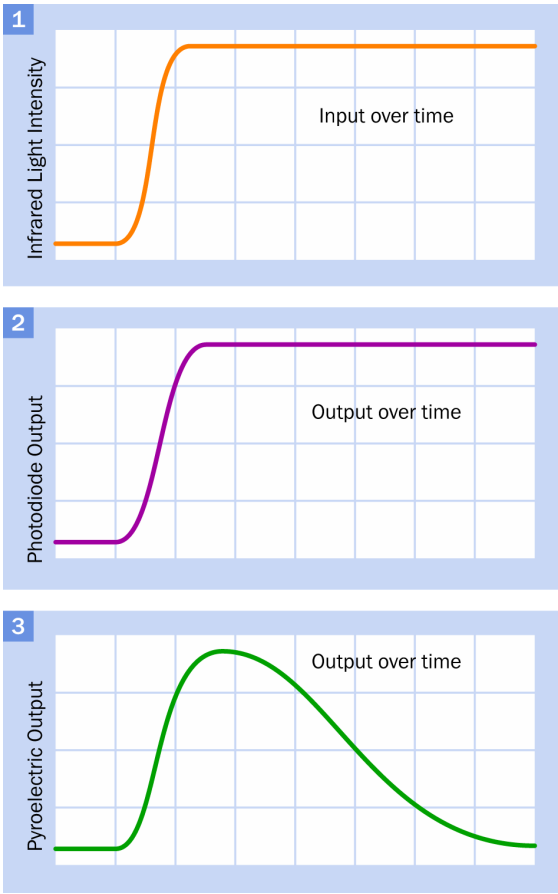

Figure 4-2 *Top: incident infrared light intensity. Center: the voltage output from a hypothetical photodiode. Bottom: the voltage output from a hypothetical pyroelectric detector.*

A pyroelectric detector in a PIR module is mounted in a sealed metallic container, as shown in Figure 4-3. The rectangular window in the detector is usually made of silicon, which is opaque to visible wavelengths but transparent to long-wave infrared radiation.

Elements

The pyroelectric detector used in a PIR contains at least two *elements* with opposite polarities, connected in series. If a sudden change in temperature affects both elements equally, their

responses will cancel each other out. Thus, the detector ignores changes in ambient temperature. However, if a source of infrared radiation in the appropriate waveband affects one element before the other, the detector will emit two pulses of opposite polarity. See Figure 4-4.

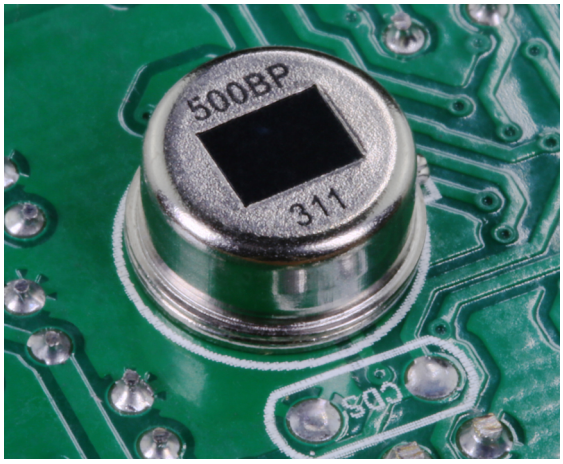

Figure 4-3 *A pyroelectric detector mounted on a small circuit board in a passive infrared radiation sensor.*

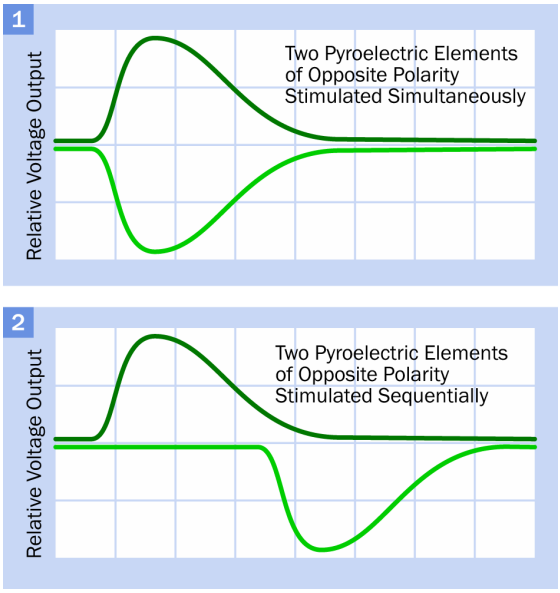

Figure 4-4 *Top: in a pyroelectric detector, if a change in temperature affects two elements of opposite polarity simultaneously, their voltages cancel each other out. Bottom: if one element is triggered before the other, the detector emits a signal.*

Lenses

Lenses are used to trigger the elements sequentially. Each lens faces toward one visible zone in the target area. When a source of infrared radiation moves from one zone to the next, it energizes the elements alternately, creating an output.

In some PIRs, four pyroelectric elements are used instead of two, to provide better coverage. The pairs of sensors may be wired in series or in parallel, but the principle remains the same.

The lenses are molded into a polyethylene dome that is often white and covers the pyroelectric detector. The dome appears smooth on the outside, but fine patterns of concentric ridges are molded on the inside. These are *fresnel lenses*, which are much cheaper, smaller, lighter, and easier to fabricate than conventional optical lenses. A fresnel lens introduces some distortion and aberration, but these defects are unimportant in a PIR.

Figure 4-5 illustrates the principle of a simple fresnel lens. The first section of this figure shows a conventional optical lens with one flat side and one curved side. A distant object emits almost-parallel beams of infrared light that are focused by the lens. Section 2 shows the same lens divided into segments that are stacked with no space between them. They behave in exactly the same way as the original lens. In section 3, each segment has been reduced in width, but because the optical faces still have the same geometry, they will still have the same function, although a small amount of distortion will be added by the reduction in width. This is a fresnel lens, which found an early application in lighthouses, where it greatly reduced the weight of very large glass lenses that focused the beam.

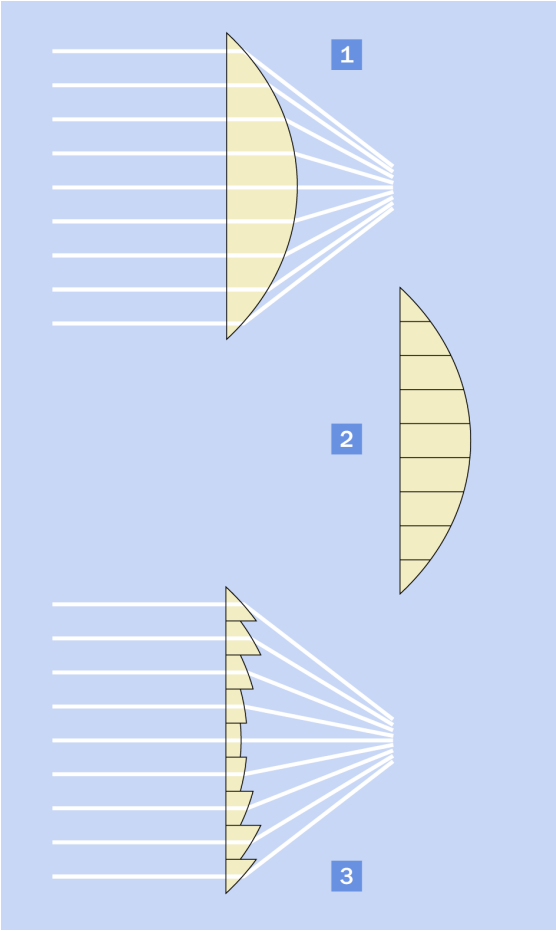

Figure 4-5 *Principle of a fresnel lens. See text for details.*

The same principle can be applied to a lens in which both surfaces are curved, as shown in Figure 4-6. In practice this will introduce more imperfections in the image, although some compensation is possible by adjusting the exact shape of the lens.

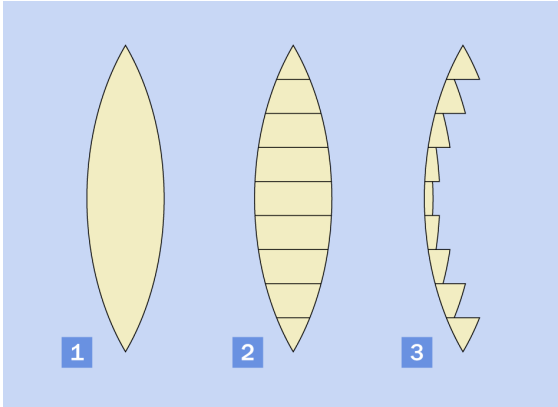

Figure 4-6 *The principle of a fresnel lens applied to a conventional lens in which both surfaces are curved.*

Figure 4-7 shows three curved fresnel lenses placed edge-to-edge, seen from above. In section 1 of this figure, infrared rays from a distant source are focused by the first lens onto the right-hand element of a pyroelectric sensor. In section 2, the external source has moved laterally, and the rays now focus on the left-hand element. In section 3, the source has moved into the zone covered by the centrally located fresnel lens, which focuses on the right-hand element again. The fluctuating inputs will trigger the sensor.

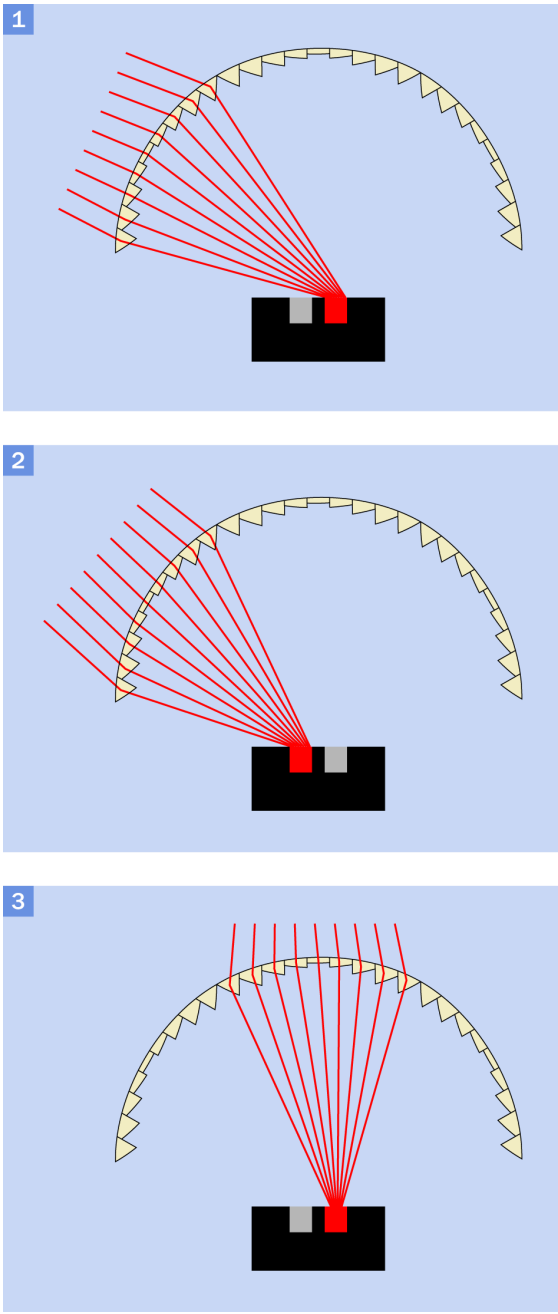

Figure 4-7 *Sections 1, 2, and 3 show fresnel lenses focusing an external source of infrared radiation on individual elements of a pyroelectric sensor.*

PIRs may combine fresnel lenses in a variety of patterns. Figure 4-8 shows an evenly weighted mosaic that would be suitable for a motion detector mounted on a ceiling, facing directly downward. Figure 4-9 shows a pattern weighted toward lateral motion, providing less sensitivity for motion above and below the primary band.

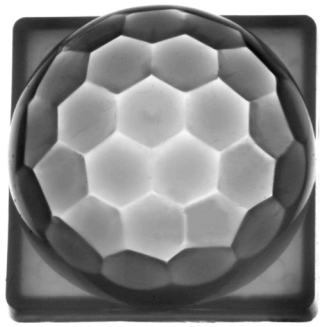

Figure 4-8 *An evenly weighted mosaic of fresnel lenses.*

Figure 4-9 *A mosaic weighted more toward sensing lateral motion. The grooves of the fresnel lenses are visible.*

Variants

PIR sensor modules are available mounted on a small board such as the one shown in Figure 4-10 from Parallax, Inc. The detection range is 5 to 10 meters, selected by a jumper on the board. The three pins visible in the photograph are for power supply (3VDC to 6VDC), ground, and output. The output can source up to 23mA with a 5VDC power supply. Power consumption of the module is only 130µA when it is idle, or 3mA when it is active but has no load.

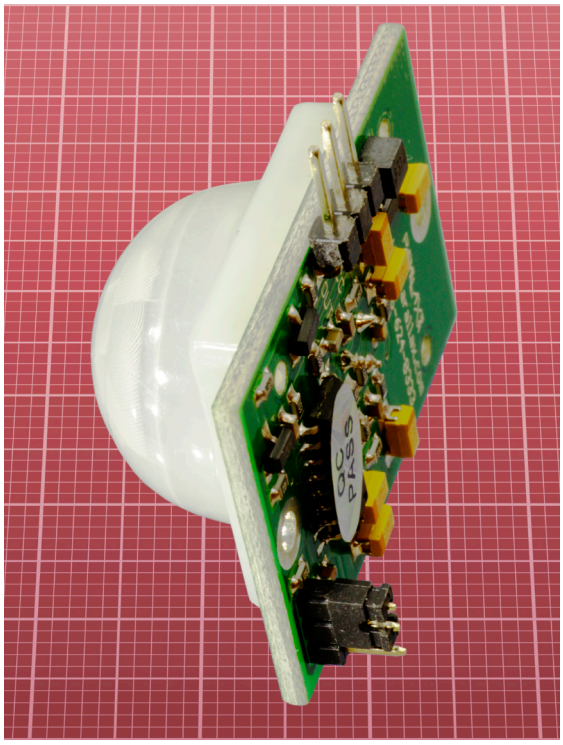

Figure 4-10 *A passive infrared detector mounted with basic necessary components on a small board.*

A board of this type still requires additional components to set the "on" time for a light or alarm, and to deactivate the PIR during daylight hours.

Various lens patterns are available, sold separately.

A PIR can be bought as a single component containing two elements and FET transistors to amplify the signal. Surface-mount and through-hole versions are available, requiring a typical power supply of 3VDC to 15VDC.

However, a PIR bought as a "bare" component requires significant external circuitry, using comparators or op-amps. Circuit design is non-trivial, entailing practical problems such as op-amps being sensitive to voltage spikes caused by activating a relay that shares the same power supply.

An easier alternative is an all-in-one detector, lens, and control circuit such as the Panasonic AMN31111, which is ready for board mounting. Its small output current of 100µA would be capable of activating a solid-state relay. Similar Panasonic PIRs offer a variety of ranges, sensitivities, and supply voltages.

The AMN31111 is in Panasonic's AMN series. There are many type numbers for combinations of analog or digital output, lens shape, and black or white lens. A selection of lens shapes, derived from the manufacturer's datasheet, is shown in Figure 4-11.

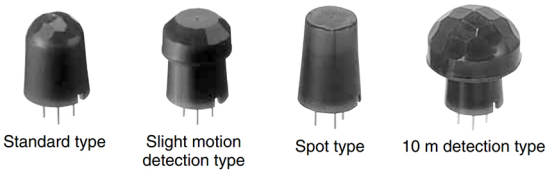

Figure 4-11 *Four lenses from the Panasonic AMN series of passive infrared sensors.*

What Can Go Wrong

Temperature Sensitivity

In warmer weather, objects in the field of view of a PIR will tend to be warmer, and the temperature difference between them and human skin will diminish. This can degrade the performance of a PIR.

Detector Window Vulnerability

The silicon window on a detector is vulnerable to dirt or grease. Avoid touching the component if it is not protected by lenses.

Moisture Vulnerability

Water absorbs far-infrared light. Consequently, condensation on the lens or detector can degrade performance, and a PIR may not function in heavy rain or snow.

proximity sensor

5

Proximity sensors that use infrared, ultrasound, and capacitance are described here. This Encyclopedia does not include proximity sensors that use magnetism, inductance, or other methods of determining distance.

Sometimes proximity sensors are referred to as *distance sensors*. An ultrasonic proximity sensor may be described as a *range finder* or a *ranger*.

High-end ultrasound proximity sensors sold as large, sealed modules with cabling can monitor the status of industrial processes. These commercial units are outside the scope of the Encyclopedia.

A sensor that detects whether an object is present, but does not measure the distance to it, is considered to be an **object presence** sensor and has its own separate entry. See Chapter 3. Many devices that are sold as proximity sensors or distance sensors actually do not provide meaningful distance data, and therefore in this Encyclopedia they are included with presence sensors.

Phototransistors and **photodiodes** may be used as sensing elements in proximity sensors. These components have their own entries as light sensors. See Chapter 22 and Chapter 21.

OTHER RELATED COMPONENTS

- **object presence** sensor (see Chapter 3)
- **passive infrared** sensor (see Chapter 4)

What It Does

A proximity sensor measures the distance between itself and a physical object that is often described as the *target*. The output from the sensor may be analog (voltage), serial data, or pulse-width modulation. It may be transmitted via a serial protocol such as SPI, TTL, or I2C, and may be stored as digital data in a register that is accessed by a microcontroller, using I2C. For additional details about protocol, see Appendix A.

Schematic Symbols

Either of the schematic symbols in Figure 5-1 may represent a proximity sensor, but are not used consistently. The sensor may also be represented as a rectangle containing text describing its function.

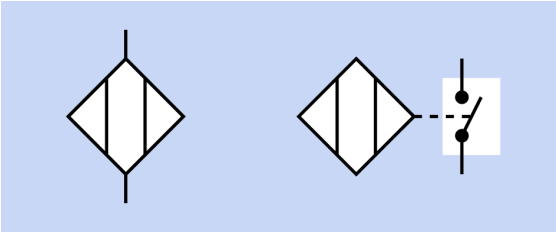

Figure 5-1 *Two ways to represent a proximity sensor in a schematic.*

Applications

In robotics, a proximity sensor can prevent a collision between a robot and an object or barrier in front of it. Some sophisticated proximity sensors can provide sufficient data for software to map the entire environment, but are outside the scope of this entry.

Proximity sensors can also be used in alarm systems, or for liquid-level sensing in storage tanks, or in automobiles to sound a warning if the driver is backing into an obstacle (although these devices are being augmented with rear-view video monitors).

In handheld devices, proximity sensors are used to sense the presence of the user's hand or face —for example, to shut down the display when a person raises a phone to talk into it.

Variants

This entry is subdivided to describe proximity sensors that use ultrasound, infrared light, and capacitance.

Ultrasound

An ultrasonic proximity sensor functions by emitting a short burst of sound and then listening for echoes from objects in front of it.

The sound is created by a **piezoelectric transducer** (see Volume 2) at a frequency between 30kHz and 50kHz, well above the range that can be detected by the human ear. The transducer may do dual duty as a microphone, sending and receiving sound on an alternating basis; or a second transducer, serving as a microphone, may be mounted beside the emitter on a small circuit board. The economically priced HC-SR04 is an ultrasound proximity detector popular in the robotics community, working reliably in the range of 2cm to 5m.

A board on which the sensor is mounted may include a microcontroller to measure the delay between propagation of a pulse and reception of the echo. Distance to the reflecting object is then calculated using the speed of sound in air at sea level, which is approximately 340 meters per second.

Infrared

An infrared proximity sensor requires a beam of infrared light from an LED that may be incorporated in the sensing module or mounted separately. Light reflects from the target and is detected by a **phototransistor** or **photodiode**. From the angle of the reflected light, onboard electronics can calculate the distance to the target by a process known as *triangulation*. See Figure 5-2. (This diagram is simplified. An actual sensor may use a linear array of photodiodes to assess the angle of the returning light beam.)

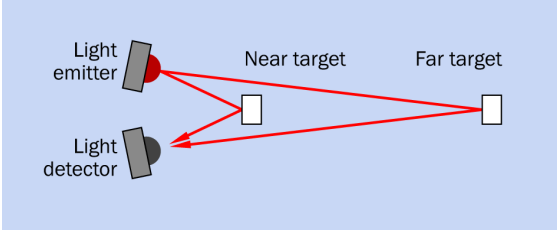

Figure 5-2 *An infrared proximity sensor determines the distance to an object by assessing the angle of reflected light.*

To reduce the risk of false positives, light from the LED contains only a narrow range of infrared wavelengths. Also, it is modulated at a frequency recognized by sensing circuitry in the module.

Relative Advantages

Ultrasound Devices

- Generally more suitable for detecting objects that are more than 1 meter away.
- Unaffected by direct sunlight, fluorescent tubes, and other light sources that can interfere with infrared devices.
- More accurate, often capable of placing objects within 5mm.
- Able to measure the distance to liquids and transparent objects, which may not be easily detected with infrared.

Infrared Devices

- Physically smaller—especially surface-mount versions.
- Able to measure the distance to soft objects, which may not be easily detected by ultrasound.
- More appropriate for targets that are closer than 10mm.
- More affordable.

Ultrasonic Examples

The proximity sensor in Figure 5-3 is a low-priced model, popular in the robotics community. Manufactured by MaxSonar, it uses a single element to send and receive. The manufacturer claims that it can detect a 6mm (quarter-inch) dowel 1.8 meters directly in front of it, and a 9cm dowel at 3.3 meters. This performance is beyond the capability of almost all infrared sensors.

MaxSonar offers a variety of sensors that appear physically very similar but have different range capabilities. Each has three outputs that can be accessed simultaneously: serial data at 9,600bps, analog voltage, and pulse-width modulation.

Figure 5-3 *The MaxSonar MB1003 can detect large solid objects as far away as 5 meters. Photo derived from an image by Adafruit.*

The serial output uses the RS232 protocol and consists of the letter R followed by four ASCII-coded numerals representing the measured range in millimeters. Thus, R1000 would indicate an object at 1 meter distance.

The analog voltage ranges linearly from 293mV when sensing an object at 300mm to 4,885mV for an object at 5,000mm.

The pulse-width output sends pulses ranging from 300µs indicating an object 300mm away to 5,000µs indicating an object 5 meters away.

The unit incorporates a temperature sensor that compensates for the lower density of air when its temperature increases. Weatherproofed versions are available. The power supply is 5VDC and must be smoothed.

Imports

Some international sources offer minimal paired ultrasound components at a very low price, such as the HC-SR04 from Cytron Technologies in Malaysia. See Figure 5-4.

Sound dispersion of the transducer is claimed to be plus-or-minus 15 degrees, and the claimed range is up to 4 meters. The module requires a triggering input pulse that must last at least 10µs. This prompts it to emit eight rapid

ultrasound signals at 40kHz. The module measures the response time and applies a high state to its echo pin for a duration that is proportional with the distance measured. An external microcontroller must time the duration, then divide by a factor of 58 to obtain distance in centimeters.

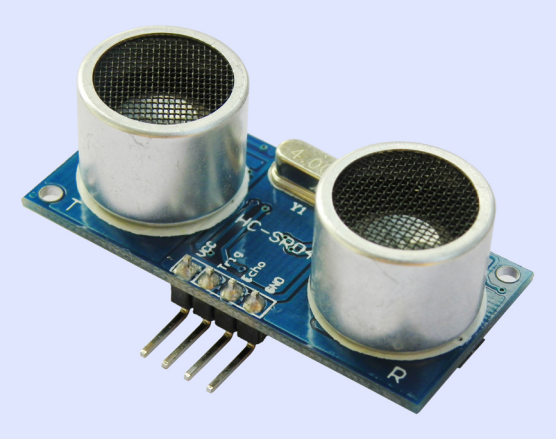

Figure 5-4 *The HC-SR04 is a very low-cost import that can provide acceptable performance when used with an external microcontroller.*

Many online sources offer simple code libraries for Arduino or PICAXE microcontrollers for use in conjunction with the HC-SR04.

Individual Elements

Individual ultrasonic components such as those shown in Figure 5-5 are available from many vendors. The user must add circuitry to generate a high frequency for a short duration, amplify the microphone signal, measure the time difference, and calculate distance.

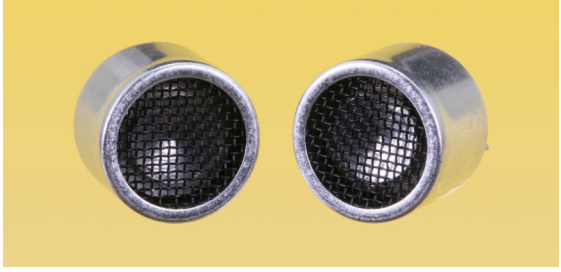

Figure 5-5 *These components, listed as the "40TR12B-R ultrasonic sensor kit" by the online supplier Jameco, could form the basis of a DIY ultrasonic proximity sensor.*

Infrared Examples

Sharp manufactures four infrared proximity sensors that are widely regarded as accurate and easy to use. They are popular in the robotics community. Their part numbers and ranges are:

- GP2Y0A51SK0F (20mm to 150mm)
- GP2Y0A21YK0F (10cm to 80cm)
- GP2Y0A02YK0F (20cm to 150cm)
- GP2Y0A60SZLF (10cm to 150cm).

The GP2Y0A60SZLF is the most recent product, with the most impressive specification. The GP2Y0A21YK0F is shown in Figure 5-6.

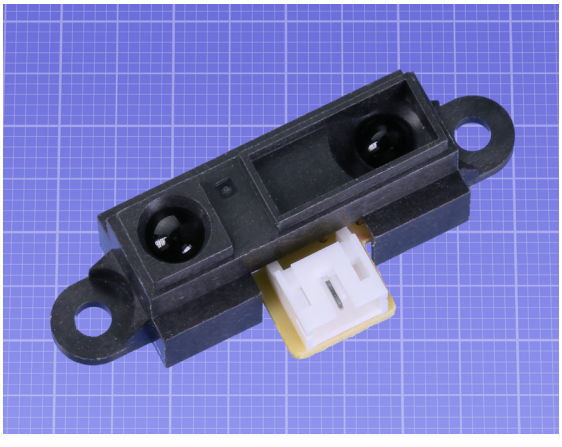

Figure 5-6 *The Sharp GP2Y0A21YK0F infrared proximity sensor. The background grid is in millimeters.*

Sharp describes these sensors as having an *analog output*. The voltage on an output pin varies in inverse proportion with the distance being measured. The relationship is illustrated by the graph in Figure 5-7, derived from the manufacturer's datasheet for model GP2Y0A02YK0F.

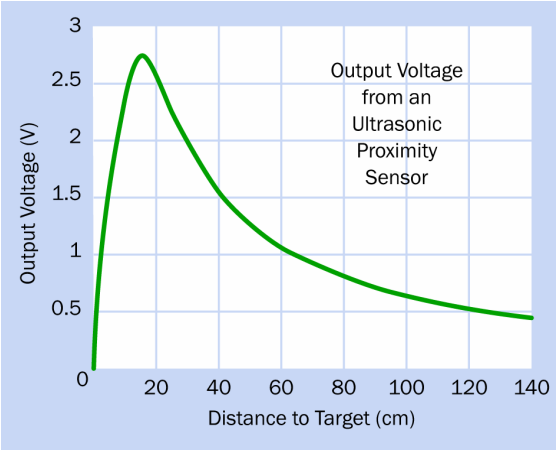

Figure 5-7 *Relationship between output voltage and target distance for a Sharp infrared proximity sensor, derived from the manufacturer's datasheet.*

The Sharp sensors can work with 5VDC. They consume around 30mA, except for the GP2Y0A60SZLF, which uses less current. Because the infrared LED functions in bursts, the manufacturer recommends protecting other components sharing the power supply by placing a 10µF capacitor across the sensor supply pins.

Trends in Infrared Proximity Sensing

Like many other types of sensors, proximity sensors have been affected by the huge market for handheld devices.

Handheld applications have had four consequences:

Miniaturization

Infrared proximity sensors are now commonly found in surface-mount chips measuring 5mm × 3mm or smaller.

Onboard processing

The status of a photodiode can be processed by a microcontroller on the same chip, to determine what the sensor is really "seeing." Input from an included ambient light sensor is factored into the evaluation.

Cost reduction

While chip-based proximity sensors have become increasingly sophisticated, their unit cost has plummeted, so that they are now actually much cheaper than simpler devices such as the Sharp analog sensors described above.

Complexity

Modern sensors must be programmed with a complex variety of instructions, and their coded output must be interpreted with a separate microcontroller running its own program. Whether this compensates for the low price and added functionality is something for the individual developer or experimenter to decide.

The Silicon Labs Si1145/46/47 series are chips with the kind of sophisticated capabilities required for handheld devices. An external microcontroller communicates with the sensor via an I2C connection, and can instruct it to adjust its distance range (from 1cm to more than 50cm), its analog-to-digital conversion sensitivity, and its current-sinking capability for up to 3 external LEDs. The chip incorporates ultraviolet sensing and ambient-light sensing capability. Its I2C connection can run at up to 3.4Mbps. Because its light output is pulsed for only 25.6µs every 800ms at 180mA, the average power consumption is only 9µA, assuming a supply voltage of 3.3VDC.

For additional details about protocols such as I2C, see Appendix A.

In addition to its use in handheld devices, the manufacturer suggests applications including heart-rate monitoring, pulse oximetry, and display backlighting control. These applications

require only a subset of the features built into the sensor, but its price is so low, it may be cost-effective even when many of its capabilities are unused.

Proximity sensors with comparable specifications are available from many manufacturers. Examples are the Vishay VCNL4040 and the Avago HSDL-9100. Figure 5-8 shows the Silicon Labs SI1145 on the left, and the Avago HSDL-9100 on the right.

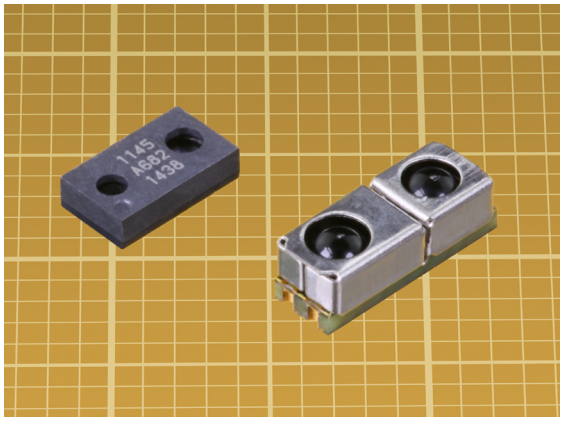

Figure 5-8 *Two sophisticated surface-mount proximity sensors with digital output. Left: Silicon Labs SI1145. Right: Avago HSDL-9100. The background grid is in millimeters.*

Several guidelines must be observed when using this kind of sensor. First and most obviously, if an external LED is used, it must have a peak wavelength compatible with the photodiode in the sensor. The LED must be placed as near as possible to the photodiode, as reducing the separation increases the sensitivity; but crosstalk between the photodiode and LED must be minimized, usually by placing a thin barrier between them that is barely taller than the higher component.

If the light emitter and/or light sensor are protected behind a transparent glass or plastic panel, it must have minimal resistance to infrared wavelengths, and its thickness must be chosen in compliance with guidelines in the sensor datasheet. To prevent light from reaching the sensor by reflection from the rear of the panel, a thin, opaque tube can be installed between the LED and the panel.

A sensor of this type may be configurable with a "detection scheme," meaning high and low sensing threshold levels appropriate to the object that is likely to be detected. Determining this may be a process of trial and error.

Capacitive Displacement Sensor

This is also known as a *capacitive linear displacement sensor*. It should not be confused with a capacitive **single touch** sensor, a human-input device that has its own entry. See Chapter 13.

A **capacitive displacement** sensor measures the distance between itself and a target that must be electrically conductive. Unlike optical or ultrasound position sensors, no additional source of light, sound, or other radiation is required. Unlike a magnetic position sensor, it does not require a separate permanent magnet. It simply measures its electrical capacitance with the target.

High-precision capacitive displacement sensors are used mainly for industrial process management. Lower-precision variants are much less expensive and can be used as **object presence** sensors to determine if an object is anywhere within a specified range.

A typical maximum range would be 10mm. For larger distances, optical and ultrasound sensors are more appropriate.

A selection of cylindrical sensor probes is shown in Figure 5-9.

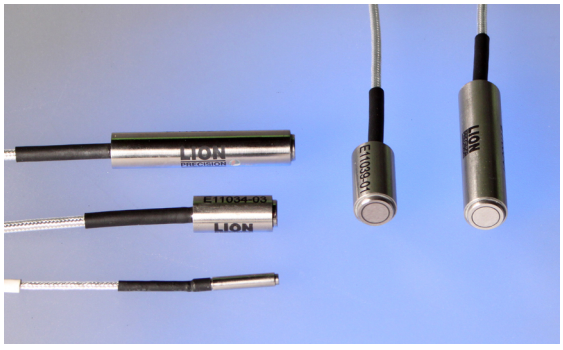

Figure 5-9 *Some high-precision capacitive displacement sensors from Lion, which builds them into cylindrical probes ranging from 3mm to 18mm in diameter.*

Applications

The high-precision variant of this type of sensor is commonly used during the production of small devices, such as disk drives. It can also measure vibration of a rotating metal part, such as a motor shaft, and may maintain automatic focus of a microscope.

Lower-precision variants can be used for applications such as counting objects on a conveyor.

When used to measure materials thickness, the sensor finds applications in checking automobile brake rotor fabrication and the thickness of silicon wafers.

How It Works

When two plates of electrically conductive material are placed opposite each other, they possess capacitance. This means that they have an electrical storage capacity enabled by accumulation of opposite charges on each plate.

The capacity is directly proportional to the plate area, inversely proportional to the distance between the plates, and is affected by the medium separating the plates, known as the *dielectric*.

If the plate area and dielectric remain constant, the distance between the plates will be the only factor affecting the capacitance. Therefore, the distance between the plates can be calculated by measuring the capacitance.

Measurement can be performed by evaluating the *displacement current* that passes through the dielectric from one plate to another when a pulse of voltage is applied. (Hence the term "capacitive displacement" in the name of this type of sensor.)

A detailed explanation of displacement current is included in the second edition of *Make: Electronics*.

The sensor itself functions as one plate of the capacitor while the target functions as the opposite plate. Alternating current is applied as a rapid series of pulses, and the current that passes between the plates is proportional to the distance between them.

Ideally, the target should be grounded to the current source. However, since AC is being used, capacitive coupling of the target to the current source is also possible, so long as the additional capacitor has a value of 0.1µF or higher.

Sources of Error

To obtain a meaningful measurement, the electric field from the sensor is focused on the target. Some dispersion will still occur, and the combination of sensor and target must be compatible. A target typically should be flat and should have a larger surface area than the sensor.

Humidity can affect sensor performance, as it changes the value of the dielectric. Temperature can affect performance, partly because it causes small dimensional variations in the sensor and the target.

The surface of the sensor and the surface of the target should be precisely parallel, because the spot where the field hits the target will be elongated if the target is tilted relative to the sensor. Elongation increases the capacitive area and affects the accuracy of measurement.

This type of sensor can also measure the thickness of a nonconductive material, if the material is a thin sheet that can be interposed between two sensors. In this mode the material functions as a dielectric, and its thickness will affect the AC current passing through it.

While lower-precision capacitive displacement sensors are relatively unusual, they can potentially serve as a relatively affordable and simple **object presence** sensor, so long as the target is conductive and will not be damaged by passing a small alternating current at a relatively low voltage.

Values

A high-precision capacitive displacement sensor can measure distances usually ranging from 0.25mm to 10mm with an accuracy that can be better than 0.05mm. High voltages are not required, with a supply of plus-or-minus 15V being common.

The sensing element, often referred to as a *probe*, is usually plugged into a custom-designed control unit that converts the capacitance measurement into a variable output voltage. The performance is then expressed in millimeters per volt. Thus if the voltage varies by 5V over a distance of 1mm, the sensor is rated as providing 0.2mm per volt.

What Can Go Wrong with Optical and Ultrasound Proximity Sensors

Object Too Close

Because both types of proximity sensors (ultrasonic and infrared) may include emitters that are angled toward the distance range for which they are designed, they may fail to "see" an object that is closer. Consequently the sensor will provide no response, or may detect a different object that is further away. In either case, if the sensor is being used on a moving device, the device may collide with the undetected near object.

Multiple Signals

If two or more sensors and emitters are used concurrently, their combined signals can interfere with each other and create inaccurate readings.

Inappropriate Surfaces

Ultrasonic proximity sensors are intended to identify a single object that is closer to the sensor than other objects, within a narrow beam dispersion angle. Multiple objects, complex surfaces, soft surfaces such as clothing or furnishings, or an unusual configuration of interior walls can create inaccurate readings.

Infrared sensors may be unable to "see" liquids or transparent objects, and may give different assessments of distance depending on the properties of a surface. Human skin, for example, is a poor reflector, as it absorbs some infrared radiation.

Environmental Factors

An ultrasonic transducer uses a very small moving diaphragm to generate sound. Like any system containing moving parts, it will be vulnerable to moisture or excessive humidity, and may need to be protected.

After a device is built and tested indoors, in a controlled environment, it is likely to behave differently if it is moved outside where the temperature is significantly higher or lower.

Deterioration of LEDs

As noted in the section on presence sensors (see Chapter 3), LEDs tend to suffer from gradual reduction in light output over time. The performance of an infrared proximity sensor may deteriorate over a period of years, depending on how intensively it is used.

linear position sensor

A **linear position** sensor may also be described as a *linear displacement sensor* or a *linear position transducer*. It is sometimes categorized as a type of **proximity** sensor, but in this Encyclopedia a proximity sensor emits a signal and receives an echo to measure the distance from itself to an object. By comparison, a linear position sensor measures the position of a sliding object within a stationary enclosure.

An **object presence** sensor can be considered as a form of linear position sensor, but it only responds to the presence of an object, without measuring its position.

OTHER RELATED COMPONENTS

- **proximity** sensor (see Chapter 5)
- **object presence** sensor (see Chapter 3)
- **rotary position** sensor (see Chapter 7)

What It Does

Control of a mechanical device may require accurate and timely information about the position of a movable part in the device. A **linear position** sensor can be used for this purpose.

Three attributes are likely to be of interest:

- Position
- Direction of motion
- Speed of motion

Typically a linear position sensor measures only the first attribute. Additional electronics may calculate the second and third attributes by taking multiple position readings. Thus a *speed sensor* is very likely to be built around a position sensor, and therefore this Encyclopedia does not have a separate entry for speed sensors.

Applications

Robotic arm positioning, wing flap and rudder positions on an aircraft, computer-controlled machine tools, 3D printers, and automobile seat position sensors are some of the many applications.

Schematic Symbol

In a schematic, a linear position sensor may be represented by symbols for the sensing elements that are inside it (potentiometer, LED, phototransistor, or others).

How It Works

Linear potentiometers, *magnetic linear encoders*, *optical linear encoders*, and *linear variable differential transformers (LVDTs)* are described here. Other options are available, but they tend to be more specialized, and are not included.

Linear Potentiometer

For a full description of **potentiometers**, see Volume 1.

A linear potentiometer, often referred to as a *slider potentiometer*, contains an electrical resistance in the form of a straight section of *track*. The track may be a strip of *resistive polymer* or (less often) may consist of an insulator with a coil of nichrome wire wrapped around it.

For sensing purposes, the potentiometer is wired as a voltage divider, and a fixed potential is applied across its full length, as shown in Figure 6-1. A *wiper* slides along the track, sensing a voltage that varies linearly with the wiper's position. Output from the wiper can be used directly to control an analog indicator such as a meter, or can be processed by an analog-to-digital converter.

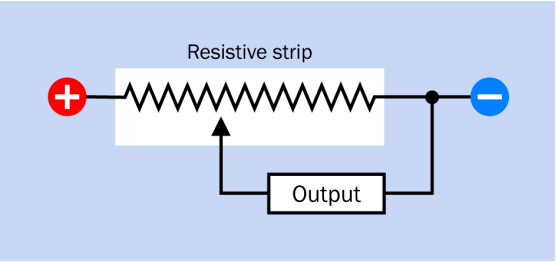

Figure 6-1 *A linear potentiometer can consist of a fixed track with a known voltage applied at each end, and a movable wiper.*

For audio applications, a slider potentiometer may have resistance that varies logarithmically with the position of the wiper. However, this type of component is not generally used as a position sensor.

For sensing purposes, the potentiometer is usually protected by a long, narrow box or tube through which a rod slides on sealed bearings. An example is shown in Figure 6-2.

Figure 6-2 *A linear potentiometer contained in a tube with sealed bearings.*

Small linear potentiometers for position sensing are available from companies such as Bourns. The one shown in Figure 6-3 is about 20mm long, and the rod that slides through it has a travel of approximately 10mm. The component is available with resistance values ranging from 1K to 50K, and its power rating is 1/8 watt. The manufacturer claims a life expectancy of 500,000 cycles.

Figure 6-3 *A miniature linear potentiometer. The body is about 20mm long.*

A linear potentiometer is simple, inexpensive, compact, and requires few additional components. The track contains a lubricant, but inevitably some wear occurs as a result of motion of the wiper. Life expectancy will be reduced by vibration or by contamination with dirt or moisture.

A linear potentiometer may rarely be described as a *linear potentiometric sensor*.

Magnetic Linear Encoders

A ferrous rod or strip can be magnetized with alternating north and south poles. When it slides past a single bipolar Hall-effect sensor, it generates a pulse train from the sensor that can be interpreted to provide positional information. The principle of the component is shown in Figure 6-4. (Magnetic rotary encoders also exist; see "Rotary Encoders".)

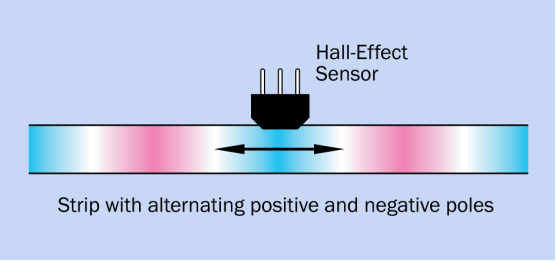

Figure 6-4 *When a strip magnetized with alternating north and south poles slides past a sensor, the pulse train from the sensor can be decoded to indicate the relative position of the strip.*

The sensing element may be described as a *read head*. If two are used, with a spacing equal to half the interval between the north and south poles on the strip, the phase difference between the pulse trains from the sensors will indicate the direction in which the magnetized strip is moving. This is shown in Figure 6-5.

The combination of pulse trains is known as *quadrature*, because there are four possible combinations: A and B both high, A and B both low, A high and B low, or A low and B high. The same principle is used in an optical rotary position sensor; see Figure 7-6.

This type of linear position sensor is often described as a *magnetic encoder*, meaning that the position of the sliding part is encoded in a series of pulses. Relatively high resolution is possible, as the north and south poles on a strip of ferrous material can be as close as 2mm. Optical encoders may use the same principle; see "Optical Linear Encoders".

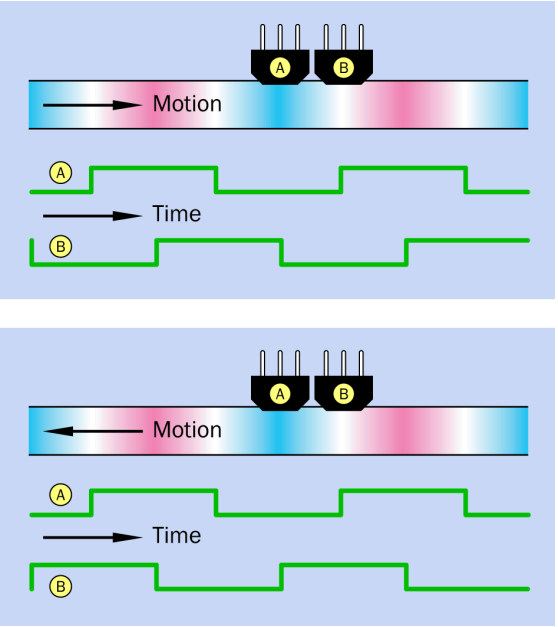

Figure 6-5 *Pulse trains from Hall-effect sensors A and B are shown in green. The phase difference between them can be interpreted to show the direction in which the magnetized strip is moving.*

The sensor can be built into a module containing an analog-to-digital converter that provides numeric output defining the position of the read head.

In an *absolute* magnetic encoder, nonvolatile memory can store the digitized position when the device is switched off. An *incremental* magnetic encoder does not store this information, and will require at least one additional *home sensor* to detect when the encoder is at either end of its travel. At power-up, an initialization routine moves the magnetized strip until the home sensor is triggered.

For details of Hall-effect sensors see "Hall-Effect Sensor".

Optical Linear Encoders

The operation of an optical linear encoder is identical to that of the magnetic linear encoder described immediately above, except that a sliding *optical grating* is used in conjunction with a light source and a detection device such

as a **phototransistor** or **photodiode** that functions as the read head. The principle is shown in Figure 6-6. The grating may be described as a *codestrip*.

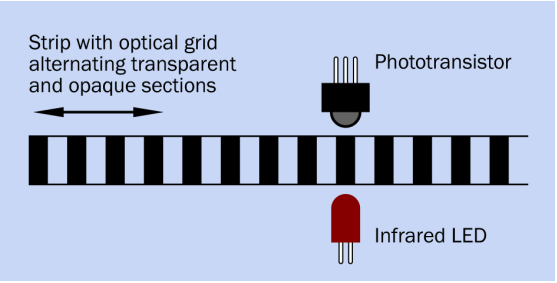

Figure 6-6 *An optical linear encoder uses the same general principle as a magnetic linear encoder.*

For details of phototransistors, see Chapter 22. For details of photodiodes, see Chapter 21.

An example of a low-cost optical linear encoder is the Avago HEDS-9 series, which consists of a horseshoe-shaped module with an LED in one arm and an array of photodiodes in the opposite arm. When a codestrip passes between the arms, the module emits two pulse trains from internal comparators. The pulse trains are 90 degrees out of phase, and can be interpreted to show which way the codestrip is moving.

These sensors have a body measuring approximately 10mm wide and are designed to read opaque/transparent intervals ranging from 1.5 to 7.87 cycles per millimeter. The output rate can be as high as 20kHz. No pullup resistor is required on the output, as a 2.5K resistor is integrated.

A *codewheel* may be used, in which case the module senses rotation instead of linear motion. This is described in detail in the entry on **rotary position** sensors. See Chapter 7.

Linear Encoder Applications

Optical or magnetic linear encoders are found in some laboratory equipment, machine tools, and industrial robots. The mean time between failures can range from 100,000 to 1,000,000 hours. Optical encoders must be sealed to provide good protection from dust and dirt.

Linear Variable Differential Transformers

This type of sensor, often referred to by the acronym LVDT, tends to be used in industrial environments where great reliability is required under severe conditions. Examples are high-temperature steam valves and nuclear reactor control mechanisms. However, the robust, frictionless design suggests other possible applications, and custom fabrication is a possibility.

Figure 6-7 illustrates the general principle. Three coils are wound sequentially around a (nonmagnetic) stainless-steel tube, enclosed in a second tube also made of stainless steel. The coils act as transformers with the variable voltage ratio determined by the position of a solid iron armature that slides through them.

The center coil is the primary winding, to which AC is applied between 2kHz to 50kHz, depending on the application. (The frequency must be at least ten times the maximum rate of motion of the armature.) The iron armature is attached to a nonmagnetic rod. The voltages on the secondary windings provide the output from the sensor.

While more than one wiring arrangement is possible, the most common schematic is shown in Figure 6-8. The secondary coils are in series, with one of them reversed, so that the phase of the output is inverted as the armature moves from one end of its travel to the other. The phase detector responds to the phase difference by creating a DC output that varies with movement of the armature. All the functions shown in the schematic are available on a single integrated circuit chip.

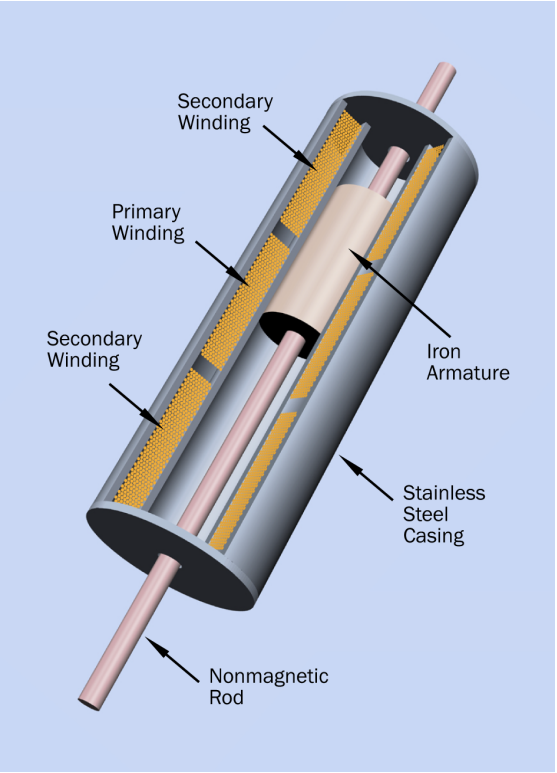

Figure 6-7 *Cutaway drawing showing the internal design of a linear variable differential transformer, in which the position of a sliding iron armature determines the voltage induced in the secondary windings.*

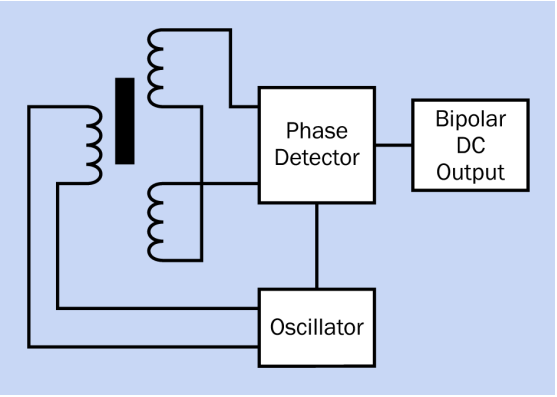

Figure 6-8 *Typical schematic for using a linear variable differential transformer.*

An example of a linear variable differential transformer is shown in Figure 6-9.

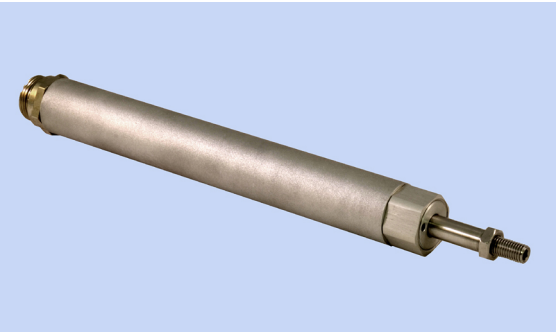

Figure 6-9 *External view of a linear variable differential transformer.*

What Can Go Wrong

Mechanical Issues

Any sliding mechanism will involve friction, and will be vulnerable to wear and tear, resulting in looseness that will degrade its accuracy. In addition, optical systems are vulnerable to dust and dirt.

LED Longevity

Light output of an LED diminishes over a period of years if the LED is "always on." This will limit the life of the sensor.

rotary position sensor

7

Alternative terms for **rotary position** sensor are *rotary sensor*, *rotational position sensor*, *angular position sensor*, and *angle sensor*.

The terms *rotary* and *rotational* are used interchangeably. In this entry, an attempt has been made to use the term that is most common for each specific application. For example, "rotary position sensor" versus "rotational encoder."

A few sensors are available that specifically measure *rotary speed*, but generally a rotary speed sensor uses information from a rotary position sensor. Therefore, this Encyclopedia does not include a separate entry for rotary speed sensing.

A **rotational encoder** can be used as a rotary position sensor. It is mentioned briefly here but is described in more detail in Volume 1 of this Encyclopedia in the entry describing **switches**.

OTHER RELATED COMPONENTS

- **linear position** sensor (see Chapter 6)

What It Does

Control of a mechanical device may require accurate and timely information about the orientation of a rotating part in the device. A **rotary position** sensor can be used for this purpose.

A sensor may be capable of measuring three attributes:

- Angular orientation
- Direction of rotation
- Speed of rotation

Typically a rotary position sensor measures only the first attribute. Additional electronics are required to calculate the second and third attributes by taking multiple position readings. Thus a *speed sensor* is very likely to be built around a position sensor, and therefore, this Encyclopedia does not have a separate entry for speed sensors.

Applications

In robotics, a rotary position sensor is commonly used to show the orientation of a pivoting arm or strut. It can also be used as a limit switch on a motor.

Specific applications include solar array positioning, remotely piloted vehicles, guidance and navigation, antenna positioning, and wind turbine pitch control.

Pulses from a rotary position sensor are used to measure speed of rotation in vehicles, industrial processes, and aviation. Small rotary speed sensors are built into devices such as cooling fans and computer hard drives.

Schematic Symbol

In a schematic, a rotary position sensor may be represented by symbols for the sensing elements that are inside it (potentiometer, LED, phototransistor, and others).

Potentiometers

Single-turn and multiturn potentiometers may be used as rotary position sensors. For basic information about **potentiometers**, see the entry describing this component in Volume 1.

Arc-Segment Rotary Potentiometer

An *arc-segment rotary potentiometer* is often referred to simply as a "potentiometer," as this type is more common than the multiturn type or the linear type. When used as a sensor, it can measure a turn angle that is less than 360 degrees.

This component contains a resistor in the shape of an arc, referred to as the *track.* It may be a strip of *resistive polymer* or (less often) may consist of an insulator with a coil of nichrome wire wrapped around it.

For sensing purposes, the potentiometer is wired as a voltage divider, and a fixed potential is applied along the full length of the track, as shown in Figure 7-1. A *wiper* slides along the track, sensing a voltage that varies linearly with the wiper's angular position. Output from the wiper can be used directly to control an analog indicator such as a meter, or can be processed by an analog-to-digital converter.

For audio applications, an arc-segment potentiometer may have resistance that varies logarithmically with the position of the wiper. However, this type of component is not generally used as a position sensor.

Low-cost potentiometers were traditionally used as volume or tone controls in stereo systems. When a potentiometer is designed for use as a sensor, it tends to be more ruggedly built and better protected against dust, dirt, and moisture. Its advantages are that it is simple, inexpensive, compact, and requires few additional components.

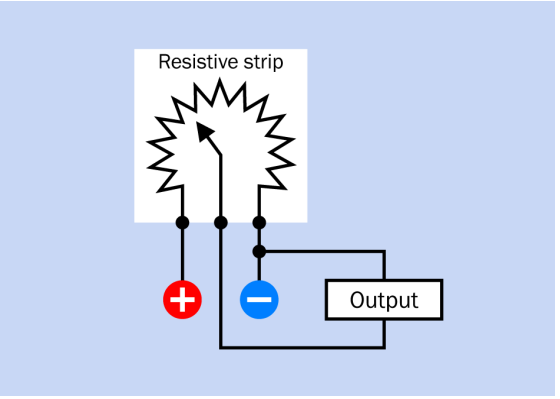

Figure 7-1 *An arc-segment potentiometer consists of a fixed track in the shape of an arc with a known voltage applied at each end, and a movable wiper.*

The major disadvantage is that although the track contains a lubricant, some wear will gradually result from friction with the wiper. Life expectancy will be further reduced if there is vibration or contamination with dirt or moisture.

End Stops

An arc-segment potentiometer usually has *end stops* to prevent the wiper from running off either end of the track. Typically, these stops limit rotation to around 300 degrees.

A few arc-segment potentiometers allow unrestricted rotation. The Bourns 6639 series is an example, although the wiper still passes through a "dead zone" of 20 degrees between the start and end of its track. An application for this type of potentiometer could be as a direction sensor for a weather vane.

Multiturn Rotary Potentiometer

A spiral track, which resembles a coil spring, enables a rotary potentiometer to make multiple turns. The wiper rotates inside the track and follows its contour. A potentiometer of this type

will still be calibrated in degrees; thus, a 10-turn component may be listed as allowing an *electrical travel* of approximately 3,600 degrees.

The exterior of a multiturn rotary potentiometer is shown in Figure 7-2.

Figure 7-2 *A multiturn rotary potentiometer. Each pair of solder tags is attached internally to one end of the internal coiled track. The smaller tag at the far end connects with the wiper.*

A simpler type of multiturn potentiometer is intended for use as a trimmer—a small potentiometer that can be mounted on a circuit board to allow adjustment or calibration, often during the manufacturing process. This type of trimmer contains a worm gear that engages with a spur gear internally. The wiper is mounted on the spur gear. It has no applications as a sensor, but is mentioned here to avoid ambiguity, as it is probably the component that is most commonly referred to as a "multiturn potentiometer."

Magnetic Rotary Position Sensor

Externally, a modern magnetic rotary position sensor may look very much like an arc-segment rotary potentiometer. Internally, a permanent magnet is attached to the base of the shaft, and one or more **Hall-effect** sensors are mounted on a small circuit board immediately below the magnet, in the bottom of the enclosure. A simplified diagram appears in Figure 7-3.

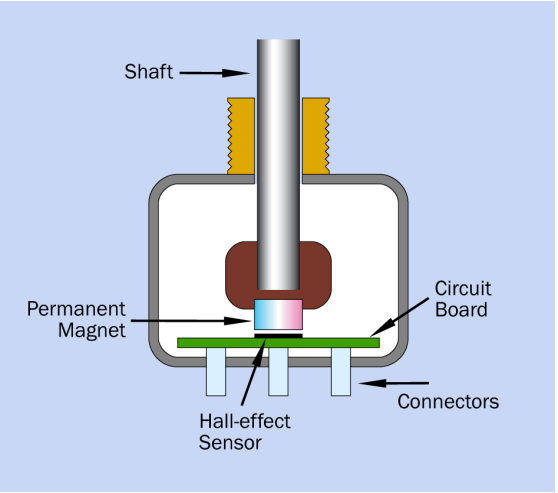

Figure 7-3 *Simplified interior view of a magnetic rotary position sensor.*

For more information about Hall-effect sensors, see "Hall-Effect Sensor".

A magnetic rotary position sensor may be described as a *noncontacting* sensor. Two views of an example are shown in Figure 7-4.

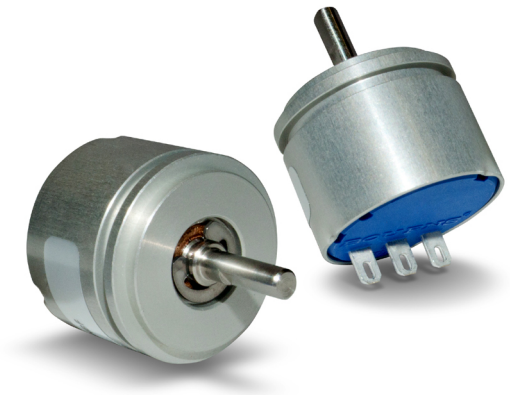

Figure 7-4 *Two views of a Bourns AMS22 magnetic rotary position sensor.*

The AMS22 sensor shown in Figure 7-4 has an analog output ranging from 0.1VDC to 4.9VDC when powered with 5VDC. A noncontacting sensor of this type will cost three to four times as much as a conventional potentiometer, but has the great advantage of extreme durability, with the manufacturer claiming a life of 50 mil-

lion shaft rotations. A disadvantage is its low-current output, limited to 10mA. The maximum rotation speed of its shaft is 120rpm.

Rotary Position Sensing Chips

Chips of the type used in a magnetic rotary position sensor are available as individual components, many of which have advanced features. For example, the AM8192B angular magnetic encoder by RLS is a 44-pin surface-mount chip containing Hall sensors that detect the orientation of a permanent magnet above or below the chip. Various outputs provide information such as sine or cosine of the turn angle, incremental pulses, and digitized output via an SPI interface.

Rotary Encoders

Many rotating position sensors communicate their angle of rotation with an output that consists of a pulse train or some other coded signal. This type of rotary sensor is known as a *rotary encoder* or *rotational encoder*. (Linear encoders also exist; see "Magnetic Linear Encoders".)

The simplest version of this component is a *mechanical encoder* containing two small electromechanical switches that are activated, out of phase, by a toothed wheel attached to the rotating shaft. This component is described in detail in Volume 1 of the Encyclopedia, where it is categorized as being a form of **switch**. Its low cost and simplicity has made it popular for rotary controls on car radios and small stereo systems, but its switches have a limited life expectancy and create a "noisy" output that must be *debounced* if connected with a logic chip or microcontroller. Typically the microcontroller will include a pause of up to 50ms in its program code to allow time for the switch contacts to settle (although some manufacturers claim only 5ms).

Confusingly, a mechanical encoder is often identified only as a "rotational encoder," even though optical and magnetic rotational encoders also exist, as described immediately below. As a general rule, if a component is described simply as a rotational encoder, it probably contains electromechanical switches.

Optical Rotary Encoders

This type of component works on the same principle as an *optical linear encoder* of the type described in "Optical Linear Encoders". The difference is that a *codewheel* is used instead of a *codestrip*. Typically the codewheel is supplied by the manufacturer of the component that is designed to read it.

A *transmissive* codewheel is shown in Figure 7-5. The distance between the light emitter and the light detector has been exaggerated in this diagram for clarity.

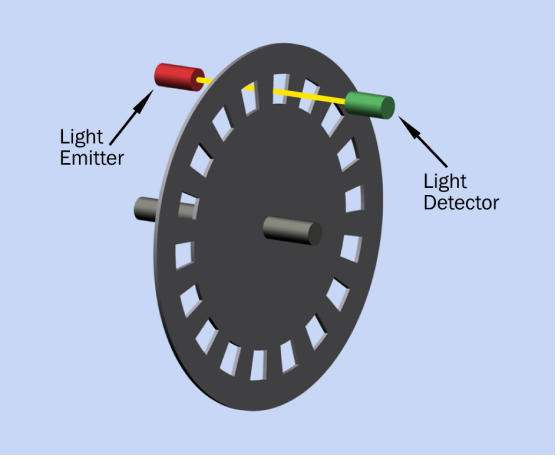

Figure 7-5 *A light-transmissive codewheel for use in an optical rotary encoder.*

Some optical rotary encoders use a *reflective* codewheel, in which case alternating sections of the wheel are light-absorptive and light-reflective, and the emitter and detector are both on the same side of the wheel.

If only one light emitter and light detector are used, the pulse train from the sensor reveals how many increments the wheel has turned relative to its previous position.

A single sensor cannot indicate the direction of rotation, but if a second emitter-sensor pair is added, 90 degrees out of phase with the first, a microcontroller can assess the phase difference between pulse streams to determine which way the wheel is turning. This principle is illustrated in Figure 7-6 where one transmitter-detector pair is located in position A and another is in position B. The resulting pulse trains, for clockwise and counterclockwise rotation of the wheel, are shown in green. The combination of pulse trains is known as *quadrature*, because there are four possible combinations: A and B both high, A and B both low, A high and B low, or A low and B high.

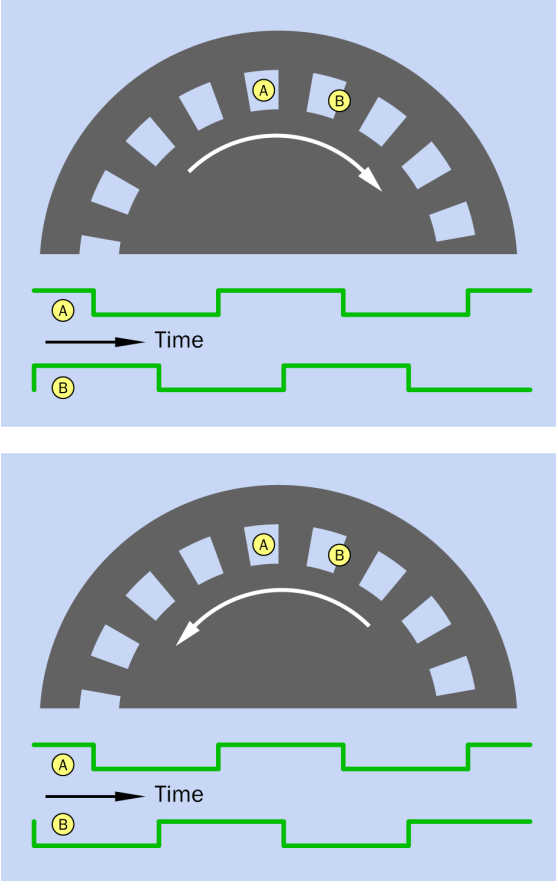

Figure 7-6 *With transmitter-detector pairs mounted at positions A and B, the phase difference between their pulse trains can show the direction of rotation of the wheel.*

This is the same principle as illustrated for a magnetic linear position sensor in Figure 6-5.

An alternative system of quadrature for an optical rotary encoder uses two separate tracks on the disc, each having an equal number of opaque and transparent sections, but half an interval out of phase.

Any system that reveals the relative motion of the wheel, but cannot determine its absolute angular position, is an *incremental sensor*.

Optical Products

High-end optical rotary encoders may use discs with as many as 600 sequential opaque and transparent segments to provide extremely high resolution. They are outside the scope of this Encyclopedia.

Moderately priced optical encoders are available as shaft-driven assemblies very similar in external appearance to potentiometers. Typically they have four terminals, one pair for power and ground connections and another pair for quadrature output from the two internal sensors, usually identified as A and B in datasheets. Some encoders also contain an on-off switch that is activated by pressing the shaft, in which case two additional terminals will be provided.

Bourns is a leading manufacturer of this type of encoder, an example being the EM14, which is mounted in a box-shaped body measuring 14mm square. It uses a 5VDC power supply and provides pulses of 4VDC minimum with intervals of 0.8VDC maximum. Variants are available with 8 to 64 pulses per revolution. Intended for audio applications, this type of encoder has a maximum rotation speed of 120rpm.

An example of an optical rotary encoder from a German manufacturer is shown in Figure 7-7. Its resolution is 25 pulses per rotation. The rectangular package measures approximately 19mm × 25mm. The power supply can be 3.3VDC or 5VDC.

Optical rotary encoders of this type cost about five times as much as mechanical rotary encoders at the time of writing, but their longevity and their clean output signals make them an attractive alternative, and the price difference may diminish over time.

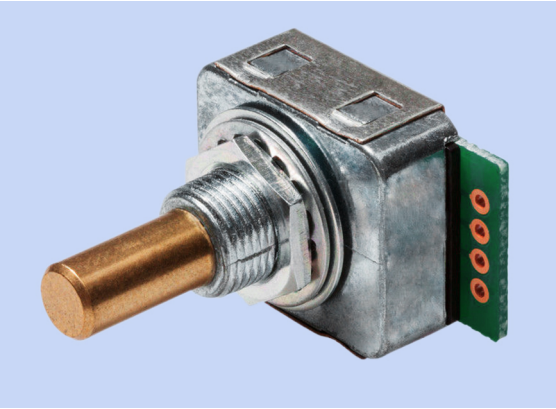

Figure 7-7 *A compact incremental optical rotary encoder in the MRB25 series from Megatron Elektronik AG & Co.*

Encoders such as the Avago HEDS-9 series are not protectively enclosed, and require assembly with a codewheel supplied by the manufacturer. See Figure 6-6 for additional information.

A more basic optical rotary encoder, shown in Figure 7-8, is sold by Cytron Technologies as an *optical switch* mounted on a small board, with a separate codewheel consisting of a slotted disc. This low-cost kit is intended for use in DIY robotics. More information about optical switches will be found in the entry dealing with **optical presence** sensors. See Figure 3-3.

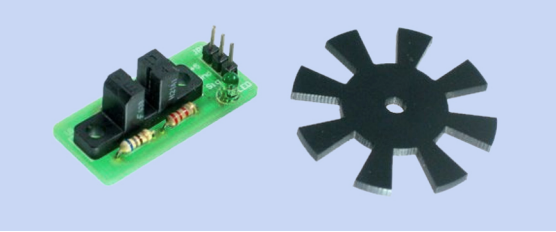

Figure 7-8 *A bare-bones optical encoder for DIY robotics.*

Computer Mouse Principles

The original design of a computer mouse, with a hard rubber ball, contained two optical rotary encoders oriented at right angles to each other. Each of them used a transmissive codewheel. The rolling ball turned the codewheels as the mouse was moved across a desktop, and electronics in the mouse converted the outputs from the encoders into a pulse train that could be interpreted by a computer. Figure 7-9 shows the primary components.

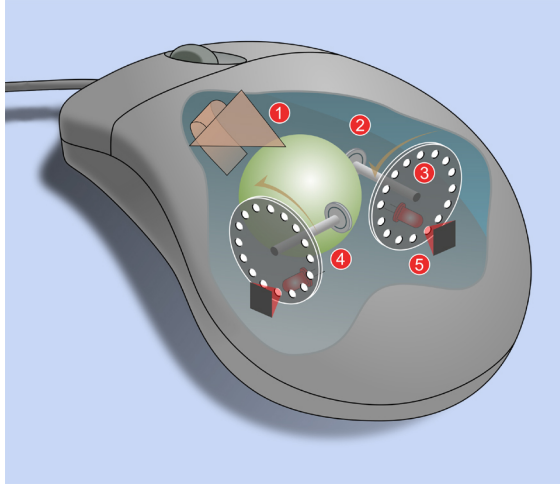

Figure 7-9 *From Wikimedia Commons, this rendering by Jeremy Kemp shows (1) rotation of the ball, (2) a roller touching the ball, (3) a transmissive optical codewheel, (4) an infrared LED that shines through a second codewheel, and (5) a sensor detecting the pulses of light.*

An *optical mouse* works on a different principle, maintaining a monochrome image of the desk surface on an optical array that functions like a very low-resolution camera sensor. Electronics in the mouse detect displacement of the image as the mouse is moved.

Rotational Speed

Incremental rotary encoders, which only supply relative data, are adequate in many applications, especially speed measurement, where a microcontroller can compare a pulse stream from a sensor with a target frequency, and can also provide feedback to control motor speed

appropriately. This is convenient when a stepper motor is being used, or a DC motor that is controlled with pulse-width modulation. (See the entry on **motors** in Volume 1.)

Toothed wheels or magnetized wheels are commonly used to measure speed of rotation in applications ranging from automobile transmissions to computer disk drives.

While a second sensor can be added to determine the direction of rotation, this still does not provide information about the absolute orientation of a part.

Absolute Position

If associated electronics are equipped with nonvolatile memory, it may be used to store a sensor-wheel position from one session to the next. This may be sufficient in noncritical applications such as volume control in a car radio or stereo system.

Alternatively, an additional single window in an optical wheel can activate a *home sensor*. When the device is powered up, the wheel is turned until the home sensor is triggered, at which point the orientation of the wheel is known, and subsequent pulses from rotation sensor(s) will add or subtract angular information.

The pulse generated by a home sensor may be described in datasheets as a *reference signal* or *index signal*. In the early days of desktop computers, each 5.25-inch floppy diskette was perforated with an index hole for this purpose.

The Gray Code

For greater reliability in determining absolute position, an optical wheel can be divided into several concentric tracks, each of which contains a different coded sequence and is assigned its own light emitter and light sensor. The sensors are arranged in a radial line to scan the disc as it rotates. Since each detector will provide either a signal or no signal, output from the set of sensors can be combined to create a binary number.

Figure 7-10 shows binary codes from 0000 through 1111, corresponding with decimal numbers 0 through 15, where a white square is equivalent to a numeral 1 and a black square is equivalent to a numeral 0.

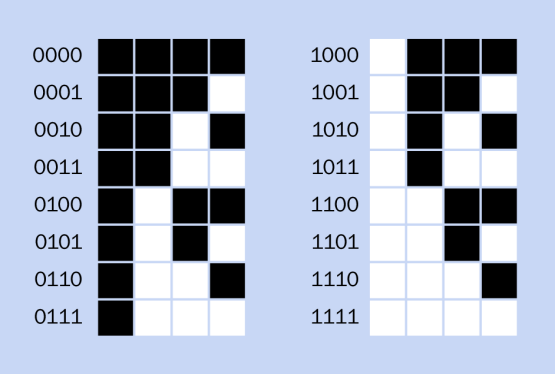

Figure 7-10 *Binary codes from 0000 through 1111, using white to represent 1 and black to represent 0.*

Figure 7-11 shows this system mapped onto a codewheel. The red circles indicate the locations of four stationary light detectors, which begin by providing a reading of 0000, since they coincide with four opaque areas of the wheel. Now if the wheel makes 1/16th of a full rotation in the direction of the arrow, the detectors will register 0001. If the wheel continues to rotate, the detectors will count in binary up to 1111 before the sequence repeats.

The problem with this design is that small manufacturing inaccuracies and other imperfections will result in some light detectors responding fractionally more quickly than others as the wheel rotates. This will occur in transitions where two or more adjacent segments of the wheel change between transparency and opacity. For instance, where 0011 is followed by 0100, transient values of 0010, 0001, 0111, 0110, or 0101 are possible. Although they will be brief, these values may trigger associated electronics.

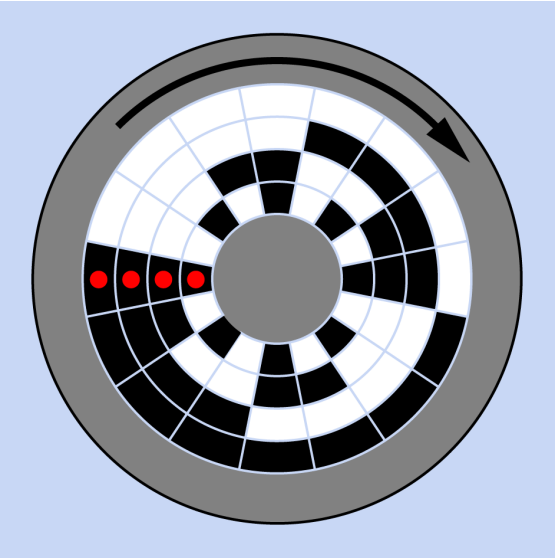

Figure 7-11 *The binary sequence mapped onto a code-wheel as areas of opacity and transparency. Red circles indicate light detectors.*

To eliminate this problem, a different code sequence can be used in which only one of the four sensors is allowed to make a transition from each value to the next. This is called a *Gray code*, and eliminates the issue of simultaneous transitions. A commonly used Gray code is shown in Figure 7-12.

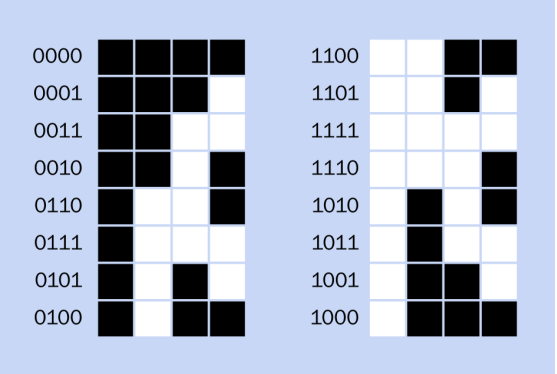

Figure 7-12 *A Gray code that allows only one binary digit to change in each transition from one value to the next.*

Magnetic Rotary Encoders

If a ferrous wheel is magnetically polarized in multiple domains, its rotation can be detected by a Hall-effect sensor in much the same way that a wheel divided into transparent and opaque sections can be assessed by light detectors and emitters. This is illustrated in Figure 7-13, where magenta and cyan bands indicate north and south magnetic poles.

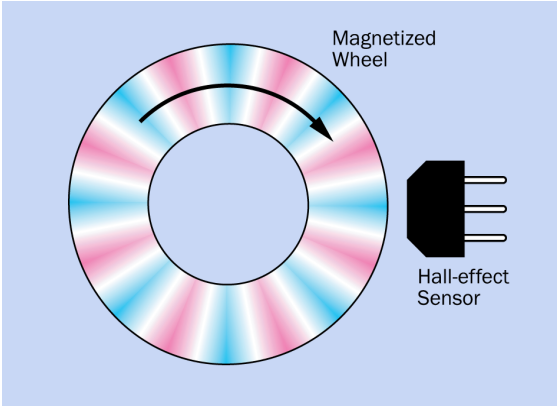

Figure 7-13 *A Hall-effect sensor can detect the rotation of a wheel that is divided into multiple north and south magnetic poles.*

See "Hall-Effect Sensor" for information about Hall-effect sensors.

An additional Hall sensor can be added, offset from the first, as in Figure 7-14. Once again the phase difference between the pulse trains can be used to determine the direction of rotation.

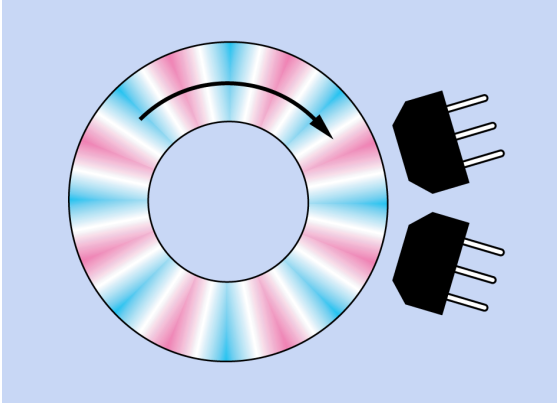

Figure 7-14 *Direction of rotation of the wheel can be deduced from the phase difference between the pulse trains from two sensors.*

Alternatively, a toothed wheel can be used, as suggested in Figure 7-15.

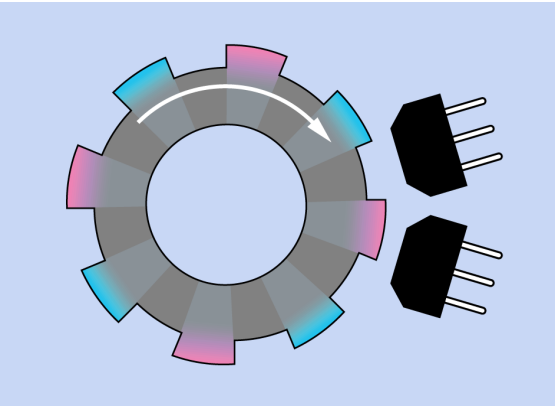

Figure 7-15 *A toothed wheel can trigger a Hall sensor if the teeth are magnetized.*

Another option is to mount a pair of magnets on a nonmagnetic wheel, with a Hall-effect sensor in the center. If it is a sensor with an analog output, the voltage will fluctuate smoothly between positive and negative, relative to the power supply for the sensor. Alternatively, a bipolar Hall-effect sensor can be used to provide a binary output. The concept is illustrated in Figure 7-16. An advantage of this configuration is that it provides approximate information about the absolute position of the wheel.

The two magnets will provide usable linear sensor outputs over a span of plus-or-minus 30 degrees of rotation, approximately. Additional magnets or sensors can produce a more complex output that would be decoded by a microcontroller.

How to Use It

An optical or rotary encoder is well suited for use with a microcontroller program that can count pulses, compare pulse trains, or interpret a Gray code. The microcontroller then takes appropriate action. For example, if a rotational encoder is used to control the gain of an audio amplifier, the microcontroller determines the direction and angle through which the encoder turns, and can respond by changing the value of a **digital potentiometer** (see Volume 1).

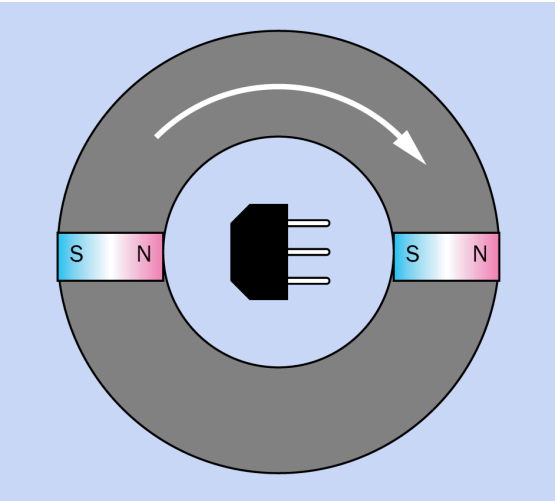

Figure 7-16 *A Hall-effect sensor can detect the angle of rotation of a ring on which two magnets are mounted as shown.*

Integrated circuit chips are available to convert a sequence of quadrature signals into an up-pulse or a down-pulse, thus eliminating the chore of achieving this with a microcontroller program. The LS7183 by LSI Computer Systems is an example.

What Can Go Wrong

Wiring Errors

If two sensors are used to detect the direction of rotation of a rotary encoder, and outputs from the sensors are accidentially swapped, the component will seem to work normally except that the indicated direction will be inverted.

Coding Errors

Microcontroller code that interprets quadrature signals must be fast enough to keep up with the pulse streams. If a microcontroller is performing other tasks, an interrupt may be necessary for processing the rotational data. This should not be a significant problem when interpreting human input from a knob or dial, but

for a motor-driven encoder, pulse counting in hardware may be a better alternative.

Ambiguous Terminology

Rotational encoders are often referred to simply as "encoders," because they are more common than linear encoders. When searching for an encoder, check each datasheet carefully to determine which type you are dealing with.

tilt sensor

A *tilt switch* is defined here as an electromechanical switch, while a *tilt sensor* uses electronics. Both types are included in this entry.

A *tipover switch* is very similar to a tilt switch and uses the same principles. Therefore, it is included in this entry.

Some manufacturers' datasheets refer to tilt sensors as *tip sensors*. Some Asian supply catalogues refer to tilt switches as *breakover switches*.

An **accelerometer** can measure the angle at which it is held relative to the downward force of gravity, but it has additional capabilities. Therefore, it has its own separate entry in this Encyclopedia.

An *inclinometer* measures the incline, or positive slope, from an observation point to the top of an object such as a building or tree. The height of the object can be calculated from the angle. A *clinometer* can additionally measure a decline, or negative slope. These measurement devices are fully featured products as opposed to sensors, and are not included in this Encyclopedia.

OTHER RELATED COMPONENTS

- **accelerometer** (see Chapter 10)
- **vibration** sensor (see Chapter 11)

What It Does

Three principal types of tilt sensor exist.

1. Single axis, single output. The sensor responds to being tilted around one horizontal axis, relative to the downward force of gravity.
2. Dual axis, dual output. The sensor contains two sensing elements at 90 degrees to each other. Each has an output determined by its angle of tilt from vertical around one axis.
3. Dual axis, single output. A single sensor responds to an angle of tilt from vertical around any horizontal axis.

A *tilt switch* is usually of the third type, and is defined here as containing an electromechanical or electronic switch that opens or closes a connection. Most tilt switches are SPST (normally open) or SPST (normally closed). A minority are DPDT.

A *tipover switch* is a type of high-current tilt switch that cuts power to a device such as an electric heater when it is tipped over.

This Enclopedia defines a *tilt sensor* as being an electronic component, as opposed to an electromechanical component. The distinction is often observed in datasheets, but not always.

Schematic Symbol

No specific schematic symbol is generally used for any variant of a tilt sensor. It can be represented with an annotated switch symbol.

How It Works

Because a tilt switch is a simpler device than a tilt sensor, it will be described first.

The most common type of tilt switch consists of a cylindrical metal or plastic enclosure, often measuring about 5mm by 15mm, containing two spherical steel balls that may be nickel-plated or gold-plated. When the switch is tilted, the balls eventually run downhill, and the lower ball completes an electrical connection between two contacts or between a single contact and the metal enclosure of the switch. The second ball is included to add weight and suppress vibration in the first.

Figure 8-1 shows a switch manufactured by Comus Global, rated for 0.25A at 60VAC or 60VDC, maximum. The body of the switch measures approximately 10mm x 5mm, and the switch is activated when tilting -10 degrees from horizontal. It is deactivated when tilting +10 degrees. A scale drawing of the interior is shown in Figure 8-2.

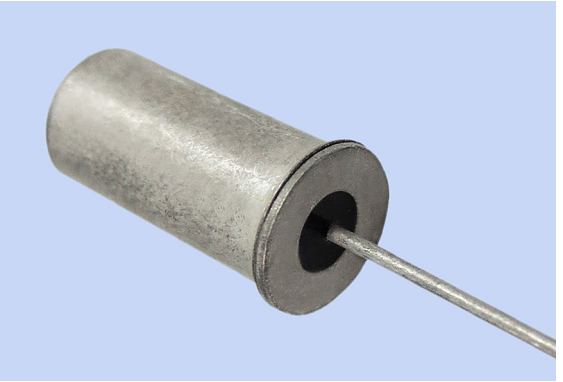

Figure 8-1 *The CW1300 tilt switch manufactured by Comus Global.*

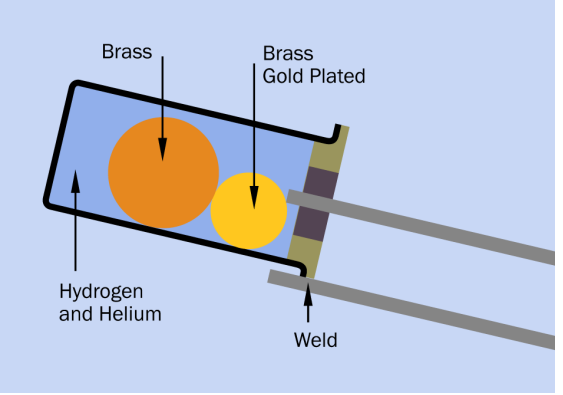

Figure 8-2 *Interior of the CW1300 tilt switch, from a scale drawing supplied by the manufacturer. The lower lead is welded to the shell of the sensor. The leads may be inserted in a circuit board.*

Figure 8-3 shows three common internal configurations of a generic tilt switch. The top version has axial leads and uses the metal shell of the switch to complete the circuit. The center version has radial leads, with a plastic shell. The bottom version has radial leads, one of which is attached to the metal shell to complete the circuit.

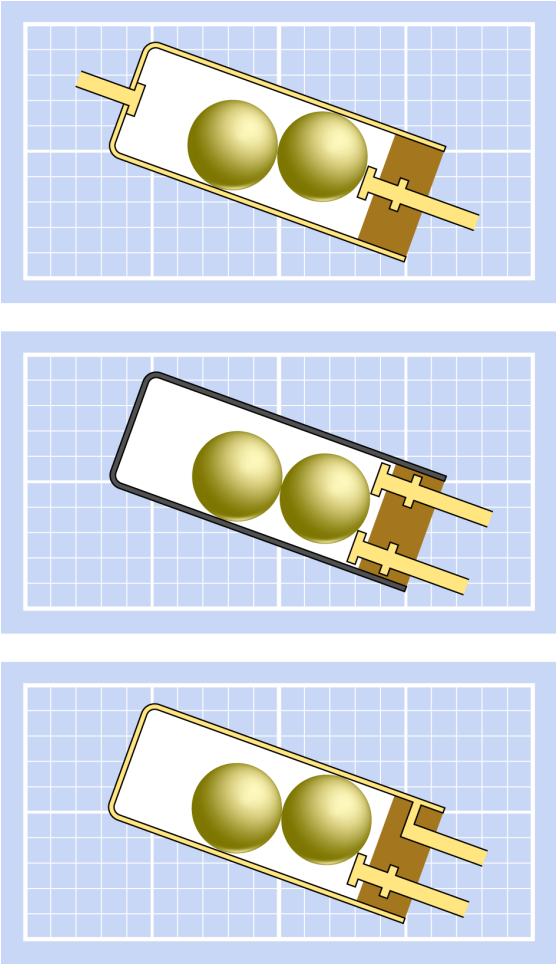

Figure 8-3 *Three variants of a generic ball-operated tilt switch. The graph-paper scale is in millimeters.*

Figure 8-4 shows the parts of a disassembled tilt switch.

Simplified Version

Where size is not a significant consideration, a tilt switch can be created by attaching a pivoting, weighted arm to a small snap-action switch.

Applications

An old-style (nonelectronic) thermostat may contain a tilt switch attached to the end of a bimetallic strip coiled into a spiral. When the strip bends in response to a drop in temperature, the switch closes its contacts, activating a relay that starts a heating unit. If the temperature rises, an additional set of contacts in the same relay may activate an air-conditioning unit. In old thermostats, the tilt switch may contain mercury in a glass tube, which should be handled with caution.

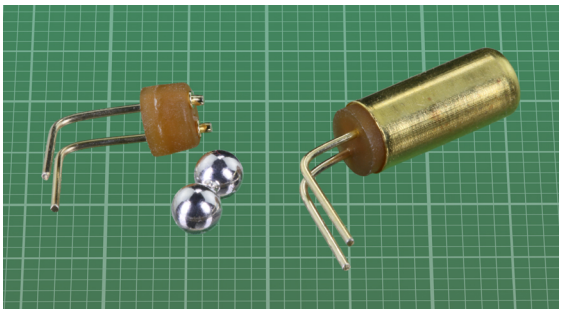

Figure 8-4 *At right, a tilt switch. At left, the cap removed, and the two balls that make internal contact. The background grid is in millimeters.*

A tilt switch may detect the opening of a door or window in a simple alarm system.

Tilt switches have been used in automobiles to switch on the interior light in the trunk when its lid is opened.

A normally closed tilt switch is often used to stop the inflow of granular material to a bin when it is almost full. This is colloquially known as a *bin switch*. In industrial applications of this kind, the switch is activated by a long lever that has a ball mounted at the end. The switch assembly is physically large. See Figure 8-5.

A normally open tilt switch may operate a valve or start a pump when the liquid in a tank drops below a certain point. If the switch uses a float to sense the level of the liquid, it is often known as a *float switch*. This is described in the entry on liquid level sensors. See Chapter 15.

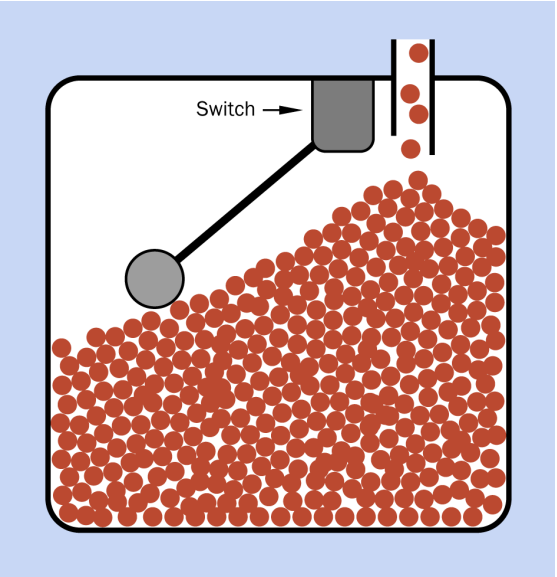

Figure 8-5 *The flow of granular material into a bin can be sensed and stopped by a tilt switch of this type, often known as a bin switch.*

A *tipover switch* may use the simplified system of a weighted arm that activates a snap-action switch. When used in conjunction with a room heater, the switch must handle substantial current.

A motorcycle may contain a tipover switch to stop the electric fuel pump if the motorcycle falls on its side.

Four tilt switches placed in a cross-shaped pattern on a flexible mount can be used as the basis of a very simple game controller, with a joystick mounted in the center.

Variants

The three configurations of ball-type tilt switches shown in Figure 8-3 are functionally interchangeable and can be chosen for convenience of their leads in fitting the circuit.

Mercury Switches

Early tilt switches contained a blob of mercury in a glass bulb. When the bulb was tilted, the mercury rolled to the end and made an electric connection between two metal contacts that penetrated the bulb.

A small mercury switch is shown in Figure 8-6. This type of sensor became less common after many countries classified mercury as an environmental hazard and established regulations restricting its use.

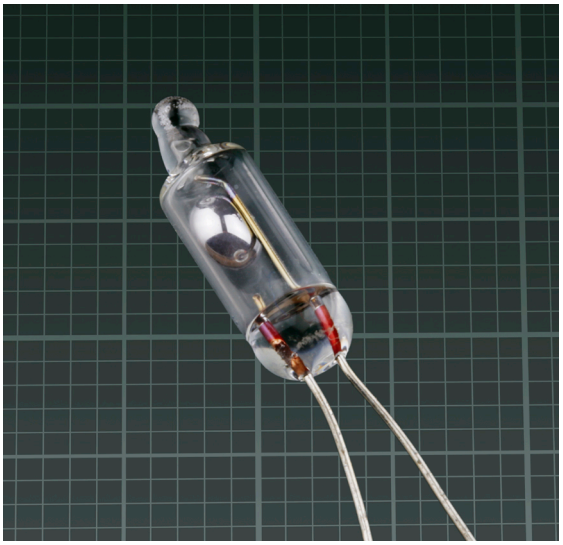

Figure 8-6 *Small mercury switch rated for 0.3A at 24VDC or 24VAC. Larger mercury switches can switch more power; 1A at 230V is common. The background grid is in millimeters.*

Mercury is an excellent electrical conductor. It remains in a liquid state between about -38 degrees Celsius and +356 degrees Celsius, and has very high surface tension, encouraging it to form a single blob instead of breaking up into small droplets. Because free space in the bulb is filled with an inert gas to prevent oxidation of the electrodes, a mercury switch can have a very long operating life. In the United States in the 1970s, some light switches were sold containing mercury switches with a claimed life expectancy of 100 years.

Pendulum Switch

This type of switch, now relatively rare, was found in vintage pinball machines. It consists of a pendulum about 5cm long, suspended inside

a steel ring about 1cm in internal diameter. If the machine was rocked sufficiently to bring the pendulum in contact with the ring, the game was cancelled and the word "Tilt" appeared on the display. Consequently this was referred to as a tilt switch, although really it was a form of **vibration** sensor with a long period of oscillation.

Magnetization

Some tilt switches use a steel ball that is weakly magnetized, so that it will seat itself more firmly when it rolls into a circular depression or ring. This type of switch must be tilted back through a larger angle to dislodge the ball. Therefore it will exhibit greater *hysteresis*.

Tilt Sensors

Unlike a tilt switch, a tilt sensor is not built around an electromechanical switch.

The principle of a rolling ball has been miniaturized and encapsulated in a small enclosure (10mm square or smaller), in which the ball rolls to interrupt a beam from an internal LED shining on a phototransistor. Examples are found in the Panasonic AHF series. Internal circuitry ensures a clean on-off signal, free from the switch bounce that is a problem in basic ball-type tilt switches. However, the switch requires a power supply, and the open-collector output must be used with a pullup resistor. By comparison, a simple electromechanical tilt switch can be wired directly to the device that it controls.

Diagrams from the Panasonic datasheet show the three types of AHF sensor available for vertical, horizontal, and reverse mounting. In each case, the ball (dotted circle) rests in a shallow cup (dotted curve) where it obstructs the beam from an internal LED (not shown). See Figure 8-7. An exterior view of the AHF22 is shown in Figure 8-8.

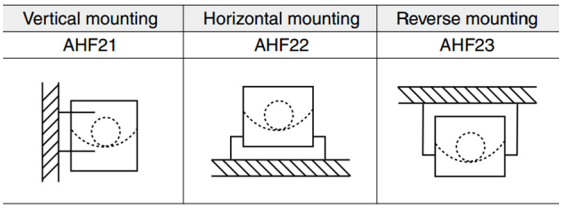

Figure 8-7 *Three types of Panasonic tilt sensor, from the manufacturer's datasheet. See text for details.*

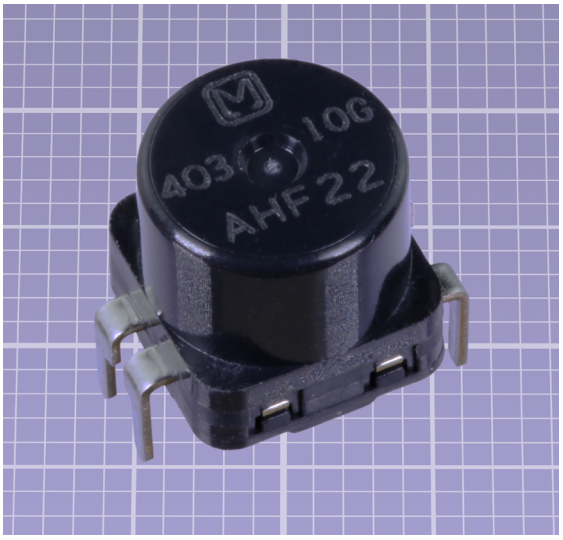

Figure 8-8 *Exterior view of the Panasonic AHF22 tilt sensor. The background grid is in millimeters.*

Two-Axis Tilt Sensors

The Rohm RPI-1035 is a surface-mount tilt sensor about 4mm square, with two phototransistor outputs that indicate which axis the sensor is tilting around. The outputs can be interpreted as a 2-bit binary number, with its four possible states indicating the rotation of the switch around two axes at 90 degrees to each other. Switches of this type were developed to indicate the orientation of consumer-electronic devices such as digital cameras, but more sophisticated sensors containing accelerometers are becoming price-competitive.

Surface-mount 2-axis tilt sensors have been made available on small breakout boards that are easy to use experimentally. An example is the Parallax 28036 shown in Figure 8-9.

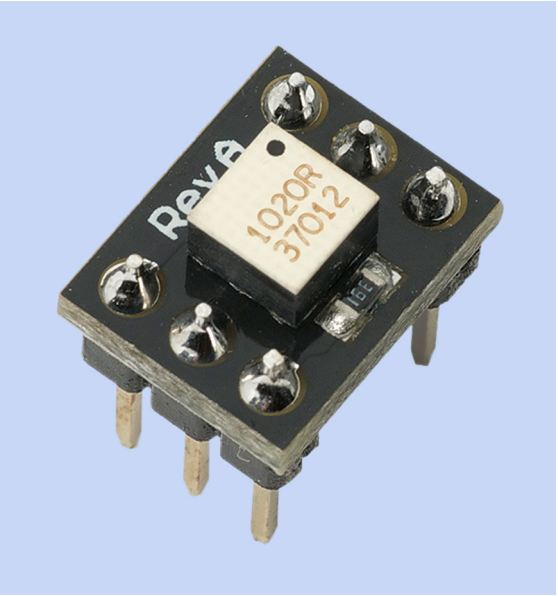

Figure 8-9 *A 2-axis tilt sensor mounted on a breakout board available from Parallax.*

The behavior of the rolling-ball sensor at the heart of this board is shown in Figure 8-10. The sensor contains a square cavity in which the ball is depicted as a blue circle. At one corner of the cavity is a red LED, while two phototransistors, labeled A and B, are at the corners on the left and right. When the sensor is held as in section 1 of the figure, with the LED at the top and the ball resting at the bottom, both phototransistors have a high output as they receive light from the LED.

In section 2 of Figure 8-10, the sensor has been turned through 90 degrees. The ball now prevents light from reaching sensor B, while phototransistor A is still active. In section 3 of the figure, the sensor has been turned through another 90 degrees, so that the ball prevents light from escaping from the LED, and both phototransistors are now dark. In section 4, the ball obstructs phototransistor A but not phototransistor B.

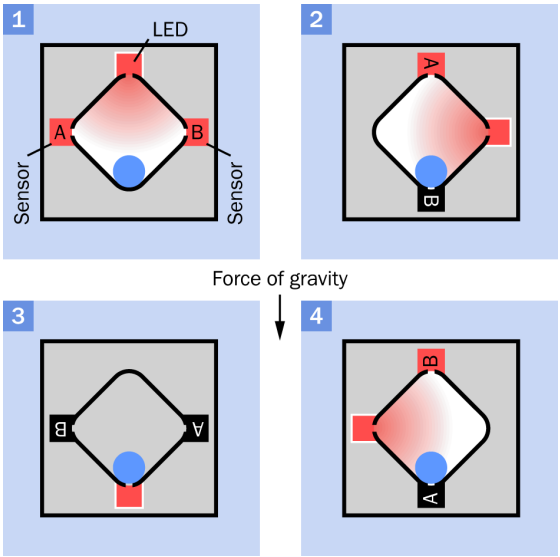

Figure 8-10 *The rolling-ball sensor inside the Parallax 28036. See text for details.*

Suppose that the sensor is placed flat on a horizontal surface. The sensor will now respond to being tipped either way around two horizontal axes. This justifies its description as a 4-directional tilt sensor, although its design suggests that it may have been intended for use as described above, rotating through four positions around one horizontal axis.

Values

A heavy-duty tilt switch can be rated as highly as 10A at 240VAC. More commonly, a tilt switch about 15mm long can be expected to switch about 0.3A at 24VAC or 24VDC.

The *operating angle* is the angle through which the switch must be turned to activate it, relative to its normal rest position.

The *return angle* is the angle to which the switch must be returned to deactivate it. Hysteresis results from the return angle being smaller than the angle that activates the sensor.

Tilt sensors with an open-collector output will specify maximum forward current for the internally mounted LED (usually no greater than

50mA), the maximum collector-emitter voltage at the output (typically 30V), and the maximum collector current (often 30mA). An explanation of open-collector outputs is given in Appendix A (see "3. Analog: Open Collector").

How to Use It

An electromechanical tilt switch can be connected directly between a power supply and a device, so long as the device does not draw more current than the switch is rated to handle. Note that inductive loads such as motors draw an initial surge that can be at least twice the operational rating, while relays may be more likely to create a voltage spike when disconnecting. Switches should be chosen accordingly. For more discussion of this topic, see **switch** in Volume 1.

A small tilt switch can be used in conjunction with a relay or transistor to amplify its signal sufficiently to drive a larger load.

If an electromechanical tilt switch is connected to an electronic device such as a microcontroller or logic chip, output from the switch will have to be *debounced* to prevent a series of brief voltage spikes that can cause false triggering when the switch turns on or off. A debouncing logic circuit or chip can be used, or the program code in a microcontroller can introduce a wait period of up to 50 milliseconds to allow the contacts to settle.

Mercury switches are much less likely to create a noisy output than rolling-ball switches, and may require little or no debouncing.

For an application that must sense rotation around two or three axes, multiple single-axis tilt switches can be combined. A microcontroller or logic gates will be necessary to evaluate signals from the switches, to determine the orientation.

What Can Go Wrong

Contact Erosion

If a ball-type tilt switch is subjected to current that exceeds its specification, arcing may erode its contacts, and they will become less reliable, especially if the contacts are plated with a thin metallic film that is eroded. For additional information on arcing in switches, see the **switch** entry in Volume 1.

Random Signals

During the brief time when a ball-type tilt switch is turning from one position to the other, vibration of the ball(s) inside it is likely to create erratic, random signals. If the output from the switch is being evaluated by a microcontroller, a debouncing routine may be insufficient to prevent the random signals from being sensed, and some programming will be necessary to ignore the signals during this transitional phase. If the switch is connected directly to a relay, the intermittent signals may occur sufficiently rapidly that the relay will ignore them.

Environmental Hazard

A device that incorporates a mercury switch may have to be re-engineered in the future if the availability of mercury switches becomes unreliable as a result of tighter environmental regulations. For the same reason, the end user may have difficulty replacing a mercury switch if it fails. Therefore, a ball-type tilt switch should be used instead of a mercury switch in any newly designed device.

Requirement for Gravity

Because a tilt switch depends on gravity to roll a ball or move a blob of mercury, it will not work in low-gravity, reversed-gravity, or zero-gravity conditions—for example, in a rocket during the unpowered phase of ascent and descent, or in an aircraft that performs aerobatic maneuvers. Performance of a tilt switch in a vehicle that accelerates or decelerates sud-

denly may also be unreliable. Likewise, it cannot be used on a small boat.

Requirement for Stability

A tilt switch will tend to give erroneous results in a location where there is significant vibration or where the object containing the switch may be turned or repositioned unpredictably by the user.

gyroscope

Historically, a **gyroscope** always contained a spinning disc. Some devices for navigation still depend on rotating elements, but they are outside the scope of this Encyclopedia. This entry deals primarily with *vibrating gyroscopes*, also known as *resonator gyroscopes*, that are MEMS devices contained within silicon chips.

OTHER RELATED COMPONENTS

- **accelerometer** (see Chapter 10)
- **GPS** (see Chapter 1)
- **magnetometer** (see Chapter 2)

What It Does

A **gyroscope** resists rotation around any axis at right angles to its own axis of rotation or vibration. Consequently, if the gyroscope is allowed to move freely on gimbals in a sealed enclosure, the gyroscope will tend to maintain its orientation while the enclosure can rotate freely around it.

Taking this concept a step further, if the enclosure is mounted in an aircraft, the aircraft's rotation around two axes can be determined by referring to the gyroscope. If additional gyroscopes are added orthogonally to the first, the aircraft's rotation around all three axes can be determined.

A gyroscope does not measure linear motion in any direction, or any static angle of orientation.

Schematic Symbol

A chip-based gyroscope, magnetomer, or accelerometer may be represented in a schematic as a rectangular box containing abbreviations to identify pin functions (as in any integrated circuit chip).

IMU

An **accelerometer** measures variations in linear motion and will also measure its own static orientation relative to the force of gravity. If an accelerometer rotates around its own axis, it will not measure angular velocity.

A **magnetometer** measures the magnetic field surrounding it, and may be sufficiently sensitive to determine its orientation relative to the Earth's magnetic field.

When an accelerometer and a gyroscope are contained in the same package, optionally with a magnetometer, they may be described as an *IMU* (inertial measurement unit), which can provide necessary data to maneuver aircraft, spacecraft, and watercraft, especially when **GPS** signals are unavailable.

Applications

The first chip-based gyroscope was used in automobiles in 1998 as a yaw sensor in a skid-

control system. Subsequent automotive applications include active suspension control, air bag sensors, rollover detection and prevention, and navigation systems.

Gyroscopes may be installed in military ordnance to provide backup in case an onboard **GPS** system fails, possibly as a result of radio jamming.

Handheld 3D game controllers and headsets may use gyroscopes to control images displayed to the viewer. A digital camera may employ a gyroscope to provide image stabilization. Gyroscopes are usually found in quadcopters or drones, are used to stabilize two-wheeled vehicles such as the Segway, and are used in robotics.

How It Works

The traditional form of gyroscope is a rotating wheel, which will resist turning forces perpendicular to its own axis of rotation. In Figure 9-1, three directions at right angles to each other are defined in the bottom-right corner of the diagram as X, Y, and Z. The wheel is rotating around the X axis, as shown by the green arrow. It will resist any turning force around the Y axis (red arrows) or the Z axis (yellow arrows).

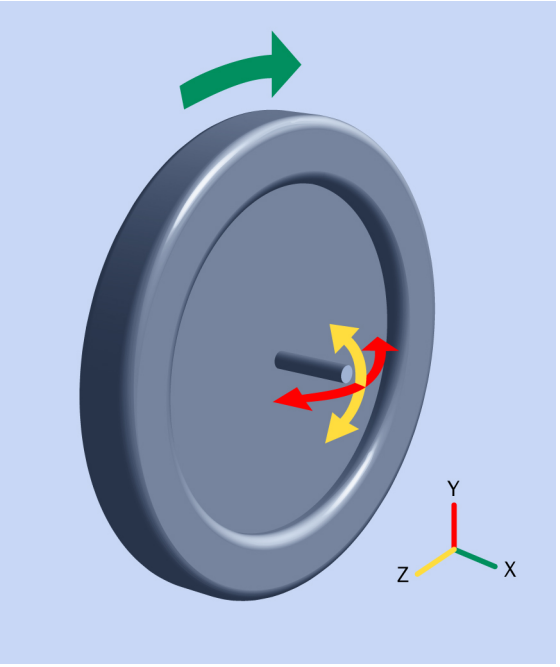

Figure 9-1 *In a traditional gyroscope, a wheel that is rotating (shown by the green arrow) will resist a turning force on either of the axes (shown by red and yellow arrows) perpendicular to its axis of rotation.*

Vibrating Gyroscope

A vibrating fork can be substituted for a wheel. In Figure 9-2 a fork is secured at its base while its tines are induced to vibrate toward each other and away from each other, as suggested by the double-ended arrow. In a chip-based gyroscope, this vibration is induced piezoelectrically or by static electricity.

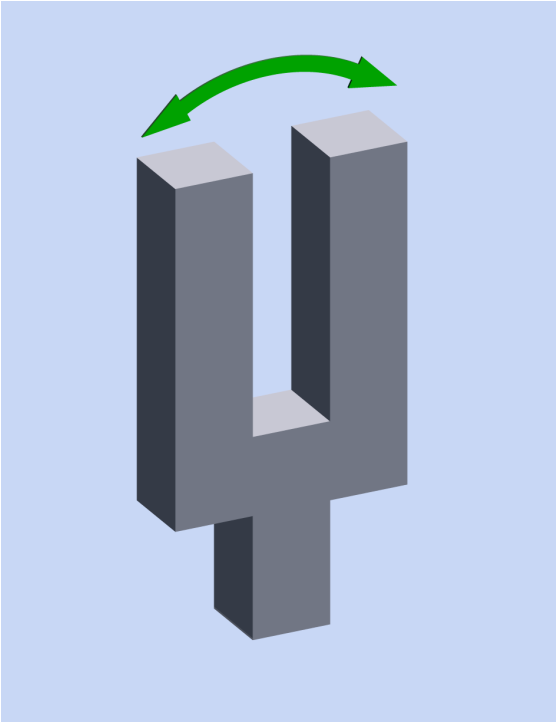

Figure 9-2 *A vibrating fork (green arrows) can be substituted for a rotating wheel in a gyroscope.*

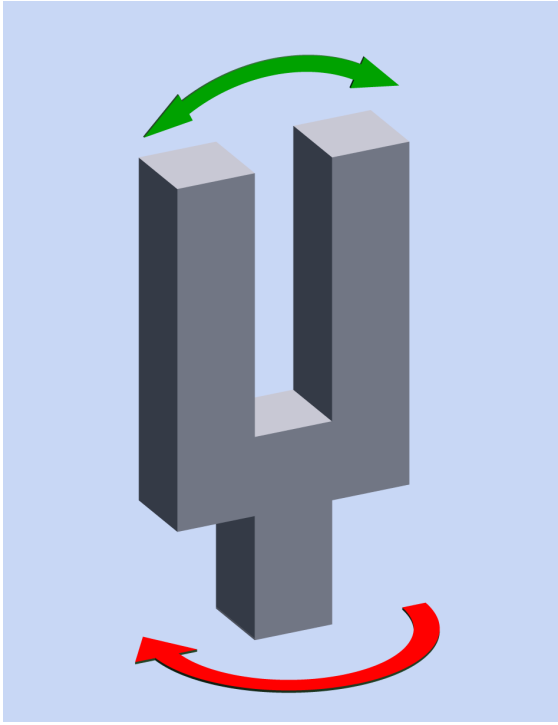

Figure 9-3 *A turning force is applied to the base of the fork around a vertical axis, as shown by the lower arrow.*

Now suppose a turning force is applied around the vertical axis at the base of the fork, as suggested by the lower arrow in Figure 9-3.

The angular momentum of the vibrating tines causes them to resist this turning force, and consequently they will tend to bend, as shown by the yellow arrows in Figure 9-4. The amount of their deflection can be measured capacitively. This system is used in many chip-based gyroscope systems, and may be referred to as a *vibrating gyroscope* or a *resonator gyroscope*.

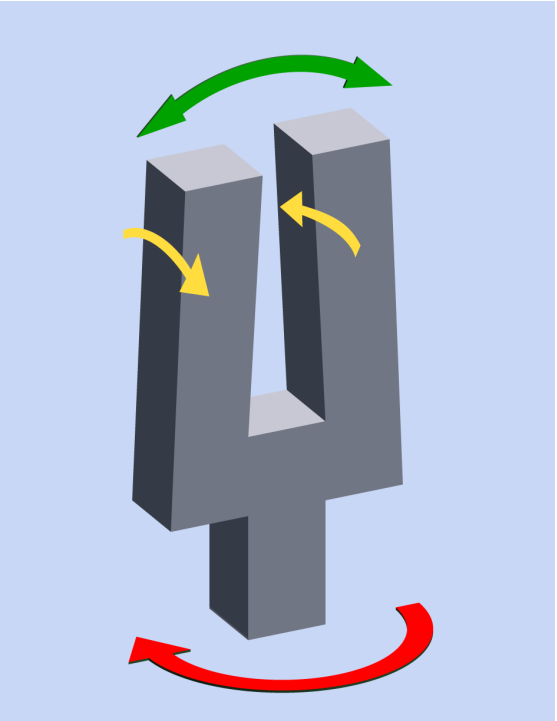

Figure 9-4 *The angular velocity of the rotating fork causes deflection of its vibrating tines, shown by the yellow arrows.*

An assembly of microscopic forks can be etched into a silicon chip. In Figure 9-5, an electron micrograph shows the interior of this type of chip. It contains three rotational sensors, responding to the X, Y, and Z axes of motion. These sensors respond to *pitch* (rotation around the X axis), *roll* (rotation around the Y axis), and *yaw* (rotation around the Z axis).

Fork-based sensors are analog devices whose values are converted to digital values by an onboard *analog-to-digital converter* (ADC). The values are stored in registers that are available to other devices, often via the I2C protocol, which is widely used by microcontrollers.

For additional details about I2C, see Appendix A.

Typically there will be two 8-bit registers for each axis. Each register stores the binary equivalent of a signed integer, where the positive or negative value represents the direction and magnitude of deflection, usually in degrees per second (dps).

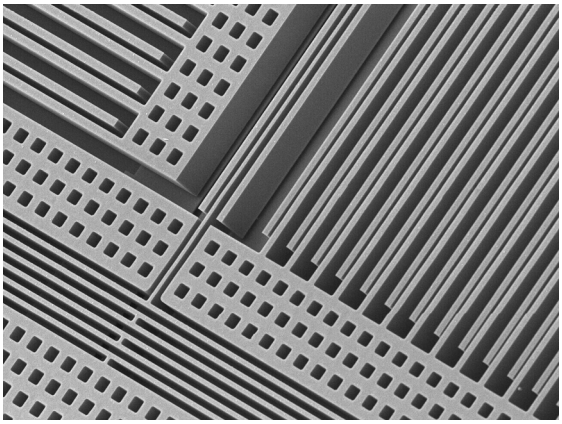

Figure 9-5 *Electron micrograph of the STMicroelectronics LIS331DLH vibrating gyroscope installed in the Apple iPhone 4. The parallel plates at bottom-left function as a spring, while the elements at top-left and at right measure capacitance as their orientation varies according to rotational velocity. Photo courtesy of MEMS Journal published by Chipworks*

Variants

The L3G420D by STMicroelectronics is a 3-axis gyroscope-only chip. It communicates via the SPI or I2C protocol, is approximately 4mm square, and can measure rotational rates up to plus-or-minus 2,000 degrees per second.

The Freescale FXAS21002C has a similar specification. Gyroscope-only chips of this type have fallen in price to the point where they are comparable to the retail cost of everyday components such as a small-signal relay or an audio amplifier on a chip.

IMUs

Chips that only contain gyroscopes are becoming less common as the cost of adding accelerometers decreases.

Gyroscopes and accelerometers are complementary, as gyroscopes are insensitive to linear motion or the Earth's gravity, but accelerome-

ters can measure the rate of change of linear motion and orientation of the chip relative to the Earth. Software can combine this data to calculate the shape of the path being described by a device containing the chip, in addition to the changing velocity of the chip along that path.

The InvenSense MPU-6050 is a common 3-gyroscope, 3-accelerometer chip. It also includes an interface for connecting an external 3-axis magnetometer. The SPI and I2C communications protocols are supported. The MPU-6050 has been a popular choice in the hobby-electronics community, so that Arduino-compatible code to interpret its data is available from many sources. Breakout boards are available with the MPU-6050 installed. An example is the Sparkfun SEN-11028 shown in Figure 9-6.

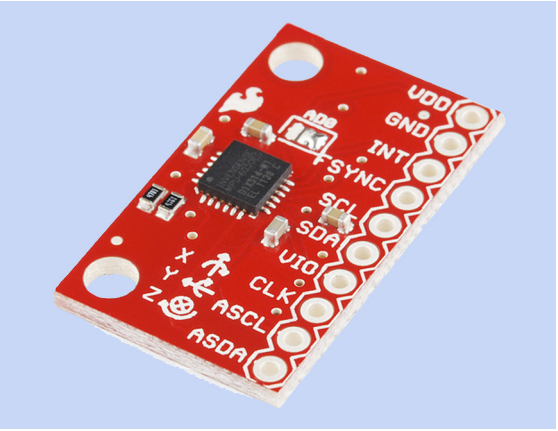

Figure 9-6 *A breakout board from Sparkfun, providing easy access to the InvenSense MPU-6050 chip combining three gyroscopes and three accelerometers.*

Values

The *rotational velocity* of a gyroscope element is usually expressed in degrees of rotation per second (dps), and sometimes in rotations per minute (RPM).

A datasheet will specify the number of sensor axes (usually 3), supply voltage (3.3VDC is common), maximum digital-low and minimum digital-high output voltages, and power consumption in normal mode and sleep mode. Power consumption is usually less than 10mA.

The *dynamic range* is the maximum forward and reverse rotational velocity, which usually will not exceed plus-or-minus 2,000 degrees per second. Lower ranges may be user-selectable. The advantage of selecting a lower maximum rate of change is that it can be converted to a digital value with higher precision.

The *sensor resonant frequency* will be several kilohertz, and must be higher than the frequency of any vibration that is applied to the sensor during use.

The *communications protocol* is usually I2C and SPI may be offered as an option, with a selectable digital output data rate.

Bias temperature coefficient describes the effect of temperature on the gyroscope.

The *resolution* of the gyroscope relates to the number of bits used in the digital output from the onboard ADC. A 16-bit resolution is common.

How to Use It

Using a smart chip such as the MPU-6050, the circuit designer can take advantage of its onboard digital motion processor (DMP). Still, obtaining orientation information from the contents of registers on the MPU-6050 is non-trivial. Online sources and code libraries are necessary. The book *Make: Sensors* contains code listings for the Raspberry Pi as well as the Arduino.

What Can Go Wrong

Temperature Drift

Vibrating materials at the heart of a chip-based gyroscope are likely to change their behavior with temperature. Typically the chip will con-

tain a temperature sensor, the value of which can be used to adjust the output value of the gyroscope.

Mechanical Stress

Stress can be induced when a surface-mount chip is soldered to a board. The vibrating parts of a chip-based gyroscope may be adversely affected. Datasheets will supply information regarding maximum acceptable temperature during the soldering process.

Vibration

Because a chip-based gyroscope depends on the consistent behavior of internal vibrating parts, external vibration can degrade its accuracy. Sensor design can minimize the effects of vibration, but the datasheet should be consulted for details.

Placement

A gyroscope should be placed on a circuit board near a hard mounting point where deflection of the board will be minimized.

accelerometer

10

OTHER RELATED COMPONENTS

- **GPS** (see Chapter 1)
- **gyroscope** (see Chapter 9)
- **tilt** sensor (see Chapter 8)
- **vibration** sensor (see Chapter 11)

What It Does

Acceleration is the rate at which velocity changes over time. If a car takes 10 seconds to increase its speed from 30kph to 40kph relative to the road on which it is traveling, it is accelerating at an average of 1kph each second. If it then reduces its speed back to 30kph during another 10-second interval, it is decelerating at the same rate—although deceleration is really just negative acceleration.

While a car is accelerating, passengers will feel a lateral force exerted on them. Similarly, astronauts in a rocket that blasts off will feel a downward force. According to Einstein's theory of equivalence, forces resulting from acceleration are indistinguishable from the force of gravity.

Consequently, a sensor that measures acceleration can also measure gravity. This sensor is an **accelerometer**. Its output may be measured in *gravities*, abbreviated with the letter g (not to be confused with the usage of G to measure the strength of a magnetic field in gauss).

If three accelerometers are mounted orthogonally (at 90 degrees to each other), their readings can reveal:

- The direction of acceleration of a moving object.
- If an object has been dropped and is falling freely.
- Which way up it is being held in a stationary position.
- The severity of an impact when a moving object collides with some other object.

IMU

A **gyroscope** measures the rate of rotation of the enclosure in which it is mounted. This is properly known as the *angular velocity*. A gyroscope will also respond to changes in the rate of rotation. It does not measure linear motion or a static angle of orientation.

A **magnetometer** measures the magnetic field surrounding it, and may be sufficiently sensitive to determine its orientation relative to the Earth's magnetic field.

When an accelerometer and a gyroscope are contained in the same package, optionally with a magnetometer, they may be described as an *IMU* (inertial measurement unit), which can pro-

vide necessary data to maneuver aircraft, spacecraft, and watercraft, especially when **GPS** signals are unavailable.

Schematic Symbols

A chip-based accelerometer may be represented in a schematic as a rectangular box containing abbreviations to identify pin functions, as in any integrated circuit chip. No specific symbol is used for any of these components.

Applications

In the past, accelerometers were laboratory devices that calibrated the performance of cars, airplanes, and other types of vehicles. Measuring the ability of car tires to withstand cornering forces was an application where an accelerometer was used.

Miniaturization of accelerometer elements, coupled with a radical reduction in their cost, has enabled them to be installed in small electronic devices ranging from smartphones to hard drives.

In a phone or a camera, accelerometers can determine which way up the user is holding the device. The camera can rotate the picture appropriately, and the orientation of the picture can be saved with its image data.

In an external hard drive containing rotating platters, accelerometers can protect the read-write heads by rapidly parking them during the fraction of the second that elapses between someone dropping the hard drive and its impact with the floor.

Accelerometers can be installed in a 3D mouse or virtual-reality headset to determine its orientation and motion. This enables a video image to be updated appropriately. For example, the Nintendo Wii Remote has been marketed with an ADXL330 accelerometer.

In an automobile, an accelerometer can trigger the deployment of an air bag when the deceleration caused by an impact exceeds a threshold level.

How It Works

The simplest conceptual model of an accelerometer consists of a mass attached to one end of a coiled compression spring. The other end of the spring is anchored in an object whose acceleration is being measured. The mass can only move along the same axis as the spring.

Figure 10-1 shows three views of a simplified accelerometer, which is a sealed tube shown in dark red. In the center image, the accelerometer is in its rest state. The top image shows the mass (a dark blue square) responding when the tube accelerates from left to right. The third image shows it decelerating (that is, undergoing negative acceleration, or acceleration from right to left). Using an ideal spring, the displacement of the mass will be proportional to the rate of acceleration, within reasonable limits. The displacement can be measured optically or capacitively.

Note that the rest state will resume when the acceleration stops, regardless of constant motion in any direction. An accelerometer only measures a *change* in velocity. It does not measure a constant velocity.

An accelerometer cannot measure rotation around its own axis of movement. Therefore, it may be used in conjunction with a **gyroscope**, which measures angular velocity.

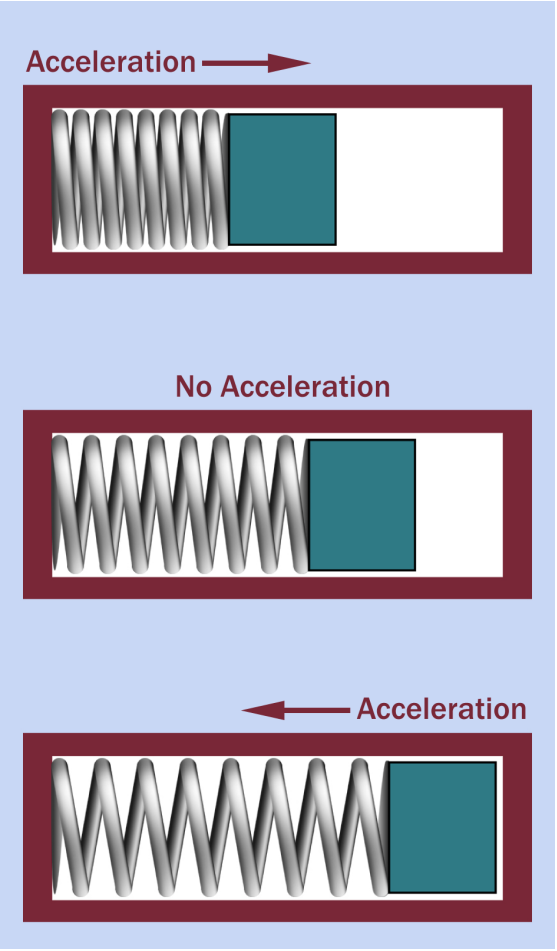

Figure 10-1 *Simplified view of an accelerometer consisting of a sealed tube (dark red outline) with a spring anchored to it at left. A small mass (dark blue) is attached to the right end of the spring. The mass responds to acceleration of the tube.*

Gravity and Free Fall

If a device containing the simplified accelerometer described previously rests on the ground, and is mounted vertically as in the left section of Figure 10-2, gravity acting on the mass will apply a force to one end of the spring, while the other end is restrained. The accelerometer will now measure 1g as a downward force.

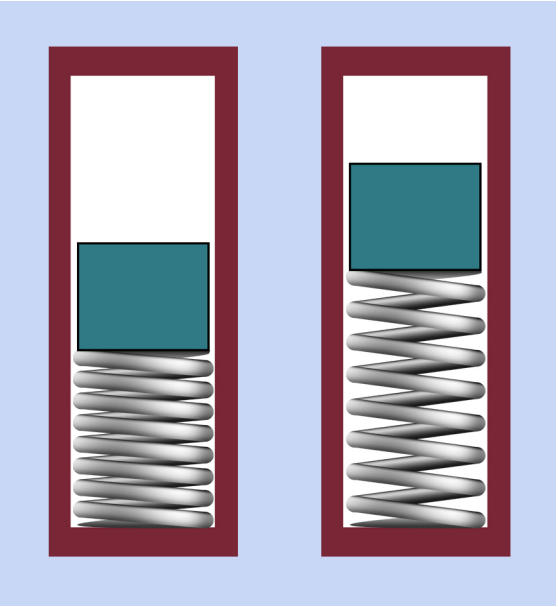

Figure 10-2 *Left: an accelerometer resting on the ground measures 1g, as the force of gravity pulls the mass downward. Right: in free fall, the accelerometer measures 0g.*

If the device is dropped so that it falls freely under the influence of gravity, it is in *free fall* and will accelerate at approximately 9.8 meters per second each second. This is usually written as 9.8m/sec^2, or can be described as 1 gravity, often expressed as 1g.

An accelerometer in free fall will measure 0g, as shown on the right in Figure 10-2, because all parts of the accelerometer are now accelerating equally under the force of gravity.

If three accelerometers are assembled orthogonally, and if one accelerometer is vertical, and the device is held motionless relative to the Earth, the vertical sensor will show 1g while the other two accelerometers will show 0g. If the device is dropped, all sensors will show 0g.

Rotation

If a device containing three accelerometers is turned over, and is not in free fall, accelerometers mounted orthogonally will show values that vary depending on their alignment with the force of gravity.

Calculation

The force acting upon an object will cause a rate of acceleration that can be calculated by Newton's Second Law of Motion, provided that the object can move freely and is not being subjected to any additional forces, such as the force of gravity. If F is the force, m is the mass of the object, and a is the acceleration:

```
F = m * a
```

And therefore:

```
a = F / m
```

If the mass is restrained by a spring whose compression or extension has an approximately linear relationship to the force applied to it, acceleration can be calculated as a function of the linear displacement of the mass.

These statements ignore relativistic effects that are insignificant unless ultra precise time and motion measurement may be involved.

In a real-world accelerometer, movement of the mass will require some form of damping to prevent it from oscillating.

Variants

Accelerometer prices dropped radically after 2010. In an effort to maintain profitability, manufacturers have loaded more features onto chips. While a 2-axis accelerometer such as the Memsic 2125 seemed a good option when first introduced, it is now facing obsolescence as 3-axis accelerometer chips that also contain 3-axis gyroscopes have become ubiquitous—and no more expensive.

Early chip-based accelerometers provided analog outputs where voltage was proportional with acceleration and could be processed by a comparator. On some breakout boards, such as the Dimension Engineering DE-ACCM6G, which used the STMicroelectronics LIS244ALH chip, a comparator was included (see Figure 10-3).

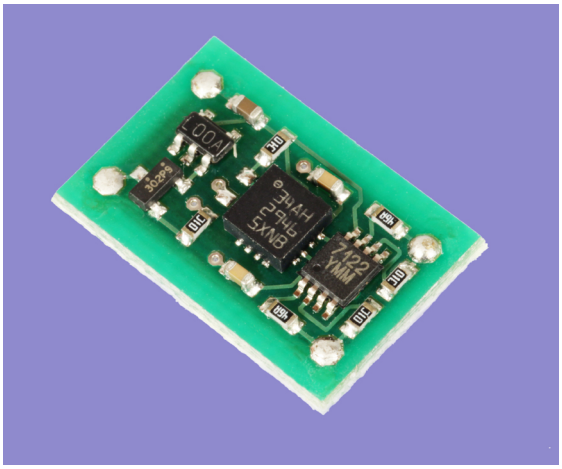

Figure 10-3 *A relatively early, relatively expensive breakout board using the 2-axis accelerometer LIS244ALH chip by STMicroelectronics. It has been superceded by chips that combine accelerometers, gyroscopes, and processors to provide a digital output.*

Because this board allowed a maximum output of only 0.83mA, it was only suitable for high-impedance logic chips or a microcontroller. However, because the output was analog, it could be passed through another comparator for direct connection to a piezo beeper to create a device that would sound an alarm when tilted. This is shown in Figure 10-4.

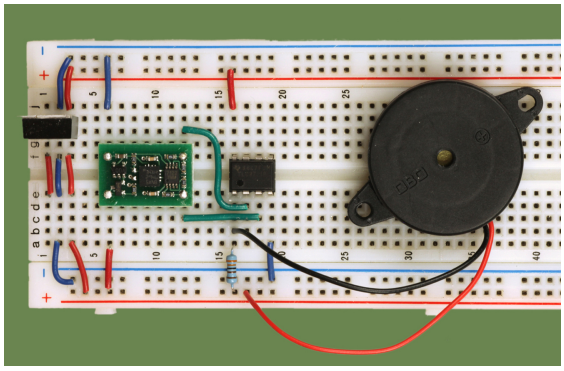

Figure 10-4 *Connecting the analog output from the DE-ACCM6G 2-axis comparator breakout board through a comparator to a piezo beeper.*

Many chips now contain gyroscopes as well as accelerometers. The electron micrograph in Figure 10-5 shows the interior of a chip of this

kind, where the zig-zag shapes are "springs" etched into the die, the large areas patterned with dots are masses that can respond to various forms of motion, and the parallel plates are capacitive sensors.

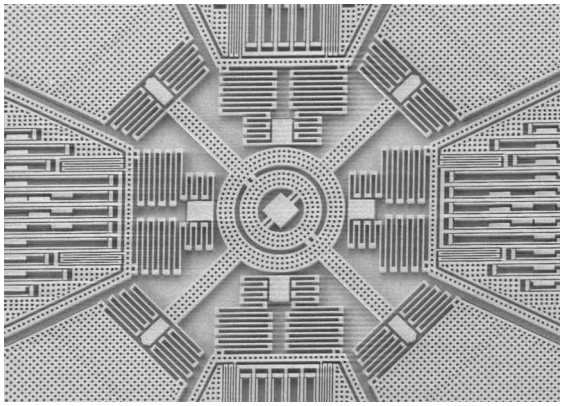

Figure 10-5 *Interior of a chip combining gyroscopes with accelerometers.*

The complexity of a chip combining two types of sensors creates a need for more complicated code to process the six outputs. Consequently most accelerometer chips now have their own onboard ADCs, and digital registers for communication with microcontrollers via the I2C communication protocol. Some chips also have onboard processing to interpret the mix of data. However, microcontrollers still need code to make sense of the data.

The hobby-electronics community has responded. A breakout board such as the LSM9DS0 from Adafruit, using a chip from STMicroelectronics that shares that same part number, tries to make this extremely complex chip accessible to experimenters. Shown in Figure 10-6, the LSM9DS0 contains a 3-axis magnetometer in addition to a 3-axis gyroscope and a 3-axis accelerometer.

The datasheet for the LSM9DS0 runs to more than 70 pages. At the time of writing, Adafruit is still refining code for the Arduino to make the features of this chip accessible.

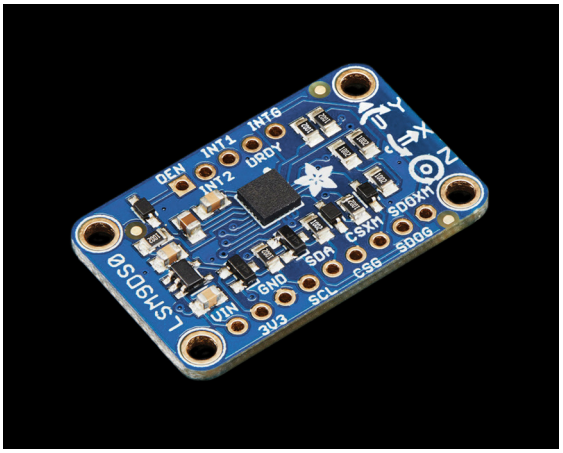

Figure 10-6 *This breakout board from Adafruit is built around an LSM9DS0 chip that combines accelerometers with gyroscopes and magnetometers.*

Despite the complexity of the LSM9DS0 chip, the breakout board sells for approximately the same price, at the time of writing, as the DE-ACCM6G 2-axis analog-output magnetometer four years ago. In the future we may expect IMU prices to fall still further, so that this type of multifunction chip becomes the default, and users simply ignore the functions that they don't need.

Values

Current consumption will vary depending on the activity of the chip, and may be broken down for different types of sensors on multi-sensor chips. A modern accelerometer may typically draw less than 1mA. Gyroscope power consumption will be greater, as a segment of the chip will be maintained in a state of vibration.

Linear acceleration measurable by an accelerometer is customarily expressed in gravities, abbreviated g. Current generations of chips may be able to measure as much as plus-or-minus 16g, but because the value is converted internally to a digital quantity, smaller accelerations will not be expressed so accurately. Therefore the measurement range for acceleration is

usually user-selectable by sending an appropriate code to the chip. Ranges may include plus-or-minus 2g, 4g, 6g, 8g, and 16g.

Sensitivity defines the smallest increment of acceleration measurable by the least significant bit (LSB) in an output register, for each of the acceleration ranges. In a range of plus-or-minus 2g, the internal 16-bit ADC may be capable of measuring 0.06 milligravities. When the range is reset to plus-or-minus 16g, the smallest increment may be around 0.7 milligravities.

The measurable range of gravities should not be confused with the maximum acceleration that the chip can tolerate without suffering internal mechanical damage, either while it is powered or unpowered. This will be more than 1,000g provided the duration is brief, and would only be experienced during an impact.

Linear acceleration sensitivity change versus temperature is usually expressed as a percentage, such as plus-or-minus 1.5%.

Output type will be analog or digital. If digital, the data protocol will be I2C or SPI. If I2C, the address of the device should be configurable. The data transfer rate is typically at least 100kHz, and this also may be configurable to different rates.

For additional details about protocols such as I2C, see Appendix A.

What Can Go Wrong

Mechanical Stress

Stress can be induced when a surface-mount chip is soldered to a board. The moving parts in a chip-based accelerometer may be adversely affected. Datasheets will supply information regarding maximum acceptable temperature during the soldering process.

Other Problems

If the accelerometer function is combined with other sensing functions such as magnetometer or gyroscope, see Chapter 2 or Chapter 9 for additional cautions about potential problems affecting these kinds of sensors.

vibration sensor

11

An **accelerometer** can measure some aspects of vibration. However, this entry deals primarily with mechanical devices (often described as *vibration switches*) and piezoelectric devices (often described as *vibration sensors*) that are solely intended to measure vibration.

A *vibrometer* measures vibration using a laser beam aimed at a reflective spot applied to a surface. It is usually a laboratory instrument, beyond the scope of this Encyclopedia.

OTHER RELATED COMPONENTS

- **accelerometer** (see Chapter 10)
- **tilt** sensor (see Chapter 8)
- **force** sensor (see Chapter 12)

What It Does

A vibration sensor responds to repetitive mechanical motion. Most versions contain two switch contacts that are normally open and will close if the sensor vibrates in its designed frequency range. In some sensors, the frequency range and sensitivity are manually adjustable.

Large sensors are used as automatic shutdown switches responding to excessive vibration in machinery, and may be capable of switching substantial currents (10A or higher). Smaller versions can shut down domestic appliances such as a washing machine that is seriously out of balance during a spin cycle.

A vibration sensor can be used as a simple user-input device in toys and games.

A shock sensor can detect abuse of a sensitive device, for example, by including the sensor and a data logger when the device is transported.

Schematic Symbols

Either of the symbols in Figure 11-1 may represent a piezoelectric or piezoresistive vibration sensor, but they also represent other piezo-based devices.

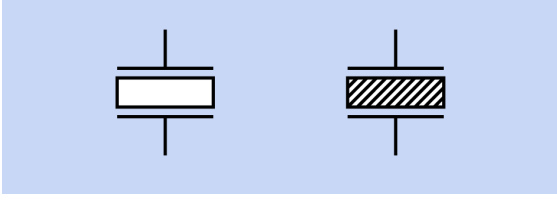

Figure 11-1 *Either of these symbols may represent a piezoelectric or piezoresistive device, including (but not limited to) vibration sensors that operate on this principle. The symbol on the left is more common.*

Variants

Vibration sensors use a wide variety of detection methods.

Pin-and-Spring

Probably the simplest type of sensor consists of a small, thin pin in the center of a miniature coil spring. The spring is anchored at its base, but its other end is free to vibrate. If the vibration reaches a sufficient amplitude, the spring touches the pin, completing a circuit between the two leads of the device.

An example is shown in Figure 11-2, where two identical sensors are shown, one of them cut open to reveal the gold-plated rod and spring inside. This sensor is rated for 10mA at up to 12VDC.

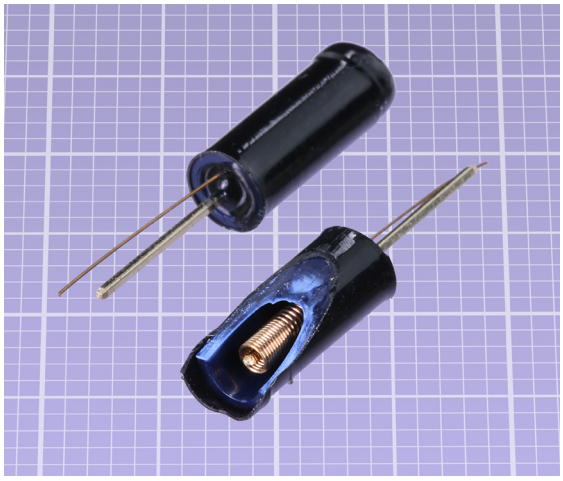

Figure 11-2 *When the spring in this sensor vibrates, it touches the pin that is centered in it. The background grid is in millimeters.*

Advantages of this system are low cost, ability to respond along two out of three axes, no power supply requirement, and ability to switch AC or DC. However, because the internal contact is extremely brief, it must be connected with a latching component of some type. A flip-flop could be used, or a 555 timer. The switch may also be connected with an input pin on a microcontroller, provided a pullup or pulldown resistor is used to prevent the input from floating when the switch is open.

Externally, the packaging of a pin-and-spring vibration sensor is almost indistinguishable from a small **tilt** sensor that contains one or two spherical metal balls. The tilt sensor may respond to vibration, but only of a large amplitude and low frequency.

A miniature board containing a pin-and-spring vibration sensor, comparator, and trimmer potentiometer for sensitivity control is sold cheaply by the Chinese supplier Elecrow as their product SW-18015P, shown in Figure 11-3. Elecrow also offers a wide range of other low-cost sensors.

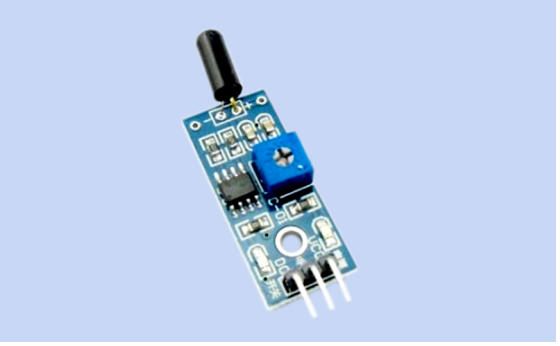

Figure 11-3 *A pin-and-spring vibration sensor mounted on a board with sensitivity control.*

Piezoelectric Strip

The LDT0-028K by Measurement Specialties is a section of piezoelectric polymer film laminated to a polyester substrate. The film is designed to be anchored at one end, allowing the other end to vibrate. An unweighted version and a weighted version are shown in Figure 11-4, each measuring about 13mm x 25mm. Addition of the weight alters the resonant frequency of the sensor.

Deflection of about 2mm is sufficient to generate a surprising 7VDC between the two leads. Larger deflections will generate higher voltages. The manufacturer suggests that direct connection to a CMOS component is possible. An op-amp may be used for signal conditioning.

A piezoelectric device of this type only generates voltage during the process of deflection. If

the strip is held in a curved position, its output diminishes to zero.

This sensor has a resonant frequency around 170Hz when there is no weight attached to its free end.

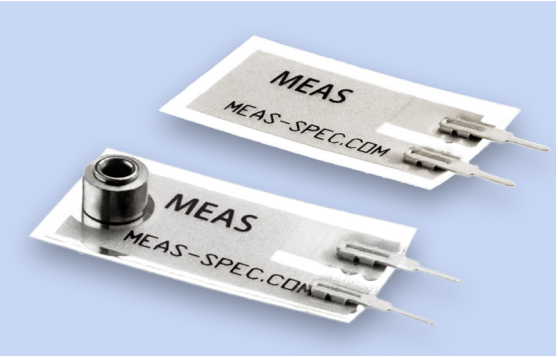

Figure 11-4 *Two versions of the LDT0-028K vibration sensor from Measurement Specialties, one with an added weight to lower its resonant frequency.*

Chip-Based Piezoelectric

The Murata PKGS series is an example of a surface-mount piezoelectric shock sensor. Measuring only about 1mm x 2mm x 4mm it has an analog output designed for connection through an op-amp. The manufacturer suggests application in a hard-disk drive to block read-write operations when vibration occurs. Similarly, these shock sensors may be used in CD-ROM or DVD drives. They may also be installed in cash dispensing machines to sound an alarm if vandalism occurs.

Toshiba's TB6078FUG is a similar product. Note that because these devices contain electronic components, they require a power supply (usually 3.3VDC to 5VDC) for operation.

"Mousetrap" Type

Some vibration switches rely on a simple system of leverage that is comparable to a mousetrap, in that a relatively small stimulus releases a strong spring. In Figure 11-5 the upper part of the figure shows the switch at rest, held in its position by a powerful spring and by the weight of a mass attached to a pivoted arm. In the lower part of the figure, severe vertical vibration has caused the assembly to move up and down with sufficient energy to overcome the tension in the spring while the inertia of the mass has resisted the motion. Consequently the arm has moved past the position where the spring is aligned with the pivot, and the spring now acts to hold the arm against a snap-action switch. A system of this type is used in sensors on some power-station cooling towers, where the loss of a large fan blade can result in major vibration.

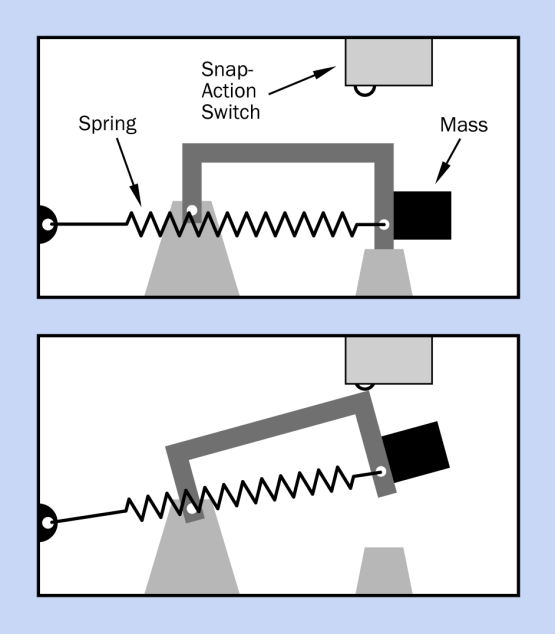

Figure 11-5 *A spring-loaded vibration sensor.*

Magnetic

Typically this method is used to detect excessive vibration in machines or other devices containing heavy rotating mechanical components. The sensor may be physically large, moving switch contacts that are designed to handle currents of 1A or significantly more.

In one system, a steel ball is retained by a permanent magnet that is barely powerful enough to prevent the ball from falling. Excessive low-frequency vibration will dislodge the ball, which falls and completes a circuit between

two contacts. This activates a relay that powers down the piece of machinery that is vibrating.

The ball may be spaced a small distance from the magnet by a beveled nonmagnetic seat, and the seat may be movable with an external screw. This will adjust the sensitivity of the switch. After the switch has been triggered, it must be reset, which may entail using an external lever to raise the ball back to its location near the magnet.

Another magnetic system is shown in Figure 11-6, where a magnet on a vertical arm can be displaced by horizontal vibration, and an inertial mass on a spring-loaded horizontal rod can also dislodge the magnet in response to vibration along the other two axes.

Figure 11-6 *A magnetic vibration switch. See text for details.*

Mercury

A small *mercury switch* may be used as a vibration sensor, although this application is uncommon. See Chapter 8 for more information about mercury switches.

Values

Measurement of vibration is a complex science of special interest in mechanical design, especially in areas such as the powertrain and suspension geometry in an automobile. Only a few fundamentals will be summarized here.

Primary Variables

The four primary variables in vibration are frequency, displacement, velocity, and acceleration. Frequency describes how rapidly the vibration occurs; displacement describes how far the vibrating object moves in each direction; velocity describes how fast it moves during each cycle; and acceleration describes how rapidly the velocity changes during each cycle. Different types of sensors can be chosen for their responsiveness to each attribute.

Figure 11-7 shows the theoretical relationships between displacement, velocity, and acceleration plotted against the frequency of vibration. The y axis of this graph (the vertical axis) is often labeled "amplitude," but in reality it is being used to measure three different units, as shown. The curves indicate that if the velocity of vibration remains constant while frequency increases, acceleration must increase as a function of the frequency while displacement decreases. The acronym "rms" denotes that the values are measured as the "root mean square" of their fluctuations.

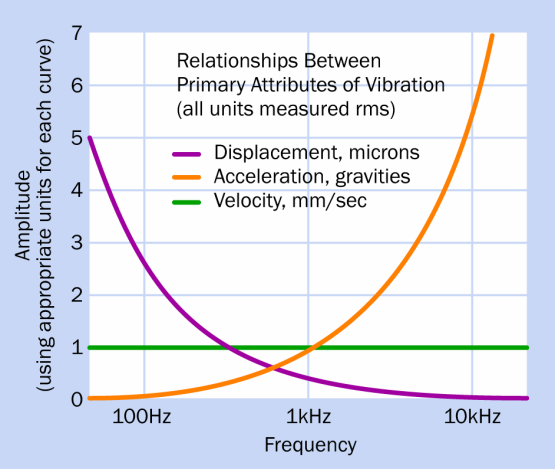

Figure 11-7 *Theoretical relationships among the primary attributes of vibration.*

Mechanical sensors or switches that respond to displacement are best suited to low frequencies, while piezoelectric sensors that are sensitive to acceleration are best suited to higher

frequencies. Serious mechanical problems tend to result in low-frequency vibrations, while wear on bearings and in gear trains will be more likely to create high-frequency vibration.

Dynamic Attributes

Datasheets for small piezoelectric sensors may only show basic values such as the voltage range that is likely to be created.

Small mechanical sensors of the pin-and-spring type will be rated for maximum voltage and switching current. Typical values may be around 12V (AC or DC) and 10mA, indicating that the output from this type of sensor should be used with an op-amp, microcontroller, logic chip, solid-state relay, or other semiconductor with a high-impedance input.

Sensors that are manufactured for industrial applications will be rated for attributes such as measurable acceleration range (in gravities), temperature sensitivity, frequency response, resonant frequency, capacitance, and power requirement.

The sensitivity of piezoelectric sensors is usually expressed in mV/g. This type of sensor will require a comparator to process the tiny amount of current that it creates.

How to Use It

If a vibration sensor has an analog output requiring a comparator, the output from the comparator is likely to be of the open-collector type. This will require a pullup resistor of a value that provides an appropriate voltage for the next stage in the circuit. For more information about comparators, see Volume 2. For more information about the use of an open-collector output, see "3. Analog: Open Collector".

A *coupling capacitor* can remove the DC component from the comparator output, allowing only the frequency of vibration to pass through. The choice of capacitor value will depend on the frequency.

When using a piezoelectric sensor with analog output, a 10M resistor may be installed across its two terminals to reduce voltage drift.

The primary challenge in getting a vibration sensor to work successfully will be matching it to the source of vibration. Manufacturers' datasheets for chip-sized sensors often provide very little information about the optimal values for their products. Peak performance will occur when the natural resonant frequency of a sensor is close to the frequency of vibration that it must detect. Trial and error may be necessary.

A sensor must be mounted appropriately. Most sensors are directional, at least to some extent, and many will not respond significantly to vibration at 90 degrees to their primary axis of sensitivity. Their performance will also diminish if they are placed too far from the vibration source, or if they are mounted on a flexible or yielding surface that will tend to absorb vibration.

While industrial vibration switches may be adjusted manually, the response of small devices designed for circuit-board mounting can only be tweaked using external components to filter out unwanted signals from the sensor.

What Can Go Wrong

Long Cable Runs

The output from a piezoelectric vibration sensor is primarily an AC signal, fluctuating at the frequency of the vibration. Long cabling, or inadequately shielded cabling, can potentially introduce capacitive effects that can degrade the sensor signal. This issue will only affect higher frequencies.

Interference

Sensor signals can also be affected by electromagnetic interference from power lines, transformers, and large motors. This is a significant

issue, as a primary application for industrial vibration sensors is to measure vibration created by motors.

Correct Grounding

For large sensing equipment, grounding may be important to shield cables that transmit data. In an industrial environment, however, grounding is primarily motivated by safety considerations, and an electrical ground can carry unwanted interference. Ground loops may be created if there are multiple ground points. Ideally, a "ground tree" should be used, where there is only one primary grounding point, and grounds to equipment branch out from it.

Fatigue Failure

In installations where some vibration normally exists, cables should be anchored properly to minimize the risk of fatigue failures.

force sensor

12

A *load cell* or *load sensor* is generally intended to measure a static load, while a *force sensor* can respond dynamically. However, this semantic distinction is not always observed. This entry differentiates between load cells and force sensors but includes them both.

Traditional types of *hydraulic* and *pneumatic* load sensors are not electronic devices. They are outside the scope of this Encyclopedia.

Capacitive, *ultrasonic*, *magnetic*, *optical*, and *electrochemical* force sensors are relatively unusual, and are not included in this Encyclopedia.

A force sensor is occasionally described as a **pressure** sensor, but that term is ambiguous, as it is more often used in conjunction with fluids. This Encyclopedia assumes that a pressure sensor only measures gas or liquid pressure. See Chapter 17.

A **vibration** sensor reacts to rapidly changing forces, but usually cannot measure them accurately, and is simply triggered when vibration exceeds a threshold. See Chapter 11.

Impact sensors that measure the force of a collision are outside the scope of this Encyclopedia.

A sensor designed to respond to a single touch from a fingertip is considered a human-input device and is discussed in the **single touch** sensor entry. See Chapter 13.

OTHER RELATED COMPONENTS

- **vibration** sensor (see Chapter 11)
- **single touch** sensor (see Chapter 13)

What It Does

A **force** sensor measures physical force that is applied to it, either by a person or by an object. Many force sensors respond rapidly and can measure fluctuating forces.

A *load cell* or *load sensor* is usually intended to measure the static weight of an object.

Applications

In robots, force sensors can provide feedback to limit the grip of a mechanical hand. They can also provide haptic feedback for a surgeon performing robotic surgery. In the future, force sensors may find increasing application in agriculture, as mechanized handling of fruit and other foods requires a carefully controlled gripping force.

In medicine, the use of force sensors to evaluate muscle strength in hands or limbs can be important as an indicator of neurological problems or to monitor progress in occupational therapy. Thin force sensors can be installed in shoes to check the weight distribution of each foot. They can also be used for entertainment purposes, to light LEDs in sneakers.

A force sensor may respond to a single-touch user input. See Chapter 13 for more information about **single touch** sensors. Some video game controllers use resistive force sensors to measure the amount of pressure applied to a button. The PlayStation is an example. (Old PlayStation DualShock 2 controllers are a salvageable source of pressure-sensitive buttons.)

Load sensors are used to weigh industrial products, and are also used domestically in kitchen and bathroom scales.

A load sensor can also detect human presence—for example, in the passenger seat of an automobile, where an air bag must not deploy if a young child is present, or in a hospital, to monitor the number of times the patient gets out of bed.

Schematic Symbol

No specific schematic symbol is used for either a force sensor or a load sensor. If a force sensor uses a piezoelectric or piezoresistive element, it may be represented by the symbol shown in Figure 11-1, which is used for many piezo devices.

How It Works

Two methods of force measurement are commonly used: resistive and piezoelectric.

A *piezoelectric* force sensor uses a piezoelectric element, often consisting of a quartz crystal, to convert force to a small voltage that can be amplified. However, this type of sensor only responds to changes in force. If a constant load is applied, the output peaks quickly and then gradually diminishes to zero.

Resistive force sensors change their electrical resistance when force is applied. They include *metallic strain gauges* and *plastic-film* sensors in which two layers of conductive ink are pressed together.

In SI (standard international) units, the force needed to activate a sensor is measured in newtons, abbreviated with a capital letter N. A newton is defined as the force that would accelerate a mass of 1 kilogram at 1 meter per second each second. More practically, in the gravitational field at the surface of the Earth, 1N = about 100 grams of weight. There are about 28 grams in an ounce; thus 1N is slightly less than 4 ounces.

Strain Gauge

A strain gauge is often made from metallic foil applied to an insulating flexible backing. The backing is glued to a shaped piece of metal, usually steel or aluminum, which is designed to flex slightly under pressure and may be referred to as a *spring*, even though it is often one solid object. Its deflection will be related to the force imposed on it.

The maximum deformation of the spring under a strain gauge is usually 500 to 2,000 parts per million (ppm) when subjected to the maximum force that it is designed to measure. A change of 1ppm is referred to as a *microstrain* (abbreviated μe).

The strain gauge has no polarity, and functions like a force-controlled **potentiometer** (see Volume 1). The ratio of the change in its resistance to the change in the strain that it experiences is called the *gauge factor*. For metal foil gauges, the gauge factor is usually around 2.0. This is an approximately linear relationship.

The most common type of foil pattern is shown in Figure 12-1. In the figure, if a stretching force is applied horizontally, the multiple thin sections of foil are slightly elongated, and their

resistance increases within the limits of elasticity of the foil. This effect is multiplied by the number of sections. If the stretching force is applied vertically, the sections are merely separated slightly, and the result is negligible.

Wheatstone Bridge Circuits

The very small changes in resistance in a strain gauge must be amplified to be usable, and the first step is to use a Wheatstone bridge circuit. The simplest form of this circuit is shown in Figure 12-2.

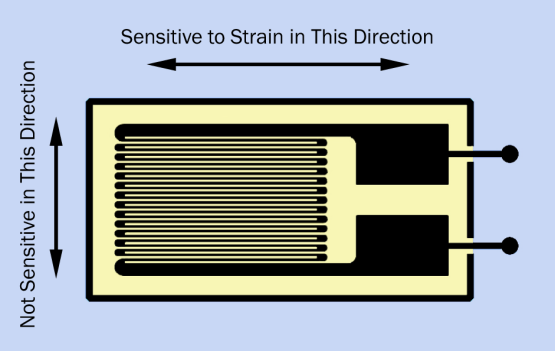

Figure 12-1 *The pattern of metallic foil used in a typical strain gauge.*

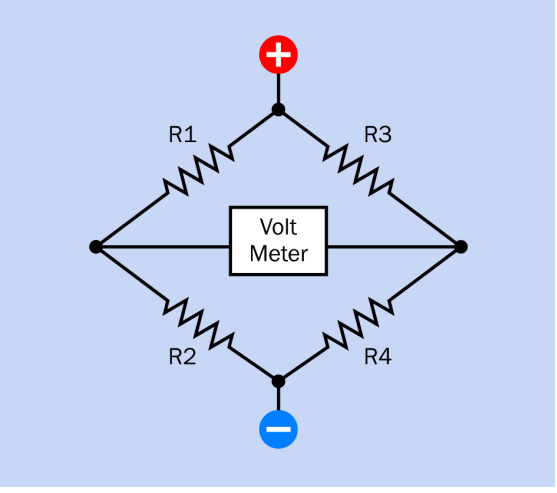

Figure 12-2 *A demonstration version of the basic Wheatstone bridge circuit that is often used to detect small changes in a resistance.*

Each pair of resistors (R1 + R2, and R3 + R4) functions as a voltage divider. If all the resistors have an exactly equal value, the voltage at the midpoint of each pair will be identical, and the volt meter at the center will have a zero reading. However, if the value of one resistor changes slightly, the meter will register the imbalance. This circuit is commonly used because of its sensitivity to small variations.

In Figure 12-3 two strain gauges have been substituted for resistors R3 and R4. The upper strain gauge has been mounted so that it experiences an increase in force at the same time that the lower strain gauge experiences a decrease, usually because one gauge is mounted on the top side of a flexing element while the other gauge is mounted on the underside.

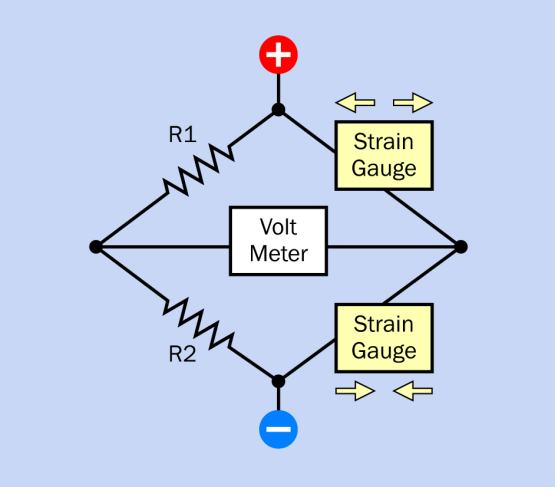

Figure 12-3 *Two strain gauges, oppositely oriented, can be used as resistances in the Wheatstone bridge circuit.*

Using two strain gauges in this way doubles the sensitivity of the Wheatstone bridge circuit. The configuration is known as a "half Wheatstone" force sensor, and will have three connecting wires. One will be black, one will be red, and the third will be a different color. The red and black wires are for connection to the power supply, as shown in the schematic, while the third wire is common and should be considered as an output.

If an additional two strain gauges are inserted in the Wheatstone bridge circuit, this is now a "full Wheatstone" force sensor (see Figure 12-4). Note, however, the diagonally symmetrical orientations of the strain gauges, necessary to multiply their effect.

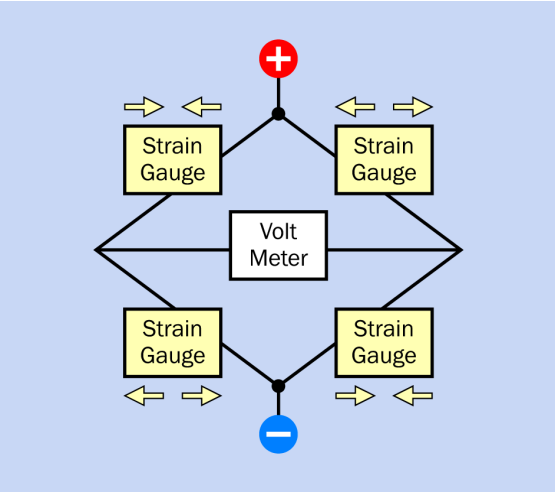

Figure 12-4 *Two additional strain gauges create a "full Wheatstone" circuit.*

A typical digital bathroom scale contains two half-Wheatstone force sensors, wired to create a full-Wheatstone configuration.

The force sensors shown in Figure 12-5 are rated for up to 50kg each, and can thus weigh up to 100kg if they are combined in a scale. In this figure, one sensor has been turned over to show its underside. The strain gauges are hidden in each sensor where the steel sections overlap.

Wheatstone Bridge Errors

Where more than one strain gauge is used in a Wheatstone bridge, they should ideally have identical performance. Since this is impossible as a result of manufacturing tolerances, some error correction is built into devices using multiple strain gauges.

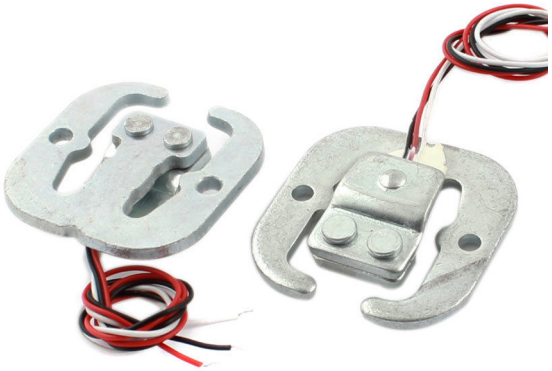

Figure 12-5 *Two force sensors suitable for a bathroom scale, each containing a pair of strain gauges that will flex oppositely under load.*

Strain-Gauge Amplification

The voltage output from a Wheatstone bridge circuit is given by the following formula, where V_{IN} is the supply voltage, V_{OUT} is the output, and R1 through R4 are the resistance values that were used in Figure 12-2.

$$V_{OUT} = [(R3/(R3+R4)) - (R2/(R1+R2))] * V_{IN}$$

The good news is that the output when a strain gauge is used will vary linearly with the load applied. The bad news is that it will be very small.

To amplify it, an op-amp such as the AD620 is often recommended. Using external resistors, its amplification factor can be adjusted from 1:1 to 10,000:1. Alternatively a chip such as the HX711 by Avia Semiconductor contains a 10-bit analog-to-digital converter and is specifically designed for use in weighing scales. Its digital output uses a very simple serial format. Sparkfun sells a breakout board incorporating this chip. See Figure 12-6.

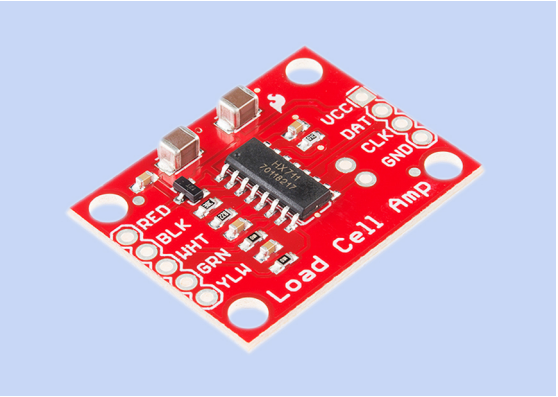

Figure 12-6 *Sparkfun HX711 breakout board for the HX711 amplifier chip, specifically designed for a full-Wheatstone array of strain gauges in a force sensor.*

Other Strain-Gauge Modules

Strain gauges are built into a variety of sensor modules. Figure 12-7 shows a selection, all of which are available from Sparkfun. Many more can be found online.

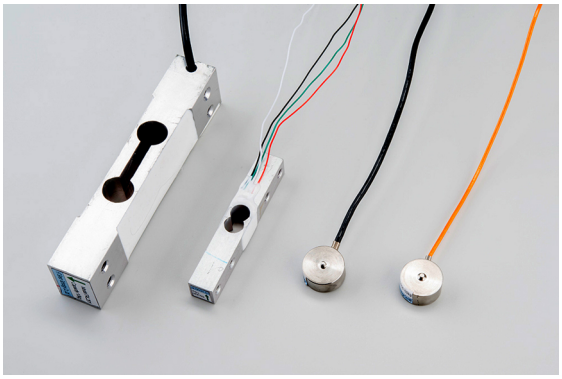

Figure 12-7 *A selection of load cells containing strain gauges, available from Sparkfun.*

Plastic-Film Force Sensors

Plastic-film resistive sensors contain two layers of conductive ink, sealed between two layers of thin, transparent plastic film. The resistance between the ink layers diminishes when they are pressed together. It may vary from as little as 30K when fully loaded to more than 1M when unloaded.

Like a strain gauge, this sensor has no polarity and requires no power supply.

Examples of this type of sensor are shown in Figures 12-8 and 12-9. Other shapes and sizes are available. Manufacturers include Tekscan, whose product is named FlexiForce; Alpha Electronic, in Taiwan; and Interlink Electronics.

Figure 12-8 *A FlexiForce A401 resistive film sensor made by Tekscan, Inc. Its sensing area is 25.4mm in diameter (1 inch) and is rated to measure up to 111N (25lbs).*

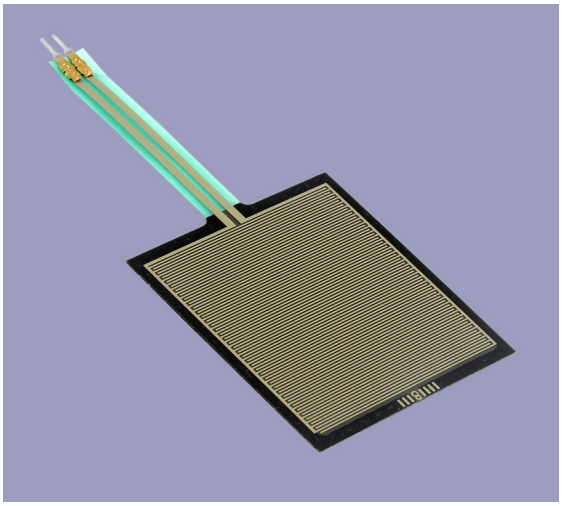

Figure 12-9 *An Interlink FSR406 resistive film sensor. Its sensing area is slightly less than 40mm square, and is rated to measure up to 20N (4.5lbs).*

Plastic-film sensors should not be confused with film-based piezoelectric vibration sensors, which are described in the **vibration** entry (see "Piezoelectric Strip"). Those sensors provide a transient output when they flex rapidly. The

resistive sensors provide a stable output in response to a steady load.

Deformative Force Sensors

A sheet of natural or silicone-based rubber can be impregnated with conductive particles. The conductivity of the sheet may not change significantly when it is compressed, but if it is separated from a metal plate by a mesh of thin nylon fibers, compression will result in greater conductivity by pushing the rubber into the gaps between the fibers. See Figure 12-10.

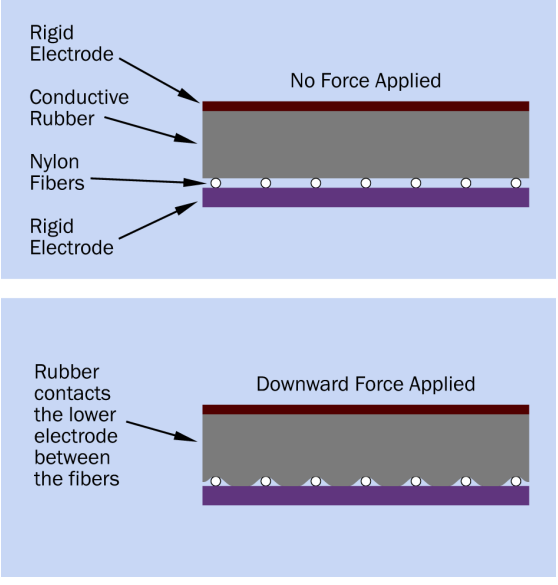

Figure 12-10 *In the top image, a flexible conductive layer is separated from an underlying rigid electrode by nylon mesh. In the lower image, a load applied to the flexible layer has forced more of it into contact with the electrode, reducing the resistance between them.*

Improvised Resistive Sensors

Polyethylene film impregnated with carbon particles is available under the brand name Velostat, owned by 3M. Although it was developed as an antistatic packaging material for semiconductors, it can be used to make a DIY force sensor. When the material is stretched, the embedded particles are more dispersed, and electrical resistance increases. When the material is compressed, its resistance is reduced.

Antistatic foam of the type used to package CMOS components can be used in the same way, although some types behave like memory foam, being slow to recover from pressure. The foam can be sandwiched between a pair of copper-plated circuit boards as electrodes.

How to Use It

Plastic-Film Resistive Force Sensors

The conductivity of a plastic-film sensor has an almost linear relationship with the force applied. In other words, if F is the force and I is the current:

```
I = k * F
```

where k is a constant determined by the characteristics of the materials used.

By Ohm's Law, R = V / I where V is the voltage drop across a resistance of value R. By substitution, using k * F instead of I:

```
R = V / (k * F)
```

Therefore, if a constant voltage is applied across the force sensor, the resistance of the sensor will be proportional to the reciprocal of the force (i.e., 1 / F). These relationships are shown in Figure 12-11.

For convenient measurement, it will be helpful if the resistance of the sensor can be converted to a voltage output that varies linearly with the force applied. To achieve this, a resistive force sensor of this type is customary amplified with an **op-amp** (see Volume 2). Using the schematic shown in Figure 12-12, the amplification ratio, A, is found from this formula:

```
A = 1 + (R2 / R1)
```

where R2 if the potentiometer, and R1 is the resistive force sensor. Therefore, the output from the op-amp should have an approximately linear relationship with the force applied to the sensor.

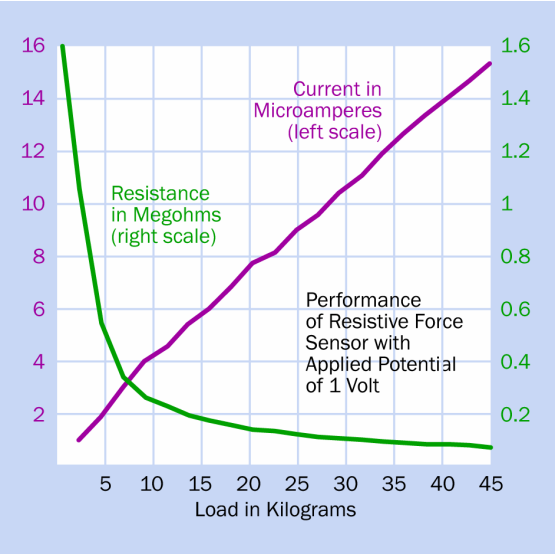

Figure 12-11 *The relationship between force, current, and resistance in a flexible resistive sensor, assuming a constant voltage of 1V is applied across it (derived from FlexiForce Sensors User Manual).*

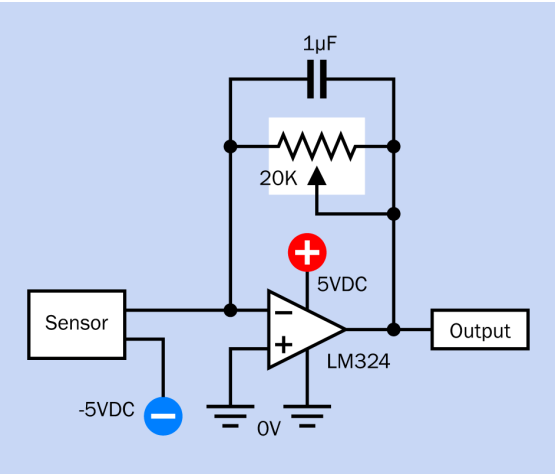

Figure 12-12 *An amplification circuit with an output that is approximately linear with force applied to a resistive film sensor.*

The capacitor in this circuit is added to suppress noise that the circuit might otherwise pick up.

An alternative is to wire a resistive sensor in series with a capacitor, and connect the other side of the capacitor to a comparator that has adjustable feedback. The resistance of the sensor will determine how quickly the capacitor charges. However, because of the mathematics describing the charge rate, the output from the comparator would not be linear with the force on the sensor. Also, provision would be necessary to discharge the capacitor intermittently.

Values

Film-Based Force Sensors for User Input

A very light pressure with a fingertip could be around 50g. A more defined finger-press would be 250g, and a heavy push with a finger would be around 1kg.

The Interlink range of flexible force sensors requires a minimum pressure of 0.2N, or about 20g. Similarly, Alpha products range from a minimum of 10g to 30g.

These specifications suggest that film-based force sensors may be used for one-touch user input, but the no-load resistance will be at least 1M, and more than 10M in some instances. A small amount of pressure is unlikely to reduce this electrical resistance much below 500K. Using an op-amp or comparator to detect that difference and convert it into a reliable on-off output may be vulnerable to noise and power-supply disturbance.

Another consideration is that film-based sensors provide no tactile feedback. For these reasons, and because film-based products are described by their manufacturers as "force sensors" rather than as "touch sensors," they are included in this entry rather than in Chapter 13. That said, they may be considered as an option for one-touch user input where they are appropriate—for instance, in games where players are likely to slap or hit a sensor vigorously.

Specifications for Film-Based Force Sensors

Durability of film-based sensors is excellent, with manufacturers claiming that performance

is not degraded after 1 million applications of a 20kg load. Sensors have no polarity, will function using voltages from 1V to 15V in most cases, and have a response time of less than 5ms. They do not generate, and are not vulnerable to, electromagnetic interference.

Important attributes when evaluating film-type sensors are their limits of tolerance for applied force, and resistance values at each end of the range. Unfortunately these values are poorly documented for many sensors, or may be unspecified.

Maximum force may range from 20N to 440N, depending on the brand and model of sensor.

Electrical resistance is at least 1M when unloaded, and may be as high as 20M.

Accuracy ranges from plus-or-minus 2% to plus-or-minus 5% from one application of force to the next, depending on the model of sensor and the manufacturer. If force is not applied each time in exactly the same area of the sensor, results will vary. If a sensor is swapped with another sensor of the same type, sensor-to-sensor consistency will be uncertain. Therefore, film-based force sensors are not a good choice for applications where accuracy is important.

Sensors may be rated for 5% to 10% hysteresis.

The area of active detection may range from about 4mm wide (FlexiForce sensors) to more than 40mm wide (Interlink FSR-406).

Strain Gauges

Strain gauges are not sold as individual components by most electronics suppliers. They are sometimes available as surplus parts or from sites such as eBay, where specifications range from 100 ohms to 1K as the resistance when no load is applied.

A load sensor on which a strain gauge has been preinstalled is much easier to use, and will be plug-compatible with an appropriate amplifier chip as previously described.

What Can Go Wrong

Soldering Damage

The pins on plastic-film resistive sensors are embedded in thin plastic. Heat from a soldering iron can easily damage this plastic. Heat-sink alligator clips should be used while soldering, or the pins can be socketed instead of soldered.

Bad Load Distribution

Film-based sensors will not provide accurate readings if a load is imposed unevenly or inconsistently, or extends outside the detection area. A *puck* consisting of a small, rigid disc may be interposed between the source of the force and the sensor, to distribute the load within the maximum area. A puck may also be referred to as a *shim*.

Similarly, the sensor must be mounted on a flat, smooth surface, and if this is not available, a rigid plate should be interposed.

Water Damage

Although film-based sensors are enclosed in plastic, they are not waterproof. Immersion may cause the layers to delaminate.

Temperature Sensitivity

Because electrical resistance tends to vary with temperature, readings from resistive force sensors will vary with temperature.

Ambient temperatures of 70 degrees Celsius and above may damage a film-based sensor.

Leads Too Long

Although film-based sensors are supplied with a variety of lead lengths enclosed in the laminated layers of flexible plastic, the leads may be too long for a particular application. If they are trimmed, wires cannot be attached with solder, as it will melt the plastic. Conductive epoxy should be used.

single touch sensor

13

This entry only describes *capacitive* touch sensors. A *conductive* sensor, which uses the fingertip to complete a circuit between two exposed contacts, is not very common, and is not included here.

The type of touch sensor described in this entry requires no physical pressure for activation. It should not be confused with a resistive or piezoelectric **force** sensor that requires pressure. See Chapter 12.

An integrated circuit chip that processes a signal from a *touch pad* is often described as a *touch sensor*, even though it does not contain a sensing element. This entry describes it as a "touch sensor chip" to eliminate ambiguity, and refers to touch input elements as "touch pads."

Touch pads that contain *tactile switches* or *membrane switches* are described in the entry discussing **switches** in Volume 1. All types of switches are described in that volume, with the exception of a *reed switch*, which is magnetically activated and is therefore categorized as a sensor.

Capacitive touch sensors are sometimes referred to as *capacitive proximity sensors*, because they sense the proximity of a human fingertip. In this Encyclopedia, and in most other sources, a **proximity** sensor measures distance, not touch. See Chapter 5.

A *capacitive displacement sensor* employs the same principle as a capacitive touch sensor, but is used to detect the position of an object, not for human input.

OTHER RELATED COMPONENTS

- **force** sensor (see Chapter 12)
- **touch screen** (see Chapter 14)

What It Does

A *touch pad* detects the presence of a human fingertip (or other part of the body) and signals an integrated circuit chip, which is very often termed a *touch sensor*, even though it does not contain a sensing element itself. The chip creates an output to signify that human touch has been recognized.

A keypad of the type found on microwave ovens may appear similar to an array of touch pads, but is more likely to contain *membrane switches* or *tactile switches*, which are described with other forms of switches in Volume 1. The type of touch pad described in this entry requires no physical force and contains no parts that move or flex when pressed.

A modern **touch screen** is usually a capacitive device and can be thought of as an array of touch pads. See Chapter 14.

Applications

Capacitive touch sensors have become common as their cost has fallen relative to simpler components that respond to being pressed.

A touch sensor can be used to start or stop a process, or to power up or power down a device. Multiple sensors may be found wherever user input of a few alphanumeric characters is required. Because touch pads can be completely sealed, they are useful where hygiene is important.

Specific applications include the activation of a backlight in a handheld device, wake-up from standby, ear detection in a cellular telephone, control of medical devices, and activation of interior lighting in some automobiles.

The absence of moving parts or electrical contacts means that a touch pad is more reliable than any type of electromechanical switch. A disadvantage is that it provides no tactile feedback, and therefore will require a visual or audible confirmation when it responds to input. Lack of tactile feedback makes touch pads unsuitable for computer keyboards and other key-entry devices where rapid typing is required.

When the capacitive elements of a touch pad are transparent, it can be mounted in front of a screen.

Schematic Symbols

Either of the schematic symbols in Figure 13-1 may sometimes be used to represent a touch sensor, but not on a consistent basis.

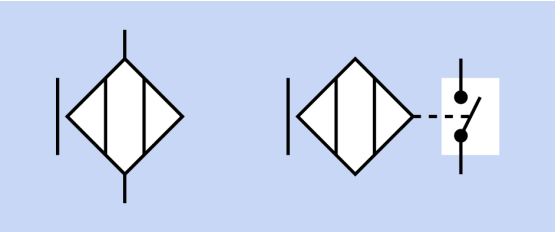

Figure 13-1 *Two possible schematic symbols that may represent a touch sensor.*

How It Works

The two plates in a capacitor are separated by an insulator known as the *dielectric*. Paper, plastic, glass, air, and other insulators can serve this purpose. Although no electrical connection exists between the plates, AC passes through the dielectric as a field effect.

Electrical capacitance exists between any pair of electrical conductors. The human body has high electrical resistance but still is electrically conductive, and therefore has capacitance with other conductive objects.

A touch pad can function as one side of a capacitor, with a fingertip functioning as the other side. In this mode, AC can pass from the touch pad and through the human body to ground. The current is very small, but fluctuations can be detected by an appropriately designed integrated circuit chip, or by a microcontroller.

The precise characteristics of a dielectric will affect the performance of a capacitor to some extent, but will not prevent it from working. Therefore a touch pad can function even when it is shielded behind a protective layer of glass or plastic, as is often the case.

A touch sensor chip generates pulses of low-voltage AC and sends them to a touch pad. The chip detects any variation in the current through the touch pad, indicating the presence of a fingertip. Where an input occurs, the chip changes its output, which usually requires a microcontroller for processing.

How to Use It

Touch sensor chips are available in as many as 40 different formats and configurations. All of them are surface-mount. For breadboarding, an experimenter can use breakout boards that have sensor chips installed. Figure 13-2 shows a product from Adafruit that is capable of addressing 12 touch pads. Its output is accessible from a microcontroller via the I2C protocol. For additional details about protocols such as I2C, see Appendix A.

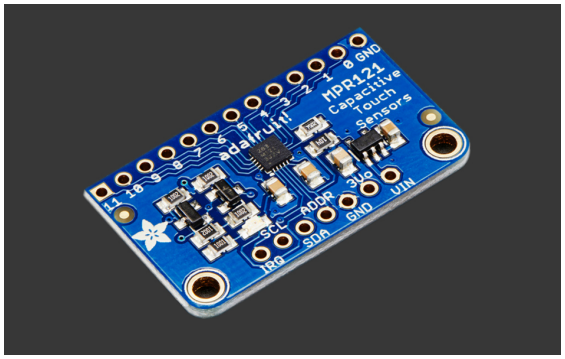

Figure 13-2 *A capacitive touch sensor chip on a breakout board from Adafruit.*

Similar breakout boards are available from Sparkfun, and from large online vendors such as *http://www.mouser.com* (where they are categorized as *development tools*).

While most touch sensor chips require a microcontroller, a few are available with the same number of output pins as touch-pad input pins, and each output pin will transition between logic-high and logic-low when an input on the corresponding pin is detected. Another breakout board from Adafruit, the AT42QT1070, uses this simple system.

A library exists for Arduino that enables two pins to sense touch on a piece of aluminum foil.

It can also work with conductive ink or paint.

Obtaining Touch Pads

Sensor chips are widely available as components, and are very inexpensive. On the other hand, touch pads are not common as components, probably because a touch pad is usually created as a pattern of copper traces etched onto a circuit board by a device manufacturer.

Touch pads from hobby-electronics sources usually include touch sensor chips. Sparkfun offers a 12-key keypad on this basis, and also a 9-key keypad designed as a "touch shield" for use with the Arduino. Both of the Sparkfun products are shown in Figure 13-3. They include the same MPR121 touch sensor chip as the breakout board from Adafruit shown in Figure 13-2, and require an I2C connection with a microcontroller.

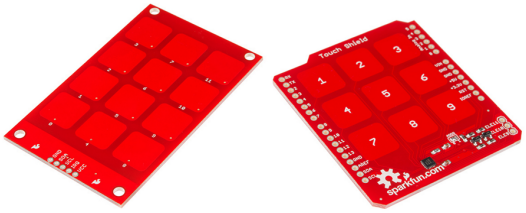

Figure 13-3 *Two capacitive keypads from Sparkfun, the one on the right designed as an Arduino shield.*

Because a capacitive touch pad is usually mounted inside an enclosure, the appearance of the bare touch pad as a component is unimportant. The outside of the enclosure can be printed with a design showing key outlines.

Individual Touch Pad

Adafruit sells the AT42QT1010 touch pad that emulates a momentary switch. Its output transitions from logic-low to logic-high when a finger presence is detected, and transitions back to logic-low when the finger is removed.

An alternative, shown in Figure 13-4, toggles between a logic-high and logic-low output and latches in each state with each single key press.

Both of these keypads contain sensor chips to generate the output.

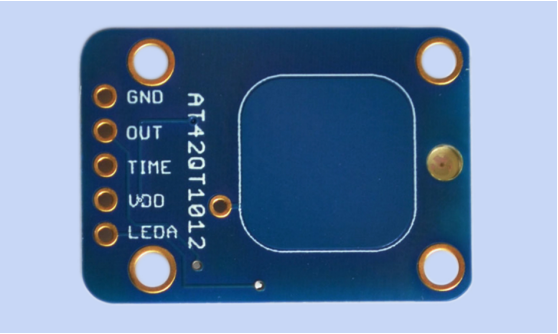

Figure 13-4 *The output from the AT42QT1012 sensor chip on this touch pad from Adafruit toggles between logic-high and logic-low each time the pad is touched.*

Wheels and Strips

A touch wheel uses a circular pattern of conductive traces, often referred to as *electrodes*, to receive finger input. A simple configuration is shown in Figure 13-5. The traces interlock without making contact with each other, so that moving the finger in a circular motion creates a capacitive input that rises and falls sequentially on each element. In the figure, three sections are used, each colored differently here for purposes of clarity. Other touch wheels may contain more sections.

Firmware that is designed to interact with wheel-shaped touch pads will generally assume that two electrodes are receiving input at one time. The firmware attempts to calculate the position and motion of the finger by assessing the relative capacitance of adjacent segments. Ideally the capacitance values should vary linearly and complementarily; that is, from a 50-50 value at a midpoint between two segments, the progression should change to 60-40, 70-30, and so on, as the finger moves around the wheel.

A *touch potentiometer* consists of multiple touch pads, usually arrayed in a straight line. This may be described as a *touch strip*. An example is made by GHI Electronics and sold by Robot Shop as their L12 Capacitive Touch Module, shown in Figure 13-6.

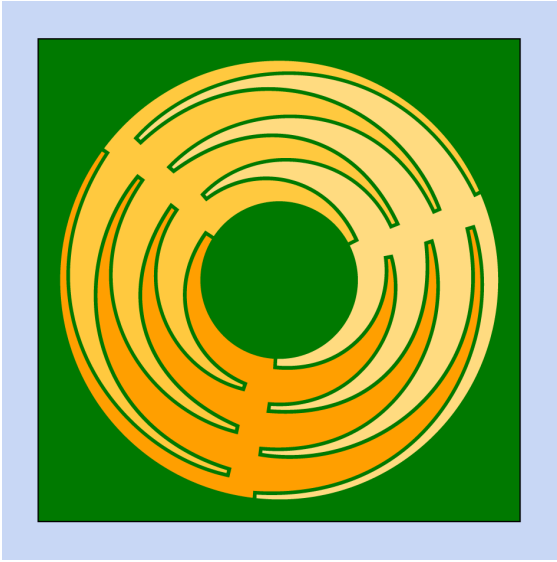

Figure 13-5 *A touch wheel created by copper traces on a circuit board (green). Each section is colored differently, for purposes of clarity.*

Figure 13-6 *Multiple capacitive touch pads arrayed as a strip, made by GHI Electronics.*

Design Considerations

A simple touch pad is often surrounded by additional copper that is grounded and may be described as a *shield* or a *guard*. The capacitance of a fingertip (spaced above the electrode by a layer of plastic or glass that functions as the dielectric) interferes with the field between the electrode and the shield.

The underside of the circuit board is often plated and grounded to protect the touch pad from electromagnetic interference. This, too, can be referred to as a shield or a guard. The ground plating can be in a hatched pattern to reduce its capacitance with the electrode above.

Layout of a circuit involving a single touch sensor chip can affect its performance significantly. A touch sensing device may have to be "tuned" to detect finger presence reliably.

A long trace between the touch sensor and an electrode will tend to pick up noise and will increase capacitance.

The distance between adjacent traces from multiple touch pads must be maximized to reduce capacitance between them. If output from a sensor chip uses the I2C or SPI digital protocol, any trace carrying that digital signal should be at least 4mm from input traces. If they cross, they should be at 90 degrees to each other.

Electrodes should not be shaped to resemble numbers or other characters printed above them. A single basic electrode should be circular.

What Can Go Wrong

Insensitive to Gloves

Gloves are a challenge for touch-sensor design, as they alter the dielectric and the distance between the electrode and the finger. Capacitive touch sensors may not work at all with some types of gloves. However, special gloves containing metallic threads are available.

Stylus Issues

A nonconductive stylus cannot activate a touch pad.

Conductive Ink

Ink that prints the shapes of touch pads on the exterior of a device should be nonconductive.

touch screen

14

The term **touch screen** is written as two words in this Encyclopedia. In many sources, the words are concatenated as "touchscreen."

The two words are hyphenated here when they function as an adjective, but not otherwise. In manufacturers' datasheets where the two words are used, they are not usually hyphenated.

OTHER RELATED COMPONENTS

- **single touch** sensor (see Chapter 13)
- **force** sensor (see Chapter 12)

What It Does

A touch screen is a video display with embedded touch sensing. The screen reports the position of the touch, and is used as a pointing device as an alternative to a mouse or trackpad. Some touch screens report pressure as well as position.

Touch screens are widely used in smartphones and tablets, and also in some laptop computers. Smaller, simpler touch screens may be found in office equipment such as photocopiers.

Schematic Symbol

No specific schematic symbol is used to represent a touch screen.

Variants

Early designs used infrared LEDs recessed into the edges of a frame around a screen. A matching photodiode picked up the focused beam from each LED. The presence of a fingertip was detected when it interrupted one or more of the beams. This system was not capable of high resolution, but was adequate for detecting user input at predefined locations.

Most touch screens currently are either resistive or capacitive.

Resistive Sensing

A resistive touch screen consists of two transparent layers that can be installed over a separate video display.

Each of the layers has uniform electrical resistance. Pressure from a fingertip on the outer layer (which we can refer to as layer 1) forces it to make contact at a point with the inner layer (referred to here as layer 2).

Two vertical electrodes connect with layer 1 along its left and right edges. Two horizontal electrodes connect with layer 2 along its top and bottom edges. When voltage is applied between the vertical electrodes on layer 1, the layer acts as a horizontal voltage divider. The voltage at the point where the layer is being pressed is applied to layer 2, and can be read from either of the electrodes on layer 2, so long

as the metering has a much higher impedance than that of the layer. The voltage is decoded as a value for the horizontal position on layer 1.

An external switching device now repeats the procedure, except that it applies voltage to layer 2, and reads it from layer 1 to supply a value for the vertical position on layer 2. The sequence is illustrated by the top and bottom sections of Figure 14-1.

Because only four connections are necessary, this is referred to as a *four-wire* resistive touch screen. Five-wire variants exist, but are less common, and are not included in this entry.

Advantages of a resistive screen include:

- Simplicity. Only four connections are necessary, and the layers of the screen do not have to be subdivided into separate conductors.
- Low cost, relative to capacitive touch screens.
- Will respond equally well if a user wears gloves or uses a stylus.

Disadvantages of a resistive screen include:

- Some resistive versions require a stylus input instead of finger pressure.
- Resistive screens only respond to a one-location input. Two-finger gestures are not supported.
- Contact bounce occurs when the flexible layer is pressed against the underlying layer, and voltage spikes may be associated with switching power to the screen. To address this issue, firmware in a microcontroller may have to take a median value from several rapid readings.
- The flexible membrane is vulnerable to damage from sharp objects.

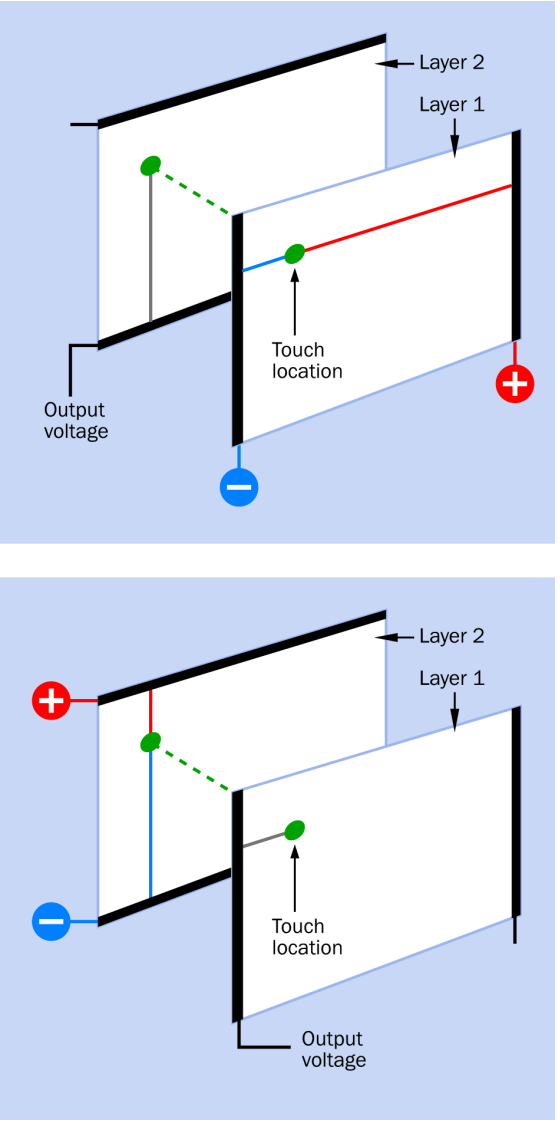

Figure 14-1 *Sections of a resistive touch screen are shown displaced for clarity. In reality they would be separated by a very small gap, allowing one section to make contact with the other in response to finger pressure.*

Capacitive Sensing

A capacitive touch screen can consist of an array of **single touch** sensors printed onto a glass panel as vertical and horizontal lines of transparent conductive ink.

Alternatively, a small capacitive screen can measure the tiny amount of current drained by

a fingertip from four sources located at corners of the screen.

For more information about capacitive touch sensing, see the entry on touch sensors in Chapter 13.

Screens Available as Components

A wide variety of screens can be found in diagonal sizes ranging from 2 inches upward. Onboard electronics can be suitable for connection with a microcontroller using the I2C and SPI protocols, or USB. Different screen resolutions are available.

An example of a 3.5-inch touch screen with 320x200 resolution, mounted on a breakout board that can be used with a breadboard and an Arduino, is shown in Figure 14-2.

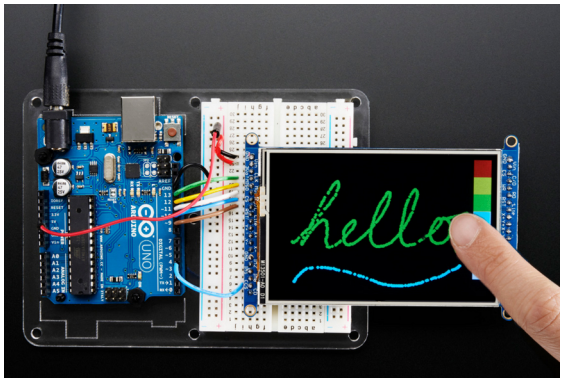

Figure 14-2 *An Arduino-compatible touch screen mounted on a breakout board, available from Adafruit.*

A 7-inch resistive touch screen that can be mounted on a separate video display is shown in Figure 14-3. It can be used with the STMPE610 controller chip, which converts resistive screen values into digital coordinates and can be accessed by a microcontroller over both SPI and I2C. This surface-mount chip is available on a breakout board.

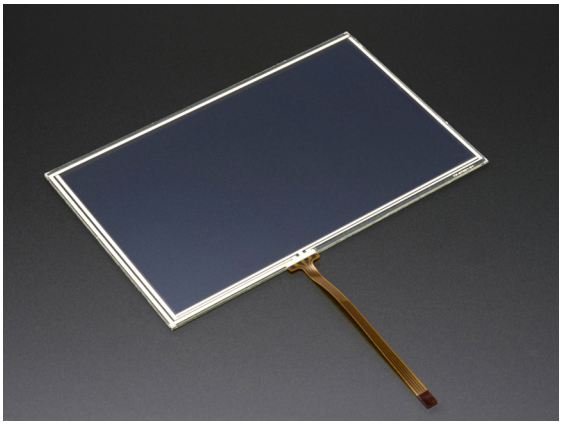

Figure 14-3 *This resistive touch screen is intended for use as a layer applied to a 7-inch video display. The screen is available from Adafruit.*

When choosing a touch screen as a component for a DIY project, the availability of microcontroller code libraries for reading and refreshing the display is an important consideration.

liquid level sensor

15

Level indicators that contain no electronic components are not included in this entry.

Specialized industrial level-sensing equipment is generally outside the scope of this Encyclopedia. This entry discusses small-scale, lower-cost sensors.

Liquid volume can be assessed by measuring liquid pressure at the bottom of a reservoir. Sensors for this purpose are discussed in the entry describing **gas/liquid pressure** sensors. See Chapter 17.

OTHER RELATED COMPONENTS

- **liquid flow rate** sensor (see Chapter 16)
- **gas/liquid pressure** sensor (see Chapter 17)

What It Does

Measuring the volume of liquid in a storage vessel or reservoir is such a fundamental task, countless methods have been devised, of which only the simplest and most common will be discussed here.

A liquid level sensor can have a binary output, meaning that it signals when the volume rises above or falls below a level that can be preset or reset. Often the sensor will be connected to a pump or valve that maintains a relatively constant volume in a container.

Alternatively a sensor can indicate the actual stored volume, either with an analog output or in digital increments.

Schematic Symbols

Three variants of a schematic symbol for a simple liquid level sensor are shown in Figure 15-1. They are not always used, however, and a sensor may be shown simply as an annotated switch.

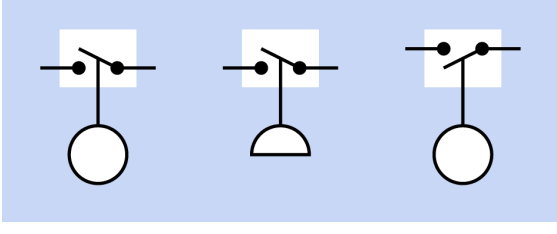

Figure 15-1 *Three variants of a schematic symbol to represent a liquid level sensor. The rightmost symbol indicates that a rising level closes, rather than opens, a switch.*

Applications

The fuel gauge in a vehicle is one of the most commonly encountered applications of a liquid level sensor. The water tank in a recreational vehicle or boat may use similar electronics. In industry, the choice of a sensor will be influenced by the type of liquid that is being stored, the desired accuracy, the temperature range, and whether the storage tank is sealed or open to atmospheric pressure.

How It Works

Desirable attributes of any liquid-level sensor include resistance to vibration, some damping to average out fluctuations caused by turbulence or sloshing in the liquid, resistance to chemical reactions with the liquid, and few moving parts that may require maintenance if the sensor is inside a sealed tank. Desirable attributes of an analog float sensor include a linear response, and some hysteresis if the application requires it.

This entry compares a variety of sensing strategies.

Binary-Output Float Sensor

The term "binary output" is used here to describe an output that only has two states (on and off, or logic-high and logic-low). The simplest type of liquid-level sensor with a binary output consists of a donut-shaped float that contains a permanent magnet and is free to slide vertically up and down a sealed tube containing a reed switch. The tube is supported on a bracket that can be mounted on the wall or the lid of the vessel containing the liquid.

The tube and float must be nonmagnetic, and the float must have a significantly lower specific gravity than the liquid that is being used ("significantly" because the float requires sufficient buoyancy to carry the weight of the magnet and overcome any friction between itself and the tube). A diagram illustrating this configuration is shown in Figure 15-2.

To change the level setting of the sensor, the bracket may be mounted on a screw thread to adjust its vertical position.

The reed switch can be normally open or normally closed, as needed to respond to a rising or falling liquid level. For basic information about reed switches, see "Reed Switch". Additional, detailed information about reed switches is included in the book *Make: More Electronics*.

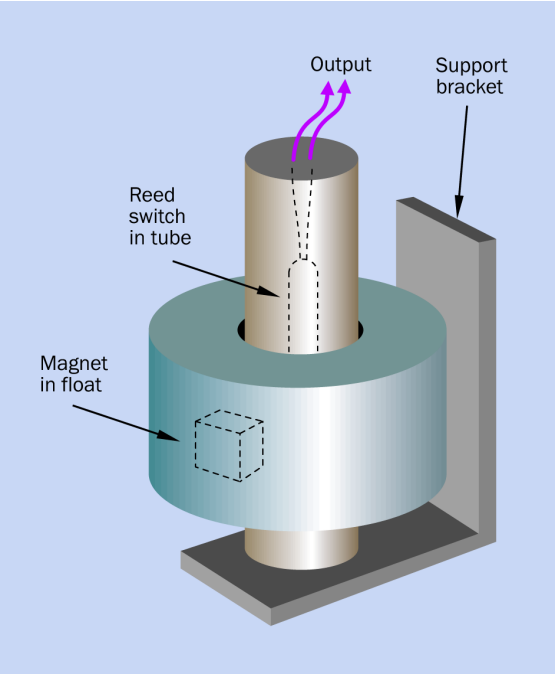

Figure 15-2 *The principal parts of a basic binary-output float sensor.*

For increased reliability, a Hall-effect sensor could be substituted for a reed switch. See "Hall-Effect Sensor" for general information about Hall-effect sensors.

Another binary-output float sensor is shown in Figure 15-3. This is a sealed plastic capsule containing a snap-action switch and a steel ball. The cable is attached to the underside of the top of a tank, and the capsule dangles into liquid in the tank. A separate weight (not shown) has a hole in the middle, and is threaded over the wire. The weight keeps the wire approximately in a vertical position as it dangles into the tank.

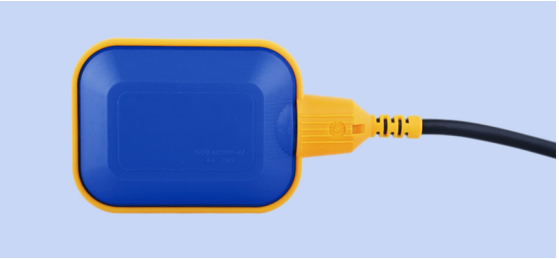

Figure 15-3 *An air-filled float that switches external power depending on its orientation.*

Figure 15-4 shows the components inside the float. When the liquid level in the tank falls, the float adopts the position shown on the left in the figure. The ball drops against a lever that closes a snap-action switch, which starts an external pump to replenish the tank. As the liquid level rises, the buoyancy of the air-filled float changes its orientation to that shown on the right in Figure 15-4. The ball drops and the switch opens, stopping the pump.

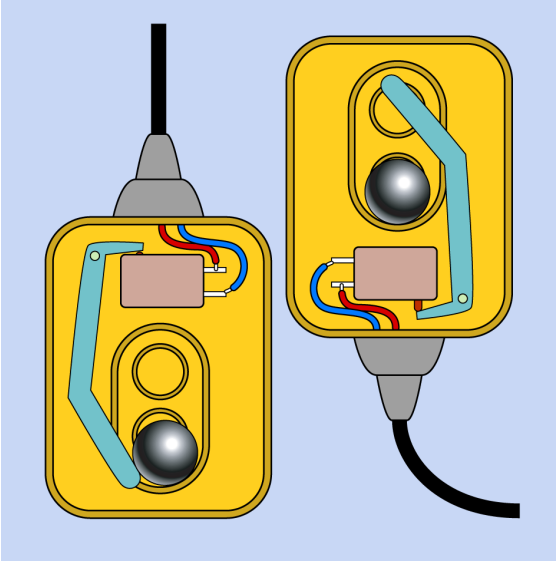

Figure 15-4 *Internal components of the float shown in the previous figure.*

Two circular indents on the inner surface of the plastic capsule prevent the ball from rolling erratically if there is turbulence in the liquid. They also provide some hysteresis.

Analog-Output Float Sensor

The simplest type of liquid-level sensor with an analog output consists of a float on an arm attached to a potentiometer, as shown in Figure 15-5. This very basic design was used in fuel tanks in vehicles for many decades. Disadvantages include a nonlinear response and the limited life expectancy characteristic of potentiometers. Some compensation for the nonlinear response can be made by using an analog fuel gauge with a nonlinear scale.

For more information about potentiometers, see "Arc-Segment Rotary Potentiometer".

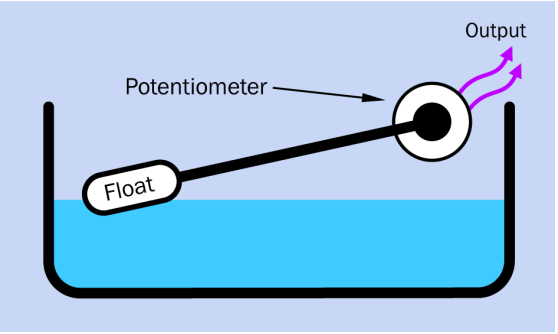

Figure 15-5 *A basic float sensor with an analog output.*

Incremental-Output Float Sensor

A schematic diagram for a simple float sensor with incremental output is shown in Figure 15-6. A magnet embedded in a donut-shaped float, similar to that shown in Figure 15-2, interacts with a sequence of reed switches installed in the central tube. The switches are spaced at equal intervals and apply power between resistors of equal value wired in series. This system has been used in motorcycle and automobile fuel tanks, where the switches may be enclosed in a (nonmagnetic) stainless-steel tube. The accuracy is limited by the number of reed switches.

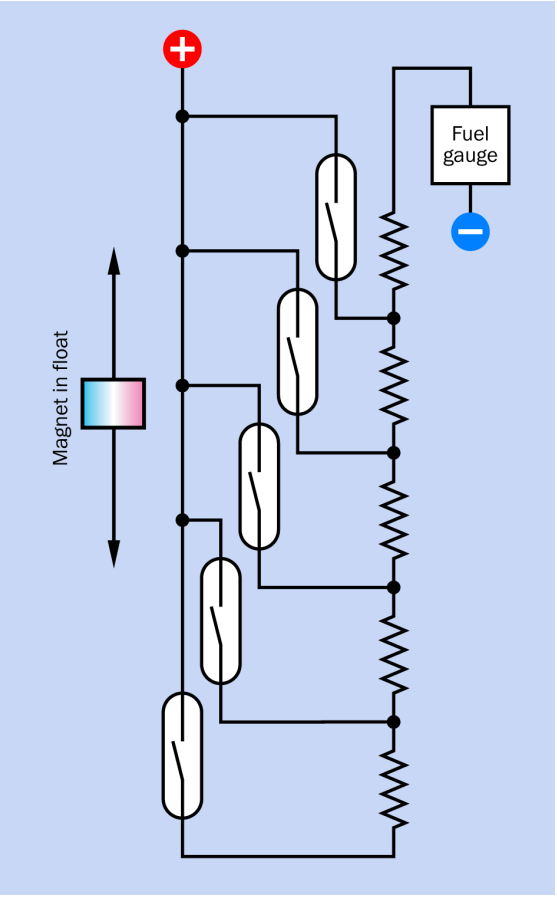

Figure 15-6 *A float sensor with incremental output.*

Displacement Level Sensors

If a heavy object, described as the *displacer*, is suspended in liquid, the effective weight of the object diminishes as the liquid rises up around it. This occurs because according to Archimedes' Principle, the upward buoyant force is equal to the weight of liquid that the object displaces. The displacer is suspended from a load sensor that measures its weight. Analog output from the sensor will be approximately linear with liquid level.

For a simplified diagram showing a displacement level sensor using this concept, see Figure 15-7.

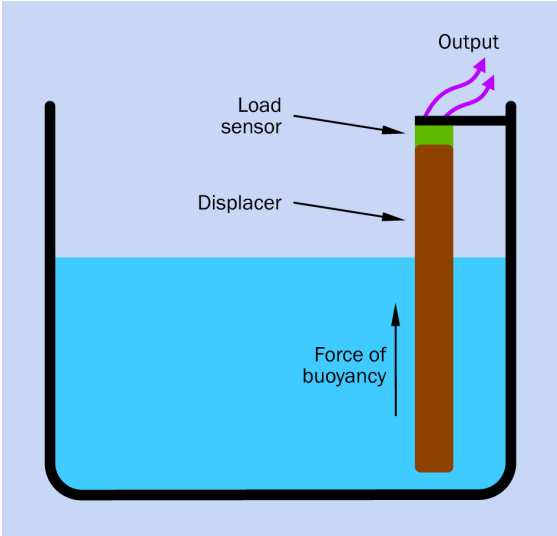

Figure 15-7 *A displacement sensor. The displacer is heavier than the liquid around it, but its effective weight diminishes as the liquid rises.*

For more information on load sensors, see Chapter 12.

Ultrasonic Level Sensors

An ultrasonic sensor can be used to measure the level of liquid in a reservoir, as shown in Figure 15-8. For more information about this type of sensor, see the entry discussing proximity sensors in Chapter 5. A disadvantage of using ultrasound for liquid level sensing is that the speed of sound will be affected by any vapor given off by a volatile liquid.

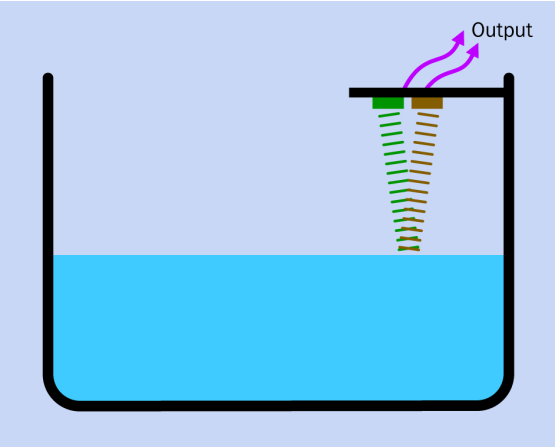

Figure 15-8 *An ultrasonic proximity sensor can measure the level of liquid in a reservoir.*

Reservoir Weight

The weight of a reservoir can be measured to assess the volume of liquid in it. This can be done by mounting the reservoir on load sensors. However, pipes leading to and from the reservoir must be designed so that they do not add or subtract any significant weight. Figure 15-9 suggests an arrangement, although the outflow will still change the weight to some extent depending on the amount of suction that is applied. For more information on load sensors, see Chapter 12.

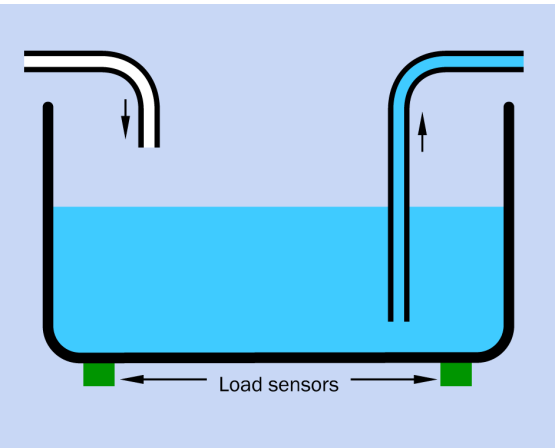

Figure 15-9 *Using load sensors to assess the weight of liquid in a reservoir requires that the weight of plumbing should not be imposed on the structure of the reservoir.*

Pressure Sensing

A differential pressure sensor can be added to a pipe near the bottom of a reservoir. The sensor measures the difference between the liquid pressure and ambient air pressure. See Figure 15-10.

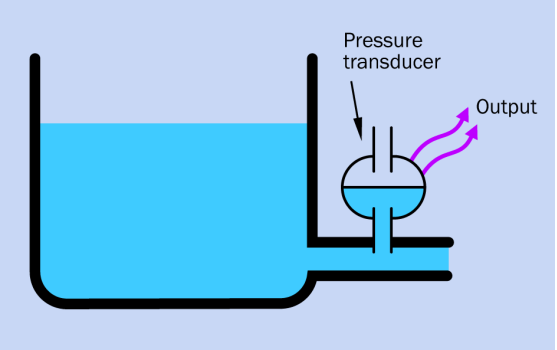

Figure 15-10 *A pressure sensor can assess the volume of liquid in a reservoir.*

This arrangement assumes that the reservoir is vented so that air pressure above the liquid level is equal to air pressure at the sensor. If the reservoir is not vented, a pipe must connect the reference port on the sensor with the space above the liquid.

The reservoir must have straight, vertical sides for the pressure to be directly proportional to the liquid volume.

Liquid volume can also be assessed by measuring the pressure inside a container, near the bottom. A submersible pressure sensor can be used, typically consisting of a watertight capsule fitted with a diaphragm that connects with an internal strain gauge. The sensor is lowered on a cable that also contains an air line. Because pressure in a liquid is affected by atmospheric pressure above the surface of the liquid, the sensor requires an air line so that its measurements are relative to the outside air.

Submersible pressure sensors are useful where access is limited—for example, when measuring fluctuations in an open-air municipal water reservoir.

What Can Go Wrong

Turbulence

Surface turbulence consisting of ripples, waves, or sloshing of liquid will tend to occur when a reservoir is refilled rapidly or is subjected to lateral movements as a result of being mounted in a moving vehicle. To minimize output fluctuations, some *damping* is desirable.

Baffles consisting of perforated plates inside the reservoir are a common strategy, as shown in Figure 15-11. In the upper section of the figure, lateral acceleration causes submersion of a float sensor in the reservoir. In the lower section, perforated baffles minimize the problem.

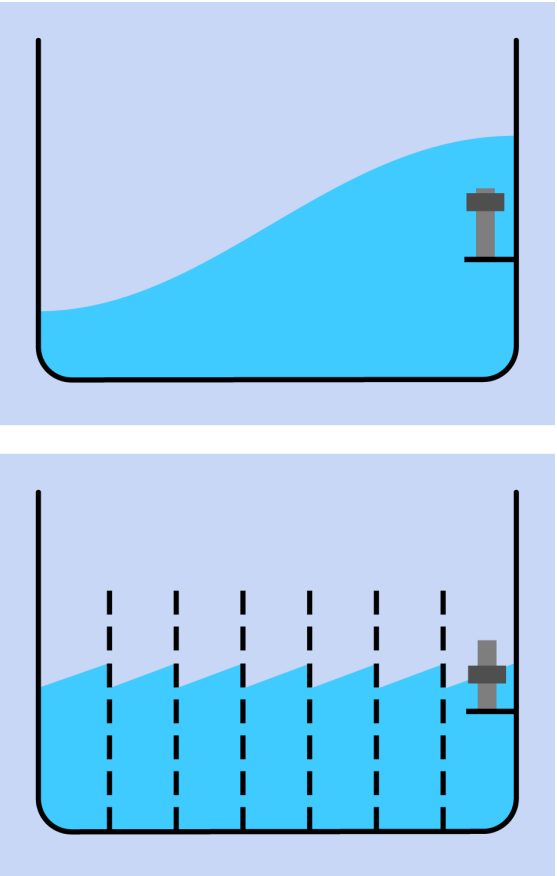

Figure 15-11 *Insertion of perforated baffles in a reservoir minimizes the sloshing that otherwise tends to occur when the reservoir is subject to lateral motion.*

Sensors that measure the weight or pressure of a liquid are less susceptible to turbulence. In a displacement sensor, the weight of the displacer provides a damping effect.

Tilting

All level sensors will tend to give inaccurate readings when a reservoir is tilted. A float sensor will be affected less if it is mounted centrally in a reservoir, because the reservoir will tilt around the sensor, as shown in Figure 15-12.

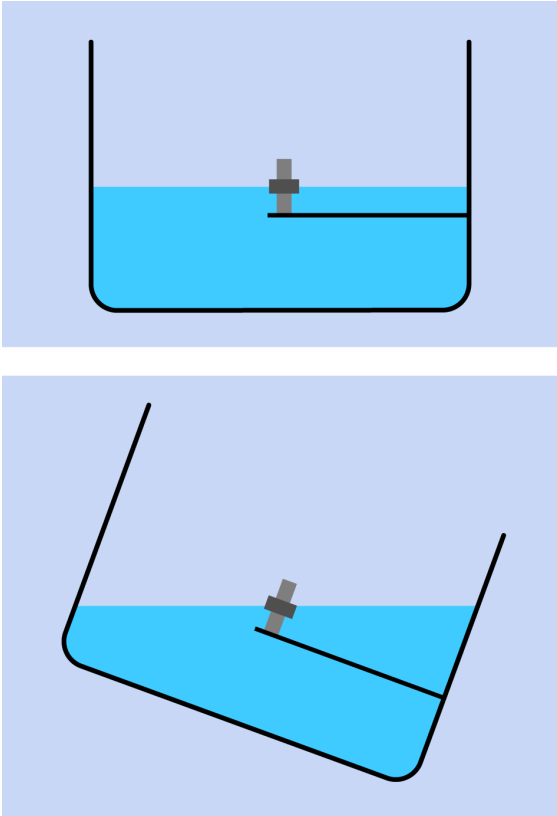

Figure 15-12 *If a float sensor is mounted centrally in a reservoir, it will be significantly less affected if the reservoir tilts.*

liquid flow rate sensor

16

Flow rate sensors that contain no electronic components are not included in this entry.

Some methods of liquid flow sensing can also be applied to gases, but sensors are usually designed for one application or the other. Therefore, gas flow sensors have their own entry. See Chapter 19.

Many liquid flow rate sensors are large devices designed for industrial applications. This entry focuses on lower-cost solid-state sensors.

OTHER RELATED COMPONENTS

- **liquid level** sensor (see Chapter 15)
- **gas/liquid pressure** sensor (see Chapter 17)
- **gas flow rate** sensor (see Chapter 19)

What It Does

A liquid flow rate sensor measures the rate at which liquid flows past or through the device. A water meter is an example of a flow rate sensor.

A sensor may have a binary output, meaning that it signals when flow stops or starts, or if its rate rises above or falls below a level that can be preset or reset. However, most flow meters have an analog output that varies with the volume per unit of time.

Measuring the flow rate of a liquid can be challenging if the viscosity is very high, the liquid is chemically reactive, or the rate is very low. Such factors may require specialized equipment that is outside the scope of this Encyclopedia.

This entry compares the most popular sensing strategies.

Schematic Symbols

Many specialized symbols are used in flow diagrams to represent pumps, valves, and sensors. Typically they involve a single letter or an X in a circle. These symbols are not generally found in electronic schematics, and therefore they are not included here.

Paddlewheel Liquid Flow Rate Sensors

The simplest and most common liquid flow rate sensor uses a *paddlewheel*, also referred to as a *rotor*, that is mounted with its axis of rotation at 90 degrees to the direction of liquid flow. An example is the Koolance INS-FM16 shown in Figure 16-1. This sensor is intended for use in an aftermarket cooling system for the CPU in an overclocked desktop computer, but can be used in any system where the rate of flow ranges from 0.5 to 15 liters per minute. The paddlewheel has a pair of magnets mounted in

it, activating a *reed switch* that is mounted in a sealed enclosure beneath the wheel. (For more information regarding reed switches, see "Reed Switch" in the entry describing **object presence** sensors.)

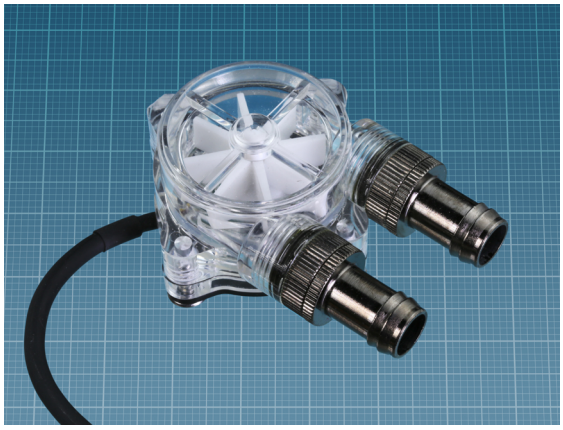

Figure 16-1 *A low-cost, simple paddlewheel sensor designed for rates of 0.5 to 15 liters per minute. The background grid is in millimeters.*

While the reed switch in the Koolance flow sensor inevitably suffers from contact bounce, it has the advantage of simplicity and can be used in conjunction with appropriate hardware or microcontroller code to debounce the pulse stream.

As in any device with a rotating part, friction and wear will afflict a paddlewheel sensor, especially because the bearings are often in the chamber through which the liquid passes. This eliminates the possibility for roller bearings. Typically a plain bearing is used, consisting of a pin that engages in a hole in the casing. Friction wears the bearing surface, creating a larger gap, which allows the rotor to vibrate or bounce instead of spinning smoothly. Flow resistance increases and accuracy is degraded.

In modern designs, the mass of the rotor is minimized to reduce the friction. Also, if the shaft is horizontal (but still at 90 degrees to the direction of the flow), buoyancy of the rotor in the liquid can reduce friction still further, as suggested in Figure 16-2. Ideally, the density of the rotor and the density of the liquid will be the same.

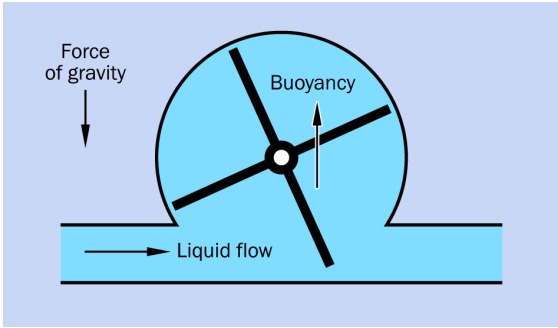

Figure 16-2 *In this configuration, friction on the rotor bearings is mitigated by taking advantage of the buoyancy of a low-density rotor in the liquid that passes through.*

The U-shaped flow path in the Koolance sensor in Figure 16-1 maximizes the responsiveness of the rotor, but an inline path is more common. An example is shown in Figure 16-3.

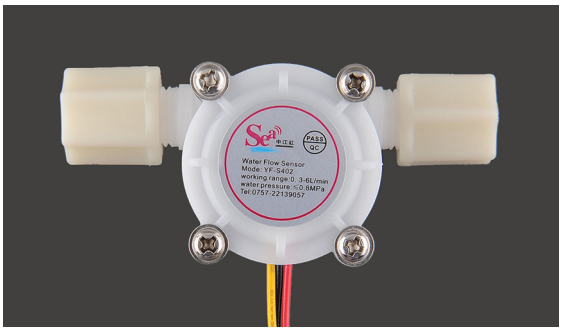

Figure 16-3 *An inline flow sensor rated for 3 to 6 liters per minute.*

Turbine Flow Rate Sensors

In a turbine-type sensor, two or more spiral blades are attached to a hub that rotates around an axis in line with the liquid flow, as shown in Figure 16-4. A magnet in each spiral blade triggers a reed switch or Hall-effect sensor mounted in a bracket that suspends the turbine from the interior walls of the tube.

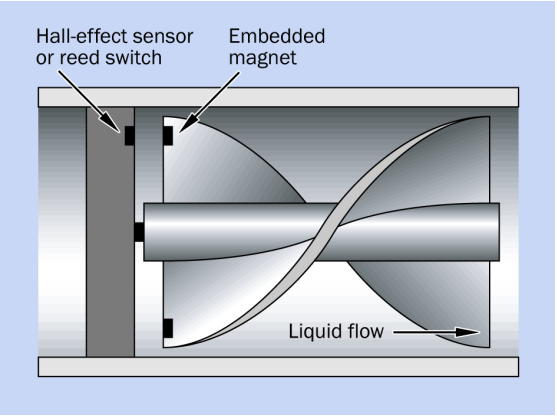

Figure 16-4 *Simplified view of a turbine flow rate sensor mounted inside a tube.*

The support bracket often consists of four struts, which impose resistance to liquid flow. The bearings suffer from the same kinds of problems as the bearings in a paddlewheel sensor, and must withstand additional load resulting from the inline force exerted by flow. Overall, while the turbine type of sensor is popular in laboratory equipment, it has disadvantages that are not shared by the bulkier paddlewheel type.

Limitations of Paddlewheels and Turbines

Both the paddlewheel and turbine types of sensors require a minimum flow to overcome the friction in their bearings. Below this minimum, liquid will find its way around the rotor without turning it. Even when the flow exceeds the minimum, response of the rotor is likely to be nonlinear as a result of turbulence and other factors.

Above a limit stated by the manufacturer, turbulence increases to the point where output from the sensor is no longer meaningful. Wear on the bearing will also increase with flow rate.

A significant problem for these types of sensors is that they do not respond well to sudden variations in flow. The paddlewheel, in particular, has inertia as a function of the diameter of the rotor, and will take some time to spin up in response to an increase in flow. Conversely, when the flow diminishes, the paddlewheel will tend to overrun.

The viscosity of the liquid passing through a paddlewheel or turbine sensor will have a very significant effect on its performance.

Thermal Mass Liquid Flow Rate Sensor

The thermal-mass system is commonly used when volumes are extremely low. The system is illustrated in Figure 16-5. A tube containing liquid is fabricated from a heat-conductive metal such as aluminum. It is enclosed in a larger tube, and the gap between them is filled with thermal insulation. A temperature sensor such as a thermistor measures the temperature of liquid entering the system. A second sensor, combined with a small resistive heater in the form of a coil around the tube, is placed downstream. Liquid passing through the tube will tend to remove heat more effectively at higher flow rates, and the difference in temperature between the two sensors is a logarithmic function of the flow rate.

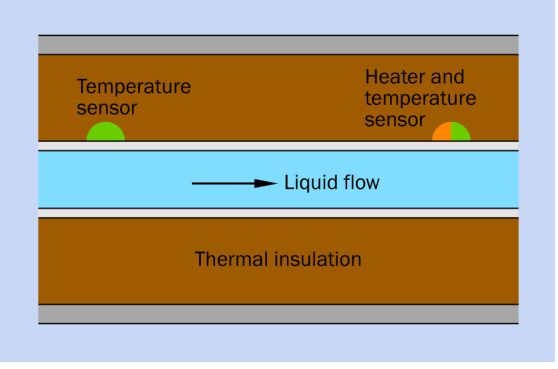

Figure 16-5 *In this type of low-flow sensor, the temperature differential between the two sensors is a logarithmic function of the flow rate.*

Variants of this system use slightly different tube configurations and sensor placement, but the principle is the same. Its advantages include the lack of any moving parts, and the

avoidance of any probes intruding into the liquid, which is desirable in biochemical and medical applications.

The same principle is applied in many **gas flow rate** sensors. See "Mass Flow Rate Sensing".

Sliding Sleeve Liquid Flow Switch

This sensor is used in some domestic systems, where flow-activated water heating is required. A vertical section of brass (nonmagnetic) water pipe contains a sliding inner sleeve that incorporates a magnet. An external reed switch is activated when the sleeve is moved by water flowing through it. When the flow stops, the sleeve is returned to its rest position by the force of gravity.

Sliding Plunger Liquid Flow Switch

Figure 16-6 shows an exploded view of a similar device, using a plastic plunger that slides inside a nylon plumbing fixture designed for 3/4-inch pipe. The plunger contains a magnet and is restrained by a compression spring and a circular perforated plate. When water flow is sufficient to overcome the resistance of the spring, the plunger slides far enough for the magnet to activate a reed switch sealed into the external housing.

Ultrasonic Liquid Flow Rate Sensor

This type of sensor passes ultrasound through a liquid in a pipe. The speed of sound through the liquid is affected by the flow rate, and external electronics translate this lag time into a value for volume-per-minute. The system adjusts for variations in temperature that also affect the speed of sound.

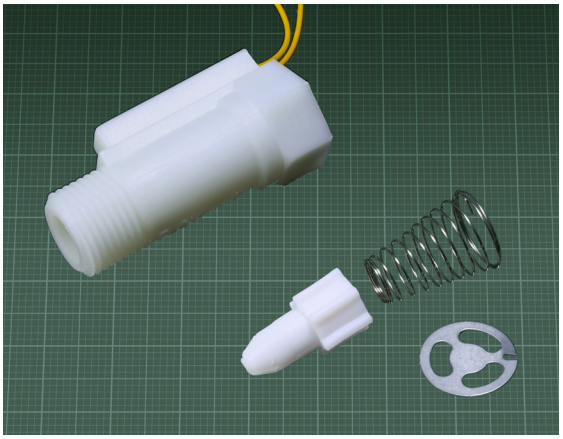

Figure 16-6 *Parts of a flow switch. The small plunger is inserted into the pipe and retained with the perforated plate and compression spring.*

Various configurations are available, some allowing ultrasound sources and detectors to be clamped to the outside of a pipe, as shown in Figure 16-7. To eliminate other variables, one ultrasound pulse is transmitted in the same direction as the flow, followed by another pulse contrary to the flow, and the difference between the two transmission times is used as an indicator of the flow rate.

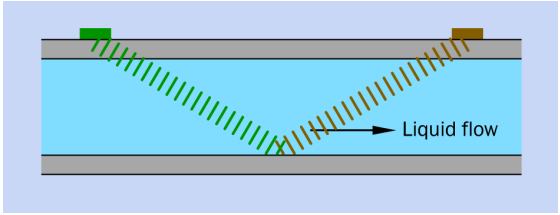

Figure 16-7 *Some ultrasound flow sensors are designed to be clamped externally to a pipe.*

Magnetic Liquid Flow Sensor

A magnetic field is induced in a metal pipe by a coil generating its field perpendicular to flow. The inside of the pipe is lined with nonconductive material in which two electrodes are mounted. Because water containing ions is conductive, the flow of water through the magnetic field induces a small potential difference

between the electrodes. This voltage can be used as an indication of the flow rate.

To eliminate external factors that would also affect the potential difference, the polarity of current through the coil around the pipe alternates rapidly. The induced field remains the same regardless of the direction of the current.

A magnetic flow sensor should not be confused with a magnetic flow *switch.* Various types of switches are made, including large, heavy-duty devices where flow moves a magnet that triggers a shutoff valve. This type of industrial device is outside the scope of the Encyclopedia.

Differential Pressure Liquid Flow Meter

In this system, a pipe contains a perforated plate or some similar constrictor that partially obstructs the flow of liquid. Pressure is measured by a pair of pressure transducers placed before and after the constrictor. The pressure difference is an indicator of flow, because it increases as the flow rate increases.

This system was developed originally for large industrial applications but has been miniaturized and etched into silicon to measure very small flow rates. The Omron D6F-PH is an example, measuring less than 3cm square. It contains digital correction to enable a close-to-linear output. Because of its small size, it can be used only for slow flow rates, or as a bypass sensor. The general concept of a bypass sensor is illustrated in Figure 19-7, in the entry discussing gas flow sensors.

What Can Go Wrong

Vulnerability to Dirt and Corrosive Materials

MEMS liquid flow rate sensors containing very delicate, very small sensing elements are very vulnerable to contamination with dirt. Liquids should be filtered to minimize this risk. A manufacturer's datasheet should provide information about the use of corrosive or chemically active liquids.

gas/liquid pressure sensor

17

Pressure measurement devices that do not contain any electronics, such as a nondigital tire-pressure gauge or a mercury manometer, are outside the scope of this Encyclopedia.

Many pressure sensing methods can be used with both gases and liquids. To avoid duplication, gas pressure sensors and liquid pressure sensors do not have separate entries. Both types are described here.

This entry deals almost exclusively with MEMS components. It does not include pressure measurement devices sold as industrial products.

Some manufacturers and vendors use the term *pressure sensor* to describe a component that measures mechanical load or force. In this Encyclopedia, the term only describes components that measure liquid or gas pressure. Mechanical load cells and force sensors will be found in the section on **force** sensors. See Chapter 12.

OTHER RELATED COMPONENTS

- **liquid level** sensor (see Chapter 15)
- **liquid flow rate** sensor (see Chapter 16)
- **gas flow rate** sensor (see Chapter 19)

What It Does

A pressure sensor measures the force exerted by a gas or liquid, often in a container or pipe.

Static pressure is measured under conditions that change slowly or not at all. *Dynamic pressure* is subject to fluctuations. Pressure sensors tend to be designed for one condition or the other.

Schematic Symbols

Many specialized symbols are used in flow diagrams to represent pumps, valves, and sensors, including pressure sensors. Typically they involve a single letter or an X in a circle. These symbols are not generally found in electronic schematics, and therefore they are not included here.

Applications

Barometric sensors are found in barometers and weather stations. Altimeters are really a specialized form of barometric sensor, used in airborne vehicles. Gas pressure sensors have many industrial applications, and are used to monitor tire inflation in vehicles and the output from air compressors. They may also measure liquid pressure indirectly, as in a blood-pressure cuff.

Liquid pressure sensors are widely used to measure oil pressure in automobile engines and hydraulic braking systems. They have med-

ical applications, and monitor water pressure in municipal systems and pumped supplies.

Design Considerations

As a result of random molecular movement, gases will tend to disperse to fill a container. After a gas reaches equilibrium, the pressure will be almost equal in all directions, affected only slightly by gravity. Where a gas is in a sealed, rigid container, pressure will vary linearly with temperature.

A liquid will tend to accumulate at the bottom of any container under the force of gravity. Liquid pressure in a container will be highest at the bottom, because of the weight of liquid above it. However, because almost all liquids are not easily compressible, they transmit force from any point in a container to any other point, including the sides of a container.

Units

Pressure is measured as force per unit area, which can be expressed in a confusing variety of units.

In the United States, gas and liquid pressure are still often expressed in pounds per square inch, abbreviated as PSI, or more often as psi, or sometimes as lb/in^2.

In standard international (SI) units, 1 bar of pressure is approximately equal to atmospheric pressure at sea level. Millibars are popular among meteorologists, 1 millibar being 1/1000 of a bar, equivalent to 100 pascals, where 1 pascal = 1 newton per square meter.

A bar is equivalent to 14.504 psi.

Blood pressure is measured in millimeters of mercury, because mercury manometers were used for this purpose originally. Atmospheric pressure may also be measured in millimeters of mercury, because the earliest barometers used a tube containing mercury. In the United States, some sources still refer to inches of mercury.

How It Works

Pressure sensing usually entails three stages.

1. A *sensing element* translates pressure into the mechanical displacement of a flexible part.
2. A *transducer* converts mechanical displacement into an electrical effect, either modifying resistance or creating a small voltage or current.
3. Electronics are used for *signal conditioning*. This may entail modifying a nonlinear signal, or may convert an analog output to a digital output.

As pressure sensors are increasingly taking the form of MEMS devices, all three stages may be combined in one silicon chip.

Basic Sensing Elements

Figure 17-1 shows four types of sensing elements that are used, or have been used, to convert pressure into mechanical motion. In each case, a green arrow shows where gas or liquid is introduced under pressure. 1: A Bourdon tube flexes under pressure, increasing its radius. The tube is hollow, open at one end and sealed at the other. 2: A coiled Bourdon tube uncoils partially under pressure, causing the top end to rotate. 3: A simple flat diaphragm. 4: A ribbed diaphragm.

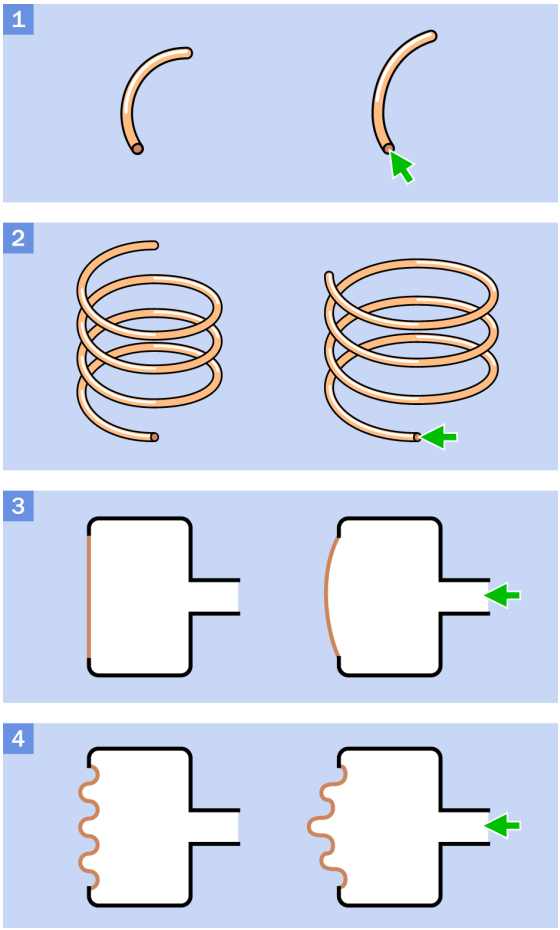

Figure 17-1 *Sensing elements. See text for details.*

The sensing elements numbered 1 and 2 are less likely to be used in modern systems, although a coiled Bourdon tube may be used to turn a potentiometer in low-cost oil-pressure sensing designs. Number 3 is well suited to MEMS devices, as it can be etched into silicon using the principle illustrated in Figure 17-2.

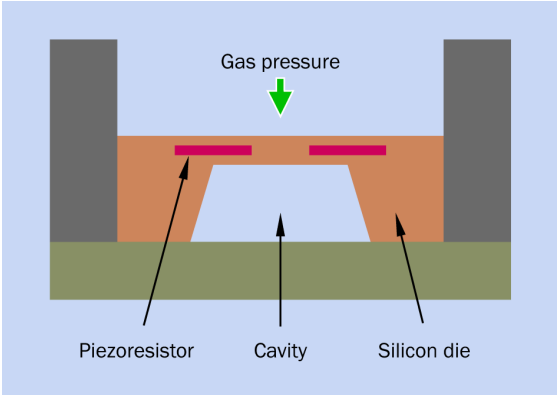

Figure 17-2 *A section of a flat-diaphragm pressure sensor, viewed from the side. An aperture in the top face of the chip allows air to enter. The sensor is etched into silicon, and the deflection of the wafer is measured using embedded piezoresistors.*

Relative Measurement

Pressure is a relative measurement. It is expressed relative to a *reference pressure* of some kind. Three types of measurement are commonly used:

1. *Absolute pressure*, relative to the zero value of a vacuum.
2. *Gauge pressure*, relative to ambient pressure (that is, pressure in the environment around the sensor). Air pressure is the reference source for gauge pressure, and a *vent* is incorporated into the sensing system.
3. *Differential pressure*. In this case, the pressure being measured is relative to some other pressure—for example, the pressure differential between two sealed tanks.

Figure 17-3 illustrates these three measurement types.

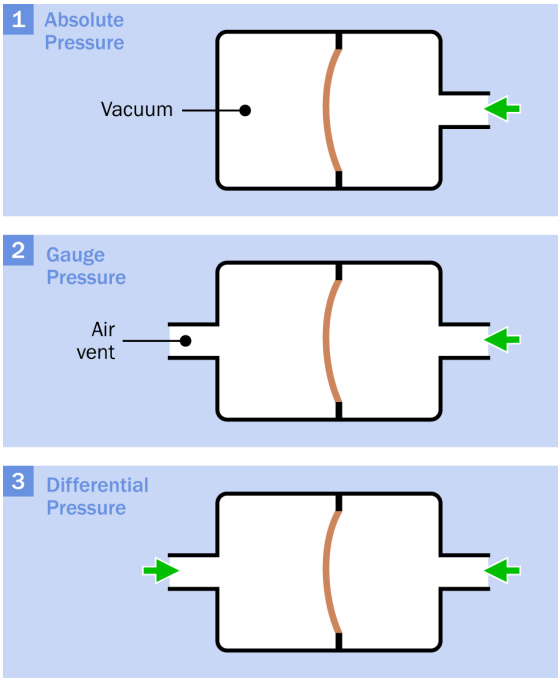

Figure 17-3 *Three ways in which pressure is measured.*

Variants

Ambient Air Pressure

A *barometric* sensor measures the pressure of air around it. This is an absolute value, relative to a vacuum.

The earliest barometers consisted of a tube sealed at one end, containing mercury. No air was allowed to enter the tube. It was inverted so that its open end was immersed in a small reservoir that was open to the air, the pressure of which supported the column of mercury in the tube. Thus, the height of the column was ratiometrically equivalent to atmospheric pressure. Because low air pressure is often an indicator of inclement weather, a barometer was a very simple tool for weather forecasting.

A modern barometric sensor consists of a chip with a vent hole in its upper surface, allowing ambient air pressure to reach a sensor inside the chip. A popular example has been the Bosch BMP085, shown soldered onto a breakout board in Figure 17-4. The BMP180 has a very similar specification, the primary difference being that it is designed for a SPI bus instead of I2C. For additional details about protocols such as SPI and I2C, see Appendix A.

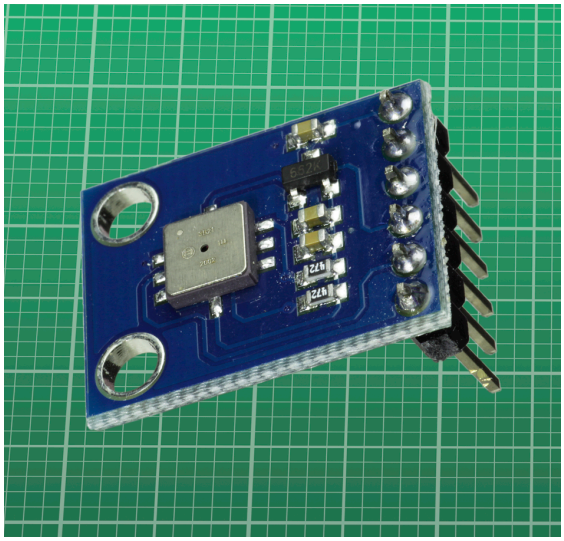

Figure 17-4 *A Bosch barometric sensor on a breakout board. The background grid is in millimeters.*

This sensor uses a supply voltage ranging from approximately 2VDC to 3.5VDC, but a breakout board includes a voltage regulator that tolerates a 5VDC supply. The output is digitized for access by a microcontroller, but the format is quite complex and consists of raw data that must be converted to air pressure by applying a formula. The manufacturer offers free code in the C language for this purpose. A thermometer that is built into the chip enables temperature compensation.

Subsequent products from Bosch include the BME280, which adds a humidity sensor. Breakout boards using this and other barometric chips are available from sources such as Sparkfun and Adafruit, where Arduino code libraries to interpret the data are available for download.

Altitude

A barometric sensor can be used to determine altitude. At sea level, air pressure is approxi-

mately 101kPa (kilopascals), or 760 millimeters of mercury. At 5,000 meters altitude, air pressure drops to 56kPa. The transition is nonlinear, changing most rapidly at lower altitudes.

Air pressure will be affected by temperature and weather conditions. Weather is unlikely to affect the value by more than plus-or-minus 1%, and temperature has a smaller effect; but the barometric sensor can be reset to a zero point based on current temperature and weather data.

Gas Pressure

Thousands of board-mountable gas pressure sensors are available from retail component suppliers. The need to make connections via tubing imposes a minimum size limit on these parts. Many have a through-hole format, but even the surface-mount variants can be relatively large (e.g., 10mm × 10mm). Most tend to have barbed tubing ports, the "barbs" being ridges to retain push-on flexible tubing. Output may be analog or digital, the digital protocol being designed for I2C, SPI, or plain TTL serial buses.

These components are designed for pressures ranging up to 500kPa (kilopascals). Some manufacturers use psi in their specifications, while others use bars and millibars, and a few state gas pressures equivalent to inches of water.

Dual-ported gas sensors for differential pressure measurement can be used for gauge measurement (i.e., relative to ambient air) if one port is left open. Absolute pressure sensors have only one port, as they measure pressure relative to a vacuum maintained inside the chip, behind the diaphragm.

- Some gas pressure sensors can do dual duty as liquid pressure sensors, but others cannot, and datasheets must be consulted carefully, as online vendors may not include this information prominently.

The sensor in Figure 17-5 by All Sensors Corporation is designed for flexible tubing with 1/16" internal diameter (1.6mm). Its pin spacing is 0.1" (2.54mm), making it breadboardable. This sensor is intended for gases only, but has a "10-inch" water-equivalent rating, meaning that it can tolerate a maximum pressure equivalent to that of a 10-inch (25.4cm) column of water.

When supplied with up to 16VDC, an internal Wheatstone bridge circuit provides an analog output that varies ratiometrically by a few millivolts over the full range of measurable pressures (the exact specification depending on the power supply). The output may be amplified with an external op-amp. Although this is a differential sensor, it can provide gauge pressure if one of the ports is left open.

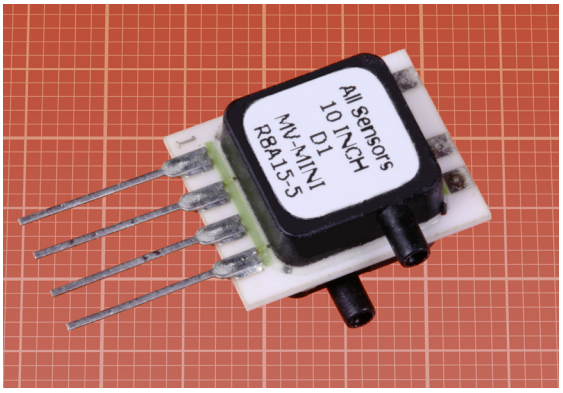

Figure 17-5 *A gas pressure sensor for use with 1/16" (1.6mm) internal diameter flexible tubing. The background grid is in millimeters.*

The larger sensor in Figure 17-6 is in the ADCA range from All Sensors Corporation, designed for flexible tubing with 1/8" internal diameter (3.2mm). This is intended for gases only, and has a "5-inch" water-equivalent rating. It requires a 5VDC power supply and has an internal op-amp that provides an output that varies ratiometrically by 0.2VDC (centered on 4VDC) over the range of measurable differential pressures. Like its smaller cousin, it can provide gauge pressure if one of the ports is left open.

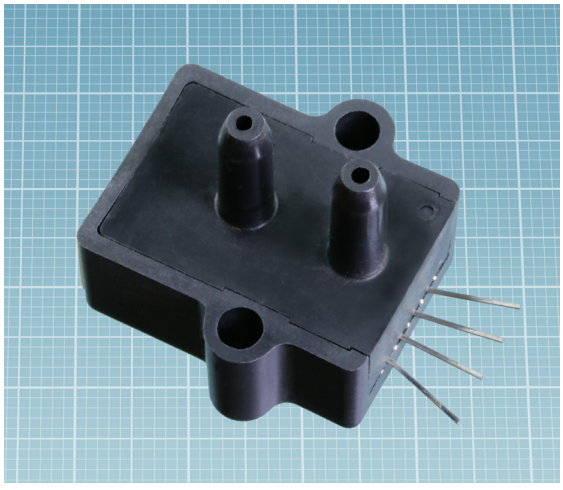

Figure 17-6 *A gas pressure sensor for use with 1/8" (3.2mm) internal diameter flexible tubing. The background grid is in millimeters.*

What Can Go Wrong

Vulnerability to Dirt, Moisture, and Corrosive Materials

MEMS pressure sensors containing very delicate, very small sensing elements must inevitably come into direct contact with gases and, in some cases, liquids. Datasheets will provide warnings regarding humidity and corrosive fluids, but the risk of contamination with dirt remains. Liquids should be filtered to minimize this risk.

Barometric sensors have a hole in the package, exposing the sensor element to the ambient air. This vent must be protected from direct contact with the environment.

Light Sensitivity

If light is allowed into the vent hole in a barometric sensor, it can create photocurrents in the chip. This will affect accuracy.

gas concentration sensor

18

Humidity sensors and *vapor sensors* are included in this entry, as they measure concentrations of a liquid while it is in its gas phase.

Sophisticated *industrial sensors* are available for accurate gas sensing, but this entry deals almost entirely with lower-cost solid-state sensors that are often classified as *board-mount* components.

OTHER RELATED COMPONENTS

- **gas/liquid pressure** sensor (see Chapter 17)

What It Does

Small semiconductor-based gas sensors provide a low-cost method for detecting specific gases in ambient air. The sensors vary their electrical resistance or capacitance in response to the concentration of the gas. They may be used in conjunction with an alarm system that will sound if gases such as *propane* or *carbon monoxide* exceed a preset level, or if the concentration of *oxygen* drops below a preset level.

Because vapor consists of a liquid in its gas phase, gas sensors can respond to vapor, as in the case of *alcohol sensors*.

A *humidity sensor* measures the amount of water vapor in the air, which can be important in refrigeration, HVAC (heating, venting, and air conditioning), medical equipment, meteorology, and storage rooms where art objects, antiques, or paper archives must be preserved in an environment that is neither too dry nor too moist, and is held at a constant temperature. Humidity control can be important also in climates where growth of mold is a concern. Humidity sensors are also used in automobile climate control and windshield defogging, and in the storage of food, fabrics, wood products, and medications.

High humidity coupled with high temperature contributes to the decomposition of many substances, while low humidity can cause desiccation. High humidity can also create damage if it causes materials to expand as a result of taking up moisture.

Many methods have been devised to detect individual gases, but semiconductor sensors are now dominant in applications where accuracy and gas-specificity are not crucial.

Schematic Symbol

No specific schematic symbol exists to represent a semiconductor gas sensor.

Semiconductor Gas Sensors

During the development of transistors in the 1950s, engineers noticed that semiconductor p-n junctions were sensitive to the presence of some gases in the atmosphere. This was regarded as a problem, which was solved by encapsulating transistors to prevent their exposure.

During the 1980s, Japanese law required installation of sensors in every home to detect hazardous concentrations of propane gas. This encouraged the development of cheap, long-lasting components that took advantage of semiconductor sensitivity.

Tin oxide is widely used in a variety of solid-state gas sensors. A sintered layer of the compound is deposited on a ceramic substrate in combination with other compounds such as antimony oxide. The granular layer functions as an n-type semiconductor in which electron transfer increases when certain gases are adsorbed among the grains. When the gas concentration diminishes, oxygen atoms displace the gas molecules, and the sensor returns to its original state. It is unimpaired by being activated, and has a life expectancy of at least 5 years during active (powered) use.

Each sensor includes a tiny resistive heater that is necessary for the chemical reaction to occur. Voltage must be applied to two pins that are connected with the heater. Two other pins connect internally with the sensing element. The resistance between these pins will vary with presence of the target gas; thus, this type of component has a resistive output.

It is a feature of semiconductor gas sensors that they tend to suffer from *cross-sensitivity*. That is, one sensor may respond to more than one gas. Manufacturers control this problem to some extent by adding filtering material around the semiconductor element, or by adjusting the proportions of dopants used in the semiconductor. Datasheets should be consulted carefully to see if a sensor may give false positives as a result of other gases that are likely to be present in the area where it will be used.

Figure 18-1 shows an MQ-5 propane sensor from Hanwei Electronics. The component also responds to methane, hydrogen, alcohol, and carbon monoxide, but with much less sensitivity. The manufacturer recommends calibrating the sensor by using a resistor ranging from 10K to 47K in series with the output resistance.

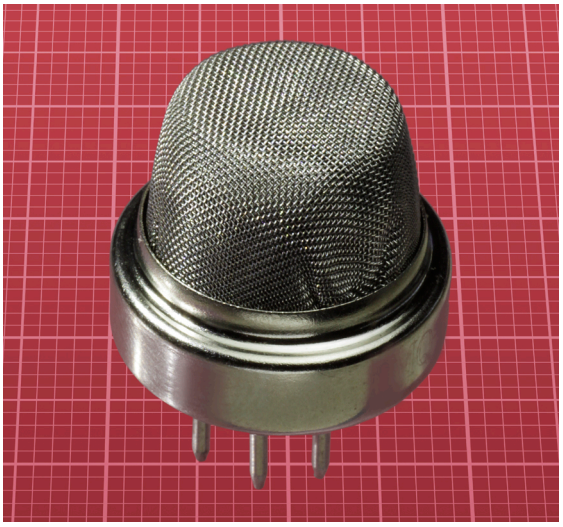

Figure 18-1 *A propane gas sensor. The background grid is in millimeters.*

Figure 18-2 shows an MQ-3 alcohol sensor, also manufactured by Hanwei. It has some sensitivity to benzene, but this is unlikely to be a problem, as benzene is seldom present in significant concentrations in ambient air. However, the response of the sensor to alcohol varies with temperature and humidity. Consequently this component can only be used as a "breathalyzer" if the user can be satisfied with an approximate response.

Semiconductor gas sensors are also available for detecting methane, carbon monoxide, hydrogen, ozone, and other gases.

These components are not low-current devices. Typically the internal heater in the Hanwei range has a resistance of slightly more than 30 ohms, and will draw 150mA to 160mA at 5V (i.e., slightly less than 1W). Because the heater is a simple resistive device, it can be used with AC or DC. The output resistance of the sensor can also be assessed with an AC or DC signal.

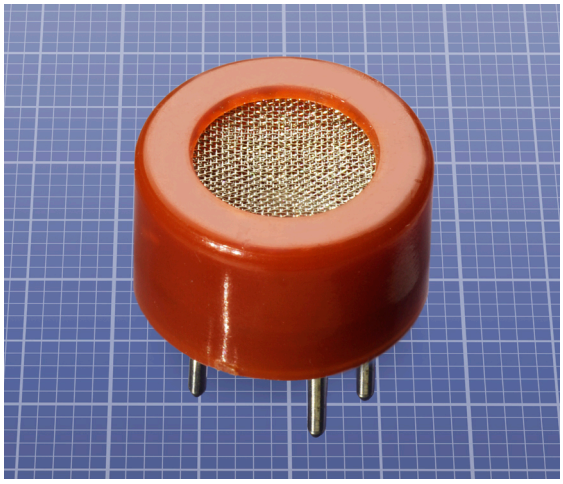

Figure 18-2 *An alcohol sensor. The background grid is in millimeters.*

A breakout board from Parallax simplifies the use of Hanwei gas sensors. The board is shown in Figure 18-3. It is compatible with carbon monoxide, propane, methane, and alcohol sensors, each of which can be plugged into a socket on the board. Two trimmers establish the sensitivity and the trip point for the sensing element, and the TTL output is then logic-high when a gas is detected, and logic-low otherwise.

Figure 18-3 *A Parallax breakout board to simplify the use of Hanwei gas sensors.*

Oxygen Sensors

Oxygen sensors are often built using a membrane made of zirconium dioxide. This material has the property that it can transport oxygen ions when heated. One setup is to have a zirconium membrane separating the gas to be measured from ambient air. This is a type of fuel cell, called a concentration cell or Nernst cell. If the oxygen concentration differs between the two sides of the membrane, oxygen ions will flow through it. Only oxygen ions can move—not neutral oxygen atoms or molecules. The ions are negatively charged, so the transport will lead to a potential difference over the cell, which can be measured with platinum electrodes.

To comply with emissions regulations, automobiles sense the oxygen level of exhaust gases. This data controls the fuel-air ratio in the fuel injection system. Too much air results in the formation of nitrogen oxides, while too little air results in excessive carbon monoxide.

Humidity Sensors

Moisture content of the air is expressed in three different ways:

Absolute humidity
: This is the weight of water vapor in a fixed volume of air. It is measured in grams per cubic meter in the metric system. An absolute humidity sensor is properly called a *hygrometer*.

Dew point
: If a sample of air is cooled without a change of pressure, the dew point is the temperature at which moisture will start to condense. The dew point is a way of describing how humid the ambient air is currently, as water will condense more readily in humid conditions.

Relative humidity
: This is often referred to by its acronym, RH. If temperature, pressure, and volume of a sample of air remain constant, relative humidity is the ratio between the current value of absolute humidity and the hypothetical level where the addition of

water vapor would result in condensation. The ratio is expressed as a percentage. Thus, if moisture is already condensing in an air sample, relative humidity is 100%. If an air sample contains half the weight of moisture required for condensation to begin, relative humidity is 50%. If there is no moisture at all in the air, relative humidity is 0%.

Colloquial usage of the term "humidity" usually means relative humidity, and sensor output is usually convertible to this value. However, some absolute humidity sensors do exist.

Dew-Point Sensor

Historically, meteorologists used a *chilled mirror hygrometer*, in which a metal mirror was exposed to the atmosphere and cooled until the surface was seen to become misty with condensation. The temperature where this occurred was the dew point.

This system is still used in conjunction with an LED and a **phototransistor**. The LED is positioned so that its light reflects from a mirror, directly onto the phototransistor. The mirror is cooled until mist starts to form, which diffuses the reflected light and causes a well-defined change in output from the phototransistor.

Although the formula linking dew point with relative humidity is complex, a simplified approximation is available that is reasonably accurate so long as the relative humidity is 50% or greater. If RH is the relative humidity, t is the current temperature, and t_D is the dew-point temperature at which mist forms:

$$RH = 100 - (5 * (t - t_D)) \text{ approx.}$$

Although a chilled-mirror dew-point sensor has a reputation for being accurate, it is heavy, expensive, and impractical for most applications outside of meteorology.

Absolute Humidity Sensors

An absolute humidity sensor may use two NTC (negative temperature coefficient) **thermistors** in a Wheatstone bridge circuit. One thermistor is sealed in a compartment containing dry nitrogen, with zero humidity. The other is exposed to the atmosphere. Current passing through the thermistors raises their temperature to at least 200 degrees Celsius. Because heat radiates less efficiently when there is moisture in the air, the exposed thermistor will run hotter, and its resistance will be higher, at higher levels of humidity. This type of sensor is used in clothes dryers and wood kilns, among other applications.

See Chapters 23 and 24 for more information about thermistors.

Relative Humidity Sensors

Two main types of sensing elements are used to measure relative humidity: resistive and capacitive.

In a *resistive* sensing element, a thin layer of polymer, salt, or other hygroscopic substance is deposited on a substrate consisting of ceramic or other unreactive material. When the substance absorbs water, its electrical conductivity increases. Voltage is applied to the sensing element, and AC is used to avoid polarizing it. The current flow is processed externally, with conversion to DC followed by linearization, meaning that the current is processed to establish an almost linear relationship with gas concentration, with temperature compensation factored in. Alternatively, these functions can be performed by hardware built into the sensor, and a digital value for relative humidity can be accessed by an external microcontroller.

In a *capacitive sensor*, once again a thin film of polymer or metal oxide is deposited on a ceramic or glass substrate, but the film functions as a *dielectric* between two metal electrodes that serve as the plates of a capacitor. The dielectric value changes as the film absorbs moisture, and this causes the capacitance to

vary, typically by 0.2pF to 0.5pF for each 1% change in relative humidity. This is almost a linear relationship extending over the entire range from 0% to 100% relative humidity.

The actual capacitance value at 50% relative humidity is likely to be between 100pF and 500pF. The sensor may be excited with AC from an external source, or can be incorporated in a chip that derives AC from a DC power supply and provides a digital output.

To determine the dew point or absolute humidity from a value for relative humidity, ambient temperature must also be measured. A chip such as the Si7005 from Silicon Labs includes a temperature sensor with a relative-humidity sensor based around a capacitor in which polyimide film forms the dielectric. If condensation forms, an on-chip heater will cause it to evaporate so that normal operation can resume. Data from the chip is supplied via an I2C interface.

Humidity Sensor Output

When the output is analog, resistance or capacitance of the internal sensing element is available via two pins or solder pads on the sensor. The analog value must be converted to a value for relative humidity by performing a calculation that takes the current temperature into account. The component may or may not include a temperature sensor.

With a digital output, an internal analog-to-digital converter can be accessed by a microcontroller via serial, I2C, or SPI interface. Alternatively, the sensor may communicate values using pulse-width modulation. Either way, the output is a value for relative humidity, calculated on the chip with reference to an onboard temperature sensor.

Analog Humidity Sensor

The Humirel HS1101 is a low-cost analog-output humidity sensor that varies its internal capacitance between approximately 160pF and 200pF as relative humidity increases from 0% to 100%. The response is almost linear, with the curve steepening slightly when humidity exceeds 80%. The component is shown in Figure 18-4.

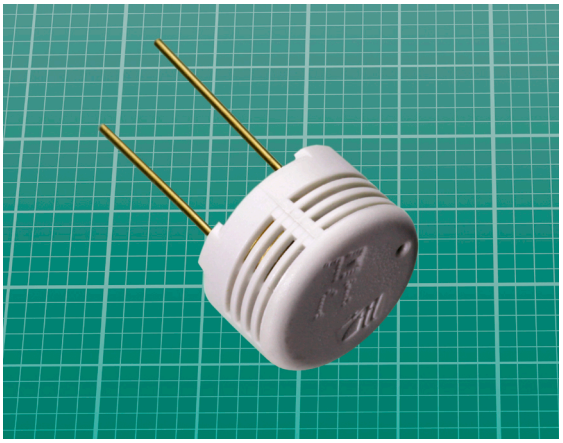

Figure 18-4 *A Humirel HS1101 humidity sensor. The background grid is in millimeters.*

The manufacturer claims a recovery time of 10 seconds after 150 hours of condensation. In other words, the performance of the sensor should be restored to its original specification.

A microcontroller can evaluate the output by measuring the charge time of the internal capacitor in the sensor. If the sensing element is wired in parallel with a 10M resistor, this will allow the capacitor to discharge before the microcontroller charges it again. A 220-ohm series resistor should be used between the microcontroller and the sensor, to limit the charge current. This circuit is illustrated in Figure 18-5.

Alternatively, the sensor manufacturer suggests using the capacitance value to control the output frequency of a 555 timer. A counter or microcontroller may be used to count the number of pulses per unit of time.

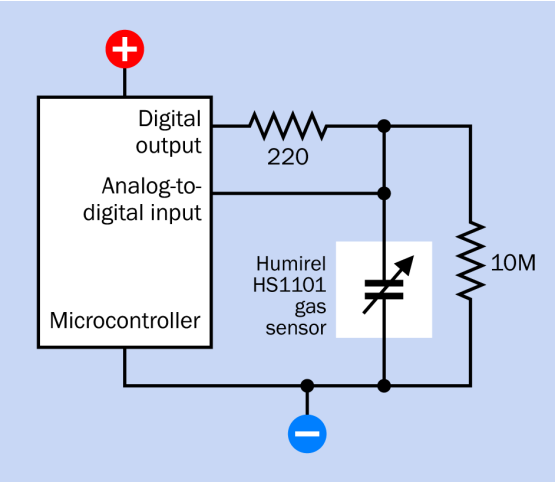

Figure 18-5 *Using a microcontroller to measure the charge time of a gas sensor with capacitive output.*

The Honeywell HIH4030 is a surface-mount humidity sensor with a more convenient analog voltage output that increases almost linearly from approximately 0.8VDC at 0% humidity to 3.8VDC at 100% humidity, assuming a 5VDC power supply. The sensor is available on a miniature breakout board from Sparkfun, shown in Figure 18-6.

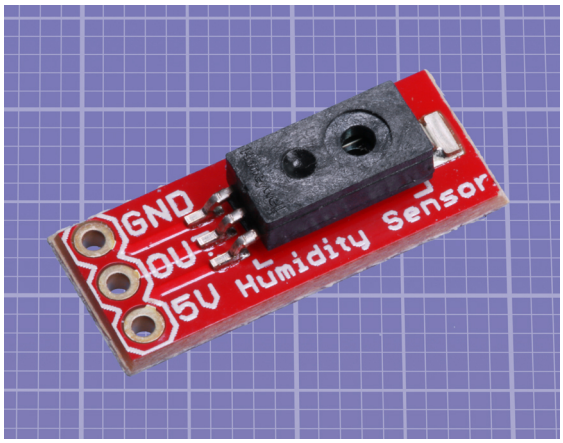

Figure 18-6 *The Honeywell HIH4030 on a breakout board from Sparkfun.*

Design Considerations

As relative humidity is temperature-dependent, a relative-humidity sensor must have the same temperature as the air it measures. Many datasheets recommend that when a sensor is mounted on a printed circuit board, slots should be milled around it to minimize heat transfer to it. The sensor should also be mounted as far away as possible from heat-generating components.

Where a capacitive humidity sensor with an analog output is located some distance from the electronics that will process its output, shielded cables or twisted pair cables should be used to minimize capacitance in the wiring. A decoupling capacitor between the supply voltage and ground close to the sensor can help to keep the supply voltage stable.

Digital Humidity Sensor

The AM2302, available from Adafruit, is a capacitive humidity sensor with a digital output accessible by a microcontroller via the I2C protocol. Onboard electronics calculate relative humidity with reference to an included temperature sensor. This component is pictured in Figure 18-7.

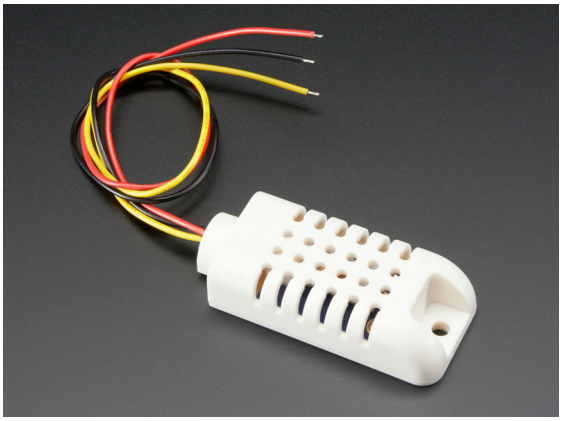

Figure 18-7 *A low-cost humidity sensor with temperature-compensated digital output. From a photograph by Adafruit.*

What Can Go Wrong

Contamination

A semiconductor gas sensor can be damaged by exposure to volatile chemical vapors. This

would be unusual in a domestic environment, but is still an important consideration, as there will be no obvious indication that damage has occurred.

Recalibration

If a humidity sensor is exposed to very high humidity where condensation occurs, some datasheets advise a baking procedure, where the sensor is placed in warm, dry air for several hours and then allowed to rehumidify.

Soldering

Semiconductor gas sensors should be soldered quickly and at a controlled temperature, to minimize heat transfer.

gas flow rate sensor

19

Sensors that contain no electronic components are not included in this entry.

A **gas flow rate** sensor may often be described as a *mass flow* sensor or *mass flow rate* sensor. Although it measures volume rather than mass, the mass of gas can be calculated so long as its temperature and pressure are controlled.

Some methods of gas flow sensing can also be applied to liquids, but sensors are usually designed for one application or the other. Therefore, **liquid flow rate** sensors have their own entry. See Chapter 16.

An *anemometer* is a gas flow rate sensor that measures air speed. It is included in this entry.

Many gas flow rate sensors are large devices designed for industrial applications. This entry focuses mostly on lower-cost solid-state sensors that are often classified as *board-mount* components.

OTHER RELATED COMPONENTS

- **liquid flow rate** sensor (see Chapter 16)

What It Does

A **gas flow rate** sensor measures the volume of gas flowing past or through the device, usually inside a pipe. In most applications, users wish to know the mass of the gas that is passing per unit of time. Consequently a gas flow rate sensor is very often identified as a *mass flow rate* sensor. If it functions by heating the gas and measuring the heat dissipation, it is a *thermal mass flow rate sensor*.

A sensor that measures the flow of open air is often described as an *anemometer*. Its output will be expressed as a velocity, not as a volume or mass.

Applications

Mass flow rate sensors are used frequently for laboratory and medical applications, although the reliability and affordability of thermal mass flow rate sensors is now making them attractive for metering municipal gas supplies.

Anemometers are used mostly in meteorology, aviation, and on boats.

Schematic Symbol

Many specialized symbols are used in flow diagrams to represent pumps, valves, and sensors, but they are not schematic symbols of the type generally found in electronic circuit diagrams, and are not included here.

How It Works

Because an anemometer functions so differently from a gas flow rate sensor that is enclosed in a pipe, the two types of sensors will be discussed separately.

Anemometer

The name of this device is derived from the Greek word *anemos*, meaning "wind." The *cup anemometer* was invented in 1846, using four hemispherical cups attached to horizontal arms rotating on a vertical shaft. The rate of rotation was proportional to wind speed over a substantial range, but the conversion factor between wind speed and RPM varied depending on the size of the cups and their distance from the shaft.

Anemometer design was simplified to three cups in 1926 and was modified in 1991 by adding a tag to one cup. This causes the speed of rotation to fluctuate as the tag rotates through the wind stream, and the direction of the wind can be calculated from the speed fluctuations. Not all anemometers rely on this principle, however, and a separate wind vane can be used to determine wind direction.

The basic design of a modern anemometer is illustrated in Figure 19-1.

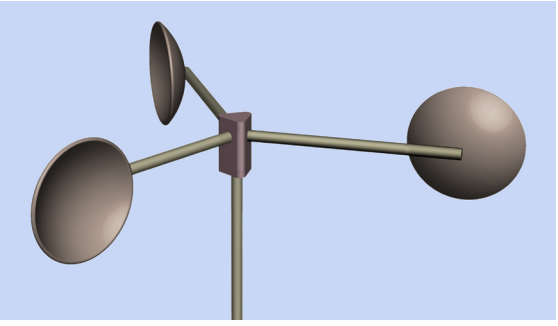

Figure 19-1 *The basic design of a metereological cup anemometer.*

Anemometers traditionally used a mechanical counter to log the number of rotations, which were checked at fixed intervals to derive the wind speed. The output of a modern anemometer may be achieved by generating AC or DC power, or from *Hall-effect sensors* (see "Hall-Effect Sensor" for a full discussion of Hall-effect sensors).

Handheld Anemometer

A digital handheld anemometer for personal use is shown in Figure 19-2. A cup anemometer made by Vaavud for use with a mobile phone (with appropriate software) is shown in Figure 19-3.

Figure 19-2 *A handheld digital anemometer.*

Figure 19-3 *A cup anemometer sold as an accessory for smartphones.*

Ultrasound Anemometer

The movement of air affects the speed of sound, enabling calculation of both wind direction and wind velocity by using an array of

ultrasound emitters and receivers. The lack of rotating parts promises greater reliability, and in Figure 19-4 an ultrasound anemometer manufactured by Biral Metereological Sensors also includes heaters so that it will be immune to snow or ice accumulation during freezing conditions.

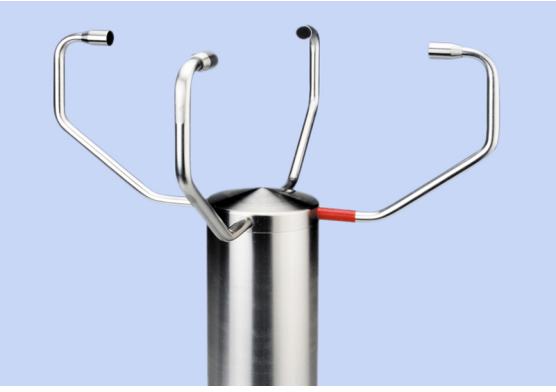

Figure 19-4 *Made by Biral Metereological Sensors, this anemometer uses ultrasound to determine wind speed and direction.*

Ultrasound anemometers have been built on a DIY basis by hobbyists, typically using off-the-shelf ultrasound emitters and an Arduino to decode the signals. Several of these projects are documented online.

Hot Wire Anemometer

A hot wire anemometer measures the cooling effect of the air. It heats a thin wire by passing current through it, and measures the heating power needed to keep the temperature constant.

It is also possible to keep either the voltage over the wire or the current constant, and to assess the wire temperature. The temperature can be measured directly or calculated from the wire's resistance, which increases as the wire gets hotter.

Mass Flow Rate Sensing

A mass flow rate sensor measures the flow speed of a gas. When this is multiplied by the density, the mass flow rate can be calculated.

Most sensors of this type heat the gas and are categorized as *thermal mass flow rate* sensors. The gas passes over a *thermopile* (consisting of several thermocouples wired in series), then a heater, and then another thermopile. These components are miniaturized and can be etched into a chip measuring 2mm square or less.

The temperature difference between the two thermopiles increases as the flow of gas becomes faster and transports more heat to the second thermopile. This is known as the *heat transfer principle*, illustrated in Figure 19-5.

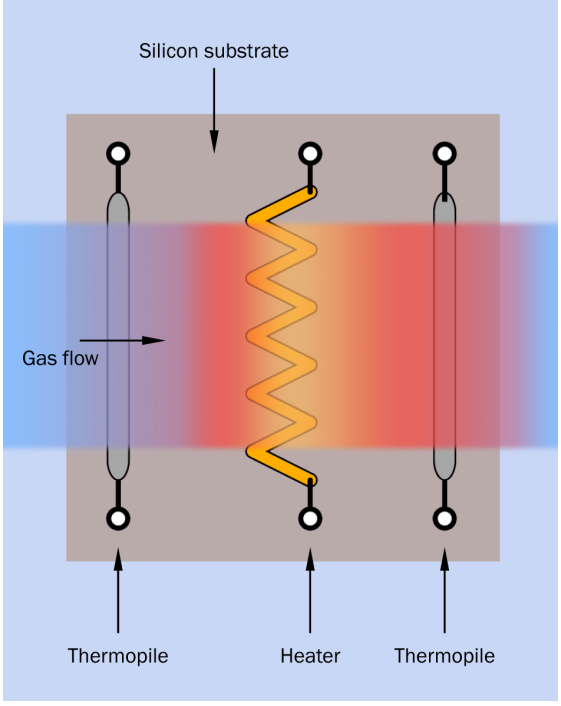

Figure 19-5 *In a thermal mass flow sensor, the flow of gas heats the thermopiles disproportionately, and the temperature difference can be used to evaluate the rate of flow.*

This principle is used also in a liquid thermal mass flow rate sensor, described in "Thermal Mass Liquid Flow Rate Sensor".

An example of a thermal mass flow rate sensor is shown in Figure 19-6.

Figure 19-6 *A thermal mass flow rate sensor made by the Chinese manufacturer Zhengzhou Winsen Electronic Technology Co. Ltd.*

Applications

In medicine, mass flow rate sensors are used in anesthesia delivery, respiratory monitoring, sleep apnea machines, ventilators, and other devices. Industrial uses include air-to-fuel ratio measurement, gas leak detection, and gas metering.

While the metering of municipal gas supplies was traditionally done with all-mechanical devices, MEMS-based meters are replacing many of the 400 million mechanical gas meters estimated to exist worldwide.

Units

Mass flow rate sensors are often rated in SLM, meaning standard liters per minute. A "standard liter" has a temperature of 0 degrees Celsius and a pressure of 101.325 kPa (kilopascals). This pressure is equivalent to that of air at sea level. Because temperature and pressure are specified, the mass of a gas in a standard liter can be calculated by knowing the density of the gas. Thus SLM is a way of measuring mass flow, even though it is a measurement of volume.

The acronym SLPM is also used, but it means the same thing as SLM. SLs and SLPs are measurements of standard liters per second, while SCCM refers to standard cubic centimeters per minute.

Measuring Higher Volumes

MEMS sensors are typically equipped with inflow and outflow nozzles suitable for flexible tubing of 3mm or 5mm internal diameter. The nozzles are "barbed," meaning that they have ridges to retain the tubing.

Small tubing can only deal with low flow rates. A few sensors are threaded for standard plumbing pipes, and can accept volumes of up to 10 liters per minute. They are a minority. A low-rate sensor can still be used to measure higher volumes if it is supplied with just a percentage of the primary flow. This principle is illustrated in Figure 19-7, where an adjustable vane in the main pipe creates a pressure differential. A narrower, constricting section of pipe could have a similar effect, but it would not be adjustable.

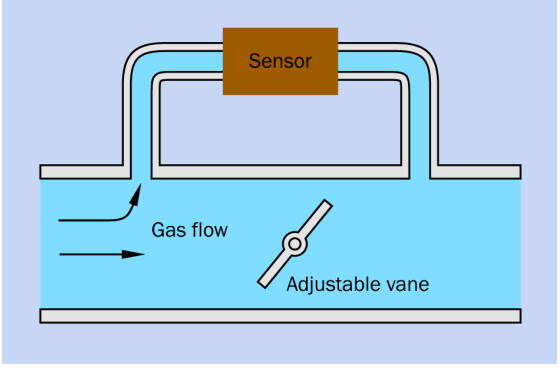

Figure 19-7 *A vane in a primary pipe can divert a percentage of the flow to a sensor.*

Output

Many mass flow sensors have an analog output consisting of a voltage that varies ratiometrically with gas flow. With a typical 5VDC power supply, output voltage may vary from around 1VDC to 4VDC.

Some sensors now incorporate analog-to-digital converters and data processing to provide SLM digital values, accessible from a microcontroller via an I2C interface.

What Can Go Wrong

The primary risk for gas flow rate sensors is damage caused by particles and contaminants in the gas stream. A 5-micron filter is recommended. A *dust segregation system* can also be used, consisting of a small compartment containing semicircular centrifugal chambers. Dust tends to follow the outer edge of the flow path, while the flow sensor is placed on the inner side of the path.

photoresistor

20

A **photoresistor** has a function similar to that of a **phototransistor**, but as its name implies, it is a purely passive component that varies its resistance in response to light.

The term *photocell* was used formerly, but has been displaced by the term **photoresistor**, which describes its function more accurately. The term *photoconductive cell* is sometimes used, or *light-dependent resistor* (or its acronym, *LDR*).

OTHER RELATED COMPONENTS

- **resistor** (see Volume 1)
- **photodiode** (see Chapter 21)
- **phototransistor** (see Chapter 22)

What It Does

Formerly known as a *photocell*, a **photoresistor** is a disc-shaped component with two leads. When light falls on the surface of the disc, resistance between the leads will diminish. Some photoresistors have a resistance in darkness as high as 10 megohms. A few have a resistance in bright light as low as 500 ohms, although several kilohms would be more common.

A photoresistor is less sensitive to light than a **phototransistor** or **photodiode**, and unlike them it is a passive component with no polarity. It presents equal resistance to current in either direction, and may be used with DC or AC.

Because cadmium sulfide is commonly used in this component and is regarded as hazardous to the environment, photoresistors are now unavailable in some regions (notably, Europe). However, at the time of writing, they are still available from many Asian sources, and from some importers in the United States.

Schematic Symbol

Six schematic symbols for a photoresistor are shown in Figure 20-1. They are functionally identical, regardless of whether the single slanting arrow across the resistor symbol is omitted.

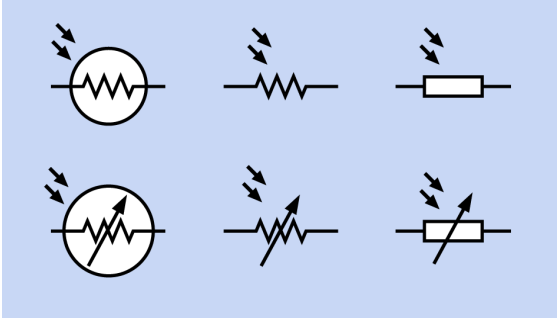

Figure 20-1 *All six symbols for a photoresistor are functionally identical.*

How It Works

Cadmium sulfide is a semiconductor. When exposed to light, more charge carriers are excited into states where they are mobile and can participate in conduction. As a result, electrical resistance decreases.

Construction

A closeup of a photoresistor appears in Figure 20-2. The brown material is a layer of cadmium sulfide deposited onto a ceramic base. The silver material is a conductive compound evaporated onto the cadmium sulfide to form two interlocking electrodes, in a pattern that maximizes the length of the boundary between each of them and the semiconductor. The electrodes connect with leads projecting from the back of the component.

Figure 20-2 *Closeup of a photoresistor. Two interlocking electrodes are mounted on a brown semiconductor layer.*

Variants

Figure 20-3 shows a variety of photoresistors, illustrating the range of sizes available. Small photoresistors may be less than 5mm in diameter; large ones may be 25mm in diameter. The size generally suggests the ability of the component to pass current.

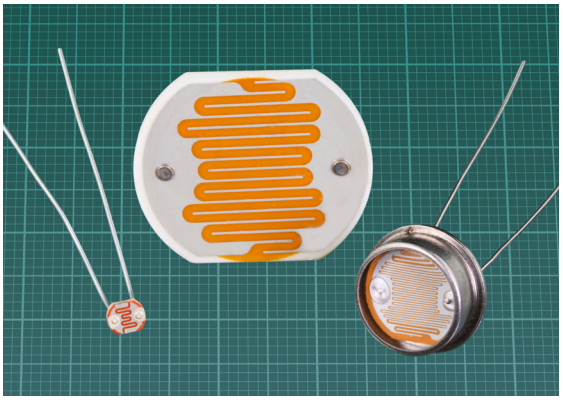

Figure 20-3 *Photoresistors are available in a wide range of sizes. The component in the center is shown at the same scale as the others. Generally speaking, larger components are able to conduct higher currents. The background grid is in millimeters.*

Photoresistors in Optical Isolators

An *optical isolator*, popularly known as an *optocoupler*, contains an LED opposite to a photoresistor, in a sealed package. This is discussed in Volume 2. A *Vactrol* is a similar component, except that the LED is placed opposite to a photoresistor. An example is shown in Figure 20-4.

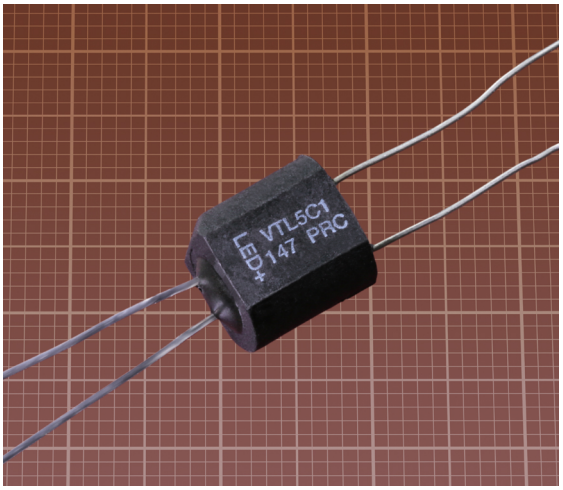

Figure 20-4 *A Vactrol, containing an LED opposite to a photoresistor. The background grid is in millimeters.*

Vactrol is a brand name owned by its initial manufacturer, Vactec. It was developed to con-

trol a vacuum tube, hence its name. In the 1950s, Vactrols were used in guitar amplifiers to control tremolo.

Because of the relatively slow response time of a photoresistor, and its sensitivity to temperature, optical isolators based on photoresistors are not used in digital devices. They still retain some utility in audio components and music equipment, where the ability of the photoresistor to pass AC is an advantage and its response time is adequate.

Values

Datasheets for a few photoresistors can still be found from some suppliers, such as Digi-Key, but are mostly unobtainable, as major semiconductor companies have stopped making these components. Vendors may quote basic values, but in the absence of part numbers or a manufacturer name, a buyer cannot verify the information.

The resistance range can be determined by testing a sample component. A typical range would be from 50K in a light intensity of 10 lux, up to 1M in darkness. Maximum power dissipation is likely to range from 100mW for a small photoresistor to 500mW for a large one.

Maximum voltage may be as high as 200V, but photoresistors will work just as well at low voltages.

Comparisons with a Phototransistor

Slower response
: A photoresistor typically takes several milliseconds to respond to bright light, and can require more than 1 second to regain its dark resistance. A phototransistor is much more responsive, and a photodiode is faster still.

Narrower range of resistance
: The maximum resistance of a photoresistor is almost always significantly lower than the effective maximum resistance of a phototransistor in darkness, and the minimum resistance is likely to be significantly higher than that of a phototransistor in bright light.

Greater current-carrying capacity
: Often a photoresistor is rated for twice as much current as the output from a phototransistor.

Not directional
: Because a photoresistor is not packaged with a lens, it is sensitive to incident light from anywhere in front of it. If an application requires that light sensitivity should be confined within a narrow angle while the component is insensitive to incident light from other directions, a phototransistor or photodiode should be used.

Temperature dependent
: The resistance of a photoresistor varies more with temperature than the effective resistance of a phototransistor.

Cost
: At this time, photoresistors are likely to be more expensive than phototransistors.

Lack of information
: Photoresistors are often sold without means of checking their specification in a datasheet.

How to Use It

While the effective resistance of phototransistors and photodiodes varies with the applied voltage, photoresistors present the same resistance for a particular light intensity regardless of the voltage applied. This property has made them suitable for use in “stomp box” guitar-effects pedals.

Because the minimum resistance of a photoresistor in bright light tends to be relatively high, and because its response time is quite slow, it is

suitable primarily as an analog component rather than as a switch.

In principle, any resistor in a circuit can be replaced by a photoresistor, and its smooth response to light variations would make it suitable, for example, as the resistance in an RC oscillator circuit, where it would determine the charge time of a capacitor. The frequency of the circuit would thus become light-dependent.

Cadmium sulfide photoresistors respond most actively to wavelengths of light ranging from 400nm to 800nm. This is especially important where an **LED indicator** is used as a light source, as LEDs often emit an extremely narrow range of wavelengths. (See the entry for LED indicators in Volume 2.)

Choosing a Series Resistor

To convert light intensity into a voltage, a photoresistor can be connected in series with a regular resistor, to form a voltage divider. There are two ways to do this, as shown in Figure 20-5. On the left side of this figure, light falling on the photoresistor will cause the output voltage to rise. On the right side, light will cause the output to drop.

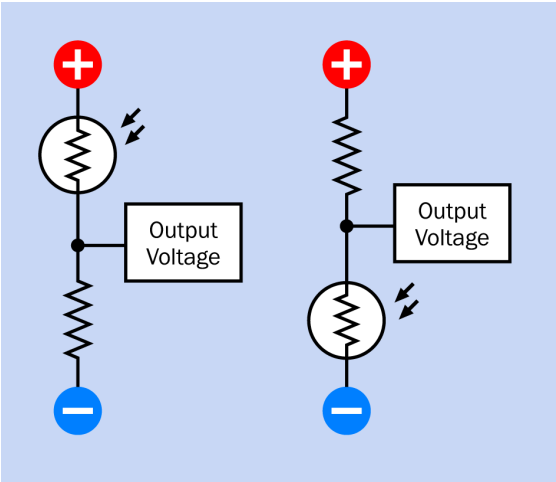

Figure 20-5 *Using a photoresistor to create a variable voltage. See text for details.*

If R_{MIN} is the minimum photoresistor value in the brightest light that will be used, and R_{MAX} is the maximum value in the dimmest light that will be used, a simple formula can be used to find R_S, the optimum value for a series resistor, which will provide the widest range of voltage values at the center of the voltage divider:

$$R_s = \sqrt{R_{min} * R_{max}}$$

What Can Go Wrong

Overload

Because a datasheet may be unavailable, a photoresistor may have to be used on a trial-and-error basis. A test-to-destruction approach may be necessary to determine the limits of the component.

Excessive Voltage

Exceeding the maximum rated voltage for a photoresistor, even for a short time, can cause irreversible damage. Depending on the component, overvoltage can range from 100V to 300V.

Confusion Among Components

Because photoresistors often have no part numbers printed on them and may be sold in miscellaneous assortments, one component may be easily confused with another that has different characteristics. Where two or more photoresistors are used in one device, their characteristics should be measured to determine whether they are functionally identical.

photodiode

21

OTHER RELATED COMPONENTS

- **diode** (see Volume 1)
- **photoresistor** (see Chapter 20)
- **phototransistor** (see Chapter 22)

What It Does

Light falling on a **photodiode** causes it to generate a very small current. This is often called the *photovoltaic effect*. The component functions like a solar panel; in fact, a solar panel can be thought of as being an array of very large photodiodes.

Often, a DC power source is used to apply *reverse bias* to a photodiode. This enables the component to deliver more current. It is now operating in *photoconductive* mode.

Schematic Symbols

Schematic symbols for a photodiode are shown in Figure 21-1. Wavy arrows are often (but not always) used to indicate infrared light.

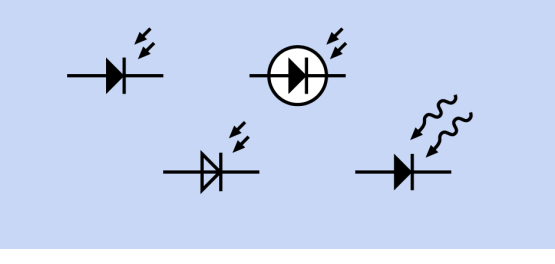

Figure 21-1 *Symbols representing a photodiode.*

Applications

The rapid response of photodiodes makes them suitable for use in optical disc drives, telecommunications, infrared data transfer, digital cameras, and optical switches. Many sensors in this Encyclopedia use a photodiode. **Proximity** sensors, optical encoders, and light meters are examples.

How It Works

When light falls on a semiconductor, it can excite an electron to a higher energy state. The electron then becomes mobile, and leaves behind an *electron hole* (See the entry discussing **diodes** in Volume 1.)

In photovoltaic mode, incident light creates pairs of electrons and electron holes in the semiconductor material. The electrons move to the cathode of the diode while the holes move to the anode, creating voltage between the two. Note that this happens to some extent even in the absence of visible light, as the photodiode may respond to infrared radiation. The tiny amount of current created without visible light is called *dark current*.

In photoconductive mode, light falling on the photodiode creates pairs of electrons and elec-

tron holes in the semiconductor material. These will move in opposite directions due to the bias voltage, which means a small current flows through the diode.

Photoconductive mode enables a faster response than photovoltaic mode, because reverse-bias voltage makes the depletion layer wider, which in turn decreases the capacitance. (The same effect is used in *capacitance diodes*.)

Simplified circuits showing the component in photovoltaic mode and photoconductive mode appear in Figure 21-2.

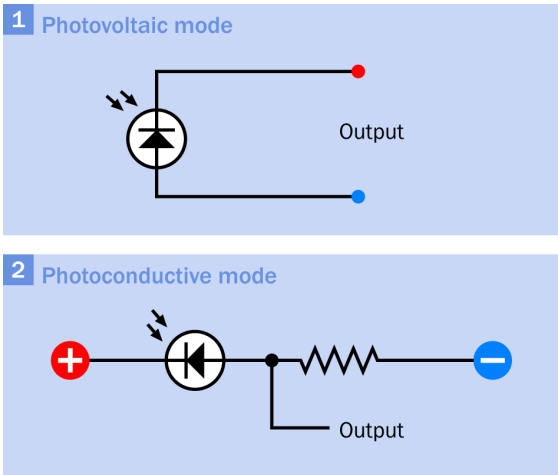

Figure 21-2 *Two modes in which a photodiode may be used. In photovoltaic mode, voltage between the two pins must be measured.*

Variants

PIN Photodiodes

Like *PIN diodes*, PIN photodiodes incorporate an undoped (intrinsic) semiconductor layer between the p- and n-doped layers. They are more sensitive and have faster responses than regular PN photodiodes. Many of the photodiodes available are of the PIN type.

Avalanche Diodes

When light enters the undoped region of the avalanche photodiode, it triggers the creation of electron-hole pairs. When electrons migrate toward the *avalanche region* of the diode, the cumulative field strength increases their velocity to the point where collisions with the crystal lattice create further electron-hole pairs.

This behavior causes the avalanche diode to be more sensitive than a PIN photodiode. However, the sensitivity also makes it vulnerable to electrical noise, and it is significantly affected by heat. A guard ring is added around the p-n junction, and a heat sink is often used.

Packages

Many surface-mount and through-hole versions are available. A selection is shown in Figure 21-3 and Figure 21-4. While a through-hole photodiode may look indistinguishable from a through-hole 3mm or 5mm LED, versions are available without lenses, and some are sensitive to incident light coming from the side (they are referred to as *side-looking* or *side-view* variants).

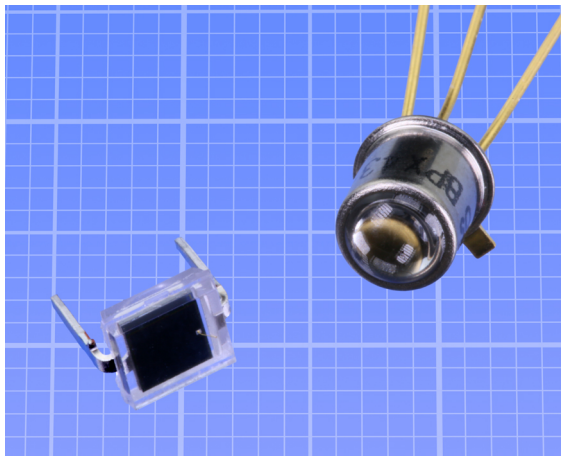

Figure 21-3 *Two sample photodiodes. Left: top-view unfiltered Vishay BPW34. Right: Osram BPX43 in metal can suitable for temperatures up to 125 degrees Celsius.*

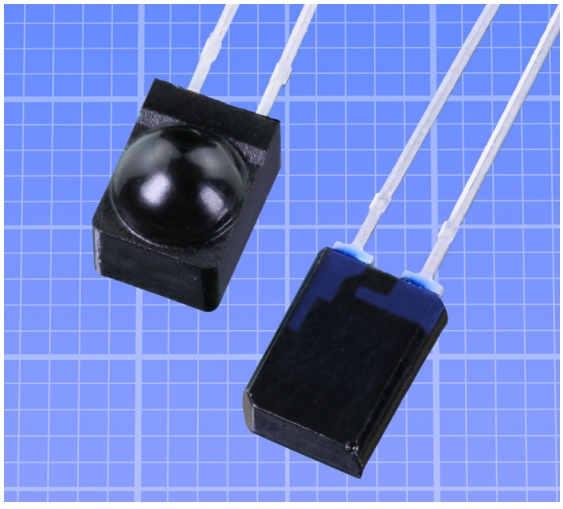

Figure 21-4 *Two side-looking photodiodes. Left: Vishay BPV22NF with lens. Right: Vishay BPW83 without a lens. Both have daylight-blocking filters.*

Wavelength Range

In order for a photon to be detected by the photodiode, it must carry enough energy to be able to create an electron-hole pair. This energy is a property specific to the semiconduct material, and is known as its *band gap*. Additionally, the epoxy packaging of the photodiode may be designed to block some wavelengths of light. Often, an application will require that the component should only respond to infrared light, not visible light.

Photodiode Arrays

A *photodiode array* has several photodiodes mounted in a row or in a grid, for imaging or measurement applications. A row of photodiodes may be used in a flatbed scanner, where it is moved relative to the reflective object being scanned.

In some arrays, photodiodes are available with color filters preinstalled, to facilitate full-color scanning using the transmitted primary colors.

Output Options

Because the output from a photodiode must be processed to be usable, options exist to convert it to a more convenient form, such as a wider range of voltages, a square wave signal where the frequency is proportional with light input, or a binary value accessible by a microcontroller via a serial bus such as I2C. For a discussion of sensor outputs see Appendix A.

Specific Variants

Light to Frequency

The Taos TSL235R is a 3-pin, through-hole chip. It combines a photodiode with logic that creates a square-wave pulse train in which frequency is proportional to the light intensity.

Logarithmic Light Meter

The Sharp GA1A1S202WP light sensor has an output voltage that changes logarithmically with the light level. This gives the sensor a large dynamic range, from 3 lux to 55,000 lux, without requiring a high-resolution analog-to-digital converter. (Human perception of light and sound levels is approximately logarithmic.) This is a surface-mount chip, but is available on a breakout board from Adafruit.

Ultraviolet to Analog

The ML8511 from Lapis Semiconductor combines an ultraviolet-sensitive photodiode with an op-amp that provides an output voltage from approximately 1V to 3V, varying with ultraviolet intensity. A breakout board containing this surface-mount chip is available from Sparkfun and many other sources.

Ultraviolet to Digital

The SI1145 from SiLabs combines ultraviolet sensing with data processing to create a UV index, readable from a microcontroller with I2C. Adafruit offers it on a breakout board.

Color to Digital

The Taos TCS3414FN module contains photodiodes sensitive to red, green, blue, and clear (no filtering). Four 16-bit analog-to-digital converters, one for each

channel, provide a digital output accessible over an I2C bus. This module can be used to determine the color of ambient light with some accuracy.

Color to Analog

The Taos TCS3200 also uses red, green, blue, and clear photodiodes but encodes the output from each as a square wave in which the frequency corresponds with the light intensity. The surface-mount chip is available on a breakout board from Robot Shop, shown in Figure 21-5.

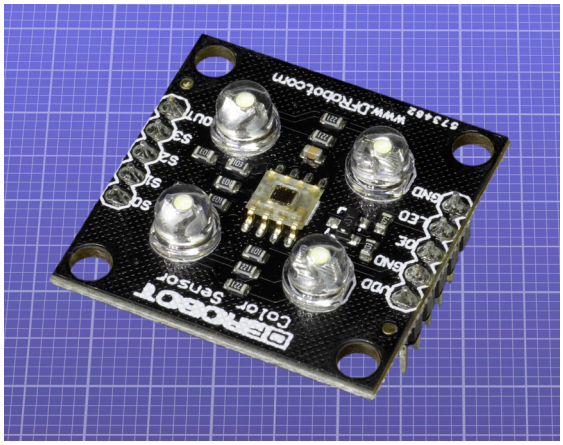

Figure 21-5 *This breakout board from Robot Shop uses the Taos TCS3200 chip to analyze the color of incident light.*

Values

Abbreviations found in datasheets are included in the list below, with values in parentheses for an Osram SFH229FA infrared photodiode, which resembles a 3mm through-hole LED. It has a peak sensitivity of 880nm and appears black to the human eye, being opaque to wavelengths of light shorter than 700nm, the red end of the visible spectrum.

In Figure 21-6 the SFH229FA is shown beside the SFH229, which has the same peak sensitivity of 880nm but is encapsulated in an untinted module, allowing a sensitivity that tapers gradually to below 400nm, in the green part of the visible spectrum. With the exception of their spectral range, the two photodiodes have identical specifications.

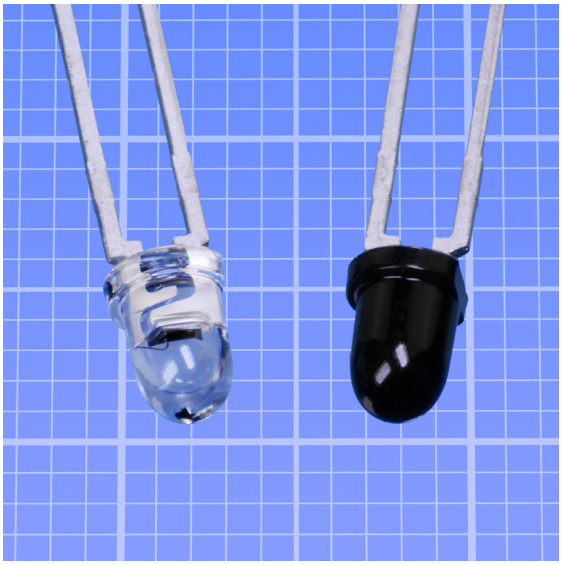

Figure 21-6 *Osram infrared photodiodes SFH229 (left) and SFH229FA (right). The background grid is in millimeters.*

- Typical forward voltage: V_F (1.3V)
- Typical photocurrent: I_P (20µA)
- Maximum power dissipation: P_{TOT} (150mW)
- The *half angle* is measured from the axis of the photodiode to the angle at which the sensitivity has dropped by 50% (plus or minus 17 degrees)
- Dark current: I_R (50pA)
- Wavelength of maximum sensitivity: $\lambda_{S\ MAX}$ (880nm)
- Response speed is the rise and fall time of photocurrent: t_r and t_f (10ns)

Infrared photodiodes exist with a variety of peak wavelengths. They are designed to function in conjunction with an LED that has a matching wavelength.

The angle of sensitivity depends on the geometry of the package.

Rise and fall speeds are important for high-speed measurement, signaling, or data transfer. The rise and fall time of a typical photodiode can be 1,000 times faster than that of a phototransistor. See "Values" in Chapter 22 for a comparison. Note also that the dark current of a photodiode is much lower than that for a phototransistor.

How to Use It

In photoconductive mode, the photodiode can be connected in series with a suitable resistor so that a voltage divider is formed, as shown in Figure 21-2. The voltage at the output will then vary almost linearly with the intensity of the light.

In the photoconductive mode of operation, the output signal is generally measured in millivolts and microamperes. This signal needs to be amplified, usually with an **op-amp** (described in Volume 2).

Figure 21-7 shows simplified schematics for a standard voltage amplifier, in section 1, and a transimpedance amplifier, in section 2.

A transimpedance amplifier measures the current through the photodiode and converts it into a voltage, without the need for a voltage divider. Advantages include less noise, and no need to determine the value of a voltage-divider resistor.

The output voltage of this amplifier is calculated by using this simple formula:

$$V = R * I_P$$

R is the value of the feedback resistor, which determines the gain of the amplifier.

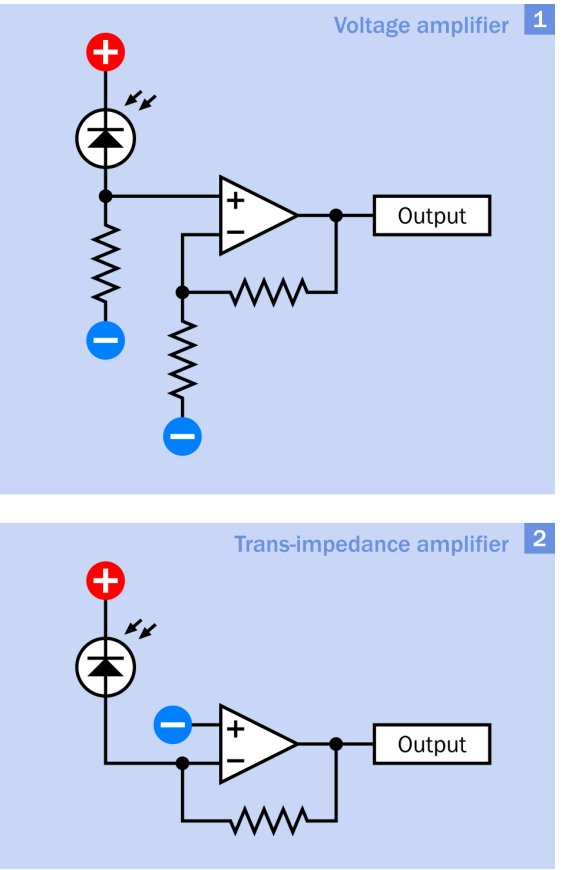

Figure 21-7 *Simplified op-amp circuits for use with photodiodes.*

What Can Go Wrong

Photodiodes can be hard to distinguish from phototransistors and LEDs, in particular infrared ones. They are typically not marked with type numbers. Using a meter may not be helpful, as regular LEDs behave similarly to photodiodes.

Decision procedure:

1. Does the component conduct in either direction while shielded from light? If so, it is a diode and not a phototransistor or photodiode.
2. Pass a weak current (e.g., 4mA) in the forward direction. If it emits visible or infrared light, it's an LED. (Infrared light may be visible when using a digital camera, or can be detected with a known phototransistor or photodiode.) If the package is clear but cloudy so that the die cannot be seen, it is probably a white LED in which the cloudiness is the fluorescent pigment converting blue light into white.

phototransistor

22

OTHER RELATED COMPONENTS

- **photodiode** (see Chapter 21)
- **photoresistor** (see Chapter 20)
- **passive infrared** sensor (see Chapter 4)
- **transistor** (see Volume 1)

What It Does

A **phototransistor** is a transistor controlled by exposure to light. (**Transistors** are described in Volume 1.) It can be either a bipolar transistor or field-effect transistor (FET), and its body is often superficially similar in appearance to a 3mm or 5mm **photodiode** or **LED indicator** encased in resin or plastic. (LED indicators are described in Volume 2.) However, some phototransistors are encased in a metal shell with a window in it.

The window or the plastic body is either transparent to visible light, or may appear black if the component is intended for use only with infrared while blocking visible wavelengths. A selection of phototransistors is shown in Figure 22-1 (left: Optek/TT Electronics OP506A with a broad spectral response centered around 850nm; center: Vishay TEKT5400S with a side-view lens; right: Vishay BPW17N).

Typically a phototransistor has two leads that connect internally with its collector and emitter (or source and drain, in the case of an FET). The base of the transistor (or the gate of an FET) responds to light and controls the flow of current between the leads.

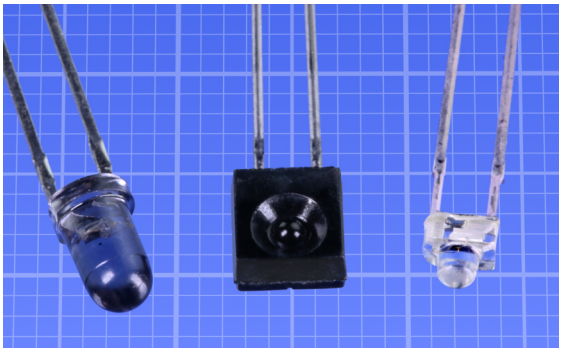

Figure 22-1 *A variety of phototransistors. The background grid is in millimeters. See text for details.*

In the absence of light, a bipolar phototransistor permits leakage between collector and emitter of 100nA or less. When exposed to light, it conducts up to 50mA. This alone differentiates it from a photodiode, which cannot pass much current.

Schematic Symbols

Symbols for a phototransistor are shown in Figure 22-2. They are functionally identical, with the exception of type C, where an additional connection to the base is included. Often (but not always), wavy arrows indicate infrared light.

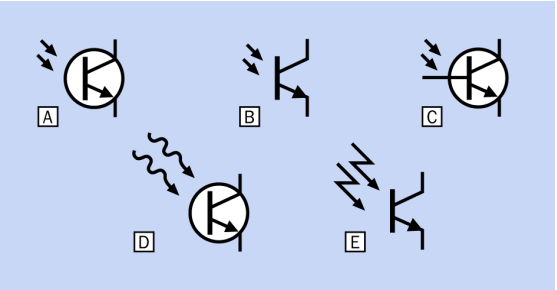

Figure 22-2 *Schematic symbols for a phototransistor.*

Applications

A phototransistor may be used for light measurement or as a light-sensitive switch.

Often the output from a phototransistor is used in conjunction with a *microcontroller* containing an analog-to-digital converter.

Where a clean on-or-off signal is required, a phototransistor can drive the input of a logic chip that contains a *Schmitt trigger*, or it can be processed by a **comparator**.

An *optocoupler* or **solid-state relay** (described in Volume 1) usually contains a phototransistor that is activated by an internal LED. Its purpose is to switch current while electrically isolating one section of a circuit from another.

How It Works

Like a photodiode, the phototransistor responds to light when the light generates electron-hole pairs in the semiconductor material. For a bipolar NPN phototransistor (the most common variant), the important region for pair generation is the reverse-biased collector-base interface. Photocurrent generated here acts as current injected into the base of an ordinary transistor, and permits a larger current to pass from the collector to the emitter.

The behavior of a phototransistor can be visualized as being similar to a photodiode controlling an ordinary bipolar transistor, as shown in Figure 22-3.

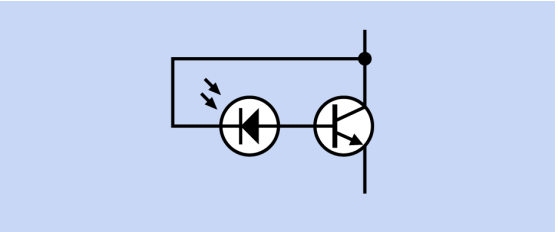

Figure 22-3 *A phototransistor is functionally similar to a photodiode controlling an ordinary transistor.*

Variants

While surface-mount variants are very widely available, through-hole packaging also remains common. When encapsulated like an LED indicator, a phototransistor gathers light from a relatively narrow angle. Variants with a flat surface are sensitive to light from almost any direction in front of the component.

Optional Base Connection

The base of a phototransistor is usually not accessible. However, some variants provide a base connection (or gate connection, in an FET) in addition to the collector and emitter (or the source and drain, in an FET). This third connection allows the application of a bias current, which can prevent low light levels from triggering the transistor.

Photodarlington

A photodarlington is a pair of bipolar transistors, the first being sensitive to light while the second acts as an amplifier for the first. This configuration is very similar to that of a *Darlington transistor* (described in Volume 1). The two-stage design makes it more sensitive to light than a regular phototransistor, but makes the response slower and less linear.

PhotoFET

A field-effect phototransistor is sometimes identified as a *photoFET*. They are relatively uncommon as separate components, but are used in optocouplers, because they have some interesting properties:

- Provided the applied voltage is low enough (less than 0.1V) the photoFET works as a controllable resistance—in contrast to bipolar transistors, where the current is controlled, and is relatively independent of the applied voltage.
- The FET transistor is symmetrical, functioning similarly for signals of either polarity. This makes an FET optocoupler suitable for AC signals.

Values

Abbreviations found in datasheets are included in the list below, with values in parentheses for an Osram SFH300FA infrared photodiode, which resembles a 5mm through-hole LED. It has a peak sensitivity of 880nm and appears black to the human eye, being opaque to wavelengths of light shorter than 700nm, the red end of the visible spectrum.

In Figure 22-4 the SFH300FA is shown beside the SFH300, which has the same peak sensitivity of 880nm but is encapsulated in an untinted module, allowing a sensitivity that tapers gradually to 450nm, in the green part of the visible spectrum. With the exception of their spectral range, the two phototransistors have identical specifications.

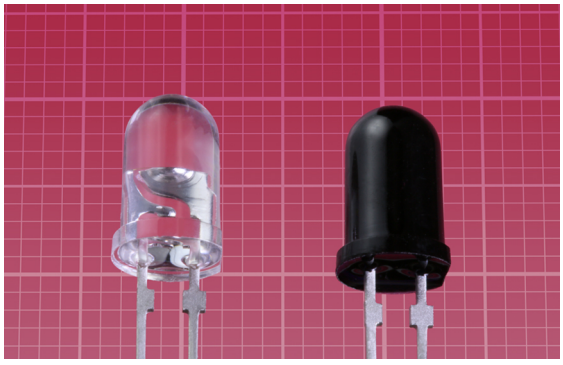

Figure 22-4 *Osram infrared phototransistors SFH300 (left) and SFH300FA (right). The background grid is in millimeters.*

- Maximum collector-emitter voltage: V_{CE} (35V)
- Maximum collector current: I_C (50mA)
- Maximum power dissipation: P_{TOT} (200mW)
- The *half angle* is measured from the axis of the photodiode to the angle at which sensitivity has dropped by 50% (plus or minus 25 degrees)

The angle of sensitivity depends on the geometry of the package. For phototransistors that resemble an LED indicator, with a rounded end that acts as a lens, typical values are plus-or-minus 20 degrees.

- Dark current (when the phototransistor receives no incident light): I_{CE0} (1nA)
- Wavelength of maximum sensitivity: $\lambda_{S\ MAX}$ (880nm)

Infrared phototransistors exist with a variety of peak wavelengths. They are designed to function in conjunction with an LED that has a matching wavelength.

- Response speed is the rise and fall time of photocurrent: t_r and t_f (10 µs)

Behavior Compared to Other Light Sensors

An extended list of comparisons between a photoresistor and a phototransistor will be found in the entry on **photoresistors**. See "Comparisons with a Phototransistor".

A photodiode has a close-to-linear electrical response over a much wider range of intensities of light than a phototransistor. Consequently, photodiodes tend to be the component of choice in applications where measurement of light must be wide-ranging and precise.

Photodiodes can pass less current than a phototransistor, but also tend to draw less current,

making them appropriate in battery-powered devices that must draw as little current as possible.

Rise and fall speeds are important for high-speed measurement, signaling, or data transfer. The rise and fall time of a typical phototransistor can be 1,000 times slower than that of a photodiode. See "Values" in Chapter 21 for a comparison. Note also that the dark current of a phototransistor is much higher than that for a photodiode.

The ability of a phototransistor to sink 20mA to 50mA at its output is useful where it will be connected to a component that has relatively low impedance. For instance, a phototransistor can drive a piezoelectric audio transducer directly, or an LED indicator.

Unlike a photodiode, a phototransistor is a solid-state switch. Its saturation voltage (listed in datasheets as $V_{SE(SAT)}$ as described above) is the voltage drop between collector and emitter, and seldom exceeds 0.5V.

Binning

Small variations that occur during the fabrication process can cause inconsistency in the performance of phototransistors that share the same part number. To provide a more consistent response, manufacturers use *binning*, meaning that units sharing the same bin number are likely to share a tighter tolerance. (The same concept is used to minimize variations in **LED area lighting**, described in Volume 1.)

Datasheets will provide information on the availability and meaning of bin numbers, if available.

Bins with higher photocurrents typically have longer response times.

How to Use It

Most phototransistors are bipolar devices with an *open collector output*. That is, the collector of the transistor is accessible from one of the two leads, making it "open" to being used. See Figure A-4 for general instructions on using an open-collector output. A summary relating to phototransistors is included here.

The schematic in Figure 22-5 shows the basic concept. The resistor is referred to as a *pullup resistor*. When the phototransistor is receiving very little light, its effective resistance is high. Consequently almost all the current flowing through the pullup resistor will go to any device attached to the output, and the output voltage will seem to be "high."

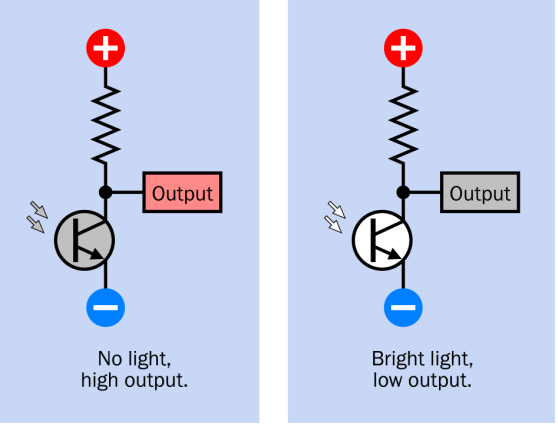

Figure 22-5 *How an open-collector output works.*

If the phototransistor is exposed to a significant light source, the effective resistance between the collector and emitter drops dramatically, and the phototransistor will sink current to ground. Consequently, the output will seem to be "low."

The pullup resistor is necessary between the power source and the collector pin to protect the phototransistor from sinking excessive current when it is exposed to light. The ideal value of the resistor will depend partly on the impedance of any device attached to the output.

In this scenario, exposure to light causes low output whereas darkness causes high output. What if we wish to have it the other way around?

The protective resistor can be moved to the emitter pin, where it becomes a pulldown resistor. It will still protect the phototransistor from passing excessive current, so long as the output is connected to a high impedance. The output is taken from the emitter pin, and will transition from low to high when the component is exposed to light. This is illustrated in Figure 22-6.

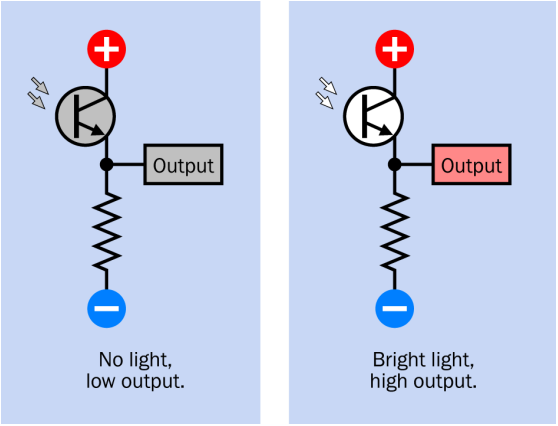

Figure 22-6 *Moving the resistor and taking an output from the emitter pin inverts the behavior of a phototransistor. Any device attached to the output must have a relatively high impedance to protect the phototransistor from excessive current.*

Output Calculation

Using an open-collector output, the photocurrent is almost independent of the applied voltage V_{CE}, provided that the voltage is higher than the saturation voltage $V_{CE(SAT)}$, which is typically between 0.4V and 0.5V.

If the pullup resistor has value R, the voltage across it is

$$U = R * I_P$$

where I_P is the photocurrent passed by the phototransistor.

When choosing R, one should consider the range of currents expected in the light conditions that will be measured, and the voltage range suitable for the next stage of the circuit. 10K is a reasonable starting point (e.g., when measuring light intensity with a microcontroller's analog input). The resistor value can be reduced from there, if necessary.

The value of the pullup resistor must also be chosen to restrict current within the limits specified by the phototransistor datasheet. A value for the resistor guaranteed to be safe is

$$R = V / I_{MAX}$$

where V is the supply voltage and I_{MAX} is the maximum allowed current. With this value, the resistor limits the current to the highest allowed value, even if the phototransistor is brightly illuminated and assumed to conduct perfectly.

When V = 5V and I_{MAX} = 15mA, R should be at least 330 ohms.

What Can Go Wrong

Visual Classification Errors

Phototransistors can be visually similar to LEDs and photodiodes. They are easily confused, as neither type of component is usually marked with any identification number. The entry for **photodiodes** describes a system for distinguishing the three types of components. See "What Can Go Wrong" in Chapter 21.

Output Out of Range

The output voltage from a phototransistor will depend on the intensity of incident light, the value of any pullup resistor that is used, and the supply voltage. While a circuit is being developed, the light range may seem predictable, but in actual use the output range may not fall within expectations.

NTC thermistor

23

PTC thermistors, in which the resistance increases as the temperature increases, have a separate entry. See Chapter 24.

A *resistance temperature detector* or **RTD** has a resistance that increases as its temperature increases, but it is not usually classified as a thermistor, because its sensing element is fabricated differently. Its entry will be found at Chapter 26.

Semiconductor temperature sensors and **thermocouples** each have their own entries.

Infrared temperature sensors and **passive infrared** motion sensors have their own entries. They are *noncontact* temperature sensors that respond to infrared radiation.

OTHER RELATED COMPONENTS

- **PTC thermistor** (see Chapter 24)
- **infrared temperature** sensor (see Chapter 28)
- **passive infrared** motion sensor (see Chapter 4)
- **semiconductor** temperature sensor (see Chapter 27)
- **thermocouple** (see Chapter 25)
- **RTD** (resistance temperature detector) (see Chapter 26)

What It Does

An NTC thermistor is the most common type of discrete-component temperature sensor, and is usually the most affordable. Its resistance diminishes as its temperature increases. This behavior is referred to as a *negative temperature coefficient*, which is the source of the acronym NTC.

This is a simple, passive component that is not polarized. It requires no separate power supply, but an external device must pass a small AC or DC current through it to determine its resistance. This is known as an *excitation current*.

Schematic Symbols

Schematic symbols for a thermistor are shown in Figure 23-1. Those in the top row may still be found in the United States, but are being replaced by the European variants in the second row. The addition of -t° to the symbol indicates an NTC type of thermistor, while +t° indicates that it is the PTC type, with a positive coefficient (see Chapter 24). If no indication is shown, the thermistor is likely to be the NTC type.

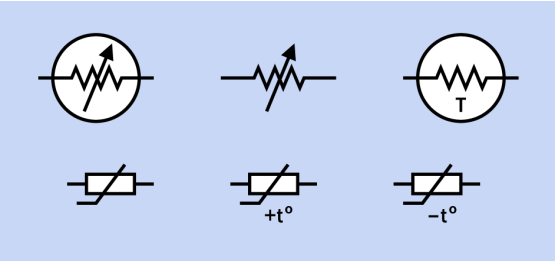

Figure 23-1 *Schematic symbols representing a thermistor. Letter t preceded by a plus or minus sign indicates whether the thermistor is the PTC or NTC type, respectively.*

Applications

Thermistors monitor temperature in air-conditioning systems, clothes washers, refrigerators, pool and spa controls, dishwashers, toasters, and other domestic devices. They are used in laser printers, 3D printers, industrial process controls, and medical equipment.

As many as 20 thermistors may be found in a modern automobile, measuring temperature in locations ranging from the transmission to the ambient air in the passenger compartment.

Comparison of Temperature Sensors

In this Encyclopedia, contact temperature sensors, which measure temperature by making contact with the source, are divided into five main categories, each of which has a separate entry. For convenience, these categories are listed in a comparative summary at the end of this entry. See "Addendum: Comparison of Temperature Sensors".

How an NTC Thermistor Works

Although the term *thermistor* suggests that it is a thermally sensitive resistor, in fact an NTC thermistor is a semiconductor.

Some metal oxides, such as ferric oxide or nickel oxide, become n-type semiconductors when they are treated with dopants. The exact mix is a proprietary secret of each manufacturer. Raising the temperature of this kind of material increases the number of charge carriers in it, promoting electron mobility and thus lowering its effective resistance.

To create a thermistor, the metal oxide mix is heated until it melts and turns into a ceramic. Typically a thin sheet is cut into small pieces for individual sensors. After two leads are connected, the assembly is dipped into epoxy or encapsulated in glass. The most common packages consist of a glass bead, surface-mount chip, or ceramic disc.

Figure 23-2 shows three NTC thermistors. At left is a Murata NXFT15XH103FA2B100 approximately 1mm in diameter, with a reference resistance of 10K and a tolerance of plus-or-minus 1%. At center is a Vishay NTCALUG03A103GC rated 10K at 2%, fitted with a mini-lug. At right is a TDK B57164K153K rated 15K and 3%.

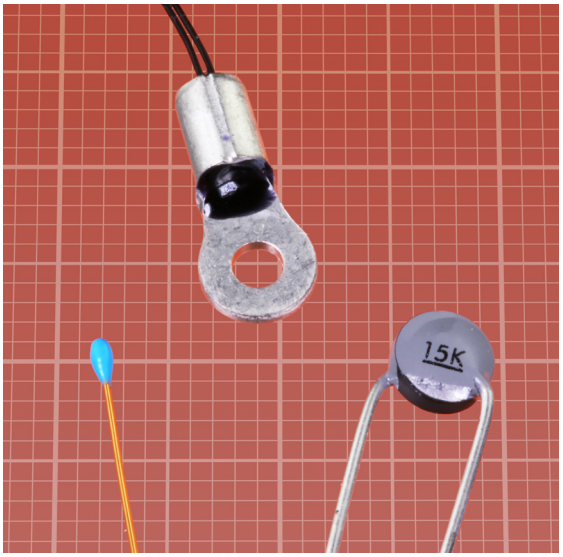

Figure 23-2 *Sample NTC thermistors. See text for details. The background grid is in millimeters.*

Output Conversion for Temperature Sensing

Ideally, the electrical behavior of a temperature sensor should be a linear function of temperature. Thermistors fail in this respect, as their resistance is an approximately inverse exponential function. This is illustrated in Figure 23-3, where the measured resistance of a thermistor rated for 5K at 25 degrees is plotted against temperatures from 0 degrees to 120 degrees Celsius.

- In many datasheets, graphs of this kind may appear flatter because they are customarily plotted against a vertical logarithmic scale.

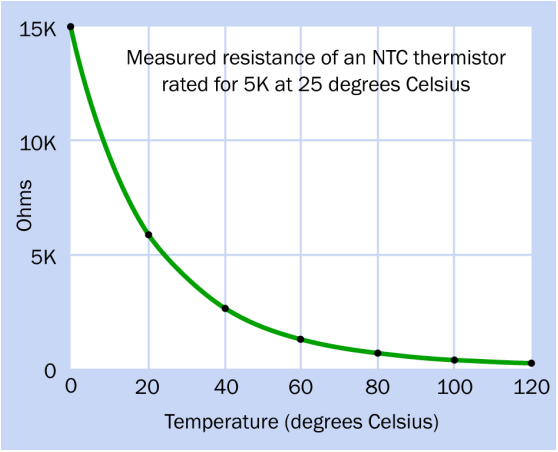

Figure 23-3 *Resistance of a thermistor from 0 to 120 degrees Celsius.*

To monitor the resistance of a thermistor, it can be placed in a simple voltage divider as shown in Figure 23-4, where the fluctuating resistance of the component creates a fluctuating voltage at point A.

- The voltage can be used as an input to a microcontroller that contains an analog-to-digital converter. Alternatively it can be connected directly to a solid-state relay, or amplified with an op-amp, or can be passed through a comparator to create an adjustable switching threshold.

Although this circuit is a voltage divider, it is also known as a *half bridge*, as it is half of a Wheatstone bridge.

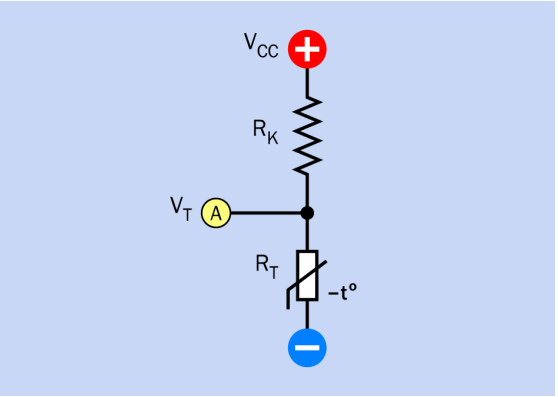

Figure 23-4 *A half-bridge circuit for determining the resistance of a thermistor.*

If V_{CC} is the supply voltage, V_T is the measured voltage at point A, R_T is the resistance of the thermistor, and R_K is the constant value of the series resistor, the basic formula for a voltage divider looks like this:

$$V_T = V_{CC} * (R_T / (R_T + R_K))$$

By transposing terms, a formula can be derived to obtain a value for R_T from the measured voltage and the value of R_K:

$$R_T = (R_K * V_T) / (V_{CC} - V_T)$$

Choosing a Series Resistor

The value for R_K in the formula should be chosen to provide a reasonably wide response over the range of temperatures for which the thermistor is likely to be used. To calculate R_K, another formula must be applied. If R_{MIN} is the resistance of the thermistor at the lowest likely temperature, and R_{MAX} is its resistance at the highest likely temperature:

$$R_k = \sqrt{R_{min} * R_{max}}$$

(This is the same formula as suggested in Figure 20-5 to find the value of a series resistor for use with a photoresistor.)

Wheatstone Bridge Circuit

The half-bridge circuit has the disadvantage that it does not compensate for nonlinearity of a thermistor. Voltage values will change rapidly at the low end of the temperature range, but will change more slowly at the high end, requiring an analog-to-digital converter with a high degree of accuracy to distinguish one voltage value from the next.

A full Wheatstone bridge circuit has a nonlinear output that compensates, somewhat, for the inverse nonlinearity of the thermistor. Referring to the circuit shown in Figure 23-5, the three resistors R_K are chosen using the formula above.

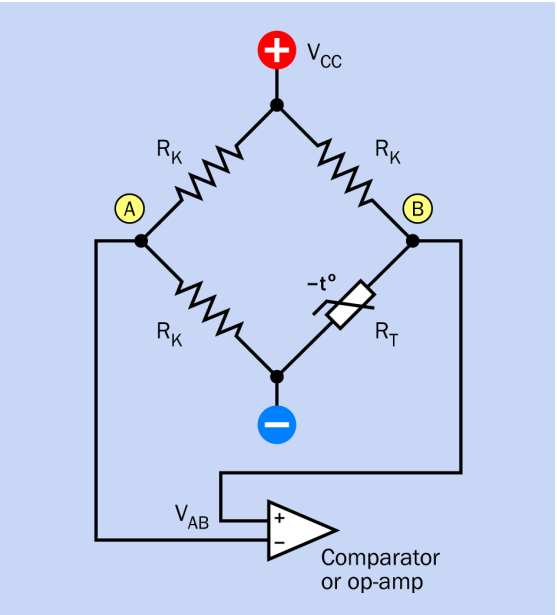

Figure 23-5 *A thermistor may be placed in a full Wheatstone bridge circuit. Outputs A and B are often connected with the two inputs of an op-amp or comparator.*

A standard formula provides the relationship between R_T, the resistance of the thermocouple; V_{CC}, the supply voltage; R_K, the fixed resistances; and V_{AB}, the output voltage measured between points A and B:

$$V_{AB} = (V_{CC} / 2) * (R_T - R_K) / (R_T + R_K)$$

From this formula, a version can be derived to calculate R_T by measuring the output voltage, V_A:

$$R_T = R_K * (V_{CC} + (2*V_{AB})) / (V_{CC} - (2*V_{AB}))$$

- The polarity of V_{AB} is reversible, depending on whether R_T is greater or less than R_K. To accommodate this, A and B can be connected to the two inputs of a comparator or op-amp.

Deriving the Temperature Value

After the resistance of the thermistor has been calculated, it can be converted to a temperature value. The datasheet for a thermistor will usually provide a table showing temperature values tabulated against resistance values, so that a lookup table can be created in a microcontroller program.

Alternatively, a datasheet usually includes constants that can be inserted in a resistance-to-temperature conversion equation, but this is nontrivial and requires natural logarithms, which may not be available in a language implemented on a particular microcontroller.

Inrush Current Limiter

NTC thermistors with appropriate characteristics can be used to limit the inrush of current that tends to occur when a circuit is switched on and large capacitors in the power supply charge very quickly.

An *inrush current limiter* is also known as a *surge limiter*, or may be referred to by its acronym, *ICL*. It is an NTC thermistor whose initial resistance diminishes rapidly as its temperature increases.

While NTC thermistors are the type most often used for inrush limiting, PTC thermistors can

serve this purpose if wired differently. See "PTC Inrush Current Limiting". The remainder of this discussion refers only to NTC current limiters.

A suitable NTC thermistor can be placed as shown in the simplified schematic in Figure 23-6, where a rectified AC source is connected with a DC-to-DC converter, and a large smoothing capacitor is used. Initially the thermistor has resistance that is sufficient to limit current and generate heat. But the rise in temperature causes the resistance of the thermistor to fall. Eventually it reaches a steady state where it remains sufficiently warm to maintain a low resistance that imposes a negligible load on the circuit.

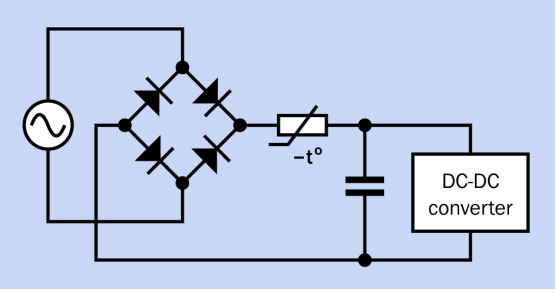

Figure 23-6 *Placement of an NTC thermistor that is designed for inrush current limiting.*

In thermistors that are used for temperature measurement, self-heating is an undesirable attribute. By contrast, an inrush current limiter depends on self-heating to perform its function.

The TDK B57237S509M inrush limiter, shown in Figure 23-7, is rated for 5A and has an initial resistance of 5 ohms at 25 degrees Celsius while not passing current. When tested with a 2,800µF capacitor at 110VAC, its resistance drops to a minimum of 0.125 ohms at 5A. The relationship between current and resistance is shown in Figure 23-8.

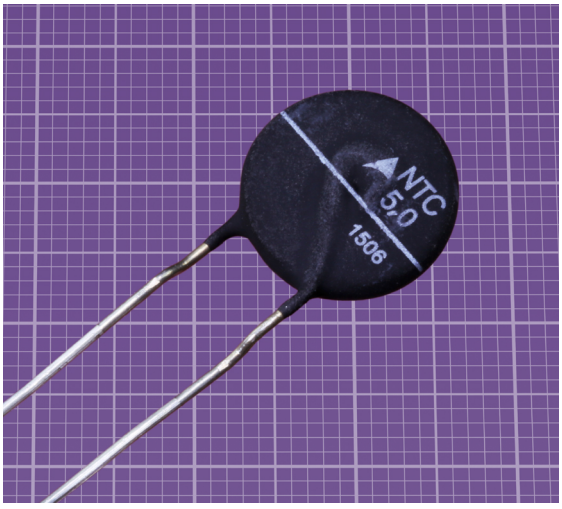

Figure 23-7 *A TDK B57237S509M NTC thermistor designed as an inrush current limiter, rated 5 ohms at 5 amps. The background grid is in millimeters.*

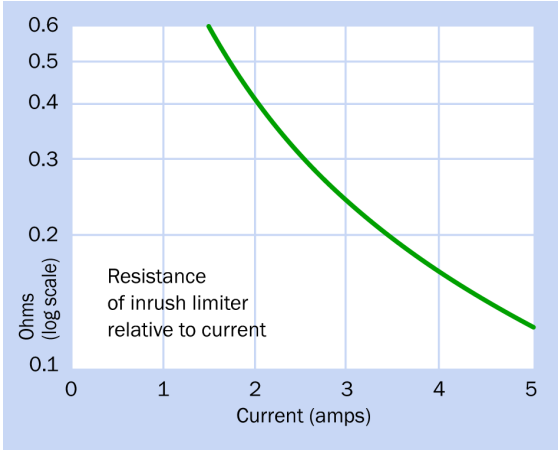

Figure 23-8 *This graph shows the relationship between resistance and current in a TDK B57237S509M inrush limiter.*

Restart

If a protected device is switched off momentarily and is then switched on again, the thermistor cannot provide protection, as it has not had time to cool down and regain its resistance. However, during the 30 seconds to 2 minutes required for heat in the thermistor to dissipate, smoothing capacitors are unlikely to lose much of their charge. Therefore, if the device is restarted, an inrush of current should not occur.

Thermistor Values

Datasheets for thermistors may be more complex and cryptic than for many components.

When examining a datasheet, first check to see if the thermistor is described as being suitable for temperature measurement or inrush current limiting. A component designed for temperature measurement will not survive inrush current, while one designed for inrush current limiting will have a very low resistance making it unsuitable for temperature measurement.

Time and Temperature

In most datasheets, lowercase letter t is used for values relating to time, whereas an uppercase T is used for values relating to temperature. Unfortunately, T may also be used as an abbreviation for "thermistor."

Resistance and Response

Letter R often means resistance, but may indicate response time, depending on the context in which it is used. For example, R_T is the resistance of a thermistor, and t_R is a response time.

Kilohms and Kelvin

Letter K may be used to represent temperature in degrees Kelvin, 0 degrees on the Celsius scale being approximately 273 degrees Kelvin. However, letter K is also used to represent thousands of ohms, sometimes in the same datasheet. In both instances, K is capitalized.

Reference Temperature

This is the temperature at which many attributes of the component are measured, such as its temperature coefficient and resistance. Usually the reference temperature is 25 degrees Celsius, but in some cases it may be 0 degrees, and other values are occasionally used. The term is abbreviated T_{REF}.

Reference Resistance

The reference resistance for a thermistor (sometimes described as its nominal resistance) may be referred to as R_R, and is the resistance at the reference temperature. It may be referred to as the "R value," but in thumbnail product descriptions it can be cited simply as "Resistance."

In datasheets, R25 or R_{25} is the resistance at 25 degrees Celsius. If this is the reference temperature, R_R and R_{25} will be the same.

Dissipation Constant

DC is the *power dissipation constant*, a ratio normally expressed as milliwatts per degree Celsius (written as mW/°C). This is a measurement of how much thermal power the thermistor can transfer to the environment for a 1 degree increase in temperature.

Temperature Coefficient

TC may be used as an acronym for the *temperature coefficient*, which represents the sensitivity of the thermistor. (Sometimes TCR is used instead of TC, the letter R denoting resistance. The two acronyms both mean the same thing.) The value is the percentage change in resistance for each change in temperature of 1 degree Celsius. Thus, if the resistance of a thermistor drops from 800 ohms to 768 ohms when the temperature increases from 28 to 29 degrees Celsius, TC = -4%. For NTC thermistors, which have a resistance that decreases when temperature increases, the temperature coefficient is negative. However, the minus sign may be omitted.

The coefficient may be expressed in parts per million (abbreviated ppm) instead of as a percentage. To convert parts per million to a percentage, divide by 10,000. Thus, a figure of 50,000ppm is equivalent to 5%.

Thermal Time Constant

Unfortunately TC is also used to represent the thermal *time constant*. If T_D is the temperature difference between the thermistor's initial temperature and a new, higher ambient temperature in which it finds itself, TC is the time it takes for the thermistor to add 63.2% of T_D to its cur-

rent temperature. TC is expressed in seconds, and is defined without power being applied to the thermistor. A low thermal time constant is characteristic of a physically small thermistor that acquires heat rapidly. (TC is very similar to the concept of a time constant for a capacitor acquiring charge. See the entry on **capacitors** in Volume 1.)

Tolerance

The *tolerance* of a thermistor is a measure of its accuracy, usually at 25 degrees Celsius, unless a range of temperatures is stated. A thermistor rated for 5K, with a tolerance of plus-or-minus 1% at 25 degrees, may be found to have an actual resistance ranging from 4,950 to 5,050 ohms at that temperature. Some thermistors have a tolerance of plus-or-minus 20%. A tolerance better than plus-or-minus 1% is relatively rare.

Temperature Range

The *working temperature range* of any thermistor that uses silicon dioxide is usually between about -50 and +150 degrees Celsius (slightly wider for versions encapsulated in glass, and slightly narrower if accuracy is important).

Switching Current

For a thermistor with a nonlinear response, the switching current is the approximate current that forces a sharp transition in resistance. It is represented by I_S.

Power Limitations

Operating current is the maximum current recommended to avoid self-heating. The *power rating* is the maximum allowed power (usually 100mW to 200mW).

Interchangeability

To measure temperature reliably, two thermistors of the same type, from the same manufacturer, should display the same characteristics. This is known as *interchangeability*. A value of plus-or-minus 0.2 degrees Celsius is common for a modern thermistor, but is not often mentioned in a datasheet.

What Can Go Wrong

Self-Heating

Self-heating can affect the accuracy of an NTC thermistor that is used for temperature measurement. To get accurate temperature readings, keep the current as small as possible. When the resistance of a thermistor is at the high end of its range, brief pulses of current can be used.

Heat Dissipation

Where a thermistor is used for inrush current limiting, it will create some heat during the whole time that a device is switched on. If insufficient air space is allowed between the thermistor and other components, they may be affected.

Lack of Heat

An NTC thermistor will sometimes fail as an inrush current limiter. In very cold climates, it may never become warm enough for its resistance to drop to an acceptable level. Conversely, in a very hot location (such as close proximity to a hot-water pump) it may not get cool enough to provide adequate initial protection.

Addendum: Comparison of Temperature Sensors

A chart illustrating the five main types of contact sensors, and their variants, is shown in Figure 23-9.

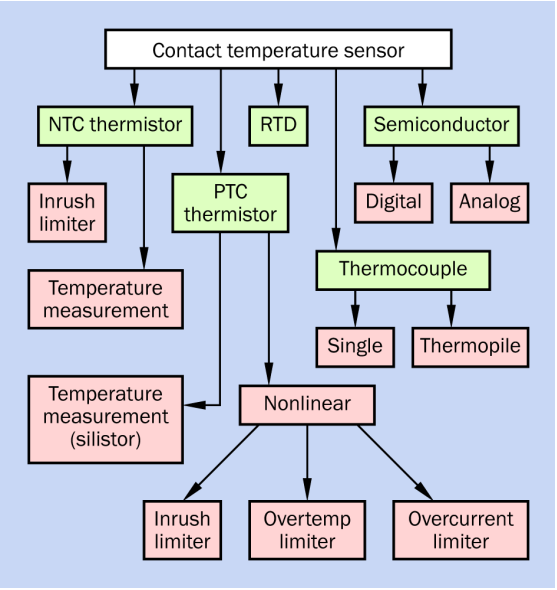

Figure 23-9 *Five types of contact temperature sensors (green boxes) and the variants (red).*

NTC Thermistor

The electrical resistance of an **NTC thermistor** diminishes as its temperature increases. Thus, it has a *negative temperature coefficient*, which is the source of the acronym NTC.

An NTC thermistor is traditionally used where low cost and simplicity are desirable and a relatively limited temperature range is acceptable (often -50 to +150 degrees Celsius). It has the advantage of familiarity, having existed in its present form for many decades. It remains the lowest-cost option among the various types of temperature sensors, and can be connected directly with an external device such as a solid-state relay, in which case no microcontroller is necessary.

PTC Thermistor

The sensing element for a positive-coefficient thermistor is a polycrystalline compound that increases in resistance very rapidly above a threshold temperature. This makes it suitable for blocking a high current to prevent circuit overload.

A *silicon temperature sensor*, sometimes called a *silistor*, can be considered as a PTC thermistor, in that it is a resistive component with a positive temperature coefficient. Its sensing element is etched into silicon.

PTC thermistors are passive, nonpolarized components with two leads or solder pads. For more information about them, see Chapter 24.

Thermocouple

This sensor consists of two wires made from different metals, joined at one end. The differing thermoelectric properties of the wires creates a very small voltage between their free ends. Thermocouples have the widest range of any contact sensor. They are simple, robust, and free from self-heating effects, as they consume no power. Their response is rapid, but very nonlinear, and their sensitivity is limited. They are used in industry and in laboratories, often plugged into a panel meter that combines a digital temperature display with hardware to decode the signal from the type of thermocouple being used.

For more information about thermocuples, see Chapter 25.

Resistance Temperature Detector

Often known by its acronym **RTD**, and sometimes referred to as a *Resistive Temperature Device*, it commonly uses a sensing element fabricated from pure platinum, nickel, or copper. The element may consist of wire wound around a core, or a very thin film deposited on an insulating substrate.

An RTD has a positive temperature coefficient, as its resistance increases while its temperature increases. It is very accurate and stable, providing an almost linear output, especially near the center of its range. However, its sensitivity is often one-tenth of that of an NTC thermistor.

Like a thermistor or a thermocouple, an RTD is a passive device, able to operate at a wide range

of voltages and requiring no power supply. It is nonpolarized, with two leads or solder pads.

For more information about resistance temperature detectors, see Chapter 26.

Semiconductor Temperature Sensor

This is a chip-based sensor that requires no additional components to linearize its output, as linearization is performed in the chip.

The temperature range is similar to that of an NTC thermistor, but the output is a variable voltage with a positive temperature coefficient of about 20mV per degree Celsius, supplied by a built-in op-amp. Response time is 4 to 60 seconds.

This type of sensor requires a power supply, typically of 5VDC or less. It does not have to be calibrated before use, as it is trimmed during the production process to achieve accuracy that can be better than that of a thermistor. Manufacturers may claim plus-or-minus 0.15 degrees over the whole temperature range, which is usually -50 degrees Celsius to +150 degrees, but may be less for variants in which accuracy is more important.

The linear analog output is very convenient for use with a microntroller that has an analog-to-digital converter, and the relatively low cost makes this type of sensor increasingly competitive with thermistors.

An analog-to-digital converter may be included on the sensor chip, in which case it is often described as a *digital temperature sensor* or *digital thermometer*, with an output in degrees Celsius (or, sometimes, Fahrenheit) accessible via I2C or SPI bus. For additional details about protocols such as I2C and SPI, see Appendix A.

A *digital thermostat* or *thermostatic switch* is a semiconductor temperature sensor with a binary output that transitions from logic-high to logic-low (or vice-versa) if the temperature goes above a maximum or below a minimum level. The level can be programmed into the chip.

Semiconductor temperature sensors are identified with a variety of other names. For more information, see Chapter 27.

PTC thermistor

24

A *silistor*, or *silicon-based thermistor*, is included in this entry as a form of **PTC thermistor**.

A *resettable fuse* is not quite the same as a PTC thermistor. For more information, see the entry on **fuses** in Volume 1.

NTC thermistors, in which the resistance decreases as the temperature increases, have a separate entry. See Chapter 23.

A *resistance temperature detector* or **RTD** has a resistance that increases as its temperature increases, but it is not usually classified as a thermistor, because its sensing element is fabricated differently. Its entry will be found at Chapter 26.

Infrared temperature sensors, **semiconductor temperature** sensors, and **thermocouples** each have their own entries.

OTHER RELATED COMPONENTS

- **infrared temperature** sensor (see Chapter 28)
- **semiconductor** temperature sensor (see Chapter 27)
- **thermocouple** (see Chapter 25)
- **NTC thermistor** (see Chapter 23)
- **RTD** (resistance temperature detector) (see Chapter 26)

What It Does

The electrical resistance of a PTC thermistor increases as its temperature increases. Variants can measure temperature or can protect circuits by detecting excessive heat or current.

Because a PTC thermistor is a resistive sensor, it has no polarity. Current may flow through it in either direction, or AC may be used.

Schematic Symbols

The schematic symbol for a PTC thermistor is very similar to the symbol for an NTC thermistor. See Figure 23-1.

Comparison of Temperature Sensors

In this Encyclopedia, contact temperature sensors are divided into five main categories, each of which has a separate entry. For convenience, a comparative summary is included in the entry for

NTC thermistors. See "Addendum: Comparison of Temperature Sensors". Also see Figure 23-9.

PTC Overview

PTC thermistors can be subdivided into two groups:

- *Linear*, with a chip-sized silicon-based sensing element. They are sometimes referred to as *silistors*. The component has a very linear response and is used for temperature measurement. It may be connected directly to a microcontroller.

- *Nonlinear*, mostly using a sensing element containing barium titanate in a polycrystalline compound that increases in resistance very sharply above a threshold temperature. This type of sensor may be described as a *switching thermistor*, because its nonlinear output can activate a switching device.

The sensing elements in positive-coefficient thermistors are different in principle from the element in an NTC thermistor.

Nonlinear thermistors are used in two different ways:

Externally heated
: The thermistor responds to ambient heat or to the temperature of a device to which it is attached. It can be used to protect a circuit or a motor from overheating. Current through the thermistor is minimized to avoid self-heating.

Internally heated
: The thermistor responds to its own temperature caused by current passing through it. It can activate a warning signal or shut down equipment in the event of a short circuit. It can also control current for starting a motor or a fluorescent tube, and is sometimes used as a source to create localized heat.

Silistor for Temperature Measurement

A silicon-based PTC thermistor, sometimes known as a *silistor*, provides a highly desirable, almost linear relationship between temperature and resistance. A popular example is the KTY81 series from NXP, a sample of which is shown in Figure 24-1.

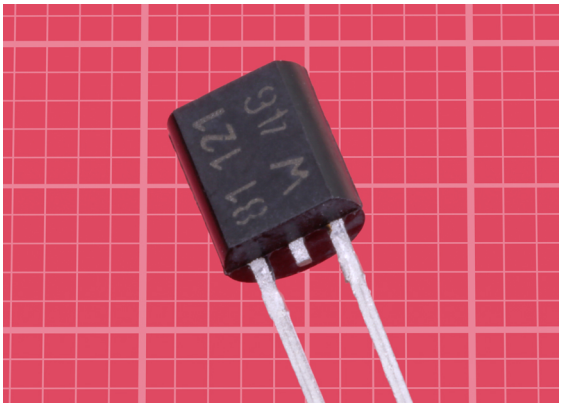

Figure 24-1 *A KTY81 thermistor from NXP. The background grid is in millimeters. Note the amputated center lead.*

The response of this thermistor is shown in Figure 24-2.

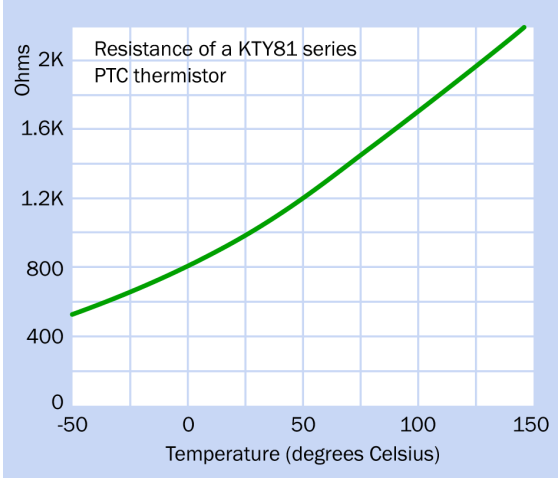

Figure 24-2 *Resistance of the KTY81 thermistor in response to temperature.*

Note that this graph is plotted with a linear vertical scale, unlike the performance curves for many thermistors that are plotted with a log scale. The log scale tends to make a response curve look flatter.

The sensor is a silicon chip designed on the "spreading resistance principle," in which current fans out from a metal contact through a thin layer of silicon to a metallized bottom plane. This effect progresses less actively as the temperature increases. Although the result is partly dependent on polarity, a second metal contact is biased in the opposite direction, and when the two active regions of the chip are wired in series, the result is a component that has no polarity.

- The almost-linear output of this type of sensor makes it easy to use with a microcontroller that has a built in analog-to-digital converter.

Tolerance ranges from plus-or-minus 1% to 5%, depending on the temperature. Variants have a typical reference resistance of 1K or 2K. The temperature coefficient is commonly about 1%, which is considerably lower than that of a typical NTC thermistor, where 4% is common.

- Guidance on reading thermistor datasheets will be found in the entry describing NTC thermistors. See "Thermistor Values".

For correct operation, a typical silistor requires a current ranging from around 0.1mA to 1mA.

- The lower sensitivity and slightly higher price of a PTC temperature-measurement thermistor, compared with an NTC thermistor, may explain why the NTC type seems to remain more popular, with many more variants available. In addition, the NTC type is much more tolerant of variations in current.
- Silistors continue to find some automotive applications, measuring oil temperature, transmission temperature, and climate control, among other parameters.

As a simple strategy to determine its resistance, a series resistor can be used with a PTC sensor to create a voltage divider. The circuit is identical to that used for NTC thermistors. See "Output Conversion for Temperature Sensing".

RTDs

A *resistance temperature detector* or **RTD** is sometimes classified as a PTC thermistor. However, it has a different type of pure-metal sensing element, much lower sensitivity, and is discussed in a separate section of this Encyclopedia. See Chapter 26.

Nonlinear PTC Thermistors

Over-Temperature Protection

This type of nonlinear thermistor is externally heated, but has a switching function. If it is incorporated among other components on a circuit board, its output can be used to activate a warning signal, or can trigger a relay to shut down the circuit until the temperature subsides. This is of special interest for battery chargers where excessive heat can often be a problem, but is also useful in electronic devices generally.

To avoid the possibility of self-heating, current passing through the thermistor must be minimized to a few milliamps.

Some thermistors in the Vishay PTCSL series will make a transition at a temperature as low as 70 degrees Celsius. Others will be triggered by temperatures above 100 degrees. A typical response curve is shown in Figure 24-3, where resistance rises from 100 ohms at 25 degrees to around 1K at the transitional reference temperature of 90 degrees, and reaches at least 4K at 105 degrees.

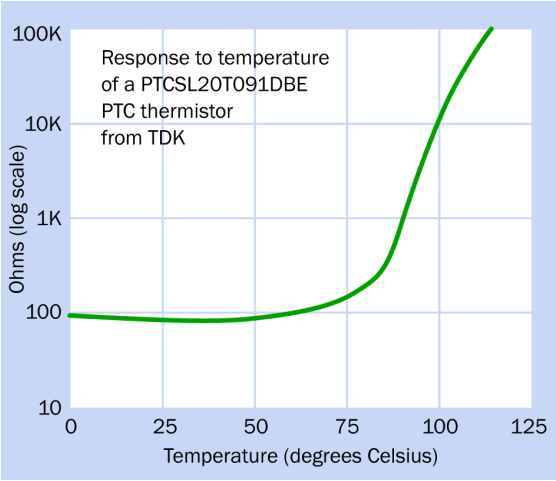

Figure 24-3 *The relationship of resistance to heat in an over-temperature protection thermistor.*

To respond to this transition, the manufacturer recommends a Wheatstone bridge circuit with its outputs connected to a comparator, as suggested for an NTC thermistor in Figure 23-5. The comparator can then activate a signal or a relay.

A picture of the PTCSL20T091DBE thermistor appears in Figure 24-4.

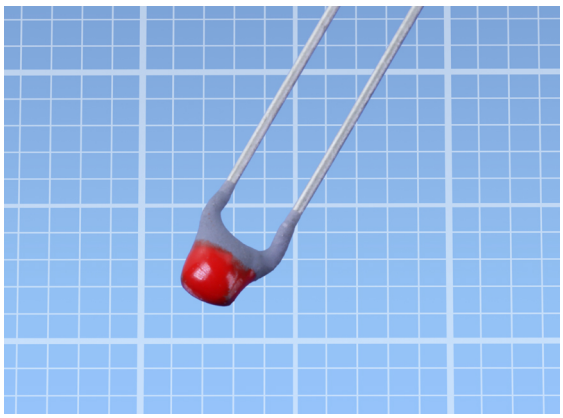

Figure 24-4 *A thermistor in the PTCSL range from TDK. It is color coded using a proprietary scheme by the manufacturer to indicate a reference temperature of 90 degrees Celsius. The background grid is in millimeters.*

This type of thermistor can tolerate a maximum of 30V (AC or DC).

Over-Current Protection

This type of nonlinear thermistor is a substitute for a fuse, as it responds to internal heat created by current passing through it. If the flow of current is excessive, the resistance of the thermistor increases, throttling the flow. When the over-current problem is resolved, the thermistor returns to its normal state. Whereas a fuse must be placed in a location allowing replacement, the thermistor is unharmed by its transition and does not have to be replaced.

Over-current may occur as a result of failure of other components, such as a rectifier diode or a capacitor, or can occur in situations such as a DC motor locking up.

The B598 series from TDK can tolerate voltages over 240V, AC or DC. They typically respond when currents exceed 100mA to 1A, depending on the specific component (a few fall outside that range), and many can withstand 1A to 7A. The B59810C0130A070 pictured in Figure 24-5 is switched by 980mA, can tolerate as much as 7A, and has a reference resistance of 3.5 ohms, rising above 10K when excessive current causes sufficient heat.

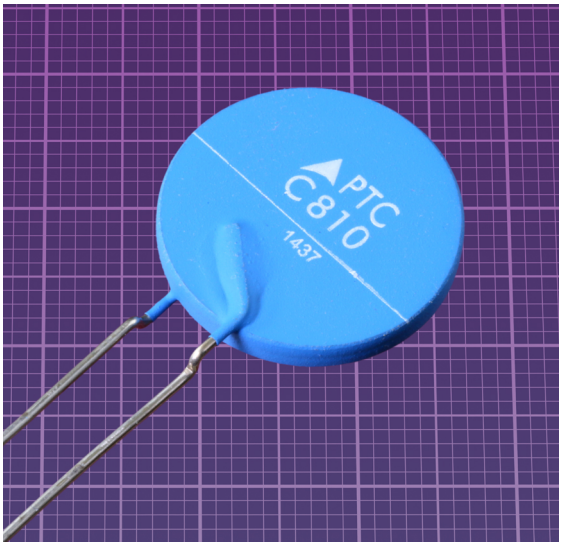

Figure 24-5 *A large over-current protection PTC thermistor. The background grid is in millimeters.*

An over-current thermistor of this type remains wired into the power supply for a device on a permanent basis. Its reference resistance will generate some heat, which is why this type of component is usually restricted to applications where the triggering current is below 1A.

The Murata PTGL07BD220N3B51B0 pictured in Figure 24-6 provides over-current protection with a reference resistance of 22 ohms, has a trip current of 200mA, and tolerates a maximum of 1.5A.

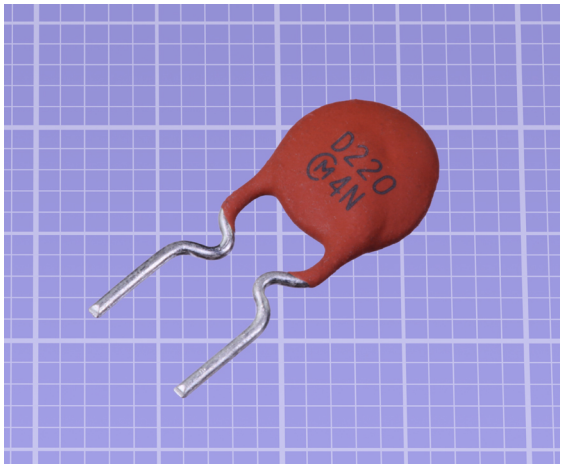

Figure 24-6 *An over-current protection PTC thermistor with a trip current of 200mA. The background grid is in millimeters.*

PTC Inrush Current Limiting

This nonlinear thermistor responds to internal heat caused by an inrush of current when power to a device is switched on. The inrush occurs when current flows rapidly into smoothing capacitors, charging them very rapidly. This can overload a power supply and shorten its life expectancy.

NTC thermistors are traditionally used as inrush limiters. The initially high resistance of this type of component blocks the surge in current, but as heating occurs, the resistance of the NTC thermistor drops rapidly. It remains in the circuit, imposing a relatively small load while the device functions normally. For more details of this application, see "Inrush Current Limiter" in the entry discussing NTC thermistors.

However, an NTC thermistor used in this way will waste some power. Suppose a supply of 120VAC is being used. If the power consumption of a device is 1,000W, the current will be approximately 8A. An NTC thermistor that has a resistance of 0.2 ohms while running warm will introduce a voltage drop of approximately 1.6V, consuming about 13W. This power loss will be greater in applications where the current is even higher—for example, in an electric vehicle recharging station.

To eliminate the loss, a timed bypass relay can be added around the thermistor. The relay closes automatically after a short interval, eliminating the power loss. This is known as *active inrush current limiting*.

However, in this arrangement, an ordinary resistor could be used instead. But in that case, why not use a PTC thermistor that has a reference (cold) resistance of 50 ohms or more? This not only limits the inrush current, but provides additional protection. If a smoothing capacitor in the circuit suffers a short circuit, or if the bypass relay fails to close, excess current passing through the PTC thermistor quickly raises its resistance, protecting the rest of the circuit.

The B5910 series of PTC thermistors from TDK is designed for inrush current limiting. They are packaged in a flame-retardant phenolic resin plastic case, as shown in Figure 24-7. The B59105J0130A020 has a reference resistance of 22 ohms that rises quickly beyond 10K when the temperature exceeds 120 degrees Celsius, as shown in Figure 24-8. This type of component is robust enough to withstand a complete short circuit across a 220-volt supply.

Figure 24-7 *This inrush current-limiting PTC thermistor by TDK is packaged in a flame-retardant case. The background grid is in millimeters.*

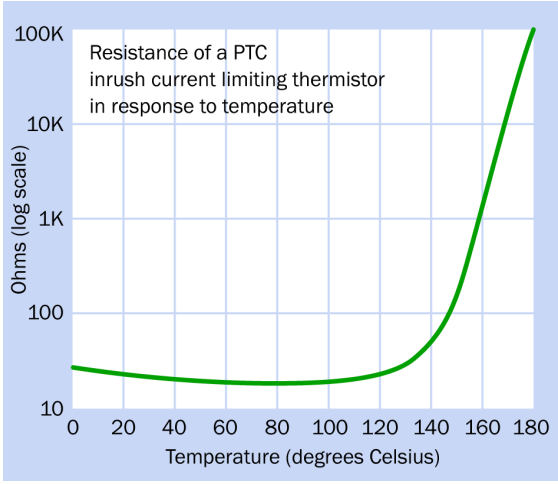

Figure 24-8 *Relationship of resistance to temperature in a PTC inrush current limiting thermistor. Note that the vertical axis has a logarithmic scale.*

PTC Thermistor for Starting Current

In some applications an initial inrush of current is actually necessary and desirable. An air conditioning compressor, for example, requires a surge of high current for "torque assist" when it is starting from a rest state.

High-current PTC thermistors may be used in this kind of situation. The Vishay PTC305C series is an example. These are heavy-duty components that have a switching time of about half a second, a maximum voltage rating of 410VAC or more, and a current rating from 6 to 36 amps.

The PTC thermistor has a relatively high temperature while the motor is running, and must be allowed time to cool before a restart is possible after shutdown. A waiting time of 3 to 5 minutes is imposed by a thermostat or separate time-delay relay.

PTC Thermistor for Lighting Ballast

The starting sequence for a fluorescent lamp requires that current should flow through the cathode heater initially. The thermistor allows this by bypassing a capacitor. Within less than a second, the resistance of the thermistor rises to block current. By this time, the heater has done its job and the lamp runs from high-frequency AC.

PTC Thermistor as a Heating Element

For small applications, a heating element can be made from a PTC thermistor, using its internal resistance to create heat. It has the advantage of being self-limiting, as its resistance rises with temperature. The TDK 5906 series is an example, shown in Figure 24-9. The component is approximately 12mm in diameter, and is designed to be clamped in place, not soldered. It has automotive applications for diesel fuel preheating and spray nozzle defrosting. Residential applications include vaporizers for air fresheners.

The initial resistance is as low as 3 or 4 ohms, rising very quickly at a transition temperature ranging from 70 to 200 degrees Celsius, depending on the specific component.

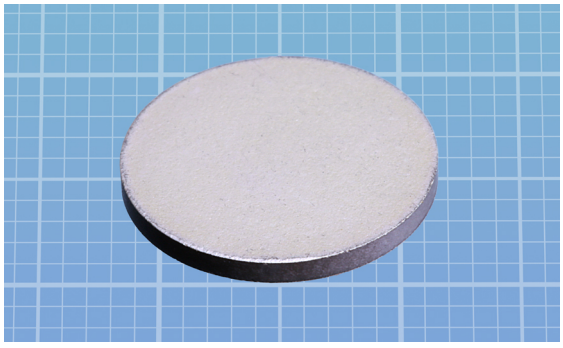

Figure 24-9 *This TDK B59060A0060A010 heating element is a PTC thermistor whose resistance rises rapidly around 80 degrees Celsius. Rated for 12VDC, it is intended for automotive applications. The background grid is in millimeters.*

What Can Go Wrong

Self-Heating

Self-heating may affect the accuracy of a temperature sensor. To get accurate readings, keep the current small. When the resistance of a thermistor is at the high end of its range, brief pulses of current can be used.

Heating Other Components

In cases where the self-heating of thermistors serves a useful purpose, as in surge protectors and when used for delays, the heat can damage nearby components or materials.

thermocouple

25

Because a *thermopile* is an assembly of thermocouples, it is included at the end of this entry. Other types of temperature sensors have their own entries.

OTHER RELATED COMPONENTS

- **NTC thermistor** (see Chapter 23)
- **PTC thermistor** (see Chapter 24)
- **semiconductor** temperature sensor (see Chapter 27)
- **RTD** (resistance temperature detector) (see Chapter 26)
- **infrared temperature** sensor (see Chapter 28)

What It Does

A **thermocouple** measures temperature by using a pair of wires made from dissimilar metals. At one end of each wire, they are joined together, often by welding them. The differing thermoelectric characteristics of the wires generates a very small voltage between their free ends, from which the temperature of the joined ends can be derived.

No power supply is needed for a thermocouple, but the voltage that it generates is extremely small (measured not just in millivolts, but microvolts) and very nonlinear, requiring hardware and/or software to convert it to a temperature value. Laboratory equipment or integrated circuit chips are available for this purpose.

Different types of thermocouples are available to measure different temperature ranges, and each type has its own characteristics, requiring appropriate conversion.

A "raw" thermocouple looks very unimpressive, as it merely consists of two wires welded together at one end. This is illustrated in Figure 25-1. The full length of the photocouple is shown in Figure 25-2.

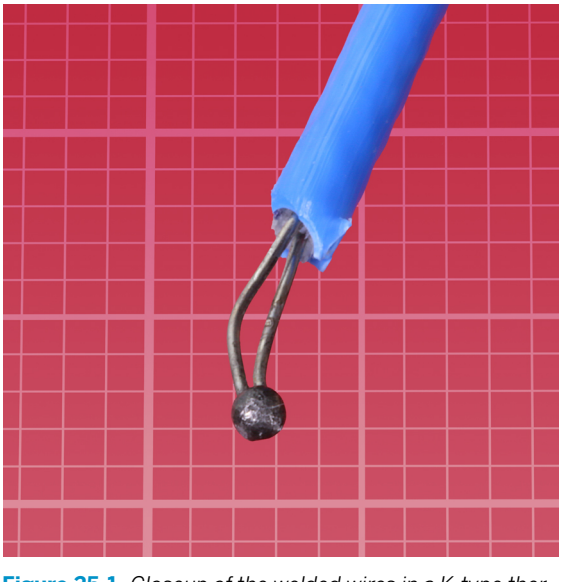

Figure 25-1 *Closeup of the welded wires in a K-type thermocouple. The background grid is in millimeters.*

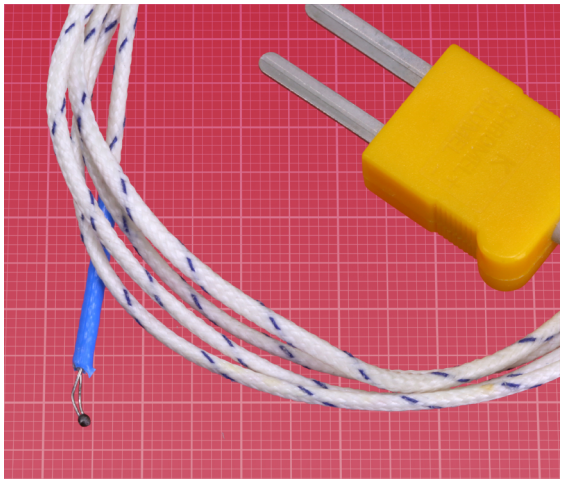

Figure 25-2 *Overview of the thermocouple in the previous photograph.*

A thermocouple sold as a commercial product is likely to be enclosed in a probe, as shown in Figure 25-3.

Figure 25-3 *A probe that contains a thermocouple.*

Schematic Symbol

A schematic symbol that is often used to represent a thermocouple is shown in Figure 25-4. Because this component does not consume current, the plus and minus signs do not mean that power should be applied to the wires. The positive sign indicates which wire will generate a higher voltage than the wire with the negative sign.

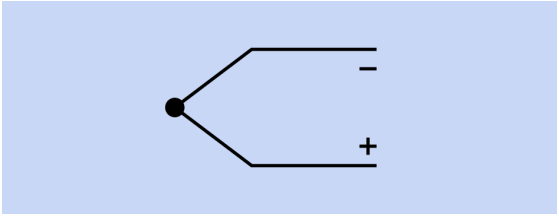

Figure 25-4 *A symbol that is often used for a thermocouple.*

Comparison of Temperature Sensors

In this Encyclopedia, temperature sensors are divided into five main categories, each of which has a separate entry. For convenience, a comparative summary is included in the entry for **NTC thermistors**. See "Addendum: Comparison of Temperature Sensors" for an overview. Also see Figure 23-9.

Thermocouple Applications

Thermocouples have a wider range than any other form of contact temperature sensor, some types being capable of measuring up to 1,800 degrees Celsius. The main limitation is the ability of the joint between the wires to withstand the heat. Appropriate insulation must be used, but segments of ceramic tube are marketed to serve this purpose if necessary.

The very small thermal mass of a thermocouple enables a rapid response to temperature fluctuations. No self-heating occurs, because the thermocouple consumes no power. It is simple and robust. However, its response is very nonlinear, and the tiny voltages involved are vulnerable to corruption by electrical noise. Accuracy is usually not better than plus-or-minus 0.5 degrees Celsius, and may be less at low temperatures.

Thermocouples are commonly found in laboratories and in some industrial applications, such as monitoring the temperature in a blast furnace or inside an internal combustion engine.

They may also measure temperatures as low as -200 degrees, but at temperatures below -100 degrees the temperature coefficient diminishes to the point where voltage increments are less than 30µV per degree Celsius.

How a Thermocouple Works

When one end of a piece of wire is maintained at a temperature that is different from the other end, the temperature gradient along the wire creates a small electromotive force that manifests itself as a difference in electrical potential between one end of the wire and the other. This is known as the *Seebeck effect*, named after the man who discovered it. The magnitude of the potential will depend on two factors: the temperature difference between the ends of the wire, and the type of wire that is used.

Figure 25-5 illustrates the concept. Part 1 of this figure shows two wires, named A and B. The left ends of the wires are heated to the same temperature, T_X, while the right ends remain at a cooler temperature, T_Y. Because the wires are composed of different metals, the voltage drop across each wire will be different.

To make this model useful, some factors must be eliminated. In part 2 of Figure 25-5, the hot ends of the wires have been welded together. This now guarantees that they share the same temperature and the same voltage, V_X. We do not yet know what these X values are.

In part 3 of the figure, the cold ends of the wires are clamped in an isothermal block, which keeps them at an equal temperature, still represented as T_Y. The block is not electrically conductive, so the cold ends of the wires still have different voltages, V_A and V_B. We cannot measure these voltages directly, because they are relative to V_X, which is unknown. However, a volt meter can measure V_A and V_B relative to each other.

The volt meter will have its own voltage gradient on its wires, and possibly a temperature gradient too, but both of these wires are made of the same metal (probably copper) and share the same temperature gradient. Therefore, their effects will be equal.

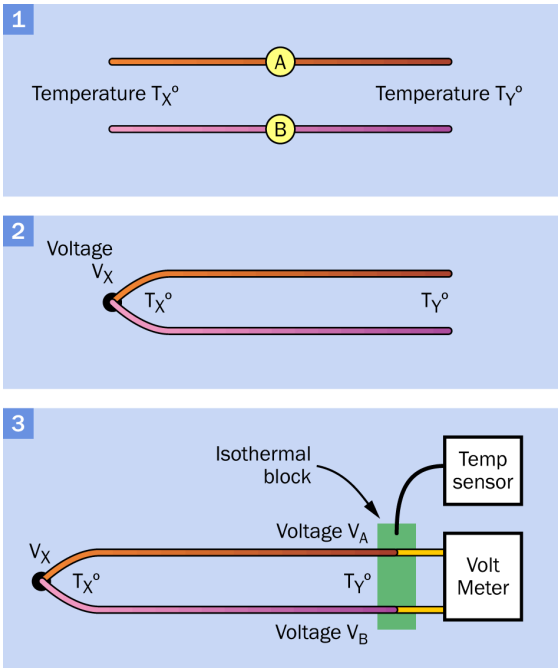

Figure 25-5 *Basic principles of a thermocouple. See text for details.*

A mathematical relationship exists between the temperature gradient and the voltage difference in each thermocouple wire. Suppose K_A is a constant or function that enables the voltage difference in wire A to be determined from its temperature gradient, and K_B serves the same function for wire B. Suppose T_{DIF} is the difference in temperature between T_X and T_Y. We may state:

$$K_A * (T_{DIF}) = V_X - V_A$$

$$K_B * (T_{DIF}) = V_X - V_B$$

By subtracting the second equation from the first and rearranging the terms, we get:

$$T_{DIF} * (K_A - K_B) = V_X - V_A - V_X + V_B$$

The two V_X terms cancel out, leaving $V_B - V_A$ on the right. We can recognize $V_B - V_A$ as the volt-

age difference measured by the meter. Call it V_M. So:

$$T_{DIF} = V_M / (K_A - K_B)$$

This enables calculation of the temperature difference between the ends of the wires, based on the meter reading and the conversion factor for each wire, which can be found experimentally. Because T_Y is being held at a known, constant value, we can determine the value of T_X:

$$T_X = T_Y + T_{DIF}$$

Thermocouple Details

When the thermocouple was first invented, the cold ends of the wires were placed in a bath of ice and water, forcing them to acquire and maintain a known temperature of 0 degrees Celsius.

The advent of accurately calibrated thermistors made it possible simply to measure the temperature of the cold ends. In this way, a thermistor enables a thermocouple to work. This prompts the question: why not just use the thermistor to measure T_X, and throw away the thermocouple? The reason is that a thermistor has a more limited range, seldom being used for temperatures above 150 degrees Celsius.

Note that the "hot end" of the thermocouple wires does not actually have to be hotter than the "cold end," even though those terms are commonly used. The equation to find T_X works just as well if T_Y is higher than T_X. The temperature difference will simply have a negative value instead of a positive value.

Because "hot" and "cold" are misleading terms, modern documents generally refer to the "measurement junction" and the "reference junction" of the wires. Note, however, that the wires are not actually joined with each other at the reference junction.

A common misconception is that voltage is generated where the wires are joined at the measurement junction. This is not correct. The voltage is a function of the temperature gradient between the measurement junction and the reference junction in each wire. Therefore, the way in which the wires are joined is irrelevant, provided there is an electrical connection between them. They can be welded, soldered, brazed, or crimped together.

How to Use It

Where a thermocouple is used in a laboratory, typically each wire is insulated, and they terminate in a plug that is inserted in a meter. The reference junction is hidden inside the meter, along with some electronics to decode the temperature data. The meter must have a setting that is appropriate to the specific type of thermocouple being used, so that the conversion factors are correct.

Because the type of metal in each wire must be consistent all the way from the measurement junction to the reference junction, other types of wires cannot be used to extend the reach of a thermocouple. Any extension must use wires made from the same metals. Connectors, also, must have pins and sockets that match the types of metals in the wires.

An extension wire for a thermocouple is shown in Figure 25-6.

Figure 25-6 *Extension wire for a type K thermocouple. Note the polarized plug.*

Types of Thermocouples

Thermocouples are identified by ANSI standard codes consisting of single letters of the alphabet, shown below. Temperature ranges are approximate, in Celsius, with minimums rounded up and maximums rounded down to the nearest 50 degrees. Some data sources recommend narrower temperature ranges for practical use.

K type
: -250 to +1,350 degrees. Most popular type of thermocouple. Positive wire is a nickel-chromium alloy, negative wire is a nickel-aluminum alloy. Commonly used in 3D printers.

J type
: -200 to +1,200 degrees. Positive wire is iron, negative wire is a copper-nickel alloy. The iron wire is magnetic and vulnerable to corrosion. This thermocouple is not recommended for low temperatures, even though it is theoretically capable of measuring them.

T type
: -250 to +400 degrees. Recommended for cryogenic applications. Positive wire is copper, negative wire is a copper-nickel alloy.

E type
: -250 to +1,000 degrees. Most sensitive type, with the highest temperature coefficient. Positive wire is a nickel-chromium alloy, negative wire is a copper-nickel alloy.

N type
: -250 to +1,300 degrees. An alternative to the K type, more stable at higher temperatures. Positive wire is a nickel-chromium-silicon alloy, negative wire is a nickel-silicon-magnesium alloy.

R type
: -50 to +1,750 degrees. For high-temperature applications. Positive wire is a platinum-rhodium alloy, negative wire is platinum. Very low temperature coefficient.

S type
: -50 to +1,750 degrees. For high-temperature applications. Positive wire is a platinum-rhodium alloy, negative wire is platinum. Very low temperature coefficient.

Seebeck Coefficients

Datasheets for thermocouples list the Seebeck coefficient, which is the temperature coefficient caused by the Seebeck effect, measured in microvolts per degree. In other words, the value provided by a Seebeck coefficient is the number of additional microvolts that a thermocouple will generate for an increase in 1 degree Celsius.

Each type of thermocouple has a different coefficient, and because thermocouples tend to have a very nonlinear response, the coefficients will vary with temperature. Figure 25-7 shows the variations for six types of thermocouples, over a range from -400 to +1,400 degrees Celsius. It is important to understand that the vertical scale shows the coefficient for each type of thermocouple—that is, the *change* in voltage, not the *actual* voltage, at temperature values along the horizontal axis.

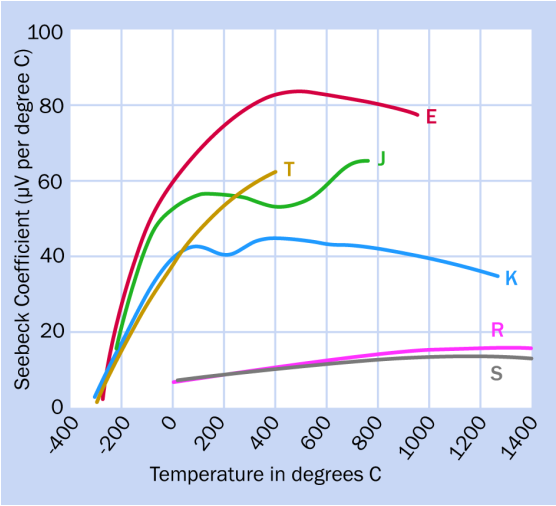

Figure 25-7 *The Seebeck (temperature) coefficient for six types of thermocouples. Partially derived from a datasheet published by Analog Devices.*

R and S type thermocouples have a relatively consistent response, but cannot achieve great accuracy, because the voltage increment is so small for each change in temperature. The K type thermocouple does relatively well between 0 and 1,200 degrees, but the J type only performs adequately between 0 and 800 degrees, while the T and E types are quite inconsistent.

For lower voltage readings, electrical noise becomes an issue. Thermocouple wires are often twisted together, and may also be shielded, to reduce sensitivity to noise. The electronics that decode the thermocouple voltage should include a filter to reject 50Hz or 60Hz interference from wiring in the vicinity.

Chips for Output Conversion

Meters that are designed to interpret the output from a thermocouple and display a temperature tend to be expensive, and may not be convenient for a custom-built application. Fortunately integrated circuit chips are now available to amplify the thermocouple output and apply signal conditioning to create an almost linear response.

The AD8494 and AD8496 from Analog Devices are precalibrated by laser wafer trimming to match the characteristics of J type thermocouples, while the AD8495 and AD8497 match the characteristics of K type. The chips require a power supply of at least 3VDC and have an analog output of 5mV per degree Celsius, enabling measurement over a range of almost 1,000 degrees. They require a very low supply current of 180µA. The manufacturer claims an accuracy of plus-or-minus 2 degrees Celsius.

The chip contains a temperature sensor which should be at the same temperature as the reference junction of the thermocouple. This means that the reference junction (typically, at the socket where a thermocouple plug is inserted) should be as close to the chip as possible, and the chip should be protected from heat created by other components. Any difference in temperature between the reference junction and the chip will create a temperature measurement error.

The MAX31855K chip from Maxim Integrated Products is another thermocouple-to-digital converter. It linearizes the output from the thermocouple and digitizes it as a temperature that is accessible by a microcontroller via a serial SPI bus. Breakout boards with this chip are available. The last letter of the chip number specifies the thermocouple type. Variants for J, K, N, T, S, and R are available.

The AD8495 is mounted on a breakout board from Adafruit, and the MAX31855K is mounted on a breakout board from Sparkfun. These boards are pictured in Figure 25-8.

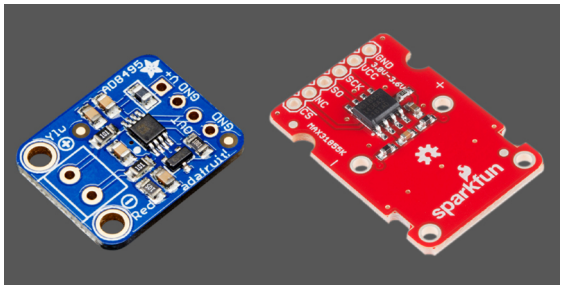

Figure 25-8 *Thermocouple amplifier/conversion chips from Adafruit (left) and Sparkfun (right).*

Thermopile

A thermopile is an assembly of thermocouples connected in series, as suggested in Figure 25-9, where a hot area is shown on the left and a cooler area is shown on the right. The figure assumes that the orange-colored wires have a voltage difference of 5mV from left to right, as a result of the temperature difference, while the purple-colored wires only have a voltage difference of 1mV from left to right. Therefore, the voltage difference between each reference junction and the next is 4mV, as shown on the right side of the figure. So long as the temperature difference exists, the voltage differences will be cumulative, totaling 16mV between top and bottom in this example.

Note that the multiple thermocouple junctions are not electrically connected with each other in each temperature zone.

In reality, more thermocouples than this will be added, and the voltage differences may be lower.

Generally a thermopile is not sold as a separate component from retail suppliers, but is built into other devices. It may be used to generate small amounts of current from a heat difference, as in an infrared thermometer. It can also be used as a safety device to shut down a gas supply if a burner is not lit. See Chapter 28.

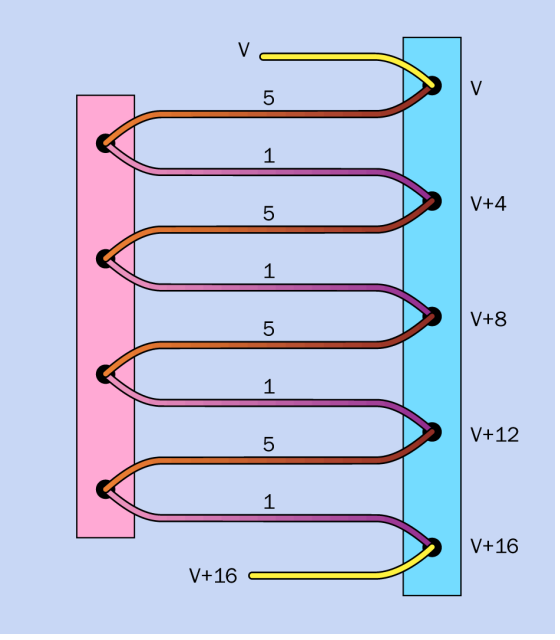

Figure 25-9 *The operating principle of a thermopile. The numbers represent mV, but are chosen arbitrarily as an example.*

What Can Go Wrong

Polarity

The output from a thermocouple has polarity. If this is not observed, an error will result.

Electrical Interference

Thermocouple wires are vulnerable to electrical interference, and should be a twisted pair or, ideally, shielded.

Metal Fatigue and Oxidation

The wire used in some thermocouples tends to be relatively brittle, and cannot withstand much flexing. Also, some metals or alloys are vulnerable to oxidation.

Using the Wrong Type

Different types of thermocouples have totally different characteristics. The electronics to decode the signal from a thermocouple must be matched to the type of thermocouple being used. The plugs on the ends of the thermocou-

ple wires are often retained with screws. A detached plug should be replaced immediately, to avoid the error of attaching it to the wrong type of thermocouple.

Heat Damage from Creating a Thermocouple

If a thermocouple is made from two wires on a DIY basis by welding the tips of the wires together, minimal heat must be used to avoid degrading the alloys in the wires.

RTD (resistance temperature detector)

28

RTD is an acronym, either for *resistance temperature detector* or *resistive temperature device*. No definitive information seems to exist regarding which term is correct, but *resistance temperature detector* is more common.

Occasionally an RTD may be described as a *PTC thermistor*, but its sensing element is different, consisting of pure metal wire or film.

OTHER RELATED COMPONENTS

- **thermocouple** (see Chapter 25)
- **NTC thermistor** (see Chapter 23)
- **PTC thermistor** (see Chapter 24)
- **semiconductor** temperature sensor (see Chapter 27)
- **infrared temperature** sensor (see Chapter 28)

What It Does

A *resistance temperature detector*, also known as a *resistive temperature device*, is usually referred to as an **RTD**. It has a positive temperature coefficient (that is, its resistance increases as its temperature increases) but differs from a **PTC thermistor** in that its sensing element is pure metal instead of a semiconductor.

Comparison of Temperature Sensors

In this Encyclopedia, temperature sensors are divided into five main categories, each of which has a separate entry. For convenience, a comparative summary is included in the entry for **NTC thermistors**. See "Addendum: Comparison of Temperature Sensors" for an overview. Also see Figure 23-9.

RTD Attributes

Positive attributes of RTDs include:

- Accuracy, often plus-or-minus 0.01 degrees Celsius. This very small tolerance allows excellent interchangeability.
- Stability, with a response that drifts by as little as 0.01 degree per year.
- The output is an almost linear function of temperature, making them easily used with a microcontroller.
- Immunity to electrical noise.
- Reasonably rapid response to temperature changes (about 1 to 10 seconds).

Undesirable attributes include:

- Temperature coefficient about one-tenth of that of an NTC thermistor.
- To measure the resistance, some current must pass through the sensor, raising the possibility of self-heating (as in the case of other temperature sensors, with the exception of a thermocouple).
- Relatively high cost, especially of the wire-wound type.

The resistance curves for three generic NTC thermistors are shown in Figure 26-1, plotted against the resistance for a generic platinum RTD that has a reference resistance of 100 ohms at 0 degrees Celsius. Note that this graph is unlike many that illustrate the response of NTC thermistors, in that its vertical scale is not logarithmic.

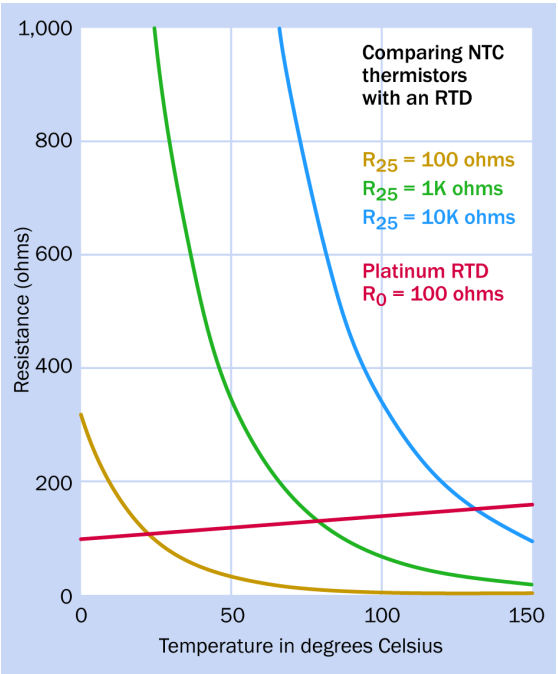

Figure 26-1 *The brown, green, and blue curves show the resistance of three generic NTC thermistors varying with temperature. The red line shows the resistance of a platinum RTD. Derived from a diagram created by Texas Instruments.*

Schematic Symbol

There is no specific schematic symbol for an RTD. Often the symbol for a thermistor may be used. See Figure 23-1.

Applications

Because of its high accuracy, an RTD may be used where precision is important. It can calibrate other temperature sensors, and may measure the temperature of a reference junction of a thermistor. However, it requires sensitive electronics for signal conditioning, because of its low temperature coefficient.

How It Works

An RTD exploits the fractional increase in electrical resistance of a metal film, metal filament, or (in some cases) a carbon film, when the temperature of the metal rises. In its simplest form, an RTD is a 2-wire device with no polarity.

The sensing element is often made from platinum, as this has a linear response to temperature over a wide range. High-quality RTD sensors with a wide temperature range usually consist of platinum wire that is wound around a glass or ceramic core. Smaller sensors may be fabricated from a thin layer of platinum evaporated onto an insulating substrate. Nickel may be substituted for platinum, and has a more sensitive but less linear response.

The wire-wound type is usable at temperatures as high as 500 Celsius (up to 1,000 degrees for some platinum-element types). Some variants are able to measure temperatures as low as -250 degrees.

DIN 60751 is an international standard defining the performance of platinum RTDs. It specifies a reference resistance of 100.00 degrees at 0 degrees, and a temperature coefficient between 0 degrees and 100 degrees. Outside of this range, a formula defines the response.

The response is almost precisely linear, ranging from 100 ohms at 0 degrees to approximately

138 ohms at 100 degrees. The temperature deviation from a straight line, between 0 and 100 degrees, is no more than plus-or-minus 0.8 degrees.

However, current through the RTD must be restricted to avoid self-heating. A range of 0.5mA to 1mA is recommended.

Variants

Some RTDs are potted in glass or resin, as shown in Figure 26-2. This shows an RTD in the TFPTL range from Vishay, containing a nickel thin-film sensing element with a temperature coefficient of about 0.4% and a tolerance of 0.01%. It is available with a very wide range of reference resistances, from 100 ohms to 5K (measured at 25 degrees Celsius). The temperature range is -55 to +70 or -55 to +150 degrees, and the maximum voltage is 30V to 40V, depending on the specific component.

Figure 26-2 *An RTD in the TFPTL series from Vishay. The background grid is in millimeters.*

The flat package shown in Figure 26-3 may be encased in a protective sheath of plastic or silicone rubber, and can be used for surface temperature sensing where the component is glued to the exterior of a flat-sided container. This figure shows an RTD in the L420 range from Heraeus Sensor Technology, containing a platinum thin-film sensing element with a temperature coefficient of 0.385%. It is available in reference resistances of 100, 500, and 1,000 ohms (measured at 25 degrees Celsius). The temperature range is -50 degrees to +400 degrees.

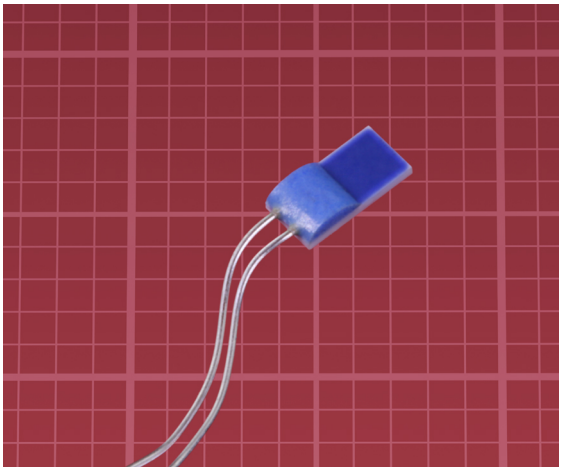

Figure 26-3 *An RTD in the L420 series from Heraeus. The background grid is in millimeters.*

Wiring

The leads to an RTD can be a source of error. If a simple 2-wire configuration is used, the leads will have an unknown resistance that will be affected by temperature, just as the element inside the RTD will have a temperature-sensitive resistance.

To enable temperature compensation, a three-wire design can be used. Figure 26-4 illustrates the principle. In the first section of this figure, resistances R_A and R_B remain unknown. In the second section, the resistances of R_B and R_C can be found by passing a test current through one wire and back through the other, bypassing the component. Assuming that all of the leads are identical in length and composition, the resistance of $R_A + R_B$ will be equal to that of $R_B + R_C$.

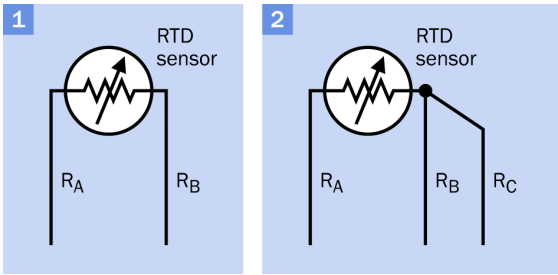

Figure 26-4 *A three-wire configuration enables temperature compensation for the leads to an RTD. See text for details.*

RTD Probe

For practical applications, an RTD sensor is often packaged inside a probe that can be indistinguishable from the type of probe used with a **thermocouple**. However, a thermocouple always uses two wires, as the wires themselves create the voltage. An RTD often uses three wires, as shown in Figure 26-5. This particular sensor is sold for use in a "Brew-Magic" system for brewing craft beer on a commercial basis.

Figure 26-5 *A three-wire RTD is packaged inside this steel probe.*

Signal Conditioning

To process the signal of an RTD, a chip such as the LM75 from National Semiconductor can be used. This is calibrated for connection with a platinum RTD. Internally it converts the resistance of an RTD to a value of 5mV per degree Celsius. This then passes through an analog-to-digital converter on the chip, creating a digital value that can be read via an I2C bus.

What Can Go Wrong

Self-Heating

Self-heating is an issue for RTDs, just as it is for thermistors. Current through an RTD should be limited to 1mA, especially when measuring low temperatures.

Insulation Affected by Heat

The resistance of insulation on the wires leading to a sensor can change with temperature, leading to incorrect resistance readings. This is a more likely source of problems for RTDs than for thermistors, as RTDs are often used at higher temperatures and have a lower temperature coefficient.

Incompatible Sensing Element

If signal conditioning is applied to an RTD that has an incompatible sensing element, temperature readings will be incorrect. For example, an RTD with a nickel element should not be used with signal conditioning designed for a platinum element.

semiconductor temperature sensor

27

This type of sensor may also be referred to as a *bandgap temperature sensor*, a *diode temperature sensor*, a *chip-based temperature sensor*, or an *IC temperature sensor*.

The unfortunate term *integrated silicon-based sensor* is sometimes used, which can be confused with *silicon temperature sensor* (also known as a *silistor*), which is a type of **PTC thermistor**. See Chapter 24.

Some vendors do not divide temperature sensors into clear categories. Semiconductor temperature sensors may be classified as *board-mount* temperature sensors, even though many of them have leads and are not specifically designed to be mounted on circuit boards.

A semiconductor temperature sensor with a digital output is sometimes described as a *digital temperature sensor* or *digital thermometer*. This can be misleading, as the outputs from other types of temperature sensors may be digitized with appropriate components.

OTHER RELATED COMPONENTS

- **thermocouple** (see Chapter 25)
- **NTC thermistor** (see Chapter 23)
- **PTC thermistor** (see Chapter 24)
- **infrared temperature** sensor (see Chapter 28)
- **RTD** (resistance temperature detector) (see Chapter 26)

What It Does

A **semiconductor** temperature sensor is an integrated circuit chip incorporating a sensing element composed of transistor junctions. It has an approximately linear response and is easy to use, in some cases being designed for direct connection with a microcontroller, requiring no additional components.

In analog variants, the output consists either of voltage or current that varies with temperature. These components have a positive temperature coefficient, except for a few CMOS variants where a voltage output diminishes as temperature increases.

Digital variants are becoming more common, creating a numeric output accessible by a microcontroller.

In almost all semiconductor temperature sensors, the characteristics of silicon dioxide limit the temperature range to approximately -50 to +150 degrees Celsius (sometimes less).

This type of component is not (yet) as low in cost as a thermistor, but can include its own amplification, signal processing, and (optionally) analog-to-digital conversion on one chip.

Comparison of Temperature Sensors

In this Encyclopedia, temperature sensors are divided into five main categories, each of which has a separate entry. For convenience, a comparative summary is included in the entry for **NTC thermistors**. See "Addendum: Comparison of Temperature Sensors" for an overview. Also see Figure 23-9.

Semiconductor Temperature Sensor Applications

When a semiconductor temperature sensor is used in surface-mount format, it can measure the temperature of the board on which it is mounted. This enables protection from overheating, often in power supplies.

Because the sensing elements and signal processing circuits are all chip-based, they can be transplanted into other types of sensors. For example, a gas pressure sensor or a proximity sensor can have onboard compensation using a semiconductor temperature sensor. They have also been built into computer CPUs such as the Pentium series from Intel.

Some variants are manufactured in a three-lead TO-92 package, appearing superficially similar to bipolar transistors. They are suitable for remote temperature sensing, and have automotive applications such as measuring the temperature of the transmission, engine oil, or cabin interior. They may also be found in some heating and air-conditioning systems, and some kitchen equipment.

Schematic Symbol

No unique schematic symbol has been developed for a semiconductor temperature sensor. It may be represented by a rectangle containing text abbreviations to represent pin functions, similar to other types of integrated circuit chips.

In the case of a sensor with an output consisting of current that varies with temperature, the sensor may be shown as a *current source*, using the symbol in Figure 27-1. However, this symbol is not specific to temperature sensors; it is used for any component that is a current source.

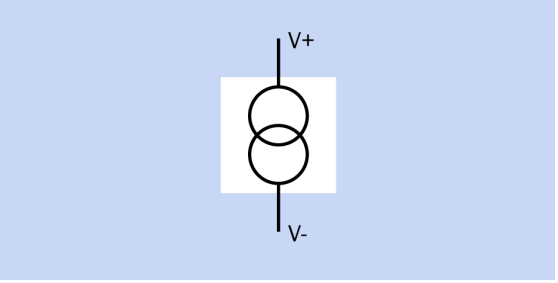

Figure 27-1 *A temperature sensor whose output consists of current varying with temperature may be shown in a schematic as a current source, using this symbol.*

Attributes

Desirable attributes of a semiconductor temperature sensor include:

- Easy to use. Few or no external components may be required, and little or no signal processing.
- Factory-calibrated, with an almost linear response.
- Versions with a digital output are easy to add to any system that already has an I2C bus. For additional details about protocols such as I2C, see Appendix A.

Undesirable attributes of semiconductor temperature sensors include:

- Limited temperature range, the same as thermistors.
- Self-heating issues, especially in versions where signal-processing functions are built into the same chip.

- Not as rugged as some types of temperature sensors.

For an explanation of terminology used for temperature sensors in datasheets, see "Thermistor Values".

How It Works

When a constant current is flowing through a p-n junction in a diode, the voltage across the diode will change by about 2mV for each change in temperature of 1 degree Celsius. This can be demonstrated by the simple circuit shown in section 1 of Figure 27-2.

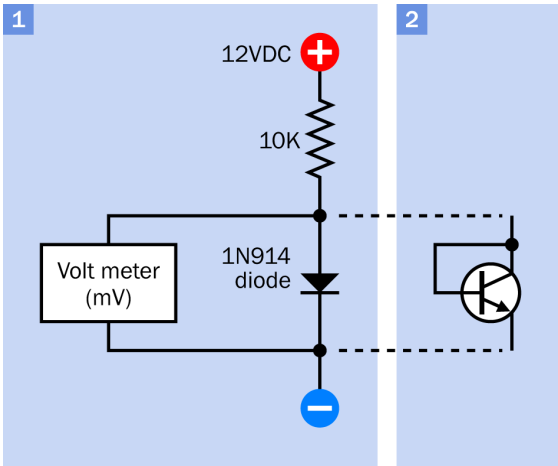

Figure 27-2 *Left, a basic circuit for demonstrating the temperature sensitivity of a diode. Right, an NPN transistor can be substituted to emulate the diode.*

Similarly, the voltage across the p-n junction in an NPN transistor varies with temperature, if the current is constant. A transistor can be substituted for a diode as suggested in section 2 of Figure 27-2. Integrated circuit chips that contain transistors can measure temperature by exploiting this phenomenon.

CMOS Sensors

Some semiconductor temperature sensors use CMOS instead of bipolar transistors. The general concept is similar, but they are described separately, below. See "CMOS Semiconductor Temperature Sensors".

Multiple Transistors

The heat sensitivity of a bipolar transistor can be defined with an equation. If the base-emitter voltage is V_{BE}, q is the charge of an electron, k is a constant (known as Boltzmann's constant), T is the temperature in degrees Kelvin (relative to absolute zero), I_C is the collector current, and I_S is the saturation current (which is less than I_C):

$$V_{BE} = ((k*T) / q) * \log_e (I_C / I_S)$$

The term $\log_e$ means, "the logarithm to base e of the expression in parentheses."

Because k and q have known values, the base-emitter voltage turns out to be proportional to the logarithm of the collector current divided by the saturation current. However, the saturation current depends on the geometry of a transistor, and varies with temperature in a nonlinear way.

To eliminate the factor of saturation current, one transistor can be compared with another transistor that has a larger emitter area. This enables the derivation of a new equation that specifies temperature while getting rid of the troublesome saturation currents, with their nonlinear behavior.

However, it may not be easy to fabricate two transistors, in the same silicon chip, that have the same characteristics except that the emitter area of one is bigger than that of the other. It is much easier to add multiple transistors in parallel, each of them identical to the first. The total emitter area will then be equal to the area in one transistor multiplied by the number of transistors.

In Figure 27-3, assuming all the transistors are at the same temperature in addition to being of identical specification, we can now write two equations. The figure allows room to show only three transistors, but suppose there are N of

them. If V_{BE0} is the base-emitter voltage of transistor Q0, on the left, and V_{BEN} is the aggregate base-emitter voltage of the N transistors on the right:

$$V_{BE0} = ((k*T) / q) * \log_e (I_C / I_S)$$

$$V_{BEN} = ((k*T) / q) * \log_e (I_C / N*I_S)$$

From these, an equation can be derived that gets rid of I_C and I_S:

$$V_{BE0} - V_{BEN} = ((k*T) / q) * \log_e (N)$$

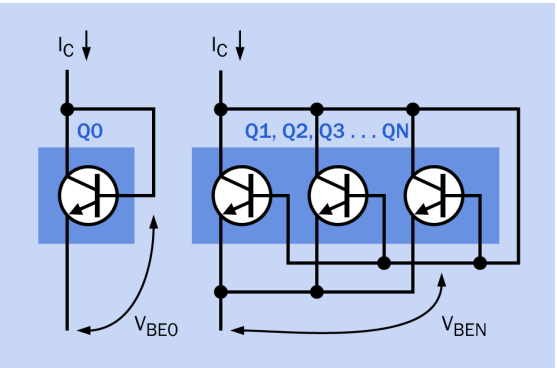

Figure 27-3 *Comparing the base-emitter voltage of one transistor with a set of identical transistors can enable measurement of temperature regardless of the collector current and saturation currents, so long as all the transistors are at the same temperature. See text for details.*

PTAT and the Brokaw Cell

Now if a comparator is added to control the current, a circuit known as the Brokaw Cell is created, shown in Figure 27-4. This is also known generically as a *bandgap temperature sensor*. (A couple of resistors have been omitted for the sake of simplicity.)

Typically, N = 8. That is, there is a set of eight transistors in addition to Q0 (only three being shown here). The voltage difference in the previous equation, V_{BE0} - V_{BEN}, now appears across R2 in the figure, and the voltage across R1 is *proportional to absolute temperature*, often referred to by its acronym, *PTAT*. This voltage can be found from this equation:

$$V_{PTAT} = ((k*T)/q) * \log_e(N) * (2*R1/R2)$$

The Brokaw Cell was the basis of the AD580 chip introduced in 1974 by Analog Devices, and the principle is now used very widely in semiconductor temperature sensors.

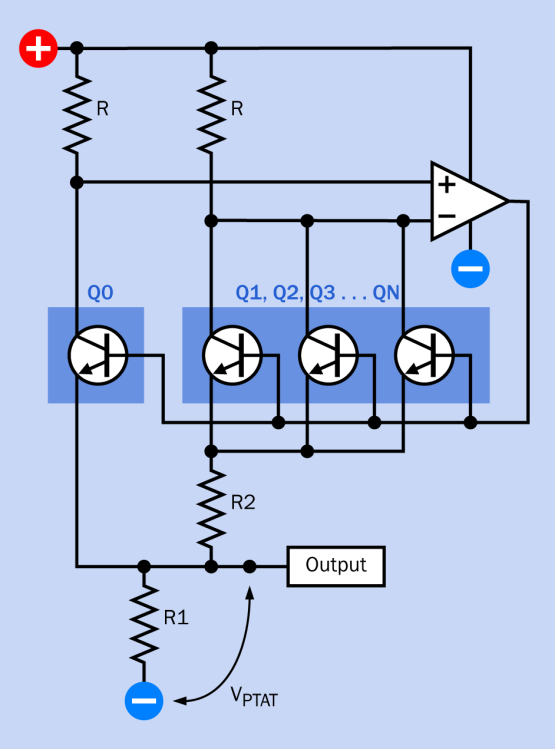

Figure 27-4 *The Brokaw Cell. See text for details.*

Variants

Three output types are used:

- Analog voltage output (voltage varies with temperature).
- Analog current output (current varies with temperature).
- Digital output.

A fourth type creates an output in the form of a square wave, either with a frequency or wavelength proportional to temperature. The Maxim MAX6576 and MAX6577 are examples. How-

ever, this type of output is so rare, it is not described in detail here.

Some semiconductor temperature sensors are CMOS-based, and have a voltage output with a negative temperature coefficient. They are described separately. See "CMOS Semiconductor Temperature Sensors".

Analog Voltage Output

LM35 Series

The LM35 is a typical, widely used semiconductor temperature sensor, available from Analog Devices, Texas Instruments, and other manufacturers. Its output voltage changes by 10mV per degree Celsius over a range of approximately -50 degrees to +150 degrees. Accuracy is stated to be plus-or-minus 0.25 degrees at room temperature and plus-or-minus 0.75 degrees over the whole range.

The sensor can be obtained packaged like a transistor, in a TO-92 plastic capsule or metal can. It is also available as a surface-mount component, or in a TO-220 package, like a 5V voltage regulator, as shown in Figure 27-5.

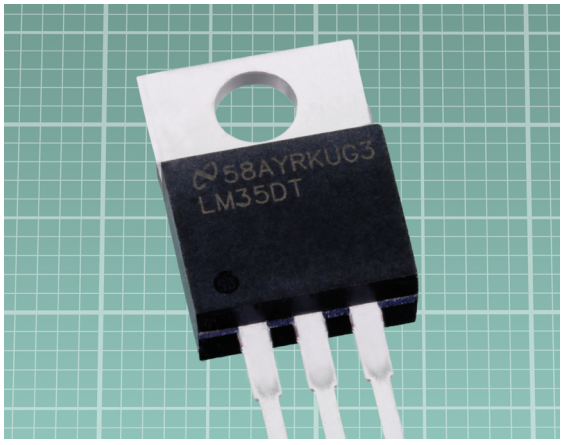

Figure 27-5 *This version of the LM35 can be used to measure surface temperature when secured with a bolt. The background grid is in millimeters.*

This is a three-wire component, two pins or solder pads being used for the power supply while the third serves as the sensor output. The supply voltage typically ranges from 4V to 30V. Necessary current consumption is only 60µA, which minimizes self-heating.

Because this device is specifically designed for the Celsius temperature range, its output is scaled to 0mV at 0 degrees. A pulldown resistor can be added to measure temperatures below zero.

A bypass resistor of 200 ohms between the output and ground is recommended as a precaution against capacitive effects in the cable run.

The LM34 is almost identical to the LM35, except that its output changes by 10mV per degree Fahrenheit instead of 10mV per degree Celsius.

LM135 Series

Although this sensor contains multiple NPN junctions, the manufacturer describes it as behaving like a zener diode in which the breakdown voltage is directly proportional to absolute temperature. The output increases by 10mV per degree over a range from -55 to +150 degrees Celsius.

For the LM135, the manufacturer claims an error of less than plus-or-minus 1 degree Celsius between 0 and 100 degrees. For the LM235 and LM335, in the same product series, the temperature range is narrower, the accuracy is lower, and the price, also, is lower. An LM335 sensor is shown in Figure 27-6.

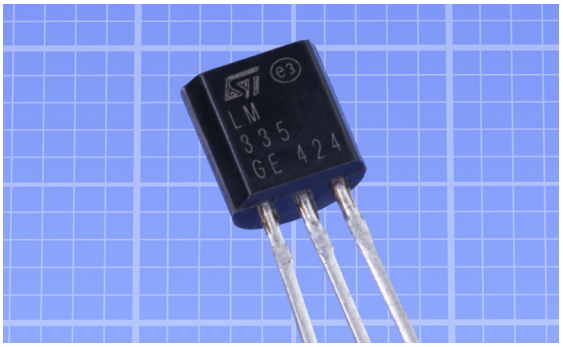

Figure 27-6 *A sample of the LM335 temperature sensor in a TO-92 package. The background grid is in millimeters.*

The sensor is available in a TO-92 package (plastic, like a transistor) or a TO-46 (metal can). It is also manufactured in a surface-mount format. The negative terminal is connected directly to ground, while the positive terminal is connected through a series resistor to the positive side of a power supply that can range from 5V to 40V. The third terminal, labeled "ADJ" on datasheets, allows for the output to be adjusted. Figure 27-7 shows the basic circuit. The value of R1 can be chosen to establish an optimal current of 1mA through the sensor, although a range of 400µA to 5mA is tolerable.

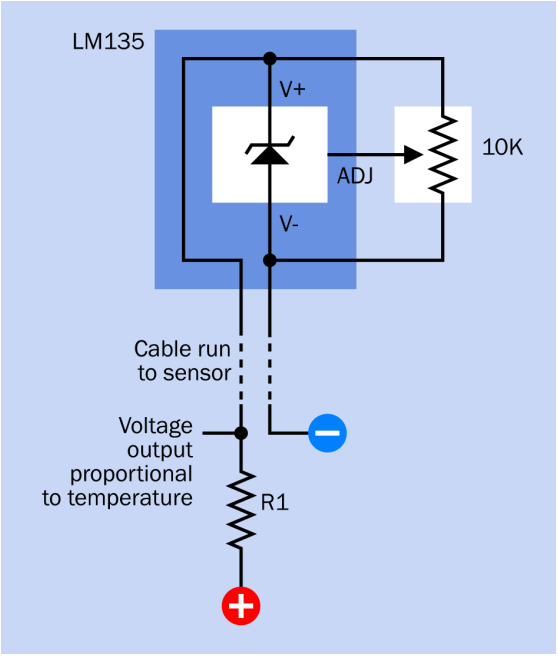

Figure 27-7 *Basic schematic for using an LM135, including output adjustment. Because the sensing element behaves like a zener diode, it is represented with the zener symbol.*

Analog Current Output

Fewer components exist using output current to measure temperature. The output is applied to a grounded resistor, and the voltage across the resistor then changes with current from the sensor.

The useful aspect of a current output is that its accuracy is unaffected by a cable run as long as 200 or 300 feet. Therefore, this type of component is appropriate as a remote sensor.

LM234-3 Series

This is a three-wire sensor, two wires being used for bias power supply and ground (labeled V+ and V- on the datasheet) and a third (labeled R) that delivers current proportional to temperature. The current from pin R passes through an external resistor to ground, and the voltage across this resistor varies by 214µV per degree Kelvin. A bias voltage ranging from 1V to 40V is required.

A sample of the LM234 is shown in Figure 27-8.

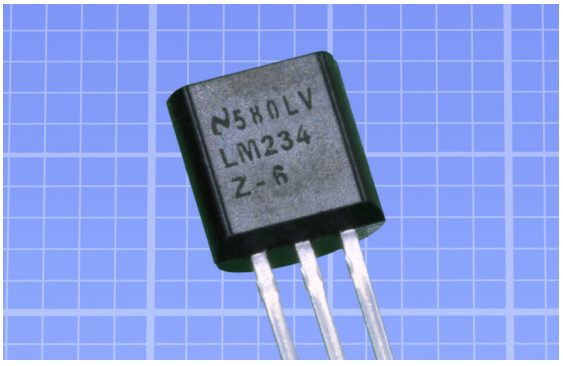

Figure 27-8 *The LM234Z temperature sensor in a TO-92 package. The background grid is in millimeters.*

If the component is used for remote sensing, the resistor should be 230 ohms and can be connected directly between pin R and pin V- of the sensor at the far end of a wire run. At the "home" end of the wire run, temperature output is taken from above a 10K resistor that is placed between the return wire and ground, as shown in Figure 27-9. With these component values, the output voltage will change by 10mV per degree Kelvin.

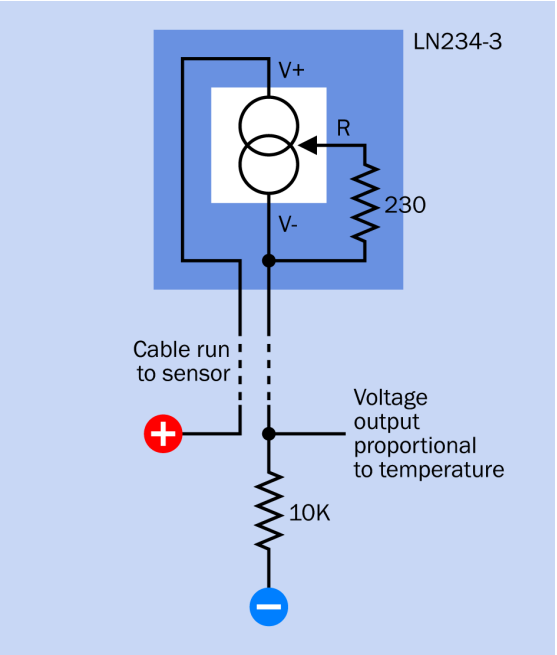

Figure 27-9 *Using an LM243-3 sensor with a current output that varies with temperature.*

The LM234-3 can be encapsulated in a plastic TO-92 package or a TO-46 metal can. A surface-mount version is also available.

The claimed accuracy is plus-or-minus 3 degrees. The temperature range is -25 degrees to +100 degrees.

AD590 Series

The Analog Devices AD590 (successor to the original AD580) is a current-output sensor that uses only two wires. Like the LN234-3 it is available in a TO-46 metal can, but with one lead making no internal connection. It also can be bought in a two-wire "flatpack," or as a surface-mount chip (with eight solder pads, only two of which are connected).

Using a supply voltage of 4V to 30V, the sensor's high-impedance output changes by 1µA per degree Kelvin. Voltage supply variations produce very small errors in the output current; substituting 10V for 5V creates a deviation of only 1µA.

Figure 27-10 shows an application for the AD590 using a resistor and a trimmer to adjust the scale factor. When properly set up, this circuit provides an output that changes by 1mV per degree Kelvin.

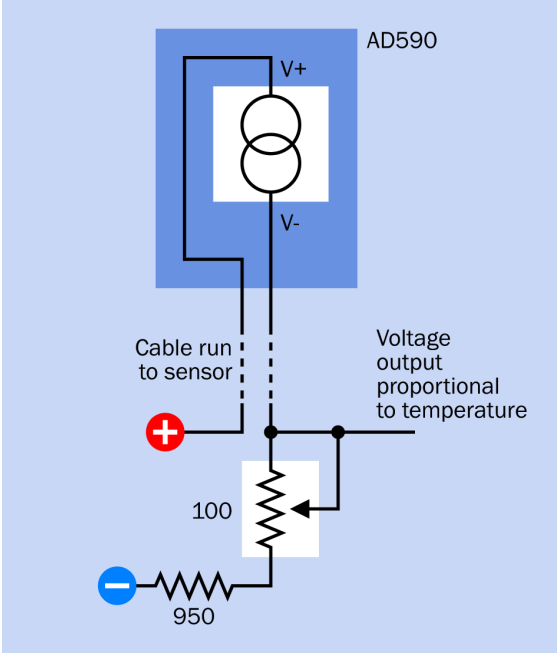

Figure 27-10 *The simplest circuit allowing fine adjustment for use with an AD590 sensor.*

Digital Output

Some of the most popular examples of semiconductor temperature sensors with digital output include the TMP102 series from Texas Instruments, MCP9808 series from Microchip, LM73 series from Texas Instruments and National Semiconductor, and DS18B20 series from Maxim. All of these components can measure a range typical of semiconductor temperature sensors, from approximately -50 to +150 degrees Celsius. Most of them claim an accuracy in the region of plus-or-minus 1 degree over the full range or 0.5 degree in the 0 to 100 range. With the exception of the Maxim DS18B20, which uses its own unique protocol, the components communicate via either the I2C or SMBus protocol.

TMP102 Series

This is available only in a surface-mount format. It has fewer features than the other sensors listed here, and is less accurate, claiming plus-or-minus 3 degrees Celsius over its maximum range of -40 to +125 degrees Celsius. However, it is less expensive. (For greater accuracy, the TMP112 is available.) This is a low-voltage chip requiring 1.4V to 3.6V as its power supply, drawing a quiescent current of 10µA. Temperatures are stored in a 12-bit or 13-bit format that requires some conversion, as a single bit represents 0.0625 degrees Celsius. An alert pin is activated when the measured temperature deviates above or below limits that are preset by the user. No hysteresis adjustment is available for the alerts. The TMP102 is available on a breakout board from Sparkfun, as shown in Figure 27-11.

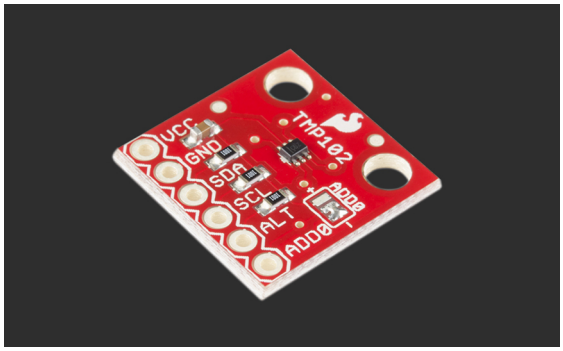

Figure 27-11 *The Texas Instruments TMP102 on a breakout board from Sparkfun.*

MCP9808 Series

This multifunction sensor is available either as a regular surface-mount component, or as a surface-mount with an exposed "thermal pad." It conforms with the I2C bus standard at up to 400kHz, allowing up to 16 sensors to share the same bus. The chip has a variety of temperature alert features, including high and low limits that can activate a dedicated "alert" pin, and a hysteresis value that can be set for the limits, to ignore brief temperature excursions. The chip can be put into "comparator mode," where it simply provides logic-high or logic-low output if the temperature is above or below a user-specified value. This feature makes the chip operate as a thermostat. Temperature resolution is user-selectable. The temperature storage format requires some conversion to obtain a Celsius value, to deal with negative values and fractional values. However the chip is available on a breakout board from Adafruit, as shown in Figure 27-12, and an Arduino code library is available.

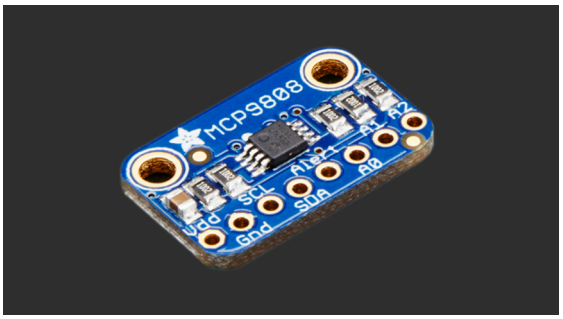

Figure 27-12 *The Microchip MCP9808 on a breakout board from Adafruit.*

LM73 Series

This sensor is only available in surface-mount format. It conforms with the I2C bus standard at up to 400kHz. Its temperature resolution can be set to 11, 12, 13, or 14 bits. An "alert" pin becomes active if the temperature exceeds a preprogrammed limit. An "address" pin can select one of three device addresses by being held in logic-high, ground, or disconnected status. The chip can be put into shutdown mode when power conservation is necessary.

DS18B20 Series

Unlike most digital sensors, this is a three-wire component, because it uses Maxim's proprietary "1-wire bus" with a unique protocol. The bus allows access to a 2-byte register storing digital output from the temperature sensor, but also allows the user to perform other functions, such as setting the resolution of an onboard analog-to-digital converter (which has a maximum resolution of 12 bits), setting a high-temperature and low-temperature alarm, and

allowing the sensor to be identified, as each component has a unique 48-bit serial number in ROM.

The chip can draw sufficient power from the data bus to operate, so long as the bus is held high by a 4.7K pullup resistor. (Maxim describes this as "parasite power.") An internal capacitor sustains the chip briefly while the bus is used for its normal purpose of transferring data, but if the bus has low voltage for more than 480µs the chip will reset itself. The "parasite power" feature also will not work above 100 degrees Celsius. Perhaps recognizing that this system may create more problems than it solves, Maxim has also given the component a normal power input pin.

The DS18B20 is available in the TO-92 package and two sizes of surface-mount chip. Its lack of a standard I2C bus, and its use of complicated proprietary codes, create a steep learning curve. Still, it remains a popular sensor, and an Arduino code library for it is available online.

CMOS Semiconductor Temperature Sensors

CMOS variants of semiconductor temperature sensors have appeared relatively recently compared with the bipolar variants. They draw a very low quiescent current (typically, a few microamps) and can work with a power supply from 5.5VDC down to 2.2VDC, making them suitable for handheld battery-powered devices. An analog output is common. Popular examples are the LM20 and the LMT86 series.

Like bipolar sensors, the LMT86 sensors have a limited temperature range, between approximately -50 and +150 degrees Celsius. Again, like the bipolar sensors, they are available optionally in TO-92 and surface-mount packages. A significant difference is that the output has a negative temperature coefficient, diminishing by 10mV per degree Kelvin, because of the characteristics of CMOS semiconductors. The claimed accuracy is plus-or-minus 0.25 degrees Celsius. The output voltage covers a range of about 2V, diminishing from 0.5V below the supply voltage at -50 degrees Celsius.

A sample of the LMT86 is shown in Figure 27-13.

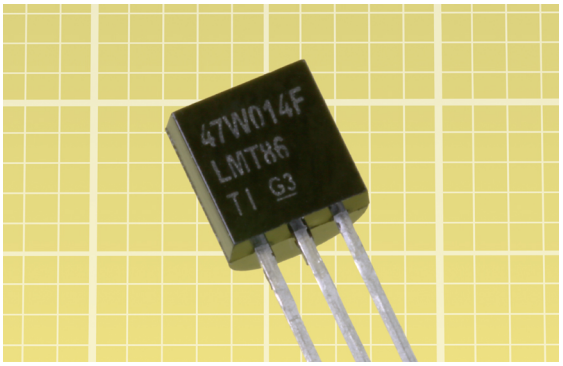

Figure 27-13 *A sample of the LMT86 CMOS temperature sensor. The background grid is in millimeters.*

What Can Go Wrong

Different Temperature Scales

Some voltage-output sensors create an output convertible to degrees Kelvin, while others use degrees Celsius. While the temperature degrees are the same in each scale, a component with an output in millivolts may assign 0mV either to 0 degrees Celsius or 0 degrees Kelvin (equivalent to -273.15 degrees Celsius). The advantage of using a Kelvin scale is that it avoids the problem of negative temperature values.

Rarely, a sensor may use degrees Fahrenheit.

Interference in Cable Runs

Sensors with a voltage output are susceptible to electrical interference. Twisted-pair or shielded cable runs are recommended when sensors are placed remotely.

For the Maxim DS18B20, which uses a 1-wire bus, multiple sensors should be connected along one run of wire (linear topology) instead of each sensor being connected to a central point (star topology). If the cable lengths are

longer than a few meters, the topology starts to matter.

Latency

The packaging of semiconductor temperature sensors can create latency in their response time. While a thermocouple consists only of a pair of wires joined by a small dot of melted metal, a TO-92 semiconductor package adds thermal mass that will slow the response considerably. Moreover, copper leads will conduct heat from a circuit board if the board is warmer than its environment.

Surface-mount chips have a very low mass, but must be soldered to some kind of board, even if it is a very small one.

Generally, other types of sensors may be appropriate where rapid response is necessary.

Processing Time

In a sensor with a digital output, the onboard analog-to-digital converter will add a small delay before the data becomes available, and during that delay, the component cannot respond to a new temperature. The output from an analog device may be more suitable for rapid detection of temperature variations.

infrared temperature sensor

28

An **infrared temperature** sensor is sometimes described as a *thermopile*. In reality the sensor module *contains* a thermopile. In this Encyclopedia, a thermopile is considered to be a separate component, described in the entry discussing **thermocouples**. See "Thermopile" in Chapter 25.

Other terms that are sometimes used for an infrared temperature sensor are *contactless thermometer* or *infrared thermometer*. This Encyclopedia classifies a thermometer as a commercially marketed product, not a component.

Devices such as a *radiation pyrometer*, *IR pyrometer*, *optical pyrometer*, or *thermal imager* provide ways of measuring infrared radiation, but are outside the scope of this Encyclopedia.

A **passive infrared** motion sensor (PIR) can detect infrared radiation, but only responds to fluctuations in intensity. An infrared temperature sensor measures the steady-state value of incident radiation.

OTHER RELATED COMPONENTS

- **passive infrared** motion sensor (see Chapter 4)
- **thermocouple** (see Chapter 25)

What It Does

Most temperature sensors discussed in other entries in this Encyclopedia are *contact sensors*, meaning that to measure the temperature of an object, liquid, or gas, they must make contact with it. In situations where contact is not possible or desirable, an **infrared temperature** sensor can be used. It responds to the *black-body radiation* (sometimes known as *characteristic radiation*) that is emitted by all materials above absolute zero (0 degrees Kelvin). This varies with temperature as a result of the movements of molecules.

Situations where noncontact sensors may be preferable to contact sensors include:

- An object is inconveniently located or too far away.
- The temperature of a large area must be measured.
- Contact with a small object would change the temperature of the object. The act of measurement would change the value being measured.
- The object is corrosive, abrasive, or otherwise liable to damage a sensor.
- The object is moving or vibrating.
- The surface of the object must not be contaminated (for example, unprotected foods).

- The temperature of the object is lower than around -50 degrees Celsius or higher than 1,300 degrees Celsius.

However, noncontact sensors have some limitations:

- Normally, only the surface temperature of a target can be measured.
- The optics of the sensor must be protected from dust, dirt, and liquid.
- The target must be clearly visible, in line-of-sight.
- Air pollution will degrade the temperature measurement. Some gases, such as carbon dioxide, will tend to absorb infrared radiation.
- The sensor will be affected by other sources, including reflected, transmitted, and convective heat.
- While an infrared sensor can theoretically respond to a very wide range of temperatures, in practice separate sensors of differing sensitivity are needed to cover a full range.
- Different types of materials emit differing intensities of black-body radiation, even if they are at the same temperature. Some compensation is necessary, or the surface of the object may have to be painted.

Applications

Handheld contactless thermometers were an early application for noncontact sensors.

In astronomy, the thermal radiation from the Sun and other stars is of interest to astronomers.

More recently, the declining cost of an infrared temperature sensor, and the ease of deploying it, have made it appropriate in consumer products. A significant area of adoption is in notebook computers and handheld devices, where processor performance must be balanced against the need to prevent the case from becoming too hot to hold comfortably. In this kind of application, gluing a sensor to the interior of the case would be a manual operation during the production process and would require a wired connection. An infrared temperature sensor mounted on the circuit board, viewing the underside of the case, can achieve the same objective more simply.

A contactless sensor is also very useful for measuring the temperature of rotating objects, such as heating rollers in a laser printer.

Schematic Symbol

No specific schematic symbol exists for an infrared temperature sensor.

How It Works

While nanometers (abbreviated nm) are generally used to measure visible wavelengths, the longer wavelengths of far-infrared are often measured in micrometers (abbreviated µm). The measurable infrared values are defined as ranging from 0.7µm to 14µm, corresponding to peak emissions from a black body ranging in temperature from 200 degrees Kelvin to 6,000 degrees Kelvin (about -70 to +5,700 Celsius).

Unfortunately an object does not emit just one wavelength of black-body radiation for each temperature value. It emits a spread of wavelengths that becomes wider as the temperature increases. However, the peak intensity also increases with temperature, when measured as *spectral radiance*, which is defined as watts per steradian, per micrometer of wavelength. (A steradian is the solid angle at the top of a cone, in this case the cone being of emitted radiation.) Because the intensity increases, it can be used to calculate the temperature.

Figure 28-1 illustrates this concept. Note that both of the axes have logarithmic scales.

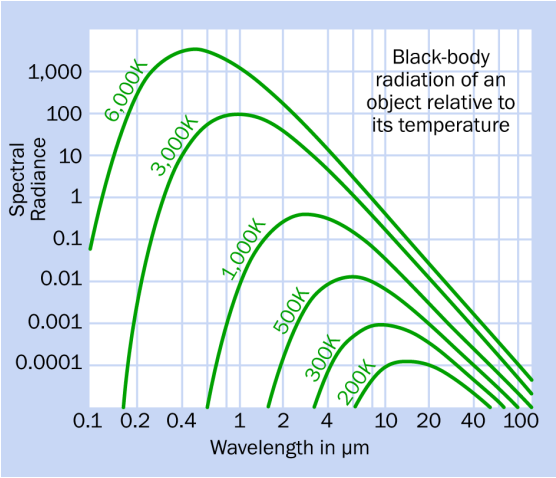

Figure 28-1 *The increase in intensity, and the widening spread of wavelengths, of black-body radiation emitted by one object at six different temperatures (in degrees Kelvin).*

All the curves are for one object. Each curve is specific to one temperature in degrees Kelvin, showing how the intensity of emitted radiation varies with wavelength. Note that radiation at wavelengths shorter than 0.7µm is within the visible spectrum; thus, objects at 1,000 degrees Kelvin, or hotter, may be seen to glow visibly.

Because of the wide variety of intensities and temperatures, an infrared sensor that is ideal for measuring a temperature of 1,000 degrees Kelvin will not provide an accurate result at 200 degrees Kelvin. The peak spectral radiance at 1,000 degrees is more than 10,000 times the peak at 200 degrees. Also, the curves in the figure are for an "ideal" object emitting pure black-body radiation. In reality, glass, plastic, and many other materials have a much lower *emissivity*, meaning that they emit less radiation, and are classified as *gray bodies*. A metallic object with a polished surface may emit one-tenth of true black-body radiation.

These issues cannot be ignored, but may be dealt with by relatively simple strategies. Infrared sensors will be rated according to their suitability for different temperature ranges, and the emissivity of the object being measured can be determined by consulting standard tables. Alternatively, the object can be spray-painted with special black paint (such as "Senotherm" or "3-M Black") that has a known emissivity of about 0.95 of pure black-body radiation. Alternatively, a specially formulated black sticker may be applied to the object that is being measured, so long as its temperature is within reasonable limits.

However, a basic infrared temperature sensor will not function reliably if it is pointed randomly at a variety of objects that vary widely in temperature. Specialized, expensive industrial devices incorporate compensation to deal with these issues, but they are outside the scope of this Encyclopedia.

Thermopile

A typical low-cost, chip-based infrared temperature sensor contains a *thermopile* consisting of multiple thermocouples etched into silicon and connected in series. The concept of a thermopile is illustrated in Figure 25-9, where a brief explanation is included.

The configuration of the thermopile is arranged so that the hot junctions of its thermocouples are all clustered in a small central area, where they receive incoming radiation through a window (often made of silicon) that is transparent to infrared wavelengths. The cold junctions are dispersed around the periphery, where they are shielded from incoming radiation. One way to visualize this is shown in Figure 28-2, although this is not a literal depiction of an actual sensor.

Instead of using alternating types of wire, as in a **thermocouple**, a chip-based thermopile often uses alternating segments of n-type and p-type silicon. The hot junctions are mounted on a thin film that has very little heat capacity, while the cold junctions are mounted on a thicker substrate that acts as a heat sink.

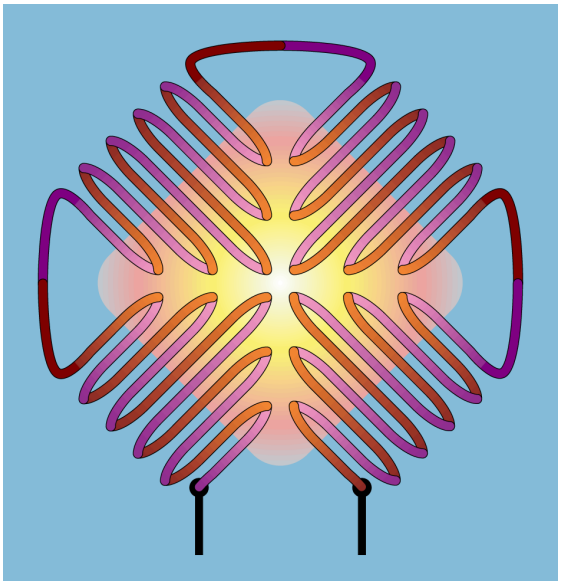

Figure 28-2 *Simplified diagram of the thermopile configuration inside an infrared sensor chip. Radiation arriving through a window in the chip affects the thermocouple junctions in the central region, while junctions around the edges remain at a lower temperature.*

Temperature Measurement

The voltage generated by the thermopile is related to the difference in temperature between the hot and cold thermocouple junctions. Thus there are three interrelated variables: hot temperature, cold temperature, and voltage. To calculate one variable, we must know the other two.

The hot temperature is what we wish to know. Therefore we must establish the voltage (which can easily be measured) and the cold temperature. The cold temperature can be determined by adding a thermistor inside the chip.

Typically an infrared temperature sensor with an analog output will have two pins that provide access to the internal thermistor, so that its temperature can be calculated from its resistance. Another two pins provide the voltage between the ends of the thermopile.

Interpreting and reconciling these values is not a trivial matter, especially bearing in mind that the thermistor has a negative temperature coefficient and a nonlinear output, and the thermopile will also have some nonlinearity. To simplify this situation, some infrared temperature sensors incorporate electronics to perform the necessary calculations and provide a digital output. This output can be converted to degrees of temperature by some fairly simple mathematical operations in an external microprocessor.

Variants

Two types of sensors are popular. One is surface-mounted, such as the TMP006, shown in Figure 28-3. This type generally has a digital output. The other type is a discrete component with four leads, such as the Amphenol ZTP135, shown in Figure 28-4. Discrete components may have either an analog or a digital output.

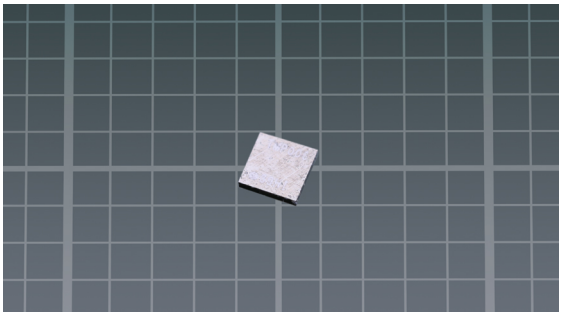

Figure 28-3 *A surface-mount infrared temperature sensor with digital output. Eight tiny solder pads are located on the underside. The background grid is in millimeters.*

Both types of sensors allow infrared light to enter through an area that is opaque to the visible spectrum but transparent to the appropriate range of wavelengths.

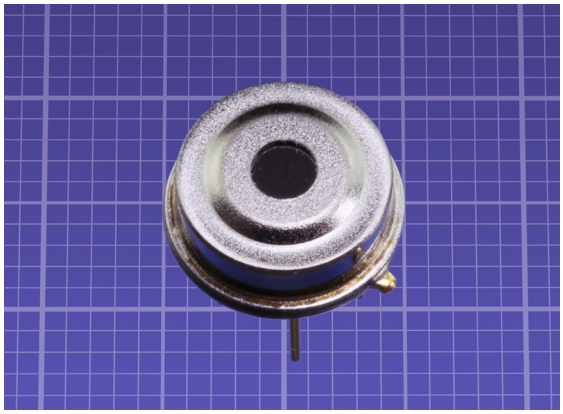

Figure 28-4 *A through-hole infrared temperature sensor with analog output. The background grid is in millimeters.*

The ZTP135 has an analog output shown in Figure 28-5.

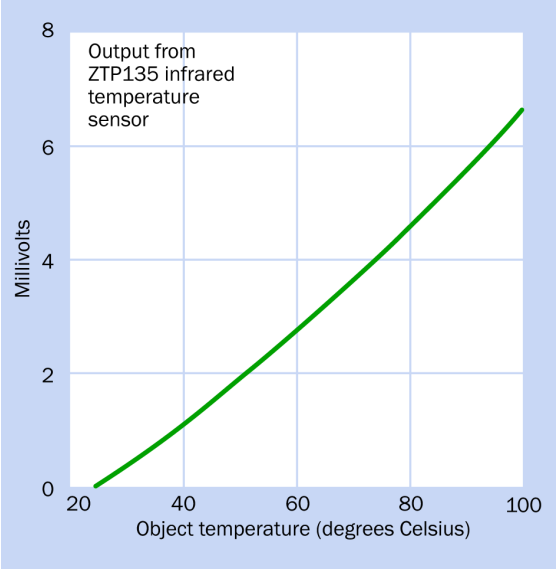

Figure 28-5 *Analog output from an infrared temperature sensor.*

The TMP006 is only about 1.5mm square, but is available on a breakout board from Sparkfun. Its successor, the TMP007, is available on a breakout board from Adafruit, shown in Figure 28-6.

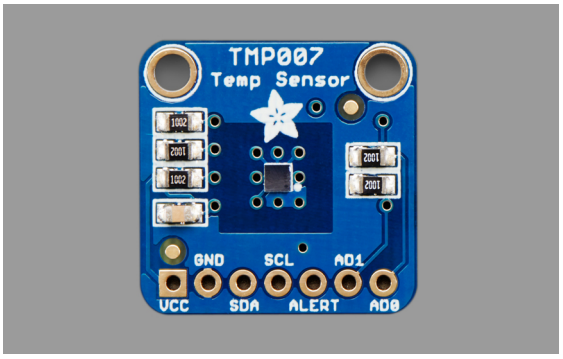

Figure 28-6 *The TMP007 sensor mounted on a breakout board from Adafruit.*

Surface-Mount Specifications

The TMP006 and TMP007 require a supply voltage that can range from 3.3V to 5V. These chips support the SMBus and I2C bus protocols, using a bus address that can be user-selected. An internal analog-to-digital converter uses 1 least-significant bit to represent 1/32nd of a degree Celsius, and data is saved as a 14-bit signed integer. Up to 16 temperature samples can be averaged internally.

Measurable temperature range is -40 to +125 degrees Celsius. Some hysteresis is built in. The TMP007 supports an alert mode if temperature falls above or below a user-specified threshold.

Sensor Arrays

Using multiple thermopile sensors arrayed in a line or a grid, with an array of lenses, it is possible to capture an image of temperature variations over a surface or a scene. This is known as *thermal imaging*. It can detect heat leakage from buildings, indicating poor insulation, or can locate hot spots in electronic circuits. Heimann Sensor has pioneered the miniaturization of a 31 x 31 grid of thermopile sensors in a single TO-8 or TO-39 package.

Values

Temperature Range

Chip-based infrared temperature sensors are typically designed for a range from about -20

degrees Celsius to about +125 degrees Celsius. Their peak sensitivity is to wavelengths between 4µ and 16µm.

Other types of infrared temperature sensors can have a much wider temperature range, but are more costly.

Field of View

Often referred to by its acronym, *FOV*, the field of view is the angle at the apex of an imaginary cone extending outward from the sensor, defining a boundary where the sensitivity diminishes below 50% of the value directly in front of the sensor. Greek letter ϕ may be used to represent the angle between the surface of the cone and the center line, while θ represents the angle between the opposite surfaces of the cone (i.e., 2 * ϕ). This is shown in Figure 28-7. θ is usually the angle defined as field of view.

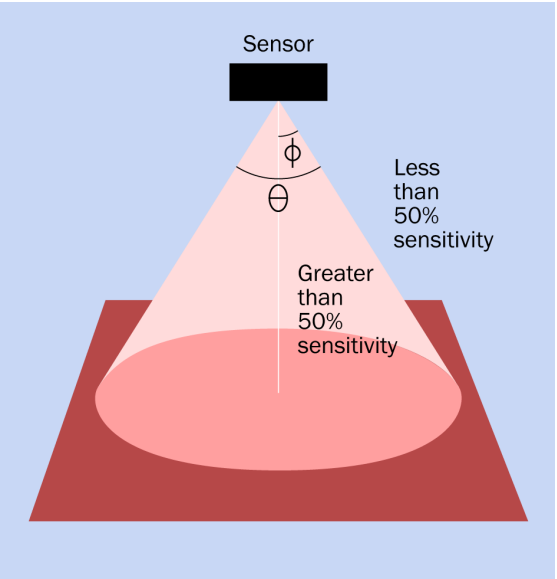

Figure 28-7 *Measurement of the field of view from a sensor, defined as the boundary of an imaginary cone where sensitivity drops below 50%.*

Because most infrared temperature sensing components do not have a lens, they are sensitive over a wide angle. The field of view is typically 90 degrees.

What Can Go Wrong

Inappropriate Field of View

The object being evaluated must fill the field of view of the sensor, to avoid measuring other objects around it.

Reflective Objects

A reflective object has lower infrared emissivity, and also may provide misleading output if the sensor is actually measuring thermal radiation reflected in the surface of the object in front of it. In a permanent installation, such as inside a device, the surface to be measured may have to be painted to reduce its reflectivity.

Glass Obstruction

Because glass is opaque to the spectrum of infrared that is of interest, temperature cannot be measured through a glass window. Silicon is opaque to visible wavelengths but is transparent to wavelengths longer than 2µm.

Multiple Heat Sources

Heat is transferred by convection, conduction, and radiation. While an infrared temperature sensor is designed to be sensitive to radiation, it will also respond to other heat sources. Warm or cold air currents will affect its response, and so will heat conducted through the material on which it is mounted. Careful placement of the sensor is important. A shield around the sensor, with a small hole in the center, can prevent convection, while correct location on a circuit board can minimize conduction.

Thermal Gradients

An infrared temperature sensor should be mounted in a stable environment where it will not be exposed to thermal gradients (one side being hotter than another). This asymmetry can cause inaccurate readings.

microphone

29

OTHER RELATED COMPONENTS

- **speaker** (see Volume 2)
- **headphone** (see Volume 2)

What It Does

The sensation of sound is created by rapid waves of air pressure impinging upon the eardrum. A microphone can convert these pressure waves into an alternating electrical signal that can be amplified, recorded, broadcast, transmitted through wires, and reproduced as sound by a headphone or speaker. The principle is illustrated in Figure 29-1. (For more information about sound reproduction, see the entries on **headphone** and **speaker** in Vol. 2.)

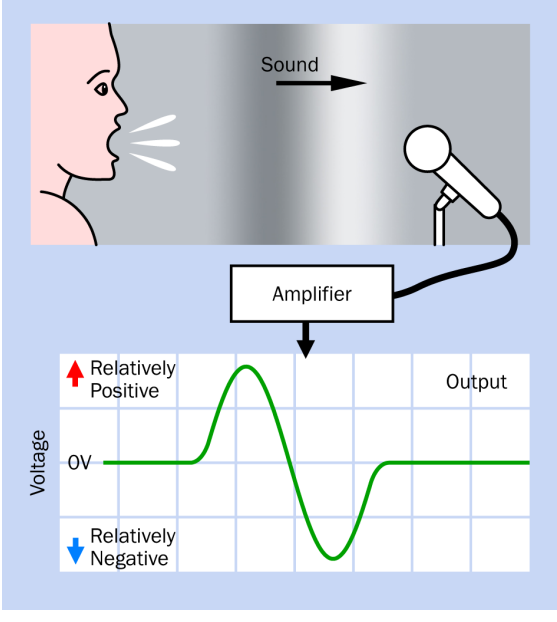

Figure 29-1 *The principle of converting pressure waves into an alternating electrical signal (adapted from an illustration in Make: More Electronics).*

Schematic Symbol

Various schematic symbols for a microphone have been used during the decades since its invention. A selection is shown in Figure 29-2. Each symbol assumes that sound is traveling from left to right. This is important when interpreting the symbol at top right, which can represent an earphone when it points in the opposite direction. Unfortunately, some schematics do not conform with this rule.

The two symbols at the bottom, showing a capacitor inside the microphone, should be reserved for condenser or electret microphones.

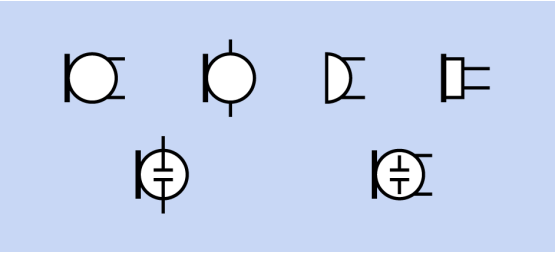

Figure 29-2 *A selection of schematic symbols that represent a microphone.*

How It Works

Some types of microphones generate a small voltage, while others have a fluctuating resistance that modulates a DC current.

Carbon Microphone

This was a very early attempt to reproduce sound. It contained carbon granules whose packing density increased and decreased in response to air pressure waves. When the density increased, the resistance between the granules diminished, and vice-versa. The principle is illustrated in Figure 29-3, and was patented by Thomas Edison in 1877 for use in telephones. As late as the 1950s (and even later in some countries), wired telephone handsets contained carbon microphones. Their bandwidth was extremely limited.

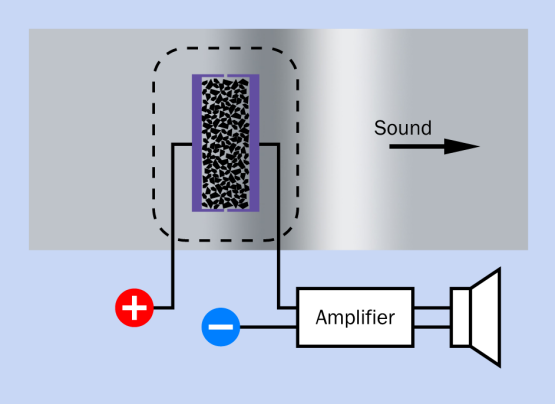

Figure 29-3 *The principle of a carbon microphone.*

Moving-Coil Microphone

Also known as a *dynamic* microphone, this consists of a very small, light coil of thin wire on a cylindrical tube that can vibrate along the axis of a permanent magnet. This principle is illustrated in Figure 29-4. A diaphragm is attached to the front of the tube, and responds to air pressure waves that penetrate the perforated enclosure of the microphone. Movements of the coil around the magnet create small alternating currents in the wire. The inertia of the coil, tube, and diaphragm, and the force needed to overcome the interaction between the coil and the magnet, impose a limit on the high-frequency response of this design.

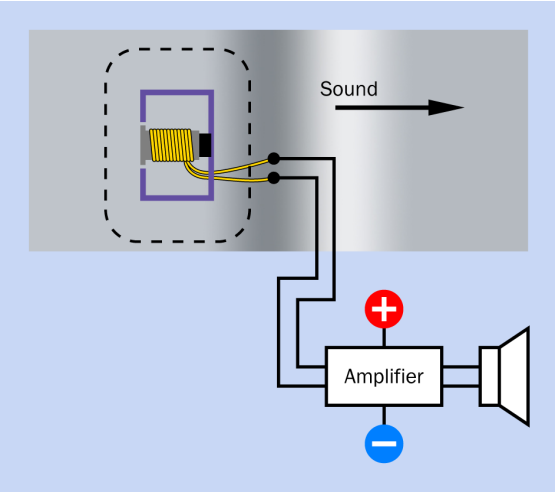

Figure 29-4 *The principle of a moving-coil microphone.*

Condenser Microphone

This type of microphone contains two thin discs or plates that form a capacitor. (In the early days of electricity, a capacitor used to be known as a condenser. The terminology has persisted for microphones.) An equal and opposite charge is applied to the plates. One plate is flexible, and as it responds to pressure waves, the capacitance between it and the other, rigid plate fluctuates. If the charge on the plates is kept approximately constant while the capacitance fluctuates, the voltage across the

capacitor fluctuates also. These fluctuations can be amplified, as suggested in Figure 29-5.

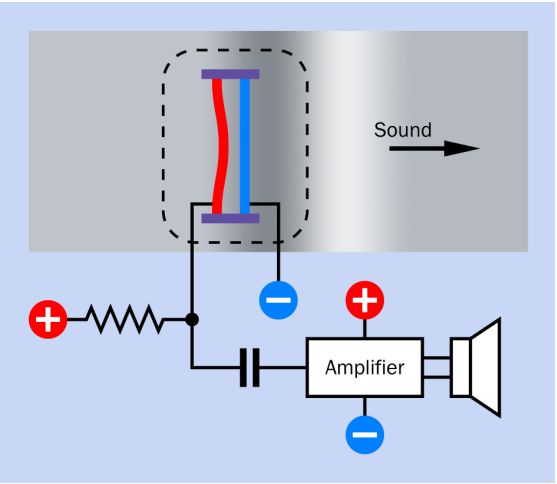

Figure 29-5 *The principle of a condenser microphone.*

Electret Microphone

This works on the same principle as a condenser microphone, except that its plates are made from a ferroelectric material that retains an electrical charge, just as iron will retain a magnetic polarization. The name of the microphone is derived from "electrostatic" and "magnet." While early electret microphones were of poor quality, they have evolved to rival condenser microphones, and are extremely affordable. Because the electret creates very small currents, it usually includes a transistor or op-amp in its package to boost the signal, and has an open-collector output. The basic circuit for an electret is shown in Figure 29-6. For more information about using an open-collector output, see Figure A-4.

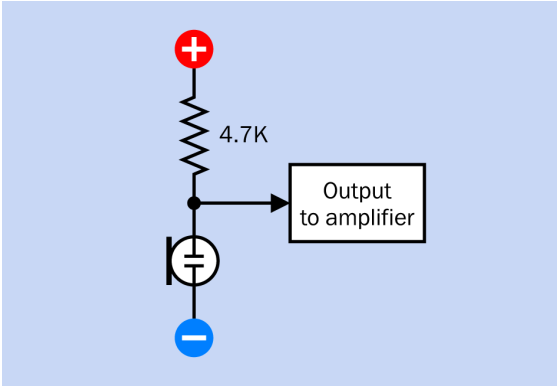

Figure 29-6 *The basic circuit for using an electret microphone.*

An example of a low-cost electret microphone is shown in Figure 29-7. This type of component is sold either with leads attached, or with solder pads.

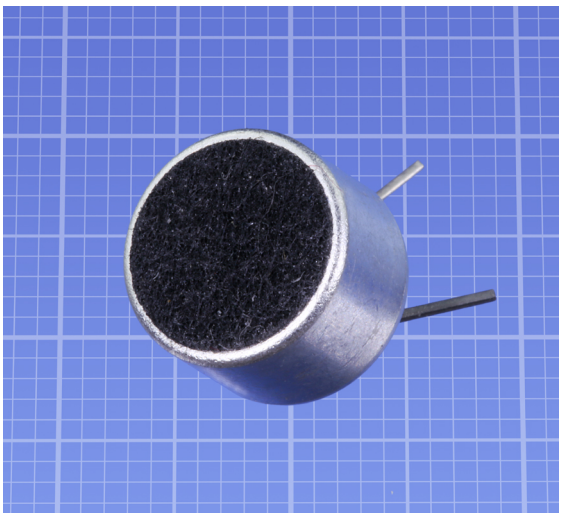

Figure 29-7 *A generic electret microphone. The background grid is in millimeters.*

MEMS Microphone

This type, often used in mobile phones, is a capacitive device that works on the same principle as a condenser microphone, although the component is etched in silicon and has a diaphragm that measures only about 1mm square. Many MEMS microphones have an analog output that is amplified in the same chip. Others have a digital output, using *PDM encoding*. This

reduces the analog signal to a very fast bit stream, in which the density of the bits represents the amplitude of each fluctuation in a sound wave. PDM is an acronym for *pulse density modulation*. It requires an external clock signal to time the bit stream.

A breakout board from Sparkfun, on which is mounted an Analog Devices ADMP401 MEMS microphone with a preamplifier, is shown in Figure 29-8.

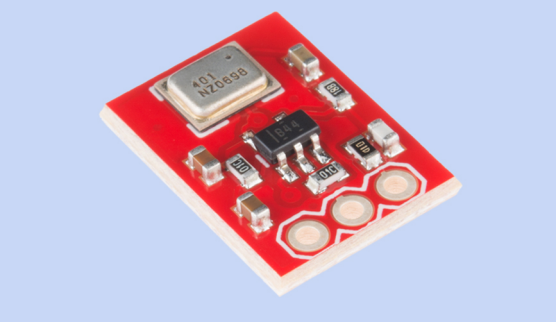

Figure 29-8 *A breakout board for a MEMS microphone (the metal-clad rectangular component at the far end).*

Piezoelectric Microphone

This has also been known as a *crystal* microphone. It contains a diaphragm that functions as a transducer. When it flexes in response to pressure waves, the mechanical energy is transformed into a small amount of electrical energy. Piezoelectric microphones were replaced by the moving-coil type in domestic audio devices when vacuum tubes were replaced with transistors, but may still be used as contact microphones to amplify acoustic musical instruments, or to trigger the playback of digitally sampled musical sounds.

Other variants include *ribbon* microphones (which were common in recording studios in the 1950s and 1960s, but have become rare), *laser* microphones, and *fiber-optic* microphones. They are not sufficiently common to be included in this entry.

Values

Sensitivity

Sound pressure is a complicated topic, explored in detail in the **transducer** entry in Volume 2. It can be measured in pascals, where 1 pascal = 1 newton per square meter.

The *sound pressure level* is a different concept. It measures the *relative* intensity of a sound, in a logarithmic scale calibrated in *decibels* (abbreviated dB). The reference value for this relative scale is 20 micropascals, considered to be the threshold of human hearing, comparable to a mosquito three meters away. This is assigned the value of 0dB.

From this point upward, the actual sound pressure doubles for each additional 6dB. A table of noise sources and their approximate decibel values is shown in Figure 29-9. This is derived from averaging eight similar tables, which are not always consistent in their estimates. It is an approximate guide only.

Decibels	Noise Example
140	Jet engine at 50 meters
130	Threshold of pain
120	Loud rock concert
110	Automobile horn at 1 meter
100	Jackhammer at 1 meter
90	Propeller plane 300 meters above
80	Freight train at 15 meters
70	Vacuum cleaner
60	Business office
50	Conversation
40	Library
30	Quiet bedroom
20	Leaves rustling
10	Calm breathing at 1 meter
0	Auditory threshold

Figure 29-9 *Decibel values for some common sound sources. Reproduced from Volume 2 of this Encyclopedia.*

The decibel unit is important when understanding the specifications of microphones, because it is used to measure their response. Microphone sensitivity is established with a standard input sine wave of 1kHz in frequency and 94dB in intensity (equivalent to 1 pascal in actual sound pressure), measured at the microphone. The sensitivity of an analog microphone is then defined as the number of decibels in an output signal of 1V. Because the output is an AC signal, voltage is measured as a root-mean-square (RMS) value.

For digital microphones, sensitivity is measured as the decibels that can be reproduced by a full-scale digital output. This value is abbreviated as dBFS.

Directionality

A microphone that has a directional response is desirable in many situations. Often, for example, sounds in front of the microphone are more important than sounds from behind the microphone. The directionality of a microphone (sometimes referred to as its *directivity*) is usually represented with a *polar graph* in which the microphone is seen from above, and its sensitivity to sounds from various directions is shown with a curve such as those in Figure 29-10. The circles are drawn at intervals of 5dB, with 0dB at the periphery and -30dB at the center. The precise response for an individual microphone should be shown in its documentation.

Frequency Response

Every microphone tends to be more sensitive to some sound frequencies than others. A manufacturer will provide a graph showing this sensitivity, in decibels, plotted against sound frequency on a logarithmic horizontal axis. Theoretically, human hearing extends from around 20Hz to 20kHz, but few people are actually capable of hearing the high end of that range, and 15kHz may be a more realistic limit for a young person, diminishing to 10kHz with middle age.

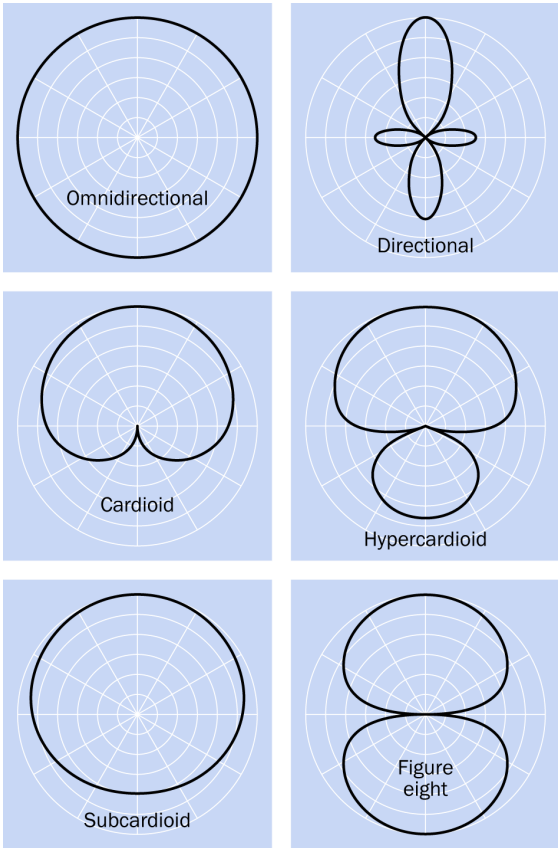

Figure 29-10 *Six generic sensitivity patterns. Individual microphones will deviate somewhat from these generic curves.*

An ideal flat response would show that a microphone is equally sensitive to all frequencies. In reality, *rolloff* usually occurs at low frequencies, and will eventually occur at high frequencies, although it may be preceded by a rise in response. If the central section of a curve is flat within plus-or-minus 1dB, this is a level of performance that was attained only by expensive studio microphones in the past. Electrets and MEMS microphones can now provide equivalent frequency response for $1 or $2 apiece, as opposed to the hundreds or even thousands of dollars that used to be necessary for professional equipment.

The response curve shown in Figure 29-11 is for the eMerging i436, an electret microphone sold in a module as an accessory to enable high-

quality recordings on handheld devices. The rise around 15kHz may have been introduced deliberately by the manufacturer to compensate for reduced sensitivity of the human ear in that range.

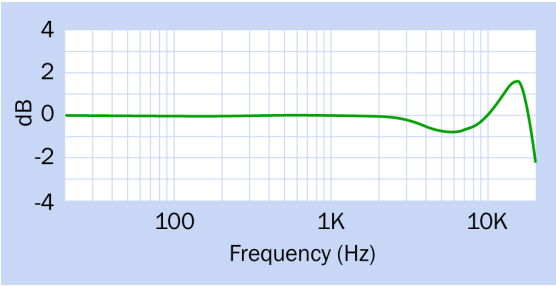

Figure 29-11 *Frequency response for an electret microphone.*

Impedance

The impedance value for a microphone is a function of its resistance, capacitance, and inductance. An amplifier input will also have an impedance rating, and for ideal power transfer between microphone and amplifier, the impedance values should be identical. However, a more important consideration in audio equipment is to avoid voltage loss between the output device (in this case, the microphone) and the input device (the amplifier). To achieve this, the output device should have a low impedance, while the input device should have a high impedance. Most microphones are rated at 150 to 200 ohms, while an amplifier may be rated at 1.5K to 3K.

Total Harmonic Distortion

When an audible sine wave is converted to an electrical output by a microphone (and by its preamplifier, if one is included in the module), the output may become corrupted by some multiples of the basic frequency. These are known as *harmonics*, and they are considered as a distortion of the signal. Total harmonic distortion, measured by a spectrum analyzer over the entire frequency range, should ideally be less than 0.01%.

Signal-to-Noise Ratio

Often abbreviated as S/N or SNR, the signal-to-noise ratio in a microphone is measured in decibels, and should be 60dB or higher.

What Can Go Wrong

Cable Sensitivity

Audio amplification is always vulnerable to electrical noise, which tends to be amplified along with the signal. Small signals from microphones require the use of shielded cables to reduce hum and other types of interference.

Noisy Power Supply

For similar reasons, power supplies must be as free as possible from voltage spikes and other fluctuations.

current sensor

30

The entry describes components that can be installed to monitor current on an indefinite basis. It does not include test equipment, such as test meters or multimeters.

A *current transformer* may be used to measure current, but is not included in this Encyclopedia.

OTHER RELATED COMPONENTS

- **voltage** sensor (see Chapter 31)

What It Does

A current sensor measures the flow of electricity through a wire or a device, and supplies an output that can be interpreted either visually or by a microcontroller to provide a reading in amperes or fractions of an ampere.

Applications

Current sensing is important in industrial applications such as the control of high-powered motors. It can be used to monitor the performance of an inverter, or for everyday purposes such as monitoring the long-term power consumption of an appliance. During product development, a current sensor can indicate the power consumption of a circuit as it changes with modifications.

This entry describes three methods to measure current: an ammeter, series resistor, and Hall sensor. While other methods exist, they are outside the scope of this Encyclopedia.

Ammeter

An ammeter that is sold as a standalone device with leads for circuit testing is often described as a *test meter*. Its functionality is usually built into a *multimeter*. Test meters and multimeters are outside the scope of this Encyclopedia.

An ammeter designed for permanent installation in a device or prototype is a type of *panel meter*, such as the one shown in Figure 30-1. This traditional-style analog meter may be less expensive than the many digital types that are available. It uses a magnetic field created by current flowing through a coil to pull a needle across a scale, against the force of a spring.

Figure 30-1 *A traditional-style analog ammeter.*

A digital ammeter allows a wider range of values to be viewed more easily. The meter from Adafruit in Figure 30-2 has a range of 0A to 9.99A, at voltages from 4.5VDC to 30VDC. The meter can be powered parasitically from the currents that it is measuring, or can use a separate isolated 5VDC supply.

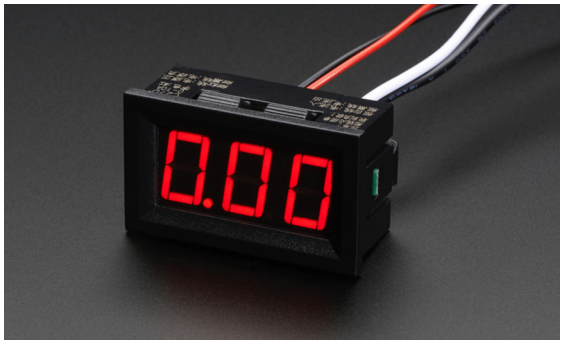

Figure 30-2 *A panel-mount digital ammeter that can measure up to 9.99A.*

Schematic Symbol

An ammeter may be represented in a schematic with the letter A inside a circle, as shown in Figure 30-3.

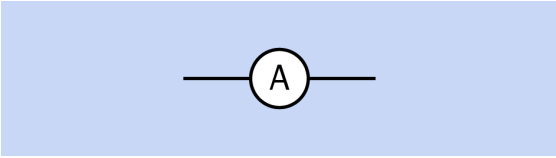

Figure 30-3 *An ammeter may be represented like this in a schematic.*

Ammeter Wiring

Two ways to use an ammeter in a circuit are illustrated in Figure 30-4, where the load may be any equipment, device, or component that provides some electrical resistance. Because current is the same at all points in a simple circuit, the current that the meter measures flowing through itself will be the same as the current flowing through the load, and the sequence of components is immaterial.

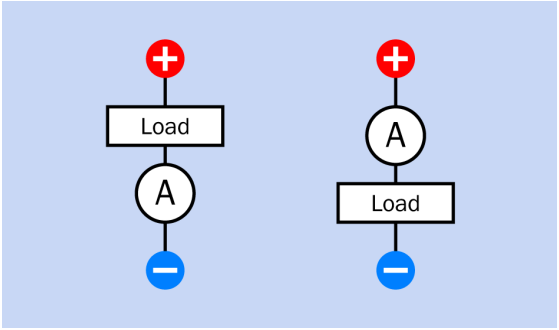

Figure 30-4 *Two options for placement of an ammeter in a circuit.*

However, regardless of the placement of the meter, the process of measuring current will inevitably change the value of the current being measured. This is because the ammeter imposes some internal resistance of its own. The resistance is extremely low, and may be considered negligible for loads of more than a few ohms.

- The low internal resistance of an ammeter means that it must never be connected in parallel with a load, or directly across a power source.

A disadvantage shared by analog and digital meters is that they are not usually interchangeable between AC and DC.

Series Resistor

The current flowing through a load can be calculated by measuring the voltage across a series resistor that is inserted between the load and its ground connection. The concept is illustrated in Figure 30-5.

Using Ohm's law, if U is the voltage drop, I is the current, and R is the value of the resistor:

```
I = U / R
```

This tells us that for a fixed value of R, current is proportional to voltage. Therefore, measuring the voltage enables calculation of the current, so long as the value of R is known.

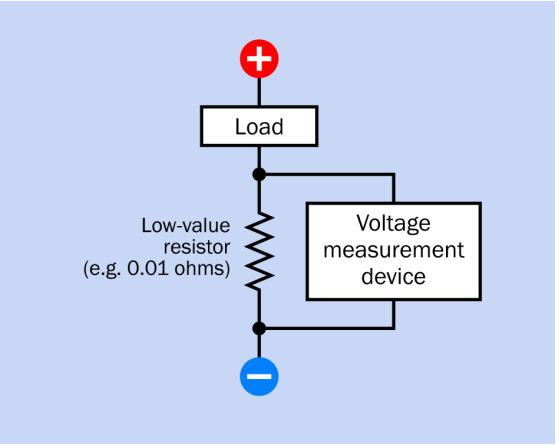

Figure 30-5 *A basic circuit for measuring current as a function of the voltage drop across a small-value resistor. The load in this figure is any circuit or device with a relatively higher resistance. The voltage measurement device could be a microcontroller or analog-to-digital converter.*

Suppose that R has a very small value, which is trivial compared with the resistance of the load. Consequently, the current in Figure 30-5 will be mainly determined by the load, and we may consider the value of the current to be almost the same with or without the addition of R. In that case, the voltage drop across the resistor will be smaller if R is smaller. A smaller voltage drop will not be as easy to measure, but a lower resistance will result in less wastage of power.

If P is the power:

$$P = R * I^2$$

An example may help to make this clear. Suppose the resistor has a value of 0.5 ohms, and the voltage drop across it is measured to be 1V. Ohm's law shows that current flow is 1 / 0.5 = 2A. The power formula shows that P = 0.5 * 4 = 2W.

To waste less power, the value of the resistor should be reduced further. Suppose a resistor of 0.01 ohms is used, and the voltage drop across it is measured as 0.02 volts. The current is 0.02 / 0.01 = 2A, as in the preceding example, but the power dissipation is now only 0.01 * 4 = 0.04W, which is negligible.

But are resistors available that have values measured in fractions of an ohm?

Current-Sense Resistors

In fact, many *current sense* resistors are available, with values of 0.1 ohms, 0.001 ohms, 0.0001 ohms, and many in between. Some resistors have values measured in micro-ohms. Examples are shown in Figures 30-6, 30-7, and 30-8.

Measuring a small voltage drop is easily done by using a microcontroller. However, the connection to the microcontroller must be made as near to the resistor as possible, to eliminate the additional resistance of wires or circuit-board traces. For this reason, precision current-sense resistors may be equipped with four terminals. Two are wider, and are meant for connection to the flow of current. The other two are narrow, for measuring the voltage over the resistor. With this *4-point* configuration, voltage drop over the resistor can be measured as close to it as possible. The 0.001-ohm surface-mount resistor in Figure 30-8 is designed for 4-point measurement.

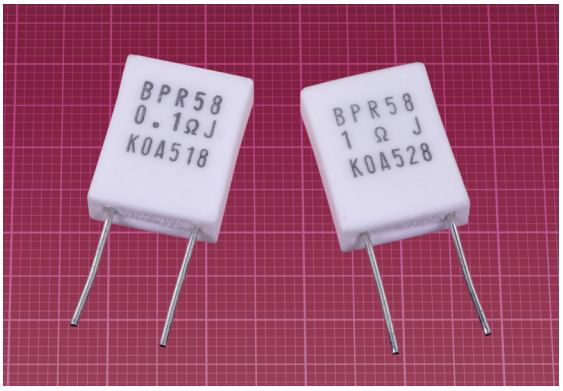

Figure 30-6 *Two current resistors manufactured by KOA Speer. Left: 0.1 ohms, 5W, 5%. Right: 1 ohm, 5W, 5%. The background grid is in millimeters.*

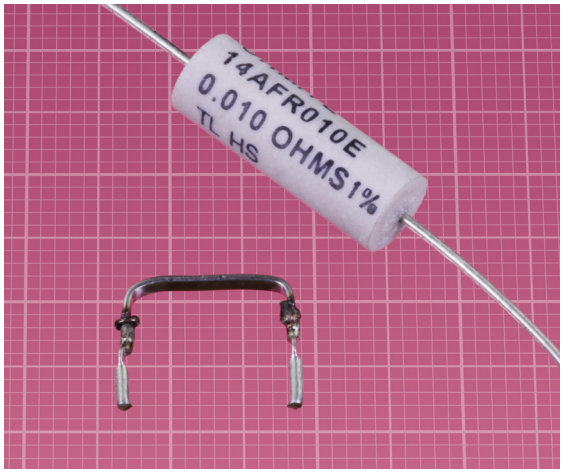

Figure 30-7 *Two styles of current resistors rated for 0.01 ohms. Bottom left: A plug-in version from TT Electronics, rated 1W and 5%. Top right: Ohmite, 4W, 1%. The background grid is in millimeters.*

Resistors that have the lowest values and are intended to tolerate high current may consist of just a metallic strip welded to solderable pins. This type of component is sometimes called an *open-air resistor*. It is commonly used in multimeters, for measuring currents up to 10A or above.

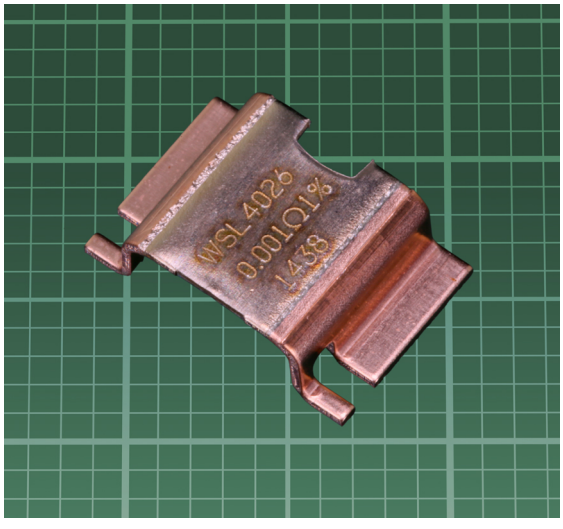

Figure 30-8 *This Vishay 4-terminal surface-mount current resistor is rated for 0.001 ohms, 3W, 1%. The background grid is in millimeters.*

Voltage Measurement

Some chips are designed for amplifying the voltage drop across a current-sensing resistor. An example is the Texas Instruments INA169.

A few chips contain an analog-to-digital converter in addition to the amplifier. The INA219 by Texas Instruments is designed to measure voltage as well as current, on the "high side" of a circuit—that is, between the positive power supply and the power input of the circuit. It makes its digital data available over an I2C bus.

For additional details about protocols such as I2C, see Appendix A.

Measuring current from the voltage drop across a series resistor offers the advantages of simplicity, ability to work with AC or DC, and low cost (although some resistors of extremely low value can be relatively expensive). A possible disadvantage is that the measurement circuit is not isolated from the circuit whose current is being measured.

Hall-Effect Current Sensing

The principle of a Hall-effect sensor is explained in the entry for **object presence** sensors. See "Hall-Effect Sensor". Normally this type of sensor is activated by an external permanent magnet, but it can also react to the magnetic field generated by current flowing through a wire.

Because the field generated around a wire is proportional with the current, the analog output voltage generated by a linear Hall-effect sensor can also be proportional with the current.

Hall-effect sensors for this specific purpose are available in 8-pad surface-mount packaging. The current to be measured passes through a copper conductor that is embedded in the chip. An example is Allegro's ACS712, for AC or DC currents up to 30A. The internal resistance of the current path through this chip is stated

as 1.2 milliohms, and the path is isolated from the sensing circuitry.

Three variants of the chip are available, for currents of plus-or-minus 5A, 20A, and 30A. Depending on which variant is used, the output will range from 66mV to 185mV for each increase of 1A in the current path. Because the current path is isolated, the chip requires a separate power supply of 5VDC.

The 5A version of the AVS712 can be bought on breakout boards from Sparkfun. In Figure 30-9, the board at top-left contains only the ACS712, while the board at lower-right adds an op-amp with sensitivity control, to amplify the voltage output when measuring small currents.

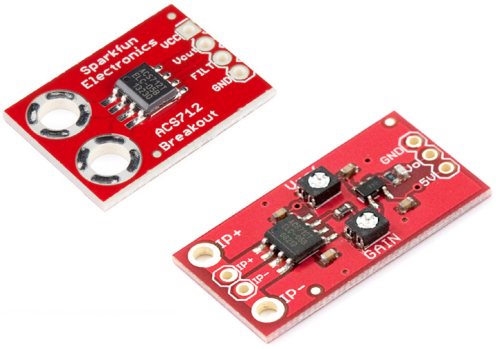

Figure 30-9 *Breakout boards using the AVS712 Hall-effect current sensor. The one at lower-right includes an op-amp to amplify small signals.*

What Can Go Wrong

Confusing AC with DC

A panel meter that is designed only to measure DC should not be used with AC, and vice-versa. Erroneous readings or damage to the meter may result.

Magnetic Interference

A disadvantage of Hall-effect current sensing is that the sensor can be affected by stray magnetic fields. Because a Hall-effect chip is responding to very small magnetic effects, it is vulnerable to interference. Consult the manufacturer's datasheet carefully regarding correct placement of a chip on a circuit board.

Incorrect Meter Wiring

The correct wiring of an ammeter is in series with a load, not in parallel with a load. This may seem an elementary error, but is easy to make if an ammeter and a volt meter are both being used, and they look similar.

Because some panel meters are not fused, applying an ammeter directly across a power supply, without any series resistance, may result in immediate and hazardous destruction of the meter.

Incorrect wiring can also occur when using a digital meter that has four wires emerging from it: two for current testing and two for a separate power supply. This issue is especially important when measuring substantial currents (above 1A).

Current Out of Range

Attempting to measure a current that exceeds the range of an ammeter may damage the meter or blow its internal fuse, if it has one.

voltage sensor

31

The entry describes the type of component that can be installed to monitor voltage on an indefinite basis. It does not include test equipment, such as test meters or multimeters.

OTHER RELATED COMPONENTS

- **current** sensor (see Chapter 30)

What It Does

A voltage sensor measures the electrical potential between any two points in a circuit, or the voltage supplied by a power source, and provides data in volts or fractions of a volt. It should not be confused with an *analog-to-digital converter*, which is not a sensor in itself, but can process the voltage output from a sensor by digitizing it. More information about analog-to-digital conversion is in the Appendix. See Appendix A.

Applications

Voltage measurement is important in conjunction with all types of power supplies, to verify their performance. A volt meter may also be used to show the output from various types of analog sensors that have voltage output.

A graphical display may be used in audio equipment to indicate signal level, which can be proportional with voltage.

Volt Meter

A volt meter that is sold as a standalone device with leads for circuit testing is often described as a *test meter*. Its functionality is usually built into a *multimeter*. Test meters and multimeters are outside the scope of this Encyclopedia.

A volt meter designed for permanent installation in a device or prototype is a type of *panel meter*, which is described here.

An antique analog panel meter is shown in Figure 31-1.

Figure 31-1 *An antique analog volt meter.*

The four scales on the dial correspond with separate input terminals at the rear of the unit. The

unequally divided scales are a simple way to compensate for the nonlinear response of the mechanical movement inside the meter.

Modern analog volt meters are still manufactured, and may be cheaper than their digital equivalents. However, a digital volt meter allows a wider range of values to be viewed more easily. The meter in Figure 31-2, sold as a low-cost battery tester, measures voltages from 4VDC to 13VDC to an accuracy of two decimal places. It needs no separate power supply.

Figure 31-2 *A panel-mount digital volt meter.*

Sometimes the number of digits in a volt meter is specified as ending with one-half, as in 3.5 or 3-1/2 digits. This means that the most significant (leftmost) digit can only be a 1 or a blank. The extra "half digit" may seem inconsequential but doubles the range of displayable values. For example, a 2-digit display can only show 100 values, from 0 to 99. A 2-1/2-digit display can show 200 values, from 0 to 199.

Schematic Symbol

A volt meter may be represented in a schematic with the letter V inside a circle, as shown in Figure 31-3.

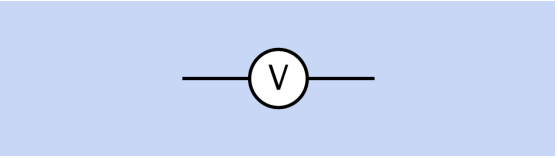

Figure 31-3 *A volt meter may be represented like this in a schematic.*

Volt Meter Wiring

Two ways to use a volt meter in a circuit are illustrated in Figure 31-4, where the load may be any equipment, device, or component that provides some electrical resistance.

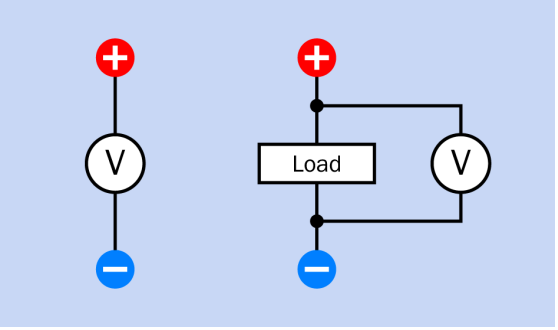

Figure 31-4 *Two options for placement of a volt meter.*

On the left side of the figure, a volt meter may be connected directly across a power source, because the internal resistance of the meter is so high, it will draw very little current. In this configuration, the meter measures the voltage of a source when the source is virtually unloaded.

On the right, the meter can measure the voltage drop across a load, or can measure the voltage across any component, or group of components, that are a subset of the load.

A disadvantage shared by dedicated analog and digital volt meters is that they are not usually interchangeable between AC and DC.

How It Works

An analog volt meter usually contains a built-in, high-value fixed resistance, and an ammeter

measuring the current passing through it. The current sensed by the ammeter is then converted to a reading in volts.

Suppose that R represents the fixed resistance, U is the voltage drop across the resistance, and I is the current flowing through it. Ohm's Law tells us:

```
U = I * R
```

The formula shows that if the resistance is fixed, the voltage will vary in proportion with the current, and therefore can be calculated from it.

Load-Related Inaccuracy

When the meter is measuring the voltage drop created by a load that has high resistance comparable to the internal resistance of the meter itself, the meter will not give an accurate reading. Figure 31-5 illustrates this problem.

On the left side of the figure, two resistors 10M each are wired in series between a 9VDC power source and negative ground. Because the resistors are equal, each of them imposes an equal voltage drop of 4.5V.

On the right side of the figure, an additional 10M resistance has been added in parallel with the lower resistor. When two resistors of values R1 and R2 are wired in parallel, their total resistance, R, is given by this formula:

```
1 / R = ( 1 / R1 ) + ( 1 / R2 )
```

Therefore, the total resistance in the bottom half of the circuit is now 5M instead of 10M, and the voltage drop across the upper resistor becomes twice the voltage drop across the two lower resistors.

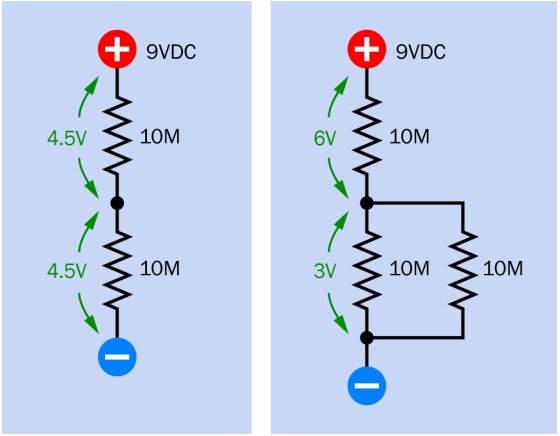

Figure 31-5 *If a meter measuring the voltage drop across a load has an internal resistance comparable to that of a load, the meter will not give an accurate reading. See text for details.*

Now suppose that the additional 10M resistor is actually the fixed resistance inside a volt meter. In fact, many volt meters do have an internal resistance of around 10M. Because the meter has reduced the resistance in the bottom half of the circuit by a factor of 2, it measures the voltage drop as 3V. If the meter had an ideal, infinite resistance, it would give the correct value of 4.5V. In the real world, that is impossible.

Bar Graph

Sometimes it is useful to represent voltage with a graphical display. A *bar graph* component makes this possible, and is often used in audio equipment.

The bar graph can consist of a row of *LEDs*. In a component designed for this purpose, there are usually 10 or more. To represent 0 volts, all the LEDs remain dark. More LEDs are illuminated as the voltage increases.

Because the bar graph itself only contains LEDs, a driver is necessary to convert voltage into the "rising thermometer" effect. Examples are the LM3914 (linear), the LM3915 (logarithmic, 3 dB per step), and the LM3916 (using VU or Volume Units, for audio). Each of these components has 10 LED outputs, and is fabricated using a chain

of resistors as a multitap voltage divider, with 10 comparators.

A driver can be set to show only one LED corresponding with the current voltage level, or (more commonly) a cumulative string of LEDs from zero upward. Some bar graphs also contain different colored LEDs, such as green for the first 7, yellow for the next 2, and red for the final one.

A microcontroller containing an analog-to-digital converter can be used to illuminate a bar graph, instead of a driver chip.

An example of a bar graph is the Avago HDSP-4830, shown in Figure 31-6.

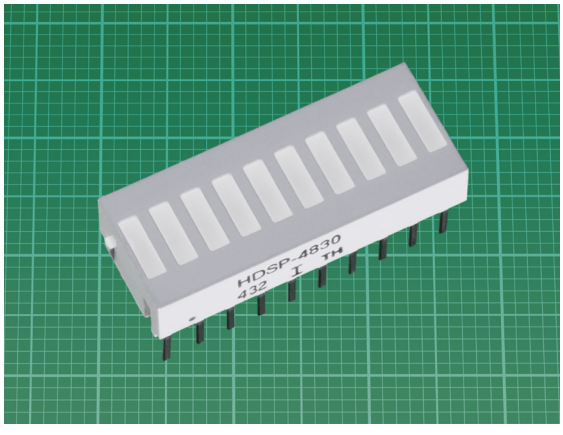

Figure 31-6 *A bar graph LED display, which can be used to represent voltage. The background grid is in millimeters.*

What Can Go Wrong

Confusing AC with DC

A panel meter that is designed only to measure DC should not be used with AC, and vice-versa. Erroneous readings or damage to the meter may result.

High Circuit Impedance

When a meter is measuring the voltage drop across a high-value resistance, it will give an inaccurate reading, as it is diverting a significant proportion of the current.

Voltage Out of Range

Attempting to measure a voltage that exceeds the limited range of a meter can damage the meter or blow its internal fuse, if it has one. Attempting to measure a voltage that is at the very low end of a meter's range will result in an inaccurate value.

Voltage Relative to Ground

If one input to a digital meter is connected with ground, the meter will only be able to measure voltage in a circuit relative to ground.

Sensor Output

A

This appendix provides some basic information about nine forms of sensor outputs, and the ways in which they can be processed. Other types of encoded output exist, but those examined here are the ones most likely to be found.

Figure A-1 provides an overview. Every sensor initially creates an analog output, which is sometimes connected directly to an output pin. In thermistors and photoresistors, for example, the internal resistance of the component constitutes its output. In many sensors, however, the behavior of the sensing element is processed internally to create voltage, open collector, encoded pulse stream, or current output.

If the sensor is chip-based, it may process the analog sensor response internally to create a binary output or a digital output.

In this Encyclopedia, the term "binary output" means "an output that has two states," usually logic-low or logic-high. The states may be accessible via an output pin, or may be processed internally to create a pulse stream. In that case the stream fluctuates between the two states as a way of encoding an analog value with pulse-width modulation (PWM) or frequency. Other types of encoding are also possible, but are unusual.

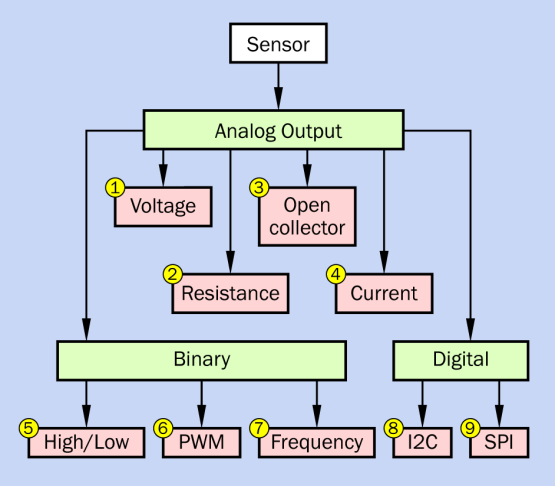

Figure A-1 *Nine possible types of output from sensors. The primary categories are highlighted in green.*

The term *digital output* is used here to mean one or two bytes of data that are stored in a register (memory location) in the sensor chip. While other forms of output are "always on" and can be accessed at any time from an output pin, a digital output is usually not available until an external device, such as a microcontroller, sends an instruction to the sensor chip, telling it to return the data. This two-way communication usually is handled by the I2C or SPI protocols (other protocols exist, but are less common).

Analog Outputs

Voltage is by far the most common form of analog output. Other forms of analog output can easily be converted to a voltage value, using the simple techniques described here.

1. Analog: Voltage

Direct Connection: Analog-to-Analog

An analog voltage output can be connected directly to an analog input, so long as the range is compatible and the sensor can provide sufficient current. Examples of external analog devices would be an analog volt meter, a light source or sound source that changes intensity, or a transistor or op-amp that will amplify the output for other audio/visual purposes.

If the voltage output from the sensor rises above a usable range, it can be converted to a lower value by applying it across two resistors connected in series to form a voltage divider. This is shown in Figure A-2.

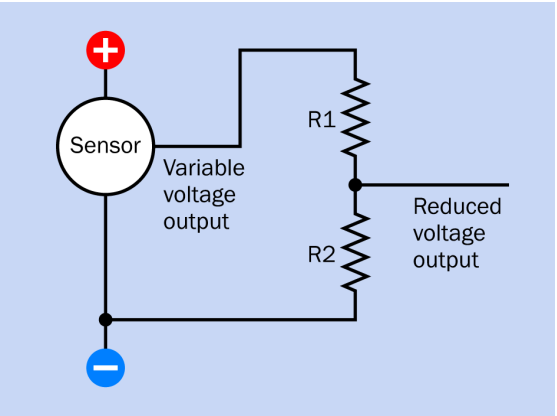

Figure A-2 *Using a voltage divider to reduce the range from a sensor.*

The values of R1 and R2 can be derived from this basic formula, where V_{SEN} is the voltage from the sensor and V_{OUT} is the output from the voltage divider:

Example A-1

$$V_{OUT} = V_{SEN} * (R2 / (R1 + R2))$$

The impedance of the device used for voltage sensing must be high relative to the values of R1 and R2. Note also that if the analog voltage out from the sensor varies linearly with the phenomenon being sensed, this relationship is likely to be disturbed by the voltage divider.

Analog-to-Binary Conversion

The term "binary" is used here to mean an output that can be in one of two states, such as logic-high and logic-low.

A varying analog voltage output can be simplified by passing it through a component that transforms the signal into binary form. This may be done by using a logic chip with a *Schmitt trigger* input, a *zener diode*, or a **comparator**. (For a description of comparators, see the entry in Volume 2.) A comparator provides desirable features such as adjustable positive feedback to create hysteresis. It may be used, for example, to convert a slowly changing signal from a phototransistor while the sun is setting, to a high/low output that can activate a relay to switch on a light.

Analog-to-Digital Conversion

The analog voltage output from a sensor can be digitized by an external analog-to-digital converter (ADC), either inside a microcontroller or by a separate ADC chip.

If a microcontroller is used, a sensor may often be wired directly to an input pin that connects internally with an ADC. A program in the microcontroller can then assess the integer output from the ADC and either execute a conditional statement or convert the value to a format appropriate for another device, such as a digital display.

If an ADC chip is used, there are thousands to choose from. A few basics:

- A *flash* converter contains a row of comparators with different reference voltages generated with a chain of equal resistors. The comparator outputs are fed into a priority **encoder**

that outputs a binary number. This system is very fast but has limited resolution.

- A *successive approximation* converter uses a single comparator, comparing the input voltage with the output from a DAC. The binary number that is supplied to the DAC is determined one bit at a time, from the most significant to the least significant bit, using the comparator's result to determine if the bit should be 0 or 1. These bits are stored in a register, called a successive approximation register (SAR). When the process finishes, the SAR contains a binary representation of the input voltage. This type of ADC can achieve high resolution (many bits) at the cost of lower conversion speed.
- In a *dual slope* converter, a capacitor is charged for a fixed time, with a rate proportional to the input voltage, then discharged at a known rate while measuring time by counting clock pulses. The resulting count is the ADC output.

  The name of the converter is derived from the voltage on the capacitor.
- A *voltage-to-frequency* converter uses a voltage-controlled oscillator to produce pulses with a frequency proportional to the input voltage. If the pulses are counted over a fixed time interval, the count is proportional to the signal level.

The number of the bits in the output from an ADC must be sufficient to digitize the input voltage range with desired accuracy. Because the voltage range may contain unexpected peaks, a cautious strategy is to use many more bits than are necessary. However, this means that for most of the time, only a few bits will be used to represent the low end of the voltage range, and accuracy will suffer.

For example, suppose a voltage input normally ranges from 0V to 2V, with occasional brief excursions to 8V. An 8-bit ADC can provide 256 digital values to represent input voltages. If the values are spread uniformly over the full 8V input range, the least significant bit can measure 1/32nd of a volt, or about 31mV. Smaller voltage fluctuations will be ignored. On the other hand, if the 256 values are used to measure a range of just 2 volts, the least significant bit can measure 1/128th of a volt, or slightly less than 8mV—but voltages higher than 2V will be clipped.

An ADC will typically require a reference voltage, and will digitize the range from 0V to that voltage. The reference voltage must be chosen with the issues of accuracy and range in mind.

A microcontroller may provide a feature in its language to perform automatic scaling of an analog input within limits set by a variable in program code. This is done by comparing the input with a selectable voltage level, such as the voltage of the power supply, an externally supplied voltage, or a fixed built in reference. While the ADC in the microcontroller normally digitizes values from 0V to the supply voltage for the chip, the conversion routine can instruct the microcontroller to use its full number of bits (often, 10) to digitize an input range from 0V to 1V.

For a higher sample rate, an ADC chip may be connected with the microcontroller over an I2C or SPI bus.

2. Analog: Resistance

Resistance-to-Voltage Conversion

A sensor that changes its resistance as it responds to its environment can be placed in a *voltage divider* to provide an analog voltage output. This is illustrated in Figure A-3.

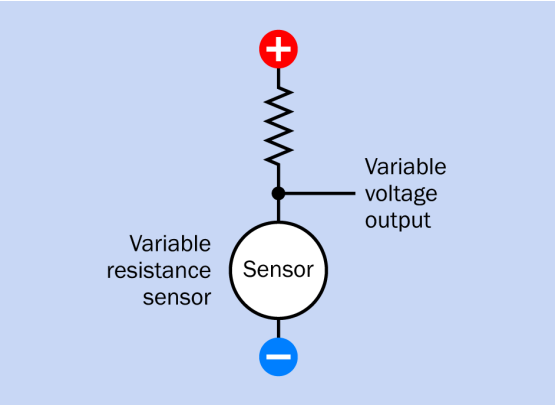

Figure A-3 *The basic principle of putting a variable-resistance sensor in series with a fixed resistance, to create a voltage divider.*

To choose the value for the series resistor, if R_{MIN} and R_{MAX} are the minimum and maximum resistance values for the sensor, the optimum value R_S for the series resistor, to produce the widest variation in voltages, will be found from this formula:

$$R_s = \sqrt{(R_{min} * R_{max})}$$

When the sensor has been set up in this way, the output can now be processed in the same way as any analog voltage output from a sensor.

The datasheet of the sensor should be consulted to make sure that a series resistor value does not allow any chance of the sensor being damaged by excessive current.

3. Analog: Open Collector

Many sensor packages or modules include a bipolar transistor that has an *open-collector* output (or *open drain*, if a CMOS transistor is used). The transistor may or may not be incorporated in an internal **op-amp** (described in Volume 2). Either way, the principle is the same.

Figure A-4 shows a sensor, in darker blue, that has one connection for positive power, another connection for negative ground, and a third connection to the collector of the internal transistor.

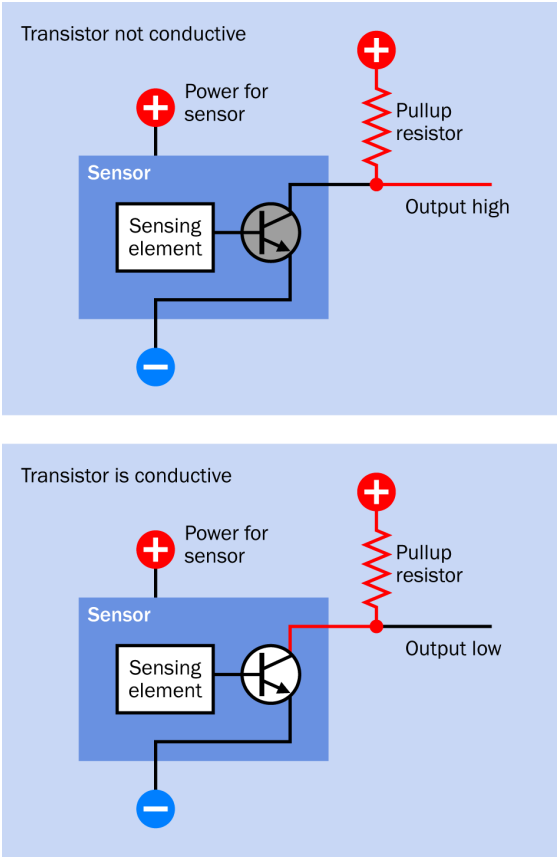

Figure A-4 *How to use an open-collector output from an internal transistor.*

In the upper section of the figure, the sensing element is not applying voltage to the base of the internal transistor, and the transistor only conducts a tiny amount of leakage current. Power applied to it through an external *pullup resistor* cannot reach negative ground in any significant quantity, and therefore it can provide a voltage input to a high-impedance device such as a microcontroller, or can power a component such as an LED, which draws relatively little current (20mA or less).

In the lower section of the figure, the sensing element is now applying voltage to the base of the transistor, drastically lowering its effective

resistance. The transistor diverts current from the pullup resistor to ground, and the output appears to go low.

The type of sensing element will determine whether the transistor becomes conductive or nonconductive when the element detects a stimulus.

The value that should be chosen for the pullup resistor will depend on the impedance of any device attached to the open-collector output. A 10K resistor may be appropriate for use with a device such as a microcontroller, which has very high impedance. At the other extreme, if the device is an LED, a 330-ohm resistor may be necessary. The value of the pullup resistor must be sufficiently low to enable reliable operation, but sufficiently high to prevent excessive current from passing through the internal transistor when it becomes conductive (20mA is a common maximum value).

The voltage from the open collector can be processed in the same way as any analog voltage output from a sensor.

An open-collector output may be used when the outputs from multiple devices share the same bus. One device can drive the bus without the problem of other devices attempting to hold the bus voltage high.

4. Analog: Current

Relatively few sensors provide an output consisting of variations in current. Some semiconductor temperature sensors function in this way. The output current can be converted to a voltage output simply by placing a fixed series resistor, as shown in Figure A-5.

The voltage at the point shown, relative to negative ground, will vary linearly with the current. The value of the resistor should be defined in a datasheet for the sensor.

The voltage can now be processed in the same way as any analog voltage output from a sensor.

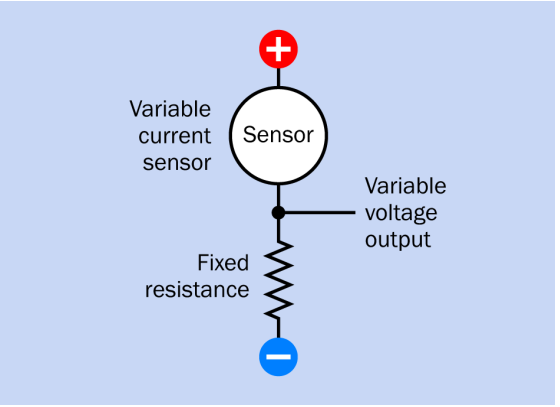

Figure A-5 *How to convert the output from a variable-current sensor.*

5. Binary: High/Low

A sensor that provides a binary output (that is, an output that is either logic-high or logic-low) can be connected directly with a microcontroller, if the voltage range is compatible. Program code in the microcontroller can then test the pin to establish its state. Note that some microcontrollers require a 3.3VDC power supply, while sensor chips may use 5VDC.

A binary output can also be used to control a solid-state relay, or an electromagnetic relay if transistor amplification is used. The output may be sufficient to power an LED indicator.

6. Binary: PWM

PWM is an abbreviation for *pulse-width modulation*. The sensor emits a stream of square-wave pulses with a fixed frequency, but the width of each pulse varies with the stimulus to which the sensor is responding. The width of each high pulse, relative to the wavelength between the start of one pulse and the start of the next, is called the *duty cycle*. A duty cycle of 0% means that there are no pulses at all. With a duty cycle of 100%, there are no gaps between pulses, so the output is high all the time. With a duty cycle of 50%, the duration of each high pulse is the same as the duration of the gap between pulses.

Various microcontrollers offer different ways to decode a PWM pulse stream. The most basic way is for a program to check an input pin repeatedly, as fast as possible, until a high state is detected. The microcontroller copies the value of its internal clock into a variable, then continues to check the input repeatedly until the pulse ends. The pulse duration that has been measured can be converted to a sensor value with a formula or lookup table.

This system is not recommended, as the microcontroller may miss the next pulse while it is converting the value of the previous pulse. To address this problem, a microcontroller language may offer a function that blocks execution of code while waiting for a pulse. The pulseIn() function on the Arduino is an example of this feature. However, the microprocessor must now spend most of its time waiting for a pulse instead of doing useful work.

A better solution is to write a program that is interrupt-driven.

Another option for decoding PWM is to use a low-pass filter that converts the pulse stream into an analog voltage, although some ripples will tend to remain.

Finally PWM can be used directly to power an LED or a DC motor, with transistor amplification as required. The speed of the motor or the brightness of the LED will vary with the duty cycle.

7. Binary: Frequency

Here again, the pulseIn() function on the Arduino may be used, so long as the frequency is a square wave with a known duty cycle.

8. Digital: I2C

In digital electronics, a *bus* is a communal pathway for sharing data among components or devices. The *I2C bus* is an abbreviation for *inter-integrated circuit* bus, developed originally by Philips in 1982. (Philips has since been subsumed into NXP Semiconductors.) The correct notation for I2C is I^2C, and it is spoken as "I-squared-C." However, the term is very commonly written as I2C.

The I2C standard defines a data sharing protocol that is limited to 400kHz (with some exceptions) and designed to work on a small scale, almost always within one device, and usually on one circuit board. It is a low-cost, simple design. Data is transmitted serially over two wires, and the devices sharing the bus are connected in parallel.

Typically there is one *master* device on the bus, and a number of *slave* devices. Masters and slaves can both transmit information, but the master normally initiates communication. It also emits a clock signal for synchronization of data.

A sensor is a slave device that can be interrogated by a microcontroller in its role as the master device. Because multiple slave devices can share a bus, the microcontroller needs a way to identify the slave that it wishes to talk to, and each slave is assigned a unique address for this purpose. Often a slave will allow the user to modify the last two bits of the address, so that up to four identical devices can share a bus.

Code libraries to support the I2C protocol are available for most microcontrollers, and communication with a sensor that uses I2C should simply require knowledge of the sensor's I2C address. However, the data registers in a sensor can be quite elaborate, requiring careful study of the manufacturer's datasheet. Multiple procedures may be required to set functions on a device (such as the sensitivity range of an accelerometer, or the threshold for a temperature alarm). Multiple procedures may also be required to read data out of a sensor (such as two bytes to define a temperature, and several bytes to obtain time as well as location readings from a GPS module).

9. Digital: SPI

SPI is an acronym for serial peripherals interface, a standard introduced by Motorola that serves a similar function to the I2C bus, described immediately above. The SPI standard is slightly more sophisticated, enabling duplex communication and higher data transfer speeds. However, SPI requires a minimum of three wires shared by all devices on the bus, and an additional device-selection line for each slave device. The benefit of the extra device lines is that devices are easier to select and address than on an I2C bus, where more program statements are required. As is the case for I2C, code libraries for microcontrollers are widely available to support SPI. However, the requirement for SPI to use three pins on a microcontroller, plus an additional pin for each slave device, is a disadvantage.

More sensors have I2C capability than SPI capability. The SPI protocol is potentially much faster than I2C.

A sensor that is SPI-enabled will almost certainly be available in a similar version that uses I2C. An increasing number of chip-based sensors support both protocols.

Glossary

This glossary is not comprehensive. It contains only the technical terms that have been used most frequently in this book in conjunction with sensor attributes.

ADC Analog-to-digital converter, which accepts a varying signal (usually, a voltage) as an input, and converts it to a digital value in the form of a binary number. This number is likely to have a high limit ranging from 255 decimal to 65535 decimal. Many microcontrollers contain their own ADC, which is multiplexed to assess the inputs on several pins. On an Arduino Uno, the ADC creates a digital value ranging from 0 through 1,023.

analog output When a sensor creates a voltage or varies its resistance without steps or increments, as a function of the phenomenon that it is measuring, this is an analog output.

binary output In this Encyclopedia, the term "binary output" describes a sensor output that only has two states: logic-high and logic-low, or on and off. The term is used in some datasheets, but more often a binary output is described, misleadingly, as an analog output.

breakout board A small printed-circuit board containing one or more integrated circuit chips, usually surface-mounted. The board makes the features of the chips easier to access, because it has pins or connectors with 2.54mm (0.1") spacing for convenient experimental use with a breadboard. Additional features may be included, such as a voltage regulator.

chip-based sensor This term is used in the Encyclopedia to describe a sensor that is etched into a silicon chip and usually has signal conditioning components and circuitry built in.

contact bounce The tiny and rapid vibrations of mechanical switch contacts, when the switch opens or closes. If the switch is connected with a digital device such as a logic chip, debouncing hardware may be necessary, to allow the contacts time to settle. If the switch is connected with a microcontroller, a delay from 5ms to 50ms may be written into program code. Different switches have widely different settling times.

decibel A unit that expresses relative power or intensity, often (but not exclusively) applied to audible sound. The decibel is one-tenth of a bel, and is abbreviated dB, with the B capitalized because it is derived from the name of Alexander Graham Bell. Because dB is a logarithmic unit, the scale has no zero origin. However, 0dB may be assigned arbitrarily to any intensity, in which case lower intensities will have a negative value. An increase of 3dB corresponds to a doubling of sound intensity (acoustic energy). However, when a sound is sensed

by the human ear and evaluated by the brain, its subjective loudness doubles when the intensity increases by 10dB.

dielectric The insulating layer separating two plates in a capacitor.

hysteresis The difference between thresholds for switching an output on and off. When a sensor exhibits hysteresis, it may be unresponsive to a stimulus slightly above or below its equivalent current value. This may be useful to eliminate numerous responses to very small stimuli —for example, in a room thermostat.

I2C Interintegrated circuit bus. Sometimes written as I^2C, and often referred to verbally as "I-squared-C." A communications protocol that is often used between a microcontroller and other components on a circuit board. For a description, see "8. Digital: I2C" in the Appendix.

IMU Inertial measurement unit, consisting of three accelerometers and three gyroscopes, sometimes with the addition of three magnetometers. It can be used as a navigational aid. It may also be used in handheld user input devices, such as game controllers.

Kelvin A temperature scale, often abbreviated with the letter K, in which each degree is equivalent to a Celsius degree, but 0 degrees is at absolute zero—the temperature at which materials have no heat energy at all. 273 degrees K is approximately equal to 0 degrees C.

MEMS Microelectromechanical system, i.e., an integrated circuit chip that also contains tiny moving parts. For example, a MEMS accelerometer is built around microscopic springs that respond to accelerative forces.

newton A unit of force named after Isaac Newton, abbreviated with the capital letter N. A force of 1N will accelerate a mass of 1kg at a rate of 1 meter per second each second.

open collector output Many sensors have an open collector output, or contain an op-amp that has an open collector output. The output pin is attached to the collector of an internal transistor, with its emitter connected to negative ground. Positive voltage applied through a pullup resistor to the open collector will be grounded when the internal transistor is conducting current, but will be available for other devices when the transistor is off. See "3. Analog: Open Collector".

orthogonal Angled at 90 degrees. Three orthogonal elements in a sensor will all be angled at 90 degrees to each other.

pascal A unit of pressure equivalent to 1 newton of force per square meter.

PIR Passive infrared sensor. See Chapter 4.

pullup resistor A resistor that pulls up an output or input voltage in the absence of a signal. May be used in conjunction with an **open collector output**.

quadrature An encoding system for output from a pair of sensors. If the sensors are identified as A and B, four output combinations are possible: A high and B low; A high and B high; A low and B high; A low and B low. A common application is to show the direction of movement of a magnetic or optical pattern past the sensor pair.

reference temperature The temperature at which the output signal of a temperature sensor is measured. This is often listed in a datasheet.

register A section of memory that stores a digital value (usually 1 or 2 bytes in a sensor).

target Any object that is being detected by a motion sensor, proximity sensor, or presence sensor.

temperature coefficient The percentage increase or decrease in the value of a sensor as a result of unit change in temperature (usually 1 degree Celsius). Often abbreviated as TC. The

value may be resistance, voltage, or current, depending on the sensor. The temperature coefficient should be negative if the value of the sensor diminishes when its temperature increases. If it is expressed in parts per million, abbreviated ppm, it can be converted to a percentage by dividing by 10,000.

Wheatstone bridge A network of four resistors. At least one of the resistors has an unknown value, while the others have precisely known reference values. The network enables calculation of the unknown value. See Figure 12-2.

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Colophon

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(54) MAGNETIC VORTEX WORMHOLE GENERATOR

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(57) **ABSTRACT**

This invention relates to a magnetic vortex generator which has the ability to generate negative mass and a negative spring constant which, according to Einstein's General Theory of Relativity, is required in order to create a stable wormhole between our space and hyperspace. Two separate, but electrically connected, toroidal coils of differing radii, carry magnetic flux in opposite directions about their common centerline. According to Maxwell's equation, this produces bucking electric fields along said centerline. Because the two solenoids have different radii, the parallel spring constant of both coils is negative. The negative mass together with the negative spring constant produce a real resonant frequency which can distort the spacetime curvature due to the creation of powerful spikes of negative mass. This phenomenon, similar to the common electrical thunderstorm, opens up a wormhole into hyperspace through which low-density hyperspace energy can enter into our dimension. This energy finds many application in new types of power supplies, inertia-less and mass-less spacecraft, vehicles that can travel light-years by moving out of dimension through hyperspace, surgery-less medical tables, cranes for lifting heavy objects, cold-welded crystals for crystal rotors, folding space waveguides, and electromagnetic field propulsion vehicles using highly relativistic fields.

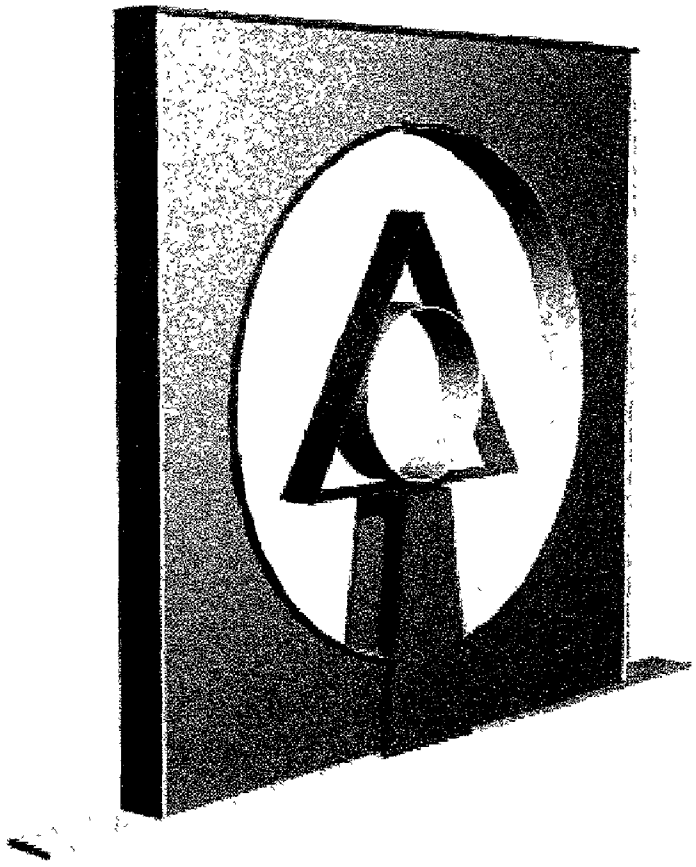

Figure 1

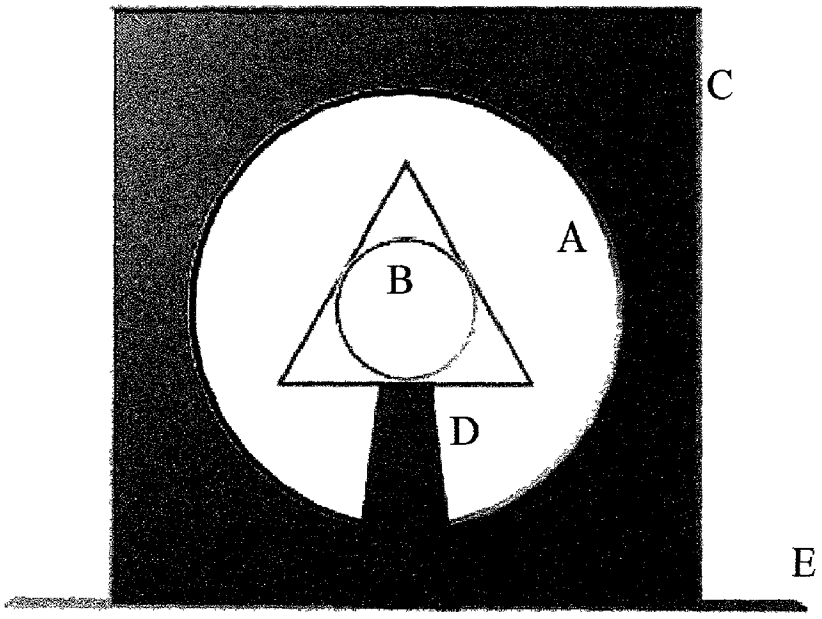

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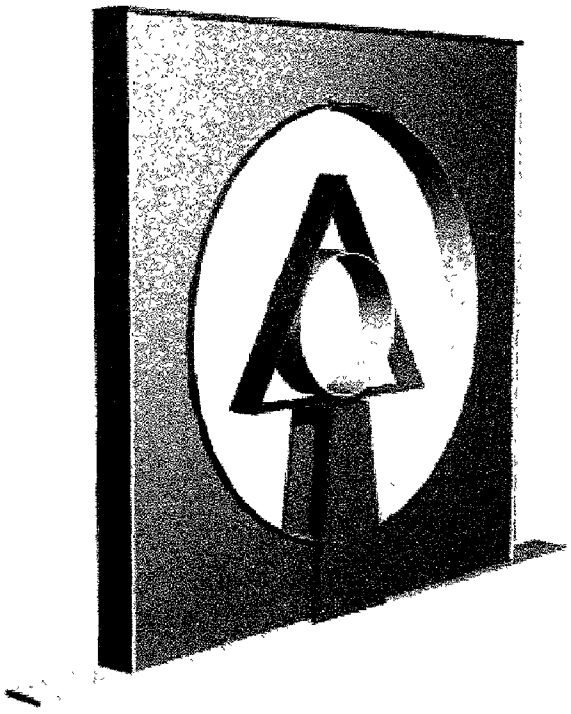

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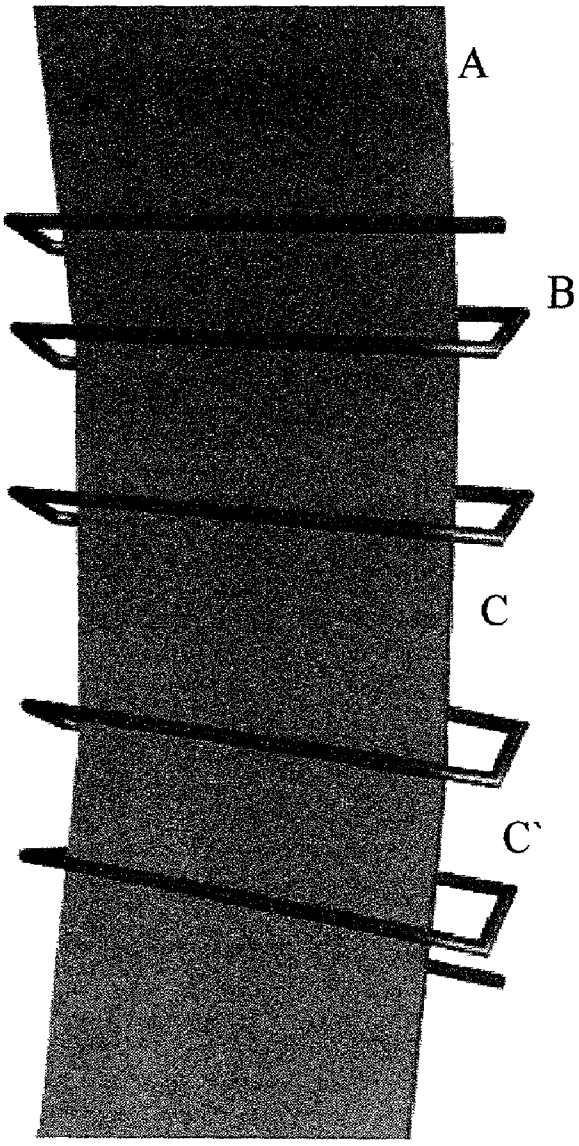

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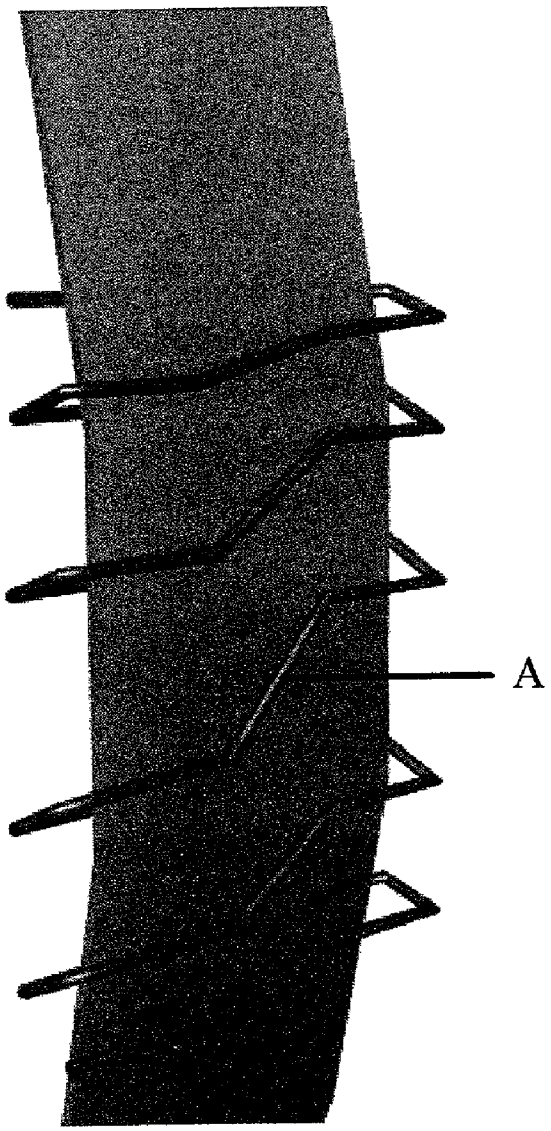

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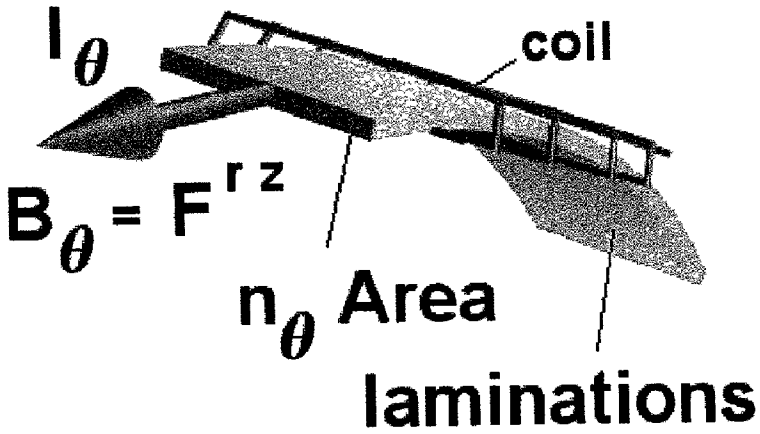

Figure 6

$$F^{\mu\nu} = \begin{array}{c|cccc|} & t & r & \theta & z \\ \hline t & 0 & 0 & 0 & 0 \\ r & 0 & 0 & 0 & B_\theta \\ \theta & 0 & 0 & 0 & 0 \\ z & 0 & -B_\theta & 0 & 0 \end{array}$$

Figure 7

$$k^z = \frac{\text{coul}}{\text{sec}} \cdot m^2 \cdot \frac{1}{m^2} \cdot \frac{\text{kg}}{\text{sec} \cdot \text{coul}} = \frac{\text{newton}}{m} = \frac{\text{force}}{m}$$

Figure 8

$$k^z = \frac{1}{(r+a)^2} - \frac{1}{r^2} = -a\left[\frac{(2 \cdot r + a)}{(r+a)^2 \cdot r^2}\right]$$

Figure 9

$$g_{\alpha\beta} = \begin{array}{c|cccc|} & t & r & \theta & z \\ t & -1 & & B(\cos\theta - \sin\theta) & 0 \\ r & 0 & 1 & 0 & 0 \\ \theta & B(\cos\theta - \sin\theta) & 0 & r^2 & 0 \\ z & 0 & 0 & 0 & 1 \end{array}$$

Figure 10

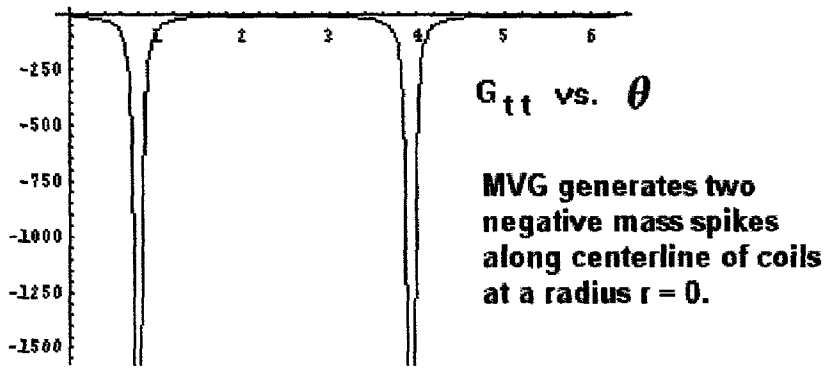

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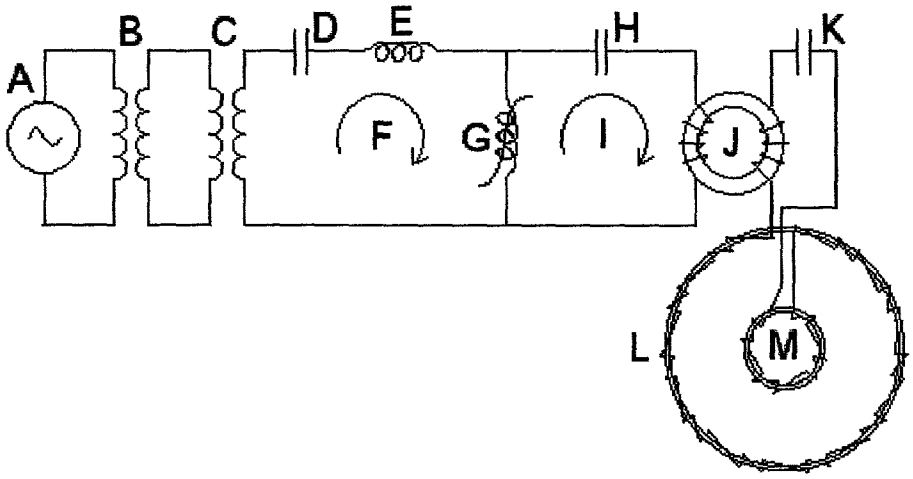

Figure 12

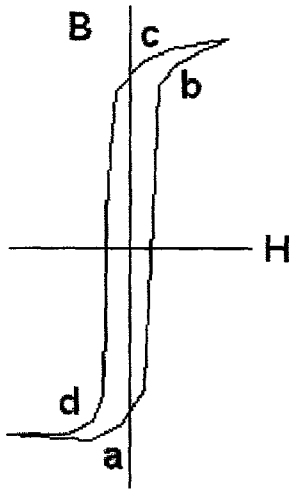

MAGNETIC VORTEX WORMHOLE GENERATOR

BRIEF SUMMARY OF THE INVENTION

[0001] This invention, which is the subject of my present application, is comprised of two solenoids wound with a common wire in opposite directions on two separate toroidal curved-sheet transformer laminates of differing radii. The smaller solenoid is mounted along the centerline of the larger solenoid. This circular magnetic geometry creates linear bucking electric fields along the centerline of the coils. Because the magnetic flux in the laminates travels in opposite directions along arcs of differing radii in the two coils, a negative mass and a negative spring constant are generated by the system. From the theory of gravitational physics, a negative mass is prerequisite to producing a wormhole because it allows the throat of the wormhole to remain open and stable. The creation of the wormhole is facilitated by the appearance of a negative spring constant which allows the spacetime curvature to resonate to such a degree that said wormhole develops between our dimension and another co-dimension of hyperspace. Because the physics constants of hyperspace are different from ours, the wormhole allows hyperspace energy having a low speed of light to enter our dimension. Because electromagnetic fields obey the Lorentz transformation, it is now possible with this lower velocity of light to create huge relativistic fields which can drive the new electromagnetic field propulsion vehicles.

BACKGROUND OF THE INVENTION

[0002] The idea for this coil configuration comes from the observation of powerful thunderstorms, as described by physicist Dr. Richard Feynman in his *Lectures on Physics,* a copy of which is enclosed as a reference. Upon reading his explanation, I realized that the thunderstorm is actually a hyperspace physics phenomenon.

[0003] After the passage of a large lightning storm, people have observed that a car tire rim has merged with the trunk of a tree growing in the ground. Due to the large branches of the tree, there is no possible way that it could slide down the branches and around the trunk. It was observed also that a straw of wheat became embedded in the hard wood of a telephone pole. It turns out that the thunderstorm offers an explanation as to how this can occur.

[0004] After reading Feynman's explanation, it can be seen that the key to this phenomenon is that there is a downward and an upward lightning bolt, sometimes occurring together if the leader branches into two paths. Bolts of lightning also like to strike tall objects such as telephone poles or trees. Now an electrical current moving downward produces a clockwise magnetic B field, as seen from above. On the return stroke, the current is moving upward which produces a counterclockwise magnetic B field. Thus the thunderstorm produces two huge bucking magnetic B fields which is the magnetic geometry of this magnetic vortex generator. Using my tetrahedron diagram, I will then show that the low density hyperspace energy with its low speed of light is able to pull the rim out of dimension so that it can merge with the tree at the moment the lightning strikes.

SUMMARY OF THE INVENTION

[0005] It is the object of this invention to produce two toroidal oppositely-directed magnetic flux fields in two separate yet electrically connected solenoids of differing radii. Because the lines of flux are traveling in toroidal, curved-sheet transformer laminates along arcs of different curvature, the fields produce what is known in gravitational physics as negative mass. Negative mass has the property that if you project it onto a hot surface, the surface will cool rather than heat up. The negative mass, together with the resonance of the spacetime curvature involving a negative spring constant, create a wormhole into hyperspace. This interdimensional connection allows low speed of light hyperspace energy into our dimension which can be used to decrease the weight of an object, or produce huge relativistic electromagnetic fields that can be used to drive the new electromagnetic field propulsion spacecraft.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0006] Not Applicable.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIG. 1**. Front view of magnetic vortex generator.

[0008] **FIG. 2**. Perspective view of the magnetic vortex generator.

[0009] **FIG. 3**. The non-linear coil winding on the interior face of the laminations.

[0010] **FIG. 4**. The non-linear coil winding on the exterior face of the laminations showing that there is an electrical current component in the theta direction.

[0011] **FIG. 5**. The coil variables for the tensor calculation of the negative spring constant.

[0012] **FIG. 6**. The Faraday electromagnetic tensor showing the position of the magnetic field in the {r,z} slots.

[0013] **FIG. 7**. The units of the spring constant.

[0014] **FIG. 8**. The parallel spacetime spring constant.

[0015] **FIG. 9**. The cylindrical g metric tensor including the magnetic fields.

[0016] **FIG. 10**. A plot of the mass term G_n for Einstein's G curvature tensor showing that two negative mass spikes are created along the centerline of the generator. Negative mass is required to keep open the throat of the wormhole.

[0017] **FIG. 11**. Circuit diagram for the magnetic vortex generator.

[0018] **FIG. 12**. BH curve for non-linear SuperMalloy toroidal core. From the equation, $B=\mu H$, the slope of the line is equal to the permeability $\partial B/\partial H=\mu$.

DETAILED DESCRIPTION OF THE INVENTION

[0019] 1. The fact that negative mass is required to keep the throat of a wormhole open has been shown to be valid by physicist Dr. Kip Thorne in the enclosed reference physics paper. The key point of this invention is that if you have a negative mass, you also require a negative spring constant in order to get a real frequency and vice versa. The angular frequency of vibration is equal to the square root of the spring constant K divided by the mass M, or $\omega=\sqrt{K/M}$. If the mass is negative, and the spring constant is positive,

the frequency is imaginary. Therefore, in order to get a real frequency, the spring constant has to be negative also.

[0020] 2. Referring to **FIG. 1**, the magnetic vortex generator consists of a large toroidal solenoid (A) and its support structure (C), a smaller toroidal coil (B) with its support structure (D) which holds the coil along the centerline of the larger coil. The entire structure sits on a base (E).

[0021] 3. The two solenoids are wound with a common wire in opposite directions on two separate toroidal curved-sheet transformer laminations of differing radii. From the right hand rule, a changing circular magnetic field in the direction of the fingers produces a linear electric field in the direction of the thumb. Because there are two coils producing two magnetic fields in opposite directions, there are two bucking electric fields down the centerline of the coils. This duplicates the thunderstorm conditions. A perspective view of the generator is shown in **FIG. 2**.

[0022] 4. A enlarged view of the non-linear coil winding is shown in **FIG. 3**. The wire (B) is wound around the thin transformer laminations (A) with a non-linear coil spacing as shown by the difference in spacing between length (C) and (C'). On this inner side of the coil, the wire is wound straight across where it can be seen that the wire is normal to the edge of the laminations. Not shown are two strips of Velcro which keep the wire aligned and offset from the tape-covered metal laminations.

[0023] 5. Since the wire is straight across on this side, the opposite side has to have the wire run in a diagonal manner as seen in **FIG. 4A**. In terms of cylindrical coordinates, the components of the electrical current in the coil flow in the z-direction across the breadth of the lamination and in the O-direction around the lamination.

[0024] 6. The reason for the non-linear spacing is to preserve the vector potential of the coil. The vector potential is a more important field than the magnetic field because it can extend out past the windings of a long solenoid. If you look at the units, it is the field momentum per charge or kilogram meter per second coulomb. Notice that the derivative of the vector potential with respect to time is an electric field, while a derivative with respect to length is the magnetic field. The inductance of the coil times the current density is equal to the vector potential. Thus the inductance gradient of the coil times the current per meter is the magnetic field. So the non-linear coil picks up an additional magnetic field around the coil besides the one created in the laminations by the winding itself

[0025] 7. Taking a closer look at the coil in **FIG. 5**, it is constructed of thin laminations taped together to form a cylindrical shape with a wire coil wrapped around it. This creates a magnetic field in the theta θ direction within the laminations. Because the coil is wrapped as a helix, there is a current component I_θ in the theta direction. The cross-sectional area Area through which the magnetic flux flows times a normal vector n in the theta direction is the tensor area n_θ Area. If the radius of the coil is r, then the curvature K is $1/r^2$ pointing in the radial direction. Because there are two coils with differing radii, the generator has two curvatures associated with it.

[0026] 8. In the geometry of electromagnetism, the magnetic field is part of the electromagnetic Faraday tensor $F^{\mu\nu}$ which is a 4 by 4 spacetime matrix having rows and columns of time t, radius r, angle θ and height z in cylindrical coordinates. The first index μ refers to the row, and the second index v refers to the column. The diagonal of the matrix is zero. The first row and column belong to the electric field. All the other slots are filled by the components of the magnetic field. The B_θ component is located in the complementary slots of r and z as shown in **FIG. 6**. Now a tensor product can be written with the available variables I^θ no Area $K_r F^{rz}=k^z$. This says that the current around the loop in the theta direction times the lamination area vector in the theta direction times the curvature K of the coil in the radial direction times the magnetic field in the theta direction is equal to a spring constant in the z-direction, or normal to the plane of the coil. All the tensor components cancel out except for the z-direction. That is, the coil produces a spacetime spring constant through the center of the coil where there are resonant bucking electric fields. So the coil is creating a magnetic spring. The units of the spring constant are shown in **FIG. 7** as force per meter.

[0027] 9. Because there are two coils operating in opposite directions in regions of differing curvature, there are two parallel spring constants generated along the centerline. Two springs in parallel sum, but the inner coil is negative due to the triple product of negative signs of current, field and area. Looking at the front view of the coils, the right hand rule shows the field going counterclockwise with the thumb pointing along the electric field in the positive z-direction. The inner coil with the field going in the clockwise direction has the electric field in the negative z-direction. Therefore the outer coil's positive spring constant sums with the inner coil's negative spring constant to produce an overall negative spring constant as shown in **FIG. 8**. The inner coil has a radius r, and the spacing between the outer and inner coil is a. In this design, the inner radius is 1, and the outer radius is 3 which is the magic ratio in physics of 1/3. That makes length a equal to 2. Substituting r=1 and a=2 into the spring constant equation shows that the ratio is negative 8/9. That is, the spring constant is negative as previously asserted. If the spring constant is negative, it must produce negative mass in order to have a real frequency of resonance. Since it produces negative mass, then it can produce a wormhole as shown by Dr. Kip Thorne.

[0028] 10. The geometry of hyperspace physics is based on the geometry of the tetrahedron which is circumscribed by the sphere. The corners of the tetrahedron touch the sphere at a latitude of 19.47122063° which turns out to be, in terms of planet cosmology, the location where all the large volcanoes and vortices occur on Earth, Mars, Jupiter, Uranus and Neptune. Furthermore, the cosine squared of this angle is 8/9, which is the spring constant ratio for the magnetic vortex generator. That is, the coil is interacting with the geometry of spacetime which is why it is such an effective wormhole generator. As will be demonstrated later, the tetrahedral geometry of hyperspace shows that the electron and proton are one and the same particle. This is a new discovery in science coming out of this research. The diagram also shows that when the speed of light is reduced, due to the low density of energy coming into our dimension through the wormhole, Planck's constant divided by the speed of light puts the electron at the boundary between space and hyperspace. That is, the electron and the proton go out of dimension which is the reason that the car tire rim can become merged with the tree. The ramifications of this magnetic vortex generator are enormous. It means develop-

ing new types of crystals through interdimensional merging which will be needed in the development of these spacecraft and their crystal rotors. It means the possibility of teleporting spacecraft through hyperspace over distances of light years using the new folding space waveguides. It means light-weight or inertia-less spacecraft which can be accelerated at hundreds of thousands of g's. It means the ability to lift extraordinary loads in construction work. It means surgery-less medical tables where tumors can be pulled directly out of the patient's body.

[**0029**] 11. Because we have a magnetic spring, then there is some resonant frequency at which the coil can be operated in order to create a large spacetime distortion. It is this distortion that creates the wormhole into hyperspace. From this it follows that the wormhole attaches to a low pressure region with a magnetic monopole. Because pressure is linear mass times the speed of light squared divided by area, a low pressure signifies a low speed of light and less dense matter. What this means is that opposite polarity spacetime curvature at two ends of an electrode will produce a voltage along the electrode, effectively creating a power supply. The reason for this is that spacetime curvature, as shown by Einstein's General Theory of Relativity equation $G_{\alpha\beta}=8\pi T_{\alpha\beta}$, is equal to the square of the electromagnetic fields in the stress-energy tensor T. So the curvature on the ends of the electrode appear as voltages and the system acts as a battery supply to power the spacecraft.

[**0030**] 12. The other characteristic of the magnetic vortex generator is that it can pull objects out of dimension allowing the object to apparently move through solid walls. The object doesn't actually move through the wall because the object is not in the same dimension as the wall; it just appears that way. Moving out of dimension and then back again on the other side of the wall would effectively move the object through the wall for all intents and purposes.

[**0031**] 13. The tetrahedron diagram is a physics diagram which plots the natural logarithm of mass to the natural logarithm of wavelength. The product of mass times wavelength is equal to Planck's constant divided by the speed of light. So the product of the electron mass times its wavelength is equal to the proton mass times its wavelength is equal to the Planck mass times the Planck wavelength. The Planck wavelength is the bottom dimensional limit of the universe. We live in the Planck box which is bounded by the Planck wavelength and Planck mass. Outside this box is hyperspace.

[**0032**] 14. Because logarithms sum, the sum of the log of the mass plus the log of the wavelength is a constant sum. Thus the electron and proton and Planck mass slide on a 45° line known as the base constant which is equal at the axes to the log of Planck's constant divided by the speed of light. Planck's constant is measured in joule-sec so that multiplying it by the frequency 1/second of light gives the energy of the photon particle.

[**0033**] 15. Planck's constant is equal to the Planck wavelength times the Planck mass times the speed of light. The 45° base constant is Planck's constant divided by the speed of light, which means that the speed of light cancels out top and bottom, leaving the area of the Planck box as the value of the base constant. Hyperspace has a low linear mass compared to our dimension. Therefore, Planck's constant is reduced when this energy enters our dimension through the wormhole created by the generator. And the base constant is also so reduced. In terms of logs, this means that the 45° base line becomes more negative and moves to the right on the diagram. As it does so, the base line intersects the electron at the Planck wavelength which is the separation point between space and hyperspace. That is, the electron moves out of dimension. Because the electron and proton are one and the same particle, as shown in reference tetrahedron diagram tet0565, the proton and hence the entire atom is taken out of dimension as well.

[**0034**] 16. All of this can be seen more easily graphically on the tetrahedron diagram itself, referring to reference tetrahedron diagram tet3025. The 45° line which intersects the electron at point (b) is the base constant for our dimension. As you can see, this base line intersects the horizontal axis at a value of −95.91546344 which is the log of Planck's constant h divided by the speed of light. Because Planck's constant is proportional to the linear mass, it is reduced in value by the low density hyperspace energy and, in terms of logs, becomes more negative. This moves the base line to the right at a value of around minus **105**. The new base line intersects the electron at point (a) which is located on the Planck wavelength that is the boundary between space and hyperspace. Thus the electron at point (a) goes out of dimension.

[**0035**] 17. It was inferred previously that a negative spring constant meant a negative mass was produced by the wormhole generator. This can actually be calculated using Einstein's General Theory of Relativity. The calculation starts with the g metric tensor which is a spacetime measurement of distance in terms of time t, radius r, horizontal angle θ and length z. This 4 by 4 matrix is shown in **FIG. 9** where the diagonal line has a signature in cylindrical coordinates of values equal to $\{-1, 1, r^2, 1\}$. All the other terms of the matrix are zero except for the magnetic fields in the two coils. Because the field is changing sinusoidally with time in the theta direction, the field has to go into the $\{t, \theta\}$ and $\{\theta, t\}$ slots of the matrix. Because the field in the inner coil is in the negative direction compared to the outer coil, and including a 90° phase shift between the two fields, a suitable magnetic field function would be $B(\cos(\theta)-\sin(\theta))$.

[**0036**] 18. Using a general relativity software package, Einstein's G curvature tensor can be calculated for this particular metric. The first term G t in the upper left hand slot in the corner is the mass term for the tensor. All the other terms are either electromagnetic fluxes or pressure terms involving the squares of the fields.

[**0037**] 19. Referring to **FIG. 10, a** plot of the mass as a function around a small circle shows that two negative mass spikes occur around the circumference of the circle. Because the radius is almost zero, the two spikes are actually coincident.

[**0038**] 20. This next section shows the electrical system used to drive the magnetic vortex generator. Referring to **FIG. 11**, the system is driven by a sinusoidal voltage source (A) into a 1:1 turns isolation transformer (B). The voltage is stepped up into the range of thousands of volts using a step-up hi-pot transformer (C). The first loop consists of a direct current blocking capacitor (D), a transformer choke (E), a variable inductance (G) and the current in the loop (F). The variable inductance is a coil winding on a toroidal core

wound with thousandth-inch thick SuperMalloy tape. This coil acts as a magnetic switch due to its variable permeability.

[0039] 21. Referring to the accompanying drawing in **FIG. 12**, the slope of the BH curve is actually the permeability of the core. At point (a) on the curve, the slope is very low and therefore the permeability is very small. The resistance of the coil is the frequency of the current times the inductance of the coil. If the permeability is small, then the inductance is low, which means that the coil resistance is low initially. With a low resistance in the coil, current (F) flows through the winding rather easily. Then the coil goes from point (a) to point (b) where the permeability and resistance increase. This change in resistance from a low to a high value dumps the magnetic energy into capacitor (H). Then the non-linear coil saturates between points (b) and (c) where again the coil has a small slope and the coil resistance switches to a low value. Capacitor (D) then dumps its charge (I) through coil (G) producing a large voltage spike in the input and output winding of transformer toroidal coil (J). The magnetic flux in coil (J) then produces a voltage spike in coils (L) and (M) of the magnetic vortex generator. The frequency of oscillation of the generator is determined by capacitor (K) and the overall inductance of the two coils. The diagram shows that the winding is non-linear and in opposite directions going from outer coil to the inner coil.

[0040] 22. Frequency of oscillation has to be kept under 20 MHz in order to create a soft wormhole that connects to low pressure regions of hyperspace. The pressure regions of hyperspace are similar to the pressure produced by a dam holding water. The upper surface of the water, where there is no water pressure, is analogous to the black void into which our universe is expanding. In the middle of the dam, there is a region just above us having a lower water pressure which corresponds to the low density hyperspace energy. This analogy is not perfect because the many frequencies of hyperspace are quantized, as we know from quantum physics, rather than being a continuous spectrum of lower and lower frequencies down to the zero frequency of the black void.

What I claim as my invention is

1. A magnetic vortex generator which can generate negative mass according to Einstein's General Theory of Relativity, which is a tested and proven theory. As a result of this theory, it can be shown that negative mass is required to create a stable wormhole between space and hyperspace. Without the negative mass, the throat would close.

2. The generator consists of two solenoids wound with a common wire in opposite directions on two separate toroidal curved-sheet transformer laminates of differing radii. The smaller solenoid is mounted along the centerline of the larger solenoid.

3. According to Maxwell's equations, said geometrical and magnetic arrangement produces linear bucking electric fields along the centerline of said coils. Since curvature and the square of the electromagnetic fields are one and the same phenomenon according to Einstein's spacetime curvature tensor $G=8\pi T$, this resonance of the electric fields causes a resonance of the spacetime curvature and the opening of the wormhole.

4. Due to the fact that the magnetic flux travels within the laminations at a curvature equal to the inverse of the radius squared, each coil produces a spring constant which depends on the current, lamination area, magnetic field strength and the individual curvature of each coil.

5. Due to the fact that the flux travels in opposite directions in each solenoid, the spring constant of the outer coil is positive, and the spring constant of the inner coil is negative. These two spring constants, one positive and one negative, add in parallel to create a negative spring constant for the generator. Because the frequency of resonance is equal to the square root of the negative spring constant divided by the negative mass, the resonant frequency is positive real.

6. This process of creating and keeping open the wormhole allows low density hyperspace energy to enter our dimension. Because the linear mass is lower, Planck's constant, equal to the Planck mass times the Planck wavelength times the speed of light, is reduced to such an extent that the electron is moved out of dimension. Because the electron and proton are one and the same particle, when considering a path through space and hyperspace, the proton is also moved out of dimension. Thus this process of moving the atom in and out of dimension using the magnetic vortex generator has the ability to create cold-welded crystals, new types of materials and new ways to cold solder one disparate material to another.

7. As a consequence of said process, highly relativistic electromagnetic fields can be created because the velocity of light has been reduced considerably. These fields than can be used to produce life in the new class of electromagnetic propulsion vehicles.

8. As a consequence of said process, refrigeration systems can be created because negative energy cools rather than heats.

9. As a consequence of said process, power supplies can be made such that a differential spacetime curvature on the ends of a carbon electrode can create a differential voltage similar to a regular chemical battery.

10. As a consequence of this process, surgery-less medical tables can be fabricated whereby tumors can be pulled directly from the patient's body.

11. As a consequence of this process, the negative mass produced by the generator can offset the mass of a spacecraft to create a mass-less, inertia-less vehicle which can accelerate at hundreds of thousands of g's.

12. As a consequence of this process, the folding space waveguide becomes a reality whereby hyperspace energy, which has a low spring constant, can be easily folded and curved using powerful, relativistic electromagnetic fields. Spacecraft will be able to teleport themselves out-of-dimension over huge distances measured in terms of light-years.

13. Because the wormhole opens up an interdimensional connection to hyperspace having a magnetic monopole, a radial magnetic field is created. As a consequence of this process, a changing magnetic monopole field crossed with a changing electric field can produce a toroidal electromagnetic flux around the circular hull of the spacecraft. As a consequence of the merger of these two fields, a spacetime curvature G_{zz} is produced over the hull of the spacecraft which creates a tension or lift force which enables the spacecraft to ascend, hover or descend.

14. An electrical system, comprised of a variable frequency generator and amplifier, an isolation transformer and voltage step-up transformer, drives a non-linear inductance which switches on and off the current in the output circuit in such a manner as to produce large voltage spikes through

magnetic vortex generator. The generator responds by producing two large negative mass spikes close to the centerline of the two coils.

15. The winding on each coil of the generator has a non-linear spacing to enhance the magnetic field and to reduce the interwinding coil capacitance.

16. The ratio of the radius of the small coil to that of the larger coil is 1/3, which is the magic ratio in physics. This creates a spring constant that is proportional to 8/9. The square of the cosine of the tetrahedral angle of 19.47° is equal to this ratio. Also the ratio of the area-to-volume ratio of the circumscribing sphere of a tetrahedron to the area-to-volume ratio of the tetrahedron is also 1/3. And the corners of the tetrahedron touch the circumscribing sphere at 19.47°. All the large volcanoes and vortices on Earth, Mars, Jupiter, Uranus and Neptune are located at this latitude. Thus this invention is more effective in developing a wormhole because it is tuned geometrically to the tetrahedral geometry of space.

* * * * *

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(54) FULL BODY TELEPORTATION SYSTEM

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(57) **ABSTRACT**

A pulsed gravitational wave wormhole generator system that teleports a human being through hyperspace from one location to another.

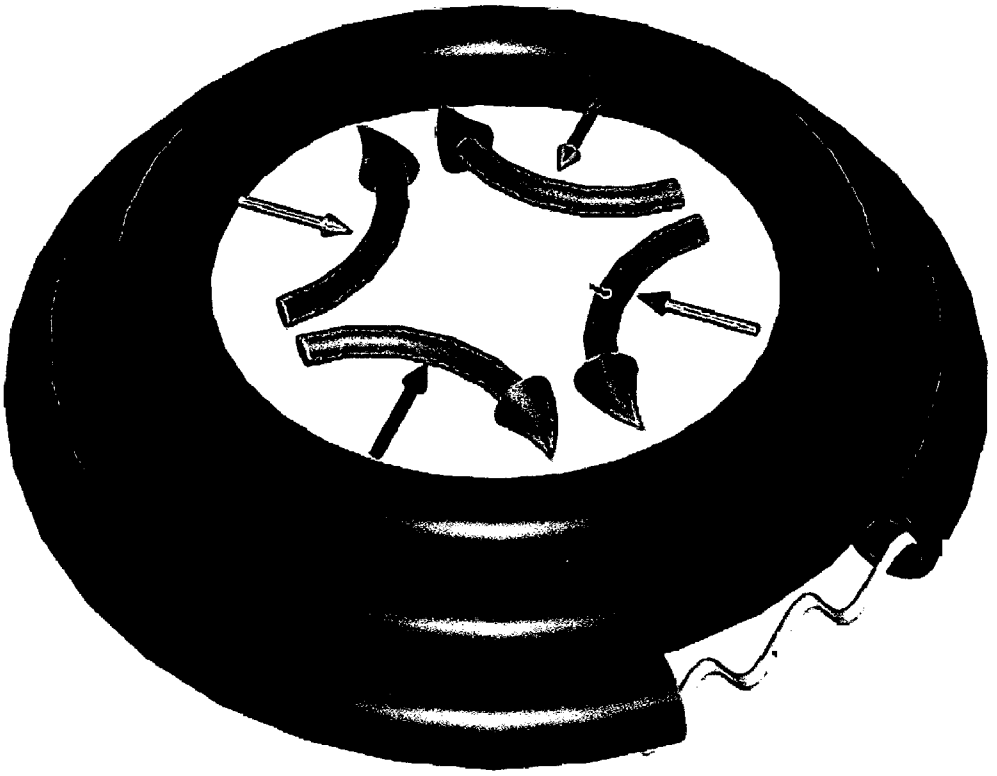

Figure 1

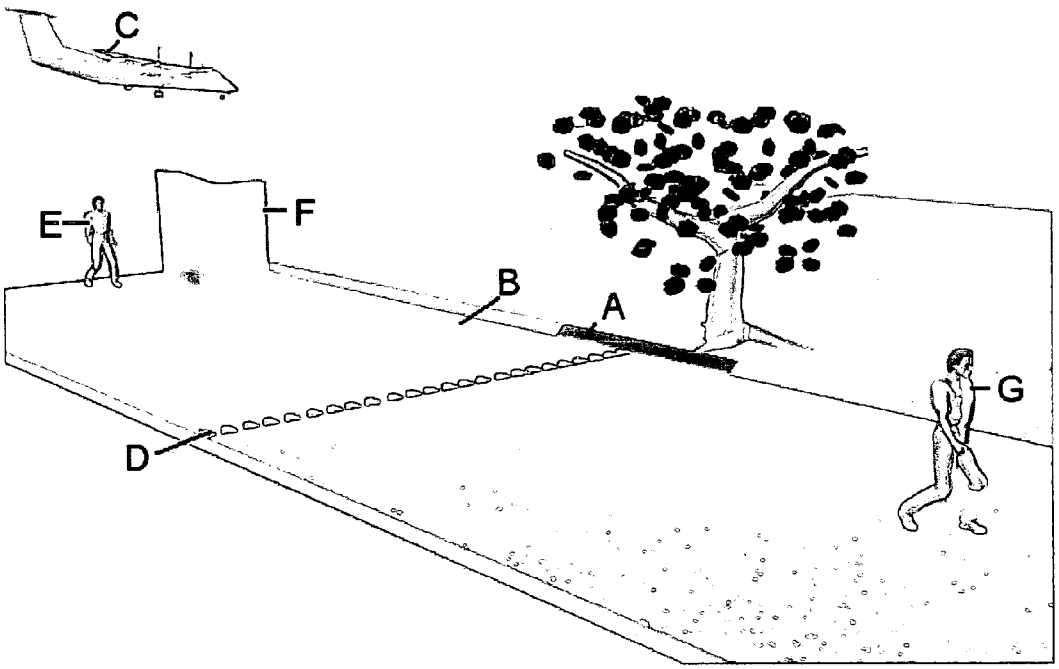

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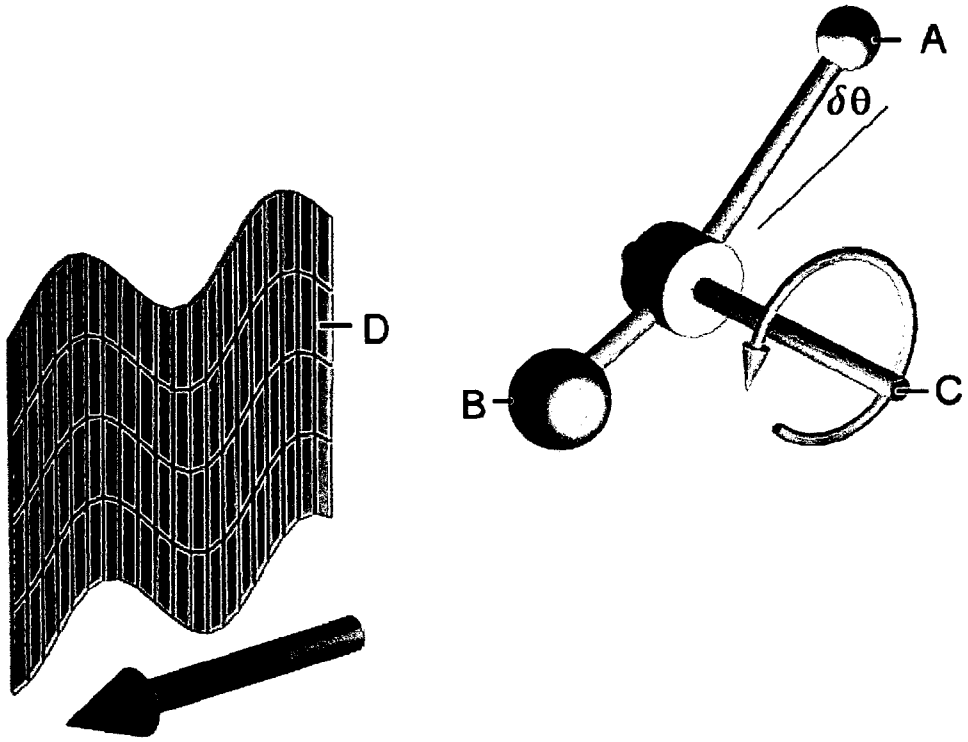

Figure 3

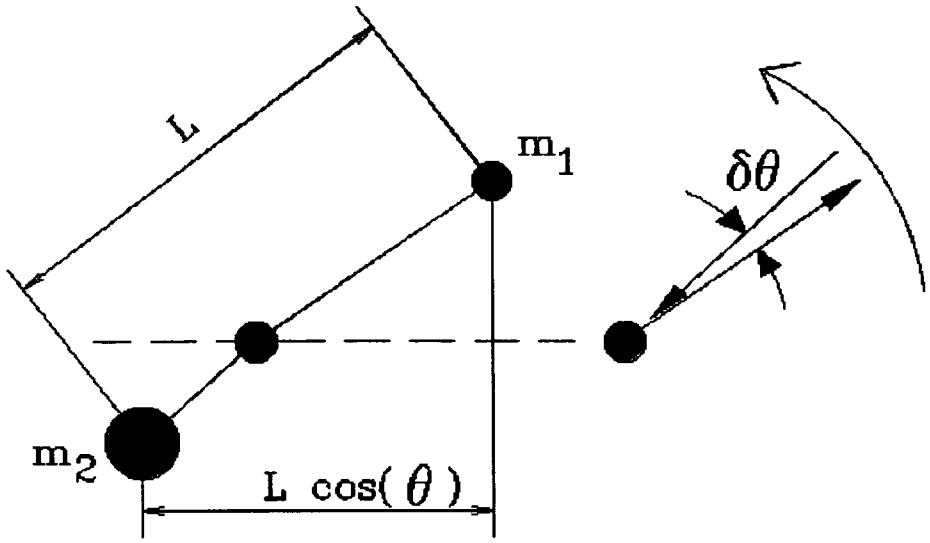

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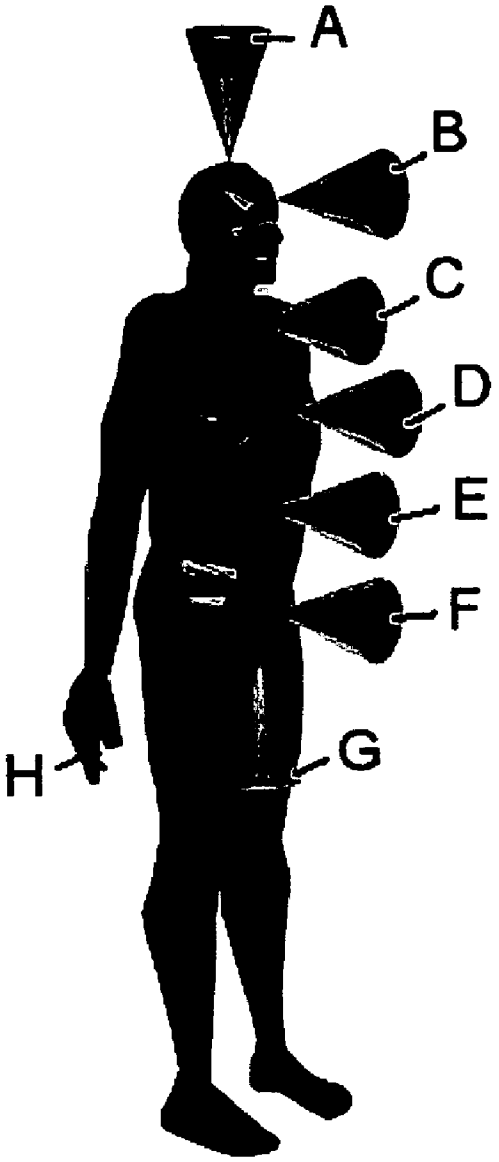

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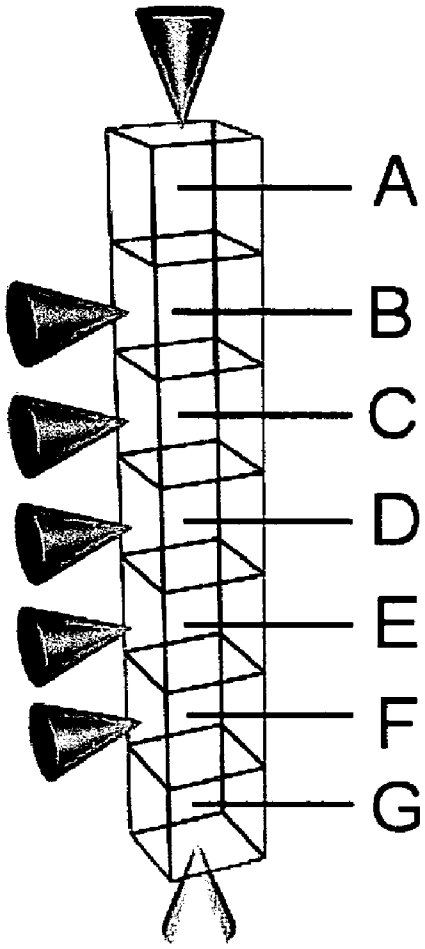

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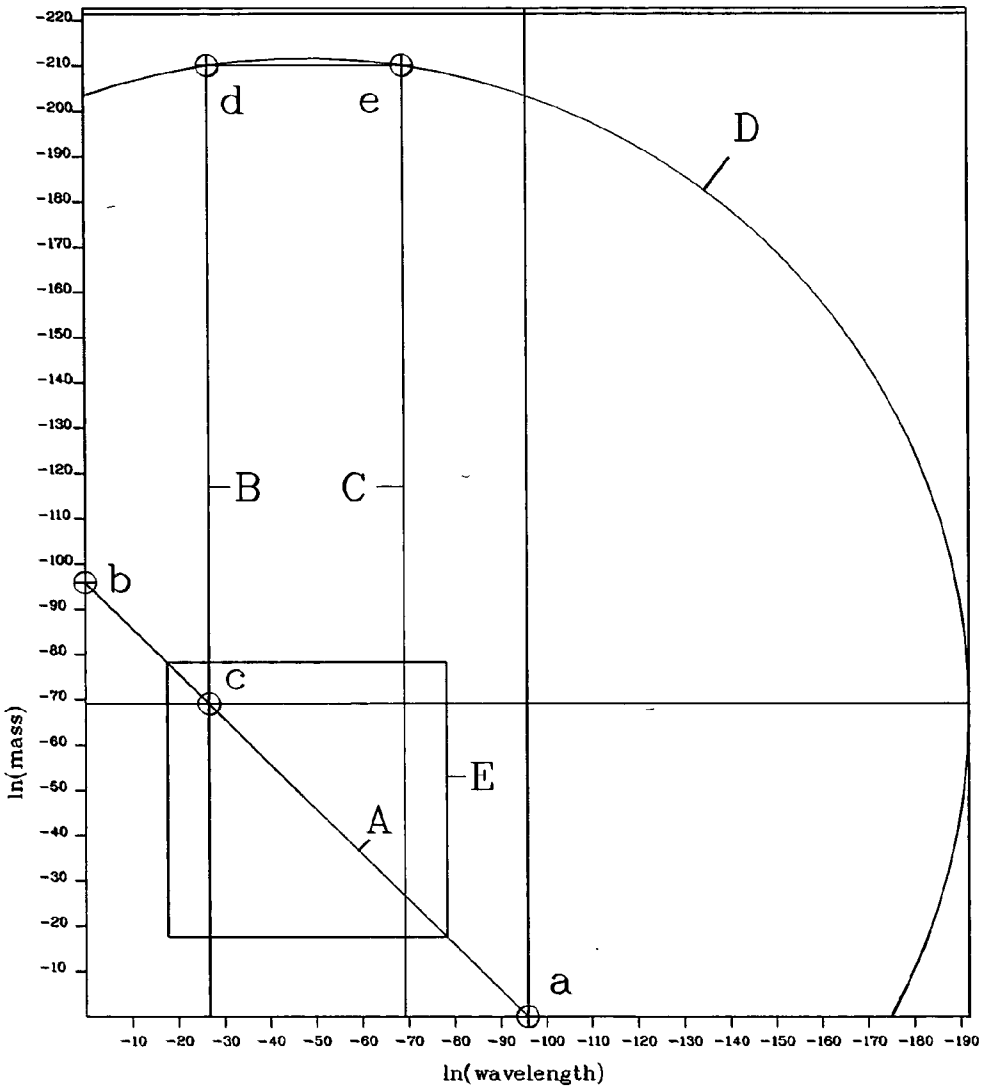
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Figure 7

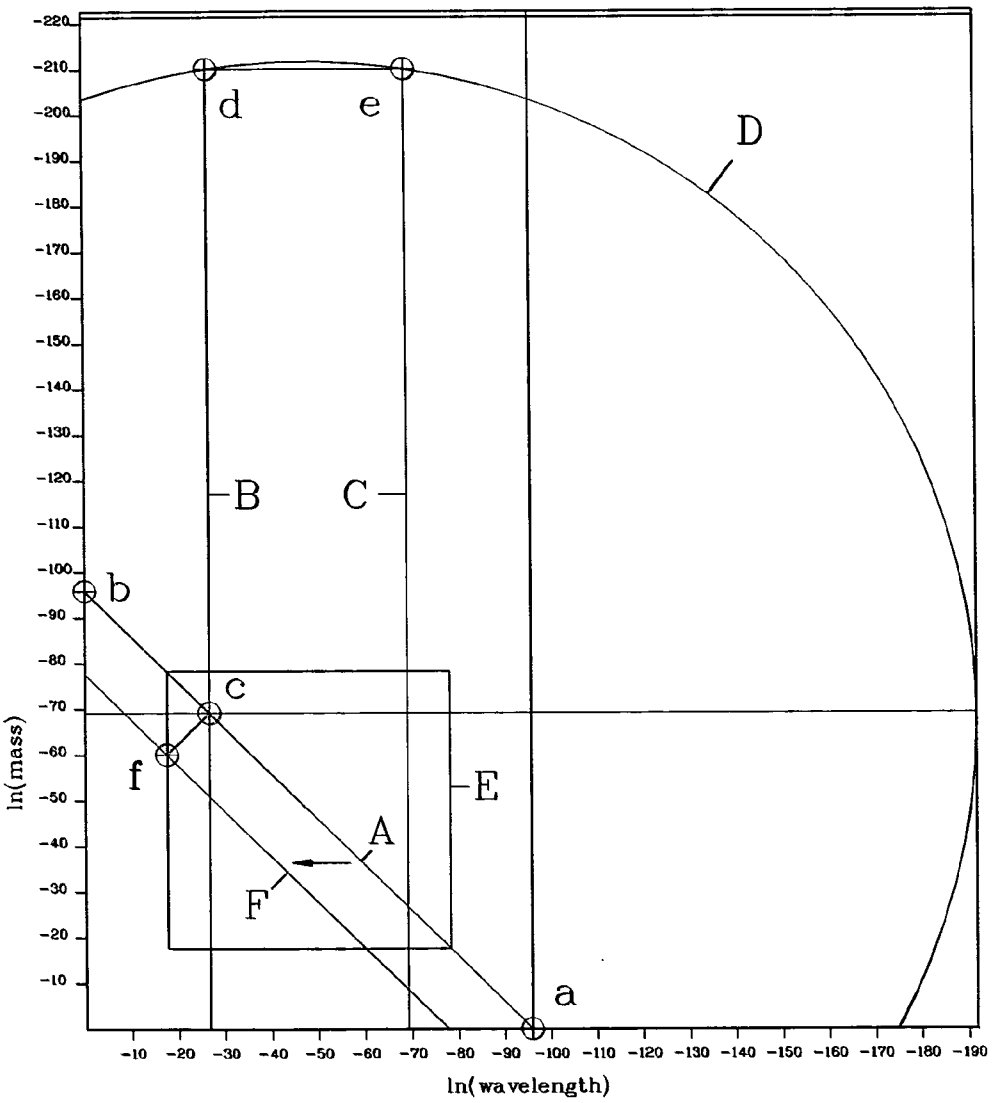
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Figure 8

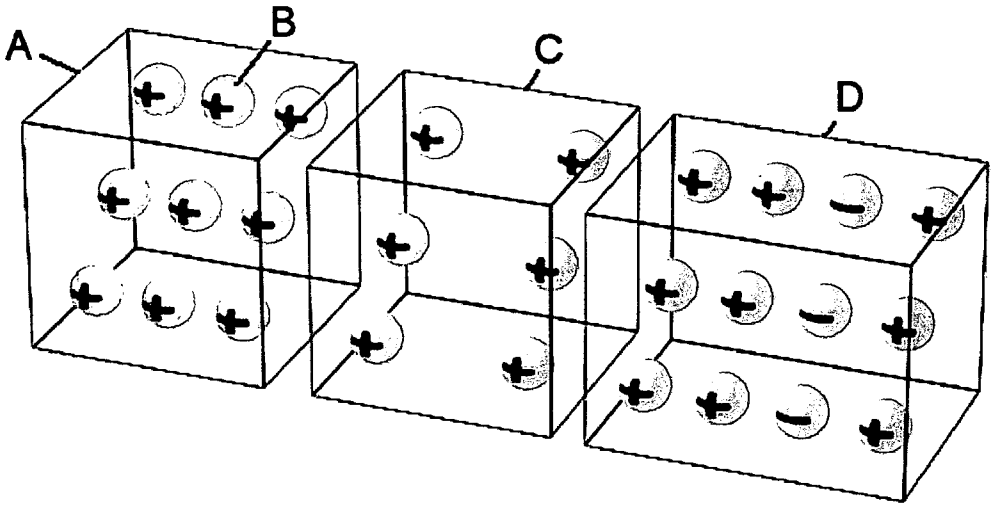

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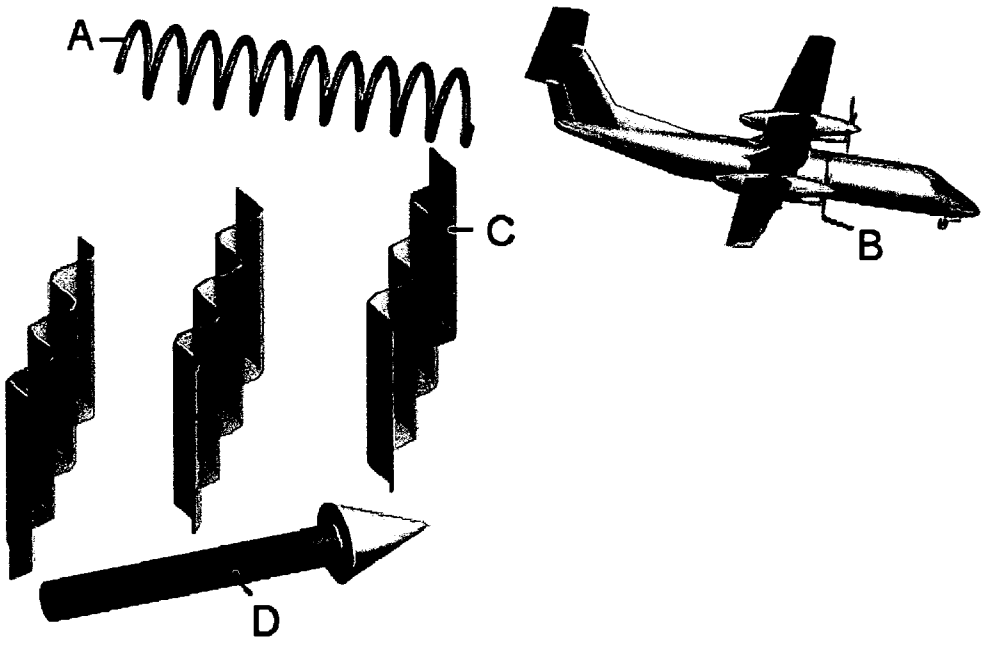

Figure 10

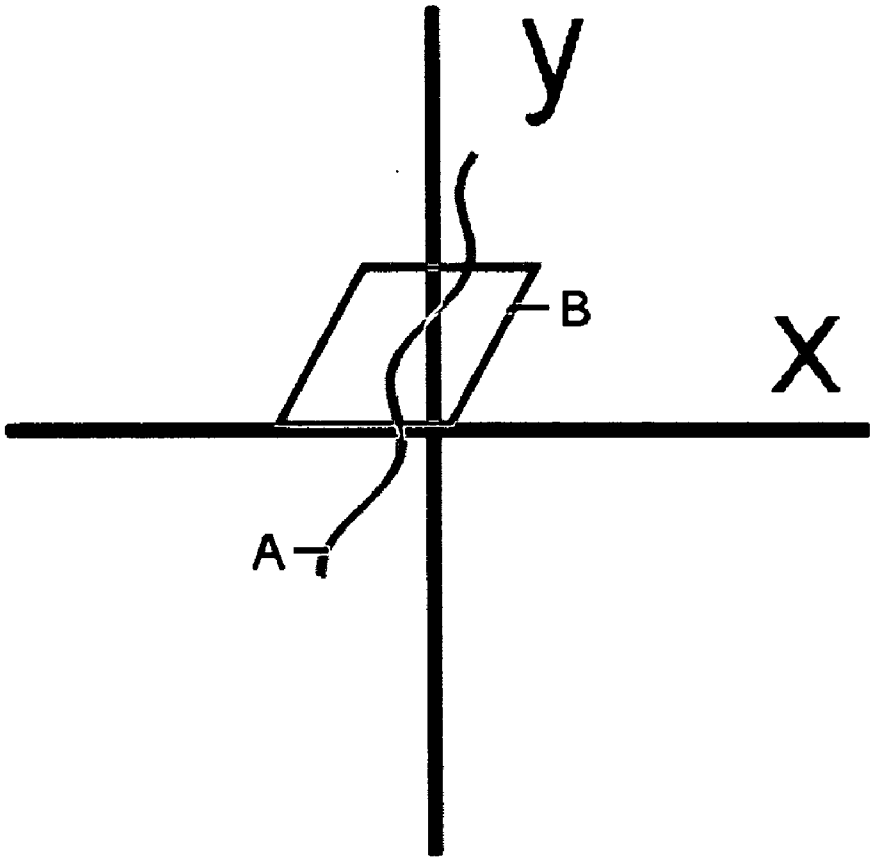

Figure 11

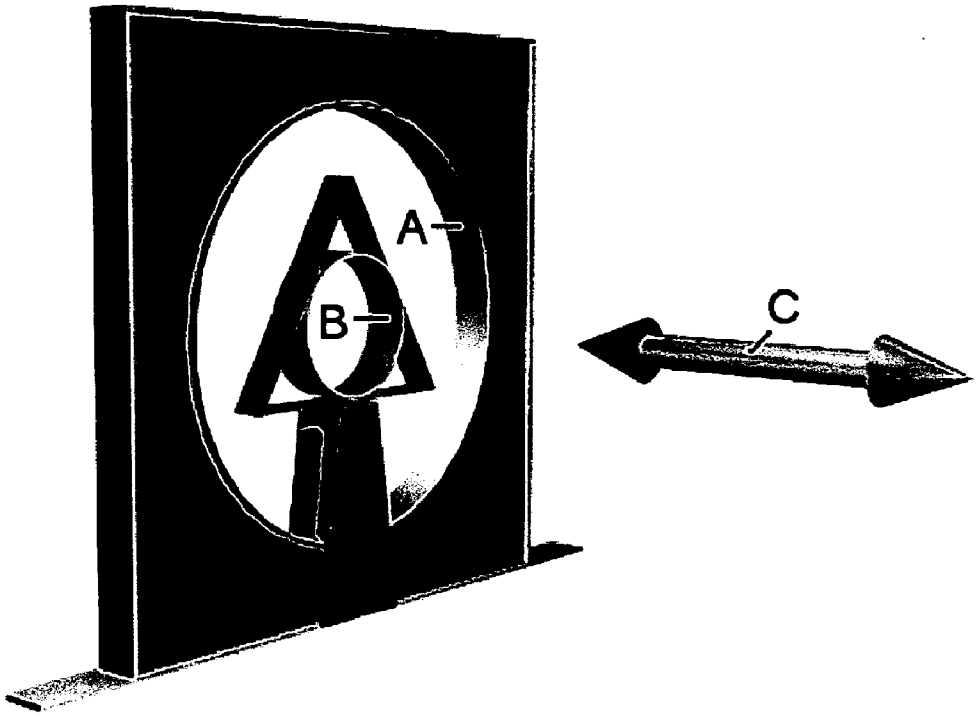

Figure 12

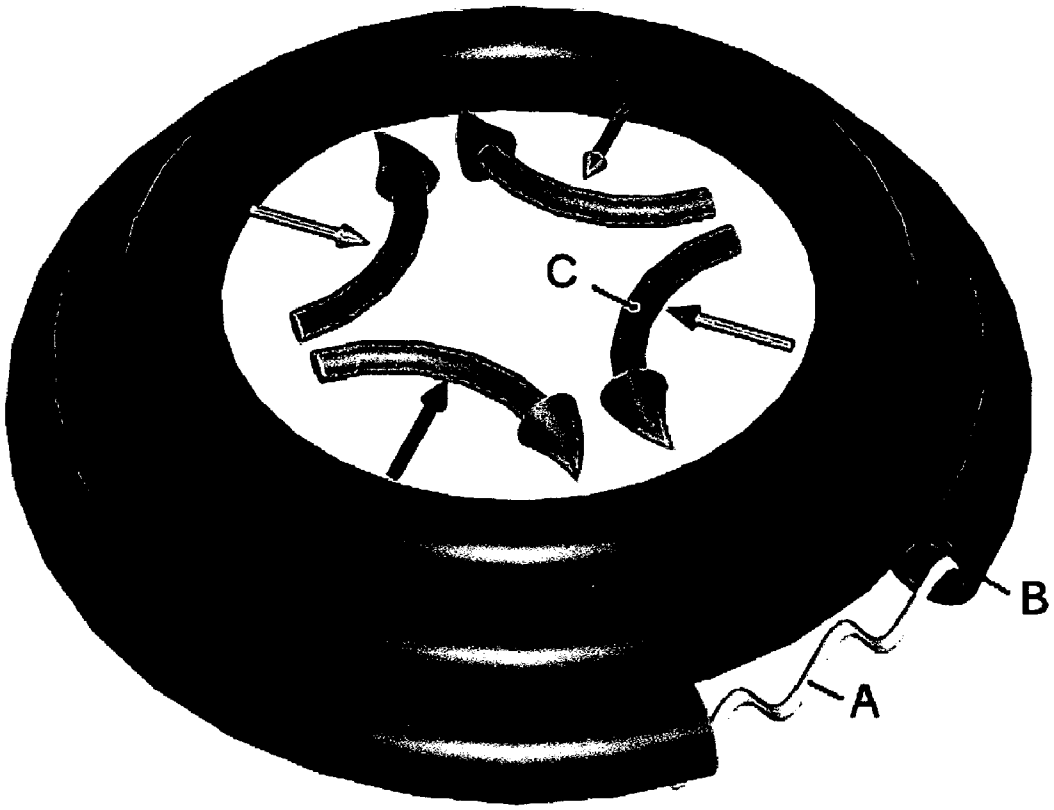

Figure 13

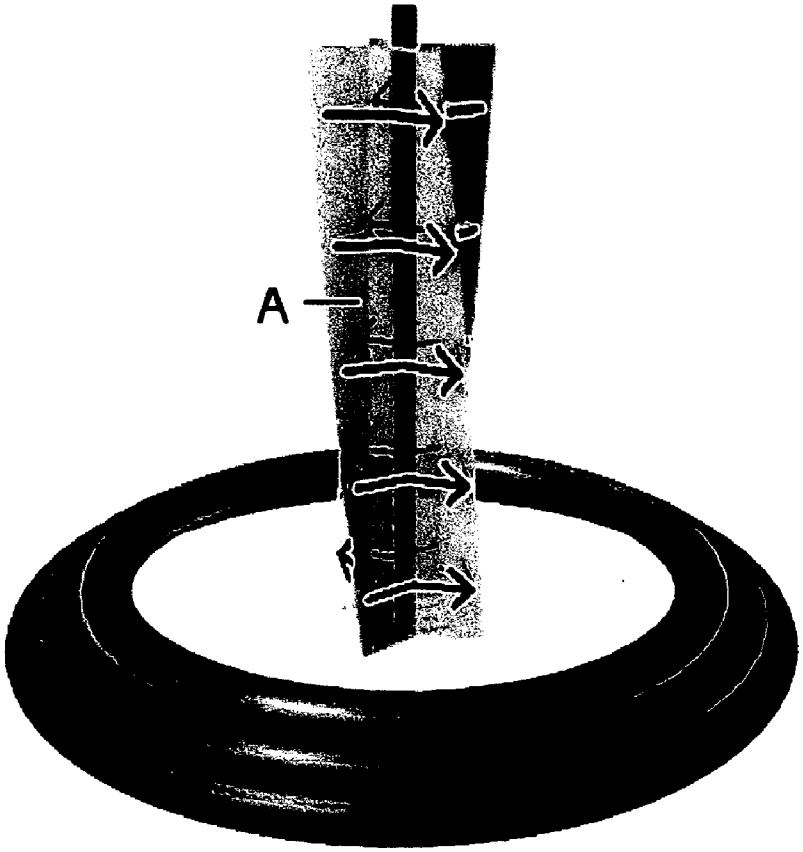

Figure 14

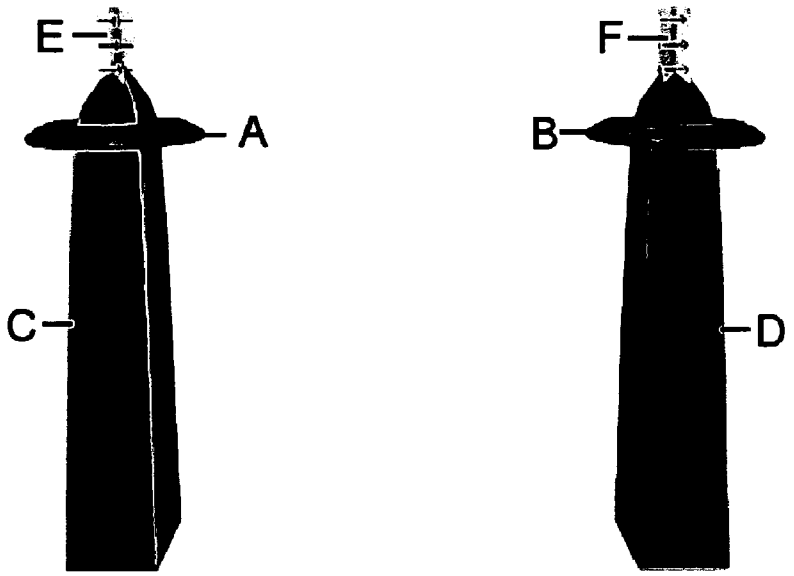

Figure 15

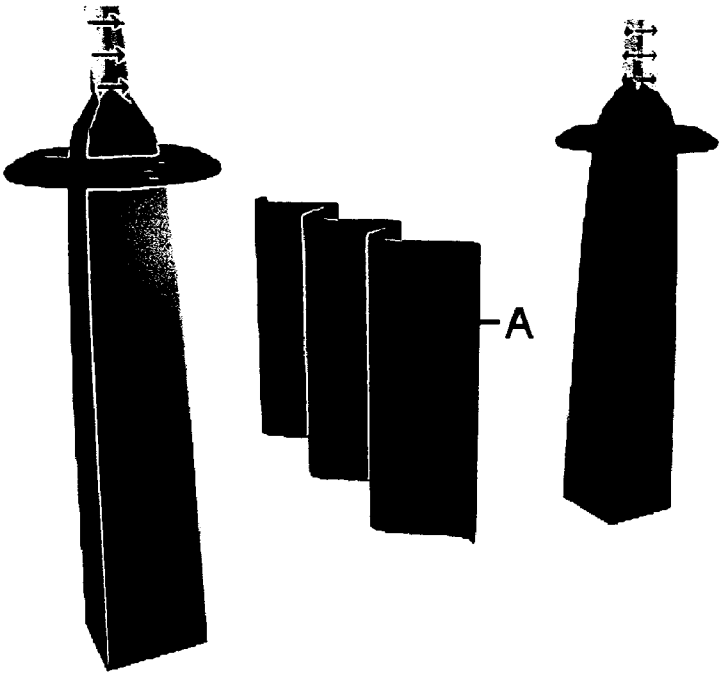

Figure 16

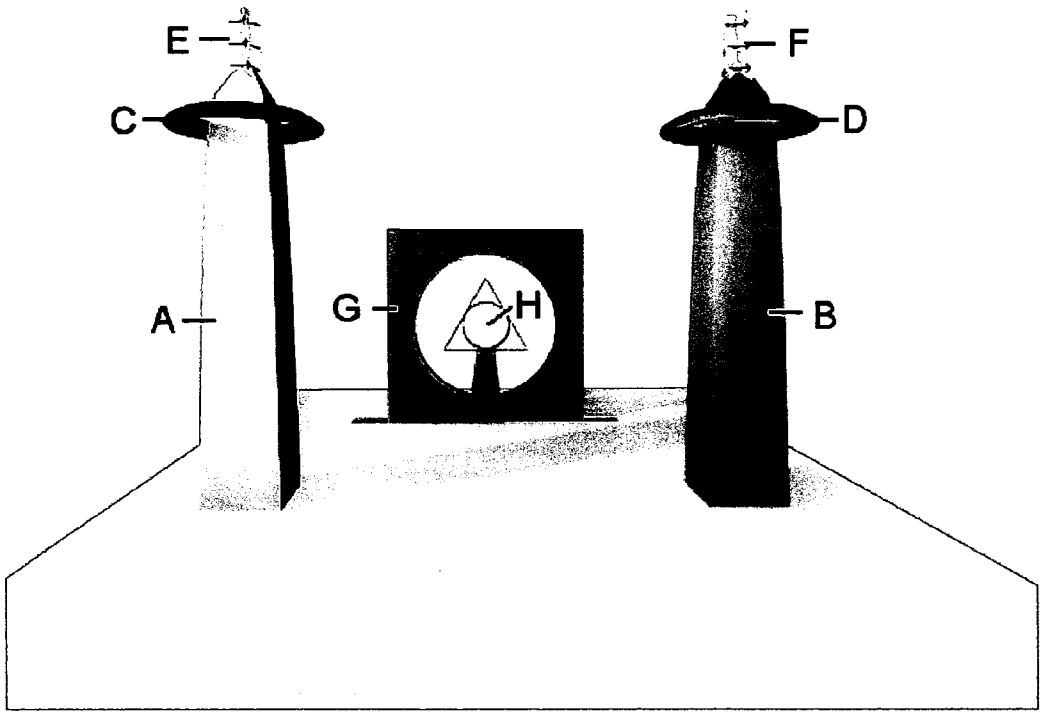

FULL BODY TELEPORTATION SYSTEM

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a system that teleports a human being through hyperspace from one location to another using a pulsed gravitational wave traveling through hyperspace.

BACKGROUND OF THE INVENTION

[0002] The basis for this invention is an event, referring to **FIG. 1**, occurring on May 2, 2004, in which the inventor ("he") personally experienced a full-body teleportation while walking to the bus stop (A) along a road (B) that runs perpendicular to the nearby commercial airport runways where planes are landing. There is a wide iron grating (D) for water drainage that crosses the road at the center of the bus stop. The grating width is such that one has to make a concerted effort to jump across it in order to get from one side to the other. Approximately 50 meters from the iron grating, he (E) felt a vertical wave (F), similar to a flag waving in the breeze, traveling down the street toward the bus stop. The wave velocity was about 1 meter per second, which was slightly faster than his walking speed. In the next instance, he (G) found himself down the street near the corner of the next block. Realizing that he had passed the bus stop, he turned around to see the iron grating approximately 50 meters up the street in back of him. Because there was no recollection of having jumped across the iron grating nor of having passed the bus stop's yellow marker line, he realized that he had been teleported a distance of 100 meters while moving along with the traveling wave. It was obvious that the wave was pulsed because the front edge overtook the inventor, moved with him momentarily, and then the back edge of wave left him as it moved on down the street. While contemplating this sequence of events, he then looked up and saw in a span of a few seconds a twin-turboprop airplane (C) in the distance crossing above the road while making a shallow descent in order to land at the airport.

[0003] It took a number of days in order to understand this sequence of events. The explanation involves knowledge of a wide range of subjects such as gravitation physics, hyperspace physics, wormhole electromagnetic theory and experimentation, quantum physics, and the nature of the human energy field.

[0004] It is obvious from the above scenario that the airplane momentarily crossing perpendicular to the road generates the aforementioned pulse. Because the airplane has an engine on each wing, there are two propellers which conceivably are rotating out-of-phase with each other. That is, the blade of one propeller could be pointing up and the equivalent blade on the other engine could be pointing in a slightly different direction. Notice that the tip of the blade traces out a helix as the plane is landing.

[0005] In gravitation physics, referring to **FIG. 2**, it is known that two masses of mass m**1** and m**2** (A,B) attached by lever arms slightly offset by an angle δθ along the radial direction to the rotating shaft (C), will produce a gravitational wave (D) traveling perpendicular to the shaft. The mass and wave are referred to as the source and receptor respectively. Referring to a side view looking along the shaft **FIG. 3**, the product of the mass m times the angular acceleration a is a constant such that m**1***a***1** is equal to m**2***a***2**. The distance between the masses is length L, which makes an angle θ with the horizontal axis. The difference in time of travel to the receptor gives rise to a difference in phase δθ equal to the angular velocity ω of the rotating shaft times the length L times the cosine of the angle θ

$$\delta\theta=\omega L\cos(\theta)$$

[0006] At the receptor, the amplitude of the wave is equal to the mass times the acceleration times the phase difference divided by the radius r to the receptor

$$A=\frac{m_1a_1}{r}\delta\theta\approx\left(\frac{m\omega L\sin(\theta)}{r}\right)(\omega L\cos(\theta))=\frac{m\omega^2L^2\sin(2\theta)}{r}$$

Even though the turboprop airplane engines have a high rotational speed and a large separation distance between masses, the gravitational wave which is produced is small and not noticed. The problem is that the gravitational constant G in this dimension has such a small value equal to the speed of light c squared divided by the linear mass Ω of the universe

$$G=\frac{c^2}{\Omega}=\frac{(299792458\ \text{m/s})^2}{1.346812891\cdot10^{27}\ \text{kg/m}}=6.673200002\cdot10^{-11}\ \frac{\text{m}^3}{\text{kgs}^2}$$

[0007] On the other hand, a gravitational wave traveling in hyperspace would be magnified enormously due to the face that the linear mass is so small. The magnitude of the gravitational constant in hyperspace can be estimated in the following manner. At the beginning of the 20th century, a man's parents were dying of tuberculosis. With their permission, he placed them and their beds on weighing scales. When each one passed away, each scale registered a drop in mass equal to 0.071 kilograms. This is the mass of the hyperspace energy being which resides in the physical body. Because hyperspace is co-dimensional with our dimension, the energy being interpenetrates the body and controls its movement.

[0008] Referring to **FIG. 4**, a human being has seven vortices (A through G) which are aligned along the centerline of the body. Each vortex is actually a co-gravitational field K which causes a pendulum placed in the field to spin in circles. For this reason, the K field has units of inverse seconds similar to an angular velocity. The vortex transports energy from our dimension to the energy being located in hyperspace. The gravitational field g and the co-gravitational field K are equivalent gravitationally to the electric E field and the magnetic B field found in electromagnetism. The equivalent gravitational solution to an electromagnetic problem can be obtained by substituting the following gravitational constants for the electromagnetic constants

Electromagnetic	Gravitational
q (charge)	m (mass)
ρ (volume charge density)	ρ (volume mass density)
σ (surface charge density)	σ (surface mass density)
λ (line charge density)	λ (line mass density)
J (convection current density)	J (mass current density)

-continued

Electromagnetic	Gravitational
E (electric field)	g (gravitational field)
B (magnetic field)	K (co-gravitational field)
ϵ_0 (permittivity of space)	$-\frac{1}{4}\pi G$
μ_0 (permeability of space)	$-4\pi G/c^2$
$-\frac{1}{4}\pi\epsilon_0$ or $-\mu_0 c^2/4\pi$	G (gravitational constant)

[0009] Referring to **FIG. 5**, each vortex is connected through the pineal gland by light cords to a separate hyperspace quantum well having its own frequency and dimension. The reason for this separation is that the conical spiritual eye, attached to vortex B, has to have its own energy structure which is different from vortex (A) which is connected to the quantum energy field in which the mental processes are developed. Due to the high speed of light in our dimension, the quantum wells are the size appropriate to molecules and atoms. In hyperspace, where the speed of light is one meter per second, the quantum wells are huge and can be manipulated. This manipulation has shown that the quantum wells are in the shape of a cube about a meter on a side. This makes the whole structure about seven meters tall for a volume of seven cubic meters. Thus the mass density ρ of hyperspace is about

$$\rho_h = \frac{.071\ \text{kg}}{7\ \text{m}^3} = .01\ \frac{\text{kg}}{\text{m}^3}$$

which per unit area is the same value. Therefore the hyperspace gravitational constant is equal to

$$G_h = \frac{c^2}{\Omega_h} = \frac{\left(1\ \frac{\text{m}}{\text{s}}\right)^2}{.01\ \text{kg/m}} = 100\ \frac{\text{m}^3}{\text{kgs}^2}$$

The enormous magnification of the gravitational constant is therefore of the order of

$$\frac{G_h}{G} = \frac{100}{6.6732\cdot 10^{-11}} \approx 1.5\cdot 10^{12}$$

The question is how does this amplified gravitational wave created by the rotating propellers and turbines get into hyperspace from our dimension?

[0010] The answer comes from experiments done using the ancient Chinese form of breathing known as Chi Kung. Using this breathing technique, we have been able to levitate the human body over six feet in the air. The internal temperature of the stomach is around 200 degrees Fahrenheit. By simultaneously squeezing the diaphragm to bring hot air up through the lungs, and breathing through the nose to bring cold air down, rotating vortices are generated in the lung passages when these two air masses meet and twist around each other as depicted in the famous Yin-Yang diagram. Because the lung has variable diameter passages from the large diameter at the throat to the final small air sacs, there is a spectrum of rotating frequencies.

[0011] From quantum physics it is known that if there is a temperature fluctuation occurring among a group of harmonic oscillators in the environment, then Planck's reduced constant ħ is increased by the cotangent of the constant times the frequency ω of the oscillator divided by twice Boltzmann's constant k times the temperature T

$$\hbar = \hbar\coth\left(\frac{\hbar\omega_n}{2kT}\right)$$

[0012] The effect of increasing Planck's constant, referring to **FIG. 6**, can be seen in the tetrahedron diagram. This diagram, of which there are now over 4000, plots the natural logarithm of mass on the vertical axis versus the natural logarithm of wavelength on the horizontal axis. In terms of mathematics, it is a subspace logarithmic manifold which projects geometrically the physics constants into our **4**D spacetime dimension. That is, it is the geometry of the tetrahedron circumscribed by the sphere that determines the mass of the proton and electron. The mass of the electron times its wavelength is equal to the mass of the proton times its wavelength which in turn is equal to Planck's constant h divided by the speed of light c

$$m_e\lambda_e = m_p\lambda_p = \frac{h}{c}$$

Taking the natural logarithm of the above equation shows that the mass plus the wavelength is equal to what is termed the base constant

$$\ln(m_e) + \ln(\lambda_e) = \ln\left(\frac{h}{c}\right) = -95.91546344$$

which is represented in **FIG. 6** by the 45 degree line (A) from point (a) on the horizontal axis to the vertical axis at point (b). The electron is located at point (c) which is the intersection of the electron wavelength (B) with line (A). The electron wavelength (B) reflects off the sphere (D) at points (d) and (e) and returns along line (C) as the electron mass. As shown in tetrahedron diagram tet0565, stored in the Library of Congress, the clockwise path of the electron transitions into the counter-clockwise path of the proton showing that the electron and proton are one and the same particle. Because the electron and proton travel in opposite directions along the path, they have the same charge but of opposite sign.

[0013] Our dimension is represented by Planck box (E) which is bounded by the Planck mass and the Planck wavelength. The Planck mass is equal to the linear mass of the universe times the Planck length which is the bottom limit of our dimension. The Planck wavelength is 2π times the Planck length. Notice that the electron is located within the Planck box.

[0014] Referring to **FIG. 7**, if there is an increase in Planck's constant due to the temperature fluctuations among the harmonic oscillators, the 45 degree base line (A) moves to the left on the tetrahedron diagram as shown by line (F).

Because of the increase in the base constant, there is a corresponding increase in the electron mass and wavelength. The electron moves from point (c) to point (f) which places it at the edge of the Planck box (F) which is the boundary between space and hyperspace. At point (f), the electron is essentially no longer in our dimension.

[0015] Referring to **FIG. 8**, imagine a box (A) filled with nine electron oscillators (B). If Planck's constant is increased near the three oscillators in the middle, these electrons will leave this dimension. This leaves six oscillators as shown in the box (C). However, box (C) is the equivalent of box (D) in which there are still nine positive mass oscillators together with 3 negative mass oscillators. Thus there is an accumulation of negative energy ($-\rho$) when information is lost from the environment to another dimension.

[0016] Dr. Kip Thorne, who co-authored the book *Gravitation* with Dr. Archibald Wheeler of Princeton University, has shown in a General Relativity spacetime curvature calculation that negative energy is required to open and stabilize the throat of a wormhole between space and hyperspace. The accumulation of negative energy in the aforementioned example generates wormholes between into hyperspace. Hyperspace has a low energy density because of the reduced speed of light in that dimension. Ordinarily, energy would not flow from hyperspace to space because space has a higher potential than the potential of hyperspace. This, of course, is the reason that the body vortices can flow energy into the energy field of the human being who is located in hyperspace. By creating negative energy, the potential becomes reversed such that low density hyperspace energy flows into our dimension as seen by the positive head

$$PE=\rho_{hyperspace}-(-\rho_{space})=+2\rho$$

The low-density energy fills the body which allows a human being to float upwards like a helium balloon as verified by Chi Kung breathing as well as spinning on a motorized platform known as the Chakra Vortex Accelerator. The latter device resulted in the first mechanical means to produce anti-gravity.

[0017] The process of creating spinning thermal fluctuations is the same as found in the hot air vortices created by the jet airplanes landing at the airport near the road where the full-body teleportation occurred. Large vortices are created over the wing of the airplane at the same time that the turbine engines are spinning hot vortices into relatively cold air. These conditions produce wormholes between space and hyperspace. It takes a twin turboprop airplane landing behind the jet to generate the gravitational wave in the region where the wormholes have formed. The gravitational wave then traverses the wormholes into hyperspace, becoming highly amplified due to the change in linear mass and speed of light. Because the propeller blades are co-linear with the road, the gravitational wave travels in the direction along the road where it was encountered by the inventor.

[0018] From experiments with cavitating bubbles (see patent application Cavitating Oil Hyperspace Energy Generator), it was found that it is possible to produce a wormhole if the surfaces of the bubble collapse asymmetrically. A symmetric collapse of a spherical bubble produces enormous spacetime curvature distortions. An asymmetric collapse, using a magnetic field to distort the collapse, produces, in addition to the same severe spacetime distortions, negative energy as the bubble collapses. Due to some General Relativity considerations, the wormhole that is created starts rotating in a manner similar to the beacon light produced by a lighthouse.

[0019] Referring to **FIG. 9**, due to the forward helical motion (A) of the propellers (B) as the airplane crosses the road, the pulsed gravitational wave (C) is skewed backward at an angle (D). Due to the wormholes created by the presence of thermal vorticity fluctuations generated by the wing and turbines of the airplane, this skewed wave moves into hyperspace where it is highly magnified and detected by the inventor.

[0020] Referring to top view **FIG. 10**, the gravitational wave (A) causes a skewed compression and expansion of the hyperspace quantum wells (B) which constitute the human energy being. Due to this asymmetric distortion in the xy-plane, the quantum wells take the physical body out of dimension as long as the wave pulse is traveling with the human energy field. Once the back edge of the gravitational wave moves on past the quantum wells, the body is then brought back into dimension.

SUMMARY OF THE INVENTION

[0021] It is the object of this invention to teleport a human being from one location to another by creating a pulsed gravitational wave traveling through hyperspace that asymmetrically compresses and expands the quantum wells of the human energy being. This spacetime curvature distortion of the hyperspace quantum wells pulls the physical body out of dimension such that the human being is teleported along with the wave. As the pulsed wave moves on past the quantum wells, the human is brought back into dimension at some distant location. The invention requires (1) a device that will generate a wormhole between space and hyperspace, and (2) a device that will generate a gravitational wave which can be inserted through the wormhole.

[0022] Referring to **FIG. 11**, a magnetic vortex wormhole generator has already been developed which generates a wormhole between space and hyperspace as described in a previous patent application entitled Magnetic Vortex Wormhole Generator. Using this generator, it was found that smoke blown through one side of the coil does not appear on the other side of cylindrical coil. The smoke flows through the wormhole and appears in a hyperspace co-dimension. It was this experiment that resulted in making first contact with the androids of the Grey aliens who told me, in a remote viewing session, that "We saw you blowing smoke into hyperspace."

[0023] The wormhole generator consists of two concentric cylindrical coils (A,B), one of larger radius than the other, made of thin transformer iron laminate wrapped in opposite directions with one continuous wire driven by a sinusoidal current. The solenoidal coil generates a magnetic field through the laminate. Because the electrical current flows in opposite directions at different radii through the two windings, bucking electric fields (C) are created along the centerline of the generator. These radially-offset magnetic fields and bucking electric fields, as shown by a calculation using Einstein's General Theory of Relativity, generate both an enormous spiking spacetime curvature and negative energy

at small radius along the centerline where the wormhole is formed. The gravitational wave generator is then coupled to this wormhole generator.

[0024] Referring to **FIG. 12**, it is known from gravitation physics that injecting an electromagnetic wave (A) into a hollow toroidal waveguide (B) produces a hyperbolic spacetime curvature stress (C) in the plane of the waveguide. The tips of the arrows indicate compression and the tail of the arrows indicate expansion or stretching of spacetime. The reason for this spacetime curvature is because the waveguide forces the electromagnetic wave to curve around and travel in a circle. Spacetime has to compensate for this toroidal-generated stress by creating hyperbolic lines of stress in the inner plane of the toroid so that the overall spacetime curvature is zero. For a greater gravitational effect, three toroidal waveguides, phased 120 degrees apart, are used to seal off the curvature.

[0025] Referring to **FIG. 13**, the three toroids create a rotating, twisting, vertical propagating gravitational field (A) through the centerline of the toroids provided that the period of the electromagnetic wave is twice the period of the gravitational wave. This phase relationship is adjusted by selecting the correct radius for the frequency of the monochromatic wave.

[0026] In order to effectively use this gravitational wave, referring to **FIG. 14**, three phased toroidal waveguides (A,B) are mounted at the top of each of two identical square granite obelisks (C,D). The two obelisks are offset by a short distance between them. As the vertical gravitational wave rotates around along the vertical axis inside the obelisk, the edges of the square obelisks are compressed and expanded such as to create two cylindrical asymmetric gravitational waves traveling radially outward.

[0027] Referring to **FIG. 15**, these waves meet to form a plane gravitational wave (A) which travels down the centerline between the two obelisks.

[0028] Referring to **FIG. 16**, the full body teleportation system consists of the twin granite obelisks (A,B) on which are mounted near the top of each the toroidal waveguides (C,D) which produce the pulsed gravitational waves (E,F) that run the length of the obelisks. Because the gravitational wave is rotating inside the obelisk, the granite stone undergoes a very small asymmetrical compression and expansion. A cylindrical gravitational wave propagates out from each obelisk such that along the centerline between the two there is generated a plane gravitational wave. This wave enters the wormhole (H) created by the magnetic vortex generator which is located a short distance from and parallel to the obelisks. The wave is amplified by a factor of almost 10^{13} when it enters the hyperspace co-dimension.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0029] **FIG. 1**. Perspective view of site where full-body teleportation occurred.

[0030] **FIG. 2**. Perspective view of gravitational wave generator.

[0031] **FIG. 3**. Planar view of gravitational wave generator.

[0032] **FIG. 4**. Perspective view of seven vortices of human energy being.

[0033] **FIG. 5**. Perspective view of seven large quantum wells of human energy being.

[0034] **FIG. 6**. Tetrahedron diagram showing Planck's constant and electron.

[0035] **FIG. 7**. Tetrahedron diagram showing electron moving out of dimension.

[0036] **FIG. 8**. Perspective view showing production of negative energy.

[0037] **FIG. 9**. Perspective view of skewed gravitational wave produced by propellers.

[0038] **FIG. 10**. Planar view of skewed quantum wells deformed by gravitational wave.

[0039] **FIG. 11**. Perspective view of magnetic vortex wormhole generator.

[0040] **FIG. 12**. Perspective view of hyperbolic lines of stress generated by toroidal waveguide.

[0041] **FIG. 13**. Perspective view of rotating, twisting, propagating gravitational wave generated by toroidal waveguides.

[0042] **FIG. 14**. Perspective view of toroidal waveguides attached to obelisks.

[0043] **FIG. 15**. Perspective view of gravitational wave generated by obelisks.

[0044] **FIG. 16**. Perspective view of magnetic vortex wormhole generator and obelisk gravitational wave generator.

DETAILED DESCRIPTION OF THE INVENTION

[0045] 1. The obelisks are quarried out of granite stone and cut with a large-diameter diamond saw that is used in highway construction. The beveled piece at the top is cut separately and cemented in place. A tapered aluminum bracket holds the toroids in place.

[0046] 2. The electronics for the magnetic vortex generator are similar to that used in the patent application Magnetic Vortex Wormhole Generator.

[0047] 3. The electronics for the toroidal waveguides is the familiar stub and coaxial cable driven by an amplifier and pulsed variable-frequency generator.

I claim:

1. A full body teleportation system consisting of:

generating a pulsed gravitational wave which propagates through a magnetic vortex wormhole generator; and

generating a wormhole with the magnetic vortex generator whereby the pulsed gravitational wave traverses through the wormhole and enters into hyperspace where the wave is enormously magnified due to the lower speed of light in that dimension.

2. The method of claim 1, wherein the step of generating the pulsed gravitational wave comprises:

using two granite stone obelisks;

mounting monochromatic-wave toroidal waveguides on top of each obelisk to create a rotating, twisting, propagating gravitational wave through the vertical axis of each obelisk; and

creating a cylindrical compression and expansion in each obelisk to produce a plane gravitational wave traveling down the centerline between the two obelisks.

3. The method of claim 1, wherein the step of generating a wormhole into hyperspace comprises:

using two concentric cylindrical solenoidal coils of different radii connected by a single wire wrapped in opposite directions on thin iron transformer laminate;

generating bucking electric fields down the centerline of the vortex generator which creates a spacetime curvature distortion with negative energy in accordance with Einstein's General Theory of Relativity.

4. A teleportation system comprising:

generating a gravitational wave traveling through hyperspace which interacts with the human energy being; and

pulling the human energy being and physical body out of dimension when interacting with the pulsed gravitational wave such that the person is teleported from one location to another through hyperspace and back again into our **4**D spacetime dimension.

* * * * *

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(54) TRIANGULAR SPACECRAFT

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(57) **ABSTRACT**

A spacecraft having a triangular hull with vertical electrostatic line charges on each corner that produce a horizontal electric field parallel to the sides of the hull. This field, interacting with a plane wave emitted by antennas on the side of the hull, generates a force per volume combining both lift and propulsion.

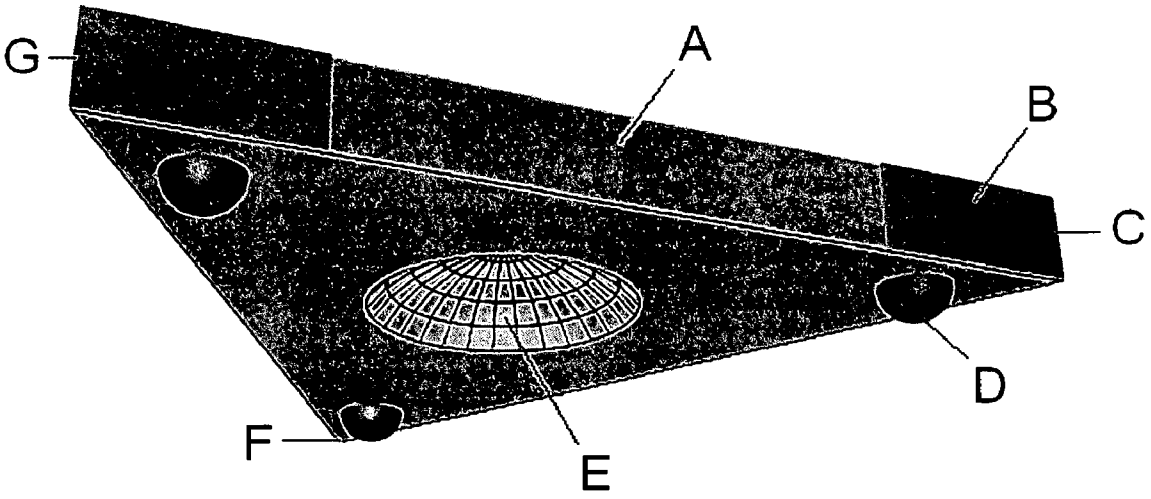

Figure 1

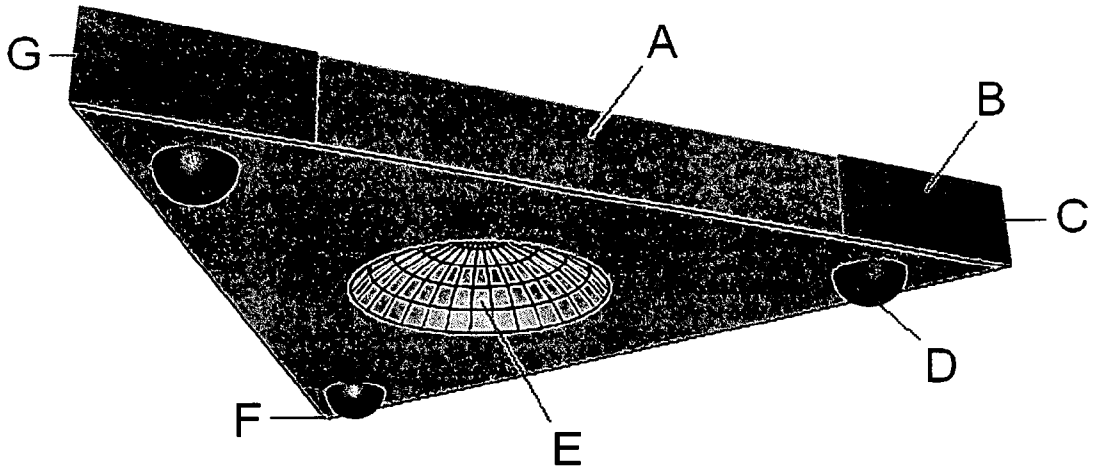

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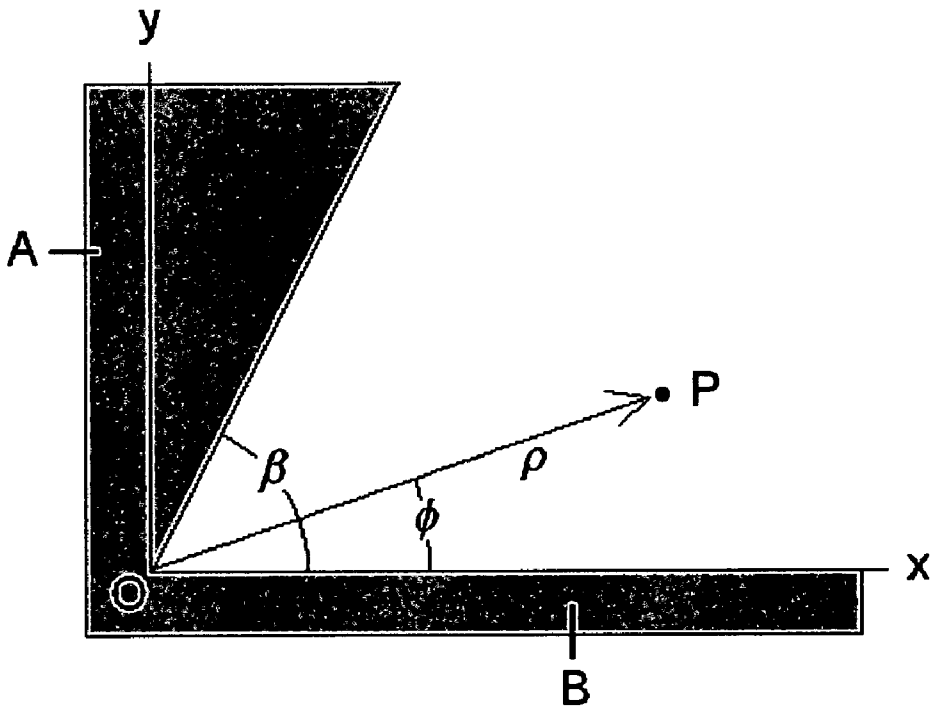

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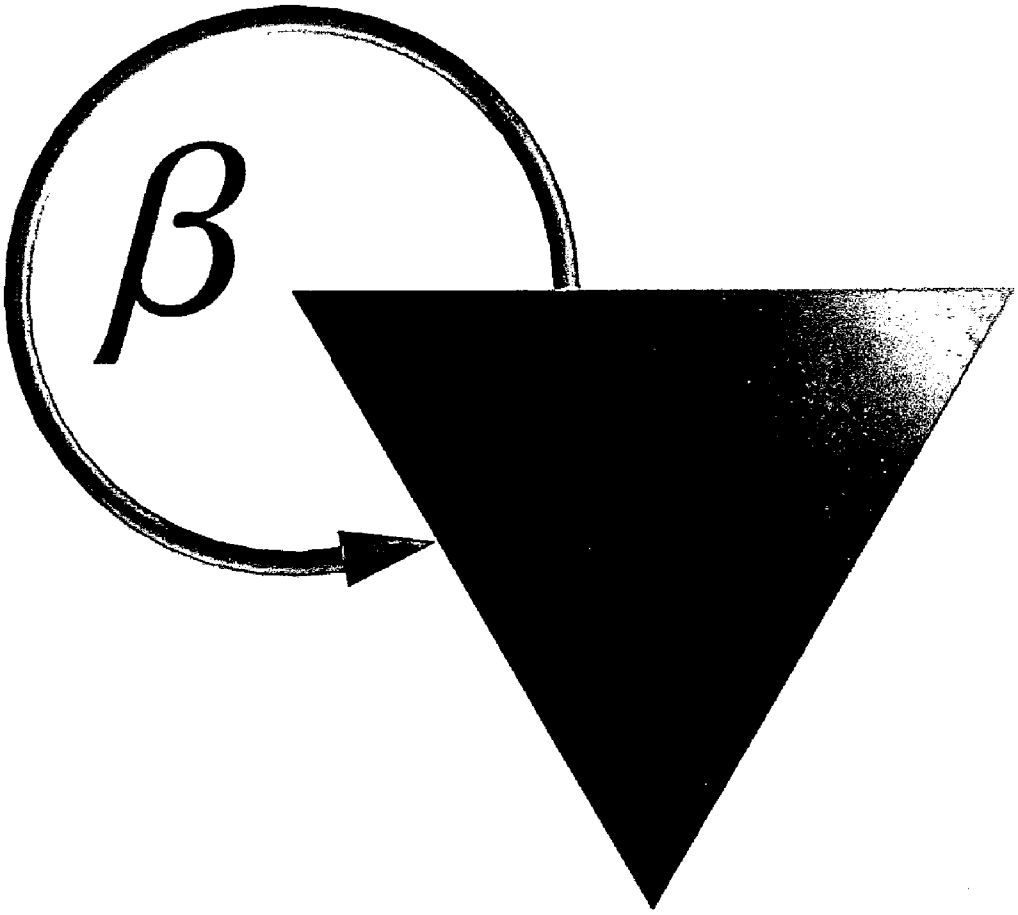

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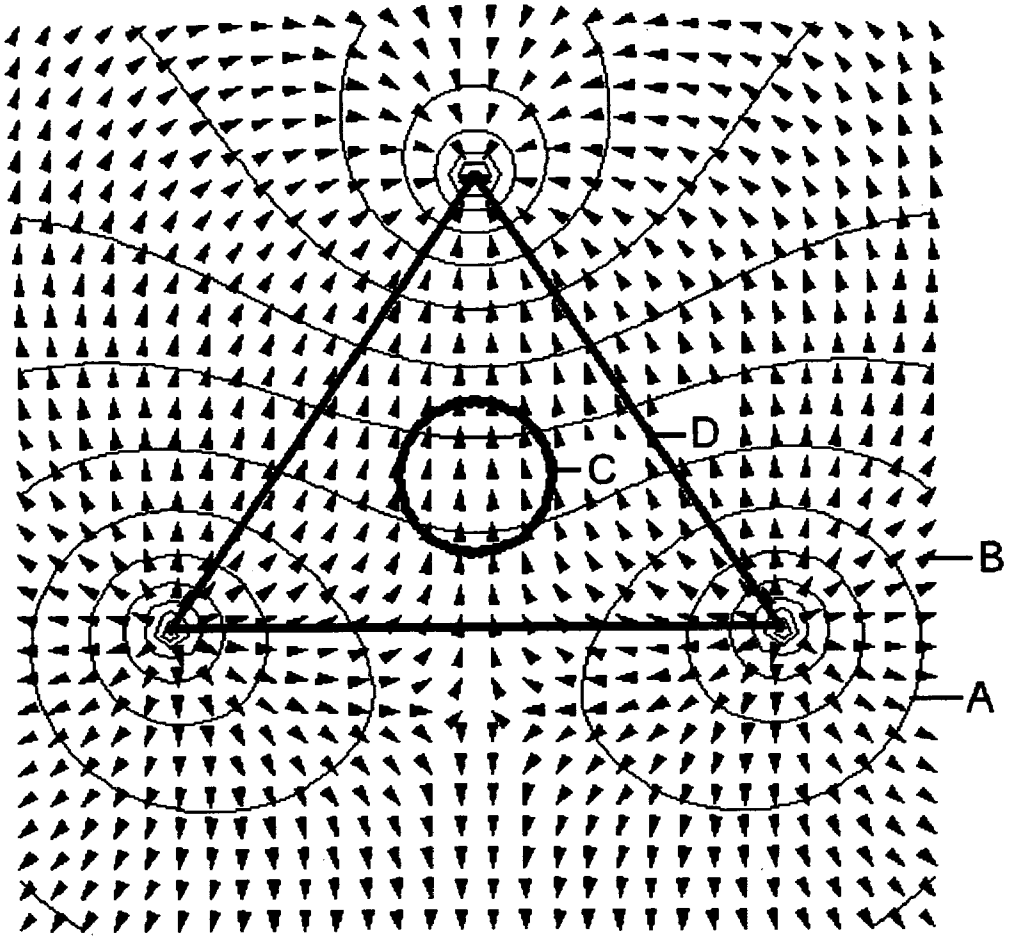

Figure 5

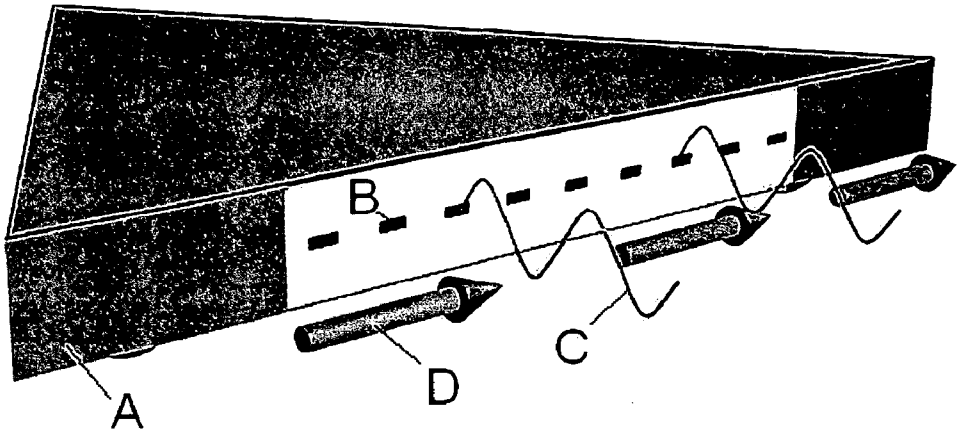

Figure 6

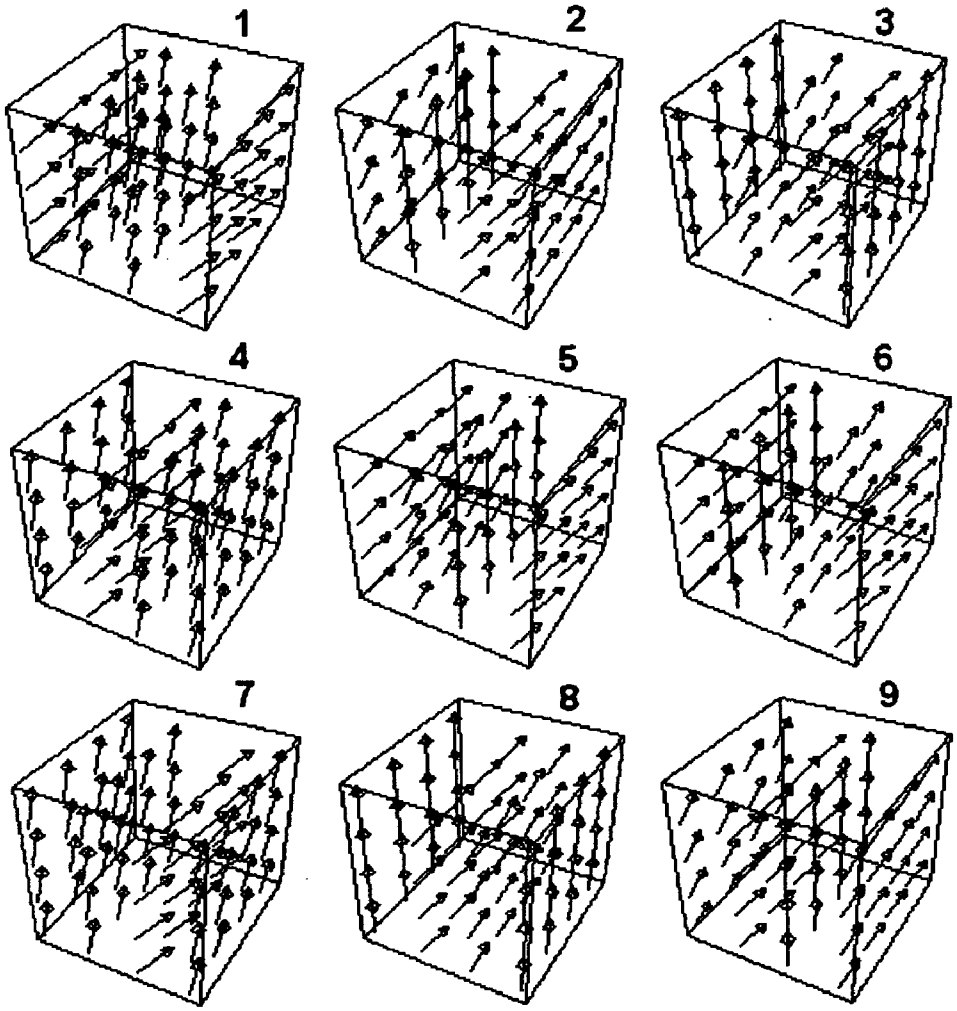

Figure 7

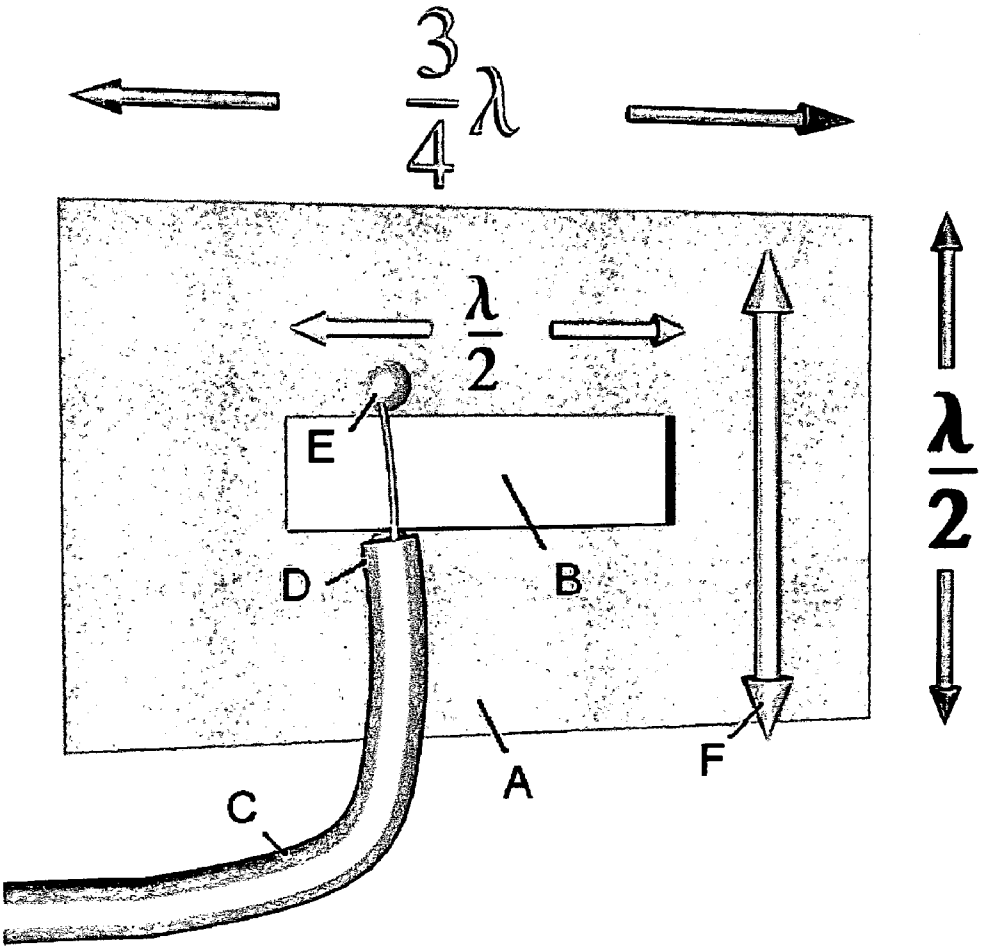

TRIANGULAR SPACECRAFT

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a spacecraft having a triangular hull with vertical electrostatic line charges on each corner. The line charges create a horizontal electric field that, together with a plane wave emitted by antennas on the side of the hull, generates a force per volume providing a unique combination of both lift and propulsion.

BACKGROUND OF THE INVENTION

[0002] Referring to **FIG. 1**, the spacecraft has a hull in the shape of an equilateral triangle. A parabolic antenna (E) is centrally located in the bottom of the hull. An array of horizontal slot antennas is located along the side of the hull (A). Each back corner (F,G) has a corner conducting plate which is charged to a positive voltage +V. The forward corner (C) has a conducting plate charged to a negative voltage −V. A motion control hemisphere (D) is located on the bottom surface in each of the three corners.

[0003] Referring to **FIG. 2**, two planes (A,B) intersect at the origin O at an opening angle β. Each plane (x,y) is charged to a voltage V. The potential at point P is determined in polar coordinates {ρφ}. The Laplace equation for the potential Φ in polar coordinates is given by:

$$\frac{1}{\rho}\frac{\partial}{\partial\rho}\left(\rho\frac{\partial\Phi}{\partial\rho}\right)+\frac{1}{\rho^2}\frac{\partial^2\Phi}{\partial\phi^2}=0$$

Using a separation of variables solution, the potential is given as the product of two functions:

$$\Phi(\rho,\phi)=R(\rho)\Psi(\phi)$$

which when substituted into the Laplace equation becomes:

$$\frac{\rho}{R}\frac{d}{d\rho}\left(\rho\frac{dR}{d\rho}\right)+\frac{1}{\Psi}\frac{d^2\Psi}{d\phi^2}=0$$

Since the two terns are separately functions of ρ and φ respectively, each one has to be constant with the sum of the constants equal to zero:

$$\frac{\rho}{R}\frac{d}{d\rho}\left(\rho\frac{dR}{d\rho}\right)=v^2 \quad \frac{1}{\Psi}\frac{d^2\Psi}{d\phi^2}=-v^2$$

These two equations have solutions:

$$R(\rho)=a\rho^{v+b\rho-v}$$

$$\psi(\phi)=A\cos(v\phi)+B\sin(v\phi)$$

The azimuthal angle φ is restricted to a value in the range $0\leqq\phi\leqq\beta$. The boundary condition is that the potential Φ is equal to V for any radius ρ when φ=0 and φ=β. This means that v has to be an integer value of π so that the sine function is zero:

$$\sin(v\beta)=\sin\left(\frac{m\pi}{\beta}\beta\right)=\sin(m\pi)=0 \quad m=1,2\ldots$$

which in turn means that the coefficient A of the cosine term has to be zero in the solution above. Choosing b=0 makes the general solution for the potential equal to:

$$\Phi(\rho,\phi)=V+\sum_{m=1}^{\infty}a_m\rho^{m\pi/\beta}\sin(m\pi\phi/\beta)$$

which shows that when the angle is zero, the sine is zero and the potential is V. If the angle is β, then there is a multiple of π such that the sine is zero again.

[0004] Because the series involves positive powers of the radius, for small enough ρ, only the first term m=1 in the series is important. Thus around ρ=0, the potential is approximately

$$\phi(\rho,\phi)\approx V+a_1\rho^{\pi/\beta}\sin(\pi\phi/\beta)$$

[0005] The electric field component is the negative gradient of the potential:

$$E_\phi(\rho,\phi)=-\frac{1}{\rho}\frac{\partial\Phi}{\partial\phi}=-\frac{\pi a_1}{\beta}\rho^{(\pi/\beta)-1}\cos(\pi\phi/\beta)$$

The surface charge distribution σ at φ=0 and φ=β is equal to the electric field perpendicular to the surface times the permittivity of space ϵ_0:

$$\sigma(\rho)=\varepsilon_0E_\phi(\rho,0)=-\frac{\varepsilon_0\pi a_1}{\beta}\rho^{\frac{\pi}{\beta}-1}$$

Notice that if angle of intersection β is less than π, then the equation says that there is a very small radius to a positive power which means little charge density accumulation.

[0006] Referring to **FIG. 3**, the value of β, in the case of the triangular hull, is equal to 360° less 60° for a total of 300° or:

$$\beta=\frac{300}{180}\pi=\frac{5}{3}\pi$$

$$\rho^{\frac{\pi}{\frac{5}{3}\pi}-1}=\frac{1}{\rho^{\frac{2}{5}}}$$

which says that there is a charge density singularity to the two fifths power for small radius. Thus, the corner plates on the hull create a huge line charge density along the sharp vertical corner edge. The equation for the potential of a line charge density is given as:

$$\Phi(x,y)=-\frac{\lambda}{2\pi\varepsilon_0}\mathrm{Ln}((x-x_0)^2+(y-y_0)^2)$$

where λ is the charge per unit length in the vertical z-direction, and x_0 and y_0 are the location of the line charge in the xy-plane.

[0007] Referring to **FIG. 4**, the triangular hull (D) is plotted together with the potential contours (A) and the electric field arrows (B) created by the three corner line charges. The line charges are perpendicular to the paper. Notice that the electric field arrows are parallel crossing the center parabolic antenna (C). The electric field is also parallel to the sides (D) of the triangle.

[0008] Referring to **FIG. 5**, along the side of the triangle (A), an array (B) of horizontal slot antennas emit electromagnetic waves that have a vertically polarized electric E field (C). These traveling waves interact with the electric field (D) produced by the line charges on the corners of the triangle.

[0009] Using differential forms mathematics, this combination of fields is represented by the Hodge star of the differential of the wedge product of the two fields. The antenna electromagnetic field is a combination of a traveling magnetic field B_w, and electric field E_w. The stationary field E created by the line charges is perpendicular to the traveling wave.

$$*d(E \wedge (B_w + E_w \wedge dt))\frac{\varepsilon}{c} = \frac{\text{force}}{\text{volume}}$$

where ϵ is the linear capacitance of space and c is the speed of light. Thus there is a force per volume around the hull.

[0010] This combination of fields produces a spacetime curvature as determined by Einstein's General Theory of Relativity. The traveling electric field has an amplitude in the vertical z-direction and travels in the x-direction

$$E_{w=Ez}\cos(x-t)$$

The Faraday electromagnetic tensor contains all the electric and magnetic fields in all the {x,y,z} directions. The first row and first column contain the two electric fields

$$F^{\alpha}_{\beta} = \begin{array}{c|cccc|} t & 0 & E_x & 0 & E_z\cos(x-t) \\ x & E_x & 0 & 0 & 0 \\ y & 0 & 0 & 0 & 0 \\ z & E_z\cos(x-t) & 0 & 0 & 0 \end{array}$$

The stress exerted on spacetime occurs in the xx, yy and zz-direction as calculated from the stress-energy tensor T of gravitational physics

$$4\pi T^{\mu\nu} = F^{\mu\alpha}F^{\mu}_{\alpha} - \frac{1}{4}g^{\mu\nu}F_{\alpha\beta}F^{\alpha\beta}$$

where g is the metric tensor for Cartesian space

$$g_{\alpha\beta} = \begin{array}{c|cccc|} t & -1 & 0 & 0 & 0 \\ x & 0 & 1 & 0 & 0 \\ y & 0 & 0 & 1 & 0 \\ z & 0 & 0 & 0 & 1 \end{array}$$

where the diagonal components are the coefficients of the elementary spacetime length ds squared

$$(ds)^2 = -(dt)^2 + (dx)^2 + (dy)^2 + (dz)^2$$

The calculation produces three stresses T^{xx},T^{yy} and T^{zz} in their respective {x,y,z} directions.

[0011] Referring to **FIG. 6**, these three stresses are plotted together as a 3D vector field animated over time in nine frames. The graphs show that there is a lift force as depicted by the vertical arrows as well as a force of propulsion as shown by the interspersed horizontal arrows. With the passage of time, these vectors exchange places with each other so that the lift becomes the propulsion and vice versa, creating a wavy stress-energy field around the hull.

SUMMARY OF THE INVENTION

[0012] This invention is a spacecraft with a triangular hull having charged flat plates on the vertical corners of the three sides. The two rear corners are charged to a potential V. The forward corner is charged to a potential −V. The 60° angle on the corner creates a line charge density singularity that produces a huge horizontal electric field pointing from the back to the front of the craft which is also parallel to the sides of the triangle. An array of horizontal slot antennas located on the sides of the triangular hull produce an electromagnetic wave with the electric field polarized in the vertical direction. This combination of fields produces a spacetime force in both the vertical and horizontal directions such that the spacecraft receives a lift force and a force of propulsion.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0013] **FIG. 1**. Perspective view of triangular spacecraft.

[0014] **FIG. 2**. Drawing of the intersection of two charged plates in order to calculate the charge density in the corner.

[0015] **FIG. 3**. Perspective view of the corner angle β for the equilateral triangle.

[0016] **FIG. 4**. Planar 2D graph showing the electric field produced by three line charges on the corners of the triangular hull.

[0017] **FIG. 5**. Perspective view of electric field produced by the linear charge interacting with the traveling electromagnetic wave produced by the slot antenna.

[0018] **FIG. 6**. 3D vector animation of the lift and thrust force generated by the fields.

[0019] **FIG. 7**. Perspective view of slot antenna.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Referring to **FIG. 7**, the antenna (A) is made out of sheet copper in which a rectangular horizontal slot (B) has been notched out using a die press and sheet metal fixture. A coaxial cable from the amplifier and frequency generator is attached across the slot by soldering the outer cable (D) to one side of the slot and the inner cable (E) to the other side of the slot. This creates the positive and negative charges across the gap which forms the vertical electric field (F) which radiates out perpendicularly to the copper sheet.

[0021] Although the invention has been described with reference to specific embodiments, such as a particular antenna system, those skilled in the art will appreciate that many modifications and variations are possible without departing from the teachings of the invention. All such modifications and variations are intended to be encompassed within the scope of the following claims.

1. A spacecraft comprised of the following components:

(a) a triangular hull in the form of an equilateral triangle;

(b) two copper plates attached on opposite vertical sides at each of the three corners of the hull (**1***a*) such that a sharp vertical edge is formed where they come together;

(c) an electrostatic generator used to charge the back two copper-cladded corners (**1***b*) to a high positive voltage, and the third forward copper-cladded corner to a high negative voltage;

(d) a horizontal slot antenna array mounted-on the sides of the hull; and

(e) a frequency generator, antenna and coaxial cables to drive the antenna array (**1***d*).

2. To create, by claims (**1***a*, **1***b*, **1***c*), an intense vertical line charge at the corners (**1***b*) and a horizontal electric field that that is parallel to the sides of the hull (**1***a*);

3. To create, by claims (**1***d*,**1***e*), an electromagnetic wave with a vertically polarized electric field traveling outward from the side of the hull (**1***a*); and

4. To create, by claims (**2**,**3**), an interaction of the electrostatic field (**2**) with the electromagnetic wave (**3**) such that a combined spacetime curvature pressure is generated on the hull in the upward and forward direction to produce lift and propulsion respectively.

* * * * *

March 25, 1969 W. C. BROWN ET AL 3,434,678

MICROWAVE TO DC CONVERTER

Filed May 5, 1965

Sheet 1 of 3

FIG. 1

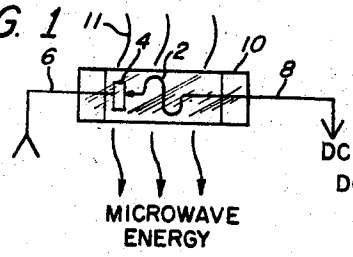

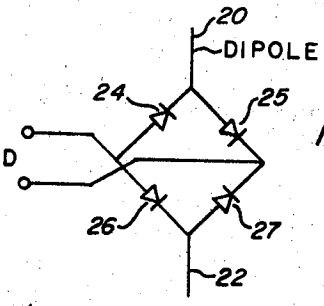

FIG. 2

FIG. 3

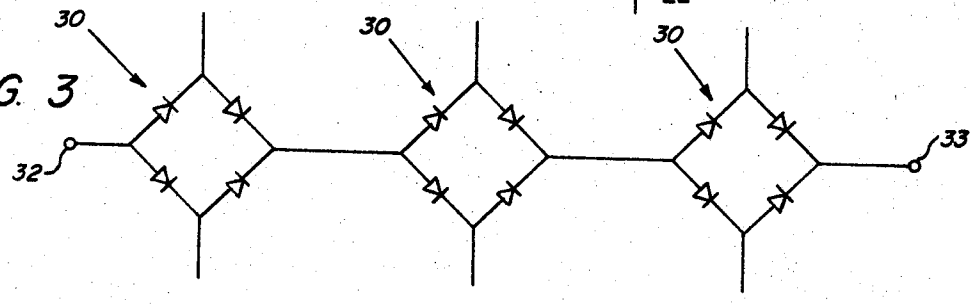

FIG. 4

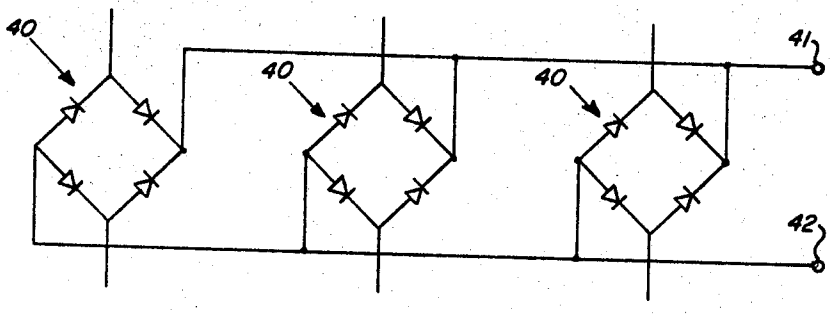

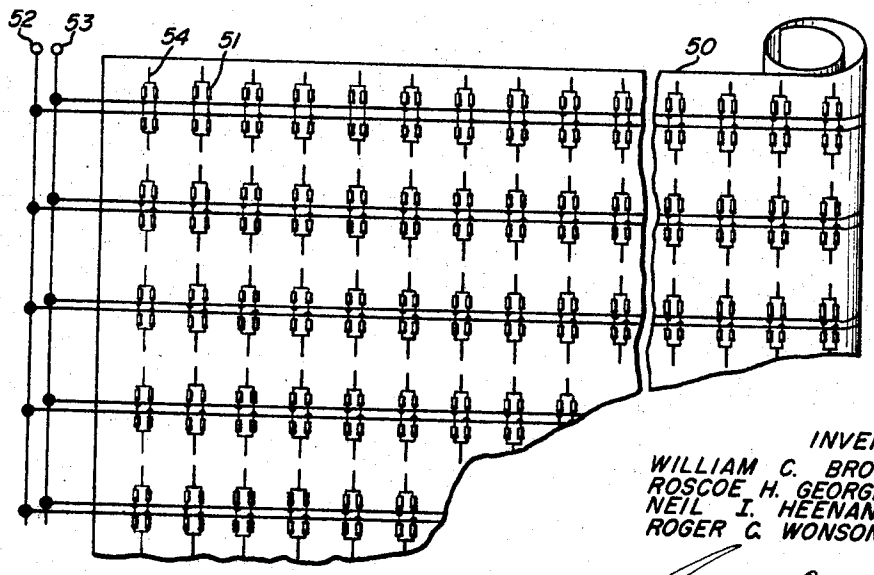

FIG. 5

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FIG. 7

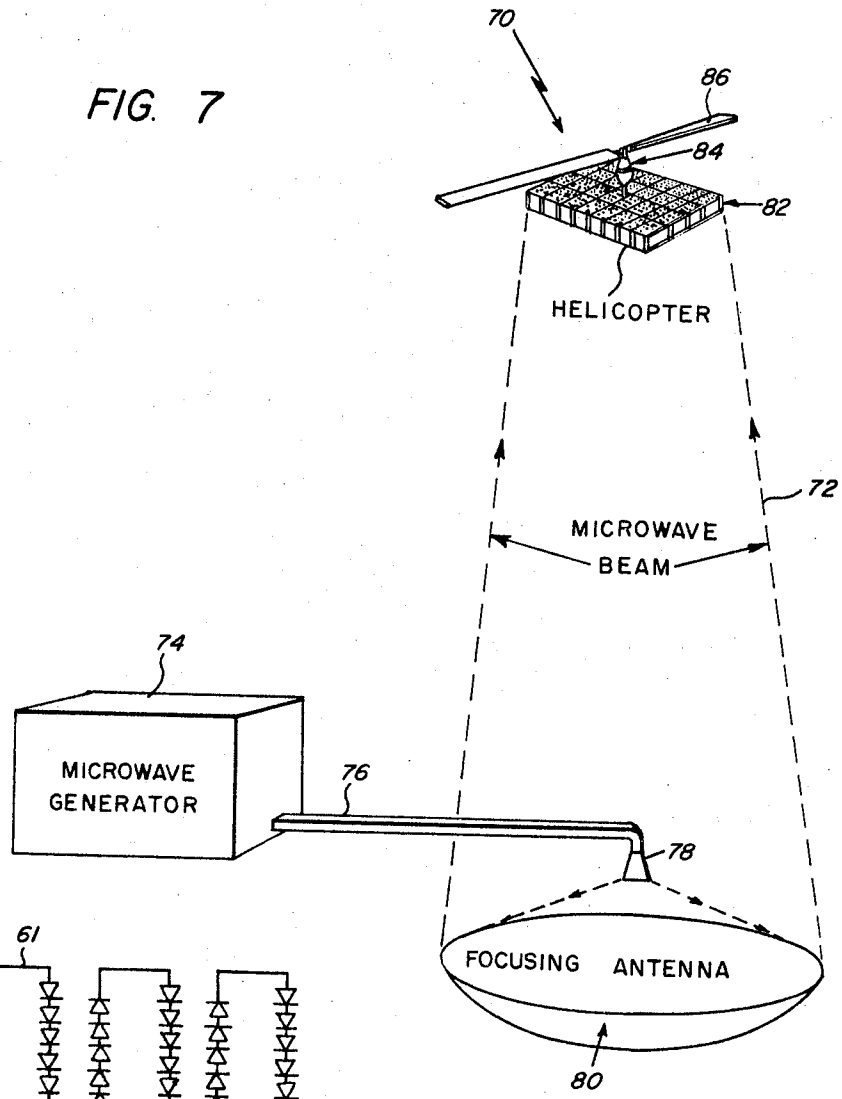

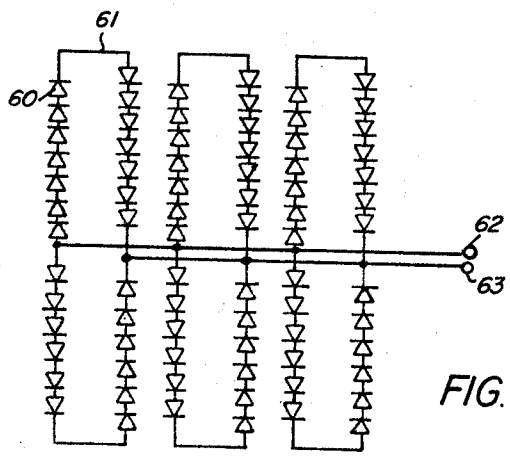

FIG. 6

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MICROWAVE TO DC CONVERTER

Filed May 5, 1965

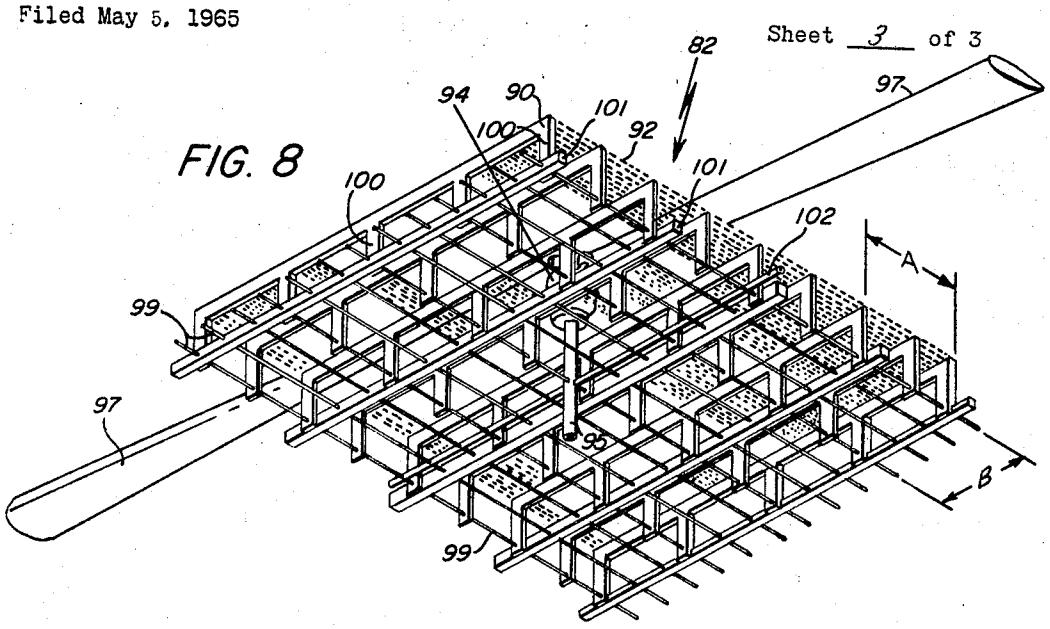

FIG. 8

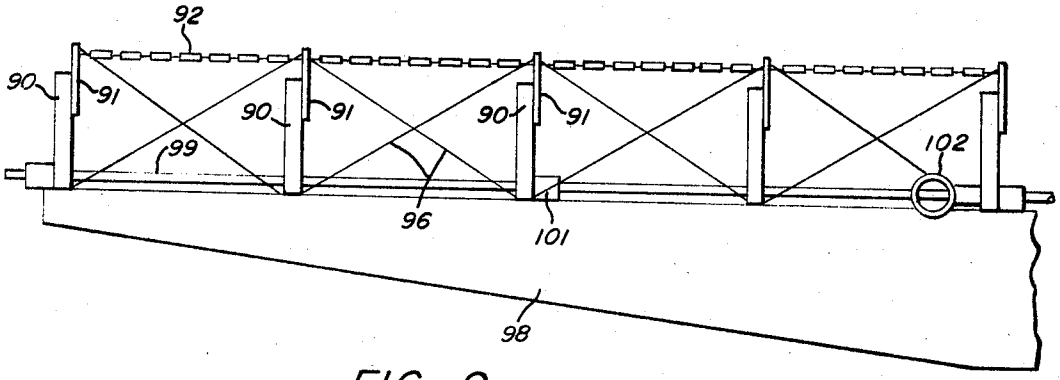

FIG. 9

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United States Patent Office

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1

3,434,678

MICROWAVE TO DC CONVERTER

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Filed May 5, 1965, Ser. No. 453,415
Int. Cl. B64g 1/00
U.S. Cl. 244—1 3 Claims

ABSTRACT OF THE DISCLOSURE

A combined antenna and conversion mechanism for reception of beamed high frequency electromagnetic energy in space including a large array of unidirectional current semiconductor rectifier devices. A self-supporting space vehicle utilizing the rectified DC electrical energy for propulsion is disclosed in an illustrative embodiment.

The present invention relates in general to the transfer of energy by means of an electromagnetic wave beam and more particularly to interception and rectification of such energy into low frequency electrical DC energy with a high degree of efficiency.

Improved technology in the field of microwave energy generation at superpower levels has resulted in the realization of electrical energy transmission over considerable distances for remote energization of devices or vehicles without the aid of wires. The transmission of microwave electromagnetic energy into space has been commonly employed in the radar pulse echo systems for the detection and orientation of desired objects within a predetermined scanning range of a transmitting antenna. Beams of a similar nature may now be employed for other useful purposes and the advantages attendant the utilization of electromagnetic energy in the microwave region in contrast with other wavelengths may now be enumerated.

Microwaves have been generally defined as high frequency radio waves whose wavelength is less than 30 centimeters, with a lower wavelength limit on the order of 1 millimeter sometimes being applied to what is commonly referred to as the "microwave region." The superiority of high frequency microwaves is due in part to the fact that it is generally desirable to focus the transmitted energy so as to achieve a high power density at a remote point or area with respect to a given power source. In accordance with the laws of optics, the sharpness of the microwave beam produced by a transmitting antenna varies as the ratio of antenna dimensions to the wavelength of the transmitted energy. Therefore, for a given or desired power density or beam sharpness, a decrease in the wavelength of the transmitted energy permits a corresponding decrease in the dimensions of the antenna. From the standpoint of mechanical considerations, it is desirable to employ small antennas and other components, and it is therefore advantageous to employ high frequency energy of very short wavelength. In addition, the difficulties encountered in long wave transmission as a result of natural and man-made interference or noise do not occur with any appreciable significance at microwave frequencies. Further, in aerospace applications with considerable distances separating the transmitter at an earth or mother planet location and the employment of shorter wavelength beamed energy is preferred since longer wave signals will generallly be reflected at certain altitudes by reflecting layers in the atmosphere.

In view of certain losses due to absorption which may occur in the atmosphere, microwaves in the region having the approximate bounds of 2 and 30 centimeters are

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readily adaptable to the convenient radiation of power to remote points without the utilization of wires. The preferred wavelengths are of the order of 5 or 10 centimeters to provide efficient focusing with existing transmitting antenna systems which may be maintained at a reasonable size. An illustrative device of the superpower high frequency microwave generators operative in the desired band is the so-called Amplitron which is an amplifier having a broad bandwidth and excellent performance characteristics for the focusing of the beam. Such devices are capable of producing 15 or 20 kilowatts of average continuous wave power in the neighborhood of 10 centimeters in wavelength with capabilities expected in the region of 500 kilowatts or more average power with 50 megawatts peak power. A complete description of such devices may be had by referring to Patent No. 2,933,723 issued Apr. 19, 1960 to William C. Brown and assigned to the assignee of the present invention.

With microwave energy capable of being generated and directed over longer distances conversion of such high frequency electromagnetic energy is of paramount concern. One conversion mechanism in the prior art involves direct conversion of such energy into heat which may then be utilized directly or indirectly for propulsion or generation of flight-producing forces. Examples of such devices for heat energy exchange as well as space vehicles utilizing such energy may be noted in Patent No. 3,174,-705, issued Mar. 23, 1965, to D. Schiff et al., as well as U.S. Letters Patent No. 3,083,528, issued Apr. 2, 1963 and No. 3,114,517, issued Dec. 17, 1963, to William C. Brown. The heat exchanger method of conversion of electromagnetic energy into useful power is limited by the overall efficiencies of approximately 25 percent in the conversion of heat into mechanical or electrical work. Desirable, therefore, would be the direct rectification of the high frequency electromagnetic energy into low frequency electrical energy for the operation of many useful aerospace devices as well as systems.

The present invention has for its primary object the conversion of high frequency electromagnetic energy in the microwave region directly into low frequency electrical energy.

A further object of the present invention is the provision of a combined nondirectional receiving antenna and microwave electromagnetic energy to low frequency electrical energy conversion means in a unitary structure.

A still further object of the present invention is a provision of a new and novel combined nondirectional receiving antenna and microwave to DC energy converter for aerospace applications.

Another object of the present invention is the provision of a new and novel nondirectional receiving antenna and microwave to DC energy converter having a high degree of efficiency.

Still another object of the present invention is the provision of a new and novel aerospace vehicle with nondirectional receiving antenna and microwave to DC energy converter means with said vehicle being capable of being supported by its own energy generation means at a distance spaced apart from the power generation means.

In accordance with the teachings of the present invention, the above and other objects are achieved by the employment of efficient unidirectional microwave power rectifiers and dipole antenna means. Such rectifying devices, while being individually limited in power-handling capabilities, normally in the order of fractions of watts, have been found to be highly efficient means for the rectification of microwave power when assembled in large numbers in various arrays. It is interesting to note that the observed collective efficiency was on the order of 40 to 70 percent. In an illustrative embodiment, point-

contact semiconductor diodes were arranged in four arm bridge connected networks with the networks interconnected in various configurations such as series, parallel and series-parallel.

In discussing aerospace applications, an additional problem is encountered in the beaming of microwave energy to a remote point and the interception and utilization of such electrical energy. In such applications the advantages of a vehicle which may be maintained in space for indeterminate periods of time without employing a local fuel source are readily apparent. Such devices could readily provide communication networks, surveillance functions using radar techniques along with numerous other functions. The acapture of the beamed high frequency electromagnetic energy raises the need for an efficient antenna means capable of intersecting the beam at high altitudes. Conventional techniques employed in microwave radar usage such as receiving antenna horns are capable of intersecting only a small portion of the beam energy and add considerable weight in applications involving heavier-than-air vehicles. In an exemplary embodiment of the invention a space vehicle, namely a helicopter, is disclosed for either moving flight or a stationary location with self-supporting electrically operative propulsion means. The semi-conductor diode rectifier arrays have been demonstrated to fulfill the receiving antenna functions as well as the electrical energy rectification means in a highly efficient manner. Such combined antenna and rectifier means has also assisted in reduction of the weight problem in airborne devices. Further, it has provided a nondirectional means for the interception of the microwave energy to thereby reduce the problems of focusing inherent in prior art directional horn type receiving antennas.

With the above features, advantages and objects in mind the invention will now be described by reference to the following detailed description together with the accompanying drawings in which:

FIG. 1 is a perspective view of an illustrative diode rectifier;

FIG. 2 is a schematic circuit diagram of a bridge connected diode network with dipole antenna means;

FIG. 3 is a schematic circuit diagram of a plurality of bridge connected networks arranged in series;

FIG. 4 is a schematic circuit diagram of a parallel bridge connected network array;

FIG. 5 is a perspective view of an illustrative embodiment of a combined antenna and rectifier array in a folded or rolled up configuration;

FIG. 6 is a schematic circuit diagram illustrating the bridge connected diode array incorporated in the aerospace vehicle shown in FIG. 7;

FIG. 7 is a schematic representation in elevation illustrative of a heavier-than-air aerospace vehicle incorparating the structure of the present invention;

FIG. 8 is a perspective view of the aerospace vehicle embodiment as viewed from the under portion thereof; and

FIG. 9 is an enlarged partial view in elevation of a portion of the illustrative embodiment shown in FIG. 8.

FIG. 1 illustrates a point-contact semiconductor diode rectifier of the type employed in radar microwave receiver apparatus to rectify returned radar pulses. Any of the high burnout semiconductor diodes having high rectification characteristics are preferred and are commercially available, such as the 1N82 or 1N830. The rectifying junction is formed by whisker element **2** contacting the semiconductor element **4** respectively connected to leads **6** and **8**. Silicon is preferred over germanium for element **4** because of its ability to operate at higher temperatures and thereby handle higher powers. Envelope **10** houses the rectifying elements and may be of a hermetically sealed dielectric material or combination metal and ceramic composition. The inherent characteristic of such diode rectifiers is that the microwave energy is intercepted and rectified in a unidirectional manner and the line **11** indicate pictorially the rays of the beamed electromagnetic microwave energy in a plane normal to the envelope. In FIG. 2 a full-wave bridge connected diode network is illustrated with the forward direction of the rectified DC electric current indicated by the direction of the arrow symbols. The network shown consists of half-wave dipoles **20** and **22** each terminated with a diode rectifier element **24** to **27** in an arm of the bridge connected network. The dipole elements **20** and **22** are of the half-wave configuration and may be spaced apart from each other a one-half wavelength at the frequency of the beamed electromagnetic energy.

Referring now to FIG. 3, an array of bridge connected diode networks each with the half-wave dipoles are shown connected in series. Each network is referred to by the numeral **30** and is similar in the bridge connections to the single element network shown in FIG. 2. The DC output of the collective rectified energy is coupled by means of terminals **32** and **33**. In FIG. 4, a similar number of individual bridge connected diode-dipole networks are shown connected in a parallel array. Each network is indicated by the numeral **40**, and the output terminals are indicated as **41** and **42**.

Any number of diode-dipole networks may be provided and in FIG. 5 such a multi-element array is illustrated by mounting on a flexible material **50** which may be rolled or folded into any desired package or enclosed within a capsule to be launched and released at a predetermined point in space. Any flexible material which is pervious to electromagnetic energy is preferred. The total power desired would be the determining factor in a number of individual diode-dipole elements required. In this embodiment, the bridge connected networks **51** are connected in parallel to the output load indicated by terminals **52** and **53**, and representative measurements of electrical characteristics have shown that approximately five watts of DC electrical energy is realizable for each square foot of area of the combined antenna-rectifier. While the dipole elements **54** have been indicated in a particular array, it is within the scope of the invention to stagger the placement of such dipoles to increase the overall efficiency of the antenna-rectifier.

To further increase the DC powder output, the full-wave bridge connected networks are preferably arranged with a plurality of diodes in series in each arm of the bridge. An illustrative schematic circuit diagram of such a configuration is shown in FIG. 6 wherein seven diodes **60** are shown in each arm of the bridge circuit and are connected in series for a total of twenty-eight diodes in each bridge network. The dipole members will then be the substantially U-shaped end portions **61** at the ends of each brace of seven diodes. In the illustration three such twenty-eight diode bridge networks are shown connected in parallel to terminals **62** and **63**. This closer spacing and compact arrangement has been shown to be a source of improved power output and is capable of a high degree of reliability through the redundant nature of the parallel series connections within each bridge network. If one of the diode rectifiers fails to function the over-all voltage drop across this element would be divided among the six remaining diode rectifiers. If any of the connecting wires between the diode elements should break, the adjacent arms of the other bridge assemblies would take the additional load due to the close proximity of the respective arms to each other. In addition, it is possible to have a number of open connections or inoperative diodes dispersed throughout the array without any serious impairment in performance.

In relation to the array concept to be hereinafter described it may be stated that within a six inch square area ten such individual bridge networks each containing twenty-eight diode rectifiers for a total of 280 diode rectifiers may be deployed in such a manner as to provide

maximum exposed area for each diode as well as the connecting leads. Such an arrangement will be hereinafter referred to as a "module" and a DC output in excess of fourteen watts has been measured for such a module. Any number of such modules could be connected provided for a desired power yield and this module concept readily lends itself to use in certain aerospace applications now to be described.

In FIG. 7 a propelled type of space vehicle **70** is shown wholly supported by means of the transfer and rectification of continuous wave electromagnetic energy via a microwave beam **72**. The source of the microwave energy which may be of the Amplitron type device as described in the aforementioned issued Patent No. 2,933,723 is indicated as **74**. This energy is fed by waveguide means **76** to a transmitting horn **78** to illuminate an ellipsoidal beam forming focusing antenna **80** for the transmission of the microwave beam **72**. It will be appreciated by those skilled in the art that the representations of the microwave generation and transmitting antenna means are pictorial representations to illustrate the usage of the invention in diagrammatic form and the present invention is not limited to any particular source of microwave energy or transmitting antenna assembly. It may be stated the reflector of the antenna assembly is considerably larger than most of the reflectors of the prior art in order to focus a large amount of the microwave power at high altitudes for use in the transfer of energy to space vehicles. Such antenna assemblies may be partially supported in a large hollowed area on the earth's surface or other convenient means of support.

The space vehicle or helicopter **70** can be described as a main body member supporting antenna-rectifier means **82** including a large number of the so-called modules connected together and rigidly supported in a planar parallel array. A motor **84** is supported by the combined body member and the receiving antenna-rectifier means and actuates the rotor **86** of conventional design employed in such self-propelled hovering vehicles. The disclosed vehicle provides for the illumination of the planar array of the semiconductor diode dipole elements by the microwave beam and the direct conversion of the microwave power transmitted by the beam into usable electrical energy for the self-propulsion of the device without any local fuel supply being required.

FIGS. 8 and 9 illustrate a space vehicle **82** comprising a plurality of the combined receiving antenna-rectifier module means for interception and rectification of the electromagnetic microwave energy beam emanating from an earth or mother planet source. A planar array of the antenna-rectifier modules is mechanically supported by means of structural members **90** of any lightweight wood or metal. Insulators **91** positioned coextensive with the members **90** support the diode rectifier array and avoid interference with the receiving and electrical performance characteristics by the structural support members. Carrying forward the module concept of 280 diode rectifiers to provide an approximate power output of 14 watts, it was noted that any number of such modules may be coupled together since the individual module outputs are relatively insensitive to a wide range of load resistances connected to the common output terminals. To achieve the desired electrical output of approximately 120 volts and 250 watts of power, subgroups of four modules each were assembled and parallel connected with an approximate 30 volts available for each subgroup. Four such subgroups were series-connected to result in a total of 4,480 diode rectifiers or 16 modules assembled in a two foot square self-supporting planar parallel array structure. The individual diode rectifiers connected in each arm of the bridge network are indicated by the numeral **92**. An exemplary module configuration would extend within the area delineated by the dotted lines and reference letter A on one side and similar dotted lines and reference letter B on the other side.

A motor **94** is connected to the DC side of the overall array and may be additionally supported by tubular member **95**. A shaft and propulsion means consisting of rotor blades **97** provide for the upward lift of the overall vehicle for the self-supporting of same in space applications. Additional structural support such as interlaced rigging **96** of a high tensile strength material such as nylon or steel wire, as well as bracing member **98**, may be employed for strengthening of the body means to withstand the vibrational forces and downwash from the propulsion means.

In accordance with the well known technology of microwave transmission the combined array of diode rectifiers and propulsion means presents a specific load impedance which must be suitably matched to the transmitted microwave energy beam to result in maximum efficiency. In aerospace applications a mismatch of approximately ten to one may be evident. Matching of the load impedance to a value of approximately 377 ohms as the free space value will be provided by a plurality of coplanar parallel metallic rod members **99** disposed in a grating array in front of the diode rectifiers a predetermined distance. Rod members **99** are linearly disposed and extend in a similar direction as the assembled diode rectifiers. A selected frontal spacing of one-quarter of the wavelength of the microwave frequency being transmitted has been experimentally determined to be suitable for impedance matching purposes. An approximate spacing of two inches between the respective members was preferred for a selected microwave frequency of 2,450 megacycles. Each of the members **90** are provided with lateral sections **100** to support the elongated bar members **101** which in turn maintain the rod members **99** in the desired position. A tubular member **102** of a lightweight metal may also be provided to combine with the motor support member **95** for structural support.

The combined antenna-rectifier array provides a source of electrical energy to render any space vehicle self-supporting. The diode rectifier elements when assembled in the antenna array have been found to be nondirectional with respect to interception of the beamed microwave energy. This represents a large step forward in the utilization of high power microwave energy over the prior art horn-type receiving antennas which must be accurately focused and pointed in a particular direction for the reception of any energy. The connections between the respective members of the diode rectifier array and deployment in the parallel configuration serves to provide maximum exposed area. Such connections and in particular the end loop portions adjacent the terminus of each arm of the bridge networks serves as an efficient dipole for the interception of the microwave energy.

Although it is not intended as a full explanation of the high degree of efficiency attained with the disclosed antenna-rectifier array, it is believed that the whisker elements within the semiconductor diodes themselves are a contributing factor and may function as additional dipole elements. The disclosed embodiment functioned efficiently when illuminated by microwave energy generating a vertically polarized beam. Hence, an efficient and light weight energy conversion apparatus is disclosed which may be self-supporting without the requirement of a large local fuel supply payload.

It may be within the purview of the invention to use the available rectified electrical energy for performing many functions in addition to the actuation of the propulsion means. Hence, communications' payloads may be maintained at predetermined positions in space in a hovering attitude utilizing a portion of the electrical energy available. Relay signals to other such vehicles or return signals to ground stations would then be within the realm of possibility. Such available energy may also be employed for servomechanisms, stabilizing and countertorque systems for the navigation of such vehicles.

The electrical efficiencies realized with the combined

receiving antenna and rectifier means have also provided certain weight advantages over other energy converters in aerospace applications. Examples of such converters would be heat exchangers or solar cells. In comparison to the present invention where five to eight pounds per kilowatt of energy realized is a normal characteristic, other energy conversion means weigh in the vicinity of 150 pounds per kilowatt of realizable energy. The inherent advantages of the present invention are therefore apparent. While the technology in the diode rectifier art is being continually advanced, new diode power rectifiers as well as integrated circuit techniques are readily available to future configurations of the present invention. The so-called Schottky barrier diodes could be employed to produce combined antenna-rectifier means weighing even less than two pounds per kilowatt of available energy.

Although the foregoing detailed description has referred to DC power rectification it will be evident that with suitable circuit components low frequency AC energy may also be made available. In addition, other propulsion means may be readily substituted using electrical energy. The embodiments disclosed herein are illustrative only and other modifications or alterations will be apparent to those skilled in the art which do not depart from the scope of the broadest aspects of the present invention as defined in the appended claims.

What is claimed is:

1. A space vehicle comprising:

body means;

said body means including spaced structural support members;

combined antenna and DC electrical energy rectification means for the interception and rectification of incident high frequency electromagnetic microwave energy carried by said support members in a planar parallel array;

said rectification means comprising a plurality of four arm full-wave bridge connected rectifier circuit networks each having a plurality of unidirectional semiconductors in each arm;

said networks being electrically interconnected to common output terminals;

electrically operable propulsion means comprising a motor and rotor members carried by said body means and connected to said terminals for the utilization of said rectified DC energy; and

means for matching the load impedance of said combined antenna and electrical energy rectification means to the incident microwave energy.

2. A space vehicle according to claim 1 wherein said load impedance matching means are arranged in a coplanar array coextensive with said antenna and energy rectification means array, and spaced therefrom a distance of approximately one-quarter of a wavelength at the frequency of the microwave energy.

3. A space vehicle according to claim 2 wherein said load impedance matching means comprise a plurality of parallel disposed elongated metallic members.

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U.S. Cl. X.R.

307—151; 318—16; 321—27; 325—494; 343—100

Teleportation of Entangled Coherent States through Visual Pathways in the Human Brain

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Abstract:
In this paper we have proposed a new model for visual consciousness based on the premise there exists a quantum teleportation mechanism between the eye and the brain. In our model, some open questions will be answered.

1) Introduction:

Schrödinger's book "What is life?" has had an enormous influence on the development of molecular biology [1]. His insight has since then inspired many researchers to investigate the molecular basis of a living organism [2,3,4]. Several researchers have noticed the sweeping consequences that would follow from the discovery that living organisms might process information quantum mechanically, either at the bio-molecular level, or the cellular/neuronal level [5,6,7,8,9]. Computational models of the behavior of networks of neurons are still mainly based on the integrate-and-fire model of neural function. Mainstream cognitive neuroscience typically ignores the role of quantum physical effects in the neural processes underlying cognition and consciousness. However, many unsolved problems remain, suggesting the need to consider new approaches. Recent contributions to the investigations of quantum effects in the human brain are due to Jibu and Yasue, Pribram, Lockwood, Mavromatos and Nanopoulous, Hameroff and Penrose, and Stapp [10]. These authors have proposed models in which the operation of consciousness is associated with some sort of explicit wave function collapse. There have been numerous suggestions that consciousness is a macroscopic quantum effect possibly involving superconductivity, superfluidity, electromagnetic fields, Bose-Einstein condensation or some other physical mechanism. Perhaps the most specific model developed thus far is that of Penrose and Hameroff and it asserts that quantum information processing takes place in microtubules (MTs). It has been argued that MTs can process information similarly to a cellular automaton, and hence Hameroff and Penrose suggest that neuronal MTs may operate as a quantum computer.
In this paper, we investigate visual information transfer from a quantum information point of view. Theoretically we consider the conscious observer looking at a quantum system and propose that the state of this system is reported via superposed photons. We address the question whether the observer can receive the exact same state of this system quantum mechanically in his/her brain or this quantum state collapses before reaching the brain. Below we investigate the problem in detail.

2) Evolution of Information from the Eye to the Brain

We assume that a conscious observer directs his/her attention to a quantum system. For simplicity we consider this system to be a manifestation of the celebrated *Schrödinger's cat*. This system can exist in two states: Live$|L\rangle$, or Dead$|D\rangle$.

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$$\psi_{sys} = \frac{1}{\sqrt{2}}(|L\rangle + |D\rangle) \qquad (2\text{-}1)$$

The state of this system is then reported via superposed photons. 4% of these photons are reflected from the cornea. 50% of remaining photons are dissipated through ocular media absorption. Other photons enter the 200-250 µm thick retina. There, photons interact with the photoreceptors in the rods and cons layer after 80% loss due to retinal transmission [11],[12]. In this case, we consider just a few remaining photons which are in a superposed quantum state. The key question here is whether this quantum state of photons can be reported to the brain.

When this state interacts with the last layer of retina, according to Thaheld, this superposed photon undergoes a wavefunction collapse. On the other hand, photons can be absorbed and then transformed into classical signals. Here, we use the symbols introduced by Tegmark [13] for the observer. The symbol $|\ddot{_}\rangle$ denotes the state for which the information on photons is not received by the brain and thus the observer is amphoteric. The symbol $|\ddot{\smile}\rangle$ stands for the state in which the information received in the brain reports that the cat is alive (and the observer is happy). Finally, the symbol $|\ddot{\frown}\rangle$ corresponds to the state in which the information received in the brain indicates that the cat is dead (and the observer will be sad). It means that:

$$U|\ddot{_}D\rangle = |\ddot{\frown}D\rangle \qquad (2\text{-}2\text{-a})$$

$$U|\ddot{_}L\rangle = |\ddot{\smile}L\rangle \qquad (2\text{-}2\text{-b})$$

Where $U = \exp\left[-\frac{i}{\hbar}\int H_{photon-brain}\, dt\right]$.

Now, we consider another state in which the brain interacts with itself. Penrose and Hameroff have proposed a model of consciousness involving quantum computation with objective reduction in *microtubules* (or MTs) within the brain's neurons (see Figure 1) [14],[15],[16],[17]. MTs are cylindrical polymers comprised of the protein tubulin which organize numerous cellular activities including neuronal motor transport. According to Hameroff and Penrose, switching of tubulin conformational states is governed by quantum mechanical forces within each tubulin interior, and an essential feature of the Orch OR model is that tubulins may exist in quantum superpositions of two or more conformations. Therefore, these states could function as quantum bits, or "qubits" by interacting non-locally (through their entanglement) with other tubulin qubits so that MTs may act as quantum computers. When sufficiently many entangled tubulins are superposed for long enough to reach Penrose's OR threshold given by E=h/T, an objective reduction (OR) "conscious event" occurs as stated in the Orch-OR model.

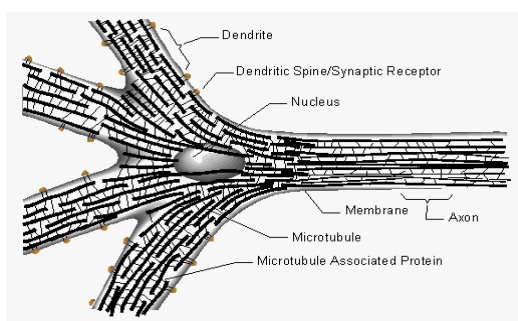

Figure 1 Representation of MTs inter a brain neuron. The Orch OR model suggests that the main information processing is implemented in these structures.

If previous evolution is described by Penrose's self-collapse in the brain (i.e. Orch-OR), MTs in the neurons of the brain collectively evolve and then collapse (i.e. conscious event) to one of the happy or sad states. It mathematically means that:

$$U|\ddot{\smile}\rangle = \frac{1}{\sqrt{2}}(|\ddot{\smile}\rangle + |\ddot{\frown}\rangle \qquad (2\text{-}3)$$

where $U = \exp[-\frac{i}{\hbar}\int H_{brain}\, dt]$.

If we compare this state (2-3) and the state which has the information about the photon (2-2), we can say that there's a great amount of correlation between the retina and the visual cortex, because their result should be identical. We know that in accordance with the Einstein-Podolsky-Rosen (EPR) pair, when two entities originate from a common source they can be entangled with each other. Retina has a similar layered structure as the gray-matter top layers of the cerebral cortex of the brain. In fact, retina is an extension of the central nervous system (the brain and spinal cord) that forms during embryonic development. One reason why scientists are interested in retinal processing is that retina is an accessible part of the brain that can be easily stimulated with light [18]. Thus, we can say that retina and visual cortex are entangled with each other. The other argument for this entanglement is that the image of a system is inverted on the retina but it is perceived in the brain directly. As we know, in two entangled entities when one has a property in some direction the other exhibits that property but in the opposite direction. Thus retina receives an inverted image, while it is received in the visual cortex upright. This property is special to entanglement.

The human body is made up of many organs, which themselves are made up of many millions of cells. How can such a system, with millions, or even billions, of parts function effectively and coherently? This is a no small feat as even small-size human societies often undergo periods of turbulence and trouble due to conflict and poor organization. Now some scientists think that quantum coherence in MTs is a major factor responsible for our bodies, and especially our brains, being so efficiency. Here, we intend to describe visual processing on the basis of quantum information theory.

3) Generation of Entangled Coherent States

Centrioles and cilia, which are microtubular structures, are involved in photoreceptor functions in single cell organisms and primitive visual systems. Cilia are also found in all retinal rod and cone cells. The dimensions of centrioles and cilia are comparable to the wavelengths of visible and infrared light (see Figure 2) [50]. Moreover, cytoskeletons are found mostly among the retina and the visual cortex in the cells of the optic nerve. Cytoskeletal structures of the centrioles can be expected to vibrate like a harmonic oscillator in its ground state. Vibrational dynamics of MT's has been the subject of a recent paper where typical frequency ranges have been discussed [19].

When a photon interacts with a centriole, its electric field can displace the potential of the harmonic oscillator and then releases it, thus generating coherent states [20]. It means that:

$$D(\alpha)|0\rangle = |\alpha\rangle \qquad (3\text{-}1)$$

Where $D(\alpha)$ is the displacement operator; $D(\alpha) = e^{\alpha a^{\dagger} - \alpha^{*} a}$, and $|0\rangle$ is the ground state of harmonic oscillator, and $|\alpha\rangle$ is the coherent state: $|\alpha\rangle = e^{-\frac{|\alpha|^2}{2}} \sum_{n=0}^{\infty} \frac{\alpha^n}{\sqrt{n!}} |n\rangle$.

Hameroff [21] and Penrose [22] have suggested that MTs inside cells permit long-range quantum coherence, enabling quantum information processing to take place at the sub-cellular level. They use this hypothesis to develop their theory of consciousness. Cells interconnected by gap junctions form networks

which fire synchronously, behaving like one giant neuron [23], and possibly accounting for synchronized neural activity such as coherent 40 Hz waves [24]. Marshall [25] suggested that coherent quantum states known as Bose-Einstein condensation occurred among neural proteins [26], [27], [28]. Other issues, such as preconscious-to-conscious transitions were identified by Stapp [29] with the collapse of a quantum wave function in presynaptic axon terminals [7]. The other reason for coherence of these structures is that light is an electromagnetic wave and thus is vibrational, and according to Froehlich's theory [44],[45],[46] it can take these cytoskeletal structures (i.e. nonlinear structures composed of electric dipoles) into one mode of frequency and coherence.

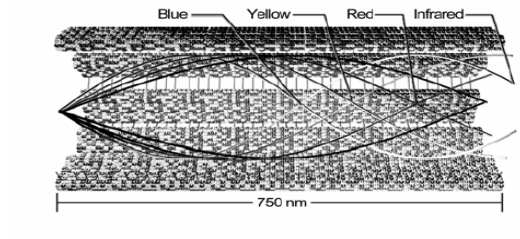

Figure 2 Representation of one centriole, the dimensions of centrioles are comparable to wavelengths of visible and infrared light.

Centrioles are two cylinders composed of MTs which are perpendicular to each other and in accordance with the Hameroff theory of the origin of cancer [30], centrioles are entangled with each other. Because of this entanglement, when a coherent state $|\alpha\rangle$ is generated in one centriole, in the other it will generate state $|-\alpha\rangle$. Now, we can say that after interaction of photons with centrioles, they generate "entangled coherent states" in these structures in the retina, i.e.:

$$|\varphi\rangle_{12} = (A|\alpha\rangle_1|\alpha\rangle_2 - B|-\alpha\rangle_1|-\alpha\rangle_2\ ) \qquad (3\text{-}2)$$

where $|\varphi\rangle_{12}$ is an entangled coherent state in centrioles with two modes 1 and 2. QED-cavity model of MTs [31] describes that coherent modes of electromagnetic radiation can be sustained in the interior of the MTs. These modes are provided by the interaction of the electric dipole moments of the ordered-water molecules in the interior of MTs with quantized electromagnetic radiation [32],[33]. Jibu, et. al.[49], have proposed that the quantum dynamical system of water molecules and the quantized electromagnetic field confined inside the hollow MT core can manifest a specific collective dynamical effect called superradiance [34] by which the MT can transform any incoherent, thermal and disordered molecular, atomic or electromagnetic energy into coherent photons inside the MT. Furthermore, they have also shown [49] that such coherent photons created by superradiance penetrate perfectly along the internal hollow core of the MT as if the optical medium inside it were made "transparent" by the propagating photons themselves. This is referred to as the quantum phenomenon of self-induced transparency [35]. Superradiance and self-induced transparency in cytoskeletal MTs can lead to "optical" neural holography [36]. Neurons (and maybe also other cells) may contain microscopic coherent optical supercomputers with enormous capacity. Thus Jibu, et. al.[49], suggest that MTs can behave as optical waveguides which result in coherent photons. They estimate that this quantum coherence is capable of superposition of states among MT spatially distributed over hundreds of microns. These in turn are in superposition with other MTs hundreds of microns away in other directions and so on. With the above conclusions $|\varphi\rangle_{12}$ can produce those photons which produced itself, thus if the state $|\varphi\rangle_{12}$ can be restored in the brain, it will reproduce the photons which were absorbed in the retina.

Additional arguments in favor of the feasibility of production of photons in the brain can be found in the conclusions of the paper [37], which also asserts that there exists a neural activity-dependent ultra-weak photon (biophoton) emission in the brain. Thus there is the possibility to restore the initial state of the photon in the brain after absorption in the eye. This process can be implemented through teleportation mechanism between retina and the visual cortex as will be discussed in the following sections.

4) The Decoherence Problem

The important question about the quantum processing in the living systems is: how is it possible for MTs to process information quantum mechanically while the environment surrounding them is relatively hot, wet and noisy?

According to the Orch-OR model, microtubular structures in the neurons of the brain process information quantum mechanically and to avoid decoherence, like lasers maintain quantum coherence against thermal noise. Water within cells is itself not truly liquid, but has been shown to be, to a large extent, ordered [38]. Most of the ordered water in the cell in fact surrounds the cytoskeleton [39]. MTs and other cytoskeletal components are embedded in cytoplasm which exists in alternating phases of (1) "sol" (solution, liquid); and (2) "gel" (gelatinous, solid). Among the most primitive of biological activities, "sol-gel transformations" within neurons and other living cells are caused by assembly and disassembly of cytoskeletal actin (e.g. regulated by calcium ions through the protein calmodulin, in turn regulated by MTs). Sol-gel transformations are essential in basic cellular activities such as ("amoeboid") movement, growth and synaptic formation and neurotransmitter vesicle release [40], [41]. Transitions can occur rapidly (e.g. 40 sol-gel cycles per second), and some actin gels can be quite solid, and withstand deformation without transmitted response [42]. Cyclical encasement of MTs by actin gels may thus be an ideal quantum isolation mechanism. In the gel phase of cytoplasm, the water ordering surfaces of a MT are within a few nanometers of actin surfaces which also order water. Thus bundles of MTs encased in actin gel may be effectively isolated extending over the radius of the bundle, on the order of hundreds of nanometers. There are many mechanisms which can protect these structures against decohering factors. In general, Quantum states of tubulin/MTs are protected from environmental decoherence by biological mechanisms which include phases of actin gelatin, plasma-like Debye layering, coherent pumping and topological quantum error correction [54]. Moreover, quantum spin transfer between quantum dots connected by benzene rings (the same structures found in aromatic hydrophobic amino acids) is more efficient at warm temperature than absolute zero[43]. It is conjectured that the "flexibility" of the resonant benzene electrons is advantageous to quantum processes by harnessing ambient thermal energy. MTs may possibly utilize nonspecific thermal energy for "laser-like" coherent pumping, for example in the GHz range by a mechanism of "pumped phonons" suggested by Froehlich [44,45,46].

5) What is the mechanism of Teleportation?

According to the definition of teleportation as stated in [47], in the process of quantum teleportation, one can construct an exact replica of the original unknown quantum state at a cost of destroying the original state. Therefore, to call a quantum state transfer operation- quantum teleportation, the process should not only generate output states with better qualities than what can be done classically but also obey the no-cloning theorem [48].The quantum state of a system can be transmitted from a location to a distant one using only classical information provided that a quantum channel exists between the sender and the receiver. Sharing entangled states between the two parties opens the necessary quantum channel. Research in quantum state transfer, especially the quantum teleportation, has emerged as one of the major research areas of theoretical and experimental quantum mechanics. Assume that Alice wants to send Bob an unknown quantum state but when she receives this state she does not know anything about that unless she affects it and collapses it to classical state, or in other hand she destroys that quantum state. She just can send classical signals to Bob through classical channel, but if there is a shared entangled channel between Alice and Bob, Bob can construct initial quantum state with the help of classical signal which is sent by Alice and quantum channel between them. This operation is implemented by operating special unitary operators. For more details see [47]. Here, we want to simulate visual information transfer with teleportation mechanism. We know that when photon penetrates the retina, it changes to action potentials or electrical signals and these classical signals are sent to the brain for interpretation. It means that *retina* (Alice) wants to send the *brain* (Bob) a *photon state* (unknown quantum state), but *retina* (Alice) absorbs

it (collapses the quantum state) and changes it to *action potential* (classical state) and send it through *membranes of axons of the brain neurons* (classical channel). *Brain* (Bob) can reconstruct the initial *state of photon* (unknown quantum state) to process it to emerge consciousness. Our arguments for this simulation are below conclusions:

Orch OR [14], [15]: There is quantum processing in the neurons of the brain (there is a quantum channel between retina and brain)

Tegmark [13]: Displacement of ions through membranes of brain neurons is a classical phenomenon (action potentials are classical signals and membranes of neurons are classical channels).

Thaheld [11],[12]: Superposed photons do collapse in the retina (the quantum state is collapsed by the sender [Alice]).

We assert that they describe different aspects of the teleportation mechanism. We simulate visual consciousness with the teleportation mechanism as shown in Table 5-1.

Table 5- 1 Simulation of the transferring visual information from the eye to the brain to the Teleportation mechanism.

Human Brain	***Quantum Teleportation Mechanism***
Retina	Alice
Membrane of axons in neurons	Classical channel
Cytoskeletal structures	Entangled channel (quantum channel)
Visual cortex	Bob
Action potentials	Classical signals

Now we want to investigate this teleportation mechanism via teleporting of entangled coherent states through visual pathways in more details. We will show how photon states are constructed in the visual cortex.

6) Teleportation of Entangled Coherent States through Visual Pathways

Super radiance and self induced transparency [49] besides Froehlich oscillations can cause the coupling of MT dynamics over wide areas and take them into a superposition and a coherent state. While in superposition, tubulins communicate with entangled tubulins in the same manner, and in MTs in neighboring neurons, and through macroscopic regions of the brain via tunneling through gap junctions and possibly tunneling nanotubes [50]. As we have already said, retina and the visual cortex are entangled with each other. Thus there is a quantum channel between retina and the visual cortex which is composed of microtubular structures. MTs interact with membrane structures mechanically by linking proteins, chemically by ions and second messenger signals, and electrically by voltage fields. The transduction of light into electrical signals takes place in the photoreceptors. Except for the ganglion cells, none of the retinal cells display action potentials [51].

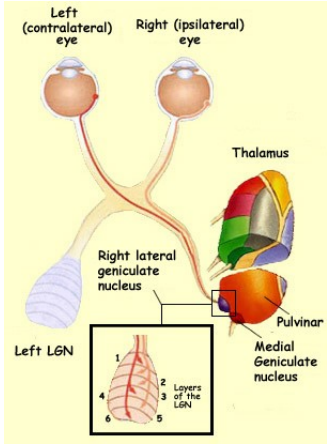

Figure 3 The LGN is a laminated structure, having 6 layers. Contralateral fibers and ipsilateral fibers couple in the LGN. The ipsilateral fibers of the optic nerve terminate in laminae 2,3 and 5 of LGN, while the contralateral fibers terminate in laminae 1, 4 and 6.[52]

Axons leaving the temporal half of the retina traverse the optic nerve to the optic chiasm, where they join the optic tract and project to ipsilateral structures. Axons leaving the nasal half of the retina cross the midline at the chiasm and terminate in contralateral structures. This arrangement means that all the axons in the optic tract carry information about the contralateral visual field. Axons of the optic tract terminate in three areas of the central nervous system, the lateral geniculate nucleus (i.e. LGN), the superior colliculus and the pretectal area. The trajectory through the LGN is the largest most direct and clinically most important pathway by which visual information reaches the cerebral cortex. About 80% of the optic tract axons synapse in the LGN. The LGN is a laminated structure, having 6 layers. Contralateral fibers and ipsilateral fibers couple in the LGN. The ipsilateral fibers of the optic nerve terminate in laminae 2,3 and 5 of LGN, while the contralateral fibers terminate in laminae 1, 4 and 6 of LGN (see Figure 3). There are about 10^6 neurons in each LGN, all of which project to the ipsilateral occipital cortex (area 17) as the optic radiations. The portion of the cerebral cortex that receives LGN axons is called the striate cortex and is usually labeled V1 to designate it as the primary visual cortical area (Figure 3). Virtually all information in the visual system is recognized as being processed by V1 first, and then passed out to higher order systems [53]. The upper visual cortex receives signals from the lower visual field and similarly, lower visual cortex process information from the upper visual field. The right visual cortex processes the left field of view and vice versa (see figure 4).

Now, we investigate the information transfer through visual pathways. The important model among quantum models about the processing in the human brain is the Orch-OR model which is based on the structure of the cytoskeleton. As already said this model asserts that the main processing in the neurons of the brain is performed in the MTs and the nature of the processing is mainly quantum mechanical. The processing unit in this model is *tubulin* which can be in a superposed state. Tubulins act like qubits in quantum computers. *Max Tegmark* believes that there is no quantum processing in the human brain. He has calculated decoherence times for every superposition state which can be possible in the neurons of the brain [13]. In his opinion, superposition states include ions such as Na^+ which are "in" and "out" of the membrane of axon. On the other hand, Na^+ ions are in the superposition of "in" and "out" with a separation distance comparable to the membrane thickness. He has considered three factors which can destroy this superposition state in neurons. *Collisions with the neighboring ions, Collisions with the water molecules* and *Interaction with distant ions* are the factors which Tegmark investigated for decoherence. He has estimated 10^{-19} s and 10^{-20} s for decoherence times. It is clear that above times are very small for the brain processes such as seeing, thinking, speaking and the other cognitive processes. Typically, dynamical timescales for neuron firing and cognitive processes are in the range of 10^{-4} to 1 seconds, whereas decoherence timescales are many orders of magnitude shorter. Thus, action potentials should be

regarded as classical signals or the displacement of ions through the membrane of axons should be investigated classically. It is remarkable that Tegmark has also calculated decoherence time for MTs, but he has used wrong assumptions about these structures (for more details see [54]) and we just accept his calculations about action potentials. Thaheld [11], [12] believes that the wave function of any superposed photon state or states is always objectively changed within the complex architecture of the eye, and any incident photons have to run a very daunting gauntlet before they are even converted or transduced to retinal ganglion cell spike trains (To learn more about Thaheld arguments, the reader is referred to refs. [55,56,57]). According to Thaheld, the quantum state of photons does collapse in the retina and it does not reach the brain.

Is Thaheld right? Is not there any mechanism to rebuild the quantum state of photons in the brain? Here we accept that the states of photons collapse in the retina but we believe that they can be restored in the visual cortex via the teleportation mechanism.

Now, the question is how can it be possible to restore the exact state of photons in the brain while its state is collapsed in the retina. The other question which one may ask is: if this state is reported through action potentials how is this information reported to the brain and how can it interpret action potentials to obtain the exact state of the photons? Our solution to the above problems involves the teleportation of entangled coherent states through visual pathways. The state of the photon is teleported from the eye to the brain. On the other hand, the state of the photon is transferred via some "cut-and-paste" mechanism from the eye to the brain. But how is it possible?

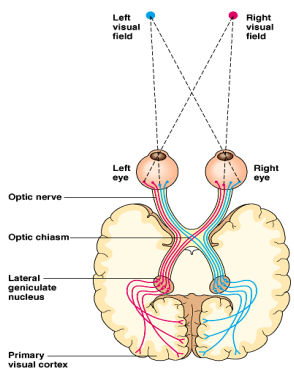

Figure 4 Visual pathways from the eye to the brain. See crossing of pathways.

We concluded before that retina and the visual cortex are entangled. Also we explained how the entangled coherent state is generated in the retina. Now, we want to formulate the process of information transfer from the retina to V1. The state (3-2) with two modes 1 and 2 should be teleported to V1. After the interaction of light with retina, modes 3, 4 and 5, 6 are generated through microtubular structures between retina and V1, and thus they produce entangled coherent channels between retina and V1. It means that the channels are:

$$|\psi\rangle_{35} = \frac{1}{\sqrt{N_\alpha}}(|\alpha\rangle_3|\alpha\rangle_5 - |-\alpha\rangle_3|-\alpha\rangle_5) \qquad (6\text{-}1)$$

$$|\phi\rangle_{46} = \frac{1}{\sqrt{N_\alpha}}(|\alpha\rangle_4|\alpha\rangle_6 - |-\alpha\rangle_4|-\alpha\rangle_6) \qquad (6\text{-}2)$$

Where N_α is the number of tubulins in each channel. Each mode is reported via a special fiber through visual pathways. All of the neurons which are collected in the LGN are divided into two major pathways: ipsilateral fibers and contralateral fibers. Information transfer in the contralateral fibers takes longer than information transfer in ipsilateral fibers because contralateral fibers have crossing relative to ipsilateral

fibers and then they have longer lengths than ipsilateral fibers. On the other hand, contralateral fibers have a retarded phase relative to ipsilateral fibers. Now we want to answer the following questions. What is this phase difference? What is the role of this crossing? And how does crossing restore the initial state in the retina?

7) The Role of Phase Shift to Restore Information in LGN

When the information is collapsed in the retina, action potentials are produced. The shape of action potentials is the same for each neuron, but the main problem is which neurons are fired, or in other words which neurons carry action potentials and information. Consider two fibers selected from ipsilateral fibers and two fibers selected from contralateral fibers. The two ipsilateral fibers are called 1 and 2, and the two contralateral fibers are called 3 and 4 while the two fibers from the LGN to V1 are called 5 and 6 which are selected from the group of magnocellular and parvocellular fibers. Now, we start from the retina. The state of centrioles and channels is:

$$|\psi'\rangle = |\varphi\rangle_{12} \otimes |\psi\rangle_{35} \otimes |\phi\rangle_{46}$$

$$= \frac{1}{N_\propto'}(A|\alpha\rangle_1|\alpha\rangle_2|\alpha\rangle_3|\alpha\rangle_4|\alpha\rangle_5|\alpha\rangle_6$$

$$-A|\alpha\rangle_1|\alpha\rangle_2|\alpha\rangle_3|-\alpha\rangle_4|\alpha\rangle_5|-\alpha\rangle_6$$

$$-A|\alpha\rangle_1|\alpha\rangle_2|-\alpha\rangle_3|\alpha\rangle_4|-\alpha\rangle_5|\alpha\rangle_6$$

$$+A|\alpha\rangle_1|\alpha\rangle_2|-\alpha\rangle_3|-\alpha\rangle_4|-\alpha\rangle_5|-\alpha\rangle_6$$

$$-B|-\alpha\rangle_1|-\alpha\rangle_2|\alpha\rangle_3|\alpha\rangle_4|\alpha\rangle_5|\alpha\rangle_6$$

$$+B|-\alpha\rangle_1|-\alpha\rangle_2|\alpha\rangle_3|-\alpha\rangle_4|\alpha\rangle_5|-\alpha\rangle_6$$

$$+B|-\alpha\rangle_1|-\alpha\rangle_2|-\alpha\rangle_3|\alpha\rangle_4|-\alpha\rangle_5|\alpha\rangle_6$$

$$-B|-\alpha\rangle_1|-\alpha\rangle_2|-\alpha\rangle_3|-\alpha\rangle_4|-\alpha\rangle_5|-\alpha\rangle_6) \qquad (7\text{-}1)$$

All of the above states are collected in the LGN. But here the role of action potentials is very important. They determine which fibers are fired. If fibers 1 and 2 carry action potentials, then it shows that information passes through ipsilateral fibers. Thus to select information from the LGN to send it via fibers 5 and 6 to V1 there is no need for phase difference (or to apply the phase shift operator on the states) and thus the state of (3-2) can be transferred like its first state through fibers 5 and 6. In the formulation (7-1) we see that if fibers *x* and *y* are fired, the expression with $|\alpha\rangle_x|\alpha\rangle_y$ should be selected from the terms with coefficients +A besides the expression $|-\alpha\rangle_x|-\alpha\rangle_y$ from the terms with coefficients $-B$. Hence,

$$1,2\ firing \quad \xrightarrow{yields} \quad |\phi'\rangle_{56} = A|\alpha\rangle_5|\alpha\rangle_6 - B|-\alpha\rangle_5|-\alpha\rangle_6 \qquad (7\text{-}2)$$

In another state, if fibers 1 and 4 are fired it means that one fiber is selected from ipsilateral fibers and the other is from contralateral fibers, thus they have phase difference with respect to each other. Hence,

$$1,4\ firing \quad \xrightarrow{yields} \quad |\phi'\rangle_{56} = A|\alpha\rangle_5|-\alpha\rangle_6 - B|-\alpha\rangle_5|\alpha\rangle_6 \qquad (7\text{-}3)$$

To restore initial information, the operator

$$R(\varphi) = e^{-i\pi a^{\dagger}{}_6 a_6}$$

should operate on the state in LGN in which fibers 1 and 4 have conveyed action potentials. This operator changes the ket $|\alpha\rangle_6$ to $|-\alpha\rangle_6$ and vice versa. It means that fiber 4 has a π radian phase difference with respect to fiber 1, and this phase difference can restore the exact state of the photon. If fibers 2 and 3 are fired, this yields:

$$2,3\ \ firing \quad \xrightarrow{yields} \quad |\phi'\rangle_{56} = A|-\alpha\rangle_5|\alpha\rangle_6 - B|\alpha\rangle_5|-\alpha\rangle_6 \qquad (7\text{-}4)$$

In this case the operator

$$R(\varphi) = e^{-i\pi a^{\dagger}{}_5 a_5}$$

should be involved. For the case of 3 and 4 firing, this yields,

$$3,4\ \ firing \quad \xrightarrow{yields} \quad |\phi'\rangle_{56} = A|-\alpha\rangle_5|-\alpha\rangle_6 - B|\alpha\rangle_5|\alpha\rangle_6 \qquad (7\text{-}5)$$

in which case the operator

$$R(\varphi) = e^{-i\pi(a^{\dagger}{}_5 a_5 + a^{\dagger}{}_6 a_6)}$$

should be involved. In this case we see that the main path is that of ipsilateral fibers which are direct to each eye and fibers 3 and 4 both have a π radian phase difference with it. We also know that there are two LGNs and the left and right V1. Now, another question emerges. How do these two left and right parts in V1 can instantaneously receive information? To answer this question, we can say that the synaptic β-neurexin/neuroligin-1 adhesive protein complex is claimed to be a device mediating entanglement between the cytoskeletons of the cortical neurons. Thus the macroscopic coherent quantum state can extend through large brain cortical areas [58].

We see that crossing or rotation of neurons in the visual pathways has an important role in restoring information in the brain. Maybe rotations or crossings of neurons throughout the body are there for this very reason.

8) Discussion

In general, we can briefly summarize our approach by listing the following properties:

1- It can combine the Orch-OR model with Tegmark's approaches and the Thaheld conclusion in a compact physical model which is called Teleportation.
2- It investigates visual pathways from atomic scales to macroscopic scales. This approach includes classical descriptions as well as new answers to open questions.
3- It explains why the shape of action potentials stays the same. Classical models state that "sensations" are action potentials that reach the brain via sensory neurons, and "perception" is the awareness and interpretation of the sensation. It is reasonable to assume that the constant shape of action potentials cannot result in different profiles of information. Thus the shape of information should be due to neurons. In this approach MTs are the representatives of information carriers. In our approach action potentials just determine which neurons fire and which do not.
4- It describes why neurons cross at some point. This crossing causes a phase shift relative to a special pathway. In teleportation of entangled coherent states the phase shift operators can rebuild initial information.

5- It explains that how the inverted image on the retina is perceived in the brain as upright.
6- It can describe how different information can be simultaneously perceived as a binding nature of conscious experience. This can be done via quantum parallel processing.
7- It explains how the brain of the observer can receive quantum information from the environment. We can see that there still exists this possibility that the mind can play the main role in the measurement problem, and this is in accord with what London, Bauer, von Neumann and Wigner (initially) asserted.

9) Conclusions

In this paper we have theoretically demonstrated the plausibility of a quantum teleportation mechanism between the eye and the brain which can describe different aspects of visual processing through visual pathways. Our model covers both quantum and classical aspects of neuroscience. This mechanism can combine some features of the Orch-OR model with Tegmark's conclusions and Thaheld's belief in one general model.

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Teleportation Physics Study

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August 2004

Special Report

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14. ABSTRACT

This study was tasked with the purpose of collecting information describing the teleportation of material objects, providing a description of teleportation as it occurs in physics, its theoretical and experimental status, and a projection of potential applications. The study also consisted of a search for teleportation phenomena occurring naturally or under laboratory conditions that can be assembled into a model describing the conditions required to accomplish the transfer of objects. This included a review and documentation of quantum teleportation, its theoretical basis, technological development, and its potential applications. The characteristics of teleportation were defined and physical theories were evaluated in terms of their ability to completely describe the phenomena. Contemporary physics, as well as theories that presently challenge the current physics paradigm were investigated. The author identified and proposed two unique physics models for teleportation that are based on the manipulation of either the general relativistic spacetime metric or the spacetime vacuum electromagnetic (zero-point fluctuations) parameters. Naturally occurring anomalous teleportation phenomena that were previously studied by the United States and foreign governments were also documented in the study and are reviewed in the report. The author proposes an additional model for teleportation that is based on a combination of the experimental results from the previous government studies and advanced physics concepts. Numerous recommendations outlining proposals for further theoretical and experimental studies are given in the report. The report also includes an extensive teleportation bibliography.

15. SUBJECT TERMS

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FOREWORD

This Special Technical Report presents the results of a subcontracted study performed by Warp Drive Metrics, Las Vegas, NV, under Contract No. F04611-99-C-0025, for the Air Force Research Laboratory (AFRL)/Space and Missile Propulsion Division, Propellant Branch (PRSP), Edwards AFB, CA. The Project Manager for AFRL/PRSP was Dr. Franklin B. Mead, Jr.

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Glossary

AEC	Average Energy Condition
AFRL	Air Force Research Laboratory
AU	Astronomical Unit
BBO	Beta (β)-Barium Borate
CGS	Centimeter-Gram-Second
CIA	Central Intelligence Agency
DARPA	Defense Advanced Research Projects Agency
DEC	Dominant Energy Condition
DIA	Defense Intelligence Agency
DNA	Deoxyribo Nucleic Acid
DoD	Department of Defense
EPR	Einstein, Podolsky and Rosen
ESP	Extrasensory Perception
eV	Electron Volt
FRW	Friedmann-Robertson-Walker
FTL	Faster-Than-Light
IBM	International Business Machines
INSCOM	Intelligence and Security Command
IR	Infrared
MeV	Mega-Electron Volt
MKS	Meter-Kilogram-Second
NEC	Null Energy Condition
NLP	Neuro-Linguistic Programming
NMR	Nuclear Magnetic Resonance
NSA	National Security Agency
PK	Psychokinesis
PPN	Parameterized Post-Newtonian
PRC	Peoples Republic of China
PV-GR	Polarizable-Vacuum Representation of General Relativity
QED	Quantum Electrodynamics
QISP	Quantum Information Science Program
R&D	Research and Development
SAIC	Science Applications International Corporation
SEC	Strong Energy Condition
SRI	Stanford Research Institute
USSR	Union of Soviet Socialist Republics
UV	Ultraviolet
WEC	Weak Energy Condition
ZPE	Zero-Point Energy
ZPF	Zero-Point Fluctuations

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Preface

The Teleportation Physics Study is divided into four phases. Phase I is a review and documentation of quantum teleportation, its theoretical basis, technological development, and its potential application. Phase II developed a textbook description of teleportation as it occurs in classical physics, explored its theoretical and experimental status, and projected its potential applications. Phase III consisted of a search for teleportation phenomena occurring naturally or under laboratory conditions that can be assembled into a model describing the conditions required to accomplish the disembodied conveyance of objects. The characteristics of teleportation were defined, and physical theories were evaluated in terms of their ability to completely describe the phenomenon. Presently accepted physics theories, as well as theories that challenge the current physics paradigm were investigated for completeness. The theories that provide the best chance of explaining teleportation were selected, and experiments with a high chance of accomplishing teleportation were identified. Phase IV is the final report.

The report contains five chapters. Chapter 1 is an overview of the textbook descriptions for the various teleportation phenomena that are found in nature, in theoretical physics concepts, and in experimental laboratory work. Chapter 2 proposes two quasi-classical physics concepts for teleportation: the first is based on engineering the spacetime metric to induce a traversable wormhole; the second is based on the polarizable-vacuum-general relativity approach that treats spacetime metric changes in terms of equivalent changes in the vacuum permittivity and permeability constants. These concepts are theoretically developed and presented. Promising laboratory experiments were identified and recommended for further research. Chapter 3 presents the current state-of-art of quantum teleportation physics, its theoretical basis, technological development, and its applications. Key theoretical, experimental, and applications breakthroughs were identified, and a series of theoretical and experimental research programs are proposed to solve technical problems and advance quantum teleportation physics. Chapter 4 gives an overview of alternative teleportation concepts that challenge the present physics paradigm. These concepts are based on the existence of parallel universes/spaces and/or extra space dimensions. The theoretical and experimental work that has been done to develop these concepts is reviewed, and a recommendation for further research is made. Last, Chapter 5 gives an in-depth overview of unusual teleportation phenomena that occur naturally and under laboratory conditions. The teleportation phenomenon discussed in the chapter is based on psychokinesis (PK), which is a category of psychotronics. The U.S. military-intelligence literature is reviewed, which relates the historical scientific research performed on PK-teleportation in the U.S., China and the former Soviet Union. The material discussed in the chapter largely challenges the current physics paradigm; however, extensive controlled and repeatable laboratory data exists to suggest that PK-teleportation is quite real and that it is controllable. The report ends with a combined list of references.

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1.0 INTRODUCTION

1.1 Introduction

The concept of teleportation was originally developed during the Golden Age of 20th century science fiction literature by writers in need of a form of instantaneous disembodied transportation technology to support the plots of their stories. Teleportation has appeared in such SciFi literature classics as Algis Budry's *Rogue Moon* (Gold Medal Books, 1960), A. E. van Vogt's *World of Null-A* (Astounding Science Fiction, August 1945), and George Langelaan's *The Fly* (Playboy Magazine, June 1957). The Playboy Magazine short story led to a cottage industry of popular films decrying the horrors of scientific technology that exceeded mankind's wisdom: *The Fly* (1958), *Return of the Fly* (1959), *Curse of the Fly* (1965), *The Fly* (a 1986 remake), and *The Fly II* (1989). The teleportation concept has also appeared in episodes of popular television SciFi anthology series such as *The Twilight Zone* and *The Outer Limits*. But the most widely recognized pop-culture awareness of the teleportation concept began with the numerous *Star Trek* television and theatrical movie series of the past 39 years (beginning in 1964 with the first TV series pilot episode, *The Cage*), which are now an international entertainment and product franchise that was originally spawned by the late genius television writer-producer Gene Roddenberry. Because of *Star Trek* everyone in the world is familiar with the "transporter" device, which is used to teleport personnel and material from starship to starship or from ship to planet and vice versa at the speed of light. People or inanimate objects would be positioned on the transporter pad and become completely disintegrated by a beam with their atoms being patterned in a computer buffer and later converted into a beam that is directed toward the destination, and then reintegrated back into their original form (all without error!). "*Beam me up, Scotty*" is a familiar automobile bumper sticker or cry of exasperation that were popularly adopted from the series.

However, the late Dr. Robert L. Forward (2001) stated that modern hard-core SciFi literature, with the exception of the ongoing *Star Trek* franchise, has abandoned using the teleportation concept because writers believe that it has more to do with the realms of parapsychology/paranormal (a.k.a. psychic) and imaginative fantasy than with any realm of science. Beginning in the 1980s developments in quantum theory and general relativity physics have succeeded in pushing the envelope in exploring the reality of teleportation. A crescendo of scientific and popular literature appearing in the 1990s and as recently as 2003 has raised public awareness of the new technological possibilities offered by teleportation. As for the psychic aspect of teleportation, it became known to Dr. Forward and myself, along with several colleagues both inside and outside of government, that anomalous teleportation has been scientifically investigated and separately documented by the Department of Defense.

It has been recognized that extending the present research in quantum teleportation and developing alternative forms of teleportation physics would have a high payoff impact on communications and transportation technologies in the civilian and military sectors. It is the purpose of this study to explore the physics of teleportation and delineate its characteristics and performances, and to make recommendations for further studies in support of Air Force Advanced Concepts programs.

1.2 The Definitions of Teleportation

Before proceeding, it is necessary to give a definition for each of the teleportation concepts I have identified during the course of this study:

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- *Teleportation* – SciFi: the disembodied transport of persons or inanimate objects across space by advanced (futuristic) technological means (adapted from Vaidman, 2001). We will call this *sf-Teleportation*, which will not be considered further in this study.

- *Teleportation* – psychic: the conveyance of persons or inanimate objects by psychic means. We will call this *p-Teleportation*.

- *Teleportation* – engineering the vacuum or spacetime metric: the conveyance of persons or inanimate objects across space by altering the properties of the spacetime vacuum, or by altering the spacetime metric (geometry). We will call this *vm-Teleportation*.

- *Teleportation* – quantum entanglement: the disembodied transport of the quantum state of a system and its correlations across space to another system, where *system* refers to any single or collective particles of matter or energy such as baryons (protons, neutrons, etc.), leptons (electrons, etc.), photons, atoms, ions, etc. We will call this *q-Teleportation*.

- *Teleportation* – exotic: the conveyance of persons or inanimate objects by transport through extra space dimensions or parallel universes. We will call this *e-Teleportation*.

We will examine each of these in detail in the following chapters and determine whether any of the above teleportation concepts encompass the instantaneous and or disembodied conveyance of objects through space.

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2.0 vm-TELEPORTATION

2.1 Engineering the Spacetime Metric

A comprehensive literature search for vm-Teleportation within the genre of spacetime metric engineering yielded no results. No one in the general relativity community has thought to apply the Einstein field equation to determine whether there are solutions compatible with the concept of teleportation. Therefore, I will offer two solutions that I believe will satisfy the definition of vm-Teleportation. The first solution can be found from the class of traversable wormholes giving rise to what I call a true "stargate." A stargate is essentially a wormhole with a flat-face shape for the throat as opposed to the spherical-shaped throat of the Morris and Thorne (1988) traversable wormhole, which was derived from a spherically symmetric Lorentzian spacetime metric that prescribes the wormhole geometry (see also, Visser, 1995 for a complete review of traversable Lorentzian wormholes):

$$ds^2 = -e^{2\phi(r)}c^2dt^2 + [1-b(r)/r]^{-1}dr^2 + r^2d\Omega^2 \qquad (2.1),$$

where by inspection we can write the traversable wormhole metric tensor in the form

$$g_{\alpha\beta} = \begin{pmatrix} -e^{2\phi(r)} & 0 & 0 & 0 \\ 0 & [1-b(r)/r]^{-1} & 0 & 0 \\ 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & r^2\sin^2\theta \end{pmatrix} \qquad (2.2)$$

using standard spherical coordinates, where c is the speed of light, $\alpha,\beta \equiv (0 = t,\ 1 = r,\ 2 = \theta,\ 3 = \varphi)$ are the time and space coordinate indices ($-\infty < t < \infty$; r: $2\pi r$ = circumference; $0 \le \theta \le \pi$; $0 \le \varphi \le 2\pi$), $d\Omega^2 = d\theta^2 + sin^2\theta d\varphi^2$, $\phi(r)$ is the freely specifiable redshift function that defines the proper time lapse through the wormhole throat, and $b(r)$ is the freely specifiable shape function that defines the wormhole throat's spatial (hypersurface) geometry. Such spacetimes are asymptotically flat. The Einstein field equation requires that a localized source of matter-energy be specified in order to determine the geometry that the source induces on the local spacetime. We can also work the Einstein equation backwards by specifying the local geometry in advance and then calculate the matter-energy source required to induce the desired geometry. The Einstein field equation thus relates the spacetime geometry terms comprised of the components of the metric tensor and their derivatives (a.k.a. the Einstein tensor) to the local matter-energy source terms comprised of the energy and stress-tension densities (a.k.a. the stress-energy tensor). The flat-face wormhole or stargate is derived in the following section.

2.1.1 Wormhole Thin Shell Formalism

The flat-face traversable wormhole solution is derived from the thin shell (a.k.a. junction condition or surface layer) formalism of the Einstein equations (Visser, 1989; see also, Misner, Thorne and Wheeler, 1973). We adapt Visser's (1989) development in the following discussion. The procedure is to take two copies of flat Minkowski space and remove from each identical regions of the form $\Omega \times \Re$, where Ω is a three-dimensional compact spacelike hypersurface and $\Re$ is a timelike straight line (time axis). Then identify these two incomplete spacetimes along the timelike boundaries $\partial\Omega \times \Re$. The resulting spacetime

is geodesically complete and possesses two asymptotically flat regions connected by a wormhole. The throat of the wormhole is just the junction $\partial\Omega$ (a two-dimensional space-like hypersurface) at which the two original Minkowski spaces are identified (see Figures 1 and 2).

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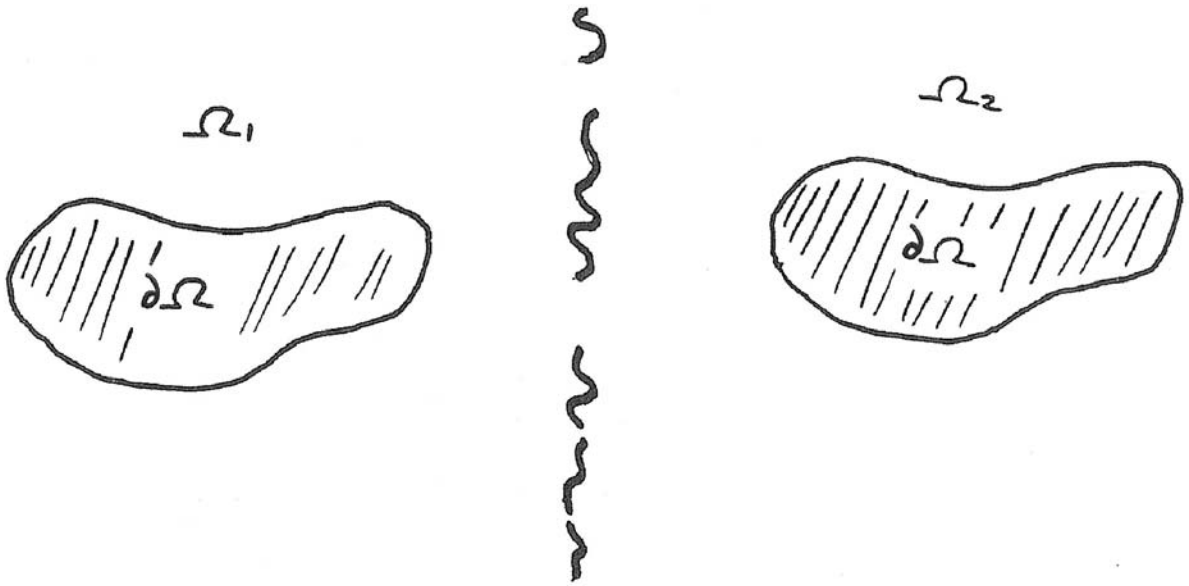

Figure 1. Diagram of a Simultaneous View of Two Remote Compact Regions (Ω_1 and Ω_2) of Minkowski Space Used to Create the Wormhole Throat $\partial\Omega$, Where Time is Suppressed in This Representation (adapted from Bennett et al., 1995)

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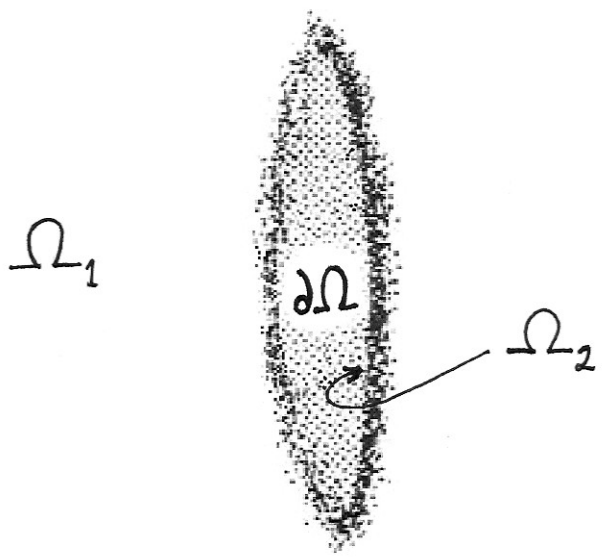

Figure 2. The Same Diagram as in Figure 1 Except as Viewed by an Observer Sitting in Region Ω_1 Who Looks Through the Wormhole Throat $\partial\Omega$ and Sees Remote Region Ω_2 (Dotted Area Inside the Circle) on the Other Side

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The resulting spacetime is everywhere Riemann-flat except possibly at the throat. Also, the stress-energy tensor in this spacetime is concentrated at the throat with a δ-function singularity there. This is a consequence of the fact that the spacetime metric at the throat is continuous but not differentiable, while the connection is discontinuous; thus causing the Riemann curvature to possess a δ-function singularity (causing undesirable gravitational tidal forces) there. The magnitude of this δ-function singularity can be calculated in terms of the second fundamental form on both sides of the throat, which we presume to be generated by a localized thin shell of matter-energy. The second fundamental form represents the extrinsic curvature of the $\partial\Omega$ hypersurface (i.e., the wormhole throat), telling how it is curved with respect to the enveloping four-dimensional spacetime. The form of the geometry is simple, so the second fundamental form at the throat is calculated to be (McConnell, 1957):

$$\begin{aligned} K^{i}{}_{j}{}^{\pm} &= \pm\begin{pmatrix} \kappa_0 & 0 & 0 \\ 0 & \kappa_1 & 0 \\ 0 & 0 & \kappa_2 \end{pmatrix} \\ &= \pm\begin{pmatrix} 0 & 0 & 0 \\ 0 & 1/\rho_1 & 0 \\ 0 & 0 & 1/\rho_2 \end{pmatrix} \end{aligned} \qquad (2.3),$$

where $i,j = 0,1,2$ and $K^{i\pm}_{j}$ is the second fundamental form. The full 4×4 matrix $K^{\alpha}{}_{\beta}$ has been reduced to 3×3 form, as above, for computational convenience because the thin shell (or hypersurface) is essentially a two-surface embedded in three-space. The overall ± sign in equation (2.3) comes from the fact that a unit normal points outward from one side of the surface and points inward on the other side. We hereafter drop the ± sign for the sake of brevity in notation. The quantities κ_0, κ_1, and κ_2 measure the extrinsic curvature of the thin shell of local matter-energy (i.e., the stuff that induces the wormhole throat geometry). Since the wormhole throat is a space-like hypersurface, we can exclude time-like hypersurfaces and their components in the calculations. Therefore we set $\kappa_0 = 0$ in equation (2.3) because it is the time-like extrinsic curvature for the time-like hypersurface of the thin shell of matter-energy. As seen in equation (2.3) κ_1 and κ_2 are simply related to the two principal radii of curvature ρ_1 and ρ_2 (defined to be the eigenvalues of K^{i}_{j}) of the two-dimensional spacelike hypersurface $\partial\Omega$ (see Figure 3). It should be noted that a convex surface has positive radii of curvature, while a concave surface has negative radii of curvature.

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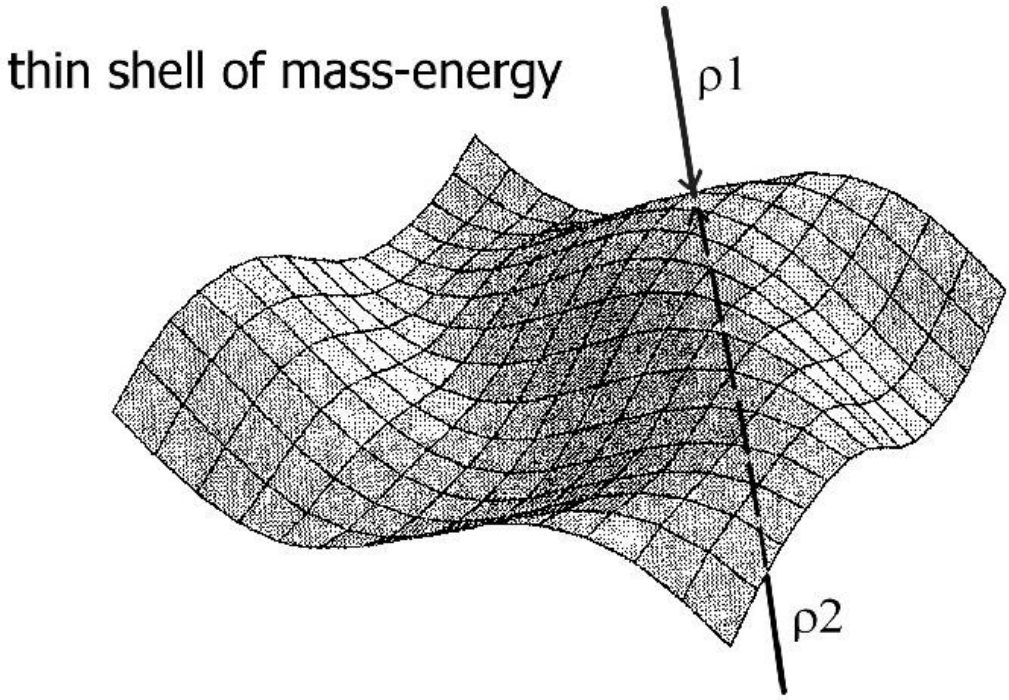

Figure 3. A Thin Shell of (Localized) Matter-Energy, or Rather the Two-Dimensional Spacelike Hypersurface $\partial\Omega$ (via (2.3)), Possessing the Two Principal Radii of Curvature ρ_1 and ρ_2

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It is a standard result of the thin shell or junction condition formalism that the Einstein field equation may be cast in terms of the surface stress-energy tensor S^i_j of the thin matter-energy shell localized in $\partial\Omega$ (note: we are exploiting the symmetry of the wormhole with respect to interchange of the two flat regions Ω_1 and Ω_2):

$$S^i{}_j = -\frac{c^4}{4\pi G}\left(K^i{}_j - \delta^i{}_j K^k{}_k\right) \quad (2.4),$$

where G is Newton's gravitational constant and δ^i_j is the (three-dimensional) unit matrix. K^k_k is the trace of equation (2.3):

$$\begin{aligned} K^k{}_k &= Tr\, K^i{}_j \\ &= \frac{1}{\rho_1} + \frac{1}{\rho_2} \end{aligned} \qquad (2.5)$$

and

$$\delta^i{}_j K^k{}_k = \begin{pmatrix} \frac{1}{\rho_1} + \frac{1}{\rho_2} & 0 & 0 \\ 0 & \frac{1}{\rho_1} + \frac{1}{\rho_2} & 0 \\ 0 & 0 & \frac{1}{\rho_1} + \frac{1}{\rho_2} \end{pmatrix} \qquad (2.6).$$

Substituting (2.3) and (2.6) into (2.4) gives (after simplification):

$$S^i{}_j = \frac{c^4}{4\pi G}\begin{pmatrix} \frac{1}{\rho_1} + \frac{1}{\rho_2} & 0 & 0 \\ 0 & 1/\rho_2 & 0 \\ 0 & 0 & 1/\rho_1 \end{pmatrix} \qquad (2.7).$$

The thin matter-energy shell's surface stress-energy tensor may be interpreted in terms of the surface energy density σ and principal surface tensions ϑ_1 and ϑ_2:

$$S^i{}_j = \begin{pmatrix} -\sigma & 0 & 0 \\ 0 & -\vartheta_1 & 0 \\ 0 & 0 & -\vartheta_2 \end{pmatrix} \qquad (2.8).$$

Thus we arrive at the Einstein field equation by equating (2.8) and (2.7) and multiplying both sides by –1:

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$$\begin{pmatrix} \sigma & 0 & 0 \\ 0 & \vartheta_1 & 0 \\ 0 & 0 & \vartheta_2 \end{pmatrix} = -\frac{c^4}{4\pi G}\begin{pmatrix} \frac{1}{\rho_1}+\frac{1}{\rho_2} & 0 & 0 \\ 0 & 1/\rho_2 & 0 \\ 0 & 0 & 1/\rho_1 \end{pmatrix} \qquad (2.9),$$

which gives the final result

$$\sigma = -\frac{c^4}{4\pi G}\left(\frac{1}{\rho_1}+\frac{1}{\rho_2}\right) \qquad (2.10a)$$

$$\vartheta_1 = -\frac{c^4}{4\pi G}\frac{1}{\rho_2} \qquad (2.10b)$$

$$\vartheta_2 = -\frac{c^4}{4\pi G}\frac{1}{\rho_1} \qquad (2.10c).$$

These are the Einstein equations. Equations (2.10a-c) imply that (for $\partial\Omega$ convex) we are dealing with ***negative*** surface energy density and ***negative*** surface tensions. This result is in fact the primary matter-energy requirement for traversable wormholes, as was proved by Morris and Thorne (1988), and later by Visser (1995), within the paradigm of classical Einstein general relativity. The negative surface tension (= *positive outward pressure*, a.k.a. gravitational repulsion or antigravity) is needed to keep the throat open and stable against collapse. The reader should **not** be alarmed at this result. Negative energies and negative stress-tensions are an acceptable result both mathematically and physically, and they manifest gravitational repulsion (antigravity!) in and around the wormhole throat. One only needs to understand what it means for stress-energy to be negative within the proper context. In general relativity the term "*exotic*" is used in place of "*negative*." The effects of negative energy have been produced in the laboratory (the Casimir Effect is one example). In short, negative energy arises from Heisenberg's quantum uncertainty principle, which requires that the energy density of any electromagnetic, magnetic, electric or other fields must fluctuate randomly. Even in a vacuum, where the average energy density is zero, the energy density fluctuates. This means that the quantum vacuum can never remain truly empty in the classical sense of the term. The quantum picture of the vacuum is that of a turbulent plenum of virtual (i.e., energy non-conserving) particle pairs that spontaneously pop in and out of existence. The notion of "zero energy" in quantum theory corresponds to the vacuum being filled with such fluctuations going on. This issue is further elaborated on and clarified in greater detail in Appendix A. We will also revisit this in Section 2.2. Finally, it should be noted that for the analysis in this section we assumed an ultrastatic wormhole [i.e., $g_{00} \equiv 1 \Rightarrow \phi(r) = 0$ in equation (2.1)] with the "exotic" matter-energy confined to a thin layer, and we dispensed with the assumption of spherical symmetry.

We can now build a wormhole-stargate and affect *vm-Teleportation* such that a traveler stepping into the throat encounters **no** exotic matter-energy there. This will require that our wormhole be flat shaped. To make the wormhole flat requires that we choose the throat $\partial\Omega$ to have at least one flat face (picture the thin shell in Figure 3 becoming a flat shell). On that face the two principal radii of curvature become $\rho_1 = \rho_2 = \infty$ as required by standard geometry. Substituting this into equations (2.10a-c) gives

$$\sigma = \vartheta_1 = \vartheta_2 = 0 \qquad (2.11),$$

which is a remarkable result. A further consequence of this is that now $K^i_j = 0$, thus making the Riemann curvature and stress-energy tensors (Riemann: $R^\alpha{}_\beta \sim K^\alpha{}_\beta$; stress-energy: $T^\alpha{}_\beta \sim K^\alpha{}_\beta$) at the throat become zero such that the associated δ-function singularities disappear there. This means that a traveler encountering and going through such a wormhole will feel no tidal gravitational forces and see no exotic matter-energy (that threads the throat). A traveler stepping through the throat will simply be <u>*teleported*</u> into the other remote spacetime region or another universe (note: the Einstein equation does not fix the spacetime topology, so it is possible that wormholes are inter-universe as well as intra-universe tunnels). We construct such a *teleportation* stargate by generating a thin shell or surface layer of "exotic" matter-energy much like a thin film of soap stretched across a loop of wire.

2.1.2 "Exotic" Matter-Energy Requirements

Now we have to estimate the amount of negative (or exotic) mass-energy that will be needed to generate and hold open a *vm-Teleportation* wormhole. A simple formula originally due to Visser (1995) for short-throat wormholes using the thin shell formalism gives:

$$\begin{aligned} M_{wh} &= -\frac{r_{throat}c^2}{G} \\ &= -(1.3469\,x10^{27}\,kg)\frac{r_{throat}}{1\,meter} \qquad (2.12), \\ &= -(0.709\,M_{Jupiter})\frac{r_{throat}}{1\,meter} \end{aligned}$$

where M_{wh} is the mass required to build the wormhole, r_{throat} is a suitable measure of the linear dimension (radius) of the throat, and $M_{Jupiter}$ is the mass of the planet Jupiter (1.90×10^{27} kg). Equation (2.12) demonstrates that a mass of $-0.709\ M_{Jupiter}$ (or -1.3469×10^{27} kg) will be required to build a wormhole 1 meter in size. As the wormhole size increases the mass requirement grows negative-large, and vice versa as the wormhole size decreases. After being alarmed by the magnitude of this, one should note that M_{wh} is **<u>not</u>** the total mass of the wormhole as seen by observers at remote distances. The non-linearity of the Einstein field equations dictates that the total mass is zero (actually, the total net mass being positive, negative or zero in the Newtonian approximation depending on the details of the negative energy configuration constituting the wormhole system). And finally, Visser et al. (2003) have demonstrated the existence of spacetime geometries containing traversable wormholes that are supported by ***<u>arbitrarily small quantities</u>*** of exotic matter-energy, and they proved that this was a general result. In Section 2.3 we will discuss how or whether we can create such a wormhole in the laboratory.

2.2 Engineering the Vacuum

Engineering the spacetime vacuum provides a second solution that also satisfies the definition of vm-Teleportation. The concept of "*engineering the vacuum*" was first introduced to the physics community by Lee (1988). Lee stated:

"*The experimental method to alter the properties of the vacuum may be called vacuum engineering…If indeed we are able to alter the vacuum, then we may encounter some new phenomena, totally unexpected*."

This new concept is based on the now-accepted fact that the vacuum is characterized by physical parameters and structure that constitutes an energetic medium which pervades the entire extent of the

universe. We note here the two most important defining properties of the vacuum in this regard (Puthoff et al., 2002):

- Within the context of quantum field theory the vacuum is the seat of all energetic particle and field fluctuations.

- Within the context of general relativity theory the vacuum is the seat of a spacetime structure (or metric) that encodes the distribution of matter and energy.

We begin our look into this concept by examining the propagation of light through space. We know from quantum field theory that light propagating through space interacts with the vacuum quantum fields (a.k.a. vacuum quantum field fluctuations). The observable properties of light, including the speed of light, are determined by these interactions. Vacuum quantum interactions with light lead to an effect on the speed of light that is due to the absorption of photons (by the vacuum) to form virtual electron-positron pairs followed by the quick re-emission (from the vacuum) of the photon (see Figure 4). The virtual particle pairs are very short lived because of the large mismatch between the energy of a photon and the rest mass-energy of the particle pair. A key point is that this process makes a contribution to the observed vacuum permittivity ε_0 (and permeability μ_0) constant and, therefore, to the speed of light c [$c = (\varepsilon_0\mu_0)^{-1/2}$].

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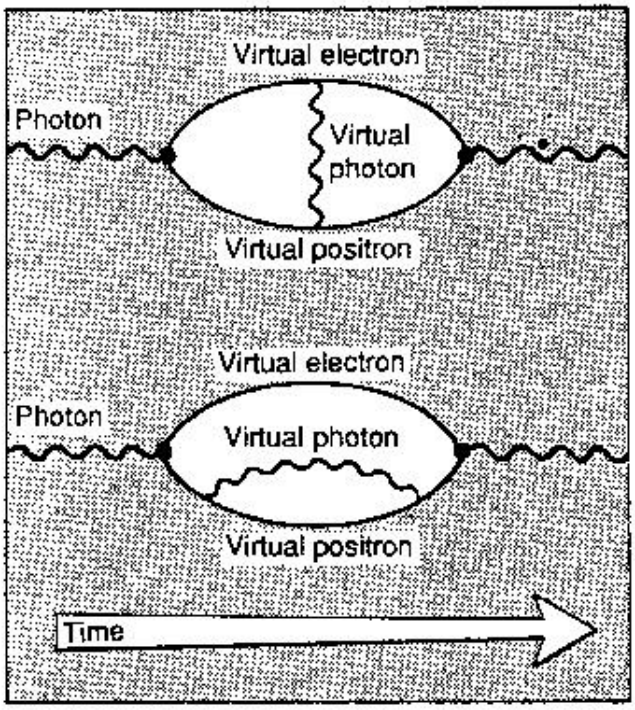

Photons can change into a variety of short-lived, or "virtual", particles as they fly through the vacuum. The processes above, represented by Feynman diagrams, are "two-loop"' processes. They affect light's speed

Figure 4. A Schematic of Vacuum Quantum Field Fluctuations (a.k.a. Vacuum Zero Point Field Fluctuations) Involved in the "Light-by-Light" Scattering Process That Affects the Speed of Light (from Chown, 1990)

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The role of virtual particle pairs in determining the ε_0 (μ_0) of the vacuum is analogous to that of atoms/molecules in determining the relative permittivity ε (and μ) of a dielectric material. We know that the absorption/re-emission of photons by atoms/molecules in a transparent medium (note: there are no strongly absorbing resonances, so the atoms/molecules remain in their excited states for a very short time before re-emitting photons) is responsible for the refractive index of the medium, which results in the reduction of the speed of light for photons propagating through the medium. This absorption/re-emission process is also known in physics as a scattering process. We know from experiment that a change in the medium leads to a change in ε (μ), thus resulting in a change of the refractive index. The key point arising from this analogy is that a modification of the vacuum produces a change in ε_0 (μ_0) resulting in a subsequent change in c, and hence, a corresponding change in the vacuum refraction index.

Scharnhorst (1990) and Latorre et al. (1995) have since proved that the suppression of light scattering by virtual particle pairs (a.k.a. coherent light-by-light scattering) in the vacuum causes an ***increase*** in the speed of light accompanied by a decrease in the vacuum refraction index. This very unique effect is accomplished in a Casimir Effect capacitor cavity (or waveguide) whereby the vacuum quantum field fluctuations (a.k.a. zero-point fluctuations or ZPF) inside have been modified (becoming anisotropic and non-translational invariant) to satisfy the electromagnetic boundary conditions imposed by the presence of the capacitor plates (or waveguide walls). The principal result of this modification is the removal of the electromagnetic zero-point energy (ZPE) due to the suppression of vacuum ZPE modes with wavelengths longer than the cavity/waveguide cutoff ($\lambda_0 = 2d$, where d = plate separation; see Figure 5). This removal of free space vacuum ZPE modes suppresses the scattering of light by virtual particle pairs, thus producing the speed of light increase (and corresponding decrease in the vacuum refraction index). We know from standard optical physics and quantum electrodynamics (QED) that the optical phase and group velocities can exceed c under certain physical conditions, but dispersion always ensures that the signal velocity is $\leq c$. But recent QED calculations (see, Scharnhorst, 1990 and Latorre et al., 1995) have proved that in the Casimir Effect system, the dispersive effects are *much weaker* still than those associated with the increase in c so that the phase, group and signal velocities will therefore *all increase* by the same amount. Note that, in general, no dispersion shows up in all of the modified vacuum effects examined by investigators.

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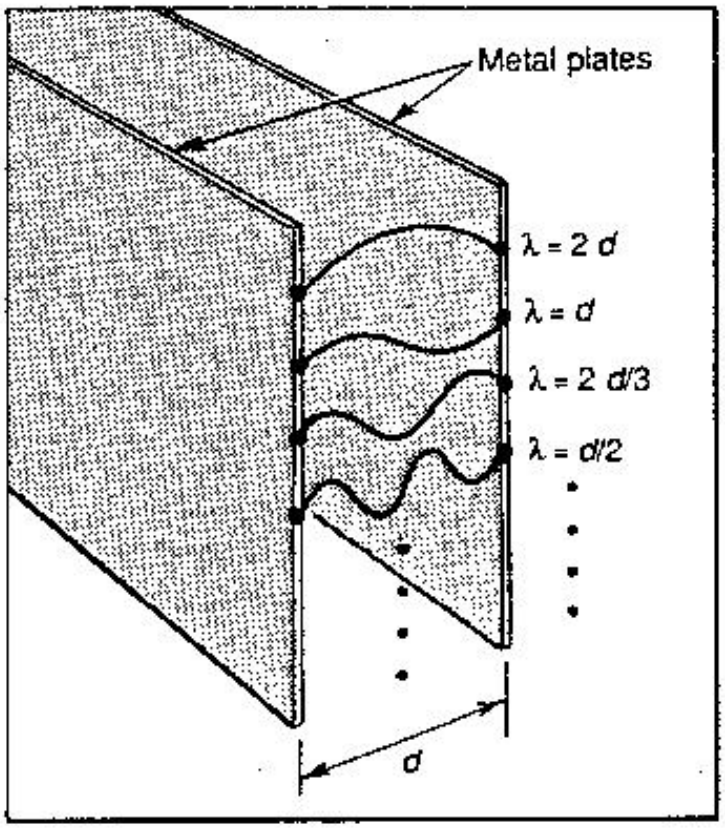

Casimir effect: the vacuum is full of virtual photons, but photons with wavelengths (λ), more than twice the separation of the plates, are excluded from the space between them. The imbalance pushes the plates together

Figure 5. A Schematic of the Casimir Effect Cavity/Waveguide (from Chown, 1990)

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Examples demonstrating the increase in light speed (decrease in vacuum refraction index) via the Casimir Effect vacuum and other modified vacuum effects, as well as those effects producing a decrease in light speed (increase in vacuum refraction index), are described as follows. The vacuum modification effect on the speed of light described in the previous paragraph is (Scharnhorst, 1990):

$$\begin{aligned}\frac{c_\perp^{\ *}}{c_0} &= \left(1+\frac{11}{2^6\bullet(45)^2}\frac{e^4}{(m_e a)^4}\right) \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1) \\ &= \left(1+\frac{11\pi^2}{8100}\alpha^2\frac{1}{(m_e a)^4}\right) > 1\end{aligned} \qquad (2.13),$$

where $c_\perp^{\ *}$ is the (modified) speed of light propagation perpendicular to the Casimir Effect capacitor plates, c_0 is the speed of light in free space (3×10^8 m/s in MKS units), m_e is the electron mass, α is the fine structure constant ($\approx 1/137$), e is the electron charge ($e^2 = 4\pi\alpha$ in quantum field theory natural units), a is the plate separation, $\hbar$ is Planck's reduced constant, and ε_0 is the vacuum permittivity constant. The condition $\hbar = c_0 = \varepsilon_0 = \mu_0 = 1$ stresses that (2.13), and all the equations that follow, are in quantum field theory natural units. The speed of light and vacuum refraction index measured parallel to the plates is unchanged from their free space values ($c_\parallel = c_0$, $n_\parallel = n_0 = 1$). The modified vacuum refraction index measured perpendicular to the plates is (Scharnhorst, 1990):

$$n_\perp = \left(1-\frac{11}{2^6\bullet(45)^2}\frac{e^4}{(m_e a)^4}\right) < 1 \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1) \qquad (2.14).$$

Equations (2.13) and (2.14) show that in general $n_\perp < 1$ and $c_\perp^{\ *} > c_0$. But $c_\perp^{\ *} \to c_0$ and $n_\perp \to 1$ when $a \to \infty$ as expected, since we are now allowing all of the vacuum ZPE modes to re-enter the Casimir cavity in this case.

We now survey the additional examples of modified vacuums which increase/decrease light speed (from Latorre et al., 1995):

- For light (photons) propagating in a Friedmann-Robertson-Walker (FRW) vacuum (i.e., a homogeneous and isotropic Robertson-Walker gravitational background with Friedmann cosmology):

$$\frac{c^*}{c_0} = \left(1+\frac{11}{45}\alpha G\frac{\rho_r + p}{m_e^{\ 2}}\right) > 1 \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1) \qquad (2.15),$$

where c^* is the modified vacuum speed of light, G is Newton's constant, ρ_r is the energy density and p is the pressure of a radiation-dominated universe ($p = \rho_r/3$). Here the speed of light is increased.

- For light (photons) propagating in a homogeneous and isotropic thermal vacuum:

$$\frac{c^*}{c_0} = \left(1-\frac{44\pi^2}{2025}\alpha^2\frac{T^4}{m_e^{\ 4}}\right) < 1 \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = k_B = 1) \qquad (2.16),$$

where T is the temperature of the vacuum and k_B is the Boltzmann constant. Here the speed of light is decreased.

- For light (photons) propagating in an anisotropic vacuum given by an external constant uniform magnetic field $\boldsymbol{B}$:

$$\frac{c_{\parallel}^{*}}{c_0} = \left(1 - \frac{8}{45}\alpha^2 \frac{\mathbf{B}^2}{m_e^{\,4}} \sin^2\theta\right) < 1 \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1)$$
$$\frac{c_{\perp}^{*}}{c_0} = \left(1 - \frac{14}{45}\alpha^2 \frac{\mathbf{B}^2}{m_e^{\,4}} \sin^2\theta\right) < 1 \qquad (2.17),$$

where the speed of light is decreased in this vacuum for polarizations coplanar (||) with and perpendicular (⊥) to the plane defined by $\boldsymbol{B}$ and the direction of propagation, and θ is the angle between $\boldsymbol{B}$ and the direction of propagation. Latorre et al. (1995) calculated the polarization-average of (2.17) to give the averaged (modified) speed of light in the B-field:

$$\frac{c^*}{c_0} = \left(1 - \frac{22}{135}\alpha^2 \frac{\mathbf{B}^2}{m_e^{\,4}}\right) < 1 \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1) \quad (2.18).$$

- For light (photons) propagating in an anisotropic vacuum given by an external constant uniform electric field $\boldsymbol{E}$, the polarization-averaged modified speed of light is:

$$\frac{c^*}{c_0} = \left(1 - \frac{22}{135}\alpha^2 \frac{\mathbf{E}^2}{m_e^{\,4}}\right) < 1 \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1) \qquad (2.19).$$

Here the speed of light is decreased.

Equations (2.16) – (2.19) are the result of vacuum modifications that populate the vacuum with virtual or real particles that induce coherent (light-by-light) scattering, which reduces the speed of massless particles. By examining the form of equations (2.13) and (2.15) – (2.19) Latorre et al. (1995) discovered that the low energy modification of the speed of light is proportional to the ratio of the modified vacuum energy density (as compared to the standard vacuum energy density, $\rho_{vac} = 0$) over m_e^4, with a universal numerical coefficient and the corresponding coupling constants. And a general rule became apparent from their analysis that is applicable to modified vacua for massive and massless quantum field theories, for low energy:

$c^* > c_0$ (vacuum refraction index < 1) when the modified vacuum has a lower energy density
$c^* < c_0$ (vacuum refraction index > 1) when the modified vacuum has a higher energy density
$c^* = c_0$ (vacuum refraction index = 1) when the vacuum is free (or un-modified) with $\rho_{vac} = 0$

The first two rules explain the sign of the change of the speed of light. From this rule and the mathematical commonality between the form of (2.13) and (2.15) – (2.19) Latorre et al. (1995) found a single unifying expression to replace these equations:

$$\frac{c^*}{c_0} = 1 - \frac{44}{135}\alpha^2 \frac{\rho}{m_e^{\,4}} \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1) \qquad (2.20),$$

where ρ is the energy density of the modified vacua under consideration such that $\rho \to \rho_E \sim \boldsymbol{E}^2$ for the electric field vacuum, $\rho \to \rho_B \sim \boldsymbol{B}^2$ for the magnetic field vacuum, and $\rho \to \rho_T \sim \pi^2 T^4$ for the thermal vacuum. If the vacuum is a FRW gravitational vacuum, then one has to substitute one factor of α in (2.20) by $-m_e^2 G$ and $\rho \to \rho_r$. Equation (2.13) for the Casimir Effect vacuum studied earlier is recovered when $\rho \to \rho_{Casimir} = -(\pi^2/240)a^{-4}$.

Let us recast (2.20) into a more useful form. We subtract one from both sides of (2.20), do some algebra, and thus define the ratio of the change in the speed of light Δc in a modified vacuum to the speed of light in free space c_0:

$$\frac{c^*}{c_0} - 1 = \frac{c^* - c_0}{c_0} \equiv \frac{\Delta c}{c_0}$$

$$\frac{\Delta c}{c_0} = -\frac{44}{135}\alpha^2 \frac{\rho}{m_e^{\,4}} \qquad (\hbar = c_0 = \varepsilon_0 = \mu_0 = 1) \quad (2.21).$$

Equations (2.20) and (2.21) are in quantum field theory natural units, which is completely undesirable for estimating physically measurable values of $\Delta c/c_0$. We thus transform or "unwrap" (2.20) and (2.21) back into MKS or CGS units by making the following substitutions (Puthoff, 2003)

$$\rho \text{ (natural units)} \to \frac{\rho}{\hbar c} \text{ (MKS or CGS units)}$$

$$m_e \text{ (natural units)} \to \frac{m_e c}{\hbar} \text{ (MKS or CGS units)},$$

and after some algebra and rearranging we arrive at the final result:

$$\frac{c^*}{c_0} = 1 - \frac{44}{135}\alpha^2 \frac{\rho}{m_e c_0^{\,2}} \left(\frac{\hbar}{m_e c_0} \right)^3 \qquad (2.22)$$

and

$$\frac{\Delta c}{c_0} = -\frac{44}{135}\alpha^2 \frac{\rho}{m_e c_0^{\,2}} \left(\frac{\hbar}{m_e c_0} \right)^3 \qquad (2.23),$$

where all quantities are now in MKS or CGS units. We chose the former units so that $c_0 = 3\times10^8$ m/s, $\hbar = 1.055\times10^{-34}$ J-s, $m_e = 9.11\times10^{-31}$ kg, and $\alpha = 1/137$. Note that the ratio of the modified vacuum energy density to the electron rest-mass energy has the dimension of (*volume*)$^{-1}$ while the quantity in the bracket is the cubed Compton wavelength of the electron having the dimension of (*volume*), and the product of these is dimensionless.

An excellent example for estimating the magnitude of the change in the speed of light (in a modified vacuum) is the Casimir Effect vacuum, since Casimir Effect experiments are common and widespread such that this would be ideal to experimentally test (2.23). We substitute the Casimir vacuum energy density $\rho_{Casimir} = -(\pi^2 \hbar c_0/240)a^{-4}$ (in MKS units) into (2.23), do the algebra, insert the MKS values for the physical constants, and make further simplifications to get:

$$\frac{\Delta c}{c_0} = -\frac{44}{135}\alpha^2\left(-\frac{\pi^2}{240}\frac{\hbar c_0}{a^4}\right)\frac{1}{m_e c_0^{\,2}}\left(\frac{\hbar}{m_e c_0}\right)^3$$
$$= \frac{11}{8100}\alpha^2\pi^2\left(\frac{\hbar}{m_e c_0 a}\right)^4 \qquad (2.24),$$
$$\approx \left(1.59\times 10^{-56}\right)a^{-4}$$

where a (the plate separation) is in meters. Another useful equation is:

$$c^* = \left(1+\frac{\Delta c}{c_0}\right)c_0 \qquad (2.25),$$

where we make the substitution $c^* \rightarrow c_\perp^*$ for the present case. H. E. Puthoff and the author (Puthoff, 2003) compared the third line in (2.24) with equation (26) in Scharnhorst (1990) and discovered that the result cited there is in error, because the numerical coefficient is four orders of magnitude too small (Scharnhorst originally pointed out this error to Forward, 1996).

We now set $a = 10^{-6}$ m (1 μm) and we get $\Delta c/c_0 \approx 10^{-32}$ and $c_\perp^* \approx c_0$, which is a horrifically small 1 part in 10^{32} change that we cannot hope to measure at present. But for $a = 10^{-10}$ m (1 Å) we get $\Delta c/c_0 \approx 10^{-16}$ and $c_\perp^* \approx c_0$, which is a 1 part in 10^{16} change that could be measurable at present or in the very near future using high precision laser technology. Last, for $a = 1.1229\times 10^{-14}$ m (11.229 fm or ≈ 11 times the nuclear diameter; 1 fm = 10^{-15} m) we find that $\Delta c/c_0 \approx 1$ and $c_\perp^* \approx 2c_0$. We are not able to do technical work at nuclear distances at this time; however, that could change as ultrahigh precision measurement technology continues to evolve. The threshold for the onset of significant changes in light speed occurs when $a < 10^{-12}$ m. This result is generally true for the other modified vacua surveyed in (2.15) – (2.19), since accessible (everyday) values for electric and magnetic field strengths, thermal temperatures and radiation densities are not large enough to overcome the size of the electron mass to create a measurable effect. However, there is a class of ultrahigh intensity tabletop lasers that have achieved such extreme electric and magnetic field strengths and temperatures that it may now be possible to consider using them to explore vacuum modification effects in the lab. We will return to this theme in a later section.

•**Key Point**: As disappointing as the Casimir Effect vacuum (and other modified vacua) results are, it should be strongly pointed out that special relativity theory says that if in one inertial reference frame an object travels only one part in 10^{16} (or even one part in 10^{32}) times faster than c_0, then one can find another reference frame where departure and arrival times of the object are simultaneous, and thus the velocity is ***infinite***. This is what motivates us to look at a teleportation mechanism based on engineering of the vacuum.

•**Technical Notes**:

- Equation (2.15) is interpreted as an increase in the speed of light due to a decrease in the number of vacuum ZPE modes. However, this effect is totally unrelated to light-by-light scattering in the vacuum because the gravitational background "squeezes" (as in squeezed quantum optics states; see Davis, 1999a) the ZPE modes, therefore reducing the vacuum energy density. We further note that the coefficient of 11 is the same for the gravitational vacuum as for the other modified vacua examples based on QED. This factor also appears in the coefficient of the Euler-Poincare characteristic spin-½ contribution to the gravitational trace anomaly (Birrell and Davies, 1982). It is beyond the scope of this study to consider the deep connections between quantum field theory and gravitation.

- We have excluded from our survey the Latorre et al. (1995) results pertaining to all other (high or low energy) modifications of the speed of massless particles. That is because the other examples invoked different QED theories possessing massless ($m_e = 0$), massive and intrinsic mass scales that introduced complex correction terms (beyond the leading low energy terms surveyed above) which are mass-related or running mass-related, and they introduced no new speed modification effects (beyond the low energy electron-positron virtual pair contributions); or no genuine speed modification was possible (especially for the massless Quantum Chromodynamic sector involving pseudo-Goldstone particles).

- There is ongoing (very noisy) controversy within the physics community over the effects of $c^* > c_0$ on causality. As this topic is beyond the scope of this study, I will make three points in this regard: 1) There are no grounds for microcausality violations in accordance with Drummond and Hathrell (1980). 2) A new definition of causality is in order for FTL (faster-than-light) phenomena. 3) Investigators have found that time machines (a.k.a. closed timelike curves) do not affect Gauss's theorem, and thus do not affect the derivation of global conservation laws from differential ones (Friedman et al., 1990). The standard conservation laws remain globally valid while retaining a natural quasi-local interpretation for spacetimes possessing time machines (for example, asymptotically flat wormhole spacetimes). Thorne (1993) states that it may turn out that causality is violated at the macroscopic scale. Even if causality is obeyed macroscopically, then quantum gravity might offer finite probability amplitudes for microscopic spacetime histories possessing time machines. Li and Gott (1998) found a self-consistent vacuum for quantum fields in Misner space (a simple flat space with closed timelike curves), for which the renormalized stress-energy tensor is regular (in fact zero) everywhere. This implies that closed timelike curves could exist at least at the level of semi-classical quantum gravity theory. Therefore, FTL causality paradoxes are just a reflection of our ignorance or inadequate comprehension of the physics of chronology and causality.

In this section we have shown how "vacuum engineering" can modify the speed of light, and how this can, in principle, lead to vm-Teleportation. The vacuum modification concepts summarized above lead us to a formal theory that implements the concept of vacuum engineering within a framework that parallels general relativity theory. This theory is called the Polarizable-Vacuum Representation of General Relativity. In the next section we will introduce and summarize this theory.

2.2.1 The Polarizable-Vacuum Representation of General Relativity

The polarizable-vacuum representation of general relativity (a.k.a. PV-GR) treats the vacuum as a polarizable medium of variable refractive index (Puthoff, 1999a, 2002a, b; Puthoff et al., 2002) exemplifying the concept of the vacuum modification (or vacuum engineering) effects surveyed and discussed in the previous section. The PV-GR approach treats spacetime metric changes in terms of equivalent changes in the vacuum permittivity and permeability constants (ε_0 and μ_0), essentially along the lines of the "*TH*εμ" methodology (see Appendix B for a brief description of this) used in comparative studies of alternative metric theories of gravity (Lightman and Lee, 1973; Will, 1974, 1989, 1993; Haugan and Will, 1977). Such an approach, relying as it does on parameters familiar to engineers, can be considered a "metric engineering" approach. Maxwell's equations in curved space are treated in the isomorphism of a polarizable medium of variable refractive index in flat space (Volkov et al., 1971); the bending of a light ray near a massive body is modeled as due to an induced spatial variation in the refractive index of the vacuum near the body; the reduction in the velocity of light in a gravitational potential is represented by an effective increase in the refractive index of the vacuum, and so forth. This optical-engineering approach has been shown to be quite general (de Felice, 1971; Evans et al., 1996a, b).

As recently elaborated by Puthoff (1999a, 2002a, b; Puthoff et al., 2002) the PV-GR approach, which was first introduced by Wilson (1921) and then developed by Dicke (1957, 1961), can be carried out in a self-consistent way so as to reproduce to appropriate order both the equations of general relativity and the match to the standard astrophysics weak-field experimental (PPN parameters and other) tests of those equations while posing testable modifications for strong-field conditions. It is in application that the PV-GR approach demonstrates its intuitive appeal and provides additional insight into what is meant by a curved spacetime metric.

Specifically, the PV-GR approach treats such measures as the speed of light, the length of rulers (atomic bond lengths), the frequency of clocks, particle masses, and so forth, in terms of a variable vacuum dielectric constant K in which the vacuum permittivity ε_0 transforms as $\varepsilon_0 \rightarrow K\varepsilon_0$ and the vacuum permeability transforms as $\mu_0 \rightarrow K\mu_0$ (see also, Rucker, 1977). In a planetary or solar gravitational potential $K = exp(2GM/rc_0^2) > 1$ (M is a local mass distribution, r is the radial distance from the center of M) while $K = 1$ in "empty" or free asymptotic space (Puthoff, 1999a, 2002a, b; Puthoff et al., 2002). In the former case, the speed of light is reduced, light emitted from an atom is redshifted as compared with a remote static atom (where $K = 1$), clocks run slower, objects/rulers shrink, etc. See Table 1.

Table 1. Metric Effects in the PV-GR Model When $K > 1$ (Compared With Reference Frames at Asymptotic Infinity Where $K = 1$; adapted from Puthoff et al., 2002**)**

Variable	**Determining Equation** (subscript 0 is asymptotic value where $K = 1$)	$K > 1$ *(typical mass distribution, M)*
modified speed of light $c^*(K)$	$c^* = c_0/K$	speed of light $< c_0$
Modified mass $m(K)$	$m = m_0K^{3/2}$	effective mass increases
modified frequency $\omega(K)$	$\omega = \omega_0K^{-1/2}$	redshift toward lower frequencies
modified time interval $\Delta t(K)$	$\Delta t = \Delta t_0K^{1/2}$	clocks run slower
modified energy $E(K)$	$E = E_0K^{-1/2}$	lower energy states
Modified length $L(K)$	$L = L_0K^{-1/2}$	objects/rulers shrink
dielectric-vacuum "gravitational" forces $F(K)$	$F(K) \propto \nabla K$	attractive gravitational force

When $K = 1$ we have the condition that $c^* = c_0$ (vacuum refraction index = 1), because the vacuum is free (or un-modified, and $\rho_{vac} = 0$) in this case. When $K > 1$, as occurs in a region of space possessing a gravitational potential, then we have the condition that $c^* < c_0$ (vacuum refraction index > 1), because the modified vacuum has a higher energy density in the presence of the local mass distribution that generates the local gravitational field. This fact allows us to make a direct correspondence between the speed of light modification physics discussion in Section 2.2 and the underlying basis for the physics of the PV-GR model. Under certain conditions the spacetime metric can in principle be modified to reduce the value of K to below unity, thus allowing for faster-than-light (FTL) motion to be physically realized. In this case, the local speed of light (as measured by remote static observers) is increased, light emitted from an atom is blueshifted as compared with a remote static atom, objects/rulers expand, clocks run faster, etc. See Table 2. We therefore have the condition that $c^* > c_0$ (vacuum refraction index < 1) because the modified vacuum has a lower energy density. In fact, Puthoff (1999a, 2002a) has analyzed certain special

black hole metrics and found $K < 1$ from the model. We will return to this theme later. In what follows we briefly review and summarize the key points and equations from the development of the PV-GR model, and we refer the reader to Puthoff (1999a, 2002a, b) for more extensive discussion and derivations.

Table 2. Metric Effects in the PV-GR Model When $K < 1$ (Compared With Reference Frames at Asymptotic Infinity Where $K = 1$; adapted from Puthoff et al., 2002**)**

Variable	**Determining Equation** (subscript 0 is asymptotic value where $K = 1$)	$K < 1$ *(typical mass distribution, M)*
modified speed of light $c^*(K)$	$c^* = c_0/K$	speed of light > c_0
modified mass $m(K)$	$m = m_0 K^{3/2}$	effective mass decreases
modified frequency $\omega(K)$	$\omega = \omega_0 K^{-1/2}$	blueshift toward higher frequencies
modified time interval $\Delta t(K)$	$\Delta t = \Delta t_0 K^{1/2}$	clocks run faster
modified energy $E(K)$	$E = E_0 K^{-1/2}$	higher energy states
modified length $L(K)$	$L = L_0 K^{-1/2}$	objects/rulers expand
dielectric-vacuum "gravitational" forces $F(K)$	$F(K) \propto \nabla K$	repulsive gravitational force

We begin by recalling that in flat space electrodynamics, the electric flux vector ***D*** in a linear, homogeneous medium can be written

$$\begin{aligned} \mathbf{D} &= \varepsilon \mathbf{E} \\ &= \varepsilon_0 \mathbf{E} + \mathbf{P} \\ &= \varepsilon_0 \mathbf{E} + \alpha_V \mathbf{E} \end{aligned} \qquad (2.26),$$

where ε is the permittivity of the medium, the polarization ***P*** corresponds to the induced dipole moment per unit volume in the medium whose polarizability per unit volume is α_V, and ***E*** is the electric field. The identical form of the last two terms naturally leads to the interpretation of ε_0 as the polarizability per unit volume of the vacuum. The quantum picture of the vacuum, where it has been shown that the vacuum acts as a polarizable medium by virtue of induced dipole moments resulting from the excitation of virtual electron-positron particle pairs (Heitler, 1954), completely justifies the interpretation that the vacuum is a medium. Note that there are other virtual particle pairs in the vacuum that also contribute to this picture; however, it is the electron-positron pairs that dominate the others, as shown in Section 2.2. The basic postulate of the PV-GR model for curved space conditions is that the polarizability of the vacuum in the vicinity of localized mass-energy distributions differs from its asymptotic free space value by virtue of vacuum polarization effects induced by the presence of the local mass-energy. Thus the postulate for the vacuum itself is

$$\begin{aligned} \mathbf{D} &= \varepsilon \mathbf{E} \\ &\equiv K \varepsilon_0 \mathbf{E} \end{aligned} \qquad (2.27),$$

where K (a function of position) is the modified dielectric constant of the vacuum due to the induced vacuum polarizability changes under consideration. Equation (2.27) defines the transformation $\varepsilon = K\varepsilon_0$.

Table 1 shows the various quantitative effects a polarizable vacuum (in the presence of positive mass-energy distributions) has on the various measurement processes important to general relativity. The effects demonstrated in the middle and right columns demonstrate the basis of the polarizable vacuum approach to general relativity. Table 2 shows what effects are manifested when negative mass-energy distributions induce vacuum polarizability changes that lead to FTL phenomenon. Experimental observations impose constraints on the model causing key physical constants to remain constant even with variable polarizability present in the local space. Puthoff (1999a, 2002a, b) has shown that the fine structure constant is constrained by observational data to remain constant within a variable polarizable vacuum, and this constraint actually defines the transformation $\mu = K\mu_0$. The elementary particle charge e is also taken to be constant in a variable polarizable vacuum because of charge conservation. And $\hbar$ remains a constant by conservation of angular momentum for circularly polarized photons propagating through the (variable polarizability) vacuum. The remaining constant of nature is the speed of light, and although the tables showed how this was modified in variable polarizability vacuums, it is interesting to see how this modification comes about. In a modified (variable polarizability) vacuum the speed of light is defined, as it is in standard electrodynamics, in terms of the permittivity and permeability by:

$$\begin{aligned} c^* &\equiv (\varepsilon\mu)^{-1/2} \\ &= (K\varepsilon_0 \bullet K\mu_0)^{-1/2} \\ &= (K^2\varepsilon_0\mu_0)^{-1/2} \qquad (2.28), \\ &= \frac{1}{K}(\varepsilon_0\mu_0)^{-1/2} \\ &= \frac{c_0}{K} \end{aligned}$$

where the permittivity/permeability transformations and the free space (un-modified vacuum) definition for c_0 were inserted. Note that (2.28) can be re-written as $c^*/c_0 = 1/K$, and this is to be compared with (2.22). Thus we see from (2.28), and by comparison with (2.22), that K plays the role of a variable refractive index under conditions in which the vacuum polarizability is assumed to change in response to general relativistic-type influences. One further note of interest is that the permittivity/permeability transformations also maintains constant the ratio

$$\sqrt{\frac{\mu}{\varepsilon}} = \sqrt{\frac{\mu_0}{\varepsilon_0}},$$

which is the impedance of free space. This constant ratio is required to keep electric-to-magnetic energy ratios constant during adiabatic movement of atoms from one position in space to another of differing vacuum polarizability (Dicke, 1957, 1961). And this constant ratio is also a necessary condition in the $TH\varepsilon\mu$ formalism for an electromagnetic test particle to fall in a gravitational field with a composition-independent acceleration (Lightman and Lee, 1973; Will, 1974, 1989, 1993; Haugan and Will, 1977).

Now we make the "crossover connection" to the standard spacetime metric tensor concept that characterizes conventional general relativity theory, as originally shown by Puthoff (1999a, 2002a, b). In flat (un-modified or free) space the standard four-dimensional infinitesimal spacetime interval ds^2 is given (in Cartesian coordinates with subscript 0) by

$$ds^2 = -c_0{}^2 dt_0{}^2 + \sum_{i=1}^{3} dx_{i0}{}^2 \qquad (2.29),$$

where $i \equiv (1 = x,\ 2 = y,\ 3 = z)$. This metric means that measuring rods and clocks are non-varying wherever one goes in spacetime to make measurements. However, this has been shown to be incorrect in general relativity theory, so the length and time transformations (between proper and coordinate values) given in the tables (middle columns) indicate that measuring rods and clocks do vary when placed in regions where $K \neq 1$. Therefore, we replace the time and space differentials in (2.29) with the length and time transformations in the tables into (2.29), and derive the general relativistic spacetime interval

$$ds^2 = -\frac{1}{K} c_0{}^2 dt^2 + K\left(\sum_{i=1}^{3} dx_i{}^2\right) \qquad (2.30).$$

Note that observers within a $K \neq 1$ region will always measure the speed of light to be c_0. Equation (2.30) defines an isotropic coordinate system, which is a common and useful way to represent spacetime metrics in general relativity studies. By inspection the metric tensor is written

$$g_{\alpha\beta} = \begin{pmatrix} -1/K & 0 & 0 & 0 \\ 0 & K & 0 & 0 \\ 0 & 0 & K & 0 \\ 0 & 0 & 0 & K \end{pmatrix} \qquad (2.31).$$

The Lagrangian density for matter-field interactions in a vacuum of variable K is given by Puthoff (1999a, 2002a, b) as

$$\begin{aligned} L_d = &-\left[\frac{m_0 c_0{}^2}{\sqrt{K}}\sqrt{1-\left(\frac{v}{c_0/K}\right)^2} + q\Phi - qA_i v^i\right]\delta^3(\mathbf{r}-\mathbf{r}_0) \\ &-\frac{1}{2}\left(\frac{\mathbf{B}^2}{K\mu_0} - K\varepsilon_0\mathbf{E}^2\right) - \frac{c_0{}^4}{32\pi G}\frac{1}{K^2}\left[(\nabla K)^2 - \frac{1}{(c_0/K)^2}\left(\frac{\partial K}{\partial t}\right)^2\right] \end{aligned} \qquad (2.32),$$

where the first term is the Lagrangian density for a free particle of mass m_0, charge q and 3-vector velocity $\boldsymbol{v}$ ($v = |\boldsymbol{v}|$, 3-vector components are labeled by i) interacting with electromagnetic fields via the electromagnetic field 4-vector potential $\boldsymbol{A}_\mu = (\Phi, A_i)$ (note that $\delta^3(\mathbf{r} - \mathbf{r}_0)$ is the delta function that locates the point particle at position $\mathbf{r} = \mathbf{r}_0$); the second term is the Lagrangian density for the electromagnetic fields themselves, and the last term is the Lagrangian density for K (treated here as a scalar variable). This last term emulates the Lagrangian density for the gravitational field. Equation (2.32) does not include any quantum gauge field interaction terms because it is beyond the scope of the present incarnation of the PV-GR approach to include them. We can obtain the equations of particle motion in a variable dielectric vacuum by performing the standard variations of the Lagrangian density $\delta(\int L_d\, dx\, dy\, dz\, dt)$ with respect to the particle variables. However, we are more interested in obtaining the "master equation" for K by varying the Lagrangian density with respect to K, and Puthoff (1999a, 2002a, b) gives the result:

$$\nabla^2\sqrt{K}-\frac{1}{\left(c_0/K\right)^2}\frac{\partial^2\sqrt{K}}{\partial t^2}$$

$$=-\frac{8\pi G}{c_0^{\,4}}\sqrt{K}\left\{\frac{\left(m_0c_0^{\,2}/\sqrt{K}\right)}{\sqrt{1-\left(\frac{v}{c_0/K}\right)^2}}\frac{1}{2}\left[1+\left(\frac{v}{c_0/K}\right)^2\right]\delta^3(\mathbf{r}-\mathbf{r}_0)\right. \qquad (2.33).$$

$$\left.+\frac{1}{2}\left(\frac{\mathbf{B}^2}{K\mu_0}+K\varepsilon_0\mathbf{E}^2\right)-\frac{c_0^{\,4}}{32\pi G}\frac{1}{K^2}\left[(\nabla K)^2+\frac{1}{\left(c_0/K\right)^2}\left(\frac{\partial K}{\partial t}\right)^2\right]\right\}$$

This equation describes the generation of general relativistic vacuum polarization effects due to the presence of matter and fields. By inspecting the right-hand side of the equation, we observe that changes in K are driven by the mass density (1st term), electromagnetic energy density (2nd term), and the vacuum polarization energy density itself (3rd term). In fact, the 3rd term emulates the gravitational field self-energy density. Note that the 2nd and 3rd terms in (2.33) appear with opposite signs with the result that electromagnetic field effects can counteract the gravitational field effects. Puthoff found that (2.33) gives the solution $K = exp(2GM/rc_0^2)$ in the vicinity of a static spherically symmetric (uncharged) mass M (in the low velocity limit $v << c_0$, $\partial K/\partial t = 0$, $\boldsymbol{E} = \boldsymbol{B} = 0$, $q = 0$), which reproduces to appropriate order the standard general relativistic Schwarzschild spacetime metric for the weak gravitational field conditions prevailing in the solar system. This solution guarantees that $K > 1$ near mass concentrations.

Of major importance to the present study are solutions giving $K < 1$ so that teleportation can be realized. Puthoff has found one such solution by studying the case of a static spherically symmetric mass M with charge Q familiar from the study of the Reissner-Nordstrφm spacetime metric. In this case Puthoff found the result

$$K=\left[\cos\left(\frac{\sqrt{b^2-a^2}}{r}\right)+\frac{a}{\sqrt{b^2-a^2}}\sin\left(\frac{\sqrt{b^2-a^2}}{r}\right)\right]^2 \qquad \left(b^2>a^2\right) \qquad (2.34),$$

where $a^2 = (GM/c_0^2)^2$, $b^2 = Q^2G/4\pi\varepsilon_0c_0^4$, and r is the radial distance from the center of M. And in this case (2.34) gives $K < 1$, which shows that FTL solutions are available in the PV-GR approach (as they are also in the Einstein theory). (For $a^2 > b^2$ the solution is hyperbolic-trigonometric and describes the standard Reissner-Nordstrφm metric where $K > 1$.)

Generally speaking, in Einstein general relativity the Reissner-Nordstrφm metric can be manipulated along with two shells of electrically charged matter to form a traversable wormhole (Schein and Aichelburg, 1996). But there are two drawbacks to this. The first is that the scheme involves dealing with the collapsed state of the stellar matter that generates the metric (a.k.a. Reissner-Nordstrφm black hole) along with the unpleasant side effects that are encountered, such as the crushing singularities and multiple (unstable) event horizons. Second, the traversable wormhole is an eternal time machine connecting remote regions of the same universe together. Now there are no black hole solutions found in the PV-GR model because in that approach stellar matter collapses smoothly to an ultra-dense state and without the creation of singularities and event horizons (Puthoff, 1999b).

In either case, the Reissner-Nordstrφm metric does not offer a viable mechanism for vm-Teleportation. We are more interested in examining other PV-GR cases (where $K < 1$ or even $K << 1$)

that emulate the effects of traversable wormhole metrics that do obey the vm-Teleportation definition, such as the example presented in Section 2.1. Equation (2.33) suggests that we search for a vacuum engineering concept that exploits electromagnetic fields to alter the vacuum dielectric constant K to induce the desired vm-Teleportation effect in the modified vacuum. (However, we can insert other source terms that will lead to the desired result.) We envision this particular teleportation concept to resemble Figure 2. [Note: Before this report went to press H. E. Puthoff, C. Maccone and the author discovered a number of $K < 1$ solutions to equation (2.33) that uniquely meet the definition of vm-Teleportation and FTL motion. We discovered that the generic energy density required to generate $K < 1$ solutions must be negative, and that the total energy density of the system as seen by remote observes is approximately zero. This unique result compares very well with the traversable wormhole mass-energy density requirements discussed in Section 2.1.2. This discovery will be the subject of a forthcoming paper.]

2.3 Conclusion and Recommendations

The concept we envision for vm-Teleportation is that animate or inanimate objects would be placed inside an environmentally enclosed vessel that would simply be moved into the teleportation device. The "teleporter" would be activated, and the vessel would almost immediately disappear and then reappear at the remote destination as if it were briefly moving through a portal or "stargate." The teleportation device might be required to operate in the vacuum of space outside of the Earth's atmosphere. We have shown two practically equivalent ways to implement vm-Teleportation. There is the manipulation of spacetime geometry via exploiting negative (i.e., quantum vacuum zero point) energy as shown by Einstein's general relativity theory, and there is the modification of the vacuum dielectric constant as shown by the PV-GR model. Both have a great deal of theoretical foundation to begin exploring experimentally. The PV-GR model needs additional theoretical work for the present application, but it is now mature enough for experimental exploration.

There already is extensive theoretical, and more importantly, experimental research proving that the vacuum can be engineered (or physically modified) so that the vacuum ZPE can be exploited (via the Casimir Effect, for example) to extract electrical energy or actuate microelectromechanical devices (see for example, Ambjφrn and Wolfram, 1983; Forward, 1984, 1996, 1998; Puthoff, 1990, 1993; Cole and Puthoff, 1993; Milonni, 1994; Mead and Nachamkin, 1996; Lamoreaux, 1997; Chan et al., 2001, and the references cited therein). But most of this research involves very low energy density regimes, which are much too low for our purposes. The Mead and Nachamkin (1996) device is actually designed to extract electrical energy from the higher frequency/higher energy density ZPE modes. However, new ultrahigh-intensity lasers became available in the 1990s that have achieved extreme physical conditions in the lab that are comparable to the extreme astrophysical conditions expected to be found in stellar cores and on black hole event horizons (Perry, 1996; Mourou et al., 1998; Perry, 2000). The power intensity of these lasers has reached the point to where they actually probe QED vacuum physics and general relativistic physics, and they have even modified the vacuum itself. The lasers were originally called petaWatt lasers (operating range of $10^{14} - 10^{18}$ Watts/cm^2 at femtosecond pulses), but they have now reached power intensity levels in the $10^{25} - 10^{30}$ Watts/cm^2 range. The lasers were made possible by a novel breakthrough called "chirped pulse amplification" whereby the initial low energy/low power intensity laser beam is stretched, amplified and then compressed without experiencing any beam distortions or amplifier damage. This laser system was initially designed as a large-optics beam-line power booster for the NOVA laser fusion experiment at Lawrence Livermore National Laboratory. But researchers found a way to shrink the optics down to tabletop scale, and one can now own and operate a tabletop ultrahigh-intensity laser for ≈ $500,000. The dimensions of the optical bench used by the University of California-San Diego is ≈ 5 m × 12 m (or ≈ 60 m^2; see Mourou et al., 1998). In tabletop lab experiments ultrahigh-intensity lasers have generated >> gigagauss magnetic fields, ≥ 10^{16} Volt/cm electric field strengths, >> terabar light pressures and >> 10^{22} m/sec^2 subatomic particle accelerations. These ultrahigh-intensity

tabletop lasers are thus the ideal instrument with which to explore the fundamental physics underlying the two possible concepts for vm-Teleportation.

There are several ideas on how to generate negative energy in the lab that could potentially be extracted and concentrated in the proper fashion to induce the traversable flat-face wormhole outlined in Section 2.1.1 or induce the $K < 1$ condition (in the PV-GR model) outlined in Section 2.2.1. The schemes for generating negative energy are:

- Casimir Effect (described in Section 2.2): This is the easiest and most well known way to generate negative energy in the lab. The energy density $\rho_{\text{Casimir}} = -(\pi^2\hbar c_0/240)a^{-4}$ within a Casimir capacitor cavity is negative and manifests itself by producing a force of attraction between the capacitor plates. This has been measured in the lab (see above references). Forward (1998) proposes a mechanism for the endless extraction of energy from the vacuum in a Casimir cavity by cyclic manipulation of the cavity dimensions.

- Moving Mirror: Negative quantum vacuum energy can be created by a single moving reflecting surface (a moving mirror). If a mirror moves with increasing acceleration, then a flux of negative energy emanates from its surface and flows out into the space ahead of the mirror (Birrell and Davies, 1982). However, this effect is known to be exceedingly small, and it is not the most effective way to generate negative energy.

- Optically Squeezed Laser Light: Negative quantum vacuum energy can also be generated by an array of ultrahigh intensity lasers with an ultrafast rotating mirror system. In this scheme a laser beam is passed through an optical cavity resonator made of lithium niobate crystal that is shaped like a cylinder with rounded silvered ends to reflect light. The resonator will act to produce a secondary lower frequency light beam in which the pattern of photons is rearranged into pairs. This is the quantum optical "squeezing" of light effect. (See Section A.2 in Appendix A for a complete definition and description of squeezed quantum states.) Therefore, the squeezed light beam emerging from the resonator will contain pulses of negative energy interspersed with pulses of positive energy. Another way to squeeze light would be to manufacture extremely reliable light pulses containing precisely one, two, three, etc. photons apiece and combine them together to create squeezed states to order. Superimposing many such states could theoretically produce bursts of intense negative energy. For the laser beam resonator example we find that both negative and positive energy pulses are of $\approx 10^{-15}$ second duration. We could arrange a set of rapidly rotating mirrors to separate the positive and negative energy pulses from each other. The light beam is to strike each mirror surface at a very shallow angle while the rotation ensures that the negative energy pulses are reflected at a slightly different angle from the positive energy pulses. A small spatial separation of the two different energy pulses will occur at some distance from the rotating mirror. Another system of mirrors will be needed to redirect the negative energy pulses to an isolated location and concentrate them there.

- Gravitationally Squeezed Vacuum Energy: A natural source of negative quantum vacuum energy comes from the effect that gravitational fields (of astronomical bodies) in space have upon the surrounding vacuum. For example, the gravitational field of the Earth produces a zone of negative energy around it by dragging some of the virtual particle pairs (a.k.a. virtual photons or vacuum ZPF) downward. This concept was initially developed in the 1970s as a byproduct of studies on quantum field theory in curved space (Birrell and Davies, 1982). However, Hochberg and Kephart (1991) derived an important application of this concept to the problem of creating and stabilizing traversable wormholes, and their work was corrected and extended by Davis (1999a). They proved that one can utilize the negative vacuum energy densities, which arise from *distortion of the electromagnetic zero point fluctuations* due to the interaction with a prescribed gravitational background, for providing a violation of the energy conditions (see

Section A.1 in Appendix A). Hochberg and Kephart (1991) showed that the squeezed quantum states of quantum optics provide a natural form of matter having negative energy density. And since the vacuum is defined to have vanishing energy density, anything possessing less energy density than the vacuum must have a negative energy density. The analysis, via quantum optics, shows that gravitation itself provides the mechanism for generating the squeezed vacuum states needed to support stable traversable wormholes. The production of negative energy densities via a squeezed vacuum is a necessary and unavoidable consequence of the interaction or coupling between ordinary matter and gravity, and this defines what is meant by gravitationally squeezed vacuum states. The magnitude of the gravitational squeezing of the vacuum can be estimated from the squeezing condition, which simply states that substantial gravitational squeezing of the vacuum occurs for those quantum electromagnetic field modes with *wavelength* (λ in meters) > *Schwarzschild radius* (r_S in meters) of the mass in question (whose gravitational field is squeezing the vacuum). The Schwarzschild radius is the critical radius, according to general relativity theory, at which a spherically symmetric massive body becomes a black hole; i.e., at which light is unable to escape from the body's surface. We can actually choose any radial distance from the mass in question to perform this analysis, but using the Schwarzschild radius makes equations simpler in form. The general result of the gravitational squeezing effect is that as the gravitational field strength increases the negative energy zone (surrounding the mass) also increases in strength. Table 3 shows when gravitational squeezing becomes important for example masses. The table shows that in the case of the Earth, Jupiter and the Sun, this squeeze effect is extremely feeble because only ZPF mode wavelengths above 0.2 m – 78 km are affected. For a solar mass black hole (radius of 2.95 km), the effect is still feeble because only ZPF mode wavelengths above 78 km are affected. But note from the table that quantum black holes with Planck mass will have enormously strong negative energy surrounding them because all ZPF mode wavelengths above 8.50×10^{-34} meter will be squeezed; in other words, all wavelengths of interest for vacuum fluctuations. Black holes with proton mass will have the strongest negative energy zone in comparison because the squeezing effect includes all ZPF mode wavelengths above 6.50×10^{-53} meter. Furthermore, a black hole smaller than a nuclear diameter ($\approx 10^{-16}$ m) and containing the mass of a mountain ($\approx 10^{11}$ kg) would possess a fairly strong negative energy zone because all ZPF mode wavelengths above 10^{-15} meter will be squeezed.

Table 3. Substantial Gravitational Squeezing Occurs When $\lambda \geq 8\pi r_S$ (For Electromagnetic ZPF; adapted from Davis, 1999a**)**

Mass of body	Schwarzschild radius of body, r_S	ZPF mode wavelength, λ
Sun = 2.0×10^{30} kg	2.95 km	$\geq$ 78 km
Jupiter = 1.9×10^{27} kg	2.82 m	$\geq$ 74 m
Earth = 5.976×10^{24} kg	8.87×10^{-3} m	$\geq$ 0.23 m
Typical mountain $\approx 10^{11}$ kg	$\approx 10^{-16}$ m	$\geq 10^{-15}$ m
Planck mass = 2.18×10^{-8} kg	3.23×10^{-35} m	$\geq 8.50 \times 10^{-34}$ m
Proton = 1.673×10^{-27} kg	2.48×10^{-54} m	$\geq 6.50 \times 10^{-53}$ m

•**<u>Recommendations</u>**:

- <u>Theoretical Program 1</u>: A one to two year theoretical study (cost ≈ $80,000) should be initiated to explore the recently discovered $K < 1$ (FTL) solutions to equation (2.33) in order to define,

characterize and model the negative energy density source(s) that induce the FTL vacuum modification. The study should also identify potential lab experiments designed to test theoretical predictions.

- Theoretical Program 2: A one to two year study (cost ≈ $80,000) should be initiated to conduct a detailed review of the negative energy generation schemes summarized above to define their characteristics, performances and requirements. The study should develop technical parameters for each of the schemes in order to identify potential lab experiments.

- Experimental Program 1: An experimental study should be conducted to test Forward's (1998) Casimir energy extraction proposal. An experiment definition study will be required to estimate the experimental method, procedure, equipment needs and costs.

- Experimental Program 2: An experimental study using ultrahigh-intensity lasers should be conducted to test the Optically Squeezed Laser Light proposal. An experiment definition study will be required to estimate the experimental method, procedure, equipment needs and costs.

- Experimental Program 3: An experimental study using ultrahigh-intensity lasers should be conducted to probe QED vacuum physics and vacuum modification as well as test elements of the PV-GR model. A starting point for this program would be to use such lasers to perform the Ding and Kaplan (1989, 1992, 2000; see also, Forward, 1996) experiment. This is an important fundamental physics experiment to do, because it can distinguish between the rival quantum vacuum electromagnetic ZPE fluctuation and fluctuating charged particle source field theory models, which would settle the acrimonious debate over whether the vacuum really fluctuates or not. R. L. Forward (1999) told the author that a Nobel Prize rides on performing this experiment and settling the issue once and for all. The Ding and Kaplan proposal is already designed to probe QED vacuum physics and vacuum modification. [The essence of the Ding and Kaplan proposal is to demonstrate that a form of photon-photon scattering predicted by QED gives rise to 2nd-harmonic generation of intense laser radiation in a DC magnetic field due to the broken symmetry of interaction (in the Feynman "box" diagram approximation). This effect is possible only when the field system (optical wave + DC field) is inhomogeneous, in particular when a Gaussian laser beam propagates in either a homogeneous or inhomogeneous DC magnetic field. In other words, a vacuum region is filled with a DC magnetic field that polarizes the virtual particle pairs (a.k.a. virtual photons) in the vacuum. This polarized vacuum then scatters incident ultrahigh-intensity laser photons of frequency ν (energy E), thereby generating outgoing photons of frequency 2ν (energy $2E$).] An experiment definition study will be required to estimate the experimental method, procedure, equipment needs and costs.

- Experimental Program 4: An experimental study using ultrahigh-intensity lasers should be conducted to establish the extreme physical conditions necessary to test the strong-field limit of general relativity with an emphasis on generating spacetime curvature and negative energy in order to induce a putative micro-wormhole. (Experimental Programs 3 and 4 could be done together to determine whether Puthoff's PV-GR theory or Einstein's general relativity theory is the correct model for nature.) A Nobel Prize is in the offing if this question were to be addressed and settled. An experiment definition study will be required to estimate the experimental method, procedure, equipment needs and costs.

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3.0 q-TELEPORTATION

3.1 Teleportation Scenario

Future space explorers and their equipment will need to easily and quickly travel from an orbiting spacecraft to the surface of some remote planet in order to get their work done, or military personnel in the United States need to easily and quickly travel from their military base to another remote location on Earth in order to participate in a military operation, or space colonists will need quick transport to get from Earth to their new home planet. Instead of using conventional transportation to expedite travel the space explorer, military personnel or space colonist and/or their equipment go into the "Teleporter" (a.k.a. "Transporter" in Star Trek lingo) and are "beamed down" or "beamed over" to their destinations at light speed. The mechanism for this teleportation process is hypothetically envisioned to be the following:

1. Animate/inanimate objects placed inside the teleporter are scanned by a computer-generated and -controlled beam.

2. The scan beam encodes the entire quantum information contained within the animate/inanimate object(s) into organized bits of information, thus forming a digital pattern of the object(s).

3. The scan beam then dematerializes the object(s) and stores its pattern in a pattern buffer, thus transforming the atomic constituents of the dematerialized object(s) into a matter stream. Alternative 1: The dematerialization process converts the atoms into a beam of pure energy. Alternative 2: The scan beam does not dematerialize the object(s).

4. The teleporter then transmits the matter/pure energy stream and quantum information signal in the form of an annular confinement beam to its destination. Alternative: Only the quantum information signal is transmitted.

5. At the receiving teleporter the matter/pure energy stream is sent into a pattern buffer whereby it is recombined with its quantum information, and the object(s) is rematerialized back into its original form. Alternative 1: The receiving teleporter recombines the transmitted quantum information with atoms stored inside a reservoir to form a copy of the original. Alternative 2: The quantum information is reorganized in such a way as to display the object on some three-dimensional (holographic) visual display system.

Problem: This generic scenario is modeled after teleportation schemes found in SciFi. There are a lot of important little details that were left out of the teleportation process because we simply do not know what they are. This technology does not yet exist. And we are left with the question of which one of the alternative processes identified in items 3 – 5 one wants to choose from. The above scenario is only an outline, and it is by no means complete since it merely serves to show what speculation exists on the subject. The above scenario describes a speculative form of what we call *q-Teleportation*.

There are questions to be addressed in the above scenario. Does the teleporter transmit the atoms and the quantum bit information signal that comprises the animate/inanimate object or just the quantum bit information signal? There are $\approx 10^{28}$ atoms of matter combined together in a complex pattern to form a human being. How does one transmit this much information and how do we disassemble that many atoms? Computer information gurus would insist that it is not the atoms that matter but only the bits of

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information representing them when considering the transmission of large "bodies" of information. But are humans simply the sum of all the atoms (and the related excited atom quantum states) that comprise them? We could possibly learn to reconstitute a beam of atoms into a chemically accurate human being. However, would this also include the reconstruction of a person's consciousness (personality, memories, hopes, dreams, etc.) and soul or spirit? This question is beyond the scope of this study to address, but it is nevertheless one of the most important concepts awaiting a complete scientific understanding.

For the teleporter to process and transmit the quantum bit information signal that encodes the animate/inanimate object's pattern will require stupendous digital computer power. For each atom comprising the object we must encode its location in space (three position coordinates), its linear and angular momentum (three vector components for each quantity), and its internal quantum state (electron orbital-energy levels and their excitation/de-excitation and ionization states, binding to other atoms to form molecules, molecular vibrational/rotational states, bound nuclei states, spin states for electrons and nuclei, etc.), etc. If we assume that we can digitally encode all of this information for a single atom with a minimum of one kilobyte (1 byte = 8 bits, 1 bit ≡ 0 or 1) of data, then we will require a minimum of 10^{28} kilobytes to encode and store an entire human being (in three-dimensions). To digitally store and access this much information at present (and for the foreseeable future) is nontrivial. It will take more than 2,400 times the present age of the universe (≈ 13 billion years) to access this amount of data using commercially available computers (operating at ≈ 10 gigabyte/sec). Top-of-the-line supercomputers will not reduce this time significantly. The computer technology needed to handle such a large data storage requirement simply does not exist. The largest commercially available computers can store ≈ 40 gigabytes on a single hard drive. We will need ≈ 10^{20} of these hard drives to store the encoded information of just one human being. Also, wire and coaxial/fiber optic cables do not have the physical capacity to transmit this amount of data between devices. These numbers will not be significantly different for macroscopic inanimate objects. The information processing and transfer technology required for the teleportation system may become possible in 200 – 300 years if improvements in computer storage and speed maintains a factor of 10 – 100 increase for every decade. There is speculation that emergent molecular, bio-molecular (DNA-based systems) and quantum computer technology may achieve the performances required for a teleportation system. In the former case molecular dynamics mimics computer logic processes and the ≈ 10^{25} particles in a macroscopic sample will all act simultaneously, making for far greater digital information processing and transfer speeds. Researchers have given no formal performance estimates for this emergent technology. In the latter case quantum computing would take advantage of entangled quantum states of subatomic matter or photons, whereby digital logic processes would occur at light speed. This technology is in its infancy, and there has been no clear direction on what performance levels will be possible in the future. This topic will be discussed further in Section 3.2.3.

In the above teleportation scenario we might consider dematerializing animate/inanimate objects into a matter stream consisting of only the object's constituent atoms or atomic subcomponents (protons, neutrons and electrons) and transmitting them at the speed of light (or close to it). To push atoms or subatomic particles to near the speed of light will require imparting to them an energy comparable to their rest-mass energy, which will be at a minimum of one order of magnitude larger than the amount of energy required to break protons up into free quarks. The energy required to completely dematerialize (or dissolve) matter into its basic quantum constituents or into pure energy is alone stupendous. At first one will have to impart to every molecule within the object an energy that is equivalent to the binding energy between atoms (atomic binding energy ~ chemical energy ~ *several* eV) in order to break apart the molecules comprising the object's macro-structure. After this an energy equivalent to nuclear binding energies (≈ *several* × 10^6 times atomic binding energy, or ≈ *several* MeV) must be imparted to every free atomic nucleus inside the object in order to break apart the protons and neutrons residing within each nucleus. And last, an energy equivalent to the binding energy that holds together the three quarks residing within each proton and neutron must be imparted to each of the free protons and neutrons within the object. According to the Standard Model and experimental data, the quark binding energy is

practically infinite. But all is not lost, because the Standard Model also predicts that if we could heat up the nuclei to ≈ 10^{13} °C (≈ 10^6 times hotter than the core temperature of the Sun, or ≈ 10^3 MeV), then the quarks inside would suddenly lose their binding energies and become massless (along with other elementary matter). This heat is also equivalent to the rest-mass energy of protons and neutrons. Therefore, to heat up and dematerialize one human being would require the annihilation of the rest mass-energy of all 10^{28} protons-neutrons or the energy equivalent of 330 1-megaton thermonuclear bombs. Compare this stupendous explosive energy with the explosive yield of the largest thermonuclear bomb ever detonated on Earth, which was a 50-megaton bomb that was built by Andrei Sakharov in the USSR and detonated on October 30, 1961; it was called "Tzar Bomba." Its first incarnation (ca. early October 1961) comprised a uranium fusion tamper, which gave an estimated explosive yield of ≈ 100 megatons. But the weapon was too heavy (27 metric tons) for a bomber to carry, so the tamper was replaced by one made of lead, which reduced both the weight and the yield. In the end we see that it is not a trivial problem to simply heat up and dematerialize any human or inanimate objects. The technology to do so does not exist unless we invoke new physics to get around the energy requirement.

Finally, we must consider the resolution and aperture of the optics required to scan and transmit the animate/inanimate object's matter (or energy) stream. The Heisenberg quantum uncertainty principle fundamentally constrains the measurement resolution of conjugate observable quantities, such as position and momentum or energy and time. The measurement of any combination of (conjugate) observables with arbitrarily high precision is not possible, because a high precision measurement of one observable leads to imprecise knowledge of the value of the conjugate observable. The quantum uncertainty principle makes it impossible to measure the exact, total quantum state of any object with certainty. The scan resolution of a teleportation system is defined by the wavelength of light used to illuminate the object's atomic/subatomic constituents and record their configurations. To resolve matter at atomic/subatomic distance scales requires that the energy of the scanner light (photons) be extremely large (according to the uncertainty principle); and during the scan this large light energy will be conveyed to the constituents, causing them to drastically change their speed and direction of motion. This means that it is physically impossible to resolve an object's atomic/subatomic particle components and their configurations with the precision necessary to accurately encode and later recreate the object being teleported. To resolve atomic/subatomic particles requires wavelengths smaller than the size of these constituents, which will typically be 1 Å – 1 fm. Such wavelengths are in the gamma ray part of the spectrum, and this becomes a major technical problem for us because at present there is no gamma ray electro-optics with which to work with. Now consider the example of teleporting an object from the surface of a planet back to its spacecraft in orbit some *several* × 10^2 – 10^3 km away. The optical aperture required to illuminate and scan an object with ≈ 1 Å – 1 fm resolution from orbit will be >> *several* × 10^2 – 10^3 km. If we are to consider teleporting an object from planet to planet or from star to star then the aperture required will be >> *several* × 10^8 – 10^{13} km. These technical problems are truly insurmountable unless totally new physics becomes available.

3.2 Quantum Teleportation

It turns out that there does in fact exist a form of teleportation that occurs in nature despite the numerous technical roadblocks described in the previous section. It is called *quantum teleportation*, which is based on the well-known concept of quantum entanglement. Erwin Schrödinger coined the word "entanglement" in 1935 in a three-part paper (Schrödinger, 1935a, b, c, 1980). These papers were prompted by the Einstein, Podolsky and Rosen (1935; denoted hereafter as EPR) paper that raised fundamental questions about quantum mechanics, whereby Einstein had loudly complained that quantum mechanics allowed physical processes resembling "spooky action at a distance" to occur. EPR recognized that quantum theory allows certain correlations to exist between two physically distant parts of a quantum system. Such correlations make it possible to predict the result of a measurement on one part of a system by looking at the distant part. On this basis, EPR argued that the distant predicted quantity

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should have a definite value even before being measured, if quantum theory is complete and respects locality (a.k.a. causality). EPR concluded that, from a classical perspective, quantum theory must be incomplete because it disallows such definite values prior to measurement. Schrödinger's perspective on this argument gives the modern view of quantum mechanics, which is to say that the wavefunction (a.k.a. quantum state vector) provides all the information there is about a quantum system. In regards to the nature of entangled quantum states, Schrödinger (1935a, b, c, 1980) stated that, "The whole is in a definite state, the parts taken individually are not." This statement defines the essence of pure-state entanglement. Schrödinger went on to give a description of quantum entanglement by introducing his famous cat experiment.

To better understand the concept of quantum entanglement/teleportation we will focus on the quantum wavefunction (a.k.a. quantum state function). Any quantum system such as a particle that possesses a position in space, energy, angular and linear momentum, and spin is completely described by a wavefunction. This is usually symbolized in a variety of ways, and we choose to represent a generic wavefunction using the traditional "bra-ket" notation of quantum mechanics: $|\varphi\rangle$. Anything that we want to know about the particle is mathematically encoded within $|\varphi\rangle$. As we discussed in the previous section the wavefunction can never be completely known because there is no measurement that can determine it completely. The only exception to this is in the special case that the wavefunction has been prepared in some particular state or some member of a known basis group of states in advance. By measuring one of the properties of a quantum system, we can get a glimpse of the overall quantum state that is encoded within $|\varphi\rangle$. According to the quantum uncertainty principle the act of doing such a measurement will destroy any ability to subsequently determine the other properties of the quantum system. So the act of measuring a particle actually destroys some of the information about its pristine state. This makes it impossible to copy particles and reproduce them elsewhere via quantum teleportation. However, it turns out that one can recreate an unmeasured quantum state in another particle as long as one is prepared to sacrifice the original particle. The trick is to exploit the EPR process to circumvent the quantum uncertainty principle.

As discussed previously, EPR discovered that a pair of spatially separated quantum sub-systems that are parts of an overall quantum system can be "entangled" in a non-local (i.e., non-causal) way. When two particles come into contact with one another, they can become "entangled." In an entangled state, both particles remain part of the same quantum system so that whatever you do to one of them affects the other one in a predictable fashion. More precisely, a measurement on one of the entangled sub-systems puts it into a particular quantum state, while instantaneously putting the sub-system with which it is entangled into a corresponding quantum state, while the two sub-systems are separated by arbitrarily large distances in spacetime (even backwards in time!). A simple example of this phenomenon is to prepare a pair of photons in the same quantum state such that they are entangled, and then allow them to fly apart to remote locations without any form of communication occurring between them along their journey. Measuring the polarization of one of the pair of entangled photons induces the other photon, which may be light-years away, into the same state of polarization as that which was measured for its entangled twin. The basic operation of quantum teleportation can be described as determining the total quantum state of some large quantum system, transmitting this state information from one place to another, and making a perfect reconstruction of the system at the new location. In principle, entangled particles can serve as "transporters" of sorts. By introducing a third "message" particle to one of the entangled particles, one could transfer its properties to the other one, without ever measuring those properties.

Historically, quantum entanglement was never reconciled with the quantum uncertainty principle and the requirement of locality (or causality) in observed physical phenomena, thus it became a paradox in quantum theory. A three-decade debate began following the appearance of the EPR paper over whether quantum entanglement (a.k.a. "spooky action at a distance") was a real quantum phenomenon or not, and this debate came to be called the "EPR dilemma." Einstein's only solution to the dilemma was to suggest that quantum mechanics was incomplete and needed a reformulation to incorporate local hidden-variables that can account for observed physical phenomena without violating causality. Bell (1964) later solved the EPR dilemma by deriving correlation inequalities that can be violated in quantum mechanics but have

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to be satisfied within every model that is local and complete. Such models are called "local hidden-variable models." Bell showed that a pair of entangled particles, which were once in contact but later moved too far apart to interact directly (i.e., causally), can exhibit individually random behavior that is too strongly correlated to be explained by classical statistics. Bell's inequalities make it possible to test whether local hidden-variable models can account for observed physical phenomena in lab experiments. Groundbreaking experimental work by Aspect et al. (1982a, b) along with further theoretical and experimental work done by others (Freedman and Clauser, 1972; Aspect, 1983; Aspect and Grangier, 1985; Hong and Mandel, 1985; Bennett and Wiesner, 1992; Tittel et al., 1998a, b; Tittel and Weihs, 2001) demonstrated violations of the Bell inequalities, which therefore invalidated the local hidden-variable models. The key result of recent theoretical and experimental work is that an observed violation of a Bell inequality demonstrates the presence of entanglement in a quantum system.

3.2.1 Description of the q-Teleportation Process

The experimental work of Bennett et al. (1993) followed by the theoretical and experimental work of others (Vaidman, 1994; Kwiat et al., 1995; Braunstein, 1996; Braunstein and Kimble, 1998; Pan et al., 1998; Stenholm and Bardroff, 1998; Zubairy, 1998; Vaidman and Yoran, 1999; Kwiat et al., 1999) made the breakthrough that was necessary to demonstrate the principle of quantum teleportation in practice. It was a remarkable technical breakthrough that settled, once and for all, the nagging question of whether quantum entanglement could be used to implement a teleportation process to transfer information between remotely distant quantum systems non-causally (i.e., at FTL speed). It is easy to describe how quantum teleportation works in greater detail. Figure 6 compares conventional facsimile transmission with the quantum teleportation process seen in Figure 7. In a conventional facsimile transmission the original document is scanned, extracting partial information about it, but it remains more or less intact after the scanning process. The scanned information is then sent to the receiving station, where it is imprinted on new paper to produce an approximate copy of the original. In quantum teleportation (Figure 7) one scans out part of the information from object A (the original), which one wants to teleport, while causing the remaining, unscanned, part of the information in A to pass, via EPR entanglement, into another object C which has never been in contact with A. Two objects B and C are prepared and brought into contact (i.e., entangled), and then separated. Object B is taken to the sending station, while object C is taken to the receiving station. At the sending station object B is scanned together with the original object A, yielding some information and totally disrupting the states of A and B. This scanned information is sent to the receiving station, where it is used to select one of several treatments to be applied to object C, thereby putting C into an exact replica of the former state of A. Object A itself is no longer in its original initial state, having been completely disrupted by the scanning process. The process just described is teleportation and not replication, and one should not confuse the two. There is a subtle, unscannable kind of information that, unlike ordinary information or material, can be delivered via EPR correlations/entanglement, such that it cannot by itself deliver a meaningful and controllable message. But quantum teleportation delivers exactly that part of the information in an object that is too delicate to be scanned out and delivered by conventional methods.

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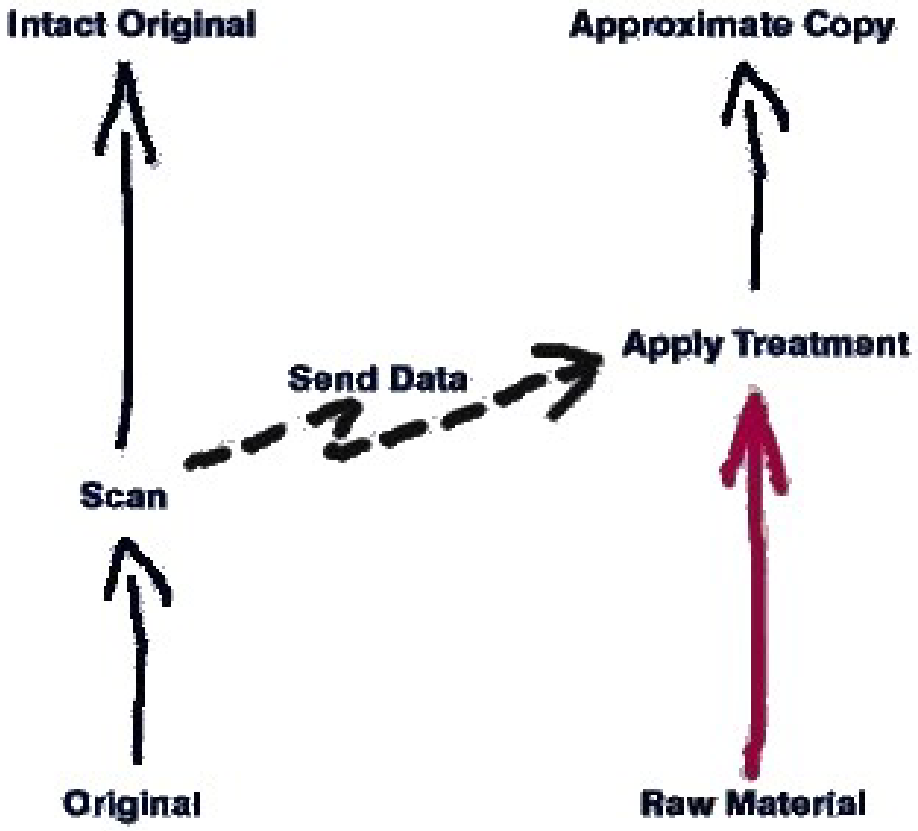

Figure 6. Classical Facsimile Transmission (Modified IBM Press Image)

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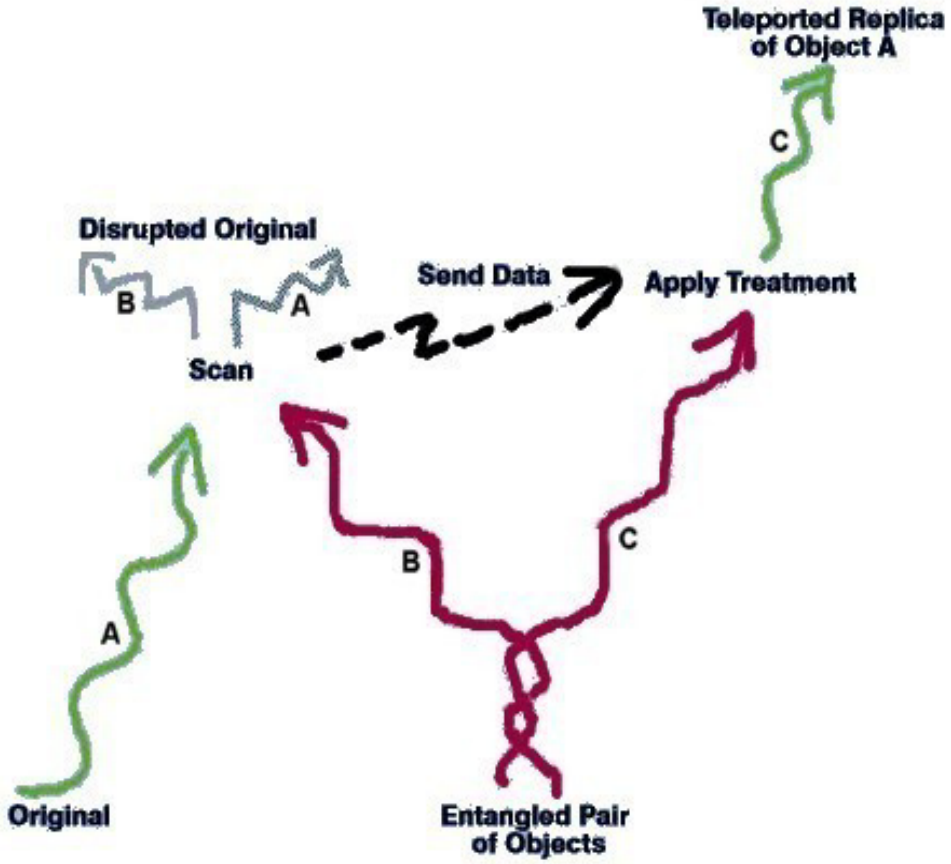

Figure 7. Quantum Teleportation (Modified IBM Press Image)

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We now go one more final step to give a simplified outline of the actual teleportation process according to Bennett et al. (1993). They propose a multistep procedure by which any quantum state $|\chi\rangle$ of a particle or a photon (that correspond to an N-state system) is to be teleported from one location to another. For example, $|\chi\rangle$ might be a two-level system that could refer to the polarization of a single photon, the nuclear magnetic spin of a hydrogen atom, or the electronic excitation of an effective two-level atom. The following scenario outlines the q-Teleportation process in a very simplified way:

1. Prepare a pair of quantum subsystems $|\varphi\rangle$ and $|\psi\rangle$ in an EPR entangled state so that they are linked together. $|\varphi\rangle$ and $|\psi\rangle$ are maximally entangled and together constitute a definite pure state superposition even though each of them is maximally undetermined or mixed when considered separately.

2. Transport $|\varphi\rangle$ to the location of the teleportation transmitter and transport $|\psi\rangle$ to the location of the teleportation receiver. (In the technical literature the transmitter is called "Alice" and the receiver is called "Bob.") The transmitter and receiver can be many light years apart in space. Note that the two subsystems are non-causally correlated via entanglement, but they contain no information about $|\chi\rangle$ at this point. The two subsystems represent an open quantum channel that is ready to transmit information.

3. Now Alice brings the teleported state $|\chi\rangle$ into contact with the entangled state $|\varphi\rangle$ and performs a quantum measurement on the combined system $|\chi\rangle|\varphi\rangle$. Bob and Alice have previously agreed upon the details of the quantum measurement.

4. Using a conventional classical communication channel, Alice transmits to Bob a complete description of the outcome of the quantum measurement she performed on $|\chi\rangle|\varphi\rangle$.

5. Bob then subjects $|\psi\rangle$ to a set of linear transformations (i.e., suitable unitary rotations) that are dictated by the outcome of Alice's quantum measurement. The quantum subsystem Bob originally first received is no longer in state $|\psi\rangle$ after the linear transformations because it is now in a state identical to the original state $|\chi\rangle$. Therefore, $|\chi\rangle$ has in effect been teleported from Alice to Bob.

Bennett et al. (1993) showed in their experimental work that this scheme requires both a conventional communication channel and a non-causal EPR channel to send the state $|\chi\rangle$ from one location to another. In addition to this, a considerable pre-arrangement of entangled states and quantum measurement procedures is required to make the process work. Bennett et al. (1993) analyzed the information flow implicit in the process and showed that Alice's measurement does not provide any information about the quantum state $|\chi\rangle$. All of the quantum state information is passed by the EPR link between the entangled particle states $|\varphi\rangle$ and $|\psi\rangle$. We can think of the measurement results as providing the "code key" that permits the EPR information to be decoded properly at Bob's end. And because the measurement information must travel on a conventional communications channel, the decoding cannot take place until the code key arrives, insuring that no FTL teleportation is possible.

The q-Teleportation scheme teleports the state of a quantum system without having to completely measure its initial state. The outcome of the process is that the initial quantum state $|\chi\rangle$ is destroyed at Alice's location and recreated at Bob's location. It is very important for the reader to understand that it is the *quantum states* of the particles/photons that are destroyed and recreated in the teleportation process, and not the particles/photons themselves. The quantum state or wavefunction contains the information on the state of a particle, but is not a directly observable physical quantity like mass-energy. The quantum information contained within a state is available in the form of probabilities or expectation values.

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Therefore, q-Teleportation *cannot* teleport animate or inanimate matter (or energy) in its physical entirety. However, some experts argue that because a particle's or a photon's quantum state is its defining characteristic, teleporting its quantum state is completely *equivalent* to teleporting the particle/photon even though the original particle's/photon's quantum state (and defining characteristic) was completely destroyed in the process (more on this in Section 3.3). Therefore, no quantum cloning is possible and we are left with a (near-perfect) copy of the now-destroyed original after teleportation (Wootters and Zurek, 1982; Barnum et al., 1996). And finally, classical information itself *cannot* be teleported faster than the speed of light via the non-causal EPR channel; however, quantum information can (more on this in Section 3.2.3).

3.2.2 Decoherence Fundamentally Limits q-Teleportation

Finally, the reader must understand that the q-Teleportation scenario described in the previous section was simplified because we unrealistically assumed that Alice and Bob shared an EPR entangled pair that was free of noise or decoherence. Decoherence is the process, whereby an object's quantum states degrade when information leaks to or from the environment (i.e., environmental noise) through stray interactions with the object. In reality, Alice and Bob have quantum systems that interact directly or through another mediating quantum system like two ions in an ion trap that interact through phonon modes of the trap, or Rydberg atoms in a laser cavity that interact via photons (Sackett, 2001; Raimond et al., 2001). Decoherence degrades the fidelity of the quantum link (i.e., the set of pure EPR entangled pairs) between two quantum systems, thus introducing a certain level of error in the exchange of quantum information between the systems.

In a real-world example of an application of q-Teleportation to quantum computation (discussed in the next section), we can devise an array of interconnected ion traps with each trap holding a small number of ions that are coupled by ions that are moved between the traps or by traveling photons (Wineland et al., 2002). The quantum link (or EPR interaction) between a pair of systems is subject to noise or decoherence through photon loss or heating of the phonons. At present, decoherence imposes a fundamental limit on our ability to perform quantum information processing. Research is continuing on whether decoherence can be reduced, circumvented, or otherwise be (partially or totally) eliminated. Dür and Briegel (2003) have taken the first step towards this goal at rudimentary level by showing that fault-tolerant quantum computation can be achieved in the presence of very high noise levels occurring in the interaction link between small quantum systems, if one assumes that local quantum processing on each end is nearly error free. They showed that the interaction link can have an error rate of two-thirds.

3.2.3 Recent Developments in Entanglement and q-Teleportation Physics

Quantum teleportation physics is still in its infancy. Both theoretical and experimental developments are advancing in many different directions, but are far from maturity at this point in time because the field is still evolving at present. Technical applications of entanglement and q-Teleportation are just becoming conceptualized for the first time, while a small number of basic physics breakthroughs and their related applications are in experimental progress at present. The research community is still in the process of discovering the full nature of entanglement and q-Teleportation, its rules, and what roadblocks nature has in store for its applications and further progression. The literature cited in this study is by no means complete, and only represents a subset of the entire field, because the research is still evolving.

An important application of quantum entanglement and q-Teleportation was the discovery made by Shor (1994, 1997) that computation with quantum states instead of classical bits can result in large savings in computation time. For example, the best algorithms take exponentially more resources to factor ever-larger numbers on a classical computer. A 500-digit number needs 10^8 times as many computational steps to factor as a 250-digit number. The latter classically requires $\approx 5\times10^{24}$ computational steps, or about 150,000 years computing time at terahertz speed, to factor. Shor found a polynomial-time quantum algorithm that solves the problem of finding prime factors of a large integer.

He showed that his algorithm rises only polynomially so that a 500-digit number takes only eight times as many computational steps to factor as a 250-digit number. And by using the quantum factoring algorithm, a 250-digit number requires only $\approx 5\times10^{10}$ steps or < 1 second to factor at terahertz speed, so that a 500-digit number will take ≤ 1 second to factor. No classical polynomial-time algorithm for this problem exists at present. This breakthrough generated a cottage industry of research into quantum computing and quantum information theory.

IBM (2001) constructed a prototype quantum computer that uses the nuclear spins of seven atoms that are part of a large molecule with the iron-based chemical composition $H_5C_{11}O_2F_5Fe$. The computer uses entangled nuclear spins for storage and has a capacity of seven qubits (qubits are defined in the bulleted list in the next two paragraphs below). All of the Fluorine atoms in the large molecule are Fluorine isotope 19 and two of the Carbon atoms are Carbon isotope 13. All the other non-hydrogen atoms have even isotope numbers and no nuclear spins. The objective of the prototype quantum computer was to factor the number 15 into its two prime factors 3 and 5 by using Shor's quantum factoring algorithm. The quantum computation required that a sample of $\approx 10^{18}$ of the large molecules be placed in a magnetic field and manipulated by nuclear magnetic resonance (NMR) techniques. This mechanism allows the spins to function as qubits, whereby Schor's algorithm can be performed via manipulation of the NMR fields. NMR was used to implement quantum computing in this prototype, because the nuclear spins are well isolated from decoherence as a result of the very long decoherence time (the time after which quantum coherence is lost due to environmental noise) in the system.

To factor larger numbers will require a system that uses more than seven qubits. It is estimated that a quantum computer using ≈ 36 qubits could very quickly perform computations that would require a conventional computer ≈ 13 billion years to perform. And such a computer could solve one of the technical problems of human teleportation discussed in Section 3.1. However, a scale-up in the number of qubits is difficult because the IBM prototype has reached the technology limit of NMR quantum computing. The prototype's operation requires that all of the qubits must be in the same molecule. And molecules with more than seven spins that can be used as qubits are not feasible at present. However, there are alternative technologies for quantum computing that show promise for scaling up the number of qubits. The technologies of nuclear spin orientation of single atom impurities in semiconductors, electron spin orientation in quantum dots, and the manipulation of magnetic flux quanta in superconductors all show promise of providing a basis for scalable quantum computers. Finally, the primary technical problem in quantum computing at the present time is decoherence, and this must be eliminated or otherwise mitigated before new quantum technology can become competitive with conventional computer technology.

A byproduct of the recent quantum computing and information research is that a modern theory of entanglement has emerged. Researchers now treat entanglement as a quantifiable physical resource that enables quantum information processing and computation. Entanglement is no longer treated as a paradox of quantum theory. It has been recently discovered that (Nielsen and Chuang, 2000; Nielsen, 2003; Terhal et al., 2003):

- various kinds of pure and mixed entangled states may be prepared in addition to the simple pure-state superpositions that was described in the previous section

- the members of an entangled group of objects do not have their own individual quantum states, only the group as a whole has a well-defined state (i.e., "the whole is greater than the sum of its parts")

- entangled objects behave as if they were physically connected together no matter how far apart they actually are, distance does not attenuate entanglement in the slightest – it has been demonstrated that information can be teleported over 40 km using existing technology (H. Everitt, Army Research Office, 2000)

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- if something is entangled with other objects, then a measurement of it simultaneously provides information about its partners

- some quantum systems can have a little entanglement while others will have a lot

- the more entanglement available, the better suited a system is to quantum information processing

- decoherence degrades the fidelity of the quantum link (i.e., the set of pure EPR entangled pairs) between two quantum systems, thus introducing a certain level of error in the exchange of quantum information between the systems; thus limiting our ability to perform quantum information processing (see more on this issue in the next paragraph below)

- mixed entangled states may be measured, distilled, concentrated, diluted, and manipulated

- the basic resource of classical information is the bit (i.e., the two values 0 and 1), while quantum information comes in quantum bits (i.e., qubits) that are described by their quantum state; qubits can exist in superpositions that simultaneously involve 0 and 1, thus giving them an infinite range of values; groups of qubits can be entangled; qubits must be insulated against decoherence, so that the coherent state of the quantum system in a quantum computer is preserved for a time that is long enough to set up a calculation, perform it, and read out the results

- quantum computers processing qubits or entangled qubits can outperform classical computers; functional requirements of quantum computers:

    - ❖ they must have the ability to initialize any qubit in a specified state, and to measure the state of a specific qubit
    - ❖ they must have universal quantum gates, which are logical elements capable of arranging any desired logical relationship between the states of qubits
    - ❖ they must also have a processor capable of interlinking quantum gates to establish rules and boundary conditions for their inter-relationships – in a quantum computation, the arrangement of quantum gates connects the qubits in a logical pattern, according to a program or algorithm, and after an interval the qubits assigned to the result are read out

- quantum error correction codes exist, whereby qubits are passed through a circuit (the quantum analogue of logic gates) that will successfully fix an error in any one of the qubits without actually reading what all the individual qubit states are; no qubit cloning is required

- a completely secure quantum key can be generated and distributed (for communication and decoding of encrypted messages) using entangled photons has been demonstrated (Tittel et al., 2000; Jennewein et al., 2000; Naik et al., 2000); any eavesdropper's attempt to intercept the quantum key will alter the contents in a detectable way, enabling users to discard the compromised parts of the data

- in an experiment which verified that EPR entanglement obeys Special Relativity (Seife, 2000; Scarani et al., 2000; Gisin et al., 2000; Zbinden et al., 2000a, b), and involving a photon detector moving at relativistic speeds (for example, Bob moves away from Alice at close to the speed of light), investigators determined that quantum information via EPR photon pair entanglement must travel > 10^7 times light speed (the photon detectors were 10.6 km apart)

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- investigators are still developing quantitative laws of entanglement to provide a set of principles for understanding the behavior of entanglement and how it is used to do information processing

- investigators are working to develop an understanding of the general principles that govern complex quantum systems such as quantum computers

Other developments are equally as interesting or compelling. For example, the quantum state of the object we wish to teleport does not have to describe single microscopic systems like photons, ions, atoms or electrons. Quantum states can describe large collections of atoms like chemical compounds, humans, planets, stars, and galaxies. Hartle and Hawking (1983) even derived the quantum wavefunction of the Universe in closed form, although, it was extremely simplified and excluded the presence of quantum matter-energy. So it has become possible to consider teleporting large quantum systems. We summarize the more recent spectacular developments in the following:

- Generation of entanglement and teleportation by Parametric Down-Conversion (Bouwmeester et al., 1997; Zeilinger, 2003): EPR entangled photon pairs are created when a laser beam passes through a nonlinear β-barium borate or BBO crystal. Inside the crystal (BBO, for example) an ultraviolet photon (λ = 490 nm) may spontaneously split into two lower energy infrared photons (λ = 780 nm), which is called parametric down-conversion. The two "down-conversion" photons emerge as independent beams with orthogonal polarizations (horizontal or vertical). (The orthogonal polarization states represent a classic example of the discrete quantum state variables that can be teleported. Other examples of discrete quantum variables that have been teleported using other schemes include the nuclear magnetic spin of a hydrogen atom, electronic excitations of an effective two-level atom, elementary particle spins, etc.) In the two beams along the intersections of their emission cones, we observe a polarization-entangled two-photon state. For the experimental realization of quantum teleportation, it is necessary to use pulsed down-conversion. Only if the pulse width of the UV light, and thus the time of generating photon pairs is shorter than the coherence time of the down-converted photons, then interferometric Bell-state analysis can be performed. In this type of experiment, the pulses from a mode-locked Ti:Saphire laser have been frequency doubled to give pulses of ≈ 200 fs duration (1 fs = 10^{-15} second). The interfering light is observed after passage through IR filters of 4 nm bandwidth giving a coherence time of ≈ 520 fs. After retroflection during its second passage through the crystal, the UV pulse creates another pair of photons. One of these will be the teleported photon, which can be prepared to have any polarization. Beam splitters and photon detectors are used to perform the Bell-state analysis during the standard teleportation process that ensues. See Figure 8 for a schematic showing the layout of a standard parametric down-conversion entanglement-teleportation experiment.

- Teleportation of squeezed states of light and continuous quantum state variables (Furusawa et al., 1998; Sørensen, 1998; Braunstein and Kimble, 1998; Opatrný et al., 2000; Braunstein et al., 2001; Zhang et al., 2002; Bowen et al., 2002; Bowen et al., 2003; Zeilinger, 2003): Squeezed light (see Section A.2 in Appendix A) is used to generate the EPR entangled beams, which are sent to Alice and Bob. A third beam, the input, is a coherent state of unknown complex amplitude. This state is teleported to Bob with a high fidelity only achievable via the use of quantum entanglement. Entangled EPR beams are generated by combining two beams of squeezed light at a 50/50 beam splitter. EPR beam 1 propagates to Alice's sending station, where it is combined at a 50/50 beam splitter with the unknown input state, in this case a coherent state of unknown complex amplitude. Alice uses two sets of balanced homodyne detectors to make a Bell-state measurement on the amplitudes of the combined state. Because of the entanglement between the EPR beams, Alice's detection collapses Bob's field (EPR beam 2) into a state

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conditioned on Alice's measurement outcome. After receiving the classical result from Alice, Bob is able to construct the teleported state via a simple phase-space displacement of the EPR field 2. Quantum teleportation in this scheme is theoretically perfect, yielding an output state which equals the input with a fidelity $F = 1$. In practice, fidelities less than one are realized due to imperfections in the EPR pair, Alice's Bell measurement, and Bob's unitary transformation. By contrast, a sender and receiver who share only a classical communication channel cannot hope to transfer an arbitrary quantum state with a fidelity of one. For coherent states, the classical teleportation limit is $F = 0.5$, while for light polarization states it is $F = 0.67$. The quantum nature of the teleportation achieved in this case is demonstrated by the experimentally determined fidelity of $F = 0.58$, greater than the classical limit of 0.5 for coherent states. The fidelity is an average over all input states and so measures the ability to transfer an arbitrary, unknown superposition from Alice to Bob. This technique achieves the teleportation of continuous quantum state variables, as opposed to the discrete quantum state variables used in the Bennett et al. (1993) teleportation protocol and its variants. The teleportation of a squeezed state of light from one beam of light to another demonstrates the teleportation of a continuous feature (of light) that comes from the superpositions of an infinite number of basic states of the electromagnetic field, such as those found in squeezed states. This line of research also involves the experimental demonstration of the mapping of quantum states from photonic to atomic media via entanglement and teleportation. Hald et al. (1999) reported on the experimental observation of a spin-squeezed macroscopic ensemble of 10^7 cold atoms, whereby the ensemble is generated via quantum state entanglement/teleportation from non-classical light to atoms.

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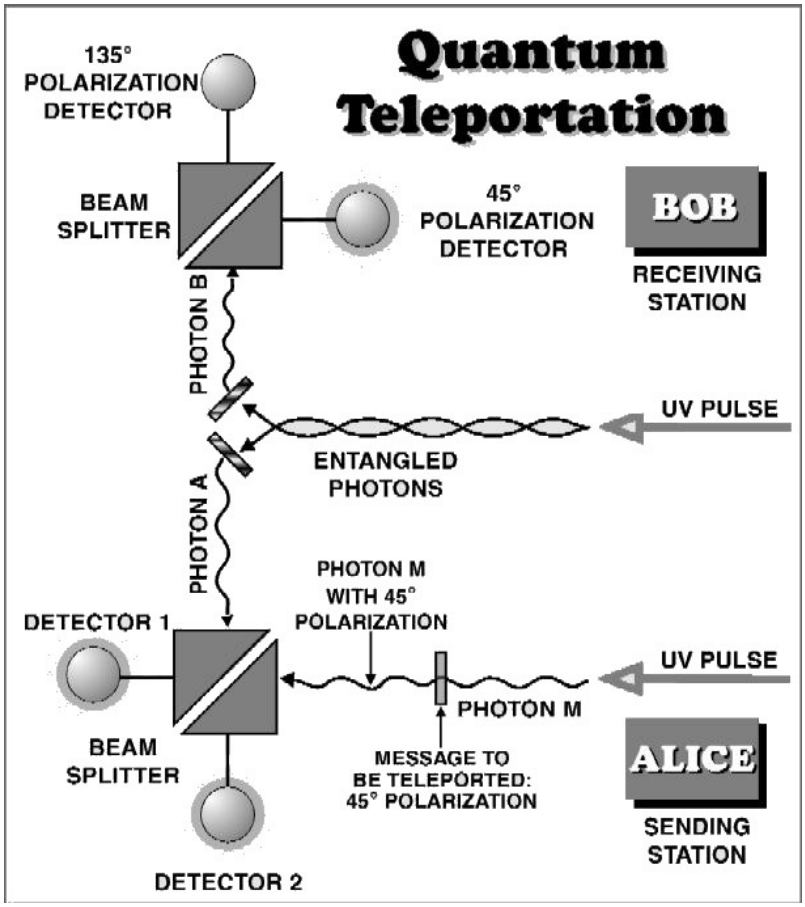

Figure 8. Quantum Teleportation (From www.aip.org)

At the sending station of the quantum teleporter, Alice encodes a "messenger" photon (M) with a specific state: 45 degrees polarization. This travels towards a beam splitter. Meanwhile, two additional entangled photons (A and B) are created. The polarization of each photon is in a fuzzy, undetermined state, yet the two photons have a precisely defined interrelationship. Specifically, they must have complementary polarizations. For example, if photon A is later measured to have horizontal (0 degrees) polarization, then the other photon must collapse into the complementary state of vertical (90 degrees) polarization. Entangled photon A arrives at the beam splitter at the same time as the message photon M. The beam splitter causes each photon to either continue toward detector 1 or change course and travel to detector 2. In 25% of all cases, in which the two photons go off into different detectors, Alice does not know which photon went to which detector. This inability for Alice to distinguish between the two photons causes quantum weirdness to kick in. Just by the very fact that the two photons are now indistinguishable, the M photon loses its original identity and becomes entangled with A. The polarization value for each photon is now indeterminate, but since they travel toward different detectors Alice knows that the two photons must have complementary polarizations. Since message photon M must have complementary polarization to photon A, then the other entangled photon (B) must now attain the same polarization value as M. Therefore, teleportation is successful. Indeed, Bob sees that the polarization value of photon B is 45 degrees: the initial value of the message photon.

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- Entanglement of Atoms (Hagley et al., 1997; Sackett et al., 2000): EPR entanglement at the level of atoms has been experimentally demonstrated using rubidium atoms prepared in circular Rydberg states (i.e., the outer electrons of the atom have been excited to very high energy states and are far from the nucleus in circular orbits). The experimental apparatus produces two entangled atoms, one atom in a ground state and the other atom in an excited state, physically separated so that the entanglement is non-local. And when a measurement is made on one atom, let us say the atom in a ground state, then the other atom instantaneously presents itself in the excited state – the result of the second atom wave function collapse, thus determined by the result of the first atom wave function collapse. This work is now evolving towards the demonstration of entanglement for molecules and larger entities followed by teleportation of their states. Bose and Home (2002) have improved on this concept by proposing a single, simple generic method by which any atoms, ions and macroscopic objects can be entangled and teleported.

- Teleportation of an Atomic State via Cavity Decay (Bose et al., 1999; Sackett et al., 2000): It has been shown how the state of an atom trapped in a cavity can be teleported to a second atom trapped in a distant cavity simply by detecting photon decays from the cavities.

- Biological Quantum Teleportation (Mavromatos et al., 2002): There are several obstacles to teleporting large complicated objects, especially biological entities. Decoherence is the primary obstacle. That is because observable quantum effects in biological matter is thought to be strongly suppressed due to the macroscopic nature of most biological entities and the fact that such systems live at near room temperature, and there is always contact between biological entities and the environment (the source of decoherence). These conditions result in very fast collapse of pertinent quantum wavefunctions to one of the allowed classical states of the biological entity. Mavromatos et al. (2002) propose a daring model that predicts dissipationless energy transfer along shielded macromolecules at near room temperatures as well as quantum teleportation of states across microtubules and perhaps neurons. It is proposed that under certain circumstances it is in principle possible to obtain the necessary isolation against environmental decoherence, so that meso/macroscopic quantum coherence, and entanglement extending over scales that are larger than the atomic scale, may be achieved and maintained for times comparable to the characteristic times for biological and cellular processes. Microtubules are comprised of tubulin that is a common polar protein found in the cytoskeleton of eukariotic cells, which is especially enriched in brain tissue. The model treats microtubules as quantum mechanically isolated high-Q QED cavities, exhibiting properties analogous to those of electromagnetic cavities routinely used in quantum optics. The model builds a microtubule network that achieves quantum teleportation of coherent quantum states, leading to decoherence-resistant bulk quantum information processing and computing within the biological matter. It is speculated that the model can explain how consciousness works, and how the brain processes and computes information.

- Teleportation of a laser beam with embedded radio signal (Bowen et al., 2003): The teleportation of a laser beam from one part of a lab to another has been demonstrated. Investigators embedded a radio signal into a laser beam, then disintegrated the beam and reassembled it a meter away, virtually instantaneously. The laser beam was destroyed in the teleportation process, but the radio signal survived. The laser light at one end of an optical communications system was disassembled and its replica was recreated elsewhere in the lab. Even though the laser beam did not survive teleportation, its encoded message did. This system could be used to transport secure data, such that it could become possible to construct a perfect cryptography system. When two

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parties want to communicate with one another, one can enable the secrecy of the communication to be absolutely perfect.

- Entanglement and Teleportation of a Macroscopic Ensemble of Atoms (Julsgaard et al., 2001): Expanding upon the earlier work of Hald et al. (1999) and Sackett et al. (2000), investigators experimentally demonstrated the entanglement of two macroscopic objects, each consisting of a cesium gas sample containing $\approx 10^{12}$ atoms. Entanglement is generated via interaction of the samples with a pulse of light, which performs a non-local Bell measurement on the collective spins of the samples. The entangled spin-state can be maintained for 0.5 milliseconds. The teleportation of macro-ensemble atom quantum states is expected to follow this experiment. This work is evolving towards the experimental demonstration of the Bose and Home (2002) proposal, which proved that there is a single generic process that can entangle and teleport any atoms, ions and macroscopic objects.

- Entanglement/teleportation of internal state and external motion information of atoms (Opatrný and Kurizki, 2001): Investigators propose an experiment for transmitting an atom's full information, including its "external" states, such as its energy of motion. This procedure replicates the quantum features of the external motion of a particle. For example, if particle-to-be-teleported C yielded a diffraction pattern after passing through two slits, then the same pattern would be produced by particle B, which receives the teleported information. The researchers propose the following idea: Dissociate a very cold molecule with a laser pulse into two atoms (called A and B). Then manipulate the two atoms so that they become entangled: each one is in a fuzzy state individually, but has a precisely defined relationship with its partner. Then let one of the entangled particles (such as A) collide with particle C, whose unknown state should be teleported. After their collision, the momentum values of the collision partners A and C are measured. With that information, the researchers know how to "kick" and deflect atom B, so that the motion of B precisely emulates that of particle C. The investigators say that state-of-the-art equipment for studying atomic collisions and quantum effects makes this experiment difficult, but feasible, to do. If this proposal proves to be correct, then the implication is that it will become possible to experimentally expand this concept to the teleportation of a large ensemble of atoms, such that the entire physical motion and quantum states of the ensemble can be teleported. This could lead to the future development of a teleportation process similar to what was discussed in Section 3.1.

- Laser-like Amplification of Entangled Particles and Entangled-Photon Lasers (Lamas-Linares et al., 2001): Entangled particles are notoriously difficult to create in bulk. To create entangled photons, for example, researchers use the parametric down-conversion technique to send laser light through a barium borate crystal. Passing through the crystal, a photon sometimes splits into two entangled photons (each with half the energy of the initial photon). However, this only occurs for one in every ten billion incoming photons. To increase the yield, researchers added a step: they put mirrors beyond the crystal so that the laser pulse and entangled pair could reflect, and have the chance to interact. The entangled pair and reflected laser pulse interfere constructively to generate fourfold more two-photon pairs or interfere destructively to create zero pairs. Following these steps, the researchers increased production of two-photon entangled pairs, and also of more rare states such as four-photon entangled quartets. This achievement could represent a step towards an entangled-photon laser, which would repeatedly amplify entangled particles to create greater yields than previously possible, and also towards the creation of new and more complex kinds of entangled states.

This list is by no means complete as new developments in this field continue to arise.

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3.3 Conclusion and Recommendations

Given the incredible advancements that have been made in the entanglement and teleportation of macroscopic objects the size of 10^{12} atoms, we are still very far away from being able to entangle and teleport human beings (and even simpler biological entities such as cells, etc.) and bulk inanimate objects (tools, technical equipment, pencils and pens, weapons platforms, communications devices, personal hygiene supplies, etc.). There still remain four essential problems:

- One needs an entangled pair of such bulk objects.
- The bulk objects to be entangled and teleported must be in a pure quantum state (as in a Bose-Einstein condensate, for example). And pure quantum states are very fragile.
- The bulk objects to be entangled and teleported must be extremely isolated from the environment to prevent the onset of decoherence.
- The Bell-state measurement of animate or inanimate objects during entanglement/teleportation will require extracting an amount of information (in bits) that equals or exceeds the number of atoms contained within the object. This infers that the computer storage and processing requirements to entangle and teleport a complete bulk object will be astronomically huge (recall the discussion in Section 3.1).

It is difficult to imagine how we can achieve an extreme level of environmental isolation for an object, let alone a living being that breathes air and radiates heat. Experiments with atoms and larger objects must be done in a high vacuum to avoid collisions with molecules. Thermal radiation from the walls of a teleportation apparatus would easily disturb a tiny amount of matter. At present, decoherence imposes a fundamental limit on quantum entanglement and teleportation. Decoherence is the primary reason why we do not routinely see any quantum effects in our everyday world. Research is continuing on whether decoherence can be reduced, circumvented, or otherwise be eliminated. And some minor progress has been made in that direction.

In q-Teleportation it is the *quantum states* of the objects that are destroyed and recreated, and not the objects themselves. Therefore, q-Teleportation *cannot* teleport animate or inanimate matter (or energy) in its physical entirety. However, some experts argue that because an object's quantum state is its defining characteristic, teleporting its quantum state is completely *equivalent* to teleporting the object, even though the original object's quantum state (and defining characteristic) was completely destroyed in the process. This goes to the heart of what is meant by identity. When an object has all the right properties and features, it will be the same object that one observes whether it was observed now or 24 hours ago. Quantum physics reinforces the point that objects of the same type in the same quantum state are indistinguishable from each other. One should, according to this quantum principle, be able to swap all the atoms in a particular object with the same atoms from a mound of raw materials, and reproduce the original object's quantum states exactly with the end result that the new object is identical to the original. Last, we do not know how to put a human being into a pure quantum state or what doing so would mean for biological functioning (including brain function), but we do know how to put $\leq 10^{12}$ gas atoms/ions and a beam of photons into a pure state in practice. Further research will be required to ascertain whether microbiological and higher-level biological systems, in addition to bulk inanimate matter, can be put into pure quantum states and entangled/teleported.

To perform a Bell-state measurement on (bulk) animate or inanimate objects, during the entanglement/teleportation process, to extract and encode its information will require extracting an amount of information (in bits) that equals or exceeds the number of atoms contained within the object. An object containing a few grams of matter will require the extraction of $> 10^{28}$ bits of data. A simple virus of $\approx 10^{7}$ atoms would require the extraction of $\geq 10^{8}$ bits of information during the

entanglement/teleportation process, whereas the extraction of a minimum of 10^{28} kilobytes will be required to encode and store an entire human being. This is beyond the capability of present digital electronic computer technology to store and process. It is difficult to see how far computer technology will advance towards meeting this requirement.

It is difficult to fathom what will be in store for the teleportation of human beings given some possible future technology. What about the effects of the q-Teleportation process on the human consciousness, memories and dreams, and the spirit or soul? We know from quantum physics that "the whole is greater than the sum of its parts." So what happens to the fundamental characteristics of a human being when he/she steps into the teleporter-transmitter, where their quantum states (i.e., their complete identity) are destroyed during the quantum entanglement/teleportation process, and then their copy is created at the teleporter-receiver an instant later? What will things be like during the entanglement process? Will a teleported individual's consciousness, memories and dreams, and spirit/soul be successfully and accurately teleported or not? This is a major ethical and technical question that will have to be addressed by future research.

•**Recommendations**:

- Broad-spectrum Quantum Computing Technology Development Program: At present, the Quantum Information Science Program (QISP) is coordinated by the U.S. Army Research Office with funding and support from the Army, the National Security Agency, DARPA, and the Office of the Deputy Director of Defense for Research and Engineering. The Naval Research Lab and the CIA are both involved in their own programs. The CIA vets new commercial development of computer technology and computer information processing via its In-Q-Tel company (reference 44). This includes R&D on quantum entanglement and teleportation for computer, information processing and secure communications. QISP was funded for $19 million in 1999. The program involves 34 projects by researchers at 21 universities, three government laboratories and two corporate laboratories. QISP goals include building a quantum computer, developing quantum information processing, and further advances in quantum teleportation. The AFRL should join QISP and provide partnership funding on the order of $1 million per year. An alternative to this would be for AFRL to collaborate with In-Q-Tel and participate in its technology R&D venture capital programs. This R&D investment would allow the Air Force to acquire very advanced quantum physics and related technological applications that can support its mission. The R&D investment benefits would include the development and implementation of quantum computing/information processing and secured quantum communications technology, which can significantly enhance the performance and security of Air Force computing and communication systems infrastructure, and aerospace weapons systems.

- Quantum Cryptography: A dedicated research program should be implemented to develop a mature quantum cryptography technology. Theoretical and experimental work is in progress among a small number of select groups (QISP, In-Q-Tel, universities, etc.), but this field is not advancing fast enough for practical applications to become available to meet increasing adversarial threats against secured military and intelligence communications. The goal of proposed quantum cryptography research is to bring the theoretical and experimental foundation of quantum cryptography and secure quantum information processing to maturity, and to fully develop and implement quantum entanglement/teleportation-based cryptography technology. Recent experimental work has demonstrated that a completely secure quantum key can be generated and distributed for the communication and decoding of encrypted messages using entangled photons. Any eavesdropper's attempt to intercept the quantum key will alter the contents in a detectable way, enabling users to discard the compromised parts of the data. There is much more work that needs to be done in this area. I recommend that the AFRL implement a

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$1 million/year program for five years in order to advance the state-of-art in quantum cryptography technology.

- Quantum Decoherence: Decoherence is the primary reason why we do not routinely see any quantum effects in our everyday world. And it imposes a fundamental limit on quantum entanglement and teleportation via the interaction between entangled/teleported quantum systems and their local environment. In order to advance quantum entanglement/teleportation physics and develop applied technologies, it is necessary that a research program be implemented by the AFRL to explore whether decoherence can be significantly reduced, circumvented, or otherwise be eliminated. An insufficient number of small university groups have slowly made minor progress in this direction. I recommend that a $500,000 - 750,000 per year R&D program be conducted for five years to overcome this technical challenge.

- Pure Quantum States: In order to entangle and teleport quantum particles and bulk objects, they both must be prepared in a pure quantum state. And pure quantum states are very fragile to decoherence. A technical challenge for entanglement/teleportation physics is whether the requirement for pure quantum states can be relaxed and how much decoherence will play a role in this situation, what technical challenges will arise when increasing the size of entangled/teleported matter to larger macroscopic scale ($>> 10^{12}$ atoms), and whether matter of mixed composition (such as a gas or Bose-Einstein condensate of mixed atomic elements) can be entangled/teleported in both pure and mixed quantum states. I recommend that a $250,000 – 500,000 per year research program be conducted for five years to study this problem.

- Entangling Bulk Matter and Bell-State Measurement to Extract Information: Recent experiments demonstrated the entanglement of two macroscopic objects, each consisting of a cesium gas sample containing $\approx 10^{12}$ atoms. Entanglement was generated via interaction of the samples with a pulse of light, which performs a non-local Bell measurement on the collective spins of the samples. In order to push the envelope on this development and take it to higher practical levels, it will be necessary to ascertain the limit on the size and composition of bulk matter entanglement (given the decoherence and pure-state constraints); and to determine what other quantum states can be used for entanglement, what other Bell-state measurement techniques can be used, and whether multiple quantum states can be entangled. The chief technical challenge is the computer technology that will be required to facilitate the huge amount of data that must be extracted, processed and stored from bulk matter quantum states during the Bell-state measurement process. I recommend that a $500,000 – 1 million per year research program be implemented for five years in order to explore these questions and ascertain what solutions may be technically available, and to develop such solutions.

- Biological Quantum Teleportation: The Mavromatos et al. (2002) theoretical model for biological entanglement and teleportation is a remarkable concept that could result in the development of a workable physics theory of consciousness. The model has potential applications to advanced quantum computing/information processing physics and the physics of psi phenomena (see Chapter 5). A research program should be implemented to continue the Mavromatos et al. (2002) work and bring their model to theoretical maturity. It is recommended that this program be funded at $500,000 – 800,000 per year for five years. A parallel or follow-up program should be implemented to experimentally test this model and ascertain any useful technological applications. One application that should be explored in the proposed research program is advanced, ultra-fast, ultra-high-capacity quantum computing and information processing using natural and/or artificial biological systems. The parallel or follow-up experimental research program should be funded at $800,000 – 1.5 million per year for five years.

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- FTL Communication: Experiments verifying that EPR entanglement obeys Special Relativity (Seife, 2000; Scarani et al., 2000; Gisin et al., 2000; Zbinden et al., 2000a, b) determined that quantum information via EPR photon pair entanglement must travel > 10^7 times light speed. Can this mechanism be exploited to achieve FTL communication? If so, then the potential military and commercial applications will be revolutionary, and the science and industry of communications will be forever transformed. A comprehensive theoretical and experimental research program should be implemented to answer this question. It is recommended that this program be funded at $700,000 – 1 million per year for five years. A modest experiment definition study should be funded at $80,000 for one year to delineate the most promising experimental approaches to be used for the larger research program. [There is much controversy and debate over FTL (a.k.a. superluminal) signals/communication, and the reader should see the selected superluminal references in the Teleportation References section of this study.]

- New Entanglement/Teleportation Breakthroughs: The most exciting developments in quantum teleportation physics has included the teleportation of a laser beam with an embedded radio signal, the teleportation of squeezed states of light (and hence, continuous quantum state variables), the teleportation of photon states to atoms/ions (from light to matter!), the entanglement of two similar/dissimilar quantum particles that are created by two (independently) different particle sources, the laser-like amplification of entangled particle/photon pairs, parametric down-conversion entanglement and teleportation (of discrete quantum state variables), quantum cryptography with unbreakable keys, the teleportation of quantum information at speeds > 10^7 times light speed, the entanglement and teleportation of macroscopic (10^{12} atoms) matter quantum states, etc. There is also the yet-untested proposal to entangle/teleport the external physical motion and internal quantum state information of atoms. This shows that quantum physics sets no apparent limit on what it is that can be teleported/entangled and how it is to be teleported/entangled, or where it is to be teleported/entangled. At present teleportation technology requires fiber optic and coaxial cables to teleport quantum state information from one location to another. Can we avoid the use of cables and teleport through free space? [Note: Before this report went to press, Aspelmeyer et al. (2003) reported their outdoor experiment that demonstrated the distribution of quantum entanglement (of laser photons) via optical free-space links to independent receivers separated by 600 m across the Danube River (during inclement nighttime weather), with no line of sight between them. This experiment is revolutionary and begins the step toward conducting satellite-based distributed quantum entanglement.] We have not discovered all the possibilities that nature has in store for us. The present breakthrough discoveries will likely introduce novel military and intelligence technology applications in the near and far future. But further R&D must be conducted in order to discover new applications for these recent breakthroughs, to make additional breakthroughs and discoveries, and to advance the state-of-art in quantum teleportation physics to meet future challenges to the Air Force mission. I recommend that a two-track R&D program be implemented over five years. The first track should be funded at $250,000 – 750,000 per year for the purpose of developing new entanglement/teleportation breakthroughs in quantum teleportation physics. The second track should be funded at $750,000 – 1.5 million per year for the purpose of developing applications for any new breakthroughs with the proviso that such applications benefit the Air Force mission and have commercial dual-use capability to leverage advance technology in the private sector.

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4.0 e-TELEPORTATION

4.1 Extra Space Dimensions and Parallel Universes/Spaces

A literature search for proposed e-Teleportation concepts based on the conveyance of objects through extra space dimensions and/or parallel universes/spaces has yielded only one result (see Section 4.2). The present state-of-art in research on parallel universes/spaces and extra space dimensions has been strictly limited to the work on developing a grand unified quantum field theory and a quantum theory of gravity, whereby the former necessarily includes the latter. Quantum gravity/unified field theory research has been evolving since the 1920s when Kaluza and Klein published the first papers to describe a model for the unification of gravity with electrodynamics. Many of the more prominent theories today invoke extra spatial dimensions, the existence of parallel universes/spaces, or both in order to quantise gravity and/or to unify gravity with the other forces of nature. It is beyond the scope of this study to provide an in-depth review of all of the research that has been done in this area, so we list below a select few of the historically prominent models that have largely gained a secure foothold in present-day research:

- Kaluza-Klein Electromagnetic-Gravity Unification Theory/Modern Kaluza-Klein Gravity Theories (Kaluza, 1921; Klein, 1926; de Sabbata and Schmutzer, 1983; Lee, 1984; Appelquist et al., 1987; Kaku, 1993, 1994; Overduin and Wesson, 1998): It was originally suggested that Maxwellian electrodynamics and Einstein gravitation could be unified in a theory of five-dimensional Riemannian geometry, where the gravitational and electromagnetic potentials together would determine the structure of spacetime. The fifth space dimension is curled up into a ball of space with a radius slightly larger than 10^{-35} m, and it was originally regarded as having no physical significance because it was simply a mathematical tool used to catalyze unification. At present, the generic name of Kaluza-Klein stands for a wide variety of approaches to quantising and unifying gravitation with other quantum fields using any number of dimensions greater than four.

- Superstring Theories (Green, 1985; Kaku, 1988, 1993, 1994): These theories come in a wide variety of interrelated concepts, and they are a highly evolved form of Kaluza-Klein theories. They are based on the dynamics of string-like fundamental quanta, whereby the observed fundamental particles are manifested by the vibrational ground or excitation states of a quantum string (open or closed loop). The superstrings are $\approx 10^{-35}$ m (i.e., the Planck length) in size. There are different versions of these theories that require ten, eleven or twenty-six extra space dimensions to unify and quantise gravity, whereby the extra dimensions are curled up (i.e., compactified) into balls of space with a radius $< 10^{-35}$ m. These theories later evolved into versions that are now called F- and M-theory. The mathematics behind this class of theories is very ugly, and it is difficult for even the best superstring theorists to make simple or sophisticated calculations and predictions. And so far, this class of quantum gravity theories has escaped experimental verification.

- D-Brane and 3-Brane Theories/Parallel Spaces (Rubakov and Shaposhnikov, 1983a, b; Polchinski, 1995; Antoniadis et al., 1998; Randall and Sundrum, 1999a, b; Weiss, 2000; Pease, 2001; Arkani-Hamed et al., 1998, 2000, 2002): D-brane theory is a recent incarnation of the original superstring theories in which open strings, corresponding to the fundamental particles of the standard model (quarks, leptons, gauge bosons), have their free ends stuck on a (hypersurface)

membrane called a D-brane (D = Dirichlet boundary conditions). But the graviton, which corresponds to a closed loop of string, can propagate in all the dimensions. It provides both unification and quantization of gravity by assuming that there are n new spatial dimensions in addition to the three infinite spatial dimensions we know about. And the extra space dimensions are $\approx 10^{-35}$ m in extent. A very recent alternative version of this model is called "3-brane" theory. In this theory, each of the n extra space dimensions is of finite extent $R \approx 2\times10^{(32/n)-17}$ centimeters. The space spanned by the new dimensions is called "the bulk." In this theory, the particles of the standard model live within our familiar realm of three spatial dimensions, which forms a three-dimensional (hypersurface) membrane or "3-brane" within the bulk. The propagation of electroweak and strong nuclear forces is then confined to our 3-brane. However, at distances (r) less than R, gravity (via gravitons) propagates in the full $(3 + n)$-dimensional space, whereby its strength falls as $r^{-(2+n)}$ with increasing separation r. When $r > R$, the gravitational force reverts to its normal Newtonian r^{-2} falloff because there is no longer any extra-dimensional space for it to spread into. If $n = 1$, then the size of the extra-dimension would have to be $R \approx 2\times10^{15}$ cm (or 2×10^{10} km = 133.3 AU; 1 AU = 1.5×10^{8} km is the mean Earth-Sun distance) in order to account for the weakness of gravity, but an extra space dimension this large would have already made itself obvious in the observed dynamics of the solar system. For this reason, investigators have discounted the possibility that $n = 1$. If $n = 2$, then the size of both extra space dimensions would have to be $R \approx 0.2$ cm (or 2 mm). In any case, inconspicuous neighboring 3-branes may be separated from the 3-brane we live on by only a fraction of a millimeter, or even much smaller distances, across the higher-dimensional bulk. Such neighboring 3-branes may be distant folds of our own 3-brane, with the same physics, but able to influence us across shortcuts through the bulk. Or they may be completely separate 3-branes possessing their own fundamental laws and parameters of nature that are completely different from our own. Several tabletop Cavendish-type experiments are now looking for sub-millimeter deviations from Newtonian gravitation as a first step towards verifying 3-brane theory, and other experiments are now being planned or are already underway (Pease, 2001). At present the preliminary experimental results have been negative for the existence of extra space dimensions, and the experimental data suggests that two extra space dimensions are now constrained to length scales << 0.2 – 0.3 millimeters while seven extra space dimensions can be no larger than 2 femtometers (Pease, 2001).

- Parallel Universes/Parallel Spaces (Everett, 1957; Wheeler, 1957, 1962; DeWitt, 1970; DeWitt and Graham, 1973; Jammer, 1974; Davies, 1980; Wolf, 1988; Kaku, 1994; Visser, 1995 and Section 2.1): There are only two other research tracts that are concerned with parallel universes besides 3-brane theory. The first tract is the traversable wormhole research that was discussed in Section 2.1. Traversable wormholes can connect many different universes in the "multiverse" (i.e., a conglomeration of many universes), and these are called inter-universe wormholes. However, traversable wormhole physics (a.k.a. Einstein's General Relativity Theory) does not provide a physical prescription for the existence and nature (i.e., fundamental parameters and physical laws) of other putative universes. The difference between inter-universe and intra-universe (i.e., two distant regions of one universe are connected with each other) wormholes arises only at the level of global geometry and global topology. Local physics near the throat of a traversable wormhole is insensitive to issues of intra-universal or inter-universal travel. An observer in the vicinity of the throat, while making local measurements, would not be able to tell whether he was traveling to another universe or to a remote part of our own universe. And one cannot rely on the topological (as opposed to geometrical) information to determine which is the case, because topological information is not enough to uniquely characterize an inter-universe connection. And General Relativity Theory does not fix the topology of spacetime, so we cannot ascertain the existence of other universes. [Note: Traversable wormholes are also geometrically possible for higher dimensional spaces.] The second tract is the "Many Worlds" interpretation of

quantum theory. This version of quantum theory requires the simultaneous existence of an infinite number of equally real worlds, all of which are more-or-less causally disjoint, in order to interpret consistently the relationship between observed phenomena and observers. The theory was proposed in an attempt to overcome a number of deep paradoxes inherent in the interpretation of the theory of measurement and quantum theory. The Many Worlds theory argues that quantum theory requires the existence of a "superspace" of worlds spanning the range of all possible quantum observations (or quantum measurements). Through our acts of measurement we are imagined to trace a path through the mesh of possible outcomes. All the "worlds" are causally disjoint, and the uncertainty of quantum observation can be interpreted as an artifact of our access to such a limited portion of the superspace of possible worlds. The evolution in the superspace as a whole is entirely deterministic.

At present, none of the theoretical concepts outlined above have been brought to a level of technical maturity, where it becomes meaningful to ascertain whether any form of e-Teleportation is theoretically possible between extra space dimensions and different or parallel universes/spaces. However, as mentioned in the item on parallel universes/parallel spaces, there is the exception that traversable wormholes (three- and higher-dimensional) provide a solid physics principle for the implementation of teleportation between parallel universes/spaces. And traversable wormholes can be devised to connect 3-branes together. See Section 2.1 for the discussion on teleportation via traversable wormholes. Also, Kaluza-Klein theories, superstring theories and D-brane theory all have the common feature that their extra space dimensions are $\leq 10^{-35}$ m in extent, which makes it impossible for any useful form of macroscopic-level teleportation to occur between space dimensions. Last, it is not yet possible to do theoretical calculations or even experimentally verify most of these theories. Three-brane theory is the best parallel space theory there is, with the possibility that macroscopic-level teleportation is possible between space dimensions (only if the extra space dimension(s) has length scale(s) >> millimeters). But this theory is still in the stage of maturing theoretically and achieving experimental verification (or falsification). Therefore, we can go no further in this section.

4.2 Vacuum Hole Teleportation

An unusual teleportation concept has been proposed by Leshan (1999, 2002), which describes the teleportation of objects throughout our universe by using the geometrical properties of spacetime. The proposal posits that there is a "zero-space" that exists outside the boundary of our universe, whereby this zero-space is a "point form" space, where the distance between any two points is always equal to zero. Leshan also calls this space a "hole." Further requirements and assumptions of the model are:

- time does not exist as a property in zero-space
- the cosmological principle (i.e., there are no privileged frames relative to another place or point in the universe) requires that the boundary or border of the universe must pass through every point of space
- virtual holes (or zero-space) in spacetime must exist at every point of the universe, which are also called "vacuum holes"
- vacuum holes exist as virtual particles

The last item is interesting because it implicitly says that vacuum holes (a.k.a. zero-space) must also be virtual particles, and in Section 2.2 we showed that virtual particles are a representation of the vacuum ZPF. Therefore, this infers that vacuum holes can be considered to be vacuum zero-point fluctuations in

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Leshan's model. Thus, a teleportation mechanism can arise in this model because distances between zero-space and any other point in the universe are zero, so that the vacuum holes can potentially exist at every point in the universe simultaneously. Therefore, if an object is sent "out of the universe" and into a vacuum hole (a.k.a. zero-space), then the object can appear at random at any spacetime point in the universe.

The mechanism for teleportation in this model is:

- to send an object outside of the universe by creating a closed surface (i.e., "hole sphere"), which consists of vacuum holes, around the object;
- while inside the hole sphere, the object then ceases to exist because objects cannot really exist outside of the universe;
- however, the object simultaneously exists at any other remote location in the universe (via the cosmological principle) at the instant it became enclosed by the hole sphere;
- therefore, it has been teleported to some remote location in the universe

Leshan points out that the teleportation device must curve spacetime so that the starting and destination points in the universe coincide, and the curved geometry must be similar to that of a black hole for an instant, so that a channel between the two points can be formed. (This sounds suspiciously like creating a traversable wormhole via an Einstein-Rosen bridge, which can be made traversable by perturbing the Schwarzschild spacetime metric an infinitesimal amount.) There is no space to traverse, so therefore there will be no passage of time during teleportation. The only expenditure of energy in this teleportation scheme is the energy that will be needed to curve spacetime.

This teleportation concept is very convoluted. Leshan does not offer any further explanations that are useful nor does he offer any precise technical description for the vacuum holes, and how they are to be produced and manipulated. There is also no mathematical physics derivation published by Leshan to support this concept. I am totally unable to evaluate this concept in the absence of a rigorous theoretical framework. This concept is too sketchy and full of technical "holes" to seriously consider it any further for this study. The reader should note that it has already been demonstrated that traversable wormholes are the best physical principle available to implement teleportation between universes and extra space dimensions.

4.3 Conclusion and Recommendations

At present, none of the theoretical concepts explored in this chapter have been brought to a level of technical maturity, where it becomes meaningful to ascertain whether any form of e-Teleportation is theoretically possible between extra space dimensions and different or parallel universes/spaces. However, there is the exception that traversable wormholes (three- and higher-dimensional) provide a solid physics principle for the implementation of teleportation between parallel universes/spaces. And traversable wormholes can be devised to connect 3-branes together. Kaluza-Klein, superstring and D-brane theories do not allow for any useful form of macroscopic-level teleportation to occur between space dimensions, because these theories require that the extra space dimensions be $\leq 10^{-35}$ m in extent. Last, it is not yet possible to do theoretical calculations to make predictions or even to experimentally verify most of these theories. Three-brane theory is the best parallel space theory there is with the possibility that macroscopic-level teleportation is possible between space dimensions. But this theory is still in the stage of maturing theoretically and getting experimental verification.

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•**Recommendations**:

- The recommendations outlined in Section 2.3 are relevant to the investigation of the possibility for e-Teleportation.

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5.0 p-TELEPORTATION

5.1 PK Phenomenon

P-Teleportation is a form of psychokinesis (or PK) similar to telekinesis but generally used to designate the movement of objects (called apports) through other physical objects or over great distances. Telekinesis is a form of PK, which describes the movement of stationary objects without the use of any known physical force. And PK is essentially the direct influence of mind on matter without any known intermediate physical energy or instrumentation. Rigorously controlled modern scientific laboratory PK, and related psychic (a.k.a. "psi", "paranormal" or parapsychology), research has been performed and/or documented by Rhine (1970), Schmidt (1974), Mitchell (1974a, b, see also the references cited therein), Swann (1974), Puthoff and Targ (1974, 1975), Hasted et al. (1975), Targ and Puthoff (1977), Nash (1978, see also the references cited therein), Shigemi et al. (1978), Hasted (1979), Houck (1984a), Wolman et al. (1986, see also the references cited therein), Schmidt (1987), Alexander et al. (1990), Giroldini (1991), Gissurarson (1992), Radin (1997, see also the references cited therein), Tart et al. (2002), Shoup (2002), and Alexander (2003).

A well-known theoretical/experimental/operational program directed by H. E. Puthoff, R. Targ, E. May and I. Swann was conducted at SRI International and the NSA, and sponsored at various times by the Central Intelligence Agency (CIA), the Defense Intelligence Agency (DIA), and the Army Intelligence and Security Command (INSCOM) over more than two decades; and the program was later carried on by E. May at SAIC (Alexander, 1980; Puthoff, 1996; Targ, 1996; Schnabel, 1997; Tart et al., 2002). This was called the Remote Viewing program, and it was a compartmentalized special access program possessing a variety of codenames during its 22 years of operation. Remote viewing involves precognition and clairvoyance, and it allows a practitioner to acquire information irrespective of intervening distance or time. The Remote Viewing program ended in 1994 and President W. J. Clinton officially declassified it in 1995. The reader should note that the very first U. S. military-intelligence R&D programs on psi, PK and mind control were conducted by H. K. (Andrija) Puharich, M.D., L.L.D during his military service at the Army Chemical and Biological Warfare Center at Fort Detrick, Maryland in the 1940s-50s. Puharich had an interest in clairvoyance and PK, and dabbled in theories for electronically and pharmaceutically enhancing and synthesizing psychic abilities. While in the Army, Puharich took part in a variety of parapsychology experiments, and he lectured Army, Air Force and Navy groups on possibilities for mind warfare. He was a recognized expert in hypnotism and microelectronics.

PK phenomenon was also explored in the Remote Viewing program. Col. J. B. Alexander (USA ret.) credits professional aerospace engineer Jack Houck for "capturing PK phenomenon and transitioning it into an observable form" (Houck, 1982, 1984a, b; Alexander et al., 1990; Alexander, 2003). During the past three decades, Houck (along with Alexander) held a number of PK sessions, whereby attendees are taught the PK induction process, and initiate their own PK events using various metal specimens (forks, spoons, etc.). Individuals were able to completely bend or contort their metal specimens with no physical force being applied whatsoever. Numerous government science advisors and senior military officials took part in and/or witnessed these events, which took place at the Pentagon, at officers' or scientists' homes, and at one quarterly INSCOM retreat attended by the commanding general and a group of colonels and generals commanding INSCOM units around the globe. Spontaneous deformation of the metal specimens was observed at the PK session conducted during the INSCOM retreat, causing a great deal of excitement among those present. Other notable trained observers were also present at this session, and they critically reviewed the events. Psychic Uri Geller (1975) is the original model for demonstrating

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PK metal bending. During a talk that he gave at the U.S. Capitol building, Uri caused a spoon to curve upward with no force applied, and then the spoon continued to bend after he put it back down and continued with his talk (Alexander, 1996). Jack Houck continues doing extensive experimental work and data collection on micro- and macro-PK phenomena. Scientifically controlled PK experiments at the Princeton University Engineering Anomalies Research Laboratory were conducted by Robert Jahn (Dean Emeritus of the School of Engineering), who reported that repeatedly consistent results in mentally affecting material substances has been demonstrated in the lab (Jahn and Dunne, 1987). In the 1980s, Jahn attended a meeting on the PK topic at the Naval Research Laboratory, and warned that foreign adversaries could exploit micro- or macro-PK to induce U.S. military fighter pilots to lose control of their aircraft and crash.

Very early investigations of, and experiments on, p-Teleportation occurred during the 19th and early 20th centuries. Many cases that were studied, and the experiments that were performed, were undoubtedly due to fraud, and few experiments have occurred under controlled conditions during that period. However, most of the credible, scientific reports of p-Teleportation phenomenon and related (controlled) experiments occurred in the late 20th century (see for example, Alexander et al., 1990; Radin, 1997). Some of that scientific work involved the investigation of Uri Geller and a variety of other recurrent spontaneous PK phenomena (Hasted et al., 1975; Puthoff and Targ, 1975; Targ and Puthoff, 1977; Nash, 1978; Wolman et al., 1986). Psychics Uri Geller (1975) and Ray Stanford (1974) claimed to have been teleported on several occasions. Most claimed instances of human teleportation of the body from one place to another have been unwitnessed. There are also a small number of credible reports of individuals who reported being teleported to/from UFOs during a UFO close encounter, which were scientifically investigated (Vallee, 1988, 1990, 1997). But there are a larger number of such reports that are anecdotal, whereby the witness data tends to be unreliable. However, we will confine our discussion to the controlled laboratory experiments that have been performed and reported.

One of the more interesting examples of controlled experiments with Uri Geller was one in which he was able to cause a part of a vanadium carbide crystal to vanish (Hasted et al., 1975). The crystal was encapsulated so it could not be touched, and it was placed in such a way that it could not be switched with another crystal by sleight of hand. A more spectacular series of rigorously controlled (and repeatable!) laboratory experiments occurred in the Peoples Republic of China (PRC). In September 1981, an extraordinary paper was published in the PRC in the journal Ziran Zazhi (transl.: Nature Journal), and this paper was entitled, "Some Experiments on the Transfer of Objects Performed by Unusual Abilities of the Human Body" (Shuhuang et al., 1981). The paper reported that gifted children were able to cause the apparent teleportation of small objects (radio micro-transmitters, photosensitive paper, mechanical watches, horseflies, other insects, etc.) from one location to another (that was meters away) without them ever touching the objects beforehand. The experiments were operated under exceptionally well-controlled conditions (both blind and double-blind). The researchers involved included not only observers from various PRC colleges and medical research institutes, but also representatives from the PRC National Defense Science Commission. Because of the involvement of the latter, it was deemed necessary that an unclassified Intelligence Information Report be prepared by the DIA (see Shuhuang et al., 1981), which included a detailed English translation of the article.

Additional research carried out by the Aerospace Medicine Engineering Institute in Beijing was reported in the July 1990 issue of the Chinese Journal of Somatic Science (Kongzhi et al., 1990; Jinggen et al., 1990; Banghui, 1990), which was also translated into English by the DIA. Reported in several articles are experiments involving the videotaping and high-speed photography of the transfer of test specimens (nuts, bundles of matches, pills, nails, thread, photosensitive paper, chemically treated paper, sponges dipped in $FeCl_3$, etc.) through the walls of sealed paper envelopes, double layered KCNS type paper bags, sealed glass bottles and tubes with sealed caps, and sealed plastic film canisters without the walls of any of these containers being breached. All of the Chinese experiments reported using gifted children and young adults, who possessed well-known extraordinary PK ability, to cause the teleportation of the various test specimens. In all the experimental cases that were reported, the test specimens that were teleported were completely unaltered or unchanged from their initial state, even the insects were

unaffected by being teleported. The experiments were well controlled, scientifically recorded, and the experimental results were always repeatable.

The Chinese papers are all extremely interesting and very well written, and they show photographs and schematic diagrams of the various experimental setups. The experimental protocols were explained in lengthy detail, and thorough data and statistical analysis were presented in the results. The combined results from the several Chinese experiments showed that:

- different research groups designed different experimental protocols, used different gifted psychics, used different sealed containers, and used different test specimens (live insects, bulk inanimate objects, and even radio micro-transmitters were used to track the location of the specimens) that were to be teleported;

- the time required for the teleportation of test specimens through various barriers was anywhere from a fraction of a second to several minutes, and this was not dependent on the test specimen that was used, the sealed container that was used (or its barrier thickness), which experimental protocol was used, or which psychic was being used

- the high-speed photography/videotaping recorded in one series of experiments that test specimens would physically "meld" or blend with the walls of sealed containers; and recorded in a different series of experiments that test specimens would simply disappear from inside the container only to reappear at another location (after seconds to several minutes of time transpired), such that the test specimen did not actually undergo total material disintegration/reintegration during teleportation – this data is important, because without the aid of electronic monitoring instruments, the average person's sensory organs and usual methods of detection are temporarily unable to perceive the test specimen's (ambiguous) existence during the teleportation process;

- the radio micro-transmitter used as a test specimen in one series of experiments (Shuhuang et al., 1981) transmitted a radio signal to several stationary electronic instruments/receivers, so that the specimen could be tracked and monitored (via signal amplitude and frequency measurements) during the teleportation process; the experimenters discovered that there was large fluctuations in the intensity (in both amplitude and frequency) of the monitored signal to the effect that it would either completely disappear or become extremely weak (to the extent that the monitoring instruments could scarcely detect it) – it was discovered that there was a definite correlation between the change in strength (i.e., radical frequency shifts were observed) of the monitored radio signal and the teleportation of the test specimen, such that the weak or absent signal indicated that the specimen was "nonexistent" (or in an altered physical state) during teleportation (note: the monitored signal amplitude and frequency of the micro-transmitter specimen were stable before and after teleportation);

- before and after "passing through the container wall/barrier", the test specimen and the container's wall/barrier are both complete solid objects;

- the gifted psychics were never allowed to see (they were blindfolded in many experiments) or touch each of the test specimens or the sealed containers before and after experiments were conducted, and only the experimenters touched the specimens and containers (using both blind and double-blind protocols);

- the experimental results were all repeatable

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- the conditions for fraud and sleight of hand were totally eliminated, and multiple independent outside witnesses (technical and military-intelligence experts) were present at all times to ensure total fidelity of the experiments

The experimental radio micro-transmitter and high-speed photography/videotaping data offer an important clue on what the teleportation mechanism is, and this will be discussed further in Section 5.1.1. The Chinese were unable to offer any significant physics hypothesis that could explain their results. Some researchers stated that it is necessary to invoke a new physics, which somehow unifies the human consciousness (i.e., physics of consciousness) with quantum and spacetime physics, in order to understand p-Teleportation and related PK phenomena. The researchers were amazed by their repeated results, and were barely able to fathom the altered "state of being" that test specimens underwent during teleportation.

It is also important to point out that during the Cold War the DIA produced three (now declassified) reports on the parapsychology research of the Soviet Union and its Warsaw Pack allies (LaMothe, 1972; Maire and LaMothe, 1975; DIA Report, 1978; other related studies were reported by Groller, 1986, 1987). The purpose of the reports was to collate and summarize collected intelligence, describe in great detail, and assess the Soviet Union and Warsaw Pact R&D on parapsychology and paraphysics. The reports outlined the history of pre-revolutionary (Czarist) Russian, and WWII and post-WWII era Soviet R&D on psychotronics, human mind/behavior control, and the entire spectrum of parapsychology. The Soviet information also mentions the psychotronic/parapsychology R&D materials that Soviet military forces took from various Nazi research centers in and around Germany at the end of WWII. The entire spectrum of parapsychology phenomena was explored by the Soviets, which resulted in the generation of a wealth of experimental data and related scientific research literature. One DIA report noted that there was an East versus West science debate in the Soviet literature over whether paranormal phenomenon and related experimental data was real or even scientifically sound in comparison to western scientific practice and philosophy. Another DIA report lists the names and affiliations of all the researchers, as well as the names of the various Soviet and Warsaw Pact research centers, that were involved. Also, Pratt (1986) reviews and summarizes the history of Soviet psychotronics research.

The U.S. military-intelligence establishment was concerned with the possibility that the Soviets and their Warsaw Pact allies were conducting psychotronics and mind control R&D in order to discover how to exploit and control powerful phenomena that could be used against the U.S. and its allies. LaMothe (1972) chronicled how the Soviets had been researching methods of influencing human behavior for over sixty years. The Soviets and their allies extensively explored an influence technology that they called "controlled offensive behavior", which is defined as "research on human vulnerability as it applies to methods of influencing or altering human behavior" (LaMothe, 1972). Also, LaMothe (1972) describes the revolutionary techniques the Soviets studied to influence human behavior, which included: sound, light, color, odors, sensory deprivation, sleep, electromagnetic fields, biochemicals, autosuggestion, hypnosis, and parapsychology phenomena (such as psychokinesis, telekinesis, extrasensory perception-ESP, astral projection, clairvoyance, precognition, and dream state, etc.). The LaMothe (1972) report became an aid in the development of countermeasures for the protection of U.S. and/or allied personnel.

Psychotronics is the general term that was used in the former Soviet Union/Warsaw Pact countries to categorize many psychic phenomena undergoing scientific research. The conclusions that were reached in the DIA reports are that within the category of psychotronics, the Soviets identified two discrete skills (LaMothe, 1972):

- <u>bioenergetics</u>: those phenomena associated with the production of objectively detectable effects such as psychokinesis, telekinesis, levitation effects, transformations of energy, i.e. the altering or affecting of matter

- <u>bioinformation</u>: those phenomena associated with the obtaining of information through means other than the normal sensory channels (i.e., ESP), such as telepathy, precognition, and

clairvoyance, i.e., using the mind to tap into the thoughts of others or to acquire present or future information about objective events in the world

These phenomena involve using the mind and/or some "field" of the body to affect other minds and inanimate objects irrespective of intervening distance or elapsed time, and without engaging any conventional tools. Bioenergetics and bioinformation are two classifications that form a single branch of science the Soviets preferred to call biocommunications. Soviet biocommunications research is primarily concerned with exploring the existence of a definite group of natural phenomena controlled by laws that are not based on any known (energetic) influence. The types of biocommunication (a.k.a. psychotronics) phenomena includes special sensory biophysical activities, brain and mind control, telepathic communications or bioinformation transceiving, bioluminescent and bioenergetic emissions, and the effects of altered states of consciousness on the human psyche. Psychotronics and remote viewing provide capabilities that have obvious intelligence applications. The Soviets and their Warsaw Pact allies invested millions of dollars in psychotronics R&D because they understood this, and saw the potential payoff for military and intelligence applications.

The U.S. response to Soviet psychotronics R&D programs was the Remote Viewing program. In addition, the U.S. Army began the JEDI Project in 1983, which sought to increase human potential using teachable models of behavioral/physical excellent by unconventional means (Alexander et al., 1990). The JEDI Project was essentially a human-performance modeling experiment based on neuro-linguistic programming (NLP) skills, whereby advanced influence technologies to model excellence in human performance was used. The program ran under the auspices of the Army INSCOM and the Organizational Effectiveness School, and was sponsored by a U.S. government interagency task force. Finally, it should be pointed out that the program had successfully trained several hundred people, including members of Congress (such as Al Gore, Jr. and Tom Downey), before being terminated.

There is a wealth of factual scientific research data from around the world attesting to the physical reality of p-Teleportation and related anomalous psi phenomena (Mitchell, 1974b; Targ and Puthoff, 1977; Nash, 1978; Radin, 1997; Tart et al., 2002). The skeptical reader should not be so quick to dismiss the subject matter in this chapter, because one must remain open-minded about this subject and consider p-Teleportation as worthy of further scientific exploration. The psychotronics topic is controversial within the western scientific community. The debate among scientists and scientific philosophers is highly charged at times, and becomes acrimonious to the point where reputable skeptical scientists cease being impartial by refusing to examine the experimental data or theories, and they prefer to bypass rational discourse by engaging in ad hominem attacks and irrational "armchair" arguments.

P-Teleportation and related phenomena are truly anomalous, and they challenge accepted modern scientific paradigm. Lightman and Gingerich (1991) wrote, "Scientists are reluctant to change paradigms for the purely psychological reasons that the familiar is often more comfortable than the unfamiliar and that inconsistencies in belief are uncomfortable." And theories change over time when anomalies enter the picture. Anomalies are particularly helpful for they point to the inadequacies of an old model and point the way to a new one. Anomalous scientific facts are unexpected and difficult to explain within an existing conceptual framework. Kuhn (1970) describes scientific discovery as a complex process, in which an anomalous fact of nature is recognized, and then followed by a change in conceptual framework (i.e., paradigm) that makes the new fact no longer an anomaly. Kuhn stated that, "Discovery commences with the awareness of anomaly, that is, with the recognition that nature has somehow violated the pre-induced expectations that govern normal science." This statement neatly describes exactly what transpired during the historical revolution that took place in physics between the classical mechanics/electrodynamics age in the 19th century and the quantum/atomic/nuclear/relativistic age in the 20th century. And this isn't the only time in human history that scientific paradigms have dramatically changed. The discovery of p-Teleportation already commenced in the 20th century, so let us continue the discovery and create a new physics paradigm for the 21st century.

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5.1.1 Hypothesis Based on Mathematical Geometry

The Chinese researchers reported in their teleportation experiments that high-speed photography/videotaping recorded test specimens physically "melding" or blending with the walls of sealed containers, and in a different series of experiments the test specimens would simply disappear from inside the container only to reappear at another location (after seconds to several minutes of time transpired). They also reported in the series of radio micro-transmitter experiments that there were large fluctuations in the intensity (in both amplitude and frequency) of the monitored signal to the effect that it would either completely disappear or become extremely weak (to the extent that the monitoring instruments could scarcely detect it); and they discovered that there was a definite correlation between the change in strength (i.e., radical frequency shifts were observed) of the monitored radio signal and the teleportation of the radio micro-transmitter, such that the weak or absent signal indicated that the specimen was "nonexistent" (or in an altered physical state) during teleportation. This data is important because without the aid of electronic monitoring instruments, the average person's sensory organs and usual methods of detection are temporarily unable to perceive the test specimen's (ambiguous) existence during the teleportation process. This data offers an important clue on what the teleportation mechanism is.

It is beyond the scope of this study to propose a complete self-consistent physics theory of consciousness/mind, which explains how the mind can activate p-Teleportation and related psychotronics phenomena. This topic has been under study in recent decades by a legion of medical science, bio- and neuro-physiology, psychology, mathematics, philosophy, and physics experts. Many different theories with varying degree of theoretical maturity and self-consistency have been proposed over the years, and most of them have not yet been experimentally tested for various reasons. However, some first-order experimental work has been done (Mitchell, 1974b; Targ and Puthoff, 1977; Wolman et al., 1986; Radin, 1997; Tart et al., 2002). Ironically, quantum mechanics theory, and the related physics of quantum entanglement and teleportation, has become the primary focus of all of the physics theories of consciousness/psychotronics that have been recently proposed (see for example, Shan, 2003). Wolman et al. (1986) and Radin (1997) provide a review and discussion on recent theories and experiments that are based on quantum physics theory (see also, Walker, 1974; Targ and Puthoff, 1977; Mitchell, 1999, and the references cited therein; Tart et al., 2002). It appears that the physics of q-Teleportation (Chapter 3) has tremendous relevance to the physics of p-Teleportation and psychotronics.

In the following I propose a parsimonious first-order hypothesis that can explain the gross features of both the Chinese p-Teleportation data and the other reported p-Teleportation phenomena. But I will refrain from including any role that might be played by quantum phenomena since the scientific community has not yet settled that particular issue. (However, it is apparent that quantum theory and quantum phenomena will likely play a key role in a formal physics theory of PK and psychotronics.)

First-Order Hypothesis:

- Fact 1: The mature discipline of mathematical geometry developed the properties of higher dimensional spaces (Reichenbach, 1957; Manning, 1977; Rucker, 1977). An example of one such property that is of relevance to the hypothesis: One can visualize a four-dimensional world by using color as the 4th dimension. We can think of a three-dimensional world, whereby objects pass through one another if their colors (i.e., four-dimensional locations) are different (Reichenbach, 1957). For example, color can be used as a 4th dimension to see how a knot in three-dimensions can be untied in a 4th spatial dimension without moving the ends of the cord. That is because a cord cannot stay knotted in four-dimensional space, because the extra degree of freedom will cause any knot to slip through itself. Two other interesting and relevant examples are that the links of a chain may be separated unbroken in the 4th dimension, and a flexible sphere may be turned inside out without tearing in the 4th dimension (Manning, 1977; Rucker, 1977).

- Proposition 1 and Fact 2: It has been proposed that our space actually possesses a slight four-dimensional hyperthickness, so that the ultimate components of our nervous system are actually higher dimensional, thus enabling the human mind/brain to imagine four-dimensional space (Hinton, 1888, 1904; Rucker, 1977). If this is the case, then the three-dimensional nets of neurons that code thoughts in our brain may form four-dimensional patterns to achieve four-dimensional thought. The "bulk" space in 3-brane theory (see Section 4.1), and experimental data from the Remote Viewing program (see Section 5.1), provide support for this concept. Can we see into the 4th dimension and have four-dimensional thoughts? Yes, we can. Proof (see, Rucker, 1977, 1984): If you look at a Necker cube for a while, it spontaneously turns into its mirror image and back again. If you watch it do this often enough, the twinkling sort of motion from one state to the other begins to seem like a continuous motion. But this motion can only be continuous if it is a rotation in four-dimensional space. The mathematician August F. Möbius discovered in 1827 that it is in fact possible to turn a three-dimensional solid object into its mirror image by an appropriate rotation through four-dimensional space (a.k.a. hyperspace rotation). Thus, it is actually possible for our minds to perform such a rotation. Therefore, we can actually produce four-dimensional phenomenon in our minds, so our consciousness is four-dimensional. Rucker (1984) shows another dramatic example of being able to see into the 4th dimension via a "Neck-A-Cube."

- Fact 3: Another property of higher dimensional geometry (Reichenbach, 1957; Rucker, 1977, 1984) is that one can move through solid three-dimensional obstacles without penetrating them by passing in the direction of the 4th (spatial) dimension. The 4th dimension is perpendicular to all of our normal three-dimensional space directions, and so our three-dimensional enclosures have no walls against this direction.

- Conclusion and Hypothesis: Therefore, the results of the Chinese p-Teleportation experiments can simply be explained as a human consciousness phenomenon that somehow acts to move or rotate test specimens through a 4th spatial dimension, so that the specimens are able to penetrate the solid walls/barriers of their containers without physically breaching them. No real dematerialization/rematerialization of the specimens takes place. The intensity fluctuations of the radio micro-transmitter specimen's electromagnetic signal, and the apparent blending of the other specimens with the walls of their containers, represent the passage of the specimens through a 4th spatial dimension. During teleportation the radio signals emitted by the micro-transmitter became weak/non-existent and fluctuated, because they were spreading out into the 4th dimension and became undetectable in our three-dimensional space. The weak signals that were ("barely") detected represent the leakage of a portion of the radio signal back into our three-dimensional space from the 4th dimension during teleportation. The observed blending of the other specimens with the walls of their containers is how the movement/rotation of the specimens through the 4th dimension was visually interpreted by the mind (along the lines of the Necker cube or Neck-A-Cube examples).

5.2 Conclusion and Recommendations

We will need a physics theory of consciousness and psychotronics, along with more experimental data, in order to test the hypothesis in Section 5.1.1 and discover the physical mechanisms that lay behind the psychotronic manipulation of matter. P-Teleportation, if verified, would represent a phenomenon that could offer potential high-payoff military, intelligence and commercial applications. This phenomenon could generate a dramatic revolution in technology, which would result from a dramatic paradigm shift in science. Anomalies are the key to all paradigm shifts!

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•**Recommendations**:

- There are numerous supporters within the U.S. military establishment who comprehend the significance of remote viewing and PK phenomenon, and believe that they could have strategic implications. Bremseth (2001), a U.S. Navy SEAL, attended the Marine War College and studied the Remote Viewing program, and interviewed many of the former program participants. Bremseth then wrote his thesis on the topic, and concluded that the evidence supported continued research and applications of remote viewing. A research program improving on and expanding, or implementing novel variations of, the Chinese and Uri Geller-type experiments should be conducted in order to generate p-Teleportation phenomenon in the lab. The performances and characteristics of p-Teleportation need to be delineated in order to develop a refined hypothesis. Such a program should be designed so that an operational model for p-Teleportation can be developed and implemented as a prototype. An experimental program similar in fashion to the Remote Viewing program should be funded at $900,000 – 1,000,000 per year in parallel with a theoretical program funded at $500,000 per year for an initial five-year duration. The role of quantum physics theory and related quantum phenomena (i.e., entanglement and teleportation) in p-Teleportation and psychotronics should be explored in this program (see for example, the Biological Quantum Teleportation recommendation in Section 3.3). An experiment definition study should be conducted first to identify and propose the best experiments for this program, which should be funded at $80,000 for one year.

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APPENDIX A – A Few Words About Negative Energy

A.1 A General Relativistic Definition of Negative or Exotic Energy

We saw in equations (2.10a-c) that the surface energy and stress-tension densities of the material required to create and thread a traversable wormhole must be "negative." For surface stress-energy, and volume stress-energy in general, this is "negative" in the sense that the material we must deploy to generate and thread the traversable wormhole must have an energy density (ρc^2, ρ = mass density) that is less than the stress-energy density (τ), or we can write this condition as: *mass-energy* $\rho c^2 \leq$ *stress-energy* τ. On the basis of this condition, we call this material property "exotic." Therefore, the term "negative" is just a misnomer in this context. The condition for ordinary, non-exotic forms of matter that we are all familiar with is *mass-energy* $\rho c^2 >$ *stress-energy* τ. This condition represents one version of what is variously called the weak (WEC), null (NEC), average (AEC), dominant (DEC), strong (SEC) or "standard" energy conditions (that are mere hypotheses!), which allegedly forbid negative mass-energy density and gravitational repulsion (antigravity) between material objects to occur in nature. Hawking and Ellis (1973) formulated these energy conditions in order to establish a series of mathematical proofs in their study of the application of general relativity theory to cosmology and black hole physics.

However, there are general theorems of differential geometry that guarantee that there must be NEC violations (meaning exotic matter-energy is present) at a wormhole throat (Visser, 1997). In view of this, it is known that static radial electric or magnetic fields are borderline exotic when threading a wormhole, if their tension were infinitesimally larger, for a given energy density (Herrmann, 1989; Hawking and Ellis, 1973). Other exotic (energy condition violating) matter-energy fields are known to be squeezed quantum states of the electromagnetic field and other squeezed quantum fields (see Section A.2 for the discussion on squeezed quantum states), gravitationally squeezed vacuum electromagnetic zero-point energy (see Section 2.3 for the discussion on Gravitationally Squeezed Vacuum Energy), Casimir (electromagnetic zero-point) energy and other quantum fields/states/effects. These examples represent forms of matter-energy that possess negative energy density. Since the vacuum is defined to have vanishing energy density, anything possessing less energy density than the vacuum must have a negative energy density. With respect to creating wormholes, these have the unfortunate reputation of alarming physicists. This is unfounded since all the energy condition hypotheses have been experimentally tested in the laboratory and experimentally shown to be false - 25 years before their formulation (Visser, 1990 and references cited therein). Further investigation into this technical issue showed that violations of the energy conditions are widespread for all forms of both classical and quantum matter-energy such as planets, stars, black holes, neutron stars, people, space dust clouds, etc. (Davis, 1999b; Barcelo and Visser, 2002). In addition, Visser (1995) showed that all (generic) spacetime geometries violate all the energy conditions. Violating the energy conditions commits no offense against nature.

A.2 Squeezed Quantum States and Negative Energy

In quantum mechanics the energy (E) and frequency (ν) of a quantum oscillator system, such as electromagnetic radiation (or light), are interchangeable via the Planck relation $E = h\nu$ ($h = 2\pi\hbar$). And from the Heisenberg quantum uncertainty principle, we know that the conjugate variable to the frequency is the oscillator phase (φ), such that $\Delta\nu\Delta\varphi \geq \hbar$ is obeyed. Phase is difficult to measure and is ignored in characterizing complex quantum systems.

Recent theoretical and experimental work has shown that in many quantum systems the limits to measurement precision imposed by the quantum vacuum zero-point fluctuations (ZPF) can be breached

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by decreasing the frequency noise at the expense of increasing the phase noise (thus maintaining $\Delta\nu\Delta\varphi \geq \hbar$), while at the same time the variations in frequency, and therefore the energy, are reduced below the ZPF such that the energy becomes "negative." "Squeezing" is thus the control of quantum fluctuations and corresponding uncertainties, whereby one can squeeze the variance of one (physically important) observable quantity provided the variance in the (physically unimportant) conjugate variable is stretched/increased. The squeezed quantity possesses an unusually low variance, meaning less variance than would be expected on the basis of the equipartition theorem. We can exploit quantum squeezing to extract energy from one place in the ordinary vacuum at the expense of piling up excess energy elsewhere (Morris and Thorne, 1988).

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Appendix B – *TH*εμ Methodology

In the formalism of the *TH*εμ methodology, the functions T and H are introduced by requiring that the Lagrangian for the motion of particles (with charge e_a and mass m_{0a} for the ath particle), under the joint action of gravity and the electromagnetic field A_α ($\alpha \equiv$ spacetime vector components), be expressed in the canonical form

$$L = \sum_a \int \left(-m_{0a} \sqrt{T - H v_a^{\ 2}} + e_a A_\alpha v_a^{\ \alpha} \right) dt + \left(8\pi\right)^{-1} \int \left(\varepsilon \mathbf{E}^2 + \mu^{-1} \mathbf{B}^2 \right) d^3x\, dt \qquad \text{(B.1);}$$

where the arbitrary functions T, H, ε, and μ are functions of the metric (a.k.a. gravitation field), $v_a^{\ \alpha}$ is the ath particle four-vector velocity, and A_α is the electromagnetic field four-vector potential, $\boldsymbol{E}$ and $\boldsymbol{B}$ are the electric and magnetic field strengths, and (B.1) is in geometrodynamic natural units ($\hbar = c_0 = G = \varepsilon_0 = \mu_0 = 1$). The Lagrangian characterizes the motion of charged particles in an external gravitational field by the two functions T and H, and characterizes the response of the electromagnetic fields to the external gravitational field by the two functions ε and μ. For all standard (metric) theories of gravity, the four functions are related by

$$\varepsilon = \mu = \sqrt{\frac{H}{T}} \qquad \text{(B.2);}$$

and ***every*** metric theory of gravity satisfies this relation, such that the Einstein Equivalence Principle is satisfied.

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Time Travel: Time Dilation

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In this paper I discuss the theory and actuality of the effects of Time Dilation, as predicted by Einstein's Special Relativity. Alongside this the research investigates the visible, experiential effects of most personal form of Time Travel from a personal, phenomenological perspective, illustrated through digital media.

The body of work, this paper and an accompanying book of modified digital images, recalls the Hafele-Keating experiment of October 1971 and parallels the Quantified Self experiments of diary photography and personal analytics in a holistic, interconnected way.

The work tracks 12 months of air travel and illustrates with practical data the physics and mathematics behind the theory and actuality of Time Dilation. The research combines the interdisciplinary worlds of Computer Arts with Data and Scientific Visualisation to create a tangible collision between the visualisation of the personal and illustration of theory

The observations are documented in ethnographic, photo essay illustrations as an investigation into the mathematics and physics of personal and interpersonal time. Using situated imaging presented as a practice-based body of work to communicate the abstract world of very small time periods and the direct relevance of Einstein's work on the personal and perceptual world we inhabit. Contrasting Newtonian mechanics and Einsteinian space-time the work seeks to illustrate the personal nature of how the reality of time travel influences every aspect of the interpersonal

Time dilation. Time travel. General relativity. Special relativity. Visual thinking. Photography. Visualisation. Practice-based research. Art.

1. INTRODUCTION

In 1971 two American researchers, J.C. Hafele and R. E. Keating, conducted an experiment.

They placed two caesium atomic clocks on passenger airplanes and flew them in opposite directions around the globe to test a hypothesis first posited in Einstein's theory of special relativity.

Their aim was to measure the effects of relativity on these highly accurate devices - the predictions indicated that the eastward flying clock would lose 40ns and the westward gain 275ns. A nanosecond is equal to one billionth of a second (10^{-9} or $^{1}/_{1,000,000,000}$ s). To compare, one nanosecond is to one second as one second is to 31.7 years.

> During October, 1971, four cesium atomic beam clocks were flown on regularly scheduled commercial jet flights around the world twice, once eastward and once westward, to test Einstein's theory of relativity with macroscopic clocks. From the actual flight paths of each trip, the theory predicted that the flying clocks, compared with reference clocks at the U.S. Naval Observatory, should have lost 40+/-23 nanoseconds during the eastward trip and should have gained 275+/-21 nanoseconds during the westward trip ... Relative to the atomic time scale of the U.S. Naval Observatory, the flying clocks lost 59+/-10 nanoseconds during the eastward trip and gained 273+/-7 nanosecond during the westward trip, where the errors are the corresponding standard deviations. These results provide an unambiguous empirical resolution of the famous clock 'paradox' with macroscopic clocks. (Hafele & Keating 1972)

The results showed that compared to stationary clocks in the laboratory the eastward clock lost 59ns and the westward gained 273ns. Whilst there has been discussion of the accuracy and therefore reliability of the measurements the experiment is commonly held up as one of the first to give practical evidence of the physical effects of time dilation.

2. SPECIAL RELATIVITY AND TIME DILATION

In special relativity Einstein States that the duration of time will pass at different rates when comparing an object at rest versus an object in motion. The greater the velocity of the object in motion, the closer to the speed of light, c, the greater the effect of what is known as 'time dilation'

The effect of this phenomenon is significant at speeds close to the constant of light speed but becomes exponentially less as the object in question approaches rest.

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Figure 1: *The mathematical relationship of time, velocity and the speed of light describing Time Dilation*

Unless our velocity is a substantial fraction of the constant speed of light the dilation effect (γ) is approximately 1. This, combined with our extremely limited lifespan is why we don't immediately notice time dilation at ordinary speeds. The fastest speed most humans will achieve, an airplane travelling near the speed of sound, gives a time dilation where γ = 1.0000000000005.

In other words, 1 second for a passenger on the plane would pass as 1.0000000000005 seconds for a stationary observer.

Time effectively passes more slowly for the traveller relative to the observer.

3. THE REALITY OF THE EFFECT

Whilst there is discussion of the validity of the results of the 1971 Hafele & Keating experiment, particularly around the 'corrections' made to their data at publication, their initial observations are clearly aligned with the predicted results to be expected from the mathematics for time dilation.

As Reinhardt *et al* (2007) note:

> Time dilation is one of the most fascinating aspects of special relativity as it abolishes the notion of absolute time

In their 2007 paper they investigate the effects of time dilation with even more accurate atomic clocks, adding more experimental evidence consistent with special relativity. There are also numerous other experiments, such as those into muon decay, that provide additional practical evidence that the effect described is real and measurable.

Figure 2: *Over Dorset: Duration 55 minutes*

4. IMPLICATIONS FOR EVERYDAY LIFE

The practical implications for everyday life at first appear intangible when one considers the seemingly miniscule time periods being discussed. Even taking some of the most extreme examples one can imagine being feasible, such as that of a cosmonaut living in a fast low earth orbit, circumnavigating the earth every 90 minutes gives γ of approximately 1.0000000003.

If one considers our astronaut in orbit for two years, the Time Dilation due to special relativity would give an increase in lifespan of approximately 20 milliseconds. A millisecond is a thousandth (10^{-3} or $^{1}/_{1,000}$) of a second.

This gap of 20 milliseconds, or two hundredths of a second, are suddenly well within human scale perception and understanding. This is a common measured gap in motor racing and fast sports like downhill skiing. Even the record for the 100m sprint is now is 9.58 seconds, run by Usain Bolt at the World Athletics championships in Berlin in 2009.

Scales in milliseconds are spaces and durations that even humans with our modest lifespans can perceive and understand.

As Ed Lu, Science Officer on the International Space Station writes, from orbit, in his blog post on experiments in 'Relativity':

> After our 6 months in space, we will have actually aged slightly less than everyone else on the ground because of an effect called time dilation. It isn't by much (about 0.007 seconds), but it is one side benefit of flying in space!

Though the effects of time dilation at human scale speeds are often imperceptibly small they are nonetheless real. Seeing the implications of this reflected in everyday life reveals the truly personal nature of the time travel that we undertake in everything we do.

The realisation that time dilation is a tangible and observable phenomena that affects ourselves and everything around us was given heightened

poignancy by spending large amounts of time flying at altitude and high speed. Observing the curvature of our planet and seeing the dark sky at the edge of space overhead, watching the mountains and deserts as they slid effortlessly under the wings of successive aeroplanes. Being able to observe the size of the individual against the backdrop of a macro-cosmic scale all the while reflecting on the fact that to a subatomic particle travelling near the speed of light, the universe is about four weeks old and it can be crossed in a matter of months.

> Nature can produce even larger particle energies. Some particles striking the Earth's upper atmosphere have energies that exceed 2*1020 eV. If such particles are protons (with mass of about 1 GeV), their speeds would be 0.999 999 999 999 999 999 999 995 c. For them, γ is 1011. Now the age of the universe is about 13 billion years for us, but for such particles, the age of the universe would be about (13 billion years/1011), ie about a month. Such a particle could cross the visible universe in a matter of months (their time).

This twist of perspective, the deliberate 'making strange' that Shlovsky (1917) describes occurs when translating the abstract of the macrocosmic to the intimacy of the personal. The act of comparing and contrasting macro-scale physics and mathematics with recordings of human scale observations evidence reveals useful and potentially significant insights into the nature of the world we actually inhabit.

Figure 3: *Sunset over Northern China. Duration: 10 hours 50 minutes*

5. THE PICTORIAL AS PRACTICE-BASED RESEARCH

As Blevis (2011) so eloquently puts it, as an introduction to the extensive list of uses of digital imagery in design thinking.

> **Visual thinking** is the use of imagery and other visual forms to make sense of the world and to create meaningful content. Digital imagery is a special form of visual thinking, one that is particularly salient for HCI and interaction design

Alongside the descriptions of digital imagery as a *'form of information'* and a '*shared and externalised memory and cognition'* (Blevis 2012) I would argue that practice-based research, when used as an investigative tool, can assist in revealing and documenting subtle but important non-verbal evidence and also provide compelling and persuasive arguments within presentation of research findings and conclusions. The research approach taken in this area is explicitly practice-based, rooted within contemporary lens based digital media and video art. The investigative material presented as the counterpart to this research paper was collated from hundreds of

minutes of digital video and several hundreds of digital still images taken while airborne on commercial passenger aircraft during January - December 2013. Taken over the course of 44 flights, totalling over 80 hours airborne the visual material is published as a 42 page visual essay, also containing text elements and descriptions taken from this academic paper.

Figure 4*: Sunset over London. Duration: 55 minutes*

6. REALISATION OF EFFECT ON THE PERSONAL

Having recorded the number of flights, durations and distances the calculations based upon the mathematics of special relativity, as discussed earlier show that.

Given 44 flights totalling 85 hours and 20 minutes or approximately 5120 minutes flying time. gives 307,200 seconds of travel per year.

If γ = 1.0000000000005 when travelling at or near the speed of sound, gives a dilation of 0.0000001536 seconds.

To slip one second from base reference, such as the clock sat on my kitchen table I need to travel at my present annual rate for 6,510,416 Years.

Or to put it a different way, travel for a little over 260,000 years to slip one frame out of sync on a standard rate video camera.

7. CONSIDERING PHOTOGRAPHY IN EVIDENCE

When collating the increasing amounts of video and photographic material recorded whilst airborne, travelling at or near the speed of sound, the overwhelming sensation of velocity, of speed, of travel is ever-present. Viewed at a macro scale the visual material illustrates this distancing, sliding nature of objects moving in a larger framework. It supports the realisation that the terra firma so often taken as a baseline for observation is in itself only a small part of a larger perspective. The perspective that the proprioceptive nature of our observations of time, informed by the physicality of the form we have evolved and the life span perspective we consider as a norm and useful context are challenged by the linking of these measurable effects. The effects of the micro-scale variations in time seen in contrast to the macro-scale movement around the curve of the earth.

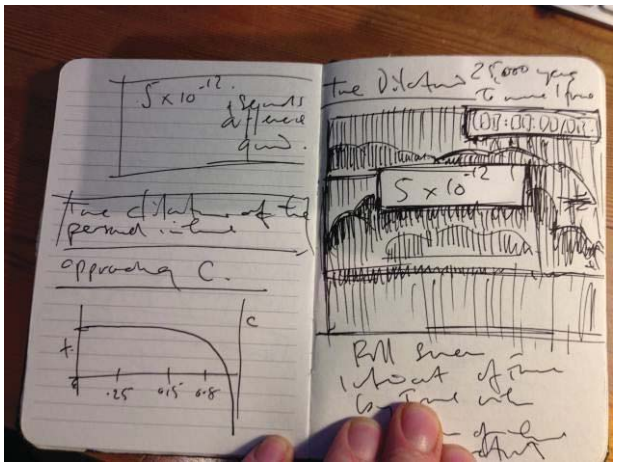

Figure 5: *An airplane travelling near the speed of sound gives a time dilation where γ = 1.0000000000005*

The visual material, when presented as an adjunct to the evidence of the universal but intimately personal nature of the effects of time dilation help communicate the simple fact that we are all time travelling. Pursuing our own clearly delineated paths and durations relative to each other. Rather than there being one universal time that exists everywhere, for everyone, all at the same moment the personal implication that there is real evidence to prove that this is an illusion is both moving and compelling.

Sitting in an airline seat riding at the edge of space, looking down on the oceans, seas, cities, forests and deserts, seeing terra firma for the illusion that it is. Not a constant underlying grid of space and time - the universal yard stick and the universal clock, such as Newtonian physics promised as it replaced the Aristotelian events-make-time view of the world that had reigned before in popular consciousness.

Realising that the H&K caesium clock from 1971 could be sat beside me, ticking away in its own little timetrack, ticking to a completely separate rhythm than its counterpart clock sat on my kitchen table at home. Realising that the slipping and sliding of our lives against each other is our own intimate version of time travel, we all move forward as future becomes present becomes past but the durations we experience, and that actually occur, and when ***now*** happens is subtly different for everyone. The

time we each experience actually does expand and contract as we move in space.

Figure 6: *Frost over Mongolia. Duration: 10 hours 55 minutes*

The illusion of the Newtonian ideal of a universal timescale, the idea of a 'universal now' is disappearing and being replaced by the ideas of general relativity. Of a universe full of individual 'nows' all unique and all moving independently. This change is akin to seeing the universe of unique, individual 'nows' at a human, personal scale and seeing a life travelling, sliding, back and forth in time against the 'nows' of those around one.

The important element this body of work seeks to describe is not physics or even a discussion of physics but an explanation of physics and the revelatory moment of seeing it in 'real' experienced life. This work seeks to relate that revelatory moment and articulate it with the artefacts, the book and the paper, telling the story of seeing how each and every one of us is travelling in time, independently, uniquely, every day.

> To see a World in a Grain of Sand
> And a Heaven in a Wild Flower,
> Hold Infinity in the palm of your hand
> And Eternity in an hour. (William Blake)

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(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2003/0230675 A1

St. Clair (43) Pub. Date: Dec. 18, 2003

(54) ROTOR INDUCTANCE PROPULSION SYSTEM

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(51) **Int. Cl.**[7] **B64G 1/40**; B64G 1/42

(52) **U.S. Cl.** **244/172**

(57) **ABSTRACT**

The invention is a spacecraft having a circular, domed hull around which dual electrically-charged rotors one above the other are counter-rotating on the edge of the hull. Embedded in the hull are three solenoids which create a positive vector potential at the rotors. The surface charge density times the radius times the vector potential times the area of the rotors creates an angular momentum in the vertical direction. This angular momentum produces a positive spacetime curvature over the dome of the hull and a negative spiking spacetime compression over the rotors. By machining circumferential grooves of decreasing height along the radius of the rotor, a negative surface inductance is generated. This negative inductance gradient times the negative spacetime compression time the rotor current density squared times the rotor area squared is a positive lift force on the spacecraft.

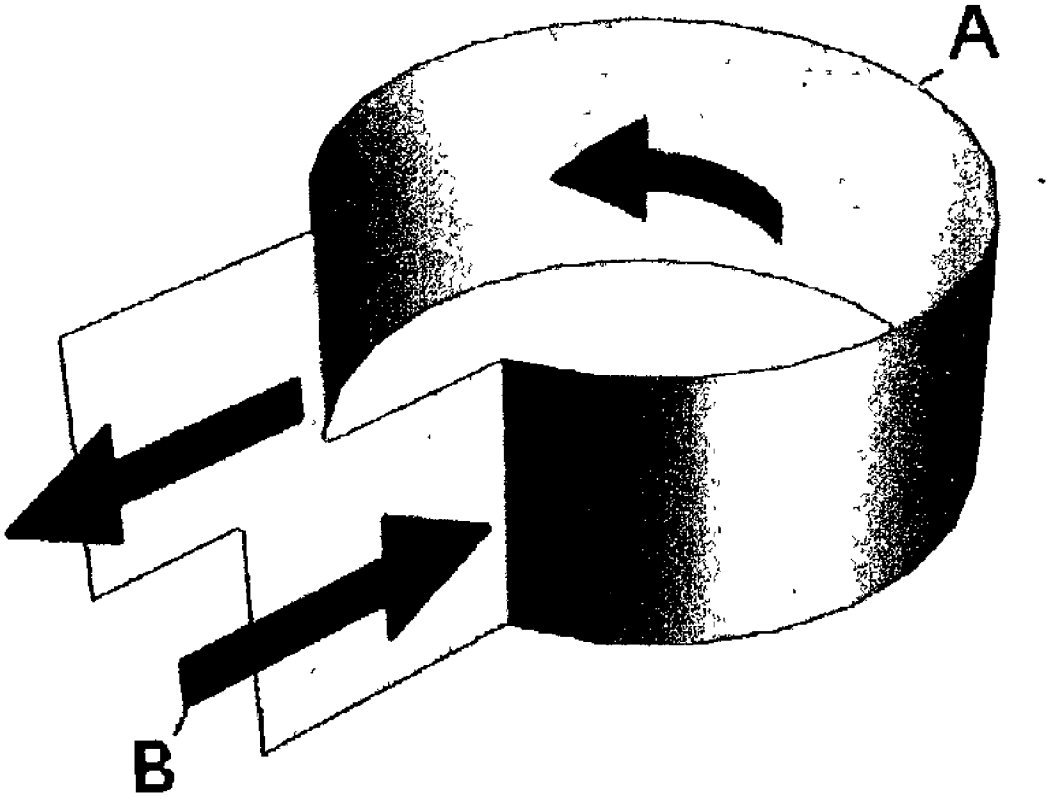

Figure 1

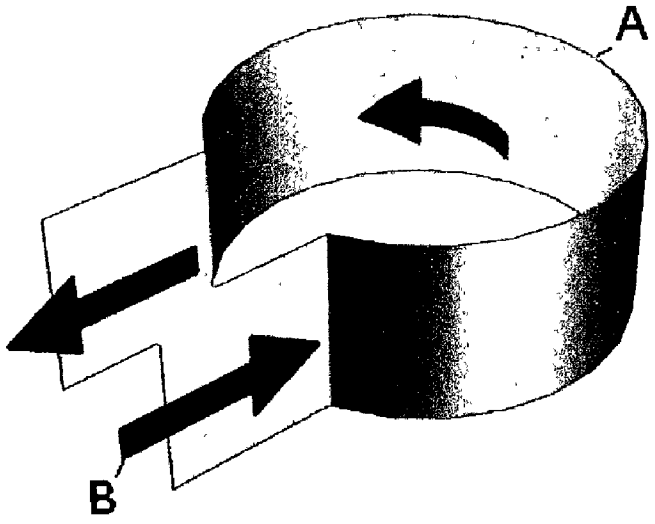

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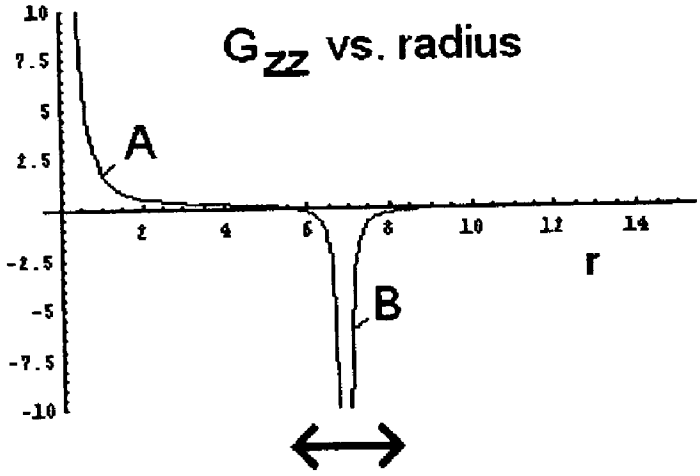

Figure 3

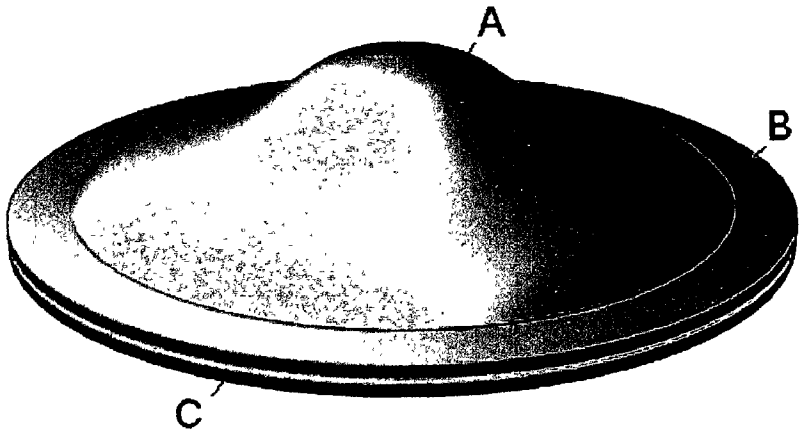

Figure 4

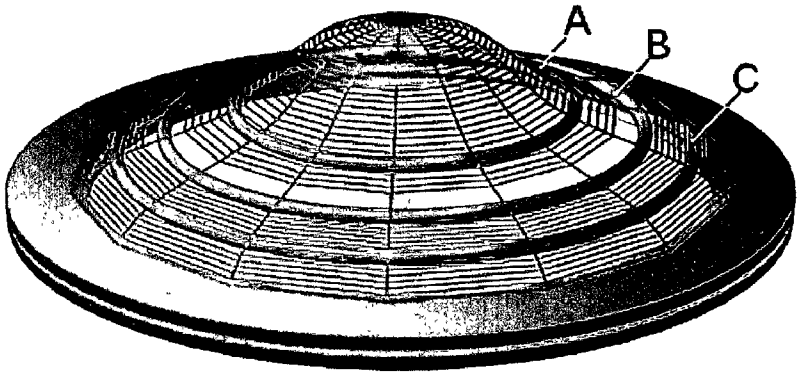

Figure 5

$$A = \frac{n I a^2}{2\varepsilon_0 c^2} \frac{1}{r'}$$

Figure 6

$$A \equiv \frac{1}{m} \frac{coul}{sec} m^2 \frac{m^2 kg\, m}{coul^2 sec^2} \frac{sec^2}{m^2} \frac{1}{m} = \frac{kg\, m}{sec\, coul}$$

Figure 7

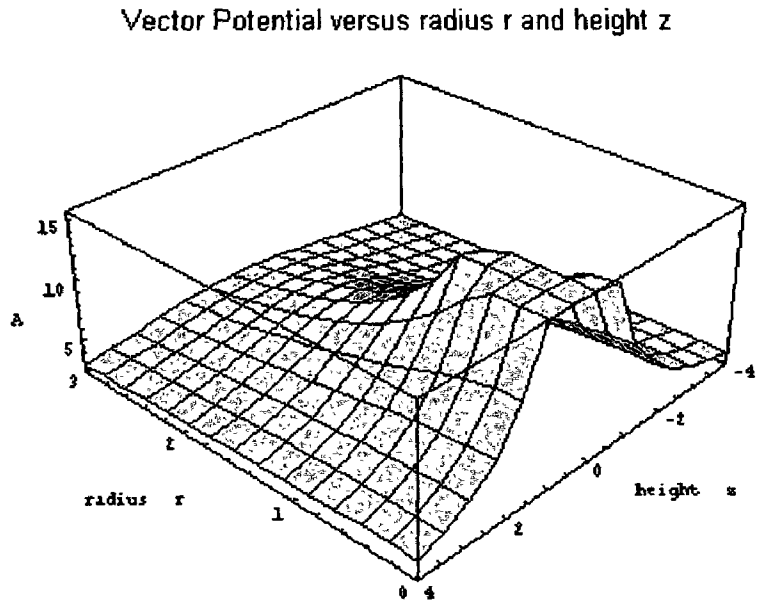

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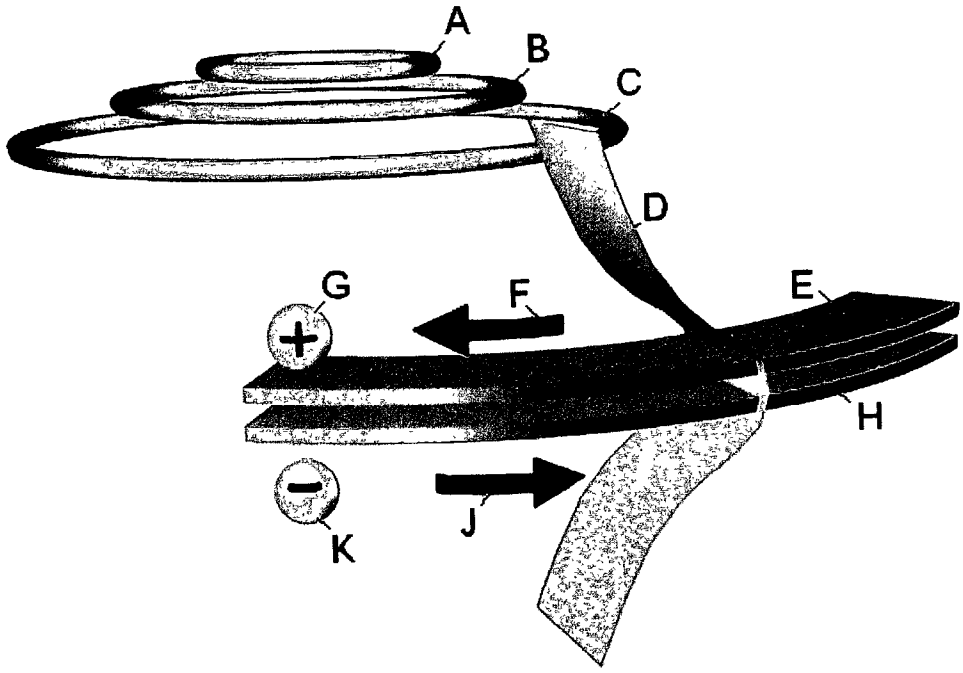

Figure 9

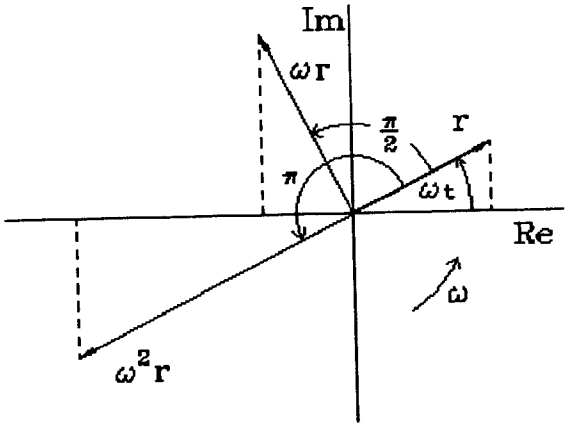

Figure 10

$$S_k = \left[-\sigma r e^{i\omega t} + \sigma r e^{-i\omega t}\right]\frac{n I a^2}{2\varepsilon_0 c^2}\frac{n_z \text{area}}{r'}$$

$$= -\left[e^{i\omega t} - e^{-i\omega t}\right]\left[\sigma r \frac{n I a^2}{2\varepsilon_0 c^2}\frac{n_z \text{area}}{r'}\right]$$

$$= -\left[e^{i\omega t} - e^{-i\omega t}\right]K$$

Figure 11

$$S \equiv \frac{\text{coul}}{m^2} m \frac{1}{m}\frac{\text{coul}}{\text{sec}} m^2 \frac{m^2}{\text{coul}^2}\frac{\text{kg}\,m}{\text{sec}^2}\frac{\text{sec}^2}{m^2}\frac{m^2}{m} = \frac{\text{kg}\,m^2}{\text{sec}}$$

Figure 12

$$e^{i\omega t} - e^{-i\omega t} = 2i\,\text{Sin}[\omega t]$$

Figure 13

$$S_k = -2iK\,\text{Sin}[\omega t]$$

Figure 14

$$ds^2 = \ldots - 4\frac{S}{r}dtd\theta = \ldots 8\frac{iK\,\mathrm{Sin}[\omega t]}{r}dtd\theta$$

Figure 15

$$g_{\mu\nu} = \begin{array}{c} \\ t \\ r \\ \theta \\ z \end{array} \begin{array}{c} \begin{array}{cccc} t & r & \theta & z \end{array} \\ \begin{vmatrix} -1 & 0 & 4\frac{iK\,\mathrm{Sin}[\omega t]}{r} & 0 \\ 0 & 1 & 0 & 0 \\ 4\frac{iK\,\mathrm{Sin}[\omega t]}{r} & 0 & r^2 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} \end{array}$$

Figure 16

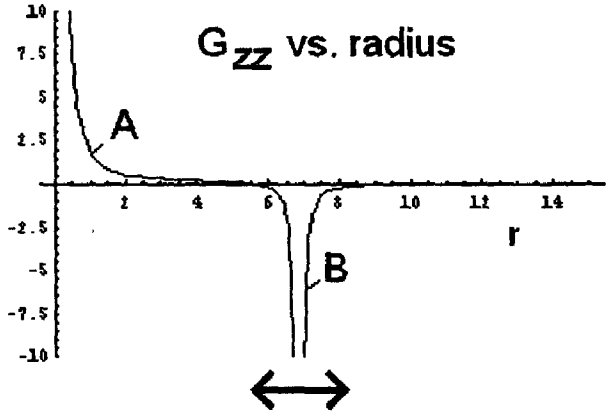

Figure 17

$$\text{Magnetic Energy} = -L\,K\,J^2\,A^2$$

Figure 18

$$\text{Magnetic Energy} \equiv -\frac{\text{kg}\,\text{m}^2}{\text{coul}^2}\frac{1}{\text{m}^2}\frac{\text{coul}^2}{\text{sec}^2\,\text{m}^2}\text{m}^4 = -\frac{\text{kg}\,\text{m}^2}{\text{sec}^2} = -\text{joule}$$

Figure 19

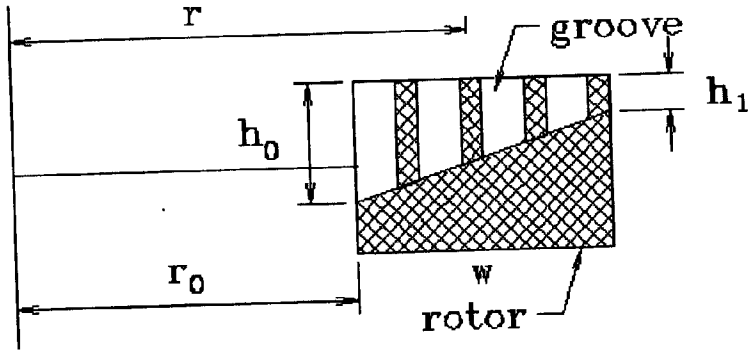

Figure 20

$$h = h_0 - (r - r_0)\left(\frac{h_0 - h_1}{W}\right)$$

Figure 21

$$\frac{dL}{dr} = \mu n^2 2\pi w \frac{\partial}{\partial r}\left(r\left(h_0 - (r - r_0)\left(\frac{h_0 - h_1}{w}\right)\right)\right)$$

$$\frac{dL}{dr} = \mu n^2 2\pi w\left(h_0 - \frac{(h_0 - h_1)(2r - r_0)}{w}\right)$$

Figure 22

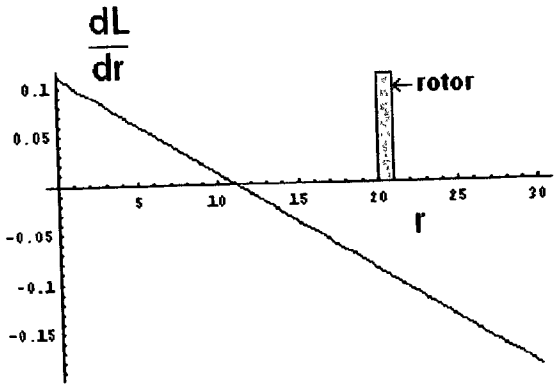

Figure 23

$$F = \frac{dL}{dr} K_c J^2 A^2 = \frac{kg\,m}{coul^2}\frac{1}{m^2}\frac{coul^2}{sec^2\,m^2} m^4 = \frac{kg\,m}{sec^2} = newton$$

ROTOR INDUCTANCE PROPULSION SYSTEM

BRIEF SUMMARY OF THE INVENTION

[0001] The invention, which is the object of my present application, is a spacecraft with a circular, domed hull around which are located dual electrically-charged counter-rotating rotors. The top surface of the upper rotor is etched with circular metallic grooves which give the rotor a surface inductance. The groove height decreases from the inside radius to the outside radius of the rotor giving it a radial inductance gradient. The surface charge density times the angular velocity produces a current density. The counter-rotating rotors produce a negative spacetime curvature over the rotors. The negative surface inductance gradient times the negative spiking spacetime curvature times the current density squared times the area squared is the positive lift force on the rotor.

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BACKGROUND OF THE INVENTION

[0007] I was reading several articles about the development of the magnetron during World War II in the Bell System Technical Journal. I was trying to understand why the device resonates because it must contain a spring constant which would arise from an inductance and capacitance due to the geometry of the cavity. As given by Feynman, inductance of a solenoid is the permeability of space times the turns per length squared times the volume of the solenoid. Referring to **FIG. 1**, the magnetron cavity (A) has a circular region connected to a planar region. The electrical current flows on the sides of the cavity shown by the arrows (B). In this case, there is only one turn per height of the cavity times the volume of the cavity times the permeability which produces the inductance. The two planar regions produce a capacitance across the ends which creates the resonant frequency.

[0008] From my previous patent application Dual Rotor Propulsion System I know that the two rotors produce a current density in the angular direction along the rotor. If I spread out the magnetron cavity into a circular groove around a rotor, then the current would flow on the side walls enclosing the groove volume. The rotors also produce a spacetime curvature profile as shown in **FIG. 2**. Curve (A) is a positive spacetime curvature tension over the dome. Curve (B) is a negative spiking spacetime curvature over the rotors. The curvature is measured in inverse meter squared. So the surface inductance times the negative curvature times the current density squared times the rotor area squared is magnetic energy. The differential of the magnetic energy would be a force. So there has to be a gradient of the surface inductance. The volume element of a groove is equal to the circumferential length times the height times the width of the groove. The easiest is to vary the height with radius. Since the curvature is negative, the gradient has to be negative as well in order to get a positive lift force. Thus the height goes from large to small from the inside to the outside radius.

SUMMARY OF THE INVENTION

[0009] The invention relates to a spacecraft with a domed, circular hull of elliptical cross-section having dual electrically-charged counter-rotating rotors located one above the other on the edge of the hull. The upper rotor is positively charged and rotates clockwise with a negative angular velocity per the right-hand rule. The lower rotor is negatively charged and rotates with a positive angular velocity. The current density is the surface charge density times the velocity of the rotor. This particular combination of velocity and charge produces an angular momentum which creates a negative spiking spacetime curvature over the rotors.

[0010] The top surface of the rotor is etched or machined with circular grooves around the rotor. This creates a surface inductance which is equal to the permeability of space times the turns per length squared times the volume of the groove. In this case, there is only one turn per height of the groove. If the height of the groove decreases from one groove to the next, then there is a negative surface inductance gradient in the radial direction. So the lift force on the rotors would be the negative surface inductance gradient times the negative spacetime curvature times the current density squared times the rotor area squared.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0011] Not Applicable.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIG. 1**. Perspective of magnetron cavity.

[0013] **FIG. 2**. Spacetime curvature G_{zz} over hull and rotor.

[0014] **FIG. 3**. Perspective view of spacecraft with dual rotors.

[0015] **FIG. 4**. Wire frame view of three solenoids.

[0016] **FIG. 5**. Vector potential equation for solenoid.

[0017] **FIG. 6**. Units of vector potential.

[0018] **FIG. 7**. 3D graph of vector potential using three solenoids.

[0019] **FIG. 8**. Perspective of vector potential along rotors.

[0020] **FIG. 9**. Rotor mechanics diagram using exponential representation.

[0021] **FIG. 10**. Angular momentum equation due to vector potential and rotating charged rotors.

[0022] **FIG. 11**. Units of angular momentum.

[0023] **FIG. 12**. Exponential equation for twice imaginary sine of the angle.

[0024] **FIG. 13**. Angular momentum equation for g metric tensor.

[0025] **FIG. 14**. Angular momentum term for elemental line length ds^2.

[0026] **FIG. 15**. The g metric tensor containing the angular momentum.

[0027] **FIG. 16**. The spacetime curvature tension G_{zz} versus radius due to angular momentum.

[0028] **FIG. 17**. Magnetic energy equation.

[0029] **FIG. 18**. Units of magnetic energy.

[0030] **FIG. 19**. Cross-section of rotor showing groove height gradient.

[0031] **FIG. 20**. Equation for the height h of the rotor groove as a function of radius.

[0032] **FIG. 21**. Equation for the groove inductance gradient.

[0033] **FIG. 22**. Plot of the groove inductance gradient as a function of radius showing that it is negative at the rotor.

[0034] **FIG. 23**. Lift force on rotors due to inductance gradient, compression curvature, rotor current density and area.

DETAILED DESCRIPTION OF THE INVENTION

[0035] 1. Referring to **FIG. 3**, the spacecraft has a circular, domed hull of elliptical cross-section with dual electrically-charged counter-rotating rotors one above the other on the edge of the hull.

[0036] 2. Referring to **FIG. 4**, embedded within the hull are three solenoids or current loops carrying a constant electrical current in the positive sense per the right-hand rule.

[0037] 3. Referring to **FIG. 5**, Feynman has shown that the vector potential {A} of a solenoid is equal to the number of turns per length {n} times the current {I} times the radius of the solenoid {a} squared divided by half the permittivity of space $\{\epsilon_0\}$ times the speed of light {c} squared times the radius {r'} prime from the center of the coil to some location in space such as the rotors. It has been found by physicists Bohm and Aharanov that the vector potential field is not confined to an infinitely long solenoid as is the magnetic B field. The vector potential has units of kilogram-meter per second-coulomb as seen in **FIG. 6**.

[0038] 4. Referring to **FIG. 7**, the three solenoids of varying radius and area produce a positive vector potential at the centerline of the rotors as seen in the graph.

[0039] 5. This graph is then rotated ninety degrees so that it can be located in relation to the rotors as seen in **FIG. 8**. The vector potential (D), which is created by solenoids (A,B,C), passes through rotors (E) and (H). Rotor (E), which has a positive charge (G), is rotating clockwise (F), and rotor (H), which has a negative charge (K), is rotating counter-clockwise (J).

[0040] 6. Referring to **FIG. 9**, rotor mechanics uses the exponential function for the harmonic motion of the rotor. The radius is $\{r\ e^{i\omega t}\}$ which when differentiated with respect to time becomes a velocity $\{i\ \omega\ r\ e^{i\omega t}\}$ where the imaginary {i} is a 90° phase lead which makes the velocity tangential to the rotor.

[0041] 7. The rotor surface charge {σ sigma} is rotating around at some radius {r}. For the upper rotor the surface charge density is positive (+σ} but the rotor has a negative angular velocity {−ω}. For the lower rotor, the surface charge density is negative {−σ} but the rotor has a positive angular velocity {+ω}. So the combined surface charge rotation is $\{-\sigma\ r\ e^{i\omega t}+\sigma\ r\ e^{-i\omega t}\}$. This charge rotation times the positive vector potential due to the solenoids times the rotor surface area is equal to angular momentum S as shown in **FIG. 10**. The units are given in **FIG. 11**. The angular momentum is equal to the negative of the difference of the exponentials times a constant. I then recalled that this difference is equal to twice imaginary sine of the angle as shown in **FIG. 12**.

[0042] 8. Referring to **FIG. 13**, the angular momentum is equal to minus two times the imaginary number times a constant times the sine of the rotational angle. In most of my spacecraft designs, the electromagnetic fields determine the flow rate of angular momentum. When the flow rate is integrated with respect to time, the angular momentum becomes imaginary. In this invention, the angular momentum is imaginary due directly to the rotors. The importance of being imaginary is that the radius resonates with the angular momentum. In some spacetime curvature equations, the denominator has a term equal to the radius to the fourth power plus twice the square of the angular momentum. In spacetime units, angular momentum is viewed as meter squared. So the square of imaginary angular momentum is negative angular momentum equal to negative meters to the fourth power. So at some radius, these two terms are equal, the denominator goes to zero, and the spacetime curvature becomes infinitely-large, creating a huge spike.

[0043] 9. This next section calculates the spacetime curvature from the equation for the angular momentum.

[0044] 10. Referring to **FIG. 14**, the elemental length ds^2 is curved by the presence of the angular momentum which is one of the energies, such as mass, charge, and electromagnetic fields, that Einstein showed can curve spacetime. Because the angular momentum is pointing in the vertical z-direction, due to the direction of the unit normal vector to the surface of the rotor, it rotates around in the angular direction {dtdθ} as found in cylindrical coordinates {t,r,θ,z}.

[0045] 11. In gravitational physics there is a g metric tensor which is a measure of length in spacetime coordinates. It is a 4 by 4 matrix with rows and columns equal to the cylindrical coordinates. Referring to **FIG. 15**, the diagonal of the matrix is $\{-1,1,r^2,1\}$ where the minus one corresponds to time which is Einstein's convention. Half the angular momentum goes in the {tθ} slot of the g metric tensor, and the other half goes in the {θt} slot.

[0046] 12. From this g metric tensor, Einstein's G curvature tensor can be calculated in the various direc-

tions. In Einstein's General Theory of Relativity, his equation is $G=8\pi T$ where G is the spacetime curvature measured in inverse meter squared, and the T tensor is the stress-energy-momentum matrix containing all the electromagnetic pressures, mass and momentum components that curve spacetime. The spacetime curvature tension G_{zz} in the vertical direction, as a function of radius, is shown in **FIG. 16**. A positive curvature indicates that there is a spacetime tension over the hull which produces lift. The curvature has a large positive spike over the dome of the hull (A) which means that there is a large lift force over the center of the hull. The curvature then falls off and spikes with a negative spacetime curvature compression over the rotors (B). This curvature also oscillates back and forth a short distance due to the sinusoidal term. The problem is to convert this compression into a lift force which this invention solves.

[0047] 13. This next section shows how the spacetime compression over the rotors generates lift.

[0048] 14. As I mentioned, I have been reading some of the World War II magnetron scientific papers of the Bell System Technical Journal. It turns out that inductance of a solenoid is equal to the permeability of space times the number of wire turns per length squared times the volume of the solenoid. Imagine having a copper strip in the shape of the magnetron cavity in **FIG. 1**. The electrical current (B) flows around the height of the strip (A), so there is only one turn per the height. Then that is multiplied by the volume of the cavity and permeability to get the inductance. The inductor is storing magnetic energy equal to half the inductance times the current squared. In this invention, current density J in amp per meter is used rather than current. So taking a hint from this information, the magnetic energy would have to be related to the inductance times the square of the current density times the area squared of the rotor and times the negative spacetime curvature. The curvature is measured in inverse meter squared. That product produces a negative magnetic energy when in fact I want a positive force. This means that there has to be an inductance gradient in the equation instead of pure inductance and, furthermore, the gradient has to be negative in order to cancel out the negative sign of the compression curvature.

[0049] 15. The equation for the magnetic energy in terms of the inductance $\{\mathcal{L}\}$, curvature $\{K\}$, current density $\{J\}$ and area $\{A\}$ is shown in **FIG. 17** with the units in **FIG. 18**. The inductance in the equation is proportional to the volume of the circular groove in the top surface of the rotor. That volume is equal to $\{2\pi\ r\ h\ w\}$ where $\{h\}$ is the height of groove (depth) and $\{w\}$ is the width located at some radius $\{r\}$. In terms of machining, it would be more difficult to machine a variable width groove rather than a deeper groove of a constant width. So I am going to say the gradient is in the radial direction with the height of the groove decreasing going from the inside radius to the outside radius as depicted in **FIG. 19**.

[0050] 16. **FIG. 20** gives the equation for the height of the groove along the radius of the rotor.

[0051] 17. **FIG. 21** gives the inductance gradient by differentiating the inductance with respect to the radius. The initial groove height ho is not very large, and the inductance gradient becomes negative at the rotor as seen in the graph of **FIG. 22**.

[0052] 18. Referring to **FIG. 23**, the lift force on the rotor is now positive due to the combined negative inductance gradient times the negative spacetime compression. The square of the negative current density is positive also. This means that that the top surface of the lower rotor can also have a surface inductance gradient which would double the lift force.

What I claim as my invention is:

1. A spacecraft having a circular, domed hull with dual electrically-charged counter-rotating rotors one above the other located on the edge of hull.

2. Said hull having embedded within it three or more solenoids which generate a positive vector potential at the rotors.

3. Said upper rotor having a positive surface charge density, and rotating clockwise in the negative direction per the right-hand rule.

4. Said lower rotor having a negative surface charge density, and rotating counterclockwise in the positive direction per the right-hand rule.

5. Said rotor surface charge density and velocity creating a negative current density on both rotors.

6. Said vector potential and rotating surface charge density on rotors generating an angular momentum in the vertical direction.

7. Said angular momentum, generating a spacetime curvature tension over the dome of the hull, and a negative oscillating spacetime curvature compression over the rotors.

8. Said rotors having circumferential grooves of decreasing height machined into the top surface of the rotors in order to create a negative surface inductance gradient.

9. Said negative surface inductance gradient times the negative spacetime curvature compression times the rotor current density squared times the rotor area squared generating a positive lift force on the spacecraft.

* * * * *

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(43) Pub. Date: Jan. 19, 2006

St. Clair

(54) WALKING THROUGH WALLS TRAINING SYSTEM

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Publication Classification

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G09B 19/00 (2006.01)

(52) **U.S. Cl.** **434/258**

(57) **ABSTRACT**

This invention is a training system which enables a human being to acquire sufficient hyperspace energy in order to pull the body out of dimension so that the person can walk through solid objects such as wooden doors.

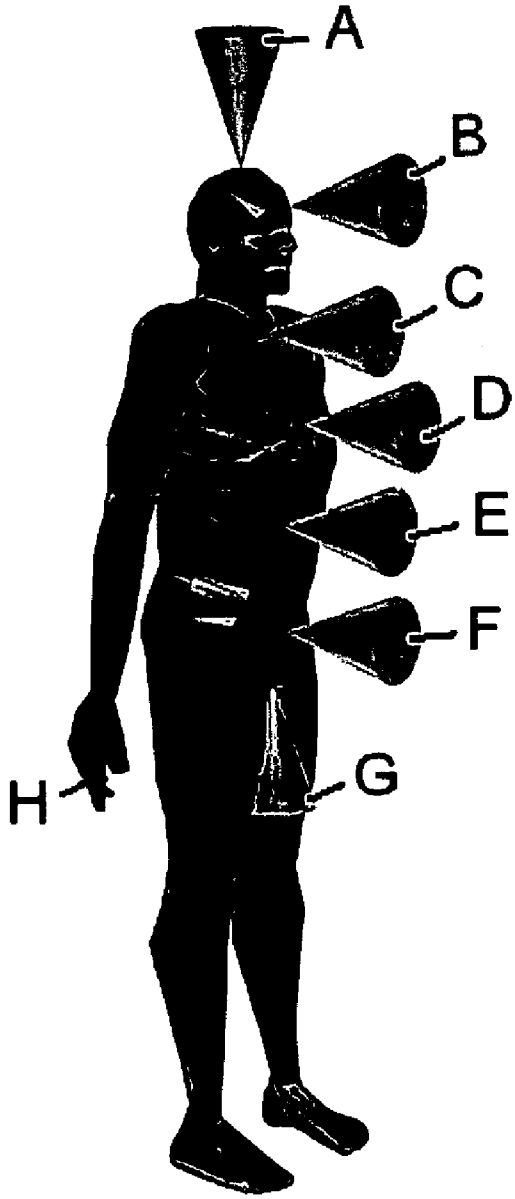

Figure 1

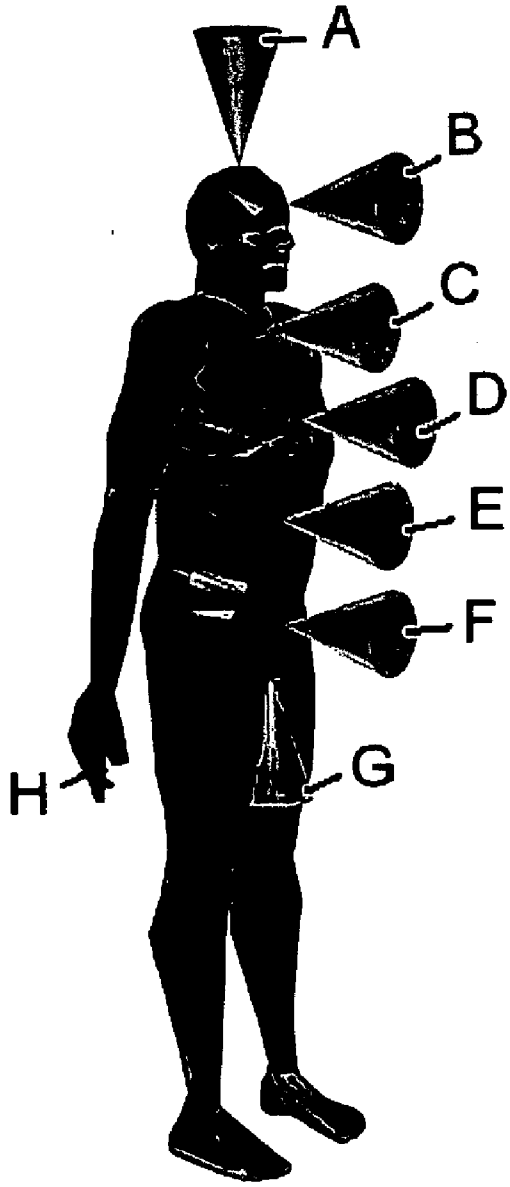

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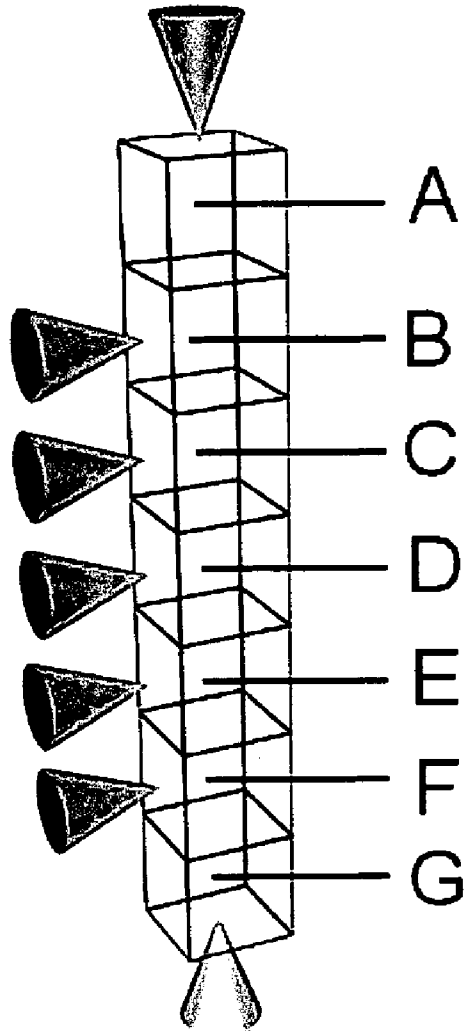

Figure 3

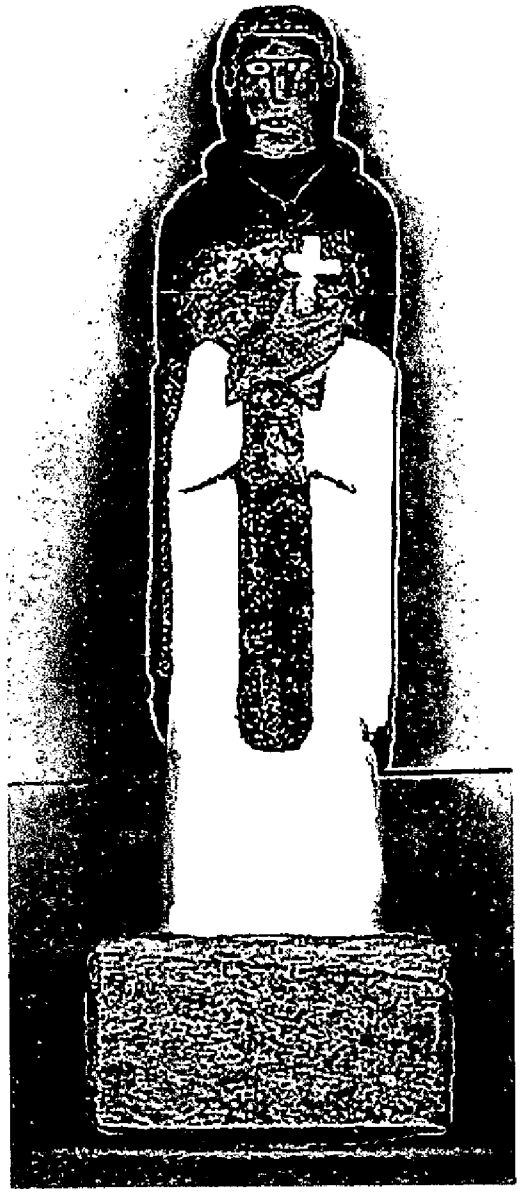

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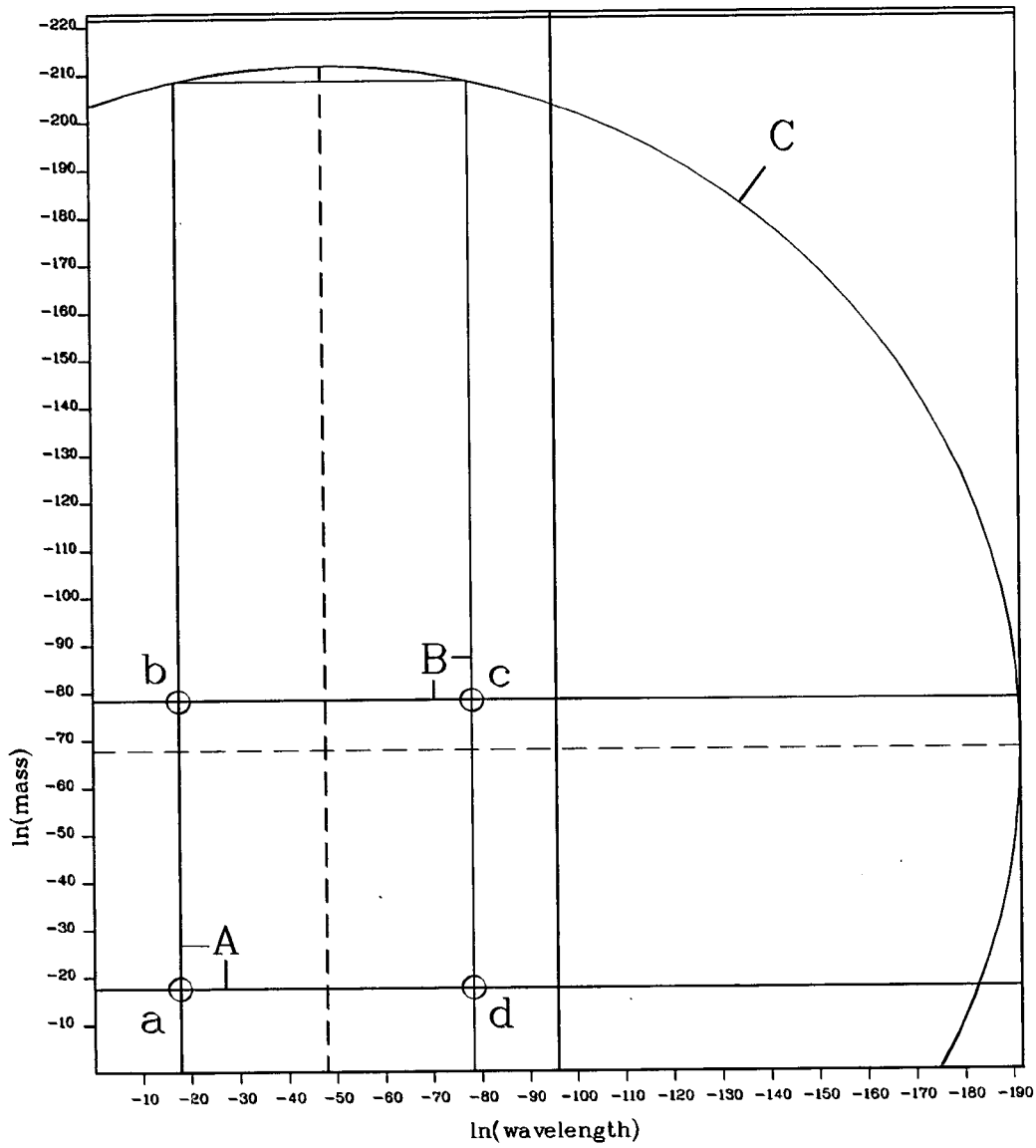
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Figure 5

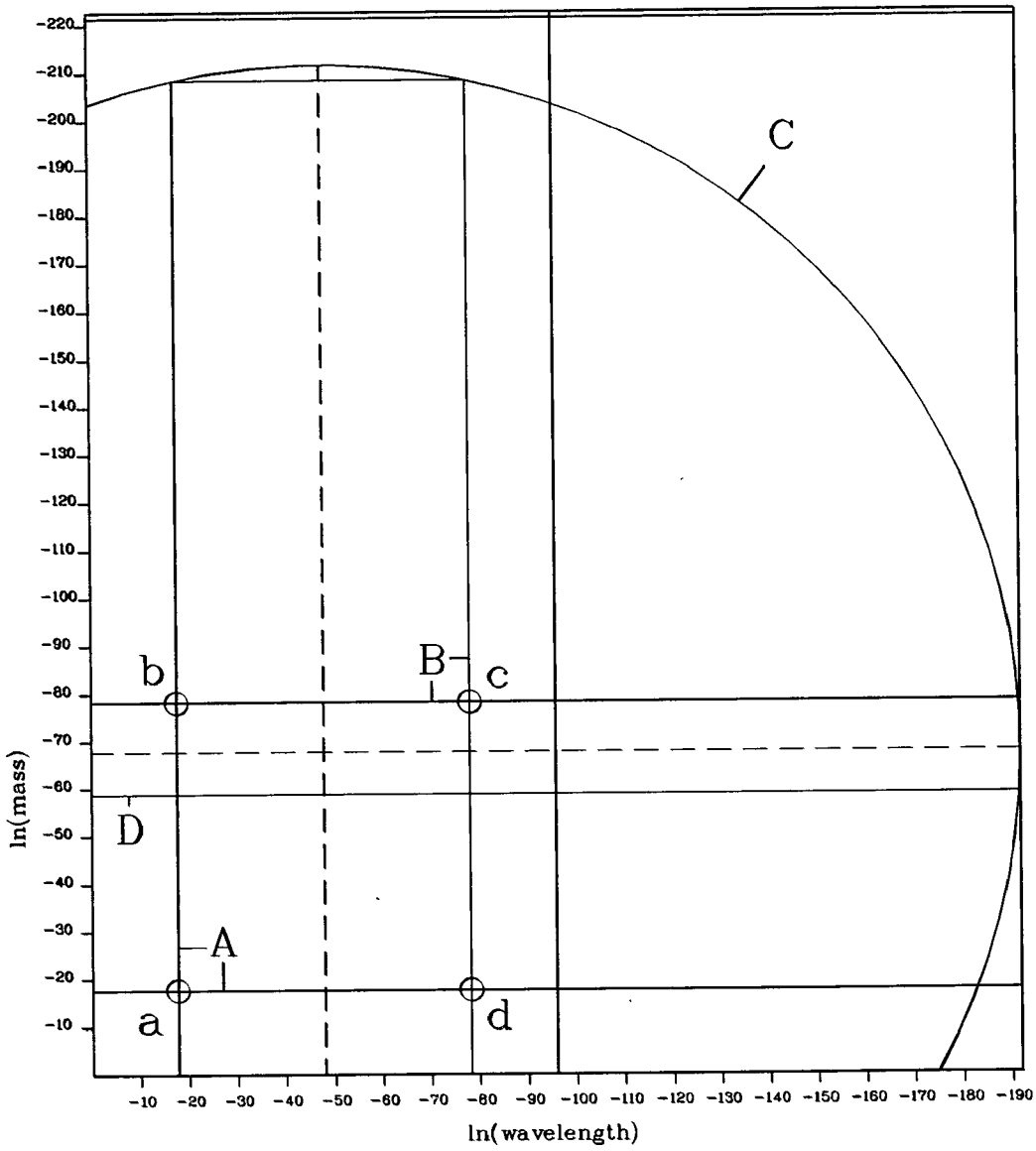
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Figure 6

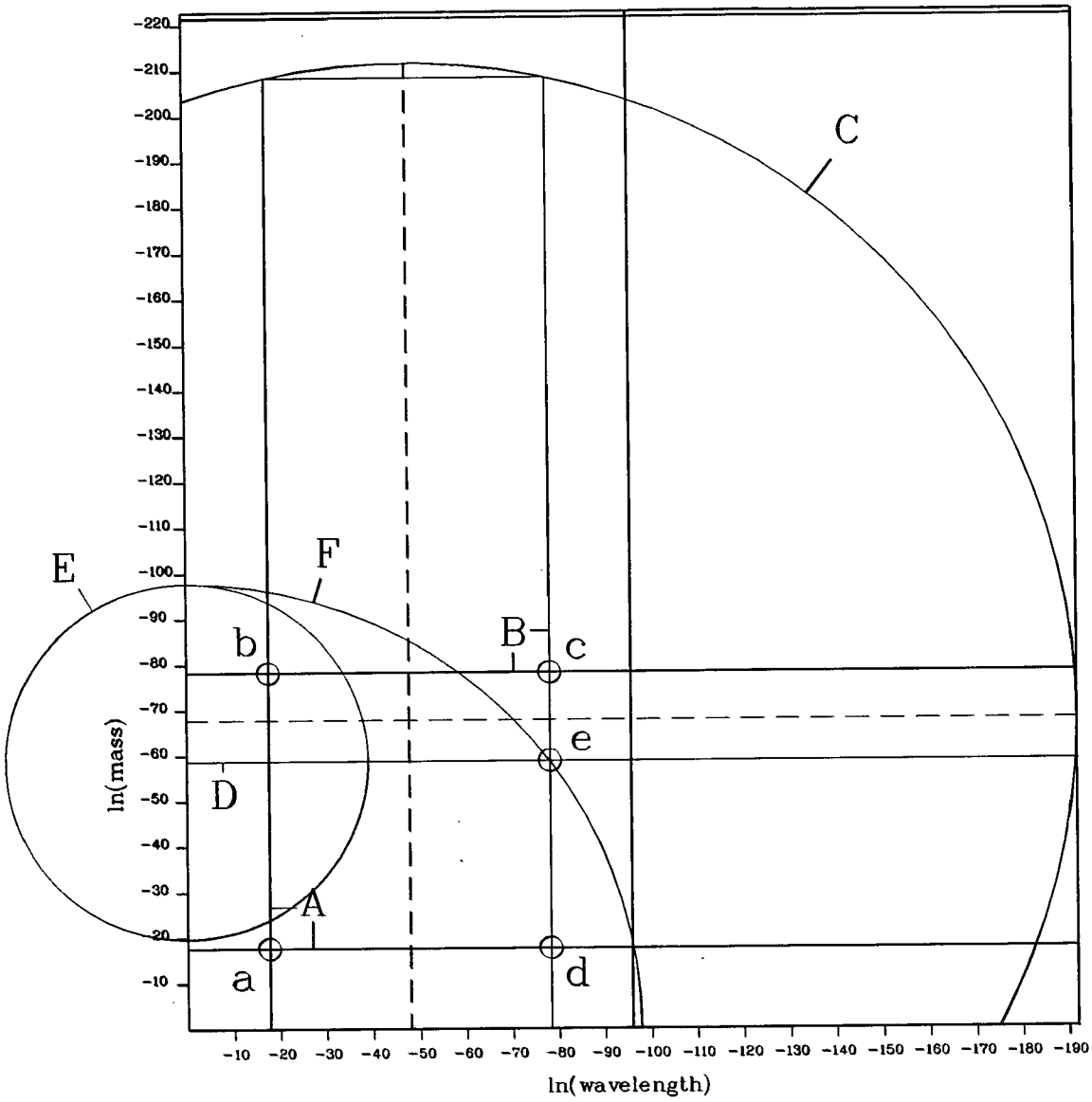
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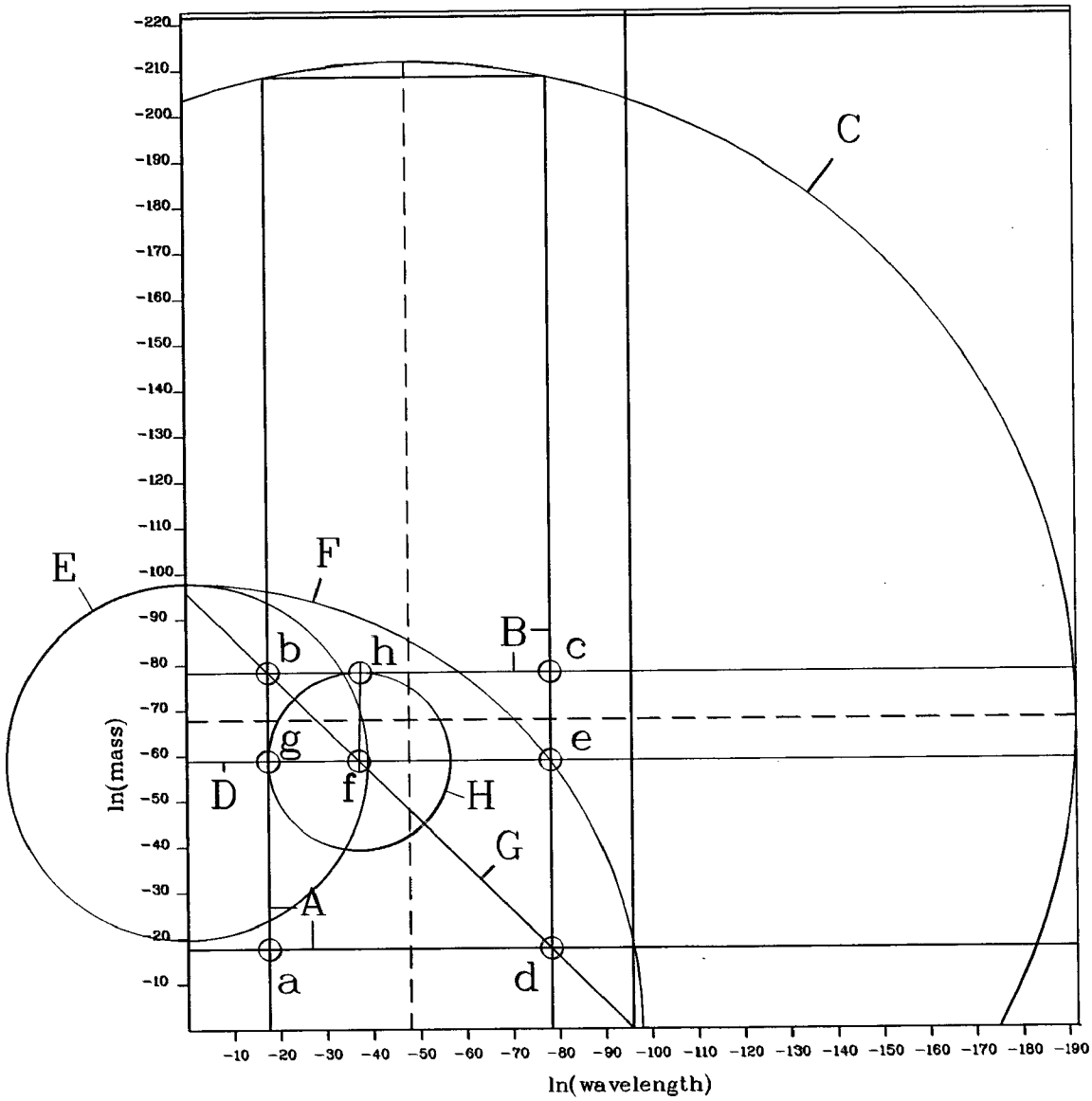
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Figure 8

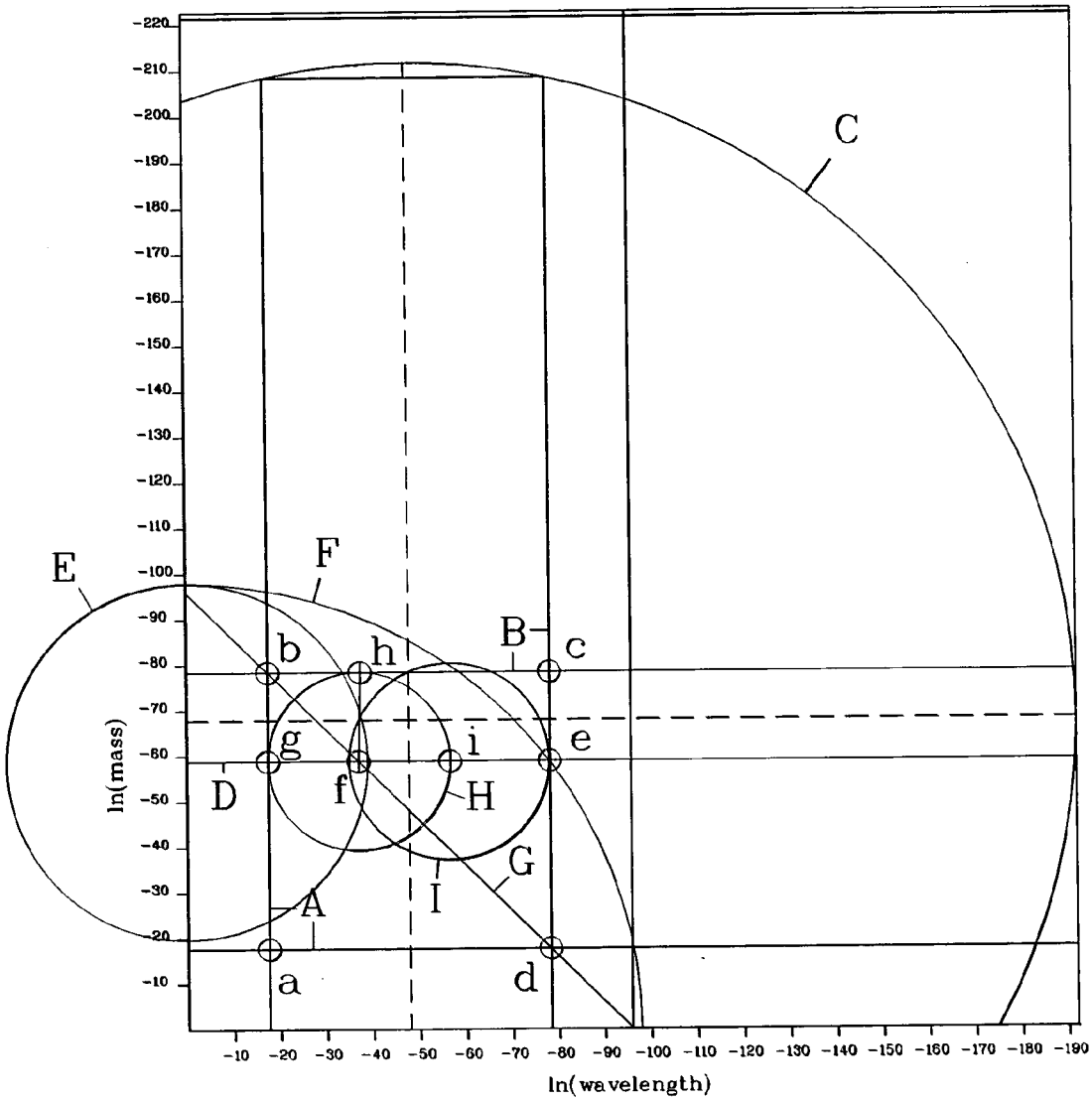
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Figure 9

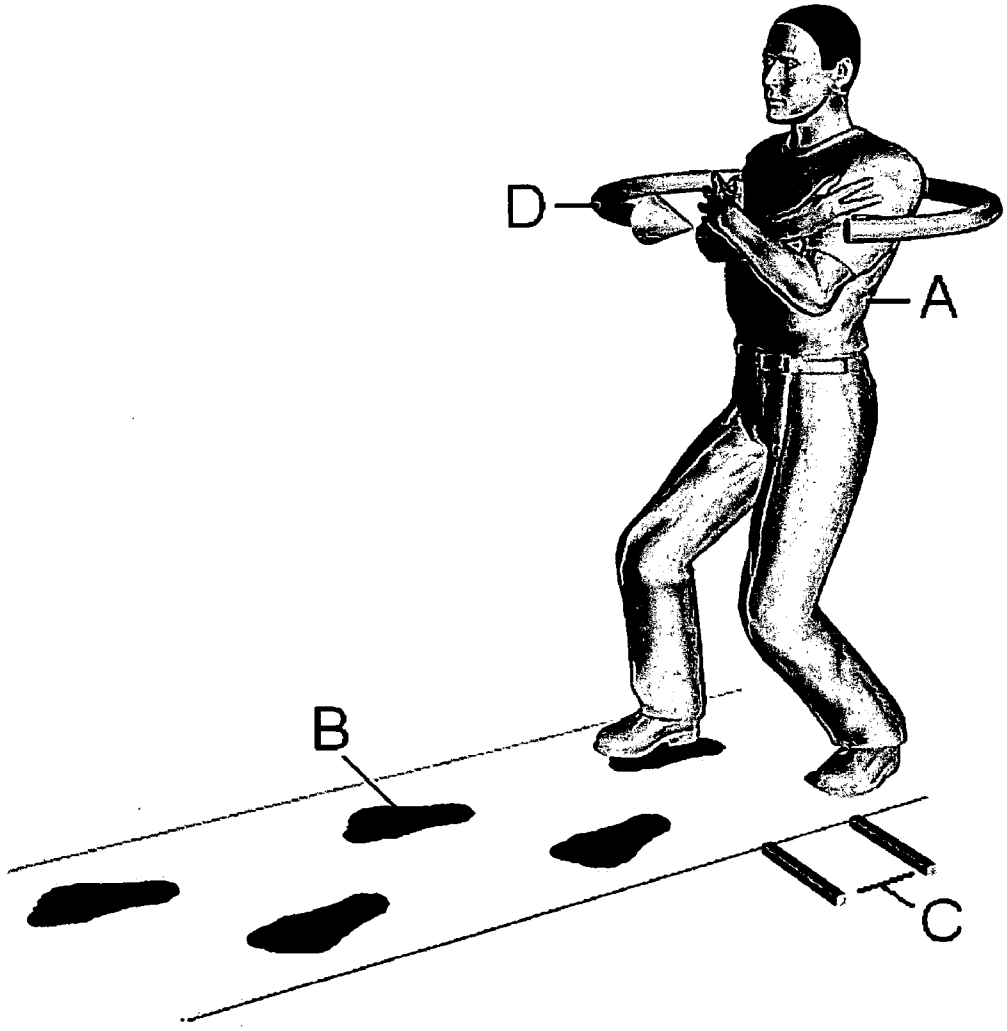

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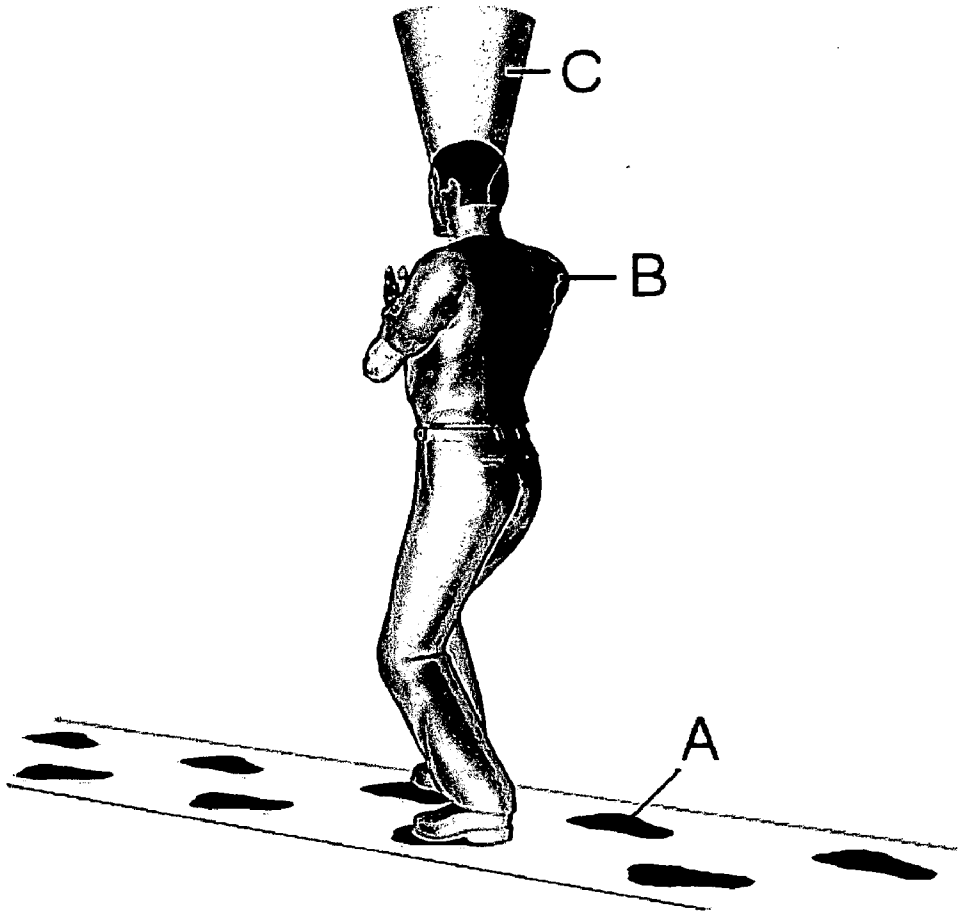

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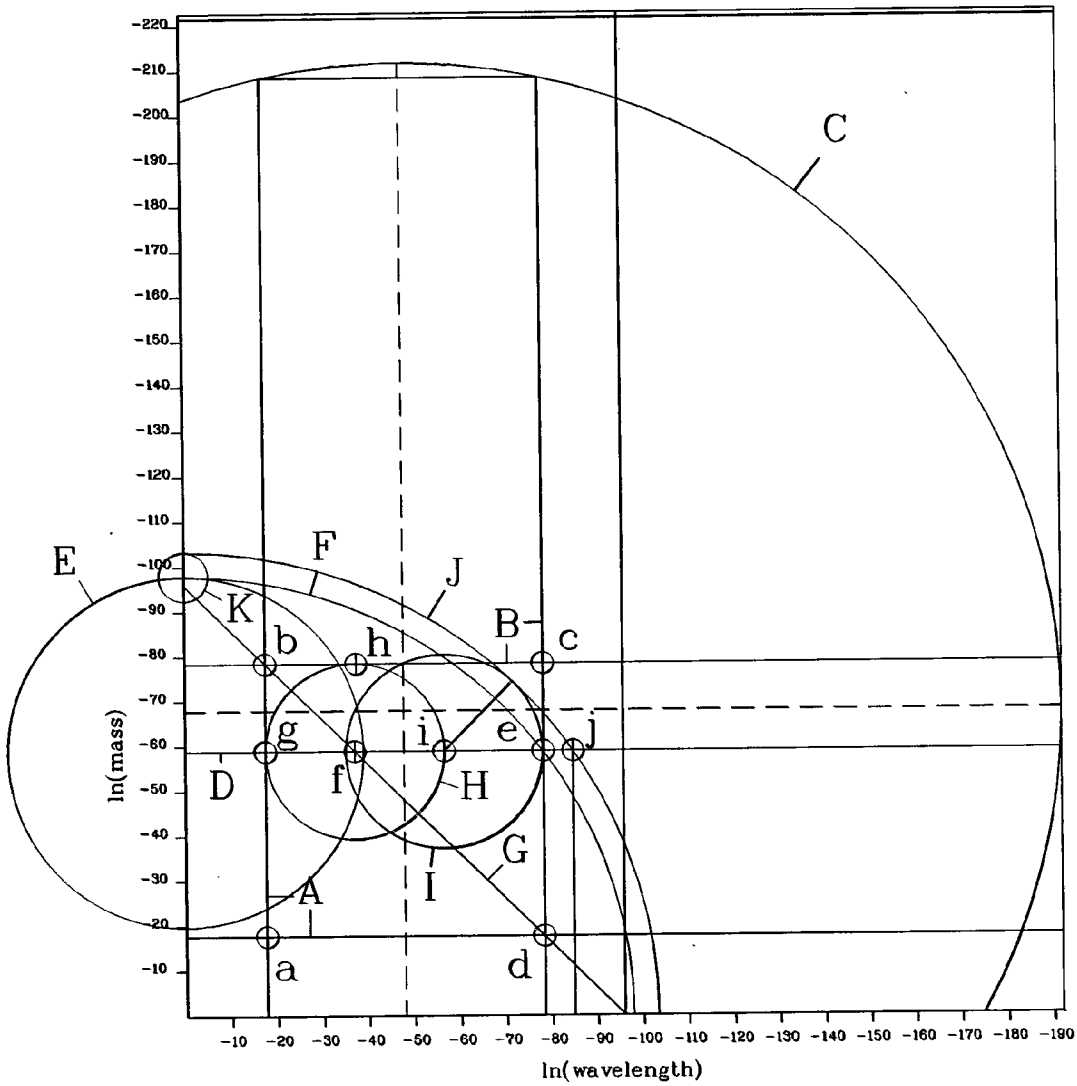
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Figure 12

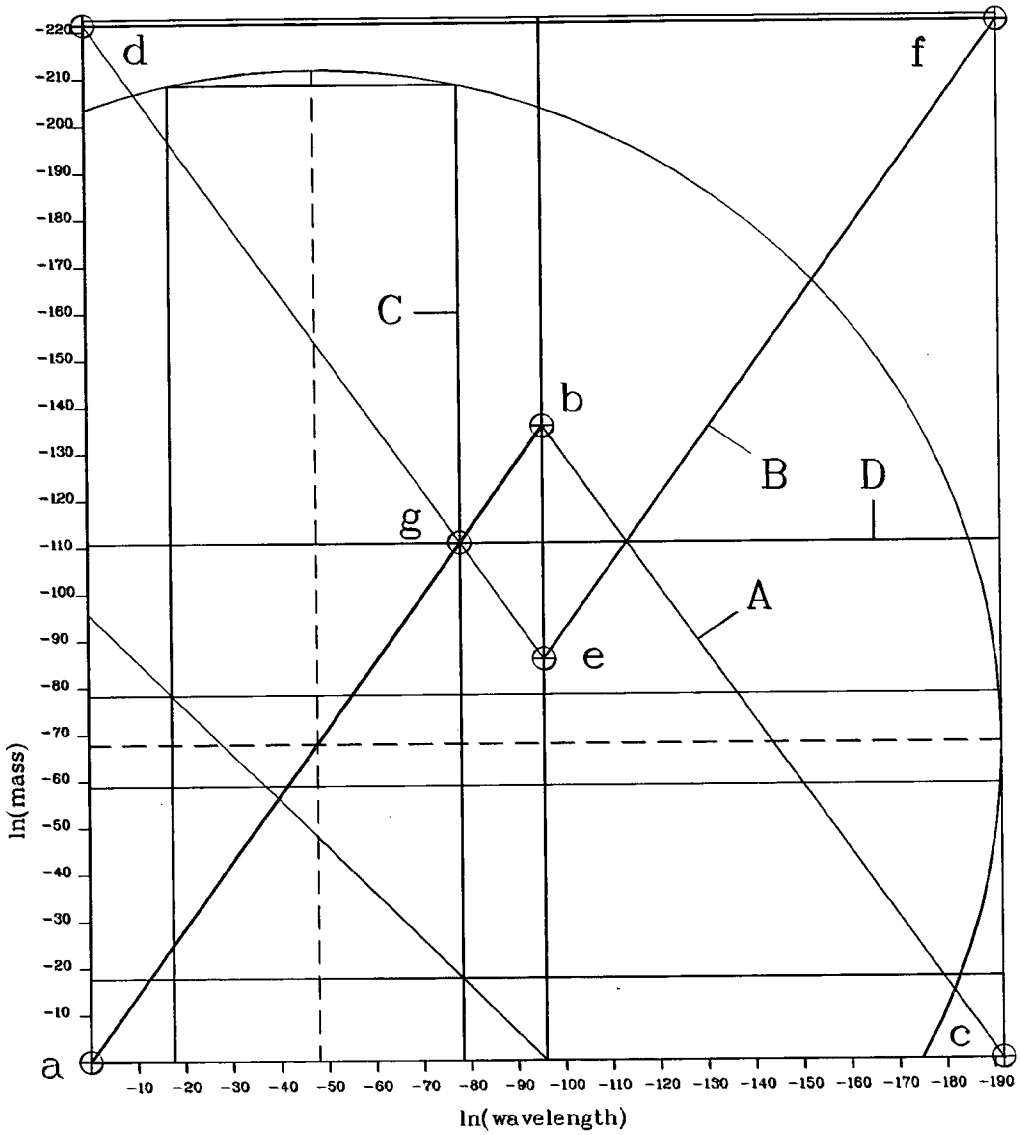
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Figure 13

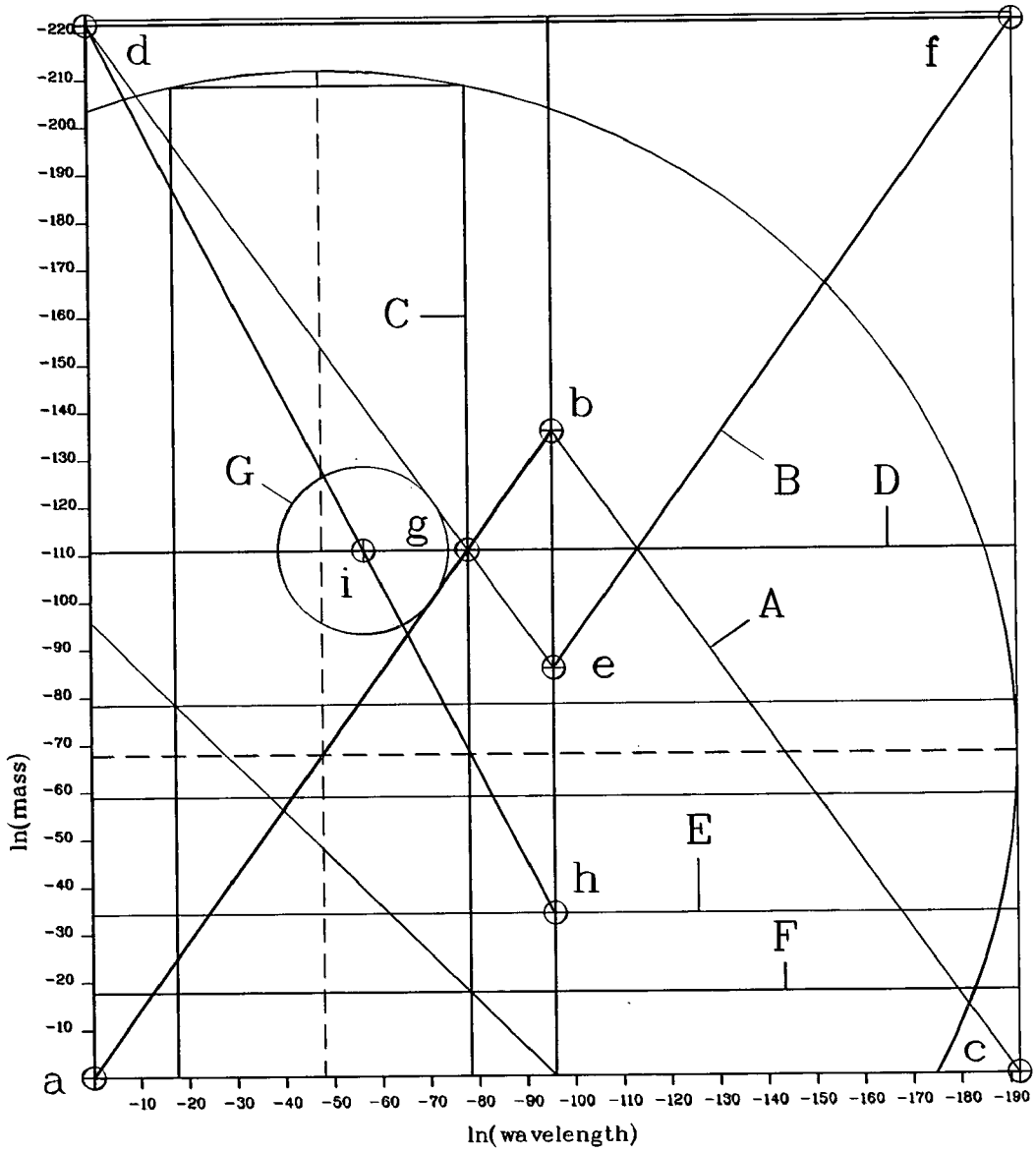
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Figure 14

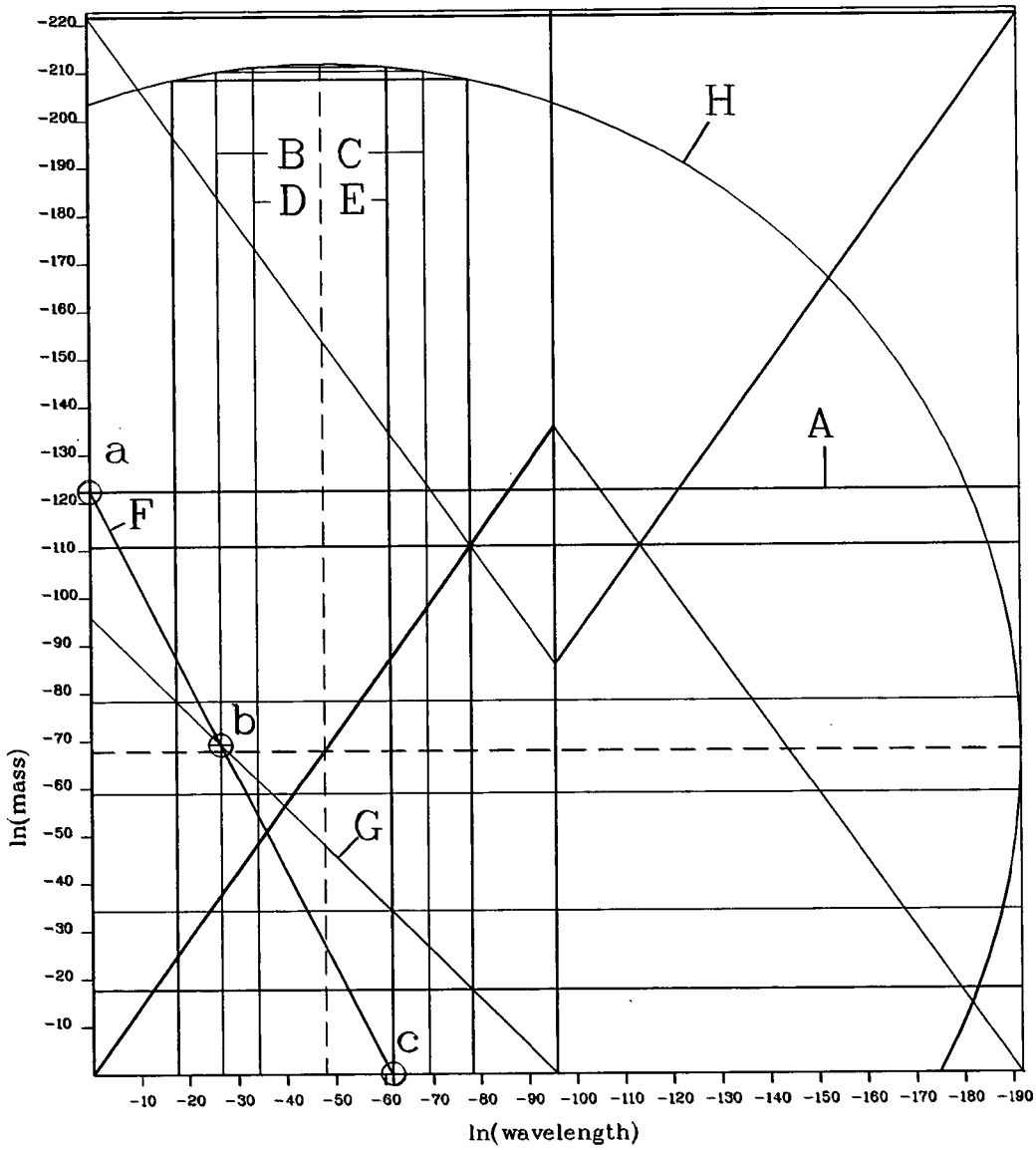
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Figure 15

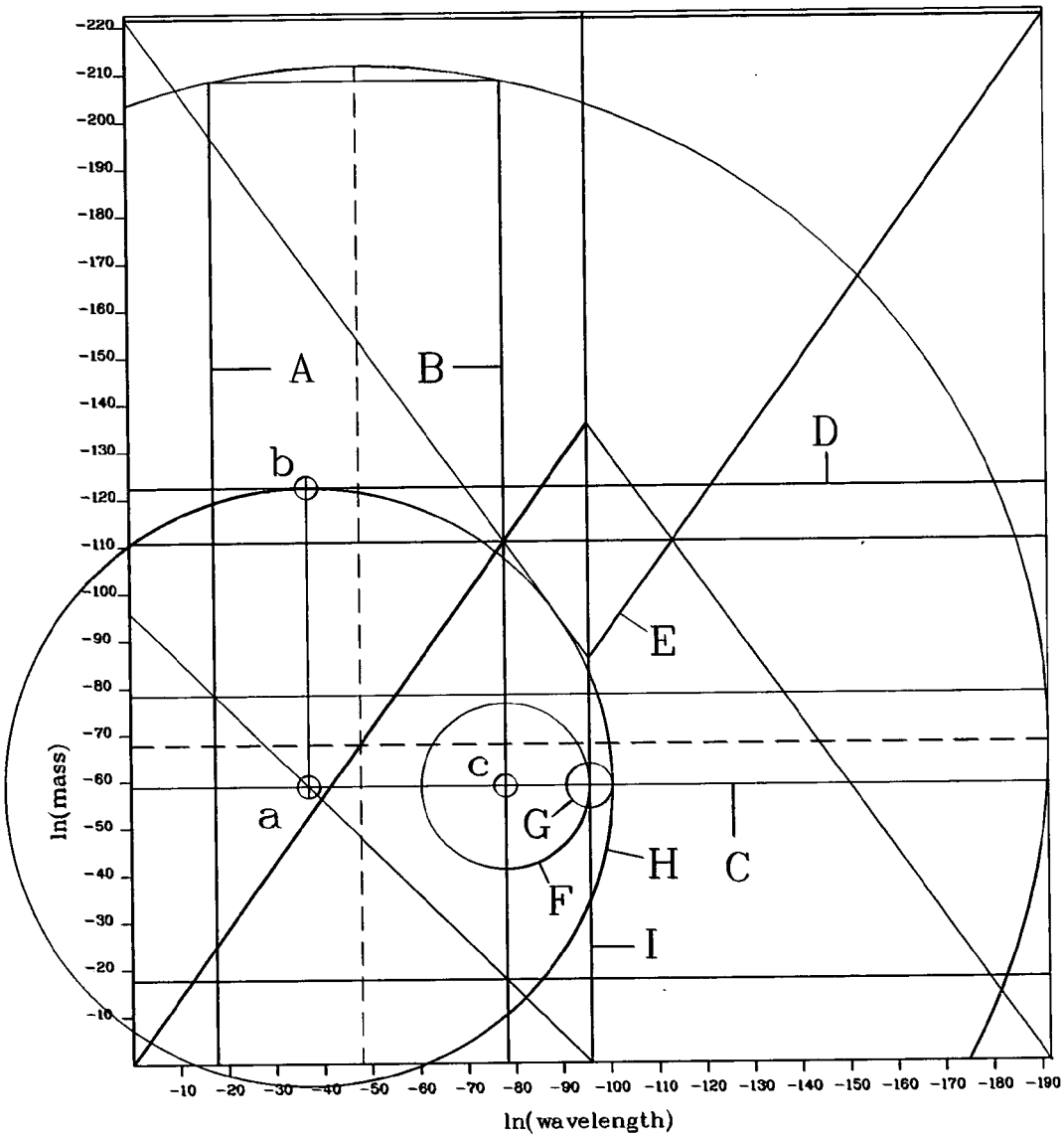
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Figure 16

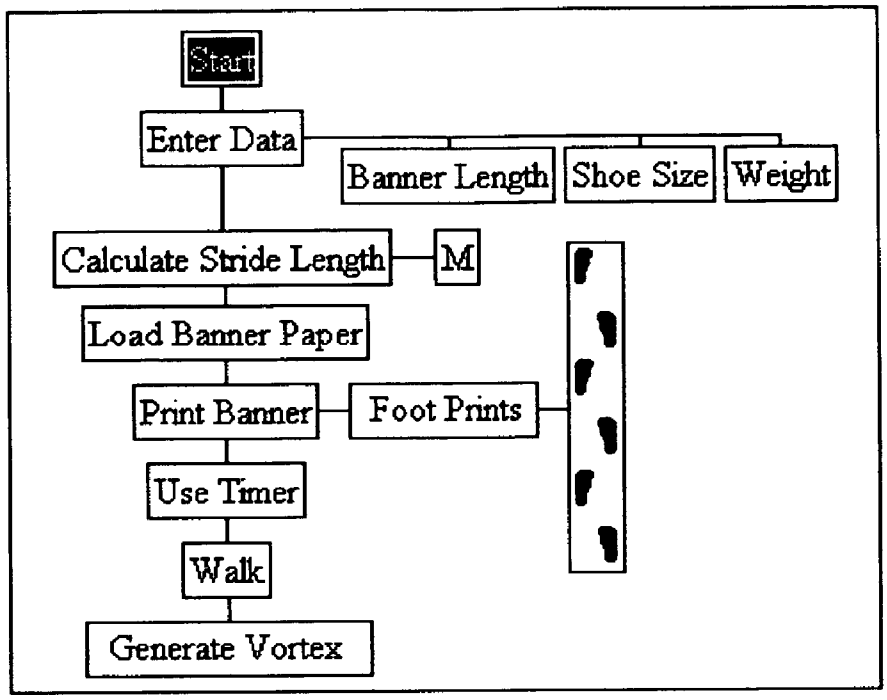
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Generate Vortex

Figure 17

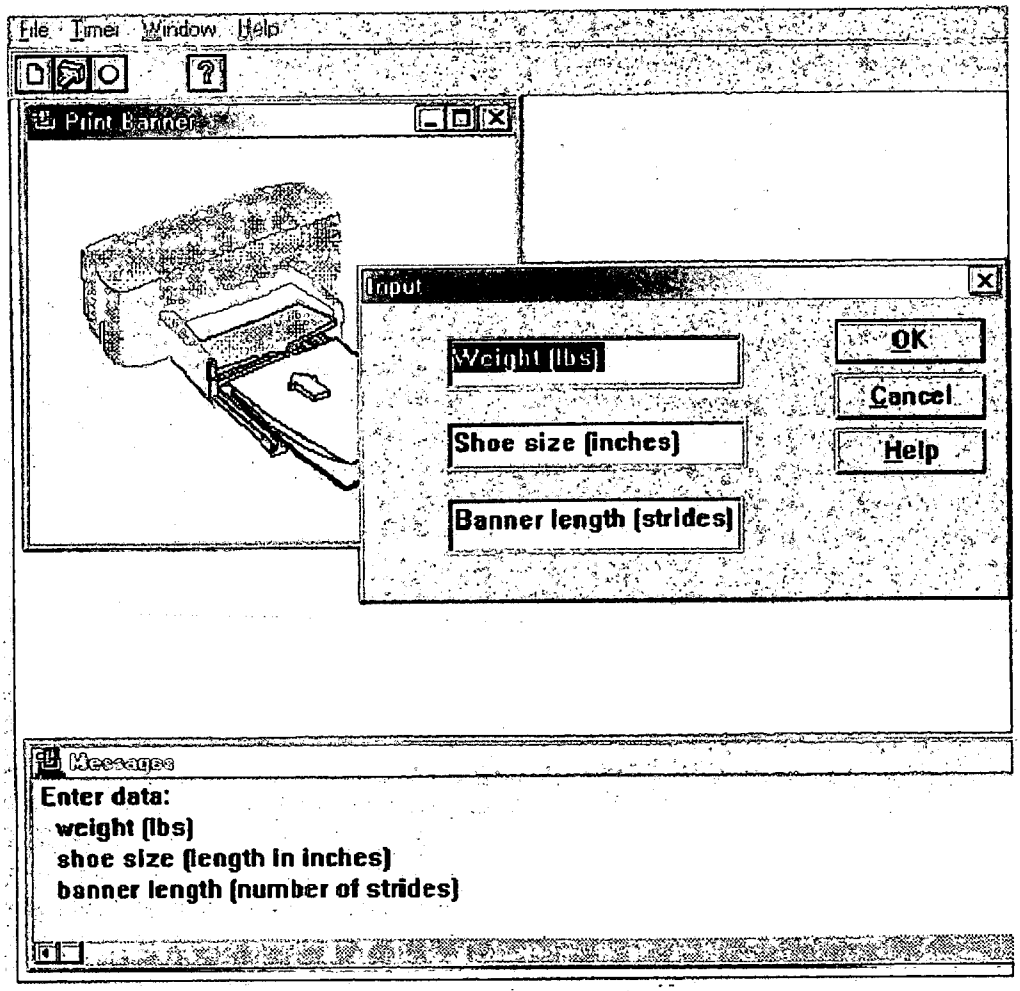
File Timer Window Help
Print Banner
Input
Weight (lbs)
Shoe size (inches)
Banner length (strides)
OK
Cancel
Help
Messages
Enter data:
weight (lbs)
shoe size (length in inches)
banner length (number of strides)

Figure 18

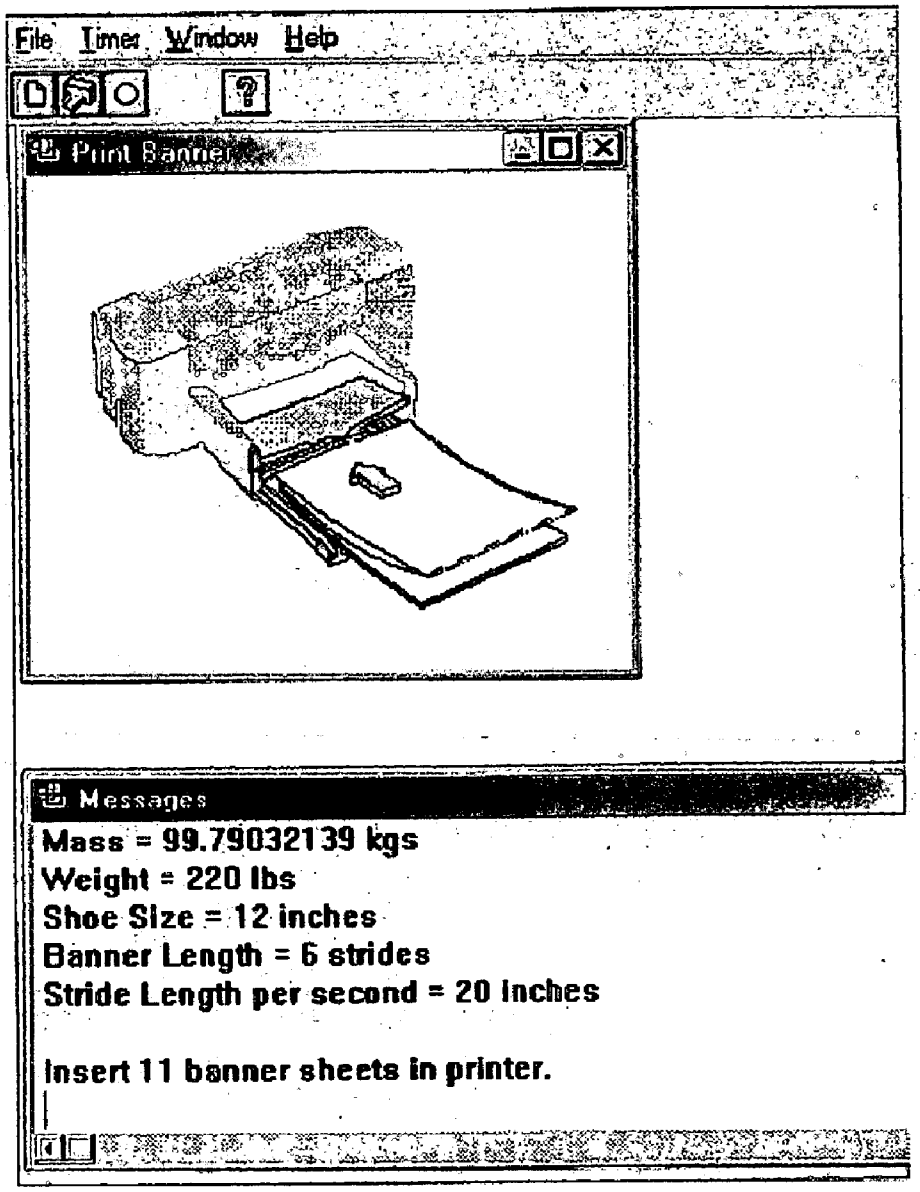
File Timer Window Help
Print Banner
Messages
Mass = 99.79032139 kgs
Weight = 220 lbs
Shoe Size = 12 inches
Banner Length = 6 strides
Stride Length per second = 20 inches
Insert 11 banner sheets in printer.

Figure 19

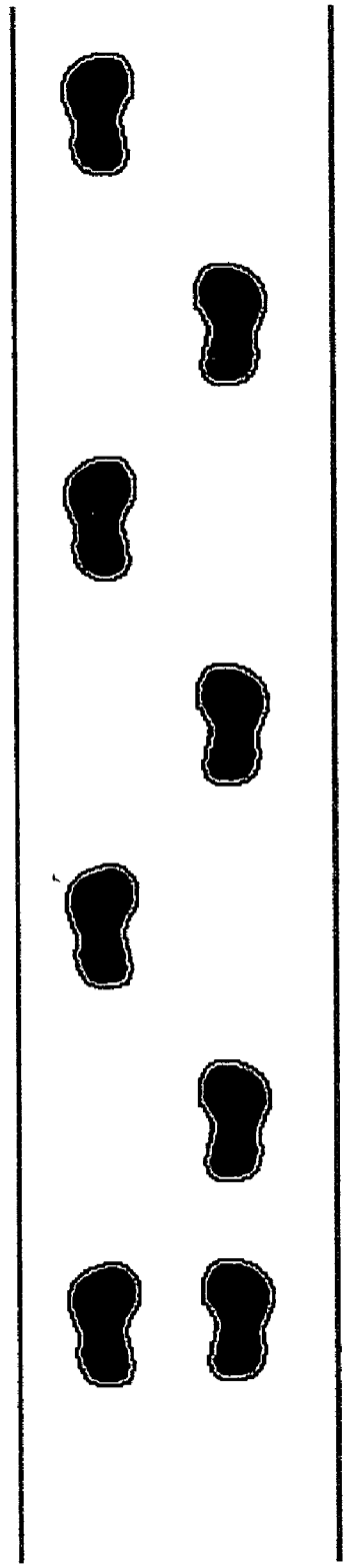

Figure 20

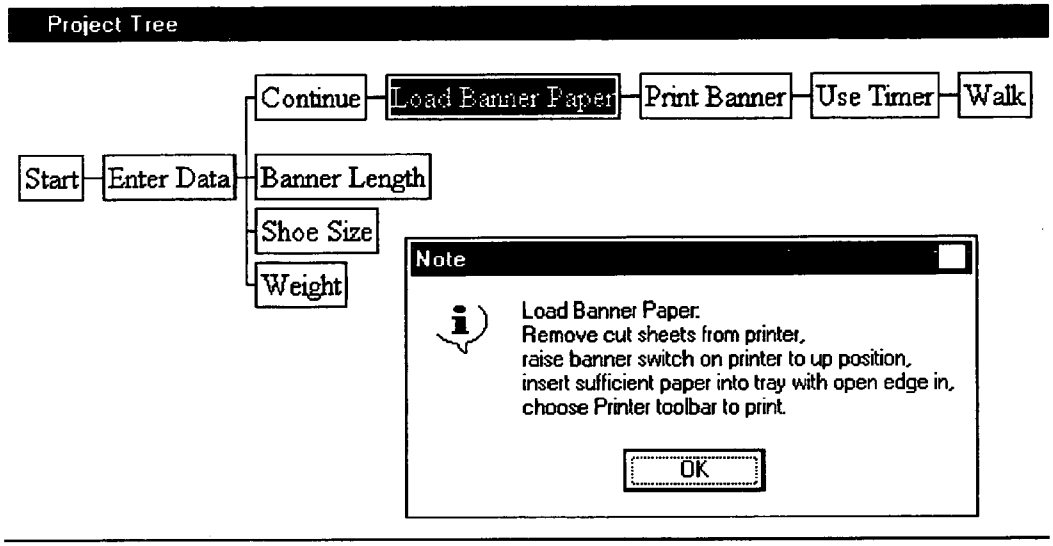
Project Tree
Start
Enter Data
Continue
Load Banner Paper
Print Banner
Use Timer
Walk
Banner Length
Shoe Size
Weight
Note
Load Banner Paper:
Remove cut sheets from printer,
raise banner switch on printer to up position,
insert sufficient paper into tray with open edge in,
choose Printer toolbar to print.
OK

WALKING THROUGH WALLS TRAINING SYSTEM

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a training system that enables a human being to acquire sufficient hyperspace energy in order to pull the body out of dimension so that the person can walk through solid objects such as wooden doors.

BACKGROUND OF THE INVENTION

[0002] A human being is a hyperspace energy being living in a physical container or body that is comprised of 67% water. This high percentage of water makes this invention possible. Referring to **FIG. 1**, the hyperspace energy being receives energy from our dimension through seven vortices that run the length of the body. Each vortex connects to a separate hyperspace dimension having its own particular frequency. This arrangement allows for the development of seven modular energy components corresponding to the mind, spiritual eye, voice, body, abdomen, plasma energy ball (battery), and ground connection.

[0003] Vortex (A), known as the top vortex, supplies energy to the mind and provides a channel of communication to other entities in the universe. This channel has been tested up to 100,000 light years which is the diameter of the galaxy.

[0004] Vortex (B), known as the spiritual eye, has a hollow cone-like appearance surrounded by white, misty, low-density hyperspace energy. Because the eye is modular, the mind can project it to vast distances, a process known as remote viewing.

[0005] Vortex (C), known as the voice and hearing module, can also be projected to enormous distances in order to communicate verbally with other entities. Using the proper remote viewing instruments, it is possible to project both the eye and verbal modules to see and talk at the same time.

[0006] Vortex (D), known as the heart vortex, provides protective energy to the upper internal organs, arms and hands.

[0007] Vortex (E) provides protective energy for the lower organs such as the intestines, liver and kidneys.

[0008] Vortex (F), known as the battery of the body, consists of an orange-colored plasma energy ball about one to two inches in diameter. The body becomes paralyzed if this ball is removed from the body. When the hyperspace energy being leaves the body, the vortices close and the battery takes over in order to keep the body functioning. This vortex also plays a role in the creation of the astral energy baby that attaches to the fertilized egg.

[0009] Vortex (G) is the ground vortex which rotates in the counter-clockwise direction in order to provide an energy ground for the electrical circuit. All the other vortices rotate in the clockwise direction as seen from the front such that energy flows into the vortex according to the right-hand rule of physics.

[0010] Vortex (H) is the hand vortex which rotates counterclockwise on the right hand and clockwise on the left hand as seen looking at the palm. Thus there is a rotating flow of hyperspace energy between the two hands when the palms are facing each other.

[0011] Referring to **FIG. 2**, each vortex feeds energy into its own hyperspace module shown by the lettered box. In terms of quantum mechanics, each box is actually a potential energy well in which each module develops separately. At the time of death of the body, these modules are joined together as a single energy being. The process is powered by the plasma energy ball battery which also contains the logical instructions for assembly.

[0012] Different people, as tested by the pendulum on the hand vortex, have different vortex sizes. Three people were tested. The first person had almost no rotational movement showing very little energy. The second person had a vortex radius of one inch. Another had a vortex radius of four inches which covered his entire hand. The latter also has the ability to lift another human being, lying prone on a table, off the table by flowing low-density hyperspace energy into the person through the hand vortices. He has also experienced walking through a solid wooden door with a dog at his side. What this means is that there is a way, as described in this invention, of creating large energy vortices which will enable a person to acquire sufficient energy to walk out of dimension through solid objects such as wooden doors.

[0013] Researching the historical records, referring to the statue in **FIG. 3**, a humble black Catholic Dominican friar of the Santo Rosario Convent, by the name of San Martin de Porres, living in Peru in the 1500's, also developed this ability to walk through doors. For his beatification, many witnesses came forward to recount his extraordinary abilities. For example, a witness, who worked in the Convent, went to the cell of San Martin to ask for something to eat. When he reached the cell, he saw San Martin leaving with some medications apparently to heal someone sick. The witness waited by the open door of the cell for his return. After having waited awhile without being distracted by anything else, he saw said venerable brother fray Martin come out from his cell from the inside and call him by name. The witness was terrified, not understanding how this was possible.

[0014] The woman who gave me the statue told me that he would walk miles and miles each day to visit the poor. The task of walking means that there is a velocity involved. Because the body has mass, then there is a mass times a velocity, or momentum, involved in this ability. Notice also that the statue shows him walking with his right arm crossed over his left arm in the form of an X.

[0015] What this walking momentum means in terms of physics is given in the following analysis. The human body consists of 67% water. A water molecule consists of two hydrogen atoms and one oxygen atom having the atomic formula H_2O. The atomic weight of one atom of hydrogen is 1.008 awu. The atomic weight of one atom of oxygen is 16.000 awu. The molecular weight of one atom of water is therefore:

Weight of two atoms of hydrogen 2 × 1.008 awu =	2.016 awu
Weight of one atom of oxygen 1 × 16.000 awu =	16.000 awu
	18.016 awu

The formula weight is just the atomic weight expressed in grams. Thus the formula weight of water would be 18.016

grams or 0.018016 kilograms. According to Avogadro's law, the formula weight contains $N=6.02\times10^{23}$ molecules. Thus the mass of one water molecule is the formula weight divided by the number of molecules:

$$\text{mass} = \frac{.018016\ \text{kg}}{N} = 2.99269103\cdot10^{-26}\ \text{kg}$$

$$\ln\left(\frac{\text{mass}}{1\ \text{kg}}\right) = -58.77103943$$

[0016] According to Einstein's Special Theory of Relativity, energy is equal to the mass times the speed of light squared. The energy of a photon is equal to Planck's constant h times the frequency f of the photon. Equating these two energies shows that

$$E = \text{mc}^2 = hf = h\frac{c}{\lambda} = \frac{h}{c}\frac{c^2}{\lambda}$$

$$\Rightarrow m\lambda = \frac{h}{c}$$

$$\Rightarrow \ln(m) + \ln(\lambda) = \ln\left(\frac{h}{c}\right) = \text{base} = -95.91546344$$

which says that the natural logarithm of the mass plus the natural logarithm of the wavelength is equal to the natural logarithm of Planck's constant divided by the speed of light c, known as the base constant in the tetrahedron diagram. This diagram plots the mass versus wavelength in natural logarithms. Notice that the left hand side of the equation is the sum of mass and wavelength, so the right hand side must also be the same.

$$\ln\left(\frac{h}{c}\right) = \ln\left(\frac{\Omega\Lambda\ 2\pi\Lambda\ c}{c}\right) = \ln(\Omega\Lambda) + \ln(2\pi\Lambda)$$

where $\Omega\Lambda$, known as the Planck mass, is the linear mass Ω of the universe times the bottom dimensional limit of the universe Λ, and $2\pi\Lambda$ is the bottom dimensional wavelength, known as the Planck wavelength. That is, our dimension is bounded by the Planck box having sides Planck mass and Planck wavelength. These boundaries have values:

$$\ln(\Omega\Lambda)=-17.64290101$$

$$\ln(2\pi\Lambda)=-78.27256243$$

[0017] Referring to **FIG. 4**, these two lines are plotted on the tetrahedron diagram. The Planck mass line (A) reflects off the sphere (C) and returns as the Planck wavelength (B) which shows the dual nature of quantum physics. This creates the Planck box (a,b,c,d) which is the boundary of our dimension.

[0018] Referring to **FIG. 5**, the mass of the water molecule is plotted as horizontal line (D) on the diagram. The energy of the water molecule is the mass times the speed of light squared.

$$E=mc^2$$

$$\ln(c)=19.51860099$$

$$\ln(mc^2)=\ln(m)+2\ \ln(c)$$

[0019] Referring to **FIG. 6**, a circle (E), having a radius equal to the speed of light squared, centered on the mass of the water molecule at the vertical axis, generates a circle (F), centered at the origin, that intersects (e) the mass of the water molecule at the Planck wavelength. That is, this intersection point sits right on the Planck box boundary between space and hyperspace. The radius of circle (F) is actually the mass of the water molecule divided by the speed of light squared.

$$E = \frac{m}{c^2} = m$$

$$\Rightarrow \frac{1}{c^2} = 1$$

$$\Rightarrow c = 1\frac{\text{meter}}{\text{sec}}$$

$$\ln(c) = 0$$

Taking the positive square root, the speed of light is one meter per second at the Planck boundary. The experiments with brain hemisphere resonance show that the resonant frequency of the human energy field is between 1 Hz to 5 Hz which is well below the hearing threshold of 20 Hz. Because the traveling wave has a wavelength of 0.3048 m and the speed of light is unity at the boundary, the frequency should be

$$f = \frac{c}{\lambda} = \frac{1\frac{m}{\text{sec}}}{.3048\ m} = 3.28\ \text{Hz}$$

which is within the middle of the experimental male range. At this resonant frequency, the human energy being pops out of the body. This represents only a first stage in the development of the energy being. But what is really wanted is to have both the physical body and the energy field move out of dimension together as San Martin did.

[0020] Referring to **FIG. 7**, the 45° base line (G) is added to the diagram. Notice that the Planck mass intersects (b,d) the Planck wavelength on this line because they sum to the base constant. The mass of the water molecule crosses this line at point (f). A circle, centered (f), with a radius equal to the speed of light, is tangent to the Planck wavelength (h) and the Planck mass (g). Since mass times velocity is momentum, the diagram says that the momentum of the water molecule is tangent to the boundaries of the Planck box which separates space from hyperspace. In order to get to point (e) from the momentum of the water molecule, a second circle is added to the momentum.

[0021] Referring to **FIG. 8**, a circle (I), centered on the water molecule mass at the speed of light circle (i), is made tangent to the Planck wavelength at point (e). The momentum M of space is equal to the Planck mass times the Planck scale times the speed of light. At point (e), the speed of light

is unity, so that the momentum is just the Planck mass in momentum units:

$$M = \Omega\Lambda c = 2.176634194 \cdot 10^{-8}\ \mathrm{kg}\frac{m}{s}$$

Circle (I) has a radius equal to

$$\text{ratio} = e^{21.572952} = 2338912700$$

Therefore the walking momentum in order to get to point (e) is the momentum of space M times this ratio

$$M_w = M \cdot \text{ratio} = 50.909573606\ \mathrm{kg}\frac{m}{\mathrm{sec}}$$

The stride length L per second that a person of mass W has to walk is the walking momentum divided by the mass W times a period T of one second

$$L = \frac{M_w}{W} T$$

For a person with a mass W of 99.79 kg (220 pounds), then the stride length L is 20.08 inches or one foot and eight inches. The person has to walk this length in one second on each foot.

[0022] Looking at the statue of San Martin, his arms are crossed over each other. The vortex of the right hand points backward, and the left hand vortex points forward due to the reversed rotation. Referring to **FIG. 9**, this creates a rotational energy channel (D) around his body (A). The stride length (C) is calculated according to the body mass, and then a banner printout is made showing where the footprints (B) are to be placed each second. The question is: "What happens when one walks the walk?".

[0023] On the very first experiment, referring to **FIG. 10**, what happens is that, after taking only six strides on the banner printout (A), a huge spinning vortex (C) develops over the top of the head and the vertex locks onto the heart vortex in the center of the chest (B). In everyday life, this vortex is not created because normal walking is much faster and the hands are held at the side of the body. The energy rush through the pineal gland is so intense that one feels immediately sleepy and starts yawning excessively due to the increased flow of melatonin.

[0024] After practicing with the banner printout, long walks were made through the park. In this case, a vertical white line rotated around a vertical axis located about six feet perpendicular to the path on the right side of the body. When the walking speed was correct, this white line would lock onto the centerline of the body. Speeding up or down caused the white line to lose synchronization and rotate away. This white line is related to the ability to levitate the body. San Martin had so much energy that, according to witness testimony, he could float horizontally in the air with his head resting against the bowed head of Christ on a carved wooden cross. Thus San Martin's energy sources were channeling energy from Christ, collective broom energy as described in a separate patent application, and the walking momentum vortex energy.

[0025] During the early part of the 20th century, a man's parents were lying in bed dying of tuberculosis. With their permission, he placed a weighing scale under each of their beds. When they passed away, he found that each scale registered a loss in weight of 2.5 ounces. This is equivalent to 0.071 kg, which is the mass of the human energy being.

[0026] After conducting a number of experiments with water vortices draining from a cylindrical tank, it can be stated from Bernoulli's theorem that the potential energy plus the kinetic energy is a constant

$$gz + \frac{1}{2}mv^2 = const$$

The shape of the inner surface of the water circulation has a velocity proportional to the inverse of the radius, so the shape of the surface is

$$(z - z_0) = \frac{k}{r^2}$$

which says that the height of the vortex is proportional to the inverse of the square of the radius.

[0027] The hand vortex area ratio between the second test subject and the third test subject is equal to the square of their radii:

$$\text{ratio} = \frac{(1\ \mathrm{in})^2}{(4\ \mathrm{in})^2} = \frac{1}{16}$$

Because the speed of light at the boundary was determined to be one meter per second, the energy of the third test subject is

$$E = \left(\frac{.071\ \mathrm{kg}}{16}\right)\left(\frac{1\ \mathrm{m}}{\mathrm{sec}}\right)^2 = 4.4375 \cdot 10^{-3}\ \mathrm{joule}$$

$$\ln(E) = -5.417664124$$

[0028] Referring to **FIG. 11**, a circle (K), having this radius, is added to the energy of the water molecule (E), to produce augmented energy circle (J). This circle (J) intersects the mass of the water molecule outside the Planck box at point (j). This means that the increased hyperspace energy moves the water molecule, and hence the body, out of dimension. Furthermore, circle (J) is tangent to the walking momentum ratio circle (I) which keeps the geometry locked together.

SUMMARY OF THE INVENTION

[0029] It is the object of this invention to create a training system that allows a person to develop the ability to walk

around out of dimension, passing through solid objects. This invention is based on one of the most remarkable relationships between the water molecule and the boundary between space and hyperspace. The mass of the water molecule is equal to the energy of the water molecule at this boundary. Because the body is composed of 67% water, the body sits on the boundary such that any additional increase in energy would move the body out of dimension into hyperspace. Because human beings are actually hyperspace energy beings living in physical bodies, the additional energy required to move the body out of dimension comes from increasing the energy of the hyperspace being. One source of this energy comes from walking cross-handed at the proper velocity in order to generate a large hyperspace energy vortex that flows energy into the potential wells of the hyperspace being. This increased hyperspace energy will then allow the person to walk around out of dimension through solid wooden doors. Because the door and the person are in two slightly different dimensions at the same moment, it appears that the person is walking through the door. After passing through the closed door, the person then returns to our dimension and emerges in the interior of the closed-door room.

[0030] This technique can be used in reverse to heal an infected hand instantaneously. A salve made from the St.Mary's herb is applied to the skin of the infected hand. The hyperspace energy then flows through the right-hand vortex such that the infected hand and the salve are taken slightly out of dimension. What happens is similar to when a short piece of straw is embedded in a hard wooden telephone pole as a tornado passes over the pole. The straw and pole are taken out of dimension such that they briefly merge together. As the tornado moves on, both objects come back to dimension merged together. Thus the salve (straw) is merged with the bacteria (pole) in hyperspace such that the bacteria is killed instantly. Removing the hand vortex brings the infected hand back into dimension cured.

[0031] Based on this information and the results of many experiments, this invention creates a large vortex by walking at a certain velocity with the hands crossed over the chest. The proper walking momentum is created by a computer program that inputs the person's weight, shoe length, and the number of strides to be taken. The program then prints out a banner showing the footprints where the person has to step each second. When a person obtains sufficient energy from these methods, the person is then tuned to the subspace geometry of the universe as will be shown using the tetrahedron physics diagram.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0032] **FIG. 1**. Energy vortices of the human body.

[0033] **FIG. 2**. Seven potential wells fed by the energy vortices of the body.

[0034] **FIG. 3**. Carved wooden statue of San Martin de Porres who could walk through solid wooden doors.

[0035] **FIG. 4**. Tetrahedron diagram showing boundaries of the Planck box of dimension.

[0036] **FIG. 5**. Tetrahedron diagram showing mass of water molecule.

[0037] **FIG. 6**. Tetrahedron diagram showing water molecule energy and mass are equal at the Planck box boundary.

[0038] **FIG. 7**. Tetrahedron diagram showing that water molecule momentum is tangent to the boundaries of the Planck box.

[0039] **FIG. 8**. Tetrahedron diagram showing the momentum ratio required to reach the Planck wavelength boundary from the water momentum.

[0040] **FIG. 9**. Perspective view of crossed-hand momentum walking using banner printout.

[0041] **FIG. 10**. Perspective view of vortex generated by momentum walking.

[0042] **FIG. 11**. Tetrahedron diagram showing how additional hyperspace energy supplied to the potential wells of the hyperspace energy being enables the human body to be pulled out of dimension.

[0043] **FIG. 12**. Tetrahedron diagram showing the inverted tetrahedrons whose crossing represents the merging of two worlds between space and hyperspace.

[0044] **FIG. 13**. Tetrahedron diagram showing that the proton wavelength is determined by the Planck mass tangent to the inverted tetrahedrons.

[0045] **FIG. 14**. Tetrahedron diagram showing that the mass of the universe determines the electron and proton elementary particles.

[0046] **FIG. 15**. Tetrahedron diagram showing that momentum walking together with the increased energy of the hyperspace energy being is tangent to the mass of the universe.

[0047] **FIG. 16**. Computer program block diagram for printing banner footprints.

[0048] **FIG. 17**. Computer program input dialog window.

[0049] **FIG. 18**. Computer program calculation of stride length per second.

[0050] **FIG. 19**. Six-stride screen banner printout for 220 lb. person.

[0051] **FIG. 20**. Project tree showing help information by double clicking on node.

DETAILED DESCRIPTION OF THE INVENTION

[0052] 1. Referring to **FIG. 12**, a tetrahedron (A, path abc) is added to the diagram. The tip of the tetrahedron (e) falls on the base constant which is equal to Planck's constant divided by the speed of light. A second tetrahedron (B, path def) is inverted around horizontal line (D) which has a geometrical relationship to the base constant. The line is located at

$$\text{centerline} = \frac{2}{\sqrt{3}} \ln\left(\frac{h}{c}\right) = -110.7536373$$

Notice that the intersection of the two inverted tetrahedrons (g) occurs at the Planck wavelength which is the boundary between space and hyperspace. Line (D) is referred to as the merging of two worlds or the connecting of two worlds, a phrase obtained by means of remote viewing. That is, it is

the dividing line between space and hyperspace. This is the reason that the two boundaries intersect at this point.

[0053] Referring to **FIG. 13**, the proton wavelength (E) is added to the diagram. The proton wavelength has a value of the electron wavelength divided by 1836.1527

$$\ln(\lambda_p) = \ln\left(\frac{\lambda_e}{1836.1527}\right) = -34.26005901$$

A line (hd), from the base constant at the proton wavelength (h), to the corner of the inverted tetrahedron (d), intersects the merging of two worlds line at point (i). A circle, with a radius equal to the Planck mass (G), centered (i), is tangent to the inverted tetrahedrons. Thus the proton is defined by the base constant and the geometry of subspace. The reason that the proton is tangent to both tetrahedrons is because the electron and proton follow one single path between space and hyperspace. Thus there is only one single particle in nature. Because the particle enters our space at two different locations, we see the one particle as two distinct elementary particles. This relationship can be seen in Library of Congress tetrahedron diagram tet0565.

[0054] Referring to **FIG. 14**, the mass of the universe MU is equal to the linear mass Q of the universe times the radius R of the universe which is 10^{26} meters

$$\ln(MU)=\ln(\Omega R)=122.3347509$$

as shown on the diagram as line (A). The electron wavelength (B) reflects off the circumscribing sphere (H) and returns as the electron mass (C). The distance between reflection points is the hyperspace charge which is equal to the charge of space less the electron charge. So the electron goes from wavelength to electric charge to mass. The proton wavelength (D) reflects off the sphere and returns as the proton mass (E) which intersects the horizontal axis at point (c). A line (abc) from the mass of the universe at the vertical axis (a) to the proton at the horizontal axis (c) intersects the electron (b) which determines the electron's mass and wavelength since this point is on the 45° base line. What this means is that cosmology determines the values of the elementary particles.

[0055] Referring to **FIG. 15**, the mass of the water molecule (C) intersects the 45° base line at point (a). A circle (F), with a radius equal to the Planck mass is centered on point (c) at the Planck wavelength boundary (B) where the mass of the water molecule numerically equals the energy of the water molecule and where the speed of light is unity. The Planck mass is tangent to the base constant which is the vertical centerline (I) of the diagram. The large circle (H), centered (a) on the water molecule, is tangent to the mass of the universe (b) and tangent to the inverted tetrahedron (E). The difference between this circle (H) and the base constant (I) is the energy the hyperspace being has to acquire in order to be tuned to the mass and geometry of subspace. This difference, shown as circle (G), has a mass

$$m=e^{-4.792671}\ \text{kg}=8.29\cdot10^{-3}\ \text{kg}$$

Thus the hand vortex radius ratio has to be the square root of the mass of the hyperspace energy being divided by this tangent mass, or:

$$r=\sqrt{\frac{.071\ \text{kg}\cdot 1\ \text{in}^2}{e^{-4.792671}\ \text{kg}}}\approx 3\ \text{inches}$$

which is a vortex radius that is three times larger than that of a normal person, but one inch smaller than the third test subject who had a hand vortex radius of 4 inches. This is the reason that the third test subject was able to walk through walls and teleport to other locations because his energy was sufficiently large enough to cross over the inverted tetrahedron into a co-dimension of hyperspace. Notice also that dotted circle (J) with a radius equal to the mass of the water molecule, centered (c) on the boundary, is tangent to the tetrahedron (K). This makes the combined geometry tangent to the inverted tetrahedrons and the mass of the universe.

[0056] 2. Referring to **FIG. 16**, a computer program generates a banner printout with footprints spaced for walking according to the weight, shoe size and length of banner desired. Some banners could fit in a small room, or be placed on the floor of a long corridor. As shown in the block diagram the program inputs these three variables with error checking. Then the program calculates the stride length L per second from the equation

$$L=\frac{M}{W}T$$

[0057] 3. In the above equation, the value of the momentum M, as determined by the tetrahedron diagram, is preferably 50.9095736 kg m/s. The weight of the person is converted to mass W in kilograms. The stride period is preferably 1 second. Referring to **FIG. 17**, the data is entered in the dialog input window.

[0058] 4. Once the stride length has been calculated, the program displays the stride length and the required number of banner sheets in the message window, as seen in **FIG. 18**.

[0059] 5. The print banner menu is selected and the foot prints are printed on continuous banner paper. A six-stride scaled screen version of the banner is shown in **FIG. 19**. The banner paper is then placed on the floor, and a one-second beeping timer is activated from the toolbar or menu. The person then walks beside the printed foot prints, taking one stride per beep, which produces the correct walking momentum to generate the hyperspace vortex. The vortex, which forms in only six strides, brings additional hyperspace energy into the quantum potential wells of the hyperspace energy being.

[0060] 6. A help system consists of a project tree which explains the various steps in using the program. Double mouse clicking on a project tree node displays the help instructions in a dialog window as shown in **FIG. 20**.

[0061] 7. In summary, the purpose of the training system is to substantially increase the energy of a human being who will then have the capability of walking through walls, body levitation, instantaneous healing of infections, full-body teleportation to another location, remote viewing at vast distances in terms of light-years, and looking into hyper-

space co-dimensions. The third test subject and I have been able to experience all the above phenomena. He did it through augmenting his energy, and I have done it through the application of electromagnetic fields, by spinning on my vortex accelerator machine and using this invention.

I claim:

1. A training method comprising the steps of:

generating a banner having a plurality of footprints spaced at regular intervals wherein the banner is placed on the ground;

generating a periodic audible signal, whereby the audible signal repeats at a regular interval of time equal to the period; and

walking on the banner by tracing the footprints spaced at regular intervals, wherein one step is made with each audible signal.

2. The method of claim 1, wherein the step of generating the banner further comprises:

providing a person's actual mass in kilograms; and

determining the stride length based upon the following equation:

$$L=(M/W)*T$$

where L is the stride length in meters, M is a constant of approximately 50.91, W is the mass of the person in kilograms, and T is the period of the audible signal in seconds, and

wherein the footprints on the banner are spaced at the stride length.

3. The method of claim 2, wherein the audible signal is a beep and the period of the audible signal is one second.

4. A training method for a person comprising the steps of:

generating an audible signal having a fixed period;

generating a banner having regularly spaced indicia for identifying preferred step locations, wherein the distance between adjacent indicia is determined by the following formula:

$$L=(M/W)*T$$

where the distance between adjacent indicia in meters is L, a constant of 50.9095736 is equal to M, the person's mass in kilograms is W, and the fixed period in seconds is T; and

walking on the marked path by stepping upon each of the regularly spaced indicia wherein one step is made with each period of the audible signal.

5. The training method of claim 4 wherein the fixed period is one second.

6. The training method of claim 5, wherein the regularly spaced indicia are footprints.

* * * * *

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(54) BOBBIN ELECTROMAGNETIC FIELD PROPULSION VEHICLE

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(52) **U.S. Cl.** **244/166**

(57) **ABSTRACT**

This invention relates to a spacecraft which generates its own magnetic moment and magnetic field gradient in order to produce lift on the hull. The magnetic moment is generated by a large area solenoid located in the hull. A toroidal core wrapped with electrical bobbins at intervals along said core produces a traveling magnetic wave along its surface. This magnetic wave creates a spacetime curvature, similar to a tilted plate, which causes the formation of a magnetic field gradient. Power is not critical because the system uses a magnetic vortex wormhole generator to lower the speed of light in order to efficiently create highly relativistic fields due to Lorentz transformation.

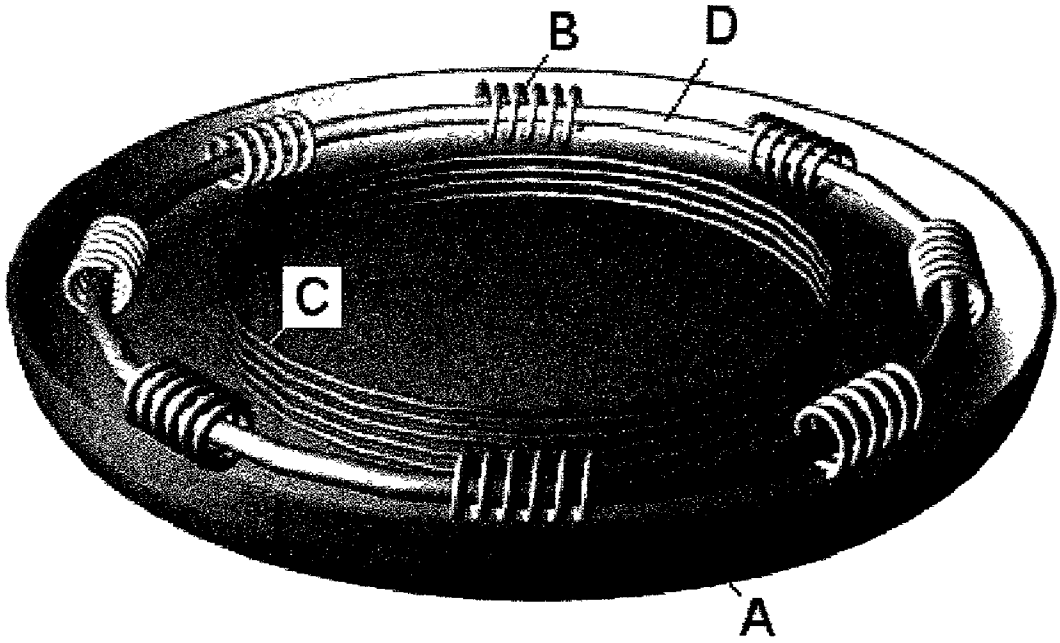

Figure 1

$$\text{Force} = \mu \cdot \frac{\partial B_z}{\partial z} = \text{amp} \cdot \text{m}^2 \frac{\text{kg}}{\text{sec} \cdot \text{coul} \cdot \text{m}} = \frac{\text{coul}}{\text{sec}} \cdot \text{m}^2 \cdot \frac{\text{kg}}{\text{sec} \cdot \text{coul} \cdot \text{m}} = \frac{\text{kg} \cdot \text{m}}{\text{sec}^2} = \text{newton}$$

Figure 2

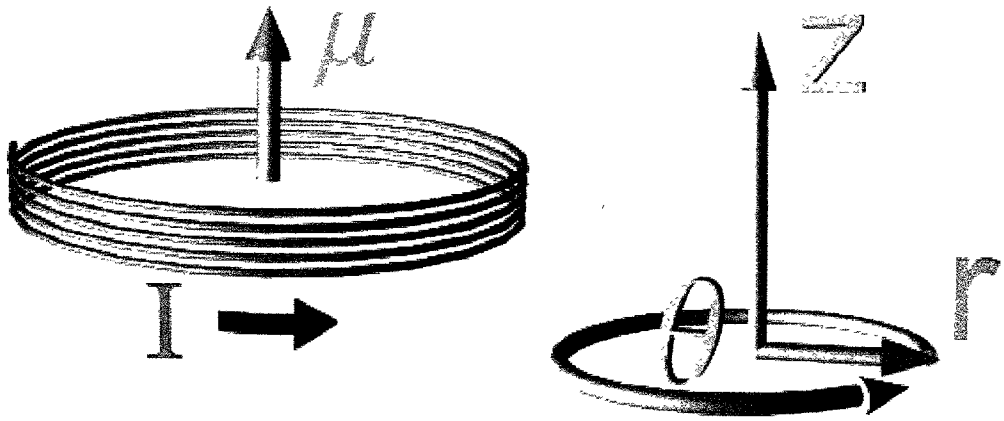

Figure 3

$$B_Z = \mu n I$$

Figure 4

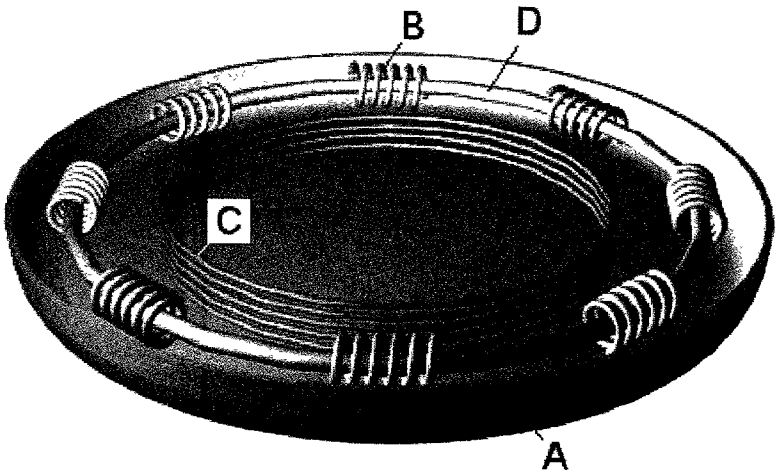

Figure 5

$$v = \sqrt{\frac{\omega}{\sigma\mu}}$$

Figure 6

$$g_{\alpha\phi} = \begin{array}{c} \\ t \\ r \\ \theta \\ z \end{array} \begin{array}{c} \begin{array}{cccc} t & r & \theta & z \end{array} \\ \begin{vmatrix} -1 & 0 & \mathrm{Sin}[\theta - t] & 0 \\ 00 & 1 & 0 & 0 \\ \mathrm{Sin}[\theta - t] & 0 & r^2 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} \end{array}$$

Figure 7

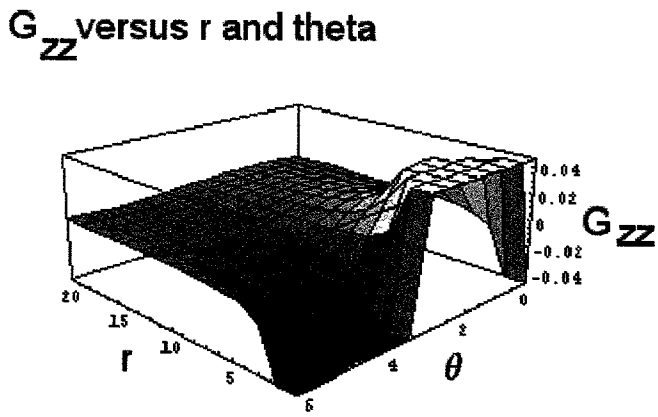

Figure 8

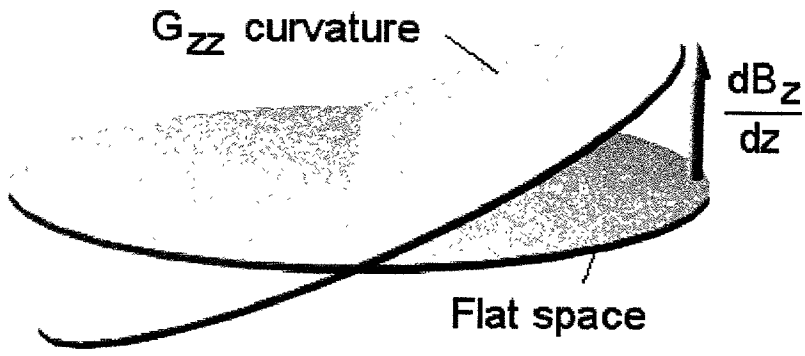

BOBBIN ELECTROMAGNETIC FIELD PROPULSION VEHICLE

BRIEF SUMMARY OF THE INVENTION

[0001] This invention, which is the subject of my present application, is comprised of a toroidal core around which are wound a plurality of electromagnetic bobbins. The bobbins are pulsed electrically to create an amplified magnetic wave that travels around the core. At the same time, a circular electrical conductor carrying direct current creates a magnetic field around its area which results in the formation of a magnetic moment. This magnetic moment, together with the spacetime curvature distortion created by the traveling magnetic wave, produces a lift force on the vehicle.

REFERENCE PAPERS

[0002] Levitron, Hones, U.S. Pat. No. 5,404,062.

[0003] *Geometry of Electromagnetic Systems,* Paul Hammond, page 179.

BACKGROUND OF THE INVENTION

[0004] The idea for this invention comes from experiments I have done using thin transformer laminations wound in intervals with bobbins of wire connected to a frequency generator. Pulsing the bobbins electrically creates a slow traveling magnetic wave along the surface of the lamination. The velocity of the wave, as shown by Hammond in the reference paper, is the square root of the frequency divided by the conductivity and permeability of the material. From Einstein's General Theory of Relativity, this type of wave around the circumference creates a spacetime curvature distortion in the vertical direction that looks like a tilted plate. The magnetic field traveling around the circumference has to follow this curvature. This creates a magnetic gradient in the z-direction which together with the magnetic moment developed by a solenoid produces lift on the vehicle.

SUMMARY OF THE INVENTION

[0005] It is the object of this invention to create a magnetic field gradient and magnetic moment in order to produce a lift force on the hull of a vehicle. The magnetic field gradient is produced by a traveling magnetic wave which produces a tilting-plate spacetime curvature around the hull. The magnetic moment is created by a simple circular wire carrying direct current around its area.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0006] Not Applicable.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0007] **FIG. 1**. The lift force on the vehicle is equal to a magnetic moment times the magnetic field gradient.

[0008] **FIG. 2**. Magnetic moment μ created by direct current I flowing counterclockwise around the wire coil. Cylindrical coordinates are shown to the right.

[0009] **FIG. 3**. The wire coil solenoid creates a magnetic field in the z-direction equal to the permeability of space times the number of turns per length of the solenoid times the current in the windings.

[0010] **FIG. 4**. Perspective view of bobbin spacecraft.

[0011] **FIG. 5**. Magnetic wave velocity along core.

[0012] **FIG. 6**. The g metric tensor in cylindrical coordinates with the sinusoidal wave function in the $\{t,\theta\}$ slots.

[0013] **FIG. 7**. The spacetime curvature G_{zz} in the vertical direction created by the magnetic wave traveling around the core.

[0014] **FIG. 8**. Tilted plate spacetime curvature showing magnetic gradient.

DETAILED DESCRIPTION OF THE INVENTION

[0015] 1. Referring to the equation in **FIG. 1**, the lift force on the bobbin spacecraft is equal to its magnetic moment times its magnetic field gradient. The magnetic moment has units of electrical current, measured in amps, times the area enclosed by the current. Thus the units of the magnetic moment are amp–m^2. The magnetic moment can be created by a large, circular coil of wire carrying direct current I as shown in **FIG. 2**. The spacetime cylindrical coordinates $\{t, r, \theta, z\}$ are shown to the right of the drawing where t is time, r the radius, the horizontal angle θ, and the vertical height z.

[0016] 2. The wire coil solenoid also produces a magnetic field in the vertical z-direction equal to the permeability of space μ times the number of turns per unit length of the solenoid n, times the current I in the winding. The equation is shown in **FIG. 3** which can be developed from Ampere's law that the magnetic field around a loop is equal to the current passing through the loop.

[0017] 3. Referring to **FIG. 4**, the bobbin spacecraft consists of a large, horizontal, highpermeability toroidal core (D) wrapped at intervals with electrical bobbins (B) which can be pulsed electrically to create a traveling magnetic wave around the core. Interior to this core is a large direct current solenoid (C) which produces said magnetic field in the z-direction. These devices are enclosed in a circular hull (A) containing the coils on the outer rim and a cabin area in the center.

[0018] 4. Referring to **FIG. 5**, the velocity of the magnetic wave on the surface of the core is equal to the square root of the wave frequency ω divided by the conductivity a times the permeability μ of the core material. When the first bobbin is pulsed, a wave starts to propagate along the surface of the core. As the wave passes the second bobbin in sequence, another electrical pulse is generated to amplify the wave. After many cycles, the wave traveling around the core becomes larger and larger in amplitude.

[0019] 5. A traveling wave has a wave function equal to a sinusoidal function with an argument of the angle θ around the periphery less the time t, or $\mathrm{Sin}[\theta-\omega t]$.

[0020] 6. In gravitational physics, there is a g metric tensor which is a measure of length in spacetime coordinates. When mass or electromagnetic fields are involved in a certain region of space, a curvature of space is created. The curvature of space can then be calculated directly from this metric tensor. The result is Einstein's G curvature tensor which shows the spacetime distortion. The g metric tensor is a 4 by 4 matrix having rows and columns equal to time t,

radius r, angle theta, and vertical height z. The diagonal from top left to bottom right has a signature equal to $\{-1, 1, r^2, 1\}$.

[**0021**] 7. Because the magnetic wave traveling around the core is varying with time t in the theta direction, the wave function has to go into the $\{t,\theta\}$ and $\{\theta,t\}$ slots of the metric tensor, as shown in **FIG. 6**.

[**0022**] 8. From this metric tensor, Einstein's G curvature tensor is calculated using a general relativity software program. The spacetime curvature in the vertical z-direction is contained in the G_{zz} component. A 3D plot of this curvature with respect to radius and theta is shown in **FIG. 7**. The axis on the right side is the angle around the periphery, and the axis on the left is the radius which goes from 0 to 20 meters. The vertical axis of the graph is the spacetime curvature in the vertical z-direction. The center of the vertical axis is zero. At a small radius, there is a sinusoidal curvature which is positive from 0 to π and which is negative from π to 2π. What this looks like is a tilted plate as depicted in **FIG. 8**.

[**0023**] 9. In flat spacetime with no electromagnetic fields or mass, the curvature would be the horizontal plate as seen **FIG. 8**. Due to the traveling magnetic wave, the spacetime curvature looks like the tilted plate. The flat-space magnetic field was pointing up in the vertical direction, having no divergence and no gradient. In curved spacetime, however, the magnetic field becomes tilted just like the plate and a magnetic gradient dB_z/dz is created. This spacetime curvature gradient of the magnetic field times the magnetic moment of the second coil produces a lift force on the hull which is anchored to these coils.

What I claim as my invention is:

1. A spacecraft that generates a magnetic moment and a magnetic field gradient in the vertical direction in order to create a lift force on the hull.

2. A toroidal core wrapped with electrical bobbins at intervals around the core whose purpose is to create and amplify a magnetic wave that travels along the surface of the core.

3. A circular, direct-current carrying solenoid, located radially inside the toroidal core, to create the magnetic moment.

4. Said magnetic surface wave creates a spacetime curvature, similar to a tilted plate, which produces a magnetic field gradient in the vertical direction.

5. A circular hull, with interior cabin, electrical power supply to drive the coils, and a computer to calculate and sequence the activation of the electrical bobbins.

6. Magnetic sensors, in the form of small coils, located on the toroidal core which can detect the velocity and position of the traveling magnetic wave as feedback to the computer control system.

7. A magnetic vortex generator, either rotating magnet or dual coil, to produce a wormhole through which low linear mass and low speed of light hyperspace energy can enter the hull in order to create highly relativistic electromagnetic fields.

8. A variable current generator to modulate the direct current in the coil so as to produce a variable magnetic moment that can control lift, hover and descent.

9. An electrical power supply using mechanical flywheel stored energy together with a large area capacitor, resupplied with energy by solar cells located on the outer surface of the hull.

* * * * *

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(19) United States

(12) Patent Application Publication

St. Clair

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(54) HYPERSPACE ENERGY GENERATOR

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Publication Classification

(51) **Int. Cl.**[7] **H01P 3/06**

(52) **U.S. Cl.** **333/243**

(57) **ABSTRACT**

This invention is a braided gold wire coaxial cable of micron size which generates hyperspace energy by coupling to the tetrahedral geometry of subspace, dimension and the Planck mass.

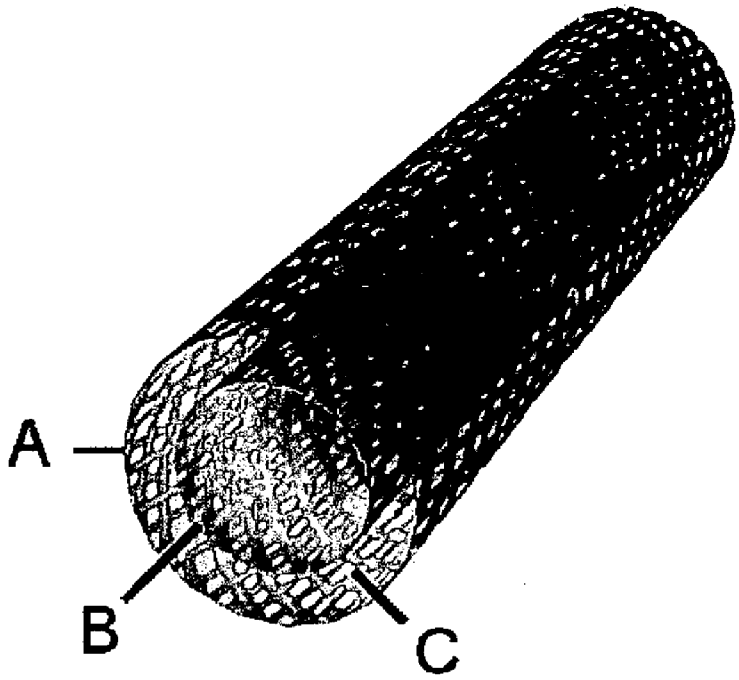

Figure 1

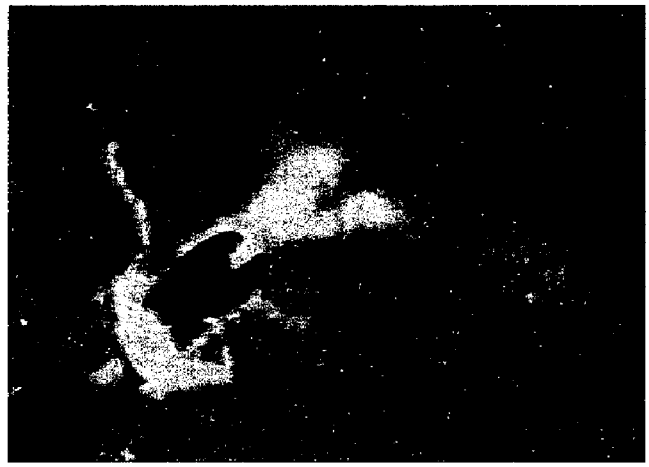

Figure 2

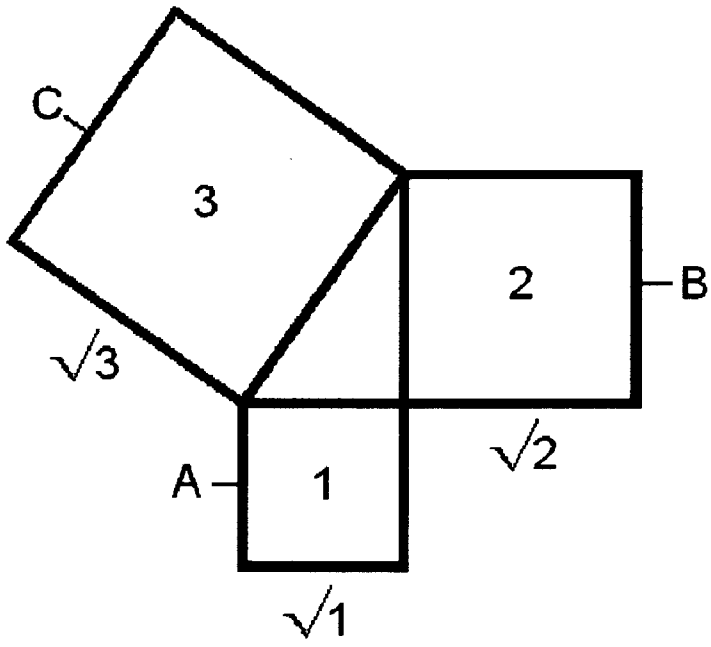

Figure 3

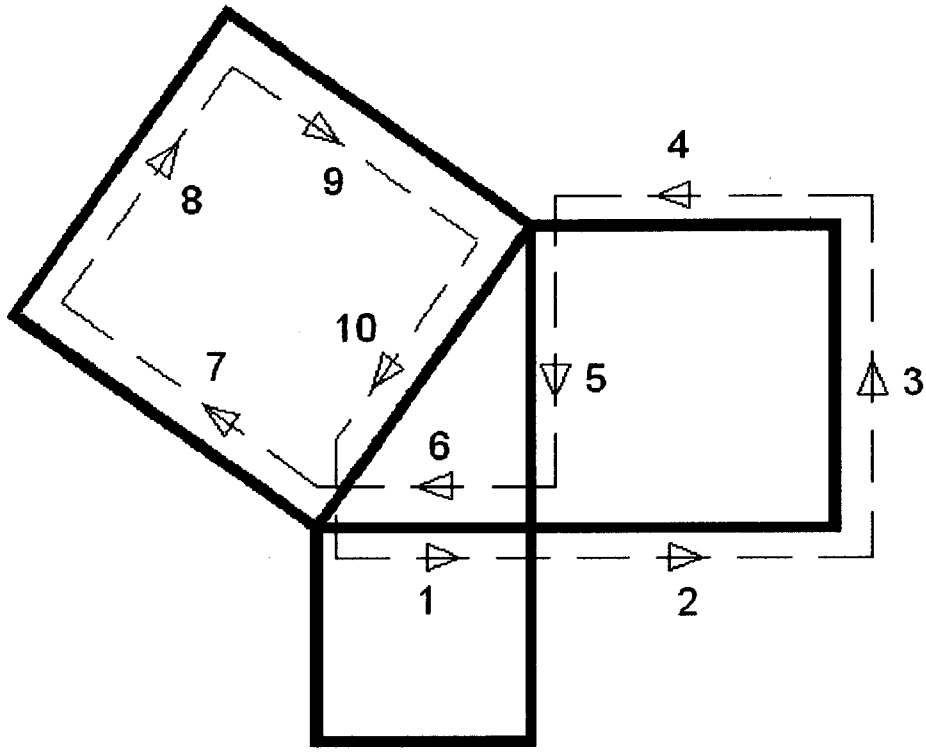

Figure 4

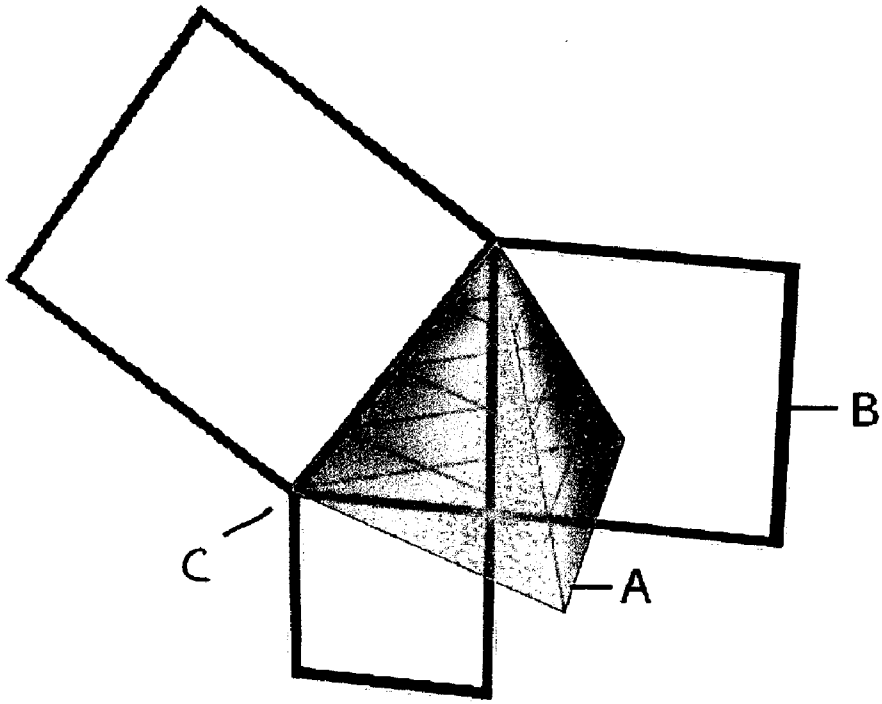

Figure 5

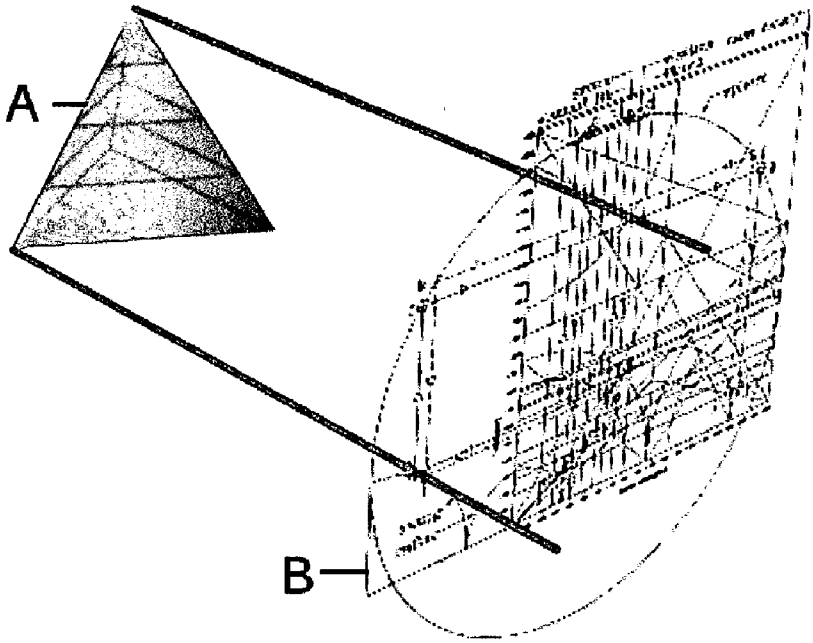

Figure 6

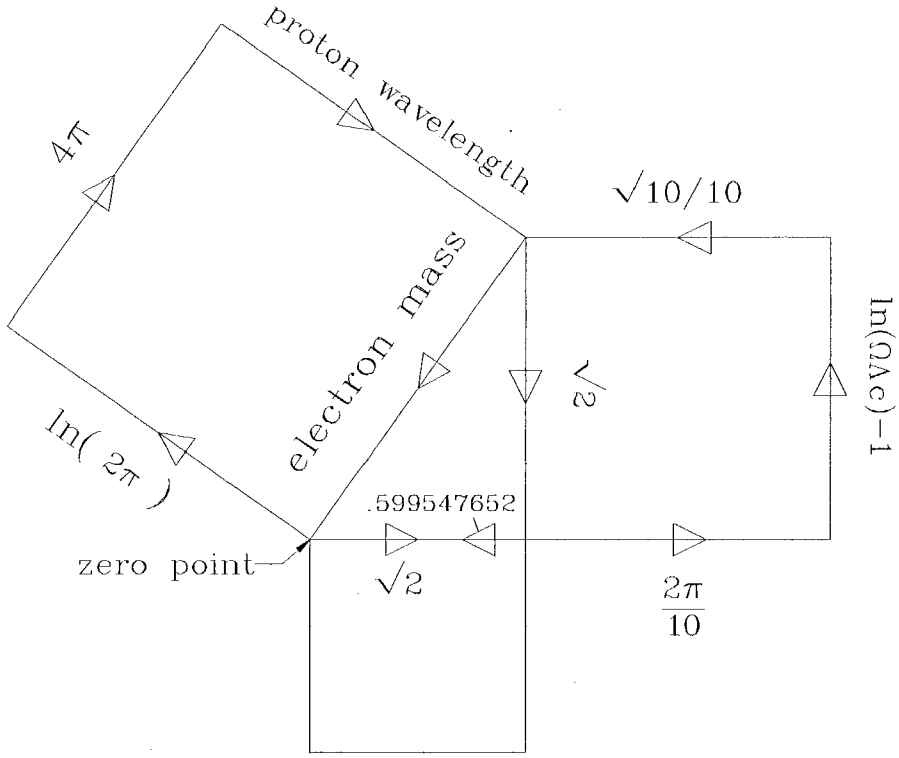
ln(ΩΛc)−1
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zero point
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Figure 7

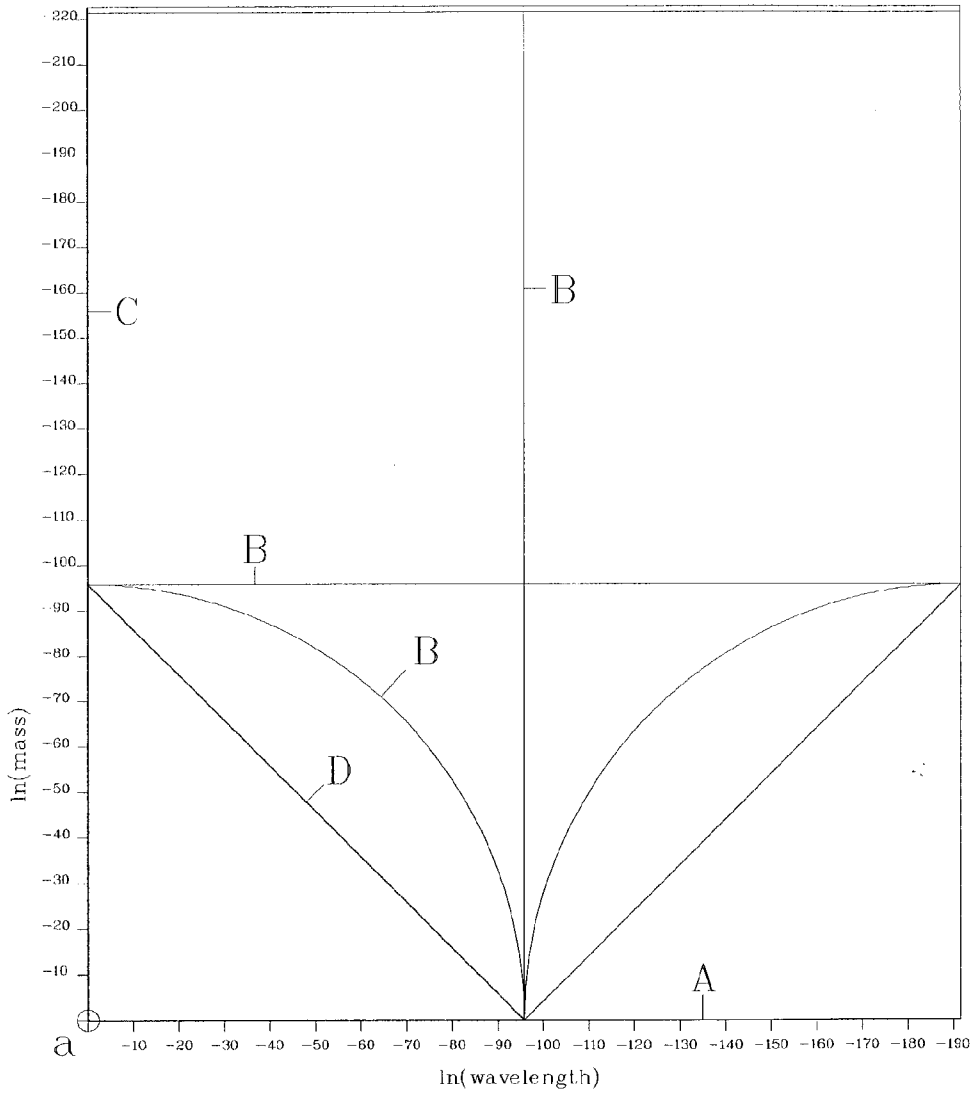

Figure 8

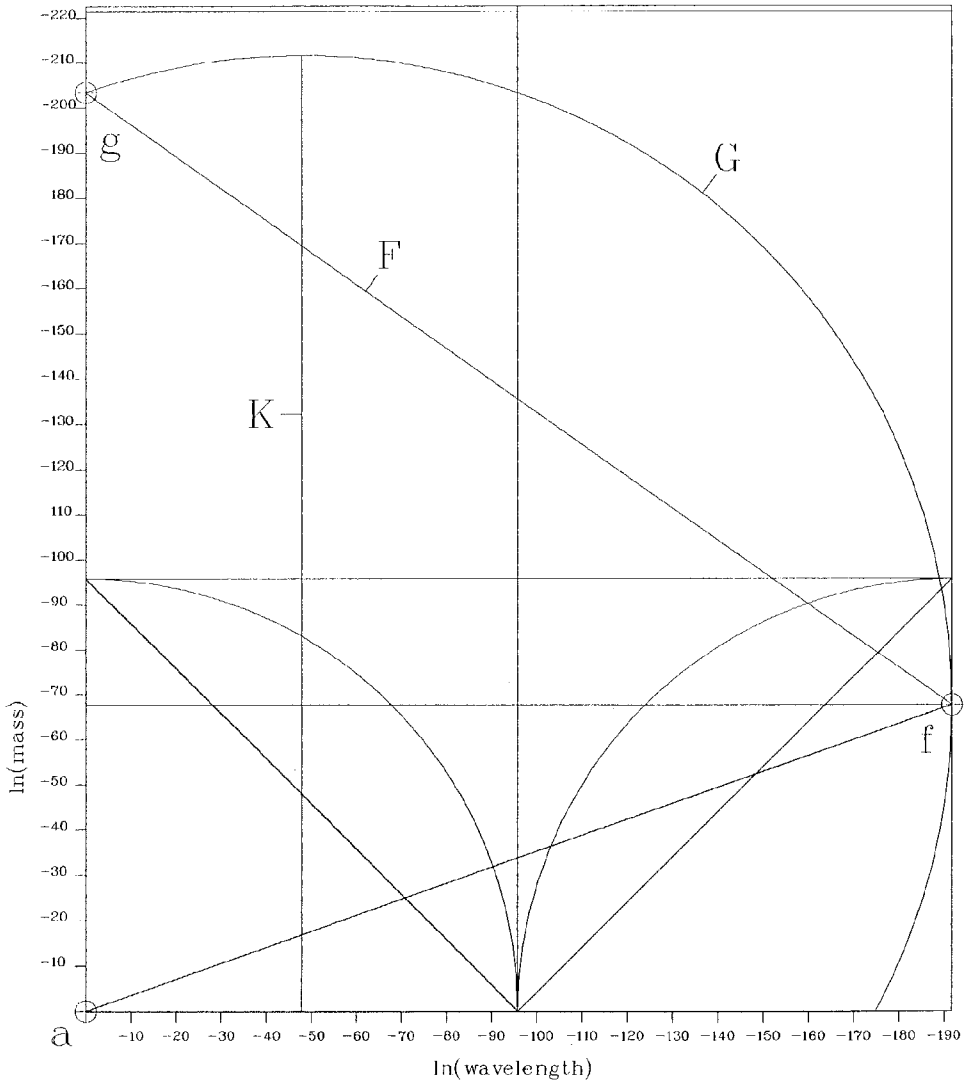
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Figure 9

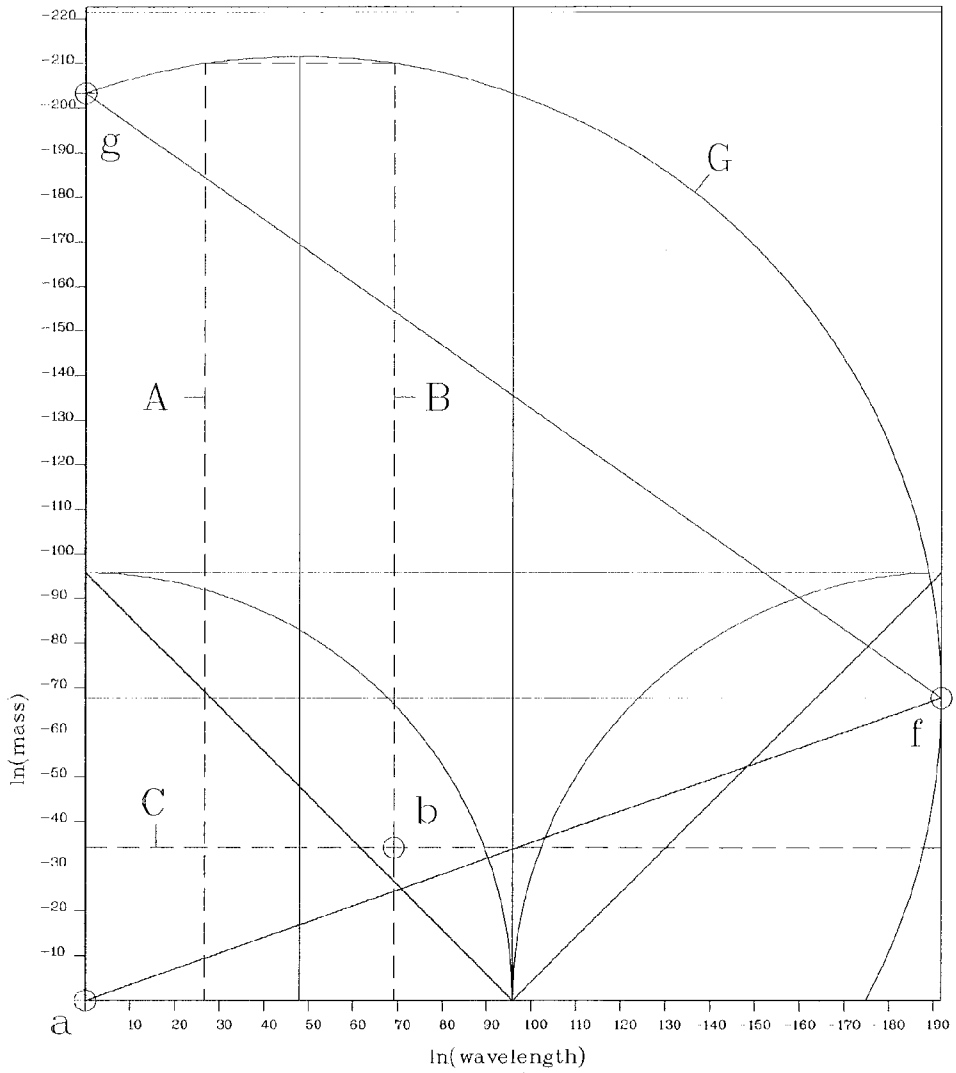
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Figure 10

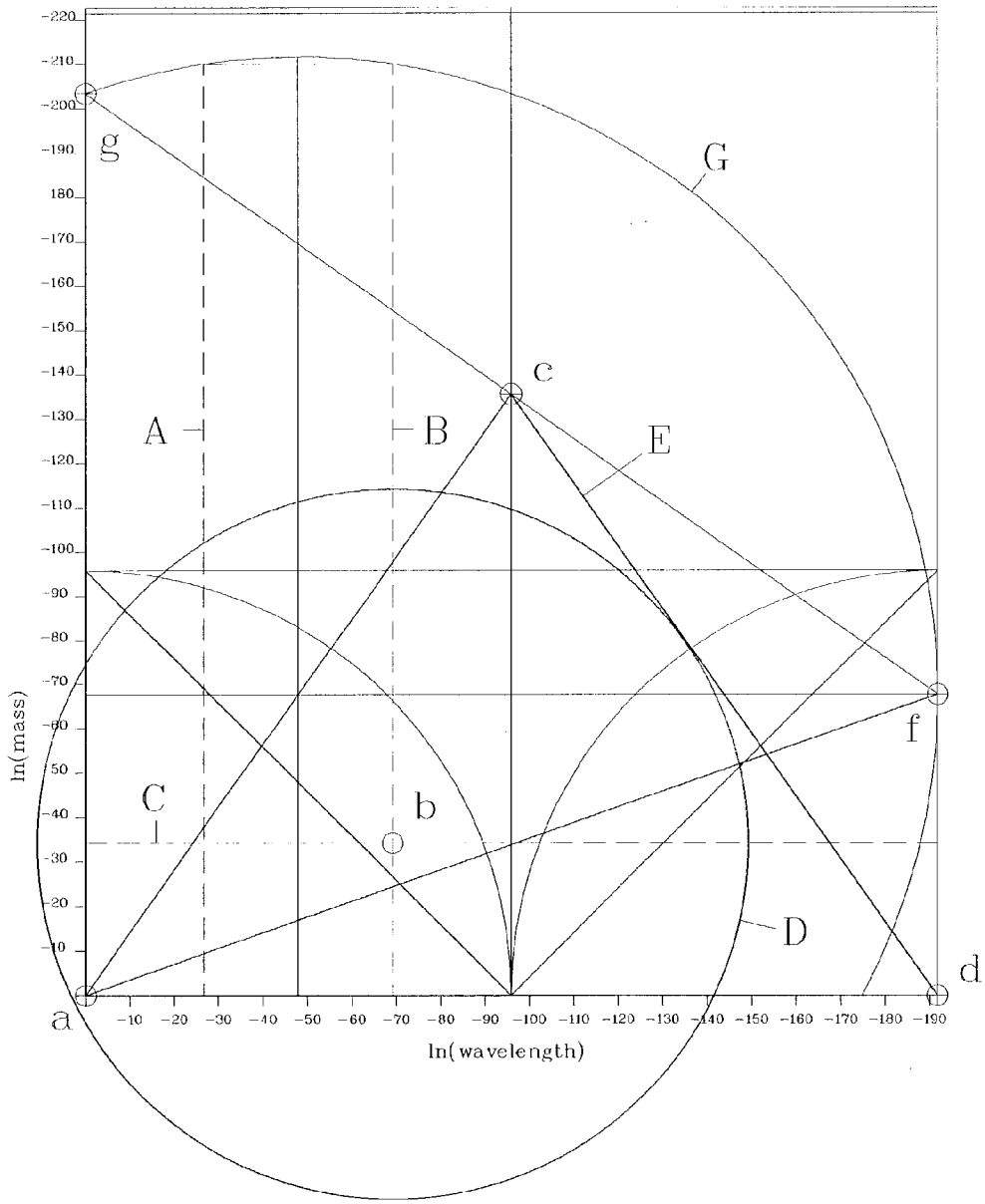
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Figure 11

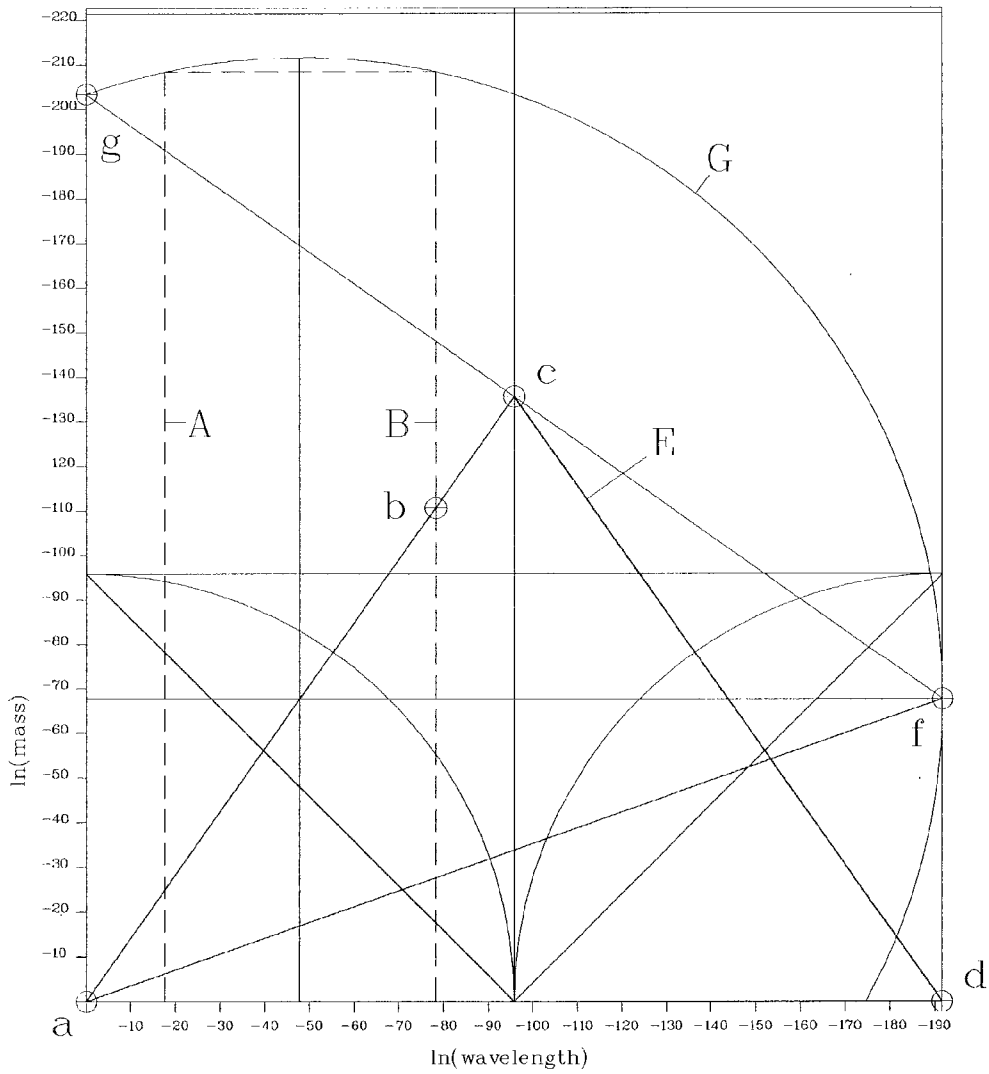
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Figure 12

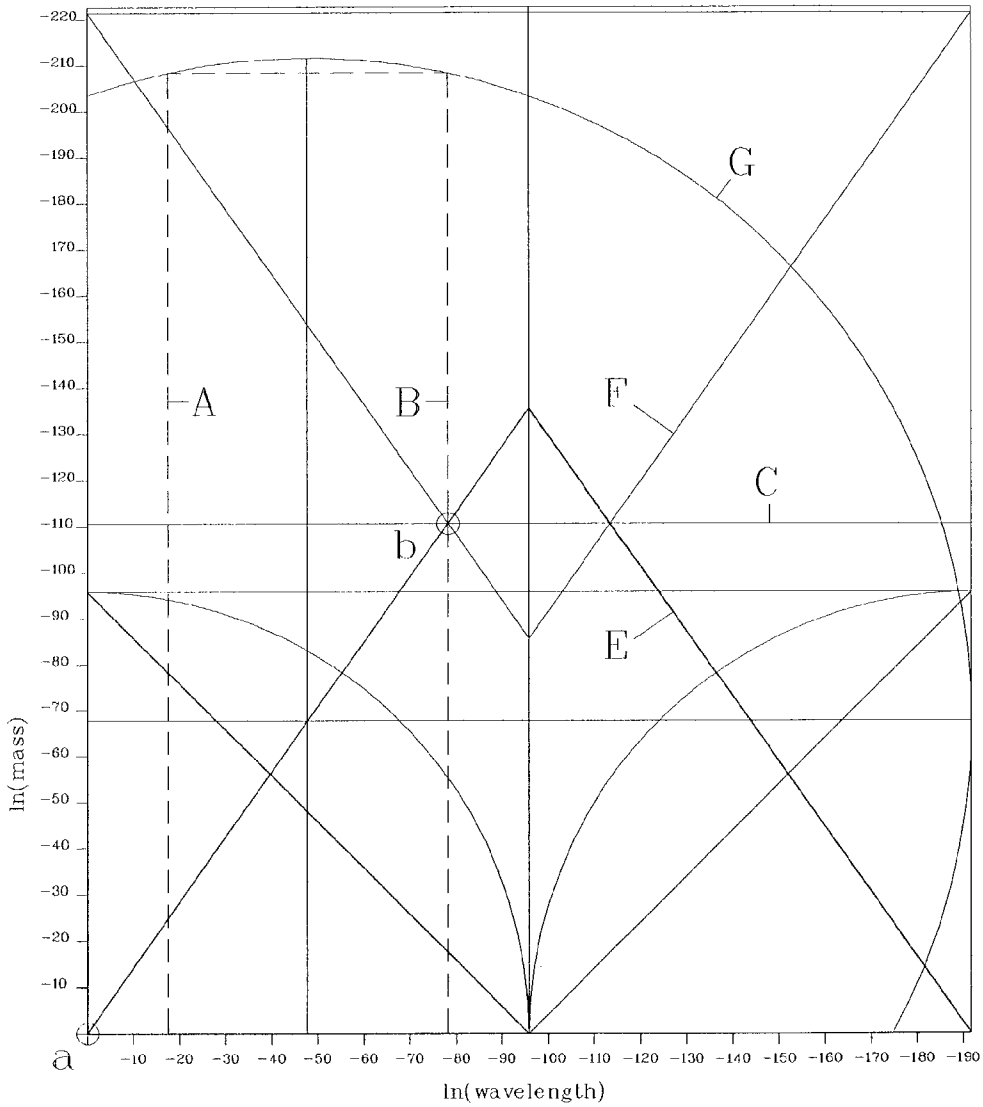
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Figure 13

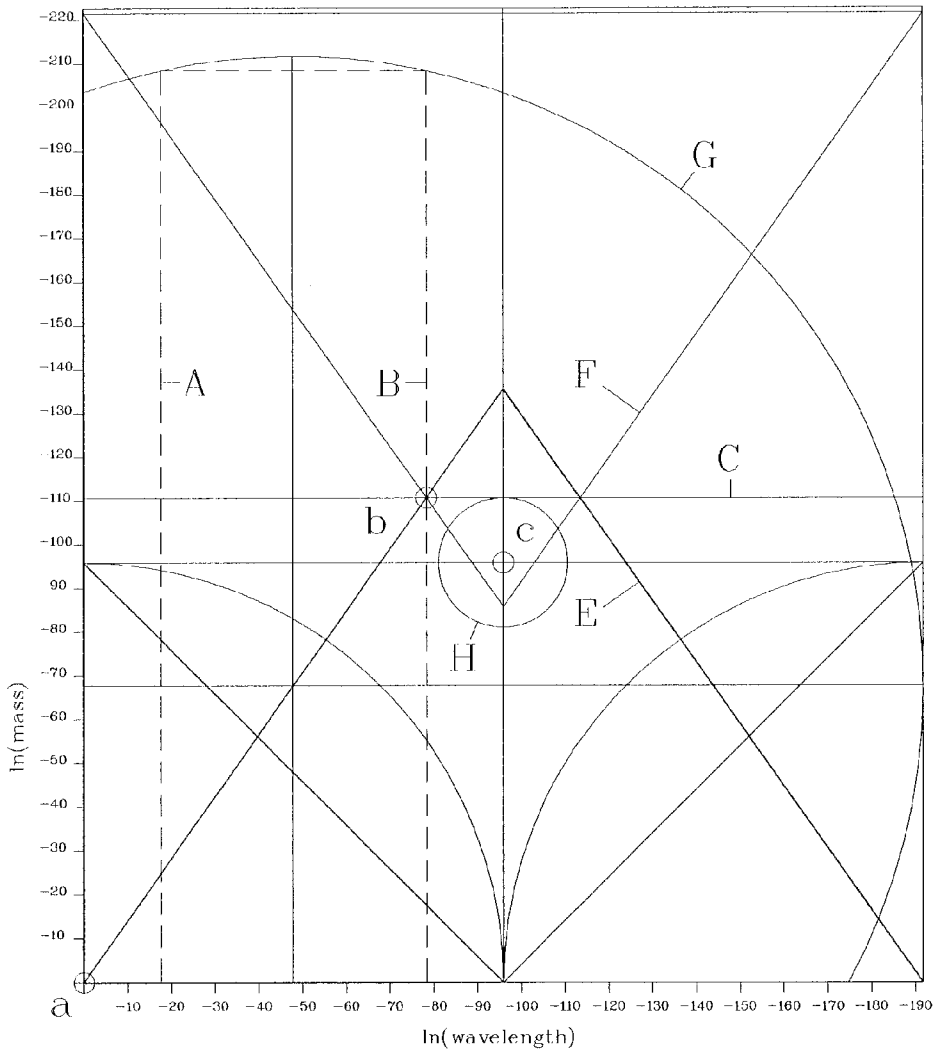
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Figure 14

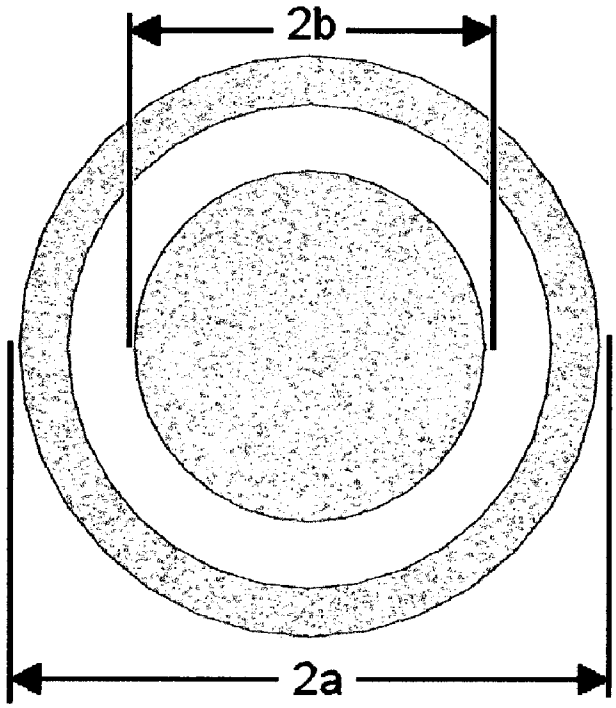

Figure 15

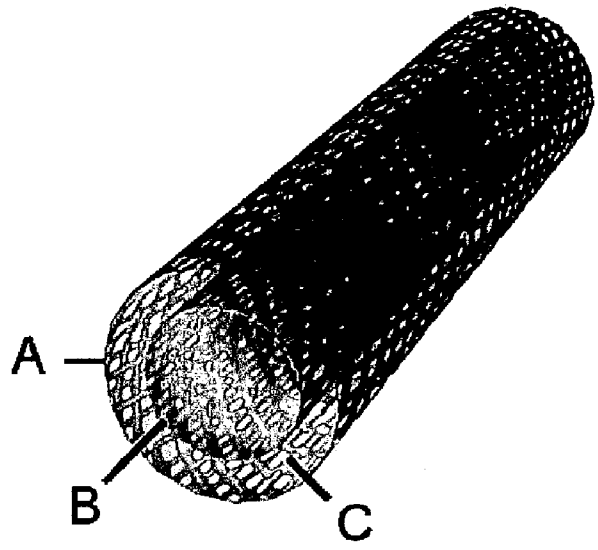

HYPERSPACE ENERGY GENERATOR

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a braided gold wire coaxial cable of micron size which generates hyperspace energy.

BACKGROUND OF THE INVENTION

[0002] Electrical experiments with micron-sized braided gold wire coaxial cable show that it is capable of generating substantial amounts of hyperspace energy. Referring to the electron microscope photograph shown in **FIG. 1**, the white mist emanating from the cable is low-density hyperspace energy that is flowing in from a co-dimension of our universe. The dimensions of the cable are of such a particular size as to couple the cable to the tetrahedral geometry of subspace, the dimension of space, the Planck mass and the linear inductance of the universe.

[0003] According to physicist Dr. Edward Witten of Princeton University, space has twenty-four dimensions, of which ten dimensions are non-redundant. Imagine taking a path around the Pythagorean triangle, as known as the planar tetrahedron, with sides equal to $\{\sqrt{1}, \sqrt{2}, \sqrt{3}\}$ as shown in **FIG. 2**. There are three squares denoted the one-square (A), the two-square (B) and the three-square (C). Each square has four sides. The edge of each square can be traversed in two directions. Thus the total number of dimensions is

$$dim_{total}=2\cdot(4+4+4)=24$$

[0004] Referring to **FIG. 3**, there is a path starting at the corner of the triangle, along the one-square **(1)**, around the two-square **(2,3,4,5)**, back along the one-square **(6)**, around the three-square **(7,8,9,10)** and back to the corner of the triangle. The numbering of the edges shows that there are ten edges. Because the path is traversed in only one direction, the number of reduced dimensions is

$$dim_{reduced}=1\cdot(10)=10$$

[0005] Referring to **FIG. 4**, the planar tetrahedron (B) forms one edge of the three-dimensional tetrahedron (A). Rotating the planar tetrahedron ±120° produces the other two edges. The tetrahedron has four faces which are equilateral triangles. The ten dimensional path starts and ends at (C), the corner of the tetrahedron known as the zero point.

[0006] Referring to **FIG. 5**, the projection of the 3D tetrahedron (A) onto a plane is called the tetrahedron diagram (B) which is the main diagram of the new geometrical physics known as Δphysics. All the constants of physics can be derived geometrically from the tetrahedron diagram and its associated planar tetrahedron. An example of this is shown in **FIG. 6** where the edges are given specific constants related to tetrahedral geometry, dimension, curvature, and the mass and wavelength of the elementary particles such as the electron and proton. The ten dimensional path includes the following constants

[0007] a. electron wavelength

[0008] b. proton wavelength

[0009] c. 47π The solid angle of the sphere. The tetrahedron is circumscribed by a sphere.

[0010] d. ln(2π) The natural log of the curvature. The subspace geometry is a logarithmic manifold. The tetrahedron diagram plots the logarithm of mass versus the logarithm of wavelength.

[0011] e. 0.599547652 A constant related to fractal dimension and the speed of light factor 2.99792458.

[0012] f. $\sqrt{2}$ The edge of the two-square.

[0013] g. $\sqrt{10}/10$ The square root of ten dimensions per 10 dimensions.

[0014] h. ln(ΩΛc)−1 The natural log of the momentum of space less one.

[0015] i.

$$\frac{2\pi}{10}$$

[0016] The curvature of space per 10 dimensions.

[0017] j. $\sqrt{2}$ The edge of the two-square.

[0018] The length of each edge is multiplied by the constant assigned to that edge. The ten edges have the order of $\{\sqrt{1}, \sqrt{2}, \sqrt{2}, \sqrt{2}, \sqrt{1}, \sqrt{3}, \sqrt{3}, \sqrt{3}, \sqrt{3}\}$. What subspace geometry does is to multiply the edge length, such as $\sqrt{1}$, times the square root of two $\sqrt{2}$. Then it takes the square root of that number and multiplies it by the next edge, which is $\sqrt{2}$, times the curvature per 10 dimensions

$$\frac{2\pi}{10}.$$

[0019] It then takes the square root of that number and so on. In equation form, this looks like the following calculation

$$\sqrt{3a\sqrt{3b\sqrt{3c\sqrt{3d\sqrt{1e\sqrt{2f\sqrt{2g\sqrt{2h\sqrt{2i\sqrt{1j}}}}}}}}}}} = 80.1104395$$

[0020] where the letters correspond to those in the list of constants. The square root sum total is equal to the Planck scale Λwhich is the bottom dimensional limit of the universe. The sum of the ten constants per a speed of light circumference is equal to unity

$$\frac{\sum_{n=10} s_n}{2\pi\ln(c)} = 1.000000000$$

[0021] where the log of the speed of light is

$$\ln(c)=\ln(299792458)=19.51860099$$

[0022] and multiplying by 2π is the circumference of a circle with a radius equal to the speed of light.

[0023] Referring to **FIG. 7**, the tetrahedron diagram plots the natural logarithm of mass on the vertical axis (C) versus the natural logarithm of wavelength on the horizontal axis (A). The reason for this is that the mass of the electron times its wavelength is equal to the mass of the proton times its wavelength which in turn is equal to Planck's constant h divided by the speed of light, known as the base constant (B). If two numbers multiply, they sum in logarithms. In subspace geometry, the sum of the logarithm of the mass of the electron plus the logarithm of the wavelength is equal to the logarithm of the base constant which has a value of −95.91546344.

$$\ln(m_{electron}) + \ln(\lambda_{electron}) = \ln\left(\frac{h}{c}\right) = -95.91546344$$

[0024] What this means is that the mass and wavelength slide on a 45° base line (D) which has end points on the vertical and horizontal axes equal to the base constant.

[0025] Referring to **FIG. 8, a** line (af) drawn from the origin at the tetrahedral angle of 19.47122063, equal to the asin(⅓), creates a tetrahedron (F) along path (afg). This tetrahedron is circumscribed by a sphere (G) with sphere diameter (K).

[0026] The Planck scale path calculation showed that the electron mass and the proton wavelength were the last two edges. The electron mass has a value of

$$\ln(m_e) = -69.17083217$$

[0027] and the electron wavelength has a value of

$$\ln(\lambda_E) = -26.74463127$$

[0028] Referring to **FIG. 9**, the electron wavelength (A) is plotted as a vertical line on the tetrahedron diagram. The wavelength reflects off the circumscribing sphere (G), and returns as the electron mass (B). So the diagram incorporates the concepts of both classical physics (point mass particles) and quantum mechanics (wave particles).

[0029] The proton wavelength has a value of

$$\ln(\lambda_p) = -34.26005901$$

[0030] The proton wavelength (C) is plotted as a horizontal line in order to get the intersection (b) with the electron mass.

[0031] Referring to **FIG. 10, a** circle (D) with a radius equal to the Planck scale is drawn centered (b) on the intersection of the electron mass with the proton wavelength, which are the last two edges of the Planck scale calculation. A line (ac) from the origin to the intersection of the base constant with the rotated tetrahedron creates the vertical tetrahedron (acd). As can be seen, the Planck scale is tangent to the tetrahedron on side (cd). This tetrahedron is the projection of the 3D tetrahedron shown before in **FIG. 5**. What this means is that the tetrahedral geometry of subspace determines the bottom limit of our universe. And this bottom limit, called the Planck scale, contains within itself the mass and wavelength of the elementary particles, curvature, dimension and planar tetrahedral geometry. Tetrahedron diagram tet0565 shows that the electron and proton are one and the same particle because the electron path rotates counterclockwise around the curvature and then returns clockwise as the proton path. This path occurs moving through space and hyperspace. Because the single particle enters our universe from hyperspace at two different positions, we see it as two distinct particles. Thus the tetrahedron diagram shows that hyperspace exists.

[0032] The speed of light is equal to the inverse of the square root of the permeability μ of space times the permittivity ϵ of space

$$c = \sqrt{\frac{1}{\mu\varepsilon}}$$

[0033] The permeability is linear inductance or inductance per length which you would find in a solenoid for example. The permittivity is linear capacitance or capacitance per length which you find in a capacitor. In an electrical circuit, the inductance and capacitance form a resonant circuit. The resonance frequency can be changed by changing the inductor or capacitor. In a similar manner, the speed of light is not constant, but can be lowered by increasing the permittivity. Hyperspace energy has a high permittivity and therefore a low speed of light. This low speed of light gives hyperspace energy a luminescent quality which is seen as a white mist (**FIG. 1**).

[0034] From Einstein's General Theory of Relativity, the stress pressure T on spacetime is proportion to the square of the ratio of the electric field E to the speed of light c.

$$T = \left(\frac{E}{c}\right)^2$$

[0035] Thus substantially lowering the speed of light creates an enormous spacetime pressure which can be used to generate the lift force on electromagnetic field propulsion vehicles. Furthermore, the electric field is subject to the Lorentz transformation

$$E = \frac{E_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

[0036] The electric field E_0 moving in a frame velocity of v, can quickly attain relativistic proportions because the speed of light could be 1 meter per second, rather than the enormous value in our universe of 299792458 meters per second. Thus one would like to permeate the hull of the electromagnetic field propulsion vehicle with this hyperspace energy in order to increase the electric field and hence the spacetime curvature around the hull which produces the enormous lift force on the vehicle. The method of bringing in this hyperspace energy is to use braided gold wire coaxial cable which is coupled to the geometry of subspace. The subspace geometry is contained in the Δphysics tetrahedron diagram.

[0037] Just as space has a linear inductance and linear capacitance, it also has a linear mass Ω or mass per meter.

Physicist Dr. John A. Wheeler of Princeton likes to invert this and call it "mom" for meter of mass. The Planck mass is equal to the Planck scale Λtimes the linear mass Ω

$$\ln(m_{\text{Plank}})=\ln(\Omega\Lambda)=-17.64290101$$

[0038] Planck's constant h is equal to 2π times the Planck scale squared times the linear mass Ω times the speed of light c.

$$h=2\pi\Lambda^2\,\Omega c=2\pi\Lambda(\Omega\Lambda)c$$

[0039] which shows that Planck's constant is actually the circumference of a circle of radius Planck scale times the Planck mass times the speed of light. The base constant is therefore

$$\text{base}=\frac{h}{c}=\frac{2\pi\Lambda(\Omega\Lambda)c}{c}=(2\pi\Lambda)(\Omega\Lambda)=-95.91546344$$

[0040] which is an area, known as the Planck box, bounded by the Planck wavelength (2πΛ) and the Planck mass. Everything outside the Planck box is hyperspace. Everything inside the Planck box is our universe. Thus the boundary between space and hyperspace is the Planck wavelength and the Planck mass. In logarithms, notice that the Planck mass and Planck wavelength, just like the electron and proton, sum to the base constant.

[0041] Referring to **FIG. 11**, the Planck mass (A) and the Planck wavelength (B) are plotted on the diagram and reflected off the sphere. The Planck wavelength intersects the tetrahedron at (b) which is the boundary between space and hyperspace known as the centerline of the diagram. The centerline has a value equal to the base times the square root of ⅔.

$$centerline=\sqrt{\frac{4}{3}}\,base=-110.7536373$$

[0042] Referring to **FIG. 12**, the centerline (C) is drawn on the diagram and the tetrahedron (E) is mirrored (F) across the centerline to indicate the co-dimensions of hyperspace.

[0043] Referring to **FIG. 13, a** circle (H), centered at the base at the base (c), tangent to the centerline (C), has a radius equal to base times the square root of 4/3 less one

$$R=\left(\sqrt{\frac{4}{3}}-1\right)base=14.83817383$$

[0044] This is the length that has to traversed in order to cross over the centerline from the base constant of our universe to the co-dimension of hyperspace. Furthermore, the Planck mass, which is the other boundary, has to be crossed in order to get to either axis as seen by the length between the vertical axis and line (A). It can be looked at also as the length needed to go from the Planck wavelength (B) to the tangent point of circle (H) in order to reach the center of the mirror tetrahedrons.

SUMMARY OF THE INVENTION

[0045] This invention is a braided gold wire coaxial cable of micron size that is coupled to the subspace geometry of the universe for the purpose of bringing in low-density hyperspace energy into our universe from the co-dimensions of hyperspace. The dimensions of the coaxial cable are of such particular size as to enable it to couple to the ten dimensions of space, the 3:1 geometrical ratio of the tetrahedron, the coaxial wave function based on the logarithm of the ratio of the outer radius to the inner radius of the cable, the length between the base constant of our universe and the centerline between mirror tetrahedrons, and the geometrical relationship between the Planck mass and the linear inductance of the cable.

[0046] Referring to **FIG. 14**, the coaxial guide has an outer braided conductor (A) and an inner braided conductor (B) in which the outer and inner conductors are at radii a and b respectively. The linear inductance L of the cable is equal to the natural logarithm of the ratio of the radii times the permeability μ of space divided by the curvature 2π

$$L=\ln\left(\frac{a}{b}\right)\frac{\mu}{2\pi}$$

[0047] It can be shown that the ratio of the area-to-volume ratio of the tetrahedron to the area-to-volume ratio of its circumscribing sphere is 3:1. It is also the ratio of the area of the three-square to the area of the one-square on the planar tetrahedron. It is also the tetrahedral angle asin(⅓) equal to 19.47122063°. It is also a maximum work condition between the velocity ratio of a fluid stream and a moving vane such as in turbomachinery. So the first constraint on the radii is

$$\exp\left(\ln\left(\frac{a}{b}\right)+1\right)\equiv 3$$

[0048] The second constraint is that the radius c of the circle, equal to the difference between the base constant and the centerline, is related to ten dimensions. The value of the radius projected into our universe is

$$c=\left(\sqrt{\frac{4}{3}}-1\right)\text{base}=.3596358547\cdot\text{microns}$$

[0049] and the dimensional constraint is

$$\left[\ln(c)+\ln\left(\frac{1}{a}\right)\right]^2=10$$

[0050] The coaxial wave function constraint is

$$\frac{\ln(a)^2}{2\pi\ln\left(\frac{a}{b}\right)} \equiv \ln(c)^2$$

[0051] The linear inductance of the coaxial cable has to be such that it gets geometrically across the Planck mass which is the second boundary of our Planck box

$$\exp\left(\ln(\Omega\Lambda) - \ln\left(\frac{\ln\left(\frac{a}{b}\right)}{2\pi}\mu\right) + 1\right) \equiv 3$$

[0052] With these four subspace constraints, the outer radius a and inner radius b of the cable are

[0053] a=8.342461828 microns

[0054] b=7.559058141 microns

[0055] so the cable has an outside diameter of roughly 16 to 17 microns.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0056] Not Applicable.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0057] **FIG. 1**. Electron microscope photograph of the coaxial cable and hyperspace mist.

[0058] **FIG. 2**. The planar tetrahedron.

[0059] **FIG. 3**. The ten dimensional path around the planar tetrahedron.

[0060] **FIG. 4**. The relationship between the planar tetrahedron and the 3D tetrahedron.

[0061] **FIG. 5**. Projection of the 3D tetrahedron onto a plane to create the tetrahedron diagram.

[0062] **FIG. 6**. Dimension, geometry, curvature and elementary particles that make up the ten dimensional Planck scale path.

[0063] **FIG. 7**. Tetrahedron diagram showing base constant.

[0064] **FIG. 8**. Tetrahedron diagram showing rotated tetrahedron and circumscribing sphere with electron mass and wavelength reflecting off sphere.

[0065] **FIG. 9**. Tetrahedron diagram showing intersection of electron mass with proton wavelength which are components of the Planck scale path.

[0066] **FIG. 10**. Tetrahedron diagram showing Planck scale tangent to tetrahedron.

[0067] **FIG. 11**. Tetrahedron diagram showing Planck mass and Planck wavelength intersecting tetrahedron.

[0068] **FIG. 12**. Tetrahedron diagram showing mirror tetrahedrons across centerline, the boundary between space and hyperspace.

[0069] **FIG. 13**. Tetrahedron diagram showing distance between the base constant and the centerline used to calculate the dimensions of the coaxial cable.

[0070] **FIG. 14**. End view of coaxial cable showing radii a and b used in the subspace geometry constraints in order to couple to hyperspace.

[0071] **FIG. 15**. Perspective view of braided gold wire coaxial cable.

DETAILED DESCRIPTION OF THE INVENTION

[0072] 1. Referring to **FIG. 15**, the coaxial cable has a braided gold wire outer conductor (A) and a braided gold wire inner conductor (B) separated by a dielectric (C). The open braiding promotes the conduction of the electromagnetic wave while allowing the hyperspace mist to seep out of the braid and permeate the surrounding material in which it is embedded.

[0073] 2. The radius of the outer conductor a and the radius of the inner conductor b have the following values in order to couple the cable to the tetrahedral geometry of subspace.

[0074] a=8.342461828·microns

[0075] b=7.559058141·microns

[0076] 3. Even though the wire size is very small, the cable can be made in limited lengths using the new nanotechnology and silicon micromotors.

I claim:

1. A coaxial cable which has:

a) a braided gold wire outer conductor of radius 8.34 microns;

b) a braided gold wire inner conductor of radius 7.56 microns;

c) a thin dielectric separator between the two conductors; and

d) an open weave to allow the hyperspace mist to seep out of the cable and permeate the surrounding material in which the cable is embedded;

2. A specific relationship between the physical dimensions of the coaxial cable, given in items (**1***a*) and (**1***b*), to the following tetrahedral subspace couplings:

a) the ratio of the area-to-volume ratio of the tetrahedron to the area-to-volume ratio of its circumscribing sphere, equal to 3:1, with a coupling to the natural logarithm of the ratio of the radii of the conductors;

b) the ratio of the area of the three-square of the planar tetrahedron to the area of the one-square, equal to 3:1, with a coupling to the Planck mass and the linear inductance of the cable;

b) the distance between the base constant and $\sqrt{4/3}$ times the base constant, equal to −14.83817383 in natural logarithms, with a coupling to the outer radius of the

conductor, the ten dimensions of space, and the co-dimensions of hyperspace; and

c) the wave function of the coaxial guide given in terms of item (**2***c*), the natural logarithm of the ratio of the radius of the outer conductor to the radius of the inner conductor, and the curvature 2π.

* * * * *

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St. Clair

(54) ELECTRIC DIPOLE MOMENT PROPULSION SYSTEM

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(57) **ABSTRACT**

A spacecraft propulsion system utilizing a rotating octagon of trapezoidal electrically charged flat panels to create an electric dipole moment that generates lift on the hull.

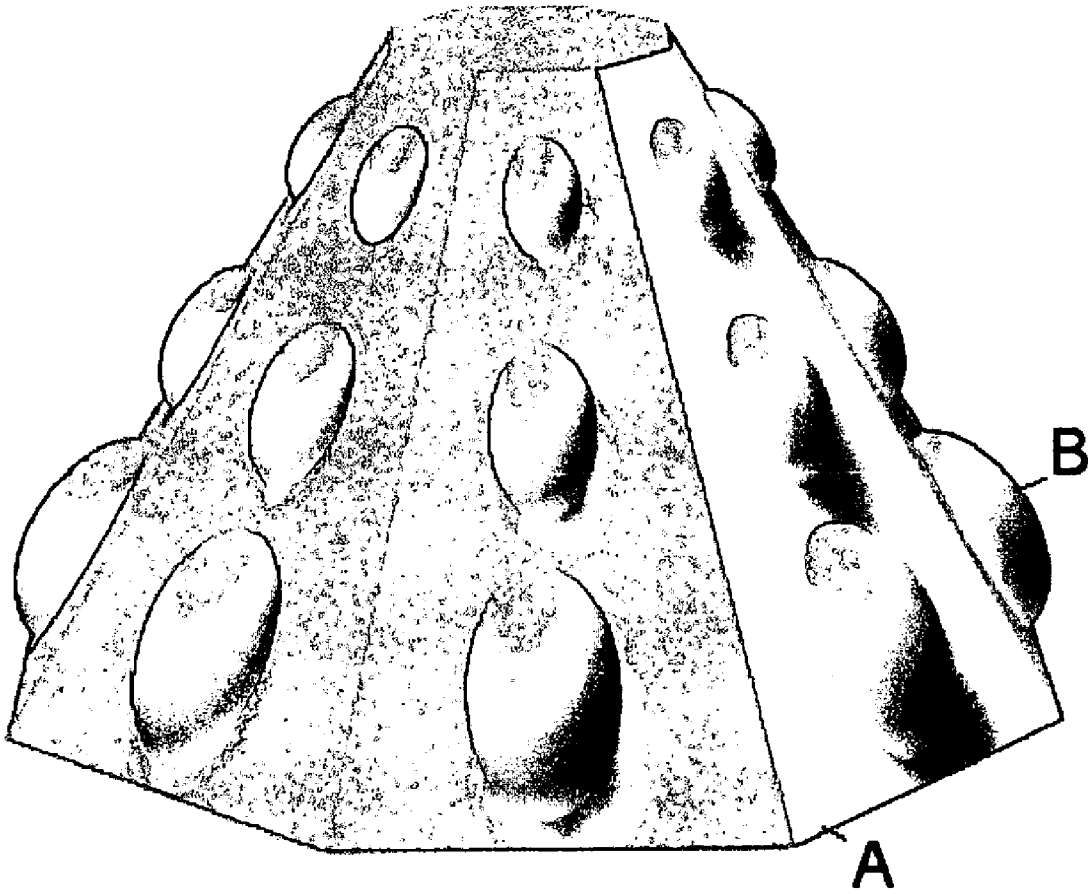

Figure 1

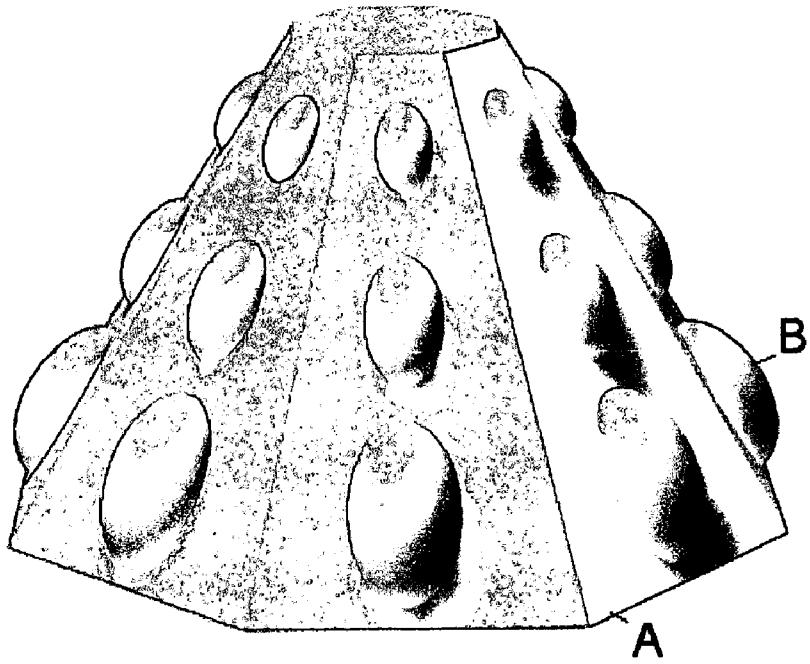

Figure 2

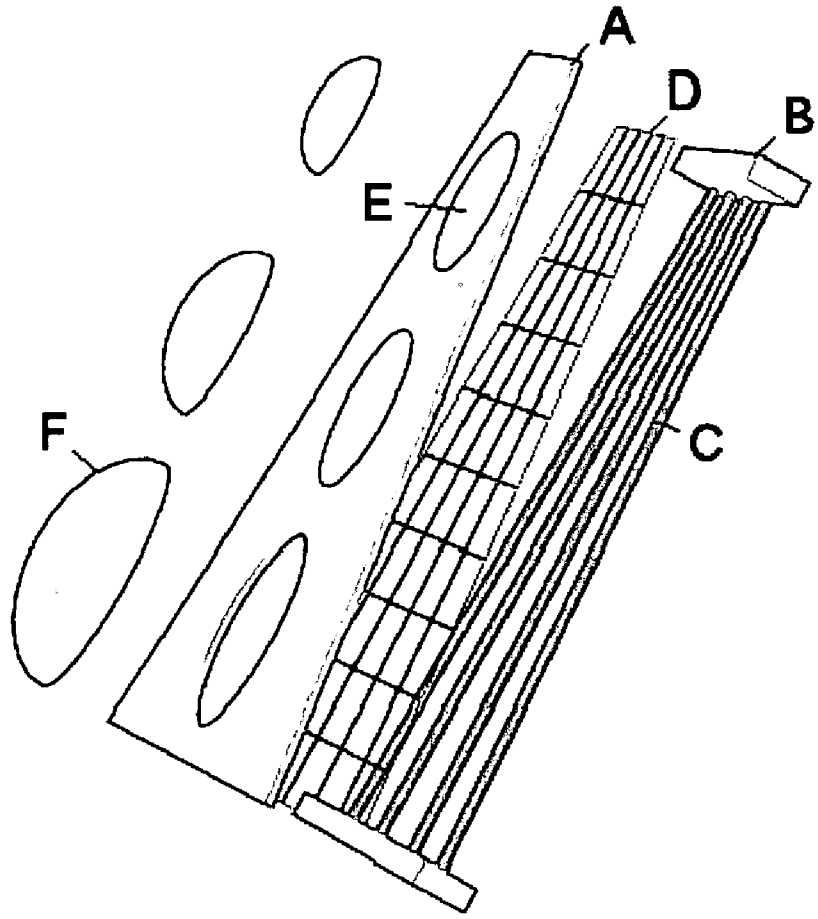

Figure 3

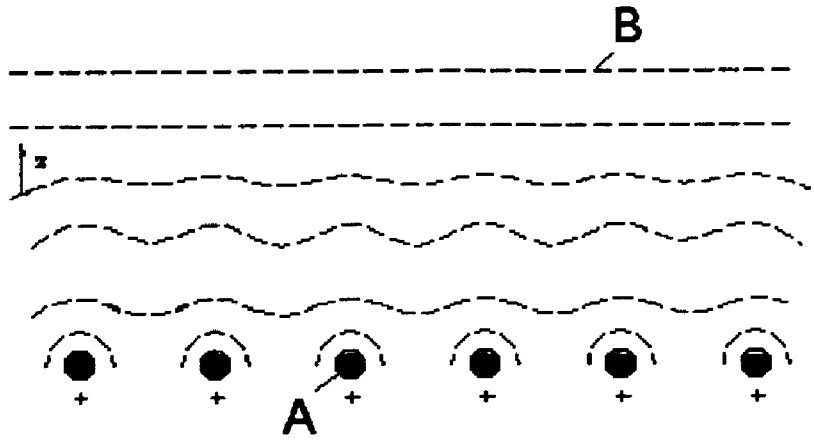

Figure 4

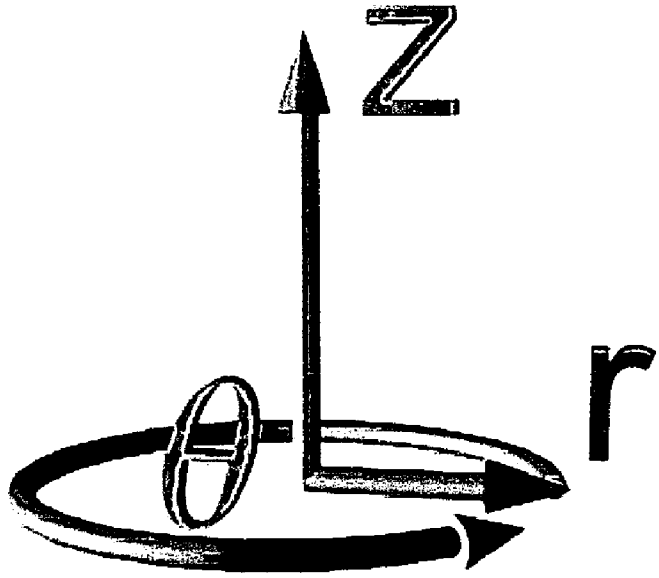

Figure 5

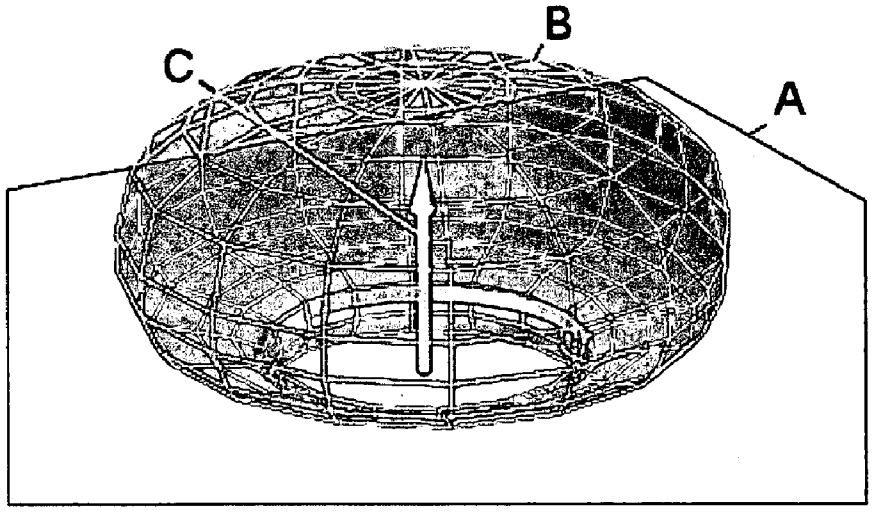

Figure 6

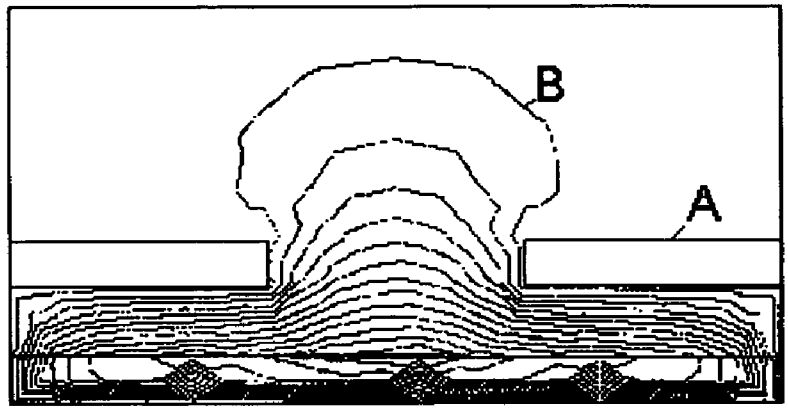

Figure 7

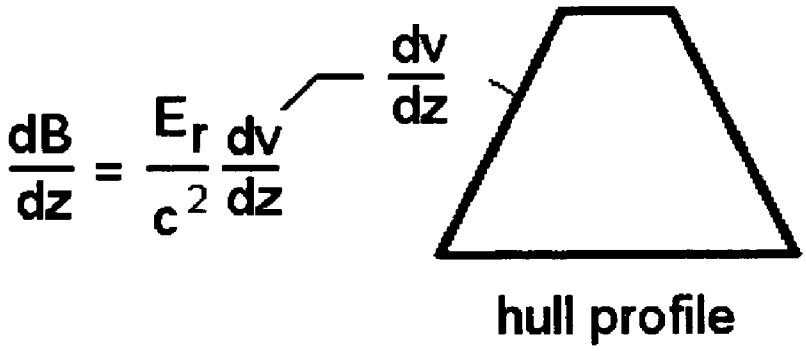

Figure 8

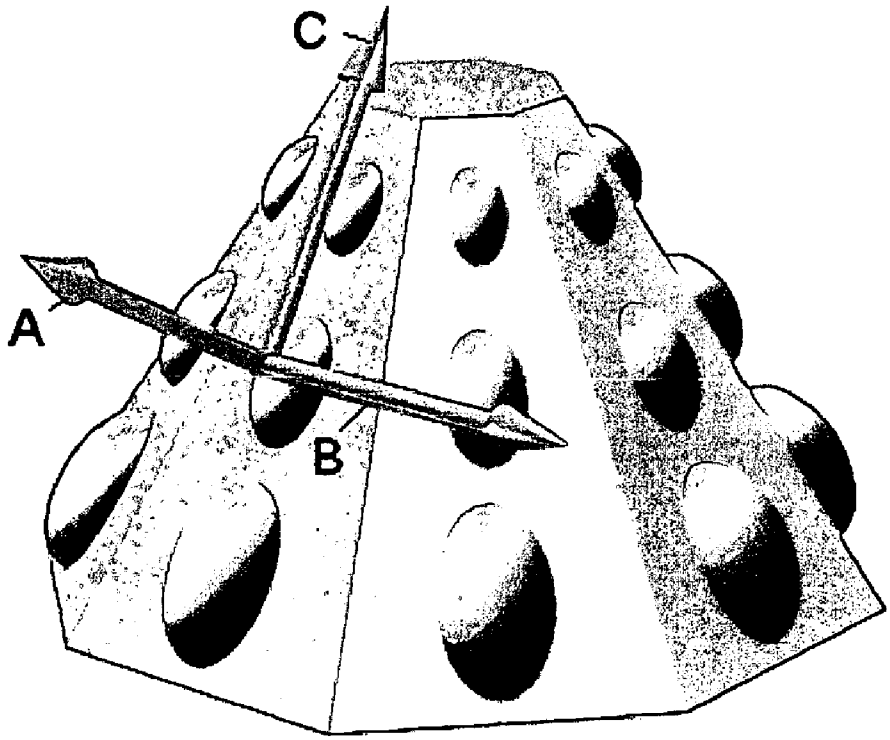

Figure 9

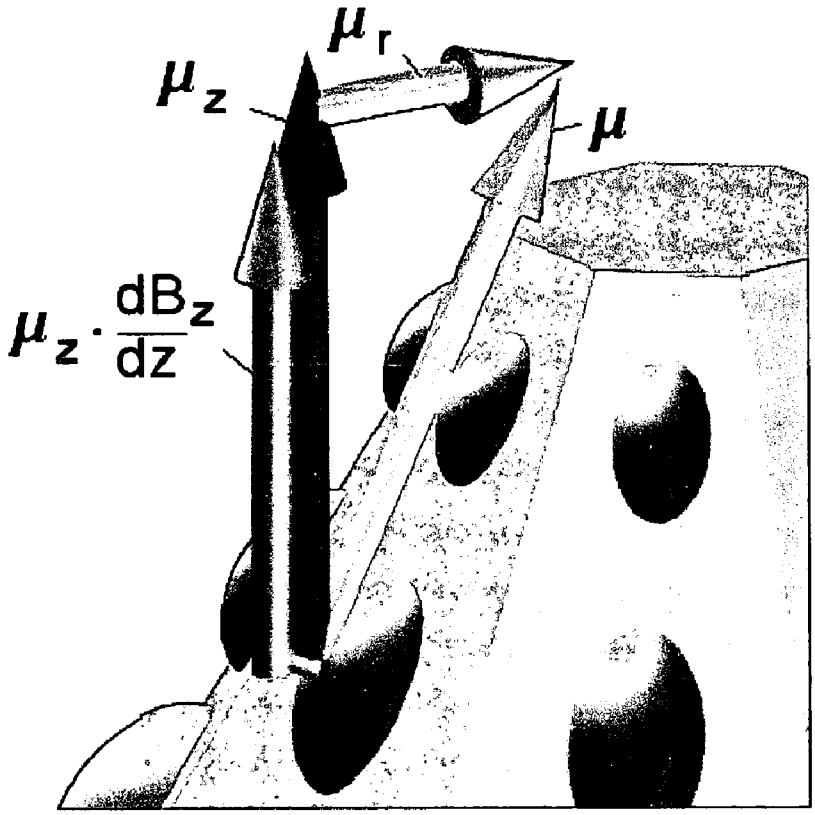

Figure 10

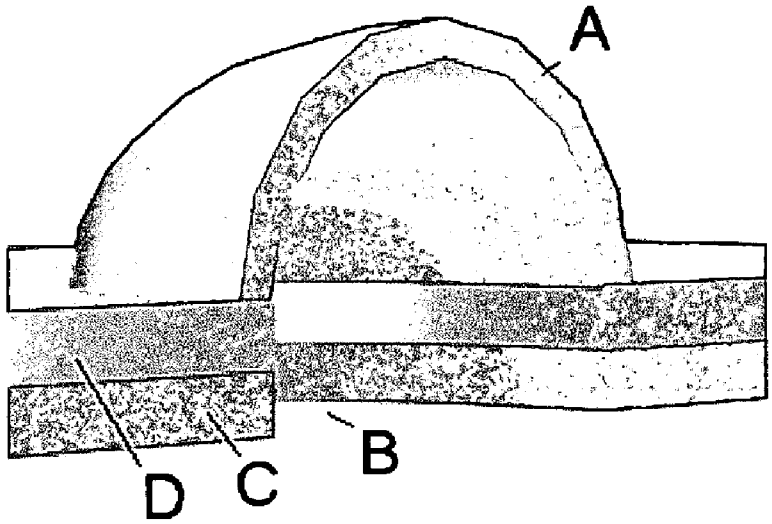

Figure 11

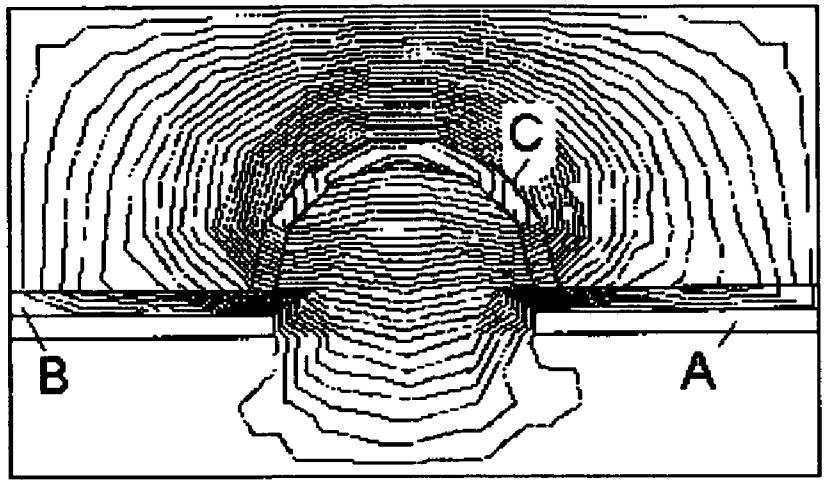

ELECTRIC DIPOLE MOMENT PROPULSION SYSTEM

BRIEF SUMMARY OF THE INVENTION

[0001] The invention is a spacecraft utilizing trapezoidal electrostatically charged flat plate panels which form a pyramidal hull. A panel contains three holes each of which produces a potential energy ellipsoidal bubble that creates an electric dipole moment. The rotation of the hull generates a magnetic moment and a magnetic field gradient in the vertical direction that produces a lift force on the spacecraft.

BACKGROUND OF THE INVENTION

[0002] It is known from electrodynamics that a hole in a conducting plane forms a potential energy bubble. This bubble creates an electric dipole moment from which it is possible to develop a magnetic moment. A rotating tilted hull produces a velocity gradient that generates a magnetic field gradient in the vertical direction. This combination produces a lift force on the spacecraft. A very large potential energy bubble is produced provided that the hole protrudes out of the plate in an ellipsoidal shape. Furthermore, a double cladding, in which each layer around the hole has a different permittivity, confines the field to the outside of the hull for even better results.

[0003] The planar potential energy is created by a grid of electrically charged wires or rods running the length of each panel. A circular potential energy from each rod very quickly sums to form a flat sheet of energy which emerges from the hole to form the potential energy bubble.

SUMMARY OF THE INVENTION

[0004] The invention relates to a spacecraft utilizing a rotating octagon of trapezoidal electrically charged flat plate panels to form a hull in the shape of a pyramid. Each panel has three protruding ellipsoidal bubbles that produce an electric dipole moment from a planar potential energy field created by a group of charged rods parallel to the panel. Because the panels are tilted and the hull is rotating, there is a tangential velocity gradient in the vertical direction. This creates the magnetic moment. Because the hull rotates, the radial electric field produces a magnetic field gradient in the vertical direction. This combination of magnetic moment and magnetic field gradient produces a lift force on the hull of the spacecraft.

[0005] On the underside of each panel is a group of high voltage electrically charged rods which run parallel to the panel. These wires or rods produce a planar electrical potential field underneath the holes in the panel. This potential energy field then bubbles out of the holes in the panel to create a large ellipsoidal potential energy field above the hull. The potential energy bubble carries an electric dipole moment which when rotated with the hull generates a magnetic moment in the vertical direction.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0006] **FIG. 1**. Perspective view of electric dipole moment spacecraft.

[0007] **FIG. 2**. Perspective exploded view of one panel with the ellipsoidal domes, flat hull panel with three holes, the charged rod grid and the planar potential energy field.

[0008] **FIG. 3**. Planar view of flat potential energy field produced by electrically charge wire rods.

[0009] **FIG. 4**. Perspective view of cylindrical coordinates $\{r, \theta, z\}$.

[0010] **FIG. 5**. Perspective view of ellipsoidal potential energy field emerging from hole in plate which produces an electric dipole moment.

[0011] **FIG. 6**. Planar view of field lines of potential energy bubble emerging from plate hole.

[0012] **FIG. 7**. Planar view of sloping hull profile needed to get a velocity gradient.

[0013] **FIG. 8**. Perspective view of hull showing electric dipole moment, the tangential velocity of the hull, and the magnetic moment.

[0014] **FIG. 9**. Perspective view of the magnetic moment components in the radial and vertical direction whereby the lift force is generated by the dot product of the vertical magnetic moment with the magnetic field gradient.

[0015] **FIG. 10**. Perspective view of cross section of dome showing two layer cladding with different permittivities to enhance potential energy field.

[0016] **FIG. 11**. Planar view of enhanced potential energy field with two layer cladding.

DETAILED DESCRIPTION OF THE INVENTION

[0017] 1. Referring to **FIG. 1**, the spacecraft is a rotating octagon of trapezoidal electrostatically charged flat panels which form a closed hull (A). Each panel has three ellipsoidal domes (B) of varying size centrally located along the major length of the panel. The purpose of the dome is to create a large ellipsoidal potential energy bubble over the hull which develops an electrical dipole moment. Because the hull is rotating, a magnetic moment is created in the vertical direction. A magnetic field gradient created by the rotating electric field on the hull in combination with the magnetic moment produces a lift force on the hull.

[0018] 2. Referring to **FIG. 2**, the trapezoidal hull panel (A) contains three ellipsoidal holes (E). A group of wires or rods (C) running parallel to and just underneath the panel are electrically charged to a high voltage at the end terminals (B). The rods produce a planar potential energy field (D) just under the holes in the panel. The field emerges from the holes in the shape of an ellipsoidal bubble and is amplified by an ellipsoidal dome (F) on the outside of the hull.

[0019] 3. Referring to **FIG. 3**, the group of parallel rods (A) are given a linear charge λ in units of charge per meter. The electric field E developed by the rod is the linear charge divided by the circumference of a circle of radius r around the wire times the permittivity ϵ of space. The analysis of this arrangement shows that within a few grid width spacings, the potential energy field ϕ due to the electric field E_0 has become planar (B) in the z-direction given by the equation

$$\phi=-E_0 z$$

[0020] 4. Referring to **FIG. 4**, the following analysis is done in cylindrical coordinates {r,θ,z}.

[0021] 5. Referring to **FIG. 5**, the ellipsoidal potential energy (B) emerges through the hole in the panel plate (A). In doing so it creates an electrical dipole moment (C) shown by the arrow normal to the hole area.

[0022] 6. Referring to **FIG. 6**, the bubble (B) emerges through plate (A).

[0023] 7. Because the bubble has the shape of an ellipse, the centroid y of the bubble would be four thirds the radius a divided by π as given by

$$\bar{y}_{ellipse} = \frac{4}{3}\frac{a}{\pi}$$

[0024] The electric dipole moment is then given as the charge q times the centroid y. The charge of the hole is equal to the permittivity E times the electric field E emerging from the hole times the area of the hole of radius a

$$q = \varepsilon_0 E\pi a^2 \frac{\text{coul}^2}{\text{m}^2\ \text{newton}} \frac{\text{newton}}{\text{coul}}\ \text{m}^2 = \text{coul} = \text{charge}$$

[0025] 8. The electric dipole moment p is the centroid y times the charge q

$$p = qy = \varepsilon_0 E\pi a^2 \frac{4}{3}\frac{a}{\pi} = \frac{4}{3}\varepsilon_0 E a^2\ \text{coul}\cdot\text{meter}$$

[0026] The electric dipole moment p times the hull velocity v is equal to a magnetic moment μ which is what creates the lift force on the hull

$$\mu = pv\ \text{amp}\cdot m^2$$

[0027] 9. The rotating hull creates the electric dipole moment velocity so that the entire hull develops a magnetic moment. In tensor notation, the magnetic moment μ is in the vertical z-direction because there is a radial component of the electric dipole moment times the velocity. The velocity is the radius r in the radial direction times the angular velocity ω in the z-direction

$$\mu^z = p_r x^r \omega^z$$

[0028] 10. The force F on the hull is the gradient of the dot product of the magnetic moment μ with the magnetic B field

$$F = \nabla(\mu\cdot B)$$

[0029] 11. By electrically charging the hull of the vehicle, a radial electric field is produced. By rotating the hull, the radial electric field changes with time. Thus Maxwell's equations will involve the curl of the magnetic field in the radial direction because the radial electric field is varying with time

$$(\nabla \times B)_r = \frac{1}{c^2}\frac{\partial E_r}{\partial t}$$

[0030] 12. The cross product involves the magnetic field in the theta direction which is zero

$$\frac{1}{r}\frac{\partial B_z}{\partial \theta} - \frac{\partial B_\theta}{\partial z} = \frac{1}{c^2}\frac{\partial E_r}{\partial t} = \frac{1}{r}\frac{\partial B_z}{\partial \theta}$$

[0031] Substituting the derivative of the electric field E

$$E_r = E_0 e^{i\omega t}$$

[0032] and integrating with respect to angle theta gives the vertical magnetic field B as the tangential velocity v times the radial electric field E divided by the speed of light c squared

$$B_z = \frac{v}{c^2}E_r$$

[0033] 13. The force on the hull is the gradient of the magnetic moment μ times the magnetic field B. In the equation for the magnetic field, the only available variable to work with in order to get a gradient of the magnetic field comes from the velocity.

$$\frac{dB_z}{dz} = \frac{E_r}{c^2}\frac{dv}{dz}$$

[0034] 14. Referring to **FIG. 7**, because the hull is in the shape of a pyramid, the velocity is a function of the height z of the hull. Using eight flat sides keeps the radial electric field pointing in the same direction in each panel. Each panel has three domes to produce the magnetic moment for a total of 24 magnetic moment generators.

[0035] 15. Referring to **FIG. 8**, the electric dipole moment (A) points in the radial direction, the rotating hull produces a tangential velocity (B), and the result is a magnetic moment (C) along the panel.

[0036] 16. Referring to **FIG. 9**, because the magnetic moment is parallel to the panel, there are vertical and radial components of the magnetic moment. The vertical magnetic moment creates the dot product with the magnetic field gradient, which is equal to the lift force.

[0037] 17. **FIG. 10** shows a cross-section of the dome (A) and the plate hole (B) with double cladding to enhance the field. The upper cladding (D) has a low relative permittivity in the range of 2 to 40, and the lower layer has a high relative permittivity in the range of 1200 to 4000.

[0038] 18. Comparing **FIG. 11** to **FIG. 7**, this dome and cladding configuration creates a much larger electric dipole moment compared to a hole in the plate. The wavy

lines are the equi-potential energy lines from the dome (C) and the upper layer (B) and the lower level (A).

I claim:

1. A spacecraft propulsion system comprising:

a rotating octagon of trapezoidal electrostatically charged flat panels which form a closed sloping hull in the shape of a pyramid;

panels each having three holes covered by three ellipsoidal domes of varying size centrally located along the major length and axis of each panel; and

a grid of high voltage electrostatically charged rods located on the interior side of each panel such that a planar potential field is produced parallel to and under each panel hole.

2. The domes, holes and rotating charged hull of method 1 producing:

an ellipsoidal potential energy field emerging from the holes and generating an electric dipole moment on the outside of the hull;

a magnetic moment in the vertical direction due to the rotating electric dipole moment; and

a rotating electric field in the radial direction which generates a corresponding magnetic field gradient in the vertical direction proportional to the velocity gradient of the sloping panels of the hull.

3. A lift force on the spacecraft hull generated by:

the magnetic moment times the gradient of the magnetic field in the vertical direction; and

a dual surface layer hull cladding having different permittivities which enhance the electric dipole moment whereby the upper cladding has a low relative permittivity in the range of 2 to 40, and the lower layer has a high relative permittivity in the range of 1200 to 4000.

* * * * *

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(54) ELECTRIC DIPOLE SPACECRAFT

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(57) **ABSTRACT**

This invention is a rotating spacecraft that produces an electric dipole on four rotating spherical conducting domes perturbing a uniform spherical electric field to create a magnetic moment interacting with the gradient of a magnetic field that generates a lift force on the hull.

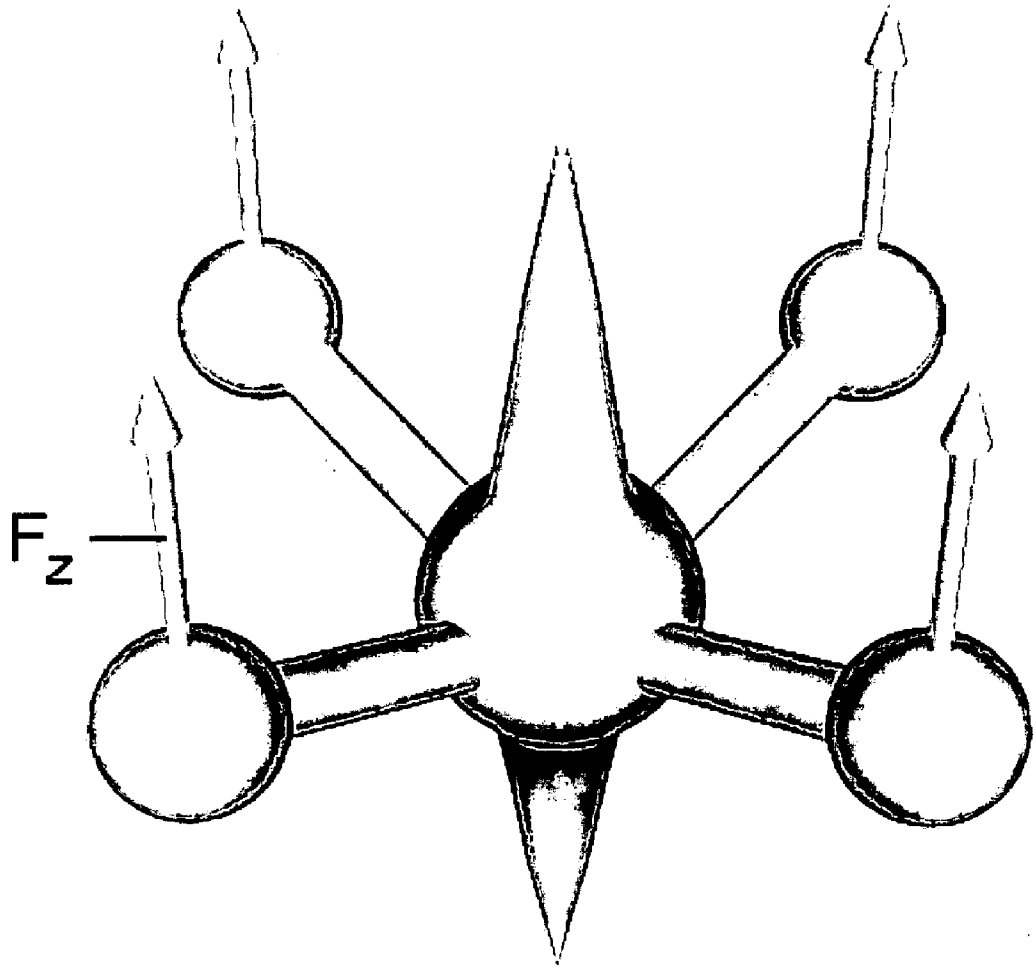

Figure 1

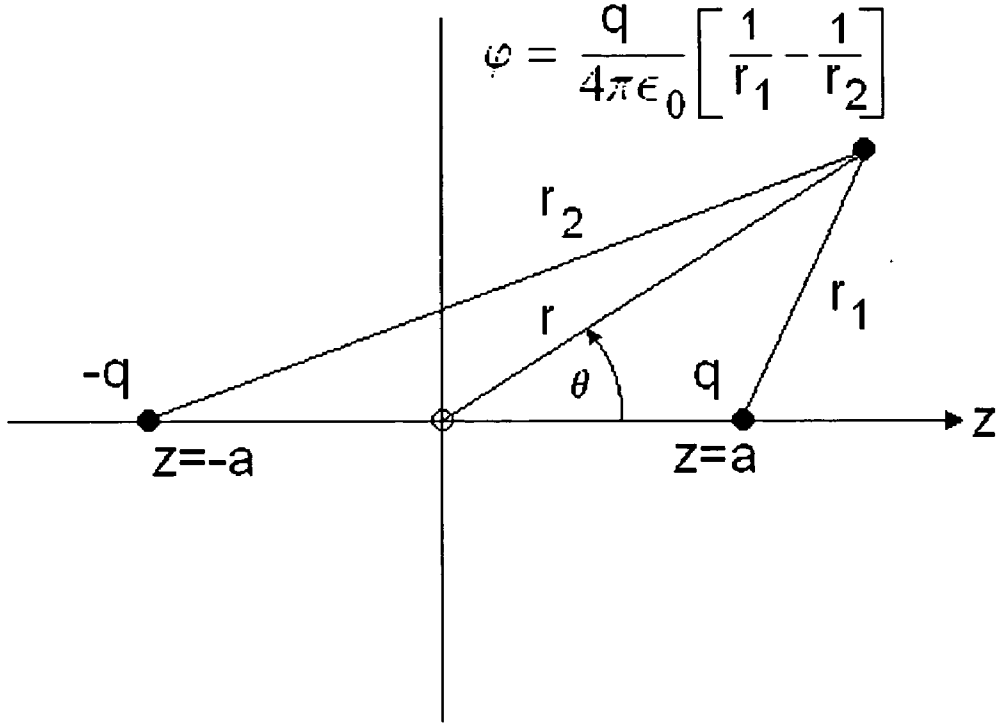
$\varphi = \frac{q}{4\pi\epsilon_0}\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$
r_2
r_1
r
θ
-q
q
z
z=-a
z=a

Figure 2

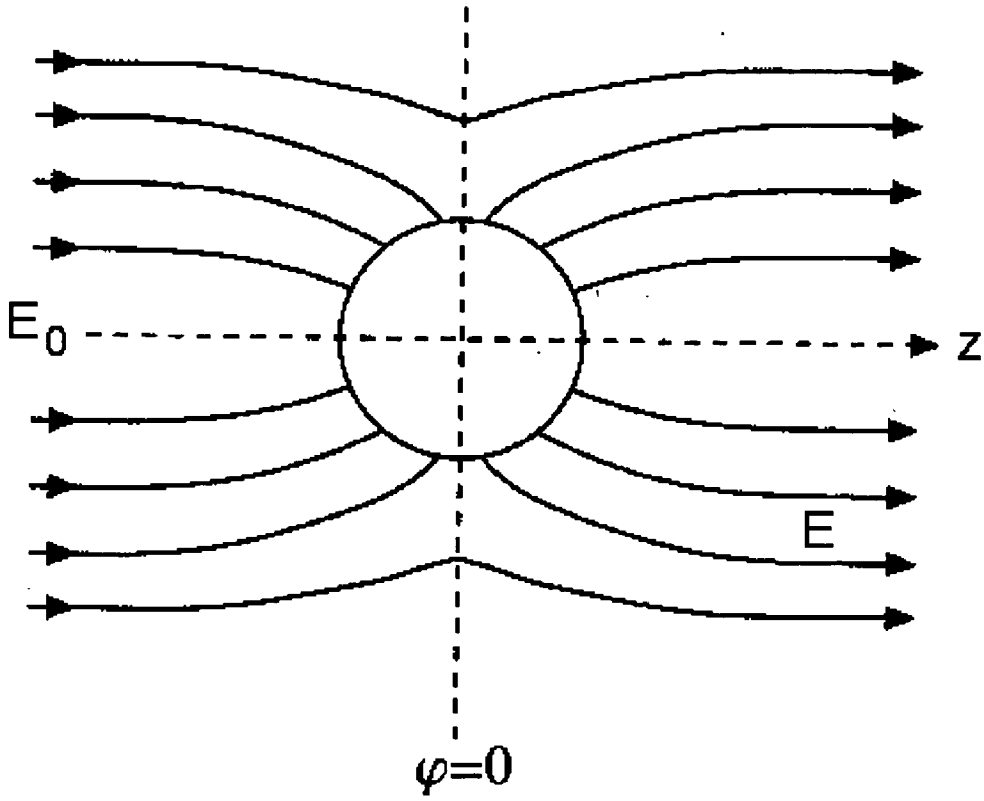

Figure 3

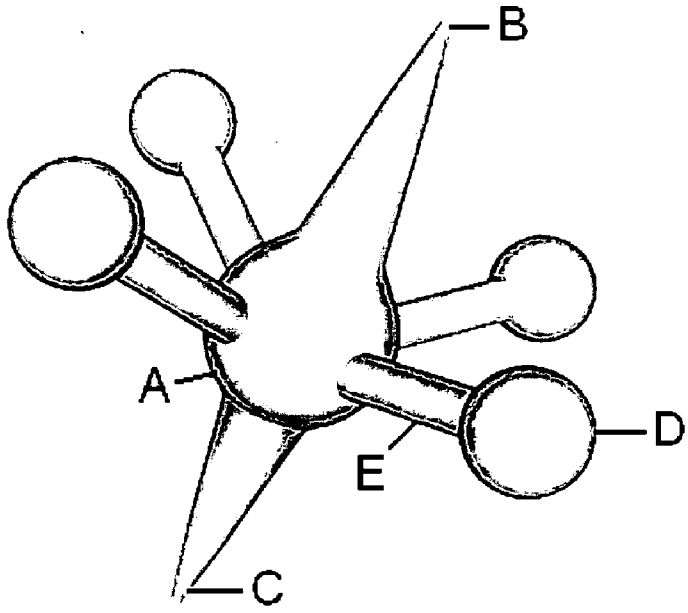

Figure 4

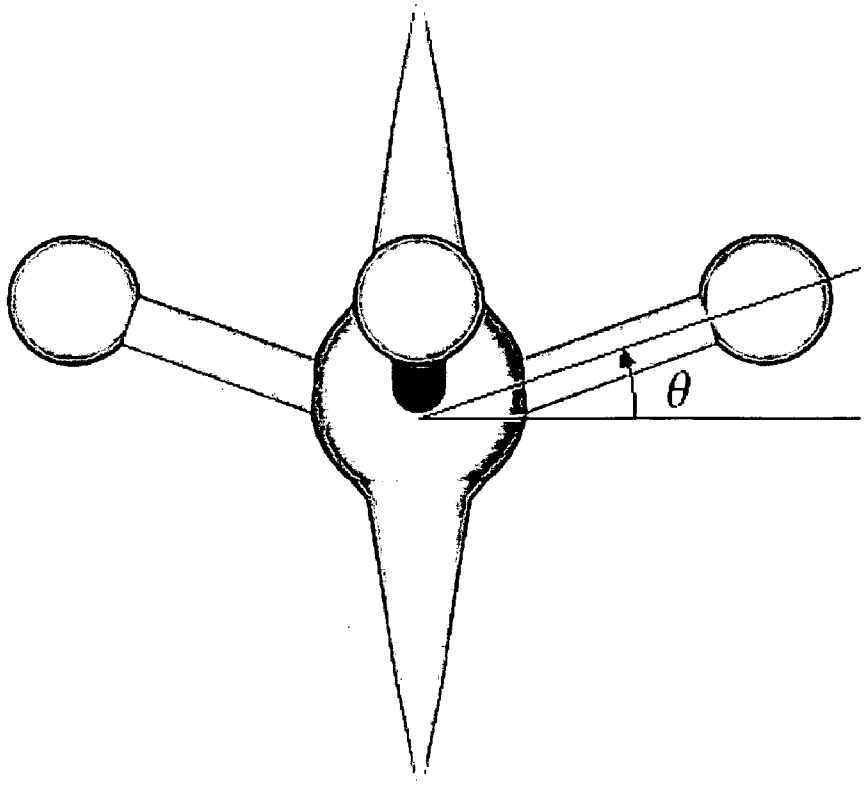

Figure 5

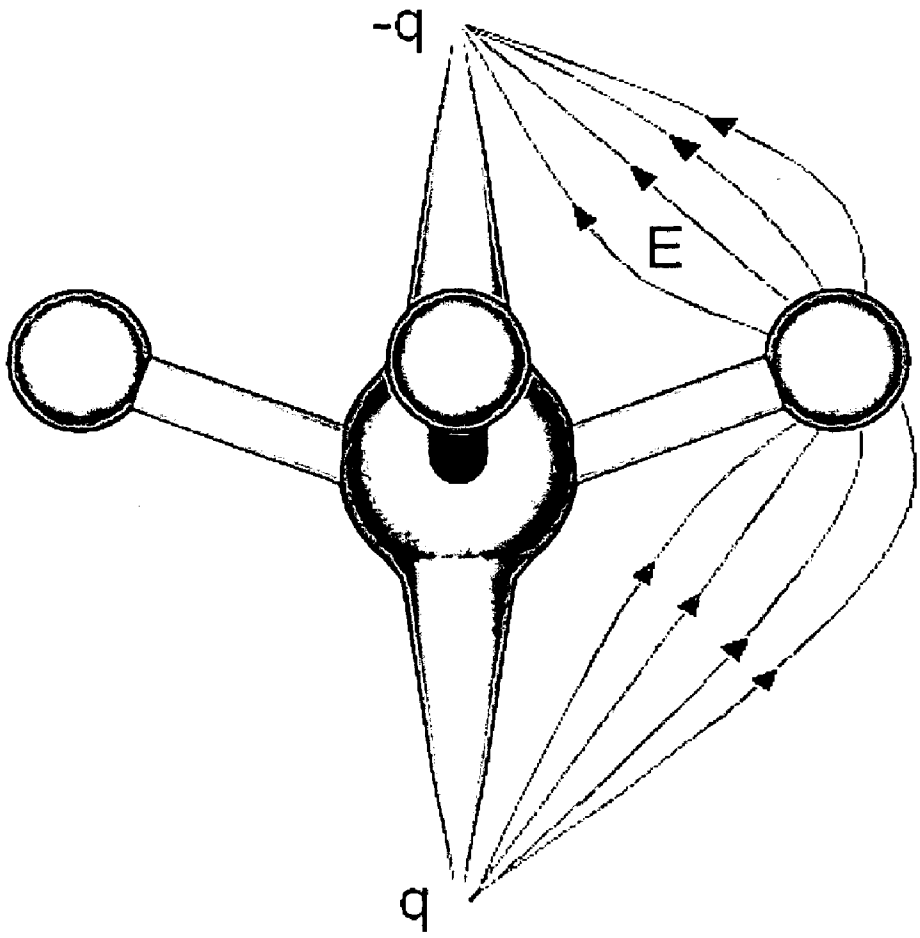

Figure 6

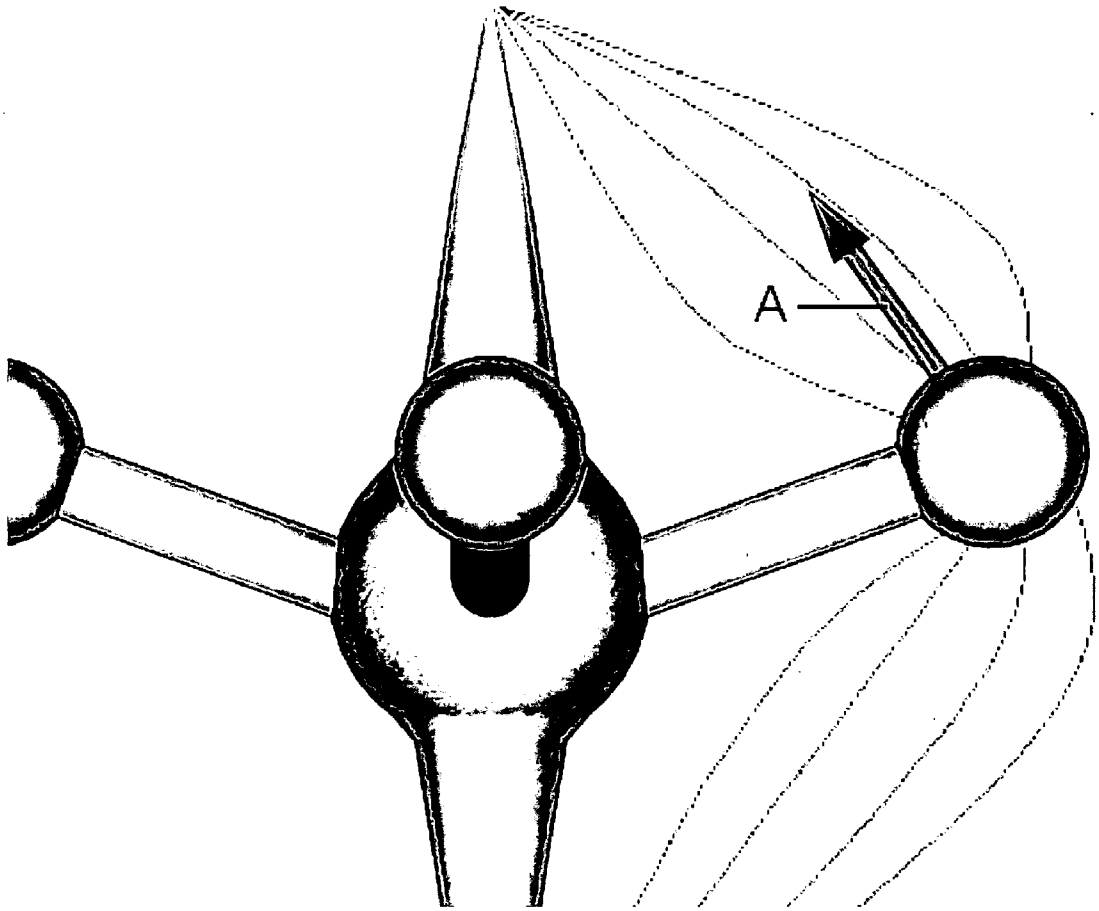

Figure 7

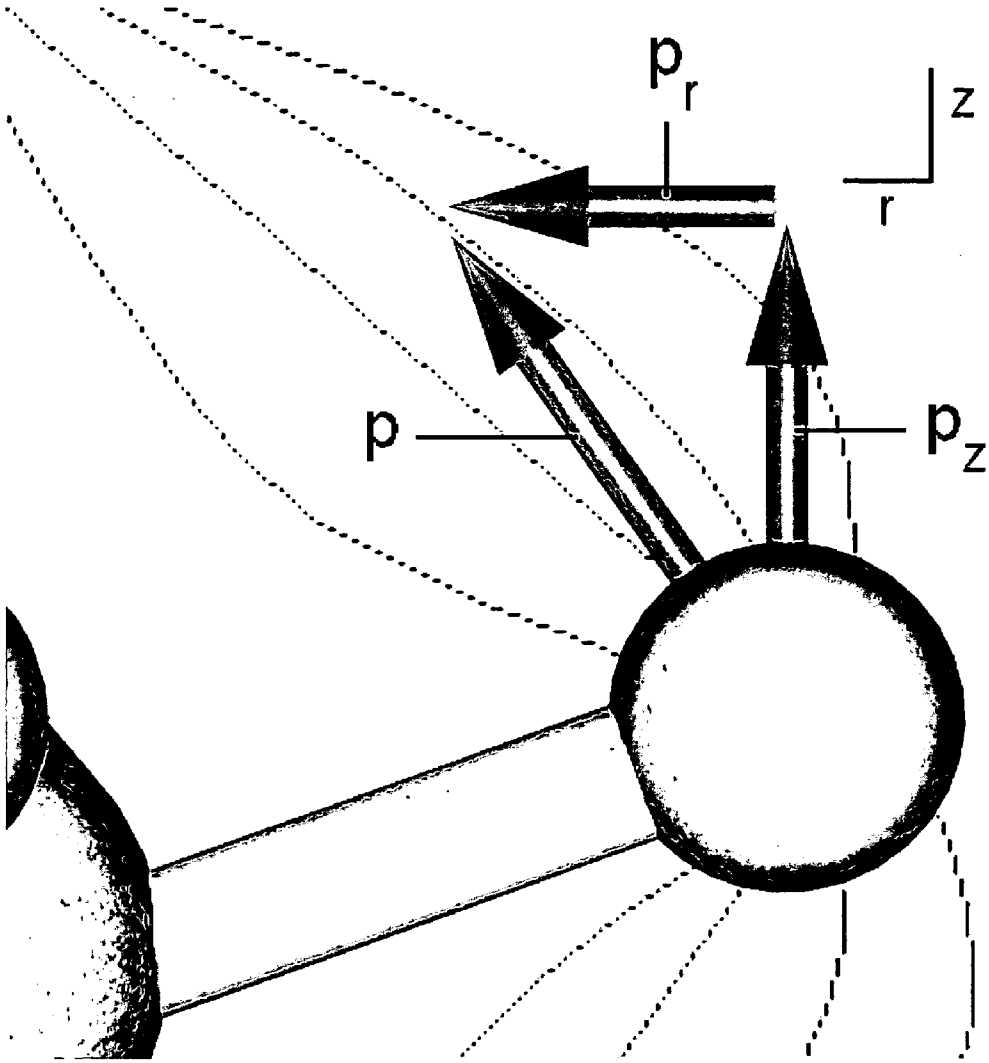

Figure 8

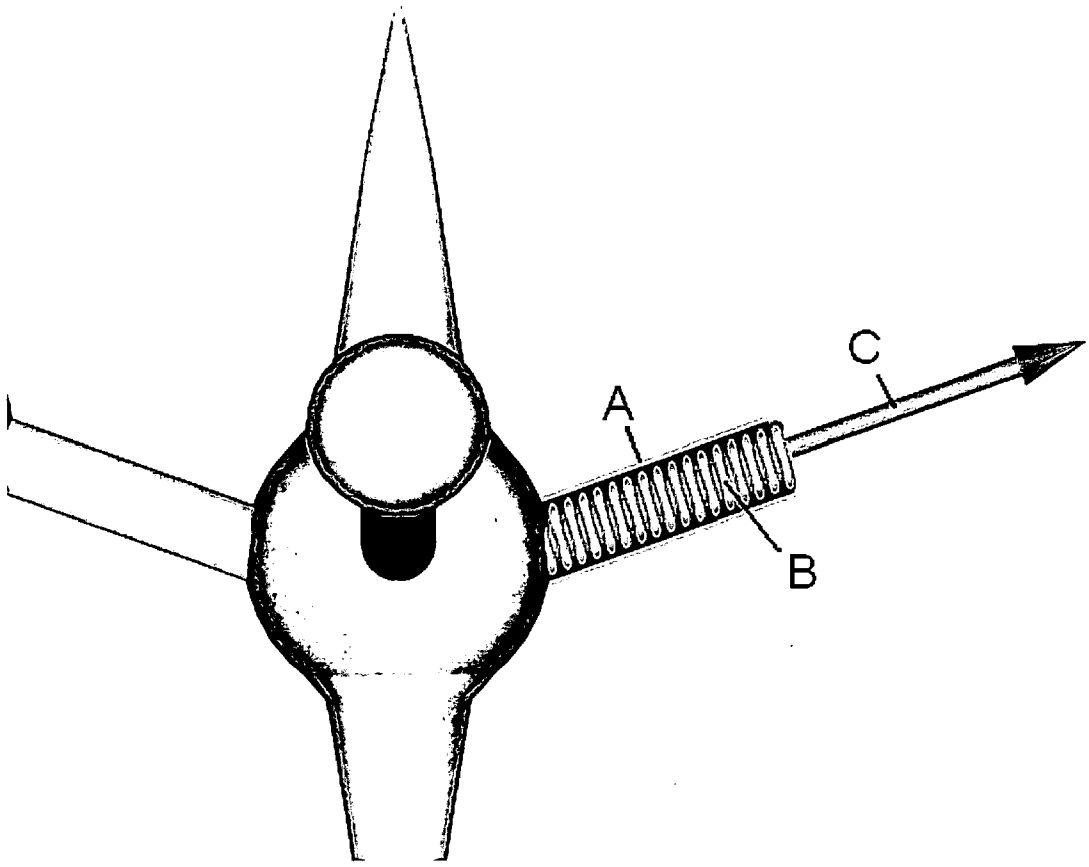

Figure 9

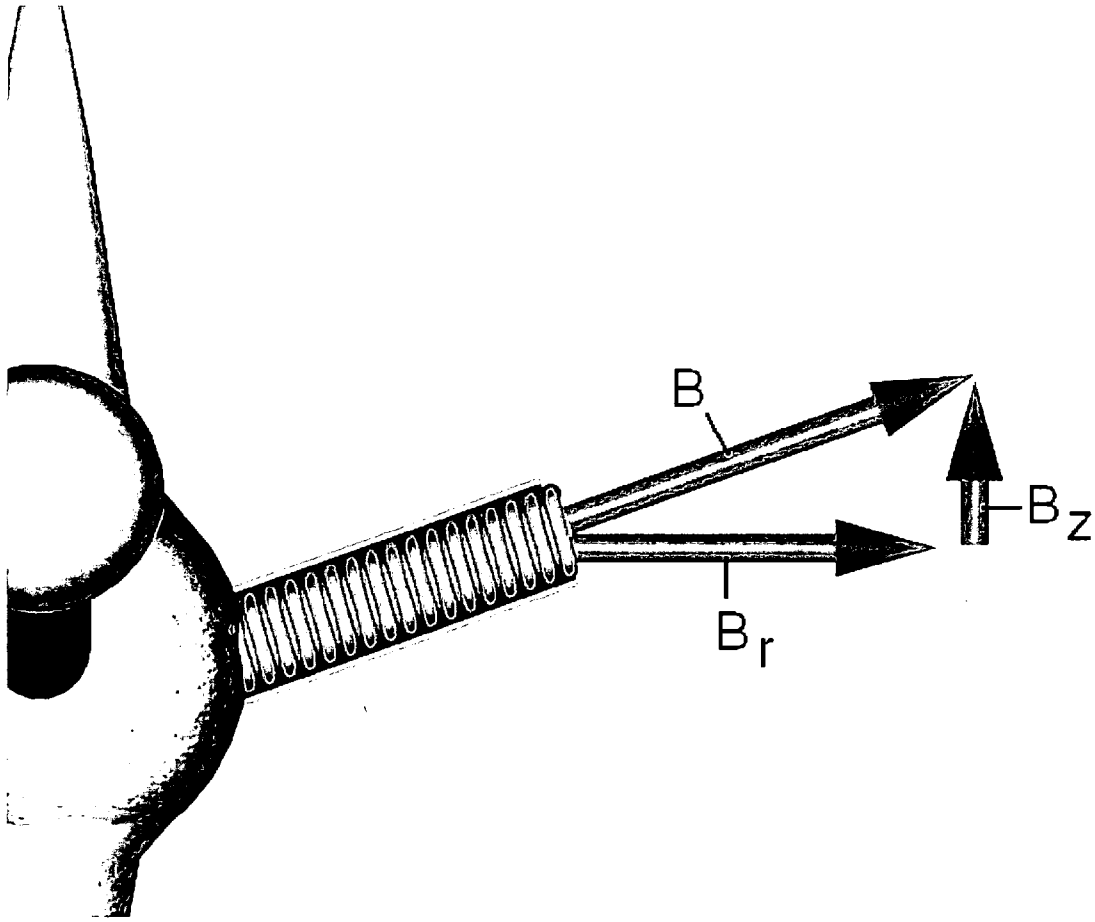

Figure 10

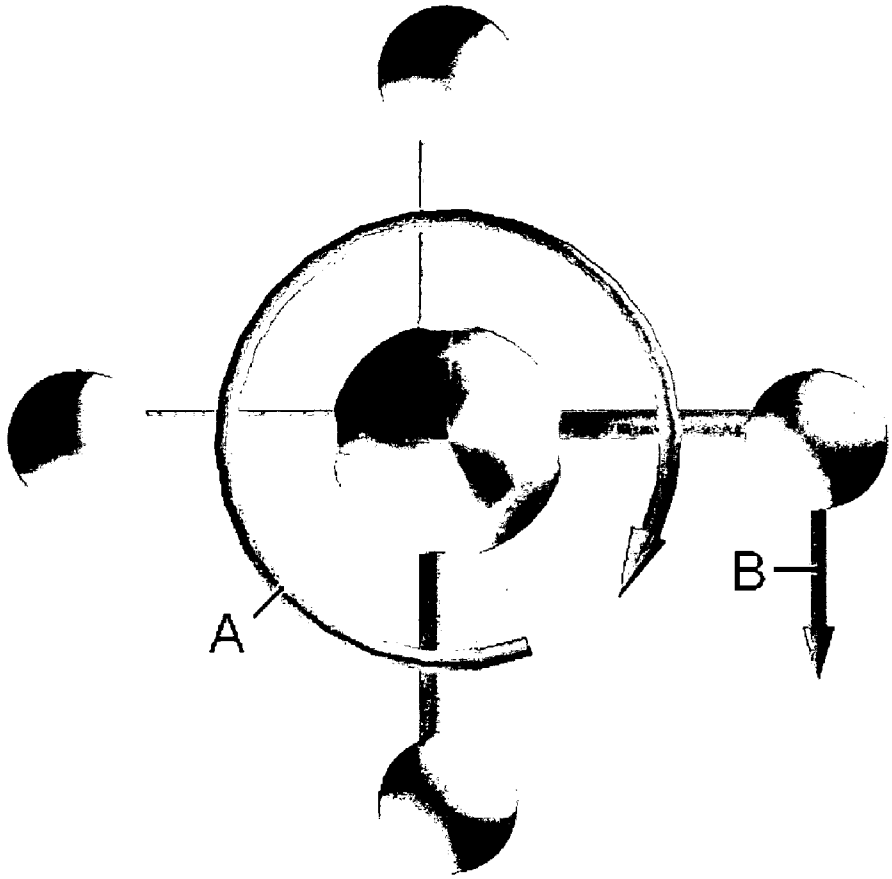

Figure 11

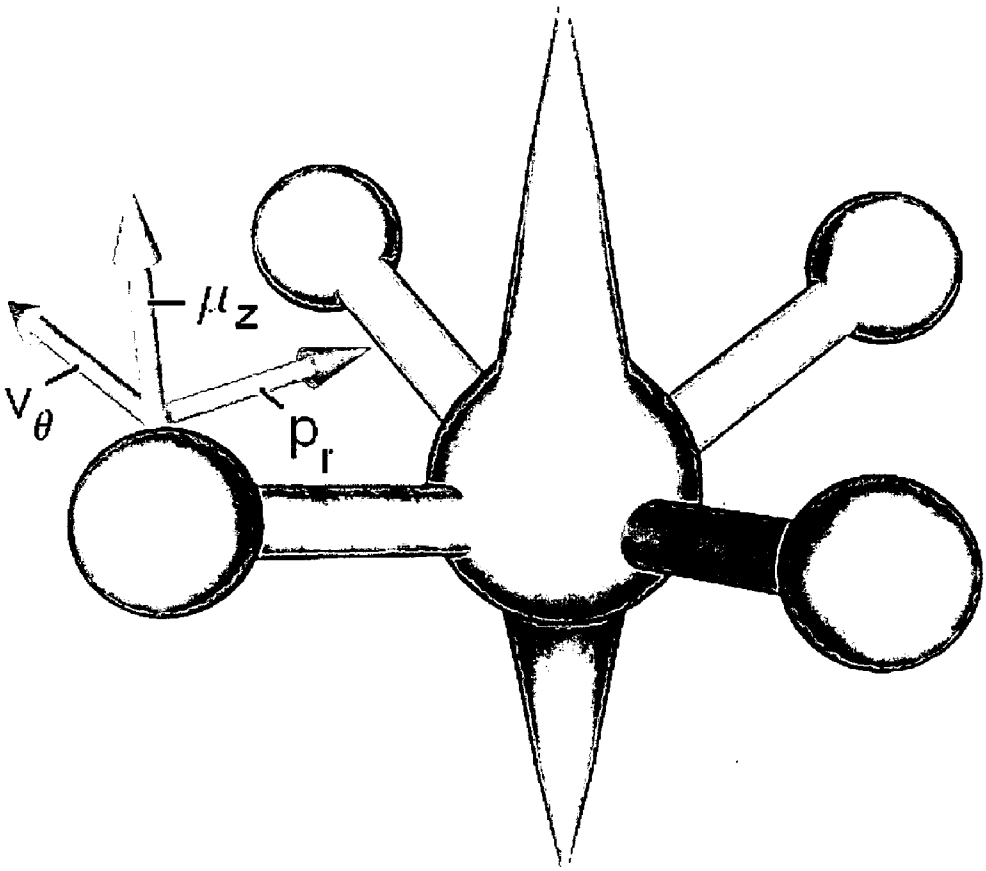

Figure 12

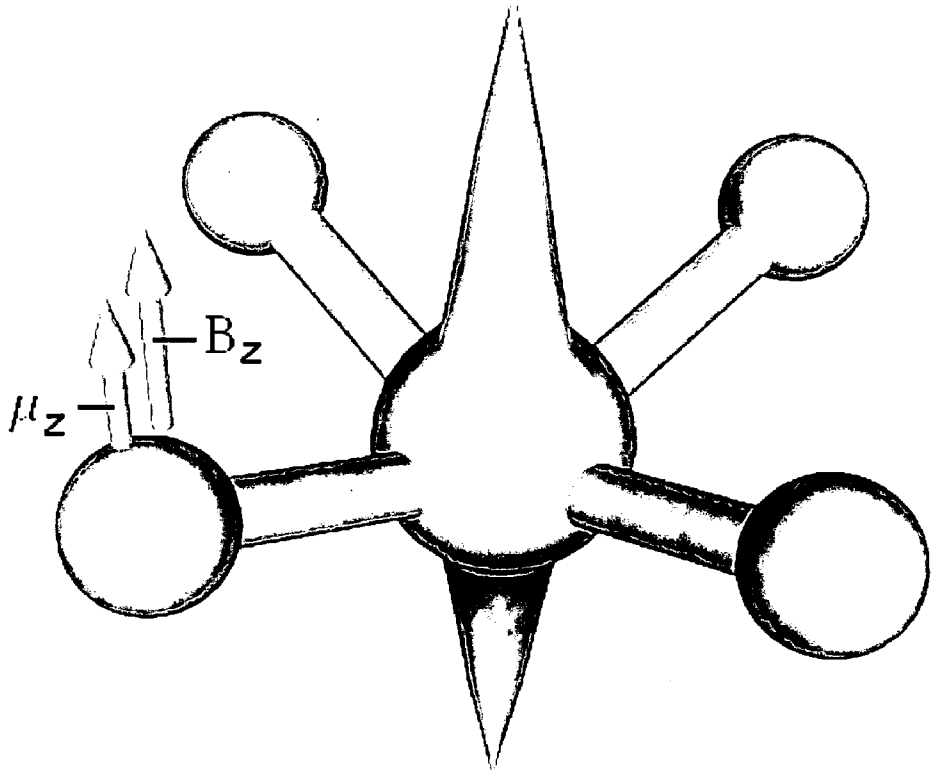

Figure 13

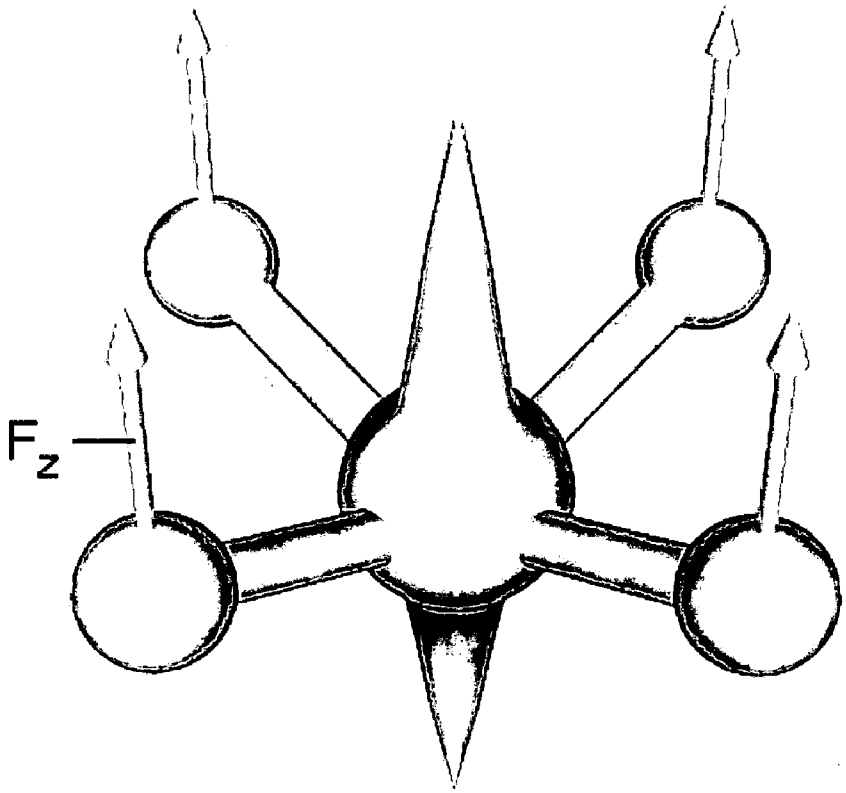

Figure 14

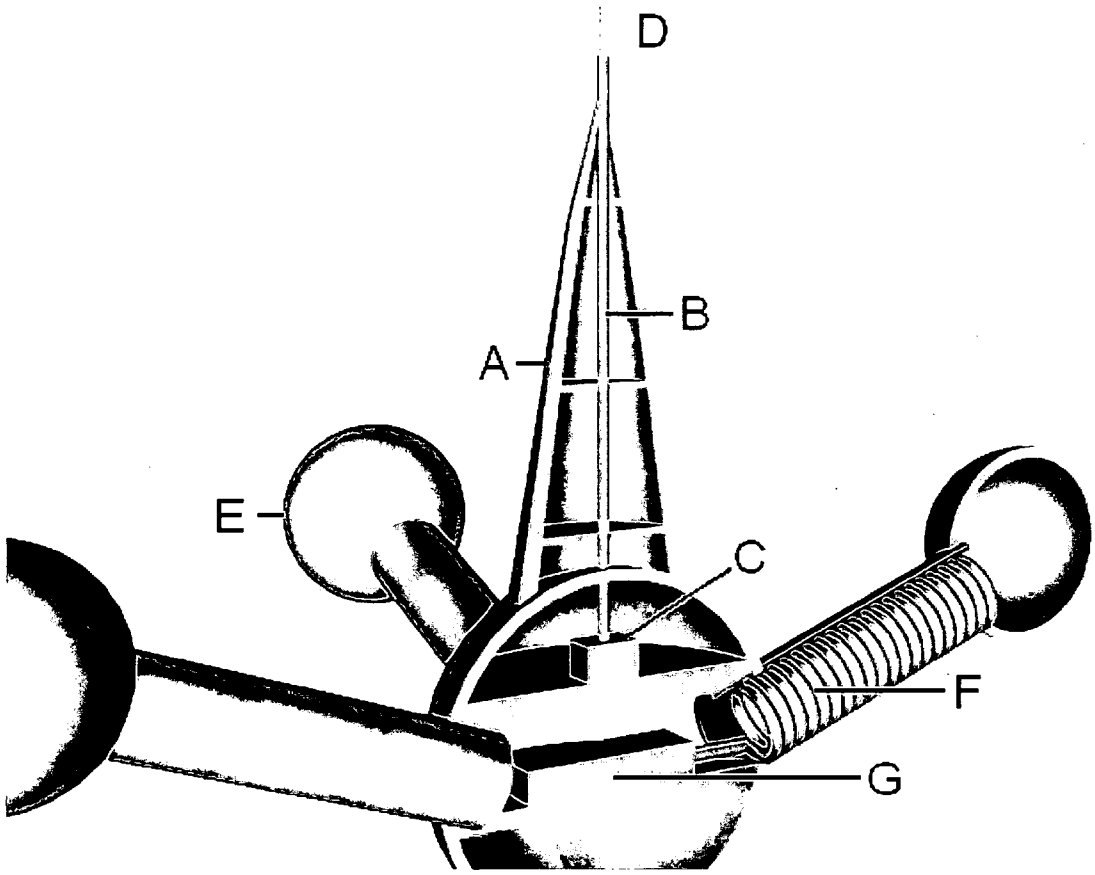

ELECTRIC DIPOLE SPACECRAFT

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a rotating spacecraft that utilizes four spherical conducting domes perturbing a uniform electric field in order to create a lift force by means of a magnetic moment times the gradient of a magnetic field.

BACKGROUND OF THE INVENTION

[0002] An electric dipole p is two electrical charges of opposite sign {q, −q} separated by a distance a.

$$p=qa=\text{coulomb}\cdot\text{meter}$$

[0003] If this dipole is moving with a velocity v, it produces a magnetic moment μ.

$$\mu = pv = qav = \text{coulomb meter}\frac{\text{meter}}{\text{sec}} = \frac{\text{coulomb}}{\text{sec}}\text{meter}^2 = IArea$$

[0004] The magnetic moment is equal to a current I circulating around an area. The magnetic field B has units of kilogram per second per charge coulomb.

$$B = \frac{\text{kg}}{\text{sec } coul}$$

[0005] The gradient of the magnetic field in the vertical direction z has units of

$$\frac{\text{dB}}{dz} = \frac{\text{kg}}{\text{sec } coul \text{ meter}}$$

[0006] This gradient interacting with a magnetic moment creates a force F measured in newtons.

$$F_z = \mu\frac{\text{dB}}{dz} = \frac{coul\ \text{m}^2}{\text{sec}}\frac{\text{kg}}{\text{sec } coul\ m} = \frac{\text{kg } m}{\text{sec}^2} = \text{newton}$$

[0007] In terms of vectors, the force is equal to

$$F=\nabla(\mu\cdot B)$$

which is the gradient ∇ of the dot product (·) of the magnetic moment with the magnetic field. This means that the magnetic moment has to be aligned with the field. The lift force on the spacecraft would then be the magnetic moment in the vertical z-direction μ_z times the magnetic field in the z-direction B_z. For constant magnetic moment, the gradient affects the magnetic field only, resulting in the same force equation

$$F_z=\nabla(\mu_z\cdot B_z)=\mu_z\nabla B_z$$

[0008] Referring to **FIG. 1**, the electric dipole has a positive charge q located on the z-axis at a distance a from the origin of the graph. A second negative charge −q is located at a distance −a from the origin. The positive charge produces an electrostatic potential ϕ_1 at a radius r_1 equal to the charge q divided by 4π times the permittivity of space ϵ_0

$$\varphi_1 = \frac{q}{4\pi\varepsilon_0}\frac{1}{r_1}$$

where the permittivity is linear capacitance, measured in farads per meter. The electrostatic potential has units of volts

$$\varphi = \frac{coul}{\left(\frac{\text{farad}}{\text{meter}}\right)}\frac{1}{\text{meter}} = \frac{coul}{\text{farad}} = \text{volt}$$

because the charge in coulombs held by a capacitor is equal to the capacitance, measured in farads, times the capacitor voltage. Because the second charge has the opposite sign, the potential ϕ_2 at a radius r_2 to the same point in space is

$$\varphi_2 = \frac{-q}{4\pi\varepsilon_0}\frac{1}{r_2}$$

[0009] The total potential ϕ at some point in space is equal to the sum of the two potentials, or

$$\varphi = \varphi_1 + \varphi_2 = \frac{q}{4\pi\varepsilon_0 r_1} - \frac{q}{4\pi\varepsilon_0 r_2} = \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{r_1} - \frac{1}{r_2}\right]$$

[0010] As seen in the diagram, the point of space is a distance r from the origin. Using the law of cosines, radius r_1 can be written as

$$r_1 = (r^2 + a^2 - 2ar\cos(\theta))^{\frac{1}{2}} = r\left(1 + \left(\frac{a}{r}\right)^2 - 2\left(\frac{a}{r}\right)\cos(\theta)\right)^{\frac{1}{2}} = r(1 - 2xt + t^2)^{\frac{1}{2}}$$

where t is the ratio of the charge location over the radius, and x is cos(θ). The potential for positive charge q_1 can be written

$$\varphi_1 = \frac{q}{4\pi\varepsilon_0}\frac{1}{r_1} = \frac{q}{4\pi\varepsilon_0}\frac{1}{r}(1 - 2xt + t^2)^{-1/2}$$

[0011] Dropping the factor $q/4\pi\epsilon_0 r$, the square root can be expressed in terms of the Legendre polynomial $P_n \cos(\theta)$ of the nth power

$$g(t, x) = (1 - 2xt + t^2)^{-1/2} = \sum_{n=0}^{\infty} P_n(x)t^n$$

where the absolute value of t is less than one. The polynomial coefficients of t^n can be obtained by using the binomial theorem to expand the generating function g(t,x) as

$$(1-2xt+t^2)^{-1/2}=\sum_{n=0}^{\infty}\frac{(2n)!}{2^{2n}(n!)^2}(2xt-t^2)^n$$

which evaluates to

$$\frac{0!}{2^0(0!)^2}(2xt-t^2)^0+\frac{2!}{2^2(1!)^2}(2xt-t^2)^1+\frac{4!}{2^4(2!)^2}(2xt-t^2)^2$$
$$1t^0+xt^1+\left(\frac{3}{2}x^2-\frac{1}{2}\right)t^2+\text{order}(t^3)$$

[0012] The first three Legendre polynomials are therefore

$$P_0=1$$
$$P_1=x$$
$$P_2=\frac{1}{2}(3x^2-1)$$

[0013] The electrostatic potential for both charges of the electric dipole is

$$\varphi=\frac{q}{4\pi\varepsilon_0}\frac{1}{r}\left\{\left(1-2\left(\frac{a}{r}\right)\cos(\theta)+\left(\frac{a}{r}\right)^2\right)^{-1/2}-\left(1+2\left(\frac{a}{r}\right)\cos(\theta)+\left(\frac{a}{r}\right)^2\right)^{-1/2}\right\}$$

[0014] The potential can be evaluated in terms of the Legendre polynomials as

$$\varphi=\frac{q}{4\pi\varepsilon_0 r}\left[\sum_{n=0}^{\infty}P_n(\cos(\theta))\left(\frac{a}{r}\right)^n-\sum_{n=0}^{\infty}P_n(\cos(\theta))(-1)^n\left(\frac{a}{r}\right)^n\right]$$
$$=\frac{2q}{4\pi\varepsilon_0 r}\left[P_1(\cos(\theta))\left(\frac{a}{r}\right)+P_3(\cos(\theta))\left(\frac{a}{r}\right)^3+\ldots\right]$$

[0015] The first and most dominant term when the radius is much greater than location a is equal to

$$\varphi=\frac{2aq}{4\pi\varepsilon_0}\frac{P_1(\cos(\theta)0}{r^2}$$

which is the electric dipole potential and 2aq is the dipole moment

$$p=2aq$$

[0016] Now imagine a constant electric field E_0 which is perturbed by a conducting sphere of radius a. The unperturbed electrostatic potential outside the sphere would the negative of the electric field times the radius times the Legendre polynomial, or

$$\Phi_1=-E_0rP_1$$

[0017] The electrostatic potential perturbed by the charges is the voltage E_0a times the radius a times the a of the dipole moment times the Legendre polynomial divided by the radius squared

$$\varphi_2=E_0aa\frac{P_1}{r^2}=E_0a^3\frac{P_1}{r^2}$$

[0018] The total potential outside the sphere is the sum of the two potentials equal to

$$\varphi=-E_0rP_1+E_0a^3\frac{P_1}{r^2}=-E_0P_1\left(r-\frac{a^3}{r^2}\right)=-E_0rP_1\left(1-\left(\frac{a}{r}\right)^3\right)$$

[0019] Referring to **FIG. 2**, the previously uniform electric field is shown perturbed by the neutral conducting sphere. The center of the sphere is taken as the origin and the z-axis is oriented parallel to the original uniform field.

[0020] The electric field induces a surface charge density σ on the sphere equal to the negative of the permittivity of space times the gradient of the electrostatic potential

$$\sigma=-\varepsilon_0\frac{\partial\varphi}{\partial r}|_{r=a}=3\varepsilon_0E_0\cos(\theta)$$

[0021] The electric field also induces an electric dipole moment on the sphere equal to the

$$p=\frac{qa}{r}\cdot\frac{2a^2}{r}=4\pi\varepsilon_0E_0a^3$$

with units of coulomb-meter. If this sphere is rotating around a central axis at a velocity v, it will create a magnetic moment μ equal to the dipole moment times the velocity.

$$\mu=pv$$

with units of ampere-meter^2.

SUMMARY OF THE INVENTION

[0022] As shown in the preceding background section, a neutral conducting sphere placed in a uniform electric field will generate a magnetic moment when rotated around a central axis. The electric field can be created by two points charges of opposite sign separated by a distance between them.

[0023] Referring to **FIG. 3**, the spacecraft has a spherical cabin (A) to which are attached cone-shaped electrostatic towers (B,C) above and below the cabin along the direction of travel in the z-direction. Because the electric field goes from the positive charge to the negative charge, the tip of the lower tower has a positively charged electrode, and the upper tower has a negatively charged electrode. Four equally-spaced neutral conducting spheres (D) are connected to the cabin by non-conducting tubes (E). The tubes make an angle with the cabin such that the distance (CD) is greater than distance (DB). The angle θ of the tube with respect to the cabin can be seen in side view **FIG. 4**.

[0024] Referring to **FIG. 5**, the charges create a uniform spherical field between the towers. The conducting spheres perturb this field such that the electric field (E) points toward the upper tower in a manner similar to that shown previously in **FIG. 2**.

[0025] Referring to **FIG. 6**, the conducting sphere produces an electric dipole moment (A) pointing at an angle toward the upper tower.

[0026] Referring to **FIG. 7**, by the law of addition of vectors, the electric dipole $\vec{p}$ can be represented by two orthogonal vectors pointing in the vertical z-direction p_z and in the inward radial direction p_r.

[0027] Referring to **FIG. 8**, the hollow tube (A) connecting the cabin with the conducting sphere contains a spiral-wound electrical solenoid (B) which produces a magnetic field (C). This magnetic field B can be decomposed into two orthogonal vectors pointing in the vertical z-direction B_z and in the outward radial direction B_r as shown in **FIG. 9**.

[0028] Referring to top-view **FIG. 10**, the spacecraft has a clockwise angular velocity ω (A) which gives the conducting sphere a velocity v as shown by the vector (B). By the right-hand rule of physics, the angular velocity vector points in the negative z-direction. The angular velocity in the z-direction crossed with the radius r in the radial direction produces a velocity v in the clockwise θ-direction using cylindrical coordinates {r,θ,z}.

$$v_\theta = w_z \times r_r = -\omega r$$

[0029] Referring to **FIG. 11**, the negative radial dipole moment p_r crossed with the negative velocity v_θ of the sphere produces a positive magnetic moment μ_z in the z-direction.

$$\mu_z = p_r \times v_\theta = (-p_r)(-v_\theta) = pv$$

[0030] Referring to **FIG. 12**, the magnetic field B_z in the vertical z-direction is dotted with the magnetic moment μ_z in the z-direction to produce a force F_z in the vertical z-direction on each conducting sphere (**FIG. 13**).

$$F_z = \nabla(\mu_z \cdot B_z) = \mu_z \nabla B_z$$

[0031] The magnetic field that is produced by the solenoid actually curves away and around. Thus there is a gradient of the field in the z-direction.

[0032] The force can also be expressed in tensor notation. The magnetic B field in the vertical direction is part of an electromagnetic 4×4 matrix Faraday tensor F

$$F^\alpha_\beta = \begin{array}{c|cccc|} & \beta = t & r & \theta & z \\ \alpha = t & 0 & 0 & 0 & 0 \\ \alpha = r & 0 & 0 & B_z & 0 \\ \alpha = \theta & 0 & -B_z & 0 & 0 \\ \alpha = z & 0 & 0 & 0 & 0 \end{array}$$

which shows that the magnetic field is located in slot F^r_θ of the Faraday tensor. In tensor notation the subscripts and superscripts have to match up on both sides of the equation. Matching subscripts and superscripts on the same side of the equation cancel. In this case, the electric dipole moment is in the radial direction p_r. The velocity can be represented as a time derivative of the θ-coordinate x^θ or

$$v^\theta = \frac{\partial x\theta}{\partial t}$$

[0033] Thus the force component in the z-direction becomes

$$F_z = p_r v^\theta F^r_{\theta,z} = (-p)(-v)\frac{\partial B_z}{\partial z} = pv\frac{\partial B_z}{\partial z}$$

where the angular and radial tensor components cancel and comma-z (, z) represents differentiation of the magnetic field in the z-direction.

[0034] The spacecraft design also has an inherent motion control system for moving in various directions. If the magnetic field of one solenoid arm is increased or decreased, the force on that sphere will be increased or decreased. Thus the spacecraft can turn in a particular direction.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0035] **FIG. 1**. Electric dipole.

[0036] **FIG. 2**. Uniform electric field perturbed by electric dipole.

[0037] **FIG. 3**. Perspective view of spacecraft.

[0038] **FIG. 4**. Angle of solenoid tube.

[0039] **FIG. 5**. Electric field perturbed by conducting sphere.

[0040] **FIG. 6**. Electric dipole generated by conducting sphere.

[0041] **FIG. 7**. Orthogonal vector components of electric dipole.

[0042] **FIG. 8**. Magnetic field produced by tube arm solenoid.

[0043] **FIG. 9**. Orthogonal vector components of magnetic field.

[0044] **FIG. 10**. Angular velocity of hull.

[0045] **FIG. 11**. Magnetic moment produced by radial electric dipole and sphere velocity.

[0046] **FIG. 12**. Dot product of the magnetic moment with the magnetic field.

[0047] **FIG. 13**. Vertical lift force on all four conducting spheres.

[0048] **FIG. 14**. Perpective view of spacecraft interior.

DETAILED DESCRIPTION OF THE INVENTION

[0049] 1. Referring to the cut-away view **FIG. 14**, the construction of the spacecraft is a thin-wall insulating thermoplastic having a dielectric constant in the range of 20 kilovolts per millimeter (A). An insulated electrode (B) runs from the cabin power supply and high-voltage transformer

(C) to the tip of each tower (D). The four spheres (E) are silver plated to make them conducting. The tube solenoids (F) are driven by a direct current power supply (G).

[0050] 2. The present model uses 3D computer design software and stereolithography fabrication techniques to create the thin-wall, low-weight, hollow structure of the hull. The computer model is sliced into many thin horizontal slices. A laser, mounted on an x-y table, draws out the slice on a table immersed in a bath of liquid polymer. Due to its sensitivity to the light, the liquid polymerizes. The table is then lowered a few thousandths of an inch more and the process is repeated. Thus making hollow spherical and conical shapes is extremely easy to do. Parts can be designed and stored in *.STL stereolithography files for transmission by Internet e-mail to the service bureau machine shop which sends the finished parts back the next day by express mail.

I claim:

1. A spacecraft comprising:

a. a spherical cabin;

b. an electrostatic conical tower mounted on top of item (**1***a*), supporting a vertically-mounted negatively-charged insulated electrode at the tip of the tower;

c. an electrostatic conical tower mounted on the bottom of item (**1***a*), supporting a vertically-mounted positively-charged insulated electrode at the tip of the tower;

d. a vertical electric dipole created by items (**1***b*) and (**1***c*);

e. a high-voltage transformer to drive item (**1***d*), mounted in item (**1***a*);

f. four tubular arms, mounted at 90° around and extending at an angle from item (**1***a*);

g. four solenoids, each of which is mounted axially inside item (**1***f*);

h. a direct current power supply to drive item (**1***g*);

i. four silver-plated conducting spheres, each of which is mounted on the end of item (**1***f*);

2. an electrostatic lift system that:

a. produces a uniform spherical electric field by means of item (**1***d*) which envelopes item (**1***i*);

b. produces a perturbed electric field due to the presence of item (**1***i*);

c. produces an electric dipole moment in the direction of item (**1***b*) due to items (**2***a*) and (**2***b*);

d. produces a vertical magnetic moment due to the clockwise angular velocity of item (**1***a*) combined with item (**2***c*);

e. produces a vertical lift force on item (**1***i*) due to item (**2***d*) combined with the magnetic field gradient in the vertical direction produced by item (**1***g*); and

f. creates a motion control system by varying the current to item (**1***g*) in order to increase or decrease the effect of item (**2***e*) on a particular item (**1***i*).

* * * * *

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(54) PHOTON SPACECRAFT

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F03H 1/00 (2006.01)

(52) **U.S. Cl.** **60/203.1**; 60/204

(57) **ABSTRACT**

A spacecraft propulsion system utilizing photon particles to create negative energy over the hull in order to generate a lift force on the hull.

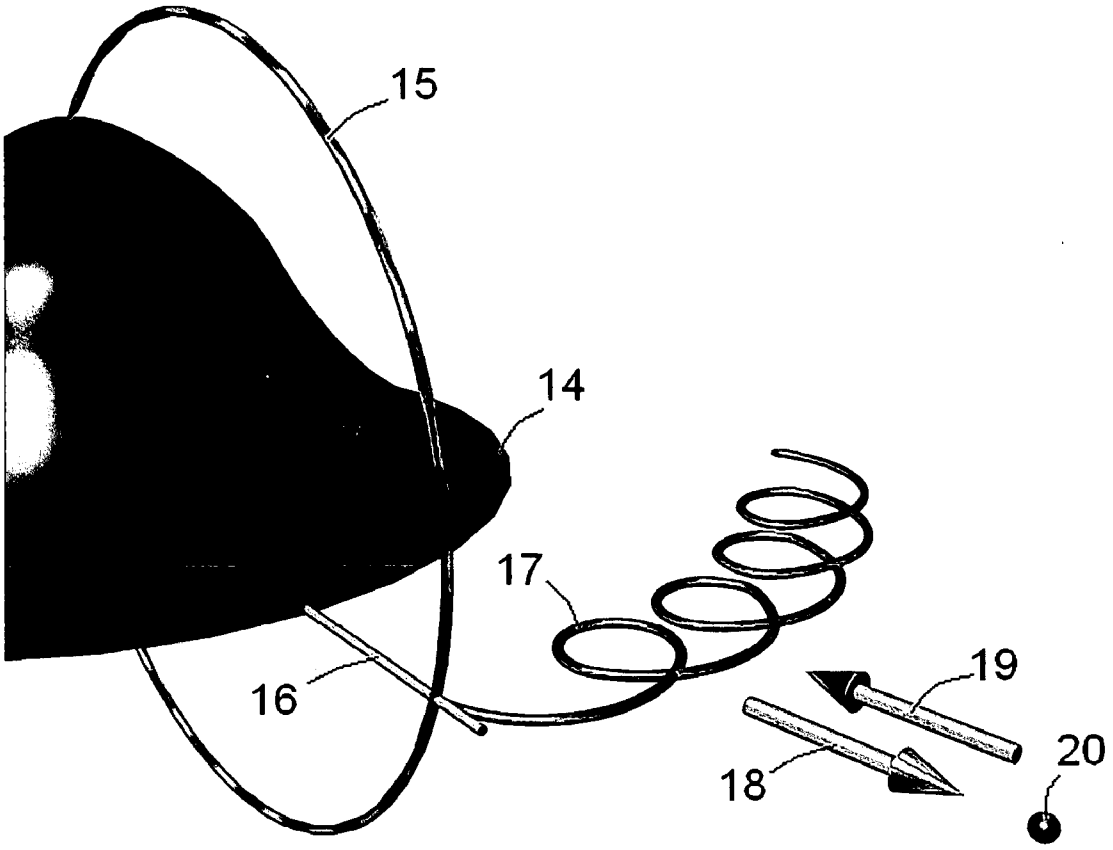

Figure 1

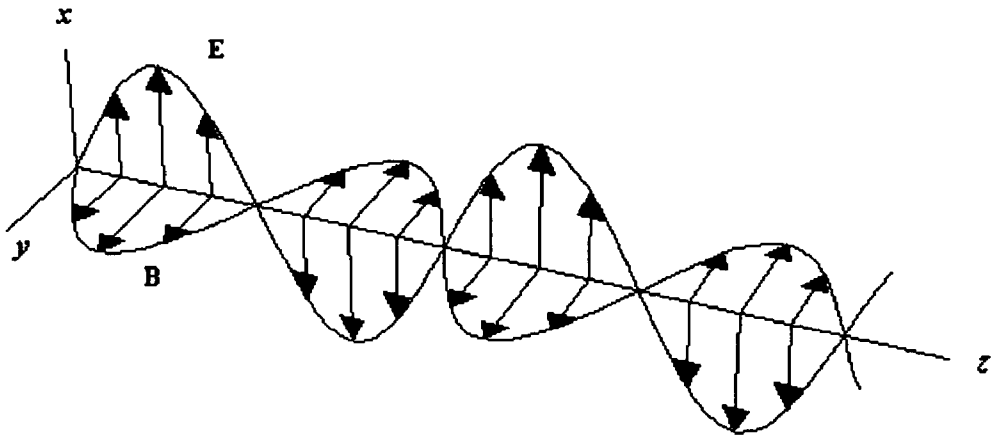

Figure 2

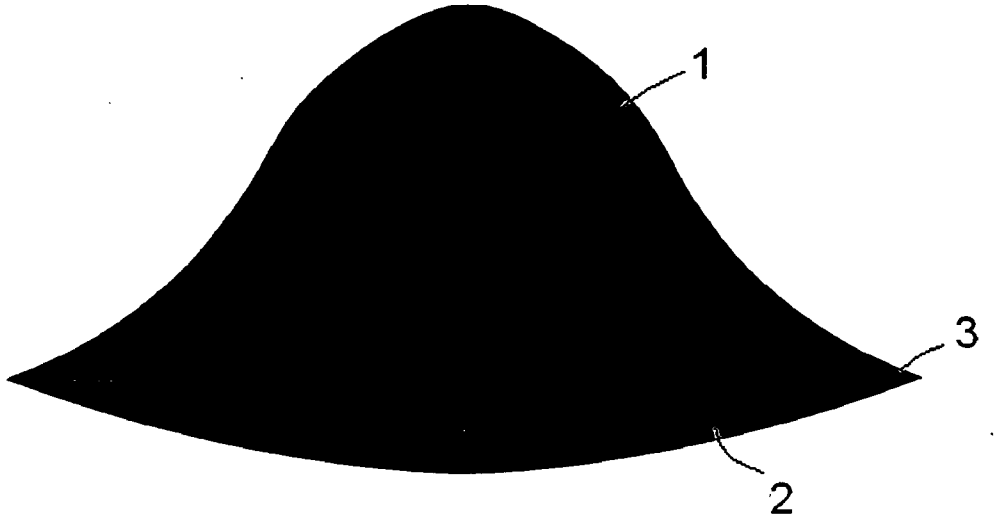

Figure 3

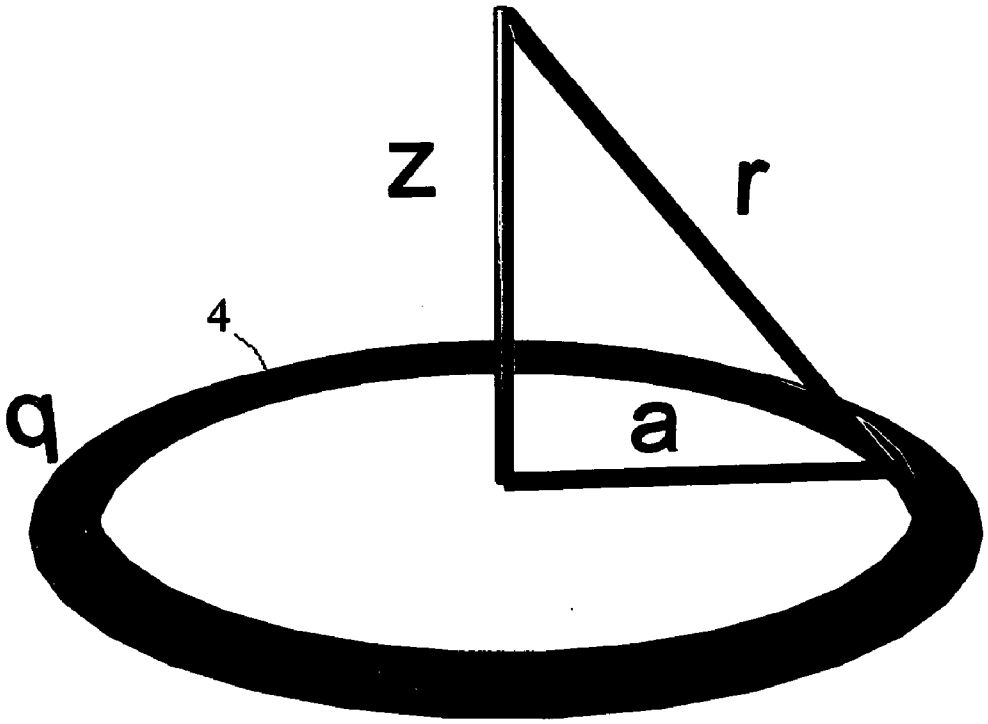

Figure 4

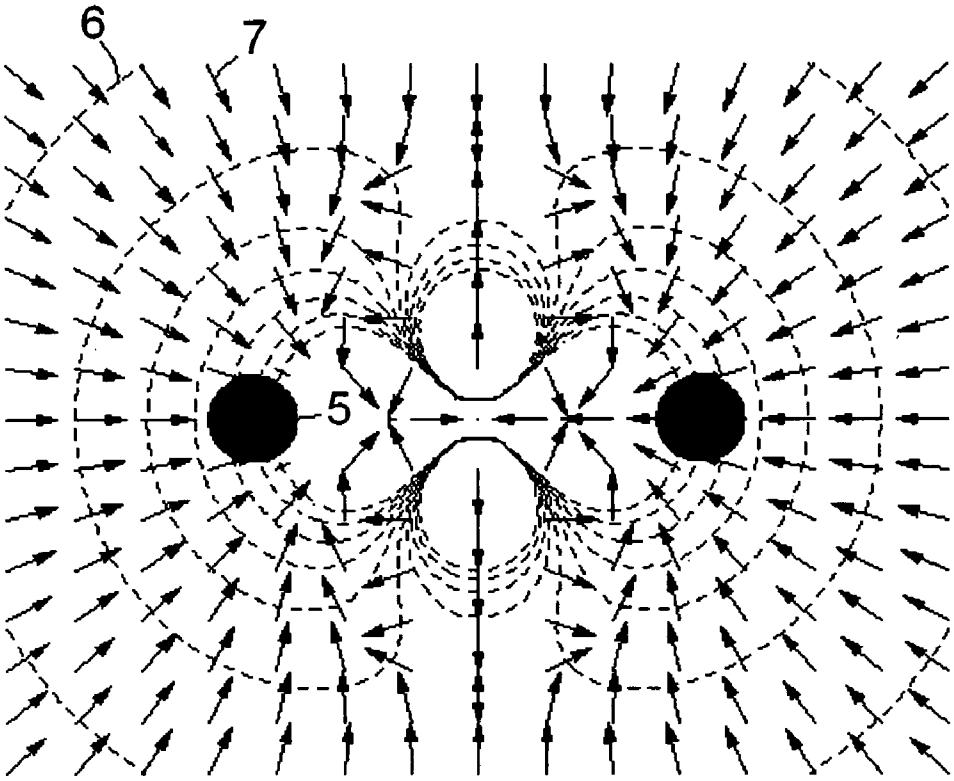

Figure 5

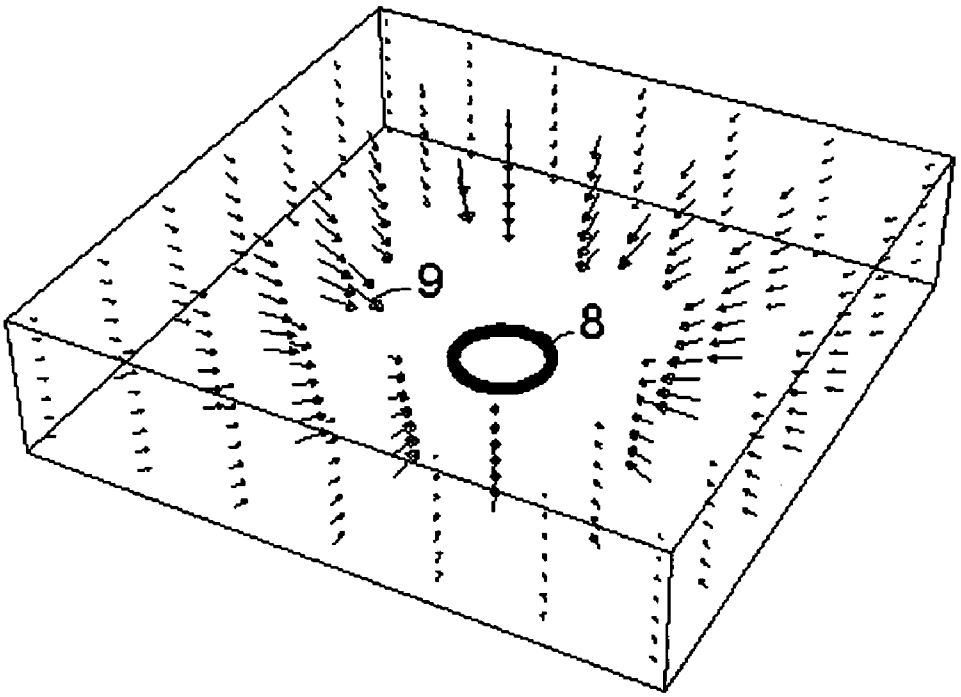

Figure 6

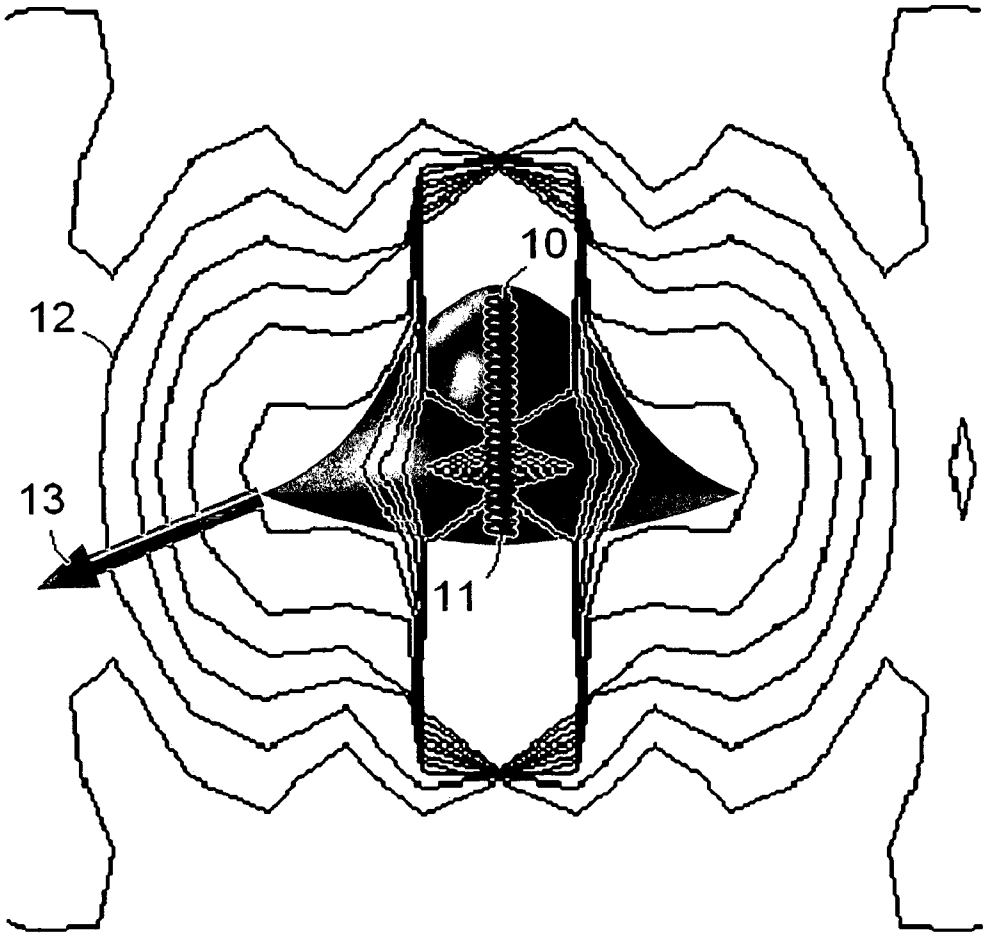

Figure 7

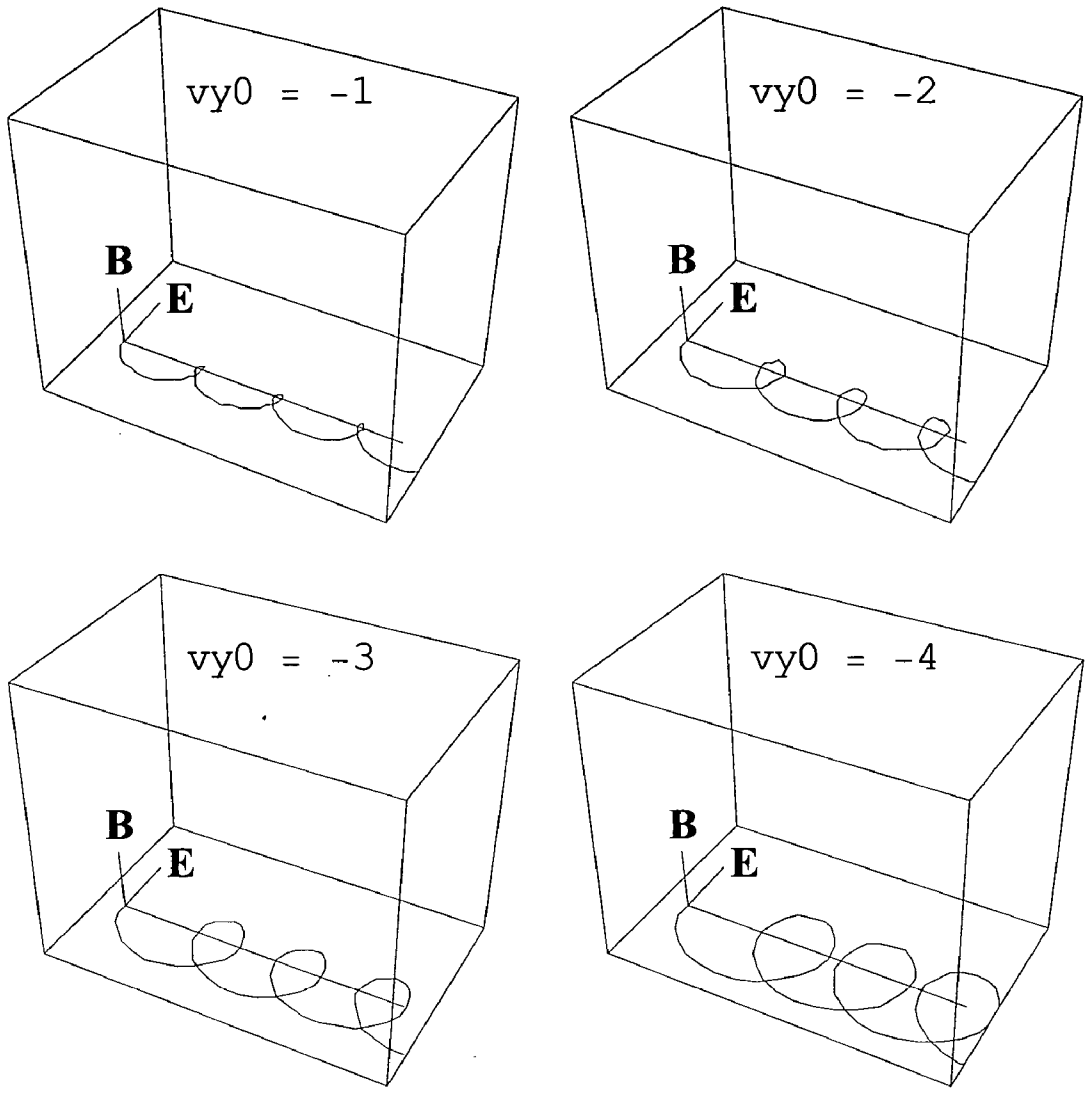

Figure 8

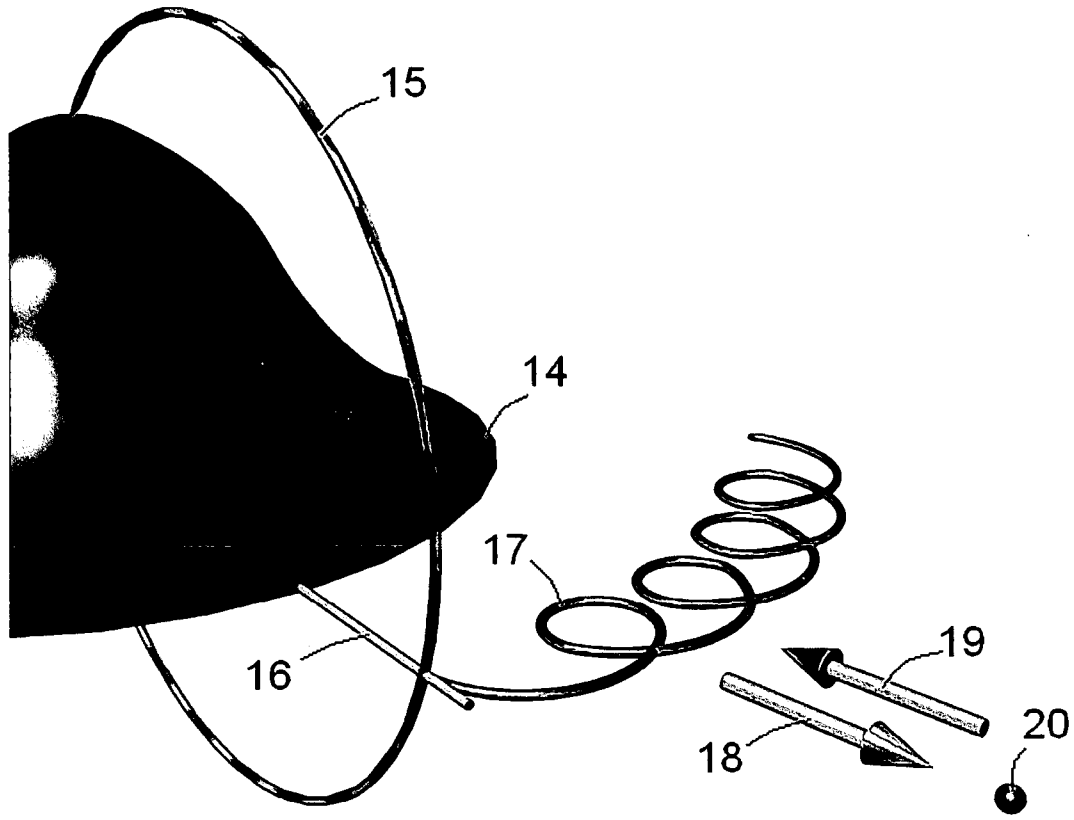

Figure 9

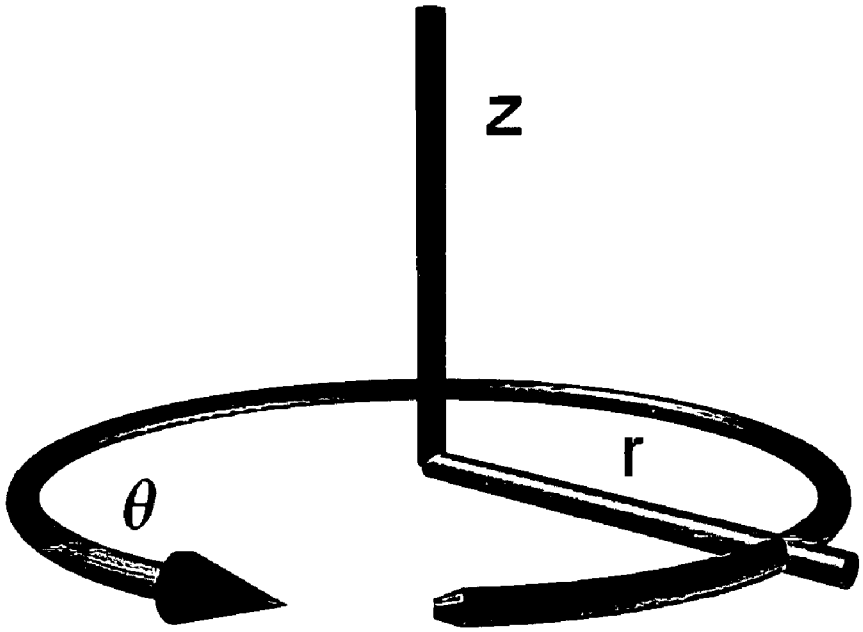

PHOTON SPACECRAFT

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a spacecraft propulsion system that employs photon particles to generate a field of negative energy in order to produce lift on the hull.

BACKGROUND OF THE INVENTION

[0002] Referring to **FIG. 1**, an electromagnetic wave traveling in the z-direction consists of an electric E field vibrating in the x-direction and a magnetic flux density B field vibrating at right angles in the horizontal y-direction. The energy-stress-momentum of this photon can be analyzed using Einstein's General Theory of Relativity and the Faraday F tensor. The Faraday tensor is a 4×4 matrix containing the electromagnetic wave components as shown here in general where c is the speed of light

$$F^{\alpha}_{\beta} = \begin{array}{c} t \\ x \\ y \\ z \end{array} \left| \begin{array}{cccc} 0 & \frac{E_x}{c} & \frac{E_y}{c} & \frac{E_z}{c} \\ \frac{E_x}{c} & 0 & B_z & -B_y \\ \frac{E_y}{c} & -B_z & 0 & B_x \\ \frac{E_z}{c} & B_y & -B_x & 0 \end{array} \right|$$

For this particular photon, this tensor is

$$F^{\alpha}_{\beta} = \begin{array}{c} t \\ x \\ y \\ z \end{array} \left| \begin{array}{cccc} 0 & \frac{E_x}{c} & 0 & 0 \\ \frac{E_x}{c} & 0 & 0 & -B_y \\ 0 & 0 & 0 & 0 \\ 0 & B_y & 0 & 0 \end{array} \right|$$

[0003] The elemental spacetime length ds squared is equal to sum of the squares of the Cartesian elemental lengths

$$(ds)^2 = -(dt)^2 + (dx)^2 + (dy)^2 + (dz)^2$$

The coefficients of this equation, $\{-1,1,1,1\}$ are the diagonal components of the g metric tensor

$$g_{\alpha\beta} = \begin{array}{c} t \\ x \\ y \\ z \end{array} \left| \begin{array}{cccc} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{array} \right|$$

The stress-energy-momentum tensor T can then be calculated for the photon using the Faraday tensor and the g metric tensor in the following equation from gravitation physics

$$4\pi T^{\mu\nu} = F^{\mu\alpha} F^{\nu}_{\alpha} - \frac{1}{4} g^{\mu\nu} F_{\alpha\beta} F^{\alpha\beta}$$

The stress-energy-momentum tensor indicates the curvature of space due to the application of electromagnetic fields, mass, angular momentum and charge. The mass of the Earth, for example, generates a negative curvature of spacetime such that objects fall toward the mass. The T tensor, which is also a 4×4 matrix, contains the momentum or flux terms in the first row and first column. The normal pressure stress is located along the diagonal. The shearing stresses are located off the diagonal. The energy term is in the upper left corner as depicted here,

$$T^{\mu\nu} = \begin{array}{c} t \\ x \\ y \\ z \end{array} \left| \begin{array}{cccc} \text{energy} & flux_x & flux_y & flux_z \\ -flux_x & pressure_x & shear_{xy} & shear_{xz} \\ -flux_y & shear_{yx} & pressure_y & shear_{yz} \\ -flux_z & shear_{zx} & shear_{zy} & pressure_z \end{array} \right|$$

[0004] Since $B^2 = E^2/c^2$, the stress-energy-momentum tensor for the photon is therefore

$$T^{\mu}_{\nu} = \begin{array}{c} t \\ x \\ y \\ z \end{array} \left| \begin{array}{cccc} \frac{-E^2}{c^2} & 0 & 0 & \frac{+E^2}{c^2} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ \frac{-E^2}{c^2} & 0 & 0 & \frac{+E^2}{c^2} \end{array} \right|$$

This remarkable result shows that the photon is actually a negative energy particle (top left corner) which is pushed along by a positive pressure wave (lower right corner). The particle has a positive flux (upper right corner) in the z-direction, as well as a balancing negative flux in the lower left corner so that the overall momentum of the universe remains the same. All four components cancel and we see the photon as a massless particle moving at the speed of light.

[0005] Thus the key idea behind this invention is that it is possible to cancel out the pressure term and leave a stationary vibrating electromagnetic field of negative energy over the hull of the spacecraft. The importance of negative energy is that it is a prerequisite to generating wormholes between space and hyperspace.

[0006] Hyperspace consists of the those co-dimensions which have different physics constants such as a low speed of light. The existence of hyperspace, which has a white misty look, is not a well-known scientific concept. Experiments with our magnetic vortex wormhole generators, hyperspace torque generator, full body levitation using Chi Kung breathing, arm levitation by spinning the co-gravitational K field, full body teleportation through hyperspace a distance of 100 meters using a pulsed gravitational wave, jumping into hyperspace, having a plate of toast enfold off the breakfast table and disappear into thin air, walking through walls and doors out-of-dimension, looking into other dimensions, remote viewing through subspace to distances of 100,000 light years, and other electromagnetic experiments carried out by co-researchers, have shown us the reality and existence of hyperspace.

[0007] Referring to **FIG. 2**, the spacecraft consists of an upper (**1**) and lower (**2**) hull attached by ceramic insulators

to a circular ring (**3**). The ring provides support and is attached to an outer sharp-edged rim which is electrostatically charged to a potential −V. The purpose of the charged rim is to generate a radial electric E field around the vehicle.

[**0008**] Referring to **FIG. 3**, the radius of the ring (**4**) is equal to a. The distance from a point on the ring to the z-axis is r. The potential on the z-axis is therefore the charge divided by the distance,

$$potZ = \frac{q}{\sqrt{a^2 + r^2}}$$

This potential is expanded as a series in terms of inverse radius r

$$potZout = \frac{35qa^8}{128r^9} - \frac{5qa^6}{16r^7} + \frac{2qa^4}{8r^5} - \frac{qa^2}{2r^3} + \frac{q}{r}$$

The potential outside the ring can be written in terms of the Legendre polynomials P

$$Vout = \sum_{n=0}^{s} \left(\frac{a}{r}\right)^{n+1} A[n] LegendreP[n, \mathrm{Cos}(\theta)]$$

where s is the number of terms in the expansion. By equating the known particular solution potZout on the z-axis with the general Vout solution, the coefficients A[n] are found to be

$$A(0) = \frac{q}{a}$$
$$A(1) = 0$$
$$A(2) = \frac{-q}{2a}$$
$$A(3) = 0$$

which are substituted back into the Vout equation to get the potential outside the ring.

[**0009**] Referring to **FIG. 4**, the potential (dotted lines **6**) looking at a slice through the ring (**5**) is shown together with the electric E field. The negative gradient of the potential is the electric field (**7**) shown by the direction of the arrows. The importance of this diagram is that the electric field points in the radial direction toward the negatively charged ring. The force on an electron is the electron charge times the electric field

$$F = q_e E_r = -|q_e|(-|E_r|) = +F$$

Because the electron charge is negative and the radial field points in the negative direction toward the ring, the force on the electron is positive. Thus the electron moves away from the ring in the positive radial direction. A 3-dimensional plot of the ring (**8**) and the electric field (**9**) is shown in **FIG. 5**.

[**0010**] The stress-energy-momentum generated by a radial electric field is calculated using the Faraday F tensor

$$F_\alpha^\beta = \begin{vmatrix} 0 & E_r & 0 & 0 \\ E_r & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{vmatrix}$$

The g metric tensor has to be given in spherical coordinates {r,θ,ϕ}

$$g_{\alpha\beta} = \begin{vmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & r^2 \sin(\theta)^2 \end{vmatrix}$$

where θ is the angle from the vertical to the radius r. The stress tensor T^{rr} along the radial direction is

$$T^{rr} = \frac{E_r^2}{8\pi c^2}$$

which shows that the pressure is negative along the radial line equal to the square of the radial electric field divided by the square of the speed of light. Because the field is squared, it doesn't matter that the electric field points in the negative direction. The square makes it positive, but the overall curvature pressure is negative. Thus this negative pressure cancels out the positive pressure propelling the photon along. The second key idea of the invention is how to generate this photon moving in the radial direction.

[**0011**] It has been known for a long time in physics that an electron moving in a circular path will emit photons in a process known by the German word Bremsstrahlung which is translated as "breaking radiation." There are several types of radiation such as classical Bremsstrahlung involving a charged particle making a collision with another charged or uncharged particle in which photons are emitted. The quantum mechanical Bremsstrahlung involves the sudden appearance or disappearance of a charged particle which also emits radiation. In space, having a field of wormholes in which the electrons are spiraling down into hyperspace would result in the emission of photons by the quantum mechanical method. Also, in the atmosphere, having collisions with air molecules results in emission of photons in the classical way.

[**0012**] In order to get the electrons to spiral around and emit photons, a crossed electromagnetic field is used as shown by the following equation

$$F = q(E_r + v_r \times B_\theta)$$

where the velocity v is in the positive radial direction due to the force of the electric field. The velocity crossed with a magnetic flux density B field in the θ-direction makes the electron move sideways back and forth in a wiggling motion.

[**0013**] Referring to **FIG. 6**, a direct current solenoid (**10**), represented by multiple current loops, running vertically

through the center of the hull, generates a magnetic field that curves around the outside of the hull, as shown by contour lines (**12**). The north pole (**11**) is at the bottom of the hull. A radial arrow (**13**) from the electrostatically-charged rim is perpendicular to the magnetic field lines. The cross product in the force equation becomes the electron radial velocity times the magnetic field $v_r B_\theta$.

[**0014**] Referring to **FIG. 7**, the electric field is in the y-direction and the magnetic field is in the z-direction. The flat looping path in the x-direction is the motion of the electron. The electron, which has a negative charge, starts to move in the direction opposite to that of the electric field. In this particular diagram, the electron acquires a velocity in the negative y-direction. Then a sideways force in the x-direction is produced due to the cross product of the velocity with the magnetic field times the negative charge

$$-q(-v_y \times B_z) = +F_x$$

Depending on the magnitude of the velocity, various size loops can be produced.

[**0015**] In terms of the hull coordinates, because the flat loop is in the plane of the electric field which points in the radial direction, the electron emits light in the radial direction. This condition means that the negative radial pressure created by the electric field cancels the radial pressure of the photon. Thus the photon becomes a stationary vibrating quantum of negative energy. This has the appearance of a luminescent light source. The stress tensor for this condition is therefore

$$T_\mu^\nu = \begin{vmatrix} -\frac{E^2}{c^2} & 0 & 0 & \frac{E^2}{c^2} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -\frac{E^2}{c^2} & 0 & 0 & 0 \end{vmatrix} = -\frac{E^2}{c^2} \text{residual negative energy}$$

[**0016**] residual negative energy

which leaves a residual negative energy per photon.

[**0017**] Referring to **FIG. 8**, the negatively charged rim (**14**) produces a radial electric field (**16**) that crosses the magnetic B field (**15**) of the solenoid. Electrons emitted by the charged rim then encounter this crossed field which makes them spiral (**17**) around the hull. Because of the tight loop, the electron emits Bremsstahlung radiation in the radial direction (**18**). The positive pressure field of the photon, which is directed in the radial direction, is canceled by the negative pressure field (**19**) created by the electric field. Because the photon energy is negative, a stationary vibrating electromagnetic quantum of negative energy (**20**) surrounds the hull.

[**0018**] This negative energy and the pressure stress created by the electromagnetic fields open up wormholes between space and hyperspace. The potential head is positive from hyperspace into space because the energy of hyperspace is more positive than the negative energy field. The low-density hyperspace energy fills the hull and its surrounding space with a white misty hyperspace energy which makes the spacecraft lighter in mass, and therefore lighter in weight within a gravitational field. The actual physics is more complicated still because the electrons find that the resistance of hyperspace is lower than the resistance of space. Thus they spiral down the wormholes which results in a sudden disappearance of charge. The quantum mechanical effect of this is to radiate even more photons which in turn produce even more negative energy.

[**0019**] The lift on the hull is generated by the radial electric field. In cylindrical coordinates, the g metric tensor is

$$g_{\alpha\beta} = \begin{vmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

Using this metric tensor, the pressure stress in the vertical direction T^{zz} is

$$T^{zz} = \frac{E^2}{8\pi c^2}$$

which is a positive curvature over the hull. The mass of Earth produces a negative curvature in which objects fall toward the mass. By counteracting this negative curvature with a more than positive curvature, lift is developed on the spacecraft. Because the negative energy lowers the effective mass of the vehicle, the acceleration is large with a modest electric field. Moreover, in our dimension, the speed of light is 299792458 meters per second. Hyperspace energy has a speed of light equal to one meter per second. Thus the stress is amplified by a factor of

$$A = \left(\frac{299792458\,m/s}{1\,m/s}\right)^2 \approx 9 \cdot 10^{16}$$

Because electromagnetic fields are relativistic, motion in a low-velocity-of-light energy field amplifies their strength.

SUMMARY OF THE INVENTION

[**0020**] It is the object of this invention to create a spacecraft propulsion system that produces wormholes between space and hyperspace using negative energy in order to generate lift on the hull. It was discovered in the Riemannian curvature calculations of gravitation physics that negative energy is required to keep open the throat of the wormhole. From experiments with the magnetic vortex wormhole generator, it is known that the proper combination of electromagnetic fields, together with this negative energy, can create a wormhole through which smoke can be blown into hyperspace.

[**0021**] Referring to **FIG. 9**, the directions of force, velocity, and electromagnetic fields are referred to in the cylindrical coordinate system {r,θ,z}. An electrostatically charged sharp-edged ring in the θ-direction around the hull of the spacecraft produces a radial electric field. A vertical solenoid in the z-direction through the center of the hull

produces a magnetic field which is perpendicular at the rim to the electric field. With the current in the solenoid flowing in the clockwise (−θ) direction, using the right-hand rule, the magnetic field points in the upward z-direction outside the rim. Because the rim is charged to a negative voltage, the electric field points toward the hull in the negative radial (−r) direction. Electrons emitted by the rim travel outward (+v) because the charge on the electron is negative which, together with the negative electric field, produces a positive radial force. The radial force on the electron causes it to acquire a velocity which interacts with the magnetic field. The cross product of the velocity (+v) with the positive (+B) magnetic field produces a sideways force on the electron in the negative θ-direction. However, because the charge on the electron is negative, the force is

$$F=-q\{v_r,0,0\}\times\{0,0,B_z\}=\{0,qB_zv_r,0\}$$

which is positive in the θ-direction. It is this sideways force that produces a flat spiraling or looping motion whereby the electron emits photons, known in German as Bremsstahlung radiation, in the radial direction. The photon, which is actually a quantum of negative energy, has a positive radial pressure which propels it along. Because the radial electric field produces a negative pressure in the radial direction, the two opposite fields cancel in the radial direction to form a residual stationary vibrating negative energy. Thus the hull becomes surrounded by negative energy which, together with the pressure stresses created by the electric field, generates wormholes between space and hyperspace.

[0022] The gravitational potential between hyperspace and space is positive because the hyperspace energy is more positive than the negative energy around the hull. Thus the low-density, low-speed-of-light hyperspace energy flows through the wormhole and fills the hull. This has the effect of reducing the effective mass of the hull. Because the electric field generates a positive pressure over the hull in the vertical z-direction, there is an upward force on the vehicle due to the pressure times the hull area. Since the vehicle has a low mass, there is a modest upward acceleration on the spacecraft equal to the force divided by mass.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0023] **FIG. 1**. Perspective view of an electromagnetic wave.

[0024] **FIG. 2**. Perspective view of spacecraft.

[0025] **FIG. 3**. Perspective view of charged ring.

[0026] **FIG. 4**. Planar plot of the radial electric field produced by charged ring.

[0027] **FIG. 5**. Perspective view of radial electric field around ring.

[0028] **FIG. 6**. Planar view of magnetic flux density field contour lines.

[0029] **FIG. 7**. Perspective view of electron motion in crossed electric and magnetic fields.

[0030] **FIG. 8**. Perspective view of production of negative energy around hull.

[0031] **FIG. 9**. Perspective view of cylindrical coordinate system {r,θ,z}.

DETAILED DESCRIPTION OF THE INVENTION

[0032] 1. The hull is made from a single sheet of aluminum which has been stretched to its yield point by hydraulic cylinders. An upper and lower die is CNC machined to the profile of the hull. The soft sheet is then clamped in the die where it takes on the smooth shape of the hull without any wrinkles. The hull is extremely rigid after forming and does not require any structural reinforcements.

[0033] 2. A section of the aluminum ring is made in a 3D computer graphics program. The model is stored as a stereolithography file (*.stl). The computer model is then sent via Internet e-mail to the stl server who prints the part in an ultraviolet light-cured polymer. The part is returned the next day by Express Mail. Using a rubber blanket mold to create several ring sections, the entire ring is assembled together in another wooden mold box having thin circular laminate-coated particulate wall boards on either side of the ring. Then a liquid rubber mold is poured on top of the ring and allowed to harden overnight at room temperature. Since the rubber mold is flexible, the ring can be extracted fairly easily. This ring model is then sent to the foundry where it is cast in aluminum using the lost wax process in which a wax mold evaporates out of the sand casting. We are also experimenting with non-magnetic copper casting metals containing beryllium having good conductivity.

[0034] 3. A 11.5 cm plastic pipe is mounted on a rotating fixture driven slowly by a microcontoller, stepper motor, and power electronics board. Using a large diameter insulated wire, such as a 17 AWG with a wire diameter of 0.127 cm, the wire is wound slowly on the pipe and expoxied so that the windings don't come loose. The solenoid is then mounted vertically in the hull supported by the support ring and driven by a current generator located nearby on the test rig.

[0035] 4. The ring is driven by a high voltage electrostatic generator similar to the night vision scope high voltage power supplies. The ring charge is isolated from the hull by ceramic insulators.

I claim:

1. A spacecraft propulsion system comprising the components:

an aluminum horizontal circular structural support ring;

an aluminum hull in the shape of a high dome on top and shallow dome on the bottom attached to the circular support ring using ceramic insulators;

an electrostatically negatively-charged sharp-edged circular ring, preferably of non-magnetic aluminum or copper, attached with ceramic insulators to the outside of the support ring;

a solenoid mounted through the center of the hull in the vertical direction and attached to the center of the support ring;

an electrostatic high-voltage generator to drive the outer electrostatic ring; and

a direct high-current generator to drive the solenoid.

2. The method of claim 1, wherein a negative radial electric field is generated around the hull by placing a negative potential on the sharp-edged electrostatic ring using the electrostatic generator.

3. The method of claim 1, wherein the current-driven solenoid generates a vertical magnetic field around the hull with the north pole of the solenoid facing down through the bottom of the hull which causes the magnetic flux density field to point up outside the rim.

4. The method of claim 1, wherein electrons are emitted radially by the sharp edge of the charged ring.

5. The methods of claims **2**, **3** and **4**, wherein the crossed electromagnetic fields cause the electrons to spiral around in flat loops during which photons are emitted in the radial direction.

6. The methods of claims **2** and **5**, wherein the negative radial pressure created by the electric field cancels the positive radial pressure of the photon to leave a residual quantum of negative energy per photon around the hull.

7. The methods of claims **2** and **6**, wherein the pressure stress created by the electric field, and the negative energy combine to form wormholes between space and hyperspace.

8. The method of claim 7, wherein low-density hyperspace energy of a higher gravitational potential flows through the wormholes to fill the hull and surrounding space around the hull with the effect of reducing the effective mass of the spacecraft.

9. The method of claim 2, wherein the electric field generates a positive pressure in the vertical direction over the hull which together with the hull surface area, generates an upward lift force on the hull.

10. The method of claim 6, wherein the negative energy, having a low light speed, amplifies the strength of the electromagnetic fields and pressure stress fields.

11. The methods of claims **4** and **7**, wherein the electrons spiral down the low resistance wormholes into hyperspace such as to create a sudden disappearance of electrical charge which quantum mechanically causes a large emission of additional photons.

* * * * *

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(54) CAVITATING OIL HYPERSPACE ENERGY GENERATOR

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(52) **U.S. Cl.** **244/10**

(57) **ABSTRACT**

A hyperspace energy generator that uses cavitating oil bubbles within a magnetic field in order to create wormholes between space and hyperspace for the purpose of permeating the hull of a spacecraft with low-density hyperspace energy.

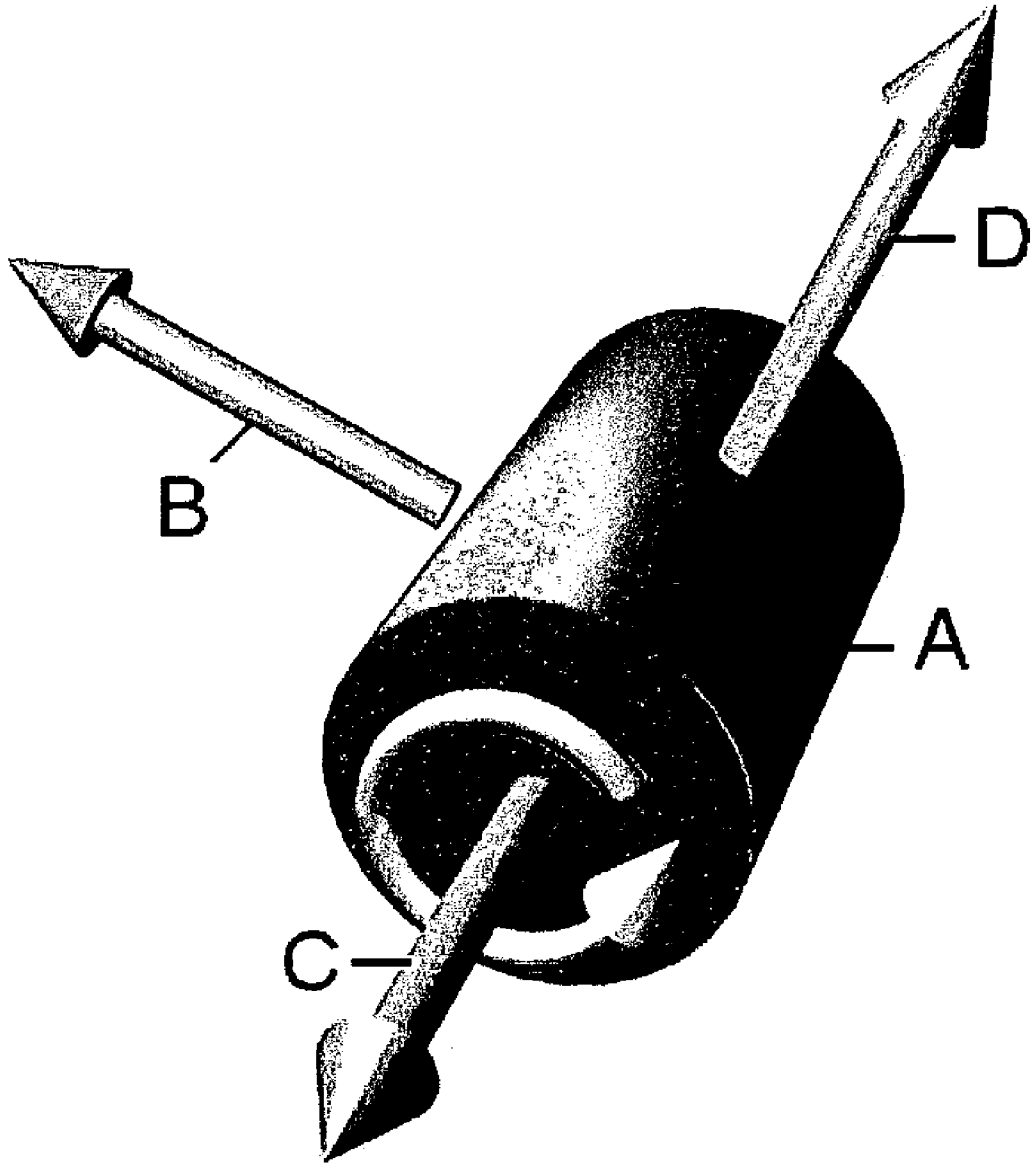

Figure 1

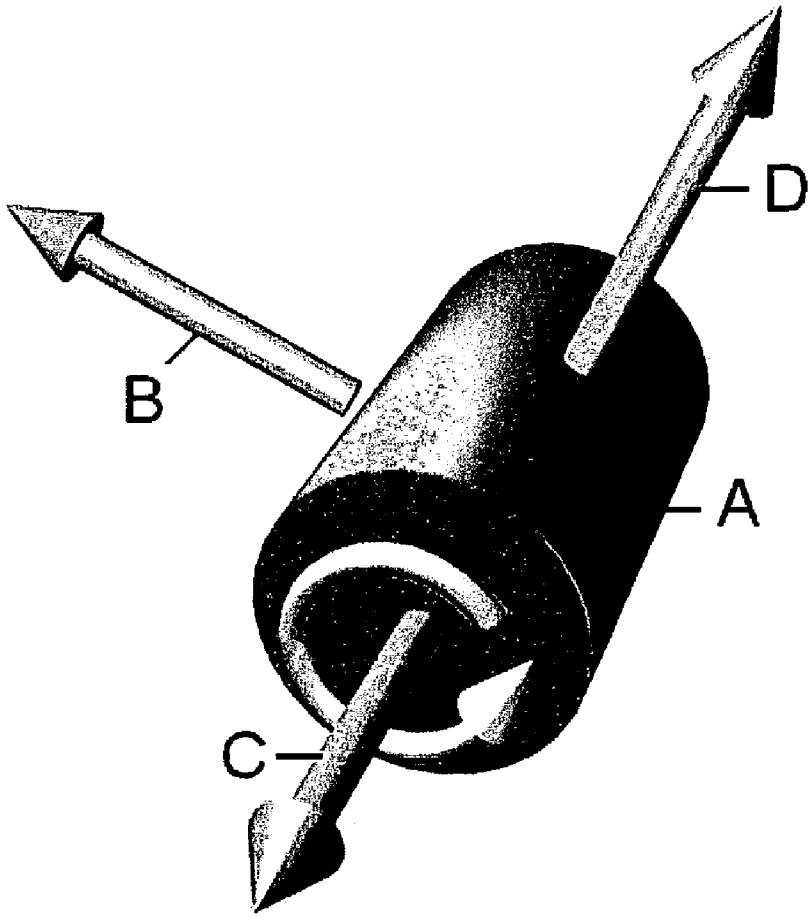

Figure 2

Figure 3

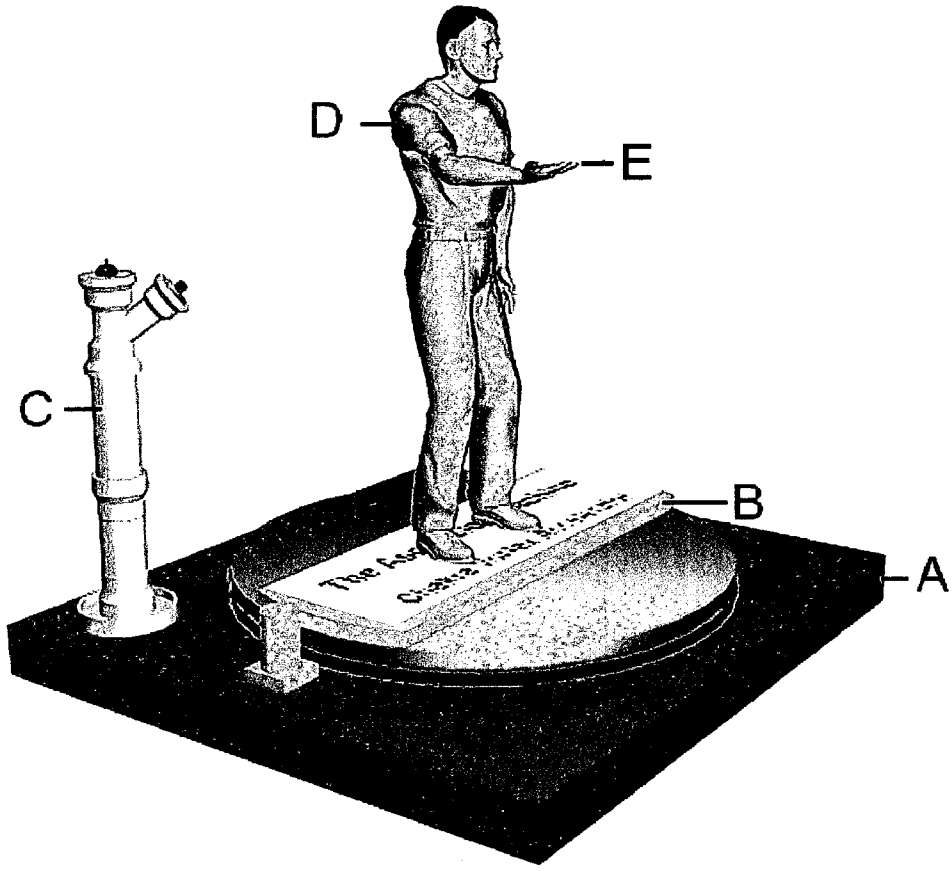

Figure 4

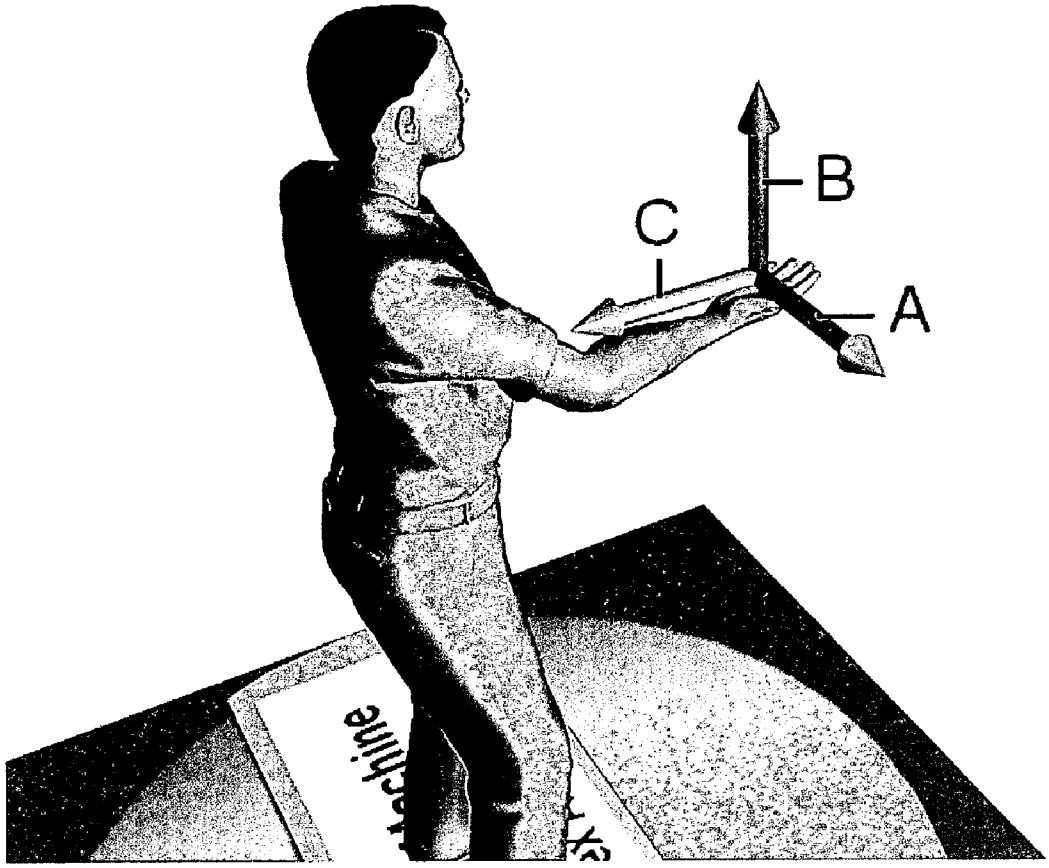

Figure 5

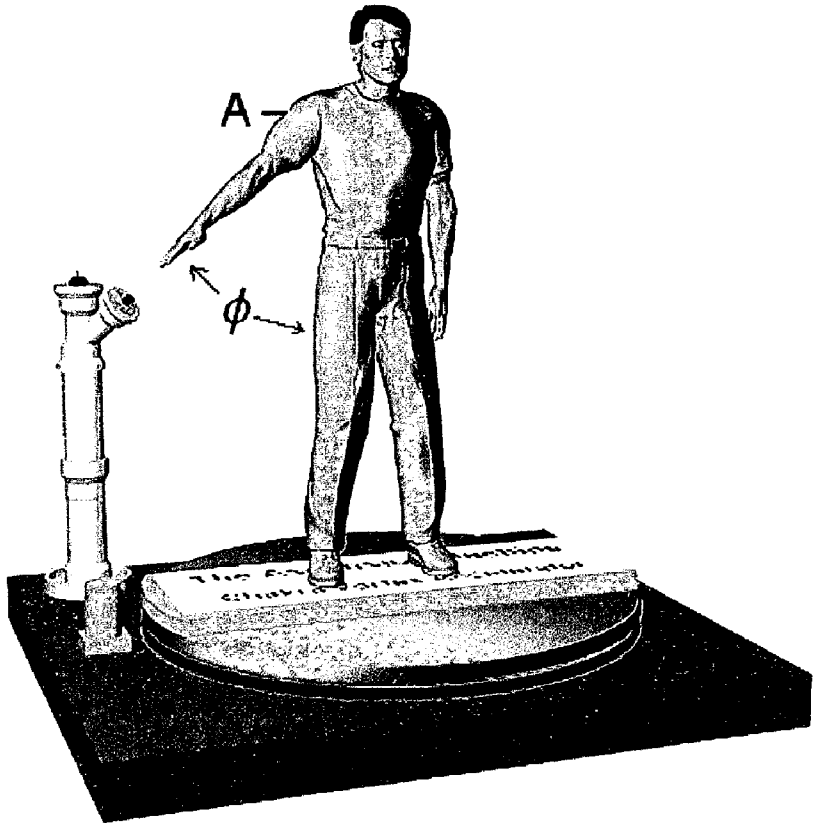

Figure 6

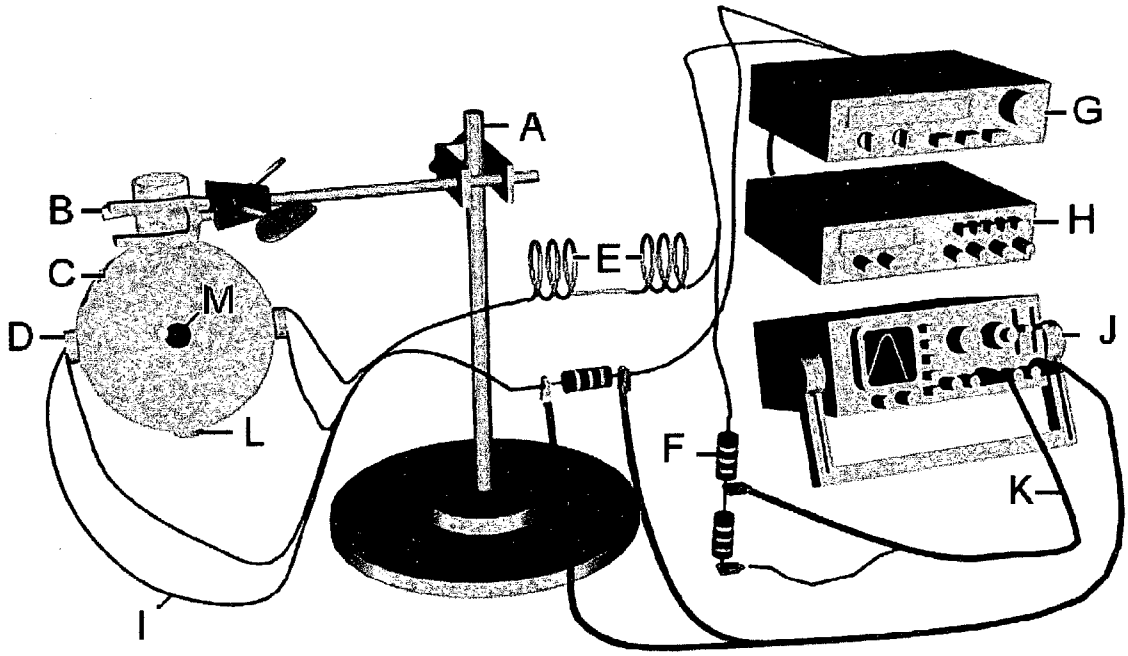

Figure 7

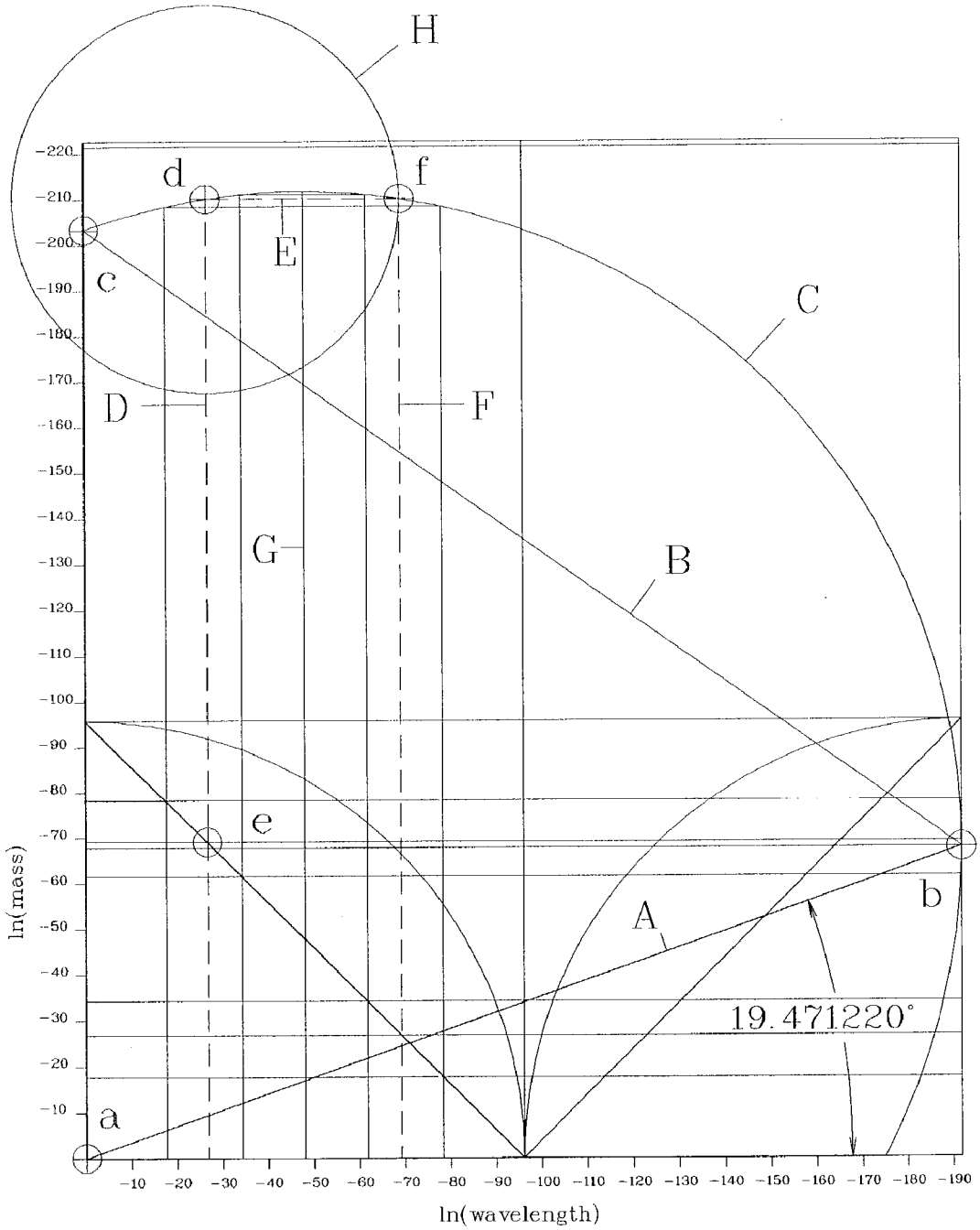
H
d
f
E
c
C
D
F
G
B
e
A
b
a
19.471220°
ln(mass)
ln(wavelength)
-220
-210
-200
-190
-180
-170
-160
-150
-140
-130
-120
-110
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190

Figure 8

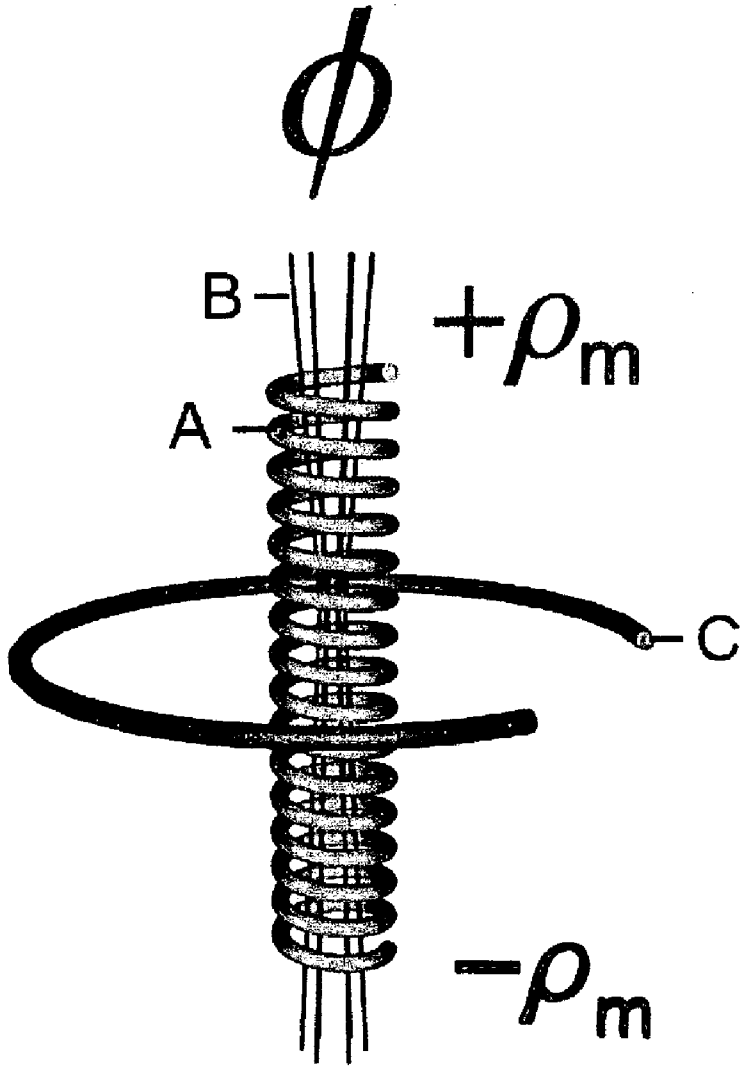

Figure 9

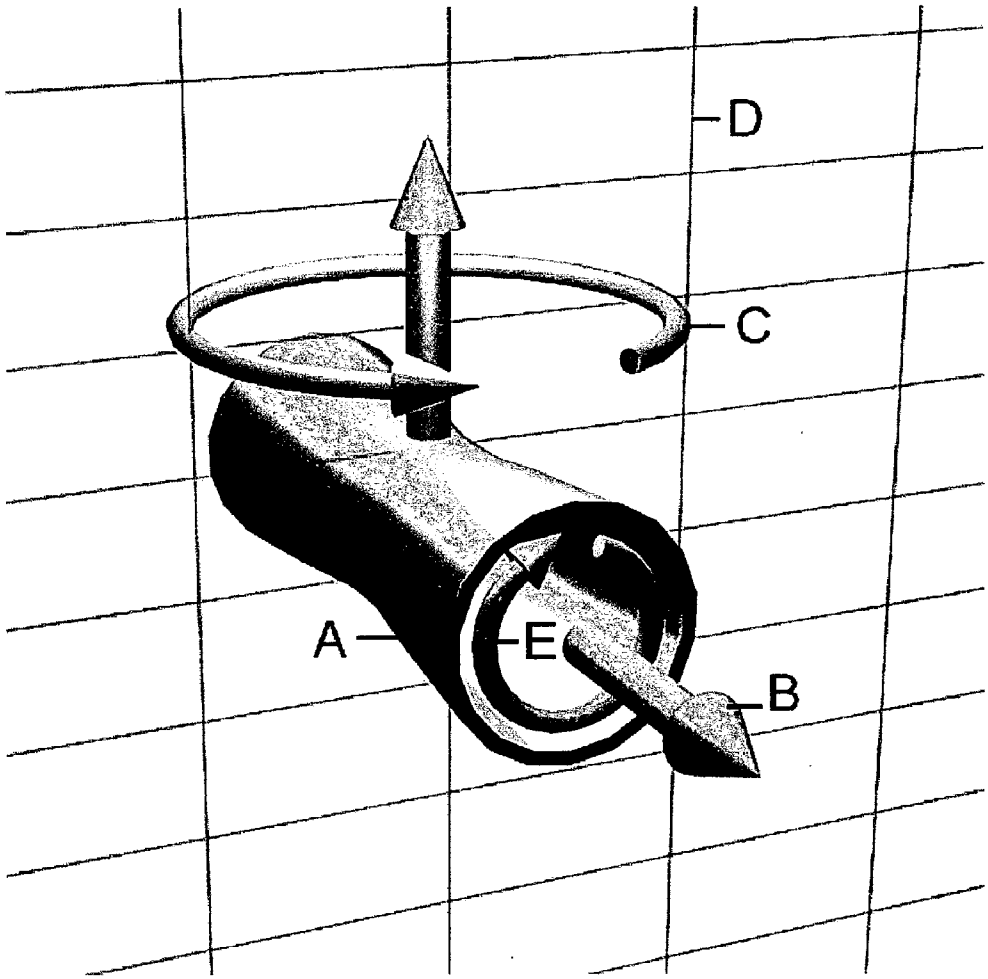

Figure 10

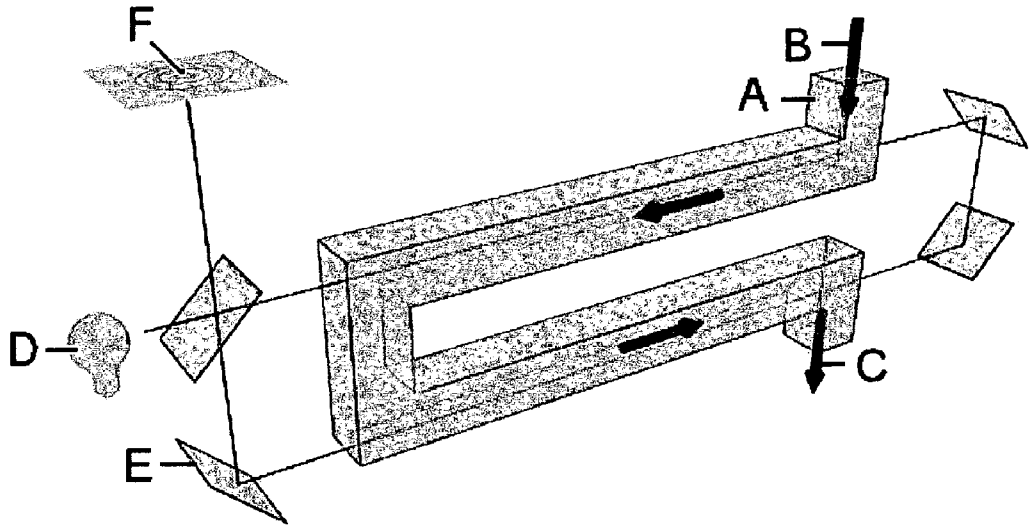

Figure 11

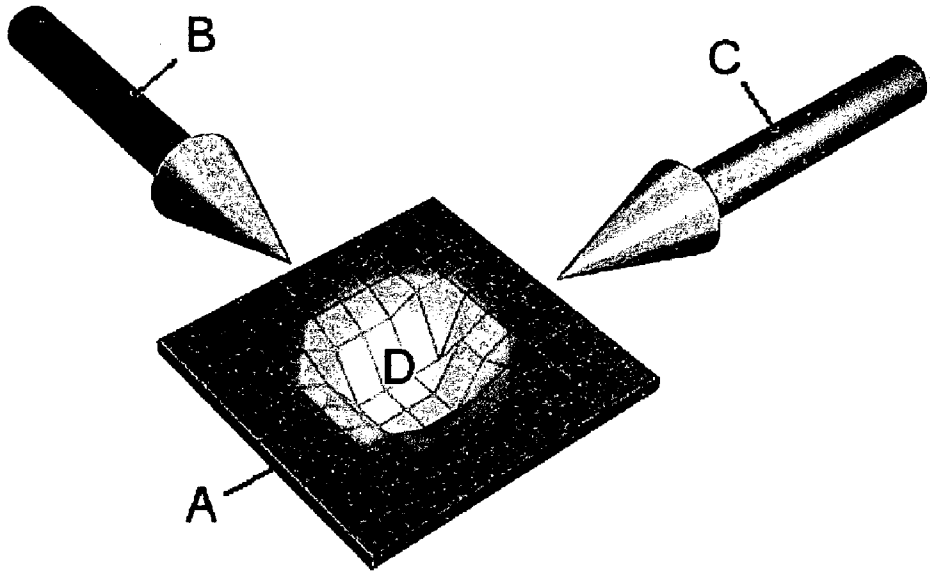

Figure 12

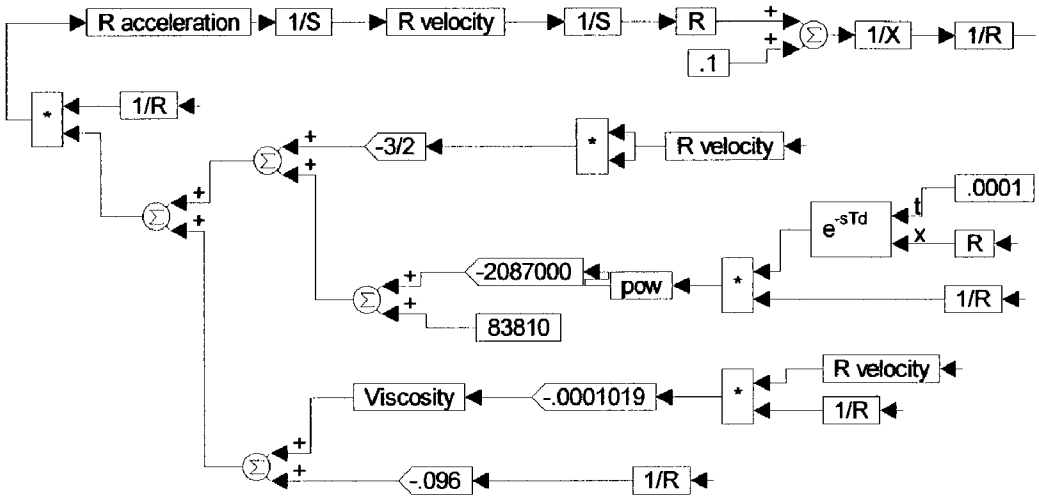
R acceleration
1/S
R velocity
1/S
R
.1
1/X
1/R
1/R
-3/2
R velocity
.0001
t
x
R
-2087000
pow
1/R
83810
R velocity
Viscosity
-.0001019
1/R
-.096
1/R

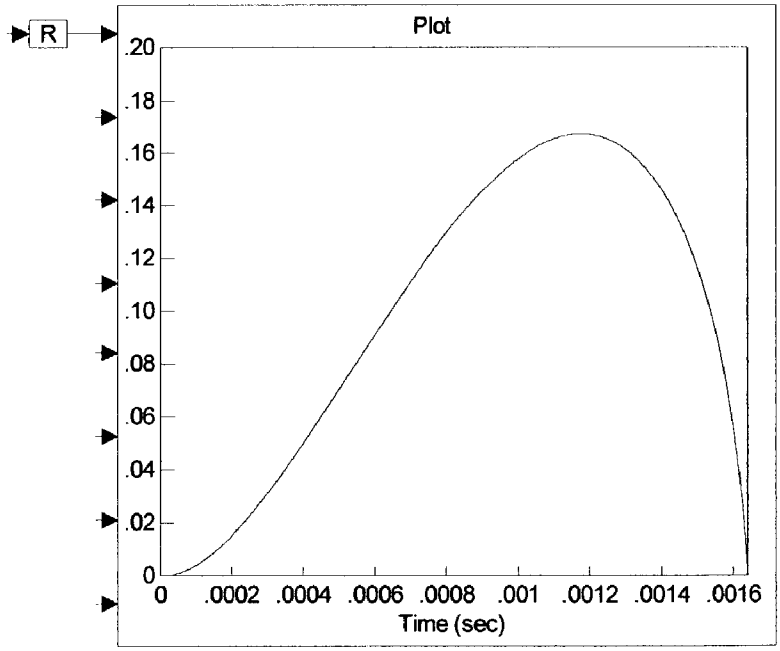
R
Plot
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
0
.0002
.0004
.0006
.0008
.001
.0012
.0014
.0016
Time (sec)

Figure 13

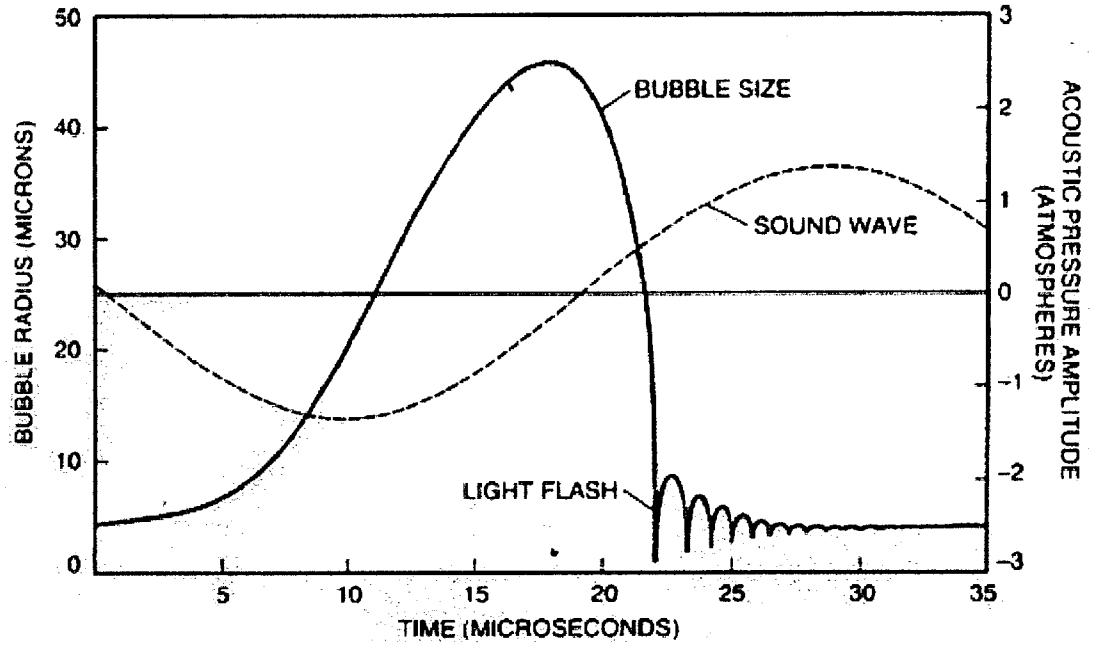
BUBBLE SIZE
SOUND WAVE
LIGHT FLASH
BUBBLE RADIUS (MICRONS)
ACOUSTIC PRESSURE AMPLITUDE (ATMOSPHERES)
TIME (MICROSECONDS)
50
40
30
20
10
0
3
2
1
0
-1
-2
-3
5
10
15
20
25
30
35

Figure 14

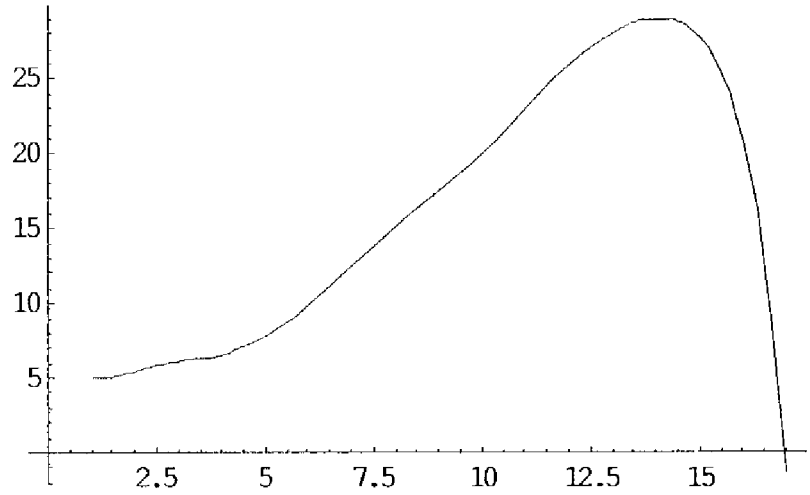

Figure 15

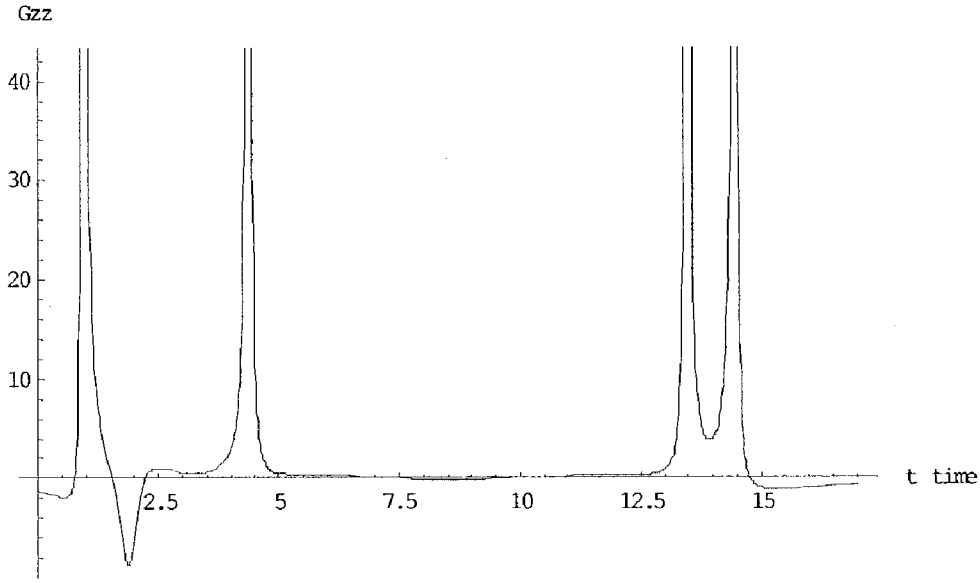

Figure 16

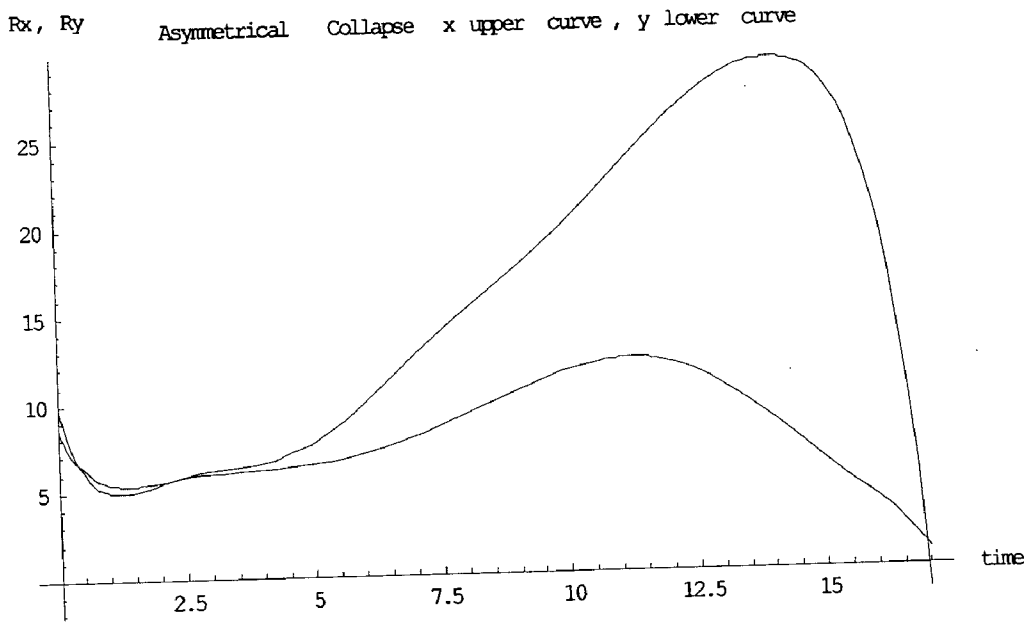
Rx, Ry
Asymmetrical Collapse x upper curve , y lower curve
25
20
15
10
5
2.5
5
7.5
10
12.5
15
time

Figure 17

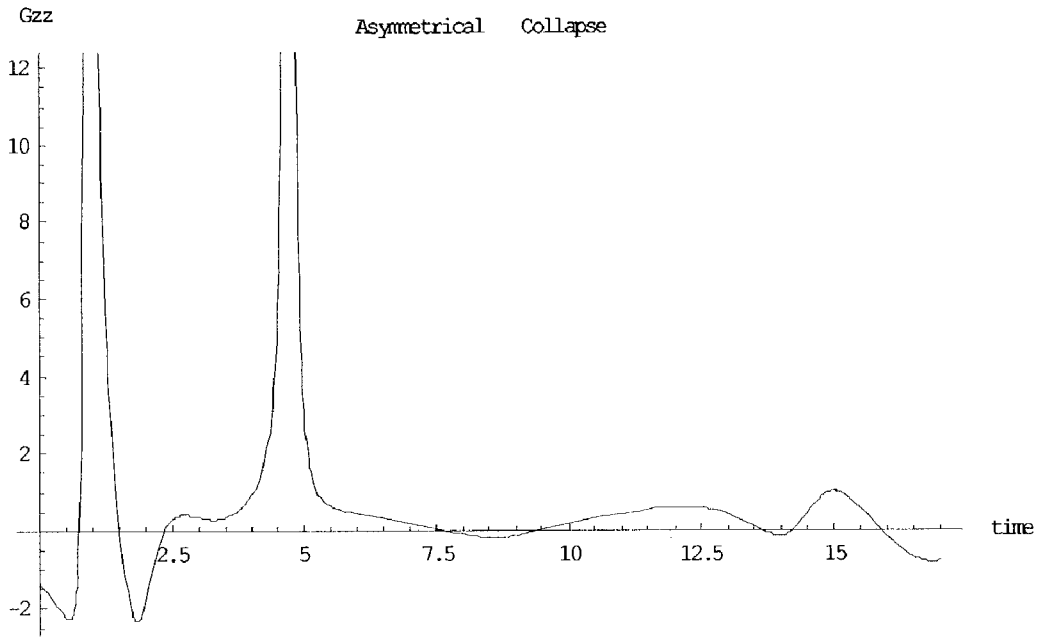

Figure 18

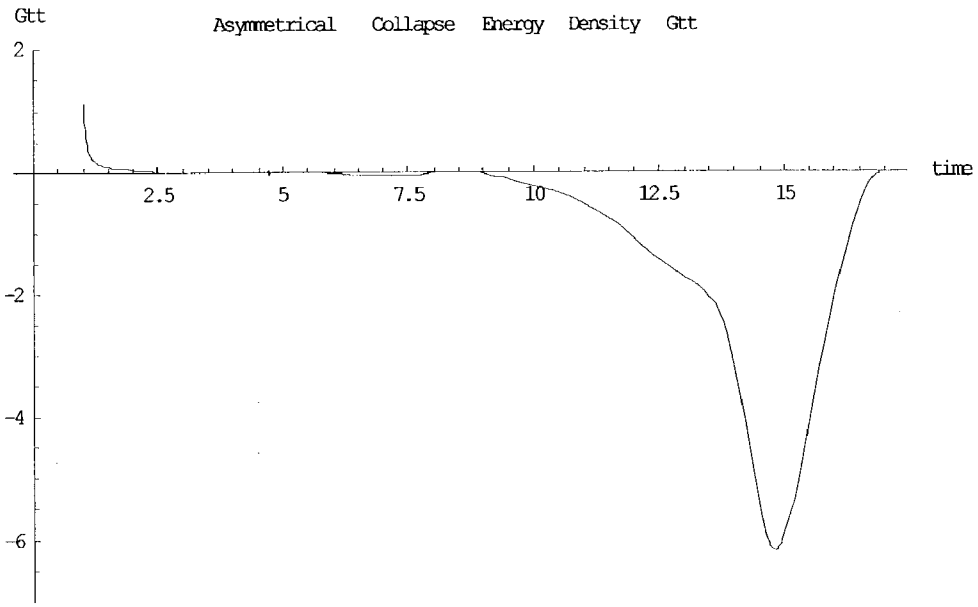
Gtt
Asymmetrical Collapse Energy Density Gtt
2
-2
-4
-6
2.5
5
7.5
10
12.5
15
time

Figure 19

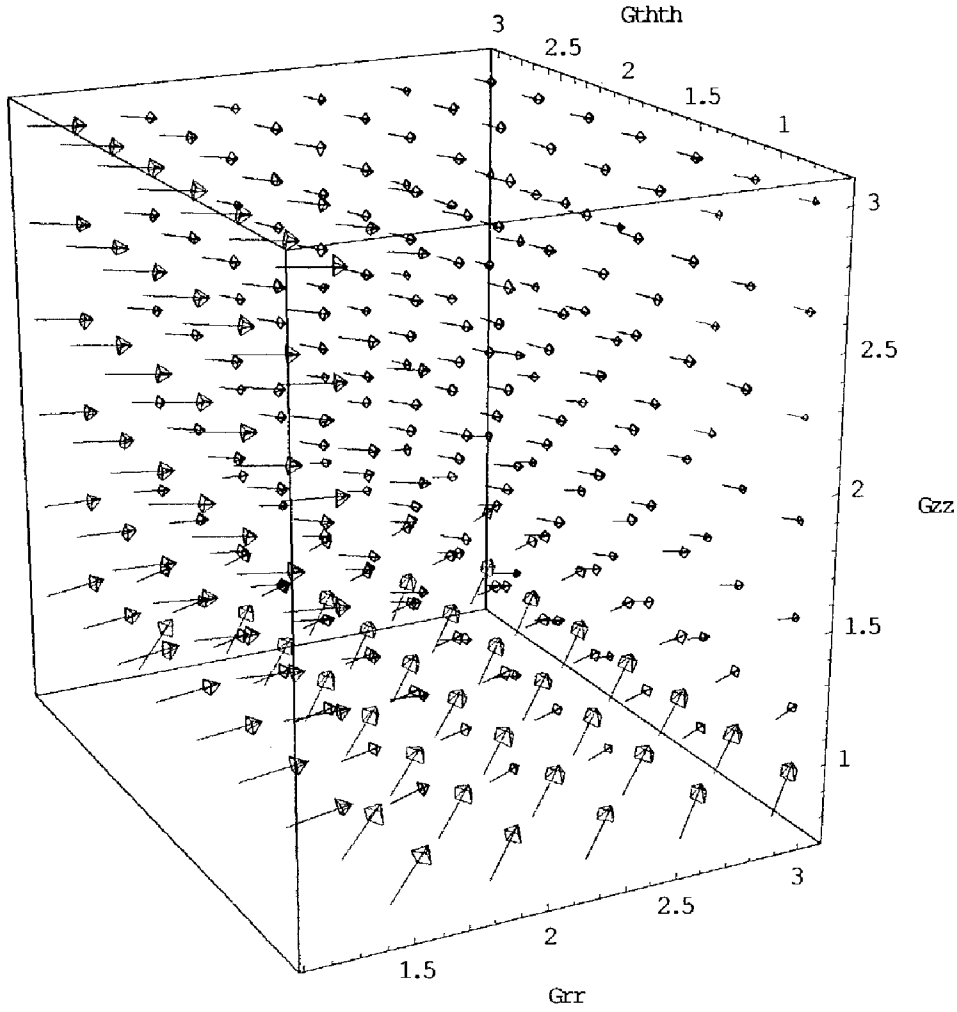

Figure 20

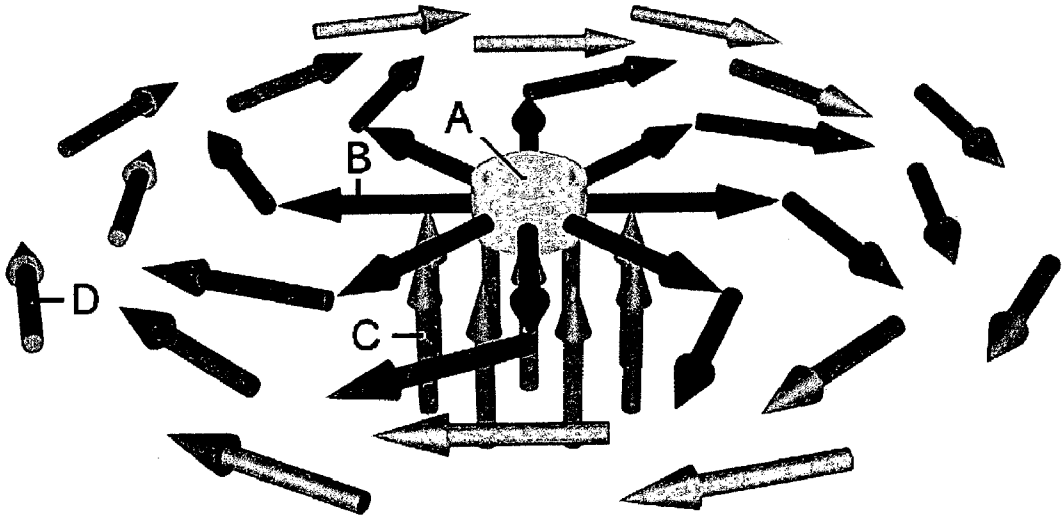

Figure 21

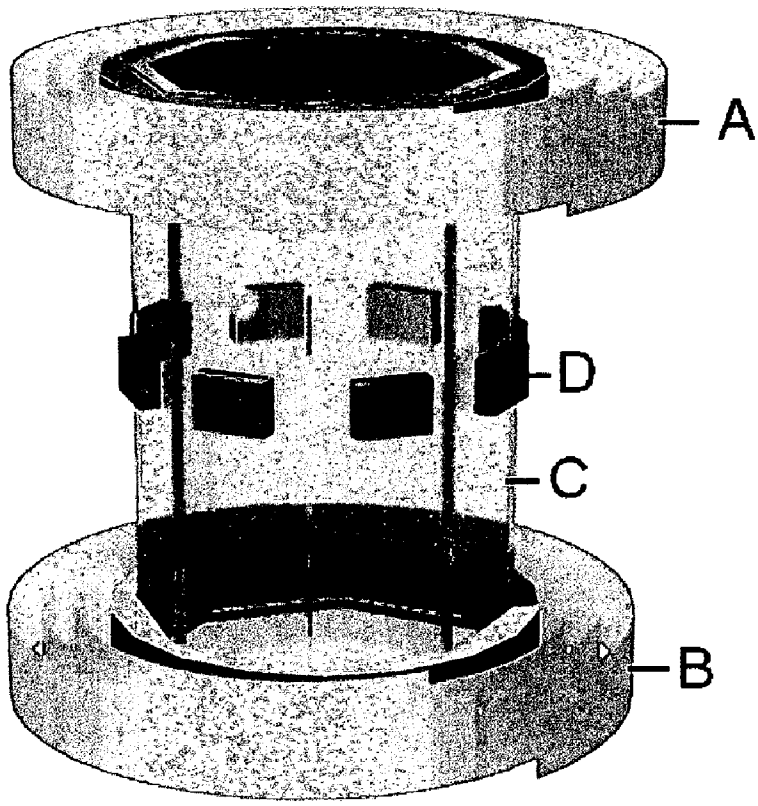

Figure 22

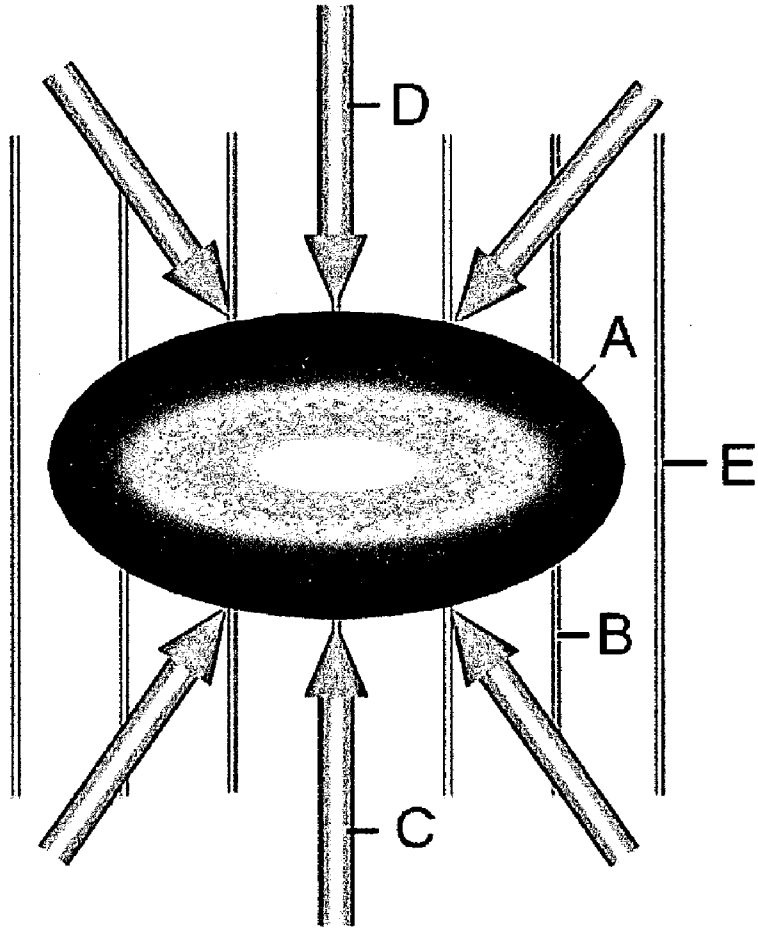

Figure 23

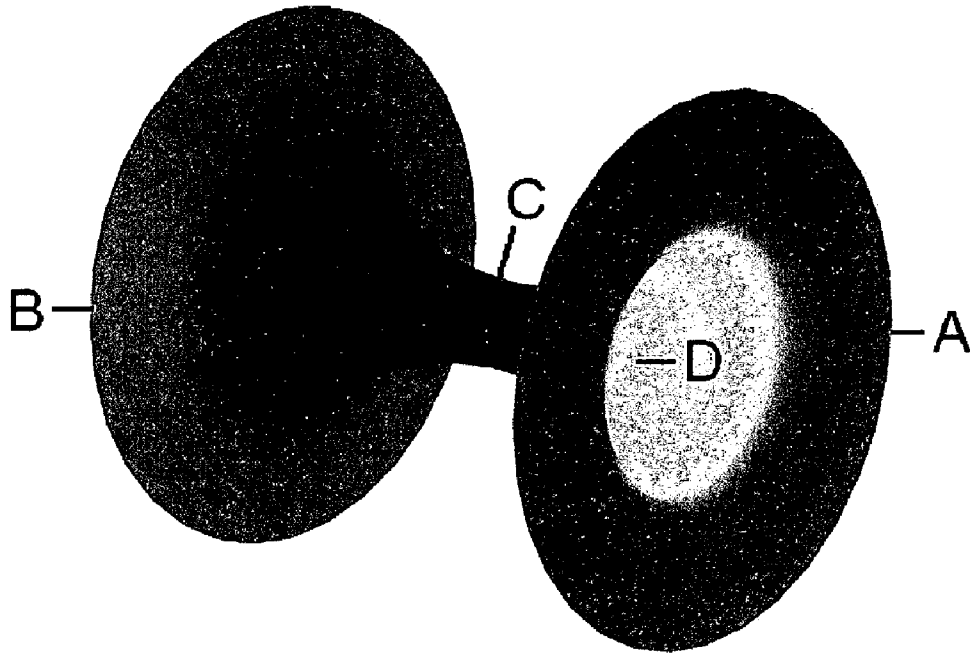

Figure 24

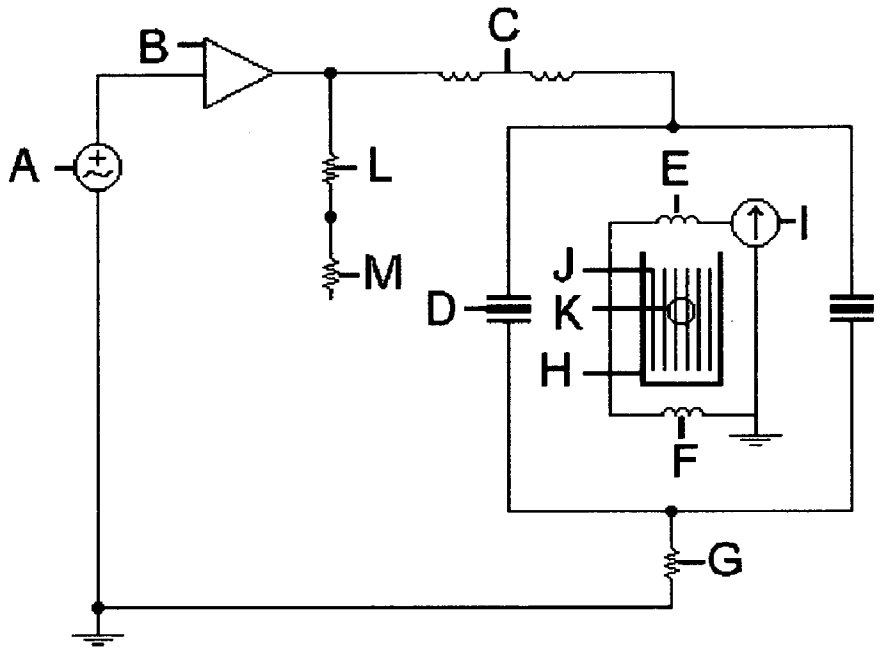

CAVITATING OIL HYPERSPACE ENERGY GENERATOR

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a hyperspace energy generator that uses cavitating oil bubbles within a magnetic field in order to create wormholes between space and hyperspace for the purpose of permeating the hull of a spacecraft with low-density, low-speed-of-light hyperspace energy.

BACKGROUND OF THE INVENTION

[0002] As shown by physicist Dr. John Archibald Wheeler of Princeton University, there is a second term in Newton's gravitational equation which includes an additional force depending on whether or not the body is spinning.

$$F=mg+m(v\times\Omega)$$

[0003] where F is the force, m the mass, g the acceleration of gravity, v the forward velocity of the body, and Ω the angular velocity of the body. Referring to **FIG. 1**, a rotating cylinder (A) is moving with a velocity (B) while spinning counterclockwise as shown by the angular velocity vector (C). The velocity crossed with the angular velocity vector produces a force in the upward direction (D).

[0004] Referring to **FIG. 2**, a pendulum (A) held in the left hand over the right hand will spin in the counterclockwise direction due to the hyperspace energy vortex (B) emanating from the palm of the right hand. This vortex arises because human beings are hyperspace energy beings that live in physical containers located in this universe. The vortex might be considered a wormhole between space and hyperspace. Notice that the angular momentum vector of the vortex points up out of the palm of the hand. If the hand were spinning from left to right, then there would be a force exerted, as shown by the above equation, that would bring hyperspace energy into the right arm.

[0005] Referring to **FIG. 3**, in order to test this hypothesis, a Chakra Vortex Accelerator was built for the purpose of spinning this hand vortex. The motor-driven machine has a base (A) on which is mounted a warehouse palletizing ring and platform (B). A control column (C) has a speed control and on/off switch. A person (D) stands on the platform with his right arm outstretched and palm facing upward (E). The platform spins from left to right.

[0006] Referring to **FIG. 4**, the velocity vector (A) points to the right. The angular momentum vector of the rotating chakra energy vortex points up. The cross product A×B=C produces a force that brings in high permeability hyperspace energy into the arm.

[0007] Referring to **FIG. 5**, after spinning 99 times per day for a few months, it was noticed that the right arm (A) would remain out at an angle ϕ from the body without making any exertion to do so. The left arm, which was not receiving the energy, remained at the side of the body. That is, the low-density hyperspace energy in the right arm was making the arm lighter and producing a subsequent anti-gravitational effect. The conclusion was that it might be possible to invent some device which would produce large amounts of hyperspace energy. This would make possible relativistic electromagnetic fields which can be used to produce the lift force for electromagnetic field propulsion vehicles.

[0008] Then in the February 1995 issue of *Scientific American*, an article appeared entitled *Producing Light from a Bubble of Air* which gave the details for producing sonoluminescence from a cavitating bubble using a kit for sale containing the piezoelectric transducers. Referring to **FIG. 6**, the experimental setup includes a ring stand (A) with a three-finger clamp (B) holding a 100 milliliter flask containing degassed water produced by a Walsh vacuum/pressure pump. Piezoelectric drive transducers (D) are mounted on the sides of the flask in order to create sound pressure waves which create the cavitation bubble (M) in the center of the flask. The transducers are connected by insulated wire (I) to a pair of inductors (E) having a mutual inductance between them. These inductors are driven by a frequency generator (H) connected to an audio amplifier (G). The oscillation signals are picked up by the oscilloscope (J) which is connected to the resistors (F) using the probes (K). The piezoelectric drive transducers act electrically as capacitors. The inductors are wired in series with the capacitance such that the combination resonates at the frequency at which acoustic resonance occurs. Bubbles introduced into the flask tend to coalesce in the center of the flask Above a certain sound intensity, the bubble will collapse and emit a dim light visible to the unaided eye in a darkened room, a process called sonoluminescence.

[0009] Further research showed that there were some earlier doctoral theses available. One of them by Dr. Steven DeWitt Horsburgh entitled *Radial Instabilities of a pulsating air bubble in water* mentioned a most interesting observed phenomenon of the surface oscillations called a "beaconing effect." When a bubble exhibited a stable or long-lived shape oscillation lasting more than two minutes, the bubble had a tendency to slowly precess. The precession rate was on the order of a few hertz which can be taken to mean around 3 Hz. Visually, the beacon looked like a light house beacon. It was a very obvious effect and when the beacon crossed the photodiode, the output voltage increased by at least an order of magnitude.

[0010] Upon reading this, it became apparent that sonoluminescence is involved with gravitational hyperspace physics. Einstein's theory says that inertia is a manifestation of the geometry of spacetime. It also says that geometry is affected by the presence of matter to an extent proportional to the factor G/c^2 where G is the gravitational constant and c is the speed of light. The inverse of this factor is the linear mass Ω of the universe. A spherical shell of mass m with a radius R will create a drag angular velocity on a pendulum equal to

$$\omega_{drag}=\frac{4}{3}\frac{G}{c^2}\frac{m_{shell}}{R_{shell}}\omega_{shell}=\frac{4}{3}\frac{\frac{m_{shell}}{\Omega}}{R_{shell}}\omega_{shell}$$

[0011] The mass of the shell divided by the linear mass (mass per length) converts the mass into a length which is then divided by the radius of the shell which is also a length. The numerical factor 4/3 is found only by a detailed calculation. The calculation, starting from a flat background spacetime manifold, showed the effect of the moving current of mass on the metric. Expressed in polar coordinates, the metric acquires a non-zero coefficient $g_{\phi t}$. Inserted into the equation for geodesic motion, this off-diagonal metric coef-

ficient gives rise to a precession according to the above equation. The numerical factor corresponds to a pendulum located anywhere inside the rotating shell of mass.

[0012] In other doctoral theses, books and physics articles on cavitation, light is emitted after the bubble starts to collapse. A very sharp peak of light is produced which lasts in terms of picoseconds. Thus this type of sonoluminescence is very different than the beaconing effect where the bubble remains stable for long periods of time. The beaconing effect is actually a rotating wormhole between space and hyperspace.

[0013] Briefly what happens is that there is ionized gas in the bubble which releases electrons. As the electrons spiral down through the wormhole from space into hyperspace, they give off light. This situation puts the electrons in contact with the charge of hyperspace. Space has a charge which is equal to the sum of the electron charge q_e and the hyperspace charge q_h. The charge of space q is equal to the Planck mass times a conversion factor between mass and charge. The Planck mass is equal to the linear mass Ω of the universe times the bottom dimensional limit of the universe known as the Planck scale Λ. The conversion factor is the square root of the gravitational constant G times the permittivity of space ϵ. The permittivity is linear capacitance or capacitance per unit length. Thus the charge of space is

$$q=\Lambda\Omega\sqrt{G\epsilon}=q_e+q_h$$

[0014] Because the electron comes in contact with the hyperspace charge, the drag angular velocity in the above equation has to be modified. Notice that if the angular velocity of the shell is modified by the electron fine structure constant α, and the mass involved is the mass of the electron, moving through a radius into hyperspace of the Planck scale Λ, then the drag angular velocity would be

$$\omega_{drag}=\frac{4}{3}\frac{\frac{m_{electron}}{\Omega}}{\Lambda}\omega_{shell}\frac{1}{\alpha}$$

[0015] The angular frequency of the shell is 2π times the electron frequency f_e.

$$\omega_{shell}=\omega_{electron}=2\pi f_e$$

[0016] The inverse of the electron fine structure constant α is equal to Planck's reduced constant $\hbar$ times the speed of light c times the factor 4π times the permittivity of space ϵ divided by the square of the charge of the electron q_e.

$$\frac{1}{\alpha}=\frac{\hbar c 4\pi\varepsilon}{q_e^2}n=137.037916527$$

[0017] Planck's constant is equal to the Planck scale Λ squared times the linear mass Ω times the speed of light.

$$\hbar=\Lambda^2\Omega c$$

[0018] Notice that the fine structure constant has a square in it and Planck's constant also has a square. If the electron charge were traveling through the Planck scale into hyperspace, then there would be a linear charge equal to the electron charge divided by the Planck scale

$$\frac{1}{\alpha}=\frac{\hbar c 4\pi\varepsilon}{q_e^2}n=\frac{\Lambda^2\Omega c c 4\pi\varepsilon}{q_e^2}n=\frac{4\pi\Omega\varepsilon c^2}{\left(\frac{q_e}{\Lambda}\right)^2}n$$

[0019] The constant equal to the linear mass Ω times the permittivity times the square of the speed of light is actually the square of the linear charge χ of space. So the fine structure constant can be written

$$\frac{1}{\alpha}=4\pi n\frac{(\chi)^2}{\left(\frac{q_e}{\Lambda}\right)^2}=4\pi n\frac{\left(\frac{q}{\Lambda}\right)^2}{\left(\frac{q_e}{\Lambda}\right)^2}=4\pi n\left(\frac{q}{q_e}\right)^2=4\pi n\left(\frac{q_h+q_e}{q_e}\right)^2=$$
$$4\pi n\left(\frac{q_h}{q_e}+1\right)$$

[0020] So the electron fine structure constant is related to the ratio of the charge of hyperspace to the charge of the electron, which is the reason that the equation had to be modified. The electron moving across the Planck scale wormhole is modified by the hyperspace charge it is seeing in a hyperspace co-dimension. This confirms that the beaconing effect is a rotating wormhole into hyperspace.

[0021] The electron fine structure constant is actually the fastest velocity in the Bohr atom. The fine structure constant is the ratio of the electron orbital velocity to the speed of light.

$$\alpha=\frac{v_n}{c}$$

[0022] where the permitted quantized n orbital speeds are v_n/n or v/1, v/2, v/3 and so on. Using a value of v/3, the fine structure constant would be

$$\frac{1}{\alpha}=\frac{3c}{v}=4\pi n\left(\frac{q_h}{q_e}+1\right)=12\pi\left(\frac{q_h}{q_e}+1\right)$$

[0023] which when substituted into the drag angular frequency equation

$$\omega_{drag}=\frac{4}{3}\frac{\frac{m_e}{\Omega}}{\Lambda}2\pi f_e\,12\pi\left(\frac{q_h}{q_e}+1\right)=17.809\ \frac{\text{radians}}{\text{sec}}$$

[0024] The frequency of precession is

$$f_{drag}=\frac{\omega_{drag}}{2\pi}=2.83\ \text{Hz}$$

[0025] which is close to the 3 Hz observed in the experiment. The ionized electrons are moving at a slower velocity

in the bubble. The 1/3 ratio could also come from the subspace tetrahedron geometry where the tetrahedral angle is determined by this ratio

$$\theta=\text{asin}(1/3)=19.47122063^\circ$$

[0026] This is an alternative possibility because this angle determines the charge of hyperspace according to the tetrahedron diagram of Δphysics. In geometrical physics, all the constants of physics are determined geometrically by the tetrahedron. The tetrahedron diagram plots the natural logarithm of mass versus the natural logarithm of wavelength. The tetrahedron is circumscribed by a sphere which reflects the electron wavelength into the electron mass. Thus the diagram combines the dual reality of classical physics, involving point mass particles, and quantum physics, involving wave-like particles. The scientific discovery that the electron and the proton are one and the same particle was made using this diagram. It also shows that hyperspace exists.

[0027] Referring to the tetrahedron diagram in **FIG. 7**, a line drawn at the tetrahedral angle produces the tetrahedral lines (A,B) along path (abc). This tetrahedron is circumscribed by sphere (C) with diameter (G). The electron wavelength (vertical dotted line D) reflects off the sphere (d,f) and returns as the electron mass (F). The distance (df) between reflection points is equal to the natural logarithm of the hyperspace charge. It can be shown that the electron charge is related to the geometry around the top of the sphere. Part of the geometry is outside the sphere which makes the charge immune to relativistic velocities.

[0028] Referring to **FIG. 8**, a current-carrying solenoid (A) produces a magnetic flux (B) through the center of the coil. The end of the solenoid behaves like a magnetic monopole. One end has a positive magnetic charge density $+\rho_m$ and the other has a negative magnetic charge density $-\rho_m$. One of Maxwell's electromagnetic equations states that the divergence of the magnetic field is equal to the magnetic charge density.

$$\nabla\cdot B=\rho_m=+\rho_m-\rho_m=0$$

[0029] Because the magnetic field is solenoidal, the sum of the charges in our spacetime is equal to zero, which is the usual Maxwell equation. In the case of the wormhole, one pole of the magnetic flux is in our spacetime and the other pole is in a co-dimension of hyperspace. In our universe, there is a net magnetic charge density, and Maxwell's equation becomes

$$\nabla\cdot B=\rho_m$$

[0030] When working with bar magnets, bringing two north poles together shows that there is a spring constant involved. The electrons on the surface of the pole spin in the same direction which creates an electrical current around the surface. The magnetic pole strength g is therefore a spring constant K divided by the current per area J.

$$g=\frac{K}{J}\equiv\frac{kg\,m}{s^2}\frac{1}{m}\frac{s\,m^2}{q}=\frac{kg\,m^2}{s\,q}$$

[0031] The magnetic charge density is then the pole strength per volume V or

$$\rho_m=\frac{g}{V}=\frac{kg\,m^2}{s\,q}\frac{1}{m^3}=\frac{kg}{m\,s\,q}$$

[0032] The divergence of the magnetic field has units of

$$\nabla\cdot B=\frac{1}{m}\frac{kg}{s\,q}$$

[0033] which are the units of the magnetic charge density. Notice that the units can also be formatted as a pressure per electrical current in the wire.

$$\rho_m=\frac{kg}{s\,q\,m}=\frac{kg\,m}{s^2\frac{q}{s}m^2}=\frac{\text{force}}{\text{area}}\frac{1}{I}=\frac{\text{pressure}}{\text{current}}$$

[0034] The current flowing through the coils of the solenoid, or around the pole face of the bar magnetic creates a pressure on spacetime. And it is this pressure that can punch through spacetime into hyperspace. Referring again to **FIG. 8**, an electrical charge winding n times around the end of the spacetime solenoid, as seen by path (C), is equal to the charge divided by Planck's constant times the pole flux

$$2\pi n=\frac{q}{\hbar}\int_{Surface}B=\frac{q}{\hbar}\Phi$$

[0035] which shows that the flux Φ is quantized by the winding number n

$$\Phi=n\frac{2\pi\hbar}{q}=n\frac{h}{q}$$

[0036] where the flux is equal to the winding number n times Planck's constant h divided by the charge. Since the flux is the pole strength in webers, the pole strength g has a value of

$$g=n\frac{h}{q}$$

[0037] The magnetic charge density is the pole strength divided by the Planck volume or

$$\rho_m=\frac{g}{\Lambda^3}=n\frac{h}{q}\frac{1}{\Lambda^3}=n\frac{2\pi\Lambda^2\Omega c}{q\Lambda^3}=\frac{2\pi n}{\Lambda}\frac{\Omega c}{q}=2\pi n\frac{B}{\Lambda}$$

[0038] The magnetic B field of space divided by the Planck length of the wormhole, acting as a linear magnetic field, times the winding number is equal to the magnetic charge density.

[0039] Referring to **FIG. 9**, the wormhole (A), connecting space and hyperspace (D), is precessing (C) in the counterclockwise direction with the angular velocity vector in the vertical z-direction. The magnetic flux (B) through the wormhole is in the radial direction. The mouth of the wormhole is an area with a normal vector in the radial direction also. This arrangement creates an electric field which circulates around the interior periphery of the wormhole. Maxwell's equation says that the curl of the electric field E is equal to the negative time rate of change of the magnetic B field.

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

[0040] This equation is difficult to manage in differential form. As both Maxwell and Feynman have said, it is better to use the integral form involving Stokes' theorem where the area da is converted into a line integral ds which goes well with Maxwell's idea of flux linkage.

$$\int_{surface} (\nabla \times E) \cdot n\, da = \oint E \cdot ds = -\frac{\partial}{\partial t} \int_{surface} B \cdot n\, da = -\frac{\partial}{\partial t}\Phi = -\Phi\, \omega_{drag}$$

[0041] The flux Φ, which is precessing around at the drag angular velocity calculated previously, is equal to the negative of the electric field around the interior perimeter (E) of the wormhole. This is the reason that the beaconing effect lasts for such a long length of time. The force on the electron is equal to the charge of the electron times the electric field. Because the charge is negative, the electron rotates counterclockwise in the opposite direction to that of the electric field. The electrons continuously circulate around the inside periphery of the wormhole. Quantum theory predicts that any radiated electromagnetic energy from an accelerated electron will give off one or more discrete quanta, or photons. The electron is accelerating because it is moving in a circular path. Because the water vapor is ionized in the cavitating bubble due to shock waves, surface oscillations and high temperatures, there are huge numbers of electrons available for producing an intense light which, as registered by the photodiode, increased by an order of magnitude when the beacon rotated by the photodiode.

[0042] From gravitational physics it is known that negative energy has to be produced in order to create a wormhole. Most experimenters are using collapsing spherical bubbles that do not produce negative energy and therefore do not produce the beaconing effect. This next background section shows that if the bubble collapses asymmetrically, then negative energy is produced.

[0043] Referring to an experiment carried out by Fizeau, **FIG. 10**, water flows (B,C) in opposite directions in two tubes of water (A). A light beam from a lamp (D) is projected through both tubes using half-silvered mirrors (E). Fizeau measured an interference (F) between light propagating with the flow and light swimming against the current, indicating that the flow of the medium does affect light propagation. A moving medium turns out to drag light to an extent quantified by a dragging coefficient

$$\alpha = 1 - \frac{1}{n^2}$$

[0044] where n is the index of refraction of the medium. Einstein's addition theorem of velocities states

$$v = \frac{v' + u}{1 + \frac{v'u}{c^2}} = \frac{\frac{c}{n} + u}{1 + \frac{cu}{nc^2}} = \frac{\frac{c}{n} + u}{1 + \frac{u}{nc}}$$

[0045] In the limit of slow flows compared with the speed of light in a vacuum, the effective velocity of light v in the medium flowing at a velocity u is

$$v \approx \left(\frac{c}{n} + u\right)\left(1 - \frac{u}{nc}\right) \approx \frac{c}{n} + \alpha u$$

[0046] The relationship between cavitating bubbles and light dragging is that when the bubble collapses, the surface has a tremendous acceleration and velocity which creates internal shockwaves that bounce back and forth within the medium. At the same time, the water vapor and air are ionized which creates short bursts of light. Thus there is light that is being dragged along by the collapsing surface of the bubble. This moving medium appears to light as a change in the metric of spacetime resembling, it turns out, a gravitational field. The velocity of the medium affects the elemental length ds^2 of spacetime as given by the metric for light dragging

$$ds^2 = c^2dt^2 - dx^2 + k(c^2dt^2 - u \cdot dx)^2$$

[0047] where k is equal to

$$k = \frac{\alpha}{c^2 - u^2}$$

[0048] and dx is the elemental length in the {dx,dy,dz} directions. The velocity u in the dot product is equal to the velocities {ux,uy,uz} in the x, y and z-directions. Expanding the equation produces the following metric

$$ds^2 = (1+k)dt^2 + (ku_x^2 - 1)dx^2 + (ku_y^2 - 1)dy^2 - dz^2 - 2ku_x dxdt - 2ku_y dydt + 2ku_x u_y dxdy$$

[0049] where velocity uz is zero and the speed of light is equal to one.

[0050] The dt^2 energy density term is modified by one plus the k factor. Thus the index of refraction of the medium, the speed of light and the overall light dragging velocity u affects the energy density. It can be shown that the speed of light in hyperspace is much lower. The difference of the squares of the velocities in the denominator creates the possibility for amplification of this term.

[0051] The factors of the elemental lengths are then inserted into the g metric tensor which is then used to calculate the spacetime distortion generated by the collaps-

ing bubble. The g metric tensor is a 4×4 matrix having rows and columns that correspond to the elemental lengths {t, x, y, z}.

$$g_{\alpha\beta} = \begin{array}{c} \\ \alpha = t \\ \alpha = x \\ \alpha = y \\ \alpha = z \end{array} \begin{array}{c} \begin{array}{cccc} \beta = t & \beta = x & \beta = y & \beta = z \end{array} \\ \begin{Vmatrix} 1+k & -ku_x & -ku_y & 0 \\ -ku_x & ku_x^2 - 1 & ku_x u_y & 0 \\ -ku_y & ku_x u_y & ku_z^2 - 1 & 0 \\ 0 & 0 & 0 & -1 \end{Vmatrix} \end{array}$$

[0052] In Einstein's General Theory of Relativity, the G curvature tensor, which is a 4×4 matrix having units of inverse meter squared, is equal to a stress-energy-momentum T tensor that is calculated from the electromagnetic fields. The stress tensor T combines energy density, electromagnetic flux, and pressure terms in one matrix.

$$G=8\pi T$$

[0053] Most of the physics constants are linear constants such as linear mass which is mass per unit length. The permittivity of space ϵ is linear capacitance or capacitance per meter. The permeability of space μ is linear inductance or inductance per meter. The speed of light converts time into meters. What this means is that energy, pressure and momentum can all be converted into meters using these linear constants. The inverse squared of the length in meters is the curvature which is measured in units of m^{-2}.

[0054] Referring to **FIG. 11**, a square bubble (A) in the xy plane collapses with a velocity in the x-direction (C), and a velocity in the y-direction (B). This produces a curvature in the vertical z-direction (D). The curvature in the z-direction is the curvature tensor component G_{zz}. which can be computed directly from the g light dragging metric tensor. The result of the calculation is an equation in terms of the velocity, acceleration and the time rate of change of the acceleration, known as jerk.

[0055] Because the profile of the bubble radius expanding and collapsing with time has been published by those researching cavitation, it is possible to differentiate the profile to get the velocity, acceleration and jerk. These equations can then be inserted into the equation for the G curvature tensor.

[0056] The radius R of the bubble depends on the air density inside the bubble ρ, the viscosity of the water μ, the pressure of the P of the environment, the surface tension σ of the water, the ratio of specific heats γ, and the velocity $\dot{R}$ and acceleration $\ddot{R}$ of the bubble radius.

$$R\ddot{R} + \frac{3}{2}\dot{R} + \frac{4\mu}{\rho}\frac{\dot{R}}{R} + \frac{2\sigma}{\rho R} + \frac{P_0}{\rho} - \left(P_0 + \frac{2\sigma}{R_0}\right)\left(\frac{R_0}{R}\right)^{3\gamma} = 0$$

[0057] Referring to **FIG. 12**, the above equation for the bubble radius is shown in the feedback simulation program. The diagram starts by solving the equation for the acceleration which is then integrated twice (1/S) to get the velocity and position. These variables are then fed back to the input through the various constants involving the viscosity, surface tension, pressure and air density. The graph at the bottom of the simulation shows the bubble radius with time.

[0058] Referring to **FIG. 13**, the bubble profile with time is reproduced from the *Scientific American* article mentioned previously. This profile was then fitted with a polynomial equation which is plotted in **FIG. 14**. By differentiating the equation, the velocity, acceleration and jerk are obtained which can then be inserted into Einstein's G curvature tensor.

[0059] Referring to **FIG. 15**, the curvature component in the vertical direction G_{zz} is plotted with respect to time. In the *Scientific American* plot, the light flash occurs at the end of the collapse marked "LIGHT FLASH" around 22 microseconds (**FIG. 13**). This corresponds to the two intense positive curvature G_{zz} spikes at the end of the collapse. This represents a symmetrical spherical bubble collapse where the velocities are the same in the x and y directions.

[0060] The energy density component G_{tt} for this symmetrical collapse is given by

$$G_{tt} = \frac{-2u_y^2 a_x^2 + 4u_x u_y a_x a_y - 2u_x^2 a_y^2}{4(u_x^2 + u_y^2 - 2)}$$

[0061] Looking at this carefully, notice that if the velocity in the x-direction u_x is equal to the velocity in the y-direction u_y, and the acceleration in the x-direction a_x is equal to the acceleration in the y-direction, then the equation reduces to zero.

$$G_{tt} = \frac{-2u^2 a^2 + 4u^2 a^2 - 2u^2 a^2}{8(u^2 - 1)} = 0$$

[0062] which means that the symmetrical collapse with equal velocities does not produce any negative energy with which to create the wormhole. Only sharp pulses of light are emitted at the end of the bubble collapse where the intense positive curvature spikes are encountered. In order to get the rotating wormhole beaconing effect, the velocities have to be different.

[0063] Referring to **FIG. 16**, the bubble is given an asymmetrical profile as shown by the two curves. The upper curve is in the x-direction, and the lower curve is in the y-direction. The collapse in the y-direction is not as severe.

[0064] Referring to **FIG. 17**, the asymmetrical collapse has the curvature spikes at the beginning similar to the symmetrical case of **FIG. 15**. Notice that there are no spikes at the end of the collapse. However, the energy density is much different.

[0065] Referring to **FIG. 18**, the energy density G_{tt} is plotted as a function of time. Rather than being zero as in the symmetrical case, there is a large region of negative energy density as the bubble collapses. This negative energy is what creates the wormhole. Because there are no large curvature spikes at the end of the collapse, the wormhole bubble is stable and precesses for a few minutes.

[0066] Experiments with the pendulum show that some people have much larger auras than others. The pendulum swings over the entire hand. One particular person who has enormous vortices was working in a television repair shop. When a television set is brought in to the shop, the large capacitor has to be discharged first. The repairman with the large chakra vortices was standing behind a second repairman who was approaching the television set. As the second repairman got closer to the set, an enormous streaming blue spark sailed over his head and zapped the first technician. Hyperspace has a much higher permittivity than our spacetime. The resistance of space R is equal to the square root of the permeability μ over the permittivity ϵ.

$$R = \sqrt{\frac{\mu}{\varepsilon}}$$

[0067] Since the technician with the large chakra vortices was producing large quantities of hyperspace energy, his resistance was very much lower due to his larger permittivity. The spark grounded on his body. The free electrons, which are created by ionization of the hydrogen atoms of the water vapor, see a very low path of resistance and flow toward the wormhole. There they are trapped in accelerated motion due to the presence of the circular electric field and give off substantial numbers of photons which produces the beaconing lighthouse effect.

[0068] The elemental length ds^2 in cylindrical coordinates {t, r, θ, z} for a mass M is given by

$$ds^2 = -\frac{dt^2}{1-\frac{M}{r}} + \left(1-\frac{M}{r}\right)dr^2 + r^2 d\theta^2 + dz^2$$

[0069] The mass M distorts the radius r of the elemental length which is what gives the mass a curvature or gravitational field. Negative energy, which is produced at the end of the bubble collapse, is equal to a negative mass times the speed of light squared. Thus mass M in the equation goes to negative mass, or M→−M. Furthermore, negative energy inverts the mass factor so that the metric becomes

$$ds^2 = -\left(1+\frac{M}{r}\right)dt^2 + \frac{dr^2}{1+\frac{M}{r}} + r^2 d\theta^2 + dz^2$$

[0070] The g metric tensor contains the factors of the elemental lengths along the matrix diagonal

$$g_{\alpha\beta} = \begin{Vmatrix} -\left(1+\frac{M}{r}\right) & 0 & 0 & 0 \\ 0 & \frac{1}{1+\frac{M}{r}} & 0 & 0 \\ 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 1 \end{Vmatrix}$$

[0071] As before, Einstein's G curvature tensor in the radial G_{rr}, angular $G_{\theta\theta}$, and vertical z-direction G_{zz} is calculated from this negative energy g metric tensor.

[0072] Referring to the 3D G curvature plot in **FIG. 19**, the strength of the curvature is given by the length of the arrow, and the direction of the curvature is given by the arrow. The curvature in the radial direction G_{rr} is along the bottom axis from the box corner origin to the right. The curvature in the angular direction $G_{\theta\theta}$ is the bottom axis from the origin to the left. The height of the box is the curvature in the vertical direction G_{zz}. Notice in general that the curvature is perpendicular to the left face (θz-plane) and then starts to curve to the right and begins to point toward the right face (rz-plane). On the bottom face (rθ-plane) there is an upward vertical curvature.

[0073] In cylindrical coordinates, the θz-plane is actually a vertical tube of radius r. So at small r, the curvature is perpendicular to the tube. At larger radius, the curvature starts to point in the θ-direction, wrapping around the tube. At small radius, there is also a vertical curvature parallel to the sides of the tube.

[0074] Referring to **FIG. 20**, the curvature in cylindrical coordinates is seen to be the structure of the wormhole. The wormhole (A) is formed due to the radial pressure (B) which pulls open the wormhole. One end of the tube connects to hyperspace, and the other end connects to our spacetime. There is also a shearing pressure (D) along the sides of the tube which slices spacetime open and helps shape the tube. Moving outward along the radius, the curvature turns sideways and produces a shearing pressure (D) in the θ-direction which gives the wormhole a vortex appearance. These wormholes can also be very large, enabling one to peer into a co-dimension as attested to by the inventor.

SUMMARY OF THE INVENTION

[0075] As described in the previous section, the cavitating bubble has to collapse asymmetrically in order to generate the negative energy which creates the wormhole. In order to collapse asymmetrically, the forces on the bubble surface have to be unequal. The force on the bubble is given in terms of the a dragging coefficient, the bubble radius R, the surface charge density D_r, the magnetic B field in spherical coordinates $\{B_r, B_\theta, B_\phi\}$. The fields are integrated over the entire solid angle Ω of the bubble to determine the force F.

$$F_r = -\left(1-\frac{1}{n^2}\right)\frac{R^2}{2}\oint d\Omega\left[\left(1+\frac{1}{n^2}\right)(D_r^2 + B_r^2 - B_\theta^2 - B_\phi^2)\right]$$

[0076] The integration of the tangential components of the magnetic field such as $\{B_\Theta, B_\Phi\}$ over the solid angle of the bubble will sum to zero. The surface charge density D_r and the radial magnetic field B_r are the only fields which can be used to create an unbalanced force. If there is no surface charge density, then the force equation reduces to

$$F_r = -\alpha\frac{R^2}{2}\oint d\Omega\left[(2-\alpha)\left(\frac{\chi^2}{\Omega_m}B_r^2\right)\right]$$

[0077] where the conversion constant is the linear charge squared divided by the linear mass of the universe χ^2/Ω_m.

[0078] In this invention, referring to **FIG. 21**, the magnetic field is created by two cylindrical solenoids (A,B) which are wrapped around the top and bottom of the glass container (C). The container has flat sides in the shape of an octagon. Each solenoid consists of a continuous roll of very thin sheet copper which are separated by beaded mylar line. The mylar beads separate the sheets electrically and provide air cooling to the coil which can get rather hot. This makes it easy to assemble the coil because the copper roll and mylar line are wound together as the solenoid is formed. The lines of magnetic flux flow vertically through the container yet do not interfere with the transducers (D) which are mounted on the flat sides of the container.

[0079] Referring to **FIG. 22**, the cavitating bubble which forms in the liquid in the container experiences a vertical magnetic field (B) due to the two solenoids. These flux lines create a radial force on the top and bottom of the bubble (D,C). The flux lines on the outside (E) do not create any radial force because they are tangential to the surface. The spherical bubble flattens into an asymmetrical ellipsoidal shape (A) which enables the creation of the wormhole and lighthouse beaconing effect.

[0080] Referring to **FIG. 23**, the spacetime curvature of the wormhole (D) creates a tunnel (C), known as the throat of the wormhole, between flat space in our universe (A) and flat hyperspace (B) which exists in a co-dimension of our universe. In general, the co-dimensions have different physics constants. Going back to the chakra vortices of the human energy field, the vortices remove energy from space and deliver it to several hyperspace co-dimensions. This energy builds up human aura modules at different frequencies in astral space. Astral space has a very low speed of light and small linear mass. This is the reason that human beings can leave their bodies and pass through solid concrete walls, or project their spiritual eye to remote locations for viewing. On the other hand, the linear mass and speed of light of space is very much greater than hyperspace. Therefore, the pressure of the space is much greater than the pressure in hyperspace. In terms of the wormhole with a throat area A, the pressure would be the linear mass times the speed of light squared over the area

$$P_{space} = \frac{\Omega_s c_s^2}{A}$$

[0081] The pressure of hyperspace on the other side of the wormhole is

$$P_{hyperspace} = \frac{\Omega_h c_h^2}{A}$$

[0082] Because the linear mass and the speed of light of hyperspace are lower than that of space, there is a positive net pressure going into hyperspace.

$$P_{net}=P_{space}-P_{hyperspace}$$

[0083] This is the reason that the human vortices can obtain energy from this universe. Because the cavitating bubble produces negative energy, the linear mass is negative on the side of space. The pressure equation is then given by

$$P_{net} = -\frac{P_s}{A} - \frac{P_h}{A} = -\frac{P_s + P_h}{A}$$

[0084] which shows that there is a reverse pressure going from hyperspace into our space. The asymmetrical cavitating bubble generates hyperspace energy. The hyperspace energy flowing into our universe also gives the light generated by the wormhole a soft white misty look.

[0085] There are many reasons for generating this hyperspace energy. Electromagnetic fields are subject to the Lorentz transformation which involves comparing the frame velocity with that of the velocity of light.

$$E' = \frac{E}{\sqrt{1-\frac{v^2}{c^2}}}$$

[0086] If the ratio of the velocity v to the velocity of light c is close to unity, then huge relativistic fields can be produced. These fields can curve spacetime to such an extent that a large lift force can be produced on the hull of an electromagnetic field propulsion vehicle.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0087] Not Applicable.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0088] **FIG. 1**. Rotating cylinder demonstrating additional lift force.

[0089] **FIG. 2**. Use of the pendulum.

[0090] **FIG. 3**. The Ascension Machine, Chakra Vortex Accelerator.

[0091] **FIG. 4**. Hyperspace energy brought into body by rotation of hand chakra.

[0092] **FIG. 5**. Antigravitational effect using low density hyperspace energy.

[0093] **FIG. 6**. Sonoluminescence experiment.

[0094] **FIG. 7**. Tetrahedron diagram showing hyperspace charge.

[0095] **FIG. 8**. Magnetic monopole.

[0096] **FIG. 9**. Precessing wormhole.

[0097] **FIG. 10**. Fizeau light dragging experiment.

[0098] **FIG. 11**. Asymmetrical velocity collapse of bubble radius generates wormhole.

[0099] **FIG. 12**. VisSim feedback simulation of the collapsing bubble.

[0100] **FIG. 13**. Cavitating bubble radius as a function of time.

[0101] **FIG. 14**. Digitized bubble radius of **FIG. 13**.

[0102] **FIG. 15**. Spiking spacetime curvature of collapsing bubble.

[0103] **FIG. 16**. Dual velocity profile required to produce negative energy.

[0104] **FIG. 17**. Spacetime curvature for dual velocity collapse.

[0105] **FIG. 18**. Negative energy generated from asymmetrical collapse of bubble.

[0106] **FIG. 19**. 3D plot of spacetime curvature using negative energy.

[0107] **FIG. 20**. Wormhole vortex.

[0108] **FIG. 21**. Perspective of cavitation tank equipped with magnetic coils.

[0109] **FIG. 22**. Flattening of bubble by magnetic field.

[0110] **FIG. 23**. Hyperspace energy generated by reverse pressure gradient of wormhole.

[0111] **FIG. 24**. Solenoid and transducer driving circuits.

DETAILED DESCRIPTION OF THE INVENTION

[0112] 1. Referring to **FIG. 24**, the transducer driving circuit uses a frequency generator (A) driving a linear amplifier (B) into a pair of variable inductors (C) which resonate with the capacitance of the transducers (D) attached to the sides of the octagonally-shaped glass container (H). Resistors (L,M,G) provides voltage measuring points for the oscilloscope.

[0113] A DC current source (I) drives the two solenoids (E,F) which produce a vertical magnetic field (J) through the container. The magnetic field produces an asynmetrical force on the bubble surface (K) such that the collapsing bubble produces negative energy. The spacetime curvature produced by the light dragging of the collapsing bubble surface, together with the negative energy, create a wormhole between space and hyperspace. The negative spacetime energy produces a negative pressure which brings low-density hyperspace energy into our dimension.

I claim:

1. A hyperspace energy generator having:

a) a glass container in the shape of an octagon acting as the resonating chamber;

b) two piezoelectric transducers, mounted and operating acoustically as a pair on opposite sides of item (1a);

c) an opaque oil-like liquid with a high index of refraction filling item (1a) acting as the resonating liquid in which the cavitating bubbles are formed;

d) two thin sheet copper solenoids, located on top and bottom of item (1a), that produce a vertical magnetic field through items (1a) and (1c);

e) two variable inductance coils for creating a resonant frequency with item (1b);

f) a linear amplifier driving items (1b) and (1e);

g) a variable frequency generator driving item (1e);

h) a direct current electrical generator driving item (1d);

2. a cavitation system which:

a) produces one or more cavitating bubbles that collapse asymmetrically due to the differential force exerted on the bubble surface by the presence of a vertical magnetic field generated by item (1d) referred to above;

b) generates negative energy due to light dragging of the collapsing bubble surface;

c) creates wormholes between space and hyperspace due to the presence of item (1b);

d) generates a negative pressure between space and hyperspace that forces low-density hyperspace energy into our dimension; and

3. optional dual electrically-charged plates that:

a) are mounted on the sides of item (1a);

b) create a differential electric charge density across the bubble surface for the purpose of creating an additional method of asymmetrical bubble surface collapse.

* * * * *

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(54) ROTATING ELECTROSTATIC PROPULSION SYSTEM

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(52) **U.S. Cl.** **244/172**

(57) **ABSTRACT**

This invention relates to a spacecraft propulsion system utilizing thrusters comprised of a motor-driven electrostatically charged cylinder rotating within an electrostatically charged annular ring for the purpose of creating a spacetime curvature stress-energy tension in the horizontal direction. The thrusters are augmented by magnetic vortex generators, either embedded in the cylinders or located above each thruster, for the purpose of increasing the permittivity of space by permeating each thruster with low density hyperspace energy generated by a wormhole created between our space and hyperspace. A combination of three thrusters mounted on the underside of the hull of the spacecraft provide thrust and yaw motion control.

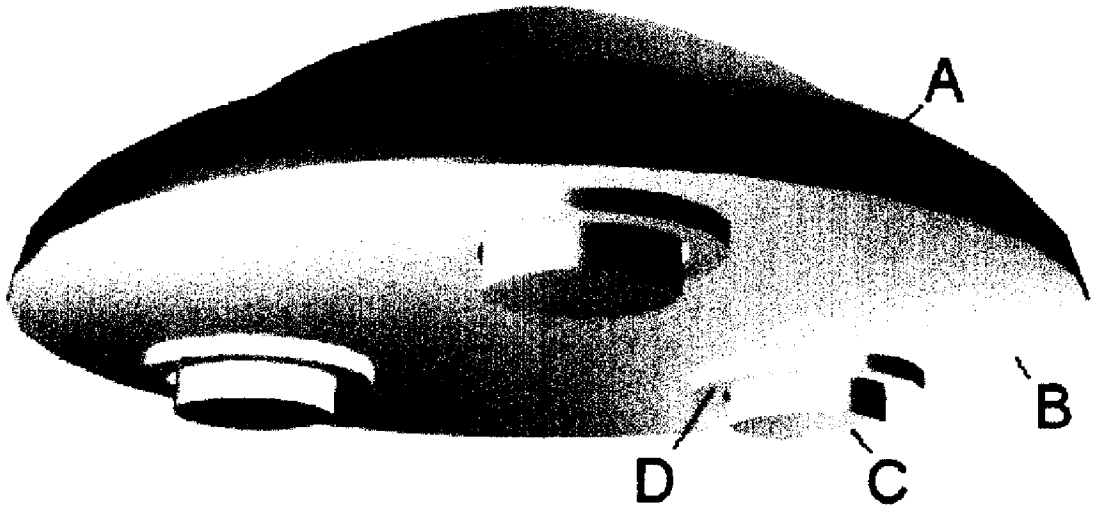

Figure 1

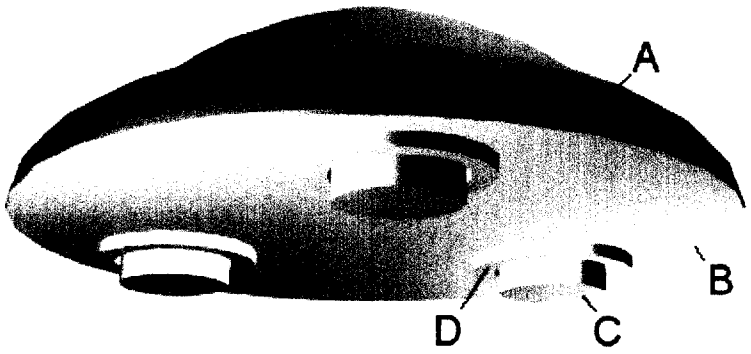

Figure 2

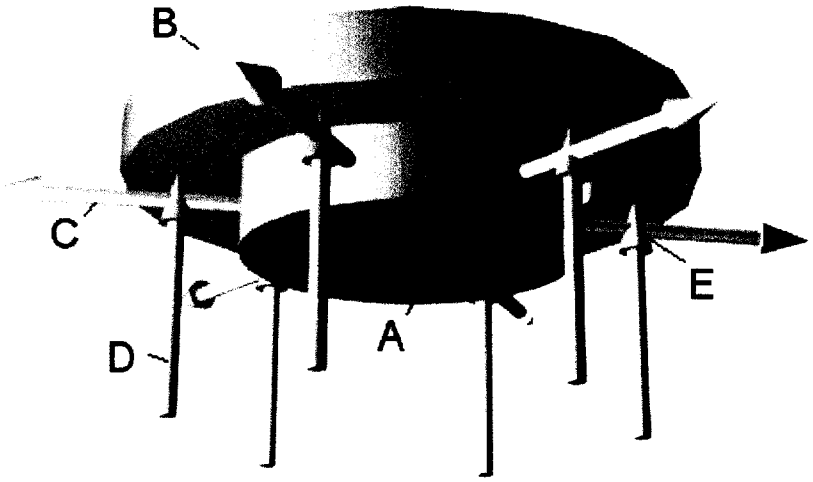

Figure 3

$$T^{zr} = -\frac{\varepsilon_0}{\Omega c^2}\frac{E_z E_r}{4\pi} = \frac{\text{coul}^2}{\text{m}^2\text{n}}\frac{\text{n}}{\text{coul}}\frac{\text{n}}{\text{coul}}\frac{\text{m}}{\text{kg}}\frac{\text{s}^2}{\text{m}^2} = -\frac{\text{kg m}}{\text{s}^2}\frac{\text{s}^2}{\text{kg m}^3} = \frac{-1}{\text{m}^2}$$

Figure 4

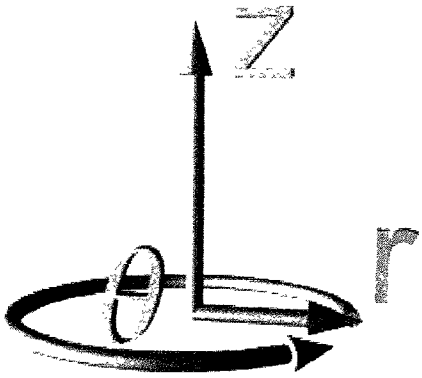

Figure 5

$$F^{\alpha}{}_{\beta} = \begin{array}{c|cccc|} t & 0 & E_r & 0 & E_z \\ r & E_r & 0 & 0 & 0 \\ \theta & 0 & 0 & 0 & 0 \\ z & E_z & 0 & 0 & 0 \end{array}$$

Figure 6

$$T^{zr} = -\frac{E_r E_z}{4\pi}$$

Figure 7

$$\frac{d}{dt} S_r = \varepsilon_0 \, \varepsilon_{r\,t\,z} x^t T^{zr} n_r \mathrm{Area} = \varepsilon_0 \, t \frac{E_r E_z}{4\pi} n_r \mathrm{Area}$$

Figure 8

$$\frac{\mathrm{coul}^2}{\mathrm{m}^2\,\mathrm{n}} \sec \frac{\mathrm{n}}{\mathrm{coul}} \frac{\mathrm{n}}{\mathrm{coul}} \mathrm{m}^2 = \mathrm{kg} \frac{\mathrm{m}}{\sec^2} \sec = \mathrm{kg} \frac{\mathrm{m}}{\sec}$$

Figure 9

$$\frac{d}{dt} S_{r,t} = \frac{\varepsilon_0}{4\pi} e^{i\omega t} E_r E_z \,\mathrm{area} + \frac{i\varepsilon_0}{4\pi} e^{i\omega t} E_r E_z t \omega \,\mathrm{area}$$

Figure 10

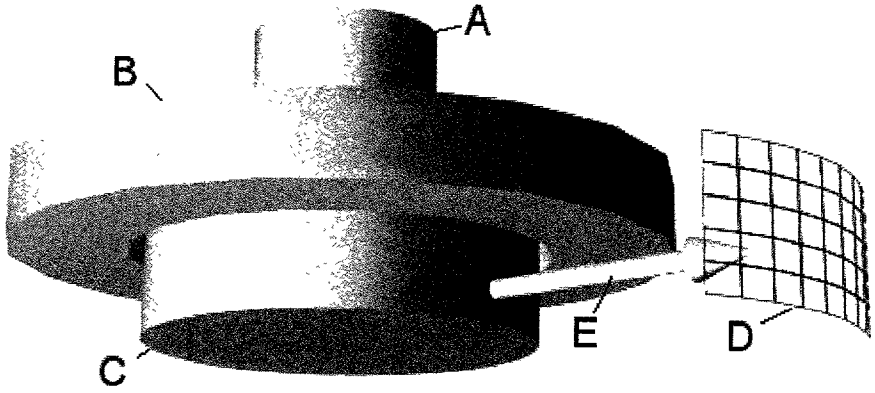

Figure 11

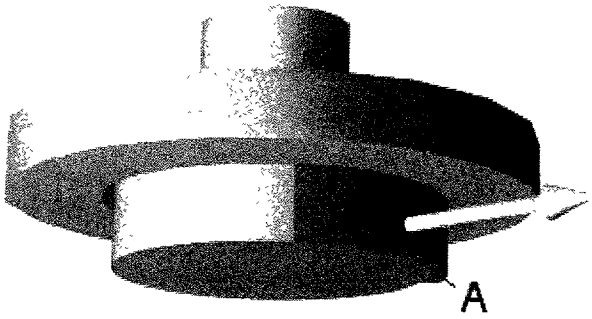

Figure 12

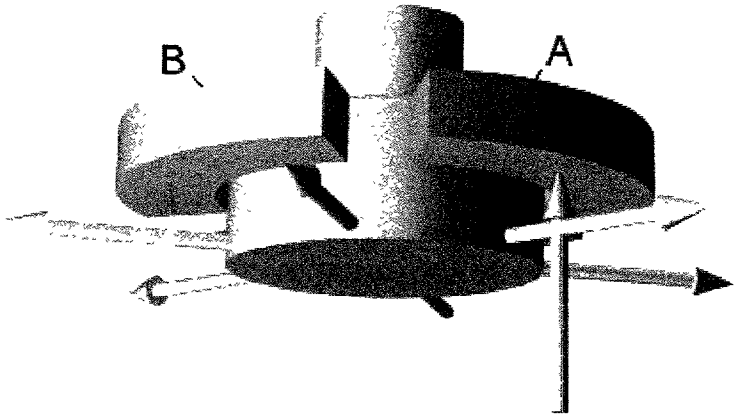

ROTATING ELECTROSTATIC PROPULSION SYSTEM

BRIEF SUMMARY OF THE INVENTION

[0001] The invention, which is the object of my present application, is a spacecraft propulsion system which develops a spacetime curvature tension utilizing a combination of a rotating radial electrostatic field and a fixed vertical electrostatic field. The two fields create a stress-energy T^{zr} gradient in the radially direction which is equal to force. The radial field is created on the side of a charged rotating cylinder on the underside of the hull. The vertical field is created by an annular charged ring concentric with the cylinder. Three rotating cylinders are located in a triangle on the bottom of the hull in order to produce a force in any direction in the horizontal plane.

REFERENCE PAPERS

[0002] *Gravitation*, Wheeler, page 80.

BACKGROUND OF THE INVENTION

[0003] When working with Maxwell's equations in tensor notation, it became apparent that a tensor can change identity depending on what permutation of variables is involved. For example, one single equation can involve both charge density and current density. And all of Maxwell's equations can be reduced to just two equations.

[0004] In the tensor equation for momentum, if the lever arm is length then the equation is equal to the flow rate of angular momentum. If the lever arm is time, then you get linear momentum. And if the field rotates with time, then the time rate of change of linear momentum is a force which is the basis for this invention.

[0005] Einstein said that mass curves space and space tells mass how to move. In this sense, generalized mass can be mass, electromagnetic fields, charge or angular momentum which create a spacetime curvature that produces a force on the spacecraft.

SUMMARY OF THE INVENTION

[0006] The invention relates to a spacecraft utilizing a rotating electrostatically charged cylinder and a concentric annular charged ring to create a stress-energy spacetime curvature in the horizontal plane on the spacecraft's underside hull. A motor drives the rotating cylinder which extends below the hull. A charged surface produces an electric field in the direction normal to the surface. The vertical and rotating electric fields combine to create a rate of change of linear momentum which creates a horizontal propulsive force on the hull.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0007] Not Applicable.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0008] **FIG. 1**. Perspective view of spacecraft hull (A) with the three electrostatically charged rotating cylinders (C) surrounded by their annular charge rings (D) extending down on the underside of the hull (B).

[0009] **FIG. 2**. Perspective view of individual thruster showing rotating cylinder and ring.

[0010] **FIG. 3**. Stress-energy tension created by two electric fields and having units of curvature.

[0011] **FIG. 4**. Cylindrical spacetime coordinates $\{t, r, \theta, Z\}$.

[0012] **FIG. 5**. Faraday electromagnetic F tensor containing electric fields in the radial and vertical directions.

[0013] **FIG. 6**. Stress-energy tensor T showing it is equal to the product of the two electric fields divided by 4π.

[0014] **FIG. 7**. The tensor equation for flow rate of angular momentum S.

[0015] **FIG. 8**. The units are linear momentum due to the time lever arm.

[0016] **FIG. 9**. The rate of change of linear momentum is the horizontal force produced by the two electric fields.

[0017] **FIG. 10**. The angular momentum flows through an area whose normal vector is in the radial direction.

[0018] **FIG. 11**. Cylinder with only one electrostatically charged segment.

[0019] **FIG. 12**. Annular ring with three individual segments which can be charged separately to create a force in a particular direction.

DETAILED DESCRIPTION OF THE INVENTION

[0020] 1. Referring to **FIG. 1**, the spacecraft comprises an upper hull (A) with three rotating electrostatically charged cylinders (C) with their concentric annular electrostatically charged rings (D) located on the spacecraft's bottom hull (B).

[0021] 2. In a closer view of one of the cylinders seen in **FIG. 2**, motor-driven rotating cylinder (A) has an electrostatically charged surface which produces an electric field (C) normal to said surface. The fixed, electrostatically charged annular ring (B), which is concentric with the cylinder, produces a vertical electric field (D) normal to its surface. This crossed field (E) creates a negative spacetime curvature tension which is the product of the two fields divided by 4π as seen in the equation, **FIG. 3**.

[0022] 3. Notice that the equation involves the permittivity of space ϵ_0 divided by the linear mass of the universe Ω and the speed of light. This produces units of inverse meter squared which is the spacetime curvature. In Einstein's General Theory of Relativity, the spacetime curvature tensor is equal to the stress-energy tensor or $G=8\pi T$ where G is the curvature, and T is the product of the electromagnetic fields. The problem with this equation, which has been resolved with this invention, is that the linear mass Ω times the speed of light c is an enormous number. Even with the square of enormous electric fields, the curvature would be too small even to notice, and little force would be generated.

[0023] 4. In another patent application of mine entitled Magnetic Vortex Generator, it was shown that a rotating

cylinder containing embedded and stacked bar magnets produces a negative mass and negative spacetime spring constant. It can be shown that this combination produces a small wormhole or interdimensional connection between our space and hyperspace along the centerline of the rotating cylinder. Co-dimensions of hyperspace have different physics constants. A low pressure region of hyperspace has a very low mass density and a very low speed of light. The wormhole allows this low density hyperspace energy to enter into our space and permeate the cylinder and annular ring. The permittivity is proportional to the inverse of the speed of light squared. The hyperspace speed of light, obtained from my tetrahedron physics diagram, is 8971 meters per second. The speed of light in our dimension is 299792458 meters per second. As shown by the enclosed reference calculation, the hyperspace permittivity is about a trillion times larger. Because the force is equal to this new permittivity times the electric fields squared times the area around cylinder, the force is greatly amplified by this increase in the permittivity of space.

[0024] 5. It is pertinent to this invention how the stress-energy is created due to the two electric fields in the vertical and radial direction. In gravitational physics, there is a Faraday F tensor which contains all the components of the electromagnetic fields. It is a 4 by 4 matrix whose rows and columns correspond to the coordinates of spacetime which in cylindrical coordinates are {t, r, θ, z} where t is time, r the radius, theta the horizontal angle and z the vertical height. These coordinates are shown in **FIG. 4**.

[0025] 6. The radial electric E_r field and the vertical electric E_z field can be inserted into the Faraday tensor seen in **FIG. 5**. The sign of the vertical field is positive because it points in the positive z-direction due to the fact that the annular ring has a negative charge. The cylinder has a positive charge. This produces the negative stress-energy tensor T^{zr} as drawn in **FIG. 6**.

[0026] 7. In order to calculate the force on the cylinder, it is necessary to calculate the flow rate of angular momentum. Momentum is mass times velocity or mass meter per second. If the mass is moving in a circle, then there is a lever arm times the momentum which makes it mass meter squared per second. If this is differentiated with respect to time, then a flow rate of angular momentum is produced with units of mass meter squared per second squared. As mentioned previously, tensors have this dual nature where depending on the permutation of the variables, it means one thing or another. In this case, the lever arm will be time, rather than length which converts the flow rate of angular momentum into just linear momentum. If you change linear momentum with respect to time, then you get a force.

[0027] 8. The flow rate of angular momentum S is shown in **FIG. 7**. The force has to be against the area whose normal vector is in the radial direction which is also the direction of the momentum. So S has an r subscript indicating that it flows in the radial direction. The permutation tensor ϵ has three subscripts which keeps track of the tensor notation. The first subscript is the same as the momentum subscript. Permutations of the coordinate variables which are in order have a plus one sign. Permutations which are in reverse order have a minus one sign. Permutations in which the variable are repeated are zero. For example, $\epsilon_{tr\theta z}=-\epsilon_{rt\theta z}$ because the r and t are in reverse order in cylindrical coordinates. Because the permutation tensor starts with r, then we can have permutations such as {r,t,z} which is a reverse order negative permutation. This negative sign cancels the negative sign of the stress tensor. The reason this permutation is chosen is because the first subscript on the stress-energy tensor is now z. Because the normal to the area is in the radial direction, then the stress-tensor matches the electric fields that we have available, which are also in the zr-direction.

[0028] 9. In this case, the second subscript of the permutation tensor is time, rather than length. So the units become, as shown in **FIG. 8**, those of linear momentum. To me, this was very surprising. Then I realized that the radial electric field rotates with time which means the differential of the linear momentum produces a force on the hull. In exponential notation, the radial electric field rotates with Exp[iωt]. This is multiplied by the time lever arm, so the term that has to be differentiated is $t\,e^{i\omega t}$. The time lever arm saves the differentiation by making one term real so that the force is real. This is shown in **FIG. 9**. The units of the first term are real newtons. In the second term, the time t multiplied by the frequency cancels out in terms of units, so the units are still force, but imaginary

[0029] 10. There is an area involved in the force equation which is depicted in **FIG. 10**. The charged rotating cylinder (C) located inside the charged annular ring (B) is driven by motor (A). The radial electric field (E) is normal to the area (D) whose normal vector is also in the radial direction. The angular momentum flows through this area which surrounds the cylinder. In doing so, it curves spacetime which produces the force.

[0030] 11. If the radial electric field is continuous around the cylinder, then the net force is zero. Referring to **FIG. 11**, one section (A) of the rotating cylinder is charged, which means that there is a force once per cycle in a selected direction depending on when the annular ring is charged. The other option, referring to **FIG. 12**, is that the annular ring is divided up into two or three sections with the feature that the charge can be turned on (A) or off (B) on a particular segment. As the rotating electric field goes around, one of the annular ring sections will have an electric field in order create a force on that side.

[0031] 12. Since there are three force cylinders, this allows for yaw motion control so that the hull of the spacecraft can pivot to change direction. After the directional change, the two back cylinders can be synchronized to produce thrust in the forward direction.

[0032] 13. There could also be a polarity change for the vertical electric field such that a positive stress-energy is produced which would reverse the direction of the thrust.

What I claim as my invention is:

1. A spacecraft propulsion system utilizing three electrostatically charged motor-driven cylinders each one of which rotates within a charged annular ring to produce a spacetime stress curvature tension in the horizontal plane on the underside of the hull.

2. Said rotating cylinder comprised of bar magnets embedded in the cylinder and stacked in groups at intervals around the periphery of the cylinder with the purpose of increasing the permittivity of space by permeating the cylinder and ring with low linear mass, low speed of light hyperspace energy by means of a wormhole between our space and hyperspace. The larger permittivity is to increase the force. Said technique is contained in my patent applications Magnetic Vortex Wormhole Generator and Magnetic Vortex Generator.

3. Said rotating cylinder and annular ring having a suitable metal surface for forming and maintaining the electrostatic charge.

4. Said rotating cylinder having one or more segments which can be electrostatically charged individually or together to produce a force in a particular direction.

5. Said annular ring having one or more segments which can be electrostatically charged individually or together to produce a force in a particular direction.

6. A combination of three such thrusters providing a force in any particular direction or for yaw motion control.

7. Electric polarity switching of the fields in order to reverse the spacetime curvature and therefore change the direction of thrust.

8. The use of a magnetic vortex generator located above each thruster in order to permeate the cylinders and rings with low density hyperspace energy which would substitute for the embedded magnets in each cylinder.

* * * * *

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(54) REMOTE VIEWING AMPLIFIER

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(52) **U.S. Cl.** **359/896**; 359/894

(57) **ABSTRACT**

An apparatus which enhances the ability of a person to perform remote viewing by connecting the human spiritual eye to the tetrahedral geometry of subspace.

Figure 1

Figure 2

Figure 3

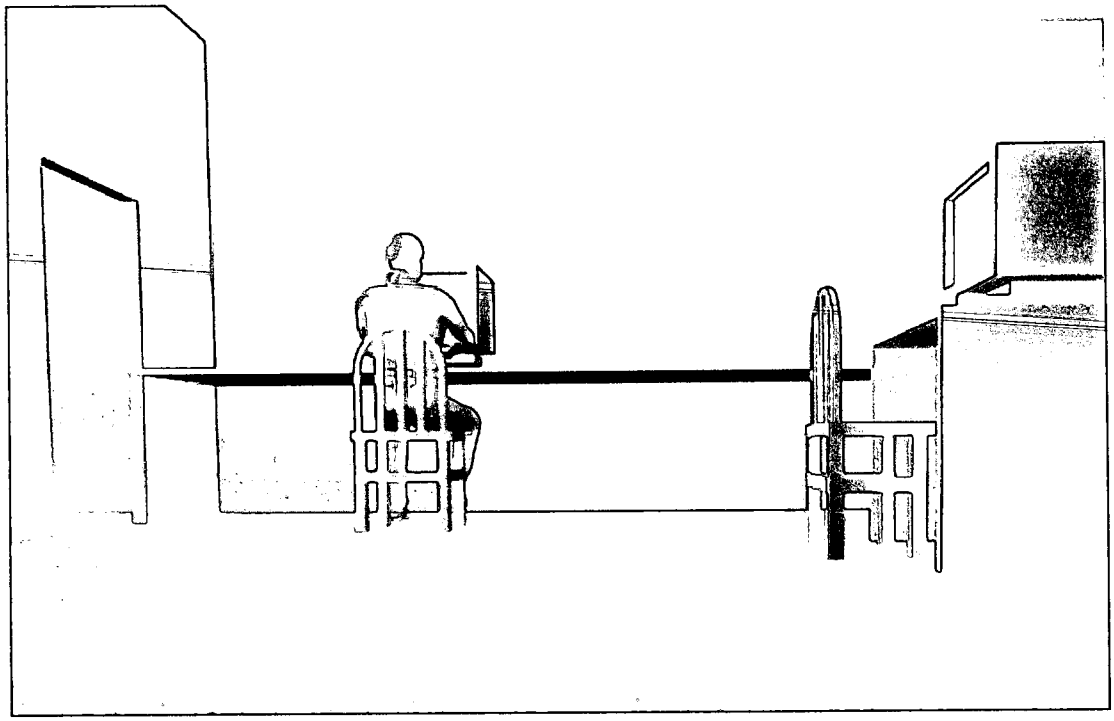

Figure 4

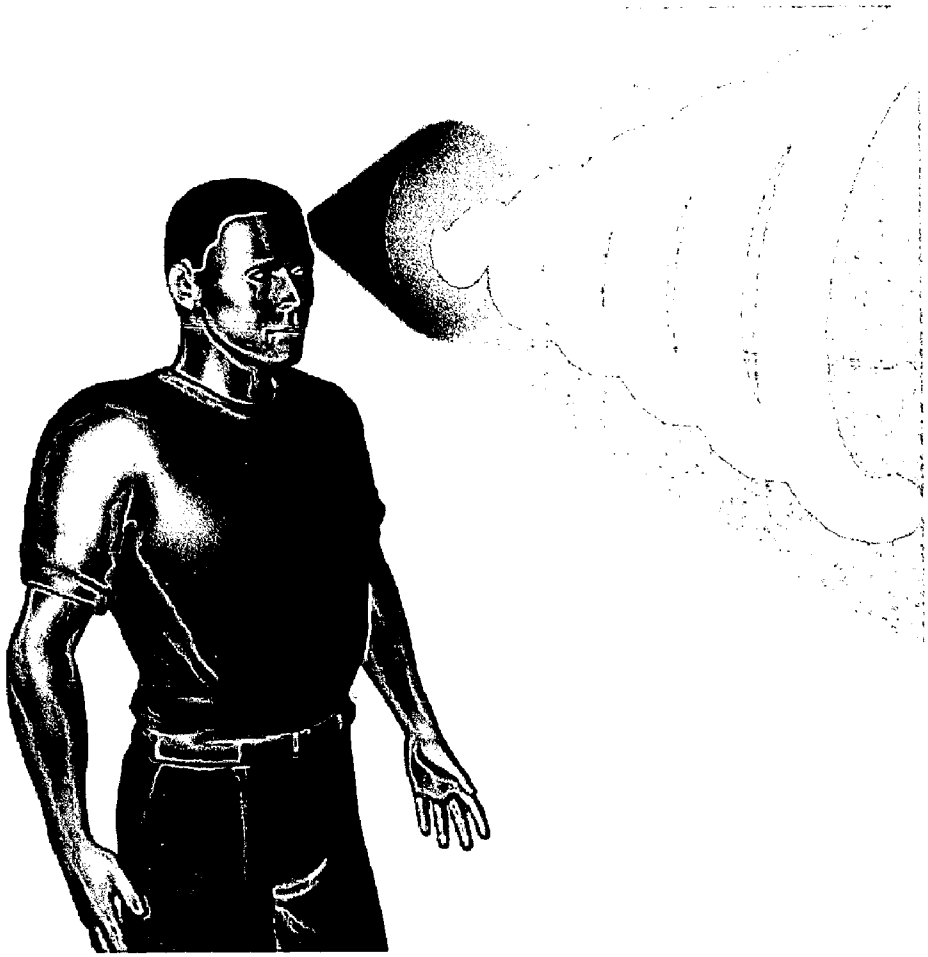

Figure 5

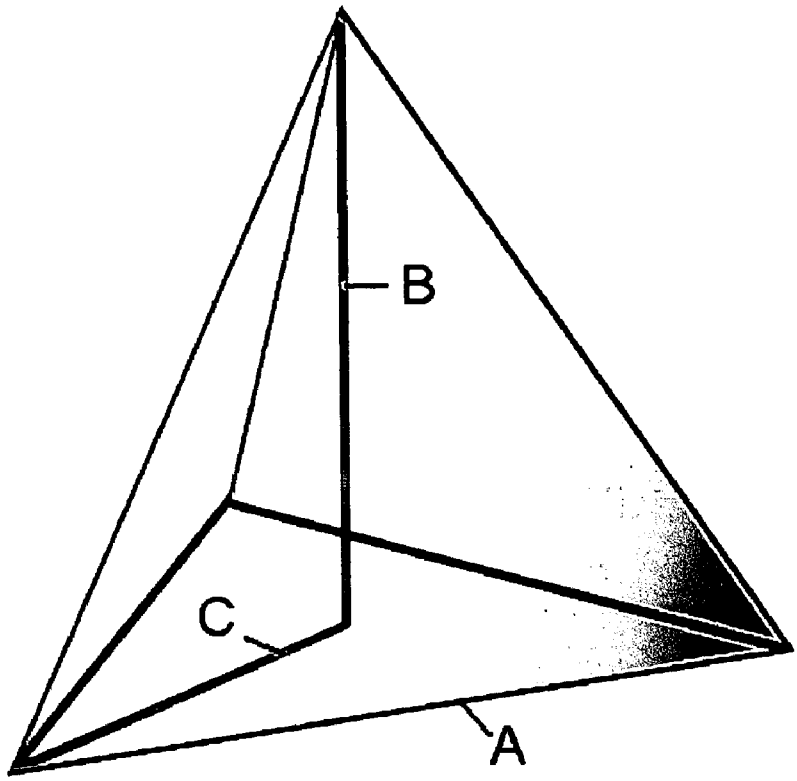

Figure 6

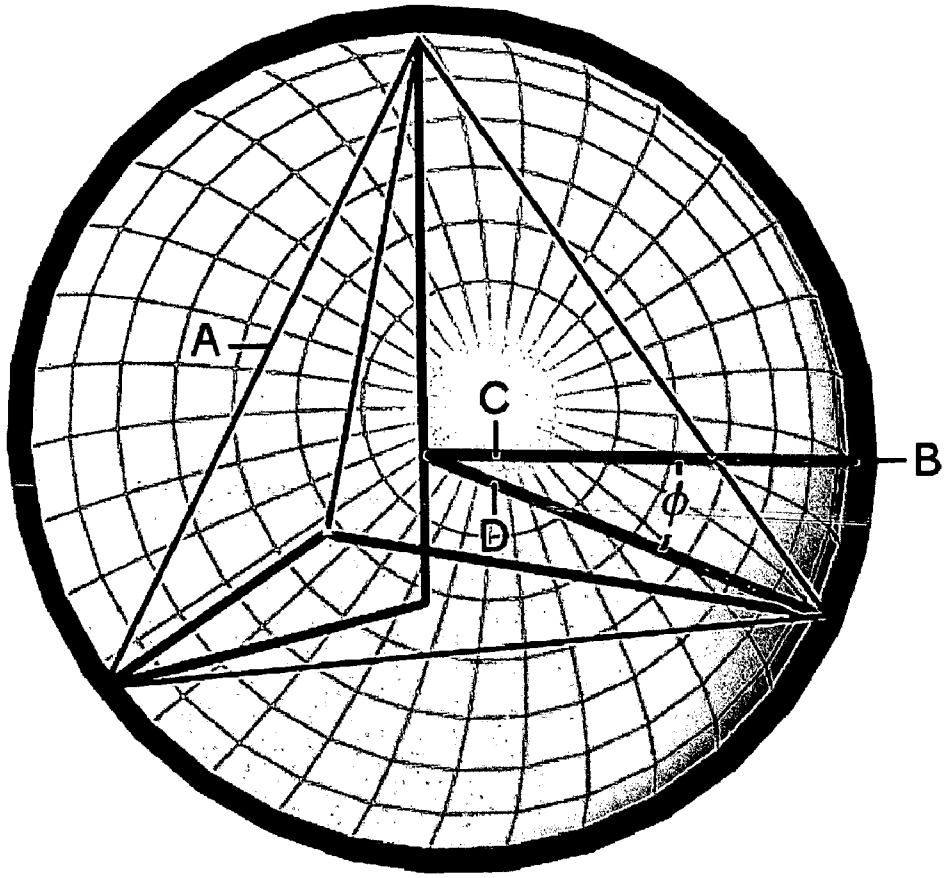

Figure 7

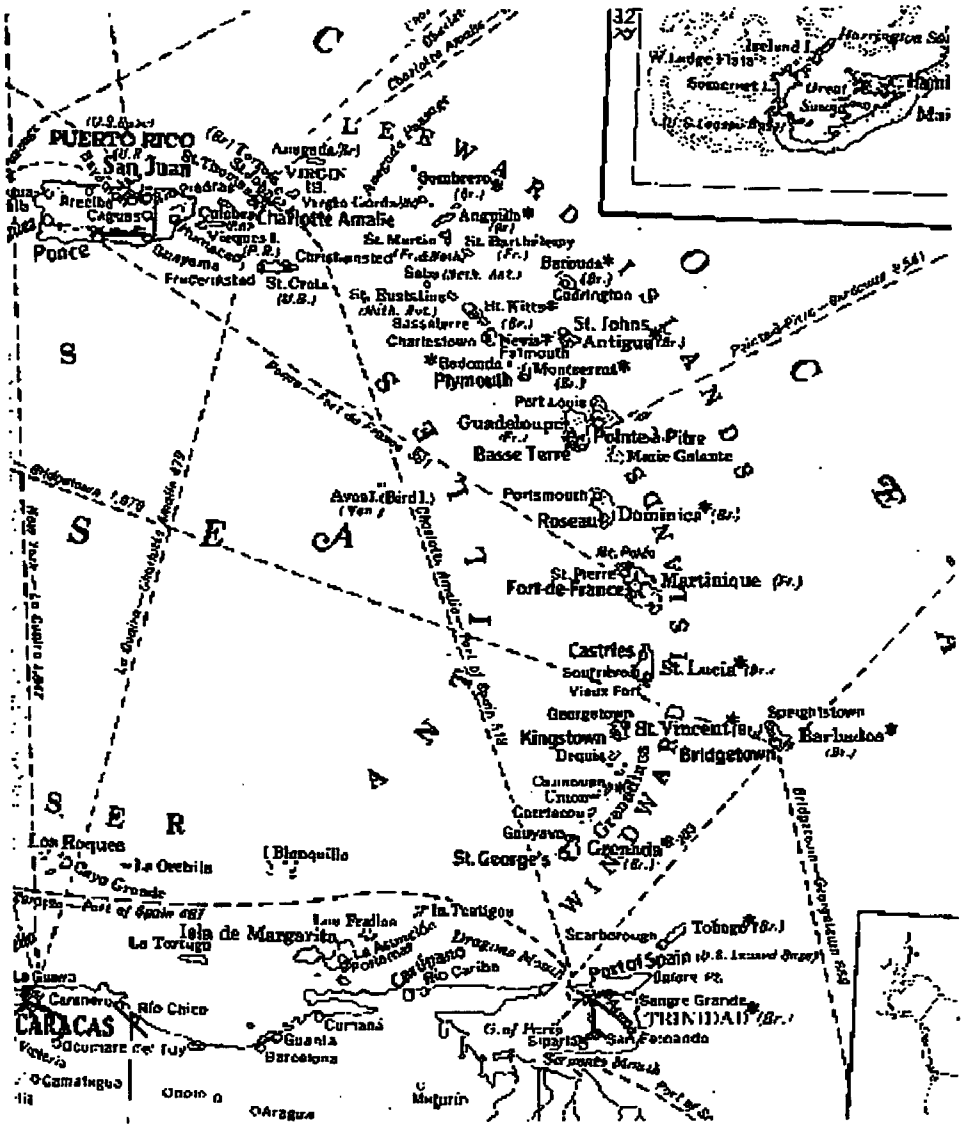
PUERTO RICO
San Juan
Ponce
Charlotte Amalie
Christiansted
St. Croix
Anguilla
Sombrero
Antigua
Barbuda
St. Johns
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Plymouth
Guadeloupe
Pointe-à-Pitre
Basse Terre
Dominica
Roseau
Martinique
Fort-de-France
Castries
St. Lucia
Kingstown
St. Vincent
Bridgetown
Barbados
Grenada
St. George's
Los Roques
Blanquilla
Isla de Margarita
La Tortuga
Tobago
Port of Spain
TRINIDAD
CARACAS
Curiaco
Barcelona
Maturin
Aragua
Cumana
Guanta
Rio Chico
Rio Caribe
Sangre Grande
San Fernando
Siparia
G. of Paria
Scarborough
Bridgetown

Figure 8

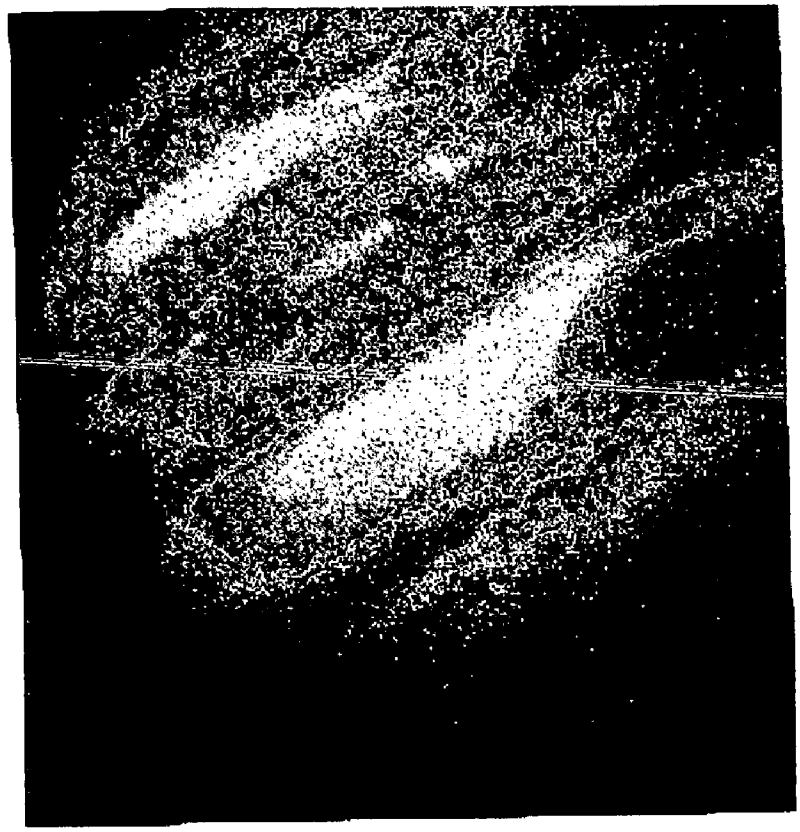

Figure 9

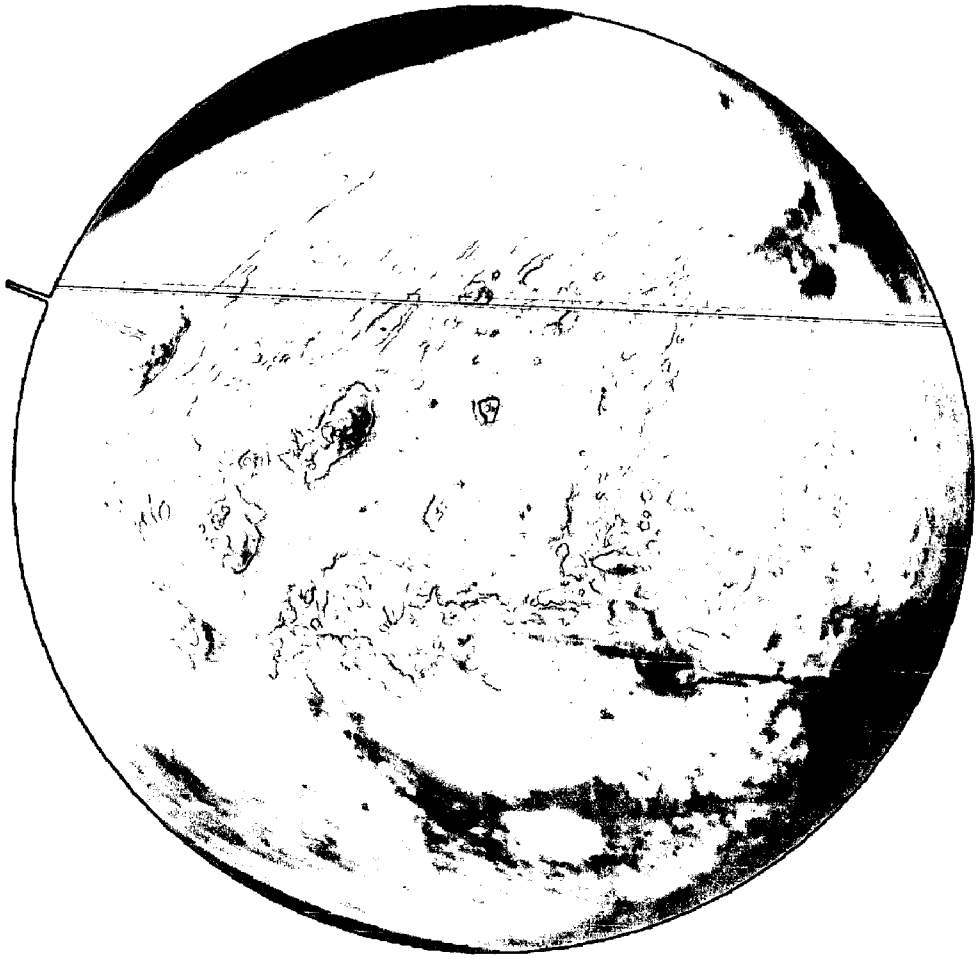

Figure 10

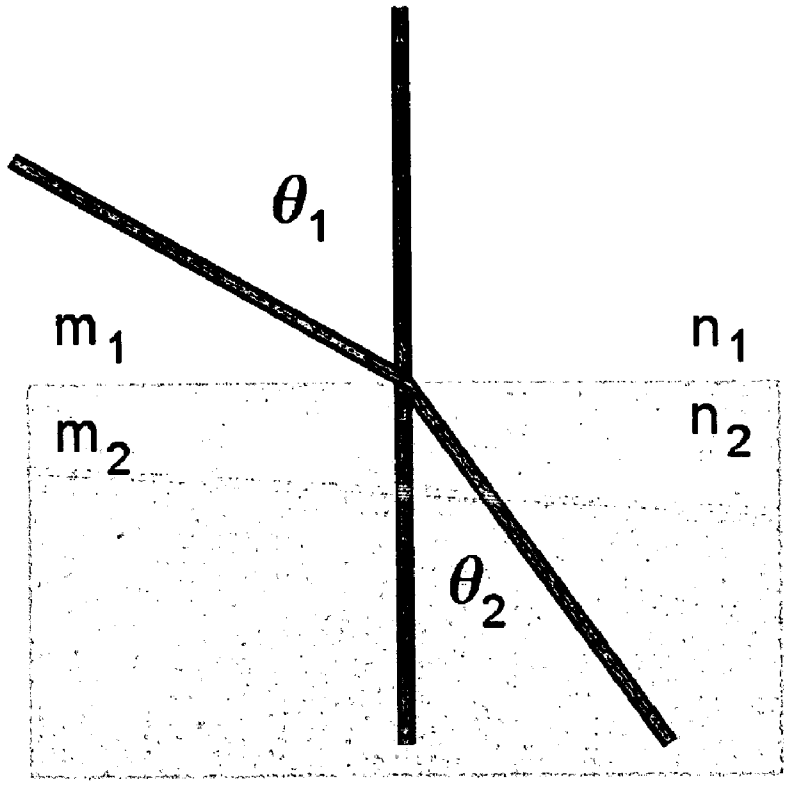

Figure 11

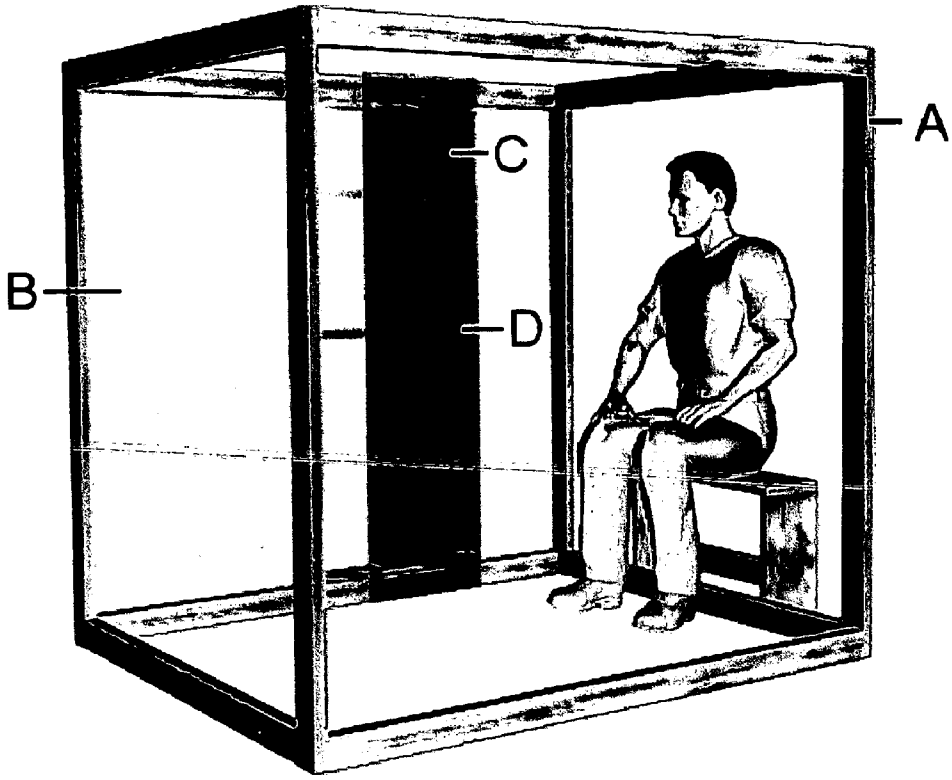

Figure 12

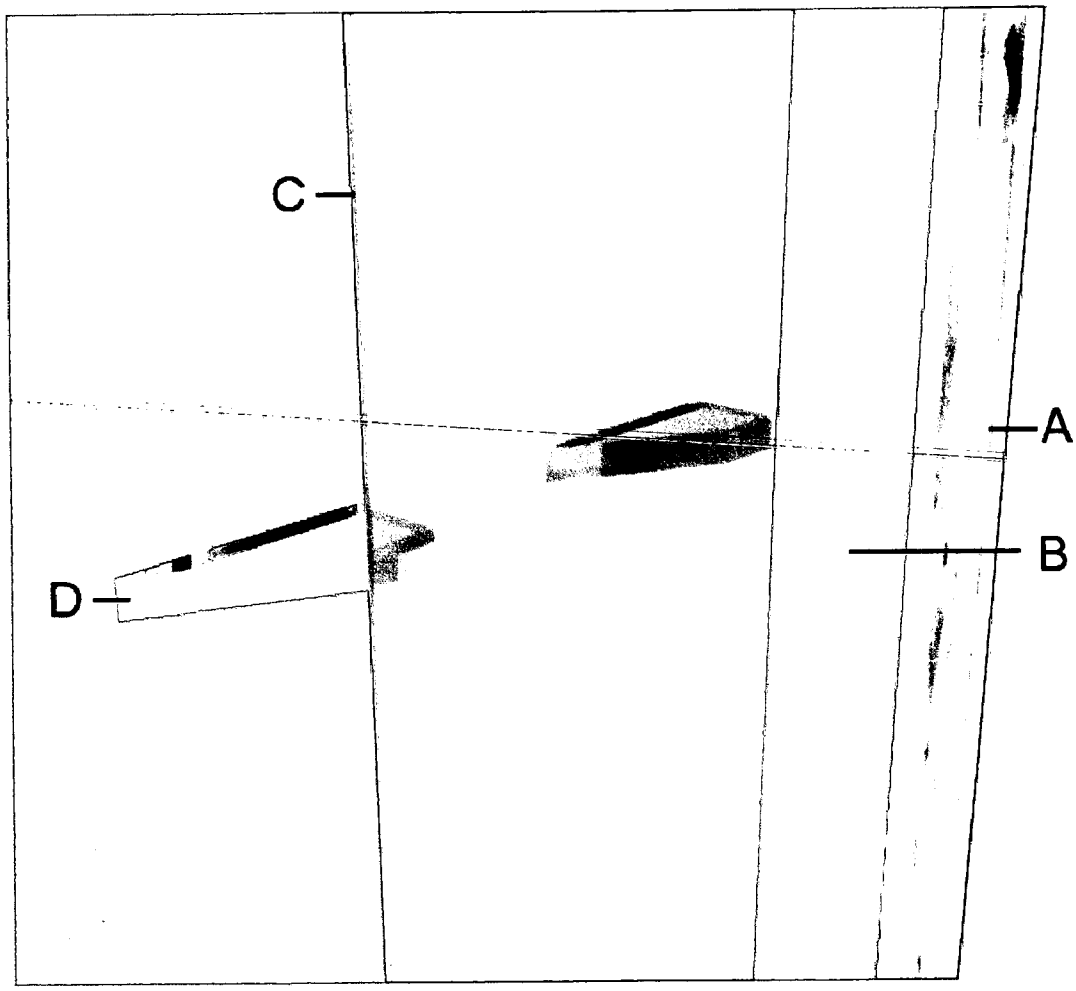

Figure 13

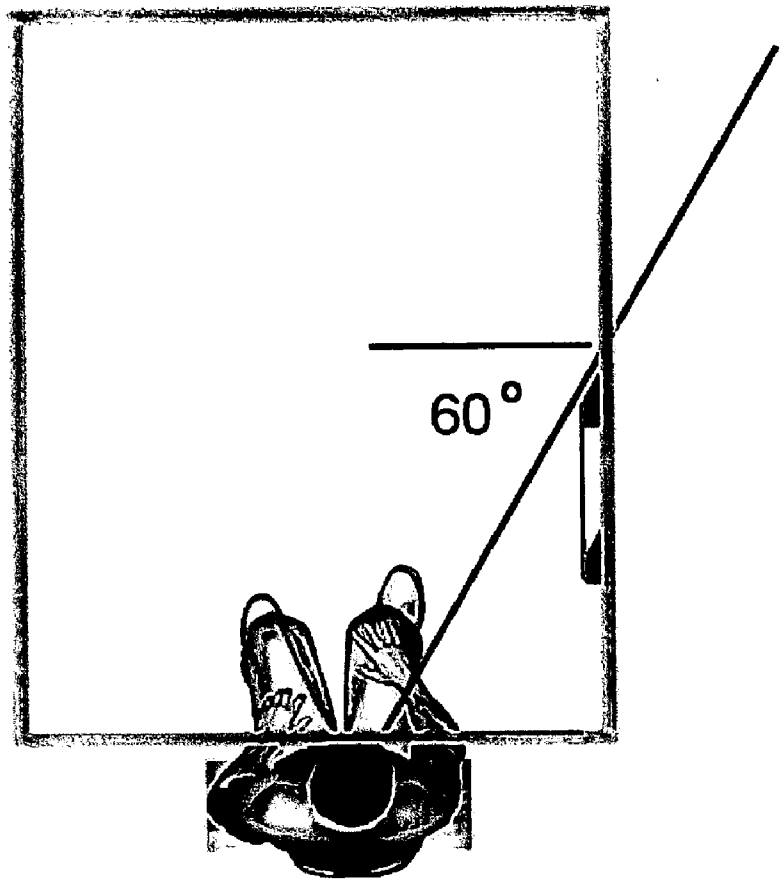

Figure 14

REMOTE VIEWING AMPLIFIER

BRIEF SUMMARY OF THE INVENTION

[0001] This invention enhances the ability of a person to perform remote viewing by connecting the spiritual eye to the tetrahedral geometry of subspace.

BACKGROUND OF THE INVENTION

[0002] Remote viewing is the projection of spiritual modules of the human energy field to distant locations in order to see, communicate and interact with other entities who live in subspace, space and hyperspace co-dimensions of the universe.

[0003] One of my first remote viewings was made at night to a distance of 10,000 miles on the sunlit side of the earth. My spiritual eye and body projected together while my mental facilities remained in my physical body. I found myself looking down on a palm tree from a height of about one hundred feet. The palm tree had several coconuts in it as seen in **FIG. 1**. I then gave the command to lower myself to the ground. At that moment I went sailing down past the coconuts, barely missing the tree! Finding myself on a pathway through the tropical forest, I then came to an extremely long wooden bridge which crossed over a river gorge. On the other side of the bridge I could see three soldiers running toward me as shown in **FIG. 2**. The two soldiers in front were carrying rifles and wearing light blue berets. The man running behind them was wearing an officer's cap with a red band. My first reaction was that I was going to be shot. I edged over on the right side of the wooden railing. They ran right past without seeing me. I then asked to see the building that these soldiers were guarding. Everything went dark, and then I found my spiritual eye peeking out of the floor of a computer room as seen in **FIG. 3**. There was one man using a computer on the opposite side of the room near an open door. He got up from his chair and came over to sit in front of a second computer located a few feet from where I was located. From the glare of the computer monitor, I could clearly see his face. Everything went dark as my spiritual eye and body projected back to my physical body.

[0004] Another time my spiritual eye, spiritual body and mind were standing outside the closed front door of my condominium. Upon patting my legs with my hands, I couldn't find the keys in my trousers. When I looked down, I realized I wasn't in my physical body. I then shot through two solid walls of concrete and returned to my awakening body.

[0005] What these two examples show is that the human spiritual energy system is modular. The reason it is modular is because there are seven hyperspace co-dimensions, each vibrating at a slightly different frequency, which receive energy from space through seven vortices located along the physical body. Over a lifetime, these vortices build up the human aura. Because all energy systems have to be grounded, the remaining six modules are the legs, body, arms/hands, voice, eye and mind. When the entire group is out-of-body as a single entity, then the soul energy powers the body in a manner similar to a battery. The soul looks like a two-inch diameter orange ball of plasma. If the soul is removed from the body, then the body becomes paralyzed except for a small movement of the eyelids. Upon death, all these separate modules are assembled into a single energy being. A light cord from the soul provides the battery power and information required to join these modules together. A second light cord from the pituitary gland transfers the modules into the energy being for assembly. This energy information transfer is the reason that people in a near-death situation say they saw their entire life flash before them.

[0006] Moving to a larger picture of things that are happening in the galaxy, I was able to make contact with the Pleiadian Federation which is located about 400 light years from earth. The Federation is a group of over one hundred intelligent beings that were brought to the Pleiades from around the galaxy. One member of the Federation calls itself the Intelligent Insect Beings. They are the ones who fly the black triangles over Belgium and France for the purpose of evacuating human beings back to the Pleiades for relocation on a planet called Earth II. The reason for this evacuation was that it was not known if it would be possible to win the battle of Revelations, which would take place about two years later here on earth.

[0007] As could be expected, the humans were angry and hysterical at being abducted. So the Intelligent Insect Beings asked me if I could calm them down. I was in telepathic communication with them, and they were in telepathic communication with their computer system, which meant that I could have my thoughts displayed to the humans on the computer monitor. It turned out that one woman was from Central America and only spoke Spanish. The Intelligent Insect Beings didn't speak Spanish so they thought there would be no way I could communicate with her. So I told them that I would spell the Spanish words letter-by-letter and she could then read my message. Since most Spanish people are Catholics, I thought a religious message would be of importance to her. I spelled out the phrase, "Que Dios te bendiga." which means, "May God bless you." I also asked the two beings to put their hands together in a form of prayer, and the woman followed suit. At that moment the Intelligent Insect Beings were reading her mind to understand her emotional state. They said, "She is crying tears . . . " After a slight but tense pause, they continued, "of joy!" They said the woman had a big smile on her face and was successfully transitioned into her new life.

[0008] One year later, the Blond Aliens of the hundred member council of the Pleiadian Federation remote viewed me so that I could celebrate with them the success of their mission to earth. The Blond Aliens, which is not their real name, fly the Beamship spacecraft. This hyperspace vehicle can teleport itself to any location in the galaxy. It dematerializes into the black void for an instance and then rematerialize anywhere in the galaxy. This ship can be seen in Billy Meier's video from Switzerland along with a picture of their envoy, Semjase.

[0009] Just recently I had a demonstration of the Beamship's ability. I heard an emergency distress call by a commander of a spacecraft who said that they had a fire onboard their spacecraft. I immediately remote viewed a Federation maintenance mothership, they got the frequency and location of the ship, and dispatched the Beamship in time to rescue the commander. The burned-out cables, which had caused the fire, were repaired by the Federation and the commander arrived home safely on his planet in his own spacecraft.

[0010] The Federation then received a message from the commander saying that he wanted his planet to join the Federation now that there was this type of communication available. So the Federation visited his planet for the signing ceremony, and I was invited to attend the proceedings by remote view. Word got around about this, and within three weeks another 20 planets joined the Federation for the same reason.

[0011] At one ceremony, which was attended by Admiral Third Class of the Pleiadian Defense Department, His Highness of the planet was signing the document of incorporation. At that moment, I could see him signing, so I exclaimed, "He is signing with his left hand." The Admiral was almost apoplectic at hearing this. After giving her the signed document, His Highness held up his hand and asked me how many fingers he was holding up. He had a fist so I said none. Then he put his index finger out and I said one. He then made a fist again and I said none. Then he held out all fingers and I said five. The Admiral said that he had a big smile on his face as he went to announce the agreement because he knew, even though his planet was located **90,000** light years away on the other side of the galaxy, he could instantly communicate any problems to the Federation. So this is the importance of developing inventions that can enhance our remote viewing ability because one day it will mean that we can become a vital part of the Pleiadian Federation.

SUMMARY OF THE INVENTION

[0012] Referring to **FIG. 4**, the spiritual eye of the human energy system is located at the pituitary gland in the forehead. It has the shape of a hollow cone which is composed of the misty white energy of hyperspace. Light coming into this vortex is then transferred by a light cord to a visual energy module which is located in a co-dimension of hyperspace. Because these modules are interconnected by light cords, the mind module is able to interpret the visual pattern the eye is seeing. More importantly, the mind can give logical instructions to this spiritual eye module for it to rotate around or move in a particular direction.

[0013] The reason that hyperspace has a white misty look to it is that the speed of light is very much less than the speed of light in our spacetime. The Lorentz transformation says that the distance L is shortened relativistically to a distance L' in a way related to the ratio of the velocity v of the object to the velocity of light c.

$$L' = L\sqrt{1 - \frac{v^2}{c^2}}$$

If the velocity of light is very low, then a small velocity creates an enormous contraction in length. By moving through hyperspace, therefore, enormous distances can be traversed. And this is the reason that it is possible to project the spiritual eye, voice and hearing to remote locations in the galaxy.

[0014] The universe is composed of subspace, space and hyperspace which are co-dimensions of each other. Subspace is defined by the geometry of the tetrahedron which is a four-sided solid whose faces are equilateral triangles having three 60° angles. Referring to **FIG. 5**, a tetrahedron whose sides are the square root of three (A), has a height of the square root of two (B), and base length equal to the square root of one (C). This forms the basic number set $\{\sqrt{1}, \sqrt{2}, \sqrt{3}\}$.

[0015] Referring to **FIG. 6**, the tetrahedron (A) is circumscribed by the sphere (B). Rod (C) is the sphere radius. A second rod (D), of equal length to rod (C), from the center of the sphere to the corner of the tetrahedron makes an angle ϕ of

$$\phi = \mathrm{ArcSin}\left(\frac{1}{3}\right) = 19.47122063^\circ$$

So the four corners of the tetrahedron touch the sphere.

[0016] This tetrahedral geometry can be seen throughout the planets of the solar system Referring to **FIG. 7**, the islands of the Caribbean curve down from Puerto Rico to Venezuela forming an island vortex. The low density hyperspace energy releasing from the corner of the tetrahedron softens the rock mantle. The hot magma then rises through the rock with the least resistance. This creates a circular arc of volcanic islands along the edge of the vortex.

[0017] Referring to **FIG. 8**, the Giant Red Spot of Jupiter is located at a southern latitude of 19.5°. This vortex is so large that the entire earth can fit in it.

[0018] Referring to **FIG. 9**, the Olympus Mons volcano is located at a northern latitude of 19.5° as shown by the marker. This volcano is the size of France. Notice the fallen plume of volcanic debris toward the north east.

[0019] The double harmonic of the tetrahedral angle is twice 19.5° or 39° which is the location of the Silver Bridge in Point Pleasant, West Va. A large wormhole opened up around the bridge during Christmas rush hour when the bridge was full of cars. Due to the low density hyperspace energy, the rivets holding the cables down popped loose and all the cars were dumped into the river. A computer simulation using Schrodinger's quantum mechanics equation for a particle in a potential well shows that as the energy becomes less dense, the particle is no longer contained in the potential well. The electron jumps out. Thus the atomic bonds are broken which softens the rivets. This is the first time that there has been an understanding of the failure mechanism of this bridge.

[0020] After downloading from the Internet several pages of the index of refraction of a wide range of materials, I noticed that the index of refraction for Plexiglas was 1.50. Another source said it was 1.51. One of the Internet sites had a movable flashlight which showed the incident ray and the refracted ray. For Plexiglas, surprisingly enough, the incident ray was coming in at an angle of 60° to the normal, and the light was refracted at 35.26°, both of which are tetrahedral angles. The angle of the equilateral face of the tetrahedron is of course 60°. The angle at the top of tetrahedron is the arc-cosine of the ratio of the height over the edge length.

$$\theta = \text{ArcCos}\left(\frac{\sqrt{2}}{\sqrt{3}}\right) = 35.26^\circ$$

According to Snell's law, the index of refraction n, times the sine of the angle $\sin(\theta_1)$ of the ray leaving material m_1, is equal to the index of refraction n_2 times the sine of the angle of refraction $\sin(\theta_2)$ of the ray entering material m_2. Referring to **FIG. 10**, the equation is

$$n_1 \sin(\theta_1) = n_2 \sin(\theta_2)$$

The index of air n_1 is equal to one. The index n_2 of Plexiglas is 1.50. If the incident ray is at $\theta_1 = 60°$ to the normal, then the output angle is

$$\theta_2 = \text{ArcSin}\left[\frac{n_1}{n_2}\text{Sin}(\theta_1)\right] = \text{ArcSin}\left[\frac{2}{3}\frac{\sqrt{3}}{2}\right] = 35.26^\circ$$

which is equal to the angle of the tetrahedron.

[0021] Then I recalled several months earlier that I had gone to the Subway restaurant to get a sandwich. I was sitting by the Plexiglas window communicating with the Admiral whose mothership was in earth orbit. She mentioned that they were bringing two people aboard. At that moment I looked out through the window and I could see both of them clearly and easily through my spiritual eye. To my amazement, I saw both of the captives start to pull out guns from behind their backs. I then projected by spiritual hands which resulted in preventing the attack on the security guards. To say the least, the Admiral was rather surprised at these events. She then asked me to look at the design of the window because she thought it had something to do with my enhanced remote viewing capabilities. Looking at the Plexiglas, I noticed that on the edge of the large window pane there was a shorter piece of Plexiglas which was mounted parallel to the window pane. This smaller panel acted to protect the yellow neon fluorescent tube. I took the measurements of the design using a piece of paper that I found near the table.

[0022] I then went home and designed up a mounting bracket with my 3D computer software. I had already installed the stereolithography software that converts the design to the *.STL file format. How stereolithography works is that it slices the design into many thin horizontal sections. The machine has a platform which is mounted in a bath of liquid polymer. An ultraviolet laser, mounted on an xy-table, then traces out the slice. Because the liquid polymer is light sensitive, it polymerizes immediately into solid plastic. Then the platform is lowered a few thousandths of an inch and the second slice is added. This process eventually builds up the complete 3D part. Using the Internet, the *.STL file is sent by e-mail to the stereolithography service provider who returns the part overnight. So the next day I had the piece from which I made a plastic mold and several additional pieces for mounting the Plexiglas bracket on a full sheet of Plexiglas that I ordered locally. It never occurred to me to measure the angles, so after I got the index of refraction for Plexiglas, I measured the incident angle and it turned out to be 61°. So then I realized that the spiritual eye was being diffracted across these two Plexiglas plates which connected it to the tetrahedral geometry of subspace. Because subspace is the foundation of space, this created a much more efficient route for remote viewing. The result is that this invention has allowed me to make contact with 430 alien civilizations. Since then I have been awarded the Aphysics prize for my work in the invention and elaboration of the tetrahedron diagram of which there are now over 4000 graphs. The scientific discoveries contained in the diagram are (1) the electron and proton are one and same particle, (2) the existence of hyperspace, (3) how mass can be taken out of dimension, (4) cosmology determines the elementary particles, (4) all the physics constants and the tetrahedral geometry are contained in the two 360° circles of the infinity symbol and (5) all the physics constants are determined geometrically and projected from a subspace manifold into our dimension. For my work in Revelations, I was awarded four beautiful galloping riderless white horses of the Apocalypse.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0023] **FIG. 1**. Remote viewing the top of a palm tree containing several coconuts.

[0024] **FIG. 2**. Remote viewing three soldiers running across a wooden bridge.

[0025] **FIG. 3**. Remote viewing computer building that soldiers were guarding.

[0026] **FIG. 4**. Spiritual eye of human aura.

[0027] **FIG. 5**. Tetrahedron.

[0028] **FIG. 6**. Tetrahedron circumscribed by sphere.

[0029] **FIG. 7**. Caribbean volcanic island vortex.

[0030] **FIG. 8**. Giant Red Spot on Jupiter.

[0031] **FIG. 9**. Olympus Mons volcano on Mars.

[0032] **FIG. 10**. Snell's Law of Refraction.

[0033] **FIG. 11**. Perspective view of remote viewing station.

[0034] **FIG. 12**. Wedge-shaped spacers for diffraction panel.

[0035] **FIG. 13**. Remote viewing angle.

[0036] **FIG. 14**. A remote viewing session taking place on a planet located 90,000 light years from earth on the other side of the galaxy showing His Highness signing with his left hand the document that allows his planet to become a member of the Pleiadian Federation.

DETAILED DESCRIPTION OF THE INVENTION

[0037] 1. Referring to **FIG. 11**, the remote viewing station is a rectangular box wooden frame (A) on which is mounted on one side a large sheet of Plexiglas (B). The diffraction panel (C), made of a shorter length of Plexiglas, is mounted with acrylic glue on the Plexiglas sheet using clear polyoptic molded plastic spacers (D).

[0038] Referring to **FIG. 12**, the wedge-shaped spacers (D) hold the diffraction panel (C) to the sheet of Plexiglas (B). The angle of the wedge is 30° which makes the incident angle 60° to the normal.

[0039] Referring to the top view perspective **FIG. 13**, sitting on the wide bench, the remote viewer can adjust his sight along the wedge for proper alignment at an angle of 60°. Due to the 1.50 index of refraction of Plexiglas, the spiritual eye is diffracted across the edge of the first panel and then refracted across the second panel at the tetrahedral angle of 35.26°.

[0040] Referring to **FIG. 14**, the remote viewing image is seen superimposed on the large sheet of Plexiglas which acts as the viewing screen.

I claim:

1. A remote viewing station comprising:

(a) a rectangular box frame made of wood having a length of six feet, a width of four feet and a height of six feet;

(b) a large sheet of quarter inch Plexiglas, having an index of refraction of 1.50, mounted on the right side of item (1a);

(c) several wedge-shaped clear plastic spacers, three inches in width and eight and a half inches in length, having a wedge angle of 30° that are mounted on the interior right side of item (1b);

(d) a shorter sheet of quarter inch Plexiglas, having a length of one and a half feet, mounted on item (1c) parallel to item (1b);

(e) a wide bench on which the remote viewer sits so that the remote viewer can align his sight along the wedge angle of item (1c);

2. A remote viewing amplifier that:

(a) diffracts the spiritual eye of the remote viewer across the edge of item (1d) at an incident angle of 60° to the normal;

(b) refracts the spiritual eye at 35.26° to the normal due to the refractive index of item (1a) according to Snell's Law of Refraction; and

(c) aligns the spiritual eye with the tetrahedral geometry of subspace due to the diffraction/refraction combination of item (2a) and (2b).

* * * * *

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(54) TRIANGULAR SPACECRAFT

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(52) **U.S. Cl.** **244/171.5**

(57) **ABSTRACT**

A spacecraft having a triangular hull with vertical electrostatic line charges on each corner that produce a horizontal electric field parallel to the sides of the hull. This field, interacting with a plane wave emitted by antennas on the side of the hull, generates a force per volume combining both lift and propulsion.

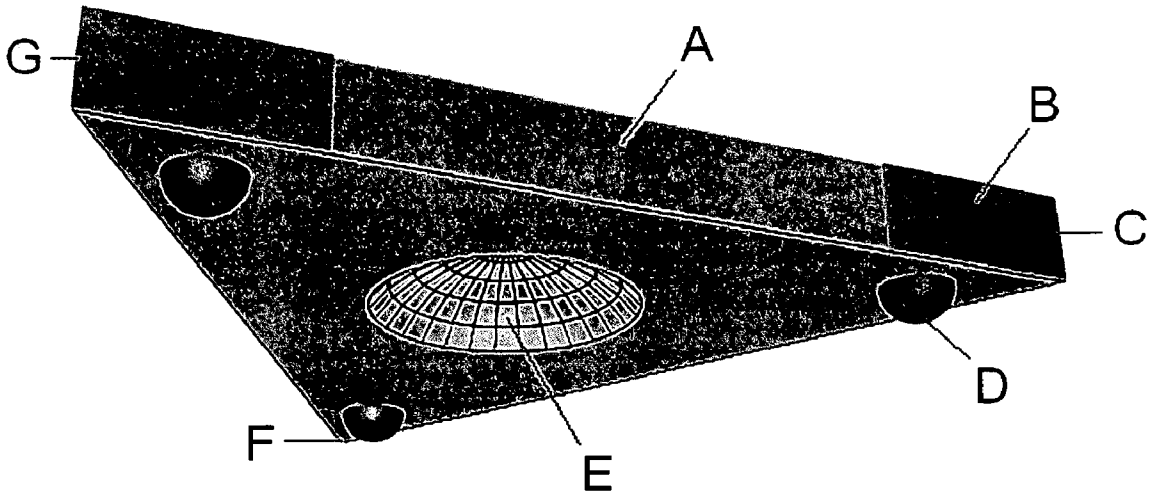

Figure 1

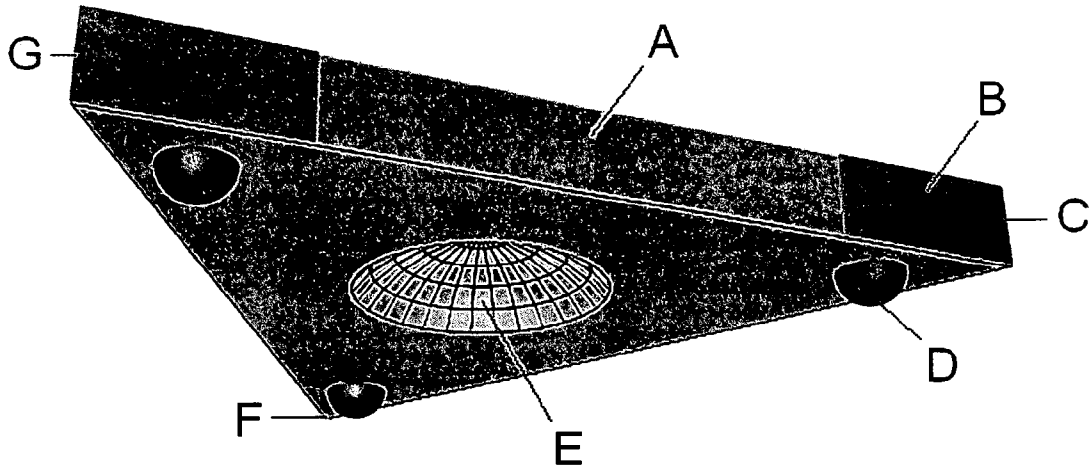

Figure 2

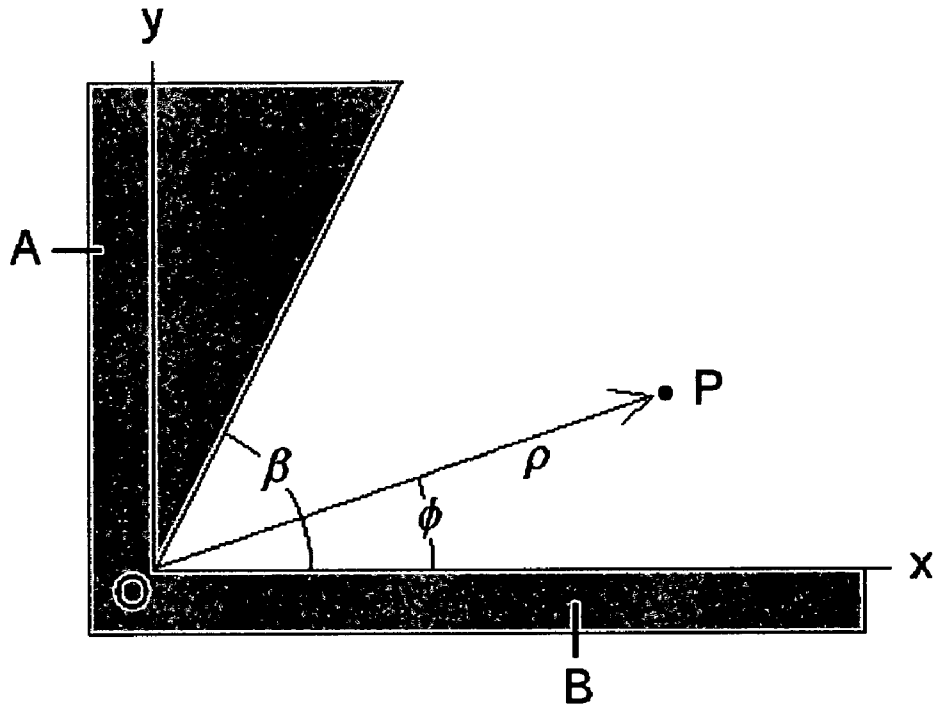

Figure 3

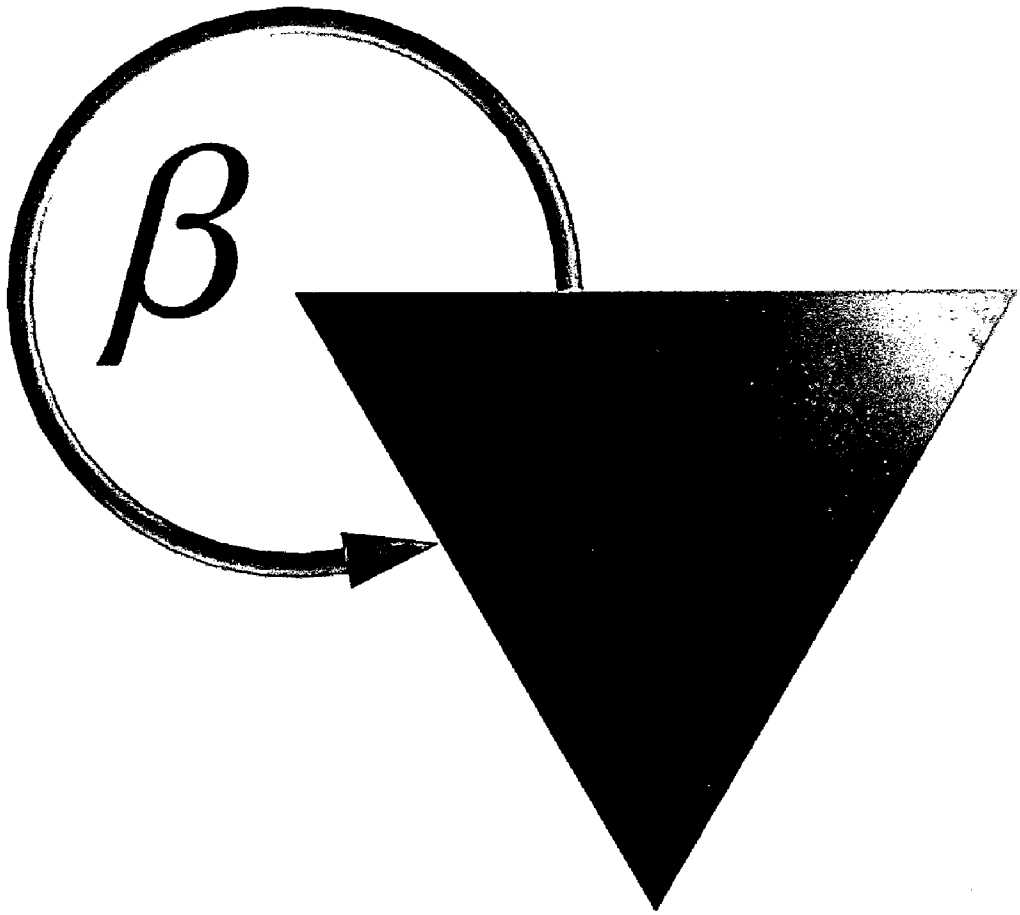

Figure 4

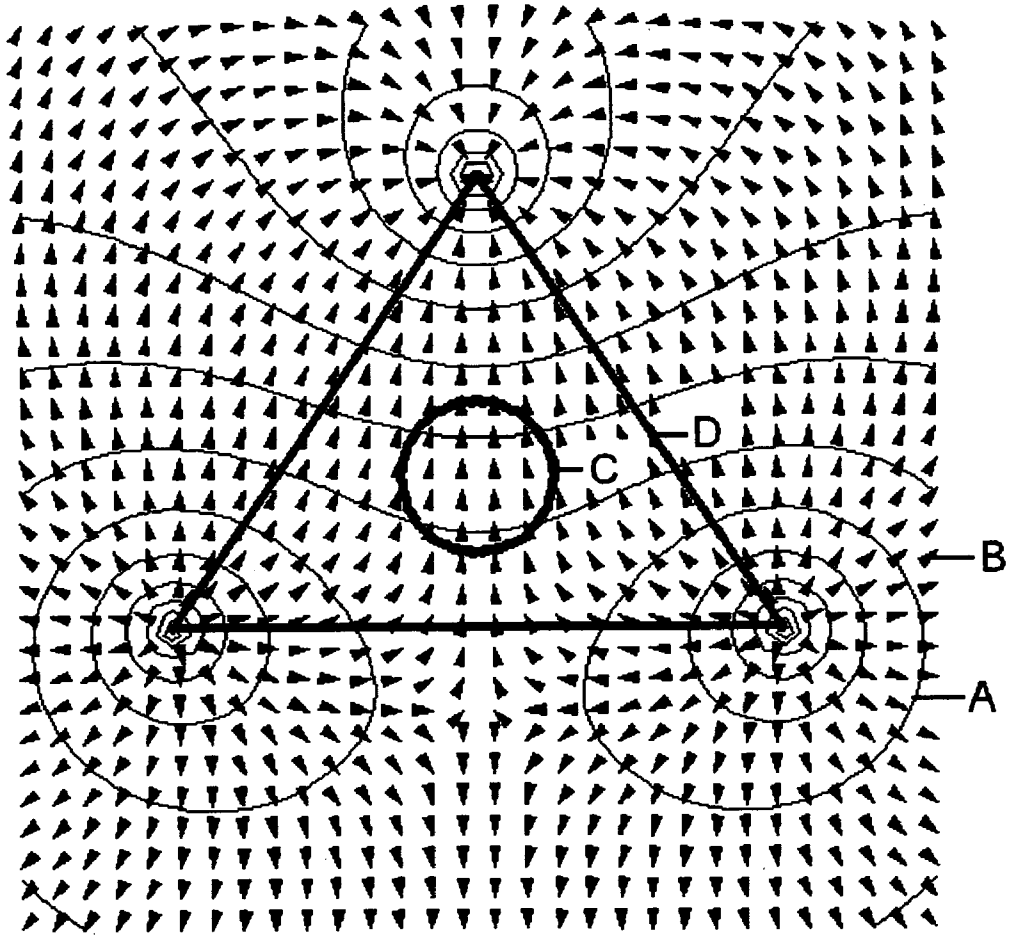

Figure 5

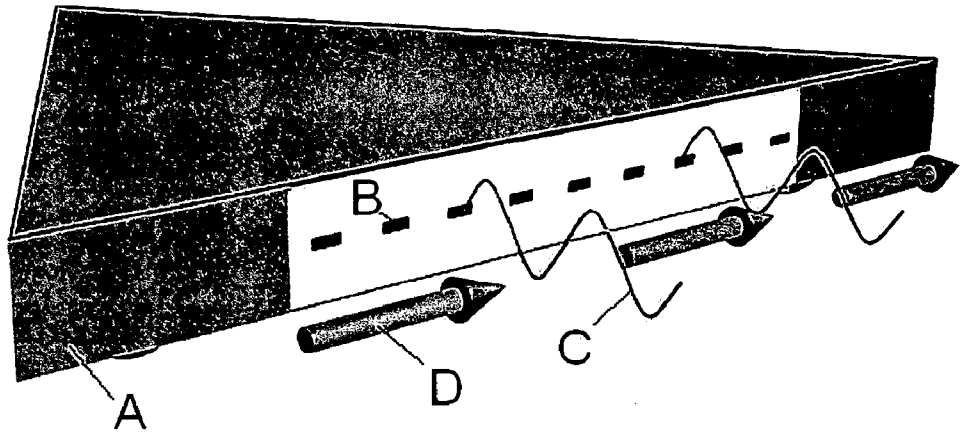

Figure 6

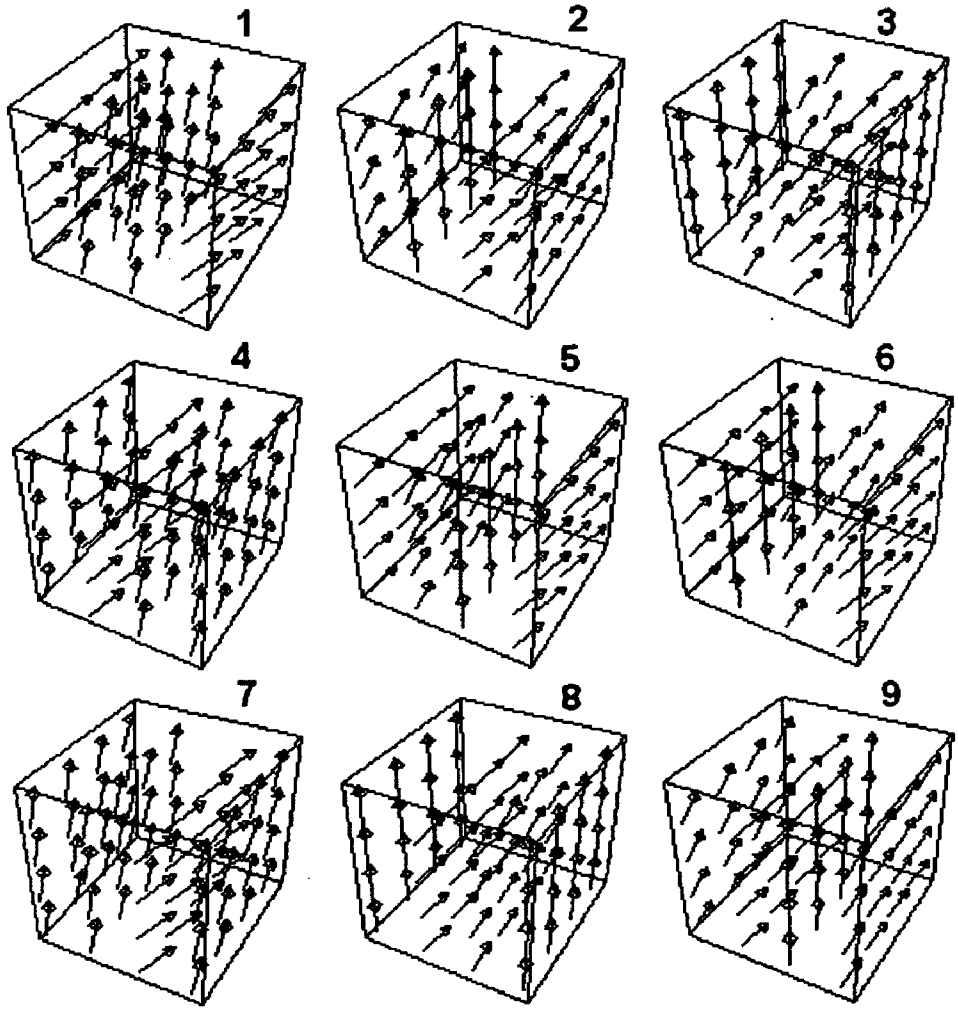

Figure 7

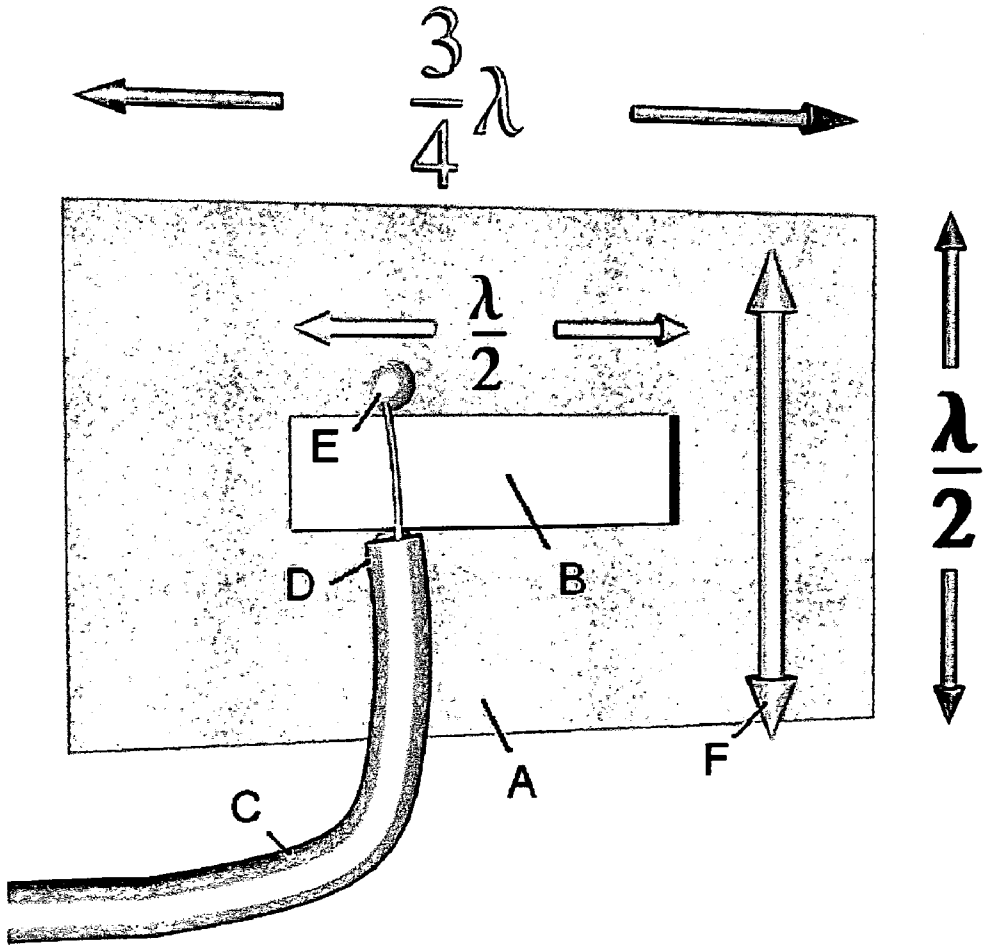

TRIANGULAR SPACECRAFT

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a spacecraft having a triangular hull with vertical electrostatic line charges on each corner. The line charges create a horizontal electric field that, together with a plane wave emitted by antennas on the side of the hull, generates a force per volume providing a unique combination of both lift and propulsion.

BACKGROUND OF THE INVENTION

[0002] Referring to **FIG. 1**, the spacecraft has a hull in the shape of an equilateral triangle. A parabolic antenna (E) is centrally located in the bottom of the hull. An array of horizontal slot antennas is located along the side of the hull (A). Each back corner (F,G) has a corner conducting plate which is charged to a positive voltage +V. The forward corner (C) has a conducting plate charged to a negative voltage −V. A motion control hemisphere (D) is located on the bottom surface in each of the three corners.

[0003] Referring to **FIG. 2**, two planes (A,B) intersect at the origin O at an opening angle β. Each plane (x,y) is charged to a voltage V. The potential at point P is determined in polar coordinates {ρφ}. The Laplace equation for the potential Φ in polar coordinates is given by:

$$\frac{1}{\rho}\frac{\partial}{\partial\rho}\left(\rho\frac{\partial\Phi}{\partial\rho}\right)+\frac{1}{\rho^2}\frac{\partial^2\Phi}{\partial\phi^2}=0$$

Using a separation of variables solution, the potential is given as the product of two functions:

$$\Phi(\rho,\phi)=R(\rho)\Psi(\phi)$$

which when substituted into the Laplace equation becomes:

$$\frac{\rho}{R}\frac{d}{d\rho}\left(\rho\frac{dR}{d\rho}\right)+\frac{1}{\Psi}\frac{d^2\Psi}{d\phi^2}=0$$

Since the two terns are separately functions of ρ and φ respectively, each one has to be constant with the sum of the constants equal to zero:

$$\frac{\rho}{R}\frac{d}{d\rho}\left(\rho\frac{dR}{d\rho}\right)=\nu^2 \quad \frac{1}{\Psi}\frac{d^2\Psi}{d\phi^2}=-\nu^2$$

These two equations have solutions:

$$R(\rho)=a\rho^{\nu+b\rho-\nu}$$

$$\psi(\phi)=A\cos(\nu\phi)+B\sin(\nu\phi)$$

The azimuthal angle φ is restricted to a value in the range $0\leqq\phi\leqq\beta$. The boundary condition is that the potential Φ is equal to V for any radius ρ when φ=0 and φ=β. This means that v has to be an integer value of π so that the sine function is zero:

$$\sin(\nu\beta)=\sin\left(\frac{m\pi}{\beta}\beta\right)=\sin(m\pi)=0 \quad m=1,2\ldots$$

which in turn means that the coefficient A of the cosine term has to be zero in the solution above. Choosing b=0 makes the general solution for the potential equal to:

$$\Phi(\rho,\phi)=V+\sum_{m=1}^{\infty}a_m\rho^{m\pi/\beta}\sin(m\pi\phi/\beta)$$

which shows that when the angle is zero, the sine is zero and the potential is V. If the angle is β, then there is a multiple of π such that the sine is zero again.

[0004] Because the series involves positive powers of the radius, for small enough ρ, only the first term m=1 in the series is important. Thus around ρ=0, the potential is approximately

$$\phi(\rho,\phi)\approx V+a_1\rho^{\pi/\beta}\sin(\pi\phi/\beta)$$

[0005] The electric field component is the negative gradient of the potential:

$$E_\phi(\rho,\phi)=-\frac{1}{\rho}\frac{\partial\Phi}{\partial\phi}=-\frac{\pi a_1}{\beta}\rho^{(\pi/\beta)-1}\cos(\pi\phi/\beta)$$

The surface charge distribution σ at φ=0 and φ=β is equal to the electric field perpendicular to the surface times the permittivity of space ϵ_0:

$$\sigma(\rho)=\varepsilon_0E_\phi(\rho,0)=-\frac{\varepsilon_0\pi a_1}{\beta}\rho^{\frac{\pi}{\beta}-1}$$

Notice that if angle of intersection β is less than π, then the equation says that there is a very small radius to a positive power which means little charge density accumulation.

[0006] Referring to **FIG. 3**, the value of β, in the case of the triangular hull, is equal to 360° less 60° for a total of 300° or:

$$\beta=\frac{300}{180}\pi=\frac{5}{3}\pi$$

$$\rho^{\frac{\pi}{\frac{5}{3}\pi}-1}=\frac{1}{\rho^{\frac{2}{5}}}$$

which says that there is a charge density singularity to the two fifths power for small radius. Thus, the corner plates on the hull create a huge line charge density along the sharp vertical corner edge. The equation for the potential of a line charge density is given as:

$$\Phi(x,y)=-\frac{\lambda}{2\pi\varepsilon_0}\mathrm{Ln}((x-x_0)^2+(y-y_0)^2)$$

where λ is the charge per unit length in the vertical z-direction, and x_0 and y_0 are the location of the line charge in the xy-plane.

[0007] Referring to **FIG. 4**, the triangular hull (D) is plotted together with the potential contours (A) and the electric field arrows (B) created by the three corner line charges. The line charges are perpendicular to the paper. Notice that the electric field arrows are parallel crossing the center parabolic antenna (C). The electric field is also parallel to the sides (D) of the triangle.

[0008] Referring to **FIG. 5**, along the side of the triangle (A), an array (B) of horizontal slot antennas emit electromagnetic waves that have a vertically polarized electric E field (C). These traveling waves interact with the electric field (D) produced by the line charges on the corners of the triangle.

[0009] Using differential forms mathematics, this combination of fields is represented by the Hodge star of the differential of the wedge product of the two fields. The antenna electromagnetic field is a combination of a traveling magnetic field B_w, and electric field E_w. The stationary field E created by the line charges is perpendicular to the traveling wave.

$$*d(E \wedge (B_w + E_w \wedge dt))\frac{\varepsilon}{c} = \frac{\text{force}}{\text{volume}}$$

where ϵ is the linear capacitance of space and c is the speed of light. Thus there is a force per volume around the hull.

[0010] This combination of fields produces a spacetime curvature as determined by Einstein's General Theory of Relativity. The traveling electric field has an amplitude in the vertical z-direction and travels in the x-direction

$$E_{w-Ez}\cos(x-t)$$

The Faraday electromagnetic tensor contains all the electric and magnetic fields in all the {x,y,z} directions. The first row and first column contain the two electric fields

$$F^{\alpha}_{\beta} = \begin{array}{c|cccc|} t & 0 & E_x & 0 & E_z\cos(x-t) \\ x & E_x & 0 & 0 & 0 \\ y & 0 & 0 & 0 & 0 \\ z & E_z\cos(x-t) & 0 & 0 & 0 \end{array}$$

The stress exerted on spacetime occurs in the xx, yy and zz-direction as calculated from the stress-energy tensor T of gravitational physics

$$4\pi T^{\mu\nu} = F^{\mu\alpha}F^{\mu}_{\alpha} - \frac{1}{4}g^{\mu\nu}F_{\alpha\beta}F^{\alpha\beta}$$

where g is the metric tensor for Cartesian space

$$g_{\alpha\beta} = \begin{array}{c|cccc|} t & -1 & 0 & 0 & 0 \\ x & 0 & 1 & 0 & 0 \\ y & 0 & 0 & 1 & 0 \\ z & 0 & 0 & 0 & 1 \end{array}$$

where the diagonal components are the coefficients of the elementary spacetime length ds squared

$$(ds)^2 = -(dt)^2 + (dx)^2 + (dy)^2 + (dz)^2$$

The calculation produces three stresses T^{xx},T^{yy} and T^{zz} in their respective {x,y,z} directions.

[0011] Referring to **FIG. 6**, these three stresses are plotted together as a **3**D vector field animated over time in nine frames. The graphs show that there is a lift force as depicted by the vertical arrows as well as a force of propulsion as shown by the interspersed horizontal arrows. With the passage of time, these vectors exchange places with each other so that the lift becomes the propulsion and vice versa, creating a wavy stress-energy field around the hull.

SUMMARY OF THE INVENTION

[0012] This invention is a spacecraft with a triangular hull having charged flat plates on the vertical corners of the three sides. The two rear corners are charged to a potential V. The forward corner is charged to a potential −V. The 60° angle on the corner creates a line charge density singularity that produces a huge horizontal electric field pointing from the back to the front of the craft which is also parallel to the sides of the triangle. An array of horizontal slot antennas located on the sides of the triangular hull produce an electromagnetic wave with the electric field polarized in the vertical direction. This combination of fields produces a spacetime force in both the vertical and horizontal directions such that the spacecraft receives a lift force and a force of propulsion.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0013] **FIG. 1**. Perspective view of triangular spacecraft.

[0014] **FIG. 2**. Drawing of the intersection of two charged plates in order to calculate the charge density in the corner.

[0015] **FIG. 3**. Perspective view of the corner angle β for the equilateral triangle.

[0016] **FIG. 4**. Planar **2**D graph showing the electric field produced by three line charges on the corners of the triangular hull.

[0017] **FIG. 5**. Perspective view of electric field produced by the linear charge interacting with the traveling electromagnetic wave produced by the slot antenna.

[0018] **FIG. 6**. **3**D vector animation of the lift and thrust force generated by the fields.

[0019] **FIG. 7**. Perspective view of slot antenna.

DETAILED DESCRIPTION OF THE INVENTION

[0020] Referring to **FIG. 7**, the antenna (A) is made out of sheet copper in which a rectangular horizontal slot (B) has been notched out using a die press and sheet metal fixture. A coaxial cable from the amplifier and frequency generator is attached across the slot by soldering the outer cable (D) to one side of the slot and the inner cable (E) to the other side of the slot. This creates the positive and negative charges across the gap which forms the vertical electric field (F) which radiates out perpendicularly to the copper sheet.

[0021] Although the invention has been described with reference to specific embodiments, such as a particular antenna system, those skilled in the art will appreciate that many modifications and variations are possible without departing from the teachings of the invention. All such modifications and variations are intended to be encompassed within the scope of the following claims.

1. A spacecraft comprised of the following components:

(a) a triangular hull in the form of an equilateral triangle;

(b) two copper plates attached on opposite vertical sides at each of the three corners of the hull (**1***a*) such that a sharp vertical edge is formed where they come together;

(c) an electrostatic generator used to charge the back two copper-cladded corners (**1***b*) to a high positive voltage, and the third forward copper-cladded corner to a high negative voltage;

(d) a horizontal slot antenna array mounted-on the sides of the hull; and

(e) a frequency generator, antenna and coaxial cables to drive the antenna array (**1***d*).

2. To create, by claims (**1***a*, **1***b*, **1***c*), an intense vertical line charge at the corners (**1***b*) and a horizontal electric field that that is parallel to the sides of the hull (**1***a*);

3. To create, by claims (**1***d*,**1***e*), an electromagnetic wave with a vertically polarized electric field traveling outward from the side of the hull (**1***a*); and

4. To create, by claims (**2**,**3**), an interaction of the electrostatic field (**2**) with the electromagnetic wave (**3**) such that a combined spacetime curvature pressure is generated on the hull in the upward and forward direction to produce lift and propulsion respectively.

* * * * *

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St. Clair

(54) PERMANENT MAGNET PROPULSION SYSTEM

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(21) Appl. No.: **11/001,217**

(22) Filed: **Dec. 1, 2004**

Publication Classification

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(52) **U.S. Cl.** **105/49**

(57) **ABSTRACT**

This invention is a propulsion system for a train that uses permanent magnets mounted on a rotating iron cylindrical plate carrying a radial current in order to create a spacetime curvature distortion which pulls the locomotive along the track.

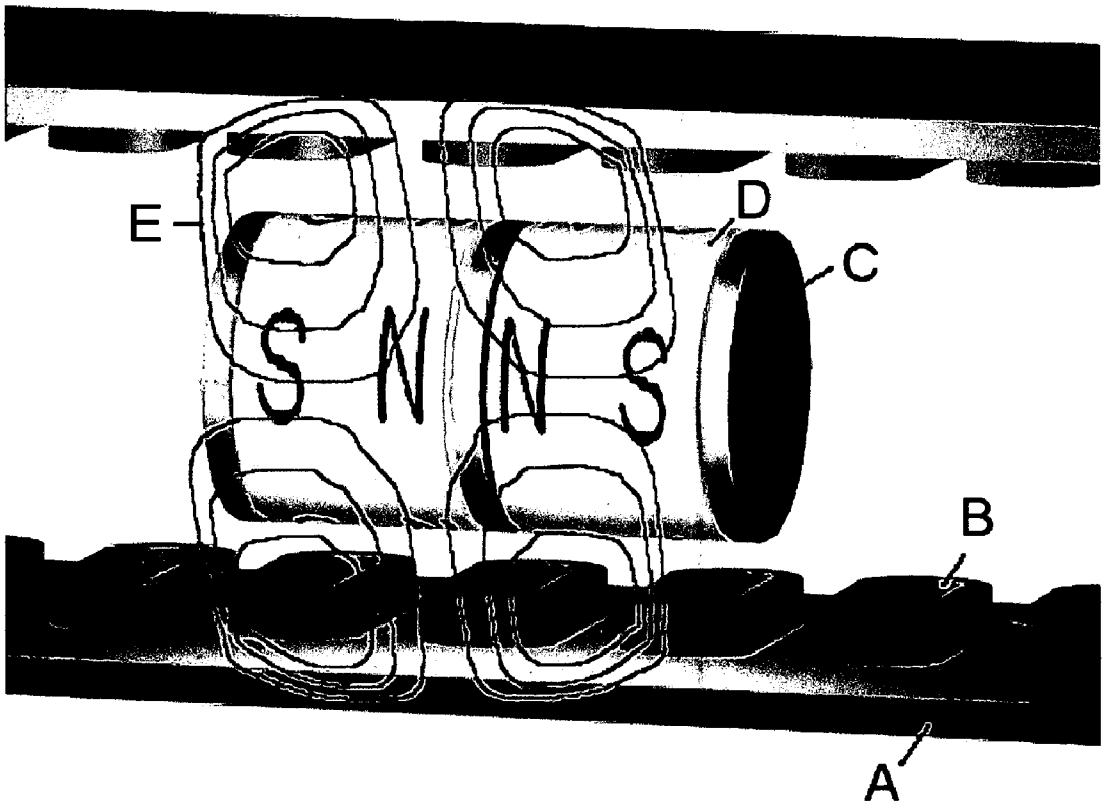

Figure 1

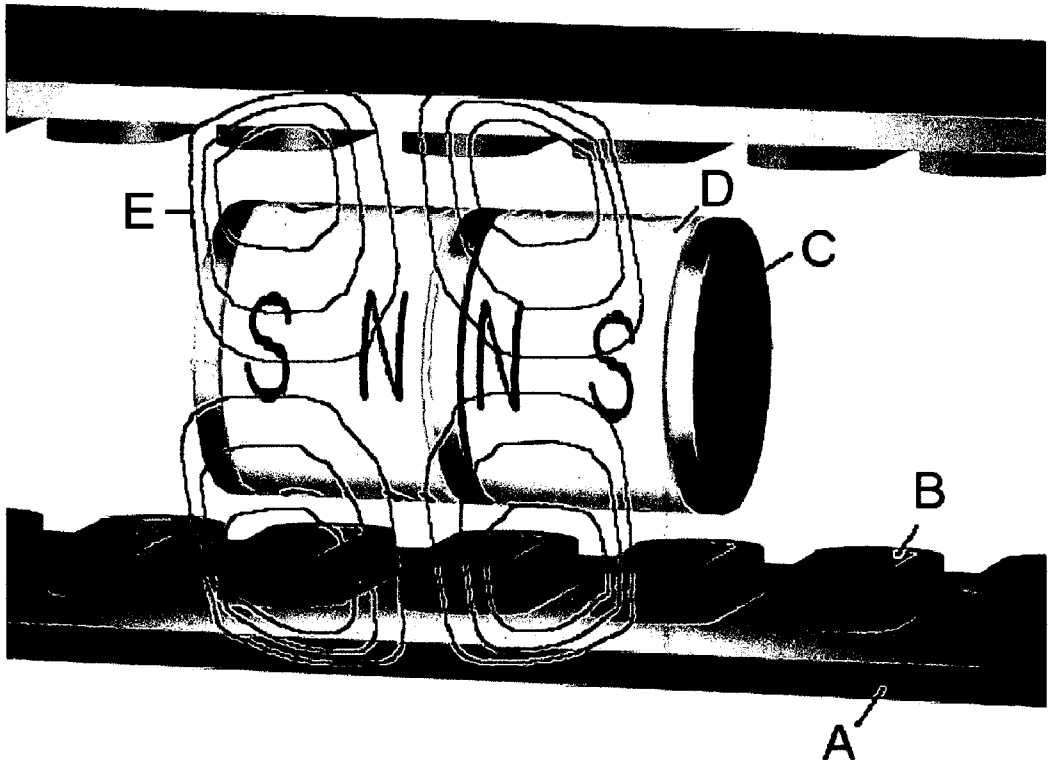

Figure 2

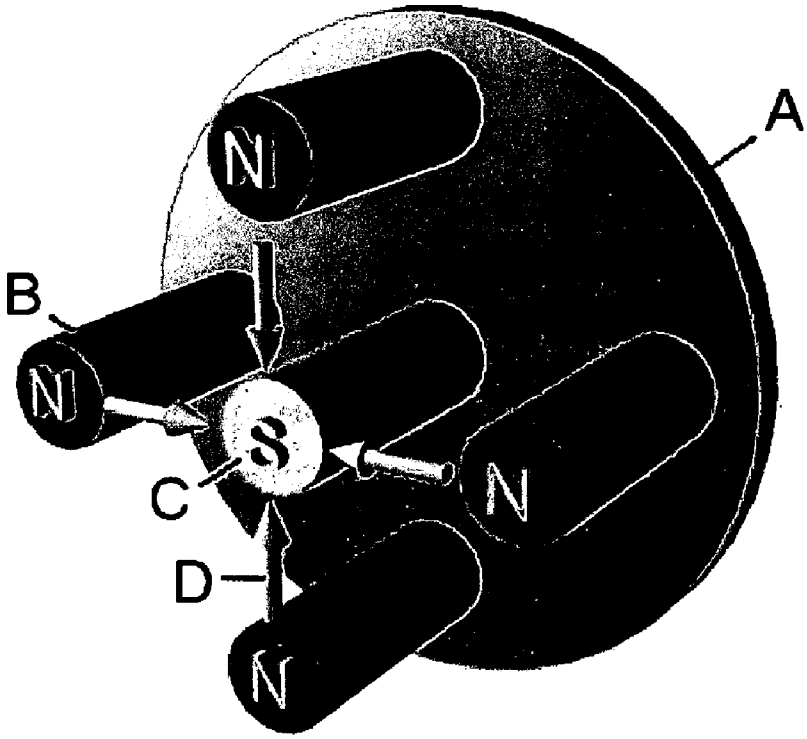

Figure 3

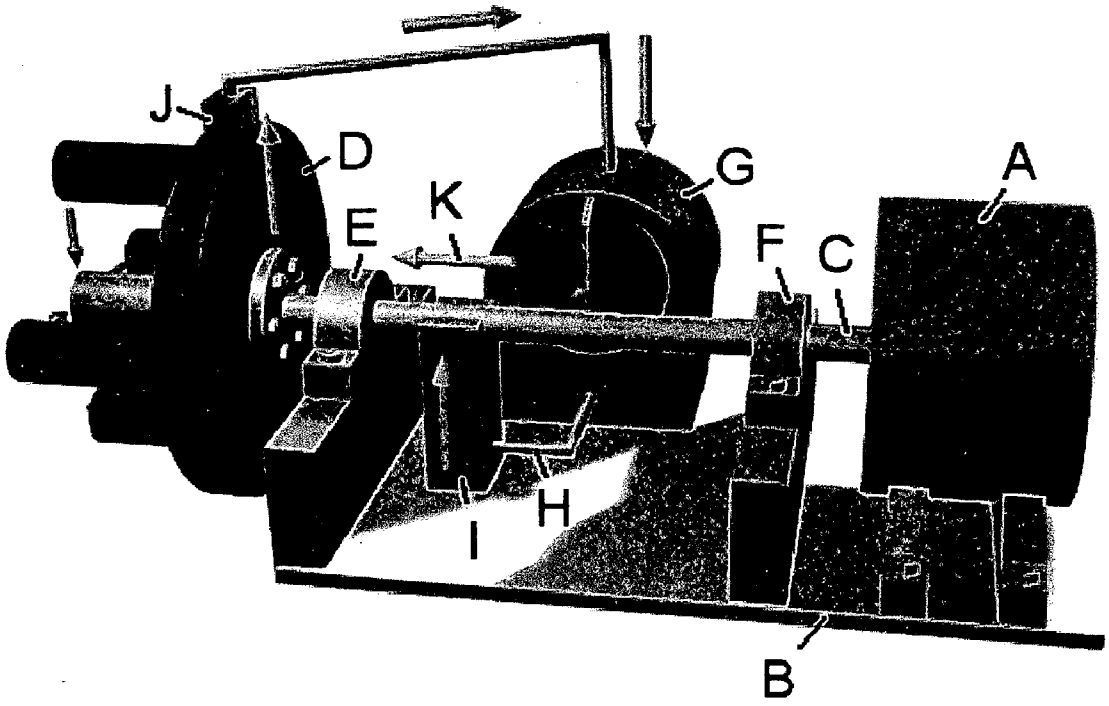

Figure 4

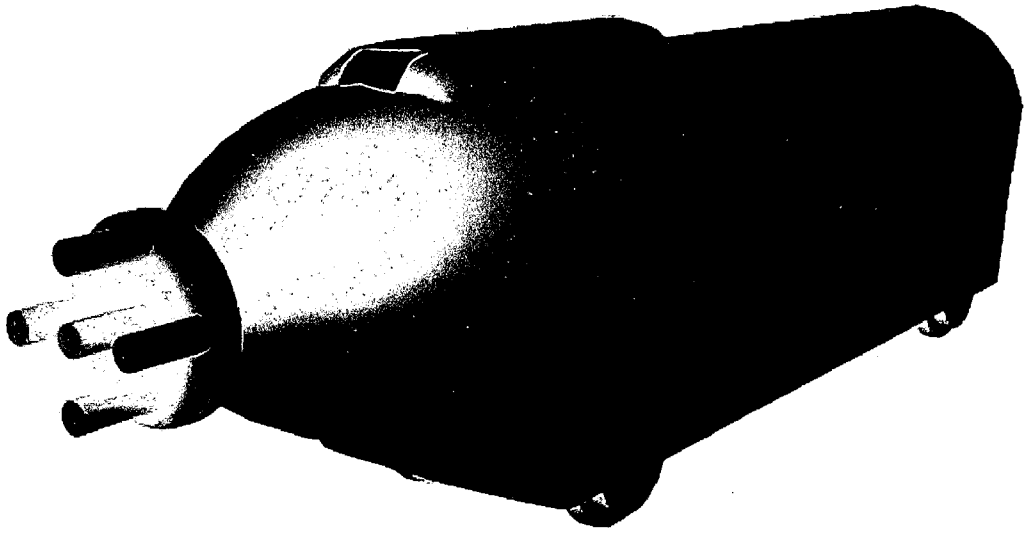

PERMANENT MAGNET PROPULSION SYSTEM

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a propulsion system for a train that utilizes spinning cylindrical magnets in order to create a spacetime pressure distortion ahead of the vehicle that pulls the locomotive along the track.

BACKGROUND OF THE INVENTION

[0002] At the present time, referring to **FIG. 1**, proposed permanent magnet propulsion systems use a dual railway track (A) supporting a series of coil windings (B) located along the track. The vehicle is attached to two permanent magnets (D) between steel pole pieces (C). The north pole of each magnet faces the interior pole piece such that the magnetic flux path (E) follows the center pole piece up through the railway bed and then back to the south pole of the magnet. As the magnets move along the track, the coil windings are activated at the correct time by Hall sensors. With the coil energized as a north pole, the permanent magnet north pole is repelled which drives the vehicle along the track The problem with this design, and other similar designs, is that it is not practical to wind huge numbers of sensor-activated electrical coils along a steel track.

[0003] From Einstein's General Theory of Relativity, it is known that a spacetime curvature pressure develops perpendicular to direction of vibration of the electric and magnetic field. As an example, the photon has an electric field vibrating in the vertical y-direction and a magnetic field vibrating in the horizontal x-direction. The spacetime curvature pressure is therefore along the z-axis of radiation which pushes the negative mass of the photon along. Thus in order to create a spacetime curvature pressure in the z-direction along the track which would pull the train forward, a magnetic flux density field is required in the radial direction.

[0004] Referring to **FIG. 2**, four equally-spaced north permanent magnets (B) surrounding a centrally-located south permanent magnet (C) are mounted on an iron cylinder which acts as the radial flux return path. The magnetic flux density field (D) is in the radial direction from the north pole to the south pole. In order to provide strength, the magnets are molded onto a steel shaft and coated with epoxy so that they don't rust. During the molding process, a capacitor-discharge magnetizer is used to create the magnetic field of the magnet.

[0005] In Cartesian coordinates {−ct,x,y,z}, the elemental spacetime length ds squared is the sum of the squares of the incremental lengths {cdt,dx,dy,dz}

$$(ds)^2=-(dt)^2+(dx)^2+(dy)^2+(dz)^2$$

where the speed of light c is unity. The coefficients (−1,1,1,1) of this equation make up the g metric 4×4 tensor

$$g_{\alpha\beta} = \begin{array}{c|cccc|} & t & x & y & z \\ \hline t & -1 & 0 & 0 & 0 \\ x & 0 & 1 & 0 & 0 \\ y & 0 & 0 & 1 & 0 \\ z & 0 & 0 & 0 & 1 \end{array}$$

[0006] The Faraday electromagnetic tensor contains the magnetic fields which determine how the spacetime length ds is curved. For a magnetic flux density field in the x-direction, Bx, and a magnetic flux density field in the y-direction, By, the Faraday tensor is

$$F^{\alpha}_{\beta} = \begin{array}{c|cccc|} & t & x & y & z \\ \hline t & 0 & 0 & 0 & 0 \\ x & 0 & 0 & 0 & -By \\ y & 0 & 0 & 0 & Bx \\ z & 0 & By & -Bx & 0 \end{array}$$

The stress-energy-momentum tensor T, which determines how space is curved, is calculated from the following equation

$$4\pi T^{\mu\nu} = F^{\mu\alpha}F^{\nu}_{\alpha} - \frac{1}{4}g^{\mu\nu}F_{\alpha\beta}F^{\alpha\beta}$$

The stress-energy in the z-direction ahead of the locomotive is

$$T^{zz} = \frac{B_x^2 + B_y^2}{8\pi} = \frac{B_r^2}{8\pi}$$

where the sum of the squares of the fields in the x and y directions is the radial B field. In Einstein's General Relativity Theory, the curvature G tensor is equal to the stress-energy tensor divided by 8π. The G tensor is the curvature of space having units of inverse radius squared.

$$G = \frac{T}{8\pi}$$

Therefore the curvature G_{zz} generated along the z-direction ahead of the train is proportional to the square of the magnetic flux density field

$$G_{zz} = \frac{1}{r^2} = \frac{G\varepsilon}{c^2}\frac{B_r^2}{8\pi} = \frac{1}{meter^2}$$

where G is Newton's gravitational constant (not to be confused with the curvature tensor), ϵ is the linear capacitance of space, and c is the speed of light. The linear mass of space Ω is the speed of light c squared divided by the gravitational constant G, so that the equation can be written as

$$\frac{G\varepsilon}{c^2}\frac{B_r^2}{8\pi} = \frac{\varepsilon}{\Omega}\frac{B_r^2}{8\pi} = \frac{1}{\frac{\Omega}{\varepsilon}}\frac{B_r^2}{8\pi}$$

where the conversion factor is the square of the magnetic vector potential A

$$\sqrt{\frac{\Omega}{\varepsilon}} = \frac{\text{kgm}}{seccoul} = A$$

which is actually the momentum per charge. Therefore the curvature equation can be written as

$$\frac{1}{r^2} = \frac{1}{8\pi}\left(\frac{B_r}{A}\right)^2$$

This equation shows that it is necessary to create a magnetic vector potential together with the radial magnetic flux density field in order to create a curvature of space. Looking at the units of A shows that it is a mass momentum per charge

$$A = \frac{\text{kg}}{sec}\frac{m}{coul} = \frac{m\omega^2 r}{I}$$

or a mass m rotating with angular velocity c) per current along the radius. In terms of the invention, what this means is that the mass of the iron cylinder has to be rotating and there has to be a radial electrical current I in order to produce the linear charge along the radius. The differential mass dm depends on the circumference times the differential radius dr, the mass density p, and the length L of the cylinder

$$dm = \rho 2\pi r L dr$$

so that the magnetic vector potential becomes

$$A = \int_0^R \frac{\rho 2\pi r L \omega^2 r}{I} dr = \frac{2}{3}R^3 \rho \pi L \frac{\omega^2}{I}$$

The value of A for the iron cylinder is

$$L = .2m$$

$$\rho = 7866\frac{kg}{m^3}$$

$$R = 1m$$

$$\omega = 2\pi f = 6.28\ \text{sec}^{-1}$$

$$I = 3000000\ \text{amp}$$

$$A = .04335\frac{kgm}{\text{sec}coul}$$

$$Br = 1.2tesla$$

$$\frac{1}{8\pi}\left(\frac{Br}{A}\right)^2 = 30.47m^2$$

$$r_{curvature} = \sqrt{8\pi}\left(\frac{A}{Br}\right) = .181m$$

What makes this possible is that the new N-machines can easily generate a minimum of 6 million amps which is twice the value of the electrical current above.

[0007] Referring to **FIG. 3**, the assembly consists of a large induction motor (A) mounted on the train's base plate (B) driving a motor shaft (C) attached to the iron cylinder (D). The shaft is held in place by two thrust bearings mounted in two pillow blocks (E,F). The current-generating N-machine (G) is electrically connected by a copper bus (H) to a copper-beryllium brush (I) on the motor shaft with a similar return brush (J) on the edge of the iron cylinder. The current (K) flows through the motor shaft to the center of the rotating cylinder and then radially outward to the edge. The magnetic flux density flows from the north poles of the outer permanent magnets to the central south pole, along the central magnet to the center of the rotating cylinder and then radially outward to the south poles of the outer magnets.

[0008] The thrust F developed is the radius of curvature of spacetime r_c calculated above times the magnet flux density field times the current I

$$F = \frac{r_c B_r I}{\sqrt{8\pi}} \approx 30000lbf$$

Using conservation of tensor coordinates, the radius of curvature is in the z-direction, the magnetic flux density field is in the radial direction and the current is in the radial direction

$$F^z = x^z B_r I^r$$

where the radial indices cancel, leaving the z-index as the direction of the force.

SUMMARY OF THE INVENTION

[0009] It is the object of this invention to create a spacetime curvature in front of a train locomotive in order to pull the vehicle along the track It is known from gravitational physics that a spacetime curvature is generated perpendicular to the direction of vibration of the electric and magnetic field. A radial magnetic field, which can be produced by permanent magnets attached to the flat faces near the rim of a iron cylinder rotating about the z-axis, will create a curvature in the z-direction. Four cylindrical north-pole-oriented magnets produce a radial magnetic flux density with is channeled into a central cylindrical south-pole-oriented magnet. The flux lines then flow radially outward through the steel rotating cylinder and reconnect with the south poles of the four outer magnets. The rotating iron cylinder generates the equivalent of a magnetic vector potential when an electrical current flows from the center of the cylinder to the edge. This current is generated by an N-machine current generator. The square of the magnetic flux density divided by the magnetic vector potential is equal to the spacetime curvature. The square root of the inverse of the spacetime curvature is the radius of curvature. The thrust developed is this radius of curvature times the magnetic flux density field times the current.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0010] **FIG. 1**. Perspective view of proposed permanent magnetic propulsion system using coil windings on the steel track.

[0011] **FIG. 2**. Perspective view of permanent magnet rotor assembly.

[0012] **FIG. 3**. Perspective view of system showing motor drive, N-machine and permanent magnet rotor.

[0013] **FIG. 4**. Perspective view of locomotive and rotor/magnet assembly.

DETAILED DESCRIPTION OF THE INVENTION

[0014] 1. The permanent magnets are made of neodymium-iron-boron material which is heated to its melt temperature and injection molded around a steel shaft threaded at one end while at the same time a pulsed magnetic field is applied to the material using a charge-discharge magnetizer. Because of the iron in the material, a coat of epoxy is applied to the magnet in order to protect it from the environment. Holes are drilled into the iron plate 90° apart near the rim, threaded, and then the steel shaft with the magnet is then inserted. Another hole is drilled and tapped in the center of the circular plate for attaching the south pole magnet which is used as the return path for the magnetic flux.

[0015] 2. Another easier way to make the magnets is to purchase short lengths of tubular NdFeB magnets and then stack them on the steel shaft with a cylindrical iron pole piece on the end of the shaft. The pole piece then holds the magnets down in place when the shaft is threaded into the plate.

[0016] 3. Referring to **FIG. 4**, the propulsion system is mounted inside the train cabin such that the rotor/magnet assembly extends out in front of the locomotive where the spacetime curvature is generated.

I claim:

1. A train propulsion system consisting of the following components:

a. a rotating iron cylindrical plate rotor of high relative permeability driven by an induction motor and horizontal steel motor shaft mounted in pillow block thrust bearings;

b. four cylindrical magnets, each molded to a steel support shaft threaded into the iron plate at 90° intervals around the rim of the plate with their north poles facing away from the plate;

c. a fifth cylindrical magnet molded to a steel support shaft which is threaded into the center of the iron plate with the south pole facing away from the plate;

d. an N-machine current generator supplying a radial electrical current from the center of the rotating plate by means of a copper-beryllium brush on the motor shaft (**1***a*) and another similar brush on the outside edge of the rotor.

e. a locomotive train on which the components are mounted such that the rotor/magnet assembly extends out in front of the locomotive with the rotor's angular velocity vector pointing along the track.

2. a closed magnetic flux path along a radial path in air from the north poles of the four outer magnets (**1***b*) to the south pole of the central magnet (**1***c*), through the center magnet and then radially outward through the rotor (**1***a*), returning back through the four outer magnets, such that the flux and electrical current (**1***d*) flow in the same outward radial direction through the rotor.

3. the creation of a spacetime curvature due to claims (**1***a* through **2**) that produces a large force on the locomotive equal to the radius of the spacetime curvature times the flux times the current.

* * * * *

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(54) WATER ENERGY GENERATOR

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(57) **ABSTRACT**

A water energy generator that generates electricity using a magnetic vortex wormhole generator and a water injector/vacuum chamber to produce low density hyperspace energy that causes the hydrogen atoms of water molecules to decay into electron pairs.

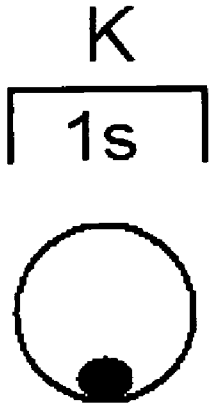

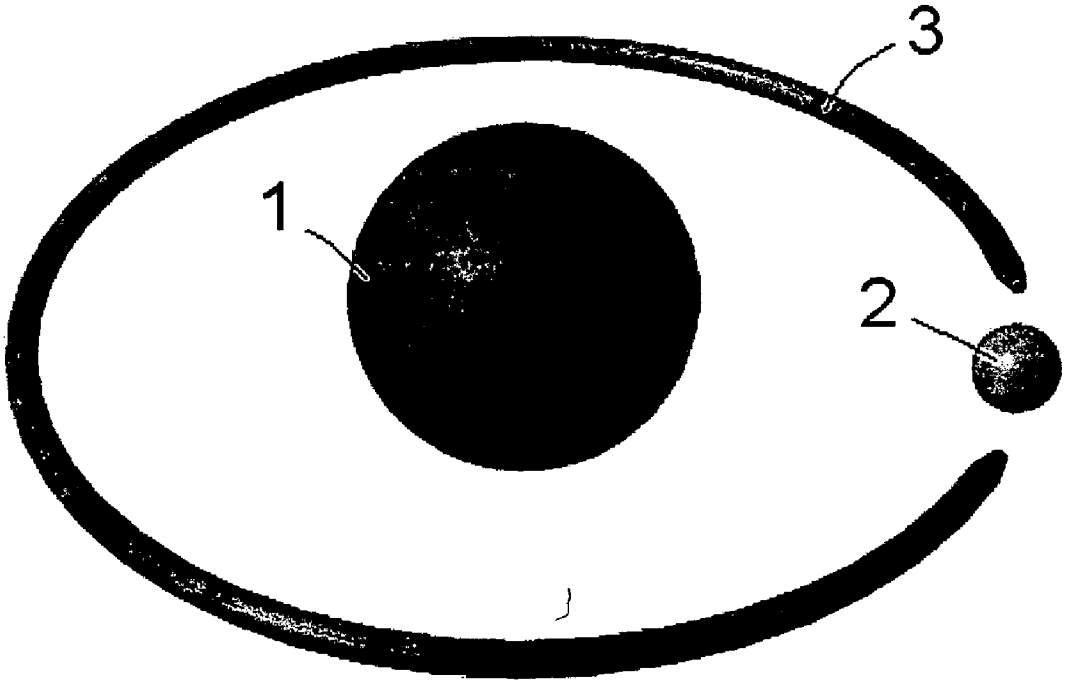

Figure 1

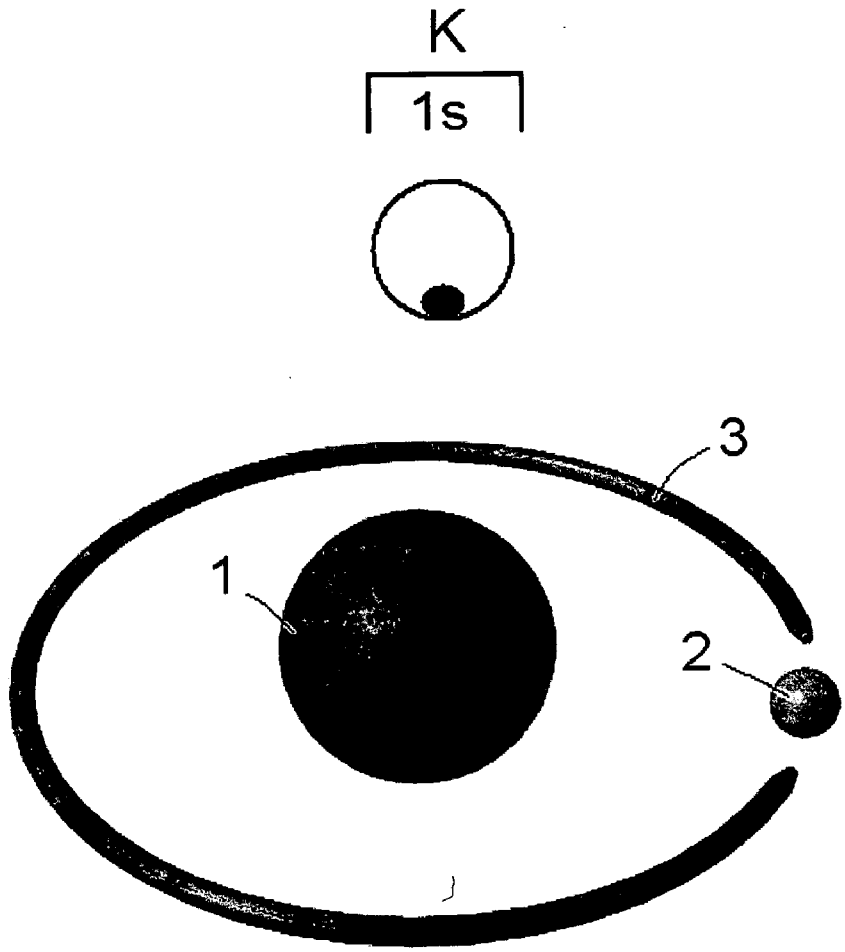

Figure 2

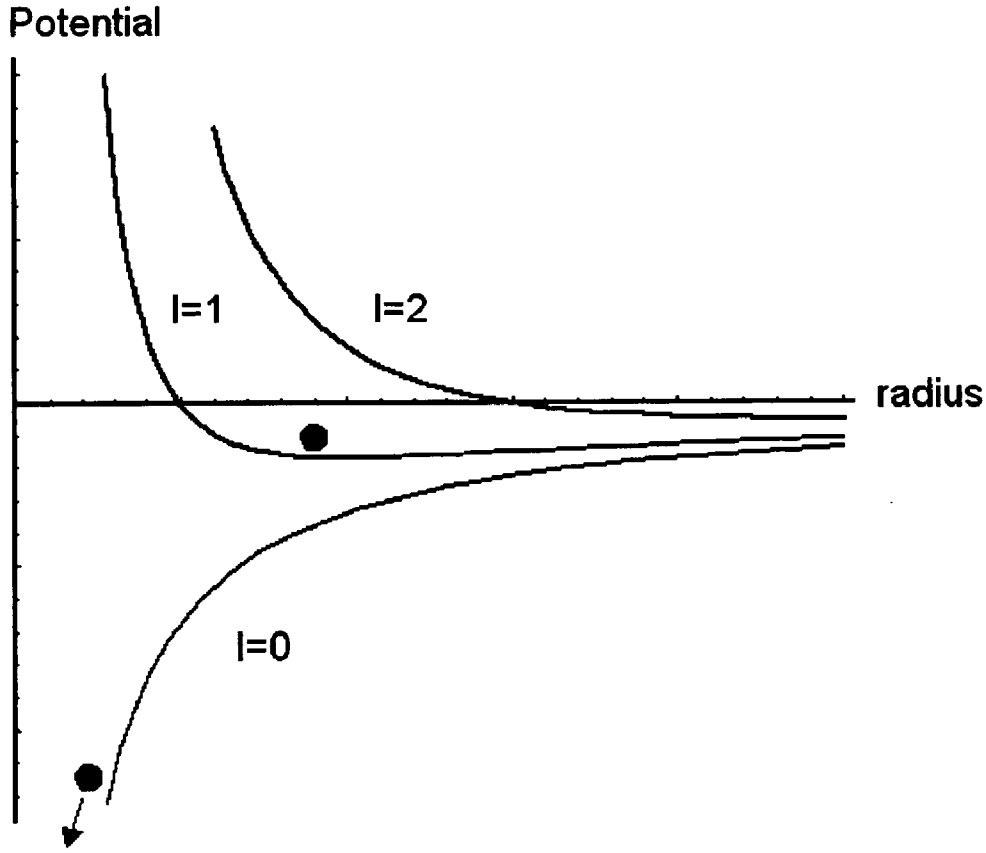

Figure 3

Figure 4

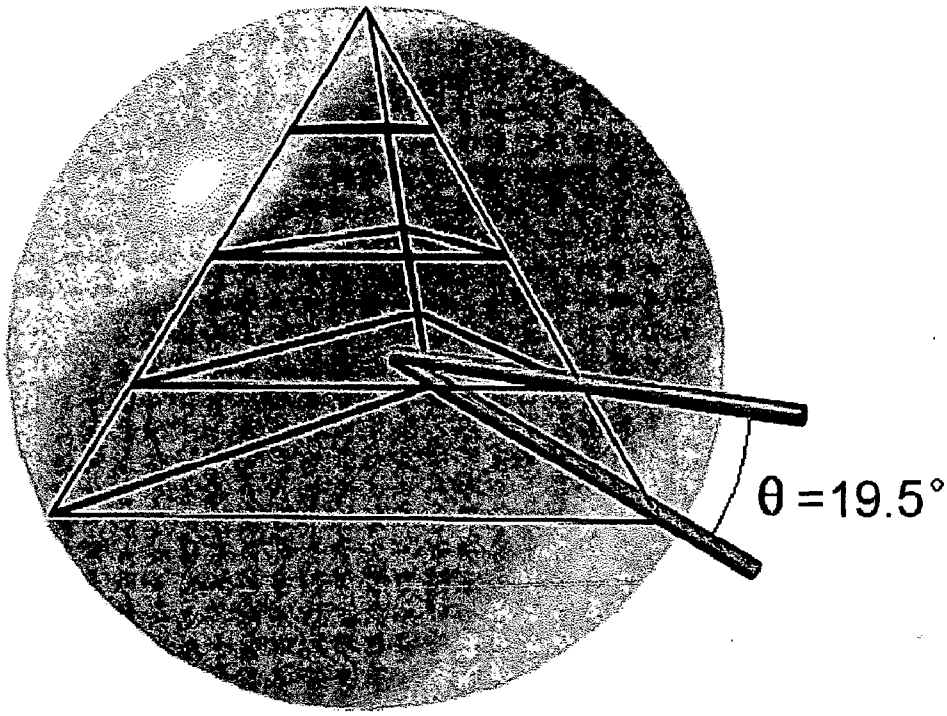

Figure 5

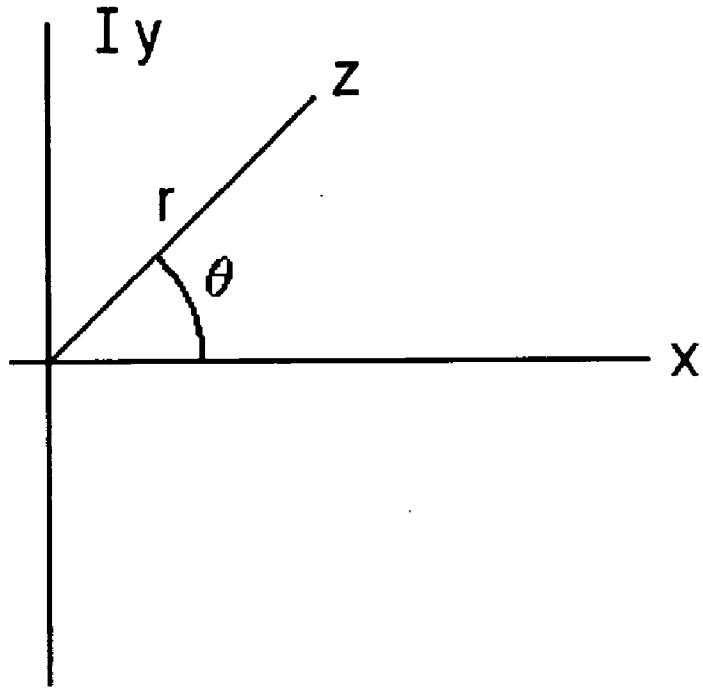

Figure 6

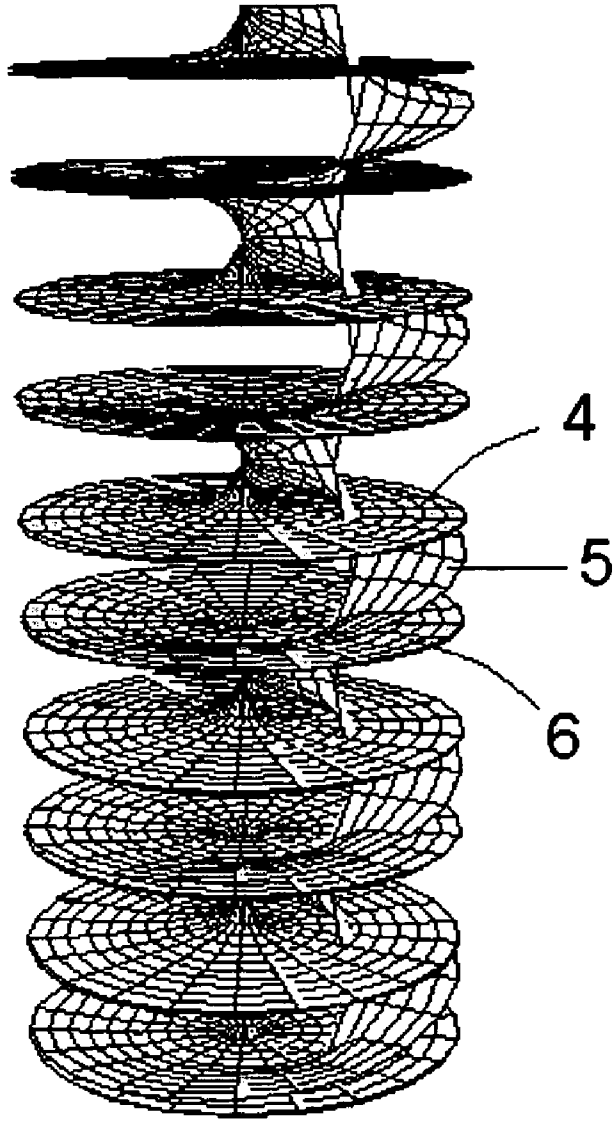

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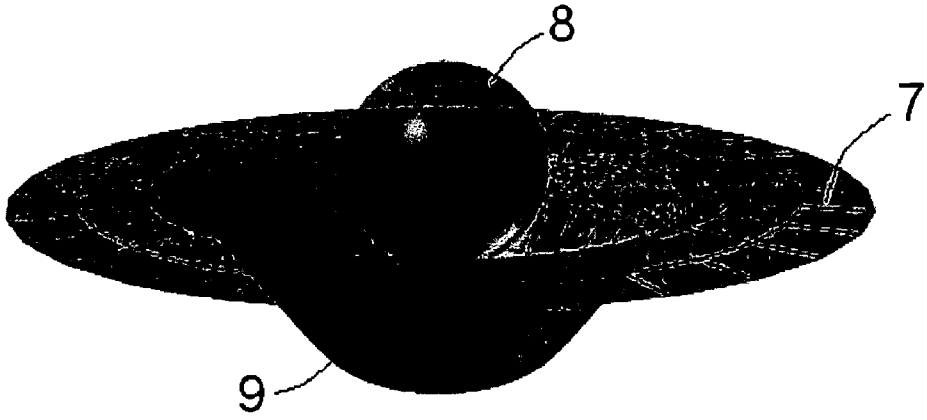

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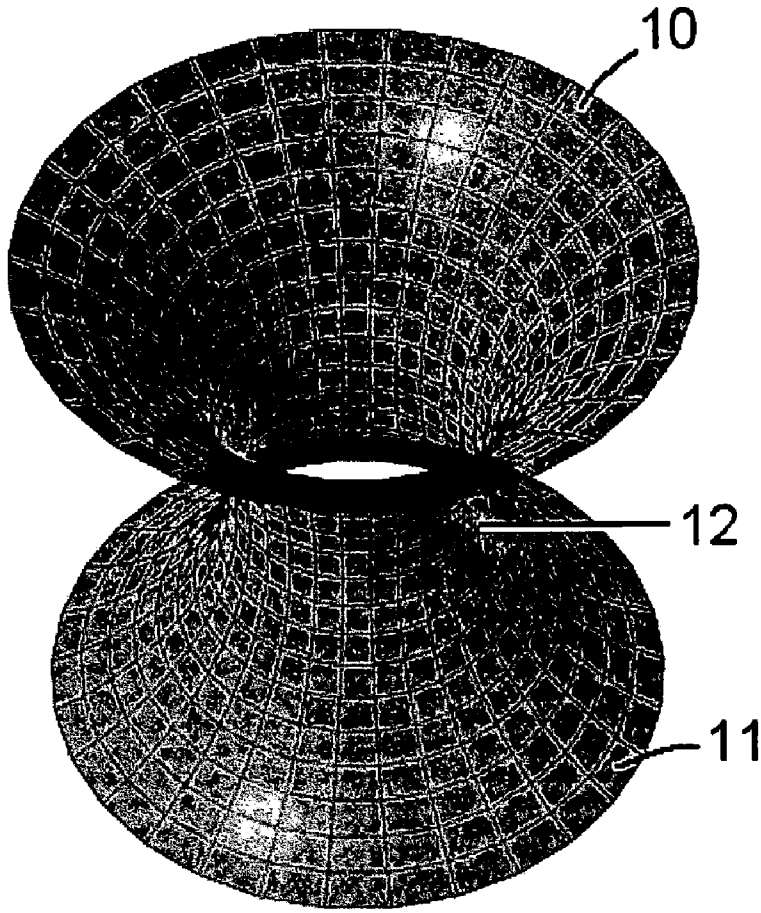

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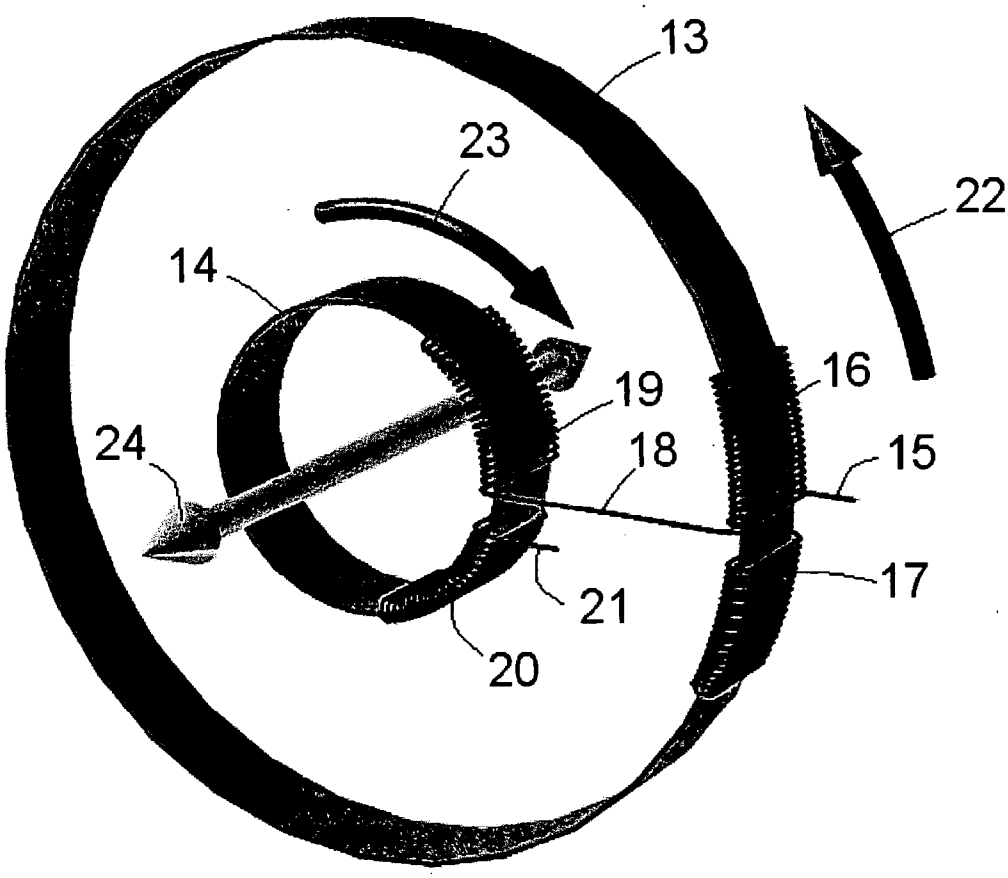

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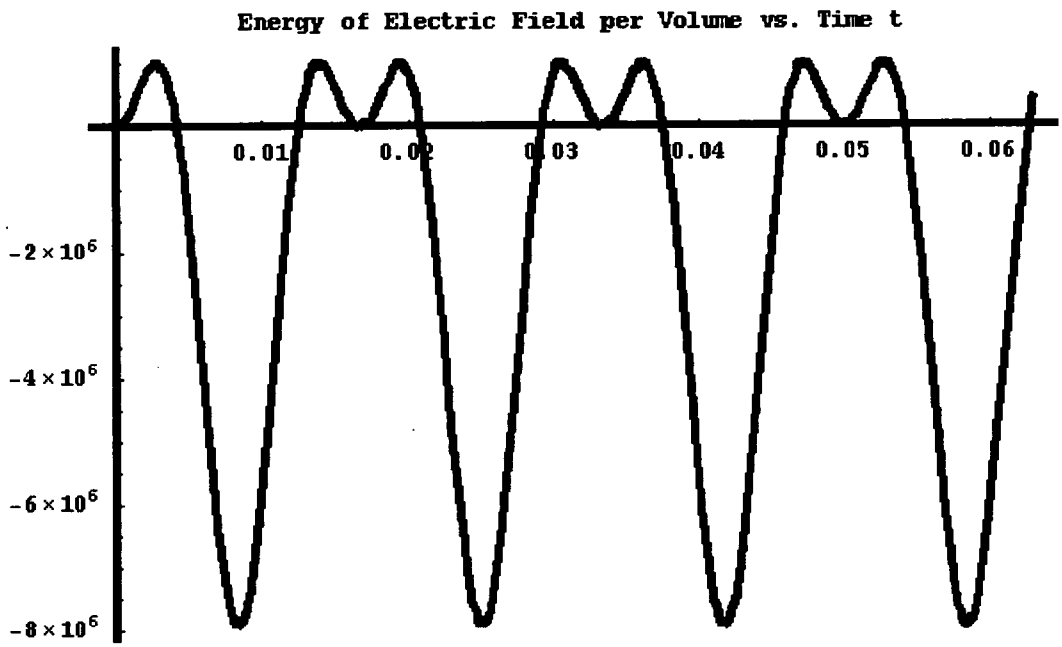
Energy of Electric Field per Volume vs. Time t
0.01
0.02
0.03
0.04
0.05
0.06
-2 × 10^6
-4 × 10^6
-6 × 10^6
-8 × 10^6

Figure 11

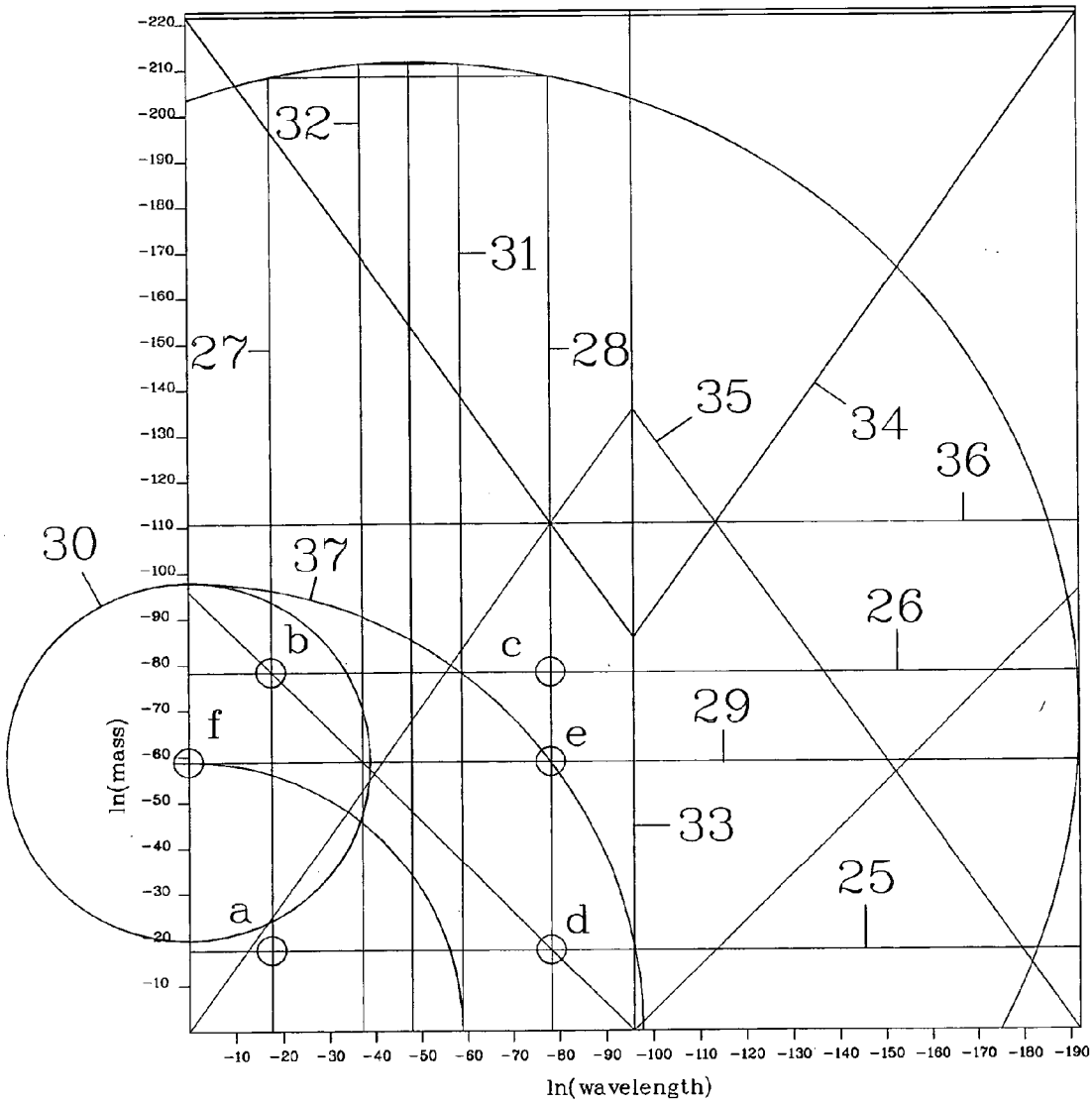
-220
-210
-200
-190
-180
-170
-160
-150
-140
-130
-120
-110
-100
-90
-80
-70
-60
-50
-40
-30
-20
-10
ln(mass)
-10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
ln(wavelength)
32
31
27
28
35
34
36
30
37
26
b
c
29
f
e
33
25
a
d

Figure 12

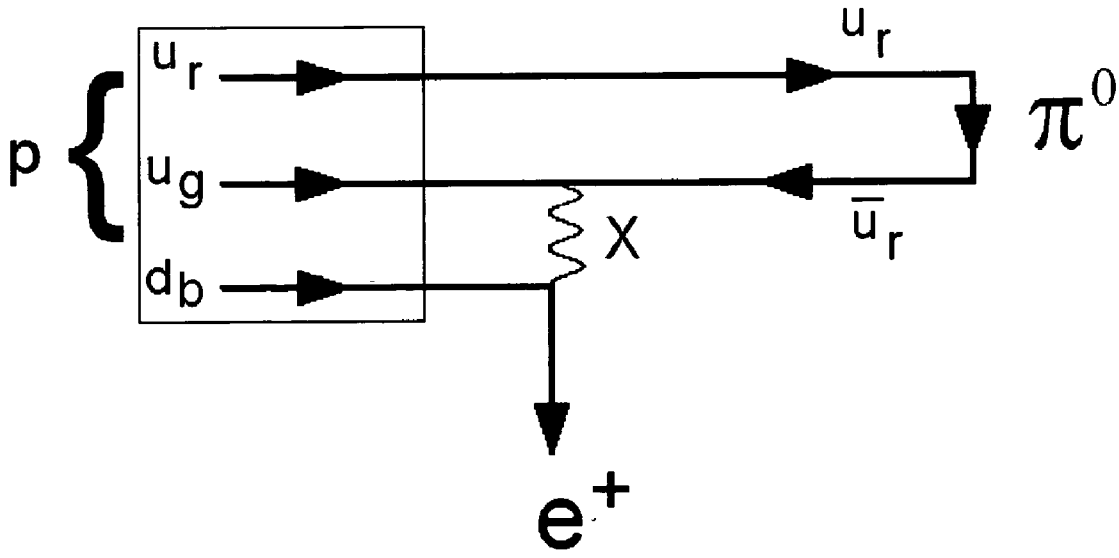

Figure 13

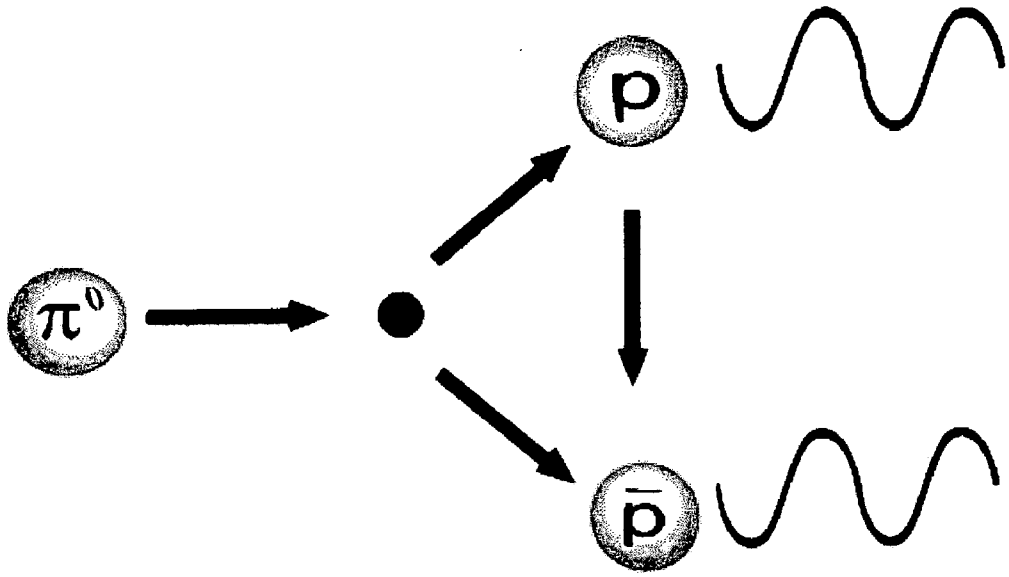

Figure 14

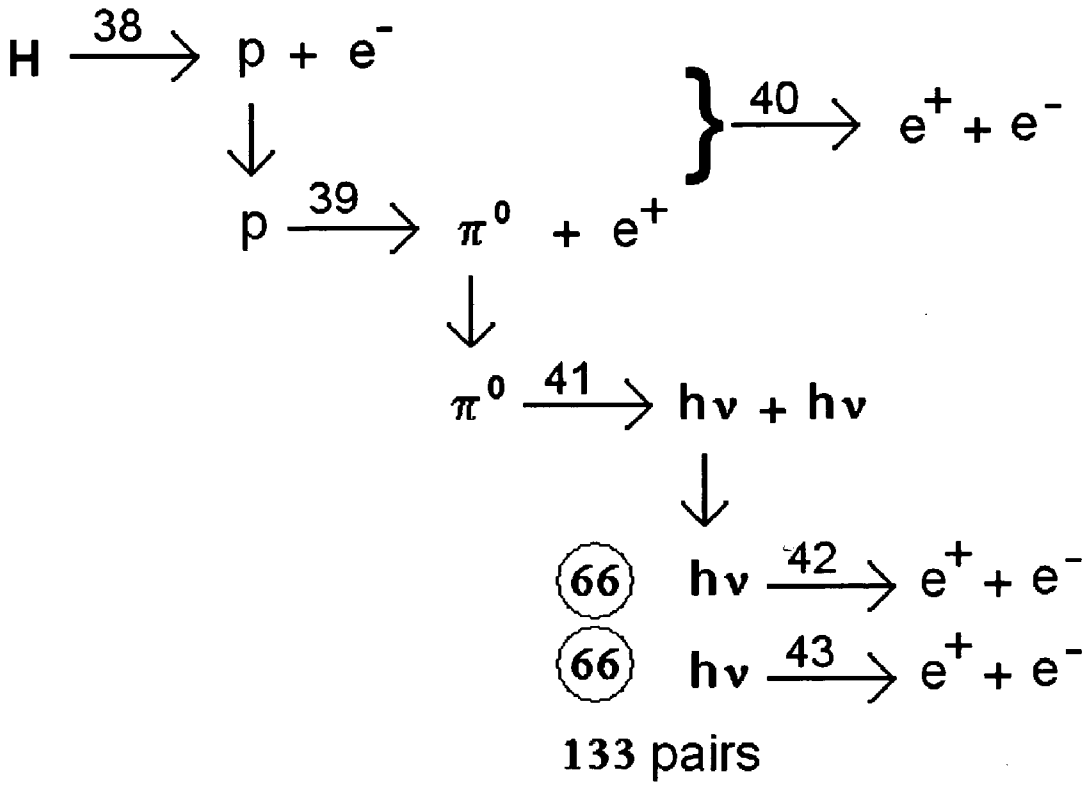

Figure 15

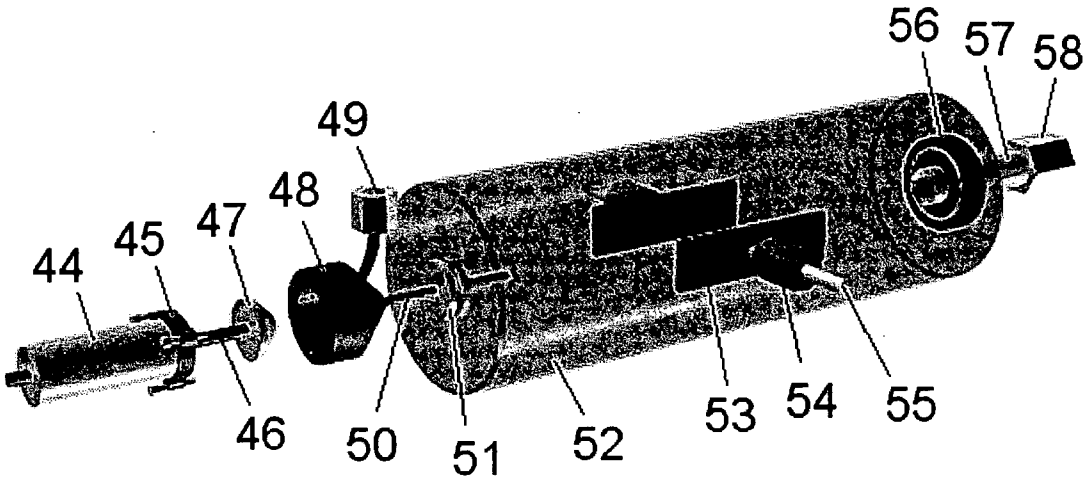

Figure 16

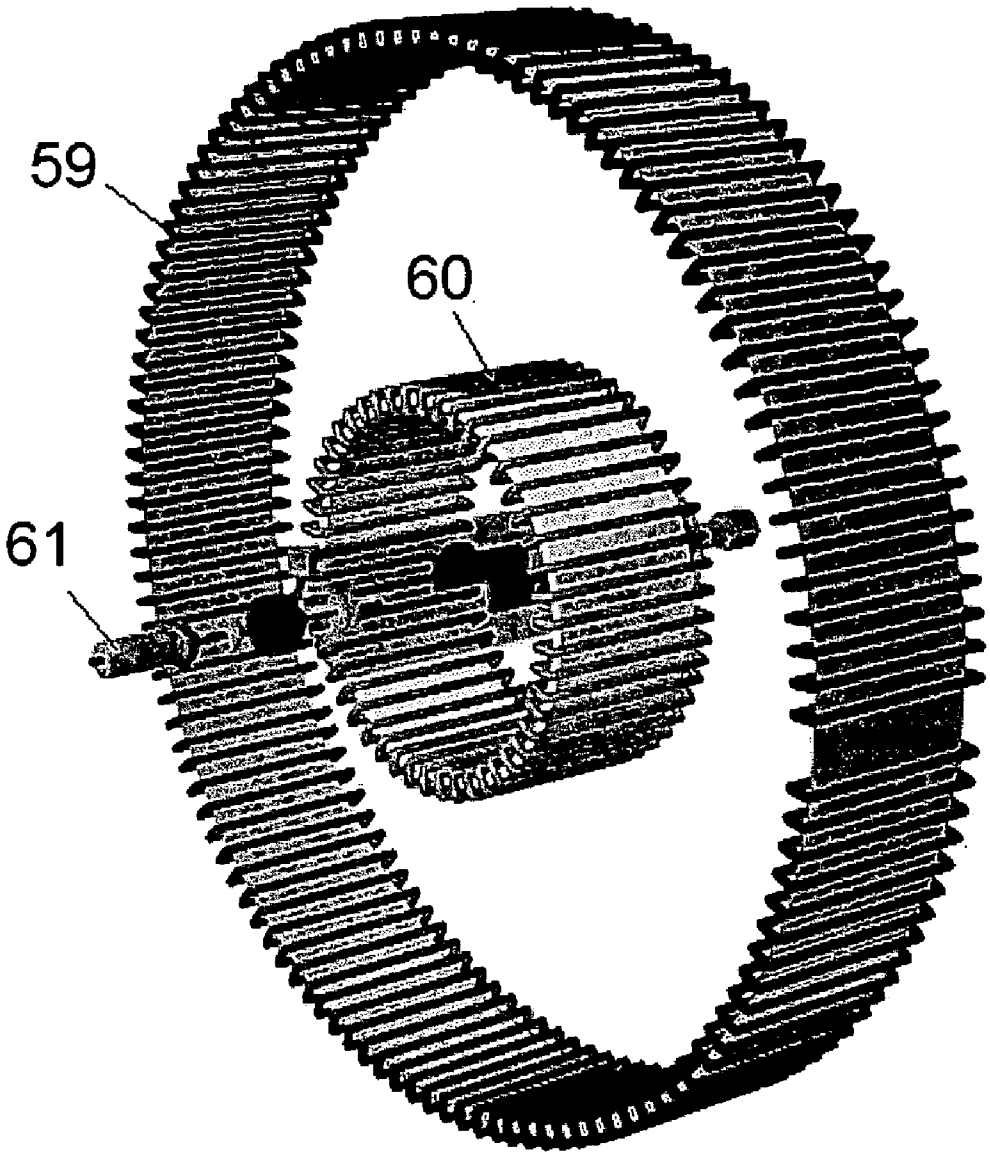

Figure 17

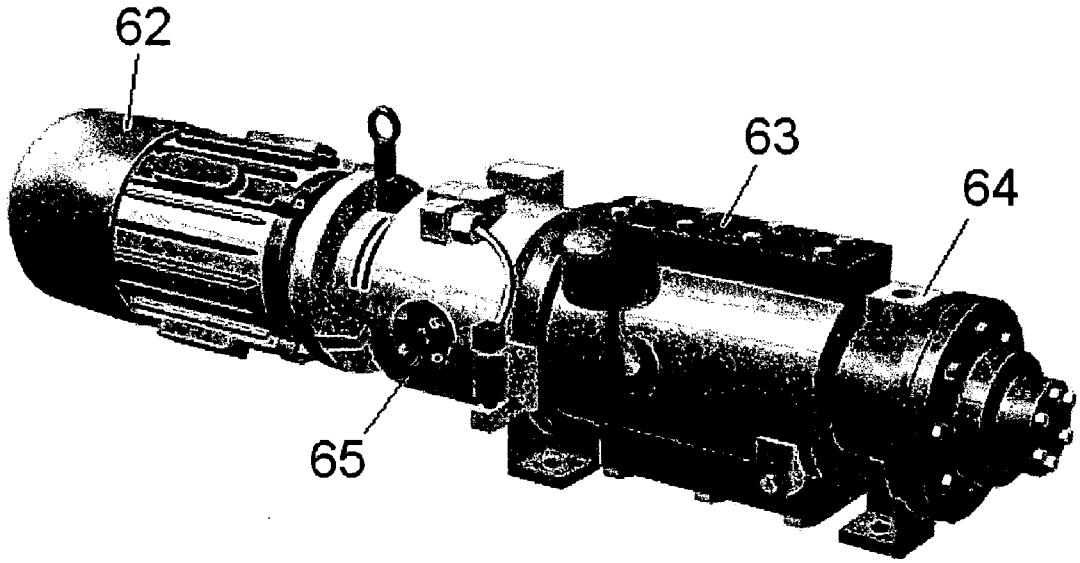

WATER ENERGY GENERATOR

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is an energy generator that uses the transition through wormholes of the hydrogen atoms of water molecules to break the bonds of the atoms and convert the protons into photons and electrons which can be collected for energy.

BACKGROUND OF THE INVENTION

[0002] A molecule of water consists of two hydrogen H atoms and one atom of oxygen O which has the chemical formula

H_2O

The hydrogen atoms can be separated from the oxygen atom by electrolysis. In this process, a direct current of electricity, such as from a battery, is passed through water decomposing it into hydrogen and oxygen. Pure water, however, is a poor conductor of electricity. It is therefore necessary to add some substance to form a solution that will conduct an electric current. Such a solution that will conduct electric current is called an electrolytic solution. A small amount of sulfuric acid or sodium hydroxide is added to the water to form an electrolytic solution. Water electrolyzed yields hydrogen plus oxygen

Water->hydrogen+oxygen

$2H_2O \rightarrow 2H_2+O_2$

Because this invention is to be used on spacecraft, the oxygen can be used for breathing and the hydrogen can be used to produce energy that will be used to create the electromagnetic fields which provide lift and propulsion.

[0003] Referring to **FIG. 1**, a single hydrogen atom consists of one proton (1) in the nucleus and one electron (2) moving in an orbital (3) around the nucleus. In quantum physics notation, there is only one main K shell and one orbital containing a single electron in the 1 s subshell. An orbital is an energy level containing one or two electrons in a subshell of an atom. Only a total of two electrons may be placed in one orbital with the added constraint that the electrons spin in opposite directions. Looking at the 1 s orbital, it can be seen that only half of it is occupied. What this means is that it is possible to add another hydrogen atom in which its electron occupies the other position in the orbital to from the hydrogen molecule H_2.

[0004] In 1925, a physicist by the name of Edwin Schrodinger developed a wave equation, which bears his name, that models the hydrogen atom. Even though the classical picture of **FIG. 1** showing a distinct electron orbiting the proton is easy to visualize, in reality the electron is a wavefunction Ψ whose square indicates the probability of finding the electron at a particular point. This then was the start of quantum physics where it was found that the electron energy can only take on certain discrete values.

[0005] A traveling wave moving in the positive x-direction can be represented by the function $\Psi_1=\Psi_1(x,t)$ of the form

$$\Psi_1=A_1 \cos(2\pi(x/\lambda-v\,t))$$

where x is the distance along the x-axis, A the wave amplitude, λ the monochromatic wavelength, v the velocity of the wave and t time.

[0006] A similar monochromatic wave moving to the left can be represented by

$$\Psi_2=A_2 \cos(2\pi(x/\lambda+v\,t))$$

where the sign of the velocity is reversed. The superposition of these traveling waves results in a standing wave, or stationary waves, of the form

$$\Psi=\Psi_1+\Psi_2=A \cos(2\pi x/\lambda) \cos(2\pi v\,t)$$

which is now a product of a spatial-dependent term A cos(2πx/λ), and a time-dependent term cos(2πv t). Taking the partial derivative of Ψ twice with respect to x

$$\frac{\partial^2\Psi}{\partial x^2}=-\left(\frac{2\pi}{\lambda}\right)^2\Psi$$

The momentum p of a particle is equal to Planck's constant h divided by the mass m of the particle

$$p=h/\lambda=\frac{2\pi\hbar}{\lambda}$$

where h bar is the reduced Planck constant. Thus Schrodinger's equation can be written as

$$\frac{\partial^2\Psi}{\partial x^2}=-\frac{p^2}{\hbar^2}\Psi$$

For a particle whose potential energy is V(x), the total energy is the kinetic energy K plus the potential energy

$$E=K+V=(p^2/2m)+V$$

Therefore,

$$p^2=2\,m\,(E-V)$$

and Schrodinger's equation becomes

$$\frac{\hbar^2}{2m}\frac{\partial^2\Psi}{\partial x^2}+(E-V)\Psi=0$$

The potential V is just the Coulomb potential of the product of two charges e divided by the radius r between them

$$V=\frac{e^2}{4\pi\varepsilon r}$$

where ϵ is the linear capacitance of space. A general wavefunction can be separated into a radial R part and a spherical harmonics part Y

$$\Psi=R_{n,l}Y_{l,m}(\theta,\phi)$$

where the first term is called a radial wavefunction which describes the "in-out" motion of the electron. When Schrodinger's equation is separated, it is found that the radial part of the wavefunction, R, must be a solution of the quantized differential equation

$$\frac{\hbar^2}{2mr}\frac{d^2(rR)}{dr^2}+\left(E-\frac{l(l+1)\hbar^2}{2mr^2}+\frac{e^2}{4\pi\varepsilon r}\right)R=0$$

This can be expressed in a simpler form by defining the function

$$f=rR$$

which is then found to satisfy the equation

$$\frac{\hbar^2}{2m}\frac{d^2f}{dr^2}+(E-V_{eff})f=0$$

where the effective potential is given by

$$V_{eff}=\frac{l(l+1)\hbar^2}{2mr^2}-\frac{e^2}{4\pi\varepsilon r}$$

where the 1's are the quantum orbital numbers. For s orbitals equal to 1=0, the effective potential is just the electrostatic potential of the nucleus. For 1 greater than zero, the first term is equal to the kinetic energy owing to the angular motion of the electron at a distance r and with angular momentum √1(l+1)h.

[0007] Referring to **FIG. 2**, the effective potential is graphed as a function of radius r and the orbital numbers. For orbital number l=0, which is the lower of the three curves, the potential does not provide a stable position for the electron (black disk) and the negatively-charged electron just crashes into the positively-charged proton nucleus as shown by the arrow. For orbital l=1, the first term is called the centrifugal repulsion which together with the electrostatic potential provides for a stable position for the electron as seen in the middle curve. The potential energy is negative which creates a slight valley in which the electron obtains a stable orbit. Higher orbital numbers l=2 produce a similar valley potential further out on the radius. The l=1 orbital does not allow the electron to come near the proton which provides for a stable hydrogen atom. So the key to this invention is how to destabilize this hydrogen atom energy system and produce usable energy which can propel the electromagnetic spacecraft and run other hyperspace inventions. Refer to my patent applications such as Dipole Moment Spacecraft, Dual Potential Hull Spacecraft, Photon Spacecraft, Electromagnetic Field Propulsion System, Full Body Teleportation, Magnetic Vortex Wormhole Generator, Electric Vortex Wormhole Generator, Sulfur S8 Wormhole Generator, Cavitating Oil Hyperspace Energy Generator, Rotor Inductance Propulsion System and Triangular Spacecraft.

[0008] Many of these patent applications involve wormholes and hyperspace which are not well-known concepts in the scientific community. Hyperspace consists of those dimensions which are co-dimensional with our spacetime. The reason I know about hyperspace is because (1) I have been in hyperspace on a number of occasions and have experienced Einstein's time dilation according to his General Theory of Relativity, (2) I have experienced more than one full-body hyperspace teleportation over a distance of 100 meters, (3) we have been able to create a wormhole between space and hyperspace with the magnetic vortex wormhole generator in which smoke was blown through one side of the coil into hyperspace, a first contact verified by the Grey Aliens, (4) I have seen the green mist associated with moving out of dimension and crossing over into hyperspace, (5) I have looked into another dimension and have seen another building, a car and a man who waving at me in the presence of an artificially-intelligent Cyborg with the "high-tech look" from the Pleiadian Defense Department, (6) I can remote view through hyperspace subgeometry to distances of 100,000 light years to the edge of the galaxy and have made first contact with around 500 extraterrestrial civilizations involving the use of patent applications such as Remote Viewing Amplifier, Quantum Dot Energy Cylinder and Walking Through Walls Training System, (7) I am the only person on Earth who has communicated with the designers of the crop circles found in England and explained their design to them in terms of subspace geometry, (8) I can walk through walls as a hyperspace energy being, and (9) I have discovered how anti-gravity is possible using low density hyperspace energy, not to mention all the other research work on these electromagnetic field propulsion vehicles. For my work in developing the geometry of the subspace manifold known as the tetrahedron diagram, I was given the Aphysics award by the Admiral, who is third in line to the Admiralty of the Pleiadian Defense Department. For my work in Revelations, she awarded me four beautiful galloping white riderless horses of the Apocalypse. The reason that the Pleiadian Defense Department was involved was that the Admiral had the task of creating the energy being that would protect the subspace manifold during the battle of Revelations which took place in the year 2001. So these are some of my personal experiences in the field of hyperspace physics.

[0009] As to the scientific aspect of hyperspace physics, observations of the solar system have noted that large vortices occur on the planets at a latitude of ±19.5°. On the planet Jupiter, for example, the Giant Red Spot vortex, which is the size of two planets like Earth, is located at −19.5° latitude.

[0010] Referring to **FIG. 3**, the Olympus Mons volcano, which is the size of France, occurs in the northern hemisphere at 19.5°. The plume of volcanic ash can be seen being blown to the upper right.

[0011] Here on Earth, just north of me at +19.5° in the Caribbean, there is a slow moving rock mantle vortex that curves the islands down toward Venezuela. Since the tetrahedron has three corners, another corner occurs at 120° to the west where the Marshall Islands are located. The reason that the volcanic islands form is that low density hyperspace energy softens the atoms and molecules to such an extent that the atomic bonds are broken. The hot magma from the core has an easier path to the surface through the soft rock compared to the hard rock of surrounding areas. As the vortex rotates, the rising hot magma creates volcanoes which form the chain of islands.

[0012] As another example of this, the Silver bridge, which is located at a double harmonic of 39° between Ohio and West Virginia, collapsed because a large wormhole

opened up and flooded the bridge with low density hyperspace energy. The metal rivets softened and pulled out of the plates holding down the suspension cables. Thus the roadway tilted to one side and all the cars fell into the river.

[0013] If you look at the quarried granite polygonal megalithic stone blocks that were used to build Machu Picchu, the blocks are put together as though they were soft putty. They fit together perfectly. Machu Picchu, or Great Picchu, is the Quichua name for a sharp peak which rises ten thousand feet above the sea. How this was achieved is described in my patent application *Rotating Magnetic Vortex Generator* which shows that rotating permanent magnets can create a wormhole between space and hyperspace. The low density hyperspace energy then floods the block as to make it weightless. The block is then floated up from the quarry which is 2500 feet below Machu Picchu. The huge 1000-ton blocks found in the platform at Baalbek in the Cedar Mountains of Lebanon were also lifted into position in this manner.

[0014] Using a technique called Chi Kung breathing, not necessarily known to the Chinese, one of our researchers has been able to levitate himself to a height of six feet. He might have gone higher but he lost his balance and his arm touched a nearby metal pipe. He then floated back to the ground. Contracting the abdominal muscles causes hot air to rise in the lungs while at the same time cold air is inhaled through the nose. This combination of hot and cold air mixing together creates environmental oscillators having a temperature fluctuation. This changes Planck's constant such that the body goes out of dimension and low density hyperspace energy fills the body.

[0015] The final example comes from Biblical times. Jesus and his father Joseph were both carpenters. A chair that Joseph had made for a client was found to be too small. So Jesus placed his hands on either side of the chair and stretched the chair to fit. The phrase in Spanish is "mas silla" which means that Jesus made more chair. In the dictionary, the Spanish word for putty is "masilla." The reason that Jesus could do this is that he passed hyperspace energy through his hand vortices which softened the wood. See my patent application called *Hyperspace Torque Generator* which shows this in more detail. The hand vortex is actually a planar co-gravitational K field that can rotate a pendulum around in circles. This solenoidal field corresponds to the magnetic H field. The electric field corresponds to the linear gravitational g field. The equations are identical for both sets of fields. I learned that Jesus actually reincarnated here on Earth in order to identify the planet on which the battle of Revelations would take place.

[0016] In summary, these are some examples as to how low density hyperspace energy can soften and break the bonds of atoms and molecules.

[0017] As mentioned previously, the astronomical observations suggest that the structure of the universe is related to the tetrahedron. Referring to **FIG. 4**, the corners of a tetrahedron circumscribed by a sphere, touch the sphere at an angle of 19.47122063°. The ratio of the area-to-volume ratio of the sphere to the area-to-volume ratio of the tetrahedron is ⅓ which is the magic ratio in physics. The arcsin(⅓) is 19.47°.

[0018] In order for all the physics constants to be projected into our universe and the co-dimensional hyperspace dimensions, there has to be a tetrahedral subspace manifold. The only mathematical function which allows multiple rotations of the complex plane is the logarithmic function Log[z].

[0019] Referring to **FIG. 5**, the complex number z in the complex plane is equal to x+I y where x and y are real constants and $I^2=-1$. The complex number z can also be written in terms of a radius and an angle

$$z=r\ \mathrm{Exp}[I\ \theta]$$

Because the angle can rotate more than once in 2π m multiples, the complex number z is actually

$$z=r\ \mathrm{Exp}[I(\theta+2\pi\ m\ )]$$

Taking the logarithm of z

$$\mathrm{Log}[z]=\mathrm{Log}[r]+I(\theta+2\pi m)$$

[0020] Referring to **FIG. 6**, it can be seen that it is not possible to go around multiple times on the same surface due to a branch cut along the origin where Log[0] is undefined. What happens is that as you rotate around on surface (4) and get to the origin, you go down along the branch (5) to the next hyperspace plane (6). Thus the universe is composed of many hyperspace co-dimensions. From personal experience, I estimate that the distance separating the two dimensions is about 3 meters when I was looking into another dimension at the man waving at me. The physics is even more complicated because there is a Lorentz dimensional transformation in which higher dimensions appear smaller and lower dimensions appear larger. In one case I was looking at a huge mothership at a much higher dimension and it looked like a tiny toy model spacecraft. They fired a laser cannon at me, and I then curved space which made the beam change course. You can see why I was awarded the four horses.

[0021] The antilog of Log[z] is

$$e^{\mathrm{Log}[z]}=z=re^{I\ \omega t}$$

where the angle is the angular frequency ω times the time t. The subspace geometry remains stationary or fixed, but the projection of the antilog into our dimension generates a system which is frequency dependent. This is why we get oscillating fields.

[0022] From Einstein's General Theory of Relativity, it is known that various kinds of energy can curve spacetime such as mass, electromagnetic fields, angular momentum and electrical charge. The elemental spacetime length ds in cylindrical coordinates {t,r,θ,z}, known as the Schwarzschild metric, shows that spacetime can be curved using mass M and charge Q

$$(ds)^2=-(dt)^2\left(1-\frac{2M}{r}+\frac{Q^2}{r^2}\right)+\frac{dr^2}{\left(1-\frac{2M}{r}+\frac{Q^2}{r^2}\right)}+(rd\theta)^2+(dz)^2$$

where you can see that the elemental time dt is dilated by the mass M and the elementary radius dr is reduced. I have actually experienced this time dilation in which, as I was jumping into hyperspace, I was hit by a car which broke my shoulder. When I came back into dimension which appeared to be a few seconds later, I found that I had an 8-inch blood ring down the right side of my chest. My shoulder blade, which sticks up about two inches, is still broken to this day.

[0023] Referring to **FIG. 7**, flat space (**7**) can be curved (**9**) by a massive body (**8**) such as a planet. For example, the mass of the Earth gives space a negative curvature such that objects tend to fall toward the center of the mass (bowl). On the other hand, using electromagnetic fields, it is possible to produce a positive curvature such that a spacecraft rises by falling upward.

[0024] Referring to **FIG. 8**, if the fields are intense enough, then a wormhole (**12**) forms between space (**10**) and hyperspace (**11**). This depiction is called an embedding diagram because there is no open space going through the wormhole. An object traversing the wormhole moves along the surface from one dimension to another. In order to open the throat (**12**) of the wormhole, negative energy is required. Referring to my patent application Dual Potential Hull Spacecraft, negative energy is produced by the interaction of a microwave beam with an oscillating magnetic H field. In terms of differential forms mathematics, this is given as the Hodge Star * of the differential d of the wedge ^ product of the magnetic H field with the electromagnetic wave {B,E}

$$*d(H\wedge(B+E\wedge dt)) = \frac{\partial(-\rho)}{\partial t}$$

which says that there is an increasing rate of change of negative energy (−ρ). Due the presence of negative energy together with the spacetime curvature pressure produced by the electromagnetic fields, wormholes open up between space and hyperspace. There is a positive gravitational potential between hyperspace and space because the low density hyperspace energy is more dense than the negative energy in this dimension. Thus the hyperspace energy flows into our dimension which reduces the mass of the spacecraft. The upward spacetime pressure stress over the hull due to the electromagnetic fields creates a lift force on the nearly massless vehicle. Because the hyperspace energy has a speed of light equal to one meter per second, the electromagnetic fields become relativistically strong since they obey the Lorentz transformation. Due to the low mass, high spacetime lift pressure and strong EM fields, the vehicle can attain very high rates of acceleration.

[0025] Another method to produce a wormhole is to use bucking magnetic fields which is described in my patent application *Magnetic Vortex Wormhole Generator.* In gravitation physics, the Faraday F tensor, which is a 4×4 spacetime metric {t,x,y,z}, contains all the components of the electromagnetic fields in the various spatial directions {x,y,z}

$$F^{\alpha}_{\beta} = \begin{array}{c} t \\ x \\ y \\ z \end{array}\begin{vmatrix} 0 & E_x & E_y & E_z \\ E_x & 0 & B_z & -B_y \\ E_y & -B_z & 0 & B_x \\ E_z & B_y & -B_x & 0 \end{vmatrix}$$

where contravariant index a refers to the rows, and the covariant index β refers to the columns. For example, the component $F^t_x = E_x$ is the electric field in the x-direction. If there were two magnetic bucking fields in the x-direction the Faraday tensor would be

$$F^{\alpha}_{\beta} = \begin{array}{c} t \\ x \\ y \\ z \end{array}\begin{vmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & B_x - B_x \\ 0 & 0 & -(B_x - B_x) & 0 \end{vmatrix} = \begin{vmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{vmatrix}$$

which says that the Faraday tensor is zero. Thus no spacetime curvature is generated from two bucking magnetic fields at the same position. On the other hand, if the two bucking magnetic fields are concentric at different radii, then the Faraday tensor becomes

$$F^{\alpha}_{\beta} = \begin{array}{c} t \\ x \\ y \\ z \end{array}\begin{vmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & B_x\delta(x_1) - B_x\delta(x_2) \\ 0 & 0 & -(B_x\delta(x_1) - B_x\delta(x_2)) & 0 \end{vmatrix}$$

which is not zero due to the presence of the Kronecker δ delta function which locates the fields at different positions. The spacetime stress-energy-momentum tensor T is then computed from the following equation

$$4\pi T^{\mu\nu} = F^{\mu\alpha}F^{\nu}_{\alpha} - \frac{1}{4}g^{\mu\nu}F_{\alpha\beta}F^{\alpha\beta}$$

where g is the metric tensor containing the coefficients of the elemental spacetime length ds. With the mass M and charge Q term equal to zero, there being just electromagnetic fields involved, the g metric tensor in cylindrical coordinates becomes

$$g_{\alpha\beta} = \begin{array}{c} t \\ r \\ \theta \\ z \end{array}\begin{vmatrix} -\left(1 - \frac{2M}{r} + \frac{Q^2}{r^2}\right) & 0 & 0 & 0 \\ 0 & \left(1 - \frac{2M}{r} + \frac{Q^2}{r^2}\right)^{-1} & 0 & 0 \\ 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix} = \begin{vmatrix} -1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & r^2 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

[0026] Referring to **FIG. 9**, the magnetic vortex generator has two concentric, thin, flat cylindrical silicon-iron cores (**13**,**14**), each consisting of a stack of three 0.020 inch thick transformer laminations wrapped with insulating tape. Using insulated magnetic wire, a flat helical coil (**16**) is wrapped counter-clockwise around the outer laminations. The coil receives power through connection (**15**). The winding then continues around the core until coil (**17**) where the wire (**18**) is extended to the inner core and the wrapping of coil (**19**) proceeds in the clockwise direction. The inner core wrapping terminates on coil (**20**) with the extension of the second power connection (**21**). Because the coils are wound in

opposite directions, the generator produces two bucking magnetic fields at different radii (**22**,**23**).

[**0027**] According to Maxwell's electromagnetic equations, the curl of the magnetic flux density B field times the square of the speed of light squared is equal to the rate of change of the electric E field

$$c^2\nabla xB = \frac{\partial E}{\partial t}$$

Multiplying both sides by the elemental area of the core and integrating over the area

$$c^2\int_0^{r_0}\nabla xBdA = \frac{\partial}{\partial t}\int_0^{r_0}E\cdot ndA = \frac{\partial}{\partial t}\int_0^{r_0}E\cdot n2\pi rdr$$

The curl of the field can be converted into a line integral around the core contour using Stokes' Theorem

$$c^2\int_0^{r_0}\nabla xBdA = c^2\oint_{r_0}B\cdot ds = c^2\int_0^{2\pi}Br_0d\theta$$

[**0028**] The magnetic flux density B field oscillates with angular frequency ω

$$B=B_0e^{I\omega t}$$

Substituting this into the equation and integrating over time for the inner core field

$$-c^2\int_0^{t}\int_0^{2\pi}B_0e^{I\omega t}r_0d\theta = \int_0^{r_0}E2\pi rdr = E\pi r_0^2$$

This can be solved for the electric E field that is produced by the oscillating magnetic flux density B field

$$E_0 = \frac{2IB_0c^2(-1+e^{I\omega t})}{r_0\omega}$$

The electric field for the outer core is the same equation except that the opposite sign of the magnetic flux density B field and the radius **r1**

$$E_1 = \frac{-2IB_0c^2(-1+e^{I\omega t})}{r_1\omega}$$

Adding these two fields together is the total electric field E

$$E = E_0 + E_1 = \frac{-2B_0c^2(-1+\mathrm{Exp}(I\omega t))(r_0-r_1)}{r_0r_1\omega}$$

The electrostatic energy of the field is equal to half the linear capacitance of space times the summation over the volume of the dot product of the electric field with itself

$$U = \frac{\varepsilon}{2}\int E\cdot EdV$$

Because the electric field points in the z-direction out of the coil, the dot product is actually the square of the electric field.

[**0029**] Referring to **FIG. 10**, the energy U per volume is plotted as a function of time with a radius ratio r_1/r_0 of 3/1. As the graph shows, the magnetic vortex wormhole generator produces mostly negative energy which is required in order to create the wormholes. Because the stress-energy-momentum T tensor is also the square of the electric field, this graph gives the spacetime curvature pressure. Thus the electric field produces both the pressure and negative energy required to open up wormholes between space and hyperspace.

[**0030**] Going back to the effective potential equation,

$$V_{eff} = \frac{l(l+1)\hbar^2}{2mr^2} - \frac{e^2}{4\pi\varepsilon r}$$

it can be seen that the first term is divided by the mass of the particle. In current gravitation physics, the mass of the particle is invariant with velocity. It does not obey the Lorentz transformation. The mass is related to the energy E of the particle and its momentum p by

$$m^2=E^2-p^2$$

In different inertial frames moving with a relative velocity v, the energy and the momentum obey the Lorentz transformation, but no matter what the relative motion, the mass of the particle is constant. In the first term of the effective potential, the mass is constant which leaves just Planck's constant.

[**0031**] Having worked for over ten years on the subspace manifold, known as the tetrahedron diagram, I found a most incredible intersection on the diagram when working with the water molecule. The water molecule has two hydrogen atoms and one oxygen atom as mentioned previously. The atomic weight of one atom of hydrogen is 1.008 atomic weight units (awu). The atomic weight of oxygen is 16.000 awu. Therefore the molecular weight of water is

$$\text{Weight of two atoms of hydrogen } 2\times 1.008\ awu = 2.016\ awu$$

$$\text{Weight of one atom of oxygen } 1\times 16.000\ awu = \frac{16.000\ awu}{18.016\ awu}$$

The gram molecular weight is the atomic weight expressed in grams, so there are 18.016 grams in Avogadro's number of molecules. So the mass per molecule in logs is

$$\mathrm{Log}\left[\frac{18.016\ \mathrm{gram-mol}\Big/\left(1000\ \frac{\mathrm{gm}}{\mathrm{kg}}\right)}{6.02\times10^{23}\ \mathrm{mol}}\right]=-58.77103943$$

[0032] Referring to **FIG. 11**, the tetrahedron diagram plots the natural logarithm of mass versus the natural logarithm of wavelength. The reason for this is that mass times wavelength is equal to Planck's constant divided by the speed of light c, known on the diagram as the base constant. At the present time there are over 4000 diagrams which are copyrighted in the Library of Congress. In logarithms, the product of two numbers is the sum of the two numbers. This means that the sum of the mass and the wavelength are equal to the base constant which has a value of

$$\ln[m]+\ln[\lambda]=\ln[h/c]=-95.91546344=\text{base constant}$$

Our dimension has a lower limit on mass and length known respectively as the Planck mass and the Planck wavelength. The Planck mass is the linear mass Ω of the universe times the Planck scale Λ. The Planck wavelength is circumference of a circle of radius Planck scale. In terms of logs, the Planck mass and Planck wavelength are

$$\text{Planck mass}=\ln(\Omega\Lambda)=-17.64290101$$

$$\text{Planck wavelength}=\ln(2\pi\Lambda)=-78.27256243$$

[0033] When these values are plotted on the tetrahedron diagram shown in **FIG. 11**, the Planck box (abcd) is formed which are the boundaries of our dimension in subspace. The line numbering is as follows

Planck mass	25, 27
Planck wavelength	26, 28
mass of water molecule	29, 31
speed of light squared circle	30
base constant	33
inverted tetrahedrons	34, 35
centerline	36

The energy of the water molecule, circle (**37**), is equal to the sum of the water molecule mass (**29**) plus the speed of light squared circle (**30**). The energy circle (**37**) intersects the mass of the water molecule (**29**) at the Planck wavelength (**28**, point e), which is the boundary between space and hyperspace. What this means is that the mass is equal to the energy at the Planck box boundary. The only way that this is possible is if the speed of light c is equal to one meter per second

$$E=m\,c^2=m\,c=1\ \text{meter/second}$$

A water molecule traversing a wormhole into hyperspace undergoes a change in the speed of light from 299792458 m/s to 1 m/s.

[0034] Planck's constant $\hbar$ is equal to the Planck mass ΩΛ times the Planck scale Λ times the speed of light c.

$$\hbar=\Omega\Lambda\Lambda c$$

By having the speed of light go to 1 m/s, the orbital term in the effective potential V_{eff} is reduced by a factor of the speed of light squared equal to 9×10^{16}. This unbalances the equation to such an extent that only the Coulomb potential term remains.

$$\frac{l(l+1)\hbar^2}{2mr^2}\ll\text{coulomb term}$$

The electron is attracted to the proton nucleus because the centrifugal term no longer provides a stable orbit for the electron. Thus the atomic binding is destroyed and the water molecule becomes soft as putty.

[0035] Referring to **FIG. 12**, the collision of the electron with the proton together with the enormous change in the proton's energy causes the proton p to become unstable and decay. According to the Standard Model of particle physics, the elementary particles are composed of smaller particles known as quarks. The six quarks have been named up u, down d, strange s, charm c, top t, and bottom b. The subscript on the quark indicates one of three colors {red r, blue b, green g). As shown in the diagram, the proton is composed of three quarks $\{u_r, u_g, d_b\}$, two of which are up quarks of which one is red and the other green, and a third blue down quark. The proton p decays into a positron e^+ which is an electron with a positive charge, and a neutrally-charged pion π^0 particle through the exchange of an X boson particle. The pion has a mass between the electron and the proton.

$$p\rightarrow\pi^0+e^+$$

[0036] Referring to **FIG. 13**, the pion π^0 then decays into a proton p and antiproton $\bar{p}$ which annihilate each other to produce two photons shown on the right by the traveling waves. So the overall energy exchange is

$$p\rightarrow\frac{2h\nu}{c^2}+e^+$$

where hv is the energy per gamma photon with frequency v. The electron of the hydrogen atom would then annihilate the positron for additional photon energy.

[0037] Referring to **FIG. 14**, the hydrogen H atom is composed (**38**) of the proton and electron as seen in the upper left corner. The proton decays (**39**) into the neutral pion and a positron. The electron from the hydrogen atom and this positron form one electron pair (**40**). The pion then decays (**41**) into two gamma photons which produce an electron pair production energy cascade into 132 pairs (**42**,**43**) for a total of 133 electron pairs. These electrons can then be captured electrostatically and used for the production of electricity.

[0038] Referring to **FIG. 15**, the electrons are captured with the water droplet injector . The plunger (**46**) of a spring-loaded cylindrical solenoid (**44**) is attached to a tapered piston (**47**). By means of ring collar and bolts (**45**), the solenoid is bolted to the injector (**48**). A supply of purified water is attached to the water inlet connection (**49**). When the solenoid is activated, it pulls back slightly so that water can enter the valve. When the solenoid is deactivated, the piston forces the water droplet out through the nozzle (**50**) into a cylindrical glass vacuum chamber (**52**). Two cylindrical glass disks (**51**) hold the nozzle in place. On the other end of the vacuum chamber is the sealed-tube con-

nection (**56**,**57**,**58**) to the vacuum pump. In the middle of the vacuum chamber, two metal plates (**53**) are attached through sealed glass collars (**54**) to electrical pins (**55**). The plates are electrostatically-charged with opposite charges so as to form a capacitor. This creates an electrical field between the plates which attracts the electrons to the positively-charged plate.

[**0039**] Referring to **FIG. 16**, the vacuum tube and water injector (**61**) are mounted along the centerline of the inner (**60**) and outer (**59**) magnetic vortex wormhole generator coils. The low density hyperspace energy traversing the wormhole along the centerline of the coils causes the injected water molecules to soften and decay into a cascade of electrons. The oscillating electric field along the centerline causes the electrons to vibrate back and forth. The crossed electric field between the charged capacitor plates causes the electrons to flow toward the positively-charge plate in order to produce electricity.

[**0040**] Referring to **FIG. 17**, the vacuum tube is connected to the vacuum pump through a hose connection to the pump air inlet (**64**). A 5 Hp electric motor (**62**) drives dual rotating flights of screws which trap the air and move it toward the exhaust outlet (**65**) shown with no muffler. On a spacecraft operating in the vacuum of outer space, this component would not be needed.

SUMMARY OF THE INVENTION

[**0041**] It is the object of this invention to generate electricity by using low density hyperspace energy to soften water molecules such that the atomic binding is broken which causes the hydrogen nucleus to decay into a cascade of electron pairs. These electrons are then collected on a positively-charged plate in order to produce electricity. The water molecules are softened by flooding them with low density hyperspace energy that is produced by a magnetic vortex wormhole generator. The generator creates negative energy and a spacetime curvature along the centerline of two concentric coils. This combination opens up wormholes along the centerline. Because the gravitational potential of low density hyperspace energy is greater than the negative energy, the hyperspace energy flows through the wormhole from hyperspace into our dimension. The hyperspace energy has a speed of light equal to one meter/second. This causes a change in Planck's constant h such that the proton orbitals of the hydrogen atom are unable to produce a centrifugal repulsion which keeps the electron in orbit. The Coulomb potential term dominates and the electron is attracted to the proton. Due to the vast change in the speed of light, and the collision of the electron with the proton, the proton becomes unstable and decays into a neutral pion and a positron. The pion then decays into two gamma photons which produce a large cascade of electron pairs.

[**0042**] A water injector, consisting of a solenoid-activated valve and nozzle, injects water droplets into a vacuum chamber which is positioned along the centerline of the two concentric coils where the wormholes form. Due to the low density hyperspace energy passing through the wormholes into our dimension, the water molecules soften and decay into electrons which are collected on an electrostatically-charged capacitor plate having a positive charge located in the glass vacuum chamber.

A BRIEF DESCRIPTION OF THE DRAWINGS

[**0043**] **FIG. 1**. Perspective view of hydrogen atom K shell.

[**0044**] **FIG. 2**. Graph showing potential binding energy of hydrogen atom.

[**0045**] **FIG. 3**. Perceptive view of Olympus Mons volcano at +19.5° Mars latitude.

[**0046**] **FIG. 4**. Perspective view of tetrahedron inscribed in sphere.

[**0047**] **FIG. 5**. Graph showing complex plane.

[**0048**] **FIG. 6**. Perspective view of hyperspace co-dimensions of logarithmic manifold.

[**0049**] **FIG. 7**. Perspective view of embedding diagram showing curvature of space caused by a mass.

[**0050**] **FIG. 8**. Perspective view of wormhole embedding diagram.

[**0051**] **FIG. 9**. Perspective view of coils of magnetic vortex wormhole generator.

[**0052**] **FIG. 10**. Graph showing that generator produces negative energy.

[**0053**] **FIG. 11**. Tetrahedron diagram showing that the speed of light at the Planck box boundary at the water molecule is one meter/second.

[**0054**] **FIG. 12**. Perspective view of proton decay into neutral pion and positron.

[**0055**] **FIG. 13**. Perspective view of pion decaying into two gamma photons.

[**0056**] **FIG. 14**. Diagram showing decay of the hydrogen atom into electrons.

[**0057**] **FIG. 15**. Perspective view of water injector and vacuum chamber.

[**0058**] **FIG. 16**. Perspective view of vacuum chamber mounted along centerline of magnetic vortex wormhole generator.

[**0059**] **FIG. 17**. Perspective view of vacuum pump used to evacuate vacuum chamber.

DETAILED DESCRIPTION OF THE INVENTION

[**0060**] 1. The coils of the magnetic vortex wormhole generator are made of three stacks of 0.020 inch silicon-iron transformer laminates. These are washed to remove the oil, and then wrapped with insulating tape in order to keep the laminations together. Using a very long bench made of wooden planks and 2×4 sawhorses, the outer coil is wrapped counter-clockwise right to left using a large spool of 14 AWG magnetic wire. A thin spacer is used between windings in order to reduce the winding capacitance. Once the outer coil is wound, the wire is continued to the second inner coil which is wrapped clockwise, leaving enough wire between coils such that when the coils are mounted in the wooden frame, the coil is one continuous winding having an input and output connection. Using an inductance meter, the inductance of the coil is measured. Using a standard frequency of 60 Hz, the capacitance of a sheet metal capacitor is calculated such that the generator is electromagnetically resonant at this frequency. The generator is connected to the line voltage by a 1:1 isolation transformer which is connected to a small primary coil wrapped on a toroidal core

whose similar secondary coil is connected to the sheet metal capacitor and inductance coil. Resonance is achieved by adjusting the spacing and overlap of the sheet metal.

[0061] 2. The vacuum chamber is made of a glass tube with sufficient wall thickness to withstand the vacuum pressure. A number of glass blowing techniques are used to make the glass-electrode connection for the capacitor plates. Then circular pieces of glass plate are cut out and ground to the inside diameter of the tube, fitted with the nozzle and vacuum connection, and then heat sealed to the chamber. The chamber and water injector are then attached to a wooden bracket mounting which is doweled and glued to the wooden frame of the generator.

I claim:

1. A water energy generator system comprising the components:

a magnetic vortex wormhole generator and driving resonant electrical circuit;

a water droplet injector;

a vacuum chamber and vacuum pump; and

an electrostatic electron capture system.

2. By means of claim (**1**), a magnetic vortex wormhole generator comprising two concentric cylindrical coils of different radii wound in opposite directions, made of thin sheet silicon-iron transformer laminations wound with one continuous length of magnetic wire providing a single input and single output connection to the driving electrical circuit.

3. By means of claim (**2**), a coil winding method and oscillating driving circuit producing bucking electric fields along the centerline of the generator normal to the coils which create a spacetime curvature pressure and negative energy.

4. By means of claim (**3**), the generation of wormholes between space and hyperspace along the centerline of the generator such that low density, low speed of light hyperspace energy flows through a positive gravitational gradient from hyperspace to space.

5. By means of claim (**1**), a water injector comprising a solenoid-activated water valve, water supply connection, seal and nozzle for injecting water droplets into the vacuum chamber.

6. By means of claims (**5**) and (**4**), the softening and particle decay of the water molecules by the hyperspace energy into neutral pions, positrons, gamma photons and finally a cascade of electron pairs.

7. By means of claims (**6**) and (**1**), the capture of the electrons on electrostatically charged capacitor plates located in the vacuum chamber for the purpose of producing electrical energy.

8. By means of claims (**1**) and (**2**), a resonant electrical driving circuit comprising a line isolation transformer connected to a primary coil wound on a toroidal coil whose secondary output coil is connected to a capacitor and the inductance coil of the generator such that the capacitance of the capacitor and the inductance of the coil form a highly resonant electrical circuit.

* * * * *

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(54) MAGNETIC MONOPOLE SPACECRAFT

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(57) **ABSTRACT**

A spacecraft propulsion system that utilizes a dual method of providing lift on the hull by means of magnetic monopoles and electromagnetic spacetime curvature pressure.

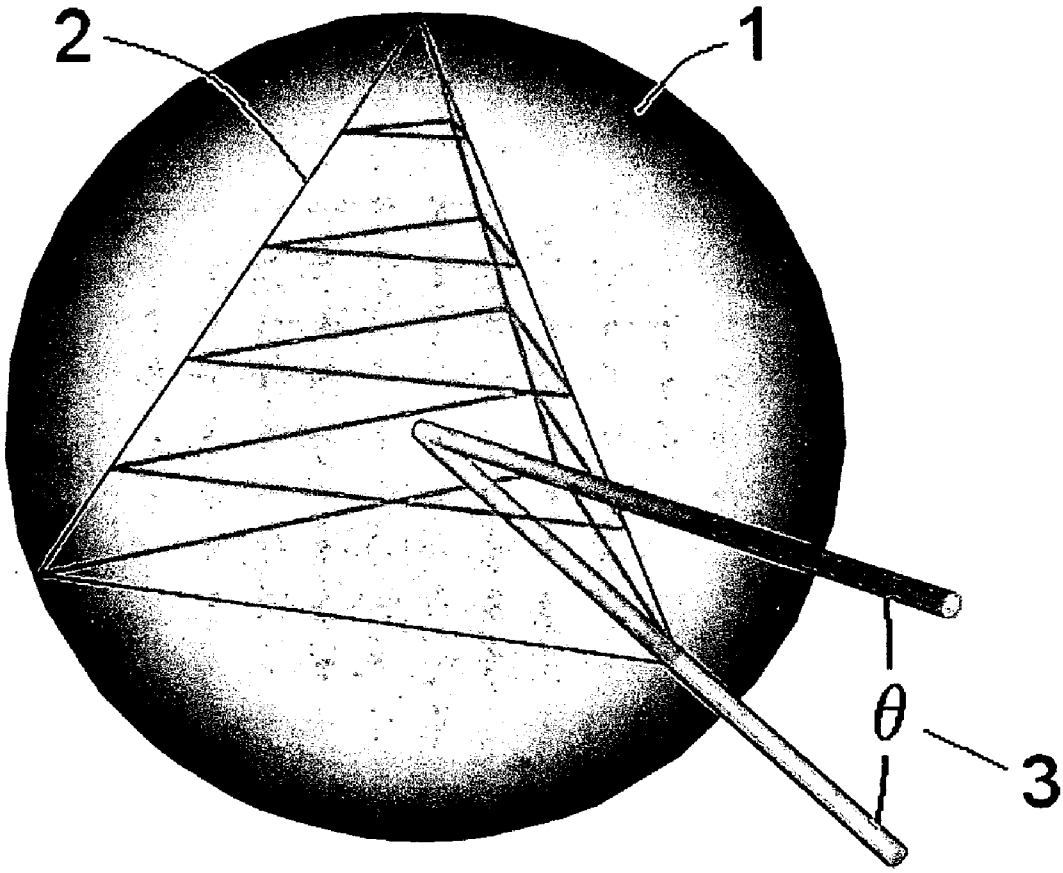

Figure 1

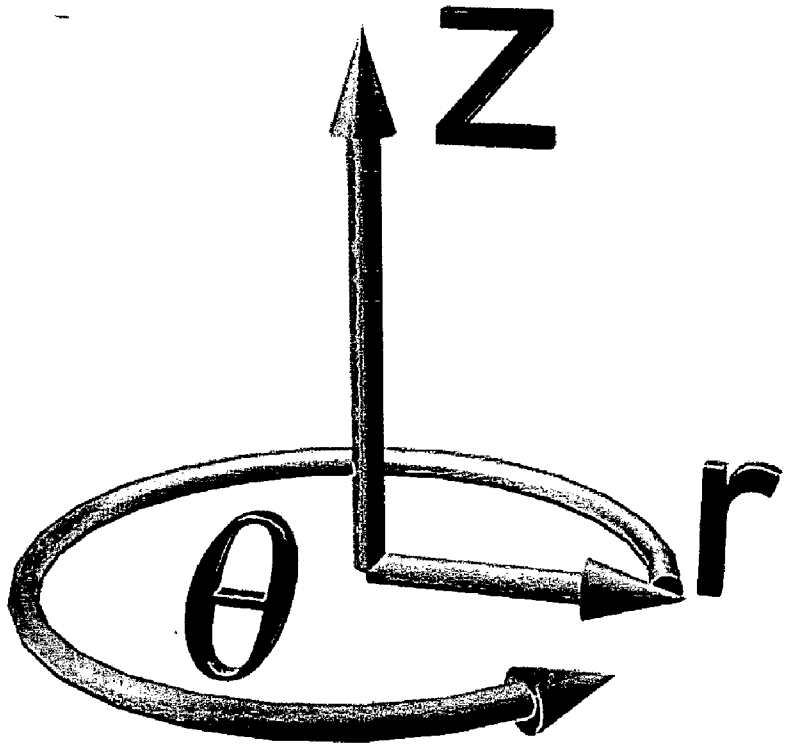

Figure 2

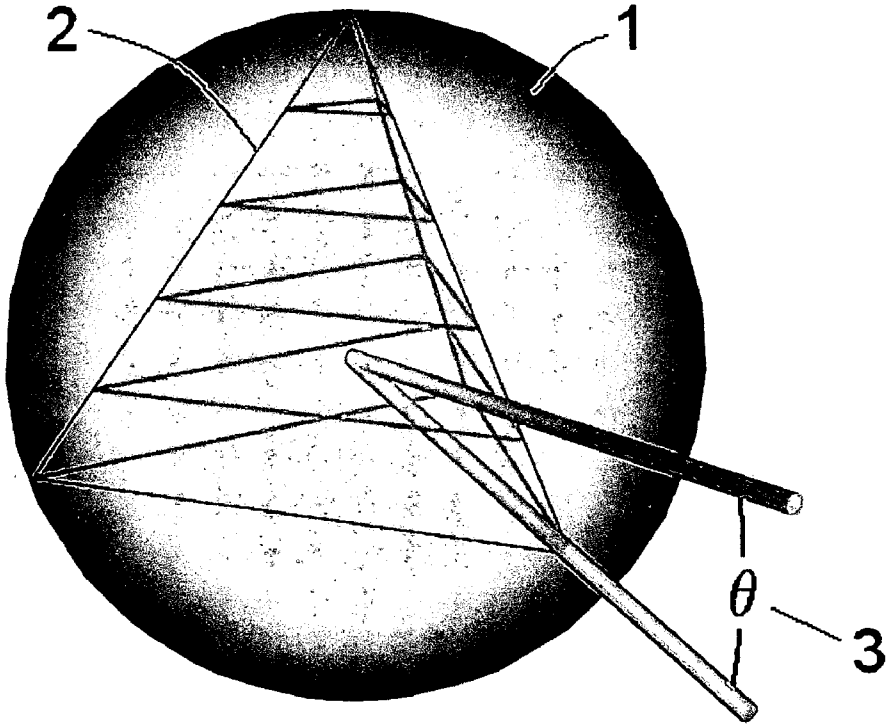

Figure 3

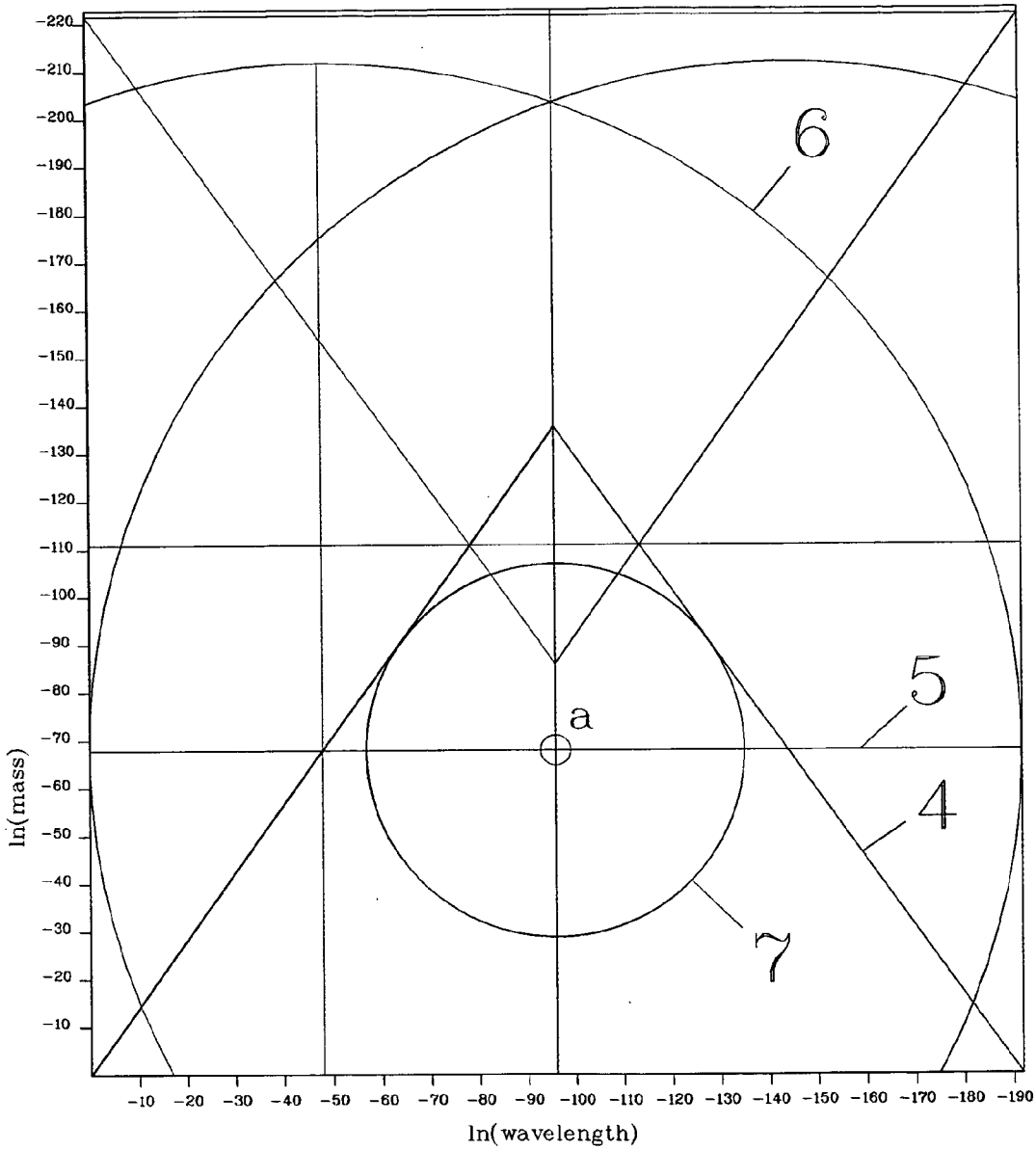
6
5
4
7
a
ln(mass)
ln(wavelength)
-220
-210
-200
-190
-180
-170
-160
-150
-140
-130
-120
-110
-100
-90
-80
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Figure 4

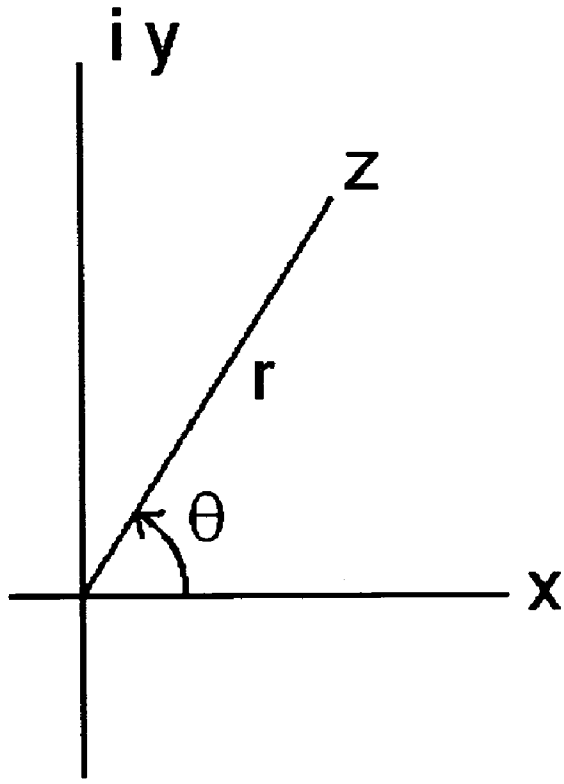

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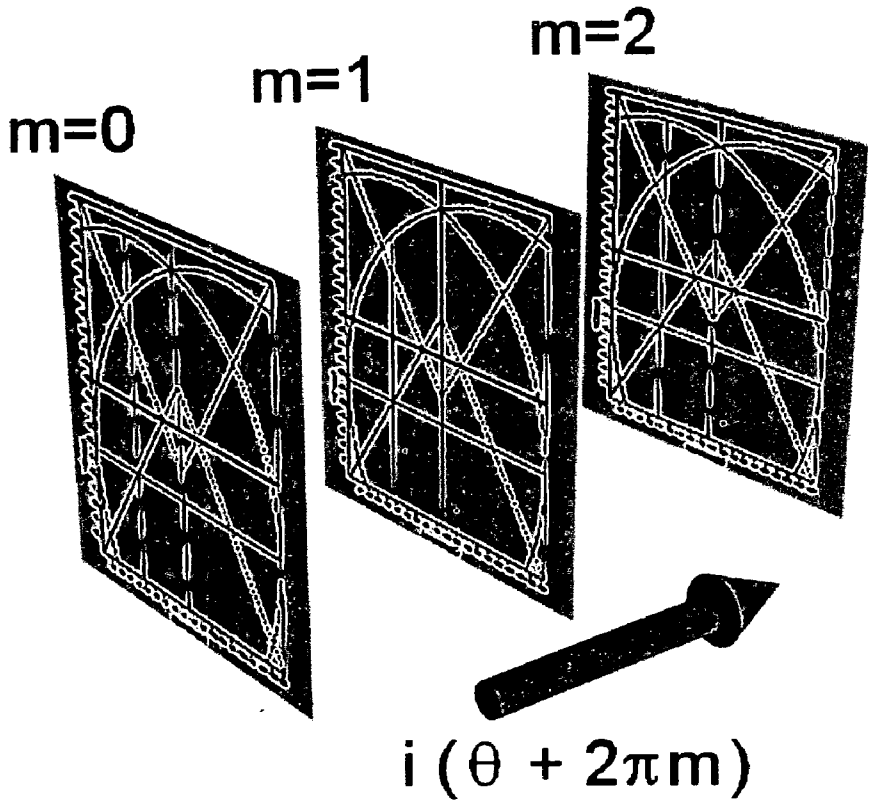

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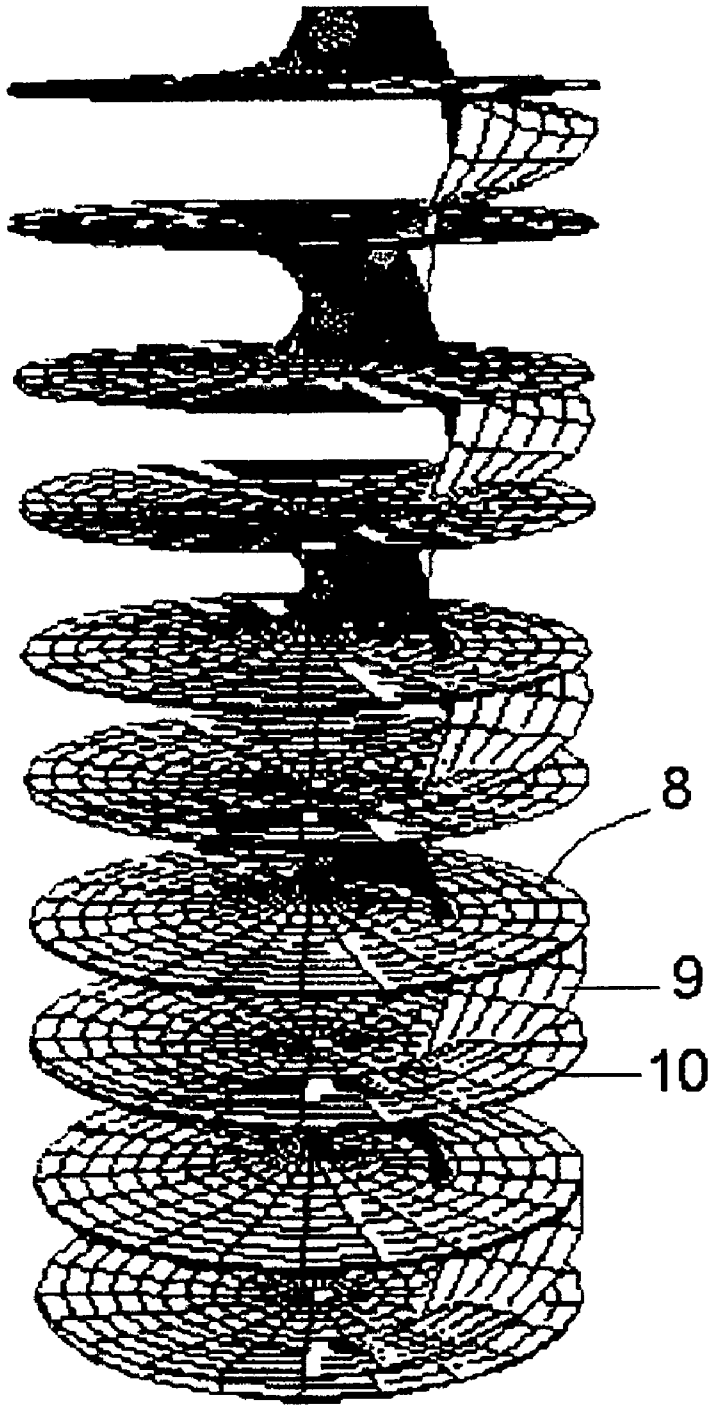

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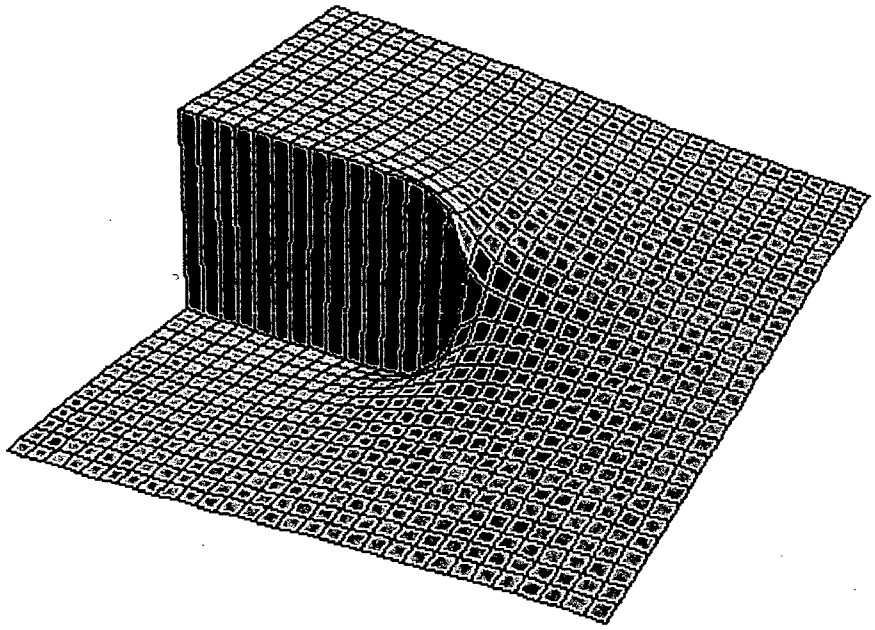

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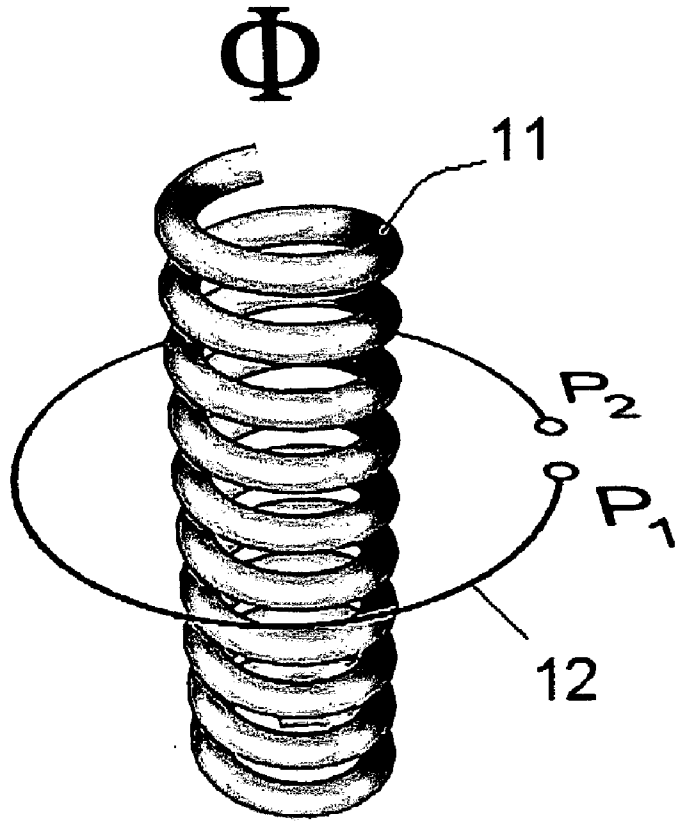

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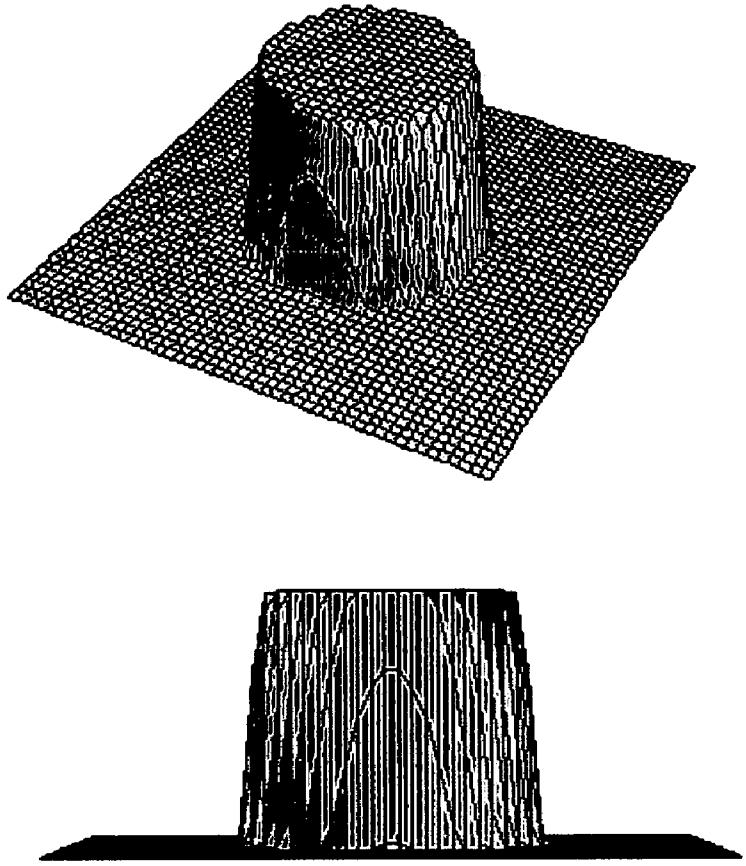

Figure 10

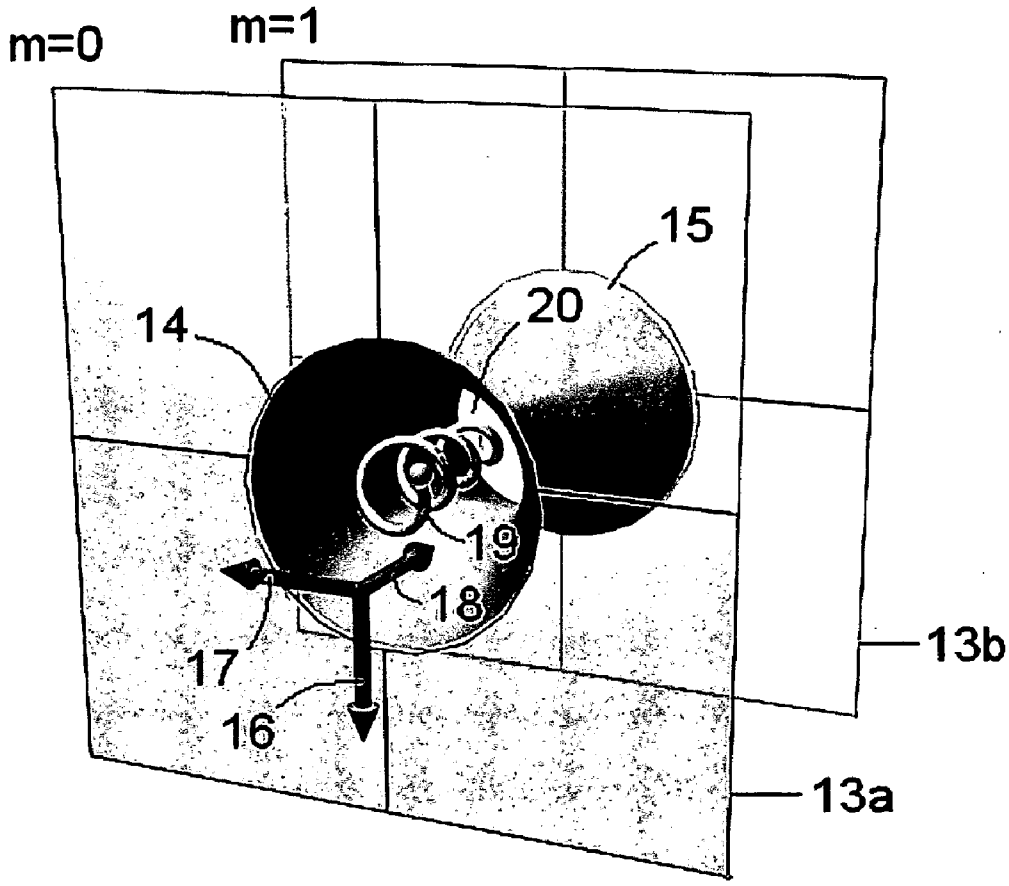

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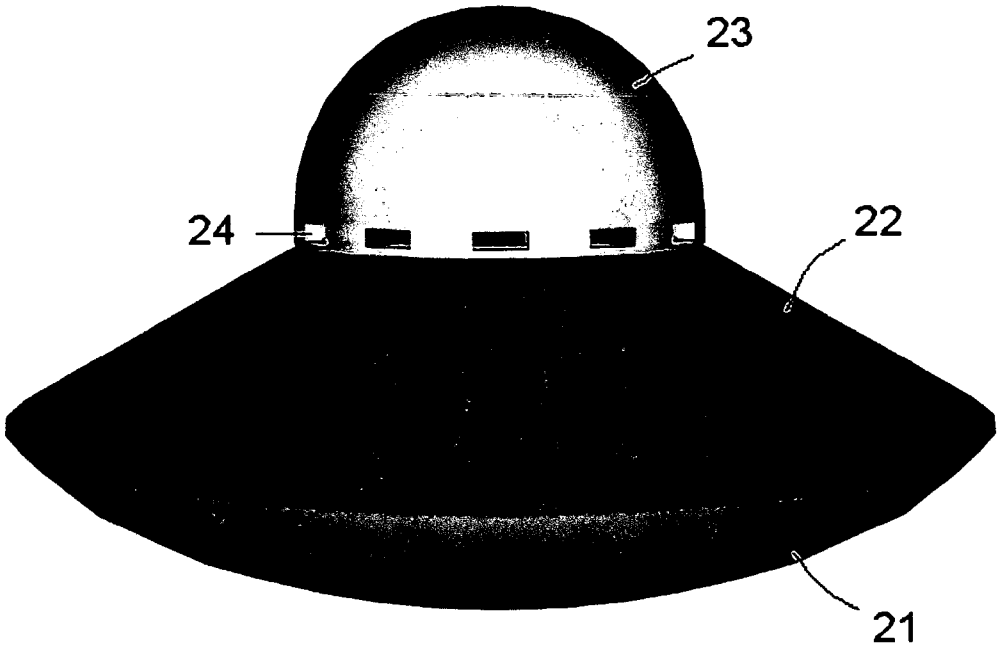

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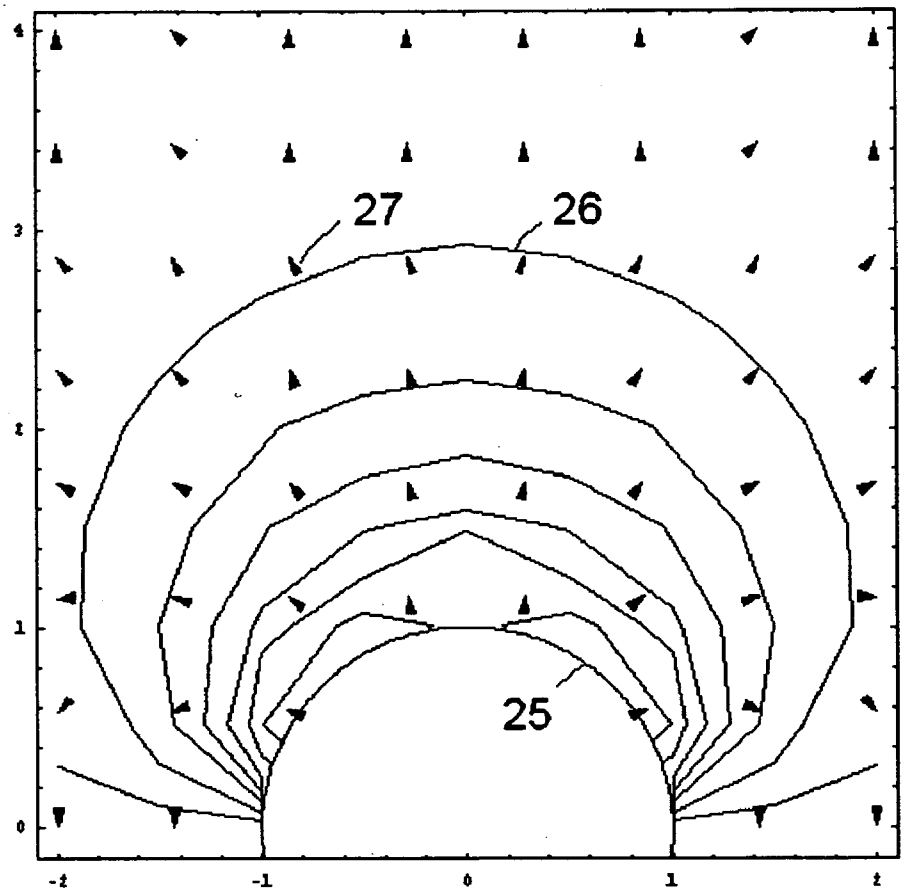

Figure 13

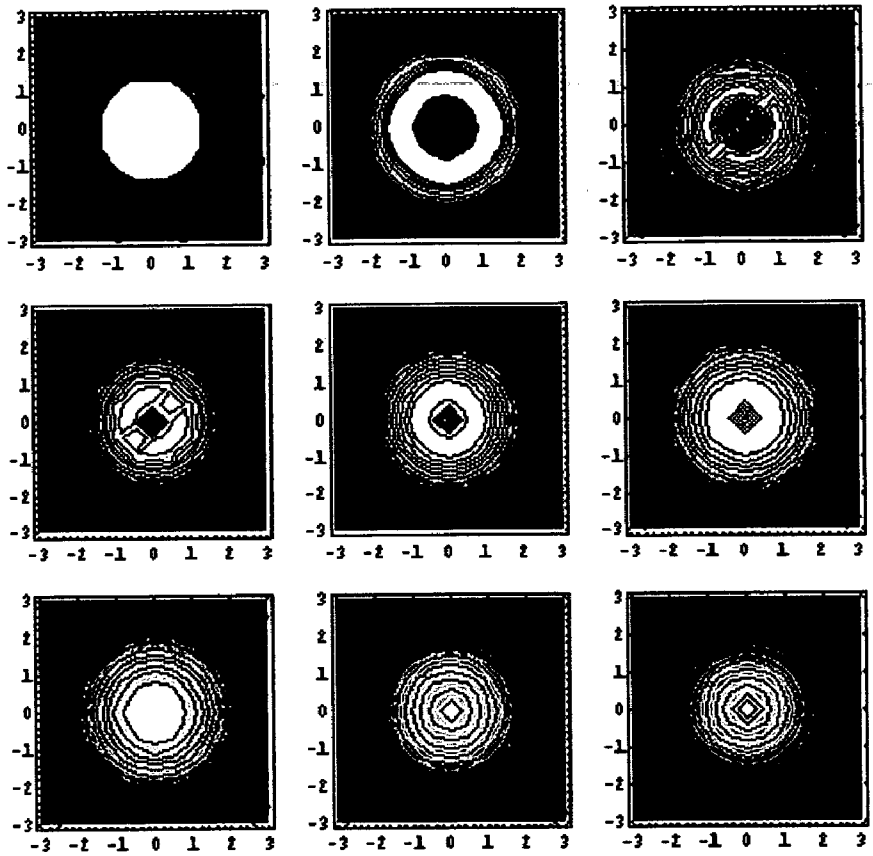

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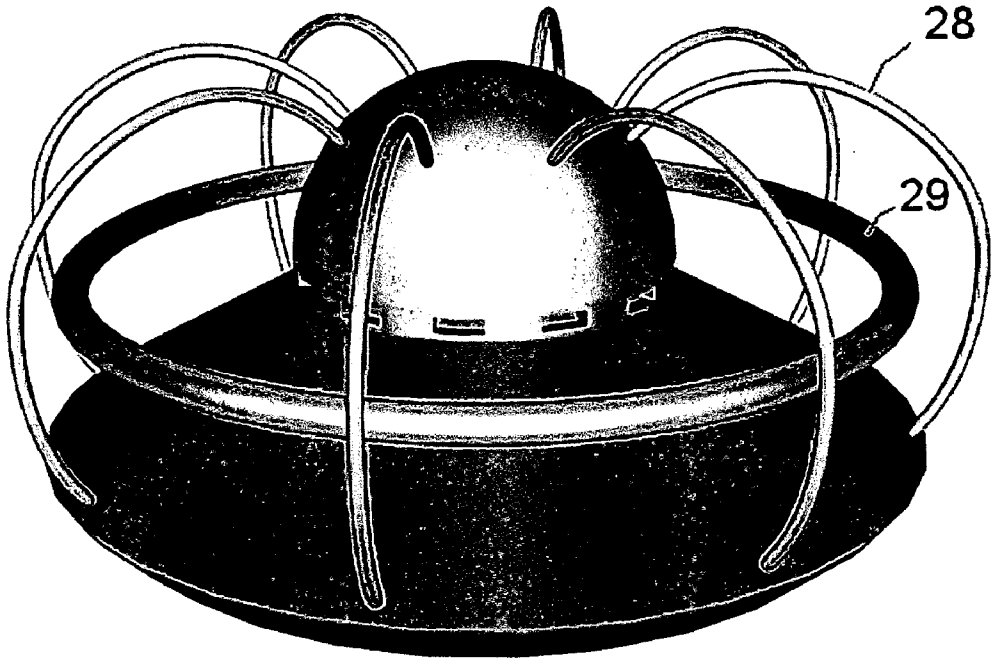

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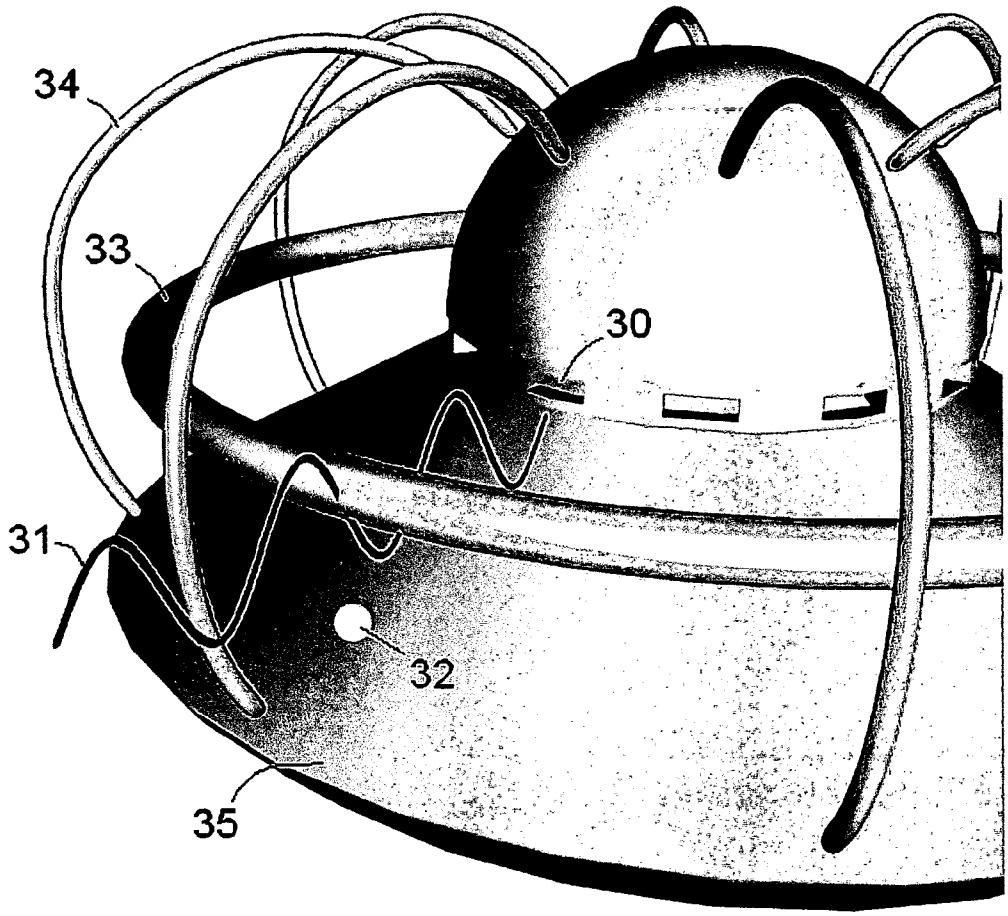

Figure 16

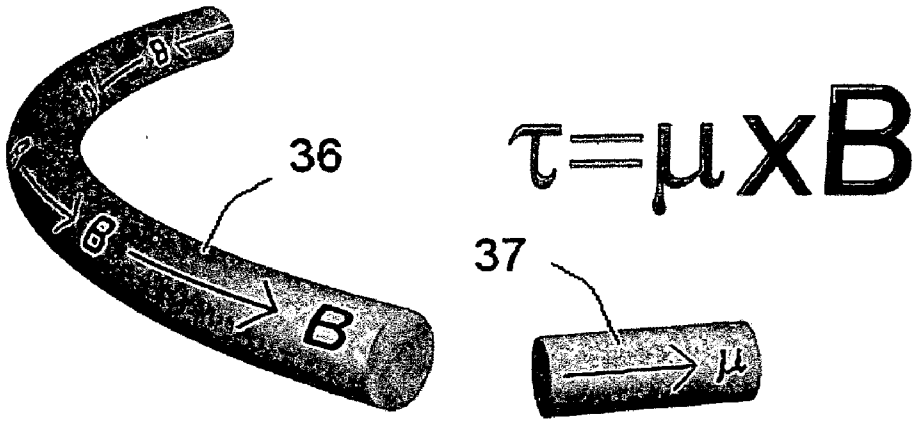

Figure 17

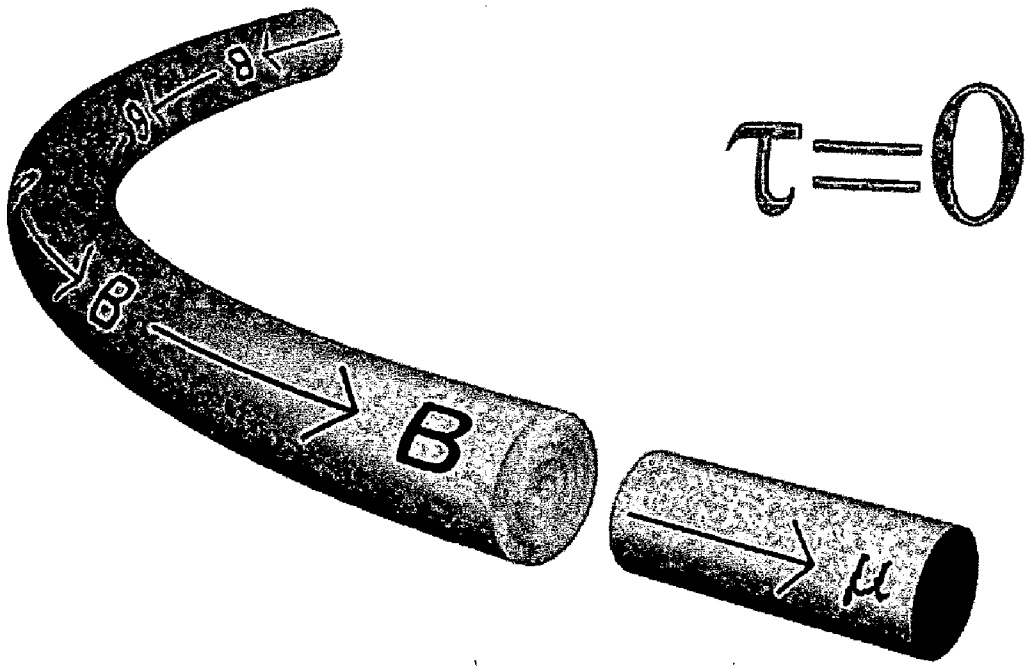

Figure 18

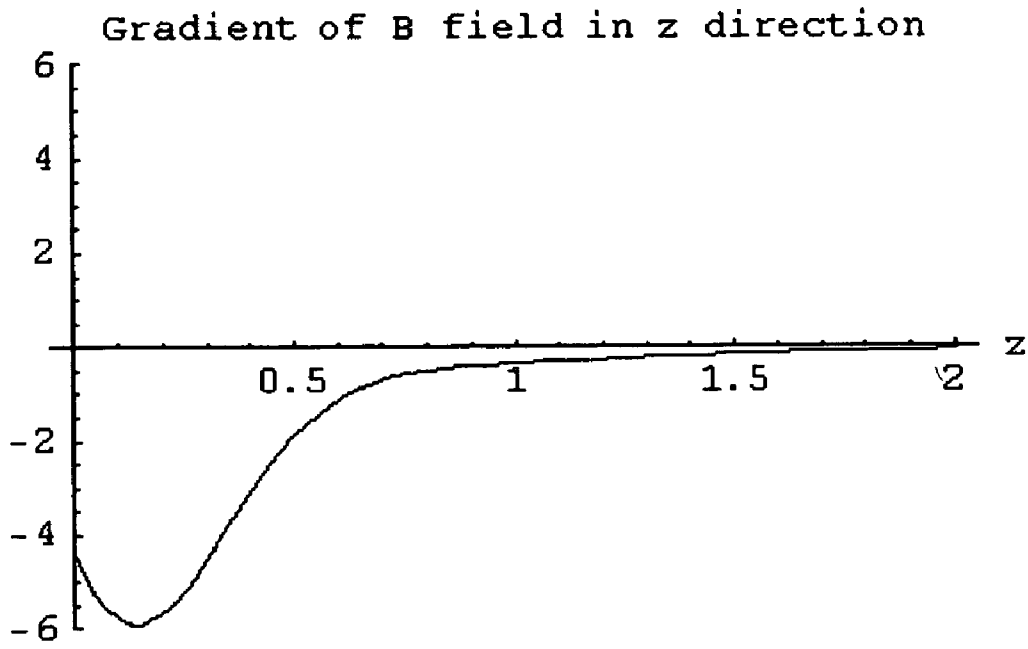

MAGNETIC MONOPOLE SPACECRAFT

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is a spacecraft propulsion system that generates a field of wormholes which are threaded with a magnetic field. Acting as two attracting magnets, the spacecraft's north magnetic field is attracted to the constantly regenerating south magnetic monopoles of the wormholes which provides lift on the hull.

BACKGROUND OF THE INVENTION

[0002] According to one of Maxwell's electromagnetic equations, the curl of the electric E field is equal to the negative time rate of change of the magnetic flux density B field.

$$\bar{V} \times E = -\frac{\partial B}{\partial t}$$

The curl can be thought of as a circulation around a closed loop specified by the right-hand rule where the fingers curl in the direction of the electric field and the thumb represents the changing magnetic flux density field through the area of the loop. At no time is the electric field diverging around the loop. That is, the divergence of the curl is zero which is a well-known vector operation

$$div\ \mathrm{curl}E = \frac{\partial}{\partial t}(divB) = 0$$

The partial derivatives of divB are zero at all points in space. Performing the integration, therefore, the divergence of B is equal to a constant

$$\mathrm{div}\ B = \mathrm{constant}$$

[0003] Referring to **FIG. 1**, the following discussion is made in cylindrical coordinates {r,θ,z}. In cylindrical coordinates, the divergence of the radial B field, div B, is equal to a constant C

$$Br'[r] + \frac{Br[r]}{r} = C$$

where the prime (') represents differentiation with respect to the radius r. The solution to this equation resides in determining the constant C. In the vacuum of space without any wormholes, the constant C is zero. Because the spacecraft is surrounded by a field of wormholes, there is a magnetic flux density field threading each one. That is, each wormhole is actually a magnetic monopole, and therefore the entire field of monopoles constitutes a large magnet with one pole in this dimension and the other pole in the hyperspace dimension.

[0004] The concept of the wormhole involves a new type of scientific thinking involving the creation of a gateway between our spacetime and that of a hyperspace co-dimension. The gateway is created electromagnetically as shown by my patent applications Rotating Magnetic Vortex Generator, Magnetic Vortex Wormhole Generator, and Sulfur 8 Wormhole Generator. The gateway can also be created ultrasonically through bubble cavitation as shown in my patent application Cavitating Oil Hyperspace Energy Generator. In one experiment, smoke was blown through one side of the coil of the magnetic vortex wormhole generator and no smoke came out the other side. The smoke was blown through the wormhole into another dimension.

[0005] The existence of hyperspace is not generally known in the scientific community. The reason it exists can be thought of in the following manner. Referring to **FIG. 2**, the corners of a tetrahedron (**2**) circumscribed by a sphere (**1**) touch the sphere at an angle (**3**) of −19.47°. Looking at the planets of the solar system, the Giant Red Spot vortex of Jupiter, which can hold two planets the size of Earth, is located at this angle. On Mars, the Olympic Mons volcano, which is the size of France, is located at north 19.5° Here in the Caribbean there is a slow moving rock mantle vortex at north 19.5° that curves the islands down toward Venezuela. So the geometry of space is related to the tetrahedron. What this suggests is that there is a subspace manifold whose tetrahedral geometry projects all the constants of physics into our dimension.

[0006] Referring to **FIG. 3**, this subspace geometry is shown in the tetrahedron diagram which plots the natural logarithm of mass on the vertical axis versus the natural logarithm of wavelength on the horizontal axis. With this diagram, it is possible to visualize the entire universe on a single sheet of paper. Triangle (**4**) is the tetrahedron whose vertical centerline shown by the small π circle (a) is equal to Planck's constant h divided by the speed of light c, known as the base constant. The base constant in logs is equal to −95.91546344. Line (**5**) is the diameter of the sphere (**6**). A circle (**7**), centered on (a), with a radius equal to the speed of light squared, is tangent to the tetrahedron. It can be shown that all the constants of physics, such as the speed of light squared and the Planck mass and the Planck wavelength, are determined geometrically by this logarithmic subspace tetrahedral geometry.

[0007] Referring to **FIG. 4**, the complex plane consists of a real horizontal axis, and a complex vertical axis where the value of the complex number z is given by a radius r and an angle θ

$$z = re^{i(\theta+2\pi m)}$$

The logarithm of z is

$$\mathrm{Log}[z] = \mathrm{Log}[r] + i(\theta+2\pi m)$$

where m is an integer m=0,1,2 . . . corresponding to multiple rotations of 2π. What this means in terms of the tetrahedron diagram, referring to **FIG. 5**, is that there are multiple diagrams separated by 2π rotations. Each multiple is another hyperspace dimension. Only the log manifold has this characteristic. Referring to **FIG. 6**, the hyperspace dimension, shown as 2π circular surface (**8**), has a cut (**9**) on the undefined Log[0] origin line such that another hyperspace dimension is created below it (**10**).

[0008] Referring to **FIG. 7**, this branch cut does not bring one back to the original surface nearing the origin. It takes one down to another level of the universe into another hyperspace dimension. I can attest personally that I have been able to look into another hyperspace co-dimension as well as jump into another dimension.

[0009] Furthermore, Dr. Stephen Hawking of Cambridge University has shown that our dimension is connected to a wormhole through complex time. That is, the hyperspace dimension is rotated forward by 90° which makes it orthogonal to us. While this is the mathematical explanation as to why there are hyperspace co-dimensions, I can attest personally to the fact, as described in my patent application Full Body Teleportation, that I was teleported through hyperspace and returned to our dimension over a distance of 100 meters. Because hyperspace exists, it is then possible, using electromagnetic fields, to open wormholes between our dimension and other hyperspace dimensions.

[0010] Referring to **FIG. 8**, the constant C in the magnetic flux density B field equation is determined as follows. The end of a solenoid (**11**) is equivalent to a local magnetic source of flux Φ which represents the wormhole. A charge (**12**) encircling the solenoid has the same value at P_1 and P_2 but there is a phase difference of 2 π n where n is an integer equal to the number of times the charge encircles the solenoid. The change in phase is equal to the charge q divided by Planck's reduced constant times the flux for a solenoid of radius r=R

$$\Delta\theta = 2\pi n = \frac{q}{\hbar}\Phi = \frac{q}{\hbar}B\pi R^2$$

Solving for the magnetic flux density field threading the wormhole

$$B = \frac{2\pi nh}{q\pi R^2}$$

The differential equation becomes

$$Br'[r] + \frac{Br[r]}{r} = C[2]$$

Solving the equation for the radial field Br

$$Br[r] = \frac{C[2]r}{2} + \frac{C[1]}{r}$$

Equating this Br field with the B field and solving for the C[2] constant

$$C[2] = \frac{-2[-2\hbar n + qrC[1]]}{qr^2}$$

Substituting for C[2], the C[1] constant drops out and therefore the wormhole magnetic flux density field becomes a constant inside the throat radius R

$$Br = \frac{2hn}{qR^2}$$

but the divergence moving from outside to inside the radius is a constant due to the discontinuity.

[0011] Referring to **FIG. 9**, the wormhole has a constant cylindrically-shaped magnetic field of radius R with a negative south pole due to the negative charge on the electron, Using a wormhole radius equal to one hundred times the electron radius with n equal to 10 turns, the magnetic flux density B field has a magnitude of 1.4×10^6 tesla.

[0012] Referring to **FIG. 10**, the wormhole surface (**14**) is a connection through a throat area (**20**) between space and hyperspace (**13**) to another surface in hyperspace (**15**). The electron path (**19**) is actually spiraling down the surface of the wormhole. The magnetic flux density field (**18**) points into the wormhole such that the cross product of the electron velocity (**16**) with the field (v×B) points toward the outside rim of the wormhole. Because the electron has a negative charge, the force (**17**) on the electron (−q v×B) is inward toward the centerline of the wormhole. Since one pole of the field is in space, and the other pole is in hyperspace, the wormhole appears to us as a magnetic monopole. The key to this invention is how to generate this magnetic wormhole field.

[0013] Referring to **FIG. 11**, the aluminum spacecraft is constructed of a flattened, shallow spherical lower hull (**21**), a circular upper hull with a flat sloping surface (**22**), a spherical dome cupola (**23**), and a cylindrical section (**24**) housing a circular array of radial microwave waveguides. Surfaces (**22**) and (**23**) are electrically charged, using high-voltage transformers, to an alternating electrostatic potential such that the potential on the dome is +V when the sloping hull has a −V potential and vice versa. This creates an electric field from the positively charged surface to the negatively charged surface.

[0014] Referring to **FIG. 12**, the dome (**25**) is charged to a positive potential. The spherical potential lines (**26**) emanate from the dome and curve around toward the sloping hull. The negative gradient of this potential field is the electric E field (**27**) which is perpendicular to the potential lines. The electric field lines from the dome then terminate on the sloping hull which can be seen in the lower right hand comer of the graph.

[0015] Looking down from above at the top of the dome, referring to **FIG. 13**, the oscillating electric field generates a circular oscillating magnetic field around the hull at various elevations. The last two graphs in the right-hand comer are near the top of the dome as seen by the smaller radius contour lines.

[0016] Referring to **FIG. 14**, the oscillating electric field lines (**28**) are between the dome and the sloping hull. The oscillating magnetic field (**29**) encircles the hull at the level of the microwave waveguides.

[0017] From gravitation physics, it is known that negative energy is required to open up the throat of the wormhole. In terms of differential forms mathematics, the negative energy is created by wedging the magnetic field with the radial

microwave beams of the waveguides. This generates an increasing time rate of change of negative energy ρ as shown by

$$*d(B\hat{}(B_{wave}+E_{wave}dt))=\frac{\partial(-\rho)}{\partial t}$$

where (*) is the Hodge Star operator, (d) the differential operator and (^) the wedge operator which joins the circular magnetic flux density B field with the electromagnetic wave (B_{wave}, E_{wave}).

[0018] Referring to **FIG. 15**, the interaction of the circular magnetic field (**33**), generated by the oscillating electric field (**34**), interacts with the radial electromagnetic field of the microwave beams (**31**) of the waveguides (**30**) to generate negative energy (**32**) over the sloping hull (**35**).

[0019] This combination of fields also creates the wormhole field over the hull. The spacetime curvature pressure T in the vertical z-direction is equal to the square of the circular magnetic flux density field

$$T^{zz}=\frac{B^2}{8\pi}$$

This stress-energy-momentum tensor can be thought of as a spacetime curvature proportional to the inverse of the radius squared, or as a pressure term which acts on the surface area of the hull. Thus there is the combination of a pressure stress and negative energy which creates the wormhole field over the sloping hull. Even though the magnetic flux density B field is oscillating, it is the square of the field which creates the stress. Thus the tension is still in the positive vertical z-direction.

[0020] Due to the low speed of light of hyperspace, the hyperspace energy is low density. Thus there is a positive gravitational potential between hyperspace and our dimension such that the hyperspace energy flows through the wormholes and onto the hull of the spacecraft. When this happens, a white mist forms over the hull. The effect of the hyperspace energy is to lessen the mass of the spacecraft, and relativistically increase the strength of the electromagnetic fields due to the smaller speed of light.

[0021] Referring to **FIG. 16**, the circular magnetic flux density field (**36**) is interacting with the magnetic monopole (**37**). The monopole acts as one pole of a magnet and therefore has a magnetic moment equal to the area times the electrical current circulating through it as the electrons move from our dimension into hyperspace. The great physicist Maxwell (**1870**) pointed out that the energy associated with charges and poles is potential energy and that therefore these objects tend to move in a direction that will decrease the potential energy, similar to a brick sliding down an inclined plane. Now to reduce the potential energy is the same as to reduce the field which gives a measure of the potential energy. If two like charges are brought together they strengthen one another's field, while opposite charges reduce one another's field. Thus like charges repel and unlike ones attract.

[0022] However, the energy associated with electric currents is not potential but kinetic in origin, because it is associated with moving charges. Now in mechanics it is well known that bodies move in a direction to increase their kinetic energy, if there is a source of external energy. The magnetic field of currents is a measure of kinetic energy and currents will try to move in a direction that will increase the field. Thus similarly-directed currents attract and unlike currents repel. In **FIG. 16**, the monopole will act so as to increase the field of the circular magnetic B field generated by the spacecraft. The monopole will then rotate into alignment with the flux tube. This increases the field strength of the flux tube. There is a torque τ on the monopole equal to the cross product of the magnetic moment with the B field

$$\tau=\mu\times B$$

[0023] Referring to **FIG. 17**, when the monopole is aligned with the flux tube, the cross product is zero and there is zero torque on the monopole. Notice that even if the oscillating B field points in the opposite direction, there is still zero torque since the torque depends on the sine of the angle between them. The sin(0°) or sin(180°) is the same zero value. With the monopole aligned with the flux tube, the kinetic energy is now maximized. That is, both the flux tube and the monopole point in the θ-direction.

[0024] The magnetic B field can be represented as a vector having three components. The only component is in the angular direction

$$B=\{B_r,B_\theta,B_z\}=\{0,\ B_\theta(z),\ 0\}$$

where the field varies, as was seen in **FIG. 13**, in the vertical z-direction. The magnetic monopole field also points in the θ-direction

$$\mu=\{0,\mu_\theta(z),0\}$$

where there is a negative gradient of the monopole field in the z-direction due to the location of the microwave waveguides near the sloping hull.

[0025] The force F on the monopole is the gradient of the monopole's magnetic moment μ with the magnetic flux density B field

$$F=\nabla(\mu\cdot B)=\{0,\ 0,\ \mu_\theta\ B_\theta'(z)+B_\theta(z)\mu_\theta'(z)\}$$

which says that there is a force on the monopole in the z-direction equal to the magnetic moment times the gradient of the magnetic field in the z-direction plus the magnetic field times the gradient of the magnetic moment in the z-direction.

[0026] Referring to **FIG. 18**. differentiating the magnetic field in the z-direction shows that the gradient is negative outside the hull. This can also be seen visually in **FIG. 13** where the graphs decrease in intensity.

[0027] A negative gradient for both the magnetic moment and the field means that the force on the monopole is negative. The force on the tube connected to the hull is therefore the negative of a negative, yielding a positive lift force.

$$F_{monopole}=-\{0,\ 0,|\mu_\theta B_\theta'(z)+B_\theta(z)\mu_\theta'(z)|\}=-F_{tube}$$

$$F_{tube}=+\{0,\ 0,|\mu_\theta B_\theta'(z)+B_\theta(z)\mu_\theta'(z)|\}$$

which says there is an upward lift force on the hull due to the combination magnetic monopole and flux tube. This lift

force is in addition to the vertical lift force generated by the spacetime curvature created by the electromagnetic fields themselves.

SUMMARY OF THE INVENTION

[0028] This invention is a spacecraft propulsion system that utilizes electromagnetic fields and microwaves to generate negative energy and a spacetime curvature over the hull. The hull consists of a hemispherical dome, a circular array of radial microwave waveguides, a sloping flat hull, and a shallow spherical hull on the bottom. Alternating current high voltage transformers connected to the dome and the sloping hull generate a curving oscillating electric field between the dome and the sloping hull. Due to this oscillation, a horizontal circular oscillating magnetic flux density B field is created around the dome.

[0029] By firing the microwaves at right angles to the B field, negative energy is created over the hull. The negative energy and spacetime curvature pressure generate wormholes between space and hyperspace. Because hyperspace has a low speed of light and positive gravitational potential, low density hyperspace energy flows through the wormholes and onto the hull. The effect of the hyperspace energy is to lessen the mass of the vehicle and to increase the strength of the electromagnetic fields. Because the resistance of hyperspace is less than the resistance of space, electrons spiral down the wormholes into hyperspace. This creates a magnetic field through the wormhole with one pole in our dimension and the other pole in hyperspace. Thus a field of magnetic monopoles is created over the hull.

[0030] The magnetic monopoles, which represent kinetic energy, align themselves with the magnetic flux tubes in order to maximize the total magnetic field. Because there is a gradient of the monopoles and field in the vertical direction, a negative force develops on the monopoles equal to the gradient of the dot product of the magnetic moment of the monopole with the B field. Thus the opposite reaction is a positive force on the flux tubes attached to the hull which is equivalent to bringing the north pole of a magnet together with the south pole of a second magnet. Because the hull constantly regenerates the wormhole field, the hull experiences a constant upward lift force. This is in addition to the lift generated by the spacetime curvature pressure which is proportional to the square of the magnetic flux density B field.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0031] **FIG. 1**. Perspective view of cylindrical coordinate system {r, θ, z}.

[0032] **FIG. 2**. Perspective view of tetrahedron circumscribed by sphere.

[0033] **FIG. 3**. Tetrahedron diagram showing speed of light squared is determined by the tetrahedron.

[0034] **FIG. 4**. Complex number z representation in the complex plane.

[0035] **FIG. 5**. Perspective view showing multiple log manifold hyperspace dimensions.

[0036] **FIG. 6**. Perspective view of orthogonal hyperspace dimensions.

[0037] **FIG. 7**. Perspective view of Log[z] showing cut along origin.

[0038] **FIG. 8**. Perspective view of charge phase shift around a magnetic flux.

[0039] **FIG. 9**. Perspective view of wormhole magnetic flux density B field.

[0040] **FIG. 10**. Perspective view of magnetic monopole wormhole.

[0041] **FIG. 11**. Perspective view of spacecraft.

[0042] **FIG. 12**. Graph showing electrostatic potential and electric field over dome.

[0043] **FIG. 13**. Animation showing circular magnetic field around dome at increasing elevation.

[0044] **FIG. 14**. Perspective view of electric and magnetic fields around hull.

[0045] **FIG. 15**. Perspective view of generation of negative energy.

[0046] **FIG. 16**. Perspective view of monopole misaligned with flux tube with torque.

[0047] **FIG. 17**. Perspective view of monopole aligned with flux tube at zero torque.

[0048] **FIG. 18**. Graph showing negative gradient of flux tube in the z-direction.

DETAILED DESCRIPTION OF THE INVENTION

[0049] 1. The aluminum hull is made by a technique called stretch forming which uses hydraulic cylinders to stretch a large sheet of aluminum to its yield point. This makes the aluminum sheet soft and pliable. Using a die which has been CNC machined to the desired hull profile, the sheet is then die pressed into a very rigid, smooth and lightweight structure requiring no other support. There are actually three dies consisting of a spherical dome, sloping hull, and shallow spherical dome.

[0050] 2. The rest of the hull consists of a cylindrical hull with a radius equal to the upper dome. A segment of this hull is designed on a 3D computer graphics program and stored as a stereolithography *.stl file. The file is then transmitted over the Internet to a server who prints up the part on an xy-plotter with an ultraviolet laser and ultraviolet light sensitive polymer bath. The computer model is sliced by a special program into many thousands of slices which are printed one over the other until the part is completed. The server returns the part next day by Express Mail. Several parts are then molded using liquid plastic such as to form the complete ring. A sand mold is then constructed from all the molds to form a plastic cylindrical hull having the waveguide slots molded into it. The waveguide silver-coated aluminum boxes are then installed in the slots and connected to the frequency generators and amplifiers. The purpose of the plastic waveguide cylinder is to separate the electrostatic charges on the dome and the sloping hull In this particular case we used a dome from another spacecraft design which saved on the cost of the die.

I claim:

1. A spacecraft propulsion system consisting of the following components:

a lower hull made of aluminum sheet having a shallow spherical profile;

a circular flat sloping hull made of aluminum sheet attached to the top of the lower hull on the periphery;

an electrically-insulated plastic-molded tubular cylindrical hull containing slots for mounting an array of radial microwave waveguides, attached to top of the flat sloping hull;

a hemispherical cupola in the shape of a dome made of aluminum sheet mounted on top of the insulated cylindrical hull;

an array of rectangular microwave waveguides mounted in the waveguide slots of the cylindrical hull;

a high-voltage alternating current transformer with one side electrically attached to the upper dome and the other side electrically attached to the flat sloping hull; and

a frequency generator and amplifier to drive the microwave waveguides.

2. By means of claim (**1**), an oscillating electric field is created between the upper dome and the sloping hull using the high-voltage alternating current transformer.

3. By means of claim (**2**), an oscillating circular magnetic flux density field is generated around the sloping hull and upper dome.

4. By means of claims (**1**) and (**3**), negative energy is generated by the radial microwave beams of the waveguide array impinging on the circular magnetic flux density field around the hull.

5. By means of claim (**3**), a positive spacetime curvature pressure constituting a lift force is developed over the hull in the vertical direction proportional to the square of the field.

6. By means of claims (**4**) and (**5**), a field of wormholes between space and hyperspace are generated over the hull.

7. By means of claim (**6**), due to the positive gravitational potential between hyperspace and space, low-density hyperspace energy flows through the wormholes onto the hull to reduce the mass of the spacecraft and strengthen relativistically the electromagnetic fields.

8. By means of claim (**6**), electrons, emitted by the charged hulls, spiraling down the wormholes, generate a field of magnetic monopoles with one pole in space and the other in hyperspace.

9. By means of claims (**6**) and (**3**), the magnetic monopoles maximize their kinetic field energy by aligning with the magnetic flux tube.

10. By means of claim (**9**), the gradient in the vertical direction of the dot product of the magnetic moments of the monopoles with the magnetic flux density field is a negative force on the monopoles and an equal but opposite positive lift force on the magnetic flux tubes attached to hull.

11. By means of claims (**10**) and (**5**), a dual method of providing apositive lift force on the spacecraft is constituted.

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(54) METHOD OF GRAVITY DISTORTION AND TIME DISPLACEMENT

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(57) **ABSTRACT**

A method for employing sinusoidal oscillations of electrical bombardment on the surface of one Kerr type singularity in close proximity to a second Kerr type singularity in such a method to take advantage of the Lense-Thirring effect, to simulate the effect of two point masses on nearly radial orbits in a 2+1 dimensional anti-de Sitter space resulting in creation of circular timelike geodesics conforming to the van Stockum under the Van Den Broeck modification of the Alcubierre geometry (Van Den Broeck 1999) permitting topology change from one spacelike boundary to the other in accordance with Geroch's theorem (Geroch 1967) which results in a method for the formation of Godel-type geodesically complete spacetime envelopes complete with closed timelike curves.

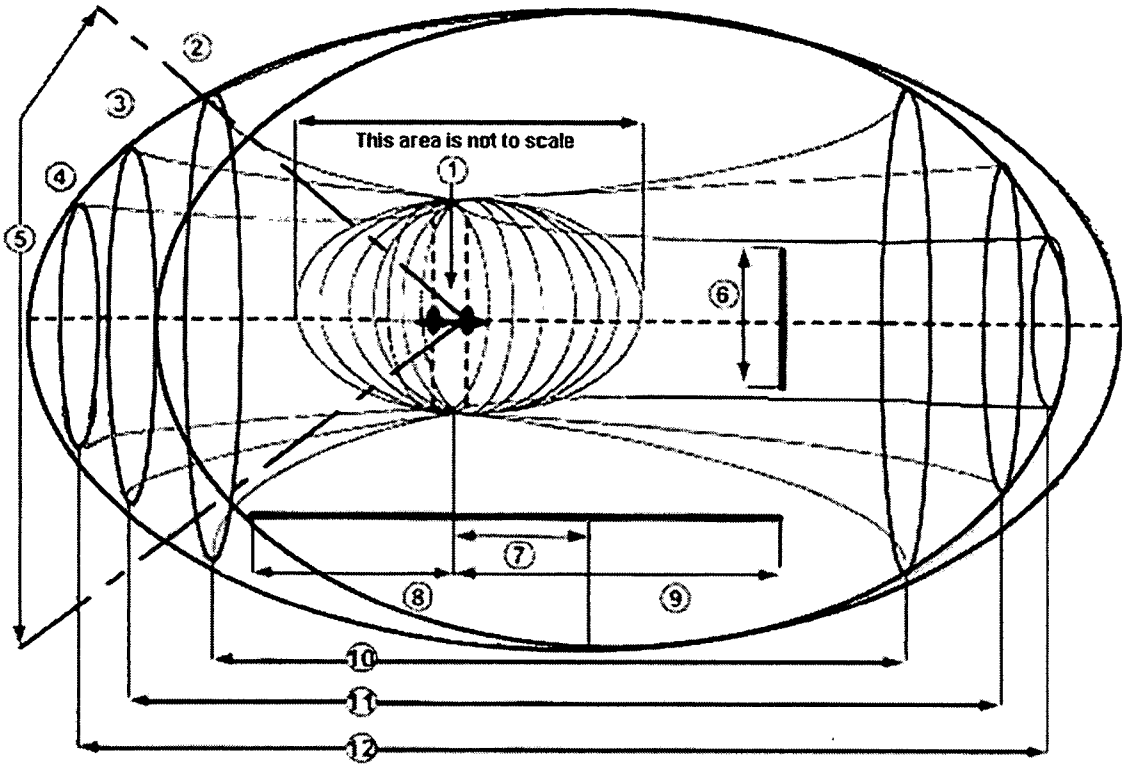

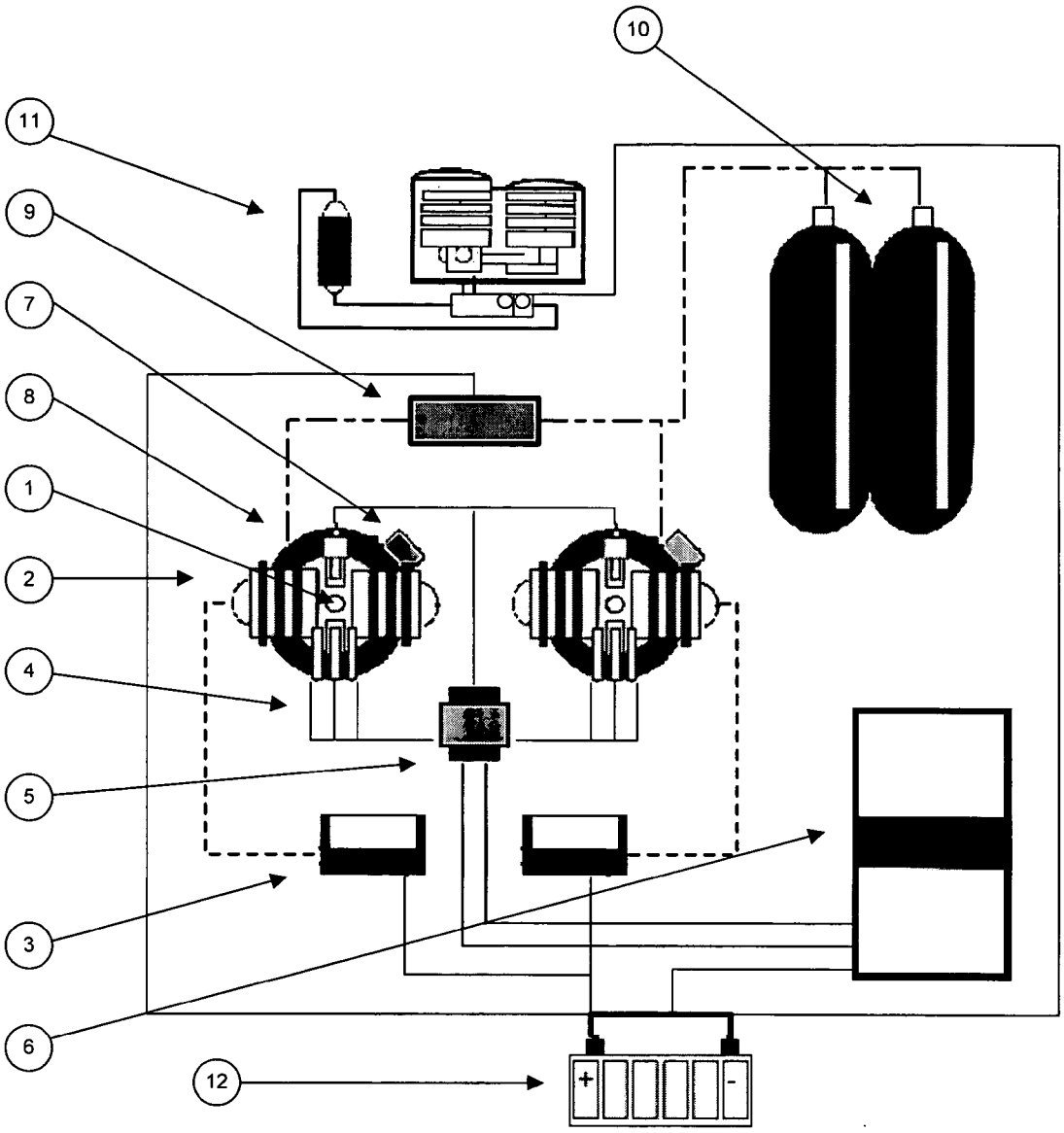

Figure 1

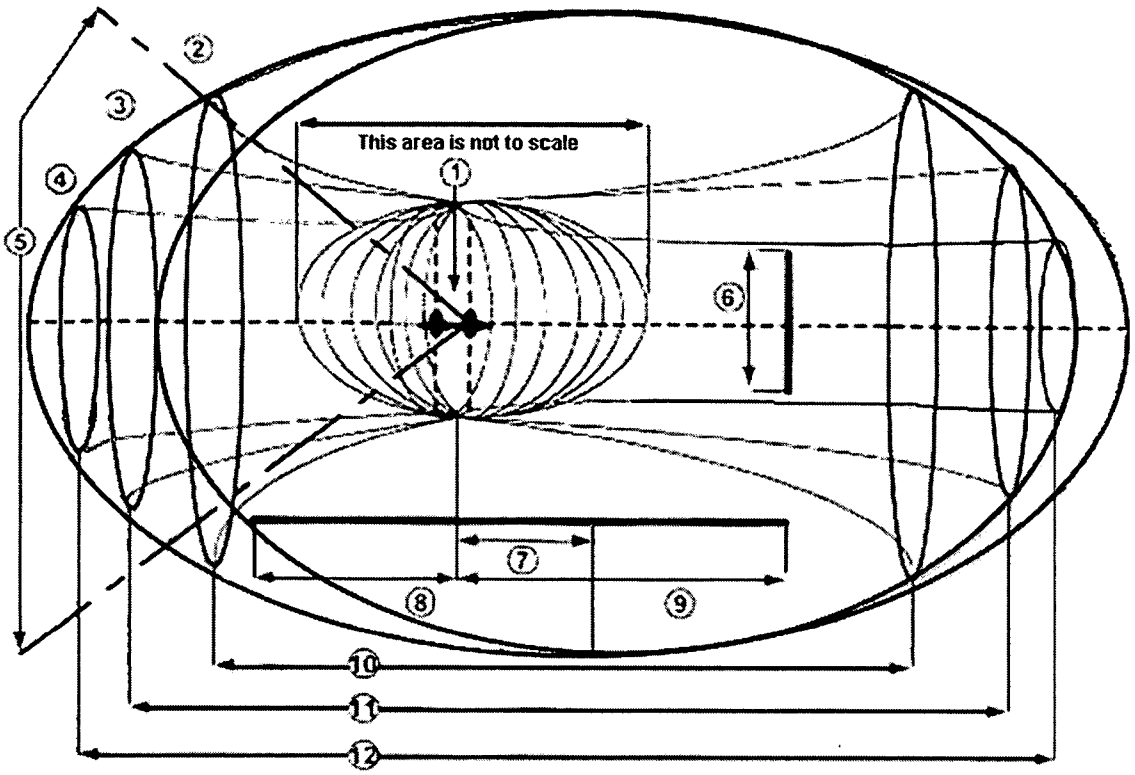

Figure 2

METHOD OF GRAVITY DISTORTION AND TIME DISPLACEMENT

FIELD OF THE INVENTION

[0001] The present invention relates to the use of technical time displacement devices, which operate by the modification of gravitational fields. These drive systems do not depend on the emission of matter to create thrust to take advantage of time dilation, but rather create a change in the curvature of space-time, in accordance with general relativity. This allows travel across topologies by warping space-time, to produce a topology change from one spacelike boundary to the other in accordance with Geroch's theorem (Geroch 1967)

THEORETICAL BACKGROUND OF THE INVENTION

[0002] The concept of gravity should be examined in the light of quantum gravity and in turn as a component of quantum physics itself. The fundamental minimal quantum of energy in quantum physics is Planck's constant; h. Thus in accordance with the energy equivalence formula $E=mc^2$, the fundamental minimum quantity of mass (m_q) can therefore be derived, from known constants by; $m_q=h/c^2$ (1). Taking this minimal mass, it is possible to show that the formation of all matter, the forces of nature and indeed space-time itself derive from this single quintessential quantity.

[0003] Thus if the number of quintessences in a system is; $n_q=m/m_q$: then the total Energy of the system is more logically given by, the energy of a single quintessence (h); directly multiplied by the number of quintessences (n_q) in that system, thus

$$E=hn_q=mc^2 \quad (1\text{ a}).$$

[0004] Furthermore, this minimal mass, termed quintessence, can form the basis of the existence of a quantum gravitational field in the form of a space-time lattice, from which quantum gravity may be derived from first principles. Furthermore, the conglomeration of these quintessences also accounts for the formation of the elementary particles and the forces acting between them, as in superstring theory. This concept explains the formation of matter and the forces of nature on a quantum mechanical basis and directly explains the existence of wave particle duality. Thus as $n_q=m/m_q$; the frequency of light and matter (f) is determined, directly, from the number of constituent quintessences. This leads automatically to the fundamental equation, derived from (1), $f=n_q=E/h$, where n_q is the number of quintessences, which leads directly to the frequency of both light and matter. This in turn leads directly to a Universal wave equation for matter and light $\lambda=c/\beta n_q=hc/\beta E$ (2), where β is the relative directional velocity, v/c. As the momentum, $p=\beta\times E/c$, then this equation also gives the standard de-Broglie wave equation, $\lambda=h/p$ in agreement with current theory and experiments[1].

[0005] Using the Universal wave equation, the standard equation for special relativity, $m'=m_o/(1-\beta^2)^{1/2}$, derives from first principles. Also from these observations, a modified Dirac wave equation may be derived, $E\psi=(-j\beta\cdot\nabla+\beta m)\psi$ (2a), the results of which have been recently verified by a paper in which the orbitals of electrons were experimentally directly visualised[2]. Moreover, a fundamental equation for general relativity can be formulated, where G is the gravitational constant and r_q is the given radius of quintessence; $G=9(r_q)^2c^4/\lambda\beta E$ (3), such that the Universal wave equation is in direct agreement with general relativity[3]. Thus special and general relativity and quantum mechanics can be unified.

[0006] From here it is possible to proceed in a number of ways; the geometric structure of the electron and the forces of Nature may be derived from first principles and in turn the structure of the quarks, including the top and bottom, otherwise known as truth and beauty can be seen. Moreover, the presence of a space-time lattice results in an understanding of quantum EPR effects. By allowing a theoretical flow of energy through the space-time lattice it can be shown that:

[0007] Energy is not bound by space-time

[0008] Thus logically accounting for phenomena such as entanglement and quantum tunnelling. Quintessence can also be used to explain, logically, the inner physics of a black hole, the missing mass of the Galaxy, the continuing expansion of the Universe, Guth's inflationary theory and the Big Bang. Hence, it is now possible to understand the Universe, including space-time, matter and the forces of nature from the radius, mass and vibration of a single quantity, quintessence.

[0009] With this understanding of space-time, matter and the forces of Nature, and in particular gravity, it is possible to demonstrate that the modification of gravitational fields, and in turn the warping of space-time, can be technically readily achieved.

[0010] Using standard equations for special relativity, $m'=m_0/(1-\beta^2)^{1/2}$, it can be demonstrated that by differentially increasing the velocity of electrons, by applying a differential current, their mass can be increased in a specific way. In turn by increasing the mass of electrons, by general relativity, the number of gravitons emitted from these electrons can be modulated. By multiplying this effect using an ultracentrifugational device the differential graviton emission can be manifestly amplified. This in turn, in accordance with general relativity, will cause a change in the curvature of space-time.

[0011] This effective warping of space-time does not, of necessity, imply superluminal velocities, but does allow the creation of warp drive systems, which do not depend on the creation of thrust by the ejection of material as used in current space technologies.

Part 1—Fundamental Laws of Physics

[0012] Quintessential Mass

[0013] The quantum physical, minimum component of energy is Planck's constant; h. To define the minimal component of mass, using the standard energy equivalence formula; $E=mc^2$, such a minimal mass (m_q) would be required to have the value equivalent to; $m_q=h/c^2$ (1). The total mass of a system (m) would then be; $m=n_qm_q$, where (n_q) is the number of these minimal units. Thence, the total energy of a system can be derived from the minimal energy; h, multiplied by the number of these energy units (n_q). Thus as, $E=mc^2$, then also $E=m_qn_qc^2$ and substituting $m_q=h/c^2$, the energy equivalence formula has the more logical formulation; $E=hn_q$(1a). Thus the energy of a system is equivalent

to the minimal energy unit; h, multiplied by the number of those minimal energy units (n_q).

[0014] Taking this minimal mass/energy, it is possible to show that all matter, the forces of nature and space time can be constructed from this single quintessential quantity. Moreover, using this quantity the laws of physics can be derived from first principles. Thus, a priori, all components of the physical universe, including space-time, can be constructed from this minimal mass component, termed quintessence.

[0015] Wave Particle Duality

[0016] If the presence of quintessence accounts for the structure of matter and if matter itself forms from the number of quintessences, then the frequency of matter and thus wave particle duality directly arises from first principles. Specifically the wavelength of matter derives from the vibration of quintessence from which it is constituted. Thus the frequency (f) and in turn the wavelength of light and matter is directly equivalent to the number of quintessences contained within it. We find that the actual frequency of light can be directly derived from first principles from the effective mass of the photon (m,) and thus by the number of quintessences (n_q) it contains.

[0017] Thus for light conventionally:

$$f=E/h$$

[0018] and if $E=mc^2$, and $h=m_q c^2$, then

$$f=m_\gamma c^2/m_q c^2$$

and

$$f=m_\gamma/m_q=n_q$$

Thus

$$f=n_q \quad (4)$$

[0019] Thus the formula for the frequency of light E=hf is now readily explained by the observation that the frequency is determined quite directly from the number of quintessences n_q within the photon.

[0020] The wavelength is thus also given by:

$$\lambda=c/f=m_q c/m_\gamma=h/p$$

[0021] We can now show that the frequency of matter also has the same derivation from quintessence, as has the frequency of light. The frequency of matter is again equivalent to the number of quintessences it contains. Thus the wave particle duality of matter itself can be explained by its composition from quintessence. The amount of quintessences contained within a electron sphere will depend on the number of quintessences constituting the electron and those passing through it as a result of its relative velocity β^2 (where $\beta=v/c$); effectively its relativistic momentum (p). The frequency will then be related to the total number of quintessences. Thus for matter,

$$f=\beta^2 n_q \quad (4a)$$

[0022] Thus it is possible to derive the conventional de Broglie wave equation for matter from first principles. Thus, as $\lambda=v/f$, we have:

$$\lambda=v/\beta^2 n_q \quad (5)$$

[0023] thus as $n_q=E/h$

$$\lambda=hc/\beta E \quad (2)$$

[0024] and as conventionally $\beta E/c=p$, then for matter:

$$\lambda=h/p$$

[0025] Provided that in the de Broglie equation, the momentum of the object is calculated using the relativistic mass, thus accounting for the total number of quintessences n_q in an object, this gives an accurate value for the wavelength of matter[1].

[0026] Thus the wavelength of matter follows directly from its constituents, quintessence. As matter is made of quintessence, similarly to light, its frequency depends on the number of quintessences n_q within it, traveling relative to the speed of light. Moreover, $\lambda=hc/\beta E$, underpins a fundamental relationship between wavelength and energy. Furthermore, this is mathematically the same as the term $\lambda=hv/\beta^2 E$, giving a relativistic expression for the wavelength of matter, from which the relativistic equations may be directly derived

[0027] Wave Equations

[0028] The derivation of wave particle duality from first principles also now allows the derivation of a modified wave equation for matter.

[0029] To derive his wave equation Shrodinger commenced with the de Broglie equation using momentum (p). For lower energies the momentum of an electron is conventionally derived from the kinetic energy of the electron and the mass of the electron m_0. Thus conventionally:

$$E_k = \frac{1}{2} m v^{1/2} \quad \text{and} \quad p = m_0 v$$

Thus

$$E_k = p^2 / 2m_0$$

then

$$p = \sqrt{(E_k \cdot 2m_0)}$$

[0030] and conventionally, the de Broglie equation can also be written as:

$$\lambda=h/p=h/\sqrt{(E_k \cdot 2m_0)}$$

[0031] In turn the Shrodinger wave equation directly derives from the square of the above classical non relativistic term for kinetic energy:

$$\lambda^2 = h^2 / E_k \cdot 2m_0$$

$$\text{thus } E_k = \frac{h^2}{2m} \cdot \frac{1}{\lambda^2}$$

$$\text{As } E = E_k + V$$

$$\text{then } E\psi = -\frac{h^2}{2m} \cdot \frac{d^2\psi}{dx^2} + V\psi = jh \cdot \frac{d\psi}{dt}$$

[0032] However, the Shrodinger equation, may be refined by taking into account relativity. Thus the true values for the energy are given by the relativistic momentum (p).

[0033] A fundamental relativistic wave equation for ψ, and its logical derivation may now be developed through the concept of quintessence as a fundamental constituent of matter.

[0034] The amount of quintessences in the electron is determined by the number of quintessences forming the electron at rest, plus the amount of quintessences passing through it due to its relativistic velocity, which will determine the relativistic momentum (p) of a particle.

[0035] The frequency of matter can now be readily calculated from first principles to give a more accurate result. Thus as matter is made of quintessence, similarly to light, its frequency is equal to the number of quintessences n_q within it. The wavelength will depend on its velocity travelling relative to the speed of light and thus multiplied by the relative velocity compared to c(β=v/c);

[0036] Hence for matter as previously shown:

$$\beta=v/\beta^2 n_q=hc/\beta E \quad (2)$$

[0037] And conventionally

$$E=(p^2c^2+m_0{}^2c^4)^{1/2}$$

[0038] Using these equations, we can now, also, reformulate the Shrodinger wave equation, which has the advantage that relativity can be treated in a quantum mechanical way. Thus if the wave energy of matter is defined as:

$$E_\lambda = \frac{\beta\sqrt{p^2c^2+m_0^2c^4}}{c^2}$$

thus

$$E_\lambda = \sqrt{(\beta^2p^2/c^2)+\beta^2m_0^2}$$

[0039] which in complex space generalises to

$$E_\psi=(-j\beta\cdot\nabla+\beta m)_\psi \quad (2a)$$

[0040] As the term

$$\alpha = \frac{e^2}{hc}4\pi\varepsilon_0;$$

also represents the ground state ratio of the velocity of the electron to c. Thus α=β=v/c=1/137.

[0041] Thus, also

$$E_\psi=(-j\alpha\cdot\nabla+\beta m)_\psi$$

[0042] This is thus the standard relativistic equation that Dirac was able to construct from the Shrodinger wave equation. This relativistic equation can be derived from the modified wave equation. This takes into account the relative mass energy which the quintessential wave equation contains.

[0043] Where importantly the term β·m is the mass m, multiplied by the ratio of the relative velocity to light β=v/c, and the term a is also essentially the relative velocity of the electron.

[0044] The Dirac equation was an empirical formula which worked mathematically, nevertheless even Dirac admitted it was not logically understood. The importance of these equations is that they show that the existence of quintessence allows the waveparticle duality of matter to be explained and mathematically derived from first principles, Thus the frequency of matter or even light is simply determined by the number of quintessences it contains.

[0045] Indeed, a recent publication in Nature has suggested that the direct visualisation of the orbitals of electrons shows that these are in very close agreement with theory. However, there is a significant departure from theory, in the interstitial molecular regions, suggesting that the higher velocities of the electrons obey the modified Dirac equation. Thus these orbitals were in keeping with the modified Dirac equation, which itself may be derived from the wave equation above, λ=hc/βE

[0046] The Shrodinger wave equation will approximate to the correct values until v approaches c. Indeed the Shrodinger equation will give similar answers as that derived from equation, under most experimental conditions.

[0047] However, equation 2 and its derivative may have advantages over standard Shrodinger theory with relativistic speeds. Furthermore, equation 2, conceptually shows that the wave particle duality of matter derives from the principle that the frequency of matter is directly equal to the number of quintessences it contains. Importantly it also mathematically allows relativity and quantum mechanics to be united.

[0048] With v≅c, the modified Dirac equation will yield more accurate results, particularly compared with the Schrodinger equation. We also find that the equation λ=hc/βE is equivalent to the de Broglie wave equation, λ=h/p, provided we use the relativistic mass in the de Broglie equation. Given this, these equations yield accurate experimental results.

[0049] Thus we find that the modified formulation of de Broglie wave equation λ=hc/βE leads directly to a modified Dirac relativistic wave equation and is supported by recent experiments which measure the wavelength of matter and demonstrate the electron orbitals experimentally from these wave equations for matter.

[0050] Wave Particle Duality and Relativity

[0051] From here it is possible to proceed in several ways using the relativistic wave equation. It is apparent that the reintroduction of the term for relative velocity into the wave equations will enable the reintroduction of special relativity into quantum mechanics. In particular we should now be able to derive the term

$$\sqrt{\left(1-\frac{v^2}{c^2}\right)}$$

as a special case of quantum mechanics.

[0052] Thus if:

$$\lambda = hc/\beta E$$

$$\text{As } E = \sqrt{p^2c^2+m_0^2c^4}\text{, squaring}$$

$$\lambda^2 = \frac{h^2c^2}{\beta^2\cdot(p^2c^2+m_0^2c^4)}$$

-continued

Conventionally $p^2c^2 = \frac{E^2v^2}{c^2}$

then

$$\lambda^2 = \frac{h^2c^2}{\beta^2 \cdot ((E^2v^2/c^2) + m_0^2c^4)}$$

Thus as $\beta^2 = \frac{v^2}{c^2}$ and $m_0^2c^4 = E_0^2$, then:

$$\beta^4E^2 + \beta^2E_0^2 = \frac{h^2c^2}{\lambda^2}$$

hence $\beta^4E^2 = h^2c^2 \cdot \frac{1}{\lambda^2} - \beta^2m_0^2c^4$ thus

$$\beta^2 = \frac{h^2c^2}{\beta^2E^2} \cdot \frac{1}{\lambda^2} - \frac{\beta^2m_0^2c^4}{\beta^2E^2}$$

As $E^2 = m^2c^4$

$$\beta^2 = \frac{h^2c^2}{\beta^2m^2c^4} \cdot \frac{1}{\lambda^2} - \frac{\beta^2m_0^2c^4}{\beta^2E^2}$$

Substituting $h = m_qc^2$

$$\beta^2 = \frac{m_q^2c^6}{\beta^2m^2c^4} \cdot \frac{1}{\lambda^2} - \frac{\beta^2m_0^2c^4}{\beta^2E^2}$$

As $m_q/'m = 1/n_q$ (eq. 2)

$$\beta^2 = \frac{c^2}{\beta^2n_q^2} \cdot \frac{1}{\lambda^2} - \frac{\beta^2m_0^2c^4}{\beta^2E^4}$$

Thus if $f = \beta^2n_q$; (eq. 7a)

$$\beta^2 = \frac{v^2}{f^2} \cdot \frac{1}{\lambda^2} - \frac{\beta^2m_0^2c^4f^2}{\beta^2E^2}$$

As $1/\lambda^2 = f^2/v^2$

$$\beta^2 = \frac{v^2}{f^2} \cdot \frac{f^2}{v^2} - \frac{\beta^2m_0^2c^4f^2}{\beta^2E^2}$$

Thus

$$\beta^2 = 1 - \frac{\beta^2m_0^2c^4}{\beta^2E^2}$$

As $E^2 = m^2c^4$

$$\beta^2 = 1 - \frac{m_0^2}{'m^2}$$

Hence

$$m_0/'m = (1 - \beta^2)^{1/2}$$

Thus

$$'m = m_0 \Big/ \left[1 - \frac{v^2}{c^2}\right]^{1/2}$$

[0053] Thus this derivation now allows relativity as a universal case of the quintessential wave nature of matter.

[0054] The original premises on which special relativity was based were: that the speed of light is a constant and that all observers are equal. As the speed of light has dimensions of length and time but not apparently of mass, the relativistic change in mass is not accounted for. Using quintessence logically and directly accounts for the relativistic mass changes.

[0055] Moreover, relativity can be derived from the de Broglie equation, and visa versa, directly, thus linking relativity and quantum mechanics by taking into account the existence of quintessence mass.

[0056] Hence, it is now possible to derive the relativistic equations for mass and in turn for space and time from the quintessential wave equation, thus deriving special relativity as a universal case of quantum mechanics and thus uniting special relativity and quantum mechanics. This now allows a further understanding of the nature of space-time.

[0057] The Space-Time Lattice

[0058] The understanding of the true nature of space-time and how it is formulated in three dimensions of real space is crucial. To simply assume that space-time exists, and thence not to question the nature of that existence, denies a deeper understanding of the universe.

[0059] In order to understand the nature of space-time itself, at the quantum level a further look at the nature light and the photon is necessary. Since Einstein's description of light as a particle (the photon) and the description of the photoelectric effect, the standard picture of light as simply a wave can, no longer be applied. If light was to exist as a photon, it could not exist in one dimension, as ordinary waves do, it would need to be three dimensional, with the addition of time. Let us suppose, in this case, that a photon is a three dimensional helical ringlet of light, travelling in the x vector, and spinning around the x-axis. Conventionally this ringlet has a radius; $r=\lambda/2\pi$. The ringlet itself would be vibrating in the y and z vectors. The vectors x, y and z would represent the photon, the substance of which, would be travelling in the x direction and oscillating in the y and z vectors, which would represent oscillatory energy. This in turn would allow it to act as a wave, and create oscillatory electromagnetic fields.

[0060] It is important to re-examine space-time itself in this light, this would have one directional vector with two vector dimensions of energy, one of capacitance and one of electrical permeability, thus accounting for the well known constants of free space; the permittivity of free space (ϵ_0) and the permeability of free space (μ_0) respectively. The vector dimension of direction x, would be the direction of travel and those "quintessences" travelling in an outwardly direction would account for none other than the expansion of the universe. Three of these quintessences would naturally constitute three dimensional visible space-time. These constituents of space-time would interact with the generations of the other vector dimensions reciprocally. Thus one quintessence would sweep out one vector of permeability and one vector of permittivity, through which the other two quintessences could travel, and vica versa, creating a three dimensional space-time lattice.

[0061] The permittivity of free space, (ϵ_0) which is equivalent to capacitance, would as with capacitance plates, be determined by the effective separation between quintessences. The permeability of free space (μ_0) is in fact a force, measured as $4\pi\times10^{-7}$ N/A^2, would result from the force produced by the vibration of quintessence and would be

dependent on the density of quintessence. Hence these two parameters would be reciprocal and thus the product of these two would therefore be a constant, which is recognised as none other than the speed of light.

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$

[0062] This space time lattice would in effect be created by quintessences travelling in all directions with a speed of c within the lattice. The quintessences of the space time lattice would in effect produce a non-static ether. A non-static ether is fully compatible with special and general relativity. Indeed such an ether explains how space time can be curved as in general relativity. Furthermore, the existence of a non-static ether, was espoused by Einstein in his University of Leyden lecture on general relativity of May 5, 1920. In Einstein's own words;

[0063] "According to the general theory of relativity space without ether is unthinkable."

[0064] Recent evidence from a number of sources now strongly support the presence of this non-static ether, in the form of quintessence. An editorial from a major journal states "combined with other observations such as those of distant Supernova, the QMAP results corroborate the prevailing theory of inflation with the twist that the Universe is only one third matter (both ordinary and dark) and two thirds quintessence, a form of energy possibly inherent in empty space".

[0065] If we take into account the existence of quintessence and as such a three dimensional space-time lattice, matter which is intrinsically made of constituents of charge would interact with this lattice to produce the effects of mass. Mass would be perceived as a result of matter (whose constituent particles appear to contain charge) interacting with this lattice directly due to the inhibition of motion by the lattice's electrical permeability and permittivity vectors, which would form the existence of complex space. These quintessences would in the direction in the y and z vectors produce small vibrations of the order of the Planck length (10^{-35} m), whilst passing through the vectors of permeability and permittivity, thus producing the effects of mass.

[0066] The vibration would endow quintessence itself a (non rest) mass m_q equivalent, to the minimal mass of:

$$m_q = h/c^2 = 7\times373\times10^{-51}\ \text{kg·sec} \tag{1}$$

[0067] The presence and magnitude of Planck's constant (h) and especially the speed of light (c) is thus explained. Indeed, the speed of light

$$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$$

is not in itself a fundamental quantity.

[0068] As the energy equivalence formula is $E=mc^2$, the minimal mass of a single quintessence, would thus be the minimal mass, h/c^2, hence again:

$$m_q = h(\mu_0\epsilon_0) = h/c^2 = 7.373\times10^{-51}\ \text{kg·sec} \tag{1b}$$

or

$$m_q c^2 = h \tag{1c}$$

[0069] It is postulated by general relativity that the shape of space time itself can be altered, indeed the presence of the space time lattice now allows this to be altered by altering the density of quintessence. It is further clear that if quintessences underly the structure of the space-time lattice, they may also underly the structure of matter itself.

[0070] With regards a single quintessence, this passing through an energy vector of the space-time lattice would appear as a vibrating string. In a similar way to string theory, the conglomeration of these quintessences would produce the constituents of ordinary matter. Thus the general equation for the number of quintessences (n_q) in an object of mass (m) would be

$$m/m_q = n_q$$

[0071] The mass of the electron (m_e) for example, would be directly determined by the number of quintessences in the electron, multiplied by the mass of quintessence.

[0072] Quintessence and Complex Space

[0073] Quintessence is postulated to constitute the fundamental nature of space-time. Three quintessences each travelling in their respective x vectors at 90° to each other would create three dimensional real space-time. These quintessences would in the direction in their respective y and z vectors produce small vibrations of the order of the Planck length (10^{-35} m), this would create the vector dimensions of permeability and permittivity. The result would give space-time 9 dimensions of space as in superstring theory. However, unlike superstring theory the six hidden dimensions would not be "curled up so as to be so small as to be invisible" these six dimensions would be present in complex space. Thus, only three of these dimensions would represent ordinary three dimensional particulate space time i.e. three dimensional objects. The other six dimensions produced by the vibrations of quintessence would form complex space.

[0074] The mathematics of complex space, using imaginary √−1 or (j) numbers, is assumed in the standard formulation of the Shrodinger wave equation. Thus the presence of complex space is an integral part of quantum mechanics.

$$-\frac{h^2}{2m}\cdot\frac{d^2\psi}{dx^2} + V\psi = jh\cdot\frac{d\psi}{dt}$$

[0075] The mathematics of complex space is also an essential and integral part of the principles and application of modern electronic and control engineering. Indeed it has been well recognised for some time that each direction vector in electronic engineering can, be associated with complex vectors.

[0076] As this complex space consists of the vectors of permittivity and permeability it would only be "felt" by charged particles as in the electron. Nevertheless, as all particles are fundamentally composed of charged particles

the effects of complex space would be felt by endowing these particles with mass and in turn kinetic energy.

[0077] In conventional complex space, a 2 dimensional Cartesian Argand diagram is mathematically used. However, in order to formulate the equations for particles a three dimensional Argand diagram is essential. This will have three dimensional vectors, one real vector and two imaginary vectors. Three of these diagrams will be required to fully describe the nature of particles, each with a real vector in the x, y and z vectors, respectively. Nevertheless, in the instance below the real vector is the x vector and the two imaginary vectors are given by $({}_jy, {}_jz)$

[0078] The Three Dimensional Argand Diagram

[0079] The beauty of a three dimensional Argand diagram is that the complex conjugate (i.e. the mirror image which confers mathematical reality on the coordinates) is formed by the value of the minus coordinate in the other complex vector dimension. Thus the complex conjugate of $(C_x^{1/2}+{}_jc_y^{1/2}+{}_{-j}c_z^{1/2})$ is $(c_x^{1/2}+{}_jc_y^{1/2}+{}_jc_z^{1/2})$. These two sums when multiplied thus give a real number solution.

[0080] Furthermore it is clear that nine dimensions of space time are necessary in the general relativistic equations. By including complex space we thereby create the nine dimensional spacial metrictensor and the metric energy tensor of matter necessary for computations for general relativity From here we can begin to understand the true structure of matter.

[0081] Energy and the Space-Time Lattice

[0082] The presence of numerous experimental data for quantum tunnelling. and indeed the recent observations by Nicholas Gisin, on the entanglement of distant photons now returns us to EPR experiments.

[0083] Using the quintessential modification of the de Broglie wave equation, gives us an insight into these teleportation and EPR effects.

[0084] As

$$\lambda = hc/\beta E \tag{2}$$

and

$$E = hn_q \tag{1a}$$

then

$$\lambda = c/\beta n_q \tag{2b}$$

[0085] Importantly, as indicated by equation (2b), energy having no quintessence; would have a wavelength of infinity. Specifically pure energy containing no quintessences, would have a lambda of infinity. According to quantum mechanics an infinite wavelength would result in the probability of that energy being anywhere. As energy itself has no electrical charge it would not be impeded by the permittivity and permeability of the three dimensional space-time lattice. Moreover, energy would not be detectable in three dimensional space-time, unless it interacted with matter, as in the EPR experiments. Indeed, energy is not observed when not bound to any form of mass or particle. Thus equation 9d, takes us to our original assertion

[0086] Energy is Not Bound by the Space-Time Lattice

[0087] Thus, as the EPR experiments suggest the existence of energy separate from matter and thus separate from the three dimensional space-time lattice, it is interesting to find that experiment suggests the existence of free energy in a continuum separate from space time to produce the effects of quantum teleportation

[0088] This is not, however, teleportation across an additional dimension, this is a term to describe in partially familiar terms the dissociation of energy from the three dimensional space-time lattice. As time is inextricably linked to each dimension of space, the effects of energy would be inextricably linked to the events, such as the creation of virtual particles, we see interacting within space-time.

[0089] It is unlikely that observers have any direct day to day experience to explain quantum events. Nevertheless, quantum physics may have given us a window into the hitherto hidden workings of the Universe. Thereby, the mystery of the uniformity of the Universe, across distances which the speed of light could not apparently traverse, is readily explained by the fact that the free energy contained in the Universe is not bound by the space-time lattice.

[0090] In the case of light, due to the exceedingly small masses involved, there would be relatively easy exchange of matter with free energy within a photon. This would make the photon the ideal experimental tool to look for energy which is not bound by matter and in turn energy which is not bound in space-time. Indeed, very recently Furusawa et at. have reported to have observed the transference of energy as photons from A to B, without those photons traversing space-time. This finding which has been supported using other experimental techniques, is very important as it suggests the existence of such a quantum continuum.

[0091] We have already seen strong experimental data using photons, atomic spins and other data for quantum teleportation which have recently been published which support these findings. According to the above equations the teleportation would vary in a predictable fashion, as with photons, in line with the wavelength of the light used, relative to the size of vibration of quintessence. As regards matter, the results do confirm that the effect of quantum tunnelling is indeed dependant on the wavelength of matter and the size of that matter.

Part II—Particle Physics

[0092] Electron Structure

[0093] Understanding the electron is fundamental to the understanding of the elementary particles. The hidden nature of the electron may recently have been revealed through observations by Horst Stormer, Daniel Tsui and Robert Laughlin for which a Nobel prize has recently been awarded. They describe a quasi electron particle of charge ⅓e. This has been described on a quantum basis as a vortex of energy, bound as a quasi particle in one dimension x, but not bound in the other two dimensions y and z, allowing dispersion in space-time as a vortex. What is more intriguing are the experimental conditions in which this occurs. First of all a two dimensional electron gas is created and held between two capacitance plates. A magnetic force is then applied in the remaining dimension, virtually creating a one dimensional passage through which only a quasi electron appears to be able to pass.

[0094] Given the presence of charge of ⅓e, then three of these quasi electrons could form an entire electron in three

dimensional visible space time. Nevertheless, each would have energy and hence a wave function which would be present in the other vectors. This electron could thus follow the probability functions as described by the Shrodinger wave equation for ψ (otherwise termed as "essence" by Shrodinger)

[0095] If the mass of the electron (m_e) is constituted from quintessence, using the formula:

$$m_e/m_q = n_q$$

[0096] Then an electron would be constituted from:

$$\frac{9.11\times10^{-3}\ \text{kg}}{7.373\times10^{-51}\ \text{kg}\cdot\text{sec}} = 1.235\times10^{20}\ \text{quintessences/sec.}$$

[0097] Thus taking into account the mass-energy content of quintessence (m_q) it is independently possible to derive the magnitude of the charge of an electron (e) using the following equation.

$$e = \sqrt{\frac{m_q\varepsilon_0}{\left(\frac{4}{3}\right)\pi hc}} = 1.61\times10^{-19}C$$

[0098] This is in close agreement with the experimentally observed charge on the electron of 1.602×10^{-19} C.

[0099] Interestingly substituting $m_q = h/3c^2$ in the above equation we have:

$$e = \sqrt{\frac{\varepsilon_0}{3\left(\frac{4}{3}\pi c^3\right)}} \tag{6}$$

[0100] This can also be written as

$$e = \sqrt{\frac{\varepsilon_0}{3\left(\frac{4}{3}\right)\pi c^3}} \tag{6a}$$

[0101] Equation (6) has a number of very special implications, if re-examined, firstly three of these quasi electron spheres appear to be required to constitute the charge of the electron. More intriguingly, it indicates that the charge is related to the volume of a sphere with an apparent radius of c. Thirdly it indicates that the square of the charge of an electron (e) is proportional to the permittivity of free space (so). The charge given from equation (3) is in close agreement with the measured charge of the electron. Furthermore a more exact value for the charge of the electron (to seven decimal places) can be deduced by taking into account the gravitational field of the Earth (see Gravity and the Charge of the Electron). Furthermore the charge of the electron (e) can now be derived from first principles. Thus, equation (3) corroborates the evidence that the electron is indeed composed of three quasi electrons in keeping with recent experimental findings.

[0102] The significance of the electron, composed of three spheres each with a radius of c, is not immediately clear, but can be understood if the frequency of rotation of the electron is taken into account. Thus if the diameter of the electron was approximately 10^{-19} m, then its spin would need to be

$$\frac{1}{c}\times10^{-15}$$

m approx. eq. 10^6 cycles/sec. Thus given a very high rotation rate an electron could have an effective radius of 1/c and still occupy subatomic sizes. Indeed these observations might be used to estimate the rate of rotation of the quasi electron and its size (see Appendix 1).

[0103] With regards a single quintessence, this passing through an energy vector of the space-time lattice would appear as a vibrating string. In a similar way to string theory, the conglomeration of these quintessences would produce the constituents of ordinary matter. The electron, for example, would be constituted from approximately 1.235×10^{20} quintessences.

[0104] The dimensions of the equation for the electron can be readily resolved by considering each of the three vector dimensions. The exact dimensions of the equation need to be considered in the light of the nature of space-time itself. These dimensional equations help explain the nature of matter. Indeed the equation for the electron may be necessary for the full understanding of gravity

[0105] Complex Space and Electron Structure

[0106] The presence of complex space also now further explains the conformation of the electron, and its formulation at the quantum level, and the presence of particles, anti-particles and their spin up and spin down characteristics.

[0107] Indeed the short form equation for the charge of the electron (−e) can now be rewritten as a metric tensor with three dimensions in real space and six in complex space.

[0108] Thus if three of the x, y and z vectors are in real space and six vectors in complex space, where c is the speed of light in the real space vector, $_j$c is the speed of light in the complex vector and $_{-j}$c is the complex conjugate of $_j$c, thus the electron can be mathematically represented by the equation:

$$-e = \varepsilon_{qe}\Big/\left(\frac{4}{3}\pi\right)^{1/2}\cdot\begin{matrix}(c_x)^{1/2}\cdot(jc_y)^{1/2}\cdot(-jc_z)^{1/2}\\ + \quad + \quad +\\ (-jc_x)^{1/2}\cdot(c_y)^{1/2}\cdot(jc_z)^{1/2}\\ + \quad + \quad +\\ (jc_x)^{1/2}\cdot(jc_y)^{1/2}\cdot(c_z)^{1/2}\end{matrix}$$

[0109] Which now elegantly gives the real number solution

$$e = \frac{\varepsilon_{qe}}{3\sqrt{\left(\frac{4}{3}\right)\pi c^3}}$$

[0110] Where $e=\epsilon_{qe}$ is given as the permittivity of free space for a single quasi electron Equation 4 represents a "complex" tensor

[0111] Whilst the two dimensional Argand diagram has four quadrants, the three dimensional Argand diagram has eight cubic sectors. Two of these cubic sectors are diametric opposites and can represent "real" particulate objects. These have the primary coordinates x, y, −z; as in the electron described above, and the −x, −y, z, with the real vector x now having a minus sign. These two "real" cubic sectors, therefore, mathematically represent particles and their anti-particles.

[0112] The mathematical presence of the two primary diagonal mirror images (x, y, −z and −x, −y, z) now allow the introduction of the concept of antiparticles. This extension of the maths into a three dimensional Argand diagram thus results in the automatic formulation of the maths of anti-particles. Thus the charge of the positron (^{+}e) is formulated by the shortened form equation, where the real vectors now each have the minus sign, and therefore exist in the −x, −y, z sector of the three dimensional Argand diagram.

$$e = \varepsilon_{qe} \Big/ \left(\frac{4}{3}\pi\right)^{1/2} \cdot \begin{matrix} -c_x^{1/2} \cdot_{-j} c_y^{1/2} \cdot_{j} c_z^{1/2} \\ {}_{j}c_x^{1/2} \cdot -c^{1/2y} \cdot_{-j} c_z^{1/2} \\ -_{j}c_x^{1/2} \cdot {}_{j}c_y^{1/2} \cdot -c_z^{1/2} \end{matrix}$$

[0113] The three dimensional Argand diagram also accounts for chirality and indeed the up and down spin of the electron. There are two other "real" primary coordinates in the Argand diagram, these are themselves the partial mirror images of the above coordinates (i.e. x, −y, z and −x, y, −z). In particular the y axis is of the opposite sign, thus in particles the y axis is in the downward direction, to form down spin particles and in anti-particles in the up direction, to form the antiparticle The up spin electron is given by eq. 8 and hence the down spin electron (−e|↓≦) is given by the equation

$$-el\downarrow\rangle = \varepsilon_{qe} \Big/ \left(\frac{4}{3}\pi\right)^{1/2} \cdot \begin{matrix} c_x^{1/2} \cdot_{-j} c_y^{1/2} \cdot_{j} c_z^{1/2} \\ {}_{j}c_x^{1/2} \cdot c^{1/2y} \cdot_{-j} c_z^{1/2} \\ -_{j}c_x^{1/2} \cdot {}_{j}c_y^{1/2} \cdot -c_z^{1/2} \end{matrix} \quad (9)$$

[0114] Thus the three dimensional Argand diagram accounts directly for the presence of antiparticles and the spin up and spin down particles seen in nature. It also accounts for the necessity of the electron to form a square root spherical object, as complex space depends on √−1, otherwise known as j.

[0115] Electron Pairing and Superconductivity

[0116] As the quintessences making up the electron are in a square root conformation, each of these quasi electrons would have a tendancy to pair to form an entire sphere.

[0117] The square root sphere structure of electrons with up and down spins can now superimpose to produce a complete sphere of varying extents. This produces electron pairing as seen at the atomic and molecular levels. It also accounts for the Pauli exclusion principle. This pairing thus accounts for the reactivity of the valence electrons and the electron probability densities, which in turn accounts for the existence of chemistry.

[0118] Furthermore, it is possible to account directly for superconductivity from first principles. For if both the complex and real vectors of the electron combine completely, the product of an up and down spin electron form a perfect superimposed sphere with radius c, with a charge of 2.59×10^{-38} C, denoted by the formula:

$$e^2 = \frac{\varepsilon o}{3\left(\frac{4}{3}\pi c^3\right)} = 2.59\times10^{-38}C \quad (6b)$$

[0119] As with standard superconducting theory, superconductivity can be explained by the formation of "Cooper" electron pairs, where the electrons are forced to pair by the presence of positive crystal charge in particular formation, at supercooled temperatures. In addition the electron pair now forms a stable entity whose angular momentum cancels.

[0120] It additionally becomes clear that the charge of two separate electrons (2e) is 3.2×10^{-19} C, but the charge of the combined electrons (e^2) is 2.59×10^{-38} C. This electron pair thus appears to have 19 orders of magnitude less charge than the electron and in turn 19 orders of magnitude less resistance. It is this effective reduction in charge and in turn resistance, which may account for superconductivity. When observed directly any electrical interaction with the Cooper electron pair will, however, result in the release of the full charge of both electrons, so that the full electrical charge put in will be equal to that coming out of the apparatus.

[0121] The Fine Structure Constant

[0122] Intruiginty from our knowledge of the electron we can further define the term .alpha., the fine structure constant; from the structure of the electron. Thus as the standard term

$$\alpha = \frac{e^2}{hc\times47\pi\varepsilon_0};$$

substituting the term

$$e^2 = \frac{\varepsilon_0}{3(4/3)\pi c^3} \quad \text{(eq. 6)}$$

and

$$h = m_q c^2 \quad \text{(eq. 1)}$$

we find:

$$\frac{2\pi}{\alpha} = m_q[3(4/3\pi c^3)]^2$$

*or

$$\frac{2\pi}{\alpha} = \frac{m_q e^4}{\varepsilon_0^2}$$

[0123] For brevity we may represent the quasi electron structure as $(4/3)\pi c^3=\theta$; to signify its threefold symmetry, thus

$$\frac{2\pi}{\alpha} = m_q(3\theta)^2 \tag{10}$$

[0124] Indicating that the fine structure constant of the electron (a) is indeed related to its dimensional structure. Again taking into account the effects of gravity the fine structure constant can be derived from first principles to nine decimal places (see Gravity and the Charge of the Electron).

[0125] Fundamental Forces and Particle Structure

[0126] In order to understand the fundamental forces and the nature of fundamental particles, an overview is required. Thus, there are three major forces; strong, electro-weak and gravity, each mediated by three force particles the gluon, photon and graviton respectively. These in turn, influence three types of particle, the quark, lepton, and by general relativity space-time itself. Each of these are composed of particles with multiples of charge of ⅓, which are themselves in three generations, and are present in three dimensions of real space. It is important that a comprehensive view of nature explains this threefold symmetry.

[0127] Using the Standard Model of particles, it is well accepted there exist quark particle charges of −⅓, −⅔ and +⅓ and +⅔ in quarks and anti-quarks. Given that each particle is made up of three quarks the presence of these fractional charges support the association of the fractional charges in this way to form three dimensional charged particles. In stable particles each of the three quarks would have a vector in one dimension, giving the three quarks together an existence in three dimensional visible space time. The particles that bind the quarks (gluons) are themselves required, in stable particles, to have three different color charges, one color in each dimension, for the particle to exist in three dimensional space-time. Furthermore, there are three generations of quarks (and indeed leptons).

[0128] The Standard Model (or a modification of this) and in particular the observation of quarks and indeed quasi electrons with fractional charge of ⅓ and ⅔ in both cases, indicates that particles are constituted from the equivalent of three of these quasi particles to form an electron and quarks to form baryons. In the normal three dimensions the energy would be carried by the particle, However, because each particle is constituted of three quasi particles and in each quasi particle or quark one visible dimension would be the direction vector, in the other two hidden dimensions of each vector the waves would carry energy. Thus each particle would be associated with vibration, which would account for wave particle duality and Heisenberg's uncertainty principle in three dimensional visible space-time.

[0129] These observations lead us directly to the previous postulate that the structure of the electron is composed of none other than three (root) spheres, and that this equation for the electron allows the determination of the charge of the electron from first principles, thus:

$$e = \frac{\varepsilon 0^2}{[3(4/3\pi c^3)]} \tag{6}$$

[0130] In addition the mass of the proton (m_p) can be directly calculated from the ratio of the mass (m_e) of the electron, given by the equation:

$$\frac{m_e}{m_p} = 5.45\times10^{-4} = 3\frac{\pi}{\sqrt{c}} \tag{11}$$

[0131] Strictly we should write,

$$\frac{m_e}{m_p + m_e} = 3\pi\sqrt{c}\,;$$

which is much more elegant.

[0132] Which now gives

$$\frac{m_e}{m_p} = \frac{1}{\sqrt{c}\,/3\pi - 1} = 5.4462\times10^{-3}$$

[0133] This is in very close agreement with the experimentally derived ratio of the proton to electron masses which is also; 5.4462×10^{-3}

[0134] Thus the correlation factor between theory and experiment has a maximum error <0.00001.

[0135] If we combine equation 3:

$$e = \sqrt{\frac{\varepsilon_0}{3(4/3)\pi c^3}}$$

and equation 13:

$$\frac{m_e}{m_p} = 3\frac{\pi}{\sqrt{c}}$$

the positive charge of the proton (e_p) is given by:

$$e_p = \sqrt{\frac{\varepsilon_0}{3(4/3)\pi c^3}} \times m_e \times 3\frac{\pi/\sqrt{c}}{m_p} = e \tag{12}$$

[0136] The stable nuclear proton conformation can thus be represented by the short form equation:

$$p=3^{+}\sqrt{3(4/3)\pi c^3}\times 3(\pi/\sqrt{c}) \tag{13}$$

[0137] This forms a stable 3×3 conformation as with the stable electron structure.

[0138] Importantly the term ($\pi/\sqrt{c}$) is the 90° solution to the Shrodinger wave equation for an electron confined in a space with radius c!.

[0139] Thus the standard equation for an electron confined in a one dimensional box is given by:

$$E\psi(x) = -\frac{h^2}{2m}\frac{d^2\psi(x)}{dx^2}$$

[0140] If the one dimensional box has a length 2L the quantum amplitude (A) can only be non zero between x=0 and X=2L and the standard solution for the amplitude is none other than:

$$A=(1/L^{1/2})$$

[0141] Thus in one dimension the standard solution to the Shrodinger wave equation is:

$$\psi(x)=(\pi/L^{1/2})\mathrm{Sin}\ x/L$$

[0142] Thus not only is the electron charge derived from the equation for three spheres each with a radius of c (eq. 3); but the proton mass and charge can also be derived from the standard solution to the Shrodinger wave equation for a an electron confined in a space of radius c!.

[0143] The term ($\pi/c^{1/2}$) itself would thus most logically represent the gluon which is present in the proton. These gluons would bind the quasi electrons together to form the fundamental particles

[0144] The masses of all the known particles, including the up and down quarks, the W boson, the muon, charm, strange, the tauon, truth and beauty can thus also be derived from first principles in this fashion, and have the quasi electron as their basic constituent particle (see Appendix 1).

[0145] Thus the structure of the muon (μ) can also be derived from the ratio of the mass of the electron (m_e) and the mass of the muon (m_μ):

$$m_e/m_\mu=4.7\times10^{-3}=c^{1/3}$$

Thus

$$\mu=\epsilon_0{}^{1/2}\times m_e/m_\mu\times 3^{-}(4/3=\pi c^3)^{1/2}\times(\pi/c^{1/3})$$

[0146] Where the charge of the muon is in this equation equivalent to that of the electron e. In this case ($\pi/c^{1/3}$) can be considered to represent a specific high energy photon. Thus the structure of the muon, written in short form is:

$$\mu=3^{-}(4/3\pi c^3)^{1/2}\times(\pi/c^{1/3}). \tag{14}$$

[0147] Moreover the structure of the tauon can be calculated from the ratio of the mass of the electron and that of the Tauon (1.79 Mev);

[0148] Thus

$$0.511\ \text{Mev}/1.79\ \text{Gev}=2.85\times10^{-4}$$

$$m_e/m_\tau=(\pi/c)^{1/3}\times(\pi/c)^{1/9}=2.85\times10^{-4}$$

[0149] As the charge of the tauon is equivalent to the charge of the electron, hence the structure of the Tauon is given by the above equation

$$e_\tau=\epsilon_{qe}\times(m_e/m_\tau)\times 3^{-}(4/3\pi c^3)^{1/2}\times(\pi/c)^{1/3}\times(\pi/c)^{1/9}=e$$

[0150] This equation accurately predicts the charge −1; and mass of the Tauon (.~1.78 Gev). Thus the structure of the Tauon can in short form be given by the equation

$$\tau=-3(4/3\pi c^3)^{1/2}\times(\pi/c)^{1/3}\times(\pi/c)^{1/9} \tag{15}$$

[0151] Furthermore a more exact value for the mass of the muon and tauon can be deduced by taking into account the gravitational field of the Earth in a similar way to identifying the exact charge of the electron. In addition it may be necessary to take into account a possible mass value of the neutrino to arrive at a precisely accurate mass value of the muon and tauon. Nevertheless, the mathematical proof of these short form equations lies in the fact that they can very closely identify the charge and the masses of these particles, from first principles, as in equations.

[0152] Overall the mathematical geometrical structure of all the particles can be derived from the quasi electron, which is in turn derived from quintessence. Thus, the short form particle structures can now be derived from first principles. This includes the quasi electron (qe) and electron (e), from which the quarks (u,d) and in turn the stable proton (p) and stable neutron (n) and alpha particle (a) respectively are derived. The general structure of the force carrying bosons the photon. (g) and the gluon (γ) and the intermediate vector boson (W) can be given. It will also intriguingly be possible to derive, according to their generation, the structure of the strange (s) charm (c), beauty (b, or bottom) and truth (t or top) quarks directly from the structure of the muon (μ) and Tauon (τ) respectively.

[0153] Using the term $\Theta=(4/3\pi c^3)$, where, −/+ represents the charge of the quasi electron, we find:

[0154] 1st Generation:

$$(q_e)={}^{-}\Theta^{1/2} \tag{6c}$$

$$e=3^{-1/2} \tag{6}$$

$$d={}^{-}\Theta^{1/2}\cdot 3(\pi/c^{1/2}) \tag{16}$$

$$u=2^{+}\Theta^{1/2}\cdot 3(\pi/c^{1/2}) \tag{17}$$

$$s={}^{-}\Theta^{1/2}\cdot 3(\pi/c^{1/2}) \tag{18}$$

[0155] 2nd Generation

$$\mu=3^{-}\Theta^{1/2}\cdot(\pi/c^{1/3}) \tag{14}$$

$$c=2^{+}\Theta^{1/2}\cdot(\pi/c^{1/3})\cdot(\pi/c^{1/4}) \tag{19}$$

$$b={}^{-}\Theta^{1/2}\cdot(\pi/c^{1/9})\cdot(\pi/c)^{1/4} \tag{20}$$

[0156] 3rd Generation

$$\tau=3^{-}\Theta^{1/2}\cdot(\pi/c)^{1/3}\cdot(\pi/c)^{1/9} \tag{15}$$

$$t=2^{+}\Theta^{1/2}\cdot(\pi/c)^{1/3}\cdot(\pi/c)^{1/9}\cdot(\pi/c)^{1/4} \tag{21}$$

[0157] Particle Gluons (g):

$$g_1=(\pi/c^{1/2}) \tag{22}$$

$$g_2=(\pi/c)^{1/2} \tag{22a}$$

$$g_3=(\pi/c^{1/4}) \quad (22b)$$

$$g_4=(\pi/c)^{1/4} \quad (22c)$$

[0158] Particle Photons (.gamma.):

$$\gamma_1=(\pi/c^{1/3}) \quad (23)$$

$$\gamma_2=(\pi/c)^{1/3} \quad (23a)$$

$$\gamma_3=(\pi/c^{1/9}) \quad (23b)$$

$$\gamma_4=(\pi/c)^{1/9} \quad (23c)$$

[0159] Intermediate Vector Boson ($W^{+/-}$):

$$W^{+}=3^{+}\Theta^{1/2}\cdot 2(\pi/c^{1/6})^6 \quad (24)$$

$$W^{-}=3^{-}\Theta^{1/2}\cdot 2(\pi/c^{1/6})^6 \quad (25)$$

[0160] Stable* Proton:

$$p=3^{+}\Theta^{1/2}\cdot 3(\pi/c^{1/2}) \quad (13)$$

[0161] Stable* Neutron:

Stable * Neutron:

$$n = \begin{matrix} {}^{+}\Theta\downarrow^{1/2}\cdot 2(3\pi/c^{1/2})\cdot{}^{-}\Theta\uparrow^{1/2} \\ {}^{+}\Theta\downarrow^{1/2}\cdot 2(3\pi/c^{1/2})\cdot{}^{-}\Theta\uparrow^{1/2} \\ {}^{+}\Theta\downarrow^{1/2}\cdot 2(3\pi/c^{1/2})\cdot{}^{-}\Theta\uparrow^{1/2} \end{matrix}$$

* Stable nucleonic neutron and proton conformations differ slightly from the Standard Model, this is due to the sharing of quasi electron and quasi positron particles within the nucleus, which allows stabalisation of these particles by the formation of stable 3×3 structures. The Standard conformations which describe non-nucleonic neutrons and protons are additionally given in Appendix 1.

[0162] Alpha particle (α):

$$\text{Alpha particle } (\alpha) := \alpha = \begin{matrix} [3^{+}\Theta]\downarrow^{1/2}\cdot 2(3\pi/c^{1/2})\cdot[3^{-}\Theta]\uparrow^{1/2} \\ [3^{+}\Theta]\uparrow^{1/2}\cdot 2(3\pi/c^{1/2})\cdot[3^{-}\Theta]\downarrow^{1/2} \\ [3^{+}\Theta]\downarrow^{1/2}\cdot 2(3\pi/c^{1/2})\cdot[3^{-}\Theta]\uparrow^{1/2} \end{matrix} \quad (27)$$

[0163] The mathematical proof for these structures and their decay mechanisms is lengthy and is thus fully contained in Appendix 1. All the particle structures are accurately mathematically defined by the masses of these particles.

[0164] The structure of these particles all contain the quasi electron and thus the metric tensor structure necessary in the formulation of the gravitational equations is sustained. The respective forces created by the gluon and the photon are important as they tell us the behaviour of matter and also lead to the likely structure of the graviton

[0165] Particle Spin and Size

[0166] The significance of the electron, composed of three spheres each with a radius of 1/c, is not immediately clear, but can be understood if the frequency of rotation of the electron is also taken into account. Knowing the structure of the electron has led us to deduce its charge and thus may lead us estimate its size and spin. Thus these observations might be used to calculate the radius and rate of rotation of the electron.

[0167] Let us suppose, that nature is truly beautiful, and that the radius of the fundamental quasi electron is indeed 1/c, and in turn the radius was balanced by the velocity of rotation 2π/c. This can be directly confirmed mathematically by taking into account the known spin of the electron, h/4π. Thus the actual spin of the electron may be calculated form the known energy of the spin.

[0168] The radius of the electron is not up till now known, but the radius of a quark has been estimated, and this is the radius derived from deep inelastic collisions of the proton. These estimates reveal a radius of approx. $r_p=1.18\times10^{-15}$ m This value may be used to assist in confirming the spin of the proton in revolutions per sec. (revs) and in turn the spin and size of the electron. Firstly we may proceed to estimate the spin of the proton. Thus as h=E·t (Joules×sec) and h=E·t=F·d·t (Joules×sec), then the spin;

$$h/4\pi=F\cdot d\cdot t \quad (28)$$

[0169] As F=ma, where $\alpha=(revs\cdot 2\pi)^2 r_p$ and m=the mass of the proton, then

$$h/4\pi=m(revs\cdot 2\pi)^2 r_p\cdot d\cdot t$$

[0170] The actual distance (d) traveled in a circle of half integer spin in 1 second is: $revs\cdot\pi r_p$ thus:

$$h/4=m(revs\cdot 2\pi)^3 r_p^2/2$$

[0171] Hence:

$$revs=[h/m(2\pi)^4 r_p^2]^{1/3}$$

[0172] Taking the effective mass the proton as 1.6726×10^{-27} kg, then the rate of spin of the proton in revolutions/sec is:

$$revs=5.65\times10^6 \text{ cycles/sec}$$

[0173] From the frequency of the specific rotation of the proton, given the half integer spin associated with the proton, we can thus mathematically confirm the relationship between the radius of a particle and its spin:

$$r_p\times revs/2=1/c \quad (29)$$

[0174] Furthermore, the fundamental radius of 1/c seen in geometric structure the quasi electron, is also reflected in the rotation rate and radius for the proton, thus as above 1/c÷½ revs=1.85×10^{-15} m. Moreover, this means the actual half integer velocity of rotation is none other than 2π/c in metres/sec. So that the particle is in harmonic balance.

[0175] Using the fundamental formula h/4π=F·d·t, it is possible to obtain accurate estimates of the radius and spin rates of the electron, or indeed any particle, using the same principle of harmonic balance. Using the formula:

$$revs=[h/m(2\pi)^4 r_e^2]^{1/3}$$

[0176] It appears there are two unknowns, the radius if the electron and its revolution rate, however, in accordance with the equation, r_p=2/c.revs, which gives the revolution rate of the proton, the same principle may also be used for the electron, by substituting r_e=2/c.revs, such that:

$$revs=hc^2/4m_e(2\pi)^4 \quad (30)$$

[0177] Taking the mass of the electron 9.109382×10^{-31} kg, the rate of revolution of the electron is:

$$revs=1.048\times10^{10} \text{ cycles/sec}$$

[0178] Which gives a predicted radius of the electron as

$$r_e=6.336\times10^{-19} \text{ cycles/sec}$$

[0179] So the half integer rotation velocity (revs.πr) is 2π/c !, for the electron in keeping with the harmonic balance of the electron.

[0180] The same principle may be used to obtain an accurate estimate of the spin and radius of the muon, or any other particle. Using the above formula

$$revs=hc^2/4m_e(2\pi)^4 \quad (31)$$

[0181] Then as the mass of the muon is 1.8823×10^{-28} kg then the revs of the muon $f_\mu=5.070\times10^{-7}$ cycles/sec and the radius r_μ is thus 1.316×10^{-16} m.

[0182] It is now possible to begin to explain how the muon and the other subatomic particles are formed. If a quasi electron is complexed with another structure the total geometric structure needs to maintain harmonic balance. So the frequency of rotation would need to match geometric structure with which the quasi electron was complexed

[0183] Intriguingly we find asymptotic convergence for the formulas for frequency and mass occurs, when the geometric structure complexed with the quasi electron has the structure represented by $(\pi/c^{1/3})$ [giving the frequency divided by two, because the single integer spin of the force carrying particles compares to a half integer spin for the muon]. So that

$$(f_r 3\pi/2)^{1/3}=f_\mu$$

[0184] When the ratio of the masses of the electron (m_e) and muon (m_μ) are related, such that:

$$m_e(3\pi/c^{1/3})=m_\mu$$

[0185] Indeed we find that (allowing for the neutrino) this ratio is very close to the actual ratio of the mass of the electron to the mass of the muon, determined experimentally.

[0186] Furthermore, we have seen that these geometric structures, representing harmonics of the speed of light, which either match the frequency or the amplitude of vibration of the quasi electron, mathematically define the masses of the particles and the fundamental forces of Nature.

Part III—Quantum Gravity

[0187] Quantum General Relativity

[0188] Given the overall energy "complex" energy tensor structure of the electron and the metric tensor, assumed in general relativity, the quantum nature of gravity itself can now be explored. The spherical complex tensor for the electron and the positron give the mathematical quantum structure and energy tensor for all the other particles. Together with the time dimension these nine space dimensions account for the 10 parameters present in the metric tensor necessary to formulate the equations for gravity using Riemann geometry and thus forms the basis of quantum gravity. Intriguingly the metric tensor at each point in space time is required to consist of a collection of ten numbers, Consequently, ten dimensional space-time hypotheses, such as this or superstring theory, do automatically yield general relativity.

[0189] Furthermore, the mathematical representation of the graviton and the gravitational constant may be directly estimated from the knowledge of the mass and radius of quintessence. Thence, the force of the vibrations of quintessence lead directly to quantum gravity.

[0190] The radius of quintessence should be approximately in keeping with the Planck length estimate (r), which is conventionally derived from the standard dimensional equation:

$$r_q^2 \cong Gh/c^3 \quad (32)$$

[0191] Given the nine spacial parameters present in the metric tensor, used in general relativity we find that the actual formula for r_q^2 is mathematically in agreement with theory when:

$$9r_q^2=Gh/c^3 \quad (33)$$

[0192] This again supports the 9 dimensional view of space and the size of the vibrations of quintessence can thus be estimated.

$$r_q=1.35\times10^{-35} \text{ m} \quad (33a)$$

[0193] This value is in agreement with the Planck length. Indeed if the above equation is correct then we find that we can derive the standard equation for the general relativistic increase in radius, r', (eq. 34) directly from first principles and arrive at a more fundamental equation for quantum gravity. As

$$r'=G\cdot M/3c^3 \quad (34)$$

[0194] By substituting eq. 33) into equation 34, a fundamental relationship between r' and M is obtained.

$$r'/3r_q^2=GMc^3/Ghc^3=Mc/h$$

[0195] And substituting the quintessential equation, $h=m^q c^2$ (eq. 1) then:

$$r'/3r_q^2=M/m_q c=n_q/c \quad (35)$$

[0196] Hence the ratio of the change in radius to that of the radius of quintessence squared, is proportional, by a factor of c, to the ratio of the mass M of an object to that of the mass of quintessence, effectively the number of quintessences. Thus the change in radius, r' due to gravitation, is related to none other than the ratio of the mass and radius of an object to the mass and the square of the radius of quintessence. Thus again the gravitational change in radius is directly related to the number of quintessences.

[0197] Naturally, this would be exactly what would be logically expected if quintessence, like the equation for the charge of the electron (eq. 6) forms from a root sphere. Thus the change in spacial radius of a normal sphere is dependant on the square of the quintessential radius.

[0198] This increase in apparent radius represents none other than the (gravitational) binding energy for quintessence.

[0199] The meaning of the above dimensional equation (33) might itself be further understood by substituting the mass of quintessence (where $m_q=h/c^2$) into the equation. Thus in nine dimensions the gravitational constant (G) may be more logically given as,

$$9(\pi r_q^2/m_q)=G\pi/c \quad (36)$$

[0200] Where πr_q^2 is the cross sectional area of quintessence and m_q is the effective mass of quintessence, and thus

($\pi r_q^2/m_q$) represents the effective mass per unit area which quintessence exerts. This equation reduces to:

$$9r_q^2/m_q=G/c \quad (37)$$

[0201] From this we may derive the standard general relativistic relationship for the apparent change in radius (r') around a mass (M), from an understanding of the mass m_q and number (n_q) of quintessences. As $m_q=M/n_q$, then:

$$3r_q^2=G\cdot M/3c\cdot n_q \quad (38)$$

[0202] Then if

$$n_q=r'c/3r_q^2 \quad (39)$$

[0203] thus directly substituting for n_q in eq. 38:

$$r'=G\cdot M/3c^2 \quad (34)$$

[0204] The importance of this is that the gravitational change in radius now logically derives from equation 36, which describes the gravitational force as resulting directly from the mass of quintessence exerted/per unit area of quintessence.

$$9(\pi r_q^2/m_q)=G\cdot\pi/c \quad (36)$$

[0205] Thus equation 34 is the conventional equation for the general relativistic increase in radius (r') in a gravitational field, which is here derived from the underlying nature of quintessence. Thus the gravitational constant is derived from the mass and radius of vibration squared of quintessence from first principles.

[0206] Indeed it is apparent that a more fundamental equation for gravitation now exists, for equation (39) is mathematically accurate and numerically agrees with eq. 34:

$$r'/3r_q^2=n_q/c \quad (39)$$

[0207] These equations may be readily mathematically verified. If in accordance with standard general relativity, the apparent increase in radius r' is:

$$r'=GM/3c^2 \quad (34)$$

[0208] Then given that the mass of the Earth is 5.9745×10^{24} kg;

$$r'=1.478\times10^{-3}\text{ m}$$

[0209] Accordingly if $r'=3r_q^2\cdot n_q/c$; (eq. 39). Given the number of quintessences n_q constituting the Earth is M_E/m_q, then

$$n_q=5.9745\times10^{24}/7.3725\times10^{-5}=8.104\times10^{74}$$

[0210] As $r_q^2=1.823\times10^{-70}$ (eq. 33a) then:

$$r'=1.478\times10^{-3}\text{ m}$$

[0211] Thus equation 39 gives the same answer as the standard equation and may be understood on a logical basis. Indeed the meaning of c in the equation may be understood as it has been previously shown as being the basis for the radius of matter (eq. 6). Hence the general relativistic change in radius, r', is none other than the effective binding energy for quintessence.

[0212] Quantum Gravity and Wave Particle Duality

[0213] Quantum gravity can now be readily linked with quantum mechanics, indeed any observations which are self consistent must be able to do so easily.

[0214] The frequency of light has been previously derived

$$f=E/h=n_q$$

[0215] Thus the formula for the frequency of light (E=hf) has previously been explained theoretically by the simple observation that the frequency is determined quite directly from the number of quintessences (n_q) within the photon. The same principle has also been shown to apply to matter.

[0216] Let us now follow these equations for matter by calculating the wavelength of a photon from the Gravitational constant as an example; and also as a test of these observations and to demonstrate that the gravitational equations can also apply to the quantum world.

[0217] If

$$n_q=r'c/3r_q^2 \quad (39a)$$

[0218] where r' is the general relativistic increase in radius, and r_q is the radius of quintessence (eq. 33). Where $f=E/h=n_q$, substituting for n_q, then the frequency of the photon f_γ(where $\beta=1$) is given by:

$$f_\gamma=r'c/3r_q^2$$

[0219] Using the standard equation, $r'=GM/3c^2$ (eq. 34); we may substitute for r', thus we have:

$$f_\gamma = GM/9r_q^2c \text{ 15 Thus}$$

$$f_\gamma = \frac{G}{9r_q^2c^3}\cdot m_\gamma c^2 \text{ and as } E = m_\gamma c^2;$$

$$f_\gamma = \frac{GE}{9r_q^2c^3} \quad (40)$$

$$\text{Indeed as } 9r_q^2 = Gh/c^3, \text{ then } f_\gamma = E/h = n_q$$

[0220] It is possible to also demonstrate that the same relationship holds for the wave equation for matter. If we take the relativistic wave energy of matter, which has been previously derived,

$$f=\beta^2 n_q$$

[0221] This includes the term for the number of quintessences flowing through the electron, in the complex vectors of space-time, to give the relativistic electron momentum (p) and a term for the rest mass, thus substituting into (40)

$$f_\gamma = \frac{GE}{9r_q^2c^3} \quad (40)$$

[0222] As $f=\beta^2 n_q$ for matter then the equation expands to:

$$f_m = \frac{G}{9r_q^2c^3}\cdot\beta^2 E \text{ As } \lambda = v/f, \text{ then}$$

$$\lambda = \frac{9r_q^2c^3v}{G\beta^2E} \quad (41)$$

[0223] Then the equation again reduces to:

$$G = \frac{9r_q^2c^4}{\lambda\beta E} \tag{3}$$

[0224] Equations 3, 40 and 41 are important as they show that the quantum wavelength of any particle of rest mass m can be derived from the gravitational constant G. Thus linking quantum mechanics to quantum gravity.

[0225] It is therefore important to confirm the numerical accuracy of the above equation (40). We can do this by comparing the result to the standard computation of the de Broglie equation, in a range where de Broglie itself is likely to be most accurate; which according to these observations is in the low energy range (see section on Wave Particle Duality).

[0226] If we take an electron with an energy of 0.1 KeV the wavelength is conventionally given (where the kinetic energy of the electron E_k is given by the product of the charge of the electron (C) and the potential applied eV=0.1 Kev), by the standard equation:

$$\lambda = h/p = h/(E_k \cdot 2m_0)^{1/2} \text{ thus}$$

$$\lambda = 6.63\times10^{-34}/[1.602\times10^{-19}\times1\times10^{2}\times18.22\times10^{-31}]^{1/2}$$

hence

$$\lambda \cong 1.23\times10^{-10}m \text{ Using}$$

$$\lambda = \frac{9r_q^2c^4}{G\beta E} \text{ Where } E = \gamma m_0c^2 \tag{3a}$$

[0227] At 0.1 Kev, electron velocity is 6×10^6 r/sec, thus $\beta=2\times10^{-2}$ and $\gamma=1/(1-v^2/c^2)^{1/2}=1.0002$. Thus:

$$\gamma = \frac{9\times1.82\times10^{-70}\times80.78\times10^{32}}{6.76\times10^{-11}\times\beta\times1.0002\times9.11\times10^{-31}\times8.998\times10^{16}}$$

$$\lambda = 1.21\times10^{-10}m$$

[0228] Divergence between the de Broglie equation and the above equation (2) occurs at intermediate and high energies where it is generally accepted that the standard de Broglie equation may be less accurate. The values for eq. 2 and de Broglie are compared to recent experiments, which demonstrate a relativistic curvilinear plot for wavelengths of matter in keeping with eq. 40.

[0229] The de Broglie equation in the non-relativistic format yields a simple log/linear scale, which is not in keeping with relativity; whereas eq. 3 is dependent on relativity and mathematically accounts for both relativity in calculating the wavelength. Indeed recent experiment on quantum tunnelling through a wire mesh strongly suggests that the relationship between energy and wavelength is relativistically curvilinear[ref 1]. Furthermore equation 3a suggests a fundamental relationship between energy (E), relative velocity (v/c=.β), gravity (G) and the quantum wavelength (λ)

$$\lambda = \frac{9r_q^2c^4}{G\beta E} \text{ Indeed as } {}^9r_q^2 = Gh/c^3\text{, then} \tag{3a}$$

$$\lambda = hc/\beta E \tag{2}$$

[0230] Equation 2 is the very same as the Universal wave equation derived form first principles for the wavelength of tight and matter, which allowed a relativistic solution to the equations for wave particle duality (see Wave Particle Duality). This now indicates that these quintessential equations are compatible with relativity, quantum mechanics and quantum gravity.

[0231] Graviton Structure

[0232] From these observations, if the value for the gravitational constant is substituted into the equation (35) we may now estimate the probable geometric structure of the gravitation, which is the force particle mediating gravity by acting on quintessence. Thus the Gravitational constant has been previously derived from the vibration of quintessence by the equation:

$$G\cdot(\pi/c)=9(\pi r_q^2/m_q) \tag{36}$$

[0233] This is in accurate agreement with the value for $G(6.67\times10^{-11}\ N\ m^2\ kg^{-2})$. This suggests that the most probable mathematical representation of the graviton (ϕ), the third force carrying particle is

$$\phi=(\pi/c) \tag{42}$$

[0234] Thus the gravitational constant (G) can be given by the mass and radius of quintessence and the structure of the graviton

$$G=9\pi r_q^2/\phi m_q \tag{43}$$

[0235] This shows the gravitational force to be related to the fundamental radius of quintessence space time, and the graviton.

[0236] Quantised General Relativity

[0237] The classical general relativistic formula, as given by Einstein is:

$$R_{\mu\nu}-1/2g_{\mu\nu}R=-\kappa T_{\mu\nu}$$

[0238] Where R is effectively the curvature of space-time, $R_{\mu\nu}$ denotes the contracted Riemann tensor of curvature and $T_{\mu\nu}$ is the "energy tensor" of matter.)

[0239] If we substitute the energy tensor matrix of the electron (eq. 9)×time, for the energy tensor of matter $T_{\mu\nu}$; and the metric tensor of the space-time latticeXtime for the contracted Riemann tensor we can arrive at the same solutions for general relativity.

[0240] Furthermore, in his published paper on General Relativity, Einstein. defined the constant κ as:

$$\kappa=8\pi G/c^2$$

[0241] Therefore Einstein's equation should be written as

$$R_{\mu\nu} - 1/2g_{\mu\nu}R = \frac{8\pi G}{c^2}\cdot T_{\mu\nu} \tag{43}$$

[0242] Einstein himself was apparently not happy about the right hand component of the equation. However, we find that this part of the equation can now be explained and quantised by substituting the gravitational constant, $G=9\pi r_q^2/\phi m_q$, (eq. 42a),

[0243] Giving:

$$R_{\mu\nu}-1/2g_{\mu\nu}R=-\frac{8\pi^2 9r_q^2}{\varphi m_q c^2}\cdot T_{\mu\nu} \tag{44}$$

[0244] By substituting $m_q \cdot c^2=h$, and further substituting $h=h/2\pi$, we arrive at a quantised solution to Einstein's equations. Where A_q is the surface area of quintessence ($A_q=4\pi r_q^2$); ϕ is the graviton [$\phi=(\pi/c)$] and h is Plancks constant. thus:

$$R_{\mu\nu}-1/2g_{\mu\nu}R=-\frac{9A_q}{\varphi\hbar}\cdot T_{\mu\nu} \tag{45}$$

[0245] The gravitational equation can now be further understood on a logical basis. The term $A_q=(4\pi r_q^2)$, where represents standard term for the surface area of a sphere of quintessence for the 9 space dimensions of the space time lattice, h is the energy content of quintessence×time and ϕ is the graviton, thus the right hand term now represents a true "metric energy tensor" of matter.

[0246] This leads directly to the standard solution to the field equations, for the general relativistic increase in radius r' of an object, where A is the surface area of a sphere of a given mass M, such that

$$r=\sqrt{(A/4\pi)}-r=GM/3c^2 \tag{34}$$

[0247] Furthermore, although equation 45, gives the same solutions as Einstein's equation, which is essentially correct, the difference is that the equation is now dependant upon Planck's constant (h), and moreover the radius of quintessence, which now defines a quantised solution to the equations.

[0248] Graviton Force Characteristics

[0249] Similar to the photon, the previously derived equation (42) for the graviton [$\phi=(\pi/c)$] appears to also mathematically represent a helical ringlet of quintessence, but with a spin of 2. For the photon, taking the direction of motion as the x vector and its axis of spin also as the x vector, would account for the electromagnetic force and its attraction and repulsion characteristics. In the case of the gluon component ($\pi/c^{1/2}$), if the direction vector is x, then the axis of spin would be in the y vector, the same as quasi electrons, accounting for the particle binding characteristics of the gluon force. In the case of the graviton, if the direction of motion was in the x vector, the graviton spin axis would be in the z vector thus, as will be demonstrated, accounting for the gravitational force.

[0250] The spin axis of the graviton can also be derived using the known characteristics of the electron. If an electron is travelling in the x direction, then its spin axis is determined by the by the sign of the $_j$y vector (up or down). This view is in agreement with conventional theory, which indicates that the electron spin is similar to a rotating planet orbiting the sun, (the electron even appears to have orbital precession). As the electron passes through the space-time lattice, this spin would generate the formation of gravitons. This would occur as a result of the ejection of the excess quintessence passing through the electron. As the electron spins, the ejection of these gravitons would occur at a tangent to the electron's direction of motion. The ejection of the gravitons would occur, similarly to the ejection of energy of a pulsar or quasar, through the equivalent of the north and south poles of the electron. Thus, propelling the graviton in the direction of the electrons y vector. The ejection of the graviton would re-orientate and impart a specific angular momentum to the gravitons which would thus end up spinning on its own z axis. If for instance the graviton is released from an up spin electron the graviton will be rotating clockwise and its leading edge will displace quintessence downwards. In turn this will provide an upwards force.

[0251] This picture accounts for Fleming's left hand rule, is logical and provides an explanation for the magnetic force around a wire. According, to the left hand rule if the direction of the current is in the x vector, the magnetic field is in the z vector, and the force is upwards, in the y vector, in accordance with the above model. Therefore, this particular spin axis and the structure of the graviton results in its force characteristics. As the graviton is very small compared to the electron and both have different rather rapid spin axis it is difficult for these to bind and interact. Nevertheless, because the graviton has a spin of 2, and as it spin axis is perpendicular to its direction of motion, in the z vector, it readily displaces space-time quintessence to produce gravity. Thus because the graviton is able to displace space-time, it is capable of escaping a black hole. How else could the effects of gravity be felt beyond a black hole?

[0252] Quantum Gravity and Electromagnetism

[0253] With the above electron model of graviton production the nature of magnetism can be understood from first principles, Furthermore, the presence of a space-time lattice links relativity, and the forces of gravity with the electromagnetic and other forces of Nature. Indeed, evidence for these links may first date back to the 1820's, when Andre Ampere first defined the Amp. The force of attraction between two parallel wires 1 metre apart each carrying 1 Amp in a vacuum was defined as none other than the permeability of free space (2×10^{-7} N per metre of conductor). Thus conventionally the magnetic field strength around a long straight wire is given as:

$$B=\mu_0 I/2\pi r$$

[0254] Where I is the current and μ_0 is the permeability of free space ($4\pi\times10^{-7}$ N A^{-2})

[0255] The attraction between two wires both carrying negative charge is, however, counterintuitive as negative charges should repel. A conventional explanation overcomes this by invoking the presence of a magnetic field which is created by the current by the production of virtual photons. Thus we appear to have an explanation for the effects of magnetism which involves virtual photons, however, these photons are not observed. More accurately, according to conventional special relativity the magnetic field is none other than the electric field viewed relativistically.

[0256] A more satisfactory explanation, therefore, lies in the interaction between the electrons and the space time lattice. The moving electrons in the two wires interact with the lattice to produce gravitons; which are in phase when both streams of electrons are traveling in the same direction. The gravitonic waves interact constructively to disperse the space time lattice between the wires and induce an attractive force between the two wires, which produces in effect the permeability of free space. Thus this force results from the vibration of quintessence itself.

[0257] Conversely in two wires with current going in opposite directions the graviton waves are in anti-phase and would interact destructively between the wires. The gravitonic waves traveling radially outward from the wires would, however, disperse the lattice outside the two wires and produce apparent repulsion between the wires, which is exactly what is observed. These effects of electricity suggest that gravitons act as waves and that phase is important.

[0258] This effect is also seen with the north and south poles of ferromagnets. Nevertheless, with matter other than iron, cobalt or nickel, the graviton emission cannot be phased as the atoms are unable to align and magnets do not appear to exist with other materials.

[0259] In ordinary magnetic system the release of gravitons from the north pole would be exactly balanced by those released from the south pole of the magnet and hence there would be no net force on the magnet until an external magnet or electrical current were applied.

[0260] Overall the magnitude of the forces in electrical systems where electrical conduction occurs are well defined by the permeability and permittivity of free space μ_0, and ϵ_0. Where v is the constant velocity of the charge and ϵ is the electric field produced by the charge.

$$B=[\mu_0\epsilon_0]v\cdot\epsilon$$

[0261] These observations suggest that the forces of electricity which produce magnetism are indeed related to the permittivity and permeability of free space and that these quantities are exerted by an apparent vacuum. Thus the effects of magnetism could be explained by none other than the phased effects of gravitational waves on the space time lattice.

[0262] Electromagnetism is of further interest to quantum gravity, particularly if we combine the standard equations, $B=\mu_0 I/2\pi r$ and $B=[\mu_0\epsilon_0]v\cdot\epsilon$, substituting for B we have:

$$2\pi r=I/\epsilon_0 v\epsilon \tag{46}$$

[0263] Thus $2\pi r$ is proportional to the inverse of ϵ_0. Thus as space time is dispersed by gravitons the permittivity field will increase in the same way capacitance increases with separation of plates. Because of the inverse relationship between ϵ_0 and $2\pi r$, as ϵ_0 increases the circumference of a circle and the apparent ratio of π is to r, will appear to diminish in accordance with general relativity. This not an actual diminution in the circumference of a circle but the effective reduction of the resistance to motion in a circular path in this field.

[0264] Incidentally, the above observations, also lead us directly to Schrödinger's formula for the average equilibrium distance (r) between an electron with charge (e) in orbit around a proton, which is conventionally given by:

$$r=n^2 4\pi h^2\epsilon_0/me^2$$

[0265] Where ϵ_0 is again the permittivity of free space, m is the mass of the electron and n is an orbital integer, h is Planck's constant and e is the charge of the electron. Furthermore if $e=[\epsilon_0/3(4/3\pi c^3)]^{1/2}$ (eq. 3); then the equation at n=1, for the electron orbital radius elegantly simplifies to:

$$r=4h^2c^3/m$$

[0266] Hence the orbital radius of the electron is related to spin of the electron (h) and its mass (m).

[0267] Quantum Gravity and the Charge of the Electron

[0268] The equation for the charge of the electron (eq. 1) contains the term so (permittivity of free space) which according to these observations should vary in a gravitational field.

$$e=[\epsilon_0/3(4/3\pi c^3)]^{1/2} \tag{6a}$$

[0269] If we combine the standard equations, $B=\mu_0 I/2\pi r$ and $B=[\mu_0\epsilon_0]v\cdot\epsilon$, substituting for B we have:

$$2\pi r=I/\epsilon_0 v\epsilon \tag{46}$$

[0270] Thus $2\pi r$ is proportional to the inverse of ϵ_0. Thus as space time is dispersed by gravitons the permittivity field will increase in the same way capacitance increases with separation of plates. Because of the inverse relationship between ϵ_0 and $2\pi r$, as ϵ_0 increases the circumference of a circle and the apparent ratio of π to r, will appear to diminish in accordance with general relativity.

[0271] Thus ϵ_0 rises when space-time is dispersed by the gravitons that produce the gravitational field, This occurs in a similar way to the process by which capacitance increases with separation of plates in a capacitor.

[0272] Nevertheless, as c is a constant and as $c=[\mu_0\epsilon_0]^{-1/2}$, then if ϵ_0 rises then μ_0 falls. This is entirely consistent as μ_0, which represents the force that quintessence exerts, would be reduced if the quintessence space time lattice is dispersed.

[0273] Furthermore, as $\mu_0=4\pi\times10^{-7}$ N A^{-2}; then as μ_0 falls, then the apparent ration π to r, also falls in a gravitational field. This is largely the same as stating, as does general relativity, that the apparent radius r', rises in a gravitational field. So this view is consistent with general relativity.

[0274] Nevertheless, to derive an exact value for the charge of the electron we must account for gravity in the above equation. We will take the specific example of the Earth's gravitational field in order to obtain the exact value for the electron. If in accordance with standard general relativity, the apparent increase in radius r' is:

$$r'=GM/3c^2 \tag{34}$$

[0275] Then given that the mass of the Earth is 5.9745×10^{24} kg; then

$$r'=1.47864\times10^{-3}\text{ m}$$

thus

$$2\pi r'=9.29057\times10^{-3}$$

[0276] Which is the incremental factor by which ϵ_0 must increase in Earth's gravitational field. So to correct ϵ_0 to account for gravity, ϵ_0 must be divided by the incremental factor, $2\pi r'$. Similarly as effectively π decreases in a gravitational field, to correct π to account for gravity it must be

multiplied by this incremental factor. So the equation for an electron in a zero gravitational field is:

$$e=[\epsilon_0/3(4/3\pi c^3)]^{1/2}\div(1+2\pi r')=1.6022\times10^{-19}\ \mathrm{C} \quad (6b)$$

[0277] This now gives the charge of the electron as measured in a zero gravitational field as 1.6022×10^{-19} C, which is the same as that measured on Earth. Notably these observations appear to suggest that the charge of the electron is the same irrespective of the gravitational field.

[0278] Virtually unlimited degrees of accuracy for the charge of the electron and for the fine structure constant (α), may be achieved by taking into account 2nd and nth order gravitometric effects. Thus if we take into account the effect of gravity upon the radius of the Earth it is also important to take into account an effect upon the instruments with which we measure quantities, this would be a second order gravitometric effect. Thus taking into account 2nd order effects (r"), we have a very small, but nevertheless relevant change, such that: $r''=r'(1+2r')$. Thus $2r''=9.3180486\times10^{-3}$, and thus:

$$e=[\epsilon_0/3(4/3\pi c^3)]^{1/2}\div(1+2\pi r'')=1.6021765\times10^{-19}\ \mathrm{C} \quad (6c)$$

[0279] This agrees exactly to the nearest 7 decimal places with the maximum accuracy of the experimental value for the charge of the electron. Furthermore by taking into account the nth order gravitometric effect, it is theoretically possible to predict accuracy for the charge of the electron to 3n decimal places. This mathematically accuracy confirms the structure of the electron from first principles and indeed the theoretical effects of gravity on the permittivity of free space (ϵ_0).

[0280] This returns us directly to the fine structure constant for the electron which is conventionally given by: $\alpha=e^2/hc\cdot4\pi\epsilon_0$. If $\alpha=e^2=\epsilon_0/3(4/3\pi c^3)$, accordingly the quintessential equation for α is structurally given by: $2\pi/\alpha=m^q[3\Theta]^2$ (where $\Theta=4/3\ \pi c^3$; see The Structure of the Electron and Matter), we must now take into account the effects of gravity, as above, thus:

$$2\pi\alpha/m_q[3\Theta]^2\div(1_2\pi r'')^2=0.007297353$$

[0281] Where the gravitational term for the increase in radius r" allows the mathematical derivation of $\alpha=0.007297353$, and the above equation is in agreement with the conventional experimental value for $\alpha=0.007297353$ to the nearest 9 decimal places.

[0282] Hence the term $(1_2\pi r'')^2$ is in accordance with these observations for the effect of gravity on electromagnetic forces. To a maximum accuracy governed by current knowledge of the mass of the Earth and the Gravitational constant and thus the term for the gravitational increase in radius r'. These observations can also be used to accurately predict the magnetic moment of the electron

[0283] Thus the presence of the fine structure constant can now be further understood, by deriving the constant from first principles; specifically from the actual dimensional conformation for the charge of the electron: $e=[\epsilon^0/3(4/3\pi c^3)]^{1/2}$ (eq. 6).

[0284] Overall the fine structure constant α (allowing for the term r' which is the general relativistic increase in the radius of the Earth due to gravitation) is given by none other than the formula for the mass of quintessence and from the structure of the electron, which can now be derived from first principles to seven decimal places or more.

[0285] Quantum Gravity and the Electron Magnetic Moment

[0286] The theoretical origin and nature of magnetism remains obscure in current electromagnetic theory. An explanation suggests these magnetic effects are produced by photons, although no photons have ever been observed. To get round this difficulty it is postulated by physics that magnetism results from "virtual" photons. However, Maxwell's equation for electromagnetism states that the photon has no net magnetic effect.

$$\delta B_x/\delta B_y/\delta y+\delta B_z/\delta z=0$$

[0287] Thus magnetism could not, by the above standard equation, be derived from a photon real or virtual.

[0288] In addition observational data suggests that black holes have powerful magnetic fields and as in theory photons are unable to escape from black holes (except for small quantities in the form of Hawking radiation), it would be difficult to explain these magnetic fields on the basis of photon emission.

[0289] Einstein postulated that magnetism was merely due to special relativity .sup.(ref 17). The postulate for the nature of magnetism in these current observations, states that the magnetic force results from relativity due to none other than the phased emission of gravitons (why postulate two invisible forces, magnetism and gravity, when one, the graviton, will do). This view as previously discussed (Quantum Gravity and Electromagnetism) is entirely compatible with standard relativity[ref 19]. Thus with the graviton origin of magnetism, the equation for the magnetic moment of the electron should have an expression in terms of quintessence and in turn the gravitational force and in particular the graviton.

[0290] The standard term for the magnetic moment of the Bohr Magneton (SIB) is:

$$\mu B=eh/4\pi m_e$$

[0291] In standard quantum mechanics the Bohr Magneton, μB, however, needs to be corrected to agree with experiment. The "correction factor" is termed "ϵ"; where $\epsilon=(\alpha/2\pi)-0.328\alpha^2/\pi^2=0.001159641$. Thus theory reveals μ_e, the magnetic moment of the electron where:

$$\mu_e=(eh/4\pi m_e)[1+(\alpha/2\pi)-0.328\alpha^2/\pi^2]$$

[0292] The conventional derivation of the term ϵ above, is given from the fine structure constant, $(\alpha/2\pi)$ which is theoretically consistent. However, a rather arbitrary mathematical correction term; $0.328\alpha^2/\pi^2$ needs to be used in this standard equation. This appears ad hoc and needless to say, more accurate measurements show, the electron magnetic moment to the Bohr magneton ratio, $1+\epsilon=1.001159652$, which suggests the correction factor is indeed incorrect. Nevertheless, this correction factor is essential for "renormalisation" and thus for quantum mechanics to work.

[0293] Quantum gravity readily explains the discrepancy between the theoretical Bohr Magneton (μB) and the actual measured magnetic moment of the electron (μ_e). In accordance with the above chapter (Quantum Gravity and the Charge of the Electron)

[0294] Thus the significant mathematical discrepancies can be removed by accounting for the effects of quantum gravity.

[0295] Thus taking the charge of the electron (e), using the equation for the Bohr magneton and the effects of quantum gravity such that gravitational change in radius is r". The magnetic moment of the electron is given by:

$$\mu_e=(eh/4\pi m_e)(1+[\alpha/2\pi\div(1+r'')])$$

[0296] This gives an electron magnetic moment to Bohr magneton ratio of 1.00115968. Thus the mathematical term for the magnetic moment of the electron is given, avoiding the arbitrary and dubious term $0.328\alpha^2/\pi^2$ used in the standard equation, simply by accounting for quantum gravity.

[0297] It is now possible to unite the equations for gravity and magnetism by substituting the fundamental key equations of quantum gravity. Thus if: $h=3m_qc^2$ (eq. 1b) and $m_e=m_qn_q$ (eq. 2). Then we can express the magnetic moment of any particle with the charge of the electron, including the proton, in terms of the number of quintessences (n_q) in that particle.

$$\mu B=ec^2/(4/3\pi n_q); \tag{47}$$

[0298] Given that the postulated structure of the graviton is: ($\phi=\pi/c$) (eq. 42), then substituting we have

$$\mu B=3ec/4\phi n_q \tag{48}$$

[0299] Showing that the equations for the magnetic moment are compatible with the gravitational equations given earlier. Principally, the quintessential equations now allow the determination of the magnetic moment of any charged object from the equation for the graviton and directly from the number of quintessences it contains. In conventional physics the magnetic moment of the electron requires a correction factor, $(1+(\alpha/2\pi c)-0.328\alpha^2/\pi^2)$, to derive the correct experimental value. These observations herein, indicate that the correction factor is more logically (1+r"), where r" is the general relativistic increase in radius around a gravitational body. This suggests that magnetism is not only affected by gravity, but can, as shown as above, be derived using the quantum gravitational equations.

[0300] Quantum Gravity and Special Relativity

[0301] Ordinary matter passing through the lattice would produce gravitons which would interact with space-time as described by general relativity. The quantity of gravitons would be determined by the apparent mass and in turn these would apparently curve space time. The geometry of this "curvature" is elegantly described by general relativity using Riemann geometry, specifically using metric tensors. Intriguingly the metric tensor is not a single number, but at each point in space time it is required to consist of a collection of ten numbers, Consequently, ten dimensional space-time hypotheses, such as this or superstring theory, may automatically yield general relativity

[0302] General relativity is indeed very elegant, nevertheless there was a logical step yet to answer. That is, how do gravitons shape space time? This can now be readily answered by considering the interaction of a three dimensional space time lattice with gravitons themselves to produce the effects of gravity. The effects of gravity are as such to compel a body in motion towards the gravitational object and to a much smaller extent visa versa. This effect can only be produced If gravitons repel quintessence (the constituents of the 3D lattice). Indeed, it has been stated that in order to explain cosmic inflation and the "flatness" of the Universe that quintessence must shun (or be shunned by) matter.

[0303] In descriptive terms a body close to a large mass will have a tendency to move toward it because the three dimensional lattice would be less dense as it approached the surface of the large mass. Overall there would be less resistance to motion in the direction of the large mass, and the motion in this direction would be facilitated by the vibration of quintessence.

[0304] In general relativity the principle governing motion is the geodesic of least distance, this can be re-expressed using similar equations using least action. Furthermore, the concept of motion due to the vibrations of quintessence is more logically and experimentally compelling.

[0305] These observations can now be used to link general and special relativity. Thus as we approach the speed of light, the mass of an object travelling through the space-time lattice would approach infinity, directly because the number of quintessences passing through a body would increase with increasing velocity, hence the equation:

$$m'=m_0/(1-v^2/c^2)^{1/2} \tag{50}$$

or

$$m'=m_0/(1-v^2\,[\mu_0\epsilon_0])^{1/2} \tag{50a}$$

[0306] In turn this would generate increasing gravitons and accordingly this would explain the observed effects of special relativity. Time itself is due to passage through the space-time lattice, and where the space-time lattice is dispersed by gravitons, time and length are reduced with increasing velocity and hence increasing space-time lattice dispersion, similar to the way in which gravity alters space-time

[0307] As a result:

$$t'=t(1-v^2/c^2)^{1/2},\ l'=l(1-v^2/c^2)^{1/2}$$

[0308] Thus resulting in the effects of special relativity.

[0309] Quintessence and Black Holes

[0310] To address the relationship of the space-time lattice to gravity directly, it is important to discuss the concept of quintessence with regard to general relativistic equations. The standard general relativistic equation for the apparent increase in radius (r) due to the curvature of space time around a gravitational object, which has also been previously derived from first principles (eq. 36), is:

$$r'=GM/3c^2 \tag{34}$$

[0311] This can also thus be written as:

$$3r'=GM[\mu_0\epsilon_0] \tag{51}$$

[0312] This standard equation, is in keeping with the above observations. Specifically, as the mass increases, ϵ_0 increases, in turn the radius will appear to increase (relative to π).

[0313] The above observations now allow us to examine the effects with regard to the interior of black holes themselves. The event horizon would represent a critical density for quintessence, in which light could not escape. The Schwarzschild radius would now be given by:

$$R_s=2GM[\mu_0\epsilon_0]$$

[0314] The event horizon will occur at the point at which there is less resistance to circular motion than motion in a

straight or partially curved line. Given that π is proportional to $1/\epsilon_0$. The event horizon should occur when the permittivity has increased by a factor of π.

[0315] Effectively because the permittivity of free space rises, π decreases. This is entirely in keeping with general relativity which predicts the effective change in the ratio of the radius to the circumference as given by the conventional equation, where r', is again the apparent change in radius.

$$r=GM/3c^2$$

[0316] Hence π will effectively decrease as we approach the event horizon of a black hole, When π decreases to 1, the circular circumference is equal to the diameter and moreover, inside this limit it is shorter for light to travel in a circle. Thus light cannot escape the event horizon.

[0317] This can give us great insights into the workings of space-time, for flat Euclidean space the standard equation is:

$$e^{i\pi}=-1$$

[0318] In accordance with general relativity, the ratio of the radius to the circumference changes in a gravitational field, and effectively $\pi=1$, at the event horizon, thus the boundary condition for the shape of space-time at the event horizon now has the direct equation:

$$e^{f}$$

[0319] Within a black hole as the permittivity of space increases by a factor of 2π an object within it will complete two rotations rather than travel in a straight line. In effect exceeding the speed of light by 2π. Hence, the condition for space-time is represented by the equation:

$$e^{i/2}$$

[0320] Thus an increase in the permittivity of free space by a minimum factor of π, to produce a black hole is estimated to result from an increase in mass by a factor of approx. 10^6 (the ratio of the mass of the earth and that of a putative black hole).

[0321] Continuing with the subject of a black hole, according to the model inside the black hole, the gravitons produced by the matter present would be in equilibrium with the density of the space-time lattice. Increasing the rate of rotation of the matter in the black hole for instance would thus increase the production of gravitons and its effective mass and increase the radius of the event horizon. A density gradient of the space-time lattice would continue to exist within the black hole. Progressively closer to the center of a black hole matter itself would be increasingly compressed and the spherical structure of the quasi electron would be predicted to collapse. This collapse would result in the formation of an exotic form of matter in the form of pure quintessence in a black hole.

[0322] This pure quintessence would produce the singularity at the centre of the black hole. The larger the black hole in terms of mass the more pure quintessence would exist at its core.

[0323] Quintessence and the Big Bang

[0324] Quintessence theory not only predicts the occurrence of the Big Bang, but allows a prediction for the value of the entire mass of the Universe, from first principles.

[0325] In accordance with quintessence theory the big bang resulted from the explosion of an immense black hole singularity, which was constituted from pure quintessence.

[0326] On the basis of quintessence, there will be a critical mass for Big Bang event; thus if entire space-time between quintessence is compacted so that no further quintessence can be accommodated, the addition of further quintessence would destabilize the immense black hole, resulting in the Big Bang.

[0327] It is possible to predict this critical mass, using the radius of quintessence as a benchmark. Given the nine spatial parameters present in the metric tensor, used in general relativity we find that the actual formula for the radius of quintessence; r_q^2, is mathematically in agreement with general relativistic theory when:

$$9r_q^2=Gh/C^3 \quad (33)$$

[0328] This again supports the 9 dimensional view of space (so crucial in superstring theory). Moreover, the size of the vibrations of quintessence can thus be calculated as:

$$r_q=1.35\times10^{-35}\ \text{m} \quad (33a)$$

[0329] The volume of each quintessence is thus:

$$4/3\pi r_q^3=1.0306\times10^{-104}\ \text{m}^3 \quad (33b)$$

[0330] So to be accommodated within unit volume of space time, with no intervening apparent space time, (given that each of 9 overlapping quintessences are required) would require approx.

$$9\times10^{104}\ \text{quintessences}$$

[0331] As the mass of quintessence is $m^q=h/c^2=7.373\times10^{-51}$ kg sec (eq. 1). Then the mass of the Universe, to two decimal places, is:

$$1.18\times10^{53}\ \text{kg} \quad (33c)$$

[0332] This is in close agreement with a recent estimate of the mass of the Universe from COBE and other satellite data, which estimates the mass to be 100 trillion trillion trillion trillion tonnes (10^{53} kg)

[0333] Moreover, the early formation of the galaxies can be readily explained, it is likely that in such a big bang some very small black holes might have prevailed and that these formed the seeds of the galaxies we see today.

[0334] The event horizon, calculated from the Schwartzschild radius, of such an immense black hole is about 10^{26} m, which would have allowed Guth's inflationary component to the early expansion of the Universe.

[0335] In addition, inflation may result directly from the observation that once electrons have formed from the primordial soup of quintessence, they emit gravitons which in turn repel space time, which might also result in another cosmic inflationary cycle.

[0336] Most importantly quintessence theory explains the Big Bang from first principles and is capable of accurately predicting the mass of the Universe.

[0337] The Nature of Energy

[0338] These observations allow a fundamental understanding of energy. The quantum physical, minimum component of energy is Planck's constant; h. To define the minimal component of mass, using the standard energy equivalence formula; $E=mc^2$, such a minimal mass (m_q)

would be required to have the value equivalent to; $m_q=h/c^2$ (1). The total mass of a system (m) would then be; $m=m_q n_q$, where (n_q) is the number of these minimal units. Thence, the total energy of a system can be derived from the minimal energy; h, multiplied by the number of these energy units (n_q). Thus as, $E=mc^2$, then also $E=m_q n_q c^2$ and substituting $m_q=h/c^2$, the energy equivalence formula has the more logical formulation;

$$E=hn_q \tag{1a}$$

[0339] Thus the energy of a system is equivalent to the minimal energy unit; h, multiplied by the number of those minimal energy units (n_q)

[0340] This leads directly to a deeper understanding of wave particle duality and the wave nature of matter.

[0341] This is encapsulated by the quintessential energy formulae

[0342] As conventionally $\beta \cdot E/c=p$, then

$$\lambda=h/p=hc/\beta E \tag{2}$$

and

$$E=hn_q \tag{1a}$$

then

$$\lambda=c/\beta n_q \tag{2b}$$

[0343] Importantly, as indicated by equation (2b), energy having no quintessence; would have a wavelength of infinity. Specifically pure energy containing no quintessences, would have a lambda of infinity. According to quantum mechanics an infinite wavelength would result in the probability of that energy being anywhere. As energy itself has no electrical charge it would not be impeded by the permittivity and permeability of the three dimensional space-time lattice. Moreover, energy would not be detectable in three dimensional space-time, unless it interacted with matter, as in the EPR experiments. Indeed, energy is not observed when not bound to any form of mass or particle.

[0344] Thus equation 2b, takes us to our original assertion regarding the existence of pure energy.

[0345] Energy is not Bound by the Space-Time Lattice

[0346] Thus, as the EPR experiments suggest the existence of energy separate from matter and thus separate from the three dimensional space-time lattice, it is interesting to find that experiment suggests the existence of free energy in a continuum separate from space time and matter to produce the effects of quantum teleportation.

[0347] This is not, however, teleportation across an additional dimension, this is a term to describe in partially familiar terms the dissociation of energy from the three dimensional space-time lattice. As time is inextricably linked to each dimension of space, the effects of energy would be inextricably linked to the events, such as the creation of virtual particles, we see interacting within space-time. It is unlikely that observers have any direct day to day experience to explain quantum events. Nevertheless, quintessence theory may have given us a window into the hitherto hidden workings of the Universe. Thereby, the mystery of the uniformity of the Universe, across distances which the speed of light could not apparently traverse, is readily explained by the fact that the free energy contained in the Universe is not bound by the space-time lattice.

[0348] In the case of light, due to the exceedingly small masses involved, there would be relatively easy exchange of matter with free energy within a photon. This would make the photon the ideal experimental tool to look for energy which is not bound by matter and in turn energy which is not bound in space-time. Indeed, very recently Furusawa et al. have reported to have observed the transference of energy as photons from A to B, without those photons traversing space-time. This finding which has been supported using other experimental techniques, is very important as it suggests the existence of such free energy.

[0349] Overall, quintessence theory gives an a priori explanation for the concept of mass, the elementary particles, the forces of nature and quantum effects. It can equally be used logically to explain the inner physics of a black hole, the missing mass in the Galaxy, the expansion of the Universe, Guth's inflationary theory and predicts the Big Bang, from first principles.

[0350] Part IV: Applied Theory with the Intent to Create Closed Timelike Curves

[0351] Electron Bombardment of the Photosphere to Induce Gravitational Shift

[0352] Leveraging the above relationship between mass and quintessence we derive that if an electromagnetic radiation with velocity v strikes the event horizon singularity of rest inertial mass mi, and U is the electromagnetic energy absorbed by the singularity, then, according to Maxwell's prediction, a momentum q=U/v is transferred to it. Mass shift $d \cdot m_b$, dependent on the external electromagnetic energy, equals the inertial mass shift dependent on the increment of energy in the particle. Since in this case the inertial mass shift does not depend on velocity V, i.e., it is related only to the momentum q absorbed, it can be obtained by making p=0 in variation $\Delta H=H'-H=c[q^2+(m_i c)^2]^{1/2}-(m_i c)^2$ from the particles inertial Hamiltonian. Consequently, the expression of d_{m_p}, is written as:

$$d_{m_p}=\Delta H/c^2=m_i\sqrt{1+U/m_i c^2\left[\varepsilon_r u_{r/2}\left\{\sqrt{1+d/w\varepsilon^2+1}\right\}^2=1\right.}$$

[0353] Comparing now the expression of m_i and m_g we have $m_g=m_i-2dm_b$. By replacing m_b in this equation, given by equation above, we obtain the expression of the correlation between gravitational mass and inertial mass, i.e.,

$$m_g=m_t-2\sqrt{1+U/m_t c^2\left[\sqrt{\varepsilon_r u_{r/2}\{[d/we]^2+1\}^2-1}\right.}\cdot m_t$$

[0354] We see that only in the absence of electromagnetic radiation on the event horizon (U=0) is the gravitational mass equivalent to the inertial mass. Note that the electromagnetic characteristics, e, m and s do not refer to the singularity itself, but to the outside medium around the singularity (photosphere) in which the incident radiation is propagating.

[0355] Stable CTC Solution From Modified M-Theory

[0356] Our innovation is a method of creating an event where a dual membrane or dual boundary condition exists. We do this using generalization from a Misner space which has been modified if one analytically continues the maximal extended Misner Metric so that $ds^2=-du^2+dw^2+(dx^2)^2+(dx^3)^2$ to the Euclidean section so that u=iota zeta we obtain a Misner instanton on the section where w and zeta are both real. The Euclidean time, t, and the closed spacelike coordinate are both periodic, the later having a period of $2\Pi t^2$. Going back to the Lorentzian sector we find that the period of the closed coordinate becomes linearly dependent on the physical time. Using automorphic fields in the Hadamard function one can obtain a quantized condition for time. This gives us a figure on the order of the Plank time. This confines such a stable wormhole condition to the general area of the Plank scale in its modified form which is that area defined by the Membrane itself. As such, these Plank scale wormholes are the true source of the true virtual aspects of the vacuum and quintessence. The effects of the dual singularity system can be viewed as an overlap zone of two distinct space-times which have boundary conditions on both sides. As an object accelerates towards C it is this same boundary or horizon that object encounters when the Time defined horizon solution for the universe is imposed. At this point drawing upon Van Den Broeck's alterations for this space-time geometry to create a single closed Friedman-Robertson-Walker spacetime the space-time geometry can be represented by this equation $ds^2=dct^2-B^2[(dx-\beta fdct)^2]+dy^2+dz^2$ B can be any function that is large near the displacement device. We then consider this transformation as extended to four dimensional space-time with arbitrarily time dependent acceleration. We also present the device frame energy density T00 from a four dimensional calculation and note that the 4d classical calculation is everywhere finite.

[0357] Consider an Alcubierre interval given according to a remote frame's cylindrical coordinates by:

$$ds^2=(1-\beta^2f^2)dct^2+2bfdctdz-dz^2-dr^2-r^2df^2$$

where f is a function that is 1 at the location of the device and zero far from it.

[0358] Starting out with the first transformation z'=z−òct beta dct. Where b is first expressed here as a function of time ct. With some algebra for simplification this results in

$$ds^2=[1-\beta^2(1-f)^2]dct^2-2b(1-f)dctdz'-dz^2-dr^2-r^2df^2$$

Let g=1−f and this becomes

$$ds^2=[1-\beta^2g^2]dct^2-2bgdctdz'-dz'^2-dr^2-r^2df^2$$

[0359] Notice that this returned the original intervals form with a reversal on the sign of b and a reversal of the boundary conditions for g. Now we notice that at r=0, this interval becomes the interval for special relativity transformed to cylindrical coordinates. Thus, we have found a transformation to a frame based local to the device. One can also verify that in these coordinates the relevant affine connections vanish at r=0. a further proposed modification to this field we will reintroduce a time dilation term into the devices frame's interval. Only we will use different boundary conditions for it. We will keep A=1 both at the location of the device, and far from it, but allow it to become large in the warped region. This is achieved by the simplest means possible in the proposed field generation method. Since rotating kerr singularity under bombardment would produce an equal negative energy region. With the effect focused outward away from the device slightly by the relative alignment of the kerr singularity the actual inward going portion of such fields would overlap and cancel their effect out in the region of the device. This yields a space normal time region, which is again restored at the fringes of the outward going field. From the standpoint of a geometric picture of space-time around the device and extending outwards one has actually created a dual event horizon situation as far as time goes. The inner one is the shell of the canceled out field inside of which normal time flow is restored. The outer one is formed at the boundary where normal time resumes and within which we have a negative energy field.

SUMMARY OF THE INVENTION

[0360] The present invention is A method for the generation of a pseudo 2+1 dimensional anti-de Sitter space (DeDeo & Gott 2002) using two Kerr type positively charged rotating dilation singularities where one singularity is maintained as a axis of rotation or "reference" singularity, and the other "target" singularity is subjected to a differential electron flow so as to simultaneously pass above the photosphere of said singularity in its direction of rotation—prograde orbit—and contrary to its direction of rotation—retrograde orbit—to release a directed flow of gravitons in a sinusoidal oscillation simulating a rotational effect of the "target" singularity around the axis of rotation provided by the "reference" singularity, resulting in the creation of timelike curves in a compact time-oriented manifold permitting topology change from one spacelike boundary to the other in accordance with Geroch's theorem (Geroch 1967) which results in a method for the formation of G odel-type geodesically complete spacetime envelopes complete with closed timelike curves.

BRIEF DESCRIPTION OF THE DRAWINGS

[0361] **FIG. 1** is a schematic representation of the mechanism employed to house the components necessary to generate a 2+1 dimensional anti-de Sitter space, resulting in the creation of timelike curves in a compact time-oriented manifold

[0362] **FIG. 2** is a schematic representation of the G odel-type geodesically complete spacetime envelope created by the mechanism complete with closed timelike curves

DETAILED DESCRIPTION OF THE INVENTION

[0363] Principles of Gravity Distortion Time Displacement Systems

[0364] The theoretical understanding of quantum gravity allows the design of time displacement systems from first principles. It is unlikely that gravitons or Kerr singularities can be controlled in a precise way using current technology. Nevertheless, an understanding of three dimensional space-time and matter, does allow the design of elementary displacement systems. That is, systems whose displacement rely on direct warping space-time as opposed to the ejection of material to provide thrust resulting in time dilatational effects.

[0365] The background for these systems are already partially understood and quintessence theory allows their

further development. For this invention, the formation of black holes in the laboratory represents a crucial step in understanding the mechanisms that underlay gravitational physics and in turn the warping of space-time. The existence of black holes permits the localized application of the Axial torsion Spin-Rotation Coupling Effect (Zhang & Beesham 2002) resulting in a Rotating Frame with Relativistic Factor (Zhang 2003) which can be used in the creation of a Alcubierre space time bubble under the Van Den Broeck modification of the Alcubierre geometry (Van Den Broeck 1999) resulting in a method for the generation of a pseudo 2+1 dimensional anti-de Sitter space (DeDeo & Gott 2002) using two Kerr type positively charged rotating dilation singularities where one singularity is maintained as a axis of rotation or "reference" singularity, and the other "target" singularity is subjected to a differential electron flow so as to simultaneously pass above the photosphere of said singularity in its direction of rotation and contrary to its direction of rotation to release a directed flow of gravitons in a sinusoidal oscillation simulating a rotational effect of the "target" singularity around the axis of rotation provided by the "reference" singularity. In this instance the space-time lattice would be repelled by gravitons in such a way as to disperse space-time quintessence in a circular fashion around each of the singularities, producing multiple event horizons around the simulated axis of rotation provided by the reference singularity.

[0366] The release of gravitons from the target singularity is controlled by differentially governing the electron flow across the photosphere with the use of powerful electric currents. In turn the differential direction of flow across the photosphere of gravitons would determine the direction of motion through the space time lattice and the resulting time displacement from one spacelike boundary to the other in accordance with Geroch's theorem (Geroch 1967) when implementing this approach it is important to remember that the black hole is not excited by the smashing of the clump as it "hits" the horizon. The hole is rather excited when the metric perturbation associated with the clump is "felt" by the background metric. The excitation event therefore constitutes a smooth process whereby in-fall of a clump from .rmb and through r+ serves as a source in the Teukolsky (1973) equation for small perturbations to the Kerr geometry (with appropriate boundary conditions at r+ and r∞). This is an important distinction with a great deal of relevance to the practical engineering of the displacement unit since we need to gauge the "driving" of QNR modes in terms of an e_ective coupling from clump in-fall.

[0367] What results is a method for resonant driving of the quasi-normal ringing (QNR) wave modes of the Kerr geometry of the target singularity. The micro black hole hyper-accreting at rates ÿ M. 1 M□sec. 1 from a neutrino cooled disk is pushed through to oscillate near resonance of its (l,m=2, 2) quadrupole QNR frequency due to the in-fall of compact mass over-densities from the cusp in e_ective potential on a dynamical time scale. This mode is induced via induced magneto-rotationally induced fluid dynamics in the ultra-relativistic region of the flow bounded from below by the marginally bound orbit radius: rmb If the QNR modes are fed resonantly for a few seconds of hyper-accretion, the enhanced amplitude of the oscillations yields a very high rate of energy deposition into gravitational waves. Indeed, the integrated energy deposition is large enough to "evaporate" the equivalent of a factor of a few times the total rest mass-energy of a single clump into gravitational waves, which in turn interact with the reference singularity

[0368] Application of the method described in the previous section results in translation outside of the cosmological horizon, where F(R)<0. The topology of the resulting geodesic, for large constant R, is mathematically equivalent to a Euclidean cylinder of the condition R×Sn where T is the coordinate along the cylinder. I± are located outside the future/past cosmological horizons, where R is timelike and T is spacelike. In the case of a rotating Kerr black hole, there are two circular photon orbits that can exist in the equatorial plane and be exploited to create a tipler sinusoid. One is a prograde orbit moving in the same direction as the black hole's rotation, while the other is a retrograde orbit moving against the black hole's rotation. Their radii are respectively given by

$$r1=2M(1+\mathrm{Cos}(2/3\ \arccos(-|\alpha|/M)))$$

$$r2=2M(1+\mathrm{Cos}(2/3\ \arccos(|\alpha|/M)))$$

where a is the angular momentum per unit mass of the black hole. The orbits fall in the range M greater or equal to r1 greater or equal to 3M greater or equal to r2 greater or equal to 4M The fact that a prograde photon or in or case cooper pair with Bose characteristics orbits the black hole at a smaller radius than a retrograde one can be attributed to the well-known Lense-Thirring effect, i.e., the dragging of inertial frames due to the black hole's rotation which we control and influence via electromagnetic induced load coupling with the open magnetic field lines threading the BH horizon. This dragging would cause charged cooper pairs to revolve around the black hole relative to a static observer at infinity. Thus, to such an observer, a prograde cooper pair would have to orbit at a smaller radius to compensate for the 'extra' angular momentum acquired, while a retrograde one would have to orbit at a larger radius to compensate for the 'lost' angular momentum. Indeed, in the limit of zero rotation, these two orbits coincide at r D 3M, giving the single circular orbit of the Schwarzschild black hole. Now, recall that orbits around the Schwarzschild black hole are necessarily confined to a plane passing through its center, because of the spherical symmetry of the space-time. However, the Kerr black hole space-time has only an axial symmetry (in addition to being stationary), and this raises the possibility of non-planar orbits. One could, for example, contemplate the existence of spherical Boseon orbits—orbits with constant coordinate radii that are not necessarily confined to the equatorial plane—around the Kerr black hole. Such orbits would be a nontrivial generalization of the two circular photon orbits that lie in the equatorial plane. At first it may seem a little surprising that such spherical orbits could even exist, but there is an interesting reason as to why they are possible. Note that an object in a spherical orbit would, in addition to moving around the black hole in the azimuthal direction, be undergoing some periodic motion in the latitudinal direction. This is only possible if there is a conserved quantity associated with motion in this direction, just as angular momentum is necessarily conserved by its rotational motion in the azimuthal direction. (This result can be seen, for example, using action-angle variable) Now, because the Kerr space-time has only axial symmetry, geodesics in it should have only two constants of motion, namely energy and angular momentum. However, Carter discovered the remarkable fact that geodesics in the Kerr space-time possess a third constant of motion. It turns out that Carter's new

constant governs the motion of geodesics in the latitudinal direction, although it is not related to any obvious space-time symmetry. Thus, spherical timelike orbits, which assume eigenlike properties around the Kerr black hole, are possible and when coupled with charged Bosons may be exploited to manipulate the relative event horizons of the "target" singularity. The location and the temperature of the modified event horizon depend on the time, charge and angle of incidence of the cooper pairs. The Fermionic spectrum of Dirac particles displays a spin-rotation coupling effect due to the interaction between the particles with spin-1=2 and the black holes with rotation. The effects arise from the interaction between the spin of Dirac particles and the rotation of the evaporating black holes. The feature of this spin-rotation coupling effect is its dependence on different helicity states of coupled particles with spin-½ and its irrelevance to the mass of particles.

[0369] In order to design a mechanism for time displacement exploiting the Carter asymettry cited above we utilize two positively charged top spin rotating kerr type black holes aligned on demand to create a simulated rotational effect around a central axis provided by the "reference" singularity. In the case of the Kerr blackhole (singularity), this is accomplished by an inverse Blandford-Znajek (BZ) process utilizing the magnetic flux of open field lines connecting the horizon and an induced remote load. (Ding-Xiong Wang, Kan Xiao & Wei-Hua Lei, 2001) permitting the microscopic blackhole (singularity) to be rotated along its horizontal axis in at relativistic centrifugational speeds. A differential current is then applied in such a way as to pass through the entire photosphere in the desired direction. As a result the gravity field can be manipulated by three factors that affect it in distinct ways. Adding electric charge to the singularities increases the diameter of the inner event horizons. Adding mass to the singularities increases the area of gravitational influence around the singularities. Rotating and positioning the polar axis of the singularities affects and alters the resulting gravity sinusoid

[0370] In order to create a sinusoid capable of inducing a topology change from one spacelike boundary to the other in accordance with Geroch's theorem The electric charge in the upper half of the photosphere would be maximised. The electrons will have a vector in the left to right direction as the singularity spins clockwise. If a maximised current is applied to the singularity in the same direction this will result in a increase in the velocity of the electrons relative to the centre of gravity of the singularity, due to the flow of current. In turn, according special relativity and to the space-time lattice model, this wilt result in an increase in the relativistic mass if the electrons and in turn by general relativity an increase in the release of gravitons.

[0371] Conversely in the lower half of the singularity the electrons will have a vector of motion in the right to left direction due to the spin of the singularity. This will be relativistically slowed by the differential current applied in the same direction as the current above, and hence in the opposite direction to the direction of rotation. The charge can be separately applied and adjusted to ensure that the electrons are relativistically stationary relative to the centre of gravity. In turn this will minimize the relativistic mass and result in a decrease in the release of gravitons for the lower half of the singularity.

[0372] The overall result will be a greater release of gravitons in one direction and a lesser release of gravitons in the converse direction. The effect will be enhanced by the use of a multi-phasic current simultaneously applied. This will result in the release of multi-phasic gravitons which will disperse space time in the singularity with increase in density in the converse this effect can also be produced and supplemented with the use radio frequency pulses, The radio frequency pulses must be designed to produce a change in the spin of the particle to enhance the release of gravitons in the desired direction

[0373] With the use of large currents the drift velocity of the electrons across the photosphere could be greatly increased. Within this region the electrical resistance is virtually eliminated. Thereby allowing large currents to be induced with minimum total power output.

[0374] The result is the production of cooper paired electrons of high speed and hence high relativistic mass in the desired half of the singularity, whilst producing low speed and thus low mass paired electrons at the converse of the singularity, in accordance with special relativity. The imbalance in the rotating singularity will be continuously present creating a dynamic warping of space-time. In effect, the differential current flow, will produce differential graviton production and in turn, by general relativity, the warping of space-time

[0375] As the cooper pairs cross the photosphere, accretion of the Bose particles results. Near-hole accretion across the target singularity is then motivated by magneto-rotationally induced, ultra-relativistic disk dynamics in the region of the flow bounded from below by the marginally bound geodesic radius rmb. As the particles impelled have high spin values, a largely coherent magnetic field in this region has the dynamical implication of compact mass segregation at the displacement nodes of the non-axisymmetric, MRI modes. This results in prolific gravitational wave emission coincident with the gamma-ray stage. The gravitational wave emissions are then manipulated to influence the reference singularity to produce a variable gravitational sinusoid which is then used to mathematically approximate the gravametric distortion, inducing a topology change from one spacelike boundary to the other in accordance with Geroch's theorem.

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[0529] Appendix A: The Synthetic creation of micro singularities. Throughout this patent application the creation of micro singularities has been maintained. While at first glance this may seem to be a deficiency in the patent application it is in fact an engineering problem that is in the process of being solved. In the International Journal of Theoretical Physics 41 (11): 2073-2090, November 2002 L. J. Garay published "Black Holes in Bose-Einstein Conden-

sates". In this article Garay showed that there exist both dynamically stable and unstable dilute-gas Bose-Einstein condensates that, in the hydrodynamic limit, exhibit a behavior completely analogous to that of gravitational black holes. This discovery coupled with creation of color glass condensate (CGC) an extreme form of nuclear matter in which a nucleus travels at near-light (relativistic) speed which flattens like a pancake in its direction of motion and spawns a large number of gluons hold the key to high energy singularity formation.

I claim:

1. A method for the generation of a pseudo 2+1 dimensional anti-de Sitter space comprising the steps of:

creating two Kerr type positively charged rotating dilation singularities, including the steps of

maintaining one of the singularities as a axis of rotation reference singularity,

maintaining the other of the singularities as a target singularity, and

subjecting the target singularity to a differential electron flow so as to simultaneously pass the differential electron flow above a photosphere of said target singularity in a direction of rotation thereof and contrary to the direction of rotation thereof, in order to release a directed flow of gravitons in a sinusoidal oscillation simulating a rotational effect of the target singularity around the axis of rotation provided by the reference singularity.

2. A method of generating a force around a body, comprising the steps of:

employing sinusoidal oscillations of electrical bombardment on the surface of one Kerr type reference singularity in close proximity to a second Kerr type target singularity to take advantage of the Lense-Thirring effect, wherein the electrical currents employed in the bombardment are passed simultaneously across the photosphere of said reference singularity in its direction of rotation and contrary to its direction of rotation to release a directed flow of gravitons in a sinusoidal oscillation simulating a rotational effect of the target singularity around the axis of rotation provided by the reference singularity;

creating timelike curves in a compact time-oriented manifold of Godel-type geodesically complete spacetime envelope under the Van Den Broeck modification of the Alcubierre geometry, resulting in the creation of timelike curves in a compact time-oriented manifold permitting topology change from one spacelike boundary to the other in accordance with Geroch's theorem.

* * * * *

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(54) CHI ENERGY AMPLIFIER

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(57) **ABSTRACT**

A Chi energy amplifier that utilizes a co-gravitational K field to generate a flow of hyperspace energy into or out of a ceramic dome containing a slot antenna.

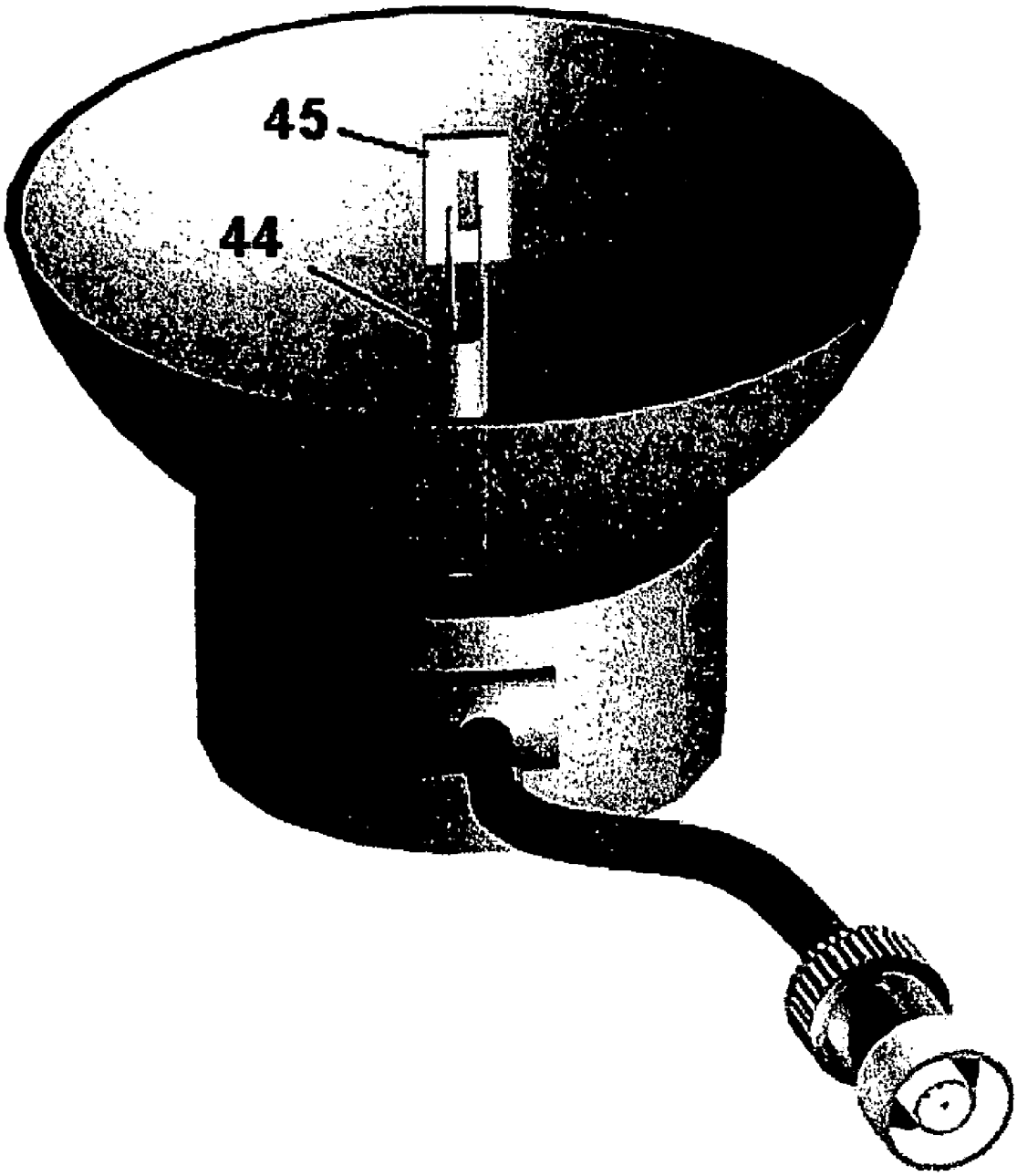

Figure 1

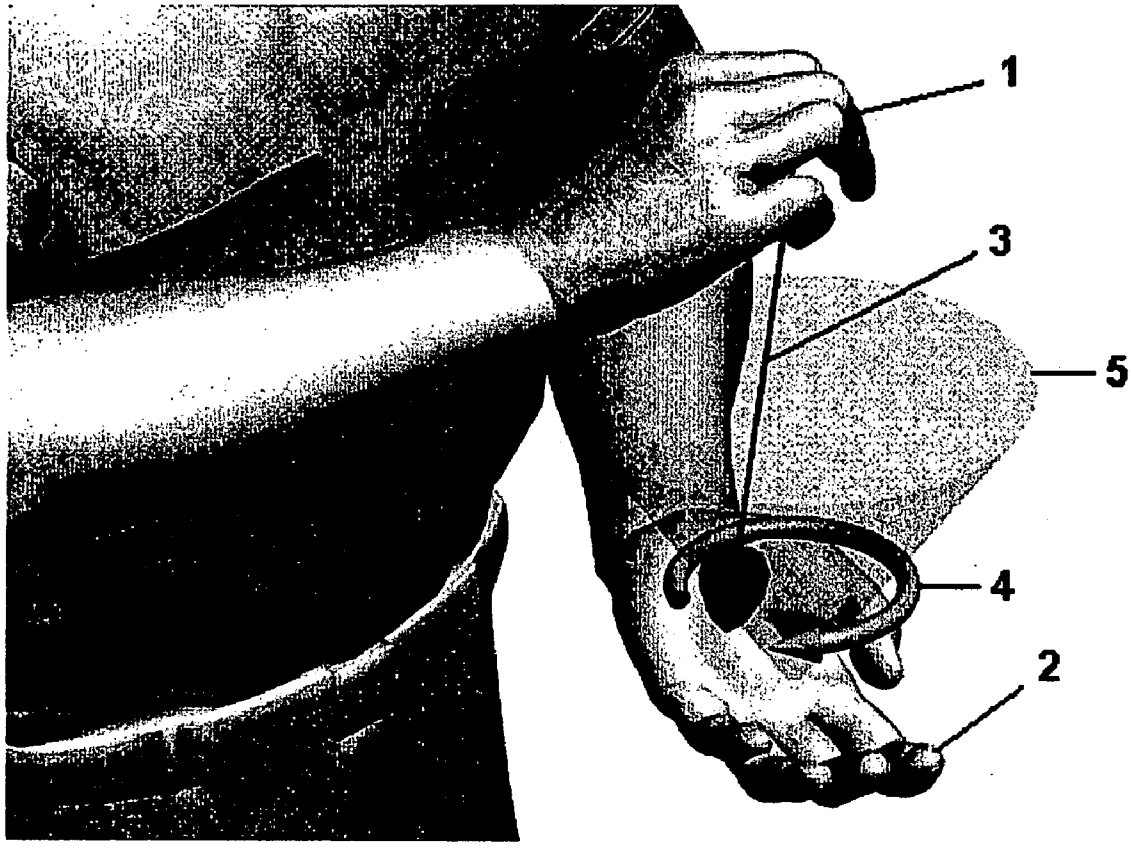

Figure 2

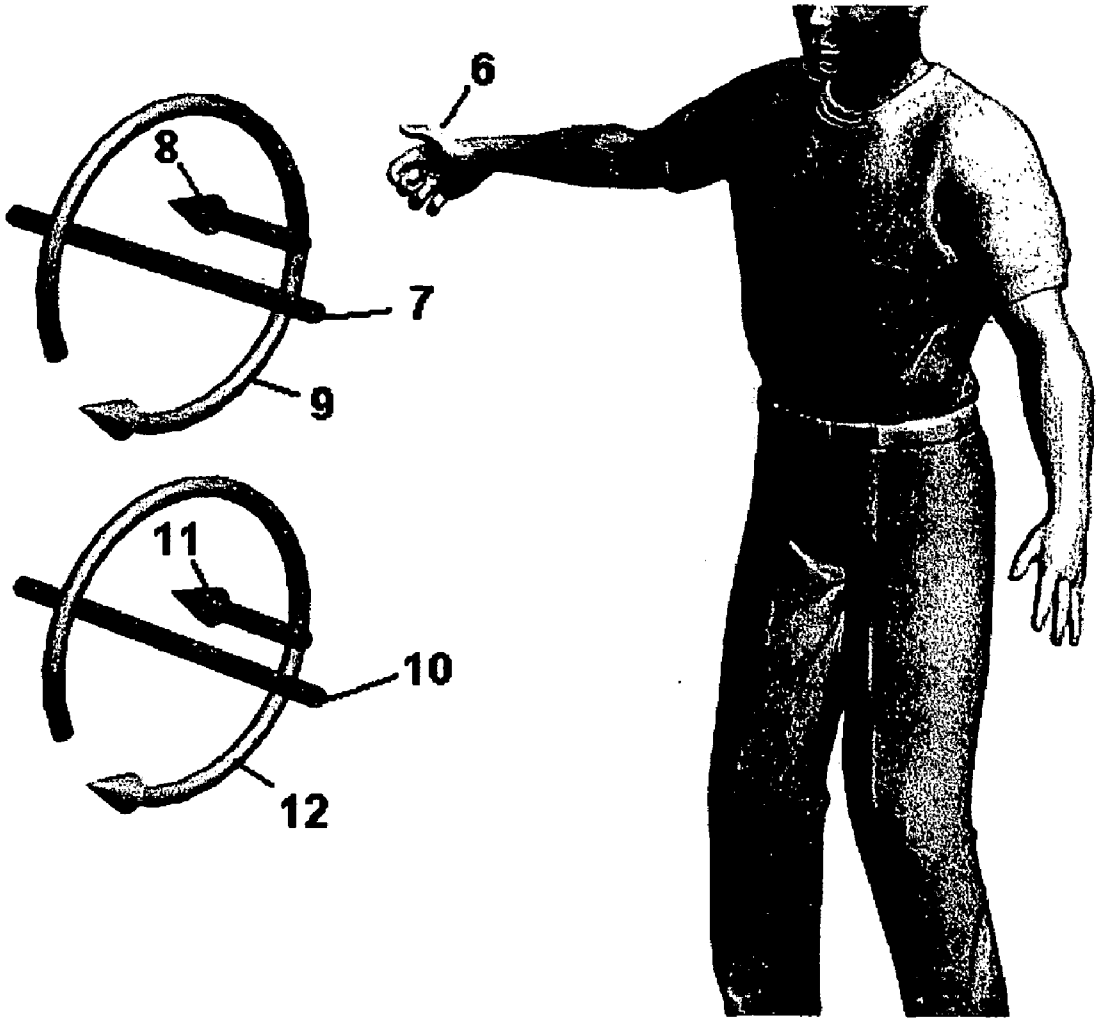

Figure 3

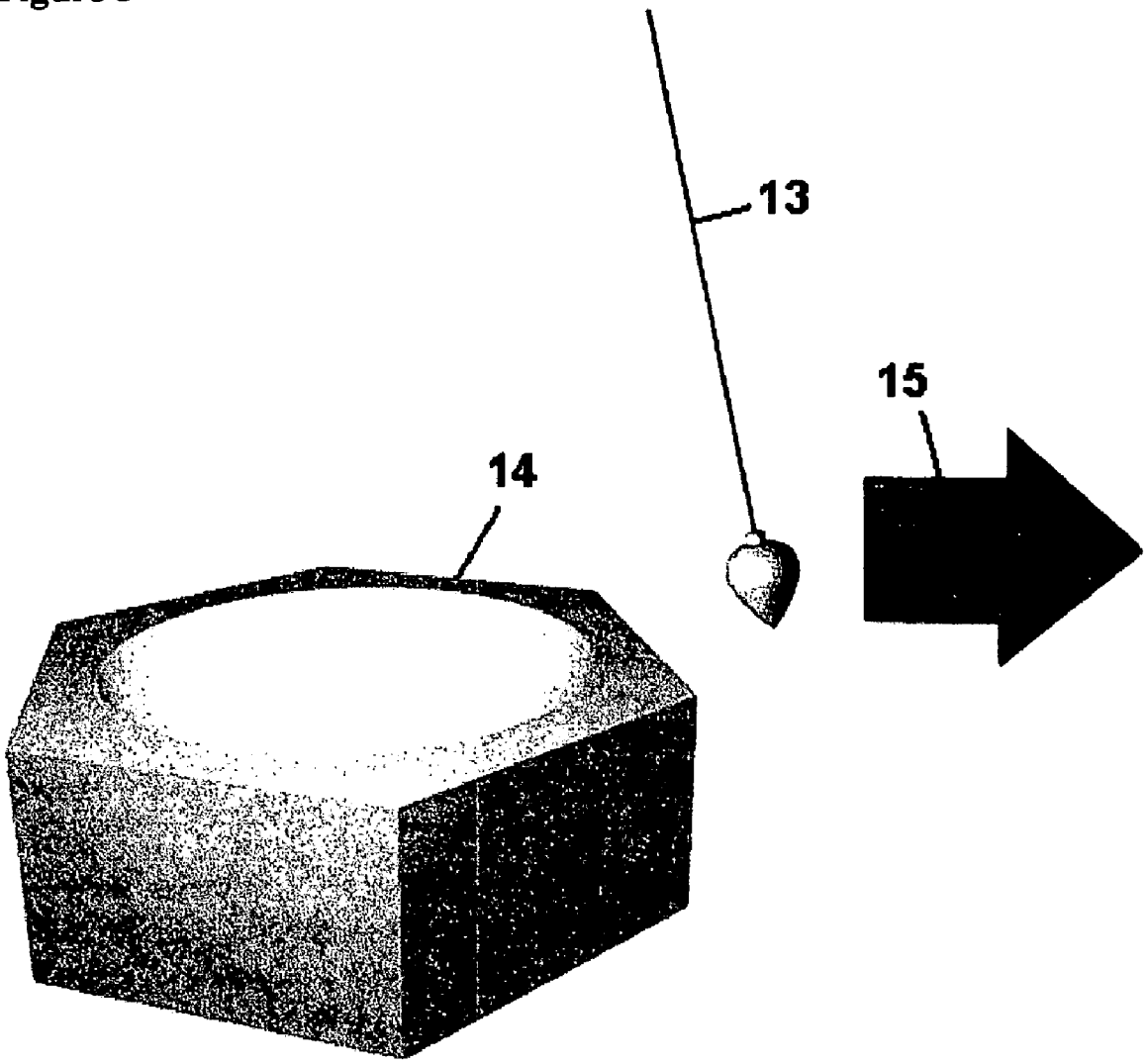

Figure 4

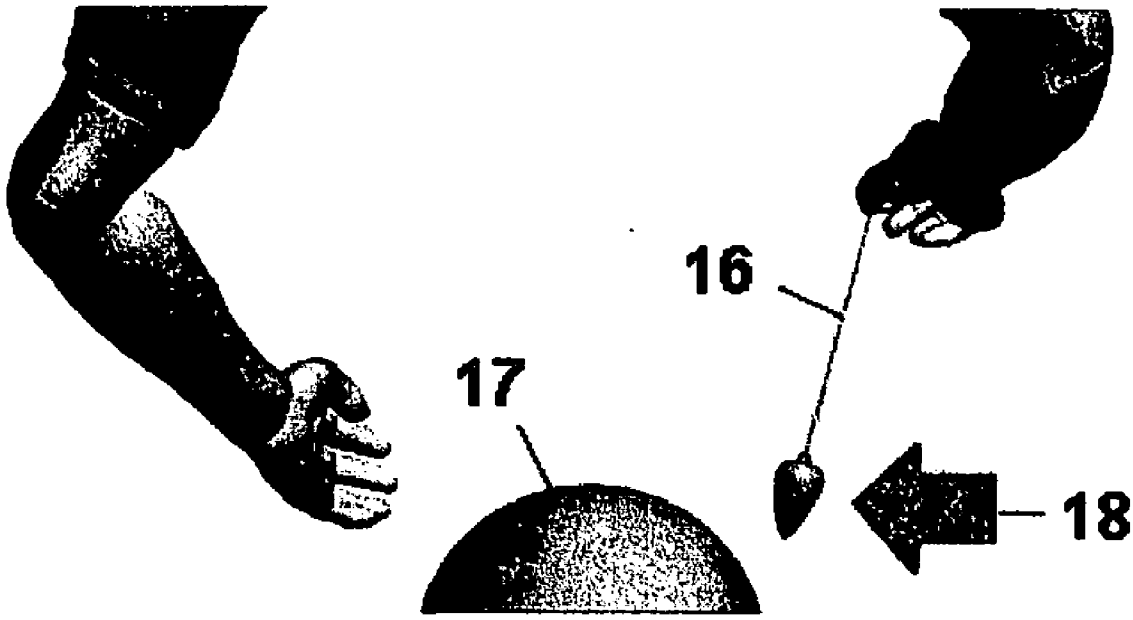

Figure 5

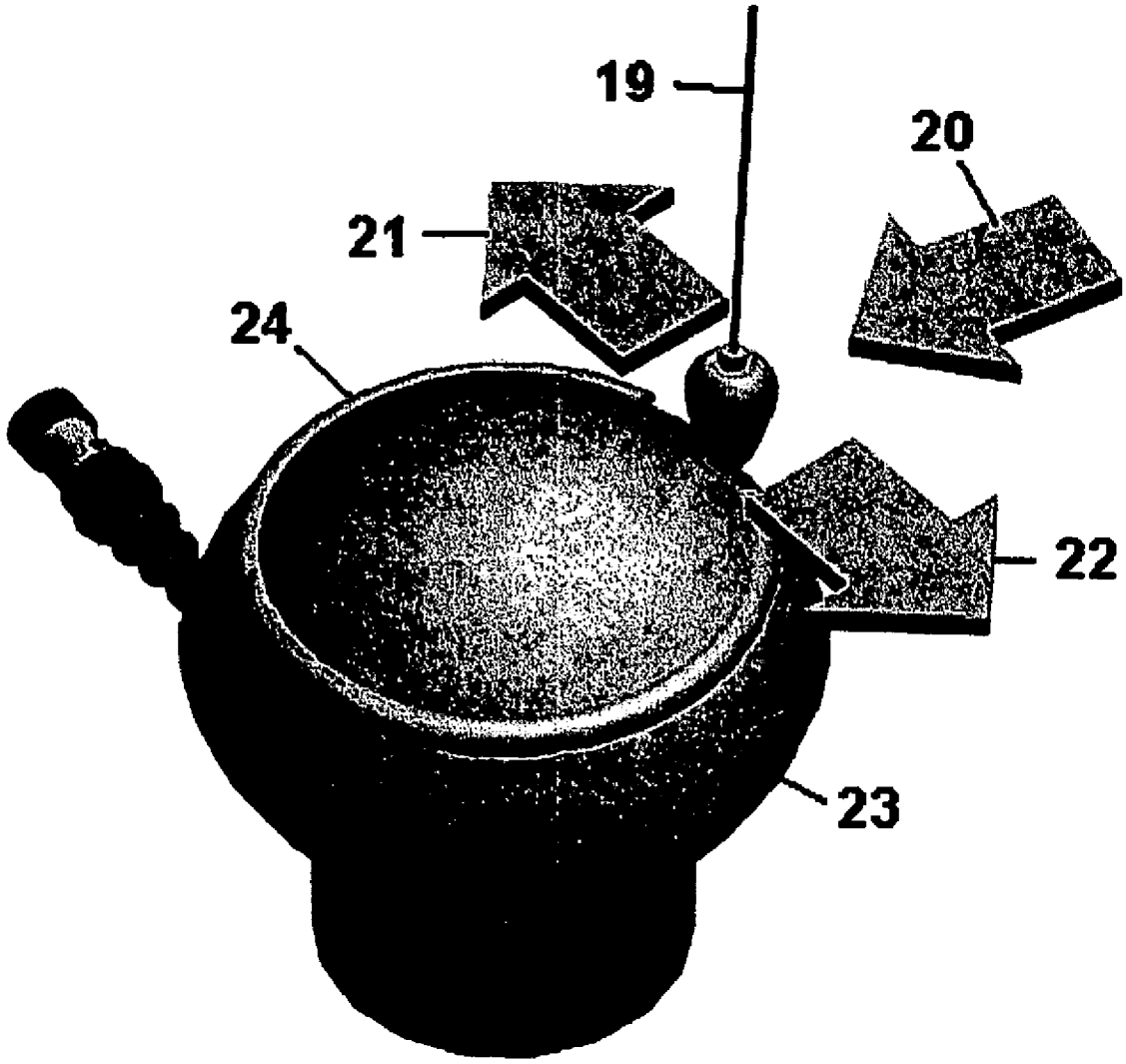

Figure 6

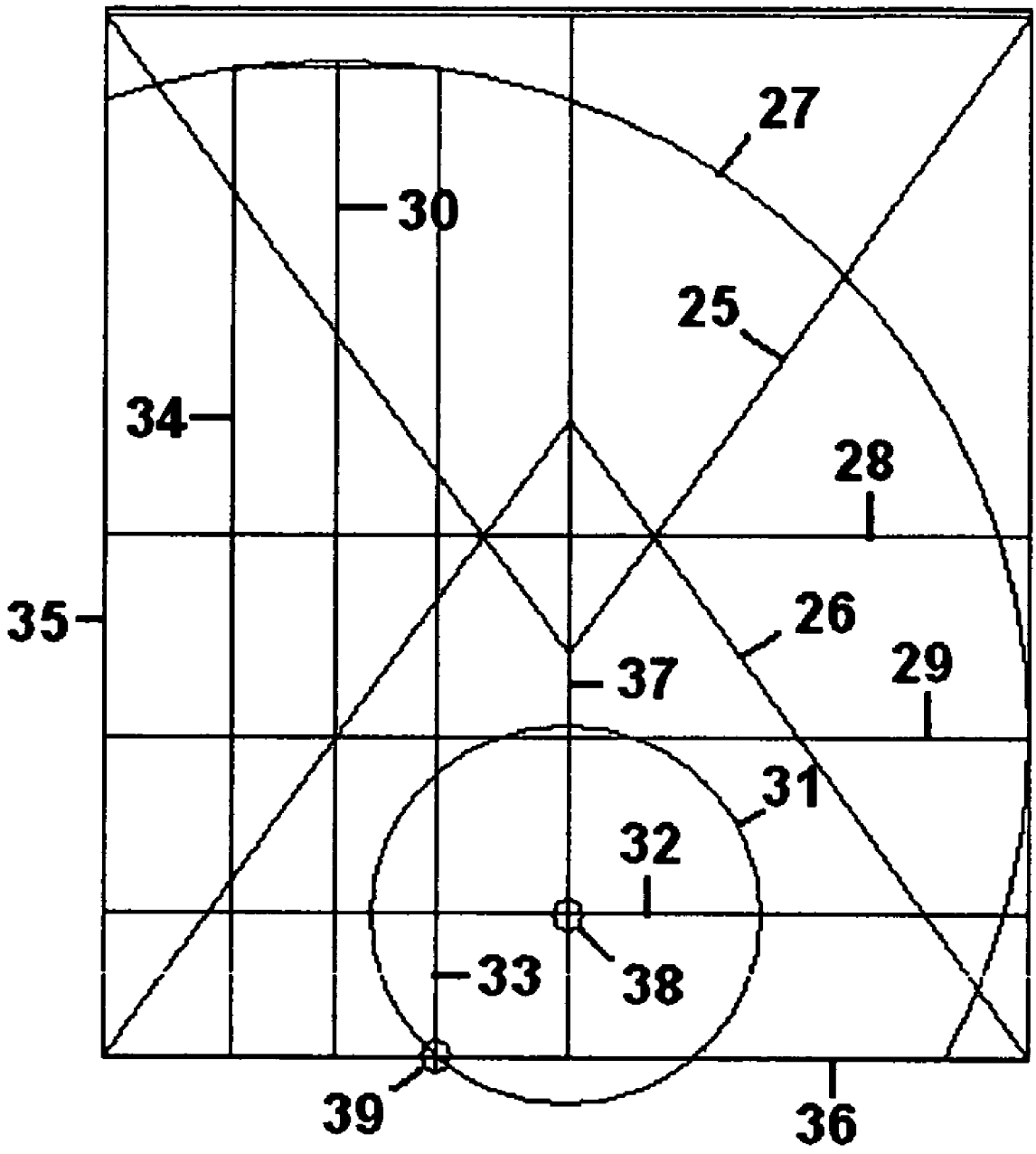

Figure 7

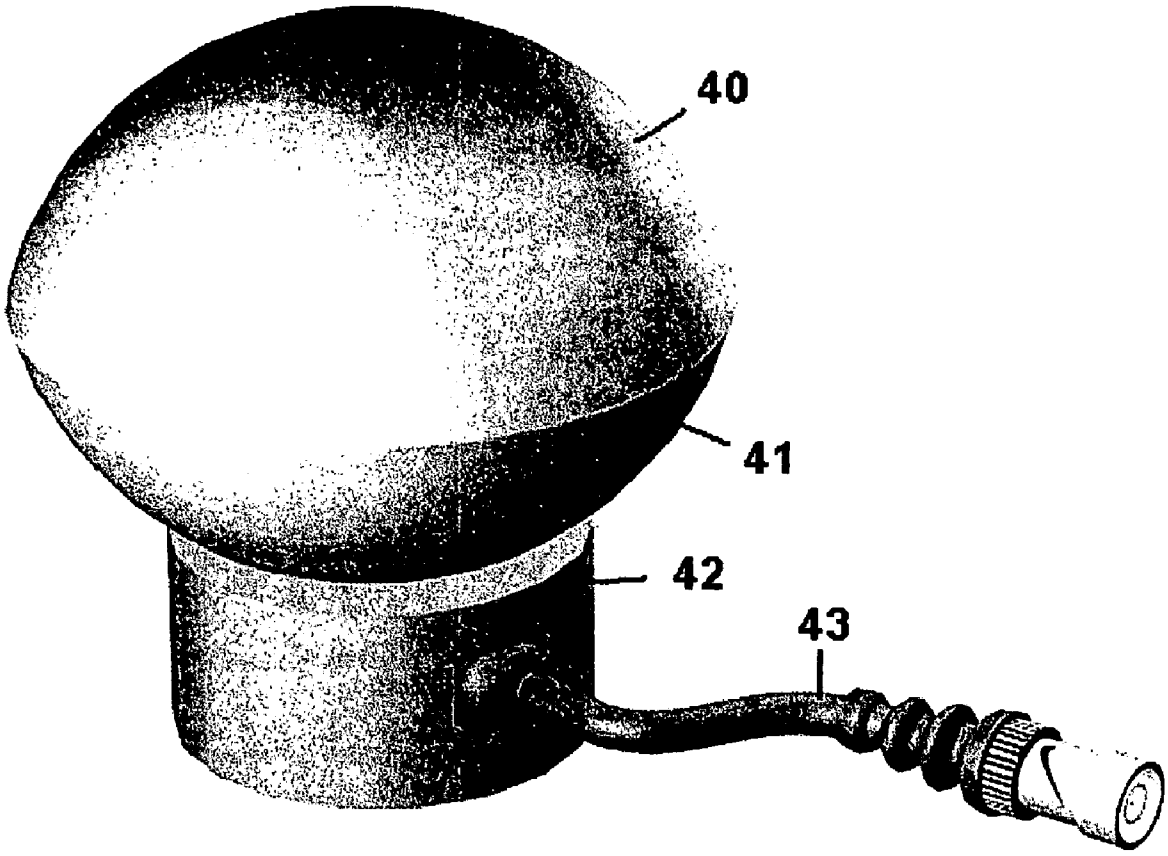

Figure 8

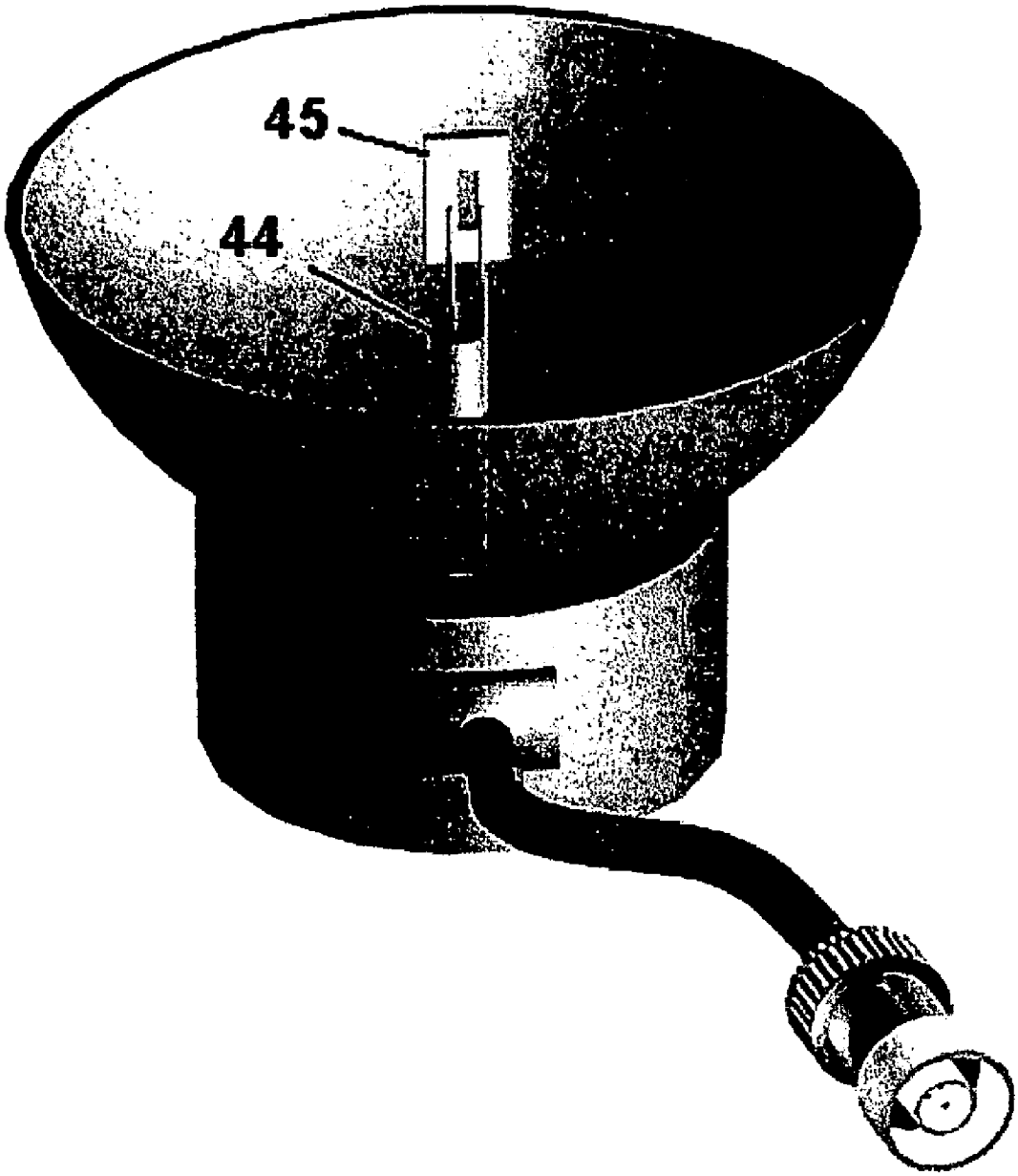

Figure 9

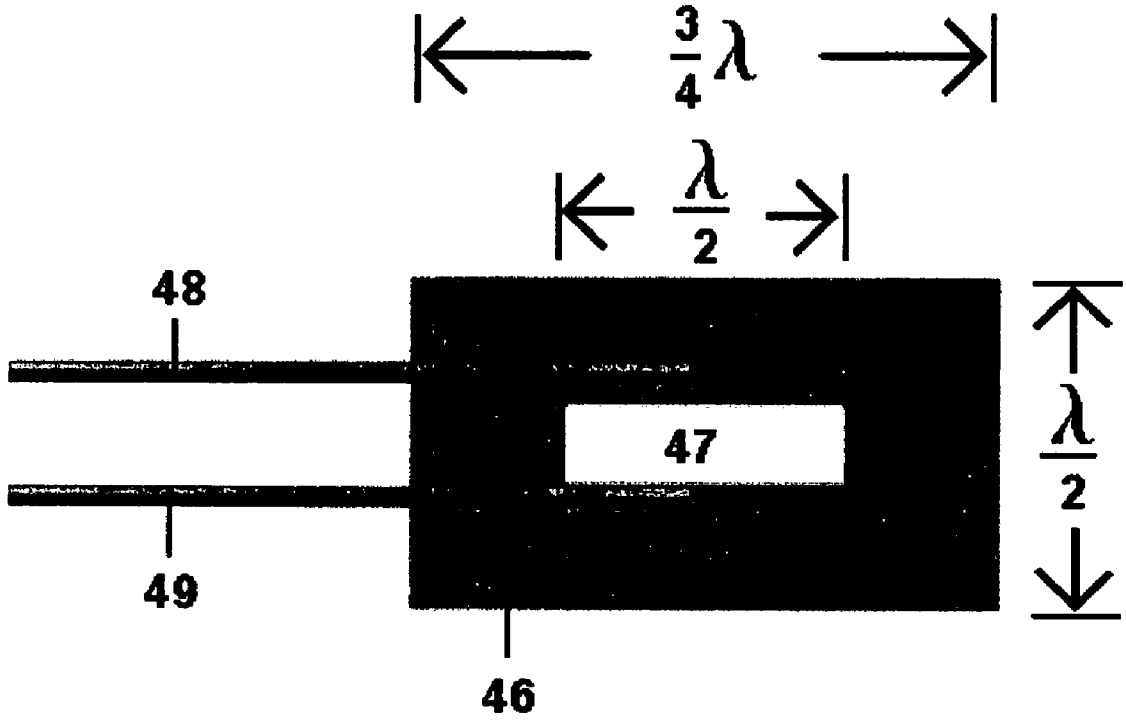

Figure 10

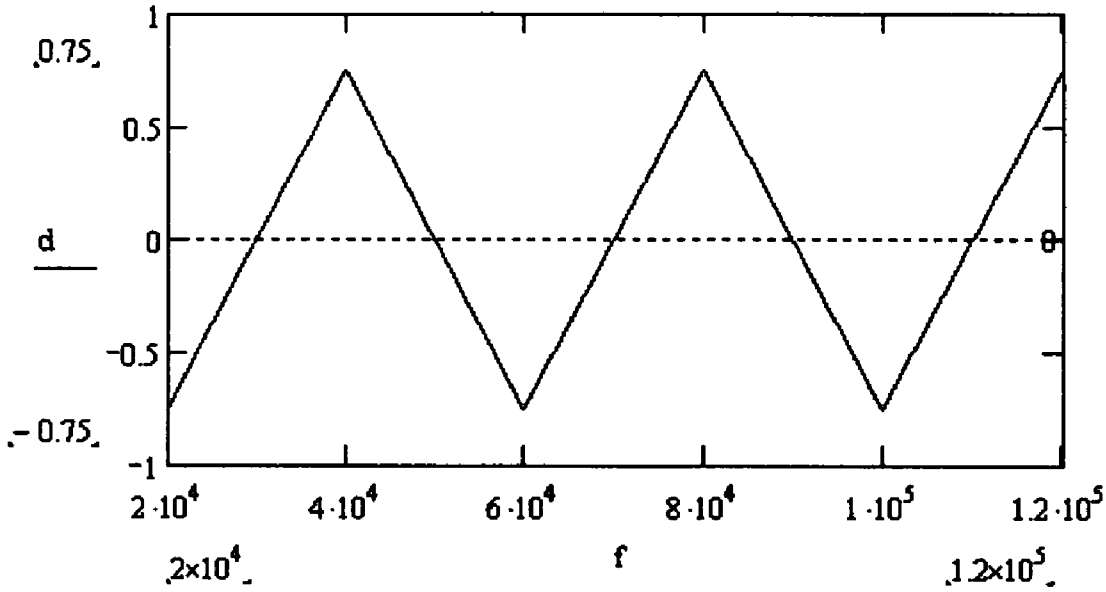
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Figure 11

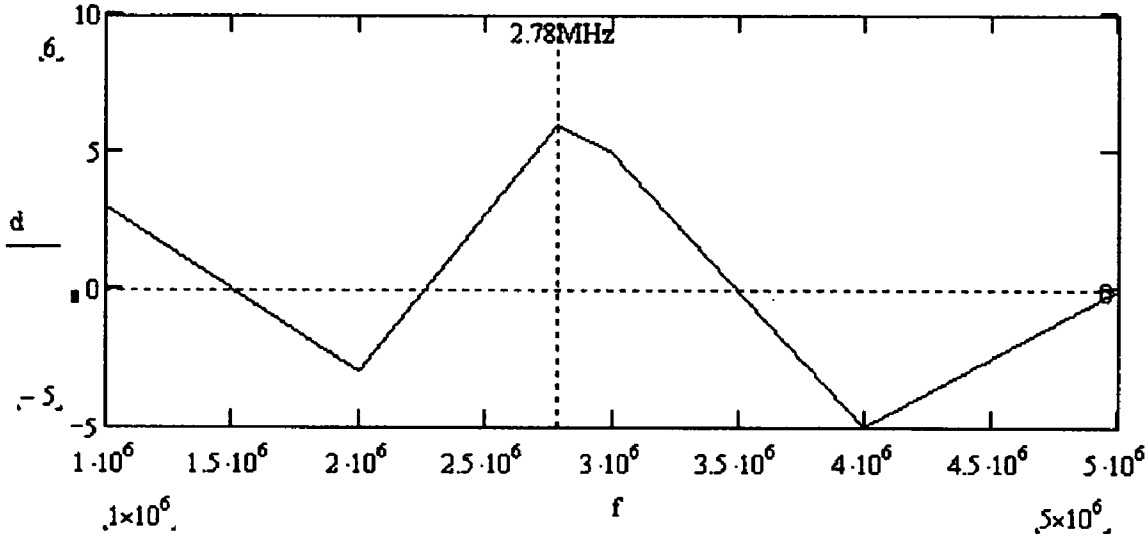
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.5×10^6

Figure 12

CHI ENERGY AMPLIFIER

BRIEF SUMMARY OF THE INVENTION

[0001] This invention is an energy amplifier that controls the direction of the second co-gravitational K field by means of a slot antenna located in a resonating sphere. The hyper-space mass flow rate entering into this dimension is determined by the frequency of the antenna. This energy flow is used to increase the energy of the human energy field known as Chi.

BACKGROUND OF THE INVENTION

[0002] Referring to FIG. **1**, a pendulum suspended by a string (**3**) is held by the string with the right hand (**1**) over the upright palm of the left hand (**2**). The pendulum swings in circles shown by the clockwise direction of the arrow (**4**). The pendulum swings at a constant frequency at about 1 to 2 Hz. What this means is that there is a second gravitational K field (**5**) that can cause a mass to rotate in circles.

[0003] Everyone is familiar with the linear gravitational g field which is defined as Newton's gravitational constant G times the mass of the earth divided by the square of the radius of the earth. This is the field that causes objects to accelerate radially toward the earth's surface. Newton's gravitational constant G is equal to the speed of light c squared divided by the linear mass Ω of the universe. The speed of light is

$$c = 299792458\ \frac{\text{meters}}{\text{second}}$$

$$\Omega = 1.346812891 \cdot 10^{27}\ \frac{\text{kilograms}}{\text{meter}}$$

$$G = \frac{c^2}{\Omega} = 6.673200002 \cdot 10^{-11}\ \frac{meter^3}{second^2\ \text{kilogram}}$$

The mass and radius of the earth are

[0004]

$$ME = 5.977 \cdot 10^{24}\ \text{kilograms}$$

$$RE = 6371.03\ 10^3\ \text{meters}$$

$$g = G\frac{ME}{RE^2} = 9.82\ \frac{\text{meters}}{second^2}$$

[0005] From electromagnetism, the electric E field is linear and the B magnetic field is circular or forms closed loops. The electric field starts and ends on electric charges. Since there are two electromagnetic fields, it makes sense that there are also two gravitational fields. A flow of electric current through a straight wire causes a circular magnetic B field to form around the wire. In a similar manner, a flow of mass through a channel causes a circular gravitational K field to form around the channel.

[0006] Referring to FIG. **2**, the right hand rule (**6**) shows that if the flow is along the direction of the thumb of the right hand, then the field curls around in the direction of the fingers. If an electric current is flowing through the wire (**7**) in the direction of arrow (**8**), then a counter-clockwise magnetic field circles the wire shown by arrow (**9**). In the bottom view, a mass flowing through a channel (**10**) in direction (**11**) generates a counter-clockwise gravitational K field shown by arrow (**12**). This field is the reason that the pendulum swings in circles. The gravitational K field only exists if there is a mass flow. In the wire there is also an electric field driving the electrons, so it must be that there is a g gravitational field driving the mass along the channel.

[0007] The correspondence between electromagnetic and gravitational constants must be the following:

Electric	Gravitational
Charge q	Mass m
Electric Field E	Gravitational Field g
Magnetic Field B	Co-gravitational Field K
Linear Electric Charge λ	Linear Mass Ω
Permittivity of Space ϵ_0	$-1/4\pi G$
Permeability of Space μ_0	$-4\pi G/c^2$
Convection Current Density J	Mass Current Density J

[0008] Maxwell's equation for the curl or circulation of B involves the current density J and an electric field E changing with time t

$$\nabla \times B = \mu_0 J + \frac{1}{c^2}\frac{\partial E}{\partial t}$$

The corresponding gravitational equation is therefore

[0009]

$$\nabla \times K = -\frac{4\pi G}{c^2} J + \frac{1}{c^2}\frac{\partial g}{\partial t}$$

[0010] If the g field is constant with time, then the circulation of the K field only depends on the mass density flow through the channel. Notice the minus sign in front of the first term which says that if energy is entering our dimension through a channel, then the K field is in the counterclockwise direction as indicated by the pendulum. As seen in FIG. **1**, the energy is leaving through the left hand because the rotation is clockwise. On the right hand, the pendulum rotates in the counterclockwise direction indicating that energy is coming from the hand. Thus there is a flow of energy between the hands known as the Chi energy. The purpose of this invention is to amplify this energy.

[0011] The g gravitational field is due to a negative space-time curvature created by the mass of the earth. In many physics books this is depicted as a bowl. So the idea was to acquire a ceramic kiln which could produce ceramic bowls using earthenware clay and a bowl mold. The curvature created by the bowl, if any, could be detected by the pendulum.

[0012] Referring to FIG. **3**, a pendulum (**13**) held in the right hand with the left hand near the side of the concave mold (**14**) starts to swing toward the right, away from the plaster mold as shown by arrow (**15**).

[0013] Referring to FIG. **4**, a pendulum (**16**) held in the right hand over a positive curvature dome (**17**) swings toward the top of the dome as shown by arrow (**18**).

Supposedly the K gravitational field rotates in circles, but these experiments showed that the pendulum movement was radial.

[0014] Referring to FIG. **5**, the pendulum (**19**) swings radially (**20**) toward the top of the dome (**23**) because the forces (**24**) around the dome counteract each other as shown by arrows (**21**, **22**). Thus there is no sideways pressure on the pendulum.

[0015] The next question was what is the value of the co-gravitational K constant? In electromagnetism the electric field is the speed of light times the magnetic field. So the g gravitational field should be the speed of light times the co-gravitational K field.

$$\begin{aligned} K &= \frac{g}{c} \\ &= \frac{1}{c} G \frac{MU}{RU^2} \\ &= \frac{1}{c} \frac{c^2}{\Omega} \frac{MU}{\frac{MU}{\Omega} RU} \\ &= \frac{c}{RU} \end{aligned}$$

$$\ln(K) = -40.34861143$$

[0016] where the radius RU of the universe is 10^{26} meters and c is the speed of light. The speed of light divided by the radius is angular frequency measured in Hz. Recall that the pendulum over the hand has a frequency f of 1 Hz which makes the angular frequency o equal to 2π radians per second since $\omega=2\pi f$ So the question is whether or not this value of K means anything in terms of hyperspace physics?

[0017] The universe has a geometrical sub-manifold based on the tetrahedron. All the physics constants of the universe are determined by this tetrahedral geometry. As shown in diagram tet0565 stored in the Library of Congress, the electron and proton are one and the same particle. There is a continuous clockwise path from the electron wavelength, through electric charge to electron mass and returning out-of-dimension back along a counterclockwise path as the proton. Because the paths are in opposite directions, the proton has a positive charge and the electron has the opposite negative charge. Because this path crosses into our dimension from hyperspace, we see two different particles. Thus Nature only has one particle. The tetrahedron diagram also shows that our dimension is offset from the origin of the diagram by the Cabibbo angle which is found in particle physics. Our dimension is determined by the Planck mass and the Planck wavelength which are the bottom limits of our dimension, known as the Planck box. If the proton mass is centered on the Planck mass, a tangent line to the circle can only be made by using the down quark and up quark which comprise the proton (duu). And the tangent line is drawn at the Cabibbo angle. So the diagram verifies some important experimental physics data.

[0018] Referring to FIG. **6**, the tetrahedron diagram is drawn with a vertical axis (**35**) corresponding to the natural logarithm of mass. The horizontal axis (**36**) is the natural logarithm of wavelength. The inverted tetrahedrons (**25**, **26**) cross at the centerline (**28**) which is known through remote viewing as "the merging of two worlds." The centerline is the separation point between space and hyperspace. The circumscribing sphere (**27**) has a horizontal diameter (**29**) and a vertical diameter (**30**). The electron wavelength (**34**) reflects off the sphere and returns as the electron mass (**33**).

[0019] Because the K co-gravitational field is related to circular or spinning motion, as well as vorticity per area, it might be imagined that it has something to do with the spinning electron. The energy E of the electron is equal to the mass m_e of the electron times the speed of light c squared.

$$m_e = 9.1093897 \cdot 10^{-31} \text{ kilogram}$$

$$c = 299792458 \cdot \frac{\text{meter}}{\text{second}}$$

$$E = m_e c^2$$

$$\ln(E) = -30.13363019$$

[0020] The tips of the inverted tetrahedrons pass through the base constant, vertical line (**37**), which is equal to Planck's constant h divided by the speed of light.

$$h = 2.210260685 \cdot 10^{-42} \text{ kilogram meter}$$

$$\text{base} = \ln\left(\frac{h}{c}\right) = -95.91546344$$

[0021] On the tetrahedron diagram, the co-gravitational circle K (**31**) is centered on the base (**37**) at the electron energy (**32**) shown by the small π circle at the intersection (**38**). As can be seen, the K circle determines the electron mass (**33**) at the horizontal axis (**36**) as shown by intersection (**39**). Because the electron is the proton, it also sets the constants of the proton such as wavelength, charge and mass. Thus the K co-gravitational field determines our elementary particles. Because these particle paths go in and out of dimension, it means that hyperspace exists. And because the K field is circular, depending on the direction of the energy flow, another purpose of this invention is to control the direction of the field.

SUMMARY OF THE INVENTION

[0022] Referring to FIG. **7**, the Chi energy amplifier consists of two ceramic domes (**40**, **41**) resting one on the other such as to form a hollow internal clam-like structure. The domes are mounted on a cylindrical ceramic base (**42**) containing a reinforced passageway for the coaxial cable and BNC connector (**43**). The BNC connector plugs into the frequency generator (not shown) which has a frequency range of 0.4 Hz to 5 MHz.

[0023] Referring to FIG. **8** with the upper dome removed, the coaxial cable (**44**) extends vertically through the base into the lower dome. The cable is soldered to a slot antenna (**45**). The center conductor of the cable is soldered to the left side of the slot and the ground shielding is soldered to the right side of the slot. Thus there is a voltage difference on the two sides which produces an oscillating electric field across the slot which radiates electromagnetic energy into the hollow dome.

[0024] A close-up of the slot antenna is shown in FIG. **9**. The antenna is a 0.050" thick copper sheet (**46**) with a width of ¾ wavelength by a height of ½ wavelength. A slot (**47**)

of ½ wavelength is electric-discharge machined into the copper sheet (**47**). The center conductor (**48**) from the coaxial cable is soldered to the top of the slot. The ground wire (**49**) is soldered to the bottom of the slot. This configuration produces a voltage difference between the inner top and bottom surfaces of the slot. The frequency generator produces an oscillating voltage across the slot which generates an electric field that radiates from the antenna into the ceramic cavity.

[0025] The wavelength of the antenna and the dimensions of the ceramic cavity have to be tuned to the geometry of our dimension. Newton's gravitational constant G is equal to

$$\ln(G) = -23.4303342$$

$$f = e^{23.4303432} * \text{Hz} = 15\ Ghz$$

$$\lambda = \frac{c}{f} = .020 \text{ meter} = .787 \text{ inch}$$

$$\text{slotwidth} = \frac{\lambda}{2} = .393 \text{ inch}$$

$$\text{antennawidth} = \frac{3}{4}\lambda = .590 \text{ inch}$$

The frequency of the antenna is the inverse of the gravitational constant. The reason for this is that when a circle of radius natural logarithm G is centered on the proton on the tetrahedron diagram, the circle intersects the corner of the Planck box which bounds our dimension between space and hyperspace. It is the low-density hyperspace energy that the amplifier will bring into this dimension.

[0026] The size of the ceramic cavity based on the angular frequency ω=2πf is

$$\frac{\frac{\omega^2}{c^2} + \frac{1}{ab}}{\frac{\omega^2}{c^2} + ab\left(\frac{\omega^2}{c^2} - \frac{1}{a^2}\right)\left(\frac{\omega^2}{c^2} - \frac{1}{b^2}\right)} = \frac{\tan\left(\frac{\omega}{c}(b-a)\right)}{\omega}\frac{c}{b-a}$$

where b is inside radius of the cavity, a is the radius of an object at the center of the cavity and c is the speed of light. Using the object radius as a=0.020 meter to account for the antenna, the inside radius of the cavity is b=4.25 inches which is the size of the 8.5 inch diameter ceramic dome using ¼ inch thick clay. The frequency is then equal to

$$f = \ln\left(\frac{\omega}{2\pi}\right) = 23.45$$

which is close to the inverse of the gravitational constant G of −23.43. Thus the amplifier is tuned to the gravitational constant of the universe both in size of the cavity and the frequency of the slot antenna. Using a SMD surface mount capacitor and inductor in the picofarad and nanohenry range, it is possible to get up to this high frequency, but it was found that it was not necessary because the amplifier works at lower frequencies that are pulsed.

[0027] Referring to FIG. **10**, the swinging movement of the pendulum measured in inches at the side of the dome is plotted against a range of frequencies from 20 kHz to 120 kHz. At 20 kHz, the pendulum swings ¾ inch away from the dome. Then at 40 kHz, the pendulum swings ¾ inch toward the dome. This pattern is repeated until 120 kHz. What this means is that the amplifier can control the direction of the co-gravitational field using frequency. The tetrahedron diagram shows that this phenomenon is related to the two axes of the circumscribing sphere of the tetrahedron.

[0028] Referring to FIG. **11**, the swinging of the pendulum is plotted for a range of frequencies from 1 MHz to 5 MHz. At a frequency of 2.78 MHz the pendulum was swinging strongly from the vertical to the horizontal, a distance of six inches. On the tetrahedron diagram, the distance from our base constant to the centerline between inverted tetrahedrons is equal to 14.838168. This corresponds to a frequency of

$$f = e^{14.838168} * \text{Hz} = 2.780574169 \text{ MHz}$$

which is close to the experimental value.

[0029] Referring to FIG. **12**, the Chi energy flowing between the hands, shown by the arrows, is amplified by placing the hands across the dome. This energy from the right hand mixes with the hyperspace energy entering the dome from hyperspace. The combined energy is then absorbed in the left hand vortex. The effects of this amplified energy are simply amazing and have to be experienced to appreciate what it means.

A BRIEF DESCRIPTION OF THE DRAWINGS

[0030] FIG. **1**. Perspective view of pendulum movement over left hand vortex.

[0031] FIG. **2**. Perspective view of right hand rule of physics showing similarity between electromagnetism and gravity.

[0032] FIG. **3**. Perspective view of plaster mold cavity showing negative curvature.

[0033] FIG. **4**. Perspective view of dome showing positive curvature.

[0034] FIG. **5**. Perspective view of dome showing radial pendulum movement.

[0035] FIG. **6**. Graph of co-gravitational K field on tetrahedron diagram.

[0036] FIG. **7**. Perspective view of Chi Energy Amplifier with BNC coaxial cable.

[0037] FIG. **8**. Perspective view of slot antenna in dome.

[0038] FIG. **9**. Perspective view of slot antenna showing dimensions.

[0039] FIG. **10**. Graph of pendulum movement versus frequency of antenna, 20 KHz.

[0040] FIG. **11**. Graph of pendulum movement versus frequency from 1 MHz to 5 MHz.

[0041] FIG. **12**. Perspective view of amplifying Chi energy.

DETAILED DESCRIPTION OF THE INVENTION

[0042] The dome of the amplifier is made of red earthenware clay from Minnesota having a cone 06 kiln firing temperature of 1828° F. over a period of 7.5 hours. The clay is placed between two hardwood ¼ inch thick slats. It is then rolled flat with a rolling pin. The sheet of clay is cut in half and one half is placed in a 9-inch diameter bowl mold using a soft sponge to push it into position. The second half is then added to the first with the seam between worked flat with a metal kidney and elephant ear sponge. The top of the mold

is scrapped flat to create the bowl shape. The moist clay is left to dry for one day after which it falls out of the mold due to shrinkage. After completely drying, the dome is then placed in a kiln which runs the computer-controlled cone 06 temperature firing profile. A preheat at 180° F. for one hour is required to make sure the dome is completely bone dry. It takes 7 to 8 hours to fire the dome with another 12 hours to cool down naturally.

[0043] The base is also made of ¼ inch clay. A circular shape is cut out and fitted with a ribbon of extruded clay from a clay gun to make the cylindrical wall. Using a hole cutter made of hollow tubing, a hole is made in the side of the base for the coaxial cable. The second lower dome has a hole cut in the bottom when the clay is leather hard.

[0044] A 0.050" thick copper sheet is EDM machined to cut a half wavelength slot in the copper. The inner conductor of the coaxial cable is soldered using silver epoxy to the one side of the slot. The ground shielding of the cable is silver epoxied to the other side of the slot. The other end of the coaxial cable has a BNC connector which plugs into the frequency generator.

[0045] The pendulum is made out of soft brass rod and machined on a lathe into a plumb bob shape. A hole is drilled in the stem to hold the 6" long string.

I claim:

1. A Chi energy amplifier comprising:

a. a hollow ceramic dome in the shape of a clam shell with a hole in the lower half that provides access to a coaxial cable;

b. a cylindrical ceramic base on which the dome is mounted with holes that provide access for a coaxial cable into item (a);

c. a slot antenna soldered to the coaxial cable, located midway inside item (a), such that the inner conductor of the cable is soldered to one side of the slot and the ground shielding is soldered to the other side of the slot;

d. a frequency generator connected to the other end of the coaxial cable by means of a BNC connector for the purpose of providing an oscillating voltage to item (c);

e. an electromagnetic wave generated by items (c, d) that resonates inside item (a);

f. a co-gravitational K field generated by items (a, b, c, d, e) whose direction can be controlled by the frequency of item (d); and

g. a flow of hyperspace energy into or out of the dome due to item (f).

* * * * *

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FIP8106 OR 685,958

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No. 685,958. Patented Nov. 5, 1901.

N. TESLA.

METHOD OF UTILIZING RADIANT ENERGY.

(Application filed Mar. 21, 1901.)

(No Model.)

Electric stepping motor energized by corpuscular energy from sun

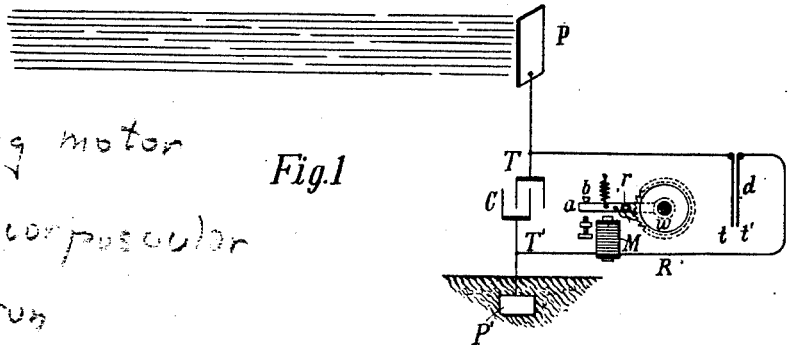

Fig.1

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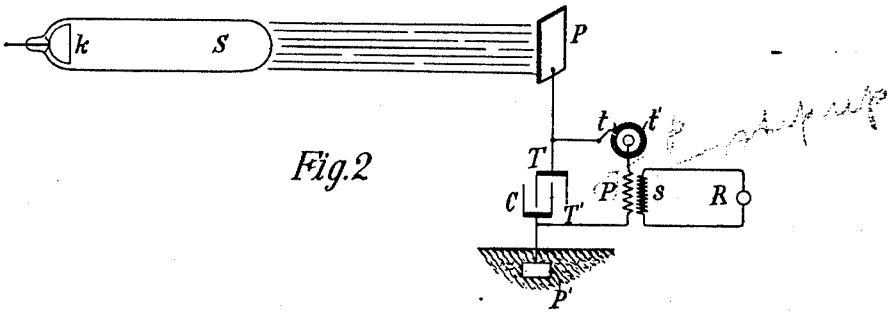

Fig.2

Witnesses:
Raphael Netter
M. Lamson Tyler

Nikola Tesla, Inventor
by Kerr, Page & Cooper Attys

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UNITED STATES PATENT OFFICE.

NIKOLA TESLA, OF NEW YORK, N. Y.

METHOD OF UTILIZING RADIANT ENERGY.

SPECIFICATION forming part of Letters Patent No. 685,958, dated November 5, 1901.

Application filed March 21, 1901. Serial No. 52,154. (No model.)

To all whom it may concern:

Be it known that I, NIKOLA TESLA, a citizen of the United States, residing at the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Methods of Utilizing Radiant Energy, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

It is well known that certain radiations—such as those of ultra-violet light, cathodic, Roentgen rays, or the like—possess the property of charging and discharging conductors of electricity, the discharge being particularly noticeable when the conductor upon which the rays impinge is negatively electrified. These radiations are generally considered to be ether vibrations of extremely small wave lengths, and in explanation of the phenomena noted it has been assumed by some authorities that they ionize or render conducting the atmosphere through which they are propagated. My own experiments and observations, however, lead me to conclusions more in accord with the theory heretofore advanced by me that sources of such radiant energy throw off with great velocity minute particles of matter which are strongly electrified, and therefore capable of charging an electrical conductor, or even if not so may at any rate discharge an electrified conductor either by carrying off bodily its charge or otherwise.

My present application is based upon a discovery which I have made that when rays or radiations of the above kind are permitted to fall upon an insulated conducting body connected to one of the terminals of a condenser, while the other terminal of the same is made by independent means to receive or to carry away electricity, a current flows into the condenser so long as the insulated body is exposed to the rays, and under the conditions hereinafter specified an indefinite accumulation of electrical energy in the condenser takes place. This energy after a suitable time interval, during which the rays are allowed to act, may manifest itself in a powerful discharge, which may be utilized for the operation or control of mechanical or electrical devices or rendered useful in many other ways.

In applying my discovery I provide a condenser, preferably of considerable electrostatic capacity, and connect one of its terminals to an insulated metal plate or other conducting body exposed to the rays or streams of radiant matter. It is very important, particularly in view of the fact that electrical energy is generally supplied at a very slow rate to the condenser, to construct the same with the greatest care. I use by preference the best quality of mica as dielectric, taking every possible precaution in insulating the armatures, so that the instrument may withstand great electrical pressures without leaking and may leave no perceptible electrification when discharging instantaneously. In practice I have found that the best results are obtained with condensers treated in the manner described in a patent granted to me February 23, 1897, No. 577,671. Obviously the above precautions should be the more rigorously observed the slower the rate of charging and the smaller the time interval during which the energy is allowed to accumulate in the condenser. The insulated plate or conducting body should present as large a surface as practicable to the rays or streams of matter, I having ascertained that the amount of energy conveyed to it per unit of time is under otherwise identical conditions proportionate to the area exposed, or nearly so. Furthermore, the surface should be clean and preferably highly polished or amalgamated. The second terminal or armature of the condenser may be connected to one of the poles of a battery or other source of electricity or to any conducting body or object whatever of such properties or so conditioned that by its means electricity of the required sign will be supplied to the terminal. A simple way of supplying positive or negative electricity to the terminal is to connect the same either to an insulated conductor, supported at some height in the atmosphere, or to a grounded conductor, the former, as is well known, furnishing positive and the latter negative electricity. As the rays or supposed streams of matter generally convey a positive charge to the first condenser-terminal, which is connect-

ed to the plate or conductor above mentioned, I usually connect the second terminal of the condenser to the ground, this being the most convenient way of obtaining negative electricity, dispensing with the necessity of providing an artificial source. In order to utilize for any useful purpose the energy accumulated in the condenser, I furthermore connect to the terminals of the same a circuit including an instrument or apparatus which it is desired to operate and another instrument or device for alternately closing and opening the circuit. This latter may be any form of circuit-controller, with fixed or movable parts or electrodes, which may be actuated either by the stored energy or by independent means.

The rays or radiations which are to be utilized for the operation of the apparatus above described in general terms may be derived from a natural source, as the sun, or may be artificially produced by such means, for example, as an arc-lamp, a Roentgen tube, and the like, and they may be employed for a great variety of useful purposes.

My discovery will be more fully understood from the following detailed description and annexed drawings, to which reference is now made, and in which—

Figure 1 is a diagram showing typical forms of the devices or elements as arranged and connected in applying the method for the operation of a mechanical contrivance or instrument solely by the energy stored; and Fig. 2 is a diagrammatical representation of a modified arrangement suitable for special purposes, with a circuit-controller actuated by independent means.

Referring to Fig. 1, C is the condenser, P the insulated plate or conducting body, which is exposed to the rays, and P′ another plate or conductor, all being joined in series, as shown. The terminals T T′ of the condenser are also connected to a circuit including a receiver R, which is to be operated, and a circuit-controlling device *d*, which in this case is composed of two very thin conducting-plates *t t′*, placed in close proximity and very mobile, either by reason of extreme flexibility or owing to the charater of their support. To improve their action, they should be inclosed in a receptacle from which the air may be exhausted. The receiver R is shown as consisting of an electromagnet M, a movable armature *a*, a retractile spring *b*, and a ratchet-wheel *w*, provided with a spring-pawl *r*, which is pivoted to armature *a*, as illustrated. The apparatus being arranged as shown, it will be found that when the radiations of the sun or of any other source capable of producing the effects before described fall upon the plate P an accumulation of electrical energy in the condenser C will result. This phenomenon, I believe, is best explained as follows: The sun as well as other sources of radiant energy throw off minute particles of matter positively electrified, which, impinging upon the plate P, communicate an electrical charge to the same. The opposite terminal of the condenser being connected to the ground, which may be considered as a vast reservoir of negative electricity, a feeble current flows continuously into the condenser, and inasmuch as these supposed particles are of an inconceivably small radius or curvature, and consequently charged to a relatively very high potential, this charging of the condenser may continue, as I have found in practice, almost indefinitely, even to the point of rupturing the dielectric. Obviously whatever circuit-controller be employed it should operate to close the circuit in which it is included when the potential in the condenser has reached the desired magnitude. Thus in Fig. 2 when the electrical pressure at the terminals T T′ rises to a certain predetermined value the plates *t t′*, attracting each other, close the circuit connected to the terminals. This permits a flow of current which energizes the magnet M, causing it to draw down the armature *a* and impart a partial rotation to the ratchet-wheel *w*. As the current ceases the armature is retracted by the spring *b* without, however, moving the wheel *w*. With the stoppage of the current the plates *t t′* cease to be attracted and separate, thus restoring the circuit to its original condition.

Many useful applications of this method of utilizing the radiations emanating from the sun or other source and many ways of carrying out the same will at once suggest themselves from the above description. By way of illustration a modified arrangement is shown in Fig. 2, in which the source S of radiant energy is a special form of Roentgen tube devised by me having but one terminal *k*, generally of aluminium, in the form of half a sphere with a plain polished surface on the front side, from which the streams are thrown off. It may be excited by attaching it to one of the terminals of any generator of sufficiently-high electromotive force; but whatever apparatus be used it is important that the tube be exhausted to a high degree, as otherwise it might prove entirely ineffective. The working or discharge circuit connected to the terminals T T′ of the condenser includes in this case the primary *p* of a transformer and a circuit-controller comprising a fixed terminal or brush *t* and a movable terminal *t′* in the shape of a wheel with conducting and insulating segments which may be rotated at an arbitrary speed by any suitable means. In inductive relation to the primary wire or coil *p* is a secondary *s*, usually of a much greater number of turns, to the ends of which is connected a receiver R. The terminals of the condenser being connected as indicated, one to an insulated plate P and the other to a grounded plate P′, when the tube S is excited rays or streams of matter are emitted from the same, which convey a positive charge to the plate P and condenser-terminal T, while terminal T′ is continuously receiving negative electricity from the plate

P'. This, as before explained, results in an accumulation of electrical energy in the condenser, which goes on as long as the circuit including the primary p is interrupted. Whenever the circuit is closed, owing to the rotation of the terminal t', the stored energy is discharged through the primary p, this giving rise in the secondary s to induced currents which operate the receiver R.

It is clear from what has been stated above that if the terminal T' is connected to a plate supplying positive instead of negative electricity the rays should convey negative electricity to plate P. The source S may be any form of Roentgen or Lenard tube; but it is obvious from the theory of action that in order to be very effective the electrical impulses exciting it should be wholly or at least preponderatingly of one sign. If ordinary symmetrical alternating currents are employed, provision should be made for allowing the rays to fall upon the plate P only during those periods when they are productive of the desired result. Evidently if the radiations of the source be stopped or intercepted or their intensity varied in any manner, as by periodically interrupting or rythmically varying the current exciting the source, there will be corresponding changes in the action upon the receiver R, and thus signals may be transmitted and many other useful effects produced. Furthermore, it will be understood that any form of circuit-closer which will respond to or be set in operation when a predetermined amount of energy is stored in the condenser may be used in lieu of the device specifically described with reference to Fig. 1, and also that the special details of construction and arrangement of the several parts of the apparatus may be very greatly varied without departure from the invention.

Having described my invention, what I claim is—

1. The method of utilizing radiant energy, which consists in charging one of the armatures of a condenser by rays or radiations, and the other armature by independent means, and discharging the condenser through a suitable receiver, as set forth.

2. The method of utilizing radiant energy, which consists in simultaneously charging a condenser by means of rays or radiations and an independent source of electrical energy, and discharging the condenser through a suitable receiver, as set forth.

3. The method of utilizing radiant energy, which consists in charging one of the armatures of a condenser by rays or radiations, and the other by independent means, controlling the action or effect of said rays or radiations and discharging the condenser through a suitable receiver, as set forth.

4. The method of utilizing radiant energy, which consists in charging one of the armatures of a condenser by rays or radiations and the other by independent means, varying the intensity of the said rays or radiations and periodically discharging the condenser through a suitable receiver, as set forth.

5. The method of utilizing radiant energy, which consists in directing upon an elevated conductor, connected to one of the armatures of a condenser, rays or radiations capable of positively electrifying the same, carrying off electricity from the other armature by connecting the same with the ground, and discharging the accumulated energy through a suitable receiver, as set forth.

6. The method of utilizing radiant energy, which consists in charging one of the armatures of a condenser by rays or radiations, and the other by independent means, and effecting by the automatic discharge of the accumulated energy the operation or control of a suitable receiver, as set forth.

NIKOLA TESLA.

Witnesses:
M. LAWSON DYER,
RICHARD DONOVAN.

New Energy Technologies

Published by Faraday Laboratories Ltd. Issue #3 (6) 2002

Research on advanced propulsion systems and new energy sources

Time Control experiments

Also in this issue:

* New experiments: magnet monopole beam cures cancer
* Electrogravity experiments
* High efficiency ceramic heater
* New aether experiments
* Instantaneous telecommunication

Editorial

Dr. Chernobrov and NET editor Olga Leontyeva.

The head of the Moscow research group "Kosmopoisk" Dr. Vadim A. Chernobrov (our readers certainly remember his articles on experiments with time) has recently visited the editorial office of New Energy Technologies in Saint-Petersburg, Russia. His visit was caused by discussion on the Time Machine project (investigation of active properties of time), started under agreement with Faraday Labs Ltd. Our magazine will inform readers on the topic in later issues.

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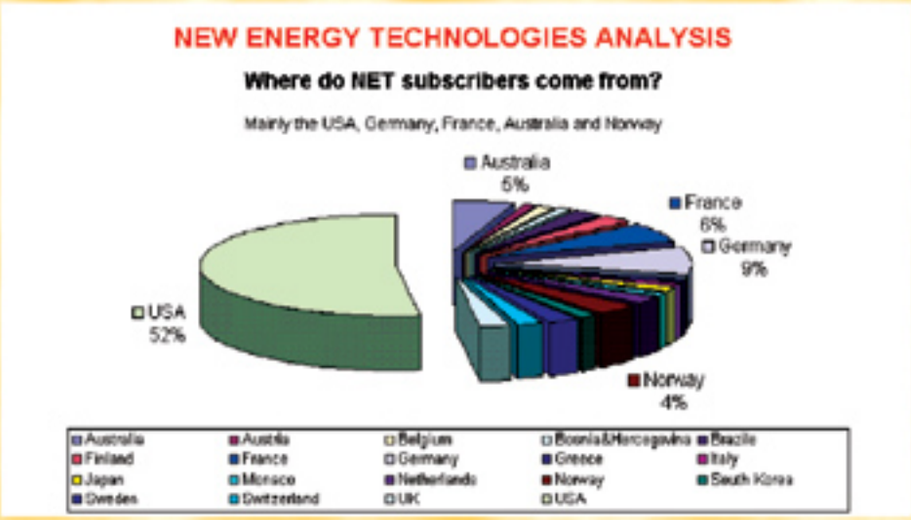

LUTEC 1000

News from Australia

Magnet motor-generator

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John Christie (left) is the co-founder, CEO and chairman of Lutec (Aust.) Pty Ltd.

Ludwig (Lou) Brits (right, above) is the co-founder, managing director and head of development of Lutec (Aust.) Pty Ltd. He is Chairman and director of TTI Pty Ltd. TTI Pty Ltd is a state government recognised R.A.P. (remote area power) system provider.

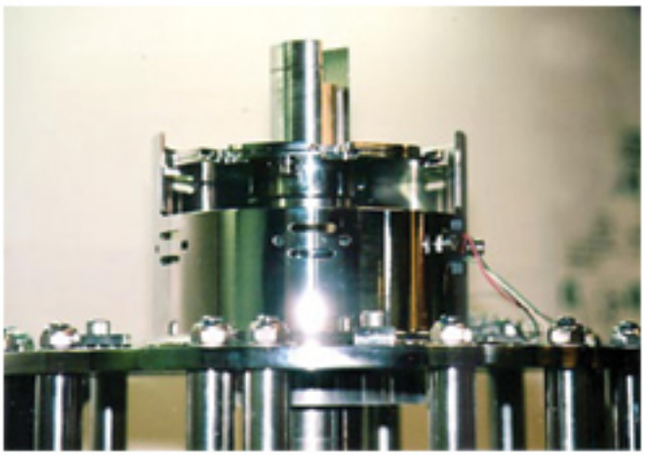

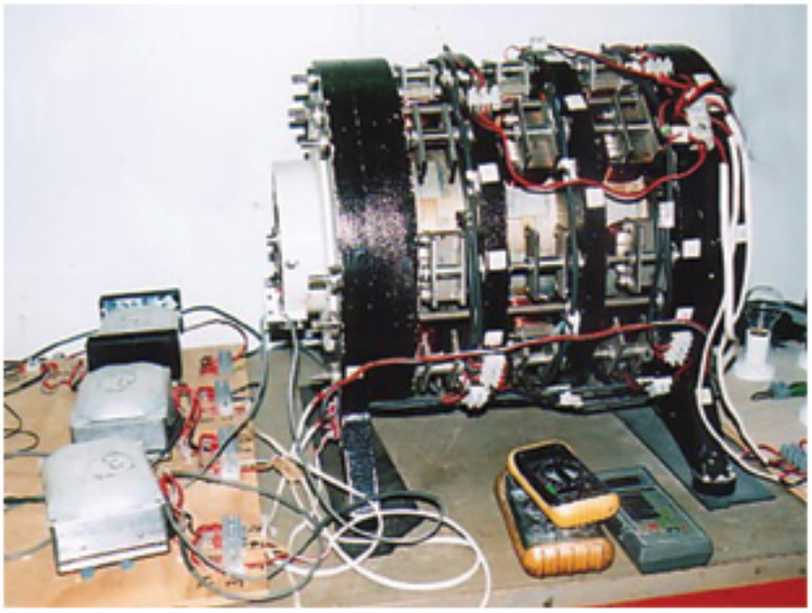

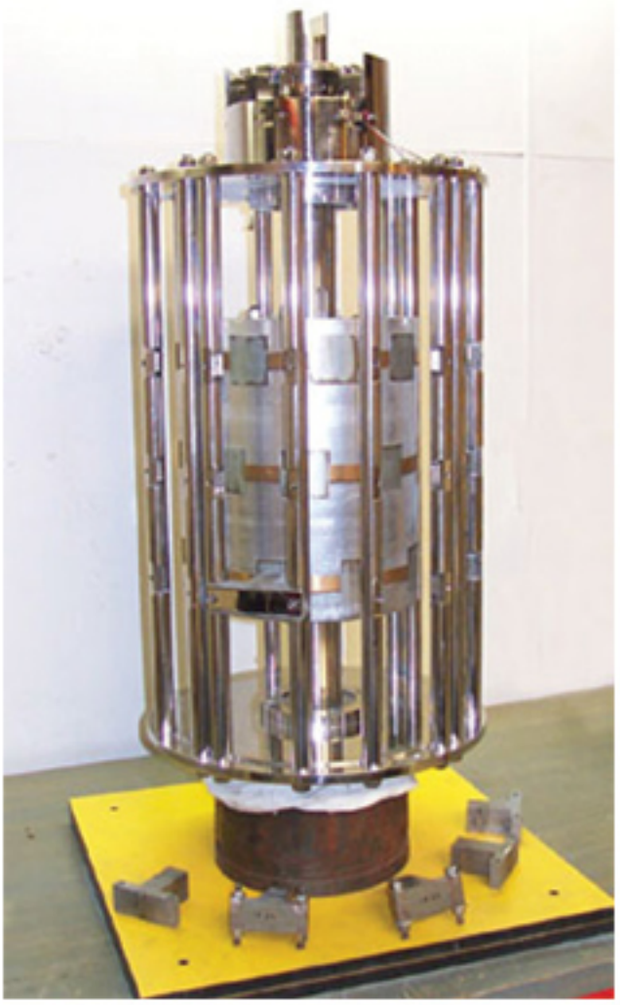

Electrogravity

by Tim Ventura
tventura@attbi.com

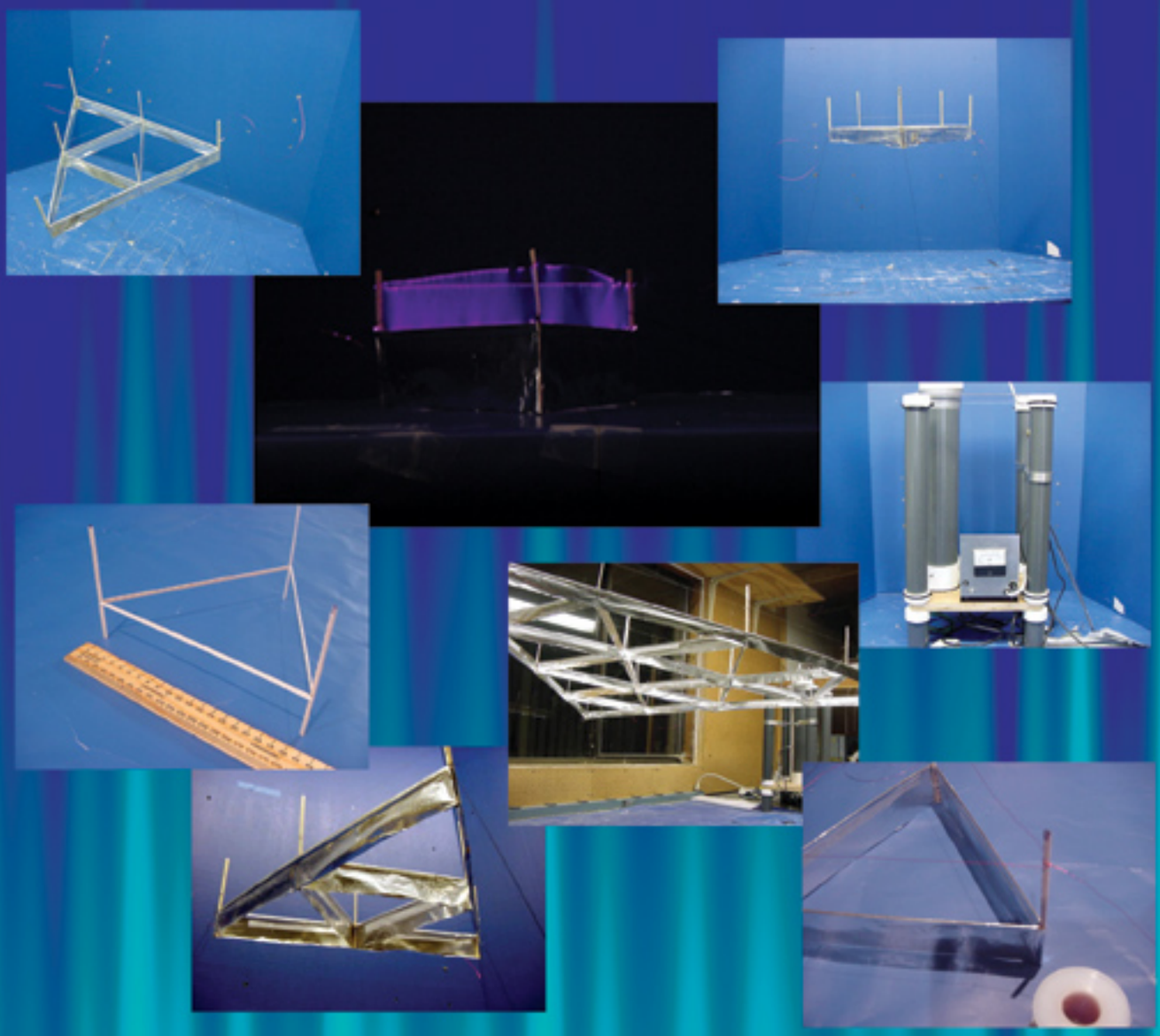

In this issue a report by Tim Ventura, USA on experimenting with asymmetrical capacitors.
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NEW ENERGY TECHNOLOGIES #6

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3. Physical Principles of The Time Machine, **Alexander V. Frolov**
4. Time Machine Project by **Alexander V. Frolov**
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20. The capacitor, which has energy of atomic bomb (Review of A. Gaponov's research)

consequence of many commonly accepted concepts and dogmas of the modern "scientific perspective of natural phenomena". This crisis situation in modern physics is a direct consequence of many conservative scientific viewpoints, unfortunately supported and protected by modern official academic science. The evolution of our consciousness has been influenced by many undoubtedly well known experts and has been evolving for a long time in the environment of specific scientific vacuum and requires immediate revival. Even methods used for dissemination of new knowledge should be improved, if one actually wishes to accelerate the progress of Humankind.

The perspective for practical applications of new previously unknown scientific phenomena and effects looks very attractive, and they may be achieved by cooperative efforts of the human intellect. New breakthrough technologies of the 21st Century will require serious changes of many commonly accepted concepts and dogmas in fundamental physics. This process of progressive development cannot be stopped.

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Large-Scale Sakharov Condition

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Abstract

Recent far reaching theoretical results have used the quantum vacuum noise as a fundamental electromagnetic radiation field to derive a frequency (ω) dependent version of Newton's gravitational coupling term, $G(\omega)$. This paper reconciles the cut-off frequency with the observed cosmological constant, and then briefly puts forward a realizable laboratory test case in the 10 - 100 MHz frequency range. One analogy is drawn between the classical vacuum energy experiments with attraction between two closely spaced plates (Casimir cavity) and the arbitrarily dense material boundaries possible in Bose condensates, such as irradiation at MHz frequencies of superfluid helium or superconductors.

Theoretical Background

Zel'dovich [1] first suggested that gravitational interactions could lead to a small disturbance in the (non zero) quantum fluctuations of the vacuum and thus give rise to a finite value of Einstein's cosmological constant in agreement with astrophysical data. Using dimensional analysis and the suggestion by Zel'dovich, Sakharov [2] derived a value for Newton's gravitational constant, G, in only one free parameter, frequency, ω:

$$G \sim c^5 \Big/ h\int \omega d\omega \sim 1 \Big/ \int \omega d\omega$$

where c is the speed of light and h is the Planck constant. The free parameter in frequency when integrated over all values from zero to high frequencies must contain the usual integration cutoff value (Planck frequency on observable electromagnetic phenomenon).

Puthoff [3] and others [4 5] have extended Sakharov's condition in a relativistically consistent model to determine constants of proportionality. His model derives an acceleration term in first order expansion (in flat space time), then equates inertial and gravitational mass (by the equivalence principle) to make contact with the gravitational constant, G, directly as:

$$G = \left(\pi c^5 / h\omega_c^2\right) \sim 1/\int \omega d\omega$$

which is the Sakharov condition [2,3]. This paper revisits the meaning of the cutoff frequency, ω_c ,for radiation interactions, of which the quantum vacuum [6-10] and

Planck frequency are only the leading terms, and for which linear combinations of forces can introduce other plausible frequencies. One purpose of this reexamination is whether the resulting gravitational coupling constant, G, can be reconciled with the anticipated energy density of the universe [11] without resorting to extreme space time curvature and thus yield enough critical density to contain the expansion of the universe. Finally we particularize the case to the high-density fluctuations possible in Bose condensates [12], a potential experimental test case for how the effects of vacuum noise might manifest observably.

One far-reaching consequence of the vacuum energy model is the attractive force of gravity becomes reducible to the radiative interaction between oscillating charges, e.g. the zero point field (ZPF) applied to subatomic charges. Mass and inertia arise from the fundamentally electromagnetic ZPF oscillations.

This random background gives the usual quantum mechanical energy spectrum from particle field effects:

$$\rho(\omega)d\omega \sim \omega^3 d\omega$$

a very important dimensional relationship, since the third power in frequency avoids anomalous Doppler shifts from velocity boosts, or stated alternatively is the correct spectra for a Lorentzian (non accelerated) invariant radiation field [13].
More specifically, the energy spectrum [3] can be written as:

$$\rho(\omega)d\omega = [\omega^2/\pi^2c^3][h\omega/2]d\omega =$$
$$= h\omega^3/2\pi^2c^3 d\omega \sim \omega^3 d\omega$$

which is an expression in the first parenthesis of the density of the normal modes and in the second parenthesis of the average energy per mode. When this energy density is integrated over all frequencies, the ω^3 divergence produces well known infinities in the integration limit of high frequencies, thus an assumed cutoff frequency (appropriate to experimental observation limits at the Planck frequency), is usually introduced:

$$\omega_\rho = \left(c^5/hG\right)^{1/2}$$

For mass, m, moving in an accelerated reference frame $g = -a = Gm/r^2$, the resulting energy spectrum includes a gravitational spectral shift [3],

$$\Delta\rho'(\omega)d\omega = h\omega/2\pi^2c^5[Gm/r^2]^2 d\omega \sim 1/r^4 d\omega$$

a kind of short range ($1/r^4$) gravitational energy shift, but electromagnetic in origin when zero point fluctuations are included. (N.B. To account for equal gravitational mass effects in neutrons and protons, the ZPF oscillations must involve subatomic charges, or 'parton' effects. The assumption derives from high frequency interactions of ZPF wherein these subatomic particles are asymptotically free to oscillate as independent or free particles as quantum noise).

A further far reaching consequence [3] is mass itself becomes interpretable as a dependent quantity derived from a damped (with decay constant Γ) oscillation driven by random ZPF:

$$m = \Gamma c^3/G = 2h\Gamma/\pi^2c^3 \int \omega d\omega$$

with the only two free parameters, the damping factor Γ, and again the frequency, ω. The internal kinetic energy of the system contributes to the effective mass.

This leads to an overall average spectral density, written in terms of mass as:

$$\Delta\rho'(\omega) = m^2c^5\omega/2h\omega_c^4 r^4$$

for the electromagnetic field distribution near ($1/r^4$) to the mass, m, which in detail is half electric and half magnetic.

One additionally attractive feature is the correspondence between this derivation and the view of gravity as a dynamical scaleinvariance breaking model (e.g. symmetry breaking near the Planck mass energy [14]). A final result includes the force calculation between two ZPF radiation oscillators of the correct form yielding Newton's average force law

$$< F >= -Gm^2/r^2$$

Thus, for a Newtonian force to first order in a flat space time, Sakharov [2] could be credited for proposing gravity as not a fundamentally separate force and Puthoff [3] and co workers [4-5] applied the vacuum electromagnetic field to equate gravity to a long-range radiation force (e.g. van der Waals like force). Higher order oscillatory gravity modes vary as $\left(\sin[\omega_o/\omega_c]\right)^2$.

To first order, a weak G coupling constant, $G = \left(\pi c^5/h\omega_c^2\right)$, appears for high frequency cutoff at the Planck scale. A corollary in analogy to electromagnetic shielding by ordinary matter can be rationalized as the problem of frequency mismatch at high Planck frequencies, e.g. ZPF cannot be fundamentally shielded. In other words, frequency mismatch precludes gravity shielding by matter.

The purpose here is to revisit the only free parameter, the frequency cutoff, more in the spirit of a mass resonant frequency. The motivation for this approach

can be summarized as: 1) the generality of other complementary radiation effects without relying on ZPF alone (e.g. other isotropic, homogeneous radiation sources); 2) the weak coupling constant, G, yields a vastly smaller than observed size of the universe (e.g. too small cosmological constant) when the Planck frequency is used as a cutoff value; and (3) the particle mass, $m = \Gamma c^3/G$, can be viewed as a renormalized or 'dressed' mass with a resonant interaction potential that is frequency dependent in its coupling constant, G, and with 'bare' mass that is large, $m_o \sim \left(m_\rho^2 / m\right)$, where the experimentally unobservable, $m_\rho = \left(hc / G\right)^{1/2}$ is the Planck mass.

In particular, why this large 'bare' mass does not generate a large gravitational field is not a unique anomaly in the Sakharov derivation, since similarly large vacuum point energies are common to field theories. The important point is that the derivation $G(\omega)$ is general however to any isotropic radiation field with the Lorentz invariant energy spectra $\left[\rho(\omega) \sim \omega^3\right]$, thus the candidates for the cutoff frequency of the particular radiation source can be interpreted as a Planck scale only if the rest mass, m_o, is not composed of many terms, rather than just the ZPF leading term. Since the ZPF is akin to a van der Waals force [3 5], polarizability (in charge and mass) must be considered, but without also excluding any number of linear combinations that might have alternative cutoff frequencies, ω_c, or damping terms, Γ, 'ala particle physics interpretations for resonant masses during renormalization. In other words, once a gravitational energy spectrum, $\rho(\omega)$ is postulated that is Lorentzian invariant, many fundamental sizes (or corresponding frequency values) are smeared (or dressed) by any number of characteristic frequencies between zero and the high frequency electromagnetic (Planck) cutoff ω_ρ. Quite simply, is the expression, $\omega_c = \omega_\rho$, a requirement for all radiation sources?

Many types of particle oscillations may satisfy the general requirements of a Sakharov condition, each having a characteristic mass (and energy) as in calculating the mass of any fundamental particle at its resonant frequency (including underlying partial charges or dense bosons). This brings the calculation to a consideration of the high density fluctuations characteristic of a Bose condensate [15 19]. While the high density variation may intrinsically be of interest, the exploration has more to do with reconciling the ZPF interpretation of the Sakharov condition with the observed cosmological constant [14].

A "top down" view of calculating the cutoff frequency imposes the self consistency test for the cosmological constant, Λ, from the outset. To calculate, the total frequency integrated energy density of the universe must be included:

$$\rho(E) = \int \rho(E) dE = h\omega_c^4 / 8\pi^2 c^3$$

which must have a mass equivalent, contribute to the universe's curvature, and thus have a fundamental relation to the critical density to contain the expansion of the universe [14 15]. The mass - equivalent ZPF to reach the universe's critical density [15], $\rho \sim 10^{-29}$ g cm^{-3} would necessarily limit the cutoff frequency for gravity to the value, $\omega_c < 7 \cdot 10^7 s^{-1}$, or between 10 -100 MHz.

A higher frequency greatly overshoots the cosmological constant, Λ, and induces extreme curvature in the universe. This problem has been cited frequently and stated most bluntly, as either ZPF or the cosmological constant requires revision. The relevance here arises from similarly large positive coupling terms in quantum gravity [15], which also generate a local gravitational Instability for typical upper limits on the cosmological constant, $\Lambda/8\pi G < 10^{12}$ cm^{-4}.

Rather than to dwell on the inconsistencies that plague attempts to reconcile quantum gravity, we particularize the problem to a case where the restriction to Planck scale becomes less clew, namely the high density fluctuations and universal scaling introduced in a Bose condensate. A Bose condensate, such as superfluid helium or superconductors [15 19], becomes of potential interest, mainly because of its arbitrarily dense boundaries and the classic Casimir experiment [20 22] which allows such dense material boundaries (two closely spaced conducting plates), if available, to modulate the background quantum fluctuation of ZPF. In other words, the matter-ZPF interaction becomes measurable by the observed attraction between two material boundaries. What dense boundaries might generate in Bose condensates remains a subject of great interest.

The significant case to investigate is whether Casimir-like interactions [20 22] will not only couple to ZPF radiation at a scale comparable to the quantum noise (or other radiation field), but also alter the value imposed by the Sakharov condition for G. It remains an open question whether this potential coupling interaction shares, as in ordinary critical phenomenon, the density correlation function, Φ, that is both independent of the coupling strength (or universal in renormalization) and consistent with the observed average energy density of the visible universe.

Thus the purpose here has bow to restate the Sakharov condition in the gravitational coupling constant, G, based on its only free parameter, a frequency cutoff, ω_c. Any potential relevance arises from similarly large values for the positive coupling term in quantum gravity, which generate conditions for a local gravitational instability for typical upper limits on the constant, $\Lambda/8\pi G < 10^{12}$ cm^{-4}.

To restate the Sakharov condition, matter in the vacuum provides boundaries for reduced 'Casimir like' modes available for otherwise isotropic radiation from quantum fluctuations (broad spectral noise). That this view reproduces Einstein gravity has been examined, including the full relativistic derivation [4-5]. The details of the appropriate mass, however, remain buried in the kinetic energy of general internal particle ('parton') motion [3]. Any appeal to a specific parton representation is limited only by essentially free particles with high frequency interactions, including underlying partial charges or dense bosons. The basis of considering arbitrarily high-density fluctuations in Bose condensate in analogy to the ZPF-Casimir experiment remains both an empirical and theoretical case to examine. There exist laboratory scale cases [15-19] where resonant radiation in the required 10-100 MHz range appear to produce anomalous effect for such Bose condensates as superconductors, but further work to confirm these results would be needed. In other contexts, these effects have been discussed as the Schiff-Barnhill effect for superconductors interacting with a gravitational field [23], but for the static rest moss rather than an effective mass in a conduction band.

Experimental Propositions

J. Weber [24,25] proposed the use of a superconducting Bose condensate for gravity wave detection, principally because of its potentially higher signal to noise ratio in carrying electrical signals upon length dilations in a relativistic framework for gravity waves travelling near the speed of light. W. Weber and Hickman [26] derived an experimentally testable relation based on torquing of a charged capacitor parallel to a gravity field, with

$$\tau = 2E_g / \pi[\alpha / (1-\alpha)^{1/2}]$$

where the capacitor will rotate relative to the gravity vector, for $\alpha = 2GM / rc^2$, is Schwarzschild radial coordinate [$dR = dr(1-\alpha)^{1/2}$] , E_g is dependent on the capacitor charge and geometry of the plates, $E_g = [Q^2 d/2\varepsilon WL(1-\alpha)^{1/2}]$, for a plate separation, and radial dimensions,W and L, charge Q, and ε the permittivity of free space. For plate separations of 2 mm on Earth, the maximum torque is approximately $\tau = 10^{-12}$ Nm, when charged to 2/3 dielectric breakdown. While not entirely promising for detection of such low torques, the large separation (2 mm) distance between capacitative plates naturally prompts generalization to the classic Casimir force [21] experiments only recently confirmed experimentally [20]. In particular, we rewrite the torque values to include the frequency terms derived with the Sakharov condition

$$[G = (\pi c^5 / h\omega_c^2)]:$$

$$\alpha = 2M\pi c^3 / h\omega_c^2 r$$

The appeal of this formulation is that a frequency dependent torque is derived, which further makes contact with proposals to modulate the Casimir capacitative plates for continuous extraction of energy [27]. This result requires further investigation experimentally, particularly to compare with previous reports for anomalies in AC- tuned electrical capacitors [28].

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The Problem of Electron and Physical Properties of Time:

To the Electron Technologies of the 21st Century

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"...it is necessary to periodically subject to the deepest revision the principles, which were recognized as final and were no longer discussed".
Louis de Broglie

Abstract

The results of an approach based on the synthesis of standard quantum electrodynamics and of the ideas of self-organization in physical systems are briefly outlined. The quantum model of electron as an open self-organizing system is constructed, with the physical mechanism of self-organization consisting in the back influence of the own field created by electron on the same electron. The own field is considered as a physical property of electron, intrinsically inherent in electrically charged matter, which is included in the definition of the particle from the very beginning. The own field of electron endows the particle with wave properties and represents a bearer of superluminal signals, which can be used for the creation of qualitatively new communication systems. Because of the inseparable link between space and time, the force in relativistic mechanics is the cause of change not only of the velocity of particle, but also of the course of time along the particle's trajectory. For this reason the flow of time in some area of space depends on the character of physical processes, occurring in it, and, therefore, time can be controlled by slowing down or accelerating its course with the help of material processes. The conclusions of the paper are not in conflict with the special theory of relativity (STR); they are a direct consequence of relativistic equations of motion and represent an essential development of the generally accepted notions about space and time. At present all the necessary prerequisites are available, both theoretical and technical, for the practical mastering of the own fields of particles and of the physical properties of time.

1. Introduction. The Problem of Electron and Future Outlook

Electrodynamics, what is this? What is its value for man? Electrodynamics is the theory of electromagnetic interaction, one of four interactions existing in nature. Its role in the life of society is seen from the fact that the most part of natural phenomena, which we encounter at every step, is of electromagnetic origin: it is due to the interaction of electromagnetic field with electrically charged particles entering into atoms and molecules. It is fair to say that electromagnetism plays a crucial role in the life of mankind as it determines the ways of technical advance of society [1].

The key problem of quantum electrodynamics is the problem of electron, which can be formulated as follows: to construct from the first principles a non-contradictory model of electron, which takes into account experimental facts, i.e. to find the dynamical equation capable of describing the unique physical properties of electron, its internal structure, its behaviour when it interacts with electromagnetic field.

Electron was discovered a little more than 100 years ago, in 1897. With discovering the electron the revolution in physics began, which has resulted in unprecedented technical advance of society. The summit of development was reached in the middle of the 1950s and then the long period of evolutional development followed, when new physical principles were used to describe various physical processes and phenomena. The violent development of physics became slower in the 1970s and was replaced by stagnation in the subsequent years. The stagnation in electrodynamics continuing already over a period of several decades is gradually giving place now to a new ascent. The new scientific revolution is starting, which is associated with electron again, much as it happened hundred years ago. The reason is that electron is the most unique particle storing in itself the deepest mysteries of nature and the degree, to which they are disclosed, determines the

wants to stay anonymous, until his patent application is done and university verification tests will be done). The claims are: 1200 Watts coil out with about 1076.4 Watts in into the driving motor at 3450 RPM. 8 amps 117volts at no load 9.2 amps 117 volts at full load. The output of about 1200 Watts is already a total overunity operation! As they just increase the input power by about 140 Watts only between idle and load state and they get 1200-Watts output it seems indeed a case, where Lenz law is violated! This generator also has NO motor effect! If you supply current to the coil, the permanent magnet in the center will not rotate; cause the flux just stays inside the toroid core! There you can see, that the back drag does not influence the mechanical rotation of the magnet!" Stefan used very good criterion to prove high efficiency of the design: **There is no back-torque effect! It is most important aspect of Gramm's generator.** You can contact directly Stefan Hartmann: Keplerstr. 11 B, 10589 Berlin, Germany. Tel: +49 30 345 00 497, FAX: +49 30 345 00 498 email: harti@harti.com info@ccard.net (Please, note: Dr. Harman referred to my old web site www.time-machine.spb.ru which is closed now).

So, basic principles of MEG and Φ-machines are the same. It was patented more than 100 years ago. Primary magnetic flux is topologically separated in two (or more) fluxes, which are mutually compensated in the ring core. Advantages of MEG are absence of moving parts since special input coils produce changes of primary flux. Also level of saturation in ferromagnetic material obviously should be corresponding to intensity of primary magnetic field, which is created by the permanent magnet, Fig.4.1.

Besides MEG the same principle can be (and already was!) realized in many other systems. So, there is no any news in the USA patent #6,362,718 granted for "The Motionless Magnetic Generator". What did they claim? You can find it in the patent: "The first input coil and the first output coil **extend around portions of the first magnetic path**, while the second input coil and the second output coil **extend around portions of the second magnetic path.**" Yes, it is the same bi-directional principle we discussed above: two parts of the magnetic flux and each coil produce effect to reduce flux due to this superposition.

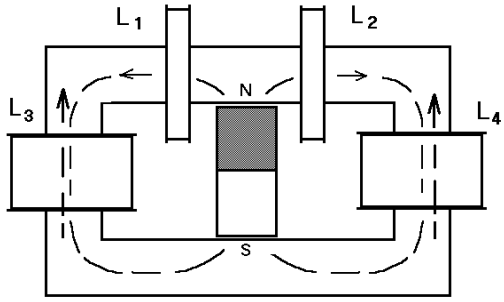

Fig.4.1

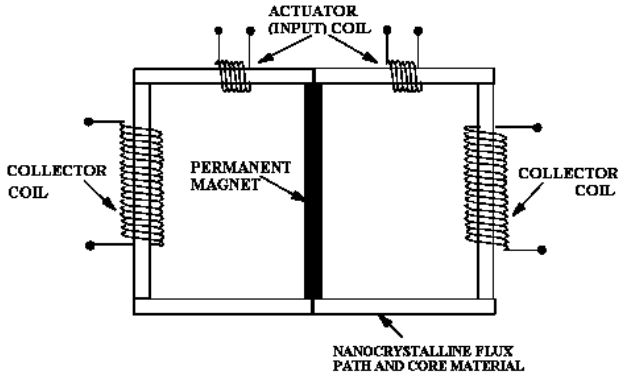

Fig.4.2
Diagram of prototype by Bearden.

In conclusion I'd like to confirm our sincere interest to develop joint work with all new energy research teams if they are not trying to obscure the issue of the technology by means of complex theoretical constructions and common words about zero point energy.

Matter as a Resonance Longitudinal Wave Process

Alexander V. Frolov

Abstracts

There is experimental data on gravitation anomalies for cases of resonance irradiation of the Bose condensates (superfluid helium or superconductor) at 10-100 MHz frequencies. It is developed by the author in frames of his aether theory that can be used for practical applications in aerospace and new energetics.

ZPF or aether fluctuations

The fundamental electromagnetic radiation field (Zero Point Field) ZPF or the quantum vacuum noise is a recently accepted physical notion. In the article [1] David Noever and Christopher Bremner used it to derive a frequency – dependent version of Newton's gravitational coupling term G. On the other hand we can consider the quantum vacuum noise as aether fluctuations. Dr. Alexander Mishin [2] described experiments on registration of these processes by means of special equipment. Both approaches (ZPF and aether fluctuation) allow to conclude that mass and inertia arise from these oscillations. However if we are considering the oscillation as some aether process then we can assume and describe some physical mechanism of this process.

One of consequence of the vacuum energy model, which is described in [1] is that "the attractive force of gravity becomes reducible to the radiative interaction between oscillating charges..." Let's clarify which kind of radiation can be created by oscillating electric charges.

There are many different sources to find the answer on this question and one of them is the article by Prof. Kirill P.Butusov [3] on symmetrization of Maxwell's equations and practical methods of generation of longitudinal waves in vacuum. So, ZPF model has a direct relation with the aether model since indirectly it leads to the question of longitudinal waves in vacuum. Physically they are waves of density of energy and in the aether model the waves are areas of more dense and more rarefied aether. Let's note that there are standing waves besides moving waves.

To consider the interaction of some mass particles and the fundamental field the notion of subatomic charges "partons" was introduced [1]. So, the mass itself "becomes interpretable as a dependent quantity derived from a damped oscillation driven by random ZPF" [1]. The authors wrote about "internal kinetic energy" of the mass particle and it can be considered as a function of ZPF oscillation frequency. In the aether theory of mass there is a similar notion of "aether vortex", which represents some cyclical process of some frequency and it is possible to calculate its kinetic energy. This aether vortex model of matter elements allows to assume real methods to change parameters of vortex and to get changes in parameters of existence of the matter. On the other hand we can discuss the possibility to change some physical parameters of aether in areas of the vortex to get the same result. This possibility follows from the well-known N.Kozyrev's experiments, which were named "investigation of active properties of time". N.Kozyrev used chronal (temporal) approach in his theory. We have to change his notion "the density of time" to "the density of aether" to get a direct link between his experiments and the aether theory of mass.

N.Kozyrev and others have [4,5,6] experimentally demonstrated that irreversible processes in matter produced changes of aether density in the area of the experiment. Detectors of different type can register this change. It is obviously that any matter element (i.e. the aether vortex) in this area of changed aether density should get more inner (kinetic) energy or slow the inner motion. From the chronal point of view these are changes of inner time of this matter element.

Gravity shield

One more interesting point that is discussed in the article by Noever and Bremner [1] is a problem of gravity shield. The authors show that resonance interaction with ZPF produces "the particle mass" and it can be viewed as "a renormalized or "dressed" mass with a resonant interaction potential. Similar resonance approach is used in the conception of de Broglie's matter waves. Also the authors [1] mentioned the existence of an experimentally unobservable mass. In this case ZPF cannot be fundamentally shielded by matter since "frequency mismatch precludes gravity shielding by matter" [1]. The only way to get screening of ZPF fluctuations seems to be very complex: it is necessary to provide frequency matching for whole wavelength band of the oscillations.

I think some specialization is necessary here to explain experimental gravity anomalies with Bose condensates experiments (superfluid helium or superconductors): **special process in matter can be used as the gravity screen and this approach does not involve the frequency-matching problem.**

We have concluded above that any matter element is a resonance process and its energy is derived from ZPF. It is useful to note that these are longitudinal wave oscillations of energy density in aether. In this case, the gravity shield problem can be solved in frames of the aether vortex conception of matter.

The longitudinal wave is a moving (or standing) areas of rarified and thickened aether. Let's consider the moving wave, which is responsible for gravitation attraction effect. How can we stop, re-direct or reflect longitudinal wave in aether by means of aether vortexes (matter elements)? **We can produce interaction with this wave only by means of other longitudinal waves.**

In macro-level this idea can be realized as longitudinal wave generator. Electromagnetic processes, which can be used as sources of directed longitudinal waves, are known and some of them are described in [3]. In other way the gravity shield can be produced as longitudinal waves generated by natural aether vortexes (i.e. by matter elements) if the matter exist in a special exited state, for example for cases of resonance irradiation of superfluid helium or superconductor at 10-100 MHz frequencies.

Matter element as resonance process

In [1] the authors wrote that it is possible to calculate "the mass of any fundamental particle at its resonant frequency." There is the question: what is the general basis of whole spectrum of stable elements masses?

In 1996 the author published the article "The concept of mass process" [7]. At first in this work physical sense and notion of 3-dimensional curvature was introduced. By analogy with known mathematical notion of linear curvature $\rho_1 = \frac{1}{r}$ (where r is radius) and uniform surface curvature $\rho_2 = \frac{2}{r}$ it was proposed to calculate curvature of a 3-dimensional space as

$$\rho_3 = \frac{3}{r} \qquad (1)$$

The radius r in this case means that in a 3-space there is some periodical process. In other words, 3-dimensional matter is a resonance process.

Further, de Broglie used formulations E=hf and E=pc (where p is momentum, h is Planck constant, f is frequency and c is velocity of light) to derive the following:

$$hf=pc \qquad (2)$$

that allows us to get the well-known formulation

$$\lambda = \frac{h}{p} \qquad (3)$$

There is another logical branch of this idea that leads to the understanding of the mass properties of matter as a resonance process. Instead of E=pc in [7] it was proposed to use $E=mc^2$. In strength of the wave-particle duality we can write the equation

$$mc^2 = hf \qquad (4)$$

and from this equation the mass can be presented as resonance electromagnetic oscillations

$$m = \frac{h}{c^2} f \qquad (5)$$

Let's note that f=1/T, where T is some period of oscillation. So, we can write the following

$$m = \frac{h}{c^2}\frac{1}{T} \qquad (6)$$

where $\frac{h}{c^2}$ is new constant between mass and period of time.

There is an important conclusion: any mass is a process and there is some period of time, which corresponds to this mass. In other words, there is no physical sense of time separate from some process of existence of mass. Product mass and period is a constant value, which was named as a chronal constant

$$mT = \frac{h}{c^2} = const \qquad (7)$$

The chronal constant is a parameter of some real space and it is equal to $0.73725 \cdot 10^{-50} [Js^2 / m^2]$

Also in this work [7] there was a demonstration of several examples of newly discovered physical law: spatial curvature of some natural objects (proton, planet, DNA molecule) is a whole number. There is some analogy with the nuclear physics notion of wave number. From this fact we can assume that main natural matter elements exist in main resonance states. For example, if Bohr radius is 0.52917 Angstrom, then we can find the wave-length $l = \pi d$ and the linear curvature is $\rho = 1/l = 3.0075 \cdot 10^9$ (m) and 3-dimensional curvature of this object is $\rho = 3/l = 1.0025 \cdot 10^9$ (m) that is unit of mater, corresponding to simplest atom, i.e. unit matter engine. Let's note that it is near the unit and some distortion of 0.0025 means non-ideal resonance state of the system.

Calculations for planet Earth in [7] were based on the known period of orbital rotation T=31557600 sec that corresponds to frequency of electromagnetic oscillations

$$f = 1/T = 3.168861 \cdot 10^{-8} (1/s) \qquad (8)$$

and wave-length

$$\lambda = c / f = 9.46... \cdot 10^{16} (m) \qquad (9)$$

The curvature (if this wave-length is considered as radius of the resonator) is following wave number

$$\rho = 1057.00 \cdot 10^{-20} (1/m) \qquad (10)$$

Also we can use other known data about the planet. Daily rotation period of our planet is known T=86400 sec and we can calculate its wavelength $\lambda = 3469{,}82(m)$ and corresponding curvature (wave-number). Sure, it is also a whole number with a good accuracy:

$$\rho = 2882 \cdot 10^{-7} (1/m) \qquad (11)$$

The laws of physics in macro cosmos and micro cosmos are similar. From these calculations it was assumed that whole formation of mass spectrum of stable chemical elements of matter is determined by similar physical mechanism.

Creation of mass

In short we can summarize that technology of longitudinal waves in aether is a real basis for creation of matter with mass and inertia properties. N. Tesla used this method to produce different objects: from ball lightning up to electrons. Velimir Abramovic says in his article [8]: "The principle of resonance and harmonic oscillation of aether seems to be so clear that all problems of modern physics, especially a problem of energy conversion, will be solved with its development. By means of his vacuum tube Tesla got protons, electrons and neutrons directly from aether and reproduced them at any distance. Instead of giving a possibility to the bundle of protons to move through space to some place, he created conditions for momentary appearance of arbitrary quantity of particles in the given place."

Any objects can be classified as aether vortex and parameters of this vortex determine its mass, electric charge and other properties of matter.

The "parton" as element of matter in [1] is a useful tool for description of physical properties of aether.

Longitudinal waves in Woodward's experiment

In [1] the authors state that resonant radiation in the required 10-100 MHz range appears to produce

anomalous effects for such Bose condensates as superconductors. In my opinion it is a particular case of discussed above technology of longitudinal waves in aether due to possibility of transformation of transverse electromagnetic waves in longitudinal waves in the superconductors. This transformation in plasma is a well known physical mechanism.

More facts to prove this idea: by Woodward [9] there is a special requirement, i.e. the frequency of mechanical vibrations should be twice the frequency of electrical oscillations in the capacitor, which demonstrates the weight anomalies. But from the other hand it is a common rule for creation of longitudinal weaves in plasma! Also it is a necessary condition for generation of parametrical oscillations! So, we can assume that basis of the effects in [1] and [9] is a generation of longitudinal wave in aether.

Conclusion

Any element of matter can be considered as resonance process of aether oscillations, which are longitudinal waves. There is an analogy with description of these longitudinal waves and well-known matter waves by de Broighl. Experimenting on the longitudinal waves generation and especially experiments on standing waves to get gradient of aether pressure allows to develop gravity control technology.

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Gerlovin's Theory of Activation

Alexander V. Frolov

It is a review of the famous book by Ilia L. Gerlovin "Basis of unified theory of all interactions in matter"published in 1990, St.Petersburg, Russia. We hope this article let you discover some new aspects of physical vacuum structure to develop more new experimental methods. Comments made by Alexander V. Frolov, Editor.

In [1] the author wrote about different methods to activate water solutions: mechanical, thermal, acoustic, magnetic and electrical. One of the known methods is an activation by means of electrohydraulic method. There is also some information about activation of other mediums, mainly liquids, but also some gases and solid bodies.

There are no theoretical explanations of these facts to explain all aspects of these phenomena. Furthermore, complexity of interpretation of these phenomena in frames of common physical notions induced some scientists to announce these phenomena as non-existing and "illegal".

Ilia L. Gerlovin formulated the physical principles of theory of activation of mediums on the basis of new physical theory, the Theory of Fundamental Field (TFF). These principles are based on his two important conclusions from the TFF:

a) "Space around us is not empty, physical vacuum consists of material physical objects, i.e. elementary particles of vacuum (EPV). These particles are responsible for main activation processes;
b) Force interactions between atoms in molecule, between molecules in crystals has not spherical symmetry in the crystals of solid bodies, but an axial symmetry and the interactions are changing in time with very high frequency of about 10^{18} Hz. This feature of force interactions also makes its own contribution to the activation of mediums." [1, p. 314]

So, it was assumed that the phenomenon of activation of mediums can be defined as anisotropy of force interactions, which leads to **"meta-stable state, which can be called *structurally activated state of the given structure".***

Here is some difference in principle between chemical term "activation", which characterizes a transformation of molecule or atom in some active state with an increased energy, which is sufficient to provide a chemical reaction. It is ***energy activation*. Gerlovin described new notion, a *structural activation:* "This phenomenon can be classified as some change of structure of activation object. With this, energy of molecule can have no changes, and *active properties***

Coupled with aetherodynamics time conception, which was suggested by Alexander V. Frolov, the works on the control of space-time parameters gain the possibility for development and commercial application. As a theoretical basis there are those N. Kozyrev works where his conception of "time density" are replaced by that of "aether density" according to Frolov.

In September 2002, Faraday Labs Ltd Company plans to complete testing of the first experimental system, and to start the patenting and research of applied aspects, first of all in medicine.

Physical Principles of the Time Machine

Alexander V. Frolov

Experimental success of research team headed by Dr. Vadim A. Chernobrov, Moscow was reported in [1]. The time course can be controlled as rate of any process in local space-time (inner space of the Time Machine). It can be decelerated or accelerated by means of special "converging electromagnetic waves". Ordinary waves move from the source whereas special "converging waves" move to some central point, i.e. into the focus of the system. In Chernobrov's design of the Time Machine this process is organized by means of several spherical envelops, which consist of several electromagnets. Electronic control unit controls the processes in this design. Dr. Chernobrov reported about 3% change of the time course in 4th version of the system, which was tested with a human inside. The goal of Dr. Chernobrov's work is to research the medical aspects and experimental investigation of the principles. Several important conclusions were obtained from the project: the time course can be controlled and character of the changes is different for acceleration and deceleration mode.

Other known publication and research projects on the same topic seem to be very far from any commercial and practically useful application. Obviously the topic is very new and fantastic for most of scientific community and at first we have to clarify the physical principles of the time control project, which is started by Faraday Labs Ltd.

In this project we believe that notion of time is one of possible description of real physical properties of our Universe. So, it is not mathematical abstraction but some aspect of physical reality and we can discover some physical properties of time. Russian astrophysicist N. A. Kozyrev [2] developed a theory of active properties of time and according to his point of view there are two properties: time course and time density. Prof. Kozyrev demonstrated experimentally that time density in area of some process (changes of matter) is dependent on entropy parameters of the processes. In [3] it was demonstrated that Kozyrev's experiments could be interpreted in aether theory and it has led to simple physical conclusions and clear experimental perspectives: **time course and its density can be explained and controlled as parameters of aether.** Directions of aether flow and density of aether are subjects of experimenting with non-reversible changes in matter, for example, in crystallization or melting processes. Also it is possible to use special electromagnetic processes, for example, Chernobrov's "converging waves" or other longitudinal waves as methods of aether compression or rarefaction. If we assume that process of existence of elements of matter physically can be explained as aether vortex processes then its rate is a parameter of **aether income/outcome balance** (aether inflow in element of matter and aether outflow from the element of matter). It was also described in Time Rate Control (TRC) theory [3]. To control this balance it is necessary to develop technology of longitudinal waves generation, its focusing and resonance effects. The previous research and experimenting on the topic has been made by N. Tesla.

Let's assume that we have some technology to change parameters of time course. How should we organize this local space-time (what is spatial topology of the design)? There is a very interesting experiment to get the answer: rotation of a heavy cone (for example, lead cone) entrains surrounding aether, so a vortex appears, which is a toroidal formation of aether (rings). The rings can exist in space for a long period. The further question is: Why does the beam of light (laser beam) directed to the cone by tangent create a luminous ring? We can assume that due to natural properties of photons (light propagates along the geodesic line in space) some autonomous closed toroidal space should be created in such experiment. The next thought is: since space and any matter exist in time then we can speak about some autonomous time. The general conclusion is to be the following: autonomous 4-dimensional space-time can be created as toroidal aether vortex.

Here is point to note some aspects of research project by Prof. Robert Mallett, Connecticut University, USA. In fact, sometime next year, he hopes to produce the first piece of technology that eventually will allow him to build a time machine. By Mallett it will be a device that employs lasers "to twist space". Why is he going to close the beam of light? His theoretical background is knowledge about black holes, i.e. understanding of the connection between gravity and curvature of space-time. In Einstein's theory both matter and energy can bend space and time. So Prof. Mallett assumes that curvature of space-time can be changed not only by mass (like a black hole) but it can be affected by energy of photons. This has led Prof. Mallett to consider the possibility of using a circulating beam of light to twist space and to create closed loops in time. It is predicted that a spinning neutral particle, when placed in the ring, is dragged around by the resulting gravitational field [4]. From the

first view it is the same approach we have considered above (experiment with aether toroidal rings). But proposals by Prof. Mallett differ in principle from the aether conception.

The main aspect of this technology is a creation of autonomous (self-closed) toroidal space-time. Autonomous geodesic world line of this space-time is self-closed. Any photon should be circulating in this system due to its properties: photon is always moving along the straight line of the space.

More deep understanding of this technology follows from the explanation of photon as oscillation of aether. Any photon can be considered as result of relative motion of the matter (observer) in absolute space (immovable aether). Usually a photon is considered as moving object in space. But we can assume that observer is in the motion and the photon is oscillations of the absolute space (immovable aether). Which approach is more real one? Sure, it is more easy to consider a photon as moving object but let's remember fact of our real motion in the Universe and fact of the Universe expansion.

So, ideas by Prof. Mallett are very far from the **aether nature of the time phenomenon.** He follows the black holes theory and general understanding of space-time distortion due to mass or energy presence. Also he knows that a light beam should be closed in a ring. However Prof. Mallett is very far from physical basis of the effects. **The key of time rate control is technology of artificial aether flow, creation of aether vortex systems (AVS), management on density and direction of aether flow.** There are several technical methods to produce it. Any light beam should be curved in self-closed "light ring" if it is placed in a toroidal aether vortex and we can say that this system has own space-time.

What does "some changes of time course" mean? We can measure it as some changes of standard rate of oscillation process, for example, some stable wavelength of laser beam or quartz oscillations. There is a well-known experiment with two atomic clocks (one of the clocks is placed on the roof of some building and another one is placed on surface of planet). Due to vertical component of gravity the time course should be different and it can be measured. How can we organize difference in these measurements if both atomic clocks are placed in the same altitude?

It is necessary to consider gravity nature in frames of the aether conception. Two atomic clocks demonstrate difference in measurements due to difference in aether flow density. Hence, by means of aetherodynamics methods it is possible to control the rate of oscillation processes in the atomic clocks and in any matter (i.e. time course itself).

The aetherodynamics methods have a clear analogy with electrodynamics: **motion of charge produce field and there is the induction law**. Really, classical electrodynamics can be considered as particular case of the aetherodynamics. So, physical sense of any field is stress or deformation (it is some static field) or oscillations of aether.

Let's introduce the notion of chronal (temporal) charge to consider some technical aspects. In electrodynamics we assume an electric charge as element of matter with positive or negative electric properties and we have to compare it with some reference (zero charge or test charge). Let's note that in any case we have to consider "charge of some particle" but not an "abstract charge". So, we can postulate that any element of matter has **zero chronal charge** if it is moving from Past in Future with standard (usual for measurements of surface of our planet) time course. If the time course (i.e. existence of some element of matter) is decelerated then it can be measured as decrease of standard oscillation frequency of the matter. Time course acceleration means some increase of standard oscillation frequency of the matter. Let's determine that in the first case it is negative chronal charge and in the second case it is some positive chronal charge. Atomic clock is one of possible methods to measure zero chronal charge or to find some relative positive or negative difference.

It is predicted here that motion of chronal charge should produce a chronal field. Some provisional data was received by Frolov from simple experiments on the rotation of a heat source. Accelerated motion of chronal charge (changes of density of chronal current) should produce aethero-induction effect that is an analogy (or more general case) of Faraday's induction effect. This effect can be detected as secondary (induced) deceleration of time course in nearest area of accelerated time matter. Another case is a secondary (induced) acceleration of time course in the nearest area of decelerated time matter.

Technical realization of aethero-induction method seems to be very close to idea, which is described in classical epic "Back to the Future". At first, it is necessary to create or to collect some chronal charge in a "flux condenser" and then to accelerate it in space up to some velocity. According to the aether conception, this creation of the chronal charge is a real technical process.

It is assumed that estimated chronal effects are demonstrated as some threshold field, i.e. space-time has some stable discrete energy levels and changes of its curvature should have discrete threshold mode. All new aspects disclosed in this paper are the subject of a patent process. Faraday Labs Ltd organizes experimental program on the topic. Practical application of this technology is new energy systems and propulsion methods.

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investigated completely yet. It was found also that harmful effect on biological systems is not related to the process of movement in Time itself but is a result of the difference of the Time rate value in various parts of a body (a biological system).

Inside of the laboratory setup it was also discovered that Time could be changed with some inertia. Areas of space having different Time rates have vague borders. With sufficient difference in Time rate the human can see an area with a different Time rate as some white mist. Higher the difference – the mist is denser, that can be used as an alarm signal for biological systems. It is possible to consider Time-travel as possible and (after experiments with mice) there are reasons to suppose it will be safe for travelers if they follow certain rules. It is especially necessary to emphasize: the trips through Time (due to new discovered properties of Time) can't affect the Past and they can't change our past history. All the so-called paradoxes for the traveler in Time (for example when "he meets himself in the Past" or "he kills his grandfather in his childhood" have clear solutions in 3-dimensional Time.

It is possible to consider as a proven fact that Time has more than one dimension, i.e. O. Bartini's theoretical calculations are confirmed by these experiments: Time has 3 dimensions. Hence our Earth world can be considered as a 6-dimensional object: length, width, height, age or date of Time, variant of a History or erosion of Time, density or rate of Time. The concept of "the Arrow of Time" as fourth dimension (moment of Time) is a particular case of the concept of sixth dimension (rate of Time) that leads to the physical concepts of gravitation and energy and they are simultaneously connected. Concepts of the " Einstein-Rosen bridges" known since 1916 or "worm-holes"

introduced into science by John Willer in the 50's, are travels in 5th and 6th dimensions, i.e. the "classical" Time travels, which were described by H. Wells.

Editor's: As the reader could note, the author does not disclosure the secrets of the TM design. From the photo you can see the electromagnets, which form the regular stereometrical construction as well as the cables from the TM to the control unit. Dr. Chernobrov mentioned the converging electromagnetic waves only. So, to understand how it works, it is necessary to get a clear notion of the converging electromagnetic waves. Let's imagine the ripple effect created by a stone in the water. The waves move from a central point to periphery. The converging waves are just an opposite process: the waves move from periphery to the central point. Is it possible in Nature? Yes, sure. Dr. Chernobrov wrote: "Let's throw a hoop on the water and inside of the hoop we'll see converging waves." The Time Machine technology by Dr. Chernobrov is based on the similar principle.

Time Machine Project

Alexander V. Frolov

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Faraday Labs Ltd and Dr. Vadim Chernobrov have signed the agreement on scientific-research work on investigation of active properties of time.

In the course of the previous experimental works, carried out by Dr. Chernobrov's research team during the period from 1984-2002, four versions of Time Machine had been made and tested. At these devices (the biggest system is about 1 meter in diameter) the effects of deceleration and acceleration of time course were created and measured. The principles of control of time course velocity were based on the

Alexander V. Frolov, General Director Faraday Labs Ltd and Ph. Dr. Vadim A. Chernobrov have just signed the Contract

interconnection of electromagnetic processes and physical properties of space-time. Special electromagnets, operating in pulse mode, are placed at the spherical frame. They create the so-called "converging wave", which by Alexander Frolov is a longitudinal wave in nature.

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Kozyrev-Dirak Radiation
Its influence on animals

Dr. Ivan M. Shakhparonov

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In the experiment with animals, that were made in the Center of Oncology Researches (COR) at the Russian Academy of Medical Sciences (RAMS), on the applying of Kozyrev-Dirak's Focused Radiation (KDFR), it has been found that KDFR decreases the quantity of glucose in the blood, reduces its tenacity, promotes the strengthening of immunity and the rise of the quantity of marrow cells.

Introduction

This time researchers in Russia and abroad experiment on ball lightnings by means of nonoriented circuits, which are similar to the electric analogues of Mobius band, also by means of Klein bottle and their combinations. Non-oriented fields are investigated very intensively now. Accordingly, organisms of the researchers, who observe the interactions of such fields with a matter, are also changed, thus they should take it into account on making such experiments. The aim of the article is to show in which way the fields of nonoriented circuits influence on animal and human organism. Besides the article has for its object the prevention of negative consequences, which can appear for experimenters through the research process.

Experiments with animals that were carried out in 1992-1993 in Russian Academy of Medical Sciences (RAMS) had not been published in proper time because there were no quantitative methods of radiation detection. Later, in 1996 they were developed [1] and KDFR parameters were measured in that geometry, which were applied in RAMS. In 1998 powerful and super-powerful KDRF sources were obtained. These sources were applied (and are applied now) in the researches at the controlled radioactive decay [2]. Kozyrev and Nasonov [3] and later also Lavrentyev with the collaborators [4,5] have proved experimentally that the Sun and some stars generate the radiation, which has early unknown properties. We suggest that the radiation, discovered by Kozyrev [3], and the radiation, which is researched by us and by other experimenters with nonoriented circuits, are of the same phenomenon. At first, it should be noted that on interaction between Kozyrev-Dirak radiation (KDR) and a matter made it colder. As it was demonstrated above [1], cooling effect can be explained by matter re-magnetization under the influence of KDFR beam (adiabatic demagnetization). According to the still unpublished data, KDFR bunch destroys matter lattice by the way of it's moving. However, after a couple of week matter reconstructs it to the almost tabulated points, without defects, blockness and other damages, which are peculiar to other natural crystal structures. **In the definite sense nature demonstrates the way to rejuvenate compound structures**. As it is well known, vital functions of biological systems on the Earth depend on the structure and composition of water. Therefore, we have a right to expect considerable changes in the vital functions of biological organisms under the influence of KDFR.

Experimental Devices

In experiments with animals there were applied the devices, which concentrated KDR (KDCR) and had 50 Wtt aggregate electrical power. The description is presented in [2].

KDFR indication was obtained by calorimetric method [1], along the way of movement of the main bunch (with 10 cm across diameter) and at angle of 45° from the geometrical axis of a device.

Researches of Bleeding Duration

Let us consider KDFR influence on the blood composition of animals. At the experiment 24-28 gram weighting, pelletized fed male mice were used. In the process of the experiment it was discovered that 3 and 4 hour processing of mice with KDFR at the distance 2.5 m and at the presence of animals in the sphere of maximum radiating power, caused some changes of fibrillation system. The bleeding duration was determined according to Duke method. Two groups of animals were used at the experiments: a group with 4-hour duration of KDRF processing and a group with 6-hour duration. Time of bleeding was considered in dynamics at 1, 2, 7, 14, 21, 28 and 35 day (Fig. 1). The bleeding duration of the intact animals was determined by the value 128±11 sec. After the applying of KDFR there was noticed some increase of bleeding duration to 261±15 sec and 223±21 sec on the first day after the stopping of the influence. In the subsequent periods bleeding duration gradually decreases up to the level of physiological norm. The whole normalization of the index is observed at the animals, which were processed by KDFR during 4 and 6 hours, on 28-35 day up to 115±12 and 133±18 sec correspondingly. In the process of observations at the animals, the correlation between time of fibrillation and periods of KDRF processing of the animals has not been revealed (Fig. 1).

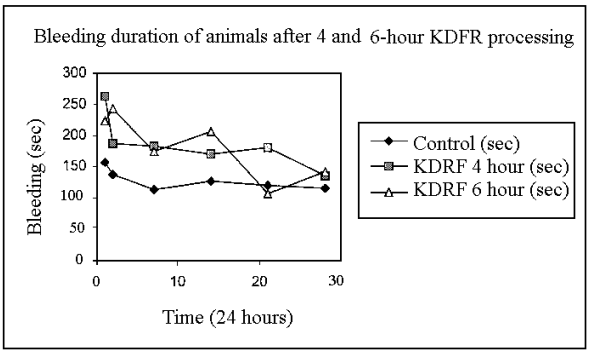

Fig.1

In the course of the experiment the strongly marked chronometric hypocoagulation was discovered due to the extension of the parameter "K" or, probably, because of the change of aggregation properties of platelets (Table 1).

For the determination of biochemical indexes serum was obtained from 5-8 ml of rats' venous blood. Beforehand (24 hours before the slaughter), forage was taken away from the animals. The determination of biochemical indexes was provided by means of biochemical analyzer HITACHI. As a result of the experiment it was determined that at the first day after influence of KDRF there was a tendency of decrease of the glucose content (Table 2). Other indexes varied in the limit of physiological norm.

Table 1 Parameters of thromboflexogramm after KDFR, 4 hours

Animal #	Parameters of thromboflexogramm			Fibrio gene	Fibrinal activity
	R (sec)	K (sec)	Ma (mm)		
1	72	∞	10	-	-
2	102	∞	18	-	-
1	90	∞	10	275	75
2	180	150	52	315	90
1	180	∞	5	-	100

Table 2 KDFR influence on the glucose content in blood of the rats

Time (days) after the experiment	KDFR 4 hours (mmole/l)	Test (mmole/l)	KDFR 6 hours (mmole/l)	Test (mmole/l)
1	3.14	6.12	6.39	7.27
10	7.59	9.35	8.90	6.69
30	6.05	6.69		

Research of haemopoiesis system

Several criteria were considered: the dependence of biological effect on the distance, on the power flux density, on the duration of processing. Besides, KDRF influence on mice survival was considered.

At the experiment 24-28 gram weighting, pelletized fed male mice were used. The marrow was examined in the dynamic at 1, 3 and 7 day after KDFR influence. Six animals were taken on each point. After the decapitation of the mouse their thighbones were taken out and after that the absolute number of myelokaryocytes was calculated by the standard method in Goryaev chamber.

Dependence of the biological effect on the distance

In all experiments the maximum flux density along the geometrical axis of KDCR device was a constant. There were used four temporal modes of the influence (1, 2, 3, 4 hours) and three points of long distance between KDSR and the biological object (0.5; 1.5; and 2.5 m). At 0.5 m distance there were no differences in the number of marrow cells in comparison with the control cells. With the increase of distance between KDCR and the object from 0.5 to 1.5 m some tendency to the increase of the number of marrow cells up to the 7th day was observed. Four-hour KDRF processing caused the increase of the number of karyocytes up to $29.99 \pm 1.25 \times 10^6$ ($P < 0{,}001$). Thus, any dependence of the biological effect on the exposition has not been revealed. For instance, at the 7th day after one hour of the exposition the number of karyocytes was equal to $28.45 \pm 1.87 \times 10^6$ at the same time after 3-hour processing it came to $27.65 \pm 0.74 \times 10^6$. Alongside with the change of the distance to the biological object from 1.5 to 2.5 m the tendency towards the increase of the number of marrow cells has kept within the same limits $28.27 \pm 1.32 \times 10^6$ and $29.57 \pm 0.88 \times 10^6$.

Dependence of the biological effect on the power flux density

The comparative investigation of KDFR influence on the biological object in the coverage of KDCR (along its geometric axis) and outside the coverage has demonstrated that alongside with the increase of the radiation intensity there was a tendency towards the decrease of stimulative influence of KDFR on haemopoiesis.

Dependence of the biological effect on the duration of processing

On processing the animals at distances up to 2.5 m from KDCR and on increase of exposition to 3-4 hours it is possible to obtain reliably significant difference in the number of marrow cells from the physiological norm to the 7th day.

KDRF influence on the survival of mice

The experiments, determining the survival reaction of animals, were made by means of gamma radiation. 30-day survival is the criterion of determination. Conditions for the experiments are the following: in the coverage of KDCR and aside the coverage, (the distance between the KDCR and the object is 2.5 m in the coverage of KDCR and 0.5m outside the coverage). Time of influence is 4 hours. Animals of both sex were used. Two groups of animals were used. The test group was put to the gamma radiation in the diapason of doses, which caused marrowy syndrome, i.e. from 7.5 to 8.5 Gr. The second group of animals after the irradiation in the same diapason of doses was repeatedly processed with KDFR. Time of the influence is 4 hours at 7.5 Gr gamma radiation on 15 mice in one bath and 8.5 Gr on 15 mice in another bath. Total gamma radiation of the animals was made by means of the source ^{137}Cs with the dosage rate of 5.2 Gr/min. Gamma radiation in this dose diapason causes death of the animals during the development of the marrowy syndrome, i.e. from the 6th to the 20th day along with the aplasia of haematogenic tissue. Combination of gamma radiation and KDFR sometimes leads to the slight increase of the number of survived animals. If the animals are irradiated by gamma rays at first and then by KDFR, the death control at 7.5 Gr radiation is equal to 5.5% from the total number of the animals and at the following KDFR processing 16% of the irradiated animals die. However, 67% of the animals in the tested group have died after KDFR processing and after the coming next gamma radiation with 8.5 Gr total dose. And in the group, which was processed with KDFR, only 46% of the animals died.

Immunity strengthening

For the investigation of KDFR influence the following tests were chosen: activity of natural killers and T-killers, which had been obtained by the immunization in vitro in the unidirectional mixed culture of lymphocytes and also in the reaction of blast transformation on the specific mitogen [6, 7]. All tests were made on the 7th day after a single KDFR influence. Unfortunately, data have been obtained with the applying of radioisotope preparations. Though the experiments of this kind were successful and though they have demonstrated the increase of some immune reactions' level, there is a certain doubt in the relevancy of radioisotopes application [2]. Thus the series of experiments was made. These experiments were aimed at the investigation of KDFR influence on the development of the swelling process. The aim of the experiment is the investigation of KDFR influence on the development of Ehrlich cancer and sarcoma-37, which were repeatedly inoculated to mice. At the first stage of the experiment there was a single KDFR influence on the mice repeatedly inoculated with sarcoma-37, on the 2nd day after the repeated inoculation of the swelling cells to the animals. The repeated inoculation was made intramuscularly in a right thigh, in a dose 10^6 of cells per a mouse. Time of KDFR influence for the first group of animals was equal to 1 hour; for the second one it came to 2 hours; and for the third one it came to 4 hours. Each group consisted of 6 animals. The test group consisted of six mice with repeatedly inoculated sarcoma-37 and which had not been processed with KDFR. As a result, the average lifetime of tested animals was equal to 9 days. The average lifetime of animals of KDFR groups came to 48 days (for 1-hour KDFR influenced group); to 12 days (for 2-hour group); and to 31 days (for 4-hour group). Thus, the average lifetime of the experimental group came to 29 days. Besides, in the group, which has been processing with KDFR during 1 hour, **the half of mice had survived (three of six mice).**

At the second stage of the experiment the repeated (5 times during 2 hours) KDFR influence on the mice was applied. These mice have been inoculated with sarcoma-37 at seven days before the beginning of the influence. As a result, the average lifetime of the animals was equal to 27 days, and for the mice, which were processed with fivefold KDFR influence, the average lifetime was equal to 76 days. The obtained results are the evidence of inhibition of swelling development for the animals, which were processed with KDFR influence. This leads to the increase of lifetime of such animals in comparison with the test. **Thereby, at a great extent the results of the previous experiments on the strengthening of immune status after KDFR influence were confirmed.**

Results and discussion

Let us make a conclusion. At the KDFR influence on animals' organism the following effects were observed: decrease of blood viscosity; strongly pronounced hypocoagulation; decrease of contents of glucose. Increase in the number of karyocytes and the extended lifetime of the animals, infected with Ehrlich cancer and sarcoma-37 were also observed.

As for human being, the researches in this area have not been carried out yet and they are still confined to the single observations. It is possible to give an example from the author's practice. In 1975 nonoriented circuit of 3kWtt power was examined. Field strength was measured. The author of the article had been working in the field for about 8 hours. And after five hours after the experiment I had felt bad. That time it was nothing known about the influence of the new radiation on human organism. The arrived ambulance has quickly diagnosed that I was close to hypoglycemic coma. On several hours after the intravenous glucose injection, my state has become normal. **Now we know that before the experiments with powerful KDFR bunches it is necessary to eat sugar.** Thus we believe that the data, which were obtained after the experiments with animals, can be applied to a human being. We can suggest that the manifestation of the symptoms of the KDFR influence on human organism depends on the power of the applied source, on the total mass of the organism and on the time of it in the coverage of the irradiation. From aforesaid it is clear that the experiment with powerful KDFR sources is far from being harmless

and it is better to make it distantly after exclusion of man presence near experimental stands and devices. At the same time it is quite obvious that on applying of small capacity and fixed time of irradiation it is possible to develop methods for curing of human diseases, which are considered now as incurable (for instance of diabetes, some diseases of haematogenic system, of cancer and possibly of AIDS.

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Effect of Magnetic Blow Wave Field on Wine Systems

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Introduction

Authors communicate the data on influence of Magnetic Blow Wave (MBW) field on several wineproducts. It was found, that MBW did not lead to significant changes in the major components of the wineproduct (sugar, organic acids, minerals). At the same time the taste and aroma of treated wine become more pleasant; content of heavy alcohols and wine stone in the treated samples was less than in non treated ones. A mechanism of transformations was also discussed.

Keywords: *Magnetic Blow Wave (MBW), Wineproduct, GLC of aroma compounds and ethanol, HPLC of sugars, Atomic Absorption Spectrometry (AAS) of minerals, Heavy alcohols and aldehydes, Wine stone, Turbidity tendency, Organoleptic evaluation*

Magnetic Blow Wave (MBW) was obtained for the first time during the investigations on ball lighting generation under the laboratory conditions (Shakhparonov 1994). MBW as a physical object is interesting because of some facts, which suggest that MBW is a magnetic monopole. The MBW can also interact with the matter and transforms it in a definite way. Typical example is an elementary carbon in the form of graphite, which is transformed by such magnetic treatment into ferromagnetic substance (ibid). The graphite, which is initially diamagnetic, transforms to paramagnetic one with general radiation doze of about $7 \cdot 10^{19}$ neutrons/cm^2. Other types of radiations could not affect this way (Svoistva 1975). So one unit of MBW can be considered as $1 \cdot 10^5$ of neutron masses. This fact may be regarded as an indirect evidence for assuming that MBW and magnetic monopole are the same things. In the absence of excited radioactivity a slow MBW [$v/c < 1 \cdot 10^4$] occurs, which does not ionize atoms (Devons, 1963). Therefore, their interaction with the matter can be observed only indirectly. No data exist on the interaction of MBW with organic substances. The experiments and results reported in the present communication may be a starting point for development of technology and to formulate the methods for vintage wine and best quality spirit production.

Materials and Methods

Assuming that MBW and magnetic monopole are the same things, a number of conditions were selected for all experiments. The MBW source and the samples were placed in the same axis and the axis was oriented according to magnetic meridian direction. Such magnetic orientation is appropriate, as the energy of magnetic monopole theoretically increases in a magnetic field (Devons, 1963). All of samples were placed at 250 cm distance from MBW source, in hermetically closed glasses. It should be noticed that MBW could penetrate through many other barriers, for example into cast iron reservoir with wall thickness of 5 cm (Amaldi, 1970).

The quality investigations were made by using of standard equipment. HPLC, equipped with refractometric detector was used for sugars estimation. Separation of organic acids in forms of their ethyl esters and acid esters was carried out chromatographically using a column packed with polyethylenglycol succinate and the following temperature option: initial temperature is 120°C, final temperature is 220°C, temperature growth rate: 8°/min. GLC was also employed for determination of ethanol. Minerals content

conclusion: in order to obtain complete information about any system, it should be destroyed. However, destruction of tissues of the man in order to get information about their state is a too high price to pay for the information about his health.

However, the above Van Hoven's criterion can be satisfied with the minimum influence, when the cells are not destroyed and the atoms of these cells, being primary sources of torsion spectrums to be registered, are bring into the non-equilibrium state by means of outer disturbing influence.

In order to choose the frequency of the disturbing torsion influence correctly, it is necessary to take into account the role of water in physical and biochemical organization of tissues of the human organism.

At the same time, it is necessary to take into account the resonance torsion frequencies of various human organs. Finally, it turns out that the signal of torsion disturbance should be rather sophisticated considering both these factors. The TORDI system is a ready-to-use production device. Nevertheless, it is important to understand that the model is not the limit of scientific and technical potential incorporated in it and that enhanced variants of the system will appear with the course of time.

Summing up, I would like to draw your attention once more to the fact that work on torsion technologies is not limited by the directions that were discussed here. Actually, as it was pointed out in the beginning, on-going development includes all branches of economy, industry, agriculture and medicine, as well as all problems of everyday life. Technologies that we mentioned are the forerunner of the fact that the mankind is on the threshold of the age of torsion technologies, which, we believe, will change our life in the 21st century more than all the scientific and technical revolutions of the 20th century.

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The Electrical Vortex Non-Solenoidal Fields

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A mistake was found in the electrodynamics: it is detected that all electrodynamics' postulates corresponds to the experimental facts, but vortex electric fields has unclosed inductive lines.

When the magnet is moving, then the current of magnetic induction is moving together with it. From known velocity of motion **v** and the value of magnetic induction **B**, it is possible to calculate the intensity **E** of appearing vortex field according to electrodynamics formula of transformation of fields **E=vB**.

If to change the E=vB on induction $D=\varepsilon_0 E$ in formula of fields' transformation, that will get $D=\varepsilon_0 Bv$, where D is electric induction, B is magnetic induction, v is velocity of motion, ε_0 is electric constant.

Herewith the appearing electric induction is always transverse to the direction of motion. It is possible to formulate the rule of origin for electric induction under the condition of rectilinear motion: if to dispose the right hand palm so four fingers shows the motion direction of the magnetic flow (the field), connected with moving magnet, and the vector B fells into palm, then the moved aside big finger will indicate the direction of vector D. The given rule is like the rule for Lorenz' force, but on the contrary (the difference is in frame). In the first case the charge moves, but the magnet rests. Here the magnet moves, but the charge, which points the direction for lines of force of electric induction, is immovable. So, there it is the rule for left hand, but here, on the contrary, it is the rule for right hand. Thereby, if the charge moves, but the magnet is immovable, then the rule of left hand uses for determination of the force. But if the magnet moves, but the charge rests, then the rule of right hand uses for determination of the force.

The origin of electric force is connected with that, the vortex electric field $D=\varepsilon_0 Bv$ appears around moving magnet (the magnetic field does not act on immovable charges).

In common literature on electrodynamics there is no any difference between electric vortex field and solenoidal field, but these are different notions. The sign of solenoidal field is the closed lines of electric induction (the flow of vector D through the closed surface is a zero), but for the vortex field the sign is following: the work of forces can be different from zero under the condition of motion along a closed line. That is to say, the vortex fields can agitate the rotational currents.

From the electrodynamics textbook: "The work of forces of vortex electric field can be different from zero, when the electric charge is moving along a closed line."

For instance, when the magnet moves, the vortex electric field appears and this field can be solenoidal or not, depending on magnet's orientation. Let's take such example: the magnet moves evenly, rectilinearly, and it's poles are oriented transversely to direction of motion. According to the rule of origin for electric induction ($D=\varepsilon_0 Bv$ that is the rule of right hand), the appearing vortex electric flow is not a solenoidal, since the lines of electric induction are not closed. Its begins in one conditional area of disturbance (+), accompanies the moving magnet, and it finish in another area of disturbance (-). For presentation it is enough to consider only two areas (+) and (-), represented on Fig.1. These dissimilar areas of disturbance appears because that flow of magnetic induction inside the magnet has the inverse direction, that outside the magnet.

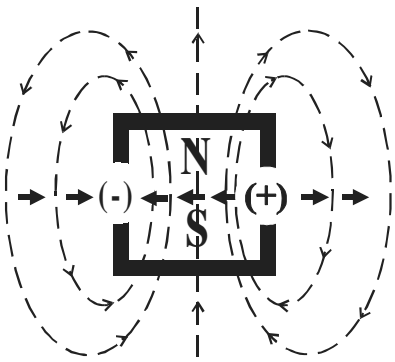

Fig.1

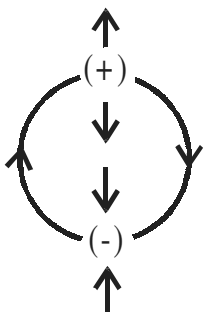

Fig.2

That moving disturbance of electric and magnetic fields presents itself as transverse electromagnetic disturbance. Also, it is necessary to notice, that under such magnet's motion, the appearing vortex electric field is not closed, but the current of electric displacement, connected with it, is closed (a currents are always closed). In given example, for clarity, it is possible to present a intensity of electric field through the Lorenz' force, if to take the frame, in which the magnet rests, and the test charge moves.

On the Fig.1 the moving magnet is conditionally represented (motion is toward to the text, magnet is moving away). N and S are poles of magnet. The direction of lines of electric induction, appearing when the magnet is moving, specified by arrows → and ←. Part of the lines begins in positive area (+) and finishes in negative area (-), the areas are placed on the ends of magnet. **The flow of electric induction through closed surface is not a zero; that is to say, these areas of disturbance are moving electric charges.**

From the electrodynamics textbook again: "The flow of vector D through any closed surface is equal to algebraic amount of external charges, covered by this surface. In the electrodynamics these postulates has the same role, as Newton' laws in classical mechanics."

Thereby, according to postulate, it is necessary to consider the appearing dissimilar areas of disturbance (+) and (-) to electric charges, or it is necessary to change the postulate.

It is interesting, that a part of lines of electric induction, which placed frontal and behind magnet, starts and finish at infinity, since the distribution of magnetic induction around magnet has not determined borders.

For clarity, it is possible to make following calculation. For instance, the coil (loop or turn) with current, as a magnet, moves evenly and rectilinearly, but its magnetic poles are oriented transversely on motion direction. Under such motion the lines of electric induction are not closed, and the dissimilar areas of electric field's disturbance appears in space on the edges of this coil.

On Fig.2 the moving coil with current is conditionally represented. It moves from left to right side of the page. The arrows on the coil indicate the direction of current. The appearing dissimilar areas of disturbance of electric field are marked by signs (+) and (-). Knowing, that in medium of the coil $B=\mu_0 I/2r$ and according to $D=\varepsilon_0 Bv$, it is possible to find the electric induction, appearing in the center, between two dissimilar areas $D=\varepsilon_0\mu_0 Iv/2r$, where I is current in the coil, r is radius of the coil, v is velocity of motion, ε_0 is electric constant, μ_0 is magnetic constant. The electromagnetic disturbances in transverse electromagnetic waves has the similar field construction, there also dissimilar areas of disturbance of electric field exists, that is to say the lines of electric inductance are not closed. Only the currents of electric displacement and magnetic induction are closed.

Let's consider another example: magnet moves rectilinearly, but its poles are oriented longitudinally to direction of motion. According to the rule for origin of electric induction ($D=\varepsilon_0 Bv$ is the rule of right hand), the appearing rotational electric flow is solenoidal, since in this case the inductive lines become closed lines. **Usually in books on the electrodynamics such moving magnet is considered, and the wrong conclusion is thereof done, that vortex electric field is always**

solenoidal, herewith it is forgotten, that poles of the magnet can be oriented not only along the direction of motion, but across also.

From the electrodynamics textbook: "The vortex electric field differs from electrostatic field that it is not related with any electric charges and its lines of intensity are closed lines."

From theory and from experiments it follows, that under transverse motion of magnet the lines of disturbance of vortex electric field can be unclosed and, accordingly, the flow of induction through the closed surface is not a zero. Then there is a direct discrepancy to facts in modern electrodynamics. It is strange, but for the whole history of researches in magnetism the transverse magnet's motion was not is considered. It leads to revising of electrodynamics' postulates, which plays such role in electrodynamics, as the Newton's laws plays in classical mechanics. The postulates, giving invalid belief about field processes, accordingly, do not allow to make some correct calculations. Fallaciousness of these postulates was one of the reasons, on which the electrodynamics could not to consider and to calculate the discrete electromagnetic waves (photons), where the magnetic field also is the transverse field (the field construction and calculation of photons are represented on the page http://www.comail.ru/~alemanov). **That is to say, not only particles has the charges, but areas of disturbance of field (without particles) are the charges also,** where the flow of electric induction through the closed surface is not a zero. Thereby, the vortex electric fields can be not only as closed flows of induction, but as well as inducted electric charges, accordingly, the laws for electric charges are valid for induced electric charges also. For instance, in the law of conservation of charge: if somewhere the area of disturbance with positive sign appears, that negative area appears also.

From the electrodynamics textbook: "The vortex electric field is generated by the variable magnetic field. Its force lines are always closed, like force lines of magnetic field."

But before this fundamental postulate, confirming, that force lines of vortex electric field are always closed, it was necessary to consider all variants of change for the magnetic field, including the variant of the transverse motion of the magnet. That is to say, the consideration of physical processes could not be unilateral. Faraday considered the longitudal motion of magnet and discovered the electromagnetic induction, but the transverse motion of magnet that have the principle importance for understanding of field processes in electrodynamics was not considered. Thereby, the longitudal motion of magnet brings to arising a vortex electric field with closed force lines, but transverse motion of magnet brings to arising a vortex electric field, where the lines of forces are not closed. In this case it lead to induced electric charges. It is necessary to notice, that this is first mistake, detected in electrodynamics postulates for all time of existence of electrodynamics.

From the electrodynamics textbooks: "…Gauss' theorem is valid not only for electrostatics, but also for electrodynamics, which using a variable in time electromagnetic fields. We are not sure if this hypothesis is valid or it is not valid… Only the experiment can give the answer on this question. The whole collection of experimental facts speaks in favor of this hypothesis." But, unfortunately, the experiment with transverse motion of magnet was not considered seriously in this textbook.

(Editor's note: Well-known Searl's experiments and Godin & Roshchin's experiments are based on such transverse motion of magnets (rollers). In Alemanov's article it was demonstrated that in this case the experiment should lead to induced electric charges. Really it was detected in experiments. Hence this missed aspect of electrodynamics is very important for development of the new energy technologies.)

Gravito-Inert Mass

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Nature of mass is one of the important problems of modern physics. It is accepted to consider that the mass of elementary particle is determined by fields, which are connected with it (electromagnetic, nuclear and others). However, we didn't create any quantitative theory of mass. There is no theory to explain why masses of elementary particles form a discrete spectrum of values and to allow determining this spectrum.

Mass (m) is a physical value, one of characteristics of matter, which defines its inert and gravitational properties. Accordingly, we distinguish inert mass (m_i) and gravitational mass (m_g).

Inert mass (m_i) characterizes dynamical properties of a body, its property to accelerate under the action of the force $(\vec{F}_i)$ and according to the second Newton's law is considered to be constant coefficient of proportionality for the given body between $\vec{F}$ and acceleration $\vec{a}$.

$$\vec{F}_i = m_i \vec{a} \qquad (1)$$

Gravitational mass (m_g) is a source of gravity field. Every body creates its gravity field, which is

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The Principle of Self-Organization, which can be formulated as follows: any material object represents an open self-organizing system whose internal structures are formed with the participation of the whole universe. Apparently, the Principle of Self-Organization, incorporated in nature as one of the integral properties of matter, is nothing more nor less than a spirit (or absolute idea, or creator) which operates the world and creates all its variety.

Physical Mechanism of Nuclear Reactions at Low Energies

V.P. Oleinik* and Yu.D. Arepjev

Tell me what the electron is,
and I shall explain to you everything else.
W. Thomson

Abstract

The physical mechanism of nuclear reactions at low energies caused by spatial extension of electron is considered. Nuclear reactions of this type represent intra-electronic processes, more precisely, the processes occurring inside the area of basic localization of electron. Distinctive characteristics of these processes are defined by interaction of the own field produced by electrically charged matter of electron with free nuclei. Heavy nucleus, appearing inside the area of basic localization of electron, is inevitably deformed because of interaction of protons with the adjoining layers of electronic cloud, which may cause nuclear fission. If two or more light nuclei occur "inside" electron, an attractive force will appear between the nuclei that may result in the fusion of nuclei. The intra-electronic mechanism of nuclear reactions is of a universal character. For its realization it is necessary to have merely a sufficiently intensive stream of free electrons, i.e. heavy electric current, and as long as sufficiently a great number of free nuclei. This mechanism may operate only at small energies of translational motion of the centers of mass of nuclei and electron. Because of the existence of simple mechanism of nuclear reactions at low energies, nuclear reactor turns out to be an atomic delayed-action bomb, which may blow up by virtue of casual reasons, as it has taken place, apparently, in Chernobyl. **The use of cold nuclear reactions for production of energy will provide mankind with cheap, practically inexhaustible, and non-polluting energy sources.**

Introduction

Nuclear reactions at low energies, occurring in physical and biological systems, and, in particular, the cold fusion (CF) of nuclei, attract ever increasing attention (see review articles [1,2]). This is explained by the fact that research on CF (in what follows, by cold fusion we shall understand any nuclear reactions at low energies) opens up the way to the solution of the problem which was set more than 50 years ago in the field of controlled thermonuclear reactions (CTR) and which has not been solved that is the problem to provide mankind with cheap fuel. An important point is that CF allows to create not only cheap, but also non-polluting energy sources, as nuclear reactions at low energies are not accompanied by radiations dangerous to health (γ-radiations, streams of fast neutrons and other particles). Note that the energetic problem facing mankind is presently of special interest in connection with the fact that, according to expert evaluations, the oil-and-gas resources in the world will suffice only for some decades. For this reason the study of CF is among the most important problems of physics.

It is necessary to note that, relying on the standard theory of nuclear reactions describing nuclear processes in vacuum, experts in the field of nuclear physics, engaged in CTR, reject the very possibility of existence of nuclear fusion at low energies. Two basic objections are raised against CF:

1. at low energies the penetrability of Coulomb barrier around nuclei is so small that the probability of nuclear fusion is practically equal to zero;
2. distinction between the atomic and nuclear energy scales is so great that the energy, which might be evolved as a result of nuclear fusion, could not be transferred directly to atomic lattice; therefore the energy above should be emitted in the form of streams of γ-quanta, fast neutrons and other particles. However, such streams of sufficient intensity have not been registered.

The answer to the first objection against existence of CF is that at the heart of CF are nuclear processes occurring in environment, and the basic role is played here, apparently, by collective effects caused by interaction of nuclei with particles of environment in which the nuclear reaction takes place. The laws governing the behavior of interacting nuclei in vacuum are inapplicable to the description of CF of nuclei [3]. Nuclear reactions occurring at low energies submit to completely different laws, which can be established only provided that collective effects mentioned above are taken into account. For this reason the standard theory of nuclear reactions in vacuum can by no means refute the existence of CF.

As to the impossibility of transferring the energy between levels of various scales, we can give an example of the phenomenon of sonoluminescence (luminescence of a liquid when a sound wave causing cavitation passes through it) [4], in which the energy transfer from an acoustic wave to electromagnetic field occurs with appreciable probability in spite of the fact that the distinction between energies of acoustic phonons and quanta of light reaches 11 orders.

As early as 10 years ago J. Schwinger, the Nobel winner and the known expert in the field of the theory of elementary particles and quantum electrodynamics, asserted that it is impossible to deny the reality of CF phenomenon [3,4]. Since then the CF phenomenon for nuclei was repeated hundreds times in laboratories all over the world, tens of patents on the ways of energy generation on the basis of CF were registered and enormous number of experimental works were published, which not only confirmed the existence of effect, but also contained its detailed analysis.

The most convincing evidence for the existence of nuclear reactions at low energies seems to give the mass-spectrometric research of reaction products [5] as well as research on biological systems [6]. Detailed study of electric explosion of foil made of especially pure materials in water, described in [5], suggests that at electric discharges transformation of chemical elements occurs. Study of optical spectrum of plasma arising at discharge and of the mass-spectrometric analysis of sediments, which remained after the discharge, shows that in plasma there is an appearance of a significant number of chemical elements which were not presented in the initial material of explosive foil and electrodes and also that the isotope structure of the foil material changes appreciably. The change of experimental conditions, for example, of energy contribution in foil, its mass and dimensions results only in redistribution of intensity of plasma spectral lines, i.e. in the change of statistical weight of chemical elements in plasma, but the composition of chemical elements remains unchanged and it essentially depends on the material of foil. As it is seen from the received results, nuclear reactions, which take place at electric discharge, are not accompanied by the occurrence of a neutrons stream and γ-radiation and proceed at low energies of atomic nuclei.

The research mentioned above as well as many others, carried out by different researchers in different laboratories, **allow to draw a conclusion that existence of nuclear reactions at low energies is reliably established.**

The development of research on CF is hampered by the absence of theory of the phenomenon. As noted by Schwinger [3,4], the situation in CF is closely parallel to that one in high-temperature superconductivity: reality of the last, as a result of careful experimental research, is completely established, though theory of the phenomenon is absent till now.

In [5], to account for the transformation of chemical elements, the hypothesis is put forward that at the electric explosion of foil in the plasma channel magnetic monopoles are formed which may overcome the Coulomb barrier even at insignificant kinetic energy due to the great magnitude of their magnetic charge. The monopole, appearing not far from a nucleus, causes its polarization: those nucleons of the nucleus, which are situated more close to the monopole, experience stronger influence of the last, than the nucleons situated on the opposite side of the nucleus. As a result, a deformation of the nucleus arises (the nucleus is lengthened), which may result in nuclear fission.

Obvious drawback of this mechanism of nuclear reactions is that magnetic monopoles have yet to be found out in nature.

Numerous attempts to construct a consistent theory of CF (see reviews [1,2]) have not been crowned with success. As it was noted above, for the CF to be described, the account of the collective effects may be important caused by interaction of nuclei with environment, in which nuclear reaction takes place. But does it suffice to take into account these effects in order that the theory of the phenomenon is constructed? The analysis of the experiments on transformation of chemical elements at low energies and on the CF of nuclei suggests that the discussed phenomenon does

not fall within the domains of exotic ones: it seems to occur in nature constantly, at every step, in both physical and biological systems. Therefore, it is natural to expect that nuclear reactions at low energies should have a simple physical explanation.

However such explanation, which is not beyond the scope of existing representations, is yet to be found. Does not it mean that we are facing here the situation similar to that which has arisen in physics at the end of the 19th century and which has been figuratively described in the words: on the light sky of physics there are only two small dark clouds – the radiation of absolutely black body and the Michelson experiments? Let us remind that in order for these clouds to be removed, it has taken the revision of physical notions about electromagnetic field as well as about space and time.

As is noted in [8], there is a simple physical mechanism of nuclear transformations at low energies which existence follows from the quantum theory of electron as an open self-organizing system [9]. If two or the greater number of light nuclei appear inside free electron, more precisely, inside the area of basic localization of the particle, because of interaction of nuclei with electrically charged matter of electronic cloud, a force of attraction appears between the nuclei which may result in fusion of nucleus. This means that **cold nuclear reaction represents an intra-electronic process** which character is defined by physical properties of the own field produced by electrically charged matter of electron. The purpose of this paper is more detailed consideration of the mechanism above stemming from the spatial extension of electron.

In section 2 physical ideas are formulated and basic results are schematically presented of quantum theory of electron as an open self-organizing system. The theory outlined is necessary to elucidate the origin of the mechanism resulting in the occurrence of nuclear reactions of fusion and fission at low energies. The essence of the developed approach consists in that **the own field created by electron is treated as a congenital, integral physical property of electron, intrinsically inherent in the particle by the very nature of things and for this reason the own field and self-action are included in the definition of the particle** at the initial stage of formulating the theory. As is seen from the received results, electron represents a quantum (elementary excitation) of the field of electrically charged matter. It is a solition, which physical and geometrical properties are described by the non-linear and non-local dynamical equation similar to the known Dirac equation.

In section 3 the application of quantum model of self-organizing electron to nuclear reactions at low energies is considered. It is noted that because of the presence of simple physical mechanism of nuclear reactions at low energies, which is of a universal character, nuclear reactors represent, in effect, nuclear delayed-action bombs, which from time to time may blow up by virtue of the casual reasons. Hence, though nuclear stations may provide mankind with energy, however atomic engineering is a very dangerous way of energy production. The only acceptable way of solving the energetic problem consists in the use of nuclear reactions at low energies.

Quantum model of electron as an open self-organizing system

The basis for the standard formulation of quantum electrodynamics (QED) is the hypothesis that electron is a structureless point particle which does not experience self-action. This assumption results in serious difficulties – the divergences of mass and charge of electron and the impossibility to explain stability of the particle (see, for example, [10-12]).

The difficulties mentioned above are very serious. According to Dirac, **the difficulties of QED "in view of their fundamental character can be eliminated only by radical change of the foundations of the theory, probably, radical to the same extent as transition from the Bohr orbits theory to modern quantum mechanics"** ([13], p. 403). "Correct conclusion", Dirac emphasizes, "is that the basic equations are incorrect. They should be changed in such a way that divergences do not appear at all".

The main reason of occurrence of difficulties is the assumption that electron is a point-like particle. Therefore, abandonment of this hypothesis is inevitable. As an analysis of the problem shows, the key to constructing a consistent quantum theory of electromagnetism lies in taking account of the Coulomb self-action of electron, i.e. the back action of the own field created by charged particle in environmental space upon the same particle. In the special case that the particle is at rest in an inertial reference frame, own field of the particle turns into static Coulomb field.

E.Schrödinger who suggested the historically first physical interpretation of quantum mechanics put one of the boldest ideas concerning the problem of electron forward. According to Schrödinger's hypothesis, the quantity $e\left|\Psi(\boldsymbol{r})\right|^2$ (e and $\Psi(\boldsymbol{r})$ are charge and wave function of electron, respectively) is the density of spatial distribution of electron's charge and, consequently, **the linear sizes of electron are the same as those of atom** [14,15]. However, they did not succeed in substantiating the interpretation and, for this reason, it was rejected by the majority of physicists [16].

An important step to the correct understanding of the physical nature of electron was made by A. Barut and by his collaborators [16-18] who formulated and developed quantum theory of electromagnetic processes on the basis of self-energy picture (the Self-Field QED). Using expression for the total own energy of electron, they managed to calculate the Lamb shift and other radiative corrections and to show that radiative phenomena may be described in terms of the

action function, without using the second quantization method. As is pointed out by Barut [17], "the correct quantum equation of motion for radiating electron is not the Dirac or the Schrödinger equation for bare electron, but an equation containing an additional non-linear self-energy term".

New lines of approach to the problem of electron are offered in [9, 19-24]. The formulation of electrodynamics is considered which represents a synthesis of standard quantum electrodynamics and ideas of the theory of self-organization [25]. The physical mechanism of self-organization of electron consists in self-action. Taking into account the self-action means that electron is treated as a feedback system.

Let us outline schematically the results of the formulation of quantum electrodynamics in which electron is an open self-organizing system.

Editor's note: The authors develop mathematics by using Lagrangian functions, 7 equations. You can contact the authors for more information about.

Thus, the negative result is received: we have tried to take into account self-action of electron in a natural way by supplementing the Lagrangian function with the self-energy term, but we came to an equation that has no reasonable physical solutions at all. This result seems to mean that the standard theoretical scheme reaches here the limits of its applicability and so, remaining in its framework, it is impossible to solve the problem of electron and elucidate the physical nature of electromagnetic interaction.

Essentially new point, which is introduced in [9] into quantum mechanics consists **in the replacement of the model of isolated system described by harmonic oscillator with the model of open system**. Let us advance the arguments indicating the inevitability of using the model of open system as a basis of the description of interaction between microparticles [26].

Note, first of all, that quantum particle theory based on the use of the models of isolated system is, strictly speaking, physically meaningless. Really, any observation conducted on a system represents a process of interaction of the system with the means of observation. But in case of microparticles (quantum particles) this interaction is not weak and consequently it is inadmissible to neglect it, i.e. microparticles should be necessarily considered as essentially non-isolated systems.

A starting point of the standard formulation of quantum mechanics is the physical idea that interaction between physical fields can be reduced to collision of the particles corresponding to these fields, the particles before and after collision being considered as free ones. According to these representations, quantum mechanics is based on the notions of "bare", non-interacting particles, with the interaction between them being considered as an additional factor which can only insignificantly alter the physical properties of non-interacting particles. However, such an approach to interaction between physical fields is obviously of an idealized character because particles constantly interact "with vacuum as with some kind of physical medium in which the particles move" [27]. Interaction of particles with vacuum fluctuations is not small and it cannot be removed.

It is well also to bear in mind that the necessary intermediary at studying micro-objects are the means of observations (the devices) with the classical field corresponding to them which should be taken into account in consistent quantum theory [28]. Inclusion in theoretical scheme of arbitrarily weak classical external field results in occurrence of non-zero width Γ of energy levels of "dressed" particles. The basic impossibility to isolate a real particle from vacuum fluctuations of the field and from the classical sources connected to the means of observation is indicative, thus, of necessity to take into account the non-zero width of energy levels of real particles [26].

The use of the harmonic oscillator model, when describing the interaction of electromagnetic radiation with substance, seems to be the main source of serious difficulties of the standard formulation of quantum theory, as such an approach means apparent neglect of those physical processes which, proceeding constantly, are responsible for inseparable coupling of real physical system to surrounding medium. Introducing artificial notion about switching on and switching out of interaction of oscillator with radiation field, we are able to calculate within the framework of existing theory the width of energy levels of oscillator, but we cannot assert with certainty that such an approach results in correct description of interaction.

From the reasoning given above it is seen that they are the models with energy levels of non-zero width that should form the basis for the description of interaction of radiation with substance. It is necessary to formulate such a quantum theory, which would take into account the energy levels of non-zero width Γ. The case in point is that one should introduce an infinitesimal damping Γ into the initial set of equations describing interaction of charged particles with electromagnetic field. Such an approach means the violation in infinitesimal of homogeneity of physical system relative to translations in time. Necessity of violating the homogeneity of time follows from that fact that in the usual approach (with $\Gamma = 0$) the states of the system of interacting fields have degeneracy of infinitely large multiplicity in relation to time translations. According to the fundamental Bogoliubov's concept of quasi-averages [29], when describing the behavior of degenerate systems, one should include into Hamiltonian an infinitesimal term removing degeneracy. In the theory presented here degeneracy of states of quantized fields relative translations in time is removed by introducing the infinitesimal damping Γ into Lagrangian. Thereby the degeneracy under study is removed already in the initial, zero-order approximation, which is of

fundamental importance for the approach based on perturbation theory.

Formulation of the physical idea that quantum friction arises at the very elementary level - at the level of one particle is given in monograph [26]. Impossibility to isolate real particle from the surrounding world is that property which should be taken into account already in the one-particle theory (for each kind of particles), even before switching on the interaction with other particles. Model of the particle as an open system ($\Gamma \neq 0$) is attractive owing to the fact that from the very beginning the degeneracy of states relative to time translations is absent in it, the degeneracy, which is removed in standard approach by taking into account the interaction of particle with vacuum field fluctuations and classical fields. The basis for the developed formulation is the fundamental concept of quasi-averages supplemented with the requirement that the equations of motion of the particle with $\Gamma \neq 0$ follow from the action principle. It should be emphasized that the non-zero damping Γ is introduced into electrodynamics with the aim to establish the structure of the Lagrangian function, which takes into account the property of openness of physical system. After establishing the structure, the limiting transition $\Gamma \to 0$ is fulfilled.

In our opinion, the development of quantum theory will be inevitably connected with the use of models of open system; as such models reflect more completely the physical essence of interrelations in the real world. It is necessary, thus, to define more exactly the concept of openness of physical system, which, on the one hand, would describe real system accurately enough and, on the other, would be simple enough to describe the particular physical processes.

As open system has the richer physical contents in comparison with isolated system, some essentially new mathematical ideas are needed for its description. First of all, it is necessary to increase the number of independent dynamical variables describing the particle as open system. In papers [9,19-24], as a basis for the description of self-acting electron, the simplest model of open system is used which can be described by the Morse-Feshbach-Bateman Lagrangian function [30,31] and which was successfully used for the description of dispersive medium (the review of articles, in which applications of the model of open system to electrodynamics of dispersive medium are considered, is given in monograph [26]). In this model the number of dynamical variables is doubled as compared with the isolated system, namely, to each dynamical variable of "bare" particle, Ψ, there correspond two dynamical variables, which are denoted by Ψ and $\tilde{\Psi}$. These quantities are considered as components of the wave function describing the quantum state of self-acting particle. One of them, say, Ψ, corresponds in a sense to the particle alone (to the "bare" particle) and the other, $\tilde{\Psi}$, to the surrounding medium, in which the particle moves.

Editor's note: You can contact the authors directly for more information (8-16 equations).

Equation (16) coincides in its appearance with the usual Dirac equation for charged particle in an external field described by 4-potential . However, in reality, it differs essentially from Dirac's equation. The distinction consists in that **equation** (16) **is non-linear and non-local**, with the non-locality being of both spatial and time character. Potential ($A_{||}$) and vortex ($A_{\perp}$) components of the 4-potential, entering equation (16), differ from each other by their physical nature: the former describes the Coulomb field and is expressed quadratically in terms of the wave function components of electron, and the latter describes transverse electromagnetic waves and is expressed in terms of vortex electromagnetic field. As a detailed analysis shows, solutions to the basic dynamical equation describe the clots of self-acting electrically charged matter, localized in space, i.e. the particle is a soliton.

The internal energy spectrum of electron is discrete with an indefinitely large number of levels, and to each value of internal energy E_k (k is the set of quantum numbers) there correspond certain linear dimensions and geometrical form of the region of localization of electron's charge. Dimensions and the number of extreme of wave function increase with increasing the value of energy E_k. The distribution of electric charge of atomic electron in the ground state consists of the range of basic localization with the linear dimensions of the order of Bohr radius a_0 ($a_0 \sim 10^{-10} m$) and of the tail stretching up to infinity. It is essential that because of non-linearity of the dynamical equation of electron, wave function does not obey the superposition principle. By virtue of this, electron acquires the properties of absolutely rigid body: the perturbation acting on electron at an instant of time in the range of basic localization becomes known at the next instant $t + 0$ at any distance from the particle.

In Fig. 1 the results of calculation are represented schematically, carried out on the basis of equation (13), of the distribution of electric charge in atomic and free electrons in the ground (a) and first excited (b) states.

According to [9,19], the atom represents a system of nuclear and electronic solitons interacting with each other, the internal energy spectrum of the hydrogen atom, due to electromagnetic interaction, being of a zoned character. The occurrence of zoned structure of energy spectrum of hydrogen atom is explained as follows. Free nucleus, because of existence of Coulomb self-action, has a discrete internal energy spectrum. As the interaction of nucleus with electron is small in comparison with the energy of Coulomb self-action of the nucleus, it can be taken into account by perturbation theory. From here it follows at once that each energy

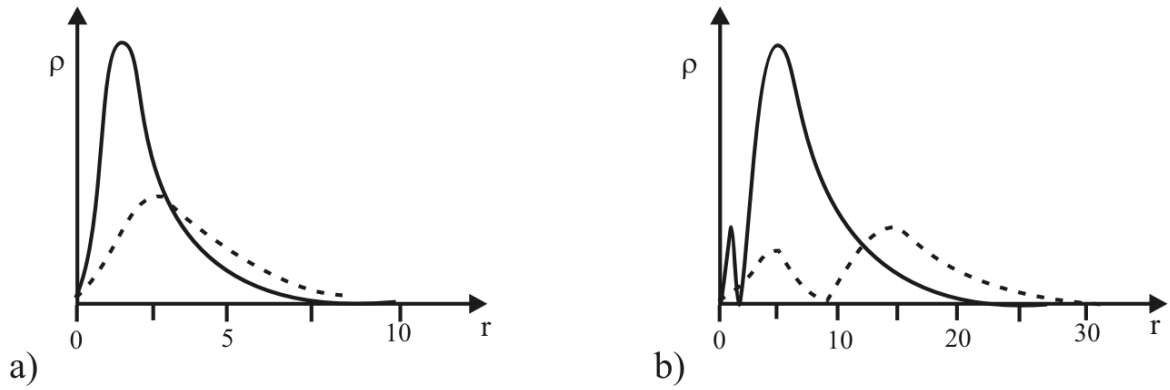

Fig. 1. Density of electric charge (ρ) of electron in the ground state (a) and in the first excited state (b): the continuous lines correspond to electron in the hydrogen atom, and the dotted ones to free electron, r is the distance from the center of mass of electron measured in Bohr radii.

level of free nucleus is split in a zone. There are indefinitely many zones (Balmer's replicas) and in each of them there are indefinitely many energy levels. The lowest zone coincides with the usual Balmer spectrum.

Physical mechanism of nuclear reactions at low energies

The quantum theory presented above schematically of electron as an open self-organizing system is indicative of the existence of the following mechanism of nuclear reactions at low energies [8].

If there occur in the region of basic localization of free electron, which linear sizes in the ground state of the particle are several times as large as those for hydrogen atom (see Fig. 1), two or the greater number of nuclei, each of them attracts on itself the adjoining areas of electronic cloud, resulting in compression of the electronic cloud as a whole. As a result, there appears automatically an attraction of the nuclei, which proved to be "inside" electron, on each other (see Fig. 2).

Calculation shows that the Coulomb barrier around nuclei is deformed, its height decreases and the probability of penetration through the barrier accordingly increases due to tunnel transition. Under certain conditions this process may result in fusion of nuclei. Obviously, the process in question can occur only at small energies of translational motion of the centers of mass of electron and nuclei: nuclei should be "inside" electron long enough for them to have time to come nearer to each other as a result of electron-nuclear interaction. This mechanism of nuclear fusion is of a universal character. In order for it to be realized, it is necessary to have only a stream of free electrons intensive enough, i.e. heavy electric current, and as long as sufficiently great number of free nuclei.

If heavy nuclei appear "inside" free electron, owing to their interaction with the electronic cloud there occurs polarization of nuclei. Because the own field of electron interacts with protons more strongly than with neutrons, nuclei are deformed (become extended), and this process may result in the decomposition of nuclei to fragments (in nuclear fission).

As is noted in [7], the official version of the reasons for Chernobyl accident contains serious contradictions, a number of facts concerning the accident has no convincing explanations, and this circumstance forces to search for the true reasons for the happening, since

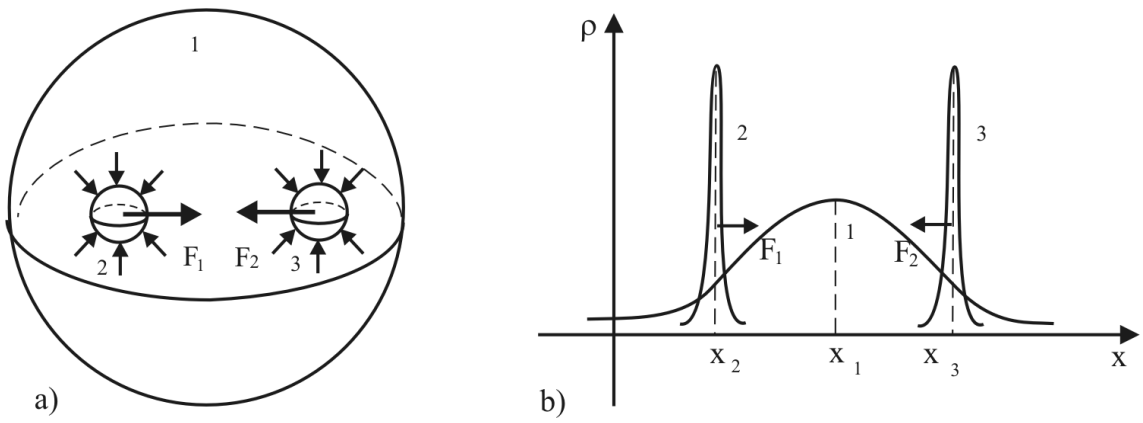

Fig. 2.
The schematic image of interaction of nuclei with electronic cloud: (a) 1 is the region of basic localization of electron, 2 and 3 are nuclei, F_1 and F_2 are the attractive forces between nuclei, which appear at the expense of electronic cloud compression induced by Coulomb forces; (b) ρ is the charge density, 1 is electronic soliton, 2 and 3 are nuclear solitons, X_n (n=1, 2,3) are coordinates of the centers of mass of particles.

"not having understood the mechanism of the one tragedy, we sooner or later shall become witnesses of the other". The authors hypothesize that the reason of the accident was penetration into the nuclear reactor of magnetic monopoles, which have caused the decay of nuclei ^{238}U, and this has resulted in production of delayed neutrons, growth of power output of the reactor and explosion. As an argument in favor of the assumption, the fact is presented that nucleus ^{238}U are disintegrated under the action of "strange" radiation appearing at explosion of foil.

In the opinion of the authors of [5,7], "strange" radiation is created by those magnetic monopoles, which form bound states with nuclei of atoms. These compound particles give the abnormally wide tracks similar to those of a creeping caterpillar, and also the tracks of complicated shape reminiscent of spirals and gratings. Character of tracks changes when imposing magnetic field, which, as the authors believe, is an argument in favor of the assumption above. There are also some special tracks very similar to scratches and ink spots. "Strange" radiation is of spherical form, it resembles a ball lightning, and its duration is more than ten times as great as that of the current pulse arising at electric discharge. With the course of time the luminous sphere (the ball-like plasma formation) is dividing into many small "balls".

It is our opinion that "strange" radiation is caused by free electrons in excited state arising in the area of electric discharge. According to [9, 19], linear sizes of the region of basic localization of such electrons can make many tens of sizes of atom. The heavy nucleus, for example, the nucleus ^{238}U, appearing inside the electronic cloud, is inevitably deformed because of interaction of protons with adjoining layers in the distribution of electric charge of electron, and this deformation can cause nuclear fission. If two or the greater number of light nuclei appears "inside" electron, then attractive forces arise between nuclei, which may result in fusion reaction. When electric discharge is strong enough, the areas of basic localization of some electrons can overlap, and if a nucleus lands in the area of overlap, because of Coulomb attraction of nucleus on the adjoining layers of electronic clouds, a bound state may be formed, of two electrons and the nucleus, characterized by the relative stability and significant spatial extension.

Obviously, if the concentration of free electrons is great enough, there may be formed some relatively stable bunch of plasma consisting of great number of free electrons and nuclei, which in virtue of chaotic movement of nuclei and because of the absence of preferred directions should have approximately spherical form. Let us note that atomic electrons, belonging to additional energy zones of atom (Balmer's replicas associated with nuclear self-action, see Section 2) can contribute to "strange" radiation.

As is seen from above, to account for the reasons for Chernobyl accident, there is no need to involve magnetic monopoles. The scenario of development of events during the accident, described in [7], seems to be quite plausible if only to understand by initiators of nuclear fission not hypothetical monopoles but free electrons, which powerful pulse might arise as a result of electric discharge in the region of turbo-generators.

The existence of simple physical mechanism of nuclear reactions at low energies, indicated in this paper, implies that nuclear reactors are, in effect, nuclear delayed-action bombs, which will blow up from time to time. Explosion of nuclear reactor may take place because of casual short circuit at an electric subcircuit, owing to which there appears an intensive stream of free electrons. This stream, having got for any reasons in nuclear reactor, may initiate explosion of the reactor. It follows from here that though nuclear stations may provide mankind with cheep energy, atomic energetics represents a very dangerous way of producing energy (as well as the energetics using controlled thermonuclear fusion). The only acceptable way of resolving the energetic problem consists in the use of nuclear reactions at low energies.

According to the results obtained, nuclear reactions at low temperatures occur "inside" electron under the action of own field of particle. Hence, to elucidate physical mechanism of CF, it is necessary to study in detail intra-electronic processes and physical properties of own fields of particles. Note that the own field, by its physical properties, essentially differs from the field of electromagnetic waves: this is the field of standing waves of matter, it is of purely classical character and may not be reduced to the set of photons. The own field of charged particle plays in nature a special role, consisting in that it transforms environmental space into the physical environment (physical vacuum) with the properties of absolutely rigid body [32].

As it was repeatedly noted in the literature [1,2], experiments on CF are badly reproduced, and this fact gives rise to doubt the very existence of the phenomenon. Bad reproducibility of results seems to be explained by the fact that CF depends upon great number of parameters: upon electric current density, concentration of free nucleus, concentration of impurities and dislocations in samples, sizes of samples etc. In order to obtain reproducibility of results, it is necessary that all these parameters, describing the environment in which nuclear reactions occur, be the same in various experiments, but to achieve this as a difficult task.

In conclusion we shall dwell upon the problem of linear dimensions of electron, which is of special interest in connection with the mechanism of nuclear reactions indicated here. The inference that the dimensions of electron in the ground state of atom are of the order of Bohr radius, i.e. of the order of atomic dimensions, following from dimension considerations [9,19] and confirmed by quantum model of electron, seems completely unexpected. At first sight, it is in conflict with both the theory of quarks and experimental data

on scattering of electrons. According to quark models, the radius of electron corresponding to its quark structure makes up the quantity of the order of 10^{-22} m [33]. It is necessary to emphasize, however, that the above-mentioned magnitude of linear dimensions of electron refers to the internal structure induced by Coulomb field. The last is long-distance and consequently the linear dimensions of internal structures produced by it (i.e. spatial inhomogeneities in the distribution of electric charge in various quantum states) should considerably exceed the dimensions of quark structures connected with electron. There seems to exist a hierarchy of internal structures of particle produced by Coulomb forces, nuclear forces, inter-quark interactions etc. characterized by the smaller and smaller linear sizes.

As to the experiments on scattering of high energy electrons, according to which the internal structure of electron is not manifested up to distances of the order of $10^{-16} \div 10^{-17}$ m, two arguments, at least, can be adduced in favor of that there is no contradiction here with the experiment. Firstly, in experiments on scattering, investigators were trying to register the details of internal structure of electron within intervals much smaller than Bohr radius, which is why it is not surprising that results of experiments proved to be negative: at high energies electrons behave like point particles, their internal structure has no time to be manifested. Secondly, the results of experiments were analyzed from the point of view of standard representations about electron, which refer to a point particle, but are obviously inapplicable to real, self-acting electron. According to the predictions of quantum theory of electron as an open self-organizing system, real electron is a special object - soliton, i.e. such a cloud of electrically charged substance which, when interacting with other particles, tends to keep its sizes and geometrical form.

At present there is as yet no scattering theory of this kind of particles and for this reason it is impossible to predict with certainty how can the internal structure of electron be manifested in experiments on scattering.

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The Evolution of Lifter Technology

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INTRODUCTION

Readers of the electric-spacecraft journal might know a little about the Lifter technology popularized recently be Jean-Louis Naudin, but they probably don't know the whole story. In the short amount of time that has transpired since the publication of that article, this technology has both literally and figuratively taken off – going from a "proof-of-concept" prototype by Naudin to an international group of researchers investigating how to give the lifter higher-performance and greater efficiency. With the first commercial products now on the horizon, if you haven't taken the time to read up on lifter technology, this is the perfect time to do so. . .
To give you a complete up-to-date overview of where this technology is, where it is going, and what I think it is capable of, let me start with the basics – an overview of how I became involved with Electrogravity research and what eventually led me to become involved with lifter technology.

MY BACKGROUND

I started college at 16 years old, back in 1992 – at the same time, I purchased a kit containing "hoverboard plans" from Hovertech, Inc. The moment that I received that $20 white-manilla envelope in October 1992 was the moment that I became involved with what has now been nearly 10 years of electrogravity research.

I worked with Bill Butler – the president and chief-scientist of Hovertech – on a variety of different antigravity, Electrogravity, and levitation ideas from approximately 1992 through 1996. While putting in my college time, I was also taking distinct advantage of the enormous college library at Western Washington University to read up on everything that might possibly relate to Electrogravity. I read books on standard electronics and physics theory alongside with books by the masters of this science, such as TT Brown and Nikola Tesla.

Bill and I played with several different ideas – many of them only peripherally related to Electrogravity. For instance, I published a manuscript initially in 1996 describing Tesla's theory on how to reliably produce Ball-Lightning using a standard Tesla coil – the information courtesy of WWU's excellent library. Bill also assisted me with obtaining video footage of a Searl-effect conference that he attended in Denver in the early 90's – this footage was an excellent overview of Searl's design and construction concepts for what he believes is the next major technological step in aviation and space travel.

Bill and I eventually found different paths, and in some ways drifted apart. Bill moved into Geomagnetic levitation research and started intense investigation on the patents of How Wachspress and the magnetic dipole levitator. I went to more traditional technologies – eventually becoming a UNIX system administrator for AT&T Wireless.

I hadn't heard from Bill Butler in about 6 months when he sent me a short email containing the words "hey, check this out" – and a link to Jean-Louis Naudin's "Lifter Experiments" home-page. I visited the site, watched all of the video clips, and then watched them again. This was the technology that I had been waiting for!

LIFTER TECHNOLOGY

I can say without a doubt that the lifter technology is completely revolutionary, but you might not realize how profoundly revolutionary it is until you've stopped to think about it for a bit. What is it about the lifter that makes it so unique, especially when so many inventions claim to produce more and better electromagnetic thrust? The answer is simple – the lifter works repeatedly.

Jean-Louis Naudin started a figurative bonfire when he decided to replicate a "proof-of-concept" experiment by a small Huntsville, AL aerospace contracting firm. The lifter initially came into being in the mind of Jeff Cameron – the chief scientist of Transdimensional Technologies – in the 1970's from experiments conducted with high-power military and research-grade lasers. A device in the lasers called a "pre-ionizer" was used to apply a high-voltage to the lasing-medium to facilitate better performance. Repeated operation of the pre-ionizer had a common side-effect of horribly twisting the wire and foil combination out of shape, which required a decent amount of work to repair.

Jeff Cameron realized that the torsional effect on the pre-ionizer was a side-effect of some unknown force acting on the pre-ionizer apparatus, and he began a long-term investigation into what was causing the apparatus to deform. His eventual results indicated that a force in the foil collector in the pre-ionizer was causing a net-thrust in the entire pre-ionizer apparatus that was making it twist and move on its mounts within the laser – the lifter came to him later as a three-dimensional device to demonstrate this force.

Naudin's genius became readily apparent not through a giant breakthrough in technology, but rather in a more subtle fashion – he replicated the lifter experiments of Transdimensional Technologies and published videos, articles, and complete construction plans on his website to allow others to do the same. In a manner similar to the open-source software movement, Naudin had taken an incredible scientific find that might have otherwise been overlooked and done and incredibly charitable and intelligent thing – he gave it away for others to play with. By following Naudin's instructions, inventors all over the globe began to slowly replicate the

Transdimensional Technologies experiments and thereby validate the proof of concept that Jeff Cameron had created to show that his "mystery force" was real after all. Naudin of course took advantage of these replications of the experiment by showcasing them on his own website – which in turn lends additional credibility to his research.

As far as technology goes, the lifter demonstrates that science and engineering have more than their share of humorous irony. For the years that I researched Electrogravity and antigravity claims, all of the devices that I had seen required something "magic" to make them work. For instance, Bob Lazar's UFO-claims could have been reverse-engineered except that they require 'element 115' to make them work – an element chemically related to Bismuth that is theorized to potentially have electrogravitic properties. I will come back to the possible electro-gravitational properties of Bismuth in a bit, as it turns out that this element may in fact provide some use for future lifter technology.

The Searl-effect disc is an even better example of the "magic" usually involved with building a working Electrogravity device. Searl's ideas seem valid enough, but although he supposedly demonstrated several working prototypes in the 1950's, he is currently pursuing millions of dollars in research funding in to replicate those experiments in a modern-day setting.

The irony involving lifter technology is that while inventors all over the world have been searching for the perfect electro-gravitational device for decades, the possible working proof of concept for many of these theories has been sitting in front of us the whole time – the lifter costs less than $10 in parts to build, and none of them are magic – in fact, for my experiments, all of them were at stores within 2 blocks of my house — balsa wood from the craft store, aluminum foil from the supermarket, 30-gauge magnet wire from the local Radio Shack, and an old computer monitor for the high-voltage power-supply.

LIFTER PHYSICS

Whether or not Jeff Cameron knew it at the time he constructed his lifter prototype, what he was actually building was a 3 dimensional representation of a drawing on a patent application by TT Brown in the 1950's. In the patent application, the drawing shows a positively charged wire suspended over a grounded foil body which was meant to demonstrate the most basic Biefeld-Brown effect generator. While Brown's drawing is a little different than Jeff's design, the resemblance is uncanny enough to indicate that both of these men had the same basic force in mind.

TT Brown's patent indicates that this Biefeld-Brown effect generator works due to a gradient electrostatic-field between the wire and the foil – in essence, these two elements compose a low-efficiency, high-voltage air-gap capacitor in which the difference in geometries between the two capacitive elements generates a net-directional force from the larger element towards the smaller element. Jeff Cameron seems to have a practical axiom that goes along with this scientific philosophy, which is that there must be both a leakage current and a capacitance between the wire and the foil in order for the lifter to function.

Conventional physics says that two capacitor elements of different sizes will not generate a net-directional force, so what gives? This is actually the thinking that convinced me to abandon my research into Biefeld-Brown effect technology in 1996 – physics says it doesn't work. What the books say will happen is that since the wire can only maintain a lower-capacitance than the foil, the overall capacitance between the two elements will be reduced to be equivalent to that on the smallest element (or plate) in the capacitor. This, of course, assumes a 2-element series-wired capacitor, such as the lifter.

I can give you the conventional physics answer to this small riddle by simply saying that the lifter uses a manifestation of ion-wind. This would state that the electrons crossing the air-gap cause a breeze that causes thrust – since the breeze would be traveling down from the wire to the foil, the thrust would be up, as demonstrated in testing. In the ion-wind explanation, the electrons are emitted from small-diameter of the positively charged wire in such great abundance that they move a significant airflow down to the foil where they are absorbed and transported electrically back to the HV power-supply's electrical ground.

Conventional physics would seem to have the theoretical answer to why the lifter causes lift, but in the experimental setting, which is what we now have an abundance of thanks to Jean-Louis Naudin, the conventional physics explanation doesn't suffice. Experimentally, there are several deviations from the ion-wind explanation that seem to invalidate it. For instance, if you completely contain the lifter in a plastic-enclosure, it will still generate lift – this would not be the case if a breeze was responsible for lifting the device. How could it be, if the breeze is limited to the inside of an enclosure which itself is levitating?

A more compelling proof that Biefeld-Brown is something other than ion-wind comes from Purdue University, where the lifter experiment was replicated inside a vacuum-enclosure with positive results. While ion-propulsion can work in space, it usually assumes that there is argon, krypton, or other noble gas to be used as the propellant – the vacuum enclosure showed that with no gas available for transport the lifter showed a moderate improvement in performance.

The vacuum enclosure tests are definitely compelling evidence that something else is going on other than ion-wind – at least compelling enough for NASA to file patent number 6,317,310 – "Apparatus and Method for Generating Thrust using a Two Dimensional, Asymmetrical Capacitor Module". The NASA patent description – which can be accessed from Naudin's lifter

website – is as vague is it is compelling in that NASA is basically requesting a patent on any technology that generates force using two geometrically dissimilar capacitive plates. Disregarding the fact that this patent was issued nearly 50 years after TT Brown's patent using nearly identical descriptions and pictures, and also disregarding the fact that NASA also doesn't understand why the lifter generates thrust, it seems apparent the this phenomena is gaining credibility in engineering circles while physicists seemingly continue to deny that anything is going on.

THE EVOLUTION OF LIFTER TECHNOLOGY

Every good movie always has a sequel, and in technology, if at first a major government agency 'liberates' your idea, it may seem that a sequel is in order. In the case of the lifter, it would appear that the NASA patent would cover this technology to at least some degree – at least until someone overturns this patent under the prior-art rule – which means that the next generation has to be considerably more advanced to escape having the research and development be forfeit to the government.

The pursuit of more advanced versions of the lifter technology is currently underway by several independent inventors, as well as Transdimensional Technologies themselves. Most of the private research by inventors has delved into improving the current lifter design to produce a greater force output and utilize less power to do so. Because the lifter is so simplistic in design, many of these enhancements have been of a very basic nature.

Jean-Louis Naudin was the first independent inventor to do serious work with improving the technology behind the lifter – and even so, the majority of his work has utilized similar materials in more complex arrangements. Naudin has demonstrated dramatically increased lifting forces by building a "lifter inside a lifter" for demonstration purposes. Naudin has also done a great deal of work in taking breaking up the concept of the single triangular lifter into a parallel series of lifting cells – which means that these cells, working in parallel, can contributed to greater stability and higher force output than any single lifting element.

Saviour – an independent inventor working with Jean-Louis Naudin – has done some of the most interesting improvements on lifter design since those by Naudin himself. Saviour's concerns have not focused around the "bigger is better" philosophy that many inventors have stuck by – he has done several experiments to determine the radiation output, remote-controlled applications development, and materials analysis and improvement on the lifter that others have not had the time or expertise to conduct.

A recent experiment by Saviour demonstrates just how this gentleman's foresight is helping other experimenters – Saviour substituted nichrome heating wire for the common lightweight wire used for the emitter, and demonstrated that the lifting force greatly increased when a higher potential 12-volt charge was used to heat the emitter wire in conjunction with the standard high-voltage charge coming off it.

Transdimensional Technologies – the developers of the initial lifter design – are taking the approach to optimizing lifter performance to another level. They are currently not-so-secretly working on a 2nd generation lifter, which will consist of a 1-piece layered material to replace the current wire and foil design.

The layered material approach to the lifter is an idea that Jeff Cameron may or may not have had after some lengthy discussions with Travis Taylor – the man responsible for testing some anomalous materials known as "Art's Parts".

Art's Parts were some pieces of material sent by an unknown person to the Art Bell radio talk-show with a note stating that the they were pieces of UFO wreckage taken from the often-cited "Roswell crash" in 1947. Whether or not the pieces of material actually came from that crash is unknown, but Art Bell did the honorable thing by sending them to an acquaintance in US Army research named Travis Taylor for a professional scientific investigation.

Taylor, who apparently tested the materials after-hours in a world-class research lab to avoid potential classification by his superiors, used an electron-microscope to determine that the layered materials were actually pieces of metal – containing several hundred microscopically thin layers of magnesium and bismuth. Taylor also tested the layered-metal with a high-voltage apparatus, which seemed to indicate that when a voltage was applied to the material, the layered metal would move – and in some cases levitate.

Taylor reported his findings to Art Bell and sent video clips of his high-voltage experiments, which eventually made it back to a permanent home on the Art Bell radio show website. In addition, Taylor conveyed his belief that the only manner in which the pieces of metal could properly be produced was through an advanced form of electron-deposition technology, due (apparently) to an absence of oxygen-molecules between the different layers of metals. Additionally, the layers of metal were too thin to have been mechanically produced.

Jeff Cameron indicated that Transdimensional Technologies maintained some contact at one point in time with Travis Taylor, apparently as professional colleagues in the defense community in Huntsville, AL. I am not an expert on this relationship, other than to say that to the best of my knowledge these two individuals knew and contacted each other, and that this is how Jeff Cameron might have come up with the 2nd generation lifter idea.

ADVANCED LIFTER TECHNOLOGY

As an inventor, I couldn't care less whether or not the idea for the technology came from a crashed UFO. To be perfectly honest, I'm not what you would call a "believer" anyways, although I have often wondered

about it. My point is not to attempt to lend any credibility to "Art's Parts", but rather to tie in the properties of the anomalous material's high-voltage movement with the underlying theory of lifter operation.

Even mentioning a UFO in a respected publication or article is the kiss of death in today's world – and I wouldn't do it if it wasn't an intricate part of the story. The other interesting thought is that the layered material is once again partially composed of Bismuth – which is thought to possibly have some of the same electro-gravitational properties as Bob Lazar's Area 51 "element 115". Is there a similarity, or merely a coincidence between a claim that hasn't gained credibility and a technology currently under development?

The lifter in its own right is essentially a layered material. One of those layers is the emitter wire, which is highly charged with about 30kV worth of electrons, another layer is the air-gap, which is approximately 3 cm in height, and the final layer is an electrically-grounded "skirt" of aluminum foil that surrounds the lifter. It is also reasonable to expect that there are only two possible forces at work in the lifter – one of which being a possible ion-wind effect moving down from the emitter to the foil, and the other being a possible Biefeld-Brown effect, moving up through the foil to the emitter.

There are a few shortcomings in the lifter as a design that might be overcome if we could transition the layered material from one containing an air-gap to one that does not. For instance, the lifter is currently a rather delicate object, in that having a wire under tension as the emitter makes construction difficult for future automated assembly. Additionally, because the air-gap requires struts to support the emitter wire, a trade off involving the weight versus the strength of the struts is additionally involved in any current implementation of lifter technology.

Some of the other changes that would be helpful to implement when transitioning lifter technology from one type of air-gap to another are changes in the materials used to increase the dielectric capacity. High-K dielectric materials may be used to increase the displacement of electrons in the material to enhance charge transport. And since increasing the dielectric potential of the layered materials also increases the breakdown resistance, it means that thinner materials can be used.

Designing a lifter without an air gap would accommodate lower voltage requirements between the foil and the emitter. The voltage would not have to create the large e-field gradient to create a leakage current across such a large void. Therefore the overall voltage across the device could be greatly reduced, without much cost in thrust. A lower operating voltage in turn means that a lower-output power-supply can be used for a given amount of current, which increases the overall efficiency.

Transdimensional Technologies recent research is utilizing the layered materials approach to eliminate the air-gap and substitute for it high-k dielectric materials that may allow higher overall performance. Although they have not yet released details about the exact composition or thickness of the materials that they are working with, they claim to currently have a 10% reduction in weight using a low-voltage current across the thickness of their newest device.

FUTURE LIFTER TECHNOLOGY

Thanks to the tremendous amount of research being done on lifter technology by Transdimensional Technologies and a loosely affiliated group of inventors around the world, the future of lifter technology seems very bright at this point.

Transdimensional hopes to release some breakthrough research to allow replication of their newest 2nd generation experiments in the very near future, and along with that stands the massive body of research and advancements being done by inventors and researchers such as Jean-Louis Naudin, Saviour, the Lifters-group, and myself.

My personal goals are to attempt to assist Transdimensional Technologies in popularizing this technology to increase awareness of it and help "spread the word" about what it is and how it can potentially help the world.

Imagine if instead of getting in your car and driving through the usual maze of thoroughfares and side streets you were able to simply type in your destination and have a flying vehicle take you there automatically. The lifter technology offers to potential to transform the current transportation market by offering point-to-point aerial transport without the need for roads or freeways.

Additionally, unlike the magnetic-levitation ("Maglev") technologies that are currently being promoted as the future of transportation, the lifter does not require a specially constructed and exorbitantly expensive track to operate – the greatly reduces the per-unit cost on the technology and opens the door for wider adoption by the general public for transportation solutions.

Other individuals are currently working to see if lifter technology may offer cost-effective methods of transport into space, which would reduce the cost greatly and allow a one-piece, reusable method of moving things into orbit.

LIFTER RESOURCES

All of the research involved with the lifter technology is available to the public on the internet. The list of resources below are some of the better and more common resources to obtain detailed lifter information.

American Antigravity
→ http://tventura.hypermart.net

→ The author's website that includes video clips, complete instructions, and other related lifter information.

Jean-Louis Naudin's "Lifter Experiments Website"
→http://jnaudin.free.fr
→ A very in-depth website containing video clips, complete instructions,

World-Wide Lifter Replications
→ http://jnaudin.free.fr/html/lftwrld.htm
→ An overview with photos and video from many of the independent inventors who have replicated the lifter experiments.

Transdimensional Technologies, Inc
→http://www.tdimension.com
→ The home page for Transdimensional Technologies, the developers of the lifter design.

Blaze Labs (Saviour's Research Website)
→http://bel.150m.com
→An excellent site on research into lifter enhancements, radiation testing, sealed devices, power supplies, and other topics relating to lifter technology.

Lifter Builders Group
→ http://groups.yahoo.com/group/Lifters
→ An email group for the exchange of research findings for those interested in building lifters or staying current on the state of the technology.

NASA Patent #6,317,310
→ The NASA patent regarding obtaining thrust from an asymmetrical two-dimensional capacitor, grant Nov 13, 2001.

Research on the Capacitance Converter of Environmental Heat to Electric Power

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Nickolay E. Zaev works on creation of the prototypes of converter energy, which do not require any fuel. The direct conversion of environmental heat to electric power is possible in the processes of "charge-discharge" in non-linear condensers or by means of "magnetization-demagnetization" of ferrites. Such converters of energy create cold and electric power without any fuel.

Theory of the converter, results of early experiments on the generation of microwatt power, methods and features of research are given in this article. The methods of generation of a few watts power are described in details. The possibilities and difficulties of creation of powerful capacitance converters are discussed in this article.

I. Grounds of research.

1.1. From positions of orthodox physics there is no subject of research. It is evident that the energy of charging (C) A_c condenser C_x is always equal or more than the energy of discharging (D) A_d, i. e. always $A_c \geq A_d$. Only the advanced analysis shows that it is not always true. Exactly, in C_x, where $\frac{\partial C}{\partial V} < 0$ an inequality $A_d > A_c$ is possible, and in C_x, where $\frac{\partial C}{\partial V} < 1$, then the work $A_c > A_d$. Therefore we should discuss the nonlinear capacitors (NC). In the end of 1969 I noticed a systematic inequality $A_d > A_c$ during the measurement of A_c and A_d of many capacitors with different dielectrics. Theoretical grounds and results of measurements of this phenomenon are given in the publications in 1984 [1], [2, page 73]. On the industrial standards NC (varicond), ceramic condensers VK2-ZSH, $4 \cdot 6{,}8 \cdot 10^{-9}$μF with an optimal voltage about 95 V it was stated that $\frac{A_d}{A_c} \sim 1{,}21$ with the power to about $98 \cdot 10^{-6}$ Wt and "generated" extra power is equal to $21 \cdot 10^{-6}$ Wt.

1.2. In [1] and [2] the strict theoretical proofs of realization of $A_d > A_c$ (there are four of them) are given. On 1m³ of dielectric $|A_d| - |A_c| = -\frac{1}{2} a \cdot \varepsilon_0 \cdot E_c^{\,3}$ (E_c is an intensity of the field, V/m; ε_0 is a dielectric constant of vacuum, a is a coefficient of nonlinearity of the capacitor). Below we state one more proof more connected with the parameters of circuit.

It is well known that with the charge of a linear capacity from the source of constant voltage V_0=const through the resistor R=const it gets an energy $A_c = \frac{C \cdot V_0^{\,2}}{2}$ exactly equal to the output energy in the time of charging t_c. The output energy irradiated from the load R is a Joule heat $\Theta = R \cdot \int_0^{t_c} i^2 \cdot dt$ [3, page 546]. If NC (nonlinear condenser) is charged, then there are no proofs of such equation. The NC are the variconds or other capacitors, which have $\frac{\partial C}{\partial V} > 0$ in the interval $V = 0 \div V_k$. For the variconds V_k is some voltage, which corresponds to the maximum C_v. If $V > V_k$, then $\frac{\partial C}{\partial V} < 0$. For some other capacitors V_k is a voltage breakdown.

For further consideration let's believe that in the operating area of the given sample of varicond a function

Reality and Consciousness in Education and Activity

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Relation of thought to existence is the main question of philosophy as science on general laws of Nature was formulated but it still did not interpreted and solved in the frames of generally accepted logic standards. The ways to solve it lead to futile discussions of materialists and idealists, to senseless disputes of determinists with eclectics and apologists of the "chance". This discussion lost its sense without a determination of terms under discussion and condemned debaters to have subjective "gustatory" senses, which were changing while aging and depended on the extent of received and conceived knowledge. Such is the situation in this link of World studying, which does not allow creating a logic chain of reasoning in the understanding of cognizable things.

A paradoxicality of all things that happen is connected with incorrect translations and interpretation of wisdom of ancient philosophers and scornful attitude both to the knowledge of distant past and classical heritage, which highlighted the elements of natural-science approach to Weltanschauung.

According to Plato, **an ideal thing** is a visual thing, which can be felt by our organs of sense. Therefore, the understanding of objective reality is mediated by the crowd of our feelings in such a way that perception of reality by means of these feelings gives us a notion of the World. Hence, **our notions about reality are the subject of research in science, but not the World itself, i.e. the World outside of our consciousness.** So, what should be studied in our notions about the World? Let us refer to the wisdom of ancient scientists again: " The World is given in motion and its laws are the laws of motion". Then, we should speak about laws, order, i.e. about relation and interrelation in the phenomena of motion. This is the distinctness in notions and actions (determinism) to predetermine further development of reality cognition logic, i.e. what has an influence on us and determines specific character of our perception. Further we can speak about formation of ideas about reality, which require some premises, principles to organize these ideas. These principles are given in classical heritage, in "Dialogues" by G. Galilee [1] and "Mathematical principles of natural philosophy" by I. Newton [2]. A notion of force as a measure for momentum was introduced, which manifests in action and disappears from the body after the action is over, and the body keeps its new state due to the inborn "inertia force". **But the force itself cannot do anything without its application with a certain speed.** Then we introduce a notion of action as a product of acting force F_A and the speed of action V_A.

We offer a law of interaction, which determines the interaction between action of the cause and the effect appeared during this action as a reaction, i.e. the product of the force of reaction F_R and the speed of reaction V_R. Thus, this interaction between the cause and the effect is determined by the transfer of action from one object to another in equal quantity, but with appearance of new quality, which is determined by specificity of interacting objects according to fundamental law of interaction:

$$\mathbf{F_A V_A = -F_R V_R}.$$

Unfortunately, an incorrect interpretation of interaction manifestation as an opposite counteraction became strong in our mind. This manifestation is perceived as a compensation of cause by action of the effect. Moreover, the incorrect way of writing of the mathematical form of Newton's third law manifestation established in textbooks and scientific literature due to the incorrect translation as $F_A = -F_C$. This very tragic situation for the science suppressed the development of logic in description of processes. Chance and statistic approach to the description of phenomena has taken place in our perception. This approach is based on the model of non-interacting elements, in which there is no order stipulated by the interrelation of elements. The science has developed this model and its properties, and this fact predetermined the evolution of notions about real World.

This ideology penetrated in mathematics, which for sake of physics began to study properties of objects, but not operations with them. Moreover, a possibility to reflect specific character of real physical processes in the interconnection of cause-effect relations by mathematical operations is not realized. It is essential, that fundamental law of interaction establishes manifestation and description of elementary act of cause and effect interrelation, **the law of manifestation of a Fact.** It means that order in the World is conceived through manifestation of concrete facts. The action of law of interaction lies in the basis of these facts.

So, there is a conclusion: the World is perceived through the discrete manifestation of motion forms evolution. Hence, the discrete mathematics of finite discrete aggregate can be applied to describe the World, but not the continual mathematics, which lies in the basis of traditional orthodox physics. All these circumstances lead to numerous problems and difficulties in description of our notions of reality, to the plenty of used principles, which are in contradiction to each other, as R. Feinmann noticed once [3].

And what we can get from determinism, which is based on fundamental law of interaction, law of cause and effect interrelation? **The change of force value in a reaction takes place, i.e. the change of value of the potential gradient, i.e. the change of energy**

concentration. This circumstance is visually demonstrated by the operation of Archimedean lever as well as in all phenomena of the real World. This is Archimedean lever, where the loss of speed takes place, but there is a gain in force. And the load raised on a lower height than the way, which was made by the applied force, will give a huge power during its free fall. This power is higher in so many times, in how many times the time of the load fall is less than the time of action spent on its raising! And this is the fact, which determines specific character of **creation in the real World**. We should attribute both quantitative and qualitative characteristics to energy. This is the side of energy manifestation, which is reflected in Plank's formula: energy is proportional to frequency.

Manifestation of fundamental law of interaction also lies in the basis of general universal regularity of evolution of real many-particle systems with the change in external conditions. This process develops in multistage way, and on the each stage the logarithm of the ratio between the event happened and the event to happen always is equal to the work of external forces. In other words, the relation of the event happened to the resource is in exponential dependence on the initial conditions and extent of external influence. Exponential character of development of processes is the evidence that Nature develops according to the law, which conserves itself during evolution. This regularity, which manifests everywhere, can be naturally called **the Principle of Order.**

Fundamental law of interactions and Principle of Order appeared to be enough to describe and understand phenomena in the observed World. And it is natural to expect that this principle of Nature manifest in finer World also. This World includes lower and higher frequencies, which are not available for us yet to watch this wide-range frequency-wave emanating Universe.

From all aforesaid we should make a conclusion that the logic, which exists in the traditional physical tool, appeals to the model and principles of the World of non-interacting elements using the range of regularities, which also reflect some features of the real World, but they do not include fundamental law of interaction and Principle of Order, which are necessary and sufficient to describe reality. Descriptions existing in traditional physics are phenomenological ones and concern only those aspects of the phenomena under investigation, which do not include possible qualitative changes during development of processes, because the main property of real processes of interactions (creation of new energy property) was excluded.

The current situation in physics had a strong influence on formation and development of other sciences, other fields of knowledge, since the logic of reflection of cause-effect links was initially excluded. These are the links to determine existence, i.e. existence of constant creation of the World. All these circumstances give grounds to fundamentally revise educational programs, first of all, in physics, philosophy, mathematics, chemistry and biology. A change to the offered logic of cognition, which is based on the Principle of Order and fundamental law of interaction, will fundamentally change our notions about the World as well as will open big opportunities for new technique and technology. A Man has got huge opportunities in cognition and existence, but due to his immorality and features of incorrect aims in the logic of cognition he cannot use these gifts of Nature. We present wider and deeper view on the World and a Man in it, which allow analyzing, watching and operating with those fields of reality, which manifest in finer World, World of higher-frequency energies and other structures of fields. Logic of cognition had not touched these structures yet.

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Old New Energy

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Two kinds of energy, accumulated energy [1] and free energy [2], are considered as an inexhaustible source of natural energy created by Nature itself. It is ecologically clean and possible to be renewed in natural conditions.

The energy accumulated in substance is released as a result of partial decay of substance in elementary particles. At that, the acquired defect of mass is so small that it does not change chemical properties of substance and is compensated in natural conditions. Physical mechanism of energy-release lies in the fact that an electron in plasma layerwise takes sufficiently smaller elementary particles (electrino) from positively charged atoms or fragments of substance (ions). Electrino give their kinetic energy to plasma, heat it up and move beyond the bounds of reaction zone in the form of thermal and optical radiation. There is no substance, which could not take part in such process of energy-release, i.e. phase transfer of higher form (PTHF). The most appropriate, available and low-cost substances are air and water, which play the role of nuclear fuel in PTHF. It is turned out that usual combustion is also a process of PTHF, in which oxygen is a nuclear fuel and organic fuel is a donor of electrons. In the process of combustion oxygen atoms get the defect of mass equal

concentration. This circumstance is visually demonstrated by the operation of Archimedean lever as well as in all phenomena of the real World. This is Archimedean lever, where the loss of speed takes place, but there is a gain in force. And the load raised on a lower height than the way, which was made by the applied force, will give a huge power during its free fall. This power is higher in so many times, in how many times the time of the load fall is less than the time of action spent on its raising! And this is the fact, which determines specific character of **creation in the real World**. We should attribute both quantitative and qualitative characteristics to energy. This is the side of energy manifestation, which is reflected in Plank's formula: energy is proportional to frequency.

Manifestation of fundamental law of interaction also lies in the basis of general universal regularity of evolution of real many-particle systems with the change in external conditions. This process develops in multistage way, and on the each stage the logarithm of the ratio between the event happened and the event to happen always is equal to the work of external forces. In other words, the relation of the event happened to the resource is in exponential dependence on the initial conditions and extent of external influence. Exponential character of development of processes is the evidence that Nature develops according to the law, which conserves itself during evolution. This regularity, which manifests everywhere, can be naturally called **the Principle of Order.**

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to 10^{-6} %, which constitutes the so small value that it cannot change chemical properties of oxygen and does not call killing radioactive emanation.

There is a possibility to use energy properties both of oxygen and nitrogen of free air in the process of PTHF. To do this it is necessary to destroy nitrogen molecule at least in atoms or smaller fragments by some initiating influence. It is achieved by electrical discharge, magnetic flow, explosion and other means. These means consume much less energy than produced in PTHF. In particular, such processes were achieved in combustion engines. Such nitrogen mode of operation and combustion is accompanied by oxidation to H_2O, but not to CO_2, which is more effective in energy and ecological aspects. Accordingly, the power of engine increases and organic fuel is saved. Exhausts from this process mainly contain water vapor [3].

PTHF processes with excessive power release (more than consumed power) were also obtained in heat-generators operating with water.

Free energy diffused in the surrounding space could be transformed into mechanical, electrical or another kind of energy by means of vibration-resonance, electromagnetic and other energy systems. Classification of these systems as well as physical mechanism of energy transformation is given in [2]. The known Searl's engines can serve as an example of energy systems working with free energy.

The developed physical mechanisms of energy-release processes will allow to create industrial, stably operating, ecologically clean energy systems, which do not consume organic and nuclear kinds of fuel, harmful for humankind.

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On General Nature of Forces

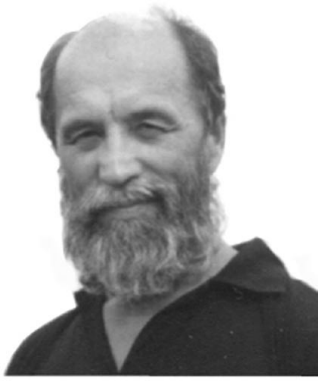

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Introduction

In techniques and in our life we got used to certain physical notions concerning force. We usually use these notions in creation of automobiles, airplanes, rockets and other techniques, but we don't think about **the origin of forces** in general. Usually appearance of force in continuum is connected with presence of momentum gradient.

A number of works, which describe various versions about origin of a force appeared [1, 2, 5, 8, 17, 21, 22, 23, 25, 30, 35, 36, 38, 39]. Different mechanisms of appearance of force are considered in these articles. Usually they consider origin of a force in one of the fields, which are: electromagnetic, gravitational and others. **There was a theoretical attempt to connect the force initiation with energy gradient [33]. Experimental proof of force initiation due to energy gradient was obtained in the works [7, 38].**

Below we made an attempt to show the general regularity of force initiation, which is connected with non-uniform distribution of energy in space. With this process, physical nature of any kind of energy and specific mechanism of force initiation does not play any role. These are only particular cases of general nature of force initiation.

General nature of forces

We are surrounded by space, which is full of energy. Here we mean the energy of any nature: mechanical, thermal, electromagnetic and others. Energy is related with material world and its value is connected with the volume.

Any particle (volume) of continuum has energy:

$$A = A(x, y, z, t) \qquad (1)$$

where *x, y, z* are Eighler's coordinates of the center of particle, *t* is time.

Transmission of energy from one point of space to another one can take place by various methods, both in connection with energy transmission by material particle itself (which is a "carrier" of energy in this case) and without such transmission (for example, with wave motion). For the volume degenerated in ideal point the energy will be zero. That's why it is more comfortable to operate with the energy density concluded in the

increasing constantly. We are the first who analytically got the law of gravity of the masses from the known equation of thermal conductivity. Appeared that on the relatively small distances (in the bounds of the Sun System) the law of gravity by Newton remains valid, but on the larger distances the sudden decrease goes on (Gauss integral), which naturally solves the famous Zelinger's paradox of gravity.

As a conclusion we should note that in the bounds of a stable galaxy of a spiral kind there is the circulation of ether. Ether moves from the periphery of the galaxy to its center (nucleus) by two spiral branches. This becomes apparent as a weak magnetic field (8-10 micro Gauss). In the nucleus of the galaxy there is the impact of two strings as well as there is formation of the spiral toroidal circles (protons). Then the protons form the adjoined vortexes around themselves (electron shells) and from the proton- hydrogen gas the stars are forming, which are moving to the periphery by the same branches. There they dissolve in ether at the periphery since the protons will loose their energy and stability due to the viscosity. Ether which have got the freedom will return to the nucleus of the galaxy and this process is going on in our galaxy for hundreds milliard years and it will keep going until the new center of vortex formation will begin to concentrate ether. Then the new galaxy will appear and our galaxy will disappear. But it will not happen soon and we have enough time to understand that we should return to the concept of ether in modern science.

Experimental Demonstration
of Cosmic Influence on the Earth Life in N.A. Kozyrev's Researches
("On the Influence of Time on Matter")

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Editor's note: this article represents a part of the big scientific conception "World models in the new scientific progress". On applying of this conception a great number of practical technical devices have been created (as an example of such device we offer the description of universal electrical bio-heater, which was created by the group of researchers from Bishkek, Kyrgyz Science Technical Center "Energy" during the *work on ceramic electroconvector).*

We have to note that the position of our editorial board concerning "time" and Kozyrev's work is not in a good correlation with the authors' one.

Nicolay Alexandrovich Kozyrev scientifically and experimentally discovered the action of relations' interconnection, which was falsely named as time. Time cannot cause action because it is absolute and does not have any physical sense (Samat Kadyrov. Monograph "Theory of unified field").

Author's note: relations' interconnection is an interaction of structurally similar objects. It is a nuclear resonant gain-frequency process: in a stationary electric field, which is modeled by systematic organization, there is a development of similar to structural one, in-focus rays of powerful regular coherent radiations. These coherent radiations are determined by properties of chemical components of interrelated substances.

According to N.A. Kozyrev, it is ought to expect not identical density of relations' interconnection in space. Some processes decrease density; others on the contrary increase density of relations' interconnection. Action of the increased density is weakened according to the law of reversed squared distances; it is shielded by a solid matter, at thickness about 5cm, and is reflected by a mirror, according to the familiar optics law. The action of the decreased density on a detector is shielded, but does not reflected by a mirror. Properties of a matter can be changed under the influence of relations' interconnection. In this sense there is a big advantage in changes of electric current conductivity of resistor, which is brought into Witson bridge and is located near some process. For instance, in order to increase density it is useful to realize the process of evaporation of a volatile liquid; and for density decrease the process of cooling of a warmed-up agent can be realized. Due to these processes, change of conductor resistance is actually realized with opposite signs. Increase of density of the conductor with positive temperature coefficient leads to decrease of its resistance. At negative temperature coefficient there is an effect of the opposite sign, in the direction of changes, caused by temperature changes. Such correspondence to fall in temperature should be observed at changes of other properties of a matter, **because disorder in a matter structure is reduced along with fall in temperature**. The researches have shown the following results at the resistor, which was situated near processes of acetone evaporation on cotton wool and of solution of sugar in water. The

relative resistance change of resistor was observed at the 6th or 5th digit after comma (or even at the 4th digit if resistors had especially high temperature coefficient).

There is now a possibility to study the Universal World not only by means of the investigated spectrum of electromagnetic oscillations, but also through physical properties of relations' interconnection.

At many researches the influence of relations' interconnection on resistor electroconductivity was investigated. Acetone evaporation (at 10-15 cm distance from the resistor) was applied there as the process, which controls sensitivity of a system. However, the process of evaporation can influence on the resistor not only with density increase, but also due to temperature increase that occurs at evaporation. In order to take into consideration this cooling effect, (in the area of evaporating acetone) temperature was measured by Beckman mercurial thermometer with 0.01°C multiplying factor. The first experiments (without thermal protection) have shown the fall in temperature by several hundredth of degree. This fall was enough to cause the changes of resistor electroconductivity. However, the thermometer had been keeping on the demonstration of practically the same fall in temperature at thermal insulation of the resistor. The thermometer reacted on the radiation of relations' interconnection at acetone evaporation.

The part of the thermometer with a placed in a pasteboard tube mercury tank was laid round with cotton wool and put into a glass retort. The experimental process was fulfilled near the retort, and the reading of mercury altitude in capillary was determined by the scale of the thermometer through the closed window in the next room. The mercury altitude was decreased at dissolution of sugar in water (with steady temperature) and it was increased at the release of the squeezed spring, which was placed near the thermometer.

The radiation of the relations' interconnection was observed from many stars. It is caused by the inner processes, which take place on these heavenly bodies. The Sun (with its turbulent processes) radiates the relations' interconnection besides the searched electromagnetic radiation. Actually, if sunlight is recovered with a thin screen, the significant influence on the resistor will be discovered. The influences of the Sun to the Earth through the relations' interconnection become doubtless. These influences of the Sun should have a particular significance in vital functions of organisms, because it brings the beginning for life support. The totality of the researches demonstrates the dependence of matter state from the changes of the general background of the relations' interconnection. The drift of the devices (that show daily changes) usually stops about at midnight and then changes its direction. As for the seasonal course, there is a density decrease of the relations' interconnection in spring and summer; and there is an increase of it in autumn and winter. It is connected with the absorption of the relations' interconnection by the vital functions of plants and with the return of it at their fading. There are indications at the seasonal changes of chemical processes. For instance, reaction of polymerization has more difficulties in its realization in springtime. V. Zhvirilis observations of minimum and maximum light admission by means of the crossed Nickolya prisms can be explained by the crystalline reconstruction of these prisms.

By Kozyrev, as being invisible, vital source is disseminated everywhere in Nature, thus possibility of its accumulation is the only necessary thing. Such a possibility is realized in vital organisms because all vital functions counteract to the usual course of systems' destruction. The ability of organisms to keep and accumulate this counteraction is the reason, which determines the great role of biosphere for the Earth life. But even if we assume, that spreading of life in Space is one of its peculiar properties, biosphere will not have a decisive significance.

Cosmic bodies (and first of all stars) can serve as the reservoir, which gathers vital source. Enormous stocks of energy flow out of stars in a very weak degree through the radiation of comparatively cold external layers. Inner stars energy is preserved so well, that even at the lack of supplement, matter of the Sun would become cold only at one third degree per year. For the Universe the creative source carries the relations' interconnection. Thus cosmic bodies are necessary for support of life.

Author's note: We apprehend relation's interconnection as natural radioactive background. In fact, it is a nuclear resonance gain-frequency interaction of inertial masses that depends on living systems, especially on its rituals and that regulates its survival. Cosmic bodies regulate this process. Humanity is able to control nature only obeying to natural laws. In-focus beams of powerful laser streams are formed in the electric field of living system organisms. The creation of proton-antiproton pair in the living cells, alongside with the process of the absolute release of energy serves as a creative vital force. The process of radiation, support, absorption of energy by the organization (assembly of particles) is realized through the relation's interconnection and regulates its total mass.

Humanity is able to control nature only obeying to natural laws.

Life without Diseases and Old Aging Preventive Electrical Heater with Programmed Features

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Universal electrical bio-heater is intended for heating of rooms and preventive clearing of an air atmosphere from disease-producing organisms at continuous exposition (continuous work). The principle of its work fundamentally differs from those of the existing analogues. Carbon crystals are in the basis of bio-heater, which makes it environmentally appropriate.

Bio-heater represents a range of ceramic cylinders, jointed with metal plates on top and underneath. These plates play the role of load-carrying structure. It is used in production areas and living rooms for heating alongside with destruction of pathogen microorganisms. One bio-heater with 0,2 kWtt power is oriented for heating of the area with volume 35-45m^3 (in the future production of modernized models powered from solar cells is planned).

As distinct from the usual oil heater, preventive electrical bio-heater destructs agents of infectious diseases, whereas, according to the researches, oil heater stimulates their reproduction.

Absolute ecological cleanness is obtained by release of the quarters from the effect of increased atmospheric dampness with the temperature, appropriate to sanitary code. Any type of mold or fungus disappears in the quarter and in the future these forms do not renew their existence (even after removal of bio-heater).

The absence of injurious radiations is attained by the following: features of raw material, which is used during the process of electrical bio-heater production; radiation is normal during bio-heater working. Pollution-free temperature influence is attained by favorable infrared radiation.

Among the other properties of electrical bio-heater there are following: fire-safety; explosion proof; chemical inertness; enormous effectiveness from the point of view of electric energy demand. Structural simplicity facilitates its durability; there is nothing in bio-heater to be broken.

Technical aspects (applied Know How): In the process of technologic production of ceramic cylinders, from which bio-heater is consisted, **diamond-like cellular ceramic structure** with superimposed combination of atoms of lattice elements is created. Rhythmic work of cells, which form ceramic mixture, leads to resonance and creates a kind of blow wave (at micro level). This blow wave physically destroys microorganisms that have no calcium framework. It is related only to those microorganisms that are agents of infectious diseases, such as: staphylococcus, enterococcus, enterobacterium, etc. Thus parameters of the evoked blow wave coincide with vibration frequency of the definite types of bacterium and elementals. These blow waves cause the similar effect in room near of bio-heater, e.g. colonies of microorganisms are noticeably decreased there (even at the absence of bio-heater in the nearest room).

Due to its self-organization, bio-heater works in the range of living systems, it is approached to them. There is a realization of active connection with living coaly forms of biological systems. Actually the work of bio-heater is adjusted to them. Bio-heater properties can be programmed at the process of its production.

Bio-heater is a patented product. Patent KR #464 MKI C 04 V 33/24 "Ceramic mixture, possessing heat-radiating properties". Application #20010075.1 at Patent KR #464 MKI C 04 V 33/24 "The way of creation of energy, renewable, programmed hard-phase ceramic-carbon mass structure". Application at Patent KR #464 MKI C 04 V 33/24 "Technology of producing of electrical heaters with anti-resonant air prophylactic effect".

Finale product (FP) purchase is not more expensive than those of existent models of electrical heaters. Cost value is noticeably brought down on organization of the scaled production. It is ought to take into consideration that from all existent types of heating, from the customer's point of view, this one is the most energy-efficient. Manufacturing of such bio-heaters can be organized on the base of acting industrial production of ceramic fabrics. It will require some expenses. Moreover production service is rather cheap because there is no need in maintenance staff.

Electrical bio-heater can be applied everywhere, where there is a need in: a) economical heating; b) decrease of air moisture; c) disinfections of rooms.

As for the life cycle of bio-heater it does not become obsolete morally and technically. It is produced from the materials, which are not liable to wear.

The invention has a certificate of KR Gosstandart. From the end of 1998 the first unimproved modification of bio-heater (with power 0,6 KWtt) were put into serial production in Bishkek (with small test production runs). This time bio-heaters are readily used as medical equipment in hospitals and maternity hospitals in Bishkek. **Inventor: Alexandra L. Belyaeva.**

Technical Report

The comparison of quantity of heat energy, required for heat of rooms, and of heat quantity, which is produced by Belyaeva's electroconvector.

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Editor's note: this calculatious demonstrates the advantages of the device, which at 340 Wtt energy consumption produces about 700 Wtt of heat power.

The calculation of heat output, coming from the ceramic electroconvector to a room, was based on the basis of research statement of EVNA-0.2/220 electroconvector's influence on air micro flora of industrial rooms at 23.10.01. - 06.11.01. period.

The researchers were carried out in the arbitrary room in a four-storied large-panel building. This room was on the 3rd floor, with facing east windows. The room was of 52.5 m^3 air-space, 3.5 m height and 15 m^2 area. The calculation of heat, was made on the basis of "Methods for calculation of the requirement in heat and electric energy of buildings". These methods were registered by Department of Justice of Kyrgyz Republic on 08.09.2000, #154. According to the normative data, temperature of inner air (t_{in}) in the room must be equal to +20° C. In Bishkek planned specified temperature of external air (t_{ex}) for heating is minus 23°C. The average temperature of heating period is t_{av}= -0.9°C, specific heat characteristic of the building is:
q=0.4 Kcal/m^3 h °C.

Medium quantity of heat energy, which is required for heating, is determined by the formula:

$$Q_{av}heating = q \cdot V \cdot (t_{in} - t_{ex}) \cdot 1.12 \cdot \cdot [(t_{in} - t_{av}) \div (t_{in} - t_{av})] \text{Kcal/h}$$

$$Q_{av}heating = 0.4 \cdot 52.5 \cdot (20+23) \cdot 1.12 \cdot \cdot [(20+0.9) \div (20+23)] = 492 \text{Kcal/h}$$

Thus at the average annual temperature of the heating period, which is: t_{av}= - 0.9°C, the quantity of heat energy required for this room, comes to 492 Kcal/h.

According to the research statement, the trials of the electroconvector with 200Wtt power were carried out at the following external air temperature: +10.2°C; +8.5°C; +10°C; +6.6°C. The calculation data and results of its examination are brought together in a table. The parameters of electroconvector with 340Wtt power are demonstrated in the same table.

Table 1
Table of determination of heat entry and heat consumption's correspondence in the experimental room

#	External air temperature, °C	Inner air temperature °C	Normative heat consumption KWtt (Gcal/h)	Experimentalheat consumption KWtt (Gcal/h)	Percentage depending on normative heat consumption %	Economy of heat energy kWtt (Gcal/h) comparing with power consumption of the device 0.2 kWtt (0.000172 Gcal/h)	Economy of heat energy kWtt (Gcal/h) comparing with power consumption of the device 0.34 kWtt (0.000292 Gcal/h)
1	- 0.9	+20	0.572 (0.000492)		100	-	
2	+10.2	+20	0.267 (0.00023)		100	-	
	+10.2	+16		0.158 (0.000136)	59	0.2-0.158=0.042	0.34-0.158= =0.182
3	+8.5	+20	0.314 (0.00027)		100		
	+8.5	+17		0.233 (0.000200)	74	0.2-0.233=-0.033	0.34-0.233= =0.107

4	+10	+20	0.273 (0.000235)		100		
	+10	+23		0.355 (0.000305)	130	0.2-0.355=-0.155	0.34-0.355= =-0.015
5	+6.6	+20	0.366 (0.000315)		100		
	+6.6	+19		0.338 (0.000291)	92	0.2-0.338=-0.138	0.34-0.338= =0.002

Calculation data demonstrate a considerable economy of heat energy at daily unevenness of external air temperature.

Heat productivity of the new structure of electric convector with 340Wtt power was calculated on the assumption on the suggestion that heating of the room is carried out by the irradiation at the process of heat exchange.

$$E = \varepsilon \cdot C_o \cdot T^4 \cdot 10^{-8} \quad \text{Wtt/m}^2$$

where: C_0 =5.67 Wtt/m^2 K^4 is a radiant emittance of blackbody, ε=0.93 is an emissivity factor of the surface of earthenware duct tube; T=70°C=343 K is the temperature of the surface of earthenware duct tube.

On substitution of the known values into the formula we get:

$$E = 0.93 \cdot 5.67 \cdot 343^4 \cdot 10^{-8} = 727 \text{ Wtt/m}^2$$

As the area of irradiation surface is equal to S=0.96 m^2, then quantity of heat, which is evolved by the convector, comes to:

$$E_k = S \cdot E = 0.96 \cdot 727 = 698 \text{ Wtt (or 600 Kcal/h)}$$

The quantity of heat, which is required for the heating of the room, is 492 Kcal/h (at the external air temperature equal to minus 0.90 and temperature in the room equal to plus 200).

Thus, electric convector with 340 Wtt power is able to heat totally the room with 60m3 area.

Editors note: 340 input and 700 output!!!

Longitudinal Waves in Vacuum: Creation and Research

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The author presents a new elegant system, which is the symmetrized Maxwell's equations. In practice it gives a possibility to create the longitudinal waves in vacuum. This system is of great importance in telecommunications and aerospace technigue.

There is a stable paradigm in electrodynamics that the existence of the longitudinal waves in vacuum is impossible. This paradigm played its negative role preventing scientific minds from solving this problem. However, Maxwell was not as categorical in his opinion on this question as his following were.

Particularly he wrote: "Science of electromagnetism as well as optics is not able to confirm or deny the existence of longitudinal oscillations."

Maxwell's dynamic equations are usually considered as partial derivatives in time. However, the total derivative in time includes the so called substantial derivative, which was shown in the equations for the moving coordinate system. In particular, one of these equations was written by Maxwell himself to explain the phenomenon of electromagnetic induction discovered by Faraday. This induction takes place in the conductor moving across the field lines of electromagnetic field:

$$\vec{E} = \vec{V} \times \vec{B}\,; \qquad \text{(I)}$$

Other equations were obtained later by other scientists. In the table I below Maxwell's equations are given in a split form. Their static and dynamic parts are given separately as well as the equations for moving and fixed coordinate systems. Such matrix concept of Maxwell's equations allowed finding their incompleteness. Really, the analysis of the matrix shows its high symmetry. However, full symmetry of the system of equations is broken by the absence of the equation (X). It seems to be strange and calls a desire to remove this defect in such an elegant system of equations.

A new equation is introduced in the Table 1 for the full symmetry of the matrix:

$$\nabla \cdot \rho = -\frac{1}{c^2} \cdot \frac{\partial \vec{j}}{\partial t}\,; \qquad \text{(X)}$$

Fundamental Properties of Aether

Alexander M. Mishin

Author's note: In the article the principles determining major properties of aether are formulated on the basis of an empirical material.

Real aether [1-6], the primary and superfine essence of which is still a secret, has turned out to be absolutely non-standard superfluid three-dimensional material medium, which simultaneously is at solid, liquid and gas phases. The first master phase of aether is a specifically solid absolute space or an energetical "bottom" of the Universe ("celestial stronghold"). At that the solid phase is considered as mesomorphic vortical-wave structure, which has particular holographic properties. Classical matter represents to be one of the stable and energetic space-time levels of the Universe. Aether vortexes exceed all conceivable space scales, have quasi-material properties and create a great number of stereo-dynamic subspaces (parallel worlds).

The first basic principle, to which aether entirely follows, is the principle of the least disturbance (the least action). Many well-known and unknown physics laws are the subsequent of this principle. In particular, any motion in macroscopic aether happens in such a way to minimize the interaction with the matter of our world, with zero moment of the disturbance momentum. In the classical physics this principle has been reflected as Le Shatelye principle, as variation principle, laws of thermodynamics etc.

The second principle is the principle of fractality, which confirms the similarity of forms and properties of quantum aether vortex structures regardless of their space scale. This principle also determines the Universe as stereodynamically multivariate system in the form of hierarchy of vortical-wave structures of the unified aether (fractal matreshka). On the researching of the macroscopic objects of the Universe it is possible to make a conclusion about microcosm structure if taking into account the changes of frequencies and velocities of action transmission.

In the third place there is a principle of physical autonomy, which confirms that any solitary mass (for example a planet) creates aether system. The particular principle of relativity, which reflects one of the fractal properties of the Universe, can be applied to this system. Such autonomous mass becomes similar to the miniuniverse with its aether subspaces, which repeat the basic phases of the Universe spectrum in more narrow (which depends on the size of mass) frequency band of space-time frequencies. Thus, in the local system of the Earth solid aether reproduces the structure of gravitational field with energy "bottom" in the mass center. As the result such spherical body occurs to be an energy drain and warms up from within.

The fourth is the principle of interaction between matter and vortex-wave forms, which do not depend to the spectral part of the Universe, that is quasimatter. This is the principle of new interaction in nature. The value of energy interaction in each experiment diminishes in time according to exponential law that is explained by the forming of energy informational or adaptation barrier, which separates parallel worlds and reflects the properties of vortex tenacity of aether as superfluid medium. At that, time of interaction is proportional to the size of quasimatter and the barrier for the earthly conditions is lowered at the indefinite period, on the assumption of only thrice-repeated observation of forces (triad law).

According to this principle, aether dynamic experiments in the earth laboratory do not have classical repeatability that, from the one hand, gives occasion to doubts in the objectivity and scientific character of the non-traditional experiments and from another hand it is the most reliable test feature of macroscopic aether motions. Biosystems have special relations with this principle.

The fifth is the principle of many-dimensional autobalance of forces. All vortex and linear motions of macroscopic aether organize themselves in the way that in the band of space-time spectrum of the local system (usually with the aid of fluid and gas aether) occurs to be self-balanced, that is they have zero resulting impulse and the moment of impulse due to the existence of the proportionate antivortexes and antistreams of another spectral structure at the same space volume. The self-balanced vortex structures and streams are practically closed for the outer watch from the direction of our material world, at least with respect to the methods of classical physics. The principle of autobalance of forces reflects aether properties as unified synergetic system and has a significant applied meaning.

Let call the principle of viability of aether dynamic systems as the sixth principle. Only a stereodynamic multivariate system is a viable one, that is a system, which during a definite period of time has the opportunity, called as life cycle, to realize interconcerted self-oscillating processes of vortex-wave character simultaneously at different phase states (subspaces, layers) of aether. The most important features of such a system are its space-time quasimaterial (vortex-wave) broadbandness and finite time of existence, which is determined by the conditions of creation of the energy-informational barrier. Self-oscillation regime demands the presence of an energy source, oscillatory circuit (a pendulum) of any character, intensive process (of negative tenacity) and a channel of positive feedback (negative entropy).

In the sense, referred above, any material system is viable and occurs to be a big system in the form of coordinated community of multivariate subsystems. In its turn each big system as a part of the hierarchy is a

constituent of bigger system, until everything is embraced by the Biggest System, that is the Universe.

The seventh principle of the universal energy interchange is the physical realization of the law of unity and struggle of oppositions. This principle determines spontaneous creation of thermodynamic and antigravitation potentials. Any local matter mass (a body), situated in the open space, creates an exchange process with the surrounding aether volume in the way that more fine-structure fluid aether is absorbed by the body, and the less power-consuming gas aether is radiated. As the result the body as a heat engine gets energy due to the cooling of aether exteriors. At that, antigravitation forces acts between bodies and aether exteriors, which have different temperature.

This principle, which establishes the existence of antipodes of the second law of thermodynamics and Newtonian attraction, is realized mainly in cosmic scales and explains in which way the energy is created in the bowels of planets and stars and why the Universe is stable as regards to gravitation. Obviously, the most unexpected for the modern Physics is the discovery of non-traditional nuclear processes where conditional reactions of decay and fusion occur at the usage of quasimatter.

More deep research of new experimental results and of the stated above scientific principles lets to determine the priority-driven strategic tendencies in Physics, to open more entirely the laws of mechanics and thermodynamics of many-dimensional aether, including the theory of non-traditional waves and new types of electromagnetism. At that, the supreme aim is the research of differences in aetherodynamics laws on the Earth (in a laboratory) and in outer space, the unknowing of these differences has caused logical insularity, false all-sufficiency of classical physics, which had refused as "not wanted" the aether conception and fundamental Universal laws.

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Irving Langmuir and Atomic Hydrogen

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Editorial

In this paper Dr. Nicholas Moller describes the history of development of Atomic Hydrogen technologies in details. It is remarkable that this technology can be applied not only for welding processes but also as a clean free energy source. It is important to note that in this case the hydrogen process does not involve a consumption of hydrogen, which is not combusted in the process. Atomic hydrogen is not really a fuel but rather a medium, gateway or a super-conductor of ZPE form the vacuum of space, converting ZPE radiation and ultra-high frequency electrical energy into infrared (heat) radiation.

This is the story of Irving Langmuir who was the first to develop a theory on Atomic Hydrogen on the basis of empirical research and experimentation. His work in this field lasted from 1909 to 1927. During this period he was employed by the Research Laboratory of General

Irving Langmuir.

Electric Company. Patents and discoveries developed by Langmuir during his time with General Electric were to a considerable extent instrumental in laying the foundations for what is today one of the largest corporations in the world.

The question that gave birth to this article, is why his work and discoveries on Atomic Hydrogen were the only work that received hardly any attention at all and why his revolutionary breakthrough was deprived of world attention for almost 100 years? This question becomes even more relevant when taking into consideration the high standing he enjoyed with his contemporaries (including being awarded the Nobel Prize in Chemistry)

and it is better to make it distantly after exclusion of man presence near experimental stands and devices. At the same time it is quite obvious that on applying of small capacity and fixed time of irradiation it is possible to develop methods for curing of human diseases, which are considered now as incurable (for instance of diabetes, some diseases of haematogenic system, of cancer and possibly of AIDS.

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Effect of Magnetic Blow Wave Field on Wine Systems

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Introduction

Authors communicate the data on influence of Magnetic Blow Wave (MBW) field on several wineproducts. It was found, that MBW did not lead to significant changes in the major components of the wineproduct (sugar, organic acids, minerals). At the same time the taste and aroma of treated wine become more pleasant; content of heavy alcohols and wine stone in the treated samples was less than in non treated ones. A mechanism of transformations was also discussed.

Keywords: *Magnetic Blow Wave (MBW), Wineproduct, GLC of aroma compounds and ethanol, HPLC of sugars, Atomic Absorption Spectrometry (AAS) of minerals, Heavy alcohols and aldehydes, Wine stone, Turbidity tendency, Organoleptic evaluation*

Magnetic Blow Wave (MBW) was obtained for the first time during the investigations on ball lighting generation under the laboratory conditions (Shakhparonov 1994). MBW as a physical object is interesting because of some facts, which suggest that MBW is a magnetic monopole. The MBW can also interact with the matter and transforms it in a definite way. Typical example is an elementary carbon in the form of graphite, which is transformed by such magnetic treatment into ferromagnetic substance (ibid). The graphite, which is initially diamagnetic, transforms to paramagnetic one with general radiation doze of about $7 \cdot 10^{19}$ neutrons/cm^2. Other types of radiations could not affect this way (Svoistva 1975). So one unit of MBW can be considered as $1 \cdot 10^5$ of neutron masses. This fact may be regarded as an indirect evidence for assuming that MBW and magnetic monopole are the same things. In the absence of excited radioactivity a slow MBW [$v/c < 1 \cdot 10^4$] occurs, which does not ionize atoms (Devons, 1963). Therefore, their interaction with the matter can be observed only indirectly. No data exist on the interaction of MBW with organic substances. The experiments and results reported in the present communication may be a starting point for development of technology and to formulate the methods for vintage wine and best quality spirit production.

Materials and Methods

Assuming that MBW and magnetic monopole are the same things, a number of conditions were selected for all experiments. The MBW source and the samples were placed in the same axis and the axis was oriented according to magnetic meridian direction. Such magnetic orientation is appropriate, as the energy of magnetic monopole theoretically increases in a magnetic field (Devons, 1963). All of samples were placed at 250 cm distance from MBW source, in hermetically closed glasses. It should be noticed that MBW could penetrate through many other barriers, for example into cast iron reservoir with wall thickness of 5 cm (Amaldi, 1970).

The quality investigations were made by using of standard equipment. HPLC, equipped with refractometric detector was used for sugars estimation. Separation of organic acids in forms of their ethyl esters and acid esters was carried out chromatographically using a column packed with polyethylenglycol succinate and the following temperature option: initial temperature is 120°C, final temperature is 220°C, temperature growth rate: 8°/min. GLC was also employed for determination of ethanol. Minerals content

was examined with Atomic Absorption Spectrometry (AAS). Electronic spectra of samples were obtained with double beams UV Vis spectrophotometer equipped with permanent wavelength scanning. Redox potential was measured with EV-74 potentiometer.

The aroma alterations in the wine samples were investigated by GLC method after preliminary concentration of aromas by solid phase adsorption. The concentration was carried out by barbotation of inert gas (nitrogen) through liquid and consecutive catching of volatiles with tube trap, filled by Polysorb 1 sorbent (Lur'e 1972). The well-known analogue of Polysorb 1 is Porapak Q. The tube may be regarded as a short chromatographic column, and volatiles go through it according to their retention times. The choice of sorbent was motivated by the fact, that retention times of water and ethanol was rather small (ibid). Thus, a concentration process can be ended at the moment, when water and ethanol have passed through the column, as the other volatiles remained bonded. The aroma desorption was made with ethyl ester. The analysis of the concentrates obtained was carried out with gas chromatograph equipped with flame ionisation detector (FID), column 3 m x 3 mm, packed by Carbovax M on the Supelcoport. Temperature for the analysis was programmed from 100 to 190°C with increase of 1°/min. Isothermal conditions in the borders had durations of 2 and 40 min respectively. The "mild" conditions of separation were also employed (initial oven temperature was 80°C with isothermal condition duration 5 min, temperature growth rate 1°/min, final temperature 150°C and isothermal condition duration 40 min).

Optical activity was tested with Spectropol at D line of Na (580 nm). The samples were evaluated organoleptically by a group (12 persons) of workers from Russian Institute of Canning Industry. Turbidity tests were made under the methods of Valuiko et al (1987). In some cases, qualitative tests were completed by MPL turbiditymetric measurements. Before testing samples were filtered. Determinations of heavy alcohols and aldehydes contents were carried out in accordance to National Standard (GOST, 5363-67) as follows below. Determination of the constituents of "heavy spirits"(i pentanol, i butanol) was based on reaction of the sample with salicylic aldehyde in a presence of H_2S0_4. Rose colour develops if sample contains the heavy alcohols. The density was measured with Vis-photometer and the quantative determination was carried out using standard graph made with mixture solution of i pentanol and i butanol. A method for determination of aldehydes content is based on a reaction of fuchsine sulphite. The developed colour was measured with Vis-photometer. Calibrating plot constructed basing on typed solutions was used for quantification.

Results and Discussion

Investigations of wine quality changes after MBW treatment were performed using two samples of portwine ("Zemfira") type wine. Sample 1 was a reference (non treated) and sample 2 was treated with MBW.

In both samples, the fructose and glucose levels were practically the same and amounted to 43.8 ± 3,32.22.5 g/*l* respectively. Sucrose and maltose were absent. Total sugar content was 76.0 g/1 though the level marked on the label was 80 g/*l*. It is thus apparent that the treatment of wine with MBW does not lead to noticeable changes of sugars content. Results of organic acids determinations are given in the Table 1.

Table 1
Main organic acids content, g/1

Acid	Treated wine	Initial wine
Lactic	0.0265	0.00187
Oxalic	0.010	0.0088
Succinic	0.209	0.18
Malic	4.56	4.22
Tartric	0.0805	0.0895
Citric	0.401	0.483

Standard deviation for the determination method was estimated as 7 %. This fact shows that differences in organic acids content are not significant. It should be noted that a tendency of slight increase in light acids (up to malic) in the treated wine was observed in contrast to noticeable change in more heavy acids. The ethanol content of both of samples was 181 and 184 g/*l* for non treated and treated samples, respectively, though the label on the bottle indicated 190 g/*l* concentration. Standard deviation was 5 %. Thus, MBW treatment does not lead to significant changes in alcohol content.

Atomic Absorption Spectrometry (AAS) data indicated that the samples were practically identical in terms of K, Na, Ca, Mg, Fe, Cu and Zn contents (data are not shown).

Similarly, spectra of treated and non treated wines, diluted 150 times before photometring, were practically identical, thereby pointed out that polyphenols are unchanged.

When wine is industrially treated with IR or microwave heating, ultrasonic, ultraviolet and g radiation, different reactions occur and there include redox reaction, esterification, condensation, hydrolysis, Maillard reactions, etc (Kishkovsky 1988). Most of reactions are accompanied by redox potential changing. Increase in Redox potential points out the increase in concentration of oxidants, i.e. oxygen, peroxides, and other compounds, which are electron acceptors. Redox decrease is a result of oxidation processes (ibid). Redox potential was practically constant ($\Delta E =$ 145 mV and 150 mV in samples # 1 and 2 respectively). Evidently, oxidation processes, like they occurred during heat treatment, were absent during the MBW treatment.

One of the important reactions to be considered is the Maillard reaction. Essentially it appears in form of browning, decrease in reducing sugars and amino acids, and new aromas formation. While our result evidences on absence of irrelevant aromas, alterations of wine colour, and sugar content, thereby indicating insignificant contribution of Maillard reaction on wine quality changes due to MBW treatment. Technological treatment often leads to esters accumulation that improves wine aroma. It's well known that the most important in this context are the esters of C_6-C_{14} fatty acids (Kishkovsky 1988). During heat treatment, storage and other physical influences, different kinds of acid esters accumulate. These have weaker aroma than esters of fatty acids. But their appearance proves the existence of esterification processes. A comparison of aromas chromatograms of the samples 1 and 2 proves occurrence of changes in concentrations of the individual substances (increasing of peaks length with retention times of 13.10, 100.9; decreasing of peaks length of 54.85 min). An order of peaks exit of different volatives is given in the Table 2.

Table 2

Exit order of different volatiles

Exit order, from published data for Carbovax 20 M	Retention time in our experiments, min	Exit order, from published data for Carbovax 20 M	Retention time in our experiments, min
Acet aldehyde	3.8	i-Pentanol	23.56
Ethyl acetate	4.71	i-Amyl butyrate	
Diacetyl	4.82	Acetone	
Methanol	4.91	n-Pentanol	27.92
Ethanol	6.01	i-Amyl valerate	
n-Propanol		Ethyl lactate	
i-Butanol	13.58	Ethyl caprilate	52.6
Butyl acetate	13.59	Acetic acid	
i-Butyl acetate		Diethyl succinate	
Ethyl valerate		Ethyl laurate	
n-Butanol	17.73	Phenyl ethanol	
Amyl acetate	20.70	Diethyl malate	

A comparison of retention times of components with peaks of standard substances of wine aroma indicates that butyl acetate and i-butanol are very close to peak 2. Data on chromatographic separation with mild condition showed that i butanol and butyl acetate peaks exited simultaneously. Organoleptic evaluation recorded a nice smell in the treated wine, thereby due to the formation of butyl acetate. Data indicated the presence of ethyl malate, ethyl tartrate and ethyl citrate in the samples, in addition to two peaks corresponding to ethyllactate and ethyl oxalate. The large experiment error does not allow any inference on changes of their height after magnetic treatment. Identification of peaks with retention time factor especially in such complex system is not unquestionable. However, the best way is to use the chromato mass spectrometer, which allows inference according to their individual mass-spectrum.

Organoleptic evaluation can depend on aliphatic alcohols content. Determination with GLC shows (Table 3), that their quantity in the both samples is rather small with respect to average values taken from literature for this type of wines. Thus such changes can not be recognized with such evaluation. For both of samples pH was equal to 4.0.

Table 3
Aliphatic alcohols content, mg/1

Alcohol	Sample #1	Sample # 2	Average literature values (Kishkovsky 1988)
Methanol			80-350
i-Propanol			0,3-3
n-Propanol	less than 20		5-50
i-butanol	less than 20	less than 20	20-100
n-Butanol	less than 10	less than 10	2-10
i-Pentanol	less than 20	less than 20	100-250

The results of optical activity measurements indicated, that both samples are not optical active. Filtration, clarification and dilution could not change the optical activity. Perhaps, there is a compensation of different forms of D- and L- compounds in the samples, thus total activity was very close to zero, and magnetic influences could not change equilibrium between the forms.

Organoleptic evaluation of more delicate taste and aroma of the treated sample with respect to non treated one, MBW treated sample as more complete, harmonic, noble, and natural in contrast untreated sample was recorded as excessively bitter and sour in spite of practically the same pH of samples.

It is interesting to test the tendency of wine to make a different kind of turbidity after the MBW treatment. Data showed that both samples were not positive for protein turbidity. In term of reversible colloid turbidity formation, after storage at 7.5°C for 1 day, the MBW treated sample was homogeneous, in contrast to the formation of different phases with different refractometric numbers in untreated sample. Both the phases in untreated sample were liquid, with a density very close to each other, but the borders of phases were like broken lines when crystallization begins in crystallization process. This alteration in untreated sample may be due to micelle state changes or of structurization of product.

The tendency test for polysaccharide turbidity based on the reaction with phenol in presence of H_2S0_4 and determination of the derivative formed by photometrically, indicated, that difference in concentrations of polysaccharide in the both samples are very small, the levels being 119 and 106 mg/*l* for untreated and treated samples respectively. These values are close to range of polysaccharide stability (150-200 mg/*l*), and thus do not allow any conclusion on changes of relative stability of the samples. A tendency for polyphenols turbidity, due to polyphenols associates precipitation upon addition of salt did not show differences. Turbidity, as determined in MPL apparatus, was 15 FEM as against value of 0.2 FEM before testing in untreated sample. These numbers were respectively 14 and 0.3 FEM for treated sample. Thus it indicates that both the samples are very stable with respect to polyphenols turbidity and that the magnetic treatment does not lead to alteration in the polyphenols stability.

The data on the colloid stability indicate, that both the samples showed rather high resistance against protein, polysaccharide and polyphenols turbidities. Besides, treated sample showed higher stability with respect to reversible colloid turbidities.

It is interesting to investigate as to how heavy alcohols and aldehydes, which are often produced, when low-grade technology is used, are affected by magnetic treatment. For these studies, a system of simple mixture, consisting only of spirit and water, was used. Commercial vodka bottled in standard 0.5 l bottles and artificial solutions, containing 40 % of food derived rectified spirit were used. Data showed, that MBW treatment significantly influenced the heavy alcohols content, as the reduction in heavy alcohol was more than two times. In addition, it reduced aldehydes by more than 3 times in vodka, and more than 30 % in rectified spirit. Data indicate that efficiency of aldehydes removal is higher when the sample contained higher level of aldehydes. Thus, the MBW treated vodka and rectified spirit will be better than untreated one. It is however stressed that untreated samples were also recorded as good by sensory panel. So, limits for aldehydes are usually present in high quality vodka established by National Standard (GOST 5363- 67) are 6 - 15 mg/*l*. Thus the organoleptic evaluation of samples does not allow to find difference in aldehyde levels in these samples.

Table 4

The main results of heavy alcohols and aldehydes determination (mg/1) in vodka and solution, contained 40 % of rectified spirit

Substance	Non-treated vodka	Treated vodka	Non-treated spirit	Treated spirit
Alcohols	8.7	2.55	3.38	1.5
Aldehydes	1.5	0.4	0.6	0.4

Sediments formation and its character were also evaluated. The sediment in treated grape juice was dense and more dark, the formless, non crystalline sort, and gel like form. The volume of the sediment occupied up to 30% of total volume. The sediment did not sink or float, nor it stick to the walls of glass. It was found that 100 ml of juice gave about 155 mg of dry sediment. Microscopic investigations showed an absence of any kind of bacteria or fungi in the sediments.

The effects of high energy of magnetic influences on sediment were also investigated. The experiments were carried out with "Portwine Erevanski, vol. 0.5 1, white, spirit content 19 vol %, sugar 10 %, prepared according to GOST (National Standard) 7208-84". Crystalline sediment appeared on the walls and especially on the bottom of the bottle after the BMW treatment. An amorphous precipitate was also presented, and it can be separated by decantation. Crystalline sediment, after washing with ethanol and drying to constant weight, weighted 69.2 mg, and was of bright brown colour. A tartrate content as a tartrate acid, of the sediment was 59% mass. If it is considered as a tartar (a wine stone) of potassium sodium tartrate, then tartar content in sediment works out to be 86%. If it is considered as a tartar of dipotassium tartrate, tartar content in sediment will be 93%.

Generalization of data shows the positive effect of magnetic treatment on the wine samples, leading to harmonic taste of treated wine and absence of non

pleasant tastes. Most of the changes were found to bein the flavour and taste components, which were minor substances in the product. For example esters concentration changes during the treatment. At the same time the content of major components, such as sugars, organic acids, particularly, heavy organic acids, and especially ethanol remain constant. It seems logical from kinetic point of view, when simple processes, like esterification, are preferable with respect to many stages reactions, and reactions with high activation energies, which can go at hard conditions. Also, it seems logical that magnetic treatment may influence on electrical state of colloid species. Thus magnetic treatment can be considered as mild, selective in the comparison with many other physical methods. Nevertheless, the changes lead to acceptable energetical and nutritious value of the product. Data show that difficult problems, such tartar removal, can be solved by MBW treatment.

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The Fundamentals of the New Principle of Motion

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The concepts of active and passive interaction between the moving object and the space form the basis of the new principle of motion.

So as to be more understandable, let's consider what is the old principle of motion. For this we will use the concept of a moving object and the space in which the object is moving. Naturally, material objects and the space can't interact between each other directly, because the space is the philosophical category. In this case we can understand physical essence of natural phenomena easily. In our view, the material objects interact with some fundamental energy of space (FAM), which fills all space with a different density. Thus the energy (FAM) is inalienably connected with the space. One of the first names of this energy is "ether" in the early scientific works. So, for the simplicity we will accept that the object and the space interact between each other.

Thus, all existing methods of motion which have been invented by mankind till the present time are based on activity of the material object that means the one expends some energy to produce the motion, and at the same time space is passive, it means that space does not need to spent any energy to move the object. And so in common case space tries to keep the object in the former state interfering with accelerated movements of the object (in accordance with **the 1st , the 2nd and the 3rd Newton's laws**).

It should be noticed that such method of motion (for the speed, which is much less than the speed of light) takes place both in animate and inanimate natures. In this case the level of energy of motion and reaction of space (or an environment) are not very high. Incidentally, the energy of object can be of different types: electrical, chemical, biochemical, mechanical etc. The common consequence of this type of motion is existence of the ***inertia***. The classical physics can't answer the question: "what is inertia?» The same situation is applied to the concept of ***mass,*** which is closely connected with inertia. The classical physics says that ***the mass is a measure of inertia.***

There is the new principle of motion of material object: the object is passive and space is active. In this case it's more favorably for space in the energy aspect to move the passive object and to spent some power then to keep the object in the present place in the former state of immobility (in accordance with **the 1st, the 2nd and the 3rd Newton's laws**). And so we should introduce **the 4th law of** Newton's **mechanics**. It says that ***there are the systems of coordinates in which the body is moving not rectilinearly with acceleration when this body is in the state of immobility***.

The basic and the main differences of the offered principle of motion from the existing methods at the end of the XX century are the following:

1) The absence of inertia of motion;

2) There are no limits for the speed of motion;

3) The absence of "fuel reserves" "on board" of the moving material object.

Nikola Tesla and Instantaneous Electric Communication

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Nikola Tesla (1856-1943), an outstanding inventor, was and still remains one of the most mysterious persons in the history of electrophysics. Whereas the most scientists were moving together in direction of microparticles investigations, as the basis of matter structure and of nature itself, he was going in opposite direction. He had a keen interest in the investigation of electric charge of the Earth as a whole. He was looking for the ways to influence on it, to control its state and methods of its regulation.

Therefore, exactly, the most of his searches, experiments, the purpose of constructions and buildings, created according to his conceptions, cause perplexity and misunderstanding of scientists even in nowadays.

The most mysterious of his main experiments were made in USA after 1904. After Nikola Tesla death in 1943, all his diaries and records over a period from 1904 year had mysteriously disappeared. Probably they were stolen (it was known, what to take). Lost records could "cast light" on one of the most "strange" of his buildings in the form of the enough tall tower, on the top of which a specially created toroidal transformer was placed. This transformer could create there a huge electric potential up to the billion volts.

Nikola Tesla switched on this tower-device, what caused the fright and even panic in mind of people from nearby settlements. Of course! Because of very high electric potential there began air ionization, which spread very high to the atmosphere accompanying by the effect of color play. Such luminous, color-playing sky caused even a horror of people, who knew nothing about the experiment made and its goals. They did not guess that Tesla by means of the electric charge, created of the tower, was influencing on the electric charge of the Earth as a whole (about 600000 Coulomb). There was a global scale in Nikola Tesla's investigations.

There is no point in detailed analysis of the fact that the potential of the tower top influenced on the Earth charge. Interaction of charges-balls with the distortion of field lines, distortion-distribution of charge on their surfaces, induced charge, is beautifully described even in school physics textbooks. In Nikola Tesla investigations the Earth had the role of one of the charged balls. It was possible by changing of charge on the tower to deform electric charge distribution on the whole Earth surface at once. This deformation (electric currents) could be fixed at once in every point of the Earth surface. It is alluring to use this effect for data transfer telecommunication, both on the Earth, and in space.

After such introduction the question "How does the system of instantaneous electric communication for any distance look like and work?" is still opened. First of all, the readers need to know, that such instantaneous communication is possible in principle. The proving it theoretical calculations, are rather difficult for popular interpretation. Some part of readers can take it on trust, and those who are most interested in can apply to works of Oleinik V.P. (quantum physics) the professor from Kiev Polytechnic University. At the minimum there are two necessary works: Oleinik V.P. "Faster-than-light transfer of a signal in electrodynamics. Instantaneous action-at-a-distance in modern physics" (Nova Science Publishers. Inc. New York. 1999) and Oleinik V.P. "Latest development of quantum electrodynamics: self-organizing electron, faster-than-light signals, dynamical heterogeneity of time." (Physical vacuum and nature. 4. 3-17. 2000).

"PC" magazine has devoted a rather significant article entitled "Computers and teleportation" to V.P. Oleinik works, concerning instantaneous electric communication ("PC" #6, 2000). Note, that the author of the given article has also found the possibility of instantaneous electric communication, but by means of materialistic methods, absolutely different from Oleinik's ones, what is most important – two different solutions point to the possibility of this communication. "PC" #6, 2000 in the article "Circles on fields" cited mathematical formulae of the structure of electron electro-magnetic field as an illustration (it refers to the Earth too) that the author of this article has got.

The most attentive readers of that article could notice, that one vector Hz absolutely "ignores" Special Theory of Relativity, since its mathematical expression does not include the velocity of light, whereas it presents in other vectors as a product of electric and magnetic conductivity. Magnetic line of this Hz vector goes to infinity and returns back from infinity. It surrounds the whole Universe. It is alluring to use exactly this (Hz) line for the **instantaneous** communication for any distance.

It is not so difficult to do it. In the Fig. 1 the easiest and most available for understanding line of the **instantaneous** electric communication is shown. A rotating charged dielectric ball (an "electron", isn't it?) is used as transmitter. The ball can be electrically charged up to the limit of charge flow-out into the ambient space. Around the charged rotating ball there appears electro-magnetic field, entirely analogous to the electro-magnetic field of the Earth (and of the electron too). The central magnetic line Hz goes to the infinity and returns

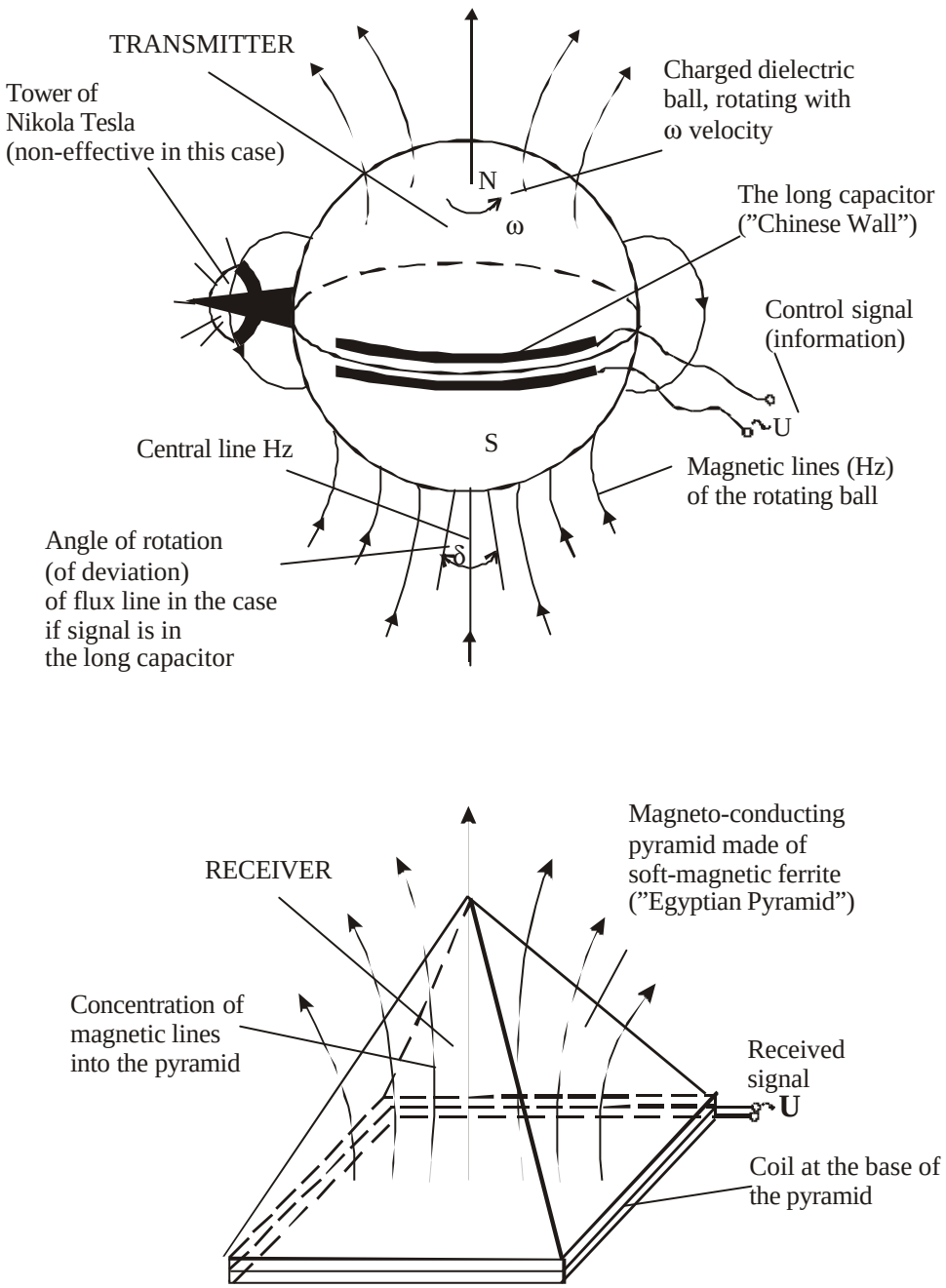

Fig.1

Line of the instantaneous electric communication on the basis of rotating charged ball and pyramid

back from it to the opposite side of the ball. In the same way the central magnetic line of the Earth (Hz) goes from one pole to the infinity through the whole Universe and returns from it to the center of the opposite pole.

If by the information to force the rotating ball (electron) to "wag by tail" (by Hz vector) which stretches through the whole Universe, then this "wagging" can be controlled instantly in every point of the Universe. While the rotating ball has a steady distribution of the surface charge, the line Hz does not change its dynamic position in the Universe.

If such distribution of the surface charge is broken, space position of the line Hz also will change. On mounting the Tower of Nikola Tesla on the surface of rotating ball and measuring the potential on this tower in time with an information it is possible to change the charge distribution on the ball, and, respectively, the space position of central magnetic line (Hz) in the whole Universe at once. Big disadvantage of the Tesla tower is that maximum influence on charge is executed in the point under the tower, and farther it began decreasing roughly (exponentially), according to physics laws.

Hence it is advisable to influence on the whole surface of charged ball, but not on some point of it. It is possible to influence at once on the very big part of surface by the long capacitor, placed on the perimeter (equator) of the charged rotating ball. Because of optimality reasons, this capacitor length should not exceed a quarter of the ball perimeter (equator) length. Charging and discharging this long capacitor on the ball equator by the data signal, only the position (angle 5) will be changed, not a value of the infinitely long magnetic line (Hz) in the Universe. It is a data transfer.

The natural question appears: "How to make on the Earth the most powerful transmitter for the **instantaneous** electric communication?" The answer suggests itself: "It is necessary to use the Earth itself as a rotating charged ball." It is not effective to use Nikola Tesla's Tower to deform the Earth electric charge. To place on the Earth very long (about thousands km) capacitor is quite easier. However, it must be placed not on the equator exactly, but moved a little bit because of the initial heterogeneity of the Earth surface charge distribution, caused by the presence of continents and oceans. It will be necessary to find the line of electric equator, where the amount of charge north and south of it is similar. This line will not be ideally straight and will be situated near the 30th parallel.

As a matter of fact, this grand capacitor is already built, but is half-broken. This capacitor is very well known – it is a Great Chinese Wall. The ancient, powerful Chinese Tzcin' Shi Huandi empire adapted and used it (capacitor) for the protection from nomads incursions. How unexpectedly and originally it is! In this case the electric iron would be the best tool for spiking. It is clear enough that the charged ball (as well as the Earth) will "wag by tail", which stretches through the whole Universe and does not change its energy, but only changes its position in space in time with information. Now we can go on to the question, concerning the way to control the Earth "wagging by tail" in the Universe, and thus to read information **instantaneously** in any point of the Universe.

In the Fig. 1 it is shown the input device of the electric communication receiver, made of the magnet sensitive material (it can be soft-magnetic ferrite) in the form of pyramid, with the proportions of well-known Egypt pyramids. Magnetic field lines of the far space pass through the pyramid from the top to the base and are concentrated by pyramid. If there is no signal (the "wagging by tail" of the far planet-transmitter is absent), then the magnetic flow, coming through the pyramid, does not change, and induced voltage in the coil, placed in the base of the pyramid, is absent (no information). If "wagging by tail" begins, then the magnetic flow, coming through the pyramid, will change, and it will cause the appearance of voltage on the coil in the base of the pyramid in time with the information.

Thus, the signal is received instantly. Here it is necessary to remind once again the difference between the instantaneous and usual radio transmission. The usual radio transmitter for the transmission of the information uses the **energy** distortion of space by the information. This energy change in space happens with the velocity of light and hence there is the loss of time for information passing. In the considered case there is no **energy** change in space, there is only a change of magnetic lines position (Hz).

This is exactly the vivid and fundamental difference between the usual electric communication and the instantaneous one. **In other words, in usual transmitter during the fixed time interval there is the change of signal energy (instantaneous value), whereas in instantaneous transmitter there is no this change (only information). This is exactly the fundamental difference.**

Evidently, to receive instantly the signal from the opposite part of our Galaxy, we need rather big pyramid, in order to concentrate a big amount of field lines into the oscillatory circuit under the pyramid. The question can appear: why the pyramid, why not a cone? The point is that lines of the Earth magnetic field (the very lines that compass needle reacts on) in the any place of the pyramid horizontal section have the same density of distribution and are directed strictly parallel to the pyramid base. The cone in its horizontal section cannot provide such uniformity of distribution that is why it is not advisable to use it. From the space magnetic field lines pass through and concentrate in the pyramid strictly at right angle to the pyramid base.

This is the riddle of pyramids wonderwork. Any person coming into a pyramid, at the same moment feels the change of mental and physical condition of organism; whish is very different from that it was before the entering into a pyramid. Of course! Visitors come inside, into concentrated magnetic field lines of the powerful and functioning magnetic core of the receiving electric circuit, what is absent outside the pyramid.

It is strange, but most of tourists are afraid of the ill effect, which can be produced by electrical systems on their health, but there they stand in a queue to feel this effect in pyramids. Concentration and division of magnetic field lines are the easy and effective way to reject a noise, created by the Earth magnetic field.

It is clear, pyramids should be oriented very thoroughly, so that lines of the Earth magnetic field would be strictly parallel to the base and to the opposite (East-West) sides of pyramid. To get such exactness of orientation in modern conditions is very problematically.

The most convenient place to build a pyramid (pyramids) is on the electric equator, in the place of its intersection with the electric meridian. Such place is located in Egypt, near its capital Cairo. And again we meet a paradox: such pyramids are already built on the Earth, but they are half-

broken. And Egypt was not less powerful than the ancient Chinese empire.

The Egyptian dynasty of Pharaohs has “completed” and adapted pyramids to burial-vaults, where mummies of dead Pharaohs were buried. Perhaps, it is even more incredible than in China. The impression is given that ancient powerful civilizations on the Earth had a competition between themselves, who will use radio-engineering constructions for instantaneous galactic communication in the most incredible way. Let’s give to a reader an opportunity to select a “winner”.

It must be noted that «PC» already published information that the Chinese Wall and Egyptian Pyramids are radio engineering constructions, intended for the instantaneous galactic communication (PC #114, 1997, etc).

There appears an interest in the possibility to produce very simple and manufacturable systems of instantaneous electric communication right now. Radio-electronic industry can produce them, but still does not guess about it.

Furthermore, such systems of instantaneous electric communication can be created at home, and even senior

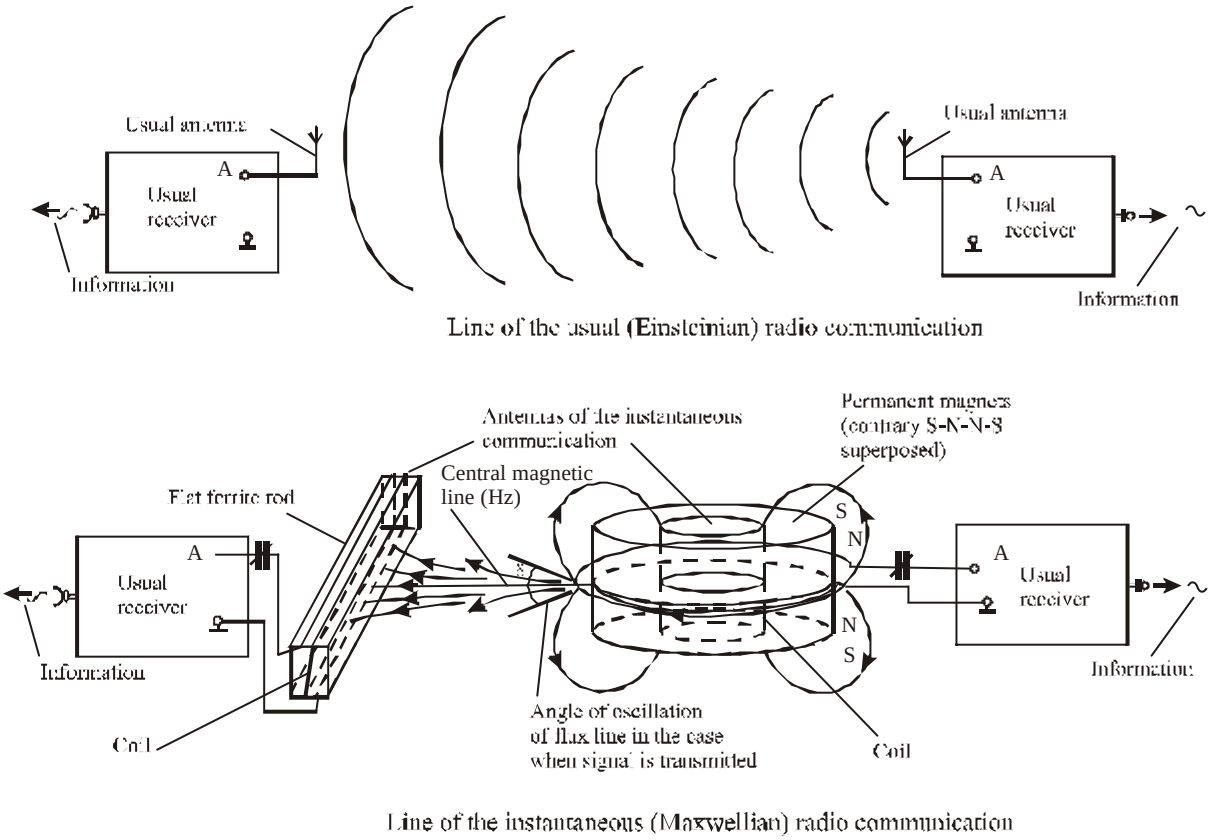

Fig. 2

Transformation of the usual line of communication of usual receiver-transmitter into the instantaneous one

pupils are capable to use them. In the Fig. 2 there is shown the construction of instantaneous electric communication line in comparison with the usual one. It can be produced even at home conditions. Two permanent magnets, connected between each other by analogous poles, are used as transmitting circuits.

Permanent magnets can be replaced by electromagnets. In the magnet connection point there is a coil, which while the signal passing through it will change its position (angle 5) in the space of the central magnetic line (Hz), coming out from the place of two magnets connection. Receiving circuit is available to be made of the flat ferrite, but coil must be winded along, through butt-ends of core, so that the whole internal part of the coil would be maximal (in area extent) filled by ferrite.

The obtained coil can be completely “winded” (screened) by flat ferrite of big size. For more clearness of the experiment the central magnet line of transmitting part must be directed strictly along the axis of the receiving coil.

Now, if we give the alternating voltage (information) from transmitter to the transmitting coil, fixed on the permanent magnet, then the receiver, connected to the circuit of the

transmitting coil, placed on the flat ferrite, will detect an alternating voltage (information). Maximum effect is achieved at the resonance (coincidence of transmitter and receiver frequencies).

It is checked. It works. The dullest experts in radio-electronic (after the reading above) can rejoin, without making an experiment, that it is an absolute nonsense that any communication is out of the question. Coils with absolutely perpendicular axes, besides one of them is screened, do not interact with each other.

And here the most interesting thing starts. In the Fig.2 as it was mentioned above, the usual communication line and the instantaneous one were compared. The usual transmitter cannot generate the vector Hz that is why systems of usual and instantaneous communication cannot see each other in strict sense. What does it mean? It means, that in the same city it is possible to transmit on the one-carrier frequency ("what a nightmare!") two absolutely different television channels without any noises of one to another.

Usually by frequency match of a transmitter to the working frequency of another one, the radio communication is broken, but here it does not happen. Here some additional explanation should be given. As the vector Hz, which "ignores" the theory of Einstein is received from Maxwell equations, it follows that the usual (Einsteinian) system and the instantaneous (Maxwellian) one work on mutually perpendicular electromagnetic field lines (vectors).

In the Fig. 2 such difference is shown clearly. These are just "jokes" of complex numbers, when one value is absolutely perpendicular to another and nevertheless together they form a single whole. In other words it means, that two greatest persons in science Einstein and Maxwell as a matter of fact are something like "Siamese twins", completely grown together at the angle of 90 degrees, even by heads. On the one hand every one is on his own, but nevertheless they are the common (complex) organisms.

Hence there are a lot of misunderstandings on happened phenomena. How many scientists tried to find some mistakes of Einstein? They produced very convincing proofs concerning instantaneous interactions in nature. These scientists did not suspect that time and still do not guess now that they already for a long time are "walking" in the complex physics, which still does not exist. Einstein and Maxwell ("Siamese twins"), each occupies his own part of the complex number (complex physics) and they cannot be already taken off from there.

The only third, free "vacancy" is left to throw on the both of them at once the common "collar" and "reins", i.e. to fasten them ("twins") together by module and argument as any complex number. In this case no matter how the one part of complex number "ignore" the other one, only its argument will change, and module always will be equal to the conditional unit. Only this single fact in principle changes the conception about "appearance" and "disappearance" of elementary particles! Even considered instantaneous and usual communications on the same receivers and transmitters in a complex conception (complex physics) eliminate appeared "misunderstandings" of all kinds.

Advantages of the instantaneous (Maxwellian) electric communication are especially evident during the connection with long-distance spacecraft. At present in the interval between sending of control signal to the station in region of Solar System peripheral planets and getting the reply it is possible to have a small break for dinner (it is very convenient).

In the case of the instantaneous electric communication use, duty operators will have "no dinner". Moreover, the system of instantaneous electric communication can realize two-way communication underwater and from underwater to overland. It is clear that input and output circuits of such system must be covered by slushing composite for the protection from aggressive effect of the salt sea-water. Such systems of instantaneous communication are very required to submarines.

Now, when readers know and understand the principle of operation of instantaneous (Maxwellian) electric communication systems and their advantages over usual ones (Einsteinian), we can only wait, when radio-electronic industry will start to produce these very required systems.

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The Unified Gravitation Theory

(The unified super-principle, which controls the Universe)

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(Editor's comments by Alexander V. Frolov)

A forum of the leading USA physicians took place in the White House in March 1998 in presence of President Clinton. There was only one question: "When will the nature of Gravitation be opened?"

The well-known USA physician-astrologer S. Hoking declared that it possibly would occur in twenty years and it would be **the Unified Theory of All.** So, the scientific world by default called it the greatest discovery of the future.

Some time later a new hypothesis pretending to this discovery has got its birth in Orenburg. Despite this fact this hypothesis would gain recognition and status of the **Greatest Discovery of Mankind** only by 2018 that was predicted by S. Hoking.

To present day there have been written a lot of hypotheses on this problem but they haven't been recognized. Many scientists consider our Universe as living and functioning according to the unified and rigid laws in Macro and Microworld, which provides automatic regulations of all its processes due to **circulation of radiant energy of the Universe life in cosmic space**. This energy is inexhaustible and environmentally clean, and Mankind may learn using it in the nearest time for the welfare and for prevention of **contradirectional irreversible ecological** catastrophe.

There is no alternative for humankind to escape and it will not appear in the future. Only cosmic energy will save us. From the book "Secret Doctrine" by E.P. Blavatskaya we can get complete information about the fact that a highly developed civilization of Atlases on the Earth had a "**General Theory of All**" yet 10-12 thousand years before our civilization. They had no automobiles, but instead they had flying objects (aircrafts) "Vimana" of various types as well as ships and submarines, on which they also used **Cosmic energy.**

While reading an abstract in General Soviet Encyclopedia, I got acquainted with the theory of "Aether wind", which was abolished in the beginning of the XX century, and then I understood that this theory contains a deposit to discover the nature of gravitation.

The nature of gravitation is the only one and there are no alternatives in theoretical as well as in physical sense. When scientific world of entire planet abolished the theory of "Aether wind", it lost the possibility to

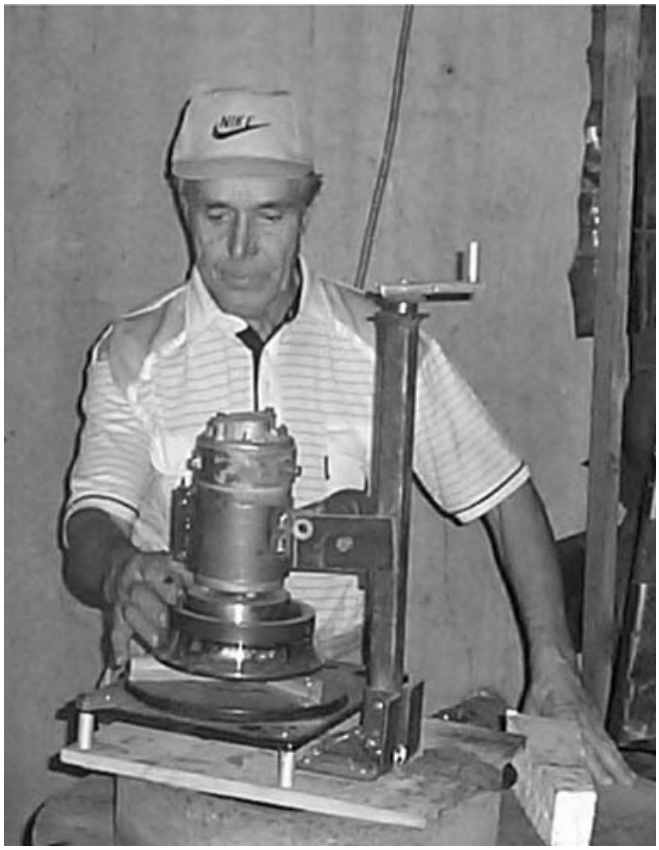

discover the nature of gravitation. The XX century was marked by a revolutionary development of scientific and technical progress, but there was an almost 100-year stagnation in cognition of the Universe elements.

The theory of "Aether wind" supposed that all Cosmos is filled with aether particles flying with the speed of light (these particles are "neutrino" according to modern understanding). **The role of gravitation, carrier of light and retarding medium in Cosmos** was attributed to this motion of particles.

But this theory allowed chaotic motion of particles, which is impossible in mechanism of the Universe, which is adjusted up to automatic mode. Besides, motion of these particles is not possible without an absolute buffer unit, which prevents their head-on collision at the speed of 600000 km/sec (it is thermonuclear explosion and death of matter, i.e. the Universe). E.P. Blavatskaya wrote that Cosmos is filled with radiant energy of the Universe life, luminophore, electromagnetic aether. Thereby she predicted a ready solution to make correction in the uncompleted theory of "aether wind". On the basis of above stated and due to the **un-assumed dawning up,** the theory of "aether wind" was completed. It was the ground to develop a hypothesis of radiant "aether wind". Particles of this wind (neutrino) are electromagnetic particles and move with the speed of light in all directions as **contradirectional paired single-stream flows** (like electrical current in twin-wire cable). Due to this, an absolutely stable concentration of these beams in cosmic space is provided according to the principle "what has come in, the same has gone out".

The hypothesis formulates new views on the problem of structure of elements of the Universe material world.

Some separate conclusions do not match the views of modern scientific thought on the problems of physical principles of material world structure and functioning of the Solar system.

List of topics of the hypothesis

1. The hypothesis disclosures the operating environment of a super-mechanism, which controls the Universe (it is a radiant "aether wind").

2. It disclosures the nature of retarding mechanism of flying objects in Cosmos (its name is Lorenz-Fitzgerald compression).

3. It proves the absence of Universal gravity and beams of light as we usually conceive it. (The beams of aether wind collide and compress matter. An alternative to the notion about beams of light is a temperature wave impulse on the beam of aether wind. It explains why the speed of light doesn't depend on the speed of the source of light. Light is a "passenger" on the beam of "aether wind").

4. This hypothesis disclosures the mechanism of stablization of rotary and orbital movement of the Universe matter in macro- and micro world due to retarding medium in Cosmos.

5. It disclosures the mechanism of reverse rotation of Venus due to the forces of autorotation.

6. It disclosures the mechanism of reverse orbital movement of planets and satellites of planets. (Such a planet had not been opened yet, but there are 6 satellites in the Solar system, which move counter to the others, and it is not an occasion, but **a particular case of the effect of aether wind beams**).

7. It disclosures a real nature of Tungusska catastrophe. (There were about 100 hypotheses, but **neither of them** was recognized to be true).

8. It disclosures **the nature of gravitation** and gives an explanation that gravitation can be:

- usual (vertical);
- horizontal;
- circular

It is important to note: not the entire matter takes part in gravitation, but 1/3, i.e. 33,3% of matter.

9. It disclosures the **nature of Levitation** and proves that 1 liter of water on the surface of the Earth can have the weight from 0 up to 3 kg.

10. It disclosures the role of gyroscope effect in life support of the Universe. The gyroscope effect allows transformation of translation energy of radiant "aether wind" to the rotational energy for practical needs of humankind.

11. This hypothesis gives scientific and technical recommendation for creation of cosmic energy converters.

12. It gives scientific and technical recommendation for producing of levitation effects for any technical systems.

13. It disclosures the possibility of cosmic flights with the super-light speed.
14. It explains experiments on metering of horizontal gravitation (The first experiment was made on February 27, 1999).

15. It disclosures the particle (neutrino) of original matter of the Universe and gives its characteristic. (Ancient thinkers called modern "neutrino" as "Aether", and it was not occasionally, because its diameter is in 10^{25} times smaller than atom's diameter.

All matter of the Universe consists of the same indivisible particles "neutrino" presented by three groups:
- "energy" group, which is in the beams of "aether wind";
- building group, which forms the part of any micro particle;
- free group (neutral-reserve) as a building material for new matter and operating environment of all electromagnetic processes.

All neutrino of three groups rotate with the speed of 3×10^{43} rps (equatorial speed of neutrino is equal to the speed of light).

Fields are formed in every particle as a result of rotation:
- strong field of a small volume doesn't allow particles to close up;
- weak field of a big volume is a general mechanism of gravitation.

As scientists write at the present time, the World is subdivided on a dense world (which we can see) and fine world (invisible). At that the density of such world is in 10^{15} times less than density of water.

It is known in science that all matter of the Universe both great and small rotates and is a gyroscope. Particles of matter get rotation with their birth, thus the fields are born in them simultaneously. **Matter cannot exist without rotation, which generates fields.**

All mechanism of interaction between three groups of particles is based on the mutual repulsion. This is the only mechanism, which always and automatically is able to create the necessary stable interval between the particles and only this mechanism provides the function of gravitation.

Many scientists of the late XX came close to the discovery of the nature of gravitation, but they didn't accept a thought to conceive **the motion of aether particles as a pair-counter flow**. And there are three necessary conditions to realize gravitation:

1. The particles should have the fields of repulsion.
2. The contradirectional flows should envelop the particle of matter from two sides.
3. While one beam is passing a matter mass then the force of fields should decrease and gravitation effect should appear.

Mechanism of gravitation

Gravitation appears due to the intersection *(Editor's note: interference)* of fields, produced by beams particles and fields of the visual matter. As it was mentioned above, the beams are paired and contradirectional. Usually the beams in cosmos are mutually balanced and they do not call gravitation effects.

But on the surface of the Earth the contradirectional beams are not similar in their power. The powerful beams come from above, i.e. they only penetrate the atmosphere, and the weakened beams come from below, i.e. they penetrated all the Earth. Thus, gravitation appears.

Gravitation is a unique property of "aether wind" beams to loose part of their power during penetrating of matter mass. **Gravitation** is the difference of forces of contradirectional beams. *(Editor's note: Really other authors reported this idea also. I cannot find who was the first in discussion about gradient of aether as nature of gravitation.)*

Horizontal gravitation

As a particular case, there is **horizontal** gravitation on the surface of the Earth. It appears on the boundary between lowland (of the sea) and plateau. In this case one beam goes above the surface of the Earth (water), and the counter beam penetrates mountain range and

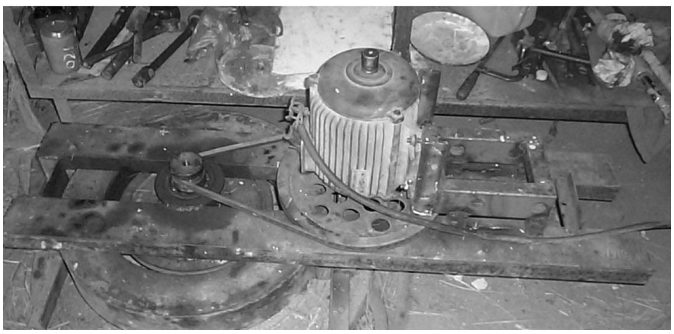

weakens. The first measurements of horizontal gravitation effect were made on February 27, 1999 on the route Orenburg – Samara at 49 km before Syrtinskiy slope.

A leaden load (0,5 kg) on the float (a piece of foam plastic) moved on the water surface (not in the sea but in basin) towards the mountain.

Horizontal gravitation is much more weaker than usual gravitation, but it can reach the value that makes water to flow at some angle upwards.

Circular gravitation

Only fast-rotating bodies can create circular gravitation.

All bodies rotate by their orbits around the Sun in the open space of Solar system **due to circular gravitation guided by rotating the Sun.** Furthermore; circular gravitation always is direct (co-directional to the Sun rotation) and reversed gravitation on the periphery of Solar system. A planet with reverse orbital movement had not been discovered until now, but 6 satellites of planets in the Solar system have reversed orbital movement.

Here is the proof of the fact that circular gravitation appears only around the fast-rotating bodies and **slow-rotating bodies, for example, the planets Venus and Mercury cannot form circular gravitation**, that's why they have no satellites.

Our Sun is a prototype of mechanism to transform translation energy of aether wind beams into rotary energy.

(Editor's note: According to Kozyrev, any star is a transformer of time (chronal type of energy) into heat energy. Really, the aether wind can be considered as the chronal type of energy in our understanding and for our usual three-dimensional measurement equipment. To my mind it is a clear link to notion of 4-dimensinal objects, i.e. the time. ***Time can be described by parameters of the aether wind, i.e. its velocity, direction and density. So, we can say that quantitatively time can be described by formulations for kinetic energy of the aether movement. From the other hand it is equivalent of heat energy, which can be measured by usual methods after transformation of the longitudinal waves of the aether in transverse electromagnetic waves).***

Therefore, any mechanical disk rotating very fast will create a circular gravitational field, which is able to rotate all bodies in the direction of the disk (for example, a rim mounted on its bearing co-axially with rotating gyroscope). I designed and tested a similar device in January 2000. A gyroscope (of 200 mm diameter and 3 mm thick) was over-speeded up to 18 thousand rpm. Rotation of gyroscope called slow (but with a good momentum) rotation of the rim of 15 kg weight.

The gyroscopes with the mass of 0,5 kg, 15 kg and 90 kg were tested during summer of 2001. All them called rotation of the rims.

(Editor's note: There are other experimental facts. Fast rotation of mass should produce rotation of some part of nearby aether. Self-closed aether forms vortex and if photon is trapped by this vortex, then

experimenters can see "ring of light" near rotating mass. The rings or self-closed photos can exist in the same place after the mass was stopped or removed away.)

Nowadays gyroscopes in military devices are over-speeded up to hundreds of thousands of rpm. The more rates the gyroscope has, the more energy the rim will produce if it is connected to some generator. But these research works led to single-valued conclusions that gyroscopes themselves cannot produce big quantity of additional cosmic energy not jointly with permanent electromagnets. The Sun as well as planets has natural electromagnetism and their circular gravitation increases in many times due to the presence of electromagnetic fields.

(Editor's note: I think it is obviously that a rotating magnet can involve into the rotation much more quantity of aether than any simple rotating mass. In some theories any magnetic field is considered as circulation of aether particles.)

Electromagnetic fields are the unique boosters of circular gravitation. So, the gyroscopes themselves cannot produce necessary quantity of cosmic energy per unit mass of gyroscope without using of electromagnetism.

In October 2001, I got a copy of 24 patents description. There were patents on "perpetual motion machines". But since such "perpetual motion machines" cannot exist in reality, then we can explain them as gyroscopical transformers of cosmic energy. Efficiency of these transformers varies from 150% up to 10^6 % and practically all of them work using gyroscope. But nowadays only the transformer (Bauman's machine) works in Switzerland, in Maethernitha theological community, Linden city. Some systems have been working from 1980 and producing total power of 750 kWtt, the gyroscopes of 2m diameters are provided with constant magnets.

Besides, there are ready transformers of cosmic energy in Russia. The Professor of Moscow State University, Academician of Russian Academy of Natural Science Leonid Leskov spoke about them in the first half of 2001. He actually said that Mr. Chubais does not allow innovation of energy transformers, which are ready for commercialization (see newspaper "Raduga", Samara, July 2001).

I assume that any kinds of such transformers work on the energy produced by "Aether wind" beams. Perhaps our earth ancestry (Atlases) used this energy to fly as well as extraterrestrials. I remember information about flying platforms, which were designed in Germany in 1943-1945. Nowadays there are publications that there are not less than 10 captured extraterrestrial's spacecrafts on the Earth, and some samples were tested in Russia and the USA.

On the basis of all above-mentioned it becomes extremely clear that the main secret of Nature was discovered, and let's representatives of conservative science don't pull the wool over people's eyes to prove that "it is impossible". It is possible! Physics is an experimental science in its main part, and there is no completed theory until now.

As a result, I'd like to make some conclusions: The secret of Gravitation nature was discovered not in connection with new scientific investigation, but due to dawning up and understanding of the fact that gravitation since earliest times was produced by "Aether winds", which fill all cosmic space. Instead of improvement of "Aether wind" theory, academician science abolished it and forgot it such as some scientists of nowadays don't have an idea of it. While abolishing of "Aether wind" theory, scientific world spent 100 years in vain to find an alternative to it. A real Cosmic scientific and technical progress was slowed down during this term. Without this progress all humankind will kill environment of the Earth in 30-40 years!

Rush hours for humankind to turn to cosmic energy came, we have not even an hour to wait, and otherwise we will loose a chance to survive. Today the scientific and technical level is such that taking into consideration the buildup made by inventors – enthusiasts, who created more than 50 types of Cosmic energy transformers, it is possible to begin repetition work in one year. Now there is the only barrier to do it, i.e. market relations in energetics developed during last 100 years.

Let's look into near Future. The process of energy resources (coal, oil, gas) formation in bowels of the Earth took hundreds million years. There was period of clean ecology in the World Ocean, on land and in the atmosphere. **And all it catastrophically had been diminishing during 2-nd half of the XX century**. **There are about 40 years for our civilization to reach the boundary of having no chance to support normal life on the Earth.** An irreversible process of struggle for survival using underground environment and protection from mortal ecology will begin. Our close posterity will not forgive us this betrayal.

Is there any solution? Yes, there is.

It is necessary to publish the descriptions of all "perpetual motion machines" models as well as unprofitable publication of short technical documentation in the Internet and magazines, which will give a chance to many companies, research groups and individuals to re-produce them. But at first we should choose the models, which are the most reasonable in technology and prime cost. Such a way of replication of the models will give people confidence, interest and reliable information on existence of inexhaustible salutary cosmic energy. And the victory will be the reward for courageous, enterprising and advanced people.

which generates electrical voltage $E_{\updownarrow} = \ell \frac{dB_{rot}}{dt}$ in the structure of vacuum. This voltage generates Gravitational Impulse itself $G = 4\pi E_{\sigma} S \cdot (\Delta r_g)^2$, where $\Delta r_g = e_0 \frac{E_{\updownarrow}}{b}$.

The supposed "Gravitational Impulse" in the experiment by Podkletnov is modeled by a quarter of cosine curve.

Duration of this curve is determined by the decrease of magnetic field "trapped" into the superconductor due to the partial heating of semi-conductor emitter after plasma passed the discharge of 2MV with the current strength of 10000 A. The formula of the model is the following:

$$X'' = Ae^{-2\pi f_0 D_0 t} \cos(2\pi f_0 \sqrt{1 - D_0^2}\, t) \qquad (1)$$

the calculation is made for the frequencies of 30, 3, 0,3 and 0,03 Hz and acceleration of 12 m/sec^2, which appears for the mass of the pendulum 30 g with the force horizontally to gravitation 0,03·12=0,36 N.

It can be supposed that it is necessary to make more careful solution of the problem to find the effect on the pendulum by its reaction, which is known from experiment. We should apply the more correct use of spectral method of solution of differential equation for the pendulum with setting of impulse effect. Further, having the recording of temporal function of magnetic field by Hall-effect devices and using Maxwell formulas, we should find electrical field acting in physical vacuum. This field will give us the force of gravitational impulse.

The experiment by V. Roshchin and S. Godin is simpler for physical modeling (Editor's note: the author assumes it is simpler than Podkletnov's effect). All input and output parameters are known to the authors, i.e. force of the magnets, frequency of variable magnetic field in the local place of space vacuum, change of gravity. Furthermore, there are known cylindrical formations of magnetic "loops" around the device and their approximate arrangement with the intervals divisible by the half of rotor radius. Effects of temperature decrease at 8° C in cylindrical atmospheric formations can be simply explained by adiabatic decrease of air pressure due to the decrease of gravitation between molecules of air. Formulas for estimation of decrease of gravitational and inertial forces are the same that for Podkletnov's experiment:

$$E_{\updownarrow} = \ell \frac{dB_{rot}}{dt}, \qquad (2)$$

$$G = 4\pi E_{\sigma} S \cdot (\Delta r_g)^2, \text{ where } \Delta r_g = e_0 \frac{E_{\updownarrow}}{b}. \qquad (3)$$

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New Sources of Energy from the Point of View of Unitary Quantum Theory

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Abstract

The Unitary Quantum Theory (UQT) is a new version of the field quantum theory, which has been developed by the principal author (Prof. L.Sapogin) of this paper for over 25 years. The theory is directly related to the problem of new energy sources, and this paper can be of interest for Journal of New Energy for it is the UQT (and not the classical Newton mechanics or the modern standard quantum mechanics) that provides a theoretical basis for the development of new sources of energy and for the explanation of the operation principles of the existing and functioning over unity devices.

The fundamental provisions of the UQT and a number of results received on the basis of it were published in many scientific journals and reported at international conferences (see [1-6], etc.). Generally, the UQT as expressed by the language of formulae and equations represents a new mathematical model of interaction and movement of elementary particles in the form of a complicated system of non-linear integral-differential equations, an important property of this model principally defines the trajectories and velocities of the particle movement in space (unlike the standard quantum theory, which directly defines only the probabilities of the presence of the particles at a certain point in space). Another, and the most essential (for the problem of new energy sources) property of the UQT is the absence of the energy conservation laws and the

impulse for single particles in it. That is why the UQT makes theoretically possible processes of energy generation as if from nothing, if they are regarded from the classical mechanics point of view or the standard quantum theory (while the UQT is able to explain the phenomenon), as well as creation of a device with efficiency above 1. In other words, the UQT provides for a theoretic possibility of making a perpetual mobile!

In the 1970's, when the UQT started to be developed, there was nearly no data of the observed phenomena, or any experimental results confirming this unusual theory. Today, such data are abundant. For example, such processes can be named as generation of excessive heat energy during cavitation of very small water bubbles; generation of excessive electric energy in an anomalous gas discharge; excess generation of electric energy when electric current passes through proton-conducting ceramics, etc. Besides, and still more important, operating devices that have been created much more energy than it was necessary for these devices functioning: electric current generators "Testatica" (Switzerland); thermal cell CETI (J.Patterson, USA); heat generators (Yu.S. Potapov, Moldavia, J.Griggs, USA); electric current generators (P.Correa, A.Correa, Canada); electric engines on magnetic ceramics (Japan), and others. The said phenomena and operation principles of the above-mentioned devices can be explained with the help of the UQT.

In this paper we will also touch upon such an important problem as cold nuclear fusion. The feasibility of this nuclear process, which is categorically denied by the standard quantum theory and nuclear physics specialists, was predicted by the author of the UQT as far back as in 1983. This phenomenon was discovered in 1989 (electrochemical experiments, M.Fleischmann, S.Pons). Many subsequently received experimental data confirmed the existence of nuclear reactions under very small energies, of nuclear transmutations in plants and biological objects, very slightly connected with generation of energy [7-8]. From the point of view of the UQT, which provides an explanation of the cold nuclear fusion mechanism, this process can be applied in practice (after the relevant devices are designed) for generation of energy, for production of isotopes, and for nuclear waste liquidation.

Introduction

Inventors, as well as swindlers of all kinds, had long ago been trying to construct, or at least design, a *perpetual mobile*, i.e. an imaginary machine that produced work without any outside energy. Peter the Great even founded the Imperial Russian Academy of Sciences for such research, but the modern Russian Academy of Sciences does not like to recollect this circumstance. On the other hand, the French Immortals in 1755 decided not to consider any *perpetual mobile* projects at all, and, as we would see, were quite right as regards the Newton mechanics. The brilliant success of the classic mechanics has strengthened still more the sacred belief of the mankind in the Divine Infallibility of the Conservation Laws, and today it is nearly indecent to express any doubts about these laws.

Let us first of all find out the origin of the conservation laws in ordinary mechanics. Practically any textbook will tell you that the Energy Conservation Law (ECL) follows from the homogeneity of time, the Impulse Conservation Law from the homogeneity of space, and the Angular Momentum Conservation Law from the isotropy of space. That is why many people have an impression that the conservation laws themselves follow only from the quality of time and space, which is today an undoubtedly relativistic notion. But, for example, the angular momentum is not a relativistic notion. So, such a narrow approach is not altogether correct, and it is necessary to turn to the second Newton law, or the equation of relativistic dynamics and the system insularity. However, *the qualities of the time and space ensue exactly from the analysis of the Newton mechanics*, though they are often construed incorrectly. Let us remind you the correct interpretation.

Homogeneity of time suggests that *if at any two moments of time two similar experiments are made in similar closed loop systems, the results thereof will not differ.*

Homogeneity and isotropy of space mean that *if a closed loop system is moved from one part of space to another, or is oriented differently, nothing will change.*

The making of the fundamental energy and impulse conservation laws from the Newton equation is very simple. Let us put down the main equation of dynamics as

$$\mathbf{F} = \frac{d\mathbf{P}}{dt}$$

For closed loop system $\mathbf{F}=0$ (no external forces operating) and the equation integral will be $\mathbf{P} = Const$ the impulse conservation law.
Now let us take the main equation of dynamics as:

$$\mathbf{F} = m\mathbf{a} = m\frac{d\mathbf{v}}{dt}$$

and multiply it scalarwise by $\mathbf{v}$

$$\mathbf{F}\cdot\mathbf{v} = m\frac{d\mathbf{v}}{dt}\mathbf{v} = \sum_{i=1}^{3} m\frac{dv_i}{dt}v_i = \sum_{i=1}^{3} m\frac{d}{dt}\left(\frac{v_i}{2}\right) = \frac{d}{dt}\left(\frac{mv^2}{2}\right)$$

where v is the module of the velocity vector $\mathbf{v}$. For closed loop system $\mathbf{F}=0$, and the equation integral will be

$$\frac{mv^2}{2} = Const$$

one of the forms of the energy conservation law. From the definition of the angular momentum for a particle,

$$\mathbf{L} = [\mathbf{r} \times \mathbf{P}]$$

Differentiating both parts by *t*, we get

$$\frac{d\mathbf{L}}{dt} = \left[\frac{d\mathbf{r}}{dt} \times \mathbf{P}\right] + \left[\mathbf{r} \times \frac{d\mathbf{P}}{dt}\right]$$

Since the impulse vector is parallel to the velocity vector, the first bracket will equal to zero. On the basis of the resultant equation and the definition of central force as not creating any momentum, we get

$$[\mathbf{r} \times \mathbf{F}] = 0 \quad \text{or} \quad \mathbf{L} = Const.$$

In case of the central force in an unclosed system, the angular momentum is preserved by value and direction. The angular momentum conservation law for a closed loop system results in the same way as the impulse conservation law from the equation of the rotary motion dynamics:

$$\mathbf{M} = \frac{d\mathbf{L}}{dt}$$

For a closed loop system, the momentum of external forces **M**=0 and the integral of the equation will be the angular momentum conservation law

$$\mathbf{L} = Const$$

In relativistic dynamics the emergence of the energy and impulse conservation laws separately can be easily received from the relativistic ratio for energy and impulse

$$E^2 = P^2c^2 + m^2c^4$$

Term m^2c^4 is an invariant, i.e. the same in all reference systems. In other words, it is a certain constant. This equation can be represented in a slightly different form

$$E^2 - P^2c^2 = Const$$

For the equation to be valid, it is required that

$$E = Const \text{ and } P = Const$$

and this none the other but conservation laws for energy and impulse.

Strictly, relativistic mechanics has a conservation law for 4-impulse vector P^{μ}, but we will not dwell on these details, because small energies are what we are interested in.

In the classical theory, the energy conservation law states that the energy of a closed loop system remains unchanged, so, if the energy of such a system is designated at a moment *t=0* as E_0, and at the moment *t* as E_t, $E_0 = E_t$.

Conservation laws in ordinary quantum mechanics

The standard quantum theory formulates the energy conservation law in the same way. In quantum mechanics we have the same movement integrals as in classic mechanics. A certain value *L* will be a movement integral, if

$$\frac{d\hat{L}}{dt} = \frac{\partial \hat{L}}{\partial t} + \left[\hat{H}, \hat{L}\right] = 0 \qquad (1)$$

Since $\left[\hat{H}, \hat{L}\right]$ is defined by commutator of operator $\hat{L}$ and of Hamilton's operator, any value *L*, *not depending explicitly on time*, will be the movement integral, if its operator commutes with the Hamilton's operator. When value *L* does not explicitly depend on time, the first item in (1) turns to zero. There remains

$$\frac{d\hat{L}}{dt} = \left[\hat{H}, \hat{L}\right] = 0 \qquad (2)$$

and for the movement integrals not explicitly depending on time the Poisson quantum bracket equals zero. From (1) and (2) it follows that the average value of the movement integrals does not depend on time:

$$\frac{d}{dt}(L) = 0$$

All good papers on the quantum theory prove that probability $w(L_n, t)$ to find at any moment *t* any value of the movement integral, i.e. L_n, does not depend on time. Further, is constructed as the movement integrals not explicitly dependent on time. Since operators $\hat{\mathrm{L}}$ and $\hat{\mathrm{H}}$ commute, they have common proper functions, which are functions of stationary states. Let us note that the latter follows from solutions of the equation without time, which was received from the full equation with imposition of requirement

$$\Psi(\mathbf{r}, t) = \Psi_0(\mathbf{r}) \exp\left(i\frac{E}{t}\right)$$

equivalent to search of only periodic solutions. Further, quite naturally, *there appeared an equation without time with actually imposed conservation laws, because now nothing depends on time*. Expansion by such proper functions looks as follows:

$$\hat{L}\Psi_n = L_n\Psi_n \qquad \hat{H}\Psi_n = E_n\Psi_n$$

where

$$\Psi(x,t) = \sum_n c_n \Psi_n(x) \exp\left(-i\frac{E_n}{\hbar}t\right) = \sum_n c_n(t)\Psi_n(x) \qquad (3)$$

$$c_n(t) = c_n \exp\left(-i\frac{E_n}{\hbar}t\right) = c_n(0)\exp\left(-i\frac{E_n}{\hbar}t\right)$$

Since (3) is expansion into proper functions of operator L_n, probability does not depend on time:

$$w(L_n, t) = |c_n(t)|^2 = |c_n(0)|^2 = Const$$

Since energy is a movement integral and probability *w (E,t)* to find at a moment *t* an energy value equaling E, does not depend on time, then:

$$\frac{dw(E,t)}{dt} = 0$$

Let us note once again that it is *the probability to find a certain value that does not depend on time, but not the value itself, which for any separate event is accidental and can assume a wide range of values.*

The quantum energy conservation law in the above form suggests a possibility of defining energy at a given moment without subjecting it to uncontrolled change, which raised no doubts in classic mechanics. But in the quantum theory the energy, without changing its value, can only be measured to

$$\Delta E \geq \frac{\hbar}{\tau}$$

where r - is measurement duration. Formally, it does not present any difficulties for the energy conservation law, since energy is a movement integral, and we have much time to make long measurement. For example, let us make measurements during time r, then leave the system to itself for time *T*, and then define energy again. The classic quantum energy conservation law states that the result of the second measurement will coincide with the result of the first measurement to $\Delta \mathrm{E} \approx \frac{\hbar}{\tau}$.

But even in the ordinary quantum theory all this is not consistent enough. For the real vacuum fluctuations can interfere, that always influences the results of a single process, but their influence disappears after the passage to an ensemble of events. Here we have a violation of the conservation law due to vacuum fluctuations, though existence of movement integrals, unlike in the Unitary Quantum Theory (UQT).

The generally accepted quantum theory carefully avoids the question of conservation laws for individual events in the case of small energies. This question is either not discussed at all, or it is said that *the quantum theory does not describe individual events. Yes, it does describe individual events, but it can only predict a probability of this or that result.* It is clear that in this case there are no conservation laws for individual events (it is wrong to speak about it in case of an accidental result of an individual event), and they appear only after the averaging by large ensembles of events. Essentially, it can easily be proved that classic mechanics follows from quantum mechanics after summing up by a large number of particles, because for a sufficiently big mass, the length of the de Broglie wave becomes much less than the body dimensions, and no quantum-wave qualities can be talked about.

Conservation laws in Unitary Quantum Theory

In the UQT [1-14] any quantum particle is not a point, but a source of field like in the ordinary quantum mechanics, but it represents a bunched field (wave packet) of a certain unified field. The dispersion equation of such a nonlinear field turned out to be such that the wave packet (particle) during its movement periodically appears and disappears, and the envelope of this process coincides with the de Broglie wave. Numerous particles during their periodic disappearance (spreading in the Universe) are repeated appearance from vacuum fluctuations. A theory of quantum measurements has been built, and the probability interpretation follows from the mathematical formalism of the quantum theory [10,11], and it is not postulated as in conventional quantum mechanics. Unfortunately, the main UQT equation turned out very complicated, for it is a system of 32 nonlinear integral-differential equations, which could require for their solution some new mathematical methods. But from this the relativistically invariant Hamilton-Jacoby equation, and the Dirac equation system strictly follow.

Papers [13,14] give a solution of the simplified scalar integral-differential UQT equation, which gave a localized solution for the form of a wave packet representing a particle. It turned out that the integral from a bilinear combination of such a solution for the whole volume gives with the precision of 0.3% the value of a non-dimensional elementary electric charge [13,14], which was essentially its first theoretical calculation. Then, this solution in the form of a periodically appearing and disappearing wave packet (which square describes the density of a spatial charge) can be replaced by an oscillating charged particle [15-18], the movement whereof will be described by the conventional Newton equations:

$$m\frac{d^2\mathbf{r}}{dt^2} = -2Q\mathbf{GRAD}U(\mathbf{r})\cos^2\left(\frac{mt}{2\hbar}\left(\frac{d\mathbf{r}}{dt}\right)^2 - \frac{m\mathbf{r}}{\hbar}\frac{d\mathbf{r}}{dt} + \varphi_0\right) \quad (4)$$

$$m\frac{d^2\mathbf{r}}{dt^2} = -2Q\mathbf{GRAD}U(\mathbf{r})\cos^2\left(-\frac{m\mathbf{r}}{\hbar}\frac{d\mathbf{r}}{dt} + \varphi_0\right) \quad (5)$$

where *m, Q,* **r** - mass, charge, and radius-vector of the particle, *U*(**r**) – external potential, φ_0 - initial phase.

Since $\mathrm{E} = -\mathrm{GRAD}U$, and a magnetic field also exists, the Lorenz force should also be calculated for $\mathbf{F} = \frac{Q}{c}[\mathbf{v}\times\mathbf{H}]$, but in the electromagnetic wave **E** and **H** are equal, and for small energies value $\frac{v}{c} \to 0$, and

force **F** can be ignored. Both these equations produce qualitatively similar results for different problems, but the first non-autonomous equation evidently does not have any movement integrals at all, and any hope for analytical solutions is very unreal. But for the second autonomous equation such hope still exists. Let us note that these equations describe more accurately the experimental results of scattering on the coulomb potential than the classic Rutherford formula! Application of these equations for the tunnel effect and scattering on short potential also produces correct results, but in this case passage through a high barrier (tunnel effect) will be defined by the initial phase. Of greatest interest, however, is the harmonic oscillator problem.

It is possible that a change in the properties of a material point in the process of its movement is just another step in the material point movement theory. In conventional mechanics this idea is not altogether new. There are Meshchersky's equations for bodies with a changing mass, and Tsiolkovsky's equation for a rocket. But so far, in the conventional quantum theory, the particle has a permanent and stable in space and time set of properties, and in the UQT all the parameters of the particle are changed and oscillate during movement.

It should be noted that *Newton did not introduce the notion of a material point at all,* and it would be ridiculous to think that he was not able to have this natural and rather trivial idea. Most probably, and it is not by chance, for today many troubles of the field quantum theory are rooted in the approach to the particle, as to the point, the most vivid example being a large bouquet of divergences. Nevertheless, this approach is very convenient and should only be used correctly. Let us also remember, that in accordance with the Newton corpuscular theory, beams of light were to be regarded as a flow of certain particles. They are emitted by a shining body in all directions and move in an empty space or a homogeneous medium evenly and straight, i.e. in the same way as the ordinary material particles do in the absence of any external or interaction forces. Newton explained reflection and refraction of light beams on the surface of border between two homogeneous mediums by the effect of certain forces on this border, in the direction perpendicular to the surface. These forces changed the normal velocity component, but did not touch upon the tangential one, which allowed to derive the reflection and refraction laws. However, the inability of such a theory to account for the light partial reflection and passage phenomena, as well as the Newton rings (which he himself discovered), led him to bouts (or fits) theory, which is quite modern, although nearly forgotten. Newton believed that for full explanation of all the processes it was necessary to suggest that some light particles could experience reflection bouts, and others – passage bouts. Let us imagine light falling to a flat surface, which is partially, reflects and partially passes. With quantum description of this phenomenon, a particle connected to the falling wave at the time of hitting the surface has a certain probability of passing or being reflected, and Newton simply used the word "bouts" in place of the word "probability".

It is absolutely clear that all descriptions of processes by the equation with an oscillating charge will be an approximation, because it is evident that no movement equations for a material point can describe even the simplest interference processes on a semi-transparent mirror, during which a material particle should be divided in two parts which will later eliminate each other by destructive addition. It is surprising, but the numerical solution of the problem of scattering on a short potential (the Ramsauer effect) for equations (4) and (5) gives the correct diffraction picture! But if we want to describe an individual particle correctly in the conventional quantum mechanics, the picture becomes inexact and purely probabilistic. At every given moment of time a particle can exist in only one of the mutually incoherent states, because one particle cannot move in different directions simultaneously (it cannot have many impulses at the same time). Nevertheless, there seems to exist a whole class of processes, where description with the help of equations (4) and (5) have certain sense. It is well known that in all experiments the local energy and impulse conservation law in individual quantum processes are true only under high-energy values. But under small energy values it is not so, at least because of the ratio of uncertainties and the probabilistic character of all the quantum theory predictions, and the idea of a global, not local ECL, is invisibly present in the quantum mechanics, and is certainly far from new.

In the strict UQT and the quantum measurement theory, a great role belongs to unavoidable vacuum fluctuations. It is clear that these fluctuations are totally unpredictable and non-invariant in relation to space and time translations. The same can be said otherwise: there are no habitual properties of time and space in this theory. Space-time is now not homogeneous and not isotropic. For example, if the system is transferred to a new point in space, or a certain experiment is repeated at another time, at the point where particle parameters are studied, and it interacts with the macro-device, a new value of vacuum fluctuations (different from the previous one) can appear and produce a different result. Of course, all this is only true for small energies and individual events.

Still more destructive is the UQT for the notion of a closed system. For individual events under small energy values this notion is simply unacceptable for the following reason: vacuum fluctuation at the location of the particle (e.g. in a potential pit) can be sharply changed at any moment. It can be caused by different factors – the nature of vacuum fluctuations itself, or the tunnel effect of another random particle.

Sometimes it is stated that conservation laws follow from the Nether theorem, though these results are present in the works by D. Gilbert and F. Klein. For any physical system, the movement equations from which can be received from the variation principle, each one-parametric continuous transformation that leaves the

variation functional invariant, corresponds to one differential conservation law, and there exists a clearly conserved value. It is easy to see, however, that vacuum fluctuations imposed on the varied function (integral of Lagrangian) do not in sum remain unchanged during parametric transformations (at least today it seems so), and this consideration does not work without preliminary of ensemble.

And now we are in for a little philosophy. The local Energy Conservation Law (ECL) in individual processes follows from the Newton equations for closed systems. It would be naive to think that its local formulation will be preserved forever, and would be a bad mistake to transfer the ECL from the Newton mechanics to the quantum processes without any changes, because the latter are more fundamental.

References to the first principle of thermodynamics are, strictly speaking, groundless, because this principle is a postulate. For example, well-known Russian mathematician N. Luzin, in a letter to an inventor wrote that the first principle of thermodynamics is the result of unsuccessful attempts of the mankind at building a *perpetual mobile*, and strictly follows from nothing. *Today it may be said with a great degree of certainty that no sophisticated machine in the framework of the Newton mechanics can be a perpetual mobile,* and the decree of the French Academy of 1755 not to consider any *perpetual mobile* projects is still valid. We will only add that now it is valid only for those projects that are based exclusively on the Newton mechanics.

There is the tendency in modern physics to reduce ECL, especially in theory, to the rank of a secondary derivation from the movement equations (movement integrals). Some physicists restrict the ECL to the framework of the first principle of thermodynamics, others, like D. Blokhintsev [37], think it quite probable that with the development of a new theory the form of the ECL will undergo certain changes. F. Engels wrote in his "Dialectics of Nature": "…none of the physicists actually regard the ECL as an eternal and absolute law of nature, a law of spontaneous transformation of the movement forms of the matter and the quantitative constancy of this movement in all its transformations". But many people do not share this opinion. M. Bronstein in his book "Structure of Matter" wrote: "The ECL is one of the main laws of the Newton mechanics. Nevertheless, Newton did not ascribe to this law the general character that this law actually possesses. The reason for this *erroneous* (italicized by authors) opinion of Newton of the ECL is very interesting…". It is now clear that in view of the above, such an opinion was not at all erroneous. Let us remind you that Newton predicted many things, even the UQT, in his "bouts theory".

On the other hand, the authors of quantum mechanics realized that there was no conservation law for single quantum processes under small energies at all. The idea that the construction of ECL, together with the second law of thermodynamics, was a statistical law, true only on the average and inapplicable to individual processes with small energy, first occurred to Schroedinger, and later to Bohr, Kramers, Slater, and Gamov. In 1923 Bohr, Kramers and Slater made a desperate attempt to develop the theory, where the energy and impulse conservation laws in case of scattering would be true only statistically, on an average for long periods of time, but would be inapplicable to elementary events. Lev Landau even called it "Bohr's wonderful idea".

Later, however, the authors gave up this approach and, besides, this idea at that time did not follow from the quantum theory equations, and the authors, *to come out of the predicament, simply declared that quantum mechanics did not describe individual events at all*. Thus, the most vivid paradox of the quantum science was removed by a simple ban on thinking about it! But the ingenious idea that conservation laws do not apply to individual quantum processes and emerge only after the averaging by the ensemble of particles remains alive. This idea might have been a little premature, and, possibly, should be a little different.

The Unitary Quantum Theory (UQT), on the contrary, individual particles, and the difference in their behavior is accounted for by the initial phase of the wave function. In this case, local conservation laws do not exist for a single particle, and measuring the initial phase or some other parameters for an individual particle is quite a different matter. It is not true that the UQT has given up probabilistic description. Probabilistic interpretation remains, but the probability now is strongly dependent on the initial phase. Although the equations with an oscillating charge can determinately predict a particle's behavior, the measurements can be made only with the help of a macro device, which will give only a probabilistic result. Impossibility to determinate measurements does not change anything, for the UQT provides for a possibility of influencing the probability value, which was earlier unavailable. The existing Von Neumann theorem about hidden parameters does not effect our result, but the relevant discussion is too cumbersome, and we will leave it out.

*In other words, **all the requirements**, wherefrom the classical conservation laws follow, are now absent. We can hardly expect the conservation laws for individual particles to be preserved under small energies in such a situation.* Today we are convinced that the classical energy, impulse and angular momentum conservation laws for individual quantum objects are not valid under small energy values because of periodic appearances and disappearances of the particle. All direct experimental tests of the conservation laws were made for large energy values, and for small energies of an individual particle only probabilistic results can be received, and, in this case, it would be indecent even to recall the conservation law.

Energy generation and perpetual mobile

Let us make the following imaginary experiment. For simplification purposes we will use in our reasoning a

certain quantum ball-particle. When a classical ball approaches a wall (perpendicularly for simplification), the speed of the reflected ball is always equal to the initial speed (we ignore friction and regard the ball and the walls as absolutely elastic). In the case of a quantum ball, the speed of the reflected ball will acquire in different experiments with absolutely equal initial conditions a whole range of values: some balls will be reflected at a speed greater than the initial speed, others – at a speed equal or lower than the initial speed, and all this is described by quantum mechanics.

Let us ask the following question: what if a second wall is found, parallel to the first one, in order for the ball to increase its speed after each reflection from the wall? Then we will have increased ball energy without any special efforts on our part. Such phenomena appear in the problem of particle oscillations in a potential pit (not necessarily parabolic) on the basis of equations (8) and (9), when four types of solutions are possible, three of which are most important for us: stationary, "maternity home", and "crematorium". In the two latter solutions traditional conservation laws do not work. These solutions are presented in Fig. 1. Such oscillator behavior explains many experimental facts. From the physical point of view, it means that in stationary solutions with fixed discrete energies (conventional quantum mechanics) the speed of the particle reflected from the wall will be equal to the speed of the falling particle. If the speed of the particle is decreased after each reflection, it will mean the "crematorium" solution, and if it increases, the "maternity home". Scenarios for situations will depend on the initial phase of the wave function and the particle energy. In ordinary situations the "crematorium" and "maternity home" solutions always compensate each other, and we find conservation laws.

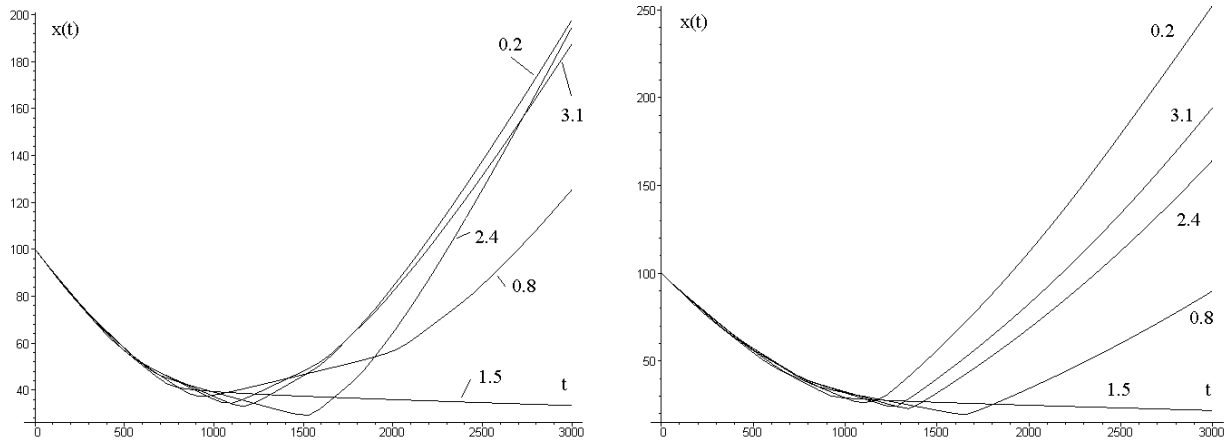

Fig. 1. Dependence of the distance between the moving charge and the nucleus on time for autonomous and non-autonomous equations.

The task of the future developers of new energy systems of the 21st century will consist in creating such initial conditions for a great number of particles making up a body that only the "maternity home" solution would be realized, and the "crematorium" solution would, if possible, be suppressed.

It follows from the above that if the unitary quantum theory ideas are applied correctly, there is no fundamental taboo for a perpetual mobile. Such a taboo, as it was shown, does not formally exist even in conventional quantum mechanics (no conservation laws for individual processes with small energies), and, in order to generate energy, they should be somehow accumulated (all random processes with excess energy should be grouped together). But conventional quantum mechanics refuses to describe individual events and is unable to offer any ways for such grouping. The unitary quantum theory seems to offer such an opportunity.

However, the great idea of free energy generation was distorted by effort of some research associations interested to keep their stability degree, that everyone who started speaking about it was considered to be a crazy man.

Modern experimental physics has verified the correctness of conservation laws either for very large energies in individual quantum events, or for big macroobjects, when automatic averaging by ensemble is made, but the area of very small energies for individual events today is a *terra incognita*.

In order to see how the conservation laws for reflection (repulsion) of an individual particle from the Coulomb heavy nucleus with different values of the initial phase are violated, we have solved numerically one-dimensional equations (8) and (9) under the different initial conditions:

$$\hbar = 1, m = 1,\ 2Zze^2 = 1,\ x_0 = 100,\ V_{x0} = -0.1$$

In the Fig. 2 the distances between the moving particle and repulsive nucleus are shown as a time function, for

different initial phases in cases of non-autonomous and autonomous equations.

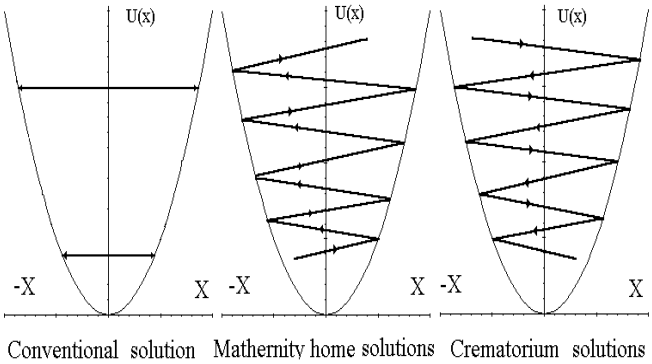

Fig.2 Three types of solutions for oscillator

It is evident from the calculations that the speed of a reflected particle can be equal, lower or higher than the speed of a falling particle. This situation seems to be true for all potentials.

Calculations were also made for other potentials: harmonic oscillator, Yukawa, Gauss, dipole, hyperbolic secant, and Wood-Saxon, and the quality results were nearly the same. If we sum up the impulse of all the particles falling with different phases and compare it with the summarized impulse of all the reflected particles, the summarized reflected impulse, for example, for the Coulomb potential, will be several percent higher than the summarized impulse of the falling particles. For other potentials such a small deviation can even be in the opposite direction. On the whole, this problem is very complicated and requires additional research, because all this is also dependent in quite a complex way on the initial conditions (initial speed, phase and distance).

Philosophically, any categorical taboos, like the impossibility of creating a *perpetual mobile*, are absolutely unacceptable. If everyone is convinced of it forever, the conservation laws and *perpetual mobile* taboos will remain unshakable as long as the human civilization exists. Of course, the funeral of the Conservation Laws can be very prolonged. Anyway, we are not going to do it, and our article might be just a cleanup for the future tomb, and the splendid funeral with all the necessary honors will be organized by future generations. *On the other hand, these laws will never die out completely and will surely be applied, but such spheres of science and technology will appear, though small at first, where these laws are not valid.*

The truth should be accepted irrespective of where it comes from. Words of F. Engels from the "Dialectics of Nature" will be quite appropriate here: "When the solar system ends its life circle and shares the fate of all the finite things, when it falls victim to death, what will happen next? Thus, we come to a conclusion that the heat emitted into the universe should have an opportunity, in a way yet to be established by the natural sciences, to turn into another form of movement, where it can be accumulated again and start functioning. And in this casethe main problem that prevented transformation of dead suns , back to red-hot nebulas will disappear".

The question of whether the conservation law exists in global form (we have already proved its not being local) remains open, because nothing leads to it except the inertia of the human mind. This inertia was based on the Newton laws, which were replaced by quantum laws. This mental inertia leads to a situation, when in case excessive energy is generated during solution of movement equations, a question arises how it can happen, and where it comes from. Of course, if a particle (e.g. a photon) falls on a semitransparent mirror, the packet is divided into two halves, which, due to imposition of vacuum fluctuations, will be recorded by photomultipliers as full-fledged photons [1-5]. The result is that energy is taken as if from vacuum: two photons appear in place of one. Another photon can be divided on the mirror into two halves, but they will not be recorded by the meters, and the energy will allegedly pass into vacuum. So, at one time we borrowed energy from vacuum, and then gave the same amount of energy back to vacuum at another place. You can think like that, and this process might take place. But if we consider the equation with an oscillating charge, the energy and impulse conservation laws are not valid there for solution of the movement problem, and vacuum fluctuations have nothing to do with it at all. As for the question of where the energy comes from, it is the result of our mental inertia, and is, essentially, an atavism imposed by the Newton mechanics. But the latter appears as a result of an extreme passage from quantum mechanics, which is more fundamental.

It is interesting to note that there is a bomb in the logical definition itself of the energy conservation law. If energy is something that cannot appear or disappear and always simply passes from one form to another, the only value satisfying this condition is zero. We are far from assuming that energy does not exist. But the problem of existence is solved differently in different philosophical systems, and the mathematical approach seems to be the most correct one: *an object exists if it is free from contradictions*. Energy has bad luck in this case, for under such an approach it should be zero.

Some cosmologists (for example, British prof. Fred Hoyle) are very willing to have a process, in accordance with which the Universe has certain places where energy appears from other certain places, in which it is eliminated. Besides, any philosopher at least a little bit familiar with astronomy, looking at the bright night sky, will see the birth of matter and its expansion into a still greater space. But for this purpose the Global Energy Conservation Law is superfluous and only denies what is observed. The head reels…

Cold Nuclear Fusion and Nuclear Transmutation.

Let us approach the epoch-making experiments made by Fleischmann and Pons in March 1989 [30] from the positions of the equation with an oscillating charge. One

of the authors predicted in 1983 [9] the possibility of such nuclear reactions under very small energies. Without going into well-known details, we will sum it up very briefly: cold nuclear fusion exists, and there are no people or theories capable of giving a clear explanation. The chain of various mechanisms meant to explain this intriguing phenomenon is growing, but few really believe in them. The reason is as follows.

When a charged particle interacts with the nucleus, the potential energy is like in Fig. 3, where the right top part of the curve is conditioned by mutual Coulomb repulsion between the nucleus and the charged particle.

The repulsion potential will be

$$U(r) = \frac{Zze^2}{r}$$

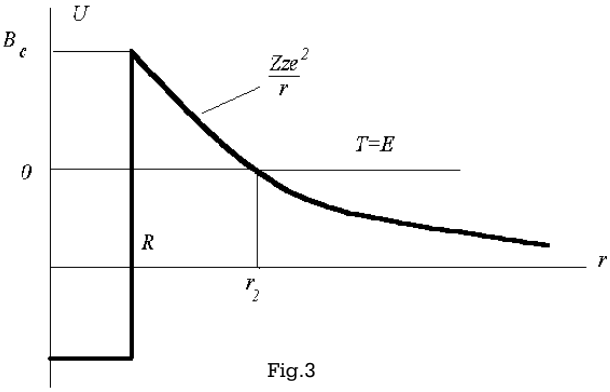

Fig.3

where Z – charge of the nucleus, and z – charge of the approaching particle, e – charge of the electron, r – distance between the particle and nucleus. When $r=R$ (critical distance), then the potential energy curve goes sharply down, which is due to the emergence of intense nuclear gravitation, the potential whereof today appears more complex than could be imagined mathematically. If the charged particle overcomes the Coulomb barrier with a height of

$$B_c = \frac{Zze^2}{R} \approx \frac{Zz}{\sqrt[3]{A}} MeV$$

it will further get into the nuclear gravitation area and a nuclear reaction will take place.

Let us look at the nuclear interaction of a charged particle with kinetic energy $T < B_c$. From the point of view of classical mechanics, there will be no nuclear reaction in this case, because the particle will approach the nucleus and at a certain distance $r < R$ from the top of the Coulomb barrier will turn back and be reflected from it. However, from the point of view of quantum mechanics, there exists a tunnel effect, and the probability of such a tunnel passage, or transparency of potential barrier D is described by a well-known formula:

$$D \approx \exp\left(-\frac{2}{\hbar} \int_{r_1}^{r_2} \sqrt{2\mu(U-T)}\,dr \right) \qquad (6)$$

where $\mu = \frac{Mm}{M+m}$ is reduced mass. The bottom integration limit r_1 coincides with the nucleus radius R, and the top limit r_2 can be found from the condition $T = \frac{Zze^2}{r_2}$. After integration we will get

$$D = \exp(-2g\gamma)$$

where $g = \frac{R}{\lambda_{B_c}}$; $\gamma = \sqrt{\frac{B_c}{T}} \arccos\left(\sqrt{\frac{T}{B_c}}\right) - \sqrt{1-\frac{T}{B_c}}$,

and value $\lambda_{B_c} = \frac{h}{\sqrt{2mB_c}}$, the de Broglie wavelength corresponding to the kinetic energy of the particle equal to the barrier height $T = B_c$. If $T << B_c$, expression (6) is easily transformed to look as

$$D = \exp\left(-\frac{2\pi R B_c}{\hbar v} \right) = \exp\left(-\frac{2\pi Zze^2}{\hbar v} \right) \qquad (7)$$

where v is velocity.

Let us now see what the shocking cold nuclear fusion will look like on the basis of the above considerations. The deuteron energy in an ordinary electrolytic Fleischmann-Pons cell will be about 0.025 eV, and the height of the Coulomb barrier for this case is $B_c = \frac{Zze^2}{\sqrt[3]{A}} = 0.8MeV$. In classical mechanics it would be just naive to talk about overcoming such a barrier with a height dozens times greater than the kinetic energy. Let us now see how the tunnel effect will improve the situation. Let us assess the value of g and γ for the case of collision between two deuterons with such energy:

$$g = \frac{R\sqrt{2mB_c}}{\hbar} = 1.9;$$

$\gamma = \sqrt{\frac{B_c}{T}} \arccos\left(\sqrt{\frac{T}{B_c}}\right) - \sqrt{1-\frac{T}{B_c}} \approx 8883$ and the probability of such a process will be $\exp(-2 \cdot 1.9 \cdot 8883) \approx 10^{-7328}$, i.e. practically pure zero. The fusion cross-section will be defined by the product of nuclear cross-section and the tunneling probability:

$$\sigma = \sigma_{nucl} D$$

and, in the case under review, is also a very small value. If the clash parameter of deuterons is not zero, the emergence of centrifugal potential

$$U = \frac{\hbar^2 l(l+1)}{2mr^2}$$

will still further lower the probability of such interaction.

It is these very circumstances that make the nuclear physics scientist think that there is no cold nuclear fusion as such. For example, such a serious and responsible edition as Encyclopedia Britannica 2001 found no place for the notion of cold nuclear fusion at all. Such an official position can be understandable only from the point of view that quantum mechanics is absolutely true and unshakable. Despite this, for the 12 years since the Fleischmann-Pons experimental discovery, nearly 30 international conferences have been devoted to this subject, there are lots of books and magazines on this subject, and the number of articles on the problem is nearing ten thousand. Today the situation is gradually developing in the positive direction, and the research in the field of hot nuclear fusion, which has already wasted over $90 billion for 45 years, is slowly coming to naught.

But today there exist well known experimental data on cold nuclear fusion. They are numerous and various. We will dwell only upon the most important and sufficiently reliable results. Thus, the classical view of electrolysis of a palladium cathode saturated with heavy hydrogen in heavy water identifies an anomalous quantity of heat energy up to 3 kWt/cm^3, or up to 200 Mj per small sample. Products of nuclear reaction have also been found: tritium (10^7 - 10^9t/s), neutrons with energy of 2.5 MeV (10-100n/s), and helium. Absence of He^3 among the reaction products shows that heat is not generated by reaction $d+p$. Besides, emission of charged particles ***(p, d, t, γ)*** is observed. Similar processes are observed in case of a gas discharge on a palladium cathode, of phase passage in different crystals saturated with heavy hydrogen, irradiation of deuterium mixture with a powerful sound or ultrasound flow, in cavitating microbubbles in heavy water, in a tube with palladium powder saturated with heavy hydrogen under a pressure of 10-15 atm., etc. In certain reactions (e.g. $d + t \rightarrow \alpha + p$) neutrons of 14 MeV are absent, and such a strange situation occurs in other cases too. Activity of Li^6 , Li^7 in reactions with heavy hydrogen and protons failed to be discovered, whereas reaction

$$K^{39} + p \rightarrow Ca^{40}$$

was well recorded even in biological objects. But the most intriguing fact of all these processes is the shortage of nuclear reaction products for explanation of the emerging heat effects. Thus, in certain cases the number of nuclear reaction products (tritium, helium, neutrons, quanta) should be millions of times greater in order to account in some way for the quantity of the generated heat. Generation of such a big amount of energy cannot be accounted for by either chemical or nuclear reactions, or by phase passages. The well-known interaction $d+d$ goes along three channels:

D + D —> T (1.01) + p (3.03) *(Channel 1)*
D + D —> He (0.82)+ n(2.45) *(Channel 2)*
D + D —> He + γ(5.5). *(Channel 3)*

All these reactions are exothermal. The third channel has a very small probability. It was experimentally discovered that they could occur under very small energies. In a molecule D_2 the equilibrium position between atoms is 0.74A and in accordance with the conventional quantum theory, these two deuterons could accidentally enter a nuclear fusion reaction. But the interaction value is very small $\lambda_{D_2} = 10^{-64} c^{-1}$. There is a known estimate that in the water of all seas and oceans there are 10^{43} deuterons, and in 10^{14} years there will be only one fusion.

It follows from the aforesaid that the main problem impeding the occurrence of the $d+d$ reaction lies in the existence of a very high Coulomb barrier. Our approach allows for this problem to be solved, and there is such an opportunity in the UQT. The UQT equation solutions show that the distance to which deuterons can approach each other is strongly dependent on the phase of the wave function (by the way, it is absolutely clear intuitively).

Let us consider the one-dimensional problem [15-18,31]. There is a stationary nucleus with charge *Ze* at the point of origin, and another nucleus is approaching it along axis x (charge *ze*, mass *m*) at a certain initial velocity. The non-autonomous and autonomous equations of such a problem will look as follows:

$$m\frac{d^2x}{dt^2} = -\frac{2Zze^2}{x^2}\cos^2\left(\frac{m}{2\hbar}\left(\frac{dx}{dt}\right)^2 t - \frac{m}{\hbar}\frac{dx}{dt}x + \varphi_0\right) \quad (8)$$

$$m\frac{d^2x}{dt^2} = -\frac{2Zze^2}{x^2}\cos^2\left(-\frac{m}{\hbar}\frac{dx}{dt}x + \varphi_0\right) \quad (9)$$

Since an analytical solution was not found for all the areas of initial phases , numerical methods were applied with the following initial values: $Z=z=1$, $e=1$, $m=1$, $x_0=-10$, $\hbar=1$ for different initial velocities and initial phase values. As had been expected, braking or acceleration of the particle happens only when the charge is large. But at the last stage, under certain initial phases close to $\frac{\pi}{2}$, a wonderful process occurs: velocity, charge and repulsing force are very small. Due to phase ratios, the small charge is not changed for a long time, which means that the particle (or rather what is left of it) is not influenced by any forces, and it is crawling at a permanent small speed for a very long time ("the snail effect") inside the field of another particle, and can come very close to the center. Such movement with a very small charge and a small speed can last for several hours, and disconnection of the external field will not effect this movement. This process reminds of quiet and

invisible scout penetration into the enemy territory. This phenomenon occurs only in certain phase areas, and can be conveniently called a phase hole, which is illustrated in Fig. 4 resulting from the solution of equation (8).

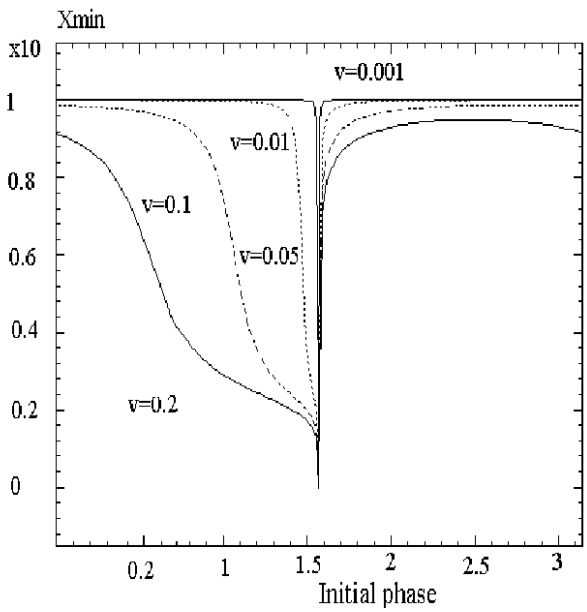

Fig.4. Distance to the turning point of the moving charge depending on the initial phase value for different initial velocities.

Let us note in passing that now we can account for one of the nuclear physics anomalies, which has a tendency to be totally ignored. Under a nucleon energy of 1 MeV, its velocity is 10^9 cm/s, nuclear radius is 10^{-12} cm, and the passage time of the nucleus is 10^{-21}s, but the time period in which the nucleon passes is usually anomalously long - 10^{-14} and even more, and it is absolutely unclear what the nucleon is doing in the nucleus so long. In our model it is easily explained by the "snail effect".

For the same equation, the minimum distance was calculated between the charges dependent on velocity (Fig. 5) for different initial phase values. For comparison, Fig. 5 also shows the result of the classical calculation based on the Coulomb law. It is obvious from Fig. 4 and 5 that the minimum distance to which charges can approach each other is nearly independent of kinetic energy, but with reduction of speed the initial phase area width is reduced as well. In other words, reduced energy brings also reduced probability of a nuclear reaction.

The same results are true for the autonomous equation (9). Under the conventional quantum theory, the ratio of the reaction speeds in the tritium and neutron channels should be close to unity: $\frac{t}{n}=1$. But in many experiments on cold nuclear fusion this value is very different from unity and equals $\frac{t}{n}=10^9$. In different

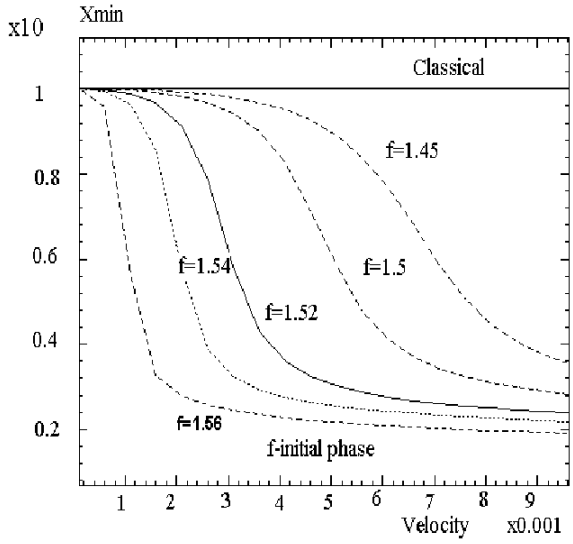

Fig.5 Minimum distance between charges depending on the initial velocity for different initial phase values.

experimental situations it is reproduced by different experimental groups with a very high accuracy. This very intriguing problem has so far received no simple explanation. Let us dwell on a possible cause for such aphenomenon. With a small velocity in the phase hole, neutrons are affected by nuclear gravitation forces, and protons are affected by electrostatic repulsion forces. Under the effect of this momentum, the deuteron will have enough time to turn in such a way that the neutron parts of the deuteron would faceeach other. After the neutron gravitation the nuclear forces will be saturated, which will weaken the proton connection, and one of the protons will leave the system. This reaction can be conditionally presented in the following form:

$$d+d \rightarrow p+(n+d) \rightarrow p+t$$

This reminds of the Oppenheimer-Phillips effect.

It is well known, however, that under big energies, the probabilities of the first and second reaction channels are the same, and this phenomenon should somehow be accounted for. Increased probability of the neutron channel with growing energy can be connected with the appearance of secondary neutrons in the reaction *T + D = He + n (14.1 MeV).* In a deuterium-rich environment, a big part of the resultant tritons will pass to neutrons in the process of this reaction, which has a cross-section of 5 barns under an energy value of 70 KeV. According to assessments in [32], the number of such secondary neutrons per one triton is $7.9\cdot10^{-12}, 1.7\cdot10^{-9}, 2.7\cdot10^{-6}$ for energy tritons 10, 20 and 100 KeV respectively. Thus, the prevalence of $\frac{t}{n}>10^6$ can be expected only in those reactions, where tritium is born with energies over 40 KeV.

It should not be assumed, however, that the phase hole phenomenon in its whole area leads to a nuclear reaction. It can be assumed that reduction of the Coulomb repulsion is followed by reduction of strong

interaction. But how? Today nobody knows the exact equation of the strong interaction potential. Besides, the particle approaches the turning point X_{min} is rather "thin". Will it be able to take part in a full-fledged nuclear reaction, or will it fly through, like it happens with the electron in the s – states of the atom? There are very narrow phase areas, when soon after the particle stops the charge grows quickly and is sharply accelerated. The charge can even be maximum in the nuclear force effect area. May be, it is this narrow phase area that is responsible for cold nuclear fusion, and in case of strong interactions the phase hole mechanism must be operating as well.

It was discovered long ago that nuclear transmutations have a mass character (especially in plants and biological objects), but they have little to do with energy generation. Examples of such reactions:

$$Mn^{55} + p \rightarrow Fe^{56} \ ; \ Al^{27} + p \rightarrow Si^{28} \ ;$$
$$P^{31} + p \rightarrow S^{32} \ ; K^{39} + p \rightarrow Ca^{40}$$

In reactions of this type, a very slow proton (with practically zero kinetic energy) penetrates the nucleus in the above-mentioned way and remains there. *No intranuclear energy is generated, because both before and after the reaction the nucleus remains a stable object.* In classical nuclear physics, the nucleus usually became unstable after it was penetrated by a charged nucleon with a large kinetic energy and always broke into parts, and the nuclear debris had an even greater kinetic energy. Reactions of the above type were considered impossible under small energies and for this reasons were not studied by classical nuclear physics. It seems to be *a completely new type of nuclear transmutations, not recognized by modern nuclear science, but experimentally discovered rather long ago.* Today there is a great deal of experimental material confirming mass nuclear transmutation phenomena. Moreover, there are many projects of neutralizing nuclear excess with the help of this technology. Journals *Infinite Energy, New Energy, Cold Fusion, Fusion Facts*, etc. and Internet are full of such projects.

Of course, a change in the nuclear charge will result in restructuring of electronic atom shells, but the energy related to this process will be about several electron-volts and is nothing in comparison with the energies of nuclear reactions from several to hundreds million electron-volts. By the way, nuclear engineers are accustomed to such energy ranges in nuclear reactions. It was this circumstance that made them deny *a priori* all nuclear processes in biology, because under such energy values of the debris dozens and hundreds thousand of complex biological molecules will be destroyed.

Quite a long time ago, Lois C. Kervran [33] wrote a book about nuclear transmutations in biology, and now, nearly 20 years later, its second edition was published! It gives, evidently for the first time, numerous *experimental* data of the above-mentioned phenomena. The reaction of the official science is very interesting. For example, well-known physicist Karl Sagan, after reading the book about such *experimental* data, advised Kervran to read elementary textbooks in nuclear physics!

Some time later a research was made by Panos T. Pappas [58], who studied one of the well-observed nuclear reactions in biological cells:

$$Na_{23}^{11} + O_{16}^{8} = K_{39}^{19}$$

Classical biology has long known about the existence of equilibrium, when the ratio between the number of K and Na ions is maintained with greatest accuracy despite the shortage or even absence of K ions in food. Later, in work [59] this nuclear reaction was even called the life equation, and the existence of such nuclear reactions in biological objects was proved by M.Sue Benford with the help of direct physical methods.

All thermonuclear fusion programs are based on blunt heating and compression of the reacting material. Despite the progress achieved, the head of the works in England, Dr. Alan Gibson [34], established several years ago that the model reactor design would be created not earlier than in 50 years. Today, this point of view is generally accepted. Even if the reactor is once made (although the authors have grave doubts about it), it will be very complicated, expensive, and harmful for the environment.

Classical approaches have so far not yielded any positive results, despite multi-billion investments and a great number of physicists, engineers, service personnel, and managers involved. It is only natural that this army of researchers is a potential impediment for all alternative projects of new power engineering. It has been noted that *"viability" of any idea is proportionate to the number of people involved and investments made.* For these reasons, the Fleischmann-Pons works were given a hostile reception in the USA and other countries.

All the controlled thermonuclear fusion programs are accompanied with the adjective "controlled", although there is no control whatever. It is simply that the initial quantity of the reacting substance is *prudently* made very small. For example, a ball of lithium deuteride during laser reduction has a diameter of several mm. So far no one has been seriously considering the question of utilizing the energy of an explosion of such a ball, which is approximately equal to the energy of an explosion of a box of antitank grenades.

The straightforward approach to fusion used by the modern science is very natural, because quantum mechanics has no methods of influencing this process. The future of really controlled nuclear fusion systems may be not on the way of primitive and blunt method of heating and compression of the material, but following UQT on the way of using collisions of nuclei having small

energy and corresponding fine adjustment of the wave function phase.

It is essentially possible in case of imposition of the external controlling electromagnetic field on the reacting system, which contains quasi-fixed ordered deuterium atoms and free deuterons. The same properties can be demonstrated by special atomic grid geometry. Diffraction scattering of a deuteron flow on such grids will lead to automatic deuteron selection by energies and phases.

It seems that in the Fleischmann-Pons electrochemical experiments such an ordered system existed in the *Pd-D* grid, and some phasing occurred, which accounts for the results of these experiments [30].

Today it appear to us that the cold nuclear fusion processes will be effectively used for nuclear waste liquidation and production of isotopes.

Many researchers [35,36] discovered that the quantity of heat generated in the process of electrolysis of ordinary water on nickel electrodes (there is no hope for nuclear reactions in such systems) is the same as in the electrolytic cell with heavy water. It confirms other measurements, which showed that the quantity of nuclear reaction products is millions times less than is required for such an amount of generated heat, and its origin remains a mystery.

Further we will give certain concrete data demonstrating the phase values of a deuteron with an oscillating charge, under which the deuteron can approach the nucleus to a critical distance of 10^{-12} cm or less, i.e. giving the data to estimate the value of the above-mentioned phase "hole" in the interval (0,π) of the phase change.

Assume that the stationary nucleus with the charge q is placed to the coordinate origin x=0 and the deuteron with the same charge q is placed at the initial moment t=0 to the point $x_0 < 0$on the x-axis, and the deuteron velocity equals $\dot{x}_0 = v_0 > 0$. The units of mass, length and time are chosen in such a way that $m = 1, \hbar = 1, c = 1$ (*m* - deuteron mass, *c* - light velocity). Charge *q* equals 0.085137266. Our units are connected (to 4 significant figures) with the system (kg, m, s) as follows:

1 mass unit = 3.345×10^{-27}kg,
1 length unit = $1.049\cdot 10^{-16}$ m,
1 time unit = $3.502\cdot 10^{-25}$ s.

The electron velocity corresponding to its energy of 1eV equals $5.931\cdot 10^{7}$ cm/s. The deuteron velocity corresponding to such energy will be assumed to be 3680 times less, and in our units it will be $5.372\cdot 10^{-7}$ (if $c = = 3\cdot 10^{10}$ cm/s). Then the deuteron movement towards the nucleus is described by the equation

$$\ddot{x} = -\frac{2q^2}{x^2}\cos^2(\frac{1}{2}(t+t_*)\dot{x}^2 + x\dot{x} + \varphi_0), \qquad (10)$$

where the parameter t_* is defined under the condition that the argument of cosine equals φ_0 for $t = 0, x = x_0, \dot{x} = \dot{x}_0$ (thus $t_* = -(2x_0)/\dot{x}_0$), and this parameter may be considered as the initial moment of so called local time.

In the interest for us are namely solutions of eq. (10) under very small deviation ε from phase φ_0 and so we put $\varphi_0 = \frac{\pi}{2} + \varepsilon$ and rewrite eq.(10) in the following form:

$$\ddot{x} = -\frac{a}{x^2}\sin^2(\frac{1}{2}(t+t_*)\dot{x}^2 + x\dot{x} + \varepsilon), \qquad (11)$$

where *a* = 0.0144967 Let the initial x_0 to be equal - 500000 of our length units (i.e. approximately $5\bullet 10^{-9}$ cm) and the initial deuteron velocity v_0 to be equal to the velocity v_{00} corresponding to the deuteron energy of 1 eV or less. But it turned out that the precision of numerical integration of this equation under such initial conditions and under values $|\varepsilon|$ = $10^{-15}$and less is small and besides the interval of the integration must be very large. That is why this equation also had to be transformed by passing to "slow" time $\tau = |\varepsilon| t$ to the equation relative to the variable $w = \left(\frac{dx}{d\tau}\right)^2$ as a function of *x:*

$$\frac{dw}{dx} = -\frac{2a}{x^2}\left\{\frac{1}{\varepsilon^2}\sin^2\left[|\varepsilon|(\frac{1}{2}(\tau+\tau_*)w + x\sqrt{w} \pm 1)\right]\right\}, \qquad (12)$$

where $\tau_* = -(2x_0)/\sqrt{w(x_0)}$ and +1 if ε >0, and -1 if ε < 0. It must be added also the equation for τ as a function of *x* :

$$\frac{d\tau}{dx} = \frac{1}{\sqrt{w}}. \qquad (13)$$

The system of equations (12, 13) is, so to say, a "model" system describing fairly accurately the deuteron movement under all values of |ε| from 10^{-24} to 10^{-6}. Numerical integration of this system was fulfilled under different values of e and under following initial conditions:

$$w(x_0) = 2.103, \tau(x_0) = 0, x_0 = -500000, \tau_* = 689573.18 \qquad (14)$$

It may be noted that the initial deuteron velocity v_0 equals 1.450172 (following the relation $\dot{x}_0 = |\varepsilon|\sqrt{w(x_0)}$) for given initial $w(x_0)$ and for |ε| = 10^{-7} , i.e. such velocity is approximately 3.7 times less than velocity v_{00} corresponding the deuteron

energy of 1eV. If $|\varepsilon| = 10^{-6}$ then the velocity v_0 is approximately 2.7 times greater than velocity v_{00} .

It turned out that the numerical tables for values of w, τ obtained under different values of $\varepsilon < 0$ in the interval (-10^{-24}, -10^{-6}) don't differ essentially from each other. The following table is true to three-four significant figures for τ and $\dot{x}/|\varepsilon| = \sqrt{w}$:

x	τ	$\dot{x}/\lvert\varepsilon\rvert$
-500 000	0	1.450
-50 000	$1.426 \cdot 10^6$	0.0493
-500	$1.002 \cdot 10^7$	0.000489
-200	$1.067 \cdot 10^7$	0.000440
-100	$1.090 \cdot 10^7$	0.000425
-80	$1.100 \cdot 10^7$	0.000423

If reducing the table values of x to centimeters, we obtain the following corresponding approximate values:

$$5 \cdot 10^{-9}, 5 \cdot 10^{-10}, 5 \cdot 10^{-12}, 10^{-12}, 0.8 \cdot 10^{-12}$$

The time interval ΔT , in which the deuteron reaches the critical distance 10^{-12} *cm* from the center, is $67350/|\varepsilon|$ of our time units or $(1.090 \cdot 10^7 / |\varepsilon|) \cdot 3.502 \cdot 10^{-25}$ seconds. If nuclear forces are not taking into account then the deuteron may approach the distance less 10^{-12} *cm* .

We present here the table, where are given the initial deuteron velocities v_0 in velocities shares v_{00} and the corresponding time intervals ΔT (in seconds) for different values of ε.

ε	$\frac{v_0}{v_{00}}$	ΔT (s)
-10^{-6}	2.7	$3.82 \cdot 10^{-12}$
-10^{-7}	0.27	$3.82 \cdot 10^{-11}$
-10^{-22}	$0.27 \cdot 10^{-15}$	$3.82 \cdot 10^{4}$ (≈ 10.6 hours)
-10^{-23}	$0.27 \cdot 10^{-16}$	$3.82 \cdot 10^{5}$ (≈ 10.6 hours)

Let us note that the given data change essentially under positive values of ε (10^{-6}, 10^{-7}, etc.). There is some asymmetry of solutions behavior under negative and positive values of ε. The calculations show the minimum distance $|x|_{\min}$ more than 500 of our lengths units even for relative big initial $w(x_0)$ = 10000. Thus, if we limit ourselves to the condition that the deuteron energy is not over $(0.27)^2$ eV at a distance of $5 \cdot 10^{-9}$ cm from the central nucleus, and the whole process of deuteron movement towards the nucleus does not exceeds approximately 10.5 hours, then the interval $(\frac{\pi}{2} - 10^{-7}, \frac{\pi}{2} - 10^{-23})$ is approximately the sought phase "hole" in the whole interval ($(0, \pi)$) of phase change φ_0 in eq. (10).

If many deuterons with the energy not more than $(0.27)^2$eV at the distance $5 \cdot 10^{-9}$ *cm* from the nucleus are equally distributed along their phases φ_0 , the ratio of the length of this "hole" to π, equaling approximately $0.3 \cdot 10^{-7}$, is equal to a share (or a relevant percentage of $0.3 \cdot 10^{-5}$) of deuterons overcoming the Coulomb barrier.

The above figures express at least the order of probability of the cold nuclear fusion occurrence, and this order is absolutely incompatible with the figures in the classical quantum mechanics mentioned above. Let us note once again that a one-dimensional problem was solved, and in case of an accurate analysis (not zero sighting distance will be taking into account) this probability will be lower. Let us also pay attention to the large time intervals ΔT calculated if $|\varepsilon|$ is very small. It explains well the effect (observed by many researchers) of continuation of cold nuclear fusion reactions during even many hours after the disconnection of the voltage in the electrolytic cell. This effect was named even "life after death".

As for the analysis of the deuteron movement with the help of the autonomous equation, the calculations lead to initial velocities v_0 , exceeding the above mentioned numbers, although the general motion picture is the same. But the autonomous equation is interesting, because in the area of those values $x, \dot{x}$, under which the product $x\dot{x}$ is modulo small, it is possible to replace $\sin(x\dot{x})$ with $x\dot{x}$, and the eq.(11) under ε=0 to replace with simplified equation (describing the deuteron motion from initial point $x_0 > 0$ to center)

$$\ddot{x} = a\frac{(x\dot{x})^2}{x^2} = a\dot{x}^2$$

This equation has a very simple analytical solution. Without giving very simple calculations, we will present the final formulas.
Let us take the following initial conditions:

$$x(0) = x_0 > 0, \quad \dot{x}(0) = -v_0 < 0$$

Then

$$\dot{x}(t) = -\frac{v_0}{1 + av_0 t}, x(t) = x_0 - \frac{1}{a}\ln(1 + av_0 t)$$

It follows from these formulas that the velocity of a particle moving in accordance with the initial equation never turns to zero, and under

$$t = t_* = \frac{\exp(ax_0) - 1}{av_0}$$

$x(t_*) = 0$, i.e. the particle reaches the center of the nucleus, its velocity at this moment being

$$\dot{x}(t_*) = \frac{-v_0}{1 + av_0 t_*} = -v_0 \exp(-ax_0) \ ,$$

so that it *passes through the nucleus and moves further..*

For example, let $a = 0.0144967$, $x_0 = 1000$ ($\approx 10^{-11}$ cm), $\dot{x}(0) = 5.37 \cdot 10^{-10}$ (≈ 16 cm/s).

Under such initial data, the product $x\dot{x} = -0.0000537$, so it is quite possible to replace $\sin(x\dot{x})$ with $x\dot{x}$. In this case,

$$t_* \approx 2.3 \cdot 10^7 \qquad (\approx 8 \cdot 10^{-18} \text{ s}),$$

$$\dot{x}(t_*) \approx -29.9 \cdot 10^{-17} \qquad (\approx 9 \cdot 10^{-6} \text{ cm/s})$$

These figures fit well into the reasonable framework, so the autonomous model can also be of use for the movement analysis in the problem under review. The phenomenon of particle passage through the Coulomb potential accounts very well for the existence of pendulum orbits in the Bohr-Sommerfeld model, when in states *1s,2s,3s* etc. the electron passes through the nucleus. Such states in the strict theory and experiment have no impulse, so in the Bohr-Sommerfeld model they were discarded as absurd. Now they have a right to existence. Further, the experimental data for angular distribution of non-elastic scattering by nuclear reactions (including reactions with heavy ions) reveal the big amplitude of the scattering forward. It is impossible to explain such effect by the formation of intermediate nuclei but it is may be explained from the viewpoint of our UQT.

General Principles of Creating New Energy Sources

In the ancient classical *perpetual mobile* idea it is supposed that energy is just created and not taken from outside (impossibility of *a perpetual mobile* is the first law of thermodynamics). There have appeared lately many articles and even books dwelling on the idea of energy generation from vacuum. We are not in complete agreement with many of these works, and we will dwell only on some of them, which, in our view, can be of interest. One of the main ideologists of this completely new sphere in science are Daniel C. Cole and Harold E. Puthoff, and their first serious work entitled «Extracting energy and heat from the vacuum» was published in Physical Review E, vol. 48, #2, (1993). In this work authors use the Casimir forces [60] making them produce useful work. The appearance of such forces in vacuum is understandable intuitively: if in a stormy sea we put vertically into the water two big parallel plates, on the outside part of these plates the waves will hit them at random, and between the plates there will be no waves. Then, the hitting of the waves outside the plates will produce a gravitation force between them (the Casimir force discovered experimentally long ago), which the authors of this interesting work are going to exploit. It is easily seen that in this idea energy is generated from vacuum fluctuations.

Our approach is altogether different. When the equation with an oscillating charge was solved for the quantum oscillator, 4 types of solutions were discovered. For us only two of them matter – "crematorium" and "maternity home". In one solution ("crematorium") the particle slowly falls to the bottom of the pit and finally turns into a "specter" (under the strict unitary quantum theory it disappears, spreads about the Universe and contributes to vacuum fluctuations everywhere). In the other solution ("maternity home") the particle can even be born of a very small fluctuation, or accumulate a sufficiently big energy. Let us underline once again that both these processes are not at all logically connected. In other words, there are such systems where energy will disappear completely (electrolytic baths), or increase unlimitedly (it might be our Universe).

It is the energy conservation law that presents the strongest impediment in all cosmological approaches. However, universes with birth of matter have long existed in scientific cosmology independently of us. There is known the theory of British astronomer Fred Hoyle based on the idea of continued creation of matter from nothing. The question of whether such an approach is realized in nature and whether the energy emitted by quasars is the result of work produced by a certain gigantic pit, is the most intriguing question of the future.

It is yet unclear whether the values of appearing and disappearing energy in these solutions are equal. But neither in the strict UQT nor in the equation with an oscillating charge vacuum (as a big set of random oscillations) is needed for energy generation. Of course, UQT admits of such an energy exchange with vacuum. For example, during split of a photon on a semitransparent mirror, at one time both halves of the photon will not be registered and will give their energy to the vacuum and disappear for the observers for good, at another time there will appear two photons out of one, and the lacking energy will be taken from vacuum. But *the movement equations (4) and (5) themselves know nothing about vacuum and can generate energy due to their nature* (they are noninvariant relative to the coordinate translations) and the conservation laws we are so accustomed to do not exist for them.

Let us remind you once again that the latter follow from the Newton equations, and the Newton equations result from averaging by a big number of events, while for individual events of small energies no conservation laws in quantum physics exist.

In other words, it can be said philosophically that a motion of a small wave packet, once started, will give birth to other movements (energy) and, consequently, to matter. Since most various and breath-taking speculations are possible, up to the creation of a universe, we will stop here.

Thus, the generated or disappearing energy in our approach can be manifest not only in the changes of the particle velocity during movement in a certain potential, but in the appearance or disappearance of the particles themselves as well. A change of the particle velocity in movement is most easily discoverable, and it is the velocity increase that can be used for generation of heat or electric current. There can be energy systems, which exploit the fact itself of charge oscillation and the consequence of it. It is very probable that these phenomena, contradicting the most fundamental laws of modern science, have been long discovered and even applied. But these are the very phenomena that are the easiest to be exploited at the first stage of development of such new energy technologies.

When an energy generation mechanism is used, crematorium-type solutions should be suppressed. But all the quantum processes are built on the basis of elementary acts, and each of them is impossible to be controlled separately. But if the probabilities of such processes are controlled, they, being multiplied by the great number of participants in the process, automatically become macroscopic variables of quantum kinetics, and the process itself becomes possible. It can easily be achieved, if process participants with correlated initial phases are selected.

Let us remind you that the Newton and relativistic classical mechanics follow from the strict UQT, while the Newton movement equations with the resultant energy and impulse conservation laws follow from the oscillating charge equation with averaging by the particle ensemble composing a classical body (material point). But these conservation laws are nonexistent for individual microparticles in our theory, and they appear only in case of averaging by the ensemble of particles. Thus, if the energy-generating processes are accumulated, and the processes where energy disappears are suppressed, a classical *perpetual mobile* can be created.

But the UQT and the oscillating charge equation have other differences not only from the equations of classical mechanics, but also from some equations of electrostatics and electrodynamics.

There is a fundamental theorem of circulation for the electric field. Let us dwell on it in more detail. Let us have a vector field **E,** which can be an electrostatic or a gravitation field.

$$\mathbf{E} = \mathrm{P}(\mathrm{x},\mathrm{y},\mathrm{z})\mathbf{i} + \mathrm{Q}(\mathrm{x},\mathrm{y},\mathrm{z})\mathbf{j} + \mathrm{R}(\mathrm{x},\mathrm{y},\mathrm{z})\mathbf{k}$$

Line integral

$$\Gamma = \oint_l \left(\mathrm{P}\,dx + \mathrm{Q}\,dy + \mathrm{R}\,dz\right) = \oint_l \mathbf{E}\mathbf{dl} \qquad (15)$$

is called circulation of vector field **E** by contour *l*. Of course, circulation depends not only on **E**, but also on the passage direction accepted in contour *l*; by changing the passage direction we will change the circulation sign. Form (15) is convenient for mathematicians, but for our purposes we will present equation (15) in a different way. If both parts of equation (15) are multiplied by electric charge *q,* on the right we will get the integral of force $q\mathbf{E}$ by way **dl,** i.e. work for moving the charge along a closed loop contour. It is well known that this value is zero.

$$\int_l q\mathbf{E}\mathbf{dl} = \mathbf{0} \qquad (16)$$

If this value were not zero, an energy source could be created. For this purpose a charge should be moved in electric field **E** from point *a*, located in the high voltage area of the field, to point *b,* located in low voltage area of the field, and then back, but along another route. The values of work from $a \to b$ and from $b \to a$ would be different, and we could extract work from the field without making any changes in the system. When the charge is constant, it is certainly true, so for a macroscopic constant charge this theorem is an analog of the energy conservation law. The authors have not come across such an interpretation of the energy conservation law in other works. If the charge is microscopic, then in the UQT it changes, depends on time, coordinate and velocity, so work from $a \to b$ and from $b \to a$ will be different, in this case work can in principle be extracted from the field without any changes made in the system.

Discussion of Experimental Results

Let us now get down to explaining some very unusual experimental results, which the authors have nothing to do with, and which they sometimes regard rather skeptically. The point is that the sphere of new energy sources is the headache of all the human civilization, and in this sphere, like nowhere else, the dividends can be exorbitantly high, and for this reason there are in this sphere a lot of swindlers (even among the theoreticians) and simply erring people. The official science of the world does not so far believe in such research, but the most suspicious fact is the great multiplicity of such works. The authors are not inclined to regard all these people as swindlers or erring, because the UQT can offer a beautiful and simple interpretation of certain phenomena.

There are strange plants with the efficiency over 100%. They are even manufactured in small quantities and are rated among energy-saving devices already termed over unities. Japanese researchers take these problems very seriously, and the leading role in studying this problem belongs not to the USA, but to Japan, which even finances many US institutes in this framework. The total Japanese expenditures for this research exceed $200.000.000 a year. It can be forecast that with the Japanese mentality and the state policy of exporting not natural resources, but superhigh technologies and intellect, Japan will find itself among the leading countries early in the 21st century. We think that our readers will not be surprised to hear that Russia has

not allocated a single cent for this program, and all research was made on pure enthusiasm.

In the USA such works do not get official governmental support either (like, for example, the dying out hot nuclear fusion problem), but a great number of private firms and individual businessmen are conducting large-scale research. The following US journals are devoted to the subject: *Journal of New Energy, Infinite Energy, Cold Fusion, New Energy News, Fusion Facts*, and *NET-Journal* (Switzerland).

Switzerland, Italy, Germany, and France are also among the countries where the new energy problems are seriously researched from the cold nuclear fusion point of view.

A very young sphere of power engineering has emerged and is quickly developing, which researches many new energy sources. In future those new energy-saving sources will first be used, which will considerably differ from the existing ordinary energy transformers in that they will generate additional energy that can be used in the interests of the mankind. The development of civilization will then be limited not by long-expected reduction of natural fuel resources, but by heat pollution of the environment.

Let us enumerate just a few of the new energy directions:
1. The Patterson fuel cell (CETI).
2. Supermagnet-superengines of Takahashi, Aspden and Adams
3. Swiss plant Testatika.
4. Engines operating on water.
5. Hypersound Griggs pump, the Potapov and Schaffer heat generators.
6. Schoulder and Fox cluster systems.
7. N – machines of Farade, Bruce de Palma, Newman, Searl, Tewari, etc.
8. PAGD reactor of Canadian researchers P. Correa and A. Correa.

This list can be complemented with the surprising experimental results received by physicists A. Samgin and A. Baraboshkin (Russia, Institute of High-Temperature Electrochemistry under the Russian Academy of Sciences, Ekaterinburg) [24,25] and T.Mizuno [26] (Japan). They appear to have used, totally independently of each other, special proton-conducting ceramics, which, when electric current runs through them, generate a thousand times more heat energy than the electric energy consumed. In some experiments by T.Mizuno this value even exceeded 70000(!). T. Mizuno in a personal talk with one of the authors of this report said that he feared very much the radiation sickness. But no α, β, γ radiation or nuclear debris was found, and the nuclear processes are not responsible for such energy generation. Such proton-conducting (or, to be more exact, deuteron-conducting) ceramics was made using the power metallurgy methods by agglomeration under high temperatures. In other words, all the chemical processes in it had long been over. The origin of such an amount of excessive energy is absolutely incomprehensible in the framework of conventional science, for they cannot be accounted for either by nuclear or chemical reactions, or by phase passages. At first the authors of this experiment supposed nuclear fusion reactions of the D+D type. At our request, A. Samgin replaced heavy hydrogen (deuterium) during ceramics production with ordinary hydrogen. If the effect of such huge energy generation was connected with the nuclear D-D reactions, all the anomalous heat effects would have disappeared, but they persisted. After such a large quantity of energy was generated, the tablet disintegrated into powder.

These effects can easily be explained by UQT from the harmonic oscillator theory point of view. When the tablet is agglomerated, there remain in it some caverns of a size of hundreds Angstrom units. When direct or alternating current flows through it, the protons and deuterons in their movement (there are few electrons in such ceramics) get into these caverns, and a process can start which is described by the "maternity home" solution. A particle accumulating energy, oscillates in such a pit, and finally the energy will be sufficient both for heating and for destruction of the pit walls (tablet turning into powder). The same processes seem to be taking place in a palladium electrolytic cell with heavy water, and in a nickel electrolytic cell with ordinary water, which accounts for anomalously large heat generation, not related to nuclear processes.

It would be good to verify experimentally the dependence of the tunnel effect on the initial phase. But it seems us that it is more important for our opponents, since both cold nuclear fusion (CNF) and discovery of nuclear transmutations *(which, from the point of view of modern science, are even more absurd than the existence of CNF*) evidently cannot be accounted for in any other way. Besides, such a direct experiment is of a fundamental value. There are today a lot of people and groups in the world, who pin great hope on exploiting the nuclear transmutation phenomenon for the purposes of processing and recycling of nuclear wastes, and the question of industrial generation of tritium for military purposes using CNF methods was under consideration in Los-Alamos. Internet magazines are full of such information. We are not giving Internet addresses here, because everything is constantly changing in this live system.

Let us analyze some of the above-mentioned devices. The first, the oldest and the most mysterious information was information about internal combustion engines operating on water.

Let us give just one example. When we were students, one of our teachers, the late Professor G.V. Dudko (1959) told us that in 1951 he had participated in the testing of an internal combustion engine [39,55-57]. The device represented a hybrid of a diesel and an ordinary carburetor engine, where a gas of petrol was needed to start it and then ignition was switched off, and an

ordinary fuel pump sprayed into the cylinder warmed up and strongly compressed water with special additives (which the inventor himself put into the tank in small quantities, and which, as we now understand, represented the principal secret). The engine was installed on a boat. The researchers were riding for two days in the Azov Sea, and only water vapor was the engine exhaust. Professor Dudko himself drew the water fuel overboard and poured it into the tank. They needed much water, several buckets a day, but there was no shortage of it… The question of why, if everything was so great, these engines are still not in use, can occur only to a person who has never lived in Russia.

From the point of view of the solutions of the harmonic oscillator problem, the following theoretical possibility exists [40,44,47,55-57]: if water with the necessary additives (which, evidently, represent the secret of many invented engines operating on water) is compressed and sprayed into the cylinder, each drop of water, when it gets into the cylinder after being compressed, will start dilating and will pass by inertia the equilibrium position. As a result, caverns (empty volumes) can be formed in it, with a size of several dozen of Angstrom units. If a free proton (or some other microparticle) gets into such a cavern in the required phase (it is supposed that the task of the additive is exactly this), the "maternity home" solution will be realized and some of the drops will explode… Later we heard and read many times about various Russian inventors, who had successfully created and tested engines operating on ordinary water with some mysterious additives.

Of course, the possibility of catalytic water decomposition with small energy consumption before spraying into the cylinder is not at all excluded. There are films and information in Internet about testing of cars operating on water, which is catalytically (with small energy consumption) decomposed into oxygen and hydrogen. Such power engineering would be ecologically absolutely clean, and the only restriction would lie in heat pollution of the environment.

An ideal solution for the motor transport could also lie in use of some new types of electric energy generators. The UQT even admits of the possibility, which was long observed in the experiments of Nicolas Tesla and in those made by Canadian physicists the Correas, who even received a patent for a system generating energy from vacuum fluctuations (as they believe) [45]. The readers could have got acquainted with our detailed theory of these processes in [46]. But the ideal system for the automobile would certainly be Testatika.

Any imagination will be amazed at the thermal cell CETI created by James Patterson, USA [27], in which takes place the electrolysis of specially made nickel balls in ordinary water. The US paper «Fortean Times» [1] 85, 1995, wrote about it: "December 4, 1995 will go down into history. On this day a group of independent experts from 5 US universities was testing a new source of energy with a stable output heat power of 1.3 kWt. The consumed electrical energy was 960 times smaller". All experts note that the generated heat is of mysterious origin and cannot be explained by chemical or nuclear reactions, as well as by phase passages. The US ABC TV showed on February 7 and 8 1996 in the «Nightline» and «Good Morning America» cycles of programs about the development by Patterson of a new energy source generating hundreds of times more energy than it consumes. The mysterious nature of the generated heat was again underlined. It is interesting [34] that Motorola tried to buy the CETI patent from its authors for $20.000.000, but met with a refusal. We are sure that Motorola had invested a certain amount of money into the study of this problem before making such a serious offer. All that happens within the Patterson element has nothing to do with nuclear reactions (although Patterson told one of the authors that he was of a different view), and, in our opinion, can be accounted for by exactly the same processes as were described above for proton-conducting ceramics.

The sonoluminescence phenomenon, when certain liquids start shining if weak ultrasound is run through them, also looks very mysterious. No satisfactory explanation has so far been found for this experimentally proved phenomenon, discovered by Moscow University Professor S.N. Rzhevkin in 1933. As Nobel Prize winner Professor Yulian Schvinger said, "it has no right to exist, but it does exist" [38]. This phenomenon can also be explained from the above-mentioned positions.

There are also heat generators (Yu. Potapov [21-23], Moldavia, James J.Griggs [28], and Huffman [29], Schaffer - USA). In them many cavitating bubbles are formed during circulation of ordinary water, in which excessive energy is generated, with the output to input energy ratio approaching 1.7. In these experiments and plants no chemical or nuclear reactions can take place, and thousands of Potapov's heat generators have been manufactured for heating homes. In such devices (they are very different in appearance) a great number of cavitating bubbles are created in a flow of water. This is achieved either with the help of interrupting the water flow with a special rotor (J.Griggs, Huffman, Schaffer), or the water flow is twirled by a special helix and then enters the zone of sharp dilation, where cavitating bubbles are formed (Yu. Potapov). In general, it should be said that cavitation remains a great puzzle for theoretical hydrodynamics and science. For example, forged multi-ton screw propellers of big nuclear submarines under certain operation modes and geometry of the surrounding forms can be destroyed by cavitation within only a few hours. It happens because of huge energy generated in cavitating bubbles.

Under certain values of phase and energy, a particle in the pit, each time reflecting from the walls, will have a greater velocity than that of a falling particle (this is within the uncertainty relation), and after many reflections will accumulate a fairly big energy which will be generated in the form of heat or bremsstrahlung when the pit is destroyed, and, finally, the energy of the oscillations of such a particle accumulated in the

pit will always be transformed into heat in an ordinary solid body or a liquid. This physical idea immediately accounts for both sonoluminescence (although for sonoluminescence in general this mechanism is less primitive), and energy generation in proton-conducting ceramics, nickel during electrolysis in ordinary water (CETI element), and water bubbles of commercial heat generators. The theory predicts that the samples should be fissure due to increased pressure on the walls of the potential pit with the growth of energy, which fact also takes place, since both ceramic samples and nickel balls in the CETI element finally disintegrate. It is evidently for these reasons that any metal containing much hydrogen in its grid becomes fragile and is quickly destroyed, which fact is well known to engineers.

The small number of experiments does not so far allow for making concrete conclusions as to what particles generate energy in pits (microbubbles). Besides, for at least an electron to disappear a pit of about 0.5 MeV is required, while in a solid body the pits are about several eV deep, and what seems to happen is only loss of kinetic energy, and not disappearance of particles. The fact that this process requires very deep potential pits, which do not exist in a solid body, does not change the essence of the matter.

Of course, under ordinary conditions, both competing solutions usually take place at once: "maternity home" and "crematorium", which compensate for each other and the energy is preserved. For energy generation, the "maternity home" solution should prevail. Both these processes take place simultaneously and compete with each other, but, formally, they are not connected in space and time. The complexity of the energy generation problem lies in suppressing the "crematorium" solution by a careful selection of different parameters and promoting the "maternity home" solutions. So far we cannot say for sure what the optimum dimensions of such cavitating bubbles are, or which object oscillates in them, because for this purpose special experiments are needed, which so far have not been staged.

Of course, the inexorable Robber in the form of the Carnot principle stands in the way of transformation of the heat generated in a heat generator or ceramics into electrical or mechanic energy. In accordance with this principle, all mechanic or electrical energy can be transformed into heat, but the reverse process is always connected with big losses.

If there are experiments and plants in which energy generation contradicting the conventional conservation laws is discovered, there should also exist opposite ones, where energy disappears completely, i.e. the "crematorium" solution prevails. It proved to be true. There are such modes during electrolysis in electrolytic baths, under which the temperature of the solution in the bath is strongly reduced for unaccountable reasons, and this fact has no explanation at all. This phenomenon long ago was noted by attentive industrial engineers, and it is called the "bath-freezing" mode [49,50]. Chinese physicist Swe-Kai Chen from Taiwan in his experiments [48] stably observed the same phenomena. It is quite easily explained: a particle with a velocity exceeding the most probable velocity in this distribution gets into caverns on electrodes and after some oscillations reduces its velocity, which becomes smaller than the most probable one, and then the particle leaves the cavern at a small speed, and the same process can happen to another energetic particle. This leads to the cooling of the cell in the case of such mass processes.

The problem of ferromagnet magnetization (the Easing model) can also be reduced to the orientation of a magnetic doublet by the external magnetic field, and then it is essentially the harmonic oscillator equation with a slightly different return force ($F = \frac{\mu}{r^3}$) and all the conclusions made earlier remain in effect. That is why magnetization should also produce energy generation effects. This proved to be true. For the general public everything began on May 17, 1996, when Frode Olsen from the research group "Free Energy" showed on the Norwegian TV (TV2) a surprising film about a "dynamic sculpture" made by artist and sculptor Reidar Finsrud from Skaarer, Norway. The author of this "dynamic sculpture" *had no idea about physics* and had been making it for 12 years. Einstein's idea of how discoveries are made conveniently comes to mind at this point: everyone knows that a certain thing cannot be done, but there is a man who does not know it, and it is he who makes the discovery.

This "dynamic sculpture" accompanied by an "explaining" poster «*perpetual mobile*» represents an iron well-polished ball with a diameter of 2.7 inches weighing about 2 pounds. The ball is rolling along a circle on close guides resembling two parallel skids with a diameter of 25 inches past the poles of three permanent magnets, where it is magnetized. In the area of three permanent magnets three more mobile magnets are installed on special mobile 5-inch long levers, and these magnets, when the ball passes them, are slightly inclined (due to the ball gravitation) and, after the ball passes them, are raised by the holding springs (sway like yokes). The ball makes a complete turn in 3 seconds. All this magic (***they say the ball had been rolling along the close contour for more than a year***) does not have any sources of energy and is installed for everyone to see in a Norwegian picture gallery on a special stand covered with a glass cover. The authors only saw a good TV film about this installation and were mostly surprised at the fact that the ball had not stopped during uninterrupted shooting (about 20 minutes).

We are well acquainted with circus tricks, but it is absolutely incomprehensible how such a trick could be staged using some secret methods. It is clearly seen that the ball in its movement always partially transfers its energy to the three long swaying pendulums, but there is no way to use them for pushing the ball and making up for friction, this being the only trick that could, in our view, be applied here. All the rest is clearly visible and contains nothing suspicious.

Let us estimate the generated energy. At an initial speed of about 1m/s the ball stops after 30 seconds, if all the magnets are removed. It means that the energy consumed in 30 seconds is about 0.5 joules, or 1/60 Watt. The total energy generated in a month is 43,200 joules, and this is huge energy, much greater than that of a good shell!

It is clear (if the word is relevant here at all) that when the ball is approaching the permanent magnet and the process of magnetization is going on, it is accelerated, but when it mechanically gets past the equilibrium position and, moving away from the magnets, becomes demagnetized, the gravitation (which now starts slowing the ball down) will be slightly less than it was at the moment of the ball's acceleration. This small difference in forces provides for small positive work to overcome friction. Energy generation and similar things during magnetization had been *predicted* by one of the authors in magazines *Infinite Energy* vol.1, No.2, p.38, (1995); *Proceedings of the ICCF*5, p.361, April 9-13, (1995), Monte-Carlo; *Cold Fusion*, No 11, p.10, (1995); *Chinese Journal of Nuclear Physics* (vol. 19, ¹2, 1997). The quantum-mechanic processes are very complicated, but some of them can be understood.

All keen physicists were quick to understand it, and J. Naudin in France made a similar, but much simpler experiment. A ball of a soft magnetic material is swaying along parallel U-formed skids in a system of four magnets. Near the bottom of the U-form there is a small smooth step. It may have been made to make the magnetization and demagnetization processes different in time, which is very important. If there are no magnets, nothing interesting happens and oscillations are quickly (in a few seconds) damped. If the magnets are present, oscillations go on up to 3 hours 27 minutes. It appears that in this case the author failed to find good material and parameters of the plant, so friction was not compensated completely. In all these experiments demagnetization of permanent magnets does not happen, because the experiment is repeated many times with the same results.

And now a few vague words about demagnetization processes. During magnetization of the ball, the magnetic moments of its atoms are oriented (like the hands of a compass) along the field lines. When the ball leaves the magnetic field area, the atom magnetic moments are disoriented under the influence of the heat motion, and it becomes demagnetized. In the unitary quantum theory the share of the oriented magnetic moments in the external field can be bigger than in the conventional quantum mechanics (the "maternity home" solution), and the ball gravitation can be stronger due to it. Disorientation of these moments happens similarly in both theories. It seems to be for this reason and due to the difference in magnetization and demagnetization time that a difference in magnetic forces occurs when the ball approaches the magnet or moves off from it.

The scientists of the older generation will remember that a similar toy was shown in the 30's to David Gilbert, who said it was the most interesting thing he had ever seen. A question arises as to why it has not yet been realized. We do not know a physical-mathematical answer to this question, and it is not our task to analyze the social reasons of this phenomenon. Japan has a different mentality, and there is a governmental program for generating energy from permanent magnets. Takahashi [51] even seems to have made an electric engine with an efficiency of up to 318%!

Still more mysterious is the long-known problem of energy shortage in many biochemical reactions with ferments (enzymes). For example, in the well-studied reaction of disintegration of polysaccharides in the presence of lysozyme the following happens: a polysaccharide molecule gets into a special cavern in a big lysozyme molecule, and some time later its debris are thrown out of it (Fig. 6). The broken binding energy of the polysaccharide is about 3 eV, while the energy of the heat movement is only 0.024 eV. From the standard science point of view, it is absolutely unclear where lysozyme takes the energy to break the polysaccharide. No satisfactory mechanism for explanation of such reactions (and they are very numerous) was found, and all this was "swept under the carpet", as physicists say. The UQT provides for a completely new look at the catalytic processes, which has an incomprehensible source of energy reducing the molecule activation energy. From our point of view, this process is a variant of the "maternity home" solution for oscillator.

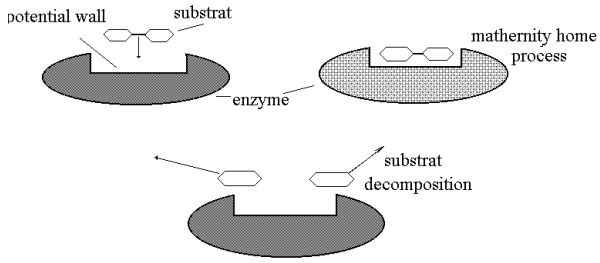

Fig.6. Break of polysaccharide molecule by lysozyme.

The most surprising thing is that in all the cases generation of excessive energy cannot be accounted for by chemical reactions or phase passages. If nuclear reactions do sometimes happen (which should not be according to modern science), they can account for only a hundredth or a thousandth share of the generated heat energy. There is no doubt that all these are effects of new physics, for in the framework of the old physics all this is simply unexplainable.

But the existence of a plant that produces *out of nothing* about 10 kilowatt of direct current electric energy with a voltage of 300 V seems nearly impossible. The story was described by one of the authors in three different magazines, and we will just give a brief resume [52-54].

In summer 1999, at the invitation of Swiss physicists (Director of the Institute of New Energy Sources in Egerkinhen Adolph Schneider), one of the authors

visited several research organizations. It is interesting that there is such an institute in small Switzerland, and there is none in big Russia. The purpose of the invitation was very simple: to explain the operation of a plant generating energy out of nothing, i.e. a *perpetual mobile*. In Switzerland such plants are called Testatik Machine M/L Converter from religious group «Methernitha» (Address: Methernitha, CH-3517 Linden, Switzerland, phone: ++41 31 97 11 24).

Such machines exist today in the Swiss town of Linden near Bern. Part of the town belongs to the Religious Christian Community, which is fenced and heavily guarded. There are about 250 members of the Community, many of them are physicists, graduates of the universities of Geneva, Lozanne, Bern. It is not only a research laboratory, they have their own TV center, a film studio, a small furniture plant, shops, garages, residential blocks, and support services. You will probably have guessed that this community does not consume any energy, and this is the most accurate fact in the whole story, for the inquisitive journalists have found out that no money from them comes to the accounts of the local power station, which provides power for all the town. In a cellar of one of the houses they have a power station that produces energy… out of nothing. The author of this inexhaustible source of free direct current energy is Swiss physicist Paul Baumann. Let us briefly describe these fantastic plants: they are of four types (sizes) with capacities of 0.1, 0.3, 3 and 10 kWt. Externally, the plant resembles very much the standard electrostatic machine with Leyden jars often used in physical demonstrations. There are two acryl disks with 36 pasted narrow sectors of thin aluminum, which rotate in different directions. In the first samples ordinary gramophone records were used for disks. The machine is started by pushing the disks in different directions by fingers. The rotation speed is 50-70 turns per minute. After the start disks rotate independently and can be easily stopped by hand, the direct current voltage is about 300-350 V, and the current is up to 30A. The mechanical energy used for rotation (only 100 mWt, according to measurements made by Austrian Professor S. Marinov) is hundreds of thousand times smaller than the generated electrical energy. The biggest plant for 10 kWt has plastic disks with a diameter of over 2 m, the smallest one – 20 cm, the weight of the plants is small enough, the 3-kWt machine weighing about 20 kg.

The charge separation process (which consumes energy!) practically does not slow down the disks. Connection of a load in the form of a 200-Wt bulb does not change the rotation speed either. No cooling or heating of the air or machine parts during long operation takes place, only a slight smell of ozone is felt. The system is noiseless, compact, environment-friendly, and can be installed anywhere.

The Community management thinks, and quite rightly, that wide spread of such systems in the world will lead to a heat explosion, because all the energy generated by the mankind finally finds itself in an energy dump (is transformed into heat), and all this can finally lead to overheating of the environment. They absolutely do not believe (and not without grounds) in the capability of the mankind as a whole to negotiate reasonable use of this invention, and they think that the harm caused by it will be greater than from nuclear, bacteriological, or conventional weapons. Their main idea for the mankind is to live in balance with the environment and to make full use of the energy of the wind, the sun, the water, etc. For this reason the Community is heavily guarded, and they are not going to donate their main discovery to the mankind.

Professor Stephan Marinov visited the Community twice (in July 1988 and in February-March 1989). He was even given such a plant with a capacity of 100 Wt (300 V, 0.3A), which he studied in his laboratory. As far as we now know, even the inventor of this machine does not fully understand its operation principle, so he contacted Marinov out of sheer curiosity of a scientist.

In 1989 Professor Marinov published a book "Thorny Path to Truth – Documents of Violation of Conservation Laws" in International Publishers East-West. The book contains a lot of photos, a measurement report, and a description of the plant. He also organized a research group called "Free Energy" within the Community (Methernitha Group Stephan Marinov Free Energy).

There are very interesting words in this book: "I can state without any doubts that this machine is a classical *perpetual mobile* in its pure form. After the initial push, it goes on rotatingby itself for an indefinitely long time, constantly producing electrical energy in the amount of 100 Watt… It is still unclear, however, how it all can happen…". As far as we know, nobody has managed to build a similar plant elsewhere.

We have an approximate idea of how the plant operates. The idea is as simple and ingenious as that of the wheel, which is absent from the surrounding nature, so the inventor could not borrow the idea. We will just show that the existence of such a plant is in full conformity with the UQT. It is natural that the plant operates on the basis of the charge separation principle. Let us have two metal spherical surfaces with a hole, isolated from the earth and from each other. If, with the help of an insulated stick, we transfer the first electron from Ball A to the internal surface of Ball B through the hole, a difference of potentials will occur, and if we transfer the second and the subsequent electrons, Ball A will attract the transferred charge, while Ball B will repulse it, and energy will have to be spent during the transfer of charges (Fig. 7).

Let us remind you that under the existing circulation theorem (16), the charge transfer work will consume the same amount of energy as will later be generated during the passage of electric current resulting from charge separation. But in the UQT the circulation theorem (16) for *an individual elementary charge* is not valid. Thus, we can select the time and route, along which the charge will be transferred in such a way, that

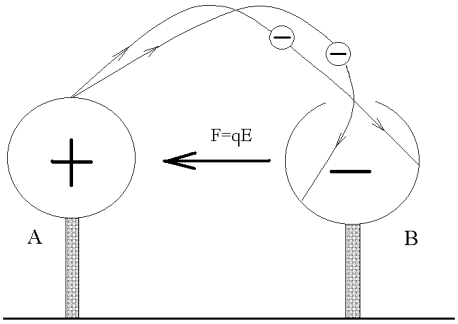

Fig.7. Work for moving the charge depends on method of movement and route.

the charge value during the transfer will be close to zero, and, consequently, the electrostatic force and the charge transfer and separation work will be close to zero too. For example, instead of selecting the route you can wait for the charge to be reduced to zero and then transfer it quickly, and when the charge increases, immediately stop the transfer and fix the charge. Or you can duly select the route and velocity. There are many options. This was evidently realized by Paul Baumann, who is *so far* practically unknown to the official science, and who can find consolation in the idea that the inventor of the wheel will never be known at all. The problem of simple arrangement of all this is just a matter of technique.

You cannot help, thinking that all these might be just tricks. The history of *perpetual mobile* abounds in evidence of downright swindling and frauds, and not a single positive result before, and who can guarantee that the information given above will not prove to be another swindle?

First of all, if all the people always piously believe in the unquestionable stability of the energy conservation law, there will never be any progress in this sphere, and it is then unexplainable how man got down from the palm at all. Secondly, to justify the proposed rebellious position, the following idea comes in mind: if 30 years ago somebody had told the authors (who were then already professors) that at the beginning of the next millennium they would deal in such research, it would have seemed not only a silly joke, but an absolutely impossible thing as well. But, as Voltaire said, "He is silly who does not change".

In conclusion we wish to express with certainty that the time of theoretical recognition and of practical universal using of overunity devices will come soon and become the epoch of new energetics. The people of our planet will regret that so much oil, coal and gas was burned causing terrible ecological losses.

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KOZYREV-DIRAC EMANATION.

INTERACTION WITH MATTER and METHODS OF DETECTING

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In this paper the authors show the possibility of creation of a new kind of emanation. The magnetic monopole beam can be made in space as a result of focusing of some natural substance. Special devices based on the Moebius band elements make the given focusing. This emanation is able to magnetize graphite and organics, decrease the radioactivity, and influence the oncology diseases .The time reverse technology is realized in such devices.

Experimental data, which allow making a conclusion about existence of previously unknown emanation, are presented in this report. Here are descriptions of experiments and methods of measurement. The effects of interaction between new type of emanation and matter have been obtained.

Till the present moment theoretical physics didn't pay attention to the nonoriented configurations and spaces. The reason of this situation is the fact, that from the philosophic point of view it is not possible to determine and locate the area of the nonoriented topological structures in our world. We (eight scientific teams) joined our forces and we needed more than 30 years to solve this problem by an experimental approach.

The fundamental tenet of the casual mechanics developed by Kozyrev can be formulated as follows. There are two types of energy in the Universe. The positive or «right» energy acts as a factor of the entropy increase. The negative, or «left» energy tends to decrease the entropy, i.e. it acts as a factor, which regulates the entropy increase. The «right» energy is transformed to the «left» one and this fact may be interpreted as a course of time from the past to the future. When the energy is transformed from the «left» to the «right» form, time is reversed. Kozyrev supposed [1] that through revolving of a body together with a

6. Activation by nuclear magnetic resonance;
7. Activation by electronic paramagnetic resonance;
8. Activation by electrochemical force.

All these methods can be used as possible way to high efficient energy systems. Gerlovin wrote: "Usually 1, 6 and 7-th methods of structural activation are realized in catalysis simultaneously. Besides, catalysis differs from macroscopic methods because it has the most minimal distances from the sources of activator fields to the activated molecules. And finally, an active participation of force fields created by nuclei of atoms and significantly more active participation of disturbed EPV is possible in catalysis. That's why catalysis is the most effective method of structural activation. The detailed account of this method exceeds the limits of this article and we can only annotate it." [1, p.333]

Information stated above is only a small part of the questions appeared under consideration in Gerlovin's theory of fundamental field (TFF). Other important questions should be considered with a new experimental data.

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Antigravitation Force and Antigravitation of Matter. Methods of its Creation

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Part I

For a long time there is an opinion in physics about antimatter as a possible source of antigravitation, but the researches on this subject came into a dead end. The existent presentations and formulas forbade the conclusion about antigravitation, but our conducted investigations brought us to the possibility to get antigravitation of substance and to the paradoxical conclusions concerning the next:

1. Two types of space exist:
   a) The Absolute space
   b) The Relative space

2.a The Gravitation Field is the relative space, which has accelerated motion, directed to the center of a planet.

2.b The Antigravitation Field is the relative space, which has accelerated motion, directed from the center of a planet.

3. Gravity force does not depend on mass of a body! The mass can be presented in three versions:

a) m_k –mass as amount of atoms.

b) $W_{m_A^e}$ - electronic-atomic energy in mass.

c) $W_{m_G^m}$ – mechano-gravitational energy in mass.

On the basis of the stated notions we offer to revise the essence of force not only in Coulomb's formula, but in Newton's formula too.

$$F = K\frac{q_1 \cdot q_2}{R^2} \qquad F = P\frac{m_1 \cdot m_2}{R^2}$$

It is well known, that mechanical energy can be bringing in electrostatic charge, where mechanical energy runs (turns) into energy of electric field, where

(mechanical energy) $F \cdot R \rightarrow \frac{E_2 \cdot V_{m^3}}{2}$ (electrical energy)

Similarly it is also possible to insert mechanical energy into mass of a body. As the result, the mechanical energy will turn into energy of gravitational field, where

(mechanical energy) $V \cdot F \cdot t \rightarrow \frac{g^2 \cdot V_{m^3}}{2}$ (gravitational energy)

Since the volume of the Earth is constant, the acceleration of gravitational field will be increased.

It should be logical to expect, that when removing the mechanical energy from mass the inverse process will occur, that is to say acceleration reduction of gravitation field will occur.

In his works I. Newton affirmed about existence of two spaces:

The Absolute space - is an immovable non-rotatable space, which represents a limited cube, with our planet in the center.

The Relative space – is a movable space. It can move with acceleration in the absolute space.

Editor's note: In aether conception this means two parts of aether: some part is involved into the motion with the mass, but another part of aether is immovable.

The main mistake in search of aether consisted in the following: Maikelson's experiments were aimed on

search of relative velocity between bodies and space. However, it was the **relative acceleration** between bodies and space that was necessary to search for.

To quote the conclusions of I. Newton: "Body can keep the quiescent mode or mode of rectilinear uniform motion …" By this, he postulates, that the relative linear velocity between solids and space does not exist. But we know that for rotation it exists (the famous experiments with revolving pail of water).

The gravitational field is the accelerated "falling" relative space, which represents a spherical form. If relative space moves, thus the question appears: where does it move? There is only answer: it moves in the absolute cubic space.

In Einstein's theory there is notion of unified and curved space in gravitational field, but the contradictions appear here, and on concerning that N. Tesla writes: "Only by presence of force field it is possible to explain the observed motion of celestial bodies, but thus the hypothesis of curvature of space is not necessary. The whole scientific literature on this subject is futile and doomed on oblivion". [1]

The fact that gravitation is the accelerated moving relative space can be proved by observation of accelerated moving rocket, where the acceleration in rocket is equivalent to the acceleration in gravitational field. Accelerated movement of rocket is relatively, that allows speaking about either acceleration of rocket motion in immovable space, or accelerated motion of space in immovable rocket!

The anti-gravitational field is the relative space, which has accelerated motion from the center of a body (for example: rotating cylinder, Earth satellite and etc.) But it is possible to create the model of anti-gravitation without rotations. On the basis of analogy between mechanical and electric energy comes to conclusion that gravity between bodies does not depend on mass of the body, but on mechanical-gravitation energy, contained in this mass, which is possible to contribute or to extract from. **Therefore, this is the internal gravitation energy.**

Part II

The "Mass" can be considered as a measure of three different conditions of matter:

m_k - as a measure of amount of atoms, representing a "framework" or "container", in which two types of independent energies are concentrated.

$W_{m_A^e}$ - as a measure of electric energy, which can be either accumulated or extracted, and it have a "compressed" form.

An example of accumulation of electric energy in mass is a big cylinder, rotating with linear velocity, close to velocity of light, in this cylinder the mass of electric and magnetic fields of atoms increases. There are another possible ways to contribute and to extract the said energy from mass.

And finally $W_m M_G$ is the mass, which can be a measure of mechanical energy, or it can be either inserted or extracted from the matter (it can be identified as the gravitational mass). This gravitational mass is what we put our attention on, because it affects upon gravitation and it is able to create antigravitation.

"In his time N. Tesla worked on more general problem, which is the problem of matter and energy. And he has found, as he believed, the new physical principle, on the ground of which he brought forth his gravitational theory that was named dynamic gravitation. But he did not tell about it until almost the end of his life". [2] **Really, dynamic gravitation is the energy of motion.**

Let's take the following indications:

V – mechanical velocity
F – force
t – time.
In this case the product $W = V \cdot F \cdot t$ has the dimension of energy. Hereinafter, let's take

I – strength of electric current
U – difference of potentials
t – time.

Then $W' = I \cdot U \cdot T$ has the dimensional of energy. Thereby, *W* ~ *W'* that is to say, the following products are accepted as equivalent:

1. $V \cdot F \cdot t \sim I \cdot U \cdot T$

2. In previous materials it was reported about untraditional way for accumulation of energy, under the condition, in which at constant current I the product $q = U \cdot t$ will depend on amount of inserted energy in unchangeable circuit L = const, in which the energy can be accumulated by untraditional way not only in electric capacity, but also in inductance.

Similarly the energy can be accumulated by untraditional way in a moving body, under the condition V=const and m_k=const (the product $qr = F \cdot t$ will depend on inserted energy and have unlimited value). **Exactly this charge will create the powerful gravitational fields.**

3. Let's take: F is mechanical force, R is distance. Then the product $F \cdot R$ has the dimensionality of energy. For the uniform electric field the product $E_a \cdot \frac{E^2 \cdot V}{2}$ also has the dimensionality of energy. In this case E_a is constant, E is intensity of electric field, V is volume. Thereby, $F \cdot R \sim E^2 \cdot V$. Similarly, $V \cdot R \cdot t \sim g^2 \cdot V$

We have received the correlations of resemblance for heterogeneous physical values, on the ground of which the following physical experiments can be offered:

On the grounds of the above-mentioned analogies it can be assumed that the accumulation of "compressed" energy is possible in mechanics, as well as in electricity. Since the velocity is relative, that the mass can have zero velocity relatively a observer, who moves with this mass, but the force field will remain unchangeable, since it depends on already invected mechanical energy.

Let's note that:
When the "compressed" electric energy is accumulated, the power field does not change.

When the "compressed" mechanic energy is accumulated, the power field increases.

Now we have come to the amazing conclusion that the gravitational force does not depend on mass of matter, but it depends on mechanic energy, which is included in this mass. This energy is unstable and at contact with land it is disappearing, and at zero gravity it can be saved for a long time.

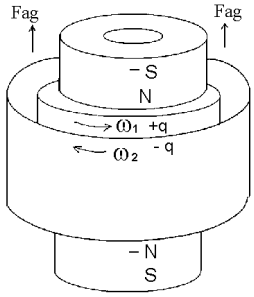

Fig. 1 The first way to obtain the antigravitational force.

1. The magnets are not revolved.
2. The cylinders of charged capacitor are revolving in different directions.

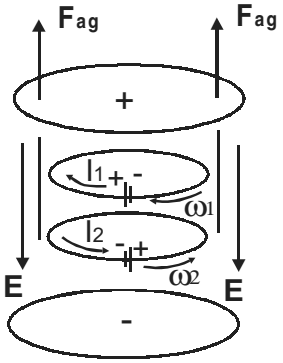

Fig. 2 The second way to obtain the antigravitational force.

1. The capacitor plates are charged and not revolving.
2. The current circuits are revolving in different directions.

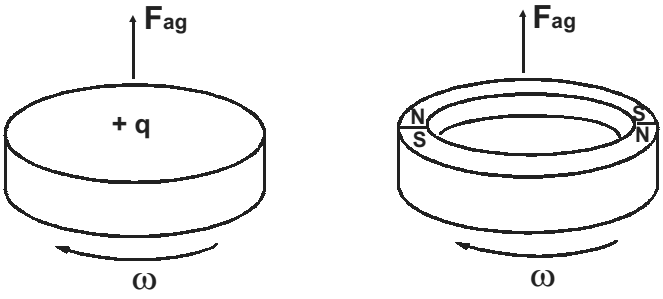

Fig. 3. The third way to obtain the antigravitational force

a) electric
b) magnetic

1. The disk and the ring are made from electrical current conductive material.

2. When these disks rotate, the currents, which emit the mechanic-antigravitational energy in the manner of heat, are formed there.

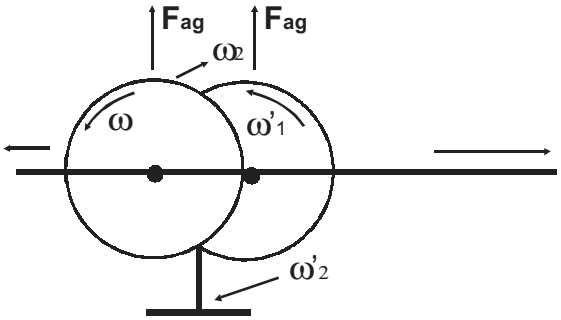

Fig. 4. The fourth way to obtain the antigravitational force. Mechanical method.

1. This is an extraction of energy from matter. It was reported in details on the 10 international symposium in Volgo-Donsk, Russia.

2. The difference with electric circuits is that it is possible not only to extract the mechanical energy, but also to insert additional energy in the system.

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2. Magazine Inventor and Rationalizator, Russia, #9, 1979, p.28

The Capacitor, which has the Energy of an Atomic Bomb

(Review of Anatoly K. Gaponov's research by Eugenie and Marina Golomolzins)

Is it possible to place a pail of water into a one-liter jar? At the first look the answer is obvious: certainly not! However, the inventor from Novosibirsk, Anatoly Gaponov thinks differently. He does not "press" water, but electrical energy, placing an energy equivalent of atomic bomb into ordinary electrical capacitor.

Everybody using ordinary batteries knows its defect: they need frequent recharging. Gaponov's capacitor is slightly smaller than a matchbox. Just come home by electrical automobile, take out the capacitor from engine, and then put it into the pocket. For home needs you can just insert the capacitor into plughole to power the light, boiler, and TV system. In general, each electronic device can have its own capacitor, then an electrical wiring is not necessary. After one

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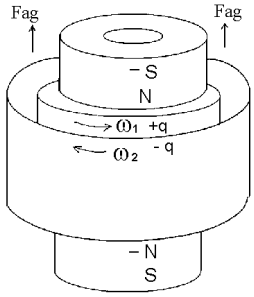

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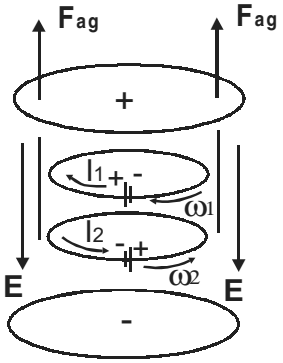

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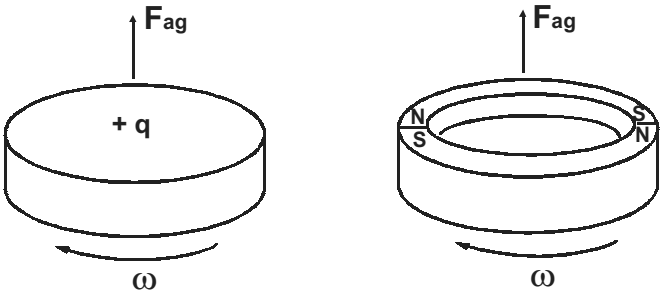

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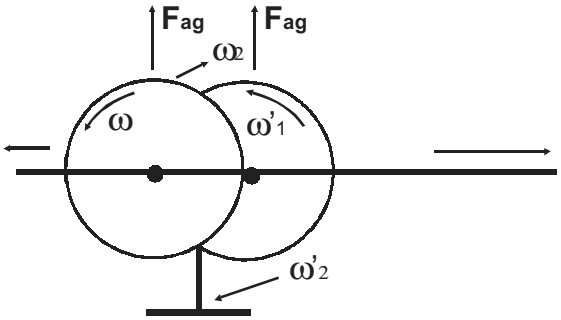

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or two years you will just have to come into electric service station and charge your magic capacitor like a gas balloon. Meantime, this research work began from hypnosis.

Anatoly Konstantinovich Gaponov (by birth from Kaluzhskaya region) is Ziolkovsky' countryman. In his youth Gaponov was brought by fate into Sakhalin, where he showed hypnotic abilities. As an inquisitive person Gaponov had organized a research group, started experiments and soon he understood that human brain had incredible possibilities.

A mental prick was made distantly to the hypnotized man, and he uttered a cry of pain. The ability to see people through, to define and to avoid organism's faults, was revealed in a hypnotic trance. It was possible to inspire pleasant emotions, to force "watching" a film on the given subject, as if on the screen. An uneducated person became an erudite, as if being connected to a certain global information database. Thus an idea to make an amazing experiment was appeared.

In one of the experiments Gaponov hypnotized the person with four classes education, and asked, if it was possible to transmit the electric current without wires? The hypnotized person gave the answer, that it was possible. For that it is required to convert the electric energy in x-ray radiation. And what afterwards? Afterwards it is required to focus that rays. By what? By the lens made from quartz glass, gold coated. It was a miracle! The person told about things that in usual condition he had no idea of! The information was received from somewhere outside.

Further quite an amazing thing has occurred. Gaponov asked the hypnotized person, if it was possible to intensify the abilities of hypnotist's brain?

He answered, that he could. "He turned me round and stared at the back of my head, - recalls Anatoly. - And suddenly the smile began to tear my mouth. I could not do anything with myself. When my mouth was sprawled literally from ear to ear, the hypnotized person in some inhuman voice declared that experience could not be continue since the cerebral hemorrhage would occur. I was hardly able to give the order to stop the experiment".

Thereby, the experiments with hypnosis gave the beginning to the thirty-years period of inventions in the field of accumulation and transmission of energy. After the return to native Kaluzhskaya region, Gaponov was occupied with physics, development of logical thinking and became the town champion in chess.

The necessary books fell into his hands by themselves: some time a certain acquaintance gave it to read; another time he found the last copy in a bookstore. As a majority of self-taught inventors, Anatoly preferred practical experimentation. In quest of laboratory for realization of his own ideas, he moved to Novosibirsk. **As a result, in 1980 Gaponov has made experimental system for compression of energy.**

From the school Physics we have known the notion of "electric arc" – it is a small blue lightning between two electrodes. Gaponov has tamed this lightning in such a way, that having drawn apart two wires, which executed the role of electrodes, by hands and got the arc by length up to half meter. Anatoly confirms that in principle, it is possible to create an arc of any desired length under any amperage.

One of the experiments found out one more enigmatic characteristic of electric discharge. During electric photography of arc a person happened to be between the camera and the system. On typing pictures, the researchers have found with surprise, that the electric arc was perfectly seen through the person. That is to say, it created the invisible field, for which material object was not an screening obstacle, and which was fixed on the film.

The further experiments with electric arc have allowed to get a new source of energy, as well as to open the possibility of setting light and sound on fire! Just imagine, you ring up a bell, it's sound waves spread at once in all directions, and then flash up with bright blaze.

(Editor's note: this experimental facts are rare modern evidences of possibility to create longitudinal electric waves. It is clear analogy here with sound waves in air since they are longitudinal waves also. Alexander V. Frolov)

When the problem of energy source was solved, Gaponov turned to the problem of energy accumulation. According to Gaponov, he has provedexperimentally the possibility of charging of an ordinary capacitor with any amount of energy. This statement sounds paradoxically: how it is possible to place the unlimited amount of contents in limited volume? However, this is not a simple way.

Gaponov believes that energy "placing" occurs not in space, but in time by means of his system! In what way? Imagine, that you fill one-liter jar with water. But already after an instant the water-filled jar is in past, and that present one is once again ready to be filled. And so ad infinitum. Water as if it fills a certain "time reservoir", and a jar is just a neck of this "time reservoir".

(Editor's note: This method is described in other articles also but usually it is pure mathematical discussion about Minkovsky space-time and theoretical proposals. Gaponov's experiments are realization of fantastical idea to take power from the time flow, i.e. from Past or from Future to get over-unity in Present space. Alexander V. Frolov)

"It is possible to demonstrate one more example, - Anatoly Gaponov adds. – Let's charge the capacitor with the expectation, that it will supply the light bulb

for one second. Thereby, on the Earth this light bulb will be on only for an instant. But if the same capacitor with light bulb is placed in rocket and dispersed around the Earth at the velocity, closed to velocity of light, time on the board of rocket will be so slowed that the light bulb on rocket will be glowing infinitely long for an observer from the Earth. It means, that in any case it is the same energy quantity, but in one case it's action is sprawling for a second, and in another one it is sprawling for eternity! It is possible to say, that in my system I have created the condition corresponding to this hypothetic rocket".

The system for accumulation of electric energy could be charged by ordinary wall plug 220 VAC. Time period of charging is different and depends on the certain scheme of the system. By the way, sea electric slopes are the certain natural analogues of such capacitor. Some elements of internal device of these sea creations reminds the "pump" elements for placing of electric energy into "temporal jar".

Finally, the third Gaponov's invention is the system for transmitting of energy without wires. As well as in two previous cases, there is an experimental device. Anatoly Gaponov speaks that he has succeeded in getting the essence of experiments for transmitting of energy, which were conducted by Tesla.

It is clear, that the main advantage of this method is an absence of wires and losses of electric energy. The electricity could be transmitted directly into any point, where receiving equipment placed, let say from Kaluga to Sahara. However, this is not so interesting for anybody, since for the present day Anatoly Gaponov's inventions don't have demand.

" The first system was created twenty years ago", - says Mr. Gaponov. – "Now I am fifty five, but things have not budged an inch". He adds dreamily: "Eh, if only I had a laboratory and some money...".

Gritskevitch's Hydro-Magnetic Dynamo

Oleg V. Gritskevitch

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Editorial: The article presents construction and operation of Oleg V. Gritskevitch's hydro-magnetic dynamo, which is an example of very powerful new energy system. The prototype in Armenia has been produced over 1500 KWtts power during several years.

The author was born on 14 August 1936 and grew up in Vladivostok, Russia. He is married and has a son Boris. Gritskevitch is a physicist by education. He worked in the Far - East branch of the USSR Academy of Sciences. Since 1985 he has been working independently as an inventor. He has more than 70 patents on inventions ranging from household engineering up to high technologies, which he has been trying to apply in our country and met big difficulties. After numerous attempts to receive the patents the author was convinced that outflow of the information occurred. Therefore he has received the state certificates as on know-how (on a French way of patenting), for all his inventions.

Introduction

During the Institute for New Energy 1999 Symposium, I lectured on my hydro-magnetic dynamo. This paper is my attempt to explain the construction and operation of my dynamo.

To fool investigators of my secrets, I have an occasion provided misleading information. For example, the drawing accompanying the Russian patent referenced below shows a cylinder across the toroid to fool readers. The real dynamo only has the toroid without the cylinder. Even its name "hydro-magnetic dynamo" is somewhat deliberately misleading.

I have some familiarity with the new energy field. Nearly all purported new energy devices are fairly small electrical generators. The dynamo may be the only new electrical generator which most nearly meets all the requirements of an ideal large-scaled electrical generator. My dynamo really is the single most valuable invention the world has ever known.

Alexander V. Frolov of St. Petersburg recommended me to contact with Dr. Patrick Bailey, Institute for New Energy since Pat has lots of contacts who could possibly help me with patenting my invention of a new source of energy in USA.

I conducted the work on the theory and creation of the electrostatic generator-converter «Hydro-magnetic dynamo» about 20 years. (See dynamo history below.) The first primitive equipment was created when I worked in Academy of Sciences. During that time various changes were introduced in the generator and in the theory of its work. It is now possible to manufacture, install, and apply it in industry.

For the first time I made the public report on this work in 1991 on a symposium in Volgodonsk city. The report received the positive replies and reviews of the experts of a nuclear industry in USSR. The same year I was accepted in International Nuclear Society. In these years I offered development of this technology to different state bodies and private enterprises. But there was the only answer: "It is very interesting and perspective project, but there is no money for it".

NEW ENERGY TECHNOLOGIES #7

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New Energy Technologies

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Patented by Research Institute of Space Systems named by Krunichev, Russia

Also in this issue:

* New gravidynamic paradox
* Experiments on weight reduction
* New possibilities of vortex energetics
* Experiments on homopolar motor
* Physical relationships of time

Gravitonics is Electronics of the XXI Century

Hypothesizes, Conclusions, Speculations

Spartak M. Poliakov,
Oleg S. Poliakov

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Today we can easily insist that ways to solve main gravitonics problems are already defined, at that the practical realization of any of them will mean the break through in engineering. So, what successes has the Russian science already achieved in the area of gravitonics, and what priorities can we lose here in the nearest future?

Introduction to Gravitonics

The electronics of the "past century" uses electron as a ball, which has weight, radius, electric charge and magnetic moment. These very parameters define electron behavior in the electrostatic, magnetostatic and electromagnetic fields. But electron abilities are not limited by it; electron spin and internal microstructure features remain unaccounted and unclaimed. Evenly speaking, General Theory of Relativity (GTR) of Einstein was a power impulse for mathematical physics development and gave birth to many productive ideas. But the main problem, that is the secret of gravitation, remains undisclosed… In works of K.P. Stanjukovich [1] and A.Z. Petrov [2], who carefully followed GTR, it was shown that this theory described neither energy, nor impulse of gravitational radiation, i.e. it can not explain gravitation. About 20 years ago V.B. Braginsky, today's RAS Corresponding Member, came up with an idea: "if the propagation speed of gravitational signal is higher than the velocity of light, there will be already another theory, not GTR!" Maybe, the reason is the postulation of equality of gravitational and electromagnetic radiation velocities?…

Today the approximate theory of gravitational radiation sources can be built on the basis of the following simple considerations: if during annihilation of "electron-positron" pair there creates the pair of gamma-quantums with energy about 0.511 MeV, then the pair of back gamma-quantums with the energy about 0.511 MeV, could create "electron-positron" pair. Is it possible to assume, that electron, positron and gamma-quantum with the energy about 0.511 MeV are just three stages of one and the same object?! If it is possible, then for the rational description of the given object we will have to suppose the existence of subparticles, named by us uniquantums [3], or named by other authors microleptons [4].

On the basis of Heisenberg uncertainty relation conformably to the energy and duration of quantum of electromagnetic radiation, measured by laboratory means, it is possible to calculate the minimal "electrical length" of photon (i.e. quantum geometrical extension in free space in wave-length units), which is equal to 137λ, and in the uniquantum theory it is equal to 137 uniquantum-antiuniquantum pairs. On the basis of these conceptions it is possible to construct the spatial microstructure model of electron. So, what kind is it?

We think, that electron can be represented as thin-walled spheroid, walls of which are two light (C) barriers, separating the "internal" part of electron from the "external" one. From the traditional physics point of view "over-barrier" space is an "imaginary" one. This very space can contain the gravitational mass of electron. The radius of the gravitational spheroid is equal to the half of the classic electron radius, and its imaginary weight is 137 times more than the rest mass of electron. Being "cut" off by the double light C-barrier, uniquantums of the spheroid internal part are as if non-existent for the outer world, and the rest mass of electron is formed by magnetic energy of three uniquantums on the external orbit with the classic electron radius. This very spheroid, rotating with the tangential velocity C, let us get the precise value of the electron spin.

The study of presented model shows, that:

- The "electromagnetic" rest mass of electron is "magnetostatic";
- The gravitational mass of electron is an imaginary value and it is 137 times more than the rest mass of electron;
- The gravitational radius of electron is two times less than the "classical" one;
- The "internal" gravitational radius of electron is 45.7 times more than the external one, i.e. the internal space is compressed per 45.7 times (!);
- The spin is equal to the classical one, but this value is imaginary one (!);
- The value of the "effective" electron charge is three times more than the classical tabulated value;
- The native magnetic field of electron is equal to $8{,}9 \cdot 10^{13}$ Oersted;
- The gravitational constant is equal to 10^{33} cm^3/g.s^2, i.e. it is about 10^{40} more than the "world" gravitational constant of the Earth;
- The gravitational energy of electron is equal to 137·0.511 MeV, i.e. 137 times more than the equivalent energy of the rest mass of electron.

The model is paradoxical. But it can be tested experimentally! Comparing "electromagnetic" rest mass of electron with the relation of electromagnetic energy to gravitational one, it is possible to determine the connection between magnetostatic and gravitational energy of electron, and, therefore, with energy of the magnetized ferromagnetic.

Gravitational constants of the Earth and of the electron differ in about 10^{40} and can be described by the same simple equation:

$$\gamma_{loc} = 2k\gamma_0 \cdot \omega^{3/2},$$

where k - is a parameter of the gyroscope shape, γ_0 - is absolute universal constant, equal to 1/137 and ω - is native rotation frequency of the gyroscope.

Let us assume, that gravitational constants of all objects should be described by this equation. By substitution of the new gravitational constant into the known equation of the gravitational energy $W = \gamma m^2 / r$ we will get the equation of the gravitational energy of rotating gyroscope with any size (from electron up to the Galaxy!). Thus, the main point of the "non-Einsteinian" theory of gravitational energy sources comes to the thing that any rotating object and any magnetized ferromagnetic have their own gravitational energy, and the sources of gravitational radiation can be only nonlinearly moved objects, or objects which are in the state of change of phase (for example, permanent magnet during its demagnetization). It is the gravitational theory and explanation of "strong" and "weak" interactions!

Laboratory test of the equations

Magnetostriction

J.P. Joule found the effect of change of ferromagnetic linear sizes and volume during magnetization as early as 1842. Magnetostriction is widely used in modern technique, but in the physical encyclopedia of 1963 there is the following honest acknowledgement: "For the most ferrites both longitudinal and transverse magnetostriction is negative; the reason of it is still unclear."

In the scientific literature magnetostriction is usually defined as $\lambda = \Delta L/L$. However, during the change of external field to some arbitrary and enough small value ΔH, it is advisable to define magnetostriction as $\lambda = 1/L \cdot \Delta L/\Delta H$, since in magnetostriction experiments the value $\Delta L/\Delta H$ (or $\partial L / \partial H$) is changed. By means of the suggested equation $W = 137(BHV) = BHV/\alpha$, which connects magnetic energy with the gravitational one, it is possible to get enough simple equation for the magnetostriction:

$$\lambda = 1/L \cdot \partial L / \partial H = \alpha \cdot k / (B \cdot H)_s \cdot H^2 \cdot \partial \mu / \partial H$$

where $(B \cdot H)_s/\alpha$ - is the density of gravitational energy in the point of magnetic saturation, k – is the parameter of share of gravitational field in the magnetostriction effect, H - is magnetic bias, $\partial \mu / \partial H$ - is differential magnetic conductivity.

The new equation qualitatively corresponds to four known features of magnetostriction [5], namely:

- The magnetostriction sign is defined by the sign of $\partial \mu / \partial H$, i.e. by the course of the magnetization curve, measured in the direction of calculated component of the linear magnetostriction;
- Graphical sum of three linear components of magnetostriction, calculated by three main axes of the anisotropy form of the model, is always negative and numerically close to the value of the volume magnetostriction;
- Magnetostriction is an even effect, since the equation includes squared value of the external magnetic field;
- Dependence of magnetic conductivity μ from the filed H and hence dependence $\partial \mu / \partial H$ has a hysteresis nature. Therefore, the magnetostriction is a hysteresis phenomenon too.

So we have the right to "close" the question of physical encyclopedia on the cause of magnetostriction. **Magnetostriction is the secondary gravitational effect of ferromagnetic "self-constriction" in its own gravitational field.**

Gravitational-optic effects of GTR

Distortion of the light beam, passing near the Sun and the photon frequency bias in the field of terrestrial gravity (the Nobel experiment of Paunda and Rebki) are the main arguments in favor of GTR canonization. It is very attractive to repeat these experiments in laboratory conditions, basing on our conception of the origin of gravitational field.

The acceleration of gravity, used in experiments with ferromagnetic, reached the value $4.72 \cdot 10^{15}$cm/s^2, i.e. about $4.8 \cdot 10^{12}$g. At such values of acceleration there is no necessity to introduce a definition "space masses". In these experiments there was used the optically transparent ferromagnetic, which was the saturated solution of manganese chloride in water at room temperature. The experiment on the beam distortion was made in 1975 [7]. It was shown, that this effect is the result of two simultaneous processes. The first is an intense drift of magnetic ions, which forms the gradient of index coefficient that causes the light beam distortion. Another process is a relatively weak gravitational beam distortion, for which, nevertheless, the relation of deviation angle to the track length (the length of the dish is about 100 mm) is turned out to be about 10^{10} more than in "Einsteinian" gravitational-optic experiments.

The experiment on bias of the optic radiation frequency [8] was made in 1978-1980 and was repeated in 1983. With use of heterodyne and interferometrical methods of measurement we were succeeded to observe effects of "red" and "blue" frequency biases in the non-uniformly magnetized ferromagnetic by means of simple displacement of the working dish (with the length about 40 mm) from one side of the magnet gap to another. The maximum displacement is about 10^{-5}, that is about 10^{10} more than in the experiment of Paunda and Rebki.

Problem of the propagation speed of gravitational radiation

There are still only few publications about such fundamental parameter as the propagation speed of

gravitational radiation; it is able to speak only about pages, or even lines! Let us refer to major sources:

I. Newton: *"The propagation speed of gravitational interaction is equal to infinity."* It is an argument, because otherwise we would have to bring the "delay" parameter Δt into the Law of Gravity, what is not noticed in real conditions of star observations [9].

P.S. Laplace in 1787, taking into account observation errors of that time, showed, that gravitational interaction speed was about $50 \cdot 10^6$ times more than the light propagation speed, i.e. it was about $1{,}5 \cdot 10^{18}$ cm/s [10].

A. Einstein: *"The propagation speed (of gravitational interaction) is equal to the light velocity".* This statement is postulated.

Even during the change of propagation speed of gravitational radiation between the Earth and the Moon it is impossible to define the signal delay about 10^{-11} s, i.e. we cannot measure directly the propagation speed of gravitational radiation (supposing that we have both generators of the gravitational radiation and receivers of it). But this speed can be estimated by the reflection impulse, what exactly was made in 1987 [3]. And its value is about $9 \cdot 10^{20}$ cm/s!

On the basis of conservation law of impulse of unidirectional radiator with arbitrary energy type we can get a simple equation:

$$F/(dW/dt) \cong 10^4 \cdot V/C^2 \qquad \text{[g/Wt]}$$

where V – is the speed of radiation propagation, F – is tractive force in grams, $dW/d\,t$ – is power of radiation in Watts and C – is velocity of light.

For making the experiment there were constructed, produced and adjusted: sensible scales with one degree of freedom (sensitivity of balance is about 1g at the oscillator mass together with the moving element of scales which is about 50kg); the indication system of small mass changes (phase-meter receiver); gyroscopic system, changing the mass in the dynamic mode (there are 16 possible operating modes – from the rotation with steady and variable angular speed up to the forced precession with the variable angle of precession, with the "right" and "left" rotation of all load-bearings elements at option); power sources and commutation automated system. The period from idea up to its realization took about two years (1985-1987) [3]. Taking into account the real parameters of the system, the program of calculation was drawn and propulsive burns were calculated. The results of machine computation can be compared with real impulses, demonstrated on the screen of the oscilloscope.

If strange speed value 177 C^2 is discarded, then the middle speed value is close to C^2, i.e. to $9 \cdot 10^{20}$ cm/s! Of course, we would like to think that this is the second fundamental matter speed of our world, which we has approached experimentally …

Gravitational receiver

During the creation of gravitational antennas and receivers there appear almost insuperable difficulties from the modern fundamental science point of view. That is why it is advisable to look at this problem from another side. At first, it is necessary to consider gravitational radiation interaction not with the mass, which it goes through without losses, but with the gravitational field of independently gravitating mass, when the interaction must be the most effective because of the principle of physical processes reversibility. At second, it is necessary to choose some critical parameter of auto-gravitating receiver as a value, which is directly measurable by gravitational detector. For example, angular velocity of free rotation of thin disk with big diameter, the frequency of magnetization precession during NMR (nuclear-magnetic resonance) or NFMR (non-linear ferromagnetic resonance) etc. can be chosen as such a value.

In 1987 there was the first successful attempt to receive the gravitational impulse. The source of external signal was gyroscopic precessing system with the variable angle of precession (the propagation speed of gravitational radiation was measured by it). Double gyroscope, setting in motion by one electric motor, but with the opposite directions of rotation, was used as a detector. Between disks there was placed the source of light, impulses of which, passing through disks openings, were registered by photodiodes. Their signal came into differential circuit of data processing. The memory oscilloscope reproduced impulses of gravitational radiation. At that radiating system and memory oscilloscope was started up simultaneously. During the work process there appeared a problem of exciting of slow auto-oscillations of gyroscope-detector. This problem together with the low frequency of auto-oscillations of mechanical system led to a conclusion that this research direction is not very promising. However, the fact of detection was proved!

Gravitational engine of continuous action

Only about nine years passed since the appearance of the idea about engine up to its realization! In 1997 the engine was produced and tested. The engine with weight about 28 kg was made "weightless" on the magnetic hanger, and longitudinal draft, appearing in accordance with the impulse conservation law, was measured by micrometer detector of longitudinal shifts (sensitivity is about 50g/point). Such engine could be built still in the beginning of the last century… However, it has a secret **that is a gyroscope with the variable radius, working in the continuous mode.**

The engine power is defined by the formula

$$\frac{dW}{dt} = 5k\gamma_0\omega^{3/2}\left(\frac{m^2}{r^2}\right)\cdot\frac{dr}{dt}$$

In June of 2000 there were made experiments with the model of gravitational engine, which represents a

gyroscope with the variable radius (see photo on the 1st cover page). The mercury was used as rotating fluid. Tests were made in the Research Institute of Space Systems named by Krunichev. In three experiments, at a certain speed of rotating fluid there was fixed a decreasing of the engine weight (38,5 kg) up to 1.0-1.5 kg (2-3%). The specific impulse of the engine was equal to 2.5-3.0 kg per kilowatt of electric power. Analysis shows, that the increasing of propulsion force is possible at optimization of design and operating modes.

Some preliminary resume

In the magazine "Foreign Literature" #1, 1967 the article "For hundred years forward…" by Jack Marabini was published. There were made some conclusions about prognostic work of firm Rand Corp., including the area of gravitational technique. Namely:

- Development of communication facilities on gravitational waves in 2000;
- Creation of spaceships with antigravity engines in 2050;
- Transformation of gravitational energy into electric one in 2100.

In the article it was noted, that the most "fantastic" predictions of this firm, as a rule, come true passing ahead.

According to our crude estimations, the propagation speed of gravitational radiation is "C" times as much than the velocity of light, but we know neither laws of attenuation and propagation of gravitational waves, nor laws of their reflection and refraction, nor laws of their interaction with the substance… The large routine work is expected: making of measurements and investigations, tabulating of obtained data, publishing and society familiarization of the results, their "popularization". It is necessary to learn to use gravitational radiation and to protect oneself from its accidental influences, to design standards and dosimeters, etc., i.e. to repeat the way of radio engineering and nuclear physics comprehension.

For that we need generators and receivers of gravitational radiation. It means that the financial support is necessary. And engineers are sure to be ready to pay the highest price for the chance to give to the Mankind spaceships, systems of instanteneous communication with them and real perspectives for the very long history.

Conclusion

We have already passed the long way, if not in space, then in time. We have made:

- Gravitational engines of continuous action with the specific impulse about 2.5 kg/kWt [11];
- Transformers of gravitational energy into thermal and electrical ones [12];
- Communication system based on gravitational waves [13];
- Receivers of gravitational (microlepton) radiation of biological and mineral objects [5];
- Devices for control of "laboratory time" flow (time machine) [14].

The main goals of the authors were to attract readers' attention to the problems, which demand an urgent solution. Some questions were decided, and even seemed to be clear. It also seems to be clear what to do further. And what do you think about it?

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BEAMSHIP TECHNOLOGY

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Experimental Research on Gravitational Propulsion System

*Editor's: It is a review of the article by **V. A. Menchikov**, the Director of Research Institute of Space Systems, named by Krunichev, Russia. The article was published in"Polyet" magazine #10,2001, p.38-39, Russia. It scrutinizes the matters on development of propulsion systems based on the unconventional approach to the problem of gravity, i.e. gravitational engines. It also cites the results of the gravitational engine model research made by means of the experimental facility, created in the Khrunichev Research Institute of Space Systems.*

The device, transforming rotary motion into unidirectional motion, looks like S.M. Poliakov's one. It also operates with rotation of liquid, which causes the propulsive force. Truly speaking, Poliakov had an agreement with Research Institute of Space Systems named by Khrunichev in 2001. Some funds were assigned to develop the device, however the project, into which Poliakov had put a lot of work, still remains unrealized. Besides, the scientist's name is not even mentioned in the patent.

***

Scientific and technological advance opens to mankind more and more wide abilities to use space for the solution of global problems. In many respects the complete realization of these abilities will be defined by the developement of means used for delivery of payloads into the space. In the XXI century the dominating use of reactive chemical and electrical propulsion systems in rocket-space technique as well as low application level of engines with other physical principles can be the factor of an "inhibitory" influence for the development of such techniques. It is caused by the fact that created rockets practically do not correspond to noticeably increased standards of safety, operating costs, costs for transport operations execution and ecological influence on the environment.

Thus, there becomes to be urgent the problem of development of alternative approaches towards the creation of propulsion systems, made for the rocket-space technique on the base of unconventional ideas and engineering solutions. A rather old-established idea of creation of gravitational engine should be concerned as one of such ideas. It is based on the unconventional approach to the problem of gravity. Nowadays many countries take part in solution of the gravitational problem, namely Russia, USA, Japan, etc., and if till recently only some scientists and inventors showed the interest to this problem, then now it arouses interest of research-and-production majors. Unfortunately, now it is not possible to speak about sufficient theoretical or practical development of this idea. However, the interest is so considerable, that practically separate experiments on this subject were made earlier and they are still made nowadays. After all, stakes are very high and are defined by applied nature of the problem (the ability to create qualitatively new engines for the rocket-space technique), as well as by its scientific significance.

One of the directions to solve the problem of the creation of gravitational propulsion systems is the realization of associated theoretical and experimental methods of the search of physical processes, leading to the antigravity effects appearance, which cannot be adequately described by existed theoretical conceptions. V. Shauberger's patent, based on the postulate of gravitational energy radiation by "disturbed rotating mass" can be considered as an example of such practical realization. Taking into account a number of known experimental results, a model of gravitational engine and experimental system for estimation of this model parameters were made in Research Institute of Space Systems named by Khrunichev to provide the practical realization of Shauberger idea (Fig.1). It is the metal construction, which provides the model displacement in upward direction with the ability of its rotation around vertical axis.

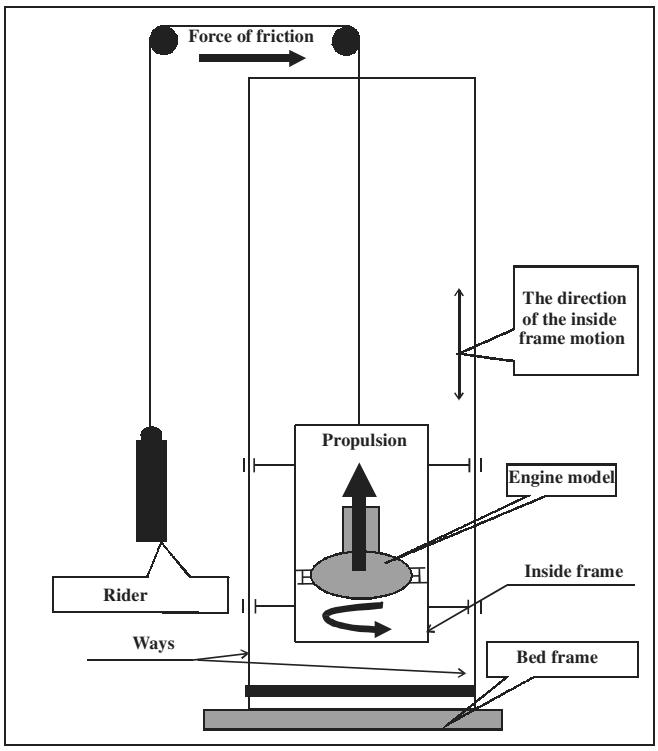

Fig.1
Schematic circuit of the experimental system

Later, to increase the system sensitivity it was improved and the block system of suspension was replaced by the lever frame.

Turning angle of the stand frame, where the model of gravitational engine is suspended, depends on the following: weight and geometry characteristics of the frame; weight characteristics of the engine (of counterweight); engine propulsion and frictional forces in bearings. Laser indicator of frame turning angle and vertical ruler let increase the gauge of lifting height of

the gravitational engine model proportionally to the arm of light beam.

On using this system there was made a wide cycle of tests, which qualitatively confirmed the presence of propulsion force. Tests were recorded by video. The analysis of experimental results shows, that acting time of propulsion was about 12 s at each switching. During repeated switching of the gravitational engine model in different conditions it is able to create the propulsion, the value of which at 40…50 s of operation can be about 3 standard units of propulsion force (1 standard unit of thrust is about 10gs), and while using the powerful electromotor it can be about 80 standard units of propulsion at the intervals up to 4 s.

Research Institute of Space Systems named by Khrunichev, works on automation of experimental researches and on development of laboratory resources for factor analysis of appearance of the propulsion vector with the usage of the described model of gravitational engine.

Patent

The patent was published in the Bulletin of Patent Information in 2001.
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(51) 7 F 16 H 27/00
(21) 2001121237/20
(24) 01.08.2001

Editorial: V.A. Menchikov together with A.F. Akimov, A.A. Kachegan and V.A. Svetlichnyi have got this patent. Dr. Spartak M. Poliakov, being the author of the principle, is not mentioned at all in the patent.

NEWS REVIEW

Boeing Tries to Defy Gravity

According to Jane's Defence Weekly (UK), http://www.janes.com, Boeing, the world's largest aircraft manufacturer, has admitted it is working on experimental antigravity projects. These projects are able to overturn a century of conventional aerospace propulsion technology and alter the entire aerospace business. Boeing uses researchers by Yevgeny Podkletnov, who claims to have developed a device, which can shield objects from the Earth's gravity. Many conventional scientists, who have not been able to reproduce Dr Podkletnov's results, view his project, named «GRASP» (Gravity Research for Advanced Space Propulsion) with suspicion.

Dr Podkletnov claims to have countered the effects of gravity in an experiment at the Tampere University of Technology in Finland in 1992. The scientist says he found that objects above a superconducting ceramic disc rotating over powerful electromagnets lost weight. The researches have shown that the reduction in gravity was small, about 2%, but the implications - for example, in terms of cutting the energy needed for a plane to fly - were immense.

His devise, named "impulse gravity generator" is capable to produce a beam of "gravity-like" energy that can exert an instantaneous force of 1,000g on any object – enough, in principle, to vaporize it, especially if the object is moving at high speed. Laboratory installation has already demonstrated the 4in (10cm) wide beam's ability to repel objects a kilometer away and that it exhibits negligible power loss at distances of up to 200km.

Applications of the device can include space launch systems, artificial gravity on spacecraft, aircraft propulsion and "fuel-less" electricity generation ("free energy"). However, observers say that Podkletnov's device could be engineered into a radical new weapon, for example, adapted for use as an anti-satellite weapon or a ballistic missile shield.

Documents, obtained by reliable sources, show that Boeing is taking Dr Podkletnov's research seriously. It is also possible, Boeing admits, that "classified activities in gravity modification may exist". The paper points out that Podkletnov is strongly antimilitary and will only provide assistance if the research is carried out in the "white world" of open development.

Boeing is the latest in a series of high-profile institutions trying to replicate Dr Podkletnov's experiment. The military wing of the UK hi-tech group BAE Systems is working on an anti-gravity programme, dubbed Project Greenglow. The US space agency, Nasa, is also attempting to reproduce Dr Podkletnov's findings, but a preliminary report indicates the effect does not exist.

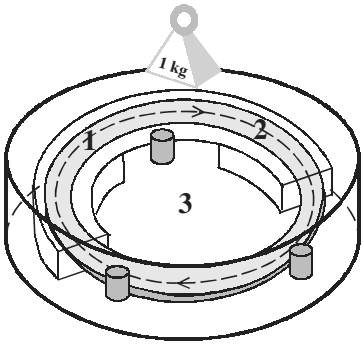

1. Solenoids create magnetic field
2. Spinning, super-conducting ceramic ring
3. Liquid Nitrogen acts as coolant

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Beamship Technology: a Re-working of Early 20th century Discoveries

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Some Basic Background

The concept of an electric aero-spacecraft with no moving parts was initiated by the Yugoslavian electrical wizard **Nikola Tesla**, who lit the entire world 100 years ago, at the turn of another century, with his revolutionary AC electric current. In 1916-17, Dr. Francis Niepher performed meticulous mass-deflection experiments under rigorous scientific conditions with lead spheres suspended by wires with shielded and unshielded containers. An accounting of this important series of experiments is in TRANSACTIONS OF THE ACADEMY OF SCIENCE OF ST. LOUIS VOL.23, 1916 and 1917. Related article is in THE ELECTRICAL EXPERIMENTER, March 1918.

Before 1905, **George S. Piggot** was routinely suspending small silver balls to water globules, corks, wood, using the electrostatic field from a specially designed Wimshurst machine in a glass container under several atmospheres of pressure to raise the current level. Output voltage was typically 500KV. The field was propagated by a charged sphere. A small curved conducting plate on the floor acted as a ground. He observed unusual patterns of blue dots with filaments over the suspended objects, sometimes with an anomalous 1/2 cm "dark band" on the suspended objects. Piggot states, "It is my firm conviction that that somewhere on the outer confines of our planet there exists a similar contracting belt thru which naught but the gravitational vibrations of the sun penetrate, and these vibrations absolutely annihilate or absorb all other less powerful ones". If the force was Coulombic in nature, objects would be first attracted, and then strongly repelled by the charged metal sphere. After the objects were suspended, Piggot found he could remove the conducting ground plate, and the objects still floated, suspended. The phenomenon of levitation was accompanied by "luminous halos".

In 1925-27, **Albert Einstein** released his scientific "gem", his "zur Einheitlichten Feldtherie", or the Unified Field Theory for Gravitation and Electricity, to the press and the scientific community. It combines electricity, magnetism, and gravitation into a single mathematical expression, showing how High-Voltage/Low Current electricity (Electrogravity) -and conversely Low-Voltage/High-current (magnetogravity) "acceleration-fields" (G-field) could be produced using then-available relatively LOW-technology. Indeed, a very simple technology. The unifying field is the electrical field (because it can produce gravitation and repulsion fields, as well as magnetism). His Crowning work was released with much press write-ups and fanfare, then it was quickly forgotten as if the scientific community and the world had suffered some kind of collective amnesia!

All of the readers of this magazine need no introduction to the pioneering work of American Scientist **Thomas Townsend Brown**, who was playing around with an X-ray tube around the same year as Einstein's Unified Field Theory was released. He filed his first patent for this newly and accidentally discovered "electrogravitational-effect" which causes motion in a high-voltage condensor or capacitor configuration. He was only 17 at that time. The discovery that high-voltage/low amperage electrostatic potentials applied to an object causes motion in the direction of the positive pole, and electrical charges naturally move to the OUTER surface of an enclosed charge-conductor, held strong prospects for what Brown would later name the "space-car", and wrote an article "HOW I CONTROL GRAVITATION". His pioneering work, and demonstration of devices in Hawaii during World War II, drew attention from the department of Naval Intelligence. He was invited to work on "Project-Rainbow" (the Philadelphia Experiment for Electromagnetic Stealth) because of his pioneering work on what was starting to be understood very covertly as a true WARP DRIVE. Experiments with certain new and classified arc-welding apparatus at the Philadelphia Navy Yards to weld armor-plate for battleships was (by use of banks of primitive but powerful avalanche-discharge capacitors) producing anomalous and unexplained effects, such as disappearing tools and other apparatus in the heavily shielded welding chamber. These strange effects were accompanied by a strange "blackout -zone" which, like Piggot's early work, was not optical in nature. TT Brown's devices in his AH Bahnson Labs home movies lift more than their own weight and move inside vacuum chambers in these films. TT Brown later founded NICAP in 1956, which became the most respected UFO data gathering and hard scientific organization in the world, besides the US department of Naval Intelligence itself, and the Foreign Technology Division at Wright-Patterson Air Force base in Ohio.

My background and work

I primarily have a background and degree in computer programming, electronics, most fields of science, Flying Saucer Technology research (almost 30 years worth), Radio/Control fixed and rotary-wing aircraft since 1972. I have been experimenting and working with high-energy and electrogravitic devices and systems since 1987. I built my first small High-Voltage generators starting around this time. I built kits from Information unlimited and elsewhere.

In late January 1990 I built my first working 2-foot flying discs, which were a direct replication of Thomas Townsend Brown's most important representation of his electrogravity-propelled scale-model vehicular concept, from US Patent #2,949,550. In January 1992, I built a 120KV high-voltage/low-current electrostatic generator from an Information Unlimited kit, primarily for force-field propulsion research.

In June 1999, I built a tower and rotor apparatus to complete the experiment, and I powered it with the output from a 100KV generator I built from an Information Unlimited Kit. The results were spectacular, and taught me a great deal about what was involved in producing and maximizing the Biefeld-Brown Electro-gravitational effect. **I suspected from my research, and my experiments, that the basic effect was not due to current-flow and resulting ion-wind. When there was current-flow, the effect is attenuated, power consumption goes up, and thrust goes DOWN.** In late June of 2000, I presented this working TT Brown Electrokinetic Apparatus with larger 1-meter discs at the 2nd Antigravity Conference in Reno, NV, hosted by Jim Cox. A VHS videotape of this working and spectacular presentation at the first part of the conference is available from
www.soundphotosynthesis.com

Now that I had mastered producing horizontal thrust, vertical thrust, or antigravity, was the next goal. About this same time, there was buzz all over the Internet about claims of two or three individuals who sounded credible at the time who had successfully replicated the many multi-layered "gravity-warp capacitor" or "electric rocket". Oddly, these claims could not be verified, and the individuals making the claims disappeared back into the woodwork. Such actions are bizarre and hinder the progress of true science, which is undergoing a shift in paradigms right now, if not a change in dogma.

I spent months die-cutting hundreds to thousands of tinfoil and aluminum-foil circular-notched conductor plates and wax paper and mylar rings. I did some initial testing with a Tin and wax-paper 400-layer gravity warp-capacitor heap, according to plans I had acquired from H & A Industries in 1992, and what was on Bill Beatty's amateur science site. No one else has come forward with positive results on this tedious and time-consuming device. So much work for so little effect! And, if you short out the stack with too much power, you must tediously and laboriously search thru hundreds of layers to find the dielectric layers with the telltale carbonized holes. The Electric rocket has been recently successfully replicated and tested in hard vacuum and patented recently by Hector Serrano. The Serrano effect is identical to the so-called Biefeld-Brown Electrogravitational effect. They are one in the same thing. I may dust off my completed 400-layer grav-cap, but I hardly find it worth the time and effort, because of my recent work starting in early October 2001.

The Lifter and The Evolution to Beamship Model Flying Craft

Although I had attempted a few small "Hagen" patent-type antigravity (VTOL) models in the early 90s, I found their performance poor at best and their power consumption high. In late summer, 2001, someone, I forget who, on the JLN's lab list of researchers and anomalous science-experiment and technology enthusiasts ran across a website owned by Transdimensional Technologies, of Huntsville, Alabama (famous for NASA research facilities, the late Dr. Rolf Schaffranke, author of the important ETHER TECHNOLOGY, under the pseudonym "Rho Sigma", and Dr. Tom Bearden) had produced a hovering device. From my previous work, I recognized it immediately as TT Brown's Electrokinetic Apparatus that I had successfully replicated and demonstrated before a live audience years earlier. I noticed the capacitors were made from Aluminum FOIL, not the thin-but-heavy Aluminum sheet stock from Home Depot that I had been using for years, (I had assumed that to make my 3-foot discs hover and ascend vertically, I would have to use voltages in the hundreds of kilovolt range, and generate high x-ray, UV, and possibly gamma-ray emissions as a by-product, in other words, a typical flying saucer with all the associated radiological effects that have been documented for over half a century) so they could lift their own weight. The result matches almost exactly the simplest graphical representations of TT Brown's patent from 1960, and De Seversky's Ionocraft patent from 1964, which was a thin foil cathode plate with a thin anode wire separated from the cathode by stand-off insulator posts. I was eager to reproduce these devices (I don't know how I overlooked this simple solution, it was all sitting in those old 1960s Brown and De Seversky patents I have studied for 15 years previously) and many people around the world, especially the webmaster of the JLN Lab's site French researcher Jean-Louis Naudin, who began replicating many different types of larger and more sophisticated devices, some of which resembled model spacecraft, and began amassing tables of very useful data, that researchers could use as basic guidelines to follow. I replicated the first hovering device, the "Lifter" (so-called by Transdimensional Technologies) as a 1-foot triangle, with 2-inch foil cathode and #42 enameled copper magnet wire. To energize it I used a commercial power supply from Gamma High-Voltage Research that I had acquired from Ebay some years ago. It was perfect

for antigravity research, having full metering, and variable voltage from 0 to 40KV, and current limiting from 0 to 1.5 milli Amperes of current. The heavy 1-meter discs of the Electrokinetic Apparatus were too heavy and the rotor-friction to great for this low-powered device (60 Watts, maximum), but for the lifter, it proved ideal.

My first "lifter" antigravity device worked, but its performance was less than ideal. It had to be stripped of its lower balsa-wood frame and some of its foil before it would degravitate (counterbary), and it "maxed-out" the current-limited power supply at 33KV I 1.5mA, for a stable hover (actually this is an upward flight configuration, because the device is tethered to the lab table with 3 sewing threads). That is 49 Watts. The concept of a hovering TT Brown Electrokinetic Apparatus had been proven to my satisfaction, however, and I initiated more research into past works and patents to raise efficiency to workable levels. The performance was slightly better than my early 1990s "wire-grid" type devices. I found this slightly encouraging.

After a couple months reading and research (why re-invent the wheel, its all been done before), I started to replicate larger models in February and March 2002, but kept coming up against a size-barrier with the Multi-cellular (grid) approach that many researchers had assumed would raise thrust, and efficiency. This approach obviously did neither, as no one seemed to be able to produce hovering devices above a certain size, the current consumed (adding to total wattage consumed) was prohibitive with the low-powered (still high-voltage, low-current) devices that most of the mostly amateur researchers were using. Researchers around the world started to replicate different versions of the basic lifter 1 (an 6 to 12-inch equilateral triangle). The lifters are always tethered to the testing surface with 3 strings to keep them from going dangerously unstable and possibly short-circuit when they reach the limit of the umbilical supplying power to the device.

From my previous Biefeld-Brown effect replications years earlier, and from carefully reading Brown's EK Apparatus patent, I knew that increasing the diameter of the wire would reduce leakage current created by coronal discharge, mostly coming from the forward electrode, which in the 2 and 3-foot saucers consisted of an arc of copper tubing in the front quadrant of the saucer, or disc. Corona robs power (amperage) from the disc that otherwise would be used to "propel" the disc. Increasing the diameter of the copper tubing, as per Brown's patent if the effect was due primarily to ion-wind, more current and current flow between the electrodes would be desired to effect more air movement. But this is not what I saw in the saucers. **There was apparently another, far more powerful but subtle force effecting silent propulsion of the saucers that had nothing to do with charge-transfer and ion-momentum.**

In February of this year, I undertook an effort to replicate and improve performance and reduce power consumption of the lifter device, based on data from my electrogravitic work of years past. I started by using thicker diameter enameled copper magnet wire, #35 to #30 diameters. I first built a 1-foot equilateral triangular basic "Lifter-1", weighing only 3.5 grams. On March 16th, I built a lifter with the thicker #35 enameled copper wire.

I made the three sides 1-foot long and exactly 2-inches high. After experimentation, I found the optimum spark gap for my High-Voltage power supply (Gamma High Voltage Research 40KV with current limiting to 1.5mA). The small silver-colored device leapt off the test table and pulled violently against its anchor strings to a distance of about a foot. This seemed like a great deal of force for such low power. The large discs of my TT Brown EK apparatus required a good deal higher voltage to initiate motion in the direction of the anode. The device consumed 26KV I 0.56mA DC, which calculates out to 14.56 Watts. I was getting more excited, because this was the best efficiency seen of any result yet posted.

On March 19th, I tested 2 lifters glued together in a "diamond" shaped configuration.

This 2-foot device weighed 6.0 grams, with the same #35 wire and a 2 and 5/8" air gap. It took 25KV to nullify the weight of the device, and it achieved a stable hover at 35KV I 0.8mA. That is 28 Watts. This is about what I had initially expected, double the power for double the Watts. Still, this was far less overall power going into the device to achieve a stable hover than my first primitive and radically shorn and trimmed device. After lift off to the extent of the anchors, I found I could reduce power slightly and maintain a stable hover. On march 22nd at 3:49 pm I got the diamond lifter to achieve a stable hover with a 2 and 5/8" air gap at 29.5 KV I 0.32mA. This was only 9 Watts! This was unheard-of efficiency. I was further encouraged to build and test larger hovering devices to see how large I could get them with my low-powered commercial power supply.

I then built a "lifter-2", which consists of three 1-foot triangular capacitor cells taped together. It weighs 11.4 grams. March 30th at 3:22 pm, the device achieved a stable hover at 38KV I 0.57mA for 19.76 Watts total power. The larger device was more energy efficient than a device 1/3 the size. I wanted to see how far this could go, so I added three more lifter cells to make a 6-cell device, 3 feet on each of its three sides. I was eager to check the performance of this fairly large device. This was the diameter of my horizontally propelled TT Brown Discs.

This device weighed 21.6 grams. I kept the spark gap the same distance on this device. However this device failed to achieve counterbary (lift). It just sat on the test table, filling the air with the smell of ozone and

making a sizzling sound (corona noise). I noticed that the current maxed-out on the power supply at a fairly low voltage and would not go any higher.

I concluded in my disappointment that all that wire from all the inter-connections to the cells was causing corona leakage and robbing current, which otherwise would be used by the device for propulsion.

The idea then hit me that perhaps I could make a device with the same outer diameter as the 3-foot device, but have greater efficiency because of a much shorter length of wire. I built basically a 3-foot (1-meter) version of the first 1-foot device. This device weighed 16 grams. It lifted off the table with amazing force and hovered stably with I 52mA 30KV which is 15.6 Watts. Not only had I achieved a larger-size device, but far better power efficiency for a much larger and heavier device. I was overjoyed! I saw that I had a great deal of lifting force to spare. I had not even come near the limit of my power supply. I added extra bracing at the corners and extra balsa and a triangular paper "payload -tray" in the center of the device, supported by three 1/16"x1/16-inch balsa stock. The extra bracing and payload area added approximately 2 more grams. With a 5 gram payload, the device consumed 39.9 KV I 0.99mA, for total power consumption of 39.5 Watts. I was really encouraged at that point, because I knew that these results were unheard-of, in terms of energy efficiency. I had solved the problem of decreasing efficiency by dispensing with a "grid-based" device. Increasing the area of the capacitor plate was one of the factors that increased performance and efficiency, lessening the input power requirements with increasing size. Now the Biefeld-Brown effect could be properly studied, now that most of the ion-flux had been eliminated, resulting conservation of energy by the device, and resulting in greatly increased propulsive force.

Since I now knew the limit of payload for the device at the power level I was using, I added a balsa framework that approximated a central cabin area, and three small styro-foam spheres on the center of the straight sides on short lengths of balsa. The device no longer looked like a test device, but now looked like a scale model spacecraft. I remembered the Edouard "Billy" Meier UFO contact case, and knew that all his original photographs and movie footage of extraterrestrial spaceships the extraterrestrials themselves called "beamships" (there are several styles and variations, all with different specific functions and capabilities, some manned, some remote-controlled "telemeter discs" that had a tri-hemispherical undercarriage that I knew from past research were propulsion condensors) and that the original un-tampered photos all passed rigorous analysis using the latest and most sophisticated computer and other equipment, case detractors not withstanding. Also the spiritual messages of these genetic brothers of Man and their accounting of humankind's history and origins from far across space rang true and struck a chord with me.

I decided to name this new 1-meter model spacecraft Beamship Variation I. The three sides of the device performed the same function on this device that the three spherical or hemispherical capacitors often seen on the underside of full-size "beamships" (Daylight-disc-type UFOs), which illustrates a similar if not identical propulsion methodology to full-size 3 to 7 meter and larger "off-Earth-built" aero-spacecraft. Clearly the propulsion methodologies were exactly the same in the model as in the full-size flight device.

I immediately built a 4-foot diameter model with a full cabin framework and internal payload area and achieved even greater performance and efficiency. I was ecstatic. This 4-foot device I dubbed Beamship Variation II. I received a suggestion from Mr. Tim Ventura of American Antigravity that performance could be increased by using small diameter stainless-steel wire. It seemed unlikely to me that smaller diameter wire would increase performance, it contradicted Brown's patent, and my own past research with large electrogravitic discs. But Stainless steel has a high number of free electrons in the outer valence atomic shells (electron orbits).

So I obtained some #40 stainless locally and the results confirmed Mr. Ventura's suggestion. Corona noise was heard at a much higher power level, and was greatly attenuated in volume. Leakage current was less, and the two Beamships now had more thrust with less power input. They even carried more payload at less power input. Variation II weighs 21 grams and loft a payload of 6 grams at 40KV I 1mA for 40 Watts total power. Again, this was unheard-of efficiency. The anode wires sang a strange harmony as the Beamships floated in the air, stably at any altitude, from floor to ceiling, without any fuel or visible means of support. This was very Beamship-like.

I thought that now since corona discharge on the anode wire was less, I could decrease the spark-gap distance without creating a spark (which kills lift). Thrust seemed initially to increase, but efficiency went down because there was current-flow now, and current consumption went way up. The supply would now max-out at 37KV I 1.5mA and would not increase because of the current limiting. The Beamships now were noisy, as the foils chattered loudly because of all the ion-wind that was now rushing downward along and past the foils. I used a concert fog machine to observe the ion-flux vector, and filmed it digitally with my Logitech web-cam, and with VHS analog video.

Analysis of the fog -tests showed a circular vortex of air surrounding the anode wire that flared out into a downwash of air below the Beamship. I was disappointed, because I thought then that the thrust action of the device was due to simple ion-transfer. A useful-enough effect, but of questionable use in the vacuum of space without an ionizing medium.

Beamship Variation III

I reasoned I had just about enough power in the supply to build and fly a 6-foot (2-meters) Beamship. Since the balsa came in 3-foot lengths, this was simple. As with all the lifter devices and the more evolved and efficient Beamship-series model aircraft, construction techniques are extremely simple and require little skill to assemble. Weight of the Beamship Variation III is 42 grams, with 6-feet of length on its 3 sides. Height of the foils was still 2". Full frame and cabin, with Searl "IGV"-type landing legs, to support the weight of this heavy and very large device. I set the spark gap at 2 and 1/2 inches. At 12:15pm EDT, May 12th, 2002 the Beamship was weightless at 32KV with current maxed-out at 1.5mA.

The device barely lifted off, and "hopped", across the floor once or twice at full power. It had the same loud rattling of the foils due to the terrific downwash of electrified air. I needed to raise the power level. I increased the distance of the spark gap to 2 and 3/4". Now the Beamship took off straight up with power to spare, as if it was one of the smaller craft. Beamship Variation III is weightless at 30KV I 0.85mA (25.5 Watts), and airborne into a stable hover at 35KV I 1.35mA. That is only 47.25 Watts. It can carry a payload of 5 grams, or 5 grams worth of additional framework and structure, to the limit of the power supply, which is 60 Watts (40KV I 1.5mA).

The 42-gram, six-foot model aero-spacecraft only consumes 47.25 Watts at hover, but my first small and trimmed device ate up 49 Watts! Clearly, using the single-cell Beamship methodology had a huge advantage over the "multi-cellular" design that other researchers had built and tested, seemingly reaching an impasse in terms of size and efficiency, which my large single-cell Beamship technique had seemingly solved. In early April my 1-meter Beamship, weighing 22 grams including 5-gram payload, consumed 39.6 Watts. So the 42-gram, 6-foot Beamship used only 7.65 Watts more total input power at stable hover that the 1-meter Beamship. Power-to-weight ratio for the 2-meter Beamship V. III works out to 1.125 Watts to lift 1 gram stably of scale model electric spacecraft. With little to no ion wind, the Beamship had plenty of upward force and achieved stable counterbary at greater efficiency than I had ever heard or read about. Also, I was not aware of any devices in scientific history that has achieved this type of counterbary for this little input power and this colossal size. I performed additional fog-tests with two red semiconductor-emitted laser beams in the plane of one side of the device, one above the wire, one below the foil. The Beamship without all the ion-wind was nearly silent again, except for "singing" and softly "thrumming" anode wires. These laser-beam tests further confirmed the marked absence of ion-wind with a larger spark gap.

At 1.125 Watts-per gram at 57KV I 1.4mA (78.8 Watts) would lift 89.775 grams worth of electric spacecraft. So not only is the larger size in a single cell far more efficient that the "grid" design, in thrust and power consumption, but the reduction in current from increasing the spark gap raised power level to the device, while dropping power consumption of the device. My initial suspicion of ion-wind producing most of the thrust in the Biefeld-Brown effect had been dis-proven also because of the great weight of the device. I never would have discovered this important fact if I had stayed with smaller devices, trying to raise their efficiency. And I never would have discovered the efficacy of the Biefeld-Brown effect if I had stayed with the multi-cellular "lifter" methodology. One of the factors that raises the level of propulsive force (if "propulsion" is the right word) is increasing the area of the plate, according to TT Brown's patents. So the larger size single-cell capacitor's ability to reduce power consumption and effect greater propulsive force and upward acceleration, was easily explained by the Biefeld-Brown Effect. Brown had been vindicated. My gut feeling had seemingly been confirmed: this was our first warp-drive (reaction-less drive).

My experiments had yielded greater efficiency, and greater size and weight of VTOL hovering models than any that I had ever heard or read about. I still am having difficulty taking in these facts; and it is very awe-inspiring to see such a large device de-gravitate and hover stably at any altitude, from floor to ceiling.

Next for me is a higher-powered supply (60KV), moving up to a three-meter Beamship Variation IV, improvements to the cathode such as a thin, symmetrical airfoil shape, as Brown suggests in his patents, tungsten wire, and then carbon-wire for the anode, and full heat-shrink coverings on the frames, running lights, onboard lasers, onboard digital/ proportional Radio/Control, and now that we know the power requirements, and have a good handle on efficiency, onboard power generation. I have already begun designing with my associates our own custom-made outboard and inboard battery-powered power supplies, and finally will cut the power umbilical to the model electric spacecraft permanently, and Beamship technology advances further. If the on/off duty cycle is pulsed at a low frequency, power input can be reduced by two-thirds, at least. Experiments conducted by Jean-Louis Naudin last fall (2001) confirm this phenomenon, suggested by Brown and De Seversky in their patents. Clearly, onboard power can easily be effected, using modern miniaturization and circuitry. Pitch and roll vector control can be achieved by electrically isolating the anode wires on the three sides of the ship, and varying pulses to these three wires. Yaw control can be achieved by simply installing a horizontal-double sided capacitor inside the ship near one corner. Simple full 4-channel flight control is thus achieved.

The Beamship series aircraft are fascinating research and entertainment devices (see cover page), and are the vanguard of a whole new generation of radio/ controlled antigravity model aircraft with no moving

parts and dead silent propulsion. But they are more than that. The Beamships, if allowed, could probably rise up at any speed thru the atmosphere, right up to near-Earth-orbit, and probably keep on going out into limitless space. No need to achieve ballistic escape velocities of miles-per-second. This is non-ballistic flight. They even have a certain amount of wind resistance outdoors and indoors because the electrical field causes air to flow AROUND the model flying craft, not into it. This is such a safer, environmentally cleaner, vibration and nearly silent and more pleasant method of aero- space travel than carrying tons of explosive reaction mass, which can and does explode. No more use of heat energy to effect transportation.

The 21st century has begun in earnest!

Beamship series aircraft are available for sale for research and hobby/entertainment use right now through the American Antigravity website: www.americanantigravity.com. Look for the Applied Electrogravitics antigravity technology website late spring, 2002. You can contact me, Russell Anderson for details on pricing, and new and improved variations, and power supplies for outboard and onboard drive, which are currently in design stages.

Editor's note: More ideas on development of T.T. Brown's patents are on our web site: http://www.faraday.ru. Read about T-capacitor!

Data Table 1

Antigravity device	Weight of device	Wire type	Voltage/current	Total Watts	Payload	Payload/power
1-foot "Flyer-1"	3.2 grams	#42 enameled copper	33KV I 1.5mA	49	None	————
1-foot "lifter-1"	3.5 grams	#35 enameled copper	26KV I 0.56mA	14.56	None	————
2-foot "diamond-lifter"	6.0 grams	#35 enameled copper	29.5KV I 0.32mA	9	None	————
2-foot, 3-cell "lifter-2"	11.4 grams	#35 enameled copper	38KV I 0.57mA	19.76	None	————
3-foot, single-cell "Beamship Variation I"	16 grams	#35 enameled copper	30KV I 0.52mA	15.6	None	————
Beamship Variation I-fully-rigged	18.5 grams	#35 enameled copper	————	39.5	5 grams	39.9KV I 0.99mA
4-foot "Beamship Variation II"	21 grams	#40 stainless-steel	————	40	6 grams	40KV I 1mA
6-foot "Beamship Variation III"	42 grams	#40 stainless-steel	35KV I 1.35mA	47.25	None	————

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SmartPAK Technology™

invention by William Alek

the world's first commercial all solid-state system that provides a "standard" platform for experimenters, researchers, and developers to do energy-related practical applications, experiments, and perform exploration of highly efficient alternate energy system

The theory of operation is based on the amount of energy that is required to magnetize and de-magnetize ferromagnetic materials utilizing a core/coil/magnet assembly. It has been discovered that it takes MORE energy to magnetize a suitable core assembly than to de-magnetize it. The SmartPAK system is designed to measure and collect the difference, and store the excess energy for later use.

The SmartPAK device is controlled by a 68HC908GP32 micrcontroller programmed to measure input/output voltages and currents, calculate COP, and contains software algorithms for a complete "turn-key" power management system. The device features a "standard" user interface, which allows the user to design their own custom core/coil/magnet "head assemblies", and immediately test and display in real-time its' performance.

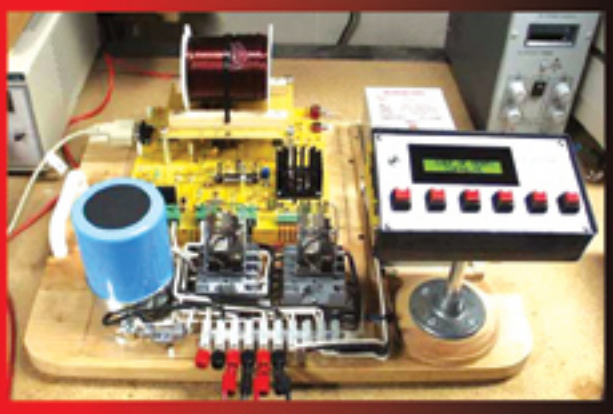

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Commercial Antigravity

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Introduction

Let me begin by posing a simple question that I would like the reader to keep in mind throughout this article: How far away is commercial antigravity? I'm not talking about a laboratory experiment where a giant magnet is used to levitate a frog, or secret UFO experiments that the government isn't sharing with the business world, but a real, viable antigravity solution to what I consider to be the most pressing issue facing the world today – transportation.

Who can answer a question like that? How far away is commercial antigravity? The author has read numerous scientific texts on the subject, and is familiar enough with contemporary theories of gravity, antigravity, and electromagnetism to suggest that most scientists believe that commercial antigravity is at least 100 years away from existence. But the author believes that most scientists are wrong.

Defining terms

Any article about antigravity would not be complete without properly defining the terms to be used. In this article, antigravity is not used in the strict sense of the word. The author's intent is to discuss a method of propulsion, which for all intents and purposes can be considered antigravity, and may include antigravity – but also may include several other forms of similar propulsion. The reasoning behind this is that experience has shown that the majority of people in the world don't care how something works – they care what it can do for them. This article is about the effect of Antigravity – not the cause.

Real Antigravity would consist of an apparatus used to either reduce the apparent mass of an object or reduce the effects of gravitational attraction between the Earth and an object. An example of an apparatus that may in fact do this is the Podkletnov superconductor apparatus currently being tested by NASA.

This Podkletnov device essentially consists of a spinning superconductor that self-levitates above a pool of liquid nitrogen and supposedly creates a "beam" or "shaft" of antigravity (or reduced gravity) directly above it as it operates. The levitation of the superconductor itself is not antigravity – it is a well-known side effect of ceramic-superconductors called the "Meissner Effect". The Meissner effect is simply a side effect of the superconductor's interaction with the Earth's magnetic field, and is easily explained by physics.

Podkletnov claims that when he worked with a team of researchers investigating superconductors in Russia around 1991, the smoke from the tobacco pipe of a fellow researcher began to climb steeply in a column directly above the superconductor. The researchers began to think that they were on to something, and Podkletnov subsequently performed several follow-up experiments that led him to the conclusion that the levitating superconductor produced a shielding effect between the Earth and anything positioned directly above the superconductor. He reasoned that gravitational shielding would provide a "column" of reduced gravity above the superconductor that should extend up and away from the Earth indefinitely. Podkletnov calculated that with a rapidly spinning levitating superconductor he had achieved a 2% loss in weight for anything directly over the superconductor.

Podkletnov's research is interesting and compelling, and it would fall into the category of "real" antigravity – but I am writing about Podklentov's type of research as well as enormous amount of research and theory available on electromagnetic propulsion systems. These can be considered "effective" antigravity.

The Harrier jet fighter can swivel its engine exhaust-nossels to create vertical lift, which resembles antigravity in that it is VTOL takeoff. However, the Harrier does not use effective antigravity because it has all of the functionality and side effects of an aircraft. A helium blimp would be a closer example to "effective" antigravity, but it too is not – because it works on basic aerodynamic principles.

Aerodynamics is not effectively antigravity – aerodynamics is instead expensive, difficult to manufacture, prone to explosive failure, and highly unreliable. This is not to suggest that a jet aircraft is unreliable, because it has a variety of backup systems, but that the technology itself is unreliable in that a jet is adversely effected by the medium that it uses to propel itself. Air pressure, humidity, temperature, and strong winds all cause a degree of unreliability. In addition, turbine engines stretch the limit of what mechanical engineering can achieve – which is why they are prone to break if even something as small as a bird gets sucked in during flight.

Antigravity is not about moving the air around — it is about a medium-agnostic means of air transportation that produces vertical and/or directional lift without relying on air-pressure like a wing or blimp. Antigravity is an electromagnetic or electrogravitic system for reducing the weight of an apparatus to allow it to lift more easily. Antigravity is pushing a button and having your vehicle take off without runways, noisy engines, minimum flight-speeds, propellers, or any of the other drawbacks that limit conventional aircraft from achieving popularity similar to what an automobile might have.

The author's definition of Antigravity for the purposes of this article is confined to electromagnetic or electrogravitic devices that reduce the weight of an

object to enable it to take off without conventional thrust-producing apparatus. This definition might also fit many of the classical characteristics known at one time as "the electric spacecraft".

1. Business Analysis versus Scientific Analysis

The author disagrees with the majority of scientists as to when commercial antigravity will become possible for some very basic and obvious reasons. To begin with, the majority of credentialed physics-related scientists come from a theoretical school of thought, which tends to limit their world-view to only contain those things that are currently or potentially explained by theory. The author, however, comes from an experimental school of thought that seeks to capitalize on existing observational data without the rigorous need to explain every last detail of its functionality. The author is an engineer, not a scientist – and engineers don't need to totally understand how something works in order to make it better.

This difference between the engineering point of view and the physicists is also different in the manner in which they seek out observational data. A physicist looks towards naturally observable data, and in the event that none exists they look towards current theories to explain potential future observations. The engineer is more open to ideas that are less rigorously tested from the perspective of scientific method, but are currently observed as potential solutions to real-world problems.

2. Potential Technologies Overivew

Phycists currently tend to dismiss the entire concept of Electrogravity, and the reasoning behind their logic is very sound. To begin with, Electrogravity is not observable in nature. In addition, many of the claims by those persons who submit Electrogravity and antigravity devices for public review are faked, exaggerated, or just plain wrong.

Physicists are responsible for maintaining a working body of theoretical knowledge, and if they were to admit results such as Schnurer's without skeptical scrutiny it would undermine the very fabric of technology itself. If the Podekletnov results were to be accepted as fact at face value without rigorous prrof, imagine the amount of money that would be wasted in attempts to build enormous Antigravity vehicles based on this theory.

In the middle of the spectrum lies the concept of Maglev, which is mentioned here only for the purpose of specifying that Maglev is not commercial antigravity. It has been mistakenly thought of as antigravity by many because it utilizes a magnetically-levitated train to improve the velocity of the train and reduce transit time between stops. In reality, Maglev is not really a vehicle at all.

The definition of a vehicle would be a device that transports itself as well as its passengers and cargo between two points. This is why an automobile is considered a vehicle but an escalator or elevator is not – the automobile transports its entire propulsive apparatus to another location, but an escalator or elevator does not move – it merely repositions its cargo between points. The Maglev train is not really a vehicle at all – it is actually a very long electromagnetic armature that transports people and cargo between its ends at high speed. While it may serve a commercial need, it is not to be confused with Antigravity.

On the opposite end of the spectrum is the author of this article – who has built and successfully tested over 30 electromagnetic "Lifters" at the time of this writing. The Lifter is a device based on research by Transdimensional Technologies and related to research by Thomas Townsend Brown that demonstrates an antigravity effect when a High-voltage DC current is applied to it.

Currently, the exact method of propulsion for the Lifter is being debated. It is thought to be one of two things – either an effective form of "ion-wind" propulsion, or else a form of field-effect propulsion based on an as-yet unknown force. While the debate about the exact nature of this propulsion is important with regard to future research, in reality it does not change the observational data that demonstrate that this technology works perfectly, consistently, and reliably.

The Lifter design was demonstrated by the author in a continuous mode of operation for over 7 hours straight on Sunday, April 21st, 2002, at the Seattle Center "EarthDay and Renewable Energy Exhibition". During this seven hour period of time, the author's Lifter hovered at a tethered height of 12 inches from the surface of the table, powered by a 30 watt load from a simple computer monitor.

This article is not meant to get into the details of methods of antigravity, only to suggest that it already exists in the form of electromagnetic propulsion systems if nothing else. The author is confident that in time physicists will find a theoretical reason for why the Lifter operates as it does, but for the time being the fact of its operation overshadows the method of its operation.

3. Market Needs

Commercial Antigravity doesn't require a 2% loss in weight to operate – it will require something akin to a 200% loss in weight. A commercial antigravity device will have to demonstrate exceptional performance to gain market acceptance, but not for the reasons that might immediately come to mind.

One might believe that skepticism from the scientific community would prevent antigravity technology from gaining the scientific acceptance needed to become a commercially accepted engineering discipline. The long term view, however, shows that this is not the case – engineering and market forces drive innovation, and formal science plays a supporting role in explaining and

quantifying the innovations that engineers have already commercially qualified as valid.

The real roadblock to success for commercial antigravity is market acceptance. The author's demonstration of the Lifter technology at the Renewable Energy Exhibition helped him to realize that the vast majority of consumers have no idea what antigravity technology could be used for, much less what they themselves could use it for. The same thinking was apparent at the dawn of the age of personal computing, when the idea of having a computer in the home was a completely foreign concept.

So in brief, a market does not exist for antigravity technology, which is why inventors working with this technology have been unable to find appreciable support for their work. Many inventors look at this technology and ask, "how could the public not understand how valuable a technology like this is?" – but that isn't the problem. The problem is that most innovators with an interest in antigravity are so closely tied to the science behind the technology that they fail to review and address the business needs that drive the market acceptance of a new technology. In other words, people don't buy antigravity – they buy solutions. People don't buy cars to simply have a car – they buy cars because people need transportation needs that they have to fulfill. People don't buy computers because they want to have a computer – they buy computers because they want to share and process information and communications.

Marketing Requirements

How will antigravity technology gain the market acceptance to become a commercially viable technology? There are a variety of ways in that antigravity technologies will become commercially viable, but only after antigravity is no longer sold as antigravity – it needs to be sold as a personal or business solution.

The solutions that antigravity technologies are best prepared to provide at the moment are in the realm of transportation technology. This includes moving people and cargo to destinations in a similar manner to conventional transportation technologies such as aircraft or automobiles.

With regard to providing transportation solutions, antigravity has the ability to incorporate the best features of both contemporary automotive and aerospace technologies into a single technology that will serve point-to-point transportation needs better than either of the two aforementioned technologies could by itself.

For a moment, assume that a person wants to travel from Los Angeles to New York in a short period of time. Currently, the most convenient method of transportation to accomplish this would require the person to take an automobile to the airport, and from there take an aircraft from the Los Angeles airport to the New York airport. After departing at the New York airport, the passenger must then take another vehicle to their intended destination.

Commercial antigravity technology could serve a dual-purpose short and long-range transportation role, taking on the aspects of both ground transport as well as air transport.

Product Delivery Requirements

In order to deliver commercial antigravity as a viable solution to business needs, a variety of work will need to be completed on the various component systems of this technology to turn it from what is currently a "proof of concept" into a commercial reality.

Let us assume for a moment that we have developed a working device based on Antigravity or some method of Field-Effect Propulsion. While this is the critical stepping stone to success, this is by no means the end al be all of the development cycle.

To begin with, the technology must be perfected to the point of being both economical and reliable. As it stands now, the market already has technologies in place that fulfill some or all of the requirements for the technology that Antigravity is being developed to replace. In order to serve as an effective replacement for these technologies, antigravity technology must then demonstrate that it both costs less in terms of operation and manufacture, as well as being more reliable than conventional air-transportation solutions.

I mention reliability in light of the recent negative media attention surrounding several recent commercial airline crashes. From a marketing perspective, air-travel disasters provide a great deal of negative publicity for the airline industry. Since the airline industry has a mostly successful track record of delivering passengers and cargo, people are for the most part willing to forgive the occasional air-disaster. However, with a new technology such as antigravity-based air-transport, there is not a long enough track record to permit public acceptance of air-disasters. One substantial disaster in the early days of antigravity could serve to forever damage the credibility of this new technology.

With regard to being economical, any type of antigravity system that intends to surpass existing methods of air-transport must be able to do so at a less-expensive rate to own and operate, and must have a vehicular lifespan at the very least similar to conventional air-transport devices. This would allow the total cost of ownership (TCO) to be less for an antigravity vehicle than it would otherwise be for a conventional craft.

There is one caveat to acceptance of antigravity technology as compared to conventional aircraft, which is simply that if antigravity vehicles are able to operate in an environment or manner that precludes conventional aircraft, then they should be able to gain a market niche without immediately having to surpass conventional aircraft in the area of TCO.

Assuming that we can develop a propulsion system that is both more reliable and less expensive to operate for the transportation of passengers and cargo, we then have to build up the skeleton of a vehicle compatible with this form of propulsion around the actual propulsion system.

For instance, a conventional aircraft has pitch, yaw, and several other flight controls, but for an antigravity vehicle there is a high likelihood that some or all of these controls will not be required, thereby changing the dynamic of flight associated with the craft. This will require new methods of pilot certification and flight-qualification, as well as requiring a control-philosophy to be created surrounding how the craft will operate.

I use the phrase "control-philosophy" instead of simply "control layout" because one of my assumptions about antigravity propulsion systems is that they will allow more flexibility in the design process for engineers to determine how the craft "should" fly, as opposed to an aircraft or helicopter, in which the components determining speed and handling are based primarily on an interaction between the design of the craft and the atmosphere.

In brief, an antigravity cargo-transport may have very different needs for flight than perhaps a lightweight passenger vehicle would, although there would also need to be a consistency between the control-systems of these devices to reduce the need for extra pilot training and competency testing.

Therefore, it should be apparent from the last few paragraphs that not only are there several propulsion-system related challenges involved with developing a commercial antigravity device, but there are also several challenges in the design, training, support aspects of this technology that also factor into the requirements to be complete before a complete product can be delivered.

Conclusion

At the beginning of this treatise, I posed the simple question of **"how far away is commercial antigravity"**. The reader, I expect, probably interpreted that question in terms of time, which is the usual measurement of questioning when new technologies will become part of our lives.

However, as I have attempted to demonstrate throughout this article, **the time component is much less important to the development process than is the distance component – that is, how far away from commercial antigravity we are.** When I use the word distance, I mean specifically what tasks must be completed in order for antigravity to go from being a proof-of-concept approach to a new form of propulsion-system to being a completed vehicle ready for manufacture.

I have attempted not to address the legal implications of antigravity technology with regard to certification for general or specific use – my thought on this is that the discussion of legal ramifications of antigravity is best left for another time. This is due primarily to the size and scope of that discussion, which is beyond what I am attempting to analyze in this article.

So, in finale, how far away from commercial antigravity we are depends not so much on time as on the rate at which we can perform the work required to provide the underpinnings on top of which the technology can be built. This seems important to me, as it underscores how close we appear to be to a working method of antigravity propulsion, and how we might consider focusing resources and goals to achieve the realization of this common dream that we share.

EDITORIAL: PERPETUAL MOBILE OF 1902

There is one more interesting example of perpetual mobile, which was described in the collected articles [1]. The motor shown in Fig.1 was invented in 1902. The vessels *b, c, d* and *e* are mounted on a shaft *a*, and have one side *f* tangential to the shaft, and the other side radial. Compressed air is forced into each vessel through the valves *p*. It is stated that under "the action of the internal pressure of the vessels, and after a slight impulse has been given to same, in the direction of the arrow, the whole apparatus will begin to move and continue to do so without ever stopping, the velocity corresponding to the pressure established within the vessels".

Really simple... Let's try to examine it.

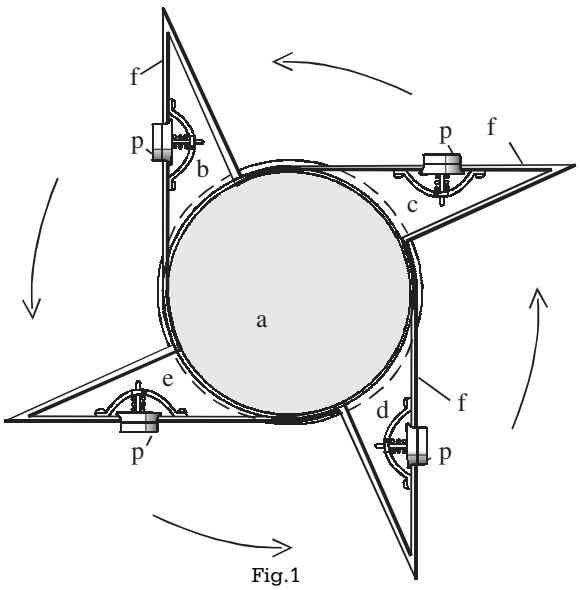

Fig.1

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Action without Reaction

New Gravidynamic Paradox

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Editorial: Yu.N. Ivanov discovered a new unusual physical phenomenon that is a gravidynamic paradox. The sense of the paradox is the existence of the situation, which is not forbidden by physical laws and which allows any man (even a child) easily hold suspended or carry things with 100kg or more weight by means of some simple device. This phenomenon is just a part of the significant applied topic and a demonstration of the possibility to cancel weight characteristics of any material object. Per se it is a work on the obtaining of the methods to eliminate aircrafts weight.

We can use only resistant things as a support!

Galilee-Newton's Laws are in the basis of classical mechanics. Thought concerned fundamental, these laws do not explain the main thing, i.e. the internal processual essence of the phenomena, described by them. There is another scientific line – the quantum mechanics, which tries to discover the essence of deep processes. There is no connection between these lines, therefore they as if exist independently. There are also long-time conversations about necessity to combine the quantum and the classical approaches. We suppose, that practically the combining has already happened, since thanks to rhythmodynamics, there appeared phase, frequency and velocity of light in formulae of classical mechanics (without these attributes the quantum mechanics is impossible). It was revealed, that phase-frequency method of late mechanics formulae presentation gives a real physical sense both to formulae themselves, and to concepts which seemed vague before *(namely: cause of motion, force, velocity, inertiality, gravitation)*. In this sense, the upcoming rhythmodynamics fills up the gap between the main physical lines and draws them together. But let's change the vector, since **the subject of the given article is to concern cases in which the third Newton law is not directly valid.**

Newton formulated the third law in the following way:

"Action always has equal and opposite interaction, in other words, actions of two bodies on each other are equal and directed in opposite sides".

This law represents the fact that one-way action of one body to another cannot exist in nature, but there is only an interaction between them, i.e. there is no action without reaction [1].

We must note, that the third Newton law is valid only for systems with 100% feedback, appeared in the interaction period. For example, during the magnet influence on the iron object it is revealed, that this object also starts to influence upon the magnet, i.e. to attract it with the same force. It happens because in the period of action of magnetic field the iron object itself becomes the source of magnetic field (Fig.1). Here the magnetic field, as an especial environmental condition, acts as a mediator, i.e. exists by itself in the interval between object and magnet .

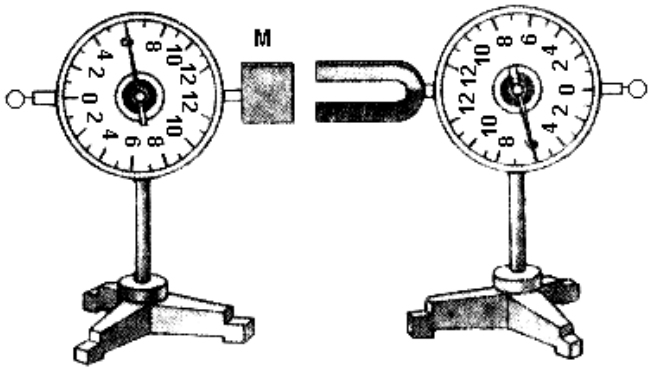

Fig. 1

Interaction of magnet and metal body M. Here the action is equal to reaction, i.e. the third Newton law is valid.

It is considered to be that magnetic field, created by electric current, spreads with the velocity of light. If current impulse is short, then the magnetic field spreads independently from the conductor and no matter if there is current in the conductor at present, or not. If the distance up to the object is big, then the magnetic field remains between source and object for some time, and has no influence upon the object. In this sense the portion of magnetic field, placed on the path between source and body, can be considered as moving independent "entity", i.e. the space by means of itself carries its changed state (magnetic properties) from one place to another. In this period magnetic properties in the form of quantum can influence neither on the source, from which the magnetic quantum is already detached, nor on the object, which the magnetic quantum still does not reach.

But having reached the object, magnetic field changes the state of this object. If as the result of influence the object becomes a source of magnetic field, then the part of the field is reradiated in the direction of source, i.e. the object itself becomes the source for some time, and by this it is able to influence on the first primary source. In this situation the principle of action and reaction works, because the feedback takes place.

If the feedback does not appear during the period of influence of one body to another, then the action and reaction law is not valid in the system. Let's demonstrate it by the example of the mechanical experiments, in which there is a feedback between objects.

Let there is a device (Fig. 2), which throws off two water (air) streams in the opposite directions in such a way, that reactive forces completely compensate each other. At that the thrown down stream compensates the gravity too. In this case the device will fly without falling, i.e. it will have zero weight.

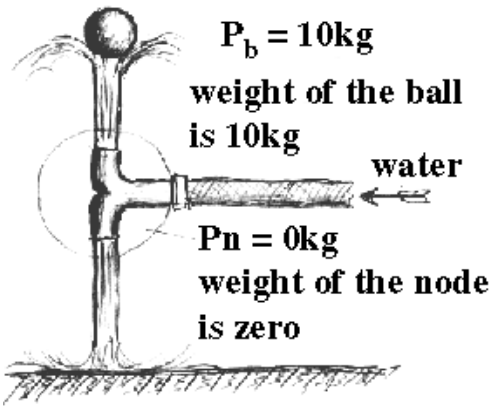

Fig. 2

The ball, suspended in the water stream, does not put pressure on the source. It happens because there is no feedback between the ball and the source. If you have such a device, then, lifting the ball by means of it, you will not feel the weight of the ball. The reason: the ball hangs due to the kinetic energy, which the stream passes to it and and this ball can not influence on the source through the water stream.

The appearance of the ball with the weight P_b does not influence on the weight P_n of the device. And even in the case if we press the ball down, i.e. essentially displace its location in the stream, the device will feel nothing.

The absence of device weight is evident for us; therefore we can easily move the device if its original (vertical) orientation remains unchanged.

Let's change the situation and place the ball (body with the shape, which is steady for hanging) in the upper stream. This ball with the weight about 10 kg is placed in a way to be kept by this stream at some distance, for example at 0.5 m. Will the device react on the changed situation, i.e. on the ball appearance? Will the weight of the ball, hanging in the stream, be added to zero weight of the device (0 + 10 kg)?

The calculation shows that it will not: $\Sigma P = 0 + 10 = 0$ [kg]. There is only an illusion that the ball is supported by the stream and that it is a part of the system. As a matter of fact, the ball is detached from the system and hangs due to the water kinetic energy. It is easy to check it by making an experiment in a bathroom: "Remove the douche sprayer, then direct the stream up and holding it by the one hand with the aim of weighting, try to influence on the source by the other hand through the stream. You will be surprised to feel that the hand, which is supported by the stream or any object, which is hanged in the stream, does not influence on the source".

At first sight the situation seems to be a paradox, however it very illustrates the possibility of the force action without reaction. So, the action can be one-way, i.e. calling no reply reaction in the form of pressure on the action source.

In such an unusual way it is possible to keep the ball of bigger weight (100 kg and more), at that to move it easily by means of the device and at the same time not to feel the presence of additional weight in the stream. **It is possible only in the case when there is no feedback between body and source,** i.e. the body, hanged in the stream, has no ability to act on the force source. Thus, we can both hold and move the heavy ball without additional efforts, and also lift it up to any height (for example, 100 m). As a matter of fact, we deal with the **new gravidynamic paradox**.

It is interesting then, how to solve the task of the following type: "Let the body with 100 kg weight is hanged in the water (air) stream in such a way, that it does not change the velocity and direction of liquid outflow from the source nozzle. How much energy the operator must spend to lift this body to the height about 10 m?" (Here it means that the operator must take the device, which supports the ball, and, moving upstairs, lift the body, which hangs in the stream, by means of this device to the height about 10 m). If to solve this problem correctly (the condition is that the operator lifts himself together with the device and the ball), we will find out, that operator's energy is spent only for lifting of the device, which creates water streams. The operator, lifting together with the device, will not even notice that in the stream there is a body with about 100 kg weight **(this is the sense of the paradox).**

The situation only seems to be absurd, and even paradoxical for theorists, but it is not a hopeless one.

We can also observe the effect of action without reaction in ultrasonic field of the source. If the source is fixed on scales (Fig.3) and body is hanged, as it was made in the stream, the scales will show only the precise weight of the source and will not react on the weight of the hanged body, no matter how heavy it is.

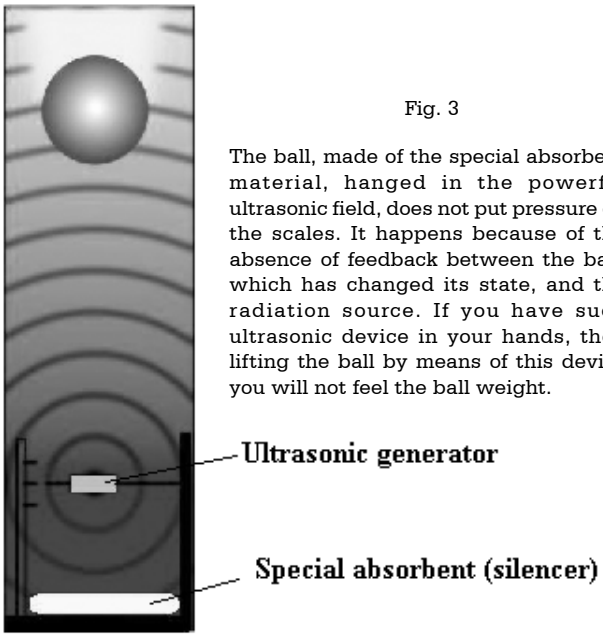

Fig. 3

The ball, made of the special absorbent material, hanged in the powerful ultrasonic field, does not put pressure on the scales. It happens because of the absence of feedback between the ball, which has changed its state, and the radiation source. If you have such ultrasonic device in your hands, then lifting the ball by means of this device you will not feel the ball weight.

The experiment of such type was made in one of the secret institutes. Water was used as an acoustic environment. The heavy ball easily floated up from the vessel bottom i.e. it behaved as if it had no weight.

The similar phenomena but such of the other organizational level, sometimes become apparent in nature. The phenomenon has its very name because the event happens unexpectedly and is not analyzable through laboratory research [3].

"A spherical ball lightning about the size of a football ball flew over a village Galtsovka of Altaisky Krai at a height of twenty to thirty meters. The first shed in its way, with ferroconcrete poles, was crushed and collapsed. Flying over a slated house, the ball lightning tore away the roofing slate together with nails, raised it into air and pulled it along, scattering its parts all over the village. Flying over a tractor station, the ball lightning crushed a frame, welded of metal angles and covered with tarpaulin. On the approaching of the ball lightning to another frame, it was at first dragged along the ground, and after the ball lightning had passed it, the frame was lifted and carried at a distance of 300 meters. The weight of the frame was no less than 100 kg".

Further the author analyzes the situation from point of view of the known physical laws: "The frame of hundreds kilograms weight was carried by fields of the flying ball lightning. However, for some reason the ball lightning kept on flying straight and did not note that some metal frame was caught to it. If the ball lightning, as it is usually considered, has a density of air and it is a weightless formation, then why the frame with the weight not less than 100 kg could not change its flight trajectory even in some extent?"

It draws attention that in some cases the ball lightning field pushed objects away, and in other cases it attracted them. It can be explained only by fact that in each case the ball lightning field specifically influenced on internal properties of objects, and then objects themselves somehow reacted on their new state (they changed their motion) . The feedback absence (in other way it happens between magnet and iron object) allows the ball lightning not react upon the things, which take place in its field. If these objects themselves became sources of similar field, i.e. reradiated it, they would influence on the ball lightning trajectory. **Most likely, in the given case, there was realized the situation when action caused no reaction.**

Conclusions

In the context of known physical laws the particular problem of direct action without feedback was formulated and solved. The solution of this problem provides deep understanding of how to control weight characteristics of material objects in open systems. As it was shown by the example with water (which is only an illustration of more fundamental processes) we can "deceive" the nature, but only through the deep understanding of the processual character of the concerned events.

By the example of ultrasound we show, that in principle there can exist such field flows, which are able to influence on bodies without the feedback effect. There were defined some conditions and criteria of bodies and methods of influence, at which the third Newton law is not directly valid (it is not published in this article).

The described type of influence can be called as pressure. But during consideration of processes at atomic or deeper level, i.e. from the position of rhythmodynamics, we find out something of another kind, that is phase-frequency one. It prompts to us, what kind of technologies will exist and how our aircrafts will look in nearest future. But not everyone is able to understand it at once.

Moscow 15.05.2002

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Comment

In the gravitation field we have a balanced open system, in which appearance of the new body at first sight must cause this system reaction such as weight increase. However, this is not the case.

The given problem is solved in two independent steps:

1) examination of interaction between water source and water (reactive effect, which is compensated by counter flow);

2) examination of interaction between water, detached from the source, and the body (unit time impulse per unit area).

It is impossible to examine the interaction between the source and the body because water has no rigidity. There are no means to influence on the source through the intermediate stream, therefore the principle of action and reaction is valid for each step individually, but not for both! But in this case the third Newton law must be developed as following: "If there is a 100% feedback between two bodies, their interactions are equal and inversely directed. And if there is no feedback, the action of one body to another causes no reaction, i.e. the action is not equal to reaction". And this is already another law!

New Possibilities of Vortex Electric Power Devices

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The earlier published article [1] was devoted to the explanation of the excess energy output at the rotation of flow medium in vortex tube (VT). The researches on VT demonstrated by the real examples that the excess energy output is a real fact, which is determined by natural physical processes. These processes take place in the fluid at its vortex (rotational) motion in the closed volume by means of phase transformations (skips) of the fluid state. However, the practice shows that for obtaining of patents and benefits for the real vortex devices, which are made for heat generation, it is necessary to write a little about their real technical characteristics, though technical and constructive possibilities of vortex devices can be much better. Temperature of water of these devices could not be higher than 120°C, and value of fluid pressure is confined within 5…6 kg/cm^2. Circulation pumps of pressure over 6 kg/cm^2 are used to increase thermal power output of vortex heat generators (VHG). It causes the discredit of VHG since at such a method their generative possibilities reduces to 100% value and less! We set a problem to discover the ways and engineering solutions for the essential increase of the coefficient of VHG energy conversion to not less than 200% value.

Our experience in development and exploitation of deep-sea physical devices has given some engineering solutions in this way. Actually, we have the opportunity to use the generally applicable circulation pumps, which have pressure not more than 4.0 kg/sm^2. At the same time we can raise the temperature of the heat carrier to 300°C and higher! and the pressure can be increased to 1000kg/sm^2! Such fluid parameters allow to use this fluid as a heat carrier in powerful hot-water generators of steam engines, turbines etc. By the way, this method allows to make the value of temperature of water enough to supply its PYROLESIS! The main point of the method is the following: all the closed system of water-filled VHG works at pressure with the value under 1000kg/sm^2. It is provided by means of the special device, the so-called automatic pneumohydraulic block (APHB). This lets to raise the temperature of working fluid to 1000°C with no change in its aggregative state. The practical functional scheme of such a device is shown in Fig.1.

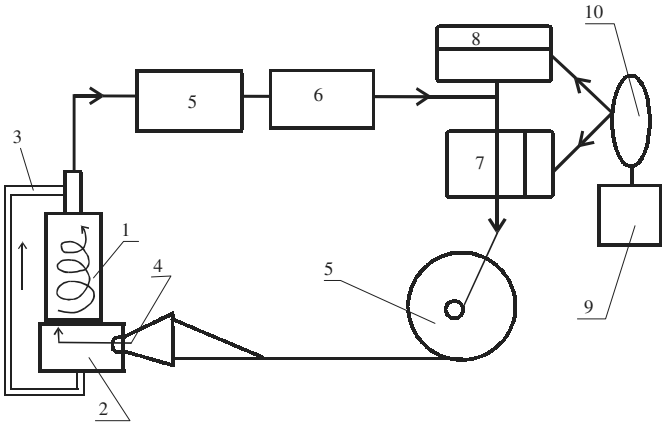

Fig. 1

1 – vortex tube; 2 – entry vortex chamber; 3 – by-pass; 4 – upstream end; 5 – circulation pump; 6 – heat-exchangers; 7 – APHB; 8 – volume of fluid leakage compensation; 9 - compressed-air flask; 10 - gas pressure regulator

The device works in the following way. The whole device is filled with working fluid without entrapped gas. At the operation of the circulation pump (5), fluid through the upstream end (4), placing in the entry vortex chamber (2), swirls, accelerates and gets into the vortex tube (1), where its "energy saturation" is realized. Then heated fluid gets into the heat-exchangers (6) for heating or for other purposes. After passing through the heat-exchangers, fluid gets into the pneumohydraulic device (7), where there is kept up the proper level of fluid pressure in the whole system. To prevent the system breakdown at the accidental fluid leakage, there is a device (8), which compensates such leakages. Compressed-air flask (9), with the volume under 1000kg/cm^2, and gas pressure regulator (10) keep up the selected level of the pressure in the system. The use of blocks (7,8,9,10) excludes evaporation in the system and prevents the breakdown of the circulation pump (5).

This VHG scheme allows to double the effectiveness of YUSMAR devices [2] only at the expense of rise in working fluid temperature in 2…3 times.

Observation of any fluid swirls and film documents of windspouts arrive to conclusion that all vortex structures are rotation bodies, created by the lines of the second order: $Y=aX^2$. In other words, as a result of the rotation in the swirl, air or fluid mass gets the acceleration of the second order. Taking into account the aforesaid, it is evident that in order to form the classical swirl in the VT, the very VT should be a tubular body of rotation. This body is created by the curve (see below Fig.2).

In YUSMAR and similar devices the vortex fluid motion take place in straight cylinder and 1/3 of this area is used for fluid deceleration that causes vortex flew

disruption. This results in the impossibility to increase additional heat in the straight tube in more than 1.54 times. It is caused by the fact that the main vortex formation takes place only in the vortex chamber and the flows separation does in the tube itself. Then, this vortex formation is right away disrupted by different plate brakes! It suggests itself that output part of VT should be made in the spiral form, expanding at the flow passage.

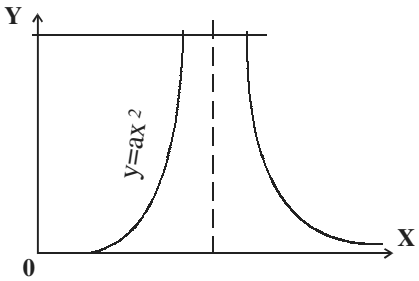

Fig. 2
Generatrix of the wall of vortex tube

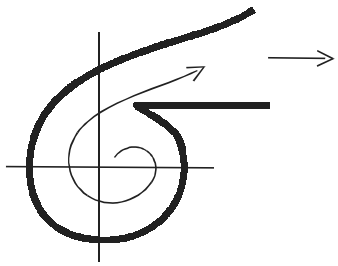

Fig. 3
Upper part of the tube

Such section, made on the outlet of the vortex tube, helps to slow down the flow avoiding its disruption, since axial-cold flow, placed along the tube axis, should stay intact. Two of such engineering solutions allow raising the level of the additional VHG energy up to 180…200%.

YSMAR devices are designed for one tube with the assigned heat output. However, if to take into consideration and to use the aforesaid conclusions, then we can raise energy conversion coefficient (ECC) above 200% at the series connection of two and more VT. The scheme of such a device is shown in Fig. 4.

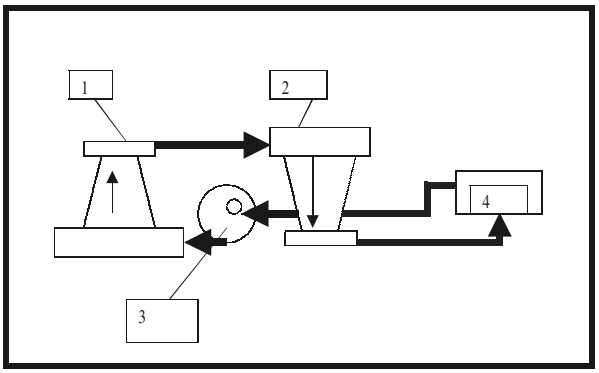

Fig. 4

Where: 1 – the first VT; 2 – the second VT; 3 – circulation pump; 4 – heat exchanger

According to Fig.4, the total energy output of the presented device is:

$$Q=K^2$$

Where: *Q* is the total output of the device; *K* is energy conversion coefficient of one VT; 2 – quantity of serially connected VT; *P* – the assigned power of the circulation pump.

In our earlier article [1], concerning VT application, we supposed that there is a straight transformation of vortex motion of ionized fluid into electric current. Under studying of many articles, devoted to the methods of water ionization, we discovered a significant one. It demonstrates that at the determined temperature, pure water increases its ionization capacity up to 3 orders without changing in the aggregative state [3]. The diagram in Fig.5 shows such dependence.

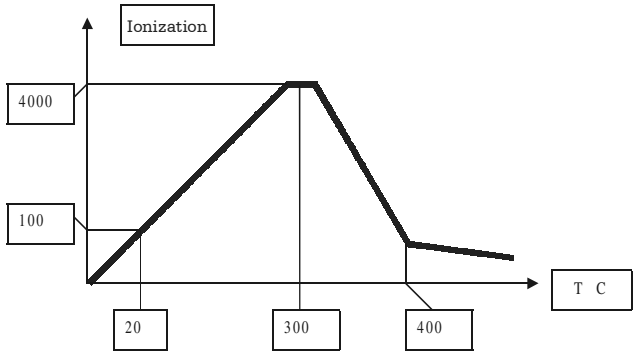

Fig.5
Diagram of the dependence of pure water ionization from temperature

The diagram demonstrates that water at 300°C temperature increase the quantity of ions in 4000 times as compared to 0°C and in 40 times as compared to 20°C. If to take into consideration that first experiments on VHG modernization help us to find the ways of fluid heating up to the practically any temperature without changing of its phase state, then on using the dependences (see Fig.5) it seems possible to create vortex fluid electric generators of the forward transformation. The aforesaid pneumohydraulic block, which is used for VHG functioning, allows to keep up water temperature at 300°C and pressure at about 90kg/cm^2 without threat of water evaporation! Presence of any rotation of fluid medium always causes appearance of two vortex flows. **These flows always move and rotate in opposite directions and if we do not put obstacles for their motion then they transform into each other and can exist without energy supply for an indefinite period of time.**

The presented VT form (see Fig.6) provides the producing of two fluid flows in the tube. These flows do not influence to each other and there is only their reciprocal overflow without disruption of the flows in the central part of VT. The tube presents a tubular body of rotation, which is created by hyperbola. There is positive angular acceleration of fluid in the lower part

of the tube; maximum speed of rotation of the axial and peripheral flows is in the middle part and negative angular acceleration, i.e. deceleration and transfer of kinetic energy into heat energy, is in the upper part of VT.

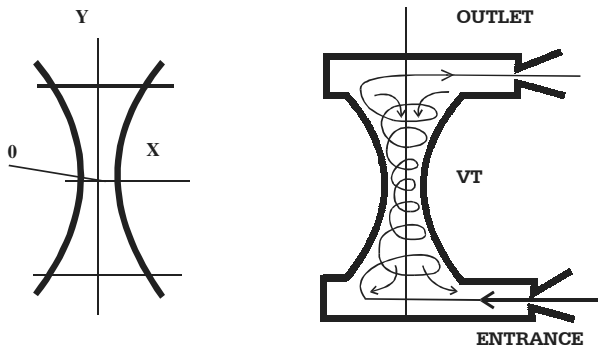

Fig.6

The maximum heating of fluid and its polarization is in the point Y=0. The polarization potential in the point can reach 10.000 V at 5m/sec flow speed for 10 cm diameter in the point. The cold flow, which comes along VT axis, is opposite to the peripheral hot flow. These flows close into one system in lower and upper chambers of VT. Thus, the presented VT classically modeled "rolling" and "unrolling" of water area.

There are no single vortexes in nature. Two vortexes, rotating in opposite directions, always appear while fluid mediums rotation! Science is not still able to describe energy overflows from one vortex center to the center of another one by means of mathematics. However we believe that this moment is close. There are maximum energy transformations of rotating water in the point Y=0.

The potential of the inner flow is equal to the outer flow by its value but is opposite by its sign. Potential difference is maximum in the point Y=0, in which removal of electric charges is the most effective.

It is appropriate mention here the name of Romanian engineer and researcher Henry Koanda, who in 20th of the last century discovered the so-called "Koanda effect" (attachment of fluid jet to the surface of usual kettle at pouring of it out the cups). Basing on this effect he suggested to make new type of aircrafts, which could have advanced bearing capacity and maneuverability. Unfortunately, money and conservatism of aircraft-industrialists did not allow realization of these engineering solutions.

At the same time, Koanda charged his disciple Patrick Flanagan with the job to research all **water properties**. The result was amazing! It was turned out that water actually has infinitely many phase states and when it is moving, then it can trap energy from the environment by some way. The publications on the point appeared in our press in the early eighties, late nineties of the last century. Most likely, they had become the basis of the invention, made by Potapov, i.e. vortex tubes for water!

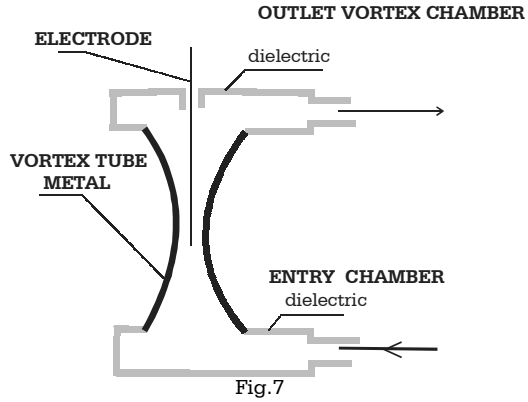

Fig.7
Scheme of vortex electric generator

In the presented scheme of electric generator the entry and outlet vortex chambers are made of dielectric material in the spiral form. This material certainly should withstand not less then 300°C of fluid temperature and about 100kg/sm^2 of pressure. Fluoroplastic or ceramic can be used as such a material.

From aforesaid it seems to be possible to submit the new scheme of electric generator for readers' consideration (see Fig.8).

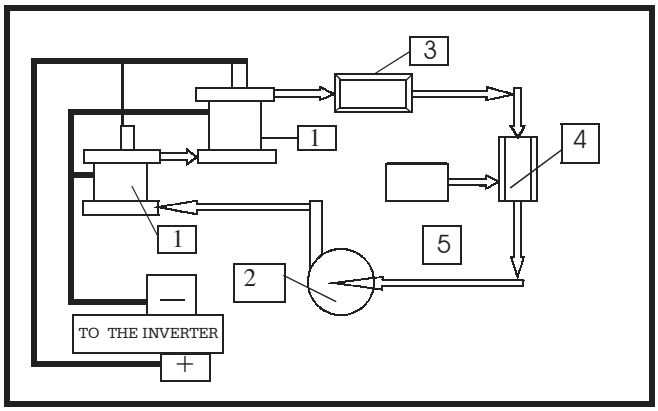

Fig.8
Generalized scheme of vortex electric generator
1 – vortex tubes; 2 – circulation pump; 3 – heat exchanger; 4 – automatic pneumohydraulic block; 5 - compressed-air flask

Actually we could finish the article if it were no disputes about excess energy, which is released at vortex motion of fluid in tubes. Having used a simple experiment, which any inquisitive person can repeat, we found the positive solution (see the scheme of the experiment in Fig. 9).

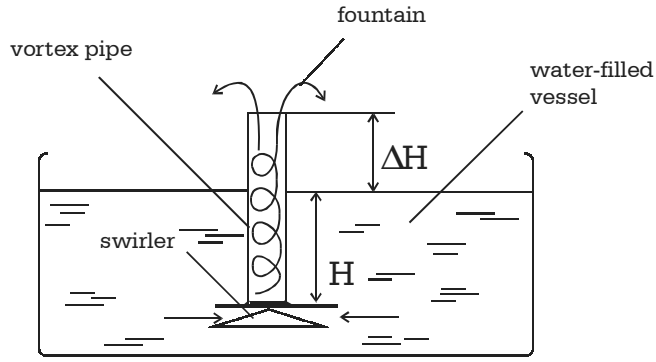

Fig.9
Demonstration of energy increase of fluid, rotating in vortex tube

A pipe with not less than 60 cm length and about 1-inch diameter is placed in a reservoir with not less than 50 cm depth. The lower part of the pipe is formed as an arm circular generator with about 15...17cm diameter. The gap width is about 2 cm. If we place the pipe with closed top end, which then will be open, into the reservoir, then water is splashed out above 20 cm of the reservoir level. Thus at the least 20% energy increase of energy mgH is observed.

By the way, we suggest orthodoxies of physics and other who have doubts to make one more simple experiment. Try to boil water in a can. When water starts to boil, swirl it with a spoon to the right or to the left. Then you will suddenly discover that all water surface is calm and only in the center of the can there is a water-steam mixture, which is about 20% higher than the level of water surface. You will also see that water is absolutely calm at walls of the can. This experiment can be reproduced anytime and anywhere, even in space, since it is a demonstration of **vortex** fluid motion and its actual influence on everything, which is around!

All presented engineering solutions are practically reproducible in any laboratory. The authors of the article would welcome the opportunity to co-operate with science and industry representatives for realization of the ideas in real serial production devices.

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3. Chemical and Engineering News. 2000 #1, p.26

Investigation of Electric Energy Transmission Processes in non-Metallic Conducting Channels

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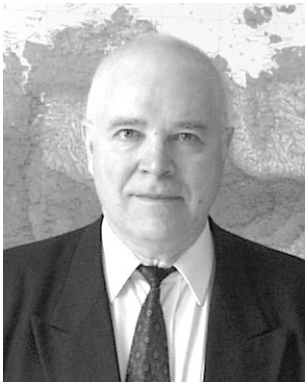

D.S. Strebkov

(Editor's notes by Alexander V. Frolov)

It has been found that at low frequency (1-25 kHz and higher) electric power can be transmitted with low losses from generator to receiver along single channel made of non-metallic conductive media such as water in plastic tube carbon thread, layer of damp soil, ITO films on glass substrate, laser and electronic beams. Transmitted power, as well as for traditional three phase lines, is limited by natural power of the transmission line and line capacity may reach at high voltage and pulse and operation modes the value 10^9 Wtt.

Introduction

The well-known methods of electric power transmission are based on transmission of active energy by means of conductivity currents in closed circuit. Electromagnetic energy spreads along power transmission lines (PTL) as progressing waves of electromagnetic field or field of charge [1]. Line wires made of aluminum or copper are conductive (guide) channels. Electromagnetic energy stream moves along these channels from generator to energy receiver and backwards to the generator. Maximum transmission possibility of 3-phase PTLs is limited by losses on the line resistance, by peak voltage (which is determined by electric strength of the insulation) and by electromagnetic stability of the line.

The modern approach to provide the electromagnetic stability consists in rigid regulation of line parameters by means of high-speed shunt reactor and consequence capacitive compensation for the purpose to except changes of electromagnetic power flows and to suppress resonant properties of a line [2].

In Tesla works [3] and in the researches of Russian scientists [4] a method of active power transfer was offered. This method supposes to transfer active power by means of electromagnetic capacitive current assisting with resonant properties of a single-wire line (SWL), made of a metal conductor. The purpose of the present work is a research of an opportunity to use non-metal conducting mediums for transmission of electric energy.

A pipe with not less than 60 cm length and about 1-inch diameter is placed in a reservoir with not less than 50 cm depth. The lower part of the pipe is formed as an arm circular generator with about 15...17cm diameter. The gap width is about 2 cm. If we place the pipe with closed top end, which then will be open, into the reservoir, then water is splashed out above 20 cm of the reservoir level. Thus at the least 20% energy increase of energy mgH is observed.

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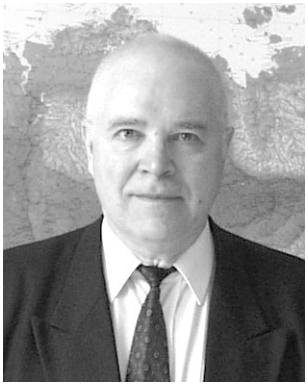

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Methods

For realization of the experiments a single-wire energy system (SWES) was used. Its electric circuit is shown in Fig. 1 a,b. SWES consists of the following parts: high-frequency generator (1) of 28V voltage AC and 1 kWtt power; transmitting (2) and receiving (3) Tesla transformer with conductive channel (4) between them; rectifier (5) and electric load (7) as an incandescent lamp or electric motor (220V, 1 kWtt power). High-voltage winding of Tesla transformer is made in the form of cylindrical winding on the ferrite core with 50-100mm in diameter, 4000-6000 turns. The internal end of a high-voltage winding is connected to the conducting channel, and the external end is not connected at all (free end). A low-voltage winding that consists of 40-60 turns provides power supply of Tesla transformer. At the submission of electric power from the high-frequency generator to the winding of power supply zero potential appears on the free end of the high-voltage winding, and voltage with corresponding to the generator 1-25 kHz frequency is formed on the conducting channel. Besides, Tesla transformer as the spiral antenna generates electromagnetic waves of 5-10 cm length , which corresponds to the turn length of a high-voltage winding. Current resonance mode is formed in a supply circuit of Tesla transformer. At the same time, voltage resonance mode (of frequency equal to the generator frequency) is formed both in the reception and transmitting circuit of high-voltage windings and in the conducting channel (1).

The following materials were used as the conducting channels: filled with water or sea water polythene tubes with 10 mm diameter and 1,5 m long; plastic tray with soil layer of 150×10×400mm; film of tin dioxide – indium oxide (ITO) on 0,3 micrometer thick and 300 Ohm resistant glass substrate; graphite thread of 0,1 mm diameter, 500 mm long and with 100 Ohm resistance. For comparison steel and copper wire of 0,1 mm diameter and 5 m long was used also.

The voltage on the conducting channel changed in limits 1-10 kV, generator frequency changed from 1 up to 25 kHz. Voltage, current and capacity were measured on SWES output and on the load by standard electric measurement equipment.

Results and discussion

The replacement of the metal conductive channel to the channel made of non-metallic conductive materials does not effect to any reduction of possibilities of transmitting SWES or heating of a material of conducting channels. The consecutive connection of the channels did not resulted in reduction of transmitted power. Circuits break in the conducting water channel by the creation of an air gap led to the occurrence of arc discharge of reactive capacitor current. However this discharge did not cause increase of water temperature at transmitted power 300 Wtt and voltage 4,5 kV within 1 hour, that confirms the absence of energy losses in the conducting channel. The increase of water temperature did not result in decrease of transmitted power. Water PH reduction from neutral value up to 4 was detected.

The increase of sea salt concentration in water up to the level of 5-7 g/l did not increase transmitted power in comparison with tap water. However the replacement of tap water to dionized water with 16 MOhm resistances resulted in 100 % decrease of transmitted power.

Thus, it is experimentally shown, that conducting channels, produced from non-metal materials, have quasisuper-conductive properties in SWES at resonant mode. Possible explanation of this effect is the absence of active conduction current in the channel and the dominant role in the process of energy transfer belongs to displacement current, for which Joule Lentz law is not valid [11]. In the supply circuit of Tesla transformer current is practically reactive, and in resonance conditions active values of inductive and capacitive currents are equal. Vectors of these currents are opposite in their phases. Current of the high-frequency converter is spent for losses (component less than 2 %) in supply circuit wires and in the core of Tesla transformer and also for creation of reactive current in the conducting channel. In the mode of voltage resonance we have measured voltage active values of high-voltage inductance windings and conducting channel, interturn capacitance of windings and the capacities of the conducting channel. **We have discovered that they were equal and their phases were opposite to each other.** Losses from transmission of capacitive current through active resistance of the conducting channel are insignificantly small. Corona discharged losses and leakage current could be decreased by isolation of conducting channel. In this case active current and magnetic field of the line are equal to zero. Electric field of the line has maximum value. As well as in usual PTLs, maximum transferred power is limited by charge power of the line. Angle between vectors of voltage is equal to zero in the beginning and at the end of a line. Quality factor of SWES at frequency 5 kHz is in 100 times above than usual PTLs at frequency 50 kHz. In the conditions of resonance it leads to the significant increase of voltage along the conducting channel and it also leads to transmission power.

In usual PTLs voltage changes along the line are insignificant. The angle between vectors of voltage in the beginning and in the end of PTL constitutes the value, which is proportional to the wavelength of line.

On the basis of the researches the methods and devices are offered for transmission of electrical energy through plastic water guide, electro-insulated from ground, through irrigational channels and through isolated pipelines, which are used for gas, oil, hot and cold water transportation. Also the energy can be transferred through fiber-optic cable with conducting film on the surface, through all-carbon composite cable and

through electro-insulated part of a ground and water surface, including highway parts. There are also methods and devices, designed for the following transmissions. These methods can be applied for transfer of power to stationary and mobile units. There are also generated requirements to electrical safety and to restriction of use of drinking and hot water from pipelines, which are under electrical voltage. These requirements and restrictions are generally the grounding of pipeline parts, which are located on certain distance from the generator. This distance is equal to the whole number of half-waves and for it SWES voltage is equal to zero. In the case of a side pipeline it is necessary to ground the parts of the pipeline that are placed on the distance of odd number of quarter-wavelength from the main pipeline. For 5kHz frequency the quarter-wavelength is equal to 15000 m.

N. Tesla grounded one end of high-voltage windings of his transformer on the receiving and on the transmitting end of SWES. Tesla considered this condition as the necessary one for the transfer of power along the Earth. The results of our researchers demonstrate that it is not necessary to use metal self-closed conductor (and current lines in the Earth) for transmission of electric energy on low frequency (1-25 kHz).

For this frequency energy could be transferred from the generator to the receiver if we have single-wire guide system created as non-metal conducting channel. By the similar way electromagnetic energy is transferred by laser beam or microwave-beam. But in our case we can obtain high degree of efficiency that is caused by slight losses on energy absorption and energy emanation. Thus one of the ends of high-voltage winding at the energy generator will have zero potential and remain free. The symmetric end of a high-voltage winding on the reception end should be connected to some natural capacity 6 (Fig. a), which can represent the case of a balloon or frame of a tractor. In our experiments we used metallic safe-box as such natural capacity.

Editor's note: In 1887, October 11, the famous Russian scientist Pavel Yablotchkov got the France Patent #120684, which described the method to increase efficiency of electrical circuit by means of "atmosphere electricity". It was confirmed in many experiments that output power can be twice more than power provided for the circuit from primary electric generator. For that it is necessary to use a single-plate capacitor. The special feature by Yablotchkov, that provides maximum efficiency, is the high degree of air ionization. For this Yablotchkov proposed to use the special capacitor, which consists of a big number of metallic needles. By its view this construction reminds of a hedgehog. Thus we can assumed; that above described natural capacity (balloon or frame of a tractor) serves as a collector of free electrons. By Yablotchkov the efficiency of such systems can be increased by means of maximization of ionization process. It will not lead to the increase of losses if the second end of the high-voltage winding is not grounded.

In the other method of energy transfer, a condenser-diode block 8 was connected to the conducting channel on the receiver end. This block is one of the known circuit of voltage doubling, Fig.1 (b). On the condenser 8 electric energy is transferred through electronic switch 9 to load 7. In this case the entire length of conducting channel 4 and Tesla transformer winding 2 at generator must be equal to odd number of quarter wave-lengths.

Non-metal conducting channel (for instance, fiber-optic or coal-plastic cable) can be used for transfer of electric energy not only along but also as perpendicular to the Earth (for example, to relay aerostat or sounding balloon).

SWES conducting channel can be also created by ionization of air ions with laser beam [13]. Neodymium laser with double frequency and with energy 1 Joule in impulse is able to create 10^{15} cm^{-3} ion concentration in air. This concentration is sufficient for streamer initiation and for transfer of electric energy through the conducting channel. Ionization potential, time of ion existence and of excited molecule state, coefficient of multiquantum absorption, all these determine the limiting length of conducting channel in atmosphere that is equal to 300 km and its wave resistance at 200-400 Ohm. Voltage which is necessary for SWES comes to the quantity 0,5 MV – 15 MV, that depends on the length of a channel.

We suggest to use relativistic electron bunches of high energy as the conducting channel out of the atmosphere. As distinct from laser bunches they do not have divergency. In this connection the Moon or artificial conducting body, where the energy receiver is placed, can be used as natural capacity 6. Whereas energy generator can be installed on the Earth or on its satellite. Transmission range of electric energy is determined by the length of the generated conducting channel. The entire length of the conducting channel in the beginning and in the end must be equal to the whole number of half-waves. Here the length of high-voltage windings of two Tesla transformers must be taken in considerations. Electric energy, transmitting through the conducting channel, can exceed the energy of electron and laser beams generators in 10-100 thousand times. These generators play the role of a directing system (of usual SWEG wires), along which the transfer of electric energy proceeds.

It was offered to use colliding and crossing electron and laser beams with conducting transitional bodies as conducting channels for transfer of energy from the Space to the Earth and back. On the heights up to 30 km compositional coaly and fiber-optic cables can be used. To create the global energy system of the Earth it was also suggested to apply single-wire energy system and conducting layers of the Earth ionosphere as the conducting spherical channel [14].

Thus for electric energy transfer at the frequency 1-25 kHz and higher in the resonance mode a single-wire channel from the following non-metal conducting

mediums can be used: water, damp soil, coal-plastic, oxide film, ionized air channels, that are created by laser beams in the atmosphere, ionosphere conducting layers, and also beams of relativistic electrons out of the atmosphere. These non-metal conducting channels in the resonance mode have negligibly small resistance losses especially if to be compared with metal conductors, which are used in the known non-resonance methods of energy transfer by means of active conduction currents in the closed circuit. Electric energy in the resonance mode can be transferred with small losses from the generator to the receiver along the single-wire channel, made of non-metal conducting materials. The transfer can be realized at the frequency 1-25 kHz and higher, to any distance and to any direction relatively to the Earth. The transmission capacity is limited by charge power of a line as well as in the usual PTL. At high voltage the transmission capacity can reach the quantity from 10 Wtt to 10^9 Wtt in the pulse and streaming modes.

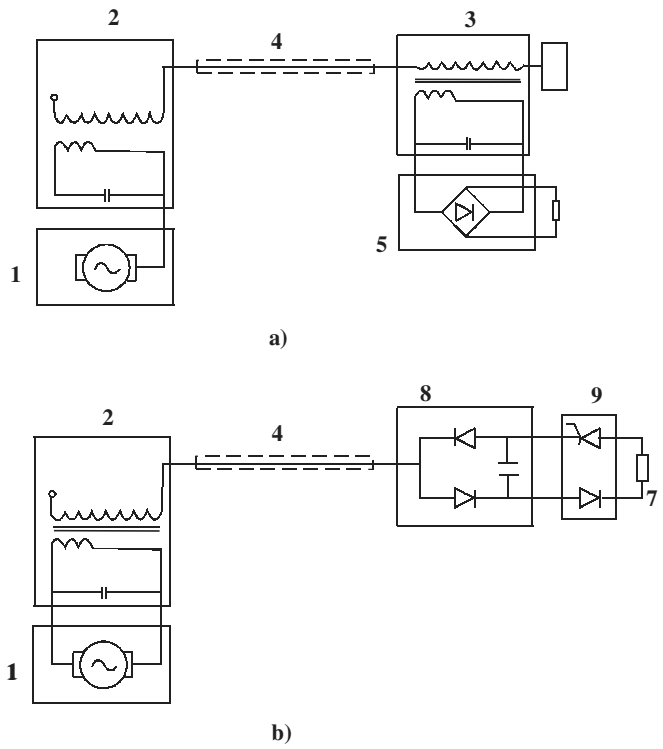

Fig. 1
Electric circuit of single-wire energetic system with non-metal conducting channel
a) SWES with symmetric array of Tesla generators

b) SWES with diode-capacitor block in the end of conducting channel

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Microcosm, Universe, Life

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The authors of this article have prepared the 3rd edition of the book "Microcosm, Universe, Life" and now they are looking for a publisher to edit Russian and English version. In particular, the mechanism of energy transformation in the Universe (Fig.1) is described in the book. Matter radiates energy in the form of photons (as well as neutrinos). In general this energy is observed in the form of Cosmic Microwave Background Radiation (CMBR). Photons and neutrinos transfer the most of energy to de Broglie longitudinal photons. Matter absorbs energy mainly in the form of longitudinal photons. Thus, a cycling process of energy transformation (as well as matter transformation) occurs in the Stable Universe.

The 3rd edition is devoted to the description of 6 World Systems (Table 1), at that the 6th System is based on Unified Field Theory, which is developed by the authors, and proceeds from the following:

(Editor's: The understanding of the energy transformation mechanism allows to develop new fuel-less energy sources based of mutual transformations: longitudinal photons $\longleftrightarrow$ transverse photons).

Table 1

System	Principal Ideas
The 1st – Geocentric (Ptolemaic system)	Geocentrism and Anthropocentrism
The 2nd – Classic (Copernicus – Newton's system)	Description of the Universe on basis of Newton's Law of Gravity
The 3rd – Compromise (Tycho Brahe's system)	The compromises between two first systems
The 4th – Fractal (Charlie's system)	Non-heterogeneity of Large-Scale distribution of matter in the Universe
The 5th – Relativistic (Einsteinian system)	Description of the Universe on basis of gravitational field equations. Anthrop principle
The 6th – based on Unified Field Theory	Electromagnetic nature of all physical interactions. Irreversibility of all elementary micro-processes in combination with circular character of transformations in Large Scale of space ($c/H=R$ order) and time ($t_H=I/H$ order).

1. For theoretical results, which agree with the facts, it is necessary to use assigned inertial system (as Lorentz did), which, as we have known, is connected with CMBR. Obtained by this way decisions can be applied to the other systems, in particular, with use of Lorentz transformation for mass, energy, momentum, time and length.

2. Theory must agree with the whole known collection of facts, starting with such established empirical generalizations as basic principles of Natural science (Giordano Bruno, Lyell) and conservation laws (Mayer, Joule, Helmholtz, Faraday, Newton, Huygens, Vernadsky).

3. All physical objects could be presented as the systems, consisting of quanta of positive electric charge (protons), quanta of negative electric charge (electrons in fermions or boson states, which are part of neutrons

and atomic nuclei) and quanta of energy, impulse, moment of momentum (apeirons).

4. The leading role in the Universe energetic belongs to de Broglie longitudinal photons (of the first class, i.e. with the spin I=0), energy of which is twice as much as apeiron energy and is equal to $h\,H$, where h – is Plank's constant, H – is Hubble's constant.

5. Longitudinal photons, polarizable and depolarizable by matter particles, are the carriers of gravitational, magnetostatic and strong interaction. Electromagnetic interaction is carried by photons with spin I=±1 and weak interaction is carried by neutrinos and apeirons with spin I=±0.5.

6. All elementary microprocesses are irreversible, that correlates with circular character of transformations in Large Scale of space and time.

7. In particular, there is an irreversibility of the process of photons and neutrinos motion. At each segment, equal to the length of de Broglie wave, photons and neutrinos lose energy $h\,H$, which is equal to longitudinal photon energy. In such a way, Hubble's law can be presented as the following:

$$\lambda = \lambda_1 \exp\left(\frac{r}{R}\right) = \lambda_1 \exp(Ht),$$

$$Z = \frac{\lambda}{\lambda_1} - 1 = \exp\left(\frac{r}{R}\right) - 1 = \exp(Ht) - 1,$$

where λ, λ_1 – are observable and laboratory wave lengths, r – is distance, R – is radius of gravitation interaction, which is equal to the radius of Metagalaxy, t – is time, Z – is cosmological red shift.

8. As resulted upon this process, the excess of longitudinal photons is absorbed by matter. At that, mass is considered as measure of capacity, which is absorbed by matter in form of longitudinal photons. Thus, energy of the matter should be increased according to the law:

$$E(t) = m_\circ c^2 \exp\left(\frac{\varepsilon'}{c^2} t\right) \approx m_\circ c^2 + m_\circ \varepsilon' t,$$

at that,

$$\frac{\varepsilon'}{c^2} = \frac{H}{137^2},$$

where ε'- is the capacity, which is absorbed by unit mass in form of longitudinal photons, c – is velocity of light. In particular, electron of the 1st Bohr orbit in hydrogen atom (i.e. in this case at de Broglie wave length) absorbs energy $h\,H$ at 1 period.

9. Being in ionization state, intergalactic matter is the general portion of average density of matter in the Universe ρ_{av}, besides, the average value of absolute velocity of baryon component is close to c/137. Let's consider this correlation to be exactly executed.

CMBR is the most powerful cosmic radiation. Its specter is close to that one of black body at temperature T_F=2.726K, i.e. its spectral density is maximal at frequency ν=160GHz. Cosmological red shift causes the increase of spectral density in radio-region (ν<160GHz) and the decrease of it in microwave region (ν>160GHz). Each of these processes is compensated by the inverse Compton effect, i.e. by the dispersion of radio-photons at matter corpuscle, first of all at protons. Calculations demonstrate, that average energy of absorbent radio-photons is equal to $0.45\cdot10^{-15}$erg (ν=68GHz) and average energy of radiated microwave photons is equal to $2.17\cdot10^{-15}$erg (ν=330GHz). There is one re-radiated microwave photon per one absorbed radio-photon. At that, the concentration of photons and CMBR spectrum remain unchangeable. Syunyaev and Zeldovich concerned the close inverse Compton-effect of CMBR dispersion on electrons in clusters of galaxies. Actually such an effect was discovered in 2 clusters of galaxies.

Thus, on transferring of energy to photons, matter corpuscles must fill the deficiency of energy by receiving it from longitudinal photons. In fact, there are observed demonstrations of longitudinal photons, they are "static fields". In this case it is a cosmic magnetic field, which accelerates charged particles of matter (Alfven). More detailed consideration let us to find a virial correlation between 4 main components of energy density:

$$\frac{\rho_{av} c^2}{137^2} = E_F = 2E_M = 2E_{kin},$$

where $r_{av}c^2$- is an energy equivalent of mass density of matter; E_F- is energy density of CMBR; E_M - is average energy density of magnetic field; E_{kin} - is average density of kinetic energy. Thus, some kinds of energy circularly transfer to another, which are interrelated (Fig. 1).

$$\frac{\varepsilon_{av}\rho_{av}V}{1.26} = E_F HV = 2E_M HV = 2E_{kin} HV = \frac{(\varepsilon_{av} - \varepsilon')\rho_{av}V}{0.26} = \varepsilon'\rho_{av}V,$$

where ε_{av} - is average capacity, radiated by unit mass in form of photons; V – is volume of 10^{81} cm^3 order, according to which the averaging is made.

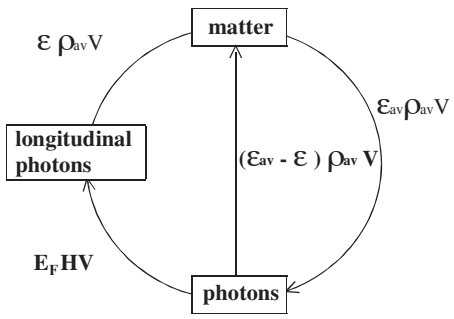

Fig.1
Energy transformation in Large Scale ε_{av}=0.0942 erg gr^{-1}sec^{-1} – is average energy, which matter unit radiates in unit time; ε'=0.07476 erg gr^{-1}sec^{-1} – is energy, which matter unit absorbs in form of de Broglie longitudinal photons in unit time; ρ_{av}=$0.8730\cdot10^{-29}$ gr cm^{-3} – is average matter density in the Universe; E_F=$4.18\cdot10^{-13}$ erg cm^{-3} – is energy density of cosmic microwave background radiation (CMBR); $V\approx10^{81}$cm^{-3} –is volume at which the averaging is made; H=$1.562\cdot10^{-18}$ Hertz.

10. These correlations include pressures, densities and temperature T_F, i.e. we have the equation of the state of intergalactic matter, and thus of Metagalaxy and the Universe. Let us present this equation in simple form:

$$E_F = \frac{\varepsilon' \rho_{av} R}{c} \approx \frac{\varepsilon_{av} \rho_{av} R}{c}$$

and let us compare it with correlation for density of radiant energy on surface of a star * or of star system

$$E_* = \frac{\varepsilon_* \rho_* R_*}{3c} \approx \frac{\varepsilon_* \rho_* R_*}{c}.$$

It is an especially amazing analogy between Metagalaxy (and the Universe) and large-scale cosmic system *g,* for which

$$E_g \approx \frac{\varepsilon_g \rho_g R_g}{c},$$

at that $E_g \approx E_F$, $\varepsilon_g \approx \varepsilon_{av} \approx \varepsilon'$.

This equation agrees with the whole observed data of globular clusters, galaxies, groups and clusters of galaxies, in particular, with empirical correlations, which are magnitude - angular diameter.

11. The stated approach lets to determine the values of many fundamental constants by different ways. As a case in point, the results of definite values ε_{av} and ε', erg g^{-1} c^{-1} are presented in the Table 2.

Table 2

#	Data	ε_{av}	ε'
1.	The boarder between two parts of the Main Sequence of stars	of 0.1 order	of 0.1 order
2.	The results of recalculation of observed star characteristics as respects to their centers	of 0.1 order	of 0.1 order
3.	The local minimum of star luminosity function near the Sun (according to G.A. Starikova's data)	of 0.1 order	of 0.1 order
4.	The correlation: mass - luminosity of white dwarf stars	of 0.1 order	of 0.1 order
5.	The correlation: mass - luminosity of neutron stars	of 0.1 order	of 0.1 order
6.	The correlation: mass - luminosity of globular clusters	less than 0.5	less than 0.5
7.	The correlation: mass - lumonosity of elliptic galaxies	more than 0.06	more than 0.06
8.	The correlation: mass - luminosity of spiral galaxies and irregular galaxies *Ir I*	less than 0.5	less than 0.5
9.	The correlation: mass - luminosity of galaxies as a whole	of 0.1 order	of 0.1 order
10.	The correlation: mass – luminosity of clusters of galaxies	of 0.1 order	of 0.1 order
11.	Empiric values of H, ρ_{av}, E_F constants	of 0.1 order	of 0.1 order
12.	The most exact values of h, e, G, E_F constants	0.0942	0.07476

12. Uncontradictory description of Microcosm and the Universe promotes the better understanding of Life, which is inseparably unified with them. The statistical data manipulation of more than 100 catalogues of microphysics and cosmic objects let us to get more than 1000 empirical correlations and diagrams, and to determine, that they agree with theoretical correlations, which were received according to the ideas on circular character of energy transformations (Fig. 1) and of matter in the Universe.

The Russian edition of the book is mailed out: the 1st edition (1995) at the cost of $3; the 2nd edition (1998) at the cost of $6.

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HYPOTHESIS OF A THEORY OF EVERYTHING

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This work grew out of an interest in curious occurrences, physical, mathematical and metaphysical. Many things just do not fit normal knowledge or are of unknown origin. Items such as gravity, time, mathematical equations of higher order, ghosts, e.s.p., etc. After a number of years, the problem began to appear to be not of this physical dimension but of a grander scale. A multi-dimensional space-time format seems to offer solutions to understanding most of the problems. In the following hypothesis all known physics and mathematics are considered to be valid. Metaphysical aspects, while not accounted for by physics and mathematics, are considered to be present in nature, either real or as a defect in physical processes, simply because they are experienced by so many people. The hypothesis will be kept simple because the details require the work of many specialists beyond my abilities and there is an endless list of speculative problems to which the hypothesis could be applied. To save time and distractions to the reader the following is stated as fact, knowing full well it may not be so, in order to present the most concise statement of the hypothesis.

The Universe, from the smallest to largest unit, is a quantum probability based fractal illusion. All matter exists in three-dimensional space, both internal and external. Any grouping can be considered a fractal space. It is both real and imaginary at the same time acting according to Eulers equation:

$$(e \wedge (i*Pi))+1=0$$

more useful in this instance is the general form:

$$e \wedge ix = -1=\cos x + i \sin x = -\tan 45 \text{ deg}$$

which allows use of a variable where Pi , a constant, is used in the original. The key to understanding of multi-dimensional space time is the realization that Pi is a variable! As we know Pi is the lock on three-dimensional space. Because of its mathematical nature it can neither grow nor diminish, thereby locking in the three dimensional form of the fractal unit under consideration. Such a fractal unit is considered to be at rest. But Einstein's equation $E=mc^2$ includes speed or movement. When objects are moving relative to a fixed point, the moving object is foreshortened in the direction of movement. A circle becomes an ellipse and Pi becomes indeterminate letting the circumference fluctuate, according to its relative speed, between two and Pi in a circle of unit diameter. If one goes beyond the value Pi the Universe grows out of bounds without limit becoming unstable. If the value goes below two then the Universe blinks out. I.e., one has exceeded the value of the constant c. Since all matter moves relative to a fixed fractal point and there are infinitely many points in the Universe of constantly changing velocities, the Universe is constantly adjusting its reality to the relative speeds of its components. Thus you get at times some weird things. Since not only time changes but the structure and observable mass also, one finds such things a matter appearing and disappearing as the small units of chaos move through the Universe. Changes in the local probability structure cause matter or reality to change in the image structure of the Universe.

To delve further into the aspects of what is happening, let us consider the following. Einstein's familiar formula gives the relationships for our three-dimensional fractal space. The inverse of the formula gives the speed with which any fractal space can change, including the Universe. There is both a positive and negative component to the change. If we consider our fractal space to be positive then we may consider any other point to be negative. There are an infinite number of such points and while the effect on our space may be small from any one point; the effect adds up. Any moving or changing of mass must effect the entire Universe. Mass and inertia are tied together in such a system. Measured mass is the attempt of the mass to return to zero relative speed in its associated fractal space according to the laws of physics, i.e. return to its lowest energy state. Inertia is the same effect of the changing state of the mass from one-dimensional state to another. Both are the result of efforts to change the dimensional state of mass. The positive aspect of the square root of the ratio of energy/mass is the view we behold from our position in space while the negative is the view from the opposite position.

In addition to the view of the Universe as being made up as fractal space, all moving at different relative speeds to any other fractal space, one must consider the make up of space having at the same time dimensional space, according to Euler's formula given above. There are at any moment an infinite number of spatial dimensions, defined by the relative speed of the fractal units involved, extending throughout the Universe. Each fractal unit is constantly changing its position in dimensional space. There are thus constantly changing energy states throughout the Universe both in relative position in real space and in dimensional space. While on one hand the distances across the Universe are immense in relative space, many points across the Universe are present in the same dimension at the same moment, possibly allowing for instance travel across space without the time penalty. This results in what might be considered a tuned circuit for the Universe or its components.

If we consider the structure of the relative Universe to be stored energy analogous to magnetic fields and the dimensional fields to be capacitive, then we can plot the results on a conventional two-dimensional chart

where x is the horizontal axis and the vertical is the imaginary axis. A well-known construction in electrical physics and which is known to very often follow relativity closely. That throws the negative side of i into the second quadrant and the positive into the fourth quadrant, if we consider the Universe to be reflective and x to be negative when i is positive. Euler's equation does not reflect a totally positive or negative result. One wonders at this point as to other equations where unity is set to one or higher dimensional equations where the three dimensional components are factored out leaving another component. The fourth is considered to be time but how do the remaining fit into a Universe as this hypothesis describes? The line of thought can be followed further into electrical analogy, which I leave to the reader. The important result is that there should be a resultant *Q*, figure of merit, of the Universe resulting in nodes, or peaks, of probability. The resultant tuned frequencies of the Universe can be calculated from known factors of the Universe. Such an effect should show nodes of reality where matter occurs.

Properly applied the above hypothesis gives speculative answers to most of the problems facing science today. Questions such as:

Is the Universe open or closed?

Both. At each fractal component of the Universe there is a separate universe each reaching limits beyond which it cannot exist. At the same time there is somewhere a top Universe that must ever remain open.

What is the structure of time?

Time results from the ever changing fractal Universe and goes forward because all justification of the Universe causes a corresponding change in reality. Time moves slower at higher relative speeds and as all time is perceived to be slower in other fractal units, changes in our time are perceived to always go forward.

What are such phenomena as ghosts, spirits, apparitions, etc?

Events such as these are fragments of probability left behind due to sudden changes in the probability of the illusion we perceive to be reality. Having little energy they are perceived but are not able to interact with the more forceful real reality. They float free in probability space interacting at random intervals with the more forceful realities of the real world.

Where is the missing matter of the Universe?

There may be clouds of matter floating about in deep space, however, most of the approximately 90% of matter missing will be found in the layers of dimensions making up space and which, though interacting, do not appear in our reality. Calculations show only about ten dimensions are active in any one reality. The rest curl up in a ball or knot. While an essential part of space or reality they are not perceivable from the fractal Universe of which they are a part.

Parapsychology?

Events of this type can be attributed to interconnections on the dimensional, or imaginary, level where there can be interactions between fractal units though not directly associated with each other in relative space. The manifestation varies or is temporary due to the constantly changing and adjusting due to interactions of the probabilities of the Universe. Due to the innate probabilities of each individual, one may be more susceptible or sensitive than other individuals.

Bible, prophesies, angels, demons, aliens, etc.

If one takes the Bible at face value, with some leeway for it's age and many translations, it pretty well describes what it purports to describe. Historic predictions and conditions of today. If we assume this hypothesis has any value then the passage in which God says "Let us make man in our image." takes on new meaning. If we assume the probability basis of the Universe and the constant changing due to justification of reality and time then the miracles listed do not seem so in violation of the physical world. The miracles only require some ability to control reality. Certainly well within the providence of a creator. It speaks of heavenly beings capable of traveling through the Universe in real time and some who interfered with mankind on the Earth and that they are still doing so today. If this hypothesis is correct then it is readily seen how such events could occur. Creation events closely compare with the way todays computers are made and organized. If man can do it, why could not the original creator? If one ignores a creator, then one is hard pressed for an answer as to how the Universe was created.

UFOs

If one accepts any part of the above then the functioning of UFOs begins to be understandable. They move through space by making spatial jumps through fractal nodes. Their appearing around magnetic and electrical sources maybe due to some, on our part unrealized, easy entry and exit to other space at those points. They are able to make right angle turns at high speeds because the speed is only from our viewpoint. From the viewpoint of the craft it is simply changing locations in space. The turning on edge may be only a different orientation of space at that point.

Particles "Out of the Vacuum"

As we shoot atomic matter at higher and higher speeds into nuclei we are able to fracture the construction of the building blocks of matter. The high speed fractal construction of probabilities of the unit used smashes into the target with enough speed to mix the probabilities resulting in new nodes from the total probabilities present. Various probabilities are ejected resulting in short lived particles in unstable nodes. At times fragments of probabilities appear out of nowhere as they form up to combine into larger nodes. Travel distance and speed observed may give a clue to the basic frequency of the Universe.

Black Holes

The midpoint of the tuned circuit of the relative structure and dimensional structure of the Universe. As matter spirals in, from the relative structure, to be torn apart into its basic probabilities it passes through to the dimensional structure of space which holds 90% of the matter. There it is available for recollection and use by the relative space.

Probability. Basic structure of the energy of space.

Everything operates at random but within preferred patterns set by the frequencies involved. If you look long enough anything can be found. As a result we find odd bones of prehistoric creatures that may have never existed. Weird things can happen. Odd pieces of structure can occur such as metaphysical events. The Q of space is sometimes sharp and sometimes rounded, spreading out to include things not really meant to be in the overall scheme of the Universe. Christ said "If you had the faith of a mustard seed, you could say to the mountain move and the mountain would move". (For those not of the Christian faith, this may be considered not as any proof but as a representative statement of the meaning of this paragraph.) That is in keeping with the quantum statements that nothing exists until it is seen and that we have some control over the probabilities. If the structure of space is based on probability then the next important question is 'What is a probability'. We look to probability as a simple mathematical work. But, what makes probability work?

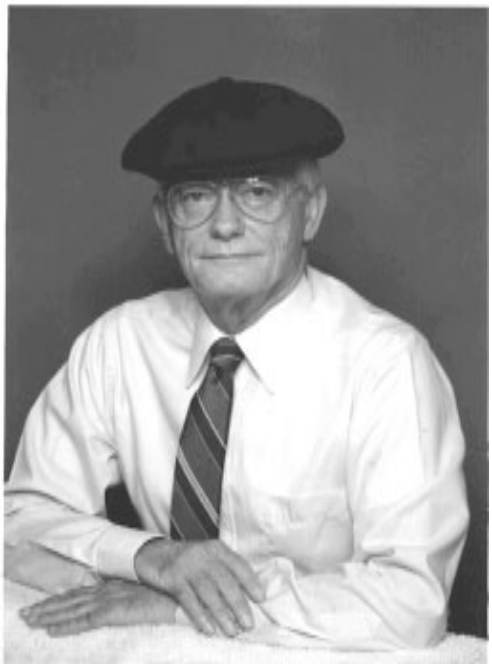

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The entire Universe is based on mathematics but we have no idea what is underneath the mathematics. Are dimensional planes perhaps better represented by other number bases? Are some of the unsolvable mathematical problems solvable in other number bases?

Gravity

All forces in the Universe are the same. Gravity happens to be the one that works on our fractal space. Others, molecular, atomic, and nuclear are the same but work in different fractal space. All are the result of matter trying to reach its lowest potential.

The above are only random questions chosen without any order. Most other problems can in some way be answered in line with the hypothesis, if not in detail. Too many questions can be fitted to the hypothesis not to take a serious look at it even though it may seem a little far out. The number of answers from one simple statement of the structure of the Universe defends the idea better than details.

One possible proof, and a relatively simple one, occurs to mind. Einstein's theory of relativity was proved when NASA flew a clock in space and then determined that time did slow down. To test the above hypothesis I would like to see four clocks used in the following manner.

Four atomic clocks in sets of two each. Two to be left on the Earth and two to be placed in space for an appropriate time. At the end of that time one of the clocks on the Earth to be taken into space and compared to the two already in space. Bring one of the clocks in space down to the Earth and compare to the clock left on the Earth.

The clock taken to space should read slower compared to the clocks in space because the ones in space were at rest compared to the one on the Earth.

The clock brought back from space should read slower, the same as the first one flown by NASA, because the clock on the Earth was at rest compared with the one in space.

The two clocks left in space should be returned after an appropriate time and compared to the ones on the Earth. The original in space should now be slower than the original on the Earth and its mate from space. The fourth clock is unpredictable.

The author apologizes for any errors in theory, mathematics, etc. There was no one to consult on the hypothesis which is an original work of my own and drawn on many references of others from the past If it has any value I am indebted to the work of all the others whose work I relied on. Any errors are entirely my own and not attributable to others. This work is freely published in the public domain to be used by any and all who wish to do so. It is not to be copyrighted or patented in any manner so as to restrict others rights to the hypothesis or it's use.

The Charge and Mass of a Photon

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Abstract

The discovery of true elementary particle named **electrino**, which has a constant mass and constant positive charge and which is a material carrier of magnetic field, electric current and all kinds of emanation, was firstly practically applied at the modernization of wireless telephone. In the review V. Anpilogov writes: "The question on the influence of low intensity microwave radiation on human health still remains open for discussion for more than 50 years" [3]. Discussion on this question has been already inappropriate still it was definitely proved in the patent application "Device, which is made to put away the charged particles flux from the head of the user of mobile wireless phone". During the talk on mobile wirelessphone $2{,}6\cdot10^{22}$ particle/sec pass through user's brain, whereas their energy is $7{,}65\cdot10^{-19}$ Joule, and the energy of binding of molecules in protein polymers ranges at $4{,}3\text{-}7{,}6\cdot10^{-19}$ Joule according to L. Poling. From that we can conclude that microwave radiation of the radiotelephone with top antenna leads to the destruction of user's brain tissue. The author of the patent application D. Baziev (#2001105456, 28.02.01. in Russia and #PCT/RU02/00054 of the international application) offers to fix the antenna on the low part of the radiotelephone and to produce radiotelephones with minimal length within 10 cm. In this case the diagram of the directional radiation pattern is on the level of the user's chin and the brain is out of the direct exposure area. This harmless of the microwave radiation could not be proved before the discovery of "electrino".

Introduction

A systems analysis of all experimental and observation material gathered in physics, astronomy, and astrophysics from the times of Galileo let us reveal the following:

1. Experimental materials do not agree with the existing physical theory.
2. There is a certain fundamental disadvantage of the experimental material, which prevents to build a consistent theory.
3. This fundamental disadvantage consists in the absence of a charge antipode of electron, which is in the form of a true elementary particle with a positive charge and finite mass.
4. The proton and positron are not true elementary particles and neither of them can be a charge antipode of the electron because they are subjected to splitting.
5. Discovery of the second true elementary particle with a positive charge could restore the charge symmetry in physics, thus leading to a radical revision of the existing theoretical physics and resolving its current crisis state.

Searching for this particle required to ascertain physical nature of Planck's constant. This became possible only after the structure of a light beam had been understood. Namely, it was the photon sector velocity, known as Millikan constant μ, rather than the speed of light *c*, that proved to be a constant, viz.:

$$\mu = \lambda_i^2 \nu_i = 119.916984 \text{ m}^2/\text{s} = \text{constant}, \qquad (1)$$

where λ_i and ν_i are the wavelength and frequency of the *ion* monochromatic beam in the light beam.

This new quantity elucidated the physical nature of Planck's constant:

$$h = m_\varepsilon \mu \frac{\sqrt[3]{4\pi/3}}{2} = \\ = 6.6262681\cdot10^{-34} \text{ kg m}^2/\text{s} = \text{constant}, \qquad (2)$$

where m_ε is the mass of the second (after electron) true elementary particle to be called "electrino". From this expression we have

$$m_\varepsilon = \frac{2h}{\mu\sqrt[3]{4\pi/3}} = \\ = 6.85575729963\cdot10^{-36} \text{ kg} = \text{constant}. \qquad (3)$$

The electrino has a positive charge ε determined by

$$\varepsilon = \frac{m_\varepsilon n_\varepsilon e}{m_u - n_e m_e} = \frac{-3.229526609098\cdot10^{-54}}{1.6578584539\cdot10^{-27}} = \\ = 1.98764431671\cdot10^{-27} \text{ C}, \qquad (4)$$

where $m_u = 1.66057 \times 10^{-27}$ kg is the mass of an elementary atom accepted as a mass equivalent of one atomic unit; $n_e = 3$ is the number of electrons in one elementary atom; $e = 1.6021892 \times 10^{-19}$ C is the charge of an electron; $m_e = 9.038487 \times 10^{-31}$ kg is an improved value of electron mass; $n_\varepsilon = 2.418198867 \times 10^8$ is the number of electrinos in an elementary atom.

Thus, it is obvious that Planck's constant is the angular momentum of the electrino. Moreover, it was Planck's constant that concealed the second true elementary particle, which is the charge antipode of the electron discovered by J.J. Thompson as far back as in 1897.

The solution of Planck's constant has become a basis for the synthesis of the new theory of physics [1]. This theory in particular shows that the electrino is the carrier of the magnetic field and electrical current. It is a photon of radiation of all ranges, and serves as a universal carrier of energy and information. The electrino plays the role of a neutrino in moving along the first order trajectories.

The first experiment

An extraordinary importance and novelty of the new theory required **an experimental proof of the electrino**. For that several experiments were made in the Institute of General and Inorganic Chemistry, Moscow. The experiment was based on the following effects predicted by the theory.

1. If assume that electrino exists and that light beam is a flux of particles having positive charge and finite mass [1] we can conclude the following. At the discharge of the dc source through an incandescent lamp in which the current is converted to light and irreversibly emitted, the source weight in charged state must differ from its weight in discharged state. If we prove this difference experimentally we may say that light does consist of material particles of finite mass and a dc charge carried away by light is positive because an incandescent lamp (W=15 Wtt) does not emit electrons, which are the carriers of negative charge.

2. The second effect to prove was that the weight of a discharging dc source is *increasing* whereas its weight when charged is *decreasing*.

To prove the validity of these predictions, several sealed containers with different dc sources inside were fabricated. The electrodes were brought out through glass insulators. The batteries were discharged through an electric lamp radiating in the visual and infrared ranges. The weight of containers was measured before and after discharge process with accuracy $\Delta W = \pm 0{,}02$ mg; balance error was equal to $\Delta = \pm 0{,}05$ mg the standard deviation of the measurements was within $\sigma = \pm 0{,}03$ mg; the buoyancy was calculated for each measurement of weight. In this paper, we present test results of only one container with four generally marketed GP rechargeable cells connected in series. The total battery voltage reached 5400 mV at 6000 mA/h charge capacity. The discharge was interrupted when the voltage dropped to 4000 mV, the duration of the discharge was measured accurate to one second. Two series of experiments were run: one in air, the other, under argon. Each series had ten charge-discharge cycles (Table 1 and Fig. 1). The total amount of the experiments and detailed discussion of results have been summarized in a recently published brochure [2].

The results of the above tests allow us to make the following conclusions:

1. Both galvanic and rechargeable cells during a discharge through an electric lamp show sufficient changes in their weight and charge thus proving that photons have a finite mass and a positive electric charge.

2. A new elementary particle, named electrino, derived from Planck's constant in August 1982, and published in May 1994, thus gets a complete and absolute experimental confirmation.

The second experiment

One of the concepts of the new theory is that the speed of light in vacuum is a function of photon frequency along the beam axis, according to the proportions:

$$c_i = \sqrt{\mu \nu_i} \quad [\mathrm{m/s}], \qquad (5)$$

$$\nu_i = \mu / \lambda_i^2 \quad [\mathrm{s}^{-1}]. \qquad (6)$$

According to the new theory, for the velocity of monochromatic light (solar light or mercury-discharge lamp, but not a laser) with a wavelength of $\lambda_r = 6.8 \times 10^{-7}$ m (mid-point of the red spectral line), we have

$$\nu_r = \mu / \lambda_r^2 = 2.59336038 \cdot 10^{14}\ \mathrm{s}^{-1}, \qquad (7)$$

$$c_r = \sqrt{\mu \nu_r} = 1.76348505882 \cdot 10^{8}\ \mathrm{m/s}, \qquad (8)$$

which is 58.823% of the speed $c_v = 2.9979246 \times 10^8$ m/s of a violet beam with a wavelength of 4×10^{-7} m.

We have to account that, according to this theory, the laser beam is not a true light beam though it is created of electrinos. The speed of laser beam is equal to the speed of beam plus the speed of current in the conductor, viz.,

$$\nu_0 = 2.8992629 \cdot 10^8\ \mathrm{m/s} = \mathrm{const} \qquad (9)$$

If we select a monochromatic beam of ultra-violet light with a wavelength of $\lambda_1 = 4 \cdot 10^{-8}$ m then its velocity will be $c_1 = 10$ C:

$$c_1 = \mu / \lambda_1 = \frac{119{,}916984 m^2/\sec}{4 \cdot 10^{-8} m} = $$
$$= 2{,}9979246 \cdot 10^9 m/\sec$$

$$\nu_1 = \mu / \lambda_1^2 = \mu / 16 \cdot 10^{-16} m^2 = 7{,}4948115 \cdot 10^{16}\ \sec^{-1}$$

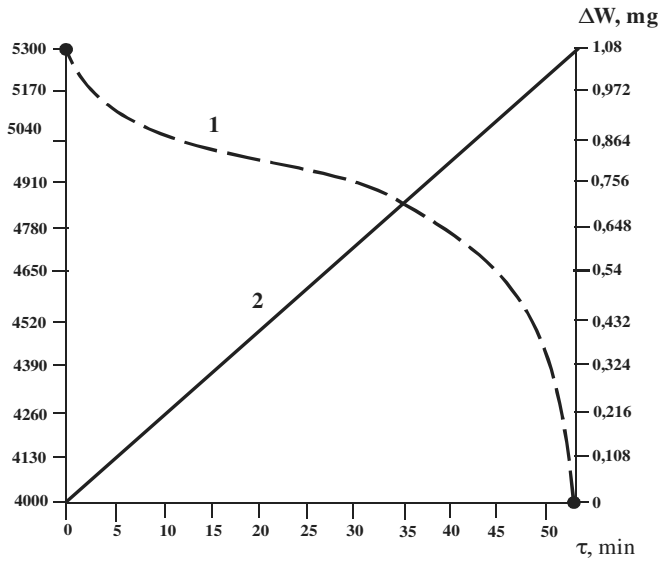

Fig. 1
Voltage drop [mV] of a battery and (2) weight increment [mg] of container #6 in an argon atmosphere during the second discharge cycle [minutes]. X-direction – is spark duration in minutes; Y-direction – is voltage of a battery; auxiliary Y-direction – is weight incensement (mg).

$$c_1 = \sqrt{\mu \cdot \nu_1} = \sqrt{8{,}987551907 \cdot 10^{18} m^2 / c^2} = 2{,}9979246 \cdot 10^9 m / \sec$$

This experiment has been run yet, and it is offered for experimental verification with further publication of experimental results.

Table 1

Weight of container #6 (under argon) in charge-discharge experiments

Run	Measured value $W \pm \sigma$, mg	Charged battery		Discharged battery			Charge weight $\Delta W_z = W_1 - W_0$, mg
		Buoyancy Gmg	Real weight $W_0 = W + G$	Measured value $W \pm \sigma$, mg	Buoyancy Gmg	Real weight $W_1 = W + G$	
1	126825.13±0,02	85.031	126910.166 ±.0.02	126825.901 ±0.01	85.002	12691.903 ±0.01	0.737
2	126825.107±0.02	86.572	126911.679 ±0.02	126826.221 ±0.01	86.538	126912.759 ±0.01	1.080
3	126825.21±0.01	86.782	126911.992 ±0.01	126826.279 ±0.01	86.560	126912.839 ±0.01	0.847
4	126825.187±0.01	86.563	126911.749 ±0.01	126826.493 ±0.02	86.385	126912.878 ±0.02	1.128
5	126825. 65±0,04	86.290	126911.941 ±0.04	126826.65 ±0.01	85.836	126912.941 ±0.04	0.770
6	126827.28±0.00	85.187	126912.467 ±0.00	126827.990 ±0.01	85.204	126913.194 ±0.01	0.727
7	---	---	---	---	---	---	---
8	126826.98±0.00	86.182	126913.162 ±0.00	12682 7.897 ±0.02	86.308	126914.205 ±0.02	1.042
9	126826.95±0.00	86.307	126913.257 ±0.00	126827.757 ±0.01	86.402	126914.159 ±0.01	0.902
10	126827.25±0.00	86.294	126913.544 ±0.00	126828.35 ±0.00	85.729	126914.079 ±0.00	0.535

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2. D.K. Basiev, Zaryad i massa fotona (The charge and mass of a photon), Pedagogika, Moscow, 2001
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About the Author

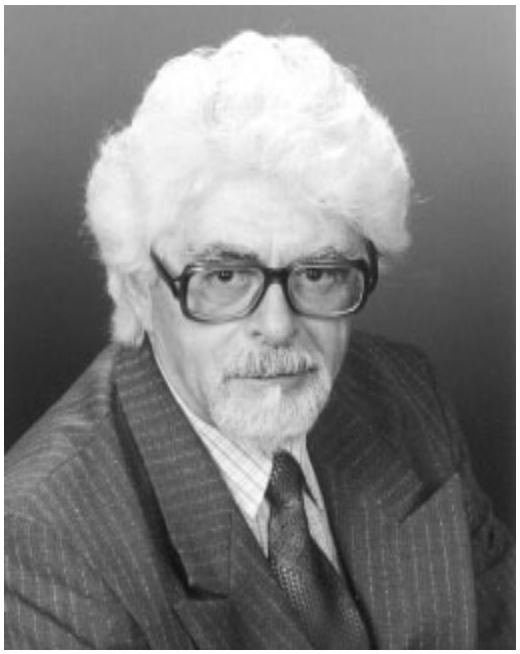

When a child Dzabrail Kh. Baziev became a political exile along with all Balkarian people; in 1956 he was rehabilitated and in 1957 graduated from the secondary school with steady purpose to become an outstanding chemist. His first higher education is biological and chemical (two-profile department of Kabardino-Balkarian State University). In 1965 Baziev also completed his post-graduate study in Biological Department of Moscow State University.

At 1979 Dz.Kh. Baziev had published 25 scientific articles on ornithology and ecology, however, this period became a sudden turn in his scientific work. In order to elaborate the basis of theoretical biology, he came to the conclusion that biological process could not be described without understanding of its physical essence. On the other hand, it had become evident that there was no any solution for physical phenomenon, which is the basis of biological process.

In 1983 the scientist gave descriptions of his first fundamental discoveries. He found the solution of the physical essence of Plank's constant and pioneered the use of it in gases analysis. It was a revolutionary step in science since the synthesis of science was realized at the fundamental level for the first time.

As the result of this considerable work there was a new interdisciplinary theory of physics. The author created new thermodynamics of real gases and new electrodynamics, which differs from maxwellian one and it considers *electrino* as the carrier of magnetic field and electric current.

Dzabrail Kh. Baziev has succeeded in the systematic analysis of the vast experimental material and discovered that ***electrino,* as the true elementary particle with positive charge, is able to provide the connection of physics with biology, chemistry and other parts of the fundamental science. Thus it leads us to the radical reconsideration of all conceptions, existing in natural science.**

The Homopolar Motor: A True Relativistic Engine

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This article discusses experiments, which enable the identification of the seat of mechanical forces in homopolar-machines. Authors provide a suitable variation on a recent work "The Unipolar Dynamotor: A Genuine Relational Engine" [3], where "relational" implies "absolutely relativistic". The authors' view agrees with both Weber's recognition in the 19th century of the importance of relative motion in electromagnetic phenomena [4] and Einstein's 1905 statement concerning electromagnetism [5].

The Faraday disk: a reversible engine

The essential components of the homopolar machine, first conceived by Faraday in 1832, are shown in Figure 1. A conducting disk, free to rotate in the neighborhood of a permanent magnet, is attached to the end of a shaft. A closing wire provides a conducting path between two arbitrary points of the disk. Such a device exhibits *reversible* behavior.

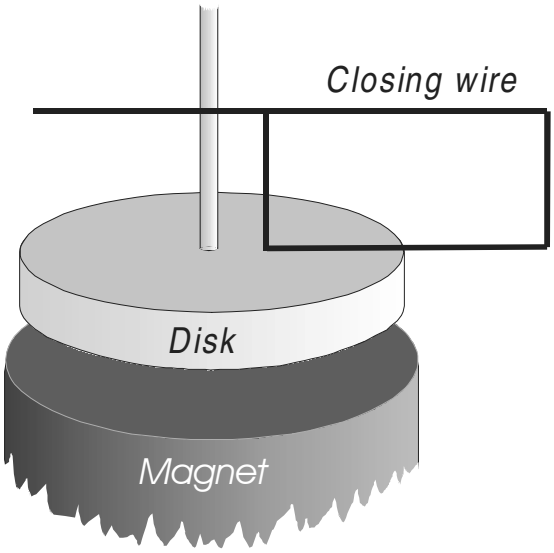

Fig.1
Faraday's setup magnet, disk and closing wire

A radial current path of length L takes place in a region of the disk when direct current (*dc*) from an external source is injected into the closing wire. The interaction of the current with the magnetic field produces a Laplace force [6]

$\boldsymbol{F} = \int_{a}^{a+L} I(d\boldsymbol{r}x\boldsymbol{B})$ causing the rotation of the disk. This set-up is the *motor configuration.*

When the disk is spun by an external source of mechanical energy, an *emf* appears in it. The displacement of free charges is produced in this case by the Lorentz force $\boldsymbol{f} = q(\boldsymbol{v}x\boldsymbol{B})$, converting the conducting disk into an *emf* source able to drive *dc* through the whole disk plus closing-wire circuit. This set-up is the *generator configuration*.

A seemingly curious fact occurs in the motor configuration, when *dc* is injected into the circuit with the disk attached to the magnet. Both disk and magnet turn together.

Two rival theories, a relativistic and an absolutistic one, have been applied to understand the observed facts:

In relativistic view, generator configuration makes sense only when there is relative motion of the magnet with respect to either the disk or the closing wire. Also, a motor configuration will only take place if the *possibility of relative motion* between magnet and either disk or closing wire is enabled.

Thus, in the relativistic framework, with the magnet attached to the disk, the closing wire becomes the "active" part for the production of mechanical forces or *emf*. In this case the disk itself behaves as a "passive" element providing a closing-circuit current path.

Conversely, in the eyes of an absolutist, a generator configuration is enabled only because of the disk or closing-wire *absolute* motion. Here, absolute means "relative to a frame where the preponderance of the mass of the universe is at rest" [7,8]. In our case, the lab frame acts as an acceptable absolute-motion reference. Thus, from an absolutistic view, the magnet's rotation with $\partial B/t = 0$ in each point of the surrounding space is unable to produce an *emf* on nearby conductors. When in a motor configuration, *dc* is injected in the circuit, and the absolutist assigns the observed rotation to the magnet "dragging" by the conductor. Here, the closing wire acts as a "passive" circuit element.

New experimental work, complementary to that currently known on the subject, introduces arguments in favour of the relativistic viewpoint. The related experiments, whose underlying physics rests upon a modified version of the original Faraday setup, are described in the following sections.

The asymmetrical rotor

Figure 2 shows the disk-shaped ceramic permanent magnet creating the axial magnetic field ***B***. The removal of a 12° sector introduces a field-reversion region. Outgoing and ingoing ***B*** field lines are represented by the and symbols, respectively.

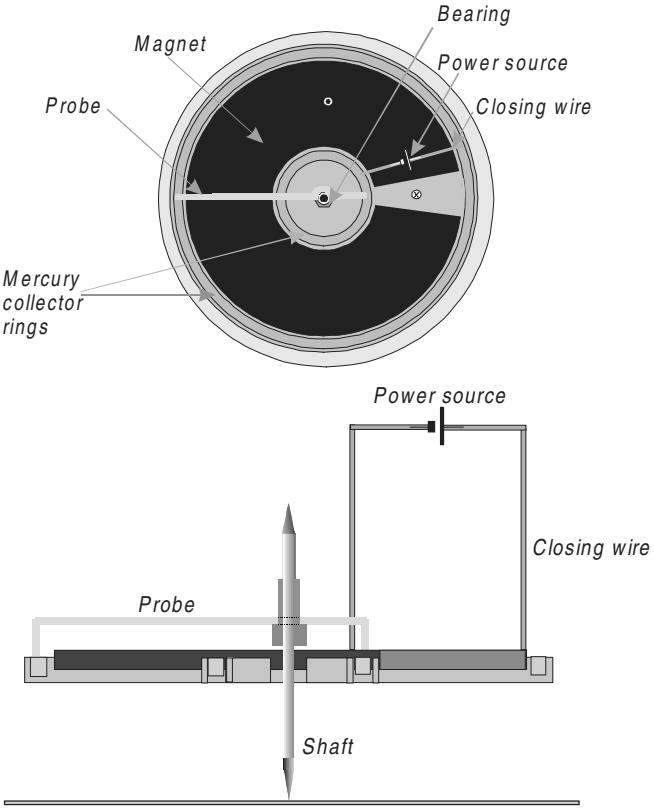

Fig.2
Layout of the Asymmetrical Rotor applied to the experiments

Two mercury collector rings are embedded in a wood cylinder. One is located close to the hollow-disk magnet inner rim and the other in the proximity of the outer rim. The magnet's inner and outer radii are 25 and 75 mm, respectively, and its height 25 mm. Its average flux density 2 mm above the magnet has been estimated to be 0.05 T based on a generator experiment with a rotating copper disk. The magnet-and-wood-cylinder body (the asymmetrical rotor from here on) is firmly anchored to a vertical shaft terminated in sharp points at both ends. While the lower one lays on a hard-polished surface, a conical bearing, enabling its almost frictionless rotation, centers the upper one.

Unlike the series-connected conductors diametrically anchored to the shaft in the Guala-Valverde case [3], only one radial conductor wire, a probe located 2 mm above the magnet's face, was considered. By mounting it on a bearing, its free rotation is permitted with its ends remaining in contact with both collector rings. A 12V lead-acid battery applied to the closing wire feeds the probe through the collector rings. In the first four experimental cases presented the closing wire remains firmly anchored to the lab. In two complementary experiments, rotation of the closing wire mounted on two shaft-centered bearings is allowed. Its behavior as a probe occurs by the injection of *dc* from an additional closing-circuit wire anchored to the lab.

Experimental

Six experiments performed are described below:

1. Rotor anchored to the lab, probe free to rotate above the magnet's upward magnetic-field region: A radially-ingoing injected *dc* in the 0.2 A range was enough to overcome conductor-bearing and mercury-wire contact friction. A net *counterclockwise rotation* of the probe took place.

2. Probe anchored to the rotor above the magnet's upward magnetic-field region, with both free to rotate: A radially-ingoing injected *dc* in the 5 A range was enough to overcome conductor-plus-rotor inertia and friction. A net *counterclockwise rotation* of the probe took place.

3. Rotor anchored to the lab, probe free to rotate above the magnet's downward magnetic-field region: A radially-ingoing injected *dc* in the 0.2 A range was enough to overcome conductor-bearing and mercury-wire contacts friction. A net *clockwise rotation* of the probe took place.

4. Probe anchored to the rotor above the magnet's downward magnetic-field region, both free to rotate: A radially-ingoing injected *dc* in the 5 A range was enough to overcome conductor-plus-rotor inertia and friction. A net *counterclockwise rotation* of the probe took place.

5. Rotor anchored to the lab, closing wire free to rotate above the magnet's upward magnetic-field region: A 0.4 A *dc* injected in the inner collector ring was enough to overcome conductor-bearing and mercury-wire contacts friction. A net *clockwise rotation* of the closing-wire took place.

6. Rotor anchored to the lab, closing wire free to rotate above the magnet's downward magnetic-field region: A 0.4 A *dc* injected in the inner collector ring was enough to overcome conductor-bearing and mercury-wire contacts friction. A net *clockwise rotation* of the closing-wire took place.

Discussion of results

Experiments (1) and (3) can be explained using either absolutist or relativistic viewpoints because of the coincidence of the probe motion relative to the lab with the probe motion relative to the magnet.

Experiment (2) can be explained by a trivial absolutist argument founded on a hypothetic probe "dragging effect" on the magnet. A relativistic viewpoint recognizes the "active" rotational torque on the closing wire rather than on the probe where, hinging on Newton's third law, the whole action may be split in two:

Magnet-probe. The magnet produces a counterclockwise torque on the probe, and the probe exerts an equal but opposite torque on the magnet.

Magnet-closing wire. The magnet exerts a clockwise torque on the closing wire, and the wire an equal but opposite torque on the magnet.

With the probe attached to the magnet, there is no chance for relative motion between them. Consequently, due to the action-reaction cancellation, rotation is forbidden. Conversely, with the closing wire mechanically decoupled from the magnet, relative motion of the latter is permitted. The torque exerted by the closing wire on the magnet is responsible for the observed rotation.

Experiment (4): Due to its similarity with (2) a trivial relativistic explanation is applicable to the counterclockwise torque exerted by the closing wire on the magnet. There is no known plausible absolutistic explanation for it. As quoted above, the hypothetical dragging effect would produce a clockwise rotation in this case. The consideration of the experiments (2) and (4) suffices to reject the dragging hypothesis.

Complementary experiments (5) and (6) confirm the short-range extension of the field-reversion region founded on the closing-wire *clockwise* rotation (6). Briefly speaking, the closing wire is not sensitive to the field reversion and the magnet's *counterclockwise* reaction explains at once the outcome of (4). Clearly, experiments (5) and (6) show that the torque on the closing wire is independent of its location on the magnet.

Figure 3 depicts the two rotational torques involved in (2) and (4).

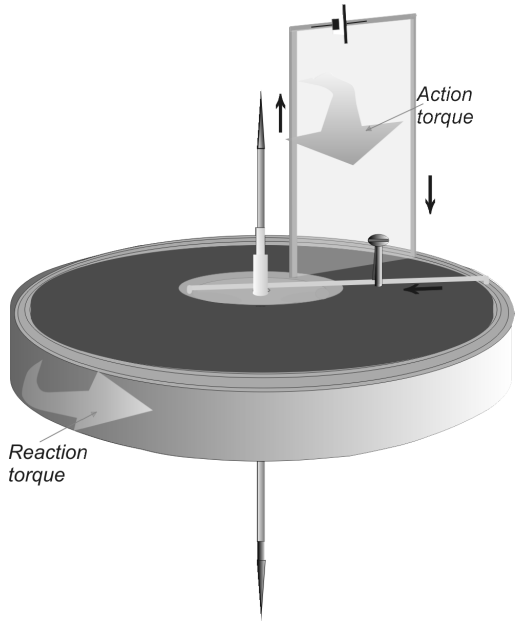

Fig.3
Rotational torques acting on the magnet and on the closing wire

Topological and miscellaneous considerations

One of the keys to the success of the above described experiments lies in the dynamotor's magnet design (see Fig.4). The short-range field reversion region allows the inversion of the Laplace force on the probe, making the force on the closing wire insensitive to that ***B**-field* reversion.

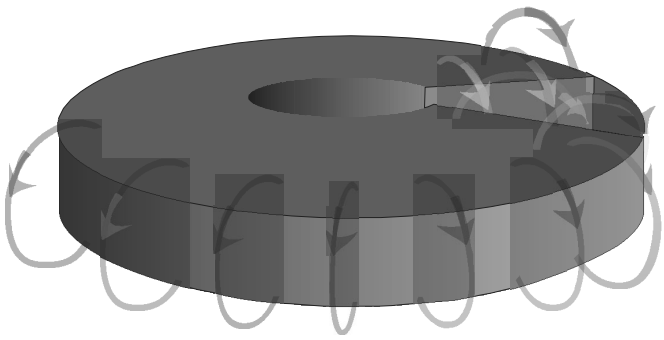

Fig. 4
The magnet's field-revision region

In all the above cases the electromagnetic forces between probe and closing wire were neglected because of its small magnitude compared to the predominant magnet-wire interaction forces.

The observed torques became, in all the experiments, independent of the location of the contact points between closing wire and collector rings. Also, the closing wire shape exhibited no noticeable influence on torques. These observations can be easily explained using the $div\boldsymbol{B} = 0$ fundamental law, Laplace force, and some elementary topological considerations.

Kennard [1], Bartlett [1], Panosky [7,8], Muller [9], Wesley [10] and some of this article's authors took absolutistic viewpoints when dealing with homopolar phenomena [11,12]. On the contrary, Weber [4], Assis [13], and Kelly [14] adopted a relativistic framework on the issue from the beginning.

By attaching the magnet to the disk in the original Faraday setup, the relative rotation between disk and closing wire remains unchanged. Therefore, in a generator configuration, the disk plus magnet rotation at with the closing wire at rest in the lab is entirely equivalent to the closing-wire rotation at – with the disk plus magnet at rest. This fact introduced a correct but physically "colorless" weak relativism to the homopolar generator description: the "unipolar generator really has three components, the magnet, the cylinder and the meter (including the contacts). A relative motion of the last two, not the first two, is required" [1].

A growing interest in basic electromagnetism [15,27] can not be ignored, and from time to time some authors, attempting to catch "free energy" from the space, have

claimed the design of homopolar engines with efficiency greater than unity, as can be checked by searching for *homopolar motor* on the Internet. The strict application of Newton's third law precludes the above non-physical possibility.

It is worthwhile to stress that the homopolar machine is a famous example where Faraday's flux rule fails. This fact worried Faraday himself and is clearly discussed by Feynman [28] who emphasized that the correct physics is always given by the Lorentz force law and the Maxwell fundamental equation *curl E = -B/t*. Homopolar induction is fully understood using only the Lorentz force. Our experiments enhance the relativistic structure of the Lorentz force because the only relevant velocity is the velocity of the conductor relative to the magnet.

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Weight Reductions Generated by Bucking-Field Permanent Magnets

LAB REPORT ON SmCo RING MAGNET EXPERIMENTS

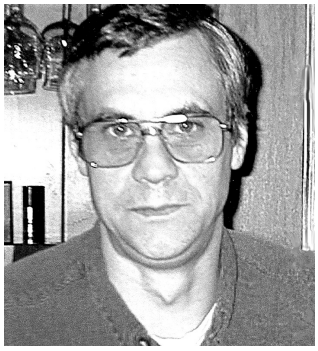

Experiments conducted by:
William C. Simpson

New Horizons Research 600 Meridian Street Extension,
#302 Groton, CT 06340
Tel. (860) 405-1157

The following experiments were conducted at the *Coastal Environmental Laboratory* (CEL) at Avery Point, Groton, Connecticut. (41° 19' 0.17" N. latitude x 72° 3' 50.27" W. longitude x 35 feet elevation above mean sea level) I wish to thank the personnelat the CEL for their generosity for providing the use of their *Mettler Toledo*® Model AG104 electronic scale for the measurements taken in the proceeding experiments. The AG104 electronic scale is an enclosed pan unit with a maximum mass range of 101-grams with 0.0001-gram readability.

The purpose of these experiments was to see if there is any detectable weight change when permanent magnets are forced together with their like-poles facing each other. The magnets were weighed individually, in both directions, with their field poles oriented vertically. The sums of the two individual magnet weights (magnet #1 and magnet #2) in each vertical orientation were compared to the weight measurements taken when they were assembled using the nylon bolt and wing nut depicted in **DIAGRAM 1**. The specifications for the two Samarium Cobalt magnets used in the following experiments are shown in **DIAGRAM 1**.

The first set of experiments with the SmCo Ring magnets were conducted January 14, 2002. An inverted paper cup was used to raise the test sample magnets 2.75" above the AG104 electronic scale pan in order to minimize possible magnetic interaction with the scale-sensing element, as depicted in **DIAGRAM 2**. The tare adjustment was used to set the scale readout to 0.0000-gram with the cup in place. The magnets were weighed individually. Magnet #1 weighed 9.9450-gram with the N pole facing up and 9.9397-gram with the S pole facing up. Magnet #2 weighed 9.9520-gram with the N pole facing up and 9.9443-gram with the S pole facing up.

The second set of experiments with the SmCo Ring magnets were conducted February 4, 2002. These experiments were shielded with Mu 80 magnetic

Editorial: This article is one more link between magnetizm and theory of aether, to my mind. It is possible to assume that in his experiments the author creates small but detectable changes in density of aether, that demonstrates itself as the weight changes.
Alexander V. Frolov.

DIAGRAM 1

RARE EARTH MAGNET SPECIFICATIONS:

Samarium Cobalt (SmCo mixed) ~ SCIENTIFICS Cat. #B30307-30
Ring type. OD = 0.75", ID = 0.43", Thickness = 0.25"
Gauss = 8,000
density = 8.7-gram/cc

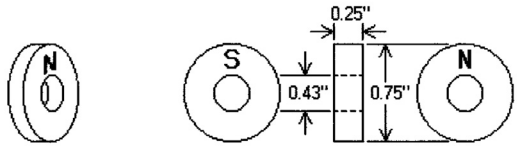

NYLON RETAINER BOLT AND WING NUT:

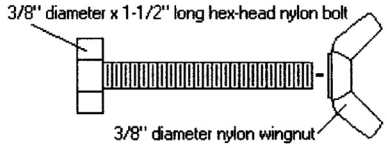

mass of nylon bolt plus nylon wing nut = 5.1610-grams

shielding material as depicted in **DIAGRAM 3**. The scale was tare adjusted to 0.0000-gram with the entire set of Mu 80 shield pieces in place. Then the magnets were weighed individually. Magnet #1 weighed 9.9483-gram with the N pole facing up and 9.9486-gram with the S pole facing up. Magnet #2 weighed 9.9527-gram with the N pole facing up and 9.9542-gram with the S pole facing up. The Nylon bolt and wing nut were placed in the Mu 80 shield can (without the magnets) and the scale was tare adjusted to 0.0000-gram. Therefore, the readouts would only be reading the weight of the bucking magnets.

The first column in **TABLE 1**, the vertical measurements, is the distance of separation d, or air gap, of the magnets. The second column shows the January 14, 2002 weight measurements of the two magnets, as shown in **DIAGRAM A**. The third column shows the January 14, 2002 weight measurements of the two magnets, as shown in **DIAGRAM B**. The fourth column shows the February 4, 2002 weight measurements of the two magnets, as shown in **DIAGRAM C**. The fifth column shows the February 4, 2002 weight measurements of the two magnets, as shown in **DIAGRAM D**.

The horizontal measurement, as depicted in **TABLE 2**, **TABLE 3**, **TABLE 4** and **TABLE 5**, are through the four basic magnetic compass headings; North, East, South, and West respectively. They are referenced to **DIAGRAM E** and **DIAGRAM F** for the January 14, 2002 experiments and **DIAGRAM G** and **DIAGRAM H** for the February 4, 2002 experiments. The corresponding graphs of the force change plots, **GRAPH 1**, **GRAPH 2**, **GRAPH 3**, **GRAPH 4**, and **GRAPH 5** accompany each table. The forces were converted from the mass readings, which are a scalar measurement, to dynes. The convention used for the force vector was chosen as plus (+) for up, or a weight reduction, and minus (-) for a weight increase.

DIAGRAM 2

01/14/2002 EXPERIMENNTS

CUP HEIGHT: 2.75" above scale pan. 1.75" upper diameter, 2.5" lower diameter

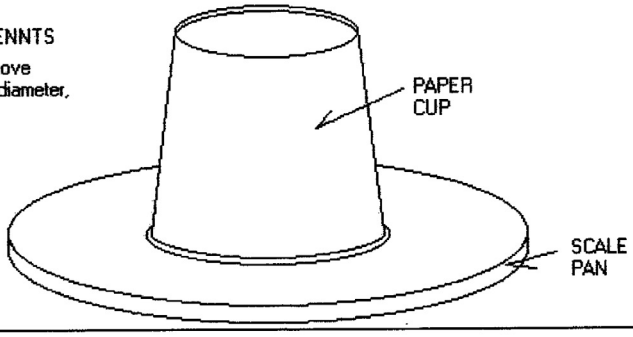

DIAGRAM 3

02/04/2002 EXPERIMENTS

MU METAL SPECIFICATIONS:

Source: NATIONAL ELECTRICAL ALLOYS
Oakland, NJ
SPECIFICATION: MIL N 14411C COMP 1
GRADE: HY MU 80 SHIELDING ALLOY
COLD ROLLED BRIGHT
DESCRIPTION: COIL
HEAT # 982011207
CHEMICAL ANALYSIS:
Ni: 80.16%
Mo: 4.6%
S: 0.0007%
C: 0.010%
P: 0.004%
Mn: 0.486%
Si: < 0.010%
Fe: BALANCE
MECHANICAL PROPERTIES:
HARDNESS: HV1 = 159
GRAIN SIZE: 8.5
COERCIVE STRENGTH:
HC = 0.0080 Oe
PERMEABILITY: MUMAX = 355000
SATURATION: 7900 Gauss
THICKNESS: 0.010"
DENSITY: 8.747-gram/cc

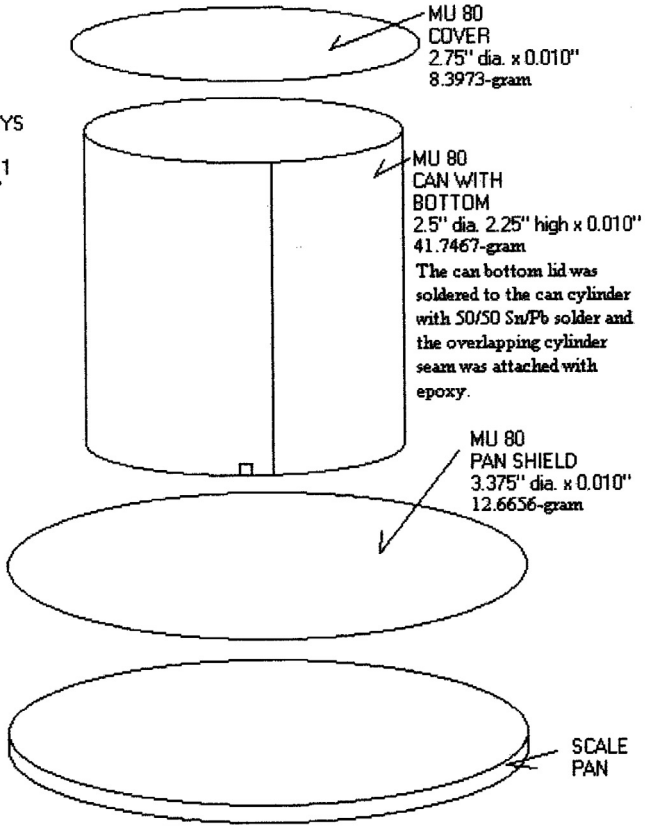

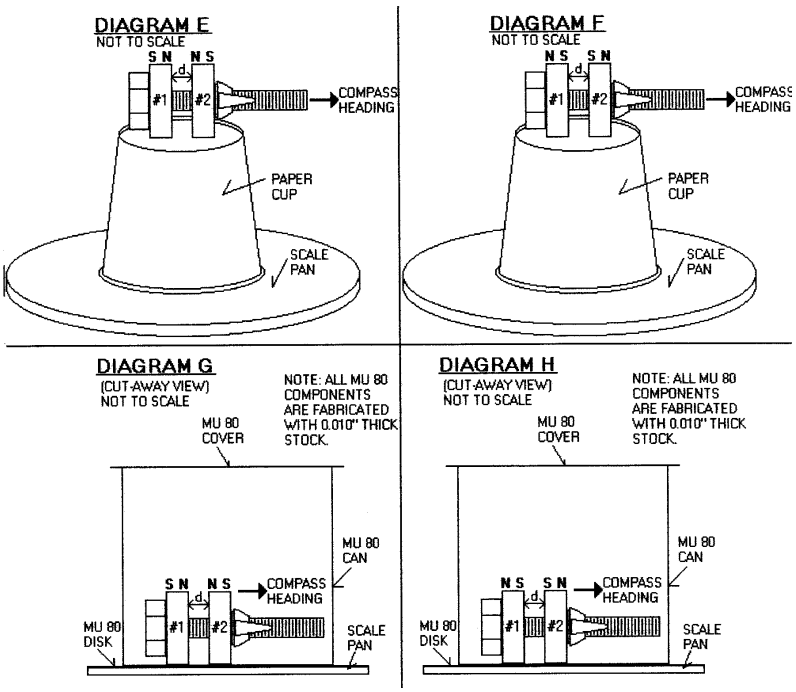

ELEVATION VIEW OF THE VERTICAL EXPERIMENTS

NOTE:

January 14, 2002 Experiments: Start time: 13:27 hours EST, End time: 15:40 hours EST.

February 4, 2002 Experiments: Start time: 13:18 hours EST, End time: 14:50 hours EST.

TABLE 1:

	01/14/2002 EXPERIMENTS OPEN, WITH PAPER CUP		02/04/2002 EXPERIMENTS WITH MU 80 SHIELDING	
Air gap d	**Diagram A** N to N vertical 19.8893-gram (Sum of 1 & 2)*	**Diagram B** S to S vertical 19.8917-gram (Sum of 1 & 2)*	**Diagram C** N to N vertical 19.9025-gram (Sum of 1 & 2)*	**Diagram D** S to S vertical 19.9013-gram (Sum of 1 & 2)*
0.0 Inch	19.8759-gram 0.0134-gram weight reduction (0.06737%)	19.8757-gram 0.0160-gram weight reduction(0.08045%)	19.8760-gram 0.0265-gram weight reduction(0.13324%)	19.8758-gram 0.0255-gram weight reduction(0.12821%)
1/8 Inch	19.8761-gram 0.0132-gram weight reduction(0.06637%)	19.8751-gram 0.0166-gram weight reduction(0.08346%)	19.8760-gram 0.0265-gram weight reduction(0.13324%)	19.8763-gram 0.0250-gram weight reduction(0.12570%)
1/4 Inch	19.8763-gram 0.0130-gram weight reduction(0.06536%)	19.8748-gram 0.0169-gram weight reduction(0.08497%)	19.8760-gram 0.0265-gram weight reduction(0.13324%)	19.8768-gram 0.0245-gram weight reduction(0.12318%)
3/8 Inch	19.8765-gram 0.0128-gram weight reduction(0.06436%)	19.8753-gram 0.0164-gram weight reduction(0.08246%)	19.8760-gram 0.0265-gram weight reduction(0.13324%)	19.8777-gram 0.0236-gram weight reduction(0.11866%)
1/2 Inch	19.8774-gram 0.0119-gram weight reduction(0.05983%)	19.8753-gram 0.0164-gram weight reduction(0.08246%)	19.8757-gram 0.0268-gram weight reduction(0.13475%)	19.8809-gram 0.0204-gram weight reduction(0.10257%)
5/8 Inch	19.8776-gram 0.0117-gram weight reduction(0.05883%)	19.8754-gram 0.0163-gram weight reduction(0.08195%)	19.8779-gram 0.0246-gram weight reduction(0.12368%)	19.8806-gram 0.0207-gram weight reduction(0.10408%)
11/16 Inch	19.8777-gram 0.0116-gram weight reduction(0.05832%)	19.8748-gram 0.0169-gram weight reduction(0.08497%)	19.8773-gram 0.0252-gram weight reduction(0.12670%)	19.8832-gram 0.0181-gram weight reduction(0.09100%)

* Magnets #1 and #2 were individually weighed in the orientation used in each experiment and their separate weights were added together.

The following equation was used to calculate the weight changes, in dynes, in the proceeding graphs.

$$\vec{\Delta F} = k \cdot \Delta mass \cdot g$$

where

$$k = 980.665 \times dyne \times gm^{-1}$$

and

$$g = 9.80665\ m \times sec^{-2}$$

which is the local rate of gravitational acceleration.

The product of the measured changes in mass, Δmass, and g is denoted as follows on the graphs:

$$NNopen_{n,1} = \Delta mass \times g$$

for N-to-N pole facings in the open (or unshielded).

$$SSopen_{n,1} = \Delta mass \times g$$

for S-to-S pole facings in the open (or unshielded).

$$NNshield_{p,1} = \Delta mass \times g$$

for N-to-N pole facings shielded with Mu 80 shielding.

$$SSshield_{p,1} = \Delta mass \times g$$

for S-to-S pole facings shielded with Mu 80 shielding. In the subscripts, $_n$ and $_p$ refers to the respective number of data points per plot. The subscript $_1$ refers to the vertical change in force (weight change) axis and $_0$ refers to the horizontal distance d axis. In **GRAPH 1**, $_n = {}_p$.

GRAPH 1:

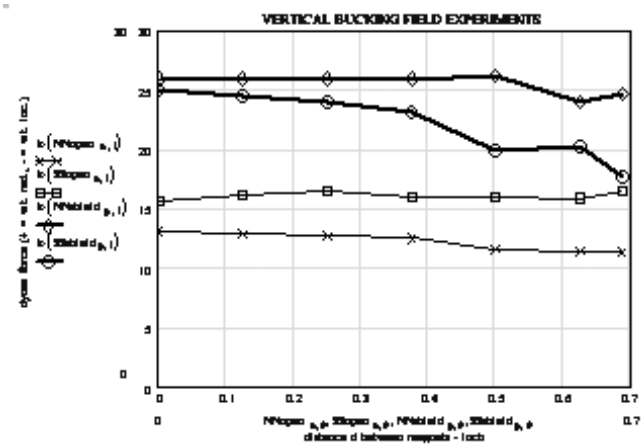

ISOMETRIC AND ELEVATION VIEW OF THE HORIZONTAL EXPERIMENTS

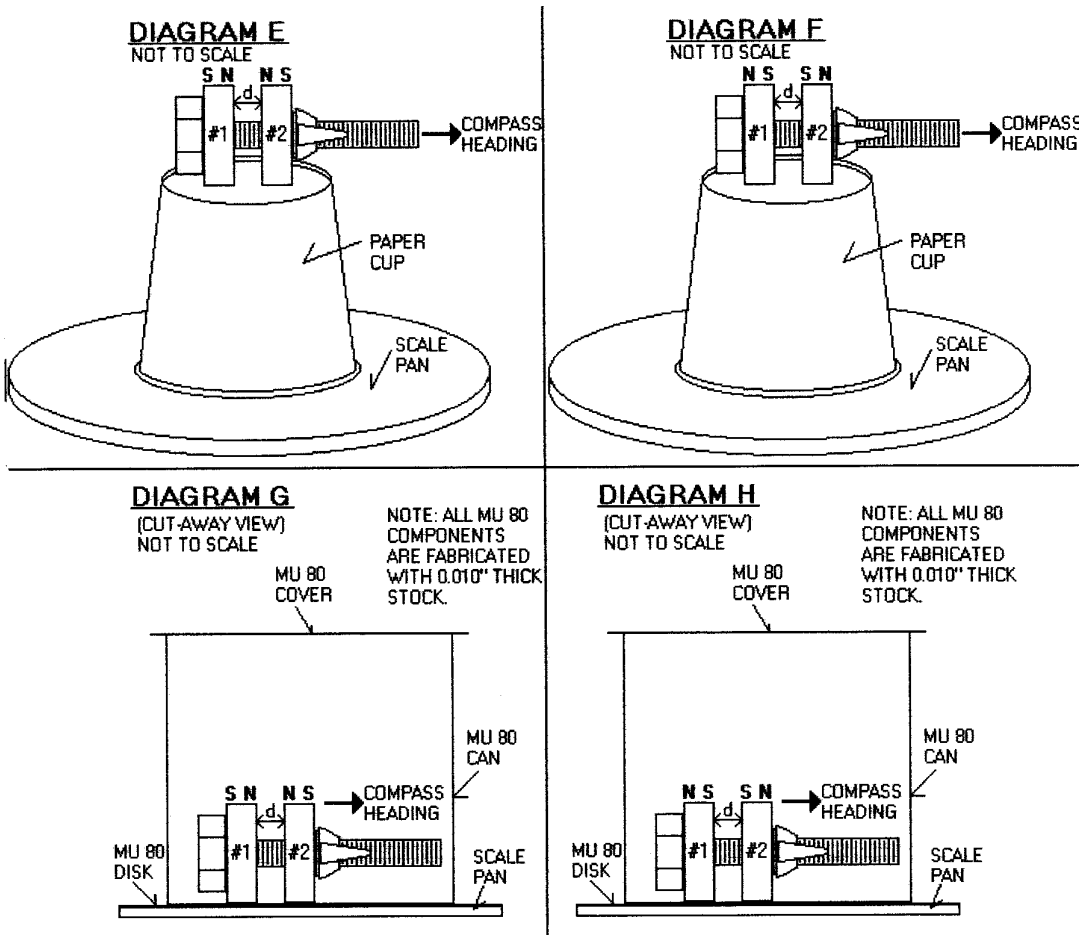

MAGNETIC DECLINATION FROM THE LOCAL TOPOLOGICAL MAP:

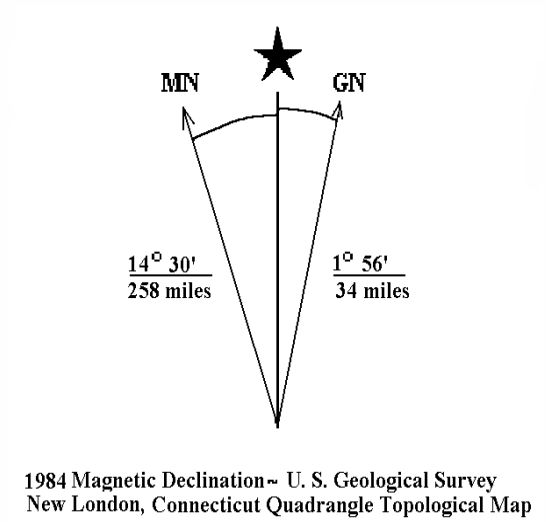

TABLE 2

North # **Heading**	01/14/2002 EXPERIMENTS OPEN, WITH PAPER CUP		02/04/2002 EXPERIMENTS WITH MU 80 SHIELDING	
Air gap d	**Diagram E** N to N horizontal 19.8905-gram (Sum of 1 & 2)*	**Diagram F** S to S horizontal 19.8905-gram (Sum of 1 & 2)*	**Diagram G** N to N horizontal 19.9019-gram (Sum of 1 & 2)*	**Diagram H** S to S horizontal 19.9019-gram (Sum of 1 & 2)*
0.0 Inch	19.8735-gram 0.0170-gram weight reduction (0.08547%)	19.8778-gram 0.0127-gram weight reduction(0.06385%)	19.8890-gram 0.0129-gram weight reduction(0.06479%)	19.8810-gram 0.0209-gram weight reduction(0.10497%)
1/8 Inch	19.8728-gram 0.0177-gram weight reduction(0.08899%)	19.8790-gram 0.0115-gram weight reduction(0.05782%)	N/A **	N/A **
1/4 Inch	19.8721-gram 0.0184-gram weight reduction(0.09251%)	19.8798-gram 0.0107-gram weight reduction(0.05379%)	N/A **	N/A **
3/8 Inch	19.8705-gram 0.0200-gram weight reduction(0.10055%)	19.8800-gram 0.0105-gram weight reduction(0.05279%)	N/A **	N/A **
1/2 Inch	19.8698-gram 0.0207-gram weight reduction(0.10407%)	19.8811-gram 0.0094-gram weight reduction(0.04726%)	N/A **	N/A **
5/8 Inch	19.8693-gram 0.0212-gram weight reduction(0.10658%)	19.8818-gram 0.0087-gram weigh t reduction(0.04374%)	N/A **	N/A **
11/16 Inch	19.8696-gram 0.0209-gram weight reduction(0.10508%)	19.8827-gram 0.0078-gram weight reduction(0.03921%)	19.9190-gram 0.0171-gram weight increase(0.08588%)	19.9029-gram 0.0010-gram weight increase(0.00502%)

Compass Heading is approximate
* Magnets #1 and #2 were individually weighed with pole faces oriented vertically, with N up then with S up, and the results were averaged and added.
** Due to time constraints, these measurements were not taken.

GRAPH 2:

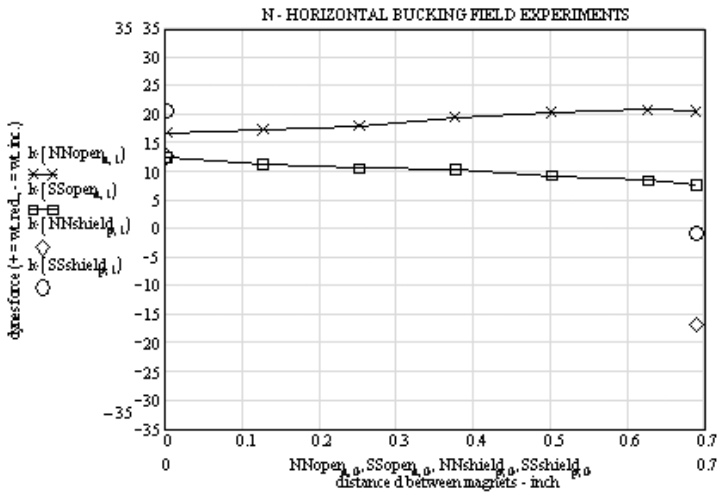

$$volume := \pi \cdot \left[\left(\frac{0.75 \cdot in}{2} \right)^2 - \left(\frac{0.43 \cdot in}{2} \right)^2 \right] \cdot \left(\frac{1}{4} \right) \cdot in$$

volume = 1.214963 cm^3

density = $8.7 \cdot gm \cdot cm^{-3}$

mass = density·volume

mass = 10.570177 gm.

This is higher than the magnetized mass of each magnet.

However, some tables give a lower density for the SmCo magnet, 0.300lb/in^3, which equals:

density = $8.303971 \cdot gm \cdot cm^{-3}$

mass = 10.089017 gm. .

This is still higher than the magnetized mass of each magnet. Does the SmCo material become slightly lighter in weight when it is magnetized?

NOTE:
The calculated mass of each magnet was determined by the following formula based upon the manufacturer's dimensions and density value.

TABLE 3

East # **Heading**	01/14/2002 EXPERIMENTS OPEN, WITH PAPER CUP		02/04/2002 EXPERIMENTS WITH MU 80 SHIELDING	
Air gap D	**Diagram E** N to N horizontal 19.8905-gram (Sum of 1 & 2)*	**Diagram F** S to S horizontal 19.8905-gram (Sum of 1 & 2)*	**Diagram G** N to N horizontal 19.9019-gram (Sum of 1 & 2)*	**Diagram H** S to S horizontal 19.9019-gram (Sum of 1 & 2)*
0.0 Inch	19.8763-gram 0.0142-gram weight reduction (0.07139%)	19.8755-gram 0.0150-gram weight reduction(0.07541%)	19.8928-gram 0.0091-gram weight reduction(0.04570%)	19.8731-gram 0.0288-gram weight reduction(0.14464%)
1/8 Inch	19.8777-gram 0.0128-gram weight reduction(0.06435%)	19.8750-gram 0.0155-gram weight reduction(0.07793%)	N/A **	N/A **
1/4 Inch	19.8782-gram 0.0123-gram weight reduction(0.06184%)	19.8743-gram 0.0162-gram weight reduction(0.08145%)	N/A **	N/A **
3/8 Inch	19.8779-gram 0.0126-gram weight reduction(0.06335%)	19.8722-gram 0.0183-gram weight reduction(0.09200%)	N/A **	N/A **
1/2 Inch	19.8792-gram 0.0113-gram weight reduction(0.05681%)	19.8715-gram 0.0190-gram weight reduction(0.09552%)	N/A **	N/A **
5/8 Inch	19.8814-gram 0.0091-gram weight reduction(0.04575%)	19.8712-gram 0.0193-gram weight reduction(0.09703%)	N/A **	N/A **
11/16 Inch	19.8815-gram 0.0090-gram weight reduction(0.04525%)	19.8720-gram 0.0185-gram weight reduction(0.09301%)	19.9338-gram 0.0319-gram weight increase(0.16021%)	19.9030-gram 0.0011-gram weight increase(0.00552%)

Compass Heading is approximate
* Magnets #1 and #2 were individually weighed with pole faces oriented vertically, with N up then with S up, and the results were averaged and added.
** Due to time constraints, these measurements were not taken.

GRAPH 3:

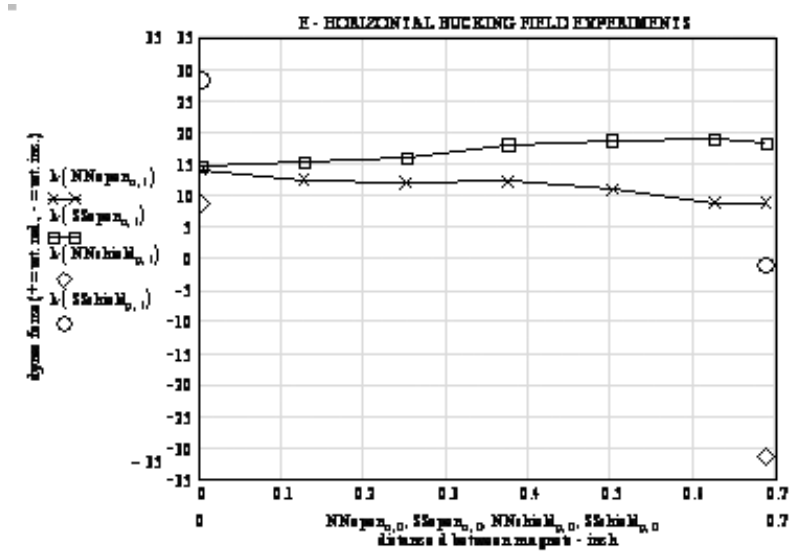

TABLE 4

East # **Heading**	01/14/2002 EXPERIMENTS OPEN, WITH PAPER CUP		02/04/2002 EXPERIMENTS WITH MU 80 SHIELDING	
Air gap D	**Diagram E** N to N horizontal 19.8905-gram (Sum of 1 & 2)*	**Diagram F** S to S horizontal 19.8905-gram (Sum of 1 & 2)*	**Diagram G** N to N horizontal 19.9019-gram (Sum of 1 & 2)*	**Diagram H** S to S horizontal 19.9019-gram (Sum of 1 & 2)*
0.0 Inch	19.8746-gram 0.0159-gram weight reduction (0.07994%)	19.8769-gram 0.0136-gram weight reduction(0.06837%)	19.8896-gram 0.0123-gram weight reduction(0.06178%)	19.8660-gram 0.0359-gram weight reduction(0.18030%)
1/8 Inch	19.8720-gram 0.0185-gram weight reduction(0.09301%)	19.8788-gram 0.0117-gram weight reduction(0.05882%)	N/A **	N/A **
1/4 Inch	19.8709-gram 0.0196-gram weight reduction(0.09854%)	19.8797-gram 0.0108-gram weight reduction(0.05430%)	N/A **	N/A **
3/8 Inch	19.8704-gram 0.0201-gram weight reduction(0.10105%)	19.8803-gram 0.0102-gram weight reduction(0.05128%)	N/A **	N/A **
1/2 Inch	19.8711-gram 0.0194-gram weight reduction(0.09753%)	19.8814-gram 0.0091-gram weight reduction(0.04575%)	N/A **	N/A **
5/8 Inch	19.8698-gram 0.0207-gram weight reduction(0.10407%)	19.8825-gram 0.0080-gram weight reduction(0.04022%)	N/A **	N/A **
11/16 Inch	19.8703-gram 0.0202-gram weight reduction(0.10156%)	19.8817-gram 0.0088-gram weight reduction(0.04424%)	19.9423-gram 0.0404-gram weight increase(0.20290%)	19.8810-gram 0.0209-gram weight reduction(0.10497%)

Compass Heading is approximate
* Magnets #1 and #2 were individually weighed with pole faces oriented vertically, with N up then with S up, and the results were averaged and added.
** Due to time constraints, these measurements were not taken.

GRAPH 4:

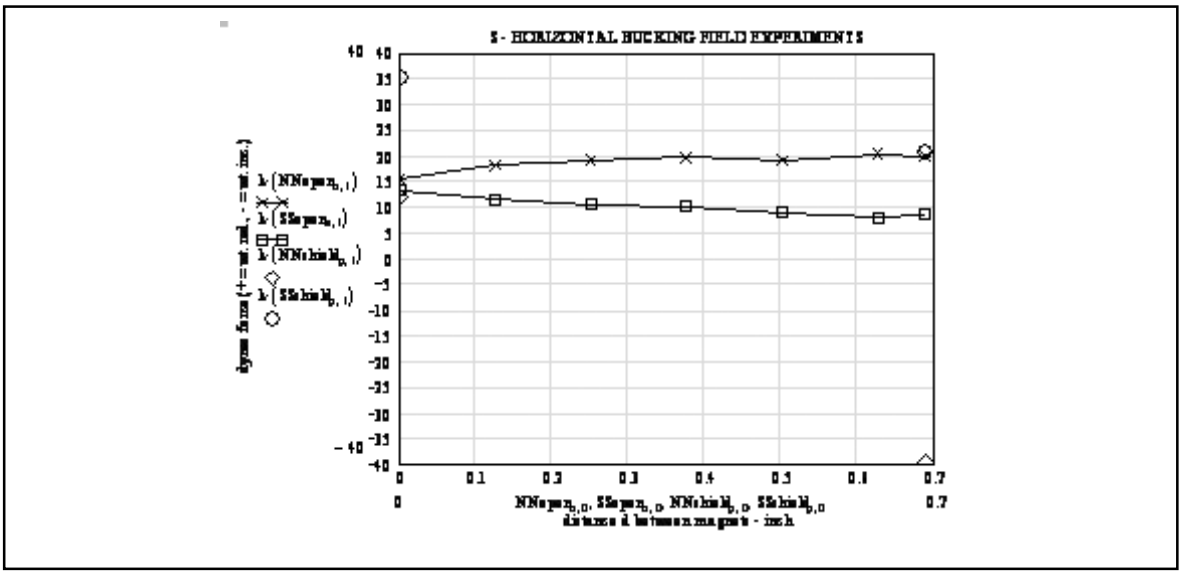

TABLE 5

West # **Heading**	01/14/2002 EXPERIMENTS OPEN, WITH PAPER CUP		02/04/2002 EXPERIMENTS WITH MU 80 SHIELDING	
Air gap D	**Diagram E** N to N horizontal 19.8905-gram (Sum of 1 & 2)*	**Diagram F** S to S horizontal 19.8905-gram (Sum of 1 & 2)*	**Diagram G** N to N horizontal 19.9019-gram (Sum of 1 & 2)*	**Diagram H** S to S horizontal 19.9019-gram (Sum of 1 & 2)*
0.0 Inch	19.8777-gram 0.0128-gram weight reduction (0.06787%)	19.8748-gram 0.0157-gram weight reduction(0.07893%)	19.8933-gram 0.0086-gram weight reduction(0.04319%)	19.8724-gram 0.0295-gram weight reduction(0.14816%)
1/8 Inch	19.8767-gram 0.0138-gram weight reduction(0.06938%)	19.8737-gram 0.0168-gram weight reduction(0.08446%)	N/A **	N/A **
1/4 Inch	19.8777-gram 0.0128-gram weight reduction(0.06435%)	19.8733-gram 0.0172-gram weight reduction(0.08647%)	N/A **	N/A **
3/8 Inch	19.8783-gram 0.0122-gram weight reduction(0.06134%)	19.8727-gram 0.0178-gram weight reduction(0.08949%)	N/A **	N/A **
1/2 Inch	19.8806-gram 0.0099-gram weight reduction(0.04977%)	19.8722-gram 0.0183-gram weight reduction(0.09200%)	N/A **	N/A **
5/8 Inch	19.8811-gram 0.0094-gram weight reduction(0.04726%)	19.8715-gram 0.0190-gram weight reduction(0.09552%)	N/A **	N/A **
11/16 Inch	19.8803-gram 0.0102-gram weight reduction(0.05128%)	19.8723-gram 0.0182-gram weight reduction(0.09150%)	19.9427-gram 0.0408-gram weight increase(0.20491%)	19.8976-gram 0.0043-gram weight reduction(0.02160%)

Compass Heading is approximate
* Magnets #1 and #2 were individually weighed with pole faces oriented vertically, with N up then with S up, and the results were averaged and added.
** Due to time constraints, these measurements were not taken.

GRAPH 5:

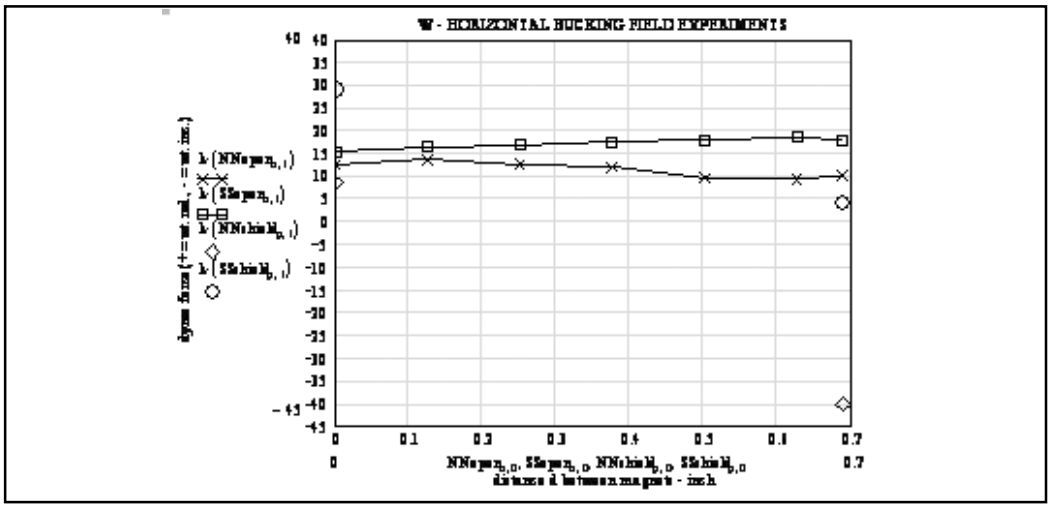

RING MAGNET #1, N UP: 9.9483-grams
RING MAGNET #2, N UP: +9.9527-grams
TOTAL WEIGHT: 19.9010-grams
WEIGHT INCREASE WITH OPPOSITE POLES ATTRACTING, AS DEPICTED IN **DIAGRAM I**, IN MU 80 SHIELD where 19.9861-grams was the measured value:
19.9861-grams – 19.9010-grams = 0.0851-gram weight increase.

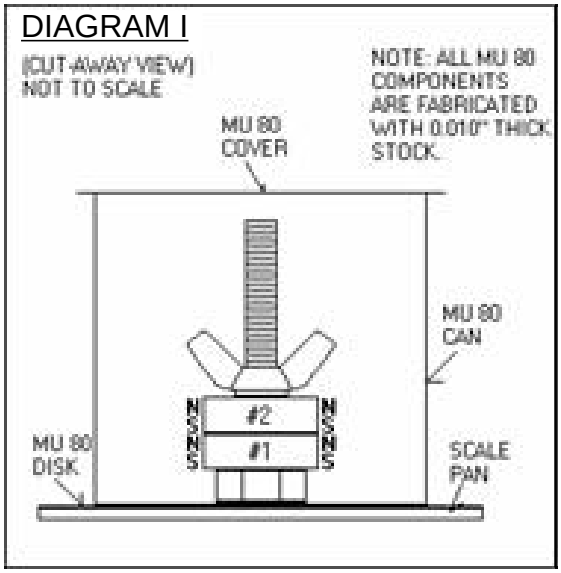

THREE RIVERS COMMUNITY COLLEGE, THAMES VALLEY CAMPUS LAB REPORT ON SmCo RING MAGNET EXPERIMENTS

The following experiments were conducted at the *Thames Valley Campus* (TVC) of the *Three Rivers Community College*, Room #207 Chemistry Laboratory, in Norwich, Connecticut on March 8, 2002. (41° 30' 34.62" N. latitude x 72° 6' 13.63" W. longitude x 115 feet elevation above mean sea level) I wish to thank the instructors at *Three Rivers* for their generosity for providing the use of their *Sartorius*® Model # 2442 analytical balance for the measurements taken in the proceeding experiments. The *Sartorius* Model # 2442 analytical balance is an enclosed pan unit with a maximum mass range of 200-grams with 0.0001-gram micrometer readability and a precision of 0.05-mg standard deviation.

The purpose of these experiments was to compare the Avery Point vertical measurements conducted on the *Mettler Toledo*® Model AG104 electronic scale, in **TABLE 1**, with the *Sartorius* Model # 2442 analytical balance measurements recorded in **TABLE 6**. The same two Samarium Cobalt magnets (magnet #1 and magnet #2) weighed individually in each vertical orientation were compared to the weight measurements taken when they were assembled using the nylon bolt and wing nut depicted in **DIAGRAM 1**. The specifications for the two Samarium Cobalt magnets used in the following experiments are shown in **DIAGRAM 1**.

The first column in **TABLE 6**, the vertical measurements, is the distance of separation d, or air gap, of the magnets. The second column shows the weight measurements of the two magnets, as shown in **DIAGRAM A**. The third column shows the weight measurements of the two magnets, as shown in **DIAGRAM B**. An inverted paper cup was used to raise the test sample magnets 2.75" above the *Sartorius* Model # 2442 balance scale pan in order to minimize possible magnetic interaction with the balance, as depicted in **DIAGRAM 2**. The fourth column shows the weight measurements of the two magnets, as shown in **DIAGRAM C**. The fifth column shows the weight measurements of the two magnets, as shown in **DIAGRAM D**. These experiments were shielded with

Mu 80 magnetic shielding material as depicted in **DIAGRAM 3**. The resultant data of **TABLE 6** is plotted on **GRAPH 6**. The results of the previous experiments at *Avery Point*, from **GRAPH 1**, and the recent *Thames Valley* experiments, from **GRAPH 6**, are plotted on **GRAPH 7** for comparison. The Mu 80 magnetically shielded experiments on the *Sartorius* Model # 2442 analytical balance at *Thames Valley* are in close agreement with the data collected with the AG104 electronic scale at Avery Point. However, the *Thames Valley* data collected for the unshielded experiments is somewhat smaller in weight reduction. I attribute this to external interference. The *Thames Valley* setup included a nonferrous tabletop, as did the Avery Point setup. However, the *Thames Valley* balance table consisted of a steel frame and legs, which may have altered the readings. The Mu 80 shielding provided a more intrinsic method for accurate data collection.

The horizontal measurements were not taken in this set of experiments due to time constraints. A final experiment was attempted to replicate the relative weight increase with the opposite poles of the ring magnets "stuck" together, as depicted in **DIAGRAM I**; however, the magnets shattered during assembly!

TABLE 6

	03/08/2002 TRCC EXPERIMENTS, @ TVC: OPEN, WITH PAPER CUP		03/08/2002 TRCC EXPERIMENTS, @ TVC: WITH MU 80 SHIELDING	
Air gap d	**Diagram A** N to N vertical 19.8734-gram (Sum of 1 & 2)*	**Diagram B** S to S vertical 19.8726-gram (Sum of 1 & 2)*	**Diagram C** N to N vertical 19.8912-gram (Sum of 1 & 2)*	**Diagram D** S to S vertical 19.8929-gram (Sum of 1 & 2)*
0.0 Inch	19.8699-gram 0.0035-gram weight reduction (0.01761%)	19.8696-gram 0.0030-gram weight reduction(0.01510%)	19.8691-gram 0.0221-gram weight reduction(0.11110%)	19.8706-gram 0.0223-gram weight reduction(0.11210%)
1/8 Inch	19.8699-gram 0.0035-gram weight reduction(0.01761%)	19.8699-gram 0.0027-gram weight reduction(0.01359%)	19.8688-gram 0.0224-gram weight reduction(0.11261%)	19.8707-gram 0.0222-gram weight reduction(0.11160%)
1/4 Inch	19.8695-gram 0.0039-gram weight reduction(0.01962%)	19.8695-gram 0.0031-gram weight reduction(0.01560%)	19.8687-gram 0.0225-gram weight reduction(0.11312%)	19.8712-gram 0.0217-gram weight reduction(0.10908%)
3/8 Inch	19.8695-gram 0.0039-gram weight reduction(0.01962%)	19.8699-gram 0.0027-gram weight reduction(0.01359%)	19.8692-gram 0.0220-gram weight reduction(0.11060%)	19.8730-gram 0.0199-gram weight reduction(0.10004%)
1/2 Inch	19.8689-gram 0.0045-gram weight reduction(0.02264%)	19.8699-gram 0.0027-gram weight reduction(0.01359%)	19.8695-gram 0.0217-gram weight reduction(0.10909%)	19.8738-gram 0.0191-gram weight reduction(0.09601%)
5/8 Inch	19.8686-gram 0.0048-gram weight reduction(0.02415%)	19.8699-gram 0.0027-gram weight reduction(0.01359%)	19.8702-gram 0.0210-gram weight reduction(0.10557%)	19.8746-gram 0.0183-gram weight reduction(0.09199%)
11/16 Inch	19.8680-gram 0.0054-gram weight reduction(0.02717%)	19.8699-gram 0.0027-gram weight reduction(0.01359%)	19.8707-gram 0.0205-gram weight reduction(0.10306%)	19.8756-gram 0.0173-gram weight reduction(0.08697%)

* Magnets #1 and #2 were individually weighed in the orientation used in each experiment and their separate weights were added together.

NOTE:
March 8, 2002 Experiments: Start time: 12:12 hours EST, End time: 13:47 hours EST.

GRAPH 6:

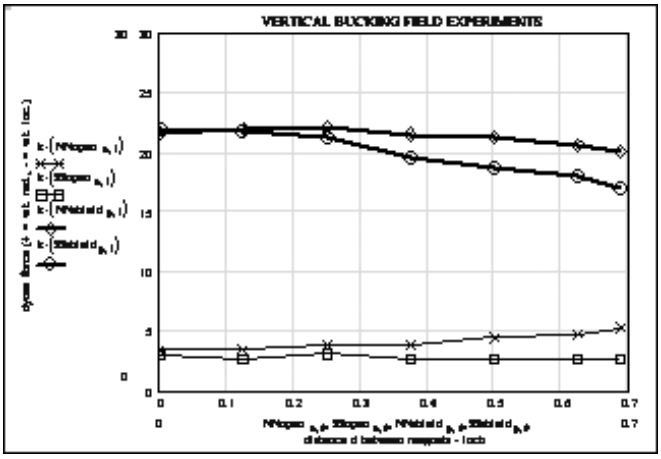

MAGNETIC DECLINATION FROM THE LOCAL TOPOLOGICAL MAP

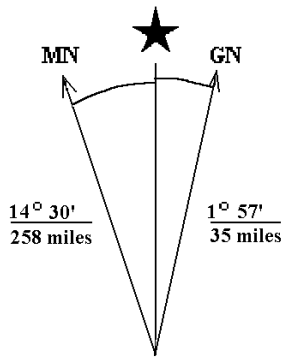

1983 Magnetic Declination ~ U. S. Geological Survey
Norwich, Connecticut Quadrangle Topological Map

GRAPH 7:

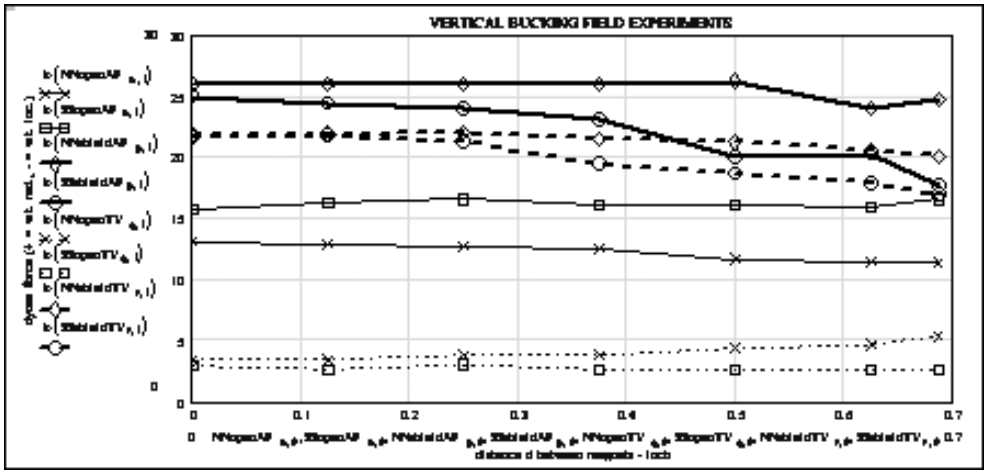

KEY TO **GRAPH 7**:

For N-to-N pole facings in the open (or unshielded) at Avery Point (AP):
NNopenAP
For S-to-S pole facings in the open (or unshielded) at Avery Point (AP):
SSopenAP
For N-to-N pole facings shielded with Mu 80 shielding at Avery Point (AP):
NNshieldAP
For S-to-S pole facings shielded with Mu 80 shielding at Avery Point (AP):
SSshieldAP
For N-to-N pole facings in the open (or unshielded) at Thames Valley (TV):
NNopenTV
For S-to-S pole facings in the open (or unshielded) at Thames Valley (TV):
SSopenTV
For N-to-N pole facings shielded with Mu 80 shielding at Thames Valley (TV):
NNshieldTV
For S-to-S pole facings shielded with Mu 80 shielding at Thames Valley (TV):
SSshieldTV

The subscripts for the data points $_n = _p = _q = _r = 7$ are all the same value in **GRAPH 7**.

Advanced Nuclear Waste Decontamination Technologies

Mark Porringa

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It is a review of nine alternative, peer-reviewed techniques as candidates for the global clean-up of nuclear waste.

The following is a reasonably comprehensive list of potentially effective nuclear waste treatment methods that might be employed to treat the entire range of radioactive wastes that have proven to be such a daunting and horrendously expensive problem for the nuclear industry (in all its forms) with major, long term implications for the environment.

A wide variety of methods will probably be required to accommodate the many different radioactive waste sources including high and low level, solids, liquids and gases. Process names used here are in some cases just convenient labels used to categorize and set them apart from each other.

Theories on several of these processes are still quite speculative and solid evidence that would pass conventional peer review is still lacking. This is after all a very new field of science.

Some of these technologies are already well protected by international or national patents, with additional US and international patents pending, and further patents may be obtained on new developments as they are made.

The Brown's Gas-Metal Matrix Process:

The BG-MMX process utilizes a patented electrolysis cell of the Australian Prof. **Yull Brown**'s design that is said to produce a stoichiometric mixture of monatomic hydrogen and oxygen or possibly a quasi-stable water molecule raised to a high-energy state. This gas has some very peculiar properties including the ability to sublimate tungsten (6000°C) with an implosive flame that burns cool in air with a temperature of only 130°C.

The gas is used to heat a proprietary mixture of metals and/or metal oxides including the radwaste to be neutralized. A highly exothermic radiant reaction appears to result in the immediate reduction of radioactivity approaching 95% of the original levels judging from preliminary tests, within seconds of treatment. The process is conjectured to be effective with high level solid wastes and possibly gasses, but probably not liquids. The high temperatures involved may also preclude the processing of more volatile wastes.

Since 1991, this technology has been successfully demonstrated, on a small scale, at least 50 times to US, Chinese, Japanese and United Kingdom officials on a variety of nuclear waste products including Americium, Cobalt, Uranium, and Plutonium. The technique can be applied for the immediate decontamination of stockpiles of nuclear waste materials being held near nuclear power plants. The process is very simple, safe, and inexpensive to develop further into robotics application for on-site treatment with no foreseen environmental effects.

Photoremediation

The *Photoremediation* process of the American Dr. **Paul Brown** is essentially conventional physics, *albeit* applied in a new and novel way. The process involves the use of a high-energy electron beam impinged on a target, which in turn produces a monochromatic gamma radiation that is tuned to induce *Photofission* and *Photoneutron* reactions in the target material causing rapid neutralization of radioactive isotopes. The efficiency claimed exceeds 500% due to the high cross-section reactions in the Giant Dipole Resonance region. The 10 MeV electron beam produces typical fission reactions in the 200MeV range effectively turning high level solid wastes such as spent fuel into an energy source. The process is apparently intended for on-site treatment with some waste-partitioning required, an aspect which may not be desirable in certain countries.

While this idea is similar in topology to a system being developed by **Los Alamos National Labs**, Dr. Paul Brown's approach offers several advantages: no need for extensive chemical pre-processing and the energy required to effect transmutation is greatly reduced. No new technology needs to be developed, yet the engineering of such a photon reactor must be completed and it could itself become a practical method for generating power.

ZIPP Fusion

The ZIPP fusion process, identified by **Mark Porringa**, induces a wide variety of fusion reactions, resulting from the radial compression of individual diatomic and other simple molecules dissolved or suspended in a light

water, carbon arc electrolysis cell. A variety of other cell configurations are envisioned.

The process appears to produce only stable isotopes, which should therefore make it capable of stabilizing a wide variety of radioactive waste materials. The theory on the process draws from Condensed Charge phenomena, Brown's Gas implosion, cavitation bubble collapse and sonoluminesence - all variations of the Casimir effect - which is believed to cohere the Zero-point energy of Quantum Vacuum Fluctuations. Transmutations using variations of this basic process may be applicable to a wide variety of nuclear wastes and appears capable of operating with an efficiency exceeding 100%.

A major implication of this process is that the Strong force of the nucleus is understood as an ultra close range Casimir effect. **Oakridge** Nuclear Laboratories in the US in conjunction with several international collaborators have just (this month, in fact) announced a deuterium cold fusion process based on the essential elements of the ZIPP Fusion process first reported in 1998. The process is very simple and inexpensive to develop.

RIPPLE Fission

The RIPPLE Fission process is an adaptation of existing potential technology utilizing a supersonic ionized gas to aerosol a counter flow heat exchanger that envelopes the radioactive waste aerosol in a vacuum induced plasma vortex which appears to disrupt the matter stabilizing influence of the Quantum Vacuum fluctuations resulting in "gentle" low recoil fission reactions which produce only stable fission products, with excess neutrons being prompt converted to protons via quenched Beta emissions. The process is apparently proven with conventional non-radioactive wastes and is believed applicable to the entire spectrum of radwaste without the need for waste partitioning. This process is also conjectured to operate with over-unity efficiency.

The LENTEC Processes

The Low Energy Nuclear Transmutation Electrolytic Cells of the Cincinnati group produce a variety of transmutation reactions using a variety of exotic electrolysis cell designs that generally produce condensed charge clusters composed primarily of up to 10^{11} electrons each. These electron charge clusters produced with the use of special electrodes can penetrate the nuclei of larger atoms in solution and transmute these atoms into stable elements.

The range of design and operating protocols and potential applications are essentially limitless provided for the waste that is dispersed in the electrolyte. The reported transmutation of thorium to stable titanium and copper by the Cincinnati Group and by the Salt Lake City group is one of the most dramatic examples of this type of treatment process. Application to other high-level liquid transuranic fissionable wastes such as surplus Plutonium seems likely. The glaring absence of normal fission yield energies is perplexing but probably explicable as another form of low recoil fission reaction, similar to RIPPLE fission.

The Plasma Induced/Injected Transmutation - PIT Processes (also known as HDCC)

Plasma Induced/Injected Transmutation processes run include a gamut from recent achievements dating back to the **Oshawa-Kushi** cold plasma transmutations reported in 1964. The patented high-density charge cluster process (HDCC) was first discovered by **Kenneth Shoulders** and added on to by **Harold E. Puthoff**. Later, the late **Stan Gleeson** discovered HDCC in properly processed solutions. Still later, **Alexander Ilyanok** of Belarus discovered HDCC, followed by **Vasiliy Baraboskin** in Russia.

The production of Condensed Charge Clusters and various plasma glow discharge phenomena in a variety of gaseous atmospheres is again implicated as the underlying cause with what should be by now an obvious connection with the coherence of Zero-point energy from the Quantum or Stochastic vacuum.

Desk-top high energy particle accelerators have also been envisioned, based on the "piggy back" principle, in which the clusters permit acceleration of "piggy-backed" heaver +ions to extremely high energies capable of causing fusion and transmutations in target materials including those in solution and the materials of which the electrodes are composed. Brown's Gas implosion and cavitation bubble collapse reactions are also believed to be prevalent in these types of cells due to the prevalence of electrolysis.

A high-density charge cluster technology was discovered and used by Stan Gleeson to stabilize radioactive liquid wastes and has been developed further in the last 4 years by a group led by **S-X Jin** and **Hal Fox**. Best results for radioactive liquids have been demonstrated in the processing of thorium for a 30-minute period and achieving a reduction of radioactivity of about 90% from a liquid sample.

Kervran Reactions

The very compelling evidence compiled by French Nobel Candidate Dr. **Louis Kervran** has identified a wide range of nuclear transmutations in biological systems that have not been adequately explained. Coherence of Zero-point energy via Casimir effects within the *Somatid* particles identified by the Canadian **Gaston Naessens** is implicated as a possible cause. A wide variety of *in vitro* and *in vivo* reactions are believed to be possible as proven in nature and numerous experiments typically involving a reaction medium composed of a dielectric fluid such as water. Highly radiation resistant microorganisms have been found

thriving in the core of nuclear reactors indicating the possibility of microorganisms being capable of transmuting some bioactive nuclear wastes in the course of the normal metabolism of such organisms.

The Monti Process

The Italian **Roberto A. Monti's** process involves confined explosions involving proprietary mixtures of materials that include radioactive waste. Ignition of such mixtures causes nuclear transmutations resulting in reduced radioactivity (to near-background levels) following combustion, gradually over 1 to 4 days.

This technique has been confirmed by the Italian **ENEA** and is supported by the French CEA scientists as a serious candidate for treatment of waste stockpiles. The system, as currently designed, required waste to be inserted into a chamber.

Higher group symmetry electrodynamics

Extremely weak, non-classical, higher group symmetry electromagnetic fields were found during a 1991 experiment made by **Glen Rein** to alter significantly the level of radioactivity in materials, even those in the environment. The experiments suggest that higher group symmetry electrodynamics modulate the quantitative and /or qualitative properties of radioactive species. If the non-classical fields directly affect the radioactive species, it is likely that the appropriate field parameters will be discovered to neutralize radioactive emissions. In 1999, a theoretical basis for the phenomenon was developed by the Welsh physicist, **M. W. Evans**, with the participation of Lt. Col. (retired) **Thomas E. Bearden**.

The technology is extremely simple and could be applied with minimum logistics for treating massive structures, *in-to* outdoors, such as the Chernobyl disaster site.

Psitronics Group Systems, International

Robert "Paul" LeBreton, 2901 Hwy. 6, HC 77 Box 42, Laguna, NM 87026 USA

E-mail: wizzard9@earthlink.net Phone:1-(505)-836-7534

Psi/Group's Magnetic Motor - Funding for New Prototype Sought:

As the engineer who designed the self-sustaining magnetic motor being advertised by Psitronics Group Systems, International. It perhaps falls upon me to explain (as well as I am able) the methods used by me in this motor's design:

The actual "picture" description is totally Intellectual Property; Protected as a Trade Secret.

However: This magnetic motor is a "perpetually imbalanced configuration" of permanent magnets; an unequal number of magnets on the rotor & stator; that revolves in a "self-sustaining" manner as the magnets seek balance... There are no electrical components in the design unless one wished to insert alternator windings in the stator to provide an electrical output...

We have discovered: through a prior unsuccessful prototype that using a para-magnetic material (we used aluminum) for the rotor & stator was self-defeating; as with the powerful rare earth magnets used in the design aluminum destroyed the magnetic fields... On further analysis of the failed prototype it was deduced that a "latch up" condition would occur between rotor & stator magnets; unless the rotor magnets were canted or skewed at an angle from the stator magnets... The plastic prototype contemplated corrects both of these problems....

We are seeking an investor willing to put up $4000 (DUS) for the prototype and who can offer $40,000 return on investment "if it proves successful" ...We have a Global Distribution 'ready to go" as well as a pledge of $ Millions towards Manufacturing & Marketing from EarthTech, International on submission of a running motor...

Very Respectfully Yours,
Paul LeBreton

http://home.earthlink.net/~wizzard9
(Psi/Group Website)

Inquiries should be emailed to:
wizzard9@earthlink.net

Experimental Investigations of the Radioactive Isotope Half-Value Period Changing in the Local Volume of Cause-Effect Relations

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Nuclear-design methods of the elemental analysis are based on the property of the radioactive isotope decay rate constant. Half period as a constant quantity is defined by the time feature (the time flow is uniform in the every space point). The given postulate is confirmed by the long-term results and raised no doubts. But in last years some researches, investigating enough fine effects by change of the registered radiation intensivity, came to the conclusion about influence of space cycles on the time flow [1]. In his turn, N. A. Kozyrev during the investigation of active physical properties of time came to the conclusion about violation of its uniform flow in the local volume of the cause-effect relations, created by the cyclic motion (rotation, oscillation) of bodies [2,3,4].

Thus, the author get an idea to use a radioactive isotope cezium-137 as a "sensor", measuring the changes of time flow uniformity in the certain local volume of cause-effect relations. In basis there are following arguments: owing to a conception of time uniformity and considerable cezium-137 half-value period, the source activity must be permanent during the experiment time. By the time flow (period) change, i.e. changes of uniformity in the local volume of cause-effect relations, the half-value period – T is changing in the direct proportion. Source activity, respectively, is changing in the inverse proportion according to the law exp (1/T) in relation to the external space volume. Hence, registered gamma-quantum intension (amplitude impulse distribution) in the absence of the cause-effect relations is proportional to the function $N_0 \sim \exp(\ln 2/T_0)$. Then the proportion $N_0/\Delta N$, where $\Delta N = N_0 - N$ is made, and by means of it a half-value period difference is defined by the formula

$$1/\Delta T = |1/T_0 + \ln(\Delta N/N_0)/\ln 2| \qquad (1)$$

N_0 – selective average amplitudes of impulses at the case of static liquid (in the absence of the cause-effect relations);
N - selective average amplitudes of impulses at the case of rotation of liquid.

In this case, there were investigations of the determination of the gamma-quantum intension change (i.e. change of a half-value period) dependence on the angular velocity of the activator rotation, and also on the coordinates location and amount of cause-effect relations (Fig. 1).

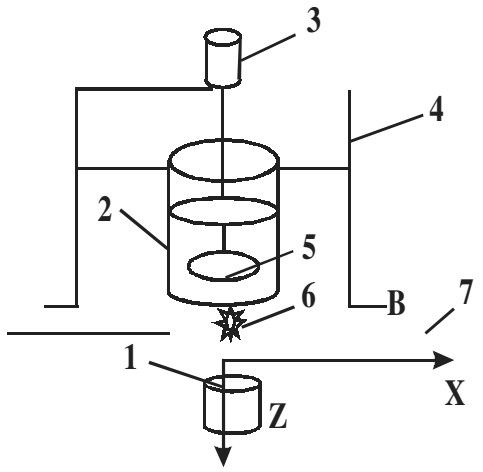

Fig.1

The following devices were used as measurement equipment: semi-conducting detector (SCD-63V) (1), preamplifier (PAG-2K), amplifier (BAI-3K) and analyzer (AMA-02F1). Energy gamma-line of 662 KeV was measured with the resolution 4 KeV. The gamma-quantum source was glued to the detector housing at the distance of 100 mm from its surface; so, any spatial change through coordinate axes was executed together with the detector to avoid even a tiny change of the source-detector geometry.

The vessel with a liquid (2) was placed above the source (6), vortex fluid motion was created by an activator (5), placed on the rod of electric motor (3). The glass with a liquid, connected with the motor and frame (4), was displaced regarding to the center of the revolved activator, what was the reason of the glass vibration in horizontal line, and, hence, one of frame sides vibration in vertical line (v). In its base, the frame was a square with the side of 200 mm. To assign the direction of the space cause-effect relations, one of frame sides was vibrating, and the opposite one (on the X axis) was fixed on the table (7). An experiment was made in such a way, that vibrating parts did not adjoin with the detector. The radius of glass is 50 mm, the distance from central axis up to the vibrating frame part is 100 mm. N-selection of the every value on the diagram (Fig. 2) corresponded to twenty measurements, roots from the average variance of numbers distribution $D \approx 160$ impulses.

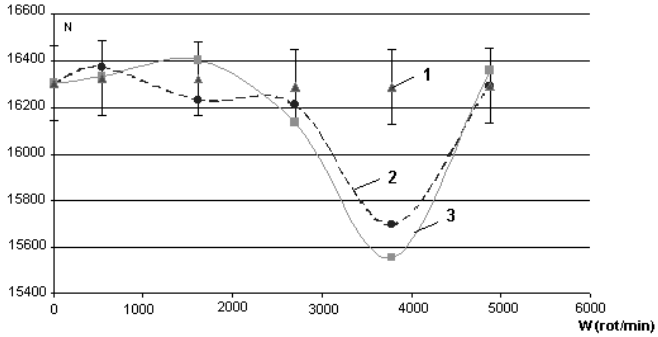

Fig. 2
Dependence of photopeak-N area from the angular velocity of rotation – W, where 1 – is photopeak area at static liquid, 2 – is photopeak area at clockwise rotation, 3 – is photopeak area at anticlockwise rotation

During two months eighteen experiments were made (at the one geometry) of the given effect fluctuation study, and there were no considerable deviation. An effect of the time deceleration always appeared at the angular speed of the activator rotation W=3780 r/min (during the vibration of the whole perimeter of the frame base). If there was a vibration on the only one side of the frame base (on the X axis), then this effect appeared at the higher speed of rotation. Unfortunately, the maximum motor speed of rotation W_{max}=4880 r/min did not let to define the precise position for the next rotation point. During the experimental results extrapolation $W_2 \approx 5930$ r/min ($W_2 \approx \pi W/2$) was obtained.

In the table there are selective middle amplitudes of impulses $-N=\sum N_n/n$ roots from the numbers distribution average variance D, dispersion of the simple average G at the different directions of the liquid rotation (for the rotation point W=3780 r/min). The half period is estimated by the equation (1) and formula $T=T_0+\Delta T$ where T_0=30.2 year (the cezium-137 half-value period).

Liquid motion	N, imp.	D	G	T, year
Static liquid	16304.0	160.7	35.9	30.200
Clockwise	15696.0	162.0	36.2	30.412
Anticlockwise	15553.0	165.0	36.9	30.423

During the investigation of the activator angular speed of rotation dependence on the registered gamma-quantum intension, **there was discovered the time deceleration effect in the fixed point of ambient space of the glass with the liquid.** The effect was versatile, during the further study of the reasons of the effect disappearance, the following regularities were found:

1. Intension change appeared only at the case of asymmetrically fixed glass, when there appeared horizontal oscillations, transmitted to the vertical oscillations of the frame;

2. An effect disappeared, if the gamma-quantum source was placed in the glass center (~ 2 ÷ 3 mm down from the glass bottom);

3. At the same speed of rotation but without liquid, with an eccentric activator, the time deceleration effect disappeared.

Will consider the system with liquid, its internal chain consisted of three cause-effect relations:

1. Activator-liquid;
2. Liquid-glass (frame);
3. Frame-table.

Glass oscillations were transmitted to the frame through the hard cohesion. There was only one cause-effect relation – an activator (a frame) – a table. Thus, amplitude of the time flow changing was, most likely, influenced on by the amount of cause-effect relation, and also, there was observed a quantum effect, dependent on the activator and liquid rotation frequency.

The time deceleration maximum amplitude appeared during the source displacement from the central axis of glass along the X coordinate to the distance ~ 5 mm. There appeared the necessity to check the given effect on space points along the all coordinate axes in the radius R ≈ 100 mm from the central point of the glass bottom (an extreme vibration point along the X axis was placed on this distance).

On this purpose there were made some experiments, results of which are shown on the (Fig. 3), (Fig. 4).

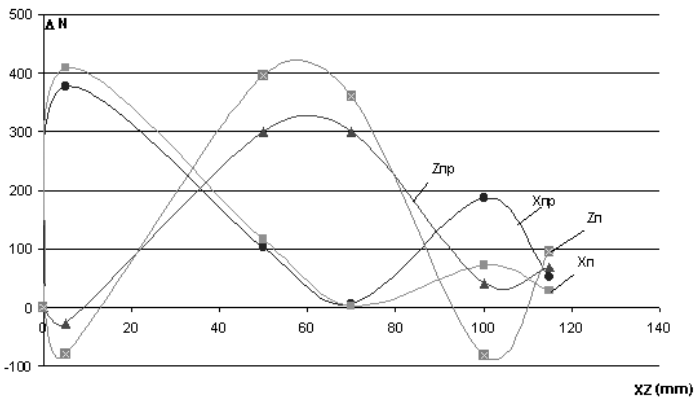

Fig. 3
Dependence of the increase of photopeak -ΔN area from the spatial interval in Cause-Effect Relations by X and Z coordinates, where X_cZ_c – is clockwise rotation, $X_{ac}Z_{ac}$ – is anticlockwise rotation

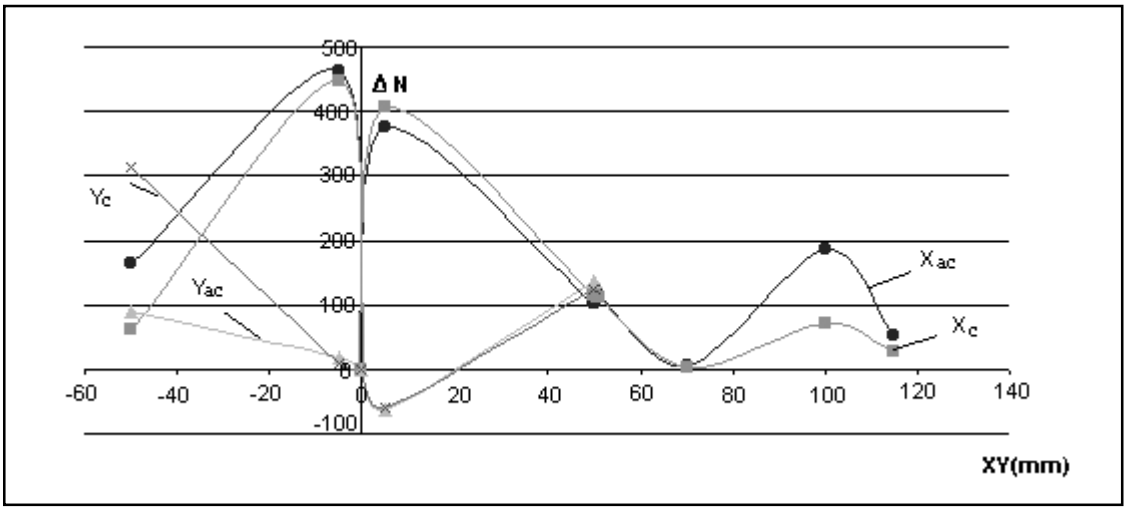

Fig. 4
Dependence of the increase of photopeak -ΔN area from the spatial interval in Cause-Effect Relations by X and Y coordinates, where X_cY_c – is clockwise rotation, $X_{ac}Y_{ac}$ – is anticlockwise rotation

Let us suppose that positive axis Z is directed from the glass bottom center to the ground and axis X – from the central axis of glass to the vibrated part of the frame (North-West), in this case Y is directed to the North-East. Along the all coordinates, in every adjusted space points on the distance R_i from the glass bottom center (R_i = 5; 50; 70; 100; 115 mm), there were forty measurements. At that in every point after ten measurements connected with the rotation there were measurements at the static liquid. It was made to avoid any systematic errors. The amplitude of the sample average impulses at the static liquid - N_0=10550 imp. In this case the root from the dispersion Δ=120, dispersion of the simple average G=19. Amplitude increment was calculated by the formula $\Delta N=|N_0-N|$. Following regularities were found:

1. If considering the difference of impulse amplitude (in the positive coordinate space) in the first cause-effect relation evidence (activator-liquid), i.e., to put the difference between the initial (5 mm) and final (50 mm) points of amplitude registration (their middle evidence between "clockwise" and "anticlockwise") $\Delta N_5^{50}=|N_5-N_{50}|$ into the formula (1), then relations $\Delta T_Z/\Delta T_X=\Delta T_X/\Delta T_Y\approx 1.11$ ($\pi/2\sqrt{2}\approx 1.11$)

2. Change of impulse amplitude difference along X is the antiphase of changes along Z and Y;

3. At the rotation clockwise and anticlockwise there takes place a periodical inversion of amplitudes difference relation;

4. At the liquid rotation clockwise and anticlockwise, there appears an obvious distinction in evidences of the increment ΔN in negative region of coordinate axes;

5. Along Y and Z-axes in points (5; 100 mm) there is observed insignificant time acceleration.

The whole cause-effect relation system was defined as an internal (activator-table), as an external one (ground - system center of gravity). **In the internal space volume time at the certain conditions breaks its own uniformity, at that the time period change is nonlinear and is defined by its quantum nature.** Therefore, standard clocks in causal relations must be considered regarding to the center of gravity and location of the measurement point in the internal system space.

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TILLEY ELECTRIC VEHICLE

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Nowadays there stays urgent the development of technologies, which could possibly be combined into a reliable, commercially successful advanced self powered vehicle with additional desirable but currently commercially unavailable features.

The advantages of electric vehicles seem to be evident – they are clean, quiet, powerful, require much less maintenance than gasoline or diesel-fueled vehicles, and are inherently much simpler and easier to manufacture. Their drawbacks have been a short range, long battery recharging time, and a heavy, bulky battery pack.

After several years of personal accomplishments in the alternative energy industry, **Carl B. Tilley, the inventor from USA,** was convinced that it was possible to build an electric car that could be powered without the help of external power to keep the battery charged.

The concept to produce a useful electric performance car that would last more than a few hours and would be economical to run, safe to drive around town or across the United States and never use a drop of fuel challenges the future of transportation as we know it today.

With the establishment of the **Tilley Foundation, Inc.**, in the year 2001, Carl Tilley set out to prove it could be done. It was an ambitious project and it broke ground on the facility in Tennessee that would build the first self-generating electric car.

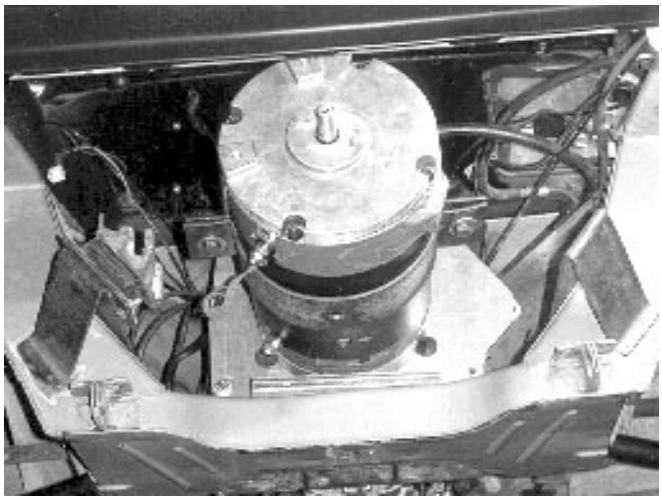

Construction of a 1,800 square foot building, that was powered with another recently developed electric device, began in the year 2002. Electricity for this car is provided from a different energy invention, which was void of any outside power supply. It is ironic that one alternative energy device actually built the invention to power and build the electric car.

The **Tilley Electric Vehicle** (**TEV**), converted from a 1981 DeLorean, energizes the imagination and defies what has been accepted as a standard in the area of transportation for years.

From the selection of the proper car to be converted, to the advanced technology, which is on board, the **TEV** performs comparably to gasoline-powered vehicles.The difference is you have no need for fuel and you do not have to stop the vehicle to charge it after driving. There is no pollution and you can cruise the highways at the same speed as any other vehicle.

There is a new car on the road today. A car built with technology that defies the concept of fossil fuel powered cars, and can run coast to coast without ever relying on the battery being charged from an outside source.

The long awaited transportation revolution and the end of our reliance on fossil fuel has now begun **....the Tilley Electric Vehicle.**

The demonstration of a DeLorean powered by an electric motor and 12-volt standard car batteries is supposed to be on September 7, 2002, at the Nashville Superspeedway, USA. The battery bank is kept in a charged condition by the "on board" charger which is the device invented by Carl B. Tilley. Racing legend Bobby Allison is one of the guest drivers for this demonstration.

Details and results of the demonstration read in our next issue

The Problem of Time: Force as the Cause of Change of the Course of Time

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Abstract

Material processes occurring in a physical system under the action of a force field necessarily influence the course of time along the trajectory of motion of particle. A general relationship is obtained which relates the course of time on one path section of a particle when moving in a force field to that on the other path section in the same inertial reference frame. According to the results obtained, the force in relativistic mechanics is not only the cause of acceleration of particle relative to an inertial frame of reference, but also the cause of change in the course of time along the particle's trajectory. ***Therein lies the physical content of the dynamical principle underlying the special theory of relativity (relativistic mechanics).*** *The applications of the theory developed to homogeneous fields - to the field of gravity and electromagnetic field, and to the gravitational field produced by a point mass particle are considered. Physical properties of the state of imponderability of particle in an external force field are investigated. It is noted that the change in the course of time in a force field is in no way connected with the change in space-time metric and is a direct consequence of the causality principle of relativistic mechanics.* ***The existence of dependence of the course of time on the state of motion of particle in a force field points to the feasibility of controlling the course of time using force fields.***

Time is among the most common concepts, which are used constantly both in everyday life and in science. This is because all the events and material processes in the world happen in space and develop in time and, hence, the laws that govern space-time connections are the most general and hold for all the forms of matter. Nevertheless, time remains one of the most mysterious concepts of physics; its physical essence is not adequately revealed up till now [1-4]. The concept of time with difficulty yields to logical analysis.

From the point of view of common sense the essence of time is that time characterizes the duration of events and processes, indicates their natural sequence, at which the present, going away to the past, gives place to the future.

Isaac Newton gave a clear-cut characteristic of the concept of time, to which the majority of physicists adheres: "The absolute, true, and mathematical time in itself and by virtue of its nature flows uniformly and regardless to any other object". Though, according to Newton, time flows equally and uniformly and does not depend on the processes, occurring in the world, the daily experience speaks in favour of the fact that the course of time is not uniform. Depending on circumstances in our history, it seems to us that time either flies swiftly or hangs heavy on our hands; sometimes it even changes suddenly, by leaps. In connection with these speculations the question arises of whether the subjective sensations of non-uniformity in the course of time familiar to everyone have an objective basis.

In Newtonian mechanics time is of an absolute character, it does not change as one passes from one inertial reference frame to another and represents merely a parameter, whose change at the will of explorer results in the change of state of a mechanical system in accordance with the equation of motion.

In relativistic mechanics time remains a parameter describing the development of system. But now time and space are intimately linked with each other to form a single system, i.e. the 4-dimensional space-time. In going from one inertial frame of reference to another time gets entangled with spatial coordinates, so that time in one reference frame represents a "mixture" of time and coordinates in the other. Time ceases to be universal, the same in all inertial reference frames; it takes on a relative character.

The indissoluble association of time and space takes on special importance in the light of the concept of physical field, which was called by Einstein the most important discovery in physics after Newton. According to this concept, the occurrence in space of a force field means that space turns into a physical environment, which is capable to interact directly with other bodies and gains, thus, physical properties, becoming an active participant of physical processes. In view of the fact that **space and time are indissolubly related to each other, the presence of a force field in some area of space must necessarily result in the appearance of physical properties of time caused by the motion of body in this area.**

Thus, from the synthesis of the notion of space-time and of the idea of physical field it follows with necessity that **the course of time in a given region of space should depend on physical processes in this region, i.e. time, as well as space, should have physical properties [5-8].**

It should be emphasized that in special theory of relativity (STR) time and spatial coordinates are independent and formally equal in rights quantities, which determine the position of elementary events in space-time. On the other hand, time stands out in relation to spatial coordinates. The special role of time is due, from the viewpoint of geometry, to the

pseudoeuclidity of geometry of the 4-dimensional space. From the physical point of view, it is associated with the dynamical principle (causality principle), according to which the state of motion of a physical system at an instant of time t uniquely defines its behaviour at the next instant of time $t + 0$. The significance of dynamical principle lies in the fact that it relates the temporal evolution of system to the physical processes caused by force fields and in doing so it allows one to determine the course of time in the system, its possible dependence upon the character of physical processes, and not just the sequence of events and their duration.

The idea about the existence of the physical properties of time belongs to N. Kozyrev [9]. By introducing into mechanics an additional parameter taking into account the directivity of the course of time, Kozyrev has formulated causal (asymmetrical) mechanics from which it follows that time has physical properties. According to the results of theoretical and experimental investigations conducted by Kozyrev and his followers [9-13], events can proceed not only in time, but also with the help of time, **information being transmitted not through force fields, but via a temporal channel, and the transfer of information happens instantaneously. The appearance of additional forces, associated with the physical properties of time and capable to fulfill work, testifies that time can serve as a power source.**

In the papers by I. Eganova [12] and M. Lavrent'ev and I. Eganova [13] it is stated the problem of direct experimental research of the physical properties of time to ascertain the relations of a new type between phenomena and to discover new methods to change the state of substance. In [14] O. Jefimenko investigated the dynamical effect of the slowing-down of time.

According to [6-8], the conclusion that physical properties of time exist follows strictly from relativistic mechanics, without introducing any additional hypotheses. The physical properties of time are of purely dynamical nature: their existence results from dynamical principle. **The availability of physical properties of time is manifested in that time has a local inhomogeneity: its course along the trajectory of motion of a point particle in a force field is continuously changed, and this change in the course of time is a result of the action upon the particle of a force field in the inertial reference frame, in which the motion is considered.**

Editor's note: The author gives a detailed consideration of the physical content of the local dynamical inhomogeneity of time. Considering the motion of a classical point particle under the action of a force field in the inertial reference frames, that moves relatively to each other, Valentin P. Oleinik derives 73 equations, that help him to obtain the following conclusion (mathematical details and physical reasoning may be found in
http://temporology.bio.msu.ru/OLEINIK/oleinik.htm*)*

The elucidation of the physical nature of time is one of the most important problems of theoretical physics. The purpose of research on the problem of time is to study the physical properties of time, i.e. to ascertain the possible interrelation between time and material processes. In particular, it is of interest to find out

- whether the flow of time depends upon physical processes and whether the back influence exists (i.e influence of the change of the time course on physical processes);
- what mechanisms of the change of the course of time are available;
- what factors are capable to speed up or to slow down the flow of time.

In papers [5-8] on the basis of Lorentz transformations relating to coordinates of points, lying on the trajectory of motion of particle in a force field, the phenomenon of local dynamical inhomogeneity of time is predicted. The main result consists in the proof that material processes occurring in a physical system under the action of a force field necessarily influence the course of time along the trajectory of motion of particle. The case in point is the change of the course of time along particle's trajectory in one inertial reference frame as compared with that in the other.

In this paper the next step is made: the relationship is obtained which relates the course of time on one path section of a particle when moving in a force field to that on the other path section in the same inertial reference frame. The main idea underlying the approach developed results from the analysis of Lorentz transformations and consists in that **the course of time of a particle moving by inertia, i.e. of a particle being not exposed to force, should be uniform.**

As is well known [17,18], the existence of dependence of the course of time upon the gravitational field potential is predicted with the general theory of relativity (GTR). According to GTR ([17], p.303), time flows differently at the different points of space in one and the same reference frame. Since "gravitational field is nothing more nor less than a change of the space-time metric" ([17], p.313), one can assert, apparently, that the change in the course of time is due, in the view of GTR, to the change of the 4-space metric. It should be emphasized that in the present paper gravitational field is considered as an ordinary force field, and the particle motion is supposed to occur in pseudo-Euclidian space-time. The main formulas of the article, (22) and (25), describe the change in the course of time in an arbitrary force field at different spatial points in one and the same inertial reference frame. As is seen from the results received, the change in the course of time in a force field is in no way connected with the change of space-time metric. It is conditioned by the force field action on particle in inertial reference frame and is a direct consequence of the dynamical principle underlying relativistic mechanics.

It should be emphasized that the existence of dependence of the course of time on the state of motion of particle in a force field points to the feasibility of controlling the course of time using force fields.

Note an important peculiarity of the non-inertial reference frame, in which the imponderability state of a particle is attained: **there is such a space-time region in which the reference frame at hand can be approximately considered as inertial.** In connection with the fact that such reference frames (it is natural to call them **quasiinertial** in contradistinction to the **true inertial** reference frames) are, generally speaking, not equivalent to each other (see previous section), the derivation of a rigorous criterion for inertial reference frame acquires especial significance. The dynamical criteria for defining the inertial and non-inertial states are considered in the papers by B. I. Peschevitsky [19]. The heliocentric reference frame seems to be among the quasiinertial reference frames, being inertial with adequate accuracy only in a restricted region of space (for example, within the limits of our Galaxy) [16].

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Time and its Physical Relationships

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Time cannot be absolutely defined, and there is no inseparable relation between time and signal velocity.
Albert Einstein [1]

Time does not exist by itself

The phenomenon of time emerges in relationships – as an expression of properties of physical bodies and changes that occur to them.

Time is a factor of energy. Time has to do with the *increase* and *decrease* of energy. For example, as energy is brought down to a "zero level", time is "eliminated", so in a sense, time cannot be "compressed" - only eliminated. In the zero-energy level, electrons occupying this level in unlimited numbers are available through state transitions for the building of matter and the vacuum [2]. So it is the extent and the nature of energy flow that determines the characteristics of time.

How do we know all this?

In his seminal foundations of physics work of the early 1900s, **Sir Edmund T. Whittaker** demonstrated by canonical quantization that there exist physical, time-like and longitudinal photons *in vacuo* [3,4,5]. The 2 scalar potential functions, *F* and *G* which completely characterize an electrodynamic field due to electrons in the ether are:

$$F(x, y, z, t) = \sum \frac{e}{4\pi} \sinh^{-1} \frac{\bar{z}'-z}{\left\{(\bar{x}'-x)^2 + (\bar{y}'-y)^2\right\}^{1/2}}$$

$$G(x, y, z, t) = \sum \frac{e}{4\pi} \tan^{-1} \frac{\bar{y}'-y}{\bar{x}'-x}$$

In these equations, for the fundamental case in which a field is due to any number of electrons moving in any way, we observe that time emerges only through the displacement of energy. Another way of putting it would be that time emerges through change in energy.

These photons have an independent physical existence. Whittaker himself observed, after computation that the "total disturbance at any point, due to this system of waves, is independent of the time, and is everywhere proportional to the gravitational potential due to the particle at the point" [6]. **A. D. Sakarov** admitted that the gravitational field is a "conglomerate of loose things and not a fundamental field of nature at all [7].

Everything electromagnetic, and probably gravitational, starts from these potentials, not fields, and under certain circumstances, there may exist photons without fields being present at all. In the *vacuo*, the longitudinal light photon travels in the direction of the beam, like an energy capsule, as a scalar four-potential-function energy standing-wave field, with many different frequencies, with an internal symmetry based on circular polarization [8,9], an energy field or nexus that "has an end, but no beginning". The time-like and space-like parts of the four potential are photons with spin –1, 0 and +1 that are longitudinally directed, and which are observed in the ***Compton*** and the photoelectric effect [10].

Movement of light affects time

Philip S. Callahan designed an elegant experiment that shows how variations in the movement of light affect time [11]. Changes in exposure settings of photographs of same objects, including coherent light laser spots results in shift of position of images. The more coherent the light, the less apparent is a shift in time. He suggested that time is neither absolute nor independent of photon activity of space.

We can also state, as a corollary, that the *movement* of light generates time. After all, the electrodynamics is associated with photons. This is particularly significant in time engineering, as will be seen later.

Time and life

Now, it is well known that the ability of cells to sense the presence of light is a primary function of life itself. If a cell can sense light, it is alive; if it cannot, it is dead [12]. Callahan was able to observe that time increments were detected on light-detecting surfaces of living organisms such as the cuticles of leaves.

The Russian time researcher, **Nikolay A. Kozyrev** considered that living systems "consume" time for their life-energy [13]. **Velimir Abramovich** suggests that living organisms are naturally-driven "time machines". They each have an inbuilt time that serves as a "code" to structure their own physical totality and to regulate their own functioning. Thus their "local time" acts as a "time operator" ("time condition") frequency [14]. The nature and level of electromagnetic fields in living systems could therefore be considered as indicators of their "energy level" and how it affects and adjusts the inherent rate of time-flow.

Time and consciousness

We append to these statements the notion that, yes, time is "consumed" by living organisms – but only if they are conscious. Essentially, time can be perceived by measurement, which always requires a conscious observer.

When we measure, we observe the differentials of energy flow. It is the measurement of these differentials - as we note from the Whittaker equations of scalar fluxes - that allows us to the measure the equivalence of time. When we measure differentials, we are effectively creating our notion of time.

It is difficult for humans to conceive that time does not exist when humans think about it. **Saint Augustine** speaks for all humans with his observation:

While I do not think about time, I know that time exists. When I begin to think about it, I stop understanding what it is.

With such conditioning, humans cannot come to grips with the notion that the Universe has no beginning and no end. It is like the paradigm of absolute nothingness – people cannot deal with the concept of no time because, effectively, consciousness, like life, consumes time. One could advance the notion that thought itself is time in motion. When we think, we are creating time. Life is movement – and the brain registers energy differentials and their associated fluxes of scalar potentials.

Time and causal mechanics

Since time is the result of movement of energy (and accordingly, light), then time is associated with the cause-effect processes linked to a first position of energy to the next. In other words, time is innate to causal mechanics.

Variations in energy flow, logically, lead to variations in the characteristics of time. They also permit variations in causality.

Conversely, changes in time lead to changes in physical structure [15]. This phenomenon was proven by Kozyrev and has been labelled as the ***Kozyrev effect*** [16]. He demonstrated that changes in the course of time affect the performance of electronic components. Figuratively speaking, a transistor is like a corral in which light behaves in a certain way. By changing the way that light behaves, a transistor becomes valueless.

To create an extra-temporal causality (with linkages to another level/dimension) one must change the light movement. Changing the light patterns means changing the behaviour of a wave, and its concordant photonic reality. By altering the photons, we make them go to another dimension.

Changes in time can effect change in living systems [17]. The engineering of "time-polarized" waves has the promise to target and amplify natural healing procession in living organisms. It is these natural activities that would restore diseased cells to their original and healthy condition [18]. Such time engineering may also include the reversal of the effects of AIDS, smallpox, anthrax, and most bio warfare agents, with treatment times of only a few minutes per week, with no more than 3 treatments required in all. Eventually it may also be possible to reverse the effects of genetic disorders, effect limb regeneration, and cure spinal cord injuries [19].

Engineering causality

Variation in the density of energy determines variation in the "the course of time". By the "speed of course of time" is meant the rate of causal transformation and the input of additional forces into systems (including mechanical tensions). According to Russian scientists [20, 21,22] there are interesting possibilities in deploying engineering for causal mechanics.

In preventive time engineering, one could delay the approach of a known cause and to artificially close the consequence loop, and thereby annulling it from ever achieving an effect. In other words, one can make the effect "happen" before its normal time, disrupting space structure with its related "speed of the course of time". One can also make it "happen" after its expected deadline. This technology could have interesting implication in strategic situations (preventing a extra-planetary body from attaining a collision course).

According to the Russian experience, when the spatial structure is disrupted by time-engineered causal mechanics, the affected region undergoes relative greater entropy (or, less order). The volume of space is forced out to somewhere else, generating torsion fields, much like a balloon will drift away from denser air. A similar phenomenon occurs when the velocity of a mass increases, the force emerges against it, called "inertia" [23]. Now, to increase velocity, the energy of the mass increases. In the case of time, as the movement of energy increases, interaction or reaction with another dimension ensues to compensate for that primary change [24].

The boundary layer between the two states of space can then act as a mirror and the approaching agent may be reflected back to its source. For example, a light beam may be reflected back to its emitter, in full, or in part, depending on the engineering.

With space-time engineering, we could develop teleportation systems [25]. The course of time goes from the past to the future, in the direction of greater disorder. Going back to the past represents deceleration. The etheric continuum is perceived by Kozyrev is containing variations of "density" of structural elements. The "denser" the etheric region, the slower is the course of time. A zone of accelerated time course would be forced out into "rarefied" ether. A zone of slowed time would be forced into denser ether, hence the basis for a teleportation technique.

***In vivo* experiments with a Time Machine**

For over 15 years, a Russian association of scientists has conducted experiments with acceleration and deceleration of time with 4 prototypes of time machines

[26]. Light-heartedly, the units are called "muskrat traps" since the experiments conducted in remote forest were disguised as a high-tech electromagnetic technology for trapping muskrats. The time machine units are spheres ranging in diameters of 30cm, 1 meter and 2.1-meter. The shells are encased with coils designed to produce convergent waves.

Team leader **Vadim A. Chernobrov** describes converging electromagnetic waves as moving from a periphery to a central point. They are observed when a hoop is thrown into the water and inside the hoop the waves converge. If a potential is applied to do work and to initiate the energy differential process, the other reverse direction scalar (the reverse-time energy flow) must react. Thus, compensation of time - in the form of the deceleration or acceleration of the rate of time - can take place [27].

The first trials involved mice, in which most (25 out of 31) died. Eventually, there were successful 2-hours runs of time travel. An experiment with a dog that was clearly frightened also showed no ill effects. This led to experiment with humans, the first being **Ivan Konov** who, on August 26, 2001 decelerated into the past by 3% of planetary time during a half-hour trial. Dozens of others have experienced the phenomenon and report such sensations as: quicker pulse, giddiness, itching skin, body twisting, numbness at extremities and a case of an out-of-body experience. Harmful effects on living systems do not appear to be linked to the change of the rate of time, but rather to the variations of the time rate value among regions of a living organism.

Some individuals reported visual experiences such as "starry sky", "luminous vortices" and colour spots. Individuals observing outside of the time travel machine noted headaches. The most interesting phenomena occurred just before the start-up: significant presence of ozone for several hundreds of meters around the machine, which was located in a forest. Also noted were strange lighting effects in the sky above the apparatus, accompanied by sounds that inexplicably appeared to generated from inside.

Factors affecting the rate of time

The experiments yielded interesting observations: the phenomenon of the rate of change of time varies according to the hour of the day and according to the lunar phase. The rate can be influenced by a variety of external inputs, including mechanical vibration.

The transition into the future differs from than into the past. It is like movement from any point in a tree – where downwards represents past time. There are many paths possible towards the future – upwards, along the branches, but only one towards the past – downwards to the trunk. The return from the past time is possible only if the time traveler does not interfere with occurring events – or the possibility of returning to another branch of the tree. However, a return move from any variant of future time is possible regardless of the behaviour of the traveller.

The Russian time-travel experiments point to a relationship between inertia and time. In changes of rates of time, the region adjacent to the spheres develops a boundary layer effect, appearing as an aura of "white mist". The greater the time differential, the denser is the mist.

A similar phenomenon has been observed, and captured on film, with some experiments conducted by **John Hutchison** involving remote-controlled lifting and disruption of objects [28,29]. It may be that the ***Hutchison effect*** involves causal mechanics.

Time and frequency

Time may be viewed as a process – or "change-of-space" in any direction that does not exist in our dimension [30,31,32]. In physics, new properties are commonly acquired as the result of change in some property: charge, current, induced magnetic field, etc. Here, the new property becomes a new dimension. For the frequency of oscillations, the formula is $f = 3/\lambda$ [l/s], where λ is wavelength in [m]. Here, the velocity of light is equal to 3 (the 10^8 mathematical degree is omitted since it is a question of scale of measurement only).

Therefore, the analogy between our dimension and frequency gives us a new notion, which is curvature ρ: $\rho=3/r$ [l/m] and $f = 3/\lambda$ [l/s]. The 3-dimensional radius is represented by $R=\lambda/\rho= r/3$ [m] and time as a period of oscillation has the relationship: $T = \lambda/f$ [s]. **Time can be considered to be equivalent to the radius of curvature ρ if the linear radius r and the wavelength λ are the same. This is a condition for the spatial resonance effect.** Note that in this analysis, *"m"* and *"s"* are unlike when length is measured in meters in our dimension. However, for a new dimension it is possible to use equal units for (m) of 4th dimension and conventional "second". Furthermore, light (photons) is possible in our dimension only as a process in such a spatial resonator.

Experiencing time dilation

Based on the above discussion, it is proposed that we experience changes in rate of time in our daily life. During sleep, as our energy level decreases, so it can be argued that time decreases and we "go" into another dimension. Aspects of what is observed during the dream-state do not obey the rules of our familiarity of physical existence, and conventional causality - because the rate of time is different. As we start our dreaming, and as we emerge from dreaming, the recalled experiences resemble more our regular experiences. Before and after sleep, our brain frequency tends to resemble the daytime's. In effect, understanding our dream state's sense of time may be a reference key to comprehending the physics and causality mechanics of time engineering.

Time and planetary gravity

The Earth's mass appears to be in continual growth. 250 to 350 million years ago, our globe may have been half size - with all of the continents as one landmass [33]. In ancient sediments, the natural angles of slope in sand beaches greatly exceeded those of today, indicating that gravity has on our planetary surface has increased 8-fold, several times, during the last 1.5 billion years. Yet the planet's average density may not have changed – only the acceleration of free fall [34,35].

There could also be another explanation possible for the change of slope of beaches. The pull of the moon may have been different in the past.

Also, the planetary magnetic fields could have increased over the millions of years, through interactions with the solar flux of hydrogen atoms. The sun is in constant explosion – production of energy differential. Earth and other planets could be responding with harmonics to compensate for the solar activity, leading to an overall increase in magnetic fields. Such a phenomenon may give the illusion that the physical body is growing larger. In other words, with time, the force of gravity would alter planetary mass and energy.

Assuming that the Earth's density has not increased, it is possible account for, mathematically, the relative increase – growth processes - of the nuclei of terrestrial atoms, including the doubling of mass of nucleons and of electrons [36]. Such calculation also accounts for the emission of 2 different photons by hydrogen atoms (also known as the "red shift" described by **E. Hubble**).

The phenomenon can be explained with the time-like and longitudinal photons described by the bi-directional 2 scalar potential functions [37,38]. Could it be suggested that matter is gravity minus time? In other words, gravity is related to accumulation of energy differential (time) in mass.

The value of gravity varies throughout the planet, in part because of the poles and in part due to local density of matter. **Kirill P. Butusov** has noted a correlation between places of civilization and regions of greater gravity. A faster rate of evolution may be associated with such gravity zones. In these zones there would be a greater influx of scalar potentials. Time would be more "authenticated" by these energy flows into conscious beings. Butusov reminds us that time has a "positive energy" and flowing into nuclei of atoms or a "negative energy" flowing out of the nuclei of atoms [39].

The outflow would be representative of gravitational energy. Longitudinal waves are known to be able to enter and to leave nuclei. Such flows of time must come from other dimensions. After all, the surface of any elementary particle separates our dimension from another. This leads to an interesting possibility in which all time-associated processes between dimensions are synchronized.

Time reconsidered

Arguments have been laid that suggest that time is equal to energy differential (including movement of light). Living systems "consume" time as part of their consciousness and measuring processes.

It is possible to engineer causality. An understanding of higher-order electrodynamics is required. Techniques exist for the generation of scalar potentials. Causality technology has many applications. They include: therapeutics, energy generation, consciousness technology, inter-dimensionality, defence systems, teleportation, and of course, "time travel".

Appreciation is expressed for guidance in this discussion by Thomas E. Bearden and Bernard de Montréal.

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Time as Phenomenon of the Expanding Universe

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Preface

In 1992 the author of this words, having been stimulated by Kozyrev's book [1], started to reflect on Time meaning and Time and Space asymmetric roles during the Universe Expanding. The development of these ideas has led to the work [2], it is available now (the Russian version only) on the website of the Institute of time nature explorations (grant #00-07-90211 of the Russian fund of basic research).

I would like to thank the Chairman of the Russian Interdisciplinary Temporology Seminar Dr. A. Levich from Moscow State University for his constant support and friendly interest. Also I would like to thank A. Moskowsky for the 20-year discussion of the physics history and philosophy.

The said work [2] pretends to revise radically a number of basic physical concepts of the Space - Time, Motion and Energy nature. It includes a detail analysis and mathematical calculations. Only a brief account of the main part of this work is presented below.

Introduction

The nature of time is not yet enough clear for natural science. In Newton mechanics time was presented as some universal formal parameter. Its value rises steadily at every point of the Universe by unknown for us reason. Each physical process occurs in space in correspondence with the time course.

In the Special Relativity (SR) time and space are integrated to the common 4D-continuum. However, in this theory the time component having imaginary factor seems also to be "exotic". In this concept the increase of time is also implied in each reference frame.

The General Relativity (GR) allowed linking the time properties with gravitational fields and the space geometry. The time currency started to be associated with a spatial expansion of the Universe.

The theoretical physics traditional approach to the process description is based upon the considering of time course as primary (original) one. There are also in the modern physics [3] several attempts to deduce the time concept as secondary one from different fundamental (microscopic) concepts.

However, the third way (inverse to the first one) is possible and forms the basis of this paper. A starting point of this way is the following question: "Does any universal process exist which could *generate* physical time?"

(Editor's note: The same question was formulated and the answer was proposed by Alexander V. Frolov in 1996, report "Matter as process", Scientific congress "New Ideas in Natural Sciences". It was assumed that similar process can be produced by special technical methods also.)

Such fundamental cosmic process really exists and it is well known in the modern science. **It presents the Universe expansion** and was opened at the first third of the 20th Century by the American astrophysicist E. Hubble and others [4]. It means the general increase of distances between all 3D-bodies. The same scattering of two-dimensional-figures happens on the surface of some spherical balloon during air incoming. The centre of this sphere does not belong to the surface; all points of the sphere (the Universe) are equivalent.

Some time earlier the theoretical physics had come to the same results. As it is well known, the Einstein's GR was published in the 1916. After that Friedmann (1922) proposed the concept of the expanding Universe. For example, in the book [5] a description of the basic cosmic model is given. Hereinafter this model is called "Einstein-Friedman model", or "EF-model". In this model the Universe is presented as 3D- hyper surface of a 4D- sphere with increasing radius. Of course, the curvature of the 3D-hyper surface increases with time too.

Basic hypothesis relative to time nature

Some simple and pictorial views consist a basis of the new concept. Hereinafter it is called briefly as "The Spherical Expanding Universe Theory (SEUT)".

In the SEUT, as well as in the EF-model, in every time the Universe represents the 3D-hyper surface of a 4D-sphere. However, there is one very important difference. In the Einstein's theory the spatial components of the metric tensor are opposite in sign to the time's one. For example, we may consider time as imaginary quantity, then spatial coordinate as a real one. On the contrary, in the SEUT the 4D-continuum is considered as purely

Euclidean, all the four coordinates are real quantities. The usual spherical geometry can be used on a surface of the 4D-sphere.

As it is well known, in the GR the Age of the Universe can be *calculated* using the EF-model or a similar one. Usually, the radius-age dependence is not a direct proportionality in such GR models. However this result may be deduced if to neglect the global pressure of matter that fills the Universe. In [2] it is demonstrated, that an account of the static pressure of matter follows to the Universe radius linear dependence on its age (see below).

On the contrary, in the SEUT the time universal course is *manifested*. The Universe age is *identified* with a current Universe radius divided by the velocity of light. Numerous important consequences may be deduced from this statement. On the other hand, it allows avoiding many other arbitrary postulates in the model.

Mechanical motion and maximum velocity in the SEUT

The SEUT states, there is no unlimited set of independent mechanical motions. Only world lines of moving bodies exist. Each of them has some inclination relative to the time line, which presents a normal to the hypersurface of the 4D-sphere. It is *an inclination angle that defines the spatial motion velocity*. At the increase of sphere radius the intersection point of word line and current hypersurface "moves" with exact correspondance with a modern physics prediction.

In particular, immovable objects (stars) have zero inclination, their world line are normal to the hypersurface. Hence they "scatter" according to the Hubble law, their mutual velocity is proportional to mutual distance. If a body world line has some inclination relative to normal, the angle is more than zero. But it can't exceed 90°, therefore *maximum* mechanical motion *velocity* appears *naturally*, it is equal to the velocity of light.

Let us consider three variants of motion (see Fig.1).

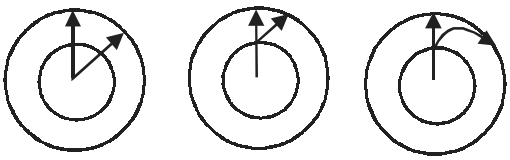

Fig. 1
Phenomenon of a "motion" of point on a sphere surface for immovable (at the left), uniformly moving (at the centre) and non-uniformly moving (at the right)

The left picture illustrates the Hubble effect. The right picture presents a general case of motion with acceleration. The central picture corresponds with an inertial motion; its world line is direct. In this case the moving body displacement increases proportionally to the Universe radius increment. So, *inertial* motion is not postulated in the SEUT, it appears as natural model consequence.

At a large 4-sphere radius values all the relationships of SR and usual mechanics laws are applicable approximately in the SEUT. A Special Relativity light cone transforms to all the hyper surface of the 4D-sphere. But the analogy is not complete, because an absolute remote SR area degenerates to this 3D- hyper surface in the SEUT (see Fig. 2).

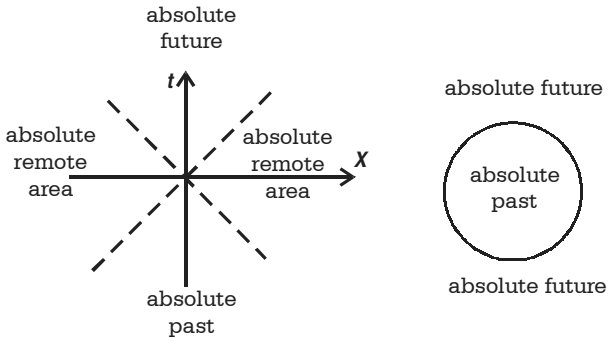

Fig. 2.
4D- continuum areas in the SR (at the left) and in the SEUT (at the right)

SEUT and Minkowski geometry

Let us consider small increments of time and space coordinates along body world lines during the Universe expanding. It is enough to consider a small area of the Universe, so we can neglect its curvature. Then it is acceptably to replace approximately concentric hyper surfaces ("isochrones") by parallel hyper planes. The space-hold corresponds with a representative point "drift" perpendicularly to isochrones, an inertial motion corresponds with displacement along inclined direct lines between isochrones.

At each time the Universe is represented by a certain isochrone that contains all the real spatial points. Let us accept that 4D-sphere radius increment divided by velocity of light presents invariant measure of (absolute) time increment. We will also state that this quantity has the same value in each *inertial* reference frame, i.e. at a motion along each *direct* world line.

Let the angles of world line inclinations from normal direction are enough *small*. Then metric relationships like Minkowski geometry ones appears in our purely Euclidean 4D-continuum. In particular, well known relationship

$$c^2\, ds^2 = c^2\, dt^2 - dr^2$$

can be deduced from the Pythagorean theorem. It connects a spatial component *dr* with a time component *dt* (at moving reference frame) through velocity of light *c*. Here *ds* is an absolute time interval (between two 4D-events at a immovable reference frame). **Hence, if velocities aren't very high, the Lorentz transform is correct in different inertial reference frames.**

On the Einstein's relativity principle

If the world lines inclinations from exact normal direction cannot be accepted as small, then Minkowski geometry relationships are correct approximately only. It means that Einstein's relativity principle is correct (in the SEUT) only for reference frames that move with velocities enough small relative to *selected* reference frame. Such reference frame is linked hardly with a body at (absolute) rest, i.e. drifting along radial world line.

The selected reference frame existing reminds of old ether theories that contradict to the Special Relativitiy views. It seems, these theories became a thing of the past irretrievably. In fact, the velocity of light in vacuum is constant everywhere and everywhen. However, the reference frame existing can be detected in principle as a light signal frequency bias, i.e. with the help of Doppler effect. Well, this phenomenon is really detected by the modern astrophysics!

The temperature diagram of the Cosmic Microwave Background Radiation (CMBR) coming to the Solar system from all the sides of the Universe is presented on Fig.3. The data was registrated during 4 years by the Cosmic Background Explorer (COBE) satellite (NASA Goddard Flight Centre, COBE Science Working Group).

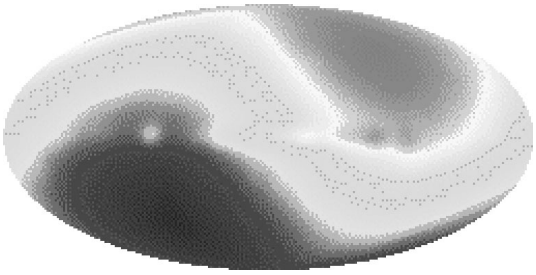

Fig. 3
The anisotropy of the Cosmic Microwave Background Radiation (CMBR)

The well-known Russian scientist J.B. Zeldovitch in the Editorial Addition to [6] in connection with earlier experiments notes that careful measurements **allowed to find out some anisotropy of CMBR.** An antenna oriented to the Lion constellation detects that the radiation temperature is 0.013% more, than mean temperature. The radiation temperature in the opposite direction is 0.013% less, than mean. **Generally, a temperature varies continuously between these two values.** The isotropy presents only for some imaginary observer. ***The Solar system, Earth move to the Lion constellation relative to this observer having velocity 390 ± 60 km/s.*** Hence, as a result of the Doppler effect, a incoming radiation seems to be more hot, and an overtaking radiation seems to be more cold. This example shows that for observer of any point of the Universe this CMBR is isotropic. We may consider this observer and the connected reference frame as selected one. The selected reference frame existence at the Universe every point looks like the physicists commonly held view preceding to Relativity. They thought that the light presented ether oscillations occupying whole the Universe. They thought also that a reference frame connected with ether was preferable, or selected. They tried to detect the Earth motion relative to ether. We know that these experiments gave the negative result: any ether doesn't exist. But the Universe evolution follows that when CMBR is observed (and only in this case!), the selected reference frame (called sometime "new ether") appears. ***The new ether or CMBR just realises the motion according to Hubble's law.***

The modern NASA's data allows to put the relation of the Solar system velocity to the velocity of light equal to 0,15%. It is enough small value justified Special Relativity and Minkowski geometry relationships application. But can we believe this phenomenon to be an exhaustive proof of the SEUT accuracy?

To test it we propose a not complicated observational experiment. If the CMBR anisotropy is due to the real selected frame existence, then it may be detected for any electromagnetic radiation. In particular, an anisotropy of solar radiation has to exist at the different year periods. It has to be detectable in August, when the both solar radiation and CMBR come to the Earth from the Lion costellation side (see Fig. 4). In February these sourses are opposite in disposition relative to the Earth, therefore the solar radiation anisotropy direction has to be opposite. The expected effect value (with account of the Lion constellation straight ascendancy and obliquity of the ecliptic) is approximately equal to 300 km/s, i.e. nearly 0,1% of the velocity of light. In November and May the anysotropy has to be practically absent.

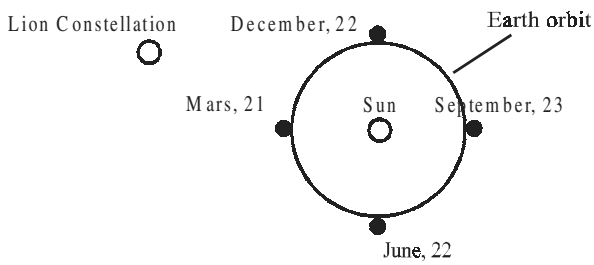

Fig. 4
The Sun and Lion constellation disposition relative to the Earth

Probably, an analogous SEUT test in a laboratry is realizable with help of artificial radiation sources.

Particle mass, energy and impulse

So, we consider the Universe as expanding 3D-hypersurface of a 4D-sphere. Mass localisation places in the Universe present the points of the hypersurface intersection by world lines. So, **these world lines have a real physical meaning, not abstract illustrative** this one. We may expect this physical meaning to be more essential than simple word expression.

Particularly, while the Universe global analysis is making, we may suppose that such fundamental

particle feature as its mass at rest presents some *relative* value. Such relation (some kind of a quantum number) may include, for example, 4D-sphere (the Universe) diameter and some characteristic size like de Broglie wave period that is inversely proportional to the mass. This hypothesis may make clear *inertia* nature as two characteristic times *relation*. It may also explain the *rest-energy* notion.

Meanwhile, the Universe radius increases with time. Well, what happens to mass? If a de Broglie wave period increased proportionally to time, we couldn't generally detect the Universe expansion, including famous "red shift". But if particle wave periods are constant, then *matter mass has to rise proportionally to the Universe age and size*.

In the Relativity (like Minkowski geometry) we use vectors having imaginary projection to time axis and real projections to space ones. Particularly, it is true for velocity, acceleration, and energy-impulse 4-vectors. As against, vectors having all the real components are only used in the SEUT. At that, a 4-interval value (length in pseudo-Euclidean space) of some relativistic vector answers the absolute time axis projection of a corresponding SEUT-vector, and imaginary component of a relativistic vector (time of motion) answers the corresponding vector length in purely Euclidean continuum of the SEUT. For example, the energy-impulse vector module presents such quantity. Its projection to absolute time axis is energy at rest divided by velocity of light, and its projections to spatial axis are impulse components. This quantity is *constant* while the particle movement is *inertial* one.

A jump to *non-inertial* motion in the SEUT is connected with a corresponding state vector *changement* law. So, if particle motion velocity changes, its *energy at rest* doesn't change, therefore full acceleration at a time interval can be calculated using the difference between new and old impulse values. Thus, the non-uniform motion equation in the SEUT can be found like SR as time derivative of an impulse expression.

The force-acceleration relation depends on a mutual orientation of force and velocity vectors in the both SR and SEUT. But in Relativity a reference frame velocity can be choised arbitrary, for example it can be zero, then the relation will be equal to one.

On the contrary, in the SEUT an *absolute* velocity is presented, it is defined by the world line inclination relative to the normal. Let the Earth move with any velocity relative to the immovable (selected) reference frame. Then we will be able to detect the absolute velocity using two measurements, the first one along the world line, and the second one in a perpendicular direction.

If this absolute velocity is really defined by direction and value following from CMBR anisotropy effect, then we can expect a relative difference near $2{,}25 \cdot 10^{-6}$ between longitudinal acceleration and transversal one.

Local gravitational fields of particles

What does the SEUT talk about body gravitational fields? Let us imagine all the bodies as immovable and drifting exactly along the *radial* world lines. If there is a mutual gravity attraction effect between two bodies in such Universe, an observer will detect some curvature of their world lines. They will seem to be bending one to another instead of a radial divergence. In essence, in this case we may replace a world line by a gravitational field line. Then the analogy allows us to identify an Universe isochronous intersection with an equal potential surface that these field lines have to be *normal* to this surface. So, we arrive to a presentation that a Universe isochronous intersection is not strictly concentric hypersurface. It is perturbed by some kind of craters (see Fig.5), that centres correspond with gravitating bodies.

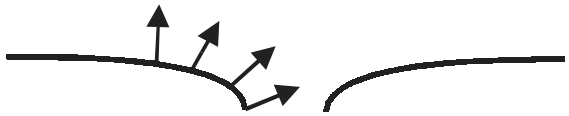

Fig. 5
Local body gravitation field

The inclination angle of a crater profile relative to non-perturbed sphere hypersurface is equal exactly to the inclination angle of a normal relative to strict radial direction. Hence, a local gravitation field intencity measure agrees practically in each point with body velocity measure that we used earlier. It authorizes energy concept using for both mechanical motion and gravitation phenomenon.

SEUT and General Relativity

Let us discuss some GR's aspects. Is it acceptable to neglect pressure of matter? When Einstein searched for his early cosmological static model solution, he had to introduce a cosmic constant in his equation. This constant answered a ***negative matter pressure***, that Einstein could not determine a meaning. In a non-stationary model a solution exists independently on cosmic constant presence, therefore it may be put often as zero. As rule, bodies' velocities may be put as zero too; therefore (*dynamic*) pressure is usually neglected.

However, we insist on necessity to account a *static* pressure of gravitating matter. Really, it can be ignored in the case when Einstein's relativity principle is applicable. Accordingly with it a gravitation field can be *always* replaced by reference accelerated frame. In this case a purely kinematical side is only accounted. However, *not every* field may be considered (even locally) as uniform one (see Fig. 6). Let the radius of a field source (or a *probe particle*) have the same order that the mutual distance. Then the Einstein's equation connecting space geometry with matter physical features seems to be incomplete. More precisely, it is incorrect to put exactly equal to zero a static pressure

in the matter density tensor, it is necessary to introduce its (unknown, calculable) value accounting **the *continuum deformation energy*.**

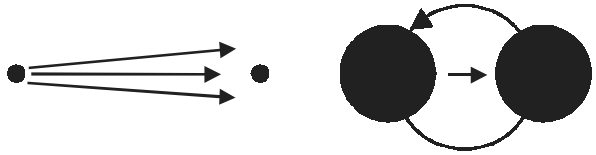

Fig. 6
At the left a locally uniform gravitation field is presented, the right field can't be considered as uniform one even locally

Are the proposed amendments important? Specialists know, that the Metagalaxy gravitation radius is *in fact* comparable with its real size. **In [2] we have showed that the Universe radius was *less* than its gravitation radius.**

It is shown also in the same work [2], that a resulting gravitational pressure in the Universe is *negative* and it is responsible for the Einstein's cosmic constant. This fact seems to be evident because a gravitation force aims to *gripe* any matter accumulation. **But it is possible to conclude it by a non-trivial way.** Let us consider a matter pressure as a reactive force operating within a uniform sphere of incompressible liquid. A pressure dependence on internal density is presented in [7]. We can see [2], **that if the sphere gravitation radius exceeds its geometric radius not more than approximately 1% (or it is still less), then a sudden negative change of the pressure appears at the internal abroad. This phenomenon may be explained as a volume "expansion" due to a metrics perturbation.**

The consideration of static pressure allows not only to find out a *new* (linear in time) cosmologic solution, but also to calculate a dependence of the Universe gravitational pressure on the radius of the Universe. This *negative* value has the representation like that one for a non-relativistic sphere (a star or a planet, for example). Also we would like to note, the formulation of density-Universe radius in the SEUT is exactly the same that the formulation of so-called *critical* density in the EF-model.

Two very important circumstances are clarified for all that. First, the **Universe mass was turned out as *linearly increasing* function of the 4D-sphere radius, and it is not a constant. A famous Einstein's programme is realized unexpectedly in the SEUT: a matter features (density) are reduced to a space features (curvature).** In other words, a necessity to introduce a mass distribution in the equations externally ("by hands") is eliminated in the SEUT. This operation is need in the GR to find out a spatial metrics changement law.

Secondly, the seeming paradoxicality of University mass (and energy!) non-conservation make us to reflect on conditions that the *accomplishment* allows to the energy conservation law correctness (see Fig.7).

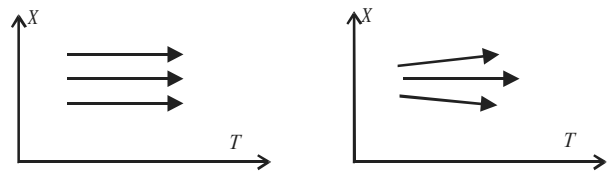

Fig. 7
If space features *do not depend* on time, then the closed system energy is *constant* (at the left). But if space features *evolve* in time, then the isolated system energy *have not to be constant*.

It is evident, we believe, that the energy can be exactly constant only in such physical system (or in whole the Universe) for which space features (in particular, a curvature) are strictly constant in time also. However, the both modern physics and SEUT issue from the opposite concept. Hence, this state can only be accomplished approximately, moderately of a bit of the modern rate of a relative space curvature evolution. This rate has order 10^{-10} per year for the modern Universe.

N.A.Kozyrev [1] basing on astrophysical observations stated the common star radiation origin that has to be due to the time-energy transformation. Accordinly with the SEUT, the relative increment of star mass (and its rest energy) is equal to the Universe age relative increment. It is interesting that the Sun mass relative lost due to the radiation consists in 10^{-15} per year, i.e. five orders less than mentioned above energy increment.

Universe origin and closed geometry

The cosmological EF-model could not say anything on the Universe origin. On the contrary, the work [2] approach allows an obvious way to study the problem.

As it is noted in [7], the metrics of any sphere area having a non-zero density is perturbed relative to Euclidean one, its geometry agrees with 4D-sphere hypersurface geometry. For non-collapsing sphere its gravitation potential relief is like a very small *"pit"* that gravitation radius is much less than its geometric size. However, when the density rises, the metrics perturbs more and more, and the pit transforms to some kind of *"crater"*. The crater is connected with the external surface by a narrow neck. Only this neck or its part is visible for an external observer, and the gravitation insurmountable barrier transmutes an object central area into "a lost world".

From the point of view of the external world, the central area presents a "black hole" absorbing irreversibly all the matter and radiation. On the other hand, for our Universe inhabitant the "navel-string" connecting with the external world has to seem a spherical "white hole", to which a matter and radiation are coming continuously (and, may be, carry out an information on the external world features). There is an old Russian fiction science book called "Sannikov Land", where an internal gigantic

trench concerning central small star is described. Our model seems to be like this picture.

Is it possible that we live in such a black hole? The present hypothesis answers affirmatively this question. The negative sign of the matter pressure due to continuously increasing of our world size allows to such conclusion. And the University self-closing can be physically explained by the way.

On the other hand, as it is shown in [2], in spite of matter average density negligibly small, the Universe gravitation radius is more than its geometrical radius; hence, it presents a black hole. This condition accomplishment agrees the Universe self-closing, the boundary absence in spite of its finite volume. Also, this fact confirms our assumption that the Universe rest energy localisation area does not exceed the gravity operation area.

A specific model of star collapse is created in the modern General Relativity. In general, it can study in *three* different reference frames. As a rule, the "point mass" models are used. *The first* model is linked with an external observer; the *second* one accompanies a matter falling to the black hole. *The third* model presents an internal reference frame, i.e. an observer within collapsing object.

From an external observer's point of view the matter falling time to the black hole is infinitely large. However, in an accompanying reference frame it is finite. Since in the accompanying reference frame time and space coordinates are expressed through the both types of external reference frame coordinates. What is more, in the internal reference frame the time and space coordinates quite trade places, the metrics tensor components are depending on time. Further, any matter point history in this accompanying reference frame starts at the zero moment and finishes after same universal time period in a special (singular) point, after which nothing exists ("time barrier").

As we believe, another lacing between internal and external collapse pictures will be possible, if we consider a non-point collapsing object. Nobody wonders now at a situation, when a time period can be finite in one reference frame and infinite in another one. **Therefore, we can believe, unlimited black hole *collapse* in the external Super-Universe may seem to present unlimited *expansion* of our Universe observing inside.** This expansion seems to *start* from a singular point, and the same point is the history end of all the matter of the external Super-Universe that fall to the black hole. I would like to note especially, it does not mean that internal time pass in opposite to external one. **Rather, it is possible to state, time within a black hole passes ortogonally to external one.**

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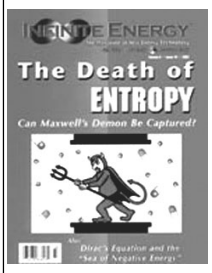

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The Experiments on Thermo-Gravitation

This review of the article by Alexander P. Schegolev, the scientist from Saint Petersburg, was received by NET editors from our reader vladrim@mail.ru and presents his own view about Schegolev's experiment [1]. The opinion of our editorial board is not fully in agreement with the author's conclusion. Also we have no information who is vladrim@mail.ru.

It is known from the science history that the very experiment gives a push to revising of old knowledge; it also checks the new designs and conclusions. The knowledge of physical theories is based on the experiment; the experiment confirms hypothesizes or refuses them. Making experiments, we ask questions to the nature. And it always answers us on the clear pointed question. However…

Michael Faraday was trying in vain to find out the relationship between gravitation and electricity. These experiments were repeated on the modern level. Further, there was made an attempt to screen gravity force, the influence of environment on gravity was also trying to be researched. Many efforts were spent on finding out of the gravitational radiation falling to the Earth from depths of the Universe, as well as artificial generation of gravitational waves.

The experimental studies of weight change must be under attention. In particular, the attempt to find the differences in weight after sharp turning of body from the quiescent state into the state of rotation around its own axis was undertaken. The experiments of the influence of strong magnetic field and temperature on the weight of a body were made.

But alas! No changes of weight were discovered in previous experiment *(Editorial: Perhaps, the author has no information about sucessful results. We reported about such results in our magazine)*. Analyzing these experiments and theoretical premises, the author of the given article has made an unusual experiment imitating the heat motion in the Earth from core to peripheries. For that experiment there was used the steel ball with 100 mm diameter. The cone hole was made in the ball up to its center. The ball was installed by the hole upwards on laboratory scales with 50 mg scale factor and laser beam was directed inside (into the hole). The directed heat flow outgoing from the center of the ball was created by this way. While the surface temperature increasing, the arrow of scales became to be rejected aside weight decrease. The temperature was measured by the contact thermocouple. After an hour and half, approximately, when the temperature was 300 degrees Celsius the laser was switched off. The difference (the decrease) in weight against initial value (in the cold state) was four grams per 4200 grams of the test body.

Further, the ball was getting cold slowly on the scales and its arrow was creeping to the initial position. For acceleration of this process, the ball was periodically

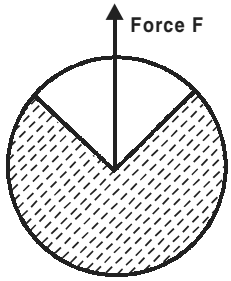

Fig. 1
The ball with cone hollow

blown on by pressure air. It was the check, if the air (heated by the ball) influences on scales or not. The stability of its data independently on actions of pressure air stream excludes such suggestion. When the temperature of the ball became the same with room temperature, its weight return to the value nearly initial. However it is necessary to add, that this "nearly" is about 200 mg. This confirms that the change of the weight was not occurred because of the evaporations of metal from action of laser beam, and we were the witnesses of absolutely unusual phenomenon. *(Editorial: Perhaps, it is necessary to take into account the deformation).*

That is all concerning the question, which was given to nature by the author of the given article. However, one more doubt remains: did the heat radiation (coming from the ball) affect on mechanism of scales? To check this, the control experiment was made, under which the same ball was heated by usual way in the electrical furnace. In spite of its temperature was about 600 degrees Celsius and the ball was placed on scales for a long time (until full cooling down), the arrow did not move from the initial position. Thus, we have really turned out face to face with a phenomenon requiring an explanation.

If the weight change in this experiment has happened in consequence of gravitational interaction, then, therefore we must revise some fundamental concepts. Today it is difficult even to assume the consequences. The only thing, which is possible to say certainly, is **that divergent on radius uni-directional (single-vector) heat flow** is the object for observation, absolutely unknown to us or unnoticed before, which holds the ensemble of surprises. Up to now, we have dealt only with **chaotic** heat motion, which was researched by the thermodynamics and heat transmission.

For analogy, it is possible to give the example **of the electric current arising, which is possible to get only under directed electrons moving.** In general, more than ten experiments were made, and all of them have given the same result: the weight of the body was decreased. Who will solve this enigma?

Editor's note: The question is presented above. The answer is the aetherodynamics theory. Any directed (unidirectional) heat flow is also a flow of aether. The mass changes are the demonstration of natural mechanism of existence of this mass as aether vortex (Alexander V. Frolov).

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The RotoVerter from arkresearch

Editor's: The description of this invention was received from Hector D. Perez Torrez, designer of the "RV" Rotoverter and TV transverter OU "transformation" devices.

Here is the first prototype, used to test a 3PH generator. Light bulb was a 100W 120V, AC generator required 380W for excitation to 120VAC plus the light bulb load for a total of 480W. Input to rotoverter was 240W for a total of 200% efficiency from the prime mover. Friction loss and prime mover loss was not calculated, PF unity, 120VAC unto a purely resistive load excitation pure DC120VDC3.1666667A (380W) + 100W = 480W. - 240W=240 excess.

It is a common 3PH dual winding 230/460V motor wired to 480V run at 120v as a ROTOPHASE converter. That's the beauty of it, OFF the shelve components preferably totally enclosed motors (so fan can be removed) low friction bearings, from 3HP to 7.5HP. Re-rating hp can be from 1/7 to 1/3 the original HP (some motors can run up to 1/2 HP capacity but will require extreme care and cooling.... and exact tuning to load).

System requires starting and running capacitance; the perfect starting capacitance is the one that gives same plate current value as 480V but running at 120V. The best running capacitance is the one that gives the lowest Amperage reading at programmed load. (ALL capacitors are AC 370V OIL "no electrolytic").

Some motors are better than others; also for generator use you must choose the over-unity generator and motor combination to obtain OU. It looks easy to gain it, but requires quite a good choice of items and common sense. In this Research we have found even a few turns or a run weld in stator can change drastically the results. Up to date best performance has being obtained from US (motors 7.5 HP, BALDOR 3,5, HP, GE 3HP totally enclosed, dual winding 230/460V). Higher HP will require professional expertise in industrial electricity and power eng. (not recommended for amateur experimenter). Anyone engaged in this experiments must be familiar with safety procedures and basic electric and mechanic knowledge. Voltages and rotating machinery must be handled with great care. SEE basic diagram and connection.

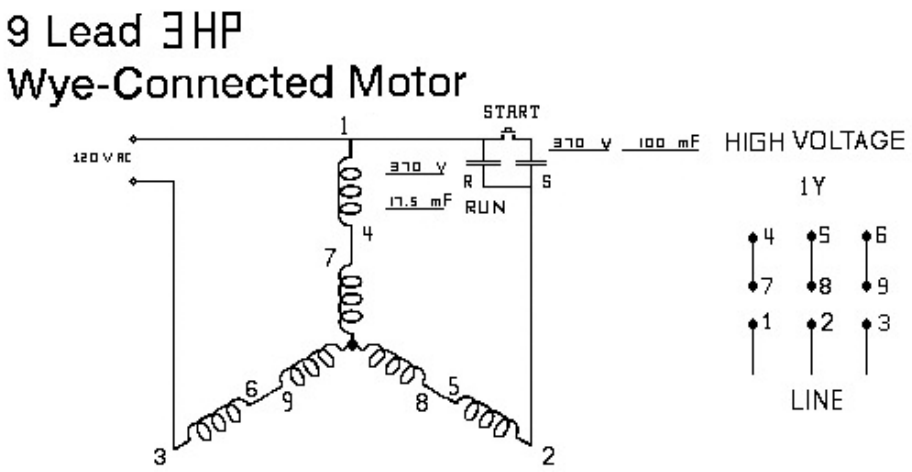

Fig. 1

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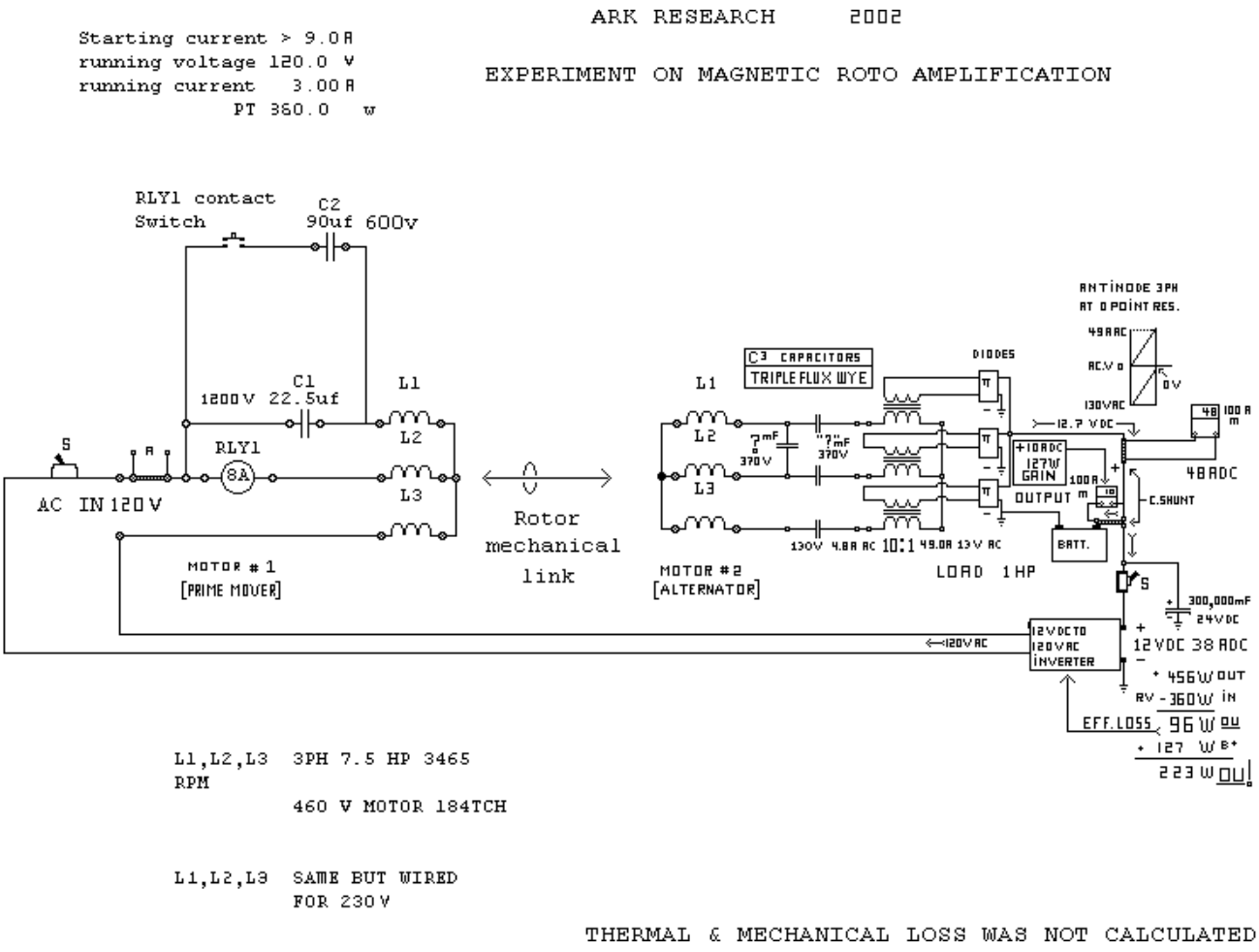

Fig.2

Subject: RV Basic level 1 Full MODEL Disclosure (Public domain)

This is the RV (Level 1) plan of a full looped RV system:

Battery provides primary power for 12VDC to 120VAC. As to run prime mover (Roto-converter), second motor acts as ansquirrel cage self-exited generator, a triple flux-capacitor LC tank tuned to best Standing wave condition as to create standing wave current node internally in battery at 0 voltage to battery "negative resistor". At 0 volts "voltage" a negative current is created as to maintain a reverse flow (charge) to battery exceeding the forward drain of the inverter demand, detuning system with a forward charge at 10 amperes with a voltage rise of approximately 0.83333 V over the battery. Voltage charge produces OU transform from the 0 point standing wave component. System gains energy from stochastic resonance within the LC tank components draining energy from "thermal" signature of the Aether and K thermodynamic-thermoelectric ambient heat (Electron spin). This is a full disclosure of an operational and tested device. System is made of standard off shelve items. Tuning is made by changing capacitor values and the proper selection of standard items for its construction, 3PH motors, 10:1 12V or 5:1 24V transformers with the proper core and winding values (standard) off shelve, diode bridges capacitor (all standard).

Warning: System opens (NON standard) space-time anomaly as time is reversed due to aether energy transform....
Extreme warning: Do not exceed 10KW Nor use of trans-uranic elements near unit as they may reach critical mass by regressive "inversed" decay. PB 206, U235, U238 must be maintained as far as possible from unit.
Extreme Warning: Dangerous Toy, Eldridge, Event horizon and hell raiser effects may be created by protoplasmic fields at extreme potentials PK.
Use wisely. You Can create Paradise or open the gates to Armageddon.

The choice is yours now....

Hector D Perez Torrez

Lifter Project

by Jean-Louis Naudin

http://www.jlnlabs.org

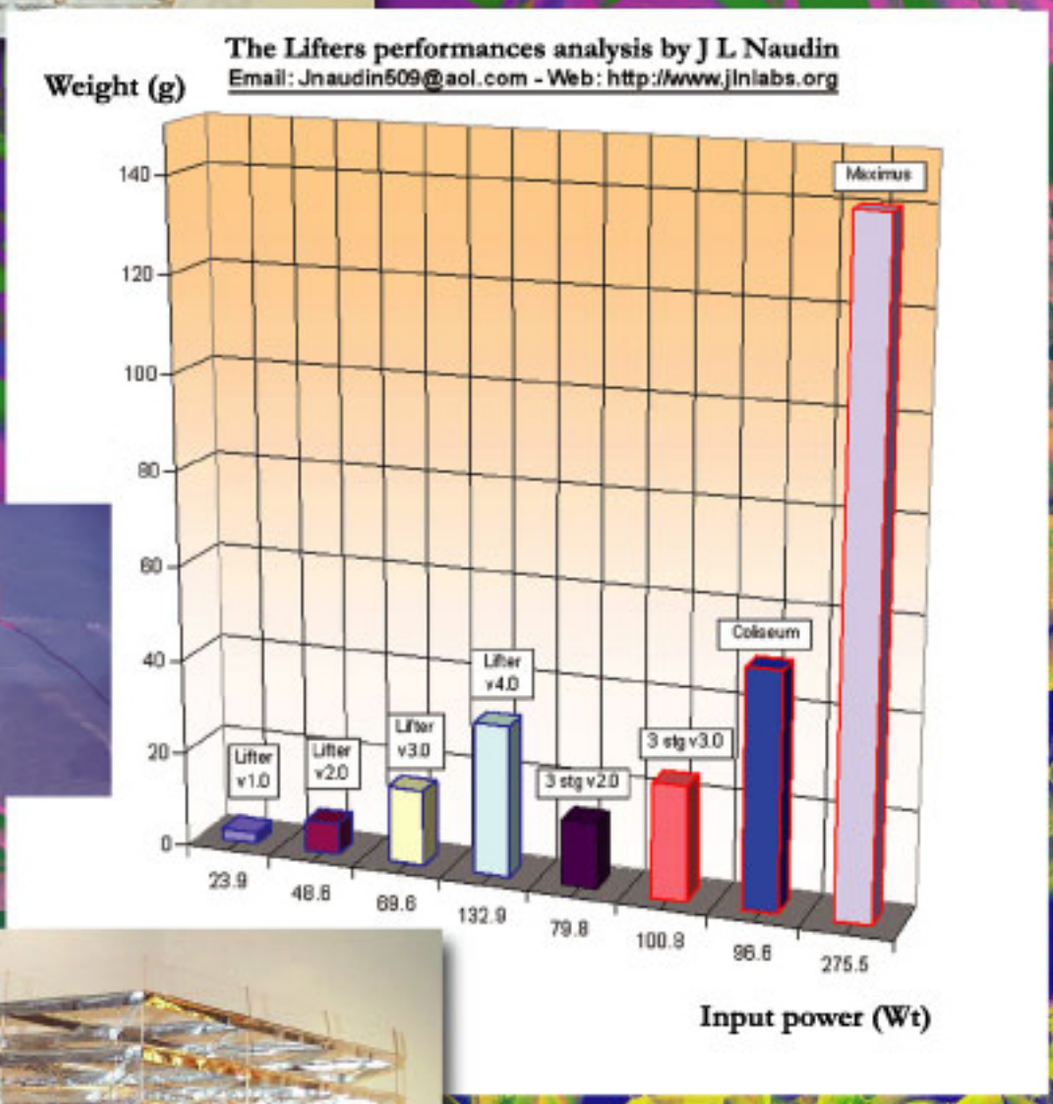

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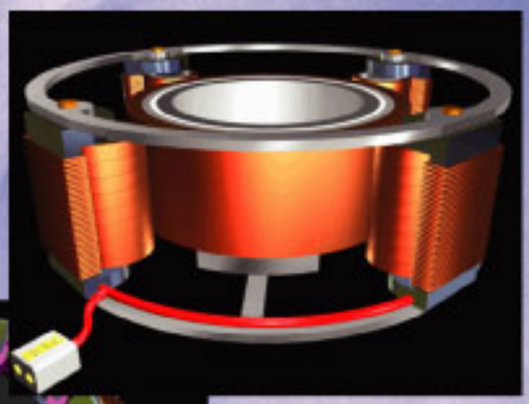

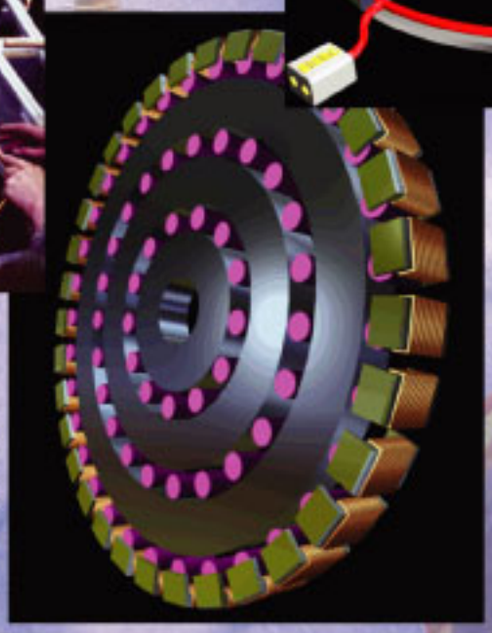

Experimental craft construction (self-rotating permanent magnet system)

15 kWt Searl Effect Generator

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(Low Energy Nuclear Reactions) "Cold Fusion"

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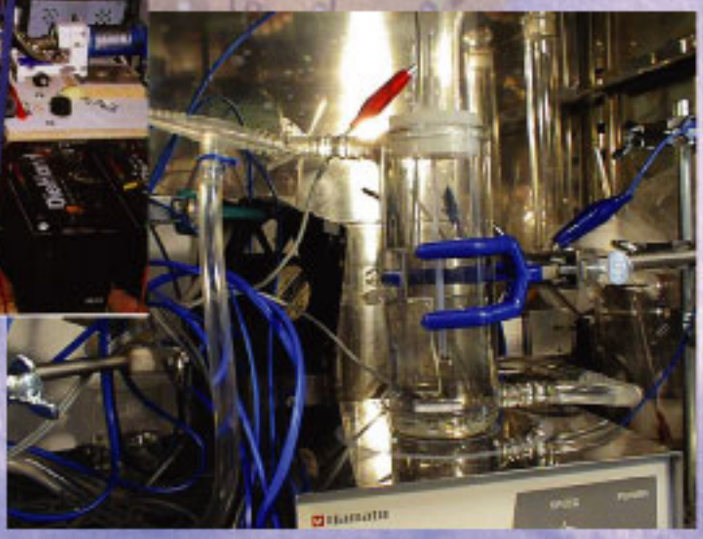

Read in this issue!

NEW ENERGY TECHNOLOGIES #10

1. Testatika. Review of well-known electrostatic system.
2. Cold Fusion by Plasma Electrolysis of Water. Ph.M. Kanarev, T. Mizuno
3. Cold Fusion: What is it and what does it mean to science and society? E. Storms
4. Technical Introduction to LENR-CANR (Low Energy Nuclear Reactions). E. Storms
5. It started in 1989… (History of Cold Fusion Development). P. Hagelstein
6. A Science Tutorial (Cold fusion). T. Chubb
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8. On Electrogravitation. A.V. Lemeshko
9. Avalanchedrive Propulsion Device. M.L. Filho
10. Hydrogen-Powered Vehicles. P. Behr, G. Schneider
11. Unusual Permanent Magnet Motors. T. Valone
12. Hydrogen Energetics. A. Pashova
13. On the Longitudinal Electromagnetic Waves. A.V. Frolov
14. Space and Terrestrial Transportation and Energy Technologies. T.C. Loder
15. Commercialising the “Searl Effect”.
16. Interesting Publications of the Last Year.
17. “Lifter” Project
18. New Electric Fire Technology. V.D. Dudyshev
19. New Effect of “Cold” Evaporation. V.D. Dudyshev
20. Conceptual Hurdles to New Millennium Physics. D. Reed
21. Resonant Phenomena Occurring in Alternating Current Circuit. A.V. Frolov
22. Books Review

TESTATIKA

Review of well-known electrostatic system

Editor comments by Alexander V. Frolov
General Director, Faraday Lab Ltd

A running "free energy" machine coming from Switzerland, Europe. It was developed over a 20 years Research period by a religious group called Methernitha. This group lives in Linden, Switzerland. The head engineer of this superb machine, Mr. Paul Baumann discovered its principles while observing nature. He claims its running principle was found by studying the lightning effects from nature. The documents being offered here shed light on this energy marvel.

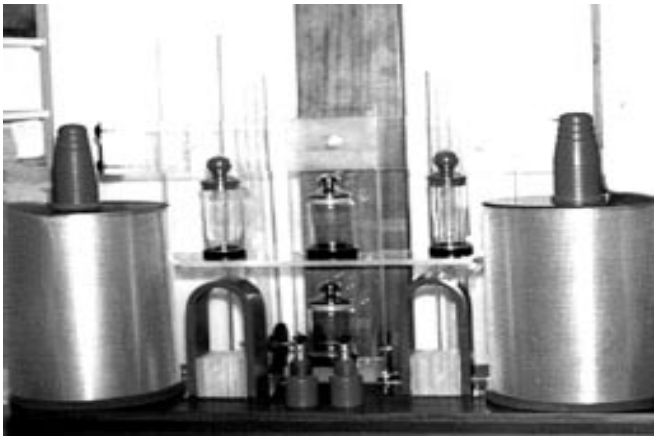

These documents are the result of work of people who have witnessed this wonder machine over the years... And here are the facts:

- The Testatika is a rotary-type machine that runs on it's own, once started by revolving it's two discs by hand!
- The machine not only runs on it's own energy, but produces also a huge amount of excess power, at least 3 KWtt of power! This is almost enough to supply a small house with one machine!
- The machine is about 70cm wide, by 40cm deep and is about 60cm in height!
- It delivers from 250 volts to about 320 volts direct current, depending on the humidity in the air! At this voltage it can supply at least 10 Amperes of pulsating direct current!
- Testatika is not a perpetual motion device, but an energy machine that collects it's huge amount of energy from the ions contained in air. However, there are some technological secrets implemented to overcome the normal drag-resistance of conventional generators. This is but one of it's secrets held by the Methernitha group.

There are many different sized Testatika machines, some of the smaller units deliver only about 200 to 300 watts, none of which are mass-produced. These devices are still laboratory prototype units.

Methernitha is a spiritual community (Christian Alliance) http://www.methernitha.com. They wrote: "We are fortunate in gaining the experience that paradoxically the most beautiful and useful results can be achieved by just using the most simple means. Never did we use any borrowed capital because we want to stay free Swiss citizens and do not want to be hindered or even bound in any way in the pursuance of our aims."

The two contrary-rotating discs generate an electrostatic charge. One disc represents the earth, the other the cloud. Using grid electrodes the charges are bound. After that they are collected by non-contacting so-called antenna keys and then sorted.

After being initially turned on by hand, the discs rotate by themselves according to the electrostatic laws about attraction and repulsion. A rectifying diode keeps the cycles in steady state. Otherwise the impulses of attraction and repulsion would accumulate and cause the discs to run faster and faster. The correct speed is of great importance and for optimal power generation the discs have to run quite steady and slow.

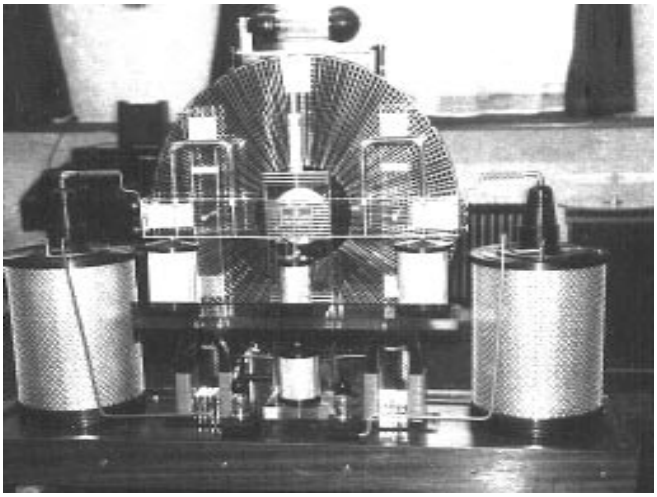

By means of grid condensers the energy is stored and then uniformly discharged, at the same time reducing the high voltage and building up power with additional devices. Finally the machine supplies a uniform direct current, which varies according to the size of the model. The machine furnishes about 3-4 kWt permanent output, depending on humidity, whereby the electric potential ranges from 270 to 320 Volt. High humidity of the atmosphere prevents the build-up of electric potential. The drier the air is, the better.

(Editor: It is necessary to note that the analogues method was used by Russian inventor Pavel N. Yablochkov who in 1877 take out a patent #120684 "The system of distribution and amplification of electrical currents by means of atmosphere electricity..." As it was shown by Yablochkov devices, power doubled in lamps, though current of consumption did not increse.)

No doubt, through the so far achieved results one main objective has been reached, namely to prove that it is possible to use Free Energy. Nevertheless the research work is not yet completed.

To the educated physicist many things of this machine may seem impossible, maybe even crazy. Maybe he is also offended by the conceptions used to explain the whole. Only partly we could use the concepts of conventional physical terminology to explain and define only approximately the functions and properties of the various parts of the machine.

After all it will be necessary to create some more new concepts like the one we have already used before, when we termed the non-contacting collectors of electric charges as antenna keys.

This machine puts experts, which are just trained in conventional physics to a very hard test, because its mode of action is not explainable with the state of the art of officially accepted physical knowledge, or at the most only partially explainable. However also a trained specialist should remain free and independent in his thinking, and should avoid to be limited by the temporal framework of publicly admitted knowledge in any science.

It has to be noted that the established science was already many times forced to change or give up some of its very fundamental concepts. Think about Galilee, to name only one example. Our human society almost condemned this man as a sorcerer and magician, just because he investigated and discovered a truth that seemed unacceptable by the established science of the days.

The book knowledge of any times is not wrong, but it is incomplete, and therefore allows to draw wrong conclusions.

There was used information from the official web site: http://www.methernitha.com

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COLD FUSION BY PLASMA ELECTROLYSIS OF WATER

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Abstract: It has been disclosed that transmutation of the atomic nuclei of alkaline metals and the atomic nuclei of the cathode material takes place during plasma electrolysis of water.

Key words: atom, nucleus, proton, neutron, electron, cathode, low-current.

INTRODUCTION

Cold nuclear fusion is the first hypothesis of a source of additional energy in heavy water electrolysis. Fleischmann and Pons, the American electrochemists, are the authors of this hypothesis [1]. They reported about it in 1989. Since that time a large number of experiments has been carried out in order to obtain additional energy from water [2], [3], [4], [5], [7], [8], [9], [10], [11], [12]. We continue to discuss this problem.

THE FIRST EXPERIMENTAL PART

In order to check this hypothesis, the following experiments were performed. Two cathodes were made of iron with mass of 18.10 g and 18.15 g. The first cathode operated during 10 hours in KOH solution; the second cathode operated during the same period in NaOH solution. Mass of the first cathode remained unchanged; mass of the second one was reduced by 0.02 g. The voltage by plasmaelectrolysis process was 220 V and the current (0.5-1.0) A (Fig.1). The indices of the consumption of the solution and the gases being generated were as follows (Table 1).

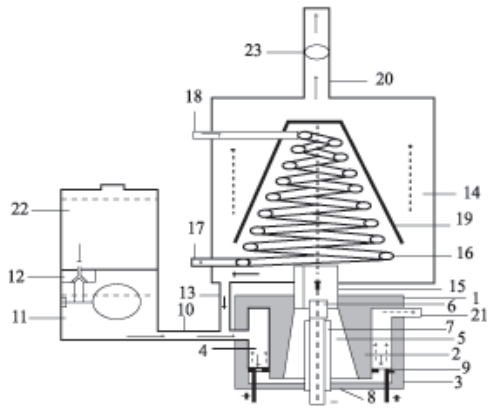

Fig. 1.
Diagram of gas generator. Patent # 2175027:
1 - lid of the reactor; 3 - body of the reactor; 6 - the cathode; 9 - the anode; 11 - solution dosing unit; 16 - cooler; 20 - pipe for gas release; 23 – anemometer

Table 1
Experimental results

Indices	Water consumption, kg	Volume of gases, m^3	Energy expenses, kWh/m^3
KOH	0.272	8.75	0.28
NaOH	0.445	12.66	0.21

In order to increase safety of experimental results, the volume of the gases introduced with the help of anemometer is reduced twofold.

It is known that from one litre of water it is possible to produce 1220 litres of hydrogen and 622 litres of oxygen. Quantity of the gases generated by the plasma electrolytic process is much greater than it is possible to get from consumed water (Table 1) [6]. It gives the reason to think that not only water molecules, but also the nuclei of alkaline metals and the atomic nuclei of the cathode material serve as a source of these gases. The analysing experiment has been performed in order to check this fact.

Tadahiko Mizuno, the famous Japanese scientist (the co-author of this article), who works at the Division of Quantum Energy Engineering Research group of Nuclear System Engineering, laboratory of Nuclear Material System, Faculty of Engineering, Hokkaido University, Japan, kindly agreed to perform chemical analysis of the cathode samples with the help of the nuclear spectroscopy method (EDX). Here are the results of his analysis. The content of chemical elements on the surface of non-operating cathode is as follows (Table 2).

Table 2
Chemical composition of the cathode surface prior its operation in the solution

Element	Fe
%	99.90

The new chemical elements have appeared on the working surface of the cathode, which works in KOH solution (Table 3).

Table 3
Chemical composition of the surface of the cathode, which operates in KOH solution

Element	Si	K	Cr	Fe	Cu
%	0.94	4.50	1.90	93.00	0.45

The chemical composition of the surface of the cathode, which operates in NaOH has proved to be different (Table 4).

Table 4
Chemical composition of the surface of the cathode, which operates in NaOH solution

Element	Al	Si	Cl	K	Ca	Cr	Fe	Cu
%	1.10	0.55	0.20	0.60	0.40	1.60	94.00	0.65

Thus, the hypothesis concerning the participation of the nuclei of alkaline metals and the atomic nuclei of the cathode material in the formation of gases during plasma electrolysis of water has experimental confirmation. Let us carry out the preliminary analysis of the data being obtained (Tables 2, 3, 4).

THE FIRST THEORETICAL PART

In any of these cases, the atoms and the molecules of hydrogen are formed. The part of it is burned and the other goes out with the steam. We have already shown that the processes of fusion of the atoms and the molecules of hydrogen and its isotopes result in occurrence of additional thermal energy [6]. Numerous experiments show that up to 50% of additional thermal energy are generated during the plasma electrolysis of water, it is less than the results of the calculations originating from the existing cold fusion theories [6]. That's why it is necessary to analyse energetics of the particle creation process during the atomic nucleus transmutation.

Having considered the model of the electron we have found out that it can exist in a free state only when it has a definite electromagnetic mass [6]. Being combined with the atomic nucleus it emits a part of energy in the form of the photons, and its electromagnetic mass is reduced. But stability of its condition does not become worse, because the energy carried away by the photons is compensated by binding energy of the electron in the atomic nucleus [6].

If the ambient temperature is increased, the electron begins to absorb the thermal photons and to pass to higher energy levels of the atom reducing binding with it. When the electron becomes free, it interacts with the atom only if the ambient temperature is reduced. As this temperature is reduced, it will emit the photons and sink to lower energy levels [6].

If the electron is in a free state due to an accidental external influence on the atom and the environment has no photons, which are necessary for it to restore its mass, **it begins to absorb the ether from the environment and to restore its constants in such a way**: mass, charge, magnetic moment, spin and radius of rotation. The electron acquires the stable free state only after it has restored its all constants [6].

Thus, if an interchange of the free state and binding state with the atom takes place due to the accidental influences on the atom, **the electron restores its electromagnetic mass every time due to absorbing the ether. It means that actually it plays the role of a converter of the ether energy into the thermal photon energy.**

The Japanese investigators Ohmori and Mizuno [4] registered neutron radiation during plasma electrolysis of water and reported that not only the nuclear process, but also the process of the electron capture by the free protons can be the source of this radiation.

As hydrogen plasma is generated during the plasma electrolytic process of water electrolysis, there exists a tendency of the capture of the free electrons by them.

It is known that rest mass of the electron is $m_e = 9.109534 \times 10^{-31}$ *kg*, rest mass of the proton is $m_p = 1.6726485 \times 10^{-27}$ *kg*, and rest mass of the neutron is $m_n = 1.6749543 \times 10^{-27}$ *kg*. The difference between the mass of the neutron and the mass of the proton is equal to $\Delta m_{np} = 23.058 \times 10^{-31}$ *kg*. It is $23.058 \times 10^{-31} / 9.109 \times 10^{-31} = 2.531$ of the mass of the electron. Thus, the proton should capture 2.531 electrons in order to become the neutron. The question arises at once: what will happen to the remained of electron mass $(3.0-2.531)m_e = 0.469m_e$? The disturbed balance of masses in this process is explained by modern physics in a simple way: a neutrino is created [6].

As the neutrino has no charge, it is very difficult to register it. If the neutrino takes the excess mass away or replenish the lacking one, can the elementary particles execute this process by themselves?

As the photons are emitted and absorbed only by the electrons, the proton, which absorbs the electrons, cannot convert the remainder of mass of the third electron into the photon. If the electron is absorbed by the third one and gives more than a half of its mass to the proton in order to convert it into the neutron, the remaining part of mass ($0.469m_e$) of the electron, which has no possibility to become the photon, is converted into a portion of the ether, which "is dissolved" and mixed with the ether in the space. The fact that plasma has no photons with the mass corresponding to the part of mass of the third electron, which has not been absorbed by the proton during its conversion into the neutron, can serve as a proof of such affirmation. Let us calculate energy of such photon [6].

The difference the mass of the neutron and the proton is equal to $\Delta m_{np} = 23.058 \times 10^{-31}$ *kg*. If we subtract this value from the mass of three electrons, we'll get mass m_F, from which the photon should be formed [6]

$$m_F = 3m_e - \Delta m_{np} = 3 \times 9.109534 \times 10^{-31} - 23.05810^{-31} = 4.270602 \times 10^{-31} \text{ kg} \quad (1)$$

If the photon is formed from this remainder of mass m_F, its energy will be [6]:

$$E_{ph} = m_F \times C^2 = \frac{4.270602 \times 10^{-31} \times (2.997924 \times 10^8)^2}{1.602189 \times 10^{-19}} = 23.956126 \times 10^4 eV \quad (2)$$

This value of energy corresponds to roentgen spectrum, that's why the creation of each free neutron should be accompanied by the creation of one roentgen photon. If it does not take place, we have two opportunities: the first one – we should think that in the case when the neutron is created, the neutrino was formed from mass m_F=4.270602 × 10_{-31} *kg* and flew away in the unknown direction; the second one – there were no conditions for the formation of the photons in the process being considered, and mass, which failed to be formed as a particle, "was dissolved" in the ether. Which variant is closer to the truth [6]? There is no exact answer, but it is known that the Japanese scientists registered only neutron radiation with intensity of 50,000 neutrons per second, and they failed to register roentgen radiation [4].

If in this process the roentgen photons were created, they would not exceed heat efficacy of the plasma electrolytic process, because they would not be the thermal photons. The thermal photons are radiated and absorbed when the electrons make the energy transitions to the energy levels, which are the most remote from the atomic nuclei, where the infrared photons and neighbouring ones from the optical range of the spectrum with energies of ≈(0.001-3.3) eV are generated (Table 5) [6].

Table 5
Electromagnetic spectrum bands

Bands	Wave-length, m	Energy, eV
1. Low- frequency band	$\lambda \approx (10^{7}...10^{4})$	$E \approx 10^{-15}...10^{-11}$
2. Broadcast band	$\lambda \approx (10^{4}...10^{-1})$	$E \approx 10^{-11}...10^{-6}$
3. Microwave band	$\lambda \approx (10^{-1}...10^{-4})$	$E \approx 10^{-6}...10^{-3}$
4. Relic band (maximum)	$\lambda \approx 1 \times 10^{-3}$	$E \approx 1.2 \times 10^{-3}$
5. Infrared band	$\lambda \approx (10^{-4}...7.7 \times 10^{-7})$	$E \approx 10^{-3}...1.6 \times 10^{-2}$
6. Light band	$\lambda \approx (7.7 \times 10^{-7}...3.8 \times 10^{-7})$	$E \approx 1.6 \times 10^{-2}...3.27$
7. Ultraviolet band	$\lambda \approx (3.8 \times 10^{-7}...10^{-9})$	$E \approx 3.27...1 \times 10^{2}$
8. Roentgen band	$\lambda \approx (10^{-9}...10^{-12})$	$E \approx 10^{2}...10^{5}$
9. Gamma band	$\lambda \approx (10^{-12}...10^{-18})$	$E \approx 10^{5}...10^{9}$

Thus, the neutron fusion processes in plasma electrolysis of water will not generate additional thermal energy. But the appearance of the neutrons in plasma will promote the formation of the nuclei of deuterium and, possibly, of tritium. As the balance of masses remains almost unchanged, we have no reason to expect that **additional energy will take place** when deuterium and tritium are formed. But it is sure to appear during **fusion of the atoms of deuterium and tritium, i.e. the hydrogen atoms [6].**

In order to become a proton, the neutron should radiate something, which mass is Δm_{np}=23.058 × 10^{-31} *kg*. Let us convert this mass into energy [6].

$$E_{ph} = \Delta m_{np} \times C^2 = \frac{23.058 \times 10^{-31} \times (2.998 \times 10^{8})^2}{1.602 \times 10^{-19}} = 1.294 \times 10^{6}\ eV \qquad (3)$$

This energy corresponds to the gamma range photons, i.e. not to the thermal photons, and this process does not give additional energy. Thus, if the process of the formation of the helium atoms takes place during plasma electrolysis of water, it should be accompanied by gamma radiation. If there is no such radiation, but the helium atoms are formed, the neutrino takes away the above-mentioned portion of mass Δm_{np} or this mass, which has no opportunity to be formed as the photon, "is dissolved" in the environment, i.e. it is transferred into the state of the ether [6]. As the roentgen photons and the gamma photons are not the thermal ones, this process gives no excessive thermal energy [6].

Another variant is possible. When the atoms of alkali metal bombard the cathode atoms, they are destroyed completely and destroy the atoms of the cathode materials. Under the notion "completely" we'll understand such state when both the atom and the nucleus are destroyed. In this case, the protons of the destroyed nuclei begin to form the hydrogen atoms. The process of fusion of the atoms and the molecules of hydrogen generate additional thermal energy [6]. But one should bear in mind that if plasma disintegrates water molecule into hydrogen and oxygen and if these gases contact plasma, hydrogen is combined with oxygen, and water is formed. Noise generated by plasma is hydrogen microexplosions. Taking into consideration the above-mentioned fact the larger the volume of hydrogen burnt in plasma, the smaller its volume in the gas-vapour mixture. It means that such reactor operation modes are required when quantity of burnt hydrogen is minimal one. Our theory allows us to have such results.

As iron is the cathode material, the nuclei of its atoms are the targets of the atomic nuclei of potassium, alkaline metal. During the transmutation of the iron nuclei (Fig. 2 b), the atomic nuclei of chromium (Fig. 2 a) and the atomic nuclei of copper (Fig. 2 c) are formed [6].

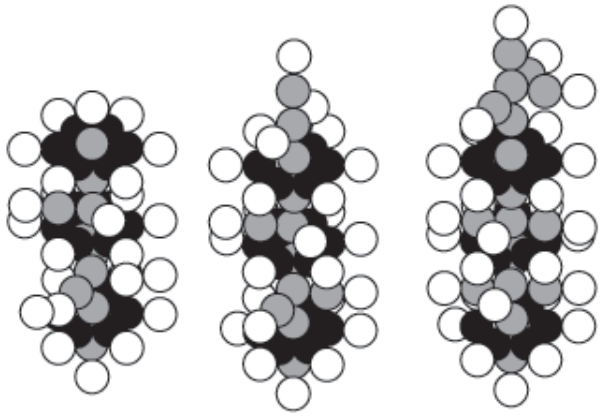

a) Cr (24,28) b) Fe (26,28) c) Cu (29,34)

Fig. 2.
Diagrams of the atomic nuclei of: a) chromium, b) iron, c) copper

When the atomic nucleus of iron (Fig. 2 b) pass into the atomic nucleus of chromium (Fig. 2 a), two protons and two neutrons are released; two atoms of deuterium or one atom of helium can be formed from them. If the neutrons pass into the protons, four atoms of hydrogen are formed.

It is easy to see (Fig. 2) that the atomic nucleus of iron (Fig. 2 b) should lose two upper protons and two neutrons in order to pass into the atomic nucleus of chromium (Fig. 2 a).

Three additional protons and six neutrons (total 9 nucleons) are required for the formation of the atomic nucleus of copper (Fig. 2 c) from the atomic nucleus of iron. As on the cathode surface (Table 3) the number of chromium atoms, which probably are formed from the atomic nuclei of iron, four times more than the number of atoms of copper, then the solution is sure to have superfluous protons and neutrons of the destroyed atomic nuclei of iron, and we can determined their approximate relative quantity.

Let us suppose that four nuclei of the iron atoms pass into the nuclei of the chromium atom. The total quantity of free protons and neutrons (nucleons) is equal to 16. As one atom of copper falls on each four atoms of chromium, 9 nucleons are spent for the formation of one nucleus of the copper atom, and 7 nucleons remain free.

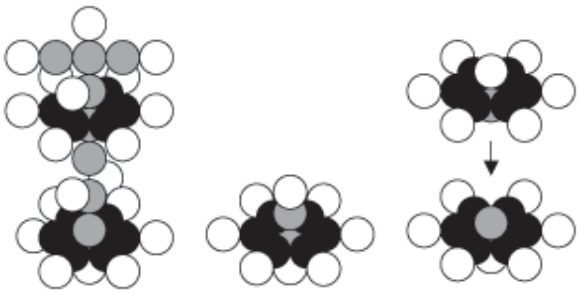

a) K (19,20) b) O (8,8) c) Si (14,14)

Fig. 3.
Diagrams of the atomic nuclei of:
a) potassium, b) oxygen, c) silicon

Let us see what is formed when the nucleus of the potassium atom is destroyed. Potassium is situated in the first group of the fourth period of the periodic law. Its nucleus contains 19 protons and 20 neutrons (Fig. 3 a) [6].

In Fig. 3 a, we can see a weak link of the nucleus of the potassium atom [6]. It is situated in the middle of its axis neutrons. When the transmutation of the nuclei of the potassium atoms takes place, the nuclei of the oxygen atoms can be formed (Fig. 3 b) as well as its isotopes and the nuclei of the silicon atoms (Fig. 3 c).

The analysis of the structure of the nuclei of the potassium atom (Fig. 3 a) shows that it is the most probable source of the nucleus of the silicon atom (Fig. 3 c), which atoms appear on the cathode (Table 3).

It is easy to count that during the destruction of one nucleus of the potassium atom and the creation of one nucleus of the silicon atom 5 free protons and 6 free neutrons, i.e. 11 nucleons, are formed.

Thus, the transmutation of the nuclei of the iron atoms and the potassium atoms results in the formation of free protons and neutrons. As the protons cannot exist in free state, the hydrogen atoms are created from them. If the protons are connected with the neutrons after the destruction of the nuclei of the iron atoms and the potassium atoms, the formation of deuterium, tritium and helium is possible.

Let us pay attention to the main fact – absence of the sodium atoms in the cathode material. It is natural that the potassium atoms have appeared on the cathode, which operated in KOH solution (Table 3). Why are no sodium atoms on the cathode, which operated in NaOH solution? The answer is as follows: the nuclei of the sodium (Fig. 4,a) atoms are completely destroyed during the plasma electrolytic process. The presence of potassium on the surface of the cathode, which operated in NaOH solution (Table 4), can be explained by insufficient ablution of the reactor after the operation with KOH solution.

As free protons and neutrons appear during the destruction of the nucleus of the sodium atom (Fig. 4,a), some nuclei of this element begin to form the atomic nuclei of aluminium (Fig. 4, b), chlorine (Fig. 4, c) and calcium (Fig. 5).

But not all free protons and neutrons are spent for the construction of the atomic nuclei of aluminium, chlorine and calcium. A part of them is spent for the hydrogen atom formation.

If we knew the total quantity of transmutating atomic nuclei of iron, potassium and sodium as well as the exact composition of the gases generated during the plasma electrolytic process, it would be possible to determine the atomic nuclei being formed from additional nucleons. Now we can only suppose that the majority of new nuclei are the protons, i.e. the nuclei of the hydrogen atoms. The increased volume of the gases generated during the plasma electrolytic process is explained by it [6].

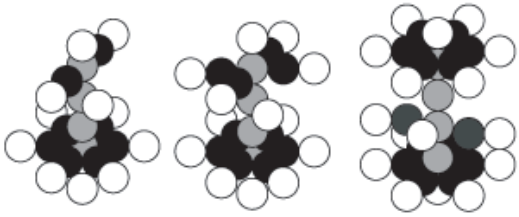

a) Na (11,12) b) Al (13,14) c) Cl (17,18)

Fig. 4.
Diagrams of the atomic nuclei of:
a) sodium, b) aluminium, c) chlorine

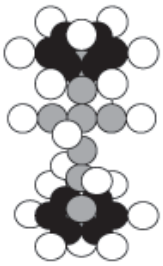

Ca (20,20)

Fig. 5.
Diagram of the nucleus of the calcium atom

The analysis of these Tables shows that transmutation of the nuclei of iron, of which the cathodes are made, results in the formation of chromium and copper in both cases. Apparently, aluminium, chlorine and calcium are formed from the destroyed sodium nuclei. In any case, free protons and neutrons are formed.

But not all free protons and neutrons are spent for the formation of the atomic nuclei of copper, aluminium, chlorine and calcium. A part of them is spent for the formation of the hydrogen atoms. In any case, the atoms and the molecules of hydrogen are formed. The analysis has shown that plasma electrolytic process extracts not more than 0.005 kg of alkaline metal from one litre of the solution. It appears from this that if all neutrons of the atomic nuclei of the molecules of water and alkali metals are transferred into the protons and the atoms and the molecules of hydrogen are formed, the formed volume of gas will be considerably less than the one registered during the experiment (Table 1). A question arises: where do additional gases come from? In order to get the answer on this question we made the next experiment.

THE SECOND EXPERIMENTAL PART

First of all we take into account, that high temperature of plasma forms the conditions when a set of various processes takes place at the cathode. First of all, water is boiled and evaporated. At the same time, one part of water molecules is disintegrated with a release of the atomic hydrogen; another part of the molecules forms the orthohydrogen molecules. A part of water molecules is disintegrated completely and is released at the cathode together with hydrogen and oxygen. A part of hydrogen is combined with oxygen again generating microexplosions (noise) and forming water.

During plasma electrolysis of water, water vapor, hydrogen and oxygen are released simultaneously. If vapor is condensed, gas mixture is released. In order to measure gas flow rate the electronic anemometer have been used. Diameter of the electronic anemometer was equal to internal diameter of the gas make tube (23, Fig. 1). Its readings were registered and processed by the computer. The experiment was performed dozen times, and each time its readings were reproduced with small deviations [11]. But we had no hydrogen analyzer, that's why the results being obtained cannot be considered as final ones. We admonished it in all editions of the book Water is a New Source of Energy with such a phrase: "We abstain from lending an official status to these results with the hope to get necessary financing and to repeat them with a complete set of the necessary devices" [12, page 176].

In the middle of the year of 2002 we received small financing, which allowed us to make a new reactor and to buy some measuring instruments, in particular the scales with the measurement limit up to 600 g and accuracy of 0.02 g. Careful preparation allowed us to increase duration of continuous operation of the reactor (to 10 and more hours) and to register solution consumption for gas production.

The main difficulty of operation with the hydrogen is in the fact that its mixture with air (4-74)% or oxygen (4-94)% is combustible, and the fact was emphasized more than once during the experiments that made the researches be very careful. The second difficulty during hydrogen quantity measurements generated by the plasma electrolytic reactor is in the fact that its molecule has the smallest dimensions, that's why it penetrates easily to the places where the molecules of other substances do not penetrate. Molecular hydrogen diffuses easily even into metals. For example, one volume of palladium absorbs up to 800 volumes of hydrogen.

Gas flow speed was measured with the help of various anemometers, its readings being registered with the help of the computer. Numerous measurements and numerous analysis of gas flow speed measurement accuracy with the help of the anemometers showed that error of a conventional anemometer can be 100%.

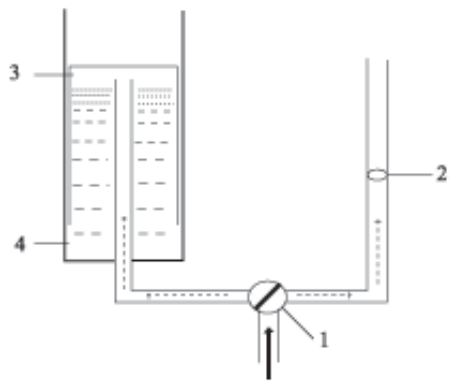

Fig. 6.
Diagram of measurement of flow rate of the gas and its volume:
1 - tap for gas flow movement direction switching,
2 – anemometer, 3 – graduated tank, 4 – water tank

It is known that it is possible to produce 1220 litres of hydrogen and 622 litres of oxygen from one litre of water. Quantity of the gases generated by the plasma electrolytic process is much greater than it is possible to get from consumed water (Table 1). It was a strong reason for a search of the measurement error. For this purpose, the diagram of measurement of flow rate of the gases and their quantity was used (Fig. 6).

The results of the measurements were as follows. The anemometer showed that 200 litres of gas mixture penetrated through it during 10 minutes. Nearly one litre of gases was in the graduated tank during this period.

Thus, the measurement of gas flow with the help of the anemometers distorted the result 200 fold. It should be mentioned that the reactor operated in the production mode of hydrogen and oxygen in the cathode zone. As a result, their mixture burst. The pulses of these explosions increased the readings of the anemometer.

It has become necessary to return to the reactor operation modes when no oxygen is released in the cathode zone. Our theory allows us to do this easy.

PROTOCOL
of tests of the first model of low-current Electrolyzers

It is known that it is possible to produce 1.22 l of H_2+ 0.622 O_2= 1.843 (H_2+O_2) from 1 ml of H_2O

Table 6
Experimental results

Indices	1	2	3	Average
1-duration of experiment, hour	1	1	1	1
2-voltage, V	70	70	70	70
3-current, A	0.038	0.080	0.098	0.072
4 – power, W	2.7	5.60	6.44	4.91
4-volume of consumed solution, ml	1.67	3.98	4.32	3.32
5-density of the solution, kg/l	1.04	1.04	1.04	1.04
6-volume of consumed water, ml	1.60	3.83	4.15	3.19
7-volume of the gas mixture being produced, l	2.95	7.06	7.85	5.95
6-volume of hydrogen being produced, l	1.95	4.67	5.07	3.80
7-energy consumption per 1 l of hydrogen, W·h/l	1.38	1.20	1.27	1.28
8-energy consumption per 1m^3 of hydrogen, kWh/m^3	1.38	1.20	1.27	1.28
9-existing energy consumption for production of 1 m^3 of hydrogen from water, kWh/m^3	4.00	4.00	4.00	4.00

CONCLUSION

Transmutation of the atomic nuclei of alkaline metals and the atomic nuclei of the cathode material during plasma electrolysis of water existed. Plasma electrolytic process opens new prospects in study of matter on the nuclear, atomic and molecular levels. The low-current electrolysis allows us to get the inexpensive hydrogen from water.

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LENR
(Low Energy Nuclear Reactions)

http://www.lenr-canr.org

Editorial: There is a collection of some papers on LENR (Low Energy Nuclear Reactions), also known as Cold Fusion. CANR, Chemically Assisted Nuclear Reactions, is another term for this phenomenon. These original scientific papers are reprinted with permission from the authors and publishers.

Website http://www.lenr-canr.org features a growing library of scientific papers about LENR and an extensive bibliography of journal papers, news articles and books about LENR.

COLD FUSION: What is it and what does it mean to science and society?

Edmund Storms

Cold fusion is important because it promises to be a new source of pollution-free, inexhaustible energy. In addition, it is important because it reveals the existence of a new way nuclei can interact that conventional scientific theory predicts is impossible. What then is this phenomenon that suffers such promise and rejection?

Energy can be obtained from the nucleus in two different ways. On the one hand, a large nucleus can be broken into smaller pieces, such as is experienced by uranium in a conventional nuclear reactor and by the material in an atom bomb. This is called fission. On the other hand, two very small nuclei can be joined together, such as occurs during fusion of deuterium and tritium in a Hot Fusion reactor and in a hydrogen bomb. This process, called fusion, also takes place in stars to produce much of the light we see.

The fission reaction is caused to happen by adding neutrons to the nucleus of uranium or plutonium to make it unstable. The unstable nucleus splits into two nearly equal pieces, thereby releasing more neutrons, which continue the process. As every one now knows, this process produces considerable waste that is highly radioactive. The uranium used as fuel also occurs in limited amounts in the earth's crust. As a result, this source of energy is not ideal, although widely used at the present time.

The normal hot fusion reaction requires two deuterium or tritium nuclei to be smashed together with great energy. This is accomplished by raising their temperature. However, this temperature is so high that the reactants cannot be held in a solid container, but must be retained by a magnetic field. This process has proven to be very difficult to accomplish for a time sufficient to generate useable energy. In spite of this difficulty, attempts have been under way for the last 40 years and with the expenditure of many billions of dollars. Success continues to be elusive while the effort continues.

Cold fusion, on the other hand, attempts to cause the same process, but by using solid materials as the container held at normal temperatures. The container consists of various metals, including palladium, with which the deuterium is reacted to form a chemical compound. While in this environment, the barrier between the deuterium nuclei is reduced so that two nuclei can fuse without having to be forced together. Because the process causing this to happen is not well understood, the possibility is rejected by many conventional scientists. Difficulty in producing the process on command has intensified the rejection. While this difficulty is real, it has not, as many skeptics have claimed, prevented the process from being reproduced hundreds of times in laboratories all over the world for the past 13 years. As you will see by reading the reviews and papers in our Library (see http://www.lenr-canr.org/LibFrame1.html), the process continues to be reproduced with increasing ease using a variety of methods and materials.

What is the nature of this process and why has it been so hard to understand? To answer this question, a person needs to understand the nature of the barrier that exists between all nuclei. Because all nuclei have a positive charge in proportion to their atomic number, all nuclei repeal each other. It is only the surrounding electrons that hold normal matter together, with the nuclei being at considerable distance from each other, at least on the scale of an atom. When attempts are made to push the nuclei closer, the required energy increases as the nuclei approach one another. However, when deuterium dissolves in a metal, it experiences several unique

conditions. The surrounding metal atoms produce a regular array that is able to support waves of various kinds. These waves can be based on vibration of the atoms (phonons), vibration of the electrons, standing waves of electromagnetic energy, or a wave resulting from conversion of the deuterium nuclei to a wave. In addition, the high density of electrons can neutralize some of the positive charge on the deuterium nuclei allowing a process called tunneling, i.e.. allowing passage through the barrier rather than over it. The mechanism of this neutralization process is proposed to involve a novel coherent wave structure that can occur between electrons under certain conditions. All of these wave processes have been observed in the past under various conventional conditions, but applying them to the cold fusion phenomenon has been a subject of debate and general rejection.

While the debate based on wave action has been underway, people have proposed other mechanisms. These include the presence of neutrons within the lattice. Normally, neutrons are unstable outside of the nucleus, decomposing into a proton, an electron, and a neutrino. Presumably, this reaction can be reversed so that neutrons might be created in a lattice containing many free electrons and protons. Having no charge, the neutron could then interact with various atoms in the lattice to produce energy. These neutrons might also be hidden in the lattice by being attached to other nuclei in a stabilized form, to be released when conditions were right. Several particles normally not detected in nature also have been proposed to trigger fusion and other nuclear reactions.

While search for a suitable mechanism has been underway, an understanding of the environment that triggers the mechanism has been sought, the so-called nuclear-active-environment. Initially, this environment was thought to exist in the bulk of the palladium cathode used in the Pons-Fleischmann method to produce cold fusion. It is now agreed that the nuclear reactions only occur in the surface region. Recent arguments suggest that this surface layer does not even require palladium for it to be nuclear-active. Nuclear reactions have now been produced in a variety of materials using many methods. The only common feature found in all of these methods is the presence of nano-sized particles of material on the active surface. If this observation is correct, four conditions seem required to produce the nuclear reactions. First, the particle must have a critical small size; second, it must contain a critical concentration of deuterium or hydrogen; third, it must be constructed of certain atoms; and fourth, it must be exposed to a source of energy. This energy can take the form of a sufficiently high temperature, a significant high flux of hydrogen through the particle, application of energetic electrons or charged particles, or application of laser light of the proper frequency. Until, the importance of these factors is understood, the effect will continue to be difficult to replicate.

Technical Introduction to LENR-CANR

Edmund Storms

At low energies, the Coulomb barrier prevents nuclei from coming together and fusing to form a single nucleus. To initiate a nuclear reaction, several methods are used. Nuclear reactions are normally initiated by pushing two atoms together with enough force to overcome the Coulomb barrier by brute force, or by using neutrons which penetrate the nuclei without seeing a barrier. (Neutrons have no electrical charge, so the Coulomb barrier does not stop them.) These forces are normally provided by high-temperature plasma or by accelerating ions to high energies. In contrast, LENR describes the mechanism and conditions that cause a variety of nuclear reactions to take place with relatively low activation energy. These unique conditions reduce the need for excessive energy. The normal method forces the nuclei together, while the new method encourages them to come together. The challenge has been to understand the unique characteristics of the necessary solid structure such that this structure could be generated at will.

Because the proposed method is unique, at odds with current nuclear theory, and is still difficult to reproduce, support for studies in many countries, but not all, has been very limited. Nevertheless, considerable information has accumulated over the last 13 years since Profs. Stanley Pons and Martin Fleischmann showed the world the possibilities inherent in this phenomenon. Much understanding is buried in conference proceedings and reports that are not available to a serious student. This information will, as time permits, be made available on this site. Students of the subject are also encouraged to use this site to interact with other people in the field and provide objective critiques of the work published here.

PHENOMENA DISCUSSED IN SOME OF THE PAPERS

At least 10 ways have been demonstrated to produce anomalous heat and/or anomalous elemental synthesis. A few of these methods will be described here. For course, not all of the claims are worthy of belief nor are they accepted by many people. Nevertheless, the claims will be described without qualifications in order to provide the reader with the latest understanding.

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The most studied method involves the use of an electrolytic cell containing a LiOD electrolyte and a palladium cathode. Current passing through such a cell generates D+ ions at the cathode, with a very high effective pressure. These ions enter the palladium and, if all conditions are correct, join in a fusion reaction that produces He-4. Initially palladium wire and plate were used, but these were found to form microcracks, which allowed the required high concentration of deuterium to escape. Later work shows that the actual nuclear reaction occurs on the surface within a very thin layer of deposited impurities. Therefore, control of this impurity layer is very important, but rather difficult. The use of palladium is also not important because gold and platinum appear to be better metals on which to deposit the impurity layer. This method is found, on rare occasions, to generate tritium within the electrolyte and transmutation products on the cathode surface. Different nuclear reactions are seen when light water (H_2O) is used instead of D_2O, although the amount of anomalous energy is less when H_2O is used. These observations have been duplicated hundreds of times in dozens of laboratories.

Application of deuterium gas to finely divided palladium, and perhaps other metals, has been found to generate anomalous energy along with helium-4. Both palladium-black as well as palladium deposited as nanocrystals on carbon have shown similar anomalous behavior. In both cases the material must be suitably purified. Palladium deposited on carbon can and must be heated to above 200/260°C for the effect to be seen. When deuterium is caused to diffuse through a palladium membrane on which is deposited a thin layer of various compounds, isotopes that were not previously present are generated with isotopic ratios unlike those occurring naturally.

A plasma discharge under H_2O or D_2O between various materials generates many elements that were not previously present. When the electrodes are carbon and the plasma is formed in H_2O, the main anomalous element is iron. This experiment is relatively easy to duplicate.

Several complex oxides, including several superconductors, can dissolve D_2 when heated. When a potential is applied across a sheet of such material, the D+ ions are caused to move and anomalous heat is generated.

If deuterium ions, having a modest energy, are caused to bombard various metals, tritium as well as other elements not previously present are generated. These ions can be generated in a pulsed plasma or as a beam.

When water, either light or heavy, is subjected to intense acoustic waves, collapse of the generated bubbles on the surrounding solid walls can generate nuclear reactions. This process is different from the fusion reaction claimed to occur within a bubble just before it disappears within the liquid because neutrons are not produced in the former case, but are produced in the latter case. This method has been applied to various metals in heavy water using an acoustic transducer and in light water using a rotating vane which generates similar acoustic waves...

HOW TO EXPLAIN THE CLAIMS

A major problem in deciding which model might be correct is the absence of any direct information about the nature of the nuclear-active-environment. At this time, two important features seem to be important, the size of the nanodomain in which the reactions occur and the presence of a deuterium flux through this domain. The domain can apparently be made of any material in which hydrogen or deuterium can dissolve. Until the nature of the nuclear-active-state (NAS) is known, no theory will properly explain the effect and replication of the claims will remain difficult.

When fusion is initiated using conventional methods, significant tritium and neutrons are produced. In addition, when other elements are generated, they tend to be radioactive. This is in direct contrast to the experience using low energy methods. These products are almost completely absent and, instead, helium-4 is produced. When radiation is detected, it has a very low energy. This contrasting behavior, as well as the amount of anomalous energy, has made the claims hard to explain using conventional models. This difficulty has been amplified by a failure of many skeptics to recognize the contrasting effect of the environment, a plasma being used in the older studies and a solid lattice of periodic atoms being present as the new environment.

Over 500 models and their variations have been proposed, some of which are very novel and some are variations on conventional ideas. Most models attempt to explain the nuclear reaction once the required environment has been created, without addressing what that unique environment might be like. These models involve conversion of a proton (deuteron) to a neutron (dineutron), creation of an electron structure that is able to neutralize the barrier, conversion of deuterium to a wave which interacts without charge, and the presence of otherwise overlooked neutrons and/or novel particles. Many of the models will have to be abandoned or seriously modified once the nature of the nuclear active environment is understood.

It Started in 1989 . . .

Peter Hagelstein

Many of us recall the controversy surrounding the announcement of claims of observations of fusion reactions in a test tube that were made in 1989. At the time, these claims were greeted with considerable skepticism on the part of the physics community and the scientific community in general.

The principal claim of Pons and Fleischmann

The principal claim of Pons and Fleischmann in 1989 was that power was produced in palladium cathodes that were loaded electrochemically in a heavy water electrolyte. The evidence in support of this was a measured increase in the temperature in the electrochemical cell. There was no obvious evidence for nuclear reaction products commensurate with the claimed heat production. Fleischmann speculated that perhaps two deuterons were somehow fusing to He-4 through some kind of new mechanism.

Rejection by the physics community

This claim was not accepted by the physics community on theoretical grounds for several reasons:

First, there was no mechanism known by which two deuterons might approach one another close enough to fuse, since the Coulomb barrier prevents them from approaching at room temperature.

Second, if they did approach close enough to fuse, one would expect the conventional dd-fusion reaction products to be observed, since these happen very fast. Essentially, once two deuterons get close enough to touch, reactions occur with near unity probability, and the reaction products (p+t and n+He-3) leave immediately at high relative velocity consistent with the reaction energy released. To account for Fleischmann's claim, the proposed new reaction would seemingly somehow have to make He-4 quietly and cleanly, without any of the conventional reaction products showing up, and would somehow have to arrange for this to happen a billion times faster than the conventional reaction pathway. Most physicists bet against the existence of such a magical new effect.

Third, the normal pathway by which two deuterons fuse to make He-4 normally occurs with the emission of a gamma ray near 24 MeV. There was no evidence for the presence of any such high energy gamma emission from the sample, hence no reason to believe that any helium had been made.

Finally, if one rejects the possibility that any new mechanisms might be operative, then the claim that power was being produced by fusion must be supported by the detection of a commensurate amount of fusion reaction products. Pons and Fleischmann found no significant reaction products, which, given the rejection of new mechanisms, implied an absence of fusion reactions.

An alternate explanation is proposed

The physicists decided in 1989 that the most likely reason that Pons and Fleischmann observed a temperature increase was that they had made an error of some sort in their measurements. When many groups tried to observe the effect and failed, this led most of the physics community to conclude that there was nothing to it whatsoever other than some bad experiments.

The claim of Jones

A second very different claim was made at the same time in 1989 by Steve Jones. This work also involved electrochemistry in heavy water and the observation of reaction products corresponding to the conventional dd-fusion reactions. The initial publication showed a spectrum of neutron emission that Jones had detected from a titanium deuteride cathode loaded electrochemically. The response of the physics community was skeptical, as the signal to noise ratio was not particularly impressive. Given the polarization of the physics community in opposition to the claims of Pons and Fleischmann (which were announced essentially simultaneously), the physicists were not of a mood to accept much of any claims that fusion could happen in an electrochemical experiment at all. Jones went to great lengths to assure fellow scientists that his effect was completely unrelated to the claims of Pons and Fleischmann, and was much more reasonable.

Also rejected

Physicists had reason to be skeptical. Theoretical considerations indicated that the screening effects that Jones was relying on were not expected to be as strong as needed to account for the fusion rates claimed. As this experiment could not seem to be replicated by others at the time, it was easy for the physics community to reject this claim as well.

Cold fusion, weighed and rejected with prejudice

Cold fusion, as the two different claims were termed, was dismissed with prejudice in 1989. The initial claims were made near the end of March in Utah, and the public refutation of the claims was made at the

beginning of May. It only took about 40 days for the physics community to consider the new claims, test them experimentally, and then announce loudly to the world that they had been carefully weighed and rejected.

Following this rejection, physicists have treated cold fusion rather badly. For example, Professor John Huizenga of Rochester University was selected to be co-chair of the DOE ERAB committee that met to review cold fusion and issue a report. Shortly afterward, he wrote a book entitled Cold Fusion, The Scientific Fiasco of the Century, in which he discusses the claims, the experiments, and the extreme skepticism with which the new claims were greeted. Robert Park discusses the subject in his book entitled Voodoo Science. You can find many places where physicists and other scientists happily place the cold fusion claims together with claims of psychic phenomena.

A Science Tutorial

Talbot Chubb

First it is important to recognize that there are four distinct types of energy production:
1) chemical energy, that powers our cars and most of our civilization;
2) nuclear fission energy, as used to generate about 15% or our electricity;
3) hot fusion nuclear energy, which powers the sun and most stars;
4) cold fusion nuclear energy, which appears as unexplained heat in a few experimenter's laboratory studies and which most scientists believe is impossible.

The three types of nuclear energy produce 10 million times as much heat per pound of fuel than occurs with chemical energy. How do these types of energy differ? To understand this question you need to know some chemistry and physics.

Lesson 1

Nature has provided us with two types of stable charged particles, the proton and the electron. The proton is heavy, normally tiny, and has a positive charge. The electron is light, normally large and fuzzy, and has a negative charge. The positive charge and the negative charge attract each other, just like the north pole of a magnet attracts the south pole of a magnet. When you bring two magnets together with the north pole of one facing the south pole of the other, they pull together, bang! When they bang into each other they release a little bit of energy in the form of heat, but it is too small an amount to easily measure. To pull the magnets apart you have to do work, which is another way of saying you have to use up energy. It's almost like pulling a rock back up a hill. Rolling the rock down a hill actually creates a little heat, and pulling the rock back up the hill takes energy. In the same way the positive charge of the proton pulls on the negative charge of the electron and they stick together releasing energy in the process. The result is a hydrogen atom, designated H. A hydrogen atom is nothing but a fuzzy electron hugging a compact proton. The proton is the nucleus of the hydrogen atom. If you knock the electron off the hydrogen atom you get a positive ion H+, which is nothing more than the original proton. An ion is the name applied to an atom or molecule that has lost or gained one or more electrons, hence is no longer electrically neutral.

Lesson 2

As you know, nature has provided us with more than one type of atom. We have oxygen atoms, nitrogen atoms, iron atoms, helium atoms, etc.. How do these atoms differ? The answer is that they all have different types of nuclei (plural of nucleus, from the Latin). And these different nuclei all have different numbers of protons inside them, which means they all have different plus charges. The nucleus of the helium atom has 2 protons inside it, hence has plus 2 charge, and requires 2 electrons to neutralize its charge. When 2 electrons stick to it, it becomes a helium atom. The oxygen nucleus has 8 protons and has charge 8. When 8 electrons stick to it, it becomes an oxygen atom. The nitrogen atom has 7 electrons, and the iron atoms something like 26. But all the atoms are built more or less the same way, with a compact positively charged nucleus embedded in a cloud of fuzzy electrons. The difference in size between the compact nucleus and the fuzzy electrons is enormous. The sun has a diameter only about 100 times that of the earth. The electron cloud on an atom has a diameter which is about 100,000 times that of the nucleus. Cube these numbers to get the difference in volumes.

Lesson 3

We now are in a position to understand what chemical energy is. The atoms, all electrically neutral, can actually join with each other and release more energy. This is another way of saying that they can join into more stable configurations. The electrons in an atom try to configure themselves so as to get as close as possible to their nucleus, but their fuzzy nature requires that they take up a certain volume of space. However, if they join together with the electrons of another atom they can usually find a tighter configuration that leaves them closer to their beloved

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nuclei. For example, 2 hydrogen atoms can join together into a more compact configuration if each hydrogen atom contributes its electron to a 2-electron cloud, which the separate protons share. In this manner they form a grouping of the 2 electrons in a single cloud, together with the 2 isolated protons spaced apart from each other but still within the electron cloud. The result is a heat-producing chemical reaction H + H => H_2. (The => means "goes to" or "becomes".) The H_2 configuration is the hydrogen molecule, and when you buy a tank of hydrogen gas, H_2 molecules is what you get. Furthermore, the 2 electrons of the H_2 molecule and the 8 electrons of the O atom can find a still more compact configuration by combining their electrons to create the water molecule H_2O, plus heat. The water molecule is really a single cloud of electrons in which are embedded the three point-like nuclei to form a minimum energy configuration. So when we burn oil or coal we reconfigure the electrons to produce more stable configurations of point-like nuclei embedded in electron clouds, liberating heat. So much for chemical energy.

Lesson 4

We have slid over one point in the above discussion. How does Nature make a nucleus containing two or more protons in the first place. After all, each of the protons has a positive charge, and the positive charges repel each other very strongly when they are separated by a tiny distance, equal to the distance across a nucleus. The repulsion of like charges is just like the repulsion between the north poles of two magnets when they are pushed together the wrong way. Something must overcome this repulsion, or else the only kind of atoms we would have would be those of hydrogen. Fortunately, this is not what we observe. The answer is that there is a second kind of force which acts on protons. This is the nuclear force. The nuclear force is very strong but requires particles to almost sit on each other to have any effect. Also, there is a second kind of heavy particle, which is just like a proton, except that it has no positive or negative charge. It is not pushed away by the proton's plus charge. This other kind of particle is called the neutron, since it is electrically neutral. A peculiar fact of life is that it exists in stable form only inside a nucleus. When not in the nucleus it changes into a proton, an electron and a very light anti-neutrino in about 10 minutes. But it lasts forever inside a nucleus. Anyway, the neutron and the proton very strongly attract each other once they get close enough together, and then they combine to form a highly stable pair called a deuteron, which we designate D+. The single deuteron, when it combines with a single electron, forms the heavy hydrogen atom called deuterium, designated D. A second nuclear reaction occurs when two deuterons make contact. When they can be forced together so as to make contact, the 2 deuterons fuse, making a doubly charged particle. The grouping of 2 protons and 2 neutrons is even tighter than the proton-neutron grouping in the deuteron. The new particle, when neutralized by 2 electrons, is the nucleus of the helium atom, designated He. Larger groupings of neutrons and protons exist in nature and serve as the nuclei of carbon, nitrogen, oxygen, and iron, etc. atoms. All of these groupings are made possible by the very strong nuclear force, which is felt between particles only when they are in contact or share the same nucleus-size volume of space.

Lesson 5

We can now understand normal nuclear energy, which is really nuclear fission energy. During the early history of the universe massive stars were formed. In the explosion of these massive stars, lots of different types of nuclei were formed and exploded back into space. Second and later generation stars and planets were formed from this mix, including the sun. In the explosion process probably every possible stable configuration of protons and neutrons was produced, plus some almost-stable groupings, such as the nucleus of the uranium atom. There are actually 3 different types of uranium atom nuclei, called uranium-234, uranium-235, and uranium-238. These "isotopes" differ in their number of neutrons, but they all have 92 protons. The nuclei of all uranium atoms can go to a lower energy configuration by ejecting a helium nucleus, but this process occurs so rarely that the Earth's uranium has already lasted over 4 billion years. But the uranium nuclei are unstable in another way. In general, groupings of protons and neutrons are happiest if they have about 60 protons-plus-neutrons. The uranium nuclei contain more than three times this number. So they would like to split in two, which would release a lot of heat. But nature doesn't provide a way for them to split apart. They have to first go to a higher energy configuration before splitting in two. However, one of the three forms of uranium nucleus found in nature called uranium-235 and designated ^{235}U, gains the needed energy if it captures a neutron. The energized nucleus that results from neutron capture then splits apart with the release of an enormous amount of energy, and incidentally with release of additional neutrons. The additional neutrons can then split more uranium-235 nuclei, keeping the reaction going. This is what happens in nuclear power plants, where the heat, which is the end product of the nuclear splitting process, is used to boil water, generate steam, and turn electrical generators. (One also gets lots of radioactive products, which are a nuisance to dispose of safely.)

Lesson 6

We are now also in a position to understand hot fusion nuclear energy. As mentioned in lesson 5, the groupings of protons plus neutrons is most stable when the numbers of neutrons and protons approximate those

found in the nucleus of an iron atom. Just as uranium has too many neutrons plus protons to be comfortable, so the light elements like hydrogen, helium, carbon, nitrogen and oxygen have too few. If the nuclei can be made to make contact under proper conditions, they can combine to create more stable groupings, plus heat. This is the process of fusion. Nature has found a way of doing this in stars like the sun. All Nature has to do is heat compressed hydrogen hot enough and wait long enough and hot fusion will occur. If Nature were to start with deuterium, which already has a paired proton and neutron, the task would be relatively easy in a star. Temperature is a measure of how much speed an atom of a given type has as it bangs around inside a cloud of such atoms. The higher the temperature, the higher the speed and the closer the atoms get to each other momentarily during a collision. In a star the temperatures are high enough that all the electrons quickly get knocked off the atoms, so one is really dealing with a mixed cloud of electrons and nuclei. At very high temperature the nuclei occasionally get close enough during collisions for the pulling-together short range nuclear force to turn on. Then the nuclei can stick together and go to a lower energy grouping of protons plus neutrons, releasing heat. Hot fusion nuclear energy is an attempt to carry out this process in the lab, using deuterium and mass-3 hydrogen (whose nucleus is a compact grouping of 1 proton and 2 neutrons) as the gas. Hot fusion requires that the gas be contained at temperatures of hundreds of millions of degrees, which can be done with the help of magnetic fields, but only for 1 or 2 seconds. The hope is to contain the gas for longer times. During the period of high temperature containment nuclear reactions occur during collisions. The main form of energy release is ejection of high energy neutrons and protons. The proton energy quickly converts to heat. The neutron energy can also be converted to heat but makes the equipment highly radioactive. It then becomes difficult to repair the equipment, which could make hot fusion a poor candidate for commercial power production. In any case hot fusion power is a dream that is still probably at least 50 years away. But most scientists view hot fusion as the only way to achieve fusion power. Hot fusion produces less radioactivity than fission power, is environmentally benign, and has a virtually limitless fuel supply on earth (many millions of years at present energy usage rates).

Lesson 7

So now we come to cold fusion. Cold fusion may provide an easier and non-radioactive way of releasing nuclear fusion energy. Cold fusion relies on a different way of letting the protons and neutrons in one nucleus make contact with those in another nucleus, so that the nuclear force can bring them into a more stable configuration. The requirement for any nuclear reaction to occur is that the reacting nuclei occupy the same volume of space. This condition is called particle overlap. In hot fusion particle overlap is brought about briefly by banging the nuclei together so as to overcome momentarily the repulsion of the two positive charges which try to keep the particles apart. In cold fusion particle overlap conditions are achieved by making deuterium nuclei act as fuzzy objects like electrons in atoms, instead of like tiny points. When either light or heavy hydrogen is added to a heavy metal, each hydrogen "atom" occupies a position inside the metal where it is surrounded by heavy metal atoms. This form of hydrogen is called interstitial hydrogen. With interstitial hydrogen the electrons of the hydrogen atom become part of the pool of electrons of the metal. Each hydrogen nucleus oscillates back and forth through a negatively charged electron cloud provided by the electrons of the metal. They can be thought of as moving back and forth like the pendulum in a grandfather clock. This vibration exists even at very low temperature, due to a peculiarity of a branch of physics called quantum mechanics. The vibration is called zero point motion. The nucleus then becomes a fuzzy object, like the electrons in an atom. But this amount of fuzziness is not enough to permit a hydrogen nucleus to make contact with another hydrogen nucleus. To get two or more hydrogen nuclei to share the same volume one must go one step further. In a metal electrical current is carried by electrons that act more like vibrating matter waves than like point particles. If electrons did not become wave-like inside solids, there would be no transistors and no present day computers. This wave-like kind of electron is called a Bloch function electron. The secret of cold fusion is that one needs Bloch function deuterons. One needs wave-like deuterons inside or on the surface of a solid in order that two or more deuterons share the same volume of space. But once the Bloch function deuterons are created, the nuclear force comes into play and the protons and neutrons making up the deuterons can rearrange themselves into the more nuclearly stable Bloch function helium configuration, with release of heat. To study cold fusion the experimenter has to force deuterons to assume the wave-like form and keep them in the wave-like state. Cold fusion experiments demonstrating release of excess heat show that this can be done. But at present no one knows how to do it reliably. Since cold fusion promises millions of years of energy without the problems of global warming or radioactivity, a real effort should be made to learn how.

For more tutorials go to www.hometown.aol.com/cffuture1 and www.hometown.aol.com/cffuture2

LENR (Low Energy Nuclear Reactions) Experiments

Review from
http://www.lenr-canr.org

Have you ever wondered what a physics laboratory looks like? They are seldom spacious or organized the way they are shown in movies. Most LENR researchers work at universities or home laboratories, with tight budgets in a crowded space. They keep old, broken equipment on shelves to scavenge parts for new experiments. In this section we present some photographs of equipment provided by researchers, and close up pictures of equipment. The actual cells, cathodes and other equipment used in electrolysis experiments often have an ad-hoc, home-made appearance, because they are made by hand. They have to be; they are unique, one-of-a kind prototypes. Nothing quite like them has ever been made before.

A visitor seeing a LENR experiment the first time may feel disappointed. It looks like any other electrochemical experiment. The heat or neutron flux produced by the experiment are so small they can only be detected with sensitive instruments. A null cathode that produces no effect looks exactly like an active cathode. The difference between one cathode and another is in the microscopic structure, or the traces of elements mixed in with the palladium. Only one kind of cold fusion looks dramatic i. e. the glow discharge reaction.

Here are a few photographs of cold fusion cells and devices (also see the cover page).

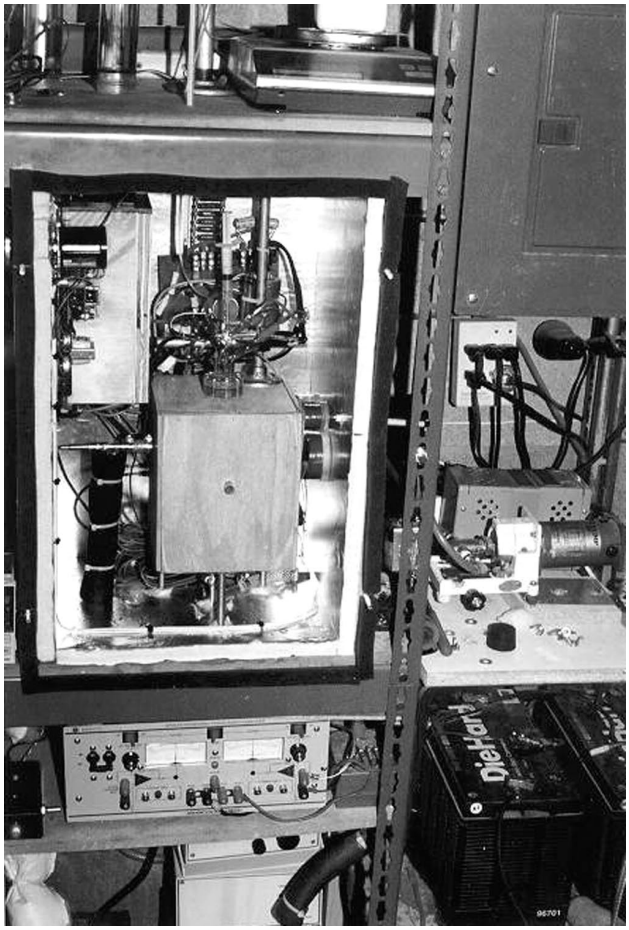

Fig.1
Box Calormeter

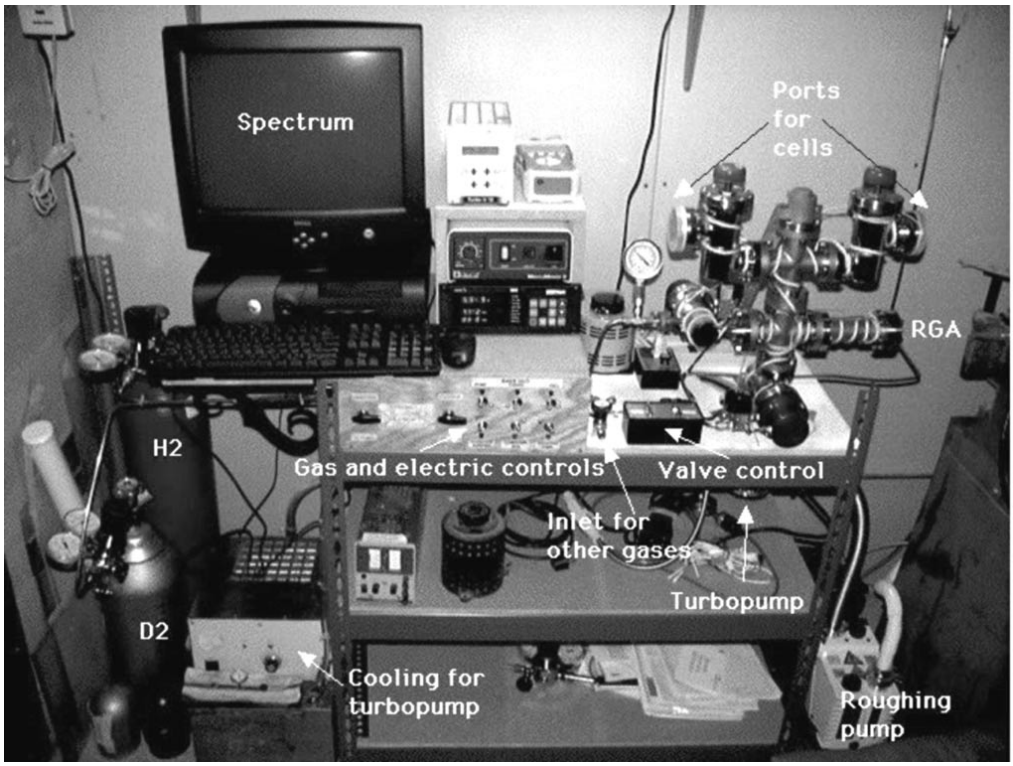

On Fig. 1 there is a calorimeter constructed by Edmund Storms. Note the DieHard® battery, lower right, that serves as an unninterruptable power supply. A power failure can ruin an experiment. Whenever possible, inexpensive, ordinary materials and instruments are used. However, experiments are never cheap, and they cannot be done on a shoestring. The equipment, arranged for another experiment (see Fig. 2), costs about $40,000.

Fig.2 (On the left)
Vacuum system to prepare particles for gas loaded cold fusion cells, courtesy E. Storms.

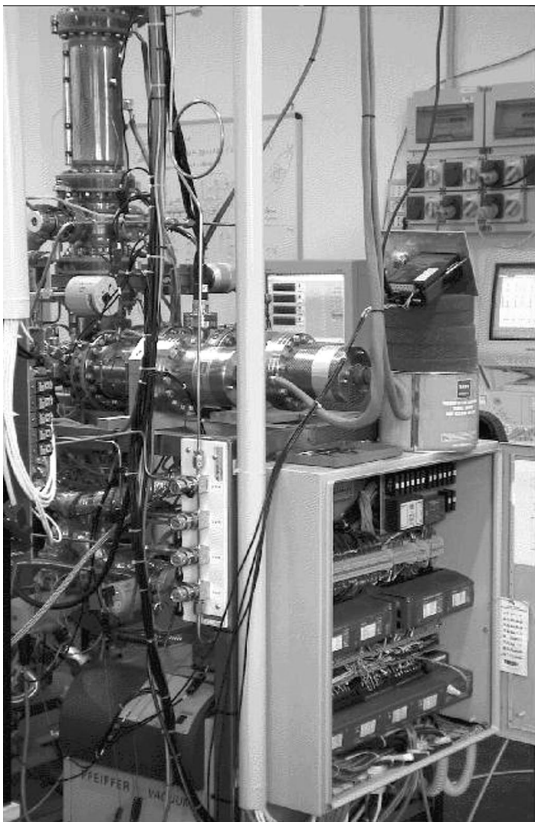

Fig.3
A high resolution mass spectrometer used for on-line helium detection during a cold fusion experiment at C. R. ENEA Frascati. (http://www.frascati.enea.it/nhe/)

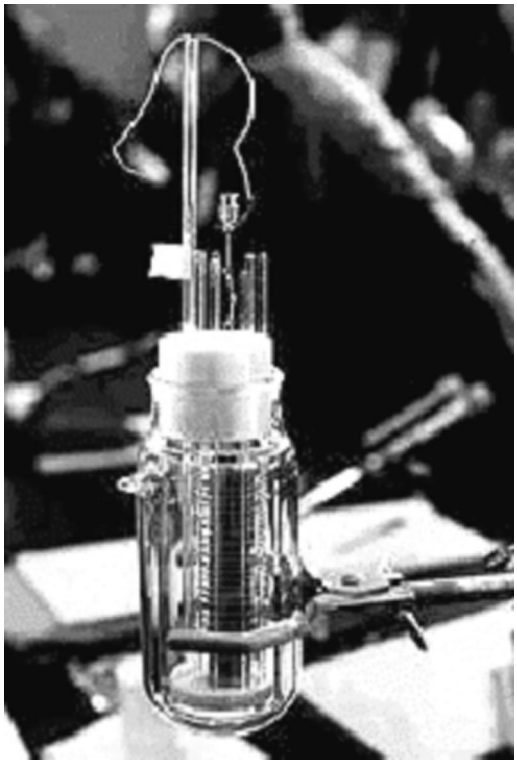

Fig.4
A cell at ENEA Frascati

Fig.5
A flow-type cell, courtesy E. Storms

Fig.6
Close up of a Miley-style cell, courtesy E. Storms

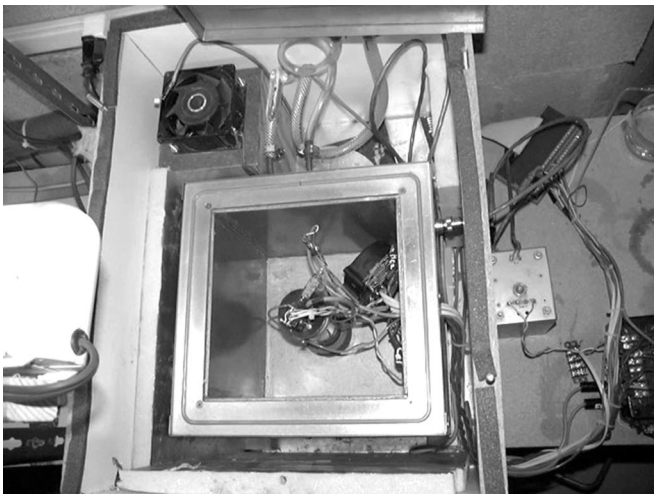

Fig.7
A cell installed inside a Thermonetics Seebeck calorimeter with the lid removed, courtesy E. Storms

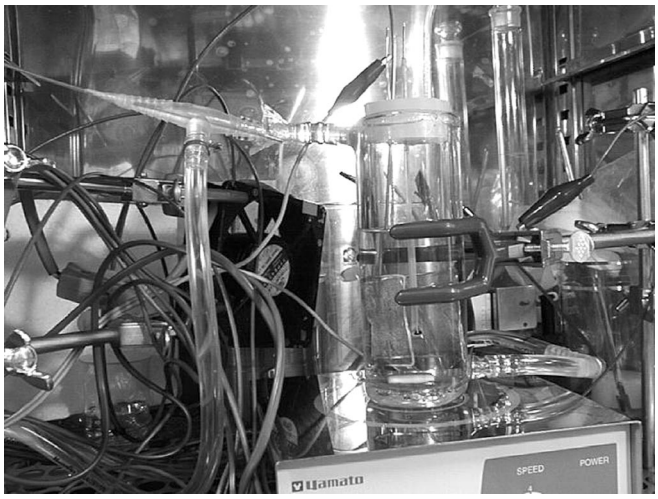

Fig.8

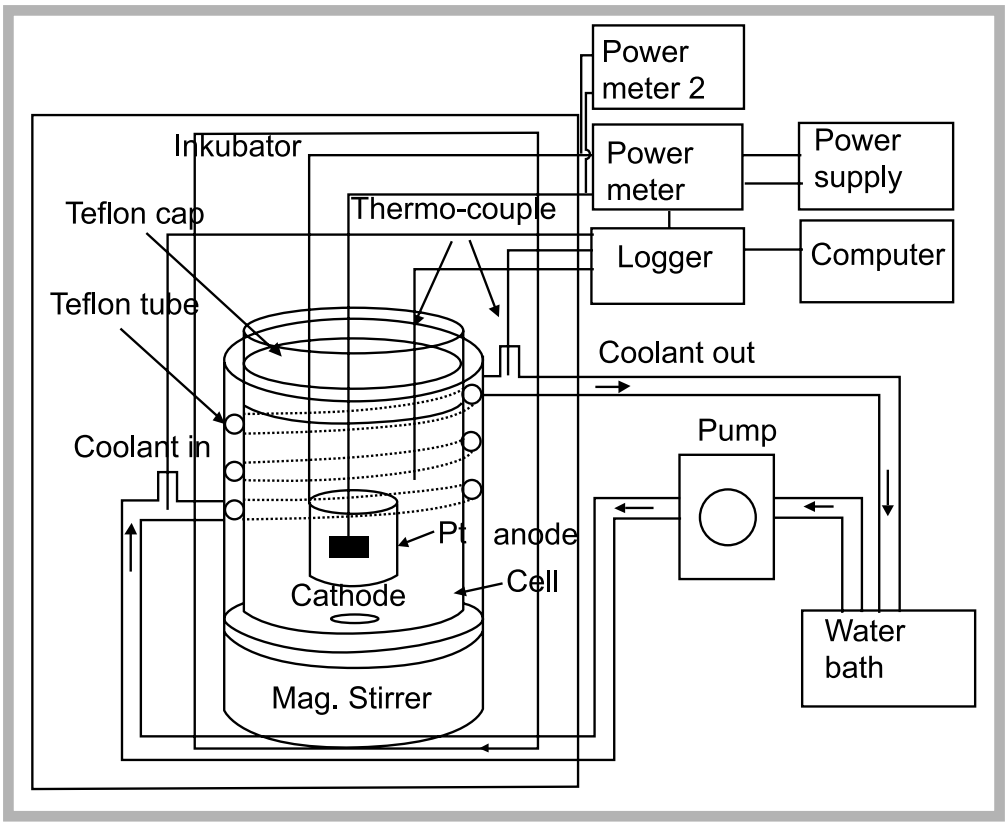

On the Fig. 8 you can see a glow discharge electrochemical cell at Hokkaido University, courtesy T. Mizuno. The cell is installed inside a crowded constant temperature air-cooled chamber. It placed on a magnetic mixer. Cooling water is pumped through the plastic tubes attached to the top and bottom. The muffin fan at the back circulates the air in the chamber

Fig.9

A schematic of the calorimeter shown above.

Hydrogen power engineering

Faraday Laboratories Ltd, Moscow, and Spectrum Investments Ltd, London, started joint R&D project on hydrogen power engineering. Photo: Alexander V. Frolov, Faraday Laboratories Ltd and Nicholas Moller, Spectrum Investments Ltd. The project includes designing and building of prototype to use hydrogen recombination process for heat generation.

On Electrogravitation

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Part I

"let's go to the Mars!"

Nowadays it becomes evident that exploration of deep space by means of rocket equipment is impossible. Aircrafts, which run on jet thrust, are too expensive and unreliable. Besides, they are too slow-speed if were considered on a scale of solar system. For example, the flight to the remote areas of our planetary system can drag on tens years. But the main disadvantage of rockets is their low load-carrying capacity. Thus, the most powerful transport system "Progress" can deliver less than 100 ton of load to the orbit of the Earth, and only 1 ton to the orbit of the Mars. Rather natural question arises as to whether any alternative ways of space exploration exist? Are there any transport systems, which can compete with rocket equipment on the interplanetary routs of future? Actually, at present there is only one technology, which is alternative to rocket ones – it is the so-called light sailers, using light pressure for acceleration. Laser and maser can be also used for their acceleration from satellites. However, there are also some disadvantages here.

There is also one more transport system, which is undeservedly consigned to oblivion. It uses electricity in acceleration aggregate. This transport system or the electric propulsion system is a result of researches and investigations of two little-known, but extremely talented American physicians and inventors, Thomas Townsend Brown and Paul Alfred Biefeld (the last one was also a professor of Astronomy).

Thomas T. Brown was the first who discovered electric principle of this propulsion system. Thus, in twenties of the XX century Thomas T. Brown, being the student of secondary school, became interested in X-rays. He wanted to reveal if the rays, outgoing the X-ray unit, could take positive effect. For his researches the inventor had got Coolidge Tube, the device, which radiates X-rays and consists of a glass tube. Deep vacuum is created in this glass tube. Anode and cathode are placed in the tube. Cathode radiates electrons and anode brakes them. X-rays are created at striking of electrons against anode. Brown used Coolidge Tube in the way nobody had done before. For ease of handling the researcher suspended the device on wires, which run to anode and cathode parallel to the Earth. During the operation of the device he noticed that every time when current fed to the tube, the tube was moved aside and tended to make slight progressive motion. Subsequent experiments demonstrated that the deviation value depended only on the value of voltage, which is between anode and cathode. The higher voltage is, the more deviation. X-rays were neither here not there. Much later at participation of Paul A. Biefeld, the same tendency to move was revealed at plane disc capacitors. The reason, which causes this motion, is the same, i.e. voltage, which exists between plates and not between anode and cathode as in Coolidge Tube.

Having run series of experiments, the researchers proved that electric energy could be directly transformed to mechanical. They also devised the physical principle, which were included in the scientific annals as Biefeld-Brown effect.

Editor's: Let us note that earlier Ampere and Faraday have been working on Electrokinetic effects which are easily detected at strong current. Modern researches on this point are known as "Sigalov's effect" (force appears in electric conductor which is bent at angle and at current impulse).

The essence of this effect lied in the fact that charged disc electric capacitors tend to move in the direction of their positive pole. At formulating of the essence of this effect the scientists consciously did not mention Coolidge Tube in order to demonstrate that according to their experimental observations, electron streams were not involved in generation of electromotive force. This effect of the direct transfer of electric energy to mechanic one (Biefeld-Brown effect) is observed, when current is fed to the Coolidge Tube or to the plane disc capacitor.

However, all this was realized much later, when in 1923 Brown became a student of Dennis University in Greenville, Ohio, where he met his teacher and later on a coauthor, Paul A. Biefeld. In school time the inventor came to the conclusion that the reopened by him phenomenon has nothing in common with X-rays and that high voltage, used for rays generation, is the basis of this phenomenon. Besides, Brown designed a device named "Gravitor". It looked like a usual bakelite box and was made as a simple construction, which consisted of several flat aluminum plates. The plates were placed as coins in a rouleau and separated with dielectric. It had only to place the box on the scale and connect it to some energy source with 100 kV voltage as the device either lost or put on about one percent of its weight that depended on polarity. An outside observer, who was not familiar with the essence of this effect, could think that mass was really changed. *(Editor's: Weight but not the mass is changed here. Weight is the force. There is a possibility of partial compensation of the weight by another force.)* But this was not the case. For better understanding of the processes, which take place at gravitor operating, let us make a mental experiment. Let us take a weight, put it on the scale and then raise it a little. The scale will certainly show that the weight has become lighter. After that let us press the weight then the scale will show that it has become heavier. However, in fact mass does not change. In the same way motive force, caused by high voltage, slightly raises the gravitor and at changing of polarity presses it. At that it seems that there is some change in weight. Thus, as if by chance, the scientist has discovered effect of direct transition of electric energy into mechanical one. *(Editor's: Let us specify the author's terminology. In T.T. Brown's Patent of 1927 it was mentioned that there*

was generated a force which partially compensated weight. The matter was always about the generation of x-force while gravitational field remained unchangeable).

Having graduated from the University, from 1926 up to 1952 Brown already by himself was being occupied with development of his electrical propulsion system. At the same time whether in chase of fame or in hope to obtain money for his researches, T.T. Brown began asserting that he had discovered something new in physics, viz "electrogravitation", i.e. some connecting effect between gravitation and electricity. *(Editor's: In my opinion, T.T. Brown has never posed a problem in such a way. The matter always concerned the fact that X-force appears while gravitational field does not change.)* As for the development of the invention, it came to the decrease of weight of the device and increase of DC voltage, which fed the plates of the "gravitor". As a result the devices could fly and lift weight which greatly exceeded their own. Thus in 1953 in his laboratory Brown demonstrated the flight of aircraft which had a disk form. The device made 51 m/c (180 km/h), flying at circular course of 6 m diameter. This device was nothing but very lightweight capacitor in which by means of the special construction electromotive force was redirected in two planes upward and sideward. It made the device rise in air and fly around the mast. Current of 50kWtt voltage was supplied to the central mast by the wire. Then speed of "flying disks" became higher, the payload capacity was increased but that was again resulted by decrease of weight and increase of the supplied voltage. T.T. Brown so succeeded in decreasing of the thickness of capacitor plates and in making his devices superlight, that the witnesses of these demonstrations called these devices as "air films".

Later on all works in this area were placed on secret list and then closed because of lack of prospects. Thus, accounts and experiments demonstrated that it was impossible to overcome terrestrial attraction entirely and go to outer space by means of the gravitor because there are no such natural materials which could take huge electric and heat loads. Besides, sufficiently massive electric power station would be needed to produce required currents. *(Editor's: Thereupon the following question appears: why the author looks for "currents" while the essence of the technology is in applying of high voltage but not of the currents?!)* Moreover some alternative was made, i.e. jet engines. Gravitor could not compete with them by above-mentioned and quite objective reasons. In time, since the mechanism of transition of electric energy into mechanical one was not disclosed and Brown's populist idea has received some publicity, this effect became surrounded with idle talks and guess-works. However the scientists who researched this very effect, has developed only three theory wh ich could explain its existence.

The first theory was suggested by T.T. Brown, the discoverer of this effect. To his dying day Brown asserted that he had discovered the effect which could connect gravitation and electricity, i.e. "electrogravitation". But this theory can be easily refuted by practice. It is enough to put Brown's bakelite box to the scale in such a way as to place the plates of the "gravitor" at right angle to the surface of the scales. Then poles of the "gravitor" will be placed at the same level and parallel to ground and as a consequence electromotive force will influence in no way on the scale, since this force is directed sideward but not upward or downward. The scale will accurately show that there are no changes in weight and hence there is no **electrogravitation**. *(Editor's: The author will obtain propulsive force and it is directed not upward and downward but sideward. However the effect exists in any case. The changing of weight appears only when propulsive force generated by the device is directed against the weight force, i.e. upright.)*

The second theory was suggested by T. Brown's opponents. They asserted that electromotive force appears as a result of the so called "electron wind", i.e. electron streams which exist between the plates of the "gravitor". In their argumentations Brown's opponents rest upon the following facts which are well-known to every physicist. Fast electrons, as well as photons, have dual properties, i.e. interacting with matter and environment, they behave both as a wave and as a material particle. Since light or photons carry energy, then they heat bodies which are in their way and put pressure on the illuminated surface etc. Similarly electron streams carry heat or kinetic energy and hence they can put pressure on the anode of Coolidge Tube and get it moving forward. This theory seems to be interesting, however it explains appearance of electromotive force only in Coolidge Tube, but there is no explanation why discoid capacitors tend to move. Point is that there are no free electron streams in the capacitors. Usually between the plates of capacitors there is a dielectric which brings electron streams to nothing. If there is no electron wind, then what makes capacitors move?

Editor's: There is always a surface charge and reactive outflows of ions. But it is just a partial explanation of Biefeld-Brown's effect.

The third theory is based on the following fact. It is well known that electrons can have heat or Brownian chaotic motion. Free electrons, placed in a conductor, are in the similar chaotic heat motion before voltage is applied to this conductor. The higher temperature of the environment is the higher speed of this heat motion. According to school course of physics, heat energy or energy of chaotic motion of molecules (electrons) can be entirely transferred into mechanical one. If all molecules (electrons) start to move simultaneously and in the same direction, and if they push some piston toward this direction then heat energy of molecules (electrons) will be entirely transferred into mechanical work. In other ways, this piston will move until molecules (electrons) calm down. It is considered that this process is unrealizable in practice.

However, it seems that this is not quite the case, i.e. it is possible to regulate chaotic heat motion of electrons. Obviously this process takes place in the capacitor and in Coolidge Tube. It is no secret that when negative electrons try to move to the neighbor positive charged electrode, then dielectric layer which is placed between the plates of the capacitor prevents it. Electrons rest upon this layer and start to heat. Their internal energy is also increasing. The higher voltage is the higher heating of electrons, i.e. their capacity to have chaotic heat motion increases. However, chaotic motion of

electrons is not observed on the capacitor plates, since the directed force (voltage) influences electrons. Electrons tend to move upward, downward, to the right and to the left, but voltage prevents it. Thus they just are forced to move in space in one direction and with the same speed. Capacitor or gravitor has to move alongside with electrons because plates of the capacitor (gravitor) become a piston which is pushed by heated electrons. This piston is in progressive motion. It starts to move under the influence of electrons, or rather together with electrons. The higher voltage is, the higher temperature of electrons and hence the higher their speed. Therefore speed of capacitor (gravitor) increases at voltage increase. There is a usual chain, i.e. electric energy transfers into heat energy and heat energy transfers into mechanical one. Approximately the similar process takes place in Coolidge Tube, but there the heat of electrons is caused by thermoelectric emission on the cathode. Electrons evaporate from the cathode surface. Voltage, existing between anode and cathode, makes electrons move in one and the same direction. They move towards anode, which serves as piston and takes heat push upon itself, i.e. it transfers heat energy of electrons into mechanical work. It is clear that the higher voltage is the more intensively electrons are heated. Therefore electrons more intensively influence anode and the suspended tube is deviated to a greater extent. (*Editor's: Nowadays this very explanation is the most admitted one.)*

Resting upon Biefeld-Brown's theory and experimental results and at sufficient financing, already within the next few years it would be possible to create a unique electric engine which can operate on hot or quick electrons. Besides there will appear a possibility to orbit the first spaceship equipped with a propulsion system similar to gravitor one's. In near future scheduled cargo-and-passenger service could be organized within planetary system. First of all such transportations can be organized between the Mars, Moon and Venus orbits that will let to start active colonization of these planets.

Thus, more than 200 flights to the Moon and back and about 70 flights to the Mars are possible by means of the gravitor which is made of modern fusions and dielectric materials and which is placed on the Earth orbit. At that there is a minimum risk for its breakdown during the flight, because gravitor has no movable parts and no explosives are used. Negative consequences for the crew in an improbable emergency are insignificant. Even if high voltage causes disruption of dielectric layer between the electrodes and voltaic arc appears then the spaceship, equipped with such a propulsion system, will mechanically arrive its destination. The source of energy will be its only trouble spot and it will happen only if nuclear reactor instead of solar batteries is used. There is also an idea to attach dwelling capsules and cargo bays, equipped with such electric engine, one after another, like carriages are attached to a locomotive. It will let to equip this interplanetary vehicle in several stages by compactly packed modules which are delivered from the Earth. Unfortunately, this project exists only on paper and support of government or financial institutions is not expected in the near future. Faint hope is rested upon enthusiasts but there are too few of such people, besides almost all of them are rather hardly related to space flights and science. Most of scientists even hear nothing about Biefeld-Brown Effect, because it has never become widely known, since all works of this field, except the very first experiments from the USA, were run and then closed in secrecy.

Part II

"...it's time to go to the stars"

Due to the theory of relativity there is an ingrained belief of several generations that it is impossible to move with more than 300 000 m/c speed, i.e. to move faster than light, since the postulates of this theory read that mass is directly depended on speed. Calculations demonstrate that while speed of some accelerated body verges towards light speed its mass will increase and in the point of equilibrium (V=c) it will unrestrictedly increase. Hence acceleration will tend to zero and speed will not virtually increase, no matter how long acceleration speed acts on the object. In other words, the accelerating mass dissipates speed. In principle it is correct but another conclusion can be also drawn from the dependence of mass and speed, for example, the following one: to accelerate an object to the speed which exceeds light speed, mass of the accelerated body should decrease and its speed should increase. Any physicist will say that this statement is correct. At first sight it is practically impossible to realize this idea therefore it was wrongly give to writers of science fiction. They added this idea to their armory and the hypothetical device, which realizes it, was named as gravitational engine. Let us realize this idea from the practical point of view and basing only on facts and logic.

Thus let us apply to the facts and give the description of one experiment. Professor of Pulkovo Observatory N.A. Kozyrev is the author of this experiment, he was also the first to discover the phenomenon of lunar volcanism. Kozyrev used a gyroscope, i.e. the device consisting of two rings of different diameter. These rings are placed athwart one in another and movably jointed. Top is attached to the inner ring through the cardan. The scientist put usual thermos filled with hot water near the beam scale. The top of the gyroscope was preliminarily spun up counterclockwise. At that balance indicator showed that gyroscope top at 90 gram weight became 4 milligram lighter in weight. Then Kozyrev started to pour water of room temperature inside the device through the vinyl chloride tube fixed into the hole, which was made in the plug of the thermos. Seemingly it is impossible to influence upon the gyroscope operating and its weight by a balloon filled with hot water, which is being cooled. Besides the thermos consists of a double-walled container which practically entirely excludes heat exchange with the environment. However balance indicator moved at one or two points, i.e. such connection existed.

This experiment can be divided into two steps. At the first stage the thermos filled with hot water is placed near the gyroscope and we can register the decrease of the top weight. At the second stage water of room temperature is poured into the thermos and the scale again shows that the weight has been changed. Somehow Kozyrev explained the second stage of this

experiment. He assumed that when we pour cold water in the thermos, then the equilibrium of the system is broken because some irreversible processes take place there. Cold water can not cause temperature increase of water in the thermos. Until the system come to equilibrium at a new level, i.e. until the same temperature is set in the whole volume of the thermos, this process will cause the condensation of time which "additionally" influences the top. However the scientist missed that the weight of the top had decreased long before the moment when cold water was poured into the thermos, i.e. before irreversible processes appeared there. *(Editor's: Evidently, the author of the article is not well familiar with Kozyrev's researches and with works of other experimenters who investigated this problem.)* In other words, at the first stage of the experiment there is nothing to condense time and that insignificant weight condensation, which was equal to 4 milligram, absolutely does not fallen into his theory. Some other process is presented there.

It is quite possible that at the first stage of the experiment we deal with nullification of the top weight, i.e. mass of the top tends to zero. Some conclusion arises from this assumption, i.e. hot water can influence the mass of the top in some still incomprehensible way. *(Editor's: The point is not in water temperature but in the process of changing of the entropy.)* Thus there is a simplest and primitive model of the gravitational engine, viz there are hot water along with gyroscope and the required decrease of mass at the "outlet". Certainly, it is very bold assumption but it can be easily checked. Near the gyroscope there should be placed thermos filled with not boiling water (of 100°C temperature) but with water of 50°C temperature. If the weight of the top decreased by one half (for example, by 2 milligram instead of 4 milligram), then we can surely ascertain that the hotter water in the thermos is the more decrease of mass. Besides, each 100°C of water heating will decrease mass of the top by 4 milligram. It is not very difficult to calculate the temperature at which mass of the top will verge toward zero and the top will start accumulating negative mass.

Let us now assume that our experiment was successful then water as well as any other matter cannot be heated to such high temperature. However it is possible to heat electrons. They are very compact and have insignificant mass and can be heated to very high temperature. It is necessary to take several plates then to place a dielectric between them and to apply voltage. Electrons rest on the dielectric and start heating. The top can be rotated anti-clockwise by means of electric engines, i.e. capacitor and gyroscope should be combined in one system with common center of gravity. It is not very difficult, as the saying goes, it is just an engineering problem. The higher temperature of electrons is the more decrease of the top mass. Finally there is a moment when mass of the capacitor-gyroscope system will reach zero and this electric machine will rise to the surface of the gravitational field of the Earth or any other planet. It will be Biefeld-Brown's force that will make our apparatus taking off the gravitational field of the Earth. This very force will start to accelerate our apparatus in the space vacuum and top of the gyroscope will lose its mass which appears at acceleration. Thus it is quite possible to reach speed, which is close to the light one, or even to overcome the threshold of light speed.

Part III

"...what is new?"

What is implied by gravitational waves? This question has been exciting the scientists from the half of the XX century. But still nowadays, in spite of all attempts of the scientists to dissolve the problem, these waves were not discovered. There is a standard way to discover them, which is based on general relativity. Basing on this theory, scientists assume that gravitational waves should change in some way the weight of material objects. According to this assumption the scientists suspend very heavy balls to very precision scale and then try to trace changes of their weight. There were only negative results. It seems that mass changes so quickly and to such short period of time that scale fails to react upon these changes. However there is another way which seems to be very promising.

Dependence of time and gravitation is a well-known fact. Thus speed of time course depends on force of the gravitational field of an object. Stars and planets can be considered as an example. The more intense attraction near them the more slowly time passes there. In other words, the greater mass of the planet the more slowly time passes near it. It is possible that oscillations of masses, which generate gravitational waves, in some way change speed of the time course along the whole way of the propagation of gravitational waves. In other words, gravitational waves are always attended with slight time fluctuations. Time starts to pass a little faster or a little more slowly as compared with its usual course. These changes can be traced by means of usual quartz plates. Let me remind of the fact that quartz plates are used at some models of clocks to keep time. Thus, oscillations of gravitational masses produce in space both gravitational waves and time fluctuations (chronowaves), which can be easily detected. Possibly these chronowaves are the part of gravitational waves. This assumption is already a scientific fact which is unfortunately ignored by more than one generation of researchers.

Professor N.A. Kozyrev was the first who surmised about the existence of time ways (chronowaves). He called them as "time flows". The scientist worked out and run a simple experiment to confirm his hypothesis. Telescope and quartz plates were used. Quartz plates were placed in focus of the telescope, which was pointed to some bright star. Its objective lens was covered with black paper or tin plate in order to exclude the influence of light beams. At that quartz plates reacted upon the presence of chronowaves. Thus there was changed the frequency of oscillations of plates which were placed in focus of the telescope.

Besides the scientist discovered that in focus of the telescope there were changed electroconductivity and volume of some matters. It is explainable since some parameters of space as well as speed of passing of some physical processes and phenomena depend on the speed of time course. Outwardly it appears in change of electroconductivity and volume. In spite of the fact that during the experiments tin plate (thick metal cover) was used some skeptics insisting that the point is in infrared radiation which is produced by the heated cover. However they was silenced by Kozyrev's researches. Basing on the fact that we usually see stars not where they really are, but at the place they were at the moment

of emanation of light signal, the scientist calculated the location of Procyon star, which is the nearest to the Earth. Kozyrev pointed the telescope to this "clear" part of the sky zone that allowed to avoid the influence of infrared radiation and to fix the location of the star. Thus it is nothing but chronowaves generated by the star that can change oscillation frequency of quartz plates.

After Kozyrev's death this field of research is not considered by official science and the very existence of chronowaves is denied. Only some theorists warily impute the above-listed effects to the action of some torsion fields and waves the existence of which is rather questionable. However chronowaves exist and they can be used in practice, for example, to get information from any point of our galaxy in several seconds. **It is quite possible since chronowaves have no mass and thus they are propagated more quickly than light waves.** However it is still a question what will transmit this information to us because the transmitter of these waves yet has not been invented. *(Editor's: It is interesting what mass of light waves the author means. It is a pity that the author of the article did not read 9 previous issues of NET magazine! There was a detailed demonstration of the connection of Kozyrev's theory and experiments with the theory of longitudinal waves in aether. If to replace Kozyrev's notion of "waves of time density" by the notion of "waves of aether density" then we will get a real experimental approach which can help to solve the problem of antigravitation and time control.)*

Of course theoretically chronowaves can be also generated without participation of great gravitational waves (it seems that heat processes can also generate them). However no particular success was achieved in this field. Thus by means of chronowave transmitter it is possible just to "listen" to remote stars the light of which will reach the Earth in many years. This receiver is very simple and it can be made by anyone who knows a little about radio engineering. *Under home conditions it is better to use a miniature incandescent bulb (lamp with filament tungsten) as a receiver and usual ohmmeter as measuring instrument.*

If in usual receivers radio waves are excited by weak electric currents existing in antenna then chronowave antenna is constantly under tension. Chronowaves do not excite current there but change some characteristics of it, influencing on electroconductivity of the matter which was used for the antenna (let us remember Kozyrev's experiments). Later on these insignificant changes are transferred in audio signal or fixed by any other means. That is the principle of operation of the device.

Editor's: These experiments on the registration of flicker effect in more detail are described in A.M. Mishin works which were published in previous issues of our magazine. As the reader could notice, the editors' opinion in many respects does not coincide with the author's point of view. (Alexander V. Frolov)

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Time Machine

Alexander V. Frolov gave this interview to the Spain magazine "Mas Alla de la Ciencia" ("Science"). The interview concerns some questions about scientific-research work on investigation of active properties of time. Let us remind that in 2002 Faraday Lab Ltd and Vadim A. Chernobrov (Moscow) started the join Time Machine Project.

Miguel Segui: How does it value the results obtained by the prototype of time machine?
Alexander V. Frolov: Usually it is about 3% changes, i.e. 3 sec per 100 sec of experiments.

M.S.: How other devices are preparing inside the project Time Machine?
A.F.: Now we have project with special electromagnets, which are emitters of the longitudinal waves. So, other devices are electronics parts to provide impulse current. But it is not the only one version of the system. If the emitters of the longitudinal waves are based on other principles so all device has other design.

M.S.: Do you believe that some day the time trips will be possible?
A.F.: Yes, sure. We have the clear theory for it and it is based on understanding of physical sense of the aether,

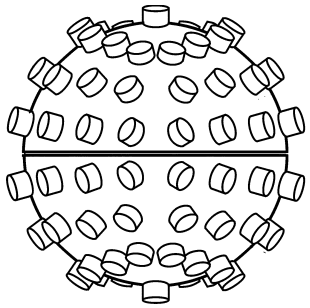

its relation with notion of time and with concept about existence of elements of matter in space-time. According to aether-vortex theory any element of matter is created from aether and its temporal parameters depend on density of aether.

M.S.: What practical applications can have the prototypes that are developing?
A.F.: Any change in the time course is the method of influence onto biological systems and the medical aspect is the main application. Also any physicist know relation between G (the gravity constant) and time course (rate of time). For example, time is slower on the surface of Earth than in space. So, local time changes (which are changes in density of aether or direction of aether wind) can be used to get propulsion force without reactive mass

flow. Also we can hope that some new materials can be produced in special area of slowed or accelerated time course.

M.S.: Which are the main difficulties of developing of these devices at the moment?
A.F.: For us now it is a part of the work that is related with designing of the powerful current electronics circuits. Also there are no known analogies for patent work, but we hope to complete our patent claim in March of 2003.

M.S.: Is it foreseen that they carry out experiments with human beings and the machine of modification of the time, just as V. Chernobrov carried out?
A.F.: We, i.e. Faraday Laboratories Ltd, are developing small unit for testing of the principles. In future we'll work with other design and with participation of the pilot (human passengers). But it will be the system of other kind. Let me explain: now we are working to get small local change of the aether density, so called "chronal charge". It is analogy with electric charge, which produces electric field in space. If the electric charge is moving then it will produce magnetic field. According to our plans after confirmation of the principles we are going to create design with moving "chronal charge" to generate "chronal field". There are suppositions that this field can be used practically for antigravitation propulsion transport.

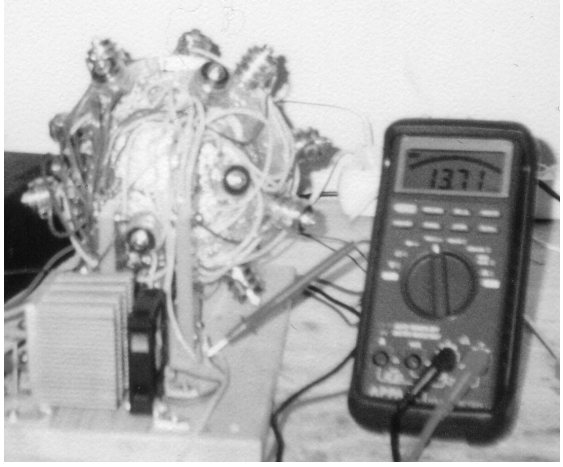

"FRCM" – Avalanchedrive
Fractioning and Replacement of a Constant Mass

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For the while, this project has only these two names, as above. There is still a lot to do upon this development that involves free energy and / or "over-unity". It is designated to be of free use and application by everybody and everywhere, without any royalties just like it was a very old idea, which is now opened for entire community use. The inventor has enough strong reasons for this will.

This is a kind of donation, a personal donation, for the very best future of the Earth. Pioneers are needed (late pioneers?) Any person may be involved in this development to make money since there are no barriers for that. This means that this is an open idea and in this way it must stay. The principles are new and original and the energy involved is quite huge. In the inventor's mind there is realized the possibility to create an expert hands-on group to finish the project. In this article there is a rough draw which seems to be enigmatic but in fact it can clear the understanding of the principle and show the situation at which body may offer controlled spatial variation of length for the same weight.

The short text and a schematic draw (see Fig.1) are the way to show the principles and a few possible construction solutions. The photo shows a part of the device which can clear the so called weight localized rarefaction. Possibly the understanding of capacity for an observer will be a little forced. If necessary author can send the full patent requirement text, which contains 54 pages and 32 figures, not in English but in Portuguese.

FRCM – "AVALANCHEDRIVE"

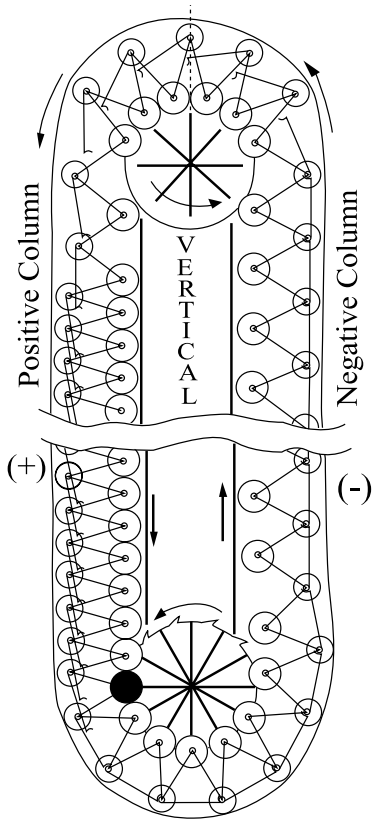

Fig. 1

Understanding of **FRCM / avalanchedrive** is a challenge in itself. When you start to learn about FRCM you will find complete original problems to deal. **Free your mind basing on some mechanical and physics knowledge and then avalanchedrive will come to make a part of your life. Feel free to work.**

PATENT REQUIREMENT RELEASE

This patent requirement is basically the application of a new physical principle which could be defined and found at least 400 years ago, so simple it is. Surely it is one of such things which was let behind by human mind and concern. FRCM is odd and amazing. The key for this project is a special body that can behave like a solid and like a fluid, at the same time, with combined characteristics just as designed and required.

The mass potential of a specially designed segmented body is hold and managed, and throughout proper means is sequentially fractured while suspension balance is kept. This causes, after start, a constant and cyclic movement, since arrangement goes, and the conducting and forcing form of the mass is not interrupted.

Also called "avalanchedrive", this principle work is based on just three main parts or components: 1st is the special segmented body – a chain; 2nd is the stationary and external assembling to hold and conduce the chain; 3rd is the straight vertical, in order to achieve the maximal weight storage position in the arrangement.

The chain is an endless repetitive zigzag construction with weights and defined angles that looks like an entire and elongated ellipse. Its design makes easy the change of its profile and form (mutant profile) that will be contracted or elongated, according to the way it is organized, supported and driven. When contracted or expanded, the chain assumes its maximal or minimal weight, in comparatively the same heights and level, but at different cross sections (tunneling?).

For distribution of the chain track the external assembling forms a kind of duct or rail, which is also elliptical. It allows to the chain to be contracted and expanded, to change direction, move, and pass away, as desired. The chain follows the way that the rail allows, in four different zones: mass-united zone, or positive column, or weight capacitor; the lower reversion input zone; the liberation zone, or negative column, with same height of the positive one; and the upper reversion zone, and its "zero point", or non-resistance top.

Both reversion zones are composed mainly of wheels. However, while the lower zone has to hang, open and bolt the chain, in order to change its profile and natural falling-down trajectory, the upper has a very passive function, that is just to let the chain cross over, and avoid any turn back possibility.

Fact is that in all circuit the chain follows with passivity the "voids" of trails, but assumes a very strong positive and pressure action in mass-united zone, especially in the button, where to the wheel there is applied all the active potential weight of the device, formed by the entire stack of the full contracted state, forcing movement.

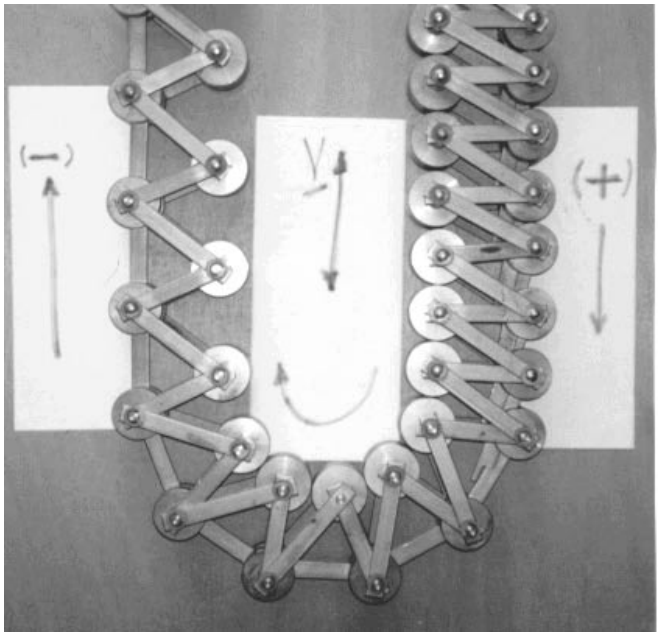

Photo of FRCM (Avalanchedrive)

It is easy to understand how and why FRCM works. Weight of the positive column is directly connected – as a compressed spring – against the relatively lighter negative column, through lower reversion wheel, where happens a kind of flux (the "solid flux") of the chain, that never can find a state of rest. Cycles of "breaking" of the chain can beconsidered as the instant of touch of each corner of the chain to the lower step wheel. To complete the circuitry, the chain excess, which is much lighter, passes over the upper wheel and turns back to the positive column top. It is impossible to turn the full subtracted potential to its source but mechanically the easier job to be done in FRCM.

FRCM manages and converts mass in energy...

The chain flows from the positive column, naturally finds changed profile and reverses to opposite way, and then it is pushed up to the negative column and to top. Finally it is collected, friendly, to restore the potential, at non-stop run! The only alternative to the chain is to move and move, and apply the positive surplus of weight to wrench under axle of the wheel.

This FRCM principle allows develop the equipment which is going to be able to take energy, work and force from gravity potential, so as it happens from wind and water at electrical generator machines, today. The potential is kept in such critical situation, that the only way for it is to escape and move. Besides in consequence of the suspending mass state the linear constant repetition of event will suffer. Water and other fluids do not offer "mutant profile" with fixed value of pressure, just as solid materials. There are many arguments for this view.

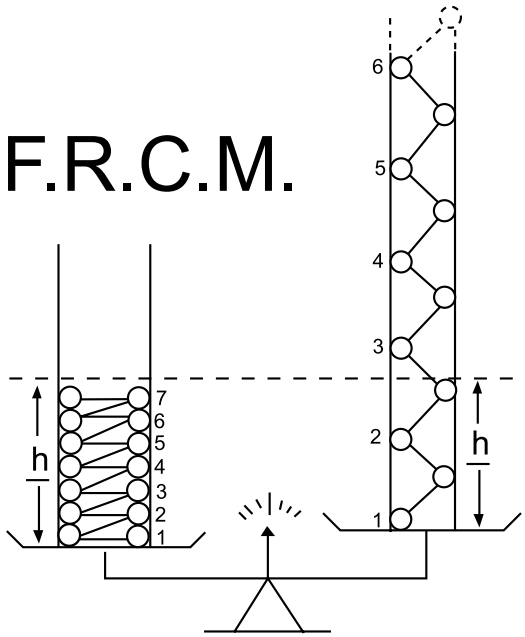

Fig. 2
Segment of a chain

Considering all mechanical losses, a part of the mass will be very active and applied in eccentric, or radial position to the wheel, even with the risk to cause too high speed. FRCM manages and converts mass in energy.

See a non-scale schematic draw (Fig. 2) and photo of a chain segment to compare densities between columns at right and at left.

A theoretical case can be calculated: at total chain weight - 100, general losses - 20, total negative resistance - 30, active or positive surplus is 50 – 30 = 20. This surplus that may be of 2kg, 200kg or 2,000kg, depending on scale, will force and free edge of the wheel, while the total weight keeps confined in the device. In the above case the difference of balance is 1.66. This means that the flowing velocity of the negative pile is 1.66 times higher than the falling of opposite positive pile. Just like a "solid venture", this change and relation is fixed, and in other cases may be varied or calculated to 3, 4 or even more! In all cases the speed must be hold that is not very easy job while one faces gravity acceleration.

The author of FRCM conceptions feels like these ideas have been around for many centuries, and that they are now discovered just like old draws. And this can be the bigger and the best moment to release this. Many thousands of different designs and solutions are coming in the future at looking for the better performance, costs and durability. Author thinks it to be strange that previous guesses could not reach this macro-physical concept. To build FRCM circuits, even re-applied or used old pieces, for example from ships and trains, will be useful.

This is only a start to a "new-old" development and clue to the sources of the modern mechanical engineering. Certainly some oppositions should be overcome. It is expected that other names are also going to be created and proposed to FRCM, but "avalanchedrive" seems to be a good one.

Author expects to get the invention and concept credits but not royalties and would also be glad to keep working on this concern. So, this message is a kind of invitation...

Editor: Unfortunately we have no photo or video documents of the operative device. We wait for readers' comments on this invention.

Complete text of the patent is avaible in Pourtuguese only.

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Hydrogen-Powered Vehicles at Least a Decade Away

Peter Behr
Greg Schneider

Washington Post
http://www.washingtonpost.com/wp-dyn/articles A635122003Jan29.html
Thursday, January 30, 2003; Page A09

This information is forwarded as a courtesy from:
http://www.integrityresearchinstitute.org

President Bush's vision of a hydrogen-powered, non-polluting "Freedom" car for the next generation of American motorists pulled out silently from a Newport Beach, Calif., garage with Gregg Kelly at the wheel, bound for his office 10 miles away.

Kelly, president of a California robotics company, happens to drive a Toyota prototype of a hydrogen-fueled car, one of a handful in the United States today.

It will take at least a decade before a host of technological, economic and political barriers are overcome, permitting a fleet of these revolutionary vehicles to appear on U.S. highways, industry experts said. But by including the goal of hydrogen fuels in his State of the Union message Tuesday, Bush has opened the door to a fledgling movement that has already attracted a surprising coalition of supporters.

Environmentalists, automakers, oil companies and coal producers, engineering labs and strategists have seized on hydrogen as an almost too-good-to-be-true power source. It is abundant in water and air, it burns cleanly and it could free the nation from its dependence on Middle Eastern oil.

"For President Bush to frame the goal as he did is significant," said Jeremy Rifkin, consultant and author of a book advocating a transition from oil and gas to hydrogen. "How much is made of this, time will tell."

The president said he hoped that Americans born today would learn to drive in hydrogen-powered cars, a schedule that auto experts said could technically be met. But whether these vehicles will be commercially available depends on a huge array of variables.

First, the technology is still incomplete and unaffordably expensive. The specially equipped Toyota Highlander that Kelly drives has no price tag. The Japanese manufacturer, after investing millions of dollars in research, lent the vehicle to a University of California research project that Kelly's company supports. "My checkbook isn't fat enough," Kelly said.

The car is powered by electricity generated in a fuel cell by chemically combining hydrogen and oxygen. The engine spits out water drops instead of the carbon dioxide and other pollutants generated by burning gasoline.

With foreign manufacturers committed to press ahead, Detroit's carmakers have had to accelerate their research programs. In June, Ford Motor Co. will unveil a prototype car that uses hydrogen to power an internal combustion engine – part of a "bridging strategy" to help ease hydrogen into the marketplace until fuel cells are fully developed.

General Motors Corp. has developed a fuel cell-powered, car-sized "skateboard" – four wheels attached to a platform less than a foot thick, to which any kind of car body could be buckled.

Rather than use fuel cells, BMW has refitted 10 of its $70,000 Model 745 sedans with hybrid engines that burn either gasoline or liquid hydrogen directly. It could be mass producing them by the end of the decade at a "reasonable" cost for its customers if there were enough hydrogen fueling stations to power them, said spokesman Gordon Keil. "We're trying to get [fuel suppliers] interested in hydrogen. We've not met with a lot of enthusiasm."

As daunting as the engineering challenge is the need for a national hydrogen fuel infrastructure – factories to produce the fuel, pipelines and trucks to distribute it and stations to store and sell it. Environmentalists dream of a totally "green" strategy in which solar or wind power is used to separate hydrogen from water – an approach whose costs now would be prohibitive. A nearer prospect is producing hydrogen from natural gas or coal, however in either case, the carbon dioxide byproduct would have to be injected underground to avoid a huge increase in greenhouse-gas emissions, experts say.

Rifkin argues that an eventual scarcity of oil and gas, decades ahead, will push prices of these fuels up to a point where hydrogen becomes cost-competitive. "It isn't a problem that will yield to technology alone," agreed David M. Nemtzow, president of the Alliance to Save Energy.

While all the major automakers are developing fuel-cell technology, most are cautious about hyping it. "We don't want to get too exuberant about it in that sense, overselling it," said Greg Dana, vice president for environmental affairs at the Alliance of Automobile Manufacturers.

Fresh in some minds is the experience of the Clinton administration, which launched a high-profile, $1.5 billion research venture with the

Detroit automakers a decade ago to produce an 80 miles-per-gallon family car. No cars emerged, and the Bush administration halted the venture in favor of its hydrogen strategy.

Some of the president's political opponents contend the hydrogen option is a way of deflecting criticism over administration policies favoring energy production over conservation. "The president seems content with the auto industry's approach: 'Don't make us do anything today'," said the Sierra Club's Daniel Becker. Others say it does not go nearly far enough. Sen. Byron L. Dorgan (D-N.D), chairman of the Democratic Policy Committee, said recently, "It's moving in the right direction. But his proposal is rather timid. I think we need a bolder plan."

Bush's spending plan for the hydrogen project, $1.5 billion over five years, represents a $500 million increase over his current budget. The administration proposes to earmark $273 million for the 2004 fiscal year, but did not offer many specifics yesterday. The funding would support research on fuel cells, vehicle technology and distribution issues.

The magnitude of the goal demands an effort on the scale of the Apollo Moon project, Dorgan said yesterday. "You have to set benchmarks for five, 10 years out."

UNUSUAL PERMANENT MAGNET MOTORS

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Abstract

Permanent magnet motors that try to achieve unusual overunity efficiencies with changes in wiring geometry, electronic switching schemes and magnetic configurations often are not successful. There are some designs that should be regarded as conventional and others as promising. Hopefully this article will help the reader to tell the difference before investing or accepting investment. Note: patents can be viewed for free at www.uspto.gov and also http://gb.espacenet.com/espacenet.

Introduction

An article about permanent magnet (PM) motors would not be complete without first reviewing the basic configurations that are present on the market today. Commercial PM motors are necessarily DC motors since their magnets are permanently polarized before assembly. Many PM motors which use brushes are switching to brushless motors that promise less friction and wear. Brushless motors include electronic commutation or step motors. A step motor, often used in the automotive industry, offers more continuous duty torque per unit of volume than any other electric motor but it is often a lower speed motor. The electronic commutation design is applicable to the switched reluctance (SR) motor. The SR motor substitutes soft iron in the place of higher cost permanent magnets for the outer stator and instead has an inner PM rotor.

Brushless motors in general produce torque from current in the armature by the application of Faraday's Law. The ideal PM motor has a linear torque vs. speed curve. There are both outer rotor and inner rotor designs that are standard in PM motors.

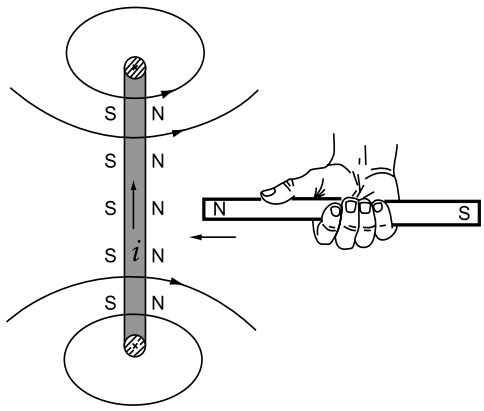

Fig.1

Lenz's Law
Induced B-field opposes motion.

To point out the focus of many of the problems with analyzing motors, the *Motion Control Handbook* (Designfax, May, 1989, p. 33) says that there is a "very important relationship between torque and back emf that is sometimes not understood." This relates to the electromotive force (emf) that is produced by the application of a changing magnetic field (dB/dt). In engineering terms, the "torque constant" (N-m/amp) equals the "back emf constant" (V/radian/sec). In physics, the motor terminal voltage

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Abstract

Permanent magnet motors that try to achieve unusual overunity efficiencies with changes in wiring geometry, electronic switching schemes and magnetic configurations often are not successful. There are some designs that should be regarded as conventional and others as promising. Hopefully this article will help the reader to tell the difference before investing or accepting investment. Note: patents can be viewed for free at www.uspto.gov and also http://gb.espacenet.com/espacenet.

Introduction

An article about permanent magnet (PM) motors would not be complete without first reviewing the basic configurations that are present on the market today. Commercial PM motors are necessarily DC motors since their magnets are permanently polarized before assembly. Many PM motors which use brushes are switching to brushless motors that promise less friction and wear. Brushless motors include electronic commutation or step motors. A step motor, often used in the automotive industry, offers more continuous duty torque per unit of volume than any other electric motor but it is often a lower speed motor. The electronic commutation design is applicable to the switched reluctance (SR) motor. The SR motor substitutes soft iron in the place of higher cost permanent magnets for the outer stator and instead has an inner PM rotor.

Brushless motors in general produce torque from current in the armature by the application of Faraday's Law. The ideal PM motor has a linear torque vs. speed curve. There are both outer rotor and inner rotor designs that are standard in PM motors.

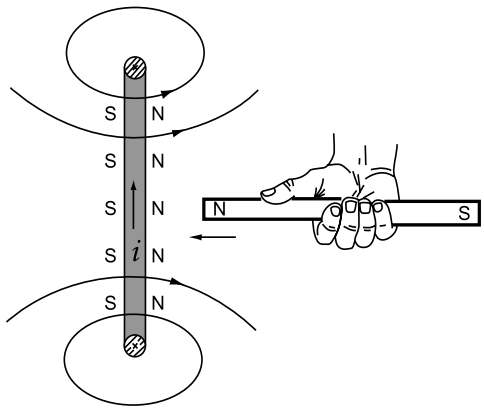

Fig.1

Lenz's Law
Induced B-field opposes motion.

To point out the focus of many of the problems with analyzing motors, the *Motion Control Handbook* (Designfax, May, 1989, p. 33) says that there is a "very important relationship between torque and back emf that is sometimes not understood." This relates to the electromotive force (emf) that is produced by the application of a changing magnetic field (dB/dt). In engineering terms, the "torque constant" (N-m/amp) equals the "back emf constant" (V/radian/sec). In physics, the motor terminal voltage

is equal to the back emf minus the IR drop due to internal resistance. (Example: V = 8.3 v, back emf = 7.5 v, IR drop = 0.8 v.) This physics principle, also referred to as **Lenz's Law**, was discovered by Friedrich Lenz in 1834, three years after Faraday invented the homopolar generator. The oppositional nature of Lenz's Law, and its back emf, is built into a physical law called **Faraday's Law**, which is at the root of motor drive. The back emf is the reaction of the changing current in the coil. In other words, the changing magnetic field naturally creates a back emf because they are equivalent.

Therefore, it is recommended that Faraday's Law be carefully reviewed first before proceeding. An article such as "Faraday's Law—Quantitative Experiments" (*Amer. Jour. Phys.*, V. 54, N. 5, May, 1986, p.422) will help convince the valiant new energy experimenter that the change in flux which causes a back electromotive force (emf) is INHERENTLY equal to the back emf. It cannot be avoided or circumvented for excess energy benefit, unless the amount of magnetic flux change per time is also altered. They are two sides of the same coin. The energy into an inductive coil style of motor will naturally equal the energy out. Also referred to as "electrical induction," the changing flux "induces" a back emf.

Switched Reluctance & Field Switching Motors

To explore an alternative method for inducing motion, the "Permanent Magnet Motion Conversion Device" by Ecklin, patent #3,879,622, uses rotatable shutters for alternately shielding the poles of a horseshoe magnet. Repeated again in the Ecklin #4,567,407 "Biased Unitized Motor Alternator with Stationary Armature and Field," the idea of switching the magnetic field with a "flux switch" is common to these types of motors. To illustrate the underlying principle, Ecklin states, "The rotors of most of today's generators are repelled as they approach a stator and are attracted back by the stator as soon as the rotor passes the stator in accordance with Lenz's law. Thus, most rotors face constant nonconservative work forces and therefore, present generators require constant input torque." However, "the steel rotor of the unitized flux switch alternator actually aids the input torque for half of each rotation as the rotor is always attracted and never repelled. This construction makes it possible for some of the current or power fed to the motor windings to magnetically feed through a solid magnetic path to the AC output windings ..." Unfortunately, Ecklin still to this day has not achieved a self-running machine.

Also related is the Richardson patent #4,077,001 which discloses a low-reluctance keeper physically moving in and out of engagement with the ends of a magnet (p.8, line 35). Lastly, the Monroe patent #3,670,189 uses a related principle but accomplishes gating with the passing of rotor poles between permanent magnet stator poles. Monroe's claim 1, seems by its length and detail, to have almost guaranteed its patentability but of course its utility remains questionable.

It seems unlikely that as a closed system the Field Switching Motor can become self-running. In many examples, a small electromagnet will be necessary to help push the keeper into a synchronized rhythm. The Magnetic Wankel from Popular Science (June, 1979) can be compared in a basic manner to this type of invention. Also, the Jaffe patent #3,567,979 can also be compared (see abstract). The Minato patent #5,594,289 is also of a similar type as the Magnetic Wankel and quite intriguing to many people.

It has been found with inventions such as the Newman motor (U.S. Patent Application Serial No. 06/179,474), a nonlinear effect such as an impulse voltage is advantageous for overcoming the Lorentz force conservation effect of Lenz's Law. Also similar is the mechanical analog of the Thornson inertial propulsion device which uses nonlinear impact to transfer momentum along an axis perpendicular to the plane of rotation. A magnetic field contains angular momentum which only becomes apparent under certain circumstances such as Feynman's Disk Paradox, where it is still conserved. The impulse technique may possibly be used to advantage in this Field Switching Motor if the field switching can be done fast enough, with a rapid rise time, but more research is needed.

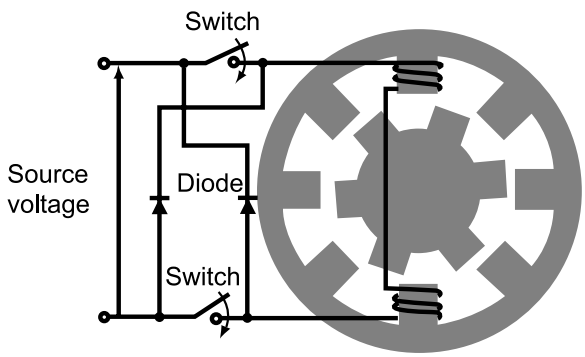

Fig. 2
Switched Reluctance Motor (*IEEE Spectrum* 1/97)

The best Switched Reluctance Motor that also has full accommutation is the Dr. Harold Aspden patent #4,975,608 which optimizes the performance of the coil input and operating above the knee of the B-H curve. Switched reluctance motors are also explained and praised in *IEEE Spectrum* (1/97).

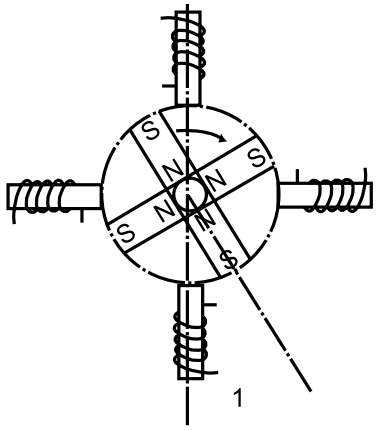

Fig. 3

Adams Motor

The Adams motor has attracted many followers including an endorsement from *Nexus* magazine as the best free energy motor they have seen. The performance of the machine, however, can be fully explained by Faraday's Law. The pulsing of adjacent coils which moves a magnetized rotor is actually following the same configuration as a standard switched reluctance motor. The delay that Adams speaks of in an Internet posting of his motor can be understood from the exponential voltage (L di/dt) of the back emf. The latest addition to this category, which gives credit to the Adams motor, comes from down under with PCT WO 00/28656 awarded to Brits and Christie in May, 2000. The simplicity of this motor is immediately obvious with the switchable coils and permanent magnet on the rotor. The patent also makes it clear that the "input DC current as supplied to the stator coil produces the magnetic repulsion force and is the only outside input to the overall system for total movement...." It is a well-known fact that all motors work on this principle. The key to their design is on p.21 of their patent where the inventors want to "maximize the influence of back EMF which tends to maintain rotation of the rotor/armature in a single direction." All of the motors in this field-switching category try to achieve this effect. Figure 4A of Brits and Christie disclose the voltage sources "VA, VB, and VC." Then, on page 10 it is stated, "At this time current is applied from the power source VA and continues to be applied until the brush 18 is no longer in contact with one of the contacts 14 to 17." There is nothing unusual about this design compared with the more sophisticated attempts listed previously in this section. All of these motors require an electrical power source and none of them are self-running.

When pulsing a coil with the passing of a permanent magnet, a suggestion that would help prove the claim for free energy is not to use battery power for the coil current. Instead, the amazing Weigand wires are recommended (*Pop. Sci.*, May, 1979) that exhibit a huge Barkhausen jump of magnetic domain alignment and a very well-defined pulse shape. Having a coil wrapped around a Weigand wire produces a substantial pulse of several volts with a changing external magnetic field passing a certain threshold. No electrical input power is required for this pulse generator.

Toroidal Motor

As compared to motors on the market today, the unusual design of the toroidal motor is similar to the Langley patent #4,547,713 with a two-pole armature in the center of the toroid. If a single-pole design is chosen, with for example North poles at each end of the armature, this would resemble the radial magnetic field for the armature which the VanGeel patent #5,600,189 uses. The Brown patent #4,438,362 assigned to the Rotron company, utilizes varying magnetization segments for a rotor in a toroidal air gap. The best example of a carousel toroidal motor is the Ewing patent #5,625,241, which also resembles the Langley patent mentioned above. Based upon magnetic repulsion, the Ewing invention uses a microprocessor-controlled carousel, basically to try and take advantage of Lenz's law and get a jump ahead of the back emf. The Ewing invention may be seen in operation, with co-inventor David Porter, in the commercial video, "Free Energy: The Race to Zero Point." Whether it may be more highly efficient than other motors on the market remains an open question. As the patent states, "it is also possible to operate the device as a motor using a pulsed direct-current power source" (col. 7, par. 30). It also contains a programmable logic controller and power control circuit which the inventors thought would send it over the top of 100% efficiency.

Unless a prototype proves to be successful in achieving a torque or force conversion linkage, the internally propelled magnet may be left without a practical application. Commercialization of these types of motors may not be favorable, since many competing designs are currently available on the market, with high flux linkage.

Linear Motors

The area of linear induction motors is well known in the literature. Schaum's Outline Series, *Theory and Problems of Electric Machines and Electromechanics* (McGraw Hill, 1981), explains that these are the same as cutting the rotor and stator of a standard induction motor and laying them out flat. The late Dr. Laithwaite, author of

Motion Without Wheels, was famous for monorail designs for trains in England based on linear induction motors.

The Hartman patent #4,215,330 is an example of one that achieves a linear motor transportation of a steel ball up a magnetized incline of approximately 10 degrees. Another invention in this category is the Johnson patent #5,402,021, which uses permanent arc magnets on a four-wheel cart, exposed to a parallel track of alternating permanent magnets which are in a fixed position. An even more amazing permanent magnet patent is the Johnson #4,877,983 which an eye witness has seen operating at the Johnson home in a closed loop for hours. It is reasonable to assume that a pickup coil could be positioned nearby so that each trip would result in a pulse of electricity to charge a battery. The Hartman patent could also be arranged in such a circular track so that perpetual motion of the first kind can finally be demonstrated.

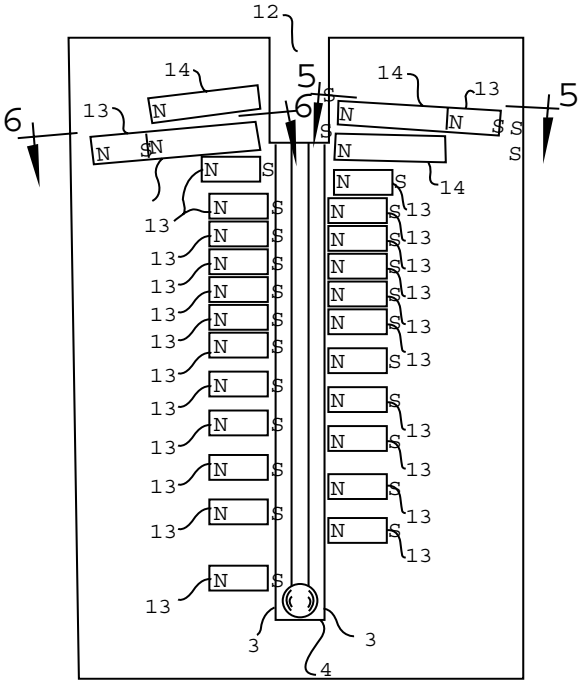

Fig. 4

Hartman patent #4,215,330

The Hartman patent is based upon the same principle as the famous electron spin experiment in physics called the Stern-Gerlach experiment. With an inhomogeneous magnetic field (one that is non-uniform) the force on an object with a magnetic moment is the gradient of the potential energy. Every physics textbook points out that this type of field, that is strong at one end and weak at the other end, will result in a unidirectional force on the magnetic object equal to dB/dx. That is exactly what the Hartman patent possesses (note spacing of magnets). Therefore, the resulting force propelling the ball up a ten degree incline, in the x direction, is in keeping with the laws of physics.

With state-of-the-art magnets, including ambient temperature superconducting magnets which are now finishing the development stage, a demonstration of impressive cargo weight will be shown to be transportable without maintenance electricity costs. Superconducting magnets have the unusual property of retaining the initial magnetized field for years, without the need for periodic energization to restore the initial field strength. Examples of the state of development of the superconducting magnet market can be found in the Ohnishi patent #5,350,958 (lack of cryogenics and lighting system output) as well as the reprinted article from *IEEE Spectrum*, July, 1997 on magnetic levitation.

Static Electromagnetic Angular Momentum

In a provocative experiment with a cylindrical capacitor, Graham and Lahoz (*Nature*, V.285, No.15, May, 1980) have expanded upon the proof published by Einstein and Laub in 1908 that the Lorentz force needs an additional term to preserve action and reaction. The article they cite has been translated and published in my book, *The Homopolar Handbook* (described below). Graham and Lahoz emphasize that there is a "real angular momentum density to r x (E x H)/c^2" and suggest how to see this energy effect in permanent magnets and electrets.

This is encouraging work, with an impressive source of Einstein and also Minkowski for its information. It is possible that it may have a direct application for the homopolar generator as well as the magnetic energy converter mentioned below since both have an axial magnetic field and a radial electric field like the cylindrical capacitor experiment of Graham and Lahoz.

Homopolar Motor

My book, *The Homopolar Handbook* (HH), covers experimental tests and history of the Faraday discovery, including Tesla's contribution to it. Recently however, there have been new developments into a multi-rotor design of a homopolar generator, similar to the invention of John R. R. Searl.

Recurring interest in the Searl device, as pictured on the cover of *Antigravity*, the biography of Searl by John Thomas, should also center on the

homopolar generator (HG). Preliminary analysis reveals that there are actually two separate HG phenomena occurring simultaneously, one which can be called the "revolution" effect (#1) and the second that could be called the "rolling" effect (#2). The first effect can be visualized as magnetized segments of an imaginary solid ring revolving around a common center. As suggested by drawings in HH, p.141-2, there are precedent designs that allow for segmenting an HG rotor.

With this model in mind, the #1 effect can be calculated, for 1 Tesla strength magnets, magnetized axially, adjacent to a single ring 1 meter in diameter, to produce more than 2 volts emf across each roller, (E-field directed radially from outer diameter of rollers to outer diameter of the adjacent ring) with say, 500 RPM. Note that this #1 effect is independent of any rolling of the magnet. The magnetic field in an HPG is tied to space and not to the magnet so rolling will not affect this large scale homopolar generator's Lorentz force effect (HH, p.10).

The #2 effect, located within each roller magnet, is the one noted in *Electric Spacecraft Journal*, Issue 12, 1994, (HH, p.160) where each roller, is a small homopolar generator. This effect is found to be somewhat weaker as it generates electricity from the center of each roller to its periphery. This design is like Tesla's HG (HH, p.81) where a rolling belt is contacting the outer edge of a circular magnet. With rollers in the vicinity of a tenth of a meter in diameter rolling, without slipping, around a 1 meter ring, approximately a half of a volt will be generated. The Searl design of ring magnetic material will normally strengthen the roller's B field.

It is important to realize at this point that the principle of superposition applies to these two effects. The #1 effect is a uniform E field across the diameter of the roller. The #2 effect is a radial effect as stated above (see HH, p.6-8). However, only the emf in the section of a roller between the two contacts, say at the center of the roller and its edge which contacts the ring, will actually cause current flow in any external circuit. This realization means that the effective voltage from the #1 effect will be half of the available emf, or a little more than 1 volt, which is still about double of the #2 effect. Upon applying superposition in the limited region indicated, we also find that the two effects oppose each other and the two emfs must be subtracted. The result of this analysis is that approximately one half of a volt of regulated emf will be present to generate electricity from a single set of rollers and one ring about 1 meter in diameter. As current is drawn, a Ball Bearing Motor effect will also take place (HH, p.54) that actually pushes the rollers along, assuming the roller magnets have a reasonable conductivity *(Thanks to Dr. Paul La Violette for this reminder)*.

In a related work, (*Tech. Phys. Lett.*, V. 26, #12, 2000, p.1105-07), Roshchin and Godin have published experimental results of their one-ring device, called a "Magnetic Energy Converter," with rolling magnets on bearings. It was designed as an improvement to the Searl device. Though my above analysis does not depend upon the ring being made of magnetic material, Roshchin and Godin did so. Their findings are encouraging and detailed enough for researchers to find renewed interest in this type of magnetic motor.

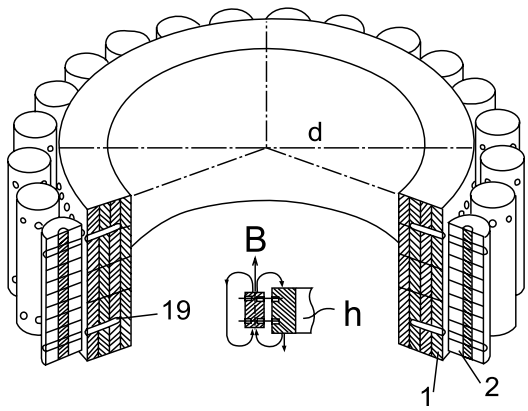

Fig.5

Magnetic Energy Converter in the experiment by Roshchin and Godin (Russia)

Conclusion

So far, a couple of permanent magnet motors may have achieved perpetual motion, which exceeds 100% efficiency. Of course, conservation of energy concepts have to be considered and the source of the alleged extra energy examined. If permanent magnet field gradients do offer a unidirectional force, as the textbooks predict, then it is about time for its conversion toward useful work. The roller magnet geometry, now called a "magnetic energy converter" is also a unique style of magnetic motor. Exemplified in the Russian patent #2155435 by Roshchin and Godin, it is a magnetic motor-generator that shows potential for excess energy output. Since it relies upon the circulating cylindrical magnet rolling around a ring, the design is actually a generator rather than a motor. However, as they utilize the torque produced by the self-sustained motion of the magnets to run a separate electrical generator, it is working as a motor.

Reprint from Proceedings of Institute for New Energy Conference, 2001

Hydrogen Energetics

Review by Alla Pashova

A Russian writer Ludmila Ulitskaya, who is rather far from energy problems, says: "I'm quite sure that cheap electric energy sources have been already worked out and are hidden in oil king's safes. However such projects won't be taken out of the safes until the last oil drop is combusted. They don't want redistribution of money, world, power, and soon". Experts are sure to agree with the writer.

Now only ideas which can coexist together with the traditional oil power engineering and with a system of world oil distribution can escape the safes. Some expensive scientific toys promising future universal welfare are created to reassure ecologists, viz automobiles equipped with hydrogen engine. According to estimation of Japan representatives of motor car industry, installation of the hydrogen engine into such a car as a classical Sedan now comes to about $700 000. Approximate cost of a hydrogen bus named Kitaro achieves the astronomic amount of $1.25 million.

The hydrogen engine consists of several fuel elements, which are known as fuel cells. Hydrogen under pressure of 1.5-2.7 atmospheres comes to an anode. A cavernous catalyst splits the molecules into electrons and protons. The electrons set the electric engine in motion, and the protons come through a membrane acting to a cathode as an electrolyte. Here the catalyst combines them with the working electrons and with atmosphere oxygen into water molecules. It should be noted that the Europeans and the Americans are extremely charmed by this water streamlet which is exhausted instead of poisoning gases. Moreover, output of the fuel cell is 3-5 times more than output of the petrol engine.

The first hydrogen power station inaugurated in Las Vegas, Nevada, in 2002, (see Fig.1, 2) represents a system of the fuel cells with the proton penetrable membrane as an electrolyte (they are designed and produced by experts of Plug Power Inc.). The station produces hydrogen transforming and cleaning natural gas and generates electric power combining hydrogen stored in reservoirs with atmosphere oxygen. The USA Energy Department and Air Products Inc. together paid $ 10.8 million for this project.

It is necessary to note that the priority branch of the hydrogen engineering is providing new means of transport with fuel, and electric power production is just the second aim. The mentioned station produces electric power in addition to its main function. Nevertheless, if fuel market begins to decrease then the electric power payments will provide the "hydrogen magnates" with stable profit.

Fig. 1
Hydrogen power station

Nowadays the hydrogen automobiles allow oil kings keep the system of centralized fuel distribution and the infrastructure of service stations which will provide the means of transport with methanol, natural gas with hydrogen blend, and liquefied or gaseous hydrogen. Thus interested companies control the hydrogen engineering and scientific thought.

Moreover, oil can be applied as it is useful for board reforming (conversion), i.e. it can be used as a hydrogen source. The systems based on conversion have been known for a long time but there was need to work at them.

Russian experts improved the conversion system by replacement of the catalyst by plasma. Thus the conversion occurs in gas discharge of HVF appearing in the blend which needs to be converted. According to experts' opinion the Russian system is portable and has high output. In 2001 a group of experts of Russian Centre of Automobile Engine represented experimental prototype basing on Chevrolet Pickup S 10.

The ideal of modern hydrogen engineering is the following: "There should be minimal changes in the system of fuel distribution, non-polluted air, and thin streamlet of distil exhausted". However, evidently, the exhausted water is an ideal source for hydrogen fuel reproduction by means of high effective electrolyzing. If the closed system is worked out we would obtain an energy source powered by continuous chain of electrolyzing and recombination whose efficiency would be more than 100 %.

What are the known ways of hydrogen production? The greatest amount of the gas is produced on the base of catalytic conversion of hydrocarbon with water vapor. Temperature of the process depends on the catalyst composition. It is known that temperature of propane reaction can be decreased to 370° using bauxite as a catalyst. Approximately 95% of by-product carbon monoxide is further used in the reaction with water vapor.

A significant part of the total hydrogen production is given by a method of water gas. The essence of the method lies in reaction of water vapor with coke that is followed by the producing of carbon monoxide with hydrogen mix. The reaction is endothermal, it occurs at 1000°C. The heated coke is processed by the vapor; extracted purified mix of gases contains some hydrogen, some carbon dioxide, and great share of carbon monoxide. Further vapor processing of the carbon monoxide at 370°C increases the hydrogen extraction. The amount of carbon dioxide increases as well however it is easy to be removed by passing the gases mix through a scrubber sprayed by a water contraflow.

Fig. 2

There is a well-known iron-vapor method according to which vapor is passed above iron at 500-1000°C. Hydrogen obtained by this method is usually applied to hydrogenise fats and oils. Composition of the iron oxide depends on the process temperature. Iron-3 oxide (Fe_3O_4) prevails at the temperature below 560° C. If the vapor is passed above the iron at the temperature above 560° C then iron-2 oxide (*FeO*) share increases. A slight admixture of carbon monoxide is removed when the heated mix passes above a catalyst. At this time the carbon monoxide is transformed into methane.

In the processes of oxidation and thermal cracking of hydrocarbons at soot production hydrogen is produced as a by-product.

The next effective method is methanol-vapor one. It is an endothermal reaction which is proceeds in common iron reactors at 260° C temperature and at 20 atmospheres pressure.

There should be also mentioned a catalytic reaction of ammonia decomposition at which nitrogen and hydrogen is produced. The reaction can be profitable if it is necessary to produce great amount of hydrogen. The method is useful if the obtained hydrogen is directly applied.

Electrolysis is the oldest method to produce hydrogen. Direct current comes to electrodes, the cathode collects hydrogen, and the anode accumulates oxygen. The technology makes hydrogen to be too expensive energy carrier. There is often used a technology of hot processing of water vapor at 700-900° C accompanied with light petrol and heavy liquid fuel which bleeds oxygen. This method is quite expensive as well.

As it is known, **wasteful power consumption of classical electrolysis** is caused by the fact that it is used to overcome forces of hydrate bound of ions with water molecules and to compensate endothermal effect of water decomposition. Therefore, ions reduction at corresponding electrodes requires more current intensity than in the case of absence of this physical phenomena. Hence production of 1 cubic meter of hydrogen requires 18-21.6 MJ, and total power consumption exceeds 50 MJ (taking into account the electric power production). Therefore hydrogen becomes too expensive.

In 1888 D.A. Lachinov patented a method of non-contact electrolysis. Improvement of this method promises huge amount of cheap hydrogen and appearance of high effective energy source operating as a closed cycle. The main problem of Lachinov's method is a gas layer covering the electrode in some time and impeding the reaction. It was proposed by I. A. Goryachev to prevent the gas layer using pulsating electric field. A.V. Frolov has proposed to increase electrolysis efficiency by means of rotation. Centrifugal force causes more swift detach of gas blebs from electrodes surfaces. Power consumption to overcome frictional force in the construction and to generate potential electric field is insignificant as compared with output. Hence efficiency of the system may exceed 100%.

There is also described the experimental device for production of hydrogen and oxygen from water where modulated voltage (not dc voltage) is applied to the electrodes. Modulation frequency is in connection with proper oscillation frequency of water molecules as well as with spatial structure. Possible efficiency of water electrolysis in spark discharge which removes oxygen admixture should be investigated . Water electrolysis at the radiation

by electromagnetic waves of light range needs to be investigated as well.

Ikar Research Centre informs that plasma electrolysis can be the most probable source of cheap hydrogen. In 1987 a group of Russian scientists patented the first plasma-electrolytic reactor. Since the reactor had been worked out at a defense establishment then the patent was restricted and not covered by press. The patent contains a structural scheme of the reactor and some results of cleaning and disinfection of water by plasma. The patent does not represent any information of additional energy generated by plasma or hydrogen production.

In April of 1989 American scientists Pons and Fleishman published their experimental results on additional energy production at common water electrolysis. They claimed cold fusion to be source of this energy. However there is no reliable proof for this phenomenon.

In 1996 Yu. Beklyamishev, one of the co-authors of the first plasma-electrolytic reactor, published his experimental results. They demonstrated that there was additional energy in the plasma-electrolytic process. However he did not explain the energy source.

In 1998 there were published new experimental issues of appearance of additional energy in the plasma-electrolytic process. A group of Russian scientists tested one of the plasma-electrolytic reactors and officially fixed the additional energy. A report of the testing session was published in issue #22 of "Infinite Energy" magazine. In May of 1998 the third edition of a book named "Crisis of Theoretical Physics" was published by Prof. F. M. Kanarev. It contains data of additional energy production at plasma electrolysis of water defining the energy source. Soon Ohmori and Mizuno (Japan) published their results in works of Vancou ver conference on cold fusion and in issue #20 of "Infinite Energy". Ohmori and Mizuno observed neutron radiation occurring at a plasma process as well as iron, chrome, nickel, and carbon appearance on a wolfram cathode. That seemed to be a strong evidence of cold nuclear fusion at plasma electrolysis of water. Ohmori and Mizuno have explained neutron radiation as a result of electrons captured by protons. Nevertheless their conclusions raise doubts as cold fusion would have produced much more additional energy than it was fixed.

In 1996 there appeared the first publications where hydrogen atoms fusion instead of nuclear fusion was supposed as the additional energy source at usual electrolysis as well as at plasma source. In Russia first experimental results demonstrating energy consumption decrease for hydrogen production at plasma electrolysis of water were published in 1999 by Prof. F.M. Kanarev. (See F.M. Kanarev's article in this issue of NET).

Fig. 3

Honda FCX-V3 uses hydrogen as a fuel. Hydrogen is fed under high pressure in the engine.

Nevertheless we have to note that high efficiency electrolysis is possible! O. Hvolson in his "Physics" (Berlin, 1923) explains a method of designing of a machine which can produce heat due to positive difference between energy of hydrogen combustion and energy consumed to hydrogen production by means of water electrolysis. In this case we do not consume energy to split the atoms. It occurs due to intermolecular forces at water dissociation by sulphuric acid ions. Energy is consumed only to neutralize charges of existent hydrogen ions and acid residue ions. Hydrogen combustion produces the energy which would have been consumed to split the atoms in the air. **Hence 67.54 Kcal of energy can be produced at 5 Kcal consumed. (F. Lepehin)**

High effective electrolysis application is clear future of energetics. Nowadays Stuart Energy Inc applies water electrolysis as a hydrogen source in a frame of hydrogen-fuel project. Experts of Stuart Energy Inc have designed a refueling unit which produces hydrogen and stores it in a 104-pound reservoir. Thus several auto are provided with fuel and it takes a couple of minutes to refuel.

It is quite simple to predict social and economical consequences of innovation of high effective energy source operating as a closed cycle energy system. Economic activity and private life of people will be independent of cities, of their industry and power engineering. People will move out of the cities and they will use compact and powerful energy sources there. Hence, decentralization of world economics will happen.

Regions of any country become more free from the central authority, the power of which nowadays is based on centralized fuel energetics.

On the Longitudinal Electromagnetic Waves

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Concerning acoustic waves, we deal with longitudinal oscillations of the medium, since degree of air (medium) compression and rarefication changes along the direction of the wave spreading. Notion of the medium of electromagnetic waves propagation, i.e. notion of "aether", as well as the very possibility of the existence of longitudinal electromagnetic waves is disputable for some scientists. Let's clarify the situation and demonstrate that usual photon is longitudinal wave of energy density, which can be described as Umov-Poynting vector.

The transverse character of electromagnetic waves means that vector of electric field and vector of magnetic field are directed across the wave line. However, these vectors are just our subjective way to describe the process. Notions of electric and magnetic fields can be replaced by the notion of **unified helical field**, since to describe the motion of the point along the helical line there should be concerned the linear transfer (it is detected as electric field) and the process of rotation (it is described with the magnetic field). Thus notions of electrodynamics are just one of the ways to describe reality. Energy density of the given point of space is the real (objective) parameter of the wave. This energy density is described by the known Umov-Poynting vector $\overline{S} = \overline{E} \times \overline{H}$.

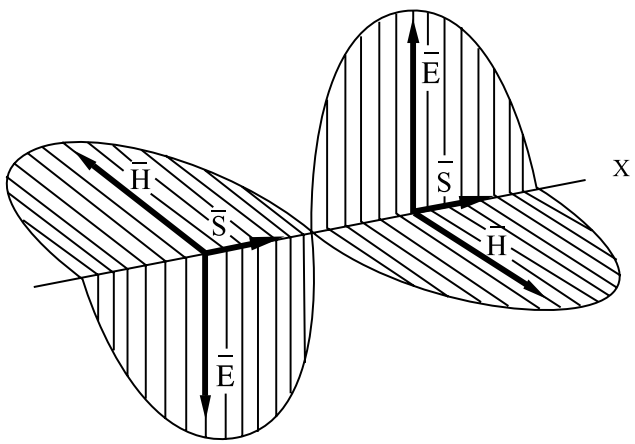

Fig.1

Let us consider electromagnetic wave in classical representation (Fig.1). Then we discover that direction of Umov- Poynting vector coincides with the wave line. The vector is unidirectional and "pulsating", because its quantity changes from zero to some maximal value and then it is reduced to zero, besides it takes place at half of the period of transverse wave. So, it is the explanation of the fact that frequency of longitudinal oscillations is twice as much than frequency of transverse oscillations (Fig. 2). **Previously it was known from the mechanism of energy interchange between longitudinal and transverse plasma oscillations and from the phenomenon of parametrical resonance. However the physical meaning of this phenomenon was not disclosed.**

From the presented here conception it follows that from the physical point of view, electromagnetic waves are **longitudinal oscillations of energy density**. In usual case these oscillations are unidirectional pulsations that determines the ability of the photon to be moving unidirectionally. Practically it is possible to create other types of photons, i.e. types of oscillations of energy density with qualitative new physical properties. It can be achieved by setting of definite functions and superposition of $\overline{E}$ and $\overline{H}$ vectors.

For example, in 1996 a conference "New Ideas in Natural Science" was organized by us in Saint-Petersburg, with the participation of 30 foreign guests and more than 100 Russian scientists. The report made by Academician Ignatyev, Krasnoyarsk, aroused great interest. During the experiments with rotating of crossed vectors $\overline{E}$ and $\overline{H}$ (see Fig. 3) there was created Poiting's vector, which corresponds to propulsion force of 60 N (about 6 kg).

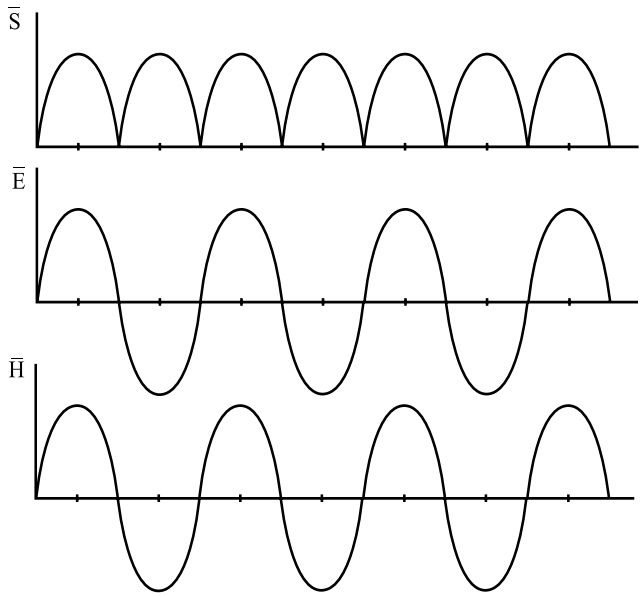

Fig. 2

The experiment is demonstrated on the photo (see Fig. 4), where the diameter of the device is equal to 4 meters and ends of the coils are to toroidal capacitors. This experiment was made in Krasnoyarsk.

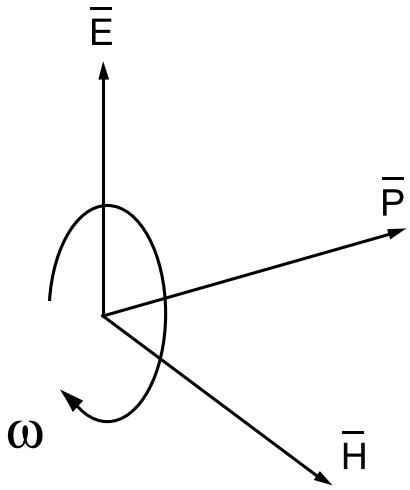

Fig. 3

Since it is impossible to consider vacuum, where some form of energy can exist, as "emptiness" then we can speak about vacuum as about some medium. Faraday and Maxwell, classics of electromagnetic theory, wrote exactly about deformations, stresses and expansion of aether. From this point of view electromagnetic waves are analogues of the waves of longitudinal deformation of elastic medium. More than 60 years ago Nicola Tesla wrote: "I showed that the universal medium is a gaseous body in which only longitudinal pulses can be propagated, involving alternating compressions and expansions similar to those produced by sound waves in the air. Thus, a wireless transmitter does not emit Hertz waves which are a myth, but sound waves in the ether, behaving in every respect like those in the air, except that, owing to the great elastic force and extremely small density of the medium, their speed is that of light." [1]

Nowadays, the development of engineering and the new views upon the phenomena of electromagnetism, impel us to consider physical **vacuum as material medium of the special type**, which has the well-known properties, in particular electrical and magnetic properties. Moreover, this medium has energy, and energy density can be changed in case of propagation of any photon. Thus, as Tesla stated in his article "The True Wireless": "The Hertz wave theory of wireless transmission may be kept up for a while, but I do not hesitate to say that in a short time it will be recognized as one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history".

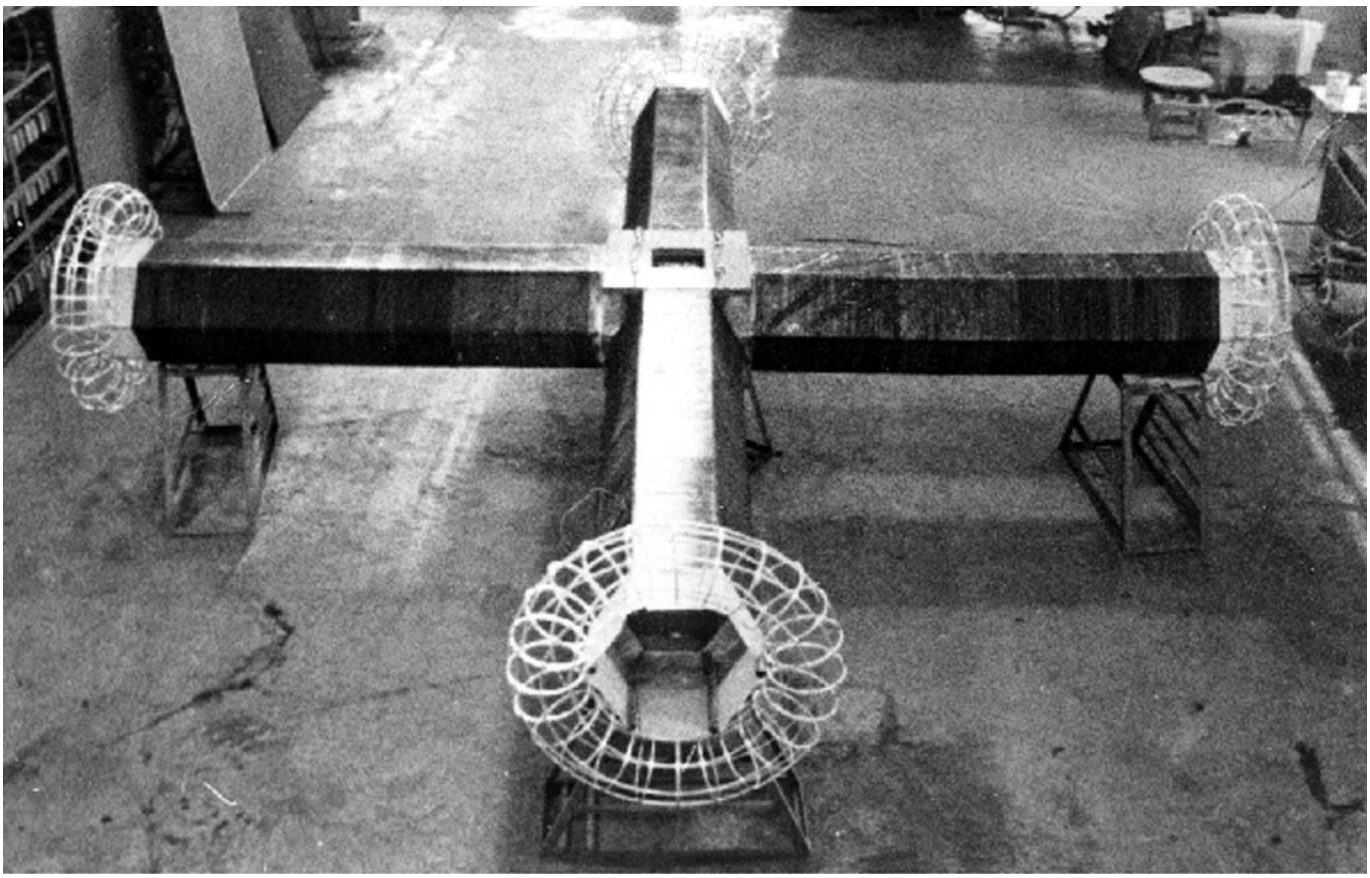

Fig. 4

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"OUTSIDE THE BOX" SPACE AND TERRESTRIAL TRANSPORTATION AND ENERGY TECHNOLOGIES FOR THE 21ST CENTURY

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Abstract

This paper reviews the development of antigravity research in the US and notes how research activity seemed to disappear by the mid 1950s. It then addresses recently reported scientific findings and witness testimonies - that show us that this research and technology is alive and well and very advanced. The revelations of findings in this area will alter dramatically our 20th century view of physics and technology and must be considered in planning for both energy and transportation needs in the 21st century.

Historical Background

Townsend Brown's Technology of Electrogravitics [1]

In the mid 1920's Townsend Brown [2] discovered that electric charge and gravitational mass are coupled. He found that when a capacitor is charged to a high voltage, it has a tendency to move toward the positive pole. His findings, which became known as the Biefeld-Brown effect, were opposed by conventional minded physicists of his time.

The Pearl Harbor Demonstration. Around 1953, Brown conducted a demonstration for military top brass. He flew a pair of 3-foot diameter discs around a 50-foot course tethered to a central pole. Energized with 150,000 volts and emitting ions from their leading edge, they attained speeds of several hundred miles per hour. The subject was thereafter classified.

Project Winterhaven. Brown submitted a proposal to the Pentagon for the development of a Mach 3 disc shaped electrogravitic fighter craft. Drawings of its basic design are shown in one of his patents. They are essentially large-scale versions of his tethered test discs.

Review of Issues from the 1950s

In 1956, a British research company, Aviation Studies (International) Ltd. published a classified report on Electrogravitics Systems examining various aspects of gravity control. They summarized the pioneering work of Townsend Brown and then described the use of electrogravitic thrust as follows:

"The essence of electrogravitics thrust is the use of a very strong positive charge on one side of the vehicle and a negative on the other. The core of the motor is a condenser and the ability of the condenser to hold its charge (the K-number) is the yardstick of performance " [3].

In one of their conclusions, based on Brown's work, they suggested that: "Electrostatic energy sufficient to produce a Mach 3 fighter is possible with megavolt energies " [4].

In spite of Brown's solid research, they later stated that, "One of the difficulties in 1954 and 1955 was to get aviation to take electrogravitics seriously. The name alone was enough to put people off" [5]. It seems that is as true today as it was in the 1950s.

A report by another British company, Gravity Rand, Ltd. in 1956, agrees with this assessment and states: "To assert electrogravitics is nonsense is as unreal as to say it is practically extant. Management should be careful of men in their employ with a closed mind or even partially closed mind on the subject." [6]

However, a trade press magazine, The Aviation Report, made numerous references to antigravity projects and listed many of the companies pursuing research in this area. Quotes from The Aviation Report listed in the Aviation Studies (International) Ltd. Report [7] are suggestive of what was going on behind the scenes.

In 1954 they predicted that: "... progress has been slow. But indications are now that the Pentagon is ready to sponsor a range of devices to help further knowledge."... "Tentative targets now being set anticipate that the first disk should be complete before

1960 and it would take the whole of the 'sixties to develop it properly, even though some combat things might be available ten years from now." (Aviation Report, 12 October 1954) [8].

During this time period many of the major defense and technology companies were cited as either having research projects or activities in this new field. For example: "Companies studying the implications of gravitics are said, in a new statement, to include Glenn Martin, Convair, Sperry-Rand, and Sikorsky, Bell, Lear Inc. and Clark Electronics. Other companies who have previously evinced interest include Lockheed, Douglas and Hiller." (Aviation Report, 9 December 1955) [9].

Others of these reports mention: AT&T, General Electric, as well as Curtiss-Wright, Boeing and North American as having groups studying electrogravitics.

During the same time period, the Gravity Rand report notes that: "Already companies are specializing in evolution of particular components of an electogravitics disk." [10]

However, in the area of predictions, the Aviation Report stated the following based on an extrapolation of technology development: "Thus this century will be divided into two parts – almost to the day. The first half belonged to the Wright Brothers who foresaw nearly all the basic issues in which gravity was the bitter foe. In part of the second half, gravity will be the great provider. Electrical energy, rather irrelevant for propulsion in the first half becomes a kind of catalyst to motion in the second half of the century." (Aviation Report, 7 September 1954) [11].

Looking back it is easy to say that they missed the mark. Did they really miss it by a half a century? Reading through these reports it is quite obvious that there was much interest in antigravity among a number of very high profile companies, as well as in the Department of Defense. What happened to this interest and why was it all downplayed during the following four plus decades? After all, T. Brown had shown that there is a demonstrable connection between high voltage fields and gravity. Why has it taken until the 1990s for more than just a few scientists to look at these results and publish on them in the open literature? A review of recent statements by former military personnel and civilians connected to covert projects begins to shed light on research activity in these areas over the last half century. **And it appears that there had been significant breakthroughs during this time period, well shielded from both the scientific and public eye.**

Recent Scientific Developments

In this section we consider developments in the antigravity field since the late 1980s and why the confluence of scientific findings and the testimony of witnesses associated with the military and covert groups indicates that a gravity solution with technological implications has been found.

Although general relativity has not been able to explain Brown's electrogravitic observations, or any other antigravity phenomenon, the recent physics methodology of quantum electrodynamics (QED), appears to offer the theoretical framework to explain electrogravitic coupling. Recent papers by members of the Institute for Advanced Study Alpha Foundation are putting a solid theoretical foundation onto the antigravity effects within the theory of electrodynamics and include papers by Evans [12] and Anastasozki et al [13].

Earlier in a 1994 breakthrough paper, Alcubierre showed that superluminal space travel is, in principle, physically possible and will not violate the tenants of the theory of relativity [14]. Puthoff [15] later analyzed these findings in light of the present SETI (Search for Extraterrestrial Intelligence) paradigms that insist that we could not be visited by extraterrestrial civilizations because of the speed-of-light limitations dictated by the general relativity theory. He suggests that super-luminal travel is indeed possible. This leads to reduced-time interstellar travel and the possibility of extraterrestrial visitation, which our limited under-standing of physics and scientific arrogance has "forbidden" in some sectors for most of the 20th century.

The second aspect of these physics findings deals with the zero point or vacuum state energy shown by the Casimir effect [16], which predicts that two metal plates close together attract each other due to imbalance in the quantum fluctuations. The implications of this zero point or vacuum state energy are tremendous and are described in several papers by Puthoff [17] starting during the late 1980s. Bearden [18] and colleagues have also written extensively on the theoretical physics of zero point energy and additionally have described various technological means of extracting this energy (for example see the recent paper by Anastasozki et al [19].). A theoretical book on zero point energy (and antigravity) was published by Bearden in 2002 [20]. There is significant evidence that scientists since Tesla have known about this energy, but that its existence and potential use has been discouraged and indeed suppressed over the past half century or more [21].

The coupling of the electrogravitic phenomena observations and the zero point energy findings are leading to a new understanding of both the nature of matter and of gravity. This is just now being discussed in scientific journals (though some evidence suggests that it has been understood for decades within the black project covert community). The question that is being addressed is: what keeps

the universe running? Or more specifically, where do electrons get their energy to keep spinning around atoms? As electrons change state they absorb or release energy, and where does it come from? The simplistic answer is that it is coming from the vacuum state. Puthoff [22] describes the process as follows: "I discovered that you can consider the electron as continually radiating away its energy as predicted by classical theory, but **simultaneously absorbing a compensating amount** of energy from the ever-present sea of zero-point energy in which the atom is immersed. An equilibrium between these two processes leads to the correct values for the parameters that define the lowest energy, or ground-state orbit (see "Why atoms don't collapse," NEW SCIENTIST, July 1987). Thus there is a DYNAMIC EQUILIBRIUM in which the zero-point energy stabilizes the electron in a set ground-state orbit. It seems that the very stability of matter itself appears to depend on an underlying sea of electromagnetic zero-point energy."

Furthermore, it appears that it is the spinning of electrons that provides inertia and mass to atoms. These theories, linking electron spin, zero point energy, mass, and inertia have been presented in a number of recent papers, such as those by Haisch [23] and colleagues and provide us with a possible explanation of the Biefield-Brown effect. It appears that an intense voltage field creates an electromagnetic barrier that blocks the atomic structure of an atom from interacting with the zero point field. This slows down the electrons, reducing their gyroscopic effect, and thus reducing atomic mass and inertia, making them easier to move around.

Evidence of Extensive Antigravity Technology

The B-2 Advanced Technology Bomber

In 1993, LaViolette wrote a paper [24] discussing the B-2 bomber and speculating on its probable antigravity propulsion system, based on a solid understanding of electrogravitics, [25] the aircraft's design and the materials used in its manufacture. It appears that the craft is using a sophisticated form of the antigravity principles first described by T. Brown. Support for this thesis came from the Aviation Week and Space Technology (March 9, 1992), which reported that the B-2 bomber electrostatically charges its leading edge and its exhaust stream. Their information had come from a small group of former black project research scientists and engineers suggesting the B-2 utilizes antigravity technology. This information was supported by Bob Oechsler, an ex-NASA mission specialist who had publicly made a similar claim in 1990. These findings support the contention that there have been major developments in the area of antigravity propulsion which are presently being applied in advanced aircraft.

LaViolette later states the obvious that "the commercial airline industry could dramatically benefit with this technology which would not only substantially increase the miles per gallon fuel efficiency of jet airliners, but would also permit high-speed flight that would dramatically cut flight time." [26]

The Hunt for Zero Point [27]

This recent book contains some of the strongest evidence yet for major efforts and success in the field of antigravity technology. The author, Nick Cook, who for the past 15 years has been the Aviation Editor and Aerospace Consultant for Jane's Defense Weekly, spent the last 10 years collecting information for the book. This included archival research on Nazi Germany's antigravity technology and interviews with top officials at NASA, the Pentagon and secret defense installations. He shows that America has cracked the gravity code and classified the information at the highest security levels. **Because antigravity and its allied zero point energy technologies potentially offer the world a future of unlimited, non-polluting energy it has been suppressed because of the "huge economic threat".** His findings support those reported by many of the Disclosure Project witnesses cited above.

Antigravity Technology Demonstrations

Although T. Brown reported many of his findings nearly a half century ago, other experimenters have just recently begun to reproduce his work and report on it in the open literature and on the WWWeb. For example, Davenport [28] published the results of his work in 1995 supporting the findings of T. Brown, while Bahder and Fazi [29] in 2002 described their assessment of the forces associated with an asymmetric capacitor. Transdimensional Technologies [30] in the USA and J. Naudin [31] labs in France have posted on the WWWeb: diagrams, web videos, and data on their versions of antigravity "Lifters" based on an extension of Brown's work. It is a sad commentary on this whole area of research to see that public science is requiring us to demonstrate principles that were demonstrated nearly fifty years ago.

There have also been a number of other demonstrations of "antigravity" phenomena by researchers throughout the world. This includes the work of Brazilian physics professor, Fran De Aquino, and such devices as: the Searl Electrogravity Disc, the Podkletnov Gravity Shield and Project Greenglow, the Zinsser Kineto-baric Field Propulsion and the Woodward Field Thrust Experiments on Piezoelectrics. All of these are described in more detail by Greer and Loder. [32]

Implications of This Research

Antigravity and zero point energy research and their applications are finally being addressed by some of the open scientific community. This means there will have to be a rewriting of textbooks in this area so our new generation of students can apply this "new knowledge." Its application will lead to major breakthroughs in transportation technologies both earthside and in outer space. The implications are that we have the potential for human exploration of our solar system and beyond, if we have the will, within our lifetimes. It also means that the majority of 20th century space technology will be obsolete and in fact may already be so.

The zero point or vacuum state energy source is seen as a totally non-polluting energy source, which has the potential to replace all the fossil fuels on this planet. It also will provide the energy needed for long range space flights. This means that fuel cells and solar cells in common use today for space flight energy applications will only be needed until we transition to these new energy technologies.

Based on an analysis of trends in antigravity research over the last half-century and the information provided by numerous witnesses, it appears that there is both good and bad news. The good news is that it appears that we (at least covert projects) have already developed the theories of antigravity, and additionally have developed working spacecraft based on these principles. The bad news is that these technologies have been developed for at least several decades, at the public's expense and that human kind has been deprived of these technologies, while continuing to waste energy using less efficient and pollution enhancing technologies.

Supporting this contention is the following quote from Ben Rich, former head of the Lockheed Skunkworks. Just prior to his death, he stated to a small group after a lecture [33] that: "We already have the means to travel among the stars, but these technologies are locked up in black projects and it would take an act of God to ever get them out to benefit humanity…" He further went on to say that, 'anything you can imagine we already know how to do.' Strong words from a knowledgeable deep insider and words that support what a number of the witnesses stated as well.

As the reality of this knowledge begins to be understood, there will be an outcry among space scientists not on the inside for release of these technologies to allow all of us to explore space. There will be major changes in the way that NASA does its business, though predicting these changes is difficult.

Not only has space exploration in the public sector suffered, but our planet's environment has suffered as well. Thus as this knowledge begins to sink in there will be an outcry among all concerned citizens on this planet for release of these technologies to allow all of us to reduce and ultimately eliminate global warming and environmental pollution that so threatens our way of life. These technologies will not only affect space travel technologies, but will also have a profound effect on transportation and energy production on the earth's surface.

In conclusion, we might consider the observation made by Halton Arp [34]: "We are certainly not at the end of science. Most probably we are just at the beginning!"

Acknowledgements

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Congress "The Time Machine"

Faraday Labs Ltd invites to participate in scientific congress devoted to experiments on changing of space-time properties. It is planned April 12, 2003, Moscow. Main topics of the congress are time and gravitation in the context of eatherodynamics, experiments and applied aspects of these technologies. The main report is "Method to Control Temporal Parameters of Physical Processes" by Alexander V. Frolov.

Organizing committee: Vadim A. Chernobrov (KOSMOPOISK research center) and Alexander V. Frolov (Faraday Labs Ltd). The registration fees are not required.

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☐ I would like to submit an oral presentation (report). (Please, enclose one-page abstract).

☐ I intend to participate as a guest

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COMMERCIALISING the "SEARL EFFECT" for ENERGY and PROPULSION SYSTEMS

Review from web site http://www.sisrc.com/
Email address: admin@sisrc.com

The "Searl Effect", discovered by J.J.R. Searl, is a method of extracting energy. Some current expressions for the source of this energy being The Space Fabric, Quantum Space Field, and Zero Point Energy.

SISRC Ltd has been formed to develop and license Searl Effect Technology (SET) on a global basis.

THE COMPANY

SISRC Ltd is the company formed to administer the implementation of the Searl Effect Technology, (SET) invented by J. R. R. Searl. SISRC Ltd designs, develops and implements Searl Effect Technology as it is initiated in various applications and territories. SISRC Ltd is the administrative hub of the group and will continue to be based in the UK. SISRC Ltd will grant production and marketing licenses for Searl Effect Technology applications to different companies in specific territories. Currently proposed related companies include:

* SISRC -Germany, SISRC -Iberia, SISRC - Sweden, SISRC - Australia, SISRC New Zealand.
* SISRC -AV (Audio Visual) provides computer graphics presentations of the SET.

BACKGROUND

The Searl Effect Generator (SEG) technology, as applied to the commercial market, had been previously developed to the point where a few prototype SEG generators were made, and used for electricity generation and motion. Commercial interest at that time focused on the SEG's transport potential and, under commercial pressure to deliver a fully functioning system, the original generators were used and lost in a series of vehicular propulsion experiments and demonstrations. Funding was insufficient to continue with the manufacture of the required larger-scale pressurized cabin machines - resulting in the termination of the project at that time.

Although all the operating principles, precise proportions and weights of the required materials are known for three of the four required operating materials, the precise data of the original magnetic layer is uncertain. The objective of the current R&D programme is to re-establish the original magnetic layer using modern and more efficient materials.

Originally, the layered materials were constructed and magnetized by the now-defunct Midlands Electricity Board under the direction of John Searl (see colored photo of the experimental craft construction on the cover page).

Modern magnetic materials have advanced considerably, and old ones discontinued, so a series of tests need to be conducted to establish the optimum materials and processes. These tests need to comply with the working criteria required and must lead to a cost-effective manufacturing process.

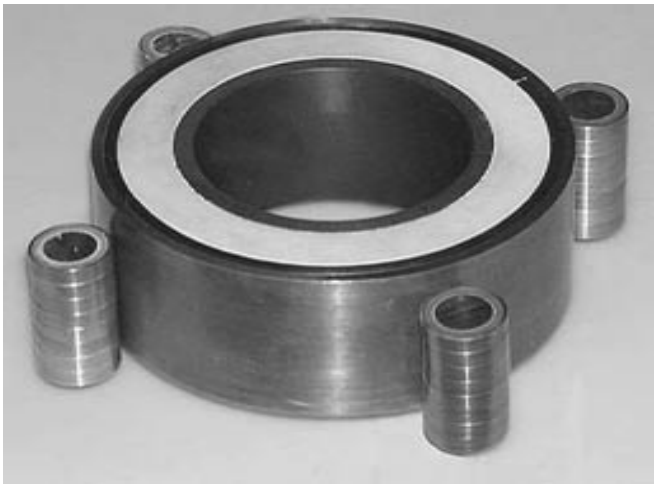

Fig.1
Experimental ring and rollers

In recent times SISRC has been re-establishing the original research. Due to the very limited funding that has been available, only a partially functioning demonstration prototype of the SEG principles has been possible. This prototype consists of the innermost of the three composite rings required and several rollers.

We would like to hear from anyone who worked on or was involved with Searl Technology prior to 1983. Also anyone who has any old technical data, photographs or films relating to the technology. Such information could greatly assist this technology to reach the marketplace for the benefit of all and would be dealt with in the strictest of confidence.

TECHNICAL DESCRIPTION

Physically the Searl Effect Generator (SEG) consists of three concentric rings each made of a composite of four different materials which are also concentrically attached to each other. The three rings are fixed to a base. Surrounding each of the rings, and free to rotate around them, are rollers - typically 10 on the first ring, 25 on the next and 35 on the outer ring. Surrounding the rollers on the outer ring are coils which are connected in various configurations to supply either AC or DC current at a variety of voltages.

Multiple magnetic poles are imprinted on the rings and rollers to form frictionless magnetic bearings. These also arrange the static charge into opposing charge clusters which cause the rollers to rotate around the circumference of the ring (as shown in Fig. 2).

Some expressions currently in use to describe the source of the energy for the SEG are The Space Fabric, Quantum Energy field of Space or Zero Point Energy. This is an unlimited and constant source of energy which can be made to flow when the correctly proportioned masses concerned are stimulated by the correct frequencies creating an 'open system'.

The idea of utilising this source of energy is currently the subject of various devices and experiments such as the 'Lamb shift', 'Casimir Effect' and the work of the Russian Nobel Prize winner Ilya Prigogine. However these devices and experiments tend to only prove the existence of the energy and not a method to create a coherent, ordered flow to produce useful power.

Fig. 2
15 KWt Searl Effect Generator (SEG)

In contrast, John Searl has discovered that, in order to create a steady and stable flow, all the masses of the device (and the stimulating frequencies) must conform to precise values determined mathematically by the 'Law of the Squares'. A machine constructed to these principles produces a stable and useful power output.

DEFINITION OF A SURFACE OPERATING S.E.G. (J. Searl) 15.09.00

A Linear motor operating on a magnetic bearing with the characteristics of an auto-transformer. The S.E.G. is defined as a device, which is constructed from 2,124 component parts, which make up 3 plates and 66 roller sets (see figures on the cover page). 12 of the 2,124 components create the 3 plates, which act as reaction components. 2,112 components are employed to create 66 roller sets, which act as active components. Each roller set consists of 8 segments constructed from 32 components. Each segment cannot be less than 34 grams in weight, as the law of the squares defines that value as the lowest value suitable for the reasonable generation of electricity. Therefore the smallest roller set must weigh 272 grams, making a grand total of 2,244 grams per roller set for the smallest surface bound SEG.

Tolerance should be about 0.05 gram per roller set. The larger the error the greater is the loss of power within the unit. Therefore the total tolerance for the smallest SEG roller set must not be greater than 3.30 grams - above this factor the SEG will not function. **For the best results, the tolerance across the total 66 roller sets should not exceed 0.05 grams!**

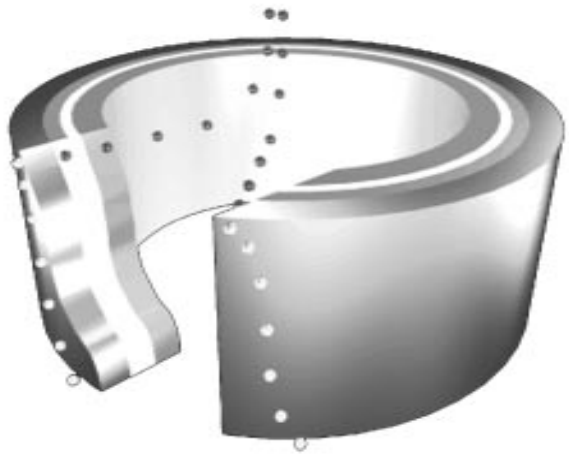

Fig.3

The S.E.G. is a step up rotary transformer. In fact it's a 'three rotary transformers' operational system, within a unit. The inner transformer output is fed in to the input of the second plate which increases the output of the second unit, which output feeds as an input to the final unit, thereby increasing its finaloutput to a very high voltage. Therefore the S.E.G. is just a prime mover for the production of clean electrical energy. The output windings must be designed to step down this output to 240 volts at 15KWt's.

During 1968 it being upon this issue, as development progress both here and in the USA, new findings are being created, and updates will be added to this page, as they are certified. When the SEG rollers are brought into close proximity to the SEG Ring, the Searl Effect resonant magnetic field causes negative ions and electrons to be drawn into and accelerated through the machine. This process is assisted by the highly electron-attracting rare earth metal Neodymium.

The unique mechanical and material arrangement of the SEG pulses the neodymium to continually release and replace the surplus electrons to provide electrical or mechanical power, or both.

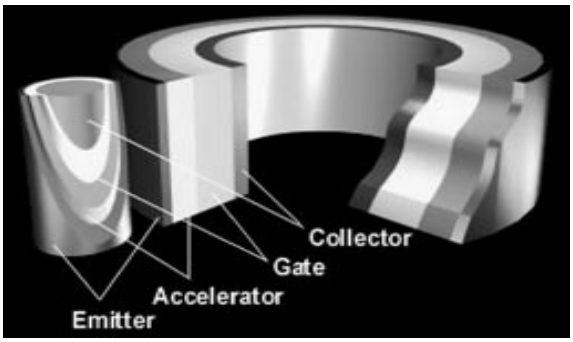

Fig.4

DEVELOPMENT

Prior to the production of complete 15KWt Searl Effect Generators (SEGs), a minimum of two demonstration Ring & Roller prototypes are to be produced.

The "Ring" is typical of the innermost of the three rings required to make a complete SEG. The 69-roller sets in a complete three ring SEG are identical. Six roller sets will be made for the prototype inner rings so that the Searl Effect can be demonstrated.

The production of a self-running Ring & Roller prototype will establish the precise sequence and parameters of electrical, magnetising and material processes required for the SEG and will demonstrate electrical power generation. An operating single inner ring with 1-8 rollers will also determine if a particular material will function correctly and at what level of power output.

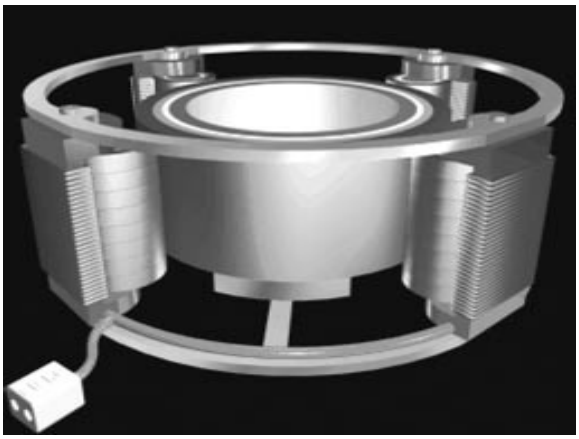

Fig. 5
Demonstration ring and rollers

The five phases of the development programme that commenced in October 1999 have been completed and the rollers successfully magnetised with 'Searl Effect' magnetic fields. A sixth phase is now required to apply the technology developed in Phase five to the "Ring". This sixth Phase resulting in a demonstration Ring & Roller prototype has duration of 6 months.

NEWS REVIEW

Scientific Breakthrough Liberates Energy Users from Fossil Fuel Dependence

Information from
http://www.genesisworldenergy.org/genesis_world_energy.htm

Story originally published by Diana Echeverria, USA

Director of Public Relations
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208-345-4143 208-602-0325 (cell)

Technology breakthrough harnesses energy from the molecular structure of water

BOISE, ID - Dec. 5, 2002 - Genesis World Energy, a privately funded consortium created by a group of military and space program research and development specialists, today unveiled a scientific breakthrough that allows consumers to easily access the energy contained within the hydrogen and oxygen molecular structure of ordinary water. This scientific breakthrough provides a limitless, low cost and environmentally clean source of energy that can be implemented with minimal cost and effort. The viability of using water as an energy source, previously a theoretical concept, is now a reality. "Water has always been the source of life on this planet, now it will also transform the way we create energy" said Charles Shaw, corporate counsel and spokesperson for Genesis World Energy. "The implications for worldwide energy generation and consumption are nothing less than staggering."

The Edison Device

The first application of this technology is represented in the "Edison Device", a self-contained, self-sustaining energy generation unit. Roughly the size of an outdoor air conditioning system, the power source can be quickly and easily installed in any home or business to provide virtually unlimited energy from any available water source. The Edison Device utilizes the existing electrical wiring and natural gas plumbing in a home or business to replace the energy provided by utility companies. The home version of the Edison Device produces approximately 30 kWtt of combined gas and electrical energy per day. By comparison, the typical home uses between five to six kilowatts per day. The commercial model is capable of producing 100 kilowatts of energy per day. The energy generation portion of the devices has no moving parts. In fact, the only "mechanical" aspects of the equipment are small circulation pumps and micro-valves, making the Edison Device both silent and virtually maintenance-free. A minimum amount of water is used over an estimated 20+ years of service life.

Interesting Publications of the Last Year

Discovery by a Group of Scientists Headed by Valerian Sobolev

Some time ago mass media announced that a sensational discovery was made by a group of Russian scientists headed by Valerian Sobolev. This discovery aroused ambiguous attitude of physic community. We have written about this fundamental and, to a certain extent, revolution discovery. Let us revise the fact that Sobolev claimed 7 scientific discoveries which were made, i.e. the process of depletion (a special electrochemical process), magnetic discharge, a new energy source, a method of low temperature plasma generation and superconductor. A laboratory system of the experimentally disclosed process as well as its industrial prototype is easy to be realized in practice for creation of new energy sources and wide-ranging production of ultrastrong materials. In many cases these materials can replace existing constructional materials.

The materials produced as a result of the process are multielement chemical compounds which are new states of matter. This new state of matter has **a time-changing magnetic field that can be EMF source in a coil of a generator.** Ordered structures of matters which are in the new modified state are nothing but a magnet charge. Materials containing the magnet charge and representing a continuous matters are **new energy sources.** Due to the new state matters become able to produce electric power as well as to generate low temperature plasma. It is easy to be realized in the process of common technological procedures. That promises designing of propulsors for "unsupported" transportation systems in near future.

Basing on realization of the disclosed process and using new materials the group of Russian Scientists headed by Sobolev together with American businessmen has created superfine and flexible glass for packing. The glass was called as "strong glass". It seems to demonstrate higher pressure stability than steel. A method of production of these materials was patented in 1999. In the patent the scientists of Valerian Sobolev's group are represented as authors of this new method, and the owner of the patent is Dynelec Corp (Columbus, Ohio, USA). You can read about the patent at the Web-site of http://patft.uspto.gov/netahtml/srchnum.htm (patent #5,964,913, October 12, 1999).

Sobolev's group has appeal to the Russian government for sponsorship; however only foreign investors have provided funds for new energy sources developing. According to Russian Information Agency "News", Sobolev's group has signed a $168 million contract with one of Canadian companies for developing industrial production of energy sources. Manufacturing of such energy sources **can change energy supply system all over the world**. According to the contract the Canadian company is going to finance building of at least two plants. One of the plants is going to be built in Russia, and the other one is planning to be established in Canada. Each plant is supposed to produce 70 thousand of the self-running energy sources a year. Power output of the sources will come to 3-10 kWt. In other words, in the nearest future every person will be able to buy such an energy source and to apply it in household.

Single-Wire Electric Power System

(see photo on the cover page)

Experimental Results of Russian Scientists

Scientists of the All-Russia scientific research institute of electrification of agriculture (VIESH) academician D.S. Strebkov, engineer S.V. Avramenko, dr., A.I. Nekrasov, post-graduate student O.A. Roshchin developed a new method and the equipment for transmission of electric energy on a single-wire line using resonant idle operation mode and reactive capacitive currents for transmission of active electric power. Tesla transformers and frequency converter were used at the experiments.

First there was created the experimental sample of single-wire electric power system (SWEPS) with **10 kW** electric capacity and 3000 V voltage. As a result, obtained SWEPS electric parameters a hundred times exceeded parameters of a usual two-wire or three-wire alternative and direct current line.

In the end of 2002 there was made an attempt to increase transmitted capacity by using of more powerful condensers, which were installed in resonant circuit. There was developed the electric technique of **20kW** single-wire electric power system (SWEPS) with two Tesla transformers. As a result parameters of a low-voltage winding of the step-down transformer were changed. They **exceeded parameters of a usual two-phase or three-phase ac line or dc line in two hundred times.** At room temperature effective specific transmitted electric power was 4 MW/mm^2 and specific current density was 600 A/mm^2. These parameters could be achieved for existing methods of electric energy only at use of special materials in a mode of low temperature superconductivity. The measurements which were made at wire with diameter of 1mm, 100 microns and 80 microns, demonstrated that parameters did not depend on diameter of a wire. There was also experimentally confirmed the property of a single-wire line to transfer active power without essential losses on line resistance. Irradiation losses at low frequency 3,4 kHz were small. In single-wire power system the 80 microns wire plays a role of directing system for an electromagnetic energy flow, which runs from the generator to the load.

We present update information on the experiments with Lifters or asymmetrical capacitors, which use High Voltage to produce a thrust. ***By Jean-Louis Naudin it was demonstrated with "Maximus" experiment, that a Lifter can be scaled up and also that such a device is able to lift up to 60 g of payload (total weight: 194 g). According to Naudin, it is now possible to build a craft which will use the Biefeld-Brown effect to fly silently and without moving parts only powered by electrical energy.*** *It was also declared that on January 8th, 2003, there was successfully done two historical flights with a mouse as a test pilot of the Lifter "Maximus"* ***(propellantless electrokinetic craft)****. Below there is an analysis of electrogravitation experiments made by Jean-Louis Naudin and Tim Ventura. (See color photos on the cover page).*

Review of Electrogravitation Experiments made by Jean-Louis Naudin and Tim Ventura

Tim Ventura

Tim Ventura Website: http://www.americanantigravity.com
Email: TVentura@seattle.telecomsys.com, tventura6@atbi.com

There is a spreadsheet containing a jpeg-snapshot of data that I have assembled based upon Jean-Louis Naudin's published results (JLN Labs Website: http://jnaudin.free.fr. and http://www.jlnlabs.org). In the graphs that I've created, it seems to indicate that current plays more of a role in propulsion than voltage does — i.e.: for a given amount of power in watts, raising the current and decreasing the voltage seems to create a higher level of thrust.

In light of this, I have been increasing the thrust of my own Lifters by creating an electrical-bypass of the "load-resistor" on my power-supply's high-voltage output. This has an interesting result:

I use a current-driven power-supply, which means that if no load is connected to it the voltage will build up on the high-voltage output until arcing occurs. In my case the voltage will build up to around 65kV, at which point the power-supply will automatically shut down. Conversely, if a very light load (such as a short circuit) occurs, the opposite effect happens and the power-supply will deliver much higher current at a much lower voltage until the supply is overdrawn and once again shuts down.

Normally the output load-resistor constrains the current, and in doing so it maintains the voltage on the high-voltage output at the nominal 50kV output level. However, bypassing the output load-resistor allows the power-supply to deliver voltage and current that are based almost entirely on the type of load connected to it.

When I connect a normal Lifter to the bypassed power-supply, the voltage will build across the air-gap until ions begin to flow in a conduction-current across the air-gap. Although this begins to happen at approximately 15kV, it seems to have some type of "peak efficiency' at approximately 22.5 kV. The amount of current climbs to approximately 11mA at this voltage.

This method of experimental setup seems to allow the Lifter to "find its own sweet-spot" for operation, instead of using the output-resistor to "force" a specific voltage on it for operation. This appears to maximize the thrust output during operation.

Lifter Efficiency Spreadsheet

Description	Lift capacity (grams)	Length (cm)	Efficiency (g/m)	Lifter Weight (grams)	Voltage (kilovolts)	Corona Air-Gap (centimeters)	Current (mA)	Power (watts)
Lifter 1	3.3	60	5.5	2.3	41.9	3	0.57	23.9
Lifter 2	9.6	180	5.3	6.6	43.35	3	1.12	48.5
Lifter 3	20	360	5.6	16	27.5	3	2.53	69.5
Lifter 4	36	720	5	32	44	3	2.01	132.9
3-Stage Lifter 3	54	1080	5	24	30	4.5	8.06	240
Coliseum Lifter	90	2160	4.16	50	31.769	4.5	8.06	254.15

New Electric Fire Technology

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Abstract

The article proves importance and prospects of development of combustion technologies. In particular there is considered application of a new electric fire technology for environmentally appropriate combustion of any matters and gases. The technology uses electric fields as combustion catalyst. There is observed application of technology in heat-and-power engineering, transport heat engines, disposal units etc. [1, 2]. It is demonstrated that the new technology allows intensify combustion processes and increase their controllability (i.e. the control of temperature, gases pressure, gradient of heat conductivity, and so on). There is made a conclusion about availability of the technology to solve critical energetic and ecological problems of the civilization.

We hope that this article will excite interest of a wide circle of readers, i.e. of professionals in the area of combustion and heat technologies, physicists, ecologists, and those people who are interested in new scientific ideas.

Global Ecological Problems are the Problems of Ineffective Combustion of Hydrocarbon Fuel

The ecological problems become more and more serious and threaten to grow into world ecological catastrophe. The main cause of the atmosphere pollution in megapolises is imperfection of combustion technologies (of heat-and-power engineering, heat machines, transport engines, waste combustion…). It has been proved that their share of pollution of the planet atmosphere comes to 70-80%. The combustion technologies mean any technologies of combustion of fuel, matters and gases. The combustion technologies are the most popular technologies in the world. The modern civilization without the combustion technologies is impossible. There are many industries, which apply these technologies, such as heat-and-power engineering, transport, metallurgy, food industry, oil-and-gas refining industry, chemical industry, waste combustion neutralization.

Therefore the global ecological problems will not be solved until the mankind develops the combustion technologies. The article describes and discloses the essence of the new technology of ecologically appropriate and effective combustion of fuel and wastes of any type.

Why is it difficult for ecologists to conserve nature?

Modern methods and technology used for solving of the ecological problems consist in **analysis** of extent and sources of the environment pollution (ecological monitoring), and, moreover, in **refinement of atmosphere, water and soil, which are used in different technologies or have been polluted due to the imperfection of the technologies** (it is refinement from such toxic components as drinking and run-off water, exhaust and waste gases etc.).

Unfortunately, methods of measuring of the huge spectrum of toxic matters, which are thrown into the atmosphere at matters combustion, as well as the methods of their utilization are impartially difficult, expensive and imperfect. Even using of an ideal technics for measuring of the atmosphere pollution is not effective since it is a struggle with **consequences** of the combustion and other technologies imperfection but not with **causes** of the atmosphere pollution.

Ecological and energetic effectiveness of the known combustion technologies

It is known that real effectiveness of transformation of chemical energy of fuel in the combustion process is low. For example, in heat engines it comes to 25%, effectiveness of transformation of heat energy into electric energy in thermoelectric power stations does not exceed 40%. If energy consumptions of mining, processing and delivery of the fuel to consumers are taken into account then the summary efficiency of the existent combustion technologies (of heat machines and devices) comes to no more than 10 – 15%! It means that more than the half of chemical energy of the fuel is transformed into heat and different toxic matters and waste gases, which pollute the planet atmosphere. They cause acid precipitation, a global "greenhouse" effect, which threaten to cause the climate warming, the world flood, and final poisoning of the living nature. Thus the share of imperfect power engineering in the nature pollution comes to 70 – 80%! How is it possible to cleanse the planet atmosphere, especially the environment of world megapolises, in the situation when the amount of toxic matters produced by transport and industries is comparable with the amount of rest pure air?

Until the mankind learns burn matters and gases by effective and ecologically appropriate way the planet atmosphere will remain polluted and in near future it can become uninhabitable. Thus we will not solve the ecological problems until we gain the understanding of the combustion processes and processes of combustion transformation of matter chemical energy into heat energy, and then into other useful types of energy (i.e. electric energy, mechanical energy, light energy).

Physical Essence and Problem of Classical Combustion of Matters

Combustion is one of the most difficult phenomena, which are known by the humankind. From the scientific point this phenomenon is a chain reaction of sequential fragmentation of fuel particles into smaller charged radicals; it is physical chemical processes of transformation of chemical energy of intermolecular connections as well as combustion also includes physical processes of transformation of energy into heat and light on molecular and atomic levels. Many other processes, which proceed simultaneously, are involved.

From school years we know that combustion is a process of interaction of fuel with an oxidant that is accompanied by heat and light energy generation. In higher school the words of "as well as by cryptic energy of chemical connection of waste gases" are added to the school definition. The combustion processes are studied and improved by scientists and experts of different areas (chemists, physicists, heat-and-power engineering specialists, thermalphysicists etc.). There are known fundamental investigations of combustion chain reactions made by such Russian scientists as N.N. Semenov, Ya.B. Zeldovich and their followers.

Until now intensiveness of fuel combustion is increased by air blowing into the combustion zone that increases the amount of waste toxic gases thrown into the atmosphere. **Let us arouse several questions, which seem naive at first sight. Why is an oxidant (air or oxygen) needed for matter combustion? Is it possible to do it without any oxidant?** How does the combustion process begin and proceed? There are a lot of vague questions in physics of combustion. For example, how can the temperature and the intensiveness of the combustion be regulated? Can the heat conductivity of the flame be controlled? How can heat motion of particles be regulated in the flame and in the waste gases, and what can it cause? There is another problem of combustion. It is the very hydrocarbon fuels, which are applied at modern heat processes. The great Russian scientist, D.I. Mendeleev stated that to use oil is the same thing as to stoke a stove with banknotes.

Since the hydrocarbon fuels are complicated chemical matters and the combustion processes are imperfect then in the process of their combustion a great amount of different by-product matters and toxic gases are produced. They waste unused self-energy of fuel into the atmosphere and pollute our planet.

Physical essence of the new electric combustion technology

How is it possible to burn the hydrocarbon fuel by environmentally appropriate way? How can this environmentally appropriate technology be realized in practice? A brief answer is following**: it is necessary to make such conditions of combustion of organic fuel, and to introduce such a combustion catalyst that the energy of intermolecular and intramolecular connections of the organic fuel becomes absolutely free. At that the chemical energy can be transformed into energy of electromagnetic radiation, for example, into light energy and heat energy without generation of by-product polluting matters and gases. Then a working body (for example, water) is effectively heated by this directed concentrated electromagnetic radiation. In this process effects of electromagnetic waves reflection and concentration are used, or the electromagnetic radiation is directly transformed into electric energy.** In this case there is a new opportunity to regulate flame temperature and to extremely decrease quantity of the oxidant, i.e. to create organics combustion with minimal quantity of waste gases.

Is it principally possible to burn organic matters and gases without the atmosphere pollution using electric field as a catalyst? It is possible if parameters of this field are correctly chosen. More precisely it is possible if huge Coulomb forces of the electric field are correctly regulated by interaction of electrically charged particles of the fuel and the oxidant with force lines of the electric field.

One variant of an experimental device is represented in Fig. 1.

Devices for approbation of the new electric combustion technology

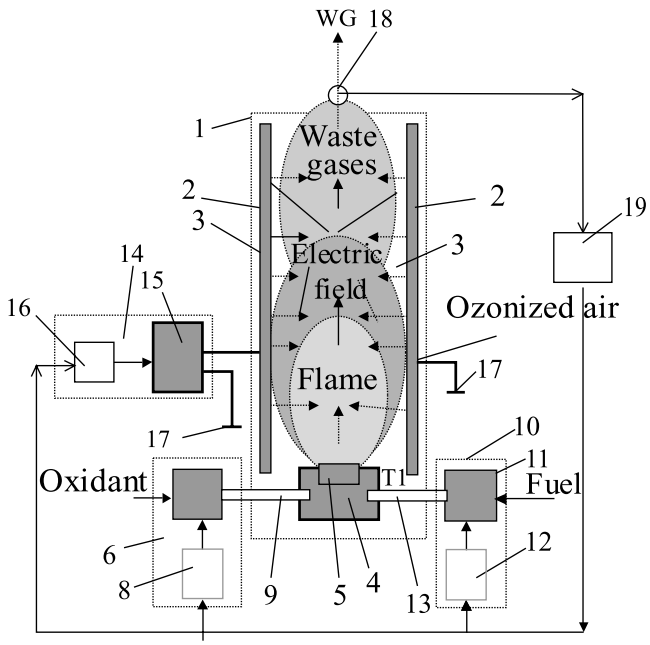

Fig.1 a
Plan of the experimental device

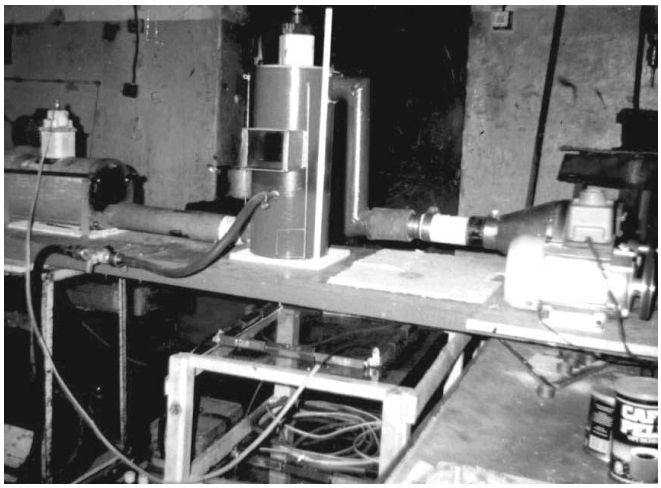

Fig. 1 b
Photo of the experimental system

A structure chart of the experimental device, which was designed to investigate the new electric combustion technology, is demonstrated in Fig.1a. The device contains a body (1) equipped with flat electrodes, which are insulated from the body (2), (they can be placed in either horizontal flat or vertical flat). The electrodes (2) are located on opposite inner walls of a combustion chamber (3). The device is equipped with a mixer (4) with a device for supplying of blended fuel to the zone of combustion. At the same time the device (5) is used for electrical combustion of the blend. The described device is equipped with an air track (6), which contains an oxidant activator (7) joined with a regulator (8) by a control circuit and with the mixer (4) by an air pipe (9). The regulator (8) serves for regulation of the oxidant activation extent. At the end of the air pipe it is possible to place a vortex device (it is not shown in the figure). Also the device is equipped with a fuel track (10) containing a fuel activator (11) and a regulator (12) of the activator and consumption of fuel. The block (11) is joined with the mixer (4) by a fuel pipe. The device is equipped with an electric combustion activator (14) containing a high-voltage transformer (15) of intensity and frequency joined to its regulator (16) by a control circuit. An electric outlet of the block (15) is joined to one of the electrodes (2), and the second outlet is safely electrically grounded by a grounding mat (17). The high-voltage wire of the outlet of the block (15) is connected with the electrode (2) through a bushing insulator (it is not demonstrated in Fig.1a). The device is equipped with a gas toxicity calculator (18) joined to the inlet of a mode optimizer (19), which is a control system for interacted regulating of all the parameters of combustion. For that the outlet of the mode optimizer (19) is joined to the inlets of control of the regulators (8), (12), (16).

The device operates in the following way. At first an activated oxidant of O1 is applied through the air track (6), activator (7) and air pipe (9) to the mixer (4). Then an activated fuel of F1 is applied through the fuel track (10) and the activator (11) to the same mixer (4). A blended fuel is prepared in the mixer (4) and then is atomized and combusted by a sparkle of the block (5). In the combustion chamber (3) flame and waste gases are processed by strong alternating electric field, which is generated by the block (14) in a gap between the electrodes (2). In the process of combustion waste gases toxicity is measured by the special toxicity sensor (18). Depending on current toxicity the parameters of flame combustion are regulated by the mode optimizer (19). More precisely the oxidant consumption and the extent of its activation are changed by the regulator (6), the fuel consumption and the extent of its activation are changed by the regulator (12), the intensity and frequency of the alternating electric field generated by the block (14) in the combustion chamber (3) is changed by the regulator (16). Let us note that the electric field in the combustion chamber (3), viz in the gap between the electrodes (2), catalytically influences on both the flame and the waste gases. The essence of the process lies in the fact that the processes of fragmentation and oxidation of fuel radicals and of toxic oxide molecules are accelerated. Intensiveness of combustion and of toxic gases refinement increases as well as the intensity of this field and its frequency do. As a result of the interconnected regulation of all the listed parameters fuel of any kind can be fully, intensively, "cleanly" combusted.

In Fig.1b there is a photo of the operating experimental device designed to investigate the processes of influence of electric field on the process of matters combustion and of cleaning of waste gases. The photo represents following things.

1. In the left side there is a furnace with a high-voltage electrode in a higher part of its body.
2. In the centre there is a vertical column of the electric combustion cleaning (after-burning) of toxic gases in the electric field; on the top of the column a high-voltage electrode can be seen. Gas pipes designed for toxic gases supply–withdrawal are connected with the column and located to the right and to the left from it.
3. A regulable blower is represented in the upper right side of the picture. It is designed for toxic gases withdrawal and connected with the gas pipe by the column.
4. At the foot of the picture there is a regulable high-voltage tension source (the electric field source), which is connected with the furnace and the column of toxic gases cleaning by high-voltage wires.

It is experimentally proved that combination of two stages of the combustion activation (i.e. in the furnace and the column) ensures ideal cleaning of toxic gases at combustion of any toxic matters.

Some Results of Experiments

Our experiments and investigations of many-sided influence of electric and high-voltage electromagnetic fields on the combustion process have proved that such practically ideal condition of fuel and matters combustion is possible to be realized in practice [1].

Low-powered static and alternating electric fields (i.e. the fields of constant sign and of variable sign) of more than 1kV/cm intensity were used as combustion catalysts as well as high-frequency electromagnetic fields of low power with some frequency of oscillations of molecules in the flame (flame power is 0.1 – 1% of heat power of the flame of the combusted organic fuel).

Peculiarities of Oxidants Application in the New Technology

It is known from the thermodynamics and combustion theory that optimal ratio of the oxidant mass, for example air, and the fuel is approximately 1:16 in an average combustion process. In our experiments with the electro-field catalyst the ecologically appropriate combustion of the hydrocarbon fuel (mazut, straw oil) was achieved at oxidant deficiency (for example, at the ratio of oxidant mass and the fuel of 1:1). For experts it means that there is a real possibility for 10 – 15 times decrease of amount of waste gases of any heat machines and to while their former power is the same. As the experiments demonstrate carbon and hydrocarbon are absolutely removed from the waste gases. In the experiments oxides of hydrogen and nitrogen were 4 – 8 times decreased and flame existence was 5 – 10 times increased.

The issues of the experiments prove the hypothesis about possibility of effective environmentally appropriate combustion as a process of direct transformation of chemical energy of organic fuel into electromagnetic radiation energy of the flame (including heat and optic diapasons). The transformation is accompanied by removal of polluting toxic components from the waste gases that occurs due to many times intensification of the combustion process under action of electromagnetic catalysts.

Operations of regulable activation of fuel oxidants (simultaneous or separate), which are introduced into the combustion technology, ensure additional improving of the combustion process. Especially it occurs at heavy oil fuel combustion and water-fuel emulsion combustion that was experimentally tested by us. The process becomes especially effective if the flame of the combusted activated blended fuel is additionally processed by alternating electric field. Due to introduction of the operation of all the combustion parameters regulation (of consumption of fuel, oxidant, of their activation extent, and of their combustion intensiveness extent), according to the information of the waste gases toxicity, it is possible to achieve effective combustion of fuel and waste products of practically all kinds.

Our experiments demonstrate that combination of the very flame procession with procession of the waste gases and air (i.e. an oxidant) by electric field is very effective for the waste gases cleaning. The essence of this additional cleaning of the waste gases lies in fragmentation of carbon particles and exhaust opacity by electric forces of an alternating field as well as in after-oxidation of some toxic oxides in the medium of an ozonized oxidant. Energy consumption for activation of the flame combustion by strong electric fields is small and does not exceed 1–3% of heat energy of the flame. Advantage of this invention is universality of the application for combustion of any inflammables. It is possible due to widening of the diapason of the electric field parameters regulation (of intensity and frequency), especially in the mode of their interconnected regulation.

The essence of catalytic action of the alternating electric field on the flame combustion process consists in effective breaking of dipole radicals of fuel by an activated (dipole) oxidant. Moreover, the essence lies in better mixing of layers of combusting flame with the oxidant that occurs due to removal of a doubled electric layer from the limit line of the flame. Thus this technical solution allows achieve new positive effects due to its significant peculiarities, i.e. extending of application area of the known electric combustion method over the combustion process of any inflammables as well as it allows significantly increase controllability of the flame combustion process.

Let us note that in the experiments on the combustion of organic fuel in strong electric fields the regulation of the flame temperature and of its existence was achieved at unchanged consumption of fuel and of oxidant. That was achieved by changing of the parameters of the combustion electric-field catalyst (intensity and frequency) of a longitudinal electric (electromagnetic) field. Rotation and stabilization of the flame was achieved by a rotating transversal electric field. Changing of the flame height was realized by the longitudinal electric field.

The investigation, which has been performed by us, proves that directly acting on the flame the very electric field which directly influences on the flame and emission of electrons flow (ideal type of oxidation) into the flame can most effectively intensify the combustion process and make it harmless for the humankind and for the environment!

It has already been experimentally proved that energy consumption required for generation and regulation of this electric field and of the electrons flow for intensification and environmental

appropriateness of the combustion is quite small relatively the combustion energy and comes to fractions of a percent of the flame energy. Thus our experiments prove that the best **"oxidants" and combustion catalysts are** not superfluous air but **the electron and the electric field!**

Regulation of Heat Conductance of the Flame and the Heat Flow

As our experiments have demonstrated, the electric field can act as an effective combustion catalyst as well as a regulator of its intensiveness; moreover, it can control even a vector of heat conductance. It is proved by the experiments that the parameters of this field can be regulated as well as temperature of the flame and gradient of the flame heat conductance. Interesting experimental results were obtained measuring full heat of combustion of the same quantity of fuel at the usual method of fuel combustion and at the method, which uses combustion electric catalysts, even in the case of oxidant deficiency. In the last case the energy of fuel combustion almost 1.5 times increases that can be explained by fuller transformation of fuel chemical energy into electromagnetic radiation. At the usual combustion methods the chemical energy of the organic fuel was not completely used and remained as a cryptic summary chemical energy of intermolecular connections of many toxic waste gases, which were exhausted into the atmosphere by heat devices. Basing on the performed experiments it may be supposed that, evidently, specific heats of matters are 20-50% higher at this method than at their usual combustion method. The essence of the new electric combustion technologies consists in this new physics of combustion.

The author has already got patents for invention of Russian Federation [3 – 12] for the methods of regulation and intensification of matters combustion processes.

Some peculiarities of atomization, inflammation and combustion of organic fuel in electric fields

We have not discussed all the potential capabilities and advantages of the new electric combustion technology for different areas of technics. Let us demonstrate them in more details.

One of characters of the new electric combustion technology is **effects of oxidant ozonization, of electrostatic atomization and electrostatic injection of electrically charged particles of fuel and the oxidant that is followed by generation of the finest aerofuel opacity on a molecular level in a combustion chamber**. Naturally, such fine atomization of the fuel causes its easier evaporation, inflammation and combustion especially in the medium of the ozonized oxidant. **The mechanism of fuel electrostatic fragmentation is physically explained by Coulomb interaction of repulsion from each other of electrically likely charged fuel drops (particles) that is accompanied by their progressing fragmentation and corresponding decrease of their mass and electric charge**. As the experiments have shown the extent of the fuel drops (particles) fragmentation depends on initial electric potential of fuel charging and initial size of injected fuel drops (particles), which for their part depend on configuration and size of a fuel-injection nozzle as well as on pressure occurring in a fuel line of the heat machine.

Generated by dipolar high-voltage potentials catalyzing electric field can be introduced into the atomization zone or (and) the combustion zone of the combustion chamber of an engine. Its Coulomb forces accelerate motion of electrically charged particles of fuel and oxidant to an opposite electric potential, which is connected with, for example, a piston of an engine. Thus electric field acts as an electrostatic pump that allows decrease pressure in a fuel line as well as allows practically ideally atomize the fuel and mix it with the oxidant. Moreover, it lets simplify and improve the systems of injection and inflammation of the blended fuel in heat machines and devices, for example, in internal combustion engines or in boiler plants. Their application can cause additional improving of energetic and ecological characters of the combustion technologies. According to our information, such high-performance fuel-injection nozzles have yet been unknown in technics therefore they have not been applied in heat machines (injector internal combustion engine).

Is it possible to combust water? Water as a fuel!

More amazing experimental results were obtained at 40-80% dilution (emulsification) of liquid organic **fuel**, for example diesel oil, with **habitual water**. Summary energy as heat and light, which is generated in the process of such blend combustion, was not practically changed that can be explained by liberation of energy of chemical connections of water as well as of fuel. In the process of the experiments on combustion of the emulsion at first **it was transformed into the finest water vapor on the molecular level by means of capillary electroosmosis and of electrostatic atomization. Then dipolar water molecules, which had been electrified by field, were fragmented into hydrogen and oxygen, and then the hydrogen was effectively combusted in the medium of the ozonized oxygen.** Let us note that at this mechanism of water "evaporation" and of following splitting of water molecules into hydrogen and oxygen the electric field expends energy, and heat of organic fuel combustion just accelerates (catalyze) this process.

Editor: It is necessary to note that electric field can not expend energy. If there are no conduction currents then the field source does not decrease difference of potentials. Hence it can be concluded that effectiveness of such power systems is possible to be UNRESTRICTEDLY HIGH. The author writes about it below as about an "incomprehensible phenomenon".

The most amazing and incomprehensible fact is that the electric field transforms water into "vapor" and breaks the water molecule into hydrogen and oxygen practically **without any expenditure at minimum of energy consumption**. Electric power of the intensity high-voltage transformer, which is necessary for strong field generation, lies in the interval from several watts to tens of watts. As the experiments have demonstrated electric consumption of the high-voltage source practically is not changed at correct shunting of the flame by the electric field (i.e. through an air gap). Current consumption practically did not increase depending on mode of fuel atomization and its combustion (of flame height, of combustion intensiveness...).

There are only two conditions of effective work of static electric field as an electrostatic pump-atomizer of fuel and as a catalyst of blended fuel combustion. The first one is intensity of the field in the zone of fuel atomization and in the zone of flame combustion. The second one is enough emission of electrons into the blended fuel flow. In this mode Coulomb forces make work of electrostatic pressure generation and of electrostatic fragmentation of particles and molecules of fuel and water. The forces repulse likely charged drops of water. Heat motion of fuel radicals, which are combusted and fragmentized in the flame, impedes their chemical recompounding into water molecules in the zone of combustion. Moreover, it causes proceeding of a very physical chain reaction of hydrogen combustion in the flame.

Therefore additional light and heat energy, which is generated in the flame by combustion of hydrogen generated from water molecules that occurs in the ozonized oxygen, does not decrease summary energy of combustion of blend of fuel with water but increases it.

Thus using of electric and electromagnetic fields as the strongest catalysts of combustion of organic fuels and any matters clears great **prospects** of combustion technologies improving. Moreover it allows create ecologically appropriate heat machines and devices and 20-50% increase their effectiveness due to fuller transformation of chemical energy of inflammables into heat or light energy.

Ways of radical improvement of heat machines or about a new mechanism of transformation of heat energy into mechanical energy and into kinetic one

For clear realization of causes of extremely low output of modern heat machines that has generally lead the civilization to the ecological catastrophe it is necessary to understand their common principle of operation as well as a cause of heat energy non-effective using in them.

A mechanism of transformation of heat energy, which is generated by fuel combustion, is the same for all known heat machines. It consists in generation and transformation of superfluous pressure of a heated working body (i.e. gas, vapor etc.) into kinetic energy of a working element of the heat machine (i.e. a piston of an internal combustion engine, a turbine of an aviation engine, a reaction jet flowing out a rocket nozzle etc.) in special chambers of the machines.

It is also known that the higher the temperature of the heated working body, for example of a gas, the higher initial pressure in the working chamber of a heat machine. **Why output of heat machines is so low?** Any expert of thermal physics, thermodynamics, and heat machines can answer that efficiency (output) of heat energy transformation into mechanical one is defined by the second law of thermodynamics and is clearly illustrated by Carno heat cycle. According to these postulates, **output** of an ideal heat engine does not depend on a working matter and on the engine construction but is defined by temperatures of the working body in the starting point and in the final point of the cycle, i.e. by the temperatures of the heater and of the refrigerator of the **heat machine**. Real output of the heat machines is limited by heat stability of materials and by imperfection of engine constructions.

Nevertheless known thermodynamic processes and lows of heat motion of particles and molecules are significantly changed in strong electric fields and demonstrate new prospects for improving of heat machines.

A solution of the problem can be briefly formulated as: to increase output of heat machines it is necessary to use a new mechanism of redistribution of heat energy into energy of directed pressure of a compressed working body (i.e. gas, vapor, etc.) on the working element of the heat machine. At the minimal pressure it should be redistributed on sidewalls of the working chamber.

Can it be realized in practice? On the face of it the technical solution is unrealizable nevertheless it exists. It is possible to redistribute and to regulate heat motion

(pressure) of heated gas inside a closed reservoir and, hence, its temperature in a certain direction. To achieve this aim **it is necessary to introduce static electric field into the combustion chamber of a heat machine and to orient heat motion of electrically charged and dipolar molecules of expanding working bodies (i.e. gas, vapor) along force lines of the electric field by electric Coulomb forces**. Something similar occurs, for example, in liquid crystal cells of electronic timer, in Kerr cells (electric optic effect) at periodical application of electric field to them that causes dipolar molecules turn along a field vector as well as change of light penetrability of these matters.

There is a difference between this known in electrooptics phenomenon and our case. The difference lies in the fact that polarized gas molecules remain movable along force lines of the electric field in contrast to liquid crystals, which do not. This fact causes redistribution of parameters of heat energy (i.e. pressure, temperature, and heat penetrability) of dipolar molecules of heated gas just along force lines of the field. The more the intensity of the field at the initial temperature of the working body is the more the difference of pressures on the sidewalls of the chamber and on the working element, for example, on an engine piston.

Heat motion of polarized particles of heated gas can be decelerated by combination of three electric fields of constant sign in accordance with all three coordinate axes; hence it is possible to significantly and quickly decrease temperature and pressure of the gas. In this case the heat energy of the heated gas makes jump transformation into electromagnetic radiation.

Editor: Historically this method, i.e. plasma retention by electric field, was proposed by Oleg Lavrentiev in 1948. He had 7-grade education and served as a sergeant in Armed Forces in Sakhalin. After he sent Stalin a letter containing a phrase, as "I know a secret of hydrogen bomb creation" he was invited to Moscow to set his ideas out to academicians. His ideas were not lost nevertheless the scheme of plasma electrostatic retention was not applied ("Expert" magazine #23, 18 of July of 2001). In 1950 Sakharov and Tamm proposed a scheme of a toroidal magnetic thermonuclear reactor which has been developed until now. Why is it so? It is difficult, expansive and practically unreal…

Thus introduction of strong electric fields into heat machines allows significantly increase effectiveness of transformation of heat energy of a working body into mechanical and kinetic energy of working elements of the machines by means of directed regulation of temperature and pressure of heated gas, for example, in the starting point and in the final point of a working stroke of a piston. In other words it allows increase output of the machines.

APPLICATION AREA OF NEW ELECTRIC COMBUSTION TECHNOLOGY

Practical application of the new combustion and thermal technologies

The new technology is universal and applicable in practically all spheres of technics. Therefore we believe that further development and application of this new technology of fuel and waste products combustion is very important for radical improving of all the heat machines and of all thermal technologies. As the civilization uses hydrocarbon fuel and matters in its life circle then just this new technology can solve critical ecological and energetic problems of the civilization.

It is impossible to view in details all proposed perspective technical solutions based on this technology [1-25] within one article. Therefore we give only one striking example.

Environmentally appropriate engine for motor transport

Since the transport, which uses thermal internal combustion engine (ICE), is most harmful for the environment then let us discuss ways of their ecological and energy improving. Several years ago the author patented "method of intensification of ICE operation" [7]. The essence of the invention consists in introduction of controllable electric field into combustion chambers during the whole operation period of an engine by special monoelectrode spark-plugs (Fig.2).

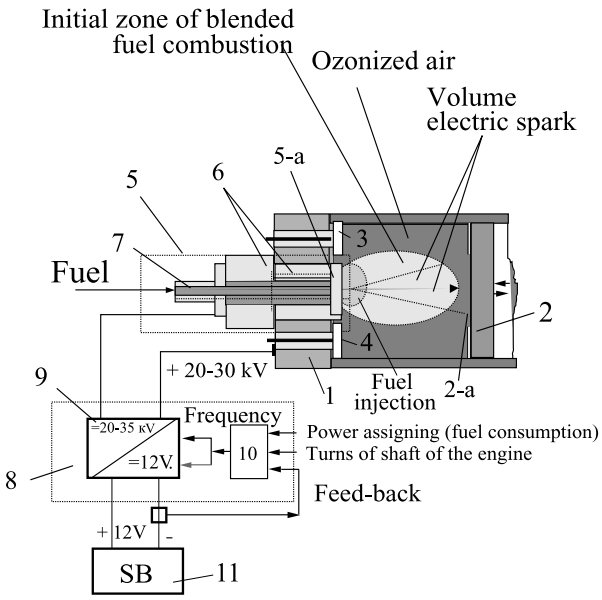

Fig.2a
Plan of an environmentally appropriate ICE (for transport)

1. – combustion chamber;
2. – piston, 2a –heat-resistant surface of the piston (zone of electric-spark discharge)
3. – admission valve (its canal is not indicated)
4. – exhaust valve (its canal is not indicated)
5. – combined mono-electrode spark-plug; 5a – fuel nozzle with hollow central electrode and end disk electrode
6. – electric insulator of the spark-plug – fuel nozzle
7. – fuel pump (for example, an electrostatic one)
8. – high-voltage regulable transformer (electric field source)
9. – force block of tension high-voltage transformer (=12V/25kV)
10. – system of regulation of electric field source (9)
11. – board current network =12V (SB is a storage battery of an automobile).

This structure chart briefly demonstrates basic components of a new ICE, where there is directed pressure of gases on a piston. In particular, many inventions of the author are realized in practice here, i.e. semi-digital spark-plug, electrostatic fuel nozzle (5), electrostatic fuel pump (7). A new mode of volume inflammation of blended fuel has been realized in practice, i.e. "a spark coming from a disk electrode (5-a) to a piston (2-a)". Since it is possible to regulate the electric field intensity generated by a high-voltage source of tension then an advance angle of blended fuel inflammation can be regulated, gases pressure on the piston at explosion stroke of ICE operation can be regulated as well.

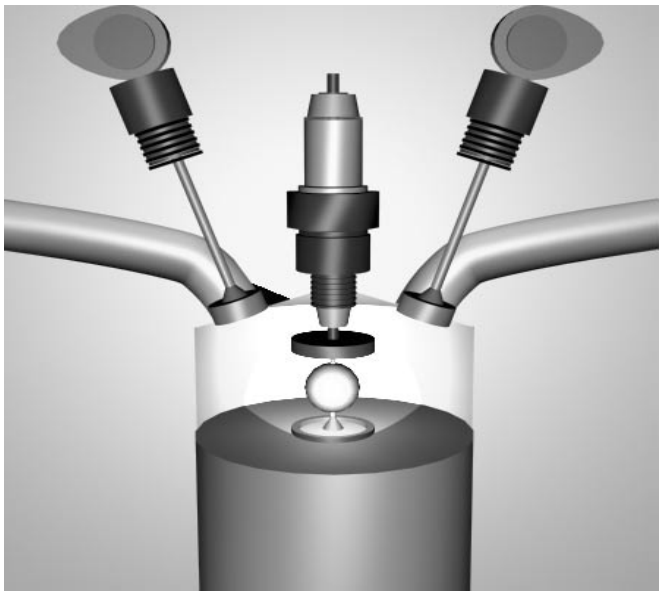

Fig.2b
Photo of a simplified construction of the new ICE

Fig.2b demonstrates simplified three-dimensional construction of the proposed energetically and ecologically perfect ICE. There are observable elements such as a combustion chamber, a piston, valves, a monoelectrode spark-plug, and an electrostatic fuel nozzle (in the centre on top), which is connected with the spark-plug. In the centre of the combustion chamber it can be seen volume inflammation of the blended fuel at spark appearance from end electrode to the piston.

As a result a summary positive effect of ecological, construction and energetic improving of ICE is achieved, i.e. effective cleaning of exhausted gases directly in the combustion chambers of the engine, significant simplification and perfection of a fuel injection system, improvement of system of distribution and electric inflammation of the blended fuel. In this engine a distributor (as well as its analogues) is removed at all since sparking and intensive inflammation of the blended fuel automatically appears between central electrode of the spark-plug and the piston which comes to the upper "dead" point. The central electrode of the spark-plug is constantly under high tension. The advance angle of ignition is regulated by change of the electric field intensity. Powerful multipoint ignition causes simultaneous intensive inflammation of the blended fuel that occurs throughout the whole chamber. The electric field as a powerful combustion catalyst intensifies the process of the blend combustion at the explosion stroke of the engine and at after-burning of waste gases directly in the combustion chambers at the following output stroke of the engine operation. Directed along the axis of the piston in the combustion chambers this electric field serves as a transformer of gases heat energy into mechanical energy of the thermal engine pistons. That is caused by the fact that the field orients heat motion of the expanding gases along the axis of the pistons in combustion chambers of the engine at explosion stroke of ICE just. It causes redistribution of heat energy and increase of the gases pressure on the very pistons that significantly improves effectiveness of transformation of heat energy of the fuel combustion into mechanical energy of the piston motion (theoretically the improvement is by two-three times), i.e. it two-three times increases output of a classical thermal engine making it come to 70-80%.

The electric field, which is introduced into the combustion chambers of an internal combustion engine, ensures significant economy of fuel (up to 30-40%) at saving of its working characteristics. It occurs due to fog electrostatic spray of fuel and to the fuel electrization as well as due to oxide ozonization. Moreover it occurs as a result of deep after-burning of hydrocarbon components of fuel, combusting blend and waste exhaust gases. This method allows effectively regulate temperature of the blend combustion in the chambers while required compression in cylinders is the same, for example, to minimize nitric oxide generation in the exhaust gases. As a result there is no necessity in external devices for cleaning of exhaust gases of internal combustion engines; ecological appropriateness improvement can be simultaneously achieved. Additional aerosol hydro-alkaline processing of these gases can allow totally clean **exhaust gases** of the transport, which operates on thermal engines.

Workability of such an environmentally appropriate engine in two-stroke and four-stroke variants is experimentally demonstrated. There are also experimentally shown decrease of all toxic components in exhaust gases, 20-30% increase of useful power of the engine, and simultaneous decrease of fuel consumption.

Thus practical application of the new electric combustion technology can exert revolutionary influence upon propulsion engineering development and upon increasing of ecological compatibility and effectiveness of the transport, which operates on thermal engines.

Diagram of operations of technology of effective using of refinery wastes in heat-and-power engineering

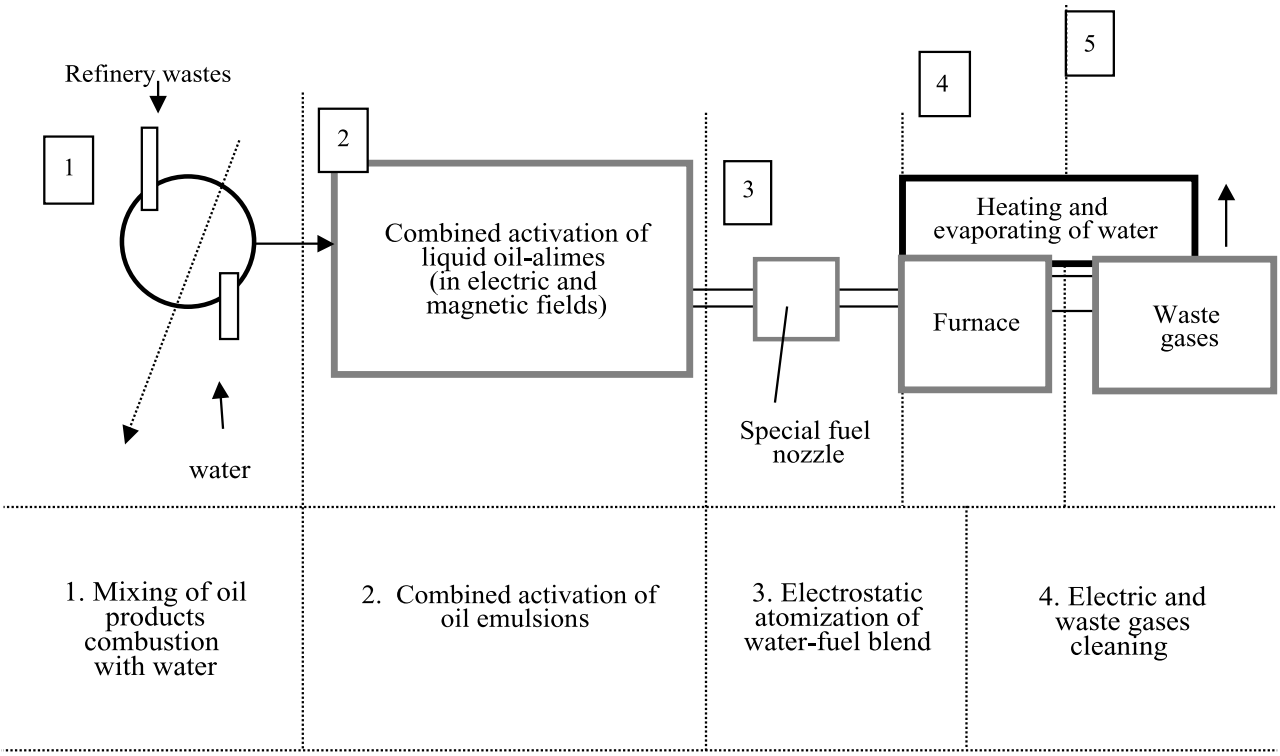

Fig.3

Technology of environmentally appropriate combustion of refinery wastes as fuel for boiler plants

The author has patented other technical solutions of improvement of different devices, which are based on these technologies. These solutions concerning boiler plants, gas turbine engines and jet engines and many other heat machines and devices allow increase their effectiveness and simultaneously significantly improve their ecological factors. As an example of application of this technology in heat-and-power engineering there is a diagram of operations of the technology of the environmentally appropriate combustion of refinery waste as a fuel for boiler plants (Fig.3). Unfortunately the limits of one article do not allow discuss these inventions in details nevertheless the author will realize it in practice in future works.

Conclusions:

1. The existent methods of solving of the ecological problems are ineffective as well as work of organizations, which deal with ecological and nature conservation activity. It is caused by the fact that they are oriented to search and remove consequences of ecological pollution of the nature instead of their causes.
2. The article demonstrates real causes of global ecological problems, which consist in imperfection of technologies of generation and transformation of energy.
3. Using of strong electric and electromagnetic fields of low power as combustion catalysts allow significantly improve ecological factors of combustion technologies and of devices, which realize the technologies in practice. In other words it allows realize in practice "clean combustion of fuels and wastes and possible existence of "clean" heat technics".
4. Application of electric and electromagnetic fields in the combustion technologies allows significantly increase effectiveness of transformation of chemical and heat energies of fuel into mechanical and electric energies.
5. The electric combustion technology allows realize in practice principally new ways to control combustion process as well as to control many thermal and kinetic processes (i.e. processes of pressure, heat conductance, temperature, etc.), i.e. allows increase output of heat machines.

6. The new electric combustion technology is a universal method of solving of ecological and energetic problems of the civilization and a universal way of radical improvement of technics (i.e. of the transport, boiler plants, oil-and-gas processing plants, combustion wastes recycling plants, etc.).

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New Effect of "Cold" Evaporation and Dissociation of Liquids Based on Capillar Electroosmosis

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There is discovered new electric physical effect of intensive "cold" evaporation and dissociation of liquids and aqueous solutions into fuel gases **without any energy consumption** due to high-voltage capillar electroosmosis [1].

Prospects and problems of hydrogen engineering

Effective obtaining of hydrogen from water is a long-standing tempting dream of the civilization. That is connected with the fact that there is a huge amount of water on the planet, and hydrogen engineering promises the possibility to obtain unlimited quantity of "free" energy obtained from water. All the more, the very process of hydrogen combustion in oxygen medium, which is obtained from water as well, ensures ideal high-calorie and environmentally appropriate combustion.

Ecological and energetic problems are very actual nevertheless they have not been effectively solved. All known methods and devices of production of hydrogen and other fuel gases are ineffective since there is no a real high-performance technology of evaporation and splitting of liquid molecules. The main cause of ineffectiveness of the analogous consists in their difficulty and in energy consumption for breaking of intermolecular connections at dissociation of water liquid fractions.

Physical-chemical structure of even habitual tap water is quite complicated since there are numerous intermolecular connections, chains and other molecular structures in water. In particular, in habitual tap water there are different chains of oriented water molecules, which are peculiarly connected with admixture ions (cluster formations), its various colloidal compounds and isotopes, mineral matters as well as various dissolved gases and admixtures.

It is a paradox but in the living nature there is a long-standing effective way of electric capillar delivery and "cold" evaporation of liquid, which allows transform it into gaseous state without heat energy and electric energy supply line. This natural effect is realized in practice by plants, which deliver aqueous solution and make its "cold" evaporation by capillar electroosmosis. It is quite comprehensible that this natural energetically perfect technology is applicable in methods of liquids transformation into fuel gases. The author of this article has designed such experimental devices of cold electric capillar evaporation of liquids according to electric pumps of trees (Fig.1-3).

The simplest operating device, which experimentally realizes in practice the effect of high-voltage capillar electroosmosis of the "cold" evaporation and dissociation of water molecules, is demonstrated in Fig.1.

New Electroosmotic Capillar Method of Obtaining of Fuel Gas from Water

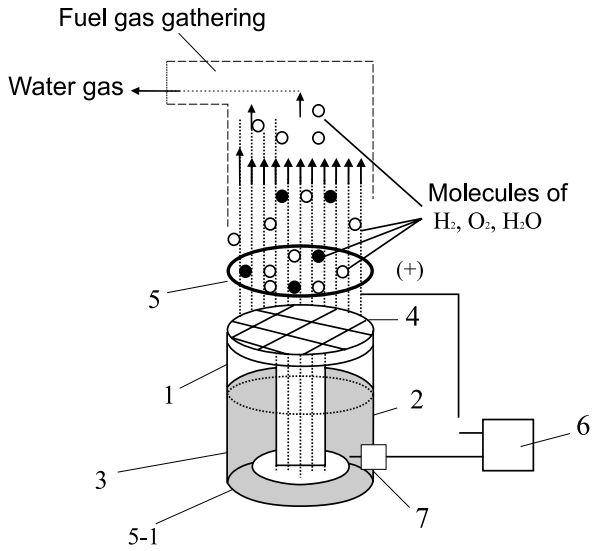

Fig.1
Simplest device of capillar electroosmosis of liquids

First experiments on the electric capillar dissociation of liquids were made with using of habitual water as well as its solutions and water-fuel emulsions of various concentrations as liquids. In all these cases fuel gases were successfully obtained in spite of the fact that these gases greatly varied due to their composition and heat capacity. The experiments on the electroosmotic evaporation and dissociation of liquids are realized in practice by the following way. First a wick (3) and a porous evaporator (4) are moisten with a water-fuel blend (emulsion) (2) then the blend (2) is poured into a reservoir (1). Then a high-voltage source of tension (6) is switched on and high-voltage difference of potentials (about 20 kV) is supplied to the liquid at some distance from the capillaries (i.e. from the wick (3) and the evaporator (4)). The source of electric field is joined to the device by electrodes (5-1) and (5). A plate perforated electrode (5) is placed above the evaporator (4) surface at a distance, which is enough to prevent an electric breakdown between the electrodes (5) and (5-1). Electrostatic forces of longitudinal electric field acts on the liquid. As a result dipolar polarized molecules of the liquid move along capillaries of the wick (3) and evaporator (4) from the reservoir to an opposite electric potential of the electrode (5) (i.e. electroosmosis occurred). Liquid molecules are detached from the evaporator (4) surface by these forces and transformed into a visual fog, i.e. the liquid is transformed into another aggregative state at minimal energy consumption of the electric field source (6). After that they provide electroosmotic elevation of this liquid. In the process of detaching and collision of evaporated liquid molecules with molecules of air and ozone as well as with electrons there is occurring partial dissociation between the evaporator (4) and the upper electrode (5) in an ionization zone. At the process a fuel gas is produced, which can come thorough a gas collector (7), for example, into combustion chambers of motor transport engine.

It has been experimentally shown that change of intensiveness of process of evaporation and dissociation of vapor molecules depends on change of distance from the electrode (5) to the evaporator (4). Moreover, this dependence is conditioned by the following factors, viz by changing of the evaporator area, kind of the liquid,

quality of capillar material of the wick (3) and the evaporator (4), parameters of the electric field as well as the source of intensity (of power) (6).

The author's first experiments on this simplest device, which were organized in 1986, demonstrated that "cold" water fog (i.e. gas) appears in capillaries from liquid (i.e. water) at high-voltage electroosmosis without any observable energy consumption but just using potential energy of the electric field. This conclusion is evident since in the process of experimenting consumed electric current of the field source was the same and equal to the consumed current of the source idling. This current was not changed depending on the appearance of the liquid evaporation.

The experiments demonstrated that capillar electroosmosis evaporated quite significant quantity of water (1 liter) without any energy consumption for 10 minutes at a 10-centimeter-diameter capillar cylinder. That is to say that the consumed electric power (10 Watts) of the electric current source, i.e. of the tension high-voltage transformer (20 kV), was unchangeable and did not depend on mode of its operation. It has been experimentally stated that the whole consumed energy supplied by the current network is insignificantly small comparably with the energy of liquid evaporation. It can be explained by the fact that power was consumed only to generate the electric field and did not increase at liquid capillar evaporation that occurred due to work of an ionic pump and of a polarized pump. Hence the effect of cold electric-capillar evaporation of liquid is very economical in respect to the process energy consumption.

In spite of the fact that energetic essence of this process has not been disclosed it is evident that both "cold evaporation" and water dissociation are realized in practice by potential energy of the electric field. More precisely, the visual process of evaporation and water splitting into H_2 and O_2 at the capillar electroosmosis is realized by powerful Coulomb forces of this strong electric field.

Editor: It is not the most surprising fact. The most astonishment is aroused by school-day stereotypes that work of a field at a closed cycle is equal to zero. These stereotypes have been kept in mind of people for a long period of time. Everybody understands that a field can do work but if a body falling from some height is accelerated in a potential field and its kinetic energy increases then it requires energy consumption to relevate the body up to this height. Nevertheless, the analogy of a gravitation field with an electric one is not one-valued since the electric field may be generated only at a part of trajectory of the accelerated body motion. An electric field can be pulsating, it can be screened or it is possible to change its direction at the reverse part of the trajectory in such a way that the field constantly accelerates the body. Hence a principal conclusion can be made: summary work of a potential field may not be equal to zero. This conclusion has earlier been proposed by A.V. Frolov in his article published in the USA (Newsletter of the Institute for New Energy. May 1994. p. 1-4).

In principle this uncommon electroosmotic pump-evaporator-splitter is an example of the perpetual motion machine of the second type. Thus the high-voltage capillar electroosmosis of aqueous liquid provides really intensive and energetically free evaporation and splitting of water molecules into the fuel gas (H_2, O_2, H_2O) by means of using of potential energy of the electric field.

To produce more complete dissociation of water molecules into the fuel gas it is necessary to make the whole water molecules collide each other and be split into molecules of H_2 and O_2 in an additional transversal alternating field (Fig.2).

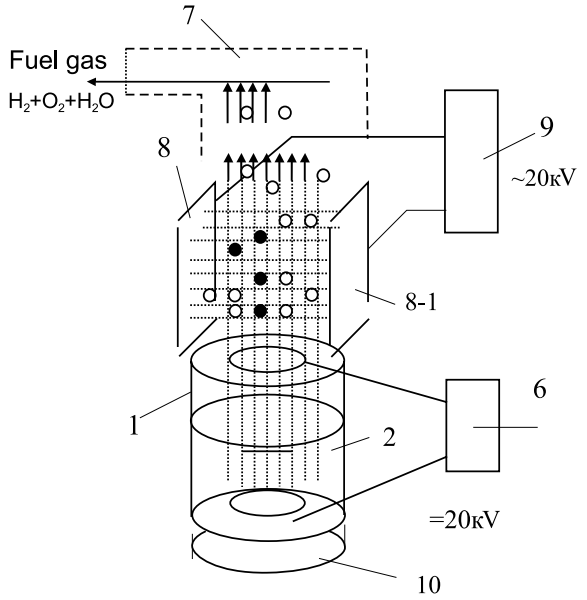

Fig.2

Device for production of fuel gas by electroosmosis. The device is equipped with an additional high - voltage splitting center of liquid molecules by electric alternating field.

At the second stage of water dissociation the energy of the second electric field is used, more precisely, powerful electrostatic forces are used to intensify oscillation resonant process of "collision-repulsion" of electrified water molecules represented as water gas. The result of this process is complete breaking of liquid molecules and generation of fuel gas molecules.

Conditions of optimal dissociation vary due to a kind of the liquid, to capillaries properties, and to the field parameters. These conditions are caused by required productivity of the process of dissociation of concrete liquid. Fig.2 demonstrates in details functional structure and composition of the device equipped with two sources of the electric field.

In the case of preliminary division of initially chemically neutral water into chemically active fractions (i.e. acid fraction and alkaline fraction) realization of the technology of production of fuel gas from water becomes possible at temperature below zero (up to –30°C). In winter it is quite important and useful for motor transport. This "fractional" electrically activated water does not freeze at degree of frost; hence the device designed for hydrogen production from such activated water can operate at environment temperature below zero and at degree of frost.

This principle of additional chemical activation of water (or liquid) is realized in practice in the device

(Fig.3). In contrast to the devices mentioned above (see Fig.1, 2) this device is supplied with an electrochemical activator of liquid (3) with evaporators (4).

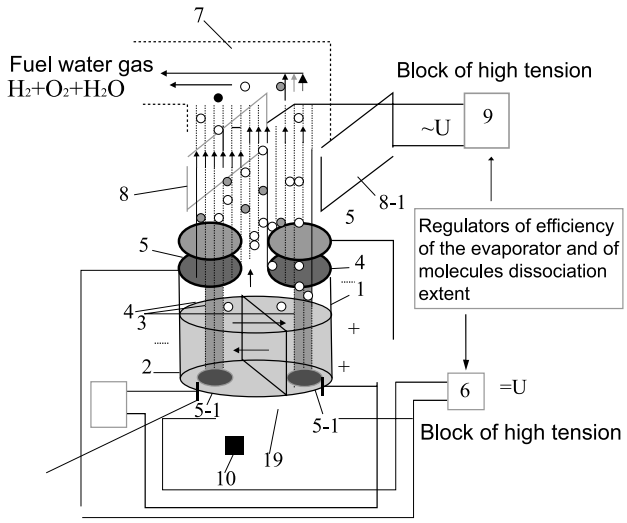

Fig.3

Hybrid device equipped with two sources of electric field and liquid electric activator

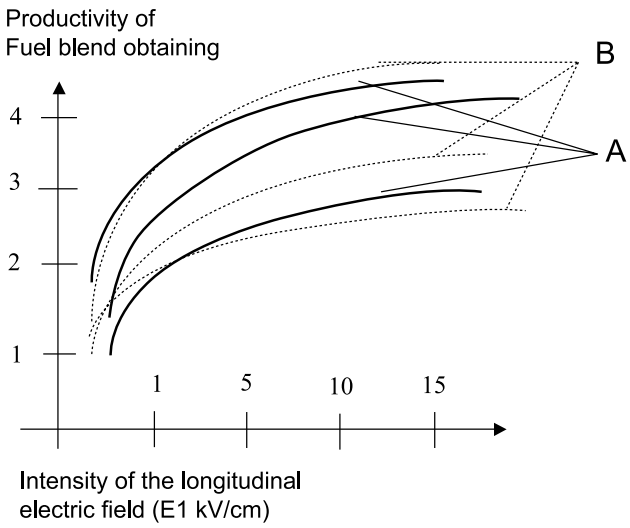

Fig.4

Productivity of the method increases as well as oscillation frequency of the second transversal electric field (A) and evaporating area (B) increase.

There is a known and low-expenditure progressive electric technology by Stanly Mayer, which has been worked out to obtain fuel gas from water (Mayer cells). Our technology is more progressive and ensures higher productivity than Stanly Mayer's technology does [3]. It can be explained by the fact that this electroosmotic effect of evaporation and liquid dissociation combined with a mechanism of the electrostatic pump and the ionic pump ensures intensive evaporation and dissociation of liquid as well as effective detachment of gas molecules from the dissociation zone. The process of gas molecules detachment is accompanied by acceleration from the upper end of the capillaries. Therefore in our case the effect of screening of the working zone of molecules electric dissociation is not produced. All these processes proceed at minimal energy consumption, which is similar to analogous energy consumption. Moreover, the process of fuel gas production does not slow down as the process in Mayer's technology does therefore gas productivity of our method is significantly higher than that of this progressive analogue at similar minimal energy consumption.

Some technical and economical aspects of the new technology realization

In the near future production run of these high-effective electroosmotic generators of fuel gas from practically any liquids (including tap water), which are based on the proposed new technology, can be established. At the first familiarization level it is especially easy and economically appropriate to realize in practice a variant of the device of transformation of water-fuel emulsion into fuel gas. A prime cost of the production-run device for generation of fuel gas from water of 1000 m^3/hour productivity comes to approximately 1 thousand of US dollars. Consumed power of such an electric generator should come to no more than 50-100 Watts. Therefore such compact and effective fuel electrolyzers can operate practically in any motor car. As a result heat engines can work on any hydrocarbon liquid or even on habitual water. Mass application of these devices for the motor transport can cause immediate energetic and ecological perfection of the motor transport as well as designing of an environmentally appropriate and economical heat engine. Approximate financial expenditures for working out and designing of the device for fuel gas obtaining from water, and for bringing the investigation of the first testing device of 100 m^3/sec productivity to an experimental-industrial model come to about 450-500 thousands of US dollars. That contains the expenditures for projecting and investigation, for designing of the very experimental device and of a testing bed, which is necessary for approbation and engineering development of the device. The author is interested in business and creative cooperation with those companies, which can provide this project with investments to bring the device to the experimental-industrial model and introduce the perspective technology into practice.

Conclusion

Electroosmotic "cold" evaporation and dissociation of water and aqueous solutions through capillaries is a perspective way of highly productive fuel gas production at minimum of energy consumption.

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Conceptual Hurdles to New Millennium Physics

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Abstract

Time, space, energy and mass form the four-fold conceptual basis for gauging physical reality. The following paper, as a follow-up to a previous exposition [1] which focused on the necessity to change the current paradigm for time, continues in this same vein, but will also consider in greater depth the interrelations of this phenomenon with the other three yardsticks cited above. Again, information garnered from a wide variety of sources will be considered. We hope to provide, through just such a unique eclectic format, the beginnings of a possible fresh understanding of the workings of nature and perhaps ultimately furnish a conceptual basis for extending the structure of current physical theory to compatibly encompass the elements of a unified framework of physics and metaphysics.

Introduction

In the former article cited above, by investigating the following varied sources and research [2-17], we came to the inescapable conclusion that the phenomena of time and space are considerably more intimately related than is currently suspected by modern science, and will require a drastic re-working to fit the conclusions of the various evidence cited. Towards this end, the adoption of a more expansive paradigm for these yardsticks was suggested, which incorporates a fluid-field nature for time and space where both are derivatives of the fundamental ground-form of energy in flux or oscillation. These new approaches involve the inclusion of a Kozyrev-type of "substantial"(active) time-flow as opposed to the conventional "relational"(passive) concept of time, where it is used as a static parameter signifying duration. The substantial aspect of time pre-supposes that it is an essence which can and does affect physical processes, and that those same physical systems can cause a reverse action on time [8]. Such active fluctuating (deformable) types of time or space, implies the establishment of a revolutionary notion: positing completely *non-scalable* metrics for both time and space. This is in direct contrast to all contemporary orthodox models for physical reality, either in Einsteinean relativity (Special or General theory), quantum field theory, or even superstring/supersymmetric theory, all of which continue to consider both of these yardsticks from their relational (length or durational) standpoints. Consequently, all these formalisms require scalable metrics of some sort for their proper description (for refreshing viewpoints on this matter, see [7]). For instance, in the standard equations of quantum theory, time is regarded merely as an unchangeable static parameter. When we later consider applying these novel substantial aspects of time to the edifice of quantum theory, we will see that time must then become a "hidden variable". It will be seen that by considering time in this manner, a clearer and more tractable explanation of the inevitable probabilistic aspects of quantum theory, evidenced in the signature Uncertainty Principle, complementarity and non-locality will arise, without having to invoke the counter-productive and ill-conceived Copenhagen Interpretation.

Oscillatory Models for Time and Space

Upon accepting non-scalable metrics for time and space, we observe that a similar field nature for **energy** and **mass** must in turn also be postulated. Moreover, from the Killick description of how (sub-atomic) tachion-pairs operate [6], shuttling their energy back-and-forth in a free-wheeling but purposeful manner and creating oscillatory features of time and space by their action, we should consider the possibility of another unprecedented concept: a "value-motivated" energy might be at the foundation of the structural integrity of physical matter. This is conceivable when considering Killick's description of the tachion-pair dynamic/evolutionary cycle as necessarily including the 3-step process of observation – reflection – action (**trinitivity** of motion). Along the same lines, from the Smith book **The New Science** [5], we learn that a so-called "tempic field" energy exists, which could be described as the parent structure out of which our standard conception of "clock-time" (entropy changes) results. The tempic field is essentially a scalar (but not static) function which has vectorial nature only in terms of its distribution or *gradient* in space. Because of the nature of the tempic field, its derivatives – the electric and magnetic fields can operate on each other in a specific geometric/topological manner, to produce a local change in the *time-frame* of matter, to use a term coined by the entity Kryon [4]. This theoretical description of the alteration of inertial/gravitational mass and time-frame has possibly seen recent actual demonstration in the dramatic experiments of John Hutchison [10] and Rudolf Zinsser's "kinetobaric" effect [11], as well as unpublished research of both Wilbert Smith and Ken Killick with electric caduceus-wound coils [5,6].

New Models for Relativistic-Fluidic Vacuum-Structure and Possibility of its Manipulation

All of this evidence allows us to conclude that measurable changes in relativistic parameters of time, space, mass and energy might not only be a feature accompanying rapid uniform movement of physical objects (Special Relativity), or representative of large gravitating astrophysical objects (General Relativity). Indeed, by relying on current limited paradigms, contemporary physics may have missed ascertaining the possibility of being able to alter these same relativistic parameters by the artificial technological manipulation of the tempic (vacuum) fields of sub-atomic particles in stationary matter, by use of specific electromagnetic fields. Tom Bearden, for one, has articulated on these various "futuristic"-type technologies in his many writings over the years [15]. We have recently seen that some of the novel theoretical conceptions of the more visionary physicists such as David Hestenes on the zitterbewegung (vacuum "jitter") phenomenon exhibited by the electron [12-14], has finally caught up with some of these advanced ideas by presenting new mathematical demonstrations (using geometric Clifford-algebraic) manipulations of the Dirac equation. In summary, the Hestenes' study concludes that the Dirac wave function and its properties, including

the Dirac equation and relations to physical observables such as energy-momentum, spin and position probability current, all possess heretofore obscured important geometric relations. These results imply that probabilistic features of the quantum theory of the electron/positron arise principally from the electromagnetic interaction of the accompanying zitterbewegung-spin field of these particles with the ambient dynamic vacuum. This is, of course, in direct contrast to the conventional received view that ascribes wave-particle duality as a property of matter that is completely independent of the nature of its interactions. This revolutionary geometric interpretation of electron dynamics incorporates in its model an electron spin which arises from a helical or spiral world-line in space-time. The essential unprecedented feature of the Hestenes' zitterbewegung idea is the association of the spin with the local circulatory-helical motion characterized by the *phase* of the electron wave function. Thus, we reach the conclusion that the complex phase factor of the electron wave function can be directly associated with an objective helical motion of the electron which is, in turn, a derivative of the zitterbewegung. One intriguing feature of this structure is a frequency of oscillation that is inversely proportional to the scalar radius of curvature of the particles' helical world-line. Moreover, the Clifford-algebraic analysis reveals that this oscillation frequency is identical to electron/positron *mass*, revealing a possible key variable particle mass-energy (*frequency measure*), which is in inverse relationship to particle size. It is clear that this new model has important classical implications not yet considered by established physics which nevertheless directly correspond to some of the key features of sub-atomic behavior enumerated above and previously. Here, we refer to the tachion-pair dynamics [1,6], and also to the microscopic dynamics of elementary particles revealed by the selected esoteric sources previously considered [1-5].

Another researcher who echoes many of these conclusions is C. Sano [21]. Sano built on the work of A.P. Smirnov [22] who postulated that Newton's Third Law of action/reaction actually modeled "screw" structures, implying that elementary particles (specifically electrons/positrons) possess chiral-spiral field configurations. Accordingly, Sano posited that all actions/reactions are transmitted between actors and reactors by parallel or perpendicular clutching of the rotating chains of electromagnetic spirals of the hidden electrons and positron-pairs of the vacuum. Also, similar to the Hestenes' development cited above, Sano postulated that the radius of the outer electromagnetic spiral surrounding the electron/positron pair can change, oscillating in size around either particle, and thus producing the particles' electric or magnetic character. Supporting his theory, Sano cites the key research of I.M. Shakhporanov [23] whose experiments claimed that magnetic monopoles were generated, by employing an electrical circuit based upon Moebius band topology. Some of the unusual phenomena demonstrated by this apparatus, tending to support the magnetic monopole hypothesis, was transformation of diamagnetic substances into paramagnetic, the ferromagnetization of normally non-magnetizable materials (graphite, etc.), acceleration of chemical reactions, acceleration or deceleration of the decay of radioactive materials, etc. Sano also claimed that extraction of energy from the vacuum was possible using rotational action/reaction using magnetic monopoles.

Referencing this research to the current exposition, we recall that the key element of Killick's hypothetical tachion-pair operation was the similar non-linear/non-orientable Moebius-type dynamic cycle which results in the corresponding deformation (compression or rarefaction) of time/space/energy parameters [1,6]. In this regard, the remarkable similarity of this model to the research of Sano and Shakhporanov may be much more than mere coincidence. In fact, later we shall examine new research outlining an apparatus (yet untested), which claims to overcome the Coulomb barrier in low energy nuclear reactions (LENR), and achieves nuclear fusion by producing local time-dilation of soft photons in proximity of the deuteron reactants.

Additional Key Russian Research

To motivate the reader's sensibilities towards consideration of some of these unorthodox ideas, we defer to the previous article [1] in which many of these notions and mentioned research are explored in greater depth, as well as consider the following corroborative research.

One intriguing example of such experiments is the work of V. Chernobrov, from which he has claimed to demonstrate both acceleration and deceleration of local time-rate, within a small spherical enclosed volume conducted since 1988 [18]. The experimental system to produce these effects, was a set of electromagnets, connected in series and parallel and installed inside the globe-shaped surface in several layers. In various arrangements including up to 3 to 5 of such layers, these electromagnetic working surfaces (EWS) of various diameters were installed inside each other (similar to the Russian toy doll "matrioshka") with the maximum EWS diameter was about 1 meter, and the minimum (internal) diameter of 115 mm. With this configuration, Chernobrov claimed to measure small but detectable deceleration (-30 sec/hr.) and acceleration (+30 sec/hr.) of time within the sphere to time monitored outside its field of influence. One interesting difference was noted between the slowing down vs. the speeding up of time. The deceleration occurred considerably more smoothly and steadily whereas with acceleration, sharp discontinuous jumps were observed. These instabilities accompanying time-acceleration was observed in connection with cycles of the moon, diurnal fluctuations, and also operator presence. Chernobrov also noticed another phenomenon that also was reported in connection with the alleged legendary Philadelphia experiment, where matter in different time-frames apparently exhibited strange relative optical phenomena [see 1,4]. Specifically, the human eye in the time-frame exterior to the experiment perceives matter within the time-frame created by the apparatus as either transparent or surrounded by a vague white mist. We note with interest that transparent "shimmering" effects of substances in the target area were also occasionally a feature of Hutchison effect [10].

Academician A. Chernetsky produced what he termed a self-generating discharge (SGD) in a plasma that exhibited longitudinal energy density waves from a

structured vacuum. Some unusual effects noted were over-unity energy generation (C.O.P. > 1), as well as change of the electrical conductivity of matter (reduction of the resistance of resistor) placed between the capacitor plates of the SGD. A local structured vacuum was definitely produced since the resistance value remained unchanged even when the generator was turned off. Here reference must be made to the Kozyrev experiments [1,8], in which a type of similar *memory* process was activated ostensibly within the vacuum. Specifically, it turned out that in experiments with a vibrating torsion balance (or pendulum), at points of support the emerging additional forces did not disappear when the irreversible process (vibration) was stopped, but remained in the system for an appreciable time. The SGD plasma device may have also produced a detectable change in local time-flow rate as evidenced by decrease in frequency of a quartz oscillator placed in the discharge of the generator. The Chernetsky generator thus possibly caused anomalies in time-rate at a local space position. There were also basically anecdotal phenomena where psychic ability of personnel in proximity to the SGD was apparently enhanced [19]. The latter effects are not inconceivable once the intimate connection of consciousness to space and time is ascertained, from consideration of not only hypothetical "value-motivated" tachion-pair dynamics, but from the more prosaic studies as we shall see next.

Pathological Studies in Time-Perception

We can motivate further understanding for the claimed intimate connection of time to space by considering the results of a recent study of patients possessing a disjointed sense of time by Metod Saniga of the Slovak Academy of Sciences [20]. Saniga discovered the brain is hard-wired to perceive space and time as interconnected. Specifically, time pathology is apparently always accompanied by space pathology, in a sense that space either loses dimensions or acquires other dimensions. To quote Saniga "When time seems to stop, people often feel as if space becomes 2-dimensional. On the other hand, when the subject feels they perceive the past, present and future all at once, they simultaneously have the impression that space has infinite dimensions". This phenomenon is apparently not culturally endemic since Saniga illustrates that both pathologies cross cultural lines, evidencing similar studies cited from Italian, German and English psychological journals. In his report, Saniga combined mathematical models ("pencil-conics") and pathology reports of schizophrenic, drug-induced and other abnormal perceptions of time. His current work also encompasses studies of near-death experiences. He found that most of those who claim to have allegedly crossed over to the "other side" and back, tell similar tales. For that brief moment of near-death, the universal subjective experience of all individuals in this state of consciousness is that time loses its meaning. Although such evidence can at best be considered as anecdotal, since subjective conscious experience transcends the possibility of scientific proof, nevertheless perhaps these results from pathological and near-death studies also give us a hint towards new conceptions of time and space that necessitate both phenomena to be inextricably linked.

Investigation of the Possible Internal Properties of Time

One inescapable conclusion that results from all the above varied studies, either scientifically or psychologically based, and which cries out for future experimental verification, is the possible existence of an internal structure for time. Such a structure also implies the necessity for constructing a new edifice for physical reality that incorporates non-scalable metrics for the four fundamental yardsticks. We shall first investigate supporting evidence for internal time structure and subsequently the various implications of space, time, energy or mass that is non-scalable.

First, accepting an internal time structure, we are led to conclude that in quantum theory, time must then attain "hidden variable" status. One recent study that brilliantly articulates this notion, is the thought-provoking paper by X. Chen [24]. By positing 3 time variables as quantum hidden variables, Chen derives the Dirac equation classically. Moreover, he demonstrates that the non-intuitive property of "spin" of an electron or positron , arises naturally as a topological property of 3-dimensional time + 3-dimensional space. By extrapolating from this model, Chen then concludes that the inherent probabilistic aspects of quantum theory itself, as evidenced in wave-particle duality, Uncertainty Principle, quantum non-locality ("entangled" particles), etc., can be interpreted as the behavior of a single particle in 3 + 3 time-space. Chen postulates that the three dimensions of time geometrically form a "time sphere", with a generic point on the sphere possessing the following 3 coordinates: time radius, and two "time angles". The mathematical formalism arising from the process of stereographic projection from the north pole of this sphere, having radius of one-half, to any point on the spherical surface, incorporates both the positive-energy (north hemisphere) and negative-energy (south hemisphere) solutions to the Dirac equation (see Fig. 1 for clarification; note Z is a four-component spinor wave function). Also, by considering the evolution of a single particle, from the standpoint of this model of internal time-space, we can derive a picture of different paths on the time sphere of different weights, and on each path causality is satisfied. Through this process, Chen derives a purely classical explanation of the originally quantum-mechanically canonized Feynman Path Integral concept. This result emerges since each path from the time-sphere center to the surface corresponds to each Feynman path, and the surface of the sphere corresponds to the "surface" of the wave function. Chen also classically explains the processes inherent to Bose-Einstein-condensation (BEC) and superconductivity with this model. In such phenomena, two particles with the same spatial coordinates, cannot possess the same time angle, and thus will not have any interaction with each other and occupy the same quantum state as evidenced in BEC and superconductivity. Finally, Chen's solutions of the Dirac equation for a free particle correspond to Hopf bundles in monopole theory, and each Hopf fiber corresponds to each plane wave with different momentum states. This picture corresponds to wave packet diffusion in quantum theory. When a particle is in a fixed momentum state, each space point can contain only one Hopf bundle (one time angle), and various different time angles will be distributed in the whole

space but with the same Hopf bundle. Consequently, that particle can be found everywhere. This picture appears to describe the Uncertainty Principle classically using 3 + 3 dimensional time-space. Along similar lines R. Kiehn [25] has also recently underscored the important but overlooked classical connection between spinors, minimal surfaces and the Hopf map.

Recently, Chen's work has been further developed by H. Kitada [26] who, by introducing both 3-dimensional time and energy operators, sheds new classical light on the uncertainty relation that holds between these two parameters as well. Moreover, Chen is not the only reseracher to derive the Dirac equation classically. R.A. Close has published a paper which presents a classical mathematical description of circularly-polarized waves in 3-dimensions [27]. It turns out that these chiral space waves are satisfied by a four-component wave function which satisfies a Dirac equation. Furthermore, much like the Hestenes' zitterbewegung interpretation of quantum theory, the term normally associated with electron mass in the Close equation, introduces a rotation or oscillation frequency of the propagation direction.

Classical models for nuclear processes have also recently been proposed which incidentally also imply internal time structure. Notable among these, C. Cagle claims to have developed a fusion energy device employing LENR based upon such a classical theory [28]. Normally, Deuterium nuclei are diffuse in momentum space (having high relative velocities). The process Cagle outlines produces a compactification of their momentum space (low relative velocities), so that the deuterons develop a common de Broglie wavelength that is greater than or equal to the inter-particle distance. This is claimed to be accomplished by passing soft x-ray photons near the region of two deuterons in a lattice structure of Lithium Deuteride. **The soft x-ray, when absorbed , produces a region of total *time-dilation*, causing two effects: first, ionization of atoms by strongly repelling any associated electrons in the area, and secondly and most importantly, the physical extent of the time-dilation causes two adjacent normally repelling Deuterium nuclei to overlap in a common momentum space; that is, their relative velocities achieve very low values.** Consequently, due to the time dilation, for a very short time their common de Broglie wavelength exceeds their inter-particle distance. Thus, they become strongly attractive and undergo nuclear fusion.

Cagle also claims to clarify misconceptions about the fusion process in a thermonuclear bomb. He maintains that it is not due to extreme kinetic energies (high temperatures) of particles as supposed in current paradigms, but due to nuclear processes caused by absorption of a time-dilated soft photon flux, produced by Compton scattering of hard x-rays from a fission igniter, passing through a foil of depleted Uranium. Again, just like the controlled nuclear fusion process, this causes overlapping of deuterons in momentum space (low kinetic energies) for a few pico seconds, and subsequent fusion with normal exothermal processes ensuing.

Furthermore, as a fundamental component of his LENR fusion device, which ostensibly produces time dilation and controls energy production from the fusion process, Cagle incorporates a topological field structure termed an electromagnetotoroid. The toroidal field current oscillates between toroidal and poloidal modes in a dynamic cycle which is amazingly virtually identical to Killick's description of the oscillation dynamics of a single unit toroidal tachion [1,6](also see Cagle's website for animated simulation).

Regarding dynamics of astrophysical structures, Cagle further claims that the stellar jet core star of HH30 is also a gigantic electromagnetotoroid. During the poloidal current mode, vast quantities of matter are produced and ejected along the poloidal axis when the mode changes from poloidal to toroidal. This leads one to consider the possibility that the source of superluminal gamma ray bursters, which have heretofore mystified astrophysicists and defied explanation in terms of current paradigms, might be the result of large- scale abrupt changes in the time-frame of celestial vacuum regions, subsequently causing a boost in light velocity.

Implications of Non-scalable Metrics

When postulating fluid-field natures for the four yardsticks of physical reality: time, space, energy and mass, we must assume the existence of a *non-scalable* metric for our vacuum structure. Such a non-scalable vacuum, absent of a defined reference frame, must of necessity possess a *dual* nature. That is, the primary feature of a dual vacuum structure implies that infinitely small quantities must be treated on an equal footing with those that are infinitely large. In other words, information encoded into infinitesimal elements, is also instantly present in the unbounded infinite extents as well. This is tantamount to the existence of a holographic information encoding and transmitting vacuum field, which would structure events in space and time as a non-Markovian chain. In a non-Markovian chain of events, the prediction about the next link in the chain, requires a knowledge of **all** links, not just the one preceding it.

Metod Saniga's research into mystical perceptions of superconscious reality appears to support such a primordial non-Markovian holographic mapping of time and space. To quote from a transcript of such a vision: "I wake up in a whole different world…a different space…This space was distinct from the one we all know. It had different dimensions, everything contained everything else. One was situated in a state of being in which the 'will be' (future) and the 'vanishing' (past) were already included, and this being was my consciousness. It contained it all. The 'being contained' was present very vividly in a geometric way in the form of circles of different sizes which again were all part of a unity since all of the circles formed exactly one circle. The biggest circle was a part of the smallest and vice versa."[20].

Such a structure of time and space can best be topologically encoded in a non-orientable structure such as the Moebius band or Klein bottle. Similar to the data presented in the above mystical revelations and in the previously treated Killick tachion-pair dynamics [1,5], in such configurations "inside" and "outside" lose their meanings and meld into one another; ordinary dichotomic relations distinguishing thesis from antithesis are sublated and supplanted by a higher unity defining the evolutionary process of the system. In the

mathematical edifice abstracted from such a vacuum structure, duality rather than exclusivity of field structures holds sway. This in turn, presupposes a static-dynamic triality of fundamental field structures, characterized by the three magnitudes: zero, infinity and the mediating factor of unity, the latter being an indication that each of the other two field extremes are in perfect balance. Accordingly, we will assume that the stability (coherency) of non-scalable fields results whenever more than half their reality is in common.

Further development pertaining to a specific algebraic-geometric structure that would inherently incorporate this field model, will be carried out in a future paper. Nevertheless, the interested reader can skirmish on this frontier by consulting the relevant recent references to a Clifford-algebraic structure which encodes the projective duality of "space" and "counterspace" into a model for mechanics on the quantum level [29]. This promising model accounts classically for the phenomenon of quantum non-locality. It also heralds a new version of quantum field theory which, by treating electron-positron pairs as topologically non-orientable, is free of the detrimental divergences in self energy and charge, thus obviating the necessity for the ad hoc prescription of renormalization so endemic to current theory [30].

However, due to the limited scope of the current treatment, here we shall only make general comments on the significance of the above-mentioned concept of field triality. Although this model may appear foreign to current physical theory, we underscore that exactly such a system was delineated by W. Smith in the book, The New Science [5]. Observing, as we have [1], that this book in some parts of its exposition can cause confusion, we carefully choose the following selected passages that are most instructive in clarifying the notion of non-scalable metrics and in pointing the way to new paradigms (my comments in parentheses). General comment on non-scalable metrics: "Unity is half way between zero and infinity and always remains the fulcrum about which all other values regardless of scale pivot". On the electric field: "Between the two limits of zero and infinity and through unity there is divergence which we recognize as the electric field, but with the exception that there is no point charge at zero. Our awareness establishes the charge at radius unity with exactly half of it being 'inside' and the other half being 'outside'". On tempic field dynamics: "The tempic field being purely scalar in nature merely contributes to the manner in which changes can occur in the system. If, however, through some characteristic of configuration, the tempic field within a composite particle displays some irregularity, this will manifest as a 'vibration', and if the magnitude of the vibration is sufficient as to cause the interpenetrating fields to exceed the half-and-half point , the whole system will come apart: radioactivity. When a system does come apart, those field which were coherent and interpenetrating in the correct proportion will remain so and take off down the tempic field gradient and become radiated energy". On velocity of light/Planck's constant: "Within the universe we perceive, we are reasonably satisfied that the maximum value of all the coherent fields involved in our particles and radiated energy have the same value. Planck's constant is the numerical expression of this value, and the velocity of light is the expression of the numerical value of the (local) tempic field intensity". On nuclear fusion: "If a region is selected in which there are two fields of the same kind, same magnitude, same direction, such that very nearly half the reality of each is within the region, then the two fields are just on the verge of becoming coherent. If the fields are not coherent, the total energy in the region is the sum of the energies of the two fields; i.e., twice the square of the field intensity of each integrated over the region, or twice the energy of the two fields incoherent. This represents the 'packing energy' of bits and pieces of atomic nuclei, and also points the way to the precipitation of energy out of the cosmic background (vacuum engineering)". Notice how this description, written 45 years ago, of how a tempic field gradient (time-stress) operates between atomic nuclei to produce coherency (half-in half-out condition), perfectly parallels the recent Cagle view, which claims the fusion process takes place only as a function of time-dilation [28]. Finally, on gravitation: "With the exception of skew electric fields (electric field possessing tempic field gradient) all the other fields of an aggregate mass may be considered as static because they have no component of the tempic field at right angles to them. The skew fields (spiral-helical?) on the other hand, are dynamic because they do have a quadrature tempic field component. Furthermore, skew fields are largely incoherent (gravitation cannot normally be shielded) simply because the usual almost random orientation precludes their meeting the half-in requirement of form to become coherent. Since the gravitational field is due to the skew electric field, or stated differently, to the induction from the 'motional magnetic field' (longitudinally moved magnetic field), this is the logical region to explore for the mechanism by which fields may be produced to combine with the gravitational field (of Earth) to produce a resultant more to our liking (alteration of local gravitational potential)".

This last quote describes the gravitational field of a mass as a residual field phenomenon, similarly to the Sakharov and Puthoff conclusions which attribute gravitational and inertial mass to the interaction of accelerated or gravitating matter with the zero-point-vacuum-fluctuations (ZPF) causing a vacuum reaction force [31]. Moreover, similar to the Hestenes' claims, in their recent papers [32], Haisch/Rueda/Dobyns propose that, via this new interpretation of inertial mass as an acceleration-dependent electromagnetic (Lorentz) force, that a former postulate of quantum mechanics appears to be derivable classically via the interpretation of rest mass as the energy of the ZPF driven zitterbewegung; that is, the de Broglie wavelength of a moving particle, may be derived from Doppler shifts of the Compton frequency oscillations associated with zitterbewegung that occurs when a particle is placed in motion.

For further studies of physical theories with non-scalable metrics, the reader is directed to the excellent work of A.A. Nassikas [16]. Like few theories hitherto postulated, Nassikas posits a fundamental probability density function for vacuum energy, out of which oscillatory-deformable sub-atomic level physical aspects of time and space then emerge. This is the reverse to most contemporary paradigms, which view energy as a derivative of matter, time and space, even at the quantum level. Finally, A. Frolov has used Nassikas' theory to explain over-unity energy generation that has been demonstrated in some LENR electrolytic cells of the Pons-Fleischmann variety [17].

Editor: Actually Prof. Nassikas wrote in this patent that the idea which is described in the patent was proposed by Alexander Frolov. In 1996 these questions were discussed by us in Saint-Petersburg. Specifically, a Palladium cathode over-saturated with protons produces an imbalance of the vacuum engine in this area, with an accompanying change in the local time-rate and subsequent breakdown in the Coulomb barrier of the nuclei as per schemes articulated by C. Cagle [28] and T. Bearden [15].

Conclusions

In this journey through the latest research and speculations involving new interpretations of the four physical yardsticks: time, space, energy and mass, we hope the reader and technical specialists/theorists have been inspired to continue research along the lines suggested in the above dissertation. In this regard, certain open-ended questions present themselves that focus squarely on the viability of technological future developments in the new energy field. First, could the missing element in our eventual understanding of all devices featuring documented over-unity energy generation, change in mass (gravitational potential), LENR-based transmutation of elements and the amelioration of radioactivity, etc., be due the alteration of local time-flow in sub-atomic vacuum fields within the apparatus? Secondly, could the frustrating feature of the capriciousness of over-unity power and the like to yield to testable replication in many cases, be due to currently unperceived uncontrollable aspects of time and the vacuum which must be addressed in order to solve these problems? Thirdly, could incorporation of non-orientable topological structures such as the Moebius band, Klein bottle, etc. in new models of electrodynamic field structure, be instrumental in finding the answers to both of the previous questions? With sufficient probing for possible answers to such questions, the present author has the firm belief that new paradigms are certain to soon result that will crystallize these thoughts into viable scientific hypotheses subject to experimental testable verification. As an offshoot and definite bonus of this process, possibly a new more expansive understanding of the role of the vacuum in both nature and consciousness will be in the offing.

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Resonant Phenomena Occurring in Alternating Current Circuit

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There is a classical (according to manuals) notion that resonant phenomena can not influence on efficiency of a transformer or a motor as in a capacitive circuit or in an inductive circuit power produced at minimal power at the input of an oscillation circuit is reactive (let us remind that active power is measured at active resistance).

At the beginning of the last century this aspect was viewed differently. Advantages of a resonant case in alternating current circuits were used in practice. Let us appeal to a rare book by J. Claude-V. Ostwald named "Electricity and its applications by popular language" (I.N. Kushnerev Press, Moscow, 1914, p. 463).

"The phenomenon proceeds in a corresponding electric circuit as well as it occurs in hydraulic model: if self-induction and capacity parallel connected with each other are under influence of an alternating electric propulsion force then the total current coming through the system is equal to the difference of currents which pass two certain paths.

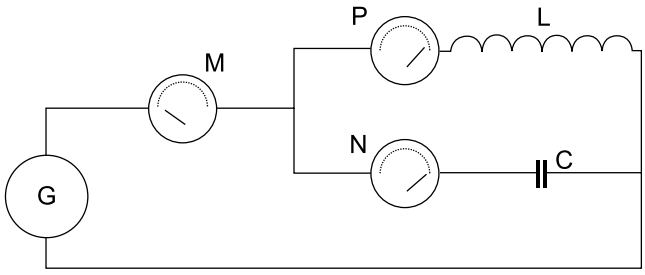

Fig.1

… join ammeters to the general circuit (M) and to either path (P and N). If P demonstrates 100 Amperes and N demonstrates 80 Amperes then the total current will be equal to 20 Amperes instead of 180 Amperes. Thus alternating current has its own "summary" so we should consider its condition. …capacity introduction compensates self-induction action in some way… let us begin to change the self-induction by moving a core into. What will happen if the current coming through the coil achieves 80 Amperes, i.e. is equal to the current observed in the path with a capacitor?

As you guess, since the total current is equal to difference between currents passing the paths then now it will be equal zero. It is an incredible case:the device produces zero current dividing into two paths and in each of these paths current is equal to 80 Amperes. It is a good example for the first acquaintance with alternating current, isn't it?"

Andrey A. Melnichenko (Moscow) is one of modern investigators who research this phenomenon. Any motor of alternating current can be considered as inductance. A circuit consists of motor coils and some capacitor connected in series with the motor winding. Thus if we take the circuit, consisting of motor coils and a capacitor which is connected in series to motor winding and adjust it in resonance, then mechanical power occurring on the motor shaft is produced at zero (minimal) power consumption of an alternating current source.

Melnichenko applied a simple method of voltage increase by meanse of resonance: he succeeded in obtaining of normal voltage for operation of standard motors of 50 Hz 220 V from a source of 50 Hz 110 V and 70 V. The circuit consumption for overcoming of its active resistance (of coils) can be considered as insignificant. Low frequency currents require a large capacitor. Nevertheless even at higher frequency, for example at 400 Hz, the system can be compact and effective. This method is worth to be applied in a scheme consisting of an alternating current motor in resonance mode and an electric generator which has a stable load. Change of load causes change of rotation speed therefore the system requires to be readjusted for resonance.

Experiments with powerful alternating current motors (about 100 Amperes as J.C. Ostwald wrote) working in resonance mode should demonstrate all advantages of the resonance mode application.

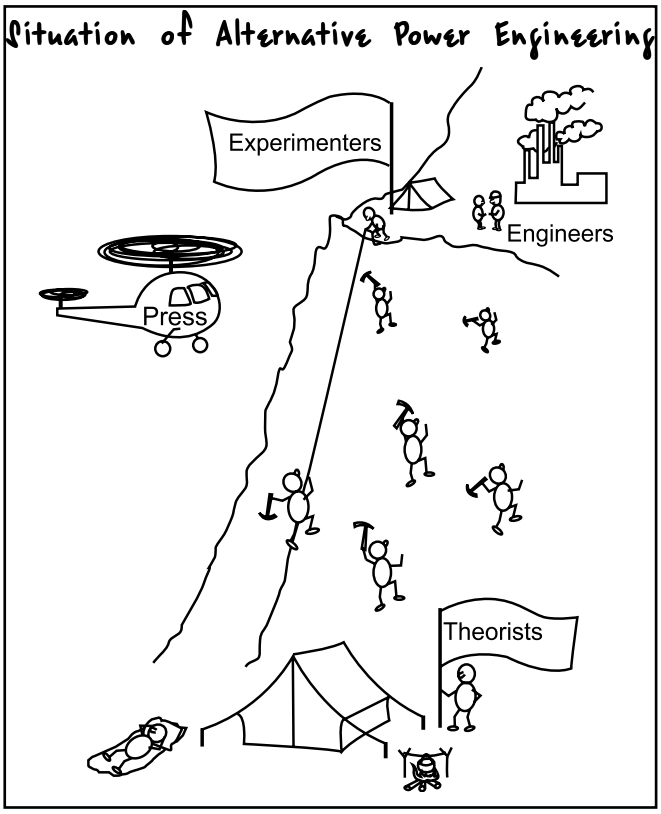

Space Power Generator and Paramahamsa Tewari Update

Submitted by Toby Grotz, USA

http://www.tewari.org

A new generation of Space Power Generators is being built by Paramahamsa Tewari. The new design is expected to achieve substantial gains over previous models which has been measured over unity by experts in the utility industry as well as by independent consultants. Details are presented on the web site http://www.tewari.org.

From the Electron to a Perpetual System of Motion

Paramahamsa Tewari, B.Sc. Engg

As is well known, an electron, despite high-speed interactions with electric and magnetic fields and other particles of matter, remains unaffected structurally—maintaining its mass, charge, inertia, and locality after the interactions. This single fact itself is sufficient to postulate on the existence of some unique universal entity constituting the electron, such that the structure explains the known properties and behavior of the electron – as to how it sustains the collisions with the other particles and, yet, remains permanently indestructible without any reduction in the quantities of its basic properties. A theory that explains this enigmatic fact is framed and described in detail elsewhere. It reveals that the electron is a perpetually rotating system, a space-vortex (vortex of absolute vacuum) that through the process of motion in electric current, and interaction with external magnetic field can also lead to the development of a system partially violating Lenz's law and, thereby, capable of achieving perpetual motion in a machine. Such a conclusion has a new theoretical basis, as well as experimental confirmation – briefly outlined in this paper.

The basic understanding of the interaction of electric current with magnetic fields requires deeper knowledge of the fundamental nature of the electric current as well the magnetic field; this, in turn, leads to an inquiry on the nature of "electric charge" and its distribution in the electron structure. The origin of electron mass and charge, electrostatic and electrodynamic forces are described below with the vortex structure of electron, which further facilitates explanation of atomic structure and, thereafter, an over-unity efficiency generator. Due to brevity, predominantly qualitative-descriptions of the physical processes involved have been presented.

The full theory and diagrams are presented in From the Electron to a Perpetual System of Motion at http://www.tewari.org.

Universal Principles of Space and Matter (A Call for Conceptual Reorientation)

A new book, *Universal Principles of Space and Matter* has just been published by Paramahamsa Tewari. Arangements are being made with the publisher to provide these books outside of India. The price is expected to be about $30 depending on shipping costs from India.

A new theory of matter, that confronts with the existing concepts of space in the contemporary physics.

The basic phenomena dealt with are:

* Structural interrelationship between space and matter
* Origin of mass, inertia, and electric charge
* Creation of the electron from space

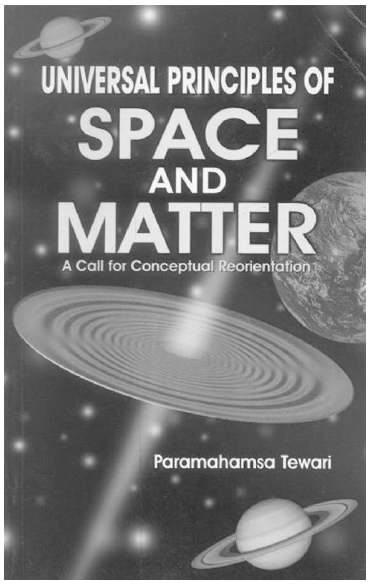

* Discovery of new fundamental equations on mass and charge
* Derivation of the presently known universal constants (gravitational, Coulomb's constant, dielectric, magnetic permeability, electron charge, electron mass, Planck's constant etc.) with the postulate of a single universal costant – the speed of light in the absolute vacuum
* Discovery of an inward force in nuclear structure against the Coulomb repulsive forces, hitherto unknown
* Relationship between light and gravity
* Theoretical derivation of the surface gravity of the Earth, Sun and the planets
* Discovery of electrical repulsive forces between the Sun and the planets, unknown in celestial mechanics
* Derivation of the planetary orbits
* Prediction of the continuous creation of universal matter at glactic centers and existence of electrical forces of interaction btween the stars and galaxies, so far least suspected
* Identifying the fundamental particle of matter
* Revelation of conceptual errors in the modern understanding of the basic nature of light
* Vindication of Einstein's conclusion of the speed of light as the limiting speed
* Vindication of Descartes' principle of property-less ether.

New Reviews of P. Tewari's work

New reviews of P. Tewari's work have been received from Dr. John A. Wheeler and Prof. Umberto Bartocci. A copy of Universal Principles of Space and Matter was forwarded this summer to Dr. John A. Wheeler at his summer residence in Maine.

Dr. Wheeler saw the development of modern physics while working with Neils Bhor at age 27 and was a colleague of Albert Einstein's at Princeton. Credited with being the "father of the Black Hole Theory", Dr. Wheeler is well schooled in quantum mechanics and relativity.

After receiving his copy of Universal Principle of Space and Matter Dr. Wheeler called the book "a unique gift". Further reviews of P. Tewari's work by Dr. Wheeler can be found at: http://www.tewari.org/Critical_Reviews/critical_reviews.html.

Prof. Umberto Bartocci

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This is a very singular book, in front of the current paradigm of contemporary Physics, a "cartesian-inspired" work which calls for reorientation in the foundations, by wisely warning that:

The conclusion of the modern physics that absolute space, time, simultaneity, and space filling media are discredited ideas is certainly premature (p. 178).

The books deals with arguments such as: Discovery of Charge and Mass Equations; Fundamental States of Cosmic Energy, Fields and Forces; Gravitation; Universal Constants; Motion of Electron; Atomic Structure; Light; Creation of Cosmic Matter (about Tewari's physical conceptions see also the second section of this Episteme's special issue http://www.dipmat.unipg.it/~bartocci).

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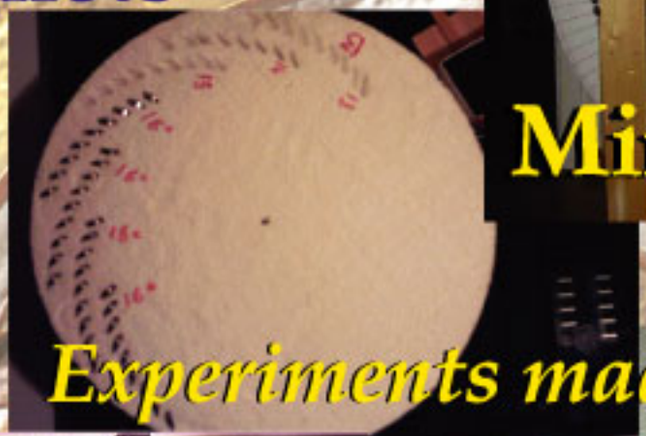

Experiments made in Sweden

by Eric Vogels

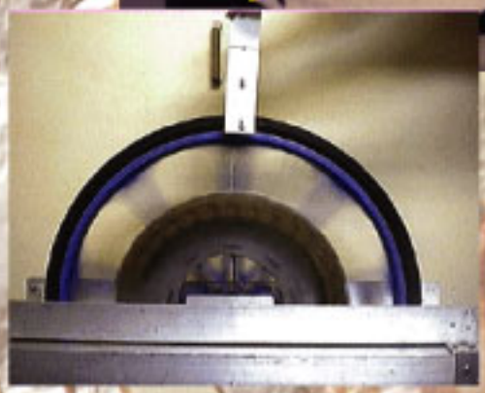

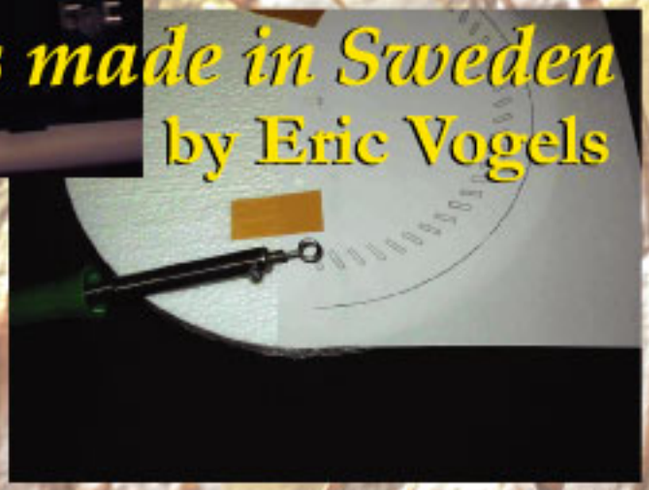

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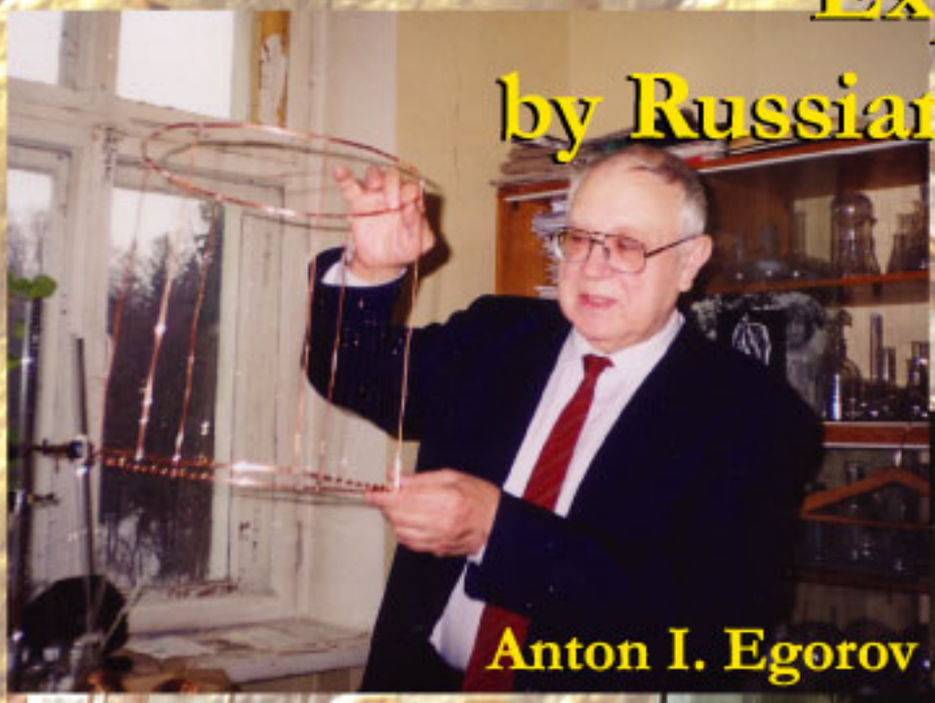

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The standard ball formation

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Minato wheel. Experiments in Sweden

Eric Vogels, Sweden

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The self-running bicycle wheel was shown to the public at the First International New Science Symposium in 1997, held in Korea. The inventor of the wheel, Mr. Kohei Minato, was a speaker during the symposium. On www.keelynet.com you can find the quote of an eye-witness:

"The motor is actuated by moving the N pole of a large permanent magnet (the drive magnet) toward the wheel. As this magnet is moved toward the wheel, the wheel starts to spin. As the magnet is moved closer to the wheel it spins faster.

The acceleration of the wheel is rapid. So rapid in fact, as to be startling. To put it another way I was very impressed. The motor works. And it works very well. In the film clip (see http://fdp.hemsida.net) a slight pumping action of Minato's hand holding the magnet is apparent. When I braced my hand so that there was no pumping action, the motor still ran. In fact it seemed to run better.

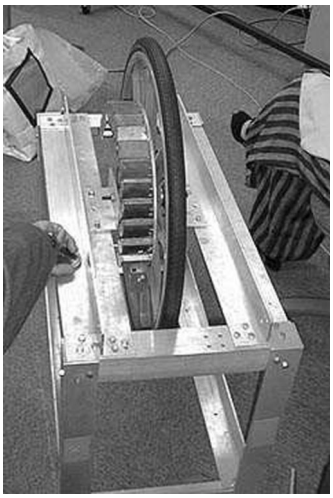

Fig. 1

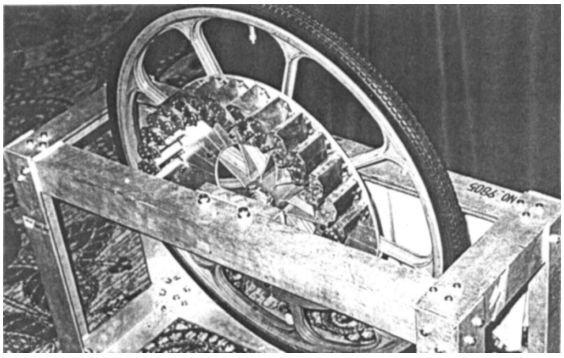

Fig. 2

Pumping action by the hand held magnet **is not** the power that drives the motor. When the drive magnet is moved away from the wheel it coasts rather quickly to a stop and comes to rest in a manner typical of any spinning bicycle wheel. Again when the wheel is at rest and a large magnet is moved up to the wheel it starts to spin. At no time it is necessary to touch the wheel to get it rotating."

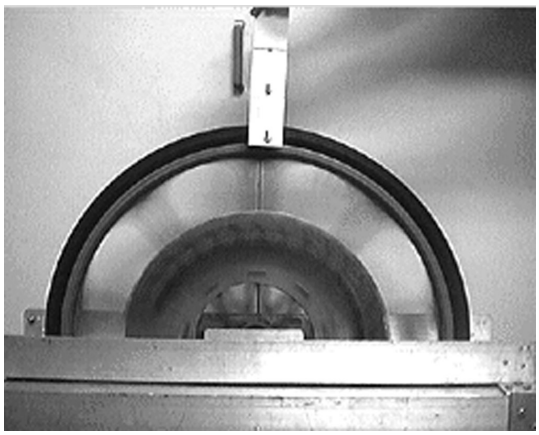

Fig. 3

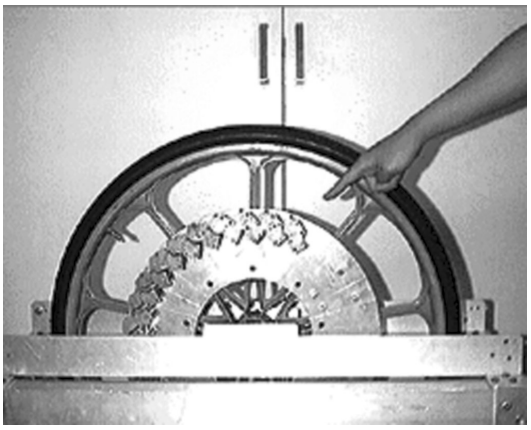

Fig. 4

Since the symposium in 1997 and the first publications in the Internet several people have tried to replicate the wheel, as it seemed to be a **perfect energy source for the future**. Some claims are made that replication was successful but no proof in the form of pictures or video clips are given.

Because I have a great interest in magnets and free energy and the fact that I did a lot of experiments to find a device that could be rotated only by means of permanent magnets, I decided to try to replicate the wheel by myself.

This journey started by searching on the Internet and collecting all the material that was available. A good way to sort all the found material was building my own website at http://fdp.hemsida.net where all my findings are presented.

One of the devices I build was made from a 'how to build a Minato wheel'-manual that I found on the Internet.

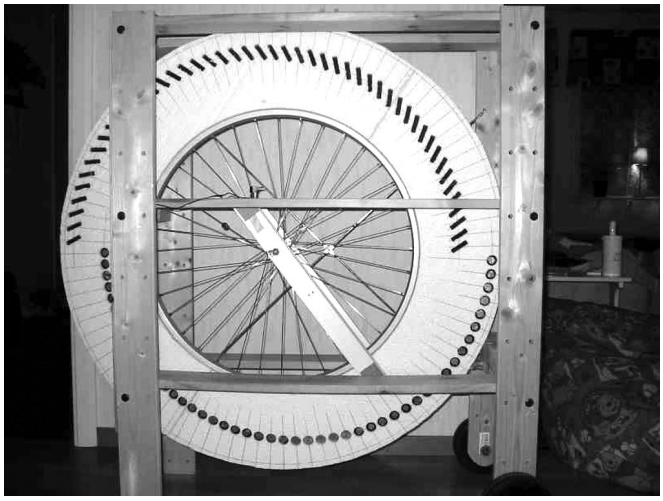

Fig. 5

Unfortunately this wheel did not show any movement at all. I mounted the magnets at several angles and distances from the rim without achieving any positive results. Since the size of the wheel (1 meter diameter) was not very practical to handle and since the results were negative I searched for an easier way for testing. I found that the use of Styrofoam, an old turntable and Neodymium disc magnets kept the whole project within the edges of my kitchen table. I developed a computer program to help me design wheels, since I want to be able to replicate my own wheel, in case I find a model that works. I do not believe in an engine that works after several weeks of tuning and that fails to function as soon as one magnet is replaced. Individual tuning is okay to optimise a working design but if a design does not show the potential to rotate by itself it's a flawed design.

After optimising the way to build the small wheels, I could design and make a wheel in 30 minutes. I made a test scenario and the results for every test were posted on the web site.

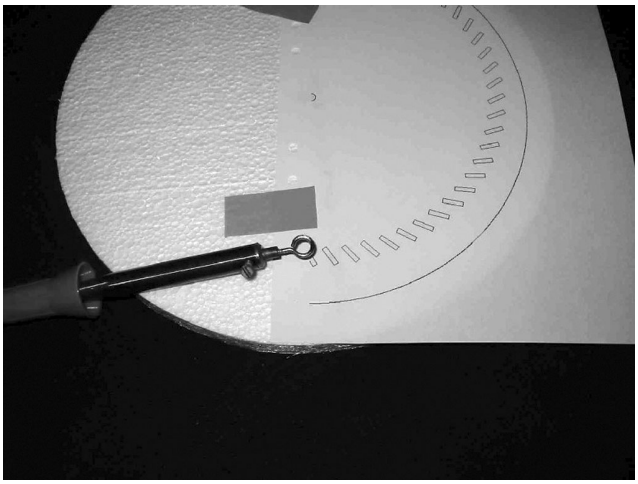

Fig. 6

I searched for the 'perfect' angle, number of magnets and position. The set-up with the strongest thrust was used as the base for the other experiment. By this time I realized that I was not really trying to rebuild the Minato wheel but that I wanted **a rotating device, powered by permanent magnets.**

When for the first time I decided to split a track of magnets that covered 180 degrees of the wheel in a number of smaller tracks, **the results became much better**.

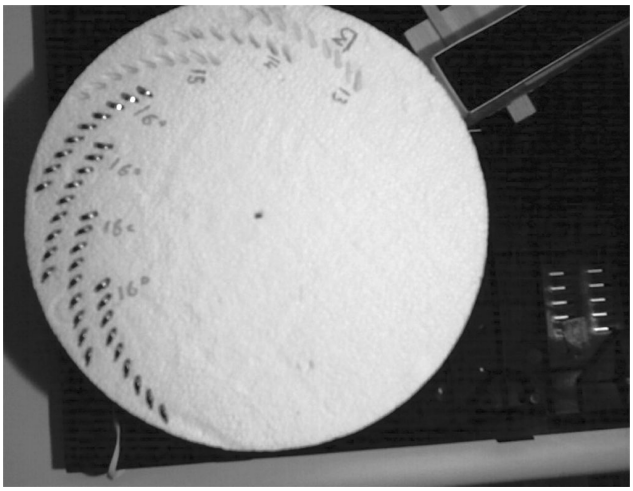

Fig. 7

By using this way of placing the magnets, every track differs a little bit from the next track, depending on its place on the wheel. The angle of the magnets influences on the thrust that is given by the stator magnet, depending on the speed that the track is entering the magnetic field of the stator. In other words: the track at the beginning of the wheel, with magnets covered side of the wheel, gives less thrust than the track at the end. This is important since a track with a lot of thrust has a big 'sticky spot' that should pass the stator. This 'sticky spot' stops the wheel during its rotation just before the first track enters the magnetic field of the stator.

During the last experiments the stator magnet changed place and pushed against the magnetic fields of the tracks from above. Simply because more thrust was developed by this way. The next wheel will have the tracks mounted on a different level. It means that the first track will have a bigger distance to the stator magnet than the last track. This should make the sticky spot weaker and the final 'kick off' stronger. The final wheel will be mounted vertically, like the Minato Wheel.

Thanks to the invention of the Neodymium magnet in 1983, magnets became much more powerful while the size and length decreased. Before 1983 a lot of the experiments could not be done since the size of the magnets made the positioning of several magnets in tracks like this was impossible. It is my personal believes that the strength of these magnets will lead to results that are impossible according to the physical law books, because these magnets did not exist when those books were written.

Until the moment I write this I have not found the perfect energy source yet but by exploitation all the material and findings on my web site I hope that more people get interested and will help searching for a great energy device that will not pollute the air which our children and grand children have to breath.

Mechanism of Drive-Free Motion

Sergey A. Gerasimov, Russia

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The article presents results of the experimental study of the motion created by vibrations of an internal mass of the system of bodies accompanied by impacts of the unbalanced load with the external body. This type of propulsion drive is known by a number of names. Among these are the ***vibrational propulsion device*** *and* ***reactionless machine****. Sometimes it is called the* ***inertioid*** *[1, 2]. The vibrational transposition is proved to go on by means of internal forces of a system of bodies [3-5]. The Tolchin's inertioid [6] is considered to be the first device that used the forces of inertia to create the reactionless infinite motion in space. We are not in a position to be a judge of this. There exist a number of projects of such machines but experimental results concerning such kind of motion are very limited. Below there are the experimental results on average velocities of such a motion and the description of a propulsion device a main particularity of which is absence of wheel-drive.*

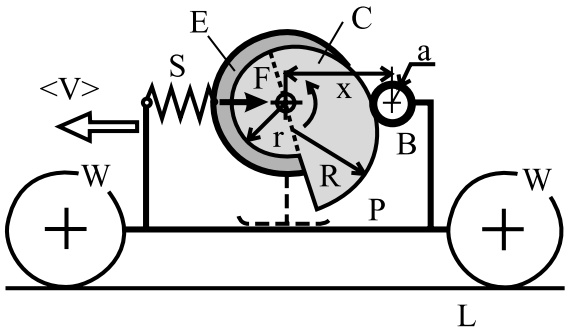

Fig. 1

Scematic representation of a vibratory-impact self-transposition

The unbalanced load in this device is an electric motor E of mass m that executes undumped vibrations relative to a platform P of mass M with four wheels W which can roll on a horizontal surface L with rolling friction the coefficient of which is k. The frictional force is determined to be a force which adjusts to keep the cart from motion across a surface. A disk cam C at one end of the axle of the motor ensures a prescribed character of the vibrations and elastic impacts between the load m and the follower B of radius a. In present experimental device, the cam C consists of two semicircles of different radii r and R as it is shown in Fig.1. In this experiment r=0.03m, R=0.05m and a=0.01m. The electric motor and the platform are coupled by a connecting spring S. The force F by means of which the electric motor is pressed to the follower varies linearly from F=4N at x=0.04m to F=4.8N at x=0.08m. The compressed spring S is necessary not only for creating close contact between the cam and the follower. The restoring force of the spring produces the transposition of the cart in a direction opposite to **F** when the follower moves without contact from x=2R-r+a up to an impact at $x=r+a$. The impact suppresses the transposition. Another mode of transposition is also possible when the impact of the cam on the follower is a reason of the transposition of the cart in the direction of the force **F**. In this case the frictional force extinguishes the transposition of the cart.

Friction between the load of mass m and the cart is negligible since the corresponding effective coefficient is less than 0.001. The same is for the friction between the cam and the follower. The mass of the spring is m_S=0.007 kg , and the mass of the cam is m_C=0.019 kg. The total mass of the wheels is m_W=0.082 kg. This value can be useful for a theoretical

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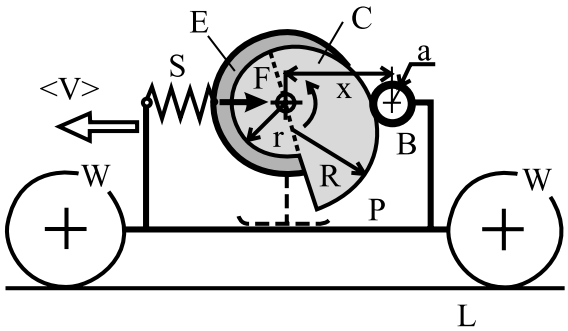

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analysis. Thus, the total mass of the unbalanced body is chosen to be much larger than the mass of the cam or the spring: $m = m_E + m_C + m_S \approx m_E$.

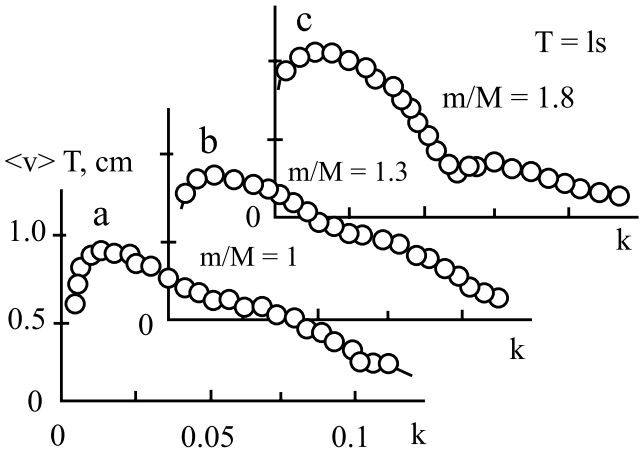

Fig. 2
Frictional coefficient dependence of average velocity of the platform at the period of vibrations T=1s for various mass ratios m/M:
(*a*) M=0.9 kg , (*b*) m=1.2 kg , (*c*) m=1.6 kg

At least in the case of irreversible mode, one could expect that the value of average velocity of transposition $<v>$ must be proportional to the number of impacts per unit of time. In the other words the path traveled by the cart per one impact must not depend on frequency of vibrations. This is a reason why the dependence of the product $<v>T$ versus the value of the friction coefficient k and ratio of masses d = m/M is investigated in this work. Measurements were carried out for two magnitudes of rotation period T= 1s and T=6s of the cam. The obtained results are presented in Fig. 2 and Fig. 3. First of all, the assumption mentioned above is not confirmed.

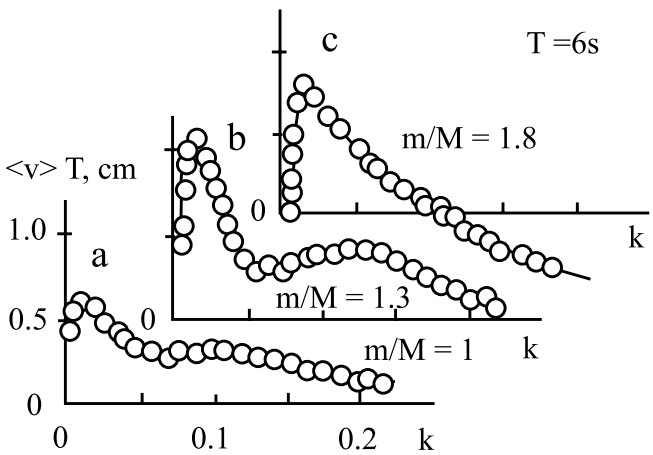

Fig. 3
Average velocity of the platform $<v>$ as a function of frictional coefficient k at T=6s for various mass ratios m/M: (*a*) M=0.9 kg , (*b*) m=1.2 kg , (*c*) m=1.6 kg

The value $<v>T$ for the period of the rotation T=1s sufficiently differs from that for T=6s measured at the same conditions. Besides, when the mass ratio is large the cart can change its direction of transposition. The reason of these results is not clear but this device provides a challenge to explain and investigate this kind of motion that enables us to discover the reactionless motion if it is probable. One should pay attention to a fact that the infinite transposition of the platform takes place even if the friction coefficient k is small.

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About the Author

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Production of Ball Lightning in Laboratory Environment

Report by our correspondent Alla Pashova

Three years ago a working device producing a ball lightning in laboratory environment was designed in Saint-Petersburg Institute for Nuclear Physics (SPINP). The produced ball lightning is accessible for detail investigation and quite stable. The lifetime of the ball lightning comes to about one second that is rather significant for alike artificial formations. The experiments on the device made by scientists of SPINP, i.e. A. E. Egorov, G. D. Shabanov, S. Stepanov, are not supported or financed. Let us note that every scientist of the group searches proofs for his own hypothesis of nature and structure of the ball lightning at all.

A leading expert of SPINP, Anton I. Egorov, pays attention to dethronement of scientific myths:

— There is a myth of ball lightning that is created by mass media. The mythical ball lightning is a concentrate of mysterious energy which is extremely dangerous for a human. It destroys houses, kills animals, pursues people. After meeting it a human can lose his hair or teeth and different misfortunes begin to happen. Supposing a simple story of a farmer-eyewitness: "It thundered, and a fist-sized fire ball rolled down along a drainpipe. It fell into a barrel of water, the water gurgled. I came up to it and put my hand into the water. The water seemed to become warmer…". After republishing of the story by several newspapers a dramatic story about a ball lightning which has evaporated a barrel of water appears. No wonder that such familiar attitude to facts causes hundreds of hypotheses of ball lightning nature.

— **What is your hypothesis about ball lightning structure?**

— At the beginning of 90th I. D. Stakhanov, a member of Institute of Magnetism (IZMIRAN), developed a special method to interview eye-witnesses that resulted a right notion on ball lightning phenomenon. According to Stakhanov, ball lightning is a clot of hydrated plasma which is generated in wet air at electrical discharge.

Water as a chemical compound is remarkable for its anomalous properties: combining of two lightest elements does not generate gas but produces a high-boiling liquid. This is caused by extremely irregular distribution of electrons in a water molecule. Due to this property it acquires properties of an electric dipole. Water molecules interact with charged ions, aerosol particles, and with each other in a special way.

If a positive ion and a negative ion are introduced simultaneously into a puff of warm wet air then water dipoles immediately produce hydrate shells around the ions. When the hydrated positive ion approaches the hydrated negative ion additional water molecules are drown into gaps between them. As a result, there is a stable cluster in which the charged ions are conserved. The cluster consists of two ions of opposite charges and the hydrate shell. Water molecules prevent the ions' approaching and recombination, hence, lifetime of the ions in the cluster increases up to tens of minutes, i.e. in 12-13 orders. Interaction of clusters causes open-chain structures followed by space structures. That is to say, there is appeared a clot of cold hydrated plasma that accumulates great energy (up to 1 kylojoule per liter). The clot of plasma loses this energy at recombination of ions.

— **Could you, please, tell about the design of the device? What processes proceed when the device is operating?**

— Our task is to introduce an abundant population of ions into a puff of warm air saturated with water vapors. A base of the device for laboratory reproduction of ball lightning is a capacitor bank which is able to be charged up to 5.5 kV. The positive pole of the capacitor bank is connected to a ring electrode by means of a copper bar. The ring electrode is placed on a bottom of a polyethylene reservoir filled with water. The negative pole of the capacitor bank is connected to a carbonic electrode which is placed in the centre of the reservoir near water surface. A quartz pipe encloses the electrode in such a way that it is possible to drop water or to put some natural matter on it.

To generate a ball lightning 2-3 drops of water are put on the electrode. When impulse discharge occurs a bright plasma spout escapes the centre of the electrode that is accompanied by a quiet plop. A glowing plasmoid which is an artificial ball lightning parts from the plasma spout. It comes up slowly in the air and then disappears falling to pieces in 0.2-0.3 seconds.

We have made thousands of experiments for investigation of ball lightning properties, i.e. defining size, lifetime, colour, average temperature, excessive charge, content of a dust component.

It was ascertained that the artificial ball lightning is generated in a narrow interval of breakdown tensions. The average size of such a ball lightning is 12-20 cm,

and its lifetime comes to 1 second. Temperature of the ball lightning is not very high, i.e. 50° C. This can be defined if to take into account speed of rising of the ball lightning. If the plasmoid is accepted as a puff of warm wet air of 14-centimeter diameter which in atmosphere comes up at 293 K at speed of 1-1.2 m/sec then, consequently, its temperature should not exceed 330 K.

Colour of the lightning varies greatly and depends on presence of aerosol of matter trapped in the moment of discharge. Usually the lilac central part of the plasmoid is surrounded by a diffusive yellowish layer. Some admixture of natrium salt and calcium makes the core of the plasmoid yellow or orange.

If the central carbonic electrode is replaced by an iron or copper or aluminum one then the fundamental character of the phenomenon does not change. However, colour of the plasmoid depends on a radiation spectrum of excited atoms of the electrode, i.e. iron plasmoids are whitish, copper plasmoids are greenish, aluminum ones are white with reddish shimmer.

— **A generated ball lightning exists for about 1 second. How can it be made more stable?**

— Lifetime of an artificial ball lightning depends on many conditions, i.e. size and geometrical form of the central electrode, voltage between the electrodes, value and duration of a current impulse, temperature and electroconductivity of water which is put on the central electrode. Besides, lifetime of the plasmoid can be changed by introducing an additional dispersive phase into it. We have tested tens of matters and begun to investigate suspensions of colloidal graphite and fine-dyspersated ferric oxide.

A suspension of 3 g of colloidal graphite, 8-10 ml of acetone (which played role of penetrating agent), and 90 ml of water is put on the central carbonic electrode. When an electrical discharge occurs a layer of the suspension forms a flying spherical plasmoid. It comes up slowly and disappears in 0.3-0.8 seconds. The core of the plasmoid has a colour of flame, i.e. colour of burning carbon.

To prolong the existence of the generated ball lightning without application of aerosols it will be possible to use the so-called "Faraday's cylinder" whose production has been already begun. For the same purpose G.D. Shabanov proposes to put a stopping potential on a probe of detention.

— **There is an opinion that physical nature of ball lightning is similar to the process of controlled thermonuclear fusion. In this case, if your work on generation of a stable ball lightning is successful then you will be a competitor of the expensive project of controlled thermonuclear fusion**.

— I think that it is totally incorrect. Hydrated plasma is the first enemy of the thermo-nuclear fusion as water molecules do not allow neutrons approach each other. Effective cold fusion should be realized in organic liquids, for example, in heavy acetone or in a water-free medium. Somehow, it should be an absolutely "dry" process. No experiments on real "dry" cold fusion have been realized in practice. It has not been also examined the surfaces on which the combination of heavy hydrogen atoms produces maximal heating.

Scientists should pay attention to two most effective cold fusion processes. The first one expects association of two atoms of deuterium occurring on a totally dry deuterated surface which consists of, for example, zirconium deuteride. In the moment of fusion of a deuterium molecule local heating appears, and neutrons depart. The other perspective method of realization of the cold fusion process requires an absolutely "dry" organic liquid, i.e. liquid acetone in which hydrogen atoms are replaced by deuterium atoms (C_3D_6O) or by atoms of cyclic compound of $C_6(D_2)_6$. A tellurium or zirconium tip of an ultra-sonic dispersant is placed into a reservoir of this liquid. Cavitation blebs are formed on the surface of the dispersant. Neutron output comes to 10^4 particles. Maximal neutron output, which was achieved by Lipson, an American experimenter, consists of 10^8 neutrons at a desired result of 10^{13}. Certain quantity of neutrons can be obtained during ultrasonic cavitation which is accompanied by a phenomenon of sonoluminescence. Due to sound resonance the only cavitation bleb is generated in acetone. When the bleb collapses weak glowing is observed. The cause of this phenomenon consists in gas heating occurring in the bleb that is the result of high pressure produced by its collapse. The burst can last from 1/20 up to 1/1000 sec. Light intensiveness depends on quantity of gas in the bleb. If gas is absent in the bleb then the glowing does not occur. Light emission of the bleb is very weak, it becomes visible if it is strengthen or in absolute darkness.

— **Is it rightful that cold fusion is the future of world power engineering?**

To my mind another direction seems to be more perspective, i.e. extraction of uranium from sea water and then its burning in heavy hydrogen reactors like one which exists in Canada. Photo voltaic accumulators can also become a successful approach of the alternative traditional fuel engineering. By the way, a working model of such a device to utilize free solar energy has recently been created in our Institute (official web site: http://www.pnpi.spb.ru).

Editor: Read the publications on this theme in following issues of our magazine. Below there is a description of other attempts to generate a ball lightning in laboratory environment or at home. Besides, we publish an article dedicated to the problem of laser control of ball lightning. In the article there are photos (also see the cover page) and a scheme of the working device designed by this scientific group.

Ball Lightning Experiments

Information from
http://www-personal.umich.edu/~reginald/ball_l.html

Ball Lightning in the Microwave

This is a great experiment to try at home. It requires a microwave oven, a candle, a toothpick and a lighter. First you put the candle (~1-2 inches in height) in the microwave (remove glass plate from bottom so candle sits on metal). Put the toothpick in the candle sticking straight up. Light the toothpick on fire so that flames are leaping off the tip. Shut the door quickly and turn on oven full blast. There will be loud popping noises and then balls of fire will leap from the toothpick and fly around inside the microwave while making a buzzing sound like a bee. If it doesn't work at first try to move the position of the candle in order to find the "hot spot" in the oven for it to work.

Real Ball Lightning Generated by Pulsed Power Inductor

This experiment is very DANGEROUS. The author did this one a few years ago. The Idea was got from an article about a guy generating ball lightning using a high current transformer (TBA). The author had an idea of using an inductor to store large amounts of electrical energy. The conductor on the end of the stick touches the metal ring. This completes the circuit, and start the inductor. Then there was used the air compressor nozzle to blow out the arc as the wire was pulled away. The copper wire explodes and creates rapidly rotating and burning molten balls of copper. These 'Balls of Fire' exhibit many of the properties of real ball lightning.

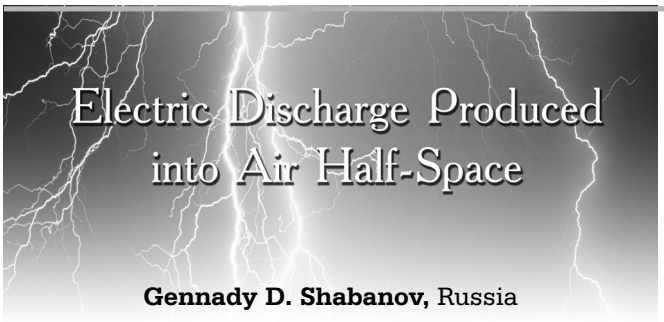

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In the article a possibility of streak lightning control by means of low intensive laser emission is observed.

During investigation of an electric discharge into air half-space [1] it was noticed that this discharge can be controlled by a low intensive laser beam. Now there is a problem of laser control of lightning discharge [2]. However, numerous works on this approach demonstrate that "the hope to get a quick solution of the problem of lightning control by laser emission has not been confirmed" [3].

Careful observation of this problem in [2] has shown ways out the situation. The authors of [2] consider plasma channel produced (by means of laser) in free atmosphere at a possible greatest height to be of doubtless interest of the science of lightning. Finally, creation of the plasma channel should be of benefit for lightning protection. The authors of [2] give notice that "there are many difficulties of fundamental and practical importance on this path".

Weak theoretical understanding of lightning generation causes pessimistic estimations of solution of the problem. The article [2] notes particularly that "there are neither adequate theory, nor numerical calculations and qualitative understanding of the phenomena defining the speed of a leader… The situation of a theory of the leader channel is little better (from quantitative point of view)…".

Realistically the following statement can refer to the lightning discharge: "The electric discharge appeared to be very "unhandy" for theoretical description but the most interesting phenomenon in the experimental aspect" [4].

Experimental Part

In this work a capacitor bank with 0.6 mF capacity, which can be fed up to ~5 kV, was used to produce impulse discharge into air half-space. A scheme of the device is presented in Fig.1. At connection/disconnection of a discharger 5 a "spout" is let out of an electrode 3. The spout carries the potential of the cathode (virtual cathode) at a significant height into air half-space. A probe placed at the height of ~15 cm fixes a potential which is similar to the potential occurring at the cathode. The researches have demonstrated that the produced formation continues to glow for several hundreds of milliseconds (the glow is fixed from a zone located at 15-45 cm above the cathode). Typical time of the discharge comes to 100±20 msec and depends on the cathode material. Electric field generated in the spout comes to less than 8 V cm^{-1}.

Ball Lightning Experiments

Information from
http://www-personal.umich.edu/~reginald/ball_l.html

Ball Lightning in the Microwave

This is a great experiment to try at home. It requires a microwave oven, a candle, a toothpick and a lighter. First you put the candle (~1-2 inches in height) in the microwave (remove glass plate from bottom so candle sits on metal). Put the toothpick in the candle sticking straight up. Light the toothpick on fire so that flames are leaping off the tip. Shut the door quickly and turn on oven full blast. There will be loud popping noises and then balls of fire will leap from the toothpick and fly around inside the microwave while making a buzzing sound like a bee. If it doesn't work at first try to move the position of the candle in order to find the "hot spot" in the oven for it to work.

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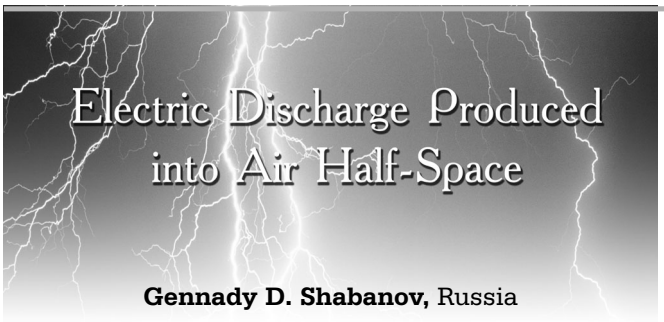

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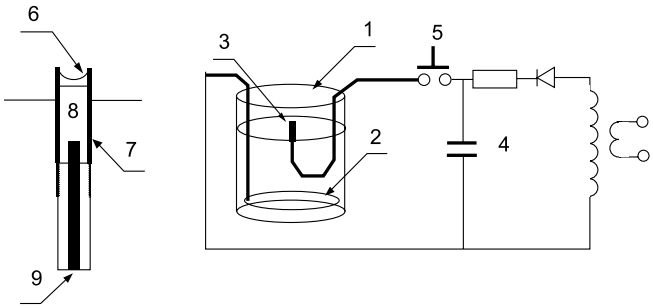

Fig 1
A scheme of a device made for producing of long-living plasmoids

1 – a polyethylene reservoir, 2 – a ring electrode, 3 – a central electrode, 4 – a capacitor bank of 0.6 mF capacity, 5 – a discharger, 6 –water or aqueous suspension drop, 7 – a quartz pipe, 8 – a carbonic or metal electrode, 9 – a copper bar.

The spout was acted by weak laser emission of less than 1 mW at 22-centimeter height. The laser beam was directed perpendicular to the discharge axis, the spout achieving the laser beam moved along the beam towards the laser.

In Fig.2 the spout has moved ~8.5 cm along the laser beam, and a usual sphere formation was generated. Due to the horizontal motion it was distorted if to be compared with usual sphere formation. The usual sphere formation is represented in Fig.3 (also see the cover).

Fig. 2
Motion of the leader channel (spout) along the laser accompanied with the sphere formation

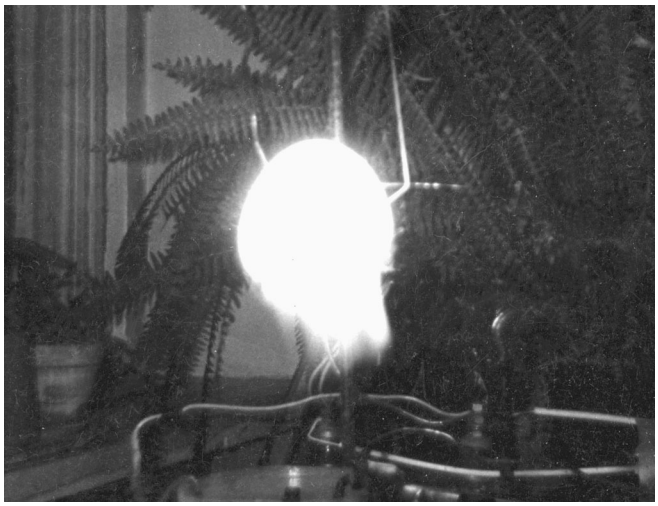

Fig.3
The standard ball formation

Discussion

As it is evenly mentioned in [5], results of model experiments are difficult to be applied directly to laser control of lightning because in short intervals characteristics of the discharge differ from characteristics of lightning discharges. Actually, at comparing considered current and the field existing in a lightning (i~100 A, ~3 V cm^{-1}) with these phenomena occurring in a laboratory spark (~1 A, ~300 V cm^{-1}) incorrectness of modeling of this process becomes obvious. From the other hand the authors of [2] note that "the leader channel is like a channel of electric arc… At current strength of ~100 A plasma of the channel of the arc is supported by fields the densities of which come to several volts by a centimeter. The lightning has such leader currents".

Even an air arc of atmosphere pressure has a field of about 100 V cm^{-1} at currents of about 1 A. The generated discharges (spout) accompanied by the field of less than 8 V cm^{-1} (maximal current appearing in the discharge gap is 50-60 A) are more appropriate for modeling the leader channel of the streak lightning than typical discharges used for investigation of these processes, for example, like [6].

At first approximation the leader channel is considered as an ideal conductor in the article [2]. We make research to define the field in the discharge (spout) more exactly. The article [2] makes the following consideration about a cause of occasional generation of new leader heads: "the surface of *equipotential* plasma conductor (channel) *has* a property of *instability*. There is an occasionally generated sharp jut. An intensified field appears at the jut along the edge. Under the influence of the field the jut becomes to grow in any direction including at the significant angle to the weak outer field". The aforesaid seems to explain why our leader channel changes its direction and runs at right angle to its initial motion. (Fig.2). Weak harmonic action of the laser beam to the leader channel causes generation of a new head which continues motion "on the significant angle".

The effect of plasma motion towards a light beam is a demonstration of a general tendency of propagation of the discharges to an incident electromagnetic field [7]. "Area occupied by plasma usually increases towards the laser emission" [8]. Leading character of motion of this formation is confirmed in [9] as well as the interaction with the laser beam is confirmed in [10]. It should be taken into account that in the works [9-10] experiments were performed at devices which generated such a discharge. However, that discharge was by 2 orders weaker than the discharge generated by the device represented in this work. Naturally, the results were less defined. Comparison of the discharges is presented in [11].

According to our data, the leader channel (spout) has a very abrupt bound (less than 1 mm). In this layer the field can come to ~30 kV cm^{-1} (at height of 15 cm).

Conclusions

Due to the assumption [2] about *instability* of the surface of the *equipotential* leader channel there has been successfully performed the "control" action on an electric discharge which models a streak lightning. It has been achieved by means of weak harmonic oscillations made by the laser. This mechanism is supposed to be applied for streak lightning control.

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In general the conception was formulated in 1995 and today we can say that the concept of physical vacuum, which is a new source of energy, finds more and more supporters. The fundamental works about nature of "zero point energy" are published, for example, Andrew D. Sakharov [1], Hal T. Puthoff [2] and many other interesting works. It is clear now that space or "physical vacuum" has its internal structure, therefore it can be used as a new source of energy if we organize the process of changing of this structure. Moreover, according to some theories, the existence of reality (i.e. the World of some certain parameters of space and time) is defined by the function of probability of energy density. For example, Dr. Nassikas, Greece [3], proves that it is not possible to consider the space without its energy, and there is no space without energy. The internal structure of reality is coexistence of two forms: gravitational energy and electromagnetic energy. Any local increase of the first one should produce decrease of the second one, so the sum amount of the change is zero.

In some other articles about energy transformation processes (gravitational form of energy into electromagnetic heat radiation of mass, for example) we can find that both increase of entropy and the inverse processes (decrease of entropy) are possible and in this case the electromagnetic energy can be converted into the gravitational form, that is shown in details in the works of Nobel laureate I. Prigozhin, Order and Haos. Man's new dialog with Nature, London, 1984. Since **the direction of time** (the time course) **and direction of the entropy change** (increase or decrease) are related notions then free energy technologies are considered by Kozyrev as methods of practical application of natural time course [4] that is presented in aether-dynamics by Frolov as aether flow of some density and this aether density determines the time rate as hardness of cause-effect connections for any process, and also for the process of existence of matter in space-time of this aether density.

According to this theory, in any point of space it is possible to get power by means of energy transformations without any consumption of mass-fuel. We can say also that in this case some change of the energy density of space should be detected.

Let's clarify some determinations:

1. The Potential (lat. Potentia that means "force"). In physics this is scalar parameter, it's gradient expresses the intensity of field of a certain force. In common sense, the potential is possibilities, which exist for execution of some task, for completion of some work.
2. The Work is a quantitative parameter of energy transformations. The transformation means here change of form.
3. The Energy (Greek "Energie" means "action, activity") is a quantitative characteristic for different forms of motion.
4. The Power is amount of work per unit of time.

According to the given determinations by The Soviet Encyclopedic Dictionary, edition of 1988, Moscow, **the fact of presence of potential (scalar) field, for example, electrical or gravitational filed, is real possibility to produce some work if we can organize change of energy forms. Let's note that power source is not required to keep the potential field in force. It is free.**

...the potential (scalar) field can produce real work!

The example of this work, which is produced by the field: body falls in gravitational field and when it strikes on the ground then some part of its potential energy is transformed to heat, that is the work as transformation of energy forms. So, there is a conclusion: the potential (scalar) field can produce real work! But we have considered only a half of cycle and in classical case in the second half of the cycle it will be necessary to produce the same work against the field to raise the body to the initial point.

Let's formulate the task to produce the work periodically and to get the power in load from this process. Usual mistake is to accept the particular case (the same body returns back in the same field) as a single possible case. But in special case changes of the system are possible, for example, the field intensity is not a constant but some variable value (alternating or pulsing), or the body changes its own parameters. In this case in each of half-cycle of the process the field can produce real positive work to accelerate the body.

The main technological solutions are obvious: **it is necessary to create gradient of field in space** (full or partial screening of trajectory of the body, which is moving in the field) **or gradient of field in time** (pulsing mode of field). This is quite easy for electric and magnetic fields, but for system, which uses gravitational field to produce the work, we can assume changes of parameters of the body only.

It is possible to understand why professional physicists dislike the question about possibility to use scalar (potential) fields to produce useful work in a load since they think about The Law of Energy Conservation. To find mutual understanding it is necessary "to upgrade" this Law for 4-dimentsional case of real physical system. It is necessary to introduce **the notion of the structure of space-time** where the considered process is created. In other words, for real practical engineering tasks it is necessary to consider **space-time of the real process** but not an abstract space-time. Usually the energy density of technical processes is small in comparison with natural energy density of space (aether density), which is a result of real astrophysical processes, i.e. motion of planet, star, galaxy. If we discover structure of this real rhythm of the space-time of our planet then we'll be able to design it in our technical devices to use aether-dynamics as theoretical basis.

So, in orthodox physics there is the unchallengeable formulation: the work of potential field on closed trajectory of motion is equal to zero. Yes, it is right for only case: if one part of work is positive (the acceleration) and another part is negative (the deceleration). But one part of the trajectory or a part of periodic process with the negative work can be excluded by different methods: by means of spatial superposition, pulsing mode and change of interaction polarity or by the screening of electromagnetic interaction.

For example, minor changes in vacuum tube design (the grid is located under cathode) allows increasing the kinetic energy of electrons and to increase emission current by means of the potential on the grid only. Also vector potential of magnetic field or gravitational potential can be used by similar way.

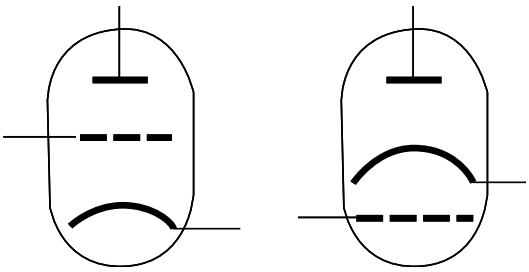

Fig. 1

Besides this way it is possible to use pulsed mode and switch-off the primary energy source before the emission electrons will reach the anode, Fig.2. In this case there is not the conductivity current between anode and cathode and the primary source is not discharging during its work.

Therefore, it is not a news that potential field can produce real work. In any textbook there are examples of positive and negative half-cycles that result to zero net work. But for the case of consequent execution of two processes the parameters of one of the processes can be changed, that **the work, which is produced on the closed trajectory can be formed as two or more parts of positive work.** Important aspect is following: it is necessary to determine the point (moment) of change the sign of the interaction and at that point (moment) to change the parameters of the process accordingly.

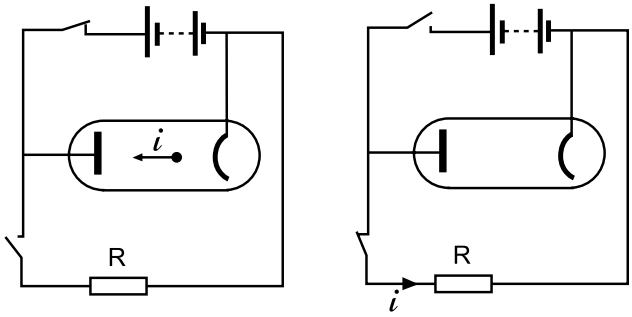

Fig. 2

The good sense requires the answer: what is the source of the power to produce this work if this proposed concept is right? Let's notice that before the considered examples, the existence **of power interactions of potential fields** must make the same question. For example, how the ordinary permanent magnet (i.e. its vector potential) holds a piece of metal making work against force of gravity without any fuel? How the potential field can move and accelerate ions, i.e. kinetic energy of ions can be increased without any fuel? What provides the forces of elasticity? Let's try to find answers from consideration of inner structure of electric and magnetic field, especially let's develop **our understanding of the notion of gradient, which describe properties of space-time design in area of this field.**

The concept of potential as bi-directional flow of photons and anti-photons was proposed by English mathematician E. Whittaker, and then it was developed by Dr. Thomas E. Bearden [5]. In this concept, the generalization of the Third Newton's law looks as the requirement of complementary pair to the process of the electromagnetic radiation. Since "process" means a change of information in time, this paired anti-process is reversed in time. Of course, it is development of process to its own future, but from our point of view, it goes from future to past. According to generalized Third Newton's law the radiation of photon is paired with anti-photon. In this case, the internal space-time structure of electric potential field is formed by two contrary flows of energy: photons spread from charge source and the anti-photons "inflow" into the charged mass. Let's notice that this concept defines the relationship of charge and mass. The charge without mass does not have any sense.

The flow of energy outgoing from charged mass is responsible for all phenomena of radiation. Incoming flow of energy is responsible for the gravitational interaction. Therefore, the notions "radiation" and

"gravitation" can be considered as complementary pair; that is considered in details in concept of Josef Hasslberger [6].

...it is impossible to get "something" from "nothing"

There is a quite correct question: since "something" can not be created from "nothing" then what and where will be changing if we create the process of free power dissipations in local area of our space-time by means of asymmetrical potential interaction?

Let's try to present a "process" as some change of "information" in time and from this point we'll get the conclusion about results of this energy disbalance of the natural internal structure of potential field: in this case the entropy process in direct time (heat dissipation in load) should be balanced with equal anti-entropy process in reversed time. In other words, the disbalance is change of the space-time curvature and changes in the time rate.

So, it is impossible to get "something" from "nothing" but if we have understanding of the balance (process in time and anti-process in reversed time) then in the Universe the 4-dimentsional balance is not violated. It is assumed here that it is impossible to create one process but it is possible to create two opposite balanced processes, and each of them produce real work in the load. In astrophysical consideration it was stated in 1964 by Academician Gustav Naan, Estonia, Tartu. He wrote [7]:

"In our real world we could extract any amount of energy from vacuum if some technology provides at the same time the extracting of the same amount of energy for anti-world. Total sum value of energy is equal to zero."

Let's note also that similar conception of "dynamical zero" was applied in ancient India mathematics, i.e. "zero" is not "nothing" but it is hidden possibilities (balance of forces).

One more interesting question appears: what is about reality of the particle of matter after we have claimed that its mass-parameters are parameters of certain process? With this idea the material world as a whole is certain process and "stability" is not a property of some object but a parameter of its existence, which is a process in space-time of some certain energy density and some certain structure. By analogy the vortex in liquid is a process but it is not a liquid.

Thereafter, as electron was presented by Shredinger as wave packet and by Whittaker as function of two scalar potentials, the old idea of instability or **dynamic structure of matter** has the possibility of experimental testing and development as a teleportation technology. This idea is technology of space-time engineering, i.e. creation of the space-time with some certain parameters where curvature (or rate of time) determined rate of existence of the matter in space. It is related with some energy density, which can be increased or decreased. Since by this way it is possible to consider any material particle of substance as certain process, which is balanced by corresponding time-reversed process, so there is no theoretical difficulties to develop technologies of chemical transmutation, materialization, dematerialization, teleportation etc.

So, the using of potential energy to create a process of dissipation of power in load does not violates the Law of Conservation, and this Law can be generalized: the total energy of four dimensional system is amount of energy of processes in time and energy of processes in reversed time, it is constant and it is equal to zero.

Now let's try to review some free energy projects (the systems to produce work without consumption of fuel). Russian Peter the Great had intention to visit Germany in 1725 to test the Orferius' device. There is a very old description of "perpetually rotating wheel", which was made in India by inventor Bhaskar in 1150! From that times the mind of inventors is developed to other modern systems but due to the efforts of scientific groups, which are interested to keep in force the ideas of primitive materialism, the great idea of free energy transformation is distorted to such extent that any person, who began to speak about free energy, had a chance to get the name of "mad". Why? The reason is common understanding of the "power", which is "some work per unit of time" and generally it can be presented only as result of some transformation of matter structure, i.e. disintegration, chemical reaction, nuclear decay, nuclear synthesis or any change of structure of a matter. In any case, a material (the firewood, oil products or nuclear fuel) is considered as the fuel, regardless of its transformation method.

Some concepts did not consider the fields (electromagnetic, gravitational and others) as a kind of matter. So hypotheses, and even successful experiments on transformation of "non-material" type of energy in energy of material object (into the work) were not taken into consideration. The physics is a study about measurable and tangible quantities. New measurement methods let us work with a new physical phenomenon. So, we can see that **real situation in alternative energy is changing due to experimenters efforts** but not from the great theoretical team.

Some time ago the electric energy was not considered as a material object, but gradually people have been able to refuse the gas pipes, which were real material source of power for the gas light lamp, in favor of electric wires for electrical illumination. In a short time, I think, it will be possible to refuse the wires and we'll

consider the aether (physical vacuum) as unlimited energy source if we organize **the process of transformation of space-time parameters.** It will be necessary to drop the old conception of "primary source of power", which should be connected with the consumer by some method and to develop conception of free energy source in any place "on-demand".

Let's consider, what the term "free energy" means today. The energy in general sense means the "ability of body to produce some work". The energy of closed system is constant. Certain device can look like "perpetual mobile", but nobody will be shocked because the way of energy "inflow" is known. For example, solar panel battery is obtaining its power from external source of light. But in general case, 3-dimensional observer can see nothing similar to the inflow of energy into the system if multi-dimensional energy balance is not analyzed. In other words, "perpetual mobile" is a right name since for its description it is necessary to use notions of "Time", "Eternity", "Causality" and other categories, which are more related with philosophy and religion but not with modern physics.

The "perpetual mobile idea" is really value to be the purpose of serious scientific work. In the book "Great experiments in physics" published by "World", 1973, Professor G. Lipson wrote: "Joule was the person of a very practical kind of mind and he was enthusiast of the perpetual mobile idea". I hope that it is not necessary to explain here who was Joule. However, "practicality" of free energy generators is obvious only for energy customers, but not for energy producers, who created the centralized system of energy distribution. This is the main reason of absence of alternative fuel-less energy systems in the modern market.

Let's consider the existing classification of "perpetual mobiles":

1. "Perpetual mobile" of the first kind is a design, which can "create energy". It is disputable aspect and all patent offices refuse to consider the patent claim of such type. They answer that "energy can not be created or destroyed" but energy can be transformed from one type into another type.

2. "Perpetual mobile" of the second kind is the collector of environmental heat. It is not a "thermo-pair" which uses temperature difference to produce electricity, but it is the "heat pump". This type of devices works with negative entropy, or more exactly, with sintropy. The terminology still is not defined but we can say that in entropy systems the produced work is equivalent to the dissipated heat and the work, which is produced by sintropy systems is equivalent to some absorbed environment heat.

3. The "perpetual mobile" of the third kind is a demonstration of perpetual motion without friction. The analogue is electric current in superconductors. Development of this idea is creation of systems with negative friction. In electromagnetic systems it corresponds to the known cases of the "negative conductivity", i.e. some electrical circuits in this mode can generate output power.

Additionally, let's show that "creation of energy" is possible in theory, for example: two processes of equal power compensate each other $A + B = 0$. Let's assume that some technology creates another (inverse) process as: $0 = A + B$ i.e. two processes of some power in sum create zero result. In general principle, also there is possibility to use many processes balanced situation as $A + B + C + \ldots = 0$ and this interesting conception is known as theory of multipolarity.

Let's consider some quite real (to my mind) examples from the history of development of free energy technologies. Nikola Tesla's investigations are not well known to modern scientists and engineers. In his works on development of wire-less telecommunication Tesla used flat spiral coils as a secondary winding of transformer. The magnetic field of such coil is radial and it is placed in the plane of the coil. In 1995 the author of this article experimented with similar flat spiral coils. I have to claim that when such coil is operating as secondary winding and the solenoid is the primary winding of the transformer then we can measure asymmetrical mutual induction, i.e. connection of active load (lamp) to output circuit of the transformer is free from input power in the primary winding. It is the simplest example of technical realization of the asymmetrical cause-effect connection, described by Kozyrev in his theory of active properties of time.

... "creation of energy" is possible in theory...

Another Tesla's invention is his resonance transformer. Modern electrical engineering describes transformer with forced electrical oscillations and radio engineering considers operation of resonance systems mainly. Tesla put the question on transformation of power in resonance transformer and by this way the efficiency can be more than 100%. With high frequency currents and high power level Tesla used single-wire terminals as loads, i.e. the lamps and other single-wire receivers of power (motors) were powered from high frequency changing electric field. Such single-wire terminal does not consume any power from primary source because it uses the change of potential in point of connection to conductor (let's note also that for maximum efficiency this point of connection should be one of the maximums of standing wave).

The notion about "free vibrations" belongs to Tesla and this term describes sinusoidal oscillations in electric circuit that is created after short non-sinusoidal impulse due to real vibrations of the free electrons. Resonance mode of the free vibrations can be the real way to excess power output.

Original Tesla's approach to electrodynamics allowed him to build in 1934 fuel-less car with electromotor, which was powered from some 12 vacuum tubes generator of unknown design.

The standing waves of electric field that were observed by Tesla during thunderstorm brought him to conclusion about possibility of the system to power remote energy consumers from energy generator without any transmission lines and without radiation methods. He assumed that it is necessary to create special standing wave of electric potential (or variable in time electric potential field) around the generator, then the unlimited number of loads (lamps, motors) in area of this potential field can be powered if they are tuned in resonance with oscillations of the generator. Let's notice that in each receiver the power can't be more than power of this generator but it is possible to install many independent "receivers" without mutual interference.

The modern investigations on these problems sound as sensation, because Tesla's works are unknown for the modern generation of scientists. Of course, modern electronics components and the tools facilities allow to create real "miracles" in comparison with the past age experiments. For example, engineer Avramenko described his work on single-wire power transmission in Journal of Russian Physical Ideas, 1991, No.2, and in journal "Inventor and rationalizator" 1992, No. 5, 6. The light bulb (or ventilator) was used as load of the single-wire power transmission line. This line can be made of high resistance material, for example, tungsten, but the power can be transmitted without heating of wire! It is possible to say that in this experiment a wire does not transmit power from the generator to the load, but the wire is the conductor of information signal, which is created by polarizational current opened and described by M. Faraday.

It is not difficult to repeat the experiments with single-wire line: it is necessary to place two diodes on the end of a line, which is connected to secondary windings of high voltage transformer (I used television set high voltage unit) by such a way that different poles of the diodes are connected to the line, Fig.3.

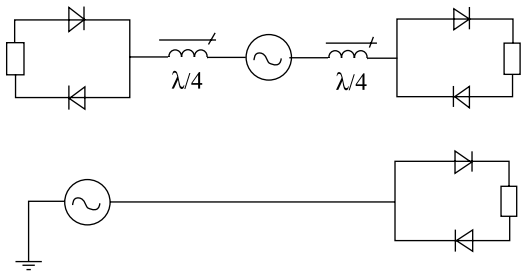

Fig.3

Two other poles of diodes create the source of potential difference (voltage), from what it is possible to charge the capacitor or to power the load (luminescent bulb). This diodes scheme is named as "Avramenko's diodes plug". In my experiments it was determined that high efficiency mode is resonance mode in real line and in this case the maximum change of potential is created in the point of connection of the "Avramenko's diodes plug". There is well known formulas to calculate this resonance as quarter-wave antenna vibrator system. Of course, high frequency and high potential allow creating high power in the load. In 2001-2003 New Energy Technologies magazine have published new experimental results on single-wire power transmission reported by research team from Moscow (Prof. Strebkov, Avramenko, Nekrasov and others). For example, they built and tested lines from 20 to 100 Kwtt power level!

... the electric potential field can create non-compensated force in the system and to produce a work without any power input.

One more well known researcher on the subject of free energy was Thomas Townsend Brown. He considered creation of reactionless propulsion force by means of electric forces only. Ionization is not considered here! According to his works, the electric potential field can create non-compensated force in the system and to produce a work without any power input. English patent by T. T. Brown #300,311 of August 15, 1927 describes the method to create propulsion force and power from electric energy source only. In this first patent it was claimed that in ordinary flat electric capacitor (two flat plates and dielectric between them), which is charged up to 50 kilovolts and more, Brown discovered propulsion force. This force moves the capacitor to positively charged plate direction. It is only one of his ideas and in his other patents of 1930 - 1965 Brown has described many new methods to create propulsion force and free power in load by means of electric field only (scalar potential field as a source!).

... the efficiency of "electric system can be million to one"

We have to exclude ideas on electrokinetic apparatus since it is just a reactive method and propulsion force is result of ionization flow. Especial case is Brown's **idea to create the asymmetry of electrostatic forces** by means of some special form of surface, USA patent #3187206 of June 1, 1965, application of May 9, 1956 (Fig 4).

The schemes and descriptions by the Brown's patents are undoubtedly the work of great practical value. As was mentioned by Brown, the efficiency of "electric system can be million to one" because the potential field can produce real work, for example, rotate some electro generator, but it does not change the primary source of field.

In 1927 T. Brown demonstrated the devices in Ohio, later he worked in France. His works in France were

stopped and he returned in the USA. Detailed information on his works can be received from descriptions of patents http://www.soteria.com/brown and from the book “Electrograviticis Systems” by Thomas Valone, Integrity Research Institute, USA.

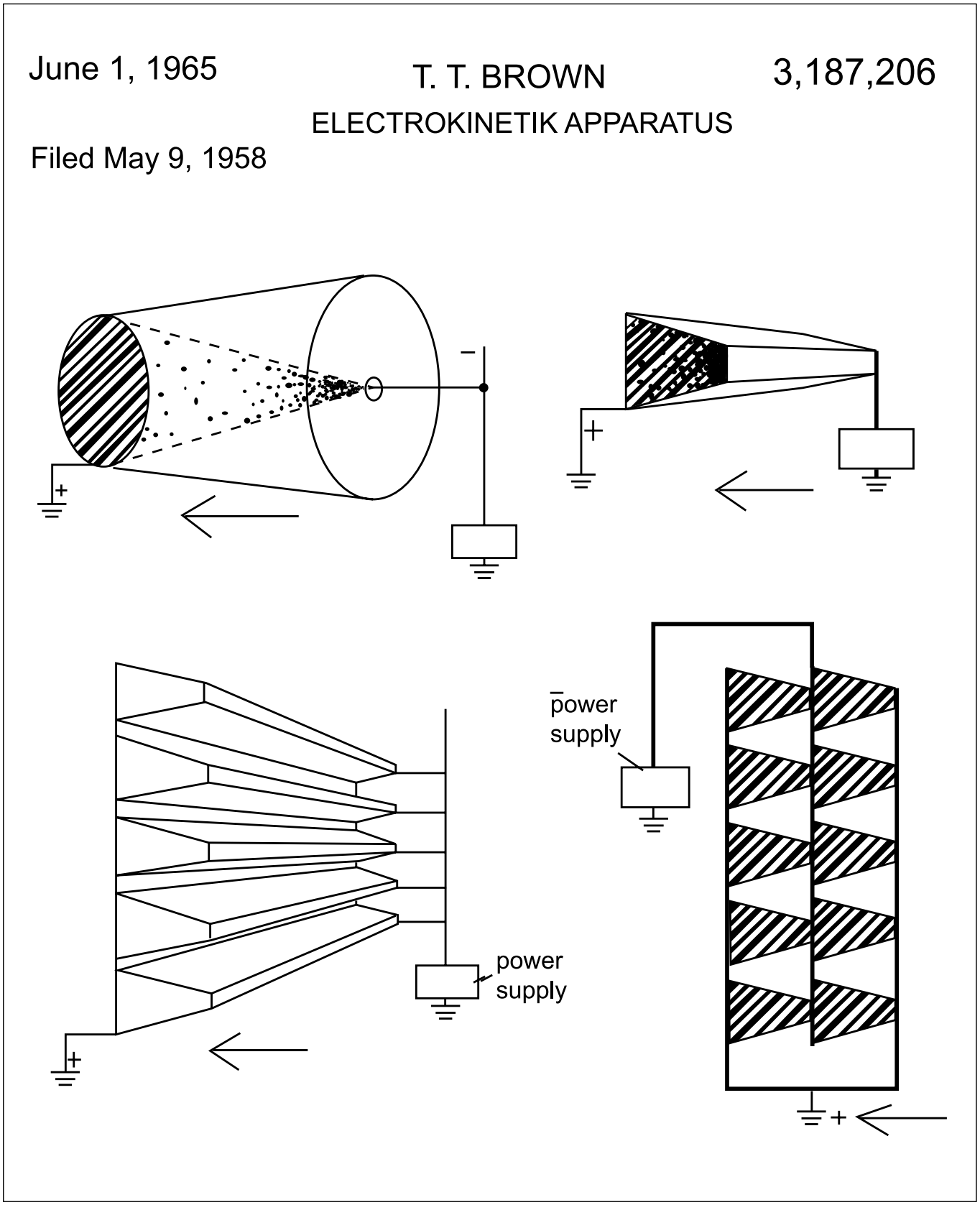

Fig. 4

Electrokinetic apparatus by T.T. Brown

Besides, there is the simplest example of creation of real work by means of potential field that is also resulting from the Brown's works. Usually two plates of electric capacitor are equal to each other. However, if one of the plates is small and another one is large then the electric field between them is not isotropy field and in this case there is some **gradient of intensity of the field**. In such field any dielectrical object, for example a ball, will be polarized unevenly and due to this fact some force should make it to be moving aside, where the field has the greater intensity. I have to note for mathematicians that since the intensity is "gradient of potential" then gradient of intensity is the **gradient of the gradient**, i.e. it is the second derivative of potential. This idea is an example of the well-known rule: the change gives the new quality.

The example of creation of the propulsion force by means of potential field is also connected with "perpetuum mobile" task, since conductivity currents in the capacitor are very small and it almost does not require power consumption (after being charged once time) and the system can produce mechanical work permanently, in this case it is the work against the gravity force. In general case, if the design allows asymmetrical energy transformations, then the surplus output power and reactionless propulsion force can be created in this system.

Most likely future aerospace systems, which are based on the electrogravity, are the most perspective direction of free energy technologies. Why not for the power engineering? It is clear that now there are some existing fuel heating systems, heat stations and power industry to provide by some traditional way all current needs of the society and due to this fact the innovation of any free energy technology is related with hard competition. However, for commercial programs for cosmos the reactive rockets principles are not acceptable more. Each satellite during its operation should produce profit to compensate large expenses for the rocket-carrier. Only fuel-less propulsion systems can allow developing space commercial programs that are new infinite market. Let's note that the gravitational (reactionless propulsion) technologies are not related with cosmodrome and their cost can be quite acceptable to realize the project with private funds.

... future aerospace systems, which are based on the electrogravity, are the most perspective direction of free energy technologies.

There are some known examples of free energy systems.

In 1921 The Seattle Times, as well as Denver Post of August 8, 1921 published the articles about inventions of Alfred Earl Hubbard. His device included the central core with coil and eight remote coils placed around the central core. After primary impulse, the impulses in all coils were powered and rotating magnetic field was created in central coil. The power produced in the central coil was quite sufficient for self-excitation of the system and for producing of useful work in the load (motor). The boat and the car with electromotor, which was powered from the Hubbard's generator, were demonstrated.

In 1928, Lester Hendershot invented the electric generator of 300-Watts power. This device was designed of details used in radio-receiver to get oscillator (500 kilohertz) and non-inductive coil. Later, in 1970, William Cooper experimented with non-inductive bifilar coils. He used induction phenomenon in the case of zero magnetic component (two-wire winding or flat spire coil).

The Cooper's USA patent 3610971 of 1971 describes **the principle and the device to create power in secondary circuit without reaction on primary circuit**, as well as method to get reactionless propulsion force for aerospace application. Cooper also has found that specially designed coils can produce the field, which can not be screened and this field has some common parameters with the gravitational field.

The gravitation is considered by Cooper as a polarization of atoms in gravity field of planet. So he declares in description of his patent: "the electronic generator... of super high frequency creating the pulsing electric field of single polarity... acting in opposite direction to the Earth gravitational field... that to depolarized the atoms and to release them from the gravitation".

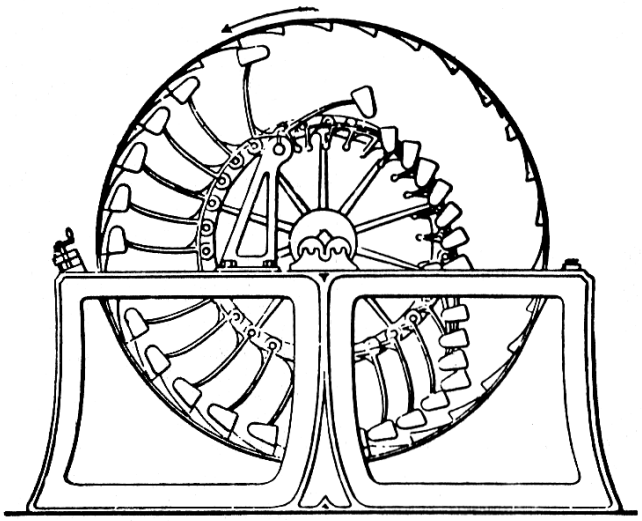

Fig.5

By the way, the gravitational field itself can be used to get a power. "Unbalanced wheel" is a well known design. The weights on the one side of the wheel, which is rotating in vertical plane, can be organized to be moving to axis, but on the another side the same weights can be organized to be shifted from the axis to the periphery of the wheel. By this way there is some

constant shifted center of gravity in the system and it can be permanently rotating system. One of the inventors who built such wheel is Hugo R. Fraga, Havana, Cuba (The Perpetual Motion Mystery. R.A. Ford, Lindsay Publications Inc., Bradley, IL 60915, USA, 1987, see Fig. 5).

The earliest information about such systems is dated of 1150 and the name of inventor is Bhaskar, India. He used the tangential disposed pipes, which were half-filled with water. In France (1235-1240) William de Onnecure demonstrated self-rotation wheel with seven weights. In Italy (1438) Mariano de Jacopo has built the system made of eight bars disposed in the plane of rotation, and the bar can be fold up in the middle like elbow joint to provide rotation. One of the well-known and documented events of real demonstration of perpetual rotation wheel was mentioned in 1620. Edward Somerset (Second Marquis of Worcester), author of the book "Century of Inventions", 1963, has built and tested the wheel of about 4 meters in diameter, 14 weights of 25 kilograms each. The test of this machine was organized in London, in witness of King Karl, Grand Duke Hamilton and Grand Duke Richmond, and there are files in royal archives about this test. The descriptions of these and other systems are published in the book "Perpetual mobiles: past and present time" by Brodiansky, Moscow, Energoatomisdat, 1989.

Fig.6

In different idea, which is known from Leonardo Da Vinchi drawings, lifting of water is produced by the helical "Archimedes' screw" of small diameter with large centrifugal acceleration, which reduces weight, but lowering of water was organized with the screw of other (large) diameter, so the force of weight is working to rotate this screw by the weight of the falling water. The paradox of these systems will be removed if to consider them as systems of variable topology, as it was done at the beginning of the present article. Practically, the **cycle is separated here into two processes** (the lifting and falling of mass) in the system with different parameters (the topology) for the first stage and the second stage of the cycle, but herewith **it is necessary to consider two different physical systems, not one and the same.** In that case, the classical theory can explain the work created by potential gravitational field of our planet as energy exchange between two different systems.

Other well known topic is research projects by John Searle, i.e. the "Searle's disks" (Fig. 6). It is necessary to note that the inventor mentioned in his articles anti-gravitational effect and free energy output also. The address is: John Searle, 13 Blackburn Lower Strand, Graham Park Estate, London MW9 5 NG, United Kingdom.

In several words we can say that rotor makes free electrons to be displaced to the peripheries of the system. With sufficient velocity it was mentioned that there is phosphorescence and ionization around the disk. It is possible to assume that main effect is based on well known Lorenz forces and understanding of the Poynting vector, which is circulating in this system. The ionization currents are closed through the space from periphery to the center, and self-rotation of the disk is provided by the classical Lorenz force, since the current interacts with magnetic field of the rollers.

In Russian experiments of 1992 Roshin and Godin built similar system of 7KWtt power output and they claimed that 100 kg axial force and areas of decreased temperature in environmental also were detected. Fig.7 demonstrates main parts of the system by Godin and Roshin.

It is necessary to note that similar anti-gravitational effects appearing for the case of over-unity operation were observed by different inventors independently. For example, in 1990 Floyd Sweet demonstrated his invention named as "vacuum triode amplifier" VTA. The barium magnets were pre-conditioned by special method to be used in special "trigger mode". This "bi-stable condition of magnet" provides possibility of transition from one direction of field to another direction due to the weak control signal, which was provided from external generator. It is known that if the material was pre-conditioned by the magnetic switching of 60 Hz frequency then its control signal must have the same 60 Hz frequency. A part of output power was closed to provide feedback and additionally some power can be used in output coil for the load. Tom Bearden studied the scheme of vacuum triode amplifier and confirmed that it demonstrates the work with negative energy. It means that the work in the load is connected with use of negative time. In this negative time, according to Bearden, the gravity is repulsing force. The experiments on VTA demonstrated that VTA decreased its weight according to level of the power, which is extracted from vacuum. Additionally we can

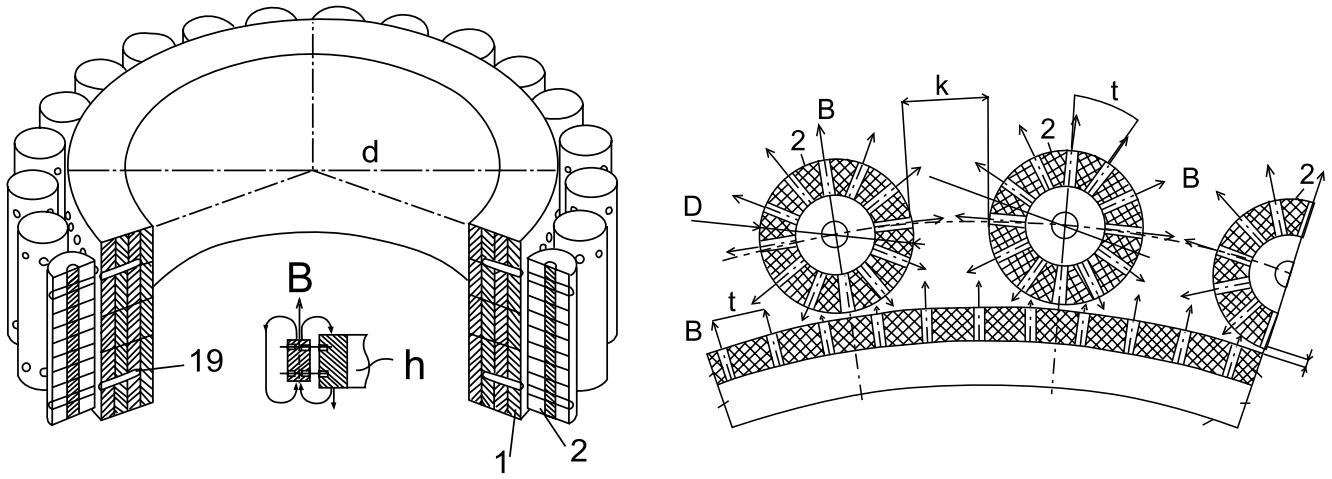

Fig.7

say that permanent magnets and coils of VTA were self-cooling during operation and the temperature difference was about 20 degrees in contrast with the environmental temperature.

One of VTA schemes includes two sets of magnets 4 x 6 x 1 inch, placed on two walls of frame. The attraction is created between them. Output and controlling coils are located between them. The axes of output coils are parallel to the magnetic field lines, but the axis of control coils are placed under 90 degrees angle. The secret of system is the "conditioning process", which "brings the magnets to the special condition". It is necessary to create great number of micro-cracks in the magnet due to re-orientations of magnetic domains. In such "half-magnet" the domains get the ability to be orientated in the same direction in a weak "control" magnetic field. In fact, they are not domains but large parts of magnet's material, separated by micro-cracks, that is to say acoustic domains. Many researchers repeat Floyd's works. Let's note that arc discharge of alternating current through magnet barium ceramics directly can provide the best results of the "conditioning" process. The coil of "conditioning" is not necessary in this case. The frequency of alternating current must be corresponded to the frequency of the control signal. Thereby, Sweet was creating **the bi-stable solid-state condition of magnetic substance.** The acoustic resonance is the reason of oscillations with the frequency according to the control weak magnetic field. Floyd Sweet died on July 5, 1995 at age of 83 years old. It is known, that his widow sent the archives to some great Automobile Corporation.

... the extraction of space energy is result of transformation of vacuum energy but from the other hand the energy density in this case determines so called "time rate"

It is interesting to note again that the magnets of VTA demonstrated self-cooling during operation, up to 20 degrees difference in comparison with the environmental temperature. It is one more example of relation between notion "density of time" and "energy". We can say that the extraction of space energy is result of transformation of vacuum energy but from the other hand the energy density in this case determines so called "time rate".

Kozyrev's articles [4] on causal mechanics theory and experiments describe possibility to use "time course for producing of useful work". Kozyrev introduced notion "density of time" and he demonstrated experimentally several methods how to change the density of time, which depends on irreversible processes intensity. Powerful "generator" of such processes is biosphere of our plane and it creates **season and daily changes of the density of time**. It is known that VTA power output also was variable in different time of day and night. It can be explained by Kozyrev. Next step in logical development of this idea is **to change notions from the "density of time" to "density of aether"** [10].

Relation between magnet phenomena and aether circulations was known from the beginning of the electrodynamics and now we can assume that VTA was real example of asymmetrical cause-effect connection, where the hardness of this connection depends on the density of aether. In this case the season and daily variation of the aether density are reason of VTA output power variations. So, we can make a conclusion: conception of **asymmetrical cause-effect connections** should be used as theoretical basis of all over-unity systems.

Generation of extra power in nonlinear materials (ferrites and dielectrics) was considered by Nikolay E. Zayev, Journal of Russian Physical Ideas, #1, 1991. Discovery was claimed as "Cooling of some dielectrics by changing electric field with generation of energy", Russia discovery #32-OT-10159, November 14, 1979; the inventions were also claimed as "Method of transformation of heat energy of dielectrics into electric

energy", Russian patent claim #3601725/07 (084905), of June 4, 1983 and "Method of transformation of heat energy of ferrites into electric energy", Russian patent claim #3601726/25 (084904), of April 3, 1983. This theory is not about some transformation of space-time structure but in any case the practical application of conversion of environmental heat is very important because this work is real basis of free energy systems.

In one of Zaev's articles, which were published in Journal of Russian Physical Ideas, he quoted from K. Zialkovsky: "If the heat can be transmitted from cold body to hot body, then it must have enormous importance, and not only philosophical or scientific, but also practical importance. The Clausius postulate is not confirmed in this case. The gravitational force, as well as other reasons (number of the reasons is unknown) break this postulate... heat can be transmitted from cold body to hot body but only as the result of some exclusive conditions", published in Russian, "The Second beginning of thermodynamics", Kaluga, Russia, 1914. So, the inventor of free energy system should provide this "exclusive conditions" to organize collection and transformation of environmental heat in his free energy system.

Another well-known free energy system is Swiss electrostatic machine. In spiritual commune Methernitha, Linden in Switzerland, since 1980 several free energy devices have been generating total power of 750 kilowatts. From the technical point of view, these devices are modernized electrophore generator. Permanent magnets also included into design of these devices. The machine of 20 cm diameter produces about 200 watts, and a big machine has the disk of 3 meters and it produces about 30 kilowatts, Fig. 8.

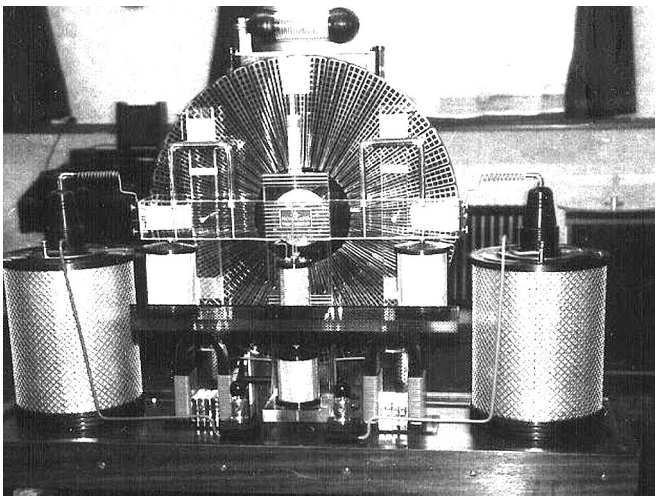

Fig.8

One of the modern technical decisions, which are very close to this Swiss machine is patent USA No. 4897592 by William Hide, January 30, 1990. This device is "system to generate power from electric field". It is one more example of work, which can be produced by potential field, in particularly by means of electric field that can be used as free source of power. The energy (the potential energy) is the possibility to produce work and the power is a work per unit of time, i.e. it is a process. The properly organized process, for example acceleration of rotor in Hide's machine, uses the potential field on the part of positive work (acceleration) and the author of the patent provides meta screen on the part of the trajectory, where the field decelerates the rotor.

... it is "perpetuum mobile" and it can not be patented even if it really works!

One more example is Reed's motor, which uses energy of permanent magnets. By the description of 1991 it is made of four disks (two immovable discs and two rotating discs), and eight magnets are placed on them. Howard Johnson used similar method, USA patent #4151431, Fig.9

U. S. Patent Apr. 24, 1979 Sheet 1 of 2 4, 151,431

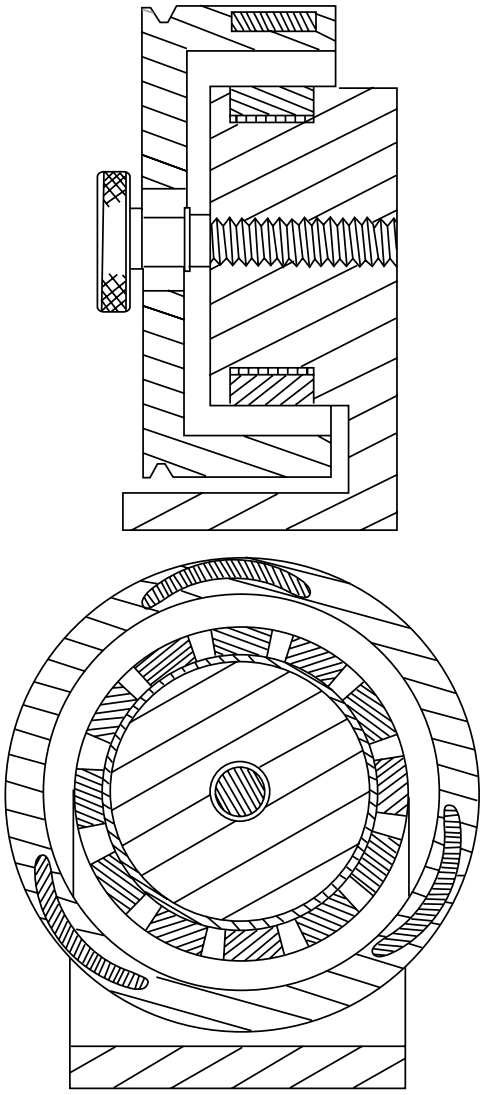

Fig.9

Journal "Science & Mechanics" of 1980 describes this invention. Hovard filled the application in 1973 but he has got the confirmation only in 1979! The reason of delay is very clear: it is "perpetuum mobile" and it can not be patented even if it really works! Johnson found clear and simple description of generation of power in his device and explained it as "extraction of power from inner energy of electron spin in ferromagnetic material".

From text of his description it follows that USA patent #4,151,431 of April 24, 1979, "Permanent magnet motor", author Howard R. Johnson, application #422,306 December 6, 1973 was developed from the prototype that is USA patent #4,074,153 of 1978, class of international classification H02K 41/00E:

"The invention is directed to the method of utilizing the unpaired electron spins in ferromagnetic and other materials as a source of magnetic fields for producing power without any electron flow as occurs in normal conductors, and to permanent magnet motors for utilizing this method to produce a power source. In the practice of the invention the unpaired electron spins occurring within permanent magnets are utilized to produce a motive power source solely through the superconducting characteristics of a permanent magnet and the magnetic flux created by the magnets are controlled and concentrated to orient the magnetic forces generated in such a manner to useful continuous work, such as the displacement of a rotor with respect to a stator. The timing and orientation of magnetic forces at the rotor and stator components produced by the permanent magnets to produce a motor is accomplished with the proper geometrical relationship of these components."

...conception of asymmetrical cause-effect connections should be used as theoretical basis of all over-unity systems.

It is reported that functioning Johnson's model produced about 5 kilowatts power free of any primary source of energy. Let's note that Johnson writes in his patent about permanent magnet as about system with "super conductive parameters". The currents of electrons in permanent magnet are manifestation of real superconductivity and for this case it is not necessary to provide the cooling for zero ohmic resistance. Moreover, the "resistance" must be negative since the magnet could save and renew its magnetized condition. Thereby, any permanent magnet is the example of perpetuum mobile of the third kind on the micro level. Also we can say the same about each atom.

Also, let's note that in general case motion (rotation) can be created due to the discussed above gradient of field, which in Johnson's device is result of asymmetry in "rotor-stator" system. By the similar way the gradient of velocity of airflow above and below wing creates the gradient of pressure and this fact produces great lifting power in airplanes.

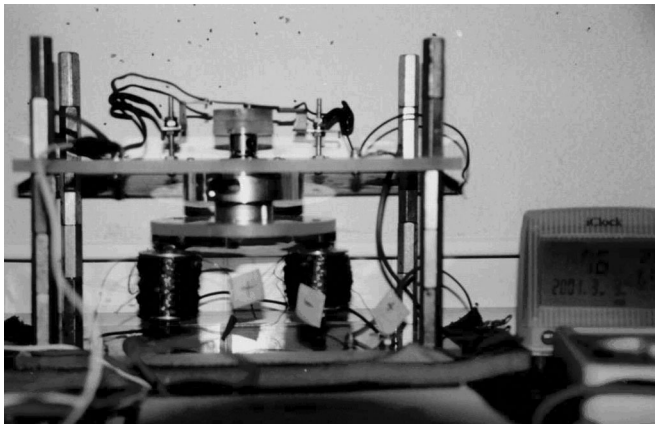

Fig.10

Well-known variant of permanent motor-generator is Adams motor, Fig.10. The rotor with radial orientated (the same pole outward) permanent magnets is rotating and creating inducted currents in stator coils, which are placed around rotor in the plane of rotation. From the point of traditional electrical engineering, any motor-generator without closed magnet flux is not high efficient device. However, exactly open magnetic flux of the Adams motor allows to take off power without deceleration of the rotor. We can assume that in this case phenomenon of electromagnetic induction is not important but in this design there is magnetic induction only, i.e. magnetization and demagnetization of cores in the field of the moving magnet. It is a perfect analogy with phenomena of electric induction that is "electrization by influence". Similar "magnetization by influence" differs from electromagnetic induction and secondary magnetic field in winding of generator is not related with deceleration of the rotor. Robert Adams works with Harold Aspden under patenting of their system. Adams is more than 70 years old but from our correspondence with him we can say that he is going to build demonstration version of 10 Kwtt generator.

...any permanent magnet is the example of perpetuum mobile of the third kind on the micro level.

There is also special name "alternators" for this class of devices, which use interruption of magnetic flux, for example it is the device by USA patent of John Echlin #4567407.

The experiments to investigate the alternator principles were organized also by the author of this article and it was demonstrated that ferrite core of the generator coil is self-cooling. The simplest experiment is based on electro motor, which rotates iron plate and it periodically appears in the gap between magnet and coil. But it is necessary to note that change of the flux in the coil area should be organized by such a way to decrease the flux of the field in the rapprochement half-cycle and to increase the flux for the moving off half-cycle. In this case the

rotor is accelerated by the secondary field (back-EMF). From 1994 to 2003 several experiments were produced and main principles were claimed in the patent description, Fig.11.

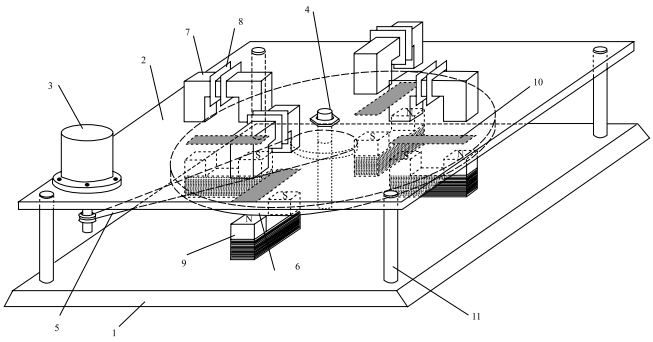

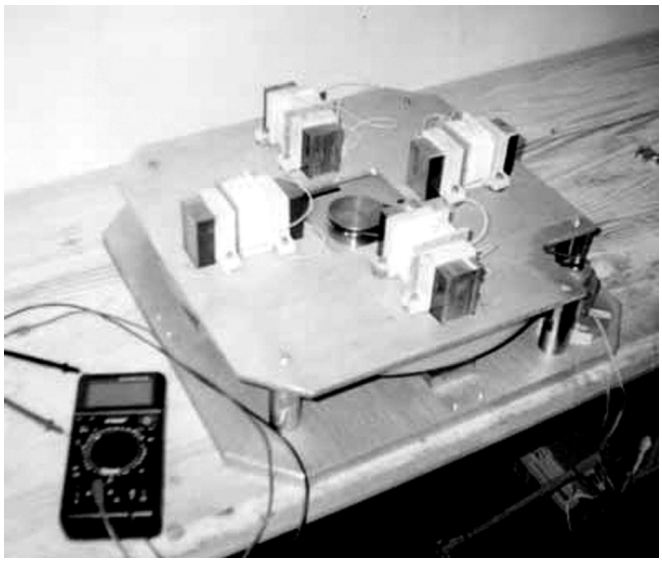

Fig.11

One more topic is "extraction of power from air" and Josef Swenson has conducted the series of simple experiments to develop it. The frequency of natural pulsations of electric field of planet is about 7.5 Hz and it is well known from Tesla's age. Swenson works with frequency 375 kilohertz and antenna of 10 meters. Please, contact for more details: Josef Swenson 423 North 15th Street, Moorhead, Minnesota 56560, USA. However, everybody remembers from the school story about simplest electrical experiments by Lomonosov and Rihman, who investigated arc discharge in gap between iron wire from a roof ("antenna") and ground wire. Let's include the resonance circuit "inductance-capacity" and diode rectifier to get some useful work in the load "from atmospheric electricity", Fig.12.

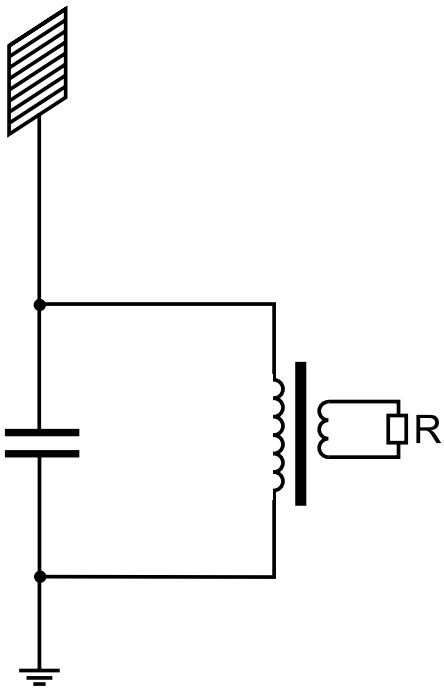

Fig.12

In 1900-1930 a lot of articles were published in technical press about Henry Moray. His demonstration systems produced more than 50 kilowatts free power output. It is known that Mr. Yakovlev (from USSR Foreign Department headed by Mr. Molotov) visited Morey in November of 1929 in New York to test his devices. The devices consist of capacitors, coils and special electronic-vacuum lamps.

In 1990 journal "Magnets", 2 (3) published article, which describe analogy between Moray's devices and Hubbard's coils, which can extract power by means of inner energy of nucleuses of materials if special resonance is created. In 1978 Cospray Research Institute has published the well-known book "The Sea of Energy" by T. N. Moray, in which theory of Moray is presented most completely.

RQM Raum-Quanten-Motoren Corporation (Schmiedgasse 48, CH-8640 Rapperswil, Switzerland, fax 41-55-2125209) offers for free energy devices of different power level: RQM 25 kilowatt and RQM 200 kilowatt. The principle of work is based on an invention by Oliver Crane and his theory. Web site http://www.rqm.ch. But I have to note that in present time they are developing capitalization of the company

mainly (actives are above 650 million dollars) than innovation of the new technology.

One more historical example: in 1925-1945, Hans Koler demonstrated his free energy devices. The system was built in Germany and it produced 60 kilowatts of free power. The description includes six permanent magnets and coils, which were superposed in plane of hexagon form. Each magnet is core of the coil.

Another interesting topic is unipolar induction effect, which is well-known from Faraday. This effect creates electro motive force (EMF) in rotating disk if axial magnetic field is applied to the disk. One of the well-known practical developments in this area is device by Bruce de Palma. In 1991 he has published the results of his tests, from which it follows that deceleration of the rotor due to back EMF in the case of unipolar induction is less than in traditional electro generators. So output power of system can exceed the power, which is necessary to rotate the rotor.

Really, motion of electrons in magnetic field, which is perpendicular to plane of rotation, is the reason of the Lorenz force and this force acts in radial direction that can not be the reason of deceleration. Indian research on this topic is developing by P. Tewari. In New Zealand there is research group headed by Dr. Ashley Gray. In 1994 the leader of Japanese market MITI published report about progress in 40 KWtt unipolar generator, which uses superconductors for its electromagnets. The interest of Japan to alternative energy projects can be explained by the position of Japan on fuel market.

There is a well known rule: Demand is related with Proposals. It is easy to imagine the prospects of local introducing of free energy systems in one or several countries, if some producers of product will be able to exclude expenses on electricity and fuel from cost sales. Other countries of their own rich natural resources (for example, oil) will be in problematic position on the new international market, mainly due to the fact that their industry and transport are oriented to conversion and consumption of oil fuel that increase the cost of all products.

... increase of the spark gap produces more surplus power in the load of the circuit.

One more modern free device was invented by Wingate Lambertson, USA. In his device free electrons get the additional energy passing through the number of thin metal-ceramic composed layers. The units were designed by the authors and each unit can generate 1600 watts, and it is possible to connect them in parallel. The address of author: Dr. Wingate Lambertson, 216 83rd Street, Holmes Beach, Florida 34217, USA.

Especially the researches on free energy with plasma processes should be noted here. In 1980-1990 Alexander Chernetsky, Yury Galkin and others have published the results of experiments on creation of "self generated discharge" SGD. The electric arc was placed consecutively into secondary circuit of electromagnetic transformer and it produces real increase of power in load and reduction of consumption power in primary circuit of transformer. The author of the present article produced simplest experiments to investigate the arc (electric discharge) in electric circuits and possibility to create the mode of "negative resistance" in this circuit was confirmed. One of the effects was demonstrated in 1996 during the conferences "New Ideas in Natural Science", St.-Petersburg.

Adjusting parameters of arc (distance between two electrodes) it is possible to see that consumption current is decreasing until zero and then it can change its direction i.e. this system begins to generate the power. During similar experiment of 1971 by Dr. Chernetsky substation transformer in Moscow Aviation Institute was destroyed in result of strong "reversed current" impulse, which exceeded consumed power in 10 times more. According to Chernetsky's concept, the reason of this mode is well known phenomenon of plasma instability and **pinch-effect for great currents.** However, the author of this article tested device, which demonstrated similar effect (switching on the load in secondary circuit of transformer and in the presence of arc in this circuit, consumption power does not increase, but reduces) for small currents about 300 mA.

Since for pinch-effect it is necessary hundreds Amperes then it was offered another explanation: the surplus power in this circuit appears due to the acceleration of electrons in the gap between electrodes, i.e. particles of plasma are **accelerated by means of electric potential field between two electrodes**. It is noted during the experiments that increase of the spark gap produces more **surplus power in the load of the circuit.** To avoid mistakes the measurements of the consumed power were organized in DC (direct current) battery circuit and therefore there is no any reason to speak of phase shifts mistakes to try to explain skeptically this effect.

... waves of density of time are used by organisms for their vital activity.

Today theory and experiments on self-generating discharge are quite well developed to build free energy systems of any power scale. The reason of delay in its practical development is a complex problem: this work leaves the frames of classical physics. In his book "About physical nature of bio-energy and its simulation", Moscow, Publ. VZPI, 1989, Dr. Chernetsky considered the structure of biological fields and bio-energy processes in living organisms from the point of **longitudinal waves conception.** Self-generating discharge in the mode of negative resistance produces such longitudinal waves and they are self-sustaining (self-powered energetically) and it is considered as field of living object.

Really experimentators of the Chernetsky's group, who worked with SGD device detected influence of biologically active radiations and fields, which can be not screened by usual methods. It was reported by Chernetsky that parameters of this radiation can be selected to accelerate the development of plants and biomass or to suppress it. So, we should speak about artificial living biological system or biological form of energy for this class of free energy devices. Perhaps by the same plasma oscillation way all living organisms provide its vital activity, since long time ago it was known that metabolism and food can not provide enough energy for vital processes.

Nikolay A. Kozyrev also wrote about "reason of life" and he confirmed that waves of density of time are used by organisms for their vital activity. Between "waves of density of time" and "waves with longitudal component" there is a clear analogy. Kozyrev and Chernetsky experimentally demonstrated methods of creation of such waves.

...any free energy system should change the causality in surrounding space-time.

New Energy News magazine, March 1996, wrote about attempts to innovate for American aerospace stations special power source, which uses similar plasma technology: anomalous electric discharge. The USA patents #5416391 and #5449989 belong to Dr. Paulo Correa and Dr. Alexandra Correa, Canada. In their report on free energy Denver conference it was claimed that efficiency is about 483% .

Let's note one more free energy topic: high efficient electrolysis. Classical electrolysis as decomposition of electrolyte in electric field is a wonderful example of work, which is produced by field and it can be organized by such a way to be free from the primary energy source (battery). The traditional scheme uses closed circuit of current through electrolyte and the battery, so the battery is discharged during the operation with electrolytic cell. However any physics textbook confirms that **ions in electrolyte are moving due to electric field only, i.e. work to organize the displacement of ions and heat power, which is connected with this work, are produced by the potential field and expenses of the primary power are not required.**

The current through the battery, which is created in usual closed electric circuit destroys the primary difference of potentials in the battery but it is not some necessary condition. For correct organization of the experiment the products of electrolysis (gases) can be created almost free and their utilization (burning) can provide more heat power than input electric power.

Prof. Latchinov, the real member of Russian Physic-Chemical Society, who patented his method of electrolysis in 1888, mentioned that in some cases the electrolytic cell is freezing during its operation. This is an effect of the law of Conservation, which forces to return the surplus power by means of heat environmental energy. In the experiment by Latchinov the electrolytic cell can create gases of high pressure and consumed power is the same as for the case of low pressure gases. However, it is clear that high pressure gases can produce more work than low pressure gases do. This question was sensational problem in scientific societies of 1888 and it is not solved yet completely.

One of other variants of high efficient electrolysis was investigated by Igor Goriatchev, Russia. Instead of usual 3 Volts level of electrolysis, Goriatchev uses 0.2 Volt pulsing mode. He claimed ratio output/input as 1500% efficiency and he hopes to increase this value twice in more perfect design.

Professor Kanarev from Krasnodar wrote about his experiments on plasma electrolysis and has proved that in electrolysis of water output power can be more than input power.

Real example of "perpetuum mobile of the second kind" is invention by Russian engineer Albert Serogodsky (Moscow) and German engineer Bernard Sheffer (Berlin). They have patented new system for direct transformation of environmental heat into electricity, Germany patent #4244016. Retro-condensation of mixture of benzine and water is organized in closed system under temperature of 154 ^{0}C degrees. You can try to get more info from: Werkstatt fur Dezentrale Energleforschung, Pasewaldtstrasse 7, 14169 Berlin, Germany.

The fundamental theoretical researches on direct transformation of environmental heat to useful work were provided by Real Member of The Russian Physical Society Mr. Gennady N. Buynov, St.-Petersburg. The description of his project on "The Mono-thermal device" was published in journal "Russian Ideas" #2, 1992.

In 1995 the scientific journal of Russian Physical Society #1-6 published article "Perpetuum mobile of the second kind (paired gas-chemical cycle)". The author Gennady N. Buynov proposed to consider that **entropy function can be abortive**, i.e. it can be undetermined in some place if reversible chemical reactions are presented in the system.

Herewith, the circular integral of entropy is not a zero and in this case the heat function but not entropy function (according to the Gess law) becomes the function of condition.

Buynov offers to use four–oxide of nitrogen as working matter for this cycle. His works are excellent example of scientific enthusiasm, which (in combination with financial interest of the customers) could produce real results for Russia many years ago. Let's note that

priority of this discovery belongs to Russia in spite of attempts of other scientists to claim and develop this idea now as their own work.

We can make a very interesting conclusion if we analyze history of so called "cold fusion" discovery. According to de-classified materials of 1960, priorities of Russia in this topic are obvious. In 1989 Pons and Fleshman have reported about results of their experiment. In 1995 Russian Journal "Inventor and Rationalizator", #1 has published article about invention made by Ivan S. Filimonenko that was named in 1957 as "warm nuclear syntheses". In 1957 he detected **extra power output in process of heavy water electrolysis** and he mentioned several applied aspects, for example, propulsion force and possibility to reduce radioactivity by means of this process. In 1960 Kurchatov, Korolev and Zhukov have supported the ideas of the author. Russian Government adopted secret resolution on this work:

1. Investigation of energy generation.
2. Development of propulsion without reactive mass flow.
3. Research on protection from radioactivity.

But in next several years this work was suppressed by people of nuclear power plant team. The only system of such type named as TOPAZ was innovated for Russian aerospace systems. World-wide innovation of this technology is a real way to introduce "warm reactors of syntheses" and it is not necessary to wait for results of high-cost "Tokomak" project and other thermonuclear researches. Let's note that secondary effects (propulsion force and influence on radioactivity) are possible due to using of "free energy" aspect if output power is result of change of space-time parameters.

In 1994 Journal "Russian Ideas", #1-6, it was published an interesting document "Conclusion of The Moscow City Council Commission on the question about Ivan Filimonenko's discovery and its development". In this document it was recognized that it is vitally necessary to renew this works. But in 2003 we still have nothing new on this topic. Why? It can be assumed that the Problem of innovation for this technology is possible military application of the methods since influence on radioactivity (for example, remote reduction of radioactivity of some object) is area of interests of the Defense Department. The fact that energy generators by Filimonenko can be used for quick restoration of the present ecological balance is not so important in this case. The same conclusion is about propulsion method, which was proposed by Filimonenko. Mr. Korolev knew about this method; however present space programs are still based on rockets and reactive principles, and anti-gravity flying machines we can see only in fantastic movies.

At the same time, development of commercial cold fusion projects was started in some countries, for example: Patterson Power Cell is introduced in Texas, USA (Clean Energy Technologies Inc., Dallas, Texas, fax 214-458-7690). More than thirty patents were owned by ENECO Corporation, which is collecting the main technological solutions in this area. The production of electrolytic thermal cells was started by Nova Resources Group., Inc., Colorado.

In August of 1995 Atomic Energy of Canada, Ltd. Company, which is member of The Planetary Association for Clean Energy, has published the review on modern methods of conversion of nucleus wastes and deactivation. Two new technologies were offered for introduction: contact processing by "Brown's gas" and remote processing by scalar (torsion) fields. Let's note that the technology proposed by Canadians and Filimonenko's technology demonstrate the effect of influence on the rates of radioactive decay.

These examples are only small part of real situation. Main references on publications are foreign and it can lead to wrong conclusion that Russia is delayed in this direction of new technologies development. In fact, Russia has more talented inventors and researchers than any other country. However, condition for work, patenting and publications of ideas are not the same, and usually Russian technologies cannot reach the level of international market. This problem depends only on real and official state policy with respect to inventors and scientists. In real life financial support of scientific institutes is mainly subsidy for management of the institutes, but not for science. The inventions and discoveries always were made by a certain real person, but not by Institute or some scientific team.

In Russia of last age and in the other world on the whole the institutes and laboratories have been creating for a new scientific problems, discoveries or new directions in science. It was necessary to claim about discovery and provide priority for own country to get official support. Main schools of thought appear by this natural way. By the same natural way the necessary in existing of some scientific institute can be removed when the idea grows up to serial production stage. If there are no any fresh ideas in this school then the institute should be transformed in design office of the production plant on this topic. It is almost impossible to create a new research institute in modern Russia, so really new ideas (if they are not ranged in frames of some existing scientific directions) can not be developed and they can not create a new school of thought in Russia.

... it is possible to make a conclusion about grandiose misinformation of society...

People (carriers of the new ideas) have to leave Russia to realize their sensational ideas on free energy and antigravitation topics. Why they do not work with Russian Academy of Sciences? It is the

rhetorical question. Usually after many years of correspondence with patent office or with official science bodies the authors can find that their ideas are published in "serious scientific magazines" but without any respect to their names...

Attachment 1 presents some information about patented technologies. When we study old and modern patent documents, it is possible to make a conclusion about **grandiose misinformation of society**, which leads to appearance of two different Worlds, separated by the level of knowledge: evident and hidden knowledge. The achievements of the second hidden world could change our planet, give a chance to remove all energy and ecological problems. Besides, we have discussed that some free energy systems (for example, self generated plasma discharge) have also the medical-biological aspects. This "influence" from free energy system is related with negative entropy processes in area of the operation of the system so some components of biological systems can be changed to less entropy. The design of free energy system defines the type of this influence. It was noted before that operation of any free energy system should be considered in high topology space-time as multidimensional system to see what the reason of the effect is.

So, since the rate of time course is determined by Nikolay A. Kozyrev as rate of cause-effect transformations, then any free energy system should change the causality in surrounding space-time. In this case we can assume that it creates quantum physics effects on the macro level. It is interesting to assume Heisenberg's uncertainty, tunnel effect and manifestation of wave characteristics (up to diffraction of objects) for macro level.

Some experimental data by Kozyrev is related with quantum effects, which were detected in his experiments with rotating and vibrating gyroscopes. This technology is the basis to design real teleportation systems, which will change parameters of space-time to allow changes of position of some material object from one point of space to another point of space (without transference on the distance between these points) by means of combining these points in the same place of space for some time.

The process of study of new technologies in alternative power industry and gravitation is developing actively in the world. Besides secret programs and institutes, it is possible to make a conclusion that activity of this work in countries of limited fuel resources is more efficient. Now Russia has rich **natural materials and oil resources but in the short time this advantage will not play any role in development of economy.**

Industrial and defense power of any country will depend on free energy technologies, knowledge on the biologically active energy and reactionless propulsion methods.

The new technology creates not only a new technical systems but also **new economical systems**. It is not physics but policy… Development of great Russian territories with industry of free energy technologies for home and commercial application is the way to change world economical balance in favor of Russia. It is difficult to say now what financial-economical group of modern Russia is most interested in development of this direction of science. The purpose of any financial-economical group is power on the market of energy resources, but when the free energy technologies are developing, then people and industrial or agricultural producers will be more independent from centralized system of energy and oil distribution, therefore, they will be more independent from influences of central authorities.

From the point of view of serious business, there is only one real argument in favor of developments of any really new technology: it should lead to increase of profit and expansion of the market. In this sense, it is possible to compare the new energy technologies with beginning of the steam machine age or with appearance of electric machines and illumination. This means the super profits and serious fight with competitors. To develop this way any efforts of scientists are not sufficient work. It is necessary to join them with the efforts of large business structures, which are interested to create new market of energy and power engineering in parallel to present monopoly fuel-energy market or to develop commercial exploration of space by means of new propulsion principles. In particular, telecommunication space satellites and projects on colonization of space could be the nearest commercial directions of the new market.

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Attachment 1

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Attachment 2

Organizations

· Faraday Lab Ltd, Lev Tolstoy Str. 7, St. Petersburg, 197376, Russia.
· The Russian Physics Society, 141002, Moscow reg., Mytishy, B. Sharapovskaya str. 3. Fax 095-2926511
· Academy for Future Sciences, P.O. Box FE, Los Gatos, CA 95031, USA.
· AERI, Advanced Energy Research Institute, 14 Devonshire Mews West, London W1N 1Fp, Great Britain.
· ADAS, Association of Distinguished American Scientists, P.O. Box 1472, Huntsville, AL 35807, USA.
· Borderland Sciences Research Foundation, P.O. Box 429, Garberville, CA 95440-0429, USA.
· Center for Action, P.O. Box 472, HCR 31, Sandy Valley, NT 89019, USA.
· Electrodynamics Gravity, Inc., 35 W. Tallmadge Ave., Akron, Ohio 44310, USA.
· Fusion Information Center, P.O. Box 58639, Salt Lake City, Utah 84158-0369, USA
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· INE, Institute for New Energy, 1304 South College Avenue, Fort Collins, CO 80524, USA.
· Integrity Institute, 1377 K Street, NW, Suite 16, Washington DC, USA. Fax 202-543-3069.
· Orgone Biophysical Research Laboratory, Inc., P.O. Box 1395, E1 Cerrito, CA 94530, USA.
· Quantum Biology Research Laboratory, P.O. Box 60653, Palo Alto, CA 94306, USA.
· SEA, Space Energy Association, P.O. Box 11422, Clearwater, FL 34616, USA.
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· Methernitha, 3517 Linden, Switzeland. Manager Francis Bosshard.
· Swiss Association for Free Energy, P.O. Box 10, 5704, Egliswilli, Switzeland.
· Space Research Institute, Box 33, Uwajima, Ehime 79, Japan. Dr. Shinichi Seike. Fax 895-24-7325.
· Nuclear Power Corporation, 581 400 Karnataka, India. Project Director Dr. Paramahamsa Tewari.
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Some General Properties of Matter and Energy Sources

Devoted to memory of Academician A.A. Harkevich

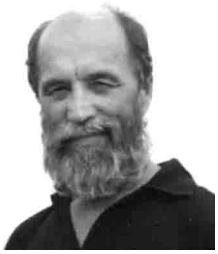

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Introduction

Nowadays there are appear more and more attempts to disclose new methods of obtaining energy from the ambient space, i.e. from heat, electromagnetic, gravitational fields, physical vacuum, aether, etc. (See, for example, publications in New Energy Technologies [1-3]). The publications demonstrate that researchers meet various incompletely investigated physical processes. These scientific areas are difficult to be investigated. All this makes obstacles for development of works on creation of new energy sources. **In this work there is made an attempt to demonstrate general properties of energy sources of any physical nature. This attempt is based on a general analysis of properties of matter.** A theory of transformers is used to investigate general properties of matter.

Action of all physical, technical and biological systems is expressed in energy transformation. Numerous theories based on particular (specific for some system) methods are applied for description of these systems. However, if the number of degrees of freedom and of elements inside a system increases then many theories are not able to describe operation of the systems. First these problems appeared in electrical engineering, radio engineering, automation and acoustics. The theory of transformers is applied to these fields of science. The theory represents a complicated system as a "black box" having several inputs and outputs. Operation of the numerous elements occurring inside the box is represented as some equivalent functions reduced to the inputs and outputs.

In the last decades methods of solution of mechanical dynamic tasks by the method of complex resistances are developed as well as representation of elements as linear transformers [11] and finite elements in liquid [14]. This tendency can be applied to the mechanics of liquids and gases. Now there are successfully developed those concepts which assume observation of models having very few degrees of freedom to be enough for analyzing processes in hydrodynamic systems [10]. However, a mathematical apparatus for description of transformers operation which is well-developed in these areas of science and engineering has a special view and is applicable only for these scientific areas.

Academician A.A. Harkevich developed a theory of a linear transformer up to the level of the general theory of transformers which is applicable for transformation of any types of energy [24]. The general theory of transformers proposed by A. A. Harkevich is applicable for description of various energy sources, flying and swimming objects, functioning of different animals' organs, and technological processes. In this work some general properties of matter and energy sources are investigated, according to the general theory of transformers.

General theory of energy transformer

The whole ambient space, from the microworld to the macroworld, is filled with energy. According to different theories, space is represented as a compact medium (i.e. having distributed parameters) or a medium consisting of a limited number of discrete elements (i.e. having concentrated parameters). On the analogy of hydrodynamics [10, 14] the compact medium can be represented as an equivalent system with a limited number of degrees of freedom. Hence, the whole space can be represented as some system consisting of elements and communications between the elements with a limited number of degrees of freedom. Energy exchange occurs due to the degrees of freedom. Energy transmission occurs if energy gradient is presented in the ambient space. Due to the energy gradient a force tends to realize transmission in the space [4]. The elements can be systems as well.

Hence, the more we observe dividing the elements on the systems and the systems on the elements the more we will penetrate into the microworld (i.e. atoms, elementary particles, physical vacuum, aether, etc.). The more we combine the elements in the systems, and the systems in the new larger systems the more we observe the macroworld (the Solar System, galaxies etc.). All the systems and the elements are interconnected. The systems and their elements are

transformers of energy. Energy motion occurs in the smallest part of space. Consequently, the whole space can be represented as a system consisting of the energy transformers. In the general case due to every type of energy limits of a transformer consist of outer limits (i.e. communications with the macroworld) and inner limits (i.e. communications with the microworld). Dividing into the macroworld and the microworld occurs in relation to the size of a transformer for every type of energy. Types of energy coming through communications of a transformer and inside it may differ, i.e. mechanical, heating, electromagnetic, chemical and other known and unknown types of energy.

The processes in which a great number of interacting elements and different types of energy participate are very complicated and do not allow describe the processes accurately by modern mathematical methods. Hence, there is a problem to find such methods of solution of the tasks which without disclosing all the communications inside the element can give the understanding of the way an element moves in the system. The following premises can be made for the method of solution of the task of a system and its elements' motion:

1. Motion of all the elements in the space is characterized by energy exchange occurring among them;
2. We are interested in a certain limited area for every individual type of energy. The chosen limited area will be called as **a transformer**;
3. The transformer has degrees of freedom both on its limits (sides) and inside it (inner degrees of freedom);
4. Further this limited area (the transformer) which has or is able to have a limited number of degrees of freedom (sides) at its limit will be observed;
5. Interaction between this transformer and the ambient space occurs only through these degrees of freedom (sides) by means of energy exchange;
6. Motion of energy between the elements of the transformer occurs according to its degrees of freedom inside the transformer. There can be a limited or unlimited number of degrees of freedom.
7. All the space is full of the transformers. All the transformers adjoin each other without gaps. Energy exchange between the transformers occurs through their sides which do not have a size but reflect general kinematical and dynamic characteristics of the energy transferred through these sides.

Editor: The full variant of the article includes mathematical description of operation of energy transformers which is followed by these conclusions:

- There can be any number of different types of elements having a corresponding number of degrees of freedom and any type of energy inside the transformer. However, on every side of the transformer a generalized force has the same value and depends only on change of energy according to this degree of freedom. Therefore, two transformers are considered to be equal if the generalized forces (energy changes) on all the sides are equal. In this case it is not necessary for the inner structure of the transformer, number of inner degrees of freedom, and energy types of these two transformers to be equal. This is **a principle of equivalency of transformers at the equivalency of the forces acting at the sides of transformers**.

- In the general case the generalized force at any side depends not only on energy exchange occurring at this side but on energy exchange occurring among the sides or at other sides of the transformer. The generalized forces are produced by energy distribution in the space.
- A transformer is characterized by the fact that there are different types of energy at its different input sides (or the energy can be of the same type but having other characteristics of motion).

Resistances of the interaction provide information about physical properties of the transformer, in particular, about physical interaction between the sides. At that a number of inner degrees of freedom in this transformer as well as the reactions at the other sides do not play any role. Proper resistances of the sides and resistances of the interaction provide information about inner physical characteristics of the transformer reduced to equivalent values at the sides. Hence, it is possible to have two transformers having equal equivalent resistances of interaction for all the sides. However, according to their geometrical and constructional characteristics and types of energy, the transformers will be different. The resistances may be a function of kinematical characteristics **(a nonlinear transformer)** or of time **(a parametrical transformer)**. Moreover, it can have constant values **(a linear transformer)**.

It is appropriate to consider physical properties of matter included in the volume of a transformer only due to resistances at the sides of the transformer.

Structure of the transformer

Every inner degree of freedom can be represented as a series circuit. By analogy with electric circuits [6, 7, 11, 16-18] the transformer can consist of various circuits. An unlimited number of degrees of freedom allows represent a transformer consisting of an unlimited number of chains. The circuits have series, parallel, or mixed junctions. A part of a circuit whose elements have the same generalized displacement is called as a branch. The branch can consist of one or several elements. A place where three or more branches are joined is called as a multiple junction. A circuit is considered to be a closed path including several branches and multiple junctions. All the elements of a chain connected in series have equal generalized displacement (as well as equal speed and acceleration). The generalized force acting on the

whole circuit is equal to the sum of forces acting on the elements of the series circuit.

The elements connected in series can be replaced by one element in such a way that the generalized displacement and the summary generalized force would not change. In the case of a parallel connection all the branches of the circuit are joined to the same pare of multiple junctions and are under influence of the same generalized force. Parallel circuits can be replaced by series equivalent circuit and vice versa [6, 7, 11, 17, 18]. Hence, a number of inner degrees of freedom and a quantity of chains may be decreased as well as increased. In this case resistances occurring on all the sides will be constant.

Structure of the linear transformer

The simplest transformer is a one-side transformer having one inner degree of freedom…

If to the input of the transformer we deliver generalized displacement (or force) which depends on time as a pure sinusoidal signal then the linear transformer will have sinusoidal reaction of the same frequency. For the sinusoidal signal with fixed frequency the linear transformer (including a transformer having an unlimited number of inner degrees of freedom) can be represented as an equivalent transformer reduced to this input as one chain. An equivalent transformer placing at this input at other fixed frequency of sinusoidal disturbance will be represented as a chain having one degree of freedom but different values of chain elements.

If the signal at the input of the transformer is of complicated time-periodical form then it can be decomposed to Fourier series. Every harmonics of the Fourier series will produce its own chain. The general complicated signal will produce the complex chain consisting of compound sum of elementary series chains. This complicated chain consists of elementary chains interconnected in series or in parallel and combined in multiple junctions and circuits. The construction principles of this complicated chain can be based on methods of identification and synthesis which are well developed in electrical engineering, automation for linear and non-linear transformers [9, 12, 13]. These principles are formally useful for transformers which transform energy of any physical nature. Identification produces so much elementary chains as the number of inner degrees of freedom. Every elementary chain reflects motion by one inner degree of freedom. Physical analogy occurring among motions of different nature is actual here [11, 16, 18]. Values of the generalized masses, elasticities, dissipative and active elements can depend on kinematical variables (non-linear chains), on time (parametrical chains), or they can be constant (linear chains).

If a series circuit includes mass and elasticity then it will have resonant frequency. At this frequency reaction of mass and elasticity will be absent in the summary reaction. It is equal to the fact that we will know nothing about the value of mass (and elasticity) and, moreover, about its presence at all. The mass can have huge value, but it will be absent for us. Hence, if we assume a transformer as an atom then the atom may include elementary chains having huge masses (much more than the mass of the Earth), but we will not know about it until we apply such frequency to the input which explicates this mass.

Any energy transformer including a transformer with distributed parameters can be represented as a system of elementary series and parallel chains connected in a certain way. A concrete transformer can have various types of these connections. All of them can be included into another combination of connections that is accompanied by change of values of masses, elasticities, dissipative and active elements. However, in this case equivalency of reaction should be fulfilled at a certain diapason of frequencies on all the sides of the transformer.

There is a special spectrum of resonant frequencies for every combination of connections of the transformer. There will be an unlimited number of degrees of freedom and, hence, an unlimited number of resonances for the transformer with distributed parameters (for example, an elastic nail, a compressible fluid having a limited size). Our influence on the transformer usually has a certain diapason of frequencies. As the result of a limited diapason of excitation frequency the transformer will represent a system having a limited number of inner freedom, even if the transformer has distributed parameters.

Values of equivalent elements depend on oscillation frequency. Moreover, according to known laws, several parallel circuits can be transformed into a series one and vice versa. Taking it into account the following conclusions can be made:

1. The generalized mass, elasticity and dissipative elements do not have constant values in nature. Their value depends on frequency of the process, i.e. they depend on the character of time-change of the disturbance acting on the transformer.
2. The generalized mass, elasticity and dissipative elements are products of time-space change of energy.

Types of energy transformers

Transformers can be nonlinear, parametrical and linear. The transformer can be **active** (having an internal source) and **passive** (having an external source). The passive transformer can never be an energy source (by definition). A transformer can accept or transform one type of energy (monoenergetic transformers) or several types of energy (polyenergetic transformers). The polyenergetic transformer includes a mechanism and

corresponding elements and chains which allow transform one type of energy into another one. Fundamentally, all the transformers are polyenergetic transformers of energy, however many of them can be represented as monoenergetic ones since other types of energy participate weakly in them. Designing a transformer it is more convenient to put the energy source out the transformer. Let us further classify the passive transformers.

The passive transformers can belong to the following types:

1. Simple transformers

In this case energy is produced at the output due to transformation of energy coming to the inputs into energy of another type or having other characteristics. The following transformation can serve as the example.

An electric transformer: resistance of one value comes to the input, and the resistance of another value comes from the output (a type of energy is the same).

A furnace for combustion of fuel: energy of chemical connections comes to the input and heating energy comes from the output (energy of radiation may be neglected).

A Wind Generator, Hydroelectric Power Station: kinetic energy of moving air or water comes to the input, and electric energy comes from the output.

2. Energy intensifiers

In this case a transformer intensifies energy coming to one of the inputs due to energy coming to the other inputs (or to the other input). Below there is an example for a *monoenergetic transformer*. Energy (an electric signal having certain parameters) comes to the input of a transformer, and the output energy has the same characteristics but it is more intensive. It can occur due to electric energy coming to the other input of the transformer.

A heat pump represents an example for a *polyenergetic transformer*. Low potential heat energy of the ambient space (air, water, ground) comes to the input of the heat pump, and electric energy from a power network comes to the other input. The output heat energy has value which is equal to the sum of the coming heat energy of the ambient space and electric energy coming from the power network through the electric engine of the compressor. The output heat energy excesses energy coming from the power network by several times. The output energy is always lower than the sum of the low potential heat energy and the electric energy coming to the input. Hence, the output of a heat pump is always less than unit.

Efficiency of the heat pump consists in the fact that a consumer pays for electric power produced by power network only (use of the low potential heat of the ambient space is free). However, the output heat energy is several times more than the energy which can be produced by the electric power coming to the input.

3. Active oscillator

An active oscillator is a device of a certain type. Energy of time-constant characteristics comes to its input, and at output there is energy of time-periodical characteristics. Energy with time-periodical characteristics can come to the input as well since these characteristics are not connected with the time-periodical characteristics of the output energy. The transformer can operate in a mode of an active oscillator if it has the following features:

1. Indirect connection as a series circuit: one of the outputs is connected to an additional transformer whose output is connected to one of the inputs of the transformer. The additional transformer provides certain changes of the input signal (time delay).
2. Energy comes to the input (it can be time-constant or time-periodical).
3. The transformer must have a certain type of non-linearity.

Examples of the active oscillator

Internal combustion engine: the indirect connection is the system of combustion, the non-linear element is the system of admission and exhaust valves, and the energy source is energy of chemical connections of fuel.

Various electric generators: all of them have the indirect connection, the non-linear element, and the energy source.

The active oscillators differ from the electrical intensifiers qualitatively. The difference consists in the fact that the active oscillator can operate and receive energy from the ambient space without additional energy coming to it (from a power network, for example).

Theorists and experimenters try to create a self-supporting self-organizing system in their works on creation of alternative sources. This fundamentally correct tendency requires using theory of active oscillators. There is the developed theory in electrical engineering, automation, and other scientific fields [25]. To simplify application of these theories it is necessary to use analogy between equal processes which take place in different physical fields.

4. Rectifiers

Time-periodical energy comes to the input of the transformer. The output energy has time-constant or practically time-constant characteristics. If the transformer has a non-linear element or elements of a certain type (a diode or a one-sided valve) then it can

operate in the mode of a rectifier. The examples are electrical rectifiers and pumps of a valve type.

Properties of energy transformers

General properties:

1. A transformer can transform energy of one type as well as transform one type of energy into another type.
2. The generalized kinetic, potential and dissipative energies are specific peculiarities of energy change in the space and time.
3. The generalized masses, elasticities and dissipative elements are products of energy change in space and time.
4. Values of the generalized masses, elasticities and dissipative elements (existing inside the transformer as well as reduced to the equivalent values on the sides of it) depend on a temporal character of changes of kinematical or dynamic disturbances. Values of the generalized masses and elasticities at the sides of the transformer are lower than the corresponding values inside the transformer.
5. Energy interchange between macrostructures and microstructures can occur through a transformer.
6. One area of space can "know" about another area of space through energy exchange only, i.e. through generalized dynamic and kinematical interactions. In the light of the fact that chains of different transformers can have similar physical properties (for example, an equal resonant structure) interference of these transformers seems to be possible including interference occurring at a great distance.

Properties of the passive monoenergetic transformer:

1. Transformation of characteristics of the same energy type.
2. The output energy can be both equal or lower than the sum of energies coming to all the inputs. The sum of the output energies decreases due to dissipative losses occurring inside the transformer.

Properties of the passive polyenergetic transformer:

1. One energy type coming to an input can be transformed into another energy type coming from the output.
2. The sum of energies of all the outputs can be equal to the sum of energies of all the inputs or less than it. The sum of the output energies decreases due to dissipative losses occurring inside the transformer. The output will always be lower than unit. If the energy coming from certain of the outputs (within the limits of one output) is considered as a positive effect then the output will be less than the mentioned value.
3. Energy of one and the same type comes to the input and from the output while other energy types can come from other outputs. This property can allow increase one type of energy coming from an output at the expense of the other types of energy coming to the inputs.

Analysis

This article is aimed to provide general properties of the energy transformers and to analyze some problems of creation of renewed energy sources, according to these properties. There are made various attempts to design a renewed energy source which would produce energy without fuel consumption. In the light of the above mentioned results, the researches on creation of the renewed energy source may be represented by the following way. Energy can be produced from the macrostructures and the microstructures.

In the case of the macrostructure, energy can be produced by a simple transformer, an electric intensifier or an active oscillator. Methods of production of energy from the ambient space by means of simple transformers (thermoelectric and hydroelectric power stations, wind generators, etc.) are developed sufficiently by the humankind. Works on producing energy from the ambient space by means of energy intensifiers are on its initial stage. Heat pumps, which utilize low potential heat energy by means of Freon-compressor heat pumps, are successfully introduced. One of the perspective approaches is replacing such a heat pump by a vortex oscillating heat pump which does not contain Freon and a compressor [3, 5, 19, 22]. In future it will be possible to replace the energetic pump by a new energy transformer of the type of an active oscillator. In this case the energy source will always obtain energy from the ambient space without using additional energy from a power network. Energy sources of the type of the active oscillator are internal and external combustion engines, stream engines, etc.

In the general case a transformer can contain different energy types and has communications with **outer microstructures**. It should be noted that the outer microstructures can be included in the geometrical size of the transformer. Energy of this microstructure can be huge; hence, this energy can be obtained from them for a very long period of time. Atomic reactors can serve as an example for this fact. The types of energy in these microstructures can be represented by known types (electromagnetic energy, nuclear energy) and unknown types (whose numerous quantity can be considered). These energy types exist in the ambient space. However, almost all the transformers of energy produced by a human (except the nuclear reactors) do not interact with the energies, and we do not obtain energy from these microstructures.

The task of creation of a new energy source consists in designing such an energy transformer which could obtain energy from the microstructures and transform it into the type of energy which is needed to a consumer. In this case all the designed transformers will not have over unit output. Efficiency of these transformers will be defined by the cost of the energy produced by them. This energy depends on a ratio of

energy coming to one of the inputs (electric power) (for example, in heat pumps) to the output energy. If the output energy is much more than the artificial energy which comes to one of the inputs then this transformer can be very useful for a consumer.

New high effective energy sources are often claimed to be created. According to the observed facts, existence of such sources is practically possible. Nevertheless, realization of this source will depend on our knowledge of physics of the microstructures and methods of transformation of energy of the microstructures into such type of energy which can be used by a consumer. Physics of microstructures is investigated badly, and many types of energy are totally unknown. Therefore, modern scientists try to create the new energy sources at random. In this case the following results can be achieved:

1. The high effectiveness of an energy source (over unit output) does not correspond to reality.
2. The output energy of the energy source is actually higher than the input energy (the source of the energy intensifier type).
3. The energy source actually produces energy without artificial input energy (the source of the active oscillator type). It can occur if an inventor failed to recognize the source of energy coming from the microstructures. It can be connected with particular or total lack of exploration of physics of the microstructures. Moreover, the fact is caused by transcendent difficulty of disclosing energy sources from the macrostructures.

Conclusions

It is principally possible to create an energy source whose output energy would be higher than its input energy (an energy intensifier) or an energy source which would produce energy without additional input energy (an active oscillator).

1. Various energy sources or transformers of energy of the macrostructures and microstructures can be designed.
2. Practical value of the energy source is defined according to cost of its output energy instead of the output value.
3. Designing new energy sources it is useful to consider them from the point of view of transformers. It is worth to define all the communications of the transformer and to state experimentally energy at all the accessible communications of the transformer.
4. Developing theories of sources it is expedient to use physical analogy and to take into account ready results of works on theories of transformers, chains, etc. of electrical engineering, radio engineering, automation and other scientific fields.
5. In the light of the fact that it is planned to obtain energy from the microstructures it is necessary to pay attention to new probable types of radiation and to their influence on a human.

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Commercial Exploration of Space

Review
by Olga Leontyeva, Editor
http://www.faraday.ru

Of late years the mankind has greatly advanced in space exploration. New spaceships are created, automatic apparatus are launched to the planets of solar system, space stations are orbited. A man has passed to outer space and begun exploring the planets of solar system. More and more specialists and people of different professions are involved in the development of space industry. However to present day only a few of them has succeeded flying into space.

At the present state of affairs space flight is very expensive and a serious reason should exist to forward a man into space if he or she does not relate to the aims of professional cosmonautics. However in last years there has appeared a certain breakthrough in the solving of the problem. Nowadays space technologies gradually turn from the sphere of experimental and scientific researches to the area of practical application. The time has come for a man to realize the real space flight without being the professional cosmonaut.

What are the ways to solve the problem? No doubt that special attention should be paid to the development of new space technologies, search of new types of fuel and attraction of investments to the sphere of space tourism.

April 28, 2001 can be considered as official date of birth of space tourism, when there was launched the space ship "Soyuz TM-32" with the first space tourist aboard. Almost in a year, on April 25, 2002 the space tourist #2 South African Republic person Mark Shattlword started on his space journey.

Today many companies give the opportunity to make a real space flight for all comers who have enough money and health. It is promised the providing of the most modern space technologies and the most perfect space equipment. It can be created a furor by the "Minimum program" of the Russian company "Atlas Aerospace" which is made by the members of Yu.A. Gagarin Center of training of cosmonauts.

In recent years at the international market there appear more and more companies which deal with search and encouragement of inventors who work on creation of alternative propulsion systems. Activity of "X Prize Foundation" company can be considered as an example.

The X PRIZE Foundation

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The X PRIZE is a $10,000,000 prize to jumpstart the space tourism industry through competition between the most talented entrepreneurs and rocket experts in the world. The $10 Million cash prize will be awarded to the first team that:

- Privately finances, builds & launches a spaceship, able to carry three people to 100 kilometers (62.5 miles)
- Returns safely to Earth
- Repeats the launch with the same ship within 2 weeks

The X PRIZE competition follows in the footsteps of more than 100 aviation incentive prizes offered between 1905 and 1935 which created today's multibillion dollar air transport industry.

For more than 30 years, the general public has waited for an opportunity to enjoy the space frontier on a first-hand basis. The X PRIZE Foundation is working to make space travel possible for all. The spaceships that compete for the X PRIZE are designed to carry passengers.

Since its inception in May 1996, the X PRIZE Foundation has registered more than 20 teams from seven countries to compete for the prize. The X PRIZE is fully funded through January 1, 2005, through private donations and backed by an insurance policy to guarantee that the $10 million is in place on the day that the prize is won. Additional funds are still being raised by the X PRIZE Foundation to implement the competition (judging, media, event management, etc.) and continue the Foundation's education mission.

The X PRIZE was inspired by the early aviation prizes of the 20th Century, primarily the spectacular trans-Atlantic flight of Charles Lindbergh in The Spirit of St. Louis which captured the US $25,000 (US$) Orteig

prize in 1927. Through a smaller, faster, better approach to aviation, Lindbergh and his financial supporters, The Spirit of St. Louis Organization, demonstrated that a small professional team could outperform a large, government-style effort.

The Societal Benefits of the X PRIZE include:

* Creation of a new generation of heroes
* Inspiring and educating students
* Focusing public attention and investment capital on this new business frontier
* Challenging explorers and rocket scientists around the world; and,
* Vehicles built for the X PRIZE will eventually serve four different industries:
- Space Tourism
- Low-cost satellite launching
- Same-day package delivery
- Rapid point-to-point passenger travel.

In Fig. 1 it is demonstrated the typical X Prize trajectory.

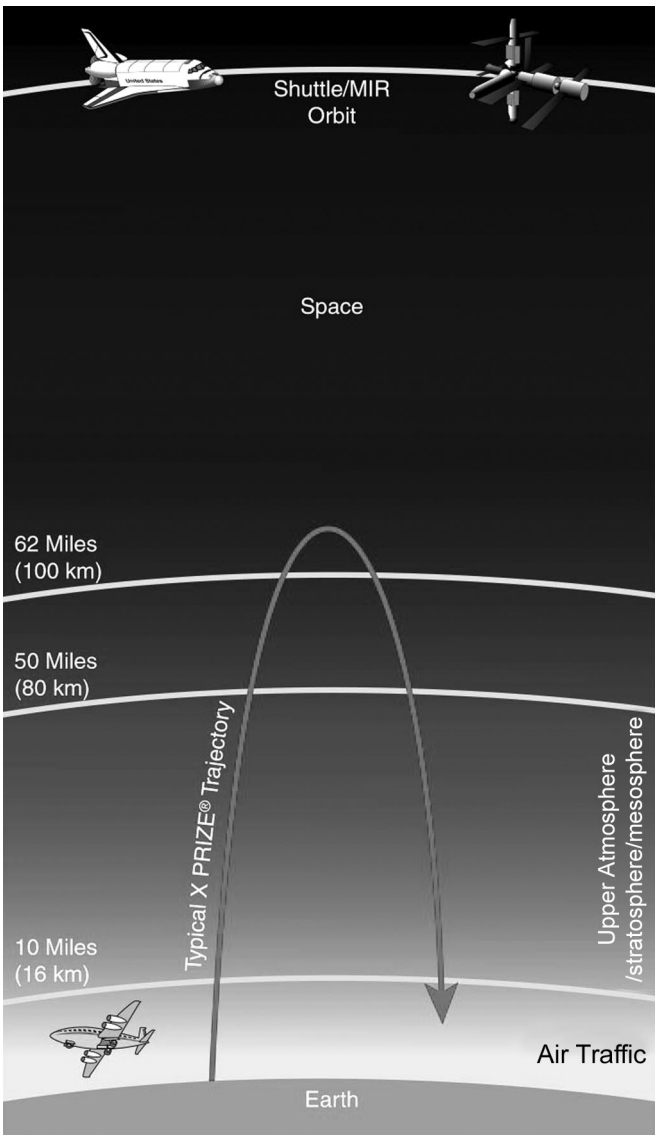

Fig. 1

Editor: Below we publish photos and brief comments about some official X PRIZE registrant teams. More detailed information you can find at http://www.xprize.org/imagefacts/photo1.html.

The Da Vinci Progect

http://www.davinciproject.com

Fig. 2
"Wild fire"

The **da Vinci Project** will launch its spacecraft ("Wild Fire") from the world's largest helium balloon. The 3,270 kg (7,200 pound) rocket will be tethered 720 meters (2,400 feet) below the balloon and lifted over the course of an hour to an altitude of 80,000 feet. The 10,000 pound thrust, liquid oxygen, kerosene engines will fire the first stage and the rocket will fly an initial angular trajectory to clear the balloon. The spacecraft then will transition to vertical flight to its apogee of 120 km in space. The rocket will reach a maximum speed on both its ascent and re-entry of Mach 4, or 4,250 kph (2,650 mph).

An innovative ballute will protect and stabilize the rocket on re-entry. A flyable parachute will be deployed at 25,000 feet and the rocket will descend under control, guided by GPS, to a predetermined landing zone. The da Vinci Project has already successfully conducted full-scale rocket motor test and has built a full-scale mockup of their vehicle.

"Discraft" corporation

http://www.xprize.org/teams/teams.html

John Bloomer, the team leader, is an aerospace engineer and he has worked on many aerospace progects, including Apollo and holds more than 60 patents on a disc plattorm aircraft. Bloomer's ship utilizes "Blastwave" Pulsejets.

Flight Sequence

Fixed, 7850-ft^2-area, laminar-flow wing take-off at about 60 mph within about 150 ft, featuring climb with gradual air-breathing acceleration (according to a fixed program) at fixed angles, to exit the atmosphere at Mach 10 on an unpowered ballistic arc to reach 75-mi. altitude: return on down-leg of same unpowered arc to gradual power-on flare-out re-entry of the atmosphere in simple reverse sequence of the take-off velocity profile. Range above 100,000 ft is about 480 mi. which is covered in about 5 minutes.

"Kelly Space & Technology"

http://www.kellyspace.com

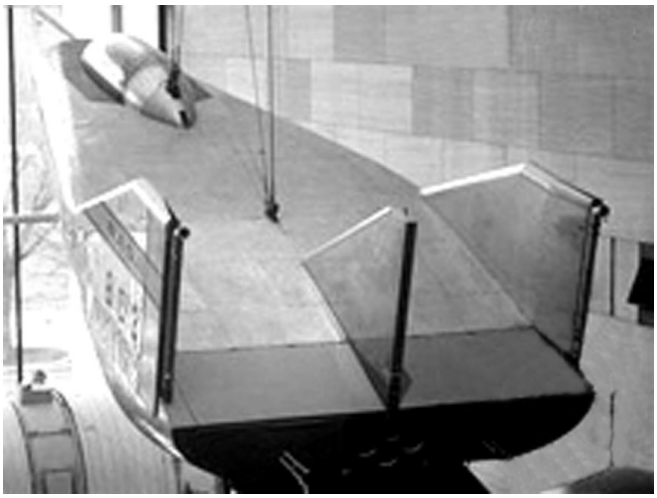

Fig. 3
"LB-X"

The vehicle is a rocket-powered delta wing glider with a liquid oxygen and kerosene liquid rocket engine. The spacecraft is prepared and fueled at the takeoff airport. The spacecraft is towed to release altitude behind a conventional jet powered aircraft such as Boeing 747 aircraft. Upon release from the tow aircraft, the main engine is throttled up for boost phase. The vehicle nominally coasts to an apogee altitude of 100 kilometers. The vehicle then glides to a landing at the takeoff airport for checkout and refueling prior to the next flight.

Flight Sequence

The lifting body will be towed to launch altitude behind another aircraft, and the rockets will be ignited. The craft will return to the landing site and make an unpowered, horizontal landing.

"Lone Star Space Access"

http://www.dynamicar.com

The Cosmos Mariner employs air-breathing jet propulsion for take-off and landing from conventional airports and rocket propulsion for ascent from cruise flight in the stratosphere to 30 or 40 nautical miles altitude. From there, the vehicle coasts to a target altitude of around 65 nautical miles. The air frame is designed to interface with two jet engines (turbofan or turbojet) each with 20,000-lbs static thrust or less. For rocket propulsion, the Cosmos Mariner will use the Aerojet AJ26-NK31A, a staged-combustion kerosene engine. The vehicle is designed to take off and land from conventional runways.

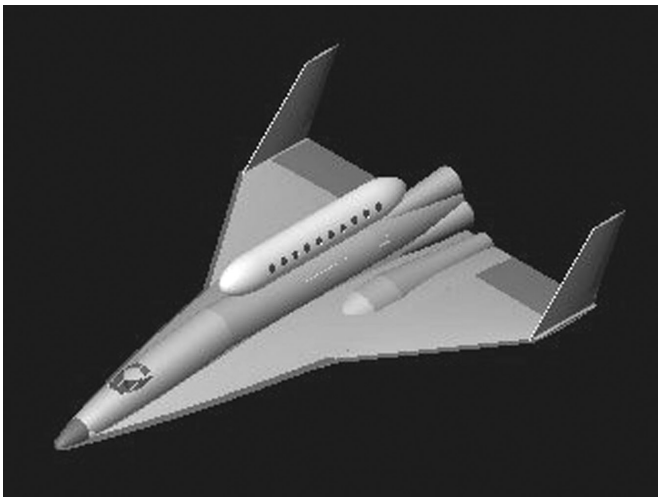

Fig. 4
"Cosmos Mariner"

*Along with X Prize Foundation it should be mentioned **ALLTRA** Company (Germany). ALLTRA consists of a small group of space experts. The main objective of ALLTRA is to 'sell' the space idea to a broad public and to identify future commercial opportunities in the space sector.*

On the official ALLTRA website http://www.alltra.de you can find collection of artist's views of the projects which are aimed at decrease in space ships value by means of using of new types of engines. Besides the Company deals with the development of space hotel projects.

JNET

New Energy Technologies collection of articles Japanese Version

Collection of articles from New Energy Technologies magazine, 2001-2002 is published in Japan.

On purchasing of the book, please, contact

Eiichi Yamamoto,
President Yama Trans Co. Ltd.

Email: admin@yamatrans.co.jp or eyama@yamatrans.co.jp

Alternative Aircrafts and Space Propulsion Systems

Editor: Nowadays all over the world there are made numerous attempts to create new types of aircrafts and alternative space propulsion systems. Below we publish the review of some interesting devices which are presented in the modern market.

"Arbortech Pty.Ltd"

http://www.airboard.com.au

Fig. 1
Airboard 2000

General Technical Specifications

Total payload, including rider — 100 kg (220 lb)
Operating time — 1 hour on full tank of fuel
Construction — Fiber glass/High-impact plastic shell, Aluminum frame, Rubber skirt
Starting — Electric key-start, Battery included
Engine — Briggs & Stratton 4-stroke
Fuel tank capacity — 5 litre (1.3 US gal)
Fuel type — 85 Octane unleaded

How does it work?

Airboard uses Hovercraft air cushion principles to glide just above the ground. The air cushion is generated from a purpose designed engine and fan which are suspended below the Airboard shell. In addition to providing an air cushion for the Airboard to ride on the fan also provides a fast stream of air exiting from the rear of the craft to provide forward thrust – just like a hovercraft. To help provide better acceleration the Airboard also includes a unique friction drive wheel at the rear. When the rider wishes to accelerate forward, weight transfer is used to bring the friction drive into contact with the ground. By engaging the friction drive clutch the Airboard can be accelerated forward without losing the feel of hovering above the ground. The control of the Airboard is provided by weight transfer of the rider, similar to surfboards, skate boards and snow boards. In operation the Airboard can be started, stopped and steered in a controlled manner and this means that riders can perform stunts, trick maneuvers and race around tight tracks against each other. In this unique way the Airboard is the first ever vehicle to deliver the advantages of hovercraft vehicle without the disadvantages of proof acceleration and handling.

"Trek Aerospace, Inc."

http://www.solotrek.com

Fig. 2

Trek Aerospace

Preliminary Specifications and Predicted Performance

Normal Gross Take Off Weight	800 Lbs.
Fuel (15 U.S. Gallons)	98 Lbs.
Mission Payload, net of fuel	352 Lbs.
Takeoff/Landing Distance	0 (VTOL)
Maximum Speed	70 Mph
Range	120+ Miles
Hover/Loiter Endurance	2+ Hours
Engine Type	Advanced Int. Combustion
Fuel Requirements	Heavy-Fuel or Gasoline

Special Features: 100% fly-by-wire control system with electronic stability augmentation; Intuitive, easy to fly safely; Minimal field service requirements; Rugged, efficient power train.

DM AeroSafe

http://dmaerosafe.freeservers.com

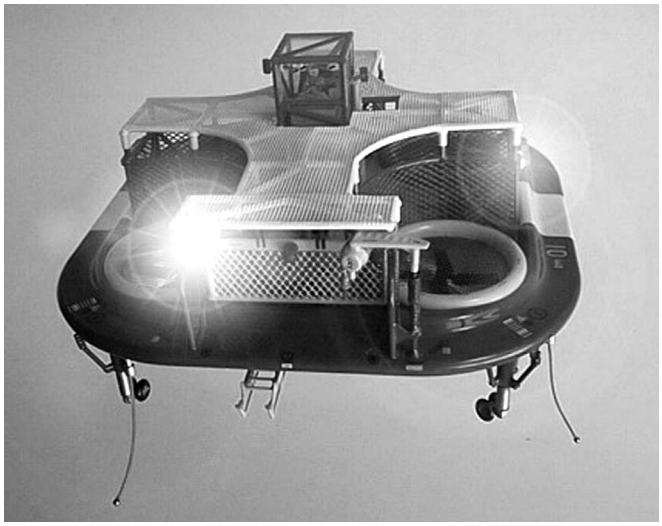

Fig. 3

EAGLE vertical take-off and landing aerial rescue platform

DM AeroSafe is a small research and development team, which has developed a totally new high-rise rescue technology to retrieve trapped people from areas which cannot be reached by conventional aerial ladder, conventional helicopter or a helicopter equipped with a Heli-Basket.

This technology could give rise to a new class of air transportation means, used for safe close-in maneuvering around tall structures, even inside the highly populated areas.

Eagle Aerial Rescue Platform's Performance Summary

Dimensions:

Length - 42 feet (12.8 m)
Width - 42 feet (12.8 m)
Height - 16 feet (4.8 m)

Weights:

Max. Gross weight - 5000 pounds (2268 kg)
Payload (Crew of two plus 10 rescued people) - about 2000 pounds (about 900 kg).

Propulsion System:

Four (4) variable collective pitch Ducted Propellers
Propeller Diameter - 7.8 feet (2.4 m)
Engines - four (4) four-cylinder radial piston aero engines with forced air cooling system 250 hp each (1000 hp total)

Performance:

Max. Duration - about 5 hours without refueling
Max. Airspeed - 40 knots (75 km/h)
Max. operating altitude - about 7000 feet (about 2200 m).

"LTAS/CAMBOT, Inc."

http://www.lvcm.com

Passenger Craft "Ltas 30-Xb"

The ships have rigid monocoque hulls, hybrid powered vectored thrust control and full active buoyancy control. (LTAS US Patent Pending).

This small 2-3 person craft at 70 to 80 feet in diameter will demonstrate ALL production systems and is designed for the LTAS FAA Type Certification program.

NASA's Langley Research Center

http://science.nasa.gov

NASA researchers are studying insects and birds, and using "smart" materials with uncanny properties to develop new and mind-boggling aircraft designs.

The "personal aircraft" that replaces the beloved automobile in people's garages may still lie in the realm of science fiction or Saturday-morning cartoons, but researchers at NASA's Langley Research Center (LaRC) are developing exotic technologies that could bring a personal "air-car" closer to reality.

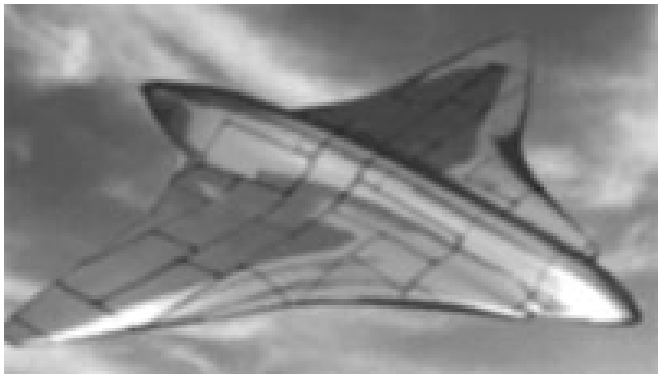

Fig. 4

And air-cars are just the beginning! Self-healing wings that flex and react like living organisms, versatile bombers that double as agile jet fighters, and swarms of tiny unmanned aircraft are just a few of the science-fiction-like possibilities that these next-generation technologies could make feasible in the decades ahead.

Laser Beam Flight

Lightcraft Technologies, Inc. (LTI)

http://www.lightcrafttechnologies.com

Lightcraft Technologies, Inc. is a new company committed to providing low-cost access to space through the use of beamed energy propulsion. (See color photos on the cover page).

Fig. 1

In 2000 at the High Energy Laser Systems Test Facility (HELSTF), Lightcraft Technologies, Inc. (LTI) set a new world's altitude record of 233 feet (71 meters) for its 4.8 inch (12.2 cm) diameter laser boosted rocket - in a flight lasting 12.7 seconds.

Although much of the flight was spent hovering at 230+ feet, the Lightcraft sustained no damage and will fly again. Besides setting the new altitude record, the craft demonstrated the longest ever laser-powered free flight and the greatest "air time" (i.e., launch-to-landing/recovery). LTI launched a total of seven vertical flights between 8:30 am and 11:30 am with three Lightcraft weighing less than 1.8 ounces (51 grams). Two of the flights by Lightcraft #3 reached 159 and 184 feet with the same propellant load!

...set a new world's altitude record of 233 feet!

The record flights were powered by the 10 kW pulsed carbon dioxide laser named "PLVTS" by the organization that owns it: the Directorate for Applied Technology, Test and Simulation (DATTS). Even though PLVTS was suffering from an arcing or grounding problem that caused it to run erratically, the laser power was still adequate to propel the craft to record altitudes.

What is a Lightcraft?

A Lightcraft is a 1kg launch vehicle, made from high temperature ceramic materials, that flies into space on a megawatt laser beam.

Fig. 2

The Lightcraft is both a single-stage-to-orbit launch vehicle and a satellite. If you have any further questions or comments, write or call LTI headquarters in Bennington,VT. The company representatives would be delighted to send you more information, or answer any inquiries over the phone.

How does it work?

A ground based laser is the power source that propels the Lightcraft into orbit. Lightcraft can deliver payloads into space for a fraction of the cost of traditional rockets because most of the engine stays on the ground, thereby unburdening the craft from having to lift the energy source for its propulsion system.

Fig. 3

The back side of the craft is a large, highly polished parabolic mirror that is designed to capture the laser beam projected at it from the ground. The mirror focuses the beam, rapidly heating the air to 5 TIMES the temperature of the sun, creating a blast wave out the back that pushes the vehicle upward. As the beam is rapidly pulsed, the vehicle is continuously propelled forward, on its way to orbit.

History of Lightcraft

1987 — Prof. Leik Myrabo invents Lightcraft for SDIO.

1997 — First successful wire-guided tests at WSMR. Solved flight stability difficulties, much like the Wright brothers did with the airplane.

1997 — Lightcraft broke Goddard's 41 ft., 1926 first successful rocket flight - but this time with no on-board fuel.

1998 — Record flight of 99 ft. with air breathing Lightcraft engine.

1999 — Record flight of 128 ft. with first rocket Lightcraft engine.

2000 — LTI sets new world record for highest flight (233 ft), longest flight time, and heaviest vehicle.

How can LTI reduce launch costs?

Conventional Launch — $175,000,000
The Lightcraft — $46,000

Chemical Rockets:

- carry massive propulsion source on board
- are expendable
- extremely costly
- prone to explosion due to fuel on board

Laser Propulsion:

- propulsion energy source remains on the ground!
- Lightcraft are inexpensive to manufacture and extremely light weight
- highly reusable power source is never subjected to the risks of flight

Lightcraft Technologies, Inc.

1914 Walloomsac Rd.
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FAX: 802-447-8216
E-mail: tmyrabo@lightcrafttechnologies.com

Alternative space propulsion systems Star Drive

Mark R. Tomion, USA
http://www.stardrivedevice.com

Re: U.S. Patent **6,404,089** for the **Electrodynamic Field Generator**, **(EDF),**
issued June 11, 2002 to Mark R. Tomion.

The 'official' name of the "StarDrive device", per the U.S. Patent and international PCT Applications, is **Electrodynamic Field Generator.** The EDF Generator uses banks of permanent magnets and rotating Field Coils to produce a very-high DC rotor voltage, and plane-parallel ring electrode arrays to electrostatically expand and control that voltage *as applied to the hull*, so that huge quantities of external Field electrons may be accelerated to energy levels that are usually reached only with a particle accelerator! It's somewhat like a glorified arc welder whose output is deliberately shorted to its own housing, and the DC voltage and current across the emitter and collector housing sections can be thermionically increased to values that are generally observed only in lightning**:** but the Field's *current density* is limited to a value which falls short of damaging the hull!

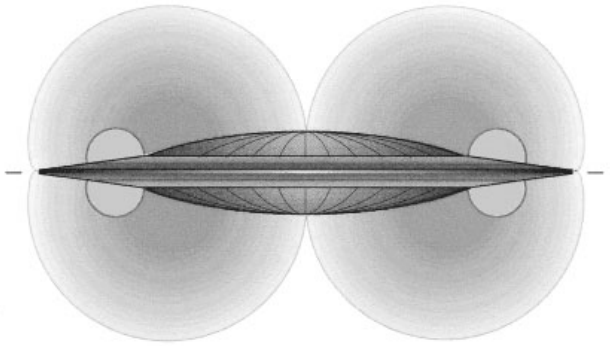

Fig. 1
StarDrive device hull & electrodynamic Field configuration

As depicted above (Fig. 1), electrons circulating in the external Field envelope can achieve an impact velocity at the central collector sections which is very nearly that of light, and applied magnetic fields allow broad modulation of the Drive Field current's properties. The *Primary Arrays* shown in the generalized schematic diagram below (Fig. 2) have control grids which allow an arc resistance imbalance to be imparted to the otherwise symmetrical Field current, so that they *render the two relativistic current impulses variably non-isometric:* thereby yielding thrust that is essentially **reactionless**! And the simple DC *Primary Power System*, like the early Faraday disk dynamo, *is wholly rotor-based* **. . .**

Note: It can be seen that the propulsive thrust developed by a StarDrive vessel is essentially brute-force in nature – it's produced simply by means of a controlled variable imbalance in the continuous *physical impact* of the two external hemitoroidal electron current streams with the collectors! If these two Field currents were of equal magnitude, no net force would be developed. However, if the "lower" current stream is stronger than the "upper", the vessel will be propelled away from the stronger current – in the "upward" direction. Since there's no 'backward' exhaust produced in the process, this type of thrust is truly and demonstrably reactionless in nature.

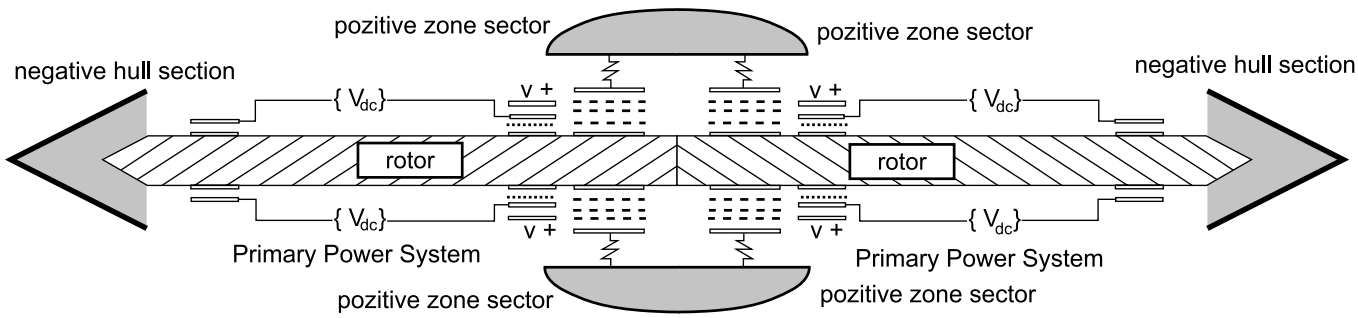

Fig. 2
Generalized schematic of rotor & dual induction ring assemblies

Needless to say, tremendous quantities of heat are produced in the StarDrive device's electron "targets" or collector housing sections, and liquid sodium must be pumped through each Primary Array's ceramic resistor network as a coolant. However, this excess heat in ground-based units may be used in the *commercial generation of electric power and desalinization of seawater*.

In fact, because an intense arc discharge field has the unique capacity to absorb vast quantities of quantum background energy, the EDF Generator is so efficient that the latter task may become truly cost-effective for the first time! And not only will large ***over-unity*** StarDrive Dynamo units be able to produce electric power at 60 to 720 MW output levels, they'll be able to do so for many years before the permanent magnet banks must be remagnetized!! *The only truly external input energy required* in the interim *is that necessary to initially bring the rotor up to speed . . .*

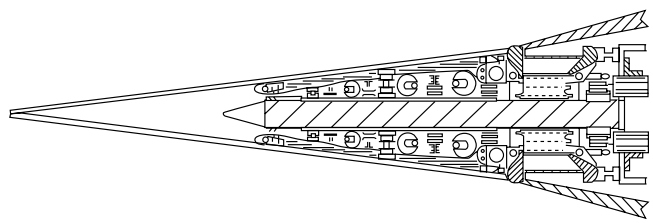

Fig. 3
A denumbered version of Fig. 1 from the EDF Generator Patent

Those of you who find this advanced technological prospect for the 21st century as exciting and fascinating as we do should consider making the

inventor's book *StarDrive Engineering* a valuable addition to your personal or reference library.

A Layman's Description of the StarDrive Device

Nearly anyone who endeavors to gain an initial understanding of the *Electrodynamic Field Generator*, even a scientist or engineer, is likely to ask for a concise layman's explanation of "how it works". This isn't easily accomplished, for this device represents an unorthodox and multidisciplinary technology. However, the overview provided below will discuss the operative characteristics of the machine's simplified *electric power generation variant* in what is hoped to be the most direct manner possible. In this case, when people ask the question above, what they generally mean is: "By what means is *over-unity* operation achieved in a 'StarDrive' Dynamo?". It is assumed here that the reader has not only already become acquainted with certain basic aspects of the design, but also understands that over-unity operation is an absolute prerequisite for any viable system of light-speed interstellar propulsion.

By way of further background, the formative mechanical design basis of the EDF Generator is of course the original Faraday disk dynamo. For whatever reason, no one seems to have bothered trying to develop this simple machine into a more sophisticated *and patentable* form before now. The principal limitation of Faraday's disk dynamo in its original form was that, when one or more permanent magnets were used to pass flux directly through the plane of a solid conductive rotor, a rather high-loss heavy current at very low voltage was produced. The first design improvement was therefore to use rotor-mounted toroid field coils in order to generate a much higher-voltage primary current, and to segment the rotor to reduce "eddy current" losses. Also, the toroid coil configuration absolutely minimizes Lenz losses, or the magnetic "drag" that is experienced by any conventional generator's rotor.

To eliminate the use of brushes, it was necessary to apply traditional vacuum tube design and operating principles. Fortunately, most of the original patent work in this field has passed into the public domain, so incorporating certain aspects of that work into the EDF Generator presented no impediment to its patentability. By using plane-parallel electrode arrays instead of brushes to charge the rotor, it is possible to limit that portion of the induced rotor current which passes through the field coils to a very low level – effectively isolating them from the actual output circuit. More importantly, however, it then becomes possible to thermoelectrically charge the Generator's housing itself in such a way that *it* carries the device's full output circuit current instead!

The reason for this unorthodox design parameter is that it was desired to actually incorporate a standing electric arc field into the output circuit, to take advantage of the electron's inherent ability to absorb quantum background energy [including *zero point energy*, if and as necessary]. As a result of a thorough study of lightning, the inventor of the StarDrive device reasoned that the electrons comprising any naturally-occurring bolt of lightning had to *recover* (or absorb) an amount of ambient photonic energy equal to that which they expended in transit – in order to satisfy the conservation of energy principle. In such a case, it is not necessary that "we" do the *work* of moving charge *against* a potential gradient; the work may be done by the charge itself in being attracted *along* the potential gradient (or voltage level).

And since it is known from the field of welding that it takes less energy to sustain an arc than it does to initiate it, it therefore becomes possible to create an electrical circuit that outputs more energy than it requires as input. This is exactly what the EDF Generator does – by incorporating a standing arc field in its output circuit. Using the StarDrive device as our mechanism, "we" only provide the work-energy required to establish and maintain the external field's potential gradient, by initiating rotor rotation and bringing the thermoelectric elements up to temperature. The electrons in the electrodynamic field do all the rest . . .

Further Notes from the Inventor

In conjunction with one of our *StarDrive Generator* prototype project funding proposals, we are presently working on an interim proof-of-concept experiment for our proposed 24 kW air-cooled EDF Generator prototype. This full-scale mock-up of the 30"-dia. Generator's rotor and dual induction ring assemblies is intended to demonstrate the fundamental design principal discussed at the close of the Technical Overview (linked to our website's Method of Operation Summary page), whereby the voltage electrostatically induced on the rotor anode rings which power each Primary Array should be roughly one-third (1/3) of the Field Coil voltage (because of the capacitive dual induction ring geometry of the Primary Power System). For safety reasons, the Field voltage in all *air-cooled* StarDrive *Generators* will be limited by design to 850 VDC, and to 1,400 VDC in the larger *liquid-cooled* StarDrive *Dynamos*.

The experiment will also assist greatly in the derivation of remaining production model specifications, and will in fact incorporate production-quality rotor segments and electrode rings. Should this proof-of-concept experiment be successful, not only will the ability of our over-unity 24 kW Generator prototype to deliver large-scale DC output that's compatible with standard AC inverters (for utility grid distribution or off-grid conventional use) be virtually assured, but a major milestone incentive in our existing funding proposals will have been fulfilled as well. Further

updates like those below will be forthcoming on the *News* page of http://www.stardrivedevice.com.

01/28/03 - International Patent Filings Secured!: We are very pleased to report that we were successful in our efforts to secure numerous international (PCT) Patent Application filings for the *Electrodynamic Field Generator* by the final deadline of January 21, 2003! These important filings were effected in Australia, Canada, the People's Republic of China, the European Union (including France, Germany, Italy, Spain, and the United Kingdom), India, Japan, Mexico, the Russian Federation, and South Africa.

The securing of these key Patent Application filings adds immeasurable value to our StarDrive Engineering Project overall, as it will greatly protect and enhance our investors' upside global market potential (assuming, of course, that our *24 kW StarDrive Generator prototype* is successful)! Be sure to check back from time to time for further updates as we proceed into the development phase of the Project.

11/07/02 - Academic Reference: Those of you kind visitors to our website who would like to have the benefit of an informed and unbiased academic opinion regarding the Electrodynamic Field Generator are welcome to contact John J. Tulip, Ph.D., Exec. Vice-Pres. of *American International University*. This consideration also applies of course to those parties who may be interested in securing a direct participation in our forthcoming EDF Generator Prototype Project. Dr. Tulip has not only expressed much-appreciated support of our efforts to introduce this important new technology, but has also had the opportunity to review our technical manual *StarDrive Engineering*. You may contact Dr. Tulip via e-mail at TulipJJ@aiuniversity.edu although we ask that you expect him to field serious and respectful inquiries only. Should you desire to speak with him by telephone, please be assured that he will endeavor to return your call whenever circumstances permit if you provide him with the proper phone number.

10/07/02 - Joint Venture Agreement Announced!: Mark Tomion, founder and president of Archer Enterprises and inventor of the recently-patented *Electrodynamic Field Generator*, is very pleased to announce that he has signed a Joint Venture Agreement with Affirm Technology Partners of Carlsbad, California to build a working prototype of his over-unity 'StarDrive' device's electric power output variant. The co-developers are planning to commence construction of a small air-cooled **StarDrive Generator** unit with a projected output rating of 24 kW and a housing diameter of only 30 inches, at a total weight of under 50 lbs., before the end of November 2002.

Should this exciting project be successful, it would represent an historic milestone in the development of over-unity electric power generation technology. Not only is this small prototype EDF Generator expected to demonstrate *a minimum Coefficient of Performance in excess of 20:1*, but the design employed is completely linearly-scalable in a very broad range of sizes that would include liquid-cooled ***StarDrive Dynamo*** units with output ratings of up to 1 gigawatt! The most remarkable feature of these large Dynamo units is that an amount of recoverable thermal energy comparable to their respective electrical outputs will be made available for desalinating seawater, or for use in centralized municipal and industrial hydronic heating systems. And this capability would make the large-scale desalinization or distillation of water truly cost-effective for perhaps the first time ever.

Interested parties are welcome to contact Mr. Tomion at office@stardrivedevice.com (585-526-6817) for further information.

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Prospects of Hydrogen Energetics

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Hydrogen is the only pollution free and inexhaustible energy carrier. But the implementation of such attractive properties of hydrogen is restrained by large expenses of energy for its production from water. Modern level of knowledge gives the opportunity to reduce these expenses [1], [2], [3].

It is known that a gram-atom is equal numerically to atomic mass of the substance, and a gram-molecule is equal numerically to molecular mass of the substance. For example, the hydrogen gram-molecule in the water molecule is equal to 2 grams, and the oxygen gram-atom is equal to 16 grams. The gram-molecule of water is equal to 18 grams. As the mass of hydrogen in the water molecule is 2x100/18=11.11% and the mass of oxygen atom is 16x100/18=88.89%, the ratio between quantity of hydrogen and oxygen is preserved in one litre of water as well. It means that 1000 grams of one litre of water contain 111.11 grams of hydrogen and 888.89 grams of oxygen.

One litre of hydrogen has mass of 0.09 grams, one litre of molecular oxygen has mass of 1.47 grams. It means that from one litre of water it possible to produce 111.11/0.09=1234.44 litres of hydrogen and 888.89/1.47=604.69 litres of oxygen. Thus, one gram of water contains 1.23 litres of hydrogen [1].

Now energy consumption for production of 1000 litres of hydrogen from water is 4 kWh and of one litre – 4 Wh. As it is possible to produce 1.234 litres of hydrogen, then 1.234x4=4.94 Wh are spent for production of one gram of water now.

Instruments and Equipment Used for the Experiment

A special experimental low current electrolyzer, a voltmeter of the highest accuracy (accuracy class 0.2, GOST 8711-78), an ammeter of the highest class of accuracy (accuracy class 0.2, GOST 871160), a balance with value of a division of 0.10 grams and 0.010 grams, and a stopwatch with value of a division of 0.1s.

Experimental Results

Indices	**Sum**
1 – duration of electrolyzer operation connected to the supply line, in 6 cycles t, min	6x5=30.0
2 – readings of voltmeter V, volts	13.6
3 – ammeter readings I, amperes	0.02
4 – power consumption (P=VxIxτ/60), Wh	0.136
5 – duration of electrolyzer operation disconnected from the supply line, in 6 cycles t, min	6x55=330.0
6 – solution mass change m, grams	0.44
7 – mass of evaporated water m', grams	0.02x6=0.12
8 – mass of water converted into gases m''=m-m', gram	0.320
9 – power consumption per gram of water converted into gases P'=P/m", Wh/grams of water	0.425
10 – existing power consumption per gram of water converted into gases P", Wh/grams of water	4.94
11 – reduction of power consumption for hydrogen production from water, K=P''/P', times	11.62
12– quantity of released hydrogen, ΔM =0.320x1.23x0.09=0.035, grams	0.035
13 – power content of hydrogen being produced (E=0.035x142/3,6)=1.397, Wh	1.397
14 – energy efficacy of water electrolysis process (Ex100/P), %	**1027**

Note: Gas output is clearly observed during many hours after the electrolyzer is disconnected from the electricity supply.

Conclusion

Low ampere water electrolysis is a way for production of inexpensive hydrogen from water and hydrogen energetics.

References

1. Ph.M. Kanarev. The Foundation of Physchemistry of the Micro World. Krasnodar, 2002. 320 pages
2. http://book.Kanarev.innoplaza.net
3. hppt://www.n-t.org/tp/ns/if.htm.

Heater Producing Healthy Effect

The First Device of Healthy Life Support in Fuel-Energy Industry

A. Belyaeva, L. Savelyeva, O. Bondarenko, Kirghizia

http://www.leteco.h1.ru
Email: leteco@mail.ru

Nowadays problems of rational use of resources including energy resources are very important. Lack of energy-efficient technologies causes consumption of great amount of electric power, coal, and mineral oil. From another hand, in the XXI century one of the main approaches of human society development is turned to healthy life-style and development of ecologically appropriate technologies. Hence, basic direction of heating systems development should correspond to, at the least, two requirements, i.e. effectiveness (energy-saving) and ecological appropriation (ecological functioning). Moreover, it is necessary to take into account additional requirements for modern works:

- Relatively low prime cost of the systems;
- Minimal operating costs;
- Availability of a system of temperature mode control;
- Use of domestically produced materials for the systems.

The aim of the work is creation of a universal electric device of natural ecologically appropriate materials. The device should maintain relative air humidity of natural atmosphere in a quarter, make its ecology healthier, meet all the listed requirements, and represent new generation energy-saving system designed for heating of industrial and domestic areas according to features of technical solution.

A.L. Belyaeva is the author of this work. The invention of this heating device was acknowledged as the best invention of Kirghiz Republic of the last two years. A.L. Belyaeva was called as a laureate of a competition of "The Best Inventing in Kirghiz Republic in 2001-2002".

Solving this problem the author based on work experience existing in the area of semi-conductors production. Actually, the model was worked out in the common area of electric engineering and industrial crystals growing. Using of knowledge and skills of the both areas made creation of this device possible.

It should be noted that initially the invention of the heating device, which is discussed here, was connected with necessity to improve microclimate and air atmosphere in a semi-conductor shop since the industrial process required optimal conditions. Hence, the device was observed as an element of the industrial process. However, soon other positive characteristics of the device were disclosed, i.e. when it was installed in a quarter all visible mould disappeared. Laboratory investigations stated that the operating device annihilated all pathogenic microflora. This rediscovered feature allowed using the device both in domestic and industrial area. After series of following laboratory investigations and bench tests construction of the device was changed and improved that allowed prepare it for line production.

Ceramic electroconvector: general characteristics

The working name of the final version of the model is *Ceramic Electroconvector TY 2971-006-22997241-2002.* Ceramic Electroconvector is an industrial and domestic electric heater of direct stationary action. It has high effective heat emission and satisfies ecological, sanitary, medical, and fire-prevention requirements.

At the same time it should be mentioned that by several characteristics this electroconvector differs from other known models of electroconvectors as well as from other existent heaters. It may be observed as a representative of an independent, specially created group of heating devices.

One of the main characteristics of the electroconvector is presence of constructive heating carbonic elements made of ecologically appropriate natural *non-metal* materials. Essentially, the electroconvector construction does not contain metal (the only metal part of the device is its supporting construction).

Production of heat of physiologically comfort zone requires 0.3 kW/h energy consumption which is 3-10 times less than energy consumption of known models of heating engineering. The Ceramic Electroconvector influences positively on ecology of a room. Room heating occurs better and more softly

as conducting carbonic elements can be heated maximally up to 100° C. As a result oxygen is not burnt, and air is not overdried in a room. Achieved minimization of metal content in the constructive elements of the device increases the level of ecological compatibility both of electroconvector constructions and operation.

The device accumulates no static electricity, neutralizes harmful magnetic field generated by alternating current in the conducting element (it is typical for all the other electrical household appliances). Therefore, **the additional positive effect** is produced and higher ecological characteristics of functioning of this electroconvector are confirmed.

Insulating strength of ceramics prevents electrical shock accidents. Ecological compatibility of the electroconvector is provided by materials of the construction. The base of the device is a studied natural silicate fiber which has quantitative and qualitative content of useful chemical elements which are the closest ones to the group of medical adsorbents listed in a medical encyclopedia. The ceramics is adjusted to emit electromagnetic waves only in infra-red spectrum.

The electroconvector produces heat waves in the average IR spectrum (8.4-8.6 mkm) which is maximally approximated to the diapason of heat waves generated by a human (9.37 mkm). It annihilates humidity of buildings independently of outer space humidity. At the same time it neither burns oxygen nor overdries air.

Healthy effect is produced by all the constructive elements made of ecologically appropriate natural materials. Electric power is transformed into heat emission by conducting elements. This process causes a mode of generation of a continuous heat spectrum of radiation. The heat radiation is similar to heat spectrum of radiation generated by a human. At the same time, this feature together with resonant oscillations of the crystal lattice of the ceramic cylinders produces a destroying effect on pathogenic and conditionally pathogenic microorganisms.

From the point of view of room ecology the proved healthy effect of the operating electroconvector becomes very significant. The effect considers continuous presence of a human in the room, i.e. risk of pathogen infection through respiration objectively decreases.

Application of the ceramic electroconvector is especially actual in patient care institutions and children's institutions, in special precision industries and space technologies. It can also be used in saunas with dry vapor.

The ceramic electroconvector is designed for unsupervised continuous work.

Structure of the electroconvector producing the healthy effect

Shortcomings of known electric heaters are: great electric power consumption (0.75-3.0 kW/h), big number of metal details, complex technical performance, and use of a necessary additional blower as a ventilator. Big number of metal details decreases ecological compatibility and productivity of the heaters. The listed devices have to use high temperatures on heat-release surfaces for warming up rooms up to the level of physiological comfort. This causes increase of energy consumption. Moreover, using of metal heating elements influences on air and relative humidity in the room. According to available data, no existent electroconvectors have healthy influence on ecology of a room.

The represented ceramic electroconvector contains a carrying frame with horizontal boards which have convective gaps. The carrying frame has heat-release monolithic hollow ceramic cylinders whose walls contain longitudinal through holes. Heating carbonic conducting elements and de-energized carbonic rods are built in the through holes. The heating conducting elements are connected in parallel-series circuit at the output of the cylinders with it's ends placed into insulating supports of the carrying frame.

Constructive heating elements are the main differences of the device. All the heat generating constructive elements, i.e. conducting and de-energized heating elements, as well as heat-release surfaces of ceramic cylinders have contiguous spectra of infra-red radiation.

Energy-efficient effect

The electric scheme of connection of the conducting elements provides different modes of work of the device. According to these modes, energy consumption is in the interval of 0.05-0.3 kW/h. The mode of 0.05 kW/h is calculated on a supporting level of warming-up of a room. Maximal energy consumption (0.3 kW/h) corresponds to the superior limit of the temperature mode of heating of working heat-release surfaces of the ceramic cylinders. In this case temperature of the heat generating elements, i.e. de-energized carbonic rods and conducting carbonic elements) lies in the limit of max 100°C. This produces a significant potential resource of electric strength and of durability of the used elements. The de-energized carbonic rods function as heat accumulators at switching on and switching off the device. Heating the conductors the de-energized rods accumulate heat through the ceramic walls of the cylinder till their temperature becomes equal to the temperature of the conducting elements. Appearing electromagnetic resonance between the conductors and the de-energized carbonic rods

intensifies infra-red radiation of the ceramic wall. Accumulative heat potential of the de-energized carbonic rods allows maintain uniform radial heating of the heat-release ceramic surface of the cylinder without decreasing energy consumption. In this case additional conducting elements of infra-red radiation become unnecessary.

The heating efficiency of the ceramic electroconvector was estimated by independent experts. Surface density of the radiation flow was calculated by formula of Stefan-Boizmann distribution law. Taking into account heating of the cylinders' surfaces up to 70° C this value came to 727 W/m^2. **Total heat generated by the electroconvector per hour comes to 600 kcal or 698 W** at the total area of the radiation surfaces of 0.96 m^2 (on the basis of 1 kcal=1.163 W/h according to [1]). The electroconvector consumes 300 W/h and produces 698 W/h. That is to say that it effectively transforms electric energy into heat energy. Operational modes of the electroconvector are based on analysis of the heating effect produced by different devices, i.e. a tube metal heater (TMH) having a conducting metal element of Nichrom, a ceramic cylinder having a Nichrom conducting element, and a ceramic cylinder having a conducting element of carbonic ribbon. The carbonic ribbon produces high heating efficiency. Temperature on the surface of the ceramic frame is up to 80° C and temperature on the conducting element is 100° C. Hence, the device equipped with the conducting element of the carbonic ribbon does not produce excessive heat radiation.

The electroconvector consumes 300 W/h and produces 698 W/h.

After one-year operation of the preproduction models in a private school it was noticed that number of respiratory illnesses and influenza among the pupils slumped, condition of skin became better, attacks of bronchial asthma among the teachers stopped, and allergic itch left the patients who suffered from allergy. A side effect was that flowers began to grow better, and those which had not blossomed began to blossom at least. Obviously, a combination takes place there: air cleaning of microorganisms, humidity normalization, warming comfort, and influence of pyramidal ceramic structures on water vapors which are transported by warm blasts.

Applied Know How

Ambient air in rooms is a complex substance including various chemical compounds, ions, dust parts, water vapors, infectious and potentially infectious microflora, etc. The electroconvector is represented by a ceramic hardphase crystal structure. Cold air blast moves close to the ceramic surface. It meets combined oscillation of crystal microlevel structures of ceramics. *Filtering electromagnetic screen* appears that breaks shell of pathogens and potential pathogens. It is a performance of **sanitation properties**. Atmospheric water contacts with structures of ceramics, then it is cleaned and structured. After that water cleans air which is breathed in by a human. Hence, the organism becomes healthier. It is a performance of the **healthy effect**. A clean room warmed uniformly improves human's health.

Main Performance Attributes of the Ceramic Electroconvector Producing Healthy Effect

Nominal required power	0.05-0.3 kWt/h
Voltage of the feeding network	220 ± 22 V
Frequency of alternating current	50 Hz
Temperature of the conducting element in operation mode	50…110° C
Temperature of the heat-release surface of the cylinder	39…90° C
Surface density of radiation flow	727 Wt/m^2
Quantity of radiated heat	600 kcal/h
Class of protection	1
General area of heat-release surfaces of the cylinders	9600 cm^2
Sizes	410 x 400 x 75 mm
Weight	18-21 kg
Durability	30 years

The ceramic electroconvector is designed as a floor construction for repetition work.

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1. Heat Engineering Reference-book, Moscow, Energy (Energia), 1975, V. 1, p. 12.

About the author

After graduating from Polytechnic University of Frunze city Alexandra L. Belyaeva (1953) participated in launching of semiconductor production. She was given a rank of Perfect Inventor and Rationalyzer for invention and rationalization action. In 1987 her invention named Method of Production of Monosilicon Seed Crystals was introduced into manufacture, according to close copyright of USSR. Since that year this introduction has allowed grow monosilicon having better semiconductor properties. She was given a rank of Inventor of USSR for the invention.

Alexandra L. Belyaeva has acknowledged and given a rank of Inventor of Kirghiz Republic. Since 1994 in collaboration with Russian specialists of ceramics she has been dealing with organization of ceramic productions in Kirghizstan. Here are the inventions by Belyaeva: Method of Production of Seed Crystals and Its Variants (Patent #42 KG), Ceramic Mass for Insulators' Production (Patent #43 KG), Ceramic Mass Having Heat-Radiating Properties (Patent #464 KG).

In 1992 Belyaeva was rewarded with a Silver medal of VDNH (Exhibition of Achievements of National Economy, Moscow) for development of technologies for production of constructive nitride-cadmium items of semiconductor wastes.

Her Method of Production of Nonexpendable Seed Crystals is at introduction stage. The seed monocrystals produced by the new method will allow grow ribbon monocrystals having certain properties. It will be possible to produce items made of the monocrystals which will meet requirements of energy-saving and ecological appropriation. These devices represent non-aging powerful energy sources, various semiconductive devices with no inner microdeffects and with unlimited durability, structural water filters.

Since 2002 she has been dealing with organization of production of ecologically appropriate industrial-domestic appliances causing healthy effect. The invention of Ceramic Electroconvector Producing Healthy Effect is now introduced. Energy-saving of the new ecologically appropriate electroconvector exceeds energy-saving of all the existent heating systems.

Belyaeva is a laureate of competition of The Best Inventing in Kirghiz Republic in 2001-2002.

Inertial Propulsion Device

Vitaly E. Senkevich, Russia

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A body is at rest or moves linearly and uniformly until it is not influenced by an external force.
(School course of physics)

Forget everything that you were taught at school.
(Arkady Raykin)

This propulsion device consists of an engine and a body. The engine (see Fig.1) is remarkable for its movable stator (S) which can make free rotation as well as a rotor (R). When the engine starts the stator and the rotor begin to rotate in opposite directions. Thus the engine has two ends and one of them is connected to a flywheel (F). This flywheel begins accelerated rotation.

A cross-beam (CB) is connected to the second end of the engine where a rotating momentum appears. Under the influence of this momentum the cross-beam presses down one of the supports placed on the body (for example, Sup.1). As a result a force which is compensated by acceleration of the flywheel (F) appears on the support. When the flywheel is accelerated up to certain speed a control system (CS) switches the windings of the engine to change the direction into the opposite one (reverse). At that the cross-beam also tends to turn to the other side and presses down the second support (Sup.2). Thus the cycle repeats. It should be noted that forces acting at the supports are **codirected** and they move the whole device.

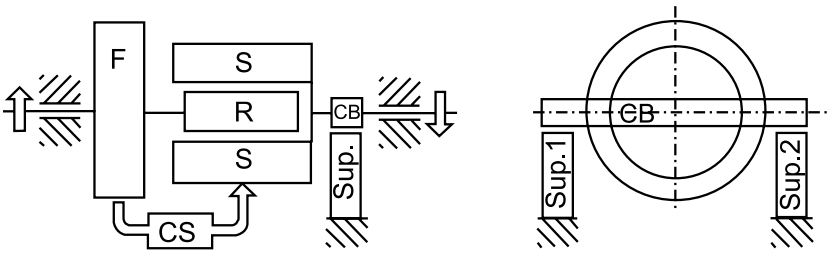

Fig.1

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A cross-beam (CB) is connected to the second end of the engine where a rotating momentum appears. Under the influence of this momentum the cross-beam presses down one of the supports placed on the body (for example, Sup.1). As a result a force which is compensated by acceleration of the flywheel (F) appears on the support. When the flywheel is accelerated up to certain speed a control system (CS) switches the windings of the engine to change the direction into the opposite one (reverse). At that the cross-beam also tends to turn to the other side and presses down the second support (Sup.2). Thus the cycle repeats. It should be noted that forces acting at the supports are **codirected** and they move the whole device.

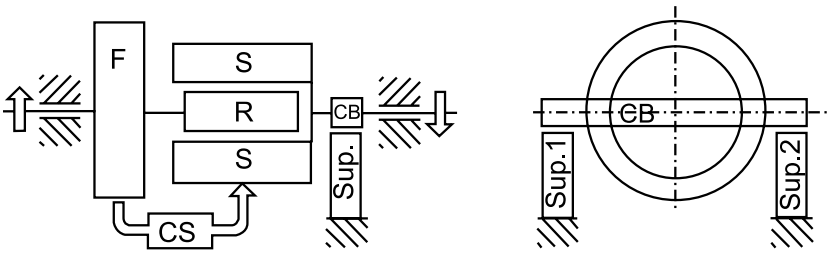

Fig.1

Unlimited Accelerated Nonreactive Motion

by G.P. Ivanov

Information from http://tts.lt/~nara/ruspopul.htm

Bias of centre of inertia of the closed system is a phenomenon exceeding the bounds of modern scientific conceptions. At the same time it is a way to the new marvelous world of earlier unknown laws and phenomena of nature. Researches made by G.P. Ivanov, Russia, have allowed him come to the following conclusion: it is a quite realizable task to create technical devices which can move under the action of nonreactive forces. However a purposeful scientific-research spade-work is required for the reliable registration of them by modern experimental facilities. According to the author during the whole XX century the known idea of latent impulse were misleading the scientists from the serious research of impulse-energy processes existing in systems at the presence of quasi-stationary electric and magnetic fields. According to G.P. Ivanov, it is related with the fact that the notion of "latent impulse" has nothing in common with the real momentum, since the very existence of "latent impulse" and "latent energy" which attends it, would make it impossible, for example, to adjust radio equipment since all effective capacitances change their value a hundred and thousand times as much (it depends on their orientation with respect to the magnetic field of the Earth).

Fig. 1, 2 demonstrate the patented by G.P. Ivanov method of realization of nonreactive motion (G.P. Ivanov, Yu.G. Ivanov. Method for production of propulsion. Patent #2172865, M., 2001). Fig. 1 demonstrates a device which consists of magnetized core with the attached metal electrodes.

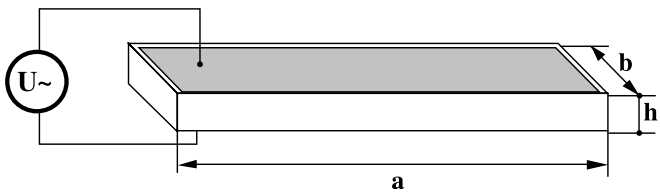

Fig. 1
The simplest "nonreactive" element

When alternating voltage is applied the device together with the center of inertia of the whole system (including power source and lead) will oscillate under the action of nonreactive force. It will move along the direction which is perpendicular to the vectors of electric and magnetic fields inside the core.

On Fig. 2 there is an analogous device supplied with a cylinder core. Magnetization of the core is defined by current of the coil which is wound around it (see Fig.2).

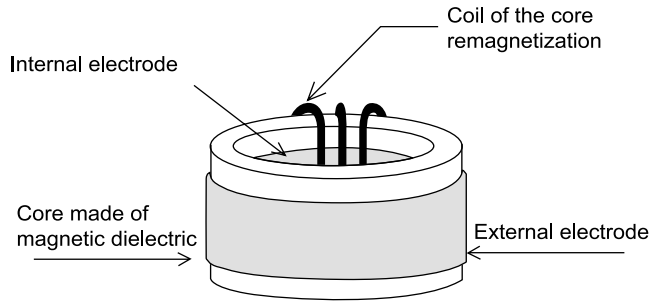

Fig. 2
Diagram of the device which can be in unlimited accelerated nonreactive motion

Let us supply the electrodes of the device with such voltage which is enough to change field density in the core (for example, according to the law $E = E_0 \sin\omega t$), and the coil with voltage enough to change the magnetization (according to the law $M = M_0 \cos\omega t$). Then nonreactive force which is constant in its direction will act on the device along the axis of the cylinder. The average of the force is $F_{cp} = \pi f E_0 M_0 V/c^2$, where E_0, M_0 are the amplitudes of density values of the electric field and amplitudes of the core magnetization, **f** is frequency, **V** is core capacity. As a result the device can either move with acceleration or act against external forces. The researches allow the author to prove the validity of the following theorem: **At motion of the open-loop system (device) the work made by nonreactive force could not be realized by means of decrease of energy of the proper (appurtenant to the system) power source.** Where this energy comes from if there are no artificial power sources outside the device? However everywhere there is such form of matter as electrovacuum. It allows us come to a conclusion that nonreactive forces make work by means of decrease of electrovacuum energy.

Existence of electrovacuum does not contradict to the modern physical picture of the world. On the contrary providing the realization of laws of momentum and energy conservation, this idea originates from and organically supplements it. The theory of electrovacuum opens quite realizable prospects in different fields of human activity which seem to be fantastic and impossible. It also proposes unusual ways to solve many problems which are considered as insoluble. For example, it becomes possible to create nonreactive cosmonautics and private aircrafts. Energetics will be changed beyond recognition since power sources which require no material fuel will occupy the place of big and small modern electric power stations. The analogous list could be continued. There are presented quite realizable prospects related to inexhaustible reserves which are hidden in the ambient space.

Revolutionary Current

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Electricity is one of the most wonderful inventions of the 18th century. It can be produced by various methods in which different types of energy are used such as mechanical or chemical energy. In this article we discuss a new type of methods in which ***electrostatic energy*** *is used.*

In this method we use **electrets** as an energy source. Electrets are permanent polarized dielectric material which is made by cooling dielectric material in a high intensity electric field. When we place an electron in the electric field of a point charge, it is influenced by a force. If the direction of the force is such that the electron moves in a closed path then it represents a current in the opposite direction along the closed path. Here closed path means a metal wire loop in which the electron movement is responsible for the current.

The charge of the electrets remains constant for many years (100) and there is no loss of energy because we use only the property of electrets that they apply force when a charge is placed in its electric field. Since here we create energy in the form of electric current then it violates the Law of conservation of energy.

Let us discuss the method in three steps:

1) Fundamental
2) Equivalent circuit
3) How we can use it as a potential source of electricity.

1. When we put a metal rod in the electric field of a point negative charge then the electron is influenced by repulsion force which moves in arrow direction and the electric field is cut by putting an earthed metal plate from any direction. When we place four charges on the corner of the metal frame and shield the electric field in particular direction as shown in Fig.1 then the force on the electron which is placed in metal frame will be in the direction of arrow and this makes a loop. The force influencing on the electron will be continuous, so the current which moves in direction opposite to the electron movement will induced in the metal frame.

2. The equivalent circuit of Fig.1 is shown in Fig2. It demonstrates that a 'V' volt battery and a resistance 'R' can be replaced by an arm of the metal frame. The polarity of the battery is shown in Fig. 1. A current of magnitude (V/R) will be induced in the circuit by this method.

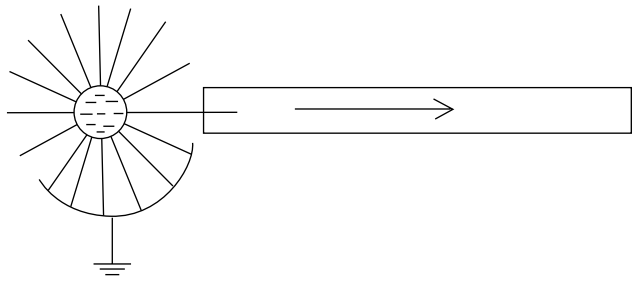

Fig. 1a

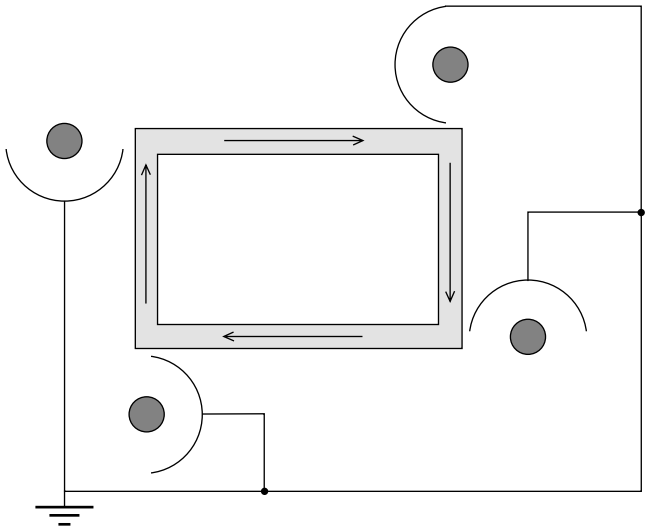

Fig. 1b

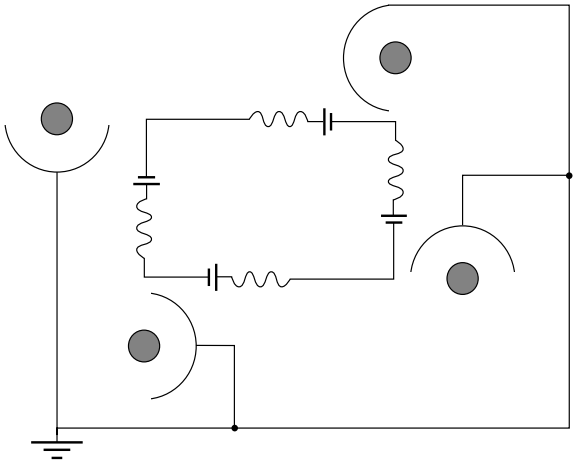

Fig. 2

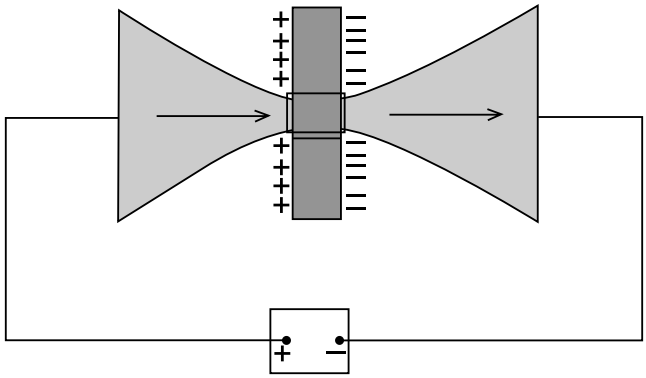

Fig. 3

3. We can use another device as a potential source (see Fig3.). Let us take an electret and make a hole at the centre. A hollow thin walled metal cylinder is fitted in the hole and a metal frame is taken as shown in the Fig. 3. We can use this metal cylinder as an electric field shield which may affect the direction of the force influencing on the electron. We may use this device as a potential source of electricity which will give electricity until the charges on the electrets vanish. The charge on the electrets remains constant for many years. Thus we can create energy and the problem of energy shortage can be solved by this method forever. We are trying to make a prototype of this but due to lack of equipment facility we are not able to demonstrate a working model. However we are trying to modify it.

NEWS REVIEW

Russian scientists are preparing new application of energy of geothermal waters

http://www.sciteclibrary.ru

A way for economical use and utilization of energy of geothermal waters was found in the Institute of Geothermal Problems (Russian Academy of Sciences). The new technology can be applied for heating in different purposes, and can compete with the power engineering, which uses the conventional energy carriers.

Geothermal springs are ideal for generating electricity by means of using of their permanent heat. This is especially important for Kamchatka, which is rich in these springs; however they are almost never used in mass power engineering, but only serve as an attraction for tourists, who admire beauty of Kamchatka geysers. At the same time the region itself freezes every year because of shortage of fuel for electric power stations.

What prevents us from using the geothermal springs?

The problem is that the storages of most of geothermal water fields have low and medium temperatures. This does not allow providing their competitiveness as regards conventional energy carriers. During tens of years this fact was an obstacle to the development of geothermal energy.

A solution was found in the Institute of Geothermal Problems. It was brought out that at many exploited geothermal fields wellhead overpressure exceeds 5-10 MPa and more. These waters contain fair quantity of dissolved organic gases. The scientists have found out that methane content of these waters exceeds 90 %. And until now at exploitation of the fields these types of energy have not been properly utilized.

The scientists of the Institute of Geothermal Problems have developed a technology of the optimum utilization of energy of geothermal waters and have increased the thermodynamic effect of the process.

This aim was fulfilled by means of transmission of thermal energy of geothermal water through the intermediate heat exchangers to the secondary heat carrier. Chemical energy of dissolved gases was used as an additional source of energy. The transmission was held by the use of primary and secondary separators. The distinctive feature of their technology is that associated potential energy of geothermal water is used as an additional source of energy. Expander and compressor placed on the same shaft are used as potential energy converters. Gas-holder and gas control point are used for utilization of energy of dissolved gases.

Thus on the bases of this technology geothermal energy can be effectively developed that will be competitive with fuel hydrocarbon energy.

Tilley Foundation, Inc.

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Editor: The advantages of electric vehicles were proved more than once. No fuel is required to set them in motion. Along with evident advantages of electric vehicles, such as their powerful characteristics and harmlessness for environment there is a side benefit, i.e. much less maintenance as compared with gasoline or diesel-fueled vehicles is required. Moreover it is easier to manufacture such vehicles.

In the previous issues of New Energy Technologies magazine we have already acquainted our readers with Tilley Electric Vehicle designed by Carl B. Tilley (USA). Below there is some up-to-date information and photos from the inventor. Besides we also publish an article devoted to the similar types of fuel-less motors.

After several years of personal accomplishments in the alternative energy industry, Carl B. Tilley was convinced that it was possible to build an electric car that could be powered without the help of external power to keep the battery charged.

The concept to produce a useful electric performance car that would last more than a few hours and would be economical to run, safe to drive around town or across the United States and never use a drop of fuel challenges the future of transportation as we know it today.

With the establishment of the Tilley Foundation, Inc., in the year 2001, Carl Tilley set out to prove it could be done. It was an ambitious project and it broke ground on the facility in Tennessee that would build the first self generating electric car.

...you have no need for fuel and you do not have to stop the vehicle to charge it after driving.

Construction of a 1,800 square foot building, that was powered with another recently developed electric device, began in the year 2002. Electricity from the building built the car from a different energy invention, that was void of any outside power supply. It is ironic that one alternative energy device actually built the invention to power and build the electric car.

From the selection of the proper car to be converted, to the advanced technology which is on board , the **Tilley Electric Vehicle TEV** performs comparably to gasoline powered vehicles. The difference is you have no need for fuel and you do not have to stop the vehicle to charge it after driving. There is no pollution and you can cruise the highways at the same speed as any other vehicle.

The rear mounted electric motor provides over 130 SAE net horsepower at 5,500 rpm. It offers a 3 speed automatic transmission that is smooth shifting and totally silent running. All this is combined with rack and pinion steering and a 35/65 rear weight bias that enables fast, sensitive handling and needs no power assistance.

...battery system will be fully charged at all times while in use.

It has 4 wheel disc braking for fast progressive, fade-free stopping. Counterbalanced gull-wing doors need only 14 inches of clearance. The rear sporty louvers are aerodynamic designed so that it almost eliminates any drag effect. All this with a stainless steel body makes for a great car.

Control center for the battery bank only allows what is needed to keep the batteries charged while in operation no matter what the speed or discharge from the battery bank. Your battery system will be fully charged at all times while in use. Simply get in, start the car and drive like any other vehicle.

A 1981 DeLorean was converted as the Tilley Electric Vehicle.Conversion of the car began in late June of 2002. State of the art metal fabrication to construct support for the electric motor, battery bank, control center and the TEV device was completed in July of 2002.

Several tests were made to validate the TEV technology. One of the last tests was made on September 7th, 2002. It has been demonstrated that after 17.3 miles driven on the Superspeedway at speeds ranging from 80MPH to 96MPH independent engineer certified batteries were full.

Assembly Pictures (see also the cover page)

Photos by Robert Gaither

Fig. 1
Removing Gas Motor

Fig. 4
Fitting Parts

Fig. 2
Fabrication

Fig. 5
Transmission Work

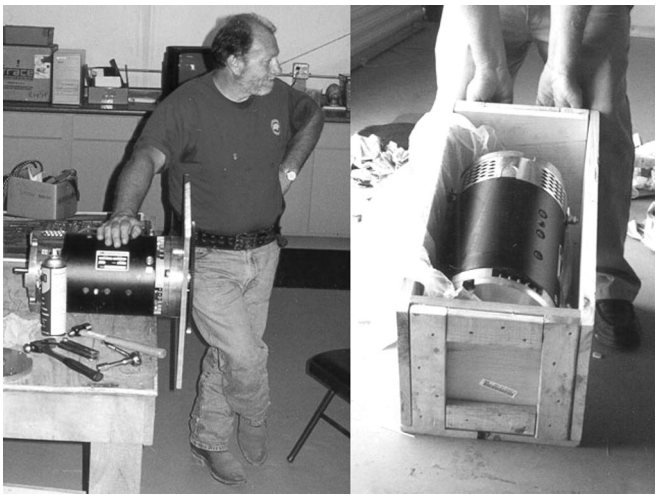

Fig. 3
Drive Motor

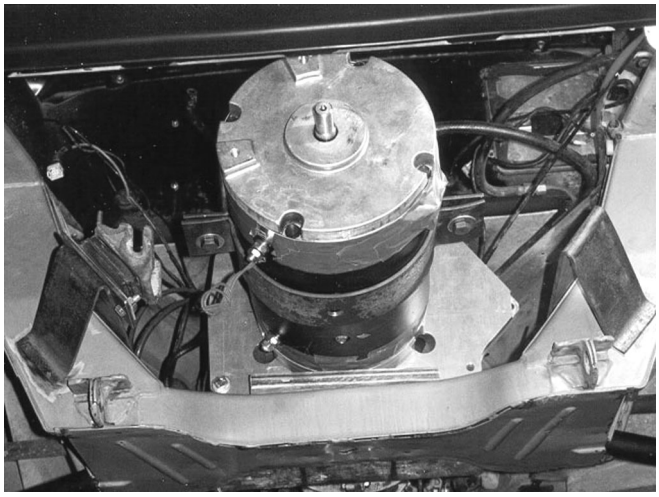

Fig. 6
Motor Mounted

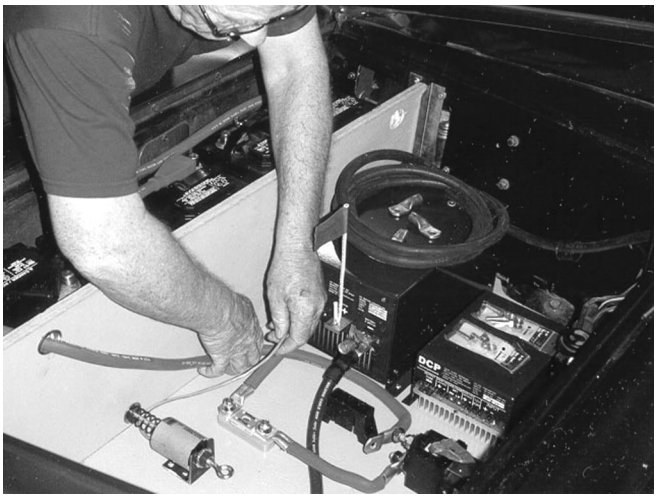

Fig. 7
Making Connections

Fig. 9
Special Wiring &Guages

Fig. 8
About Ready

Fig. 10
Car Unveiling

Trends in the Application of Motor-Generators

Adrian Akau, USA

E-mail: adrianakau@aol.com

If the Tilley generator-motor should enter into the world market, some curious consequences may result, the most important being the transition of the Honda and Toyota hybrid cars into full fledged electrics.

First of all, a comparison should be drawn between the Tilley and the two hybrid cars presently being sold, the Honda Civic and the Toyota Pirus should be made.

The Honda Civic and the Toyota Pirus both use charging systems with a gasoline motor for better milage. The Tilley motor-generator is a stand-alone electric vehicle. The Honda motor-generator is just 60mm thick and provides (10kW or 13hp). The Toyota Pirus has a 44hp unit (American Version) which feeds power into electric motors at the wheels. Both Honda and Toyota gasoline motors are off at 0 mph. Only the electric system is used until the power demand reaches 10 kW; then the gasoline motor automatically kicks in. The Pirus is able to get higher milage in city driving than in country driving from the fact that the ratio of the power from the electric part to power to the gasoline part of the motor is greater at lower than at higher speeds, that is, less power is needed to run the car in city driving than in country driving because of the lower speeds and air resistance.

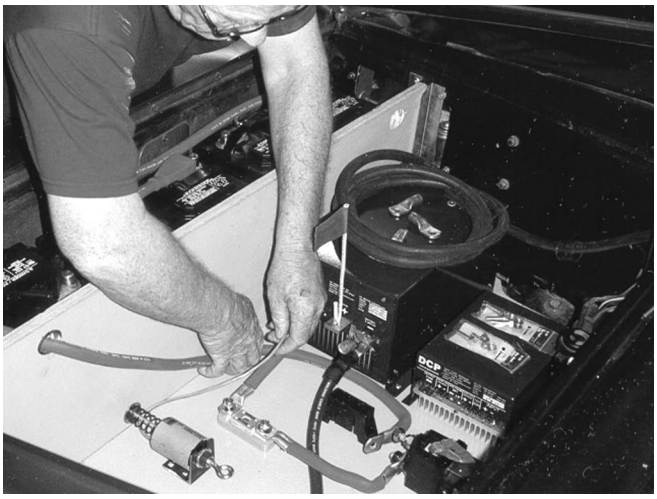

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American car companies are beginning to develop their own starter-generators to "save an extra 10% on the gas milage". Are they doing this because they don't want to be left behind in the milage competition or because they really understand the nature of the starter-generator motors used by the companies producing the hybrids?

With the advent of the Tilley motor-generator, a new factor enters into the situation. If the system proves valid, does this mean that Honda and Toyota are out of the running? Hardly not! It is likely that these companies have allowed or even planned for this contingency with larger capacity motor generators which would do a similar job. With their fine cars and superb engineering, the transition from a hybrid to a pure electric might be costly but not too difficult to engineer. Each of the two hybrid companies may already have been built, tested vehicles of this nature. However, since the primary purpose of the car companies is to make money it is doubtful if this full-fledged fossil fuel-less type will be placed on the market unless competition so requires. A car using the Tilley motor-generator might certainly push them in this direction.

Should the Tilley remains undeveloped, one might expect the second level hybrid car to arrive in a few years from Honda and Toyota. These cars should have greater electric generator-motor capacities and smaller gasoline engines. These systems could give small cars much higher gas milage and could also be placed in larger, more elegant vehicles such as the Honda Accord and the Toyota Camrey.

The transition to fuel-less motors should hopefully be slow and painless for both the pocket book as well as the human psych. If scientists cannot be convinced by studying conventional scientific laws on how these motors work, perhaps they will better see the need for the promulgation of new laws in this area.

We know that at the present time, both Honda and Toyota motor generators (M.G.) have a powers assist function while the Tilley stands alone. Let us look at the present situation (we will use the Toyota U.S. M.G. because it is the more powerful version):

Honda and Toyota classify their M.G.'s as permanent magnet types; Carl Tilley says his is and advanced D.C. motor.

Power output:

Honda is given at 10 kW at 3,000 rpm or 13 hp
Toyota is 33 kW at 1,040-5,600 rpm or 44 hp
Tilley is up to 135 hp depending on rpm's

Voltage/Battery (Ni-MH=Nickle Metal Hydride, AH=amp hours)

Honda: 144V, 120 Ni-MH cells@1.2V ea., 6.5 AH
Toyota: 274V, 228 Ni-MH cells@1.2V ea.
Tilley: 144V,12-12V lead acid (Wal-mart), 1200AH

Physical Characteristics of each M.G.

Honda: 60 mm wide
Toyota: unknown
Tilley: 9" dia., 146 pounds

The main effort should be to implement the transition away from the use of fossil fuels. We know this can be done but it takes proper attitude. Proper attitude takes knowledge and knowledge takes willingness to learn. Willingness to learn takes desire to learn and desire to learn takes humility. Unfortunately, humility is a characteristic that many people, especially learned ones lack. *Editor's: Carl Tilley's comments are also given below.*

Very Good...you seem to know what we already were aware of...before we could mass produce our Tilley car I am sure some auto company would come out with basically the same thing...I do believe they already have it and they are just waiting for the right time. The good news is that at least the Tilley car lighted their fire to get them started.

Carl Tilley

Read in the next issue!

In April 12 of 2003 scientific conference "The Time Machine" was organized by Faraday Laboratories Ltd in Moscow. There were presented the reports by V.A. Chernobrov, A.V. Frolov, A.V. Rykov, E.D. Sorokodum, V.J. Kosyev, A.N. Solonyi, V.A. Atsukovsky. There was discussed design of the device made by Faraday Laboratories Ltd. as well as main principles of control on temporal characteristics of physical processes by changing of density of space energy, i.e. aether density according to patent claim.

Details are in the next issue!

Electric Vehicle in Russia

Review by Correspondent Alla Pashova, Russia

The director of *EV* (*Electric Vehicles*) company located in Tolyatti (Russia), Alexander Mukhanov states: "If during 2 centuries intellectual efforts of a scientific thought were concentrated on an electric engine instead of the internal combustion engine then now we would have driven electric vehicles, and the greenhouse effect would not have exist".

The electric vehicle has driving-wheels which are set in motion by an electric engine, and it is powered by an electric battery. The electric vehicle appeared in Great Britain and France in 1880 and it is significantly older than the automobile equipped with the internal combustion engine.

At the beginning the speed and the fuel distance of the electric and gasoline vehicles were approximately the same. The main disadvantage of electric vehicles was a complicated system of recharge since there were no usual transformers of alternating current into direct one. Hence, the electric vehicle was recharged in a quite difficult way. An electric engine operated on alternating current was used to recharge it. The electric motor rotated a shaft of the generator which was connected to batteries of the electric vehicle. However in 1906 a rectifier which was simple to operate was invented. Despite its principle of operation was quite complicated (mercury vapor was used for transformation of alternating current into direct one) it has given a great stimulus for development of automobile industry.

There were no essential proves of advantage of gasoline vehicles as compared with electric vehicles. Nevertheless, even at that time there was an opinion that electric vehicles run more slowly and to shorter distances. However "gasoline" records were also insignificant and comparable with results produced by the electric vehicles. At the same time producers of electric vehicles did their best to demonstrate the advantages of these vehicles. If you remember, Walter Baker, one of the most famous American constructors and producer of the electric vehicles, achieved the speed of 130 km/h driving his car. An electric vehicle produced by Borland Electric company run from Chicago to Milwaukee (the distance of 167 km/h along non-asphalted road) without recharge. Next day after recharging the electric vehicle returned to Chicago by its own power without meeting any incidents. During the journey its speed came to 55 km/h.

In 1899-1900 a hereditary Russian nobleman Ippolit Romanov made an experiment on designing of the first Russian electric vehicle. Since these vehicles had been designed to run in Saint Petersburg then the city council required to produce them in the same place. In 1899 Romanov's first electric vehicle was made. Its general design was borrowed from English cabs in which a cabman sat on a high dickey placed behind passengers. Romanov's electric cab had two passenger seats situated in front of the dickey in a half-cabin having side and back windows. The cabin was equipped with a hood. The seat of a driver was placed behind and above the cabin; a box containing an accumulator was located under the driver's seat. The vehicle was four-wheeled. Diameter of the front wheels was smaller than those of the rear wheels. The front wheels were fixed by elliptical springs and were driving ones. They were connected to two independent electric motors by a roller chain drive. The regulated rear wheels had a smaller diameter and were fixed by spiral springs.

This first electric vehicle was equipped with lead accumulator which had 36 banks. It required recharging every 60 versts (1 verst – 3500 feet). The total power of both the electric motors was equal to 4 hp. Design of the vehicular part of Romanov's electric vehicle was borrowed from the models produced by an American company named *Morris-Salom*. This company had produced electric vehicles since 1898; however those models had wheels of greater diameter as they were equipped with pneumatic tires, while Romanov's vehicle had wheels with light rubber rims. Both the electric vehicles had two electric motors, but the distinction of Romanov's electric vehicle consisted in the presence of 6-row ball bearings in the wheels.

Romanov's second cab was built in 1900. This model had entirely closed and glazed cabin for passengers. The chain drive was replaced by a gear; however the basic sizes remained the same. This model was equipped with an accumulator designed by Romanov. The general weight of the electric vehicle was 45 poods (750 kg), and the weight of the accumulator came to 22 poods (362 kg). It should be noted that weight of American and French electric vehicles exceeded these figures. The speed of both Romanov's models of the electric vehicles came to 15 km/h.

Romanov's first electric bus was built in the same 1900. The electric bus weighted 100 poods (1600 kg) could make speed up to 10 km/h. For reasons beyond Romanov's control, traffic of the electric vehicles in Saint Petersburg was not organized.

A vehicular company named *"Frezer and Co."* participated directly in production of Romanov's

electric vehicles, i.e. a running gear of these vehicles was created by this company. In January 1900 *The Cyclist* magazine reported that this company had built an electric vehicle which had already been tested. A picture of this first electric vehicle by *"Frezer and Co."* can be found in advertising publications of those years. Various firms proposed the innovation for sale and described its technical characteristics.

Frezer electric vehicle was four-seated, had two engines whose total power came to 7 hp. The advertisement booklets reported as following: "The accepted system of accumulator is remarkable for its solidity and life-time. Capacity of the elements is about 15 Amperes/ hour per a kilogram of electrodes. The size of the battery is defined according to calculation of 120 W/h per one ton and per one-kilometer of the distance; its weight is equal to 30-40% of the total weight of the vehicle including a payload". Weight of Frezer electric vehicle came to 70 poods (1120 kg). It made the speed of 15-18 km/h and required recharging every 35-50 versts of the path. The second variant of Frezer electric vehicle differed from the first one for less weight of the accumulator which was located above the rear axle.

In addition to the four-seated vehicles, *Frezer* Company produced two-seated electric vehicles equipped with engines of 3.5-hp power. The two-seated electric vehicle was remarkable for its more perfect steering tube. There is known one specimen of this model purchased by somebody from Riga (Latvia). Moreover, on the territory of *"Frezer and Co."* there was a station for recharging accumulators of the electric vehicles.

In the period of the Soviet Union pilot batches of electric vehicles began to be produced only after the II World War. In general there were small lorries applied for transportation inside great buildings, for example, in a main post office or an airport.

Now there is a great probability that Moscow will be the first Russian city where the electric vehicles can find mass application. Russian capital suffers from gas pollution which is especially heavy in the center of the city. At the same time the budget of the city allows acquire own ecologically appropriate transport. Now financing of production of the electric vehicles is realized through the Fund of Ecologization of Moscow Transport. The means are assigned due to income taxes coming to the budget of the city.

To tell the truth, citizens of big cities know electric vehicles very well, i.e. usual trolleybuses and trams are electric vehicles despite they are not autonomous. An autonomous public electric transport has one advantage which is especially valuable in the conditions of the cities overcrowded by cars. This advantage is their mobility. Trolleybuses are inseparable with their wires that causes decrease of their maneuverability. For example, they cannot pass several cars which have been parked wrongly. In this case a maneuverable and autonomous electric vehicle will run to the center of the road and pass the obstacle with ease.

A Moscow company named *Eltran* which deals with exploitation of electric transport has developed a model of EV which runs the distance of 60 kilometers without recharging. Total recharging of this electric vehicle takes about 5 hours, however a half of required energy they can obtain for 1 hour. Hence, if the accumulators are recharged before their full discharge then this vehicle can operate constantly. However, a developed infrastructure of charging stations is necessary for this aim.

From the economical point of view, EV does not yield to trolleybuses and trams which house more passengers but run twice more slowly than the autonomous and compact EV. Therefore EV does not experience difficulties in jams in the conditions of the traffic of the city. It maneuvers easily in thick traffic current.

Unfortunately, now EV cannot replace automobiles equipped with internal combustion engines. Imperfection of its accumulator batteries does not allow it to become a public vehicle. The battery imperfection causes a small run on one recharging, long cycle of recharging, and high price of the electric vehicle.

To tell the truth, EV has important advantages. Maintenance charges of EV are lower than the charges of the standard automobile requiring expenditures for support of cooling systems, powering systems and exhausting systems. The lifetime of the electric engine comes to 10 thousands hours. Quantity of operations for maintenance of the engine is minimal. For example, it is necessary to change brushes in the dc motor from time to time. As for a modern three-phase electric motor and synchronous ac motor they are practically maintenance-free.

EV is easy to drive. To start the car you should only insert the key, turn it and press the accelerator pedal. You do not need to make any manipulations with adherence or gearshift.

Use of EV is justified in so called zones of higher environmental requirements that are cities, parks, vacation resorts. Electric buses, developed by *Eltran* run in the public green space of All-Russia Exhibition Center. There are about ten compact commercial EV operating in Moscow.

Taking care of environmental sanitation the management of AZLK (big automobile plant) has developed EV on the basis of two production automobile models "Moskvich-2141" and "Moskvich-pikup-2335". "Moskvich-Elektro" (Fig. 1-2) at fully loaded mass of 2060 kg accelerates up to 60 km/h at 15 seconds. Maximum speed of the load-free vehicle is 110 km/hour. Cruising range at one battery charging

is 100 km, and it comes to 80 km with 400 kg of load. At present Electrical Vehicle "Moskvich" is filled with imported component parts, which are cheaper but functional. In time it will be supplied with Russian equipment that will make it cheaper.

Fig. 1

Fig. 2

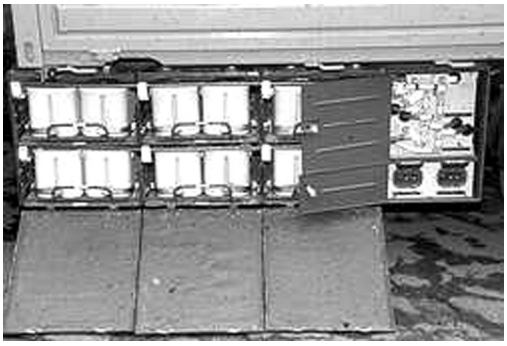

Fig. 3

The model of truck equipped with electric motor "ZIL-Electro", the authors of which being called "AVEKS" and "Optimum-electro", also enjoys the support of the Fund of Ecologization of Moscow Transport. Various privileges and free passage to any location in public green zones are promised to the future owners of "ZIL-Electro".

Forty-eight lead-acid traction batteries of roll type (Optima battery) are hanged in pairs along the ramps of the truck. They are united into 4 sections (Fig.3). Capacity of these batteries is enough for 70 km running. Probable charging station for these machines is the loading/unloading point. Charging time varies from 30 to 60 minutes. Substantial disadvantage of the model is that batteries take away a great percentage of carrying capacity. Among the advantages of the model there are small internal resistance, fast recovery (to 400 A), discharging to zero level without serious consequences.

A traction induction unit "ATAD-Optimum 50/120" serves as the engine for "ZIL-Electro". Its weight is only 100 kg and it doesn't require any diesel generator or transmission that compensates a little the loss of carrying capacity.

The engine is very simple. It is a non-contact rotor of a "squirrel cage" type rotating on the bearings. No brushes are used. Thus expensive maintenance is postponed for uncertain date. On the other hand there is asynchronism. It means that some equipment is needed for converting into three-phase current and further frequency and amplitude adjustment. However it is expensive and complicated.

In spite of all existing disadvantages, Electric Truck is considered to have a bright future ahead of it. There several reasons for that:

1 The vehicle is manufactured from cheap production component parts.
2 The system of optimum vector control of the drive is introduced. (The torque and shaft speed of rotation is regulated precisely, energy of the batteries is used rather efficiently.)
3 Microprocessor system with feedback coupling and great number of sensors (current sensor, heat sensor, velocity sensor, voltage sensor) minimizes losses, prevents the motor and batteries from overheating, protects mains from short circuit in case of an accident.
4 The vehicle is reasonably priced (for such an exotic object) – about $26 000 USD subject to serial production.

Volzhsky automobile plant has already been engaged in research of EV for a quarter of a century. Over 10 original models have been designed and produced for these years. They have been appreciated abroad as well as in Russia. These are electric vehicles "Poni", "Oka", "Elf", "Gnom", "Niva", "Rapan" "Lada-golf", etc.

The models manufactured on the basis of VAZ-1111 "Oka" became the most popular among them. These EV received many different rewards, and became world-renowned. For example, VAZ-111E "Oka", manufactured in 1993, kept all merits of a production midget car. Use of electric motor makes it a non-toxic and noiseless vehicle. Efficient fast-acting short circuit protection eliminates current rush, providing absolute car operating safety.

In EV of VAZ manufacture two direct-current motors are commonly used as a power-generating set. The first is a 25kW capacity motor with torque of 110 Nm.

Another one has 40 kW capacity and torque of 190 Nm. Motors of the first type are usually mounted on light vehicles, such as "Golf", "Oka-Electro", "Elf", while high-power motors are usually used for VAZ-2108, VAZ-2109, "Niva".

The first models of electric vehicles used to be equipped with nickel-zinc batteries. But as life time of these batteries is not long, it was decided to start using nickel-cadmium batteries, manufactured at Saint-Petersburg plants "Rigel" and "Istochnik". Nickel-cadmium batteries are power-consuming, they withstand temperature of –40°C. The only drawback of these batteries is their cost, and as a consequence a high cost of the vehicle itself. Because of that the final choice has been made in favor of lead-acid storage batteries, which were mounted at "Gamma Golf" in particular, thus reducing its price by several times. The batteries are located under the driver and passenger seats. They allow discharge of 80-85% and provide cruising range without recharge of up to 100 km within city area and several times more on a highway. Power current is transmitted from the electric motor to the front wheels through single-reduction gear unit, which substitutes the transmission.

For the present time electric vehicles are not developed to take the place of automobiles with internal-combustion engine in all industries and spheres of application, but only as a specific vehicle for highly specialized utilization. They are utilized when use of internal-combustion engine is objectionable or impossible.

It is considered that so-called hybrid models of EV would be able to replace automobiles with internal-combustion engines. These are vehicles with two motors, an electric motor and an internal-combustion engine usually running on diesel oil. In this case the combustion engine works constantly, but under the operation modes of little air pollution. Besides, fuel consumption is also much reduced.

In this direction real commercial success is possible. For example, "Toyota-Pirus" has already been chosen as a personal vehicle by tens of thousands of customers, this being a good result for such an original construction.

Nowadays three circuits of hybrid propulsion system are generally known. The simplest one is a series circuit, in which combustion engine operates together with a generator, and battery or generator powers electric motor providing propulsion. Actually this is the same circuit of electric transmission that is used at quarry trucks. Its main disadvantage is great losses of energy at transmitting the torque to the wheels. In parallel circuit the output shafts of the motor-generator and combustion engine are rigidly bound, and it doesn't allow working in steady-state mode (i.e. with permanent rotations and load).

In the third circuit, which is also the most commonly used there are an electric motor, combustion engine and a generator. The output shafts of all these units are bound by planetary differential. This allows almost lossless distribution of power between the units, and provides sustained performance of the combustion engine. The disadvantage of this circuit is the extreme complexity of coordination of units operating.

A hybrid EV was produced in Russia by automobile plant "Izhmash" though it has not been put in mass production yet. At the developing of the propulsion system instead of unique components there were used units of Russian mass automobile production that is one of the fundamental design solutions. "Orbit" Izh-21261 was used as a base for the device. It was equipped with gasoline engine (of 30 hp power and 650 cm^3 capacity), drive dc motor ПТ-125-12 (of 120V voltage and 49 H/m torque) and eight accumulators 6CE-55. Twin-engined propulsion system works according to the parallel circuit of engine joint. Electromotor serves as starter and at the acceleration it operates simultaneously with internal-combustion engine. On reaching some definite speed the electromotor changes its operation mode to the mode of generator and charges the accumulators. When the loads at gasoline engine increase then the electromotor begins to operate together with it. Operation of the hybrid propulsion system is controlled by starting regulation electronic equipment. Control unit, speed transducer of crankshaft of the internal combustion engine, detector of the accelerator pedal etc. are responsible for coordinated work of the engines.

During the tests fuel consumption of the hybrid vehicle "Orbit" was less by 20% than that of the usual model. For Russian prototype it is a good qualitative characteristic, however foreign designers reach better results, for example, "Crysler ESX3", which was presented in 1998 at Geneva auto show, consumes 3.3 liter of diesel oil per 100 km of path.

Representatives of specialized Moscow companies producing EV assert unanimously that these are hybrid electric vehicles which should change public transport with internal combustion engine. To encourage the automakers it is useful to create the proper laws drawing on foreign experience. For example, in California, USA, automakers whishing to present their production in the state market should put out 2% of automobiles with null blast. Legal system also supports an automobile user who is provided for free parking and free or cheap recharge. The user is granted with maximum of discounts to encourage him buying EV which is still twice as expensive. However it is said that in one of the villages situated near Moscow where the so called new Russians live, everybody drive electric vehicles leaving their cars with gasoline engine outside the gates. It would be quite good if EV turns to the real vehicle from the extravagancy of nouveau riches and beloved creation of ecologists.

The Richard Clem Motor and the Conical Pump

An Investigation of the Clem Motor

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rdkoontz@attbi.com

In December of 1992 Jerry Decker posted an article on the KeelyNet BBS, about a self-running motor that developed excess useable power. The information, gathered from newspaper and individual sources, gave an anecdotal account of the motor invented in 1972 by Richard Clem of Flower Mound, Texas. New information has since been added and can be found on http://www.keelynet.com/energy/clem1.htm.

Richard Clem worked with heavy machinery for the city of Dallas. He used asphalt-spraying equipment, which pumped liquid asphalt. He noticed the asphalt pump would continue to run for up to 30 minutes after the power was turned off. It was this discovery that led to the development of the motor. Modifications he made eventually resulted in a substantial 350 horsepower output from a 200-pound motor. Clem is said to have often driven a car, powered by this motor, up and down Central Expressway in Dallas. He claimed it didn't use any fuel, and only needed a change of oil every 150,000 miles.

The motor had only one moving part, a cone shaped rotor mounted vertically on a hollow shaft. Spiral channels cut into the cone wound around its length and feed into peripheral nozzles at its large end. When fluid flowed through the spiral channels it was ejected out the nozzles and caused the cone to spin. At a certain velocity, the rotating cone became independent of the starter pump and began to operate by itself. At an operating speed of 1800 to 2300 RPM the fluid heated up to 300 F, requiring a heat exchanger. Vegetable oil was used because at 300 F water boils and conventional engine oil breaks down. A 12-volt battery was the only other power source. Clem never applied for a patent because his motor design was derived from the asphalt pump that was already patented. Fifteen companies turned him down before a large coal company offered to back him and signed contracts to sell the motor. Soon after the deal was signed, Richard Clem died of a heart attack

The above account contains only what I considered to be relevant for analysis of the Clem motor. Visit http://www.keelynet.com/ for the original material.

The gear pumps, typically used for asphalt spraying, do not match the description of the pump used by the city of Dallas back in 1972. There should be public records showing what equipment manufacture the asphalt sprayer was purchased from. Since the asphalt pump was patented, I searched for a pump patent that met the following criteria:

1) Patent issued on or before 1972.
2) Delivered pressure equivalent to a positive displacement gear pump.
3) Cone shaped rotor with spiral channels.
4) Self-propelling action.
5) Capable of pumping a viscous fluid like asphalt.
6) Large heat transfer to pumped fluids.

The following illustration (Fig.1) is from US Patent 3,697,190 (Truncated Conical Drag Pump). The patent was issued October 10, 1972 (criteria 1) and appears to match the description of the asphalt pump that Clem converted into his motor.

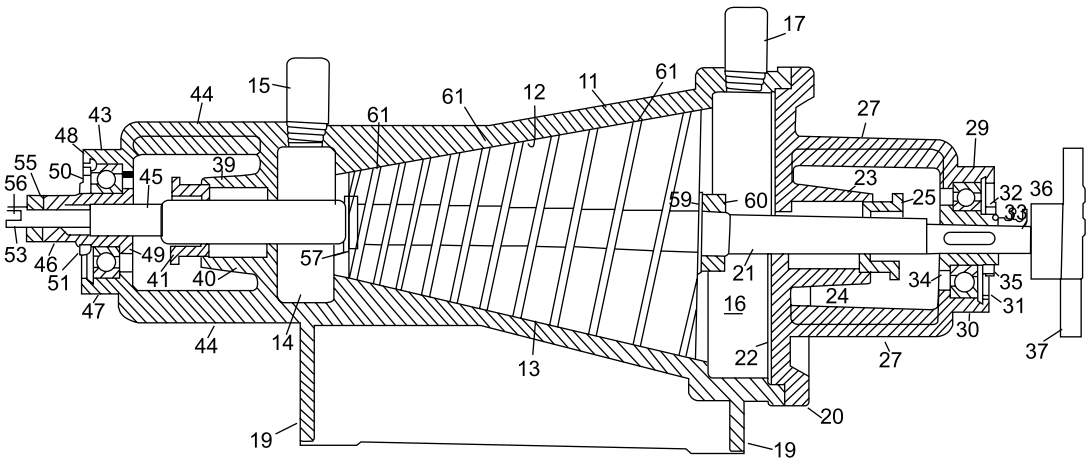

Fig.1

Housing 11, Conical interior wall 12, Conical rotor 13, Inlet chamber 14, Inlet pipe 15, Outlet chamber 16, Outlet pipe 17, Support feet 19, Detachable end cap 20, Rotor shaft 21, End cap wall 22, Boss 23, Packing 24, Adjustable gland nut 25, Bracket arms 27, Bearing boss 29, Bearing 30, Snap ring 31, Inner race 32, Sleeve 33, Shoulder 34, Retainer nut 35, Reduced diameter outer end 36, Coupling 37, Packing 39, Retainer 40, Gland nut 41, Bearing boss 43, Integrally formed bracket 44, Shaft reduced diameter 45, Bearing sleeve 46, Bearing 47, Snap ring 48, Inner flanged 49, Inner race 50, Nut 51,Shaft reduced diameter 53, Lock nut 55, Flat faces 56, Snap ring 57, Washer 59, Nut 60, Helical channel 61, Channel base 63, Channel sidewalls 64.

This is a high-pressure, low volume drag pump that can be used in place of conventional positive displacement pumps (criteria 2). It has a conical rotor that has a close fit clearance with the stationary housing wall. Delivered pressure is limited by back flow across the radial clearance and is inversely proportional to the square of the clearance. As a result, even a small increase in radial clearance would rapidly reduce pressure. The rotor is cone shaped so that the clearance can be controlled by axial adjustment of the rotor relative to the housing wall.

The conical rotor has two helical channels (criteria 3), in the form of square threads, spaced 180 apart for balance. The channel depth decreases as the rotor diameter increases. Fluid enters the channels at the small end of the rotor. The fluid is induced to rotate with the channel by boundary layer drag. The boundary layer is the thin layer of fluid adhering to the channel surface. Molecular cohesion tends to drag the adjacent fluid with the boundary layer. The fluid is also in contact with the housing wall. The boundary layer drag against this stationary wall slows the rotation of the fluid in the channels. Because the fluid rotates slower than the rotor, it is forced through the channels towards the large end of the rotor. In addition the fluid is forced towards the large end by centrifugal force.

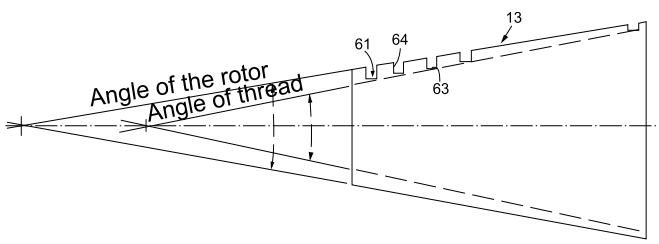

Fig.2

The above drawing illustrates the proportional decrease in channel depth as the rotor diameter increases. Why was this done? Note that as the diameter doubles so does the circumference. This means the fluid has to travel twice as far in the same time to maintain a constant slip velocity. By reducing the channel depth in half (cross-section area = depth x width) the fluid velocity is doubled thereby keeping the slip constant.

The spiral channels could be thought of as very long convergent nozzles. The increase in fluid velocity is in the opposite direction of the rotor spin. We should expect a reaction force from the acceleration of the fluid. This thrust would be directed tangent to the circumference and would increase the spin torque on the rotor. Even without the peripheral nozzles, that Clem later added, the pump rotor experiences a thrust force in a direction that would self-propel it (criteria 4).

Because fluid drag is the primary pumping force, it is well suited for viscous fluids like asphalt (criteria 5). The long channels also represent a large sliding surface area with frictional losses that would transfer heat to the pumped fluid (criteria 6).

All six of the patent search criteria have now been met. Of course this doesn't prove that it is the asphalt pump Richard Clem worked with.

A peculiar condition indicated by the patent is that as the velocity increases in the channels the pressure also increases. Bernoulli's Law requires the pressure to drop proportionally as the velocity increases. Assuming an ideal fluid without losses, when the channel depth is reduced in half, the cross section area is also half and this doubles the fluid velocity and the fluid pressure should drop in half. So what is going on here? There is a centrifugal component that would add to the fluid pressure.

My guess is it's too small to overcome the predicted pressure drop. Here is what I think may be going on. As the diameter and velocity increases the drag force propelling the fluid through the channel is proportionally greater. Energy is being added all along the length of the channel. Whatever the reason, if this high-velocity, high-pressure fluid is feed into tangent peripheral nozzles at the rotor large end, the energy will be converted to shaft horsepower.

The Clem motor is producing 350 shaft-horsepower and a large heat energy component. Where is this huge amount of energy coming from? Recent quantum mechanics zero-point field (ZPF) theories may point to the answer. From an article available at "BEYOND $E=mc^2$" Bernhard Haisch, Alfonso Rueda & H.E. Puthoff [1]:

"Our work suggests inertia is a property arising out of the vast, all-pervasive electromagnetic field we mentioned earlier, which is called the zero-point field (ZPF). The name comes from the fact that the field is held to exist in a vacuum-what is commonly thought of as "empty" space-even at the temperature of absolute zero, at which all thermal radiation is absent."

ZPF researchers theorize that mass, inertia and gravity are not intrinsic properties of matter but the interaction of matter with the zero-point field. By all pervasive it is meant that the ZPF exists not only in empty space but it is passing through your body right now and everywhere else. When you throw a stone you are interacting with this field since the ZPF resists change in motion. In essence the ZPF is the modern day aether.

The amount of energy making up the ZPF is thought to be enormous. Is the fluid acceleration in the Clem motor interacting with the ZPF in such a way as to rectify it and draw energy from it? Is it a hydraulic aether-diode? The fluid, in the Conical Drag Pump, flows through long convergent channels. Disregarding the boundary layer, is this accelerated flow laminar? Would such a long orderly flow entrain the aether energy?

From the perspective of the rotating channels the fluid appears as the discharge from a long nozzle. To exaggerate, if the fluid was held fast to the housing wall, the rotating channel would travel through the stationary fluid. This would be equivalent to achieving 100% efficiency. In reality the fluid is slipping against the stationary housing wall so that the rotating channel (nozzle) is moving faster than the fluid discharge velocity. Assuming the reaction thrust as the only propelling force, this would give efficiency greater than 100%. So, as the slip increases the reaction thrust decreases, but the efficiency increases.

Assuming the Conical Drag Pump is the pump Clem used, can it answer the following?

1) Why was a hollow shaft used?
2) Why was the cone mounted vertically?
3) Why was a starter pump needed?
4) How were the peripheral nozzles added?
5) How was the motor RPM regulated?
6) How did a large coal company get involved?
7) Was this kind of pump ever used in asphalt sprayers?

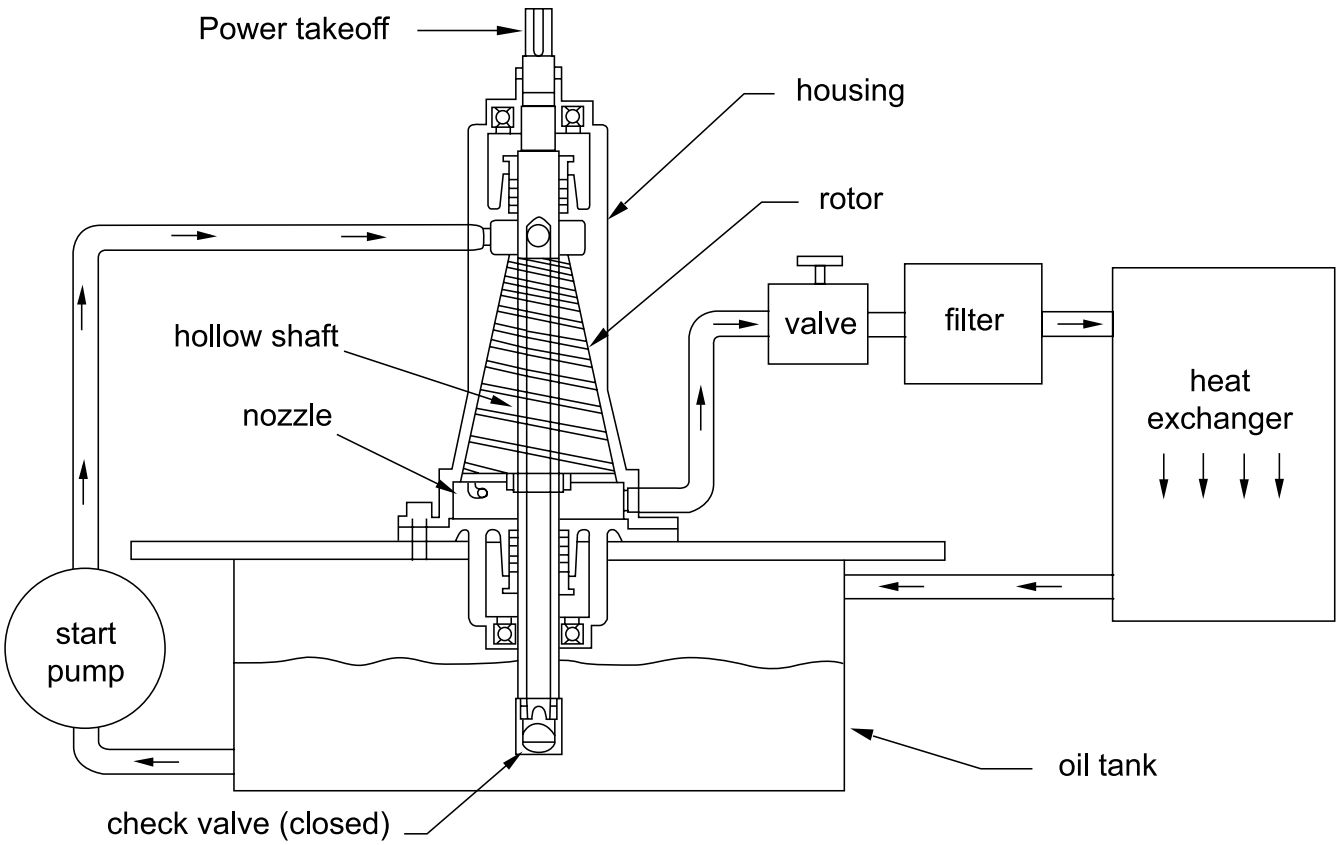

Fig.3

Clem motor shown in start mode
The arrows show oil flow

The above drawing shows a hypothetical Clem motor based on the Conical Drag Pump. The motor is mounted vertically so that the check valve on the hollow shaft is submerged down in the oil tank. The hollow shaft extends from the oil tank through the rotor into the inlet chamber. The start pump draws oil from the tank and forces it up

the external feed line connected to the inlet chamber at the small end of the rotor. This fills the hollow shaft and forces the check valve closed. The oil flows into the spiral channels and out the peripheral nozzles. The reaction thrust of the nozzles spins the rotor. The oil flows through the return line, through the valve, filter, and heat exchanger and back into the tank. The start pump is most likely a standard hydraulic gear pump. It continues to pump until the rotor spins up to its operating speed. The combinations of a start pump and check valve would be a simple way to both prime the motor and spin up the rotor.

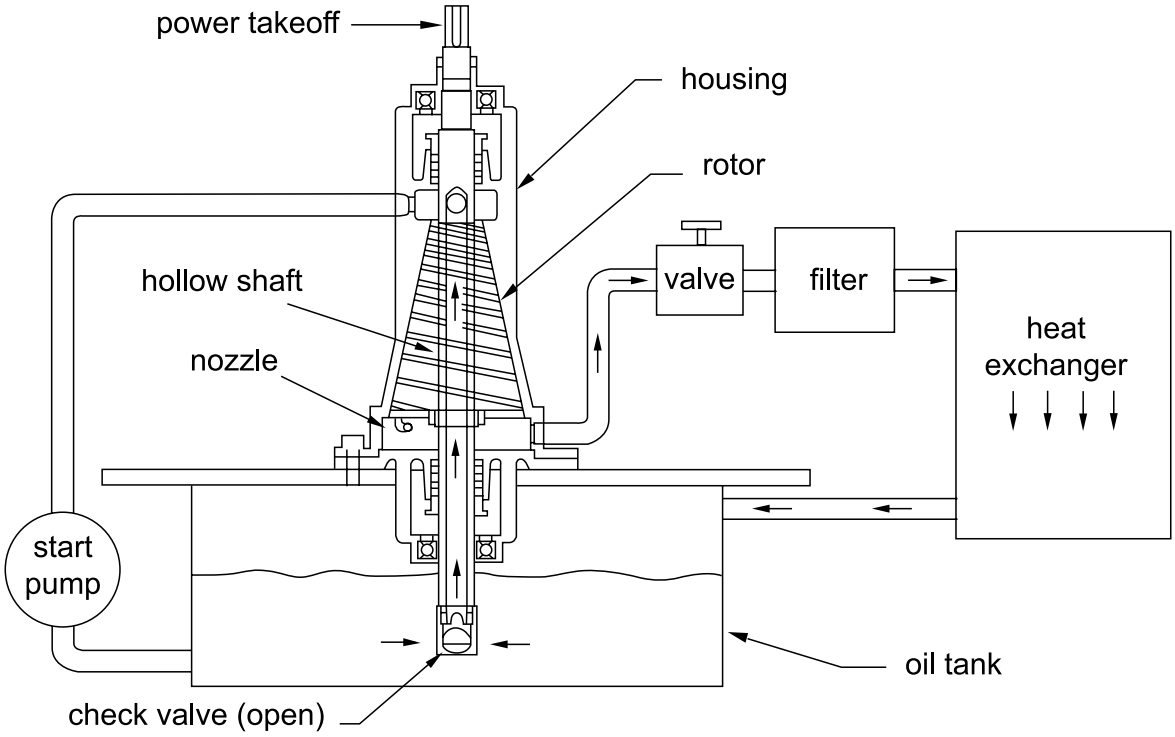

Fig.4

Clem motor shown in operation mode
The arrows show oil flow

Once the start pump is shut off the check valve is free to open. Oil is drawn up into the hollow shaft to the inlet chamber at the small end of the rotor. The spiral channels pump the oil down towards the large end of the rotor. A plate is attached to the large end of the rotor and fits with a close clearance with the housing wall. Nozzles attached to the outer edge receive high-pressure oil from the spiral channels. The jet reaction thrust from the nozzles delivers shaft horsepower to the power takeoff at the shaft top. Adjusting the valve to create hydraulic backpressure regulates the motor RPM. Closing the valve stops the motor.

When I first read about the Clem Motor I found it odd that a deal had been made with a coal company. Was there a connection with the pump? After finding the Conical Drag Pump patent, I wanted to contact the inventor Walter D. Haentjens of Barrett, Haentjens & Co., Hazleton, Pennsylvania. Otto Haentjens founded Barrett Haentjens & Co., in 1916. The business began in the coalmines of Pennsylvania with Otto Haentjens original patent on the balanced opposed impeller multi-stage volute pump. The company still supplies pumps to the coal industry. They have expanded to other markets and their pumps are installed in many industries worldwide. It is now known as Hazleton Pumps Inc., after its acquisition by The Weir Group.

I contacted Peter Haentjens, the VP/General Manager of Hazleton Pumps, by e-mail to find out if this pump had ever been put into production. He replied that they had not done anything with the patent.

An unusual pump design would have a tough time competing in the market with an industry standard like gear pumps. The Dallas asphalt sprayer may have been a one of a kind field test of the pump design. Or the pump manufacturer offered it for testing to an asphalt equipment company in the hopes of generating interest in it.

References

Bernhard Haisch, Alfonso Rueda & H.E. Puthoff, "BEYOND $E=mc^2$" //The Sciences, Vol. 34, No. 6, November / December 1994, pp. 26-31 copyright 1994, New York Academy of Sciences.

Spontaneous Flow Heat Pump

PACES : The Alternative Energy

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"Paces" is a new high performance electronic process. It is not a traditional heat pump fitted with some electronic gadgets to improve its output, but a truly revolutionary process totally unused up to now. There are no moving parts, not even a moving fluid in it. "Paces" is an electronic process because for its development the pump's fundamental element uses micro-electronic techniques.

...an average of 9000MW could be produced, that is to say the equivalent of several nuclear power stations.

The principle consists in attracting the gas neutral molecules onto a so-called "electrostatic" plate, to accelerate them and heat the plate. An intense electric field is applied in a capacitor with micro-pores covering the plate. The neutral molecules are polarized and accelerated when they penetrate these micro-pores where the intense electric field exists. Each molecule accelerates and absorbs electrical energy when it enters into a pore. But in turn it decelerates and gives off an equal amount of energy upon its exit from the pore.

The molecules, by going back and forth between the plates, continually give off and take energy, thus resulting in a total consumption equal to zero.

The gas fluid does not undergo any change of thermodynamic state, contrary to all other heat pump processes. A thermodynamic cycle remains at the level of each gas molecule, but not at the level of the entire set of molecules.

There is more to this new process, it is not just heat pump process added to an already long list: **these new characteristics also enable some new applications.** Besides the traditional heat pump applications, due to its excellent coefficient of performance this process makes it possible **to produce electricity by cooling the environment.**

For instance, if the Rhine was equipped with heat exchangers into which diverted water could flow, thus cooling its temperature by just one degree, an average of 9000MW could be produced, that is to say the equivalent of several nuclear power stations. Please note that this process would also enable **both electricity and fresh water to be produced from seawater,** an interesting application for areas of the world where water is a scarce resource.

Thus we have at our disposal an ecological process for producing electricity, it would become conceivable to produce hydrogen in great quantities; vehicles would be hydrogen powered. Ozone, CO2 or any other type of pollution would become a thing of the past.

It will most probably be the energy source of future generations, ecological and excellent, inexhaustible, powerful yet completely harmless, stable and steady (contrary to the sun and wind); an invention capable of re-launching the world economy, in particular giving impetus to the currently depressed new technology sector.

However, you have probably noticed that this invention requires advanced technology, and the few French laboratories capable to develop this process have proven inaccessibility to do it for independent researchers such as the author of the article. Besides, the invention's claimed qualities, the revolutionary aspect was very often interpreted by examiners as 'utopian', even before they read the document! Having tired of battling against concept fixed for the past two centuries, the author of the article **has now decided to place this project within the hands of the international scientific and technological community,** in order to give the best chance of success to the invention.

It will most probably be the energy source of future generations!

Initial development requires the construction of a prototype; three possibilities are described on the website (http://www.new-energy-paces.com). As there is no longer legal protection abroad, anyone is free to experiment and to market, as he or she wishes, in all other countries outside of France.

Please help me to spread the word about this project, for example through scientific forums on the Internet. This will allow you to receive feedback and gather other opinions. Your participation, even the most modest, will be of use. To those of you who help this project to see the light of day, all of humanity will be indebted.

Registration of Gravitational Waves

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Registration of gravitational waves is one of fundamental problems of physics. At the beginning of the last century A. Einstein's works predicted existence of these waves. Nevertheless, despite numerous attempts are made in different countries of the world these waves have not been fixed up today. Josef Veber, an American physicist working in 60th of the XX century, is sure to be called as the first experimenter who disclosed gravitational waves. Nowadays lots of many-million projects on registration of gravitation waves are developed and realized (LIGO (USA), GEO-600 (Germany-England), VIRGO (Italia), and TAMA (Japan)). However no positive results were achieved.

Failures in registration of gravitational waves can be explained by the fact that researchers have erroneous notion of the essence of these waves. This erroneous notion is laid in an experimental project that causes negative results.

Many researchers believe that influence of gravitational waves on the bodies should be resulted in deformation of these bodies (i.e. in change of mutual place of particles of a material body). All the attempts to disclose the gravitational waves are based on this notion. Now two types of ground gravitational antennas are supposed as priority.

The first type supposes the registration of mechanical oscillations of a massive test body that is initiated by influence of gravitational waves on it.

The second can register changes of a distance between space-apart free masses when gravitational waves act upon them. Great attention is paid to the second type of antennas in the developed projects. Failure attempts of registration of gravitational waves can be explained by their low intensiveness and insufficient accuracy of existing measuring equipments. Therefore, now there are made various attempts to register gravitational waves produced by such great cosmic phenomena as confluence of black holes. More accurate instruments and measuring equipments, for example, a laser interferometer, are developed. Nevertheless, positive results are hardly to be obtained.

Here is one of the fallacious explanations of action of gravitational waves on a body: *"Passing of gravitational waves changes an interval between objects transferring them one from another like two boats sometimes are approached sometimes moved from each other by sea waves".*

Following this example to explain influence of the gravitational waves on bodies placing on the Earth, it can be said that all bodies are in one boat and raising or sinking of the boat on sea waves does not cause change of the distance between the bodies. However, this example seems to be very simplified for explanation of influence of the gravitational waves on bodies. In fact, the case is much more difficult.

According to A. Einstein's theory, bodies moving with variable acceleration will radiate gravitational waves. **Gravitational waves represent the essence of changes of gravitational field occurring at light speed.** Since the gravitational field is a deformed space-time then the gravitational waves cause change of deformation of the space-time. Change of deformation of the space-time is accompanied with change of deformation of geodesic lines (i.e. lines by which all the bodies move).

A body moving by a geodesic line whose deformation is changed changes its acceleration. Change of acceleration of the body will change gravity applied to the body in this area of space. Hence, influence of gravitational waves on the body occurs through gravity which influences on it.

It is known that a fundamental difference between gravity and other forces appearing at a direct contact with a body consists in the fact that gravity provides all the elements of the body (all its points) with equal acceleration (deformation can not occur), and other forces influence on certain parts of the surface of a body and so cause its deformation.

Hence it is senseless to try to measure deformation of a body or change of a distance between test bodies occurring under influence of gravitational waves. It is necessary to note that, in particular, when a body is placed on an unmovable support relatively to the Earth, value and the direction of gravity coincides with weight of the body. Therefore, in this case gravitational waves can be registered at measuring of changes of the body weight.

An experiment on registration of the gravitational field of the Earth by measuring change of weight of

a test body was made. Before the beginning of the experiment there was set a problem to register gravitational waves produced by the Mercury and the Venus at approaching to the Earth. The gravitational field in which the Earth moves changes due to superposition of gravitational waves of other planets on it. These changes were necessary to be registered.

The experiment was as follows: a test body (a 100 grams weight) was weighted on an electronic balance in equal time intervals of 14 days. The experiment was lasting for 12 months. In the experiment it appeared that change of a distance between the Earth and the mentioned planets causes change of weight of the test body. The change of weight of the body occurred in proportion to the distance between the planets. The test body was weighted in the same conditions and in the same place. The performance of the experiment is so easy that every person can made it.

It is known that weight of a body changes (decreases) at moving along the Earth surface from its pole to the equator. Change of weight of a body locating in the same place has not been fixed until now.

The fixed change of weight of the test body proves change of gravity applied to it and, consequently, change of the gravitational field in which the test body moves as well as the Earth does. **These changes of the gravitational field were caused by motion (superposition) of the gravitational waves produced by the mentioned planets at their approaching towards the Earth at the distance of the existent gravitational field.**

Hence, the Earth and all the bodies locating on it move in the constantly changing gravitational field, therefore, constantly change their weight. Nevertheless, as it is known, change of the gravitational field is the influence of gravitational waves on it. Hence, measuring changing of weight of bodies we can speak about registration of gravitational waves.

In search of the 4th dimension

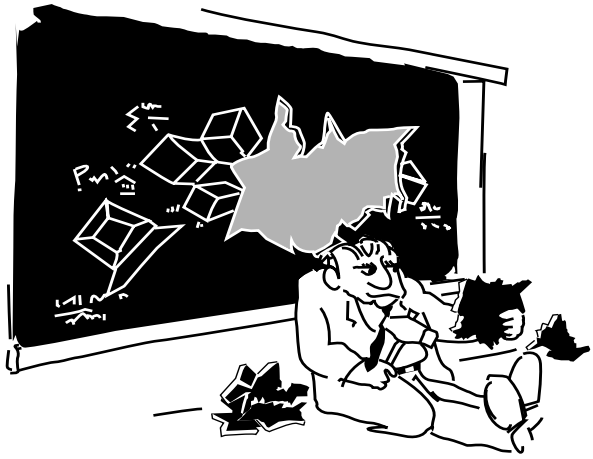

From http://home.ural.ru/~meop/index.html

High-Energy Hyper-Low-Frequency Electric Field

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E-mail: ux01w@hotmail.com

The article represents a practical and theoretical research on possibility of existence of a high-energy hyper-low-frequency electric field which is interpreted by modern measuring instruments and subjective perception as a static field. Besides there are observed a problem of the field registration, a hypothesis of relic origin of the registered field and a hypothesis of wave nature of the Universe.

A passenger on board a ship sailing in the ocean will never notice action of waves of high and low tide. At the same time, weathering waves of several numbers produce a dangerous storm. However, an ocean liner is designed for such a storm therefore the passenger would just experience some discomfort. It is another case if tide wave hides reefs… I wish our ship, i.e. the Earth, the Solar System, the Galaxy, and the Universe, not to be lead to such a place by any ignorant "navigator"!

One of the most mysterious persons in the history of electricity physics was an outstanding inventor Nicola Tesla (1856-1943). When the majority of scientists developed researches of microworld particles he followed the opposite scientific path. He was interested in the electrical potential of the whole Earth. He researched ways to influence on it, control its state and methods of its regulation. Therefore many of his patents, experiments as well as a purpose of constructions and devices built according to his ideas arouse perplexity and misunderstanding of modern scientists.

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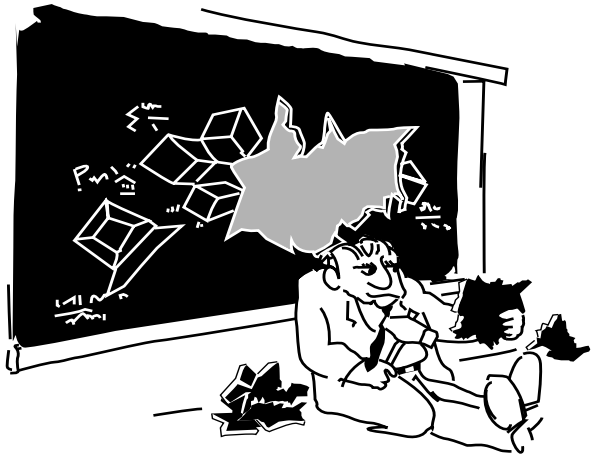

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Having formulated my own hypotheses I often think why such a Great Genius as Nicola Tesla took his invention away with him.

Danger of this invention lies in simplicity of production of devices for generating (detecting) energy.

Practical Prerequisites

Prerequisites of this and other hypotheses were some undeclared effects occurring in practical wireless communication as well as investigation of devices for distant transmission of electric power.

Distant energy transmission was demonstrated by Nicola Tesla in 1892 in London and in 1893 in Philadelphia. However, even now the way he did it remains unknown.

In 1977-1985 I had to work a lot with radio transmitting equipment of different power of middle-wave (MW) and short-wave (SW) diapasons. According to fundamentals of physics, intensive electromagnetic field is produced around antenna curtain connected to a radio-frequency transmitter. There are brightly glowing gas-discharge electrovacuum devices at the distance up to several meters in this field. Attention was paid to the fact that more than ten daylight lamps of 80 W were successfully "glowed" at 40 W power of a transmitter. In this case a distant correspondent did not note significant decrease of a level of a received signal at the indicator of the receiver. It had to return to this fact in many years. The data of this experiment are represented in a particular document.

There is one more interesting effect which is disclosed when transmitting equipment (TX) and antennas (ANT) are adjusted. An incandescent lamp, which is connected to a certain place of a break of the antenna curtain or of a power feeder (L), glows brightly. The antenna circuit is not closed as galvanic element. (See Fig. 1).

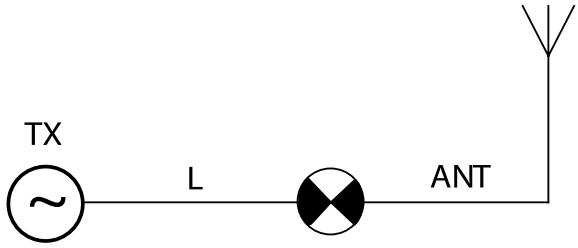

Fig. 1

Hence, the power line of the incandescent lamp is as if it is single-wire. It also had to return to investigation of this effect in many years. The data of this experiment are represented in a particular document. As in the case of the incandescent lamps, the correspondent did not note significant decrease of the level of the received signal at the indicator of the distant receiver.

S. V. Avramenko designed a plug of semiconductor diodes. Connecting this plug to a generator of alternating voltage of 10-10000 V by means of a single-wire line in the load of the plug he discovered current, which was continuous by the direction but pulsating by the value. Electric current measured in the single-wire line is very little, hence, the impression of superconductivity is produced, i.e. it is possible almost to avoid energy losses in the wires.

My experiments also represent a visual demonstration of the effect. For example, several links of light-emitting diodes connected inverse-parallel glow in the single-wire line. Garlands of light-emitting diodes and lamps having a single-wire power line can be produced. It is interesting that in this case power consumed by the generator do not increase practically (See Fig. 2, 3, 4). It was noted that if a standing wave is created around the generator "then an unlimited number of consumers would be able to apply a change of a value of this field to produce power in a load in their place" *(Editor: This phrase is in inverted commas since it is a part of the well-known article "Free Energy" by Alexander V. Frolov (Read in this issue, p. 15)).*

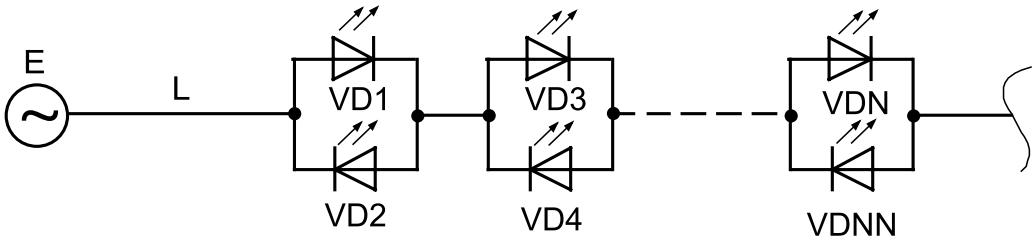

Fig. 2

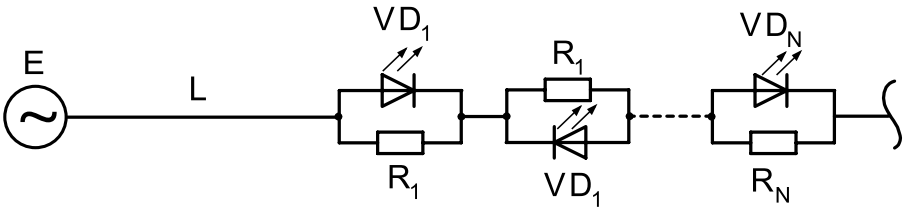

Fig. 3

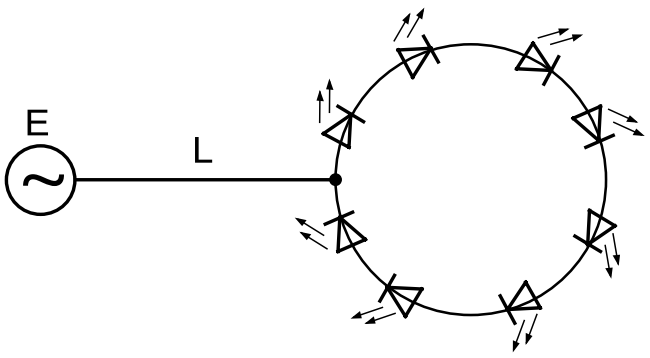

Fig. 4

Russian scientists investigated this phenomenon and proposed an explanation of producing active power in the load by means of reactive capacitive current. This was made applying resonant properties of the single-wire line made of a metallic conductor. Further, possibilities of application of nonmetallic conducting mediums for transmitting electric power were investigated. However, the researchers pay attention for the fact that this explanation is insufficient.

A task group named "Analysis" from Voronezh city (Russia) made a qualitatively new explanation of results of S. V. Avramenko's experiment. The works of this group from Voronezh are devoted to the comparison of properties and characteristics of so-called inertial and inertialess currents occurring in circuits at low frequencies. Their general and particular features have been disclosed. In the works there are demonstrated conditions at which conductivity caused by inertialess discharges predominates in conductors and conditions at which currents caused by conduction electrons predominate. There are demonstrated a description of S. V. Avramenko's experiments and the conclusions made by the researchers. The authors cite data of their test experiments which prove a part of conclusions made by S. V. Avramenko and his colleagues.

However this explanation does not have a right to exist as it does not have variants for practical application.

Results of my theoretical and experimental researches allow provide a **fundamentally new (!)** explanation of energy "transmission" having occurred in the experiments performed by S. V. Avramenko, investigations by D. S. Strebkov, V.A. Kuligin and other investigators. *(Editor: See publications of these works in previous issues of our magazine*). Moreover, they allow explain origin of many physical phenomena and processes including the origin of non-inertial charges and currents and their visualization.

First Hypothesis

Recently a number of scientists all over the world have declared a thought that surplus power is produced in the systems having overunit output due to inability to identify correctly all the existent energy sources. And a so-called phenomenology is observed due to the inability to deal with different types of energy (or fields).

In physics a negation of an overunit device follows a well known state which is considered to be true in other fields of knowledge, i.e. energy conservation law. It should be noted that it is formulated for isolated (closed) systems. I have devoted some time to the investigation of this state and to practical experiments and come to the following conclusion: there are **no isolated (closed)** systems in the nearest cosmos which can be observed by us!

Particular physical, chemical and other processes may actually be observed in closed circuits for making calculations with sufficient approximation.

Show me an isolated system, and I will prove that it is open.

Hence, according to fundamental physical laws, energy does not appear from nothing and not disappear to nowhere. However, the source of oscillations, i.e. our generator, does not provide a load with energy; nevertheless, power is produced in the load. Energy conservation law must be fulfilled! The classical formulation of the energy conservation law is as following: total energy of an isolated system is not changed in the course of time. According to this, the only fact remains valid, i.e. the single-wire system is not isolated from outer influence, hence, energy is consumed from some other source which is outer in relation to the system?! In this case our generator is one of sources of information about an amplitude, frequency, and phase.

Calculations and experiments have allowed made a following supposition. Avramenko's diode plug is a particular case of a device known in radio engineering for a long time, i.e. AM detector (a peak-detector, a limiter, a frequency mixer). I have examined the other known circuits of AM detectors and frequency mixers. The investigations are continued and by this time the supposition has been confirmed.

Let us accept an artificial generator (Tesla's transformer or any other one) as a main generator (or a main oscillator) and a hyper-low-frequency (HLF) oscillation of a huge amplitude as an envelope curve. Let us name it as RW ("relic wave") without placing emphasis on the sense of the name.

Let us suppose that the field can be of:
- local origin (artificial radio transmitters);
- atmospheric origin;
- geomagnetic Earth origin;
- the Moon – the Earth;
- the Sun – the Earth (the Sun as a nuclear reactor producing electromagnetic radiation, the Solar System);
- galactic origin;
- Universal origin – the Relic Wave; in contrast to the relic radiation occurring in the diapason of SHF (i.e. in

contrast to the convenient notion) it is the diapason of HLF. - Etc.

The researches have demonstrated that the field of local and atmospheric origin may be excluded. The other variants require to be developed. Nevertheless, the variant of the Universal scale seemed to be the most probable. There is some reason for this supposition: the modern notion of the birth and the state of the Universe, i.e. the Big Bang and the expanding Universe. The known variants of scenarios of the Big Bang are based on a nuclear explosion of enormous power. The nuclear explosion is accompanied by an electromagnetic impulse (disturbance). It can be supposed that the Big Bang caused forming of a field having enormous amplitude values and long (great) period of oscillations. Probably, we deal with this field.

The second hypothesis about inconstancy, i.e. about wave nature of the Universe

A Russian proverb says: "Everything passes, everything changes". Constant electric voltage does not exist (!). That, what is considered as the constant voltage, really is a constant component (occurring at a certain time interval). This component is formed by combining of variable sinusoidal oscillations and/or is a quite low frequency fundamental. Hence, it is a non-sinusoidal "changing" having amplitude linear part at the time interval of the observer.

For example, in reality a usual storage battery of "direct current" can not support invariable voltage, i.e. when a discharge appears the voltage decreases (changes in time, oscillates with a non-sinusoidal oscillation and a quite low frequency fundamental), when a charge appears the voltage increases.

It is necessary to observe the constant voltage occurring after a rectifier and even a stabilizer as a constant component existing in the time interval from switching on to switching off. This will correspond to that is proposed by Fourier!

Show me a device producing constant voltage, and I will prove that the voltage is not constant.

Conclusions

If the supposition is totally confirmed then the statement that an electric field plays a fundamental role in the Universe will be valid.

We live in an electric field of a huge potential but we do not notice it. Since **our reference point is the amplitude value of RW field in our point of space** then the potential is equal to zero for our perception and for measuring instruments. Besides, **RW has an amplitude linear part at the time interval of the observer**. Hence, we consider RW field existing as unrevealed or as weak interactions in natural processes. Nevertheless, this influences directly on the whole surrounding material world.

Artificial production of heterogeneities in the RW field can cause its significant visualization.

According to the concept of the physical field, which was called by Einstein as the most important discovery in physics since Newton's time, every body generates a force field in the ambient space (for example, the electric field occurring if the body has an electric charge). This force field becomes apparent when a test body located in a certain point is influenced by a force.

Discovery of the fields of this scale allows define this concept more accurately. I would like to restate the information mentioned above in the following way: every non-homogeneity of physical vacuum (aether), which is registered by our perception or by measuring instruments as a physical object or a physical field, interferes with RW (according to other interpretations, it absorbs or rereflects RW, or becomes excited) producing new wave fields. This perceived physical field has frequency which is higher than RW frequencies. It is perceived as static in the time interval of observation. Hence, the field generates a charge and not the reverse. Any linear or non-linear transmission (motion) of a material or field object changes non-homogeneity which is generated by this object.

A question about measuring of parameters of the Universe remains open. Can an oscillation of the period of T=14 billions years and of the amplitude of A~T be seen, perceived, registered or measured?

The used literature and references are not cited in the article due to its great volume. The reader can familiarize with them at the web-site of http://www.efir.com.ua. The complete text of the article and other materials can be received from the author.

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To the Question of Work Made by Electrostatic Field

Alexander V. Frolov, Russia

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We know some simple examples of work making due to the forces, which appear in electrostatic field. Since the field itself does not require energy consumption from the source (not taking into account the charge leakage), then free energy can be received with these forces. The first phenomenon that we are going to consider is a phenomenon of **electrostriction**. Mechanical forces appearing in dielectric under the influence of electrical field tend to deform it. Sometimes these forces are small, but they can be huge in special dielectrics. The character of deformation also depends on non-linearity of electrical field. Suffice it to remember that heating of a body takes place during deformation, and we can make a conclusion on possible using of the given effect in practice. Periodical deformation can be created due to the rotor or any other methods to change the field.

The second effect is not so popular. It was found by Hertz in 1881 that there is a rotation of dielectrical cylinder (or ball) in permanent electric field if it is created in some liquid or in gas (see Fig.1).

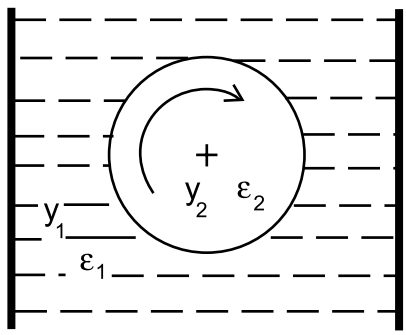

Fig.1

Here **ε1** is a dielectrical permittivity of the liquid, **ε2** is a dielectrical permittivity of the rotor, **γ1** is a conductivity of the liquid and **γ2** is a conductivity of the rotor. This effect was discovered by Hertz, then it was described by G. Quincke, Germany. Also Japan scientist I. Sumoto studied the effect in 1955. Modern research work was made by K.M. Polivanov, Moscow. There is the so called equation by Polivanov describing special conditions, which are necessary to begin rotation (**ε1/ ε2=γ2/γ1** is the Polivanov's condition).

Forces of electrostatic field produce this rotation and it is a real free energy system that can trap energy from inner structure of potential field. Let's try to describe the mechanism of this effect and then we'll be able to increase the power of the system up to the level of industrial application. So, why does it work? To my mind, there are some differences in conditions for polarization of the rotor and molecules of liquid or gas those are surrounding the rotor since there is a difference in permittivity and conductivity.

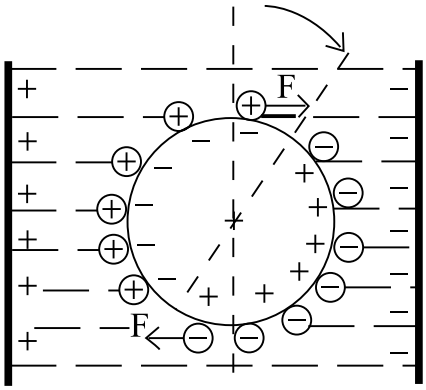

Fig.2

Due to this reason the molecules are polarized both by the field of electrodes and by the field of rotor. The rotor is polarized in the electrical field of electrodes, and molecules of liquid on its surface are polarized by the electric charge of the rotor, but not according to direction of the field. So, the rotor is surrounded by "screen" of molecules on its surface. The electric charge of this screen partially compensates the field of electrodes.

When some angle is created by the first initial turn, there is some part of the rotor surface, where molecules of liquid on the surface of the rotor are attracted to electrodes and it is the reason for future rotation. After some angle of the turn the polarization in this point of the rotor surface is changed but new molecules are incoming in the so called "sector of attraction" and the rotation is always accelerated. This well-known effect of 1881 is a very good example of possibility to produce useful work in load by means of electrostatic field only.

One more interesting effect is known as Faraday effect. In 1836 Faraday noted that raising of liquid upwards takes place in condenser with liquid dielectric (plates are installed vertically). During this process electrostatic field makes the work against gravity. A. Gyemant in 1926 established that value of this force is proportional to the square of voltage on condenser. Later in 1955 this phenomenon was studied in details by I. Sumoto, Japan. That's why in physical encyclopedias this effect is called "Faraday-Sumoto effect". In Tareev's book [1] it is pointed: "Under high voltage this phenomenon leads to flowing and turbulent boiling of liquid". I should remember for those, who see nothing unusual here, that it does not necessary to consume the power from initial source. Creating an initial field in electric capacitor, then we can use the received mechanical work. It is evident that the gradient of electrical field creates the conditions for movement of liquid dielectric. A task to create conditions for liquid circulation is more complex, but it has solution, if we take into account the presence of one more static field, i.e. gravitational field. Joint action of electrostatic and gravitational fields stipulates the circulation of liquid dielectric even in the simplest constructions. Besides, electrostatic filed can be partially screened.

The analyzed examples should draw attention of experimenters to these obvious ways of how to create useful work by means of electrostatic field.

References

1. Tareev B.M. Physics of dielectrical materials, Moscow, Energoisdat, 1982, p.199 – 200.

Editor: Below we publish the comments of our reader.

Letter On
Hertz-Quincke-Sumoto Effect

from Doug Marett
Email: doug.marett@sympatico.ca

…As far as I can tell, the original reference by Hertz is "On the Distribution of Electricity over the Surface of Moving Conductors", Wiedemann's Annalen, 13, pp.266-275,1881. Hertz's discussion of this phenomenon is cursory at best, having very little experimental work included. The real phenomenon appears to have been discovered by W. Weiler in 1893 (Zeitschrift fur den Physikalischen und Chemischen Unterricht, Vol.6, pp194-195). Weiler observed that a glass cylinder placed in a poorly conducting liquid between two spherical electrodes began to rotate when the electrodes were connected to an electrostatic generator. In 1896, George Quincke reported the same phenomenon and published a comprehensive report on it. This was in Annalen der Physik, Ser.3, Vol. 59, pp.417-486. Subsequent investigators have tended to attribute the discovery to Quincke, when in fact Weiler was the first to pioneer the work.

I do know that P.E. Secker et al. performed work on this field, references of which are available in the English language. These are:

P.E. Secker, et al., (1968) Journal of Applied Physics, Vol. 39, pp.2957-2961, and
P.E. Secker, et al., (1970) Journal of Physics D: Applied Physics Vol.3, pp 216-220.

I hope that this information might be of use to you.

The Foundations of Physchemistry of Micro World

Ph. M. Kanarev

The Second Edition

The book was published in Russian and English; you can also read it at http://book.Kanarev.innoplaza.net

The new axiomatic of natural sciences is given in the book; on its basis, quantum physics and quantum chemistry have been returned to the classical way of development. The first steps are made on this way, which have led to discovery of the structure of the photon, the electron, and the principle of the formation of the atomic nuclei, the atoms and the molecules.

The Planck's Law of radiation of perfect blackbody is given on the basis of classical concepts, and the connection of quantum phenomena with the laws of classical physics is proved.

The application of the new theoretical results to the solution of practical energy tasks on the basis of plasma electrolysis of water is shown. Due to this electrolysis, additional heat energy and the energy containing gases (hydrogen and oxygen) are generated. Cold Nuclear Transmutation of the atomic nuclei of alkaline metals and the atomic nuclei of the cathode material takes place during plasma electrolysis of water.

The book is intended for physicists, chemists and other specialists who are seeking the new directions for understanding the foundations of the micro world and the new energy sources.

Comments to Electro-Reactive LIFTER News

Alexander V. Frolov, Russia

General Director, Faraday Laboratories Ltd
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http://www.faraday.ru

March 21, 2003 we got news from France about electro-reactive propulsion system.

Blaze Labs reached 100g PAYLOAD level.

You will find all the details of the Saviour's experiment at: http://blazelabs.com/exp14.htm.

This electro-reactive ionization-flying model requires 46 kVolt, 4 mA, i.e. about 200 watts to fly with 100 g useful load.

It is interesting to note that Jean-Louis Naudin's previous opinion of 1997 – 1999 about priority of the Frolov's asymmetrical capacitor now is changed. Sometimes people wish to re-write the history. It is possible and it is easy. Naudin's web page about http://jnaudin.free.fr/lifters/story.htm (see Fig. 1) is not started from the real beginning of the story. He forgot our discussion of 1997 and also photos and MPEG video I have send to him when he has started his way in electrograviticis.

If you remember the name of Naudin's first asymmetrical capacitor "Frolov's Hat" (see Fig.2) then you know why there is this name of this technology. But really it is not important to try for some serious reply from Jean since he has no personal post address, phone, or his photo on the web site…

Also it can be useful to visit this page http://www.faraday.ru/t-cap.html to know about something **more important than electric ionization flying models (Lifters),** since it is just a reactive ionization way, which is similar to rockets.

Ideas now developing by us are not aimed to increase the power level (from 1 gram to 100 gram propulsive force). It is **a qualitatively new idea**; it is really electrograviticis instead of "electro-reactive Lifter".

So**, what is about real "history of the question" instead of the French version?** The question here is not about a priority, it is nonsense after T.T. Brown's patents. As an example the NASA patents on asymmetrical capacitors can be mentioned since the ideas were opened before the NASA patent and there is nothing new in it. The problem is that people who develop reactive ionization Lifters develop only primitive reactive technology. **It is not essence of T.T. Brown research but it is the distortion of his ideas.**

So, the team in France is working to develop and support ideas of secondary and wrong method. Why? Perhaps they either do not see the real way or have payment for the wrong way **to mask a real work.**

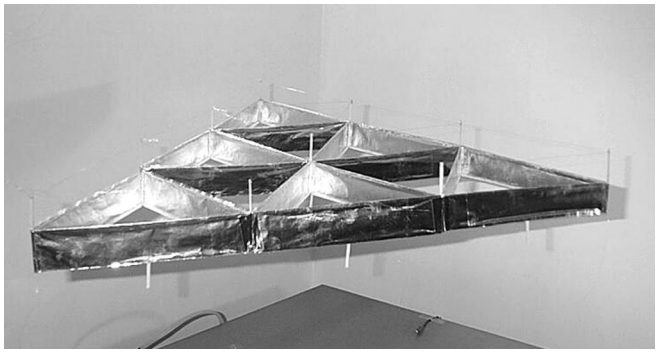

Fig. 1

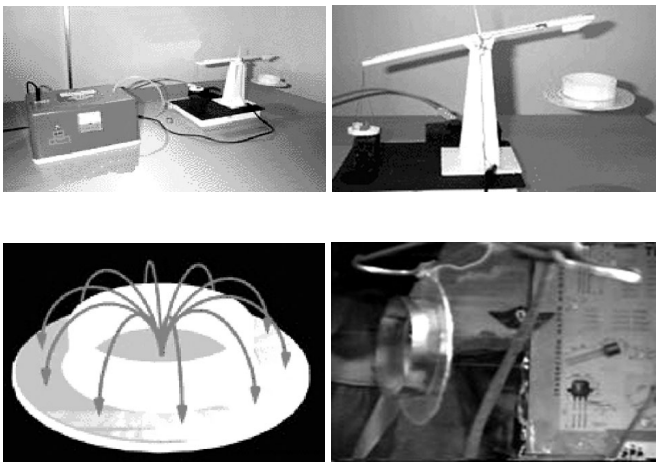

Fig. 2

Josh Werrmann (Email: jsh111@yahoo.com): I wanted to ask you a few questions about an article titled "Highly Efficiency Electrolysis" by A.V. Frolov. In this article it is stated that Dmitry A. Latchinov patented a method for electrolysis, where one of the electrodes is insulated completely from the water. It is also stated that another scientist, Igor Goryachev, used a method of pulsed electric fields. I don't know if you know, but inventor Stanley Meyer has a patent that covers both of these processes together, in a way. His patent is U.S. patent number: 4936961. Take a look at this. In the patent it states EXPLICITLY that there is a pulsed electric field, where a condition of NO CURRENT is preferred. This is very similar to the above to Russian scientists, except that the patent states a condition of resonance is necessary. I am wondering do the two scientists that are described require resonance in their devices? Or just plain pulsed electric fields, where one electrode is insulated from water.

Another patent I would like to refer you to is Archie Blue's electrolyser, U.S. patent number: 4124463. This device is similar to A.V. Frolov's idea, to get the oxygen and hydrogen bubbles off the electrodes, except he uses a blower to blow air in the cell, instead of rotating the cell like A.V. Frolov does. His invention also uses the conductivity current to work.

Alexander V. Frolov: As far as I know resonance is not created in this case. The main idea is the removal of gaseous film which appears on the surface of electrodes by rotation or some other methods.

NEWS REVIEW

Giant magnets lead the world to the new source of energy

http:// www.sciteclibrary.ru

The system of 150-tons magnets which have been developed by scientists of the USA, Japan and Russia opens a new era of safe and unlimited energy. In this system nuclear fusions serve as a source of energy. They accumulate heavy chemical elements not by means of nuclear reactions but by ultrahigh plasma pressure.

After supplementary research is held which aims to reduce manufacturing costs of the giant magnet weighing 925 tons, this magnet will be produced and demonstrated at the opening of the International Thermonuclear Experimental Reactor (ITER). This magnet in its turn will become a part of a bigger system, that is combined into a magnet weighing approximately 10 000 tons. The task of ITER is the demonstration of the process of nuclear fusion, as an energy source. During the process of nuclear fusion the light elements are combined by immense pressure, thus producing heavier elements. During this production process a lot of energy is emitted. The task of giant high-power magnets is to create magnetic fields, which must hold and control plasma, or to charge electrically the gas, in which the fusion is being held.

In Japan the system of 150-tons magnets serves as adjustment system of 925-tons magnets, which will be finally put into operation and heat up the ITER plasma. Two additional giant magnet systems will confine the plasma and will control its form. The model for one of them is presently being examined in Germany; the model of the other is in project.

Cylindrical 150-tons magnets have three main parts: external module, built by the Japanese team, internal module, built by the American team and a thin rod in the core which is equipped with process control equipment. Three different rods were separately checked, two of them were built in Japan, another in Russia.

Harnessing the Wheelwork of Nature

*(*340 pgs. Adventures Unlimited Publishers, 2002)

Thomas Valone
Email: iri@erols.com

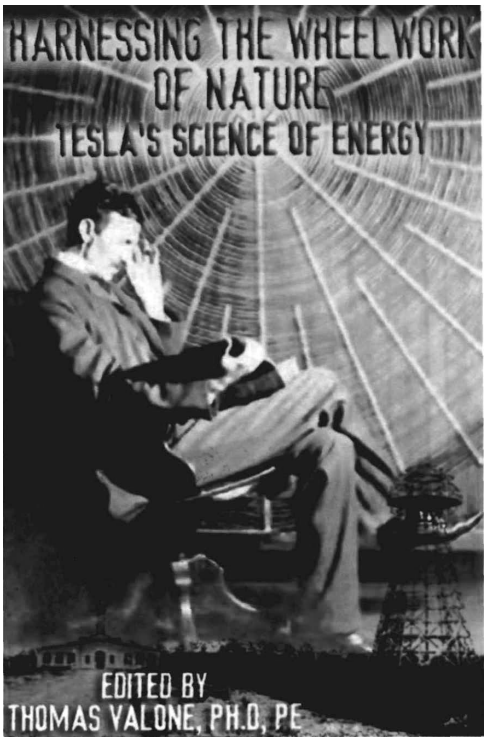

It is a new book by **Thomas Valone**, who edited this anthology in time for the **Wardenclyffe Tower Centennial (1903-2003)**. This book presents for the first time, the feasibility argument for Tesla's most ambitious dream, the wireless transmission of power. Pictured on the book's cover near his feet, the 187-foot Wardenclyffe Tower was Tesla's means to deliver natural 8 Hz electricity anywhere in the world, by longitudinal waves.

Unknown to most electrical engineers, Nikola Tesla's dream answers the energy crisis worldwide, saves electrical conversion losses, and provides a real alternative to transmission lines. In Dr. Corum's contributed papers, he explains Tesla's magnifying transmitter, which Tesla compared to a telescope. Corum points out that "the tuned circuit of his magnifying transmitter was the whole earth-ionosphere cavity resonator." This fact helps explain why Tesla stated, "When there is no receiver there is no energy consumption anywhere. When the receiver is put on, it draws power. That is the exact opposite of the Hertz-wave system...radiating all the time whether the energy is received or not." Thus, with Tesla's futuristic transmission of power, source dissipation will only be experienced when a load is engaged in a tuned receiver somewhere on the earth. This fact alone represents **a major leap forward** in electrical transmission efficiency, even one hundred years later.

Why wasn't the prototype of Wardenclyffe finished in 1903? Tesla offered this visionary conclusion: "The world was not prepared for it. It was too far ahead of time. But the same laws will prevail in the end and make it a triumphal success... Let the future tell the truth and evaluate each one according to their work and accomplishments. The present is theirs; the future, for which I really worked, is mine."

Up until now, there has been a general malaise regarding the lack of scientific comprehension of Tesla's greatest dream. For example, the Serb National Federation notes, "With the exception of the first biography of Tesla by John J. O'Neill, science editor of the *New York Herald Tribune*, and published in 1944, unfortunately no biographer since has had the necessary scientific/engineering academic credentials to discuss Tesla's work in the various fields." Contributors to ***Harnessing the Wheelwork of Nature*** are primarily physicists and engineers who are experts in Tesla technology. Their wealth of knowledge demonstrates their mastery of this extraordinarily progressive and technical subject. Finally, the best academic credentials have been brought to bear on the world's greatest electrical futurist.

This is a very readable and profusely illustrated reference volume on wireless transmission of power, besides being an excellent biographical gold mine of Tesla history. Nick Cook, editor of *Jane's Defence Weekly* and author of *The Hunt for Zero Point* says, "Tesla is one of the great overlooked geniuses of science and electricity. His full story deserves to be told. Tom Valone sheds important new light on his life and work."

Integrity Research Institute will hold a Tesla Energy Conference & Expo on November 8-9, 2003 to celebrate the Wardenclyffe Tower Centennial (1903-2003) in conjunction with the Tesla Wardenclyffe Project, Inc. (www.teslascience.org).

See www.IntegrityResearchInstitute.org for more details.

Experiment on the generation of gravitational field

by Dmitry Yu. Tsipenuk

Sergey S. Abramov

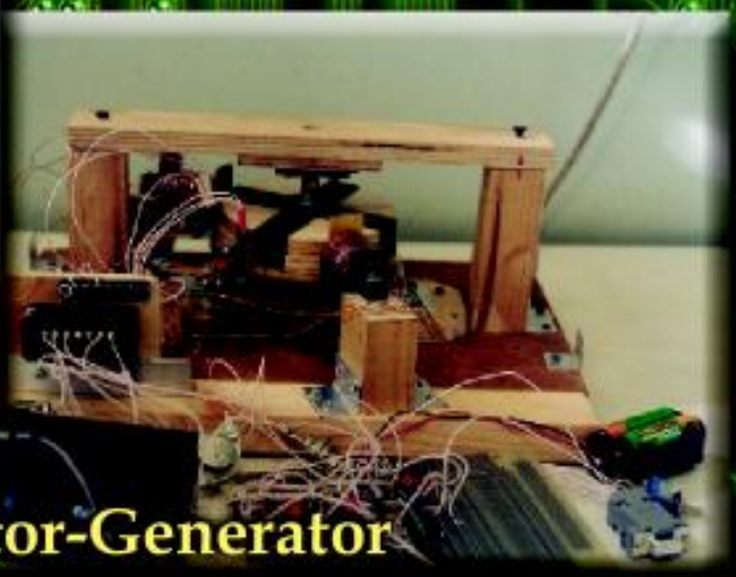

Model of Adams Motor-Generator

Electrolytic photoaccumulator for the XXI century energy systems

Read the new article by Anton I. Egorov

Flynn Generator

Original version of photomaterials is presented at http://www.flynnresearch.net

Joe Flynn Laboratory, USA

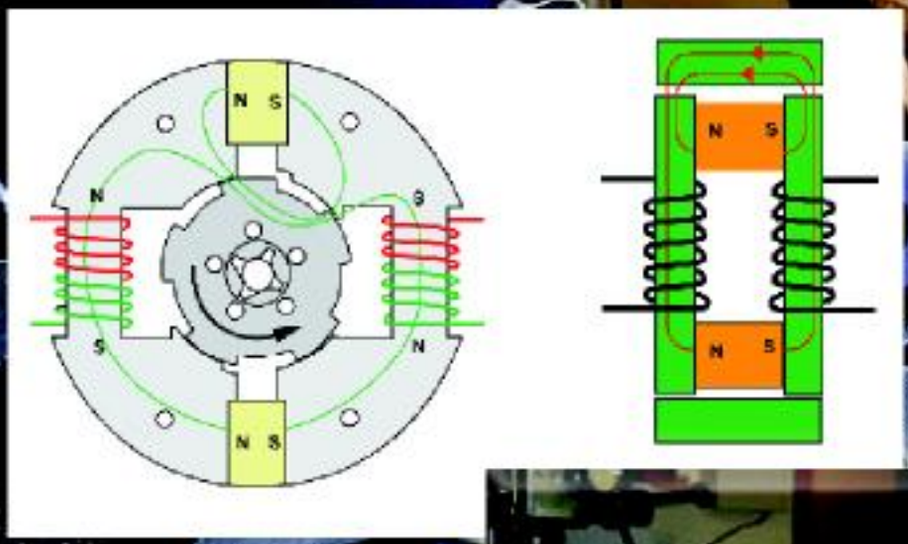

Electric generator by Joe Flynn

More than 350% efficiency generator operating on permanent magnets

ISSN 1684-7288

Read the article by Tim Harwood in this issue

New Energy Technologies

Printed version ISSN 1684-7288
Online version ISSN 1684-9698

Published by Faraday Laboratories Ltd. **Issue #3 (12), 2003**
Research on advanced aerospace systems and new energy sources

Time Machine

Conference in Moscow: discussion of the patent application on the method and device to control temporal parameters of matter

Time Machine

Experiments by research group "KOSMOPOISK"
Summer, 2001

Device designed
by Faraday Lab Ltd, 2002

Alexander V. Frolov
Vadim A. Chernobrov
April 12, 2003, Conference hall
Hotel "Cosmos", Moscow

NEW ENERGY TECHNOLOGIES #12

1. Works on the Designing of Time Machines. Vadim A. Chernobrov (Russia)
2. Control of Temporal Parameters of Physical Processes. Alexander V. Frolov (Russia)
3. Etherodynamics as a New Field of Physics. Vladimir A. Atsukovsky (Russia)
4. Electromagnetic Gravitational Interaction Vadim Ya. Kosyev (Russia)
5. Medium For Existing of Matter in Nature. Anatoly V. Rykov (Russia)
6. Adams Motor. Sergey S. Abramov (Russia)
7. Field Transformation in the Model of Extended Space. Dmitry Yu. Tsipenyuk (Russia)
8. Joe Flynn's Parallel Path Magnetic Technology. Tim Harwood (USA)
9. Flynn Laboratory Photos
10. Flux-machine and Its Analogies. Review
11. Russian Patents on Alternative Energetics.
12. Gravitational Spaceships. Gregory R. Uspensky (Russia)
13. On Velocity Of Drive-Free Motion. S.A. Gerasimov , V.V. Stashenko (Russia)
14. Electromagnetic Self-Action. S.A. Gerasimov, A.V. Volos (Russia)
15. Uranium Photoaccumulator. Anton I. Yegorov (Russia)
16. Global Energy Prize (reportage)
17. Teleportation. Alla V. Pashova (Russia)
18. "Mass Defect" in Home Conditions. Prokofy V. Sherbak (Russia)
19. Aether as Unified Field. Alexander M. Mishin (Russia)
20. Global Energy. Philip M. Kanarev (Russia)
21. Fusion Processes Of Molecules Of Oxygen, Hydrogen And Water. Philip M. Kanarev (Russia)
22. Plasma Energy Power Generation. Bruce A. Perreault (USA)
23. News
24. The Marcus Device Controversy. Tim Ventura (USA)
25. Systems of conversion of thermal energy to mechanical one. Review
26. I. Prigozin
27. Letters

Editorial: On April 12 of 2003 a scientific conference "The Time Machine" was organized by Faraday Laboratories Ltd in Moscow, Russia. It was devoted to the experiments on control of space-time physical properties. At the conference there were discussed problems of time and gravitation in the context of etherodynamics, experiments and applied aspects of these technologies. Below we publish a review of the main reports presented at the conference.

The First Results of the Works on the Designing of Devices to Control Parameters of Physical Processes (of Time)

Further Plans on Designing of the Time Machine

Vadim A. Chernobrov, Russia

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To conduct the experiments on the influence upon physical Time (density of space energy) some special devices were used as a general method of such influence. These devices can create converging waves which can cause the appearance of quasi-monopole in the confined space. *Quasi-monopole* is a part of space which has some parameters of hypothetical unitary monopole or bunch of such particles (in particular, it allows registering one magnetic pole by means of measuring equipment from the outside at some distance from this pole).

The pilot experiments have shown that it is very difficult (if not impossible) to create long-living quasi-monopole by means of permanent magnets or electromagnets operating on direct currents (in this case quasi-monopole represents a space with one outer and one inner magnetic pole). It can be explained by the fact that lines of force of the "inner pole" invariably find a weak spot in the heterogeneous surface of magnets and break out. As a result, at the device along with one "outer" magnetic pole there is a local output of magnetic lines of the "inner" pole.

During the designing of new devices there was a task to create a quasi-monopole situation in the confined space. This situation should be created not uniformly but transiently by pulsation method. Frequency of work of electromagnetic oscillators first of all was selected depending on linear dimensions of the devices. Selection of the frequency was made in such a way that one period of pulsation does not exceed the period of time which is necessary for electromagnetic waves to reach the center and opposite waves of the device.

At the designing of laboratory devices, which generate converging longitudinal waves, several different principles to obtain required parameters were considered in the multi-layer quasi-monopole, which works in high-frequency mode. Several types of the devices were realized at different degrees of development and with different success. It was shown that the simplest devices were that ones which used electromagnetic (solenoid) oscillators connected in series and in parallel. In different experiments between 3 and 5 such surfaces were used. These surfaces were called electromagnetic work surfaces (EWS). All layers of EWS of different diameters were mounted in series in each other (like matreshka). The outer layer was either mounted at force shell or simultaneously represented such a shell by itself.

The size of the maximal EWS was about 0.9 m, the diameter of the minimal (inner) EWS was equal to 115 mm that was enough to place laboratory animals inside the control detection devices. Laboratory animals were used to determine the consequences of the influence of converging spherical electromagnetic waves. Payload, (i.e. that which was directly used for transfer in Time-Space), included the afore-mentioned detection devices and (occasionaly) laboratory animals. The term "payload" was coined by analogy with the term which is used in cosmonautics. Volume of payload section was placed in the center of symmetry of the Time Machine (TM). In all the earliest Machines (except the 7th model) this volume still has not exceeded the volume of a football. The device with an outer diameter of 2.1 m and inner payload section of 1 m has the maximum size. It allows making human-aided experiments.

At different stages of the experiments the calculations were made by all available known modern methods to fix time. All types of electronic, quartz, mechanical and several specially made doubled quartz generators were used (there were compared frequency readings of measuring and etalon heat-insulated generators which were placed at a distance). Certain experiments used lightguiding diodes and some other methods. Before and after the experiment (more rarely during the experiment) readings of measurement clocks were periodically compared with those of an etalon clock and with signals of exact time which were transmitting by radio. Other physical factors causes side effects upon some types of measuring devices, for example, upon quartz-crystal clocks. However, doubling of measurement methods allowed essentially decreasing inaccuracy of measurements.

At some operating modes (which were not always predicted) the change of Time speed was attained (Prof. Nikolay A. Kozyrev called it density of Time t/t_o). This change came to about a fraction of a second per an etalon hour. Let us take usual "etalon" earth time as $t_o=+1$ then it becomes clear that it is speed range of $+0.99<t/t_o<+1.01$ which is researched in the experiments. Thus being placed inside the device, the inanimate objects and animals were transferred in the Future (with "above-zero" speed) more slowly or faster than those around them. It occurred at all operational modes of the device (deceleration or acceleration).

Difference of Time (gradient of Time speed or curvature of Space-Time field) was observed not only inside the TM, though there is no doubt that a maximal value of changed Time was registered inside the smallest "matreshka". As was expected, during the experiments Time change was also registered outside the device. However such change which had an opposite sign was smaller than the change inside the device approximately by an order of magnitude. It entirely corresponds to geometric laws, i.e. in proportion to the cube of the distance).

In other words, TM influences not only its inner part and pay load but also the environment. It bears a strong resemblance to jet propulsion but in Time and not in Space. It is a flight which is realized by rejection of Time instead of mass.

Thus it was determined that the processes of deceleration and acceleration of Time distinctly differ in their nature and consequences. In such a way the deceleration was considerably smoother and more stable. During acceleration there were observed sudden changes in readings and this operational mode was characterized by general instability and dependence on any (or many) external factors. Particularly, acceleration instability also consisted in the following: at fixed power the value speed of Time depended on the time of day and situation of the Moon. Possibly it also depended on some other factors including the presence of an operator or other people near the device. Even insignificant external influence, for example, mechanical shaking, caused the change of speed value which sometimes was rather significant.

Inside the laboratory devices there was also registered that **Time can change with some sluggishness**. After the changed Time speed influenced some physical object (for example, soil) then residual effects were observed at it for some period of time. These effects can be eliminated only by the influence of another speed of Time.

Preliminary general conclusions

The Present is the transfer or transformation of the polyvariant easily changeable Future into the univariant unchangeable Past. Thus flights in the Past (at "negative" density-speed t/t_0) and in the Future will happen in different ways. They can be compared with the motion of an ant along the tree: from any point of the tree (i.e. from the Present) there is only one way downwards open to the ant (i.e. in the Past) and many different ways upwards (i.e. in the Future). However among all the ways to the Future undoubtedly there are most probable, low-probable and almost improbable variants for development of the Future. The less probable this variant of the Future the more unstable and energy-intensive the motion to the Future will be. According to

the "law of the crown of tree", return to the Present is possible only if when being in the Past the traveler does not interfere in the course of events and does not change the course of the past History. Otherwise the chronotraveler will return to the parallel Present from the Past by another branch of History. Penetration to the Future from the Present is hampered by the choice of the branch for transference. However return from any variant of the Future into the Present is possible at any scenario if there are no fusions of different variants of History…

In other words, we have a circumstantial evidence of the assumption that Time has more than one dimension. Thus there is an affirmation of the theoretical inferences of R. Bartini who believed that Time has 3 dimensions. Hence we can consider our terrestrial globe as 6-dimensional where the dimensions are: length; width; height; age or date of Time; variant of History or blur of Time; density or speed of Time. Thus the notion of "Arrows of Time" is completely absent in the fourth dimension (date of Time) but it is a special case of the notion of the sixth dimension i.e. speed of Time. At the same time the notion of speed of Time also relates to the physical notions of gravitation and energy. Thus the notion of "Einstein-Rosen bridge", which was introduced in 1916, or notion of "worm course", which was introduced by John Willer in the end of the fifties, are connected with transference in the 5th and 6th dimensions.

Method and Device to Control Temporal Parameters of Physical Processes by Means of Changing of Energy Density of Space

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This invention belongs to the methods and devices to provide control on rate of physical processes (that includes the process of the existence of matter in space-time) by means of increasing or decreasing of energy density of space (i.e. energy density of physical vacuum or density of the aether).

Let us consider the history of the invention:

Earlier there were proposed some methods and devices to influence the rate of physical and chemical reactions, biological processes or period of oscillation of the system. In the works by N.A. Kozyrev [1] there is a description of the experiments on the influence of some process (for example, process of evaporation or crystallization of matter) upon the period of another process, which serves as a detector and can be compared with reference oscillation process. In one case, the rate of oscillations of the detector decreases in the surrounding area near the process of matter evaporation. In another case, the rate of detector oscillations increases in the surrounding area near the process of matter crystallization. If we use a term of "entropy" then it is possible to say that the processes which are accompanied with entropy increasing (for example, conversion of matter from solid state into liquid one) influence on the matter (surrounding processes) in such a way that entropy of systems decreases. In another case, for example, near the process of crystallization, entropy of systems increases in the surrounding area near this process. Kozyrev used the term "wave of density of time" and he made a conclusion that in addition to "directivity" of time (time course) there are active properties of time, for example, "density of time".

To develop this approach for applied purposes it is necessary to use in-depth analysis of the physical sense

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To develop this approach for applied purposes it is necessary to use in-depth analysis of the physical sense

of the "time density" notion. Connection of notions about "time directivity" and "entropy of the system" was demonstrated in the work "Introduction into thermodynamic of irreversible processes", 1964 by Ilya Prigozhin [2]. In the work "Quantum fluctuations of vacuum in curved space and theory of gravitation" by A.D. Sakharov [3] the conception of vacuum structure was suggested. In the USA the work "Can the vacuum be engineered for space flight applications?" by H.E. Puthoff [4] is well-known. The author considered the applied aspects for study of vacuum structure and described the method and device to obtain propulsive force by means of changes in vacuum properties.

A substantive conception of time and methods for creation of waves of energy density were also considered by Prof. K.P. Butusov in the work "Time is a physical substance", 1991 [5]. In the book "What is The Time?" by Yu. G. Belostotsky [6] the connection between the notions of time and aether was demonstrated. This connection was considered from the point of view of astrophysics there.

We can also say that the modern conception of aether is successfully developed by V.A. Atsukovsky in his works [7].

In my articles, for example, "Physical principles of the Time Machine" [8], it was demonstrated that to develop experimental works on the topic it is useful to clarify the terminology and to consider **"waves of time density" as longitudinal waves of energy density in space.** In this case the notion of "time density" has a physical sense of energy density (aether density).

This approach can be realized practically by means of classical electro-technical and radio engineering methods and it is a development of aether-dynamical conception on the nature of electricity and magnetism by M. Faraday, "Experimental researches on electricity", volume 3, [9].

Let us consider a usual bipolar magnet from the point of view of aether-dynamics. Then it is possible to say that it is inflow and outflow of aether, i.e. it is a balanced energy system which does not change energy density in space. In this case it is evident that creation of magnetic monopole or modeling of quazi-monopole by means of electro-dynamical methods is a technical basis to create some local change of energy density in space.

Electric processes could also be used alongside with the magnetic phenomena. For example, in another book "Symmetrization of Maxwell-Lorenz equation" by Prof. Butusov [10] the creation of longitudinal wave was also considered. It was demonstrated that an electrically charged sphere can radiate longitudinal wave when the sphere radius is changing, i.e. when its surface is changing while the value of electric charge is constant.

One more well-known method is described in the book "Experimental gravitonics" by Polyakov [11]. There is a consideration of the generation of gravitational waves at the high-frequency magnetization and demagnetization of ferromagnetic material, i.e. at the powerful volume magnetostriction. Since at this phenomenon there are changes of matter density (i.e. changes of energy density in space, which is occupied by matter), then volume magnetostriction is a special case of changes of energy density.

Earlier Vadim A. Chernobrov had described a method and device to control temporal characteristics of physical and chemical processes by means of creation of the magnetic monopole (quasi-monopole). In this magnetic mono-pole there is a convergent wave, which is created by several sources situated in the spherical frame. According to this method in the multilayer spherical structure where every layer (the so called "electromagnetic work surface") is an assembly of electromagnets, by means of series connection of the layers the wave is created, which converges to the center of the device. The device has the same outside magnetic poles of the electromagnets (and the same inner poles) and thus a model of macroscopic magnetic monopole is created.

We assume that at in-phase operation of all sources of waves, interference of longitudinal waves provides some change of value of energy density of space in the focus of the system.

Experimental facts prove that detectors installed in the center of the device (for example, mechanical or electromagnetic oscillators) show change of period in their own oscillations. We have protected them by shielding them from heat radiation as well as from other kinds of electromagnetic influence. Thus it is possible to assert that the detectors decelerate or accelerate their oscillation period depending on the energy density, which is generated in the center of the device.

However for the experiments made by means of such a device, accurate adjustments of all wave sources are required to provide their in-phase operation. At the same time, operational stability of the system depends on the operational stability of each of the wave sources. Increase of the impulse frequency causes increase of

the effect; however, it is limited by the parameters of electromagnets and generator of impulses. Besides, to increase the effect it is necessary to use more powerful energy sources since the current in the windings of electromagnets determines the value of the magnetic field of the created quasi-monopole.

Since the efficiency of such systems directly depends on the frequency and the value of changes of energy density in space, then in the next version of realization of this technology we suggest using of plasma shells instead of electromagnetic working surfaces. This will allow significant improvment in the specific parameters of the device.

Thus let us consider general engineering principles of operation and outline the ways to develop this method. Fig. 1 represents a three-layered electromagnetic emitter. This electromagnetic emitter is designed according to the invention in which the directed radiation of wave of energy density is created along the axis of the device.

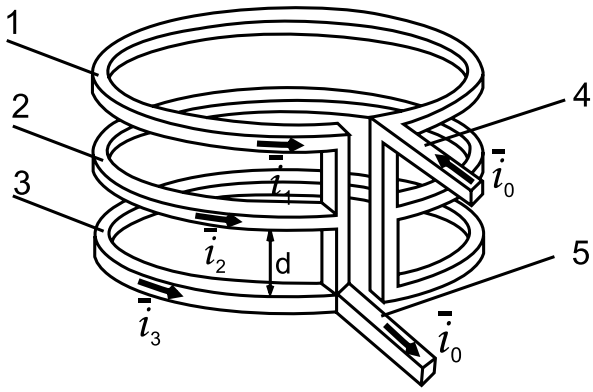

Fig. 1
Three-layered electromagnet

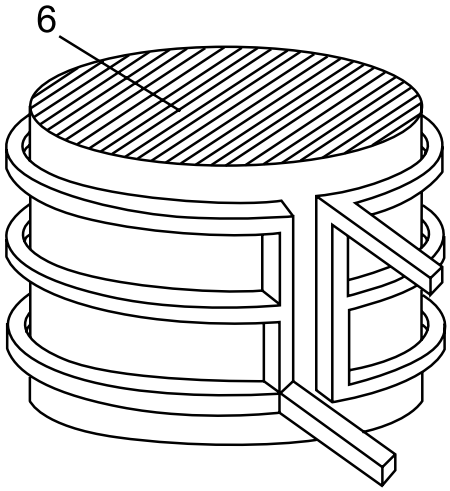

Fig. 2
Three-layered electromagnet with ferrite core

The device is designed according to the idea by Vadim A. Chernobrov for creation of the directed wave of energy density by means of phase shift in propagation of impulse front in three current branches, namely i_1, i_2, i_3. These branches are displaced along the electromagnet axis at some distance d.

The device works in the following way. When the pulsed generator is activated, front of current pulse i_0 appears at the output 4. Impulse front at branch 1 advances impulse front at branch 2 that is caused by spatial shift of current branches 1, 2, 3 relatively to each other along the electromagnet axis at the distance d. Impulse front at branch 2 in its turn advances impulse front at branch 3 for a certain time T. The second output of the electromagnet 5 is placed in such a way that impulse front at branch 1 will phase lag behind the impulse front at branch 2 (which in its turn will phase lag behind the impulse front at branch 3) for the same period of time T. Therefore at branch 5 the united impulse front is generated again.

Time T can be calculated in the following way:

$$T=d/c \text{ (seconds)} \qquad (1)$$

where c is a constant of propagation of impulse front. This constant is known as velocity of light.

At each impulse the T (i.e. the value of relative lag of impulse front) is a constant value. Thus high-frequency consequent excitation of layers of the electromagnet appears at each impulse. The frequency of the excitation is calculated in the following way:

$$f=1/T \qquad (2)$$

where T is relative lag of impulse front in seconds.

There is an example of frequency calculation: for the shift distance d=7 mm we can calculate a lag $T = (7/2.997924)\times10^{-11}=2.335\times10^{-11}$ (seconds) and frequency f=1/T approximately comes to 4.28×10^{10} (Hertz).

Thus this design of three-layered electromagnetic emitter allows creating the waves of super-high-frequency band (for example of millimeter range) without the use of a semiconductor or other radio components.

It is very expedient to use the electromagnets designed with magnetostrictive material cores, that will significantly increase energy density of the longitudinal

wave, which is generated by the multilayer electromagnet. In Fig. 2 there is an emitter with the core. In the case of high-frequency ferromagnetic magnetostrictive materials 6 the efficiency of emitter operation significantly increases.

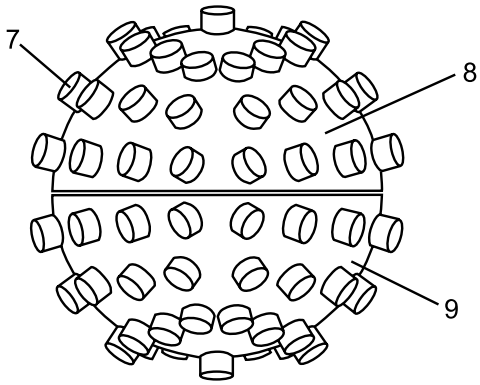

Fig. 3
Spherical design

Fig. 3 represents the spherical distribution of emitters 7 at the upper 8 and lower 9 hemisphere of the frame which could be opened in order to place detectors and different objects inside. It can also allow to establish in what way the changes of density of space energy influence the properties of different materials, velocity of physical and biological processes as well as chemical reactions. The installation of detectors 10 inside the device is shown on Fig. 4.

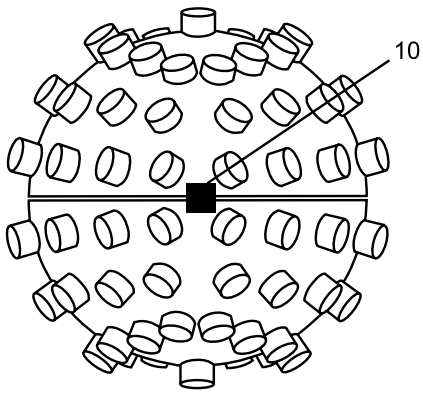

Fig. 4
Detectors inside the system

Another version of design is represented in Fig. 5, where the suggested method is realized by means of a spherical electric capacitor with three coats 11, 12, 13. Each capacitor coat is connected to the outlet of three-phase pulsed generator 14.

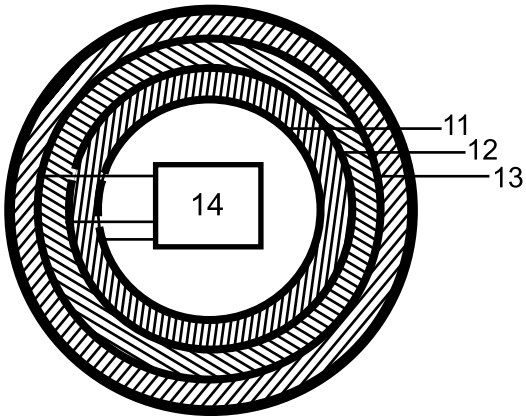

Fig. 5
Three-layered spherical capacitor

In this case the wave of energy density is created without electromagnetic emitters and this principle is not related to the modelling of magnetic quasi-monopole. The device operates due to the control unit, which provides the high-frequency changes of electric potential at each coat in such a way that the mode of high-frequency converging or diverging wave of energy density is created. In fact it is a standard three-phase generator but it produces not the rotation of the rotor of some electromotor but **"compression" or "decompression" of aether.** Aether is "pumped" in the center of the device or "pumped out" of the center.

In this case there is no need to tune separate sources of waves to make the device work in in-phased mode. It ensures reliability of the device operation if to be compared to the quasi-monopole. Besides, much less energy is necessary for the processes of charging and discharging of multi-layer spherical electric capacitor than for creation of magnetic field by means of conductivity currents.

Since the efficiency of such systems directly depends on the frequency and value of changes of energy density in space, we suggest the use of plasma shells instead of electromagnetic work surfaces for the next version of the device. It will allow significantly improvment in the specific parameters of the device. For that it is enough to place the electrodes of the multi-layers capacitor in a low-pressure gas area and these electrodes should be made as gauze electrodes. At that the wave is created in plasma, which is excited layerwise by several gauze electrodes placed in a spherical space between the inner and outer spherical bodies of the device. Therefore this version of design of the device can be considered as **the manipulation of the plasma method**.

Fig. 6 is a plan of one more design version. It is made as an inner frame 15 and outer frame 16, the space between them is filled with some gas 17. Three electrodes 18, 19 and 20 are connected to the three-phase pulsed generator 21. **Consequent excitation of plasma layers by electrodes 18, 19 and 20 creates the wave of energy density.** Propagation of this wave can be directed both to center of the device and from the center of the device.

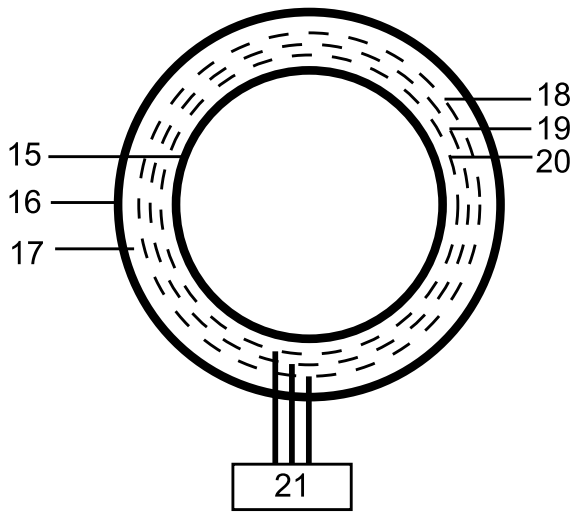

Fig. 6
Wave in plasma

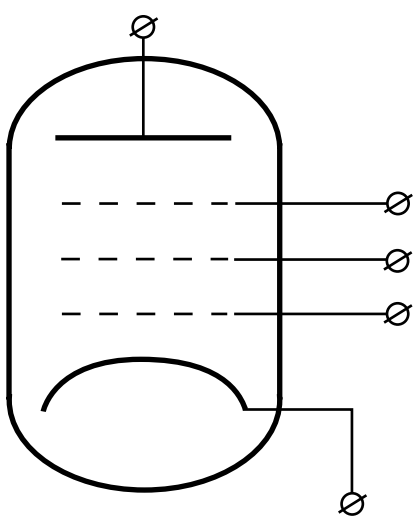

Fig. 7
Schematic electric circuit

In Fig. 7 there is a schematic electric diagram of the design.

To conclude. The work on time control has just started. We have clearly determined the main physical principles of operation of such devices, which can change the aether density in some given volume of space and thus influence temporal parameters of any physical process. The small experimental results today allow us to make real positive condusion on availability of this method and on the possibility of its practical application in applied aspects. The first aspect is antigravitation propulsion technology and we are developing the methods to detect mass (weight) changes in the time control experiments to prove this applied possibility. Another area is medical applications of the changes in the aether density.

Russian Federation patent claim #2003110067 was filled April 9, 2003. At present time we are interested in marketing for this technology as well as in search of additional investment and partners.

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Aetherodynamics as a New Field of Physics

Theory and Experiments

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A crisis exists these days both in Natural science on the whole, and, in its basis, i.e. physics. This situation is caused by fundamental errors in the methodology of its theory. The postulate method and predominance of mathematics above physical sense can be also considered as the reasons for this. Crisis situation has also taken place in the past and the way out was always to use a deeper level of matter organization than the accepted one.

A large amount of material on elementary particles of matter is collected in physics. It was discovered that all these particles can be transformed in each other. Besides that, there was discovered the ability of vacuum to create such particles at strong electromagnetic fields. In this connection it becomes clear that all these particles and vacuum have a common building material, i.e. a physical medium which fills all the world space. This medium was renamed **aether** and the element of the medium was renamed **amer**.

The worked out methodology of aetherodynamics allowed determining that aether is a usual viscous coercible gas for which all laws of usual dynamics of gases are valid. It has allowed to determine its characteristics for near-Earth space and then to describe the structures of primary stable elementary particles (i.e. proton, neutron, electron, photon, atomic nuclei, atoms and some molecules) as well as physical essence of general fundamental interactions (i.e. strong and weak nuclear interactions, electromagnetic and gravitational interactions) and some physical phenomena.

Also developed was the model of aether circulation in the Universe within the limits of perpetually existent matter, usual Euclidean space, and evenly flowing time. Formation and decay of matter, formation and decay of celestial bodies and galaxies as well as functional classification of galaxies are also included there.

To confirm some theses the author and his research team conducted several experiments mainly on electromagnetism that gave positive results. The research was conducted on testing of the presence of aether wind. These research works have confirmed the results obtained by D. Miller in 1925.

Report by Vladimir A. Atsukovsky

Electromagnetic Gravitational Interaction

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In the artide some mechanisms of electromagnetic gravitational interaction will be considered in the view of the Unified Theory of Field, Space and Time. See the complete description of The Unified Theory of Field, Space and Time at http://uic.nnov.ru/~kovy2; http://uft.h1.ru or in the book [1] which has the same title.

First of all, let us consider the structure of Space-Time where the radiation propagates. In our World gravitation is the unique substance which exists everywhere and gets over any obstacles. There are no known methods of insulation of gravitational field in modem science. It is impossible to imagine space and gravitation separately. Gravitation exists everywhere where there is some space. The gravitational field created by all masses of our metagalaxy is the aether in which cosmic objects moves and electromagnetic oscillations are propagated. The space surrounds us since the whole matter carries gravitational charge of only one sign. From astronomical research of cosmic space it follows that radius of metagalaxy is equal to the critical (gravitational radius) and hence gravitational potential is equal to $c^2 \sim 10^{17}$ $[m^2/c^2]$ in each point of space.

In our space the sum potential of the electric field is equal to zero. All bodies and space-time as a whole are electrically neutral. This assertion follows from two unique properties of gravitational space-time:

1. Values of electric charges of different signs of elementary particles are exactly equal.
2. There is an equal number of elementary particles which carry electric charges of different signs.

If electric potential is equal to zero in the given point of space then energy of alternating magnetic field passes entirely to the electric field and radiation gains the parameters of electromagnetic oscillations. However electric potential of positive and negative signs can prove its properties at the simultaneous charging of different local spatial regions. In the electric field the character of radiation differs from that one which is observed in ideal gravitational space-time (without electric potential).

In the presence of electric potential some part of magnetic energy is spent to create gravitational alternating field. Radiant energy is absorbed. Electrically charged spatial regions are perceived by us as filled with a strong absorbing substance. At the same time if the potential of the electric field can be compared to the potential of the gravitational field then spreading of radiation becomes impossible.

Change of both electric and gravitational field results in the creation of a magnetic field in the region of space-time which has a dual electrogravitational nature. Change in the magnetic field results in the creation of both electric and gravitational fields. The amplitude of electromagnetic and magnetogravitational constituents of the unified electromagnetic gravitational oscillations depends on field potential of opposite nature. The electromagnetic constituent is determined by gravitational potential and the magnetogravitational one is determined by electric potential. Transference of gravitational masses of matter in electrogravitational field-aether causes the creation of the proper magnetic field. Coming from the direction of magnetic field some force influences upon the moving electrically neutral masses. This force is similar to Laurence force.

Electromagnetic gravitational converter designed according to the Searl Effect (Fig. 1) visually demonstrates the mechanisms of electromagnetic gravitational interaction. A detailed description of the experiment is presented in the article [2] by Vladimir Roshschin and Sergey Godin (see http://www.n-t.org/tp/ts/dms.htm).

The device consists of a cylindrical stator of about 1 meter in diameter which is surrounded by 24 cylindrical rollers. Stator and rollers are made of magnetic material and they are magnetically linked (there is no contact between them). Vector of the magnetic field of the stator and rollers is vertically oriented along the axis of the cylinder but it has opposite direction. Rollers are mounted on the movable separator which circles round the stator. Each roller rotates on its axis in the same direction. The weight of the device is 350 kg. During rest, the device is electrically neutral and has proper gravitational charge, inertial mass, magnetostatic field of the stator and rollers.

On rotating of the magnetic system the following effects were observed:

- Depending on the frequency (up to 35%) the weight of the device was decreased.
- At a frequency of 550 rpm there is a spontaneous acceleration of the system and turns of the rotor abruptly increase (in quadratic dependence). To stabilize the mode it had to take off the excess energy to active load (up to 7 kWtt) by means of electromagnetic transducers.
- Magnetic field was distributed in a room as concentric surfaces of 5-8 cm thickness and 50-60 cm period. Depending on speed of rotation of the magnetic system there was a fixed temperature decrease from 0 to 8° within the regions of space which were curved by magnetic field.
- The glowing (corona discharge) appeared around the working converter.

Appearance of all mentioned effects is caused by the simultaneous presence of electric, magnetic and gravitational fields in the area of the converter.

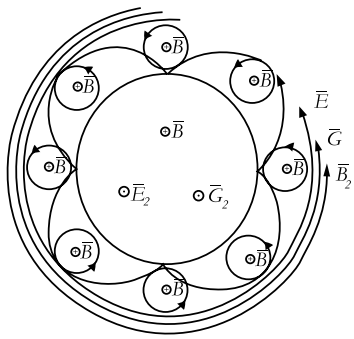

Fig. 1
Electromagnetic gravitational converter

Because of the Searl Effect a very complicated configuration of electric, magnetic and gravitational fields appears in the device. Rollers having their own field $\boldsymbol{B}$ rotate around the stator which has its field $\boldsymbol{B}$. Cycloidal motion of numerous magnets which are built in the rollers causes change in the magnetic flux. EMF $\boldsymbol{E}$ appears in the area of rotation of the rollers. EMF is directed along the perimeter around the device. The electric field creates stationary waves which are registered around the device as concentric electromagnetic gravitational walls. Magnetic rollers should be made non-conducting in such a way as to allow electric field penetrating inside. In the presence of the electric potential change of the magnetic flux causes appearance of gravitational field $\boldsymbol{G}$. This field is directed along the perimeter around the device. In the presence of electric potential the Lorenz force influences the gravitational masses of the rollers. These gravitational masses move in the external magnetic field of the stator. The Lorenz force is directed transversely to the velocity along the cycloid and in the direction of the field $\boldsymbol{B}$. The value of the Lorenz force depends on the electrical potential, magnetic intensity, mass of the rollers and their traverse speed. The electric potential in its turn depends on speed of rotation of rotor of the magnetic system. As a result the Lorenz force depends on speed according to square law. Rotating gravitational masses of the rollers generate magnetic field $\boldsymbol{B}_2$. Field $\boldsymbol{B}_2$ generates derived fields $\boldsymbol{E}_2$ and $\boldsymbol{G}_2$ etc.

Spontaneous acceleration of the system does not depend on the direction of rotation. Directions of fields and forces change at change of the direction of rotation that corresponds to acceleration in the opposite direction. When the direction of rotation is changed the weight of the device changes. When rotation is in one direction the field $\boldsymbol{G}_2$ is directed upwards (decrease of weight), when rotation is in another direction, it is directed downwards (increase of weight). In the presence of electrical potential many other interesting but still unstudied phenomena are observed (for example, curve of space, change of speed of time-flow, changes of ambient temperature…). Magnetogravitational converter transforms gravitational energy of space-time into energy of electric field which in its turn is transformed into mechanical energy of the rotating magnetic system and electric energy of the load. Energy resources of the future are not coal and gas reserves or nuclear power. They are in the inexhaustible energy of gravitational aether of our space-time.

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Medium For Existing of Matter in Nature

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By medium for existing of matter in Nature we understand physical vacuum which is a category determining all spheres of matter "life" (from particles of microworld to gravitational interactions in the Universe). Matter can not exist without this medium. Thus a question emerges, viz: how physical science can be developed without taking this fundamental aspect into consideration?

According to the Einstein postulate, in a void light always propagates with limited speed, which does not depend on the motion mode of a radiating body. It is a statement of deep physical sense which lies in the fact that only some physical medium can possess such a property. Indeed, if velocity of light, which was radiated by a body, further does not depend on speed of this body then it is possible only in a certain medium. For example, in air sound propagates with a certain speed which does not depend on the speed of the source and is determined only by density and volume elasticity of air. Thus, according to the Einstein postulate, there is a physical medium instead of void and velocity of light depends on the parameters of this medium (as is well known, velocity of light is equal to the square root from the product of inverse values of electrical and magnetic conductivity of vacuum).

The author of this article made an attempt to research this physical medium [1]. The author used a well-known experimental fact that at interaction of a photon with a charged real particle this photon transforms to electron-positron pair. Besides, it was taken into consideration that photon is an electromagnetic phenomenon. The research allows the following conclusion: the medium named in physics as vacuum (before the XX century it was called aether) is created by electric dipoles from (+) and (-) elementary charges. These dipoles are surrounded by magnetic (mass) continuum. There were determined dipole intervals, elasticity of decompression and ultimate strength of this interval. What does this model of medium mean?

1. This model is a physical validating for the "birth" of electron-positron pair at energy which is necessary to break dipole and create the "clot" of mass of these two particles. A certain model for the "birth" of mass must exist. It is not clear as yet but can be represented as a vortex of magnetic continuum inside the charge shell of electron and positron.

2. Let us suggest that values of (+) and (-) charges differ at 7.848981×10^{41} Coulomb, then this difference is sufficient for the medium to be a source of gravitation and inertia. According to Newton's law of gravity, a weak electric charge of medium (all material bodies exist in this medium) causes all bodies to attract one another (under Coulomb's law). On the other hand, weak medium charge of a like sign creates repulsive forces which manifest themselves in the form of the expanding Universe. Thus it becomes clear the amazing uniformity of gravity and forces of negative pressure for the Universe. The mentioned difference of values of (+) and (-) charges of medium dipoles is not used as arbitrary parameter but it logically follows from its electrical structure [2].

3. Hypothesis of nature of gravitation is confirmed by calculations of the deflection angle of electric waves by the Sun. Calculated angle differs from the experimental value only in the fifth sign, which depends on the accuracy of several physical values used in calculation formula. There is practically an absolute coincidence with Einstein's theory. The difference is that it is a concept of space and time (i.e. geometry) which prevails in the general theory of relativity while in the nature of gravitation physical basing is used. Velocity of light is unstable and determined by medium state which depends on electric, magnetic and gravitational potentials.

4. The existence of "black holes" relates to medium structure and nature of gravitation. At the edge of "black holes" the ultimate acceleration from gravity is realized. It causes breakdown of connections in electric dipoles of medium, creation of matter and antimatter (the so called "evaporation" of black holes which was theoretically predicted by E. Hoking, England). However at the border of a black hole the velocity of light is equal to zero since its propagation

medium disappears. According to Einstein's theory it is such a deceleration of time that electromagnetic oscillations gain zero frequency.

5. Naturally the medium is a carrier of all types of electromagnetic radiation, beginning at stationary electric voltage and ending with super-high-frequency "photons", which can be determined not as electromagnetic but as magnetoelectric phenomenon. In the latter case magnetic continuum of medium has a crucial importance since it determines very small degrees of magnetoelectric disturbance. These degrees are thousands of times less than those of a hydrogen atom. It is reasonable that such small degrees creates illusion that a photon possesses properties of particles.

6. Medium structure directly leads to the notions of Quantum Mechanics, beginning at quantification of electronic "orbits" in atoms. This medium determines the "allowed" spots for electrons to be placed around a nucleus. Thus medium is a necessary place for the existence of all matter or matter of the Universe. The so called Compton length of electron wave is one of the validations of this statement. It is directly calculated to a high accuracy according to electric structure of vacuum.

7. Thus Plank's constant is not a mysterious "quantum of action", on the contrary it is entirely determined by medium parameters. Thereby the crisis (which conventional physics is accused of) can be logically overcame by the introduction of medium which is capable to take radiation in electromagnetic region only by quanta. Plank's constant is always presented at all quantum approaches. It is additional evidence in favor of the necessity to take into account the medium as natural place for existence of all the matter in Nature.

8. It is still a question what processes take place in the centers of galaxies. The observations show that the centers of galaxies create star matter. They often flow out the centers and settle themselves at approximately the same plane. It is an evidence of the fact that centers of galaxies quickly rotate and the favorable conditions for stars to reject matter are created. Similarly planetary systems are created around the rotating stars. It is thought that centers of galaxies are gigantic black holes. In the context of the concept of medium for matter existence it can be set up a hypothesis that being at some special state the medium creates stellar systems, i.e. galaxies.

9. Astrophysicists more and more trend to accept the existence of unknown "dark" matter, which occupies approximately 70% of all matter. It is said that due to antigravitation property this dark matter is responsible for the expansion of the Universe. Hypothesis on the nature of gravitation gives the affirmative replies to such suggestions as: expansion of the Universe is caused by weak electric charge of the medium and distributed mass of magnetic continuum is the very dark matter.

10. All elementary particles (electrons, positrons, mesons, protons, neutrons etc.) are in the medium and interact with it. In the case of electrons and positrons this interaction causes the great extension of dipoles of medium which directly adjoins to borders of particles. This extension helps photons to break the particles. In case of protons, there is such a breakdown of the medium at their borders that protons turn to be dressed in "coats" of virtual electrons and positrons. And medium is shown to be in entire state only when reaching the first Bohr orbit. This interaction of the medium and particles leads to the factors which determine the life time of some of them. Thus life time of a neutron is up to 30 minutes depending on the state which it has while leaving the nucleus. For mesons "the tearing" Coulomb forces, which exist between the medium and particles, are very powerful that makes the life time of mesons very short. However if the particles moves with a high speed relatively to the medium, then these forces noticeably decrease and if the speeds of motion is close to velocity of light then these forces become very small. The life time of such particles noticeably increases. In Einstein's theory it is said about "deceleration" of time. Finally the life time of particles is determined by the inner steadiness and outer influence of the medium. Protons have fantastic binding energy and they cause such great external destructive effect that their life time becomes immense.

11. When particles move in medium with high speeds, there is a concentration of magnetic continuum which is recognized as increase of mass of particles at increase of their speed. Evidently, we can continue the list of physical phenomena which relate to the presence of medium for existing of matter in Nature. However it seems to be enough to admit that medium (physical vacuum, aether) is of a great importance for the very existence of the Universe and for the processes which take place there. "Mechanism" of gravitation and inertia has a special importance since

it is the only thing which can make clear the real mechanism of Nature. It is possible that the methodology, which is accepted in physics, is necessary for more accurate description of phenomena but it is not enough for understanding of the nature of "space" and matter. Research of the medium for existing of matter will be able to meet the conditions sufficiency.

The understanding of vacuum structure, which is created by electric lattice from charge dipoles, surrounded with magnetic continuum, gives an opportunity to control the forces of gravitation and inertia. The medium of vacuum can be influenced by:

1. The radiation which has frequencies coming to the frequency from point #11 of the list of parameters.
2. Electric voltages which exist in vacuum (it is not very promising because of real matter breakdown).
3. Magnetic intensities (magnetic flux density). It is the most promising influence method (1-10 Tesla is enough to compensate terrestrial gravity).
4. Transformations of low accelerations to high accelerations of impact type.

Potential electric and magnetic energy is immense in vacuum medium. Reasoning from energy of one dipole, which is equal to 1.6x10 (-13) Joule, we will derive the value of electric energy equal to about 10 (+31) Joule per one cubic meter of the medium that is equivalent to mass annihilation of 10 (+15) kg!

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Spartak M. Polyakov

(09 January, 1931 – 04 June, 2003)

Spartak M. Polyakov, a legendary physicist-experimentalist, known for his research in the field of gravitation, has died. Polyakov was the author of more than 50 research works, among them "Introduction into experimental gravitonics». Polyakov was the creator of the new model of photon. He also conducted numerous research in the field of electrodynamics, gravitational phenomena and superlight connection.

Spartak M. Polyakov graduated from Kishinev State University with degree in "General Physics". For many years he worked at the top secret military engineering department "Istok" (Russia).

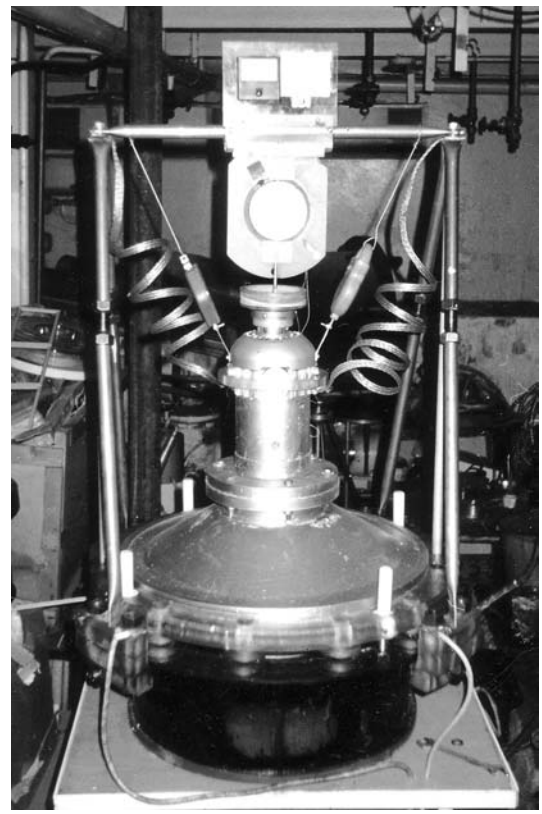

Plyakov's alternative physical theory allows explaining such phenomena as magnetostriction and optical magnetization. The basic postulate of this theory states that the speed of propagation of gravitational waves is dozens of times faster than velocity of light regarded by the traditional science as the limit. In his experiments Polyakov demonstrated such methods of generation of gravitational waves as precession of gyroscope and remagnetization of ferromagnetic.

While working for "Istok", Polyakov designed on his own a device which is possibly the first gravitational motor in history. Total specific thrust produced by rotation of gravitating mass comes to 2.5 kg/kWt. This index is close to that produced by the engines of modern helicopters, which is equal to 8 kg/kWt. Practical application and further development of Polyakov's ideas can provide humanity with new kinds of communication, gravitational engines and free energy devices.

Adams Motor

Principle of Operation and Experimental Data

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Adams' motor-generator represents the type of devices which use, as their creators claim, so-called "free energy". The term "Zero point energy" is also used in some sources [1, 2]. Due to quanta-mechanical fluctuations, this energy exists even at zero temperature. Adams' motor-generator belongs to the group of Switch reluctance motors [3]. Robert Adams, **former Chairman of the Institute of Electrical Electronics Engineers, USA (New Zealand section)**, designed this machine in the late sixties of 20th century. Similarly to all the devices utilizing free energy (referred to in come sources as "overunity devices"), Adams' device remains practically unknown to the general public. **The device is rather simple to assembled even at home, which I experimentally proved. However, it is necessary to be very careful while choosing the model parameters. As to the latter I have managed to collect quite a big number of instructions from existing sources; the summary of these instructions is presented below in this article. Based on these instructions, a low-power model can be assembled even without a mathematical analysis and modeling of electromagnetic field. Such model would certainly facilitate optimization of the device.**

Adams' motor is most frequently a DC machine; however, it can also use an AC source through a rectifier. In the latter case only the adjustment of the device and its control system can be provided.

Editorial: We disagree with some assertions of the author; however this article is of great interest.

My experiments on my own model do not yet allow me to make an unambiguously positive conclusion concerning the possibility to generate excessive energy. Experiments with my new control system designed on the base of AVR controller AT90s2313-10PI (it is produced by Atmel company (http://www.atmel.com) will allow to be more specific. Below there is a general analysis of the motor principle of operation and a number of recommendations concerning the construction and technology. I do not propose to take this as compulsory rules to follow; other technical solutions are possible.

Basing on the principle described in this article, R. Adams (the link to his articles is available at: http://www.aethmogen.com/wri/intro.shtml) created a few DC motor-generators which operate on permanent magnets. Some of them, according to information found on the Internet, have manifested 690% electrical efficiency and 620% mechanical efficiency. These devices operate at room temperature without overheating. My device has shown between 1 and 3 degrees overheating after an hour of functioning. However, it is easy to prove that such overheating is predictable for an average current of 0.15 A in coils of 35 mm long and 25 mm in cross sectional diameter. I have not been able to prove the data published on the Internet concerning the Adams motor capability to operate when the stator temperature is a few degrees lower than that of the environment. The temperature of the coil and of the power transistor is a good indicator of correctness of the circuit set-up and of functioning of the control circuit. There were cases when transistor and coil were noticeably heated after adjustment. Usually this was explained by a bad choice of points of transistor switching or by too extensive current impulses in the stator (which must amount to approximately 25% of period length). After the required adjustment the motor continued to operate almost without overheating.

Adams' motor was first mentioned in Australian Nexus Magazine in 1992. Later, Harold Aspden (Britain) proposed a slightly improved version of the motor and received Great Britain patent No. 282708 [4], which strongly reminds of the original version published by the above magazine. **Adams' device** represents an electrical motor and/or generator consisting of a rotor

with radially directed permanent magnets and of a stator also constructed with a few radially directed and periodically magnetized cores with winding. (Fig. 1). In some models axial orientation of magnets and coils are also used.

Permanently magnetized poles of rotor can include any number of poles, even an odd number. Analogous poles of the magnets (all N poles or all S poles) are directed outside. A version with alternating poles is also possible; such model allows the torque to increase. In this case, after passing a rotor pole the stator is demagnetized by the current impulse and begins to be attracted by the magnet of different polarity. This circuit requires a more complicated control; on the other hand, it manifested rather good results in certain models.

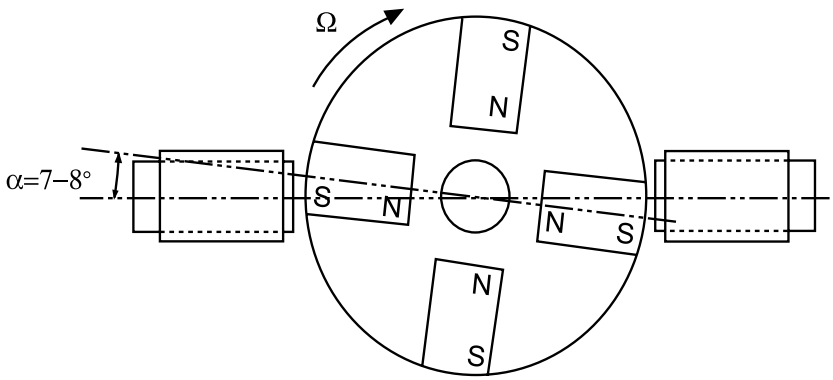

Fig. 1

Poles with winding placed on the rotor are radially oriented in order to obtain a supply of energy emerging as a result of the influence of counter emf from the rotor poles. Steel or iron cores are used for the poles of the stator with winding. It is also possible to use other materials, at that the core must have high magnetic inductivity and low level of magnetization reversal losses. The stator winding consists of a few hundred turns. The current inducted by the magnet in this winding will have the polarity which will cause repulsion of the magnet. Since the electromagnetic state of stator changes quite significantly and quite fast, then the stator core can be considered to be the most crucial element of the device. Ignoring this fact was one of the most frequent mistakes made by those who tried to reproduce Adams motor.

The current inducted in the stator is the function of:

- field size,
- number of winding turns,
- speed of flux changes.

Resultant parameters of this device cause each pole to be attracted or repulsed by stator poles when the rotor is in certain position in case when the rotor is unbalanced. To achieve this effect it is required to switch the input current in control coils after the signal from sensor of rotor position. R. Adams used a mechanical switch as a sensor. My device and a number of other devices use the signal from two Hall sensors. However, according to experimenters' information, better results are achieved if a position optical sensor is used.

Time of switching of impulses is determined by the size of the motor itself, i.e. the speed of motor rotation, location of rotor magnets towards the stator windings and the distance the rotor magnets pass while moving by the poles with stator winding.

It is necessary to take into account that any part of this motor can be modeled based on the existing electromagnetic theory and no part of the motor is in conflict with any laws of electromagnetism. There are so many ways to construct Adams' motor that any version may be considered to be correct.

One can say that the frequently pulsating electromagnetic process in the stator core is what allows Adams' device to function as a kind of diode which borrows energy from the field of permanent magnet but then does not return that energy in full.

5 stages can be defined in the periodical process which takes place in stator:

1. The magnet is attracted to the stator core. The permanent magnet is attracted to the iron core of the stator with winding. While doing so no consumption of electrical current takes place. It is as if kinetic energy is borrowed from an internal ferrite magnetic source and is supposed to be returned into the stator.
2. Stator core is magnetized. During the period when the magnet is positioned in front of stator core they both comprise a single magnetic conductor with an air gap and the stator core becomes an extension of the magnet side it faces. It is usually supposed that the energy "borrowed" on the first stage is getting back now.
3. Stator core is demagnetized. When the stator core becomes rotor magnet extension, the circuit closes and current impulse gets to stator windings. I have seen the instructions saying that the angle between

stator axles and rotor magnet must amount to 7-8 degrees as shown in Fig. 1. However, my model made it clear that at increase of speed of rotation it is necessary to start the coil a little earlier, when the magnet axle has not reached the stator axle. Probably this applies to the circuit with a Hall sensor only and if an optical switching is used the making angle will be different.

Magnetic field of this current acts to compensate magnetization of the stator, which is caused by the field of rotor magnet. Consequently, the summed current significantly compensates attractive force between rotor and stator and the rotor can freely rotate by using the inertia obtained at stage 1. This process is characterized by the fact that this current impulse is amplified by the current inducted in the stator winding by rotor magnet which, in accordance with Lentz law (1834), counteracts the power which induced it. Consequently, kinetic energy obtained as a result of attraction of the rotor to the stator at stage 1 is transformed into electrical demagnetizing impulse in stator winding during the period when the rotor and stator directions are congruent. This is the unique overunity characteristic of this model. However it is obvious that instead of returning this energy the motor transforms it into electromagnetic demagnetizing field.

4. Restoration: when the rotor is removed from the stator attraction zone the latter looses energy and returns to its initial demagnetized state. Decreasing electromagnetic field creates a current wave of reverse polarity which can be stored in the capacitor.
5. Reiteration of the process: This periodical process is renewed as described in stage 1 during the next magnetization of the stator, excluding the fact that emf preliminarily stored in the capacitor, on term of presence of suitable electrical circuit, can be used for facilitating stator demagnetization or even used to supply the load.

It may be briefly summarized that the frequently pulsating electromagnetic process in the stator core is what allows Adams device to function as a kind of diode which borrows energy from the field of the permanent magnet but does not return that energy in full. The important characteristic of such motors is that the stator windings are used for demagnetizing and not for magnetizing as it could seem from the first sight.

It is noteworthy that there is a small pause between attraction to the stator and repulsion from the stator. The effect of attraction to the core takes place a split second before the repulsion effect manifests clearly. This pause being the reason of electromagnetic asymmetry creates conditions necessary for achieving overunity effect. If the attraction to the core and repulsion by means of Lentz currents were taking place simultaneously and with the same power there would not be any overunity characteristics. That is why the rotor must be as lightweight as possible. From this point of view, T. Harwood's model is the most lightweight of the known models. In Harwood's device the magnets are mounted between two CD disks fixed on the shaft by means of plastic washers and glue. My model is heavier, which can be considered as one of its disadvantages.

The principle of operation of Adams' motor is based on the balance, which creates the electromagnetic asymmetry. To get the motor to operate the magnet must be attracted to the stator core which must have a smaller cross-section area in order to create attraction without any significant repulsion effect from the stator windings mentioned above. When stator and rotor axles are congruent the Lentz induced current must be sufficient for compensating the natural attraction of the magnet to the stator core. Consequently, stator windings must have enough turns for demagnetizing effect, but not to the extent that this effect fully manifests before the rotor reaches the stator axle when Lentz current has its maximal value.

During my experiments at 12 V voltage and on using two independently controlled stator coils the speed of rotation reached 3400 rpm. Please note that while reproducing such device it is necessary to take certain measures in order to ensure safety in case of possible breakdown. **The magnet disconnected from the rotor may be dangerous!**

Technological recommendations are as follows:

1. The device must be low power. It is better not to try to begin with a motor functioning in kilowatt range. This is feasible only on condition of having all necessary technological documentation which is not available at the moment.
2. The preferable voltage for the first model is 12 V. If the voltage is less the speed of rotation is too slow for indicating the expected characteristics of the device.
3. The best magnets are ferrite ones with dimensions 4x4x5 (where 5 is the magnet length). The practice has shown that at 12 V voltage neodymium-iron-boric (NdFeB) magnets cause a jerky rotation of the rotor.
4. The side of the stator core facing the rotor must

Control circuit with hall sensors

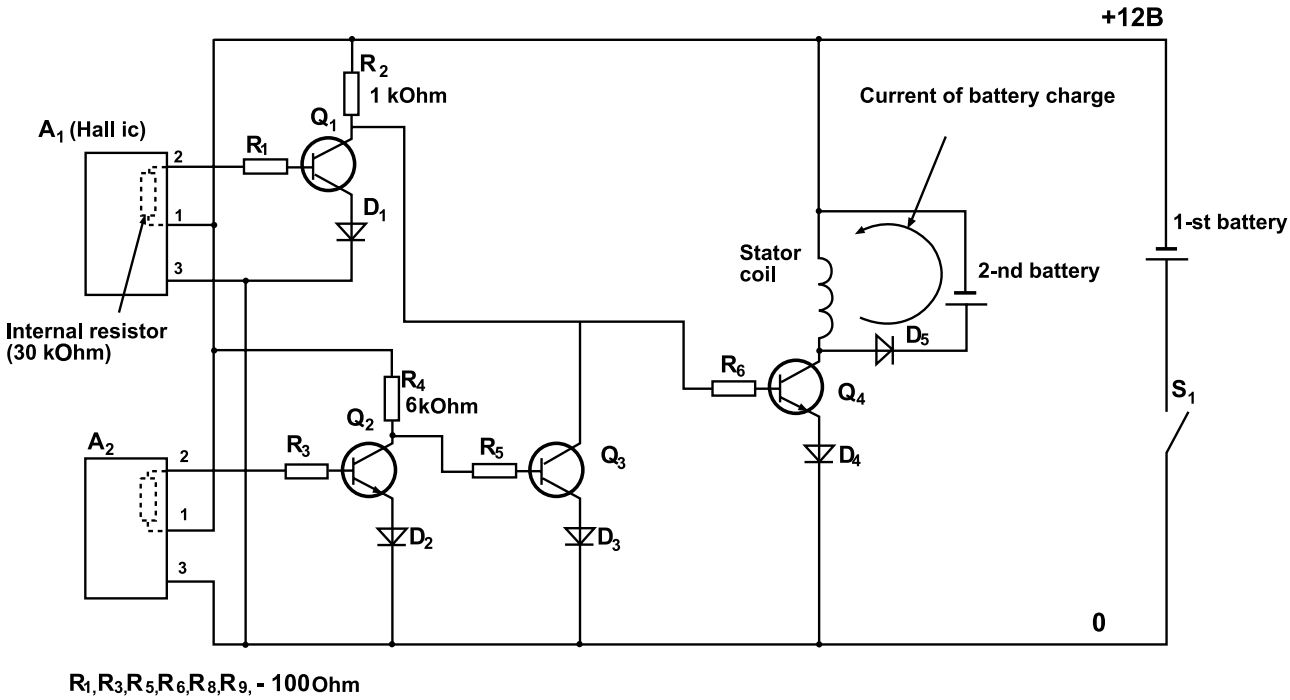

Fig. 2

have the size which is 4 times smaller than the corresponding side of the magnet. If cross-section area of the stator is larger, a bigger part of magnet field comes to the stator core when their axles coincide and thus there is nothing to induce Lentz' currents in the stator windings. It is a common point of view that it is necessary to try to minimize the volume of a device and to obtain the maximum efficiency at minimal material expense. In practice, it has always been the goal while designing electrical machines to decrease losses in stator I^2R. As for the Adams motor, it requires not only the use of disproportionate magnets but also stator windings with disproportionate number of turns specially designed to obtain maximum Lentz' currents that is achieved by hundred of turns of winding.

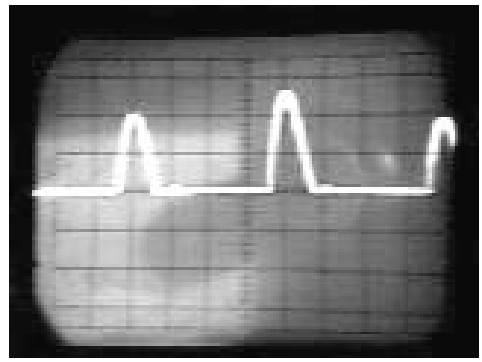

5. It is necessary to define approximately the effective zone of the magnet field. If practically applicable magnet field is equal to, for example, 8 cm, and the stator has a 10 cm long winding, then more than 20% of turns will not be efficiently crossed by magnetic force lines and will only create an excessive mass of the device. To define the degree of effective action of the magnet we can put a paperclip on the table and move it gradually in direction of the magnet until the paperclip is attracted to it. Actually if we take into account friction losses then the magnet influence zone will be a little larger. That is why the stator winding in the axle direction can be 10% larger than that in this experiment. The description of this test has been found on Tim Harwood's website (http://www.geocities.com/theadamsmotor/cdmotor.html).

6. The air gap clearance between the stator and the rotor must not exceed 1 1.5 mm.

7. Use as little metal in the device as possible. It is preferable that the metal is used in the core and stator windings only.

In order to increase the efficiency of this motor, it is necessary to build it in a manner, which allows removing the counter emf from the stator windings. To do that, this emf may be taken off and stored in the capacitor. The article published by Nexus magazine and Great Britain patent No. 282708 consider special generator windings; however, no sufficiently detailed data on operating rules are provided. Michael Smith (Australia, http://www.Fortunecity.com/greenfield/bp/16/content1.htm) has unequivocally informed me in one of his letters that

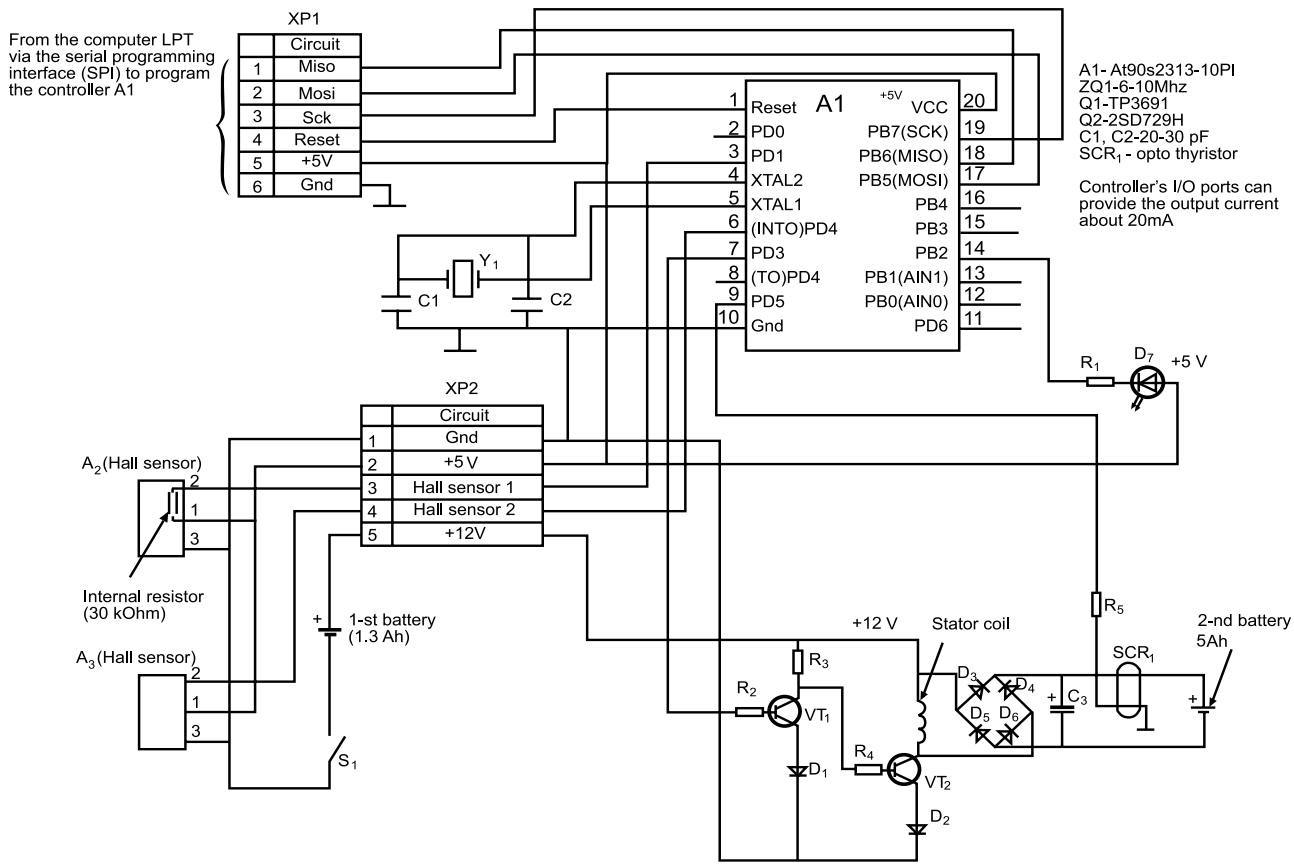

Fig. 3

he has not achieved generation of excessive energy in such a system. During his experiments a two-battery circuit proved to be more effective. In this circuit, during a part of periodical process the energy is stored in the capacitor and then a command is transferred to a thyristor, which discharges it into the second battery. At that capacity, the second battery must be no less than 4 times more than the capacity of the first one. Otherwise the excessive energy does not have enough time to be stored during the discharge. I have also managed to provide the charge of the second battery, but the control circuit has not been assembled fully yet, as it is shown below in Fig. 4. Better results are expected when its final adjustments together with AT90s2313 controller program have been made.

In order to increase the efficiency of this motor, it is necessary to build it in a manner, which allows removing the counter emf from the stator windings.

I managed to start my first model of the motor in April, 2002. Afterwards, I spent approximately six months increasing its rotational speed from 750 to 3200-3400 rpm, decreasing vibrations and improving control circuit. In order to achieve a better rotor balance I had to re-construct it twice. It is very important to align the axles of the bearings with maximum precision; otherwise a considerable decelerating torque will manifest. The shaft penetrates the lower moving base. It is possible to rotate the base at a small angle for the precise alignment of axles and then to fix it with screws and nuts.

In order to decrease aerodynamic losses, two veneer parts are mounted between the magnets. Thus I managed to increase the speed, although the rotor weight has also been increased.

Stator cores are made of plates taken from a disassembled radio transformer. Tim Harwood used nails with winding, however, my own results with such core proved to be poor. Dimensions of the core are 10x11x50 mm.

The type of power source is also important. First, I connected a 9 Volt accumulator of "Krona" type in series

with three metal-hydride 1.2 V accumulators. The speed of rotation did not exceed 1500 rpm. But when I used a lead/acid accumulator with 1.3 Ah capacity, the speed increased to 2600 rpm if there was one coil on the stator.

Four magnets mounted on the rotor have the dimensions of 20x20x35 mm and are fixed on a 105 mm glass fiber laminate disk. The current impulses proved to be too wide, by up to 40%. In order to make them shorter (down to 25-30%), I had to use the control circuit (Fig. 2) with two Hall sensors. At the signal from the first sensor the stator current is started, the second sensor switches it off. Many experimenters used a timer to control the impulse length while working with Adams' motor that is more practical since impulses are supposed to be wider during the start. I took this factor into account while designing the controller circuit. Current impulses are shown in Fig. 3. Their fronts are supposed to be shorter; it is probable that the coil has more inductivity than necessary. The impulses amplitudes are slightly different which is explained both by the difference in volume of induction of the magnets and by difficulty in achieving similar air gaps while working at home.

I have provided the charge mode of the 2-nd battery at my two-battery design. After 75 minutes of operation of the device the source lost 0.17 Volt whereas the second battery was charged at 0.36 Volt. The capacity of both batteries in this experiment was equal. Besides after such charging the second battery started to discharge quickly. The circuit where stator current charges the battery directly has to be considered ineffectual (see Fig. 1). To evaluate the charge, which is gained in non-hermetic accumulators, the density of electrolyte can be measured.

To obtain a more uniform torque I added the second stator which is controlled independently. This required installing two more Hall sensors and an additional power transistor. The angle between axles of the coils amounts to 135 (180-90.2=135) degrees. When the current is present in one part of the stator it is absent in another and vice versa. The speed has increased up to 3200-3400 rpm, and I deemed the further increasing of this characteristic unnecessary.

Increasing the number of circuit elements does not seem a good idea. Futhermore the adjustment process becomes more complicated. In order to improve the circuit of battery charge adding a timer circuit is required. Thus, I decided to use a controller circuit. A simple Basic program has been developed for AVR controllers. This program operates in mode similar to transistor circuit, but its capability can be significantly increased due to the built-in processor timers. Today program improvement is the most efficient way to solve the task of generation of excess energy in this circuit.

This article is meant to elucidate the principles of operation of one of the simplest devices which pretend to become an "overunity device", "free energy machine", "perpetual motion machine", whatever you call it. Probably someone will try to create such motor-generators on their own. I hope that my article will serve as a guide and will help to avoid the mistakes made by many experimenters (including myself) before they managed to build their own model.

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Prediction and Experiment on Field Transformation in the Model of Extended Space

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A series of preliminary experiments on checking the possibility of generation of gravitational field at deceleration of charged massive particles in matter was carried out.

Introduction

In previous works [1-3] generalization of the special theory of relativity (STR) for the five-dimensional extended space with metric (+;-,-,-,-) was offered.

The model of extended space (ESM), combining electromagnetic and gravitational interactions, was made. For this, there was made (1+3)-dimensional space extension $M(T;\vec{X})$ of Minkovsky to (1+4)-dimensional space $G(T;\vec{X},S)$. Let us call it extended space. As the 5-th additional coordinate the value already existing in Minkovsky space, i.e, S interval

$$s^2 = (ct)^2 - x^2 - y^2 - z^2 \qquad (1),$$

is used.

Let us note that attempts to combine gravitation and electromagnetism have a substantial background.

Modern approaches to this problem trace back to the work of F. Klein [10] in which he proved that classical Hamiltonian mechanics can be represented as optics in the space of a great number of dimensions.

Then T. Kaluza tried to generalize Einstein's theory of gravitation to include electromagnetism in this theory as well [11]. He proposed to consider (1+4)-dimensional space with metric depending on potentials of the electromagnetic field. Kaluza's idea was evolved by O. Klein [12], G. Mandel [13] and V. Fock, and the model they had created got the name of the Kaluza-Klein theory. They proved that the trajectory of a charged particle has the form of a geodesic line with zero-length in 5-dimensional space.

In his works on 5-optics Y. Rummer [15] proposed to assign action dimensionality to the new dimension and to consider it periodical with the period equal to Plank's constant. Note that rest mass of particles in all these constructions unlike the model of extended space evolved in the works [1-7] was considered a fixed value. Subsequent development of multidimensional theories is given in the monograph [16].

A separate approach is represented by multidimensional constructions in the theory of strings and superstrings [17].

Approach to construction of (1+4) dimensional space evolved in [18] is close to the proposed model of extended space. Here it is proposed to use mass (matter) as the 5-th coordinate. However, in this model, as its originators admit, it is impossible, for example, to create the energy-pulse tensor. There is no such disadvantage in the extended space model [8].

Mechanics of a material point [1, 2, 7] and electrodynamics [1, 8] were made in the introduced extended space. Besides Lienar-Vihert potentials [6, 19] corresponding to such a model were also considered and properties of solutions of Maxwell augmented system of equations which are in conformity with these potentials were analyzed there.

Gravitational effects in extended space, such as the second orbital velocity, red shift and light deflection [4, 20, 21] were considered. It is proved that the formulas received in the general theory of relativity for calculation of values of these effects can be received by an absolutely different method within the framework of the extended space model as well.

It was proved [6, 19] that the fields in the model of extended space can change their signs. Such change of field-intensity sign and, consequently, change of sign of Lorenz force can be associated with radiation reaction of these fields which occurs when charged particles move with acceleration.

Thus, on the one hand, it was proved in the model of extended space that it is possible to get certain formulas describing gravitational effects of the general theory of relativity [4,20] using the technique of turns in extended space. On the other hand, it was proved that the electromagnetic field can be a source of gravitational field [6, 19].

Besides, a moving massively charged particle under deceleration can create a variable gravitational field around itself [9, 6, 19]. The following experiment was offered for experimental check of the latter assumption. In this experiment probable occurrence of gravitational field at deceleration of relativistic electrons was determined by change of oscillations of a massive torsion pendulum.

Experimental device

A narrow bunch of relativistic electrons from a microtron 1 (average power of the bunch is 450 Wt, electrons energy is 30 MeV) was directed to a brake target (position 2 or 3) made of wolfram exactly where deceleration of accelerated electrons took place.

A special torsion pendulum suspended on a vertical suspender 5 made of a springy metallic string with 1,8 mm diameter was placed near the brake target to register gravitational field which could probably appear at electrons deceleration. The length of the suspender made is 85 cm. The pendulum could rotate freely on the suspender only in horizontal plane.

The pendulum consisted of a light aluminum rod 4 (with a length of 120 cm) on the ends of which massive loads 6 and 7 made of non-magnetic material were fixed. The weight of each load was equal to 4kg. In the center a pendulum was fastened to a vertical suspender 5 by a special mounting preventing slippage during turns. To reduce the influence of magnetic inducings the pendulum was grounded and additionally screened by metallic grid from all sides. The period of free oscillations of the pendulum made were about 40 s.

Rigidity of the pendulum vertical suspender could be changed by means of limiting the length of effectively operating part of the suspender. As a result, the period of oscillations could be continuously changed within the limits of 40 to 27 s.

To reduce the influence of mechanical noise and to introduce additional attenuation in pendulum oscillations two liquid dampers 10 and 11 located near the pendulum massive loads were used.

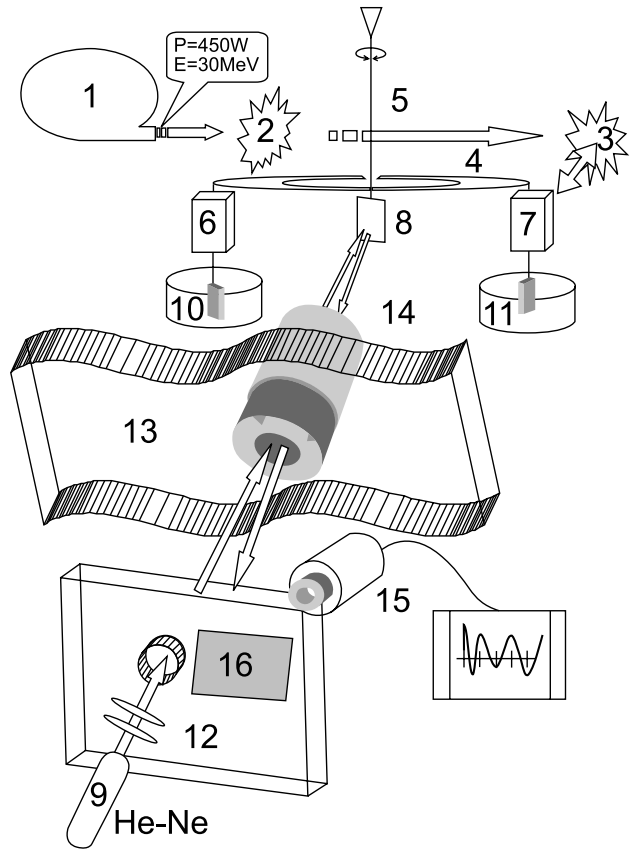

Fig. 1
Experimental device
1 – microtron, brake target made of wolfram – positions 2 or 3, 4 – rod, 5 – vertical suspender, 6 and 7 – massive loads, 8 – mirror, 9 – He-Ne laser, 10 and 11 – liquid dampers, 12 – optical system, 13 – concrete protection, 14 – observation channel, 15 – video system, 16 – screen.

Pendulum deflections were observed on a graduated screen by deflection of a laser beam reflected from a flat mirror 8. For this, the beam from a continuous He-Ne laser 9 through the optical system 12, which constricts the divergence angle of the laser beam, was directed to the mirror through a special narrow channel 14, located in concrete protection 13 around the microtron. By means of a video system 15 the beam reflected by the mirror was registered on the screen 16 located at a distance of 500 cm from the mirror. The video system allowed remote checking of vibrations of the laser spot and additionally enlarged the visual angle up to 12 times. The diameter of a focused laser beam on the screen was made 0.15 mm. The maximum turn angle of pendulum for the reflected beam to remain within the receiving channel was approximately 2 degrees. The accuracy of turn angle registration of the whole system was $5x10^{-4}$ degrees.

The pendulum was placed in such a way that one of the massive loads were close to the brake target at a distance

of about 20 cm. There was also an opportunity to move the brake target from one end of the pendulum (position 2) to the other (position 3). This allowed changing the place of deceleration of electron bunch at constant parameters of all unaccounted mechanical noise and magnetic inducing. Thus, direction of pendulum torsion was changed under probable exposure of occurring gravitational radiation.

Below there is a photo of the experimental plant (see also the colored photo on the cover page).

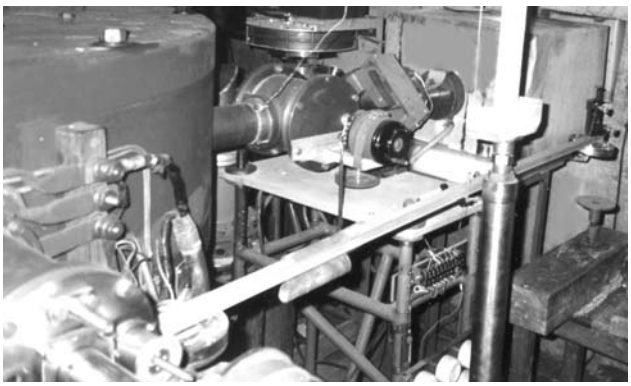

Calibration Measurements

To make measurements it was necessary to select optimal parameters of the pendulum (masses of loads, suspender rigidity and the value of oscillations attenuation). On the one hand, while carrying out the measurement it is desirable that the amplitude of pendulum oscillations should be as maximal as possible. On the other hand, the beam reflected from the mirror should not go outside the limits of observation, restricted by the diameter of the narrow observation channel in radiation protection around the accelerator. Besides, the typical operating time of the loaded accelerator usually is 10-15 minutes. Necessity to accumulate the minimum of sufficient statistical data within this time limited oscillations period and the time of setting of the pendulum in a new equilibrium position at outside influence. All these requirements were as far as possible taken into account during selection of the final setting parameters.

An example of free oscillations of the pendulum in the presence of minor mechanical vibrations caused by the operating of vacuum pumps is given in Fig. 2, series I (the experiment took place on 31 May, 2001). The diagram shows the amplitude of laser beam oscillations on the screen 16 (upper and lower rows of values) depending on the number of oscillation. The laser beam is reflected from the mirror 8 which was fixed to the pendulum. The diagram also shows the current central equilibrium position (the central row) calculated by these amplitudes. Series I represents oscillations at influence of the background mechanical noise. Series II represents the response of the pendulum to minor permanent outside force. Accuracy in determination of position of the center of a light spot was 0.1 mm.

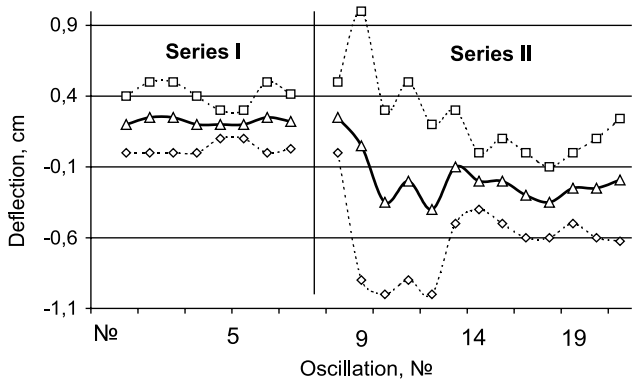

Fig. 2
Calibration Measurement 31 May, 2001

Measurement was carried out with one liquid damper in service and with increased rigidity of suspender (it was made by means of limiting the effectively operating suspender length). The period of free oscillations in these series was 29 sec. In this case there were set continuous oscillations of the pendulum around the average value of balance of 2.2 mm with the average amplitude of values fluctuation of about 0.2 mm.

Air cooling of one of the massive loads by a very light continuous air flow was carried out to study response of the pendulum to a minor constant external force. In this case (Fig. 2 Series II) noticeable change of pendulum oscillations already took place after 3-4 periods. Absolute setting of a new balance took place after 7-8 oscillations.

In the case of another series of calibration measurement (held on 7 June, 2001) both liquid dampers were used and rigidity of suspender was decreased. The period of free oscillations of pendulum was about 40 sec.

Addition of the second damper and decrease of suspender rigidity caused, on the one hand, increase amplitude of pendulum oscillations at influence of the external force and, on the other hand, in that case noticeable change of the equilibrium position of the pendulum took place after 1-2 oscillations.

Periodical checking of the invariability of initial central position of pendulum balance in time was also carried out. Thus, for example, in the series of measurement of 7 June 2001 measurement of equilibrium position was checked not only before the start of the main series of measurement, but also 2 hours after completion of the main works.

Experimental Results and Their Analysis

Within the period from 17 May, 2001 to 7 June, 2001 7 measurement series were carried out at various operation modes of the accelerator and at various pendulum parameters.

A record of check of equilibrium position of the pendulum was carried out before and after switching off the electron bunch (as well as during calibration measurement). At the same time, all electric inducing and mechanical noise remained stable within the whole measurement period. This was achieved by means of additional switching on all the devices which were used during measurement (water and vacuum pumps, magnetron, deflecting magnets, etc.) and their switching off only on completion of the measurements.

In Fig. 3 there are results on measuring the central position of the pendulum when brake target is in position 3 (see Fig. 1). Series I and III on the diagram correspond to check measurement directly before switching on and several minutes after switching off the electron bunch. Series II-A and II-B totally reflect pendulum oscillations at the time when the accelerator is operating (for about 10 minutes) and for some time after the bunch is off. Additionally, a trend line is drawn (averaging by 3 points).

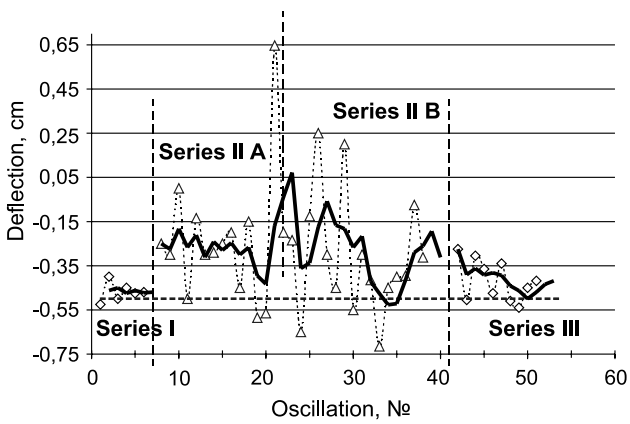

Fig. 3
Measurement of central position of pendulum equilibrium when brake target is in position 3.

Results of a similar experiment are given in Fig.4. The only difference in this experiment is that the brake target is in position 2. Also a trend line is added (averaging by 3 points). Series I and III are check measurements made directly before switching on and after switching off the electron bunch. Series II are pendulum oscillations at the time when accelerator is operating.

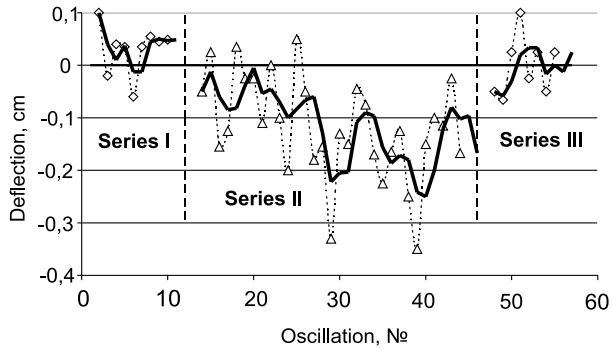

Fig. 4
Brake target in position 2

From qualitative comparison of trend lines (Fig. 3 and Fig. 4) it can be derived **that there is a correlation between switching on the electron bunch and the average deflection of the pendulum from equilibrium position if compared to checked series before and after switching on. At that, direction of deflection changes depending on what pendulum load the brake target is close to.**

Unfortunately, due to circumstances beyond the control of the author it seems to be difficult to improve experiments accuracy or to accumulate much of statistical data by now. Estimate of the value of the force which may cause such a shift of position of pendulum equilibrium was carried out. In the experiments this deflection did not exceed 1-2 mm (in the units of registering scale). Calibration of a rigid suspender (if it applies to a massive load at a pendulum end) gives the upper boundary of this force of not more than 10^{-6} N.

Conclusion

A series of experiments were made on checking the possibility to generate a field at deceleration of charged massive particles in matter.

Electrons accelerator was used as a source of charged particles. A narrow bunch of relativistic electrons (average beam power is 450 Wt, electrons energy is about 30 MeV) was directed at a brake target made of wolfram where deceleration of accelerated electrons took place.

Measurement proved appearance of statistically reliable deflection of a torsion pendulum, one of massive loads of which was located close to a brake target by the time of deceleration of relativistic electrons.

Change of direction of pendulum torsion at shift of a brake target from one end of the pendulum to the other was also registered. The value of the force which causes pendulum deflection has the upper boundary of N.

Of course, these first experimental results on checking the predictions made on the basis of development of the model of extended space are of preliminary nature and need more thorough checking. That will be the basis of future experiments.

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Joe Flynn's Parallel Path Magnetic Technology

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There is a widespread opinion common to the mainstream academic community and also to various alternative scientific forums, that some kind of exotic new physics will be required to design and implement over-unity technologies. That is to say electrical motors, electrical generators, or other apparatus, which produce an excess of magnetic force or energy above the value actually inputted.

However, this has recently been experimentally demonstrated not to be the case, as I have validated myself in simple $20 experiments undertaken at home with parts bought from the local hardware store. It is the purpose of this article to educate readers that with care, thought, and a little work, it can be demonstrated that existing textbook physical law, freely allows for the extraction of excess electrical energy from magnetic systems.

The Flynn Research Project

Joe Flynn has been engaged in magnetic flux research for over 25 years now. His work is long standing, comprehensive, and in later years, well funded. It is reported $7m has been spent to date, with over $1m alone developing a revolutionary high performance magnetic motor. His equipment is validated, and apparently already in mass production for select customers. Yet few researchers have heard of Joe Flynn. This surprising situation will hopefully shortly be changed, and Joe Flynn awarded the scientific accolades he deserves, for being the genius master mind behind one of scientific history's most outstanding research projects. Since many lines of research have been formulated and explored by Joe Flynn, the following article presents only a brief summary of some of his best art apparatus, but is nonetheless sufficient to convey the basic ideas.

The first illustration (Fig. 1) is taken from Joe Flynn's US patent 6,246,561, and explains a simple magnetic force multiplication experiment, which forms the basis for the Flynn magnetic art. If the windings on either side of the central magnet, which are normally connected in series, are properly pulsed, the field of the permanent magnet in the center will be diverted to the opposite side of the core flux path provided. Or in alternative language, the side of the core that is pulsed is demagnetized, relative to the field of the permanent magnet used in the apparatus. This is elementary textbook physics anyone can understand.

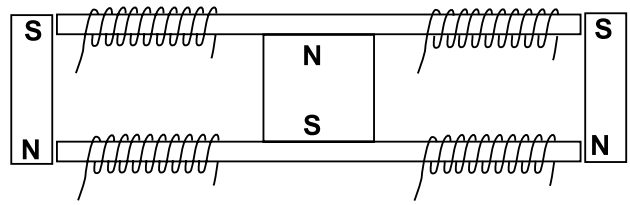

Fig. 1

1.75 times more force is delivered to the legs of the core than is provided by the electrical input to the control coils

So what is surprising about this apparently simple apparatus is that the armature on the side of the flux core will contain 1.75 times more units of magnetic force, that could be manifested by the electrical input to the apparatus alone. Since the ability to arbitrarily move the force from one point to another is the basis for motion or work, however simplistic, we therefore have a basis for a system that can be developed for practical technological purposes. Expressed in alternative language, we also have the capability to engineer a time varying magnetic field, without the need for moving parts, which will allow development of systems that output electrical energy. Both capabilities are highly desirable, and offer substantial opportunity for technical development.

Following on from this basic experiment, there is a second simple and logical improvement in layout illustrated in Fig. 2, which should be obvious, but has been shown not to be the case. In this instance, the pulse is centrally located, and a dual flux field layout employed, which both demagnetizes the core relative to one magnet, and magnetizes it relative to the other. Since the two actions are complementary, the input required to manifest the flux switching effect is halved, therefore doubling 'efficiency.'

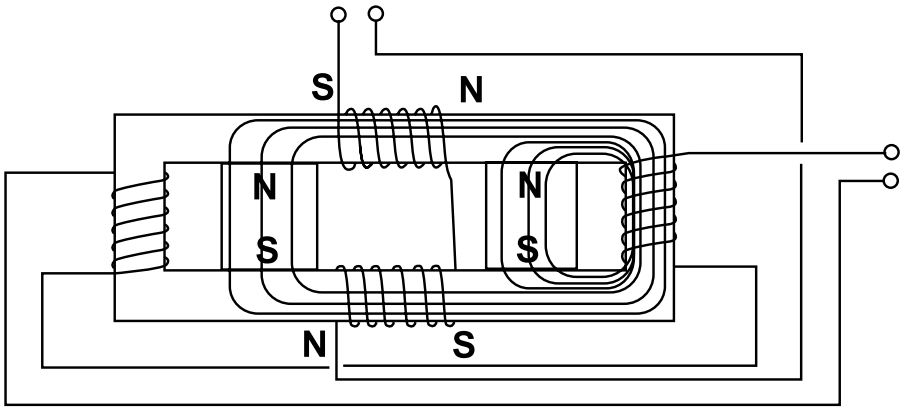

Fig. 2

3.47 times more force is delivered to the legs of the core than is provided by the electrical input to the control coils

It should be noted that while the efficiency is doubled, the absolute output may not be significantly improved. This is because the major weakness of this effect and technology is flux saturation of the core, with values depending upon the specific properties of the B-H curve of the core material employed, limiting the absolute output of both layouts the same.

The previous statements are not required to be taken on trust, and simple experiments have been proposed by Joe Flynn, such that anyone can validate this effect for themselves. Figure 3 is a simple experiment taken from the Flynn website (http://www.flynnresearch.net), that can be used to validate the principals put forth in this article.

Simple Magnetic Force Multiplication Experiments

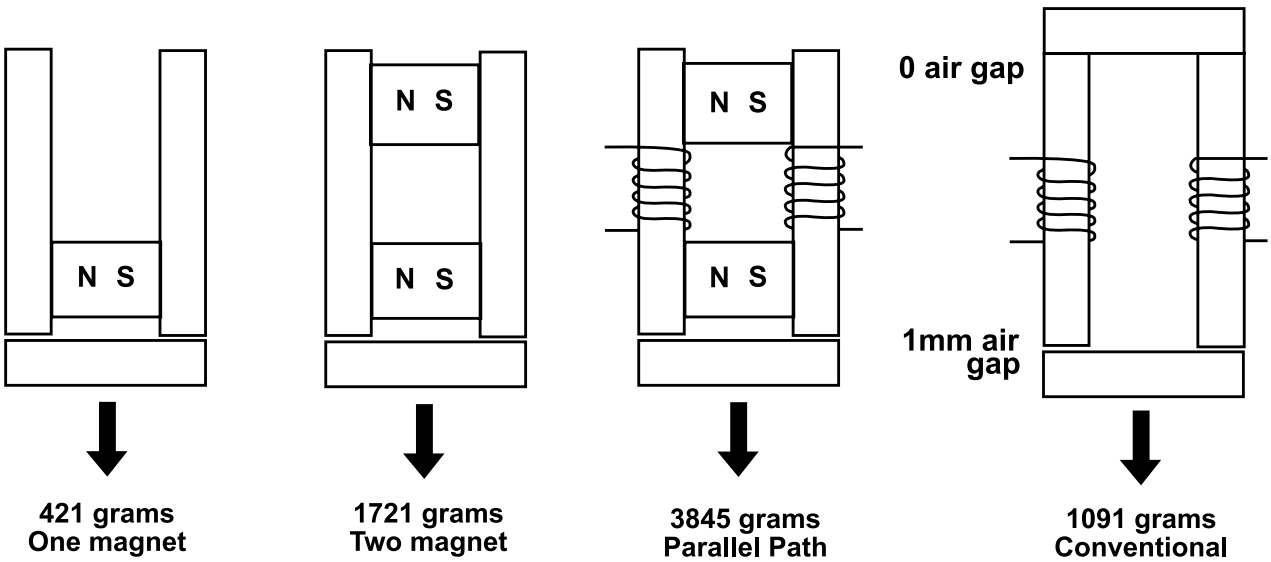

Fig. 3

Parallel Path can deliver 3.47 times more force to the legs of cores than any competing conventional technology

An even simpler non electrical flux experiment was proposed by GM in the Parallel Path Egroup. My apparatus is illustrated below in Figure 4. It is no more than magnets and steel staple strips, bought from a local hardware store for a total of under $10. The Parallel Path effect can be replicated with identical apparatus, at only a slight increase in cost and complexity, with the addition of a simple 12V polarity reversible power supply, such as those commonly sold to power computer speakers, among other applications.

Simple Magnetic Force Experiments

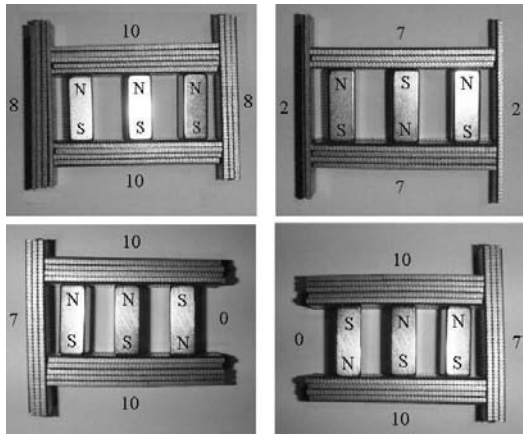

Fig. 4

Relatively small changes in layout produce large changes in force

Conservation of Energy / Field Potential

One of the aspects of the Flynn technology people find most difficult to understand, is how you can have a device that delivers 3.47 times more magnetic force than is electrically inputted, yet not violate accepted principals of text book physics, as stated in the introduction. The key point here is conservation of energy. Magnetic fields do not gain energy – they are conservative. You can only ever obtain less energy from a magnetic field minus losses, than is in fact present. I feel this apparent puzzle can not be better explained, than by reference to Joe Flynn's own words:

"Since the Parallel Path System produced 3.47 times more force than the conventional system, with the same electrical input, it appears to violate conservation, this is only true when observed from a traditional view point. The system contains three flux producing sources (2 magnets and an electromagnet) which together are capable of producing a far greater force than is actually produced. All of the flux sources together can produce a force of 13.11 units, therefore in the physical sense a loss of 1 - (9.01 / 13.11) = 31% is realized."

So the system is 350 % efficient, in terms of delivered magnetic force compared to net electrical input, yet still conforms to the accepted physical principals of energy conversation, by being only 69 % efficient, in terms of the fields present in the system. However surprising this result may appear, the analysis presented is in outline correct, with the difference between fields present in the system, and net electrical input, being the important concept presented.

Losses in the System and Optimisation

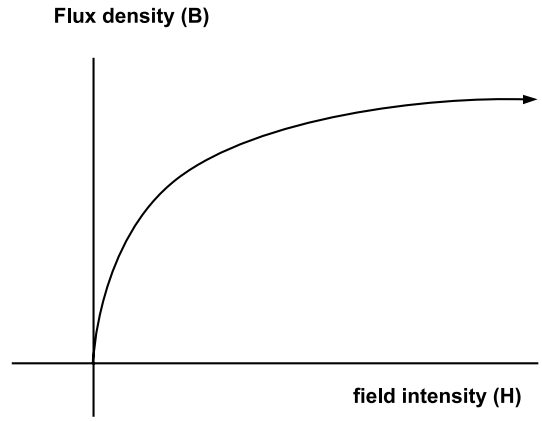

Fig. 5

In order to properly optimise flux cores, an appreciation of the physics that underlies the transfer of flux within a core is required. The normal magnetization curve, or B-H curve, is a mathematical relationship between applied field intensity H, and resultant flux density manifested in the core B. It varies according to core material, and the curve will shift, if there is a starting magnetism within the core, such as that provided by the field of a permanent magnet. If the start magnetism is excessive, the core is saturated, and will not properly respond to the applied force H. A simple B-H curves is illustrated in Fig. 5.

Hysteresis is a delay between applied magnetic force H, and resultant flux density B, that again varies according to material type. It also manifests as a delay between the termination of force H, and the manifestation of flux density B. So, the system will not turn on instantly, and will not turn off instantly, in simple terms. This is because the magnetic memory of the core, means a flux vector remains within it, even when the application of magnetic force H has been terminated. If we apply a reversed force H to the core, the basic B-H curve is now expanded as in Fig. 6, with the memory effect also illustrated.

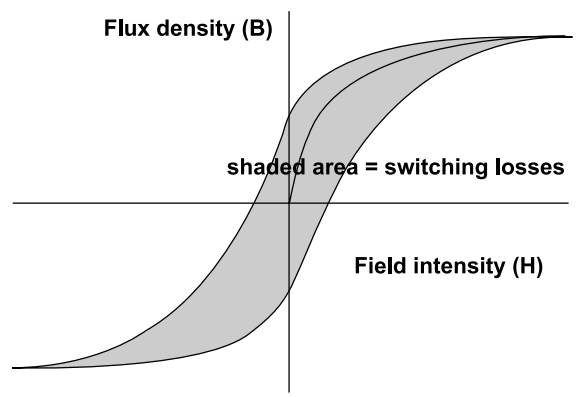

Fig. 6

Thus as can be seen, to return to the initial switched state, the remnance magnetism must now be overcome, hence input once in operation, will be greater than that required for the very first pulse. The area within the hysteresis curve gives a rough estimate for the amount of wasted energy, and along with other conventional sources of losses resultant in flux transfer within a core, is what reduces the efficiency of flux cores from maximum values of 2, or 4, down to values such as 1.75 or 3.47, typically.

Motor Apparatus

Simple Parallel Path Technology Demonstrator Motor

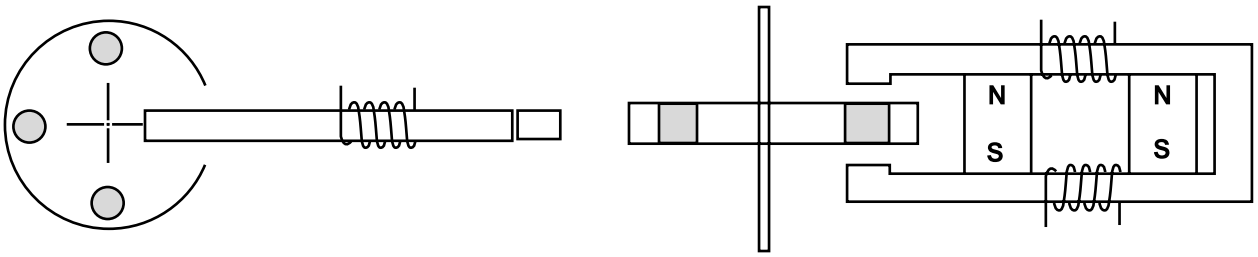

Fig. 7

Designed to demonstrate core principals, not provide over-unity

Although numerous practical applications abound for this effect, electric motor design remains the most outstanding opportunity. To this extent, again a few simple images, should be sufficient to explain how the basic flux switching apparatus, can be turned into a highly efficient electrical motor.

The first motor shown in Fig. 7 is one I have proposed to validate the flux switching effect at a most basic level. It illustrates the point made in the Flynn patent, that the armature of the core can be removed, and replaced with a motor flux path. This first motor is not claimed to be highly efficient, but it helps one to understand how the transition from simple flux core to motor takes place.

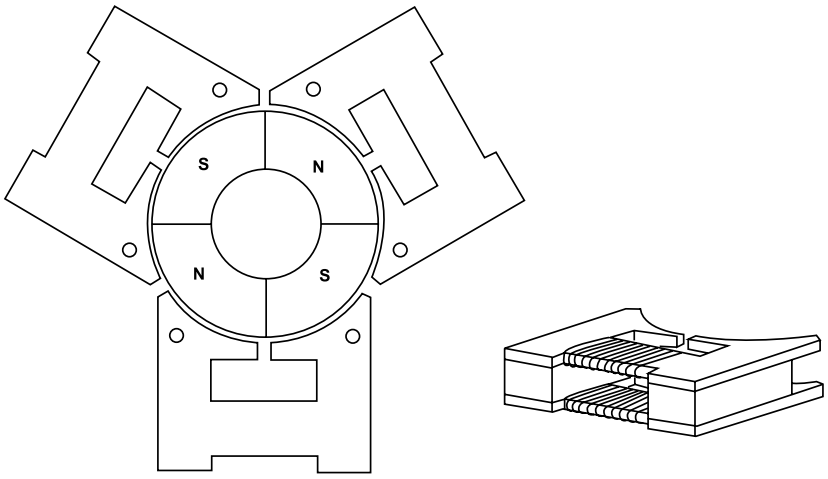

Fig. 8
Magnetic force is alternately switched from one leg to the other, imparting motion to the rotor sections

The next motor shown in Fig. 8 is again taken directly from the Flynn patent, and illustrates the next intermediate step to motor design. The fields of the permanent magnets are alternatively switched from one side of the surrounding flux cores to the other, alternately interacting with N and S poles on the rotor, imparting motion to the central rotor shaft.

With proper financial support, and the facilities to have metglas cores custom moulded, Joe Flynn was able to develop his final best art, shown in Fig. 9. No detailed performance numbers have been released for this motor, whose precise performance characteristics remain proprietary to Joe Flynn at this time. But the optimisation is so expert, it is stated to posses certain exotic properties, such as cool ambient operation, even during prolonged periods of continuous load. This 'cold running' is said to be of great interest to the American military, as it offers excellent stealth performance characteristics.

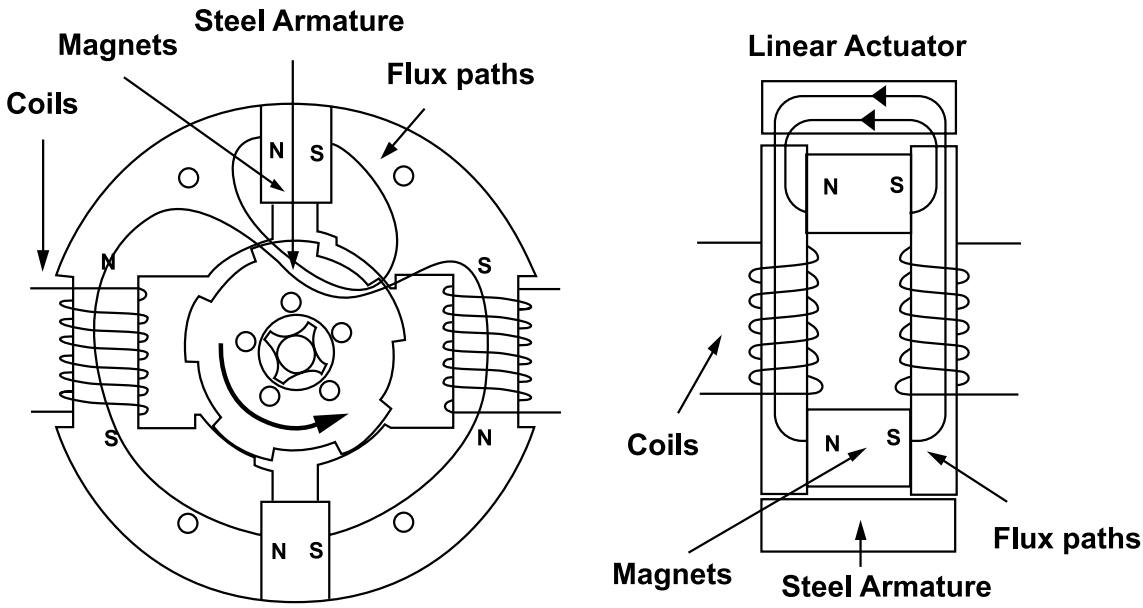

Fig. 9
Optimal Flux Core Motor Construction

Electrical Apparatus

Many readers will no doubt have noticed the similarity of the first illustration presented in this document, to the so called 'Tom Bearden MEG.' This is fair comment, and Joe Flynn has always highlighted this issue. However, it has been commonly stated Joe Flynn has simply developed mechanical apparatus, and the MEG with its electrical functionality, is distinct art, more advanced than the mechanical Flynn apparatus. However, this is shown not to be the case by a careful examination of the Flynn patent, in which the following is stated in the 'Power Conversion' section:

'The construction (shown in Fig.10 A) utilizes four control coils and a single permanent magnet and the construction (shown in 10 B) uses two control coils and two permanent magnets. The flux that would normally be supplied by a primary winding is supplied by the static flux of the permanent magnet or magnets and the control coils convert this static flux into a time varying flux in a novel way. Both arrangements use two secondary coils, the secondary coils are placed in the region of the continuous flux path that would be occupied by an armature or rotor in the linear or rotary arrangements. The regions of the flux paths that perform work are the same in all cases.'

'By alternating the polarity of the control coils during one cycle, one working region experiences an increasing flux and the opposite region experiences a decreasing flux and during the next cycle the opposite occurs. This results in the induction of a voltage in the secondary coils that is decided by the magnitude of the change in flux in the working region and the time in which this change occurs. The novelty of this discovery is that the primary flux inducing the voltage in the secondary coils is supplied by the permanent magnet or magnets and is far greater than the flux supplied by the control coils.'

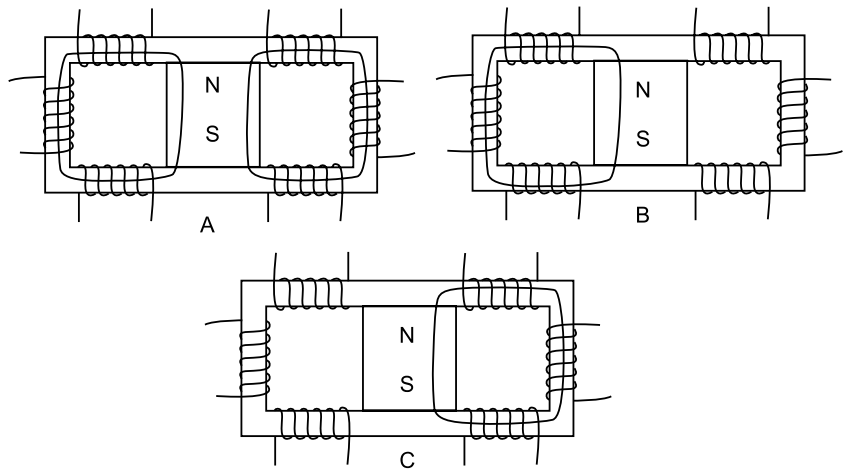

Fig. 10

Fig.10 taken directly from the Flynn patent makes the point even clearer. As can be seen, the device illustrated is in all functional respects absolutely identical to the so called 'Tom Bearden MEG.' This identical prior art, therefore calls into question the intellectual property rights of Magnetic Energy LTD, as the same invention can not be patented more than once. Joe Flynn has also stated that his intellectual property rights will be robustly defended, by legal action if necessary, and he regards himself and his company as being in possession of exclusive rights to the so called 'MEG' unit.

the input and output circuits must be closed in series. The disclosure of this technique amounts to putting the basic MEG methodology fully into the public domain.

As regards replication of electrical output orientated flux core devices, certain important details need to be stated. For example grade 8 ceramic magnets should be used, so as to avoid flux saturation of the core. A basic error, many early experimenters wasted time on. The requirement for strong magnets to obtain over-unity results, is as much of a myth, as the idea new physics is required.

But perhaps the greatest trade secret of the electrical devices, one which several lengthy non disclosure agreements are required to be signed before it can be disclosed, is that the input and output circuits must be closed in series. The disclosure of this technique amounts to putting the basic MEG methodology fully into the public domain.

The reason for this circuitry requirement is obvious enough, with only a little analysis. If the output circuit is closed when the input circuit is activated, then the input energy simply leaks into the output circuit, as in an ordinary transformer. So no flux switching effect is manifested, and the field of the permanent magnet is static in time. Thus you have an ordinary transformer, with reduced efficiency, because of the core flux saturation effect provided by the permanent magnet.

This is one of the most important point to make about the Flynn apparatus. If you approach it as if it is a normal piece of scientific equipment, then proper optimisation is not greatly problematic. For example more turns on the output coils, simply means more voltage and less current, exactly as standard textbook equations predict. Generally, problems only occur, if you imagine the effect is based upon exotic scalar type or vacuum energy physics, when in fact it is ordinary flux manipulation within a core.

Present Status of the Flynn Project

Initially Joe Flynn was remarkably open about his work and research. However, since performing a working demonstration of various advanced hardware samples for the American Department of Defence, little has been heard.

I want to clearly emphasize I do not speak for Flynn research, nor am I in any way connected with Flynn research, and by consequence, have no inside information whatsoever as to the present status of the project. But we all sincerely hope, that the project has not been swallowed whole by the American deep black military industrial research complex.

However, even if this is the case, it does not mean the technology is lost. Extensive and generous details have been provided by Joe Flynn of his research, both in his patent deposition, website, and other comments, such as to enable persons of scientific training and skill, to replicate the effects stated.

While replication of the electrical effect remains extremely demanding, the mechanical apparatus is very easy both to understand and replicate. There is no reason why scientists and home tinkers together, can not build Flynn type flux core motors, and explore over-unity flux manipulation for themselves. The future has arrived, and it is simpler and cheaper than anyone imagined to be possible.

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Flynn Research Company

http://www.flynnresearch.net

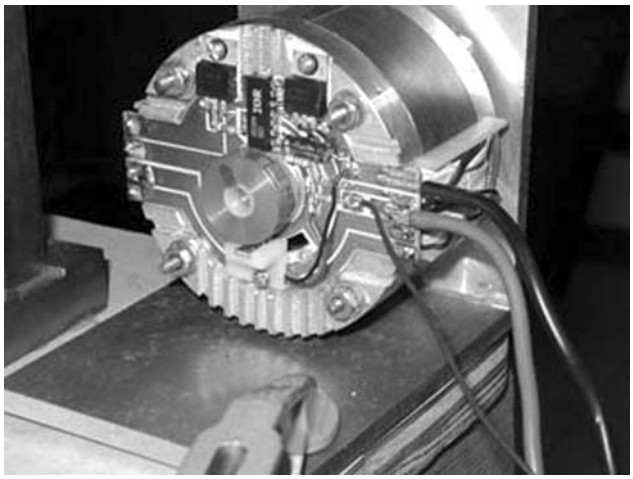

Photo 1

3.3" 1.2" stack height 1/2 hp weight 59 oz

Photo 2

Dynamometers, Power Analyzer etc.

Editor: Below we publish information and photos, represented on Flynn Research Company website (http://www.flynnresearch.net), and a description of the patent on methods for controlling the path of magnetic flux.

Flynn Research is dedicated to research focused on the novel application of permanent magnet and electromagnetic technology. Magnetism is a field that has potential for tremendous growth from both a science and application perspective. The researchers of Flynn Research Company believe that magnetism is one of the least understood and most misinterpreted of the natural forces, with the exception of gravity.

Even though much work has occurred in the advancement of magnetic materials, little advancement has occurred in the basic understanding of magnetism. The field of magnetism is based on both theory and 'myth' and is generally described as a 'phenomenon'.

We still do not know what a line of flux is and how it travels through space. We know flux "appears" to originate within a permanent magnetic material, forms a loop from one end to the opposite end of the magnetic material, appears to occur without a time constant, produces a force (attractive and repulsive) between other permanent magnets and "magnetically permeable materials and has a relationship to current flow. Everything known about magnetism is based on "effect and relationships" without a clear understanding or provable definition of what is a line of magnetic flux.

Everything known about magnetism is based on "effect and relationships" without a clear understanding or provable definition of what is a line of magnetic flux.

The research is based on the "magnetic force of attraction effect" that is related to magnetic flux by the number of lines of flux occupying a given area or flux density squared. The simple fact that if the number of lines of flux occupying a given area "doubles" the force of attraction becomes four

Photo 3

8" dia x 8" height motor presentation

Photo 5

Technology Discussion

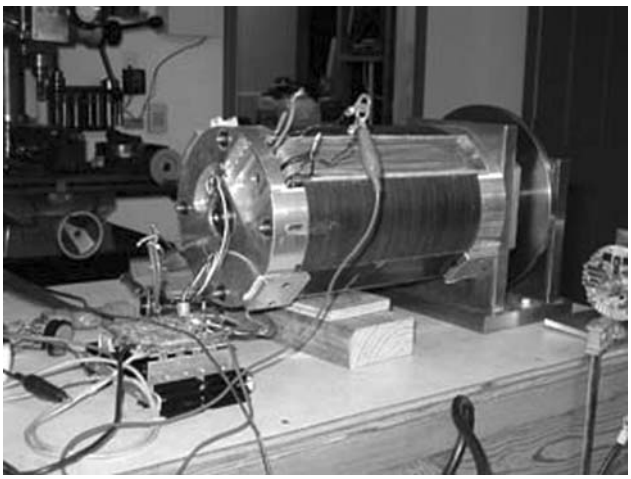

Photo 4

8" X 8" motor testing

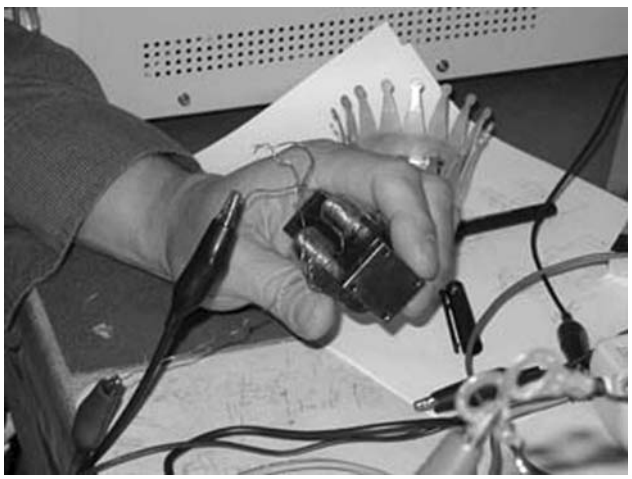

Photo 6

Parallel Path Test Apparatus

times greater. The basic model shows that with specific structures electromagnetism acting with permanent magnet materials can divide and multiply force in a manner that cannot be explained with conventional physics.

Rotary devices, linear devices, reciprocating devices and power conversion devices are now a patented product of this research. The goal of the Company is to commercialize their devices for use in an energy dependent world. Flynn Research is a research & development company and in cooperation with Magnetic Revolutions LLC licenses their technologies for use in the electric motor and power conversion industries.

The researchers do not construct their own test equipment nor write capture and data evaluation programs but use industry / scientific accepted products. Close to $1.5 million has been expended developing, protecting and evaluating the technology. Many fine minds have been involved in the development and evaluation of the technology. Many presentations have been given both to motor companies and academic groups. The prototypes have all been professionally built, which include a 1/2 hp 3.3" dia 1.2" stack height, the assembled motor weighs 59 oz and a motor 8" dia with a stack height of 8" currently undergoing testing.

United States Patent No. 6,246,561
June 12, 2001

Methods for controlling the path of magnetic flux from a permanent magnet and devices incorporating the same

Inventors: **Flynn; Charles J.** (Greenwood, MO)
Assignee: **Magnetic Revolutions Limited, L.L.C** (St. Louis, MO)
Appl. No.: **127056**
Filed: **July 31, 1998**

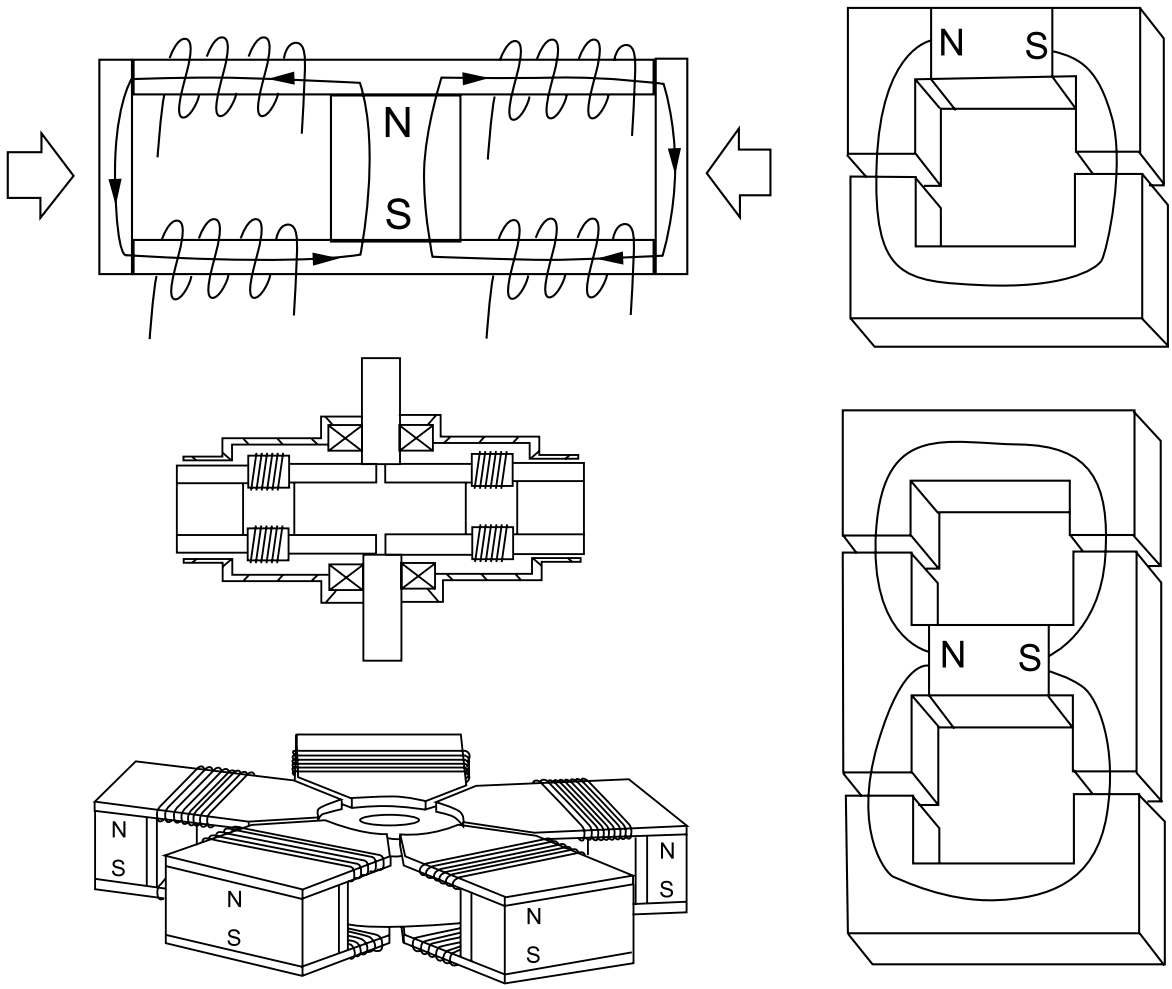

A permanent magnet device includes a permanent magnet having north and south pole faces with a first pole piece positioned adjacent one pole face thereof and a second pole piece positioned adjacent the other pole face thereof so as to create at least two potential magnetic flux paths. A first control coil is positioned along one flux path and a second control coil is positioned along the other flux path, each coil being connected to a control circuit for controlling the energization thereof. The control coils may be energized in a variety of ways to achieved desirable motive and static devices, including linear reciprocating devices, linear motion devices, rotary motion devices and power conversion.

Editorial: The principle of designing of the device (two counter parts of the flux are used) resembles Φ-machine or Gramm's generator. Read in this issue more details on these devices.

Flux-machine And Its Analogues

Review prepared by correspondent Alla Pashova, Russia

Flux-machine (or Φ-machine, since configuration of its field resembles the Russian letter "Φ") was designed by Alexander V. Frolov during the first half of 1990s. Φ-machine description was published more than once on the pages of scientific periodicals (1994, Institute of New Energy, Newsletter, June 1994, p.9.; 2002, New Energy Technologies, 2002, p.3), and it is well known to many researchers concerning themselves with such kinds of engineering.

Let us consider the arrangement of Φ-machine; see Fig. 1 (first published in 1994). A report was presented at the conference «New ideas in natural science», 1996 in Saint Petersburg (see photo in Fig. 1). The primary coil is mounted in the center of generator; two secondary ones are diametrically wound on a ring core. An air gap between ring and central magnetic circuits are of particular importance. **Two magnetic fluxes from two coils are balanced, and, thereby, there is no reaction in the primary circuit.**

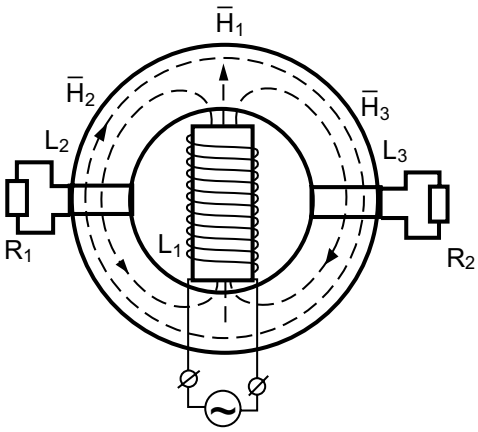

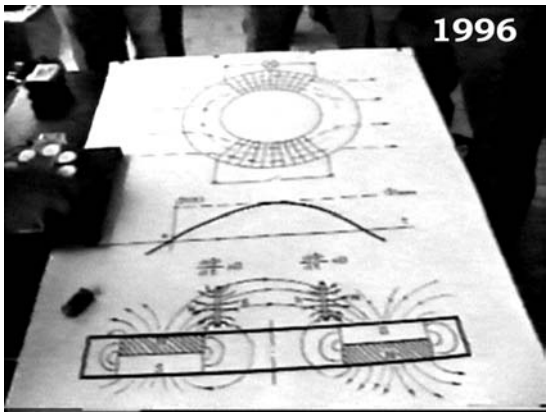

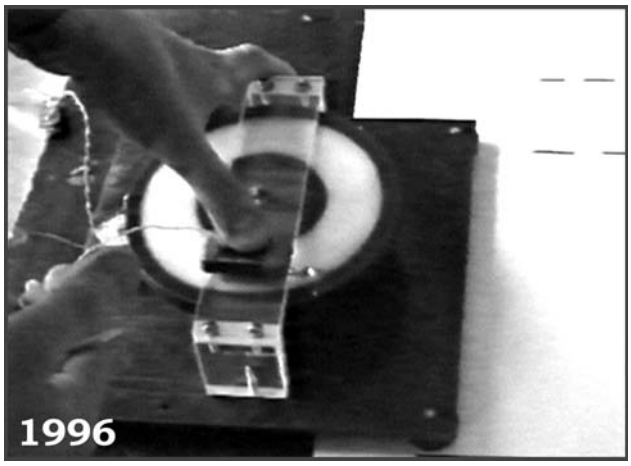

Fig.1
See also Fig. 7, p.29 – the analogy is evident

The device bears some similarity to the Gramm's generator (Zenob Theophyl Gramm, 1826-1901, Belgium-France, took out a patent for an electric ring-rotor generator in 1869). In Gramm's generator (Fig. 2) the ring rotor with a toroidal winding rotates. The toroidal winding touches two diametrically located conducting brushes. It turns out that in the ring of the rotor all winds of one rotor half create a field which is directed towards a field created by the other rotor half.

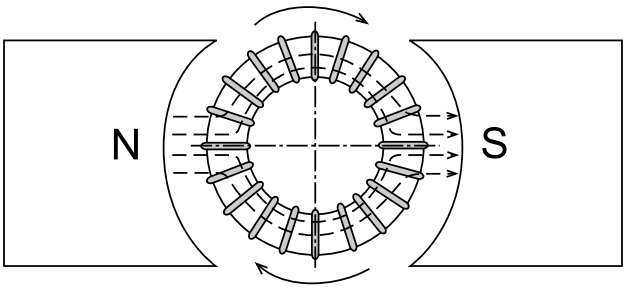

Fig. 2

An example of analogous device is represented in Fig. 3 (information is from the website: http://www.skif.biz/energy/arhiv1-6.shtml), and also in Fig. 4 (we have written about this invention in New Energy Technologies, Issue #5 (8), 2002, article by V.I. Boryak, Email: spin@i.com.ua).

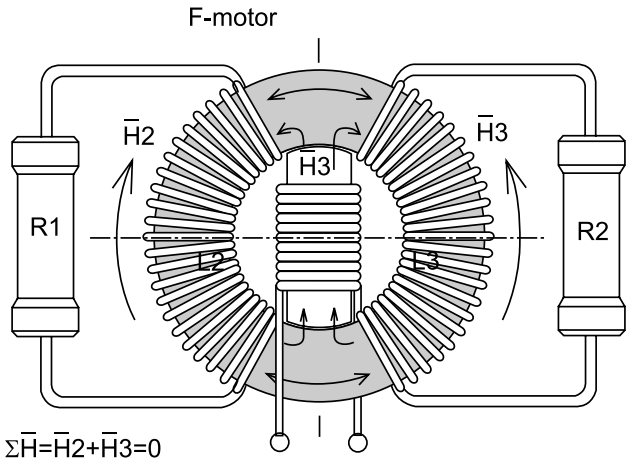

Fig. 3

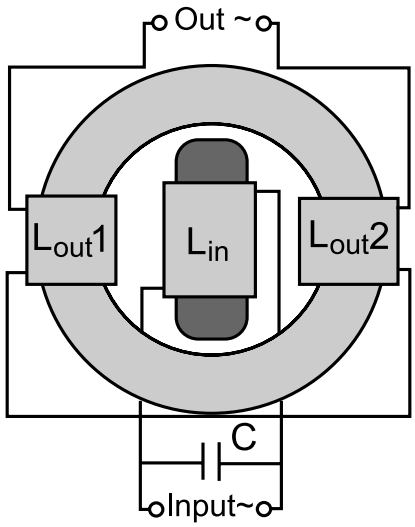

Fig. 4

In August 1999, according to Stephen Hartman (Hartman Multimedia Service, Email: hart@harti.com, info@ccard.net), a German research team designed a toroidal generator. As stated by the researchers, it obtained more than 1.200 W by load while efficiency exceeded 100%!

This subject has become very popular among different researchers. Fig. 5 illustrates a design with a magnet rotating in the center (designer - Olaf Berens, Email: olaf.berens@prognost.com).

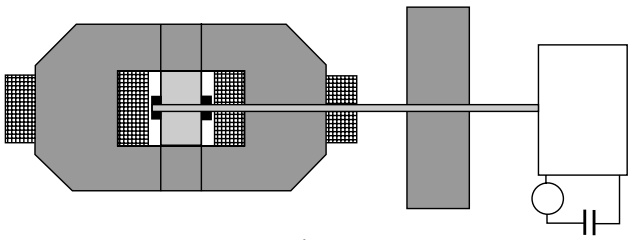

Fig. 5

One more example from the USA: in February, 2003 Donald Hofmann (USA) filed an application for patenting "Generators and transformers with toroidally wound stator winding». Below we publish the description of the patent.

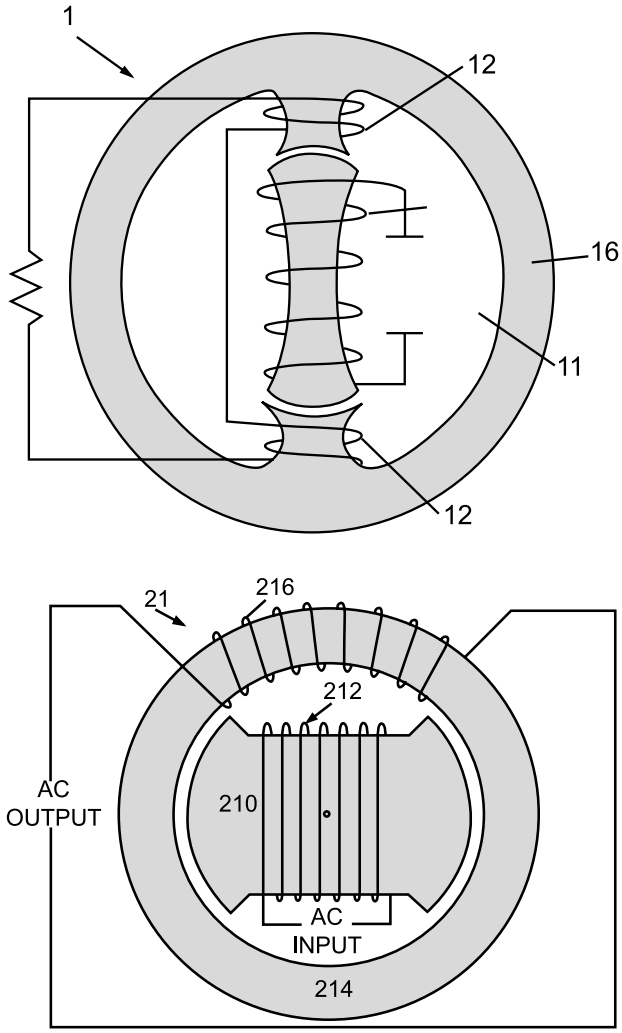

Fig. 6

Inventors: **Steven L. Sullivan, USA; David L. Goulet, USA; Donald Hofmann ,USA.**

Electrical generators are provided with toroidally wound stator windings electrically connected in series; a high permeability stator core, preferably an amorphous magnetic alloy material, glassy metal or HYPERCO™ 50 laminations; and a rotor. The toroidally wound stator coils and the stator core trap essentially all of the flux fields generated by the stator coils within the stator core. Since there is essentially no magnetic field leaving the stator, there is essentially no flux field interaction with the field generated by the rotor. The reduction of flux field interaction also reduces counter torque.

According to another embodiment of the invention, open positions of a rotor may be filled with magnetic material, preferably iron. Filling open portions of the rotor may assist in reducing undesirable flux leakage from the rotor. By trapping substantially all of the flux within the rotor, interaction between rotor and stator flux is reduced. In this manner, counter torque is reduced thereby increasing the overall efficiency of the device.

A prototype of this embodiment was constructed using a standard 10 kWtt gas-powered generator. The stator was removed from the generator and its housing. The stator windings were removed from the stator and rewound by hand using a No. 10 size copper wire with 180 winds wrapped in a toroidal fashion around approximately 180 degrees of the stator.

The stator was then reinstalled in the modified housing and re-attached to the gas-powered generator. A standard 12 volt car battery was attached to the input of the rotor. A 12.92 volt input with 0.8 Amps was measured as the input to the rotor. The output was measured as 6.5 volts with a 40 Amp output. A series of input and output measurements were taken for various inputs.

Editor: Thus input power is 10 Wt, and output power is 260 Wt.

So, the old well-known ideas have found new ways of embodiment, though their essence remains unchanged. Let us note that Faraday Labs Ltd has been working on creating a prototype of □-machine with a toroid of 200 mm in diameter.

Please, read more about this in the next issue!

Editorial: We publish the specification of several interesting patents, which were taken out by Russian inventors for recent years.

Russian patents on alternative energetics

- №93001754, 1996.06.27, Converter of gravitational forces into energy, V.V. Mironov and others
- №92008720, 1995.02.10, Slavic method to produce energy by conversion of gravitational forces, V.V. Mironov
- №93006696, 1995.04.30, Supporting converter of gravitational forces into energy, V.V. Mironov
- №2001121071, 2003.04.10, Method to create energy in liquid, heat-generator and heat-and-power device, A.Yu. Baurov and others
- №2132109, 1999.06.20, Generator of mechanical energy, A.Yu. Baurov and others
- №2001125794, 2003.05.10, Generator of static electricity, S.I. Danilov
- №2001120796, 2003.04.10, Electric power device, D.M. Beliy
- №98116077, 2000.05.10, Heat engine (monotherm, "perpetual mobile of second-type"), V.I. Likhachov and others
- №93048971, 1996.04.20, Float engine, I.P. Tchinarev
- №94023174, 1996.03.27, Gravitational-hydrostatic engine, I.P. Tchinarev
- №98112650, 2000.03.20, Water engine, V.A. Gylchuk
- №2001115953, 2003.03.20, Potential engine by Prokopenko, V.F. Prokopenko
- №2001115954, 2003.03.20, Potential amplifier by Prokopenko, V.F. Prokopenko
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- №95107181, 1997.02.20, Method to convert energy of physical vacuum into energy of physical space, O.K. Polev and others
- №92008695, 1995.04.20, Method to get overunity efficiency, Yu.V. Karasev and others
- №93006851, 1995.04.30, Principle, method and device for circulation of mass by force of gravitation and inertia, G.S. Kirichenko
- №93039885, 1996.05.20, Hydro-gravitational electric power station, L.S. Konkov
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- №93025690, 1996.07.27, Method and device to convert heat energy into mechanical one, A.I. Lendyaev
- №2001122885, 2003.04.20, Rotary method to convert magnetic energy into mechanical one, L.N. Mezentsev
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- №2001115968, 2003.03.20, Method to convert energy, V.S. Gorelyuh

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- №99121374, 2001.11.10, Perpetual mobile, E.M. Volodin
- №94026259, 1996.05.20, Device to convert magnetic field energy into kinetic energy, P. Imrish

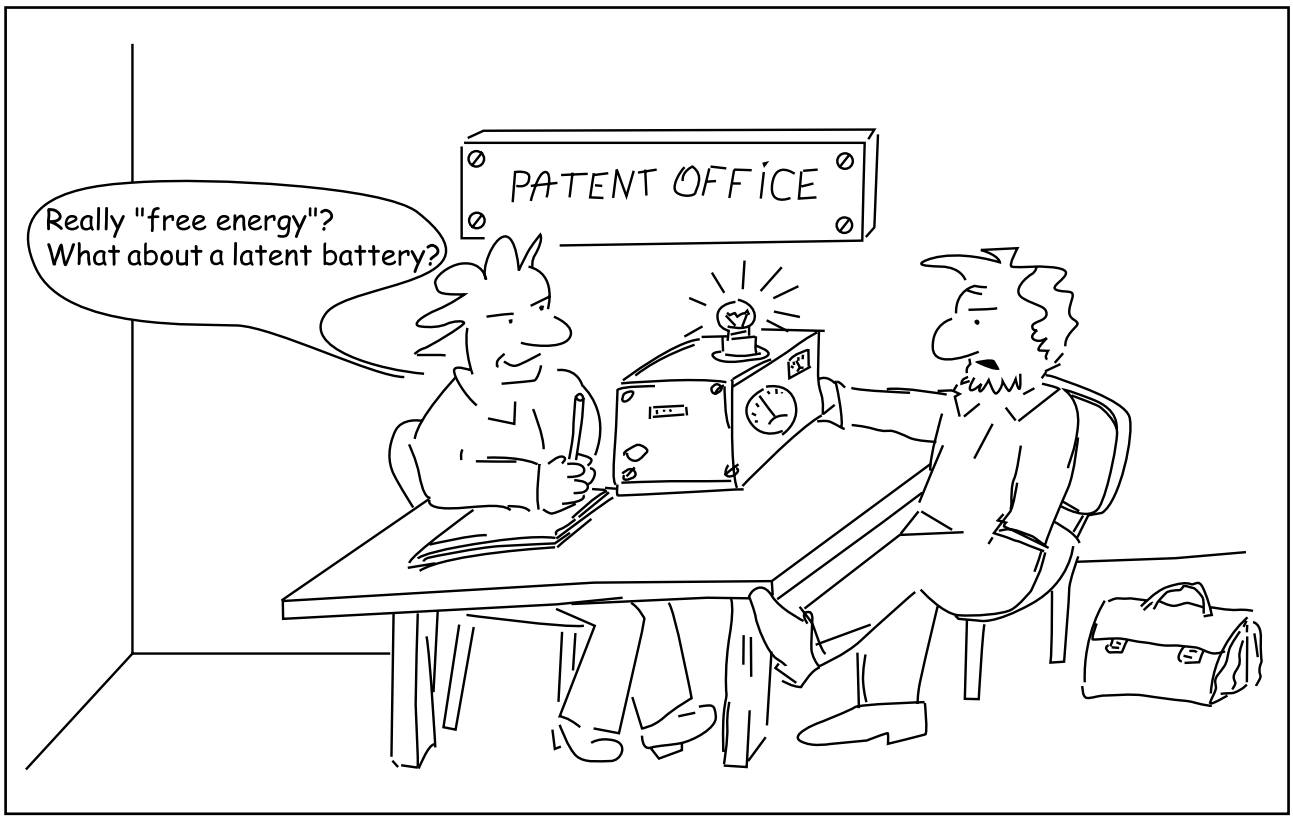

Device for conversion of magnetic field energy into kinetic energy

No. 94026259, 1996.05.20

Author: Pavel Imrish

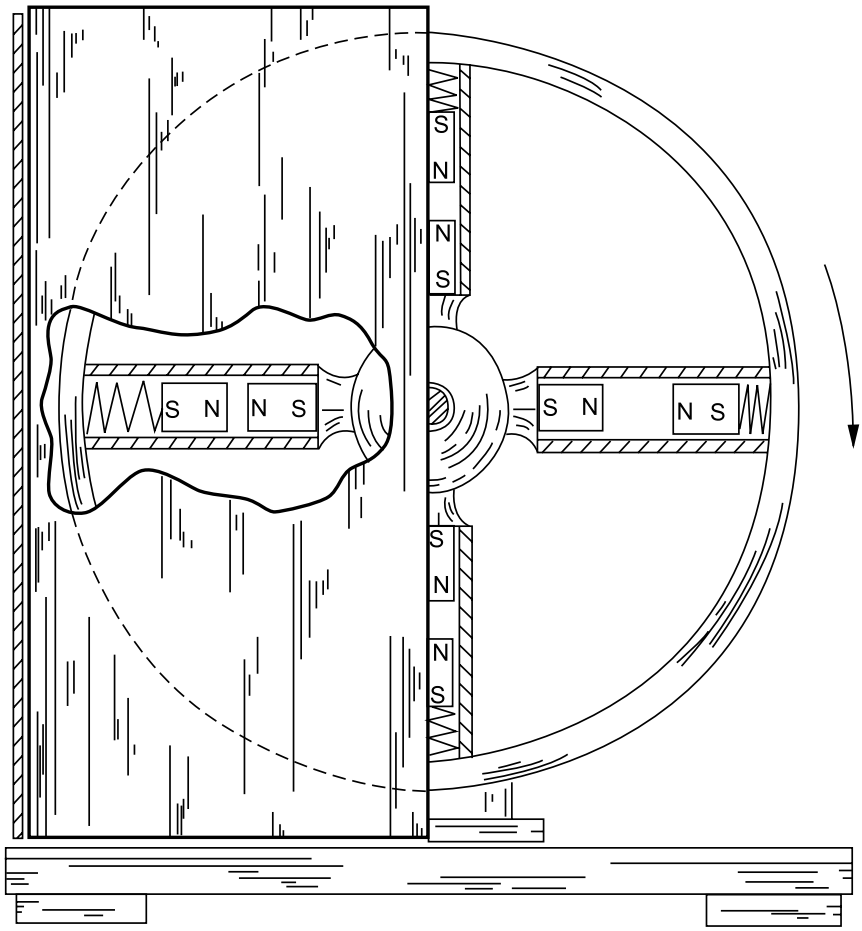

Fig. 1

The invention refers to a device for conversion of magnetic field energy into kinetic energy. The device has a rotating wheel with at least two radially opposing non-magnet holders used as guide ways for at least two permanent magnets, respectively. The permanent magnets are mounted in the holders so that there is a possibility to remove them. From the both sides of the wheel plates made of magnetic material are mounted axially; the plates surround the wheel partially. Depending on direction of the both poles, namely on location of the similar and opposite poles towards each other, compression element is situated on the holders, or between the wheel and the outer end of the permanent magnet located at the furthest radial distance from the axle of the wheel, or between two permanent magnets. (The device operation principle is obvious from Fig. 1).

Editor: We have found an example of a similar device whose description is presented in the book by R. Ford The Perpetual Motion mystery [1].

In this case, there is an analogous process, during which half of the cycle is screened and the rotor is supposed to rotate permanently (see Fig. 2).

1. RA. Ford, The Perpetual Motion mystery. Lost Technology Series, p.23.

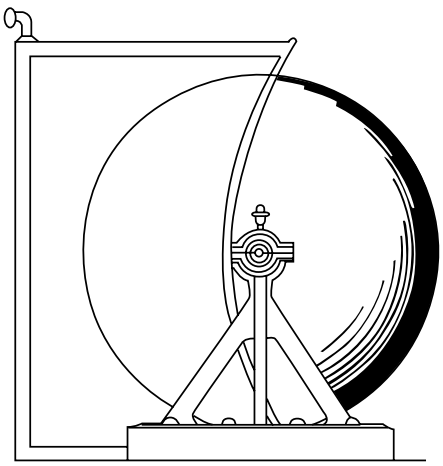

Fig. 2

Gravity spaceships

Review on Grigory R. Uspenskiy's works, Russia

http://space21.boom.ru/gravity.htm

The level of development of modern astronautics is primarily determined by the energy capabilities of space carriers. So, nowadays, the single-mission carrier rockets equipped with chemical engines allow space exploration within the solar system. These carriers have delimited the near-earth space in the form of a geostationary orbit, where the practical-purpose space complexes operate.

Newer and higher levels of quality will be reached by cosmonautics upon its mastering gravity power engineering. Flights towards the nearest stars will become possible and by the end of the next century this will be followed by travels throughout Galaxy.

Gravity engines are structurally simple (**two bodies of different density are rigidly connected**). To form some practicably significant value of thrust it is required to use absolutely new technology regarding creation and retaining of matter of high density which can be compared to that of atomic nuclei. For instance, at an engine mass of about 2 t, it is possible to attain 10 N thrust using bunches of aluminum and lead nuclei. The nuclei are approached to each other at a distance comparable with sizes of these bunches.

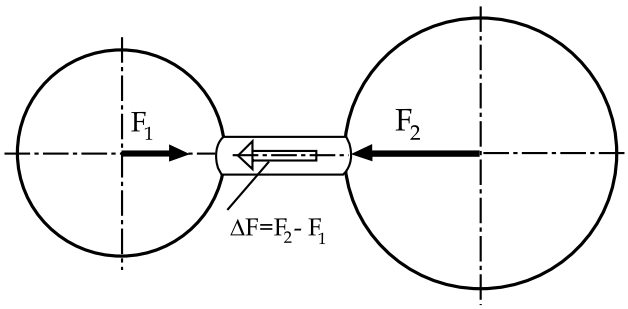

Fig. 1

Use of matter which is denser than nuclei bunch, increase of mass of the gravitating bodies, and reduction of the distance between the bodies causes increase of thrust. So, for a level of density of gravity holes (i.e. for extremely dense state of matter in which it is not attracted by other bodies) limit value of acceleration of the gravity engine reaches the order of 10^{100} ms^{-2}.

In engineering, we usually use units of distance as meters, centimeters, millimeters, and microns. Let us consider one of them – millimeters. With such a size of the gravitating bodies and distance between them, it is possible to obtain substantial thrust forces of the gravity engine and, accordingly, accelerations of its motion.

So, using an engine of 20 ton mass we will get the thrust of $2x10^4$ N, with mass of 200 ton we will get the thrust of $2x10^6$ N, and so on. Thus, by increasing the engine mass by one order of magnitude, we obtain increase of thrust by two orders, while sizes of the bodies remain unchanged. But acceleration, in this occasion, remains constant and equal to approximately 1 m/s^2.

Decrease in size of gravitating bodies of the engine leads to the corresponding increase of thrust by an order. Decrease of size is realized by increase of density of these bodies by 3 times up to 0.3 mm at the same masses. The acceleration they produce is increased by an order as well, i.e. up to 10 m/s^2. Decrease of sizes of the gravitating bodies and the distance between them down to 0.1 mm results in further increase of engine thrust by one more order and also increase of acceleration up to 100 m/s^2. If size of the bodies is 1 micron then acceleration increases up to 10^6 m/s^2.

It is apparent that even with up-to-date technological possibilities of miniaturization the gravity engine with masses of dozens and hundreds of tons is capable to create great thrust forces and form accelerations considerable enough to fly across the Galaxy. Therefore, the problem of creating a gravity engine is, mainly, the problem of producing and retaining the high-density matter. It will be possible after studying the mechanism of interaction between matter & gravitational substance followed by developing techniques for synthesizing of high-density, large-mass, and small-size substance from this matter.

It is possible to control the value of thrust of the gravity engine changing the distance between gravitating bodies. Thrust direction can be changed by turning the rigid connection of the gravitating bodies. The engine can

be activated by bringing the gravitating masses together, and switching-off by moving them apart.

In a 24-hour period, such a ship can reach a speed of 10^6 m/s and cover a distance of about 10^{10} m. In a month, with a top speed of 3x 10^7 m/s the ship will cover the distance of 10^{13} m; in a year, with a speed of 4x 10^8 m/s the ship will cover a distance of 10^{15} m; in 10 years - 4x 10^9 m/s and 10^{17} m, respectively. Apparently, the ship with sufficient over-load can be used for flights within the solar system and for manned flights towards the nearest stars.

When transporting unbreakable and non-urgent cargoes, the acceleration can be increased up to a few dozens of unities. The flight duration might be also increased by several tens of years. This extends the area of utilizing the gravity ships with over-loads of several unities. Besides these ships can be used for transporting operations within near vicinities of the Galaxy.

The high-speed flight will demand protection against approach flow of matter. So, per second (with a ship speed of 10^{10} m/s) 10^{-12}kg of matter will approach the ship. At that density of interstellar material is 10^{-24} kg/m^3 and midship area is 10^2 m^2.

The great speed of approaching matter will create a substantial resisting force. At a speed of 10^{10} m/s, this force will come to the order of 10^{-2} N, whereas with a speed of 10^{18} m/s it will come to 10^{14} N. This is a great value, but as compared to thrust of such a ship which is to equal to 10^{17} N, the former value is a small one. That is why it is possible to overcome such resisting force.

Intercommunication with these ships might be, most likely, realizable by means of distortion of gravitational field. It is possible that the gravitational field distortion will be formed, on the contrary, by generating the matter from the gravitational field, and, most probably, by a method as yet unknown.

Monograph **"General Etherodynamics. Modeling of matter structures and fields on the basis of conception of gas-like aether" by Vladimir A. Atsukovsky.** 2nd edition, M., Energoatomizdat, 2003;
Brochure **"12 experiments on etherodynamics**" Zhukovsky, Publisher "Petit", 2003.

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On Velocity of Drive-Free Motion

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Editorial: *We publish a summary of the article. The original text you can receive from the authors.*

A drive-free system made on the basis of a planar mechanism is described. The experimental results on average velocities of the drive-free propulsive system are presented in a scaled view.

During usual motion, a system is repealed from the surface in the case of its motion on a plane or from the medium when it moves in a resistance medium. This kind of motion is achieved by using a drive mechanism. In contrast to the usual motion, the drive-free propulsive system moves due to interaction of a body of a system with another body of the same system. Sometimes such machines are called inertioids [1] or vibration propulsive devices [2]. To produce such kind of motion it is sufficient to provide anisotropy of the resistance force [3-5] or asymmetry of the internal force [6]. One of the simplest ways to do it is to use a simple two-link planar mechanism. A device for such a motion is shown in Fig. 1.

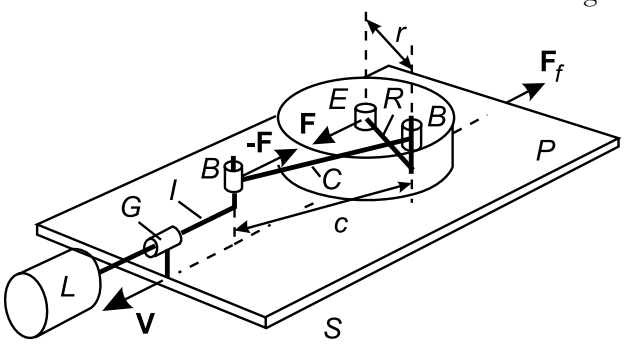

Fig. 1

Experimental device

This device with a total mass of M+m consists of a platform P on which an electric motor E rotating a drive rod R of length r is mounted. This is only one part of the planar mechanism. Another link is the connecting rod C of length c which connects the unbalanced load L and the drive rod R by means of two bell bearings B. The unbalanced load L of mass m on the rod I slides in guide G. The basic distinction of this mechanism is in that this variant of drive-free machine allows us to analyze the experimental data on average velocities of motion. Actually the only forces, which act on the platform and are collinear to the moving direction, are the force **F** caused by vibrations of the load L and the frictional force $\mathbf{F}_f$. The platform starts to move when the force acting on the platform becomes greater than the frictional force.

Let us discuss possibilities of the real propulsive system shown in Fig. 1. Measurements were made at r=0.01 m and at three mass ratios m/M. The values of frictional coefficients were measured for each parameter of the system and vary from k=0.25 to k=0.4. The system starts moving when theoretically the drift does not take place. When motion becomes reversible, the velocity of drive-free drift does not decrease.

Thus drive-free motion is possible even if the frictional coefficients are very small. When increasing the frequency of vibrations velocity does not decrease. We can not discuss the existence of some third force acting on the platform (we can suggest the existence of frictional force $\mathbf{F}_f$ and the internal force **F** caused by vibrations). Let somebody else take the liberty of making such a conclusion!

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ELECTROMAGNETIC SELF-ACTION

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The torque of a self-action exerting on the mobile part of the reactionless engine is measured. It is shown that there exists a value of the height of the mobile electrode at which the torque of self-action is maximal.

There is an opinion that a body can not act on itself [1]. The existence of the so-called force of self-action is believed to contradict to the law of conservation of momentum. This is nothing but prejudice. Though the experimental confirmations of existence of self-action [2-4], conventional science is ready to refuse modern electrodynamics and make up a new theory of electromagnetism [1, 5] in order to save Newton's third law in use. It is comprehensible. First of all, these are the theoretical [5] and experimental [3] errors. The equivalence [5] of the Biot-Savart force is mathematically coarse since in this case the highest terms of expansion of force of self-action are cast out. This equivalence violates law of action and reaction and Ampere force law for which the principle of equality and collinearity of action and reaction forces is valid. Non-linearity of dependence of the torque of self-action on the current intensity [3] makes us doubt in the validity of these results. Moreover, typical values of force [2, 4] and torque [3, 6] are too small even if direct current in the circuit is significant. It is required to pass through the direct current of hundred amperes to produce the considerable displacement or turn of a body. As a result, small values of the effect caused ambiguity in the explanation of the phenomenon [1].

In fact, searching the reactionless propulsive devices we usually forget about the magnetic self-action which arises when a body consisting of a magnet and incomplete electric circuit can move violating law of action and reaction [7]. This violation is proved theoretically [8] but peculiarities of this motion are not well discussed. The principle of such a motion is shown in Fig. 1. This is the magnetic interaction between two current elements one of which is a part of a closed circular loop L and another is perpendicular to the first one. Since the force $d\mathbf{F}_{jm}$ acting on any current element of the loop L is perpendicular to the density of current $\mathbf{j}_m$ then the **Z**-component of the torque $d\mathbf{N}_m = [\mathbf{r}_m \mathrm{x} d\mathbf{F}_{jm}]$ is equal to zero while torque which exerted on the second current element by the magnetic field of the loop, does not.

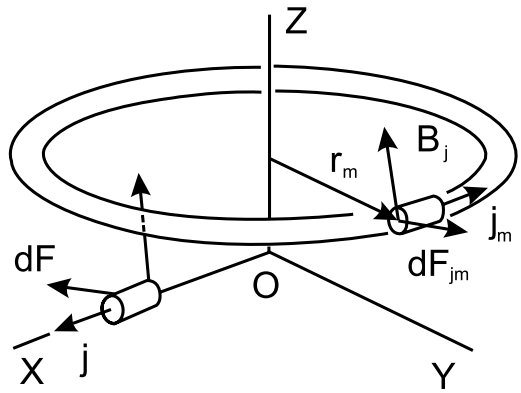

Fig. 1

Violation of law of action and reaction.
The force $d\mathbf{F}_{jm}$ with which the magnetic field $\mathbf{B}_j$ of another current element acts on the current of density $\mathbf{j}_m$, is not equal nor opposite to the force $d\mathbf{F}$ with which the magnetic field **B** of the first current element acts on the current of density **j**.

An experimental device is shown in Fig. 2. A commercially available ring-shaped carbon-steel magnet M (inner radius – 20 mm; outer radius – 55 mm, height – 25 mm) of 2.2×10^5 A/m magnetization is located on the cover of a cylindrical electrode E suspended by thread T. The electrode E is furnished with a central electrode C of the same height h and 5 mm diameter. The radius of the electrode E is 130 mm. The open end of electrode E and the central electrode C are submersed in a conducting liquid L_+ and L_- placed in two volumes of a vessel V so that the depth of submergence of these parts is about 5 mm. In this experiment the conducting fluid is 10% solution of copper sulfate ($CuSO_4 5H_2O$). The vessel V consists of two thin coaxial plastic cylinders of 2 mm thickness. The radii of the plastic cylinders having the common bottom are equal to 10.5 cm and 18 cm. The height of the vessel is 12.5 cm. A disk and a ring-shaped electrodes S_+ and S_- of 1.5 mm thickness are placed on the bottom of the vessel to supply the direct electric current of intensity I. All conducting parts of the device are made of copper. The thickness of the electrode E is 1.5 mm.

When the direct current ***I*** of density **j** flows through the electric circuit, the magnet and the electrode ***E*** rotate in the direction of the magnetic force ***d*F** which is proportional to the vector product [**j**x**B**] as shown in Fig. 2. This is a force of self-action by means of which the mobile part of this device consisting of the magnet ***M*** and the electrode ***E*** acts on itself. However there is no force of reaction which could cause such a rotation. This is really true since a ring-shaped magnet is equivalent to two cylindrical surfaces with the surface current of density $\mathbf{j}_m$. The force of self-action ***d*F** acting on the cover of the electrode is compensated by the force of self-action $d\mathbf{F}_*$ acting on the cylindrical part of the electrode ***E***. Magnetic induction field $\mathbf{B}_*$ "does its part" as shown in Fig. 2. Therefore, it would be appropriate to find out how the height of the electrode ***E*** influences the value of the torque **N**. Such an influence is demonstrated in Fig. 3.

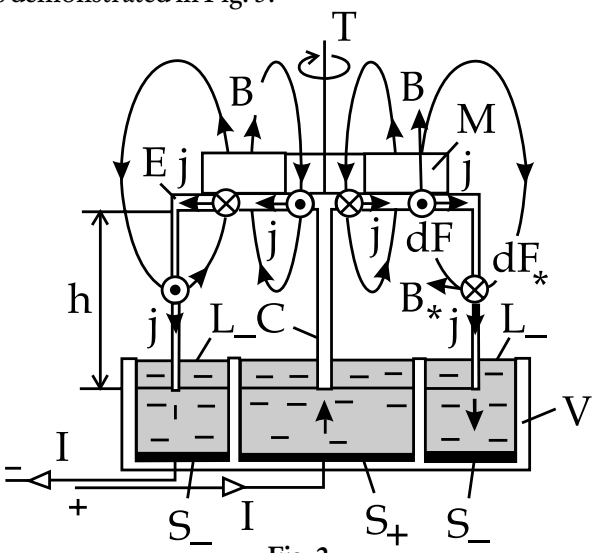

Fig. 2
Experimental device
(•) and (x) – directions of magnetic forces acting on various parts of the mobile electrode ***E***

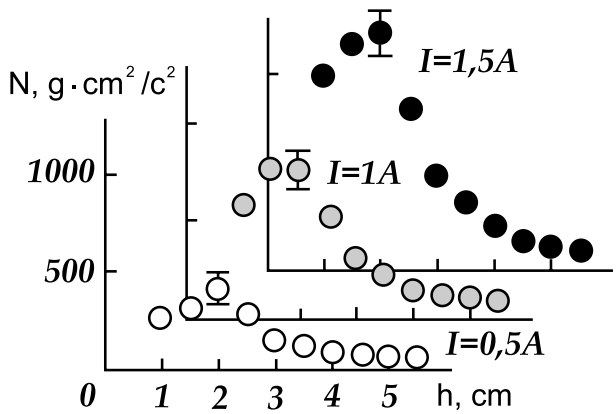

Fig. 3
Dependence of the torque ***N*** on the height of the electrode ***h*** at various values of the direct current ***I*** in the circuit

Thus there exists the value of the height ***h*** at which torque of self-action is maximal. This is the first result of the present work. At ***I***=1 A and ***h***=2 cm the electrode ***E*** turns at angle of 2.2 radian (126 °) with respect to the equilibrium position. Such a turn corresponds to 3.4×10^2 gxcm^2/s^{2}rad, i.e to the constant of torsion of the thread. The second result is that the maximum value of the torque of self-action ***N*** at the current ***I***=1 A is even larger than the value of the torque produced by the traditional unipolar device [3] at the current 50 A.

In fact, this work represents an attempt to draw attention to a more effective and simple practical application of the self-action. It remains only to transfer electric current in an unclosed electrical conductor and such a possibility really exists.

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Uranium Photoaccumulator

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Photoaccumulators are galvanic elements consisting of two communicating vessels, one of which is exposed to light and another is kept in darkness. Ionic composition of electrolyte, which fills these vessels, depends on intensity of illumination. If an inexpensive electrode is placed in each vessel, then a potential difference will appear. If the electrodes are closed at external working resistance the electron stream will begin to equalize ionic composition and the difference in illumination intensity will tend to disbalance it. As a result, a certain working mode will be established which will allow to utilize the photoaccumulator for production of industrial electrical energy. As distinct from the solar battery, which works while exposed to the light, the photoaccumulator stores some part of solar energy in its electrolyte which is supplied with electrical energy after sunset too.

The idea of photoaccumulator is not a new one. It was established in the end of 19th century that it is feasible to create a photoaccumulator containing electrolyte made of the following mixture: $Fe^{2+} + Hg^{2+} = Fe^{3+} + Hg^{+}$.

This photoaccumulator was not adopted in practice because of high toxicity of the electrolyte and very low EMF (approximately 0.018). Development of technology is accompanied by a widening range of materials and matters which can be used in large scale production and power industry. Among such materials are, in particular, titanium, depleted uranium and rare-earth elements. Nuclear power industry uses U235 isotope only. Naturally occurring compound contains only 0.72% of U235. Hundreds of thousands of U238 from which U235 has been extracted are kept as useless stock.

In the end of sixties in one of radiochemical laboratories of LINP (Leningrad Institute of Nuclear Physics) P.N. Moskalyov repeated the same experiment over a long period of time. In the morning he placed a tightly closed retort filled with uranyl-chloride soluted in compound of water, spirit and hydrochloric acid on the window-sill. The solution in the retort changed its color from yellow to emerald-green. Before leaving the laboratory Moskalyov removed the retort with green solution from the windowsill to a closed chest. In the morning Moskalyov retrieved the retort with the solution (which was already yellow) from the chest and placed it on the sill. The solution became green again and the whole process repeated daily.

Chemical processes in uranium electrolyte are rather complicated: first, under the light influence the uranyl ion oxidizes ethyl alcohol, which is then transformed to aldehyde: $UO_2^{+2} + C_2H_5OH^{+} = U^{iv}(OH)_2 + C_2H_4O$.

In the dark ions of urany-4 interact with aldehyde and are transformed to UO_2 uranyl ion and spirit again. Thus, **this cyclic process can take place over a significant period of time being supported by the energy provided by light quanta of visible light which are transformed into the heat.**

The idea of utilizing this process in order to obtain electrical energy emerged in the late nineties. The mechanism of uranium photoaccumulator is very simple (Fig. 1): two glass vessels, one made of transparent glass and another of non-transparent glass, are connected with a black acid-proof rubber tube. The communicating vessels are filled with aqueous electrolyte containing 40% of spirit, 80-100 g/l UO_2Cl_2 and 0.2 m HCL. The electrolyte is previously activated by multiple cycles of exposing it to light and then placing it in darkness in order to obtain a significant volume of aldehydic fraction. The major difficulty of designing uranium photoaccumulator is connected with the choice of the material for electrodes. In galvanic elements carbonized platinum electrodes are usually used. For practical use platinized titanium gives the best fit. Titanium foil covered with superfine layer of platinum is currently widely used in electrochemical industry and is procurable.

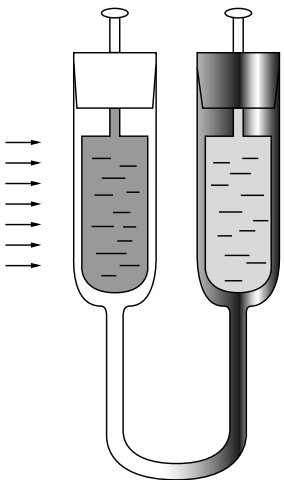

In the transparent vessel the titanium petal-shaped electrodes are parallel the light flow, so the light quanta move freely through the solution.

In working condition each photoaccumulator produces 10 mA of current at 0.3 volt voltage, so they are to be connected in large batteries, both in series and in parallel.

It is also necessary to consider the aspect of safety. Until now, the depleted uranium has been used for one purpose only, namely, for manufacturing of cores for armor-piercing shells. When used in this manner, the uranium is pulverized, which leads to environmental damage. The battery of photoaccumulators is placed in hermetic metal chest; the front panel of the latter must be made of solid safety glass. Such a system will protect the photoaccumulator battery from malicious intent and the security staff from weak uranium radioactivity.

International Prize on Power Engineering "GLOBAL ENERGY"

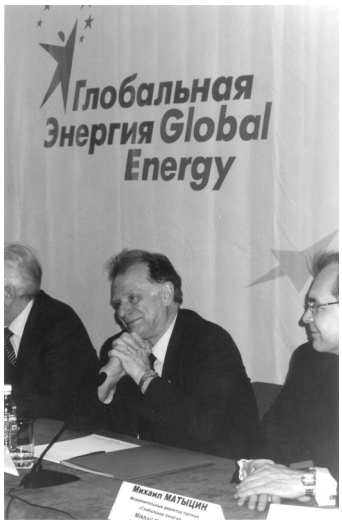

Zhores I. Alferov

International Prize "Global Energy" was first presented in St. Petersburg on June 15, 2003. The bonus fund of $900,000 was shared between three scientists "whose work has been and is still important both to the last century and future research", said Zhores Alferov, Chairman of the Global Energy Prize Award International Committee.

Nick Holonyak, Professor at the University of Illinois (USA), was awarded for "fundamental contributions to the development of power silicon electronics and invention of the first semi-conducting light-emitting diodes in a visible part of the spectrum". Thyristor invented by Holonyak allows the transformation of direct current into alternating and vice versa, to direct this process, to store and accumulate energy. This device is used for every electric locomotive, for frequency transformation. Such devices help to save significant amounts of energy, thus, about 30 percent of all energy produced in the world is processed through thyristors.

Nick Holonyak's other invention, i.e. semi-conducting light-emitting diodes in a visible part of the spectrum, has led to development of a new field of the modern power engineering. Supposedly, efficient and safe light-emitting diodes will replace daylight lamps in the next ten years.

"Although Nick Holonyak's invention dates back to the end of the 50ies of the last century, it remains current" said the Chairman of Expert Commission, Academician Vladimir Fortov. "This is one of the key inventions leading to the search of new ways of sustainable energy saving".

Diploma of Global Energy Prize laureate

Gennady Mesyats, Academician of Russian Academy of Sciences, and **Ian Douglas Smith**, Senior Scientist at The Titan Pulse Science Division, were awarded for giving birth to a new direction in the field of power engineering, i.e. power pulse energy. Due to their research, commutation of high-level currents at megavatt levels of voltage has become possible; a number of powerful current choppers have been created, futhermore, there have been developed transformer constructions which allow avoiding energy loss in power transmission lines. These research and innovations resulted in the creation of a number of unique pulse power machines and devices widely used in Russia and abroad ("Aurora", "Helia" (USA), "Sinus", "Gamma", "Maus", "Pik" (Russia) and others).

Teleportation

Review prepared by correspondent Alla Pashova, Russia

For conventional science, the term "teleportation" is not worthy of serious consideration unless ascertained by compulsory "quantum" teleportation. Thus, teleportation is unconditionally referred to microworld phenomena and, in fact, comes to distant information transfer. Spatial transference of a macroobject of definite mass has been excluded.

Teleportation of states

What does **quantum teleportation** mean? During active development of quantum theory, in 1935, the so-called EPR-paradox (Einstein-Podolskiy-Rozen paradox) was formulated in the well-known work "Can quantum-mechanical description of reality be full?" written by Albert Einstein, Boris Podolskiy, and Natan Rozen.

The gist of the paradox is as follows. There are two particles interacting for some time, thereby forming a common system. From the position of quantum mechanics, this coupled system can be described with a certain wave function. When interaction is over and particles scatter within arbitrarily large distances, they still will be described by the same function as before. At that, state of each separate particle cannot be known in principle that is apparent from uncertainty relation. Only when one of the particles enters a receiver, which records its parameters, the relevant characteristics of the other one emerge (exactly emerge, but not become known!). Thus instant unlimitedly distant "transmission" of quantum state of the particle is possible. Therewith, teleportation of the particle itself and transference of mass do not take place.

Einstein and his colleagues believed that existence of such particles predicted by quantum mechanics prove theory incompleteness. Thereof, the scientists inferred the necessity of other parameters (besides wave function) to describe quantum states. Otherwise, from the local viewpoint, correlations between elements of such a system could not be understood. It was far much later, when Bell showed that some of measurements could define these correlations and exclude any local hidden parameters. It was not until early 1980-s that famous experiments were performed finally eliminating a possibility of local hidden parameters.

In 1980, Alan Aspect experimentally proved that EPR-paradox in quantum world takes place indeed. Special measurements of state of EPR-particles indicated that EPR-pair not only has a common origin, but in addition, that one of the photons somehow "get to know" the way the second one was changed. In further experiments, existence of EPR-paradox was affirmed, even if particles of EPR-pair were removed from each other over a distance of 10 kilometers or so.

In 1993, Charles H. Bennett and his colleagues worked out a method to transfer the quantum state of some object of the microworld to another quantum object by means of EPR-pair and called this method "quantum teleportation". In 1997 a group of experimentalists under the direction of Anton Zeilinger for the first time implemented quantum teleportation of the photon state in the University of Innsbruck.

In such a way, researchers keep on improving the process of quantum teleportation. In 2001 Danish scientists managed to link gas particles spaced at a substantial interval from each other, by transmitting information about quantum state from one particle to another by means of laser. The quantum teleportation between two gaseous clouds were attained by Eugene Polzik and his colleagues in Orkhus University. They succeeded in coupling about million of cesium atoms, whereas the previous record was only four atoms.

Scientists of Australian National University destroyed a laser beam and nearly instantly recreated it in another point in space; in other words, they teleported photons of the laser beam. In contrast to previous similar experiments, the physicists managed to obtain the required result in 100 percents of cases. Ping Koy Lam, the head of the task group of Australian University, claimed that the first atom of solid substance was likely to be teleported within near three to five years. However, as most scientists admit, a task to teleport a human remains almost impracticable. Even teleportation of atoms, as compared to that of photons, is much more complicated process. It is even harder when dealing with molecules. It is basically possible (though practically very difficult) first to transfer a molecule to a minimum-energy state (ground state) causing it to radiate a certain

sequence of photons. These photons will find themselves in a certain superposition containing all the "quantum" information, which was available in the molecule. Thereafter, it is possible to teleport photon states by means of EPR-pairs. Moreover, it is also required that the classically measured information about a molecule. If molecule of minimum-energy state is present in the receiver, then this molecule, by interacting with teleported photons in a required order, will transform to the quantum state identical to that of the initial one. Consequently, the quantum state of molecule of a certain material will be transmitted, actually with velocity of light. When that happens, the quantum state at the transmitting side will be destroyed.

The human organism comprises about 10^{27} atoms. To save and transmit information on properties of that number of particles seems to be practically unachievable. "Theoretically, nothing prevents us from doing that, but complexity of the problem is such that now no one seriously thinks about the solution" – states Ping Koy Lam.

Being a method of information transmission, quantum teleportation has found its application in quantum computers, whose information is stored in the form of a set of quantum states. Impossibility to wiretap and copy transmitted information is considered to be an advantage of such computers. Those researchers, who, nevertheless, wish to answer the question of "How to teleport matter, but not its state?" have to seek for more perspective theories and techniques.

Teleportation of material objects

Those people, who really want to realize instant spatial transportation of objects, i.e. teleportation, should refer to studying properties of Space and Time. Quantum teleportation has a certain finite velocity that cannot exceed that of light. The genuine teleportation assumes that an object should set off from a starting point to a finishing point (these points differ by a certain distance X), at that the transference time comes to zero. The object to be teleported is not changed or taken to atoms to be gathered later at a distant point of space according to information transferred to this point. (Fig.1).

The object disappears from one place and simultaneously appears in another place. How is that possible? A body will disappear from point A and appear in point B if to bend space in such a way as to let point A and point B coincide. Then the object will instantly appear in point B since there is no interval between points A and B. Teleportation could be realized by a device, which would make it possible to superpose points A and B.

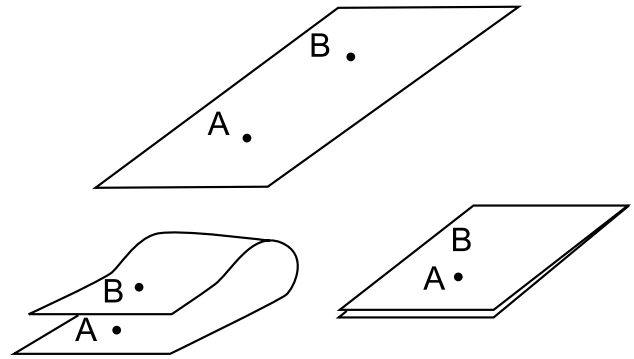

Fig. 1

Space is supposed to be unbendable without enormous energy consumption. However, Alexander V. Frolov points out that this issue is not so unambiguous: "Normally we consider space in connection with "natural" course of time existing in it. That is some degree of space curvature. Let us assume that it can be changed. The space curvature can be considered as acceleration or deceleration of time. Acceleration always demands, for instance in mechanics, some energy consumption. But if we "decelerate" time, energy is liberated and it can be accumulated for subsequent use".

K.Z. Leshan suggests surrounding a transferred object with a closed surface consisting of vacuum holes. Inside such a "hole sphere" there is geometry similar to that of a black hole. This place is absolutely isolated from the external Universe. No radiation is able to penetrate through the hole in space and time. For an observer, who is inside the hole sphere, the distance between sphere center and its border is infinitely large, since spatial metrics is ever-varying from the center to the border. Distances between the points is continuously shortened so that the distance between any couple of points comes to zero at the very hole surface. A matter transmitter can have inner or outer hole surface. In the first case a teleportation station has a spherical chamber to place the object. Equipment to produce holes should be located upon the outer side of the sphere. Such a station is capable to provide hundreds of launches a day by instantly expulsing spaceships to deep space over distances of millions of light years.

From microcosm towards macrocosm

Simeon Bocharov (member of Chemistry and Biochemistry Department, University of Delaver, Newark, USA) considers teleportation phenomenon using microobjects as an example and applying an interesting conception of protomatter.

In S. Bocharov's opinion, many paradoxes of the present-day science could be solved under condition of considering the whole existing matter to be a single continuum, i.e. protomatter. At this approach, the microcosm objects are not independent ones, being represented in the form of distortions of the very continuum and its manifestations here and now. Protomatter, whose distortion degree is beyond modern possibilities of detection, corresponds to vacuum. In the present-day paradigm redistribution of protomatter distortion corresponds to motion of particles. The important peculiarity is a refusal of such concepts as structure, dimensions, mass and other macroscopic characteristics with respect to microcosm objects, since here they are not considered as separate entities.

For experimental justification of his theory, S. Bocharov suggests to consider teleportation of microobjects incorporated in fullerens under low temperatures and pressure.

As a basis for reasoning he takes the fact that identical or similar conditions, whereon distortions are located, bring them to the state of identical or similar by lability/diffuseness. And vice versa, distortions, which are similar by lability/diffuseness, influence their near surroundings, creating, as a result, similar macroscopic states. In such a case protomatter distortion (in some spatial domains and under similar conditions) will cause appearance of similar distortions in another domain, whose degree of removal depends on presence of other distortions and their characteristics. In other words matter will be teleported from one spatial domain to another.

Possibility to realize teleportation of microobject causes the well-known phenomenon, which is nowadays described as embedding of particles into inner hollows of spheroid fulleren molecules without reacting with them. As object of teleportation there can be used distortions classified as elementary ones, such as hydrogen, helium or stable matters (noble gases). In both cases the influence of objects upon surroundings is minimized.

The researcher believes that in case of successful experiment, new pattern of matter structure will be confirmed, and valuable teleportation of microobjects (with prospects of such possibility for macrocosm objects) will be demonstrated.

One more approach to teleportation of physical macroobjects was considered in the work "Practical application of time rate control" (New Energy Technologies No. 3, 2001) by Alexander V. Frolov. It is assumed that density of space (aether) energy determines rate of passing of any processes including the very process of matter existence. Changes of aether density (increase or decrease) must result in the emergence of a force analogous to that of buoyancy, though acting towards the fourth dimension. This "chrono-motive force" (CMF) is also an analogue of electromotive force (EMF) and can be generated by analogy with electrodynamics. According to Alexander V. Frolov, laws of quantum mechanics as to discretization of levels of energy of material system, which exist in the domain of increased or decreased aether density, are valid in the macrocosm as well. Teleportation (as a transition from one state of the system to another one) can be studied with electron transference from one orbit to another as an example with the only difference that for the teleported object not only its location, but also the very spatial properties are changed. In aether of different density (after discrete transition) the same object will have different space around it, wherein time is decelerated or accelerated. Experiments of this field have already been in development stage.

Therefore, modern theoretical physics has handed the problem of teleportation to researchers-experimentalists, who possess sufficient breadth of mind. Perhaps, using teleportation technologies, they will manage to fundamentally alter the process of space exploration and raise our civilization up to radically new development level.

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"Mass defect" in Home Conditions

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The idea to conduct experiments on "mass defect" demonstration appeared after a cycle of seminars, which took place in1993-1996 at the Moscow Aviation Institute under the direction of V. I. Patrushev, Doctor of Technical Sciences, Professor of "Designing of aerohydrodynamic systems" Department (the author of the article is also a graduate of the Department). At the seminars, an enterprising group studied and developed an applied theory of "Displacing fields" by Alexis V. Murlikin and an associate "Theory of energy exchange processes". Later the group was called **"Group studying non-inertial transference"** (non-inertial natural processes).

The experiment was aimed to test some theoretical suppositions, namely, that it is possible to influence on existent energy flows which input and output to the matter. At that the simplest way to influence indirectly is to change the medium the flows come through. In general, optic experiments on luminous flux refraction show the same. But light refraction and change of speed of light propagation at passing through different mediums is one thing; and change of mass of a material body is something new that has not ever been dealt with. Moreover you can consider light (i.e. electromagnetic radiation) to be the secondary manifestation of output energy flow. Besides mass defect is very important for nuclear physics because it "helps" to develop this branch and stimulates drawing "energy dividends" in splitting reactions, decay reactions and nuclear fusion reactions. But unfortunately we can not touch element nucleus and even million nuclei while we can easily touch metallic balls of 1 gram weight.

Let us note that a concept of mass is one of the most uncertain in physics. We can not measure mass directly. It is possible to do it only indirectly, by gravity, using scales (it does not matter what kind of scales are used), or by kinetic momentum (in this case mass is a measure of inertia) by means of dynamometers.

Thus it is evident that change of WEIGHT shown by scales is not MASS change as measure of matter quantity. Since one of the most important points of the theory of "Displacing fields" is creation of a vehicle of new generation, then one of the major tasks is to overcome gravity (to decrease weight). And this "home experiment" shows the way to solve it. However we can call it "home" only in part, because for weighing there were used electronic scales (mass-comparator with measurement accuracy of 0.1 microgram. (See Fig. 1).

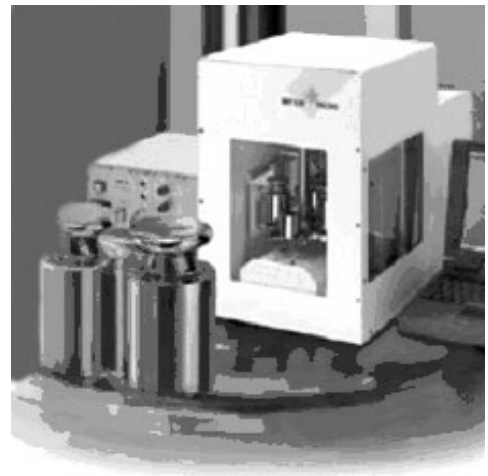

Fig. 1

Precision scales METTLER TOLEDO allows making:
High-accuracy weighing in the range
from 0.1 microgram to several tones
Measurement with resolution up to milliard points

Two sets were designed for weighing. The first one had an aluminum (Al) ball-kernel which weighed 1 gram and a lead (Pb) casing-shell consisted of two parts (half-spheres) which also has weight of 1 gram. The second set had on the contrary a lead kernel and an aluminum casing. The sets were disassembled and then hermetically assembled to make a single device with no gaps (See Fig. 2).

Since it had to be done with great accuracy and it was a piece article, not a Moscow product company undertook to produce it. And only one of the students, Nicholas Sorokin, a young boy with skilful fingers, had

helped. He invented a technology which allowed making balls of the necessary size at home conditions. He was literally pickling every micron of metal with acid and finally got the necessary size and weight.

So, the weight of a non-assembled set was: 1 gram (weight of kernel) and 1 gramm (weight of shell). Weight of an assembled set, according to the "Theory of energy exchange processes" by Murlikin, is not equal to the simple sum of the non-assembled components, and mass defect would be different for various sets right up to the change of sign.

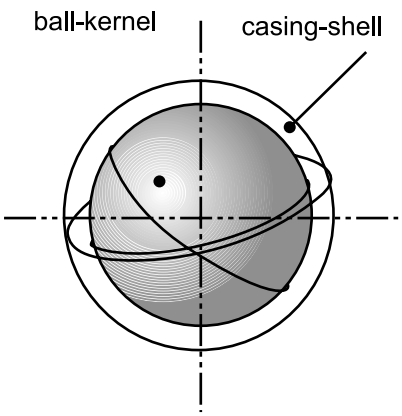

Fig. 2

Set of experimental balls

More than 50 experiments was carried out on weighing for every set. Assembled sets as well as non-assembled sets were weighed. **It was confirmed that there was an interaction between input and output flows for MATTER MAINTENANCE. It became apparent in the form of mass defect. Defect appeared in the sixth sign, i.e. it comes to the range from 0.0002% to 0.0007% of "kernel" mass (or "shell" mass). At that the lesser mass defect corresponds to aluminum shell, while the greater one corresponds to lead shell. Accuracy of weight measuring by the mass comparator exceeded the acquired result by 10 times. So we could not tell about inaccuracy of measurements.** So we had to apply to the "Russian center of testing and certification" which was very famous all over the world (Rostest-Moscow).

In general that is all, we have got an answer for ourselves, and the period of testing is behind. We have to advance; very much is still to be done. In addition let us mention one more surprise we got during the experiments. The matter concerns some time delay in receiving final results of every weighing. A qualitative picture of it is represented in Fig. 3. We did not expect that this effect would appear at such a rough level of measurement of energy exchange processes.

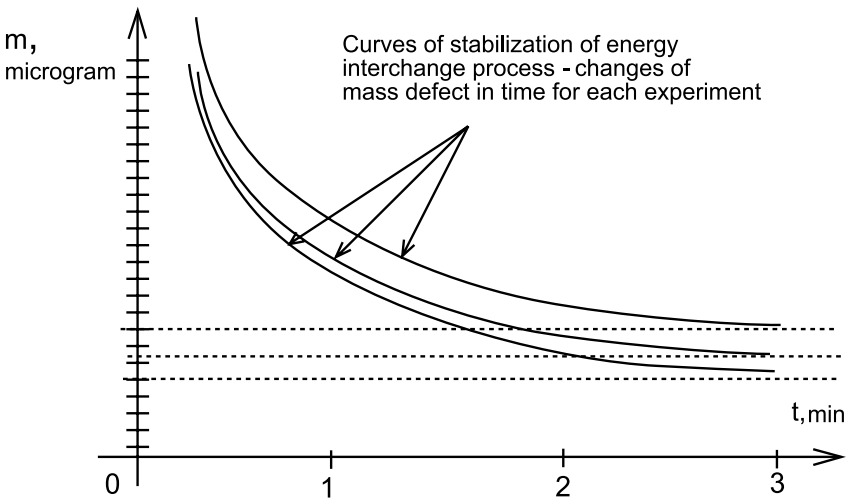

Fig. 3

Time stabilization of the process for receiving final weight

The subsequent report and detailed discussion of the experimental results by specialists (including physicists of various specializations) resulted in an unexpected non-recognition of facts and distrust. The main argument was a demand to increase the number of experiments up to 5-10 hundreds. And only then scientists would be ready to accept facts. It was quite a predictable reaction for the orthodox science in the middle of 90s. It remains to hope that if the discussion took place today it would have a paved way. However it is not a fact.

In conclusion let us note that this experiment on revealing mass defect ranks with famous experiments, in which rotating gyroscopes also demonstrate mass defect (decrease of weight) and even one of higher order than in our experiment. But in return we have no rotation, no chemical and nuclear reactions, while mass defect is presented.

Let us add that it is possible to complicate the task: to make a double casing and to choose other materials for "kernel" and "shell". (See Fig. 2). In our case low prices and availability made us use Al and Pb. The results will be more interesting, for example, with Li and Os (and with other supertransuranic elements).

Aether as Unified Field

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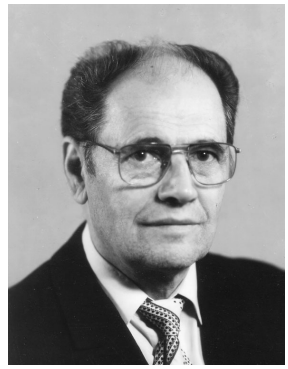

Based on the original observations and experiments, the article gives more precise definitions of aether model, than which was previously elaborated. General laws of the Universe aetherodynamic are considered. There is described a new physical reality in the form of quasi-real aetherodynamic structures ("topological harmonics") generated by dynamics of the substantial world.

At the present-day stage of physics development words of Maugham, an English philosopher, take on particular topicality: "The great verities are too important to be new". Indeed, we are increasingly making certain that our remote ancestors were familiar with fundamental laws of the Universe; furthermore, they knew these better than we do. But which methodology of cognition of Nature and what kind of information sources did the ancient scientists have? Today, we can openly say: they had not ordinary experience only, but also esoteric, pretersensual one, without feeling any necessity to be divided into materialists and idealists. For more details on evolution of physical ideas, refer to work [1].

In discovering all over again, I also had to elaborate a "cellular taction" strategy, which enables the most important characteristics of aetherodynamic processes to be sensually perceived and evaluated. The main thing is that all my sensory observations are definitely reproduced at laboratory experiments while the simplest physical equipment is used.

We may get reliable knowledge about Nature from Nature itself only. Thus foundation of classical physics describing usual substantial world is also based on empirical facts studied by Galilei, Newton, Faraday and many other physicists-natural philosophers. I also would like to defend great Newton against attacks on his adherence to inductive methods which really brought imperishable values into science.

A new convolution of cognition is possible on condition of introduction into science of new concepts based on empirical study of physical entities previously unknown. Thereupon, I share the thought of Elena Ventzel, professional mathematician: "Mathematical methods are not useful, but harmful until phenomenon is not studied at a pre-mathematical, humanitarian level". It is ideological and logical language that may be used today to discuss the aether problem, whose solution calls for comprehension of natural-science facts, which are beyond traditional notions settled over centuries.

The long-term investigations have confirmed that exhaustive definition of a fundamental natural entity was given by Rene Descartes: "Universe does not contain anything but aether and its vortexes". This is not merely a postulate; this is an objective summary of empirical observations of Nature phenomena. In any academical model of microcosm there is no answer to the question: what kind of substance are electrons, quarks, strings made of? That is the very substance our forefathers called aether. Aether is unified field indeed; and it appears that for nearly his whole life Einstein had been searching for something that was under his foot.

It must be recognized that there is no undistorted, quiescent aether in Nature; as well as no zero-size vortexes exist. Therefore, in a customary sense, the aether concept is pushed behind transcendental horizon and turned into an inconceivable entity whose mystique is tantamount to religious ideas. However, all quantum vortex-wave distortions of the superfluid three-dimensional aether, which have an appearance of tori, threads, solitons and occupy spatio-temporal spectrum from zero to inter-universe scale, are material and contain energy under scientific interpretation. Any spaces such as turbulent fields, physical vacuum, gravitational fields and, of course, matter are material. All of them are etherodynamic structures of the real world. Spatial hierarchy of aether vortices is referred to as quantum stairs, fractal structure or "matreshka" [2-5].

To understand basic laws of aetherodynamics it is necessary to give a general definition for classical matter

and other aether states. As a first approximation, let us give the name of matter to aether microscopic **left-screw** self-oscillating vortex-wave systems (elementary particles), whose existence and parameters are conditioned by higher hierarchical systems. This is our displayed world, with its electromagnetic fields and fundamental constants. Let us refer to vortex-wave structures of any vortex size, which in the considered space domain are **balanced** by a number of left- and right-screw vortices corresponding to matter and antimatter with prefix "quasi" to a free aether. Stable vortex lattices with alternating direction of helicity can be also considered in this case. Under natural conditions everything but classical matter or electromagnetic and gravitational fields can be related to the free aether. In the first place, these are the so-called physical vacuum and vortex fields, which attend gravitation. They represent anisotropic nonlinear subspaces and occupy definite places on spatio-temporal spectrum of the world aether. Particular free subspace creates an aggregate of topological harmonics [5] attending all the physical processes. Satellite of the gravitational field is distinguished because it belongs to specific class of stable vortex lattices.

Apparently, in general case, energy of free aether is virtual for our world due to its helical symmetry and quasi-matter, from the view of difference in sizes of typical vortices which correspond to protomatter. But this is not the entire point. There is also superfluidity of aether, whose vortex viscosity has marvellous properties. As a result, there are created phenomena of inertia and energy-information barrier separating material world from constant influence of quasi-real structures or turbulated space.

Classical inertia, as vortex viscosity, arises in the microscopic and more fine-structure free aether (in Newtonian space) and ever regularly reveals itself during acceleration of material bodies. However everything is different at stage of macrovortex aether, where inertia has properties of adaptation. Here it is affirmed that inertia phenomenon is "spread" throughout the spatial-temporal spectrum of vortex distortions of aether field. At that nature of inertia is changed. Within topoharmonic subspace in laboratory scales, the inertia law "diminishes" in time according to exponential dependence, whose time constant is determined by specific conditions and varied over wide limits (from seconds to many days). On the expiry of this time, inertial intercoupling transforms to the law of flicker effect. It may be said that flicker effect specify penetrability of energy and information barrier after expiry of time of paraphysical regular phenomenon [6]. Consequently, most of time the interaction with free macroaether is of random character and should be evaluated by mean observation.

To extend conceptual scope of our investigation it may be added that in classical hydrodynamics a liquid, along with ordinary inertia, has determined vortex macroinertia, which is created by vortices of the liquid itself. Therefore, it is necessary to keep on comparing processes at all levels of the unified field of aether. For instance, electric inductance is a kind of specific inertia, and topological harmonics of electromagnetic and other phenomena are subjected to the energy-information barrier (under laboratory conditions).

In the above arguments, the principle of relativity is latently and unconsciously presented. However, this complicated question needs to be separately considered. Physical nature of the energy-information barrier and reason for dependence of the inertia properties upon the size of vortices of free aether remain unclear, too. However, it can be supposed that classical elementary particles, as distinct from protomatter, have self-oscillating properties and are commensurable with vortices of the surrounding free world; and that the above-mentioned energy-information barrier does not exist for them on microscopic section of the spectrum. The gist of the barrier itself comes to "memorizing" topoharmonic processes by Earth's gravitational fields and laboratory equipment. Turbulent fields (physical vacuum) do not have such a "memory".

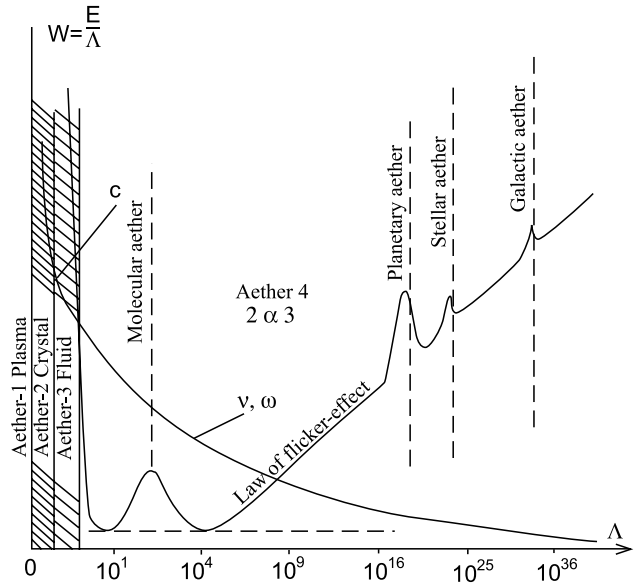

Fig.1

Fig.1 depicts diagrams of spectral density of vortices' energy; diagrams of rate of interaction transfer v and circular frequency ω depending on sizes of vortices of the world aether Λ (in picometers). As we can see, velocity of distortions propagation v is equal to velocity of light C in the physical vacuum, i.e. in electron sizes, exceeds C in nanocosm and tends to zero toward megacosms. Circular frequency of vortices rotation and course of physical time have the analogous qualitative dependence. However, vortices energy W has a feature and grows toward both ways from the lab scales; the aether numbers have been assigned conditionally, but all the specified phase states reflect some physical reality.

One of the most complicated questions is a definition of vortex matter in each particular case. The diagram demonstrates energy of free aether in the form of protomatter (simplest elementary particles – vortexes), and energy of classical elementary particles as helically definite self-oscillating emissions of aether field is localized in the most nonlinear subspace (physical or substantial vacuum). Unification of the elementary particles into atoms and macrobody does not denote direct transition to parallel world with different fundamental constants, whereas change of vortex size in the diagram exactly implies such a transition, though at a level of protomatter. This is a very intricate and crucial point. For example, a star is, unconditionally, an elementary particle of the relevant level of the Universe, even though comprising the ordinary matter.

Left wing of energy spectrum reflects property of the turbulent field of aether to gravitate, to sink down to the "bottom" transferring energy to the vortices of lesser scales. This phenomenon of distributed "gravitation" is available in every space point and explains a least-action principle. An illustrative analogue of this regularity is represented by the Earth's gravitational field and structure. Dense plasma assumed as iron core is situated in the center, and higher - there are magma, solid crust, water and air. These phase states exist in free aether within universe scales as well. Consequently, in femtocosm, and maybe at an even deeper energetic "bottom", there must be a plasmic subspace; evidently, it is assignable that aether translated from Greek means "fire".

Increase of energy to the right is connected with extending a dynamic band of the vortices spectrum, as the scale increases. In our world, this increase follows the flicker effect law, but this is only what we perceive across the energy-information barrier. Actually, at this section the vortex energy must increase well more strongly, because **our observation capabilities are limited** by accessible matter processes. Turning back to stars, one may affirm that modern science is unable to evaluate their real energy (evaluations are considerably underrated). The Galaxy vortex entrains such deep levels of multidimensional space-aether to its rotation that this causes violation of the Newton's law of inertia. Notion of "hidden mass" is unnecessary for explaining dynamics of galaxies. It is quite enough to take into account that differential rotation entrains the fine-structure aether (inertial subspace), and this process results in decreasing the inertia and external centrifugal forces. Unfortunately, Fig. 1 reflects only a characteristic size of the galactic vortex and does not visually demonstrate its active band of the spectrum. The finer is the space structure, the more inertial and closer to the absolute reference frame is the space. Obviously, the non-homogeneous, stereodynamically multidimensional and multiphase aether requires a perfectly new theory of random fields, which would also make allowance for the phenomenon of the material world.

Energy motion processes or spectral energy-cascades along abscissa axis are of decisive importance for existence of our world and the Universe. These processes have unusual properties. The "violet" cascade is attended with reduction of vortices size, absorption of matter energy and tends to increase energy concentration at the "bottom" of the world aether (near ordinate axis on Fig.1). This regularity experimentally confirmed in both spatial and temporal domains is a direct consequence of the above-mentioned phenomenon of distributed gravitation and clarifies an existence of the left wing of the spectrum. In classical physics "the violet" cascade effect is reflected in the least-action principle as well as in the thermodynamics laws.

The "red" energy cascade (right wing of the spectrum) corresponds to increase of vortices size and is accompanied with energy liberation. To start it up under earthy conditions special technologies are called for [7]. This has been confirmed with laboratory experiments and underlies the "perpetual motion" theory, where energy is pumped from nanocosm to the classical material world. Conception of artificial biofield [6], I have developed, considers methods of creating the aether vortex-wave macroscopic-scale distortions in physical systems. As a matter of fact, we deal with **ways of extending of natural spatio-temporal spectrum of aether (which settled into itself) by creation of a subspace of the topological subharmonics of the classical elementary particles, atoms and molecules**

(physical bodies), within the context of the etherodynamics fundamental law [5].

Even within action of fluctuating energy-information barrier, the spectrum right wing exhibits existence of natural processes in Nature that, supposedly, violate the known laws of thermodynamics [8]. But, as far as Nature cannot conflict with itself, we have to recognize that there is another physics, which "works" in geographic and greater scales, where role of the energy-information barrier demands to be reappraised. To all appearance, the universe vortex partialyl entrains plasmic subspace of aether into its rotation, and conditions for realizing "red" energy-cascade and generating matter are created on the sections of the maximum density gradient ("spectral" non-linearity). But the same way as a fish in ocean does not know reasons for storms and currents, we will never learn which force untwists the Universe handwheel, whose energy feeds our substantial world.

There are two components of free aether field that are the most essential for the present-day physics. The first one (left wing) is positioned on the spectrum beside the "bottom" in the form of dense liquid-crystalline "plasmatic" medium transforming to the Newtonian inertial subspace (physical vacuum). Since inertia is as regular as electric inductance is, the first subspace proves to be especially material and not such free, because it has properties which were imposed by the Universe rotation and distributed "gravitation". Let us conventionally limit the spatial spectrum of the first component with a nucleon size. The second component of aether space (right wing of the spectrum) stretches towards larger scales.

Except for known cosmic objects, this is an unknown ocean of the macrovortex and really free aether, or topoharmonics, which are born by dynamics of the substantial world. It is an experimentally proven fact that topoharmonics are generated by photons, electrons, and all the moving bodies [5, 9].

The second component has an ability to conversely affect the matter it was generated by as well as other material objects via "flickering" forces [10, 11]. This special subspace turns out to be doubly virtual, a genuine phantom. That is why, it has been winning the status of a real physical entity with such a difficulty, while Chinese philosophers were familiar with the same thousands years ago, separating entities "yang" and "yin".

The laboratory experiments indicate that topoharmonics have not only properties described in [5], but also an ability to interact with the space, creating a static domain of the excited aether in the course of propagation of the vortices-waves. At that physical bodies placing within this space volume are "charged" [2, 9]. The mentioned active domain (horizontal route) is "separated" by the Earth's gravitational field as follows: quasi-substantial constituent rapidly settles down creating vertical flow, but some phase structures are disintegrated very slowly (days, months, years).

The surprising thing is that biosystems equally belong to both aether components, not experiencing any constraint from the side of the energy-information barrier. The so-called human biofield is a topoharmonic part of physical body. It occupies its place on the spatio-temporal spectrum (Fig. 1). Quasi-substantial constituent (yang) and antiquasi-substantial one (yin) are strictly balanced, and acupuncture points and chakras are an analogue of Hartmann's geophysical grid, which is well-known to paraphysicists.

Conceptual generalization of physical ideas in the context of unified field of aether gives a constructive, cognitive impulse in solving of different problems, such as Nature's choice of exclusive laws for existence of "left-screw" material world as well as the problem of flicker-effect. At that, researching into the physical processes responsible for proton positive charge is of fundamental importance.

In conclusion, let us take note of conventional character of dividing the aether field into two components by the form of energetic spectrum. As a matter of fact, topoharmonics are generated by matter towards both larger spatial frequencies (subharmonics) and smaller ones (harmonics) and fill all levels of the Universe. The aforesaid is aimed at making perception of the most studied aspect of the **new physical entity** (vague due to diversity of hypothetical descriptions which exist in publications on this subject) more accessible.

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GLOBAL ENERGY

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Lately, the notion "Global energy" has become widely spread as a prize corresponding to this notion has been instituted in Russia. Since the Euclidean times, an unwritten law exists in science: to give definition to the notions, which are involved in scientific analysis. It is done for the purpose that everybody who uses this notion can understand the sense implied in it.

The Global energy problems have been discussed for a long time; they are well known. Depletion of natural energy carriers (oil, gas and coal) is the first problem. Environmental safety of energy carriers is the second problem. It is generally recognized that the solution of the issues connected with the aggregate of these two problems is of a global character. The results of scientific research, which should deal with global energy, originate from it. First and foremost, they are such scientific investigations, which result in the possibility to use an inexhaustible and environmental friendly energy carrier. It has been known for a long time. It is hydrogen produced from water.

Why hydrogen and why from water? At combustion of hydrogen, water is regenerated; thus, the energy carrier is inexhaustible. As far as inexhaustibility and environmental safety are concerned, hydrogen has no competitors. However implementation of these qualities is restricted by large energy expenses for hydrogen production from water. For hydrogen production, modern electrolyzers use from 10 to 20% more energy than it is produced at combustion of hydrogen.

It is easy to imagine what financial and intellectual resources of the world are included in the search of the ways to reduce energy expenses for hydrogen production from water. In Russia many scientific institutions of applied research and educational institutions deal with this problem. There is a Research Hydrogen Institute.

The associations of scientists on hydrogen energetics have been established in USA and Europe. This year, they carry out their regular scientific conferences, to which the author of this article has been invited.

Editorial: Let us note that it is not necessary to coin new scientific term "global energy", since quite for a long time the notion of "free energy" is used. This term represents the idea of the possibility to freely use energy by a consumer.

Energy problem is global not due to depletion of oil and gas, but due to their environmental unsafeness. However the confirmations exist that the world owners of energy resources do not bother about the problem of environmental unsafeness of modern energy carriers.

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Energy problem is global not due to depletion of oil and gas, but due to their environmental unsafeness. However the confirmations exist that the world owners of energy resources do not bother about the problem of environmental unsafeness of modern energy carriers.

In history of science, the facts of annihilation of the scientists who have won success in reduction of energy expenses for production of hydrogen from water have already been registered. The requesters of these actions think that they will lose their profits with the coming of hydrogen energetics. They do not understand that this process cannot be abrupt. It is impossible to replace the infrastructure of the existing energy carriers by infrastructure of hydrogen energetics within one or even ten years. Besides, infrastructure of hydrogen energetics will not be created on a blank place. It will be integrated into the existing infrastructure of energetics gradually; and its owners will automatically become the owners of hydrogen energetics. The first step has already been made in this direction. In the USA, a decision has been taken to equip all filling stations with pumps to fill the cars with hydrogen.

It is known that a priority of results of theoretical investigations is their publication in press. Usually, such priority is a personal one. Generally a patent is a priority of the results of experimental investigations. As a rule, this patent belongs to a group of authors. A published patent is a genie released from a bottle. No finesse of the authors to hamper a reproduction of experimental data given in a patent without the participation of the authors can stop the process of their implementation. Thus, the authors or a group of the authors who have filed an application for a patent are deprived automatically of the opportunity to influence the process of practical realization of their ideas.

In Russia, the state is a main patent holder of the global patents. Due to the well-known reasons, it has proved to be unable to control the course of scientific investigations and to forecast significance of their results.

It is known that if it becomes possible to reduce energy expenses for hydrogen production of water fivefold, it will be the cheapest energy carrier. Russia has already got technology, which reduces these expenses tenfold and more. However another way of looking is more perspective. Is there any use to decompose water into hydrogen and oxygen and to use hydrogen as fuel for heating, for example, of water in heating systems? Is it possible to make water generate heat? It turned out that, it is possible.

In Russia, three firms ("Yusmar", "Termovikhr" and "Noteka") sell cavitation heating equipment with energy performance index up to 150%. Official science looks awry at this activity, since such results conflict with one of the main laws of physics: law of conservation of energy. But market profit is stronger than this law.

Meanwhile, engineering practice has already proved that additional energy in the form of heat is generated in the ventilation systems and in the systems of water cavitation. Thorough scientific analysis of this problem shows that physical vacuum is the most probable source of additional energy in the systems of ventilation and water cavitation. Valence electrons of destroyed molecules of water take energy from physical vacuum and release it during repeated fusion of these molecules.

Why is additional energy generated in the air systems of ventilation and in systems of water cavitation? Because they are mechanical systems and mechanical destruction of chemical links requires half energy as compared with thermal destruction of these links. This is the main reason why one fails to increase energy performance index of cavitation processes over 200%.

Certainly, an increase of efficiency of any process by 30 or 50% is a good result; if it is obtained, it is possible to get even better one. But what if a water molecule is destroyed not mechanically, but electrodynamically? In this case, it becomes possible to find resonance frequencies of influence on the molecules and therefore to reduce considerably expenses of electrical energy for their destruction. Subsequent fusion of destroyed molecules will release determined quantity of energy unavoidably. It is a simple idea, and it has already been implemented. At electrodynamic influence on water molecules, electrical energy is converted into thermal energy with tenfold energy performance index. It means that if we spend 1 kWh of electric energy, we will get 10 kWh of thermal energy. To obtain such results, it is necessary to have knowledge of physchemistry of the microworld, which corresponds to knowledge of the 21st century, and it has already been published. Every month more than 1000 foreign scientists become familiarized with this knowledge at
http://Kanarev.innoplaza.net and
http://book.physchemistry.innoplaza.net.
The Russian speaking readers get this information from:
http://www.n-t.org/tp/ns/if.htm,
http://www.ikar.udm.ru/sb28-2.htm and
http://www.n-t.org/tp/ts/eb.htm.

I hope that now the readers will know the essence of the notion "global energy" and will understand those results of scientific researches which can really solve the related problems.

Energy Balance of Fusion Processes of Oxygen, Hydrogen and Water Molecules

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There is revealed the cause of appearance of additional energy during formation of covalent bonds in the fusion processes of oxygen, hydrogen and water molecules, besides the source of this energy is described.

Introduction

Engineering practice connected with servicing of ventilation systems allows revealing appearance of excessive thermal energy in circulated air. Similar phenomenon has been registered in systems of water circulation with the devices for its active cavitation. The results of our investigations explain not only a cause of these phenomena, but they give an opportunity to perform quantitative calculations for energy processes, which generate additional thermal energy [1], [2], [3], [4], [5].

Theoretical part

An oxygen atom is the eighth element of the periodic table. It is situated in the sixth group. The structure of its nucleus is given in Fig. 1 [1], [2], [3].

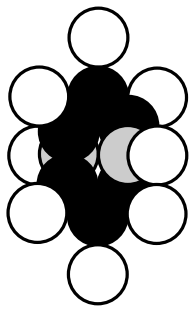

Fig. 1
Diagram of nucleus of oxygen atom: light – the protons, dark and grey – the neutrons

In Fig. 2 a diagram of the oxygen atom originating from the structure of its nudeus is given (Fig. 1). It has eight electrons. The electrons situated on the axis of symmetry are the most active ones (1, 2). Other six electrons situated in the plane, which is perpendicular to the axis line (a line of symmetry), by means of their total electric field remove electrons 1 and 2 from the nucleus at a large distance at that forming conditions for their large activity during the interaction with the electrons of the neighbouring atoms [1], [2], [3].

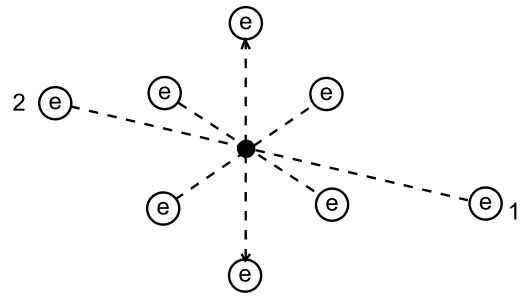

Fig. 2
Diagram of the oxygen atom

The least ionization energy of the electron of oxygen atom is equal to E_i=13.618 eV. Binding energy of this electron with the atomic nucleus corresponding to the first energy level is equal to E_1=13.752 eV. Let us call this electron the first one. The calculation of energy indices of this electron, including its binding energies E_b with the atomic nucleus, according to the formulas (1) and (2), gives the following results (Table 1) [1], [2], [3].

$$E_{ph} = E_i - \frac{E_i}{n^2} = E_i - \frac{E_1}{n^2} \qquad (1)$$

$$E_b = \frac{E_1}{n^2} \qquad (2)$$

Table 1
Spectrum of the first electron of the oxygen atom

Values	n	2	3	4	5	6
E_{ph} (exp.)	eV	10.18	12.09	12.76	13.07	13.24
E_{ph} (theor.)	eV	10.16	12.09	12.76	13.07	13.24
E_b (theor.)	eV	3.44	1.53	0.86	0.55	0.38

The oxygen molecule structure is given in Fig. 3, a. It is formed by means of a connection of unlike magnetic poles of axis electrons of two oxygen atoms [1], [2], [3]. It is known that the fusion process of the oxygen molecules is accompanied with a release of 495 kJ/mole of energy, or in calculation for one molecule

$$E_b = \frac{495 \cdot 1000}{6{,}02 \cdot 10^{23} \cdot 1.602 \cdot 10^{-19}} = 5.13eV. \quad (3)$$

What principle does the Nature follow by distributing energy of 5.13 eV between the electrons of oxygen molecule (Fig. 3, a)? Energy of 5.13 eV is a thermal binding energy between the electrons 1 and 2' of two oxygen atoms (Fig. 3, a). When the oxygen molecule is formed, it is emitted in the form of the photons by the electrons, which enter into the bond. Hence it is equal to an amount of energies of two photons emitted by these electrons. Consequently, each contacting electron emits a photon with energies of 5.13/2=2.565 eV=E_b (Fig. 3). According to Table 1, in this case the valence electrons are situated between the second energy level and the third one [1].

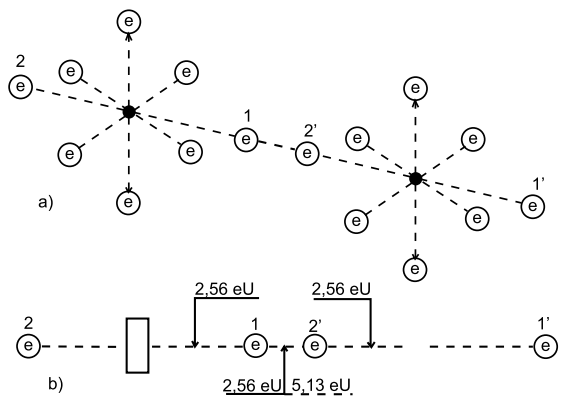

Fig. 3
Diagram of binding energy distribution between the electrons in the oxygen molecule

Two oxygen atoms are combined into a molecule in an excitation state. The excitation state is the state of an atom when its valence electrons are situated at such distances from the nuclei when the binding energy E_b between them is reduced to the thousandth of fractions of an electron-volt. In such state the atom can loose an electron and become an ion. Otherwise, without loosing electrons it is combined with an electron of the neighbouring atom by the valence electron, and a process of formation of oxygen molecule begins. It is an exothermic process when the axis valence electrons 1 and 2' emit photons, descend on lower energy levels and release 2.565x2=5.13 eV.

Let us pay attention to the fact that energy 5.13 eV is released by two electrons, which form a bond with energy of E_b=2.56 eV. In modern chemistry this bond is called a covalent bond. In order to break this bond it is necessary to use 2.56 eV of mechanical energy. For thermal cleavage of this bond, double quantity of energy is required, i.e. 5.13 eV. It is explained by the fact that the photon energy of 5.13 eV is absorbed by two electrons simultaneously. Only in this case, both electrons will be transferred to the highest energy levels with minimal binding energy E_b when they are disconnected, and each oxygen atom becomes a free one.

Thus, energy expenses for destruction of oxygen molecule depend on the method of influence upon the bond. During thermal action upon the bond it is destroyed when energy is 5.13 eV. During mechanical effect upon the bond, it is necessary to spend 2.56 eV of energy in order to destroy this bond. Therefore energetic of fusion process of the oxygen molecule depends on method of its destruction.

After thermal destruction of the oxygen molecule process of its formation begins from emission of the photons with energies of 2.56 eV by both valence electrons, and the previous electrodynamics binding energy (E_b=2.56 eV) is restored between the electrons of both atoms.

Thus during thermal destruction of the oxygen molecule the same amount of thermal energy is spent than that which is released during its further formation. No additional energy appears during thermal dissociation of oxygen molecule and at its further fusion.

If oxygen molecule is destroyed by a mechanical method, then it is necessary to spend 2.56 eV of mechanical energy for this purpose. Valence electrons of oxygen atoms are in a free state at lack of energy, which corresponds to such state, as there is no process of absorption of 2.56 eV of energy by each of them. The electrons cannot remain in such state; they should replenish immediately the energy, which they have failed to receive during a mechanical break of the bond between them. Where should they take it from? There is only one source: the environment, i.e. the physical vacuum filled with aether. They convert aether into energy of 2.56 eV immediately. The next stage is a connection of two oxygen atoms, whose valence electrons have replenished the reserves of their energy by means of aether. This process is accompanied by emission of the photons with energies of 2.56 eV by two electrons. Thus energy of absorbed aether is

converted into thermal energy of the photons. If we spend 2.56 eV of mechanical energy for destruction of oxygen molecule, we will get double quantity of energy (2.56x2=5.13) eV during further fusion of this molecule. Additional energy is equal to 2.56 eV.

Much experimental data show that in ventilation systems thermal energy of circulated air exceeds electric energy spent for a fan drive. Now we know that this energy is generated at mechanical destruction of covalent bonds in the molecules of gases, which the air consists of.

Using the above-mentioned method, let us analyse energetic of water molecule, which sometimes generates additional thermal energy. A water molecule consists of one oxygen atom and two hydrogen atoms. Binding energies E_b of the hydrogen atoms with its nucleus are given in Table 2 [1], [2], [3].

Table 2
Spectrum of hydrogen atom

Values	n	2	3	4	5	6
E_{ph} (exp.)	eV	10.20	12.09	12.75	13.05	13.22
E_{ph} (theor)	eV	10.198	12.087	12.748	13.054	13.220
E_b (theor.)	eV	3.40	1.51	0.85	0.54	0.38

It is known that combination of hydrogen and oxygen is accompanied by an explosion, but its cause remains unknown. Let us try to find it.

Energy of fusion of hydrogen molecule is equal to 436 kJ/mole, or 4.53 eV per a molecule. As the molecule consists of two atoms, then the above-mentioned energy is distributed between them. Thus energy of one bond E_b between the hydrogen atoms is equal to 2.26 eV (Fig. 4). At mechanical destruction of this bond 2.26 eV is enough. At thermal destruction of this bond double quantity is required (2.26x2=4.53 eV) [1].

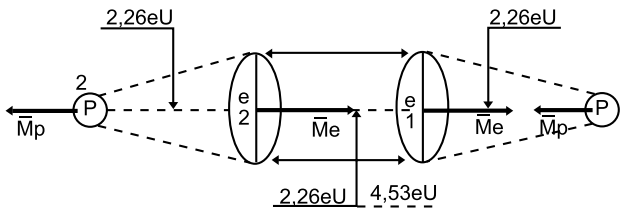

Fig. 4
Hydrogen molecule

In order to form two water molecules, it is necessary to break two hydrogen molecules and one oxygen molecule into atoms. At mechanical destruction of covalent bonds 2.26x2=4.53 eV is required to break two hydrogen molecules and 2.56 eV to break an oxygen molecule. Sum of these energies is equal to 7.13 eV. If the destruction processes of the above-mentioned molecules are carried out with a thermal method, then 4.53+4.53=9.06 eV is required for the destruction of two hydrogen molecules, and 5.13 eV is required for the destruction of one oxygen molecule. In total, it is equal to 14.19 eV. The difference between the energy spent for mechanical and thermal destruction of covalent bond of hydrogen and oxygen molecules is almost double.

It is known that during fusion of one mole of water 285.8 kJ or $285.8 \times 1000/6.02 \times 10^{23} \times 1.6 \times 10^{-19}$=2.96 eV per a molecule are released. As a water molecule consists of one oxygen atom and two hydrogen atoms, 2.96/2=1.48 eV falls per the bond (Fig. 5). Hence the electrons of hydrogen and oxygen atoms in water molecule are between the forth energy level and the fifth one at the usual temperature (1.48/2=0.74 eV = E_b), Table 1, 2 [1].

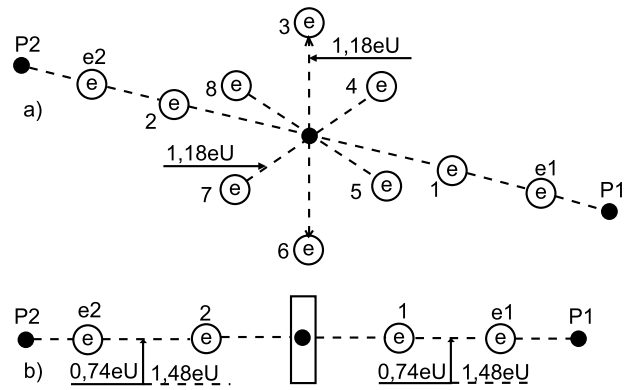

Fig. 5
Diagram of water molecule:
1, 2, 3, 4, 5, 6, 7, 8 are the numbers of the electrons of oxygen atom; P_1, P_2 are the nuclei of the hydrogen atoms (the protons); e_1 and e_2 are the numbers of the electrons of hydrogen atoms

Thus when two hydrogen molecules $2H_2$ and one oxygen molecule O_2 are destroyed by the thermal method, 14.19 eV are spent. As a result of fusion of two water molecules ($2H_2O$), 2.96x2=5.98 eV is released. There is some disbalance here since fusion process of water molecule is an exothermic one and 2.96 eV is released by one molecule. The given calculation shows that (14.19-5.98)/2=4.10 eV is absorbed during fusion of one water molecule. What is the cause of this contradiction?

The oxygen atom in the water molecule should reduce its volume when the transition from gaseous state into

liquid state takes place. It will happen when the ring electrons of oxygen atom descend on lower energy levels (nearer to the nucleus). They will emit the photons and their total energy will be equal to energy spent to destruction of two hydrogen molecules and one oxygen molecule, i.e. 14.19 eV. Since two water molecules have 12 ring electrons, each of them will emit 14.19/12=1.18 eV= E_b (Fig. 5). It is more than energy (E_b=0.74 eV) of binding of axis electron with the nucleus, and it shows that the ring electrons are situated nearer to the nucleus than the axis ones.

In this case quantity of energy produced due to fusion of two water molecules (14.19+5.98) eV exceeds energy, which was spent for the destruction of two hydrogen molecules (9.06 eV) and one oxygen molecule (5.13 eV). Energy difference of 5.98 eV is divided between two water molecules. It means that 5.98/2=2.99 eV or 285.8 kJ/mole fall per a molecule. It corresponds to the existing experimental data completely [1].

The above-mentioned facts clarify a cause of the explosion, which takes place when hydrogen is combined with oxygen. Simultaneous transition of six ring electrons of each oxygen atom in the nascent water molecules to lower energy levels is accompanied by simultaneous emission of the photons, which generate explosion phenomenon.

Let us pay attention to the fact that two binding energies E_b between valence electrons e2 and 2 and between 1 and e1 are shown in Fig. 5, b. Energy of one electrodynamics bond is equal to E_b= 0.74 eV. If this bond is destroyed by the thermal method, 0.74x2=1.48 eV is required. This energy will be released during further fusion of the water molecule from hydrogen atom H and hydroxyl ion OH^-. In this case, no additional energy is generated.

Therefore the given bond is destroyed by the mechanical method spending 0.74 eV per a bond, each electron will have energy deficit equal to 0.74 eV after bond destruction. This energy will be immediately absorbed from the environment and will be emitted during the repeated fusion of the water molecule from the hydrogen atom H and the hydroxyl ion OH^-. At mechanical destruction of one bond of water molecule, the covalent chemical bond forms E_b= 0.74 eV of additional thermal energy, which is registered in systems of water cavitation constantly (as we have already noted) [1], [2], [3].

It is known that water molecules combine and form clusters. If the bonds between the molecules in the clusters are covalent ones, mechanical destruction of these bonds should be accompanied by a release of additional thermal energy as well [1], [2], [3].

Experimental Part

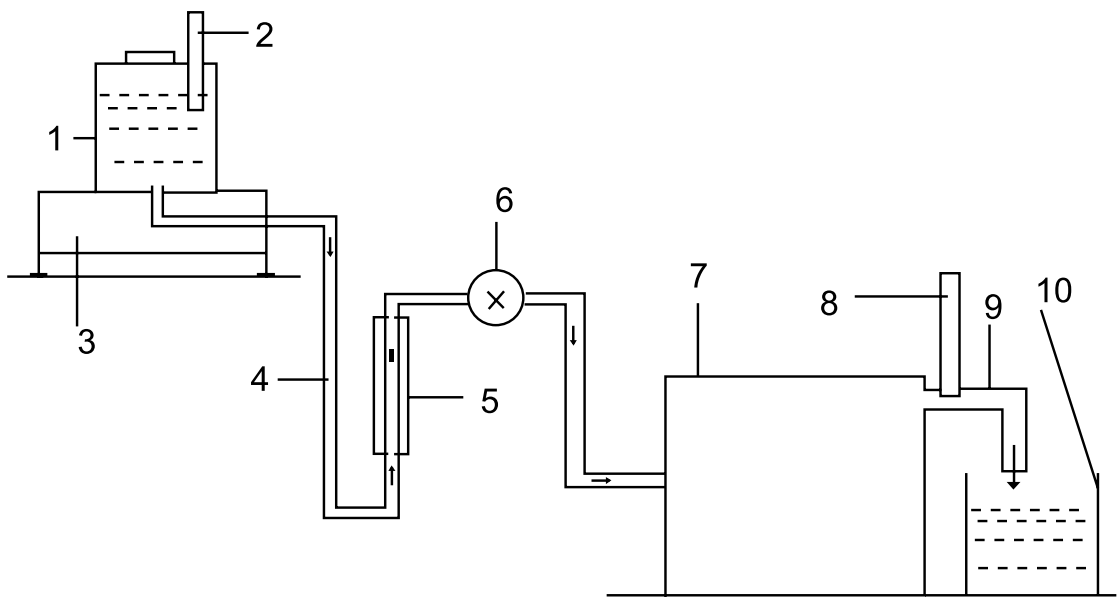

Fig. 6

Diagram of the experimental device: 1 - reservoir for solution; 2 - thermometer; 3 - electronic scales; 4 - solution supply duct; 5 - rotameter; 6 - feed solution regulator; 7 - a special thin plasma reactor is in the process of patenting; 8 - thermometer; 9 - discharge of heated solution; 10 - inlet reservoir

Thus, chemical bonds between the atoms in the molecules and the molecules in the clusters can be destroyed mechanically, by electrodynamic and thermal influence. We have already shown that the mechanical way of destruction of such bonds requires half energy as compared with thermal energy. It appears from this that energy expenses for electrodynamic destruction of these bonds should be less than thermal expenses as well. Electrodynamic impact on the bond gives the opportunity to form the resonance modes where energy expense for the destruction of these bonds is reduced to greater degree. In order to check this hypothesis a special experiment was carried out. It was connected with electrodynamic destruction of chemical bonds of water molecules with a changing frequency of impact. To test this hypothesis the check experiment was prepared and carried out by (besides the author of this article) A.I. Tlishev, G.P. Perekotiy, D.A. Bebko, D.V. Korneev. A diagram of the experimental device is given in Fig. 6. The results of this experiment are given in Table 3.

Table 3
Protocol of control test

Indices	1	2	3	Mean
1 – mass of the solution, which has passed through the reactor m, kg.	2.112	2.153	2.118	2.128
2 – temperature of solution at the input of the reactor t_1, degrees	24	24	24	24
3 – temperature of the solution at the output of the reactor t_2, degrees	33.5	33.5	33.5	33.5
4 – differential temperature of the solution $\Delta t = t_2 - t_1$, degrees	9.5	9.5	9.5	9.5
5 – durability of the experiment $\Delta\tau$, s	300	300	300	300
6 – reading of voltmeter V, B	25.0	25.0	25.0	25.0
7 – reading of ammeter I, A	1.40	1.40	1.40	1.40
8 – electric power consumption according to indices of voltmeter and ammeters, $E_2 = I x V x \Delta\tau$, kJ	10.50	10.50	10.50	10.50
9 – power spent for heating of the solution, $E_3 = 4.19 x m x \Delta t$, kJ	84.10	85.70	84.31	84.70
10 – reactor efficiency index according to the reading of voltmeter and ammeter $K = E_3 / E_2$	**8.00**	**8.16**	**8.03**	**8.06**

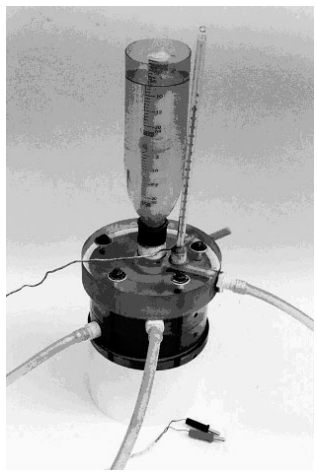

Fig. 7
Photo of heat reactor

In the Russian market three firms (Yusmar, Termovikhr and Noteka) sell cavitation water heating equipment with energy efficiency index of 150%. Soon, an air heating devices with the same efficiency will be produced. The processes of mechanical destruction of covalent bonds of the air gas molecules, molecules and clusters of water and their further fusion serve as a source of additional energy generated by these devices [1], [2], [3].

Conclusion

Analysis of energy balance of the molecules with covalent bonds shows the possibility of additional thermal energy formation during mechanical and electrodynamics destruction of these bonds.

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The Fourth State Of Matter (Plasma Energy) Power Generation

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Under the proper configurations and in the correct pre glow discharge environment more electrons can be released than what is required to trigger the release. This release of energy attains a high frequency oscillation that is indicative of the metal or metals involved in its release.

The release of high frequency energy from metals and semi metals (semi conductors) through the mechanism in the pre-glow discharge leads to the generation of radiant energy. This correlation has been identified through my findings. The release of high frequency energy from the atoms of electrical conductors is credited to my identification of the mechanism in the pre-glow discharge, or fourth state of matter. This has lead to extremely efficient alternative energy circuits.

The release of high frequency energy from the atoms of electrical conductors is credited to my identification of the mechanism in the pre-glow discharge, or fourth state of matter. This has lead to extremely efficient alternative energy circuits.

The pre-glow discharge condition occurs when a sufficient amount of charge difference is applied across the gap of two electrical conductors. It makes a hissing sound if the electrodes are surrounded by air. The electrical properties between this gap change: electrons become "stripped" from their respective atoms and are liberated. In this state, air is **ionized** and is transformed into a **plasma** and is no longer a gas. It is now in the fourth state of matter, the other three being solid, liquid, and vapor (gas). The fourth state of matter is a good conductor of electricity, its average resistance being much lower than that of the same substance in its gaseous state.

A good readily available spark gap combination is lead and iron. This combination generates plenty of radiant energy and causes noise to be heard on a radio in its vicinity. As a general rule, the better the thermoelectric difference between the dissimilar couple the more radiant energy that will be generated when it is exposed to a plasma field.

Early in the summer of 1981, the pre glow had first caught my attention. This is where I had observed it between two plastic insulated hook-up wires from radio shack. The plasma between the two wires was called into existence because of a high voltage power supply that I had obtained for my electrogravitic experiments. The two wires were twisted together and given a charge of around ninety kilovolts.

It was not until 1989 when I observed a high frequency signal on my oscilloscope coming from the pre-glow discharge phenomenon. These signals were coming from across the room and originated from a crude component that I had built. This crude component consisted of a guitar wire that was centered through a section of PVC tubing. Around this tube was wrapped a coil of insulated transformer wire. This was my first ion-valve. It was excited with the same power supply where I had observed the plasma effect several years previous.

I knew that my ion valve was generating high frequency oscillations using air ions but did not find any practical applications for it until six years later. It was in this year (1995) when I realized the importance of the ion valve and its associated high frequency ion field, known as radiant energy to Moray, it being the essential principle behind his energy receiver.

In one experimental set-up, it was confirmed that when a charged capacitor is discharged through a spark gap that the stored energy is transferred by way of high frequency electrical oscillations. It was found that these oscillations occur directly before the discharge of the capacitor, thus the term, pre-glow discharge. It was found that during the pre-glow discharge plateau, energy is transferred from a primary to a secondary electrical coil. Directly after pre-glow discharge, a surge of current is measured. At the point of current surge is where most

of the stored energy in the capacitor is released as wasted heat. It was apparent that by maintaining the pre-glow discharge plateau a very efficient mode of energy transfer and conversion can be obtained. Logically what is required is a control mechanism. This is where my ion valve finds its niche. Upon further investigation, it is found that it keeps pre-glow discharge oscillations at their plateau, and suppresses current surge in a spark gap. It is a self-regulating quenching device. When it is placed in series with an air-core transformer and arc gap, its plasma hisses smoothly, the arc in the spark gap is almost silent and is very small. Continuous oscillations can be seen on an oscilloscope. A light bulb connected to the secondary will glow brightly. This result is not possible without the ion valve included in the circuit. The ion valve has the added feature of preventing back electromotive force, generated from inductive loads, from being discharged back through the circuit. Without the ion valve, energy is normally lost when it is discharged and is transformed into heat. Using the ion valve therefore has the effect of conserving energy.

Fundamental Radiant Energy Device

"Standard" scientific principles are not being violated. There is no fringe science involved with radiant energy power generation. This is a very old source of energy being extracted and harnessed in a unique way through my discoveries. What I have discovered is practically a limitless source of energy. Radiant energy has existed since the beginning of time. What I hold daim to is an improved method to generate and to convert radiant energy, kinetically active ions, cosmic energy, call it what you will, into useful electrical power. Think of the radiant energy power generator as a type of energy detonator that liberates great quantities of energy with only a small exciting spark. No laws of physics are being violated. No new laws are being implied. They are being expanded. The concept is not that much different from how a lighted matchstick is able to start a bonfire.

The power generated from my circuits comes from the transformation of matter into radiant electricity. It does not come from the splitting of atoms. To obtain high wattage from a spontaneously radioactive substance would require unsafe amounts of radioactive material.

Under the right conditions, ordinary matter can be made to generate intense surges of radiant energy that can be heard on a radio receiver as static noise. Build a device that can efficiently capture this energy and convert it into useful electrical currents and you will have yourself a powerful source of electrical power. This device will be powered by artificially disintegrating matter as described by Gustave Le Bon in his book "The Evolution of Matter" and in his book "The Evolution of Forces".

Energy and matter are two distinct entities of the same manifestation. Matter represents a stable condensed form of energy. Heat, light, electricity, etc., are uncondensed vibrations of matter oscillating at differing rates. "Cosmic Energy" is the term that Le Bon used to define matter and energy as being one and the same manifestation. He theorized that when stable matter is disintegrated it is transformed into energy that we recognize as heat, light, electricity, radioactivity, etc.

Semiconductors will generate intense surges of electron oscillations that become powerful sources of radiant energy. A simple **ion valve**, or call it what you will, can be used to generate and convert this form of radiant energy into useful electromagnetic oscillations. A tuned transformer can be used to directly convert these oscillations into to a practical voltage and amperage. This unique valve is shown in Fig. 1. Before it can function it must be connected to a suitable voltage source. The circuit in Fig. 2 demonstrates the full working concept. Other embodiments are also possible. The proof of concept circuit reveals how radiant energy can be generated and converted into useful electrical currents. Many additional stages can be added for more power. Many other circuit and component configurations can also be used but the fundamental conversion principle remains the same. The circuit and components shown should give you a very clear idea of how the technology works. The actual mechanics and electronics of building and validating a radiant energy prototype are relatively simple. Contrary to what some people might think, dangerous levels of radioactivity are never used in my devices.

Ion-valve Converter Technology Explained

The ion-valve converter (ion-valve) shown in Fig.1 has an axial negatively charged tungsten cathode wire that extends the length its cylinder and is capable of emitting secondary electrons. The anode cylinder is positively charged and is made from a semiconductive material that will readily capture electrons.

Within a few milliseconds the accumulated negative ions are attracted to the positively charged onrushing atomic ions. When the negative and positive charges collide they

neutralize each other generating high frequency electrical oscillations.

There appears to be a common thread shared between several alternative energy devices. It is the pre-glow discharge. The report on the **Hans Coler** device released by the British Government indicates that there is excess energy released when electrical contacts are opened and closed. The **Lester Hendershot** device utilized a buzzer circuit that opened and closed its electrical contacts. In the **Alfred Hubbard** coil pre-glow discharge flowed through electrical contacts, a distributor cap and radium soaked spark plug. The **Joseph Newman** motor used a sparking commutator. **Thomas Moray** invented a glowing, cold cathode discharge tube that was the heart of his radiant energy device. **Hermann Plauson** was granted U.S. Patent No. 1,540,998 that used spark gaps to convert atmospheric energy. **Frank Wyatt Prentice** was granted Canadian Patent No. 253,765 that detailed his invention, which lighted 50 sixty-watt carbon lamps with an input of only 500 watts. His invention utilized a spark gap driven high frequency tuned resonant system. **Chancy Britten** used ion-valves constructed with a central wire that was surrounded by a coil of wire which is described in his US Patent No. 1,826,727. Britten's valve was said to have lit up his home in the 1930's according to a local newspaper article of that time period. **Alexander Chernetski** experimented with what appears to have been a type of ion-valve that was filled with hydrogen gas. It is said that he got up to five times more energy out of his device than what he put into it. **Edwin Gray** was granted U.S. Patent No. 3,890,548 for his efficient spark gap driven capacitive-discharge motor. He improved on this patent by replacing the spark gaps with a pre-glow discharge switching tube. His U.S. Patents No. 4,595,975 and No. 4,661,747 describes this tube in detail. Gray's patents claim to conserve battery power by sending unused energy back to the supply batteries. On close examination, we also find that his switching tube is actually a quenching device.

Radiant energy was generated during the pre-glow discharge cycle that also contributed to recharging the batteries. **Paulo N. Correa** and **Alexander N. Correa** obtained patents to a pulsed pre-glow discharge system that recovers energy and recharges a battery.

I have found that radiant energy is generated when a plasma field is in contact with the atoms of an electrical conductor. Most importantly, the quantity of radiant energy is greatly increased when the plasma field occurs between the inter-electrode couple of two differing electrical conductors. That, the wattage produced will depend largely on the type of electrode materials that are used. I do not suspect that the above referenced inventors were aware of this amplifying mechanism.

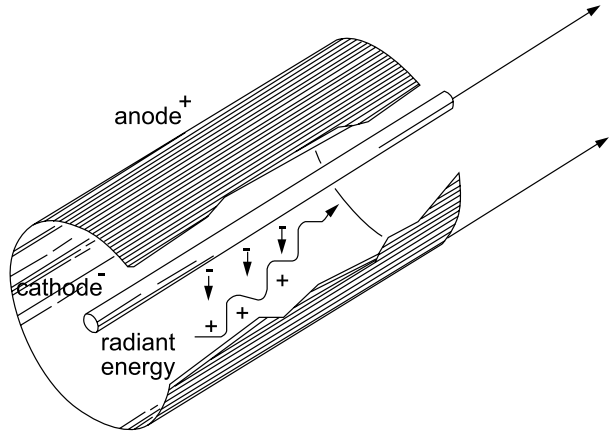

Fig. 1

Ion Valve

In the embodiment in Fig. 1 the negative charge on the wire in the ion-valve negatively ionizes any gas that contacts it. These ions rush towards the positively charged cylinder. When a metal ion that carries an excess electron hits head-on with an elementary differing positively charged onrushing metal ion a violent union of the two metals occurs. This causes the newly formed bimetallic alloy to violently oscillate, break up (dissociate) and to liberate a burst of electrons. The **"sea electron model"** helps to explain this effect. According to the sea electron model metals are bonded to each other through electron sharing. The model suggests that metal atoms be bathed in a sea of valence electrons. If this model is taken one step further it can be seen that when metallic atoms are dissociated from each other excess electrons are released in the form of electrical oscillations of high frequency (radiant energy). This occurs because the electrons no longer take part in the inter-atomic binding force that existed before the dissociation took place. It becomes clear that the freed electrons will add amperage to the output circuit to which it is connected. Henceforth, the equation **I x E = P** holds true in this system. Where, "I" represents the electrons (amperage), "E" electromotive force (ionic voltage), and "P" the power generated.

Obtaining Electrical Energy from the Transformation of Cosmic Energy

Matter is cosmic energy in a condensed state according to Le Bon and Moray. What this means is that matter can be excited its plasma state and caused to rapidly disintegrate transforming itself into electricity.

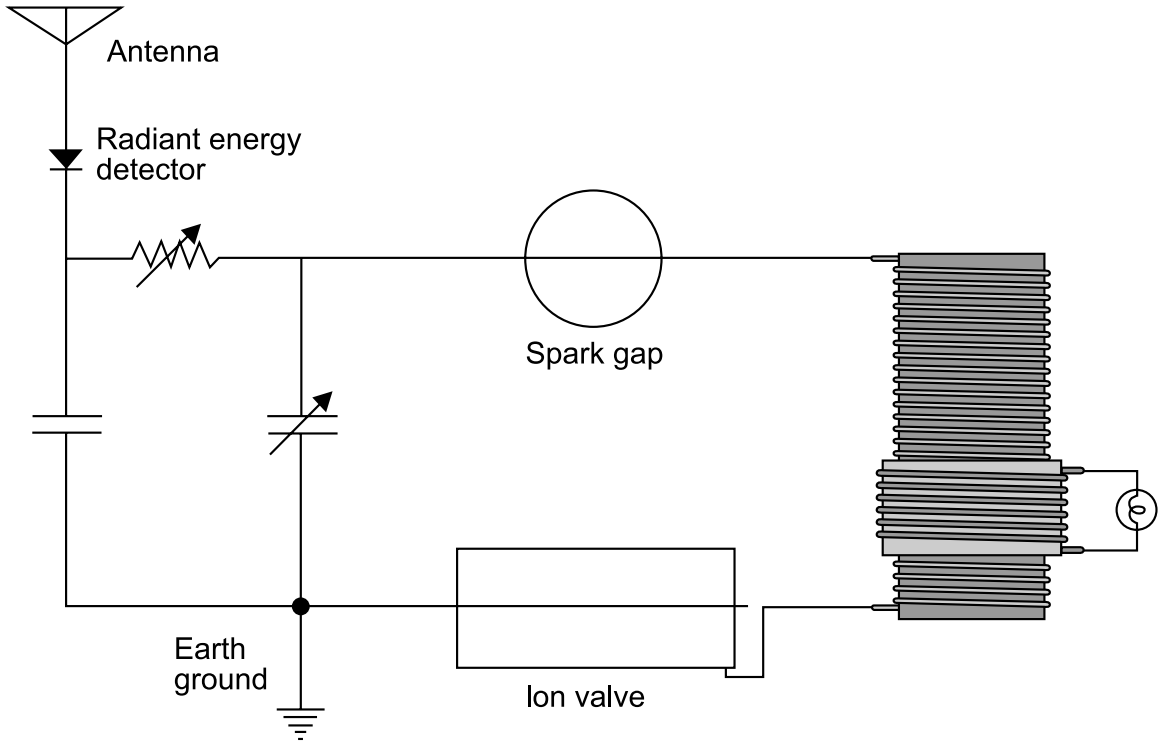

Fig. 2

Proof of Concept

The proof of concept shown will obtain energy from the dissociation of matter bringing the circuit to life. It does this by creating a plasma field between differing electrical conductors. Electrons are unleashed and feedback to the circuit where they are converted into useful power.

Plasma oscillating on the correct wavelength will act like a spark on a mass of explosive material but releasing electrical particles instead of heat. This is to say that the excited fourth state of matter (plasma) causes condensed energy (solid matter) to become uncondensed (radiant energy). The reaction will be far superior to the force that invoked it in the first place because the energy stored in matter is released. The energy that is condensed in the elements of matter is immense. The result is that an enormous amount of energy is released with only a slight loss of matter. Gustave Le Bon proved this when he demonstrated that the action of solar light and from electric arcs on bodies produced electric particles similar to those of uranium. He showed that it caused all bodies to disintegrate to different degrees.

the excited fourth state of matter (plasma) causes condensed energy (solid matter) to become uncondensed (radiant energy). The reaction will be far superior to the force that invoked it in the first place because the energy stored in matter is released

According to the law of conservation, when we give to a material body a determined quantity of energy, this energy might be transformed, but the body will never give back a quantity in excess of what it received. This principle is considered too self-evident to be disputed. It makes sense that matter can only give up energy that is given to it and is unable to create excess energy. Without violating this law, matter can be excited into giving up its stored inter-atomic energy. Condensed matter can become uncondensed if its oscillations become violent enough and henceforth transforming itself into radiant energy. No laws have been violated. They have been expanded. The first law of thermodynamics describes the principle of the conservation of energy. It states that "energy is not created or destroyed; it merely changes form". The fact is that the creation or destruction of energy is a result of matter being broken down or built up. They both go hand in hand.

Naturally occurring radioisotopes were created through the billions of years of **cosmic ray** bombardment of ordinary matter. Their matrixes became unbalanced. The

correct trigger will cause these isotopes to seek their original balanced state. Enormous amounts of electrical energy can be obtained from the transformation of stored cosmic energy. These isotopes contain a very old energy reserve that can be released in a unique way with my discoveries.

Have you ever wondered about spontaneous radioactive decay? Is it really a super charged state of matter? If an atom can become ionized by either gaining or by losing electrons then why can there not be a nuclear ionization too? I hypothesize that atoms do become ionized on the nuclear level by gaining or losing neutrons. This may appear incidental but could be at the very heart of an ultra-chemistry. It is highly probable that this hypothesized phenomenon is behind natural spontaneous radioactive decay and explains many unanswered questions about nuclear science.

Liberated Energy

With a slight excitement from a pre-glow discharge in a spark gap, or even with no excitement at all, as we observe in spontaneously disintegrating radioactive bodies, such as U235, we can obtain large quantities of energy. Clearly, we did not create this liberated energy, since it already exists in matter, but we release it under the right conditions. This is being done without violating the law of energy conservation. The idea that matter could be transformed into energy was absurd before the acknowledgement of nuclear transformations.

A Nu Science is on the horizon. It involves the means of transforming matter into energy without splitting atoms. This science recognizes several isotopes of matter that spontaneously liberate energy as observed in naturally occurring radioisotopes. My research indicates that it is also possible to artificially speed up the natural decay process of condensed energy (matter) using a minute plasma field, as from a pre-glow discharge, etc… With a very small quantity of energy, we will be able to produce a very large quantity of energy without splitting the atoms.

Capture Capacitor

Nature offers us cosmic energy that manifests itself in many different forms. Electricity is only one of its manifestations. From this knowledge, we can obtain electrical power with no moving parts. The natural world contains many storehouses of this cosmic energy. Energy is all around us just waiting to be transformed. The capture capacitor is one such example. It is called a capture capacitor because it captures and transforms electrical charge into electrical current. It does this with the aid of naturally occurring radioactive matter (N.O.R.M.). Put a pair of dissimilar metal electrodes together with a porous ceramic dielectric material sandwiched between them, along with a weak electrolyte and you have built a capture capacitor. In a low power capture component there exists a minute impurity of N.O.R.M. It is always present in clays and is usually present in ceramic materials.

If you want a capture capacitor to generate more power all you have to do is to add additional amounts of radioactive material to the dielectric. Lead–210 is the optimum choice because it has a half-life of around 22.3 years and is a pure beta (electron) emitter. Its half-life is almost twice as long as tritium. This means that it is feasible to build a component that will put out power for several years with little maintenance. Lead-210 is a decay product of radon gas. The parent source of radon is uranium. Therefore, uranium ore can be powdered and mixed into the ceramic material.

The atomic ions emitted from naturally occurring or artificially induced radioactive transformations can be directly converted to electrical power. The circuit shown can be used to convert radiant energy into useful electrical currents. Additional stages can be added for more power. The circuit shown gives a general idea of how such an energy conversion device functions. By no means is this technology limited to this one circuit, configuration, or source of radiant energy.

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NEWS REVIEW

A new type of high field superconducting magnet from Oxford Instruments has enabled physicists at the University of Nottingham to balance the force of gravity and levitate heavy and dense materials such as lead, gold and diamonds. The patented Minimum Condensed Volume™ (MCV™) Cryofree™ superconducting magnet, developed and manufactured by Oxford Instruments in collaboration with the University of Nottingham, is the first of its kind in the world. Unlike conventional superconducting magnets, the MCV magnet never needs to be refilled with liquid helium and yet can generate a field over 300,000 times stronger than the Earth's magnetic field. MCV has a very small footprint and, operating at 4.2 K with a room temperature bore, can generate highly stable magnetic fields up to 16 Tesla.

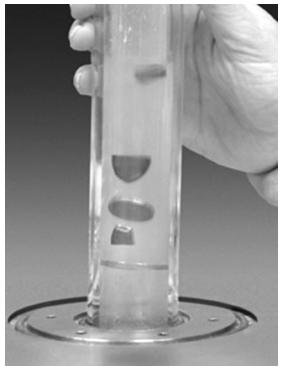

http://www.oxford-instruments.co.uk

Polish inventor Zygmunt Orlowski called attention of the scientific society to his perpetual motion machine **METOZ**, which according to the author after further improvement will be able to extract energy from the earth's gravitation.

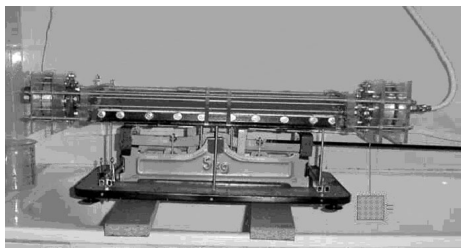

http://www.nets.pl/~metozor/perpetual_motion_machine.htm

It is necessary to change behavior of people in order to decrease environmental damage. This was the message of **"Green Week 2003"** which took place since June 2 through June 5 in Brussels.

The conference's key issues were three aspects of United Europe environmental policy: sustainable production and consumption, renewable energy and water supply.

Green Week is the first environmental forum of such a scale. Three thousand participants from all over the world represented governments and funds, industry and mass media. The exhibition organized in the framework of Green Week included 62 displays from 14 European countries and were dedicated to the newest environmental technologies and projects. During the Green Week 26 conferences and seminars took place, as well as a great number of press conferences and actions for young people.

British researchers (Gardner Watts company) **believe that they have made a groundbreaking scientific discovery after apparently managing to "create" energy from hydrogen atoms.**

The device represents "thermal energy cell" which appears to produce hundreds of times more energy than that put into it. If the findings are correct and can be reproduced on a commercial scale, the thermal energy cell could become a feature of every home, heating water for a fraction of the cost and cutting fuel bills by at least 90 per cent.

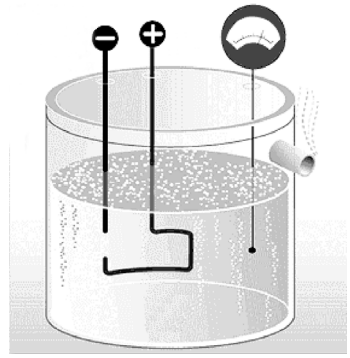

http://www.telegraph.co.uk

Gravity Conversion Rotary Device

The below figure is from
http://www.theverylastpageoftheinternet.com/newclaims/GravityMotor/gravity_motor.htm

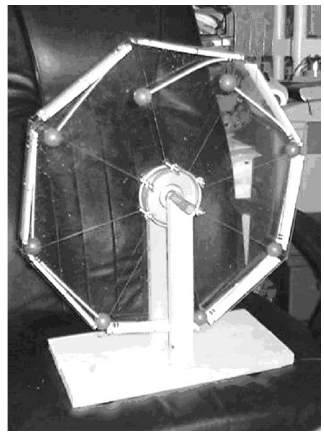

Does it really work?

The Marcus Device Controversy

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http://www.americanantigravity.com/marcus.html

Editorial: This overview is devoted to the fantastical device created by inventor Marcus Hollingshead that encountered more than its share of publicity and controversy between November 2002 and March 2003. You can participate in discussion on aggroup@yahoogroups.com.

The problem with Marcus has been that he was pressured by too many people to produce too fast results. I started talking to him in November, and he is always sounded like an honest, rational man with a good heart. The problem is that once people started to hear his private claims that he could lift something like 2 tons of weight, things kind of went south.

While people in general have been very well-meaning, they are desperate to solve many of our current energy-problems, and when Marcus appeared with a potential solution it got out of control. Pretty soon film crews were showing up at his house unannounced, and he was getting unwanted phone calls from people who had looked up his number online.

In my opinion, it is really a problem of a "social dynamic" at work here – too many people, with too much access, all at once. This also correlates to the type of person that different people are. For instance, I am a very open person, and I really do not value my privacy a heck of a lot — therefore, when TV crews drop by with 5 minutes notice (and they have), I tend to just let them in for a demo. However, Marcus, who is much more of a private person, seems to have become a bit overwhelmed at this proposition.
Also, keep in mind that I had initiated working with the media because I felt that it was time for the excellent work in the Lifters groups to see the light of day. There was some debate about this, but the Lifters group as a whole has greatly benefited from being about to tell people about this new technology.

Marcus had not actually "gone public" about his work. He had leaked information about his research to a few people, and from there it was leaked to several others, who in turn told their friends about it. Unlike the Lifter technology, which has hundreds of people that can talk about how it works and where it came from, Marcus technology was represented solely by himself. That means that everything surrounding his device came back ultimately to him alone. Without any real group ownership of the expertise behind the device

As I said before, Marcus was new to the publicity, and did not have time to prepare the resources that the rest of us have had to answer questions, provide demo materials, etc. Naudin and Saviour have a masterful manner with regard to teaching people about Lifter technology, but they have had years to prepare this information and perfect a method of presenting it to people.

Most of us in the AG groups tend to proselytize for the technologies that we believe in. I know that I do, and if you haunt the newsgroups much you will notice that everybody there believes in something and can go on for months non-stop telling the world about it (again, I do this). Marcus, however, does not really have this personality — he is more of a "take it or leave it" type of person.

For me, this was another indicator that he was the "real deal". You have to understand that I have never seen working prototype pictures of the Marcus device, and all that I had to go on was the feeling that I got from interacting with him on the phone and online. The fact that he did not try to "sell me" on the idea was a big plus. He told me about the device, and his story was always consistent. The other people that he talked to also had a consistent story – I have not talked to anybody and heard a different version than I heard from Marcus himself. That is a big plus from the credibility perspective.

Marcus initial goal (from when I started talking to him in November) was to gradually ease into working with

the public to tell them about the technologies he was working on. Unfortunately, I probably aggravated the issue a great deal, because his early descriptions of the technology might have gone unnoticed if it had not been for some of the things he had mentioned about his research.

When I read Marcus' firsts posts on the device, my very first thought about his claims was that they were bogus. Judging from the reaction of the Antigravity newsgroup, I gathered that a few other people also had the same initial reaction. The reason might be a little selfish – after you hear claims but do not see results for a long enough period of time, you tend to protect yourself emotionally by becoming skeptical to the idea that somebody can be lifting hundreds of pounds of weight using a completely new and revolutionary technology.

Nonetheless, something that Marcus had said resonated with me. I remember that he was talking about his results being based on a study of the Earth's fields, which is something that I had read about myself during the college years. Telsa had done a lot of work involving the Earth's electrical and magnetic-fields, and I had always felt that this research might come in handy later as a potential basis for Antigravity research. However, I did not have any specific ideas, and began asking Marcus questions offline to find out more about his research.

In reality, I am nobody special, so I think that perhaps this would have happened in any event no matter what my reaction would have been. Certainly I am not the only person that took an early interest in his work, and from what I learned later he had already been a little bit too honest in the BBC online newsgroup before he ever became involved with the Antigravity newsgroups.

From January to mid-February Marcus became like somewhat of an addiction in the newsgroups. This was a strange phenomenon to watch, but if he did not answer questions in the newsgroups for even a day people started asking whether he had been kidnapped or the government had assassinated him.

You have to understand that most inventors tend to segregate their time into "public" and "private". I do, Naudin does, and everybody does this. When you talk to the public about what you have built, you really get into it — but when you are actually working on it, you tend to hole up in the garage and put the entire world on "ignore" until you have finished with whatever it is that you are doing.

Marcus really started to get publicity in late November 2002, and it built up over a few week period of time. By mid-December, he had a healthy following in the Antigravity newsgroup and people in the 5 or 10 other AG newsgroups were developing more than just a passing interest. Great stuff for Marcus – he had thought that he was the only person doing this research, and it turned out that lots of people shared this common interest with him. We had lots of really valuable and productive exchanges.

Marcus bided his time working on the projects – he had initially stated that he could lift around 200 pounds of weight with his November version (prototype #161, if I remember correctly). He did not have a digital camera, and he did not want to publish photos until he had a better prototype anyways. That was OK with me – I am used to work with a variety of inventors and came to realize a long time ago that everybody has their own style. I was content to wait until Marcus had additional data, and the only thing that I insisted upon was that sooner or later he ante-up and provide some photographic evidence.

Despite lacking photos or video evidence, Marcus did have documentation. In fact, he wrote more documentation about his device than I had ever hoped to receive. He cranked out about the equivalent of 30-pages of "real" documentation in a very detailed form within 1-month, and had the email equivalent of many more pages in postings about how the device worked online. Marcus had already been publishing details online for about 2.5 months.

Despite the incredible amount of published data that Marcus was able to complete, in some ways it made things worse for him than not having anything at all. The reason was the nature of his research. My work, currently focused on Lifters, was in a technology that is easy to explain – the device is built like this, it works like that, and it can be described in a manner similar to some other thing ....basic, easy to explain, and easy to compare.

After all, Lifters have been accused by science of being ion-wind devices. If nothing else, rebutting this claim gives us someplace to start – something to compare against to provide people with an idea about how the device works. Additionally, we had tons of video and photographic evidence to back up our claims. In Marcus case, the documentation that he provided made things worse because his technology is so utterly different. It is not ion-wind, nor the Biefeld-Brown effect, nor

apparently the Searle effect. In fact, the more than you tried to pin down exactly what it was, the harder it became to describe it.

Also, its not like he could simply fall back onto describing the construction of the device **– reason being that it contained a series of interrelated coils with a unique configuration that were intrinsically tied to the operation of the device.** Every time he wrote a detailed summary of the construction of the device, we had come away with more questions than we had started out with. After a time I gave up trying to understand how it was constructed, because I only had bits and pieces.

Marcus was using an arrangement of 6-coils, and what are described as "bifilar windings". Essentially, this means that you wind two wires together around a coil and then tie one of the ends to another, making the two wires essentially one long wire wound "against itself" down the length of the armature its on. There are 6 of these armatures on the device, mounted around a central RP (or reference point).

Marcus created all of the terminology for these parts – this lends additional credibility to the idea that he had had 7 years of experience with it. These are ideas that you just do not "make up" for publicity. For instance, the bifilar windings on the armature-coils are self-cancelling fields, and even a basic-electronics education will tell you that. However, the interesting thing is that once you really start to get into the advanced "post-scientific" research on magnetic fields you start to see self-cancelling magnetic coils all over the place. The reason is apparently that while the "B-field" *(Editor: i.e. magnetic field)* of the coils cancels, the "A-field" *(Editor: i.e. vector potential)* that Tom Bearden keeps talking about does not, which means that you can isolate the really interesting effects from the coil without having to deal with the high field-intensity effects from normal electromagnetism.

Marcus had described these six armatures as being activated in a series, or order, to obtain results. Each of the coils was spun by an electric motor mounted on the armature, and when the coil was spun up to a certain speed and "stubs" mounted a periodic intervals on the side of the armature were fired in sequence the antigravity effect was created.

Marcus Antigravity effect was a directional force that was applied in a unique manner depending on which coils were activated. This means that by activating (for instance) coils 1 and 3, he could create an antigravity effect and move the device left – or something to that effect. Turning on and off each set of coils gave him movement on one axis of thrust, which corresponded to X, Y, or Z in a standard 3-D geometric graph. Since you can move in either direction down any given axis of thrust, this means that you have 6 axis of movement height (up and down), width (left or right), and depth (forward or backward). His device provided movement on any axis by either one coil or an arrangement of coils.

For a while Marcus did not want to talk about side effects, but I pressured him into it. The reason was that I have seen side-effects that were pretty darned strange in a number of different experiments, and I was willing to bet that if I pressured him a bit he would talk about what he had seen but did not want to reveal (for fear that people would not take him seriously). It turns out that I was right.....

Marcus had talked about the RP, or "Reference Point" upon several occassions. This is a multi-layered device that acts somewhat like a capactive element. It sits in the direct center of the Marcus device, and it is the reference-point for the entire device. The RP is manufactured from cast-iron, and Marcus says that he has a local company build them for a few bucks each by pouring iron into a mold based on one of his designs.

You can active the RP at the same time that you activate the coils. You have coils rotating around the RP, with "stubs" on the coils firing periodically at points corresponding to spots on the surface of the RP. Meanwhile, you also have an electrical charge on the RP itself, which means that there are a lot of elements interacting at once to create a very complex dynamic.

One of the interesting side effects was a darkening and "blurring" effect of the RP, as if light was being reflected off it. Another was a Star-Trek like "force shield" around the RP. These only occurred when all of the coils were activated at once. Also note that since the coils are opposing in nature (one for each direction on each axis), that when you are creating the force field effect the device cannot be levitating. However, the device is operational, and you have a force-field that you can apparently bounce a heavy hammer off without being able to penetrate it (Marcus description).

Another interesting note is that the force-field effect can be modified to create a vacuum. I am not sure how

Marcus noticed this, but he had said that it appeared to create a vacuum inside of the field's boundaries during operation. Interestingly, it also ran very cold – apparently down to a hundred degrees below zero, but only within the localized boundaries of the field.

I am not a professional physicist, but this is something that has been reported with the Searl effect and several other experiments, and the reason that I believe it occurs is because you are taking the kinetic energy of the device as well as some of the kinetic energy of its molecules (i.e.: heat energy), and injecting it into another dimension. After all, anytime we directly modify a gravitational field we are creating a dimensional effect, but in normal life we do not notice it because the boundaries between gravitational fields are very gradual.

Well, in the Marcus device the boundary between gravitational fields is not a several thousand mile-long gradient like the Earth's field is – instead of you have a gradient perhaps 10-times more intense focused within a 3 to 4 inch area. That means that you are creating essentially a rift in time and space (self-healing) that is kept open by the energy that you are pumping into the device.

the energy input is used only in putting the device into another frame of reference, but that any interaction between us and our "normal" frame would have to be modified for any interactions with the "modified" frame.

To the best of my knowledge, this is the most accurate description that I have seen yet for why his device does this. Marcus himself could not explain why these effects occurred, and to be honest I scared him more than a little when I told him my theory.

In the hypothesis that I just put forth on the origin and functionality of the Marcus device effect, the interesting this is that there really is not a direct correlation between input energy and the effect itself. That is because you are not using the input energy to actually cause an effect – you are essentially using the input energy to translate the device into another dimension (although it is still partially within ours).

Einstein called these "frames of reference". The idea is that the energy input is used only in putting the device into another frame of reference, but that any interaction between us and our "normal" frame would have to be modified for any interactions with the "modified" frame.

Again, this takes place in normal physics – but usually it involves motion, and normally it takes place over a vastly larger gradient of time/space/whatever. The difference between two frames is the difference between two locomotives moving at different speeds – the energy input goes into accelerating each locomotive up to that speed, but the actual work is performed if those two trains interact is solely a product of the frame of inertial reference (mass & velocity = energy).

Another excellent example is a helium-balloon. You put the energy into condensing the helium and pumping it into the balloon, but it is not the helium that creates lift – it is the surrounding atmosphere. In a very real sense a helium balloon gets its energy from the surrounding environment. The energy that you put into "maintaining flight" in a helium balloon is only the strain on the fabric used in holding the helium into the confines of the bag that encloses it. With the Marcus device, I would bet money that it is not the input energy creating these effects – it is instead the difference in frames of dimensional/inertial reference between "our" environment and the "device's" environment, whatever that difference may be.

You see, even though this sounds like a load of BS, magnetism is not real. This is not an idea that I am making up – in fact, it is an entire chapter in the physics 101 textbook kicking around downstairs in my house. Take two magnetic fields, and project them in the same direction at the same speed. Field A can not interact with Field B, because neither of the fields really exists – they are merely ripples on a pond, and that pond is the background of the time-space continuum. People that believe in relativistic gravitational effects take for granted that things like this happen – after all, gravity is not a force per se in relativity – only a modification of the dimensions of time-space. Well, most people do not realize that Einstein based his theory of gravitational force on his study of magnetism. Magnetism is the same thing – it is a modification of the fabric of time-space.

Take two magnetic fields that did not interact from a moment ago, and now change the direction that one of them is traveling in. Suddenly, the two fields that could not even see each other a moment ago now create an incredible "torque" – this is the same thing that we see in bar-magnets and electric motors. This is the "torsion field" research.

Bar magnets are different than pure fields because they are composed of the discrete fields of thousands of tiny magnetic "domains". That is why the fields from bar-magnets are never "invisible" to each other – it is because that the fields in bar magnets are too jumbled to ever really "line up" to the point of being invisible. Pure fields can do this, however, reinforcing the supremacy of Einstein's relativistic effects with relation to electromagnetism.

Anyhow, that is about it for now – I will try to come up with a more detailed picture for you on this if you like, but I expect that you will probably have more questions about Marcus theory and device in near future. It is a very complex idea underlying his research, but the basis of it is the idea of "rotating magnetic fields".

If you want to do additional research on your own into related fields of study, I would definitely look up "relativity and magnetism" – it provides an excellent example of how to visualize relativity theory in the study of magnetic field interactions. This is something that electronics engineers are not taught, which is why you have never heard of this in an engineering sense before. However, in physics is a well-known concept, although most physicists prefer to work with quantum mechanics rather than relativity these days.

In terms of rotating magnetic fields, you can look up "torsion fields" – again, the Russians have the best understanding of advanced torsion field physics, although their best material probably has not been translated yet. Additionally, rotating magnetic fields are the basis for the Searle Effect and the Hamel device.

Marcus was intrigued by Searle's claims, because they appear to have matched many of his own results. Interestingly, Marcus had developed his work within an "intellectual vacuum" and had never heard of Searle before I told him about the similarities. Nevertheless, force-fields, ice-cold operating temperatures, and antigravity seem to be a pervasive similarity between all manners of experiments that have been reported using rotating magnetic fields. I had assumed that Searle's claims were bunk, but after hearing about similar effects from Marcus research it led to reconsider some of the criticism surrounding Searle lately.

One a final note – one group that may lend additional credibility to this research is Godin and Roshchin in Russia. They obviously benefit from the years of knowledge that the Russians accrued in magnetic field systems theory, and they attempted a replication of the Searle effect device some years back (and claimed to get some results). I hear that they have been working on a revised version of their experimental setup recently and hope to have even better results in the very near future.

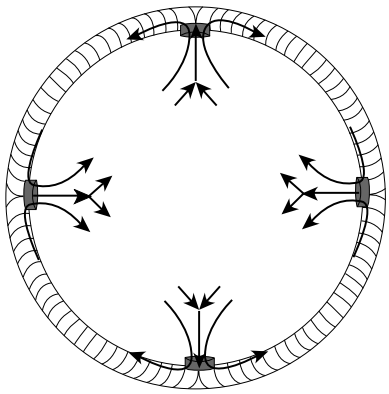

Fig. 1

Magnetic flow for a bifilar-wound toroid that is split at four points on the toroid. This configuration occurs when the coils in the nubs are charged to match the charge on the toroidal coil. The configuration is a quadra pole with a minimum magnetic field at the center

Fig. 2

Marcus recommends the Kikusui 6000L and 18000L multipurpose AC power-supplies

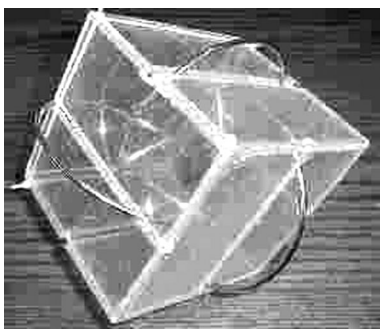

Fig.3

A scale-model mockup of the ring-arrangement within the Marcus device, showing the interlinking coils

History pages

Systems of conversion of thermal energy to mechanical one

Review prepared by correspondent Alla Pashova, **Russia**

There is a wide class of closed-cycle heat engines using differential temperature of water and ambient air. This kind of systems enables thermal energy to be directly converted to mechanical one so as to perform a useful work. We publish patent specifications of two analogous devices of this kind.

PATENT FOR INVENTION

Specification

of the engine, which uses differential temperature of water and ambient air.

To the patent by **P.I. Dobrokhotov** filled on October 22, 1928 (#34248).

Patent grant is published on March 31, 1930.
Patent is valid during 15 years from March 31, 1930.

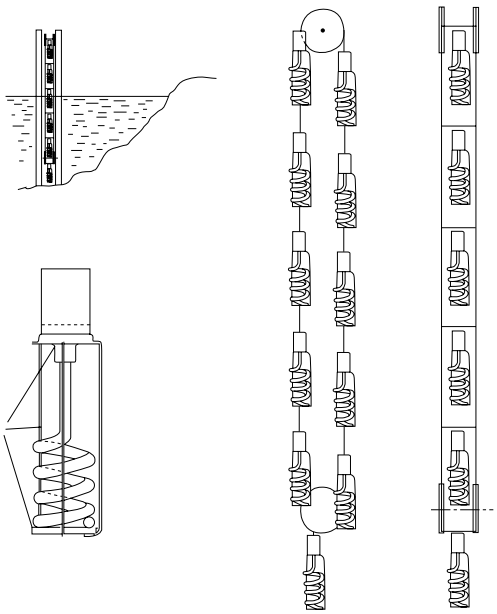

In 1928 **P.I. Dobrokhotov** proposed a design of such an engine. It represents an endless chain thrown over a pair of blocks and partly immersed into water. The chain consists of coiled pipes filled with a volatile liquid (such as sulfurous anhydride or ammonia). One end of each coil is fastened to a frame, while another end is fastened to a cylinder piston mounted on the same frame. When overwater elements are heated by means of ambient air, the liquid inside the coil evaporate. Vapor put pressure upon the pistons which being in motion compress air in the cylinder, and thereby reduce volume of each element. When submerging, the element gradually cools down, thereupon causing a decrease in pressure of vapor of the liquid, which is enclosed within coils. The pistons move in backward direction, and the volume of air available inside the cylinder increases. Increase of volume results in increase of water buoyancy force that sets the device in motion.

INVENTION SU1404681 A1

23.06.88
Yu.S. Grigoryev
Prototype: USSR patent #13534
F 03 G 7/06, 1928

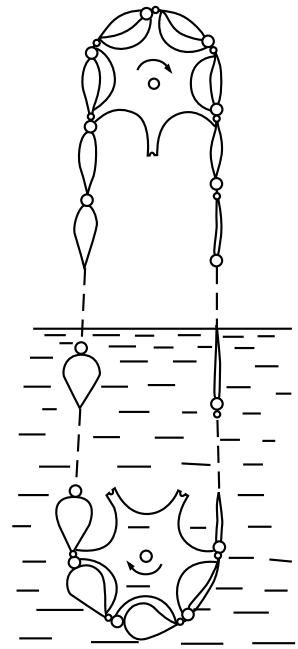

In 1980, **Y.S. Grigoriev** developed his forerunner's idea by improving the system described above. The inventor aspired to enhance the effectiveness of this method of conversion of heat energy to mechanical one. He suggested fixing the volume of chambers filled with a heat-sensitive actuating medium at its minimal magnitude before immersing of those chambers into warm water. In water the actuating medium heats and partially evaporates. At a maximum depth of submersion, the chambers are released from fixation to be expanded during emersion. Thus one may avoid expansion of the chambers during their submersion. Futhermore, there is a possibility to activate the device and get the useful work without preliminary spinup from an external drive.

Iliya R. Prigozhin
(25 January, 1917 – 28 May, 2003)

Iliya R. Prigozhin, aged 86, Nobel Prize Winner, Belgian scientist of the Russian origin, died on 28 May in Brussels. Prigozhin made a number of prominent discoveries in the field of thermodynamics and statistical mechanics of nonequilibrium processes. In particular, he developed a concept of irreversibility as applied to thermodynamics. Prigozhin was studying time as a physical phenomenon. In 1977, he was awarded the Nobel Prize for chemistry "for works on thermodynamics of nonequilibrium processes".

The scientist formulated one of the major theorems of the theory of nonequilibrium processes. This theory was later named after him. According to Prigozhin's theorem, stationary state of the system corresponds to minimal entropy generation. The outstanding physicist was also an initiator of applying methods of theory of nonequilibrium processes in biology.

Thermodynamics principles were enunciated in the middle of the XIX century after the invention of a steam-engine, when interaction of heat, electrical, and mechanical work aroused a higher interest. In accordance with the first law of thermodynamics representing an energy conservation principle, energy neither disappears nor appears in any closed system, but transforms from one form to another.

The Prigozhin's theorem sounds as follows: stationary state of the system (under conditions impeding attainment of equilibrium state) corresponds to the minimal generation of entropies. If there are no such impediments, then production of entropy reaches its bare minimum, i.e. zero. The theorem was proved by Prigozhin in 1947.
In thermodynamics the nonequilibrium specifically open systems were of most interest for Prigozhin. In such systems either or both (matter and energy) interchange in reactions with an environment. At that, quantity of matter and/or energy increases or decreases in the course of time.

It is obvious that human society as well as the biological environment is an example of dissipative and nondissipative structures. In the 60s and 70s, Prigozhin developed his theory of dissipative structures and described the formation and development of embryos. Critical points of bifurcation in his mathematical model are correlated with a point, where a biological system becomes consecutive and stabilized.

For his scientific career time, the physicist was awarded over 40 scientific rewards and admitted as an honorary member into national academies of many countries all over the world.

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The 11th Russian Conference on Cold Nuclear Transmutation of Chemical Elements and Ball-Lightning (RCCNT&BL-11) is to be held during September 28- October 5, 2003. The place of the Conference is in Dagomys near the city of Sochi.

The program of the Conference includes the following subjects:

- Experimental research in cold nuclear transmutation (fusion) and ball lightning;
- Theoretical models with respect to cold nuclear transmutation (fusion) and ball-lightning effects;
- Applied to these problems technologies and devices.

The Organizing Committee of the Conference is pleased to invite you to attend the Conference. The terms of your participation are as follows:

The full cast is $900, which will include the registration fee, hotel reservation and living, three daily buffet meals, conference proceedings, transportation from the Sochi airport and back, social dinner and special excursion or entertainment.

The languages of the Conference are Russian and English.

The total cost can be reduced to $800 if transferred before August 10 to the account of the Organizing Committee, which is to be announced on having received from you a confirmation about your decision to attend the Conference.

If you make a decision to take part in the Conference, please, let us know before July 1 about the title and abstract of your report.

Contact telephone: (7) (095) 196-9476 (ask Mr. Igor Goryachev), Fax: (7) (095) 196-6108
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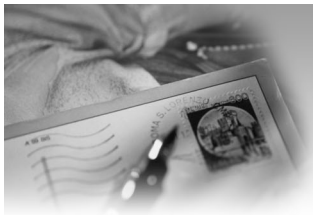

Letters from our readers

Thank you for publication of my article. Your magazine becomes more and more popular.

My special thanks to Editor-in-Chief Alexander V. Frolov. Whatever they say or write in the press, he has done a great work and it is not only my own opinion. He has managed to do that everybody had been waiting for a long time. My colleagues (not only from Rostov-on-Don State University but also from other Rostov Institutes of higher education) ask me personally send the best regards to the editorial staff of your magazine.

Sergey A. Gerasimov

Free energy?

The scientific community says that it cannot exist. Where did we hear that before? Academician Valery Sobolev from the Academy of Sciences, the head of the research group working on the experiment says: "This is not some new physics, but just experiments that have been performed very seriously. Make surge of electrons from the environment, remove them, deplete the fused electrolyte with basic typical metals; what you derive from it is what cannot be produced by chemical methods. This is a new state of substance." As the researchers say, first they discovered a particular electrochemical process where high-temperature materials in a new state are the product. This in its turn allowed to discover a new state of substance, new class of materials, a new source of energy, a new method of cold plasma generation, a new superconductor. See whole article at: http://english.pravda.ru/science/19/94/379/9675_energy.html

Josef Hasslberger

Personal home page on physics, energy technology, social and economic issues: http://www.hasslberger.com

Interference disc generator with permanent magnets

inventor Alan Francoeur, Canada

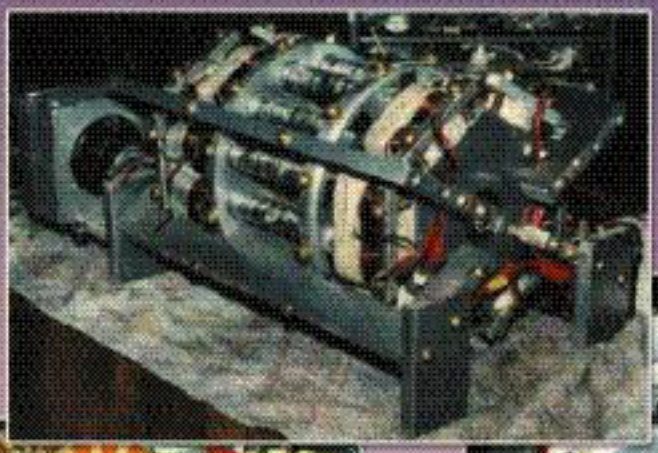

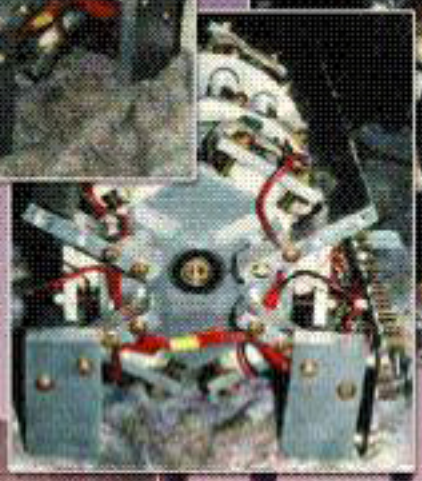

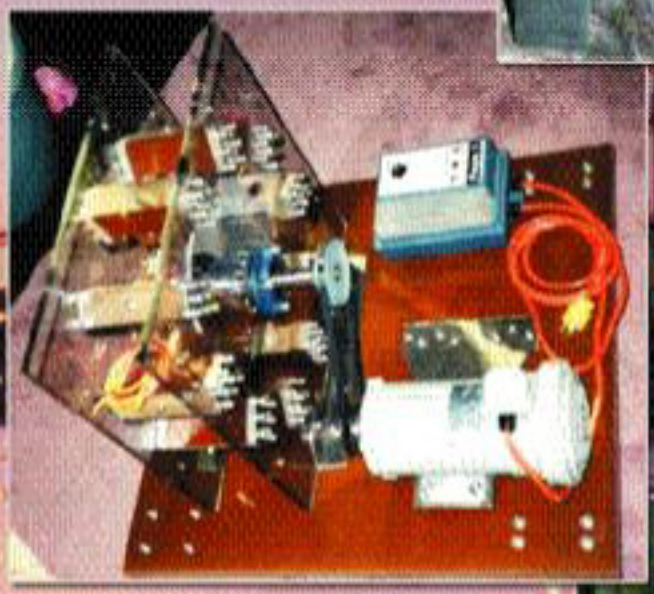

Carl Reich

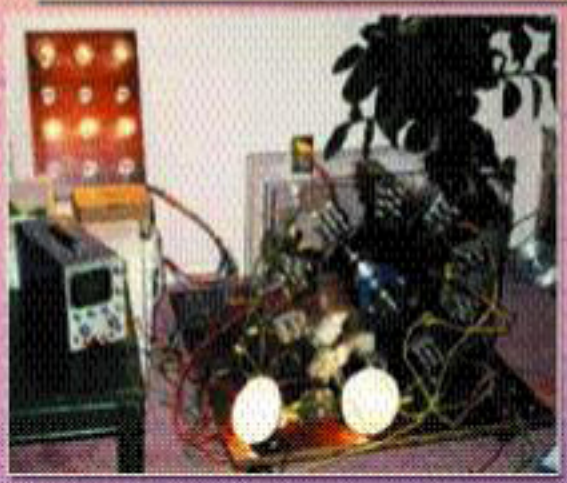

Bud Johnson

Vortex heat pump

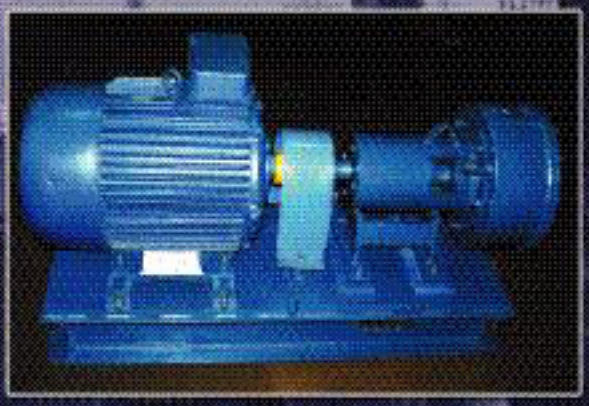

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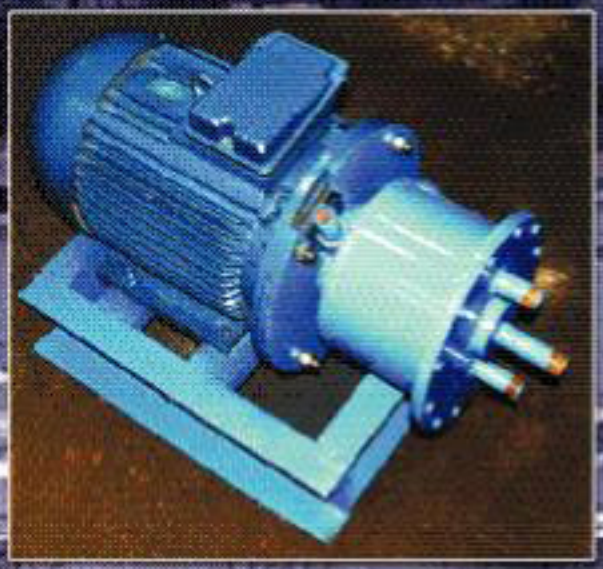

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Gravity-heat power system

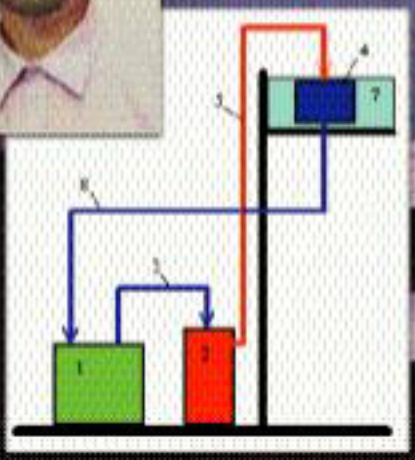

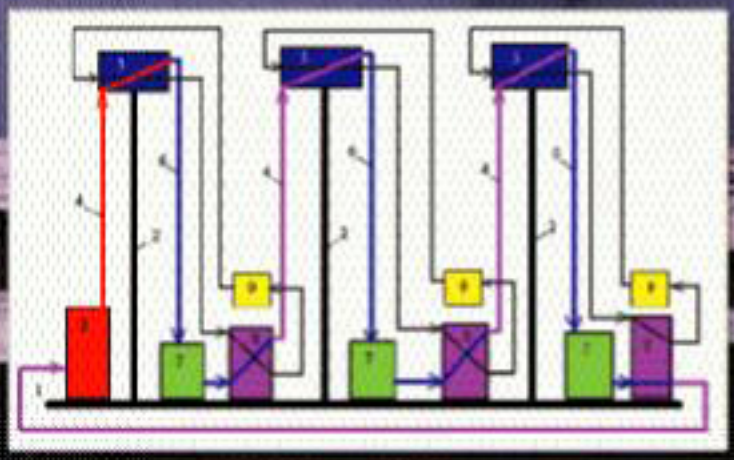

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- capillary perpetuum mobile
- Hutchison effect

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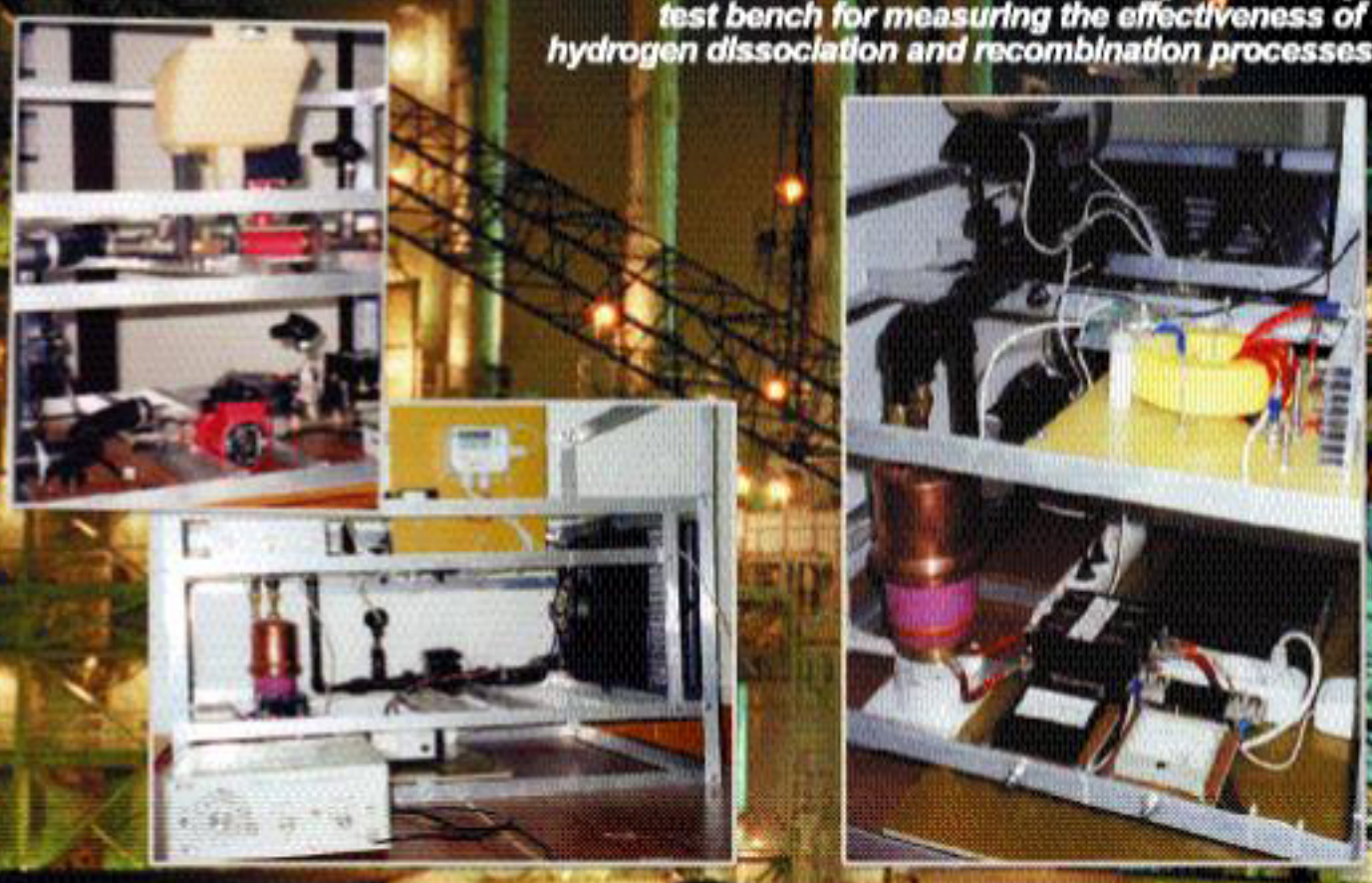

Bogomolov's Invention

Over-unity from elastic forces of spring, compressed by rotation.

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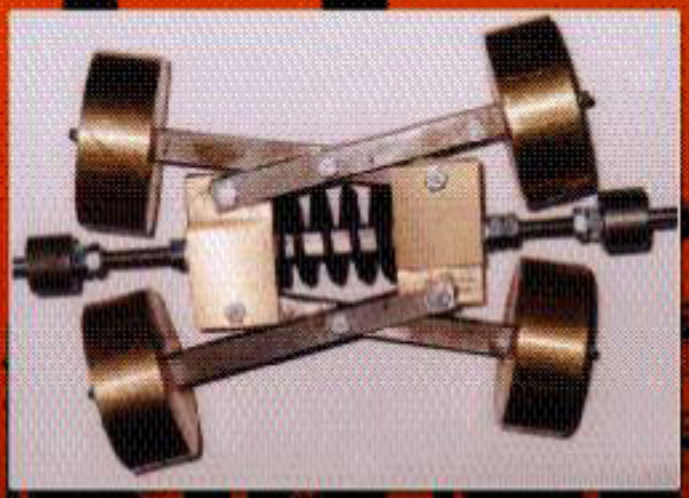

Spin Wave Laser of Ines Espinoza, USA

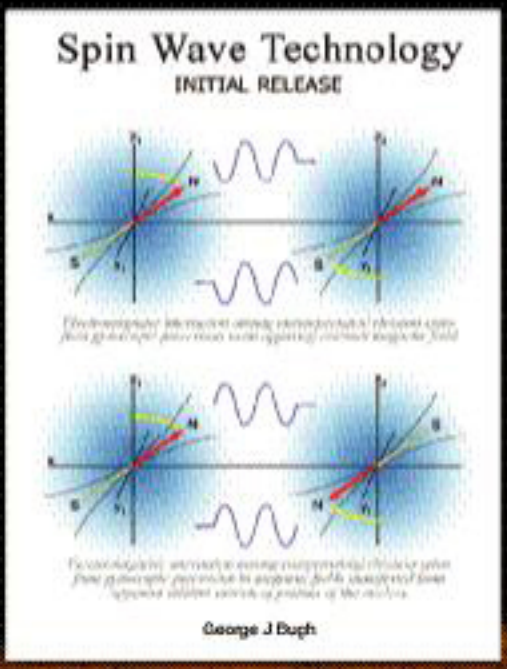

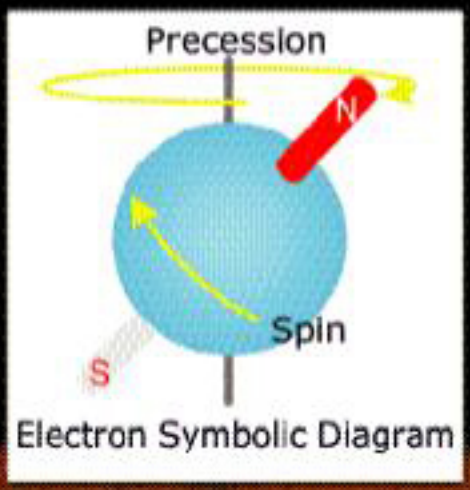

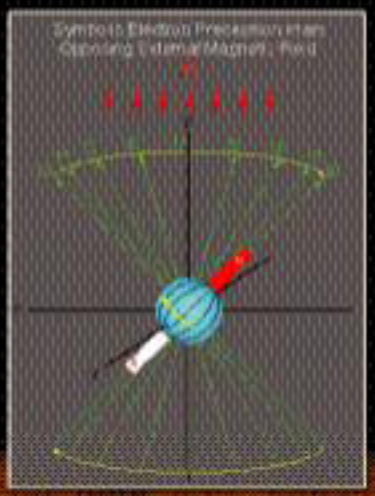

NEW ENERGY TECHNOLOGIES #14-15

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Faraday Lab News

One of the most interesting research projects of our company in the year 2003 has been the research on hydrogen dissociation and recombination processes. It has taken us about half a year to build a special vacuum tube and in October, 2003 we obtained some experimental results on the heat output and efficiency of the system. The system we designed in our laboratory is shown in Fig.1 and also on the cover. The water-cooling system and the heat measurement system make it possible to measure the heat output within the range of 100 W to 5 kW with pinpoint accuracy. In the year 2004 we are planning to go on with our research work.

Fig.2

We have completed the second stage of designing and developing a high-efficiency magnetic generator with the neodymium permanent magnets of 1.25 Tesla. We confirmed the possibility of double output increase from the usage of two magnetic induction counter fluxes produced by the two coils wound on the generator core (Fig.2).

Our laboratory continues designing and perfecting a powerful "alternator"-type generator with permanent magnets and a drum-type rotor. We will give our readers more detailed information after we are aware of the patent examining result.

Our research on "The Control of Temporal Characteristics of Physical Processes by means of Ether Energy Density Change" is also awaiting the results of the patent examining group. This research on time and the construction of the "time machine" is not a pure theory but it has quite real prospects of being applied to the aerospace industry as a propulsion method.

Fig.1

It is worthy to note that now the alternative energy prospects in Russia do not entirely depend on financial factors. The cooperation is important between researchers, investors and organizations interested in the innovative development of Russian industry rather than in the development of Russia as the world primary natural resource is also important. Progressive political and public organizations should develop and introduce alternative energy programmes as well as render support to local researchers. The successful innovation of new technologies is impossible without this support and lobbying government. Let us hope that the year 2004 will bring along new opportunities and promising contacts.

Alexander V. Frolov
General Director Faraday Laboratory Ltd
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Novozhilov's Motor

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An interesting but a very simple motor has been designed. It operates on the basis of heating differences of its components due to temperature variations of contacting environments or due to variable radiation intensity.

Motor structure

The motor structure (see Fig.1) includes a metal or plastic wheel (1). In the center of the wheel there is an axis (2), on which spoke ends are fixed (3). Other spoke ends come through a hole in the wheel rim. On the spoke end there are weights, for example, in the form of small balls (4).

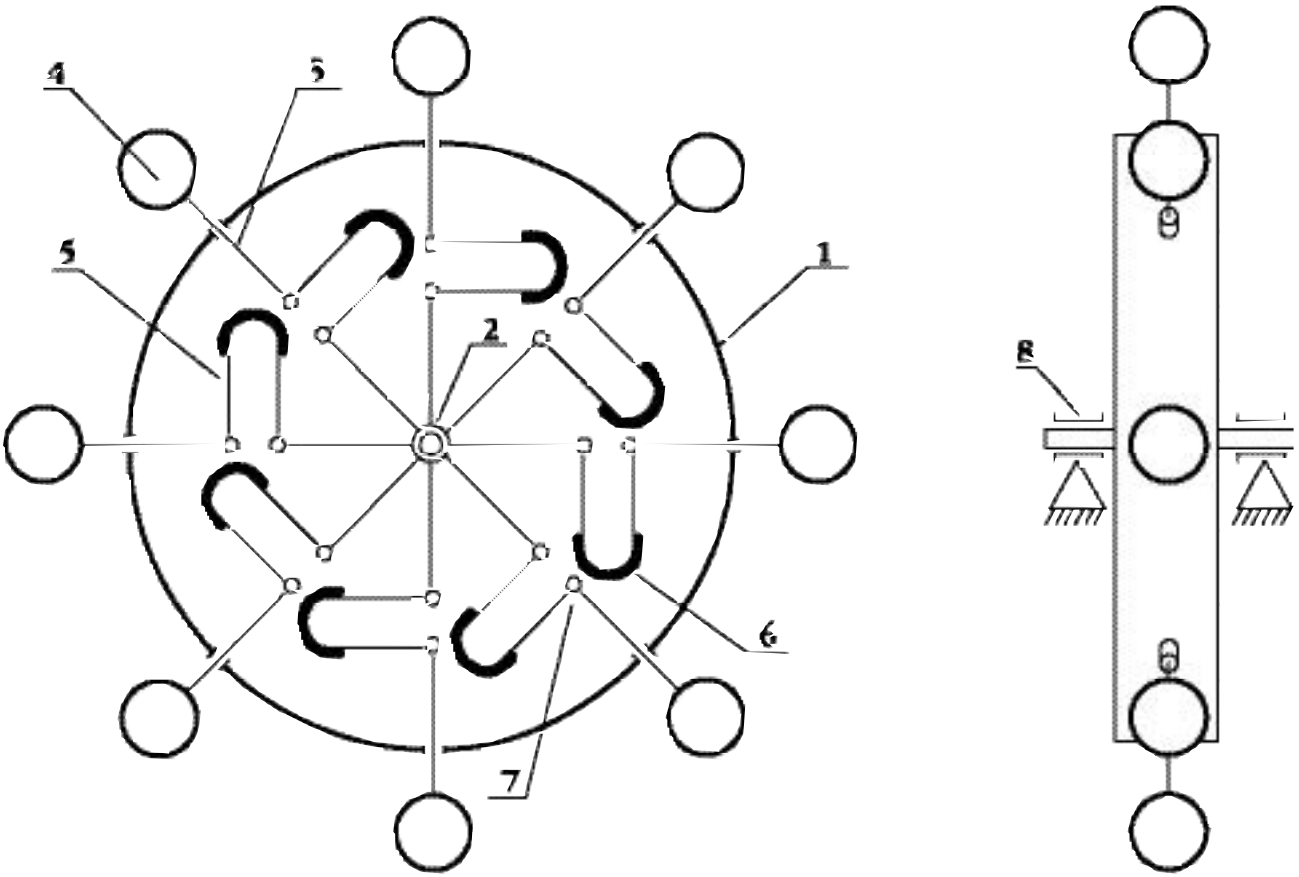

Fig.1
Motor

The structure peculiarity is preconditioned by a loop-shaped part placed on each spoke (5), which has a form of a metal strip or core. An arched bimetal component is built in the center of each loop-shaped part (6). Joints can be fixed at the joining point of loop-shaped parts and spokes to simplify the motor movement (7).

In the motor structure described arched bimetal components become straight when heated. The motor axis ends are placed in bearings (8).

To initiate the motor movement the loop-shaped parts need to be in mediums (zones) with different temperature. For instance, the lower part of the wheel may be placed into hot water (9) and the upper part will stay in the air (10).

Motor operation

When the motor is in a medium with identical temperature, for example, in the air, the temperature of all bimetal components will also be the same; therefore, they have identical form. In this case all spokes will similarly project over the wheel rim and all weights have similar distance from the wheel axis.

This state makes the whole system balanced and immovable. But if the motor wheel is partly placed into water with the temperature exceeding that of the ambient air **the bimetal components in water will become straight and shift the axis weights from the wheel axis.** This phenomenon initiates motor operation.

Let us consider this process in more detail.

On touching water, the bimetal component in the loop-shaped part becomes straight and shifts a weight from the wheel axis. The wheel becomes unbalanced, obtains torque and turns clockwise. This rotation makes the following bimetal component on the next loop-shaped part of the following spoke touch water. This bimetal component also becomes straight and shifts a weight from the wheel axis, generating an increased torque that turns the wheel clockwise.

At the same time a bimetal component comes from hot water on the left side of the wheel in zone "A". The component cools and restores its initial form, i.e. it curves more and pulls the weight on the spoke to the rotation axis. This leads to a decrease of its counterclockwise torque that affects the wheel.

The loop-shaped parts on the left side (A) and the right side (B) of the motor wheel will cause asymmetry in the number of weights projected by the spokes. On the motor left side (A) the weights will be projected from the wheel axis when the spokes are located in corner "C". On the right side (B) the weights on the spoke axes will be shifted from the axis when the spokes are located in corner "D". Fig.2 shows that corner "D" is far larger than corner "C". This means that more weights will be shifted on the right side of the wheel in zone "B" than on the left side in zone "A".

Fig.2 shows that the wheel weights generating a clockwise torque are projected on the right side. On the left side in zone "A" only one weight is projected and it generates a counterclockwise torque. More weights shifted from the wheel axis on the right side will generate a greater clockwise torque than the weights shifted from the wheel axis on the left side. This is the cause of the wheel clockwise rotation.

This interesting effect is achieved due to the loop-shaped parts on the wheel spokes with bimetal components placed on them. When the next wheel spoke reaches corner "D", the bimetal component connected with it touches hot water, becomes straight and shifts the corresponding weight further from the wheel rotation axis. The motor wheel continues rotation, making the next bimetal component touch water. It is also heated, becomes straight and shifts the corresponding weight from the wheel rotation axis. The wheel continues rotation. Bimetal components are touching water in succession. On the left side, in zone "A", the bimetal components successively come out of hot water, cool in comparatively colder air, return to the initial sharply curved form and pull the weights on spokes to the wheel rotation axis. This is the reason for the wheel torque to decrease.

Mass movement from the axis in a rotating object commonly causes reduction of rotation speed. And, on the contrary, the rotation speed increases when the mass comes close to the axis. In motor zone "A" the weights come close to the rotation axis after the corresponding bimetal components come out of hot water, and the same number of weights move from the center in zone "B", i.e. these effects on the rotation wheel compensate each other.

In essence this is a heat machine. The heat transfer from a warmer medium – water – to the cold medium – air – is achieved owing to the heat capacity of the band-form bimetal component. This is the reason for fast heating and cooling processes. Due to the fact that bimetal components are not large, not so much heat is needed for their heating.

The motor will operate when the air temperature exceeds that of water but in this case it rotates counterclockwise.

There is another model of this motor when nitanol components are used instead of bimetal ones. Nitanol is a memory metal alloy that changes shape when reaching certain temperature. In this instance, the nitanol component is normally curved but becomes straight when heated (for example, up to 50^0 C), and the weight on the spoke end moves from the wheel rotation axis initiating rotation of the wheel. That means similar operation of a nitanol-based and bimetal-based motor.

The motor structure is very simple and its operation does not require power or fuel supply: it is enough to place its wheel into the water the temperature of which is different from that of the air.

The motor structure may be further developed: for example, a focused sun ray can be used for the heating purposes; the bimetal component can be heated with a common electric lamp on one side of the wheel, the required heat may come from a heating radiator, stove or burning gas-jet. Such motor may be heated when installed on a mantelpiece, etc.

This article describes the motor model that can be used as a toy. Being supplied with looking-glass units it may be applied to get various luminous effects or may be installed in the shop showcases, or else at exhibitions. This motor is also able to operate in a gravity force environment, even on the Moon. There direct sun rays may heat bimetal components to 200^0 C, and the temperature of the components located in the shadow almost reaches absolute zero, i.e. the temperature difference in this instance is over 400^0 C, which enables constant efficient motor operation.

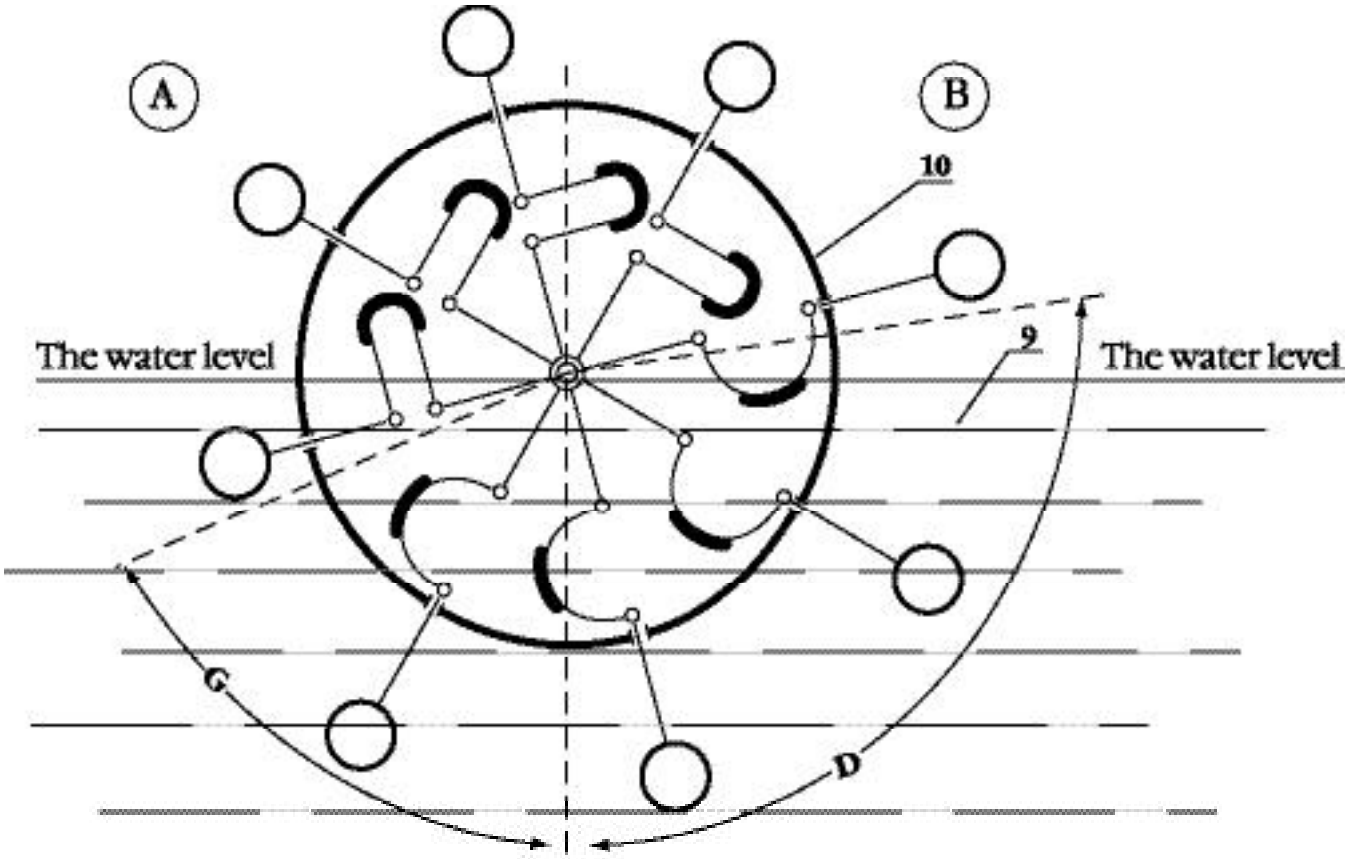

Fig.2
The motor in operation

Self-Interaction in Electromagnetic Rotation

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Introduction

The electromagnetic rotation is the motion of a magnetized body ina direction perpendicular to both the vector of magnetization J_m and the direction of the electric current j in a liquid inside which the magnet is located (Fig. 1).

Editor: Readers can compare this vector composition and the device scheme of Godin and Roschin with the Searl experiments. The similarity is evident. *A. V. Frolov*

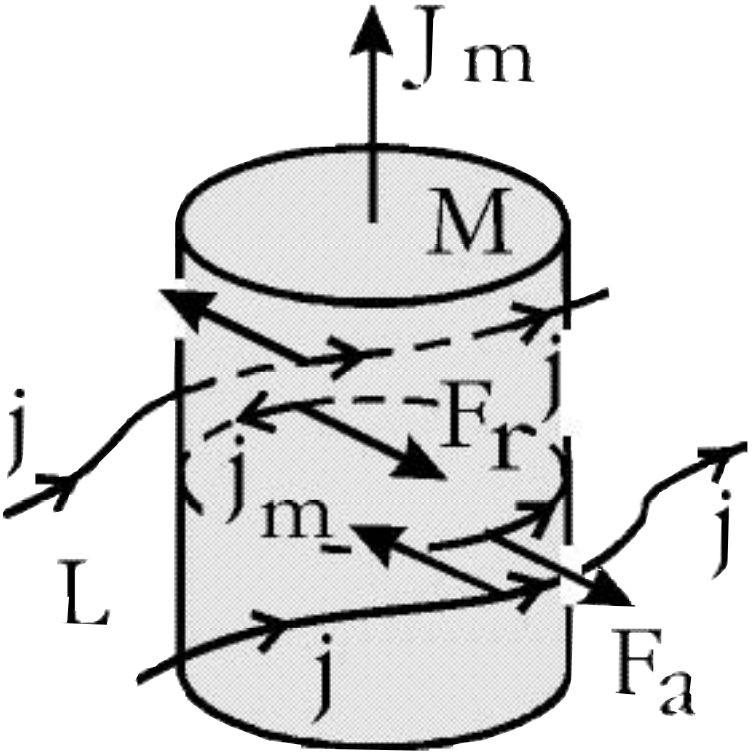

Fig.1
Electromagnetic rotation. A magnet M of magnetization J_m that is partly or entirely submerged in a conductive liquid L with a direct current of density j is moving in the direction of the force F_a+F_r

The force producing such a motion is sufficiently weak and, normally, the phenomenon is observed at rotation. Although, this is quite a well-explored phenomenon [1-6], nobody knows what makes the magnet rotate [4]. There is an opinion [2,3] that the motion of the magnet in the conductive liquid is caused by the forces of attraction $\mathbf{F}_a$ and repulsion $\mathbf{F}_r$ between currents of density **j** flowing in the liquid and surface magnetization currents $\mathbf{j}_m$ of the magnet, often called the Ampere currents as shown in Fig. 1.

The external magnetic field of a long cylindrical magnet originating far from either pole is zero. Therefore, no force is exerted on charges moving in the liquid far from the ends of the magnet. Nevertheless, the magnet still moves in the liquid with the direct current even if it is only a thin magnetized needle [5]. Thus, the deeper the magnet is immersed in the conductive liquid, the more liquid gathers around it. The deeper the immersion is, the higher the total force must be. That should be so.

In reality, it is quite different. During intermediate immersions when the magnet is partly submerged in the liquid, the torque N does not depend on the depth of immersion, in the other words, currents flowing round the cylindrical magnet do not influence the exerting force acting [6]. Moreover, during shallow immersions, the magnet moves together with the liquid. **This is none other than *the self-interaction* [7].** The conductive liquid under the magnet experiences the magnetic action. The direction of this force coincides with the direction

of the magnet motion. **Thus, the part of the conductive liquid moving in this direction under the action of the magnetic field B, affected by the frictional forces in the liquid causes the motion of the magnet in the same direction.** The only way to find out the role of the self-interaction in this phenomenon is experimental investigation. It would be appropriate to exclude the currents flowing under the magnet. In this case the magnet must rotate in the opposite direction.

Experimental system

A commercially available cylindrical magnet M of magnetization J_m=1,95•10^5 A/m and a balanced load *P* connected by a rocker R are suspended by a thread *T* as shown in Fig. 2.

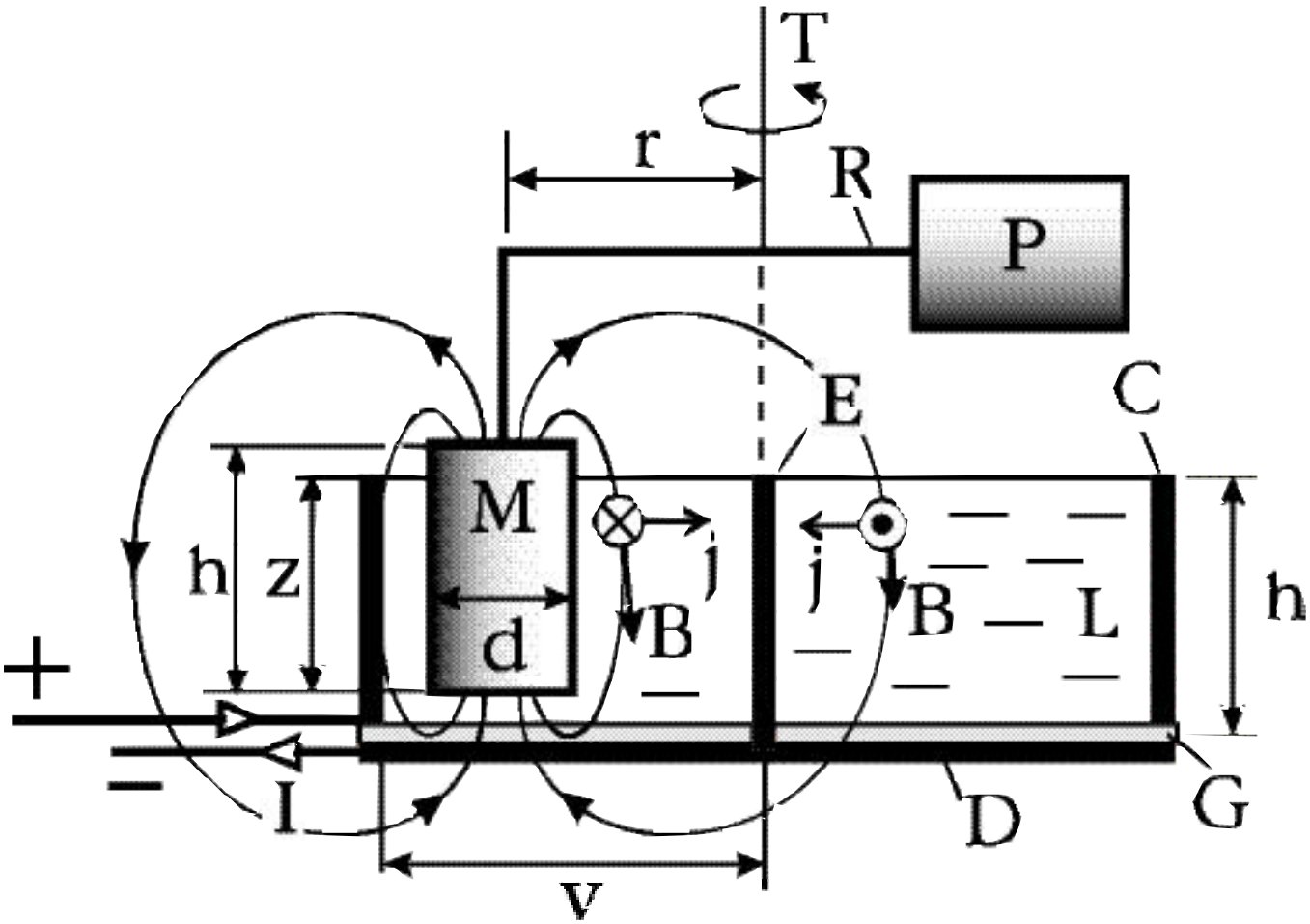

Fig.2
The experimental set and its parameters: h=50 mm, r=35 mm, d=25 mm, v=70 mm, the diameter of the central electrode E is 5 mm, the thickness of the bottom G is 2 mm. (×) and (•) are directions of the force acting on current elements of current density j in the magnetic field of inductance B

The magnet is immersed in the 5% copper sulfate solution ($CuSO_4$) so that the depth *z* of immersion can vary. A vessel containing the conductive liquid *L* is large enough for the magnet to be almost entirely immersed. The cylindrical surface *C* of the vessel and the central electrode *E* of the system are made of non-magnetic materials. The bottom of the vessel *G* is, of course, insulator. The magnet is coated with an insulating moisture-proof varnish. The length of the electrode *E* equals the height h of the vessel. A direct current of strength *I* passing through the cylindrical electrode *C*, the conductive liquid *L*, the central electrode *E* and the disk electrode *D* generate a torque of electromagnetic origin which results to the rotation of the magnet. The disk electrode *D* is intended to provide the system with the symmetrical supply of the current.

Experimental results

The size of this experimental device differs from that described previously [6]. **As a result we have obtained the torque N, which is about ten times more intensive than the former one.** But the main result is that the torque does not change its sign when the magnet is being immersed in the conductive liquid (Fig. 3).

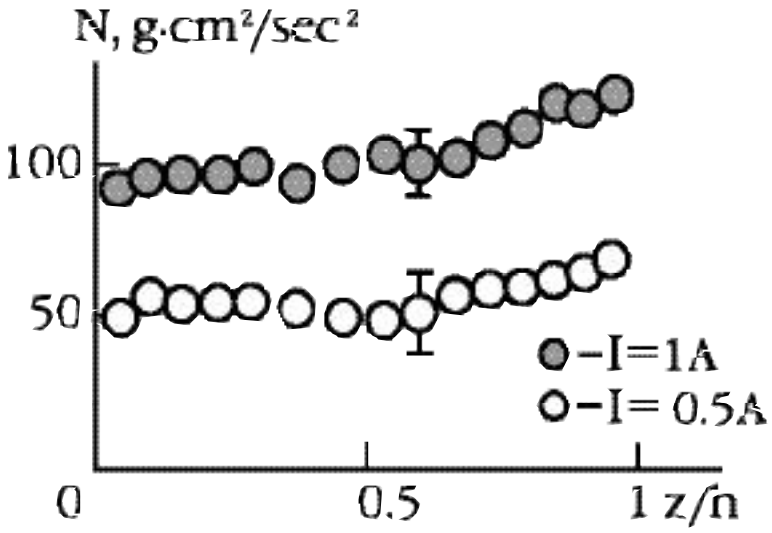

Fig.3
A typical experimental dependencies of the torque *N* acting on the magnet depending on the depth of immersion *z*

When the magnet is almost entirely submerged in the liquid the depth of which equals the height of the magnet, no currents are flowing under and above it. In this case the rotation of the magnet is expected to be the result of drag action of the rotating liquid located in the intermediate field relative to the magnet. This part of the conductive liquid is rotating in the direction opposite to that of the motion of the magnetized body. It seems to be the right way. The magnet pushes the liquid away and, therefore, is moving in the opposite direction. No, this is wrong. If it was correct, this effect would also occur during the shallow immersion. At small *z* the magnet and the liquid rotate together. So far we still do not know what makes the magnet rotate.

S.A. Gerasimov

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Capillary Motor

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For several decades the author has been organizing a contest for young inventors on the radio, television, in mass media and the Internet. There have been accumulated thousands of engineering solutions that belong to schoolchildren and youth. There are many original ones, including perpetual mobile. Though unfeasible in principle, they have interesting structure and competent engineering solutions.

For example, a child's dream to create an oblique roof over a city or field and direct the rain flow to a turbine to obtain mechanical work is of little use. But it's quite another matter if this child takes a pencil, a sheet of paper and tries to make a sketch or a drawing of such construction. Even if the construction is primitive and unfeasible, the child will get his first engineering experience and self-reliance.

I can still remember one peculiar case. Once the editors were instructed (it was in the times of the USSR) to assist an honored inventor of new machines. It was a Stalin Prize laureate, creator of a special type of lime that was widely applied in construction (I will not disclose his name). The inventor was given (that was not common practice) a large room in a shared apartment situated in a prestigious block of apartments in Moscow. It turned out that all room space, except for narrow passages at the walls, was occupied by a huge table. On the table up to the ceiling there were some pipelines, glass and metal vessels, retorts and other laboratory ware. The most impressive thing was retorts heated by gas coming through a hose from the shared kitchen. All that staff was bubbling, hissing and steaming. The inventor was creating a perpetual mobile!

I will give one more example of a situation common for the editors of the "Inventor and Rationalizer". Once we had a respectable-looking visitor who made an odd request to get the President of the French Academy of Sciences to respond to his letters about a perpetual mobile plan. The essence of Alexander Rodionov's (Maloyaroslavets, Russia) invention was that "in accordance with Newton's and Guerin's laws fluid flows up through capillaries and turns a wheel when flowing down (see Fig.1).

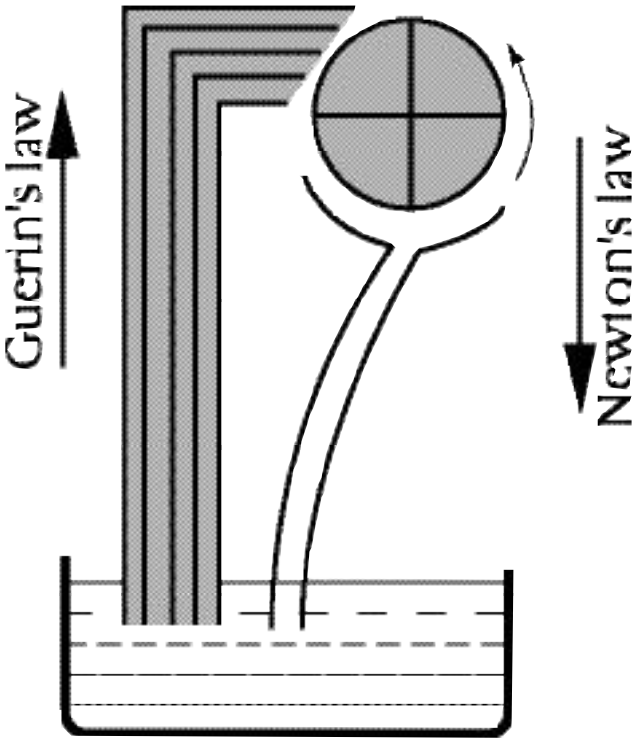

Fig. 1
Perpetuum-mobile

There are many similar projects in the history of engineering. Hence, this case may be considered as typical. We all know that the molecular adhesion forces (moistening) that push the fluid upwards will stick to it and the capillary motor will never work. But is the idea totally unfeasible? Since false modesty is inappropriate when it comes to perpetual mobile, I will present my ideas on this not so honorable subject for the reader's judgment.

It seems that all perpetual mobile inventors start not with a pencil and a sheet of paper but with experimenting on magnets, oblique plane, wicks, wheels, springs and other materials at hand. My first heat (perpetual) motor was also the result of an experiment.

The "Capillary" idea of Alexander Rodionov haunted me. I recalled that the great Lomonosov devoted lots of time to studying molecular adhesion and capillarity. They are present in everyday life, let alone the nature, especially in plants that would not be able to exist without them. How else would moisture flow up the trunks and stems? But, on the other hand, according to Mikhail V. Lomonosov's data, water flows up only for the maximum of several dozens of millimeters even through the thinnest capillary. But trees may have the height of several dozens of meters! If, as it is customarily considered, moisture flows from one capillary to another of its own accord, why not suppose that a capillary perpetual mobile is feasible? Explanations that moisture in plants flows up due to root pressure do not sound plausible. So where is the truth?

Years have passed since that visit of A. Rodionov. Now, just like I used to sympathize with, as it then seemed, a rather odd inventor, now my relatives sympathize with me. One can not blame them: for weeks and months there have been flowerpots all around the apartment - on the tables, window-sills and bookstands. With bottles, tubes and self-made water manometers to follow.

Once, when I was assembling a device, I could not find two similar glass tubes and had to put in the tube of thin polyethylene. But no matter how hard I worked the water in the communicating vessels was at different levels. In the glass tube the water level was always higher. It could not be otherwise, if you come to think of it, but isn't it the right time the words "made of equally wettable material" were inserted into the communicating vessels law?

Here is a primitive experiment: make a hole in the bottom of a plastic flowerpot containing soil and a plant, and insert there one end of an elastic tube. The other end is inserted into the bottom of a plastic bottle containing water (see Fig. 3). In accordance with the communicating vessels law, the water will flow from the bottle into the flowerpot. When we see that the soil has been made wet, the experiment shall get more complicated: elevate the flowerpot so that its bottom is higher than the liquid level in the bottle. In some days we shall notice that the soil has not dried up and the water level in the bottle has lowered. One should not be a Solomon to guess that the soil or the roots of the plant transfer the water from the lower to the higher level. Here is a typical natural perpetual mobile!

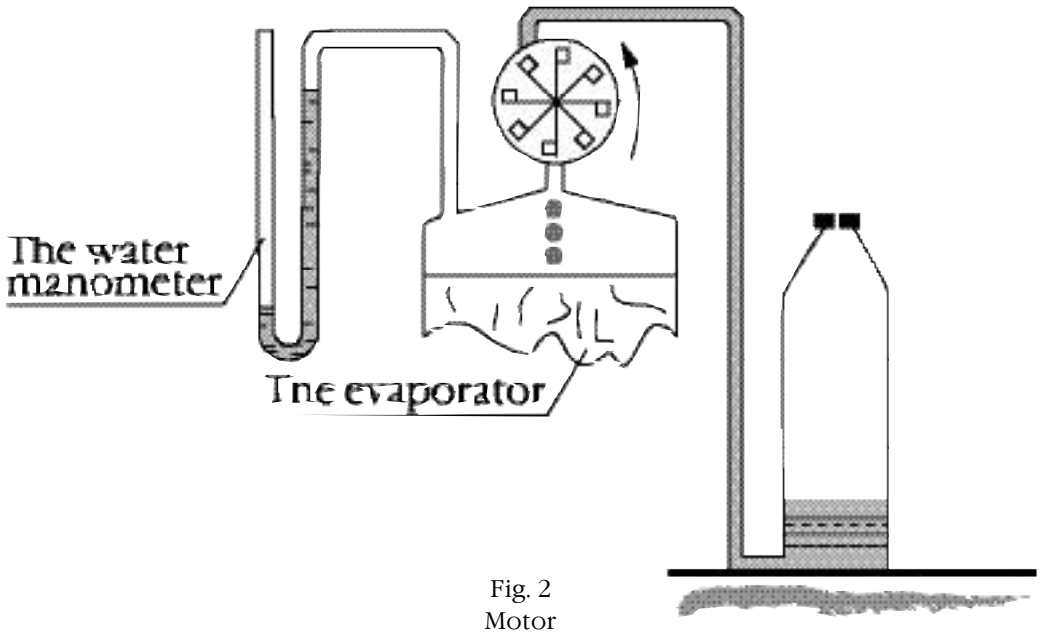

Fig. 2
Motor

It is no use referring to the molecular adhesion forces since they can not be applied at such height differences. What is it then? A molecular collision as in a boiling kettle? But a leaf has neither high temperature nor much space. Nevertheless, water evaporates both from the soil and leaf surfaces. At the same time there is rarefaction under the evaporating surface. Can it be the rarefaction that pulls up new portions of water?

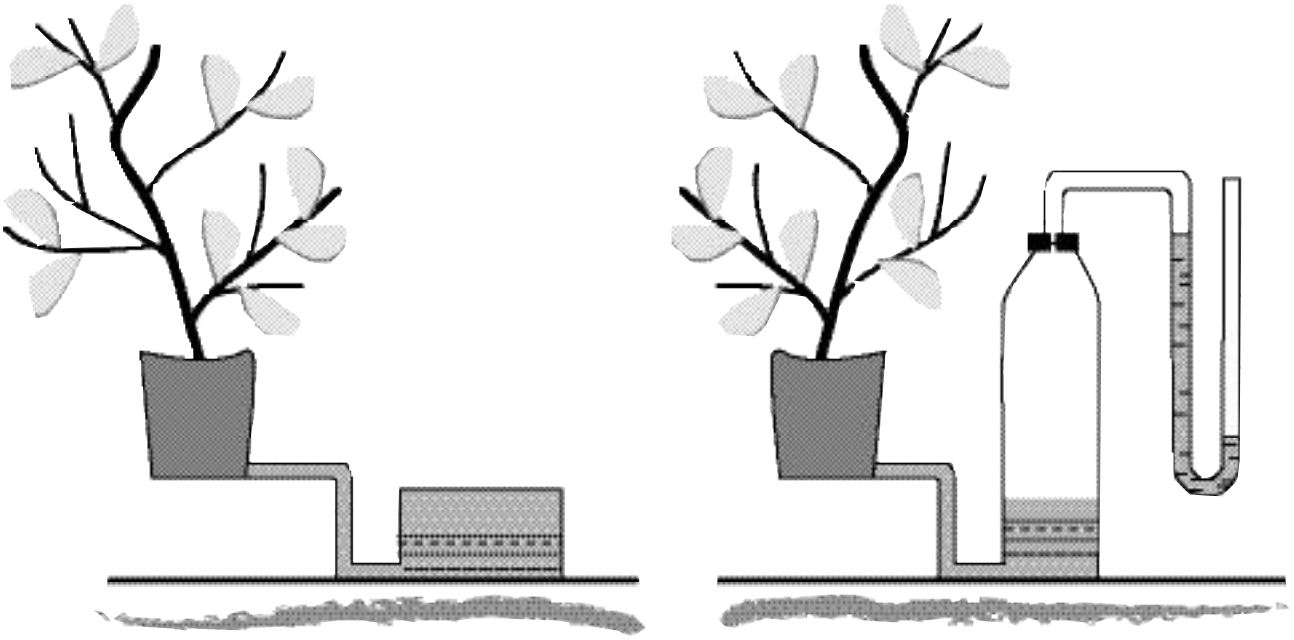

Fig. 3
Rarefaction

Let us make the experiment still more complicated. Put the leg pipe of a liquid manometer into the bottle cork. (Fig. 3) Almost immediately the water level in the closest leg to the bottle will start rising. It means that there is rarefaction in the bottle. Can it be the rarefaction that "rules" the plants?

Most likely, the essence of the mistake made by Rodionov and other authors of capillary motors consisted in attempts to get the water outflow from the capillary. **If it is not flowing out but evaporating, as it is common for the soil or plants, then, probably, vacuum will manifest itself and the capillary perpetual mobile will start working.**

I made my first capillary perpetual mobile many years ago (see Fig. 4). And it worked: though slowly, the wheel was steadily turning. No doubt, it was due to the heat inflow from the air. Therefore, such motor will work if there is a temperature difference and relative humidity of surrounding air is below 100%.

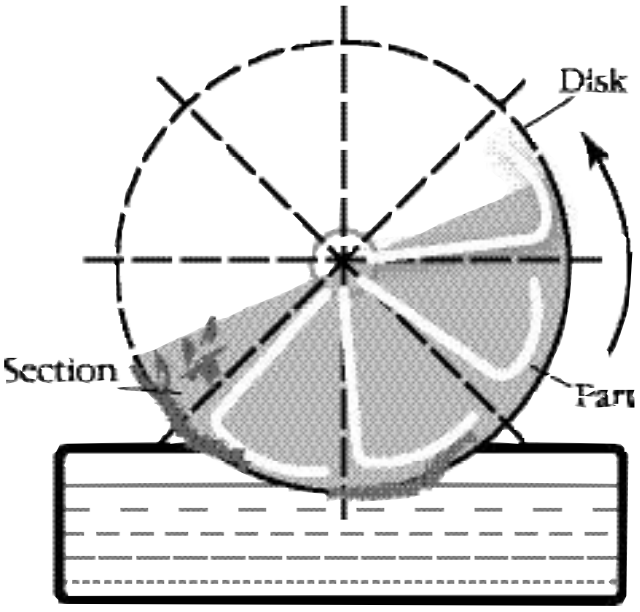

Fig. 4
Capillary Motor

The heat motor operating principle is clear from this figure. The disk (many disks on the common axis) is divided into isolated sections. Their surface is covered with a moisture-proof piece of material (filtered paper, cloth, etc.). The part of each section somewhat gets under the base of the next one. Hence, a small part of the base of one section and a part of the part following the section can get into water simultaneously. Due to the capillary moistening the section and the part will start to absorb water. Since the section is shifted about the center of gravity, the turning moment is bound to appear. The section that is out of water starts to dry up, the moment will increase and the wheel will start turning.

Having determined that, though slowly, the motor is turning, the author applied to a patent authority for a patent on the invention of the "Perpetual mobile", meaning it as a joke. I hoped that the experts (I knew some of them personally) will understand this joke. But, unexpectedly, the device was considered an invention, though under the name of the "Heat motor" (certificate of authorship USSR # 1455040).

Basically, the motor is similar to the project of A. Rodionov. I would not be surprised if he protested. The same capillaries and the spontaneous rise of liquid on the moisture-proof material. The only difference is that the liquid does not flow out but evaporates from the capillaries.

Almost without any reason - one can not predict his eccentricities - I have recently made one more capillary motor (see Fig. 3). Perhaps, it resulted from my experiments with plants. This motor directly and spontaneously lifts water to a higher level, which is more convincing. Moreover, water flows in the form of drops (or a stream) and turns the propeller! The motor is quite operable and has even been shown on TV. But do not try to verify it on your own - such work is useless without certain know-how. The author would not like to disclose the "secret" yet. I could still make a patent application.

NEWS

The Continuous Rotation Device

The essence of this invention is that in a closed circle the rotation of the object occurs without any outer influence or any power sources (electric energy, oil, diesel oil, etc.), which results in the rotation of the rotating part of the device. The torque can be easily enhanced by means of transmitting it to the reduction system. At that rate, the necessary rotation speed and rotation power can be acquired.

The device is small, easy to transport, mobile (both, in operation and switch-off), simple and inexpensive to make and assemble. It is economical, ecological and weather independent.

The device can be used in any industrial or household appliance field where the continuous rotation is required. It is especially important to note that this device can be used to generate energy on a large industrial scale as well as in small laboratories, in mountains and remote districts, in tunnels, at sea, etc. for it does not require any power lines.

Patent Claim Priority:
#20030059, April 19th 2003

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Natural hydrologic cycle is a widely recognized phenomenon. Water evaporates from the ground and water reservoir surfaces, generally, due to the Sun heat, then moves to the superstructure atmospheric layers where it is condensed, and precipitates onto the ground surface, but on higher levels compared with evaporation surfaces. In this process water is also purified and desalted. From the higher levels water flows to its main evaporation points, forming streams like brooks and rivers where water power plants could be established. Flowing to the lower surface layers with lower potential energy, water in the Earth's gravitational field performs work that can be utilized.

Natural hydrologic cycle principle is used in the gravity-heat power system (USA patent No. 3953971, International class. F03G7/04 of May 4, 1976).

In this system the temperature difference between ground surface layers (the mountain foot and its top) is used to produce electric power and obtain fresh water. The temperature difference does not change much with change of height, and the system effectiveness is quite moderate, which can be named as its drawback.

The system utilizes free environmental energy. Its efficiency (converted to the process maintaining energy) tends to infinity.

The author proposes a new gravity-heat power system that can substitute modern heat power plants. It contains all installation components as per USA patent No. 3953971 except for the heat exchanger on the ground surface whose functions are performed by a conventional steam boiler.

Gravity energy component **G** in the proposed system:

$$G = X_m \cdot T\, g\, H\,,$$

where

- X_m – fluid flow,
- **T** – time of operation,
- **g** – acceleration of gravity,
- **H** – tower height between the steam boiler and the freezer (condenser).

This formula does not allow for vapor density of operating fluid.

The vapor density is insignificant as compared with the operating fluid density.

Energy **P**, required to maintain operation:

$$P = X_m \cdot T\, q\,,$$

where **q** – specific fluid vaporization energy

Efficiency **K** – of the system should not be lower than 80%

To obtain efficiency that equals 120% the following is required:

$$H = 2{,}2q/g$$

Or **H** = 25,4 kilometers.

Construction of such towers is too complicated for modern technology. Therefore, a stratospheric balloon that is linked to the ground surface by a flexible twin-core hose rope may be used. One core is designed to send down fluid and the other to send up vapor. Flowing down to the ground surface through the hose, the fluid will generate fluid column pressure. The fluid will cross water-turbine generator cascades, after each of which the fluid pressure will decrease and the fluid will continue its way down.

There is an alternative. To make the tower several times lower the evaporation (at the tower foot) and condensation (at the tower/mountain top) should be phased (in the form of cascade) at various pressure values and with utilization of the same heat energy. For this purpose a heat carrier is used that will transfer heat from the tower (mountain) top to its foot. This operation will enable the tower height segmentation into **H/n** sections where **n** is the number of grades in a cascade.

Cascade structure is shown in Fig. 1

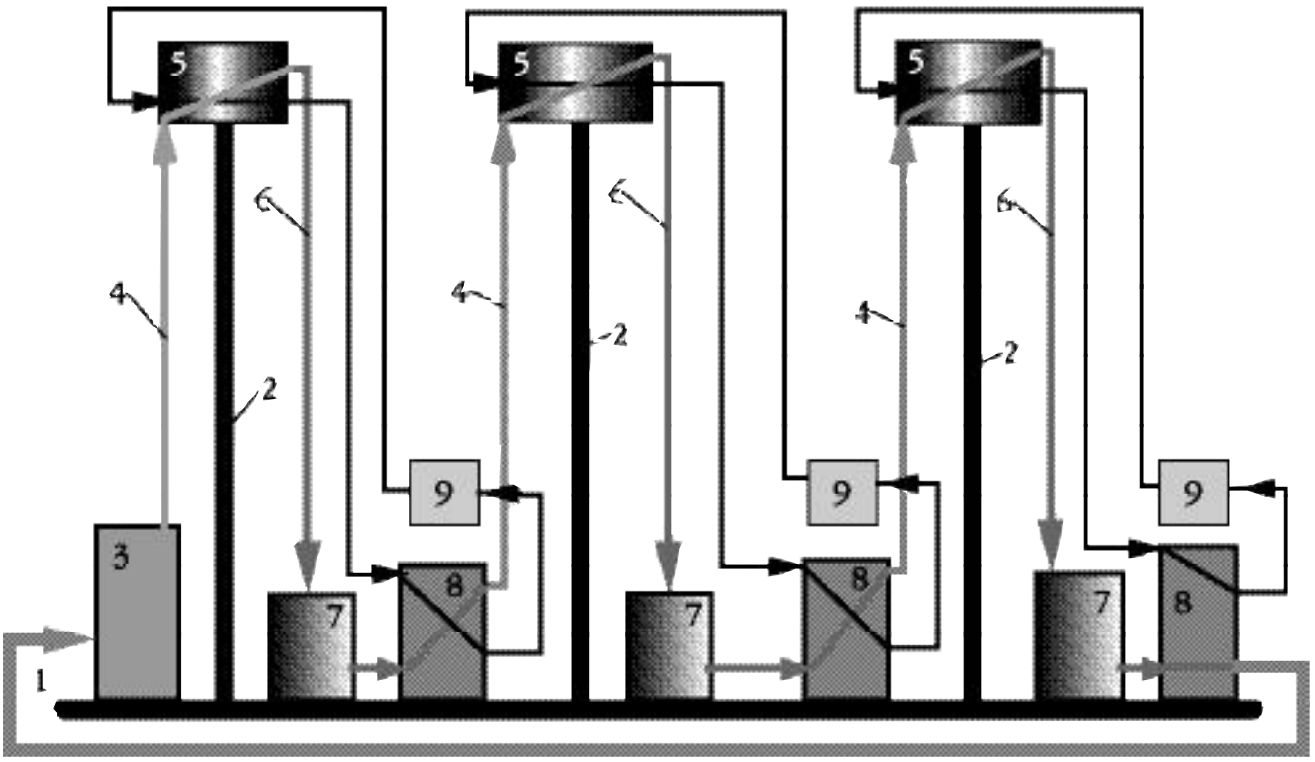

Fig. 1
Cascade

where

1 – ground surface,
2 – tower component or the smoke-stack of the steam boiler,
3 – steam boiler,
4 – steam pipe,
5 – heat exchanger and condenser,
6 – pressure pipeline,
7 – water-turbine generator,
8 – heat exchanger and evaporator,
9 – circulation pump,
10 – pipeline of the heat carrier circulation.

Cascade (operating fluid, water) with 500 meters of height can contain several dozens of grades (50 and more). **In this case the cascade efficiency may approach 120%.**

Decreasing the tower height to 500 meters (for water) will allow for utilization of conventional water-turbine generators and standard equipment.

In the proposed cascade the heat energy is required to maintain the cascade working capacity when Earth's gravitational field energy is utilized. In the author's opinion there are still other ways to use gravitation.

The system scale is its main drawback. Therefore, partial utilization of the proposed principle may

seem more attractive. The proposed engineering solution was simple.

In a thermal power station the condenser is installed on the top of the tower (mountain). After the condenser the water lift in the water tower finished at the steam boiler pressure pipe (omitting the pump that was no longer necessary). Energy required for pressure pipe operation was saved. In other words, the water tower was utilizing the Earth's gravitation at the conventional juncture of vapor condensation in the steam plant.

Such proposal was made on June 17, 1982 in the patent application USSR N3453603/06, (101161) expert code 060701KH. However, the utilization of free and environmentally friendly gravity energy did not arouse interest even on the part of patent experts.

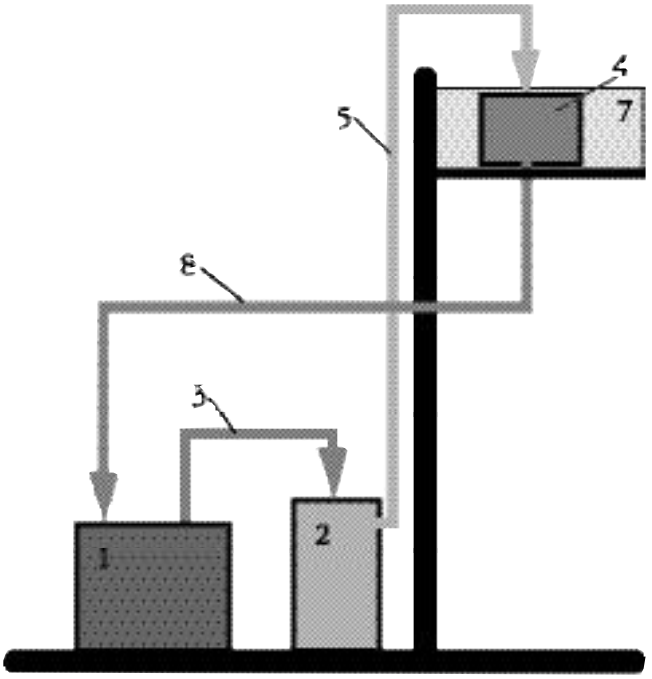

Fig. 2
System

The author is looking for serious partners.

The Alternative Energy Potential in Russia

According to the International Energy Agency (IEA) calculations, total investments into the energy industry constitute approximately 330 billion dollars annually. Almost half of this sum (150 billion annually) is allotted to the development of the electric power industry. This information only partially reflects the potential of the alternative energy development and does not include the market growth factor upon the introduction of autonomous power system technologies. Vast territories of the planet have not been sufficiently developed yet due to the absence of local energy resources and power lines. From this point of view, Russia is the country with an enormous consumer demand potential provided that the mass production of autonomous fuel-less energy systems guarantees low production prices.

Alexander V. Frolov
Editor-in-Chief

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Modern Perpetual Mobile

Review prepared by correspondent Alla Pashova, Russia.
Based on the Internet pages and other information sources

It is common knowledge that any experimental information, which is against a conventional scientific paradigm, is considered to be false, extracted from the society and finally is turned into something **classified and elite.**

Politics-oriented science as a whole and natural science in particular often result in misrepresentation and falsehood of **popular knowledge** that turns it into the fighting weapon of socio-political organizations, states and their groups.

World-outlook and political contradictions of any society often determine science development strategies. In 1885 Nicola Tesla presented his transformer in action by means of which he lit carbon lamps in a 25 miles circle without any cords, conductors or switches using the 5000-HP turbine of the Niagara hydroelectric power station. Afterward, he obtained financial support for one of his energy projects.

On a special testing ground Nicola Tesla built vacuum-energy systems. However, in 1885 the systems, as well as the testing ground, were destroyed as it became evident that if they went on the mankind would never need organic fuel again. But the destruction of the systems and testing ground does not at all mean the destruction of papers and documents...Ever since that moment people have been trying to find "free energy".

The experiment of distant lighting of carbon lamps without using any cords was repeated only once by the physicist Filippov. He managed to light the lamps in Tsarskoe Selo employing the electric generating systems in St. Petersburg. Filippov died in 1914 under mysterious circumstances.

In 1917 the Portuguese American Andres invented non-convetional fuel for an internal

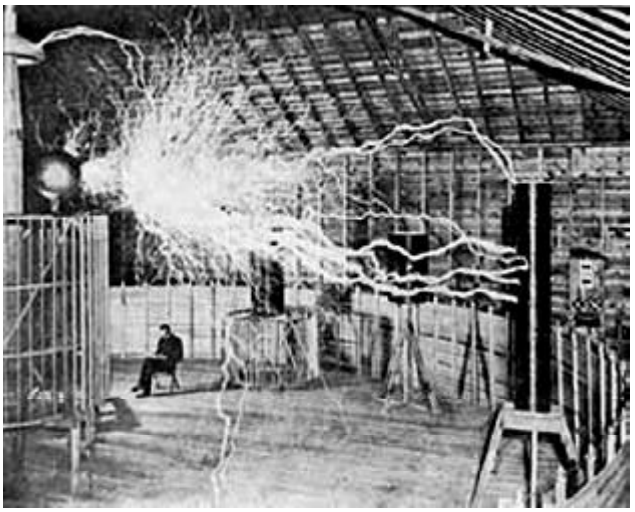

combustion engine. The essence of his invention was in some inexpensive chemicals, which he dissolved in water (some drops of chemicals per pail of water). A special state committee tested the new fuel during the New York - Washington - New York automobile races. After the races one of the largest oil monopolies in the U.S. offered Andres 2 million dollars in cash for the documents and all rights for his invention and later locked all the information in their safes. Two days later after getting the money Andres disappeared. (The information was disclosed by V. Vasilevsky, the former chief of the scientific and technical intelligence department of the KGB of the USSR, who had been in charge of the department since 1930).

The above-mentioned examples show that there were a lot of attempts to develop revolutionary energy technologies. But what then are the grounds for the 'energy crisis' complaints? The answer is simple: the desire of a group of financial and energy multinational corporations for an economic, political and, finally, for a total control of the world. That is why there is no room for "free-energy" hunters in our science, not even as laboratory assistants, not to mention some higher positions.

Practice often negates scientific dogmas, especially when it comes to the efficiency of different devices. In general, the traditional understanding of efficiency is quite limited and should be forgotten. Instead of the traditional notion "efficiency" we should consider the notion "energy-conversion efficiency" (ECE), which has no limits. In 1974 in the USA a six-stroke internal combustion engine was designed which had a double ECE. The fifth stroke of the engine operation included water injection; the sixth was characterized by the water vapor introduction. Firstly, the engine had a higher ECE than that of the Carnot cycle. Secondly, taking the 55 % ECE of the contemporary internal combustion engine, the ECE of a six-stroke engine exceeds 1.

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Before the war there appeared "studebekkers" with the fuel consumption of 5.5 l per 100 km. But the fuel-economy record was set by the Japanese. In 1986 they built up an automobile, which used only 0.055 l of fuel per 100 km (about 44 g). Unfortunately, now we do not have plants, which could manufacture automobiles of the kind.

In 1832 Tomson came up with the idea of **a heat-pump unit**. Stating the unity and interconvertibility of substance movements, he proved that the mechanical energy consumption can restore stray heat. At that time cross-Atlantic ships had low-temperature steam engines, which employed exhaust steam and ether vapors. The efficiency of those engines was already higher than the Carnot cycle efficiency.

Now with the help of the facts acquired during the last century we will prove the scientific inconsistency of the orthodox model of the second stage of thermodynamics. In 1941 the English physicists O. Hougen and K. Watson published their work featuring the experimental fact that the ammonia-saturated vapor pressure in liquids was higher than the general pressure. For example, with the general pressure of 50 atm and the temperature of 0^0 C, such pressure was 17 % higher. This means that having placed a semitransparent partition and a turbine between two containers it could have been possible to build up a natural-heat vapor-converter. This method was used by **von Platen, the Nobel prizewinner from Sweden, who constructed a self-rotating centrifugal machine, which provided a 1000 atm pressure when ammonia interacted with water. The heat emitted was enough to compensate friction losses**. It is also known that the Carnot principle cannot be applied to closed cycles. W. Vielstich, 'Combustion Cells', 1968: "**If an entropy change of a reaction is negative, it can exceed 1**. It means that a certain amount of energy can be obtained from the natural heat. Such an effect is possible in electrochemical generators, which employ a direct oxidation process before oxidation and dioxidation".

A demonstrative example of scientific experiments withdrawn from science is discovery # 13 "The knock power-transfer regularity" made on December, 18th, 1962, which makes it possible to create a mechanical "perpetual mobile". The experiment shows that the conventional "knock theory" does not work in practice: **the bouncing energy of a body after it has been knocked can be higher than its energy before it has been knocked**.

Trying to get some recognition, **E. Aleksandrov, Doctor of Engineering Science, made his demonstrative experiment in front of many different commissions: a chilled-steel ball when falling from a 10 m height onto a firmly-fixed chilled-steel plate made a 14-15 m-high bounce**. That was the notorious 'perpetual mobile' as it is. It went on like this until somebody decided to explain the result of the experiment by a metal lattice internal

energy. At once, everything was clear. Since that moment the above-mentioned principle has been successfully employed in percussion-action machines. This principle can also be used in simple electric-power systems.

Now we can see that electro-technicians had already constructed demonstrative 'perpetual mobile' machines 10 years before politicians and economists started to speak about the 'energy crisis'.

In 1921 the mass media wrote about A. Hubbard who invented an electromagnetic generator without any external energy supply. The Hubbard generator was used as a boat motor.

> *...now we can see that electrotechnicians had already constructed demonstrative 'perpetual mobile' machines 10 years before politicians and economists started to speak about the 'energy crisis'...*

In 1928 L. Nidershot invented a 300 W electric generator, which did not require any external energy supply. The device consisted of a radio-technical oscillation generator (500 kHz) and a coil. After 68 years there appeared publications about A. Melnichenko who repeated the experiment.

In 1927 T. Brown (England) obtained a patent on the ways of originating a moving power and energy using an electric field. Later, in 1955 while working in France, he presented a system with the speed-capability of several miles per hour using a 2000 eV field. After that he had to stop his experiments and was sent to the USA.

In 1943 N. Tesla presented an electric-motor automobile. The energy was generated by a previously-unknown generator.

In 1960 Stovbunenko (whose research work results were subject to a special verdict of the Military-Industrial Complex) presented his motor, which made it possible to move in his old automobile 'Moskvich' around the city for the whole day utilizing the power of a standard automobile battery.

In 1980 there was a qualitative break through in electro-technical "perpetual mobiles". Baumann's electrostatic machines of the total capacity of 750 kW started functioning in the religious community of Liden (Switzerland), serving all daily needs of the village. (See the photos below)

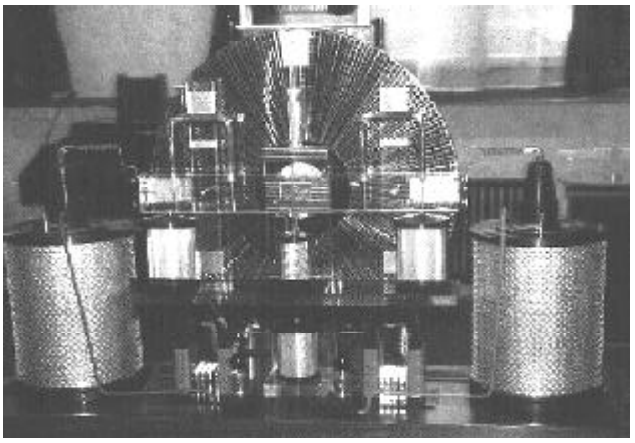

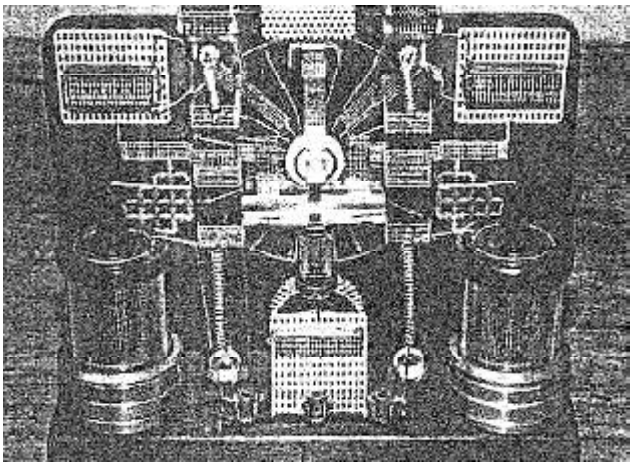

The photos are taken from www.free-energy.cc

Thus, in 1980 there appeared a community with no energy problems, no need for organic fuel and no fear for the 'energy crisis'.

In 1881 N. Sluginov discovered an energy imbalance that occurred in the water electrolysis process. In his experiments he got that the output energy was 30 % higher than the input energy. In 1980 American scientists recreated this energy imbalance and proved that while employing the steam turbine rejected heat, the water electrolysis efficiency reaches 120%.

This information introduces a story about an energy system invented in 1957 under the guidance of I. Filimonenko. The system did not simply generate energy in the form of a high-pressure vapor and output hydrogen and oxygen but also absorbed radiation. In 1960 the USSR Central Committee and Cabinet Council gave a special secret ruling, known as "The Three 'K's'" (Keldysh, Kurchatov, Korolyov) to go on with the research in this system. However, after Kurchatov's death the project was "oppressed" and later on after the death of Korolyov the project was completely cancelled. The special committee of the USSR Academy of Sciences stated that the system was functioning against "the Law of Nature". I. Filimonenko was dismissed and expelled from the party. Later, in 1980-1991 the experiments were partially renewed. Several testing systems were constructed in the Chelyabinsk region but the construction was never finished and the use of a mobile system for eliminating the damage caused by the Chernobyl accident was refused. This story is a demonstrative example of the traditional rejection of promising projects by science, which could be very beneficial for Russia.

Theoretical Background of 'Perpetual Mobile'

Originally, the term 'entropy' was used only in connection with the reasoning about limited or eternal nature of the Universe. Later it came to be used to describe the functioning principles of thermal machines. Now there exist more than 600 contradictory definitions for 'entropy', which are actually the results of a long and unfinished discussion between the supporters of Dekart and Leibnitz, who defined 'motion' in different ways. It is these permanent contradictions in the theoretical fundamentals of physics that make it impossible to explain the existence of a 'perpetual mobile'. However, standard physics has never denied the possibility of creating energy technologies allowing the ECE higher than 1.

We should remember that the basis of the so-called variational calculation is the mathematical apparatus technique of the conventional mechanics. It seems that if system behavior equations directly depend on time, this system cannot fall under any conservation laws. **This is the proof of a complete failure of the conventional energy conservation law!**

It is these permanent contradictions in the theoretical fundamentals of physics that make it impossible to explain the existence of a 'perpetual mobile'

In time-independent thermodynamics the existence of 'perpetual mobile' can be explained by the system internal energy usage. There exist two kinds of thermodynamic systems. Some of them when being heated or affected in some other way start increasing their internal energy while other systems show the internal energy decrease. The latter are called negative absorption systems. The standard version of the first law of thermodynamics does not cover all the processes occurring in such systems. The output of a negative absorption system can be higher than its energy. The additional output is acquired by the gradual internal energy loss.

To cap it all, there are more than a hundred experimental facts that show the limited nature of the Maxwell theory. They were obtained by scientists from different research institutes and construction bureaus, were tested and registered. Thus, for example, in 1973 in the USSR the acoustic magnetoelectricity effect was discovered. The author of the discovery proved the

interaction of electrons with ultrasonic waves with a 1000-times energy increase. This is against the Maxwell theory, which absolutely denies effects of the kind. But the limited nature of the theory was never accepted.

However, the examples of the machines in action prove that since 1834 when the first refrigerator was invented, when the cross-Atlantic ships were equipped with low-temperature ether-vapor steam-engines, the contemporary science had no right to introduce 'the second holy principle', especially in the orthodox form of 'the Carnot cycle efficiency'. The modern theoretical physics cannot provide grounds for the negation of creating over-unity devices. That is why we should rely on the physicists-experimentalists who develop the science in a practical rather than theoretical way.

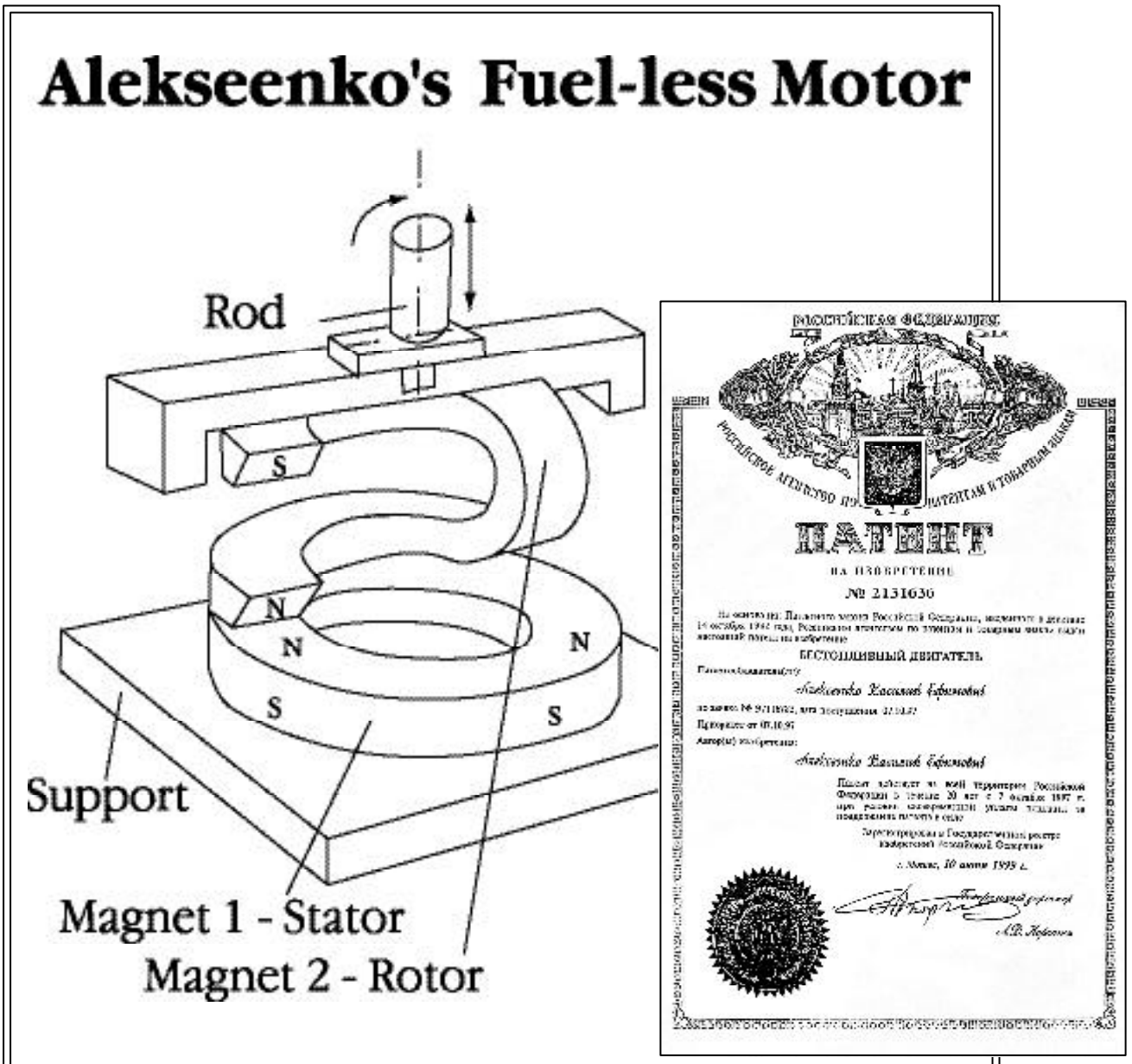

Patent # 2131636
Vasiliy E. Alekseenko

Aerospace Defense Research Finds Free Energy and Antigravity Possible

Dr. Ines Espinoza, USA
email: dr.ines@vasantcorporation.com

Editor: it is worth mentioning that the first gravitational-wave physical mechanism and the mechanism of spin-effect "grazer" (gravitational lasers) designing were described by S. M. Polyakov and O.S. Polyakov in the book "An Introduction to the Experimental Gravitational Studies", Moscow, 1991.

After a 7-year research study, a senior staff aerospace defense engineer, George J. Bugh, concludes economically free energy and even antigravity are possible.

A 7-year study of "free energy" devices, sometimes called "over unity" devices, was done to determine if any of these devices generated power by transferring energy from unknown sources and if so to determine where the energy was coming from. Included in the study is research of related devices with claimed antigravity effects. The study attempted to determine validity of claims, commonalities of device characteristics and to determine how these devices could work. **The results conclude that some devices can generate economically free energy. This study also concludes there is a possible link between gravity and electromagnetism that can be exploited to generate antigravity or electrogravity effects.**

The majority of the study was to come up with a theory to explain how the devices could work. In his research, Mr. Bugh used mostly classical electrodynamics rather than quantum electrodynamics. In Quantum theory, the wave-like characteristics of matter are described using abstract probability waves. However, Bugh proposes that the wave characteristics of matter may also be described as coming from a very real sea of unseen electromagnetic standing waves among all matter. There is a slide show presentation at the website that explains the differences between the Quantum and Classical way of explaining particle interactions.

According to classical electrodynamics, all electrically charged particles, like quarks of protons and neutrons as well as orbital electrons for example, **should radiate away energy from precessional and precessional plus orbital motion**.

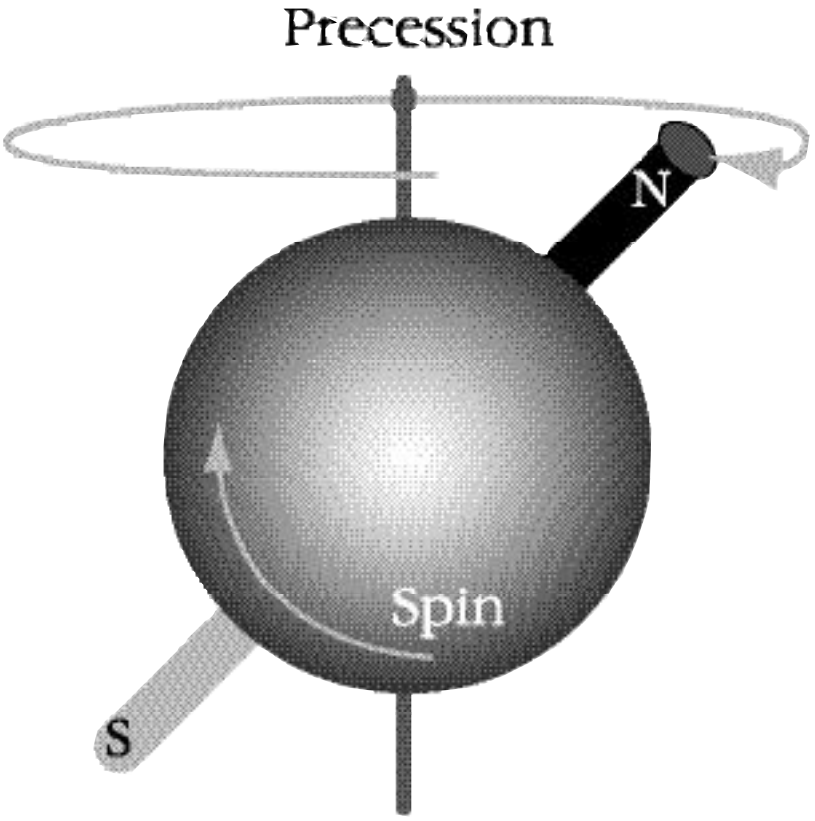

Fig.1
Electron motion

If in fact this really happens then all electrically charged particles can be radiating away energy all the time. However, all particles can also absorb just as much energy from all other radiating particles. The absorbed energy applies electromagnetic forces that naturally move all similar type particles into harmonious precessional motions with all other particles. This results in a vast sea of electromagnetic standing

waves among all matter. Even free particles would move into precessional motions that are in sync with the established sea of standing waves.

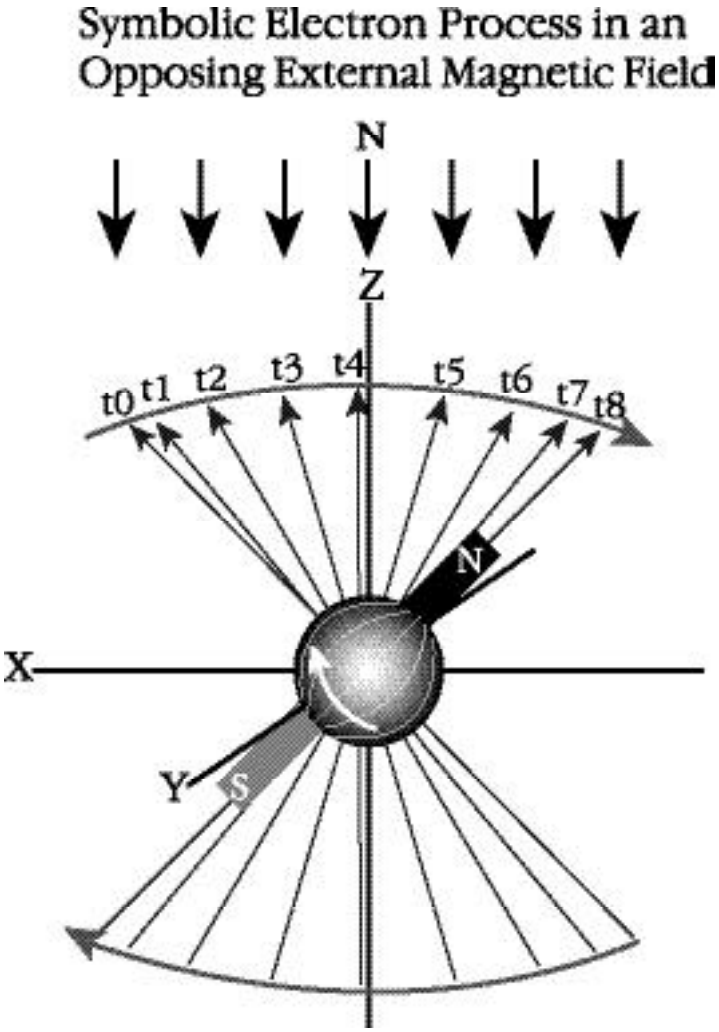

Fig. 2
Electron precession

There can be a hidden yet strong tendency towards harmony among all matter in the universe due to these unseen standing waves and spin interactions among all matter. This tendency can overcome to a great extent the tendency towards chaos and heat death of the universe. This tendency can also be exploited to perform work.

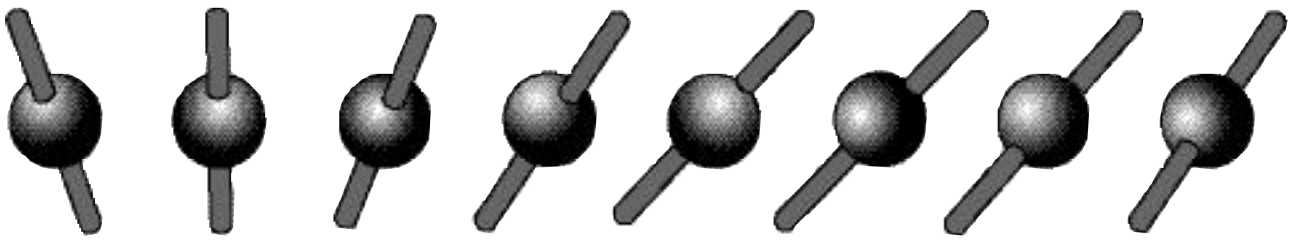

Fig. 3
Spin wave

This is an interaction among all matter that Ernst Mach alluded to as necessary to cause matter's characteristic of inertia. Einstein later called this Mach's Principle. Einstein studied Mach's ideas while developing his theory of General Relativity.

Bugh describes inertial resistance to acceleration as caused by electromagnetic forces. Changes in position of a mass will cause phase differences to develop between the precessional motions of the particles of that mass relative to the sea of standing waves. This in turn causes electromagnetic force that resists a mass from changing its position.

The research papers are published in a book and a CD titled "Spin Wave Technology Initial Release".

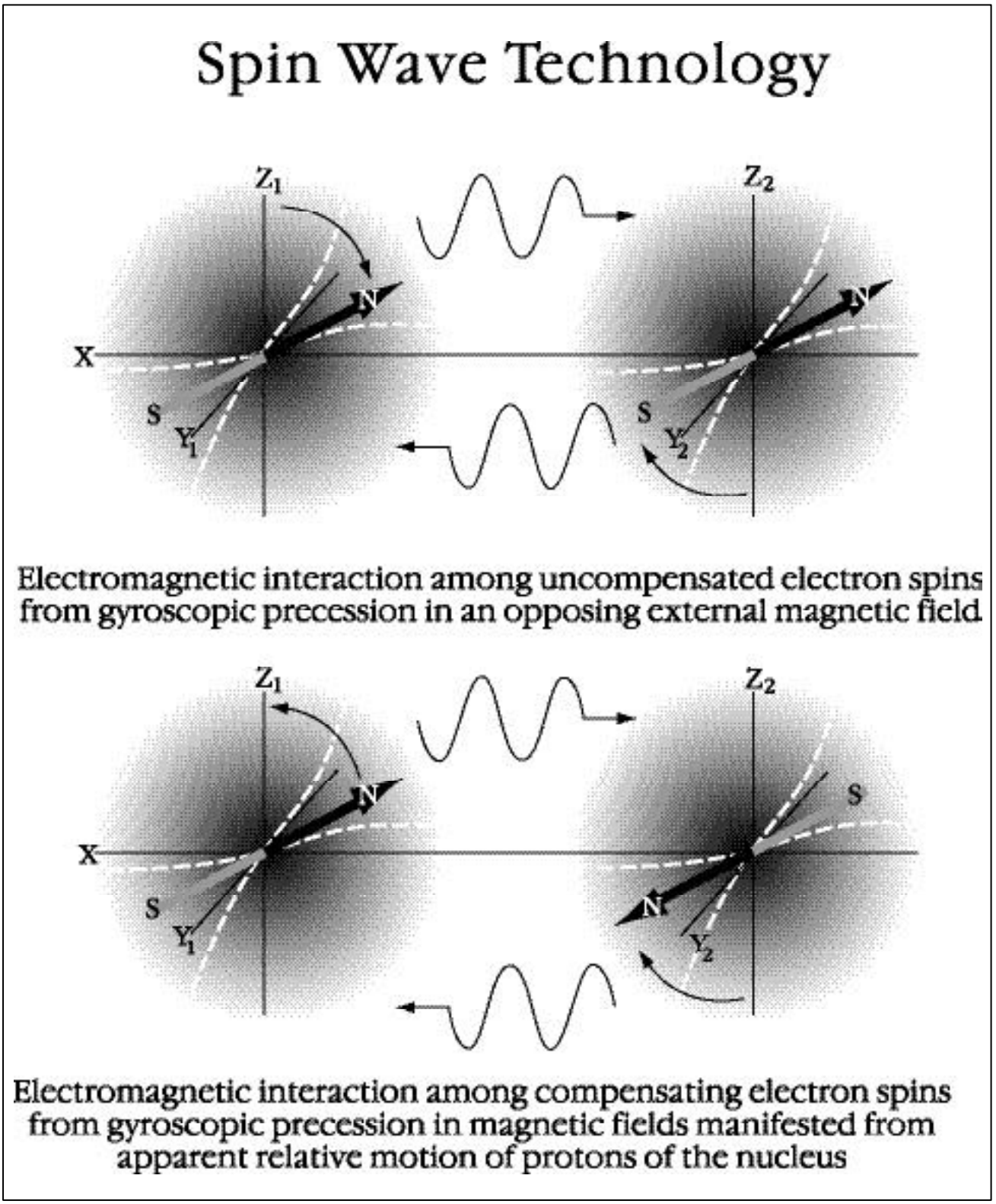

Fig. 4.
Spin wave technology

At the end of the book it suggests that it should be possible to create computer simulations of particle interactions using classical electrodynamics to demonstrate both inertial resistance and gravitational attraction and it should be possible to simulate devices that manipulate these particle interactions to demonstrate antigravity effects.

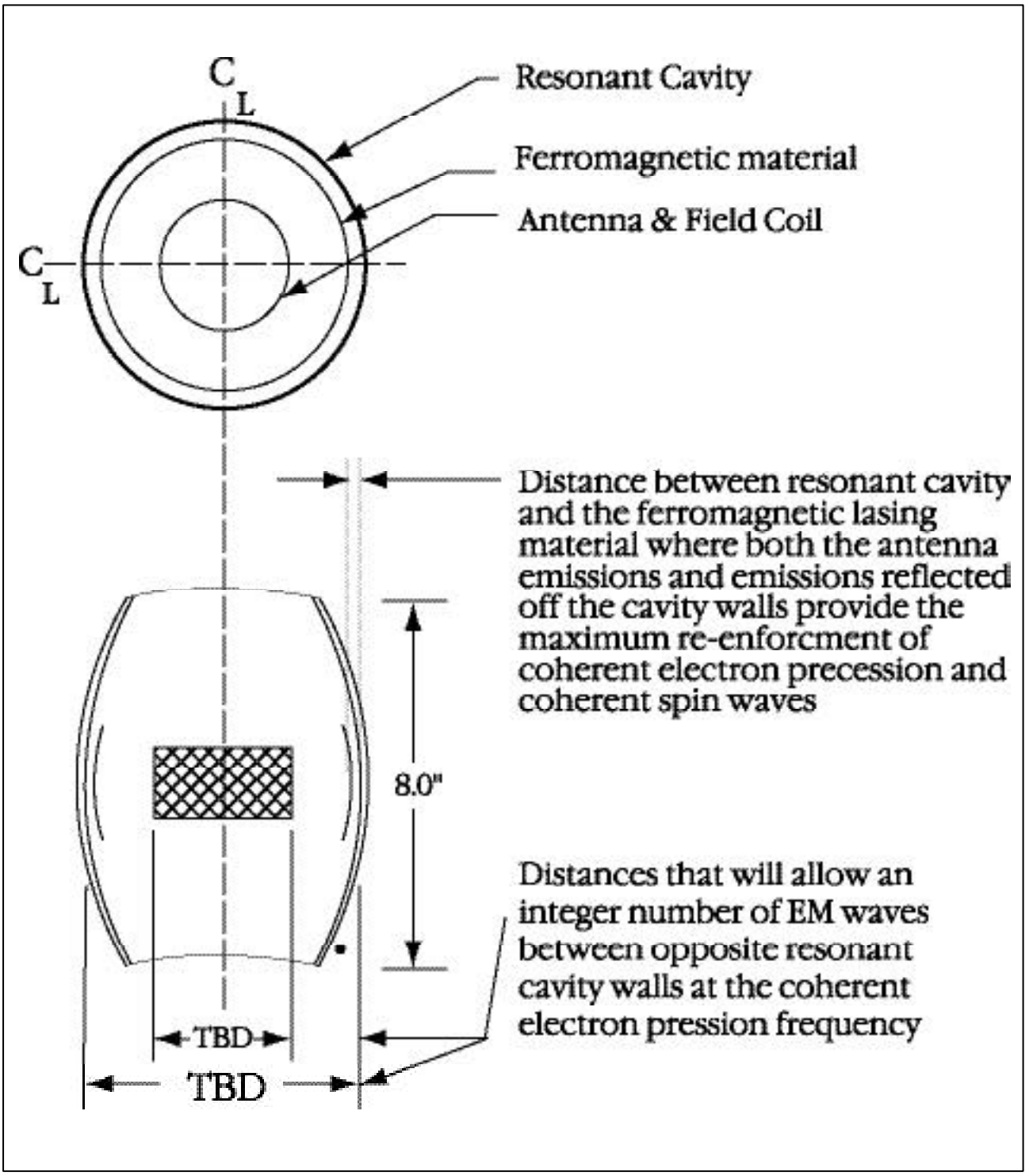

Fig. 5
Spin wave laser

More information is available about the research results at the website: www.vasantcorporation.com.

On Physics of Electromagnetism
Mechanical Analogue or Pure Mechanics?

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After publication of the article "Study of possibility of a high-energy hyper-low-frequency electric field" in the "New Energy Technologies" magazine, Issue #2, 2003 I am often asked why I have mentioned the Big Bang in my hypothesis.

I would like to reassure atheists since I do not back the Big Bang hypothesis. But I had to base myself on something. At present the origin of the Universe as a result of the Big Bang has priority and is recognized by the academic science.

Both theorists and experts have long noticed a deep analogue between vortex motion of air currents and electromagnetism. My vision of the physics of electricity and electromagnetism is fully based on existence of a vortex capable physical environment. What is considered to be and is measured **as electric voltage, electric current, magnetic or gravitational interactions is nothing but similar-originating phenomena - the result of vortex flow environment affecting our detectors - dissimilar formations for these vortex flows**.

For instance, let us consider three vectors for the flow along the skin-layer of the line conductor - aerial emitter, together with alternating voltage attached to it (Fig.1):

1) longitudinal - showing as electric voltage, the gradient of potentials between the emitter feeding point and the emitter cold end, U;

2) tangential - showing as amperage - electric current, I;

3) radial - showing as the interacting force of two flows - magnetic field (attraction/repulsion), H (not to be mixed with the commonly used term of magnetic intensity).

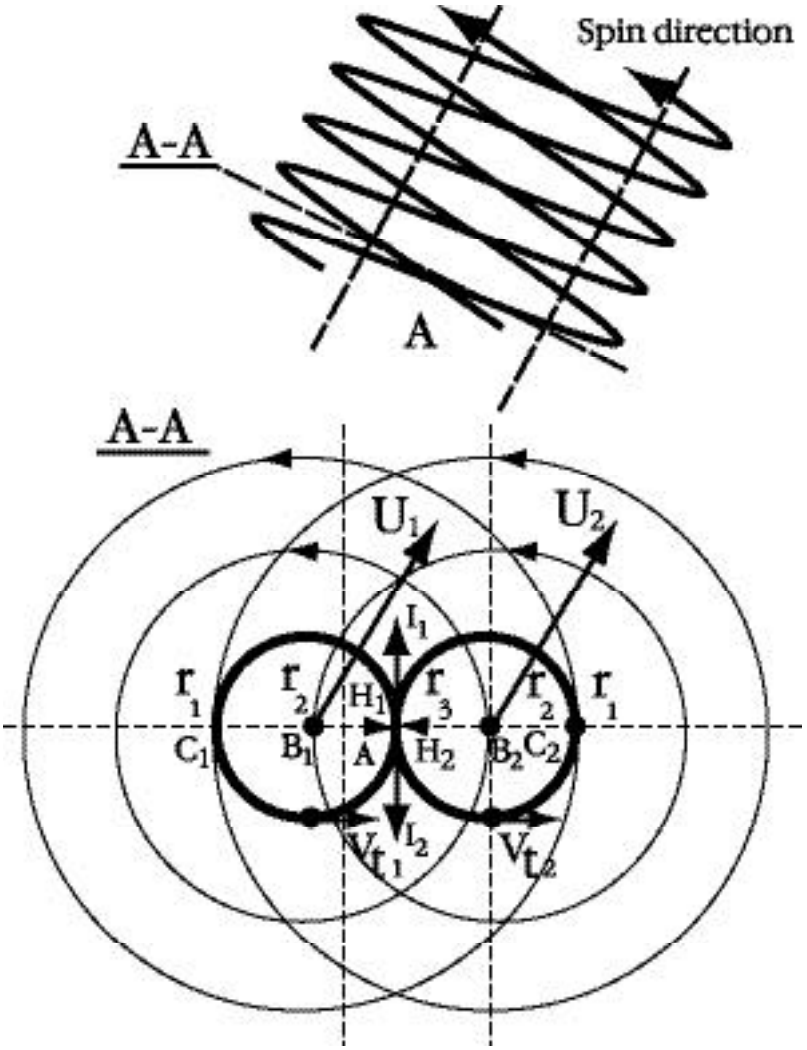

Fig.1
Interaction of two left-handed homogeneous parallel flows.

Let us consider it step by step:

Consider line conductor AB with length L in free space (Fig. 2).

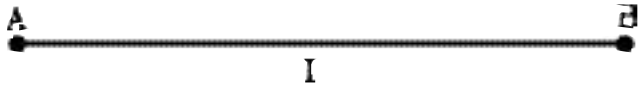

Fig.2
Line conductor in free space.

Let us assume that he is not affected by and fields. Then the gradient of potentials between A and B equals zero. Let us apply sinusoidal voltage from the generator output to point A (Fig. 3).

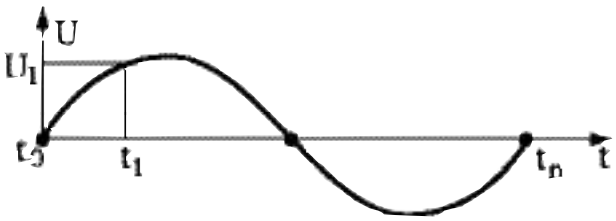

Fig.3
Sinusoidal voltage at the generator output.

Let us consider the initial time point t_0. The generator output voltage is U=0. At time point t_1 the generator output voltage has changed and took on value U_1.

It is necessary to note that (See Fig. 2) the propagation speed is finite: c=300000 km/sec. Point B will "learn" about the voltage alteration only in time $t_B=t_1+L/c$. Therefore, at time point t_1 between points A and B appears gradient of potentials $\Delta\varphi = U_1$. So what is the direction of vector U_1? Right, along conductor AB.

What practice says

One should not be a physicist or radio mechanic to notice small electro-shock of ungrounded metal objects close to aerials of powerful transmitters. Specialists term them as "electromagnetic inducers". Has an expert ever measured the actual characteristic of the field intensity distribution along a line conductor? Why should he? Everyone knows from school lessons how alternating voltage is distributed along the conductor, the length of which is comparable with the wave length (Fig. 4).

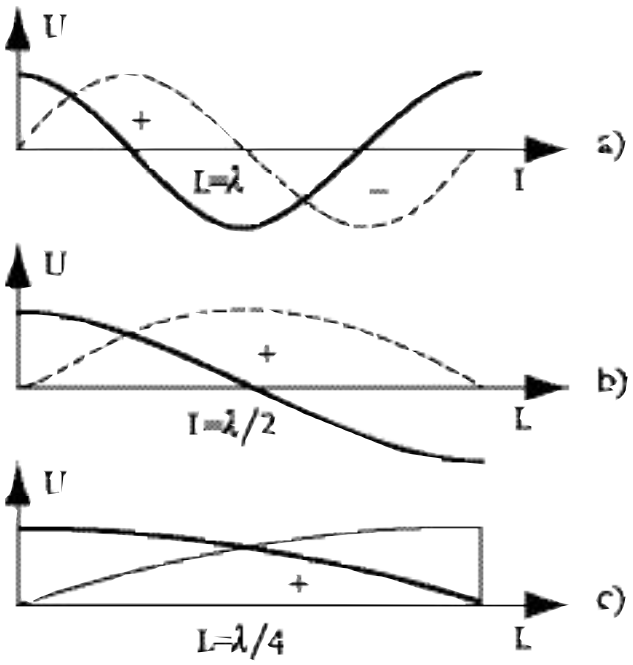

Fig.4
Classical representation of voltage distribution along a linear vibrator a) for λ, b) for $\lambda/2$, c) for $\lambda/4$.

Now let us consider what experimental measurements suggest.

An experiment of measuring the field intensity distribution along the line conductor is shown below. A classic field indicator (FI), assembled as per scheme in Fig.5, was used as an intensity measuring instrument.

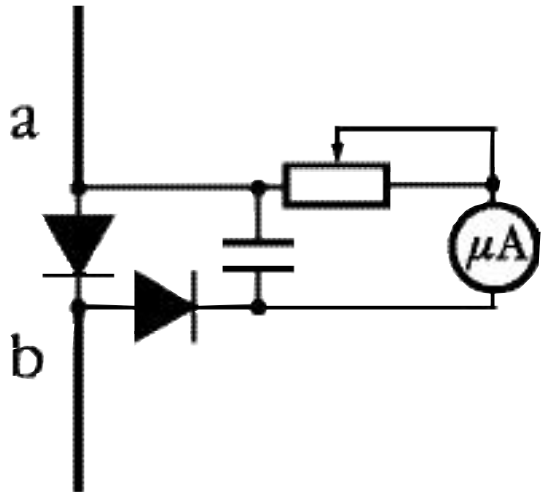

Fig.5
Field indicator principle diagram.

FI was located in immediate proximity to the vibrator but had no galvanic contact with it. Experimental frequencies were selected in

accordance with the standing wave coefficient minimum (SWC) for λ, $\lambda/2$, $\lambda/4$. Sinusoidal signal generator was connected to one end of the vibrator (Fig. 6a).

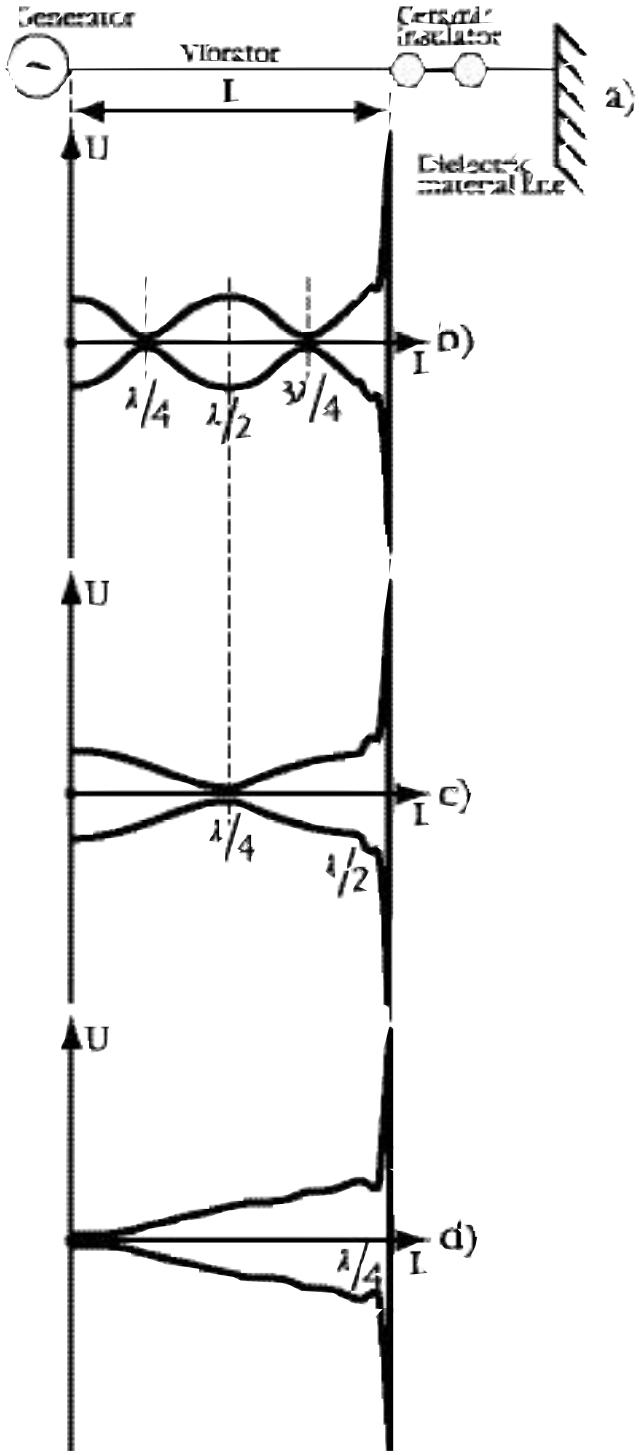

Fig.6
Measured field intensity along a linear vibrator.

To better understand diagrams in Fig. 6 curves are drawn at the upper and lower ends of each axis L that corresponds to the vibrator location. The curves were run with FI horizontally located on both sides of the vibrator.

From Fig. 6d it is clear that the diagram is axisymmetric and looks like a conic funnel.

Meanwhile, the vibrator directional diagram measured by the monitor receiver far more distant than λ, shows the characteristic that coincides with the simulated one through the Matlab-6 system (See Fig.7). As you can see from this figure, the spatial characteristic of the directional diagram is in the form of a toroid.

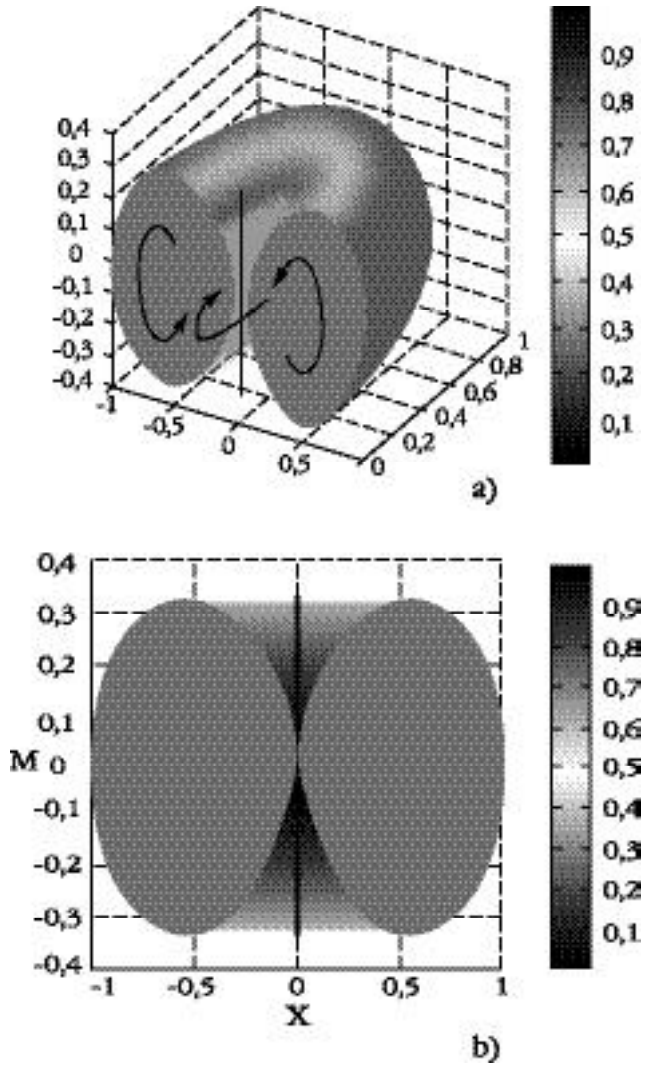

Fig.7
Matlab-6-simulated directional diagram of the semi-wave vibrator

A series of alterations was made to explore vortex ether dynamic processes with variable wave length and frequency in line conductors, solenoidal and flat coils, etc.

For certain purposes the solenoidal coil may be considered as a shortcut linear vibrator. On respective frequencies the field intensity distribution along the solenoid corresponds to the linear vibrator. This data may prove useful to many modern engineers of the Tesla transformers and generators. To increase voltage on the cold end a toroid capacitor is set in the Tesla transformers. Nuclear physicists use the hemisphere capacity for the particle accelerators. Thus, a voltage of millions of volts may be achieved.

Flat coils are best explored in terms of field intensity distribution (See Fig. 8)

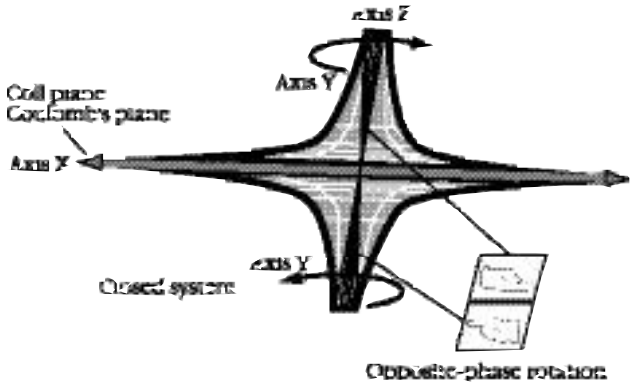

Fig.8
Field intensity distribution for a flat coil in a closed resonance circuit.

Field intensity distribution on a resonance frequency is correct.

The practical experiment for the case in fig. 6d has shown that the neon lamp that is connected with the vibrator end will be off. And this is with a 100 W generator! It is a paradox, one would say. The measurement diagram shows a "splash" of the field intensity at the vibrator end but we feel nothing. Indeed, when the FI is located as shown in Fig.9 for $\lambda/4$, the "electrodynamic vacuum" will generate. The device showed "0" intensity, which conforms neither with the diagram in Fig.6 nor with the diagram in Fig.7.

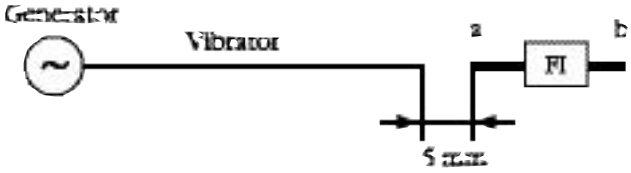

Fig.9
Field indicator shows "0" - "electrodynamic vacuum".

The same "vacuum" in the center of tornado was observed by people in the epicenter.

Remember what is measured with the field indicator (an ampere meter) along the linear vibrator. The Ampere force!

So, both people and their environment are in rotation process. The Earth rotates around its axis and around the Sun. The Sun rotates around the Galaxy center. The Galaxy rotates around the center of the Universe. The Universe rotates...

Every space point has an inceptive rotation impulse (torque). Let us remember the analogy. Water flowing out of the tub rotates counterclockwise in the northern hemisphere and clockwise in the southern hemisphere. If you set a right-handed torque in the northern hemisphere, the water will continue to flow counterclockwise.

The electromagnetism is the same. It has a natural left-handed rotation. Nevertheless, practical radiotechnology is familiar with right-handed fields artificially generated by transmitters.

The commonly used term of magnetic interactions is easier to understand if we consider the electromagnetic field as a vortex flow. Two left-handed homogeneous parallel flows are shown in Fig.1. At the point of interaction A of vector projection, the speeds of flow propagation on section plane **A-A** have opposite direction and compensate each other. The actual flow density is $\rho_1 < \rho_2 < \rho_3$. Reduced pressure occurs at point A. The flows are attracted. The resulting attraction vector for the whole flow is radially directed. The counter parallel flows will have composition, i.e. overpressure, and will repel.

One should note that graphic presentation in Fig.1 for vectors H and I for the etherdynamic systems is possible only in special cases. In dynamic vortex flows the current intensity vector is actually directed towards the flow movement and coincides with the vector direction of its propagation speed (V). The resulting vector H remains a radius-vector only for the considered point of interaction of two flows. The flow energy parameters are defined by its propagation speed V (Fig.1).

I am convinced of existence of ether vortex flows in the Universe. Modern astronomic and cosmological surveys confirm my hypotheses of aether Hyper-fields existence on a Universal scale.

The commonly used term of magnetic interactions is easier to understand if we consider the electromagnetic field as a vortex flow.

Even an amateur in aerodynamics and dynamic of gas vortex may make cosmological conclusions:

♦ vortex initiation implies the initial gradient flow of at least two counter flows;

♦ energy parameters of the emerging vortex flow can not exceed those of the parent flows

♦ there exist ether flows with energy exceeding that of our Universe

♦ our Universe has not originated from a point and is not finite. It is the spiral (vortex) structure of our Universe that testifies against the Big Bang hypothesis.

Conclusions:

Practical radiotechnology is familiar with the key difference between the field intensity distribution diagrams of aerial emitters in near and far zones. After combining diagrams 6d and 7b (Fig.10) it is possible to draw certain conclusions.

When transverse waves (radio waves) are formed around the aerial vibrator, the double transformation of the initial flow geometry starts:

♦ **the first flow is a homogeneous spiral flow on the conductor skin-layer;**

¨ **the second flow is a non-homogeneous vortex flow of the near zone;**

¨ **the third flow is a toroidal flow of the far zone.**

The toroid volume alteration in the far zone (as per the transmitter vibration frequency) forms volumetric planar transverse vibrations (spherical waves) that are called electromagnetic or radio waves. The gradient of potentials alterations (as per the transmitter vibration frequency) provoke changes of the Coulomb plane, which form longitudinal vibrations with a narrow directional diagram.

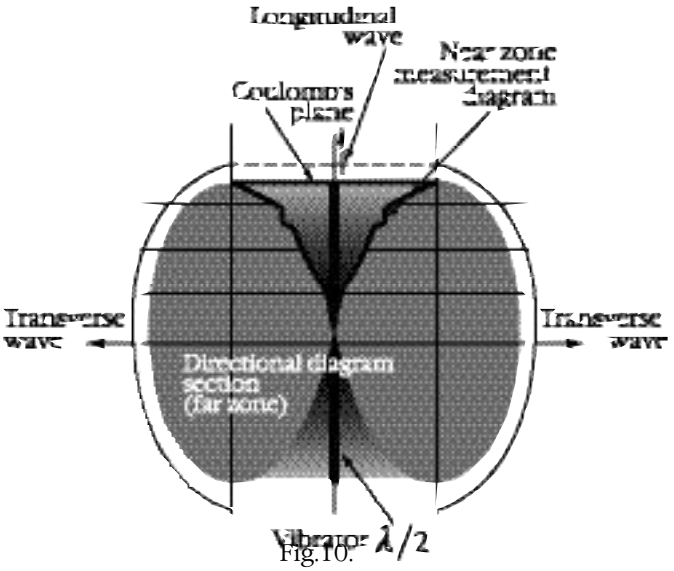

Fig.10.

The longitudinal flow is assumed to be formed as a chain of toroids (like smoke rings)

Ether-dynamic approach provides grounds for more substantial conclusions and assumptions. A new approach to energy and communication systems is made real. Further results of the experiments with transmitters and aerials, assembled on ether-dynamic principles, enabled to draw the following conclusions:

- all reasons, preventing transformation of the transmitter power into the power of transverse radio waves, are evident;
- all reasons for the transverse wave phase lagging with the increase of distance from the emitter, are also evident;
- besides the toroid that forms the transverse wave, the second flow generates a crucially new radiation that has a very narrow directional diagram along its longitudinal axis;
- the aerial ignores wave geometry for the second flow and its longitudinal derivative;
- the radiation along the second flow axis has a very high penetrating power;
- the radiation along the second flow axis has no signs of polarization.

The list of references is not shown in this article due to its size. It can be looked up at **www.efir.com.ua.**

In October 2003 the second stage of the research on the "time control" was completed. In the photo below you can see Chernobrov V. A. and Frolov A. V. in the laboratory, October 31st 2003.

The second stage conclusions are quite interesting, however the usage of timers (chronometers) as detectors is proven to be inappropriate for they are subject to magnetization and their indication variations cannot be reliable in this case.

The next stage will feature the following method of detection of the time rate changes (the rate of the matter existence) that is the radiation wave-length measurement. If it is possible to achieve significant results then we will be able to detect the change of the laser ray colour in the area of the effect and its linear path deviations. The experiments will be held to register the weight changes of the detector at the expected influence of the produced effect on the ether density.

Our company looks for cooperation with corporations, which are interested in the application aspects of these technologies.

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CELL OF THE THIN PLASMAELECTRIC HEAT GENERATOR

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E-mail: kanphil@mail.kuban.ru

EC 28 / 1!

The main task of the experiment was to check the hypothesis: "Electrodynamic influence on the water molecules gives the possibility to significantly reduce energy expenses on destruction of their chemical bonds; further fu-sion of these molecules considerably increases the output of additional energy in the form of heat".

Photo of the Thin Plasmaelectric Heat Generator

In order to solve this task, special experiments were carried out as regards the electrodynamic destruction of chemical bonds of water molecules by electric pulses of various frequencies.

CHECK TEST RECORD FOR PLASMAELECTRIC HEAT GENERATOR

Table 1

	Indices	1	2	3	Avg.
1	mass of the solution, which has passed through the reactor *m*, kg.	0.470	0.432	0.448	0.450
2	temperature of solution at the input of the reactor t_1, degrees	22	22	22	22
3	temperature of the solution at the output of the reactor t_2, degrees	66	66	65	65.67
4	temperature difference of the solution $\Delta t = t_2 - t_1$, degrees 44	44	43	43.67	
5	durability of the experiment $\Delta\tau$, s	300	300	300	300
6	reading of voltmeter V, V	4.50	4.50	4.50	4.50
6'	**Reading of oscillograph , *U'*, V**	**4.47**	**4.47**	**4.47**	**4.47**
7	reading of ammeter I, A	2.1	2.1	2.1	2.1
7'	**Reading of oscillograph , *I'*,** A	**2.2**	**2.2**	**2.2**	**2.2**
8	electric power consumption according to indices of voltmeter and ammeters, $E_2 = I \cdot V \cdot \Delta\tau$, kJ	2.84	2.84	2.84	2.84
9	power the heated solution, $E_3 = 4.19 \cdot m \cdot \Delta\tau$, kJ	79.64	80.01	80.72	80.46
10	**reactor efficiency index $K = E_3 / E_2$**	**28.04**	**28.17**	**28.42**	**28.21**

Supply voltage and current were measured with the help of a voltmeter, an ammeter and an oscillograph (Fig. 1-4)

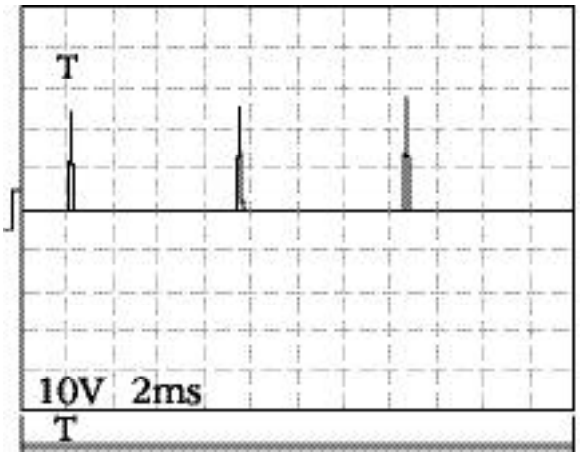

Fig. 1
Voltage

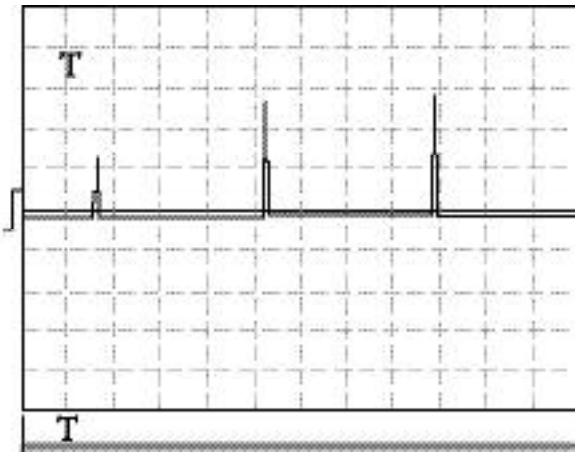

Fig. 2
Voltage

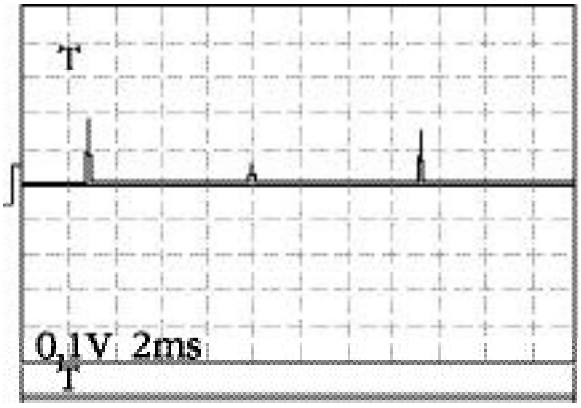

Fig. 3
Current

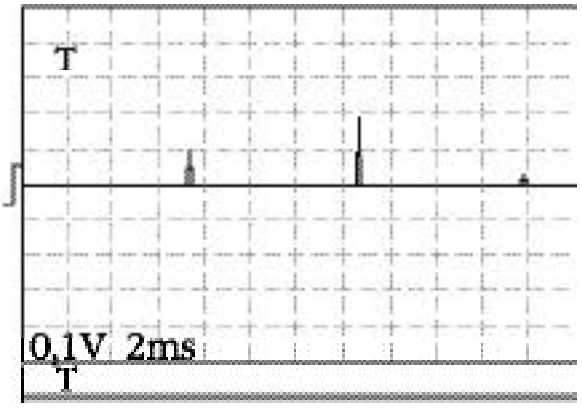

Fig. 4
Current

Process parameter calculation according to the oscillograms (Fig. 1-4) to the check test record (Table 1) gave the following results:

- Pulse scale 10.

- Average voltage amplitude according to Fig.1 and Fig. 2: Ua_{av} = (23+25+28+10+26+29) x 10/6 = 235 V.

- Average current amplitude according to Fig. 3 and Fig. 4: Ia_{av} = (20+6+17+7+10+19+3) x 10/7 = 117 A.

- Pulse repetition period T = 7.4 ms. Pulse duration t_p = 0.28 ms.

- Pulse frequency f = 1000/7.4 = 135.1 Hz. Relative pulse duration S = 7.4/0.28 = 26.32.

- Space factor Z = 0.5/26.32 = 0.019.

- Average pulse voltage U_{av} = 0.019 x 235 = 4.47 V.

- Average current in pulses I_{av} = 0.019 x 117 = 2.22 A.

Thus, it is possible to consider that the experimental test of energy efficiency of the water electric heat generator with the help of two methods gives practically identical results and confirms the above-mentioned hypothesis concerning the possibility to generate additional energy in the processes under consideration. It should be noted that as during measurements the pointer instruments of high class of accuracy of 0.2 have been used (relative conventional gauging error does not exceed 0.2%), and oscillographic measurement accuracy is much lower (usually, about 5%), the readings of the voltmeter and the ammeter should be considered more accurate.

Commercial efficiency of the water electric heat generator will depend on pulse generator economy. Since effi-ciency of powerful pulse

generators can be near one unit, energy efficiency in industrial plants that use the considered heat generators should not differ greatly from the data obtained during laboratory research.

Simplicity and one hundred per cent reproducibility of the described experiments open a prospect for quick commercialization of the water electric heat generator.

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1. Kanarev Ph.M. The Foundation of Physchemistry of Microworld (the second edition). (In Russian) http://www.ikar.udm.ru/sb28-2.htm
2. Kanarev Ph.M. The Foundation of Physchemistry of Microworld. The second edition. (In English). http://book.physchemistry.innoplaza.net
3. Kanarev Ph.M. Water Electric Generator of Heat. http://Kanarev.innoplaza.net

Professor Kanarev looks for co-projects with prospective investors.

Fantastic Projects

Smith's Generator

Review

TransWorld Energy,

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http://altenergy-pro.com

Don Smith is a University degreed professional in science & engineering. Served in three wars; WWII, Korea and Vietnam. He has enjoyed a long and successful profession as an executive in the petroleum industry. His life long outside interests include electronics and engineering. A popular walk on substitute for University Professors in physics, chemistry, biology and computer assisted drafting. Teaching style similar to Richard Feynman. He enjoys celebrity status in Japan and Saudi Arabia.

About 20 years ago, the book "Inventions, Researches and Writings of Nicola Tesla", resulted in his reconstructing, as a way of understanding the many theories and devices shown in the book. From this encounter, a very strong bonding resulted. The object then became putting his thinking inside that of Tesla, such that expanding upon and extrapolating areas not yet reached by Tesla. Technological advances in materials provide sourcing for devices not possible at earlier periods. For example, magnetic permeability which is the counter part of negative resistance is an open field for experimentation today.

Don does not sell his inventions, but trades licenses for shares in companies which then incorporate the new technology into their marketing systems. As such, he is on the Board of directors of several well established ventures located in Japan, Brazil, Mexico and Saudi Arabia.

Successful reproductions of Don's technology are present in Finland, Saint Petersburg - Russia, Yugoslavia, Romania, Japan, Hong Kong, and numerous other Countries. His book "Resonance Energy Methods" has a circulation of 40,000 copies in worldwide in many languages.

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Abstract

Mr. Don Smith has discovered that Ohm's Law of Resistance does not apply to Magnetic Resonance that travels unrestricted for great distances. Therefore, multitudes of electrons are disturbed. The Magnetic moments are translated into usable electric energy. The Magnetic Dipole provides an unlimited source of electrical current. Mr. Smith's "Dipole Transformer" has been pending since last September.

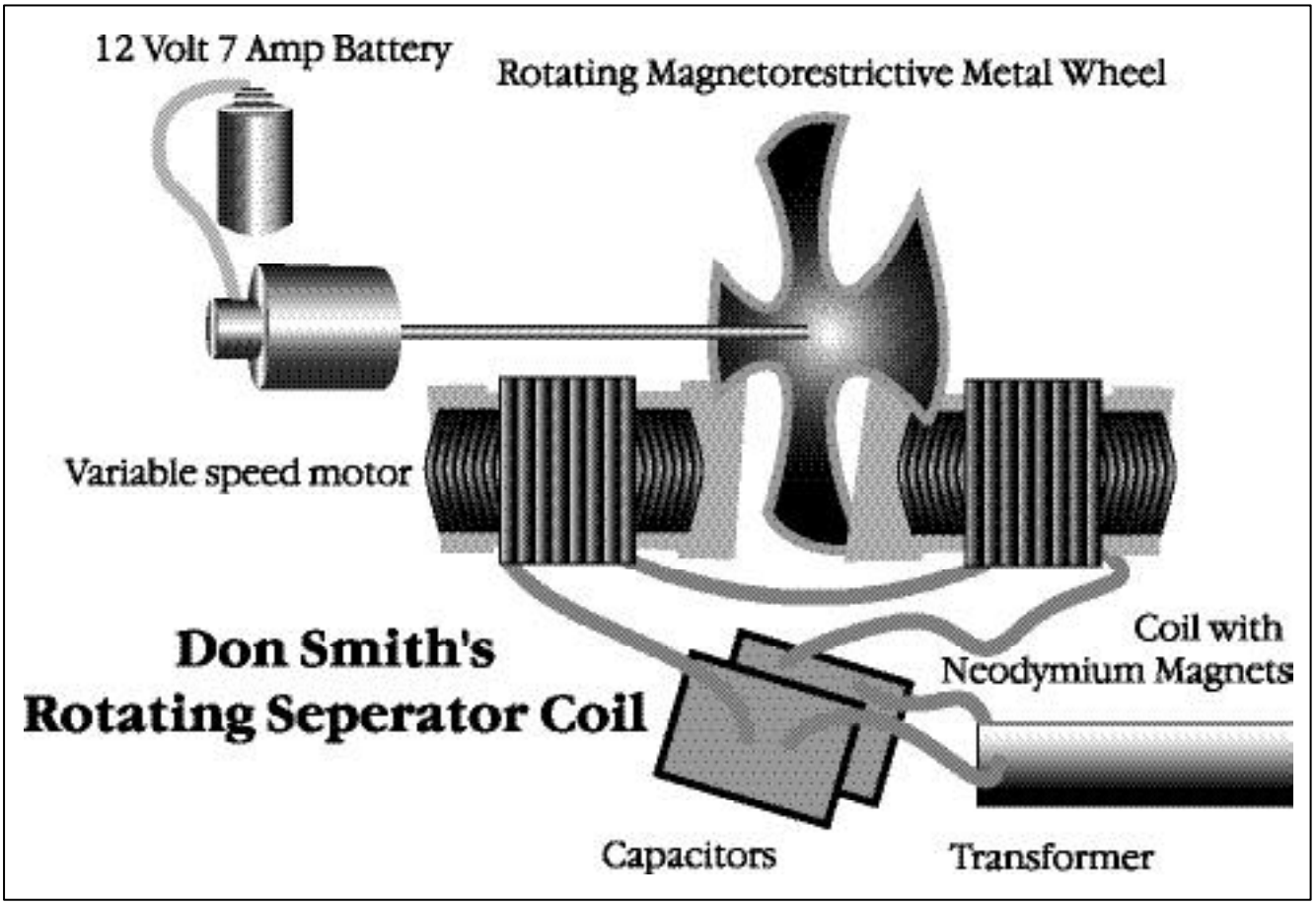

Fig.1
Smith's Energy Receiver

Useful energy occurs as the result of imbalances of ambient background energy and it is a transient phenomenon. In conventional circuits, the electrical field is in a closed system that is damped out with heat loss, which severely limits its utility. **The flip side of the electron generates magnetic waves, which is an open system, not subjected to heat loss. These being unrestricted are the universal source of energy. Universally present electrons are flipped to their electrical position, resulting in useful energy.** When properly constructed an electrical circuit can become self sustainable once started. An obvious corollary would be that the number of radio or television receivers in operation does not deplete the magnetic wave source providing the service. The key source of unlimited energy is Magnetic Resonance. To understand this requires putting a stake through outdated physics. An obvious example is the piano where the key impacts the one note giving one sound, which resonates with its two side keys providing a much higher level. Magnetic Resonant Energy clearly amplifies demonstrating more energy out than in. **Excess energy consequent to a reaction is called Free Energy and can be very large as is in the case of Magnetic Resonance.** The intentionally ignorant physicist makes a habit of ignoring this fact.

Useful electricity is obtained from disturbed electrons, which radiate magnetic fields and waves. The generator disturbs and collects this

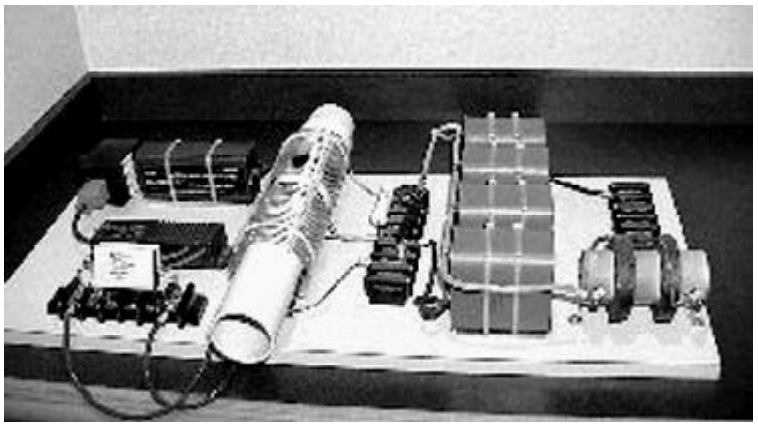

Fig.2
D. Smith's Energy Receiver

emitted electron energy. These electrons remain fully in tact and undiminished until the end of time. This Energy is free and the cost of accessing it depends on the ignorance of the collector. With an appropriate collector system an unending source of environmentally benign, inexpensive, available energy everywhere, is provided.

Editor: in September 2003 Donald Smith took part in the annual "Inventor's Week-end" Conference where he presented the report on his invention. In this issue you can find more details on the conference.

It is worth of a note that we have received ***a number of negative comments on this inventor's work****. However, we thought his articles to be quite interesting and decided to publish them. We would be glad to get readers' comments, who are familiar with the work and inventions of Donald Smith.*

NEWS

News from Farady Lab

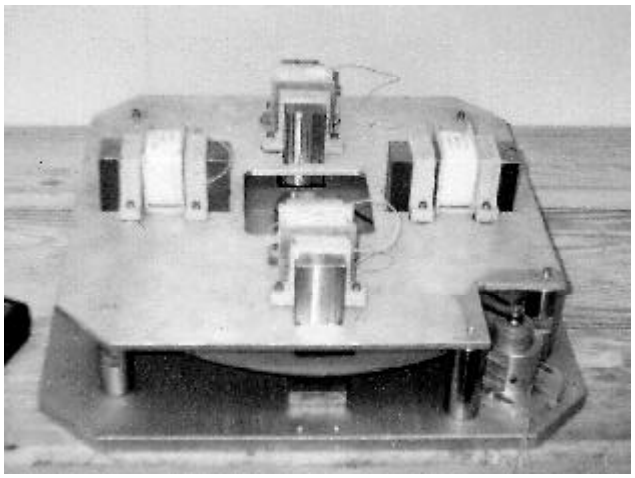

Disk permanent-magnet generator
Faraday Lab Ltd

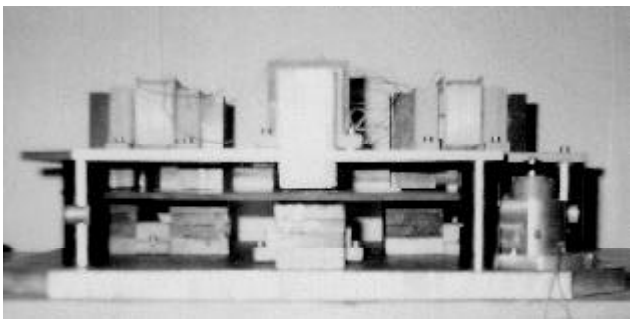

In our lab we are still working at the optimization of the alternator design (electro-magnetic generator with the permanent magnets). We have introduced the drum rotor instead of the disk rotor into the new design of the alternator. The operation mechanism is the same, namely, the alternation of the magnetic flux near the generator coils occurs as a result of the rotating elements operation of the rotor, which "shunt" the magnetic flux.

Frolov A.V.

Strategies for Launching a New Over-Unity Device

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Problem description: With any singly successful over-unity energy device comes a host of business, technical and financial problems and opportunities. A public announcement permanently will lead to a "Pons & Fleishman" effect that at best delays public success and at worst derails the entire technological effort. Careful attention needs to be applied to the marketing launch, replication, patents, legal defense and finances.

Potential Solution: With a few working devices that generate100-500 horsepower it is relatively easy to hook these units to the electrical gird and generate monthly checks from the utilities. The law states that major utilities must purchase electricity from any supplier at "cost avoidance" rate now typically, between 6 and 10 cents per kilowatt-hour. This law, California Public Utilities Commission - Rule 21, for example, is designed to help small hydro-electric producers and solar or wind farms. There is a safety requirement of grid transfer switches, but they are not terribly complicated or expensive. The entire equipment set-up must be approved by the utility, however, if you start with a diesel electric generator or small hydro plant it can be approved, operating and stable before the clandestine switch or hybrid operation with an over-unity machine. The law is strongly supportive of the energy producer and disconnection for non-safety or maintenance reasons is exceeding rare.

A key benefit of this approach is that you have established repeatability by having multiple working sites, you have established that it can generate money and the technology does real work and you have created several independent locations where press and scientists can visit to validate the over-unity effectiveness in-situ.

Typical revenues would be as follows:

Generator Horse Power	100	200	300	400	500
Annual $, 90% uptime @ 6 c/kWh	$ 35,100	$ 70,199	$ 105,299	$ 140, 398	$ 175, 498
Monthly payment @ 6 c/kWh	$ 2,92	$ 5,850	$ 8,775	$ 11,700	$ 14, 625
Annual $, 90% uptime @ 10 c/kWh	$ 58,499	$ 116, 999	$ 175, 498	$ 233,997	$ 292, 496
Monthly payment @ 10 c/kWh	$ 4,875	$ 9,750	$14, 625	$ 19,500	$ 24, 375

It will take money without the strings of investors to champion and defend a new breakthrough technology into the energy marketplace and this strategy offers a quiet way to prepare for the ultimate launch and resulting scientific and media frenzy that will ensue. It will take years for the business to form, products to be built and marketing and acceptance and industry confidence to be established. All during those years this strategy can generate cash to support engineering and operations.

Please call if there are questions at 303-941-9663 (cell),
Home: 720-887-8071
Ryan S. Wood

Fantastic Projects

The Hutchison Effect – An Explanation

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People often ask, "What exactly is the Hutchison Effect?" This brief essay is an attempt to answer that question to the satisfaction of the majority. First of all, the Hutchison Effect is a collection of phenomena which were discovered accidentally by John Hutchison during attempts to study the longitudinal waves of Tesla back in 1979. In other words, the Hutchison Effect is not simply a singular effect. It is many.

The Hutchison Effect occurs as the result of radio wave interferences in a zone of spatial volume encompassed by high voltage sources, usually a Van de Graff generator, and two or more Tesla coils.

Editor: We can call this effect "The H. Wells Effect" because he was first to describe it in his book "The Invisible man". The main character of the book used two sources of electro-magnetic vibrations and Wells said that they were not Hertz waves but something else. "But the essential phase was to place the transparent object whose refractive index was to be lowered between two radiating centers of a sort of ethereal vibration..."("The Invisible Man", chapter 20).

A. V. Frolov

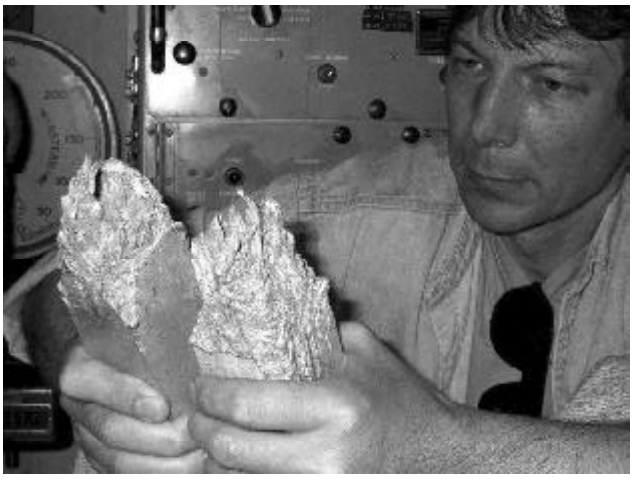

The effects produced include levitation of heavy objects, fusion of dissimilar materials such as metal and wood, the anomalous heating of metals without burning adjacent material, spontaneous fracturing of metals (which separate by sliding in a sideways fashion), and both temporary and permanent changes in the crystalline structure and physical properties of metals.

Fig.1 represents the proof of Hutchison Effect based on metal blocks. Deformation occurred at room temperature as a result of complex interaction of electromagnetic fields.

The levitation of heavy objects by the Hutchison Effect is not - repeat not - the result of simple electrostatic or electromagnetic levitation. Claims that these forces alone can explain the phenomenon are patently ridiculous, and easily disproved by merely trying to use such methods to duplicate what

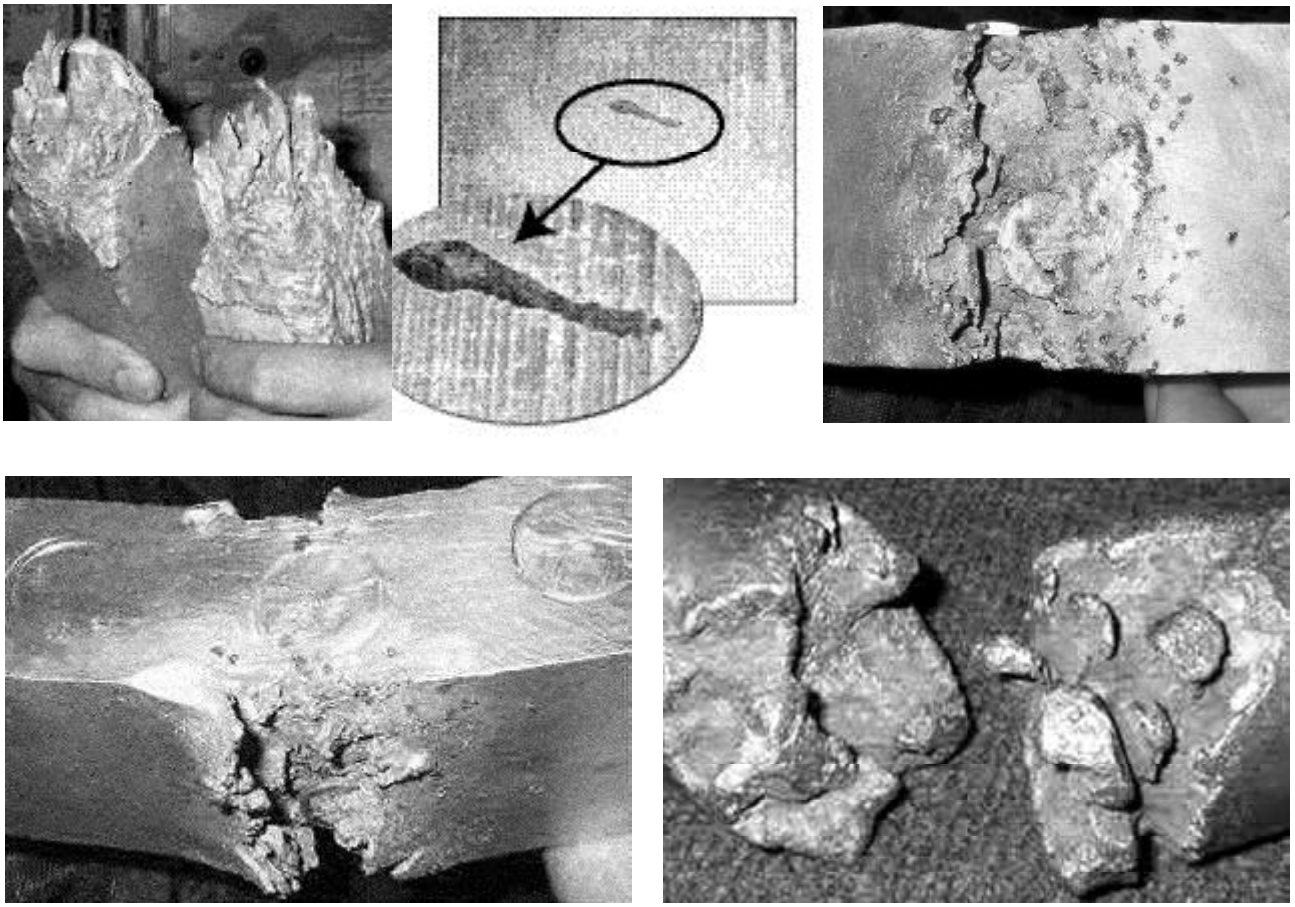

Fig.1

Cold melting of metals

The upper left: steel, The lower left: aluminium with coin prints and with a coin inserted in a partially open split; The lower right: fully torn aluminium bar; The middle upper and right: a section part of the aluminium block, into which a wood block is fused (brown matter)

http://www.rumormillnews.com/JOHN-HUTSHISON2.htm

the Hutchison Effect has achieved, which has been well documented both on film and videotape, and has been witnessed many times by numerous credentialed scientists and engineers. Challengers should note that their apparatus must be limited to the use of 75 Watts of power from a 120 Volt AC outlet, as that is all that is used by Hutchison's apparatus to levitate a 60-pound cannon ball.

The fusion of dissimilar materials, which is exceedingly remarkable, indicates clearly that the Hutchison Effect has a powerful influence on Van der Waals forces. In a striking and baffling contradiction, dissimilar substances can simply "come together," yet the individual substances do not dissociate. A block of wood can simply "sink into" a metal bar, yet neither the metal bar nor the block of wood come apart. Also, there is no evidence of displacement, such as would occur if, for example, one were to sink a stone into a bowl of water.

The anomalous heating of metal without any evidence of burning or scorching of the adjacent materials (usually wood) is a clear indication that possibly the nature of heat may not be completely understood. This has far-reaching implications for thermodynamics, which hinges entirely on the presumption of such knowledge. It should be noted that the entirety of thermodynamics is represented by the infrared portion of the electromagnetic spectrum, which is insignificant in a

context of 0 Hz to infinite Hz. The anomalous heating exhibited by the Hutchison Effect shows plainly that we have much to learn, especially where thermodynamics and electromagnetism meet.

The spontaneous fracturing of metals, as occurs with the Hutchison Effect, is unique for two reasons: (1) there is no evidence of an "external force" causing the fracturing, and (2) the method by which the metal separates involves a sliding motion in a sideways direction, horizontally. The metal simply comes apart.

Doctor John Hutchison

Some temporary changes in the crystalline structure and physical properties of metals are somewhat reminiscent of the "spoon bending" of Uri Geller, except that there is no one near the metal samples when the changes take place. One video shows a spoon flapping up and down like a limp rag in a stiff breeze. In the case of permanent changes, a metal bar will be hard at one end, like steel, and soft at the other end, like powdered lead. Again, this is evidence of strong influence on Van der Waals forces.

The radio wave interferences involved in producing these effects are produced from as many as four and five different radio sources, all operating at low power. However, the zone in which the interferences take place is stressed by hundreds of kilovolts.

It is surmised by some researchers that what Hutchison has done is tap into the Zero Point Energy. This energy gets its name from the fact that it is evidenced by oscillations at zero degrees Kelvin, where supposedly all activity in an atom ceases. The energy is associated with the spontaneous emission and annihilation of electrons and positrons coming from what is called "the quantum vacuum." The density of the energy contained in the quantum vacuum is estimated by some at ten to the thirteenth Joules per cubic centimeter, which is reportedly sufficient to boil off the Earth's oceans in a matter of moments.

Given access to such energies, it is small wonder that the Hutchison Effect produces such bizarre phenomena. At the present time, the phenomena are difficult to reproduce with any regularity. The focus for the future, then, is first to increase the frequency of occurrence of the effects, then to achieve some degree of precision in their control.

The spontaneous fracturing of metals, as occurs with the Hutchison Effect, is unique for two reasons: there is no evidence of an "external force" causing the fracturing, and the method by which the metal separates involves a sliding motion in a sideways direction, horizontally. The metal simply comes apart.

Editor: On November 17th 2003 we got to know that the inventor John Hutchison can eventually lose his home laboratory. The property can be confiscated upon court order due to neighbours' complaints. Apparently, it is dangerous to conduct experiments of the kind at home and even within a town. We wish him success!

A. V. Frolov

A SIMPLE DEVICE FOR HEAT TO ELECTRICAL ENERGY CONVERSION BY MEANS OF FERROELECTRICS

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Introduction

A few years ago, Zaev [1, 2] demonstrated experimentally the possibility of heat to electrical energy conversion by means of ferroelectrics. A capacitor filled with a ferroelectric material was charged and discharged periodically at a temperature just a little lower than the Curie point. According to Zaev, the capacitor must have a nonlinear capacitance dC/dV > 0, which means the capacitance increases with rising voltage. Besides these experimental results, it was proven by a theoretical calculation that the electrical energy obtained during discharging can reach up to 1.35 of the energy introduced to charge the capacitor. The present paper presents an inexpensive and simple electric circuit which can be used to prove heat to electricity conversion experimentally. Moreover, the physical mechanism of heat to electricity conversion is explained in the form of a thermodynamic cycle.

Thermodynamic cycle for energy conversion

The following thermodynamic cycle is composed of four reversible steps. It works only at a temperature just a little lower than the Curie point, where the dielectric constant is highly temperature dependent. Fig. 1 shows the relative dielectric constant of a representative ferroelectric ceramic as a function of temperature.

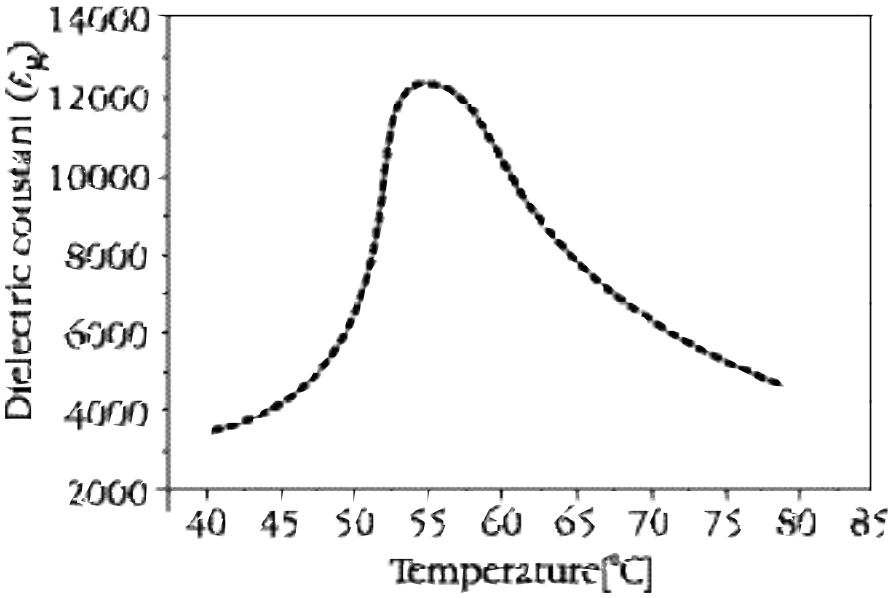

Fig. 1
Relative dielectric constant versus temperature for a barium strontium titanate ceramic (80% Ba, 20% Sr) prepared by the author. Curie point = 55^0 C.

As it can be seen, just below the Curie point in the range from 50 to 55^{0}C, small changes of the temperature cause high changes of the dielectric constant.

Furthermore, to understand the conversion mechanism, it is necessary to understand the electrocaloric effect. When an electric field is applied to a dielectric medium, the latter is polarized. For ferroelectric materials, the parallel domain alignment is the most important part of the total polarization. During the successive alignment of the domains, some material parameters in particular entropy, heat capacity and temperature change. Since the material possesses less degrees of freedom in the polarized state, its entropy and heat capacity are reduced. As a consequence, provided that no heat exchange with the environment is possible (adiabatic conditions), the temperature increases. It is very important to understand that the energy for warming of the dielectric is not taken from the polarizing electric field. The increase in temperature is a result of the decreased heat capacity only.

From this, it can be derived easily what means "nonlinear capacitance".

When a capacitor is charged adiabatically which means its voltage increases faster than any heat exchange with the environment is possible, due to the electrocaloric effect, the temperature of the dielectric must also increase. As it can be seen from Fig.1, below the Curie point, an increasing temperature leads to a higher dielectric constant. Assuming that both temperatures, the one before charging and the other after charging are still below the Curie point, one can say that the dielectric constant increases with an increase in voltage.

Since the capacitance is proportional to the dielectric constant, the capacitor has a nonlinear characteristic $dC/dV > 0$. In the same way it can be concluded that adiabatic charging just a little above the Curie point reveals a nonlinear capacitor characteristic with $dC/dV < 0$.

Quantitative experimental measurements on the electrocaloric effect in some representative ferroelectric and antiferroelectric materials were published by Thacher [3].

STEP 1: Adiabatic charging of the capacitor

We consider a capacitor filled with a ferroelectric medium at an environmental temperature a little lower than the Curie point.

An adiabatic charging of a capacitor (no heat exchange) effects an increase in temperature and capacitance due to the electrocaloric effect. We assume that this increase in temperature is so small that the temperature remains below the Curie point. Finally, the capacitor is completely charged while the dielectric medium has a higher dielectric constant and therefore a higher capacitance than it posseses at the environmental temperature.

To go further to step 2, the capacitor is hold under conditions where no discharge is possible, e.g. it is disconnected from the power supply.

STEP 2: Thermal equilibration

After a short time, the charged capacitor has cooled down to the environmental temperature. While cooling down, the dielectric constant and capacitance decrease. But the charges of the capacitor plates remain constant. As a consequence, the voltage and the electrical energy increase. This can be readily recognized from the general capacitor equation $q = C V$ (q = charge, C = capacitance, V = voltage):

$$q = \text{constant} = C_1 V_1 = C_2 V_2$$

STEP 3: Adiabatic discharging of the capacitor

While discharging the capacitor the temperature and capacitance decrease (again heat capacity changes) due to the electrocaloric effect, leading to a further increase in the available electrical energy. The ferroelectric medium posseses now a final temperature below the temperature of the environment.

STEP 4: Thermal equilibration

In order to proceed with step 1, it is necessary to reach the environmental temperature. An inflow of heat from the environment to the dielectric material is required.

Electric circuit to observe energy conversion

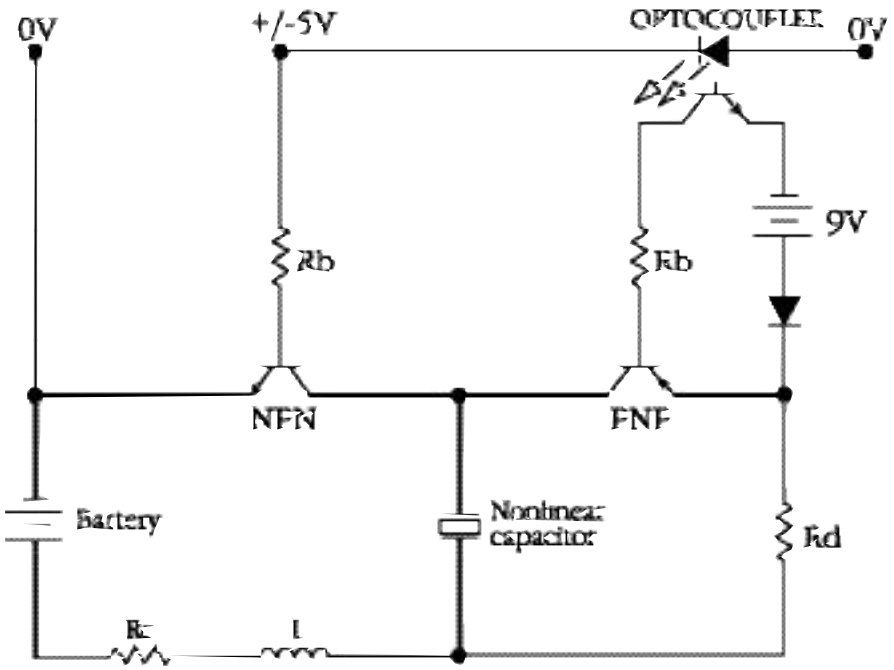

Fig. 2
Electric circuit for testing the energy conversion effect. The connections to the square wave generator are labeled with 0V and +/- 5V, the resistors Rb are to adjust the maximum base current of the transistors.

Assuming the experimenter has a nonlinear capacitor, the set-up shown schematically in Fig. 2 is proposed as a possible conversion device. The circuit contains two different types of transistors (NPN and PNP) which fulfill here the function of a switch.

The NPN junction transistor consists of two n-type semiconductors (called the emitter and collector) separated by a thin layer of p-type semiconductor (called the base). On the other hand the PNP junction transistor consists of a thin layer of n-type semiconductor lying between two p-type semiconductors. The base is the ON/OFF switch for the transistors. If a current flows to the base, there is a path from the collector to the emitter, where a current can flow (switch is ON). If there is no current flowing to the base, then no current can flow from the collector to the emitter (switch is OFF).

The charging-discharging process is controlled by a square wave generator which produces an output signal switching from +5V to -5V. The switching frequency is adjustable from 0.1 Hz up to at least 10 kHz. This output signal is applied to the bases of both transistors.

During the time the square wave generator output signal is +5V, a base current flows through the base-emitter junction of the NPN transistor which creates a low resistance path between the collector and the emitter. As a consequence, the capacitor is charged by the battery. The collector-emitter junction of the PNP transistor has a very high resistance, because here no base current flows. Therefore the capacitor is not discharged at the same time. When the output signal switches to -5V, a current flows to the base of the PNP transistor and not to the base of the

NPN transistor. Now the capacitor is discharged.

In order to understand the function of the inductance in Fig. 2, we analyze the thermodynamics of the charging process.

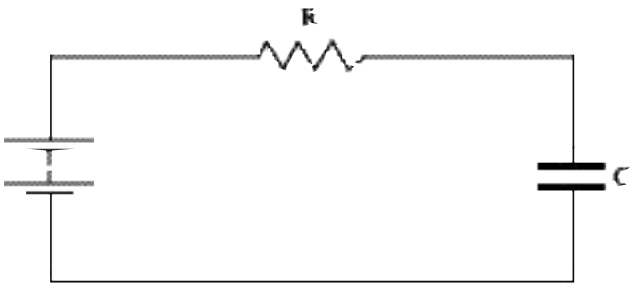

Fig. 3
Simple circuit for charging a capacitor

If a linear capacitor of capacitance C is charged to a voltage V through the load R according to Fig. 3, the energy $W = 0.5\ C\ V^2$ is stored in the capacitor. During the charging process, a time-dependent current I(t) flows:

$$I(t) = V/R \exp(-t/RC)$$

This current develops the heat Q in the load:

$$2Q = R \int I^2(t)dt = 0{,}5CV^2$$

Here the integration limits are from zero to infinity. This calculation shows, that the energy taken from the battery is the energy stored in the capacitor after charging plus the heat produced in the load, also 2•C V2. One can see that the heat Q is not dependent on the resistance value R.

The above used equations are only valid in case of a one-step charging process.

If the capacitor is charged stepwise to the final voltage V, e.g. using a ramp generator, and each voltage step effects a voltage increase , the total heat produced in the load is (N = number of voltage steps):

$$Q = N\ 0{,}5\ C\ (V/N)^2 = 0{,}5\ C/N\ V^2$$

Now the energy taken from the source is:

$$W = 0{,}5 \cdot (1 + 1/N) 1/2\ CV^2$$

If the number of steps N tends to infinity, the heat Q tends to zero.

This energy loss in the load dramatically influences the efficiency of any conversion device and must be taken into account, otherwise all experimental attempts to observe energy conversion would fail.

A more detailed discussion on charging a capacitor and the unavoidable energy losses was given by Heinrich [4] and Gupta et al. [5].

The inductance in the circuit (Fig. 2) effects a slower rising of the current during the charging process (due to self induction) and can reduce the heat generated in the load dramatically.

Acknowledgments

Financial support of this work was provided by the Brazilian agency FAPESP (www.fapesp.br) and the German Academic Exchange Service (DAAD), (www.daad.de).

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Fantastic Projects

The Gates Motor

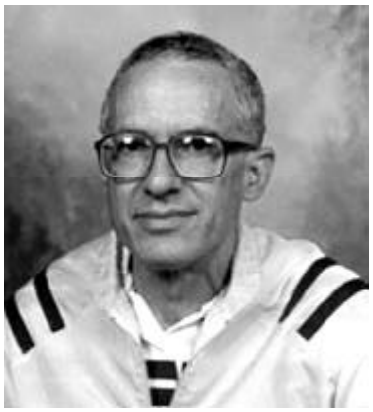

A. Akau, USA
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The Gates motor company has produced a motor that does not run on fossil fuel or on electricity. It comes in a 28 HP and a 5,000 HP version. When linked to an electric generator, the larger motor will produce 2,200 kW.

My name is Adrian Akau. I am a recently retired school teacher, having taught science and math in the public school system, state of Hawaii for the past 36 years. One of the classes I taught was on energy.

Our world should be reaching the half-way mark in easily accessible oil by about the year 2016. Since the rate of oil usage is becoming higher each year, it is unlikely that the oil supply will last as long as the 140 years since the first well was drilled in Pennsylvania. We will become more dependent upon OPEC with all the political pressures and problems that accompany this type of dependency. As the easy oil is consumed, we must look for ways to extract less accessible oil such as from shale. The added expense will be passed on to the consumer.

The burning of coal is not the answer either because coal cannot supply convenient energy as does oil. An oil-based economy cannot transfer over readily to natural gas; there is not enough natural gas available and it is again, not a convenient and concentrated source as is oil. We also have serious pollution problems with the burning of fossil fuels (natural gas being the exception) but the burning of all fossil fuels have contributed to the serious problem of global warming.

It may take all of 50-80 years to transfer to a non-fossil fuel economy. The transfer must be made slowly so as not to disturb the infrastructure of our economy which is presently based upon fossil fuels. We must gradually create a new infrastructure that is non-fossil fuel dependent.

The motor incorporates a unique spring configuration to provide rotation

The production model of the motor is 24 inches high by 48 inches in length. Connected to a generator it will provide sufficient power for about eight hundred US homes. It is designed to be tough and to last a long time. It uses a high grade airplane synthetic engine oil

to prevent friction and the build up of heat. Only the oil filter needs to be changed. The motor has special needle bearings and portions of the motor are made of high quality steel.

The Gates motor is designed to run 24 hours/day, 365 days/year without incurring any fuel costs. The larger size motor would come in pairs; the spare motor being used as a back-up unit should the regular motor be turned off for maintenance such as to change the oil or in case there should be any problems with the first motor. The company is willing to enter into a contract for maintaining the motor after installation.

The Gates motor represents a major breakthrough in motor design technology and provides practical solutions to environmental and fuel conservation concerns. **Finally, a completely mechanical motor has been developed.** It can deliver the power needed in a wide variety of service applications without any waste products or emissions to adversely affect the environment. This revolutionary new motor utilizes spring power technology. Unlike conventional motors which must reach a maximum rpm level before the desired horsepower, the Gates motor provides maximum horsepower instantly by virtue of the torque stored in the springs.

The basic operating principle of the Gates motor involves a series of springs configured to provide the required motor rotation and power delivery. Consider, if you will, the operating principle of a grandfather clock. Once the clock is wound, it continues to operate until it runs down and stops. The springs must then be rewound so it will operate again. Suppose the clock is continually being rewound as it operates. Then the clock would run continuously. This condition is what forms the basis for the operating principle of the Gates motor. The motor incorporates a unique spring configuration to provide rotation. The springs inside the motor are wound and preset at the factory at the time the motor is assembled. The amount of torque wound into the springs at the factory determines the horsepower of the motor. Inside the motor are a multiple of springs positioned horizontally in a circular arrangement. As the motor operates, the springs are unwound a set number of degrees. A double ratchet system at one end of the motor rewinds the degrees used back into the springs. As the springs are unwinding, **the power generated from all the springs reset each spring (one at a time) during each revolution of the motor**. It is this reset action that produces and delivers power from the springs to the flywheel located at the opposite end of the motor. The flywheel serves to ensure the smooth operation of the motor and to convert the springs into useable horsepower. The smaller motor has 50 foot pounds of torque at a shaft speed of 3000 RPM and will produce 28 HP. The HP can be altered by factory adjustment. The speed of the engine is controlled by a hydraulic pump which provides pressure upon the power shaft.

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Editor: We tried to get the video of this device operation from Gates Motor Co., but after a long consideration it was not provided since the authors are competitor-conscious.

Alexander V. Frolov

Longitudinal Waves

Cold Electricity

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Dr. Peter Lindemann in his book "The Free Energy Secrets of Cold Electricity" presents the story of this type of electricity which really is not electricity as electricity is normally meant to be understood. Cold electricity behaves differently than normal electricity. Regular electricity may be used in the process to generate this cold form but this transformation is not the type of change in voltage and current that occurs in a transformer. Rather, it is the extraction of a form of current from "normal" electricity by a process that uses high voltage.

In discussing the Edwin Gray motor, Dr. Lindemann relates a demonstration by Gray. Gray used a 6 volt car battery with lead wires running to a system he had devised using a voltage booster and a series of capacitors which raised the voltage to 3,000 volts. He then closed a switch that ran the high voltage into two electromagnets which caused a loud popping sound and cause the top electromagnet weighing a pound and a quarter to be propelled over two feet into the air. Gray claimed that only 1% of the system's energy was used with 99% going back to the battery. He said that he had 'split the positive' with his system.

Other evidence of using this fractionated electricity was Gray's use of a small motorcycle battery (15 amps which would normally produce W=V x A = 6 V x 15 A= 90 watts) to run concurrently six 15-watt electrical light bulbs, a portable 110 volt T.V. set and two radios. A glowing 40 watt light bulb running off the system was dropped into water without the glass breaking; the bulb gave off light but not the heat that accompanied a bulb run by regular electricity. This would mean that tungsten in the filament of the light bulb was not resisting the flow of this fractionated electricity and that this "cold electricity" was causing the luminous glow by some other means.

According to Gray's Patent #4,595,975, low voltage was chopped into pulsating DC by passing it through a multi-vibrator (buzzer like a door bell). Then the pulsed DC was sent through the low voltage winding (primary) of a transformer which changed it to pulsating high voltage DC current at the secondary side. The pulsating high voltage DC was rectified by a full wave bridge and changed into high voltage DC.

The high voltage DC was used to repeatedly charge a capacitor as the current was sent to briefly discharge across a spark gap (rated at 3000 volts). The discharge of the spark across the gap had to be in one direction only and its duration was controlled by the size of the capacitor and by the strength of a magnetic field encompassing the gap. This magnetic field had a quenching effect because it caused a back EMF each time the discharge occurred. The current from the discharge across the gap was then sent through a resistor and then to a vacuum tube (the conversion switching element tube).

Another of Edward Gray's patents "Efficient Electrical Conversion Switching Tube Suitable for Inductive Loads" (April 1987, patent 4,661,747) described the switching tube. It utilizes a low voltage anode (positive plate), a low voltage anode (positive plate) and one or more electro-static or charge receiving grids (located between the positive

plates and the cathode or negative plate supplying the electrons). This tube's function was to 'split the positive'. A normal vacuum tube usually uses only a single anode at a particular voltage to control the voltage flow within the tube. The function of the charge-receiving grids was to collect the "cold electricity".

The most unusual part of this Power Supply circuit consisted of devices specifically designed to remove excess energy when the Switching Tube was functioning. A spark-gap protection device, served to "protect the inductive load and the rectifier elements from unduly large discharge currents". As stated, the rectifier elements are the two anodes and the grids in the Switching Tube. In a normal vacuum tube, no protection would be necessary because the maximum power of the tube would be based upon the electricity provided to heat the tube filament and to charge the anode (voltage x amps). Therefore, the excess energy comes from the process occurring as the spark gap affected electrical pulses pass through the Switching Tube. The process of extracting the "cold electricity" places danger of overload upon the system. (Please take note that the "electricity" from the Switching Tube is no longer the normal type of electricity we have from our batteries or from an electrical outlet but rather a completely new form with entirely different characteristics.)

The description continues, "Should the potentials (voltages) within the circuit exceed the predetermined values fixed by the mechanical size and spacing of the elements within the switching tube, the energy is dissipated (bypassed) by the protective device to the circuit common (electrical ground)" by two strategically placed diodes (devices that permit the passage of electricity in one direction only). The question now arises "What is the cause of this large amount of excess energy which must be dumped to ground through device acting like a lightning rod in order to prevent the circuit from burning out?"

To examine the cause of the excess energy source, we must go back over a hundred years to1889. Heinrich Hertz had just announced in 1887 that he had discovered electromagnetic waves and Nicola Tesla was attempting to duplicate Hertz's experiments. Tesla used abrupt and powerful electric discharges produced with banks of capacitors charged to very high potentials and was able to explode thin wire (copper bus bars). He came to the conclusion that Hertz had mistakenly associated electrostatic inductions (electrified shockwaves in air) for true electromagnetic waves.

The explosion of the copper bars by means of the "disruptive discharges" from the capacitor bank produced sharp shockwaves which struck Tesla with great force across the entire front of his body. Tesla said they felt more like powerful gunshots rather than electrical sparks. They produced effects similar to lightning or to those produced by high voltage DC generators previously discussed; the simple closing of a high voltage DC generator caused a stinging shock. AC generators were not in use in this pre-AC era and it was shown, later on, that AC generators did not produce these effects.

This shock was first assumed to be the result of residual static charging. It stood straight out of highly electrified conductors, seeking ground paths which included workmen and switchboard operators. In long cables, Tesla estimated that this electrostatic concentration was several orders in magnitude greater than any voltage the DC generator could actually produce. It caused a hedge or crown of bluish needles or spicules to point at right angles to the cable or straight from the electrical cable line into the surrounding space. The bluish needles appeared the very instant the switch was closed and disappeared a few milliseconds later, after which the system functioned normally. However, anyone through whom the blue needles passed, especially in large regional power systems which used high exceptionally high voltages, usually did not survive. Generators rated at a few thousand volts produced hundreds of thousands or even millions of electrostatic volts during the start-up pulse. Highly insulated, heavily grounded relay switches had to be installed to protect workers from certain death.

Engineers at this time assumed **the effect to be caused by a "bunching" action which occurred when a powerful force was not able to move charge sufficiently quickly through a system.** (A similar "choking effect" also happened with large steam engines; if steam was introduced too rapidly, the steam engine could explode.) The metal of which the wire was composed somehow offered resistance to the charge carriers before they were able to move away from the generator terminals. It seemed that the wire acted as a blocking force to the electrons or to some unknown part of the electrons for the first few milliseconds, rather than as a conductor. The powerful, deadly bluish spikes sprang from the line until the current charges actually "caught up" with the applied electrical field. It was as if the spicules were a form of relieving pressure on the system by converting the voltage impulse into some other form.

Tesla began wondering why the electrostatic field moved faster than the actual charges. He believed that this effect could help him find electric waves better than his capacitors because the line resistance caused the electrostatic charges to bunch together into a density much greater that obtainable with his capacitors.

Tesla understood that ordinary capacitor discharges were oscillating currents or spark currents which "bounced" between each capacitor plate until their stored energy was dissipated. The high surge voltage of the DC generator exerted such a high one way pressure on the dense line charges, due to the millisecond resistance of the metal, that possible voltage "bounces" were also oscillations of current as was true with the capacitors. Tesla used every means possible to block the "back-rush" (bouncing) of the oscillating current in order to prevent the supercharge to prematurely decline; he wanted to maintain this powerful "bunching" effect as long as possible in order to study it and to make use of it.

His face and hands experienced a penetrating shockwave; a sharp pressure and an electrical irritation were brought on at the sudden closing of the switch. His face and hands were especially sensitive to these shockwaves which caused a "stinging" effect at close range. Tesla believed that he was being struck by material particles approaching the vapor state as they were thrust from bluish crowned wire.

Later on, he was to discover they were not gas particles. **He placed himself behind a glass shield but to his amazement, he still felt the shockwaves and stinging effects; the glass shield did not protect him.** These stinging rays could be felt at great distances from their sources and, to his amazement, would penetrate shields of both glass and copper. Tesla knew that normal electrostatic charges spread over the surface of a metal (copper, for example) shield so that the stinging effect could not have an electrostatic origin and therefore was not electrostatic in nature but was from some other yet unknown source.

Joseph Henry in 1842 had noticed the magnetization of steel needles by the discharge of a Leyden Jar (type of primitive condenser made with a glass bottle). The Leyden Jar was at the top floor of a building while the needles were in the basement. Dr. Henry, noting the passage of these magnetizing rays through brick walls, oak doors, stone and iron flooring and tin ceilings believed that the spark given off by the discharge released "light-like rays" that passed through the material obstacles with ease before magnetizing the needles.

Elihu Thomson, a physics instructor in 1872 had been attempting to make sparks from a Ruhmkorrf Spark Coil more clearly visible for his physics students. He attached one pole of the coil to a cold water pipe and noted that the previously blue spark changed to white. He then attached the other pole to a large metal table top and produced a silver-white spark that would be clearly visible to all attending his lecture. He went to the door of the room to notify his colleague but received a strong shock from the door knob. Turning off the Ruhmkorrf coil prevented the brass knob on the oak door to stop shocking. He returned with his friend, again turned on the coil and discovered that all metal objects in the entire building, no matter how distant

from the coil or insulated from the floor, produced long and continuous white sparks upon the touch of a penknife or screwdriver.

The device Tesla perfected was far superior to the Ruhmkorrf Spark Coil. The effect of his disrupter device was so strong that a single wire placed in an oil bath produced what he had originally but mistakenly thought to be gaseous streams so powerful that they visibly depressed the oil into a depth of about two inches. Tesla concluded that "besides the air, another medium is present".

> *...he placed himself behind a glass shield but to his amazement, he still felt the shockwaves and stinging effects; the glass shield did not protect him. These stinging rays could be felt at great distances from their sources and, to his amazement, would penetrate shields of both glass and copper...*

Tesla had been able to perfect his device by placing a capacitor between the switch and the D.C. generator thus increasing the power and protecting the generator windings in much the same manner as the diodes Edwin Gray's Switching Tube protected Gray's circuit. Tesla also raised the voltage and quickened the "make-break" rate of the switch to increase the power level by placing a powerful permanent magnet crosswise to the discharge path of the high voltage output of the DC generator wires. The magnetic field caused the discharge arc to automatically "blow out"; the charge passing through the wires in the presence of the magnetic field built up reverse emf (electromotive force or voltage).

Tesla believed he had discovered a new type of electricity with special characteristics. This form of electricity did not consist of alternating waves. **They were longitudinal waves** composed of successive shocking waves with effects that could be seen and felt at a distance. **Vector components of these shock waves were unidirectional. They were able to force charges in the direction of their propagation.** In his patent #787,412, "Art Of Transmitting Electrical Energy Through The Natural Mediums" (April 18, 1905), Tesla calculated the mean velocity of the waves propagated by his device to be 471,240 Km/sec. Knowing that the velocity of light is 300,000 Km/sec would indicate that the type of transmission to which Tesla is referring is different than standard electromagnetic radiation; these special longitudinal "Radiant Energy" waves moved faster than the speed of light.

After conducting hundreds of experiments, Tesla found that "Radiant Energy" longitudinal waves **could penetrate all materials and cause "electronic responses" in metals such as copper and silver.** Impulses exceeding 0.1 millisecond duration produced effects such as pain, mechanical pressures, explosion of thin wires and vibration of objects. Impulses of 1.0 microseconds caused the sensation of physiological heat; at still shorter lengths white light would fill the room. Impulses less than 100 microseconds were safe to work with and Tesla planned to use them for his power broadcast system since they could pass through all matter.

In 1890, Tesla discovered that placing a long single turn copper helix near his magnetic disrupter became covered with an envelope of white sparks. Effects were strongest when the helical coil was placed within the disrupter wire circle. In this "shockzone", the coil was surrounded by a blast of long, fluid like silvery streamers which clung to the surface of the coil, flowing over the coil at right angles to the windings. Tesla hypothesized the electrostatic-like effect was due to radiant transformation rules requiring measurements of discharge lengths and attributes of the helix used (number of turns, diameter, etc.). (Editor: resonance)

The new induction law he discovered showed that radiant shockwaves became much stronger when encountering segmented objects. The radiant shockwaves

"flashed over" the outer skin of the helix from end to end without passing through the windings of the coil; shockwaves of 10,000 volts introduced to a 24 inch coil rise to 240,000 volts. The greater the resistance in the helix turns, the higher the maximum voltage. This was completely different from magneto-induction. Remember that he was not working with electricity but with radiant shockwaves.

> *Aether particles were incompressible and could easily pass through space and matter with a speed much greater than the speed of light. This was pure radiant matter but, at the same time, pure Radiant Energy. Cold electricity is one of the forms of this Radiant Energy*

This transformer he invented used radiant shockwaves to produce pure voltage without current. Each transformer had to be "tuned" by adjusting the disrupter to a specific impulse duration. At that point, voltage impulses could flow smoothly, flowing over the copper surface much like a stream of water in a pipe. No amperage could be detected but if the stream was aimed at a distant metal plates, "current" was produced which reached several hundred or even thousands of amperes. Tesla then began to wonder what made up this white, currentless stream.

Tesla determined that normal charge carriers (electrons) could not travel as quickly as the radiant pulse; no current moved the coil because the electrons were choked in the metal lattice of the coil. **The radiant pulse moving over the surface of the coil was not electronic in nature.** He placed the legs of a heavy U-shaped copper bus bar directly to the disrupter primary and then connected the short-circuited system to several incandescent lamps. These lamps glowed with a brilliant cold white light as with Gray's light bulb, proving that the power for the light was not electrical in nature. Tesla believed that the electrons were blocked from flowing through the wire while the radiant pulse was released over the coil surface as a "gaseous" pulse (splitting the positive, according to Gray).

Tesla came to believe that voltage could be viewed as streams of aether under various states of pressure and that his transformers affected the aether as to produce the luminous effects he observed. In his patents, he describes his "light-like rays" as tightly constricted aether streams propelled from his transformers along infinitesimal ray lines along which an incompressible movement occurs instantly through space on all points along its path. Aether streams were being drawn in through his transformer at higher natural pressure and then accelerated in the electrical discharge. The voltage in his transformer could control the brilliance of light in a room but this type of light was almost impossible to register on film. He could heat up a room or cause cool breezes by controlling the voltage in impulse duration in his transformer.

Tesla saw electrical current was really a complex combination of aether and electrons. Through the application of a disrupter, the electrons were removed from the gap by the magnetic field while the aether steams continued to flow through the circuit. He considered aether particles highly mobile with infinitesimally small mass and cross-section as compared to electrons. They were incompressible and could easily pass through space and matter with a speed much greater than the speed of light. This was pure radiant matter but, at the same time, pure Radiant Energy. Cold electricity is one of the forms of this Radiant Energy.

Edwin Gray, Dr. Nicola Tesla and Dr. Thomas Henry Moray all used radiant energy technologies. It is important to understand that the Laws of Thermodynamics and Maxwell's equations do not pertain to "Radiant Energy" technologies.

Fantastic Projects

Gravity Conversion Rotary Device

Review is prepared by editor Tatiana Ezhova

Here another fuelless perpetuum mobile is presented.

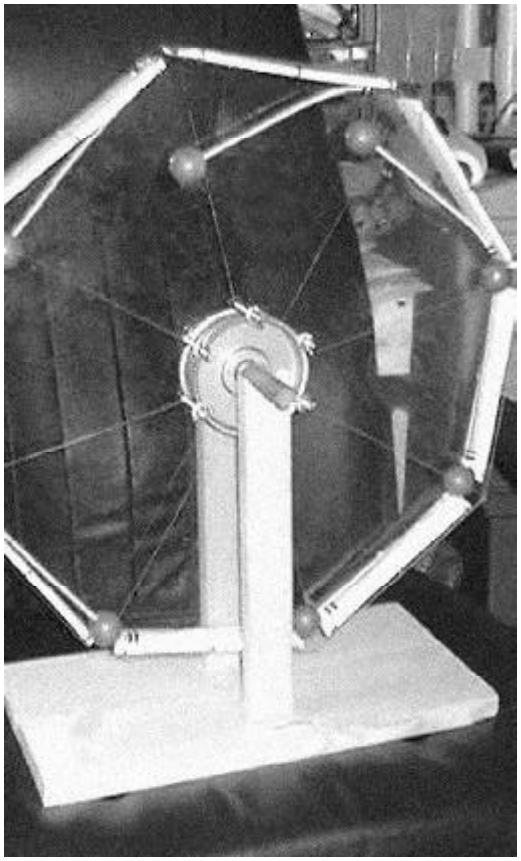

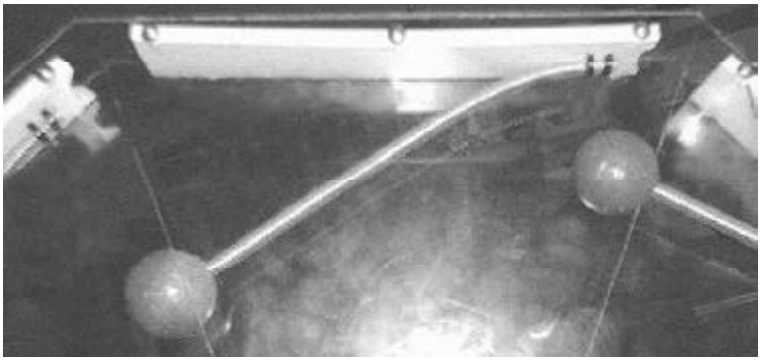

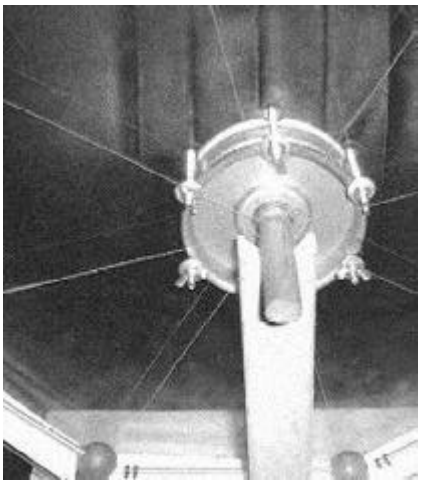

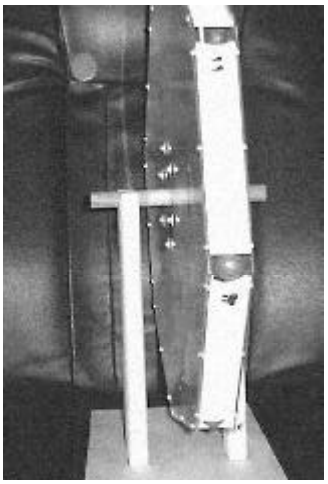

The system design

The design includes a wheel with spring spokes. Pegs may be fixed inside the wheel to balance movement of weights on springs. All parts should be homogenized as to dimension and weight. The author used 4 oz. lead balls and the 3/16" springs. The wheel measures 9" in radius as measured from hub center to center of each lead ball at outer periphery. This device is actuated and stopped by the hand. Its speed is self governing, it ramps up to speed quickly and simply stays there.

Note: you can find more detailed information about the device at http://www.greaterthings.com/News/FreeEnergy/Directory/GravityMotors/photos/. Also read in this issue article "Novozhilov's motor" that describes another wheel motor that does not require any fuel for its operation.

Torsion Technollogies

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ABSTRACT

Highly localized nuclear activation in electrochemical systems and other electrical discharge processes have been observed by many laboratories in the world. This report is an attempt to explain such anomalous phenomena by using torsion field theory and axion model. Anisotopic behaviours of radiation products, burst character, "heat after death" of excess energy release in electrical discharge systems are considered to be interpreted by the torsion coherence of vortex dynamics with the zero-point energy induced by localized intense field emission of micro-protrusion of the cathode, and the dynamic Casimir effect of transient evolution of triple region of gas, liquid solution, and electrode protrusion. Axion model and Primakoff's effect are proposed for explanation of nuclear transmutation without noticeable gamma radiation.

Nuclear products with high concentration, unidentified tracks with highly collimated lines of low energy nuclear reactions in the electrochemical systems were recorded by CR-39 solid detectors and photo-films, and localized spots with chemical alterations were observed at our laboratory. It is suggested to carry out intensive study of vortex dynamic for explaining the anomalous phenomena in wide area of nature and laboratories. Analysis of vortex dynamics with wide range from pitting corrosion of electrochemical system, laboratory plasma, tornado, to quasar spiral model with extremely high energy cosmic rays in the center region, leads to a conclusion for that vortex dynamics creates torsion fields responding to the anomalous effects.

I. INTRODUCTION

Many laboratories in the world have observed nuclear reactions and **excess heat** in electrochemical systems. The mechanism of such anomalous phenomena is not being well understood according to normally accepted physics.

Nuclear products with high concentration and tracks with highly collimated lines of low energy nuclear reactions in the electrochemical systems were recorded by CR-39 solid detectors and films at our laboratory [1,2]. These facts suggest that quasar model with spiral structure and extremely high enrage cosmic rays in the center could be used to explain the mechanism. It is supposed to use the concept of torsion field to interpret the observed phenomena, typically, the properties of axion acceleration, memory effect, and the polarized nuclear reactions with torsion effect [3].

II. PHENOMENA IN NATURE AND AT LABORLATORIES

The vortex and spiral structures are the archetype that appears at all levels of nature and laboratories, for example, atom structure, vortex lattice in superconductors, dense plasma focus, lightning, quasar etc.

Recent report of dark matter annihilation at the galactic center describes that the cold dark matter near the galactic center is accreted by the central black hole into a

dense spike [4]. Particle dark matter annihilation makes the spike to be a compact source of photons, electrons, positrons, protons, antiprotons and neutrinos. It reminds us for that there is a similarity among pitting corrosion with electrochemical noise, laboratory plasma pinching (dense plasma focus, for example), fast laser induced ion beams [5] and quasar spiral model with high-energy cosmic rays in spiral center in spite of large dimension difference. Comparing the experimental results of electrochemical cells with excess heat and nuclear transmutation to astrophysics phenomena, it is supposed that the investigation of vortex dynamics of torsion coherence with the zero-point energy is essential for tapping the zero-point energy.

As it is predicted by quantum mechanics that the vacuum is seething with active energy, even at temperature of zero point Kelvin. This zero-point energy (ZPE) can be thought as an infinite number of virtual photons that are popping out of the vacuum and going back in, but should be a measurable effect en masse. To exam the origin of ZPE background, the interaction of matter with the ZPE can be treated on the basis of charged point particles interaction with a background of electromagnetic zero-point radiation with spectral-energy density.

Based on observation in the experiments, the following features are considered in order to understand the experimental results with electrical discharge systems.

A. ELECTROCHEMICAL DOUBLE LAYER

In an electrolytic cell, the electrolysis with high conductivity and the electrochemical double layer with large layer-capacitance lead to a typical structure of the cathode potential distribution similar to the cathode drop of glow discharge in low gas pressure. For a compact layer the thickness of the double layer is equal to one ionic layer, across which there is a linear fall of potential. Thus, high electric field exists in some regions on the surface of the cathode. The local enhancement of the electric field on the cathode surface with the double layer is related to the protrusions and cracks similar to the tip discharge in air or in a vacuum. The current distribution depends strongly on the surface roughness and the work function of the electron emission. A high transient current density ($> 10^8 A/cm^2$) could be expected due to enhanced field.

B. ENERGY CONCENTRATION

On the cathode surface, the high persistent electrical fields ($>10^7 V/cm$) and large equivalent capacitance ($>25 \mu F/cm^2$) lead to a high energy concentration in the double layer [6]. The concentrated field on the tips of the protrusions or cracks after a long-loading period with deuterium on the palladium cathode surface creates a high transient electron flux because of the large distributed capacitance and the negligible inductance in a localized discharge mini-network. The experimental data show that the reactions take place only in some restricted areas that have specific properties. The idea of micro fusion due to the results of energy concentration and the high deuteron flux could be used to explain the nuclear transmutation.

C. TORSION FIELD AND THEIR EXPERIMENTAL MANIFESTATIONS

Elementary particles have the moment of quantity of motion, i.e. spin. If in any substance the spins of particle have a preferable direction, then it is interpreted as spin polarization of the substance. Every substance creates a torsion-field (or called spin-field or axial field) in the space surrounding it when polarized by spins [7]. The superposition of torsion field, generated by the atomic and nuclear spins of each molecule, determines the intensity of torsion field in the space surrounding each molecule. Torsion field has strong penetration ability and does not interact with the crystal lattice of substances. The torsion field created by rotation of some sort of matter is concentrated in two opposite beams propagating along the rotation axis. The intensity of torsion-field with some

lower constant value can be retained for several weeks after the rotation is stopped. Such property of vortex mater has been recently observed in type II superconductors with magnetic flux line lattice [8]. The studies of vortex matter of type II superconductors have shown a number of puzzling phenomena associated with vortex motion, including: low-frequency noise and slow voltage oscillations; a history-dependent dynamic response, and memory of the direction, amplitude duration and frequency of the previously applied current.

Some behaviors of the torsion-field effect have been observed in the experiments of electrolysis regarding the so-called cold fusion, such as when the gas bubble chains come out from the protrusions of the cathode surface a long time after switching off the electrolysis potential. The more surprising thing is the heat after death, which has been recorded by many labs. This phenomenon could be explained by the persistence effect of the torsion-field produced by vortex dynamics of tip effect.

D. EXPERIMENTAL RESULTS IN THE ELECTROCHEMICAL CELL

CR-39 plastic films possessing with a high degree of optical clarity and isotope in track response, and are sensitive to neutron, proton, tritium, alpha, and other charged particles, were used to detect the products of nuclear reactions. The films of CR-39 were immersed in the NaOH electrolyte of heavy water and placed adjacent to the tips of the cathode [9]. After 110 hours, electrolysis experiment with the applied voltage 1 V and current 2 ma, the solid detector was etched by 6.25 N NaOH solution in 70^{0}C for 11 hours. The photomicrograph shows the cluster of tracks with a cycle crater of 100 μm in diameter and 25 μm in depth. According to the etching condition, the energies of the most of the particles, P, T, α are estimated roughly to be in the range of 1-4 MeV. On the backside of same region of the CR-39 film detector, one can clearly see a few of tracks in the circle area or nearby. Such tracks are believed to be created by recoil-protons of forward incident neutrons. High concentration of the cluster of nuclear tracks could be explained by the quasar spiral model and by the crystal channeling effect [Fig.1]. The experimental results of the generation of tritium with single crystal metal of Pd show that none of the generation of tritium has been revealed by using non-single crystal electrodes [10]. The importance of the crystal channeling effect for nuclear reactions in the electrochemical systems can be inferred.

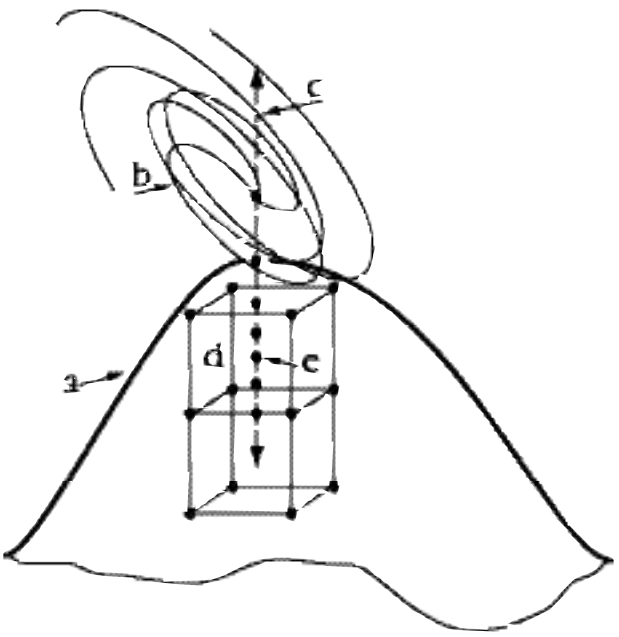

Fig.1
Schematic presentation of a micropinch spiral by tip effect in the electrolysis cell:
a) tip of the electrode; b) spiral structure of micropinch; c) electron beam; d) crystal channel; e) ion beam

To determine the spatial distribution of radiation active sites (RAS), Black-white 135 films of 27 DIN have been used to image the position of the RAS. After a 1,5 year of deposition in glass tube of finishing electrolysis experiments with light water electrolyte for more than 200 hours running, the patterns of RSA were clearly formed on the films after exposure of 100 hours [2]. The bright spots corresponding to the tips of palladium cathode edges can be seen due to

the tip effect. The effect of magnetic field on the traces of the charged particles has been observed while the Pd samples exposing to the films, which were folding and wrapping up the sample, were inserted between couple magnets. The tracks stretching along the film surfaces confirm that the tracks were created by charged particles, electrons for example, with low energy about some keVs. Highly oriented tracks can be observed by autoradiography by using normal films locally[Fig.2].

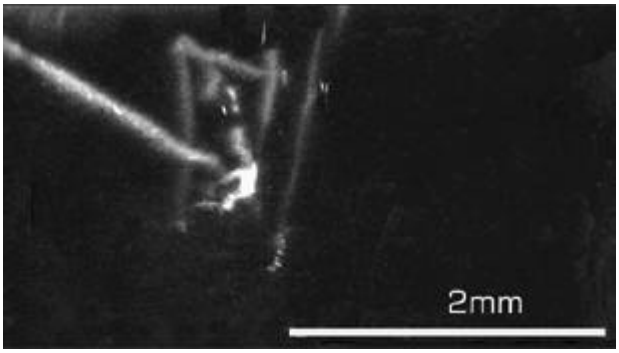

Fig.2
Autoradiography of charged particle tracks of beta delay isotopes on the surface palladium cathode. Some tracks of beta particles are paralleling the cathode surface.

E. SONOLUMINESCENCE AND "BUBBLE NUCLEAR FUSION"

Some scientists of Oak Ridge National Laboratory in America reported their articles of bubbles experiments in Science. Experimental results show that the radiation lights of sonoluminescence possess three characters: short duration with picoseconds; wide continual spectrum; highly oriented thin beams. **Based on those characters, vortex dynamics with axial acceleration of bubble collapse could be inferred.** Nuclear reaction with abnormal gamma radiation was observed [11]. Dr.Claudia Eberlein describes her conclusion on sonoluminescence that only the ZPE spectrum matches the light emission spectrum, which must be a ZPE phenomena [12]. The effect of torsion field on nuclear reactions along the axis of vortex should be taken into consideration for the low ratio of the nuclear products of n/T due to spin polarization of reaction particles.

Axion model and the Primakoff effect are proposed for explanation of nuclear transmutation without noticeable gamma radiation. Many laboratories in the world have been engaged in several experiments to search for axions, light neutral pseudoscalar particles yet to be discovered. The axion would be produced in the solar core through the Primakoff effect if its mass is a few electronvolts and could be detected in the laboratory.

III. CONCLUSION

Researchers of new energy study of "cold fusion" type should pay great attention to the general processes of electrolysis to find the key points, which could play a major role in the transit from the electrochemical processes to processes of torsion and the nuclear processes. From the authors' point of view, the evolution of double layers is of importance to understand the anomalous effect, typically on the protrusions of cathode. The change of space-time near the tips due to torsion field generated is expected to delivery the zero-point energy, and dynamic Casimir effect for the evolution of gas bubbles on the tips are expected to generate photons and excess heat [1]. The yields of transmutation products are related to the current distribution on the cathode surface. The cathodes of thin wire were benefit to the generation of nuclear reactions and excess heat for electrochemical systems. Careful examination of the evolution of electrochemical double layer will lead to a good understanding of pitting corrosion with electrochemical noise, and further to recognize the anomalous excess heat and nuclear reactions.

Heat after death was observed at many laboratories. It is believed that the persistence behaviors of torsion field can be used to explain such anomalous phenomena.

The contact between beads coated with a thin metallic layer or multilayered film and

palladium black particles could be regarded as point-contact similar to the tip-effect [13].

We may say that it is expected to reveal the puzzles of the mechanisms of high-Tc superconductivity with pinning vortices by the torsion field theory [14,15].

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Fantastic Projects

The Invention of Roman Solomyanny

Our previous issue featured an article about Roman Solomyanny who came to our office and told us amazing things. He said that during his army years (according to his words, he was in the military intelligence) he made a radio technology invention and later on built a free energy generator. The inventor claimed that his device had been working for a certain period of time without any fuel and had been producing power enough for heating and lighting his countryside house. We could not ignore such an intriguing piece of information. Moreover, Roman promised to build and present his device in 2003. We paid him for this interesting story to be published in the issue and prepared for the continuation...

Alas, to no avail... His mobile phone was silent and we started to worry about the inventor's health. Fortunately, we managed to contact his parents on his home telephone (Roman lives in St. Petersburg) and they told us that the chap was OK. It seems he's lost his interest in us. But we still hope that Roman did invent something really exciting and not only polished up his talent for writing science fiction articles. Those people, who want to know the details about this invention or discuss it with the inventor himself, can get in touch with us for his contact information. Anyway, we will be very pleased to see him again full of new exciting stories. We have already introduced the 'Humour' section into the magazine and are planning to start the 'It Just Can't Be So' section.

Editor

Physicists are Joking

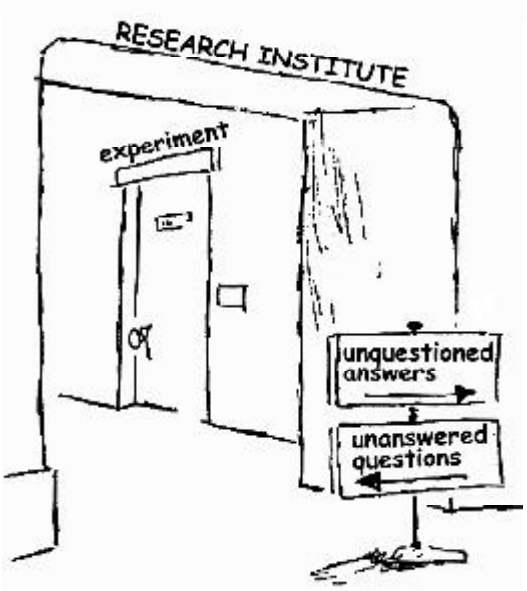

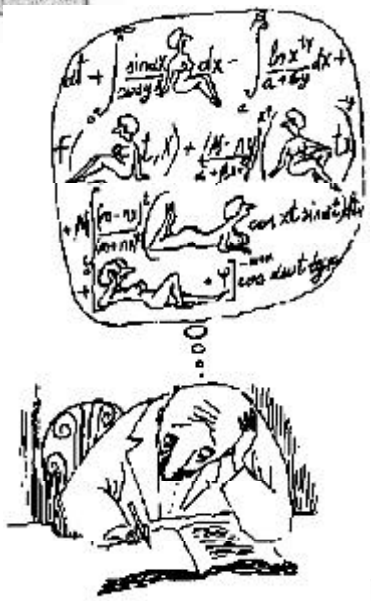

Anti-Gravity: The Holy Grail of the 21st Century

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A Primer on the Role of Electromagnetic, Electrostatic, and Torsion Fields in Anti-Gravity and Field-Effect Propulsion

Before visiting a University of Washington physics professor to talk about electrostatic propulsion, and hopefully anti-gravity, I realized: *Birds defy gravity. So do 747's for that matter. They apply the laws of physics and lift off the ground. That's anti-gravity, isn't it?* Yes, that's true, I suppose, in a metaphorical sense. But seagulls, jumbo jets and space crafts manifest anti-gravitation effects strictly speaking. What I want to address here is not the overcoming of gravity but the neutralizing of it.

Dr. Eugene Podkletnov, one of the foremost researchers in anti-gravity, and whose work is sought by NASA, Boeing and British Aerospace (now known as BAE Systems) describes the hunt for anti-gravity the greatest scientific quest of this century. He calls for an international effort, akin to the Manhattan Project that developed the atomic bomb, to conquer the secrets of anti-gravity, and usher in a new era of scientific understanding whose technological development will be at a scale so vast that the potential outcomes are merely hinted at by our previous achievements.

Just getting such a project off the ground will require unprecedented international cooperation, and public disclosure as well; the potentials are that vast, that scary, and that dangerous. Dr. Dan Marckus, noted British avionics expert, states in The Hunt for Zero Point, the seminal work-to-date on anti-gravity written by Jane's Defence Weekly aviation editor Nick Cook, that the secrets of anti-gravity in the wrong hands will make thermonuclear weapons look like firecrackers.

The secrecy surrounding anti-gravity research is phenomenal. Boeing refuses to publicly acknowledge any activity in anti-gravity development despite the fact that its competitor and sometime sub-contractor, British Aerospace (BAE Systems) is, the latter providing funds for four university research efforts as part of its Project Greenglow, one of which was a Podkletnov replication experiment headed by Dr. Clive Woods at the University of Sheffield,. Further, Nick Cook publicly, and privately to me in an email, states quite directly that George Muellner, former director of Boeing's ultra secret Phantom Works, claims Boeing sought the services of Dr. Podkletnov to unlock the secretes of his gravity-shielding research. Cook says that Muellner states Boeing was denied Podkletnov's services due to the objections of Russian officialdom, which the Russian-born Podkletnov must pay attention to, apparently, despite the fact that he works in Tempere, Finland. Dr. Podkletnov, wisely perhaps, chooses not to clarify these particulars despite our several emails.

Perhaps Boeing can deny any activity on anti-gravity because NASA is doing its own research, and as a prime contractor to NASA, such as by running the Space Shuttle Program, Boeing probably knows what NASA knows. NASA spent $600,000 recently in its Breakthrough Propulsion Physics program (BPP) to purchase Podkletnov replication equipment. Inexplicably, that equipment sits in boxes in NASA's Marshall Research Center in Huntsville, AL, awaiting more funding; according to an email I received from NASA propulsion researcher, Ron Koczor.

But enough with this business; what do we know about anti-gravity?

The search for that answer has taken me to some exciting and obscure places in this world, like the Aeronautics and Astrophysics lab at the Seattle campus of the University of Washington. I called those folks because Nick Cook in The Hunt for Zero Point, mentions that UW received a NASA contract to study theories of inertia as part of its BPP program. *That's a good place to start,* I thought, but it took backtracking to BPP Project Director Marc Millis at NASA's Glenn Research Center in Cleveland to find Dr. John Cramer at the UW Physics Department. His mission was to confirm with Dr. James Woodward the latter's 1996 preliminary research into the loss of gravitational mass in a targeted piece of metal from oscillating capacitors. Although Woodward's initial data appeared encouraging, NASA's Millis told me that their funding dried up before completing their research. Furthermore, the entire BPP became unfunded in 2002 and now in 2003 has become a hazy, privatized version of its former NASA subset self.

However, UW is continuing related research, such as magnetically confined fusion energy generators and that, for me, by using electromagnetism to contain an inner field makes it a close cousin of anti-gravity and field-effect propulsion. I spoke with Professor Uri Shumlak who told me that he and other UW staff from the Department of Aeronautics and Astronautics, along with a bevy of their grad students, are building a prototype of a fusion generator called HIT, which stands for Helicity Injected Torus.

This donut ring-shaped torus encloses a roundish chamber. Within that chamber a vacuum is first created, and then a volume of hydrogen gas is introduced and heated to a few million degrees Celsius, which separates the electrons and protons from their atoms turning the whole stew into a quasi-neutral foam of plasma. Then the torus envelopes the plasma with a magnetic field to keep it away from the sides of the chamber enabling the plasma mass to stay hot, and keep the rest of Seattle cool. (While I was standing next to his little eight foot long gizmo, Prof. Shumlak assured me there was no danger of a couple million degrees of heat escaping. The heat density of the plasma was "too low" for me to, well, break a sweat over. His quote was, "There's no more heat mass inside that chamber than what's contained in a cup of coffee." I sure hope you're right, Doc.)

Then, once the plasma field is contained, the magnetic field squeezes the plasma, fusing the nuclei of one hydrogen atom into another. As the hydrogen couples combine, a helium atom is created and a neutron is released, along with lots of energy in the form of heat. One day, such a generator will give us unlimited amounts of electricity, as the heat can produce electric voltage.

Lots of electrical power on the cheap the UW predicts; and the Department of Energy agrees, once the details of building reliable magnetic field generators are solved. What does magnetic fusion have to do with anti-gravity? Two things: first, magnets. Electromagnetism seems to be one of the major players in anti-gravity, particularly the use of electromagnetic fields to contain other fields, such as plasma fields in the HIT, or torsion fields, but more about that later. Secondly, the HIT works, or is about to. It's real and mainstream science embraces it, while anti-gravity is, well, a little more out there and reliable data is harder to obtain. So the technology of HIT lays a base that other research can build upon, such as not only containing other fields, but also building field effect propulsion systems, the most elementary of which is electrostatic propulsion, and aspects of that are already being applied by NASA.

Electrostatic propulsion uses electrical fields differently than electromagnetism does. In EM a current flows and creates a field, while in electrostatic systems the current is static and a charge builds up a field, such as in a capacitor.

These theories are utilized on NASA's Deep Space I, a probe bound for the outer reaches of our solar system. On Deep Space I, the

propellant, a tankful of xenon gas, is excited electrostatically into positive ions. The engine has a negative charge at the exit end, so the charged xenon rushes out the tail pipe with a greater thrust than if it was just using conventional chemical propellants. In fact, the electrostatic propulsion system on Deep Space I allows it to fly at 60,000 mph, or 10,000 mph faster than it would with a conventional rocket. In addition, only 82 kg of xenon is needed for its entire mission, so with its smaller mass and weight Deep Space I will fly along side its intended target, a comet, and drag race on equal footing while filming and conducting studies. Again, not anti-gravity per se, but electrically charging Deep Space I's fuel-field sets the stage for a closer look at electrostatic propulsion.

Taking that closer look is Tim Ventura and his fellow researchers at American Antigravity, an organization based in Kirkland, WA. Ventura and his crew use electrostatic asymmetrical capacitors to create a field that levitates objects, such as their small, kite-like "lifters." These lifters are very light, weighing only a few ounces, and have balsa wood struts that support the capacitors. When two capacitors of different size receive their share of a 30,000 volt charge, the lifter lifts- no motors or wings.

How, no one really knows in my judgment; and the phenomenon is replete with controversy and mystery. But as one who has seen a lifter fly, let me tell you what one looks like and what I saw when Tim Ventura's took off.

Tim has been building lifters since he was a kid and has perfected a four-foot, by-four-foot, by four foot triangular lifter which has flown so many missions in his garage that the silver aluminum foil has turned white. The thin, chopstick-like balsa wood ribs that hold the aluminum foil in place are joined every few inches by a vertical strut (much like a telephone pole on a HO model railroad set) which sticks up and secures the copper or stainless steel wire of the upper capacitor. The ribs are intersected every ten inches or so by the strut of an interior triangle, since the whole lifter is composed of interconnected isosceles triangles which give the necessary strength to the balsa wood frame. All told there is about 30 linear feet of aluminum foil and a similar run of wire.

The lower and larger capacitor is a strip of aluminum foil stretched between the horizontal balsa wood struts. The second capacitor is a thin strip of 50 gauge wire mounted about one inch above the aluminum foil. As capacitors they store electrical charge but don't pass it on in a current.

Fig.1
Lifter

The negative lead goes to the lower aluminum foil and the positive lead is attached to the upper wire. The three corners of the lifter are tethered to the work table so that the electrical leads from the power source are not broken off in flight.

The power source kicks out 15,000 volts at 250 watts. Tim uses a voltage generator made by Information Unlimited, Inc, but before the current reaches the capacitors, the voltage is stepped up to 30,000 volts by Tim's homemade voltage multiplier stack. At full throttle the lifter is straining at the tethers, bending the balsa wood frame near the point of fracture.

Throw the switch and at around 17,500 volts the lifter begins to quiver in take-off. At the full power of 30,000 volts the lifter is roaring and a noticeable downward breeze is observed. Many physicists call it "ion wind," and say that it is how the lifters fly. But what exactly is ion wind, and can it be the cause of flight?

"Ion wind is the movement of ionized air particles," according to Ventura, "which flow downward according to electrical charge." Here's his theory:

The positively charged wire on the top part of the lifter steals elections from the surrounding air, leaving the effected air molecules positively charged. These positively charged air molecules, or ions, then head downward toward the large source of negatively charged electrons generated by the aluminum foil. These air molecule ions are bigger and heavier than the electrons seeking them, so there is a net thrust downward pushing the whole lifter up. That's the theory, and frankly all I can do to verify the theory is to tell you what others tell me. Before I do that, though, let me tell you what I experienced standing next to a levitating lifter.

In flight the lifter emits a high whining, hissing buzz, and I could feel a good breeze coming up at me from the work table underneath the lifter. Also, standing next to the lifter but not touching it, the hair on the back of my head started to rise up in electrostatic-like fashion.

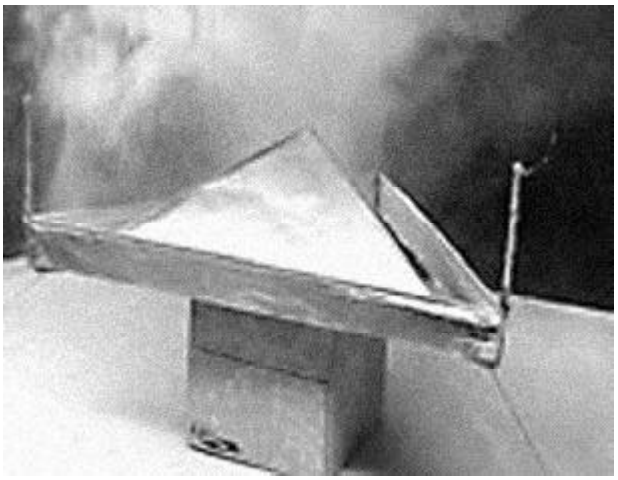

Fig.2
Lifter

To analyze the air currents Tim blew baby powder at the top of the lifter. The majority of the particulate cloud was drawn into the middle area of the lifter and then sucked downward. A kind of vortex was created at times, for intermittently I could see a cloud forming into an organized column beneath the lifter and then spreading out in 360 degrees once it hit the work table surface.

Electrostatic propulsion uses electrical fields differently than electromagnetism does. In EM a current flows and creates a field, while in electrostatic systems the current is static and a charge builds up a field, such as in a capacitor

Is that ion wind? Well, there certainly was a breeze, and it sure felt like air, but how would I know if it was ionized? Something definitely sucked the baby powder down, but was it more than just regular air blowing past me? Again, I don't know.

Is the movement of wind why lifters fly, regardless of whether it is ionic or not, or is the wind just a by-product and not the propulsion? Could the capacitors be creating a field that neutralizes gravity, allowing the craft to levitate? Or are they creating some kind of new field that is localized and the surrounding ambient field pushes this "field-bubble" up, much like a helium balloon is pushed up by the surrounding heavier air trying to fill the emptier "field" of the lighter helium?

Ventura thinks at least two phenomena are at work. Ion wind is definitely one he feels, for the breeze is self-evident. However, he thinks a second effect is at work, too, and many agree with him. Most speculation concerns what is called the Biefeld-Brown effect, the "Brown" being T. Townsend Brown, whose name is well known in early quantum research and whose work is prominently discussed in Nick Cook's The Hunt for Zero Point.

The Biefeld-Brown effect, according to Ventura, is the theory that high voltage, air-gapped capacitors with different or asymmetrical capacities generate a net

directional force upwards from the larger element to the smaller element, which on the lifter is from the aluminum foil to the wire. This force then pushes against the ambient energy field of the surrounding area, perhaps pushing against a more rigid energy field of the zero point energy field.

Brown apparently made his case for these electromagnetic effects, receiving patents in the 1960's for his research. NASA's Dr. Jonathan Campbell at Marshall Research Center in Huntsville confirmed to me that he also, has received a patent recently for his research into the thrust effects of asymmetrical capacitors.

Editor: By the way, this patent is meaningless from the point of view of a prime claim. Before that there had been many publications on the subject.

A.V. Frolov.

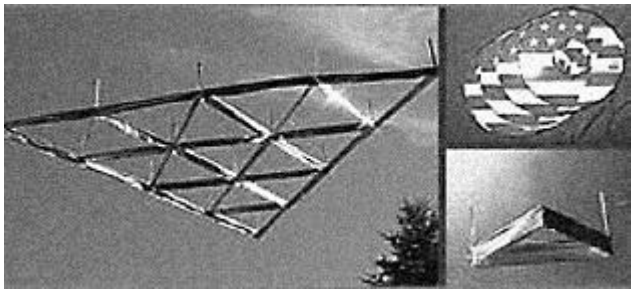

Fig.3
Lifter

However, prominent physicist Hal Puthoff, whose research is a broad swath across the fields of the 'new physics', featured in both The Field and The Hunt for Zero Point, and who was also the military's "Top Psychic" as the twelve-year director of the CIA's remote viewing squadron, has a different perspective: "I'm quite certain at this point that the so-called 'lifter' phenomena is just an electrostatic ion wind phenomena, not 'antigravity.'"

But Dr. John J. Rusek, Adjunct Professor of Aeronautics and Astronautics at both Purdue University and the United States Air Force Academy, says that "Initial findings of 'classroom' experiments with lifters show ionic wind to be way too small a factor, by three orders of magnitude." Dr. Rusek has formed a technological company, Swift Enterprises, to continue this research and bring it to the level that is "presentable to the mainstream physics community."

Along these lines, Jean-Louis Naudin shows on his extensive web site, not only how to build a lifter, but also several photos of research into the ion wind issue. Naudin's team has wrapped test lifters in plastic yet they still produce anti-gravitational effects.

Others may have a clue to the second or even a third force at work. Researcher Fran De Aquino, professor of physics at Maranhao State University in Sao Luis, Brazil, is described in the literature as showing that "bubbles of localized space-time" can exist in variance to the surrounding fields. Anecdotal experience suggests that the lifters may be undergoing such space-time anomalies.

Editor: At this point we need to interrupt the author as he has already completely confused the reader. I would recommend referring to Thomas T. Brown's patent: USA patent #3,187,206, 1965.

Alexander V. Frolov

The Hunt for Zero Point states that NASA sought the services of Dr. Eugene Podkletnov, and although their replication research languishes, The Hunt claims that researcher Ning Li, of Huntsville, AL is pursuing this line of research as a private contractor to NASA.

Another Huntsville operation, Transdimensional Technologies, is exploring these multi-faceted phenomena as well, and its extensive web site shows it to be a frequent contractor to NASA, including research into "asymmetrical capacitive propulsion," and capacitor-based devices to test "ion wind" forces. Jeff Cameron, of Transdimensional, is said by Ventura to be "the father of the lifter," having developed them while exploring anomalous torsional effects of high energy lasers. The lasers twisted and at the time it was considered a nuisance. But the unknown forces at work later led Cameron to found Transdimensional, develop lifter technology to a commercial level, and subsequently patent many pieces of related technology. Unfortunately, I have been unable to reach Jeff

Cameron or anyone at Transdimensional for any kind of confirmation.

Nevertheless, how would gravitons be blocked, or gravity shielded?

Dr. Hal Puthoff says there are two ways of looking at it. First, one can look at the issue from a quantum point of view, that there is a particle exchange between the gravitons and something else, and the net effect is anti-gravity. The how's and why's of that are speculative, so Puthoff turns to a classical approach for answers. He prefers looking at "engineering the vacuum." To do that one must first look at the vacuum.

As I understand it we are all in the vacuum, everything is. The "vacuum" is the matrix that contains all matter and all energy. It is the engineering perspective of the zero point energy field, or the *"Field"* as popularized by Lynn McTaggart in her masterpiece The Field. Puthoff shared with me statements from fellow researcher Dr. T. D. Lee that state: "The vacuum is the seat of energetic particle and field fluctuations, and ... is the seat of space-time structure ... that encodes the distribution of matter and energy.... The vacuum is energetic in its own right."

Thus energy can be drawn from the field; and spacecraft can have "vacuum propulsion systems, or propellant-less propulsion," in other words, field effect propulsion.

At any rate, more and more physicists are thinking that the vacuum can give them a whole lotta oomph, enough to propel spacecraft; and when they learn how to corral it, a whole bevy of new phenomena may be encountered, including anti-gravity. This new potpourri of research is being called by many the "new physics." And although his approach is classical, Dr. Hal Puthoff seems to be sensing what's out there waiting to be discovered.

Puthoff's current research as been to explore "the perturbation of atomic or molecular ground states, hypothesized to be equilibrium states involving dynamic radiation/ absorption exchange with the vacuum fluctuations. In this model atoms or molecules ... are expected to undergo energy shifts that would alter the spectroscopic signatures of excitations involving the ground state." Puthoff says he's had no success so far with this approach, but his words remind me of De Aquino's speculation that objects lose mass as they absorb energy. Pull energy from the field around you and you lose weight. Bingo, lift-off. **But how does one pull energy from the field?**

Editor: Some solve this problem by means of the ether density changes, which are performed with the help of vortex longitudinal-wave technologies.

A.V. Frolov

Torsion fields might play a role here according to many, and the literature on anti-gravity is filled with the phrase, "torsional effects." But what exactly is a torsion field? "It has something to do with spin," Nick Cook told me on the phone. "You have a torsion field when you spin something. Add a little electromagnetism and you might have anti-gravity." That's the short-hand version of it and here's a deeper look.

Mike Wright, resident physics expert at BeyondTheOrdinary.Net web stream radio, told me this: "When forces create curvature (such as rotation) in more than two planes, a torsion field results. Not only does the object go around, but it goes around and 'down' or 'up', and the up/down movement is an additional acceleration in that dimension. EM and gravitational fields differ by having a magnitude of force and only one direction of movement.

"A tornado is a structure of air in air. A whirlpool is a structure of water in water. So, because more than two planes are involved, objects can be created from 'nothing'; that is to say that objects can be created from the medium of the environment, such as a tornado from two air masses of differing temperature."

So spin plus movement is the key. Again, Tim Ventura is on the hunt. He demonstrated to me **that spinning magnets will cancel out their magnetic fields sufficiently so that two magnets facing each other with like poles will not push each other away if one of the magnets is rotating**

perpendicular to the force of opposition. It's not anti-gravity, but it gets us closer to the heart of the matter.

Further, Russian physicists have been researching the torsional effects of both sub-atomic particle spin, and the loss of gravitational mass in planets from the angular momentum of their orbits. Spinning makes something happen, but what? Tornadoes and Mother Nature might have a few clues.

Tornadoes spin, in a sense, although no one is Oklahoma who has spent a night in a storm shelter during an F5 event would describe the tornadoes in the night sky as *spinning*. Nevertheless, tornadoes have anomalous effects that are legendary: blades of grass stuck into mirrors, a piece of straw embedded flawlessly into a tree trunk. How? It seems as if the laws of mass, gravity and inertia are melted as winds swirl at speeds up to 300 mph in an organized vortex pattern. Is this a clue to melting the pull of gravity?

Getting information to this question has not been easy. Many scientists claim not to have even heard of torsion fields, including particle physicists at major US universities. So, again I turn to Nick Cook and The Hunt for Zero Point

Dr. Dan Marckus says that if "you generate a torsion field of sufficient magnitude the theory says you can bend the four dimensions of space around the generator. The more torsion you generate the more space you perturb. When you bend space you also bend time."

Marckus continues, "If you dipped ...one of these whirlpools ... into the zero point energy field, the seething mass of latent energy that existed on an almost undetectable level all around us [in the field would] ... react in an almost magical way by directing that energy."

The torsion field, in effect, is "a pump, a 'coupling' device that could dip into, and then direct, energy out of the zero point energy field." "But," Marckus continues, "the vortex wasn't a three-dimensional phenomena or even a four-dimensional one. It couldn't be. For a torsion field to be able to interact with gravity and electromagnetism it had to be endowed with attributes that went beyond the three dimensions of left, right, up and down, and the fourth-dimensional time field they inhabited; something that the theorists for convenience sake labeled a fifth dimension-hyperspace."

Cook concluded that the torsion fields "bind with gravity ... to produce a levitation effect -- an antigravity effect," but "it wasn't doing so in the four dimensions of this world, but somewhere else." That somewhere else is hyperspace. **So how do we activate torsion fields and enter hyperspace?**

Dr. Eugene Podkletnov may have a clue.

Podkletnov, the Russian researcher working in Finland, has studied the gravity shielding effects of superconductors. Again, Nick Cook in The Hunt, relays vital information. Cook says Podkletnov claims, "If the superconductors are rotated considerably faster than 5,000 rpm ... the disc experiences so much weight loss that it actually takes off." Thus, torsion field creates levitation. I emailed Dr. Podkletnov to find out more about this issue. He replied: "[A] fast rotating object can, under certain conditions, cause the polarization of the volume that it occupies in space and around it. This polarization causes the gravitational effect as it modifies [the] local gravity field. The vortex of the polarized particles will create a vertical thrust with a certain force and spatial momentum. Some scientists call these polarized particles gravitons. The term graviton is an artificial one and at present we are not sure if it is a wave or a particle and what type of particle. Maybe it is a usual tachyon or a superluminal neutrino (a faster-than-light-particle). Polarization of the media means that the spins of electrons, protons, neutrons and of small subatomic particles that constitute the fabric of space or vacuum would be parallel. Then a kind of gravity well is formed and the objects tend to fall into this well. We observe this picture as an object rising to the sky. Polarization of the media (of space) causes some glow around the object as it acquires additional

energy and because of it, the glow around some objects is observed."

What I understand from Dr. Podkletnov is that gravity is the effect of spin -- the spin of all subjected particles, from the sub-atomic level and up being parallel; thus they are all aligned to fall into the gravity well of earth. And spinning objects, such as his superconducting discs, when influenced additionally by an electromagnetic field, will experience a shift in the spin of the sub-atomic and atomic elements. They will be turned and not be aligned in parallel. Thus, they are able to levitate.

But how to polarize the media and get things spinning? Enter Dr. Marcus Hollingshed, an enigmatic figure allegedly from Cambridge University. Dr. Hollingshed claims to have built a six-ringed toroidal coil antigravity device, which achieved great effect using rotating magnetic fields. In January 2003 he announced on the Internet that he has developed a 160kg vehicle able to lift in excess of 2000kg and that it has both horizontal and vertical drive features. His device cannot only go up and down and sideways, but it can push things away and pull objects to it.

In addition, the field that the device purportedly generates is capable of being broadened and weakened, or narrowed and amplified in a lensing effect, with the field producing an absolute vacuum of 2.2m spherical diameter. Best of all, when it's cranked up the core of it goes invisible, although the term Dr. Hollingshed uses is that there is a "loss of reflected light." There are no reports of independent confirmation, and Nick Cook says he hasn't been invited to see it, so, he's skeptical.

Where does this leave us? Perhaps Dr. Podkletnov's words sum up our current situation."Modern theoretical physics cannot give you the direct answer to your questions (levitation, torsion fields, etc.,) and a scientist who would agree to give you the answer cannot be regarded seriously, softly speaking. If you had asked Dr. Einstein if he were an expert on gravity, the answer would be NO. I can repeat his words: No, I am not a magician, yet; I am still learning."

Wayne Macleod, USA
Email: dynamars2100@yahoo.ca, cwleod@shaw.ca

Gravity is the incremental slowing of time as we move closer to its source. If we imagine panes of glass stacked on top each other, one pane slightly denser than the one immediately above, a ray of light coming from above will constantly refract in a curved beam downward as it enters the stack. The same is true of a ray of light entering a gravity field. The analogy is not too far fetched because refraction is caused by a slowing of light in the denser medium. Of course, gravity affects material objects as well as light, but this is explained by every object traveling on a 'world line' in spacetime. We can use light as in the glass example because light is its own world line.

Why the world lines of objects take the paths they do can best be understood by compressing our normal 3 dimensional space into 2 dimensions, length and height only. When we throw a stone into the air it rises and falls in a parabolic arc in these two space dimensions. That path in space is a complete mystery until we consider another dimension, time, a dimension we can imagine measured at a right angle to the plane of the 2 space

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dimensions. By multiplying the time of the object in flight by the speed of light, we have a three-dimensional coordinate system, not of space but of spacetime. We can then graph the world line of the object. So why does the object fall? It is because spacetime near massive bodies is curved. A remarkable fact is that the curved world lines of all objects in the same gravity field, whether of a thrown ball or fired bullet, have the same radius of curvature. Hence all objects fall with the same acceleration.

To neutralize gravity we must somehow 'straighten' the world lines of objects traveling in curved spacetime. It would be as if we had in our stack of glass panes a bubble, around which the density of glass became less on approach to the bubble. Then the ray of light, when close to the bubble, would refract opposite to the path it would normally take when traveling thought the rest of the glass. Similarly, if we could manufacture a 'time bubble' in a gravity field opposite to the time slowing known as gravity, we would have any object embedded in the time bubble isolated from that gravity field.

The Electrical Levitation theory can best be understood by first considering an analogy. Let us imagine a wheel spinning on an arm like a child's propeller toy. The arm also rotates, in a direction opposite to the spinning wheel. We consider the rate of spinning of the wheel from the point-of-view of two observers, one observer stationary on the ground, the other observer rotating with the arm. Obviously the two observers will not see the same rate of spinning on the wheel. Because the arm is rotating opposite the spin of the wheel, its rotation must be subtracted from the rate of wheel spin as seen by the stationary ground observer. This is not true of the observer rotating with the arm, who will see the spin of the wheel as if there were no arm rotation.

The concept is easier to envision with linear motion, such as of a man throwing a ball on a moving train. The velocity of the ball seen by the pitcher on the train will not be the same as its velocity seen by a stationary observer on the ground. As the stationary observer sees it, that velocity will have the train's velocity subtracted from it if thrown against the train's velocity. It is the same with rotary motion: the velocity of the wheel for the stationary observer is slower because the arm's rotation is subtracted from it.

But suppose the wheel rotation is *the same* for the two observers! Something must be different between them, and that is time. As explained by Special Relativity for linear motion, time is not a universal constant; it differs between observers depending on their relative motion. The property of nature that *is* constant, that produces this relative time difference, is the speed of light. So we must look for a similar constant in nature for a relative time difference between observers in our rotary example. We have one in electron angular momentum, known as electron "spin," $h/4\pi = 5.28 \times 10^{-35}$ kg-m^2/sec, where h is Planck's constant. Like the speed of light, this quantity is constant for all observers, whether the observer is on a rotating system or stationary on the ground. Here is the tool for producing our time 'bubble'.

Let us now imagine a series of concentric rings, all rotating in the same plane and in the same direction. Electric current is pushed through these rings in the same direction as the ring rotation. (Current here is considered the flow of electrons, not conventional positive current.) The rotating rings are sandwiched between two magnetic plates, the function of which is to maintain the angular momentum of the current electrons oriented properly with ring rotation.

Analogous to the above example, each electron takes the place of the spinning wheel and the rotating arm is replaced by the rings. Thus, because electron angular momentum is a universal constant, an observer of the electrons in this rotating system will not have the same time as a stationary observer outside it. If each current electron has its "spin" oriented opposite the rotation of the rings, time on the rotating system would run faster than for a stationary ground observer, the same as in empty space relative to the Earth. The rotating system would therefore have the world line of empty space, not that of the

gravity field. Its spacetime would not be curved. Since gravity is a time phenomenon, such a system in a gravity field could not have the behavior of a normal object. This conclusion may seem erroneous considering that ring rotation could never reach relativistically significant velocities, but we have an analogy with magnetism that is caused by a Lorentz contraction of the distance between moving electrons. If we considered the diminutive drift velocity of electrons alone we would never conclude that magnetism was possible, but the effect is *accumulative* over trillions of electrons. The hypothesis here is that the same is possible with the trillions of free electrons oriented with a spinning ring, to produce an accumulative time effect.

We now come to the controversial part of this theory because the above treats electron angular momentum the same as angular momentum of a normal physical object, whereas the electron is a quantum particle and quantum particles have their own realities with bizarre consequences when analogized with our macro universe. For instance, the electron has quantum spin number 1/2, and such a particle would have 720 degrees in one rotation, not 360. Nevertheless, the electron *does possess* di-pole magnetism. It *does behave* as a spinning ball with negative charge. Electrical Levitation is therefore an empirical theory. The property of the electron that gives electron di-pole magnetism cannot be an actual physical rotation, but whatever that quantum property, if it produces di-pole magnetism there is reason to expect it to produce other macro physical phenomena as if it were.

The theoretical finding of General Relativity that time runs slower in a gravitational field was confirmed by the Pound-Rebka experiment in 1959. **It is not that gravity causes time slowing, gravity *is* time slowing.** Since time and energy are reciprocal, more time on our rotating ring system would mean less energy seen by an observer in that frame of reference than seen by a stationary observer on the ground, the opposite of the red shift of a gravity field. This energy difference must equal the energy of the mass in a gravity field that is to be levitated, its energy of weight, and lost. Experimenters should therefore be aware that their device might radiate. But this is not a free energy machine. The energy of levitation comes from its magnetic field, and the electron magnetic moment energy turns out to be $V_e = mc^2$ divided by the electrical current, *m* is the mass to be levitated and *c* is the speed of light. This is an enormous amount, but becomes practical if enough electrical current can be sent through the rings. That means the electrical resistance of the ring material must be very low. For copper it is not. No material currently exists with sufficiently low electrical resistance at room temperatures, but **superconducting materials** exist that at cryogenic temperatures experience a dramatic loss of electrical resistance.

An experimental device can therefore be envisioned using a superconducting disc substituting for the electric rings. The disc would serve as a conductor for an electric current and would therefore need to be sliced along one radius with an insulator placed in the notch. Both edges of the notch would be connected to a power source by brushes rotating with the disc. With a counterclockwise disc rotation as seen from the top, to have clockwise electron "spin" the magnetic field between the plates would have to be up. Only the moving free electrons of the current will be available for any time alteration effect. These will also **produce a magnetic field, which it is reasonable to assume would be of the same time alteration effect as the electrons, thus producing the required alternate time "bubble".**

The resources required for an experiment using superconducting material at cryogenic temperatures are beyond this writer's means and an experiment has not been attempted, but an experiment at the Tampere University, Finland, 1992, using a superconducting disc suggests that gravity shielding is possible. Owing to the immense advantages gravitational shielding would give to the present interest in space exploration, effort toward its development would be logical. This essay may offer clues on how to begin.

Editor: I find the article by Wane McLeod quite interesting as his approach is very similar to the idea I first presented in my report at the "Space, Time and Gravitation" Conference which took place in St. Petersburg in 1998. The report was included into The Proceedings of the Conference, Part I, 1999. Before that the brief version of the article was published in English in the 'ELECTRIC SPACECRAFT' magazine, Leicester, North Carolina 28748 USA, Issue 27, 1997 p.30-31.

I managed to demonstrate that the ideas of Thomas T. Brown, especially his USA patent # 3,187,206 of 1965, are something more than just the force asymmetry in the electric capacitor. According to the concept presented in my report, by creating a matter property gradient (in particular, the dielectric permittivity gradient) we actually change the curvature of the electric force line in space. Normally, the natural space curvature accounts for the electric field potential decrease with the distance increase from the surface of the charged object. By creating the dielectric permittivity gradient (described by T.T. Brown in his patent of 1965) we change the natural distance potential gradient law. We can both increase and decrease this change and even reverse it. With the dielectric permittivity change square function, the natural space curvature is completely compensated and with more extent it is reversed and can be turned to negative. At that rate, the potential is not decreased but increased with the increase of the distance from the surface of the charged object. This is the essence of my concept that has never been considered before by any author. By creating the gradient described by the quartic function we get the same distance potential gradient law as in the natural conditions only with a different sign!

T.T. Brown, who discovered a force in capacitors with a special dielectric, offered the practical application of this concept. However, he did not find the source of this force, which, according to my concept, is conditioned by two factors: the corresponding dielectric property gradient function and the elastic properties of the dielectric material, which is of no less significance. Normally, dielectric particles are attracted to the charged surface but when the reversion of the curvature of electric field force lines occurs, they are repulsed from it and we can use this propulsion force. Elastic deformations (including those occurring during the pulsating operation of the field) account for the reaction forces equivalent to the generated propulsion force. Thus, the momentum conservation law is in action, however, the device is still moving.

T.T. Brown also considered other ways of generating a force, such as the material magnetic property gradient. Logically, by analogy with the electric field we can consider the gravity field, which can be "designed" and "reversed" by means of creating a matter with the density gradient. At that rate, the gravity potential must change in accordance with a certain law when the distance from the gravity field source being increased.

We should also note that the local space volume levitation effect with the accelerated or decelerated time rate was first described in my articles "Physical Principles of the Time Machine", NET #3 (6), May-June 2002 and "Practical Application of the Time Rate Control (TRC) Theory", NET #3, November-December 2001.

Our company conducts experimental researches on creating new materials that possess the properties described. We are interested in serious business contacts with companies in the aerospace industry to further discuss eventual cooperation projects in this field, including *co-patenting*.

Alexander V. Frolov

Perpetuum Mobile Not in the Past but at the Present

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Krasnodarskaya str., 38/20-34, Moscow, 109386

In several issues of the "Nature and man. Light" magazine in 1995-97 my colleague E.Oparin and I wrote on the unscientific character of absolutizing the law of degradation of energy, on the important issue of creating the perpetuum mobile of the second kind utilizing infinitely available *environmental heat energy*. We even send a letter to Yury S. Osipov, the Russian Science academy President, but received no reply. Notwithstanding many official discussions, there are no well-reasoned objections to our arguments or proof on the part of "high" official science, because, in fact, we are right.

I have recently received one more confirmation: bright and feasible data on the negentropy cycle (the cycle with spontaneous reduction of entropy) with a chemically active working substance that will be described later.

After the publication of Victor M. Brodyansky's book "Perpetuum Mobile in the Past and at Present. From Utopia to Science and from Science to Utopia", Second Edition, one can not but return to these issues. More so because the foreword of V.A. Fabricant, member of the USSR Academy of Pedagogical Sciences, claims the law of degradation of energy to be the "law of nature" and supports shamefully the deformation of the monothermists, especially P.K.Oschepkov, by academicians P.Kapitsa, L.Artsimovich and I.Tamm ("Pravda" of November 22, 1959), followed by E. Velikhov, A.Prokhorov and V.Sagdeyev ("Pravda" of June 22, 1987).

After the publication of Brodyansky's book I met the author several times (notably at a special seminar in The Moscow Energy Institute) and expressed my opinion about his book: the book avoids serious discussion of the monothermists, stresses their failures which are quite normal in the initial development of perpetuum mobiles of the second kind.

For example, Brodyansky knew about Tsiolkovsky's discovery. Guay's book "On the Little-Known Hypothesis of Tsiolkovsky" is listed among the First Edition references. But Vladimir Brodyansky avoided analyzing this discovery both "in the past" and "at present". The Second Edition references even list the "Physical Thought in Russia" magazine, issue #1 of 1991, that contained for the fist and only time the modern edition of the "Law of Degrading of Energy" by Tsiolkovsky. "At present" V. Brodyansky knows my analysis of Boltsman's mistakes but he paid no scientific attention to my analysis either.

In Brodyansky's book the description level of chemical reaction cycles is even lower than that of Schpilrine. Schpilrine at least tried to present his arguments but here we see unsupported statements "justified" by the phrase "the detailed discussion would take too much space". Vladimir Brodyansky's analysis of anti-Stokes luminescence (pp.216-219) is also superficial. Dissipative and entropy processes prevail in it. But if there is evidence supporting higher frequency quanta than the frequency of radiating flux, **it is the evidence of negative entropy**. Vladimir Brodyansky not only is familiar with it and also shows it by the example of investigating the Sun and the Earth (p.247).

Vladimir Brodyansky's analysis of Rank's tube (pp.235-237) displays the same tendency. In the Rank's tube the dissipative processes also prevail. Its effectiveness as a refrigerator is lower than in the traditional schemes.

But one can not deny the existence of negentropy processes in it. It is these processes that "originate" the cold gas flow. And Brodyansky's "origination" on p.236 "The vortex tube in fact divides the coming gas into two fluxes: heated and refrigerated" - is totally false. That can be performed only by "Maxwell's demon" that does not exist in substance.

The refrigerated flux in the Rank's tube is formed by the "Tsiolkovsky's flux" by way of heat transfer "from cold to hot", from the tube center to its circumference by **centrifugal accelerations**. On its basis (to be more exact, on the basis of Finko's tube) the perpetuum mobile of the second kind can be created. And we have this engineering solution. E.Oparin and I made the corresponding patent application for an invention but the Federal Institute of Industrial Property again refused to consider such applications. Here one can see similarity with the causes of re-edition of Vladimir Brodyansky's book. And one need not be a big politician to admit the reality and understand the sources.

Environmental and, especially, anti-nuclear movement is invincibly expanding. Danger to human life and threat of ecological catastrophe are quite real. The Second Edition of Brodyansky's book protects behind scientific arguments those who use Russia as a source of easy money and then flee.

But we like our country - vast and austere. This austerity and space form REAL PEOPLE and support humanity and materialistic humanism of the energetic and talented, not just the rich.

In modern Russia the powerfully spread alcoholism, debauchery and drugs are the instruments of slavery. But the monothermy and development of alternative power engineering will become basis for Russia's revival and unprecedented prosperity.

Russians learn slowly, sometimes, very slowly, even disgracefully slowly. But we will learn. And then no one will stop us. The following tips are meant for those who are ready to risk their efforts and facilities in order to build alternative energy knowledge base: dissipative and negentropy processes are inseparable and very often their mechanism is the same. In our environment the dissipative processes are more effective and hide the negentropy ones. No dissipative process combination can generate the negentropy cycle. Look for examples in Brodyansky's book. To create the negentropy cycle and use the environmental energy at least one negentropy process is required that has effectiveness and negentropy exceeding entropy growth at all levels of the cycle.

News from "IntAlek" Company

William Alek [alekws@intalek.com] has updated the latest and greatest ZPOD system drawings:

hhtp://www.intalek.com/Index/Projects/SmartPAK/Projects/ZPOD/ZPOD_System05.pdf

This is release 5.0

Here is the latest electrical schematic: http://www.intalek.com/ZPOD/ZPOD_System05.gif

Based upon his "preliminary" tests thus far, he estimates the COP is around 2.0. This estimate is interpreted from the following scope traces:

http://www.intalek.com/ZPOD/in.GIF

Alan Francoeur's Generator
Canada

Alan L Francoeur, Canada
Email: al.f@shaw.ca

This is my writing and development about the Interference disc generator, and the permanent magnet dynamo machine, and other related inventions. I have always been intrigued with electricity and magnetism and aetheric energies starting at a young age. Back in 1980 I wanted to do something to help get my large vehicles better fuel economy. With this goal in mind, I experimented and designed my first heat exchanger vaporizer system to do my part to clean up our cars and trucks, fig. 1, 2, and 3 are two earlier vaporizer units under construction. For more information about this fuel system, please refer to my vaporizer fuel system report. The main body of this writing is referring the permanent magnet dynamo system that has been in the making since 1987, starting after the development of the interference disc generator.

Fig. 1

Fig. 2

Fig. 3

I invented the Interference Disc generator concept while I was employed at Giant Yellowknife Mines NWT from 1983 to early 1986. The idea of using metal blocking plates to shield magnetic fields stirred in my mind while working around heavy electrical mining equipment, and 1000hp and other electric motors with exposed coils that have heavy metal around the outer casing. I did a search at the time and found John Ecklin's work very interesting with his application of the shielding effect. During my off time in Yellowknife, I was experimenting with the interesting effect of producing induction with a stationary coil mounted beside a stationary magnet with a small air gap maintained between the magnet and the coil. During the construction of my first disc machine, I called it the Interference Shielding effect because of the interference the blocking disc does to cause induction, thus the Interference Disc Generator fits the description. The first transformer coils I used to test the interference shielding effect were used from old radios, and the magnets were alnico types. Back in 1986 in Calgary Alberta, a friend Bud Johnson and I constructed the first test disc generator model using alnico magnets, fig. 4, and later ceramic magnets were installed. Months later I designed and began construction of another larger Interference Disc machine with horseshoe shape neodymium 35 grade magnets mounted on the outside, and with the N and S magnetic poles facing toward the coils in the center portion of the machine. The coils and magnets in this larger machine are mounted in reverse of the first Interference Disc generator, fig. 5, 6.

Fig. 4

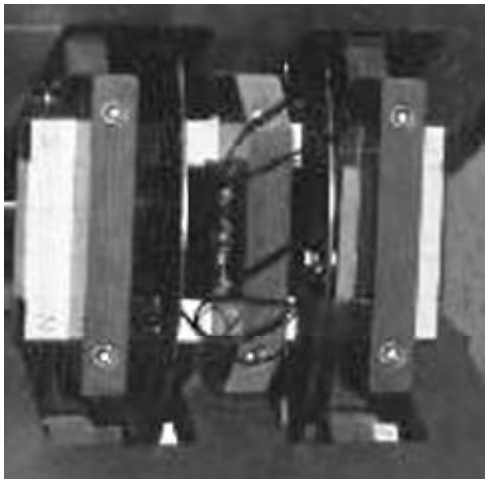

Fig. 5

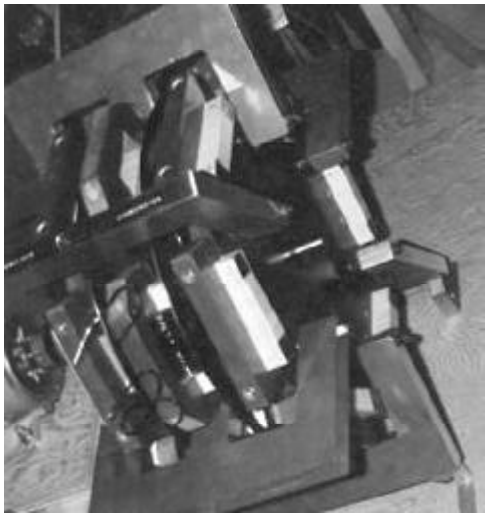

Fig. 6

General description of the interference disc generator

The Interference Disc electrical generator is made of a stator (114) consisting of an array of even number parallel mounted bar magnets (112) arranged and supported (114) in a circular fashion equidistant from each other, where the polarity of the magnets (112) are alternating when viewed at either end. Fig. 7

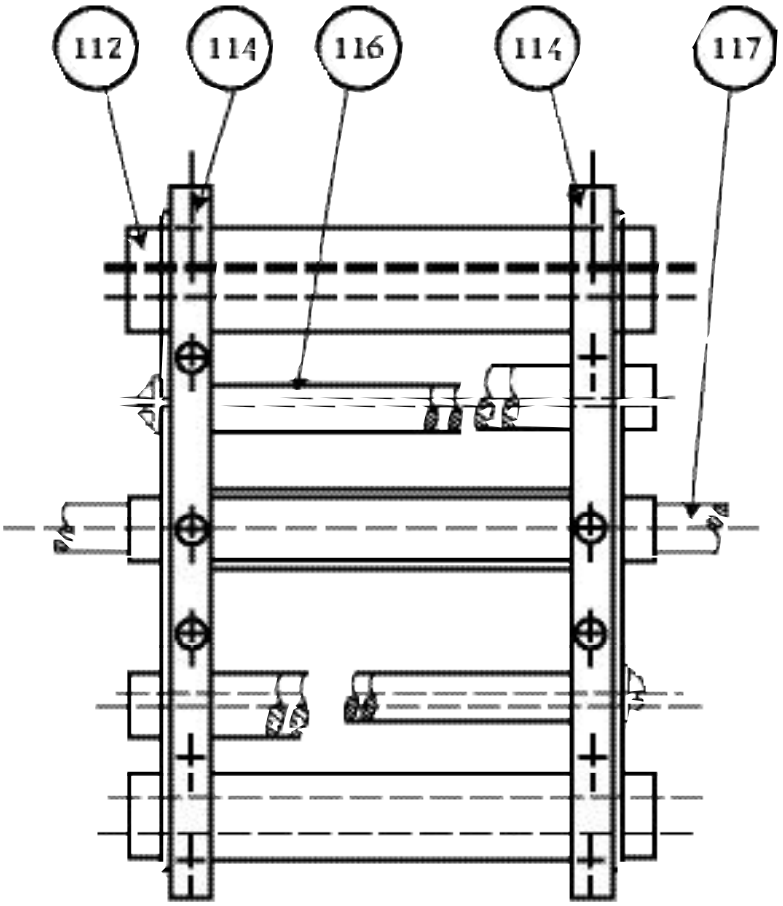

Fig. 7
Magnetic bars assembly (rotor)

Also in the stator fig. 8, (102) there are twice the number of coils (111) as bar magnets (112) wound in pairs on U-shaped cores (110). One half of the coil pairs mounted at one end of the bar magnets (112) in the same circular fashion, each corresponding to and aligned opposite to a pair of bar magnets (112) and separated from it by an air gap. On the other end of this pair of bar magnets (112) there are another set of coils (111) aligned likewise.

The rotor is made of two magnetically susceptible circular plates (109A or 109B) (such as iron or steel) Fig. 9, centrally mounted on an axle (107) fig. 7, which is in respect to the array of magnets and coils Fig. 9a.

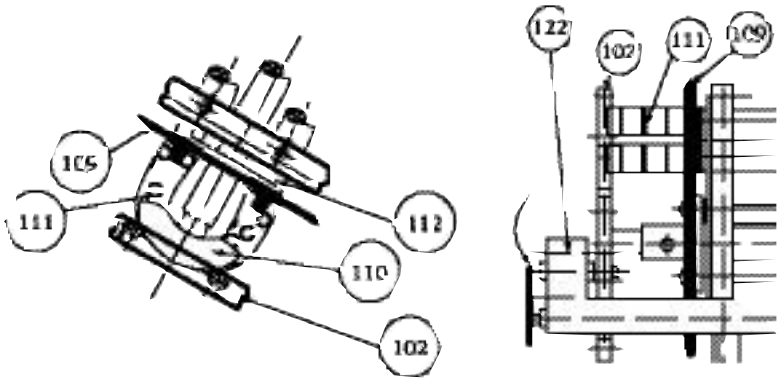

Fig. 8

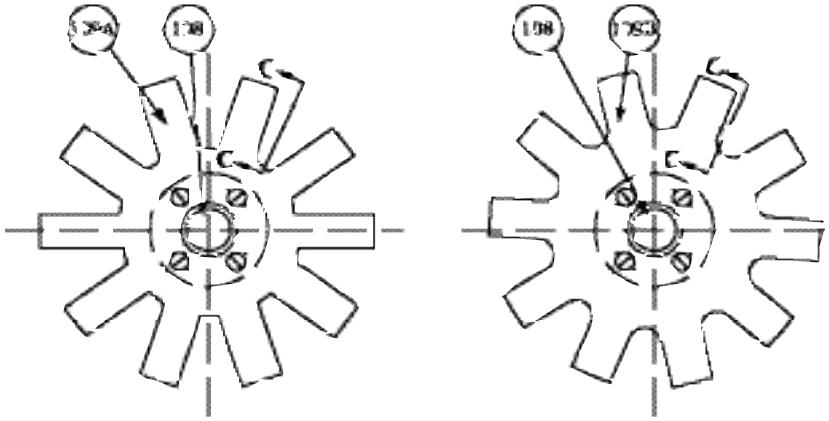

Fig. 9

The interference discs (109A or 109B) are separated from each other so that they can rotate in the air gaps between the magnets (112) and the coils (111). The interference discs (109A or 109B) have a number of **equidistant opening, either more or less in number than the number of the bar magnets (112)**.

The arrangement and size of the openings are such that when the discs (109A or 109B) are rotated by an outside motive force, they open the magnetic field between adjacent bar magnets (112), and the opposing coils (111) at both ends of the stator (114) simultaneously. Hence inducing an alternating electric current in the stationary coils (111) fig. 10.

By opening and closing the magnetic influx to the core (110) of the coils (111), an alternating current will be generated in the coils

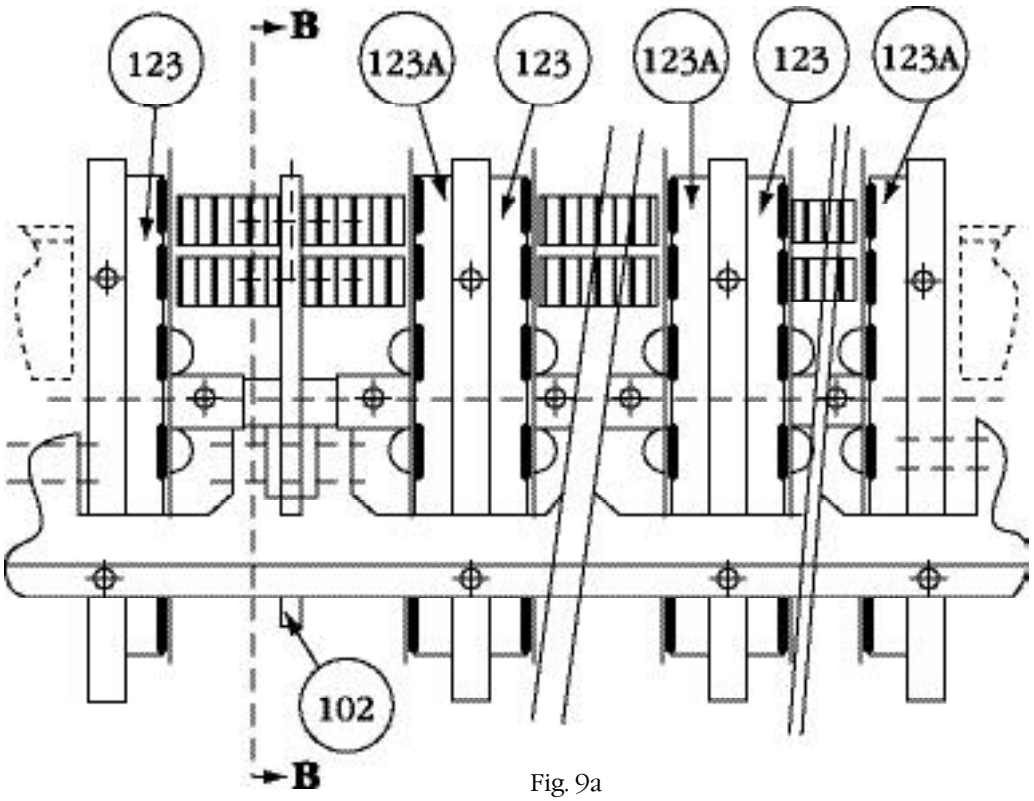

Fig. 9a
Magnetic bars assembly (stator)
Option II: multable magnetic coil-disk assembly

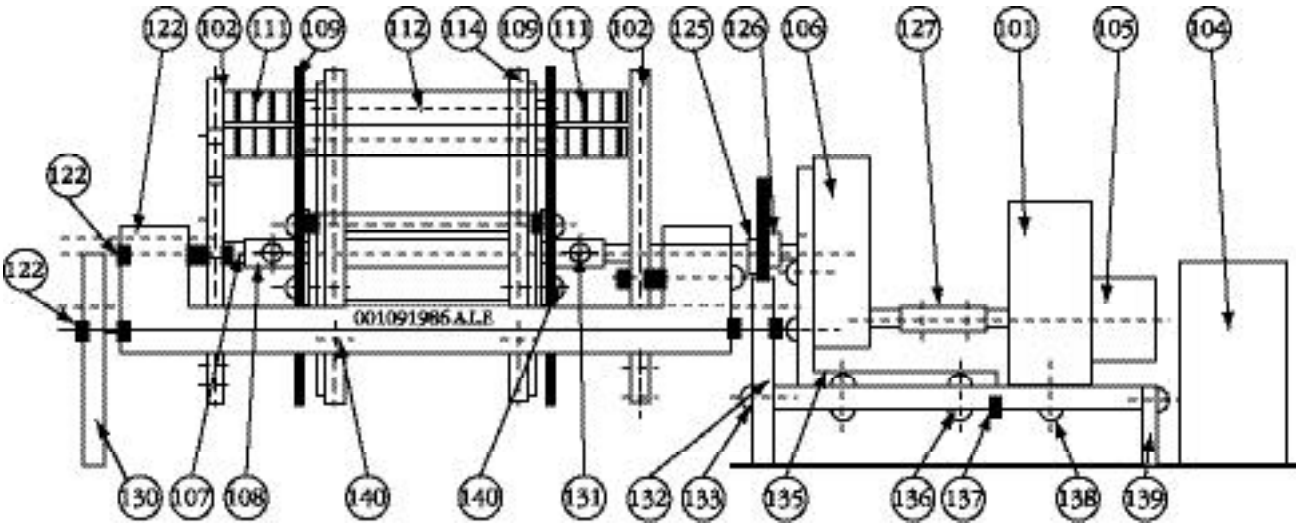

Fig. 10

(111) in a retro-order to the rotational direction of the interference discs (109A or 109B). Depending on the number of magnet-coil assemblies three phase AC current can be obtained. The regulation and attenuation of these currents can be achieved by known electric engineering methods (Fig. 10).

The efficiency of the unit would vary greatly depending on the speed of rotation, the width of the air gap, the strength of the magnets, and the materials used to construct the coils. I used nickel base amorphous metglass in the coils in both the smaller and larger machines, which as a result, shows greater efficiency as compared to conventional core laminates. Less energy is needed to spin the balanced disc rotor while causing a larger moving magnetic field to cause induction in the stationary coils. With this effect, it is easy to visualize the advantages this design has over conventional generators and motors. New testing of the coils will be conducted after the machine goes through all the upgrades to eliminate the problems with the warping interference discs.

The Interference Discs Generator described in this document **has the potential to produce more than unity effects**byeasy turning of a magnetically balanced (non-warping) interference disc. Optimizing the device with closer tolerances and correctly selected materials and incorporating internal magnetic balancing, will add to the success and improved performance of this unique generator design.

Improvements can be made with this design while the operating principal remains the same. Looking at the photographs included you will see the 1st proof of concept generator frame is constructed mainly from aluminum, this metal was used only because it was inexpensive material and easy to work with fig. 11. Non magnetic and non-conductive materials should be used to construct the generator frame supports to eliminate the eddy current losses. All of the nuts and bolts used to hold the disc generators together worked well for making the test machines capable to have adjustable air gaps, however, they can all be eliminated with design changes that preset the gaps and tolerances to optimize the conditions of the interference disc effect.

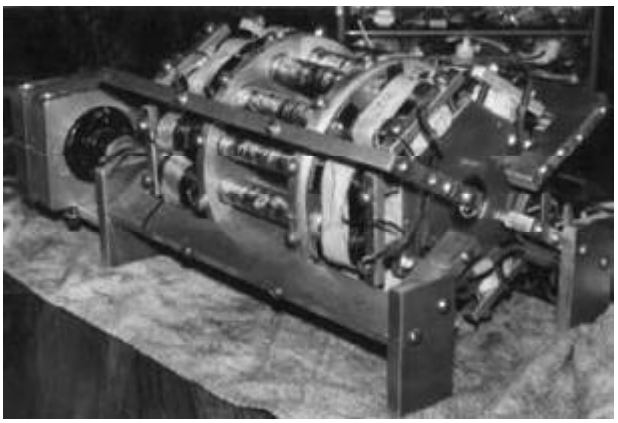

Fig. 11

Many improvements were adopted in the next larger #2 version of the Interference Disc generator fig. 12. Phanolic materials (non conductive and non magnetic) were used in the frame supporting the magnets and the coils, thus eliminating eddy current losses within the frame support. Large aluminum E bars were used to support the magnet frame support and the coil frame support with no noticeable eddy current losses. The aluminum used is positioned further away from the coils and magnets in the larger generator so as not to be affected by the magnets. Larger more powerful neodymium magnets and I shaped transformer coils were installed and tested in the larger machine which showed an increase in output power over the 1st machine fig. 13. Using more powerful neodymium magnets in this larger disc machine created some problems with the interference discs. Not only did they warp the discs they caused them to vibrate and chatter causing the fins to hit the magnets and the coils. I increased the air gap to over half an inch and moved the disc further away from the magnets to prevent damage. The effect was a reduction of magnetic flux reaching the coils that reduced the power output. The discs must be constructed much stronger and rigid if using neodymium magnet grade 35 or greater, then the air gap can be closed so more magnetic flux will reach the coils allowing for a greater electrical output.

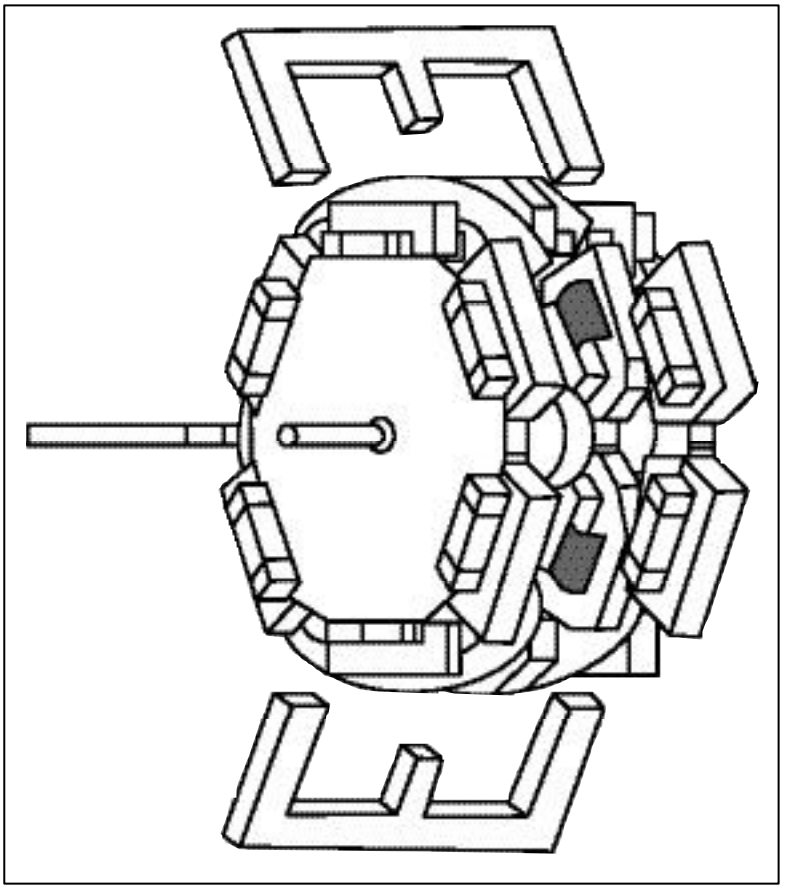

Fig. 12

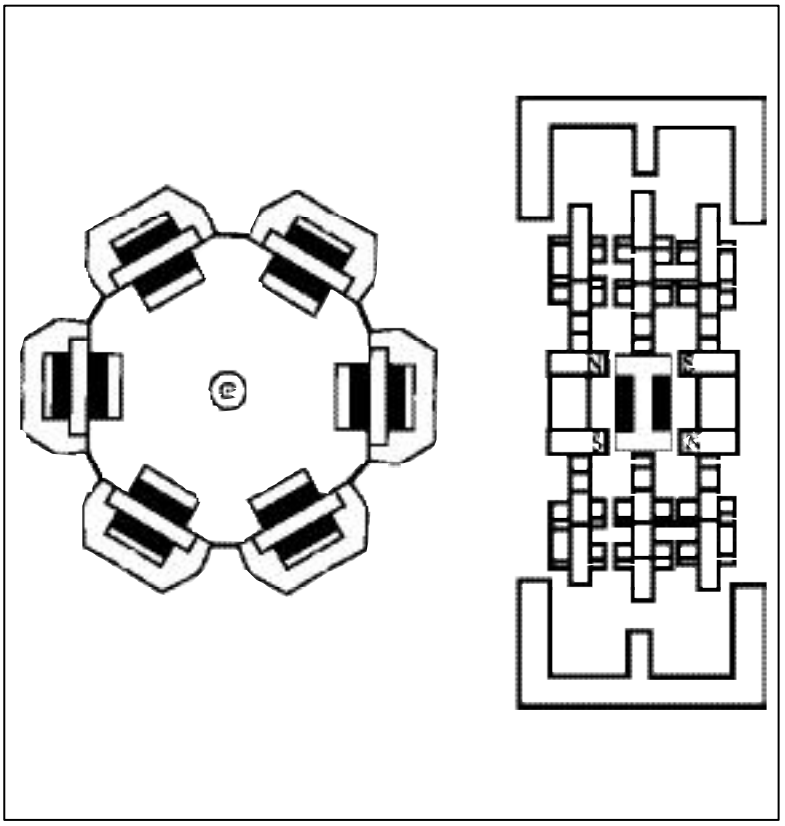

Fig. 13

The wiring of the coils circuit can be constructed by known engineering methods to achieve AC or DC power, and like any conventional transformer, wind the coils with heavy wire for more amps and more turns for more volts. The coils are stationary in this machine which makes it easy to harness AC power directly from the coils without brushes. All coils that are in phase can be wired in series or

parallel, the number of the blocking plates on the interference disc determines the phasing of the coils.

The diagram in fig. 14, 14a shows the path of the magnetic flux movement in relation to the position of the blocking plates of the interference disc. The magnetic field in the core/coil is switching polarity as the interference disc fins alternately moves in and out of the air gaps on each side of the coil. As you can see, depending on the position of the disc, positive and negative induction takes place for AC output of the coils. John Ecklin has achieved this effect using rotating blocking plates. I have achieved the same effect using balanced rotating interference discs with multiple stacks of isolated coils and poles mounted in a circle equal distance from each other.

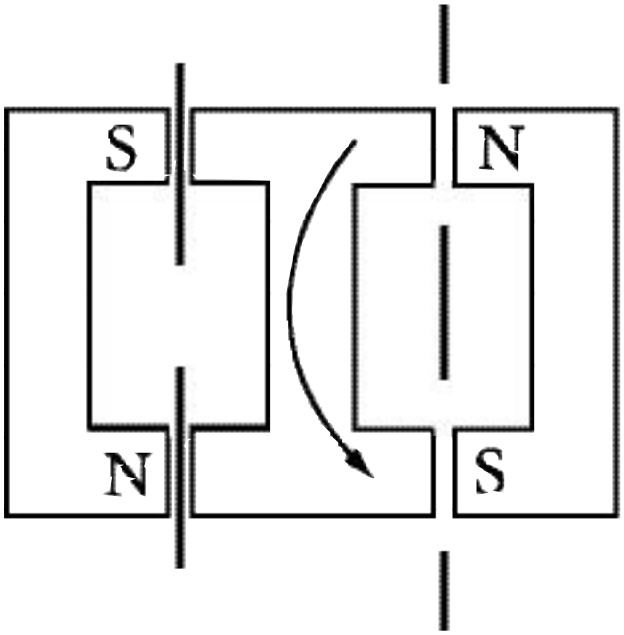

Fig. 14

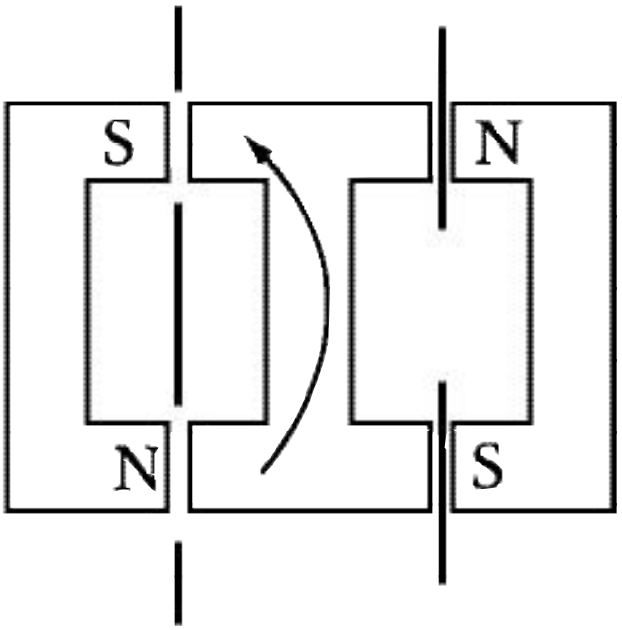

Fig.14a

The effect I reproduced with Gary Wesley's permanent magnet motor is related to the Interference Disc generator in the fact that blocking plates are used to shield the magnetic field, only we differ on methods to balance the blocking shields. Gary Wesley used springs to carefully balance the blocking plate, and I used a different number of interference fins working with the magnets to balance the blocking plates. The magnets in my Interference Disc machine become the springs.

More photos of both Interference Disc machines are shown in fig.15, 15a and 15b below.

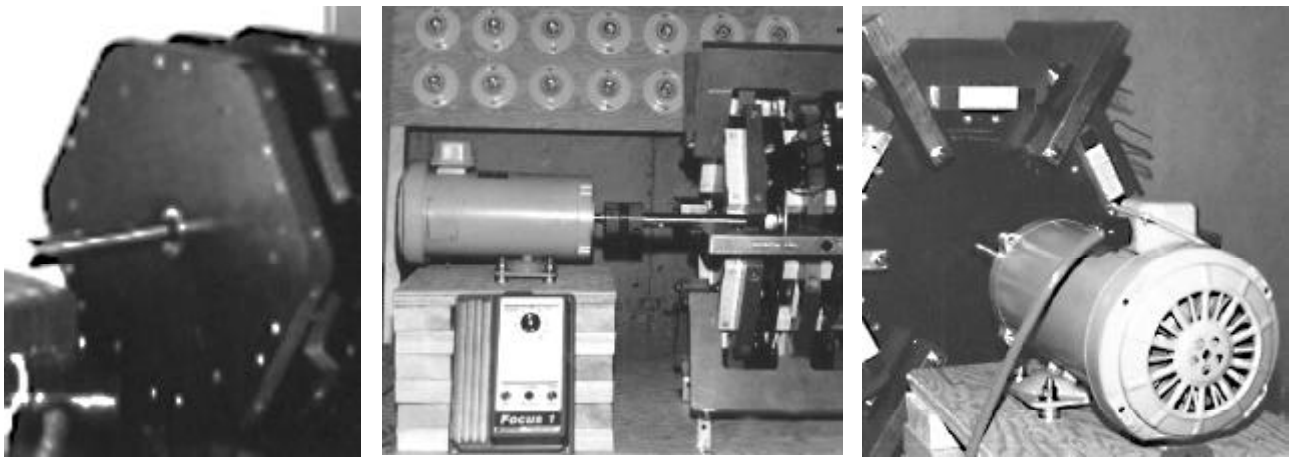

Fig. 15

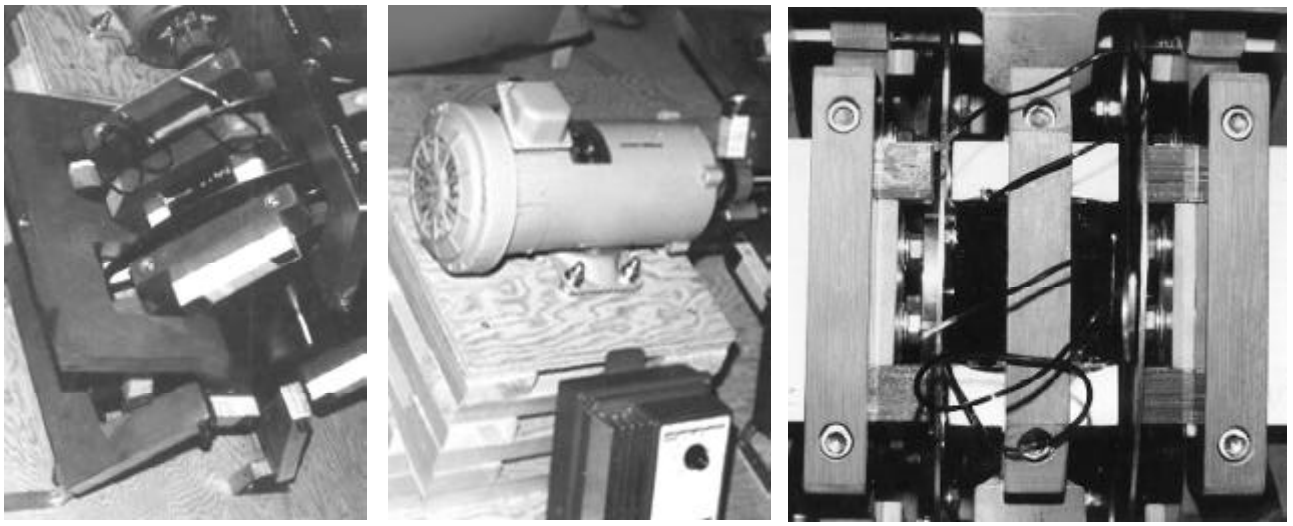

Fig. 15a

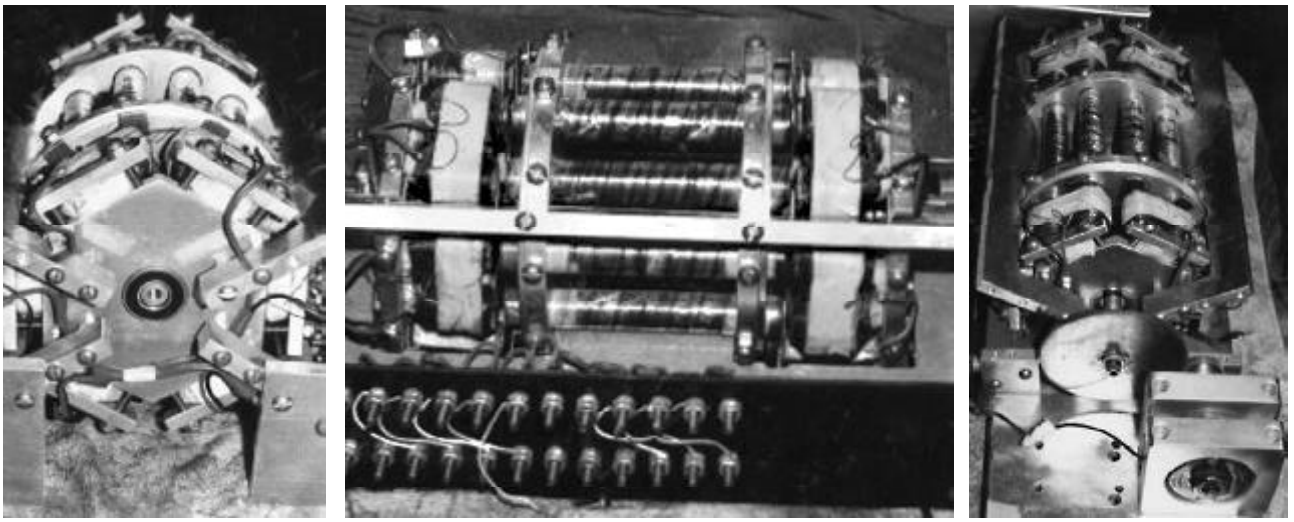

Fig. 15b

Closing comments on the disc generator

In closing this discussion of the Interference disc generator, I would like to go over and point out some of the concepts that I incorporated into the design of my permanent magnet dynamo.

As I made further progress and completed the later stages of the Interference disc generator, it became clear to me to use certain concepts of the machine and incorporate them into the design of my multiphase permanent magnet dynamo. Some of these concepts are explained here.

I have constructed several interference discs that have a different number of blocking shields, some with 10 blocking fins and some with 11 blocking fins and others with 12 blocking fins. They are all interchangeable on the machine to change the phase relations between all the isolated coils. The 12 finned disc will produce a single-phase dynamo with all the coils in phase, and the 10 finned disc on the machine will produce a three phase dynamo. One phase represents four groups of isolated coils, and the second phase represent the other four coils, and the four coils left are the third phase, for a total of twelve coils. All just by changing the number of fins on the interference disc and or adding more layers. Using 12 magnet poles and the 10 or 11 interference fins on the disc, the rotor discs becomes magnetically balanced and easy to rotate in spite of the load on the coils. The 12 finned disc has a larger holding force because

of the same number of fins as magnetic poles. However, it can be reduced to almost nil by adding more layers of interference disc and balance them against each other. Many in phase coils can then be added in series or in parallel to build your power levels to any desired potential.

Both machines have stationary coils, and the disc generator has 12 magnetic poles (6N and 6S), and the permanent magnet dynamo also has 12 magnetic poles (6N and 6S). The disc generator uses 10 or more fins on the interference shielding plate per rotor, and the permanent magnet dynamo has 10 or more coils around each rotor. There is the same number of interference blocking plates as there are induction coils on each of the two difference machines and the number of blocking fins and or coils are interchangeable. The back emf effects are different on both machines, the Interference disc generator demonstrates easy turning of the discs while the stationary coils are loaded, and when producing alternating current the permanent magnet dynamo rotor slows down when a load is placed on the stationary coils. Both machines produce AC power out of the coils and the Interference Disc generator has a closed magnetic circuit through the coils, and the permanent magnet dynamo has open magnetic circuit through the coils.

The Permanent Magnet Dynamo

I would like to begin this topic at this point by describing my permanent magnet dynamo machine.

I designed this machine to be completely interchangeable into many different motor generator combinations. These combinations involve different number of magnetic poles and different number of interchangeable coil poles in the same machine, two versions are possible, one with isolated coils and another with the coils that share a common core fig. 16.

We can change the magnetically balancing effect (*holding force*) by changing the number of coil poles or (*interference disc fins*) in relation to the magnetic poles. This turns the machine into a multipurpose, multiphase, variable output, and variable frequency ac dc permanent magnet motor generator system. I first designed this unique multi purpose dynamo in 1987 after I built my third Interference Disc generator.

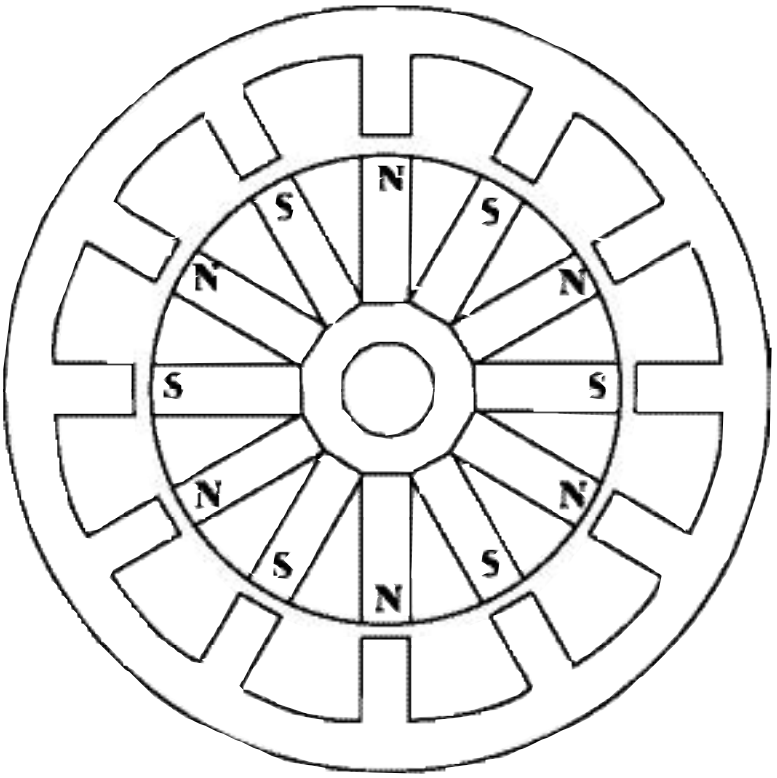

Fig. 16

Dynamo description:

Rotor:

It is well known that a bar magnet has its magnetic field concentrated at the N and S pole ends, and the half way line between the poles of a magnet is the neutral zone, this is the region where the magnetic field is canceled or neutralized. The *ferrous* keeper ring I designed for this rotor is mounted near the axle and it has machined flat decks so the magnets attach flush to the deck of the

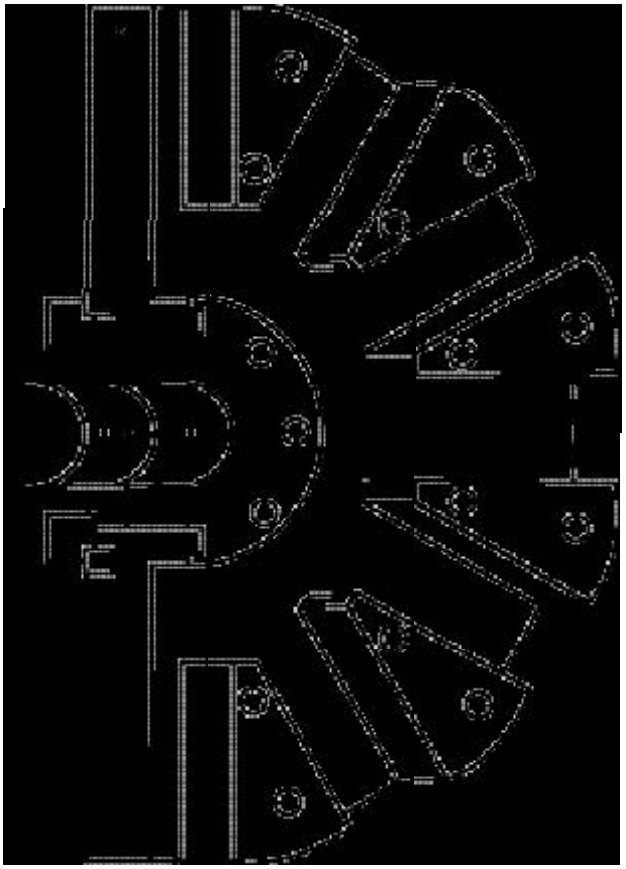

Fig. 17

keeper ring. Because of this feature, flux leakage is reduced at the keeper ring and the magnetic field concentrates at the rotor poles. With the poles of the magnet positioned near the axle and attached to the keeper ring in the rotor, the magnetic field that was there is now forced to add magnetic field density to the outer magnetic poles on the rotor rim. The density of the magnetic field at the poles is now greatly increased which makes a very powerful small size rotor. The *ferrous* inner keeper ring (*active iron*) that is installed inside this rotor design, is also the *neutral zone* of the magnetic field when viewing all the combined permanent magnets in the rotor. Shown is a cut away view diagram of the rotor, fig. 17.

I utilize rare earth rectangular shape neodymium grade 35 bar magnets with the dimensions of 3" long and 1"x1" on the end poles. There are 12 bar magnets mounted 30 degrees apart in NSNS configuration, and the bar magnets are attached to a precision machined inner keeper ring which makes the active iron the region of the middle of the magnetic field (the neutral zone). Another way to view this is to imagine two 3" long bar magnets attached together, you now have a 6" long magnet. Bend this magnet in half and install iron at the U and it now becomes a horseshoe magnet with two 3" long pole ends. It's a powerful rotor design in the fact that each of the 3" long bar magnetic poles has the field strength of a 6" long bar magnet. More poles on the rotor will allow for higher frequency ac generation at lower rpms, twelve magnetic poles on each rotor is shown in fig. 18, 19.

Fig. 18

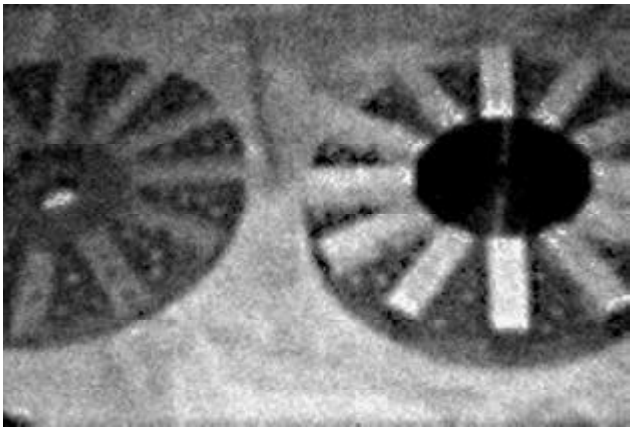

Fig. 19

The drawing in fig. 20 and picture in fig. 21, shows twelve magnet poles in each rotor in relation to the position of the coils. Ten *amorphous* cores are shown mounted around each of three rotors before they were wound with magnet wire fig. 21. The machine I have constructed houses a total of three rotors side

by side that are mounted 10 degrees apart in relation to their *magnetic poles*, each rotor has twelve magnets installed for a total of 36 magnetic poles shown in fig. 20. This dynamo concept can be constructed to any size with unlimited numbers of rotors and coil combinations to fit any power requirements.

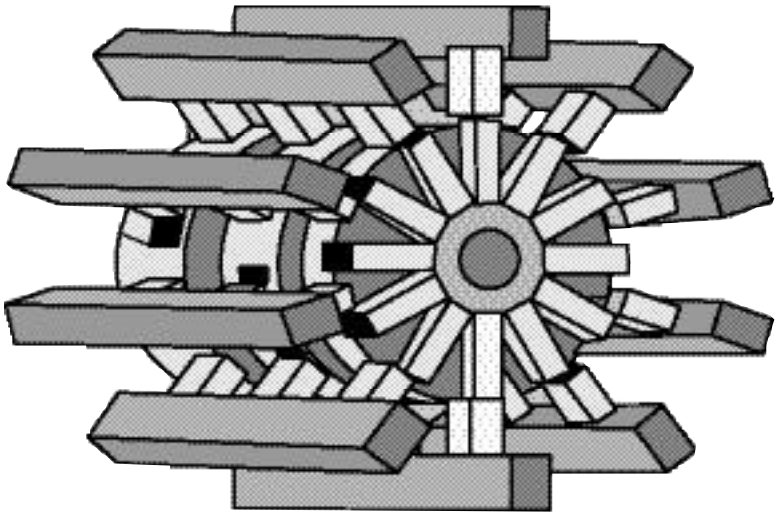

Fig. 20

Fig. 21

It is well known that a magnet exerts a force of attraction to iron bringing them closer together, after they have come together, they are in their **static position**. A force must be exerted to either the magnet or the iron in order to pull the magnet and the iron apart, removing them from their static position. The term **static position** is used to describe the point when the magnet and the iron bar are at their nearest point.

As in the Interference Disc Generator, this Permanent Magnet Dynamo I am describing also uses an internal magnetic balancing effect which reduces startup torque on the rotor.

In this system, one set of magnets is in their static position in relation to the coils, such as the impulse coils. Another set of magnets on one side of the rotor is not in the static position, and there is another set of magnets that is not in its static position on the opposite side. One side is half in to the coils, and the other side is half out the coils, allowing the rotor to have minimal start up torque in turning the rotor. The magnets function in two jobs, the first with its velocity is to cause induction into the transformer coils producing ac power.

The second function, is the opposite pair magnetic fields on the rotor balancing each magnet out of their static position in relation to the coil positions at any given time, they cancel their holding force which puts the rotor at equilibrium. This reduces the amount of start up energy required to rotate the rotor resulting in higher efficiency. It allows the rotor and or multiple rotors to turn easily and efficiently despite the inherent powerful holding force of the rare earth neodymium magnets. With the three rotor machine configuration, I have connected 6 impulse coils in three phase to function as the motor impulse circuits with a hall effect brushless motor controller fig. 22.

Star wound three phase motor impulse coils.

Fig. 22
Star wound
three phase motor impulse coils

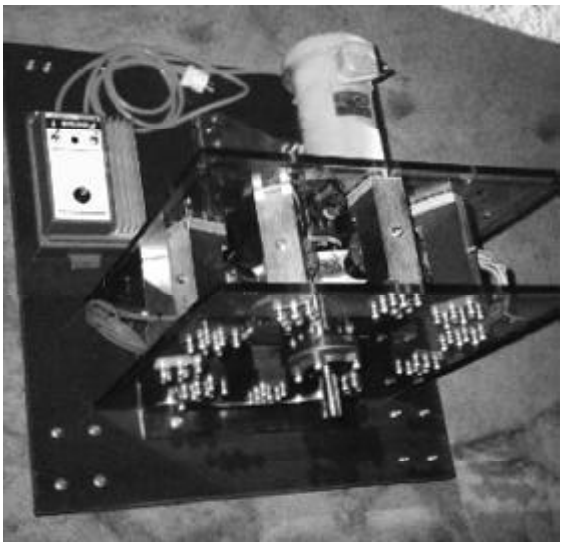

Fig. 23

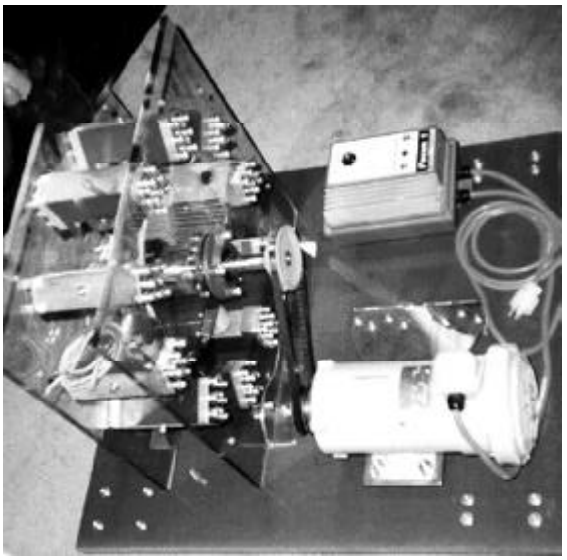

Fig. 24

Two more pictures of the one rotor dynamo option are shown with a 1hp dc motor turning the rotor with an 800 watt load on the coils, six 100 watt AC light bulbs, and two 100 watt 12 volt DC light bulbs, Fig. 25, 25a.

Fig. 25

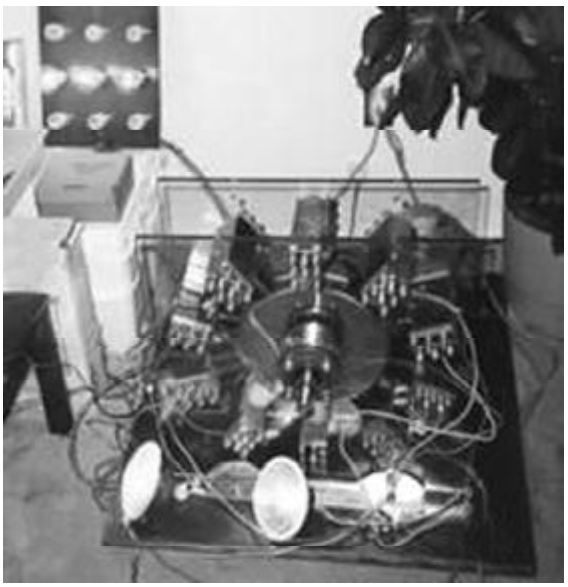

Fig. 25a

The efficiencies of this dynamo are so far inconclusive with regards to producing an endless self running machine. Our research is continuing to improve the efficiency by eliminating all conventional type ac and dc motors from this dynamo, and incorporating high voltage dc impulses of very short time duration's as Ed Gray did with his technology years ago. However, a description of my early self running attempts is included near the end of this dynamo report. These tests have manifested an abundance of heat in the 24 volt dc drive motor.

Another picture of the three-rotor dynamo configuration is shown with 12 regenerating ac to dc coils, and with the motor impulse coils removed fig. 26.

Fig. 26

Fig. 26a

Another close up of the regenerating coils and three phase motor impulse coils is shown on the dynamo fig. 27.

Fig. 27

Tests to produce an abundance of heat

I have testing the machine so as the output coils are connected to regenerate a 12 volt battery as the motor is turning the rotors. I used a bran new conventional permanent magnet 1/4 hp 24 volt dc motor that is running on 12 volts to turn the 110 pound 3 balanced rotors, and or the 35 pound 1 balanced rotor version.

The regenerating output coils produce AC to DC power with no noticeable ripple on the scope. The generated direct current from the coils is connected to go back into the battery, in which the motor uses to produce the torque needed to rotate the rotor. As this happens, the regenerated dc power from the coils is again going back into the battery first, and then to the motor. The result is that the battery supplies less power to the motor when the regenerating DC current is going into the battery. The motor takes on a load from two sources, one is from free wheeling the rotor with out loading or drawing current from the coils, and the other is the load induced on the motor when the coils are loaded to produce current.

The dc permanent magnet motor has shown that during one of many switch mode tests, it consumes 15 amps at 12 volts from the battery while a chosen number of regenerating coils supply ? the amount of current going back to the battery. The battery supplies 50% of the amps and the regenerating coils supply the other 50% amps. This effect can be changed depending on how many open isolated regenerating banks of coils are activated and loaded.

This test shows a 15 amp draw the motor while it is turning the rotors under load while regenerating current from the coils. It may be they balance each other and both battery and coils supply 7.5 amps each that make the total 15 amps draw on the motor. This accounts for the 15 amps total load that is shown on the dc drive motor. It produces an excessively large amount of heat in the dc motor that is useable output energy. On a larger scale the heat generated in a given motor can be enormous. More accurate measurements are needed to determine the true energy in verses energy out.

However, this electric heat pump effect can be altered to produce more or less heat depending on the size and type of the drive motor, and the amount of regenerating coils that are placed under load. Cooling tubes wound around the motor with water flowing through them is a way to pull the heat out for useful applications. Hot water from the drive motor and electric power from the coils at the same time.

After running the machine, the amorphous regenerating coils remain cool to the touch where as the conventional dc motor gets very hot with higher amps going through it. The machine also has a longer running time when the coils are regenerating the battery, as compared to running an outside equal load with the same amp draw, in that case the battery drains much faster.

This sheds light with the observation of high heat build up in the motor side (less efficient side) of the circuit while being cooler on the generator side (amorphous side) of the circuit. After hours of run time the battery begins to drain, when this happens, the battery begins to show tangible temperature changes from one side of the battery to the other. The whole negative side of the battery remains cool to the touch (temperature drop), while the whole positive side of the battery gets warmer to the touch (temperature rise). The effect is repeatable and only happens when the regenerating coils are connected to charge the battery as it is running. It may be approximately 20 degrees difference in temperature, depending on how many regenerating coils are activated sending its current to the battery. There must be exothermic reactions and endothermic reactions going on inside the battery motor generator combination that is causing this temperature difference. The load and heat generated can be changed the on the motor from the flick of a switch that activates and loads the output coils, which in turn dumps it's energy back into the battery pack or outside load. The efficiency ratio of the machine changes depending on how many and which banks of regenerating coils are activated, which again also effects the temperature difference manifesting on each side of the battery, motor, and amorphous coils.

Other tests

An Automotion dc brushless 3 phase motor controller with hall sensors was used to test the machine in fig. 26a. Tests have shown the 1hp dc motor and the three phase brushless dc motor controller will not be the answer to closing the loop on this motor generator machine. The brushless controller has a 50% duty cycle which will not manifest the electro radiant effect, and it also has a constant draw on the battery as a regular dc motor does. It is much less efficient than using very fast and short unidirectional dc impulses in the motor impulse coils to kick the rotor around. This brings the subject of Nikola Tesla's magnifying transmitter and Ed Gray's radiant energy impulse motors to light, and a possibly answer to closing the loop for a real auto-rotating machine.

Before I go further with this, I want to point out the many phase possibilities this dynamo has. If you look at the coil arrangements in the 10 coil machine, you can clearly see the coils that are in phase with each other. When a second and third rotor is installed with all the coils attached, one pair of coils on the first rotor is in phase with another pair of coils on the second rotor, and another pair of coils is in phase on the third rotor. With the ten coil to twelve magnet pole rotor assembly, the machine has five phases of isolated banks of coils. If twelve coil mounting bars are attached around the three rotors, and the three rotors are spiraled off set by 10 degrees, you will have a powerful three phase dynamo. If the rotors are not off set by 10 degrees and are lined up in phase with each other, all the coils on the machine will be in phase for a powerful single phase dynamo. The volts and or amperage can be tailored for an application by the winding of the transformer coils, and the machine produces 60hz at 600 rpm. This dynamo machine concept is also interchangeable into many other motor generator combinations, and sizes, and any volts or amps requirements, it all depends on the needs of the end user.

Cooling tubes wound around the motor with water flowing through them is a way to pull the heat out for useful applications. Hot water from the drive motor and electric power from the coils at the same time.

It is possible to have super efficiencies with this system using unidirectional hv dc impulses of very short duration's at the make brake contact at the closure of the switch.

I have acquired two of Ed Gray's radiant energy impulse motors #4 and #5 to revive an almost lost technology. I am proposing to combine a special permanent magnet dynamo with less back EMF that is tailored to produce 5kv dc under 2000rpm. This dynamo will energize a 5kv dc capacitor bank and replace Gray's 12 volt to 5kv dc converter. The energized capacitor bank will discharge through the conversion tubes in the very same manner as in Gray's original circuit, only the capacitors will get energized from the high voltage dc dynamo instead of from a battery through an inverter. This version of a high voltage dc dynamo will be connected to and turned by Ed Gray's EMA motor, a starter motor will disengage after it begins running.

There are three banks of high voltage coils that are connected 120 degrees out of phase from each other, each bank represents 12 - 100 watt coils for a total of 1200 watts per phase. All isolated coils in each phase are wired in series to produce the high voltage dc potential to energize the capacitor bank. The isolated capacitor bank will discharge their potential through its conversion tubes in 120 degree increments each time the impulse coils are at their closes point toward each other. One isolated capacitor bank will discharge through the conversion tube with it disconnected from the dc dynamo circuit. The second isolated capacitor is at this point beginning to receive its charge from the dc dynamo, while the third capacitor phase is fully energized just before the switching circuit disconnects it from the dc dynamo for it discharge phase. This fully aligns all the isolated 3 coil phases in this permanent magnet dynamo system to the 120 degree three phase radiant energy impulse system of Ed Gray's EMA motor #5.

The plan is to eliminate all the batteries and converter and use a rotating high voltage dc dynamo in its place. Nikola Tesla used high voltage dc dynamos with capacitors as part of his magnifying transmitter to produce radiant electricity. So it seems logical to do the same thing, merging Ed Gray's radiant energy motor and our version of a high voltage dc permanent magnet dynamo. Could it regenerate a car, or power a home, and or a factory?

Shown below are pictures of Ed Gray's motors in fig 28, 29.

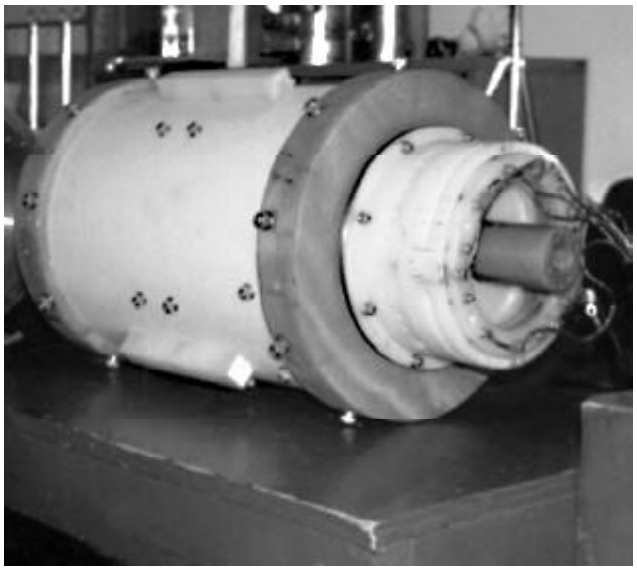

Fig. 28

Fig. 29

I would like to acknowledge two friends of mine who have helped make the Interference Disc machine possible, Bud Johnson 1986 shown in fig. 30 and the late Dr. Carl Reich shown 1987 in fig. 31. I would also like to acknowledge Wilbert Griffith and Brian & Rose Langan for their contribution in helping us make these projects possible, and there are others who wish to remain anonymous. Bud Johnson also an inventor, was one of the first people who I met after relocating to Alberta from the NWT, he made arrangements for us to construct the first disc machine in a machine shop.

Fig. 30
Bud Johnson

Fig.31
Dr. Carl Reich

Dr. Carl Reich was a pioneer in the alternate medical field and he published a book along with Robert R. Barefoot called "The Calcium Factor", copyright 1992. Through Carl's dedication and hard work with alternate health and energy, Dr. Carl Reich contributions have also helped made the Interference Disc machine and our Permanent Magnet Dynamo possible.

I also would like to thank my wife Jan Francoeur for being part of making this research possible, she has spent countless hours to prepare this report and assist in the reconstruction of these machines.

The test results and hypothesis I have written are not complete, and the research and development of the described magnetic energy machines is on going, and as such, the potential and performance and true efficiencies of these machines are still yet to be determined. This author knows that the aether is real and free energy systems are possible, and I will continue to work until I have completed the integration of Ed Gray's radiant energy motors with our larger version dc dynamo machine. When this happens, a new round of testing will begin with our attempts to run the two machines together in closed loop regenerating mode.

I hope I explained these energy machines in a way that you all can understand, and more information will be released as progress is made. ***You may find this information useful with your quest to be energy independent. However, if you profit from any of my ideas I have described in this writing, then in all fairness, please remember to reward the inventor so research and development can continue.***

This is my gift to humanity.

Interesting Information

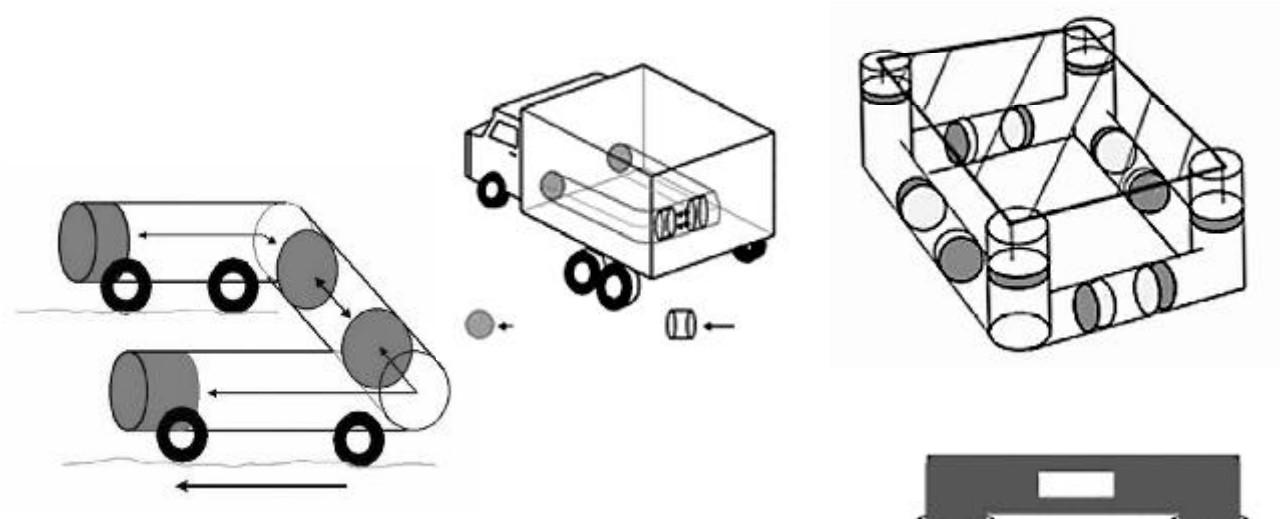

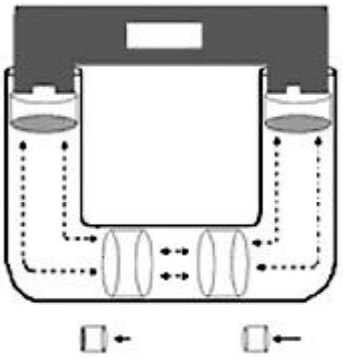

New Propulsion Letter
from Paul Toomer <jorjencar@leeds322.fsnet.co.uk>

Please take a look at this new web site on how to challenge Newton's third law of motion at

http://magnetic.propulsion.mysite.freeserve.com

A NEW PARADIGM FOR TIME

EVIDENCE FROM EMPIRICAL AND ESOTERIC SOURCES

Donald Reed, USA
1032 Borden Road, Depew, NY 14043
Email: torsionpower@yahoo.com

The author of this article presents an experimental approach to the teleportation problem and time pace control and space regularity questions.

Part I of II

ABSTRACT

The following essay seeks to establish awareness, through a far-ranging careful examination of various empirically documented anomalous research results in the field of new energy, the long-suspected evidence provided by associated key legendary secret government project work in the USA and former USSR, maverick new theoretical models in foundational physics for elementary particles/fundamental electromagnetic wave-field structures, as well as remarkably corroborative related information from esoteric (psychically channeled) sources, of the necessity for the development of a new paradigm for mass, energy and especially time. After having been guided through this process, the reader will hopefully be motivated to acknowledge the importance of this imperative for a new understanding of the workings of nature, as well as gain hints for the associated future development of new viable sustainable energy sources and related technologies.

Introduction

When we come to examine the annals of physics over the past century, we find them replete with several competing core theories of the physical world, each attempting to demonstrate a unified conception of space, time, energy and matter. Notable among these, the most successful and formally canonized in academia, are special and general relativity, and quantum theory, the latter of which includes quantum electrodynamics and quantum chromodynamics as recent offshoots.

However, even these fundamental theories have fallen short in achieving this coveted goal, due to many reasons, not the least of which is their failure to account for the anomalous but substantial documented evidence continually presented over the years by new energy research and other related empirical evidence considered outside mainstream science. In this author's opinion, these weaknesses in current physics and its relative ignorance and/or selective omission of the findings of non-orthodox scientific research, stem primarily from an ill-conceived institutionalized conception of **time**, as an immutable linear flow against which everything involving **change** can be measured. This "relational" concept of time treats it as a specific passive property of physical systems and changes happening to them. It is a one-dimensional continuous and homogeneous entity geometrically describing the property of duration. This antiquated relational view of time is abstracted from our unique prejudiced viewpoint as sentient beings whose particular point of waking conscious focus is this camouflage physical reality, which is apprehended through the limitations circumscribed by the physical senses.

Accordingly, modern physics is built on the basis of this relational conception of time. However, the use of this conception has not

so far resulted in resolving all the problems associated with time. Moreover, so far even an essential definition of time has not been formulated in physics, there are only operational definitions indicating different methods of measuring time intervals.

In contrast, the "substantial" conception of time, advanced in this paper, implies that time is an independent phenomenon of nature existing side by side with matter and physical fields, whose active essence can and does affect objects and processes occurring in the universe. Moreover, the following dissertation argues, by positing that active substantial **change** is the basic concept and relational **time** is its derivative, that those objects and processes can also have a reverse action on time.

Accordingly, we will attempt to show, through a wide-ranging examination of new energy research and other information, the necessity for the establishment of a fluidic, elastic, field nature for true active time which is malleable; one in which even the local pace of time, and mass and energy content can be influenced artificially by intelligent technological control, or naturally by conscious intent, or by a combination of these two methods. To help motivate the reader's awareness for this imperative, we will also examine several esoterically-based sources from key selected psychically channeled transcripts. These will be taken from the following sources: unpublished comments by Jane Roberts on an altered state of consciousness[1] (indicated in this manuscript by J.R.), or published transcripts from **The Seth Material** and The **"Unknown" Reality** (indicated in the manuscript by UR)[2], published chronicles from the entity Kryon, channeled by Lee Carroll [3], and concepts from Wilbert Smith's legendary discourse: **The New Science** (NS) [4]. For easier reference, all psychically channeled transcripts will appear in italics, with my additional explanatory comments in regular type within parentheses.

Granted, our unique investigative foray, ranging as it does from the concrete arena of knowledge represented by the cutting edge of visionary science to the intangible arcane realms bordering on the spiritual, will of necessity lack the exacting logic of scientific rigor.

Nevertheless, we hope to provide, through just such a unique eclectic format, the beginnings of a possible fresh understanding of the workings of nature and perhaps ultimately furnish a conceptual basis for extending the structure of current physical theory to compatibly encompass the elements of a unified framework of physics and metaphysics.

As "unscientific" as this proposed venture may appear, especially to the contemporary physicist or theoretician, we unabashedly press on, secure in the belief that the currently perceived "mutually exclusive" bodies of knowledge defined through psychic means and that of orthodox physics are more closely linked than is currently suspected. Indeed, it will be demonstrated that that some of the psychically defined data bears a striking resemblance to the tenets of present empirical knowledge.

New Research

Theories Indicate Necessity for Novel Time Concept

A body of work which postulates a fluid-field substantial nature for time, is the esoterically-based book written by Wilbert Smith in the early sixties, **The New Science**. Here, Smith outlined a unified theory of all physical interaction by positing that an active mass-free field energy he termed the *tempic field* exists, and is the parent field structure out of which our passive relational linear clock time emerges. To be sure, this book and its specific format of exposition has its weaknesses, not the least of which is a writing style which taxes one's comprehension to the limit. All researchers who have attempted to connect Smith's knowledge with the frontiers of current scientific knowledge, new energy research, etc., have been frustrated by his introduction of terms which may or not have the same meaning as the corresponding terms in mathematical science. This practice

causes many passages to appear so vague as to cause total bewilderment on the part of the reader.

> *...the establishment of a fluidic, elastic, field nature for true active time which is malleable; one in which even the local pace of time, and mass and energy content can be influenced artificially by intelligent technological control, or naturally by conscious intent...*

In coming to investigate the source of Smith's theory 25 years ago, I came into contact with Kenneth Killick of Canada. Killick was the individual who served as the original mentor and for a time a colleague of Smith in the mid-1950's. Smith, whose background was in electrical engineering, found it very difficult to accept or understand the philosophical overtones of Killick's thought. Consequently, he resorted to the use of psychic mediums to try to verify the information provided to him by Killick. This is the origin of Smith's association with discarnate entities known to those familiar with his work as "the boys topside". Thus Smith's subsequent writings promote such confusion perhaps because he only obtained a partial understanding of these cosmic ideas, and he opted to writing in a kind of code basically to try to hide his own confusion. Through my own association with Ken, I discovered that The New Science is able to be put into reference with known facts once the spiritual-philosophical elements of Killick's teachings are duly integrated. When this is done, "Wib" Smith's book can teach much and can become a cornerstone to new energy science. Otherwise, it remains at best, a fragmentary enigma.

The work by Smith and Killick is pertinent to the theme of the present paper, since they both showed through experimentation with a special caduceus-wound coil, that so-called relativistic parameters of mass and gravity, energy, and time-flow, can be altered through intelligent artificial control. Adequate delving into some of the elements of these theories will enable us to glean new insight for transforming the current paradigm of time. Further details on Ken's so-called tachion energy theory can be found in this author's earlier expositions on this subject in issues of **Energy Unlimited** (1978-1982)[5].

Smith's main error is in postulating a fundamental "spin" dynamics based upon conventional continuous rotation. As Killick points out, such a concept of spin on the microscopic level, precludes any possibility of true evolutionary change, in the cosmic sense.

Also, as we shall see presently, the continuous spin concept obviates expression by anything in the universe, of its personal moral responsibility. However, with tachion energy theory intact and untrammeled, the impersonal dualistic concept of interaction between two polar entities, such as is expressed not only in ordinary classical Newtonian physics, but its 20th century successors, relativity and quantum theory, is supplanted with the omnipresent workings of a **trinity** at all levels and manifestations of reality.

Indeed, the fundamental tachion field (mass-free) energy has **three** components: two polar opposite entities (a positive "charge" and a negative "charge"), and the ability for these two to be in what is called "static-dynamic balance". The static-dynamic balance completes the trinity.

A simple physical macroscopic manifestation of static-dynamic balance can be seen in two people arm wrestling. As the energy of one participant is brought to bear against that of the other, we will see a vibration or oscillation once a balance of their energies is obtained. As more effort is expended, the vibrations will increase in frequency and decrease in amplitude. At this point we will see a static state relative to the two arms; neither causes loss of arm position of the other. But simultaneously we also have a dynamic situation in the rapid oscillation which

maintains, and is in turn sustained by the muscular energy which produces the static state of the arms. Both states mutually support each other's existence. The two component entities (the arms) resonate together, but without losing their own identity.

The implications of this last statement, missing in current physical theory, is unique to the system of tachion energy. We will see in the following that the dynamic functioning of these sub-atomic tachions is such that by their inherent ability to manipulate space and the time-frame of matter through static-dynamic balance, they do not harm anything else in their environment, nor are they affected (forced to lose their own identity) by the ambient environment. Accordingly, inertial mass is not an inherent component of tachion energy, but is a derivative of certain tachion field modes.

We spoke earlier of tachion "charge". We keep the word in quotes to underscore that this is not to be equated to electrical charge, but merely signifies two polar energy states of the primordial ground-form, out of which all known physical forces come to be manifest. These tachion energy states can be defined in terms of "rotational" motion. Again "rotation" must also be placed in quotes as it does not signify the common idea of continuous spinning. Such a concept was suggested above in connection with evolutionary progress in its cosmic interpretation.

The tachion-pair could be described as executing a "back-and-forth" ratcheting movement. The tachion-pairs are analogous to the ends of a drum majorette's baton. But unlike the twirling motion of the baton, the tachion-pairs do not demonstrate the classic macroscopic continuous spin motion, but oscillate in a 3-component "clocking" action.

In Fig. 1 we have drawn a circle and have divided it into three 120 degree arcs. The first motion in the tachion cycle is an arc from the 0^0 -360^0 location, to the 240 degree position. This movement is stated philosophically as the question, "Can I go?" In the second phase it swings back from the 240 degree position to the 120 degree point, and then returns to the 240 degree position. This graphically represents an analysis of the first question, and can be phrased as the "Let me think" component. Finally, then it proceeds forward another 240 degrees taking it past the 360 degree point to 120 degrees. This last stage is the action motivated from the analysis in stage two, and is entitled, "Yes I can". In this activity it will be observed that all path lengths are 240 degrees.

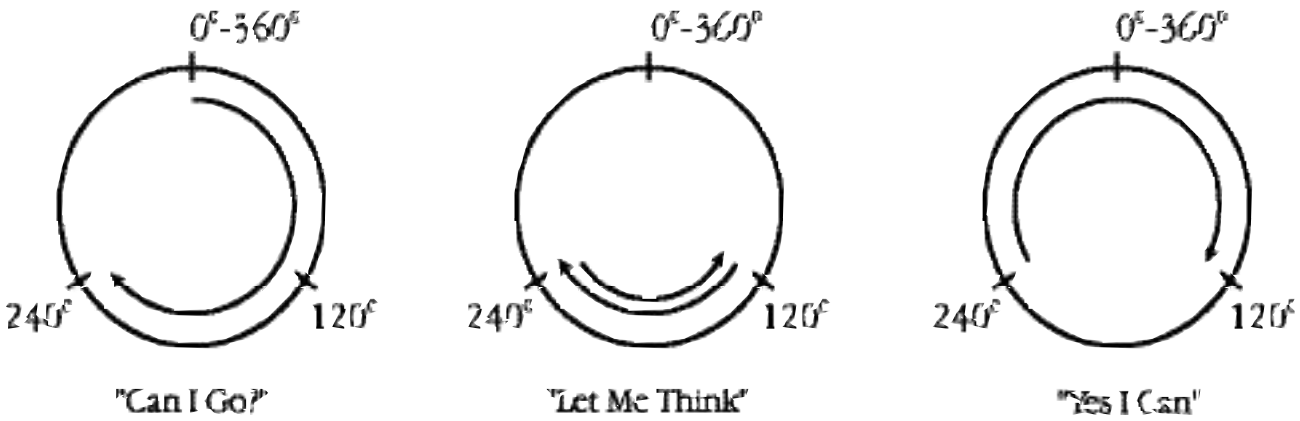

Fig.1
The 3-Component Tachion Movement

However, as representative of true evolutionary progress, the tachion-pair does not remain confined to the plane in its 3-phase cycle. After each "Let me think" stage, the entire pair unit could be considered to advance "upward", perpendicular to its plane of "rotation". The

combined motions can be viewed as an elevation up an inclined ramp, screw-fashion (Fig. 2).

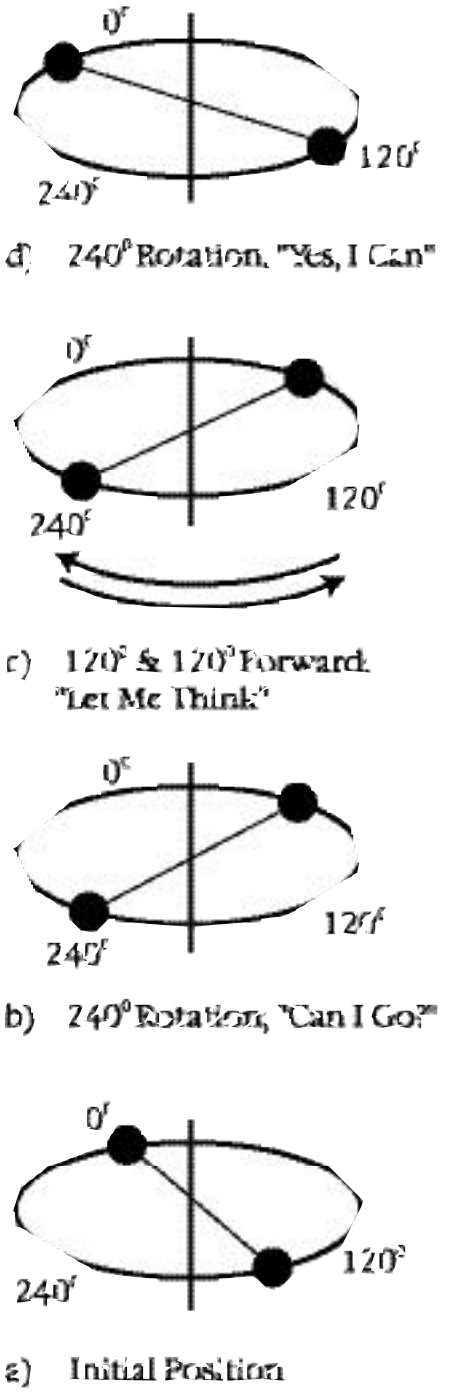

Fig.2
Tachion "Ratcheting"

Thus, while they clock themselves backwards in the plane, they never go back to where they were originally but only seem to do so from the point of view of an observer in the plane. This entire activity can be visualized as a diametrically opposed pair "rotating" in a plane, but there must still be considered an upward ratcheting movement. They execute the clocking motion simply because they adhere to the three principles of observation, analysis and motivation. A meaningful application of this idea to the structure of physics would eliminate the necessity for a totally impersonal type of interaction governed solely by force. Unlike all current theories of elementary particles, the tachion-pair, by its unique activity, thus expresses a personal moral responsibility. So this elemental energy of the universe never goes where it is not wanted, but only where it will not disturb its immediate environment.

The topological structure of each tachion in the pair is also significant in regards to this "ethical" modus operandi. First, tachions in their primordial state are massless, toroidal shaped fields which always occur in pairs. Like toroids, tachions will singly exhibit three motional degrees of freedom, to wit;

1. rotation around its major axis.

2. inner (P), or outer (N) rotation about its cross-sectional (poloidal) axis.

3. expansion and contraction of the field (each toroid pulsates radially about its cross-sectional axis).

As a pair-unit, the combined motions will give rise to the following possible orientations: two identical (N) rotations; (N) rotation - (P) rotation; two identical (P) rotations (Fig. 3).

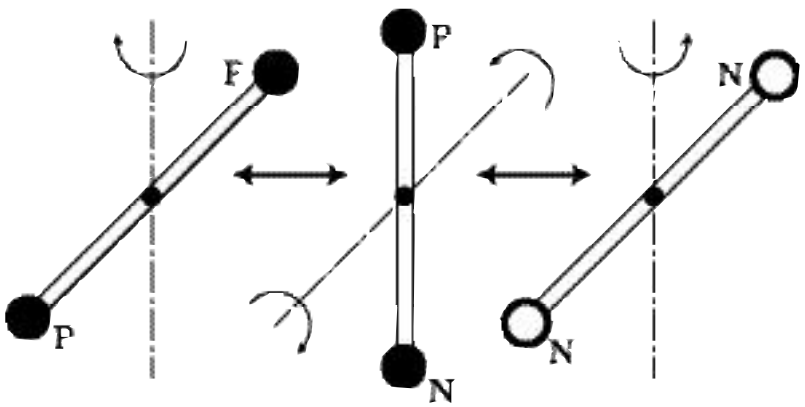

Fig.3
The Three Tachion Modes

The dual (P) or (N) rotations will always lie in the same plane, whereas in the "mixed" rotation mode, the orientations of the tachions will be mutually perpendicular. In the pair unit, the energy will shuttle

back and forth between the tachions by virtue of their harmonious expansion and contraction. The contraction of one pair partner is immediately compensated for by an equal amount of expansion in the other. When one is fully expanded and the other completely contracted, they will reverse roles executing the second portion of the cycle. There will be two points in the clocking cycle where the tachions will share an equal amount of energy ("field equity") stage. In each cycle of a tachion-pair the field equity stage is passed twice, a fact which is significant when topology of the field dynamics is considered (see [5]). Now, looking at the field geometry for the tachion-pair unit at the two field equity stages of the cycle, we observe that the two geometries are not identical but are *mirror images* of one another via a non-orientable field structure. See Fig. 5, which shows the isomorphism between the dynamics on a Moebius band (a non-orientable topological structure) and the tachion pair clocking cycle.

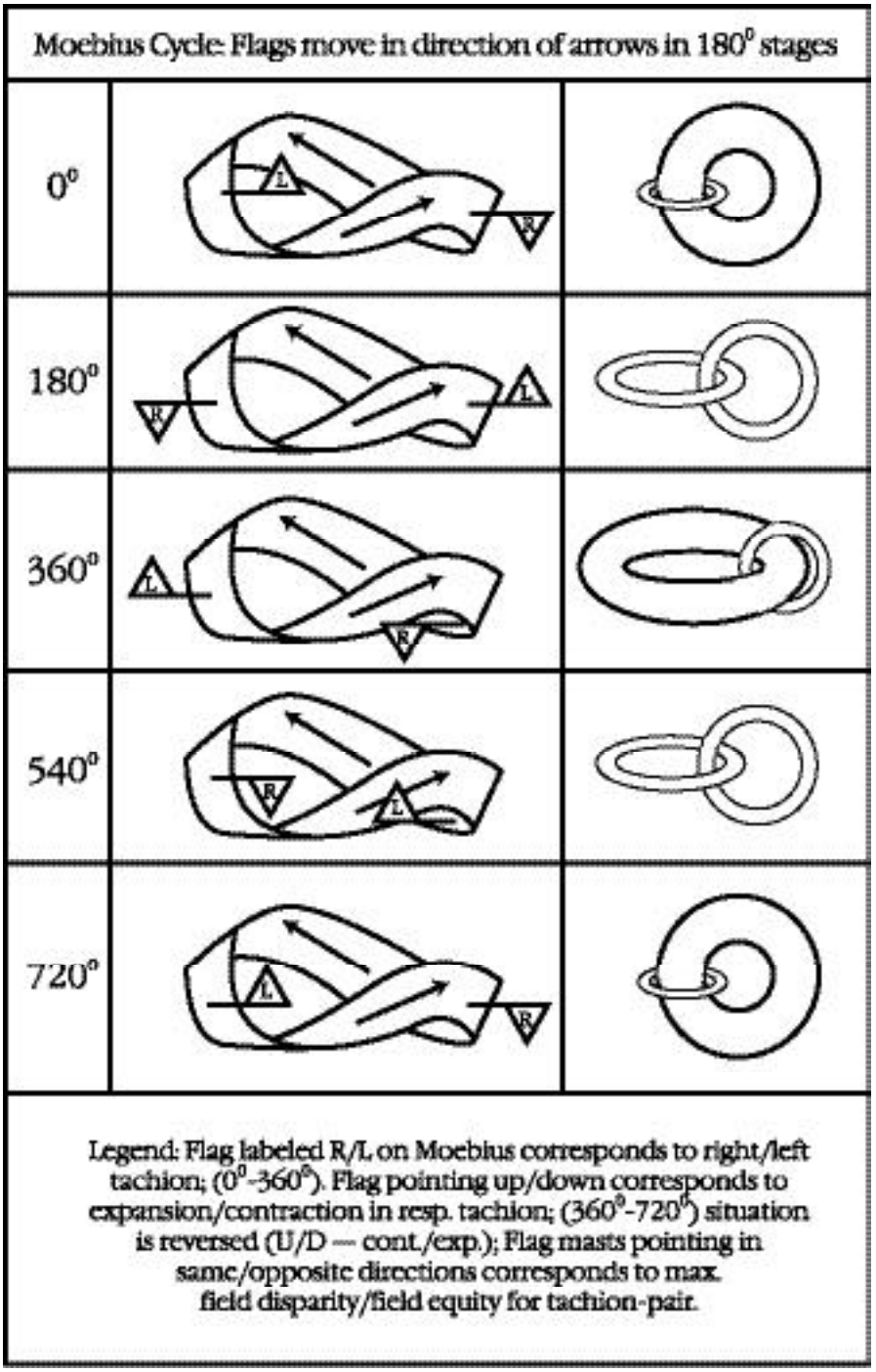

Fig.5

This suggests the remarkable idea that the space time points that the pairs generate are not, as commonly assumed, identical, static, and bereft of intrinsic character, but exhibit *enantiomorphic* topologies, which by virtue of their mirrored relationship exert upon one another a potential for dynamic interaction. For now we present a second diagram to illustrate the three pair energy modes: N-N, N-P, P-P, as well as one sequence of oscillation of the N-P pair (Fig. 4).

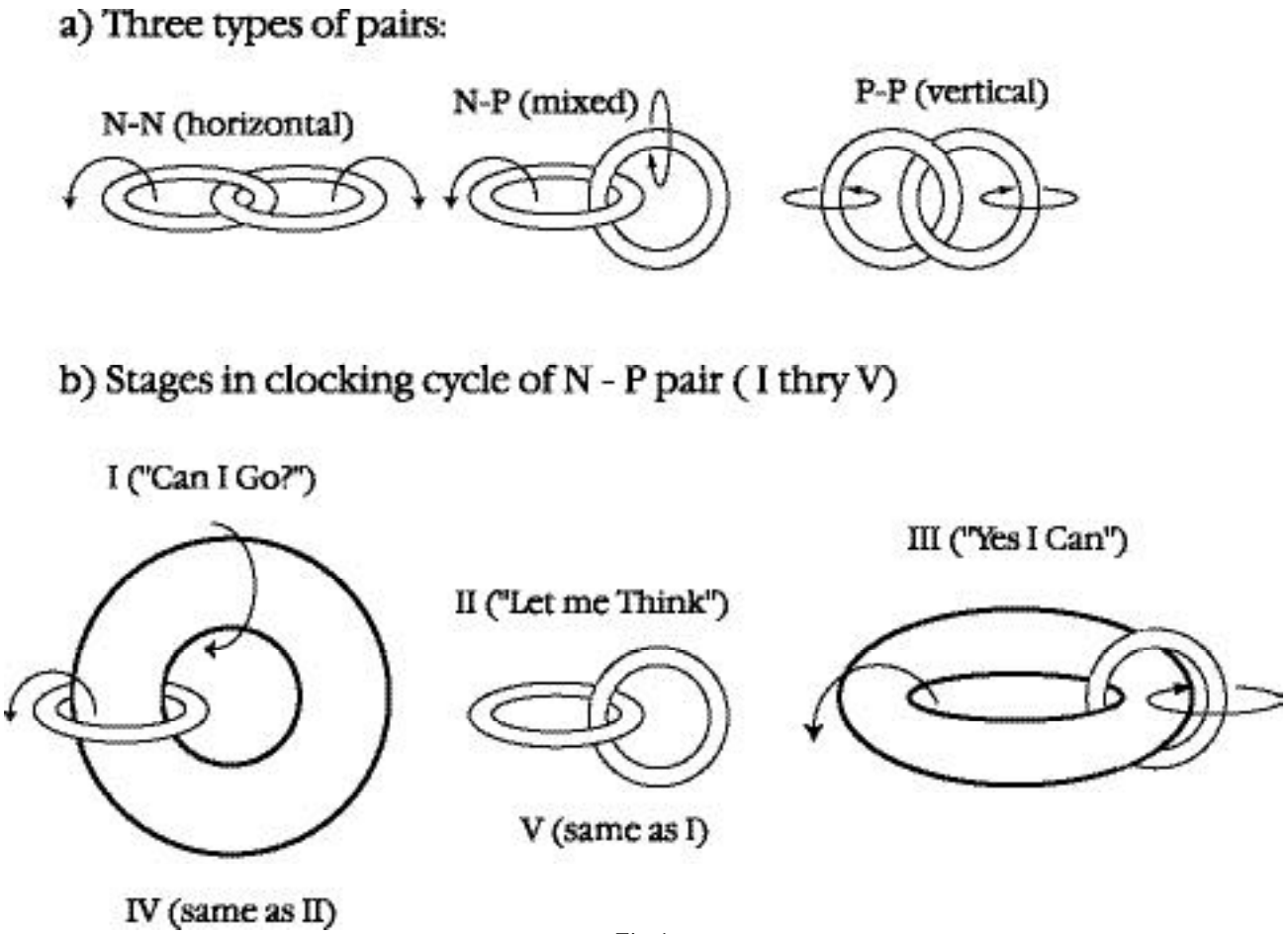

Fig.4

In this figure we note a unique trinity of field operation: two stages of maximum field disparity (I and III) connected by the intermediate condition of field equity (II). Upon postulating the additional requirement that the pair will create a new space-time location every time the field equity state is reached, we see that with each cycle the unit will not return to its original state with respect to the environment, but will advance to new evolutionary states with each pulsation. In accordance with the above comments, the tachion-pair unit "ascends" the evolutionary spiral via this unique action we have termed "clocking" motion. In acccordance with the description in Fig. 4A, in Fig. 4B, stage I represents "Can I go?", stage II represents "Let me think", and stage III represents "Yes I can".

Now, in this regard, the previous analogy of the tachion-pair as likened to the ends of a baton, where the baton rises and falls as it rotates, is quite apt. However, unlike the ends of the baton tachions are not rigidly connected but possess much freedom of movement outlined above. On the other hand, much like the baton ends, they are mutually supportive of each other's activity and requirements, never seeking to overpower, or to be eclipsed by the identity of their partner. In this manner they exhibit personal moral responsibility, as we have previously stated. By their mutual

harmonious action tachion-pairs will progress in a true evolutionary fashion, while never harming anything else in the universe by their action.

> *...the dynamic functioning of these sub-atomic tachions is such that by their inherent ability to manipulate space and the time-frame of matter through static-dynamic balance, they do not harm anything else in their environment...*

Now, the above is an inherent characteristic of tachion-pairs as long as they go about their business individually- that is, in their pre-physical state. Now, when the three fundamental tachion-pair energy modes described above exhibit a slow clocking frequency, there is opportunity for them to join together whereupon we begin to see matter being formed. The element of mass, or inertia is provided by the binding activity of the (N-P) mode, which is a function of the slow oscillation of the pair unit. Besides the clocking frequency, the factor of inertial mass or density of physical substance is also dependent upon the amount of separation between the two pair components in each individual sub-atomic tachion-pair unit. In general, the denser or more massive an object is, the slower its microscopic tachions will clock, and the farther apart will be the individual toroid components. This is a classic push-pull situation, i.e., there is a key inverse static-dynamic balance relationship between tachion-pair pulsation frequency and their area of operation (density of field). The rest mass that any physical substance displays to macroscopic observation, is thus a direct function of the amount of energy supplied by the master field to sustain the oscillation of the pair-unit. Thus, a primary feature of tachion dynamics is the following: if we change the energy, we must expect to observe a corresponding change in the manifestation of the mass, and vice versa. Consequently, in tachion dynamics there is a built-in interchangeability of energy and mass, an idea which concurs with similar conclusions in Einsteinean relativity (notably, $E = mc^2$).

But here is where tachion theory and relativity part company. We have seen that our postulated "clocking" pulsation of the pair is the factor, which determines both space and time. Both **space** (area of pair operation), and **time** (frequency of pulsation) are mutually dependent on what **we shall call the master field of thought and intention, which determines the clocking frequency**. From the dynamic influence of the master field arises subsidiary conditions of time and space which are truly "fluid" qualities of tachion operation. This is indeed consonant with the assumptions of a proper unified field theory in which all the factors of our objective world as apprehended by the physical senses, are subsumed under the relative state of a guiding master field. Moreover, under the geometrical constructs of such a theory neither space nor time should be subservient to the other but should retain their unique qualities in a mutually supportive relationship. This is guaranteed in tachion theory under the fluid give-and-take of the pair operation. Relativity, on the other hand, despite its logical consistency, does not meet the above requirements. To his great credit Einstein recognized the need to integrate time with space in a synthesis that would retain the distinctive qualities of both. The result was a theory, which extended the classical Euclidean concept of 3-dimensional space as a kind of "cosmic container" of matter, to embrace a structure of space, which arises from the laws interrelating its material content. Thus, for instance, in his General Relativity theory gravitation became interpreted as a distortion of the spatial fabric by sources of mass-energy in a non-Euclidean framework. Unfortunately, as a foundation of his theory, Einstein mistakenly assumed a subservient role of time to space. He tried to "freeze" time down into spatial-like dimensions utilizing metric equations, which were variants of a basic form. Before a true understanding of

gravitation is developed, the rationale for applying such metrics to this end should be seriously re-appraised. In short, instead of freezing time down into a spatial dimension in order to make it fit a world ruled by nothing but gravity, we must develop a conception of space sufficiently fluid to let true time have its proper place therein.

These and other similar ideas are articulated by Andrea and Paulo Correa in their recent insightful essay on the various serious shortcomings of relativity theory. They write: "Time is not treated by relativity as distinct in nature or in quality from the set of topological locations or lengths between points. Whether in the SR (Special Relativity) form of a flat Minkowski spacetime or in the GR (General Relativity) form of a curved Riemannian spacetime, the essence in relativity lies in its treatment of time as the fourth length of a 4-dimensional space. As the actual metric of a length of time is not fixed, only the intervals being invariant, one can no longer speak of the reality of timelines or of synchronicity" [6].

In their second installment, the Correas even imply the existence of a mass-free energy, which is an integral element of the Killick tachion energy theory: "From a strict physical viewpoint, only an energeticist position can make sense. While space and time may be considered to exist outside the function of matter, independently from it, *they cannot be conceived outside the function of energy*...the field remains conceptualizable (in Einsteinean relativity) only by the pseudo-Riemannian manifold, which, on its own, fails to analytically treat the difference in dimensionality between Space and Time, fails to differentiate between them as distinct manifolds, and fails to account for them as the intrinsic properties of energy in flux".

The tachion theory is such a model that delineates the functions of time and space in terms of a basic mass-free energy substratum. Now as we have seen, since tachion dynamics pre-supposes a static-dynamic balance feature connecting frequency of the pairs (fundamental time elements) with their area of operation ("fluid" space configurations), it represents such a foundation upon which to construct such a theory which will harmoniously treat time and space on an equal footing without neutralizing the unique structural features of each. Since the decrease/increase in the clocking frequency of the tachion-pairs will result in a corresponding increase/decrease of area of operation, the local *pace of time* will also decrease/increase at that space-time location. This is due to the push-pull relationship between energy and time. The intrinsic energy of a tachion-pair will be defined to be its energy of "motion" (energy in the "convergent", pre-physical state). Thus we see that an increase/decrease in the clocking frequency also implies that the intrinsic energy of the pair will also follow suit. Consequently, the intrinsic energy available for a manifestation will increase/decrease as time pace allotted for this purpose decreases/increases. Moreover, the product of intrinsic energy and time interval will always be constant due to the perfect trade-off between both factors in the tachion clocking action. This relationship is remarkably similar to the quantitative statement of the Uncertainty Principle in quantum mechanics in the form: $E \cdot t = h$. This formula states that the product of the energy exchange of a quantum mechanical particle and the time interval required for that exchange to take place, is equal to the so-called "quantum of action", or Planck's constant.

Thus, as a concomitant of tachion dynamics, which is argued could also be the basis of electron spin geometry among other things (see [5]), *time* is made malleable; no longer continuous, or rigidly uniform as in Newtonian conceptions, or subservient to space as in Einsteinean relativity, time "flow" can go to zero, and can even reverse under the application of certain electrodynamic field configurations such as provided by the caduceus coil and other devices [5]. With tachion dynamics even the laws of causality will no longer hold. This is due to the fact that tachions have a much broader field of operation than the purely physical realm. Thus, many unusual demonstrated features relative to quantum theory, such as the principle of Indeterminacy, quantum non-

locality (EPR experiment), "entangled particles" as well as hypothesized qualities of an *aether* of space, can find their source in this microscopic non-linear electrodynamic clocking oscillation attributed to the tachions. In fact, the ultimate expression of time as well as space to our sensory perception, could be a direct function of these substratum pulsations. From this consideration there emerges a new dynamic model for **fundamental time** as a "fluid-elastic" field effect arising from the unique ratcheting oscillatory motion of tachion-pair entities. Ultimately, it will be seen that tachions may even form the structural essence of consciousness itself, thus providing the long sought-for unifying link between physics and metaphysics.

N. Kozyrev

Other Recent Russian Research Implying New Dimensions for Time

Another key researcher who postulated an active substantial role for time was the Russian astrophysicist Nikolai Kozyrev [7]. He argued that the gap between the exact (physical) sciences and the natural sciences will not vanish until the principle of causality differentiating cause and effect is placed at the basis of the exact sciences. This implies the objective directionality of time or its flow. We encounter numerous manifestations of this principle in our life and in natural science. Yet this principle is new in both mechanics and physics as a whole. The natural scientist's time is not Minkowski's geometrical time, nor is it the time of mechanics, theoretical physics, etc.

Nikolai Kozyrev argued that the gap between the exact (physical) sciences and the natural sciences will not vanish until the principle of causality differentiating cause and effect is placed at the basis of the exact sciences

As Kozyrev argued, mechanics has been using only the "geometrical" property of time, its duration size, i.e., the intervals between the events under study. Timed, these intervals acquire the same passive properties as the interval measured between two points in space. It is only this property of time that the objective sciences assumed to be existing objectively, postulating that all other time properties are subjective. However, if we want to differentiate causes and effects, in reality the *flow of time* must be a physical quantity, duly expressed mathematically and entering the equations of mechanics. The physical meaning and mathematical expression of the flow of time can be obtained from the space-time properties of causality. Thus, processes in the world occur not only in time, but also *with the aid* of time. Time flow is an active property owing to which time may act on a material system. Consequently, it is in the properties of time that the source maintaining the vital processes of the world must be sought.

From these arguments, we can also derive a fundamental property of time. Let us assume that we have changed by a certain technique the flow of time in a material system. In this process we have perhaps changed the stresses within the system and hence its energy.

However, it is impossible to change the total amount of motion of the system, i.e., to obtain a momentum equivalent to an external action. In other words, time may carry energy but no momentum. Time is a non-momentum material reality. From the above property of the flow of time, Kozyrev concluded that it follows directly that the rotation of a body may be used as a device for changing the flow of time in a system. Time flows into the system in the cause-effect direction, the rotation increases the flow, and hence the system obtains additional energy.

In attempt to verify his theories, in the 1950s, Kozyrev thus performed experiments with spinning gyroscopes and discovered, in agreement with his predictions, that the weight of the spinning system changes slightly depending upon the magnitude of the angular velocity and the direction of

rotation. Although the effect detected was not large, the nature of the arising forces could not be explained by existing theories. By applying a vibrating framework to the gyroscope, Kozyrev also found that not only does time deliver an energy, but that near the cause-effect system *time density* changes. Time is rarefied near the generator and becomes denser near the receiver. In other words, time becomes stretched by cause and compressed by effect. In addition, the variation in time intensity is in inverse ratio to the first degree of the distance. This can be seen by the following consideration: Time is expressed by rotation and hence involves planes passing through a pole of the rotating system with any orientation in space. **In the case of lines of force issuing from a pole, their density decreases in inverse ratio to the square of the distance, while the density of planes can readily be shown to decrease with the first degree of the distance.**

Kozyrev discovered another property of time when investigating irreversible processes such as crystallization of a substance, condensation, or evaporation. This influence can be effected by any irreversible process and is registered by a measuring system without any preliminary excitation, i.e., when the cause and effect positions are not separated. In other words, apart from flow and density, time seems to have another property, causal orientation, resembling in a way the polarization of light [8]. This property proves to be so variable that even the sign of the observed influences may change and hence the reciprocal cause and effect positions become reversed.

Continuing his studies on the properties of time, Kozyrev (with V.V. Nasonov) conducted astronomical observations using a receiving system of a new type. When the telescope was directed at a certain star, the special detector positioned within the telescope registered the incoming signal even if the main mirror was shielded by metal screens. This fact implied that electromagnetic waves (light) had some component that could not be shielded by metal screens. When the telescope was directed, not at the visible but at the true position of the star, the detector registered a signal that was much stronger. The registration of the true position of different stars could only be interpreted as the detection of star radiation that had velocities billions of times the velocity of light. It was concluded that the radiation from stellar bodies hence had a component, which was non-electromagnetic. Kozyrev also found that the detector measured an incoming signal when the telescope was directed at a position symmetrical to the visible portion of the star relative to its true position. This fact was interpreted as a detection of the future positions of stars [9].

From the 1960's onward, additional Russian research groups continued and expanded upon the work began by Kozyrev on the unique non-electromagnetic radiation that was apparently a concomitant of all rotating bodies, whether accompanying macroscopic spinning objects of great mass (cosmological or terrestrial), or at the quantum level exhibited by elementary particles possessing recorded anomalous spin features which were not accountable by standard theories. This emanation which was exhibited by rotating bodies was termed torsion radiation [10]. Subsequently it was learned that this unique radiation was a part of all living or inert substances. This so-called "torsion field" research was carried on mainly in secret in the former Soviet Union, and only became known to the Western nations after the fall of the Iron Curtain. Many effects attributable to alterations in time and gravity have been reported through this research. For more information on this topic the reader is directed to this author's review in reference 10 and references therein.

Part II of II

Summary of Part I

It is the intention of this multi-part dissertation to motivate an imperative for considering the eventual establishment of a more expansive paradigm for the phenomenon of time, one which views time from the "substantial" as opposed to the orthodox "relational" standpoint. The

substantial concept of time implies the existence of an **active** essence which can and does affect objects and processes occurring in the universe. Furthermore, approaching time from such a fundamental basis implies that by positing active substantial change as the ground form **prime mover** and relational time (**passive** "clock-time", or entropy changes) as its derivative, that those objects and processes can also have a **reverse** action on time.

Towards this end in Part I (hereinafter referred to as I), we considered the key research of the late astrophysicist N.A. Kozyrev who, in carefully controlled experiments which were subsequently successfully replicated, recorded phenomena which have hitherto been unexplainable by standard contemporary received knowledge- whether from the standpoints of Newtonian, Relativistic or Quantum physics. Kozyrev pointed out that only by considering time as an active essence, could these cited "anomalous" phenomena, which are virtual conundrums from the viewpoints of a relational (passive) concept of time, be duly formulated on a logical basis. Accordingly Kozyrev's associated "causal mechanics" incorporates an objective directionality of time flow, implying differentiation between "cause" and "effect". **Consequently, by applying a thermodynamically irreversible process to a physical system (example: vibration to a spinning gyroscope), the rotor in this instance would be observed to lose (or gain) a small but detectable percentage of its weight, depending upon the direction of rotation.** Moreover, in this process **linear momentum** (linear speed of rotation) is not changed, but energy is nevertheless delivered to the system by additional forces directed along the axis causing a change in **angular momentum**, and that near the cause-effect system of the irreversible process, **time density** is altered - rarefied near the generator and concentrated in proximity to the receiver. Kozyrev concluded that time is a non-momentum material reality.

Other experiments of an astrophysical nature showed that registration of the true position or future position (as opposed to visual-present-position) of different stars via the non-electromagnetic component of star radiation, demonstrated the existence of an energy essence, which was apparently instantaneous, or had a propagation velocity of at least a billion times the velocity of light. In this regard, Kozyrev opposed the conventional astrophysical paradigm, which posits energy generated/ emitted by stars is a physical consequence of thermonuclear conversion. Instead he maintained that via rotation, stars converted time essence into non-physical (or pre-physical) energy. The latter was nevertheless detectable on Earth by transduction through reflecting telescopes shielded by metal screens, of stellar radiation by a Wheatstone bridge. Hence the "impact" of time was detected by resistor electric conductivity changes (see I and references therein).

Leaving no stone unturned in our investigation, we also took up a discussion of the related Killick-Smith tachion energy model for fundamental (pre-physical) reality. Here we coined a new term- a **trinitivity** of action, which was underscored as a key feature of the operation of tachion-pair entities. Accordingly, we posit the existence of two polar topologically orthogonal toroidal fields, with the unique ability, by the mutual shuttling back-and-forth of their energies, to exist in a third auto-generated state called "static-dynamic balance". Now, since tachions are hypothesized to transfer energy instantaneously, inertial/gravitational mass is not a primordial component of tachion operation (see I). Here we see a striking similarity to the Kozyrev conception of the operation of time in interaction with a physical system - where energy changes are manifested without linear momentum alterations delivered. Likewise, the Smith book, **The New Science** (see I) treats **the hypothetical tempic field as a scalar quantity, which only has direction in relation to its distribution (or "density" change). Only through establishing what Smith termed a *tempic field* gradient does the tempic field possess vectorial nature.** Similarly,

Kozyrev viewed time like space as possessing both geometrical and physical properties. The geometric property of time is duration (its scalar component), while physically the course of time is similar to vectorial field propagation and the density of time to field intensity. Although Smith and Kozyrev apparently never were aware of each other's research, the following quote from Kozyrev reveals that they both made key profound discoveries about nature which indeed bear more than a superficial similarity: "Time density is a scalar quantity, just the one observed in the above experiments. Time density decreases with increasing separation from the process creating it. Therefore, a vector property corresponding to density gradient and tractable as time obtaining, should also be observed"[7]. However, in I we also enjoined the reader to observe caution and selectivity when attempting to separate the wheat from the chaff in Smith's book.

Accordingly, the previous ideas are substantially correct, whereas his concept of "continuous spin" of tempic field energy is basically flawed. Killick replaces this outmoded counter-productive notion with a key ratcheting motion, like the escapement of a watch, which is performed by the tachion entities composing a pair-unit. Through this unique "clocking-motion", a cycle of tachion-pair operation exhibits what could only be described as an **ethical modus operandi**, passing through the three stages of observation - reflection - action. By virtue of this 3-stage process, tachion-pairs demonstrate in their individual activity and in interaction with their environment - *personal moral responsibility*.

This is indeed an unprecedented notion which implies that a type of conscious thought process can be ascribed to tachion operation. This can be related to current notions from quantum physics, relative to quantum coherence of states - such as wave-function collapse, Indeterminacy, quantum non-locality (EPR experiment), "entangled" particles, etc. This may be an indication that in such cases, whenever the Principle of Causality is breached or at least compromised, we may be witnessing the unique effects of the inherent conscious microscopic non-linear clocking oscillation of the tachions.

Along these lines, although Kozyrev did not report observing any effects of time energy, which could be considered as "value-motivated", he did report on an equally mysterious "after-effect" in many experiments, which could only be construed as signifying a **memory** process. For instance, it turned out that in experiments with a vibrating torsion balance (or pendulum), at points of support the emerging additional forces did not disappear when the vibration was stopped, but remained in the system for an appreciable time. Interestingly, **their relaxation times were found to be independent of the mass of a body but were dependent on its density**. The largest effects with maximum preservation times were observed on porous materials like brick or volcano tuff. In enumerating on this unusual preservation action Kozyrev observed: "...a body placed for a certain time near an (irreversible) process and then brought to a torsion balance, produced the same effect on it as the process itself...aluminum showed no memory. The largest memorizing effect for processes of both signs has been shown by sugar"[7]. Also, his colleague Danchakov later observed in conjunction with biological experiments that water with decreased viscosity due to having been subject to the action of a process, exerted a distant action on water that had not been under such an action, causing its viscosity to decrease as well.

In this second part of the current dissertation, we will examine other important related information gleaned principally from esoteric sources, referenced in I. These have been obtained from books by Jane Roberts: **The Seth Material**, **The "Unknown" Reality** (UR) [2], unpublished transcripts (J.R.)[1], and transcripts from the entity Kryon channeled by Lee Carroll [3]. This information is remarkably corroborative with that from Kozyrev research and the tachion energy theory. Finally, we will cap off

our exposition with a brief examination of a bold new maverick physical theory of sub-atomic electron structure, featuring variable time/mass attributes, which could be the catalyst for bringing the cited elements from esoteric knowledge and empirical physics research (Kozyrev, etc.) out from their hitherto relative obscurity, to the forefront in our ongoing mainstream investigations in probing the cutting edge frontiers of not only physics, but those of the natural sciences as well.

Other evidence

When one compares the transcripts from various esoteric sources it's remarkable how similar is their description of nature's fundamental operations at the pre-physical level. For instance, a careful reading of the Jane Roberts' channeled transcripts from the entity Seth, reveals a remarkable close connection with the particles termed EE (electromagnetic energy) units and the above Killick teachings on tachion pair dynamics. But first a word of caution to the reader. We should resist the tendency to put into the frame of reference of our sentient physical experience, structures whose essence is fundamentally non-physical. The customary physical characteristics of duality and dichotomy of fields, and the related yardsticks of mass, length and time, for the most part, may not apply in this situation.

It would be impossible, however, to formulate a comprehensive model for the EE unit dynamics were none of the factors for gauging physical reality to be able to be applied to higher dimensional realms. Fortunately, one characteristic does survive the transition to the non-physical framework- the element of **pulsation**. Seth reports in [2] how EE units, much like tachion-pairs are built up and dynamically pulsate in response to thought patterns. First, depending upon the relative intensity of the emotional energy, they will instantly be drawn together in clumps or may just as quickly disperse. Furthermore, being of a pulsating nature, these units can expand and contract. Theoretically, there is no limit to their size or frequency of pulsation. Seth describes their operation in the following manner: **Now, there are electromagnetic structures, so to speak, that are presently beyond your instruments, units that are the basic carriers of perception. Their size varies. Several units may combine, for example. To put this as simply as possible, it is not so much that they move through space, as that they use space to move through. There is a difference**.

On this point, if our conceptions remain "earthbound" we will not perceive any difference between these actions, but once we cast our mental gaze beyond physical experience, an important distinction becomes apparent. To understand this, we need only reflect on the similar non-classical logic that is the basis for the non-orientable Moebius topology that we have seen governs the dynamics of the tachion-pair unit [5]. Tachions, whose translational movement is governed by the relative pulsation frequency, apparently enter and leave our level of reality at two times (field equity stages) during each pulsation cycle. Before leaving our plane, the tachion-pair constitute what we call a space-time point.

Upon returning to our level, due to the Moebius topology of the clocking cycle, their essence creates a new space-time point with enantiomorphic (mirror image) characteristics to the first. The resulting progress of the units in physical reality is thus manifested by a "jerkily discontinuous" movement. Summing up, since the units **are** the point they create, it can now be understood that the units **use** space (or the nature of the space-time points) to move through, rather than the case of macroscopic matter which moves continuously (or appears to) through space.

Seth continues his description of the EE unit dynamics: *Laws of attraction and repulsion are used and, in a manner of speaking, thermal qualities are involved, and this is the only hint that your scientists have received of them so far. The units charge the air through which they pass, and*

draw to them other units. The units are not stationary in the way that, say, a cell is stationary. These units have no "home". They are built up in response to emotional intensity. They are one form that emotional energy takes. They follow their own rules of attraction and repulsion. As a magnet will attract with its filaments, so these units attract their own kind and form patterns which appear to you as perception. They are electromagnetic, in your terms, following their own patterns of positive and negative charge. In this instance, like definitely attracts like. The units are just beneath the range of matter. None are identical. However, there is a structure to them. The structure is beyond the range of electromagnetic qualities as your scientists think of them. Consciousness actually produces these emanations, and they are the basis for any kind of perception, both sensory and extrasensory. These emanations can also appear as sounds and you will be able to translate them into sounds long before your scientists discover their basic meaning. One of the reasons they have not been discovered is precisely because they are so cleverly camouflaged within ***all*** *structures.*

Being just beyond the range of matter, having a structure, but a non-physical one, and being of a pulsating nature, they can expand and contract. They combine qualities of a unit and a field, in other words. Since they are beyond the range of matter, upon which matter is formed, they will not follow the laws of matter, although at times they may ***mimic*** *the laws of matter. It is almost impossible to detect an individual unit, for in its dance of activity it constantly becomes a part of other such units, expanding and contracting, pulsating and changing in intensity, in force, and changing* ***polarity****. It would be as if the positions of your north and south poles changed constantly while maintaining the same relative distance from one another, and by their change in polarity upsetting the stablility of the planet- except that because of the greater comparative strength at the poles of the units, a newer stability is almost immediately achieved after each shifting.* Even the altruistic motives of the tachion-pair as cited by Killick parallels similar behavior of these EE units.

Again from J.R.: *The behavior of these units changes in the following manner. When a unit is in the act of combining with another, it aligns its components in a characteristic way. When it is separating itself from other units, it will align its components in a different way. The polarities change in each case, within the units. The unit will alter its polarities within itself, adapting the polarity-design of the unit to which it is being attracted; and it will change its polarity away from that design on breaking contact.*

Ken Killick has described the mutual action of several tachion-pairs bonding, as the origin of standard sub-atomic particles possessing features known to modern science such as mass, charge, spin angular momentum, magnetic moment, etc. Thus, according to tachion energy theory, the electron attains its validity, and maintains its structural integrity, by virtue of relations between the component pair dynamics [see [5]). Since for the bulk of their independent existence, tachion pairs are in the pre-physical state, we can speculate that they may actually be superluminal entities. Remarkably, J.R. echoes this view with similar notions: *...the electron achieves its validity because of these* (possibly superluminal) *orbital units* (tachions?). *What we see as an electron is not made of the same things as the orbital units, however; it is an* ***effect****... when you change the structure of the electron, you are changing the relationships between the orbital units. This change will require an application of energy. It may be possible to construct a chamber that would give the electron more freedom.*

Whatever we do now in the handling of electrons is not giving them enough freedom and we are structuring the way in which they can appear. The next observation made by Seth could prove to be essential in clarifying the true nature of time: *... If electrons were given more freedom they would affect* **our notion of time in perceiving them. The way the measurements (on electrons) are made forces the electron to appear**

in a particular way, but actually it's flitting around, seemingly in many places in rapid succession (pulsing in and out of physical reality). Turning to the structure of elementary particles in [2], Seth offers a similar observation in which he describes the electron as commonly perceived by scientific measurement apparatus, as merely a shadow or facade of the actual electron entity which constitutes a multi-dimensional structure.

In terms of a structural model for the electron, Seth says it would be more appropriate to view these units as composed of *interrelated fields* rather than as the current conception of a particle or a wave. Correspondingly, both of these criteria are key elements of the tachion theory, which posits the electron as composed of two-pair tachion fields. The electron achieves its stability-integrity from the interaction of these free-wheeling units.

Electron Spin and Structure of Fundamental Time

The electron "spin" feature is also claimed to be integral to the exhibit of "time's arrow" in UR [2]: *The electron spin determines time "sequences" from your viewpoint. In those terms, then, a reversed spin is a reversed time motion... electrons, however, spin in many directions at once, an effect impossible for you to perceive. You can only theorize about it. There are "electromagnetic momentums" thus achieved and maintained- certain stabilities that operate and maintain their own integrity, though these may not be "equal" at all portions of the spin. There are equalities set up "between" the inequalities... time, in your terms, then, is spinning newly backward as surely as it is spinning newly into the future. And it is spinning outward and inward* (pulsing inward and outward of physical reality) *into all probabilities simultaneously.*

It is vital that you understand this inward and outward "thrust" of time, however, and realize that from this flows the consecutive appearance of the moment. The thrusting gives dimension to time that so far you have not even begun to realize... This inward and outward thrusting allows for several important conditions that are necessary for the establishment of " relatively" separate, stable universe systems. Such a system may seem like a closed one from any viewpoint within itself. Yet this inward and outward thrusting condition effectively sets up the boundaries and uniqueness of each universal system, while allowing for a constant give-and-take of energy among them. By their unique operation , the EE-units, which form the elementary particles such as the electron, serve as the conduit for this energy flow once it is transduced by elements of thought that Seth terms "consciousness units"(CUs). Continuing in UR on this subject Seth **describes how time can be alternately created or "broken down"**: *The consciousness units serve as source points or "holes"* (Black holes or White holes?) *through which energy falls into your system or is attracted to it- and in so doing, forms it. The experience of forward time and the appearance of physical matter in space and time and all the phenomenal world, results. As CUs leave your system, time is broken down. Its effects are no longer experienced as consecutive, and matter becomes more and more plastic until its mental elements become apparent*. These observations are corroborated by Kryon in his dissertations to follow.

Specifically, in the Kryon channelings, further insight on this electron "freedom" is given in the context of change of frequency: *...There is something we call the electron haze which is around the nucleus of the atom. The space between the energy haze and the nucleus (which is great), varies more than you think in matter. As the space varies, the speed (*frequency*) of the haze must change. It is in the physics where the speed of the haze is strong and fast that you have a different time-frame than your own... you have not yet accepted that an object can seem to be stationary- yet traveling (*vibrating*) very fast. Not in a linear time from point A to point B, but in the electron haze of its vibrating parts.*

J.R. corroborates these comments in this dissertation: *Einstein considered relationships of this sort that hold in the far universe as one increases velocity towards the speed of light,*

*but there are also "inner" situations (*altered **stationary** states*) that relate these quantities, and that are much easier to get into.* In regards to atomic structure to allow for frequency changes, Kryon adds:*What is it that makes the distance between the parts change? This is the puzzle for the scientists. For the area between the nucleus and the energy haze although vast, is not void. It is a patterned soup of energy (*the so-called "vacuum"*), and it is within the pattern of this null that changes the distance, and therefore the speed* (frequency*) of the haze.*

Mass, gravity and time are intimately related to this frequency change in the atom. Witness the comments from J.R.*: **Time exists as an invisible drag on matter and this is interpreted as gravity. Time exerts a definite force like gravity, and this is connected with the behavior of the electron.** However, since we always look at electrons in a certain way and gravity in a certain way, we miss the connection.* And this related comment as well: *There is another equation to be discovered that expresses the relation between time, mass and gravity.* Kryon reiterates this sentiment, along with relatively detailed scientific information: *Gravity is an absolute product of the characteristics of mass and time... one of which you may change.*

*What has been missing so far in your thoughts is how gravity is related to time, and that the entire issue of gravity, mass and time is non-linear. You have yet to develop the formula of physics. It is not here yet, and we are going to give you three attributes of the formula, but without the formula. These attributes are understood but the way they relate are misunderstood. Your science is just now beginning to see the shadows of them, however. The first attribute of the formula is the ability to understand the **density** of mass. Why is the electron haze so far from the nucleus? We have told you that you can change this distance, and in doing so, the density will change in the mass that is defined by the atoms being shifted. The electron haze will have to vibrate faster (this is possibly the "freedom" referred to earlier by J.R.), the closer it is to the nucleus; when the electron haze vibrates faster, its **time-frame** will shift. Therefore, the second attribute of the formula is a time-shift, and they go together. Also, be aware that you make an erroneous assumption that the actual speed (frequency?) of the electron haze must always be the same no matter what the distance. This is not understood yet either. There is a difference between speed (velocity/ translatory rate) and vibratory rate, and it has to do with the actual physical definition of the **electron haze**.*

Mass discrimination is the ability to control the density of mass. With a density shift will come a time-shift, and with a time-shift will come a third attribute...we will call the **reality of location**, or where the matter is... in which dimensional reality it goes to when shifted. Here is an axiom: **shifts in dimensionality when matter is changed in this fashion create a reality where the matter has to be to exist in its new form**. It might be inches from where you changed it or miles. That depends on how much it got changed. The difficult thing to explain to you is a concept that has not been recognized... that matter has a **reality index**, and that its core attributes are linked to where it exists in time and space. Therefore, the three attributes that must work together are **density, time-frame and location**.

Electromagnetic Field Manipulation of Cosmic Lattice and Time-Space-Matter

In regards to tapping this (mass-free) energy-haze-soup, between the atomic nucleus and electron shells, Kryon speaks thusly: *There's something we are going to call APD (atomic phasic displacement). This is a term that is going to refer to the ability to tap the (Cosmic) Lattice for unlimited energy. The Cosmic Lattice is balanced, but it is not quiet. The Lattice has astounding power. It has a flow of energy that I cannot explain to you, for there is no paradigm model for it yet in your thinking. Therefore, you would not easily understand. The Lattice has vents that we can best describe as necessary for the flow of energy. It balances the slight inequity of the*

polarity. The vents also have to do with time... you will always find two vents together. One will be prominent, the other will be secondary. You might graphically and clearly see one, but you will have to look carefully to see its partner. There are always two. This is an axiom or physical rule of the Lattice energy, and of the universe: This information remarkably parallels Killick's teachings on tachion energy pairs.

Witness this Kryon pronouncement:*Hiding within common atomic structure is a marvelous peek at something that will totally and completely mystify you, for it will seem to break all the laws of time and space. The" twins" are a pair of atomic parts that always relate to each other, and are always found in pairs. You will discover that when stimulated correctly, they will always move together as a pair. When you start separating them by distance to experiment, they will continue to move exactly together. If one's energy is converted, then the other will do the same. This will cause you to totally reexamine your ideas of time and space, for this condition will not follow the "ultimate speed" of transmission that you thought was correct... that of the speed of light. You will have discovered something that travels faster than you can ever measure*. Compare this statement with the torsion energy claimed by the Russians to travel at a billion times light speed [10].

In returning to the discussion on how to tap the Cosmic Lattice for energy, Kryon continues: *The vents are very necessary for the balance of your universal energy. The vents are also energy portals, (drains, to you), and are where the front of each Lattice cell touches the back... Like so many other physical processes, however, its going to take a tremendous amount of energy in order to unbalance even one cell's null attribute... Once you understand how to" prod" the null to unbalance itself, you will be rewarded with a steady flow of energy, far beyond what you put into it. This is accomplished since you create your own tiny "vent". An unbalanced cell creates a situation where the other cells around it will try to" feed" energy to the one that is unbalanced. This creates a tap that will pull upon the Lattice indefinitely, as long as your work matches the properties the Lattice expects to see.* Kryon further expands on the specific method to accomplish this...*Here's how it works. Two magnetic fields together, postured in the correct way- a way that is very three-dimensional in your thinking process- will create a "designed magnetic field" that is very specific.*

> *...your math told you that there might be a possibility of invisibility and that was your goal. This was again because you did not understand that because the distance between the parts change, it doesn't necessarily mean that the overall size will dramatically change or that it might vanish...*

It's one you have never seen, and does not exist naturally. Start with trying several magnetic fields postured against one another- of unequal force and pattern, and at right angles. Don't make any assumptions. Think freely. Done in the right fashion, these two fields will create a third pattern which is unique and is the product of the original two. This third custom-created pattern is the one that you want to deal with, and is the one that has the potential of manipulating the Lattice. Once you have created it, you will know of its special qualities by how dramatically it changes the physics around it. And this important admonishment is given: Here is a caution. *Keep this experiment away from your body. Keep the experiment in check with your scientific methods. Go slowly. Understand what you're seeing before you go on to the next step. Do not expose yourself to any magnetic fields. Remotely conduct all energy experiments. Remember that magnetics also plays an important part within your body (DNA components).*

Here is another. Understand that if you unbalance the Lattice too grandly and too greatly, you will have a ***time displacement****,*

for the process also involves the property of ***time****... One of the actual physical players in the creative process of unbalancing the Lattice is the manipulation of the time-frame of matter.* ***This is not time travel, but time displacement.*** *It is where you are actually addressing tiny parts of matter, and changing the time-frame they are in. When the inequity of time-frames meet one another (*matter mixed up with differing time attributes*), the result is a displacement of distance (*reality of location*). Although there is no horrendous danger for Earth within this time displacement, it can and will affect the local situation within the experiment. In other words, it can create a matter-distorting effect, completely stopping the experiment, and actually dislocating the parts. We are not going to say any more about this at the moment, but the more astute scientific minds reading this will go to the next obvious step... and the answer is "yes", the Lattice is also the key to quick travel of large physical objects... even of very short distances.*

Possible Documented Demonstrations of Time-Space Warping

Such fantastic transformations were possibly evident in the Hutchison experiments [11], in which metal samples were catastrophically fractured when exposed to radiation from the unique electromagnetic field effect. It was also noticed that many physical objects of different composition which were separate in space before the electromagnetic field was applied, became inexplicably embedded in each other once these objects were radiated by the field effect. For instance, **pieces of wood contained metal knives**, etc. Other metal samples were catastrophically fractured in their molecular-atomic crystal arrangement, producing a substance which was uniform and geometrically symmetrical at one end but appeared to have the resemblance of corrugated cardboard at the other.

Also, similar to Kryon's assertion of the inevitability of time-shift with mass altering phenomena, in Hutchison's work anomalous inertial impulses were recorded on film, sometimes resulting in the complete lift/levitation of various substances of different mass. We notice also anomalous inertial impulses were a feature of the Zinsser "kinetobaric" effect [12], in which due to excitation by **sawtooth microwave impulses with very fast rise time**, a sample attached to a torsion balance, deflected the balance for days and weeks after the original excitation was extinguished. Notice the similarity between these results and those of the Kozyrev experiments, some of which reportedly featured a memorizing preservation effect on a torsion balance, etc.

We also find additional confirmation from the basically anecdotal evidence from the alleged legendary Philadelphia Experiment in 1943, which apparently caused either large time- or space (teleportation) shifts in a Navy ship. In fact, in another piece Kryon himself possibly speaks directly about the Philadelphia Experiment, providing us with further insight into important possible new paradigms for time, mass and energy: *In all your questions regarding magnetics and the massless condition, you have never asked about what happened in your year 1943. You tried to create a massless condition with coarse equipment and little understanding of what you were doing. In the process you actually did create an unstable massless condition for a moment. Its instability created a situation where, instead of a true massless condition, you received one where the time-frame changed but the parts within the sphere of the time change did not have the fine-tuned synchronicity needed for a massless object. The result was an actual distance displacement of the object instead of a true massless condition. Indeed, humans were involved on the large object and their biology was damaged greatly. Your experiment was done in an atmosphere of desperation, and your goal was flawed. For your math told you that there might be a possibility of invisibility and that was your goal. This was again because you did not understand that because the distance between the parts change, it doesn't necessarily mean that the overall size will dramatically change (or that it might vanish).*

Although this may seem like a paradox to you, the internal mechanics of small particle behavior supports this. The change is measurable but very small, much like what happens with heat and chill...Many of you have guessed correctly that ***magnetics and electricity play a critical role in the determination of the real attributes of mass****... and the magnetic variables that determine the mass product, are often working within very small particles to create the density of an object and also its time-frame. The time frame of a massless object is slightly different than your own, making you to appear slightly slower than the massless object. Its reaction to more traditional mass molecules around it is also predictable: because of the very slight time displacement, it tends to change the number of electrons within the atoms directly in contact with it. This is a clue on how to detect a massless object even if you can't see it.*

*The reason you felt the object (*ship*) would vanish was that you were able to simulate a "vanishing" in the laboratory with smaller objects. This observation was not consistent however, so you again were in desperation to try this experiment on a larger object. The "vanishing" was an illusion and was due to a distance displacement rather than an "in place" vanishing... does this give you a clue to long distance travel using magnetics and the vibratory rate of matter?... Only one human on the planet has ever captured a true massless condition, and even this was a coarse one and lasted for only for a few moments that were uncontrollable in scope. This massless condition was created in the primitive workshop of a great electrical scientist in your culture on the American continent not too long ago. If you were able to visit his workshop, you would note the holes in the ceiling and the patched glass-covered light port where his massless objects took off and wildly flew everywhere. If he had been born 50 years later he would have been able to control the attributes of the experiment. As it was, he did not have the precision tools you have now to direct and control such an experiment. It was his great passion to understand this phenomena, but because it was so uncontrollable and sporadic, he was never able to bring others to see it work, for he could not accurately create it consistently. This depressed him in his later years, for his was a great three-dimensional mind...* When asked the identity of this scientist Kryon replied*: The inventor of your multi-phase current, born in the land you now call Yugoslavia.*

From the above information, there emerges a remarkably consistent picture suggesting that atomic structure may not be as rigid or immutable as formerly thought. Changing the fundamental frequency of vibration of atomic structure can perhaps apparently not only change the density of matter by altering the distance of electron shells from the nucleus, but in so doing alter the time-frame of that object, its mass and also the reality of location of that substance. Certainly, the implications of the Kozyrev research, among others, can possibly form the basis for the eventual technological implementation of these futuristic principles. Perhaps those experimenting with the relatively detailed data provided by Kryon on APD can actually realize this coveted goal.

Maverick New Theories in Physics Suggest Fluid Nature for Time, Space, Energy

The Dirac theory is to be understood as a theory of the electron with electromagnetic interactions. It consists of the Dirac wave function and its properties, including the Dirac equation and relations to physical variables such as energy-momentum, spin and position probability current. In spite of its indisputable mathematical successes, the Dirac theory is still without a completely satisfactory physical interpretation. In particular, the so-called *zitterbewegung* ("jitter motion") is a distinctive feature of the Dirac theory which continues to be the subject of conflicting interpretations in the standard scientific literature. The concept of zitterbewegung was introduced by Schrodinger to interpret high frequency oscillations in free-particle wave packets of the Dirac theory. These oscillations with angular frequency $2mc^2/h$ arise from

interference between positive and negative energy components of a wave packet. Schrodinger interpreted the oscillations as fluctuations in position of the electron about an average motion. However, this concept has not been interpreted in the bulk of the literature as having an objective significance, but has erroneously been viewed by standard theory as a mathematical artifact of the one-particle Dirac theory which does not appear in a correctly formulated quantum field theory.

However, as noted theoretical physicist David Hestenes suggests in the first of his recent article series in the journal, **Foundations of Physics** [13], it is only by interpreting the zitterbewegung literally and objectively as point particle motion, that a complete and coherent interpretation of the Dirac theory can be achieved. Moreover, this model has implications that have not yet been previously considered by established physics that relate directly to some of the key features of sub-atomic behavior enumerated in the tachion energy theory and also in the microscopic dynamics of elementary particles revealed by the selected esoteric channelings that we have previously considered in the present exposition.

In particular, it implies that the electron is the seat of a fluctuating electromagnetic field which oscillates with the DeBroglie frequency of the electron (1.6×10^{21}cycles/sec).

Thus, it tells us that a kind of electromagnetic wave-particle duality is implicit in the Dirac theory. Of course, this contradicts the conventional view that wave-particle duality is a property of matter which is completely independent of the nature of its interactions. If the zitterbewegung is an objective phenomenon, then it originates from electron self-interaction, since it persists in the absence of external fields. In this new theory which considers the zitterbewegung as an objective physical phenomenon, the electron mass and spin can be identified with the energy and angular momentum of electromagnetic interaction. It suggests that the self-interaction is such that there exist certain stable, non-radiating but accelerated states of motion; in particular, for a free particle, this implies motion in a circle with the radius of a Compton wavelength- the zitterbewegung. The zitterbewegung implies that some of the mass, at least, is kinetic self-energy associated with a spin, and it reconciles the mass with a zero mass of the bare electron. Thus, according to this bold new theory, the electron spin arises from a helical world-line in spacetime. To be sure, some researchers have previously postulated such a helical electron dynamics. Unfortunately, such models have failed to explain why a helical motion for spin should depend on interference between positive and negative energy states or why the zitterbewegung should depend on the way a wave packet is constructed, or even how the zitterbewegung can be the origin for electron spin despite the fact that it vanishes for plane wave states that certainly describe a particle with spin.

The Hestenes model does offer an explanation for such effects and accounts for the ubiquitous feature of spin angular momentum as a function of the zitterbewegung. The essential unprecedented feature of the Hestenes' zitterbewegung idea is the association of the spin with a local circulatory-helical motion characterized by the phase factor of the electron wave function.

Thus, we reach the conclusion that the complex phase factor of the electron wave function can be associated directly with an objective helical motion of the electron, which is, in turn, a derivative of the zitterbewegung. Although the idea of helical motion connected with the electron has been considered before, it has not previously been related to electron phase to produce a complete interpretation of the Dirac theory.

Moreover, in the next installment of his dissertation [14], Hestenes argues that the zitterbewegung is not only an objective dynamical phenomenon associated with the electron, but is a ubiquitous phenomenon, with manifestation in every area of quantum mechanics, even in the non-relativistic domain. For instance, by showing that spin angular momentum can

be regarded as angular momentum of the zitterbewegung fluctuations, the zitterbewegung interpretation of the Dirac theory begun by Hestenes in reference 13 provides an explanation for the electron spin and magnetic moment in the physical circulation of momentum and charge. It also explains the mass as the energy of this circulation. Thus, the origin of the zitterbewegung is attributed to self-interaction of the electron with its own electromagnetic field. The relations derived by Hestenes in this article suggests that the interaction is of magnetic origin, since it has the form of a Larmor precession energy if spin angular momentum is proportional to a self-generated magnetic field. The so-called "rest mass" of the electron is thus a kinetic energy of self-interaction. It is this that gives the electron its inertial properties, and the flywheel-like nature of this inertia may be the ultimate origin of spin dependence in electron scattering. And the Heisenberg Uncertainty relations can now be attributed to the "zitterbewegung fact" that an electron cannot be confined to a region smaller than a Compton wavelength. Also, the stationary states of a bound electron exhibit a resonance of the orbital frequency with harmonics of the zitterbewegung frequency, which is imposed formally in the standard theory by requiring single-valuedness of the wave-function. Evidently, such resonances, so prominent in quantum mechanics, can be interpreted as zitterbewegung resonances. This leads to a new explanation of penetration of a potential barrier by sub-atomic particles as due to zitterbewegung fluctuations in momentum, and the Aharonov-Bohm effect as a shift in zitterbewegung phase. The zitterbewegung phase factor literally represents a physical rotation. The rotation rates of this phase in time and space directions are the source of the electron's energy, mass and momentum.

In his third paper [15], Hestenes draws a closer relation of the zitterbewegung dynamics to the Dirac theory by suggesting that the latter actually describes a statistical ensemble of possible electron motions, which are actually governed by the zitterbewegung sub-structure. Since the energy-momentum of the electron can now be interpreted in terms of a rotation rate in the spin-plane, Hestenes then derives a corresponding relation which defines a variable mass for the electron-another unprecedented idea which is in agreement with the information given by Kryon in his dissertations and Ken Killick's tachion theory. The mass m, the scalar radius of curvature r and the zitterbewegung frequency all covary with changes in the rotation rate in the electron spin-plane. Hestenes obtains a relation demonstrating that the electron mass is inversely proportional to the zitterbewegung frequency. This conforms to the relativistic concept of mass as a measure of energy content. But here, mass is concluded to be primarily a **frequency** measure. This also conforms to DeBroglie's original idea that the electron contains an internal clock with frequency determined by its mass, though for a free particle, the zitterbewegung frequency differs from the DeBroglie frequency by a factor of 2. Moreover, the new key relation derived by Hestenes: $m \cdot r = 1/2h$ (h, Planck's constant), says that this frequency measures the radius of curvature of the electron world-line, so it is a thoroughly geometrical quantity. Thus, as mass increases the radius of curvature decreases, in concert with the tachion dynamics as well. All this suggests that the electron mass relates our externally imposed time scale to a time scale intrinsic to the electron.

The reader can see that the information transmitted by J.R. is also remarkably similar in this connection. It should be evident that there is introduced a new concept of mass here, though, to a certain extent, it was already implicit in the Dirac theory. The formerly vague concept of mass as some kind of material stuff is completely gone. Also, no longer is vanishing mass a distinguishing feature of particles moving with the speed of light.

Corroborating Research on Oscillatory-Fluid Nature for Time

In his recent thought-provoking dissertation [16], Tom Bearden relates of

the dynamic influence of time on a material system: "But we can also legitimately state that 'time is energy' and be rigorously accurate...Time is extremely compressed EM spatial energy...Without further elaboration, we speak of a 'mass' in which a small portion exists as 'masstime' rather than mass, as having been 'time-charged' or 'time-excited'.

The t-polarization wave in the time dimension is quite unique: The *spatial* energy of the wave is in equilibrium and not vibrating at all; instead, the photons comprising the wave are vibrating in their **time**-components... In short, mass m is changed into masstime mt by photon absorption... Rigorously, a mass does not really 'travel through time' continuously, per se, but proceeds with an overall serial change mechanism, driven by its total virtual and observable photon interactions, as m→ mt→ m→ mt→...We propose that this may account for the duality of particle and wave...The particle actually oscillates at a high rate between the m and mt states... Mass 'travels through time' by an extremely high oscillation between corpuscle-like state and wave-like state". Notice how Bearden's description of the macroscopic operation of time on a physical system closely parallels Hestenes' proposed model for of the zitterbewegung dynamics at the sub-atomic level which provides the electron (and possibly photons, etc.), with a time-substructure (its internal "clock").

We can see many other places in Bearden's treatise where the unique terminology chosen can now be put into direct reference with equivalent concepts and unique phraseology employed by many of the researchers examined in the current exposition. This cross-referencing certainly provides much needed clarification about key ideas for researchers currently involved with the development of this fledgling discipline that we shall term causal mechanics, after Kozyrev's designation.

All such efforts will help to place investigative endeavors currently scoffed at by establishment science on a firm rational foundation, as well as assist in synthesizing seemingly disparate but surprisingly related "anomalous" phenomena. For instance, to implement the science he has termed "vacuum engineering", Bearden often speaks of the necessity of establishing a "local time-stress of the **vacuum potential**". This process, which as we hope to have shown here is completely legitimate, is identical to what Smith calls creating a "tempic field gradient", Kozyrev's "alteration of time-density", or Alexander Frolov's "change in the local time-rate".

It can clearly be seen that such ideas can only be perceived as science fiction fantasy, if we observe strict adherence to all current received paradigms (even in superstring theory), which consider space and time purely from their relational standpoints. These theories must of necessity involve models employing scalable metrics for their proper description. However, once we embrace the novel view posited here that vacuum energy is primary and both local space and time are derivatives of this mass-free non-scalable dynamic non-local oscillating substratum, then we can conceive of space and time properly as complementary aspects of non-local conscious reality, neither fixed in a scalable manner or subservient to the other, but fluid and mutually interdependent features of energy in constant flux (see the related ideas voiced by A. Correa and P. Correa in I).

With this approach we will then come to acknowledge the technological feasibility of many of the "futuristic" claims made in the channeled transcripts. For instance, we can see that it will no longer be necessary to propel elementary particles to relativistic velocities, or to probe astrophysical systems possessing large gravitational fields, to recognize alterations in space, time and mass parameters, since these phenomena can equally as well be accomplished in the laboratory by modifying atomic structure of stationary matter through electromagnetic means. Once again, peruse the Kryon dissertations on this process, for it may be key to future technology.

For those who wish to further investigate these theoretical possibilities, the papers of **A. A. Nassikas** are recommended. Nassikas has postulated what very few researchers before him have theorized: the existence of a ground-form probability density function for energy, as a necessary precursor to the malleable (deformable) characteristics of time and space [18]. One of Nassikas' conclusions is significant in light of ideas articulated in the present exposition concerning the hypothetical tachion-pair model for reality (see I). Here we refer to the key push-pull oscillatory ("breathing") operation between space and time, which may be responsible for the structural integrity of matter as we know it (again re-read the Hestenes zitterbewegung model).

Researcher **Alexander Frolov** has taken Nassikas' theory even further to suggest an explanation for the **anomalous over-unity effect** that has continually been demonstrated in low-energy nuclear reactions (LENR) over the past decade [19]. In such so-called "cold fusion" cells the Palladium cathode is over-saturated with protons, producing a local imbalance in the vacuum engine, causing a local alteration in the time-frame of the experiment to compensate the local change in energy density. **Subsequently, as Frolov claims, this time-frame change converts non-local time-energy directly into heat energy, similar to Kozyrev's description of energy production by stars.** Perhaps this observation might provide the hitherto missing key in our understanding of fusion by electrolytic action.

Conclusions and Prospects

In the preceding paper it is sincerely hoped that the author has demonstrated ample evidence that will spur on researchers of a kindred spirit towards the development of new paradigms for space, energy, mass and especially time. All these concepts, as well as the foundations of current classical electromagnetic theory, are in need of a drastic overhaul before we can fully appreciate and understand the operations of nature as it interrelates the metaphysical-mental realms with the physical level of reality.

At any rate, the continual appearance of research results, such as the Kozyrev effect, which up to present apparently resists explication in terms of conventional scientific paradigms, certainly offers clear evidence of the incompleteness of our knowledge of nature, even in this enlightened era since the dawn of the new millennium.

Accordingly, hints as to how the Kozyrev effect arises in association with the postulated active properties of time, and how the latter interacts with known physical forces, can assist us towards the development of a more comprehensive paradigm which embraces a wider spectrum of human knowledge - one in which the current conundrums rampant in the foundations of theoretical physics, and biological science disciplines as well, which have hitherto prevented the establishment of a unified model of all physical interaction, can find satisfactory solution. Also, such empirical evidence which generally flies in the face of current scientific wisdom, presents the greatest challenge to our ongoing search for new sustainable energy sources which will be of absolute necessity in the future.

In this light, if formally integrated into scientific thought, the tenets of tachion energy theory, which is based on an altruistic modus operandi, also may hold profound implications for the status of our very social, political and religious structures as well. Indeed, unlike the impersonally motivated interactions believed to be the basis for force interactions in modern sub-atomic physics, which help sustain our illusory belief in the supremacy of the ego, the philosophical basis of tachion dynamics is an able reminder of the humility of purpose which should be the guiding force whatever our walk of life. Like tachion-pairs, in the ideal social structure individuals will work side-by-side, yet achieving a common accord. United in the circle of their activity they will work together joyfully in freedom, each with his own task, yet always conscious of the common bond.

With the full import of these simple truths appreciated, tachions may afford a rational justification of the formerly "unprovable" mystical doctrine of the omnipresent intelligent plan behind the working of the universe at all levels of conscious reality. We will come to realize the profound truth of Einstein's vision of ultimate reality couched in his heretofore cryptic statement, *"God is subtle, never malicious"*.

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On the Rotating Permanent Magnet System

Alexander V. Frolov, Russia
7 Lev Tolstoy Str., St. Petersburg, 197376, Faraday Laboratory Ltd.

In one of our issues we published an article about the results of the experiment conducted by S.M. Godin and V.V. Roschin. They started in 1990 at Moscow Aviation Institute (MAI) when a technical physics laboratory was created in Machine Industry Projects Institute at the "Aeropromservice" Association. Their research work was financed by private investors and was continued in close cooperation with Chair 310 of MAI, especially with Prof. PhD. L.K. Kovalev, Prof. PhD. V.V. Rybakov and PhD. K.V. Ilyushin. By 1991 "a device for inner energy of matter conversion" had been designed and tested (according to the Technical Design Assignment). The prototype was finished in the middle of 1993 (Fig.1).

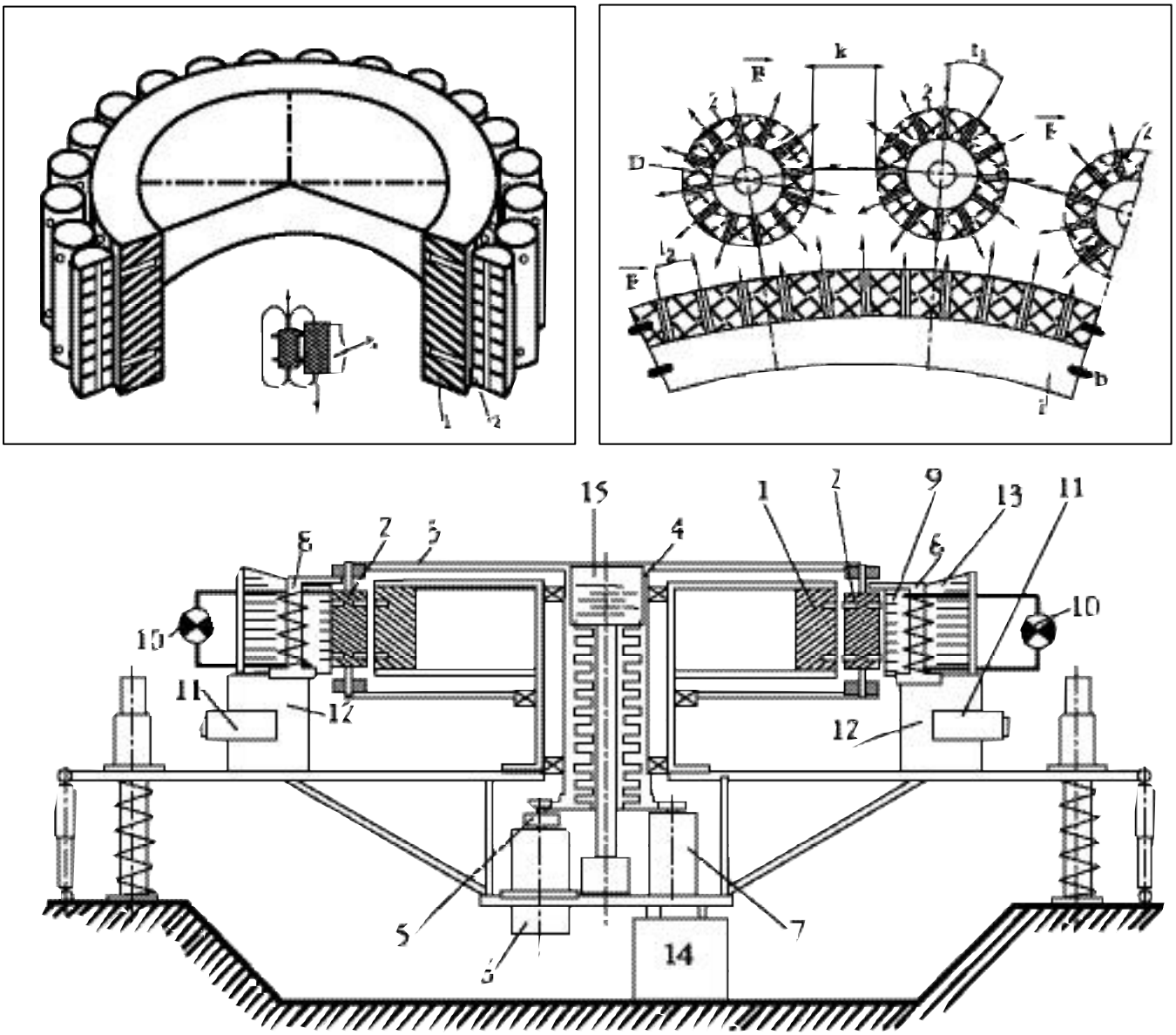

Fig.1

The experiments resulted in the possibility of creating a 7 kW output power in load after the rotor was sped up to 10 rps, but in the autumn of 1993 the laboratory was closed due to the investors' financial problems. Now their research work is continuing in Moscow and we hope the scientists will obtain new experimental results.

You can email S.M. Godin for more information at: smgodin@online.ru

Considering the theoretical basis of the functioning of these systems I should suggest a number of interesting details for prospective researchers.

S.M. Godin, V.V. Roschin et. al. (Physics of Negative Viscosity Phenomena. Prof. Victor P. Starr. Massachusetts Institute of Technology) spoke of vacuum (quantum medium) as **a physical medium possessing negative viscosity.** At that rate, it is worth making assumptions that can be useful to the developers of this topic. I think that standard (positive) viscosity of matter, from the physical point of view presupposes the presence of positive friction and a "work-to-heat" entropy transformation. Consequently, **negative viscosity** should correspond to the **negentropy cycle** "heat is converted to work". This is exactly the stray heat conversion once described by Tsyolkovsky in 1914. Apparently, **the medium of the kind supports self-sustained vortices** characterized by the surrounding medium heat absorption, which was mentioned yet not explained by S.M. Godin and V.V. Roschin.

It is possible that all the elements of matter are the self-sustainable vortex structures. To mathematically describe these physical mechanisms, the notions "heat-work-heat" transformation and "time" or "gravitation" should be interrelated. Russian philosopher Pavel D. Uspenskiy had been making related research since the year 1910.

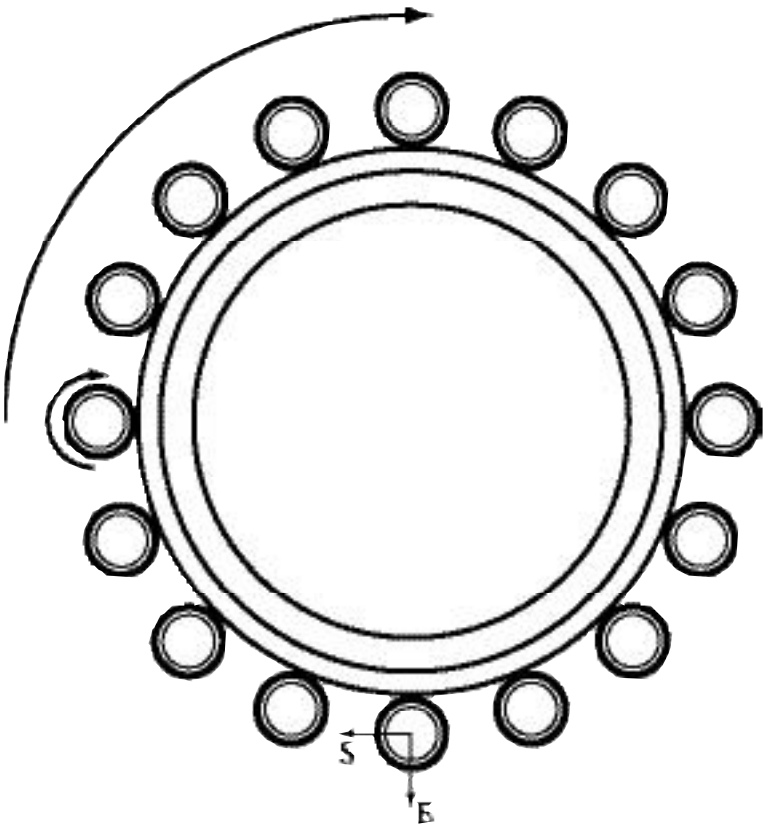

Fig.2

From the conventional point of view, this device (Fig.1) creates a circulating energy flux described by the Umov-Pointing vector (toroidal vortex) as the roller magnet field vector is vertical and the electric field is radial.

S.M.Godin (on the left) and A.V.Frolov (on the right), St. Petersburg, June 2001.

Inventor's Week Conference 2003, USA

Review is prepared by Editor Tatiana Ezhova

This year the annual Inventor's Week-end Conference was held on September 19-20 in Seattle, Washington. The conference featured several interesting inventions, including MEG.

Bill Alek demonstrated a device that he believed could let him detect Vortex-Energy. It was attached to a meter, and his belief was that if he walked into a naturally-occurring energy vortex carrying the device it would show him changes in gravitational and other energies. He cited the Vortices in Santa Cruz and Oregon as examples that might be good for experimentation.

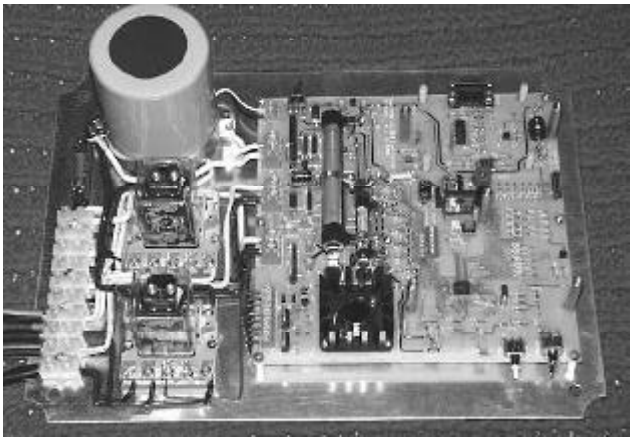

Bill Alek

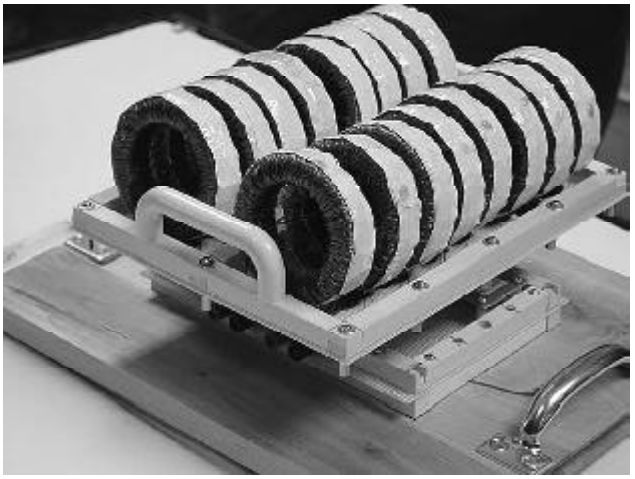

Z-Pod, Bill Alek

In his report "Introduction to Parametric Mass Fluctuation - a breakthrough in Energy and Inertialess Field Propulsion" Bill Alek presented the Z-Pod, developed to test a theory of solid-state parametric mass fluctuation. Here is the URL for a good overview of the device that he published online at www.intalek.com:

http://www.intalek.com/Index/Projects/SmartPAK/Projects/ZPOD/ZPOD_System03.pdf

Rio Von Sternberg

Rio Von Sternberg was presented as the original inventor of the MEG. He apparently has a patent on the device; however, from his presentation I understand that his configuration is somewhat different than the model that J.L.Naudin and T.E.Bearden have been experimenting with.

Alexander Peterson had a very interesting presentation on optical-mirror magnetic field systems. The crux of his presentation involved cutting precise notches into magnetic coils to separate them into identical optical-isomeric shapes. Apparently, by cutting a thin line directly down the center of the transformer-core is believed by Peterson to increase the efficiency of electric motors by up to 50%.

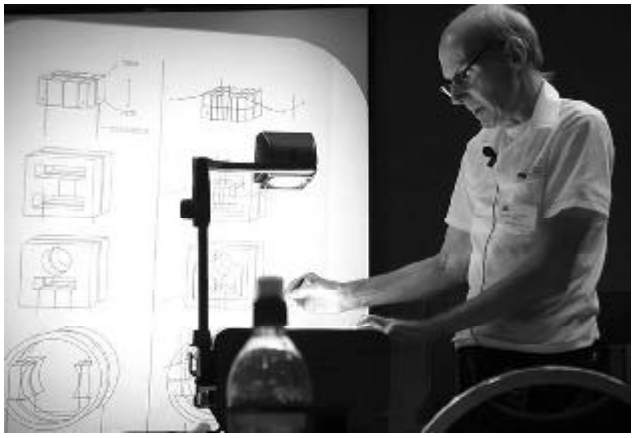

Alexander Peterson

Mark Plotkin, a well-known Washington DC attorney also took part in the conference. He is interested in new energy technologies and works with new technologies in collaboration with Mark Whitford at www.awetec.info. The photo of Mark shows him rotating a steel coil apparatus that was passed around the conference by Slim Spurling.

Mark Plotkin

Slim Spurling is an inventor from the Southwest, shown holding a helical-wound coil that he claims provides health benefits through an interface with zero-point energy. Spurling's belief is that this specific circumference of the coils provides a "Casimir-like Effect" that concentrates the energy.

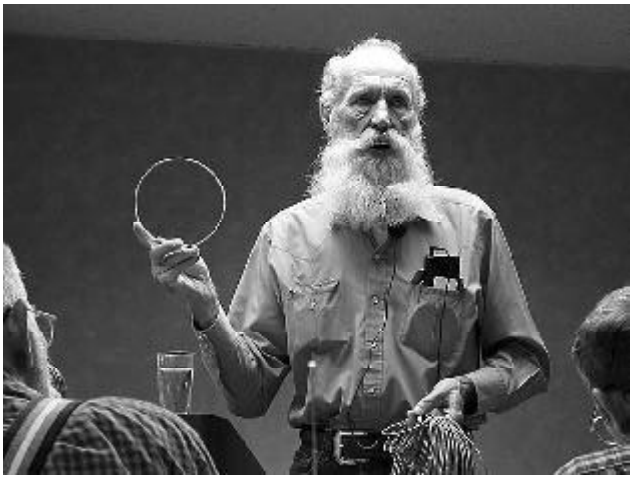

Slim Spurling

Donald Smith

Note: Donald Smith, a well-known inventor, also took part in this year's conference. His work is described in more detail in a separate article of this issue.

Full information on the conference and reports is presented at http://ionvalve.com/iw/2003/conference2003.htm.

USA "Inertia" Patents

Information from www.rexresearch.com/inertial/

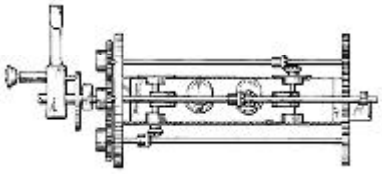

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Murray, Lawrence D.

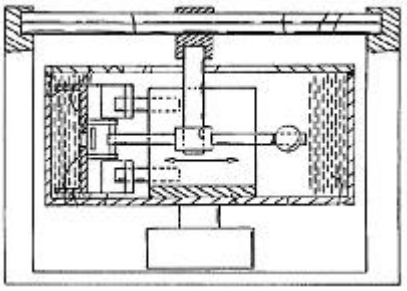

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Deschamplain, Daviv

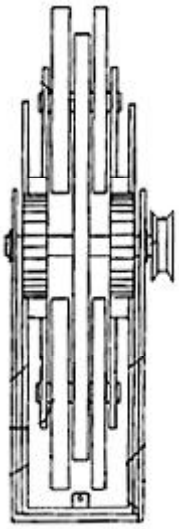

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Oades, Ross A.

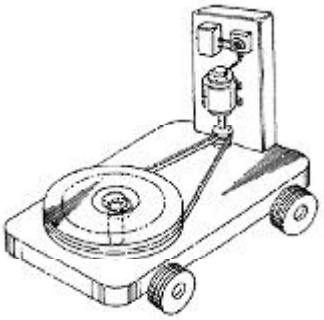

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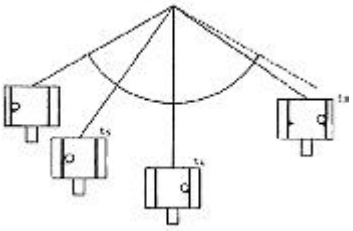

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Method & Apparatus for Propulsion
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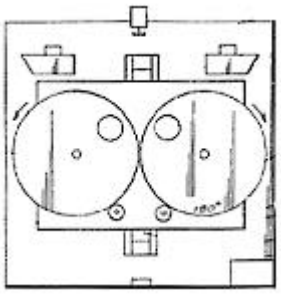

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Propulsion System
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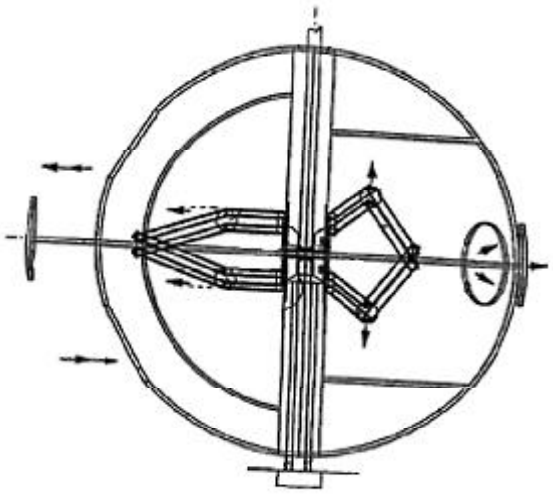

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Apparatus for Energy Transformation & Conservation
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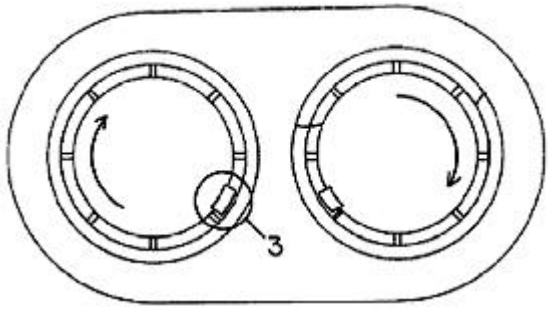

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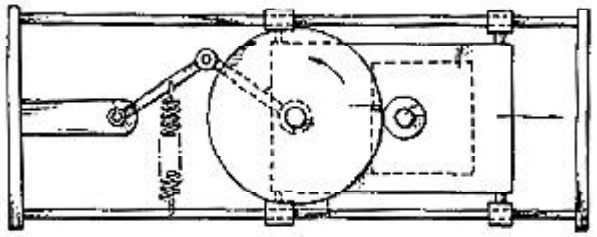

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Prime Mover
Auweele, Albert J. v.

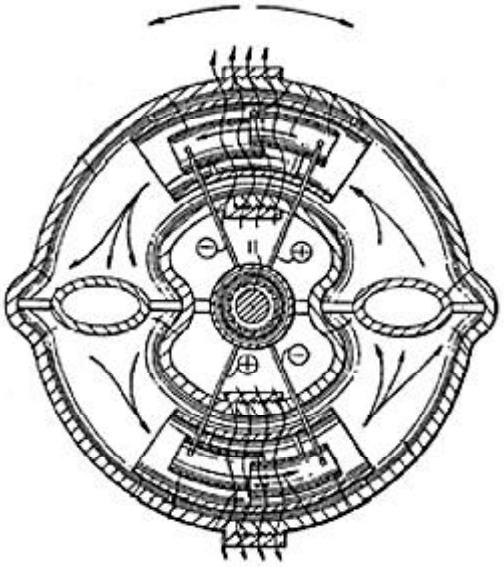

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Butka, Kemal

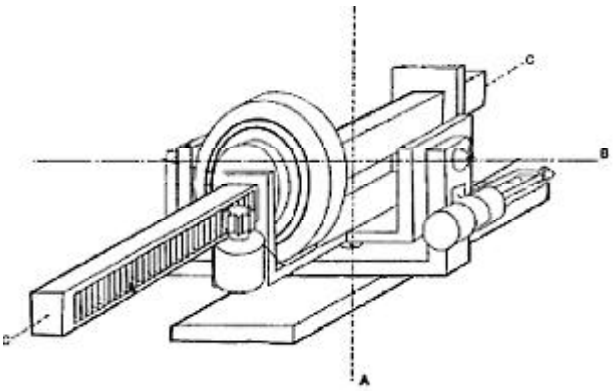

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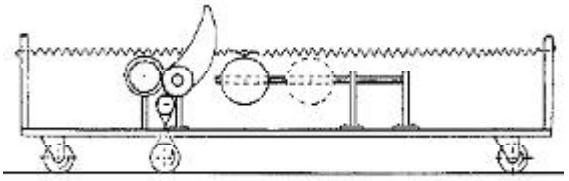

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Inertial Propulsion Plus Device & Engine
Foster, Richard E.

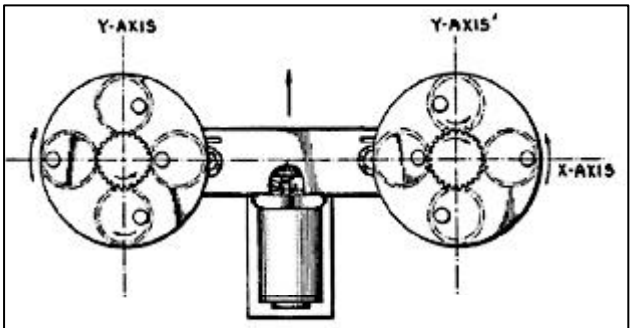

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Energy Transfer Device
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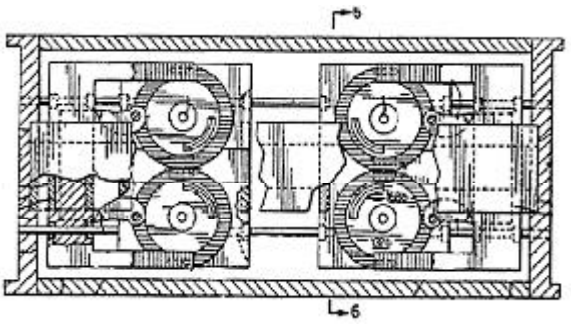

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Non-Linear Propulsion & Energy Conversion System
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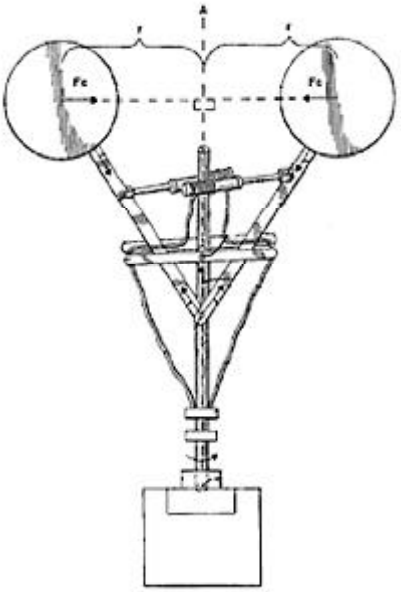

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Centripetally Impelled Vehicle
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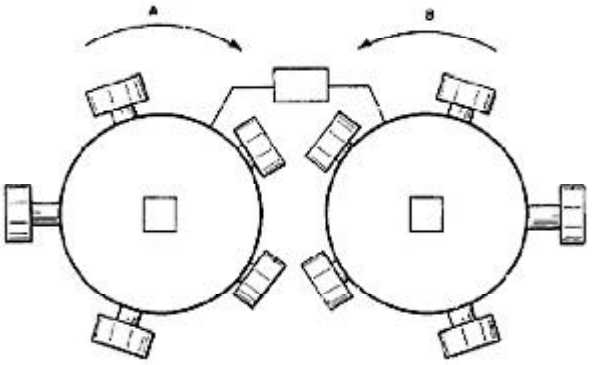

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Electromagnetically Actuated Thrust Generator
Bouden, James D.

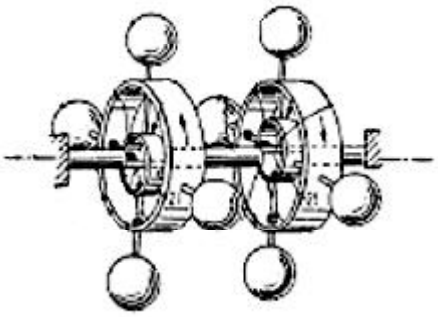

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Converting Rotary Motion to Lineal Motion
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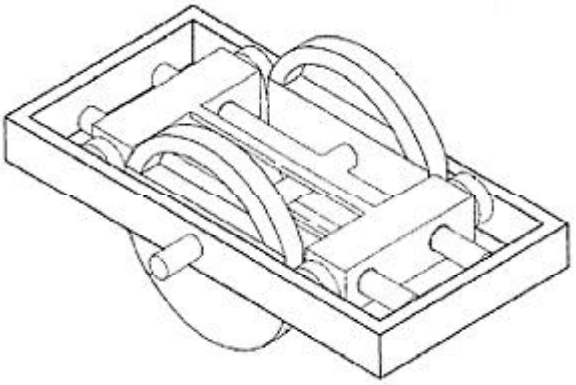

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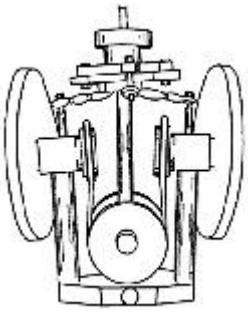

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Kidd, Alexander D.

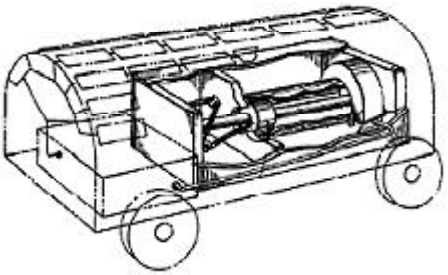

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Rogers, Charles E., et al.

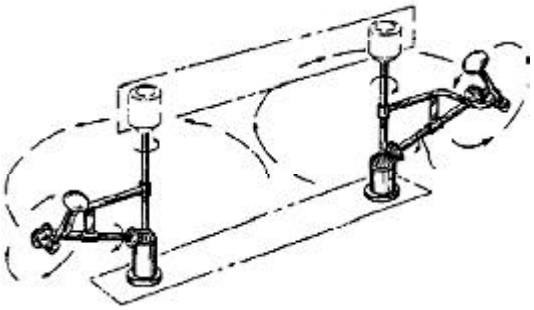

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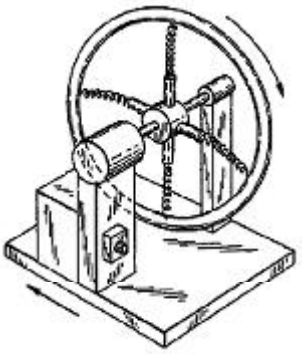

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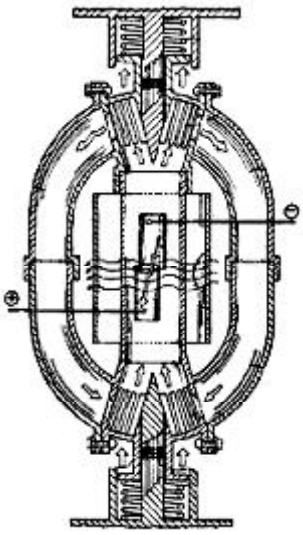

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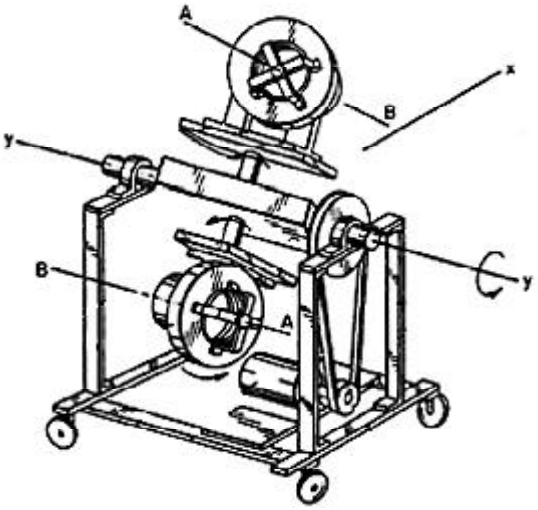

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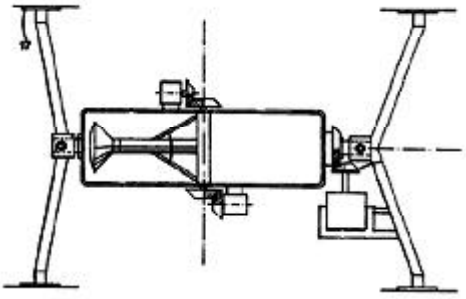

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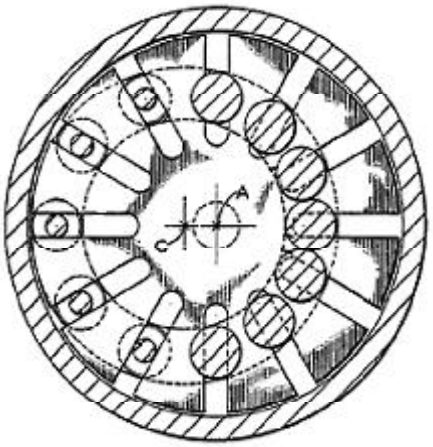

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Flywheel
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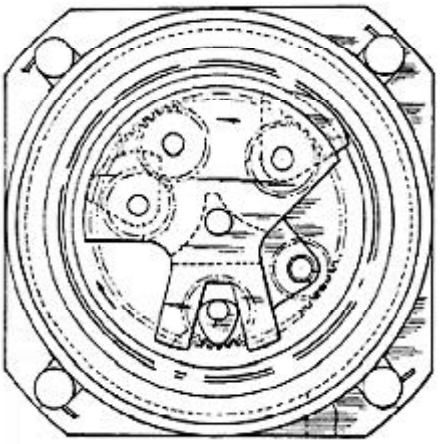

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Conversion of Rotational Output to Linear Force
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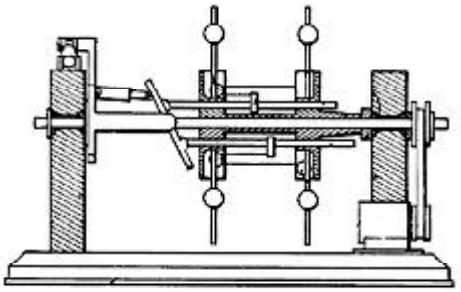

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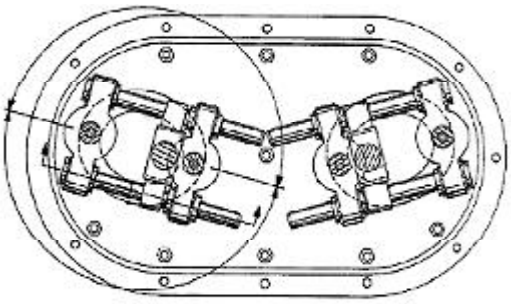

№4,770,063(9/13/88)
Universal Propulsion Powerplant & Impulse Drive Unit
Mundo, James D.

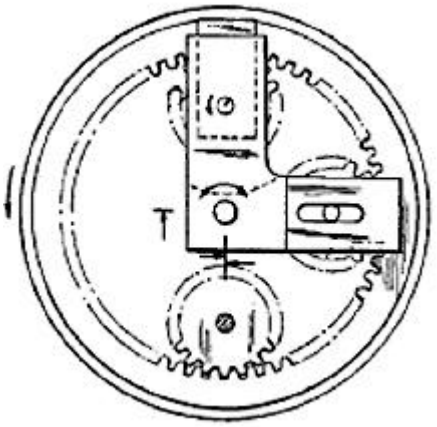

№4,856,358(8/15/89)
Conversion of Rotational Output to Linear Force
Montalbano, Paul J.

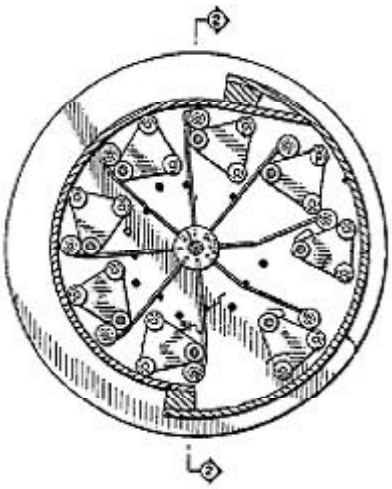

№4,744,259(7/17/88)
Apparatus for Producing a Directional Unit Force
Peterson, Oscar F.A.

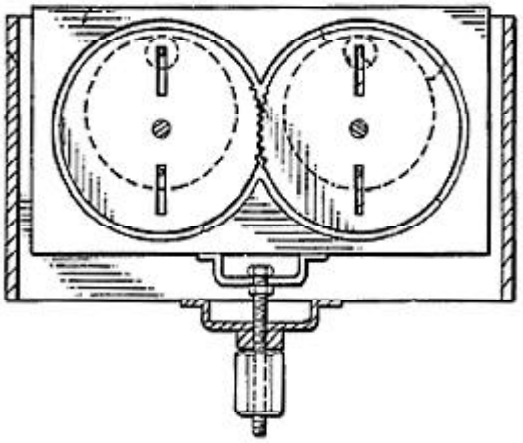

№4,712,439(12/15/87)
Apparatus for Producing a Force
North, Henry.

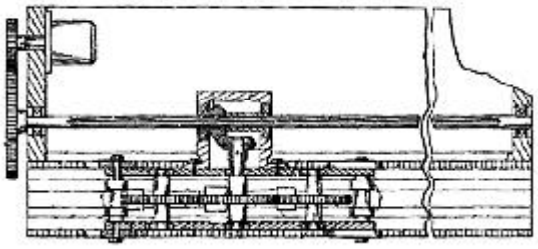

№4,242,918(1/6/81)
Mechanical Propulsion System
Srogi, Ladislaw G.

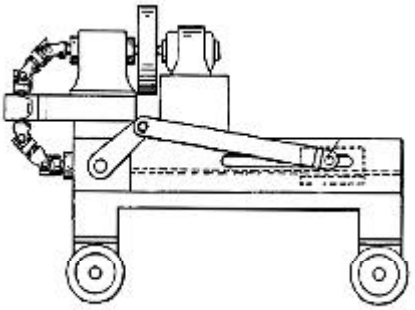

№4,674,583(6/23/87)
Impulse Drive
Peppiatt, Alvin C., et al

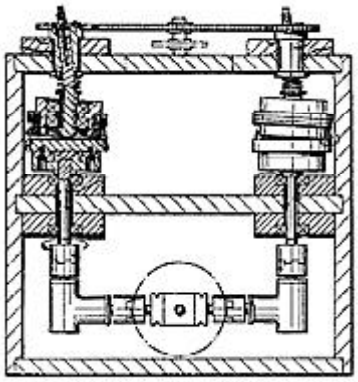

№4,409,856(10/18/83)
Propulsion System
de Weaver, Fred, III.

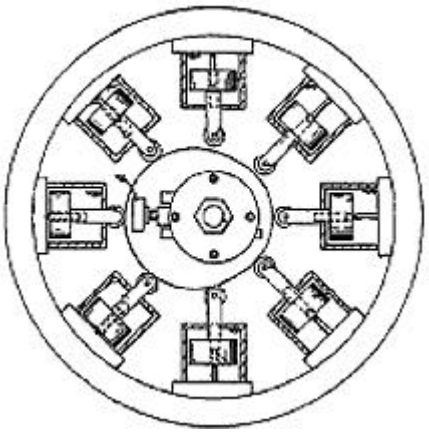

№4,579,011(3/1/86)
Propulsion Apparatus
Dobos, Elmer M.

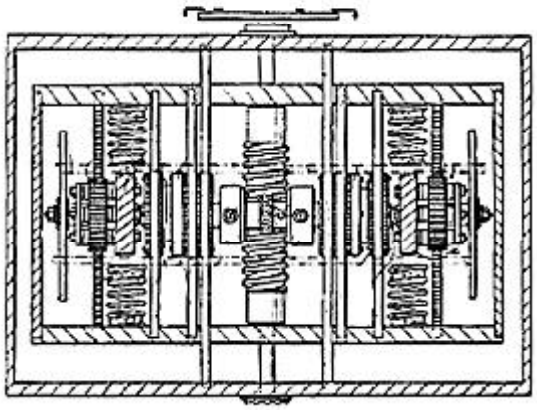

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Mechanical Propulsion System
Colla, Joseph.

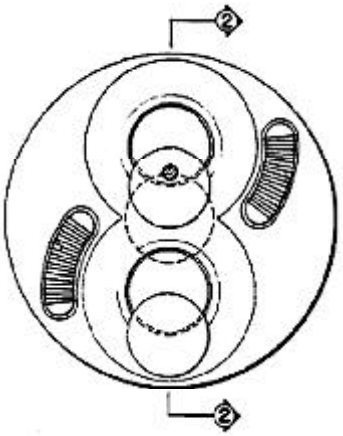

№4,631,971(12/30/86)
Apparatus for Developing a Propulsive Force
Thornson, Brandson R.

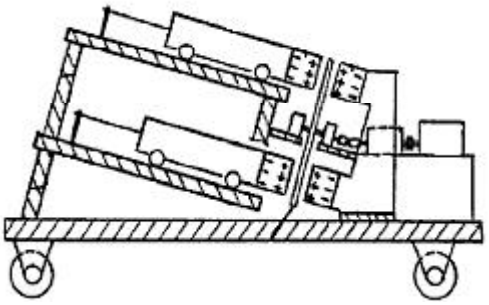

№3,889,453(6/17/75)
Propulsion System
Mast, Oscar.

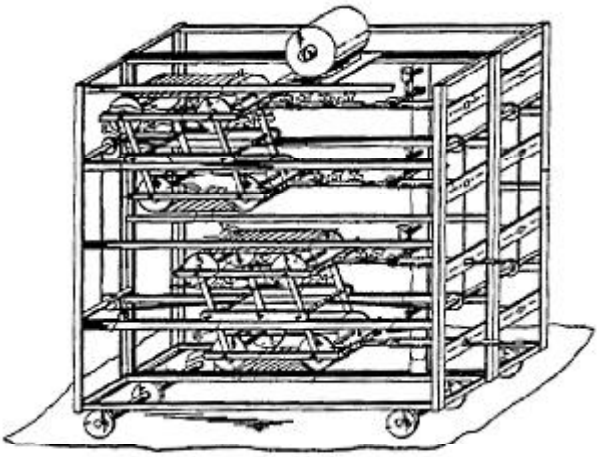

№4,726,241(2/23/88)
Continuous Force & Impact Generator
Melnick, Harry S.

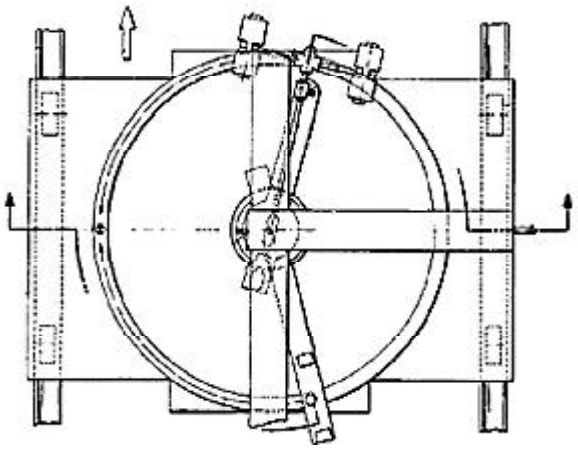

№4,238,968(12/16/80)
Conversion of Centrifugal Force to Linear Force & Motion
Cook, Robert L.

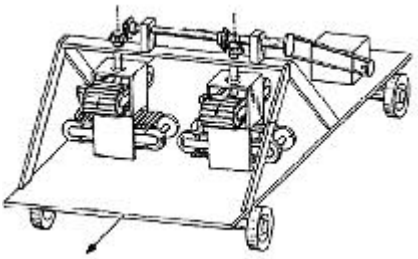

№4,261,212(4/14/81)
Unidirectional Force Generator
Melnick, Harry S.

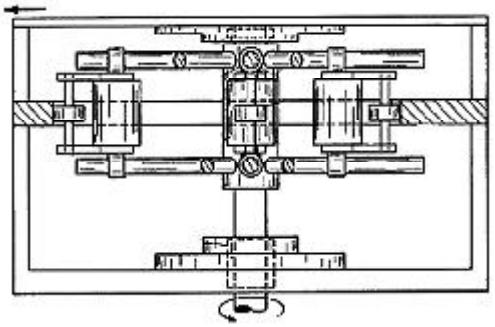

№ 3,968,700(7/13/76)
Converting Rotary Motion into a Unidirectional Linear Motion
Cuff, Calvin I.

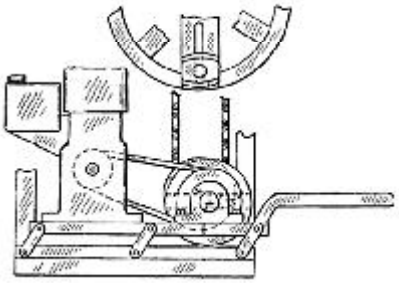

№ 4,347,752(9/7/82)
Converting Rotary Motion to a Rectilinear Force
Dehen, Frederick L.

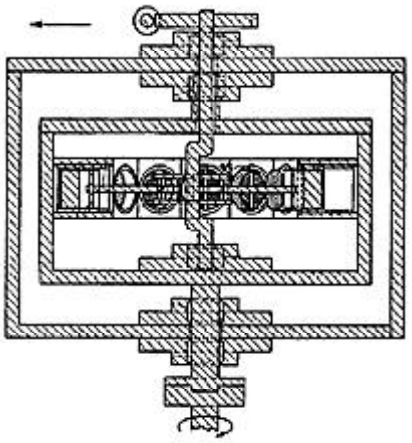

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Converting Rotary Motion into a Unidirectional Linear Motion
Cuff, Calviv I.

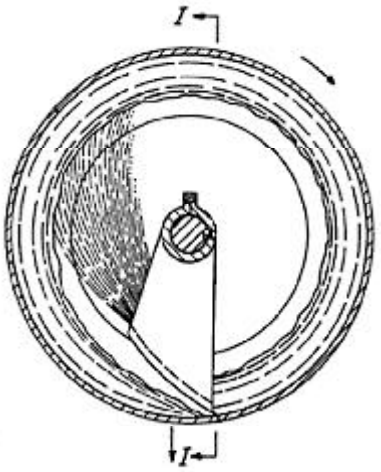

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Propelling an Object by an Unbalanced Centrifugal Force...
Schnur, Nicolas J.

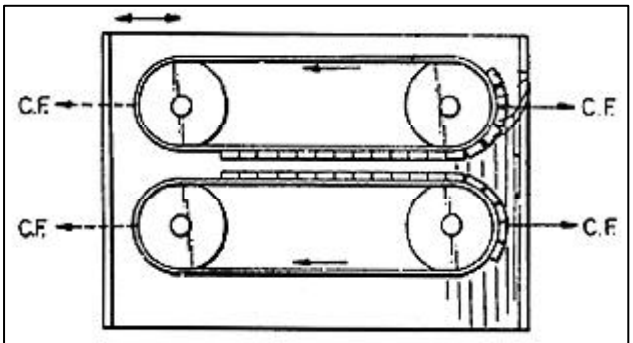

№ 4,398,431(8/16/83)
Mechanical Power Transmitting System
Melnick, Harry S.

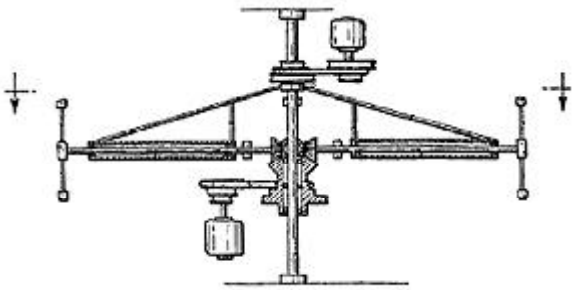

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Directional Force Generator
Young, Hersey W., Jr.

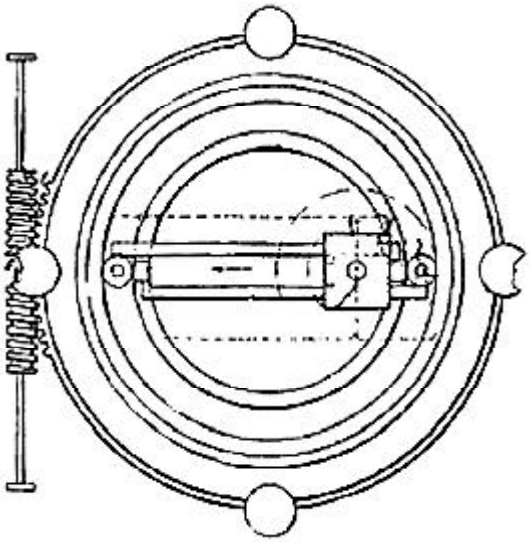

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Centrifugal
Thrust Motor
Benjamin, Paul M.

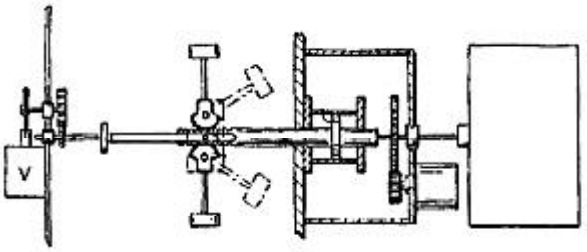

№ 3,863,510(2/4/75)
Inertia Engine
Benson, Everett H.

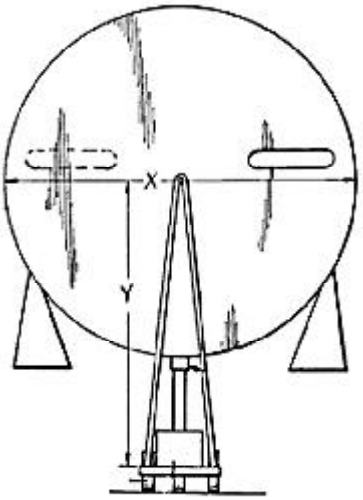

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Propulsion System
McAlister, Roy E., et al.

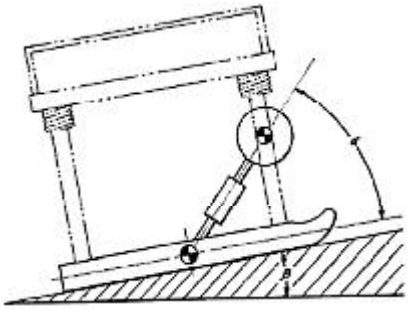

№ 3,916,704(11/4/75)
Vibratory Motion
Gaberson, Howard A.

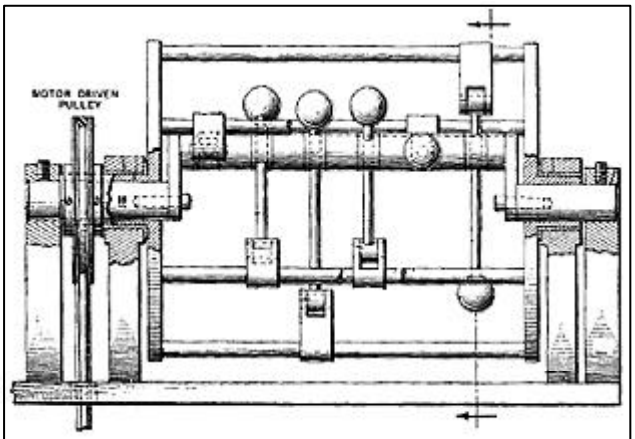

№ 3,810,394(5/14/74)
Centrifugal
Mechanical Device
Novak, Leo J.

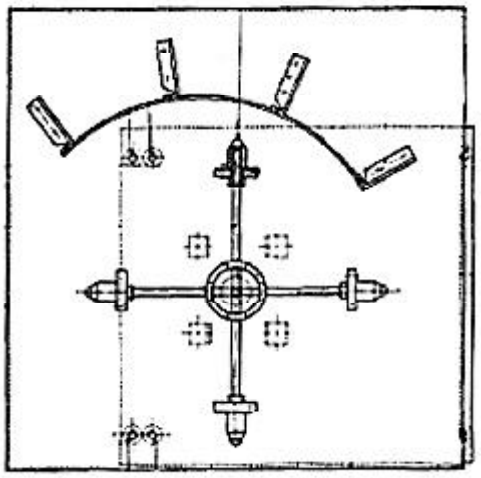

№ 3,807,244(4/30/74)
Device for Transforming Kinetic Energy
Estrade, Fernand.

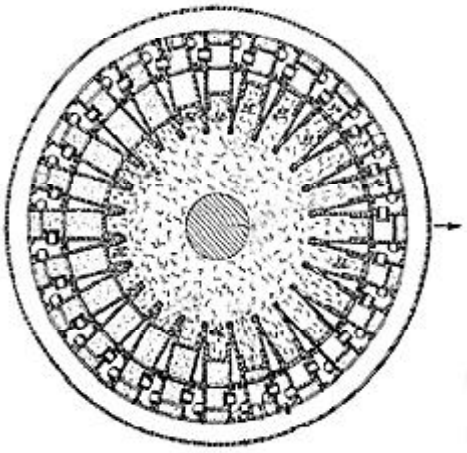

№ 3,584,515(6/15/71)
Propulsion Apparatus
Matyas, Laszlo B.

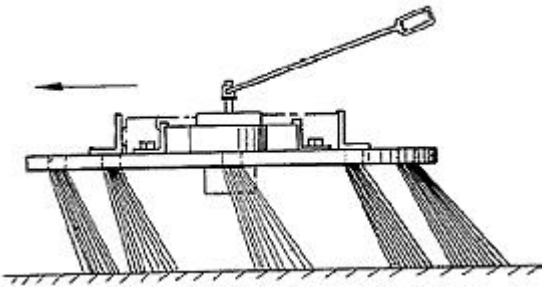

№ 3,196,580(7/27/65)
Toy Vehicle Having...Self-Contained Drive Means
Rakestraw, Robert G.

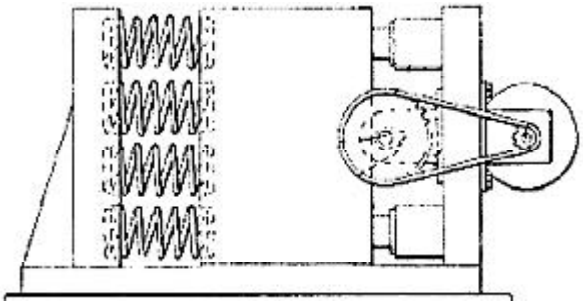

№ 3,266,233(8/16/66)
Inertia Propulsion Device
Farrall, Arthur W.

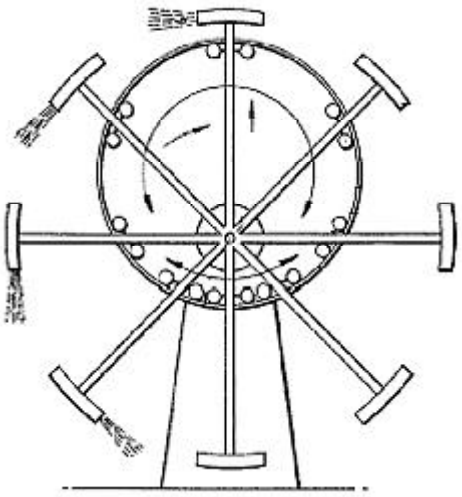

№ 3,177,660(4/13/65)
Propulsion Apparatus
Haller, Paul.

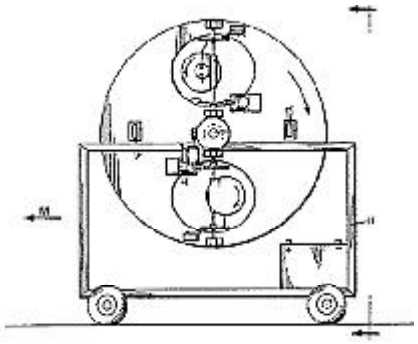

№ 3,653,269(4/4/72)
Converting Rotary Motion into Unidirectional Motion
Foster, Richard E.

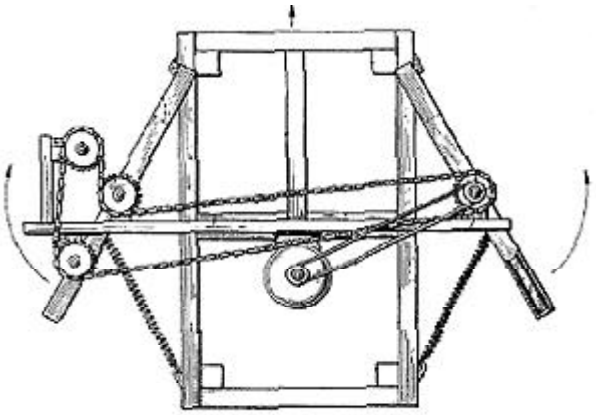

№ 3,683,707(8/15/72)
Propulsion System
Cook, Robert L.

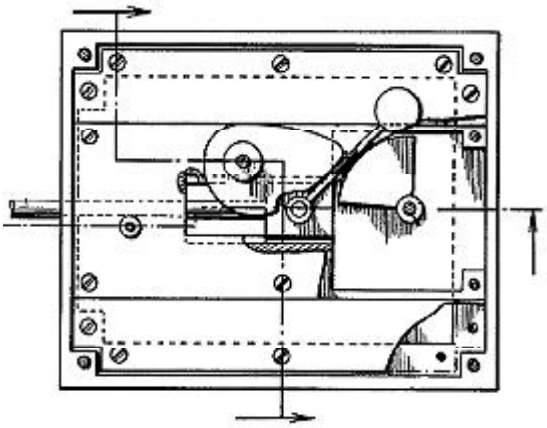

№ 3,182,517(5/11/65)
Variable
Oscillation System
Dean, Norman L.

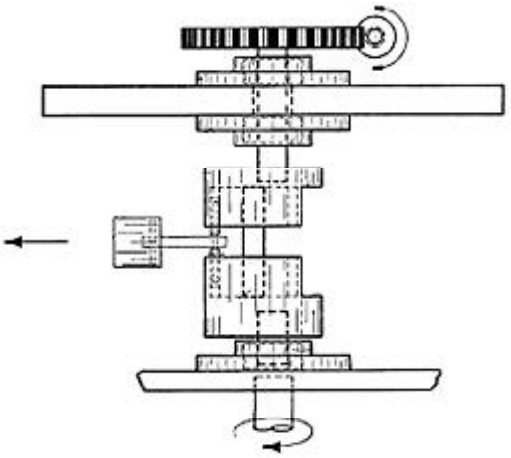

№ 4,095,460(6/20/78)
Converting
Rotary Motion into
Unidirectional Motion
Cuff, Calvin I.

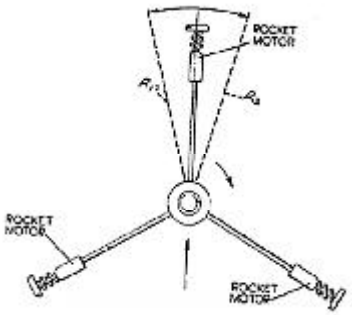

№ 4,087,064(5/2/78)
Orbital
Propulsion
Apparatus
Knap, George.

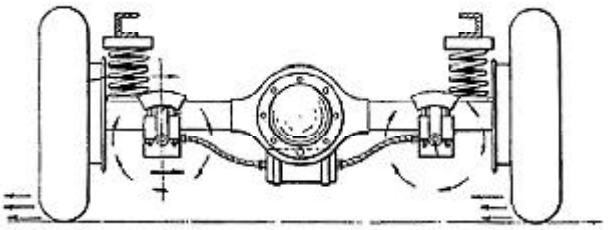

№ 2,639,777(5/26/53)
Method & Device for Imparting
Lateral Movement
Dull, Marshall L.

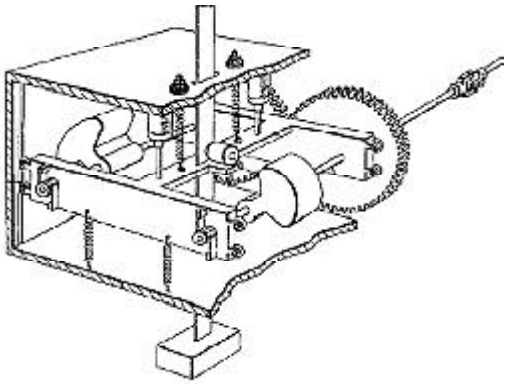

№ 2,886,976(5/19/59)
System for
Converting Rotary Motion into
Unidirectional Motion
Dean, Norman L.

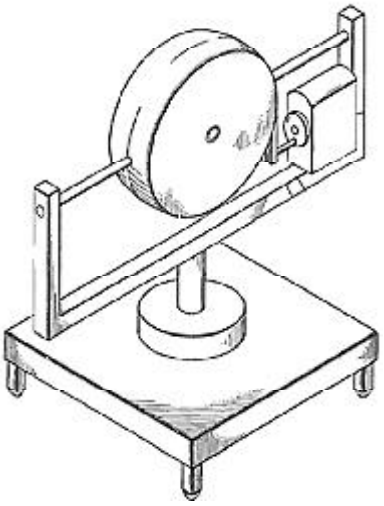

№ 3,203,644(8/31/65)
Gyroscopic
Inertial Space Drive
Kellogg, H. Dudley

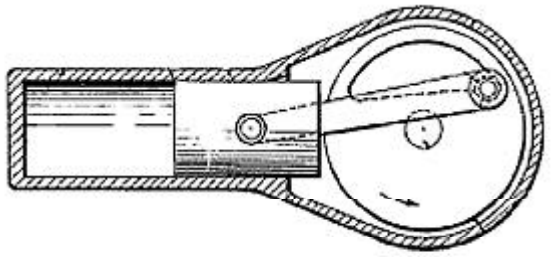

№ 2,636,340(4/28/53)
Direct Push
Propulsion Unit
Llamozas, Juan D. M.

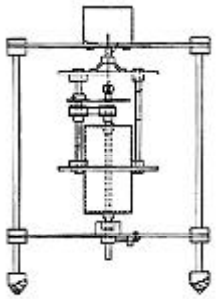

№ 5,150,626(9/29/92)
Translational Force
Generator
Navarro, T. L.

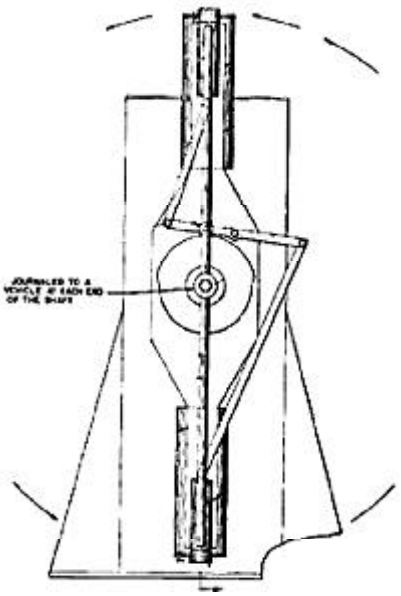

№ 3,238,714(3/8/66)
Thrust Motor
Schur, George O.

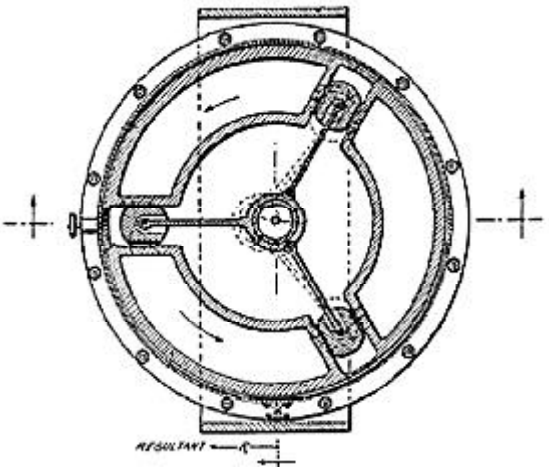

№ 2,009,780(7/30/35)
Centrifugal Variable Thrust
Mechanism
Laskowitz, Isidor B.

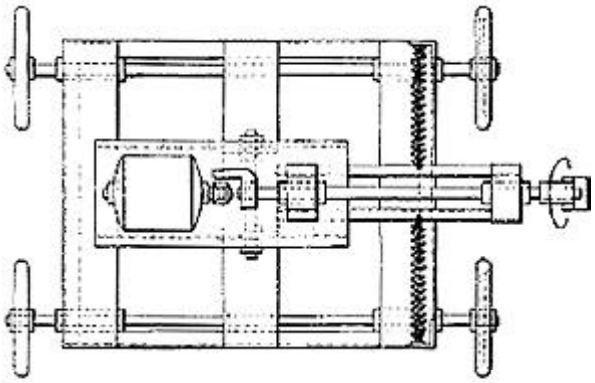

№ 2,088,115(7/27/37)
Reaction Motor
Neff, Tom.

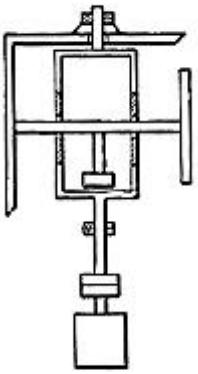

№ 3,404,854(10/8/68)
Apparatus for
Imparting Motion to a
Body
di Bella, Alfio.

The Free Energy Centrifugal Force Experiment

This experiment is conducted by Faraday Lab Ltd in cooperation with V. I. Bogomolov

In the previous issue we wrote about the invention of Bogomolov V. I. The device shown in Fig.1 (and also on the cover) was constructed and tested in our laboratory.

Fig. 1
The Device

The simplified diagram is known as "Maxwell's Pendulum" (Fig.2). This is a disk set onto the horizontal axis with two attached strings. The upper ends of the strings are fixed to the crossbar.

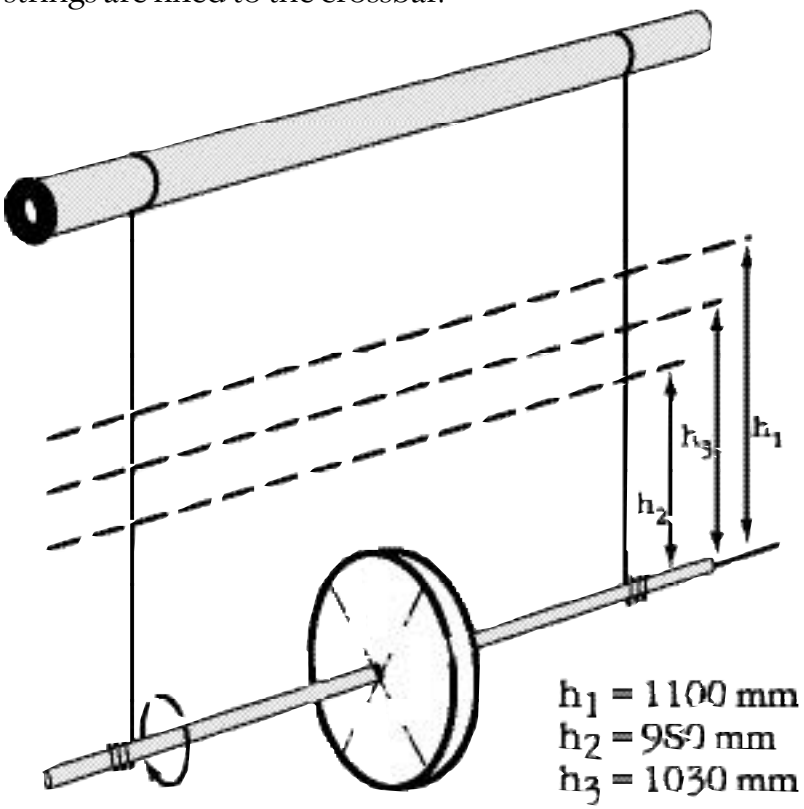

Fig. 2

If we wind the strings about the axis, the disk will lift (the height h) and store the potential energy of the Earth's gravitational field E = mgh (m - mass of the flywheel; g - free fall acceleration; h - the height of the mass fall). If we let the pendulum go, we can observe periodic "up-and-down" damped oscillations: first, the string spins and potential energy converts into rotation kinetic energy; upon reaching the lowest point the disk, still rotating, goes up using rotation kinetic energy and then converts it again into potential energy. This device is interesting: due to the energy conservation law we can observe the usage of rotation kinetic energy of the flywheel, measuring only the h-parameter, the lift height of the flywheel strings in the second semi-oscillation compared to the height with which the pendulum started falling in the first semi-oscillation, the difference h1 - h2 of the two semi-oscillations is directly proportional to the losses of rotation kinetic energy for air resistance work and friction.

We have made "Maxwell's Pendulum" more complicated by substituting the flywheel disk for the Watt centrifugal governor in accordance with its description in the article (1). The main difference of the device from Maxwell's flywheel is that the flywheel inertia momentum changes by the centrifugal force operation at the lever transferring of weights (the total weight - 1200 g) from the minimum radius position (40 mm) to the maximum radius position

(90 mm). At that, the levers compress the string with the force of about 16 N.

There have been three stages of the experiments. During the first stage we define the necessary lift height of 1100 mm at moment when the string winds around the axle. When the flywheel falls from this height, the rotation speed and centrifugal force are achieved, which move apart the loads to the maximum radius (90 mm) and which **completely compress the string**. During the second stage the loads are fixed at the minimum radius position (40 mm), thus the compress string centrifugal forces are not involved any more and we can measure the air resistance and friction **losses of kinetic energy**. At this stage the flywheel lifts up to 980 mm losing 120 mm. During the third final stage the load fixing rods are taken away and ***centrifugal forces are applied***. Just like during the second stage the Watt governor starts spin-falling from the height of 1100 mm. It compresses the string and lifts up to the height of 1030 mm thus **exceeding the second stage height by 50 mm**!

The experiment conclusions of the author:

1. At the third stage the flywheel exceeds the "loss height" h=980 mm. This means that the compression of the string was performed "for free".

2. At the third stage the flywheel converted kinetic energy into potential energy and lifted up 50 mm more. This means that in accordance with the principle of conservation of moment of momentum, the **outer compressed string energy force** has caused the moment of momentum change of the rotating masses, thus giving the additional acceleration to the flywheel and **increasing its kinetic energy "for free"**!

3. For the practical application of the Bogomolov generator in order to generate free energy it is necessary to achieve a high rotation speed (more than 10 000 rpm) and involve centrifugal forces to transfer the rotating mass to the less possible inertia radius difference.

The described centrifugal regulator diagram is not sufficient for larger experiments. For the industrial generator the author has a hydraulic-principle pneumatic string device drawing (know-how).

Editor: Also in this issue: the article on "Glen Gates Motor" by A. Akau. The principle is almost the same. The further implementation of this ideamay soon design purely mechanical power-generating systems, which use inertia and centrifugal forces.

References:

1. Bogomolov V.I. "The Bogomolov Generator", New Energy Technologies, Issue # 4, 2003.

Magnetic Power Inc. (MPI) is developing Self-Powered Generators. Together with its subsidiary, Room Temperature Superconductors Inc., (see the website www.ultraconductors.com), MPI has raised a total of more than $7 million from Angel investors to date.

Due to a pleasant surprise, solid-state electric power generators might be fabricated by modifying off-the-shelf utility hardware. If confirmed in coming weeks, this could result in serial fabrication by this time next year, since large devices of the type needed for conversion are presently manufactured worldwide.

Multiple modules may prove able to replace power plants. Smaller units appear practical for powering homes. Later, optimized designs might replace engines in every variety of vehicle. These generators may make possible very rapid utilization of fuel and pollution free electric power --a revolutionary, new, renewable energy alternative.

Accredited Angel investors can help speed the work needed to bridge into major capital, and accelerate this remarkable alternative. Multi-million dollar funding is on the horizon. Additional information is available privately. We welcome due diligence by qualified parties.

History of Perpetual Motion and Free Energy Machines

Web site http://www.phact.org/e/dennis4.html

Hundreds of people for centuries have attempted to solve the holy grail of energy production - **Perpetual Motion Machines**. Still to this day Eric Kreig gets weekly emails from people who feel they are about to get one working. Eric is very skeptical about free energy. But his collection of information is very interesting. Eric offered a special prize for those who will agree to publicly test their over-unity devices.

♦ **Villand de Honnecourt** 13th century had a drawing of one.

♦ **Leonardo da vinci** made a number of drawings of things he hoped would make energy for free.

♦ Jesuit priest, **Johanes Taisnerius** worked on a magnetic based perpetual motion machine.

♦ **Mimara** in 1518 designed a "self-blowing windmill".

♦ **John Dee** of 16th century reported seeing one - but wasn't allowed a closer look.

♦ **Cornelis Drebbel**, 1610, was an alchemist and magician supposedly made one.

♦ **Robert Fludd** 1630 proposed many machines -people were trying to patent variations of Fludd's device in the 1870's.

♦ **Edward Somerset** 1638 demonstrated many free energy water wheels to the king of France.

♦ **1635** - first of many English perpetual motion machine patents granted. - By 1903, 600 such patents had been granted. Free energy claimants love impressing people with patents.

♦ **Ulrich von Carnach** in 1664 in Germany designed a perpetual ball-moving machine.

♦ Scientist **Jean Bernoulli** (1667 - 1748) proposed a fluid energy machine.

♦ **Bockler** in 1686 made designs for self powered water mills.

♦ In 1712 **Johann Bessler aka Orffyreus** investigated 300 different perpetual motion models and claimed he had the secret of perpetual motion and got much investment money.

♦ **Dr Conradus Schiviers** in 1790 made a belt driven wheel.

♦ **Sir William Congreve** in 1827 tried a machine running on capillary action.

♦ Britisher **Henry Prince** 1866 described the first partially submerged perpetual motion machine.

♦ **Mark Zimara** of Italy had a huge air powered machine that never worked.

♦ **Horace Wickmam** of the USA got a patent to a machine with many balls that just rotate around.

♦ Austrian, **Alois Drasch** patented a machine in the US in 1868.

♦ German, **George Andreas Bockler** proposed 'self operating mills' using variants of Archimedes screws.

♦ **E. P. Willis** of Connecticut made money off a perpetual motion machine in 1870 - people eventually found out a secret source of power to it.

♦ **Charles Redheffer** in 1812 in **Philadelphia** made much money on a perpetual motion machine, tried to restrict scientific evaluation, but was eventually debunked.

♦ Scottish shoemaker **Spence** designed a magnetic based machine, which was debunked.

♦ **John Worrel Keely** of Philadelphia in 1872 (he also had a traveling show of exhibitions). He fooled many scientists with a machine, which appeared to run on water.

♦ **John Gamgee** in 1881 got considerable support for a machine very similar to Dennis Lee's, which used liquid ammonia - it got vaporized from heat readily available, thus expanding it would drive a piston. Gamgee thought the vapor would condense to liquid to start the cycle over again. The Navy appeared to have been fooled and showed it to president Garfield - it never went anywhere Tom Napier agrees that Dennis Lee may have resurrected Gamgee's engine.

♦ **J. M. Aldrich** was arrested for getting investors for his free energy machine in 1899 - he some how was able to avoid conviction and conned many investors. One of whom was finally able to inspect the machine found a hidden spring.

♦ **T.H. Moray** in the 20's demonstrated a "radiant energy device" to many people who were unable to find a hidden power source. Some how, the secret was said to have been forgotten.

♦ **Lester Hendershot** in 1928 got an Army commandant to endorse his free energy machine - but it was later found to have a hidden power source in the motor. His sons believe Lester lost his notes and that maybe they can rediscover how to get it to work.

♦ **Viktor Schauberger** claimed to have discovered some special vortex energy in water. Since he died in 1958, I don't know if his claims have been replicated, but people are still studying his works.

♦ **Mr Papf** in 1966 was a conspiracy believer alternative car engine got a few investors but killed someone during a demo. He tried to blame the problem on an investigating skeptic. He disappeared and became part of urban legend of scores of people, which the big conspiracy has been silencing for generations.

♦ **Guido Franch** was convicted of fraud in 1954 and 1973 of selling rights to distribute little green pills that would convert water into gas. He hid behind conspiracy theory and secrecy to avoid fair testing. A number of people have run this scam and many people still believe there are pill repressed by the oil companies.

♦ **Garabed T.K. Giragossian** in 1917 claimed to have a free energy machine. He was one of the early frauds to hide behind conspiracy theory. Woodrow Wilson signed a resolution offering him protection from some kind of conspiracy. After much fanfare, and delaying tactics his machine turned out to be a giant flywheel, which was charged up with energy slowly and put out a lot of energy for just a second. In spite of lack of proof of anything significant his followers still bothered the US congress for recognition.

♦ **Otis Carr** in 1958 sold stock for a company to manufacture UFO's and free energy machines from Oklahoma. He claimed inspiration from Tesla.

♦ **Edgar Cayce** even babbles about "Motor's with no Fuel".

♦ **McClintock** was claimed to use air as a fuel and had a patent.

♦ The **Evgray** machine scammed many investors (who didn't know how to test 'depleted' batteries).

♦ **Arnold Burke** in 1977 collected $800,000 of investor money (again, mostly from bible believing farmers) for a 'self acting pump'. He tried to hide behind religion. He called his device Jeremiah 33:3' Finally, an open test was done in 1979 and found a hidden source of electricity. His believers (with

an infinite supply of denial) still raised $250,000 to get out of a fraud conviction. He still went on making lots of claims with no evidence.

♦ **Robert Adams** in 1977 made all kinds of conspiracy and OU claims in New Zealand. Many still believe in the Adams Motor. - He had the obligatory battles over patents, debates over theory, debates over power measurement and dabbling in other areas of alt physics. He's 80 years old and said to have a scientific education. He has a lot of theories about Aether. Skeptical information.

♦ **Robert Stewart** in 1978 got over $3,000,000 of investment money (much from farmers) for a closed cycle engine using freon rather than water. This 'engine' used the same scheme John Gamgee tried to sell the navy in 1882. -Eric Krieg thinks this is the same approach Dennis Lee's free energy machine works on. I think he just faded away (people claim he was silenced).

♦ **Rory Johnson** of Elgin Illinois, claimed to have invented a cold fusion, laser activated, magnetic motor that produced 525 HP, weighed 475 lbs, and would propel a large truck or bus 100,000 miles. After signing a number of dealers, he moved all his equipment out of his labs, moved to CA and died. (To this day, folks say he was silenced by OPEC).

♦ **RJeseph Maglich** was a physicist and claimed to have a device in 1978, which harnessed fusion power from seawater. They say they put power in and get more power out. I've never heard of them since.

♦ **Howard Johnson** got a patent for a device that claimed to make free energy from a motor like device. As of 11/02, Stephen was claiming he would soon mail out samples of working ones. By 12/12/02, Stephen dropped out of contact.

♦ **Keith Kenyon** had a device claimed to produce more energy than consumed. Calculations seemed to not take power factor (also known as phase angle) into account. It never openly had its output hooked up to its input. Even Dennis Lee tells his followers that all the *over unity motors* (claim to make more electricity than consumed) usually just fool people who can't measure power factor.

♦ **Muller:** Bill Muller and Carmen Muller of Germany raised money on an over unity motor and got a few followers, but never actually demonstrated one working.

♦ **Dennis Lee** Since 1988 has been promising to demonstrate free electricity "in a month or two". He is much like Newman in his mixture of religion & extremist politics, evasion of qualified investigators, endless promises, threatening detractors, etc. He had a Fischer engine, a CRD device and now, and OU motor device. Dennis has invested in Searle and Stanley Meyer and joined Pantone in 2001 in a 50 state tour.

♦ **Stanley Meyer** 1996 claimed to have a water powered car and was also big on mixing Christianity and patriot politics in with fringe science. Meyer was found guilty of fraud after his Water Fuel Cell was tested before an Ohio judge. It is rare for an inventor to be prosecuted for an invention that does not work, but Meyer's problem was that he had been selling "dealerships", offering investors the "right to do business" in Water Fuel Cell technology. Meyer refused to allow anyone else to measure his device. Dennis Lee invested in him. He died in early 1998.

♦ **Joseph Newman** in 1984 claimed to have a free energy machine based on alternative physics. Like many perpetual motion inventors, he sued the US patent office. Many people wrongly measured the true power output of this machine, (they didn't realize you must specially calculate power for non sinusoidal current consumption). He now refuses to ship a unit for testing. Ten years ago, inventor Joseph Newman gave an open week-long demonstration in the Super dome in New Orleans. Over 9,000 people attended from across the country (including Dennis Lee who reportedly wanted to join his ideas with Newman). Newman is suing some former

investors he claims are trying to steal his invention. I give more information. Evan Soule of Newman's organization offers a rebuttal.

♦ **Bruce De Palma** had a machine in 1986, which appeared to one Electrical Engineering professor to put out 4 times more power than consumed. Turned out it was just a measurement error. (We could go on and on with such examples).

♦ **Dr. Potapov** sold a device that was claimed to produce more energy than consumed.

Editor: Eric's skeptical remarks can be tolerated but sometimes he writes about the things he does not know. Potapov and his team have created a technology, which have been replicated and sold by dozens of companies in Russia (see the cover picture of the Susorov heat generator). There are several devices in St. Petersburg to be tested. The efficiency is 200 % and more. The operation principle: electric motor rotates in water and causes the heating of water. We have also received the information about another Russian invention, namely the close cycle vortex generator: "water rotation – vapour – turbine – electric power " (the power is from 100 kW).

Alexander V. Frolov

♦ **John Bedini** claims to have a free energy device.

♦ **Mr. Finsrud** is a Norwegian artist who made a sculpture where a metal ball moves for weeks apparently with no outside influence.

♦ **Don Watts** of Las Vegas in around 1990 had a patented **CEACU**, which stands for Centrifugal Energy Amplification and Conversion Unit - it turned out to be one more investment fraud.

♦ **Stephan Marinov** claimed to have proven much alternative physics and to have contacted a Methernitha that claims to have a Free Energy Machine. He committed suicide on July 15, 1997 but he left behind some intense rants.

♦ **Greg Watson** sold kits for a rolling ball and track that were thought to have over unity in 1997. Attempts of replication I know of have failed.

♦ **CETI** These people have claimed to have a device that puts out anomalous yet small amounts of heat - maybe cold fusion. They raised millions. As of 10/97, they have not been willing to have me come over and see for myself. They have said, *we want people to think it doesn't work so we won't have competition.* I've wondered if the energy may have come from not accounting for friction effects from the cooling flow through the pellets. (**Jed Rothwell**, a rational editor of Infinite Energy Magazine says *"however, tests with CETI cells at Motorola, SRI and the French Atomic Energy Commission show no measurable friction"*). Milton Rothman has a response: "I openly admit that I have not followed all the history of cold fusion claims and am generally ignorant on the subject".

♦ In January 1998 **Barbara Hickox** allegedly has a patent dating from 1981 for a fusion powered free energy system.

♦ **Paramahamsa Tewari** of India claims to have a device that is 200% efficient.

♦ **RQM** is a Swiss company selling FE machines found at www.rqm.ch.

♦ **Ted King** is looking for people to buy stock for a car he plans to drive across the country using just 2 12-volt batteries. You can contact Ted if you want to buy shares.

♦ **Bruce Perreault** has claimed to have discovered a new element, the plasmatron, ion pump, radiant energy device, etc.

♦ **Daniel Pomerleau** of Canada claims to have something that works, but he isn't interested in releasing it (as 12/97).

♦ **Entropy Systems** of Ohio 1999 Sanjay Amin got 1.6 million investment dollars for a device that would violate the 2nd law of thermodynamics. I've asked them to apply for my prize for proof. - They seem to have folded. See a rational review of Amin's claims.

♦ **Brian Collin** of Australia claims revelation from God *(like most of these people)* to make a free energy device. A Stephen Mark claimed he invented it.

♦ **Kawai** and **Takahashi** - both of Japan claimed in the 90's to have overunity devices.

♦ **Carl Cella** claimed to have one of the many cars said to run on water.

♦ **Robert LeBreton** in 1999 claimed to be making a 600 hp free energy machine.

♦ **Renzo Boscolio** in 1999 in Italy claimed to have low-energy nuclear reactions but refused to supply real proof that he promised to people who came out from Infinite Energy Magazine.

♦ **Doug Konzen** of Seattle says he has an overunity motor in Jan of 2000 that anyone can see.

♦ **Troy Reed** of Oklahoma was ready to issue licenses for manufacturing his permanent magnet motor etc. He's taking investment money for a device he claims puts out more heat energy than input energy. He says he's dumped a few million into his designs over the last 10 years and had little interest in my prize offer when I contacted him in 2001.

♦ **Kipper Motor.** In 10/00, Steve Elswick thought it was overunity. But David Sligar who paid $175 for plans could not get it working.

♦ **Ludwig Brits and Victor Christie** in 2001, claim the **Lutec** free electricity over unity motor/generator will soon be in Australia.

♦ **Jasker** in 2002, an Irish company has claimed to have free electricity. (Some have said it is just a joke).

♦ **Confidential Technology -Wayne Cochran** died 12/29/02 Crazy Jack Carey took over. They have been promising FE soon for about 20 years now.

♦ **Tom Bearden's MEG device:** many articles on the Internet.

♦ **Gurbakhsh Singh Mann of India** claims to have invented gravity and buoyancy perpetual motion machines.

♦ **Michael J. Marshall** in Las Vegas has a device called QSFG , which stands for quick start fuel-less generator he says 64 nations have asked him to build factories.

♦ **Carl Tilley and Robert Kibbey** in 6/2001 in Tennessee have claimed some over unity device and other stuff. Their demonstration failed in 9/02 and as of 11/02, they have been evading proper demonstrations.

♦ **Stephen Walker** in 9/2002 promised to send me and several others a free energy machine in mail.

♦ **PerEnDev** promised to make some kind of free energy by means of magnets.

♦ **Bill Muller** of Canada in 2003 claimed to have some kind of OU device. Independent tests found it under unity.

♦ **Energie:** In 2003 this Greek company promised a homopolar magnet (De Palma design) FE design by June of 2003. They actively seek investors.

♦ **GWE Genesis World Energy** In 2002 this group claimed to have 400 people who developed some device that sounds like it separates water into H2 and O2 using less energy than mainstream science says is possible. As of 2003, they have evaded independent confirmation. More information is available.

♦ **Steven Greer (Disclosure Project)** In 02.2003, Steven announced he had discovered some real sources of Free energy, which he promised to make sure get proven to the general public.

Tesla Energy Science Conference and Exposition

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Tel: 800-295-7674
Fax: 301-513-5728
www.IntegrityResearchInstitute.org
Email: iri@erols.com

Saturday, November 8, 2003
Wireless Electricity Seminar

9:30 AM 10:15 AM

Opening Address: "Space Solar Power" – Dr. **Paul Werbos** Program Director, National Science Foundation

10:15 AM 12:15 PM

Special 2-Hour Presentation: "Nicola Tesla and the development of RF Power Systems" - Dr. **James Corum**, Physics Professor, research Scientist and Inventor and **Kenneth Corum**, Physicist, teacher, consultant.

2:00 Pm 3:00 PM

"Power Engineering Scalar Field Theory: Faraday vs. Maxwell and Longitudinal Wave Demonstration" – Professor **Konstantin Meyl**, Engineer, Author, Inventor of the Demo-Set, Professor at the University of Berlin

3:15 PM 4:15 PM

"Wireless Energy Through the Earth-Ionosphere Cavity" – Dr. **Elizabeth Rauscher,** Nuclear and Astrophysicist, Inventor of the ELF Earthquake Predictor and Triangulator.

4:15 PM 5:15 PM

"Masters of the Ionosphere HAARP Modifies the Polar Electrojet" – **BBC Video on Tesla Technology**, with Wiliam Terbo, demonstrating ionospheric excitation by radio waves.

6:30 PM 7:15 PM

Masters of the Ionosphere – BBC Video Presentation **repeated** for the Special Tesla Evening Event attendees

7:30 PM 8:30 PM

"The Wardenclyffe Dream: Tesla's Plan for Wireless Worldwide Distribution" – **Dr. Marc Seifer** Professor, Author of the best-selling book *Wizard, The Life and Times of Nikola Tesla*, presents an illustrated historical account.

8:30 PM 9:00 PM

High Voltage Tesla Coil Demo – **High Voltage Device** with **Music**: The Tesla Tower wind ensemble composition by Prof. **Holland**, Skidmore College

Sunday November 9, 2003
Electrotherapeutic and Tesla History Day

9:30 AM – 10:30 AM

"A Family Perspective on the Personality of Nikola Tesla. Review of the Popular Interest in this Scientific Icon" with Q and A Session – **William Terbo**, Engineer, Closest living relative of Tesla (Grand-nephew). Founder and Director of the Tesla Memorial Society.

10:30 AM 11:30 AM

"The Search for Free Energy: Genius, Vision and Psychology of Invention" – **Keith Tutt**, British Writer and Author of the book *The Scientist, The Madman, The Thief and their Lightbulb* that includes Tesla.

11:30 AM 12:15 PM

"Electrotherapy with Tesla Coil Design: Intorduction to Bioelectromagnetics" – Dr. **Thomas Valone** Physicist, Professional Engineer, Author of the new book, Bioeletromagnetic Healing: A rational for its Use.

12:15 PM 1:00 PM

Exhibitors Presentations – **Brief Presentations by exhibitors** (5-10 minutes each)

2:00 PM-3:00 PM

"Emerging Opportunity: cancer Electromagnetic Frequency Therapy" – Dr. **Mark Neveu** President, the National Foundation for Alternative medicine.

3:00 PM 4:00 PM

"Turn of the Century Electrotherapy Discoveries" – **Jefrey Behay** Director, The Turn of the Century Electrotherapy Museum.

4:00 PM 5:00 PM

"How a Crushed Leg Helped Me Discover High Voltage Electromagnetic Healing Device" – **Ralph Suddath**, Third generation Tesla Electrotheraphy Inventor, radio Host, Entrepreneur.

5:00 PM 5:15 PM

Closing Remarks – **Thomas Valone** Program Coordinator

The Conference Report Compilation can be purchased from T. Valone, Integrity Research Institute.

"Nornikel" and Alternative Energy

"Norilsky Nikel", the largest Russian non-ferrous metal producing company has announced the beginning of the cooperation with the Russian Academy of Science. Metallurgists are planning to invest into the development of the hydrogen energy and fuel cell R&D projects of the Russian Academy of Sciences. Accordingly, last week an agreement was signed. **Mikhail Prohorov**, the General Director of "Nornikel" said that they are ready to invest 20-40 million dollars annually into R&D projects of the Academy in this field.

"Expert" magazine, # 43, November 17-23, 2003

PERENDEV Magnetic Motor

Review

www.perendev.co.za/products/magnetic_motor/index.html

Shown below is a Magnetic Motor with Alternator (Patent Pending):

Fig.1

This is the "PerEnDev" (Perpetuum Energy Devices) company latest motor predicted to deliver some 60 kW. Motors can be built up to 4 mW.

Background of the Magnetic Motor

The Company started in 1969 with the development of a magnetic motor to drive an alternator to produce electricity. The concept was sound but the problem they faced was that the magnets that were available at the time (ferrite magnets) were not very powerful. The unit ran but had very little power and the project was abandoned.

In 1996 the "Perendev" company started to investigate the possibility of reviving the original idea, magnets had now come a long way and were very powerful (rare earth).

Fig. 2
Rare earth magnets

After the engineers successfully designed a new model, the company developed a 3 rotor system producing 6 kW, coupling this to an alternator through an 11:1 gearbox to produce electricity in 220volt and 380volt, single or 3 phase.

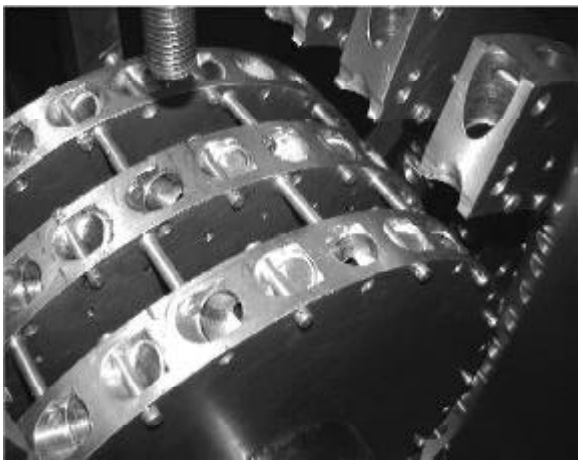

Fig.3

The units will be ideal for the small and large user, such as emergency, military, farms, plots,

industrial and large users... in fact any application requiring power.

Key Benefits Foreseen:

- No fuel costs
- Constant running
- Reliable
- Cost Effective
- Portable (6kw-120Kw)

Editor: In 2002 "Faraday Lab" got an offer from the company to buy their 6 kW generator for testing at the price of about $6,000. However, no contract was signed. The company is currently engaged in redesign of their motors and is looking for regional partners but they are not yet ready to produce on the line. In our issues we will try to inform the readers on their activities. Alexander V. Frolov

Internet Pages

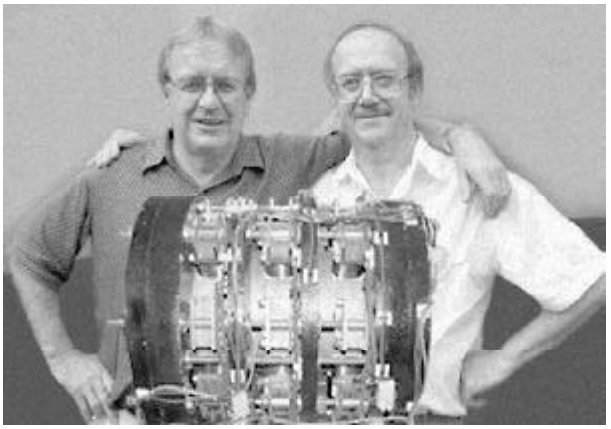

Lutec 1000

Jasker Power System

Electric Radial Motor

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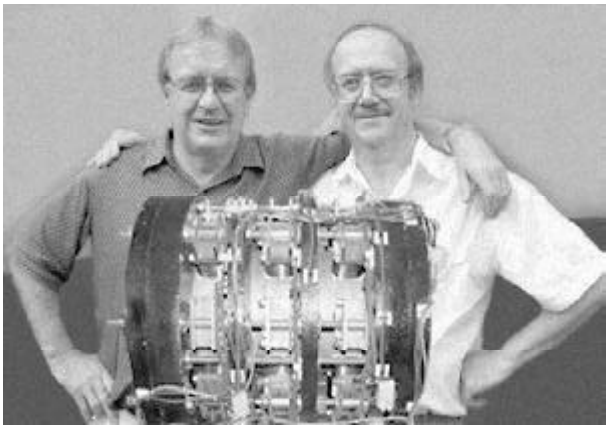

Lutec 1000

Jasker Power System

Electric Radial Motor

18 Meter Perpetual Wheel

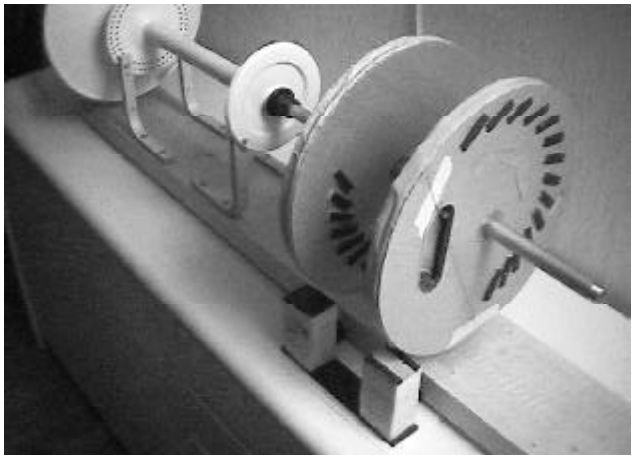

Minato Wheel, E. Vogel, Sweden

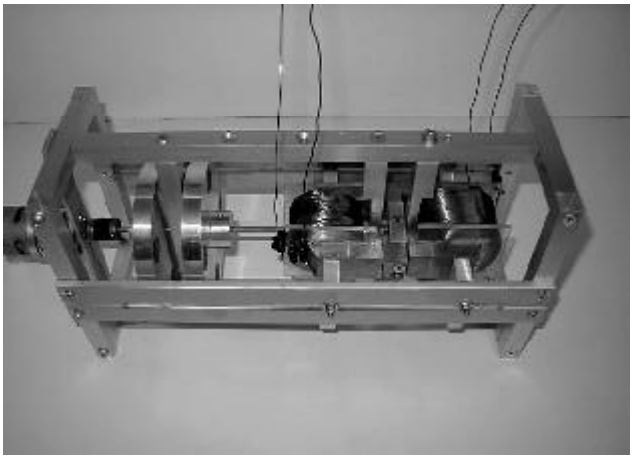

Generator from James W. German

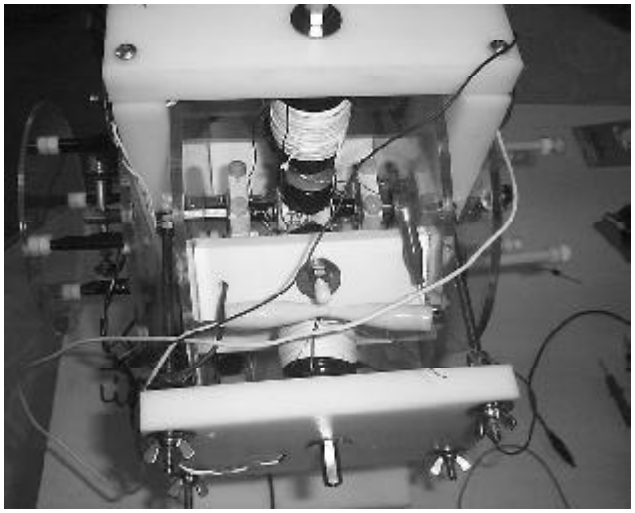

Konzen
Pluse Motor

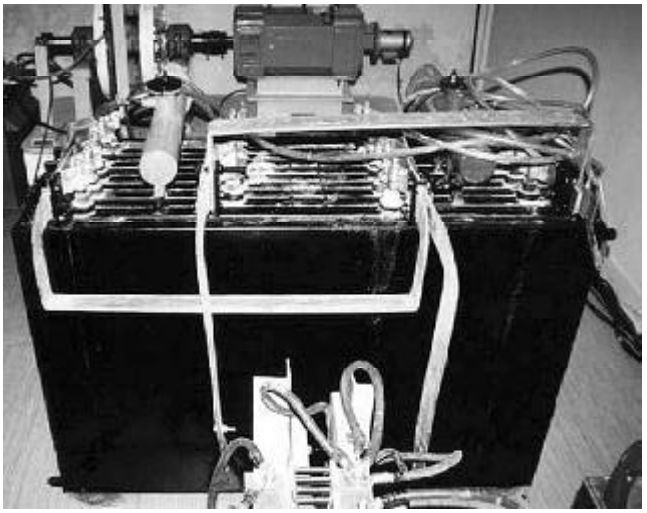

200-300 percent over-unity energy Space
Power Generator

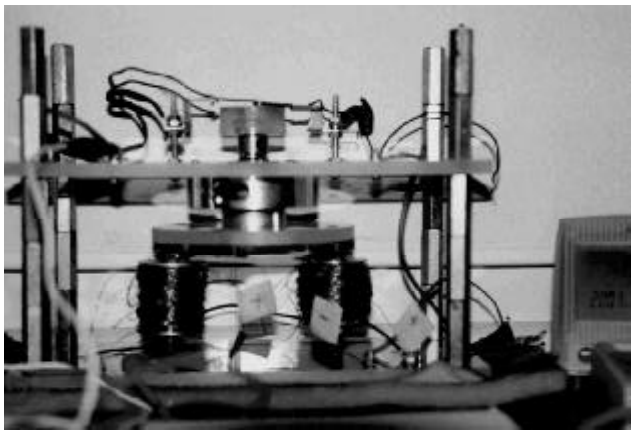

Adams Motor, Robert Adams

The RotoVerter

Bendini Pulse Motor

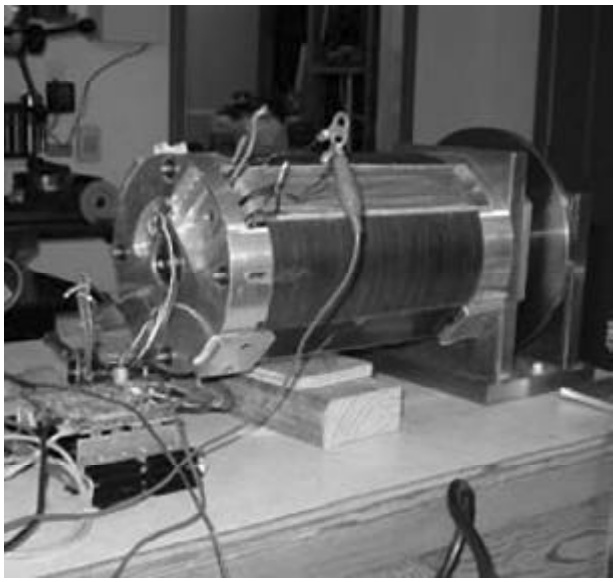

Motor based on Flynn Technology

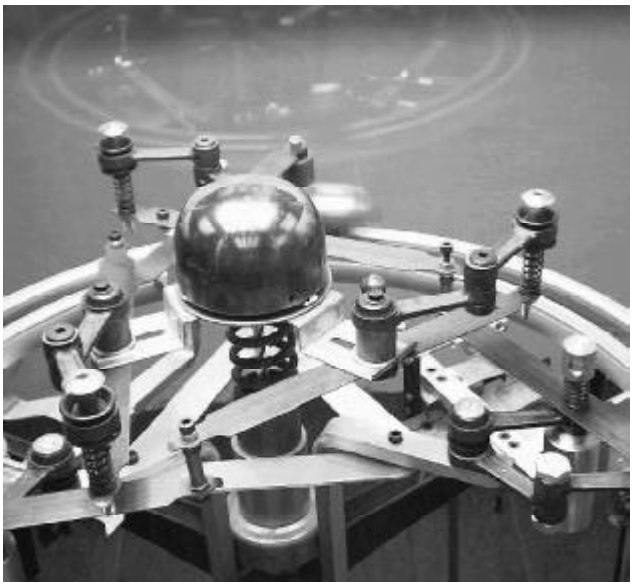

Finsrud Device

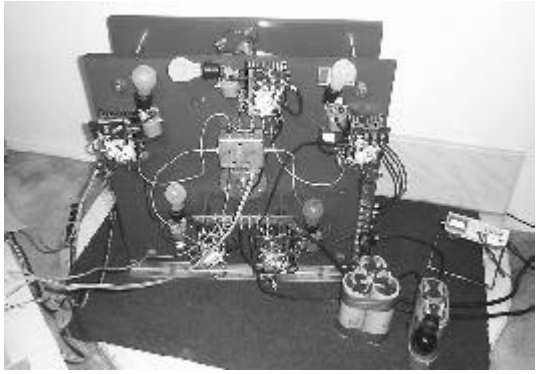

The Muller Unit

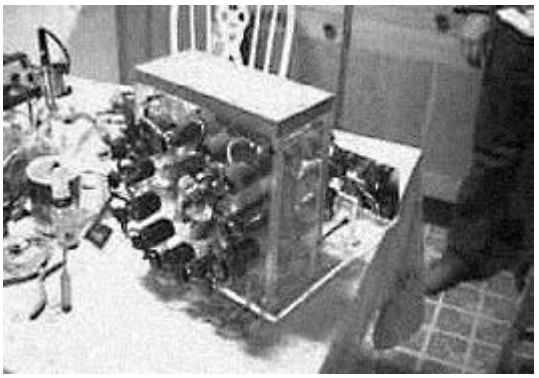

Alte Olsen Generator

Vladimir Matveev's Electrical Generator

Entirely New Kind Of Generator Invented!

(1-26-2003) TASHKENT, Uzbekistan (UPI) – An Uzbek inventor said he has created a type of electrical generator that does not rely on the principle of electromagnetic induction – on which all existing generators are based.

The new generator employs a concept called **magnetic conductivity modulation** and it has potential applications in industry, communications, households and even the military, explained Vladimir Matveev, the inventor, a specialist in electronics.

Matveev said he is convinced he has created a fundamentally different machine.

"All electrical machines I know are based on the principle of interaction between the magnetic fluxes (lines of force) of their rotor (rotating member) and stator (portion that remains fixed)," he explained.

Such machines, Matveev said, are based on electromagnetic induction, a property of energy discovered by Michael Faraday, an English physicist and chemist, in the 19th century. The machines produce electrical current either by moving a conductor across a magnetic field or by regulating the flux of that field.

"My machine has a principal difference," Matveev told United Press International. "The magnetic field of its stator does not interact with the magnetic field of the rotor (because) its rotor is not a magnet – the rotor only changes the magnetic resistance of the stator," he said.

The stator in Matveev's generator contains a magnetic core with a permanent magnet and a detachable winding. A rotor with changeable magnetic resistance is placed at a cutoff point in the core's magnetic field. It is composed of alternating magnetic and air parts and can operate in either linear or rotary form.

When the rotor is set in motion, its alternating components pass through the magnetic core's cutoff point. When the magnetic part passes through the cutoff point its magnetic resistance decreases. When the air part passes through, its resistance increases.

This pulsing of resistance results in changing the magnetic conductivity of the magnetic core, which in turn produces an alternating electrical current in the core's winding. The frequency of the winding's current can be controlled by regulating the rotor's speed or by changing certain qualities of its magnetic or air parts. Also, the generator's electrical

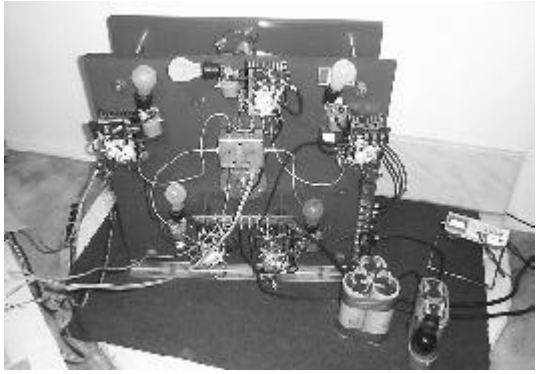

The Muller Unit

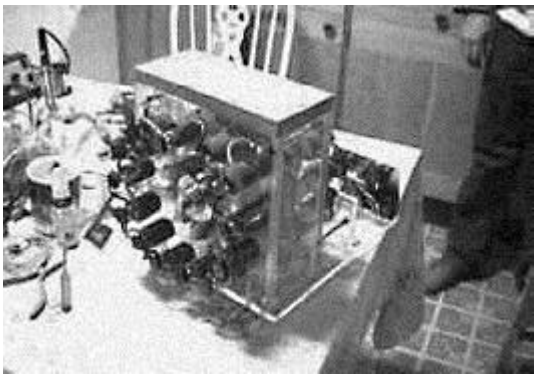

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output – its voltage – can be controlled by changing the configuration of the rotor's components, Matveev explained.

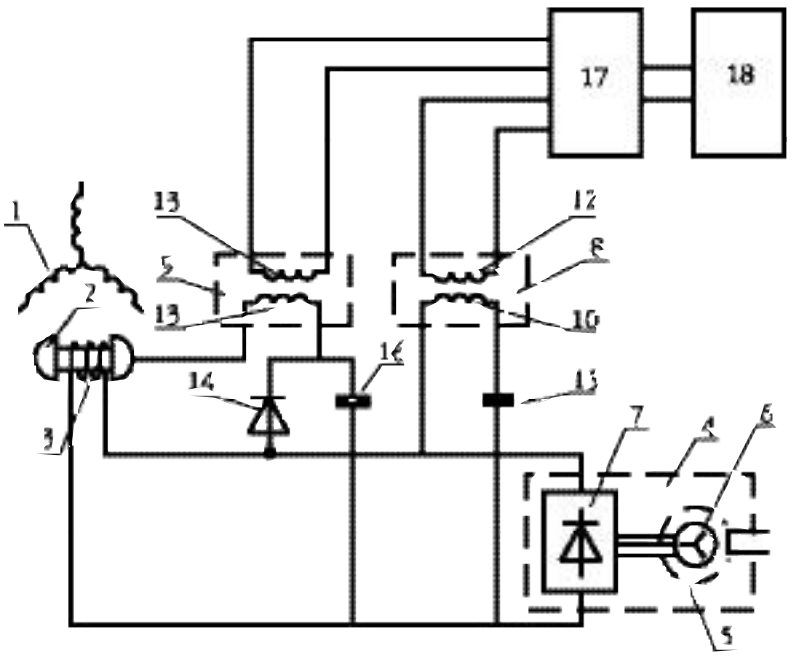

Electrical machine assembly - FEDORO V F 1996.10.10 1996RU-119822 (1998.09.27) G01R 31/34, 31/02

Addnl.Data: VOROBEI V K MATVEEV V A

NOVELTY - Device has electrical machine, non-brush field exciter with diode rectifier, two dynamics double-winding transformers, which primary windings are located on rotor and secondary windings on stator. One end of primary winding of second transformer is connected to rotor housing; another end is connected to common point of conductor which is connected between capacitor and cathode of semiconductor diode, which other terminals are connected to direct current terminals of diode rectifier. Semiconductor diode is connected to cathode group of rectifier; capacitor is connected to anode group. Secondary windings of transformers are connected to actuating member through generator of signal, which is proportional to resistance of insulation in excitation winding circuit.

USE - Electric power production

Matveev said his generator is different from an invention by Howard Johnson of the United States. Johnson discovered how to build motors that can run without input of electricity or any other kind of external energy. He obtained a patent in 1973 for describing electrical generation using only the energy contained in the atoms of permanent magnets.

Matveev also said some Russian inventors have experimented with a generator similar to his. Their generator changes its magnetic conductivity by changing temperature. However, the machine requires a lot of time to be heated and cooled alternately and results in a current frequency much lower than what generally is used in industry. Moreover, the Russian generator requires high steel density and greater mass.

Matveev's machine generates electric energy of industrial frequency. Furthermore, he said his machine is simple, reliable and requires less steel and mass than conventional generators. It also can be adapted to flows of low speeds, such as weak water or wind streams. Matveev tested the generator in his former household in Kazakhstan before he patented it in Uzbekistan.

"I want to pass the invention on to all mankind," he said.

Boris Abdurakhmanov, director of the Uzbek Koinot (Cosmos) design office and head of the laboratory of semiconductors and photoelectricity of the Institute of Electronics of the Uzbek Academy of Sciences, told UPI: "Matveev has offered a fundamentally new approach to a problem of the creation of electric power generators."

Utilization of the Gravity Force in Power Engineering

Editor: In the previous issue we made a review of Mikhail Smeretchanski's invention "Perpetual motor with magnetic control elements" (# 4, 2003). This invention was patented; shown below are some pages from the patent itself. You can contact the author by e-mail: smeretchanski.mikhail@wanadoo.fr, or the postal address: 13 av. Rochambeau 3800 GRENOBLE FRANCE

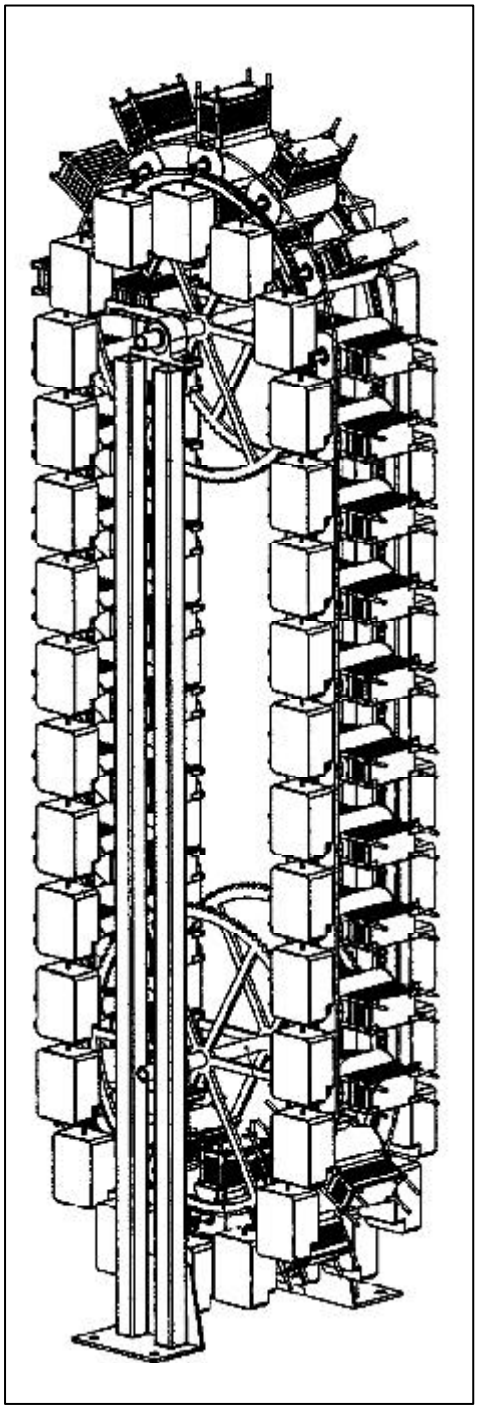

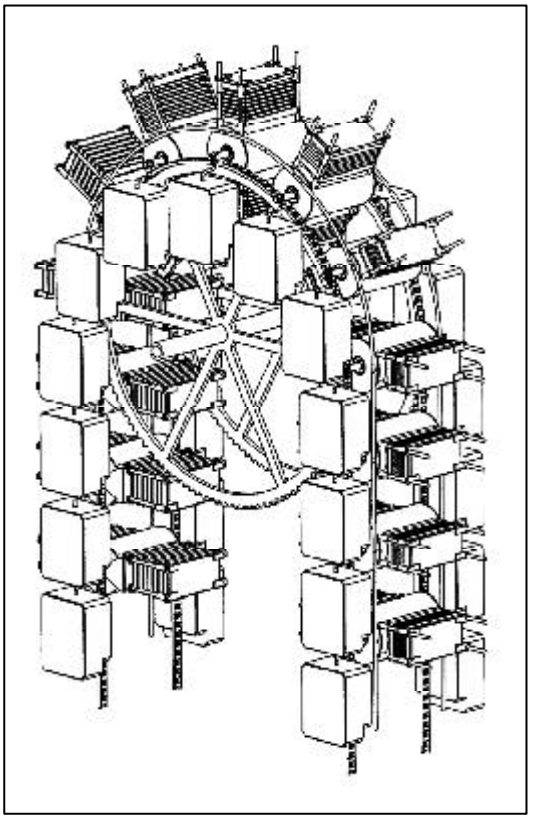

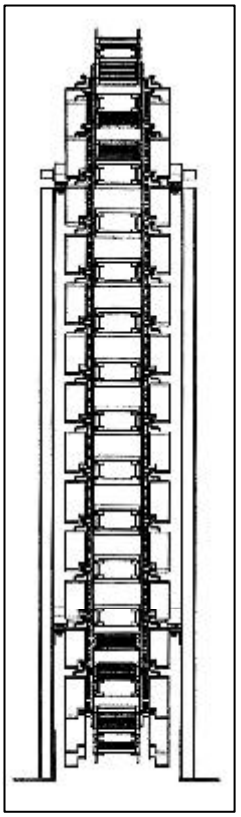

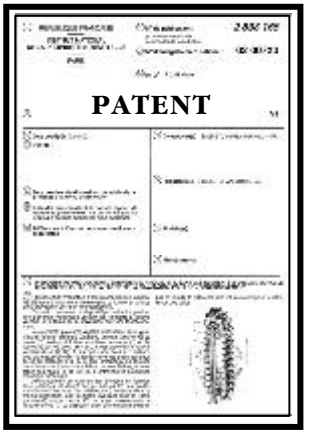

PATENT

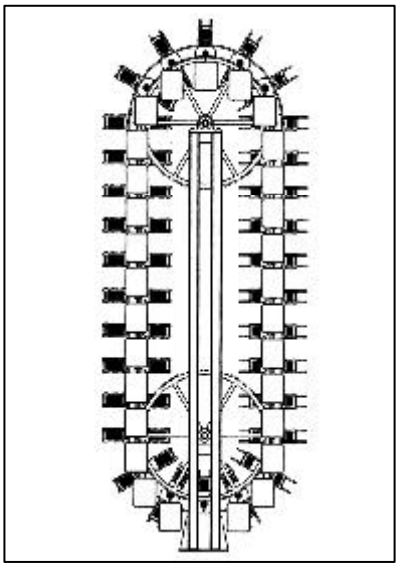

The Most Interesting Articles - 2003

In the year 2003 we have published more than 120 articles, mainly on the alternative energy, new propulsion principles and the development of ether dynamics.

"Cold fusion", low energy nuclear reactions (LENR) and highly-efficient electrolysis were represented by the works of Professor Kanarev, E. Storms, P. Hagelstein, T. Chubb and E. Cartlidge.

Almost every "New Energy" issue features articles on highly-efficient permanent magnet motor or generator experiments or patents of the kind. The articles by T. Valone, E. Vogel, A. Akau, T. Hardwood, A. Francouer and S. Abramov are of great value for engineers and researchers in this field.

The interesting articles by M. Filo, R. Koontz and V. Bogomolov reveal several principles of designing and building purely mechanical energy generating systems. All these systems possess one common feature: namely, the fact that a substance (a solid or fluid working mass) is accelerated in the gravitational field or in the centrifugal force field. The design characteristics of the system make it possible to obtain free energy.

We have published several articles by S. Gerasimov and his colleagues on the reaction-less propulsion device experiments. We hope that in the future we will keep in touch with these researchers.

The article by D. Reed on the new physics development concepts is worth mentioning too. The article by E. Sorokodum on new energy sources and the article by V. Chernobrov on the research into the active properties of time are of no less importance.

A. Egorov's article on the ball lightning makes it possible to form a number of experimental approaches to the problem of creation multi-purpose stable plasma objects.

Electrogravity questions, water-powered vehicles, longitudinal electromagnetic wave technologies, the Searl effect commercialization, capillary engines, resonance high-efficiency power-engineering, single-wire power lines, heat pumps and other similar research works were presented to our readers in the year 2003. We have minimized theoretical articles and we hope that the magazine has become more interesting and useful for the new energy practice development.

Alexander Frolov
St. Petersburg, Russia

There is interesting newsgroup of the site: http://www.overunity.com, Stefan Hartmann, email: harti@harti.com

Stefan Hartmann writes: This is the answer I got from Finsrud; it seems that the film they have done about him will be shown [on Discovery Channel] in 2004 when [if] I interpret this norwegian text right...

Subject: Documentary Film
Reidar Finsrud,

Dear Sir,

The Australian Broadcasting Company together with The Discovery Channel, have funded my company to make a documentary film entitled 'A Machine To Die For', the story of Perpetual Motion and the search for 'Free Energy'.
I have read extensively about your Perpetual Motion sculpture and we would be interested in traveling from Australia to Norway in order to film this now famous piece of work. At the same time we would request an interview with yourself.
If you are in agreement with this it is our intention to be in Norway on the 10th and 11th of July 2003.
This documentary will be released worldwide and should produce considerable interest in your Gallery.

Mark Eliot
Catherine Jarvis and Mark Eliot
Romany Mill Studios

Hydrogenics Secures $3 Million from Japan Auto Makers

Letter from RemyC remyc@prodigy.net
Contacts: investors@ hydrogenics.com

Hydrogenics Secures $3 Million in Test Equipment Orders Japanese Auto Makers Select Greenlight Power for Fuel Cell Testing Equipment

TORONTO, Sept. 30 – Hydrogenics Corporation (Nasdaq: HYGS; TSX: HYG), a developer and manufacturer of fuel cell products, announced today that its wholly owned subsidiary, Greenlight Power Technologies (Greenlight) has received orders totaling US $3 million for fuel cell test stations from two leading Asian automotive customers. Both are repeat orders for multiple machines.

Cumulatively, Greenlight is providing seven Fuel Cell Advanced Test Stations (FCATS) to two major customers. The first order is for three 3 kW PEM FCATS L-Series test systems. The second is for three 12 kW PEM FCATS H-Series test systems and one 60 kW PEM FCATS HX-Series testing station. The stations are expected to be delivered over the next two quarters.

"Our decision to open an office in Tokyo, Japan over three years ago continues to pay dividends," said Pierre Rivard, President and CEO of Hydrogenics. "The Japanese market is advancing quite aggressively towards the commercialization of fuel cell technology, as evidenced by our growth in test equipment sales to the region over the past three years. We are delighted to secure these major contracts with customers who are clearly setting the pace in fuel cell development."

Greenlight fuel cell testing systems provide high precision instrumentation, combined with full-featured software. They deliver fuel cell testing results that prove the reliability, repeatability and versatility required for world-leading fuel cell development programs.

About Hydrogenics Corporation

Hydrogenics Corporation (Nasdaq: HYGS; TSX: HYG) is a leading clean power generation company, engaged in the commercialization of fuel cell technology and test stations for fuel cells. The company is building a sustainable business, in a potentially "game changing technology" for transportation, stationary and portable power. Hydrogenics, based in Mississauga, Ontario, Canada, has operations in British Columbia, Canada, Japan, the United States and Germany. For more information, please visit www.hydrogenics.com .

About Greenlight Power Technologies, Inc.

Greenlight Power Technologies Inc. (http://www.greenlightpower.com), a wholly-owned subsidiary of Hydrogenics Corporation, is a leading global supplier of testing and diagnostic equipment to the fuel cell industry. It has supplied fuel cell test equipment to the world's premier fuel cell stack manufacturers, component manufacturers, system integrators and research organizations. Greenlight provides a full suite of test equipment for fuel cell stack, stack component, reformer and system testing for companies focused on portable, stationary, and transportation fuel cell applications.

Hydrogen Fuel Cells

Anuvu Incorporated

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Fax: (916) 921-7044
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www.anuvu.com/home.html

Now our readers can get familiar with some hydrogen fuel cell development photos. It is worth of a note that the prices are high for the majority of people. For example, a hydrogen fuel cell car costs 100 000 dollars FOB Sacramento, CA. The next picture features a fuel cell van, which costs 150 000 dollars.

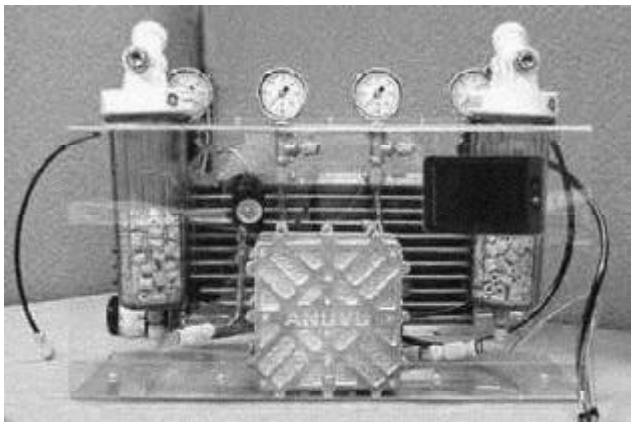

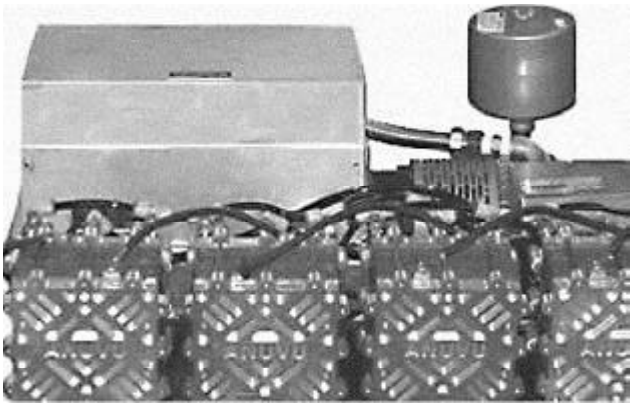

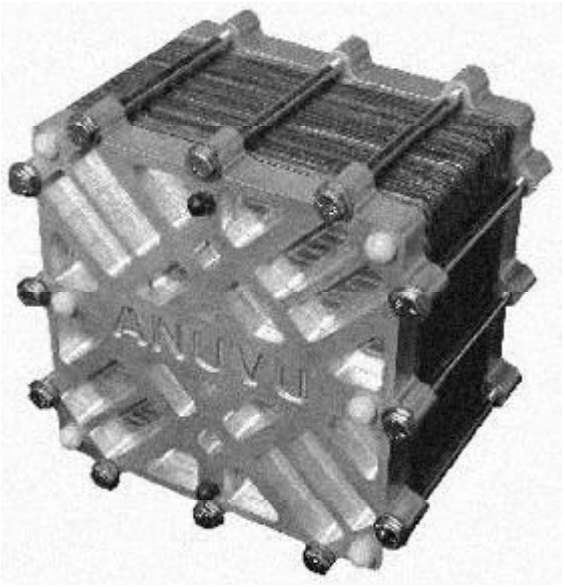

EXCESSIVE OUTPUT BY MEANS OF AIR IONIZATION

We have received an interesting article from California. Here is the short version of the article.

The Mechanism of The Electric Spark

Review of the research
by Leonard B. Loeb
Professor of Physics, University of California at Berkeley
and
John M. Meek, Research Engineer
Stanford University Press, Stanford University, California

Dedicated to Professor J. S. Townsend whose pioneer research and theory laid the whole foundation for the study of the mechanism of the electrical spark discharge.

Although the electric spark has been known to mankind in its various manifestations from time immemorial, its mechanism has to date been little understood. The initial clarification of the mechanisms involved is due to J.S. Townsend as a result of his brilliant researches in the early nineteen hundreds. On the basis of his theory of ionization by collision by electrons and positive ions, the fundamental mechanisms active and especially the coefficients required in their application were made available.

In 1936 the present senior author was forced to describe the mechanism of spark discharge in terms of a modified but distinctly unsatisfactory Townsend theory. In 1935 the discovery of photo-ionization in air by corona discharge indicated a solution was not far off. The turning point of a more successful theory came in the discovery of streamers in positive point to plane corona in 1936. The quantitative analysis of the self-propagating positive streamer in all breakdown phenomena became clearly evident as a result of the data concerning electron avalanches. As a result a qualitative mechanism of sparking by streamer propagation from anode to cathode functioning by means of photo-ionization in the gas was established.

The Townsend Sparking Criteria

It will not be necessary here to derive the famous equation of Townsend for the current [i] in a gap between electrodes as a function of the photoelectric current [io] from the cathode, the gap length [x] and the coefficients [a] and [B]. For this the reader can go to any standard text. *(Editor: the equation is omitted)*

In this equation the first Townsend coefficient [a] represents the number of new electrons created in the gas by an initial electron in its advance of 1 cm along the field axis from the cathode.

The second Townsend coefficient [B] in Townsend's original theory was the number of new electrons created by a single positive ion in its advance of 1 cm along the field from the anode.

The quantity [a] has been extensively studied in various gases. It varies with the ratio of field strength to pressure, X/p, where [X] is in volts per centimeter and [p] is in millimeters of Hg.

Note: the reason we are going through this is to determine the actual increase in current provided by the spark gap, and thus be able to design the circuit to avoid blowing out semiconductor components. It also provides a

sound and already proven scientific theory to work from giving us a good foundation and the confidence to proceed with technical design work.

The quantity [B] has been evaluated, albeit rather inaccurately, from the variations of [i] with [x] at various higher values of X/p, by many observers in different gases. Inasmuch as it has now been shown that there are numerous other mechanisms other than impact with positive ions, which can liberate the secondary electron, needed in discharge.

There has been an inclination to give up the mechanism of impact ionizations by positive ions in gas. The discovery of measurable photoelectric ionization in gas has now made it possible to explain such cases. The exact way in which photo-ionization in the gas could operate to cause a spark, was not clear until the development of the present **streamer theory**.

The Streamer Theory of Spark Discharge Anode Space-Charge Field Due to an Avalanche

Assume a spark gap of 1 cm in length. Assume that in air at atmospheric pressure the potential across the plates is 31,600 volts, which is the conventionally observed sparking potential [Vs].

Let us then calculate what happens in the field to one of those electrons. It starts across the gap, quickly acquiring an average random energy of some $E=1/2mC^2= 3.6$ electron volts and a drift velocity [v] in the field direction of about 1.5 to 2 times 10^7 centimeters per second. As it moves it creates new electrons at a rate of [a] per centimeters in the field direction so that in a distance [x] it and its progeny amount to e(ax) electrons, forming what is called an **electron avalanche**.

Therefore, e(ax) positive ions have been left behind by the electron group, virtually where they were formed in the 10^{-7} second of advance for the electrons in the distance x=q across the plates. As the electron avalanche advances, its tip is spreading laterally by the random diffusive movement of the electrons.From these data it is possible to compute the density of positive-ion space charge left behind at any point [x]. The value of [a] under these conditions is about 17, making e(aq)=e(17). The first ion pair is created at 0.0407 cm from the cathode. At 0.5 cm from the cathode there are 4914 ions, at 0.75 cm there are 3.66 times 10^5 ions, and within 0.0407 cm from the anode there are 1.2 times 10^7 ions. **Most electrons will be drawn to the anode except for some few that are bound by the positive ions, making a sort of a conducting discharge plasma in the avalanche.**

Such a distribution of ions does not make a conducting filament of charges across the gap, and hence in itself an avalanche that has crossed does not constitute a breakdown of the gap. Thus one must look further for the mechanism of the spark.

If Loeb and Meek are correct then if we assume a spark gap of 3 mm and a voltage of 5,000 voltsthere are roughly 2,000 electrons created by avalanche for every one electron leaving the cathode. They state that most of these 'free electrons' are absorbed by the anode. [This would certainly explain why the semiconductor components cannot handle the current gain.]

NOTE: Loeb and Meek make little reference to initial amperage. There are only two values they refer to 10^{-5} ampere and 10^{-12} ampere.

In conclusion: Sparks and Arcs are two different beasts. My initial research into the amperage necessary to form an arc does not apply to spark and the process of avalanche where this huge gain mechanism is possible.

Photoelectric Ionization in Gas as a Secondary Mechanism

Accompanying the cumulative ionization there is produced by electrons from four to ten times as many excited atoms and molecules. Some are excited to an energy exceeding the ionizing potential of some of the atoms and molecules present, either by excitation of an inner shell, by ionization and excitation, or in a **mixed gas like air by the excitation of molecules of higher ionizating potential, e.g., N2**. These excited atoms or molecules emit radiations of very short wave

length in some 10^{-8} second. This short ultraviolet radiation is **highly absorbed** in the gas and leads to ionization of the gas. In fact, the whole gas and the cathode as well are subjected to a shower of photons of all energies traveling from the region of dense ionization with the velocity of light. Thus nearly instantaneously in the whole gap and from the cathode new photoelectrons are liberated which almost at once begin to ionize cumulatively.

The Mechanism of Positive Streamer Formation

The photoelectrons created at points in the gas and at the cathode at any great radial distance from the avalanche axis will merely create other avalanches. Those in the gas will be short and those coming from the cathode region will be long and like that of the initial avalanche. Being smaller and, in any case, later in creation than the parent avalanche, such avalanches will be of no interest in breakdown. However, those photoelectrons created near the space-charge channel of positive ions, and especially near the anode, will be in an enhanced field, which exerts a directive action drawing them into itself. If the space-charge field [X1] is in the order of magnitude of the imposed field [X], this action will be very effective. In addition the values of [a] will be much enhanced.

The electrons from the intense cumulative ionization of such photoelectron avalanches in the combined fields [X] and [X1] which are drawn into the positive space charge feed into it, making it a conducting PLASMA which starts at the anode. The added fields will be most effective along [X] and so will the ionization. The positive ions they leave behind will therefore extend the space charge towards the cathode. These electrons also create photons, which produce electrons to continue this process. **In this fashion the positive space charge develops toward the cathode from the anode as a self-propagating positive space-charge streamer.**

As the streamer advances towards the cathode it produces a filamentary region of intense space-charge distortion along a line parallel to the field. The conducting streamer of a plasma consisting of electrons and ions extending to the anode thus makes a very steep gradient at the cathode end of the streamer tip. As this advances toward the cathode the photoelectron avalanches produced by radiation at the cathode, especially at the intercept of the extended streamer axis at the cathode, it begins to produce an intense ionization near the cathode. Hence the positive ions created there may increase the secondary emission. Thus, as the space-charge streamer approaches the cathode a cathode spot is forming which may become a source of visible light.

When the streamer reaches the cathode there is a conducting filament bridging the gap. As the streamer tip reaches the cathode the high field produces a rush of electrons towards the end of the streamer. This if followed by a current of electrons, gives a high-potential wave, which passes up the preionized conducting channel to the anode, **multiplying the electrons present by a large factor**. The channel is thus rendered highly conducting. If the metal can emit a copious supply of electrons because of the formation of an efficient cathode spot, the current of electrons continues the channel maintaining its high conductivity and **ever increasing in it**. This current, unless limited by external resistance, will then develop into **an arc**. It is, however, the intense increase in ionization by the potential wave, which gives the highly conducting channel characterizing the spark.

Conclusion: According to Loeb and Meek there are three means by which a spark in open air will provide a very large current gain. If this is true, it should be fairly easy to prove with inexpensive and unsophisticated equipment. Once the actual amount of current gain has been determined for the design parameters of the spark gap, then the rest of the circuit can be designed for the increased current value.

Editor: It is worth of a note that the current gain by means of ionization was patented by Pavel N. Yablotchkov (the patent of France # 120684, October 11th 1887). Some two years ago one of our issues featured an article about him. We think it is worth being published again.

PATENT of 1877 by Pavel N. Yablotchkov

Alexander V. Frolov
Faraday Lab Ltd,
Lev Tolstoy St., 7 St. Petersburg, 197376 Russia
Tel: 7-812-380-3844

Pavel N. Yablotchkov was born in 1847 near Saratov, Russia. He graduated as a Military Engineer in 1866 and spent several years in the Russian Army.

In 1872 he came to Moscow and started his activities in electrotechnical field. Since 1875 he had been working in Paris with the famous Louis Breget and his first French patent # 110479 of November 29th, 1875 was dedicated to an electromagnetic transformer. Then he developed and patented a lighting system (the well-known Yablotchkov electrical candle). In 1876 he patented a new electromagnetic transformer for industrial purposes, France # 115793 of November 30th, 1876.

The most interesting patent claim on over-unity devices by Pavel N. Yablotchkov is known as France patent # 120684, October 11th, 1877, "The system of distribution and amplification of electrical currents by means of atmosphere electricity..." The patent describes special capacitors connected in series with the load to increase the output current by means of ionization. Experiments were conducted together with the well-known physicists such as Dr. Maskar, Dr. Varren-Delaru and others and **they confirmed the 200 % efficiency of the circuit**. Now we will try to explain the method.

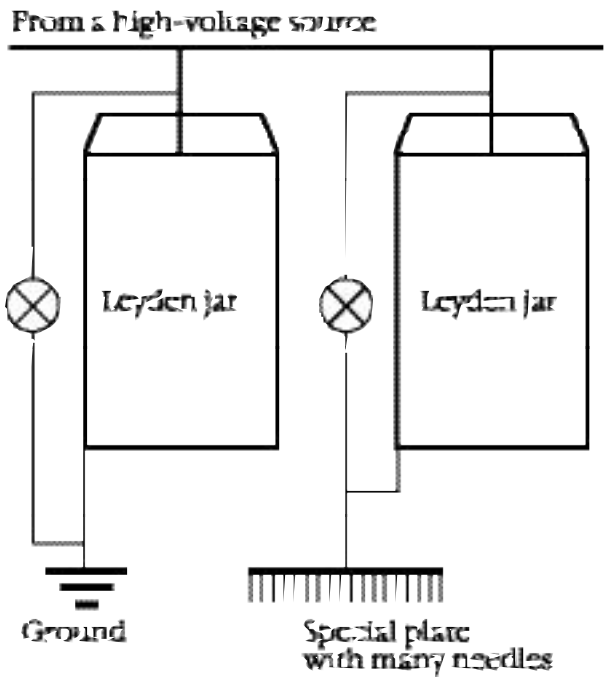

Fig.1 features a schematic drawing taken from Yablotchkov's patent. The Leyden jar is an asymmetrical capacitor, i.e. it is different in principle from a two-plate flat capacitor. The inner electrode of the jar should be connected to a high-voltage source and in this case the changes of the potential have an effect on the potential changes on the external electrode. It does not work in the opposite case and if you connect a high-voltage source to the external electrode no potential changes will be detected on the inner electrode. Connection to the ground or to a special plate (which is covered with many needles to increase air ionization) is necessary to attract the maximum number of electrons to the plate surface or to return the maximum electrons from the plate surface when potential changes on the external electrode are produced by means of electrical induction in the Leyden jar.

In conclusion I should mention one more supposition of the secrets of the well-known Swiss M-L converter (Methernitha). The main elements of the design are Leyden jar capacitors, which have the external surface made of perforated metal.

The other known fact is that great ionization of air is observed when the converter is in operation. So, the electrostatic machine can produce pulses of a very high voltage (potential difference) but it cannot be used as a source of a powerful current. In order to increase the current in the circuit we should apply a certain method and Yablotchkov's technology seems to be appropriate. A large surface of the external electrode of the Leyden jar can be a good solution to the problem. Maximum strong ionization allows us to obtain the output current several times stronger than the weak current generated by the electrostatic machine.

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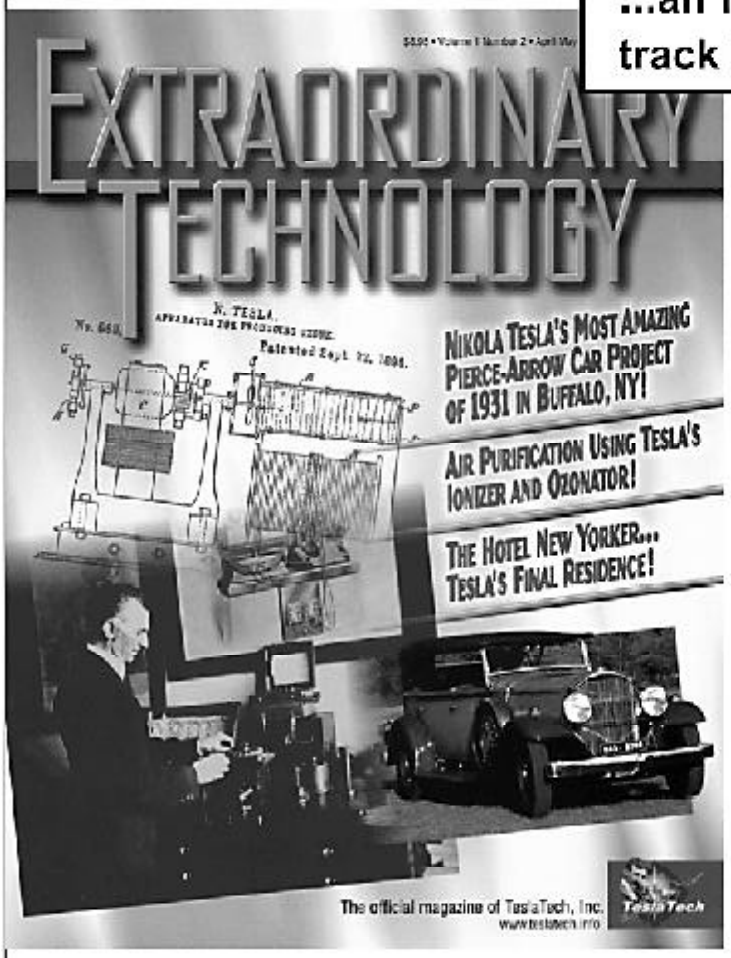

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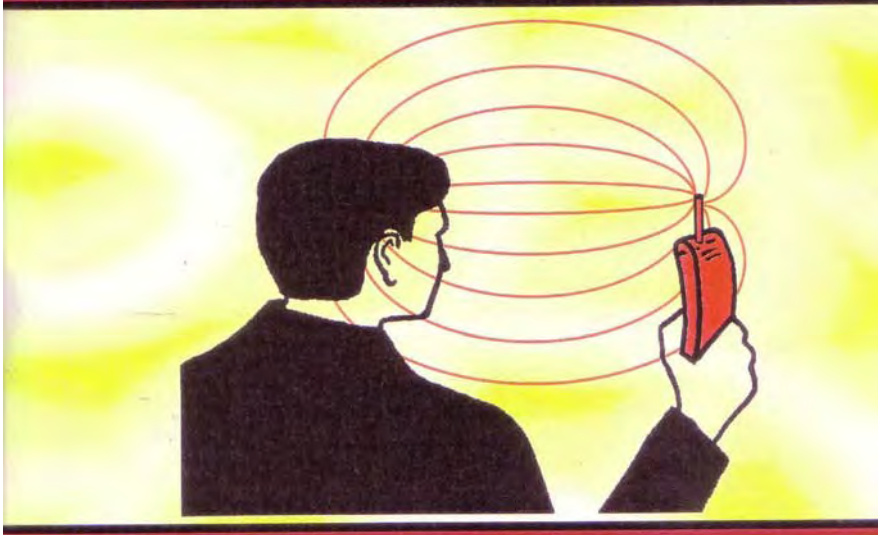

From an extended vortex and field theory to a technical, biological and historical use of longitudinal waves.

Edition belonging to the lecture and seminar „Electromagnetic Environmental Compatibility"

Preface to the lecture, 1st Edition 1996

The theme encloses the electromagnetic compatibility of both technical and biological systems. Only part of the electromagnetic wave can be considered for function troubles, namely the part that was absorbed and has rolled up to a vortex. The activity depends on the number of created vortices and of their lifetime, their decay.
The eddy current only manifests in conducting materials. In the air and in dielectric materials on the other hand the vortex of the electric field will form, also called the potential vortex. To calculate and to measure this vortex is our goal.

First we'll carry out a survey of the problems and the usual methods. From the analysis of unsolved problems the need for the introduction of the new vortex phenomena is deducted and an adequate field-theoretical approach will be chosen. Afterwards the potential vortices are calculated and their properties are discussed and interpreted. For the purpose of proving their existence, on the one hand the Schrodinger equation will be derived and on the other hand the quantum properties of the most important elementary particles will be calculated and compared with the well-known measured values. Measurement and calculation are in excellent agreement for weight, charge, magnetic moment and spin. So the theory not only proofs it's correctness, in addition it demonstrates it can achieve much more. The theory takes us to the unification of the well-known interactions and physical phenomena and shows itself as an unified theory. In the practical conversion and usage of the theory there will not only be informed but by all means also be provoked as an entrance in a fruitfully discussion. Fundamental questions will be taken up like: What is information, energy, temperature or smell? The connection to the theme of the electromagnetic environmental compatibility is formed by the technical and the biological usage of the potential vortices, the energy transmission of Nikola Tesla exactly like the in a similar way functioning nerve conduction. Here we already can expect biological reactions.

This lecture, held for the first time in the winter semester of 1995/96, is available in book form, as an edition belonging to the lecture. This lecture will not deliver ready recipes or instructions. The goal is reached when the critical sense of the listeners and readers has been inspired and discussions have been set going. Everybody has to draw the consequences out of such a theory by him- or herself.
In addition to this lecture a seminar is offered, wherein several themes are supplemented or deepened, different theories are compared and possible consequences are discussed. The appearance of an edition belonging to the seminar has started in 1998[<i>]. Regarding the conversion of consequences both politicians and scientists are equally addressed, because the electromagnetic environmental compatibility has developed to one of the most urgent problems of today's world. But in last consequence all of us bury the worldwide responsibility for our environment.

<i>: K. Meyl: Electromagnetic environmental compatibility, Part 2 and 3 of this book, Edition belonging to the seminar.

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1. Introduction

Here the extremely controversially discussed question of the environmental compatibility of electromagnetic fields will be persuaded. Limits should inform what is incompatible and what is compatible. But there are as many limits as there are commissions and specialists. And besides that differ the results from each other for several powers of ten. In course of time the legitimate doubts become unmistakable and the representatives of science slowly get to feel the burden of proof.
For the sake of efficiency, the actual discussion concerning the theme of electro-smog is analysed and the necessity to involve an until now unnoticed field phenomenon in the discussion about limits is derived: It concerns vortices of the electric field. These potential vortices, as they are called, have the corresponding properties to show biological effects even at the lowest field strengths. In any case it is not possible to exclude that at present the wrong physical phenomena are measured and made responsible.

A parable should bring clarity.
Lets imagine that the to us well-known and over our sense of touch understandable physical phenomenon of the temperature is unknown to us, neither measurable nor perceptible. Our weather station only exists of a barometer that could show us the air pressure and deliver us indications if good or bad weather is to be feared. We ready realize that there exists a connection between the air pressure and our health and make the to us well-known phenomenon responsible. When the pointer points to good weather we can go out lightly dressed. With bad weather we should take a coat, so we know from experience.
"Now we imagine the realistic situation that in winter we have a weather situation of high pressure but it's stone-cold outside. The weather station will display high temperatures with the result that some people will walk around with short-sleeved and open shirt, only to lie in bed with a cold in the evening. Of course the air pressure was to blame! Logically the "pressure sensitive", as they are called mocking, demand the limits for the allowed pressure to be reduced so far that no consequences for health are to be feared. Concerning the theme of allowed limits, science is asked and science proceeds in a systematic way: the pressure is investigated in the laboratory, isolated from all other parameters and so it is discovered that man catches no cold even at a substantially higher air pressure, so there is no reason to alter the limits.
Actually we would expect these at any time reproducible results to have a calming effect on the minds of the participants of the discussion and on the population. Instead the pressure sensitives time and again cite new knowledge that won't fit in the scheme. So is for instance stated that draught causes the same health problems although this pseudo effect has nothing at all to do with the air pressure. So owing to incomprehensibility and emotions the discussion about limits becomes a farce.

The fact that sensitive people react to effects of air electricity and possibly get ill without proof that some today measurable physical quantities are responsible should make us think. It is little calming watching our scientists poking at the dense fog whereas at the same time among the runners of the new telecommunication networks there spreads something like a gold-digger mood.
To introduce a new technology is not difficult, but to abolish it for reasons of the electromagnetic environmental compatibility is almost impossible!

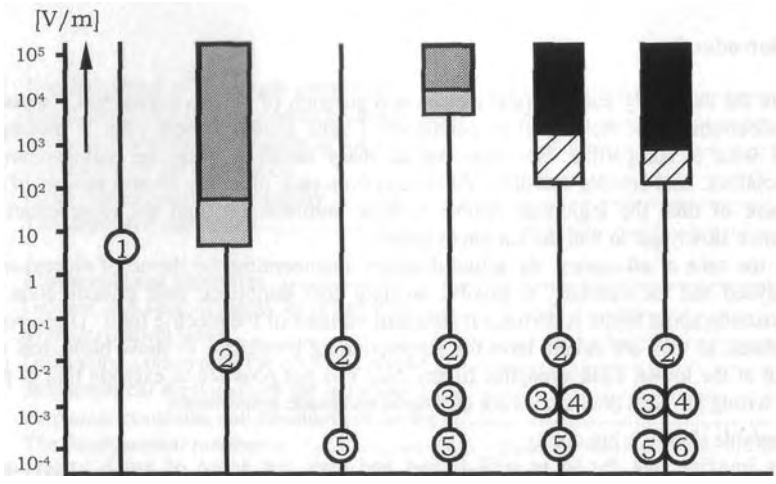

static 0 Hz	ELF (1 Hz - 100 Hz)	static 0 Hz	ELF (1 Hz- 100 Hz)	LF (1 kHz- 10 kHz)	HF (1 MHz- 10 MHz)
magnetic field [Gauss=10^{-4}T]		electric field [V/m		alternating electromagnetic field	

Fig. 1.1: Discussion about limits

Limits for professional exposition (electronics engineers) and
Limits for non-professional exposition (population in general) according to the Recommendation of IRPA/INIRC<ii>.
Limits according to VDE 0848 / 1989
Limits according to VDE 0848 / 1992
experimentally determined threshold values of reactions of biological systems <i>:

1 Increase of the activity of movement of birds
2 deflection of divining-rods
3 influence on the time of reaction of men
4 conditional reflexes of fish without electrical organs
5 conditional reflexes of fish with electrical organs
6 conditional muscular reflexes of men

taken from:
<i>: H.L. Konig: Unsichtbare Umwelt (Wetterfuhligk.), 5. Aufl., Bild 111, S. 123 Verlag Moos & Partner Munchen, ISBN 3-89164-O58-7
<ii>: Habiger u.a., EMV, Verlag Technik, Berlin 1992, S. 152

1.1 Discussion about limits

Whoever follows the public discussions concerning electro smog always sees two arguing parties, whose standpoints lie so far apart that they inevitably talk at cross purposes and there can be found no consensus.

On one side the "affected" find together who maintain to have found the electromagnetic radiation as the damaging cause for their problems. They are to be taken serious, even when only their personal sensitivity serves as means of measurement and proof and a more or less distinct sensitivity against electromagnetic phenomena. This group occasionally finds support of homeopaths who can base on reproducible laboratory results that fit as few into the view of life of science as the empirical statements of affected and possibly hurt people.
On the other side stand the representatives of the energy-supply companies and the runners of radio networks who argue with the needs of our modern industrial society and give "limits" prescribed to them by scientists. These, for their part, proceed according to strictly scientific methods. Their presented results are reproducible and there's no doubt about them.
The limits after all are fixed far below those that are recommended from a scientific viewpoint. Nevertheless both groups are separated from consensus by powers of ten. When we want to know how deep the ditch is we want to bridge, we should take a look at the determined limits (Fig. 1.1).

The limits stem from the 1RPA (International Radiation Protection Association) an organ of the World Health Organization that in turn has appointed the INIRC (International Non Ionizing Radiation Committee). These now state to have used all available scientific research results as basis for the given guidelines.
Moreover a safety range was worked into them. So the limits were fixed at substantially lower levels to guarantee that no health damage arises. In this way first the limits were determined for the people who for reasons of profession are exposed to electromagnetic fields.
For the population in general the limits for the so called non-professional exposition were reduced further to one half till one fifth for reasons of caution and care. In Fig. 1.1 these limits are registered. Thereby is distinguished between magnetic fields and electric fields that appear stationary or at extremely low frequencies (ELF describes frequencies between 1 Hz and 100 Hz). Moreover limits for low-frequency (1-10 kHz) and high-frequency (1-10 MHz) alternating electromagnetic fields are given.
The graph should serve as a rough orientation and show us the proportion of scale. As further information some thresholds of measured reactions of biological systems are registered (after Konig*[1]*). Because a logarithmic scale was chosen to fit all the values on one graph it becomes clear that between the first reactions and the recommended limits there lie up to five powers often. The ditch seems to be insurmountable.

Fig. 1.2: Set of problems of environmental compatibility by means of the example of the handheld wireless telephones (handy).

<i>: L.v.Klitzing: Neurophysiologische Einflusse durch elektromagnetische Felder wahrend und nach der Exposition, Med. Universitat zu Lubeck

1.2 Wireless telephones

Measuring technical surveys with regard to the influence of brain currents by digital radio signals by the university hospital in Lubeck have startled handy manufacturers and users equally [1]. Although in this case measurement errors could be detected, the „bugaboo on the wall" remains that we are sitting unsuspecting in a restaurant and a neighbour draws his handy out of his pocket to make a digital telephone call. Thereby synchronizing the brain currents within a radius of 100 meters on the broadcasting signal and occupying our brain useless with technical signals. The derivation will show that from the start this can't happen to all visitors, because as a prerequisite conditions of resonance must be fulfilled. But would there be an affected, he or she for sure would have considerable problems, because informations that are not picked up over the sense organs can neither be classified timely nor as regards content.
An affected whose brain has picked up technical signals not even is able to register by itself that it was fed with incorrect informations. It would be reasonable when the visitors of the restaurant would defend themselves and put the radio operator on the doorstep. The number of restaurants where apart from cats and dogs also handy's have to stay outside is increasing. How should we keep out of the way of electromagnetic fields? Should we walk around permanently with a steel helmet or even better in a knight's armour and even go to bed with them? It would be worse than in the dark middle ages.

Summarizing: it should be guaranteed that the operation of electro technical apparatus causes neither health damage nor unintentional influence or irritation. A systematic and scientific procedure should investigate in the laboratory all relevant physical phenomena individually for their interaction. Electro physics bases on two phenomena in connexion with electro-smog: on the one hand the radiation and on the other hand the thermal effect, but at a close look both factors prove to be of only little importance!
In radiation measurements the intensity of the electromagnetic wave at a certain place is determined. In laboratory experiments the field strength is increased so long till biological reactions are observed. Thermal limits are determined in a similar way. As said, the values lie about powers of ten above those that possibly bother you when you hold a handy to your ear. It is true that the microwave radiation penetrates into your head but we also know that it marches out again on the other side and this visit in your head happens with the speed of light.
Exactly like this are guest in your body constantly your local radio station, your local television station the satellites with hundreds of programs and anyway the whole radio technical world even when you did not invite them.
For an electromagnetic wave to become receivable, the field strength must lie clearly above the common noise signal and this can only be achieved by a permanent overlap, by standing waves, like in a cavity tuned to a specific frequency or an antenna. As long as people don't let themselves grow antennas on their heads they hardly have to fear direct biological effects of electromagnetic waves.
That leaves as the second phenomenon the thermal effect. With a handy held to your cheek there comes into being a local fever in your head. But that is not at all unusual or unnatural for the human body. Something like that happens to a far greater degree when you take a hot foot bath or let yourself be irradiated at one side from the sun at a tourist grill.

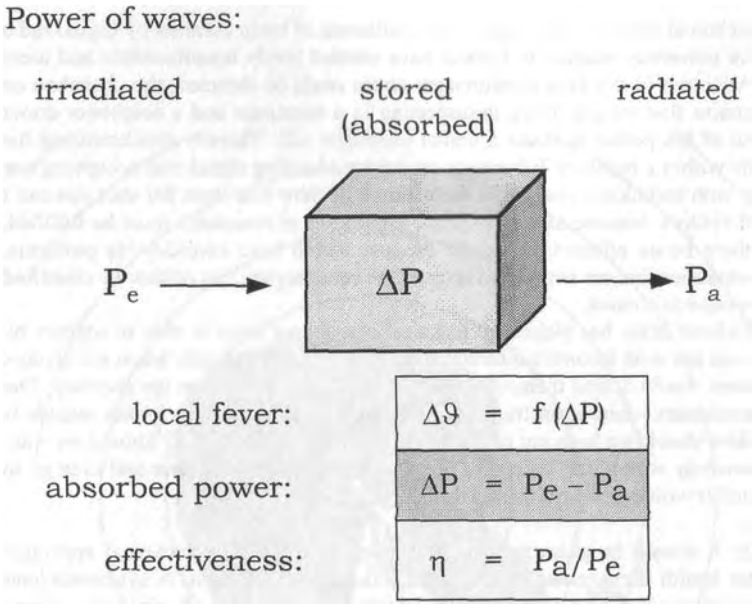

Fig. 1.3: Damping of waves and ability to absorb of a body
(our head) if we are making a phone call with a handy.

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a contribution to the theme dielectric losses

- capacitor
- high-frequency welding
- microwave oven

<i>: K. Meyl: Potentialwirbel Band 1 [Al] (only in German),
INDEL Verlag, Villingen-Schwenningen 1990, ISBN 3-9802 542-1-6
<ii>: K. Meyl: Potentialwirbel Band 2 [A2] (out of print),
INDEL Verlag, Villingen-Schwenningen 1992, ISBN 3-9802 542-2-4

1.3 Absorption of waves

The with the theme dealing physicians logically have to put up with criticism that they work only with two phenomena that not at all can be involved authoritative in the causes for biological effects. A third factor can be considered, a field phenomenon until now stayed unnoticed by science: the vortex of the electric field, the so called potential vortex. A vortex is to be considered as an oscillation around a fixed point. Through that a permanent overlap is caused, like what happens at an antenna only that the vortex is not bound to the dimension of an antenna. The potential vortex is contracting and in this way reaches extremely high energy densities at very little spatial measurement, densities that lie far above those that field strength measurements are pretending to us [Al]<i:>.

When again you take the handy at hand with which you ,,blow" the pulsed microwaves into your head. Don't worry, because with the speed of light and without provable damage almost everything comes out again on the other side, but only almost everything. A little damping of the wave has taken place and your head has absorbed this part of the irradiated wave (Fig. 1.3). Who claims this is already the thermal factor actually should realize that there exists no corresponding term in the wave equation. Here there are found merely two dual vortex phenomena as a possible damping term: the eddy current and the potential vortex. An eddy current damping is ruled out because of the bad conductivity of the head. But this favours his dual anti-vortex, the potential vortex [A1]<i>.

Seen physically the following is taking place in your head: the absorbed waves roll themselves up to vortices and through that become localized and overlap themselves permanently (Fig. 1.4b). In the course of time the vortices decay and produce the well-known eddy losses that lead to the measurable increase in temperature. When reactions or biological effects arise, simply and solely the vortex can be considered as the possible cause. Thereby play two points an important role: the number of the generated vortices and their lifetime that is determined by the time of decay.

In anticipation of the mathematical calculation of the potential vortices it is pointed out here that these are favoured not only by a low conductivity, but also by a high dielectricity. Because water has an unusual high dielectricity (ε_r = 80) and our head consists predominantly of water doubts in dealing with handy's are reasonable.

Also the relaxation time constant representative for the lifetime can be calculated [A2]<ii>. We must proceed from the assumption that both the number of the vortices and their lifetime, that is all the at a fixed point in time in our head existing and effective vortices, can be a cause and therefore have to be considered and investigated scientifically.

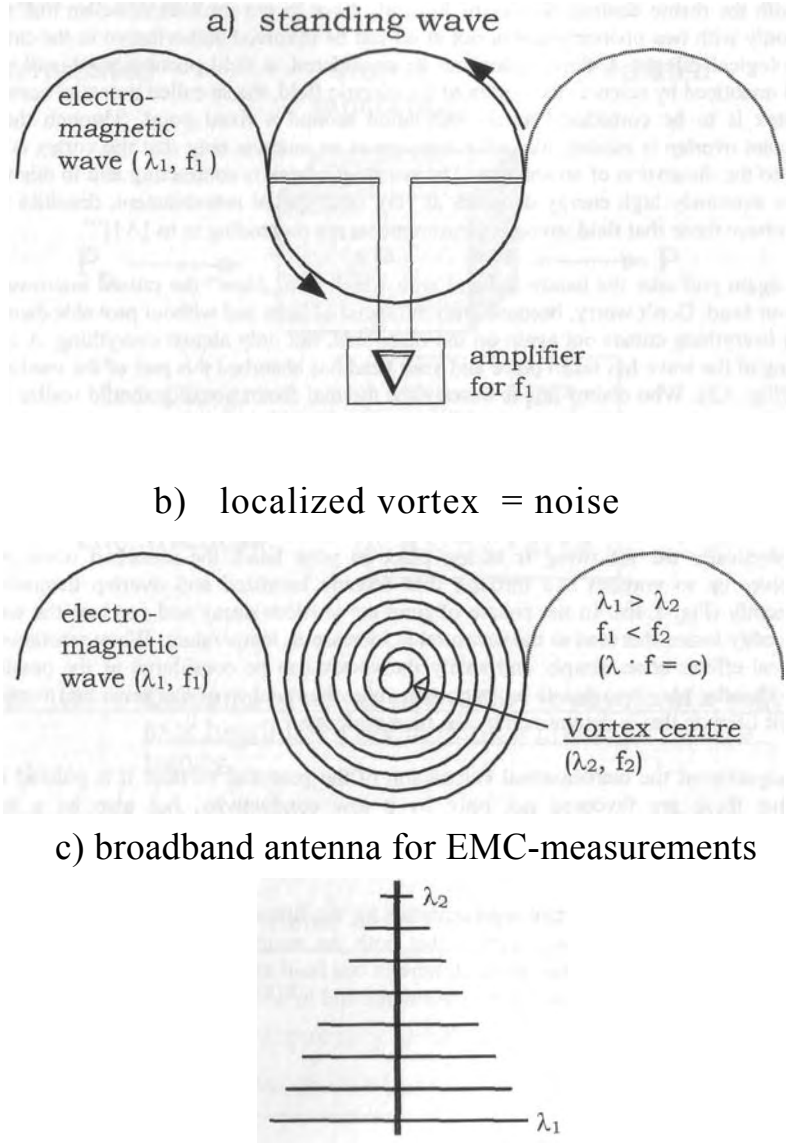

Fig. 1.4: Measurement of localized waves and vortices

1.4 Overlap effect

The graph at the left (Fig. 1.4) should clarify once more that only the in space localized and permanently overlapping field appearances can be considered as a cause for biological effects. This can concern an over an antenna standing wave (a) or a vortex (b) which is to be taken as localized by nature.
It would be allowed to in general speak only of a vortex because the standing wave can by all means be understood as a special case of the vortex. The essential difference is that the vortex is not bound to the size of a fixed antenna and can contract itself at any time to achieve in this way a substantial higher energy density. As a result this than will lead to an increased biological effectiveness.

It should be pointed at a further omission. In the discussion about limits, without exception, the absolute field strength of the broadcasting signal is valued and not the type of modulation. The last mentioned should actually not at all play a role according to the prevailing scientific opinion.
Totally different is the case with a vortex that acts damping. Such a vortex shows near it's centre a considerable smaller wavelength than more to the outside and through that it has a big frequency bandwidth [A5][<i>]. It is to be expected that in the extremely broadband pulsed signals of the digital networks the creation of vortices (or eddies) will be favoured considerably stronger than in amplitude- or frequency-modulated signals (AM/FM/C-network). In connexion with analog modulated radio- or handy-signals until now there never has been reported of any synchronization of the brain currents with handy-signals from a comparison of the EEG with the broadcasting signal.

Interestingly the for EMC-measurements usual stepped broadband antennas have exactly the construction that certainly would be favourable to the measuring technical registration of vortex phenomena (Fig. 1.4c).
With the dipole antennas of different lengths for different wavelengths there still are measured waves and not vortices but these measuring techniques is certainly accommodating to the until now unnoticed and stayed undiscovered vortex phenomenon. So there are some good reasons that the vortex is a dominating influential factor for EMC-problems.

By means of the example of the handheld wireless telephones can be studied and discussed with which set of problems the very young discipline of science of the environmental compatibility has to fight in the future. And in which ways there can be found approaches towards a solution of the problem. When the comfortable and trodden out ways of textbook physics do not lead to the goal than we will have to force our own way through the jungle of science.
At first we'll have to obtain a short overview of the actual level of research and knowledge. From the criticism to this we than can derive the tasks of the electromagnetic environmental compatibility and in particular the unsolved tasks.

<i>: K. Meyl: Wirbel des elektrischen Feldes, eine neue Storquelle? EMC Journal 1/95, 6. J, S. 56-59.

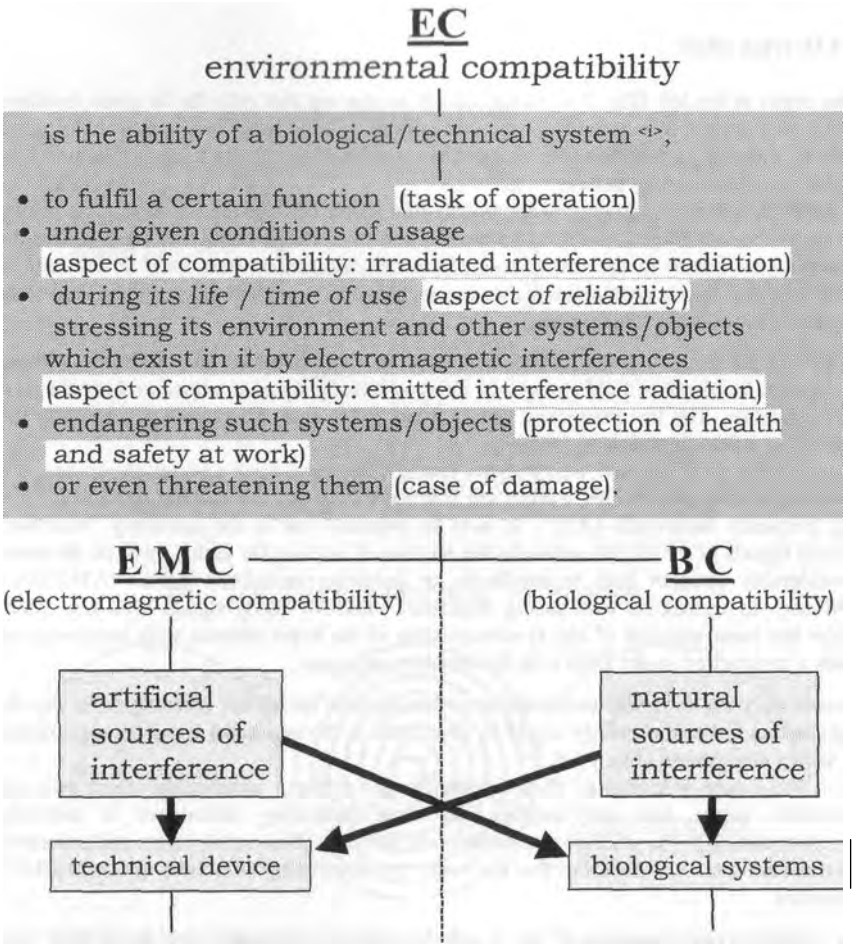

Regulations of the German Post Office since 1992: EMC-law[ii] from 1996: EU -regulation	called EMEC thirties: radio operator disease today. E-Smog, HF-, SW-therapy diathermy, etc.	know how of druids magic esoteric medicine biology

Fig. 2.1: Overview concerning environmental compatibility

<i>: E. Habiger: EMV-ubergreifende Aspekte zu benachbarten Problemfeldern, Elektrie 48 (1994), Heft 5/6, Seite 163-161

<ii>: EMVG: Gesetz uber die elektromagnetische Vertraglichkeit von Geraten, Bundesgesetzblatt Teil I vom 9.11.1992, S. 1864

2. Tasks

2.1 Tasks of the electromagnetic environmental compatibility

The environmental compatibility (EC) forms the generalization that includes both the electromagnetic compatibility (EMC) and the biological compatibility (BC). Besides the technical and functional goals of an undisturbed functional course it also pursues ethical and moral goals.
Technology should benefit to humanity and at the same time be in accord with nature. This goal will not be reached when this technology directly or indirectly is endangering humanity.
A direct attack on the health of people poses for instance the military usage of technical apparatus or the negligent usage, by pretended ignorance and unsuspicion.
Is a technology posing a danger to the environment so humanity endangers itself indirectly with this technology. After all are human beings a product of their environment. We always should reckon on the environmental sins taking revenge on us sooner or later.

In fig. 2.1 a formal definition is given that in particular concerns the claims for an undisturbed functional course: it concerns the compatibility aspects of unallowed emitted and irradiated interference radiations, the reliability and quality safety with which a function and task is fulfilled and finally the questions of the protection of health and the safety at work.

Moreover fig. 2.1 provides an overview and the structure of the 2nd chapter. First we'll treat the electromagnetic compatibility (EMC) that first of all deals with the influence of artificial but also natural interference sources on technical apparatus.
After that we'll throw a glance at the appearing fields in nature. The biological compatibility (BC) deals with the influence on biological systems.
An especially sensitive area of the environmental compatibility (EC) than describes the with a cross-link hinted influence of artificial interference sources on biological systems that is popularly described as „electro smog".

The numerous aspects of the environmental compatibility for instance in the areas of chemistry and biology that certainly are important, but do not fall in the area of electromagnetism, can't be treated in the here marked framework.

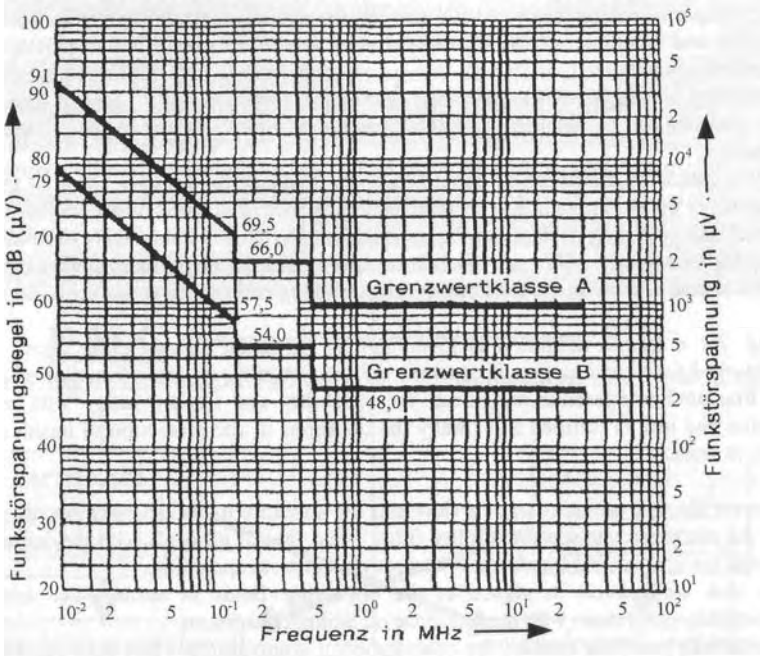

Fig. 2.2: Classes of limits according to VDE 0871 (since 1-1-96: VDE 0875)[<i>]

<i>: Anton Kohling: Grundlagen der Funkentstorung in der Bundesrepublik Deutschland, etz Bd. 108 (1987), Heft 10.

2.2 Tasks of the electromagnetic compatibility (EMC)

First of all the EMC (electromagnetic compatibility) is concerned with the function of technical apparatus. Correspondingly rational and dry sounds the official definition: "electromagnetic compatibility (EMC) describes the ability of an electrical setting-up (i.e. of a construction element, of a construction group, of an apparatus or of an installation) to function in an electromagnetic environment without stressing this environment by electromagnetic effects in an unallowed fashion ".

Actually it concerns an old need for protection that should be as old as the usage of electro technical apparatus. But in the beginning no one cared about it. The spark gaps with which Heinrich Hertz 1888 in Karlsruhe has carried out the first radio technical experiments were genuine ,,polluters", that would have been detectible at several hundreds of kilometres distance with modern receivers. For these installations that he had assembled in the lecture room with his students, today he would hardly get a permission of operation and the since 1996 required declaration of conformity he would get not at all.

1925, as in Germany the number of radio listeners had exceeded the limit of one million, for the first time a need for protection appears in the certificate of approval for radio receivers: "The public telegraphs and telephone installations must not be disturbed by the radio receiver".
Later on every backside of the good old steam radios there was found the following hint (translated): "This apparatus meets the interference radiation regulations of the German Post Office". So the manufacturers were urged to measure the emission of their apparatus and in particular to screen the HF-oscillators in the superhet-receivers.

Since the fifties, in the VDE-institute EMC-examinations in the present day sense are taken. The main point of the measurements and the by the VDE recommended limits, however is about interferences bound to a circuit. On the supply lines of the network the prevailing conditions are reproducible so that standards can be put through (Fig. 2.2).

For measurements of interference radiation maybe the time was not ripe enough or the necessity was not big enough. The usual argumentation was: what we can't measure reproducibly, can not be forbidden and certainly not be put under punishment. Therefore merely recommendations were issued or impositions weak as wax were made like: "the interference field strength ... must be so small that an undisturbed reception is guaranteed as soon as the minimum field strength for utilization exists at the place where the antenna is mounted"[1].

In common parlance that means something like: "as long as no one bleats, everything is allowed". Within a connected industrial area there even existed an officially legitimized fools freedom. Merely at the fence of the industrial area limits had to be fulfilled.

Specially for the line-frequency of the screen one has decided to build a loophole in the law so that one didn't have to throw the TV sets, that so successfully had conquered the living rooms, out of the window. Of course the flickering screens did interfere exactly as before but this EMC-interference now was officially approved.

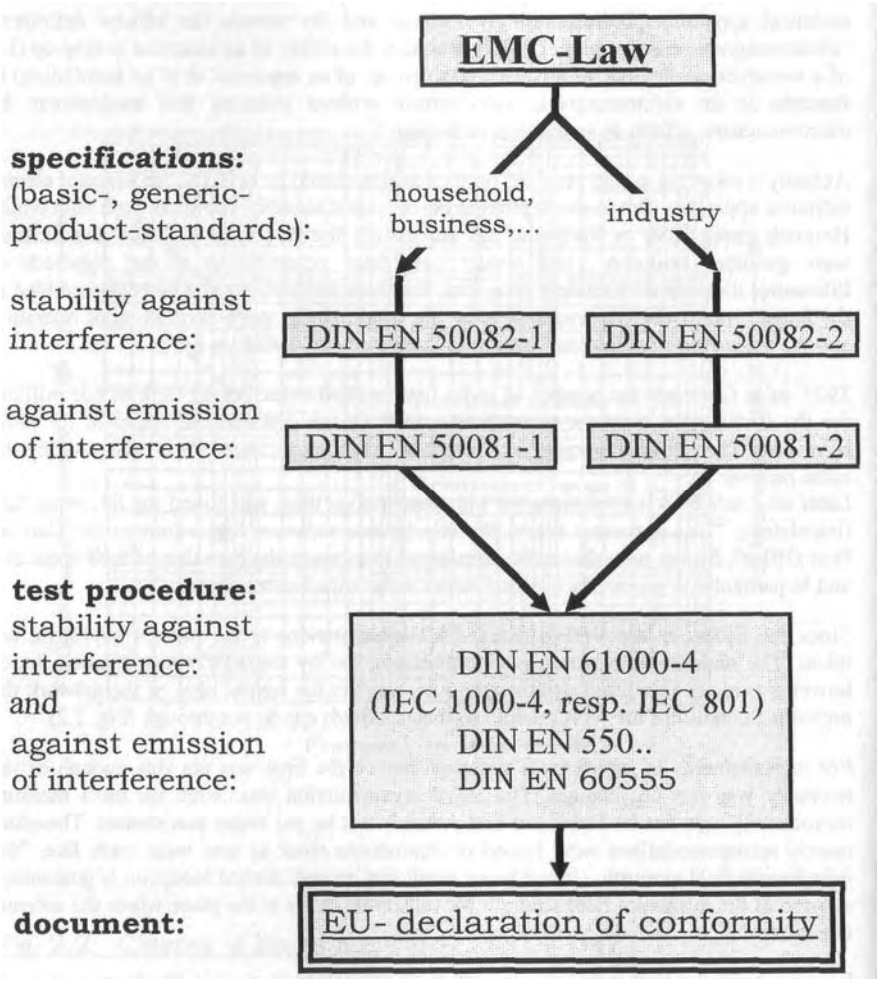

Fig. 2.3: The way to EU conformity

2.3 Declaration of conformity

In the EMC times seem to have gone as the standardizers had to fit in with the insufficiencies of technology. Meanwhile the conditions have turned up. We owe this circumstance first of all the EMC-law of 1992 that doesn't name any limits but it states the political intention to demand from technical apparatus and installations an appropriate stability against interference and at the same time limit the sent out interference. As a consequence of this law the measurement facilities and measurement processes had to be standardized to get reproducible measurement results that are not influenced by the electromagnetic environment. That goes so far that even the floor covering of a measurement hall is dictated because the conductivity of the floor influences the degree of reflexion. Normally the examinee is situated on a revolving plate that is turned around for 360° during the measurement of the radio interference field strength. Is it however not possible to turn the examinee than the antenna has to be led around it, thereby again increasing the dimensions of the measurement hall. The distance to the antenna should be up to 10 meters. Moreover it must be possible to move the antenna, up till a height of 4 meters to register the influence of the reflexions on the floor.
Moreover there is to plan a reflexion free zone around the measurement track (in elliptical form) that depends on the reachable damping of reflexions of the used absorber. Used are pyramids of foam material soaked with carbon and increasingly tiles of ferrite or shieldings of wallpaper.
Taken all together for a measurement hall doing justice to standards there result considerable measurements of for instance 18 m length x 10 m width x 7 m height.
Let's again come to talk about the EMC-law with which only the intention but not the way is fixed. To form the claims catalogue in a way that is fulfillable in general, some concrete prescriptions, the so called standards, have to be worked out. This task was transferred to the European committee for electro technical standardization CENELEC, which has established the workgroup TC 110 to at first work out some standards:
The basic standards deal independent of product with general questions of the EMC, of the testing process and of the measurement environment.
The generic standards likewise deal independent of product with the so called fundamental technical standards for apparatus in their dependence of the respective electromagnetic environment (protected computer room or medical room, environment of the house, office or industry).
The product standards concern the EMC-standards referring to products (7 product families / approx. 50 products).
In Fig. 2.3 the arduous way through the jungle of paragraphs for a technical apparatus is outlined. Corresponding to the requirements of use, first the relating ES-standards for the apparatus have to be determined and than have to be measured according to own test standards based on the fundamental technical standards. When the allowed limits for stability against interference and for sending out interferences are not exceeded, the EC-declaration of conformity is handed out. Since 1.1.96 that declaration is needed when apparatus are commercialized or - stated more exactly - "put in circulation" and operated. When still further EC-guidelines are met in the end the CE-hallmark is awarded. Since 1.1.96 only with this hallmark the access to the common market of the EC is possible. Violations can be punished with fines and if need be with imprisonment. But there are great national differences in the EC. The Federal Republic of Germany with fines of up to 50.000 Euro counts as expensive for criminals.

Simulation of network for the measurement of the interference voltages U_{st1} and U_{st2}.

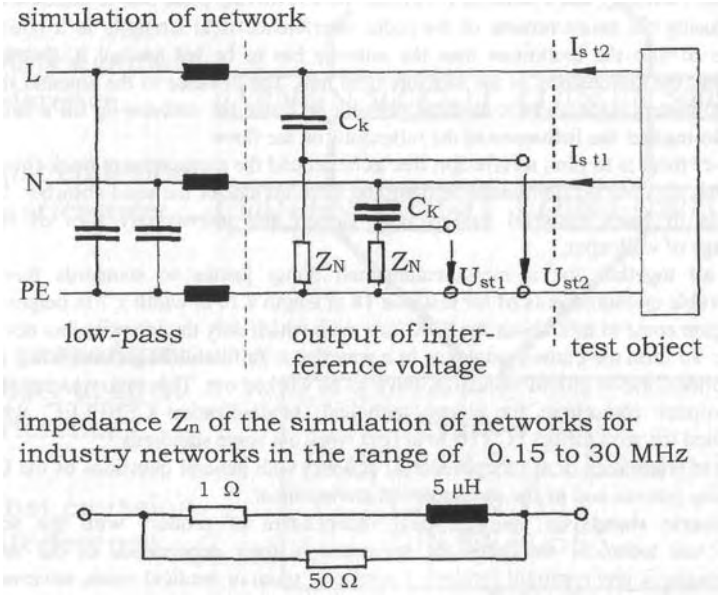

Fig. 2.4: Simulation of network for the measurement of interference voltages.<i>

<i>: acc. to Ernst Habiger: EMV, Huthig Buch Verlag Heidelberg (1992), ISBN 3-7785-2092-X

2.4 EMC-techniques to measure the emission of interference

Actually we already can be glad that it came to an europe-wide agreement for the regulation of the EMC-set of problems. But the question if we can be satisfied with what we have reached is still outstanding. All too often the lowest common denominator of the measurable and checkable was sought and not so much the technical possible was taken into consideration.

The main emphasis is put on the measurement of the emission of interferences. Traditionally the interferences bound to a circuit are registered in a frequency range up to 30 MHz. The corresponding wavelengths thereby can correspond with the length of the supply lines and form standing interference waves. Primarily the spectrum of the interference currents is measured e.g. over a HF-current converter. These currents produce a voltage drop over the internal resistance of the feeding network. Because the properties of the networks can vary very strong, a standardized end-resistor is required for the measurement of the interference voltage. For this purpose an imitation of the network is switched between the network and the examinee. This imitation in addition has the task to keep away the interference signals that come from the supplying network with the help of filter-elements (Fig. 2.4).
The measurement of the interference radiation, the field-bound interference emission, lakes place between 30 MHz and 1 GHz. For that a free field or an absorber-hall with little or no reflexions is required. The standardized distances of measurement are 3, 10 and 30 meters. The electric field strength is determined with dipole broadband antennas, the magnetic field strength with frame antennas. It must be possible to both vary the receiving antenna between horizontal and vertical polarization and to adjust the receiving antenna in the height and the position to the test object.

Typical measurement set up to measure the emission of interferences bound to a conductor[i]

A: shielded link conductor
B: bundle of conductors folded like a meander
C: connection to the reference mass
ME: receiver of interference signal
NNB: Simulation of network
PO: test object

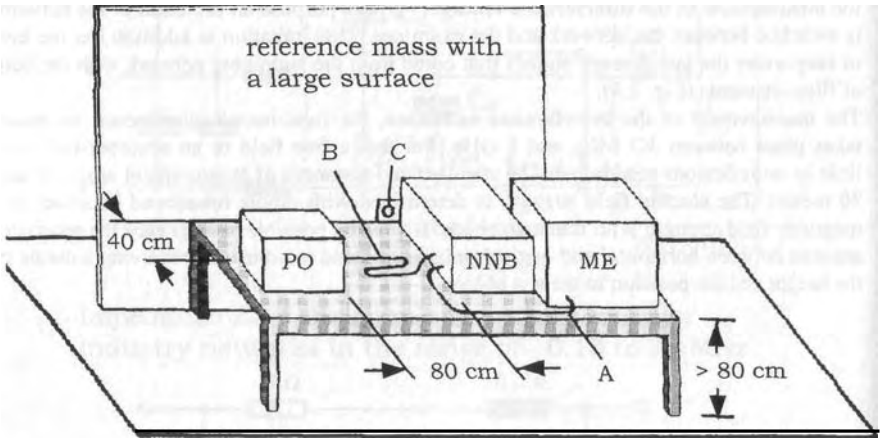

Fig. 2.5: Measurement set up to measure the emission of interferences bound to a conductor,[i]

<i>: Ernst Habiger: EMV, Huthig Buch Verlag Heidelberg (1992), ISBN 3-7785-2092-X

2.5 Electro-Smog

There is almost no end to the possibilities of variation and one needs already a lot of overview and experience to determine the field strength maximum. Nevertheless we have to ask ourselves if in this way really all emissions of interference are understandable, that popularly are described as „electro smog".

Smog is the combination of the terms Smoke and Fog. It therefore describes a pressure on the environment with fog like smoke. When for instance in the case of smog alarm all interference sources are switched off, which means all kilns are brought to a stop and all automobiles are stopped, than the fog like smoke therefore still is not vanished from the air. It just distributes itself and dissolves only very slowly.

The transfer of the smog idea on the electromagnetic interference radiation is bound to fail because, when the test object is switched off no emission of interference at all is detectable with the usual measurement means. Nevertheless the rainbow-press is trying to enumerate almost all electromagnetic field phenomena under the term „electro smog" without consideration of the fact that this term is not at all a collection term. From the sight of an expert one can only speak of smog when something like smog remains and stays active further after the switching off of an electro technical apparatus. It should be a phenomenon that is not understandable by the standardized measurements of interference radiation. Such a phenomenon would be e.g. the vortex of the electric field. However vortices are virtually not measurable in a direct way because they have the unpleasant property to whirl about around the measurement probe. But they will be detectable by their eddy losses and in the case of the electric field vortex appear as noise. Until now the standardizer however haven't planned to investigate the influence of an apparatus on the noise in the environment. Here we still grope in the dark.

At least the vortex shows a storing property that would justify the use of the idea "smog". We'll have to investigate the phenomenon.

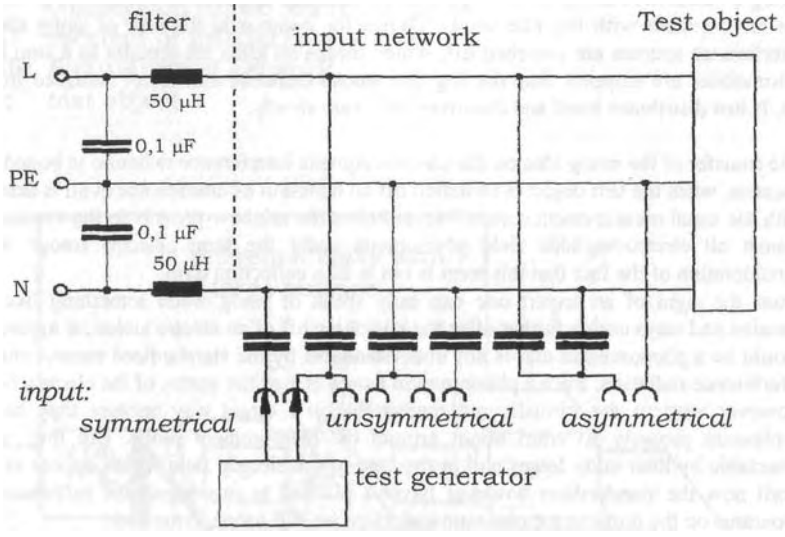

Fig. 2.6: Picking up of interference voltages in network lines.<i>

<i>: Ernst Habiger: EMV, Huthig Buch Verlag Heidelberg (1992), ISBN 3-7785-2092-X

2.6 EMC-techniques to measure the stability against interference

The question is: what kind and what intensity of an electromagnetic interference can an apparatus cope with without limiting it regarding its technical function. For that test generators are used and with their help interference signals are produced in the test object. Fig. 2.6 shows the possibilities of a symmetrical, of an unsymmetrical and of an asymmetrical production of interference voltage signals in the power supply lines of an examinee. Over and above that the testing possibilities and testing methods are numerous. In principle the following processes are used:

1. The simulation and production of interference factors typical for the network like harmonic waves on network voltages, overlapping signal voltages, changes of network voltage, decrease of network voltage, network interruptions, network unsymmetries and network frequency changes.
2. The production of both energy-poorer and energy-richer interference impulses like they can form in energy-networks by switching acts or by the effect of lightning (burst).
3. The simulation of the course of events when static electricity discharges.
4. Low-frequency magnetic fields like those that can form by network frequency operating and loading currents or by short-circuit and lightning currents in the form of a pulse.
5. The stability against interference against the influence of an electromagnetic field also called radio interference firmness. For this purpose high-frequency generators and broadband antennas are used to expose the examinee to electromagnetic fields in a frequency range between 10 kHz and 18 GHz. At the moment tests are only performed between 27 and 500 MHz. The modulation of the carrier wave should be possible to be able to imitate the interferences by radio technology as realistic as possible. Thereby the field strength values can by all means reach up to several 100 V/m.

In accordance with expectation the result of this irradiation with an outside field is that every conduction path and every wire can act as an antenna and therefore can produce high-frequency currents and measurable potentials. Building parts of the analog technology as a consequence battle with problems of drift whereas with digital logic parts and computer parts the danger exists that switching states change unintentionally. Let us remember again the overlap effect of fig. 1.4. The electromagnetic wave itself marches with the speed of light through the examinee. When a small part of the wave finds an object that it can use as an antenna than the localized overlap comes into play. This than as a cause is responsible for the effective and measurable antenna currents. Until here the text books help us to explain the problems that happen and to remove them logically.

However time and again cases are reported where textbook physics can't help us any further. Spectacular cases even came to court like e.g. the ABS (Antilock Braking System) of a truck that had failed due to EMC-interference radiation. As a consequence the brakes had failed. When after that the local radiation pollution is measured no anomaly at all can be discovered. The measurable field strength is not higher as is usual in the whole area. Maybe you also have made the experience that often the causes can't be found when your computer suddenly "crashes" out of the blue.
Here the mentioned vortex of the electric field is capable to deliver plausible explanations because it is not bound to the geometry of an antenna and in addition is highly active without being detectable with the usual EMC measurement methods of the interference radiation measurement!

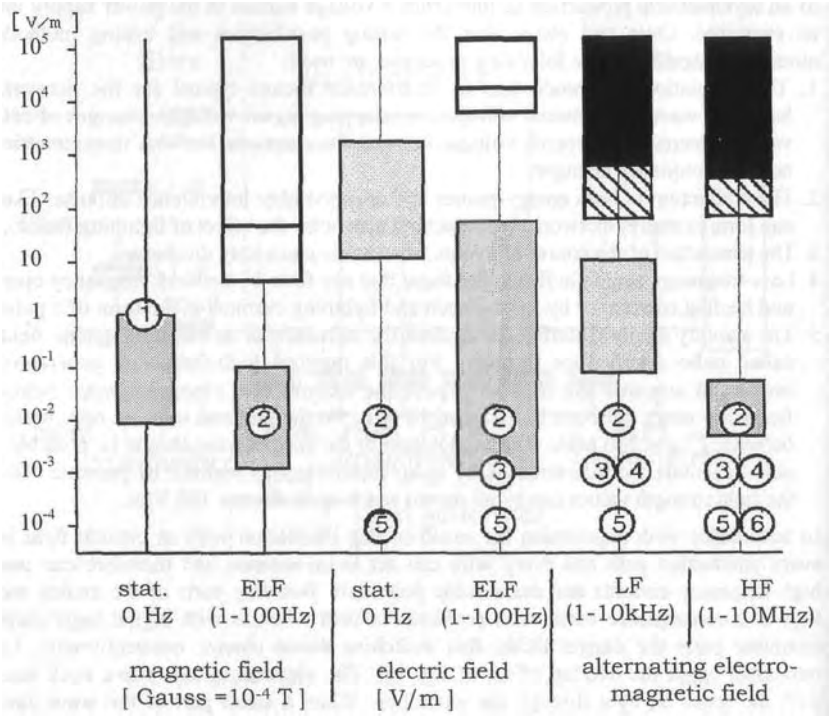

Fig. 2.7: Intensities of natural electromagnetic fields (electric, magnetic and electromagnetic fields)

In addition to fig. 1.1, page 3,
magnetic field in Gauss (= 10^{-4} T),
electric field in V/m.

<i>: A.S. Presman: Electromagnetic Fields and Life.
Plenum Press, New York - London, 1970

2.7 Tasks of the biological compatibility

The second leg of the environmental compatibility (EC) forms the biological compatibility (BC) besides the electromagnetic environmental compatibility. Whereas the interests of the EMC are looked after by electrotechnical engineers and electrophysicists, with the BC also doctors, biologists and architects are addressed.
Moreover this leg is already very old and already existed long before artificial interference sources could be created by mankind. The interaction between the arising interference sources in nature and the biological systems in general and specially men always interested the doctors, the priests, the druids and geomants, that not seldom looked after several functions in personal union equally. Unfortunately they as a rule have kept their knowledge and capabilities as secret knowledge, didn't make any recordings and merely initiated and trained their respective successors. Through that a great deal got lost and today non-medical practitioners, homeopaths and esoterics trouble themselves to take up to the far-reaching buried knowledge.
Because this concerns pure knowledge by experience, often the with the topic occupied persons themselves are not capable to say anything about the physical backgrounds and causes. One concentrates entirely on the under certain circumstances reachable results and only in rare cases on reproducable effects. In some areas the scientific assignment already has succeeded, have parascientific phenomena managed their admission in the so called "exact sciences", but in most experience disciplines the assignment is still due. There still is a lot to do here.

In the time as there not yet were operated any artificial interference sources on our planet, the senses of man naturally were a whole lot sharper for his electromagnetic environment as today. Today, where there scarcely is a place on earth where we are not irradiated by terrestrial transmitters, by satellites or by the netfrequency that is measurable everywhere. In the bluntness of our senses perhaps the hybris of modern man is founded, with which he wants to rise himself above esotericism, geomancy and other sciences of experience and thereby dispute the electric and magnetic fields their biological effectiveness.

The fields of natural origin form an electromagnetic environment for men, that they have adapted to and that they probably need for a life in accord with nature. The evolution has taken care for a corresponding adaptation.
In fig. 2.7 in addition to the limits from fig. 1.1 the intensities of natural electromagnetic fields are registered[<1>]. They lie clearly lower as the recommended limits but exactly in the area wherein the first reactions of living beings are observable.

When we ask us how much electromagnetism is good for us and how much harms us so the obvious answer is: exactly as much radiation as nature dictates in the fluctuations between day and night, between the months, years and in the end between the cycles of sunspots of 11 years. Here the guide value is found that man and nature have adapted themselves to. In fig. 2.7 the corresponding area between the natural minimum and maximum values is given.

Irradiation strengths of the field radiation in the biosphere and how the optical windows are situated in the atmosphere<i>.

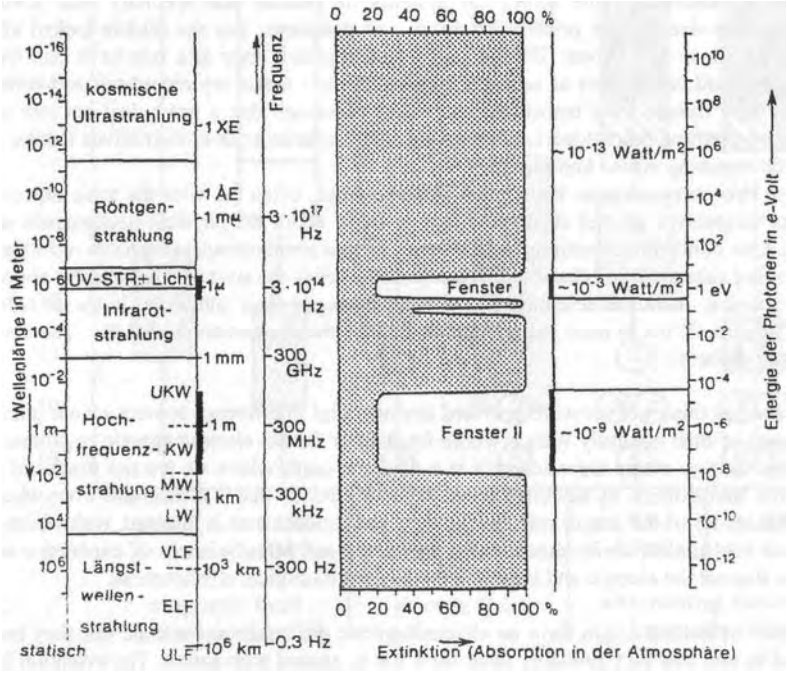

Fig. 2.8: Absorption dependent on frequency in the atmosphere

<i>: entnommen aus: H.L. Konig: Unsichtbare Umwelt (Wetterfuhligk.), 5. Aufl., Bild 8, Seite 14, Verl. Moos & Partner Milnchen, ISBN 3-89164-058-7

2.8 Natural fields

Our electromagnetic environment has something to offer:
From the magnetic north pole to the magnetic south pole of the earth run the field lines of the earth's magnetic field that we are exposed to. With a compass we use the vector character of the magnetic field to fix our position. The induction averaged over time is approx. 50 uT. But it is overlapped by short-time fluctuations caused by geomagnetic storms in the ionosphere.

These storms again are caused by the eddy currents and the currents of charged particles that come from the sun. At the same time these eddy currents in the ionosphere together with the earth's magnetic field form a protective shield with a excellent screening effect for us inhabitants of earth.
In several layers like for instance the ozone and Heaviside layers a filtering and damping until the complete suppression of the very broad cosmic spectrum is caused. This extraterrestrial spectrum of radiation doesn't leave a single frequency out and has a lethal intensity for us.

Only for a little window in the frequency spectrum, radiation can pass almost undamped, as can be seen in fig. 2.8: the light with the spectrum of the colors. For this nature has donated man a sense organ so that man can protect himself against too high dose values. After all, who will look voluntarily into the sun? We only get into trouble when our sense organ doesn't function any more (for instance in the fringe range of the visible spectrum, the UV-range).

For other frequencies of electromagnetic radiation man neither has a sense organ but that doesn't mean that he is not influenced by these. Here, as in the UV-range he only indirectly notices that he has got too high a dose when he has to discover some influences on his well-being and his health. Without the help of neutral measurement apparatus he himself by no means is in a position to make a connection between an excessive exposition to radiation and his health problems.

When natural field strengths should be used as a measure for technical limits, so there should be paid attention to the fact that nature doesn't know intense continuous irradiation. The values are subject to powerful fluctuations that leave men and nature the chance to regenerate.
The television stations not even think it is necessary to reduce their broadcasting power after the end of broadcasts and further sprinkle the sleeping population with test signals, with senseless pictures of going by underground or nonstop program advertisements. People need the intermissions. That again shows how good nature means it with us.

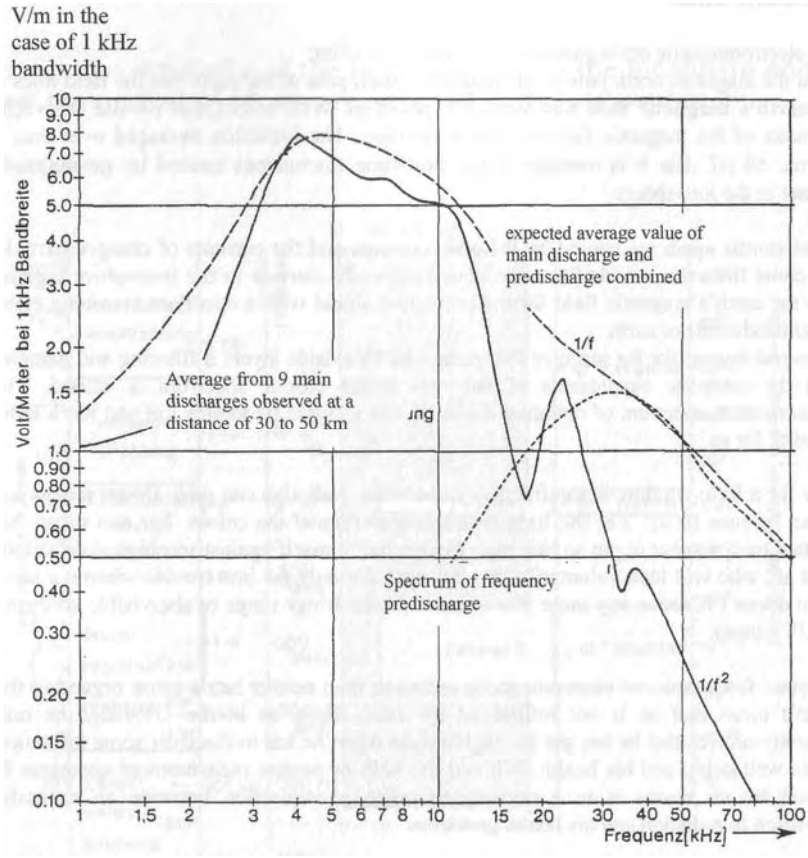

Fig. 2.9: Spectrum of frequency of one lightning, measured
field strength at a distance of 1.6 km from the place of origin. See Watt and Maxwell:[i,ii]

____ from: _____
<i>: H.L. Konig: Unsichtbare Umwelt (Wetterfuhligk.), 5.Aufl., Bild 38, Seite 27, Verl. Moos & Partner Munchen, ISBN 3-89164-058-7, see <ii>.

2.9 Electricity of the air

The electrostatic field strength of the earth lies between 50 and 500 V/m. That is a whole lot considering that voltages off 60 Volts can be lethal for man. But a living person distorts the terrestrial E-field for reason of his own field and his electric conductivity, so that there exists no danger for him as long as he doesn't grow into the sky.

Maybe the dinosaurs had to become extinct because they were to big and for instance the E-field near the ground had risen with a jump by a meteorite that brought a high charge from the cosmos. That would explain why the smaller living beings could survive the natural disaster.

Also the thunderstorm electricity can become life-threatening. Burns, heart and brain failures are the most common consequences. After all the probability to be struck by lightning is four times higher as to have six right ones in the lottery.
Over the lightning channel of approx. 1 meter in diameter charges between 10 and 200 C are transported what results in current strengths of 2000 up to 200,000 A. The main discharge lasts between 10 and 50 usec. With the preceding and all the following discharges it lasts over a second.
Field strengths on the scale of 4,000 V/m are typical but in a distance of 5 km these wear off to 8 V/m. The frequency spectrum of a lightning reaches 4 powers of ten into the range of the radio waves. In fig. 2.9 is shown the field strength measured in a distance of 1.6 km from the place of origin[<i,ii>].

The origin of lightnings is still an unsolved problem after the well-known models (Wilson) arc not in a position to explain the reason for the origin of the potential difference of more than 100 million Volts required for the ionization of the air. Also the lightnings that struck in the direction of the ionosphere still are mysterious. We'll have to come back to this[<iii>].

<i>: H.L. Konig: Unsichtbare Umwelt (Wetterfuhligkeit), 5. Aufl., Bild 38, Seite 27, Verlag Moos & Partner Munchen, ISBN 3-89164-058-7, according to <ii>.

<ii>: A. D. Watt and E. L. Maxwell: Characterisic of Atmospheric Noise from 1 to 100 Kc/s. Symposium on the Propagation of VLF Waves, Boulder, Col., Paper 35, Jan. 1957.

<iii>: see Part 1, chapter 5.4 and part 2, chapter 14.11.

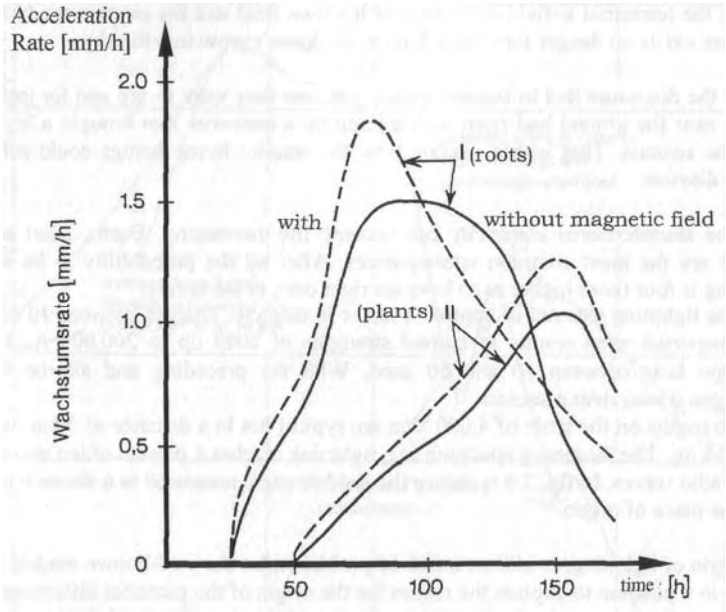

Fig. 2.10 A: Effect of a static magnetic field of 100 kA/m (0,12 Tesla) on the root (I) and on the plant (II) of barley seeds.
plants in the magnetic field: dotted line
plants for checking: drawn line
according to Novitskii[<iii>]

<iii>: Novitskii, Yu.I.: Effects of a magnetic field on the dry seeds of some cereals. Proceedings of Conference on the Effect of Magnetic Fields on Biological Objects, Moscow, p. 52, 1966.
Taken from: H.L. Konig: Unsichtbare Umwelt (Wetterfuhligkeit), 5. Aufl., Bild 72, S. 73, Verlag Moos & Partner Munchen, ISBN 3-89164-058-7

2.10 Biological effects

The in fig. 2.1 indicated connection between the EMC and the BC, by some authors inofficially described as EMC-environment (EMCE), describes the effect of artificial fields on biological systems. This concerns the sensitive range of tasks that is discussed extremely controversially in the public. The problem thereby is that the artificially produced field strengths lie above the natural field strengths for several scales. In the thirties first reports about troubles were provided by navy radio operators that complained about headache, dizzyness, concentration failure and indisposition. Besides these negative reports concerning the so called "radio operator disease" at the same time medical usages concerning high-frequency therapy were tested. In the beginning this diathermy called healing method still was a short wave irradiation. Today it is extended into the microwave range and uses the thermal effect of electromagnetic rays. The increased temperature of the tissue causes an increased local blood flow. This supports healing processes, loosens cramped muscles and can help in case of rheumatic fever. The advantage of the HF-irradiation compared to contact heat by a hot-water bottle or by infrared rays is the higher penetration depth. Herein short waves are superior to microwaves. But microwaves can be better focussed on a certain part of the body. Is the temperature further increased, so the tissue is damaged. This is used for the treatment of cancer and is called hyperthermy. Because cancer cells as a rule are flowed with blood worse than healthy cells, they are more sensitive to heat and therefore are faster destroyed than healthy cells at a correspondingly increased temperature. In this way for Instance in the USA cattle with a so called cancer eye are treated. For that the spot suffering from cancer is irradiated with 2MHz-waves for 30 seconds with a handheld apparatus of 10 Watts broadcasting power. The rate of succes is given to be 90%! The method of hyperthermy has not yet been able to establish in the area of the medicine for humans. Also at our college corresponding research work is carried out in co-operation with the radiological clinic of the university of Freiburg (Germany)[<i>].

The thermal effects of high-frequency fields are therefore well-known and subject of scientific research. On the other hand and in spite of numerous publications, non-thermal effects even today are denied by some scientists as non-existent[<ii>]. Here only a few counter-examples will be listed.

Fig. 2.10 A shows the effect of a static magnetic field of 0.12 Tesla on the root (1) and on thc plant (II) of barley seeds. The readable effect is an acceleration of the growth of the treated seeds (dotted line) compared to the plants for checking (drawn line)[<iii>].

<i>: H. Schulz, W. Oppitz: Lokale Hyperthermie durch hochfrequente Wirbelstrome, Medizin Technik 1, 1987.

<ii>: G. Nimtz: Mikrowellen, Einfuhrung in Theorie und Anwendung. 2. Aufl., BI-Wissenschaftsverlag 1990, ISBN 3-411-03203-0

<iii>: Novitskii, Yu.I.: Effects of a magnetic field on the dry seeds of some cereals. Proceedings of Conference on the Effect of Magnetic Fields on Biological Objects, Moscow, p. 52, 1966; taken from: H.L. Konig: Unsichtbare Umwelt, fig.72, p. 73, Verlag Moos & Partner Munchen, ISBN 3-89164-058-7

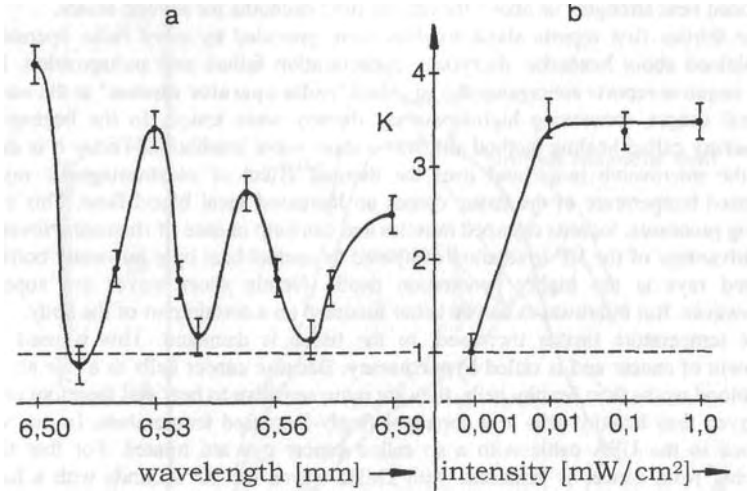

Fig. 2.10 B: Measured increase in the production (K) of colicin by colibacteria as a microwave effect

a) as a function of the wavelength,
b) as a function of the intensity of the microwaves,

according to Keilmann<i>.

taken from:
<i>: H. L. Konig: Unsichtbare Umwelt (Wetterfuhligkeit), 5. Aufl., Bild 106, S. 111. Verlag Moos & Partner Munchen, ISBN 3-89164-058-7

A static field naturally produces no induction and hence no heating will arise. In the case of alternating fields the thermal effect in experiments is excluded by working with cxtremly low stimulations. The example after fig. 2.10 B shows the measured increase in the production (K) of colicin by colibacteria at only 0.01 mW/cm^2 microwave power<i>.

In addition the example provides the interesting information that obviously only a certain frequency and it's harmonic waves increase the production, other frequencies on the other hand remain inactive. Because only minimal field strengths are used it more likely concerns an information-technical as an energetic effect (curve a). This statement is supported by the observation that an increase of the intensity not at all necessarily as a consequence also increases the production (curve b). What the colibakteria need is obviously neither energy nor heat but only a certain frequency that stimulates the colicin production or the growth.

Should it really be confirmed that biological effects of electric and magnetic fields can be produced by certain frequencies and can't happen by an energy transition so the discussions about limits must seem ample meaningless.

Maybe the one or the other in thought already draws a connection to the acceleration, the acclerated growth of kids, which is observed world-wide and stronger in cities than in the country. It started for approx. 100 years simultaneous with the electrification of the homes in the towns. In Asia the acceleration and also the electrification have started later. Other growth stimulating effects like radio waves, X-ray examinations, atomic tests and provable also the nourishment with vitamin B6 happened only until much later and at the most could support the actual effect.

But how should a proof be offered when anyway the field strength not at all can have a decisive influence on the growth of man after the statement of fig. 2.10 B? Which information is authorative? Where lies the responsible frequency window? Does the information actually manifest as frequency? Is the authorative influential factor also in this case not at all noticed and measured?

A lot of pressing questions are still outstanding. But in any case the numerous influential factors detected in experiments do not at all let themselves reduce to a sole factor, for instance the nourishment. For a family doctor it may be comfortable to be able to give an easy explanation: „Cause is the nourishment!" With such a reductionism on the other hand the actual cause stays in the dark and the asked questions in this way won't let themselves be answered.

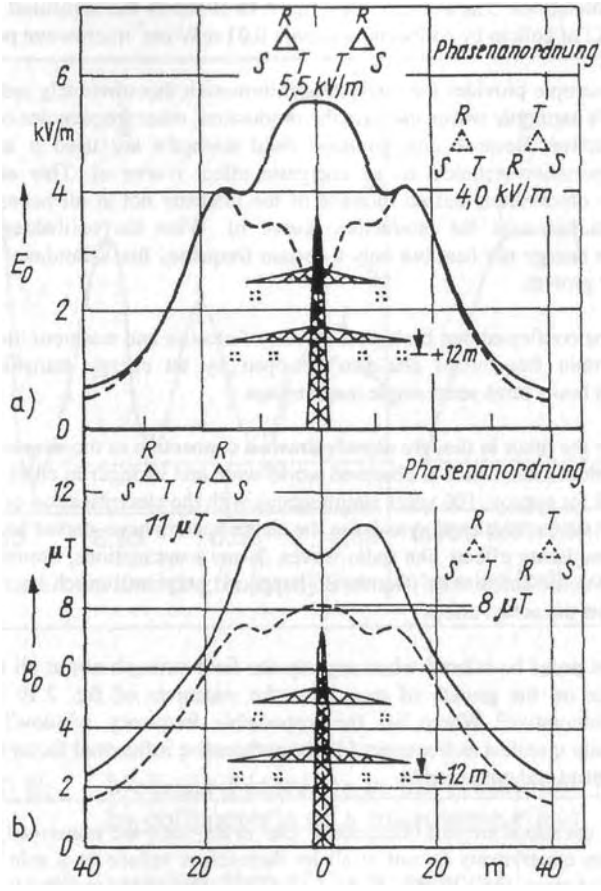

Fig. 2. 11: ____ profile of the 50-Hz-field on the ground at 380kV/1kA in each circuit.<i>
a) electric field,
b) magnetic field.

____ taken from: _____
<i>: E. Habiger u. a.: Elektromagnetische Vertraglichkeit, fig. 7.3, page 147 and Fig. 7.1, page 146, 2nd Ed., 1992. Berlin, Miinchen: Verlag Technik.

2.11 Artificial fields

The scepticism of people feeling close to nature is especially directed against artificial fields that man can't see nor hear nor smell. Objects of doubt are first of all the installations for the creation, distribution and conversion of electric energy.

An essential role plays the fact how close the supplying and the draining conductors are to each other, so that the respective fields can compensate each other. The worst solution one can think of is realized at the electrified railway. Here the rails and the earth are used as the draining conductor for the current while there exists an ample large distance to the supplying conductor. A compensation is almost impossible thus causing gigantic interference fields that are detectable even at a distance of 10 kilometers. The increased putting on of railway engines feeded by rectified current is likely to aggravate the set of problems because the non-sinusoidal absorption of current is strongly afflicted with harmonic waves.
With high tension transmission lines (fig. 2.11) the interference field strength is reduced when the three cables are suspended with only little distance between them. But even the selected phase order can play a role. Of course the optimal compensation effect is guaranteed with cables in the earth. But these are expensive and technically not realizable for such high voltage levels.

In the eighties also the computer screens got in the headlines. The terminals are furnished with a cathode ray tube and have a very broad radiation spectrum that already starts at 0 Hz. Here already static maximum values of 64 kV/m are measured[<1>]!

I'requency range	Measured maximum values E_{max} resp. H_{max}	30 cm in front of the screen
static field (0 Hz)	64 kV/m	
30 Hz. 60 Hz	10 V/m and	
	0.2 - 1 A/m	
5 Hz - 1 kHz	1800 V/m and	10 V/m and
	4 A/m	0,6 A/m
50 Hz - 0,5 MHz	1 A/m	
15 kHz-220 kHz	50 V/m and	15 V/m and
	1.1 A/m	0,17 A/m
3 MHz -300 MHz	< 0,2 V/m	

Fig. 2.11: Electromagnetic fields from screens[<1>]

system about	used frequency	measured value
radio broadcasting station (MW 2O kW)	6OO kHz	2...17 V/m
radio broadcasting station (SW 1OO kW)	15 MHz	1...25 V/m
SOS-transmitter on a ship (1OO W)	41O kHz	1...3 V/m
Epitaxiedevice (induction oven)	45O kHz	37...4OO V/m
HF-welting press (welding of plastic foils)	27,12 MHz	70...85 V/m
radar on a ship (TRN 311)	9,3 GHz	1...3O uW/cm^2
radar of an airplane	9,2 GHz	45O... 28OO uW/cm^2
domestic appliances measured in a distance		of 3O cm:
hand mixer	5O Hz	5O V/m
refrigerator	5O Hz	6O V/m

Fig. 2.12: ____ the electric field strength resp. Power density in our environment.<i>

____ taken from: _____
<i>: E. Habiger u. a. : Elektromagnetische Vertraglichkeit, Fig. 7.2, page 146, 2. Ed., 1992, Berlin, Munchen: Verlag Technik, ISBN 3-341-00993-0

2.12 Protection against artificial fields

Artificial fields more or less always occur in the neighbourhood of electric apparatus and installations. Especially problematic are those that work with the free radiation of electromagnetic fields, that is all the radio broadcasting stations, handheld and radar transmitters.
Herewith it is important that not needed parts of the antennas are shielded, that antennas with little close by field pollution are used and that the stand should be situated at least 3 km remote from inhabited areas. For instance at radar installations damping values of 10 dB and more can be obtained only by using a corresponding tree growth.
This obviously concerns a damping of the waves in a dielectric manner. We'll have to come back to this because textbook physics does not know a corresponding damping term in the wave equation.

The radiation leaking out in case of the high-frequency welding of plastic foils and of the microwave oven should be minimized.
In the case of induction ovens or of motors an active shielding often causes problems so that for simple domestic appliances like a hand mixer and especially for the electric hair-dryer non proportionally high field strength values are measured. Fig. 2.12 informs about it.
Protective measures for the operator are hardly possible. To protect uninvolved people not only the apparatus but also the rooms and eventually whole parts of buildings had to be shielded and grounded.

Sometimes also fairly simple possibilities are helpful like e.g. the usage of a remote control. By clearing away the cable salat at the workplace and at the sleeping place induction loops can be removed. Alarm-clocks operated by batteries should have preference over those operated by the network. Mattresses with metal in them and spring-beds which clearly act as an antenna should be avoided. In extreme cases even so called "current-free switches" and shielded network lines are recommended (fig. 2.13).

In the area of the network supply lines a choking coil can help decrease the spreading of high-frequency interference radiation. It is especially important that all the conducting metallic objects like e.g. water pipes, heatings, steel racks, machines, switching racks, steel armaments and metallic windows should be grounded properly, because otherwise extremly high static charges could result instead of a shielding. Construction biologists recommend to when possible do without metals when building houses and furnishing, what of course is only realizable with limitation.

In any case numerous measures are known that to a lesser extent find their legitimation in classical physics, but more likely in precaution. As long as we do not know which phenomenon causes the electrosmog and we don't have a measuring-instrument at our disposal, precaution is really the only thing we can do irrespective of the effectiveness of the measures and of the arising costs!

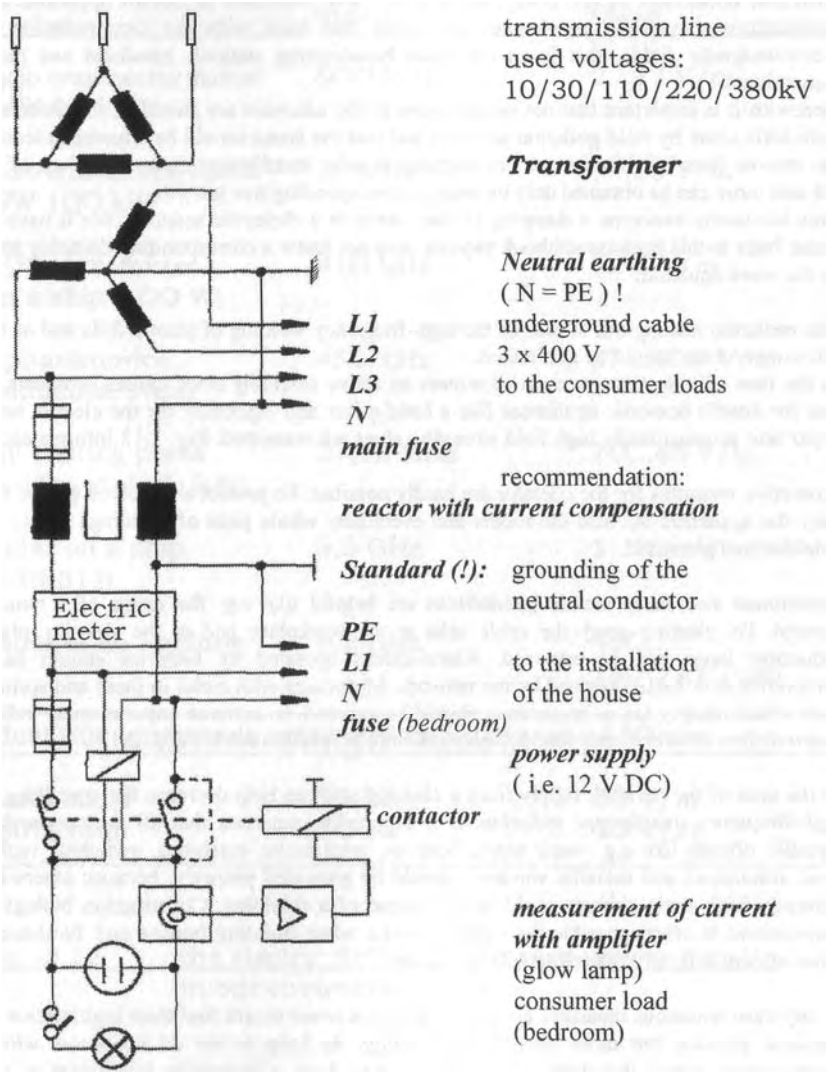

Fig. 2.13: About the circuitry and the problems involved with a "current-free switches" installation

2.13 Unsolved tasks

The report concerning the actual state of research could be continued at will. But the expositions should suffice, to understand what are the tasks of the electromagnetic environmental compatibility (fig. 2.1) and which questions still have to be supplied with a solution. One can get deeper into every of the addressed points and then discover that some questions can be expressed sharper and maybe conceivable answers can be found, but at the same time and unavoidable the number of new questions increases faster.

Let us again take up the example of the handheld wireless telephones (chapter 1.2). At least it now is clear to us that the usage of the built-in microwave antenna of a handy is problematic. In the interior of an automobile it never should be used. If, however, one uses the antenna installed on the outside on the sheet metal then the damping and screening effect of the sheet metal chassis is advantageous at least for the handy user.

With that of course the central question is not answered. The question of what the cause is for the interfering and at worst health endangering effect of the HF-radiation. Field freedom we can't find anywhere on this world. Possibly we even need the fields. But then the question is how much is necessary, how much is healthy and how much makes us ill.

The gap of explanation especially gets clear in the case of the static or of the low-frequency magnetic field: away from technical interference sources normally fields on the scale of 10 nT are measurable. Construction biologists say that 20 nT, so twice that value, should not be exceeded at the sleeping place and maybe 50 nT at the desk. These values however are determined purely empirical.

When a person is examined in a nuclear magnetic resonance tomograph that person is exposed to a field that lies between 0.2 and 1.5 Tesla. that is a value 7 till 8 powers often higher than before mentioned without this leading to the death of that person. Entirely on the contrary this method is regarded as especially caring and safe compared to the X-ray examination.

Here again the legitimation of the thesis put forward is entirely comfirmed. The thesis that the well-known physically measurable and controllable phenomena can not be considered as a cause and that possibly a until now undiscovered field phenomenon should be called to account.

Should such a phenomenon exist it should be derived, calculated and proved. We must go to endless troubles and try everything. The actual difficulties wherein the electromagnetic environmental compatibility is stuck are a challenge.

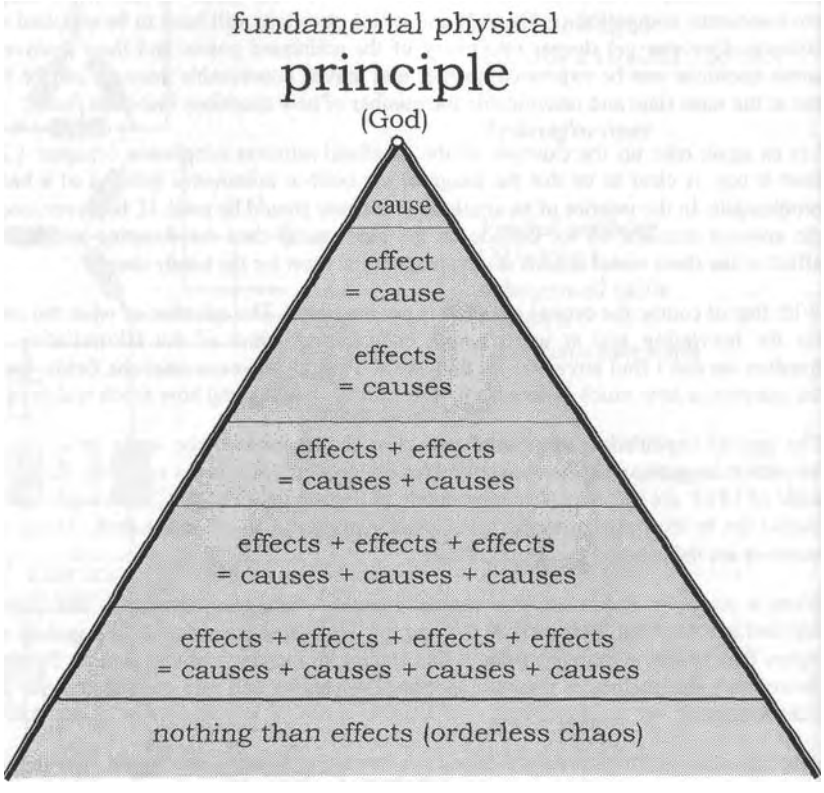

Fig. 3.0: pyramid of causality

vortices are a consequence of the principle of causality

3. Approach

In the question, if there exists a still unknown phenomenon that influences the electromagnetic environmental compatibility, we must fall back far until upon the roots of our physical understanding. Here we find a fundamental principle that until today is not doubted and that is regarded as elementary, the principle of causality. Every result of a measurement, every interpretation is checked for causality and only after passing this examination it is accepted and published.

This principle of cause and effect has established, not only in physics but also in many other disciplines of science. Is an effect observed, so there immediately is asked for the cause. This principle encounters us in daily life[<i>].

When all observable and measurable effects ever can be assigned to a cause without force and without exceptional regulations then the logical result is a pyramid of causality. On top a fundamental physical principle is found, that is regarded as given by nature or as given by god and that with its properties is responsible as the cause for different effects. These effects again appear as the cause for new effects and so on (Fig. 3.0). Sometime we have removed us so far from the top of the pyramid that a direct reference to the describable effects can't be made anymore, so the impression could arise that it concerns an isolated and independent discipline. We should take care not to think in such a monocausal way, because both delimitation and avoidance of interdisciplinary working methods will inevitably steer us into a dead end!

This pyramid of causality stands for the vision of a "unified theory", like it is demanded and sought-after by numerous research scientists. But as long as it is not found, we'll have to do with unsolved problems of causality. About this any number of examples can be given.

A physical principle based on the principle of causality is the vortex. This the eddy current demonstrates us clearly. The cause for its origin is an alternating field. According to Faraday's law of induction this induces a voltage that in a conducting medium results in a current according to Ohm's law. Around this current according to Ampere's law an alternating field forms, that points perpendicular to the current and overlaps the original alternafing field. This induced field first of all is an effect that overlaps the cause and itself becomes the cause. The effect that follows from that further overlaps and forms a new cause etc. In this way vortices form.

Vortices quasi represent the principle of causality.

<i>: When for instance a woman complains: "Doctor, my left knee hurts" (effect). The doctor diagnoses the cause: "Yes, that comes with age!" With that causality is established. "But doctor", says the woman, "my right knee is exactly as old as my left knee!" And already the doctor has a new problem of causality.

Principle of Causality:

	cause	→	effect
quantum physical approach:	quanta	→	fields
field-theoretical approach:	fields	→	quanta

---

violations of the principle of causality:

1. monopoles exist

2. starting point for the strong interaction

3. fields and quanta are a cause at the same time

4. hypothetical particles (gluons, quarks, etc.)

5. transmission of information with speeds faster than light
   - with photons (University of Berkeley)
   - with microwaves (University of Cologne)
   - with laser beams (Technical Univ. of Vienna)

6. transmission of energy with speeds faster than light
   - with scalar waves (Nicola Tesla)

Fig. 3.1: Causality or the principle of cause and effect

3.1 Principle of causality

Our physical view of life strictly obeys the rules of causality, the principle of cause and effect. But there are numerous cases, where causality at first could not be fulfilled anymore. Here alternate solutions had to be found to not endanger this very successful principle. A few examples should clarify this:

1. Technically it is impossible to produce a magnetic monopole. When a north pole is produced then the accompanying south pole is also formed. In the same way only the positive and negative pole can be assembled as the so called dipole. In the microcosm however we find monopoles. Electrons are such particles. To restore causality we must grant the microcosm its own laws that are not valid in the macrocosm! But this monocausal hypothesis contradicts the observation that the microcosm represents an image of the macrocosm and vice versa. Doubts if this assertion is allowed are reasonable.
2. Like charges repel each other and that the more the smaller the distance gets. In an atomic nucleus positively like charged protons are together at the smallest possible room without any repulsion happening. Arithmetically seen all atomic nuclei would have to explosively fly to pieces. But because this doesn't happen, shortly a new and supposedly fundamental interaction, the strong interaction, was introduced to save causality. Nevertheless this interaction now holds the like particles in a not explained manner together. Causality could be obtained only by the introduction of a new fundamental phenomenon.
3. When causality should hold as the supreme principle, it should be demanded with priority for the fundamental phenomena of physics. Instead, in quantum electrodynamics the particle is attributed the same physical reality as the field. With the wave-particle duality Heisenberg has given out the corresponding formula of compromise. This slaps the face of the principle of cause and effect.

Causality on principle allows only two approaches for a solution: the quantum physical approach. which holds the quanta as the cause for the fields, and the field-theoretical ašproach. wherein only the fields act as the cause. For both approaches there are good arguments. The field theorists cite that fields can exist also in the vacuum, so that there exist fields without particles but never particles without fields. Against that the quantum physicists hold that somewhere, even when quite far away, there exist particles and that the measurable fields merely are their action at a distance.

Both approaches first arouse the impression to be fully equal. In the course of the discoveries in the area of quantum physics, the corresponding approach has been able to establish. But it demands that all phenomena have to be understood as a consequence of particles. So should gravitons make gravitation possible, should gluons hold everything together and the quarks form the basic building parts. Meanwhile there is only worked with hypotheses. Out of poverty quantum physics meanwhile has said goodbye to strict causality, after the number of the violations of causality has risen that much and in every respect there is a lack of models of explanation. It seems as if the end is reached, as if the quantum physical approach to a large extend is exhausted.

Field-theoretical approach:

3rd Maxwell equation

$$\boxed{\text{Div}\,\mathbf{B} = O} \quad (3.3)$$

4th Maxwell equation

$$\boxed{\text{Div}\,\mathbf{D} = \rho_{el}} \quad (3.4)$$

With the relations of material:

$$\boxed{\mathbf{B} = \mu \cdot \mathbf{H}} \quad (3.5) \qquad \boxed{\mathbf{D} = \varepsilon \cdot \mathbf{E}} \quad (3.6)$$

$$\mu \cdot \text{Div}\,\mathbf{H} = O \quad (3.3^*) \qquad \varepsilon \cdot \text{Div}\,\mathbf{E} = \rho_{el} \quad (3.4^*)$$

H: source free vortex field

E: non-vortical source field

New field-theoretical approach: $\boxed{\text{Div}\,\mathbf{D} = O}$ (3.7)

thus: $\text{Div}\,\mathbf{H} = O$ (3.3^{**}) and $\boxed{\text{Div}\,\mathbf{E} = O}$ (3.7^*)

H and **E**: source free vortex fields!

Einstein:

"Is it conceivable, that a field theory permits us to understand the atomistic and quantum structure of reality? This question by almost all is answered with No. But I believe that at the moment nobody knows anything reliable about it"[<i>].

Pauli:

"The electric elementary quantum e is a stranger in Maxwell-Lorentz' electrodynamics"[<ii>].

Fig. 3.2: The field-theoretical approach

<i>: A. Einstein: Grundzuge der Relativitatstheorie, S 162, Anhang II; 5. Aufl., Vieweg, Braunschweig 1974.

<ii>: W. Pauli: Aufsatze und Vortrage uber Physik und Erkenntnistheorie. Vieweg, Braunschweig 1961, entnommen aus:
H. G. Kussner: Grundlagen einer einheitlichen Theorie der physikalischen Teilchen und Felder. Musterschmidt-Verlag Gottingen 1976, S. 161.

3.2 Field-theoretical approach

The field-theoretical approach is the very much older one. Until the last turn of the century the world in this respect still was in order. Max Planck, by the discovery of quanta, has plunged physics into a crisis.
Albert Einstein, who, apart from his lightquanta hypothesis, in his soul actually was a field theorist, writes: „Is it feasible that a field theory allows us to understand the atomistic and quantum structure of reality?". This question by almost all is answered with No. But I believe that at present nobody knows anything reliable about it[i]".

By the way the "No" can be justified by the fact that the field description after Maxwell is by no means able to the formation of structure so that it is not possible for quanta to appear as a consequence. The field-theoretical approach could, obstructed by Maxwell's field theory, not further be pursued and to this until today nothing has changed.
Nevertheless it would be an omission to not at least have tried this approach and have it examined for its efficiency. Maybe the above mentioned problems of causality let themselves be solved much more elegantly. For this however the Maxwell theory must be reworked to a pure field theory. With the well-known formulation it offends against the claim of causality, since it is field theory and quantum theory at the same time. To Maxwell himself the quanta were still unknown, but today we know that the fourth Maxwell equation is a quantum equation:

$$\mathrm{div}\,\mathbf{D} = \rho_{el} \quad (3.4)$$

After this the electric field is a source field whereby the individual charge carriers, like e.g. electrons, act as sources to form in their sum the space charge density p_{el}. The other three Maxwell equations are pure wave equations. In this way the third equation identifies the magnetic field as source free:

$$\mathrm{div}\,B = O \quad . \qquad (3.3)$$

This for Pauli probably was the reason to call, "the electric elementary quantum e^- a stranger in Maxwell-Lorentz' electrodynamics"[ii].

Let's return to the principle of causality according to which in the field-theoretical approach the fields should act as a cause and not the particles. In a corresponding field description quanta logically have not lost anything. It is only consistent to likewise demand freedom of sources of the electric field:

$$\mathrm{Div}\,D = O \quad . \qquad (3.7)$$

When the electric field is not a source field, then what is it? The magnetic field is a vortex field. Hence it would be obvious to also conceive the electric field as a vortex field. Numerous reasons speak for it:
1. A non-vortical gradient field, like it is formed by charge carriers, merely represents a special case of the general vortex field. Only by the generation of quanta a source field can form as a special case.
2. The electromagnetic wave teaches us the duality between the E- and the H-field that are directed perpendicular to each other and are in a fixed relation to each other. If one of them is a vortex field then also the dual field must be a vortex field.

Duality:

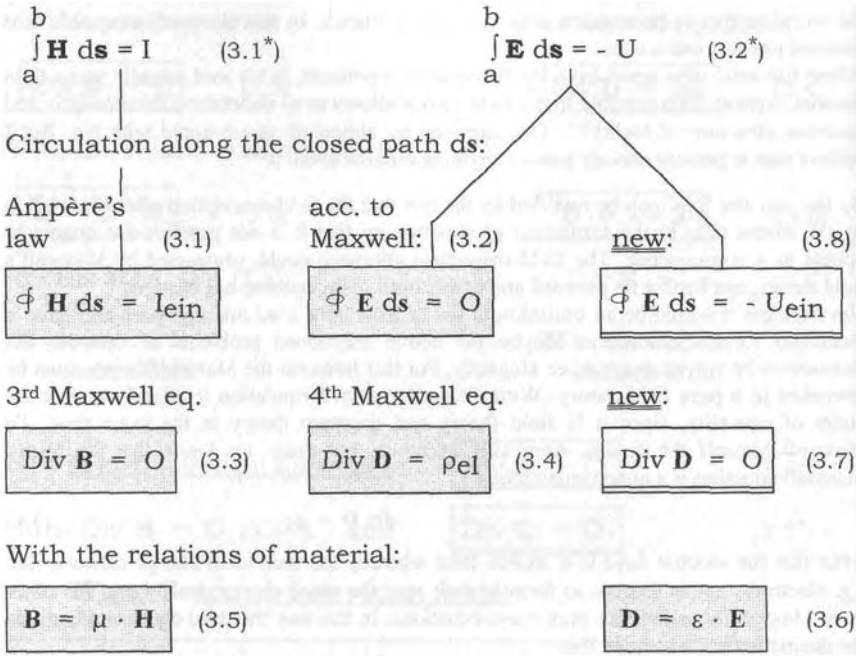

Fig. 3.3: The dual field description

Dual approach according to Jackson<i> or Lehner<ii>:

Div B = ρ_{magn} because of the 4th Maxwell equation: Div D = ρ_{el} (3.4)

ρ_{magn} = magnetic monopoles should exist,
otherwise dual extension (3.8) not allowed!

Caution: closed loop conclusion!
Maxwell theory proves the correctness of the Maxwell theory.
Result: search for magnetic monopoles unsuccessful.

<i>: J. D. Jackson, Classical Electrodynamics, 2nd Ed. , John Wiley, New York, 1975, S. 251 - 253

<ii>: G. Lehner, Elektromagnetische Feldtheorie, Springer-Verlag Berlin, Heidelberg 1990, S. 35 - 36 und S. 533 ff.

3.3 Duality

Duality is a fundamental physical principle. Opposite, but one another complementing phenomena can be assigned to each other in pairs, like e.g. (see fig. 8.8):

	Yin (female)	——		Yang (male)
	south pole	——		north pole
	⊖	——		⊕
R [Ω]	resistance	——	R^{-1} [Ω^{-1}]	conductance
U [V]	voltage	——	I [A]	current
E [V/m]	electr.field strength	——	**H** [A/m]	magnet.field strength
Q [As]	charge	——	ϕ [Vs]	magnetic flux
D [As/m^2]	electr.displacement	——	**B** [Vs/m^2]	magnetic induction
ε_0 [As/Vm]	electr.field-constant	——	μ_0 [Vs/Am]	magnet.field-constant
ρ_{el} [As/m^3]	electr.charge density	——	ρ_{magn}[Vs/m^3]	magnet.charge density
	induction law	——		Ampère's law
	potential vortex	——		eddy current
	(vortex of the electric field)			(vortex of the magnetic field)

First of all we find the duality confirmed in the case of the electromagnetic wave spreading in a homogeneous medium. Here the field pointers of E and H are directed perpendicular to each other and are in a fixed relation to each other. But if the wave is damped in the presence of matter, for instance by eddy currents, then by basing on Maxwell's field theory the duality will vanish.
A good example for perfect duality provides the integral of a field strength vector along the path from a to b:

$$\int_a^b \mathbf{H}\, ds = I \qquad (3.1^*) \qquad \text{and} \qquad \int_b^a \mathbf{E}\, ds = U \quad . \qquad (3.2^*)$$

Urn if the integration takes place along a closed path then the circulation yields:

$$\oint \mathbf{H}\, ds = I_{eing} \qquad (3.1) \qquad \text{and} \qquad \oint \mathbf{E}\, ds = O \quad . \qquad (3.2)$$

According to Ampere's law (3.1) the magnetic field can thus form enclosed currents and spatially spreading eddy currents. The electric field on the other hand should be irrotational (3.2).
Let's take the case that the electromagnetic wave is damped by eddy currents and the magnetic field in this way becomes a vortex field. The electric field itself that, as said, is in a fixed relation and perpendicular to the vortex field H, will show all the vortex-typical properties. Hence nothing would be more obvious as to also grant the electric field a formation of vortices:

$$\oint \mathbf{E}\, ds = -U_{eing} \quad . \qquad (3.8)$$

Critics of this dual approach, like for instance Jackson<i> or Lehner<ii>, point out that with reference to the fourth Maxwell equation the electric field should be understood as a source field:

$$\text{div}\, \mathbf{D} = \rho_{el} \quad . \qquad (3.4)$$

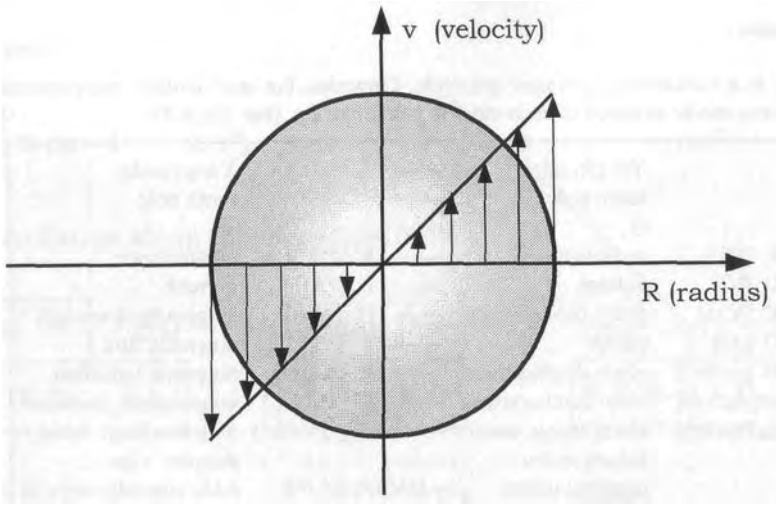

Fig. 3.4a: Velocity distribution v(R) for a vortex with rigid-
body rotation

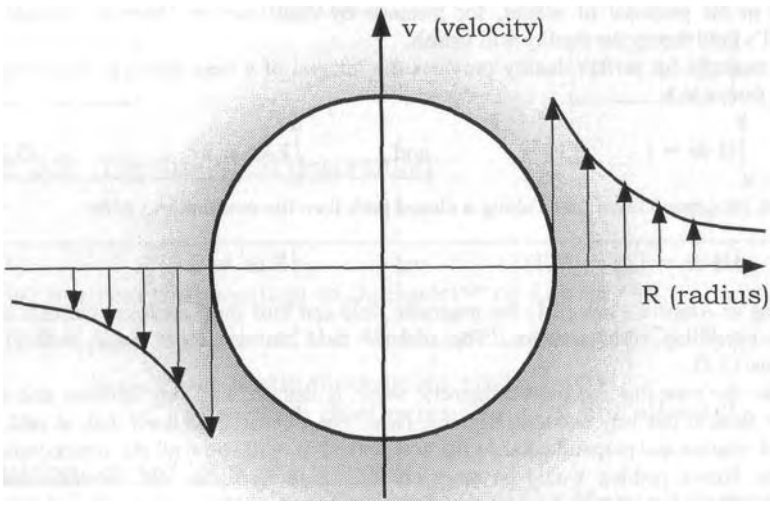

Fig. 3.4b: Velocity distribution v(R) in a potential vortex (see Lugt[<i>]).

<i> Lugt, Hans J.: Vortex flow in nature and technology. Krieger publishing company, Florida 1995; page 30 and 31, ISBN 0-89464-916-7

For a complete duality from the existence of electric monopoles, individual in the space charge density ρ_{el} contained charge carriers, the claim for magnetic monopoles is derived.
In spite of intensive search such north or south pole particles however until now could not be found. Herein from the sight of criticism is seen a confirmation for the assumption that Maxwell's field theory is self-contained and hence in principle may not be extended. The critics have a problem of causality: They postulate source fields that at the same time should be vortex fields. But if one asks how one should imagine such a field that is scalar and at the same time vectorial, then it looks as if no one has ever made any thoughts about it.

The from causality derived solution of the problem of lacking duality requires to extend the Maxwell theory in one point, by introducing the potential vortex of the electric field here and at the same time make a cut in another place:

$$\text{div } D = O \tag{3.7}$$

With this formulation, the assumption of a freedom of sources in principle, the complete duality already is reached: Now neither magnetic nor electric monopoles exist (Fig. 3.3)!
At first we have to accept the loss of the electron hoping that the calculation in the end works out: the "exchange" vortices against particles, by which the quanta can be banned from the field theory, suggests that the elementary particles themselves are nothing else as spherical vortices that have found to an own physical reality.

3.4 Flow vortices

In fluid engineering convincing and strong indications for the correctness of the chosen approach can be found. It benefits us that hydrodynamic vortices are visible or can be the injection of smoke, e.g. in a wind-tunnel.
Already Leonardo da Vinci had observed at liquids that there exist two dual basic types of plane vortices: "Among the vortices one is slower at the centre than at the sides, another is faster at the centre than at the sides."
A vortex of the first type, also called "vortex with rigid-body rotation", is formed for instance by a liquid in a centrifuge that due to its inertia of mass is pressed to the edge because there the largest velocity exists. In an analogous way the electromagnetic vortex in electrically conductive material shows the well-known "skin effect" (Fig. 3.4a).
To explain the other vortex Newton describes the experiment where a rod is dipped into a liquid as viscous as possible and then is turned. In this potential vortex the velocity of the particle increases the closer to the rod it is (Fig. 3.4b).
The duality of both vortex phenomena becomes obvious when we make ourselves clear that in the experiment with the centrifuge the more liquid presses to the edge the less viscous the medium is. And that on the other hand the potential vortex forms the stronger the more viscous the medium is. As conclusion we read in text books that the viscosity of the liquid decides whether a vortex with rigid-body rotation or a potential vortex is formed.

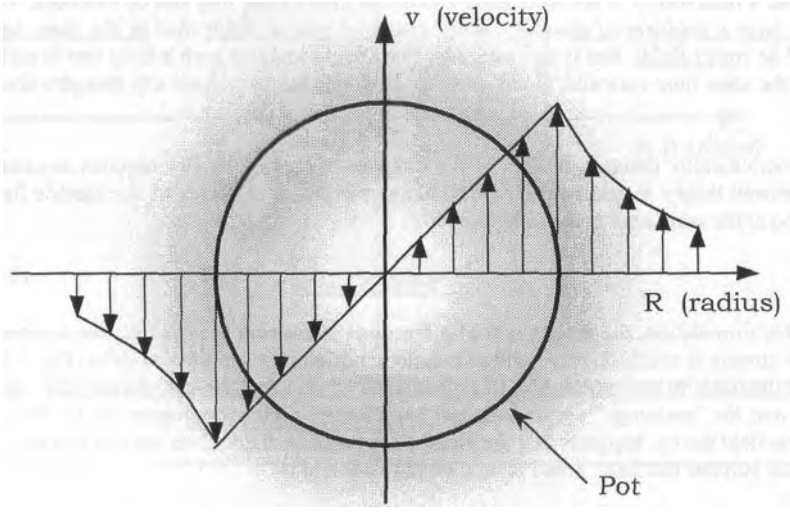

Fig. 3.5: Combination of a vortex with rigid-body rotation and a potential vortex (Lugt[i]).

<i> Lugt, Hans J.: Vortex flow in nature and technology. Krieger publishing company, Florida 1995; ISBN 0-89464-916-7

3.5 Rankine vortex

When we, in a third experiment, immerse the centrifuge filled with water into a tough medium and let the centrifuge rotate, then inside the centrifuge a vortex with rigid-body rotation forms and outside the centrifuge a potential vortex forms (Fig. 3.5).

It is obvious that one vortex always causes the other vortex with the opposite properties and so the existence of one causes that of the other. So in the first case, that of the vortex with rigid-body rotation, outside the centrifuge potential vortices will form in the surrounding air, whereas in the second case, that of the potential vortices, the turning rod itself can be interpreted as a special case of a vortex with rigid-body rotation. Hence in all conceivable experiments the condition always is fulfilled that in the centre of the vortex the same state of "peace", that we can fix as "zero", prevails as in infinity.

When we take a tornado as an example, thus a whirlwind. In the "eye of the cyclone" there's no wind at all. But when I go away from this spot, then I'm blown to the outside. I can really feel the vortex with rigid-body rotation in the inside. If. however, I am standing on the outside, then the potential vortex tries to pull me into the vortex. This potential vortex is responsible for the structure and in the end also for the size of the tornado.

At the radius of the vortex, the place with the largest speed of the wind, an equilibrium prevails. The vortex with rigid-body rotation and the potential vortex at this point are equally powerful. Their power again is determined by the viscosity, which thereby fixes the radius of the vortex!

Therefore meteorologists pursue with interest whether a tornado forms over land or over water. Over the ocean for instance it sucks itself full with water. In that way the potential vortex increases in power, the radius of the vortex gets smaller and the energy density increases dangerously.

If the knowledge from hydrodynamics is transferred to the area of electromagnetism, then the role of the viscosity is taken over by the electric conductivity. The well-known current eddy occurs in the conductor, whereas its counterpart, the postulated potential vortex, forms in the bad-conducting medium, with preference in the dielectric. The duality of both vortices is expressed by the fact that the electric conductivity of the medium decides whether current eddies or potential vortices can form and how fast they decay, i.e. convert their energy into heat.

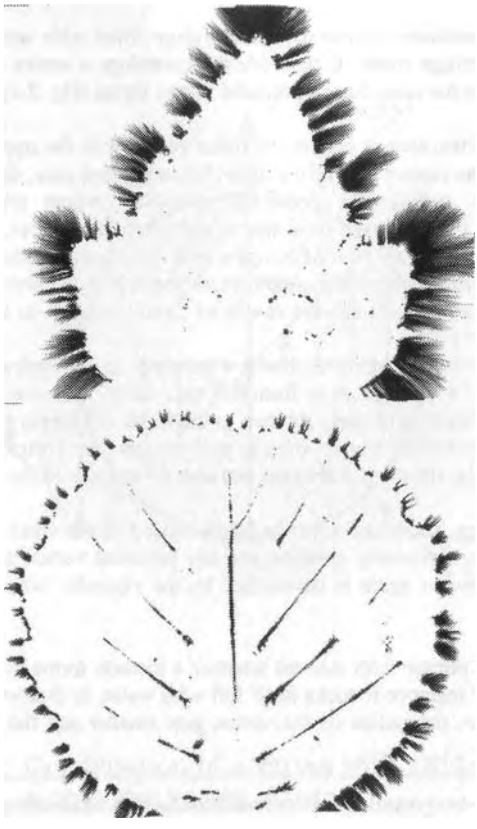

Fig. 3.6: Kirlian photograph of leaves[<i>] structured corona discharges

<i>: (produced by students of electronics in the laboratory for power electronics of the Author, University of Applied Sciences Furtwangen 1991)

<ii>: Kupfmuller, Karl: Einfuhrung in die theoretische Elektrotechnik, Springer-Verlag Berlin, 12. Auflage 1988, page 453

<iii>: Kupfmuller, Karl: Einfuhrung in die theoretische Elektrotechnik, Springer-Verlag Berlin, 12. Auflage 1988, page 208

3.6 Vortex and anti-vortex

Fig. 3.5 shows that vortex and dual anti-vortex mutually cause each other. In high tension transmission lines we find a striking example for the combination of current eddy and potential vortex. Within the conductor current eddies are formed. Thus the current density increases towards the surface of the conductor (skin effect). Outside of the conductor, in the air, the alternating fields find a very bad conducting medium. If one follows the text book opinion, then the field outside the conductor should be an irrotational gradient field! But this statement causes unsolvable problems.

When vortices occur inside the conductor, then for reasons of a detachment of the vortices without jumps at the interface to the dielectric, also the fields in the air surrounding the conductor must have the form and the properties of vortices. Nothing would be more obvious as to also mathematically describe and interpret these so-called gradient fields as vortex fields. When looking exact this argument even is mandatory!

The as laws of field refraction known boundary conditions<ii> in addition demand steadiness at the interface of the conductor to the dielectric and don't leave us any other choice. If there is a vortex field on one side, then also the field on the other side is a vortex field, otherwise we offend against the law! Here an obvious failure of the Maxwell theory is present.
Outside the conductor, in the air, where the alternating fields find a very bad conducting medium the potential vortex not only exists theoretical; it even shows itself. Dependent among others on the frequency and the composition of the surface of the conductor, the potenial vortices form around the conductor. When the thereby induced potentials exceed the initial voltage, then impact ionisation takes place and the well-known corona discharge is produced. Everyone of us can hear this as crackling and see the sparkling skin with which high tension transmission lines cover themselves.
In accordance with the text books also a gradient field increases towards the surface of the conductor, but an even shining would be expected and not a crackling. Without potential vortices the observable structure of the corona would remain an unsolved phenomenon of physics (Fig. 3.6).

But even without knowing the structure-shaping property of the potential vortices, that in addition acts supporting and that we'll have to derive, it can be observed well that especially roughness on the surface of the conductor stimulate the formation of vortices and can produce vortices. If one is looking for a reason why with large frequency the very short impulses of discharge always emerge from roughness<iii>, then very probable potential vortices are responsible for it. By means of a Kirlian photograph it can be shown that the corona consists of structured separate discharges (Fig. 3.6).

With this the approach is motivated, formulated and given reasons for. The expositions can't replace a proof, but they should stand a critical examination. Mathematical and physical evidence will be furnished later.

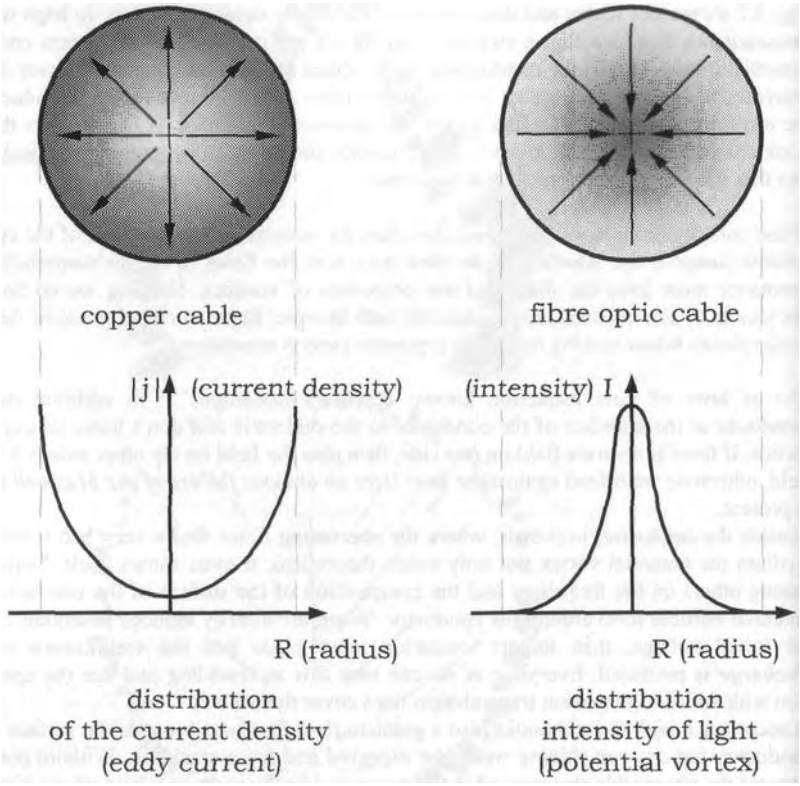

Fig. 4.1: The distribution in principle of the intensity of light
within a fibre optic cable<i> compared to the distribution of the current density in a copper cable

<i> Meyl, Konstantin: Potentialwirbel, Band 1: Diskussionsbeitrage zur naturwissenschaftlichen Deutung und zur physikalisch-technischen Nutzung, basierend auf einer mathematischen Berechnung neu entdeckter hydrotischer Wirbel, INDEL GmbH, Verlagsabteilung, Villingen-Schwenningen 1990, ISBN 3-9802-542-1-6

4. Properties

4.1 Concentration effect

It can be assumed that until now there does not yet exist a technical application for the here presented potential vortex theory unless the phenomenon was used by chance and unconsciously. About this the transmission of optical light signals over fibre optic cable can be given as a typical example.
Compared to a transmission of energy impulses over a copper cable fibre optic cables show a considerable better degree of effectiveness. The derived potential vortex theory provides a conclusive explanation for this phenomenon and therefore is put here to discussion: If we cut through a fibre optic cable and look at the distribution of a light impulse over the cross-section, then we observe a concentration in the centre of the conductor (fig. 4.1).

Herc the duality between the vortices of the magnetic and of the electric field comes to light. Whereas the current eddies in a copper conductor cause the "skin effect" as is well-known, potential vortices show a "concentration effect" and align themselves with the vortex centre. The measurable and in fig. 4.1 shown distribution of the light intensity in a fibre optic cable may confirm this phenomenon, the orientation of the potential vortex on the vortex centre.

For instance the calculation of the resistance of a copper cable provides as an important result an apparent decrease of the resistance directed towards the conductor surface. There the associated better conductivity as a consequence causes an increased current density. In the reversed direction, towards the centre of the conductor, consequently a decrease of the effective conductivity would be present, and this result is independent of the used material. According to the rules of duality this is a condition for the formation of potential vortices. As already said the conductivity is responsible for it, if the expanding eddy current with its skin effect or the contracting potential vortex with its concentration effect is predominant.

Usual fibre optic materials possess not only a small conductivity, but in addition a high dieletricity. This additionally favours the formation of vortices of the electric field. If one consciously or unconsciously supports the potential vortices, then there is a possibility that the life of the fibre optic cable is negatively influenced because of the concentration effect. Of course it can not be excluded that other effects, like e.g. reflections or the modes of the light are involved in the concentration effect. But it should be guaranteed that this actually concerns is causal phenomena and doesn't concern only alternative explanations out of ignorance of the active vortex phenomenon.

The formal mathematical reason for the concentration effect provides the reverse sign in Faraday's law of induction compared to Ampere's law (see also equation 3.1 and equation 3.8 in fig. 3.3).

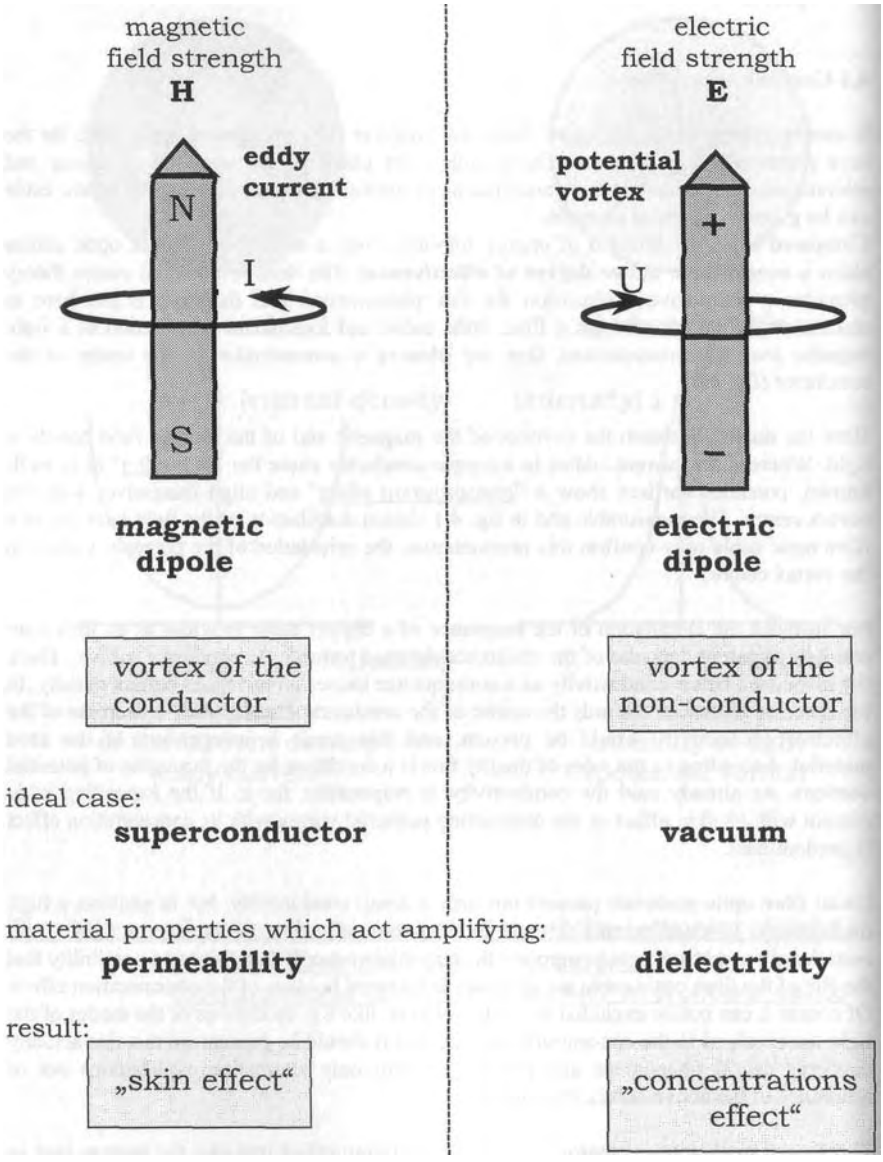

Fig. 4.2: The acting as a dipole of current eddies and potential vortices

4.2 Duality of the vortex properties

The rules of duality dictate for the vortex of the electric and of the magnetic field the following characteristics:

1. Whereas currents and eddy currents demand a good conductivity, potentials and potential vortices can only form with bad conductivity, thus in a dielectric and best in the vacuum.

2. Eddy currents run apart, strive towards infinity and thus show the well-known "skin effect" with a spatially limited arrangement of the conductor. According to the rules of duality the potential vortex will strive towards the vortex centre and in this way will show a "concentration effect".

3. Another property of vortices is shown in fig. 4.2.
On the left side a plane eddy current is indicated. Since the discovery of Ampere's law it is well-known to us that such a circular current (I) forms a magnetic dipole standing perpendicular to the vortex plane.
On the right hand side the dual phenomenon is sketched. Here charges are piled up circularly to a planar potential vortex (U). Thereby an electric dipole forms, standing perpendicular to the vortex plane. This relation directly follows from the equations of the field-theoretical approach.
Whereas circular currents and current eddies produce magnetic dipoles, the postulated potential vortices will form electric dipoles.

With these three interesting properties some key questions of quantum physics, that until now have stayed a mystery to science (fig. 4.4), can be answered conclusively and without compulsion e.g.:

I.Why are there no magnetically charged particles?
The better the conductivity of a medium is, the higher as a consequence the number of free charge carriers is. the more strongly eddy currents are formed. The answer to question I is inferred from the opposite case:
In the ideal vacuum no charge carriers at all are present, why no currents, no current eddies and consequently no magnetic poles can exist.
With this well-known fact the first question already is answered. The question why in the microcosm there can not exist magnetically charged elementary particles, why the search for magnetic monopoles doesn't make any sense. Let's ask further:

II. Why are there only electrically charged particles?
Let us for that consider the dual conditions. The worse the conductivity of a medium is, the more the potential vortex -will be favoured that because of this property also can be understood as the vortex of the dielectric.
In the mentioned extreme case of the ideal vacuum, no electric conductivity is present for reason of the missing charge carriers. But this circumstance favours the potential vortex and that, according to fig. 4.2, forms electric poles and with this also the second question would be answered clearly.
It can be traced back to the boundary conditions of the microcosm that without exception electricallv charged particles are entitled to exist; a realization derived from the field-theoretical approach, that covers all experiences.

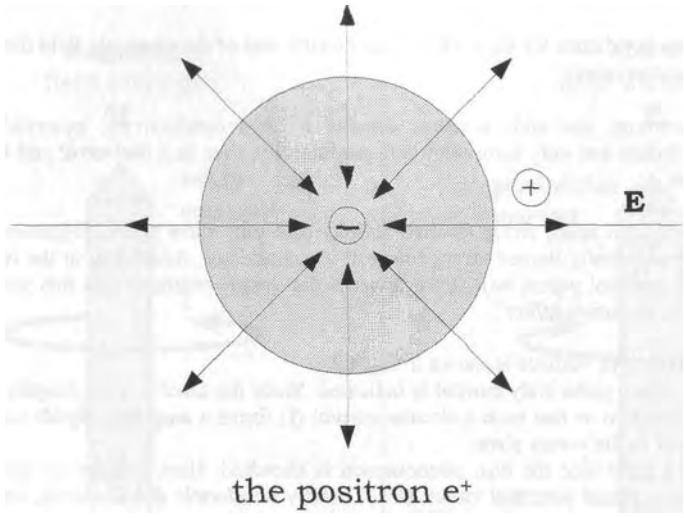

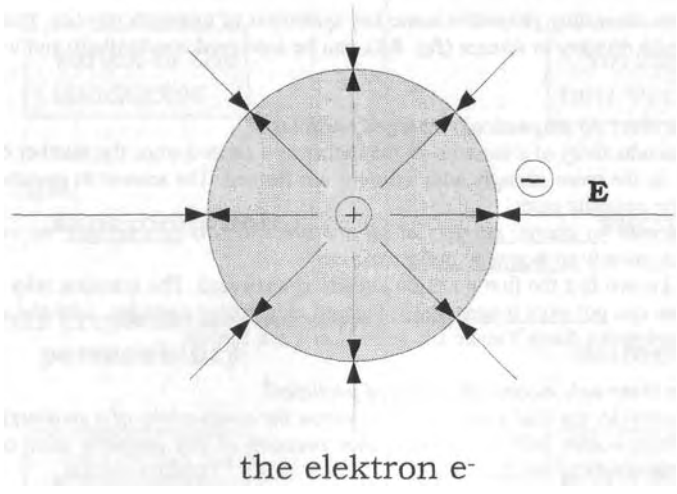

Fig. 4.3: Elementarv particles as configurations of potential vortices

4.3 Derivation of the electron as an elementary vortex

The next key question necessarily has to be brought to a conclusive answer to save the principle of causality, so that we no longer have to postulate an own physics with its own laws for the microcosm:

III. Why do these particles show as monopoles?

More concrete the question has to read:
Where is the positive pole in a negatively charged electron, if it should be an electric dipole?
The only possible answer is:
In the centre of the particle!

Thus in the centre of the electron its positive pole is hidden and in the centre of the positron its negative pole is hidden. But we only observe these particles from the outside and for reason of the field conditions of the electron we measure a negative charge and for its antiparticle, the positron, a positive charge. If in each case we wanted to measure the electric fields included in the inside, we had to destroy the particle. Then a proof would not be possible anymore.

Here also a persistent mistake is eliminated by the for a long time known axiom that monopoles can not exist at all if one considers continuity! By means of technical-physical experiments this axiom is sufficiently secured.
The quantum physical approach is standing on uncertain ground if it is postulated that other laws of nature should apply to particle physics, if a second approach, the field-theoretical approach, is conceivable that does not know these problems!

The discussed concentration effect gives the potential vortex a structure shaping property. With that also the fourth key question can be answered:

IV. Why do the particles have the form of spheres?

The potential vortex is favoured in the particle-free vacuum of the microcosm because of the missing conductivity. In connection with the concentration effect the following conclusion can be drawn:
The extremely mighty potential vortex exerts a high pressure on the microcosm and on each particle.

With that also the fourth key question, why stable elementary particles are spherical, can be answered by the potential vortex theory:
Only the sphere is able to withstand a high outside pressure.
All other forms, like e.g. dipoles formed like a rod or a club would be instable in the presence of the extremely concentrating potential vortex. They would be immediately destroyed by the pressure of the potential vortex.

I. Why are there no magnetically charged particles?
(the vacuum has no conductivity!)

II. Why are there only electrically charged particles?
(in the vacuum only potential vortices can exist!)

III. Why do these particles show as monopoles?

(the other pole is locked up in the inside of the vortex oscillation!)

IV. Why do the particles have the form of spheres?

(for reason of the outside pressure by the concentration effect!)

V. Why is the elementary quantum stable?

(without conductivity no decay of vortices takes place!)

VI. Why does for every particle of matter exist an antiparticle?

(there are two swirl directions with equal rights!)

VII. Why are particles and antiparticles incompatible?
(contrary swirl directions!)

Fig. 4.4: Key questions of quantum physics

4.4 Quanta as field vortices

The fied-theoretical approach demands removing the electron from the field equations (eq. 3.7) and at the same time introducing the potential vortex of the electric field. With this vortex phenomenon there now is a possibility that the electromagnetic wave spontaneously rolls up to a vortex in case it is disturbed from the outside. The vortex particle that is formed in such a way owes its physical reality on the one hand the concentration effect of the potential vortex, that compresses this particle to the dimension of a tiny sphere and on the other hand its localization for reason of the oscillation around a fixed point.
The sphcrical elementary particles are being compressed to inconceivably small dimensions. Therefore they are capable to bind a comparatively high energy in their inside. This is confirmed by the mass-energy relation $E = mc^2$. (4.1)

The fact that the energy is dependent on the speed of light can be judged to be a clear indication that quanta actually are nothing but oscillating electromagnetic packages, vortical oscillations of empty space!
The next question reads:

V. Why is the elementary quantum stable?
The worse the conductivity is, the more the potential vortex will be favoured, the more strongly the concentration effect will form, the smaller the spherical phenomena will get - the larger the authoritative relaxation time will be, i.e. the slower the decay of vortices and with that the more stable the vortex phenomenon will be.
In the microcosm, that comes the ideal case of a particle-free vacuum very close, the spherical vortices because of the missing conductivity have an absolute stability.

VI. Why does for every particle of matter exist an antiparticle?
Since every vortex can also oscillate
in the opposite direction, there always exist two forms of formation of spherical vortices with equal rights, one of them is assigned to the world of matter and the other to the world of anti-matter.

VII. Why are particles and antiparticles incompatible?
For reason of the contrary swirl direction they are incompatible to each other. They have the tendency to destroy each other mutually, like two trains that want in the opposite direction on a single-tracked distance.

The quantum physical approach does not have an answer to these key questions. Until now scientists have merely thought about to what the observable contraction in the microcosm and the macrocosm can be traced back. Because the approach was not able to furnish an answer, without further ado some new matter was introduced: the sluons. These binding particles should be able to exert the necessary pressure. But until now no one has been able to observe or detect this fabulous matter. Nobody knows its structure and its composition. Despite missing evidence it is stated that this matter is mass less and at the same time lumped; it is invisible because it can't interact with any other matter, not even with the supposed building parts of the atomic nuclei, the quarks. But at the same time there should be exerted a pressure on the quarks, for which reason quarks again should be able to interact with gluons!

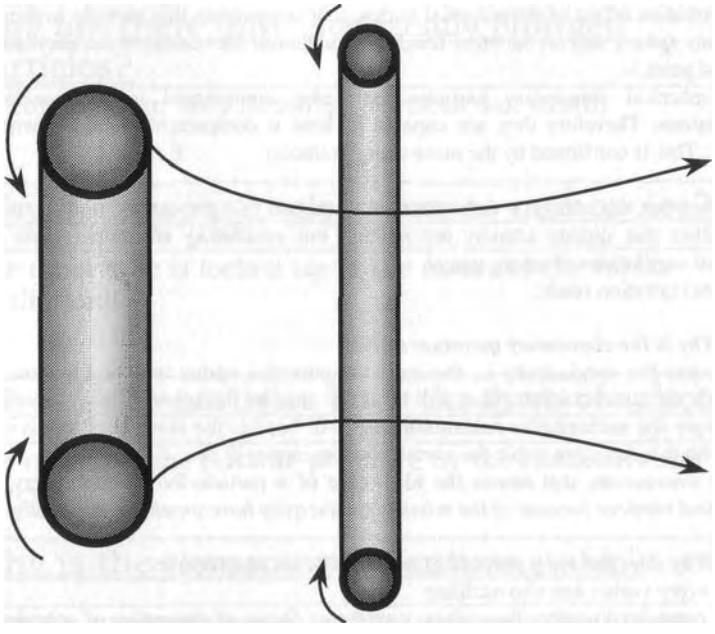

Fig. 4.5: Two coaxial oscillating vortex rings (Lugt[<i>]).

<i> Lugt, Hans J.: Vortex flow in nature and technology. Krieger publishing company, Florida 1995; page 42, ISBN 0-89464-916-7

4.5 The photon

The ability to form structures as a consequence of the concentration effect gives the potential vortex a number of highly interesting properties. To derive these properties we can make work easier when we fall back upon the observations and experiences of flow dynamics.
Here the vortex ring takes a special place. Its vortex centre is not closed, for which reason it is not stationary and propagates in space with a constant speed. It can be observed that the velocity of propagation increases with the ring diameter becoming smaller. By means of the vortex rings, that skilful smokers can produce with pointed lips, these properties can be made visible.
Now if two vortex rings run into each other with the same axis and direction of rotation then both oscillate around each other, by one vortex attracting the other vortex, thereby accelerating and thus contracting it. The second vortex then slips through the core opening and gets again slower and larger. Now the first vortex accelerates and plays the same game (fig. 4.5).
It would be obvious for the vortex of the electric field to have a corresponding property. The electron e- and with the opposite swirl direction the positron e+ will form such a potential vortex corresponding to the derivation. Two electrons, as like charged particles, would repel each other and surely will be out of the question for such a configuration. An electron and a positron however will attract each other and because of their incompatibility they will mutually destroy unless they open their vortex centres to form a vortex ring. Now the e- shows its positively charged centre that shows the same swirl direction as the e+ seen from the outside. Therefore the vortices don't hurt each other, when the positron slips through the opened vortex centre of the electron and vice versa.
This oscillating electron-positron pair has strange properties: seen from the outside one moment it is negatively charged and the next moment it is positively charged. Therefore over time on the average no charge will be measurable and no electromagnetic interaction will take place.
One moment the particle is matter and the next moment it is anti-matter. Hence no mass at all can be attributed to the particle. Interactions primarily takes place between both dual vortices. We can predict, the particle has neither mass nor charge. The environment merely sees a fast oscillating particle that only within every half cycle is capable of an interaction.
The centre of the oscillating particle is open, for which reason it is not stationary anymore. Instead it propagates in z-direction with the swirl velocity, which is the speed of light, in this way preventing a rotation around the x- or y- axis (fig. 4.6). In this way a polarizability is present.
The only possible and, as we will see, necessarily taking place rotation around the z-axis gives the particle a spin of the magnitude of a quantum of angular momentum. After all the rotation for e^- and e^+ is of the same magnitude with a spin of each time $\frac{1}{2} \cdot \hbar$. There should be paid attention to the fact that for the case of an opposite sense of direction of the respective rotation around the common z-axis the spin on the average will be zero.
In addition the particle is characterized by an outstanding property: a periodically taking place oscillation with any frequency, but that frequency has to be constant. We now only have to take a table of particles to hand. Actually we will find a corresponding particle that has all these properties: the γ-quanta, also called photon.

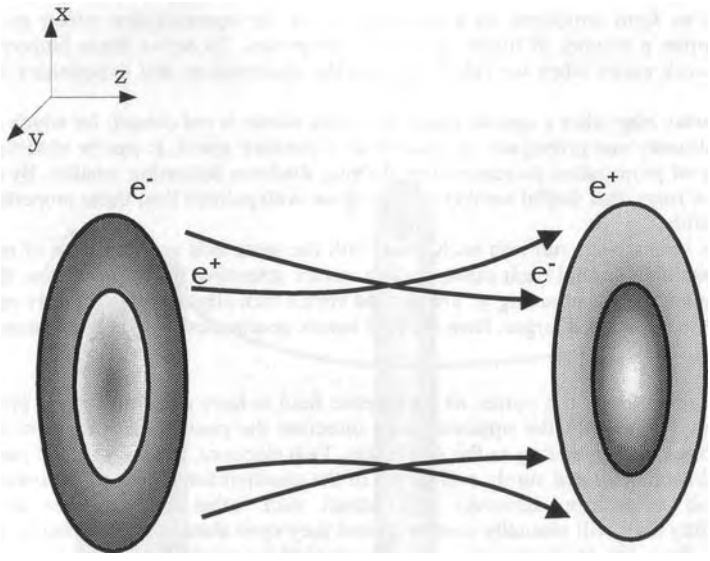

Fig. 4.6: The photon as oscillating electron-positron pair

The decay of the γ- quanta (photon)[<i>]
(= pair creation = Bethe-Heitler-process 1934):

$$\gamma \longrightarrow e^- + e^+ \tag{4.2}$$

<i> Nachtmann, Otto: Phanomene und Konzepte der Elementarteilchenphysik, Vieweg, Braunschweig 1986, S. 135, ISBN 3-528-08926-1

4.6 Pair creation

Proof for the correctness of the model concept provides the decay of the photon in an electron and a positron in the presence of a strong field, as for instance in an atomic nucleus. This observable decay is called pair creation or Bethe-Heitler process[<i>]:

$\gamma \longrightarrow e^- + e^+$ (4.2)

In this process the elementary vortices for a short time get back their localization and are therefore detectable. Otherwise the electron and positron have the form of a sphere, the photon however rather has the form of two oscillating discs.

The photon doesn't participate in the electromagnetic interaction, because the electric field lines run from one disc to the other (from + to -). The field lines are not open as they are for e^- or e^+ (fig. 4.3). To open up the field lines an energy is necessary that corresponds to the sum of the two formed particles. But from this it by no means follows that this amount of energy will be released in the reversed and much better known process, where matter and anti-matter annihilate under emission of γ-quanta. At the end of the derivation the vortex model will provide us the desired answers on questions of the energy of photons.

Here first of all only the properties will be concerned. Experiments, in which light shows as a particle, are the photoelectric effect, the Compton effect and a lot more. According to the by Maxwell developed classical theory of light however is light an electromagnetic wave that is not quantized in any way, neither as sphere nor as disc, the wave nature of light as well has a physical reality and is secured by experiment. This is witnessed by the interference patterns of overlapping coherent light beams.

A concept in which light could exist at the same place and the same time both as wave and as corpuscle could never be brought into accord with the principle of causality. Formulas of compromise, like the uncertainty principle of Heisenberg that refers to the point of view of the observer, can't change anything about this dilemma. The dual nature of light, that in this context is gladly spoken of, rather consists of the fact that dependent on the local field conditions, any time and spontaneously the wave can roll up to a vortex.

As an example of a violation of the principle of causality it has been indicated under point 3 (fig. 3.1) that both fields and quanta at the same time should be the cause of something. This concept was formulated by Maxwell and written down in modern quantum electro-dynamics by Dirac but in the field-theoretical approach we have dropped this concept because it violates all rules of causality in an elementary manner. Therefore it only is consistent, if we hold the view that the light is either wave or particle but never is both at the same time!

In the spontaneous transition of the wave to the particle all the important properties are conserved: the propagation with the speed of light, the characteristic frequency of the oscillation and the mentioned polarizability.

The process of rolling up possibly takes place already in the laboratory, in a bubble chamber and at the latest in our eyes. To receive the electromagnetic wave, we had to have antennas. We actually see the photons. It therefore would be obvious if our cells to see only could perceive vortices, in this case photons. We don't possess a sense organ for fields and waves.

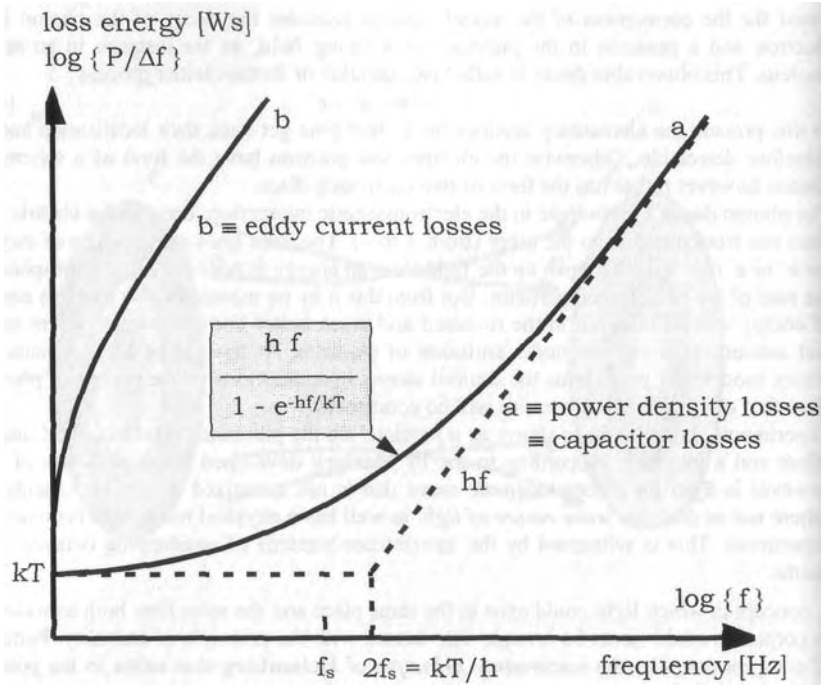

Fig. 4.7: The power density shown against frequency for noise
(a) according to Kupfmuller[i],
as well as for dielectric losses of a capacitor (also a) and for eddy current losses (b) according to Mevl[ii] (b in visible duality to a).

<i> Kupfmuller, Karl: Einfuhrung in die theoretische Elektrotechnik, Springer-Verlag Berlin, 12. Auflage 1988, ISBN 3-540-18403-1
<ii> Meyl, Konstantin: Dreidimensionale nichtlineare Berechnung von Wirbelstromkupplungen, Dissertation Universitat Stuttgart 1984

4.7 Noise

If, according to the field-theoretical approach, there exist electric field vortices then they will not only form the elementary particles in the vacuum, but will also macroscopically form and have an effect in larger dimensions.

Assuming a wave that rolls up to a plane vortex it would be obvious if polarization and velocity of propagation are conserved in the process. But how does it stand about the frequency?
The wave now will walk round a stationary point, the vortex centre. The propagation with the speed of light c will remain existent as the swirl velocity. For a plane circular vortex, where the path for a revolution on the outside is very much longer than near the vortex centre, there arises a longer wave length and as a consequence a lower frequency on the outside as more to the inside. With this property the vortex proves to be a changer of frequency: the vortex transforms the frequency of the causing wave in an evenly spectrum, that starts at low frequencies and stretches to very high frequencies (fig. 1.4). Exactly this property we observe in "white noise". The consistent conclusion would be that this concerns the vortex of the electric field. Anyone can, without big expenses, convince himself or herself of the localization, of the property to change the frequency and of the circumstance that vortices can be very easily influenced, that they avoid or again whirl about a place of disturbance, for instance an antenna. For that one only needs to tune a radio receiver to a weak and noisy station and move oneself or some objects around, then one is able to directly study the influences from the manipulation of the receiving signal.
But already the fact that the using and measurability of signals is limited by noise makes clear. which attention the potential vortex should be given.

Within a limited frequency range the power of the Nyquist or resistance noise is independent of frequency (fig. 4.7). This should be clarified particularly by the term "white noise" analogous to white light, where all visible spectral ranges independent of frequency have the same energy density.

But this relation doesn't hold for high frequencies of any magnitude. Here another noise-effect appears, that is said to have its cause in the quantum structure of energy[<i>]. Untouched by possible interpretations an increasing power of the noise is measured, that more and more turns into a being proportional to frequency (fig. 4.7, curve a). Interestingly this curve shows a remarkable duality to the power curve of eddy currents, likewise shown against the frequency, that for instance can be measured at eddy current couplings[<ii>] (fig. 4.7, curve b). This circumstance suggests a dual relation of the potential vortex of the electric field in bad conducting media on the one hand and the eddy current in inductive materials on the other hand [<iii>].

<iii>: Meyl, Konstantin: Wirbel des elektrischen Feldes,
EMC Journal 1/95, 6. J, ISSN 0945-3857, S. 56 - 59.

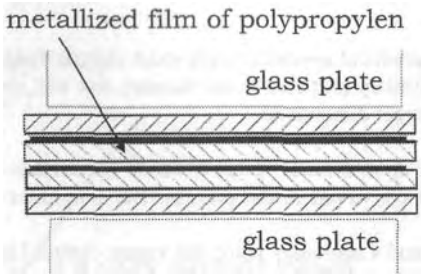

a) measurement set up according to Yializis and others[i]

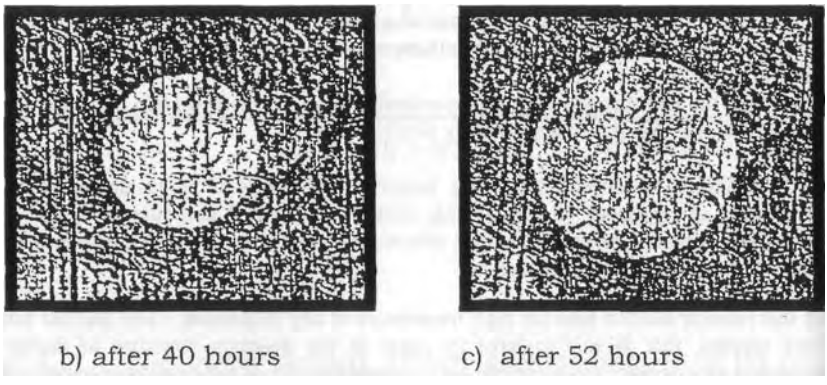

Fig. 4.8: Measurement set up (a) and photo of vortex structure
in a metallized polypropylen layer capacitor (at 450 V/ 60 Hz/ 100°C)
Observation of the formation of a vortex (b) and (c). (110 fold magnification), according to Yializis et al.[i]

<i>: A. Yializis, S. W. Cichanowski, D. G. Shaw: Electrode Corrosion in Metallized Polypropylene Capacitors, Proceedings of IEEE, International Symposium on Electrical Insulation, Bosten, Mass., June 1980;

4.8 Capacitor losses

Next the dielectric losses in a capacitor fed with an alternating voltage are measured and likewise put on against the frequency. At first the course is independent of the frequency, but towards higher frequencies it increases and shows the same characteristic course of the curve as the before mentioned power of the noise (fig. 4.7, curve a).

This excellent agreement suggests the assumption that the dielectric losses are nothing but eddy losses.
These vortex phenomena, caused by time-varying fields, are not only found in ferro-magnetic and conductive materials, but equally as dual phenomena in dielectrics and non-conductors.

As examples of practical applications the induction welding or the microwave oven can be mentioned. The process can be described in other words as follows: in both examples the cause is posed by high-frequency alternating fields that are irradiated into a dielectric as an electromagnetic wave, there roll up to potential vortices and eventually decay in the vortex centre. The desired and used thermal effect arises during this diffusion process.

The striving in the direction of the vortex centre gives the potential vortex of the electric field a structure shaping property. As a consequence of this "concentration effect" circular vortex structures are to be expected, comparable to the visible vortices in flow dynamics (e.g. tornados and whirlwinds). At the same time the dual anti-vortex arises, the diverging eddy current. It takes, as is well-known, the given structure of the conductor, so in the technical literature one correspondingly talks of a "skin effect". Now if conductor and non-conductor meet as they do in a capacitor, then at the boundary area visible structures will form. Circles would be expected, if the eddy current in the inside and striving to the outside is equally powerful as the potential vortex that comes from the outside and concentrates.

Actually such circular structures are observed on the aluminium of high tension capacitors, when they were in operation for a longer period of time. The formation of these circles, the cause of which until now is considered to be unsolved, is already experimentally investigated and discussed on an international level by scientists (fig. 4.8) [i, ii].

These circular vortex structures can be seen as a visible proof [iii] for the existence of potential vortices of the electric field.

<ii>: D. F. Taylor, On the Mechanism of Aluminium Corrosion in Metallized Film Capacitors, IEEE Transactions on EI-19,August 1984,No.4,pp.288-293.

<iii>: Meyl, Konstantin: Wirbel des elektrischen Feldes, EMC Journal 1/95, 6.J, ISSN 0945-3857, S. 56-59.

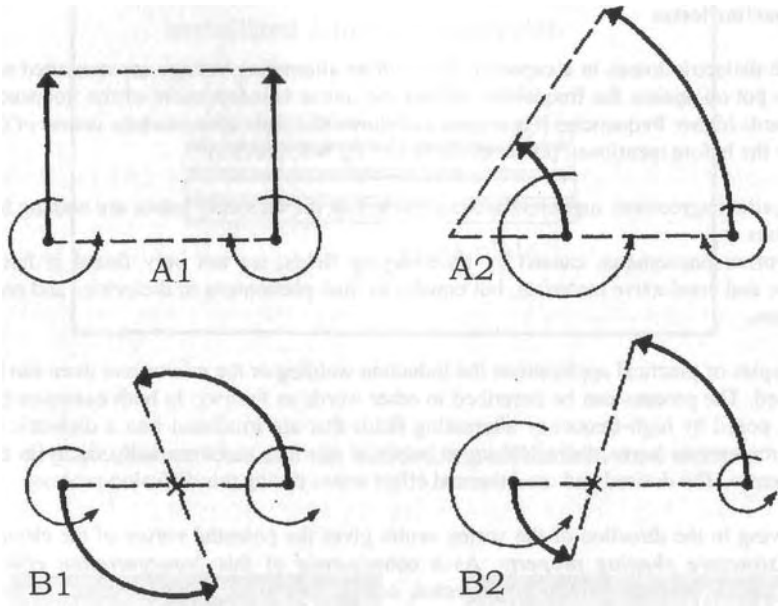

Fig, 4.9: Motion of two point vortices. (Lugt[i])
A. with opposite direction of rotation
B. with the same direction of rotation
1. for equal vortex strength
2. for unequal vortex strength

Example from practice for case Al:
vortex pair behind an airplane

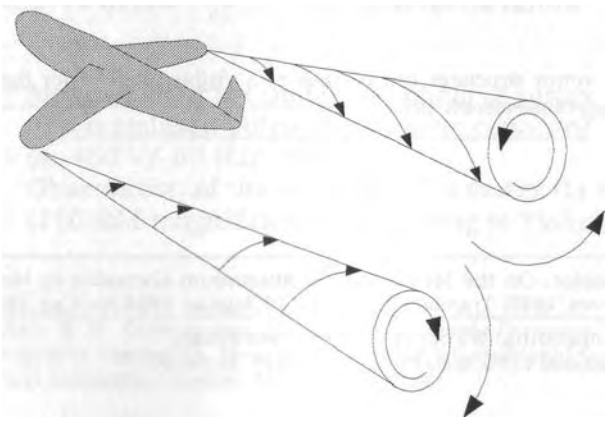

4.9 Vortex lines and vortex streets

It can be assumed that the vortex of the electric field is relevant with regard to the electromagnetic environmental compatibility. This then holds not only for microcosmic and microscopic vortices, but also for macroscopic and larger dimensions. The individual vortices can join together to balls and lines. For the study of this process it is useful to again fall back upon experiences of flow dynamics.

The co-operation of individual point vortices has been investigated thoroughly in flow dyamics. Without any outside manipulation an individual vortex rotates on the spot. That changes in the case of two neighbouring vortices. Now it depends on their mutual strength and sense of rotation. If they have the opposite sense of rotation and equal strength then their centres of rotation move straight forward in the same direction. If however the direction of rotation is the same then both vortices rotate around each other (fig. 4.9).

In this way a multitude of point vortices is capable, to form in the first case whole vortex streets and in the second case spherical vortex balls. In principle a vortex string can also consist of a multitude of potential vortices pointing in the same direction; but it has the tendency to roll up to a vortex ball in case it is disturbed from the outside, as can be shown very clear by means of computer simulations[<i>].

As a starting-point for a discussion the thesis can be put forward that also electric field vortices, in nature usually consisting of a multitude of individual point vortices, appear as vortex strings and vortex balls.

Perhaps historians see in this property an answer to the question, how it was possible for the Romans to build streets straight as a die in the wilderness. Their land surveyors, the Augures, had at their disposal neither laser, nor any other suitable gauges. Their most important tool was the Lituus, the crook, that at its upper end was rolled up like a vortex in the sense of a flat coil shaped like a spiral.
The question poses what this strange object was used for. Perhaps the roman land surveors tracked down any vortex lines with this crook and then used them to orientate themselves?
History still holds a lot of secrets, but for now only this indication is given. The following seminar will give enough opportunities for speculations and discussions[<ii>].

<i>: Lugt, Hans J.: Vortex flow in nature and technology. Krieger publishing company, Florida 1995; p.38, fig. 3.25, 3.26 and 3.27, ISBN 0-89464-916-7

<ii>: K. Meyl: Elektromagnetische Umweltvertraglichkeit Teil 2 und 3 Seminarumdrucke, INDEL Verlag VS; see part 2 and 3 of this book.

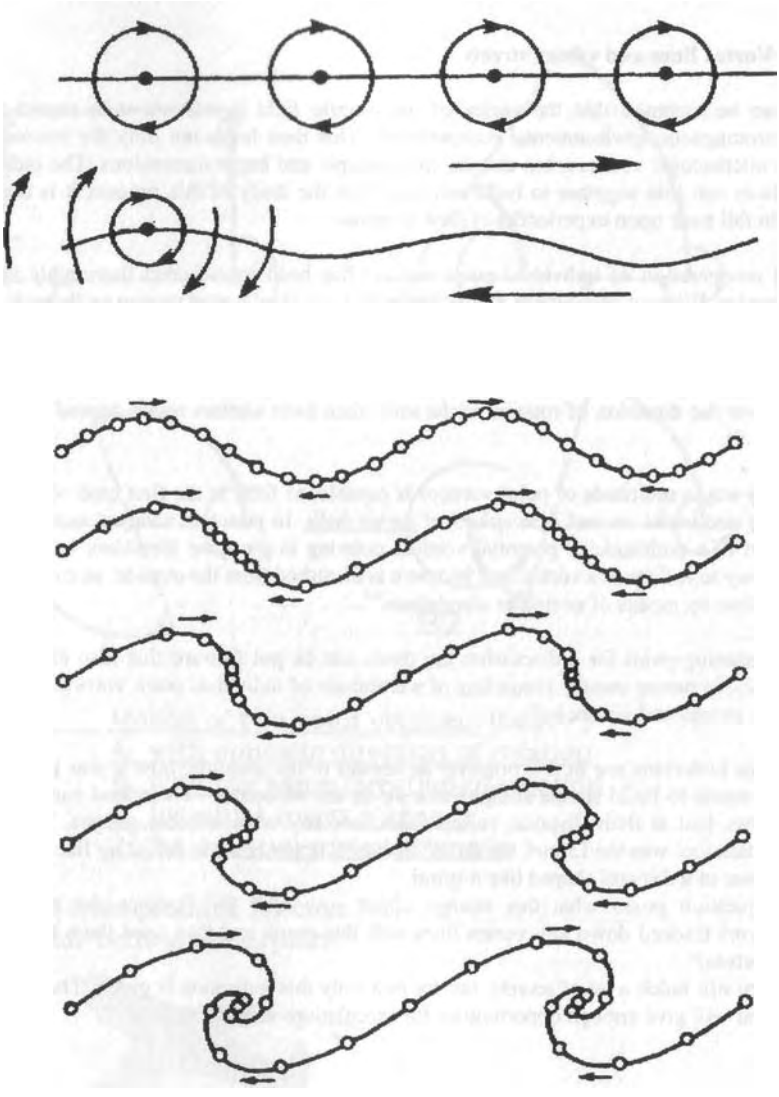

Fig. 4.10: The rolling up of a vortex chain to a vortex ball for the smallest disturbance (case Bl in fig. 4.9) (Rosenhead[<i>]).

<i>: L. Rosenhead: Formation of vortices from a surface of discontinuity. Proc. Roy. Soc. A 134, 1931, 170. taken from:

Lugt, Hans J.: Vortex flow in nature and technology. Krieger publishing company, Florida 1995; page 39, figure 3.29, ISBN 0-89464-916-7

4.10 Water colloids as vortex balls

We have to realize that in the biosphere we are staying in a relatively ideal dielectric. The two "capacitor plates" are being formed by the ionosphere and the earth. The potential vortex will, as said, be favoured by a bad conductivity and by a high dielectricity. Consequently it will dominate and take effect in the biosphere. In which way it takes effect is the central theme of the electromagnetic environmental compatibility.

Life in this world consists predominantly of water and water has a very high dielectricity! With that the effectiveness and the long life of the potential vortex increases. The human head for instance contains 7O% and plants contain over 90% water! But it does not simply concern H_2O, but structured water in a colloidal form. These water colloids could be vortex balls because they consist of a large number of water molecules in a spherical arrangement They form independent and insoluble particles with a negative electric charge (fig. 4.11).
Water is not equal water thanks to this structure. One can buy healing water and corresponding sources are well-known and famous. Many an effect can be explained by means of a chemical analysis but not everything.

The highest age in this world is reached by the inhabitants of Hunza, in the mountains of norhern India at the foothill of the Hindu Kush, at an altitude of 2500 meters. They drink some muddy glacial water that is strongly colloidal. Hence it would be obvious that plants and also we ourselves need such water for our physique. Processes are known with which the advantageous vortex balls, say colloids, are produced artificially by mechanic or chemical treatment[<i>]. Levitated water, as it is called and as it is for sale nowadays, is said to be more healthy. Unfortunately people predominantly work empiric in this area, because science occupies itself with this topic only little or not at all.
Another problem is the fact that the colloids again fall apart quickly. The like negative charge favours this process. The liquid crystals have to be stabilized from the outside. In the case of the Hunza-water the colloids are surrounded by a vegetable layer of fatty acid and are protected in this way [<ii>]. It possibly is very obliging to nature, if the water colloids also in biological systems are stabilized in that way.
Everyone of us knows that fresh spring water tastes much better than stale, bottled water, even if the chemical analysis turns out of be absolutely identical. For this fact classical science is not able to give a cause - a further problem of causality. In any case should potential vortices with their structure shaping property be considered as a cause for the formation of water colloids. It surely causes no difficulties at all to interpret the colloids as vortcx bulls.

<i>: V. Schauberger: Die Entdeckung der Levitationskraft, Implosion 1995 Nr. 112 und:
N. Harthun: NaturgemaSe Technik - Wege fur die Forschung nach Viktor Schauberger, Verlag Delta Design, Berlin 1996.

<ii>: Flanagan: Elexier der Jugendlichkeit, Waldthausen Verlag Ritterhude 1992, orig.: Elixir of Ageless

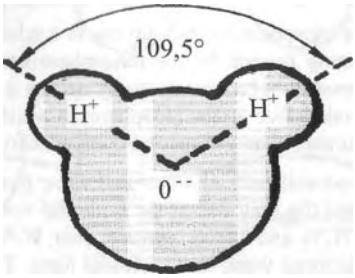

H_2O: the angle of the bond between 2 H molecules = 104,5°
angle of the bond in excited state = 109,5°

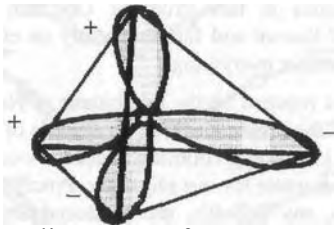

electron orbital diagram of energy (excited H_2O) = tetraeder
most stable liquid crystal = 8 tetraeder = star of octaeder

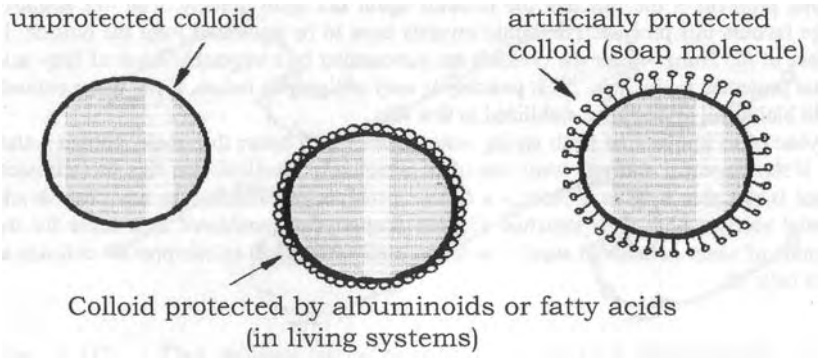

Fig. 4.11: Water molecules and water colloids

4.11 Phenomenon of transport

The vortex principle is self-similar. This means that the properties of an individual vortex also for the collection of numerous vortices again appear and can he observed in a similar manner. That's why a vortex ball behaves entirely similar as an individual isolated vortex. The same concentration effect, that keeps the vortex together, shows its effect for the vortex ball and keeps it together also.

Something corresponding holds for a basic property of potential vortices, being of a completely different nature. It is the property to bind matter in the vortex and carry it away with the vortex. Well-known are the vortex rings that skilful cigarette smokers can blow in the air. Of course also non-smokers can produce these air eddies with their mouth but these remain invisible. Solely by the property of the vortex ring to bind the smoke it becomes visible to the human eye.

If out potential vortex transports something then it rather should be a dielectric material, so preferably water. Therefore if in the environmental air we are surrounded by potential vortices that we can detect for instance as noise, then they are capable with their "phenomenon of transport", to pick up water and to keep it in the vortex. In this way the atmospheric humidity is explicable as the ability of the air particles to bind comparatively heavy water molecules. If the vortex falls apart then it inevitably releases the water particles and it rains. This is merely a charming alternative for the classical representation without claim to completeness.

Already the Romans have made use of this phenomenon to find water and sources. About this Vitruv<i> (from 23 BC) in his 8th book about architecture writes: "Before sunrise one has to lie down on the earth at the places, where to search for water,... and one has to look at the area... Then one has to dig at the place where there appears curling and in the air rising moist steam. Because this characteristic can not occur at a place where there is no water". The at a certain time of day and in certain seasons occasional in meadows and corn fields observable streaks or circular mostly moist places with differing vegetation, have to be judged as an infallible sign for the existence of this phenomenon.

This phenomenon of transport again appears for the discussed water colloids. The involved water molecules form a spherical object with a negative charge. They turn their negatively charged side to the outside and point with the positively charged end in the direction of the middle of the sphere. There, no longer discernible from the outside, a negatively charged ion can be, that is stuck, that no longer can escape and that gives the whole colloid a characteristic property. In this way nature knows various water colloids that constitute plants and animals. But starting at a temperature of 41°C the liquid crystals fall apart. This not by chance is the temperature at which a person dies. Already 10 millivolts per liquid crystal suffice for the electrically induced death.

The to a colloid identical structure we find in the structure of the atoms. Here the atomic nucleus is held in the inside of a vortex-like cloud of electrons, the atomic hull. We'll hit the phenomenon of transport a last time, when we derive the elementary particles. For the photon is already discernible the tendency of an elementary vortex, to take another vortex in its inside. Merely because the electron and positron are evenly matched a stable configuration is prevented for the photon.

<i>: Vitruvius Pollio, Marcus: Ten Books about architecture, WBG 1987

In chapter vortex calculation used differential operations:

field pointer (vector = **bold**):

$$\mathbf{A} = \mathbf{e}_x \cdot A_x + \mathbf{e}_y \cdot A_y + \mathbf{e}_z \cdot A_z$$

Gradient of the scalar function of position V:

$$\text{grad } V = \mathbf{e}_x \cdot \delta V/\delta x + \mathbf{e}_y \cdot \delta V/\delta y + \mathbf{e}_z \cdot \delta V/\delta z \quad \text{(R1)}$$

Divergence of the vector **A**:

$$\text{div } \mathbf{A} = \delta A_x/\delta x + \delta A_y/\delta y + \delta A_z/\delta z \quad \text{(R2)}$$

Curl (vortex density) of the vector **A**:

$$\begin{aligned} \text{rot } \mathbf{A} = \; & \mathbf{e}_x \cdot (\delta A_z/\delta y - \delta A_y/\delta z) + \\ & + \mathbf{e}_y \cdot (\delta A_x/\delta z - \delta A_z/\delta x) + \\ & + \mathbf{e}_z \cdot (\delta A_y/\delta x - \delta A_x/\delta y) \end{aligned} \quad \text{(R3)}$$

Laplace operator Δ:

$$\Delta \mathbf{A} = \delta^2\mathbf{A}/\delta x^2 + \delta^2\mathbf{A}/\delta y^2 + \delta^2\mathbf{A}/\delta z^2 \quad \text{(R4)}$$

arithmetic rules:

$$\Delta \mathbf{A} = \text{grad div } \mathbf{A} - \text{rot rot } \mathbf{A} \quad \text{(R5)}$$

$$\text{div rot } \mathbf{A} = O \quad \text{(R6)}$$

$$\mathbf{A} \times \mathbf{B} = -\mathbf{B} \times \mathbf{A} \quad \text{(R7)}$$

$$\text{div } (\mathbf{A} \times \mathbf{B}) = \mathbf{B} \text{ rot } \mathbf{A} - \mathbf{A} \text{ rot } \mathbf{B} \quad \text{(R8)}$$

$$\text{rot } (\mathbf{A} \times \mathbf{B}) = (\mathbf{B} \text{ grad})\mathbf{A} - (\mathbf{A} \text{ grad})\mathbf{B} + \mathbf{A} \text{ div } \mathbf{B} - \mathbf{B} \text{ div } \mathbf{A} \quad \text{(R9)}$$

$$\mathbf{A} \times (\mathbf{B} \times \mathbf{C}) = \mathbf{B} \cdot (\mathbf{A} \cdot \mathbf{C}) - \mathbf{C} \cdot (\mathbf{A} \cdot \mathbf{B}) \quad \text{(R10)}$$

* <u>important equations</u> are given in a box
* <u>new equations</u> are underlined twice.

Fig. 5.0: Collection of formulas for vector analysis

5. Derivation and interpretation

Vortices cause big problems to every measuring technician. They have the unpleasant property to whirl around the sensor even if it is as small as possible. Vortices avoid the smallest disturbance and then can hardly be detected reproducibly.

From the well-known eddy current we know of this problematic. Instead of the vortex, we are forced to measure and analyse any effects that arise from the vortex. These can be measurements of the eddy losses or effects back on the stimulating field. But only provided that the effect actually occurs.
The prerequisite for an increase in temperature by eddy losses is that the vortex falls apart. In an ideal medium it unfortunately will not do us this pleasure.

As vrtex of the dielectric the potential vortex will find fairly ideal conditions in air or in water. How should a vortex be detected, if it does not produce any effect? The classical measuring technique is here at its wits' end.

From the duality to the well-known eddy current and by means of observation in the previous chapters numerous properties of the potential vortex have been derived. But these are not all the properties. The mathematical calculation of the electric vortex field, that we want to turn to now, will reveal still further meaningful and highly interesting properties.

The observation is important, but it can't replace an exact calculation. A strictly mathematical derived result has occasionally more expressiveness than a whole book full of explanations. It will be a big help to derive and to discuss the field equation that all considerations are based on.

We facilitate the mathematical work by vector analysis. Therefore it is useful that we choose the differential form (equation 5.1 and 5.4) instead of the integral form (equations 3.1 and 3.2 resp. 3.8).

1. Ampère's law:

$$\text{rot}\,\mathbf{H} = \mathbf{j} + \delta\mathbf{D}/\delta t \tag{5.1}$$

with $\mathbf{H} = \mathbf{H}(\mathbf{r},t)$

and Ohm's law: $\mathbf{j} = \sigma \cdot \mathbf{E}$ (5.2)

dielectric displacement: $\mathbf{D} = \varepsilon \cdot \mathbf{E}$ (3.6)

relaxation time: $\tau_1 = \varepsilon/\sigma$ (5.3)

$$\boxed{\text{rot}\,\mathbf{H} = \varepsilon \cdot (\mathbf{E}/\tau_1 + \delta\mathbf{E}/\delta t)} \tag{5.1*}$$

2. Faraday's law of induction (extended according to duality rules)

$$-\text{rot}\,\mathbf{E} = \mathbf{B}/\tau_2 + \delta\mathbf{B}/\delta t \tag{5.4}$$

with $\mathbf{E} = \mathbf{E}(\mathbf{r},t)$

and the flux density: $\mathbf{B} = \mu \cdot \mathbf{H}$ (3.5)

$$\boxed{-\text{rot}\,\mathbf{E} = \mu \cdot (\mathbf{H}/\tau_2 + \delta\mathbf{H}/\delta t)} \tag{5.4*}$$

$$-\text{rot rot}\,\mathbf{E} = \mu \cdot (1/\tau_2) \cdot \text{rot}\,\mathbf{H} + \mu \cdot \delta(\text{rot}\,\mathbf{H})/\delta t \tag{5.5}$$

insert equation 5.1*:

$$-\text{rot rot}\,\mathbf{E} = \mu \cdot \varepsilon \cdot (\mathbf{E}/\tau_1\tau_2 + (1/\tau_2) \cdot \delta\mathbf{E}/\delta t + (1/\tau_1) \cdot \delta\mathbf{E}/\delta t + \delta^2\mathbf{E}/\delta t^2) \tag{5.5*}$$

$$-\text{rot rot}\,\mathbf{E} = \Delta\mathbf{E} - \text{grad div}\,\mathbf{E} = \Delta\mathbf{E}, \tag{R5}$$

if: $\text{div}\,\mathbf{E} = O$ (3.7*)

abbreviation: $\mu \cdot \varepsilon = 1/c^2$ (5.6)

3. fundamental field equation:

$$\underbrace{\Delta\mathbf{E}\cdot c^2}_{a} = \underbrace{\delta^2\mathbf{E}/\delta t^2}_{b} + \underbrace{(1/\tau_1)\cdot\delta\mathbf{E}/\delta t}_{c} + \underbrace{(1/\tau_2)\cdot\delta\mathbf{E}/\delta t}_{d} + \underbrace{\mathbf{E}/\tau_1\tau_2}_{e} \tag{5.7}$$

Fig. 5.1: Derivation of the fundamental field equation.

5.1 Fundamental field equation

We'll start from Ampere's law which provides a value for the current density at any point pace and this value corresponds to the vortex density of the magnetic field strength

$$\text{rot}\,\mathbf{H} = \mathbf{j} + \delta\mathbf{D}/\delta t \qquad (5.1)$$

We'll use Ohm's law: $\mathbf{j} = \sigma \cdot \mathbf{E}$, (5.2)

the dielectric displacement: $\mathbf{D} = \varepsilon \cdot \mathbf{E}$ (3.6)

and the relaxation time: $\tau_1 = \varepsilon/\sigma$, (5.3)

that indicates how fast the current eddies decay. So far we can fall back upon well-known relations.

The result is:

$$\boxed{\text{rot}\,\mathbf{H} = \varepsilon \cdot (\mathbf{E}/\tau_1 + \delta\mathbf{E}/\delta t)} \qquad (5.1^*)$$

The new electric field vortices demand the introduction of a corresponding time constant tau_2 that should describe the decay of the potential vortices, as an extension. The extended Faraday law of induction now provides a potential density, that at any point of space corresponds to the vortex density of the electric field strength:

$$-\text{rot}\,\mathbf{E} = \mathbf{B}/\tau_2 + \delta\mathbf{B}/\delta t \qquad (5.4)$$

with the flux density $\mathbf{B} = \mu \cdot \mathbf{H}$. (3.5)

The result fulfils the required duality to equation 5.1*:

$$\boxed{-\text{rot}\,\mathbf{E} = \mu \cdot (\mathbf{H}/\tau_2 + \delta\mathbf{H}/\delta t)} \qquad (5.4^*)$$

If we again apply the curl to equation 5.4*

$$-\text{rot rot}\,\mathbf{E} = \mu \cdot (1/\tau_2) \cdot \text{rot}\,\mathbf{H} + \mu \cdot \delta(\text{rot}\,\mathbf{H})/\,\delta t \qquad (5.5)$$

and insert equation 5.1*, we obtain:

$$-\text{rot rot}\,\mathbf{E} = \mu \cdot \varepsilon \cdot (\mathbf{E}/\tau_1\tau_2 + (1/\tau_2) \cdot \delta\mathbf{E}/\delta t + (1/\tau_1) \cdot \delta\mathbf{E}/\delta t + \delta^2\mathbf{E}/\delta t^2) \qquad (5.5^*)$$

which according to the rules of vector analysis can still be further simplified: = rot rot E = $\Delta\mathbf{E}$ - grad div E , where we should remember that the divergence has to vanish (div E = O. fig. 3.2, equation 3.7), should the corresponding field vortex be inserted!

Furthermore the following well-known abbreviation can be inserted: $\mu \cdot \varepsilon = 1/c^2$ (5.6)

With that the relation with the speed of light c simplifies to the sought-for field equation:

$$\boxed{\underbrace{\Delta\mathbf{E} \cdot c^2}_{a} = \underbrace{\delta^2\mathbf{E}/\delta t^2}_{b} + \underbrace{(1/\tau_1) \cdot \delta\mathbf{E}/\delta t}_{c} + \underbrace{(1/\tau_2) \cdot \delta\mathbf{E}/\delta t}_{d} + \underbrace{\mathbf{E}/\tau_1\tau_2}_{e}} \qquad (5.7)$$

This equation describes the spatial (a) and temporal (b, c, d) distribution of a field vector. It describes the electromagnetic wave (a, b) with the influences that act damping. As dumping terms the well-known eddy current (c) and in addition the newly introduced potential vortex (d) appear.

Field vector: ψ = E, H, j, B or D

1. elliptic potential equation:
(stationary: $t \longrightarrow \infty$ resp. $\delta/\delta t = O$)

$$\underbrace{\Delta\psi \cdot c^2}_{a} = \underbrace{\psi/\tau_1\tau_2}_{e}$$

(5.8)

2. hyperbolic equation:
(undamped wave equation)

$$\underbrace{\Delta\psi \cdot c^2}_{a} = \underbrace{\delta^2\psi/\delta t^2}_{b}$$

(5.9)

3. parabolic equation:
(vortex equation)

$$\underbrace{\Delta\psi \cdot c^2}_{a} = \underbrace{(1/\tau) \cdot \delta\psi/\delta t}_{c/d}$$

(5.10)

decay time of the eddy currents = relaxation time: $\tau_1 = \varepsilon/\sigma$ (5.3)

decay time of the potential vortices = relaxation time: $\tau_2 \sim \mu \cdot \sigma$ (5.11)

Fig. 5.2: mathematically divisible individual cases.

5.2 Mathematical interpretation of the fundamental field equation

Every specialist will be surprised to find the Poisson equation (a, e) again as a term in the wave equation. This circumstance forces a completely new interpretation of stationary fields upon us. The new damping term, that is formed by the potential vortices (d), is standing in between.

Let us start with a mathematical analysis. We have applied the curl to equation 5.4*, then inserted equation 5.1* and obtained a determining equation for the electric field strength E. Of course we could as well have applied the curl to equation 5.1* and inserted equation 5.4*. This would have resulted in the determining equation for the magnetic field strength H.

If we insert Ohm's law (5.2) and cancel down the specific conductivity, or we put in the relations of material (3.5) or (3.6) and cancel down by u respectively ε, then the field equation can likewise be written down for the current density j, for the induction B or for the dielectric displacement D.

It just is phenomenal that at all events equation 5.7 doesn't change its form at all. The field vector is thus arbitrarily interchangeable! This circumstance is the foundation for the claim of this field equation to be called fundamental.

It does make sense to introduce a neutral descriptive vector ψ as a substitute for the possible field factors E, H, j, B or D.

The fundamental field equation 5.7 consists of three different types of partial differential equations: a hyperbolic (b), a parabolic (c and d) and an elliptic (e) type. On the left-hand side each time the Laplace operator (a) is found which describes the spatial distribution of the field factor.

The potential equation of the elliptic type (e) is known as Poisson equation. It describes the stationary borderline case of a worn off temporal process ($t \rightarrow \infty$, resp. $\delta/\delta t = O$).

With this equation potentials and voltages can be calculated exactly like stationary electric currents (5.8).

The hyperbolic equation (b). known as wave equation, shows a second derivative to time. which expresses an invariance with regard to time reversal; or stated otherwise: the direction of the time axis can be reversed by a change of sign of t, without this having an influence on the course of frequency. Wave processes hence are reversible. Equation 5.7 makes clear that a wave without damping by no means can exist in nature. For that both time constants (τ_1 and τ_2) would have to have an infinite value, which is not realizable in practice. Seen purely theoretical, undamped waves could withdraw themselves from our measuring technique (5.9).

Both vortex equations of the parabolic type (c and d) only show a first derivative to time. With that they are no longer invariant with regard to time reversal. The processes of the formation and the decay of vortices, the so-called diffusion, are as a consequence irreversible. Seen this way it is understandable that the process of falling apart of the vortex, where the vortex releases its stored energy as heat e.g. in form of eddy losses, can not take place in reverse. This irreversible process of diffusion in the strict thermodynamic sense increases the entropy of the system (5.10).

Because it poses an useful simplification for mathematical calculations, often the different types of equations are treated isolated from each other. But the physical reality looks different.

field vector: ψ = E, H, j, B or D

1. Borderline case: no conductivity (vacuum)
   (σ = O; $1/\tau_1 = \sigma/\varepsilon$ = O):

$$\underbrace{\Delta\psi \cdot c^2}_{a} = \underbrace{\delta^2\psi/\delta t^2}_{b} + \underbrace{(1/\tau_2)\cdot \delta\psi/\delta t}_{d}$$

(5.12)

(damping by potential vortices)

2. Borderline case: ideal conductivity (superconductor)
   ($1/\sigma$ = O; $1/\tau_2$ = O):

$$\underbrace{\Delta\psi \cdot c^2}_{a} = \underbrace{\delta^2\psi/\delta t^2}_{b} + \underbrace{(1/\tau_1) \cdot \delta\psi/\delta t}_{c}$$

(5.12*)

(damping by eddy currents)

3. Diffusion equation

$$\underbrace{\Delta\psi \cdot c^2}_{a} = \underbrace{(1/\tau) \cdot \delta\psi/\delta t}_{c/d} + \underbrace{\psi/\tau_1\tau_2}_{e}$$

(5.12**)

(vortex)

Fig. 5.3: Two borderline cases of the damping of waves and
the diffusion equation for the decay of vortices

5.3 Physical interpretation of the fundamental field equation

In nature the different types of equations always occur in a combined manner.

1. Let's take the concrete case of the particle-free vacuum. Here the specific conductivity is zero. The relaxation time constant $\tau_1 = \varepsilon/\sigma$ responsible for the decay of vortices tends towards infinity according to equation 5.3 and the terms (c) and (e) are cancelled from the field equation 5.7. What remains is the by potential vortices (d) damped wave equation (b) (equation 5.12).

2. The reversed case (with $\tau_2 \longrightarrow \infty$) will consequently occur in materials without resistance, super conducting materials. We now are dealing with the well-known case of the wave damped by eddy currents (equation 5.12*).

Virtually all in nature existing materials however don't fulfil these boundary conditions, from which it follows that both damping terms always occur together and in addition the stationary term (e) becomes active.
It is true that every antenna demonstrates that the electromagnetic wave is convertible in high-frequency alternating currents and voltages, which then are amplified in the receiver. But until this fundamental equation was written down it however was not understood that this transition takes place by means of a vortex. Used are either antennas from well conducting material, or wave guides and horn radiators, which only have a minimal conductivity, because they are filled with air. Actually the wave can be converted in two dual ways; by means of the rolling up to current eddies or to potential vortices (fig. 1.4). Now we finally are capable to explain, why wave guides make possible a better degree of effectiveness: Owing to the concentration effect of the potential vortex the HF-power is bound in the inside and not emitted until the antenna is reached as happens for a wire for reason of the skin effect.
Therefore, physically, one has to imagine this relation, which describes the transition of an electromagnetic wave into a vortex, in the way that the wave spontaneously can roll up to a vortex in case it is disturbed from the outside. The more vortices are generated, the larger consequently is the damping of the wave (equations 5.12 and 5.12*).

3. The life span of the vortices is limited and is determined by the electric conductivity. The at first stored vortices decay with their respective time constant τ. This process is described by the diffusion equation 5.12**. The final stage of the decaying vortices finally is described by the Poisson equation (a, e: equation 5.8).

If the vortex falls apart, it converts the in the vortex stored energy in heat. These processes are known from the eddy current. We speak of heating losses, that the stationary currents cause in the conductor material.
But new is the concept that such vortex phenomena can occur as dielectric losses in capacitors or in the air. The microwave oven or induction welding are good examples of this.

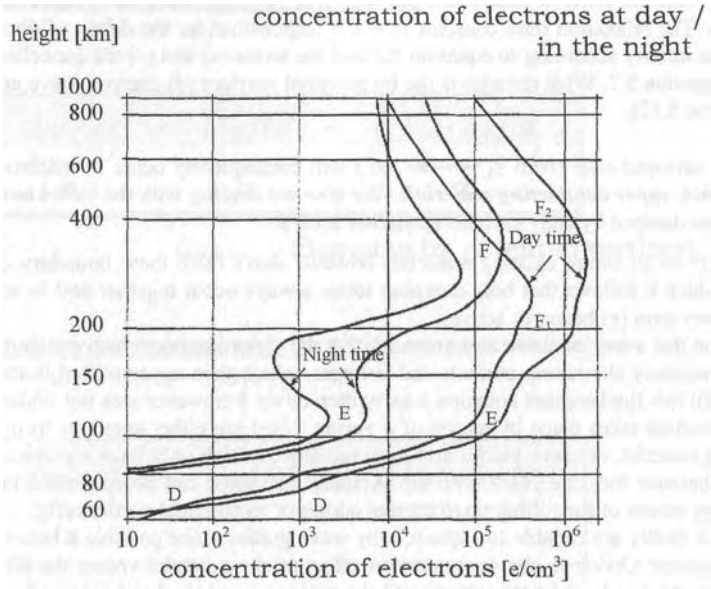

Fig. 5.4: The dependency on height of the ionisation in the ionosphere for medium latitudes .<i>

left curve: for a minimum of sun spots

right curve: for a maximum of sun spots

<i>: H.L. Konig: Unsichtbare Umwelt (Wetterfuhligkeit), 5. Aufl., Bild 6, Seite 11, Verlag Moos & Partner Milnchen, ISBN 3-89164-058-7

5.4 Phenomenological interpretation of the fundamental field equation

How does a damping by vortices take effect in practice? First of all we notice that the reception of broadcastings gets worse. "The information signal is neglectable regarding the noise" explains the radio engineer and means, the number of vortices increases at the expense of the wave intensity.
Why, does the pupil ask, is it so cold in space? There the sun shines day and night and in addition much more intensely than on earth! The correct answer would have to read that because of the extremely small conductivity no diffusion process can take place. We owe the warmth on our earth solely the here taking place decay of vortices. Responsible is the conductivity of the atmosphere.
In 60 km to 500 km height over the earth's surface, the region which is called the ionosphere, the gases predominantly exist in ionized form. There a very good conductivity prevails and eddy current losses are the result. Correspondingly high are the measurable temperatures. Besides the diffusion process the eddy currents carry out a damping of the cosmic radiation. We say the sunlight is filtered and reduced to a for nature bearable intensity.
But not all frequencies are damped in the same way (fig. 2.8). We observe a blue shift, if we look into the actually black sky. The blue sky doesn't show any spots or clouds. The reason is to be sought in the skin effect of the eddy currents, which strive outwards. Since no edge of a conductor is present here, no skin can form. The vortices spread evenly over the ionosphere.
The potential vortex however is able to structure. It merely needs a bad conductivity and this it finds in lower heights between 1 km and 10 km. It damps the wave and with that also the light, for which reason we say it becomes darker, the sun disappears behind clouds.

The clouds well visibly form the discussed vortex balls and vortex strings. Clouds can form virtually from the nowhere during intense solar irradiation, i.e. the waves can roll up to vortices. But as a rule this takes place above the oceans. Here also the phenomenon of transport has an effect. Because of the high dielectricity the water surface favours the formation of potential vortices. So the vortices bind individual water molecules and carry them away. If a diffusion process takes place, in which the vortex decays, then it rains. This can happen in two different ways:
1. Either the conductivity increases. If for instance during intense solar irradiation air ions form, the sun is able to break up clouds and fog. Or when the air is raised in higher layers with better conductivity, because a mountain forces this, then it rains at the mountain edge.
2. For potcntial vortices the electric field is standing perpendicular to them. If at one point an exceptionally lot of vortices join together, which let the cloud appear particularly dark to black, then the danger exists that the ionization field strength for air is reached, in which case a conductive air channel forms along which the stored up charges discharge. Also lightning is a diffusion process, in which potential vortices decay and rain can form.
In connection with the electromagnetic environmental compatibility great importance is attributed in particular to the storage and the decay of electric vortices. There not only is an academic-scientific interest in the question, how many potential vortices are generated, how many are stored and how many decay, if we make a telephone call with a handy, if we are staying under a high-tension line or if we are eating food, which has been heated up in a microwave oven. The necessary mathematical description is provided by the fundamental field equation 5.7.

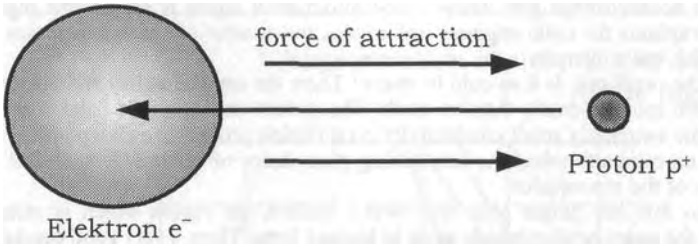

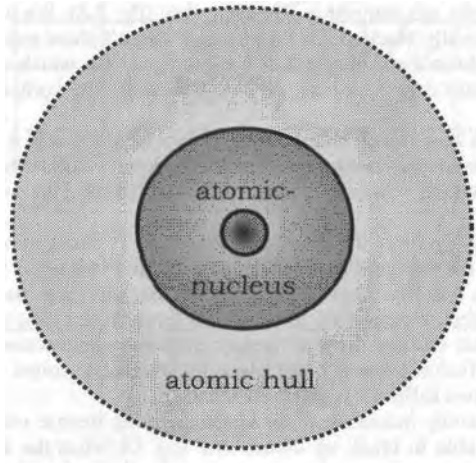

Fig. 5.5: The structure of atoms in the view of the fundamental field equation

condition for equilibrium: $\tau_1 = \tau_2$ (5.13)

5.5 Atomistic interpretation of the fundamental field equation

Let's again turn to the smaller, the atomistic dimensions. Here positively charged protons and negatively charged electrons are found. Both are matter particles and that means that seen from the outside both have the identical swirl direction. For reason of the unequal charge conditions they attract each other mutually and according to fig. 4.9 rotate around a common centre of mass as differently heavy pair. Chemists say: "the light electron orbits the heavy atomic nucleus". With small balls they try to explain the atomic structure.
But the model is no good: it contradicts causality in the most elementary manner. We are dealing with the problem that according to the laws of electrodynamics a centripetally accelerated electron should emit electromagnetic waves and continuously lose energy, to eventually plunge into the nucleus.
Our experience teaches that this fortunately is not true - and Niels Bohr in order to save his model of the atom was forced to annul the laws of physics with a postulate founded in arbitrariness.
Actually this state only exists for a very short time and then something unbelievable happens: the electron can't be distinguished as an individual particle anymore. "It is smeared over the electron orbit" do certain people say; "it possesses a dual nature" says Heisenberg. Besides the corpuscular nature the electron should in case of its "second nature" form a matter wave, "the position of the electron is to be looked at as a resonance which is the maximum of a probability density", do explain us de Broglie and Schrodinger.

These explanations can hardly convince. If the electron loses its particle nature in its second nature, then it also will lose its typical properties, like for instance its mass and its charge. but this is not the case.
THE vortex theory provides clear and causal answers: if the electron were a ball it continuosly would lose energy, therefore another configuration forms that does not know this problem. Here the phenomenon of transport takes an effect. The electron opens its vortex centre and takes the tiny protons and neutrons as atomic nucleus up into itself. The Bohr electron orbit with that is not a path anymore, but is occupied by the whole particle as spherical shell. This is confirmed by the not understood measurements exactly like the photos of individual atoms with the scanning electron microscope.
But now an electron does in its inside have the opposite swirl direction as the proton seen from the outside. As a consequence a force of repulsion will occur, which can be interpreted as the to the outside directed current eddy, the force of attraction for reason of the opposite charge works in the opposite direction and can be interpreted as the potential vortex effect.
If both vortices are equally powerful: $\tau_1 = \tau_2$ (5.13)
or if both forces are balanced, as one usually would say, then the object which we call an atom is in a stable state.
It probably will be a result of the incompatible swirl direction, why a very big distance results, if the electron becomes an enveloping electron. On such a shell not too many electrons have room. Because of the rotation of their own, the electron spin, they form a magnetic dipole moment, which leads to a magnetic attraction of two electrons if they put their spin axis antiparallelly.
As a "frictionless" against one another rotating pair they form two half-shells of a sphere and with that occupy the innermost shell in the hull of an atom. If the positive charge of the nucleus is still not balanced with that, then other electrons is left only the possibility to form another shell. Now this next electron takes the whole object up into itself. The new shell lies further on the outside and naturally offers room to more as only two vortices.

approach:

$$\boxed{\mathbf{E}\,(\mathbf{r},t) = \psi\,(\mathbf{r},t)\cdot e^{-\omega t}} \tag{5.17}$$

with

$$\omega = 1/\tau = (1/\tau_1 + 1/\tau_2)/2 \tag{5.18}$$

we insert the approach 5.17 and its derivations:

$$\delta\mathbf{E}/\delta t = -\,\omega\cdot\psi\cdot e^{-\omega t} + (\delta\psi/\delta t)\cdot e^{-\omega t} \tag{5.17*}$$

$$\delta^2\mathbf{E}/\delta t^2 = \omega^2\cdot\psi\cdot e^{-\omega t} - 2\omega\cdot(\delta\psi/\delta t)\cdot e^{-\omega t} + (\delta^2\psi/\delta t^2)\cdot e^{-\omega t} \tag{5.17**}$$

into the fundamental field equation 5.7:

$$\boxed{\Delta\mathbf{E}\cdot c^2 = \delta^2\mathbf{E}/\delta t^2 + (1/\tau_1)\cdot\delta\mathbf{E}/\delta t + (1/\tau_2)\cdot\delta\mathbf{E}/\delta t + \mathbf{E}/\tau_1\tau_2}$$

and divide by $e^{-\omega t}$:

$$\begin{aligned}\Delta\psi\cdot c^2 = {} & \psi/\tau_1\tau_2 && \text{(a) = (e)}\\ & -\,\omega\cdot\psi\cdot(1/\tau_1 + 1/\tau_2) && \text{(c, d)}\\ & +\,(1/\tau_1 + 1/\tau_2)\cdot\delta\psi/\delta t && \text{(c, d)}\\ & +\,\omega^2\cdot\psi - 2\omega\delta\psi/\delta t + \delta^2\psi/\delta t^2 && \text{(b)}\end{aligned} \tag{5.19}$$

insert the frequency according to equation 5.18:

$$\begin{aligned}\Delta\psi\cdot c^2 = {} & \psi/\tau_1\tau_2 && \text{(a) = (e)}\\ & -\,(\psi/2)\cdot(1/\tau_1 + 1/\tau_2)^2 && \text{(c, d)}\\ & +\,(1/\tau_1 + 1/\tau_2)\cdot\delta\psi/\delta t && \text{(c, d)}\\ & +\,(\psi/4)\cdot(1/\tau_1 + 1/\tau_2)^2 && \text{(b)}\\ & -\,(1/\tau_1 + 1/\tau_2)\cdot\delta\psi/\delta t + \delta^2\psi/\delta t^2 && \text{(b)}\end{aligned} \tag{5.19*}$$

summarized with equation 5.18:

$$\boxed{\Delta\psi\cdot c^2 = \psi/\tau_1\tau_2 - \omega^2\cdot\psi + \delta^2\psi/\delta t^2} \tag{5.20}$$

Fig. 5.6: Derivation of the Klein-Gordon equation (5.20) from the fundamental field equation (5.7)

5.6 Derivation of the Klein-Gordon equation

The valid model of the atom today still raises problems of causality, as has been explained. An improvement was provided by an equation, which was proposed by the mathematician Schrodinger 1926 as a model description. This equation in this way missed the physical root, but it nevertheless got international acknowledgment, because it could be confirmed experimentally. Looking backwards from the result then the physical interpretation of the probability density of the resonance of the waves could be pushed afterwards.

$$i \cdot \hbar \cdot \delta\psi/\delta t = U \cdot \psi - (\hbar^2/2\,m) \cdot \Delta\psi \quad (5.14)$$

The Schrodinger equation is valid for matter fields (of mass m), while the interaction with a outside force field the energy U indicates. It can be won from a wave equation by conversion, which possibly is the reason why it usually is called a wave equation, although in reality it is a diffusion equation, so a vortex equation!
For the derivation Schrodinger gives the approach of a harmonic oscillation for the complex wave function ψ:

$$\boxed{\psi(\mathbf{r},t) = \phi(\mathbf{r}) \cdot e^{-i\omega t}} \quad (5.15)$$

if the entire time dependency can be described by one frequency $f = W/h$ (de-Broglie relation): $\omega = 2\pi f = W \cdot 2\pi/h = W/\hbar$ (5.16)

The high-put goal is: if the structure of the atom is determined by the fundamental field equation 5.7 then one should be able to derive the experimentally secured Schrodinger equation and to mathematically describe the discussed special case. Also we select at first an approach periodic in time:

$$\boxed{\mathbf{E}\,(\mathbf{r},t) = \psi(\mathbf{r},t) \cdot e^{-\omega t}} \quad (5.17)$$

with $\omega = 1/\tau = (1/\tau_1 + 1/\tau_2)/2$. (5.18)

We insert the approach 5.17 and its derivations into the field equation 5.7 and divide by the damping term e^{-wt}:

$$\Delta\psi \cdot c^2 = \psi/\tau_1\tau_2 - \omega \cdot \psi \cdot (1/\tau_1 + 1/\tau_2) + (1/\tau_1 + 1/\tau_2) \cdot (\delta\psi/\delta t) + \\ + \omega^2 \cdot \psi - 2\,\omega\,\delta\psi/\delta t + \delta^2\psi/\delta t^2 \quad (5.19)$$

If as the next step the angular frequency according to equation 5.18 is inserted, then summarized the provisional intermediate result results:

$$\boxed{\Delta\psi \cdot c^2 = \psi/\tau_1\tau_2 - \omega^2 \cdot \psi + \delta^2\psi/\delta t^2} \quad (5.20)$$

The derived equation 5.20 represents formally seen the Klein-Gordon equation, which is used for the description of matter waves in quantum mechanics and which particularly in the quantum field theory (e.g. mesons) plays an important role. Even if it often is regarded as the relativistic invariant generalization of the Schrodinger equation, it at a closer look is incompatible with this equation and as "genuine" wave equation it is not capable of treating vortex problems correctly, like e.g. the with the Schrodinger equation calculable quantization of our microcosm.

$$\boxed{\text{Schrödinger approach} \quad \psi(\mathbf{r},t) = \phi(\mathbf{r}) \cdot e^{-i\omega t}} \tag{5.15}$$

with: f = W/h; de-Broglie relation:

$$\omega = 2\pi f = W \cdot 2\pi/h = W/\hbar \tag{5.16}$$

the derivation:

$$\delta\psi/\delta t = -i\,\omega \cdot \psi$$

rewritten for ψ:

$$\psi = (i/\omega) \cdot \delta\psi/\delta t \tag{5.21}$$

2. derivation:

$$\delta^2\psi/\delta t^2 = -i\,\omega \cdot \delta\psi/\delta t \tag{5.22}$$

inserted in equation 5.20:

$$\boxed{\Delta\psi \cdot c^2 = \psi/\tau_1\tau_2 - 2\,i\,\omega \cdot \delta\psi/\delta t} \tag{5.23}$$

= sought-for Schrödinger equation (usual notation):

$$\boxed{i \cdot \hbar \cdot \delta\psi/\delta t = U \cdot \psi - (\hbar^2/2m) \cdot \Delta\psi} \tag{5.14}$$

comparison of coefficients is needed:
Einstein relation (with the speed of light c):

with (5.16): $$W = m \cdot c^2 = \omega \cdot \hbar \tag{5.24}$$

coefficient of the imaginary part: $$-2\,i\,\omega = 2(\omega/i) = 2mc^2/i\hbar \tag{5.25}$$

comparison of coefficients for the real part: $$\boxed{1/\tau_1\tau_2 c^2 \overset{!}{=} U \cdot 2m/\hbar^2} \tag{5.26}$$

kinetic energy of a particle moving with the speed v:

$$\tfrac{1}{2} \cdot m \cdot v^2 = W - U \tag{5.27}$$

v = group velocity of the matter wave:

$$v = hf/mc = \hbar\,\omega/mc \tag{5.28}$$

Eq.5.27: $$U = W - \tfrac{1}{2} \cdot m \cdot (\hbar\,\omega/mc)^2 \tag{5.27*}$$

Eq.5.24: $W = \omega \cdot \hbar$; $(\hbar\,\omega/mc) = c$; resp.: $m/\hbar = \omega/c^2$

In eq.5.27* the sought-for coefficient reads (according to eq. 5.26):

$$U \cdot 2m/\hbar^2 = 2\omega/c^2\hbar \cdot [\omega \cdot \hbar - \tfrac{1}{2} \cdot m \cdot c^2]$$

$$= 2\omega/c^2\hbar \cdot [\omega \cdot \hbar - \tfrac{1}{2} \cdot \omega \cdot \hbar] = \underline{\underline{(\omega/c)^2}} \tag{5.29}$$

Fig. 5.7: Derivation of the time dependent Schrodinger equation

5.7 Derivation of the time dependent Schrodinger equation

With the Schrodinger approach 5.15 and its derivations the derivation is continued:

$$\boxed{\psi(\mathbf{r},t) = \phi(\mathbf{r}) \cdot e^{-i\omega t}}\ , \qquad (5.15)$$

$$\delta\psi/\delta t = -i\omega \cdot \psi\,, \quad \text{bzw.} \quad \psi = (i/\omega) \cdot \delta\psi/\delta t \qquad (5.21)$$

$$\delta^2\psi/\delta t^2 = -i\omega \cdot \delta\psi/\delta t \qquad (5.22)$$

The for a harmonic oscillation won relations according to equation 5.21 and 5.22 are now inserted into equation 5.20:

$$\boxed{\Delta\psi \cdot c^2 = \psi/\tau_1\tau_2 - 2i\omega \cdot \delta\psi/\delta t}$$

This is already the sought-for Schrodinger equation, as we will see in a moment, when we have analysed the coefficients. Because, besides equation 5.16 for the total energy W, also the Einstein relation is valid (with the speed of light c):

$$W = m \cdot c^2 = \omega \cdot \hbar\ , \quad (5.24)$$

we can replace the coefficients of the imaginary part by:

$$2(\omega/i) = 2mc^2/i\hbar \quad (5.25)$$

To achieve that equation 5.23, as required, follows from the Schrodinger equation 5.14, a comparison of coefficients is carried out for the real part:

$$\boxed{1/\tau_1\tau_2 c^2 \overset{!}{=} U \cdot 2m/\hbar^2} \quad (5.26)$$

If thc kinetic energy of a particle moving with the speed v is:

$$\tfrac{1}{2} \cdot m \cdot v^2 = W - U\ , \quad (5.27)$$

then acccording to De Broglie this particle has the wavelength h/mv. The consideration of the particle as matter wave demands an agreement with the wave length c/f of an electro-magnetic wave (with the phase velocity c). The particle hence has the speed v, which corresponds with the group velocity of the matter wave:

$$v = hf/mc = \hbar\omega/mc\ , \qquad (5.28)$$

if we insert v into equation 5.27 :

$$U = W - \tfrac{1}{2} \cdot m \cdot (\hbar\omega/mc)^2 \quad (5.27^*)$$

According to equation 5.24 on the one hand the total energy is $W = w \bullet h$ and on the other hand the relation 5.28 gives $(\hbar\omega/mc) = c$ resp.: $m/\hbar = \omega/c^2$

Inserted into equation 5.27* the sought-for coefficient reads (according to eq. 5.26):

$$U \cdot 2m/\hbar^2 = 2\omega/c^2\hbar \cdot [\omega \cdot \hbar - \tfrac{1}{2} \cdot m \cdot c^2]$$

$$= 2\omega/c^2\hbar \cdot [\omega \cdot \hbar - \tfrac{1}{2} \cdot \omega \cdot \hbar] = \underline{(\omega/c)^2} \qquad (5.29)$$

comparison of coefficients 5.26 is fulfilled if:

$$1/\tau_1\tau_2 c^2 \overset{!}{=} U \cdot 2m/\hbar^2 = (\omega/c)^2 \tag{5.30}$$

the angular frequency is given by equation 5.18. Therefore has to be valid:

$$1/\tau_1\tau_2 \overset{!}{=} \tfrac{1}{4}\,(1/\tau_1 + 1/\tau_2)^2 \tag{5.31}$$

resp.:

$$\sqrt{1/\tau_1\tau_2} \overset{!}{=} \tfrac{1}{2}\,(1/\tau_1 + 1/\tau_2) \tag{5.32}$$

arithmetic average = geometric average, if:

$$1/\tau_1 = 1/\tau_2 \text{ and: } \boxed{\tau_1 = \tau_2} \tag{5.13}$$

is valid. Eq. 5.23 is divided by c^2 and
eqs. 5.30 and 5.25 are inserted:

$$\boxed{\Delta\psi = U \cdot \psi \cdot (2m/\hbar^2) + (2m/i\hbar) \cdot \delta\psi/\delta t} \tag{5.14*}$$

= *time dependent Schrödinger equation* 5.14.

replace $\delta\psi/\delta t$ acc. to eq. 5.21 with $\omega = W/\hbar$ acc.to eq. 5.24:

$$\Delta\psi = U \cdot \psi \cdot (2m/\hbar^2) + (2m/i\hbar) \cdot \psi \cdot (-i) \cdot W/\hbar \tag{5.33}$$

Schrödinger approach 5.15 for the function of position $\phi(\mathbf{r})$:

$$\Delta\phi = (U\,2m/\hbar^2 - W \cdot 2m/\hbar^2) \cdot \phi \tag{5.34}$$

$$\boxed{\Delta\phi = -2m/\hbar^2\,(W - U) \cdot \phi} \tag{5.35}$$

= *time independent Schrödinger equation.*

Fig. 5.8: Derivation of the time independent Schrodinger equation

5.8 Derivation of the time independent Schrodinger equation

The goal is reached if we are capable to fulfil the comparison of coefficients 5.26:

$$U \cdot 2m/\hbar^2 \overset{!}{=} (\omega/c)^2 = 1/\tau_1\tau_2 c^2 \qquad (5.30)$$

The angular frequency w is given by equation 5.18. Therefore has to be valid:

$$\tfrac{1}{4}\,(1/\tau_1 + 1/\tau_2)^2 \overset{!}{=} 1/\tau_1\tau_2 \qquad (5.31)$$

$$\tfrac{1}{2}\cdot(1/\tau_1 + 1/\tau_1) \overset{!}{=} \sqrt{1/\tau_1\tau_2} \qquad (5.32)$$

As is well-known the arithmetic and the geometric average only correspond in case the variables are identical. In this case, as already required in equation 5.13:

$$\tau_1 = \tau_2\,. \qquad (5.13)$$

has to hold.
From this we can draw the conclusion that the Schrodinger equation is just applicable to the described special case (according to eq. 5.13), in which the eddy current, which tries to increase the particle or its circular path and the potential vortex, which keeps the atoms together and also is responsible for the stability of the elementary particles, are of identical order of magnitude.

As a check equation 5.23 is divided by c^2 and equations 5.30 and 5.25 are inserted:

$$\boxed{\Delta\psi = U\cdot\psi\cdot(2m/\hbar^2) + (2m/i\hbar)\cdot\delta\psi/\delta t} \qquad (5.14^*)$$

This is the time dependent Schrodinger equation 5.14 resolved for $\Delta\psi$.

Next we replace $\delta\psi/\delta t$ according to equation 5.21 with $\omega = W/\hbar$ acc. to equation 5.24:

$$\Delta\psi = U\cdot\psi\cdot(2m/\hbar^2) + (2m/i\hbar)\cdot\psi\cdot(-i)\cdot W/\hbar \qquad (5.33)$$

If we separate the space variables $\phi(\mathbf{r})$ from time by the Schrodinger approach 5.15 we obtain:

$$\Delta\phi = (U\,2m/\hbar^2 - W\cdot 2m/\hbar^2)\cdot\phi \qquad (5.34)$$

This quation 5.34 for the function of space coordinates $\phi(\mathbf{r})$ is the time independent Schrodinger equation:

$$\boxed{\Delta\phi = -2m/\hbar^2\,(W-U)\cdot\phi} \qquad (5.35)$$

The solutions of this equation which fulfil all the conditions that can be asked of them (of finiteness, steadiness, uniqueness etc.), are called eigenfunctions. The existence of corresponding discrete values of the energy W, also called eigenvalues of the Schrodinger equation, are the mathematical reason for the different quantum postulates.

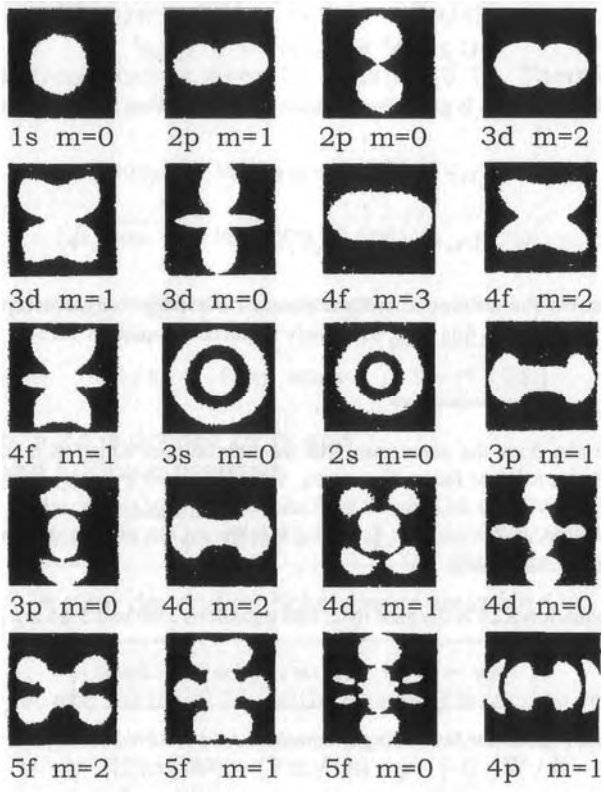

Fig. 5.9: Photographs of models of the probability densities for
different states of the hydrogen atom.
The densities are symmetrical if rotated around the vertical axis<i>

taken from:

<i>: U. Gradmann/H. Wolter: Grundlagen der Atomphysik, AVG, Frankfurt a. M. 1971, P. 190.

5.9 Interpretation of the Schrodinger equation

The interpretation of the Schrodinger equation is still disputed among physicists, because the concept of wave packets contradicts the corpuscular nature of the elementary particles. Further the difficulty is added that wave packets at a closer look never are connected, run apart more or less fast, and really nothing can hinder them doing that. But for a particle the connection represents a physical fact. Then there can be no talk of causality anymore. The monocausal division into two different levels of reality, in a space-timely localization and in an energetic description, does not represent a solution but rather the opposite, the abolition of the so-called dual nature. As has been shown, the potential vortex is able to achieve this with the help of its concentration effect.
But from the introduction of this new field phenomenon arises the necessity to interpret the causes for the calculable and with measuring techniques testable solutions of the Schrodinger equation in a new way. Laws of nature do not know a possibility to choose! If they have been accepted as correct, they necessarily have to be applied.

Three hundred years ago the scholars had an argument, whether a division of physical pheomena, like Newton had proposed it, would be allowed to afterwards investigate them in the laboratory individually and isolated from other influences or if one better should proceed in an integrated manner, like for instance Descartes with his cartesian vortex theory. He imagined the celestial bodies floating in ethereal vortices. One absolutely was aware that the whole had to be more than the sum of every single realizaton, but the since Demokrit discussed vortex idea had to make room for the overwhelming successes of the method of Newton. And this idea after 2100 years was stamped, to in the meantime almost have fallen into oblivion.
Today, where this recipe for success in many areas already hits the limits of the physical possibilities, we should remember the teachings of the ancients and take up again the vortex idea It of course is true that only details are calculable mathematically and that nature, the big whole, stays incalculable, wherein problems can be seen.
If we consider the fundamental field equation 5.7, we find confirmed that actually no mathematician is capable to give a generally valid solution for this four-dimensional partial differential equation. Only restrictive special cases for a harmonic excitation or for certain spatial boundary conditions are calculable. The derived Schrodinger equation is such a case and for us particularly interesting, because it is an eigenvalue equation. The eigenvalues describe in a mathematical manner the with measuring techniques testable structures of the potential vortex .
Other eigenvalue equations are also derivable, like the Klein-Gordon equation or the Lionville equation, which is applied successfully in chaos theories. So our view opens, if chaotic systems like turbulences can be calculated as special cases of the same field equation and should be derivable from this equation.
The in pictures recorded and published structures, which at night should have come into being in corn fields, often look like the eigenvalues of a corresponding equation. The ripe ears thereby lie in clean vortex structures flat on the soil. Possibly potential vortices have charged the ears to such high field strength values that they have been pulled to the soil by the Coulomb forces.

Consequences resulting from the derivation of the Schrodinger equation from the fundamental field equation 5.7:

1. *Any experiment which confirms the Schrödinger equation is with that able to confirm at the same time the existence of the newly discovered potential vortex and the correctness of the field-theoretical approach.*

2. *Properties of the atomic hull and of the atomic nucleus, which can be described with the Schrödinger equation, can as of now be interpreted as an electromagnetic phenomenon.*

3. *There exist no particles or wave packets from matter waves, but only configurations consisting of potential vortices and current eddies.*

4. *There exists no matter! What we call matter is nothing but an electromagnetic state of oscillation of empty space.*

The relation between the energy of oscillation and the mass is described by the relation named after Albert Einstein

$$E = mc^2 \quad . \qquad (6.1 = 5.24)$$

Fig. 6.1: Derivation of the Schrodinger equation, power of proof and consequences

6. Theory of objectivity

6.1 Proof

A new theory only has chances on acknowledgment if it is provable. For that physical phenomena in the sense of the new theory are calculated and independently of this experiments are being carried out. If the calculations are confirmed by reproducible measurement results, then with that the correctness of the approach is proven.
In the here presented case we have chosen the field-theoretical approach instead of the usual quantum physical approach. As a consequence of this we had found as a new phenomenon the vortex of the electric field. With regard to the normally used Maxwell theory this resulted in changed field equations in a dual formulation. If both equations, each of which describes a source-free vortex field, are inserted into each other the result is an only in time and space formulated, generally valid and hence fundamental field equation (5.7, fig. 5.1).
This equation has many special cases; one of them, the Schrodinger equation, could be derived by using an approach which was harmonic in time. We renounced to give special solutions of the Schrodinger equation, because these are printed in numerous text books. On the other hand experiments are known, which are capable to confirm the theoretical solutions and thus to prove the Schrodinger equation. The eigenvalues of the equation describe for instance the shell-shaped structure of the atoms with the by Niels Bohr given radii.
Now this already proven equation was derived from the new field-theoretical approach. Thus for the special case, the area where the Schrodinger equation is valid, the new theory can be said to be proven (fig. 6.1).
We still are not content with that and put another stone on top: we will calculate the quantum properties of the elementary particles for ourselves. These until now have only been measured. Today is merely sought for symmetries and for models of explanation, like e.g. the quark-hypothesis. From a calculation science is miles and miles away. We will compare the calculation results with the measurement values. Then everyone can check and compare for him or herself.
The conditions in an elementary particle are completely different. Here it concerns the vortex itself, whereas the model of the atom merely describes vortex properties, so-called actions at a distance. The differences in size and distances for an atom lie more than five powers of ten over those of a particle!
Here a new problem of causality comes to light, at which we now must have a critical look: the question of the by Einstein postulated constancy and universality of the speed of light. Seen from a relativistic and subjective point of view of an observer, Einstein by all means may be right. But may such a theory be generalized? How are the measurements concerning the speed of light and the relativity of space and time to be judged when looking at them objectively?
The current measurements of speeds faster than light speak a clear language and represent a challenge (fig. 3.1, violation of the principle of causality no. 5).

The electron as a spherical capacitor (see fig. 4.3):

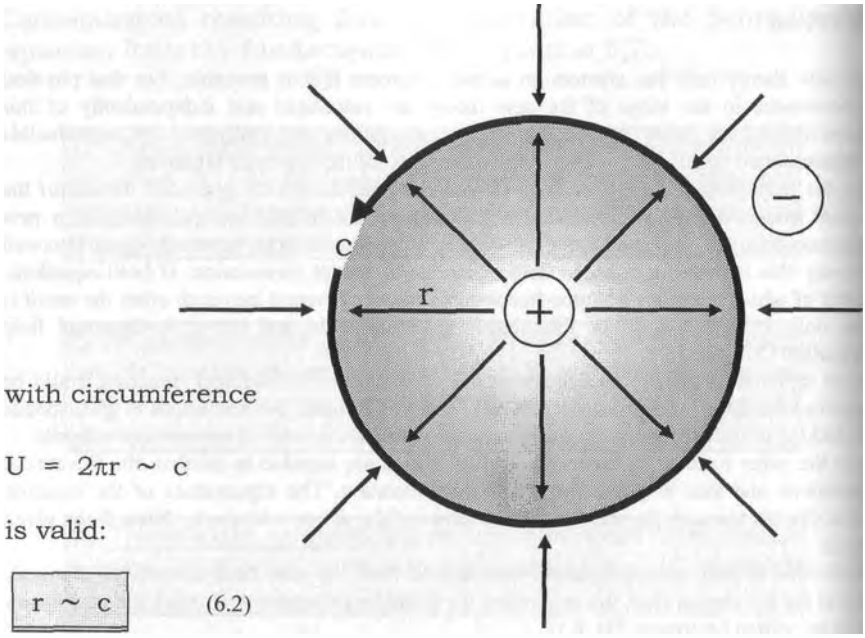

field theoretical approach (vortex particles):
The amount of energy bound in the inside of the particle is identical with the free and measurable amount of energy on the outside of the particle.

(If the number of particles is left unchanged): _____
In an isolated system the sum of the energy is constant _____

(particle = electromagnetic vortex) _____
Energy is a state description of electromagnetism.

Fig. 6.2: Derivation of the law of conservation of energy

6.2 Law of conservation of energy

Let the starting-point for our considerations be the electromagnetic wave in a particle-free vacuum. Here no vortices appear, so that the plane wave can propagate undamped with the speed of light, and in this way a transport of energy takes place. Electric and magnetic energy each are the same magnitude.
Let's now imagine the symmetry is disturbed as the wave is "slowed down" on one side. As a possible result the wave rolls up to a spherical vortex.
As we will see such a process is possible, for instance at impact on a strong field. Thus part of the energy is bound in the inside. This part from now on withdraws itself from every possibility to measure it. We can only measure the second part of the field energy, with which the particle interacts with its neighbourhood.
We can assume that:

The amount of energy bound in the inside of the particle is identical with the free and measurable amount of energy on the outside of the particle.

The same energy W_e = 0,51 MeV, we attribute to the electron for reason of its mass with the help of the Einstein relation (6.1), is also bound in its inside. This conclusion is also applicable to other elementary particles and with that to all matter.
We here again recognize the principle of the duality between the to the outside striving eddy current in the inside of the elementary vortex and the concentrating potential vortex on the outside. Thus also seen energetically both are of the same magnitude. Whereas in the case of the electromagnetic wave it concerns a symmetrical oscillation around "zero", by the process of quantization, by the rolling up to a spherical vortex, there forms an energetic state of space different from zero. The order of magnitude is determined by the number of elementary vortices, of which the particles and all matter consist.
Anti-matter forms the opposite energetic state and this again is for the particles of matter available in their inside in a bound form.
As long as we do not artificially produce new elementary vortices and thus keep the number of available vortices constant, the energetic state will not change, or as it is formulated in text books:

In an isolated system the sum of the energy is constant.

THE law of conservation of energy is not an axiom, but follows without compulsion from the vortex theory. It is not elementary, but a consistently derivable consequence of the field-theoretical approach, according to which solely the field acts as cause for all other physical phenomena, also for the conservation of energy! Because the cause of it is the electromagnetic field, the following has to hold:

Energy is a state description of electromagnetism.

Now we finally can explain why energy can be converted. Different forms of energy only are different forms of formation of the same phenomenon!
Of course this statement of the field-theoretical approach does not yet explain what, for instance, the temperature has to do with electromagnetism. I ask for some patience; no question will be left unanswered.

From

$$c \sim r \tag{6.2}$$

follows:

The speed of light determines the size of the elementary particles.

Energy of a capacitor:

$$W = Q^2/C, \tag{6.3}$$

written down for the electron (with the Einstein relation):

$$W_e = e^2/C_e = m_e c^2 = 0{,}51 \text{ MeV} \tag{6.1}$$

Capacity of a spherical capacitor:

$$C_e = \varepsilon_0 \cdot 4\pi r_e \tag{6.4}$$

"classical" radius of the electron<i> is:

$$r_e = e^2/\varepsilon_0 \cdot 4\pi \cdot W_e \tag{6.5}$$

$$r_e = 2{,}82 \cdot 10^{-15} \text{ m} \tag{6.6}$$

in the case of Kuchling<ii> the radius of the electron is:

$$r_e = 1{,}41 \cdot 10^{-15} \text{ m}. \tag{6.7}$$

Fig. 6.3: Calculation of the radius of the electron.

<i>: Mende, Simon: Physik, Gl. 10.39, VEB-Leipzig, 4. Aufl.

<ii>: Kuchling: Physik, Gl. At4, VEB-Leipzig, bis einschl. 11. Auflage 1974

6.3 Radius of the electron

For the crucial process, in which the electromagnetic wave rolls up to a vortex, it is for reasons of continuity to be expected that the velocity of propagation remains equal that thus for the vortex oscillation exactly like for the electromagnetic wave the speed of light is determining. The direction of propagation in the case of the vortex takes place perpcndicular to the in fig. 6.2 shown field direction of the electric field strength. Not even in that both field-phenomena differ.
Summarizing: the propagation takes place with the speed of light c along a circular path with the perimeter $U = 2\pi r$. Therefore holds:

$$c \sim r \quad (6.2)$$

According to this equation the radius and with that the size of the electron is determined by the speed of light. Therefore the question of the size of the electron is raised.

The energy interpretation predicts that for the theoretical case of a change of size the energy density in the inside of the particle is influenced that however the quantity of the included energy remains unchanged. We therefore can further proceed from the assumption that the bound amount of energy is independent of the size of the particle!

Consequently for the elementary quantum the energy W_e = 0,51 MeV is assumed, which it has acccording to the Einstein relation $W_e = m_e c^2$. For the electron of mass m_e the with measuring techniques determined value is inserted.
The spherical electrode of a spherical capacitor with the above given energy W_e (according to eq. 6.1) and the capacity C_e (according to equation 6.4, fig. 6.3) represents a very realistic model of the negatively charged particle.
In this manner the classical radius of the electron is calculated to be<i>: $r_e = 2{,}82 * 10^{-15}$ m.

But in the case of Kuchling it only is half this size<ii>, what according to equation 6.2 would mean that in the case of Kuchling the light would be on the way only half this fast <iii>. Therefore if one is careful, one prefers to be silent concerning this delicate theme and if one is honest, one admits not to know anything exact.
Not only the electron but also all the other elementary particles are according to the field-theoretical approach formed from concentrated potential vortices. For these equation 6.2 hence has to hold in the same manner, so that more generalized we can conclude:

The speed of light determines the size of the elementary particles.

This statement is incompatible with the assumption of a constant speed of light! Because then all elementary particles would have identical size. As is known, however, are the building parts of the atomic nucleus, the protons and neutrons very much smaller than individual electrons. The constancy of the speed of light is to be questioned. This question is of such an elementary importance that we are not content with these considerations and in addition undertake a mathematical derivation in the sense of the field approach.

<iii>: Difference = Thomas factor

The Maxwell laws, source free (figures 3.2 and 3.3):

$$\mathrm{Div}\,\mathbf{D} = O \quad (3.7) \qquad \text{and} \qquad \mathrm{Div}\,\mathbf{B} = O \quad (3.3)$$

Faraday's law of induction	and	Ampère's law
$\mathbf{E} = \mathbf{E}(\mathbf{r},t)$ with $1/\tau_2 = 0$:		$\mathbf{H} = \mathbf{H}(\mathbf{r},t)$ with $\mathbf{j} = 0$ resp. $1/\tau_1 = 0$
$\boxed{\mathrm{rot}\,\mathbf{E} = -\,\delta\mathbf{B}/\delta t}$ (5.4)		$\boxed{\mathrm{rot}\,\mathbf{H} = \delta\mathbf{D}/\delta t}$ (5.1)
with: $\mathbf{B} = \mu \cdot \mathbf{H}$ (5.5)	and	$\mathbf{D} = \varepsilon \cdot \mathbf{E}$ (3.6)

if we again apply the curl to equation 5.4 and insert equation 5.1 (cf. fig. 5.1, eq. 5.5):

$$-\,\mathrm{rot}\,\mathrm{rot}\,\mathbf{E} = \mu \cdot \delta(\mathrm{rot}\,\mathbf{H})/\delta t = \mu \cdot \varepsilon \cdot \delta^2\mathbf{E}/\delta t^2 \quad (5.5)$$

thanks to missing divergence: $\mathrm{div}\,\mathbf{E} = O$ (3.7*)
(fig. 5.2):

= wave equation: $\boxed{\Delta\,\mathbf{E} \cdot c^2 = \delta^2\mathbf{E}/\delta t^2}$ (5.9*)

with the speed of light c: $\mu \cdot \varepsilon = 1/c^2$ (5.6)

Hertz' wave = transverse wave = plane wave with:
direction of propagation: $\boxed{v = dx/dt}$ (6.8)

$\boxed{\mathbf{E} = E_z}$, $\boxed{\mathbf{D} = D_z}$, $\boxed{\mathbf{H} = H_y}$, $\boxed{\mathbf{B} = B_y}$ (6.8*)

curl operation (in y-direction): with equation 5.4:

$$\mathrm{rot}\,\mathbf{E} = -\,d\mathbf{E}/dx = -\,d\mathbf{B}/dt \quad (6.9)$$

with 6.8: $d\mathbf{E} = (dx/dt) \cdot d\mathbf{B} = v \cdot d\mathbf{B}$ (6.9*)

or generally: $\boxed{\mathbf{E} = \mathbf{v} \times \mathbf{B}}$ (6.10)

Fig. 6.4: Derivation of the laws of transformation

<i>: Prof. G. Bosse in his text book in reversed direction derives the Faraday law of induction from the law of transformation 6.10, which he again derives from considerations about the Lorentz force. G. Bosse, Grundlagen der Elektrotechnik II, BI 183, Hochschultaschenbucher-Verlag, Mannheim 1967

6.4 The Maxwell field equations

The laws of transformation of the electromagnetic field shall form the starting-point for the coming up considerations. To exclude any doubts with regard to the interpretation, the equations will be derived from the Maxwell laws under the assumption that no sources or charge carriers are present (fig. 3.2 and 3.3) and as a consequence no current density (j = 0) is to be expected. This corresponds to the vanishing of the time independent terms, which consequently are responsible for the occurring of force effects like e.g. the Lorentz force. Only at the end of this derivation we can understand the sense of this assumption (with $1/\tau_1 = 0$ and $1/\tau_2 = 0$). The procedure at first corresponds to that of fig. 5.1. Here the fundamental field equation had been derived from Faraday's law of induction and Ampere's law. With the assumptions made this time the in fig. 5.2 treated undamped wave equation is left (5.9, here 5.9*). Whom the derivation is still present can go in at this point.
In a sufficiently great distance from the source we are dealing with a plane wave, in which the field factors only depend on the direction of propagation x. The Hertz' wave is a transverse wave, in which the field pointers oscillate perpendicular to the direction of propagation and in addition stand perpendicular to each other:

$$v = dx/dt \quad (6.8), \qquad \mathbf{E} = E_z, \quad \mathbf{D} = D_z, \quad \mathbf{H} = H_y, \quad \mathbf{B} = B_y \quad (6.8^*)$$

The curl, applied to the electric field pointer, itself points in the y-direction:
rot E = - dE/dx . This for the transverse wave carried out curl operation is now compared with Faraday's law of induction (5.4):

$$\text{rot } E = -dE/dx = -dB/dt \qquad (6.9)$$

The relation won in a mathematical way, with the speed fixed by (6.8), reads:

$$dE = (dx/dt) \bullet dB = v * dB \qquad (6.9^*)$$

The result of this derivation at first only is valid for the introduced simplification, for instance for the case of the transverse electromagnetic wave. Better known is apart from that the generalized formulation, which among others by G. Bosse<i> is called law of transformation.

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} \qquad (6.10)$$

With Ampere's law (5.1) we now should proceed in an analogous manner. The result is:

$$\mathbf{H} = -\mathbf{v} \times \mathbf{D} \qquad (6.10^*)$$

This equation 6.10* is given among others by Simonyi<ii>. Now that we know, under which circumstances these equations of transformation can be derived from the Maxwell equations, the actual work can start.

<ii>: K. Simonyi, Theoretische Elektrotechnik, 7. Auflage VEB Verlag Berlin 1979. pp. 921 - 924; In addition see chapter 27.8 in part 3 of this book.

Laws of transformation:

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} = \mathbf{v} \times \mu \cdot \mathbf{H} \qquad (6.10)$$

$$\mathbf{H} = -\mathbf{v} \times \mathbf{D} = -\mathbf{v} \times \varepsilon \cdot \mathbf{E} \qquad (6.10^*)$$

and

We experience the magnetic field as an electric field and the electric field as a magnetic field simply and solely for reason of the same relative motion!

The component of the direction of motion perpendicular to the area defined by the field pointers:

$$E = v \cdot \mu \cdot H \qquad (6.11)$$

and

$$H = -v \cdot \varepsilon \cdot E \qquad (6.11^*)$$

with the relations of material:

$$B = \mu \cdot H \qquad (3.5)$$

$$D = \varepsilon \cdot E \qquad (3.6)$$

with the speed of light:

$$c = 1/\sqrt{\mu \cdot \varepsilon} \qquad (5.6)$$

additional field:

$$E_z = -v^2 \cdot \mu \cdot \varepsilon \cdot E = -(v^2/c^2) \cdot E \qquad (6.12)$$

resp.

$$H_z = -v^2 \cdot \varepsilon \cdot \mu \cdot H = -(v^2/c^2) \cdot H \qquad (6.12^*)$$

basic field: E resp. H (at $v = O$)

measurable overall field: (if $v \neq O$)

$$E_o = E + E_z \qquad (6.13)$$

resp.

$$Ho = H + H_z \qquad (6.13^*)$$

Fig. 6.5: Properties of transformation of the electromagnetic field.

6.5 Equations of transformation

As a consequence of the in fig. 6.5 again written down laws of transformation of the electromagnetic field (6.10 and 6.10*) magnetic phenomena can be traced back to electric phenomena and vice versa. The mathematical formulation reveals us the two sides of the same medal and points to a perfect duality between both fields and their factors of description.

Because a way exists, as is shown here, in which the equations of transformation can be derived from the Maxwell field equations, the same generally valid and extensive importance should be attributed to them. They can with the same right be called the foundation of electromagnetism. Wherein does lie its message for physics, the always curious researcher will ask? For that the relations of material 3.5 and 3.6 are completed:

$\mathbf{E} = \mathbf{v} \times \mu \cdot \mathbf{H}$ (6.10) und $\mathbf{H} = -\mathbf{v} \times \varepsilon \cdot \mathbf{E}$. (6.10*)

The here presented equations state, that we measure an electric field strength E, if we are moving with regard to a magnetic field H with the speed v and vice versa. The electric and the magnetic field therefore prove to be an experience of the observing person and we can say:

We experience the magnetic field as electric field and the electric field as magnetic field simply and solely for reason of the relative motion!

Let's assume, v is the component of the relative velocity (6.8), which stands perpendicular to the area defined by the field pointers (6.8*), then the equations of transformation (6.9* with 3.5) now read:

$E = v \cdot \mu \cdot H$ (6.11) and $H = -v \cdot \varepsilon \cdot E$. (6.11*)

If we are moving with the velocity v in a basic field which is present with the field strength E, then according to equation 6.11* we observe a magnetic field, which again according to equation 6.11 is to be interpreted as an additional electric field E_z:

$E_z = -v^2 \cdot \mu \cdot \varepsilon \cdot E = -(v^2/c^2) \cdot E$ (6.12)

In duality equation 6.11 inserted into equation 6.11* provides for the magnetic field strength a corresponding additional field H_z:

$H_z = -v^2 \cdot \mu \cdot \varepsilon \cdot H = -(v^2/c^2) \cdot H$ (6.12*)

W e obviously owe the measurable overlap fields in a laboratory simply and solely to the relative velocity v with which the laboratory is moving. But now we must pay attention to the fact that a terrestrial laboratory rotates along with the earth, that the earth orbits the sun and the sun again rotates around the centre of the milky way. Eventually the whole milky way is on the way in the cosmos with a galactic, for us hardly understandable speed. If we further take into consideration that for every subsystem an additional field occurs as a consequence of the relative motion with regard to the super ordinate system, then one additonal field follows after the next and overlaps this one.

Let's imagine, the relative velocity could be reduced towards zero - and maybe we are moving around such a cosmic point - then here no overlapping field would be measurable.

<*>: A derivation using vectors is written in chapter 28 (part 3).

Additional field (from fig. 6.5):

(6.12)
(6.12*)

$$E_z = -(v^2/c^2) \cdot E \quad \text{and}$$
$$H_z = -(v^2/c^2) \cdot H$$

Superposition of the fields:
The additional field (E_z resp. H_z) overlaps the basic field (E resp. H) to produce the measurable overall field (E_0 resp. H_0):

(6.13)

$$E_0 = E + E_z = E \cdot (1 - v^2/c^2) \qquad (6.13^*)$$
$$H_0 = H + H_z = H \cdot (1 - v^2/c^2)$$

transformed:

$$(1 - \frac{v^2}{c^2}) = \frac{E_0}{E} = \frac{H_0}{H}$$

(6.14)

for the Lorentz contraction holds apart from that:

(6.14*)

$$(1 - \frac{v^2}{c^2}) = (\frac{l}{l_0})^2$$

From the comparison
Follows

(6.14**)

$$\frac{E_0}{E} = \frac{H_0}{H} = (\frac{l}{l_0})^2$$

the proportionality:

$$E, H \sim 1/l^2 \quad \text{and} \quad E_0, H_0 \sim 1/l_0^2 \qquad (6.15)$$

Fig. 6.6: The field dependency of the Lorentz contraction

6.6 Field overlap

Field vectors can be superpositioned. In this manner the additional field E_z resp. H_z which depends on the velocity, according to equation 6.10, overlaps the respective basic field (E resp. H) to produce the measurable overall field (E_0 resp. H_o):

$$E_0 = E + E_z = E \cdot (1 - v^2/c^2) \quad (6.13)$$

$$H_0 = H + H_z = H \cdot (1 - v^2/c^2) \quad (6.13^*)$$

In the result something surprising the factor $(l\text{-}v^2/c^2)$ appears, which is well-known from the special theory of relativity and for instance appears in the Lorentz contraction.
If we rewrite both equations for the characteristic factor and compare with the in a purely mathematical way, over the Lorentz transformation, won length contraction $(1 - v^2/c^2) = (l/l_0)^2$, then it becomes clear that the Lorentz contraction physically seen should have its cause in the changed field conditions which a with relativistic speed moving body finds with regard to a resting body.

$$1 - \frac{v^2}{c^2} = \frac{E_0}{E} = \frac{H_0}{H} \overset{!}{=} \left(\frac{l}{l_0}\right)^2 \quad (6.14)$$

The equation is a compulsionless consequence of known physical laws. In this derivation actually no new factor was introduced and nevertheless a completely new picture for the natural scientific reality results<i>.

In our observer system, where the field E_o exists, a rule has its proper length l_0. In another system, which is moving with the speed v relative to the observer, as a consequence of the here prevailing field E the corresponding rule has a length 1. In which relation the factors stand to each other, is described by equation 6.14. Accordingly the following proportionality holds:

$$E, H \sim 1/l^2 \quad \text{and} \quad E_0, H_0 \sim 1/l_0^2 \quad (6.15)$$

If we are exterior to a very fast moving body with velocity v, we immediately can observe how this body for reason of its relative velocity experiences the calculated additional field and in this way experiences a length contraction. If the observer is moving along with the body, then he purely subjective seen doesn't detect a length contraction, because he himself and his entire measuring technique is subjected to the same length contraction. From the axiomatic approach what would be, if the field, which itself only represents an experience, would determine perceptible space and its dimensions, quickly a fundamental realization can develop if the described experiences should coincide with real observations.

<i> : Because in this point of view the subjective status of the observer is determining, it is not completely impossible that there is an error in the interpretation of the equations of transformation (6.10 and 6.10*). But because we started from the same point of view of the observer for the derivation of the length contraction from the Lorentz transformation, here the same error is to be expected. In putting both results equal (6.14), a like constituted error on both sides will cancel out in any case and the result stays above all doubts!

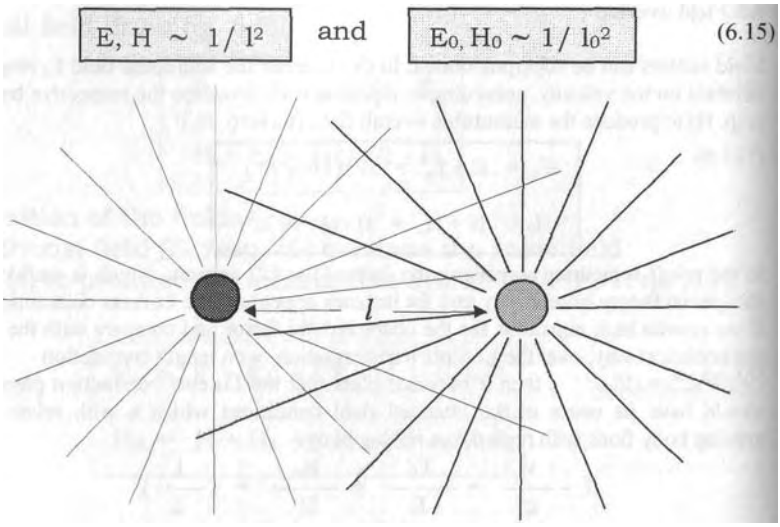

(Model):

Two particles of matter each in the field of the other particle.

Two elementary particles or two accumulations of matter consisting of these are able to reduce the distance to each other for reason of their fields, which we interpret as a force of attraction.

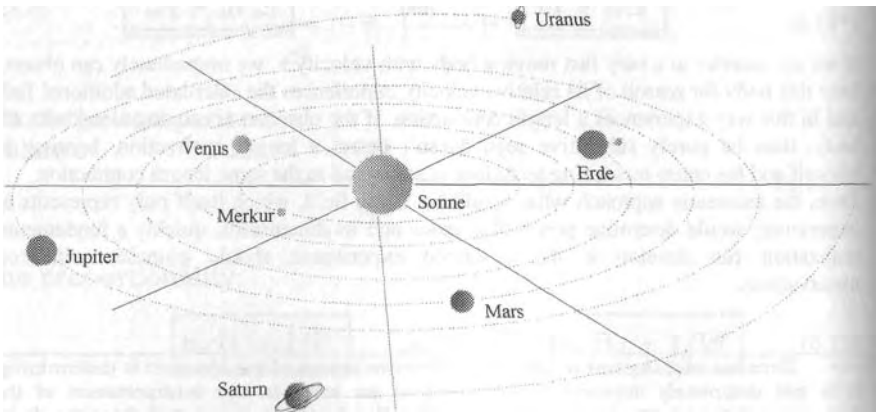

B: (Example): The orbits of the planets in the field of the sun.

Fig. 6.7: The influence of the field on interactions.

6.7 Field dependent curvature of space

Let's assume, an accumulation of matter, as big as our earth, wanted to fly past the sun in the distance earth-sun. But it would not succeed. Because the fields arising from the sun decreases with increasing distance and according to equation 6.15 as a consequence the size of the particles of matter increases. The planet hence is more strongly contracted on its side turned towards the sun, as on the turned away "night side". It bends towards the sun and its flight path becomes a circular path around the sun. That is the interaction known as gravitation!

To an earth inhabitant this curvature reveals itself merely in the observation that the duration of sunshine at daytime is longer, than it would be expected to be under the assumption of the earth as a homogeneous sphere. In this context one willingly speaks of a curvature of space. Actually it is a curvature of matter under the influence of the field dependent length contraction.
Exactly this contraction the planets owe their circular orbits around the sun and by no means the equilibrium of forces between the force of attraction and the centrifugal force (fig. 6.7 B). It obviously is a fundamental mistake to think that gravitation would causally be connected with a force effect!
If, in this context, we speak of a force of attraction for the sake of our subjective observation, then we must realize that it merely can concern an auxiliary term founded in usefulness.

A thought experiment should bring us clarity (fig. 6.7 A). The field, which surrounds every particle of matter, reaches till infinity but becomes less effective with increasing distance. If the distance between two particles is 1, then one particle is in the field of the other particle. As a consequence of the field the length 1 reduces and in this way the size determining field increases, which again leads to a further reduction of length etc. As a consequence it can be observed that both particles are moving towards each other. We speak of a force of attraction, because we can't register the influence of the field with our senses.
In this way the consistent result that we and our environment at daytime must be smaller than in the night will as well remain hidden. We experience the effect only indirectly as gravitational pull of the earth.

Because we don't see the cause of a subjectively observed force effect, for the electromagnetic interaction, just as for the gravitation, the field dependency of the length contraction will be responsible. Hence the following conclusion holds for both interactions equally way.

Two elementary particles or two accumulations of matter consisting of these are able to reduce the distance to each other for reason of their fields, which we interpret as a force of attraction.

Now the question still is open, why gravitation only knows forces of attraction, whereas the electromagnetic interaction also permits forces of repulsion and which are the causal fields for each.

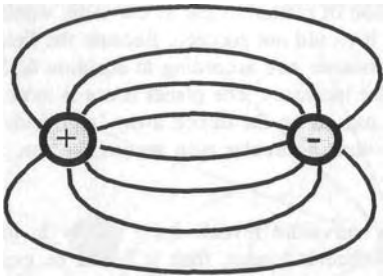

A: The field lines of the E-field for unlike charged particles

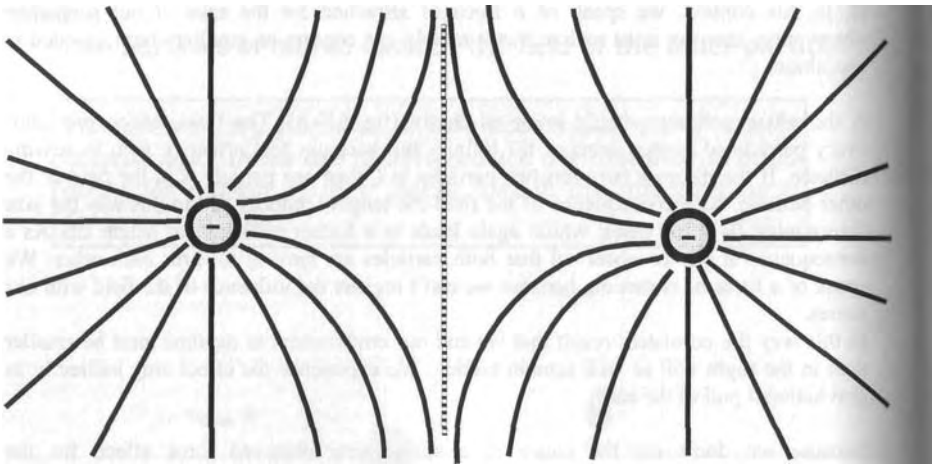

B: The field lines of the E-field for equal charged particles

The electromagnetic interaction of a particle is a result of the influence of the open field lines arising from it on the dimensions of space.

Fig. 6.8: The influence of the open field lines of the E-field

6.8 Electromagnetic interaction

A convincing answer to the open question provides us the analysis of the course of the field lines, on the one hand for charged particles and on the other hand for uncharged particles, which do not participate in the electromagnetic interaction.
If at first we consider electrically charged particles, like e.g. electrons, protons or ions.
Then all in common is that the towards infinity running field lines of the electric field are open. With this field the particle is able to interact with its environment. We measure a charge and an electromagnetic force effect. In the case of unequal charges, as is well-known, a field amplification and attractive acting forces are observed whereas for equal charges a field reduction results and repulsion is observed.

If we make a connection between the field conditions and the electromagnetic interaction in the sense of the proportionality (6.15), then the particle in reality is able to influence the distance to other particles merely with the help of its electric field. For unequal charges a compression of field lines arises, in which one particle stays in the focussed field of the other and vice versa. In this way a contraction of all lengths occurs and the observable attraction happens (fig. 6.8 A).
For equal charges the opposite case is present, in which even a local field freedom can occur (fig. 6.8 B). If the field tends towards zero on the dashed line, then the distance will go to infinity (according to eq. 6.15). Consequently, the observable effect that both bodies go away from each other, will reach to infinity.

Actually the electromagnetic interaction proves to be a result of the field dependent length contraction.

The electromagnetic interaction of a particle is a result of the influence of the open field lines arising from it on the dimensions of the space, in which it is.

It is important that the field lines are open, for which reason they are bent away from like charges and are directed towards unlike charges. Subjectively seen we find out that as a consequence of the field reduction repulsive force effects and as a consequence of the field compression attractive acting force effects are observed (fig. 6.8).
The consequence of is every electric field is, as is well-known, a magnetic field standing perpendicular on it. The field lines of the magnetic field run parallel to the surface of the particle and have a closed course (fig. 6.9 A)!
Therefore no magnetic poles form, which would be measurable. Seen from the outside the particle behaves neutral magnetically seen, because of the closed course of the field lines.
An artificial field reduction and as a consequence observable forces of repulsion, like in the case of the electromagnetic interaction, hence in principle are impossible.

The effect of the magnetic field thus is limited to a geometrical manipulation of the environment, namely the curvature of space, with which we have founded the phenomenon of the attraction of masses and of the gravitation.

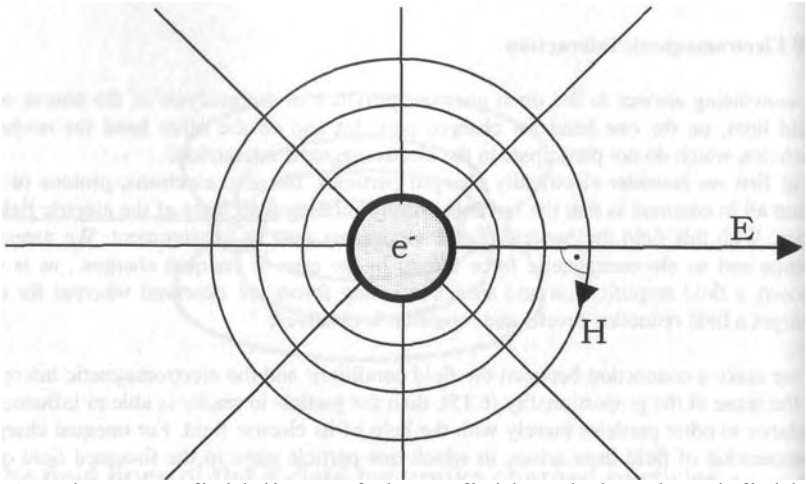

A: The open field lines of the E-field and the closed field lines of the H-field of an electrically charged particle (e.g. e-)

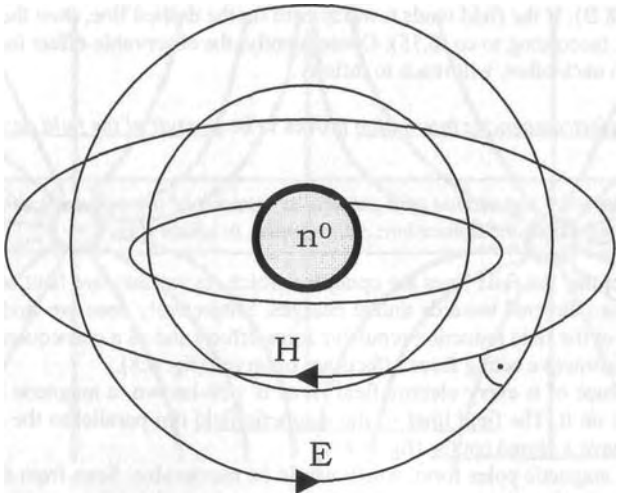

B: The closed field lines of the E-field and H-field of an electrically uncharged particle (e.g. of the neutron n°).

Gravitation is a result of the influence of the field lines with a closed course running parallel to the surface of the particles on the dimensions of the space, in which they are.

Fig. 6.9: The influence of the closed field lines of the H-field.

6.9 Gravitation

For uncharged, neutral particles (neutron, atom, molecule etc.) both the magnetic and the perpendicular on them standing electric field lines have a closed course. Now both run parallel to the surface of the particle (fig. 6.9 B).
As is said, the density of field lines with a closed course can't be influenced from the outside. If we approach a particle, the consequence of an increase of the density without exception is a decrease of the linear measures and thus a larger force of attraction. For this case of field lines with a closed course, for which in general it doesn't give a field attenuation and no forces of repulsion, there holds:

Gravitation is a result of the influence of the field lines with a closed course running parallel to the surface of the particles on the dimensions of the space, in which they are.

Both interactions logically have an infinite range. Both form a whole in the influence of the fields on the size conditions.
It surely is of the greatest importance that for this derivation of the field dependency of the Lorentz contraction from the known equations of transformation of the electromagnetic field we could do completely without the introduction of new factors of description or neglects.
Solely by consistent derivation and interpretation of the result the unification already has suceeded and the electromagnetic interaction and the gravitation could, with the derived field dependent Lorentz contraction, be traced back to a single basic phenomenon. Doing so we have to pay attention to the fact that the observer is subjected to the same Lorentz contraction as his measuring technique and therefore he can't see the field dependency at all. Merely as being an exterior observer it in rare cases will be possible to him to see the curvature of space in the presence of strong fields.

From this for an astronaut practical consequences result. If he namely would land on Jupiter, he would think flat hills to be gigantic mountains, that small he would be! Vice versa if he landed on the moon, high mountains would appear to be insignificant hills, not because of wrong altitude readings of the terrestrial mission control and measurement centre, but only because of his own body size. The astronauts of the Apollo missions were not prepared for this circumstance and after their landing on the moon were completely surprised, how little validity learned textbook physics has, hardly has one left the earth. They have brought photographs with them which prove the Lorentz contraction to depend on the field and therefore on gravitation.

The fact that force effects should arise from the interactions is an auxiliary concept and auxiliary description of the observing person founded in pure usefulness. The Lorentz force therefore shouldn't be regarded as cause anymore. It actually appears only as property of the field factors. Seen this way it only would be consistent to do without space charges and currents as a result of moving charges and to assume a source-free and quanta-free field description (fig. 6.4: $j = 0$).
From an unified theory it is demanded that it besides the electromagnetic interaction and the gravitation also is able to integrate the strong and the weak interaction. We will also solve this problem.

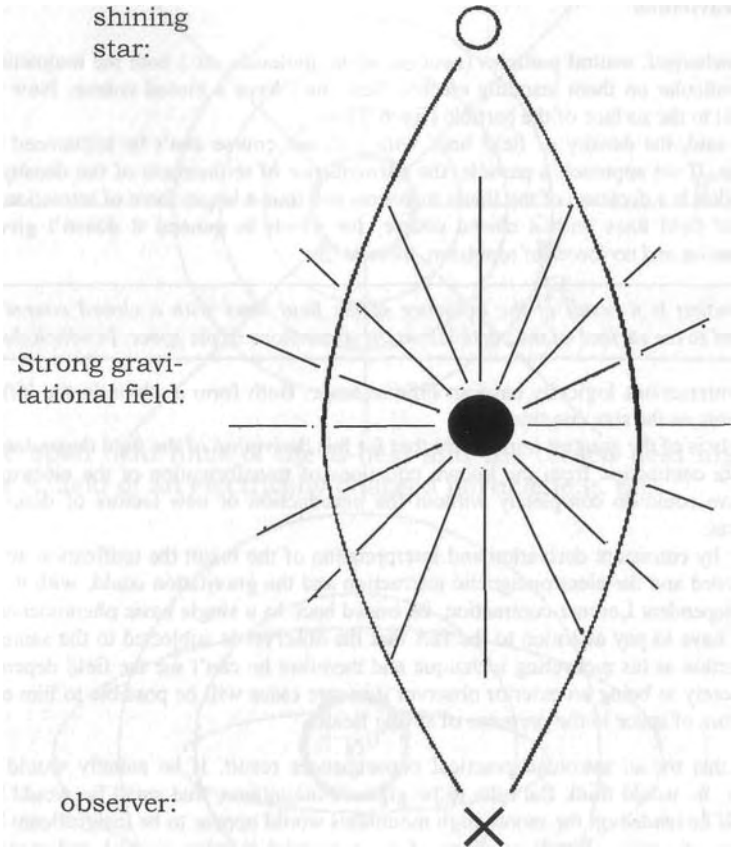

Fig. 6.10: Diversion of the light by a strong gravitational field.

Speed of light of the wave: $c = \lambda * f$ (6.16)

For the wavelength λ holds (because of eq. 6.15): $E, H \sim 1/\lambda^2$

From equation (6.16) follows (with f = constant):

$$E \sim 1/c^2 \quad , \quad H \sim 1/c^2 \qquad (6.17)$$

The speed of light depends on the field!

6.10 Field dependent speed of light

But not only matter is bent towards a gravitational field. If we only think of the much cited phenomenon that the ray of light of a star is diverted towards the sun, if it passes very close to the sun on its way to us, like this has been observed for the first time during an eclipse of the sun in 1919 (fig. 6.10).
Quite obviously the field of the sun also slows down the speed of light. On the side of the ray of light which is turned towards the sun, the field is somewhat larger and the speed of light correspondingly is slower than on the side which is turned away, and with that the ray of light changes its direction in the observable manner. Exactly this relation willingly is interpreted as a consequence of a curvature of space.
The extremely strong field of a black hole can divert the light down to a circular path, in order to in this way catch and bind it. The light now orbits the black hole like planets the sun.

At this point the open-minded reader already might have tapped the confirmation of the proportionality 6.2 ($c \sim r$), which has been derived from the vortex model (fig. 6.2).
The sceptic is offered still another derivation: for the borderline case that the relative velocity v tends towards the speed of light c (fig. 6.6), according to equation 6.13 the measurable overall field E_o (and also H_o) will go to zero and equation 6.12, with $E_z = - E$ (and $H_z = - H$), will again turn into the wave equation (5.9*) after double differentiation (fig. 6.4).
The speed $v = c$ so to speak forms the escape velocity, with which the electromagnetic wave runs away from the cosmic field. Under these circumstances of course neither an attraction of masses nor an electromagnetic interaction can be exerted on the wave.
If E_0 goes to zero at the same time l_0 tends to infinity (equation 6.15, fig. 6.6): i.e. the wave spreads all through space. This result entirely corresponds to the observations and experiences.

For the wave length λ and in the end for the velocity of propagation c only the self-field of the wave E resp. H is responsible. Because of

$$c = \lambda \cdot f \qquad (6.16)$$

and the proportionality from equation 6.15: $E, H \sim 1/\lambda^2$ (6.17*)

obtain the new relation: $E, H \sim 1/c^2$ (6.17)

If the speed of light in the presence of matter decreases, then we now also know why. It is the field, which surrounds matter, that slows down the speed of light. Therefore a gravitational field is able to divert a ray of light in the same manner as matter which flies past. Finally moves the speed of light in the proportionality 6.17 to the place of the linear measure (in 6.15).
But if the rule fails one will try to replace by an optical measurement arrangement. In this manner the field dependency of the Lorentz contraction should be measurable; but it isn't!

From the comparison of the derived proportionalities:

$$E, H \sim \frac{1}{l^2} \sim \frac{1}{c^2}$$

(6.15): (6.17)

follows:

$$\underline{1 \sim c} \qquad (6.18)$$

The speed of light is proportional to the measurement path. The variable speed of light is being measured with itself. The result at all events is a constant value.

The constancy of the speed of light is based on a measurement which is faulty from the principle!

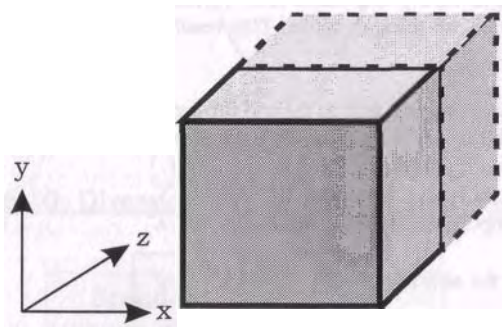

Because of c ~ r: physical length contraction

Fig. 6.11: Derivation of the length contraction (field dependent Lorentz contraction)

6.11 Universality

Why can't the rule be replaced by an optical measurement arrangement? The crucial indication provides the comparison of both derived proportionalities 6.15 and 6.17. According to them holds the same field dependency for both the Lorentz contraction and the speed of light:

$1/l^2 \sim 1/c^2$ or $$\underline{\underline{1 \sim c}} \qquad (6.18)$$

If the rule has proved to be useless, then we will experience the same disaster if we measure optically, i.e. with the speed of light.
Obviously both, the length 1 and the speed of light c as a length per unit of time, depend in the same manner on the respective local field strength. On the one hand do both measuring methods lead to the same result; but on the other hand will anything which can't be measured with one method, neither be measured with the other method.
If now the speed of light is being measured optically, then the measurement path will be proportional to the speed of light and as a result will the unknown factor be measured with itself. The result of this measurement, which is faulty from the principle, at all events is a constant value, because here two variables which stand in direct proportionality to each other are related to each other.
Was the famous experiment of Michelson and Morley unnecessary, the result trivial? And how does it stand about the postulate of the universality of the speed of light?
If we for that consider a cube (fig. 6.11). And we assume that the speed of light is a vectorial quantity, which in our experiment is for instance in one direction twice as large, as in the direction of the other two space axes. By means of the mentioned influence of the speed of light on the spatial length is, as a consistent consequence, the cube along this edge pulled apart to a cuboid. We however register this spatial body with our eyes, which is with the speed of light and that has increased proportionally to the length of the edges, for which reason we as subjective observer still see a cube in front of us and not a cuboid.
If we trust an apparent objective measurement more than our sense organ and measure the three lengths of the edges of the cuboid again with a rule then we get three times the same length, which is a cube.
We probably are dealing with an optical deception using the true meaning of the word.

If the by Einstein postulated universality and constancy of the speed of light in reality doesn't exist at all, we in no way would be capable to register this; neither to observe nor to measure it!
The Galilean theorem of the addition of speeds objectively seen still is valid, even if the fact that the speed of light apparently is independent of the speed of the source pretends us the opposite.
If for instance a light source is moved towards a receiving device or away from it, then the speeds will overlap, like for the passenger, who marches in a driving train against or in the driving direction through the corridor. For the ray of light also the fields, which influence the speed of light and the measurement equipment, overlap. As a consequence will a measuring technician, who himself is exposed to this overlapping field, always observe and "measure" the identical speed of light. The observer as a result imagines, there is an universality of the speed of light.

The field takes over the function of the aether.

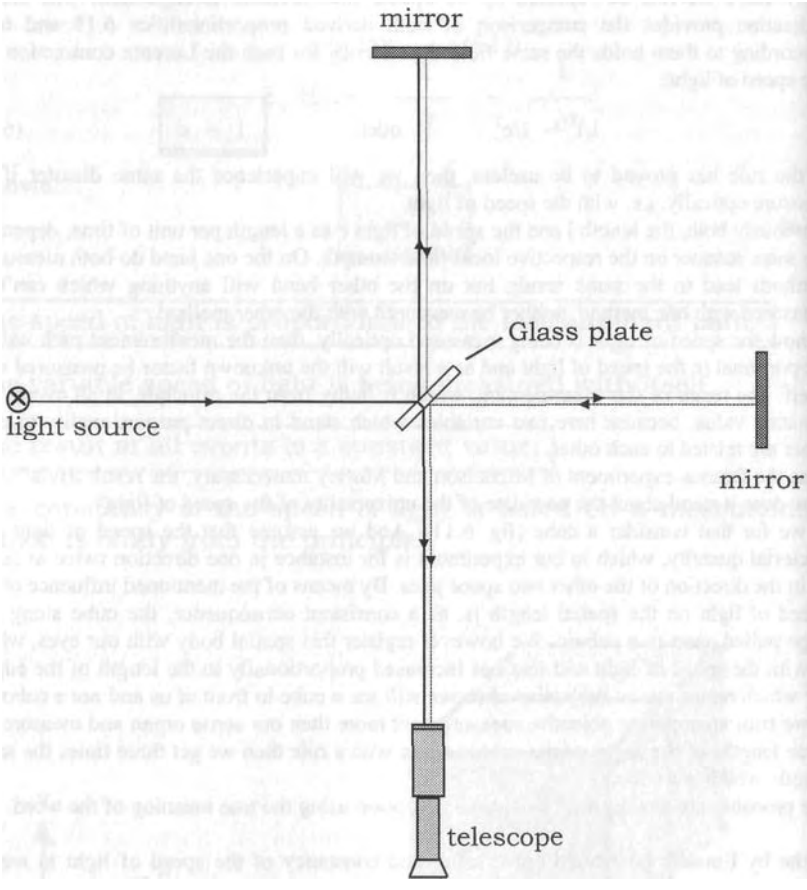

Fig. 6.12: Experiment of Michelson and Morley to detect an aetherwind<i>

<i>: A.P.French: Special Relativity, Massachusetts Institute of Technology, 1966.

<ii>: Nikola Tesla: "This is the same as writing a business letter and forgetting the subject you wish to write about". To Einstein's Theories, Rare Book and Manuscript Library, Columbia University, 15.4.1932.

<iii>: Einstein proceeds in the same manner with the time dilatation, by assuming a time constant by definition for the derivation to present at the end of his derivation a variable time. And with that he presents a result which contradicts his approach completely.

6.12 Aether

Important experiments like the one of Doppler concerning the redshift or the one of Bradley concerning the aberration of the stars show only to clear, where the influence of the speed of light subjectively still is perceptible, or for laboratory experiments like the one of Michelson and Morley, where the influence isn't perceptible anymore, because the length of the interferometers always changes proportionally to the speed of light. The look in the stars at the same time is a look in cosmic areas, where completely other field conditions prevail and as a consequence completely other values for the speed of light and for the dimensions of space are present. The mentioned observations suggest that we together with our measuring station are moving through the cosmos and therefore a relative velocity has to be present with regard to an aether which determines the respective speed of light.

If we however constrict our range of vision and retire in a laboratory, then we no longer are capable to observe the influence of the field on the speed of light. The experiments of Michelson which Maxwell had prompted to and which Morley with a higher precision had repeated with the goal, to detect the aether, inevitably had to turn out negatively. The laboratory experiments resulted in the misleading picture, as if the earth was resting in the aether.

The not understood measurements will suggest any observer, he forms the centre of the universe and everything rotates around him, entirely in the sense of the Ptolemean view of life, which, although long ago abolished, here belated has experienced support. With a Swabia caper Albert Einstein has prevented a relapse into the dark Middle Ages and removed the open contradiction in the question of the aether, which once is measured as moving and another time as resting, by without further ado abolishing the aether. With that he undoubtedly has solved a central problem of physics and at the same time created a new one. As is known does the speed of light have a certain value, and therefore the question is raised, what determines is size. Exactly for this purpose a luminiferous aether had been introduced, however it is constituted.

Scientifically it does make little sense, to make an assumption, if at the end of the derivation the prerequisite is deleted without substitute. In such a case either in the approach or in the derivation is a principal error*[1]"*. Nikola Tesla comments on the working method of Einstein with the applicable comparison, as if Einstein had, while he was writing a business letter, forgotten completely the subject he wanted to write about (fig. 6.12[ii]).

The answer, which removes all contradictions and is entirely in accord with all observations and measurements, is obvious. Naturally a luminiferous aether exists, which determines the velocity of propagation and of course it by no means is bound to the observer.

As has been derived in figures 6.5 and 6.6, will for a relative velocity v arise a field, which according to proportionality 6.17 determines the speed of light. With that we have derived completely.

The field takes over the function of the aether.

The equations 6.10 also answer the question, why no aetherwind is being observed, although such a wind actually is present: we experience, as we have discovered, an E-field with „head wind" as a resting H-field and vice versa and therefore we aren't capable to detect the head wind in the aether!

Key questions of quantum physics (fig. 4.4 + continuation):

IV. Why do the particles have the form of spheres?
(with increasing E-field decreases c)

VIII. Why is the elementary quantum localized?
(in the vortex centre: c = 0, see figures 4.3 and 6.2)

IX. Why do the elementary particles have a spin?
(spherical form demands field compensation)

X. Why is the magnitude of the spin quantized?
(cosmic basic field determines the need of E_z)

XI. Why can speeds faster than light occur in a tunnel?
(a reduction of the cosmic basic field can only be realized locally in a tunnel)

to XI:

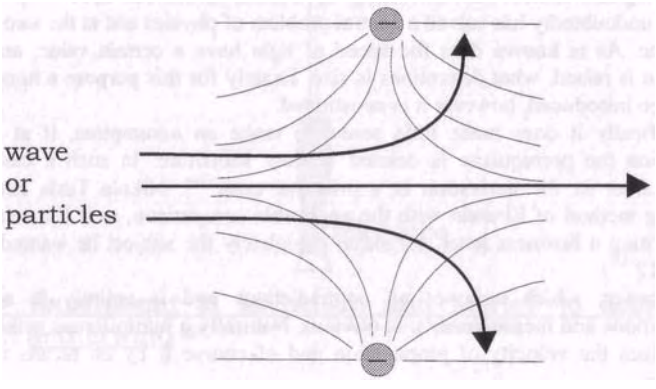

Fig. 6.13: Consequences concerning the field dependency of the speed of light: spin effect and tunnel effect <i,ii>

<i>: Nimtz,G.: Instantanes Tunneln, Tunnelexperimente mit elektromagnetischen Wellen, Phys.B1.49, VCH Weinheim (1993) Nr.12, S. 1119-1120<*>
<ii>: Thoma, P., Weiland.T.: Wie real ist das Instantane Tunneln? Phys.Bl.50, VCH Weinheim (1994) Nr.4, S. 359-361<*>
<*>: The measurement results are in accord with the theory of objectivity, not however the contradictory attempts to interpret them <i> and <ii> et al.

6.13 Spin and tunnel effect

Only with the field dependency of the speed of light (6.17) we can understand, why the elementary quanta can form as spheres, like is drawn in the figs 4.3 and 6.2. In the centre the field lines run together, i.e. the field increases and the speed of light decreases. Only in this way it will be possible for the vortex oscillation to everywhere occur with the speed of light, even in the inside of the particle! In the centre of the vortex particle the field in theory will become infinitely large and the speed of light zero. This circumstance again is the foundation why the elementary particles are localized and it answers key question VIII of quantum physics. The absence of a speed after all is the characteristic of an immobile thing.

The field dependency of the speed of light answers also further basic and up to today unanswered key questions of quantum physics, like why the elementary particles have a spin (IX) and why the magnitude of the spin is quantized (X).

A vortex particle after all does not exist alone in the world, but it is in the field of other particles. We can call this the cosmic basic field (E resp. H). This basic field overlaps the self-field and takes effect the strongest in the area of the spherical shell, where the self-field is correspondingly small. In order to keep the form of a sphere, this influence of the basic field has to be compensated. The additional field (E_z resp. H_z according to eq. 6.12) necessary for the compensation is produced by the particle, by rotating in a spiral around itself with a speed v which increases towards the outside of the spherical shell. Therefore does the elementary particles have a spin. The electron spin is therefore determined by the cosmic basic field.

Another effect of the field dependent speed of light is the tunnel effect. As an example we consider the two differently charged particles shown in fig. 6.8 A. The open, outside of the particles running, field lines of the electric field are predominantly bent towards the each time oppositely charged particle. If another particle wants to pass between the two, then it gets into an area of increased field strength. As a consequence it will be slowed down, because here a smaller speed of light is present.

Water molecules show with their polar nature exactly this property. Water has a remarkably high dielectricity e and slows down the speed of light correspondingly according to equation 5.6 ($\varepsilon \cdot \mu = 1/c^2$). The refraction of light at the water surface is an observable result of the reduced speed of light in the presence of matter.

If we now examine the case in which the two particles have the same charge as is shown in fig. 6.8 B (and fig. 6.13 belonging to XI). The field lines repel each other, so that exactly in between the two particles a field free area forms, in which the speed of light goes to infinity! This area acts like a tunnel. If we send through a particle exactly here, then purely theoretically seen it won't need any time to run through the tunnel, and for a short time the signal becomes infinitely fast.

If a particle hits only slightly besides the tunnel, then it will one-sidedly be slowed down and diverted by the respective field. We call this process reflection or scattering. Only the few particles, which exactly hit the tunnel, arrive behind the hurdle and in the ideal case even almost without loss of time!

The current measurements of speeds faster than light demonstrate in a convincing manner the superiority of the field-theoretical approach with regard to the nowadays normally used quantum physical approach.

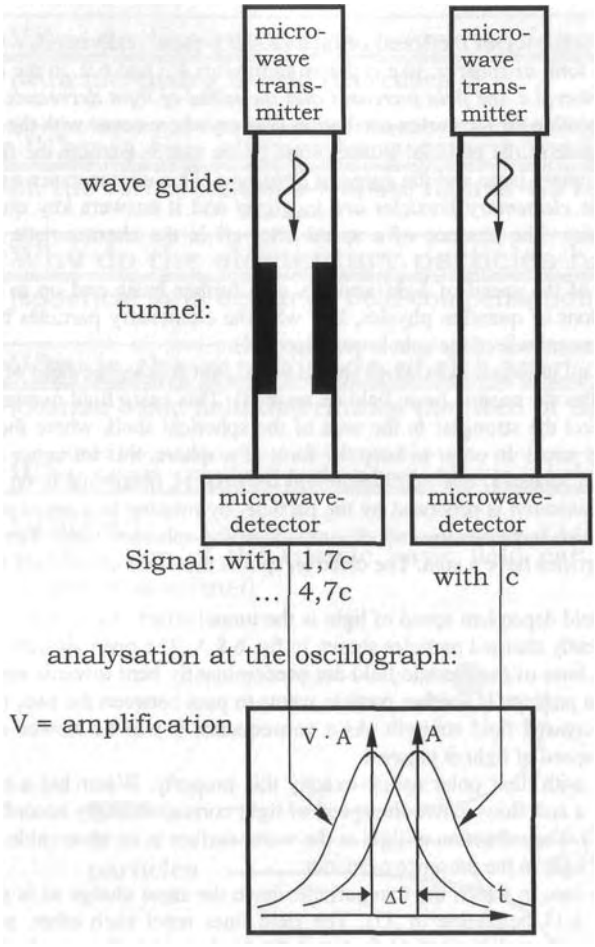

Fig. 6.14: The microwave experiment at the II. Physical Institute of the University of Cologne to measure speeds faster than light.<i>

<i>: Nimtz, G. : New Knowledge of Tunneling from Photonic Experiments, Proc. of the Adriatico Research Conference, 1996, World Scientific Publishing Company

6.14 Interpretation of the measured speed faster than light

Now the attempt can be undertaken, to interpret the spectacular experiments, in which a speed faster than light has been measured. It is reported[<i>] that in experiments with photons at the University of California in Berkeley on an average a speed of 1.7 times the speed of light has been measured by Prof. Raymond Chiao and his co-workers. At the Technical University of Vienna Prof. Dr. Ferenc Krausz already has obtained 2.4 times the, according to Einstein at maximum obtainable, speed of light with tunnelling laser light.

The first measurements of speeds faster than light have been carried out with microwaves at the University of Cologne[<ii>] by Prof. Dr. Gunter Nimtz and co-workers. They at first had published the measurement of a speed 2.5 times the speed of light. In the meantime they even have transmitted a symphony of Mozart with a speed almost 10 times the speed of light and with that have contradicted Einstein's hypothesis, according to which the speed of light in vacuum would be the highest possible speed for the transmission of signals. The different experiments only resemble each other in the point that the particles have to tunnel, because one has put a barrier in their way. This "tunnelling" apparently is the cause for obtaining speeds faster than light. With the prevailing physical view of life these measurement results are incompatible.

In the measurement set up in Cologne the microwaves are sent through a wave guide, which they pass with the speed of light. If a parts with narrowed cross-section is inserted, where the microwaves actually don't fit through at all, then the signal gets damped strongly. Now however arrives nevertheless a small part of the signal at the other end of the wire, but much faster than allowed, namely with the measurable speed faster than light.

The answer of the here presented potential vortex theory reads as follows: the waves picked up by the wave guide run up to the entry of the tunnel, in order to find out that they don't fit through. They are reflected or absorbed. A small part however rolls up to potential vortices and these fit through the tunnel. They however have to be compressed additionally. In the derivation of the photon (fig. 4.5 and 4.6) we had seen that the inner vortex always is faster than the bigger one, through which it slips through. The compression therefore causes an increase in speed. In flow dynamics is known an analogy: the Venturi-tube. The flow-technical potential vortices also confirm exactly this property. One can as well start with the Lorentz contraction (fig. 6.6, eq. 6.14*). This states that a particle moving with a higher speed actually becomes smaller and not only appears to be smaller as an optical deception of the observer. Because only smaller particles fit through the tunnel, the particles, measurable at the other end, must be correspondingly faster: quod erat demonstrandum. In the same manner also the experiments of Berkeley can be explained physically, because here is worked with photons from the start[<i>]. With that the process of rolling up the wave can be left out. The tunnel lets pass only compressed and therefore faster light particles.

<i>: R.Y.Chiao, P.G.Kwiat, A.M.Steinberg: Schneller als Licht? Spektrum der Wiss. 10/93

<ii>: B. Schuh, Gespenstisch fixe Wellen, DIE ZEIT Nr. 45, 5.11.93, S. 43.

<ii>: Enders, A., Nimtz, G.: Photonic-tunneling experiments, Physical Review B, Vol. 47, No. 15 (1993), pp. 96O5-96O9.

<ii>: Enders, A., Nimtz, G.: Evanescent-mode propagation and quantum tunneling, Physical Review E, Vol. 48, No.l (1993), pp. 632-633.

"The theory of relativity is not a physical theory... it is a mathematical poetic idea, a deduction from impossible premises."[<i>]
Oskar Kraus

"The theory of relativity is a mathematical masquerade, behind which is hidden an inextricable ball of a mixing up of ideas, contradictions, fallacies, arbitrary assumptions and ignoring of healthy logic."[<i>]
Erich Ruckhaber

"The theory of relativity not only is fantastic, but also of an inconsistency which in the history of science not yet has been present."[<i>]
Harald Nordenson

"A physics of hybrids, of contradictions and fantastic confusions, nonsense!"[<ii>]
Johann Marinsek

"This is absurd."[<iii>] (regarding mass-energy interpretation) _____
Nikola Tesla

"In my experiments I have destroyed billions of atoms, without having observed any emissions of energy. "[<4i>]
Nikola Tesla

Fig. 6.15: Some statements regarding the theory of relativity.

<i>: Walter Theimer: Die Relativitatstheorie, Seite 7, Francke Verlag, Bern, 1977, ISBN 3-772O-126O-4
<ii>: Johann Marinsek: Rationale Physik, S. 163, dbv-Verlag TU Graz, 1989, ISBN 3-7O41-O176-1
<iii>: Nikola Tesla, To Einstein's Theories, Rare Book and Manuscript Library, Columbia University, 15.4.1932. Entnommen aus J.T.Ratzlaff: Tesla Said, Tesla Book Company, pp. 238, ISBN O-914119-OO-1
<4i>: Nikola Tesla, Franz Ferzak World and Space Publications 1985.

6.15 Definition of the speed of light

If a light signal propagates in space, then as a consequence of the velocity of propagation c, it at a certain point in time t is in a distance r of the light source:

$$r = c * t \qquad (6.19)$$

Should the speed of light become smaller for instance by Δc, then the light signal obviously has covered a distance less by Ar or the time interval has changed by Δt:

$$r + \Delta r = (c + \Delta c) \cdot (t + \Delta t) \qquad (6.20)$$

This equation describes purely mathematically the most general case which can be assumed. By writing out the multiplication and subtraction of equation 6.18 the change in distance considered for itself is:

$$\Delta r = c \cdot \Delta t + t \cdot \Delta c + \Delta c \cdot \Delta t \qquad (6.21)$$

The answer of mathematics is that the change in distance can have its cause in a change in time, in a change of speed or in both. We now want to turn to the physical interpretation and have a closer look at the two possibilities, in which either c or t is to be taken constant (see fig. 6.16).

In the first case the speed of light c is constant and as a consequence the change Δc = zero. The mathematical formulation (according to eq. 6.21) therefore reads:

case 1: $$\boxed{c = \frac{\Delta r}{\Delta t}} \qquad \text{(relativity)} \qquad (6.22)$$

If in this conception world a change in distance is observed, for instance the Lorentz contraction, then in order to save this relation inevitably a change in time, for instance a time dilatation, has to make the compensation. Einstein in an applicable manner speaks of relativity, because according to his opinion in the case of both variables, the length contraction and the time dilatation, it only concerns observed changes.

For the time dilatation experiments are given. But for the measurement of time always only atomic clocks are available and their speed of running of course could also be influenced by the Lorentz contraction. In any case it can't be claimed the time dilatation is proven experimentally as long as we do not know the mechanisms of decay of atoms. Otherwise the statements of the theory of relativity are familiar to us, for which reason further remarks seem unnecessary.

In the second case the time t is constant and consequently the change At = zero. At a closer look this case is much more obvious, since why should time change. After all time has been stipulated by definition.

After all, we are the ones who tell, what simultaneity is!

The mathematical formulation for this case reads (eq. 6.21 with Δt= 0):

case 2: $$\boxed{\Delta c = \frac{\Delta r}{t}} \qquad \text{(objectivity)} \qquad (6.23)$$

This equation does open up for us an until now completely unknown and fundamentally other way of looking at the physical reality.

Concerning the definition of the speed of light c [m/s]:

r [m] = distance of the light source:

$$r = c \cdot t \tag{6.19}$$

For changes, observed or measured:

$$r + \Delta r = (c + \Delta c) \cdot (t + \Delta t) \tag{6.20}$$

$$= c \cdot t + c \cdot \Delta t + \Delta c \cdot t + \Delta c \cdot \Delta t$$

Change in distance:

$$\Delta r = c \cdot \Delta t + t \cdot \Delta c + \Delta c \cdot \Delta t \tag{6.21}$$

2 possible causes:

with $\Delta c = O$	with $\Delta t = O$
case 1:	case 2:
$c = \frac{\Delta r}{\Delta t}$ (6.22)	$\Delta c = \frac{\Delta r}{t}$ (6.23)
c = constant	t = constant
$\Delta r \sim \Delta t$ (6.23)	$\Delta c \sim \Delta r$ (6.25 = 6.2)
= time dilatation	= universality
Δr = observable length contraction	Δr = physical length contraction
Theory of relativity	Theory of objectivity

Fig. 6.16: Theory of relativity and theory of objectivity, derivation and comparison.

6.16 Relativity and objectivity

New to the second case (equation 6.23) is particularly the proportionality contained in it:

$$\Delta c \sim \Delta r \quad (6.25 = 6.2)$$

But to us it is not new, because we have derived the same proportionality from the model conept (equation 6.2, fig. 6.2), in which the elementary particles are understood as spherical vortices.
Equantion 6.25 unconcealed brings to knowledge that any change of the speed of light c [m/s] in the same way leads to a change of the radius r [m], the distance between two points in space or even the length of an object, e.g. a rule. Such a rule after all consists of nothing but spherical atoms and elementary particles and for their radius r again the proportionality 6.25 holds. Therefore it is to be set:

$$r \sim 1 \qquad (6.26)$$

and taken both together we already had derived as equation 6.18 (fig. 6.11) from the field dependency. Here the vortex model as well finds a confirmation of its correctness, as in the derivation from the equations of transformation of the electromagnetic field. Because all three, the derivation according to the model, the physical and the mathematical derivation, lead to the same result, this second case should be called "objective".

With that the first case, which describes the subjective perception of an observer, is not supposed to be devaluated. It contains the definition of reality, according to which only is real what also is perceptible. The theory of relativity of Poincare and Einstein is based on this definition.

With the second case, the case with a variable speed of light, we however get serious problems, since we observe with our eyes, and that works with the speed of light. If that changes, we can't see it, as already said. If we could see it, then "reality" would have a completely different face and we surely would have great difficulties, to find our way around. In this "objective world" neither electromagnetic interactions nor gravitation would exist, so no force effects at all. Because all distances and linear measures depend on the speed of light, everything would look like in a distortion mirror.
The concept of an "objective world" at first has not a practical, but rather a theoretical and mathematical sense. The distinction between an observation domain and a model domain is founded in pure usefulness.

The observation domain should correspond to case 1 and the model domain to case 2. The mathematical derivation tells us, how we can mediate between both domains (equation 6.21): This mediation amounts to a transformation, which provides us the instruction, how a transition from the observation into a not perceptible model concept, from the relativity into an objectivity has to.

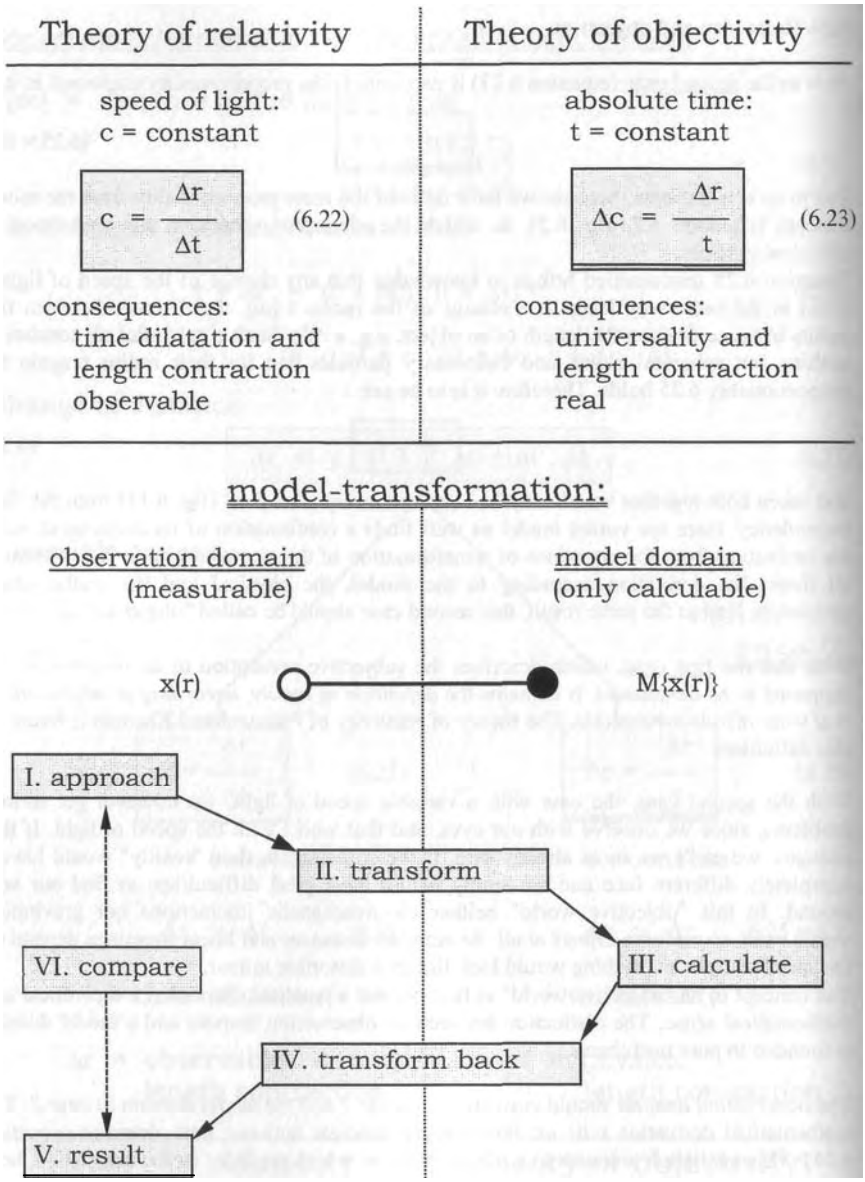

Fig. 6.17: Model-transformation between theory of relativity and theory of objectivity.

6. 17 Transformation

The observation domain is, as the name already expresses, perceptible (observable) with the help of our sense organs and measurable with corresponding apparatus. The special theory of relativity for the most part provides us the mathematics needed for that. And in that is assumed a constant speed of light. Because a length contraction is being observed and can be measured, a time dilatation must arise as a consequence. Such is the consistent statement of this theory. Because we already could make us clear that it concerns a subjective theory, of course caution is advisable if generalizations are being made, like the one of the inductive conclusion of the length contraction on the time dilatation. We'll come to speak about that in this chapter (fig. 6.20).

The model domain however is not observable to us and only accessible in a mathematical manner. Here the time is a constant. On the other hand do the radii of the particles and all other distances and linear measures stand in direct proportionality to the speed of light. If that changes, then does that lead to a change in length. The length contraction occurs physically, which means actually. We propose the name "theory of objectivity" for the valid theory which is derivable with this prerequisite and independent of the point of view of the observer.

The importance of this model domain and of the possible model calculations is founded in the circumstance that many physical relations within our observation domain aren't recognized by us and can't be mathematically derived. Besides is only all to often worked with unallowed generalizations and with pure hypotheses. Such a thing does not even exist in the model domain.

The model domain can be tapped over a transformation. For that we select an approach x(r) in the to us accessible observation domain. This then is transformed into the model domain by a calculation instruction $M\{x(r)\}$. Here we can calculate the sought-for relation In the usual manner and transform back again the result according to the same calculation instruction $M^{-1}\{x(r)\}$ but in the reversed direction. After being returned in our familiar observation domain, the result can be compared and checked with measurement results (fig. 6.17).
In this way we will derive, calculate and compare the quantum properties of the elementary particles with the known measurement values. Here we remind you of the fact that all attempts to calculate the quantum properties conventionally, without transformation, until now have failed. Not even a systematization may succeed, if it concerns for instance explanations for the order of magnitude of the mass of a particle.

A transformation at first is nothing more than an in usefulness founded mathematical measure. But if a constant of nature, and as such the quantum properties of elementary particles until now have to be seen, for the first time can be derived and calculated with a transformation then this measure with that also gains its physical authorization. We now stand for the question: how does the instruction of transformation $M\{x(r)\}$ read, with which we should transform the approach and all equations from the observation domain into the model domain?

general relations:	special theory of relativity	theory of objectivity	
domain of validity:	observation domain	model domain	
speed of light c [m/s]:	$c = c_0$ = constant	$c \sim r$	(6.25)
field strengths (6.15)	(6.15) + (6.18)		
H [A/m] :	$H \sim 1/r^2$	$H \sim 1/r$	(6.27*)
E [V/m] :	$E \sim 1/r^2$	$E \sim 1/r$	(6.27)
because of eq. (5.6) $\varepsilon \cdot \mu = 1/c^2$ is valid:			
μ [Vs/Am] :	μ_0 = const.	$\mu \sim 1/r$	(6.28*)
ε [As/Vm] :	ε_0 = const.	$\varepsilon \sim 1/r$	(6.28)
relations of material:			
$B = \mu \cdot H$ (3.5): B [Vs/m²]	$B \sim 1/r^2$	$B \sim 1/r^2$	(6.29*)
$D = \varepsilon \cdot E$ (3.6): D [As/m²]	$D \sim 1/r^2$	$D \sim 1/r^2$	(6.29)
e.g. spherical capacitor			
capacity: C [As/V]	$= \varepsilon 4\pi r$ (6.4)	C = const.	(6.30)
charge: Q [As]	$= C \cdot U$ (6.31)	Q = const.	(6.32)
energy: W [VAs]	$= Q^2/C$ (6.1)	W = const.	(6.33)
with energy-mass relation: (5.24) and (6.1)	$W = mc^2$		
mass	m [kg = VAs³/m²]	$m \sim 1/r^2$	(6.34)
relaxation time	τ_1 [s]:	τ_1 = const.	(6.35)
with	$\tau_1 = \varepsilon/\sigma$ (5.3)		
specific conductivity	σ [A/Vm]:	$\sigma \sim 1/r$	(6.36)

Fig. 6.18: Transformation of the dependencies on radius

6.18 Transformation table

The attempt to write down at this point already a closed mathematical relation as instruction of transformation, would be pure speculation. Such an instruction first must be verified by means of numerous practical cases, i.e. be tested for its efficiency and correctness. But we not even know the practical examples necessary for this purpose, if we apply the transformation for the first time!
For his reason it unfortunately is not yet possible, to calculate absolute values in a direct
We have to be content to work with proportionalities and to carry out comparisons.
In fig. 6.18 the proportionalities are compared in the way, how they would have to be transformed: on the left side, how they appear and can be observed in the view of the special theory of relativity, and on the right side, how they can be represented and calculated in the theory of objectivity.
The change, which here would have to be transformed, is the physical length contraction, which is the change in length as it depends on the speed of light. For spherical symmetry the length 1 becomes the radius r (eq. 6.26), of which is to be investigated the influence. In the observation domain we had derived the proportionality (6.15 + 6.18):

$E \sim 1/r^2$ and $H \sim 1/r^2$.

The field of a point charge or of a spherical capacitor confirms this relation:

$$E = Q/\varepsilon 4\pi r^2 .$$

Because the speed of light in our observation is constant, also both constants of material which are related to it (eq.5.6: $\varepsilon \cdot \mu = 1/c^2$), the dielectricity ε and the permeability μ, are to be taken constant.
With that the same proportionality as for the field strengths also holds for the induction B and the dielectric displacement D:

$$B \sim 1/r^2 \quad \text{and} \quad D \sim 1/r^2.$$

In the model domain everything looks completely different. Here the radius and any length stands in direct proportionality to the speed of light. In this way we get problems with our usual system of units, the M-K-S-A-system (Meter-Kilogram-Second-Ampere). The basic unit Meter [m] and as a consequence also the unit of mass Kilogram [kg = VAs^3/m^2] appear here as variable. It would be advantageous, to introduce instead the Volt [V] as basic unit.
But in any case does the dimension of a quantity show us, in which proportionality it stands to the unit of length. This in the model domain then is authoritative! As an example does the speed of light have the dimension Meter per Second. In the model domain there consequently has to exist a proportionality to the length r [m].
The speed of light determines with equation 5.6 again the constants of material:

$$\mu\,[Vs/Am] \sim 1/r \quad \text{and} \quad \varepsilon[As/Vm] \sim 1/r \qquad (6.28)$$

According to the model holds unchanged:

$$B\,[Vs/m^2] \sim 1/r^2 \quad \text{and} \quad D\,[As/m^2] \sim 1/r^2. \qquad (6.29)$$

But if we insert the proportionalities 6.28 and 6.29 into the equations of material 3.5 and 3.6, then holds for the field strengths:

$$H\,[A/m] \sim 1/r \quad \text{and} \quad E\,[V/m] \sim 1/r. \qquad (6.27)$$

Further dependencies of the radius can be read in the same manner either by inserting into well-known laws or immediately from the dimension.

In the <u>observation domain</u>:

energy density of a field:

$$w = (\varepsilon \cdot E^2 + \mu \cdot H^2)/2 \sim 1/r^4 \quad (6.37)$$

energy: $W \sim 1/r$ (6.38)

with c = constant and $W = m \cdot c^2$: $\boxed{m \sim 1/r}$ (6.39)

e^- is bigger and lighter than p^+ or n^0!

$$\boxed{\frac{m}{m_0} \overset{(6.39)}{=} \frac{r_0}{r} \overset{(6.26)}{=} \frac{l_0}{l} \overset{(6.24^*)}{=} \frac{1}{\sqrt{1-(v/c)^2}}} \quad (6.40)$$

In the <u>model domain</u>:

e.g. spherical capacitor

capacity:	C [As/V]	$= \varepsilon 4\pi r$ (6.4)		$C = \text{const.}$	(6.30)
charge:	Q [As]	$= C \cdot U$ (6.31)		$Q = \text{const.}$	(6.32)
energy:	W [VAs]	$= Q^2/C$ (6.1)		$\boxed{W = \text{const.}}$	(6.33)

(6.33) means: <u>law of conservation of energy!</u>

relaxation time	τ_1 [s]:		$\tau_1 = \text{const.}$	(6.35)
with	$\tau_1 = \varepsilon/\sigma$ (5.3)			
specific conductivity	σ [A/Vm]:		$\boxed{\sigma \sim 1/r}$	(6.36)

(6.36) means: elementary vortices are indestructible!

Fig. 6.19: Interpretation of the dependencies on radius

6.19 Interpretation of the transformation table

The transformation should tell us, what we would see if the variable speed of light would be observable to us. Doing so highly interesting results come out.
The energy density of a field is as is known $w = (\varepsilon \cdot E^2 + \mu \cdot H^2)/2$. (6.37)
In the observation domain will, according to fig. 6.19, decrease the energy density w proportional to $1/r^4$. Multiplied with the respective volume we obtain for the energy itself the proportionality: $W \sim 1/r$. (6.38)
If we make use of the Einstein relation $W = m \bullet c^2$
with c = constant holds also for the mass m: $m \sim 1/r$. (6.39)
In this manner we finally find out, why the small nucleons (protons and neutrons) subjectively seen are heavier than the very much larger electrons. As a consequence does a relativistic particle experience the increase of mass (with the length contraction according to equation 6.24*):

$$\frac{m}{m_0} \overset{(6.39)}{=} \frac{r_0}{r} \overset{(6.26)}{=} \frac{l_0}{l} \overset{(6.24*)}{=} \frac{1}{\sqrt{1-(v/c)^2}} \quad (6.40)$$

This result is experimentally secured. Our considerations therefore are entirely in accord with the Lorentz-transformation. There at least is no reason to doubt the correctness.
In the model domain we with advantage assume a spherical symmetry. As easily can be shown with equations 6.4 and 6.31, are the capacity and charge of a spherical capacitor independent of the radius (6.30 and 6.32). In that case also the from both values calculable energy (6.1) must be constant. We come to the same conclusion, if take we the above equation 6.37 for the energy density of a field or if we carry out a verification of dimensions:
W [VAs] = konst. . (6.33)
This simple result is the physical basis for the law of conservation of energy! With that we have eliminated an axiom.
The result states that the energy stays the same, even if the radius, the distance or the speed of an object should change. To the subjectively observing person it shows itself merely in various forms of expression. Consequently is the energy, as is dictated by the here presented field theory, formed by binding in the inside of the quanta the same amount of energy but of the opposite sign. The amount of energy therefore is bound to the number of the present particles, as we already had derived.
Under the assumption of a constant time (6.35) there results for the electric conductivity σ, by calculating backwards over the equation of the relaxation time (5.3), the proportionality: (6.36)

$$\sigma\,[A/Vm] \sim 1/r \quad (6.36)$$

Maybe the result surprises, because it can't be observed. Actually we know that the (microscopically observed conductivity in reality only represents an approximated averaged measure for the mobility of free charge carriers. In a particle-free vacuum however this well-known interpretation doesn't make sense anymore. Hence it is recommended, to only work with the relaxation time constants. Who nevertheless wants to eontinue to work with σ as a pure factor of description, can do this. But he mustn't be surprised, if in the model domain with decreasing radius the conductivity suddenly increases. But this is necessary, because otherwise the elementary particles would collapse. Only by the increase of the conductivity, which is produced by the spherical vortex itself, will the expanding eddy current build up in the inside of the particles, which counteract the from the outside concentrating potential vortex.

Approach:

a.The particles don't decay by themselves, but only by a corresponding disturbance from the outside.

b.The decay time is the statistical average in which such a disturbance can occur and take effect.

c.The elementary particles consist of an integral and finite number of elementary vortices, which can't decay anymore for their part.

d.If the compound particles get into the disturbing range of influence of high-frequency alternating fields, then they are stimulated to violent oscillations and in that way can be torn apart into individual parts.

e.As disturbing factor the high-frequency fields of flying past neutrinos are considered primarily.

f. Authoritative for the threshold of decay and with that also for the rate of decay is the distance, in which the neutrinos fly past the particle.

g.The distance becomes the larger, the smaller the particle is. If the particle thus experiences a relativistic length contraction, then it will, statistically seen, to the same extent become more stable!

That has nothing to do at all with time dilatationl

We are entitled to demand a simultaneity, after all we are the ones, who tell what that is!

Fig. 6.20: Proposal for an interpretation of the particle decay

<i>: Walter Theimer: Die Relativitatstheorie, Seite 106, Francke Verlag, Bern, 1977, ISBN 3-772O-126O-4

6.20 Particle decay

We still have to get rid of a fundamental misunderstanding. It concerns the problem of the time dilatation. Here the model domain doesn't give us any difficulty, because it dictates a constant and therefore by us definable time. In the relativistic view however should in moving systems clocks go wrong! But how does one want to explain a time dilatation physically, if it merely represents a purely mathematical result of the actually taking place length contraction on the one hand and the postulate of a constant speed of light on the other hand?

Nobody has troubled more about the physical interpretation than Einstein himself. But he had as less as we nowadays the possibility to verify the so-called phenomenon experimentally, by accelerating a laboratory clock to values close to the speed of light. Only atomic particles can, e.g. in accelerator systems, be brought on such high speeds and then be observed for their properties. But also these experiments don't have any power of proof, as long as we don't know the atomistic structure of the particles and there exists the danger of misinterpretations.

So the slowing down of the rate of decay of instable. particles at high speeds willingly is cited as "proof for time dilatation<1>. "The most cited example for the time dilatation is the "long-living" meson. The μ-meson is a charged particle, which exists only $2{,}2 * 10^{-6}$ seconds if it is observed in rest. Then it decays ... About 10 % of the mesons reach the earth's surface. Even if they fly with approximately the speed of light, they at least must have used $30 \cdot 2{,}2 * 10^{-6}$ seconds, in order to reach the earth. Their "life" therefore by the movement has been extended for a multiple... to the supporters of the theory of relativity here the time dilatation is revealed..."

This "proof however is worthless, as long as "the structure and the mechanism of decay of the particle are not known", like W. Theimer<1> expresses himself.

On the basis of the new field theory the approach standing on the left page is dared (fig. 6.20). Accordingly the particles don't decay by themselves, but only by a corresponding disturbance from the outside, which for instance is triggered by the high-frequency fields of flying past neutrinos. The closer the neutrinos fly past the particle, the sooner it will decay. But the distance becomes the larger, the smaller the particle is. If the particle thus experiences a relativistic length contraction, then it will, statistically seen, to the same extent become more stable!

That has nothing to do at all with time dilatation, as this proposal for an interpretation shows (fig. 6.20). The same effect of course also occurs, if atomic clocks are taken for a fly in a plane and compared to identically constructed clocks on earth.

The time was stipulated by us and therefore should be able to keep its universal validity. We are entitled to demand a simultaneity, after all we are the ones, who tell what simultaneity is!

An interesting technical use would be the acceleration of the rate of decay in order to dispose of radioactively contaminated waste. For that the waste has to be irradiated by collecting and focussing free neutrinos or with the help of a neutrino transmitter, like one which will be discussed in chapter 9. After such a neutrino shower dangerous radioactive waste would be reusable or at most be harmless domestic refuse.

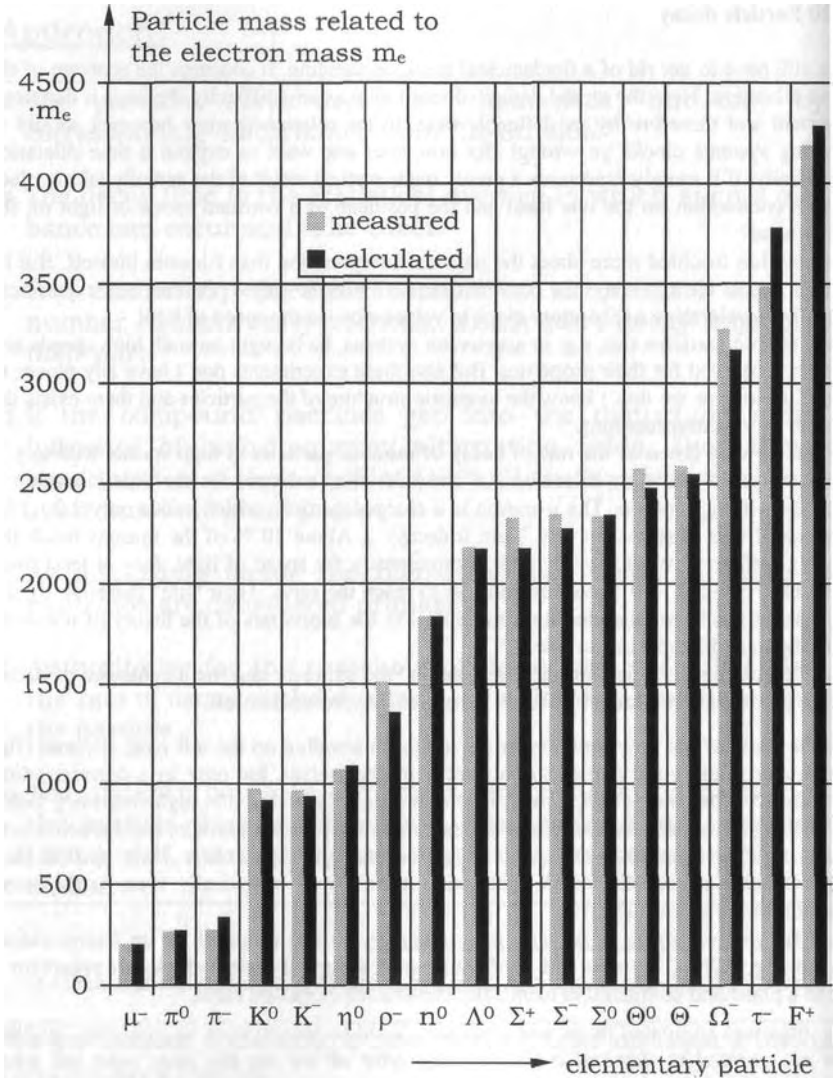

Fig. 7.0: The comparison with power of proof: the measured particle mass the calculated particle mass

7. Proof

Ample evidence is available for the correctness of the theory of objectivity. The field dependent change in length is observed and used as magnetostriction or electrostriction. If a ferromagnetic material, e.g. a nickel rod, is brought into an alternating magnetic field, then field dependent longitudinal length oscillations are observed. In the same manner barium titanate or quartz crystal oscillates in the electric field if a high-frequency alternating voltage is applied.
A practical application forms the production of ultrasound.

In this chapter are, as already announced, the quantum properties of the elementary particles calculated and in this way is furnished perhaps the most convincing proof for the existence of potential vortices and for the correctness of the field-theoretical approach and the theory which is based on it.
A special challenge represents the calculation of the particle mass. This mass stretches from 207 electron masses of the myon over 1839 of the neutron into the order of magnitude of 18513 electron masses (Y°). Doing so not only can be tested, if the calculated values correspond with the measured ones. Also the gaps have to correspond, i.e. where there doesn't exist a discrete mathematical solution also no particle should exist. The fig. 7.0 standing on the left page anticipates the result and shows that even this strict condition is fulfilled! The agreement of the calculated with the measured results is excellent. If in individual cases small deviations become visible, we always have to bear in mind that the measurements as a rule are analysed statistically and the results are falsified if small particles creep in unrecognized. Particle physics nowadays has at its disposal extremely precise gauges, but even here remaining errors can't be excluded.

Quantum physics is occupied with further taking apart the elementary particles into hypothetic particles, the quarks, and to sort these according to properties and symmetries. Seen strictly causal this procedure thus corresponds to the quantum physical approach. We however have taken the field-theoretical approach, and this excludes the introduction of hypothetic particles from the start. It should be our goal to derive and to explain the quantum structure as a field property. Yes, we even want to calculate it, with which we would have overtaken quantum physics in the scientific competition with one leap!

Strong support our approach has experienced by current experiments, in which matter was transformed in electromagnetic waves - practically the reversal of the rolling up of waves to vortices. To do so at the Massachusetts Institute of Technology (David Pritchard and others) sodium atoms were dematerialized in waves by lattice scattering[<i>]. According to Einstein one surely could have blown the whole M.I.T. in the air with the occurring mass defect; but don't worry, no emission of energy whatsoever has been observed, entirely as predicted by the vortex theory.

<i>: J. Teuber: Materie und Energie, Ganze Atome wurden zu Energiewellen,
Illustrierte Wissenschaft Nr. 7 (1996), S. 56

With the classical radius of the electron $r_e = 2{,}82 * 10^{-15}$ m:

$$C_e = \varepsilon_o \cdot 4\pi r_e = 3{,}135 \bullet 10^{-25} F \qquad (6.4^*)$$

$$U_e = e/C_e = 511 kV \qquad (6.31^*)$$

(constant independent of r_e)

Formation forms (vortex properties):

I. Amassing (formation of vortex balls):

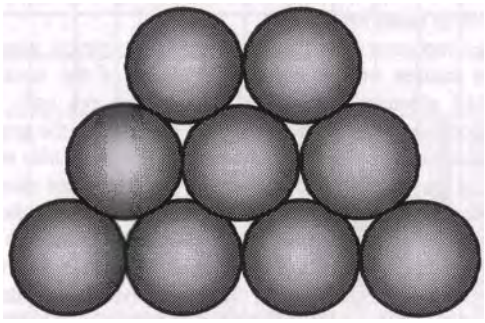

II. Overlapping (phenomenon of transport)

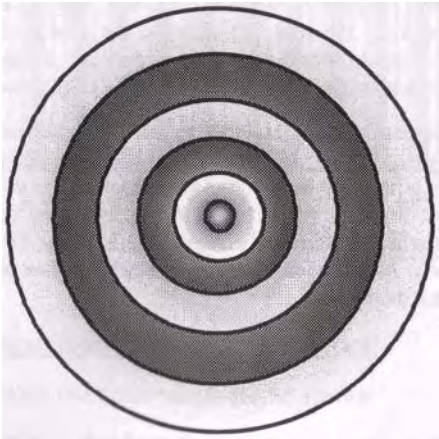

Fig. 7.1: The amassing and overlapping of elementary vortices

7.1 Elementary vortices

We had derived the electron and the positron as elementary vortices (fig. 4.3). Before we can go in the calculation, we must gain a clear picture of the possible configurations of vortices, which for reason of the derived properties are possible. For that we start with the elementary vortex and afterwards we predict the behaviour of interaction which can be expected.

Actually only one single particle is really elementary. According to the realizations of the new theory it is an elementary vortex in the form of a sphere. Its size is determined by the speed of light and this again by the local field strength; its stability is founded in the concentration effect of the potential vortex. The whirling takes place everywhere with the speed of light, even in the vortex centre, where all field lines run together, where the field increases infinitely and the speed of light goes to zero. This last circumstance owes the elementary vortex its localization.

We can attribute a charge to this vortex for reason of the field lines which on the outside run towards infinity and which we can measure (fig. 4.3). This is the smallest indivisible unit, the elementary charge e. Structure and course of the field lines suggest to understand and to calculate the elementary vortex as a spherical capacitor. By basing on the classical radius of the electron r_e given in fig. 6.3 the capacity according to equation 6.4 is calculated to be:

$$C_e = \varepsilon_0 \cdot 4\pi r_e = 3{,}135 \cdot 10^{-25}\ \mathrm{F} \quad (6.4^*)$$

Here the theory of objectivity has provided us the realization that even for a change of the radius of the electron the capacity remains unchanged constant (6.30), and this entirely corresponds to our observation.

Between the hull of the elementary vortex, measured at the radius r_e, and its centre, respectively also with regard to infinity, there exists according to equation 6.31 the tension voltage of:

$$U_e = e/C_e = 511\ \mathrm{kV} \quad (6.31^*)$$

It as well is constant and independent of the size of the elementary vortex.

Since a different solution is refused, we'll have to assume that all elementary particles consist of an integer multiple of elementary vortices. For that the amassing, like closely packed tennis balls, or the overlapping of individual vortices in the form of shells, like in the case of an onion (phenomenon of transport) can be considered.

The among each other occurring forces of attraction can be traced back to the fact that every elementary vortex is compressed by the field of its neighbour as a consequence of the field dependent speed of light. This field as a rule is for the small distances considerably larger than the field on the outside. Therefore do compound elementary particles not have the twofold or triple mass, but at once the 207-fold (myon) or the 1836-fold (proton) mass. After all there is no other explanation for the fact that there don't exist lighter particles (with a mass less than 207 electron masses)!

a. The electron-positron pair

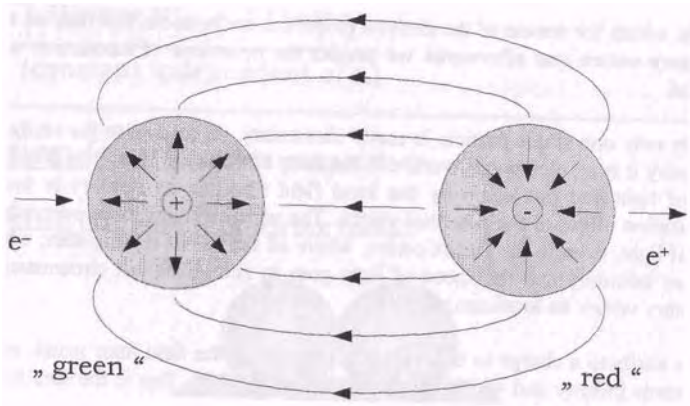

b. . The e^- - e+ pair for a small distance:

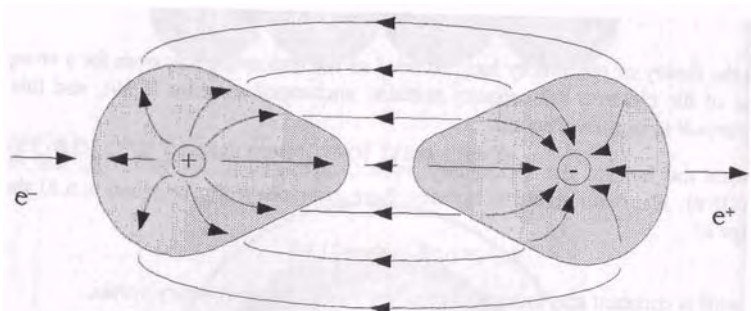

7.2 Matter and anti-matter

For the amassing or overlapping of elementary vortices several cases must be distinguished, because two inverse forms of formation are possible for the elementary vortex: the negatively charged electron and the positively charged positron. Whereas in the case of the electron the vortex produces a component of the electric field which points from the inside to the outside, has the field in the case of the positron the opposite direction for reason of a reversed swirl direction.

This statement can be generalized: if we consider the elementary particles from the outside, then we assign the particles with a swirl direction identical to that of the electron to the world of matter and call the particles with the opposite swirl direction anti-matter. It now is strongly recommended, to take colours to hand, in order to optically clarify the properties of vortices. The electron will be marked as a green sphere and the antiparticle, the positron, as a red sphere.

If we now look into the world of matter, then appears our world of matter to us "green", the world of anti-matter however "red". The uniform green colour of all the in our world existing elementary particles however doesn't exclude that red anti-vortices can exist hidden in the inside of the green vortices, where we can't discover them. But they must be completely covered, otherwise a disastrous reaction occurs, the pair annihilation, as a consequence of the oppositely directed property of the vortices which cancel out. By means of the pair annihilation a dematerialization can occur, because every elementary vortex keeps in its inside the same amount of energy with opposite sign and the fusion of two inverse particles can result in a zero sum of the energy. The best known example is the annihilation of an electron-positron pair under emission of radiation discovered by Klemperer in 1934. In the upper representation (fig. 7.2a) the elementary vortices still are symmetrical, but the outside field lines already are "bent" and linked together in such a way that, with the exception of the ones in the direction of the axis, no interaction takes place which can be measured.

The two particles for reason of the different charge approach each other quickly, and the closer they are, the larger the mutual force of attraction becomes; a vicious circle, which leads to the asymmetry shown in the lower sketch (fig. 7.2b) and only comes to rest, if both particles have destroyed themselves mutually.

The electron and the positron had the same amount of, but oppositely directed swirl activity, so that purely arithmetically seen a zero sum of the rest energy results. But it should be paid attention to both particles having some kinetic energy on the occasion of the relative motion to each other and if they rotate around their own axis also rotational energy. An emission of annihilation radiation occurs, is the explanation of particle physics.

With the knowledge of the photon (fig. 4.6) we can interpret the annihilation radiation as a consequence of the phenomenon of transport. The faster and consequently smaller vortex, for instance the green one, slips into the red one and sees the green inside, which is compatible for it. Unfortunately it only can remain there, as long as it is smaller, thus is faster, and therefore it shoots out on the other side again. Now the electromagnetic force of attraction fully takes effect. It is slowed down and the red vortex correspondingly accelerates. The process is reversed.

These around each other oscillating vortices, so we had derived, have a characteristic frequency (colour), are polarizable and are moving forward with the speed of light as a consequence of the open vortex centre. It therefore concerns the photon.

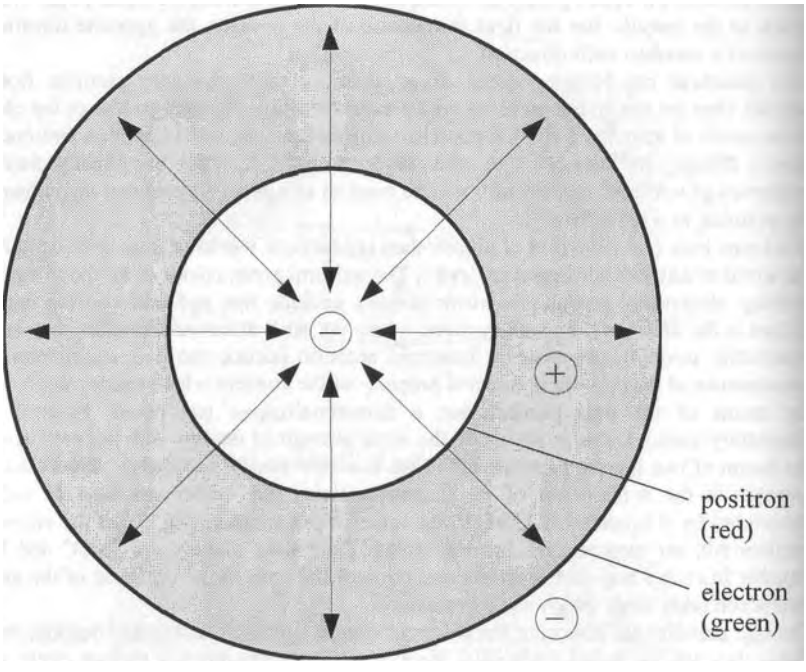

Fig. 7.3: Theoretical final state of the positronium = static γ-quant (photon).

7.3 Positronium

But before the two elementary vortices, the electron and the positron, are annihilated under emission of radiation, they will for a short time take a shell-shaped, a bound state, in which one vortex overlaps the other.
Its formation we can imagine as follows: an electron, flying past a resting positron, is cached by this for reason of the electromagnetic attraction and spirals on an elliptic path towards the positron. In doing so its angular velocity increases considerably. It will be pulled apart to a flat disc for reason of the high centrifugal forces, to eventually lay itself around the positron as a closed shell.
Now the red positron sees the electron vortex so to speak "from the inside" and doing so it sees as well red; because the green vortex has a red centre and vice versa! The result is the in fig. 7.3 given configuration.

The number of field lines, which run from the red border of the positron in the direction of the centre, is identical to the number, which point towards the green border of the electron. Here already the same state has been reached as in the centre, which corresponds to the state at infinity. That means that no field lines point from the green border to the outside; seen from the outside the particle behaves electrically neutral. It doesn't show any electromagnetic interaction with its surroundings.

If the particle were long-living, then it undoubtedly would be the lightest elementary particle besides the electron; but without stabilizing influence from the outside the positronium can't take the in fig. 7.3 shown state at all. The positron takes up the kinetic energy which is released if the electron becomes a shell around it. But before the bound state can arise, which would identify the positronium as an elementary particle, the equal rights of both vortices comes to light. With the same right, with which the electron wants to overlap the positron, it itself vice versa could also be overlapped.
If the stabilization of the one or the other state from the outside doesn't occur, then the stated annihilation under emission of y-quanta is the unavoidable consequence (fig. 4.6).

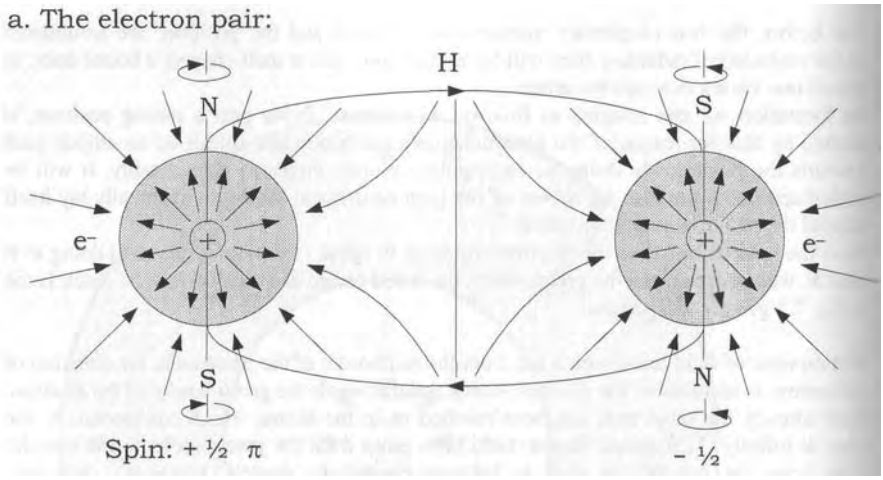

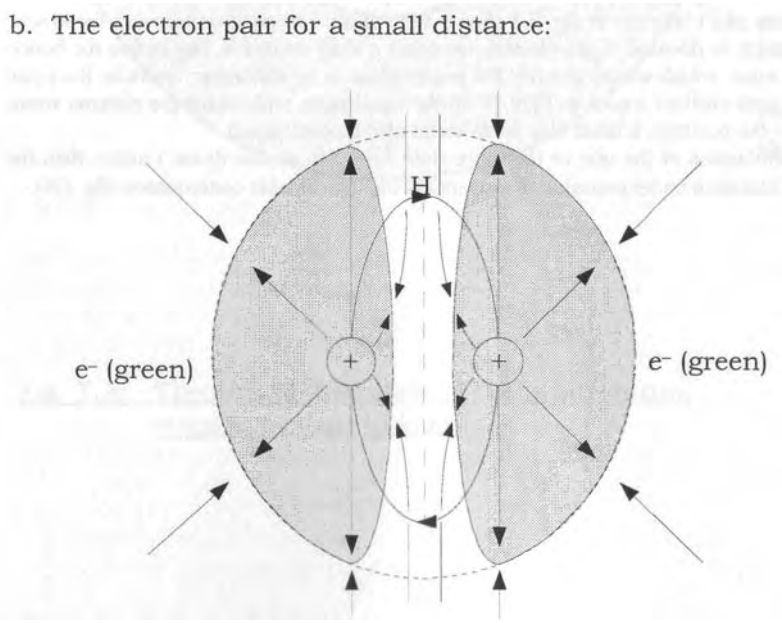

Fig. 7.4: Two electrons with oppositely directed spin

7.4 Dipole moment

As electrically charged spheres elementary vortices have a magnetic dipole moment along their axis of rotation as a consequence of the rotation of their own (fig. 7.4). This is measurable very precisely and for the most important elementary particles also known quantitatively. In contrast to the angular momentum the magnetic moment can't be constant according to the here presented theory. It should slightly change, if we increase the field strength in the laboratory.

In a particle consisting of several elementary vortices the vortices mutually increase the local field strength. Therefore we measure at the proton, which consists of three vortices, not the triple, but only the 2,793-fold of the nuclear magneton which can be expected for reason of its mass. Also the neutron has instead of the double only the 1,913-fold nuclear magneton. The deviations therefore are explicable as a consequence of the surrounding fields.

Prerequisite for this point are two other, still unanswered, key questions of quantum physics:

> XII: Why is measured for the proton approximately the triple of the magnetic dipole moment which can be expected for reason of the charge?
>
> XIII: Why does the neutron, as an uncharged particle, actually have a magnetic moment?

These questions can only be brought to a conclusive answer, if we have derived the vortex structures of the respective particles.

The elementary vortex, as a consequence of the spin along its axis, forms a magnetic north pole and a south pole. Another possibility to interact with an external field or with other particles is founded on this property. This shall be studied by means of two electrons. which form an electron pair.
For reason of the equal charge the two electrons at first will repel each other. If they rotate of their own they however will mutually contract, which, seen from the outside, is interpreted as a force of attraction. And in addition will they align their axes of rotation antiparallelly. While they now rotate in the opposite direction, a magnetic force of attraction occurs.

As is shown in fig. 7.4, the magnetic dipole field in this way is compensated towards the outside, as is clarified by the field line (H) with a closed course. Between both electrons a space free of E-field stretches. If both vortices are a small distance apart they lay themselves around this space like two half-shells of a sphere. A particle forms which seen from the outside is magnetically neutral, but it carries the double elementary charge (fig. 7.4b).
The exceptional affinity is always restricted to two vortices of equal charge with an opposite direction of rotation. Further vortices can't be integrated anymore and are repelled. This property of vortices covers the quantum condition (Pauli's exclusion principle) for the spin quantum number perfectly.

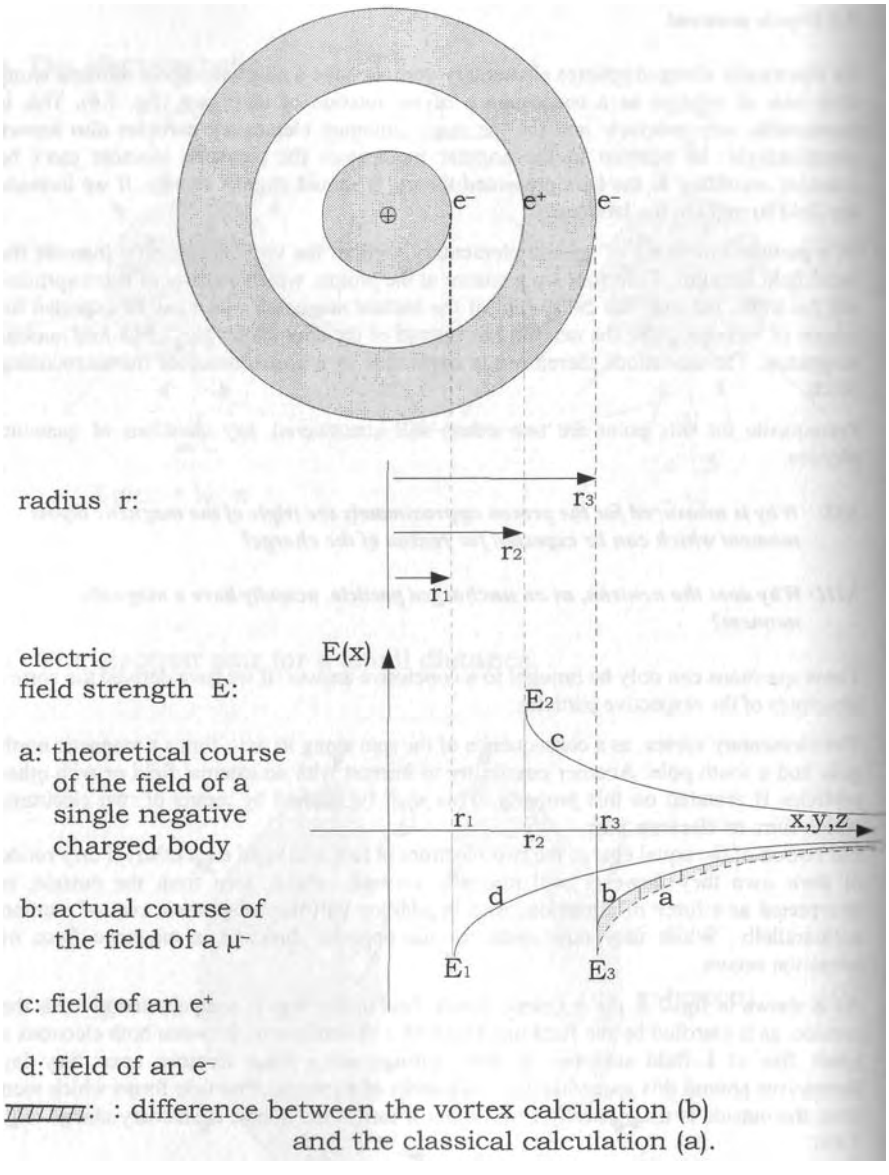

Fig. 7.5: The mvon and the electric field E(x) of the three elementary vortices

7.5 Myon

We now have discussed all conceivable possibilities, which two elementary vortices can form: the creation of a pair for like charge and the annihilation under emission of photons via the formation of the positronium as an intermediate result for unequal charge. Next another elementary vortex shall be added and all different possibilities and configurations will be derived, which can be formed by amassing or overlapping.

The positronium can, as said, only take the in fig. 7.3 shown bound structure, if it is stabilized from the outside. This task now a further electron shall take over. According to the shell model the innermost elementary vortex an electron (e^-), is overlapped by a positron (e^+) and that again overlapped by an electron (e^-).
With an in the sum single negative charge, a completely symmetric structure as well as a half-integer spin this particle will show a behaviour corresponding to a large extent to that of the electron. Merely the mass will be considerably larger, because every vortex each time compresses the other two.

It therefore concerns the myon (μ^-), which also is called "heavy electron". The myon was discovered 1937 in the cosmic radiation (Anderson and others).
In fig. 7.5 are drawn above each other the shell-shaped structure of the myon and the electric field E(x) of the three elementary vortices.
It is visible that merely in the proximity of the particle the actual course of the field deviates from and is smaller, than the course which theoretically can be expected for a single negatively charged body. The difference is marked by a hatching.

We now can tackle the calculation of the myon. For that the following considerations to begin with are useful:
Mass is an auxiliary term founded in usefulness, which describes the influence of the electromagnetic field on the speed of light and with that on the spatial extension of the "point mass".
Without exception the local cosmic field E_o has an effect on a free and unbound elementary vortex, thus on an individual e^- or e^+, and determines so its size and its mass.
But as long as we haven't determined this field strength, the calculation of its quantum properties won't succeed.
Instead the masses of compound particles will be compared to each other, which are so heavy that the field strength of the neighbouring vortices is predominant over the basic field E_0, so that a neglect of E_o seems to be allowed. The course of the calculation is made for all elementary particles in the same manner, which is explained hereafter.

Spherical capacitor: (r_i = inner radius; r_a = outer radius)

$$U = \int_{r_i}^{r_a} E\, dr \tag{7.1}$$

Electron ($r_i = 0$ and $r_a = r_e$): $U = 511\ \text{kV} = \text{const.}$ (6.31*)

$$U_1 = U_2 = U_3 = U_4 = \ldots = U_n \tag{7.2}$$

At The radius r_1 is valid: $E(r_1) = E_1$ and

$$U_1 = \int_0^{r_1} E_1\, dr = E_1 r_1 = U_2 = \int_{r_1}^{r_2} E_1\, dr = E_1 (r_2 - r_1) \tag{7.1*}$$

At the radius r_2 is valid for the 2nd and 3rd shell $E(r_2) = E_2$:

$$U_2 = \int_{r_1}^{r_2} E_2\, dr = E_2 (r_2 - r_1) = U_3 = \int_{r_2}^{r_3} E_2\, dr = E_2 (r_3 - r_2) \tag{7.1**}$$

comparison of the radii:

$$\Delta r = \overset{(7.1*)}{r_1 = r_2 - r_1} \overset{(7.1**)}{= r_3 - r_2} = \ldots = r_n - r_{n-1} \tag{7.3}$$

resp.:

$$r_2 = 2 \cdot r_1; \quad r_3 = 3 \cdot r_1; \quad \ldots; \quad \boxed{r_n = n \cdot r_1} \tag{7.4}$$

comparison of the field strengths: (7.1* with 7.1** with Eq. (7.2):

$$E_1 = E_2 = E_3 = \ldots = E_n \tag{7.5}$$

Theory of objectivity, fig. 6.18: $\boxed{E \sim 1/r}$ (6.25)

see fig. 7.5: $E_1(r_3) = E_{31} = -E_1 \cdot (r_1/r_3)$
$E_2(r_3) = E_{32} = E_2 \cdot (r_2/r_3)$
E_0 = cosmic basic field (negligible)

$$E(r_3) = E_{31} + E_{32} + E_0 = E_1 \cdot (r_2 - r_1)/r_3 + E_0 \tag{7.6}$$

$$\boxed{\frac{E(r_3)}{E_1} = \frac{2 \cdot r_1 - r_1}{3 \cdot r_1} = \frac{1}{3}} \tag{7.7}$$

Fig. 7.6: Calculation of the electric field strength E(r) of the myon from its dependency on radius

7.6 Calculation of the vortex fields

The tension voltage of an elementary vortex, like for a spherical capacitor, is determined by integrating over the electric field strength from the inner radius r_i up to the outer radius r_a:

$$U = \int_{r_i}^{r_a} E\,dr \quad (7.1)$$

For the electron ($r_i = 0$ und $r_a = r_e$) we already have carried out the integration and determined the tension voltage to be 511 kV (equation 6.31 *).
Doing so we further had discovered that it won't change, if the radius r varies. Even for a shell configuration, in which electrons and positrons alternately overlap, the approach is valid:

$$U_1 = U_2 = U_3 = U_4 = \ldots = U_n \quad (7.2)$$

At a certain radius all elementary vortices show the same density of field lines and with that also the identical field strength, so that we can solve the integral (7.1) for the each time neighbouring vortex shells and can compare the results:
At the radius r_1 with $E(r_1) = E_1$ the agreement, according to equation 7.1* (fig. 7.6), is valid for the innermost and the overlapped vortex shell.
At the radius r_2 with $E(r_2) = E_2$ the agreement according to equation 7.1** (fig. 7.6) is valid analogously for the 2nd and 3rd shell.
If still more shells are present, then we can arbitrarily repeat this procedure. For the radius of each shell we always obtain relation 7.3, which, related to the innermost radius, provides the following simple expression for the individual radii:

$$r_2 = 2 * r_1; \quad r_3 = 3 \bullet r_1; \quad \ldots; \quad r_n = n * r_1 \quad (7.4)$$

From the comparison of the integration results 7.1* and 7.1** follows further that all elementary vortices produce the same field strength:

$$E_1 = E_2 = E_3 = \ldots = E_n \quad (7.5)$$

We infer from the transformation table (fig. 6.18, eq. 6.27) that the field strengths E and H decrease with 1/r. In fig. 7.5 the decrease of the fields with 1/r is shown. Up to the radius r, the field of the innermost vortex E_1 has worn off to the value $E_{31} = - E_1 \bullet (r_1/r_3)$. This field is overlapped by $E_{32} = E_2 * (r_2/r_3)$ as well as the cosmic basic field E_o:

$$E(r_3) = E_{31} + E_{32} + E_0 = E_1 \bullet (r_2 - r_1)/r_3 + E_o \quad (7.6)$$

The local basic field E_o is not known, but it is very small with regard to the field of the neighbouring vortex shells, so that a neglect seems to be allowed. From equation (7.6) in this way follows with the radius relation (7.4):

$$\frac{E(r_3)}{E_1} = \frac{2 \cdot r_1 - r_1}{3 \cdot r_1} = \frac{1}{3} \quad (7.7)$$

For the shell-shaped configuration of the myon (fig. 7.5) relation (7.7) indicates, which field the outside vortex shell is exposed to. From this can already be seen, how much it is compressed thanks to the field dependent speed of light and how much its mass as a consequence is increased.

Structure of the proton p^+:

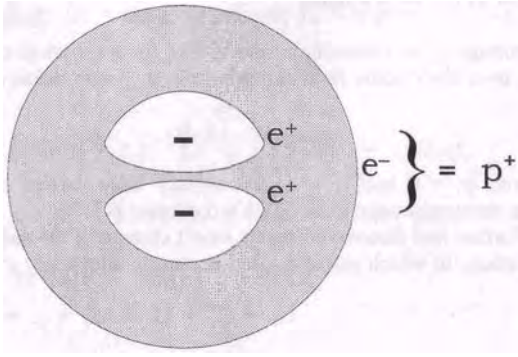

Calculation:
structure consisting of two shells, inner vortices with $2 \cdot E_1$,
field strength at the outer radius r_2:

$$E(r_2) = 2 * E_{21} = 2 * E_1 (r_1 / r_2) = E_1 \qquad (7.8)$$

Comparison of p^+ (7.8) with u^- (7.7) (z_e = number of the elementary vortices being involved with) in building up the structure, here each time $z_e = 3$):

Comparison of the radii with $E \sim 1 / r$ (6.27)

$$\frac{r_p}{r_\mu} = \frac{z_{e\mu}}{z_{ep}} \cdot \frac{E_\mu (r_3)}{E_p (r_2)} = \frac{3}{3} \cdot \frac{1/3}{1} = \frac{1}{3} \qquad (7.9)$$

Theory of objectivity (fig. 6.18): $m \sim 1/r^2$ (6.34)

$$\frac{m_p}{m_\mu} = \frac{z_{ep}}{z_{e\mu}} \cdot \left(\frac{r_\mu}{r_p}\right)^2 = \frac{3}{3} \cdot \left(\frac{3}{1}\right)^2 = 9 \qquad (7.10)$$

$$m_p/m_e = 9 * (m_u/m_e) = 9 * 207 = 1863 \qquad (7.11)$$

Measurement value, proton mass: $m_p = 1836 \cdot m_e$
Resp.:
measurement value myon mass $m_u = 207 * m_e$
myon calculated value: $m_p = 204 * m_e$. (error = 1,5%)

Since we, by using this calculation method, for the first time succeeded in deriving the mass of an elementary particle from that of another particle, the particle mass isn't a constant of nature anymore!

Fig. 7.7: Calculation of the proton

7.7 Calculation of the proton

If we again remember the affinity of two elementary vortices, which rotate with opposite spin. They align their axis of rotation antiparallel and form a very probable, but not particularly tight bound pair (fig. 7.4).
If we this time start with a positron pair, then does this pair have a double positive elementary charge. The two e^+ hence exert a particularly big force of attraction on electrons flying past them. If they have cached one and put it round as a shell, like a coat, then they will never again give it back! To again remove the electron, a triple positive charge would be necessary. But such a particle can't exist at all. The new particle therefore has an absolute stability and a very big mass, because the positron pair is considerably compressed by its outer shell. The total charge is single positive. With these properties it actually only can concern the proton. Its structure is shown in fig. 7.7.
We can start from the assumption that both positrons are very close together in the inside and thus each forms the half of a sphere. For the calculation of the proton mass we then can assume as an approximation a structure of two shells, in which the inner vortex will have the double charge and the double field ($2 * E_1$). With equation 7.4 the field strength at the outer radius r_2 is:

$$E(r_2) = 2*E_{21} = 2*E_1*(r_1/r_2) = E_1 \qquad (7.8)$$

If we want to compare the results of the p^+ (7.8) and the μ^- (7.7), then it should be considered that the field of the innermost elementary vortex E_1 only is equal, if the number z_e of the elementary vortices involved in building up the particle is identical. Here with each time $z_e = 3$ this is the case. Because of equation 6.27 (E, H ~ 1/r) now also the radii are comparable:

$$\frac{r_p}{r_\mu} = \frac{z_{e\mu}}{z_{ep}} \cdot \frac{E_\mu(r_3)}{E_p(r_2)} = \frac{3}{3} \cdot \frac{1/3}{1} = \frac{1}{3} \qquad (7.9)$$

The mass of a particle first is determined by the number of the elementary vortices z_e. According to the theory of objectivity (fig. 6.18) however also the radius has an influence on the mass:

$$m \sim 1/r^2 \qquad (6.34)$$

This proportionality should be applied to the p^+-μ^-- comparison.

$$\frac{m_p}{m_\mu} = \frac{z_{ep}}{z_{e\mu}} \cdot \left(\frac{r_\mu}{r_p}\right)^2 = \frac{3}{3} \cdot \left(\frac{3}{1}\right)^2 = 9 \qquad (7.10)$$

The calculation provides a nine times bigger mass for the proton with regard to the mass of the myon. Therefore the mass of the proton related to the mass of the electron is:

$$m_p/m_e = 9*(m_\mu/m_e) = 9*207 = 1863 \qquad (7.11)$$

It would be favourable, to start from the with measuring techniques determined value for the mass of the proton $m_p/m_e = 1836$ and calculate backwards the related mass of the myon.
Then we obtain 204 as the calculated value instead of the measurement value m_μ/m_e= 207.
The reason for the deviation of 1.5 percent is caused by the neglect of the cosmic field E_o with regard to the field of the neighbouring elementary vortex. This neglect takes very much less effect for the relatively heavy proton than for the light myon.
The cosmic field therefore will compress the myon more strongly and increase the mass more strongly as is calculated here, in agreement with the measurement results.
Summarizing: since we, by using this calculation method, for the first time succeeded in deriving the mass of an elementary particle from that of another particle, the particle mass isn't a constant of nature anymore!

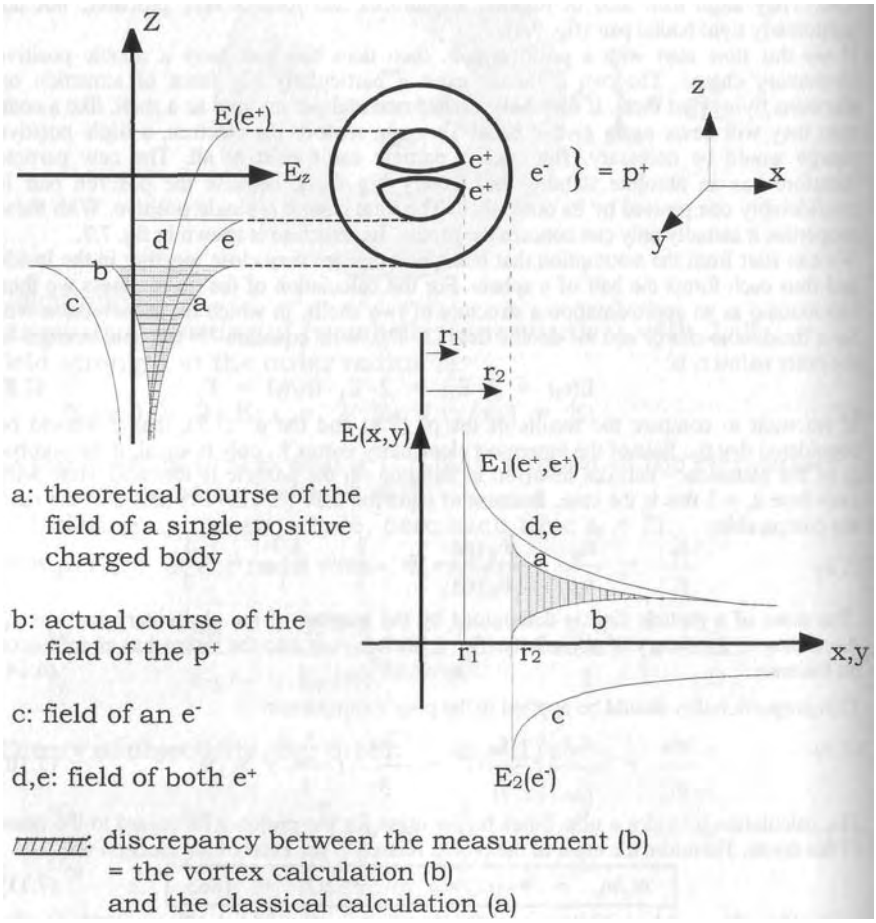

Fig. 7.8: The proton and the electric field of the three elementary vortices in x-, y- and z-direction

7.8 "Strong interaction"

A central question of nuclear physics concerns the forces which keep the atomic nucleus, which consists of many neutrons and protons, together and give it its very good stability in spite of the like positive charge (key question XIV fig. 7.13).
According to today's textbook opinion (course of the field indicated with a in fig. 7.8) the forces of repulsion between the individual protons increase further as the distance gets smaller, to obtain immense values within the nucleus. They theoretically had to be overcome by new and unknown nuclear forces. Therefore physicists assume the hypothesis of a "strong interaction". But they are mistaken.
The answer to this open question is provided by the course of the field (b) for the proton, sketched in fig. 7.8. We see that the electric field at first indeed still increases if we approach the proton, but in the proximity it contrary to all expectations decreases again until it is zero. With that then also any force of repulsion has vanished! But the course of the field follows without compulsion from the overlap of the three individual elementary vortex fields.
The field direction in the z-direction even is reversed! In this topsy-turvy world, in theory, an electromagnetic force of attraction between two like charged protons can occur. We conclude:
A strong interaction doesn't exist at all. The usually given values for "range" and "strength" just represent a misinterpretation. The hatched drawn area marks the difference which is misinterpreted by quantum physics. The model concept over and above that answers another mysterious property of the proton. As an electrically charged particle with a spin it first of all should form a magnetic moment for reason of the rotating charge. But until now the measurable order of magnitude couldn't be explained.

7.9 Magnetic moment of the proton

If the inner positrons rotate around each other with oppositely pointing spin, then the magnetic field line is already closed within the particle and no effect in x- or y-direction is observable from the outside.
As pair they however still can rotate together around the z-axis and they'll do that. The overlapping electron for reason of its rotation of its own will likewise build up a magnetic dipole moment along its axis of rotation. It also will align its axis in the z-direction, so that now all three elementary vortices have one field axis. Being comparable to individually "elementary magnets" aligned in the same direction they produce a triple magnetic moment (key question XII fig. 7.13).
If we namely would start with a single positively charged body according to the theory of quantum mechanics, then we would have expected the value of the nuclear magneton[<i>] p_m as the magnetic moment for the proton $p_m = e \cdot \hbar/2m$. Opposite to that provide experiments with protons the approx. threefold value as already predictable by the new vortex theory. In addition does the direction of the vector p_{mp} correspond with the spin-axis, so as if the proton were negatively charged. The reason for that is that only the outermost elementary vortex determines the spin of the particle, and that is actually a negatively charged electron! Also this excellent agreement in the case of the proton can be judged as proof for the correctness of the vortex model.

<i>: The nuclear magneton has the value of: $p_{mk} = 5{,}0508 \cdot 10^{-27}\ Am^2$

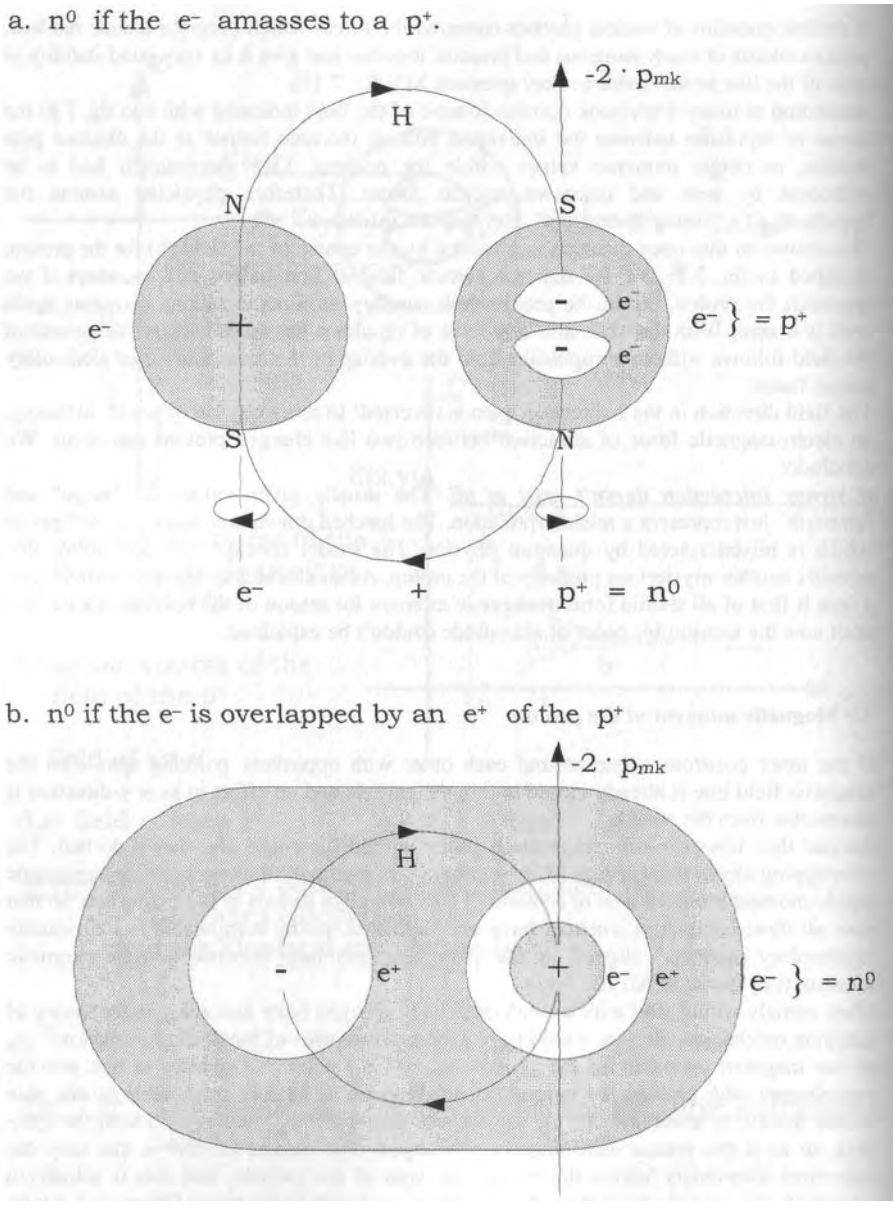

Fig. 7.10: The neutron with magnetic dipole field H

7.10 Structure of the neutron

Until now could not be solved, why despite its missing charge also the neutron n° has a magnetic moment. The experimentally determined value is approx. the double of the nuclear magneton. Further was with measuring techniques an only 0,14% bigger mass with regard to the proton determined. The difference is approximately two and a half electron masses. And how reads the answer in the view of the potential vortex theory? It is obvious that a positively charged proton and a negatively charged electron mutually attract and amass together (fig. 7.10a). A pair annihilation can't occur, because the electron, which jackets both positrons, prevents this. The formation of an outer shell is not permitted by the high stability of the proton. It would have to be a positron shell, which instead of neutrality would produce a double positive charge. Conceivable is however the configuration, in which one of the two e^+ of the proton takes up the e^- in its inside and overlaps it (fig. 7.10b).

At first appears the amassing of p^+ and e^- to be the obvious answer to the structure of the neutron also in view of the small increase in mass. Since both elementary particles (p^+ and e^-) have a spin, will they align their axes of rotation antiparallelly and rotate against one another, exactly like an electron pair. But we now have unequal conditions: the proton brings the triple magnetic moment, the electron however only the single, and its field line will be closed by the proton. The difference which remains is the measurable double nuclear magneton, with which key question XIII (fig. 7.13) would be answered exhaustively.
This structure is shown in fig. 7.10a and has as rest mass the by only one electron mass increased proton mass, but it will deviate from this value, when the unequal partner come closer. Doing so the electron will be more strongly compressed by the heavier proton as vice versa.
Mass, magnetic moment and charge thus correspond to a large extent with the measurement values. Problems are seen concerning the spin and the stability.
Set of problems concerning spin: both the e^- and the p^+ have a half-integer spin, for which reason this configuration should have an integer spin.
Set of problems concerning stability: the neutron decays as is well-known in a p^+ and an e^- , but this object should be shorter-lived as determined by experiments. If namely the partner come each other very close, then the field strength of the p^+, contrary to expectation, doesn't increase but decreases, as is shown in fig. 7.8. The e^- therefore can only be bound very, very loosely; in z-direction it even will be repelled!
For these reasons is the open structure, which is shown in fig. 7.10a, not feasible as an isolated elementary particle, but only in a spatially extended network, like it is present in an atomic nucleus. In this case the neutron is, as is well-known, lighter by the mass defect, which is interpreted as binding energy.
Possibly it only concerns an intermediate stage. The heavier final product of the n° then could look like is shown in fig. 7.10b. For this version the line of the magnetic field already is closed partly within the particle, so that also here the approx. double nuclear magneton remains as a rest with a sense of orientation, as if the neutron were negatively charged.
Without charge and with the 1/2 spin it in this configuration fulfils all important quantum properties of the neutron, even that of the stability.

the field of the e^-: $E_{31}(-) = - E_1 (r_1/r_3)$,

the field of the e^+: $E_{32} = E_2 (r_2/r_3) = E_1 (r_2/r_3)$

and in addition the e^+: $E_{31} = E_1 (r_1/r_3)$.

$$E(r_3) = E_{31}(-) + E_{32} + E_{31} + \underbrace{E_0}_{\text{negligible}}$$

With the radius relation (eq. 7.4): $r_2 = 2*r_1$ und $r_3 = 3* r_1$
The total field is:

$$\frac{E(r_3)}{E_1} = -\frac{r_1}{r_3} + \frac{r_2}{r_3} + \frac{r_1}{r_3} = -\frac{1}{3} + \frac{2}{3} + \frac{1}{3} = \frac{2}{3} \quad (7.12)$$

With $z_{en} = 4$ elementary vortices

$$\frac{r_n}{r_p} = \frac{z_{ep}}{z_{en}} \cdot \frac{E_p(r_2)}{E_n(r_3)} = \frac{3}{4} \cdot \frac{1}{2/3} = \frac{9}{8} = 1{,}125 \quad (7.13)$$

n_0 is 12,5% bigger than p±

$$\frac{m_n}{m_p} = \frac{z_{en}}{z_{ep}} \cdot \left(\frac{r_p}{r_n}\right)^2 = \frac{4}{3} \cdot \left(\frac{8}{9}\right)^2 = 1{,}05 \quad (7.14)$$

n^0 is 5% heavier than p±

Fig. 7.11: Calculation of the mass of the neutron

7.11 Calculation of the neutron

The calculation of the mass for the structure of the neutron according to fig. 7.10b has still remained open.

Because in this book for the first time has been shown, how the mass can be calculated, if the particles are understood as potential vortices, we also in this case again want to make use of this possibility.
We have, like for the μ^-, a structure of three shells with the radii r_1, r_2 and r_3. At the outer radius r_3 the fields of the elementary vortices on the inside have an effect on the electron On the outside: like is the case for the μ^-

the field of the e^-: $E_{31}^{(-)} = -E_1(r_1/r_3)$,

the field of the e^+: $E_{32} = E_2\,(r_2/r_3) = E_1\,(r_2/r_3)$

and in addition the e^+: $E_{31} = E_1\,(r_1/r_3)$.

The total field is, with the radius relation equation 7.4:

$$\frac{E(r_3)}{E_1} = -\frac{r_1}{r_3} + \frac{r_2}{r_3} + \frac{r_1}{r_3} = -\frac{1}{3} + \frac{2}{3} + \frac{1}{3} = \frac{2}{3} \quad (7.12)$$

If we compare the neutron, in which now $z_e = 4$ elementary vortices are involved, with the proton:

$$\frac{r_n}{r_p} = \frac{z_{ep}}{z_{en}} \cdot \frac{E_p(r_2)}{E_n(r_3)} = \frac{3}{4} \cdot \frac{1}{2/3} = \frac{9}{8} = 1{,}125 \quad (7.13)$$

then we infer from the arithmetically determined result that the neutron according to the radius is 12,5% bigger than the proton. The mass is calculated to:

$$\frac{m_n}{m_p} = \frac{z_{en}}{z_{ep}} \cdot \left(\frac{r_p}{r_n}\right)^2 = \frac{4}{3} \cdot \left(\frac{8}{9}\right)^2 = 1{,}05 \quad (7.14)$$

The particle therefore has a mass which is 5% larger than for the proton, slightly more as has been measured for the neutron. The difference is acceptable. The particle after all is structured very asymmetrically, in which the reason is to be seen, why the uncharged particle, looked at from close up, nevertheless shows an observable charge distribution.

Decay equations if neutrinos are involved:

$$n^0 \longrightarrow p^+ + e^- + \bar{\nu}_e \tag{7.15}$$

$$n^0 + \nu_e \longrightarrow p^+ + e^- \tag{7.15*}$$

$$\mu^- \longrightarrow e^- + \bar{\nu}_e + \nu_\mu \tag{7.16}$$

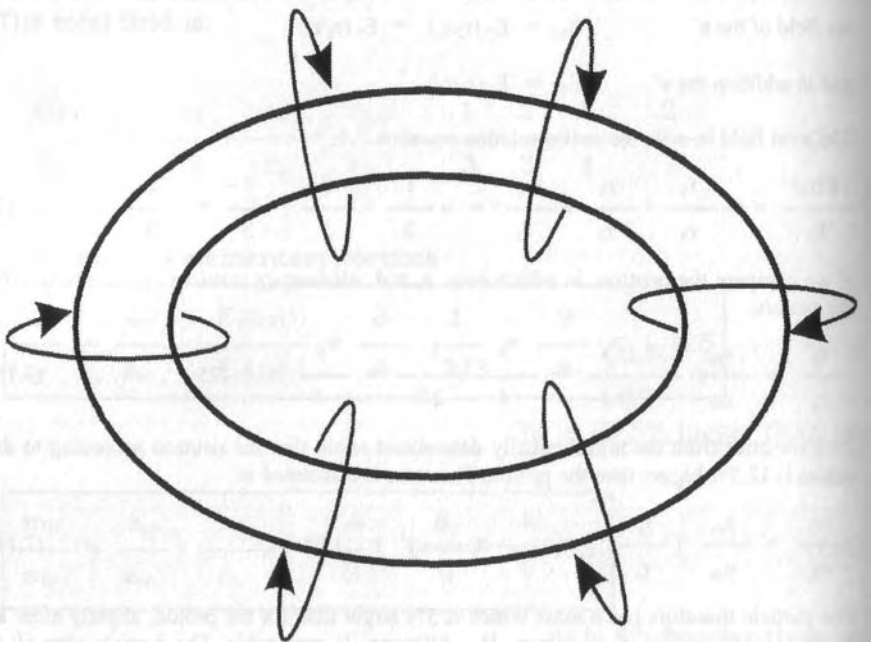

Fig. 7.12: The electron-neutrino as a ring-like vortex

7.12 ß-decay

In the case of the calculated quasistable particles, the μ^- and the n°, the verification by means of the well-known decay processes is still due. Also free neutrons, those which are not bound in an atomic nucleus, decay. But with an average life of 918 seconds they are by far the longest living among the quasistable elementary particles. Should the neutron decay be triggered by neutrinos, then obviously a distant flying past does not suffice. For that the electron is bound in the proton too tight. There probably has to occur a direct "crash", in which a neutrino is used, since the decay equation reads:

$$n^0 \longrightarrow p^+ + e^- + \overline{\nu}_e \quad (7.15)$$

As could be expected a proton p^+, an electron e^- and the mentioned electron-antineutrino ν_e are formed. What here is written down as the emission of an antiparticle, is equivalent in the absorption of the particle<i>, in this case of the neutrino. The reaction equation 7.15 can be reformulated accordingly<i>:

$$n^0 + \nu_e \longrightarrow p^+ + e^- \quad (7.15^*)$$

Also for the decay of the myon an electron-neutrino is used. In both cases it provides the energy necessary for the decay. But we can really understand the β-decay only, after we have got to know these particles better.

Without charge and without mass neutrinos show hardly any interactions with matter and as a consequence they possess the enormous ability of penetration - as is well-known. They are said to participate in the „weak interaction", which should trigger a conversion of the concerned particles, which is their decay. Pauli already has postulated the neutrino 1930 theoretically, because the transition from a half-integer spin to an integer spin for the n^0 -decay otherwise wouldn't have been explicable.

If we imagine an elementary vortex is being born, but the local field strength and energy isn't sufficient for obtaining a quantized state. The result is an incomplete potential vortex, which has an open vortex centre and as a consequence shows no localization at all. In the form of a vortex ring it oscillates around itself, while it continually turns its inside to the outside and then again to the inside.
One moment the vortex ring is green, then it is red again, one moment matter, then anti-matter, one moment positively charged and the next moment negatively charged. In contrast to the photon the number of the involved elementary vortices z_e for the neutrino is odd (for the ν_e z_e= 1). Perpendicular to the direction of propagation the neutrino has a spin $(s/\hbar = ½)$ for reason of a rotation, which overlaps the pulsating oscillation. This vortex ring is, as said, not a member of stationary matter, because it doesn't form a "black hole" in its centre, where the speed of light becomes zero. But it has an absolute stability like every elementary vortex, even if it only occurs incomplete and hence not in any quantized form,. This concept of the electron-neutrino as an open oscillating elementary vortex in the form of a ring-like vortex covers the experimentally determined realizations unexpectedly well.

<i>: Kussner, H.G.: Grundlagen einer einheitlichen Theorie der physikalischen Teilchen und Felder, Musterschmidt, Gottingen 1976, S.155

A strong interaction doesn't exist. The electric field in the proximity of the proton goes to zero within the range which is determined with measuring techniques.

A weak interaction doesn't exist. That interaction only is a special case of the electromagnetic interaction which appears in a weakened form. _____

XII: Why does the proton have approximately 3 times the magnetic moment which can be expected for reason of the only single charge?
(3 elementary vortices)

XIII: Why does the neutron as an uncharged particle anyway have a magnetic moment?
(Structure of the n°)

XIV: What owes the atomic nucleus, which consists of like charges, its stability?
(Course of the field of the p^+, instead of "strong interaction")

XV: Why does the free neutron decay, although it is stable as a particle of the nucleus? _____
(Interaction with neutrinos)

XVI: Why do neutrinos nevertheless participate in the "weak interaction", although they have no mass and no charge? _____
(Oscillating charge)

XVII: How can be given reasons for the finite range _____of the "weak interaction"?
(Reaction cross-section for particle decay)

Fig. 7.13: Further key questions of quantum physics (Continuation of figures 4.4 and 6.13)

7.13 "Weak interaction"

Let's now look again at the β-decay of the neutron, in which a neutrino ν_e is used. But this by no means will be a process of the weak interaction. Instead will neutrinos, contrary to the textbook opinion, participate in the electromagnetic interaction. They after all are one moment positively charged and the next moment negatively charged. With slow-acting gauges this it is true can't be proven, because the interaction is zero on the average. But this charged oscillating vortex ring can exert a considerable effect while approaching a neutron, which is based solely on the electromagnetic interaction.
The neutron is stimulated to synchronous oscillations of its own by the high-frequency alternating field of the neutrino, until it in the case of the collision releases the bound electron, which takes up the energy provided by the neutrino and transports it away. The interaction obviously is only very weak due to the oscillation. But a physical independency of it has to be disputed.
The finite range, which is given in this context, indicates the reaction cross-section around the n°-particle, within which the "crash" and as a consequence the β-decay occurs. This range is considerable larger as the particle itself. The electromagnetic interaction for such small distances after all is so violent, even if it only occurs in pulses, that the neutrino is thrown out of its path and can fly directly towards the neutron.

Perhaps we now understand also the β-decay of the myon. It actually were to be expected that without outside disturbance an absolute stability could exist because of the ideal symmetry of the μ^-. On our planet we however are in every second bombarded with approx. 66 milliard (billion) neutrinos per cm^2 <i>. Obviously it takes 2,2 μs on the average till a neutrino ν_e flies past a myon so close that it decays. In doing so it stimulates the outside elementary vortex to violent oscillations by trying to synchronize it. In this case the electron-neutrino ν_e carries away with it the two outer, and therefore weaker bound, elementary vortices of the myon, which meanwhile are oscillating synchronously. The innermost vortex, an electron e^-, is left behind. The decay of the myon which takes place with a probability of almost 100 % reads:

$$\mu^- \longrightarrow e^- + \overline{\nu}_e + \nu_\mu \quad \text{resp.} \quad \mu^- + \nu_e \longrightarrow e^- + \nu_\mu \qquad (7.16)$$

Thus a different neutrino ν_μ, is formed which can be distinguished from the ν_e and is called myon-neutrino since it forms from the μ^-. Actually it even has a similar structure of three shells, as is shown in fig. 7.5. But the vortex centre is open and the particle isn't stationary anymore. In the picture now only a momentarily state is shown, in which the ν_μ appears green on the outside and red in its open centre. As already for the ν_e oscillates also here the inside to the outside and vice versa, this time merely as a packet of three shells, so that also this particle shows all the typical neutrino properties discussed for the example of the ν_e.
The for potential vortices typical and already discussed phenomenon of transport here has an effect. In particular in connexion with vortex rings this property is known from hydrodynamics. It thus can be observed, how vortex rings bind matter and carry away with them. Because the neutrino is not quantized, it neither is restricted with regard to its ability to transport elementary vortices. Consequently even bigger configurations are conceivable, like configurations of 5 shells, 7 shells etc..

<i>: "Zeugen aus der Sonne", VDI-Nachrichten Nr. 45 vom 9.11.90, Seite 26

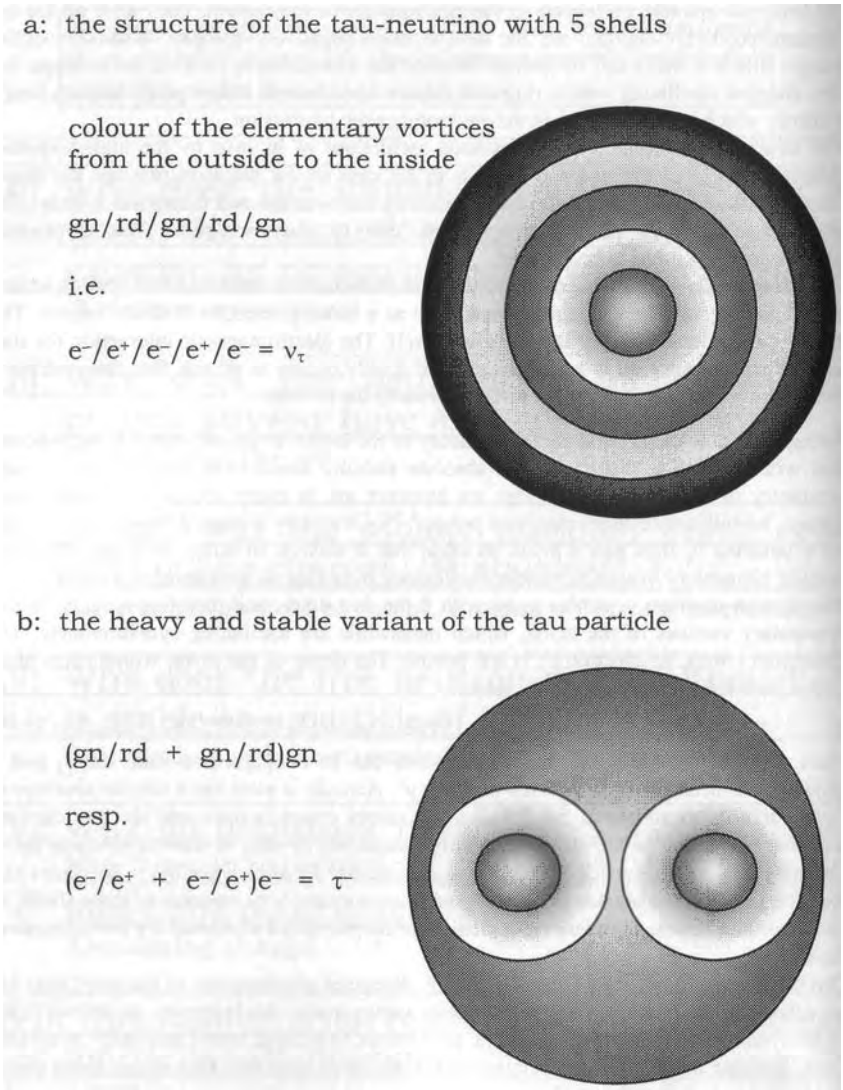

Fig. 7.14: Tau-neutrino and tau particle

7.14 Tau particle

In the table of the leptons after the e^- and the μ^- as the next particle the tau particle τ^- is found with its accompanying neutrino ν_τ. The obvious solution for the tau particle is the structure of five shells, as is shown in fig. 7.14a. With that the electron would have another particularly heavy relative with otherwise very similar properties. For the myon the neutrino was stable, the particle itself however instable. We after all huve explained the particle decay as a consequence of an outside disturbance, and disturbances always are based on interactions. Correspondingly should, with the small possibility for an interaction, also the neutrino ν_τ of the tau particle have a better stability than the particle τ^- itself.
Without doubt this structure of 5 shells fulfils all known quantum properties like spin, charge etc. Merely the check of the mass is still due. This we now want to calculate for the structure shown in fig. 7.14a.

$$m_5 = m_p \cdot \left(\frac{z_{e\tau}}{z_{ep}}\right)^3 \cdot \left(-\frac{r_1}{r_5} + \frac{r_2}{r_5} - \frac{r_3}{r_5} + \frac{r_4}{r_5}\right)^2 \quad (7.17)$$

$$m_5 = 1836 \cdot \left(\frac{5}{3}\right)^3 \cdot \left(\frac{2}{5}\right)^2 \cdot m_e = \underline{\underline{1360 \cdot m_e}} \quad (7.17^*)$$

But the for the tau particle measured value is considerable higher!
Even if this structure is the only possible in the case of the neutrino ν_τ for reason of the complete symmetry, will the tau particle however change its structure by itself if another structure exists, which is more stable, thus in which the particle can take a bigger mass. Such a maximum provides the structure shown in fig. 7.14b after checking all possible configurations with five elementary vortices:

$$m_\tau = m_p \cdot \left(\frac{z_{e\tau}}{z_{ep}}\right)^3 \cdot \left(\left(-\frac{r_1}{r_3} + \frac{r_2}{r_3}\right) \cdot 2\right)^2 \quad (7.18)$$

$$m_\tau = 1836 \cdot \left(\frac{5}{3}\right)^3 \cdot \left(\frac{2}{3}\right)^2 \cdot m_e = \underline{\underline{3778 \cdot m_e}} \quad (7.18^*)$$

This value now lies 8% above the measurement values. It would be obvious, if unbound tau particles predominantly would take the structure shown in fig. 7.14b. The remaining error becomes explicable, if a very small number of tau particles in the lighter structure according to fig. 7.14a are involved with a correspondingly smaller probability.

The enormous variety of kinds of decay, and not a single one of the dominating ones has a probability of over 50%, makes it more difficult for us, to be able to directly infer the inner structure of a particle from the decay products. It nevertheless should be mentioned that after all 35% of all decays take place by taking up and using a neutrino ν_e or ν_τ, entirely in accordance with the model of the myon decay (equation 7.16).

name	mass (m/m_e) measured	mass (m/m_e) calculated	el.-vortices z_e	charge Q	radius r/r_p	inner structure of The elementary vortices, colour: (gn=green; rd=red) from the inside to the outside
e^-	1	-	1	-1	-	Fig. 4.3 gn
γ^0	-	136	2	0	3	Fig. 7.3 rd/gn
μ^-	207	204	3	-1	3	Fig. 7.5 gn/rd/gn
η^0	1072	1088	4	0	1,5	rd/gn/rd/gn
(ρ^-)	1509	1360	5	-1	1,5	Fig. 7.14a gn/rd/gn/rd/gn
D^0	3650	3672	6	0	1	rd/gn...rd/gn
D^+ or F^+	3658 till 4188	4284	7	+1	1	gn/rd...rd/gn
(B^0)	10321	8704	8	0	0,75	rd/gn...rd/gn

7.15 Table of vortices of the calculated leptons and mesons compared with measurement values (Part 1).

7.15 Pions

Unlike the leptons, which we could derive and calculate fairly completely, the mesons don't have a half-integer spin. With this characteristic property they therefore can't represent an individually overlapped elementary particle and they probably will consist of the amassing in pairs of individual configurations of potential vortices. This kind of bond can't be particularly tight. Consequently we don't know any stable mesons.

The most important basic building part of the mesons we have got to know over the positronium in fig. 7.3. It necessarily has to amass to another particle, otherwise it annihilates under emission of a γ-quanta, as already mentioned. This γ^0-particle, as it will be named here, has the mass of:

$$m_{\gamma 0} = (2/3)^3 \cdot (1/2)^2 \cdot 1836 \cdot m_e = 136 \cdot m_e \quad (7.19)$$

which only can be determined arithmetically. As a partner, to which the γ^0-particle can amass, first of all another γ^0-particle should be considered. Because both partner will rotate against one another, this new particle would not have a spin and moreover would be uncharged. The mass now would be twice as big with:

$$m_{\pi 0} = 2 \cdot m_{\gamma 0} = 272 \cdot m_e \,. \quad (7.19^*)$$

But the two γ^0-particles will come very close together and mutually feel the local, in the same direction orientated, distribution of the field, which will lead to a weakening of the field and as a consequence to a slight reduction of the mass.
With these properties it probably concerns the uncharged pion π^0. This model concept finds an excellent confirmation in the two possible kinds of decay, which can be regarded as equivalent:

$\pi^0 \longrightarrow \gamma + \gamma$ with a probability of 99%
and

$\pi^0 \longrightarrow \gamma + e^- + e^+$ with a probability of 1%

Also in the case of the charged pion $\pi^\pm$ the observable decay offers a big help, which will take place with a frequency of almost 100 %:

$$\pi^\pm \longrightarrow \mu^\pm + \nu_\mu$$

The equation doesn't state anything about the fact, if a neutrino ν_e is used in the process. But it points at the circumstance that the partner of the γ^0-particle for the $\pi^\pm$ most likely is a myon $\mu^\pm$. The mass will be smaller than the sum of both building parts:

$$(204+136) * m_e = 340 * m_e.$$

name	mass (m/m_e) measured	masse (m/m_e) calculated	elem.-vortices z_e	charge Q	inner structure of The elementary vortices, colour: (gn=green; rd=red) from the inside to the outside
B^-	11194	9793 +?	9 +?	-1	$r/r_p = 0{,}75$ gn/rt...rt/gn
(Y^0)	18513	17001 +?	10 +?	0	$r/r_p = 0{,}6$ rt/gn...rt/gn

Some compound configurations

π^0	264	272	4	0	2 x fig. 7.3 $\gamma^0 + \gamma^0 = \pi^0$
π^-	273	340	5	-1	fig. 7.3 + fig. 7.5 $\mu^- + \gamma^0 = \pi^-$
τ^-	3487	3778	5	-1	fig. 7.14b (2x gn/rd)/gn
(K^0)	974	918 +?	6 +?	0	$r/r_p = 2$ (2x rd/gn)/ rd/gn
(K^-)	967	939 +?	11 +?	-1	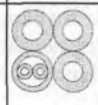 (rd/gn + gn)/ rd/gn + 3 γ^0

Fig. 7.16: Table of vortices of the calculated leptons and mesons compared with measurement values (Part 2).

7.16 Table of vortices of the mesons

The numerous kinds of decay for K-mesons suggest that these strange particles will consist of various combinations of amassed together and in pairs rotating γ^0- and $\mu^{\pm}$-particles. The possibilities of combination now already have increased in such a way that for every kaon and other mesons several solutions can be proposed. To avoid unfounded speculations, only a few clues will be given.

Besides the γ^0-particles also heavier arrangements should be considered as partner for the spin and as a building part for kaons and other mesons.
If for instance a π^0 is overlapped by a γ^0, then this particle has an arithmetically determined mass of 918 m_e. It therefore can concern a building part of the uncharged kaon K^0.

The likewise with three γ^0 formed configuration of 6 shells however, if it actually would staystable for the duration of a measurement, would have the mass of 3672 electron masses<i>.

A very much better detectability must be attributed to the configuration of 4 shells which consists of two γ^0, so to speak a heavy relative of the γ^0 and the π^0. It among others should be able to decay like a π^0. With this property and with an arithmetically determined mass of 1088 m_e it actually only can concern the η^0-meson. Solely according to the numeric value the η^0-meson could also consist of four π^0-mesons; but the decay in only two light quants speaks against it.

The kaon-puzzle in addition is made more difficult by the spontaneously possible ability to change of the involved γ^0-particles during a process of decay, as is made clear by the numerous kinds of decay. These dependent pion halves can be "swallowed" or "spit out" by neutrinos in the process, they can form from incident light or be emitted as photons and eventually they even can break up in their individual parts.

In fig. 7.16 the possible configurations of potential vortices are sketched and the respective, according to the new theory calculated, mass is given. If above that the other decay products and quantum properties, which can be given for the vortex structures, are added, like e.g. charge, spin and if need be magnetic moment, then an assignment without doubts to the until now only from measurements known elementary particles is possible. In order to better be able to assess the efficiency of the potential vortex theory, the measurement values are compared to the calculated values.

Some terms are put in brackets, because it can be assumed that the calculated part only concerns the dominating part, to which further γ^0 or other small configurations of vortices will amass for reason of its high mass. Correspondingly should the mass in that case be corrected slightly.

<i>: It could e.g. concern the D°-meson.

name	way of decay	mass (m/m_e) measured	mass (m/m_e) calculated	elem.-vortices z_e	charge Q	Inner structure of the baryon vortices
p^+	stable	1836	- (reference value)	3	+1	fig. 7.8 $r/r_p = 1$ $(2x\ e^+)/e^-$
n^0	$p^+ + e^- + \bar{\nu}_e$ (100%)	1839	1837	4	0	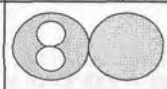 figure 7.10a $p^+ + e^-$
			1934	4	0	figure 7.10b n^0 $r/r_p = 1{,}13$
Λ^0	$p^+ + \pi^-$ (64%)	2183	(2176)	8	0	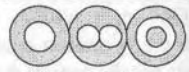 $\gamma^0 + p^+ + \mu^-$ (64%)
	$n^0 + \pi^0$ (36%)		2187 (2206)	8	0	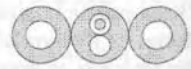 $\gamma^0 + n^0 + \gamma^0$ (36%)
Σ^+	$p^+ + \pi^0$ (51%)	2328	(2108+?)	7 + ?	+1	$\gamma^0 + p^+ + \gamma^0$ (+?) (51%)
	$n^0 + \pi^+$ (49%)		2142+? 2177	9	+1	$\gamma^0 + e^+ + p^- + \mu^0$ (49%)
Σ^-	$p^+ + \pi^-$ (100%)	2343	2274	9	-1	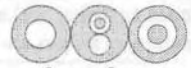 $\gamma^0 + n^0 + \mu^-$ (100%)

Fig. 7.17: Table of vortices used for the calculation of the most
important barvons with suggestions for the structure (Part 3).

7.17 Table of vortices of the baryons

The number of possibilities of combination quickly increases, if only a few elementary vortices extend the structure of a particle. This probably is the reason for the large number of observable hyperons, which recently have been produced artificially and observed with the help of particle accelerators.

Both the neutron and the lambda particle can exist in a lighter and a heavier variant. At the moment of the decay, as it for instance is observed in a bubble chamber, according to expectation the state with the smaller mass takes the bigger probability. But in the amassing with further particles as building part of bigger and heavier hyperons the heavier structure is more likely. This circumstance should be considered in calculating the mass of the hyperons.

In figures 7.17 and 7.18 the most important baryons are listed, which are characterised in the way that one of the amassed together packets of vortices is a nucleon, thus a proton or a neutron.

The given, from measurements known, kinds of decay are able to confirm the inner structure pretty good. Of course an infinitely lot of combinations are conceivable and numerous predictions are possible. But speculations are unnecessary from the time on where we are able to calculate the particles!
The restriction to the few in the table listed particles seeming to be important hence doesn't limit the universal importance of the theory of objectivity in any way!

name	way of decay	mass (m/m_e) measured	mass (m/m_e) calculated	elem.-vortices z_e	charge Q	Inner structure of the baryon vortices
Σ^0	$\Lambda^0 + \gamma$ (100%)	2334	2342	10	0	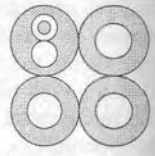 $n^0 + \gamma^0 + \gamma^0 + \gamma^0$ (100%)
Θ^0	$\Lambda^0 + \pi^0$ (100%)	2573	2478	12	0	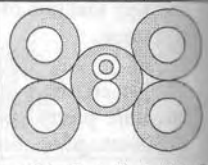 $n^0 + \gamma^0 + \gamma^0 + \gamma^0 + \gamma^0$ (100%)
Θ^-	$\Lambda^0 + \pi^-$ (100%)	2586	2546	13	-1	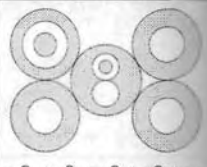 $n^0 + \gamma^0 + \gamma^0 + \gamma^0 + \mu^-$ (100%)
(Ω^-)	$\Lambda^0 + K^-$ (69%)	3273	3172 +?	17 +?	-1	$n^0 + \gamma^0 + \gamma^0 + ?$ (31%: ? = div.)

Fig. 7.18: Table of vortices used for the calculation of the most
important baryons with suggestions for the structure (Part 4).

8. Unified theory

With the theory of objectivity the longed for goal of a "theory of everything" (TOE), of an universal theory, seems to have moved within reach. If in the nineteenth century still promising field theories and approaches were being discussed, then has at the latest Einstein's theory of relativity destroyed all hopes in such a theory. Science as a consequence has become very much more modest and understands a TOE only as the unification of all known interactions.

Einstein has stated the minimum demand so: "a theory should be favoured by far, in which the gravitational field and the electromagnetic field together would appear as a whole" <i>. It is evident that a subjective or relativistic observer theory never is able to achieve this.

The presented theory of objectivity made it possible that the unification here for the first time actually has succeeded. This undoubtedly brings science a whole lot further, but it still is not sufficient to lie one's hands in one's lap being content with oneself. After all we still know very much more phenomena, which likewise should be unified. After all it is no accident that both Maxwell and Einstein, to name only two prominent representatives, after completion of their well-known works have struggled for the question, what sort of phenomenon it concerns in the case of the temperature and how this could be integrated in their theory.

The requirement reads: We must be able to derive all basic factors, which influence our system of units with their basic units, as a compulsionless result from the new theory. Besides the dimensions of space and time which determine our continuum, the explanation and unification of the basic factors mass and charge has to be tackled. If we have succeeded in doing so, we'll also tackle the problem of the fifth and last basic factor, which until now has put itself in the way of any unified theory as the question of fate, the problem of the temperature!

<i>: Einstein, A.: Grundziige der Relativitatstheorie, Vieweg+Sohn, Braunschweig 1973, 5. Aufl., WTB 58. Seite 97.

"A theory should be favoured by far, in which the gravitational field and the electromagnetic field together would appear as a whole"[i].

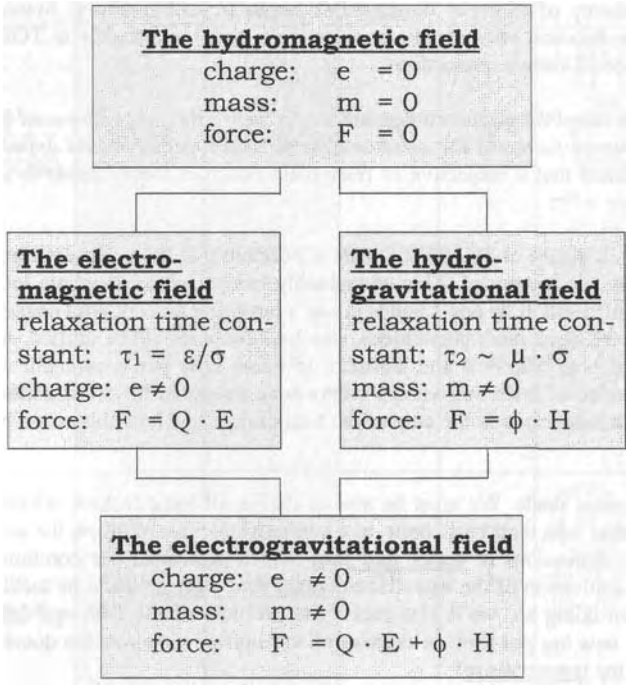

Fig. 8.1: Structuring of the fields and definition of terms

<i>: Einstein, A. : Grundziige der Relativitatstheorie, Vieweg + Sohn, Braunschweig 1973, 5. Aufl. , WTB 58.

<ii>: derived from the Greek hydro (= water).

8.1 Structure of the field theory

In contrast to Maxwell's theory the new field theory, which we derived from duality, is also able to describe fields, in which no particles and no quanta exist. It probably is justified and useful in the sense of a clearer communication, to give the new field a name of its own.
The author recommends the introduction of the term "hydrotic field". In it should be expressed, which importance water has for both the like named potential vortex and this field<ii>.
As we already have worked out, the hydrotic field is favoured particularly by polar materials and by a high dielectricity. Water is a corresponding and in the biosphere of our planet dominating material.

Whereas we had to correct the concept of a vortex free electric field, we had until now, considerable, we can take over the description of the magnetic field unchanged. This then should also be valid for its name. The new field which consists of both correspondingly is called hydromagnetic field.

In fig. 8.1 we recognize the structure. At the top stands the "hydromagnetic field", which is described mathematically by the equations of dual electrodynamics in fig. 3.3. It does not know quanta and as logical consequence neither charge nor mass! If we insert these equations, Ampere's law and the dual formulated Faraday law of induction, into each other, then there results as a mathematical description of our space-time-continuum the fundamental field equation (5.7, fig. 5.1). As a new physical phenomenon the potential vortex appears, which gives the hydromagnetic field a new and important property: this field can be quantized!

Starting-point is the wave, which for corresponding interference effects can spontaneously roll up to a vortex, which as highly concentrated spherical vortex finds a new right to exist and finds to a new physical reality.

The in the described manner formed particles show specific properties of their own. We now are able to attribute them for instance a charge or a mass. And these properties also can be investigated and described individually and isolated from each other. Thus are formed the two special cases, strange by nature, on the one hand the well-known, with the help of the Maxwell equations describable "electromagnetic field" and on the other hand the new "hydrogravitational field".

If we overlap the results of the two special cases, e.g. by adding the force effects of electric charges and accelerated masses, then we summarized obtain a field, which we accordingly should call "electrogravitational". This case is not at all unknown. Already Niels Bohr in this way has calculated the radii of the electron orbits in the hull of his model of the atom, to mention only one example. We can summarize:

The hydromagnetic field is the all encompassing and with that most important field. Apart from that the electromagnetic field of the currents and the eddy currents and the hydro-gravitational field of the potentials and the potential vortices merely describe the two possible and important special cases. For reasons of pure usefulness for every special case a characteristic factor of description is introduced, the charge and the mass!

Auxiliary terms (description of quantum properties):
* mass * charge * temperature * Planck's quantum of action

The hydromagnetic field does not know any quanta!

Structure of the fundamental field equation 5.7 (fig. 5.1):

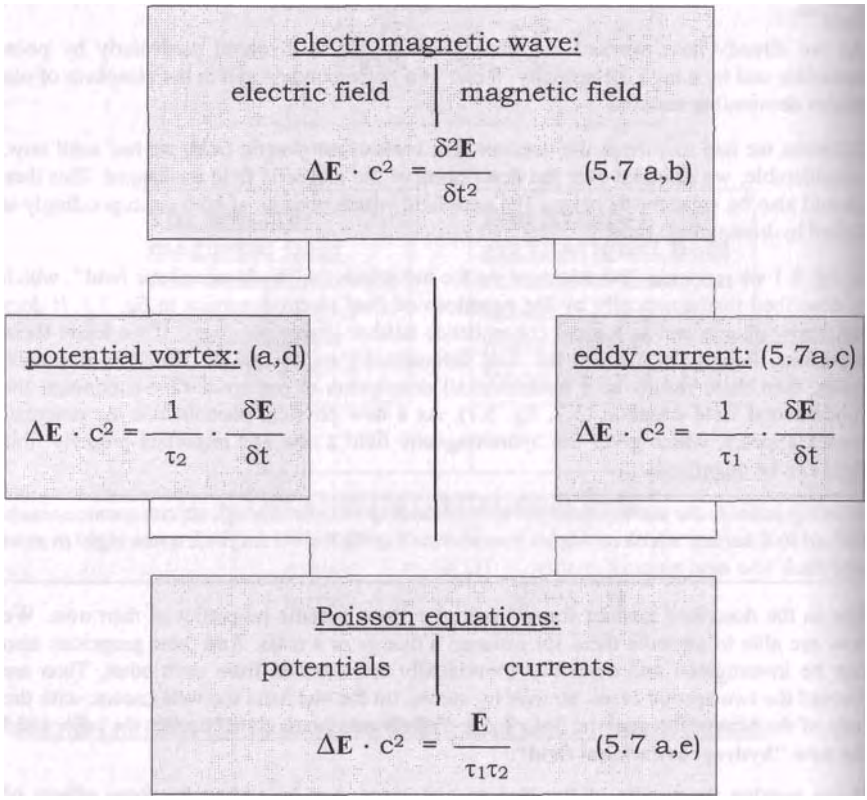

Fig. 8.2: Unified theory

*electromagnetic interaction (open field lines)
*gravitation (closed field lines)
*strong interaction (does not exist)
*weak interaction (only special aspect)

The interactions are a result of the field dependent speed of light!

8.2 Unification of the interactions

The discovery and introduction of the hydromagnetic field makes the desired unification possible, because the electromagnetic resp. Maxwell field, which describes the electromagnetic interaction, and the hydrogravitational field of the gravitation can be derived from this field as a consequence of the formation of quanta.
The kind of the interaction is caused by the course of the field lines of the field quanta which form as spherical vortices: the open field lines make the electromagnetic interaction possible. And the field, lines with a closed course lead to gravitation. Both are a direct result of the field dependent speed of light. A more perfect unification seems hardly possible.

As the next step the unification with the strong and the weak interaction is required, but it could be shown that those don't exist at all. It just concerns misinterpretations with much fantasy, which should help explain the difference between a wrong theory and the physical reality.

Numerous auxiliary terms for the description of the quantum properties exist, like for instance mass, charge or Planck's quantum of action. The prerequisite for their usability naturally is the existence of the quanta. But until these have found to a physical reality, the auxiliary terms are unnecessary. The hydromagnetic field does not know quanta, quantum properties or auxiliary descriptions. It will be shown that, according to expectation, also the temperature is a typical quantum property, which comes within the group of the auxiliary terms. In this way also the temperature is fitted into the unified theory without compulsion.

Without the by us for reasons of usefulness introduced auxiliary terms the fundamental field equation is left with its description of a spatial-temporal principle. If a world equation should exist, then this field equation 5.7 has the best prerequisites. For the fundamental field equation the division in four parts is repeated like already for the hydromagnetic field (fig. 8.1). It likewise consists of four individual parts, the wave (b), the two vortex phenomena (c and d) and the time independent term (e) (fig. 8.2). Whereas the duality still is combined in the wave, it comes to light clearly for the vortices to again be combined in the fourth case. Here arise however potentials and currents, which again can react and oscillate with each other, for instance as L-C-resonant circuit in an electronic circuit, with which the principle is repeated.
This principle is shown clearer for the phenomenon of the temperature as in all other cases. If we start at the top in the picture in fig. 8.2 we have an electromagnetic wave, which is absorbed and thus becomes a vortex. If the vortex falls apart, then eddy losses are formed. We observe that the temperature rises and propagates in the well-known manner. We have arrived in the bottom box, but this again can be taken as the top box for the now following process, because the equation of heat conduction is a vortex equation of type c or d! We discover a self-similarity:

> The spatial-temporal principle formulated mathematically by the fundamental field equation can be carried over into itself time and again.

Temperature is the oscillation of contraction of the elementary vortices resulting from the speed of light depending on field strength.

a. at absolute zero temperature:

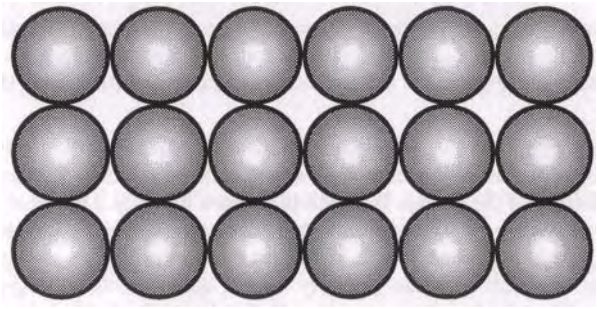

b. if thermally excited:

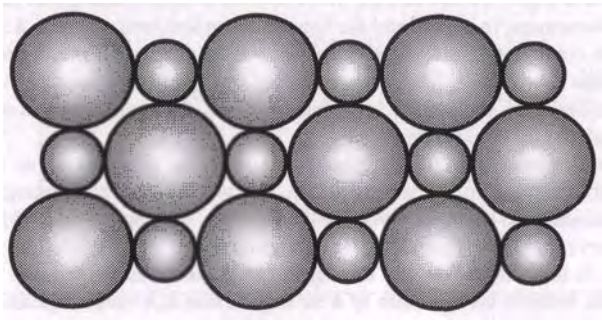

Fig. 8.3: Temperature as an oscillation of size for the speed of light depending on field strength

8.3 Temperature

Following the atomic view, in the case of heat it concerns kinetic energy of the molecules, which carry out more or less violent oscillations. In the case of gaseous materials with this concept, basing on mechanical models, actually successful calculations are possible, like for instance the speed distribution of gases won by Maxwell from theoretical considerations concerning probability.

But the attempt to apply the formulas of the kinetic theory of gases to solids and liquids only succeeds, if additional supplements and improvements are introduced. Since at all events it concerns temperature, thus the same physical quantity, of course also an uniform interpretation should be demanded, which in addition should stand in full accord to the presented design of an integrated theory (TOE).

Against the background of the new theory of objectivity we consider, what happens, if for instance the local field strength is increased by a flying past particle. The matter located at this point is contracted for a short time. By coming closer to each other, the individual elementary vortices mutually reinforce their field and are further compressed. Sometime this process comes to a standstill, is reversed and swings back.

At the same time every single particle, which in this way carries out an oscillation of size, has an effect on its neighbours with its field, to also stimulate these to the same oscillation, but delayed by some time. This phenomenon spreads in all directions. The propagation only will become stationary, if all neighbouring elementary vortices pulsate with the same amplitude. It now should be recorded:

> The oscillation of contraction of the elementary vortices we call temperature.

Also this thermodynamic state variable therefore is a result of the variable speed of light. At the absolute zero of temperature no oscillation takes place anymore, whereas the upper limit lies in infinity. Since the cause for temperature represents an oscillation of the local electromagnetic field strength around the cosmic field strength, the following phenomena must be considered as excitation and cause, as dictated by the fundamental field equation 5.7:

1. Electromagnetic waves (b) are able to stimulate matter particles to synchronous oscillations of contraction by their alternating field. In doing so energy in form of heat is transferred to the particles, with the result that their temperature is increased. The wave is absorbed completely, if the thermal oscillation corresponds with the frequency of the wave.

We speak of thermal radiation.

2. But also the two dual vortices, the eddy current (c) and the potential vortex (d) can cause oscillations of contraction. This immediately becomes clear, if we consider a vortex as the special case of the wave, in which the oscillation takes place around a more or less stationary vortex centre. In the case of the decay of vortices, of the transition of energy from vortices to matter, the increase in temperature is measurable.

In the case of this process of diffusion we speak of eddy losses and of loss heat.

Answers to open questions of thermodynamics:

1. Temperature occurs independent of the state in which the matter is (unified theory).

2. Temperature even occurs in solids, where a purely kinetic interpretation fails (unification).

3. Each elementary particle is carrier of a temperature.

4. Expansion with increasing temperature because of the increasing need for room for larger amplitude of oscillation (principle: bi-metal-thermometer).

5. For solids the thermal oscillation of size is primarily passed on by the electrons in the atomic hull. Good electric conductors therefore at the same time also have a high thermal conductivity. (principle: electrical resistance thermometer).

6. For gases the entire atoms carry out this task, for which reason a kinetic auxiliary description becomes applicable.

7. For extreme amplitudes of oscillation the atoms partly or entirely lose their enveloping electrons, when they change into the plasma state.

8. The second law of thermodynamics loses its claim to be absolute and at best reads: with today's technology we are not capable, to design a cyclic working machine, which does nothing else, as to withdraw heat from a heat container and to convert it into mechanical work.

Fig. 8.4: Questions concerning thermodynamics

3. Flying past particles, in particular unbound and free movable charge carriers (e) produce an alternating field for other fixed particles. Doing so kinetic energy can be transformed in temperature, thus in energy of pulsation. A good example is the inelastic collision. But it can also be pointed to numerous chemical reactions. Whoever searches for a concrete example, takes two objects in his hands and rubs them against one another. In that case the particles which are at the frictional surfaces are being moved past each other in very small distance, in this way causing oscillations of pulsation, which propagate into the inside of the objects according to the thermal conductivity. We speak of friction heat.

This model concept provides sound explanations for a whole number of open questions (fig. 8.4), i.e. why the temperature occurs independent of the state (1) and even in solids, where a purely kinetic interpretation fails (2). Every single elementary particle after all is carrier of a temperature (3).
With increasing temperature most materials expand, because the need for room, purely geometrically seen, increases for larger amplitude of oscillation (4). This principle is used in the case of a bi-metal thermometer.
In the case of solids the thermal oscillation of size is passed on primarily by the electrons in the atomic hull (5). Good electric conductors therefore at the same time also have a high thermal conductivity. An example of an application is the electric resistance thermometer.
In the case of gases the entire atoms carry out this task, for which reason a kinetic theory becomes applicable as an auxiliary description (6).
For extreme amplitudes of oscillation the atoms partly or entirely lose their enveloping electrons, when they change into the plasma state (7).
Finally the model concept even limits the second law of thermodynamics, which contains the postulate that it is impossible to design a cyclic working machine, which does nothing else, as to withdraw heat from a heat container and to convert it into mechanical work (8).

8.4 Heat energy

The discussed oscillation of contraction shows two characteristic properties, which must be looked at separately: the amplitude and the frequency.

Temperature describes solely the amplitude of the oscillation of size.

The heat energy however is determined by both,
by the amplitude as well as by the frequency.

Consequently the ideas of temperature and heat energy should be kept strictly apart. It therefore isn't allowed to set this oscillation equal to the electromagnetic wave in tables of frequency.
To be correct two tables should be given, one for the wave, characterized by a propagation with the speed of light, and another one for oscillations of contraction, thus for stationary phenomena and phenomena bound to matter. The latter indeed can likewise propagate relatively fast by fluctuations of pressure in the case of acoustical sound frequencies or by free movable charge carriers in the case of heat conduction, but the velocity of propagation for sound or heat is as is well-known still considerably smaller than the speed of light. Thus an assignment without doubts can be made as to which kind of oscillation it concerns.

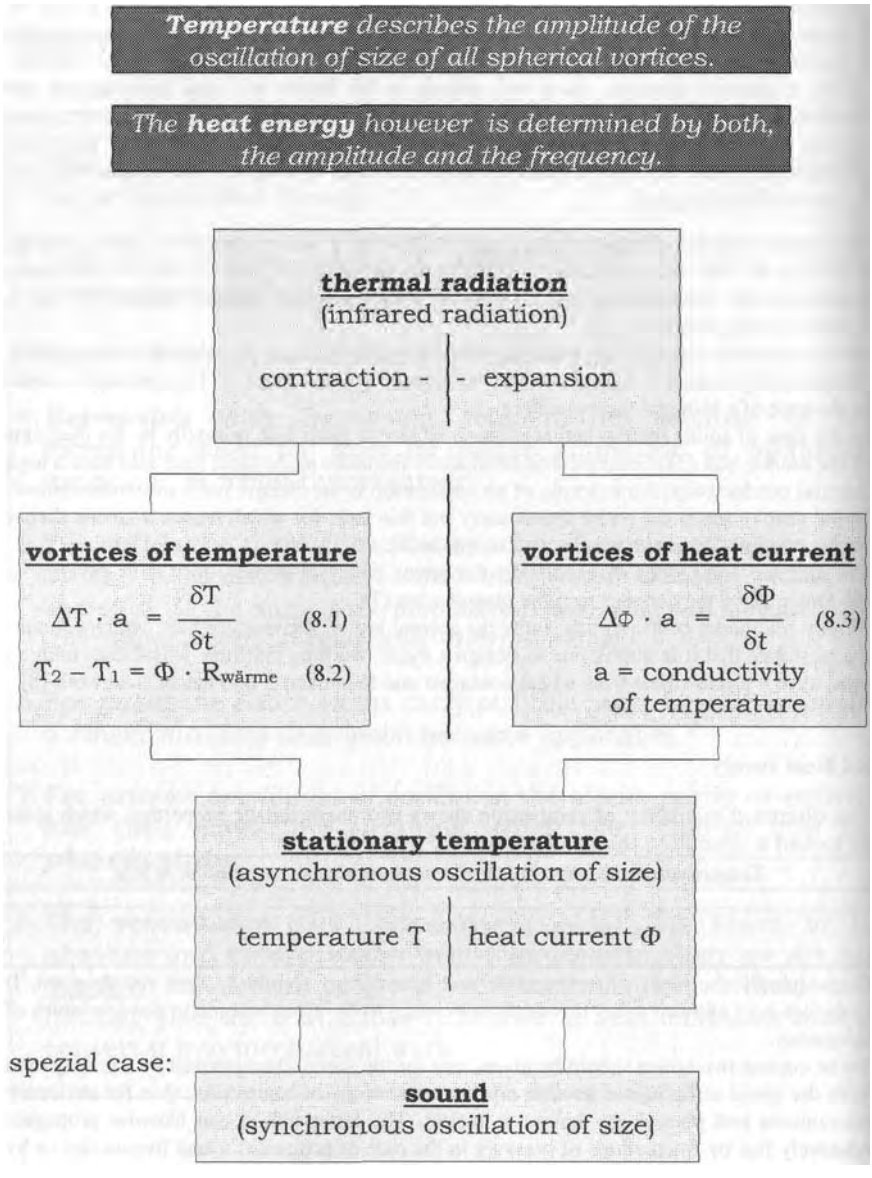

Fig. 8.5: Heat conduction resp. sound

8.5 Sound

The close relationship of longitudinal sound waves with the oscillations of contraction of thermally heated matter becomes particularly clear for ultrasound, where the arising heat in the inside of the body which is exposed to sound can be measured directly. The fundamental difference consists of the fact that the produced sound waves not only have the same frequency, but also the same phase, what needs not be the case for the temperature. The apparently uncoordinated occurring oscillations of size of the temperature, which as a rule occupy more space if the intensity increases, form a "thermal noise".

The oscillation of size with the same phase is not realizable at all in a spatial formation of particles, with one exception, the case that all particles expand and afterwards again contract simultaneously and in the same time. We can observe such a synchronization of the pulsation oscillations of all elementary vortices in the case of a pulsar. For us a pulsar looks like a "lighthouse" in space which shines with a fixed frequency. In reality it as well can concern a constantly shining sun, which carries out a synchronized, thermal oscillation of size, like a gigantic low-frequency loudspeaker. During the phase of contraction of the star its emitted light stays back. To us the pulsar looks dark. In addition the field strength is extremely increased and the light becomes correspondingly slow. During the phase of expansion the conditions are reversed and we observe a light flash. Exactly the pulsar unambiguously confirms the here presented theory of the variable, field dependent speed of light.

The well-known fact that the microcosm represents a copy of the macrocosm, already suggests that each atom is capable of the same oscillation of size as a pulsar: if next to the oscillating atom a resting one is placed, then does this one see a smaller field during the phase of contraction because of the increasing distance. It hence becomes bigger itself. If the pulsating neighbouring atom afterwards expands, it however becomes smaller. The at first resting atom in this way becomes a "pulsar" oscillating with opposite phase. The oscillating atom has stimulated the neighbouring atom as well to an oscillation of size, and this process will be repeated with the closest neighbouring atom. We speak of heat conduction.
To which extent the average distance between neighbouring atoms is influenced while a material is heated, solely depends on the structure of the atomic lattice. For matter with a fixed lattice according to expectation a smaller heat expansion will occur, as for the unordered structure of gases, in which we find confirmed well-known relations.

In a for potential vortices characteristic property sound waves and thermal waves of contraction correspond:

The propagation of potential vortex fields takes place as a longitudinal wave.

In this point vortex fields clearly differ from the transverse propagating electromagnetic waves!

1. Ampère's law (see fig 5.1):

$$\boxed{\text{rot}\,\mathbf{H} = \varepsilon \cdot (\mathbf{E}/\tau_1 + \delta\mathbf{E}/\delta t)} \qquad (5.1^*)$$

with relaxation time $\tau_1 = \varepsilon/\sigma$ (5.3)

transformed: $\delta\mathbf{E}/\delta t = (1/\varepsilon) \cdot \text{rot}\,\mathbf{H} - \mathbf{E}/\tau_1$ (5.1**)

integrated: $\mathbf{E} = \int [(\text{rot}\,\mathbf{H})/\varepsilon - \mathbf{E}/\tau_1]\,dt$ (5.1***)

2. Faraday's law of induction (in analogy):

$$\boxed{-\text{rot}\,\mathbf{E} = \mu \cdot (\mathbf{H}/\tau_2 + \delta\mathbf{H}/\delta t)} \qquad (5.4^*)$$

transformed: $\delta\mathbf{H}/\delta t = -(1/\mu) \cdot \text{rot}\,\mathbf{E} - \mathbf{H}/\tau_2$ (5.4**)

integrated: $-\mathbf{H} = \int [(\text{rot}\,\mathbf{E})/\mu + \mathbf{H}/\tau_2]\,dt$ (5.4***)

3. Signal flow diagram of the field equation 5.1***:

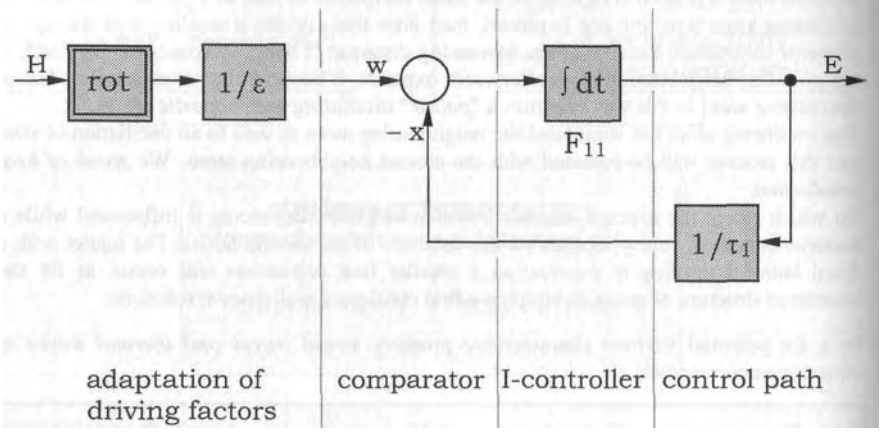

Fig. 8.6: Control technical analysis of the dual equations of the hydromagnetic field.

8.6 Basic principle of cybernetics

Surely can be attributed also information to the potential vortex. But how should information be formed? Is information a form of energy? Energy occurs as a consequence of the formation of potential vortices. Without this phenomenon there wouldn't be any energy!
Can information be described by means of a mathematical equation?
To be able to answer these questions, we subject the fundamental field equation to a control technical analysis. If it actually concerns a world equation, then an answers should be possible.

We again take up Ampere's law 5.1* from fig. 5.1 and remodel it according to the time derivative (5.1**). If the equation now is integrated over the time (5.1***), a signal flow diagram can be drawn (fig. 8.6).
The structure of a regulatory circuit is clearly visible. The individual paragraphs are described in an analogous way as for a technical control system. The execution of the curl operation on the field pointer of the magnetic field strength H and the multiplication with $1/\varepsilon$ accordingly form an adaptation of driving factors. In the comparator the difference for control from driving factor w and controlling factor x is formed and supplied to an integral controller. The control path has a purely proportional behaviour and consists of the processing of the measurement value of the electric field strength E with $1/\tau_1$, in which τ_1 describes the relaxation time of the eddy currents.
In technical control systems such a structure is found remarkably seldom, although it has an invaluable advantage: it possesses a stability in principle. Not a single adjustment of the controller exists, in which the closed regulatory circuit could become unstable, because it shows a proportionally delaying behaviour of first order. Possible changes of the adjustment of the controller or of the control path merely take effect on the speed, with which the regulatory circuit is able to follow changes of the driving factor.
This control technical basic principle convinces by its simplicity and efficiency. It meets us again in identical form in the second field equation 5.4*, the extended Faraday's law of induction. In dual formulation the electric field strength now appears as input factor and the magnetic field strength as output factor. Both regulatory circuits are coupled and connected with each other, by deriving their driving factor each time from the controlling factor of their dual partner. Is this structure actually efficient and meaningful?
Every regulatory circuit needs a target value, which is dictated from the outside. Let us think of the numerous control systems in nature. At all events a higher intelligence would be necessary for all the target values. This problematic is comparable to the question, what existed first: the egg from which a hen hatches or the hen without which no eggs can exist. Without a given target, evolution would not exist.

The connected regulatory circuit structure provides the matching answer: cybernetic systems, which usually and as is well-known strive to a state of balance, get their target value from their dual "partner". It is crucial that correspondingly dual systems are self-sufficient and can form and develop independently out of themselves without target values of a third side. This basic principle of cybernetics undoubtedly is brilliant.

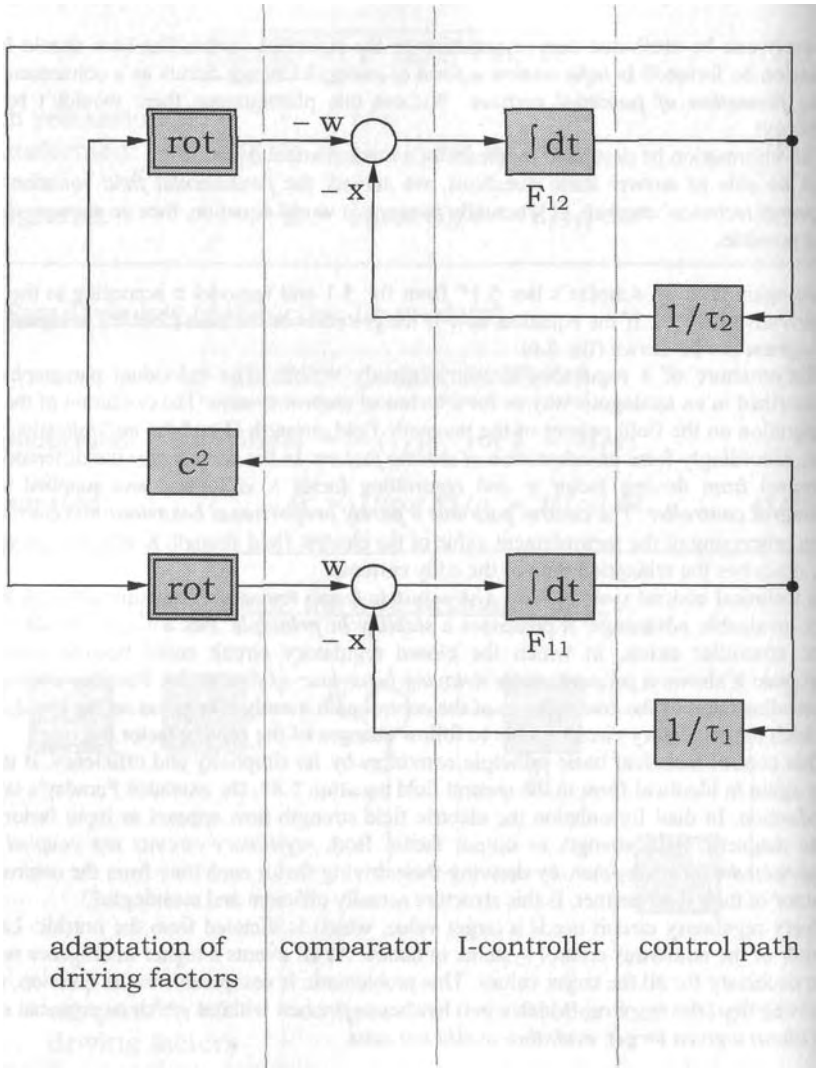

Fig. 8.7: Signal flow diagram of the fundamental field equation
with adaptive structure.

8.7 Adaptive regulatory circuit structure

If out of the nowhere something like the cosmos or like life on earth should form, then the connected regulatory circuit structure basing on duality probably is the only possible and conceivable. Thus it merely concerns the control technical representation of the fundamental field equation.

The question for the efficiency not only concerns the stability, but equally the possibility of both systems, to oscillate and to communicate with each other by the coupling and the associated exchange of information.

Fig. 8.7 shows the signal flow diagram of both regulatory circuits. These are switched in line and form a coupled circuit, which itself can be interpreted as a third regulatory circuit. Also this one shows a change of sign in the circuit like the other two circuits.

The information technical interpretation could turn out as follows: information about a regulatory process in the lower regulatory circuit F_{11} caused for instance by a disturbance is communicated over the coupled circuit to the upper regulatory circuit F_{J2}. In this case F_{11} acts as transmitter and F_{12} as receiver of the information. Afterwards both exchange their places, because F_{12} for its part reacts by a regulatory process and reports to F_{11}. The regulatory circuits adapt to each other. Obviously it concerns the basic structure of an adaptive regulatory circuit.

To analyse the coupled circuit the examination of individual special cases is recommended. If the regulatory circuits F_{11} and F_{12} are opened up in the way that the time constants tau_1 and tau_2 go towards infinity, then the double integral effect is left. Analyses of technical regulatory circuit teach us that such systems always tend to instability. Because in addition the target value is zero, an oscillation around zero will arise, which we call electromagnetic wave.
If one of both time constants becomes finite, e.g. τ_2, then damping of the waves will occur. The "subordinate" cascade regulatory circuit F_{12} will adjust itself and now has a proportional delaying behaviour of first order. Together with the integral controller of the open F_{11}- circuit the coupled circuit will show the typical and more or less optimal regulatory behaviour of a damped oscillation.

These special cases correspond with the mathematical (fig. 5.2) and the physical (fig. 5.3) interpretation of the fundamental field equation. In addition a spatial rotation, a swirling will occur because of the double execution of the curl operation.

If interpreted control technically then vortices are the temporally stable, spatial swing of a field pointer around a centre, the vortex centre.

Without potential vortices no stability, no matter, no energy nor information would exist!

As can be looked up in Goethe's Faust, it always has been a desire of humanity, to find out, "what keeps the world together in the heart of hearts".

electric field	——	magnetic field
potential	——	current
capacitor	——	coil
Faraday's law of induction	——	Ampère's law
potential vortex	——	eddy current
convergence	——	divergence
dielectricity	——	permeability
non-metal	——	metal
isolator	——	electric conductor
tuned cavity	——	antenna
cold	——	hot
Yin	——	Yang
female	——	male
minus	——	plus
introverted	——	extroverted
stability	——	dynamics
water	——	fire
implosion	——	explosion

Fig. 8.8: Table of dual correspondences
(as a supplement to chapter 3.3 and fig. 4.2).

8.8 Information

The search for an answer for numerous philosophers and physicists was tantamount to the search for a world formula. Of course mustn't be forgotten that a formula only is a mathematical description and never the physical reality itself. It is a mathematical tool in the hand of a person and not the world or the cosmos itself, which he tries to understand. What keeps the world together in the heart of hearts, has to be more than only a pure apparatus of formulas. Actually the fundamental field equation tells us more. It reveals us a basic principle basing on duality in which the dual partners mutually dictate target values and goals. This principle convinces by its simplicity and efficiency. Apart from the "self regulation" it obviously also has the fundamental possibility of a "self organization" and the "generation of information". The field equations of the hydromagnetic field thus are the starting-point for the formation not only of matter and energy, but also of information. Accordingly holds:

Information is nothing but a structure of electromagnetic vortex fields!

This statement is new and to a large extent incompatible with the conception world of Norbert Wiener, who goes as the founder of cybernetics. From N. Wiener stems the sentence: "information is information, not matter and not energy".
We hold against it that obviously a fairly direct connection exists. We have worked out that only the vortex can show a stable adaptive regulatory circuit structure. Only the vortex and not the wave exists in two forms of formation dual to each other, and the principle of duality again is the prerequisite for the formation of information, of self organization and finally for the evolution. In fig. 8.8 well-known dual partnerships are listed. From it follows in a consistent way that for the production of information without exception the electromagnetic vortices should be considered.
But how can this so important duality occur, how can it form? This question is closely associated with the question of the formation of vortices. The signal flow diagram (fig. 8.7) to that says that the dual regulatory circuits F_1 and F_2 can only exist by the coupled circuit, which provides them the necessary target values and at the same time forwards the respective information. In this way of the oscillations and the more or less damped wave F_1 and F_2 communicate with each other.

The electromagnetic wave serves solely the mediation of information and energy.

With that falls a central role upon the wave, so that vice versa is valid:

Without wave no vortices, no duality and
consequently no evolution can exist.

According to the to date state of knowledge the basic principle of cybernetics forms the basis for matter and energy as well as for information. Since the wave can only serve the transmission of information, the principle of duality and the vortex will function as carriers of information. We are entitled, to speak of vortex information, this by no means is characterized by special frequencies or modulations of frequencies. This is prevented by the property of the vortices which allows them to change the frequency. On the other hand various configurations of vortices are possible and numerous combinations and modulations are conceivable.
If technical apparatus generate vortices, then they produce information. Here a serious danger with regard to the environmental compatibility can not be excluded!

Equivalent things:

* elements of the fundamental field equation 5.7
* elements of the Greek philosophy of nature
* temperaments
* (impulses of growth)

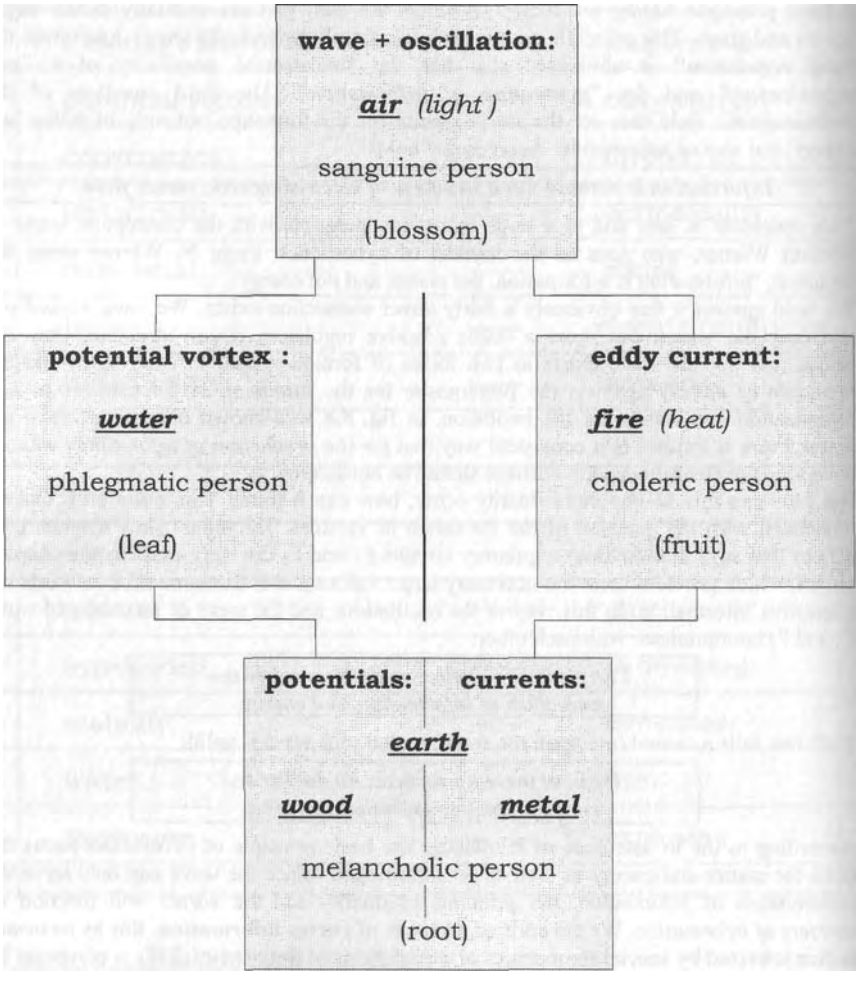

Fig. 8.9: The theory of four elements of the old Greek philosophy of nature (Aristotle and others)

8.9 Philosophy of nature

Seen in the view of the philosophy of nature now two dual points of view are possible.
The optimistic one would be:
We and our environment on the one hand are a result of the cybernetic principle and on the other hand of our observation point of view which should be valued relativistically. If really everything should be electromagnetism, a phenomenon which can't be grasped directly by humans, then the pessimist would come to the conclusion: everythins is nothing. What we observe is nothins but a deception of the senses. Perhaps therefore famous philosophers of antiquity, like Empedokles or Demokritos have ended their life in the crater of the Etna. According to the theory of the atom of Demokritos (470 to 380 B.C.) the formation of matter, earth and celestial bodies will occur by means of formation of vortices!
Empedokles (482 to 420 B.C.) was the first to develop a theory basing on four elements, which was continued and improved by Plato (428 to 348 B.C.) and Aristotle (384 to 322 B.C.). Accordingly these elements are changeable into each other and mixable with each other. From them all bodies are build up.
The terms "air, water, fire and earth", with which the philosophers have described the four elements, are of course not identical with the ones in our translation and conception world, but they were used in a philosophical sense as a substitute for the description of the respective basic principle.
There also have been different approaches, to translate these terms differently, e.g. by an assignment to the four states of matter (solid, liquid, gaseous, plasma). But the ancient texts don't get easier to read in that way.

Fig. 8.9 shows the obvious assignment to the four building parts of the fundamental field equation 5.7. It would be worth an attempt, to exchange the terms in the translations of ancient texts and to translate air with wave, water with potential vortex and fire with eddy current. The term earth has two sides, which should be translated with potential instead of wood and current instead of metal.

Let's try the translation this way with the theory of Plato[<i>], by correspondingly translating anew the talk of Timaios about the formation of the world. The perception of smell then is described as follows: "...as the potential vortex turns into waves (or) the wave into potential vortices, the smells are formed during this transition, and smells are smoke or fog. But fog is the transition of waves into vortices, the transition of the vortex into waves however smoke".
Plato here provides an indisputable and conclusive interpretation of the fundamental field equation. In this equation the potential vortex acts as damping term in the wave equation, what in the case of waves rolling up to vortices will show to the observer in the way that the electromagnetic waves and therefore also the light will be damped. We say, the visibility gets worse and speak of fog. If the damping phenomenon disappears again, as the potential vortices break up, then Plato speaks of smoke.
Numerous ancient texts, which until now only could be "interpreted" philosophically, in this way turn out to be a rational textbook description of natural scientific phenomena. They anyway only get readable and understandable for the general public with the modern technical terms.

<i>: Platon: Samtliche Werke 5, Rowohlts Klassiker Nr. 47, S. 188, 66e

Optimist:

We and our environment on the one hand are a result of the cybenetic principle and on the other hand of our observation point of view which should be valued relativistically.

Pessimist:

Everything is nothing. What we observe is nothing but a deception of the senses.

Plato<i> (talk of Timaios about the formation of the world) description concerning the perception of smell:

"...as water (the potential vortex) turns into air (waves) or air (the wave) into water (potential vortices), the smells are formed during this transition, and smells are smoke or fog. But fog is the transition of air (waves) into water (vortices), the transition of water (vortex) into air (waves) however smoke"

changed translation with the technical terms:

air_____ = ____wave
water = ___ potential vortex
fire_____ = ____ eddy current

As a consequence:

smell is vortex information

Fig. 9.0: The explanation of Plato concerning the formation of smell, smoke and fog<i>

<i>: Platon: Samtliche Werke 5, Rohwohlts Klassiker Nr. 47, S. 188, 66e

9. Usage

If the newly discovered vortex phenomenon of the vortex of the electric field exists, then it will be possible to practically use it. Whereas we still think about possibilities for technical usage, there by all means exists the possibility, that nature already is successfully using the vortex for a long time. We should look precise at things. We can only learn of nature!

Remarkable about the passage of Plato (fig. 9.0) is not only the fact, that the potential vortex already was known for two and a half thousand years and was taken into consideration for an interpretation, but also the realization of Plato, that during the described transition the smells form. Smell thus would be a vortex property!

After all vortices are able to bind information as can be inferred from the basic principle of cybernetics. With this vortex property and the statement of Plato smell obviously would be nothing else than pure information which by potential vortices is stored, distributed and eventually is caught by the hair cells for smell of the nose.
If now a dog takes up a track, does it then run after vortices which remained behind or does it analyse, according to the encyclopaedia, the chemistry left behind, or does it combine both? Does the bloodhound for instance interpret the vortical oscillations of chemical substances like lattice oscillations or the movements of the electrons in the atomic hull? A lot of work awaits the research scientist of vortices here. The seminar will offer opportunity, to deepen this topic[<i>].

Only if technicians exist, who put an electronic box on the table with a button, at which they adjust the wanted scent of rotten eggs to lavender, we honestly can claim to have understood the phenomenon of the smell.

For the majority of the people a theory only wins its sense by the practical applicability, and therefore we'll have to develop and present a technical usage on the basis of the vortex theory.

<i>: Suggestions for appropriate seminar themes: the meaning of smell, taste, the aroma therapy, the homeopathy or the effect of aetheric oils. (To that in part 3, INDEL Verlagsabt. 2003)

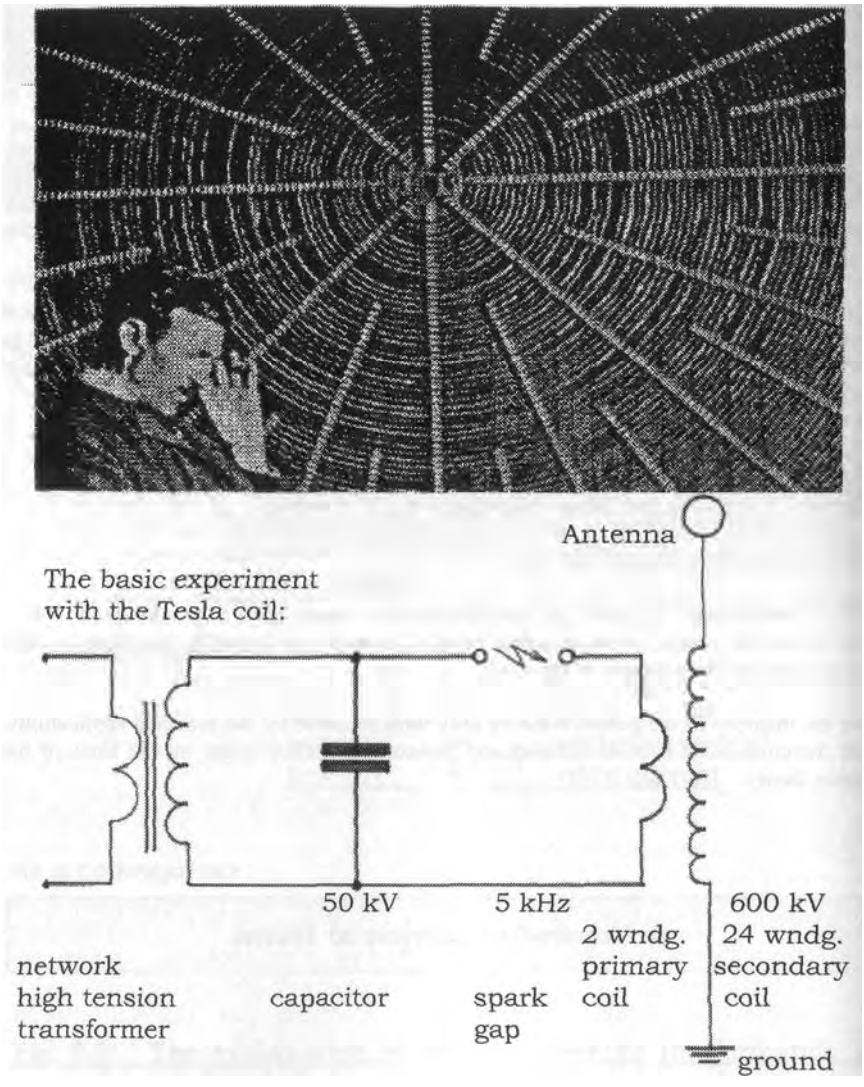

Fig. 9.1: High tension transmitter of Nikola Tesla

9.1 Longitudinal electric waves

It is important, that experts struggle for problem solutions. Only if the discussion about limits doesn't come to a result which can be grasped and verified, then also in the environmental compatibility the willingness will grow, to accept a not yet known phenomenon as a further and possibly crucial influential factor.
Already for a hundred years there has been a dispute of experts. At that time scientists all over the world were trying to verify the experiments of Heinrich Hertz. Then from America the message came, Hertz had been mistaken and the electromagnetic wave would have completely other properties. The scientists in Europe were indignant, but they had to take the message seriously, because it after all came from the important experimental physicist Nikola Tesla (1856-1943), who with his inventions of the rotary field and of the asynchronous motor has stamped today's electric energy technology as no other.

As a result Lord Kelvin boarded a steamship as a mediator and sailed 1897 to New York to convince Tesla from the opposite. But the experiments, which Tesla presented his Lordship, didn't give rise to any doubts[<i>], and thus Kelvin returned to Europe with the message: "Both are right, Tesla as well as Hertz! Whereas the electromagnetic wave which Hertz has detected, is a transverse wave, does Tesla work with a longitudinal wave"!
Lord Kelvin as a result started to draw most different vortex models, because it was clear to him, that a propagation as a longitudinal standing wave analogous to the sound wave only is conceivable, if quantized structures exist, which knock each other mutually. Kelvin therefore assumed vortex structures of the electromagnetic field. His vortex models were published and landed in the curiosity box of orthodox science.
Heinrich Hertz did have a big advantage. He could refer to Maxwell and calculate his wave with the field equations. For modern technology the mathematical calculability is almost an indispensable prerequisite!
For Tesla wave there however neither was a mathematical nor a physical theory. The only thing Tesla had, were presentable experiments.
In Colorado Springs he had build a 10 kW transmitting installation and lighted 200 fluorescent lamps of 50 Watt each on a mountain in the Rocky Mountains in a distance of 25 miles. With that he had completely transmitted the transmission power of 10 kW, as can be inferred from the press reports at that time. With Hertzian waves, which propagate spatially, this experiment even today, after over 100 years, wouldn't be realizable technologically. According to the law of the square of the distance one isn't even able to let glow a tiny little lamp in such a distance.

For sure his rotary field theory was a big help for Tesla in all experiments. Actually a rotary field can be seen as the special case of a planar vortex.
Thus Tesla obviously was able, to use the potential vortex without even knowing it. Tesla has stimulated a loosely coupled high tension coil wound like a spiral to self-resonant oscillations and emitted the produced vortices over an antenna (fig. 9.1). On the receiver side the process was then reversed.

<i>: N. Tesla: III. The Singular Misconception of the Wireless (Famos Scientific Illusions), Electrical Experimenter, Feb. 1919, p. 732.

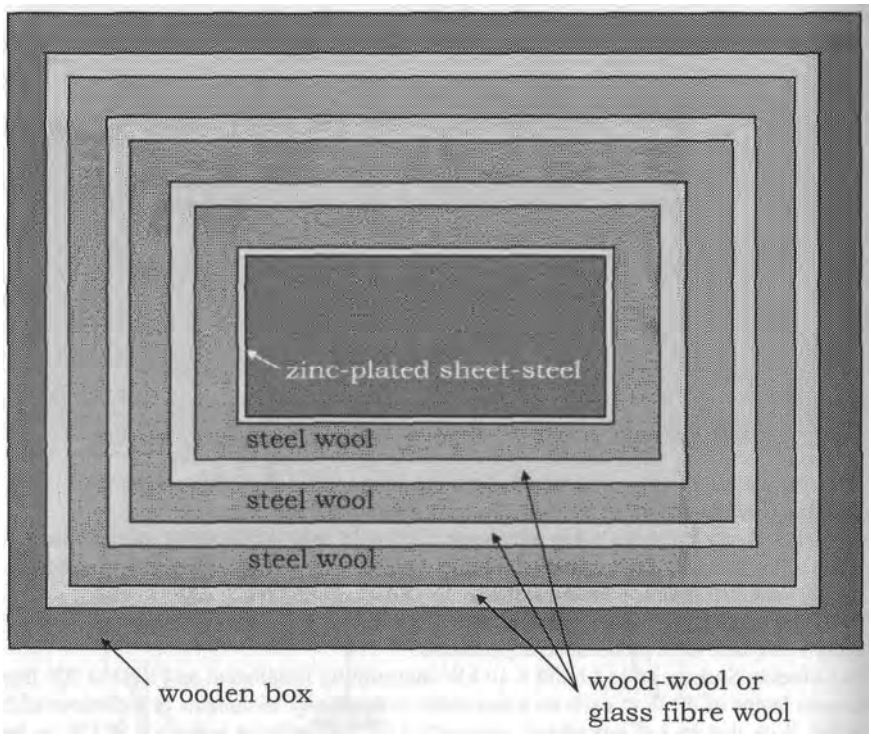

Fig. 9.2: Orgone accumulator according to Wilhelm Reich.[<i>]

<i>: Dr. James DeMeo: The Orgone Accumulator Handbook, ISBN 0-9261855-0-7

9.2 Medical technical usage

Nikola Tesla at his time was extremely popular in the area of medicine. With his inventions injuries were cured and pain eased. Modern diathermy goes back to his work. But Tesla at that time has treated the patients with vortices, whereas today, possibly out of ignorance, electromagnetic waves are used. These however have in contrast to potential vortices only a small penetration depth. Today in addition only the effect of heat is considered and in no way the information technical effect of electric vortices. Here we are missing the comparison, to be able to say. if the treatment with a Tesla apparatus was more successful than with modem microwave radiators.

The experiments of Wilhelm Reich (1897-1957) aimed in the same direction. Exactly as Tesla 55 years before also Reich emigrated to America in 1939. He had specialized in catching and collecting vortices, which he called "orgone", from the air. In this way he could store up high energies over time and then use them purposeful. With his "orgone accumulator" he was able to cure wounds faster and to ease pain. He also treated cancer and a lot of forms of anaemia. Technically Reich could demonstrate, that charged capacitor plates discharge faster under the influence of his apparatus. His orgone accumulator for instance is a wooden box, filled with wool of steel and wood, which alternate in layers. He said that the reason for this construction is, that metals repel the orgone energy, whereas organic materials become charged and accumulate it. That holds in his opinion to a particularly high degree for water.
Reich concludes that no material and no device are known, with which the orgone energy could be shielded. This with regard to the environmental compatibility of the vortex phenomenon should make us thoughtful.
As a supplement it should be mentioned, that Reich already at the end of the forties has pointed to the dying of the forests and he has made a direct connection to the orgone energy. Reich was slandered and mocked and died in the prison of Connecticut, while his writings were burned publicly.

Not much better fared the Austrian forester Viktor Schauberger (1885-1958), who also can be described as visionary. He was able to produce water with a particularly good conductivity. His water in addition goes for medicinal and healthy. Also to him travelled cancer patients of far away to get this water.
Schauberger spoke of the natural treatment of the water, whatever he meant with that. In any case he build with great success installations to transport wood by floating it and even installations to mine ore with so-called double twist pipes, which made possible a transport without friction even of materials, which are heavier than the "means of transport" water. It could be proven that no contact with the pipe took place. This was scientifically investigated and confirmed at the university of Stuttgart 1952 by Prof. Popel. Quite obviously in the double twist pipe vortices have formed, which have bound the material to be transported (see phenomenon of transport).
Today you can buy levitated water at over 100 selling points in Europe, of which is claimed, that it is prepared according to instructions of Schauberger. Unfortunately we aren't able to ask him anymore, if he agrees with such a "centrifuged" water. Thus the test of the effectiveness has to be left to everyone himself or herself.

A: Concerning the functioning of the Faraday generator (E = v x B):

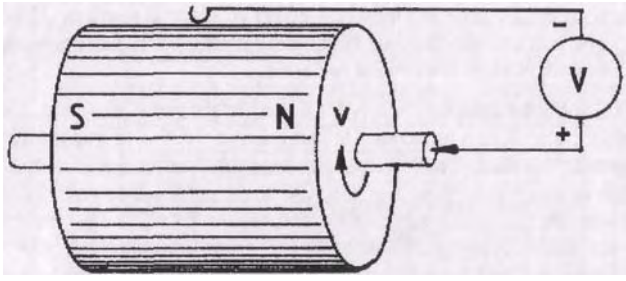

B: Construction of the flying disc:

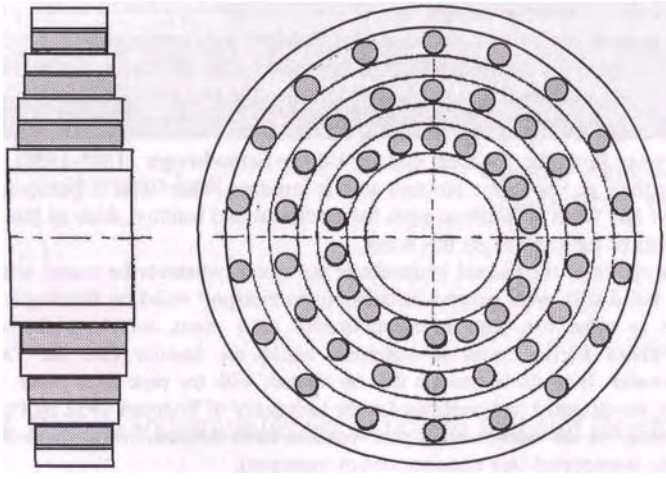

Fig. 9.3: Applications of the Faraday generator[i] in the flying disc of Prof. John Searl

9.3 Flying objects

The medium of Viktor Schauberger always was the water. He could produce light effects and very high temperatures with it with only minimal excitation in the form of impulses. An installation, which had been built according to his plans at the company of Siemens, eventually melted at 4000°C by improper operation, as he himself stated. According to that the machine would have released more energy than used, thus a perpetuum mobile. The authorities of the state in the Third Reich were impressed and put Schauberger in a concentration camp, where he was instructed to build a "flying saucer" under permanent supervision together with fellow prisoners. For him it's all about the concentration effect and the usage of the as a result occurring implosion in contrast to our today's " technology of explosion and fire" as Schauberger was accustomed to express himself. It is not known, if Schaubergers "repulsine" ever has took off.

A disc, which has proven its suitability to fly, was constructed and built by the english technician John R. R. Searl, although he said he can't explain the effect. He also had big difficulties, to get the apparatus under control. A disc broke through the ceiling and the roof of his laboratory and disappeared to never be seen again. Five other flying discs, which he after this experience started in the open, went lost in the same manner. Without knowing the effect, he of course neither could assess the dangers. His experiments have claimed serious injuries and a casualty. While he 1985 was put in prison under a pretext, his laboratory and his house were burned down and all documents destroyed. Now he works on a technical usage. According to the principle it concerns a Faraday machine. Thereby a permanent magnet, magnetized in axial direction, is turned. Now the magnetic induction B for a relative velocity v is measured as an electric field strength E according to equation 6.10: $E = v \times B$. (6.10)

Because the vectors are arranged as standing perpendicular to each other, will arise a tension voltage in radial direction (direction of E-field) which can be taken off. Apart from the friction no further force of reaction occurs in the case of the Faraday generator. Because of the small gain of energy until today no application ready for the market exists. But this principle, to convert magnetic field energy into electric, already has moved the nature of many inventors. Professor Searl has reversed this old principle. Whereas normally the component of the velocity towards the centre of rotation decreases, it increases in Searls case. For that he works with roller pivoted concentric rings, which he drives by a small electric motor (fig. 9.3). Doing so something inexplicable for him happens: After switching off the motor the revolutions per minute don't decrease again, but increase audibly and increase further, until the produced electric field shows the well-known high tension phenomena: corona discharges, formation of ozone, ionisation of the air and production of a vacuum in the inside of the disc.

The rings and rollers consist of several layers, which are built up similar to a bi-metal. The only explanation I can think of is that a change in structure would occur as a result of the physical length contraction which is caused by the increase of the E-field in the direction of the centre of rotation. The bi-metals try to withdraw themselves from this change by an increase of their rotation of their own (fig. 6.5). To compensate the field the disc builds up a spin, as also the elementary particles do (fig. 6.13). While the formation of vacuum prevents sparking in the inside of the flying disc, and the revolutions per minute further increase because there is no air friction whatsoever, the disc weighing 5 tons all of a sudden lakes off the ground and according to reports of eyewitnesses shoots vertically upwards.

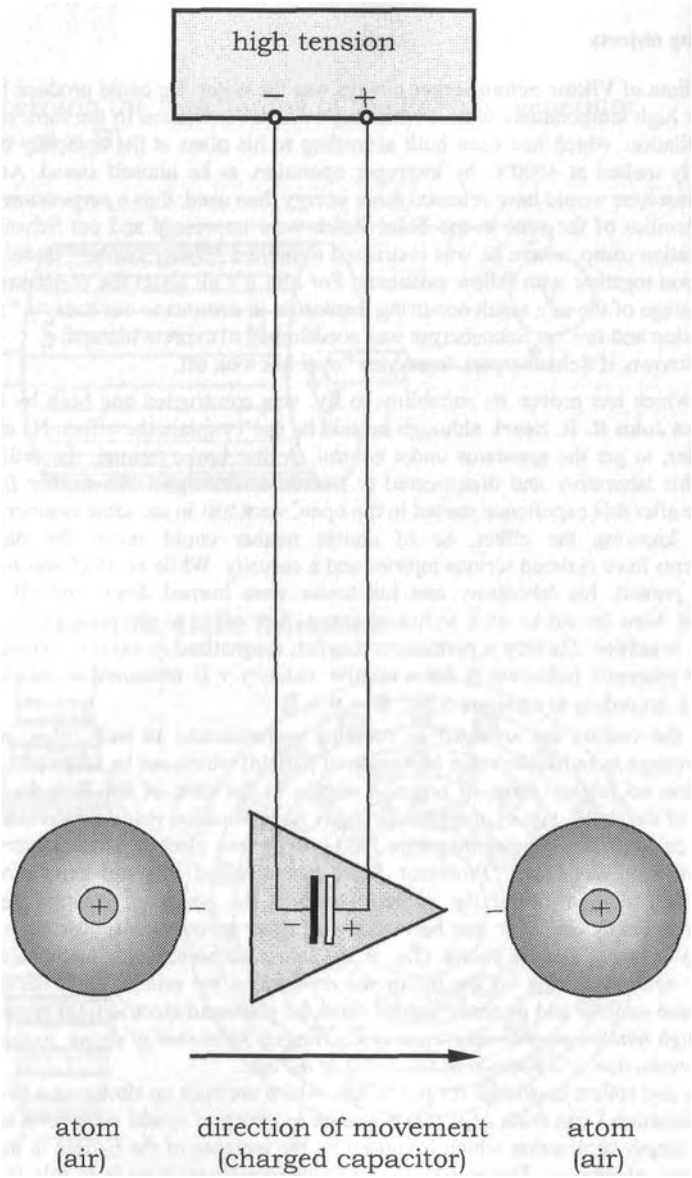

Fig. 9.4: Capacitor experiment concerning the so-called electro-
gravitation according to Prof. Biefeld / Dr. Brown

9.4 Electro gravitation?

Wild speculations circulate about the mechanism of the flight of a "flying saucer", which should function without sound and without combustion, and for which no sound barrier exists, as pilots have observed. The talk is about cancelling gravitation or about an "electro gravitation".
Reproducible in any case is an experiment, which has been systematically investigated by the american professor Biefeld and his pupil T. Brown from 1925. Accordingly does a body charged to high tension show a force effect in the direction of its positively charged note. As a check for oneself a capacitor can be suspended on its connection wires and it can be observed, how it moves visibly in the direction of the positive pole in case it is charged (fig. 9.4).
Because the Biefeld-Brown effect depends on direction, it actually can't concern gravitation at all but merely a not understood electromagnetic interaction. In the neighbourhood of the capacitor pole air molecules are found, and their negatively charged atomic hull is attracted by the positive pole. At the same time the atomic nucleus is repelled. By that the air atoms in the presence of the high tension capacitor become unsymmetrical, causing the force of attraction due to the smaller distance to exceed the force of repulsion. At the negatively charged end the conditions are exactly reversed. There a repulsion occurs. Because the polarized air atoms and molecules are sucked in, no pressure can build up and as a result no sound barrier can occur. Experiments with charged and uncharged rockets have brought the interesting result, that the electrically charged rockets flew many times as far as the uncharged ones (5-6 times as high)[<i>].
Many a person now perhaps starts to dream of the flying carpet but, as said, it isn't an "effect of antigravitation". Does "free energy" actually exist, we have to ask ourselves? From the gravitation the soviet physicist Landau calculates an energy density of 16 megawatt hours per cubic meter for the earth's surface. Immediately inventors are found, who want to use this gravitational energy.

Nikola Tesla in his laboratory in Manhattan has incidentally built resonators, of which he could bring all electric, magnetic and mechanic factors in resonance. On an evening stroll he fastened a battery operated vibrator to the tubular steel scaffolding of a new building and let everything shake and wobble. In his laboratory such a device once got out of control by inattentiveness and triggered an earthquake. In that way the road surfacing and pipes were burst and window panes got broken. The police penetrating his laboratory only could see, how Tesla forcible finished the experiment with a sledge-hammer.
The experiments which got out of control of Tesla, Searl and Schauberger have one thing in common: it concerns constructions with an unipolar arrangement of the field.
Tesla had arranged the magnetic field in a unipolar way, as he has reported himself, Searl had realized electric unipolar fields in a construction similar to the electron, and Viktor Schauberger had specialized in producing unipolar structures with water vortices.
In the case of the corresponding technical usage, which can be interpreted as making use of the occurring "spin coupling", therefore in principle utmost caution is imperative.

<i>: Rho Sigma (Dr. Rolf Schaffranke): Forschung in Fesseln, das Ratsel der Elektro-Gravitation, Ventla-Verlag, Wiesbaden, 1972, Page 67.

Nikola Tesla: ,,Ere many generations pass our machinery will be driven by power obtainable at any point in the Universe This idea is not new, we find it in the marvellous myths of Antheus, who derives energy from the earth... Everywhere in the universe there is energy. Is this energy static or kinetic? If static, our hopes are in vain; if kinetic, and this we know it is for certain, then it is a more question of time when men will succeed in attaching their machinery to the very wheel work of nature". New York, the 20th may 1891, American Institute of Electrical Engineers.

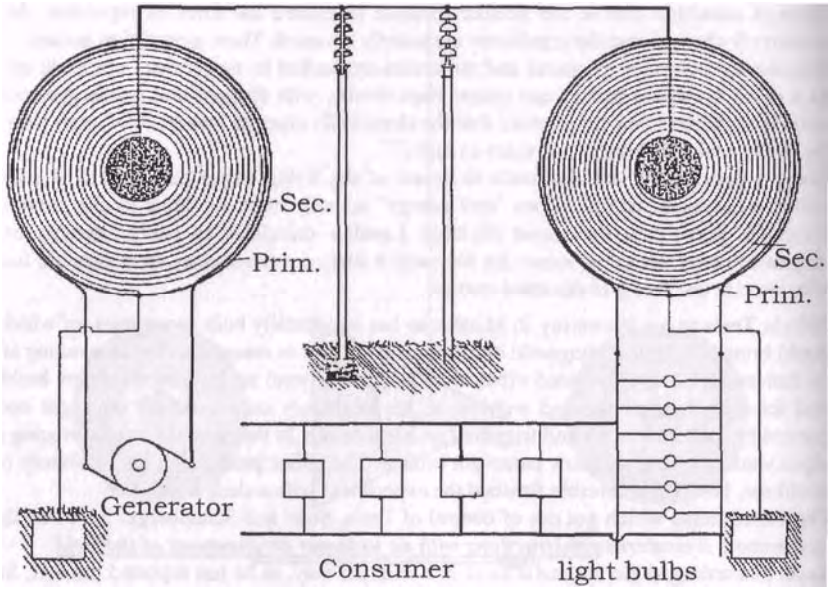

Fig. 9.5: Energy transmission bound to a wire, Patent No. 593,138 (1897) of Tesla.

<i>: Philadelphia Public Ledger, Nov. 2, 1933
<ii>: Dr. Nikola Tesla: Complete Patents, Tesla Book Company, New Edition 1983, Compiled by J. T. Ratzlaff, ISBN 0-960356-8-2, page 301-304.

9.5 Free energy?

Furthermore is reported of Tesla, he would have developed a "converter for space energy" and 1931 have built it in a luxury car (Pierce Arrow)<i>. The car was a 145 km/h fast, doing so the asynchronous motor (presumably built by Westinghouse) furnished 80 HP at 1800 Rpm. The "free energy" the converter, build by Tesla himself, got from a 1.8 m long antenna. Because the motor ran without adaptation of frequency in slipping operation, it had to be cooled correspondingly. It was on the way in trial run for over a week. Now we of course want to know, of what this "free energy" consists, which Tesla will have used and of which he already 1891 had spoken in the American Institute of Electrical Engineers.

For the electron as a spherical vortex we have calculated an electric tension voltage of 511 kV between its surface and its centre respectively infinity (equation 6.31*, fig. 7.1). The highest level of tension voltage normally used for the high tension transmission lies at 380 kV (effective value); for a direct current transmission it is 500 kV. Although still higher tension voltages would be desirable, they are avoided. This is no accident. Experiments with higher tension voltages namely have resulted in inexplicable high losses. We have an explanation: the electrons are taken apart on the way! Their inner energy amounts with the outer energy to zero. The charge carrier, which in the power station as result of an energy conversion has been sent on a journey, is in danger to vanish into thin air (e.g. corona) for tension voltages above 511 kV. The transmitter of Nikola Tesla however (fig. 9.1 and 9.5) worked with 600 kV and more. He said, with his experiments he had destroyed billions of particles without being able to observe an emission of energy and made fun of the misinterpretation of Einstein of the already at that time well-known mass-energy relation $E = mc^2$.

For the purpose of a one wire or a wireless energy transmission the tension voltage therefore has to be higher than 511 kV. With Teslas equipment however the electrons shouldn't be destroyed, but merely be pulled apart to plane circular vortices with help of the today is Tesla coil known winding. These then could be sent on a journey over the antenna, to again be caught and formed back in spherical electrons by the receiver antenna. As long as the electrons don't fall apart, they keep their structure and quantum property. Quanta pass on an excitation, for instance a bump, in form of a longitudinal standing wave, by one particle bumping the neighbouring particle, analogous to sound waves, where one gas molecule passes the bump on to the neighbour. The transmission hence takes place as longitudinal scalar wave.

Electrons pulled apart to planar vortices in addition haven't got a closed vortex centre anymore on their journey. For the by Tesla in his laboratory used and publicly presented one wire energy transmission (1897, Patent Nr. 593,138) the transmission hence doesn't take place in the wire, but as vortices around the -wire. That explains, why only a relatively thin conductor, which normally should have melted, was necessary for a demonstrated power transmission of 10 kW. Tesla however could show, that the wire stayed cold and virtually no heating losses were measurable<ii> (fig. 9.5). He himself said, that this one wire transmission technology is much better than the alternating current technology full of losses, which stems from him as well. Tesla must have known the limit of 511 kV very exactly, because on several photographs one can see, that he changed the coiling technique off this value!

<i>: Philadelphia Public Ledger, Nov. 2, 1933

<ii>: resp. Tesla's lost inventions, VAP, page 36 and page 48, 49.

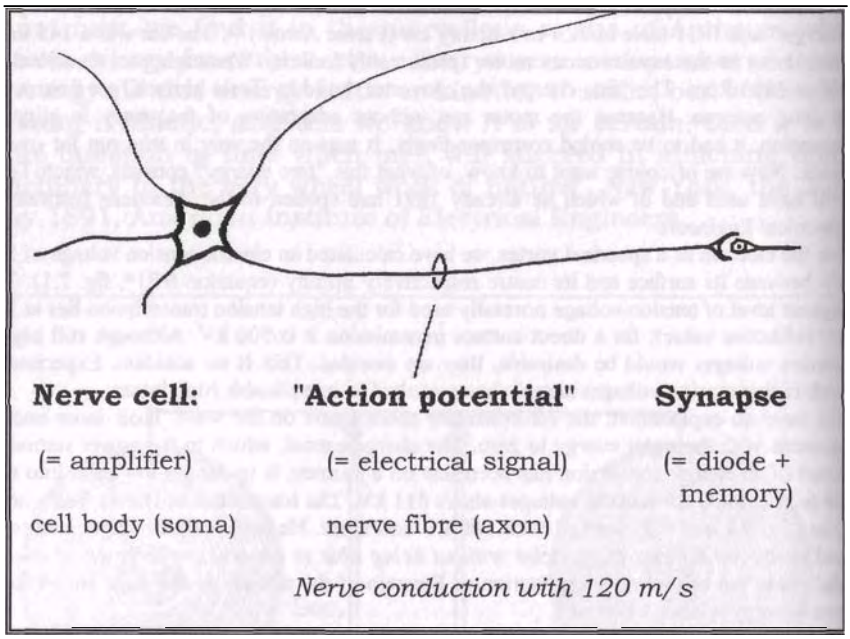

Fig. 9.6: Nerve cell and message processing (neurons)

- Material information conduction: at plants
- Information conduction with hormones: at simple animals
- Electrical information conduction: at higher developed creatures
- Analog transmission: from 10% and more difference in potential, and
- Digital transmission: number of the action potentials
- Modulated information: i.e. complex modulation of the action potential (the potential vortices)

9.6 Nerve conduction and action potential

Technical solutions often are only a suboptimum and many times they are anything but an optimum. In many cases the feasibility stands in the foreground. In the question of the current distribution at that time the decision was made for the worse system, the full of losses three phase system, because no current meters were available for the free of losses one wire technology. Without being able to collect money from the consumer, it wouldn't have been possible for the energy distribution installations to pay for themselves. Compared to that is nature with its selection principle merciless and without compromises. On1y the most efficient system has a chance to survive and to spread. If it's about transmittining information in an electric way and two different principles present themselves, then in nature only the better one will be brought into action.
Let's take a look at the nerve conduction in the human body. In the synapses ion concentrations and electric potentials of 70 to 90 mV arise. Here with conventional gauges the activity of a nerve can be detected. From a measurement of the transmission time of synapse to synapse the velocity of the signal is determined. If we however want to measure between the switch points on the line, then we have to find out, that for instance with an ammeter actually nothing is measurable. In addition the nerve fibre has a miserable conductivity.
The biologist calls the electric signal just "action potential" and draws a vortex-like ring around the nerve fibre and speaks of a mixed digital and analogue information transmission.
The doctor on the other hand knows two different types, fast and slow nerves. In the inside both are built up virtually identical. A characteristic difference consists of the fact, that the fast nerves are jacketed with a thick fat layer.
The technician would say, they are better isolated, but why they therefore should be faster, he hardly would be able to answer. If we however assume, that the action potentials or OUT potential vortices oscillate around the conductor, thus exactly in the isolation layer and are forwarded there, then possibly an explanation would have been found.
The nerve conduction moreover has much in common with the one wire system of Tesla:

1. Charges and electric potentials are transmitted
2. Doing so a transport of charge carriers, thus an electric current on the line, isn 't detectable.
3. Consequently no losses worth mentioning occur.
4. Decisive for the functioning is the dielectric insulator material which surrounds the conductor and not the electric resistance of the conductor.
5. In contrast to electric circuits a draining conductor is unnecessary.

It looks as if the one wire system is not new at all, as would nature use it already for ages in the highest perfection. We realize immediately, why our head does without a ventilator and how the high of signal processing density can be explained. Compared with our brain modern personal computer (PC) with their backward cable technology are far less than a suboptimum.

With regard to the pressure on the environment by interference radiation we had derived, that currents and eddy currents with the skin effect direct their radiation to the outside, whereas potential vortices with their concentration effect direct it to the inside. Probably for this reason the radiation field of a person is environmentally better compatible than that of a PC.

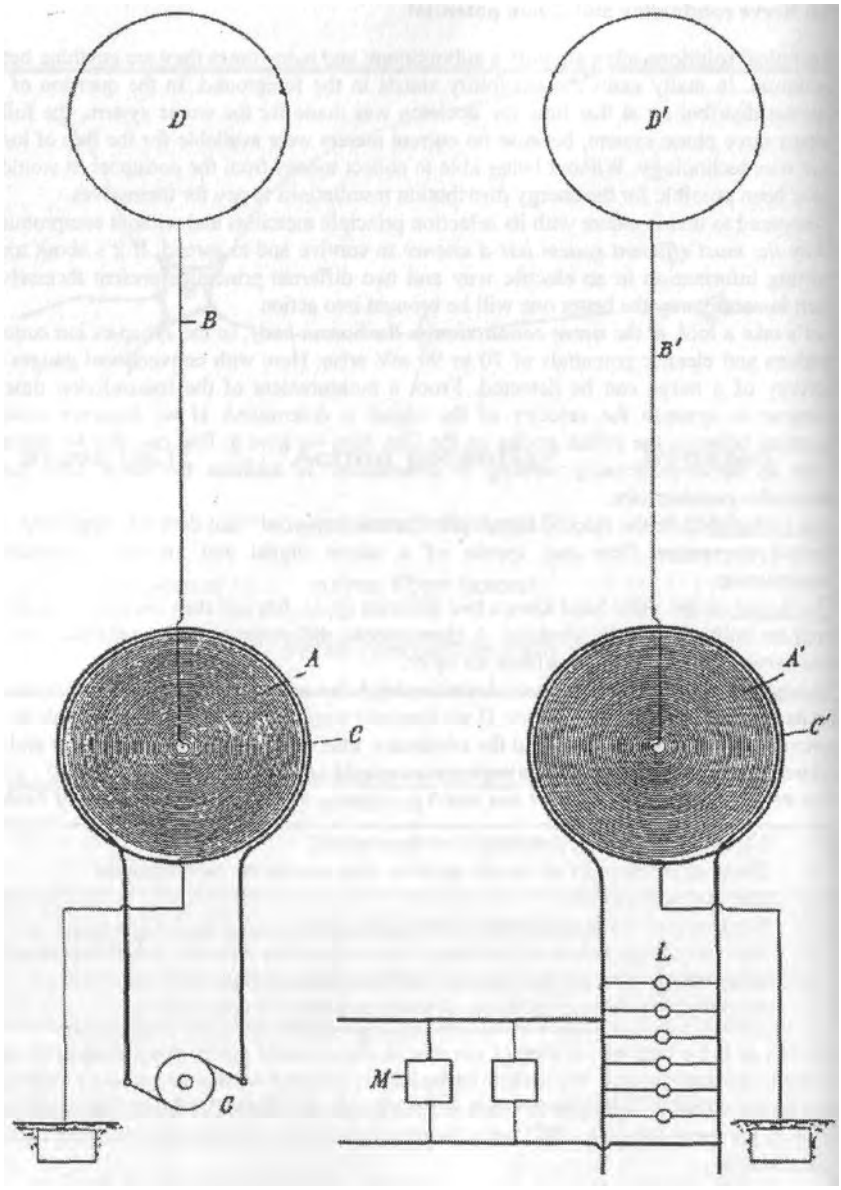

Fig. 9.7: Wireless energy transmission,
Patent No. 645,576 (1900) of Testa.<i>

<i>: Dr. Nikola Tesla: Complete Patents, Tesla Book Company, page 311-321.

9.7 Wireless energy transmission technology

Tesla still went a step further. He has cut the wire connection between transmitter and receiver (fig. 9.5) and instead has installed each time a spherical electrode (fig. 9.7). With this facility he now was able, to transmit energy completely wireless (1900, Patent No. 645,576). Building on this principle Tesla already 1890 had built a radio remote control for a battery operated submarine and had presented his patented system the navy. But they weren't able, to recognize the strategic importance of the radio technology and rejected with the words: "It's too advanced!" (fig. 9.8).

Tesla further had proven with this technology the mentioned proof concerning the existence of longitudinal electromagnetic waves. There exist descriptions, partly of Tesla himself, how he, inside or also outside his laboratory, goes in search of oscillation nodes of the standing wave with a measuring receiver[i].
He names several conditions for the wireless energy transmission:

1. "perfect resonance" (same frequency) of transmitter and receiver
2. Installation of the receiver on an "oscillation node" (maximum).

Important is also the measurement of the velocity of propagation, and that isn't constant from the start for a wave, which oscillates in the direction of propagation. From the research of earthquakes we know, that the longitudinal waves are faster than the as well occurring transverse waves. Usually the distance to the epicentre is determined from the difference in transmission time.
In the patent specification the measurement is described[i]. Tesla has sent longitudinal radio signals from his transmitter in Colorado Springs once around the earth along the earth's surface and determined a transmission time of 0,08484 seconds. This corresponds to a frequency of approx. 6 Hz. He saw his result confirmed, as he could find the oscillation node of the standing wave again (according to $\lambda/2$) in his laboratory (on the ground plate).
For the full wave length λ the Schumann resonance, which describes a standing wave of an around the earth running Hertzian wave, lies as is well-known at 7.8 Hz! Tesla calculates for his wave a speed 1.6 times the speed of light assuming the polar radius of the earth to be 6363 km.
Also this measurement result confirms, that Tesla didn't use the Hertzian wave. Tesla found the off-beat concept of Einstein, the speed of light would be the fastest possible velocity of signal transmission, only funny. If however today is claimed, 1993 in tunnelling experiments for the first time a speed faster than light has been measured, then this just isn't true. Possibly also the Tesla wave tunnelled, as the vortices for a small conductivity of the air contract and as a result of the length contraction become correspondingly fast.
Later Tesla after several goes in vain even succeeded in building a high tension tube as a tunnel, with which the velocity of the signal could be increased arbitrarily. Tesla with that pursued the goal to be able to make radio contact with other worlds[ii].

<i>: N.Tesla: Art of Transmitting Electrical Energy Through the Natural Mediums, US-Patent No. 787,412, 18.4.1905, Complete Patents pp. 397-402.
<ii>: M. Cheney: Tesla, Man out of Time, Barnes & Noble Books, New York, 1993, und S. 309, Omega-Verlag, 1996, ISBN 3-930243-01-6

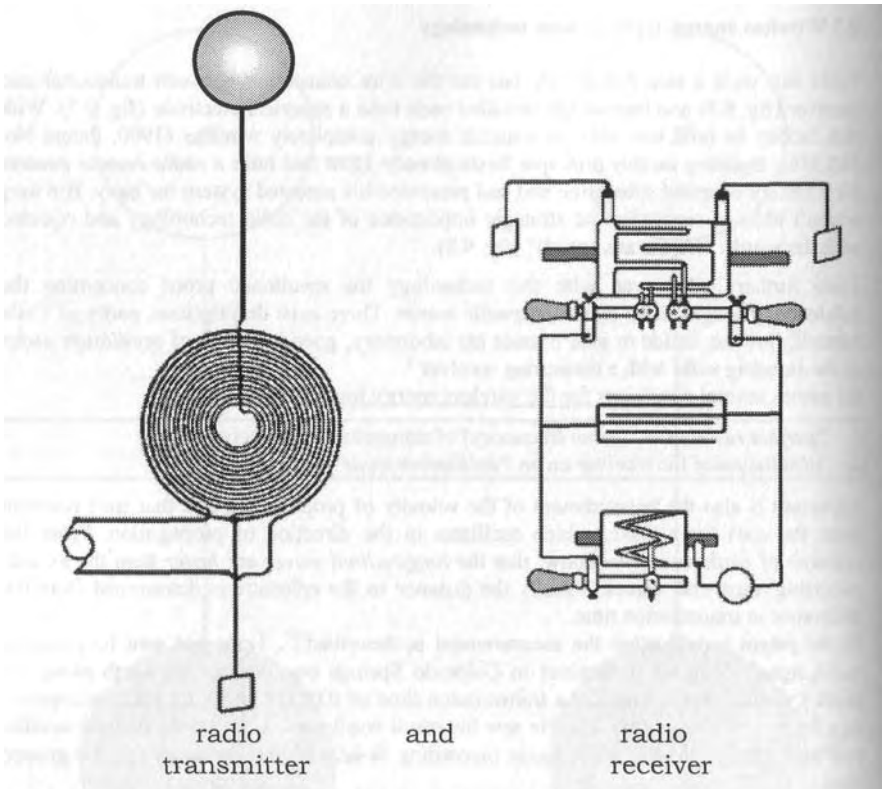

Fig. 9.8: Energy wave broadcasting system, Patent No. 787, 412 (1900) of Tesla.

In today's switching technical notation:

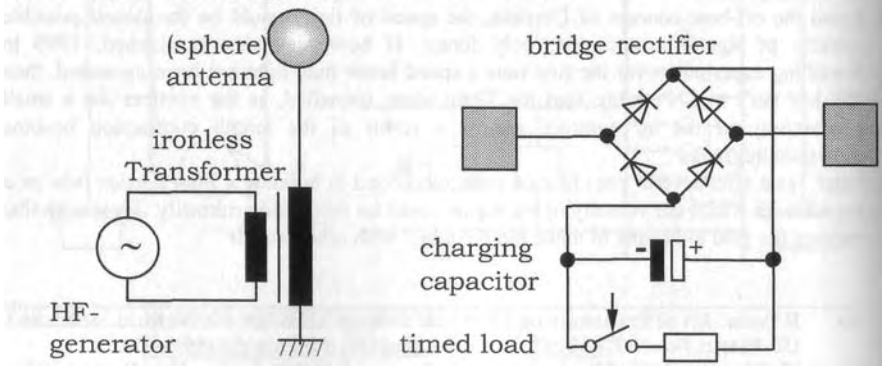

9.8 Measuring and switching technique of Nikola Tesla

As an important and accepted experimental physicist with 14 doctor titles and carrier of the Edison medal Tesla always has held on to his measurement results. Not a theoretical interpretation but exclusively correct carried out measurements have shown him the physical reality. But the by Tesla won measurement results were already for 100 years hard to digest and couldn't be brought into accord with any theory. Therefore a switching technical analysis of the by Tesla described and carried out experiments should give us now information over the nature of the free energy, the tachyon energy, the orgone, or however fantastic the terms may read.
The Tesla coil, according to the instructions of the inventor, is a flat coil wound like a spiral in contrast to the copies today on sale which, surely out of ignorance, are mostly cylindrical. Its peculiarity probably is to be seen in the circumstance, that charges moved through the wire of the coil inevitably increase their angular velocity towards the centre, In this way the electrons, which at first are spherical elementary vortices, are pulled apart to vortex rings like planar discs.
Tesla switches the "secondary" called flat coil between two "terminals". Following he sends, stimulated by his "primary", charge carriers from one terminal to the other and back again and produces a standing resonant oscillation.

Mostly replaces Tesla one of both terminals by the earth. He thus assumes, that now the earth as a spherical electrode takes over the function of one terminal. That he again infers from the observation, that a by the transmitter wireless fed little lamp goes out, if he cuts the connection to the ground. Doing so the oscillation collapses. Radio sets on the other hand can also be operated without grounding, as we know!
The degree of effectiveness of today's distribution technology of current due to the heating losses lies clearly beneath 100 per cent. Without the losses of the wiring it lies close to 100 per cent for the discussed one wire energy transmission. There the vortex rings are guided nicely one after another along the line like beads drawn over a string. This result even is to be expected, as far as no vortex "jumps off the wire or "falls apart". For the wireless version Tesla however to his own surprise had to find out that more energy could be received, than his transmitter produced. The measured degree of effectiveness lay above 100 per cent! He therefore called his transmitter a "Magnifying Transmitter" (fig. 9.10). The further transmitter and receiver were away of each other, the further the received energy increased. Tesla inferred from this, that there had to exist free energy and that he had caught that too.

Consequently he had built a receiver for free energy and registered for patent (1901, Patent No. 685,957, fig. 9.9). Tesla states that the amount of energy depends on the size of the "terminal". Of today's sight we could be willing, to describe this receiver plate as a solar panel, but we should know, that the apparatus produced energy even at night! In addition the energy gain was considerable higher than for today's solar panels. Tesla spoke of "radiations ", of an unknown radiation and he in his lifetime has in vain sought-for help of explanation.
The vortex model will also in this question be a valuable help to us.

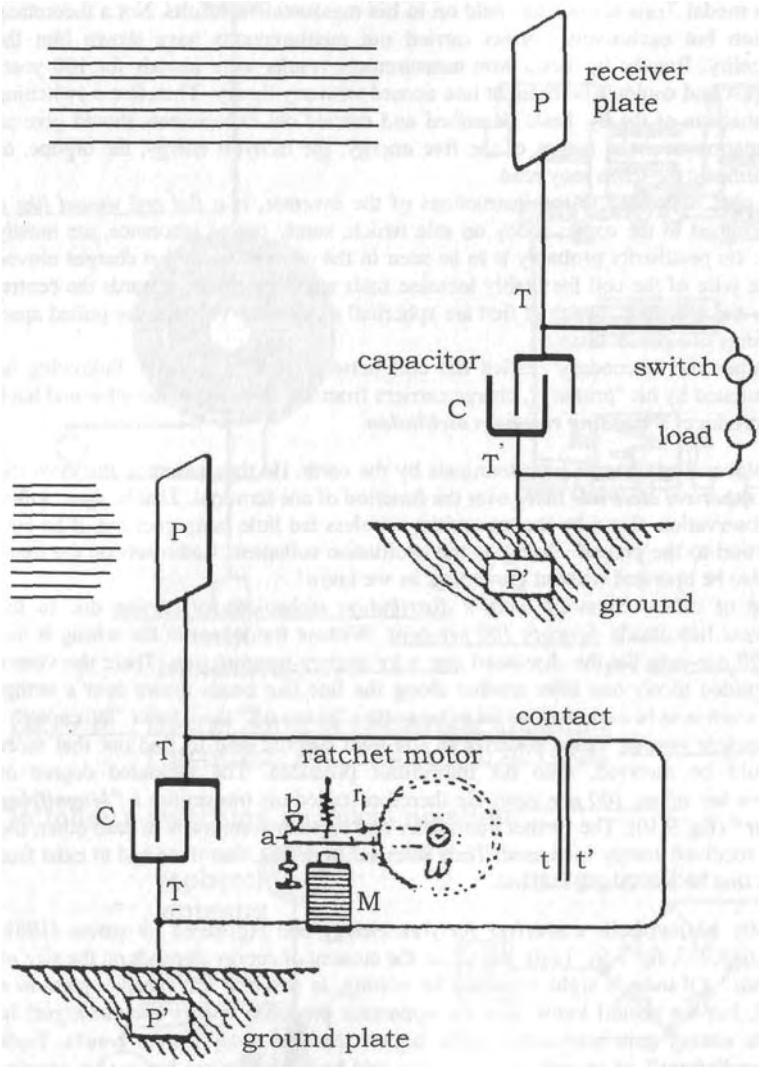

Fig. 9.9: Receiver for "free energy",
Patent No. 685,957 (1901) of Tesla

9.9 Energy technical usage

The answer of the potential vortex theory could turn out as follows:
If at the transition of the one wire to the wireless transmission the ring-like vortices is purloined the guiding wire the vortices immediately begin to turn around each other, as is observable for flow-technical ring-like vortices,. In this way the ring-like vortex the next moment shows its inside. If it before was an electron vortex (fig. 4.3), then it now shows as positron, if it was negatively charged, then it now is positively charged. Following it oscillates back again, etc. Wit that the ring-like vortex on the average has no measurable charge and no mass, because it alternately forms matter and anti-matter. Without interaction it has an enormous ability of penetration . In physics such particles are called neutrinos.
Tesla thus had, apart from his transmitted energy wave, which turned out to be neutrino radiation, by chance also caught neutrinos which oscillated synchronously.

According to the actual level of knowledge do neutrinos penetrate the earth and appear also on the night side. The order of magnitude in every second amounts to approx. 66 billion neutrinos per square centimetre. It is a true bombardment. If we would be able, to collect and convert all neutrinos, the won energy would be entirely sufficient, to cover the need for energy of the world population (approx. 27 W/m^2). We merely have to materialize them, thus give them mass, charge and the necessary localization. Tesla was able to do that experimentally! Let's record:
The ring-like vortices, which Tesla with his transmitter has sent on a journey as electrons with an open vortex centre, are neutrinos (fig. 7.12). Tesla requests that transmitter and receiver operate in resonance, thus with the same frequency. Under this condition the receiver collects in all oscillating vortices, so that no one is lost.
If the neutrinos for instance are just positively charged when leaving the transmitter electrode, then an electromagnetic force of attraction takes place, if the receiver electrode at the same time is negatively charged. The required operation with the same frequency and opposite phase guarantees that also the next moment, if both, the neutrino and the receiver, have changed their polarity, the electromagnetic attraction is preserved.
It is obvious, that strange neutrinos which fly past and by chance oscillate synchronously are as well attracted. In that way the power collected in the receiver capacitor will increase further and degrees of effectiveness of over 100% are obtainable. Tesla discharges the receiver capacitor timed with the frequency of resonance (fig. 9.9) and points to the difficulty of an exact keeping of the condition of synchronisation.
Tesla indeed did work on a theory of his own, but never published it. The patent office and his lawyers had to proceed from the Maxwell theory, although Tesla knew only too good, that his apparatus in no way could be described with this theory. It therefore can't be excluded, that important facts in his patent specifications haven't been mentioned at all - or even worse - consciously or unconsciously in an inapplicable manner have been explained with the Maxwell theory.
Perhaps this is the more profound reason, why the numerous Tesla imitations don't want to function quite so well. With the new theory there should be some changes, and we should accept the challenge for the sake of humanity.

The transmitter tower of Tesla (57 m high with a spherical electrode of 21 m) for the transmission in multiplex mode of operation (according the inventor) of:

Fig. 9.10: The planned transmitter Wardencliff of Tesla on Long Island, 7.5 MW (1902).

9.10 Environmental compatibility

We now can summarize the different observations and try to find answers for the in the first chapter raised questions concerning the electromagnetic environmental compatibility.
The by Tesla used longitudinal energy wave is a potential vortex wave in the sense of the vortex model of Kelvin, which we again could identify as neutrino radiation (Dirac).
Also other, partly quite fantastic terms, are known like "radiations" (Tesla), "orgone radiation" (Reich), "tachyons" (Feinberg), "grid radiation" (Hartmann), "bioradiation" or "water veins".
Actually these rays have nothing to do with water as a cause. Water with its high dielectricity however favours and influences the course and the local distribution of the radiation. The maximums of the standing wave considered for themselves result lines in straight as a die in the landscape. Of Tesla is known, that he measuring technically could detect the cross points of the lines, which he called oscillation nodes. There exist so-called dowsers, who can make these standing waves out even without technical aids. For that they hold a fork in their hands, which suddenly moves over such lines.
Let's remember that the same potential vortices are used at the nerve conduction as reaction potentials to conduct stimuli. If ring-like vortices arrive at a muscle, it contracts without knowing, if the signal was sent from the brain over the spinal cord or picked up from the environment over the fork and the hand.

Thus if the same signals, which we use for the tasks of controlling and thinking, are also produced by technical apparatus, then this touches the question of the environmental compatibility in a direct way. Above extremely strong points of resonance, which are called "geopathic zones", now and then even is warned about "psychotronics", a function trouble of the brain, which can show in a disturbance of the waking consciousness.
A possible explanation would be that the brain is occupied with so much vortices picked up from the outside, that it isn't able anymore to accomplish its actual tasks. For muscle cramps or an inexplicable crash of a PC an correspondingly interpretation would be obvious.
As long as no gauges are available, the highest caution is imperative!

If Tesla had been able to put into operation his transmitter tower for longitudinal waves ("World Telegraphy", Wardenclyffe, Long Island, s. fig. 9.10) with the estimated power of 7.5 Megawatt and thus had been able to realize his dream of a world-wide wireless communication, then this could have had hardly estimable consequences for the health of the world population.
Shortly before the completion of the project, in the year 1905, Tesla without notice let stop all work. He to that never made an explanation to anyone. Officially it was said, his financial backer J. P. Morgan would have withdrawn his financial means. In any case was Tesla financially ruined with this step.
Perhaps also T. A. Edison was behind it, who was his opponent at that time. Edison committed himself engaged for the use of direct current. Against the alternating current, preferred by Tesla, Edison argued with unhealthy risks, and with that he perhaps wasn't so wrong at all.

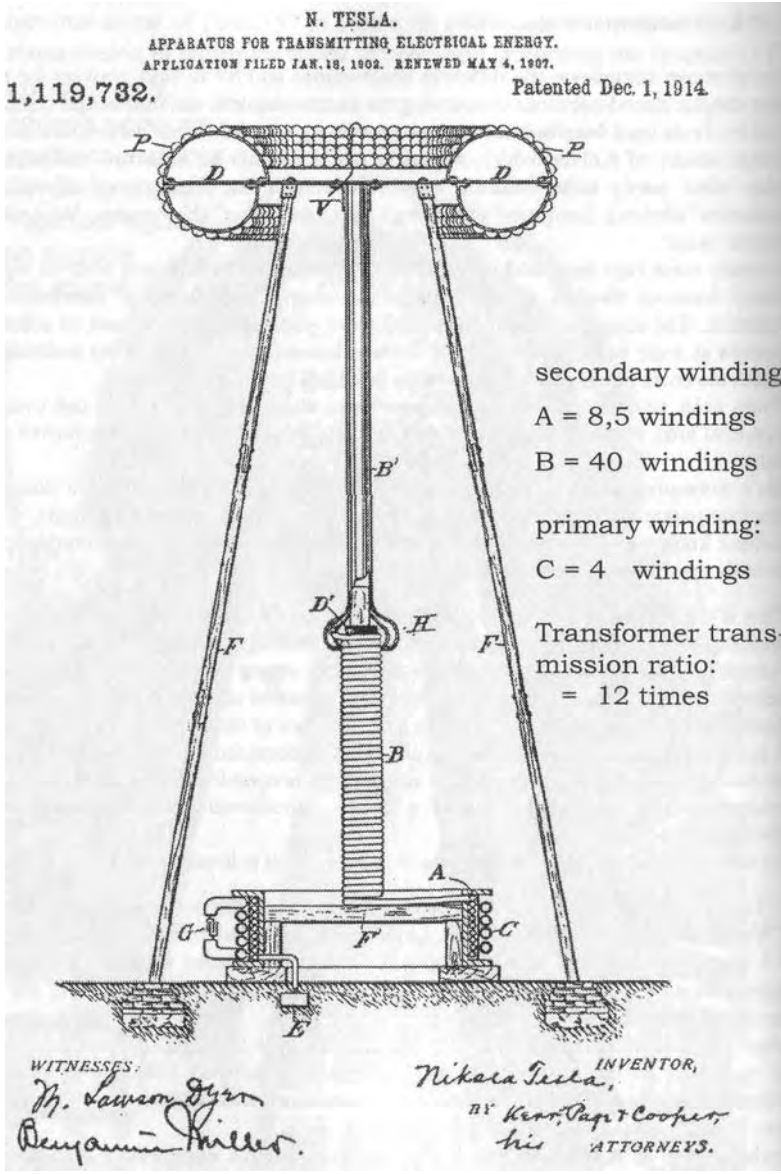

Fig. 9.11: Concerning the technology of the Wardencliff transmitter (fig. 9.10).<i>

<i>: Dr. Nikola Tesla: Complete Patents, (J.T.Ratzlaff), Tesla Book Company (1983), ISBN 0-960356-8-2, P. 435.

9.11 Ecologically fair usage

Tesla not only has stimulated ecologically fair usages of the energy radiation. To that can be counted the use of a Tesla transmitter as a radiation weapon<i> as well as the mentioned building of a Tesla interferometer, the low-frequency interferences of which can lead to mighty gravitational waves and with help of which it should be possible, to produce earthquakes, to sink ships or to shoot down planes from the sky<i>. Against the background of two world wars it can be understood, why Tesla has drawn attention to the possibilities of a use of his system for the purpose of defence.

In today's sight a technology like Tesla's wireless energy transmission (fig. 9.11) hardly would have any chance of a large technical use, because it should be reckoned with enormous problems of environmental compatibility. After all had come out in our considerations, that entirely in contrast to the Hertzian wave just of the Tesla energy wave direct biological effects are to be expected. A purposeful medical use of the Tesla rays however can be imagined.

The collecting of "free" energy waves with a neutrino receiver at first undoubtedly would be a clean and ecologically fair alternative to the present energy technology, with which we heat or nuclearly contaminate our environment. But even the use of free energy converters has limits. Should it turn out that the Photosynthesis uses such a materialization, in which the necessary free electron for the chemical reaction actually is produced from a caught neutrino in the so-called reaction centre and thus the reaction energy is won, then for an as usual excessive use by men it can't be excluded anymore, that the plants on earth die and nothing grows anymore!

I in contrast attribute big chances to the one wire transmission technology. Because for an use of alternative and regenerative energy sources, like the sun in the desert or the geothermal energy in Iceland, the transport of energy has to be made over large distances through the oceans the small losses and the possibility to be able to use sea cables, play a big role. In the residential areas and conurbations on the other hand it has a positively effect, that by the concentration effect of the potential vortices the interference radiation is directed inward. Laid on the bottom of a sea or of a river, such a line in addition is protected against the effects of lightning and sabotage, and it neither spoils the countryside, as the old-fashioned high tension pylons do.

For transportation tasks the mentioned making use of the spin coupling would surely be the most suitable drive. The denser the medium, the more efficient would be the driving effect, for which reason not only flying objects, but quite particularly also ships and submarines could be operated non-polluting in this way without combustion and without exhaust fumes. Build up effects by the water pressure or the sound barrier don't occur. But control might not be entirely unproblematic. If for the reason of a unipolar arrangement of the field a relative velocity to compensate the field becomes necessary, then a correspondingly build up arrangement will do so without considering losses. It is no accident that most apparatus which got well-known have flown the builder sooner or later "past his ears" (note of the translator: broke into pieces). Till a commercially utilizable flying saucer has been built, many technological hurdles have to be taken.

Claims to an up-to date environmental policy in view of longitudinal electromagnetic energy waves
= Tesla waves = neutrino radiation = scalar waves
= potential vortex waves:

1. Gauges must be developed and built, with which the energy waves can be measured.

2. All technical apparatus should be tested regarding the emission of energy waves. Harmful radiation should be avoided.

3. Only such transmitter antennas may be brought into action, which emit a minimum of energy waves.

4. The ability of biological systems to absorb energy waves should be determined. To that also belongs the question, how many vortices collect locally and how fast they fall apart.

5. Limits for allowed pressure produced by artificially energy waves should be fixed, regulations and laws enacted.

6. The in nature available energy waves should be brought to a technical use, with the goal of a natural energy production.

Fig. 9.12: Catalogue of claims concerning the environmental compatibility in the view of the new field theory.

9.12 Claims concerning the environmental compatibility

Now we still not know, if the using of a handy or another electronic device poses a danger to the user. Now, we surely can't exclude a danger, and the statement of the manufacturer, it is safe because all limits have been met, is worth nothing, as long as the part of longitudinal waves isn't measured. Therefore stands at the very top of the list of the catalogue of claims (fig. 9.12) the development and the building of gauges to measure Tesla radiation. More than half the 700 patents of Nikola Tesla concern the building of transmitter and receiver installations for energy waves. Here a lot of valuable clues are found, especially as he himself has built and used some of the switching circuit designs. In the seminar a rebuild is discussed, with which 1995 the existence of longitudinal waves could be proven [A7].

For an earthquake always both, the transverse and the longitudinal wave, occur simultaneously and, taken exact the same is valid for the sound wave, even if the transverse part doesn't get too far in the air. The emission of both parts in analogy is almost to be expected of an electromagnetic wave generator or transmitter. Actually both waves are detectable at the receiving point: The useful transverse wave and the longitudinally propagating vortices, which show as noise (fig. 4.7). If the vortices are predominant and the useful signal goes under in the noise, then a interruption of the radio operation occurs. Also small gardeners immediately near a radio station have made experiences as e.g. in a distance of one kilometre from the transmitter of RIAS-Berlin. They were able to light their allotments day and night with a neon tube, to which they merely had tied a free wire. The radio station immediately insinuated, that they in an illegal manner had tapped their useful wave and damped it. But it can't be excluded, that the transmitter has sent a longitudinal part in the ether too, which was responsible for the energy transport. But that suggests, that also at other transmitter antennas, thus for the mobile phones, the unwelcome parts is transmitted even than, if we don't use it at all.

Still another problem is added. If in a modern receiver radio waves arrive, then they roll up to a standing wave and according to fig. 1.4 to a vortex over the antenna. According to that we aren't able anymore to distinguish, if the transmission took place as Hertzian wave or as Tesla wave. The separation of both sorts of waves has to take place before the antenna is reached.

An up-to date measurement arrangement would look as follows: In front of the receiver antenna a path with a tunnel, which represents an insurmountable obstacle for the transverse waves (fig. 6.14), is placed. Then only the longitudinal waves pass the tunnel, and these at the end of the tunnel can be recorded and analysed with conventional technology. The tunnel is an elegant possibility, to make use of the part of Tesla waves. After all only this part is relevant with regard to the electromagnetic environmental compatibility. Concerning the above asked question we can take home at least one important realization. The probability is quite high, that you actually notice nothing of the handy radiation, because not every system react in the same manner to certain vortices. The resonance conditions regarding frequency, phase and position always have to be fulfilled, if an absorption of energy waves should occur. (fig. 2.10 B, E. coli bacteria). On the other hand it however can't be excluded, that just you or me synchronize according to frequency and collect 100 % of the transmitted energy radiation. In contrast to the Hertzian wave plays for that the distance to the source of interference only a secondary role! Seen that way worries would by all means be entitled ...

From Indian mysticism:

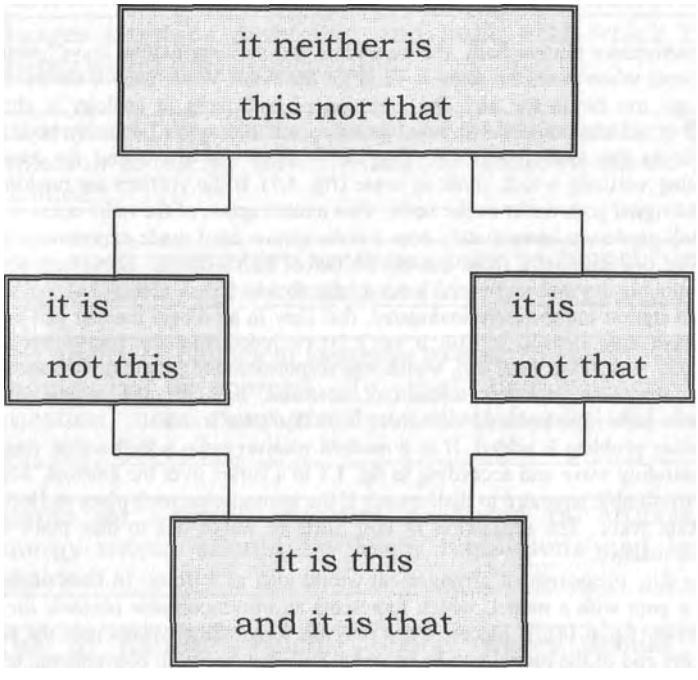

Fig. 9.13: The structure of the world equation, an example from
Indian mysticism

9. 13 Epilogue belonging to part 1

The correctness of a new theory not by all means guarantees, that it also is accepted! A new theory must be used. Only if a concrete need exists then an acknowledgement is to be expected if at first only by the direct beneficiaries.
In november 1994 in Munich the trade fair "Electronica" took place. Here invited by the Deutschen Gesellschaft fur EMV-Technologie (German association for EMC-technology, note of the translator) the books about potential vortices [Al, A2] were honoured with a prize by an internationally renowned EMC-scientist. The number of people, who the potential vortex theory helps further to find answers to problems, which until now aren't explicable, grows further.
Nevertheless, nobody should believe that something will be changed to the content of the text books in the shelves that fast. Habit and laziness encourage to further use the to date interpretation, even if a new theory has ready a better and convincing answer. It will take some time, to give an example, till the heating of water in a microwave oven is explained as eddy losses, as is described sound by the potential vortex theory already today. The discovery of a physical phenomenon may happen in a fright second. Its acknowledgement on the other hand as a rule is a lengthy procedure. If we look back in history we find out that even in the past it hasn't been otherwise.

Of the four fundamental phenomena in fig. 8.2 at first the tension voltages and the charges have been discovered by Coulomb (5.7e).
(5.7c): An effect of the eddy currents was observed already 1825 by the French physicist Arago. He discovered that a magnetic needle suspended above a rotating disc tends to rotate along. Out of ignorance he named the effect "rotational magnetism".
But the eddy currents could only be mathematically described with the help of two laws, the law of Ampere (1820) and the law of induction of Faraday (1831). Because the effect due to the eddy current losses rather was regarded as disturbing, technical applications or patents at first have stayed out. At first Riidenberg has carried out fundamental calculations for eddy current brakes in 1906. The discovery and usage of the "skin effect" is to be attributed to Tesla.
(5.7b): The electromagnetic wave for the first time was mathematically described by Maxwell (1864). He had aimed to calculate the light and he could show, that his theory actually could correctly describe all properties of the light. With that he was able to prove the correctness of his theory. But he had to deal with many sceptics, because he had postulated the dielectric displacement, without however in his lifetime being able to measure it because of its smallness.
This may be the reason, why the discovery is attributed to Heinrich Hertz and was and is spoken of the Hertzian wave. Neutrally seen Hertz at first was nothing more than a enthusiastic pupil, who had worked through the "Treatise"[<i>], Maxwells books. All results, which Hertz could observe experimentally, already were contained in the Maxwell-theory and published.

<i>: James Clerk Maxwell: A Treatise on Electricity & Magnetism, vol. 2, Chapter XX: Electromagnetic Theory of Light. Dover Publ. New York

But the great mathematical description of Maxwell at first had a purely academic importance. The interest of the general public on the other hand concentrates on the practical applicability. Hertz had experimented with antennas and has laid the foundations of the building of a gauge for electromagnetic waves (1888). The wireless transmission of invisible waves was convincing. It was an entirely new technology, which stimulated fantasy in view of a technical usage. A practical man, who was stimulated by the theoretical realizations, was Marconi. He goes for the inventor of the radio (1895, Nobel prize: 1909).
Between the three summits, first the calculation and at the same time discovery, second the measurement and third the usage of the wave phenomenon lay 31 years, and the radio technology is developing still further, even today. In the area of the cellular phone network and the telecommunication even a kind of gold mining mood prevails, which can't be impressed much even by hints of an electromagnetic environmental compatibility.

In the euphoria of the past 100 years is fallen into oblivion completely, that besides the by Hertz detected transverse wave in the wave equation according to Laplace and according to the original version of Maxwell also a longitudinal wave was described mathematically. This one was discovered and detected by Tesla in numerous experiments. With reference to his discovery Tesla initially had asserted publicly, Hertz had been at fault, with which he undoubtedly was wrong and had incurred the wrath and the scorn of the scientific community. As a result of this development his experiments haven't been reproduced and the discovery of the scalar wave could fall into oblivion.
Not enough with such sanctions against the inconvenient freethinker Tesla a series of professors like Gibbs and Heaviside have made cuts and discarded all parts from the original version of the Maxwell equations, which by that time weren't considered to be experimentally proven by experiments of Ampere, of Faraday, of Ohm and Hertz. With that the scalar waves fell victim to the axe, what, though it had encountered severe criticism, finally entered as textbook opinion into all textbooks, after Hertz also had sanctioned this measure.
If the field equations according to Maxwell in today's revised version don't describe scalar waves anymore, then all orthodox scientists, who want to bear reference to that, have to bear one thing in mind: discarding a term of an equation is the same as neglecting it. But the term only may be neglected if it is sufficiently small. The first thing every student learns in the physical practical training is that this first has to be tested. For that the term has to be measured and its order of magnitude must be determined. Then it is little helpful and extremely unscientific, if at first is neglected and on the basis of the revised field equations, which have put all scalar waves to zero, is demonstrated that the neglect was allowed or even necessary.
A practical example are the longitudinal wave parts, like they occur and are proven in the near-field of a transmitter antenna. Considering the order of magnitude a neglect is out of the question. On the other hand they should not exist at all according to textbook physics, because they had fallen victim to the axe. Since most scientists in present time do not know about the cutting action anymore, they are postulating field vortices anew in the proximity of an antenna. Field vortices, which are propagating longitudinally in the direction of a field pointer as a scalar wave.

With that they calculate their own arbitrary assumption<i>.
If in the practical training of physics a student unevaluated neglects an essential factor of influence, then his experiment goes as not passed. The experiment must be repeated so long until according to the approved methods of scientific soundness all used neglects have been tested individually and have undergone an error consideration.
Do we now have to deny the cutting action, which had been plotted by Gibbs, Heaviside and others, having the necessary scientific soundness? Do we have to review and rework all textbooks concerning the illegal neglect? Since the cutting action a gap gapes in the field theory!

(5.7d): The potential vortex fills the remaining gap in fig. 8.2. Several research scientists and scientists can be named, who already could observe this phenomenon: in front of all goes Nikola Tesla for discoverer of the Tesla currents, very weak currents which are said to cause extremely high potentials. Here presumably cause and effect have been mixed up, because weak currents never can produce high potentials. Actually the potentials prove to be a result of the potential vortices, whereas the currents aren't more than a result, nothing but leak currents. At least Tesla could use the vortex, but without a usable theory he neither could calculate nor adequately explain it. Besides Tesla Wilhelm Reich should be mentioned, who has collected the vortices in his orgone accumulator.
Mostly only certain aspects were observed and investigated: by Tesla the planar vortex, by Reich the influence on the weather, by Schauberger the water vortices and by all three the medical and biological aspect. The list of names is incomplete and could arbitrarily be continued.

With the discovery of the potential vortex (1990) the basis for the building of a gauge and the technical usage of the physical phenomenon is laid [Al]. It not only concerns the search for water, but also the detecting of the vortex balls and vortex streets, of the standing waves of the energy radiation in the air, at the workplace, at the bedroom, in clinics, in recreational areas and hotels. As explained at the start, neither the field strength of a Hertzian wave nor the arising heat development can be made responsible for biological or technical harm.
It primarily are the newly discovered vortices of the electric field, which take effect. The effects can, as we have seen, as well be good for health as bad for health. Intensity, plane of polarization, vortex configurations and many other characteristics play a role here. To research these influential factors gauges for vortices will be needed as well.
We have to realize that in the technical domain the electromagnetic compatibility of an apparatus is determined by its sensitiveness to vortices, thus by the fact how many and which vortices can cause a function trouble. To determine the environmental compatibility of a product the emitted vortices, the energy radiation, have to be measured. Limits for high tension lines, for screens or handheld phones must be given in units of the potential vortices. The potential vortex has shown us the way to a unified theory and has brought along a new picture and understanding of our environment. It with that wants to show us the correct way for an ecologically compatible dealing with nature.

<i>: Zinke, Brunswig: Lehrbuch der Hochfrequenztechnik, 1. Bd., 3.Aufl. 1986 Springer-Verlag Berlin, Seite 335

Part 1: Edition belonging to the lecture:
"Electromagnetic Environmental Compatibility"

Prof. Dr.-Ing. Konstantin Meyl

Scalar waves

Abstract: 1. Auflage 1996, 4. Auflage and 1st English Edition 2003

Both technical and biological systems can be influenced by electromagnetic fields, whereby numerous questions still are open, like e.g. concerning limits and the nature of physical interference fields. The book shall do justice to the circumstance, that a fact oriented discussion about ,,electrosmog" implies an analysis of possible reasons, a mathematical derivation and a physical argumentation.

We proceed from the assumption, that only that part of the electromagnetic wave should be considered for malfunctions, which has been absorbed and which has rolled up to a field vortex. The effectiveness depends on the amount of the produced vortices and on the life span, the decay of vortices.

Analogous to the sound wave vortices in space are propagating as longitudinal waves. In this context is pointed to numerous effects. Examples for the technical and biological use of these standing waves are the energy transmission of Nikola Tesla as well as the nerve conduction, which functions in a corresponding manner. If the same vortices, which man uses for conduction of information, are emitted by technical devices, then biological reactions can't be excluded anymore and worries with regard to ,,electrosmog" seem to be justified.

Causes, phenomena and natural scientific consequences

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Scalar Waves

From an extended vortex and field theory to a technical, biological
and historical use of longitudinal waves.

Part 2

by

Professor Dr.-Ing. Konstantin Meyl

Edition belonging to the lecture and seminar "Electromagnetic environmental compatibility"

(Original title: "Elektromagnetische Umweltvertraglichkeit")

Translated out of the German language
by Ben Jansen
(2000-2003)

* * *

Part 2: Edition belonging to the energy
technical seminar

Free energy and the interaction of the neutrino radiation

* * *

INDEL GmbH, Verlagsabteilung

Villingen-Schwenningen 1996-2003

ISBN 3-98O2 542-4-0

Preface to the seminar

The point of a seminar is, to deepen, to practise and, as far as possible, to practically appy the material of a lecture. The knowledge of the content of the lecture hence is a prerequisite for the participation.
For the reader of this book that's tantamount to the recommendation, to have read the first part, the edition belonging to the lecture, before*[1]*. Here the questions concerning the „electromagnetic environmental compatibility" are asked and the necessary bases for their answering is laid. Also practical consequences for various areas of science are indicated. The deepening most suitable should be made in form of a seminar, subdivided into the here presented part 2 to the energy technical seminar and a part 3 to the information technical seminar. Part 2 correspondingly concerns the energy technical aspect of electric or magnetic longitudinal waves, whereas part 3 is dedicated to the information technical aspect<ii>. Because it concerns a book which merely for reasons of usefulness is published in three parts, the chapters are consecutively paginated. References to chapter 1 to 9 hence automatically relate to part 1. The numbers of the figures and tables as a rule are identical with those of the chapters, in which they are discussed.

The seminar should lead on over the pure reading, consuming or listening and should stimulate to join in. All involved persons may and should give ideas and ask questions, even if these may sound little orthodox. The scientific working method takes, that is struggled for answers and even is argued, if necessary. To reach this goal, it mustn't exist any obligation or censorship, neither for the leader of the discussion nor for the participants of the seminar.

The seminar is being carried out since the summer semester 1997. The works of the seminar written by students treat the knowledge of text books of the respective theme. Following the lecture the answers are discussed and compared to those of the theory of objectivity<i> and other models of explanation. This procedure in this edition belonging to the seminar is reflected at some points, if for instance a chapter is completed with a „discussion".

The first edition of this 2nd part still was incomplete and has been handed out to the participants of a congress in Switzerland instead of a manuscript belonging to the lecture the 17th of Nov 1998. The here presented second edition in the meantime to a large extent is complete, but surely not yet perfect. In accordance with the experience made with the first part of the book also for this 2nd part a third and revised edition, in which the ideas of the participants of the seminar and of the readers find consideration, will be due to be dealt with after a year. The reader of the second edition has to console himself with the fact that a lively seminar constantly is changing and developing further. And that has to be so!

Villingen-Schwenningen, January 1999

<i>: Electromagnetic environmental compatibility, Part 1, Edition belonging to the lecture, INDEL Verlagsabteilung, 1996, see page 1-218 of this issue.

<ii>: Electromagnetic environmental compatibility, Part 3, Edition belonging to the information technical seminar, 2002, see page 443 - 625 of this issue.

10. Oscillating interaction

A theory is not an end in itself, even if it sounds very convincing. It has to be measured by its applicability. As an entry into the practical consequences, which result from the theoretical part[i], the question about the validity of Kepler's laws is raised.

10.1 Kepler's laws

The "radius vector", a line drawn from the sun to a planet, sweeps out equal areas in equal periods of time. At least has teached us Johannes Kepler it that way (fig. 10.1). The balance of forces, the gravitation on the one and the centrifugal force on the other hand results in the innermost planets of our solar system orbiting the sun very much faster than the outer planets (Mercury in 88 days, the Earth in 365 days, Jupiter in 4333 days and Pluto in 90465 days!).
For the inner planets as well as the big planets Jupiter and Saturn Kepler's laws are still found confirmed. But that shouldn't apply anymore for the outermost planets of the solar system. Beyond Saturn should prevail changed rules as is said, based on observations of the Voyager spacecrafts[ii].

If we direct our view to an unknown galaxy, then does it rotate around its centre and in doing so to a large extent keeps its form. Despite rotation of its own an elliptic, a barred or even a spiral galaxy virtually doesn't change its characteristic form. From this follows, that the inner stars of a galaxy are considerably slower on their way than the outer stars! But we expected exactly the opposite.
According to Kepler's regularity the outermost stars would have to orbit extremely slow, In order not to be hurled into space as a result of the centrifugal force. But then a galaxy wouldn't keep its structure. The spiral form, as it already has been observed and classified by Hubble (fig. 10.2), merely would be an accidental exception as a momentary picture, but by no means the rule.
We have to take note, that the structure and in particular the cohesion of a galaxy can't be explained with Kepler's laws[iii].

<i>: Konstantin Meyl: Electromagnetic environmental compatibility, Part 1 of this book: Causes, phenomena and natural scientific consequences.
<ii>: Kendrick Frazier: Das Sonnensystem, Time-Life Bucher, Amsterdam (1991)
<iii>: The basic laws of the universe start to rock: ,,What is the matter with the galaxies? They rotate in their fringe ranges much faster, as is allowed by the laws of physics. Or is something wrong with these venerable laws? The astronomers and physicists stand for the dilemma to have to decide between the two alternatives: feign the observations us an other world or do we calculate wrong since centuries?" (translated), Bild der Wissenschaft Nr. 2, 1989

Kepler's 1st law:

The planets move in elliptical orbits, with the sun at one focus.

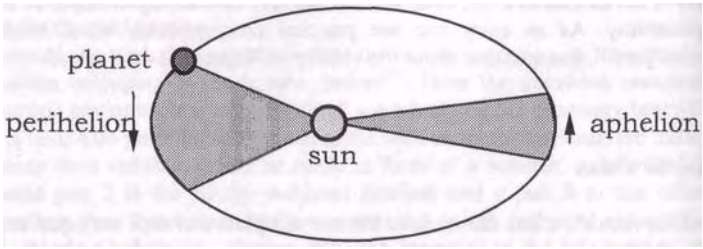

Fig, 10.1: Kepler's 2nd law (concerning the conservation of angular momentum):

The line drawn from the sun to the planet sweeps out equal areas in equal periods of time.

Kepler's 3rd law:

The ratio of the squares of the revolutionary periods of two planets is equal to the cube of their average distance to the sun:

$$\frac{t_1^2}{t_2^2} = \frac{r_1^3}{r_2^3} \quad (10.1)$$

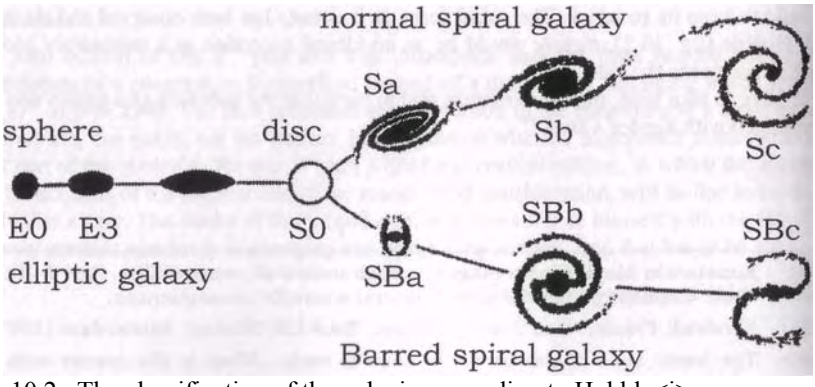

Fig. 10.2 The classification of the galaxies according to Hubble<i>

<i>: according to H. J. Lugt: Vortex Flow in Nature and Technology, page 223

10.2 Unknown interaction

So which interaction keeps a galaxy together? We today believe to know four different sorts.

I. The gravitation[i]: But since Kepler's law isn't valid in this case anymore, the gravitation is ruled out from the start. Obviously for the distances in a galaxy it hardly is effective.

II. The electromagnetic interaction: It is responsible for the structure of the atoms. Looked at from the outside atoms carry no charge, i.e. the charge conditions are balanced. A binding of our sun to the centre of the Milky Way by an electromagnetic interaction thus is ruled out as well.

III. The strong interaction: Since for the proton another charge distribution is measured, as a single positively charged particle should have according to the normally used theory, the strong interaction was introduced as a nuclear force, to explain the big error, the grave difference between measurement and calculation. The good advice hence reads: instead of giving birth to postulates at random, first of all the fault should be searched for in the normally used theory[ii]!

IV. The weak interaction: It quite obviously is involved in the particle decay[ii]. Both, the weak and the strong interaction, only have an extremely short range. With this property they consequently won't be able to keep a galaxy together.

Conclusion: In a galaxy a still unknown interaction takes effect, and science is requested to search it.

Both interactions with infinite range, the electromagnetic interaction and the gravitation occur as a result of static fields, therefore assume a constant charge or a constant mass. Considered more exactly in that case it merely can concern special cases. Gravitational waves, which reach our earth and which are detected in very costly experiments[iii], already show that the existence of alternating fields can't be excluded and oscillating interactions by all means are conceivable! The physical research at present probably is on the right track. The researchers however don't have ready an usable explanation yet. We accept the challenge!

<i>: Derivation of Kepler's 3rd law in fig. 11.10

<ii>: Konstantin Meyl: Potentialwirbel, Band 2
INDEL-Verlag, Villingen-Schwenningen 1992, ISBN 3-98O2542-2-4

<iii>: Gero v. Randow: Wenn kosmische Katastrophen Raum und Zeit verbiegen, zum Thema Gravitationswellen-Detektor, VDI Nachrichten Nr.9, 1.3.91, S.32

Analogy:

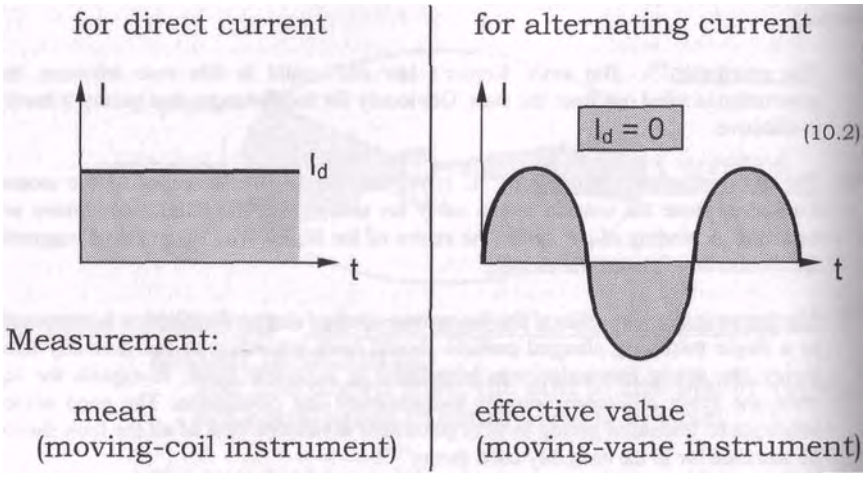

Fig. 10.3: Direct current and alternating current

constant charge: **Electromagnetic Interaction**	oscillating charge: **Resonant Interaction**
constant mass: **Gravitation**	oscillating mass: **Levitation**

Fig. 10.4, a: The four fundamental interactions

10.3 Harmony of the alternating current engineers

Today's situation can be clarified by the following picture: you engage a "direct current engineer" to measure the tension voltage in the socket of our power supply system. The „dyed-in-the-wool direct current engineer", who never has heard anything of alternating current, reports: „No tension voltage is measurable". If he for reason of your doubtful expression looks still more exact he will realize: „The pointer of my moving-coil instrument strangely fidgets around zero, but the swing is so small that one confidently can touch it", (fig. 10.3)
Modern science is accustomed to say, without a valid theory and without technical measurability nothing can exist, what mustn 't exist. If you drop dead after the experiment, then you probably had a weak heart or other afflictions. In such cases as a rule the victim himself is to blame and by no means theoretical physics!

In the case of our power supply system the answer is known: The mean of the alternating voltage of the network is approximately zero. The pointer of a moving-coil instrument for reason of its inertia can't follow the fast changing anymore and only fidgets on the spot. The effective value however amounts to around 230 Volts. But to measure it you need another device, for instance a moving-vane instrument. Seen so, direct current describes the special case of alternating current with frequency zero.

The properties of alternating current can be depicted best by an extraterrestrial observer. He will tell us: Seen from a distance at least at night a great harmony seems to prevail on earth. All lights in the streets and cities twinkle completely synchronously. All generators are in resonance among each other and with all consumers. There are two big races: The 50 Hertz race and the 60 Hertz race, which appear if the earth turns further and the 50 Hertz race is switching off again its twinkling lamps.

The synchronization necessary for an exploitation of alternating fields is so obvious for us, that hardly anybody realizes, that a consumer operated with only one Hertz difference to the frequency of the network can't be supplied with power anymore. Apart from the correspondence in frequency it even depends on the correct phase. The phase angle must be between 0 and +90°. This corresponds to an efficiency factor $\cos\varphi$ between 1 and 0. The cable connections serve both the transport of current and the synchronization of all the generators and consumers connected to the network. The frequency is kept so constant that simple clocks, switching stations and even old record-players can be operated synchronously with the frequency of the network.
The synchronization of the feeding in power stations is supervised by a station of its own, which dictates the time. It is true that we aren't capable of seeing the twinkling of the lamps anymore for reason of the inertia of our eyes, but it can be detected and filmed with high-resolution cameras. Even if we can't perceive the harmony of the alternating current engineers, it nevertheless exists.

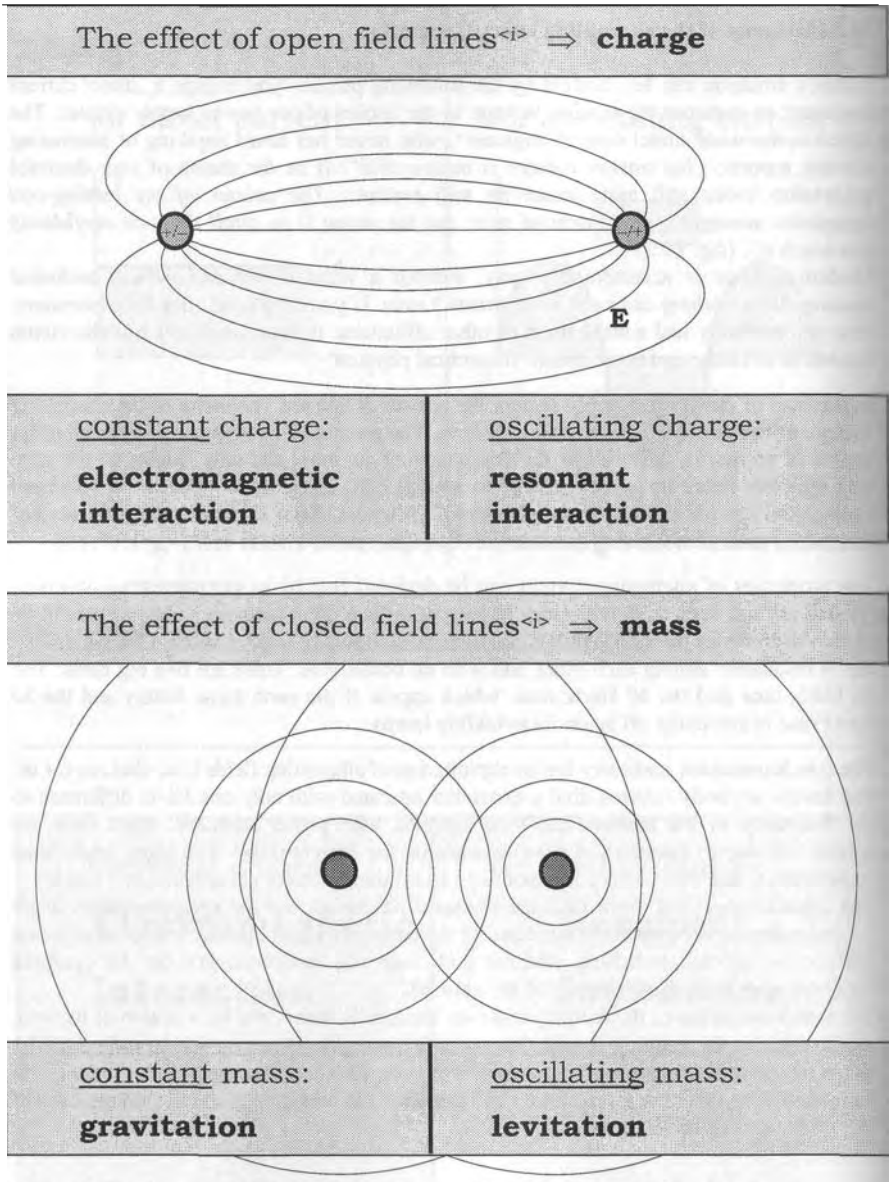

Fig. 10.4, b: Explanation of the fundamental interactions

<i>: Konstantin Meyl: Potentialwirbel, Band 2, INDEL-Verlag (1992)
see also in Part 1, chapters 6.8 and 6.9

10.4 Four fundamental interactions

These considerations suggest, that also gravitation and electromagnetic interaction merely describe the special case of oscillating interactions with frequency zero. To avoid confusions, we'll have to think of new names.
The electromagnetic interaction can be clarified by means of open field lines, which start at a charged body and end again at another body of unequal charge. In physics classes it is normal to make the field lines of a magnet visible with iron filing. Between the unlike poles a force of attraction is observed<1>.
If we this time assume that both magnetic poles change their polarity at the same time, then the force will decrease for a short time during the changing of polarity, to afterwards be active again in full magnitude and in the same direction. Therefore a force of attraction is observed again even for a reversed polarity.
The generalization hence reads: The electromagnetic interaction will occur also in the oscillating case, but in weakened form, if both bodies involved in the interaction change their polarity synchronously and if they are in resonance. A name by analogy would be "resonating interaction" (table 10.4).

It is known of the electromagnetic interaction, that its effect is larger than that of the gravitation by powers often. This presumably has to do with the described and observable bundling up of the open field lines, whereas closed field lines can't be bundled up. The gravitation hence is linked with the closed field lines, which surround all elementary particles, every atom and every body<1>.

The opposite of the bundling up is the repulsion of open field lines, for which reason here also forces of repulsion can occur. For the gravitation however no repulsion is observed, because closed field lines virtually can't be influenced.
Apart from the circumstance that the effect generally will be smaller in the oscillating case, similar properties are to be expected. Also its range will be infinite as well. It is recommended to call the case of oscillating charges, as already said, "resonating interaction" and the case of oscillating masses, the oscillating gravitation, „levitation" (table 10.4).
The term „levitation" is very appropriate, but not new. Unfortunately until now no generally binding definition existed, what should be understood by that, for which reason misinterpretations and irritations can't be excluded. Mostly levitation is linked to a cancellation of gravity, up to a state of free floating, but we will see that quite other phenomena become describable with this term.

10.5 Resonating interaction

The question, what keeps a galaxy together, now can be answered unambiguously. The well-known interactions already have been excluded. If for the enormous distances the gravitation can't keep the outer stars anymore in accordance with the Kepler rule, then the levitation won't be able at all.

Example: central star S_z with 3 planets P_1-P_3
and with 4 neighbouring stars S_1-S_4

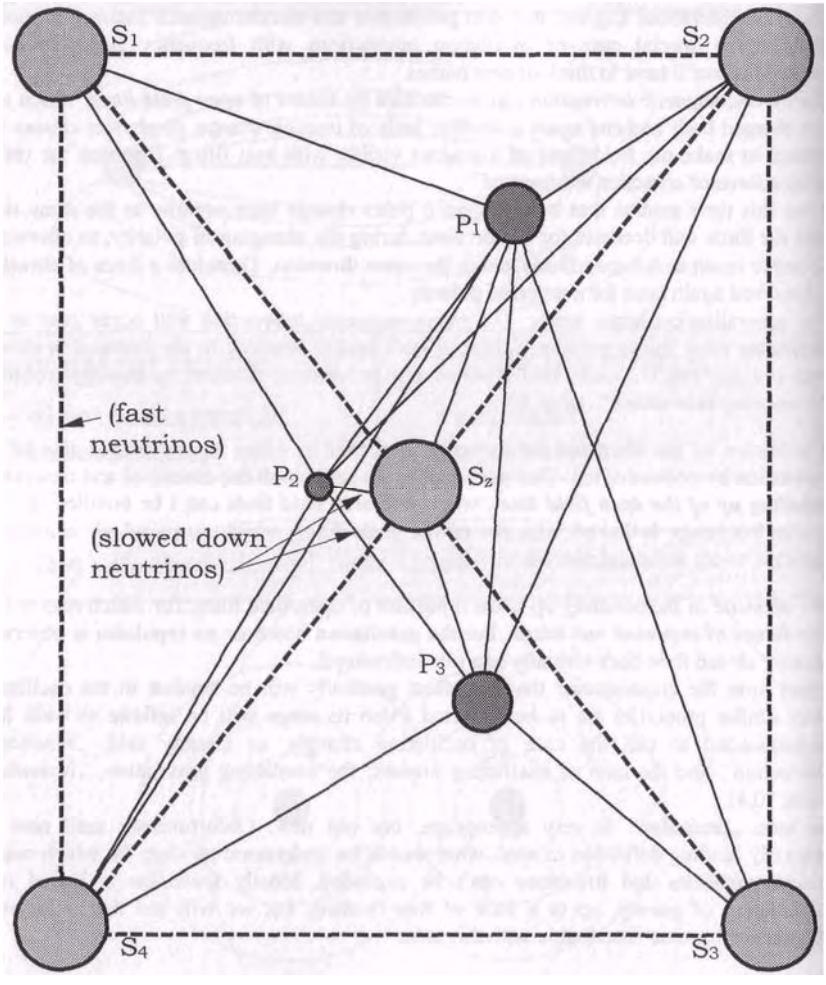

Fig. 10.5: The invisible threads of a resonant interaction

milky way-radius: $15000pc*3*10^9 = 45*10^{16}$ km
sun system-radius: $50\ a*15*10^7 = 7{,}5*10^9$ km

$\frac{45\cdot10^{16}}{7{,}5\cdot10^9} = 1{,}27\cdot10^8$	the resonant interaction is more than eight decimal powers bigger than the gravitation!

Therefore the oscillating charge is left. Actually the resonating interaction will reach to the outermost areas of a galaxy. The bundling up of the field lines results in the centre of the galaxy and one of its stars to stand in an exclusive resonance to each other, what looked at from the outside looks like, as if the star hangs at an invisible string or a "rubber band" and thus turns around the centre.
Because quite a few stars hang at the centre of a galaxy, it can be assumed that it provides correspondingly many resonance. The centre perhaps is comparable with an extremely broad banded transmitter, which operates on all channels simultaneously. The stars then pick as a receiver the for them suitable channels and hang themselves by ,,rubber band" at the heap (fig. 10.5).

Should there exist any particles with an oscillating charge, which synchronize between centre and star with the resonating interaction, then they will mediate between both partners. If we assume that the centre at one channel just is positively charged, then all at the same time negatively charged particles will be attracted, the positively charged particles however repelled. Whereas the unlike particles in the centre participate directly in the production and maintaining of the oscillation, the like positively charged particles will be hurled into space.
But at the same time does a star, which clings to the centre, have to be negatively charged. It hence attracts the repelled particle. The particle thus drifts from the centre to the star, even then if all three, the centre, the star and the particle, change in polarity. The result is, that the stars grow in diameter by collecting the particles. Only because our sun actually grows, it has the chance, to sometime become a red giant!

Since the sun radiates, as is well-known, in every second a radiation equivalent of 5 million tons, it permanently has to be supplied with a substantially greater amount of matter. If a resonating interaction should occur, then our sun will get its ,,material" supplied from the centre of the Milky Way and that is a black hole! But no particle with a mass comes out of such a hole, yes not even light. For a particle to be able to leave the black hole, it should have neither charge nor mass. At most an oscillating charge and mass would be allowed. Such a particle would have an enormous ability of penetration as a result of the missing static interaction. It would be able to rush through the earth unhindered.

According to actual knowledge only neutrinos have the described properties. One also knows that the centre of our Milky Way represents a mighty source of neutrinos. From this derivation follows:

1. As mediators of the resonating interaction serve synchronously oscillating neutrinos.
2. Starting with the proof of the neutrinos it should be able to backwards also prove the existence of the resonating interaction.
3. If, as a practical consequence, we imagine that the centre of the Milky Way wouldn't supply neutrinos anymore. Then the whole galaxy would fall apart and not one of its stars would shine anymore.

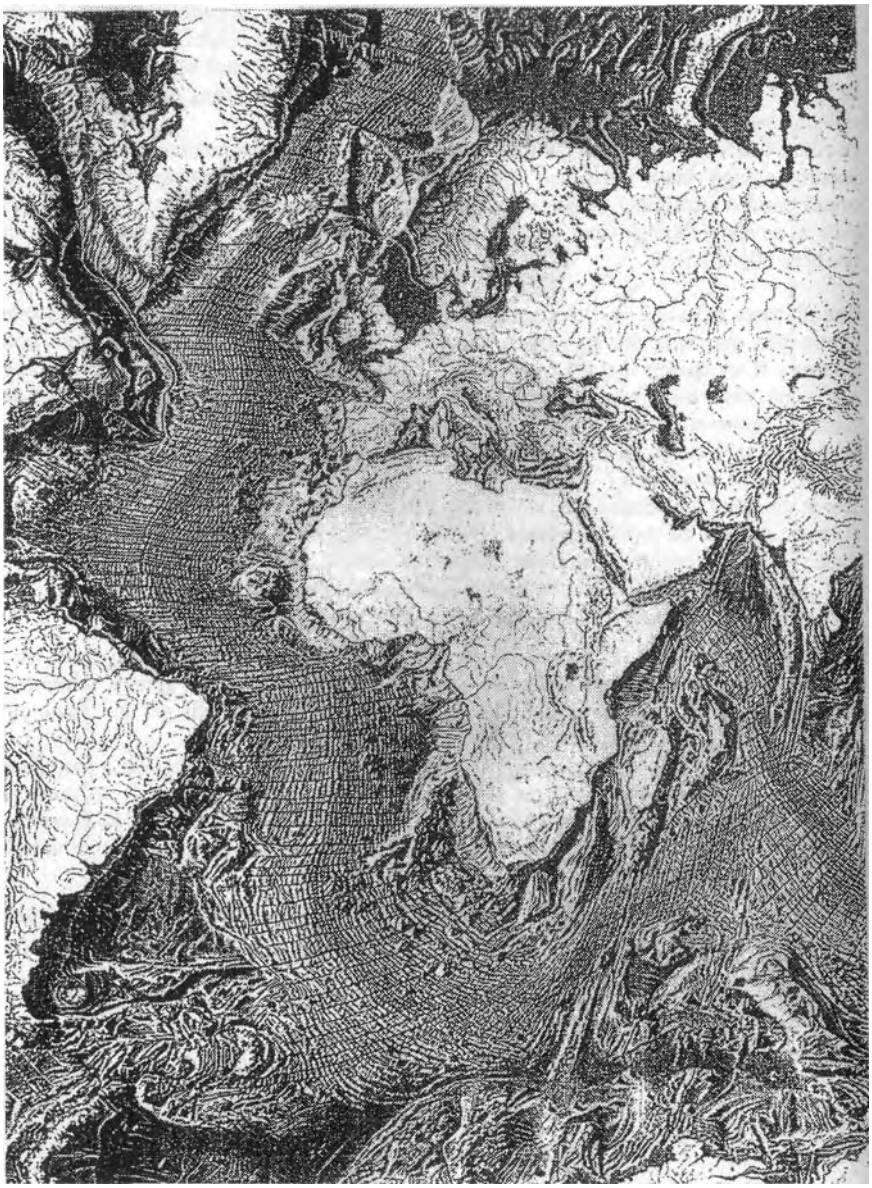

Fig. 11.1: The Atlantic ocean floor<i>

<i>: Miller, R.: Driftende Kontinente, Time-Life, Amsterdam 1991, S. 79

11. The growing globe

11.1 Long-distance effect of the neutrinos

The long-distance effect thus lies in the circumstance that the neutrinos, in the case of a resonance of the source of neutrinos and the receiver, span an invisible „rubber band" between both, which is called resonating interaction and keeps the two together.

As a transmitter of neutrinos functions for instance a supernova, the death of a star, in which 98% of the mass annihilates under emission of neutrinos or a black hole, which continually swallows light and matter and spits them out again as neutrinos after a still unexplored „process of digestion". The process, which in the case of a supernova takes place as a singular occurrence, in a black hole possibly takes place permanently. The hurled out neutrinos on the other hand serve the sun as a source of energy. A receiver of neutrinos then for instance is our sun. So that the hard and very fast cosmic neutrinos become utilizable for the sun, they at first have to be slowed down. But that is only partly successful:

1. Some very fast ones manage to pass through the sun and fly out again on the other side of the sun. The compared to the cosmic neutrinos strongly slowed down neutrinos then are called solar neutrinos.
2. Another part can be further slowed down and materialized. As a result of the oscillating mass of the neutrinos as well particles of matter as also some particles of anti-matter are formed. The particles of matter make the sun grow.
i. The with matter incompatible anti-matter annihilates under emission of light as is well-known. For this and for no other reason our sun shines!

Also the planets have such a neutrino reactor at their disposal. Only so the heat in the inside of the earth is explicable! It can be assumed that the planets materialize less the fast and hard cosmic neutrinos and that they are served more by the slowed down solar neutrinos, which our sun releases again unused.
As is well-known radiates the planet Jupiter already today twice as much radiation energy, as it from the sun receive. In this typical encyclopaedia type balance the involved neutrinos of course are not considered. But it shows that Jupiter is on the best way to become a sun itself. Its moons then will become planets.
From this the example we also see that with increasing mass the crust of the planet becomes thinner and thinner at the expense of the neutrino reactor in the inside, until it finally is eaten up and the celestial body openly starts to shine. Astronomers report for reason of their observations of the formation of more and more new stars.

One part of the collected neutrinos thus is materialized by the planet. In the case of our earth it contributes to its growth.
Who doesn't want to believe that the earth becomes bigger, should look at modern maps of the oceans, on which the topography of the ocean floor is shown. According to the theory of Alfred Wegener concerning the continental drift North and South America on the one hand and Europe with Africa on the other hand steadily drift apart since 200 million years. The result can be read at the atlantic ocean floor. The gaping, chequered rift zones to the right and left of the Mid-Atlantic Ridge show how the earth is torn apart (fig. (11.1).

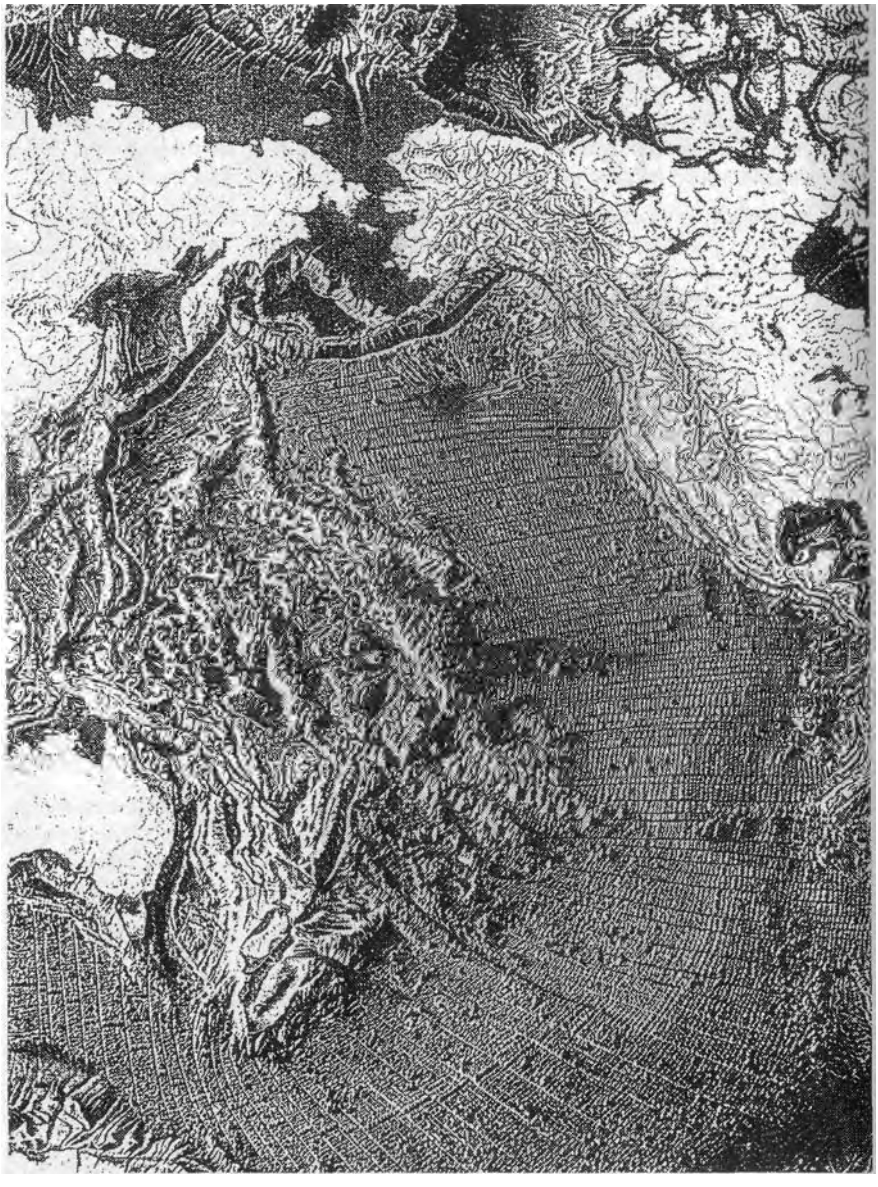

Fig. 11.2: The pacific ocean floor[<i>]

<i>: Miller, R.: Driftende Kontinente, Time-Life, Amsterdam 1991, S. 78

11.2 Model of expansion

Geographers assume that at another point to the same extent continental plates are subduced and molten. That thus has to happen in the Pacific Ocean. But the sea maps tell one just the opposite (fig. 11.2). At the ocean floor of the Pacific Ocean the same rift formations are found as in the Atlantic Ocean (fig. 11.1). That means that America drifts away from Australia and Asia exactly as from Europe, without being crushed or molten in doing so!
The only possible answer thus is: the earth grows.
The characteristic rift zones in addition are found around the Antarctic. From this the conclusion can be drawn that the 7th continent slowly is moving away, while the biggest habitable mass of land predominantly stays behind on the northern hemisphere, by Eurasia and North America forming a clip around the North Pole.

Concerning the evolution of the earth there are and were numerous approaches in various directions. Paul Dirac<i> at his time postulated, the brightness of the sun should decrease as a result of a decrease of the gravitational constant as well. In contrast to that Astrophysicists today observe just the opposite (Ingersoll 1987). According to the hypothesis of Carey<ii> energy will transform in matter in the universe. According to the idea of Oesterle<iii> aether particles are absorbed, which make our globe grow. Also other research scientists share the idea of the growth of the earth with him in their reports<i4,5,6>. As a geologist Oesterle<iii> cites his colleague Herzig: „The at the Mid-Oceanic Ridge newly produced oceanic crust has to be consumed again at other points, because otherwise the earth would expand" and criticizes the „plate tectonicians" that they would postulate their model without physical grounds.
He gives some arguments for the correctness of the model of expansion <iii>:

a) Subduction: The already discussed missing of zones of subduction and of melting of continental plates to the assumed extent.

b) Paleomagnetism: errors and mistakes in the hypothesis of the migration of the poles.

c) Continental depth drillings: They brought much higher temperatures in depths from 4000 meters, as expected and calculated according to models.

d) Stand of the sea water: Only if the water can spread in newly forming oceanic basins it can be explained, why the covering with water on earth continually is going back. This argument we want to investigate with a derivation of our own.

<i>: Dirac, P. A. M. Nature 139, p. 323 (1937)
<ii>: Carey, S. W.: Theories of the Earth and Universe. Stanford University Press: 1-413, Stanford, California
<iii>: Oesterle, O.: Goldene Mitte: Unser einziger Ausweg, Universal Experten Verlag, Rapperswil (1997), ISBN 3-9520261-9-0
<i4>: Hilgenberg, O. C: Vom wachsenden Erdball, S. 1-56, Eigenverlag, Berlin (1933) und Neues Jahrb. Geol. Palaont. Abh. 116, 1, Berlin (1962)
<i5>: Jordan, P.: Die Expansion der Erde. Vieweg 1-180, Braunschweig (1966)
<i6>: Giancarlo Scalera, K.-H. Jacob: Why expanding earth? Institute Nationale di Geofisica e Vulcanogia, Roma and Technical University of Berlin 2003

Today's earth:

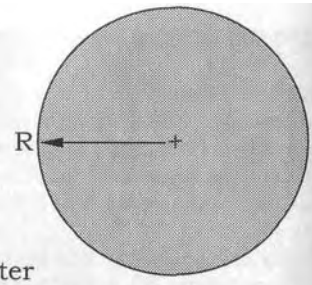

equatorial radius: $R = 6378$ [km]

earth's surface: $O_E = 4 \cdot \pi \cdot R^2$
(sphere) $= \underline{5{,}112 \cdot 10^8}$ [km²]

29% of this area is land and 71% is water
for an average water depth of $t_w = 3.8$ [km] results a

water volume of: $V_w = 0{,}71 \cdot O_E \cdot t_w = \underline{1{,}38 \cdot 10^9}$ [km³] (11.1)

The earth **200 million years ago** (super continent: **Pangaea**):

today's land area (29%) was 100% of the earth's surface!

Pangaea surface area: $O_p = 0.29 \cdot O_E$
$= \underline{1{,}48 \cdot 10^8}$ [km²]
$= 4 \cdot \pi \cdot r_p^2$ (11.2)

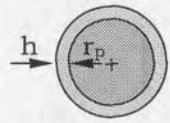

Pangaea radius: $r_p = \sqrt{O_p/(4 \cdot \pi)}$
(corresponds to $= \underline{3435}$ [km]
the radius
of the sphere of shelf): = 54% of today's radius

Pangaea volume: $V_p = \frac{4}{3} \cdot \pi \cdot r_p^3 = \underline{1{,}697 \cdot 10^{11}}$ [km³] (11.3)

Pangaea was covered with water h [km] high:

volume: $V = V_p + V_w = \frac{4}{3} \cdot \pi \cdot (r_p + h)^3 = \underline{1{,}71 \cdot 10^{11}}$ [km³] (11.4)

= 15,7% of today's volume of the earth

$r_p + h = (3 \cdot V/4 \cdot \pi)^{1/3} = 3443{,}8$ [km] (11.5)

Pangaea water-level h above the NN (sea-level) at that time:

$h = \underline{8{,}78}$ [km] (11.6)

Fig. 11.3: The calculation of the covering with water on earth 200 million years ago

11.3 Ancient Egyptian legend of Genesis

We don't have to search long for evidence. If we go back 200 million years in the history of the earth, as all continents still were united and formed the super continent Pangaea, as the 29% landmass of today thus constituted 100% of the earth's surface. At that time the diameter of the earth was almost half of today's diameter (exactly 54%). But if one distributes the amount of water of our oceans of today over the smaller earth, then possibly the water stood the young earth up to its ears in a first rough estimate. We now want to calculate how high the water stood.
For that we determine at first the water volume of today's oceans, by multiplying 71% of the earth's surface O_E with the average water depth. In doing so it is supposed that the water volume has not changed in the course of time. As an approximation this assumption could be correct if the factors, which influence the water volume, mutually compensate. On the one hand it has to be taken into account that in the process of fusion in the inside of the earth apart from other materials also juvenile water is formed, but on the other hand the water volume is reduced by photosynthesis and by the splitting of water molecules. In the case of the newly formed water it should concern roughly one cubic kilometre per year[<i>]. The photosynthesis however possibly can be estimated by means of the formed oxygen of the air just as the splitted water by the content of oxygen of the waters and the seas. Since the processes are subject to temporary fluctuations, the exact estimate is difficult. At least should an effect of compensation more or less be taken into account.

Next we calculate the surface of the earth 200 million years ago, the super continent, which Alfred Wegener called Pangaea. If the 29% continental land mass of today at that time constituted the whole surface, then the diameter of the earth at that time was determined at 54% of today's diameter, then the volume together with the water volume would amount to only 15.7% of today's volume and the water stood 8.78 kilometres high above the level NN at that time (fig. 11.3). With that even the highest peaks were under water.

Consequentially stands in the legend of Genesis of the ancient Egyptians:

„ They tell us that the earth was completely covered with water and that the earth rose from the water. It is talked about a primeval hill, of which creation took its start, on which the first sunrise and sunset was observed[<ii>].

If at that time life only existed in the water, of which we today still can detect the remains in excavations in mountains and plateaus, then it surely wasn't because the evolution had forbidden living on the land. There existed no land! All land was lying under water. But if, looked into the future, the land area increases further at the expense of the surface of the sea, then our earth sometime will dry up, as already other planets before us, e.g. our neighbouring planet Mars.

<i>: Oesterle, O.: Goldene Mitte: Unser einziger Ausweg, Universal Experten Verlag, Rapperswil (1997), ISBN 3-9520261-9-0
<ii>: Robert Bauval und Graham Hancock: Der Schlussel zur Sphinx, List Verlag (1996), S. 253 and in der Sendung: Die grossen Ratsel VII am 25.5.97 in S 3

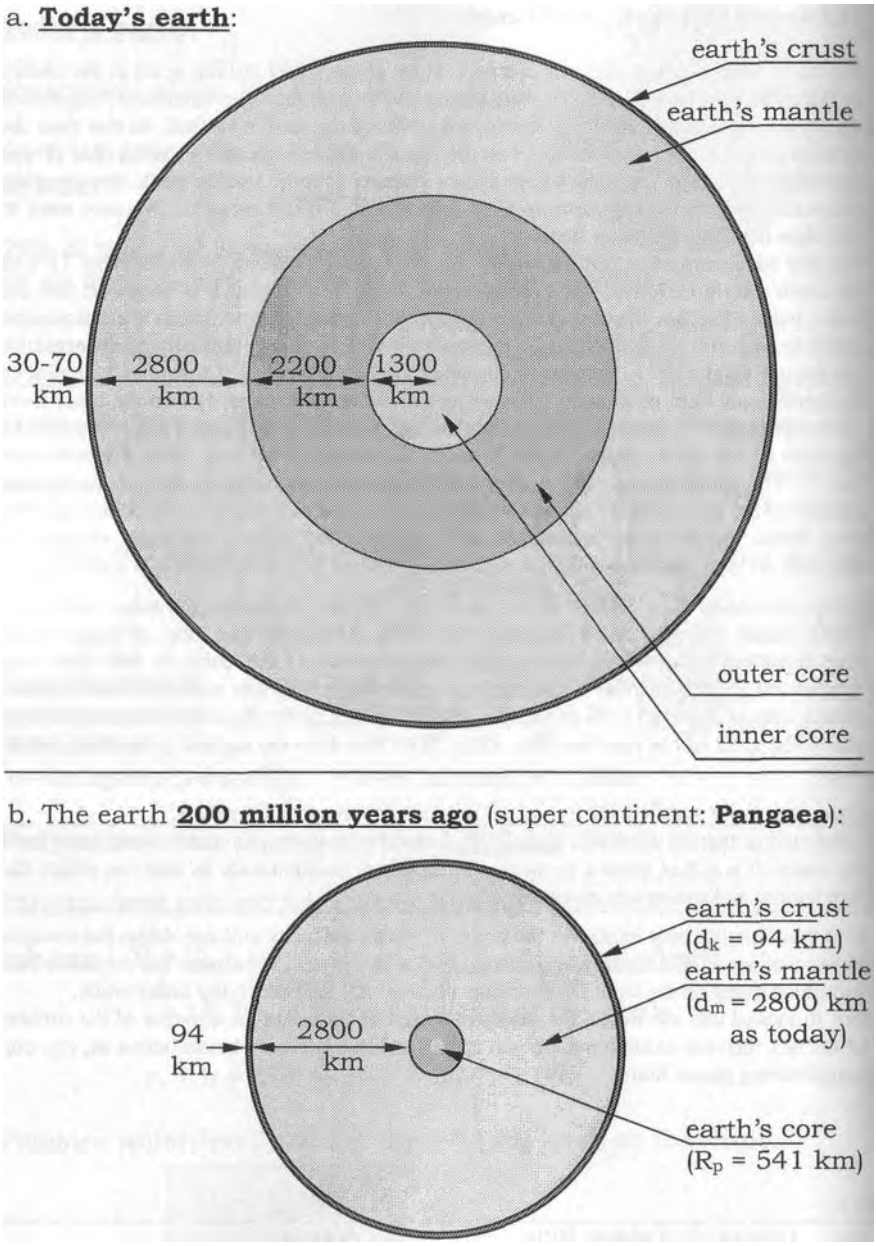

Fig. 11.4: The inner structure of the earth on an average

11.4 Inner structure of the earth

Next the question is raised: How fast does our earth actually grow? The calculated growth, distributed over the 200 million years, results in a yearly increase in the diameter of the earth of less than 0.1 mm. Carey[<i>] assumes 0.04 mm per year and Owen[<ii>] only 0.01 mm per year.
Actually the young earth must have been somewhat bigger than calculated, because as a result of the smaller gravitational acceleration the density of the matter must have been smaller. But this changes nothing to the relations, because the less dense earth was surrounded by likewise less dense water, the water-level nevertheless reached the peaks, as already calculated.
For indicating absolute linear measures and the calculation of the gravitational accleration the respective density should be considered. In most calculations the density is cancelled out, so that as well can be calculated with an unchanged density.

A grave error however lies in the assumption of a linear growth. Hilgenberg assumes an exponential growth[<iii>] and gives as a reason for the empirical approach of the e-function the „law of organic growth". In order to now not to speculate or to postulate in the same manner, we will derive and found our approach.

If namely the earth grows, then its core of fusion also grows, which causes the growth to take place accelerated, etc. A customer of a bank, who sees his amount of money grow according to such a regularity, will be given information immediately about the growth rate with a compound interest calculation.
But how big is the growing fusion reactor of our planet? According to today's level of knowledge about the structure of the earth the inner core is surrounded by the outer core and that again by the earth's mantle. On top floats the thin, but firm earth's crust, on which we live. The inner core has a radius of nearly 1390 km, the outer core stretches to a radius of 3500 km, whereas the crust is only between 10 and 78 km thick, dependent on the geographical latitude[<i4>] (fig. 11.4).

<i>: Carey, S. W.: Theories of the Earth and Universe.
Stanford University Press: 1-413, Stanford, California

<ii>: Owen, H. G.: Has the Earth increased in size? - In: New Concepts in Global Tectonics, Texas etc. University Press (1992), p. 289-295, Lubbock

<iii>: Hilgenberg, O. C: Vom wachsenden Erdball, Berlin 1933, Eigenverlag, Seite 31 und 32

<i4>: Mitton, S. (Herausg.): Cambridge Enzyklopadie der Astronomie
(The Cambridge Encyclopaedia of Astronomy), Orbis Verlag (1989)

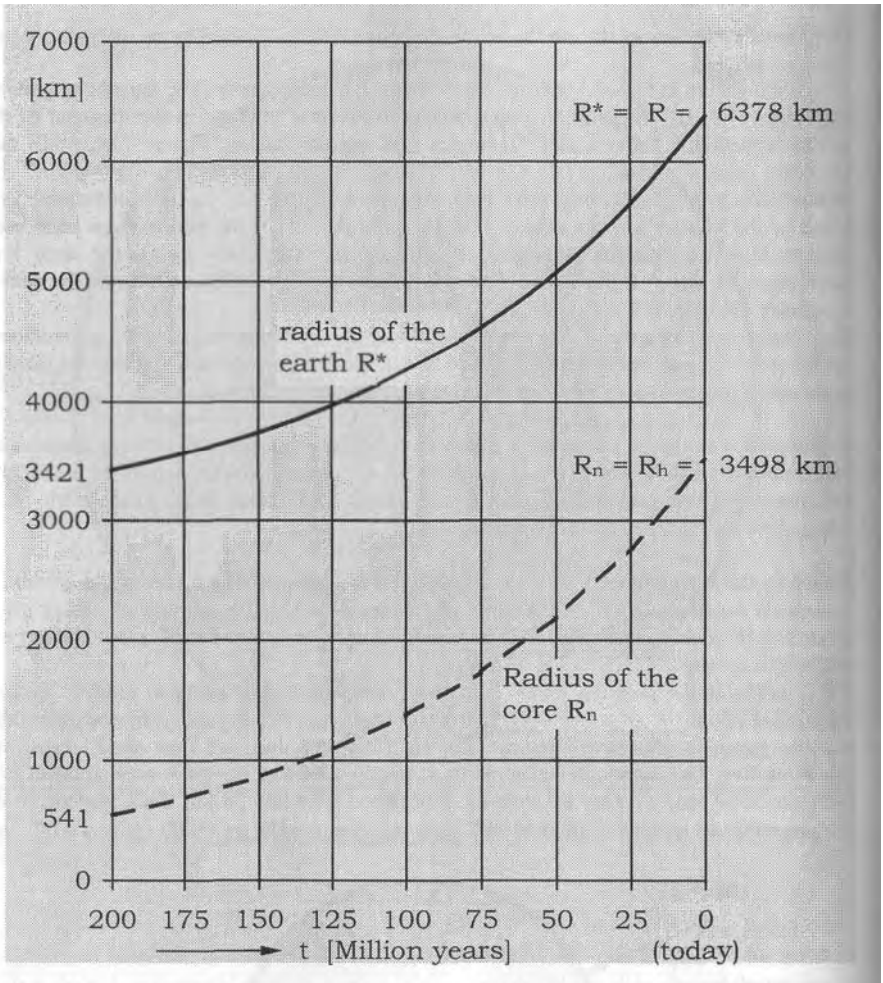

Fig. 11.5: The change in the radius of the earth and of the core in the course of millions of years until today.

calculation: (see fig.11.6)

$$R^* = 2879{,}5 + 541 \cdot q^{n/3} \text{ [km]} \quad (11.7)$$

t years ago: with: $t = 2 \cdot 10^8 - n$ [a] and: $q = 1 + 28 \cdot 10^{-9}$

correspondents to the approximation:

$$R^* = 2880 + (6378 - 2880) \cdot e^{-t/\tau} \text{ [km]} \quad (11.8)$$

with the time constant: $\tau = 107{,}1$ Mio. Jahre

11.5 Earth's core as a converter of neutrinos

I proceed from the assumption that the conversion of neutrinos and materialization in elementary particles takes place in the inner core. For the conversion no energy at all is used, because the inner energy together with the outer energy of the particle amounts to zero. The neutrinos merely have to be remodelled into another structure and for that they at first have to be slowed down with the help of the oscillating interaction.
During this process of slowing down, as said, no heat is formed because in the case of a mass less particle no energy can be set free in the domain where the classical law of conservation of energy is valid. Only after completion of the process of materialization we are able to detect mass and energy of neutrinos.
But if the oscillating interaction is taken as a basis, the oscillation with opposite phase between particle and earth's core, then contrary to all expectations a cooling down takes place. If the particle has reached its region of destination in the core, then the oscillations are overlapping. Mathematically seen they are added with reversed sign; they thus are subtracted. The result of the mutual compensation is the decrease of the thermal oscillation and the cooling down of the region which was expected.
In addition the formed particles with a mass mutually contract (see part I, chapter 8.3 and 8.4) and in doing so are further cooling down, as we will derive (chapter 12.7 with fig. 12.8). The physical limit of the process of contraction and cooling down is formed by absolute zero, at which no thermal oscillation at all occurs anymore, so that superconduction becomes possible with the result of giant electric currents and magnetic fields, which can be detected even at the earth's surface in damped form, for instance with a compass.

The necessary heat energy is flowing towards the quick-frozen inner core from the outside, principally from the outer core. Here, in the core, from the neutrinos slowed down to the speed of light various elementary particles are formed. Most of them immediately fall apart, to form other configurations. In the end only electrons and protons are preserved, which, as the only stable particles, can't fall apart anymore. These again are trying hard to take the state of an atom, which however needs very much space with the large distance between atomic nucleus and hull. Under the high pressure the enveloping electrons therefore will time and again fall into the nucleus to form neutrons together with the protons.
The neutrons need no atomic hull and can, as is well-known of neutron stars, take an extremely high density. In the case of the earth's core the neutrons however cannot be stabilized. The contraction to a neutron is accompanied by a corresponding drop in pressure, so that the neutron falls apart again. A continual oscillation of size is formed, with which the neutrinos again interact. With that also the high density of the earth's core would be explicable simultaneously.
In earth's outer core the various atoms and isotopes are formed, which in the sum release more energy than they absorb in their fusion processes. Here the fusion oven rages, which supplies the inner core with heat energy.
The formed matter is pushed further to the outside, rolls as a viscous mass through the earth's mantle and collects the surplus radiation and heat from the fusion oven.

With this model of explanation we now can tackle the calculation of the growth of the earth (fig. 11.6).

Growth in volume in analogy to the compound interest calculation:

duration: $n = 200$ million years

starting capital: $V_p =$ Pangaea volume $V_p = (4/3)\cdot\pi\cdot r^3$

final value: $V_h =$ today's volume $V_h = (4/3)\cdot\pi\cdot R^3$

savings bank formula: $V_h = V_p * q^n$ (compound interest) (11.9)

with „interest rate": $q = (V_h/V_p)^{1/n}$ (11.10)

---

radius of the core of the Pangaea sphere:

$$R_p = r - d_m - d_k = 541 \text{ [km]} \qquad (11.11)$$

with

Pangaea radius: $r = 3435$ [km]

earth's mantle: $d_m = 2800$ [km]

earth's crust: $dk = 94$ [km] (incl. covering with water).

core radius today: $Rh = R - d_m - d_k = 3500$ [km] (11.12)

earth's crust today: $d_k* = 34\text{-}78$ [km].

From $V \sim r^3$ the growth factor q is calculated to be

$$q = \left(\frac{V_h}{V_p}\right)^{\frac{1}{n}} = \left(\frac{R_h}{R_p}\right)^{\frac{3}{n}} = \left(\frac{3500 \text{ km}}{541 \text{ km}}\right)^{\left(\frac{3}{2\cdot 10^8}\right)} = 1 + 28\cdot 10^{-9} \qquad (11.13)$$

core radius after n years: $R_n = R_p * q^{n/3}$ (11.14)

radius of the earth after n years: $R* = R_n + d_m + d_k*$ (11.15)

Fig. 11.6: The calculation of the growth rate of the earth

11.6 Speed of growth

200 million years ago in the centre of the globe a core of fusion has formed and taken up its operation, probably under the influence of a cosmic occurrence connected with a high neutrino radiation. As a result the thin crust of the earth was torn apart and the oceanic basins were formed.

If we assume that the might of earth's mantle (with d_m = 2800 km) and crust (with less than 100 km) haven't fundamentally changed, then earth's core at that time had a radius of only 541 km. The „savings bank formula" now only may be applied for the core and only for its volume. On the condition of a constant neutrino density the volume of the core in every year will grow for one order of magnitude, which again depends on the respective volume itself. There results the in fig. 11.5 presented course of the radius of the core and of the earth.

According to our calculation the earth at present grows every year for $915*10^{11}$ tons, which corresponds to an increase in volume of 16500 cubic kilometres and an increase of area of 5.2 square kilometres. The earth momentarily grows for 6.5 cm per year in diameter, from which follows that the perimeter increases pi-fold and a continental drift of 10.2 cm per year is to be expected across both the Atlantic Ocean and the Pacific Ocean. Geologists today actually measure a plate movement of typically 10 cm, at individual points of up to 12 cm per year<i>!

Whoever likes to do handicrafts, can build together a globe of shells by himself. Hilgenberg for that gives a handicraft instruction<ii>. He draws the continents of a globe of today and cuts them out. Doing so, not the coast line of today is authoritative, but that of the edge of the shells, at which the mainland plates are breaking off into the deep sea. He hence also speaks of a sphere of shells and helps the handcrafters with the words: ..Because the paper shells of the sphere of shells owing to their strong curvature are difficult to nestle, we cut slits in the paper, which suitably lie there, where mountain ranges stretch and now can start with the gluing". Doing so it shows that the slits in particular in the case of the Ural and the Himalayan gape far apart, that in reversed direction in the case of the enlargement of the sphere of shells the lifting out of the mountains necessarily had to occur at these points by means of upsetting. Under these circumstances our model concept should be further rendered more precisely, If the change of the curvature of the growing surface of the earth is the cause for the lifting out of the mountains, then the surface of the earth 200 million years ago was structured merely by impact craters and by volcanic cones, then the amount of water may have been correspondingly smaller. The additional water of the oceans of today was collected by the earth either from the cosmos, by crossing the flight path of a comet with a water tail, or by the here discussed idea of a core of fusion in the inside of the earth it has produced the water itself!

How ever such detail aspects may have had an effect, it therefore nevertheless changes nothing to the model concept on the whole. Hilgenberg's globe of shells<ii> in my opinion to still makes more sense as all the models of explanation, as they are spread in today's text books.

<i>: Miller, R.: Driftende Kontinente, Time-Life, Amsterdam 1991, S. 78

<ii>: Hilgenberg, O.C.: Vom wachsenden Erdball, Berlin 1933, Eigenverlag

Actual data<i>:

mass of the sun	$m_s = 1.99 \cdot 10^{30}$ [kg]	
radius of the sun	$r_s = 696\,000$ [km]	
distance to the earth	$r_e = 149\,597\,870$ [km] (averaged)	
mass of the earth	$M = 5.976 \cdot 10^{24}$ [kg]	
moment of inertia	$J_e = M \cdot r_e^2$ (of the earth orbit)	(11.16)
orbital velocity	$v_e = \omega_e \cdot r_e = 2\pi r_e / t_e$	(11.17)
averaged<i>:	$v_e = 29.79$ [km/s] = constant	(11.18)
revolutionary period	$t_e = 365.25637$ [days] t_e = sidereal year	
equatorial radius	$R = 6378$ [km]	
moment of inertia	$J = (2/5)\, M \cdot R^2$ (of the rotation of its own)	(11.19)
rotational velocity	$v_E = \omega_E \cdot R = 2\pi R / t_E = 0.465$ [km/s]	(11.20)
sidereal time of rotation	$t_E = 1$ [day] = 86 164.1 [s]	
distance to the moon	$r_m = 384\,390$ [km] (averaged)	
radius of the moon	$R_m = 1738$ [km]	
mass of the moon	$m_m = 7.350 \cdot 10^{22}$ [kg] = constant	(11.21)
moment of inertia	$J_m = m_m \cdot r_m^2$ (of the moon orbit)	(11.22)
orbital velocity	$v_m = \omega_m \cdot r_m = 2\pi r_m / t_m$	(11.23)
of the moon averaged:	$v_m = 1.026$ [km/s] = constant	(11.24)
revolutionary period	t_m = 1 sidereal month (from fixed star $t_m = 27.322$ [days] to fixed star)	
observed revolutionary period	t^*_m = 1 synodic month (from new moon $t^*_m = 29.53$ [days] to new moon)	

Fig. 11.7: The data of sun, earth and moon of today<i>

<i>: Mitton, S. (Herausg.): Cambridge Enzyklopadie der Astronomie (The Cambridge Encyclopaedia of Astronomy), Orbis Verlag (1989)

It is an exciting matter, if one can experience for oneself, how the pieces of the puzzle fit together, how the southern end of America is wound around the Cape of Good Hope and the Falkland islands surface for the east coast of South Africa, in the vicinity of Australia how the Antarctic occupies the Pacific basin as a neighbour of Australia, von South, Middle and North America, run through by the equator, etc.
The corrections to the view of life of Alfred Wegener and the geographical evidence, which Hilgenberg gives, are sound, well founded and even after 65 years still highly actual. The physical statements of the geologists however, for instance the earth in the course of time would rotate faster and faster, cannot be followed.

11.7 Conservation of angular momentum

The question about the rotation of the earth is raised. Is it not changing at all, is it getting faster or slower? In the case of a with time growing earth there is only one possibility: The rotation of its own will decrease and not increase, as Hilgenberg supposes. For that you only need to place yourself on a turntable, to turn and if possible with weights in your hands stretch out your arms sideways, to feel, how the rotation of the table is decreasing. It surely would have done the geologist Hilgenberg good, to leave his desk for a short time for a stroll to the most nearby playground, for the purpose of the described physical experiment with himself.

In this case the law of conservation of momentum authoritatively has an effect in the formulation of the law of conservation of angular momentum for the rotating motion. According to that all angular momenta in the solar system should amount to zero. If we look at the planets which have no moon, then is remarkable that these need an eternity for a revolution around their own axis (Venus for instance needs 243 days). According to the law of conservation of angular momentum our earth owes its rotation of its own primarily the moon.

For reason of this relation we can assume a proportionality between the angular momentum of the moon J_m*w_m and that of the rotation of its own of the earth $J*w_E$ (eq. 11.39, fig. 11.10). They even have to be identical, if the partner of rotation earth and moon are seen as a closed system.
If the earth would be approached as a homogeneous, spinning sphere, the angular momentum at first would be too small for a factor 4.1 (eq. 11.29, fig. 11.9). The law of conservation of angular momentum dictates as a necessary result, that the dense core of the earth must rotate faster than the earth's crust! From the correspondence of orbital angular momentum of the moon on the one hand and the sum of the angular momenta of their own of earth's mantle and earth's core on the other hand results a 31 fold higher angular velocity of the earth's core compared to the rotation of the earth's surface (eq. 11.38, fig. 11.9).

Does our earth owe its geomagnetism this rotation of the core? At least the possibility exists that there exists a causal relation between the rotation of the earth's core and the geomagnetism. We'll further collect arguments and put the question concerning the formation of the geomagnetism under consideration.

Concerning unipolar induction (Faraday): $\mathbf{E} = \mathbf{v} \times \mathbf{B}$ (11.25)
(see part 1, eq. 58, fig. 6.4)

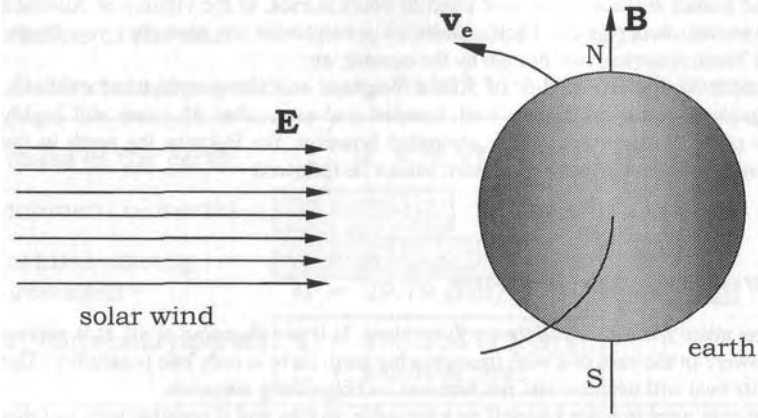

with $\mathbf{E}$ = 2 [V/m] } earth magnetic field $\mathbf{B}$ = 67 [μT] calculated
11.18: $\mathbf{v}_e$ = 29,79 [km/s] } on the average approx. $\mathbf{B}$ = 50 [μT] measured<i>

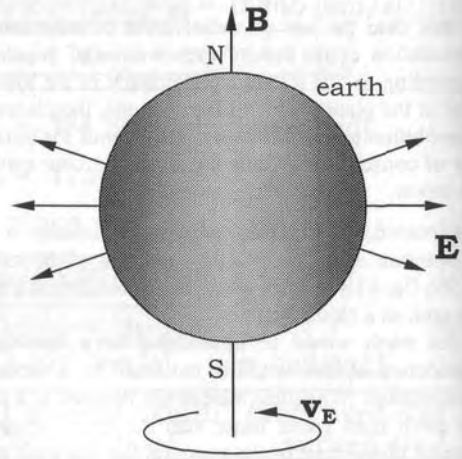

with $\mathbf{B}$ = 67 [μT] } $U = \mathbf{E} \cdot h = \mathbf{v}_E \cdot \mathbf{B} \cdot h$ (11.26)
eq. 11.20: $\mathbf{v}_E$ = 465 [m/s] } 10 km high: U = 199 [kV] calculated
and h = 6378+10 [km] } U = 200 [kV] measured<i>

Fig. 11.8: The magnetic and the electrostatic field of the earth
as a result of an unipolar induction

<i>: Measurement values in chap. 2.8, e.g. reference entry <i> (Prof. Dr. L. Konig)

11.8 Set of difficulties concerning the change of magnetization

Now investigations of the polarity of the magnetization of rocks have resulted in the fact that in irregular intervals, on an average every 500,000 years, a change of polarity of the geomagnetism has occurred and no one knows why.
If the rotation of the core should produce the magnetism, then it in any case also is responsible for the process of change of magnetization. That purely theoretically is possible in two ways: Either the core tilts out of its plane of rotation for 180° and rotates suddenly in the opposite direction or earth's mantle together with earth's crust, on which we live, is turned upside down.
It surely isn't my intention to produce any panic, but from a physical point of view only the second case is possible. Usually not the tail wags with the dog, but vice versa, the dog with the tail. The high rotational velocity of the earth's core exerts an extremely stabilizing influence. After all its angular momentum is 4.85 times larger than that of the mantle (eq. 11.33, fig. 11.9). Therefore the rotation of the core and the direction of earth's magnetic field always are preserved seen from the sun.

I further proceed from the assumption, that an electrostatic field arises from the sun accompanied by a particle flux, the solar wind, through which the earth flies through in a perpendicular direction. According to the Faraday law of induction E = v x B (eq. 11.25)
it experiences, as a result of the unipolar induction, a magnetic field which stands perpendicular on the ecliptic and thus dictates the orientation of earth's magnetic field. With that also the direction of rotation would be determined. The core thus by no means can tilt!
On the condition that the core doesn't rotate completely frictionless, the earth's mantle will in the case of the same direction of rotation be accelerated, in the case of unequal direction, after a changing of polarity, it will be slowed down again. If the process, for reasons of conservation of angular momentum, takes place alternatingly with a certain regularity, then the inhabitants of the earth for every changing of polarity might experience, how the North Pole in the shortest time turns over the equator to the South Pole, how the sun sets at the point, where it before had risen. As said, after a changing of polarity our earth is standing on its head! In the Bible corresponding clues are found<ii>.
It can be taken from the media that one reckons with such a changing of polarity in the foreseeable future. When and if it actually takes place, stands however in the stars.

If magnetism thus is produced by the rotation of the core, or by electric currents in the earth's core as a result of the superconduction or by both, then the earth is aligned in the field of the sun like the magnetic needle in a compass. If we take as a cause a solar wind with an electric field strength of just 2 V/m, then this would not only determine the direction of earth's magnetic field, but also the order of magnitude, and that at present lies at 50 uT averaged over time (chap. 2.8).
With the same mathematical relation an electrostatic field around the earth of 199 V/m results as a result of the rotation of the earth. That fairly exact corresponds to the measured values!<i> Quite obviously all is related to each other. In the question for the „how" at this point consciously no definite answer is strived for. It rather should be discussed and worked to together in the seminar.

<ii>: The Bible, OT, The 2nd book of kings 20,9-11 (king Hezekiah) and Joshua 10,12-14, literally cited on the page after the next page (chap. 11.9), note<ii>

Angular momentum $J_m \cdot \omega_m$ of the orbiting moon (with eq. 11.22 + 11.23):

$$J_m \cdot \omega_m = m_m \cdot r_m^2 \cdot \omega_m = 29*10^{33} \ [kgm^2/s] \qquad (11.27)$$

Angular momentum $J \cdot \omega_E$ of the rotation of the earth (eq. 11.19 + 11.20, same direction of turning):

(theoretically) $J \cdot \omega_E = (2/5)\ M \cdot R^2 \cdot \omega_E = 7*10^{33}\ [kgm^2/s]$ (11.28)

$$\frac{\text{Orbital momentum moon}}{\text{Angular momentum earth}} = \frac{J_m \cdot \omega_m}{J \cdot \omega_E} = \frac{29}{7} = 4{,}1 \qquad (11.29)$$

Angular momentum $J_M \cdot \omega_E$ of earth's mantle and crust (R_h = core radius)

$$J_M \cdot \omega_E = (J-J_K) \cdot \omega_E = (2/5)\cdot(MR^2-M_K R_h^2)\cdot\omega_E = 6*10^{33}\ [kgm^2/s] \quad (11.30)$$

$$\text{conservation of angular momentum:} \quad J_m \cdot \omega_m = J_K \cdot \omega_K - J_M \cdot \omega_E \qquad (11.31)$$

Angular momentum $J_K \cdot \omega_K$ of the earth's core

$$J_K \cdot \omega_K = J_m \cdot \omega_m + J_M \cdot \omega_E = 35*10^{33}\ [kgm^2/s] \quad (11.32)$$

$$\frac{\text{Angular momentum core}}{\text{Angular momentum mantle}} = \frac{J_K \cdot \omega_K}{J_M \cdot \omega_E} = \frac{35}{5} = 7 \qquad (11.33)$$

$$J_K \cdot \omega_K = (2/5)\ M_K \cdot R_h^2 \cdot \omega_K \quad (11.34)$$

With the mass of earth's core $M_K = \rho_K \cdot V_K = \rho_K \cdot (4/3) \cdot \pi \cdot R_h^3$ (11.35)

and the averaged core density $ro_k = 12000\ kg/m^3$

the angular velocity

of earth's core amounts to: $\omega_K = 3{,}3*10^3\ [s^{-1}]$ (11.36)

and that at the earth's surface: $\omega_E = v_E/R = 0{,}073*10^{-3}\ [s^{-1}]$. (11.37)

$$\frac{\omega_K}{\omega_E} = \frac{3{,}3}{0{,}073} = 45 \quad (11.38)$$

Fig. 11.9: Calculations concerning the conservation of angular momentum and the rotation of earth's core (One turn of the earth's core lasts 32 min. It results contrary to the earth rotation. Of the surface of the earth a period duration of 31 min should be observable.)

11.9 The weakly damped moon

The increasing angular velocity in the direction of the centre of the earth surely has something to do with the set of difficulties concerning the conservation of the spherical structure, comparable to the reason for the particle spin (chapter 6.13). The increasingly missing radial component of the gravitational field has to be compensated by an additional field produced by the rotation (according to part 1, equation 62, fig. 6.5).

The moon apparently doesn't know this set of difficulties. We can assume a constant mass for it (eq. 11.21). On the one hand is the moon smaller than the earth 200 million years ago, as it started to grow. On the other hand are doubts concerning the existence of an active core of the moon legitimate. In the Apollo-15 mission seismic gauges had been installed at the ground of the moon and at the start from the moon the produced seismic waves had been recorded[<i>]. The surprisingly small damping as the lunar module fell back onto the ground of the moon more likely allow the conclusion that the moon is hollow inside!
Also the small density of the moon points in the same direction, and finally no clues at all can be seen on the surface of the moon, which would point to a growth of the moon.

Apart from the mass also the orbital velocity of the moon is taken constant, what surely is true, as long as nobody and nothing drives the moon extra (eq. 11.24). The analysis of the law of conservation of angular momentum provides the in fig. 11.10 derived provisional result (eq. 11.41).

<i>: Moonquakes ever more mysteriously: ,,The by Apollo 12 triggered moonquake by ,,bombardment" of the surface of the moon with the clapped-out Lunar Module ,,Intrepid" at thursday evening puts scientists for bigger and bigger mysteries. An exact analysis of the measurement data now resulted in the by the astronauts Conrad and Bean installed ,,seismic station" on the moon ... to have recorded and to have sent to the earth 55 minutes long. ... The seismologist Dr. Gary Latham spoke of ,,important information about the structure of the moon" and meant, one now can ,,throw away the text book". One had reckoned that the impact of the Lunar Module on the moon would trigger a quake of at best some minutes", (translated) Frankfurter Rundschau vom 22.11.1969

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concerning reference entry <ii>, chap. 11.8:

<ii>: The Bible, OT, Joshua 10,12-14: There stands in the ,,book of Jasher ": So the sun stood still in the midst of heaven, and hasted not to go down about a whole day. And there was no day like that before it or after it, ...

The 2nd book of kings 20,9-11: king Hezekiah: This sign thou ... let the shadow return backward ten degrees. And Isaiah the prophet cried unto the LORD: and he brought the shadow ten degrees backward, by which it had gone down in the dial of Ahaz.

For the proportionality of the angular momenta of the earth:

$$J \cdot \omega_E \sim J_M \cdot \omega_E \sim J_K \cdot \omega_K$$

With: $$J \cdot \omega_E = (2/5)\, M \cdot R^2 \cdot 2\pi/t_E \qquad (11.28)$$

and the orbital momentum of the moon:

$$J_m \cdot \omega_m = m_m \cdot r_m^2 \cdot v_m/r_m \qquad (11.27)$$

is valid the

$$\boxed{\text{conservation of angular momentum: } J \cdot \omega_E \sim J_m \cdot \omega_m} \qquad (11.39)$$

or: $$M \cdot R^2/t_E \sim m_m \cdot r_m \cdot v_m \qquad (11.40)$$

with $\underline{m_m = \text{constant}}$ (11.21)
and $\underline{v_m = \text{constant}}$ (11.24): $$\boxed{M \cdot R^2 \sim t_E \cdot r_m} \qquad (11.41)$$

$$\boxed{\begin{array}{c} \text{centrifugal force} = \text{gravitational force} \\ \dfrac{m_m \cdot v_m^2}{r_m} = \dfrac{G \cdot M \cdot m_m}{r_m^2} \end{array}} \qquad (11.42)$$

or with eq. 11.22: $$v_m^2 = G \cdot M/r_m = (2\pi r_m/t_m)^2 \qquad (11.43)$$

---

if $\underline{M = \text{constant}}$: $$\boxed{r_m^3 \sim t_m^2} \qquad (10.1)$$

<u>Kepler's 3rd law.</u>

Here $\underline{M \neq \text{constant}}$, instead $\underline{v_m = \text{constant}}$ (11.23) and therefore follows from eq. 11.43:

(month) $$\boxed{t_m \sim r_m \sim M} \qquad (11.44)$$

with eq. 11.41:

(day) $$\boxed{t_E \sim R^2} \qquad (11.45)$$

and for an analogous derivation: (year) $$\boxed{t_e \sim r_e \sim m_s} \qquad (11.46)$$

with $\underline{v_e = \text{constant}}$

<u>Fig. 11.10: Calculation of dynamic celestial mechanics</u>

11.10 Calculation of celestial mechanics

We still need a further relation and try the balance of forces between the centrifugal force and the gravitational force. Both the to the outside directed centrifugal force and the to the inside directed gravitational force depend on the mass of the moving body, here the mass of the moon m_m, so that it is cancelled from equation 11.42.
As determining mass only that of the earth is left and that is taken constant in accordance with the knowledge of text books. The result of this assumption is Kepler's 3rd law (eq. 10.1). But beware, it here merely concerns a momentary picture! In the course of time, according to the derivation, the mass of the earth increases so that this assumption is untenable.

Instead, as already said, the average orbital velocity of the moon, one kilometre per second, can be taken constant (eq. 11.24). Since the orbital velocity is calculated from the proportion of the perimeter of the circular orbit $2 \cdot \pi \cdot r_m$ with regard to the revolutionary period of a month (11.43, left page), and at the same time from the balance of forces a dependency of the mass of the earth M and the radius of the orbit of the moon follows (11.43, right page), the interesting relation (11.44) results:
Here the mass M, the radius r_m and the revolutionary period t_m stand in a direct proportionality to each other, and that means: if the mass of the earth increases in the course of time, then the moon will go away from us to the same extent, then also every month will get correspondingly longer.

Clarified with numeric values follows from a growth of the earth for $915*10^{14}$ kg per year a going away of the moon for yearly 5.88 meters (fig. 11.11). The going away of our satellite could be confirmed by means of measurements with laser reflectors, which had been put up on the moon by Apollo astronauts, according to dpa message<i>.

In addition every month lengthens for 3 milli seconds. That is valid for the sidereal month (= 27.322 days), for which a fixed star serves as a reference point for the measurement of a revolution, as well as for the synodic month, as it is observed from the earth from new moon till new moon (= 29.53 days). The synodic month today is longer than four weeks. But 3.7 million years ago it once actually lasted exactly 28 days, as we can calculate easily (fig. 11.11).

But now also the length of a day is changing. If we insert the proportionality (11.44) from the balance of forces in that of the conservation of angular momentum (11.41), then it is shown that a day depends quadratic on the radius of the earth (11.45), that a lengthening of every day for $4.5*10^{-9}$ s can be determined with the help of the growth curve of the earth (fig. 11.5). This is really very small, but 200 million years ago the day had just 19 hours, if extrapolated to 900 million years only 18.04 hours! The result of the american geologists around Dr. Charles Philip Sonett of the University of Arizona in Tucson also is 18 hours in their analysis of correspondingly old sediment formations, as the US science magazine Science has reported<i>. The correspondence of this measurement with our calculation without doubt has force of evidence!

<i>: 900 million years ago a day had 18 hours, Washington (dpa) 1997

Going away of the moon per year with $M \sim r_m$ (according to eq. 11.44): for

$\Delta r_m = r_m \cdot \Delta M/M = 384390[km] \cdot 9.15 \cdot 10^{16}[kg/a] / 5.976 \cdot 10^{24}[kg] = 5.886\ [m/a]$

---

lengthening of month per year with $M \sim t_m$ (11.44) (sidereal): for

$\Delta t_m = t_m \cdot \Delta M/M = 27.322\ [days] \cdot 86164\ [s/day] \cdot \Delta M/M = 36\ [ms/a]$

---

synodic month (from new moon till new moon) of 28 days:

$\Delta t_m = 29.53\ [days] - 28\ [days] = 1.53\ [days] \equiv 132 \cdot 10^6\ [ms]$

linearly calculated $132 \cdot 10^6\ [ms]/36\ [ms/a] = 3.6674$ mio. years ago.

Day length 200 mio. years ago, with $t_E \sim R^2$ (11.45) amounted to t* hours

shortening: $\Delta t_E/t_E = \Delta R^2/R^2 = (R-R^*)^2/R^2 = (6378-3420)^2/6378^2 = 21.5\%$

$\Delta t_E = 0.215 \cdot 24\ [h] = 5.16\ [h]$ and $t^* = 24\ [h] - \Delta t_E = 18.84\ [h]$

Day length 900 mio. years ago, (R^*=3200 km) amounts to 18.04 hours

---

present lengthening per day amounts to: $\Delta t_E/t_E = 4.5 \cdot 10^{-9}\ [s/day]$

---

but: the year increases 130,000 times faster than the individual day!

according to the measurement of Aristarchos 2300 years<ii> ago

is $\Delta t_e = 365.25637\ [days] - 365.25062\ [days] = 0.00575\ [days]$

and $\Delta t_e/t_e = 0.00575 \cdot 24 \cdot 60 \cdot 60 \cdot 1000 / 365.25637 \cdot 2300 = 0.59\ [ms/day]$

---

going away of the earth from the sun per year, with $t_e \sim r_e$ (acc. to eq. 11.46)

for: $\Delta r_e/t = r_e \cdot \Delta t_e/t_e \cdot t = 149.6 \cdot 10^6\ [km] \cdot \Delta t_e/t_e \cdot t = 1.024\ [km/a]$

---

growth of the sun per year/second, with $t_e \sim m_s$ (according to eq. 11.46)

for:

$\Delta m_s/t = m_s \cdot \Delta t_e/t_e \cdot t = 1{,}99 \cdot 10^{27}\ t \cdot \Delta t_e/t_e \cdot t = 1.36 \cdot 10^{19}\ [t/year]$

resp. in a second for: $= 4.3 \cdot 10^{11}\ [t/s]$

and at the same time a loss due to radiation of: $5 \cdot 10^6\ [t/s]$

Fig. 11.11: Figures according to analysis of some examples concerning dynamic celestial mechanics

11.11 The biblical age

We therefore owe the growing diameter of the earth that every day gets longer and longer (eq. 11.45) and from the going away of the moon a lengthening of the month results (eq. 11.44). Not only the months and the length of the days increase, but also the whole year. A corresponding derivation for the revolution of the earth around the sun, as it has been carried out for the revolution of the moon around the earth (eq. 11.44), delivers analogous results (eq. 11.46): The sun determines the length of the year and the distances to the planets. To the extent, to which the sun grows, the solar system increases in extension. Also the distance to the earth increases proportionally with the mass of the sun. By the going away from the sun the temperature on the planets however not necessarily decreases, because at the same time the radiation intensity of the growing central star increases. According to measurements it has increased for 30% since the formation of the solar system[i].

If both the rotation of the earth and the revolution around the sun get slower, then by all means is conceivable, that the number of days per year approximately stays the same and mankind nevertheless gets less old. If we take the 2300 years old writing of the Greek Aristarchos about the sizes and distances of the sun and the moon[ii]. He determined, assuming a heliocentric view of life, the year to be 365.25062 days. Because the correction taken by Aristarchos concerned even the fifth place after the comma, we must assume that correspondingly precise gauges were available in Alexandria already 310 BC.
The today measured sidereal year with 365.25637 days has lengthened for whole 0.00575 days. From this follows that the year increases considerably faster than the individual day.
It of course would be nice, if we could calculate the lengthening of the year, but unfortunately no data about the growth of the sun are available.
If we proceed from the measurement of Aristarchos, without being able to verify or reproduce its reliability, then from that would result a going away of the earth from the sun for yearly one kilometre, then the sun should grow for $4.3*10^{11}$ tons per second. In any case the sun materializes mass considerably faster, as it loses mass in the same period as radiation equivalent, and that surely is correct (fig. 11.11). Today one generally assumes that „since its formation the earth has gone away from the sun for in total 30,000 km"[i].

But if in the past the year consisted of less days and every day moreover was shorter, if therefore the biological life time was divided in shorter periods, then mankind could get older, then obtaining a biblical age possibly by no means was unrealistic. If Adam still should have got 930 years old, according to the 1st book of Moses, then his lifetime already must have been quite long ago. While Abraham still did get 175 years old, no successor of him has reached his age anymore. In the Bible it is said: „And the LORD said, My spirit shall not always strive with man, for that he also is flesh: yet his days shall he an hundred and twenty years "[iii]. Today even the limit given by the LORD isn't reached anymore!

<i>: Is the sun loosing her Gravitation? Illustrierte Wissenschaft, Nr.l, 1995
<ii>: Hermann Wild: Technologien von gestern, Chancen fur morgen, Jupiter-Verlag Bern (1996), ISBN 3-906571-13-0, Seite 22
<iii>: The Bible, King James Version, Genesis 6.3

The balance of forces (equation 11.42 generalized):

$$\text{centrifugal force} = \text{gravitational force}$$

$$\frac{M \cdot v_k^2}{r} = \frac{G \cdot M \cdot m}{r^2} \quad (12.1)$$

results in the cosmic velocity v_k:

$$v_k^2 = G \cdot m / r \quad (12.2)$$

independent of the mass M of the satellite or planet!

For	$v < v_k$	falling back into the central mass m
For	$v > v_k$	taking the leave into space
For	$v = v_k$	stationary orbit

written down for the nth planet in the solar system:

with $r(n) = r_n$ average orbital radius of the planet

and $v(n) = v_n$ average orbital velocity

as well as: m_s mass of the sun

$$v_n = \sqrt{G \cdot m_s / r_n} \quad (12.3)$$

or:

$$v_n = G \cdot m_s / v_n \cdot r_n \quad (12.4)$$

Fig. 12.1: The first cosmic velocity v_k

12. New cosmology

Astronomy still hasn't satisfactorily solved the question of the formation of the solar system. It thereby however concerns a central problem, because it includes the origin of the earth. But as long as we not yet have understood the relations in our nearest environment, the processes, which we observe with giant telescopes in the depths of pace, will remain a book with seven seals, will lose models of explanation concerning the Big Bang and concerning the so-called unavoidable heat exitus every reliability.

12.1 Concerning the formation of our solar system

2-8-1972 the observatories of the sun reported an unusual high solar activity and 6 days later a slowing down of the rotation of the earth occurred, which was recorded as the lengthening of a day for more than 10 milliseconds. This effect hardly can be explained by the tidal friction alone already just concerning the energy balance. Instead this observation makes clear two things to mankind. On the one hand, how much our earth depends on the solar processes and on the other hand, that the changes by all means can occur not continuously, but periodically and if need be even sporadic.

If, as a result of the conservation of angular momentum, the sun determines the orbital velocity of the earth, if it dictates the rotation of the earth by its neutrino activity and the growth of the earth and if the earth in the same manner determines the orbit of the moon, then it would be obvious that the moon originally has been a part of the earth and this in turn sometime a part of the sun. As it came off, the necessary angular momentum then has been passed on proportionately to the celestial companions, with which the cause for evolution and rotation of their own would be clarified. In addition the moon goes away from the earth and the earth again from the sun, so that looking back it by all means would be obvious, if they once had belonged together.

If we assume that cosmic dust particles meet and accumulate, then all collected rubble contributes to the rotation of its own of the forming celestial body. The more matter finds together, the larger its force of attraction gets, the faster it will grow like a celestial vacuum cleaner. In the course of time this process however is slowed down again and eventually comes to a standstill, because as matter condenses, volume and spherical radius decrease and the rotation of its own increases to the corresponding extent. The celestial body rotates faster and faster and reaches at its surface the cosmic velocity vk, which is given by the mass m and the radius r of the star (eq. 12.2). Now the centrifugal force has reached an order of magnitude, for which the celestial body hurls exactly as much matter into space, as it on the other hand collects by its gravitational effect.

Our sun was lucky to have been supplied with neutrinos in the range of influence of our galaxy. It went in resonance and started to grow, this time from out of the inside. It however could not yet shine, because a crust had formed on its surface around its core of fusion and its mantle, a crust on which permanently was falling cosmic matter from the outside. The increasing viscosity of the sun becoming compressed caused a slowing down of the core of the sun and the corresponding acceleration of the mantle and crust.

Titius-Bode law of 1766:

$$a = 0{,}4 + 0{,}3 \cdot 2^{\nu} \quad (12.5)$$

in astronomical units a with:

$$r_n = a \cdot r_e \quad (12.6)$$

(r_e = 149 598 000 [km] average orbital radius of the earth)

Planet	*orbital radius acc. to the law:*		*measurement value.*
Mercury:	$\nu = -\infty$	$a = 0{,}4$	*0,39 (measured)*
Venus:	$\nu = 0$	$a = 0{,}7$	*0,72 (measured)*
Earth:	$\nu = 1$	$a = 1$	*1 (by definition)*
Mars:	$\nu = 2$	$a = 1{,}6$	*1,52 (measured)*
Asteroids:	$\nu = 3$	$a = 2{,}8$	-
Jupiter:	$\nu = 4$	$a = 5{,}2$	*5,2 (measured)*
Saturn:	$\nu = 5$	$a = 10$	*9,54 (measured)*
Uranus:	$\nu = 6$	$a = 19{,}6$	*19,2 (measured)*
Neptune:	$\nu = 7$	$a = 38{,}8$	*30,1 (measured)*
Pluto:	$\nu = 8$	$a = 77{,}2$	*39,4 (measured)*
circumsolar cloud of planets:	$\nu = 9$	$a = 154$	-
etc. ... :	$\nu = 10$	$a = 308$	-

Table 12.2: The Titius-Bode series of the planets (the theoretical values compared to the measurement values)

Sometime our like mad spinning sun had increased that much, that the crust came off like the „tread of an old car tyre" and was catapulted into space. The repulsion was achieved by the centrifugal force exceeding the gravitation for the force of cohesion, which at the moment of the separation of crust regions suddenly tears off. Like snowballs the planets lulled off the sun's surface in this process and were hurled away. Their velocity of rotation at this time was identical to the cosmic velocity of the sun v_k and with that for many a planet large enough to produce its own satellites out of its own surface, which perhaps was not yet completely ideally spherical.
With every planet, which the sun gave birth to, it gave away a part of its own angular momentum to its child as orbital momentum. Only from this time on the sun reduced its angular velocity steadily until this very day. By losing the crust it also started to shine openly. Thus at least could our solar system have been formed.

12.2 The birth of the planets

From this observation various consequences result. If stars are observed, which are rotating very fast, then they either are very young, or they have no planets. Stars, which compared to our sun are rotating less fast, have given away the angular momentum to their planets and such, which hardly are rotating, have their planets already sent away into space. But if the last planet leaves its solar system and the sun stops to rotate, then the sun, which meanwhile has grown to a red giant, without a, the spherical form stabilizing centrifugal force, will collapse. The supernova is the death of a star and thereby neutrinos are set free, the material for new life.

After the coming off of the planets these first clear free their flight paths, by together with the sun collecting the flying around matter. Even whole planets thus can collide, are slowed down and form bigger units. Finally only some few planets in very particular orbits are left. Their average distance to the sun obeys in an until now completely inexplicable manner the Titius-Bode series (equation 12.5, table 12.2).
In the case of the by the german scientist Titius 1766 formulated regularity it concerns a rule of thumb founded purely on experience. But it is remarkable, that the planet Uranus could be predicted (Bode 1772) and after systematic searching also be found (Herschel 1781) with it.

The most distant planets Neptune and Pluto however don't obey the law. Their distance should be very much larger. But this circumstance we already had given reasons for with the fact, that for them the resonating interaction already overlaps and exceeds the gravitation in its effect (chap. 10.1 note<ii> and chap. 10.5).

The arbitrary seeming series of numbers 0, 3, 6, 12, 24, 48, 96, 192, 384, ... with a respective doubling of the value, starting with the 3, the addition of 4 and the following division by 10 at first are nothing but pure acrobatics of numbers, which now really has nothing to do with physics (table 12.2). A physical background can be supposed however because of the tried and tested applicability and that should be fathomed.

Orbital angular momenta $J\cdot\omega$ of the nth planet with: $J = m\cdot r_n^2$ and $\omega = v_n/r_n$:

$$\boxed{J\cdot\omega = m\cdot r_n\cdot v_n} \quad (12.7)$$

By using	equation 12.3:	equation 12.4:	
amounts the orbital angular momentum to: $J\cdot\omega$ dependent	$= m\cdot\sqrt{G\cdot m_s\cdot r_n}$ on r_n	$= G\cdot m\cdot m_s/v_n$ on v_n	(12.8)

change of the angular momentum (1st derivation) with the ordinal number n

$$\frac{d(J\cdot\omega)}{dn} = m\cdot\sqrt{G\cdot m_s}\,\frac{d(\sqrt{r_n})}{dn} \qquad = G\cdot m\cdot m_s\,\frac{d(v_n^{-1})}{dn} \quad (12.9)$$

$$\frac{d(J\cdot\omega)}{dn} = \frac{m\cdot\sqrt{G\cdot m_s}}{2\cdot\sqrt{r_n}}\cdot\frac{dr_n}{dn} \qquad = -\frac{G\cdot m\cdot m_s}{v_n^2}\cdot\frac{dv_n}{dn} \quad (12.10)$$

with eq. 12.8:

$$\boxed{\frac{d(J\cdot\omega)}{dn} = \frac{J\cdot\omega}{2\cdot r_n}\cdot\frac{dr_n}{dn} \qquad = -\frac{J\cdot\omega}{v_n}\cdot\frac{dv_n}{dn}} \quad (12.11)$$

By comparison of the left and the right solution (of eq. 12.11), after introduction of the constant:

$$\frac{1}{N} = \frac{1}{r_n}\cdot\frac{dr_n}{dn} \qquad = -\frac{2}{v_n}\cdot\frac{dv_n}{dn} \quad (12.12)$$

the differential equations read:

$$\boxed{\frac{r_n}{N} = \frac{dr_n}{dn}} \qquad \boxed{\frac{v_n}{2\cdot N} = -\frac{dv_n}{dn}} \quad (12.13)$$

and the general solutions:

$$r(n) = r_n = r_o\cdot e^{\lambda\cdot n} \qquad v(n) = v_n = v_o\cdot e^{\lambda\cdot n}. \quad (12.14)$$

The 1st derivation: and the comparison with eq. 12.13 and eq. 12.14:

$$\frac{dr_n}{dn} = r_o\cdot\lambda\cdot e^{\lambda\cdot n} \qquad \frac{dv_n}{dn} = v_o\cdot\lambda\cdot e^{\lambda\cdot n} \quad (12.15)$$

$$\frac{dr_n}{dn} = \frac{r_o}{N}e^{\lambda\cdot n} \qquad \frac{dv_n}{dn} = \frac{-v_o}{2N}e^{\lambda\cdot n} \quad (12.16)$$

determine the coefficient λ:

$$\lambda = 1/N \qquad \lambda = -1/2N \quad . \quad (12.17)$$

The result is for a planet in the nth orbit:

for the average orbital radius	for the average orbital velocity
$r(n) = r_n$	$v(n) = v_n$
$r(n) = r_o\cdot e^{n/N}$	$v(n) = v_o\cdot e^{-n/2N}$
(12.18)	(12.19)

Fig. 12.3: Calculation of the distances and orbital velocities of the planets

12.3 The derivation of the Titius-Bode law

Even if Bohr's atomic model should be wrong, it gladly is compared to the system of the planets. The radii of the electron orbits mathematically result as eigenvalue solutions of the Schrodinger equation, and that we have derived from the fundamental field equation (chap. 5.1, eq. 15) (chap. 5.5 - 5.9). The orbital radii are calculated in increasing order in accordance with the sequence of whole numbers with n = 1, 2, 3, 4, ...

From the same sequential regularity of the planetary orbits can be derived, that they also obey the eigenvalues of the same fundamental field equation, which isn't called a world equation in vain. The quantitative distances from the sun are determined by the size of the sun: if the sun increases, then also all distances increase to the same extent.

Now result identical distances between the orbits from Bohr's model, whereas this distance in the case of the planets with increasing distance from the sun gets larger. The reason for this unevenly grading can be calculated just like that (fig. 12.3).

We arbitrarily pick a planet, which occupies the orbit n, where n again represents the sequence of whole numbers (n = 0, 1, 2, 3, ...). If the orbit of this n^{th} planet changes, then also its distance to the sun $r_n = r(n)$, its orbital velocity $v_n = v(n)$ and the orbital momentum $J \cdot \omega$ (12.7) are changed.
We try (as in equation 11.42, fig. 11.10) the balance of forces between centrifugal force and gravitational force (eq. 12.1, fig. 12.1) and solve equation 12.2 for the orbital velocity. The orbital angular momentum of the planet written down once in its dependency on r_n and in the right column next to it on v_n (eq. 12.8, fig. 12.3), is derived for the orbital ordinal number n, to record the change in angular momentum (equations 12.9 to 12.11).

In fig. 12.3 the paths to the solution for both cases are given. For the average orbital radius r(n) as well as for the average orbital velocity v(n) of the planet an exponential course (eq. 12.18 and 12.19) and in logarithmic representation a straight line (fig. 12.4) results.

Even the orbits of the distant planets Neptune and Pluto, for which the Titius-Bode series fails, now are correctly recorded, so that with good cause can be claimed, to correctly have derived the regularity of the distances of the planets physically and mathematically.

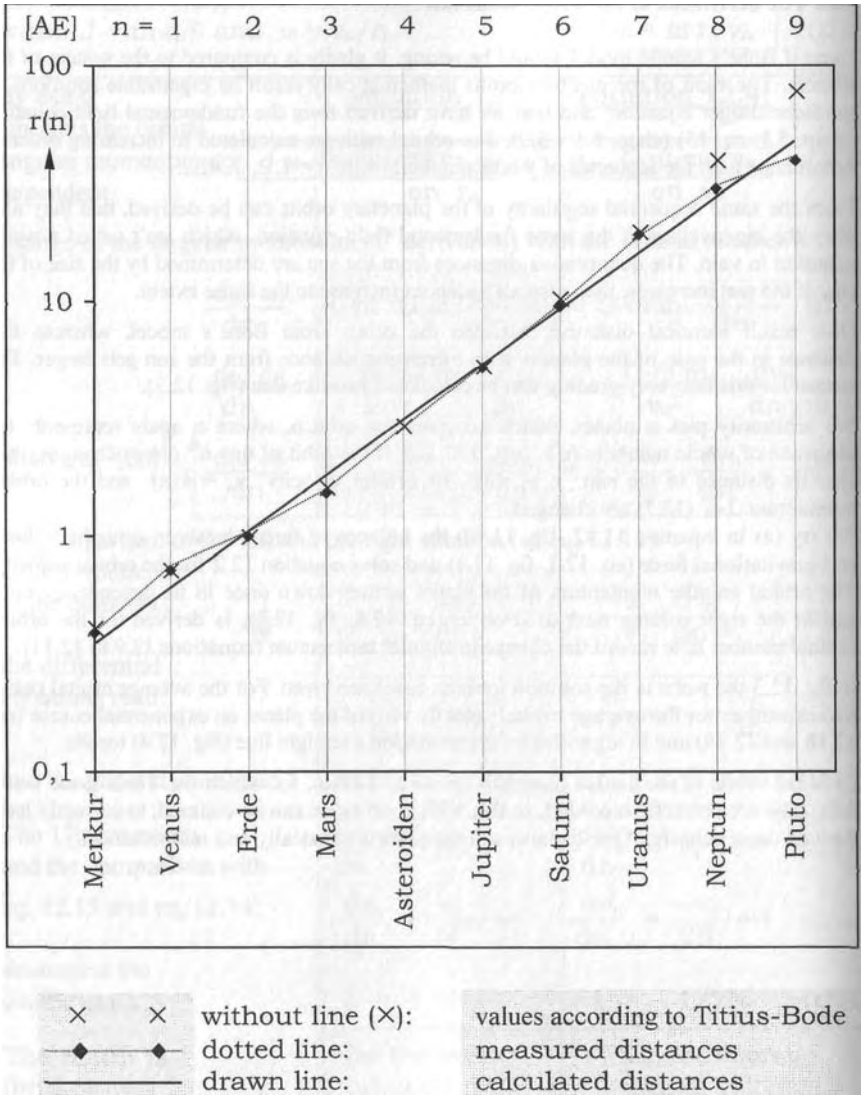

Fig. 12.4: Representation of the distances of the planets

result of the calculation:

$$r(n) = 0{,}3332 \cdot e^{\left(\frac{n}{1{,}82}\right)} \quad [AE] \qquad (12.20)$$

12.4 The hollow planet

The numerous accompanying moons of the big planets obey in the same manner as the planets this regularity, so that for the found result every coincidence is excluded. The orbits of the moons of Jupiter (fig. 12.5), of the moons of Saturn (fig. 12.6) and of the moons of Uranus (fig. 12.7) in logarithmic representation lie almost on a straight line. Some orbits certainly are occupied several times, while many an orbit has remained unoccupied. Other orbits again are occupied by a ring of countless chunks of rock, so-called planetoids. Best known representative is the asteroid belt (n = 4) between the orbit of Mars (n = 3) and that of Jupiter (n = 5). The Titius law requested the planet "Aster", but what one found (Piazzi, 1801), at first only was Ceres, the biggest representative of the small planets.
As a second asteroid, as they are called, was found (Olbers 1802) its discoverer proposed the explanation that both, Ceres and Pallas, could have formed in a cosmic catastrophe, which a bigger celestial body had suffered.
Perhaps the sought-for planet Aster actually had imploded after a collision and had been torn apart in countless fragments, of which today still more than half a million pieces are flying around. Most of the fragments however have been collected by the neighbouring planets Jupiter and Mars. Also in the case of the moons of Mars and the outer moons of Jupiter it could concern scrap of Aster. Some presumably fell on the young earth and triggered natural disasters and left deep scars.

It can be imagined that the planet Aster was hollow from the inside and thus was built up similar to the moon. Such a hollow sphere could have formed, if the sun, or in the case of the moon, the earth still was rotating with the cosmic velocity and as a result of the centrifugal force at the perimeter parts of the crust came off as connected sheets and rolled up to a tube.
The fast spinning tube then remodels into a hollow sphere with openings at the poles. In the inside of the sphere, near the equator, protected conditions and the best prerequisites for an undisturbed development, for instance of intelligent living beings, are found by the way. Apart from the advantages the hollow sphere however has as a fundamental disadvantage, that the normally protecting shell in the case of a collision with a bigger celestial body can becomes instable and can implode.

In the case of the moon the pole openings in the meantime are closed and a presumed gas pressure in the inside in addition provides stability. The wall of the spherical shell however is not evenly thick, so that the moon all the time turns the same, namely the heavier, side towards the earth. In view of the seismic measurements of the Apollo-missions, which revealed an extremely small damping of the ground of the moon (chap. 11.9, note <i>), we should look after our moon well, because a comet, which lets the moon implode, would be able to bring about more damage on earth, than if it would hit the earth directly.

Should there exist a hollow and possibly even on the inside habitable planet in our solar system, then surely Saturn should be considered. Its density is smaller than that of water, so that water would be distributed over the inside area of the hollow sphere, if it would be existent. One should examine more detailed the extremely flat pole regions of Saturn for possible openings! Also Uranus and Neptune are possible candidates. This only is thought as an idea.

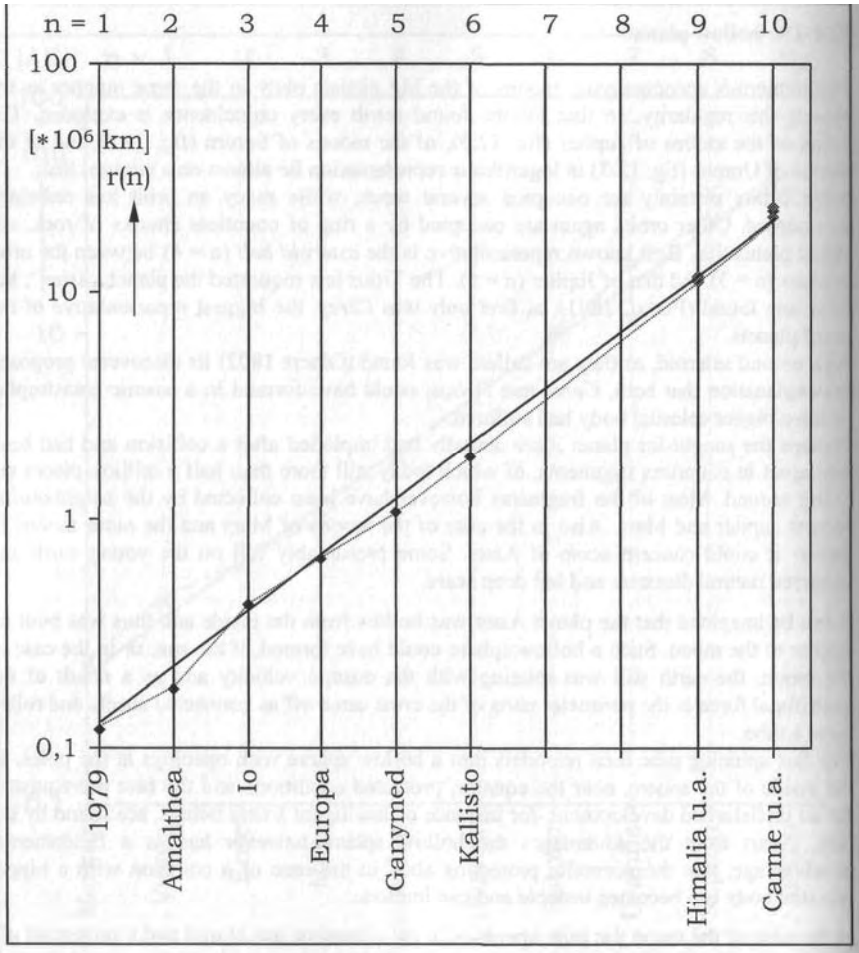

dotted line: measured distances
drawn line: calculated distances

in position n = 9 stand: Leda, Himalia, Lysithea and Elara
in position n = 10 stand: Ananke, Carme, Pasiphae and Sinope

Fig. 12.5: The distances of the moons of Jupiter

Result of the calculation:

$$r(n) = 67608 \cdot e^{\left(\frac{n}{1{,}743}\right)} \quad [km] \qquad (12.21)$$

<i>: Note to chapter 12.5:

What we observe as and call cosmos, is nothing but a structured state of space.

12.5 Concerning the formation of the universe

The widespread concept of an expanding universe bases on the observation of a red shift of the spectral lines of galaxies, which increases with their distance. As the physical explanation for the discovery of Hubble, the Doppler shift for a light source, which is moving away from us, is used. But this concept of an against the attraction of the gravitation taking place expansion is nothing more than a work hypothesis.

The by Christian Doppler in acoustics investigated effect treats the observable shift in frequency, if the source of sound or the receiver is moved with regard to the medium of propagation. But according to today's version there doesn't exist such a medium at all for light, because Einstein has abolished the concept of the aether. According to that the Doppler effect neither can be applied to changes in light frequency.
In the case of the expanding universe, for a decrease of the density and the tracing back to a Big Bang, it therefore should concern a misinterpretation!

Here another effect has to take effect, which one is not yet clarified. Perhaps the changing field relations of the observer environment play a role, after the earth moves away from the sun. But perhaps the galaxies only influence the propagation of their own light, or the light ray on its millions of years lasting way through space slightly loses energy, what is expressed by gradually increasing its wavelength and shifting its spectrum towards the red frequencies.
The hypothesis of the Big Bang moreover contradicts every causality. It is not able to give an answer concerning the origin and the future of the universe and on the question of the origin of the energy and the particles. With that its physical value of explanation goes towards zero.

If we again hold the theory of objectivity against the theory of relativity (part 1), we come to quite other answers. Here apart from the waves also vortices are found. Specially in the case of the spherical vortex a part of the wave power is enclosed in the inside, so that looked at from the outside a from zero differing energetic state results, which even is accessible measuring technically (chapter 6.2).
Wave and vortex are two possible forms of state, so that for the conversion of one state in the other state at first no energy is necessary. The change of state depends on the local field relations.
If we assume that in the beginning the cosmos was free of energy and particles. Then the first vortex was a possible product of chance with an infinite extension. This first spherical vortex, which was contracted under the potential vortex pressure, gave structure to space, gave it energy and field and took care for the rolling up and formation of new vortices[<1>].
It can be assumed, that even today new particles continually are being formed in the fringe areas of the infinitely extended cosmos, which fly towards us and in doing so contract. They are attracted and at the same time shrunk by the fields of the celestial bodies. They form the source of all matter and energy for our observable universe, which permanently is changing its structure. Because the same oscillation with reversed sign is enclosed in the inside of the spherical vortex, the sum of the energy present in the cosmos is exactly equal to zero. With that the question concerning the causality is superfluous.

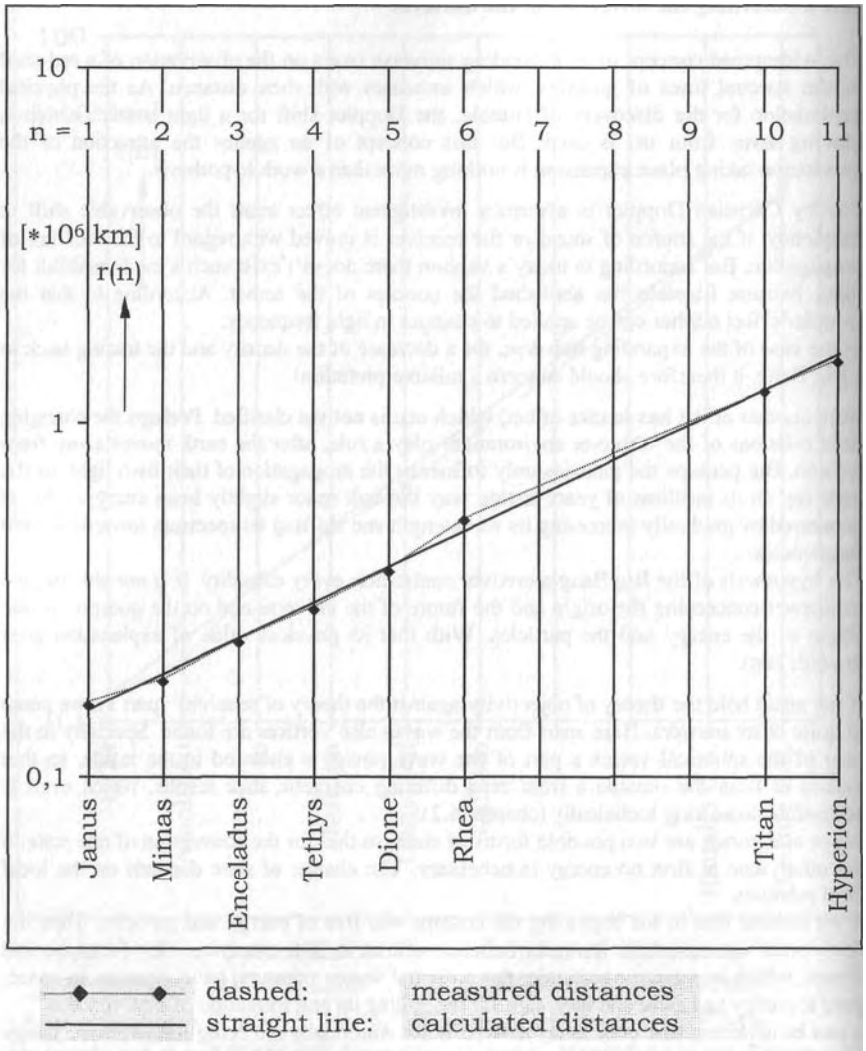

Fig. 12.6: The distances of the moons of Saturn

Note to chapter 12.6 (2nd law of thermodynamics<i>):

Heat cannot completely be transformed into mechanic or electric energy.

<i>: see Electromagnetic environmental compatibility, Part 1, fig. 8.4

The formation of the universe also can be explained causal and completely without a hot Big Bang, even if a supernova surely represents something like a "local Big Bang" for the concerned celestial bodies. According to the observations of the sky expansion and contraction, explosion and implosion occur everywhere in form of oscillations.

On the whole the expanding universe, which once was in thermodynamic equilibrium with matter, should cool down further and further. But stop, the 2nd law of thermodynamics teaches one just the opposite. If the entropy only increases, as the law dictates, then the whole universe should end in a heat death, just as mysteriously and inexplicable, as it should have been formed with the Big Bang. Perhaps something is wrong with the law (fig. 8.4)?

12.6 Counter examples concerning the 2nd law of thermodynamics

Most likely a small experiment convinces us. We heat two spheres, one somewhat less, the other somewhat more. Then we focus the heat radiation of the less hot sphere with help of a parabolic mirror and point it to the hotter one of both. That as a result becomes hotter, whereas the colder is cooled down. The heat thus has flown from the colder to the hotter sphere. Is it allowed to do that?
According to the 2nd law of thermodynamics it of course isn't. There the heat always can only flow from the hot to the cold sphere. But in this primitive experiment it measurable and verifiable flows in the wrong direction. Here the entropy, which is said to always only increase, actually decreases. Here entropy is being destroyed!
Shall we now let the carrying out of the experiment be forbidden under threat of penalty or shall we secretly put the law of entropy to sleep? It can't be denied that this law until now has quite well helped us along, at least for terrestrial processes, at least if one dispenses with the poor inventors, whose inventions offend against the since 100 years tried and tested 2nd law of thermodynamics. They haven't really arrived at the patent office at all, then they already are outside at the door again. Such inventors with their illegal behaviour even today must feel like criminals.

Just what that observed experiment can, each refrigerator and each warmth pump is using as well. And it is not an isolated case: also our sun clearly functions and operates illegally! The surface temperature amounts to only 5800 degrees Kelvin and supplies the atmosphere of the sun with energy. The energy thus flows from the sun to the corona, and that is with values above 1,000,000 degrees Kelvin for some powers of ten hotter!

Only the vortex concept resolves the many question marks without compulsion. In the case of the sun certainly vortices are at work. Here the high temperature in the corona arises as a result of vortices falling apart. We also speak of eddy losses. The transport takes place by heat radiation, exactly as in the experiment with the two spheres.
The possibility exists therefore in vortex processes as well as in technical circle processes that heat could flow from the colder to the hotter sphere. Whether this is an offence against the 2nd law of thermodynamics, is in the end a question of interpretation of the law and up to the opinions of the scholars.

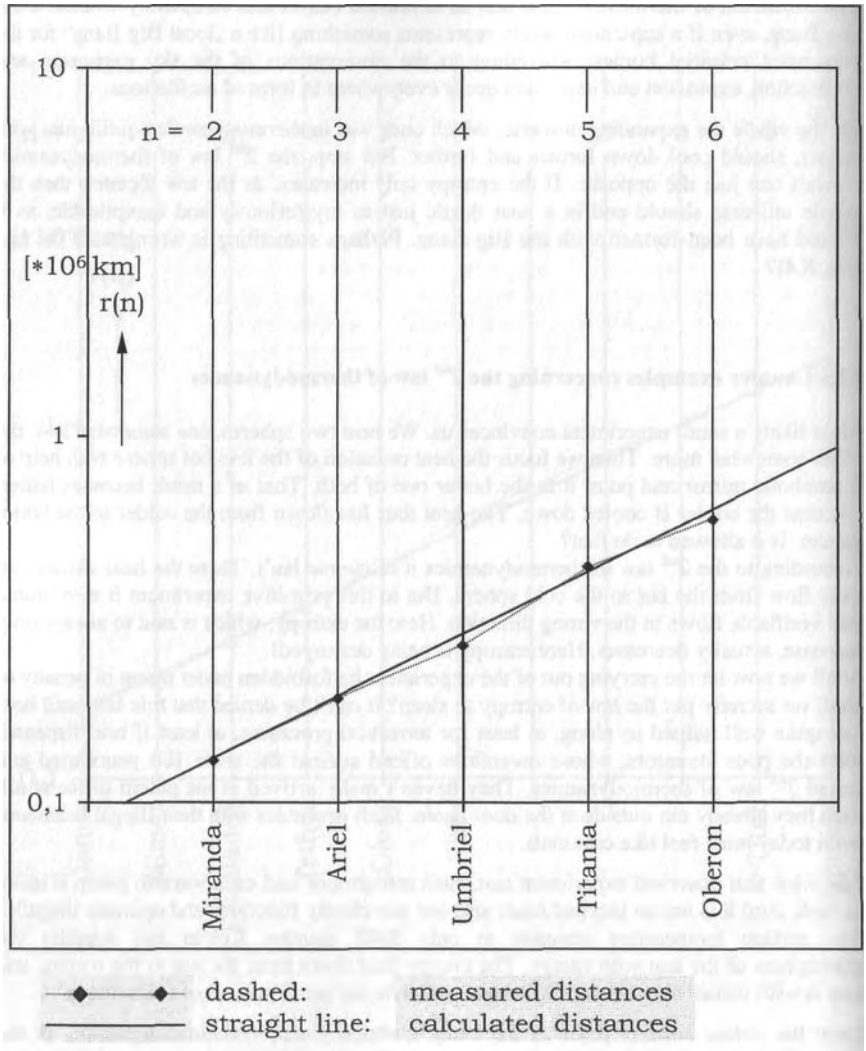

Fig. 12.7: The distances of the moons of Uranus

Note to chapter 12.7 (law of entropy):

The entropy of a closed system never can decrease. It is increased in the case of all irreversible processes. In the case of reversible processes it remains constant.

12.7 Entropy destroying potential vortices

Vortices in addition can amalgamate to balls and to planar vortex systems (4.9 and 4.10). In that case similar consequences, as they can be observed in flow-technical potential vortices in hydrodynamics, can be expected. As a result of the concentration effect (4.1) and because of the conservation of angular momentum an increase of the velocity of rotation of the vortex occurs. Like in the case of the pirouette in figure skating a spontaneous acceleration of its own is observed. In that way the kinetic energy of the system is increased, and that has to come from somewhere.
If we don't supply the contracting vortex with any additional energy for the increase of its rotation of its own, then as a source of energy only the heat energy is left. For this reason every contracting vortex generally converts heat in kinetic energy, it therefore cools down its environment! It moreover destroys entropy and offends against the 2nd law of thermodynamics (fig. 12.8).

It isn't an accident, if in the inside of a tornado it starts to hail. The whirlwinds really furnish visual instruction of the contraction and acceleration of their own of ring-like vortices. If then, even in tropical regions, hail stones are formed, the cooling effect has to come from somewhere, and it can be assumed that the vortex withdraws the heat energy from its environment (calculation in fig. 12.8).

If in specialist books is talked about matter or stars condensing, then vortex physics teaches us that they in reality are contracting and by doing that cooling down. That also is valid for whole galaxies. We owe solely the vortex laws that the continual heating by absorption of radiation is prevented and our sky in the night is dark and doesn't shine as light as day.

The cosmic background radiation, which as a result of vortices lies at almost 3° Kelvin, actually can only be given account for with a contracting of vortices of the Milky Way galaxy. If the cooling down in a compression resp. condensation process has arrived at absolute zero, the vortex becomes stationary, the contraction becomes dependent on the irradiated energy or it wholly comes to a standstill without supply of energy. An example for that is earth's inner core, which at zero Kelvin can't contract further.

From the point of view of causality it is suggested that we galactic and perhaps even cosmic to a large extent are in thermodynamic equilibrium, completely without Big Bang and heat death<i>.

Numerous inventions, as mentioned, are based on the principle of converting environmental heat in useable energy by contraction of vortices. If however the inventors don't know the vortex laws and if they have developed their concept empirically and less physically, then it very often happens that erroneously gravity is made responsible, then is talked of gravitational converters, of the use of a gravitational field energy. But the inventors don't do themselves a favour with that.

<i>: In the seminar it is desired to think about this. Doing so the philosophical faculty may feel as well addressed, as the sandpit of physics, in which completely unsuspecting is played and juggled with Big Bang hypotheses by ignoring all physical regularities and every common sense.

Evidence to counter:
planar, contracting ring-like vortex

$$\boxed{\text{conservation of angular momentum: } J\cdot\omega = m\cdot r\cdot v = \text{constant}} \quad (12.7)$$

conservation of energy: $E_{kin} = \frac{1}{2}\, m\cdot v^2 = \text{constant}$ (12.22)

	before (r_1, v_1)		afterwards (r_2, v_2)	
contracted ($r_2 < r_1$):	$m\cdot r_1\cdot v_1$	=	$m\cdot r_2\cdot v_2$	(12.7*)
with the consequences:	v_2/v_1	=	r_1/r_2	(12.23)
and: kinetic energy:	$E_{kin1} = \frac{1}{2}\cdot m\cdot v_1^2$	≠	$E_{kin2} = \frac{1}{2}\cdot m\cdot v_2^2$	(12.24)

increase of the kinetic energy:

$$\boxed{\frac{Q_2}{Q_1} = \frac{E_{kin2}}{E_{kin1}} = \frac{v_2^2}{v_1^2} = \frac{r_1^2}{r_2^2}} \quad (12.25)$$

notice: *Because of the change in energy/heat* ***no adiabatic change of state!***

change of volume:
with $V = \pi\cdot r^2\cdot h$

$$\boxed{\frac{V_1}{V_2} = \frac{r_1^2}{r_2^2}} \quad (12.26)$$

notice: *Because of the change of volume* ***no isochore change of state!***

assumption: ***isobar change of state*** *(with p = const., Gay-Lussac):*

result:
(vortices of gas)
involved with the:

$$\boxed{\frac{T_1}{T_2} = \frac{V_1}{V_2} = \frac{v_2^2}{v_1^2} = \frac{r_1^2}{r_2^2}} \quad (12.27)$$

* ***acceleration*** $v_2 > v_1$ *is the contraction of vortices* $r_2 < r_1$, $V_2 < V_1$

* ***the cooling:*** $T_2 < T_1$ and $\Delta T = T_1 - T_2 = T_2\cdot\left(\frac{r_1^2 - r_2^2}{r_2^2}\right)$ (12.27*)

* ***withdrawal*** *of heat* $Q_2 - Q_1 = \Delta Q = Q_1\frac{\Delta T}{T_2} = Q_1\cdot\left(\frac{r_1^2 - r_2^2}{r_2^2}\right)$ (12.28)

* *and* ***entropy destruction:*** $\Delta S = C_p\cdot m\cdot \ln\left(\frac{T_2}{T_1}\right) = C_p\cdot m\cdot \ln\left(\frac{r_2}{r_1}\right)^2$ (12.29)

Fig. 12.8: The cooling and entropy destroying effect of contracting potential vortices (calculations concerning chapter 12.7)

13. Recording of space and time

If observations should force us to touch the sacred physical laws, then we should first of all judge our measuring technique critically of all sides and bring it in an usable state. I suggest, we start completely from the beginning with the devices, with which the dimensions of space and time are recorded, with the tape measures for the measurement of length and the chronometers, our clocks.

We must find out, why comets are slowed down if they approach the sun like by the hand of a ghost and in going away again are accelerated, although no forces at all act on the celestial bodies from the outside.

We must find out, why in mines deep under the earth another value for the gravitational constant is being measured as on the surface of the earth[<i>]. The results hardly can be imagined, if an universal constant should lose its constancy.
Thereby can Newtonian mechanics and the well-known laws be used very successfully from today's point of view, as the derivations in the last chapters have shown. We even could verifiably and mathematically correct calculate the growth of the earth and the solar system with them. The physical laws in the normally used formulation in spite of that seem to be bound to certain limits. Some observations contradict all experience[<ii>].

<i>: H. Schuh: Eine Konstante verliert ihre Konstanz; neue Experimente nahren Zweifel an Newtons Gravitationsgesetz, Die Zeit Nr. 40 vom 25.09.97. From it the following quotation (translated):
„It already is suspected for several years, that a fifth force could exist, this suspicion goes back to exact measurements of the gravitational constant G in Australian mines and shafts. Physicists of the University of Queensland in Brisbane had determined, that G for measurements underneath the earth is about one percent larger than the corresponding, since centuries in laboratories determined size. Their proposal for explanation, namely a fifth repelling force, at first met with sharp disapproval. But an at 21 august in the journal Science (Bd. 237/87, P. 881) published work, which bases on measurements in a drilling hole in Michigan, confirms the Australian data".

<ii>: Already the nobel prize winner of physics, Lenard, pointed to the circumstance, that the relativistic representation of the astronomical aberration is incorrect, after no distinguishable aberration could be observed at binary stars, as it had been expected. With that Lenard by the way also has confirmed the existence of an aether.
P. Lenard, Annalen der Physik, Bd. 73, S. 89 (1924)

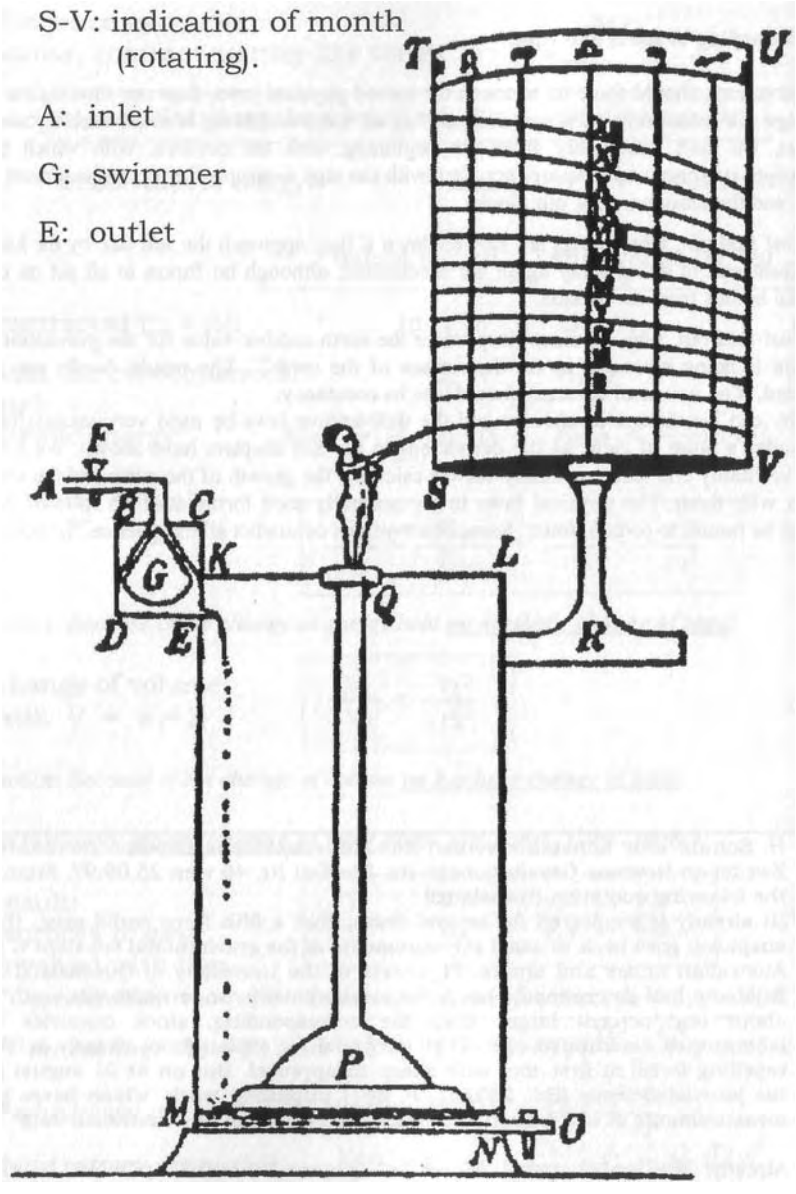

Fig. 13.1: The water meter of the Ktesibios (approx. 250 BC)
(with regulation of the water-level)

13.1 The measuring technical debacle

We are standing for a measuring technical debacle, because we have fixed our calendar to the rotation of its own of the earth. We call a 360° turn a day, divide it in 24 hours of 60 minutes each and every minute in 60 seconds. With that we determine the duration of a second.
A clock according to this definition only then is exact, if it follows the changes of the eart h to the same extent. Obviously this in particular is the case for atomic clocks. An objectively seen precise going clock however would land at the waste disposal site as completely unusable.
Alter all nobody wants to know, how late it really is. Everyone only wants to find confirmed his subjective feeling, and our experience of time simply is directed after the course of the sun, thus after the rotation of the earth!

For the moment and as an approximation also for the life time of a person, this determination of time may be sufficiently exact, but seen over larger periods of time, one doesn't get around a conversion. Actually the 200 million years since the beginning of the Creation on the mentioned primeval hill are considerably less long ago. The earth and the whole solar system are very much younger, than was assumed until now!

If we as an example again take the cited research group of the University of Arizona (chap. 11.10[<i>]), which by means of an analysis of sediment formations have found out, in accordance with our calculation, that 900 million years ago a day only had 18 hours[<i>]. Such traces in geological deposit layers can be very informative, if they are analysed correctly, since here the measurement technician himself is not subject to the process. He stands outside and hence can exactly measure the time difference.
If a geologist of that time had looked at his watch during the formation of the layers, then a day obviously would have had 24 hours, and he wouldn't have been able to understand the whole excitement at all. The accusation, he would suffer from chronic blindness caused by his job, he of course would repel resolutely. Can you now imagine, from which disease our science of today suffers?

Our chronometers are nothing but the improved model of a sundial[<ii>].

We live in the dimensions of space and time, but we quite obviously have the biggest possible difficulties with the dimensioning of both. Possibly we already aren't capable of that at all by principle. Most suitably we clarify the situation by means of examples concerning the two problem spheres.

Let us at first stay at the dimension of time. It may have become clear, how problematic the chosen determination of the time scale in seconds is and which contradictions can result if larger periods of time are considered. More and more often science fiction authors romp about on the playground of time, fantasize about some time travel, or they occasionally make jokes about it[<iii>].

<i>: 900 million years ago a day had 18 hours, Washington (dpa) 1997.
<ii>: There also exist models, of which is asserted, they go according to the moon.
<iii>: A passenger, who got on the 10 o'clock bus, passes by the church steeple clock, which only reads 5 to 10 and curses: Damn, I took the bus in the wrong direction!

Centrifugal force $F_{1,2} = (m/R)\cdot(v_E \pm v_f)^2 = m\cdot R\cdot(\omega_E \pm \omega_f)^2$ (13.1)

with: $R = 6378$ [km] (radius of the earth),

$v_E = \omega_E\cdot R = 0{,}465$ [km/s] (rotational speed of the earth), (11.20)

$v_f = \omega_f\cdot R = \pi\cdot R/t_o$ (speed of the plane) (13.2)

and: t_o [s] (duration of journey)

energy of the moving steering quanta:

$$E_{1,2} = \int_O^R F_{1,2}\, dR = m \int_O^R R\cdot(\omega_E \pm \omega_f)^2\, dR = \quad (13.3)$$

$$E_{1,2} = \frac{1}{2}\cdot m\cdot R^2\cdot(\omega_E \pm \omega_f)^2 = \frac{1}{2}\cdot m\cdot(v_E \pm v_f)^2 \quad (13.4)$$

energy balance (generally of a quantum of radiation):

$E_{1,2} + E_q = E_{ges}$ resp. $E_{ges} - E_q = E_{1,2} = \Delta E$ (13.5)

in general: $E = h\cdot f = m\cdot c^2$ resp. $m = h\cdot f/c^2$ (13.6)

and (Gl. 13.4 mit 13.6):
specifically: $\Delta E = h\cdot\Delta f = E_{1,2} = h\cdot f\cdot(v_E \pm v_f)^2/(2c^2)$ (13.7)

$\Delta f/f = \Delta t_{1,2}/t_o$ resp. $\Delta t_{1,2} = t_o\cdot\Delta f/f$ (13.8)

(eq. 13.7 inserted into eq. 13.8)

resulting in: $\Delta t_{1,2} = t_o\cdot(v_E \pm v_f)^2/(2\cdot c^2)$ (13.9)

time of travel around half the earth: $t_o = \pi\cdot R/v_f$ (13.2)

results in a difference in going of: $\Delta t = \Delta t_1 - \Delta t_2$ (13.10)

$$\Delta t = [(v_E + v_f)^2 - (v_E - v_f)^2]\cdot\pi\cdot R/(v_f\cdot 2\cdot c^2) \quad (13.11)$$

result calculated: $\Delta t = 2\cdot v_E\cdot\pi\cdot R/c^2 = \underline{207}$ [ns] (13.12)

measured by Hafele and Keating<i>: 214 [ns]! (13.13)

Fig. 13.2: The difference in going of two atomic clocks
(caesium resonant clocks)

<i>: Hafele-Keating-Experiment, Oktober 1971; s. a. W. Bauer: Klassische Physik, Graphia Druck, Salzburg (1975), Eigenverlag

13.2 The clock paradox

The theme „time dilatation" in connexion with the particle decay already has been treated (part 1, chapter 6.20). It has been shown, that a fast moving and with that length contracted particle to exactly the same extent (Lorentz's square root) becomes more stable and longer-living. If relativists pack an atomic clock based on radioactive decay in a plane and detect a difference in going between the one, which has been flown around and a second identically constructed clock, which has stayed at the ground, then they have with that detected experimentally a very small length contraction, which really occurred, and by no means a time dilatation, as they claim.

Now we in addition owe Einstein, that the aether has been abolished and from that follows, that it can't play a role in which direction the plane flies. If therefore both clocks are taken along each in a separate plane, one plane flying to the west and the other to the cast, both planes meeting again for the first time on the other side of the globe, then according to Einstein's theory it shouldn't be possible to determine a difference in going, if both planes constructed identically were on the way with the same velocity. But this is not the case!

Actually a difference in going is measured, which however can't be calculated with the theory of relativity, yes, which is completely incompatible with this theory and clearly brings anyone to the eye, that the effect actually can't have to do anything with a time dilatation, that the moving clocks merely go wrong and we have to ask us, why<1>.

These experiments were carried out with atomic clocks, which are constructed as caesium resonators and work with an exactness of one second in 300000 years. As a resonator serves a quartz crystal, which is controlled by an ion current of caesium atoms, which have lost their outermost enveloping electron. The system is fed back, because the oscillating quartz controlled by the caesium ions again adjusts the caesium vapour by radio wave and finally its own atomic controlling current (fig. 13.7).

The reason for the measured difference in going is seen in the field and here specially in the different gravitational field. The centrifugal force directed opposite to the gravitational force at least is not the same, because for a westward flight along the equator the speed of the plane v_f should be subtracted from the velocity of rotation of the earth v_E, whereas in eastward direction it should be added (eq. 13.1).

For the steering quanta supplied by the caesium resonator now the energy balance is put up (13.5 with 13.4) and the change of the reference frequency is calculated (13.7). With the change in frequency is connected directly a change of the at the two clocks readable times $t_{1,2}$ (13.8). For a journey around half the earth, where one clock is flown westwards and the other one eastwards, the difference in going should, according to the calculation, amount to 207 ns. Interesting of the result (13.11) undoubtedly is, that the velocity of the planes doesn"t play a role. It is cancelled out.

October 1971 caesium atomic clocks were sent around the world in scheduled planes in the Hafele-Keating experiment. To be able to estimate the inaccuracy in going of the clocks and with that the measurement error, four clocks were used. Between the westward journey (273 ±7 ns) and the eastward journey (59 ±10 ns) a difference in time of 214 nanoseconds was determined. This under strict scientific conditions determined result once more proves the correctness of the theory of objectivity by confirmation of the calculated value. That however is not valid for the special theory of relativity, because that doesn't appear in the calculation at all!

Who now believes, we would have less problems with the dimension of space, I must disappoint. The determination of the linear measures equally ends in a fiasco.

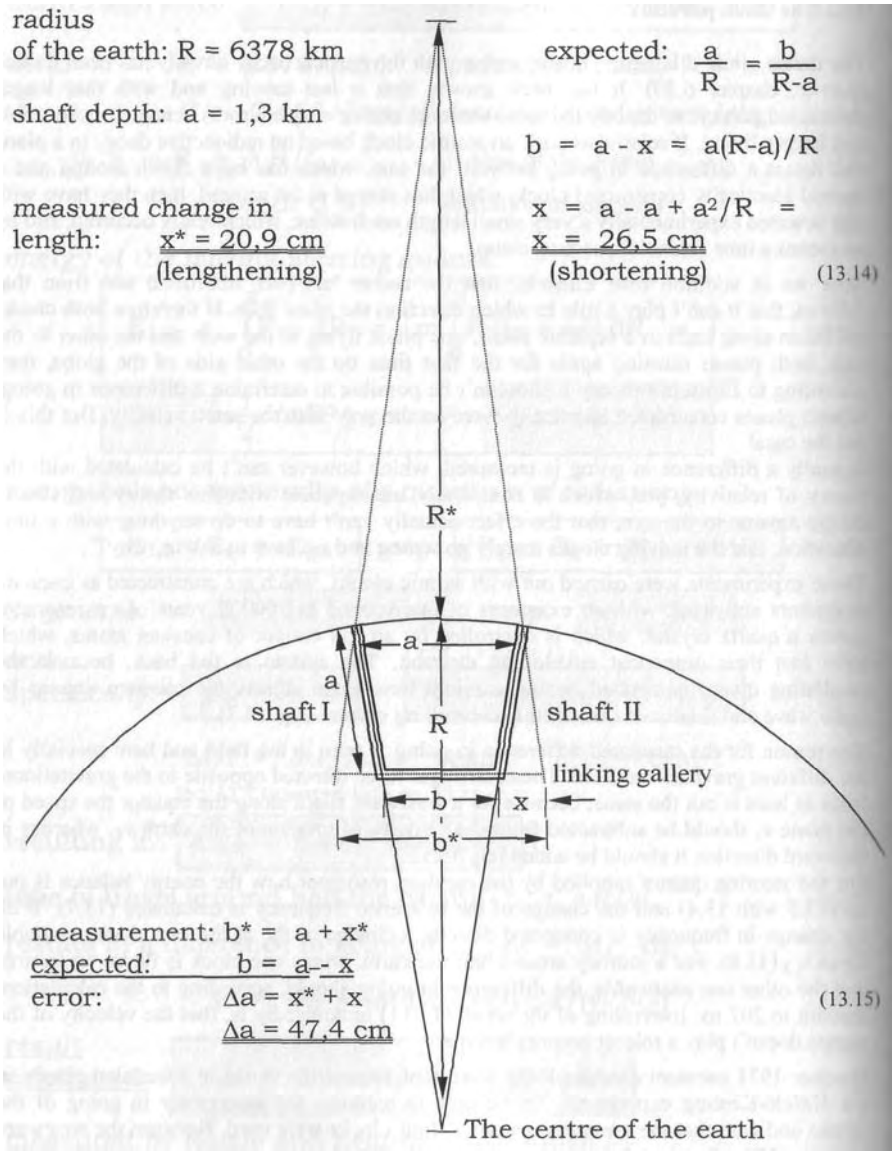

Fig. 13.3: Expectation and measurement in the Tamarack mines

(The curvature of the earth and the length of the shaft a are drawn strongly exaggerated for clarification)

13.3 The Tamarack mines experiment

As long as the ,,foot measure" depended on the shoe size and the ,,cubit" on the forearm of the tailor, the world still was OK. The sciences however request a reproducible quantity for comparison, and that can be fetched at the Bureau International des Poids et Mesures in Sevres near Paris. The original meter is a Platinum alloy. Because the length of the metal always depends on temperature, it is stored at a constant kept temperature of 0° Celsius. Now there in addition still exists a field dependency, an electrostriction resp. magnetostriction. And how is the measurement bar behaving, if the earth grows and the density increases? Is it then shrinking just like other objects in its environment? At this point already chaos is proliferating.

The newest definition of the length measure meter acts as a blow for liberty and thus marks the abyss, at which we are standing: The length is determined by means of a measurement of transmission time of an electromagnetic wave, e.g. of a light signal. It is said that with this determination a higher reproducibility should be obtained. Actually a photo optical facility to measure length is as exact as the built-in facility to measure time, and there we use it again, our sundial. In addition a constancy of the speed of light is taken as a prerequisite, and that is given in meters per second. From a change of the speed of light for forinstance 10% a change in length for 10% as well would result[<i>]. Because we see this process with the help of our eyes as well with the speed of light, we never can see the change. We neither can technically measure it, because all gauges we construct are built up corresponding to our sensory impression. We ourselves have shovelled the hole, in which we fall.

Only if we succeed in taking a neutral standpoint outside of the events, the true relations will become visible to us. For the field dependency of the space measures a very clear experiment has been carried out, of which I now want to report[<ii>].

1901 the French government was offered the possibility to carry out an experiment in the shut down Tamarack mines near Calumet (Michigan) with the goal to determine the diameter of the earth more exact. For that the geophysicists let down two plumb-lines of 27.2 kg each in two perpendicular winding shafts, which were at a distance of 1.3 km from each other. The plumb-lines were tied to hardly expandable piano wires of as well 1.3 km length. It now was expected, since the plumb-lines hung in direction of the centre of the earth, that in a linking gallery between the two shafts a length of (1.3 - x) km should be measurable. From the shortening x one wanted to infer the diameter of the earth (fig. 13.3). But it came completely different.
Instead of a shortening a lengthening for x* = 20.9 cm was measured in the gallery! The point of intersection of the lines through the two shafts had to be not in the inside of the earth, but in space! Immediately ,,hollow earthers" appear, who claim we would live on the inside of a hollow world[<ii>]. Perhaps one should shoot them to the moon, because from there the earth without doubt is seen as a sphere. Obviously we aren't dealing with a surprise of a fair, but with a fundamental measuring technical problem.

<i>: for that see also part I, chapter 6.11 and 6.12
<ii>: http:/www.t0.or.at/subrise/hollow.htm

Volume of the globe: $V = (4/3)\cdot\pi\cdot R^3$ (13.16)

and of the inner sphere in depth a: $V_a = (4/3)\cdot\pi\cdot(R-a)^3$ (13.17)

resulting in the relative change:

$$\boxed{\frac{\Delta V}{V} = \frac{V-V_a}{V} = 1-\left(\frac{R-a}{R}\right)^3 = 1-\left(1-\frac{a}{R}\right)^3} \quad (13.18)$$

from $m = V\cdot\rho$ for a constant density ρ (13.19)

and<iii>: $m = \phi/\sqrt{G\cdot 4\cdot\pi\cdot\mu} = A\cdot\mu\cdot H/\sqrt{G\cdot 4\cdot\pi\cdot\mu}$ (13.20)

follows: $\boxed{m \sim V \sim H}$ (13.21)

resp. the relative change:

$$\boxed{\frac{\Delta H}{H} = \frac{\Delta m}{m} = \frac{\Delta V}{V} = 1-\left(1-\frac{a}{R}\right)^3 = \underline{0{,}061\%}} \quad (13.22)$$

According to the theory of objectivity the length of the measurement wire is field dependent<ii> with:

$$\boxed{H \sim 1/a^2} \quad \text{and} \quad \boxed{H_a \sim 1/(a-\Delta a)^2} \quad (13.23)$$

and the relative change:

$$\boxed{\frac{\Delta H}{H} = \frac{H_a-H}{H} = \left(\frac{a}{a-\Delta a}\right)^2 - 1} \quad (13.24)$$

Shortening of the rule Δa is calculated from the comparison of equations 13.22 and 13.24:

$$\boxed{\frac{\Delta H}{H} = 1-\left(1-\frac{a}{R}\right)^3 = \left(\frac{a}{a-\Delta a}\right)^2 - 1} \quad (13.25)$$

$$\Delta a = a\cdot\left(1-1/\sqrt{2-(1-a/R)^3}\right) \quad (13.26)$$

$\underline{\Delta a = 40}$ [cm] (result of the calculation)

$\underline{\Delta a = 47}$ [cm] (measurement value for comparison, 13.15)

Fig. 13.4: Calculational verification of the measured shortening

13.4 Field dependent linear measure

If a measurement result delivers just the opposite, as was expected by the experimentators, then the layman is amazed and the expert is surprised, at least at first. But then, out of a feeling of panic, the whole view of life could collapse, as many as possible scientists and renowned professors are being informed and integrated, if they want it (Prof. Mc.Nair) or not (Prof. Hallock, Columbia University) and eventually the matter is buried third class and a guise of silence is spread over it. The censorship of the scientific making of opinion in advance doesn't permit publications, which are not in accord with our view of life, out of the animal survival instinct<i>.

A science, which deserves this name, should look different. There it must be permitted, to ask questions and to publicly discuss about it.
I proceed from the assumption, that the earth is a sphere, which we inhabit from the outside; I have no doubts about that. With this as a prerequisite there is only one possible answer to the Tamarack mines experiment: The 1.3 kilometres long measurement wire, which in the gallery in a depth of 1.3 km had to jut out for 26.5 cm, instead is too short for 20.9 cm, from which immediately follows that it, howsoever, is shrunk for 47.4 cm in the depth.
At first of course the experiment was checked for possible measurement errors. The shafts were covered to exclude any draught. The measurement path was optically checked, but the result remained unchanged. But if the cause for the unexpected result doesn't lie in the experiment, then theoretical physics is addressed, after all it is still the experiment which shows us the physical reality and not some theoretical model concept.
In the 1st part of the book already the derivation of a useful explanation is found: The speed of light and with that also the linear measure depends on the field<ii>. The measurement wire accordingly gets shorter, if it is exposed to a larger field strength (eq. 13.23). We can verify the measured shortening calculative (fig. 13.4).
For that we at first determine the change of the field strength, as it is to be expected in a depth of 1.3 km. We here are dealing with the closed H field lines, which are responsible for the gravitation. In a past derivation it has been shown, that a gravitating mass can be converted into a magnetic field<iii>. Between a mass m and a field strength H hence exists a proportionality (13.21), in the same way as between the same mass and its volume, if a constant density is present (13.19).
The result accordingly is a relative decrease of the volume of the earth and the corresponding mass being under the measurement place, as well as a relative decrease of the radial component of the field strength, but a corresponding relative increase of the tangential component of the field for 0.061% (13.22 with 13.18).
In the gallery the measurement wire however is spread out in the direction of the tangential component of the field lines, and that shortens the measurement wire as a result of the field dependency of the linear measures<ii> (13.23). From the above increase in field the calculational shortening of the rule for 40 cm results, which compared to the measurement result also should be rated as a confirmation of the theory of objectivity which was taken as a basis<ii>!

<i>: Example: K. Meyl: Potentialwirbel, Bd. 1, reference entry /5/
<ii>: for that see also part 1, chapter 6.6, equation 65 and chapter 6.10
<iii>: K. Meyl, Potentialwirbel Band 2 (1992), page 27, equation 20

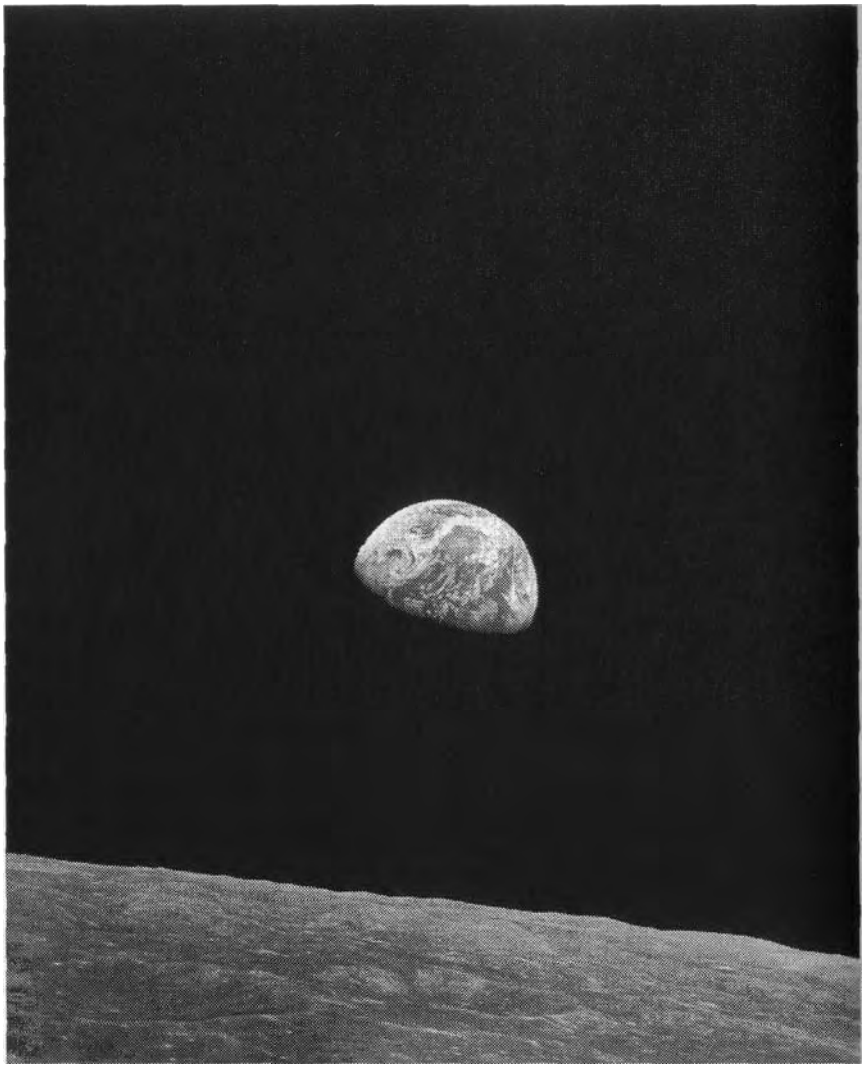

Fig. 13.5: Rise of the earth over the horizon of the moon""

<i>: Mitton, S. (Herausg.): Cambridge Enzyklopadie der Astronomie, Orbis Verlag (1989), note: No star is seen!

<ii>: see also the references in part 1, chapter 6.9

13.5 Experiences from space travel

The good correspondence of the calculated shortening of the measurement wire and the until now not understood measurement in the Tamarack mines shows both qualitatively, and quantitatively the correctness and useful applicability of the theory of objectivity of the field dependency of the linear measures. Our measurement laboratories normally are situated on the earth's surface and there everywhere are found approximately identical field relations. But if we leave the usual measurement environment and move the laboratory for instance in the sky, then we experience a complete mystery. Here however prevail the reversed conditions as in the mines experiment, in which in the inside of the earth. for an increase of the field strength, a length shortening was measured. In the sky the field strengths decrease and the linear measures correspondingly increase.
This experience astronaut Roosa made in the Apollo 14 mission. While he alone in his capsule orbited the moon, he depicted mission control, he could see the lunar module and observe his two colleagues at their work on the moon. Nobody wanted to believe the astronaut, since he was flying in a height of 180 km!
Commander Armstrong (Apollo 11) at the first landing on the moon indicated, the target crater Mackensen, 4.6 km in diameter measured from the earth, just has the size of a soccer field! Astronaut Scott (Apollo 15) called Mount Hardley, which is said to be 4.8 km high, a practice hill for skiing. Perhaps they somewhat have exaggerated, but a true core in the statements always is present!

Actually the gravitational field of our satellite is very much smaller than that of the earth. On the surface of the moon there is only one sixth of the gravitational pull of the earth. If we, to be able to compare, stick to the details of size, as they are measured by our laboratory on earth, then the astronauts on the way to the moon together with the lunar module and their rover had grown for a factor $\sqrt{6}$,then the first footprint is 2.5 times as large as on earth, then the astronauts were moving like giants in the scenery of a model of the railroad (eq. 13.23 and note<ii> at fig. 13.4).
On the moon there exists almost no atmosphere, for which reason the astronauts had imagined a wonderful view of the star-spangled sky, at least before they started. After the landing they were bitterly disappointed. The sky was black and not one single star could be seen! They have brought many photographs, but nowhere stars have been photographed, they apparently have moved outside the range of vision (fig. 13.5 and 13.6).
Many will still remember that the first pictures, which the space telescope Hubble supplied 1990, were completely blurred. The problem obviously was, that the mirrors had been adjusted on earth and not in space. Only after the optics had been given glasses in 1994, sharp pictures could be radioed to earth. Somehow the distance to the stars had changed. The telescope had become short-sighted, resp. the distance to the star-spangled sky appeared to be gotten larger. We already know why. If we remove us from the gravitational field of the earth, the field strength decreases and the observable distances increase! The highly sensitive telescope already sufficed the 5% deviation, with which should have been reckoned for the near earth orbit, to be fatal.
One should have familiarized the astronauts before with the laws of physics. Then this disappointment would have been spared to them, and in the case of the Hubble telescope the NASA and the european ESA could have saved a lot of money for the sake of the tax-paying population<ii>.

Fig. 13.6 a: Illustrierte Wissenschaft Nr. 11 (1997) Page 62

1st example: landing on the moon gravitational ...

$$\frac{\text{...pull of the earth}}{\text{...pull of the moon}} = \frac{g_E}{g_m} = \frac{M / R^2}{m_m / R_m^2} = \frac{M}{m_m} \cdot \frac{R_m^2}{R^2} = 6{,}0375 \quad (13.27)$$

in space everywhere on the surface of a sphere is valid: $A = 4\pi R^2$

eq. 13.20 (fig. 13.4<iii>): $m \sim \phi = A \cdot B = 4\pi R^2 \cdot \mu H \sim R^2 \cdot H$

as well as eq. 13.23 (fig. 13.4<ii>) for the field dependency: $H \sim 1/l^2$

and further:

$$6{,}0375 = \frac{g_E}{g_m} = \frac{H_E}{H_m} = \frac{l_m^2}{l_E^2} \quad (13.28)$$

resulting in the length dilatation (expansion) on the moon:

$$l_{m\,(Mond)} : l_{E\,(Erde)} = \sqrt{6{,}0375} = \underline{2{,}457} \quad (13.29)$$

2nd example: communications satellite in a geostationary orbit (at h = 36000 km above the equator, R = 6378 km).

$$\frac{l_h}{l_E} = \sqrt{\frac{H_E}{H_h}} = \frac{R+h}{R} = \underline{6{,}64} \quad (13.30)$$

Fig. 13.6 b: Examples of calculation for length dilatation<i>

<i>: If the theoretical value of 6.64 could be quantitatively confirmed by observations from off the earth with a telescope at a corresponding magnification, then with that would have been proved, that in the case of the spherical aberration it actually concerns the calculated influence of the field.

<ii>: U. Seiler-Spielmann: Das Marchen vom toten Mond, Zeiten Schrift 5/94,S.39

13.6 Spherical aberration

It is true that the problem of the changed length relations is known to the experts under the term of a "spherical aberration". But with that it is neither qualitatively nor quantitatively understood. Only the theory of objectivity soundly gives reasons for, why the astronaut Roosa has seen his colleagues almost 3 times as large, why weather satellites in a height of 1500 km are approx. 25% larger and why communications satellites in a 36000 km high geostationary orbit even increase to the 6.64 fold of their original size[i]. It also explains, why the neutral point between earth and moon, at which the attraction of masses of both celestial bodies mutually cancel, wasn't reached at the point where it had been expected by the moon rockets[ii].

We, the inhabitants of the earth, are adapted completely to the conditions on the earth's surface. If we find our way well in the dimensions of space and time, as we observe them, then that must not be valid by all means for science, because that has made it its business to find out the secrets of nature.

If it wants to deserve the name science, then it on the one hand has to consider, that we, the organic materials, as well as all inorganic materials are assembled from the same atoms and molecules and with that are exposed to the same length relations. If changes in length between day and night (as a result of the gravitational field of the sun (see chap. 6.7), between summer and winter or as a result of changes in field occur, then we aren't able to register this at all. That even today the ,,foot" is used as a measure, for instance in the air traffic, shows only too clearly, how man raises itself to the measure of all things. Science asks for modesty!

On the other hand it should be paid attention to the fact, that man eyes everything with speed of light with the optics of his eyes, and that speed by no means has to be constant. Solely the definition of the speed of light c as a linear measure per unit of time points to the direct proportionality between c and a length 1 (see chapter 6.3):

$$c \sim 1 \qquad (13.31)$$

If a rule has proven to be unusable for measuring a distance, then we'll experience the same disaster, if we measure optically, i.e. with the speed of light. Obviously both, the length 1 and the speed of light c depend in the same manner on the respective local field strength. On the one hand both measurement techniques lead to the same result, but on the other hand what can't be measured with one method, neither can be measured with the other.

To prove the constancy, it is normal to measure the speed of light optically. But since there exists a proportionality between measurement variable and measurement path (53), the unknown variable is being measured with itself. This measurement faulty by principle in all cases delivers a constant value. In contrast to the textbook opinion of today by no means a constancy of the speed of light can be assumed. In the case of the in a vacuum measurable 300,000 km/s it concerns a capital measurement error, at best a constant of measurement, but never ever a constant of nature!

With the postulate and the misinterpretation of a constancy of the speed of light as a universal constant of nature Einstein already let several generations of physicists run into the same dead end, in which they today are stuck altogether. It surely is no accident, that the big time of discoveries abrupt came to an end with Einstein.

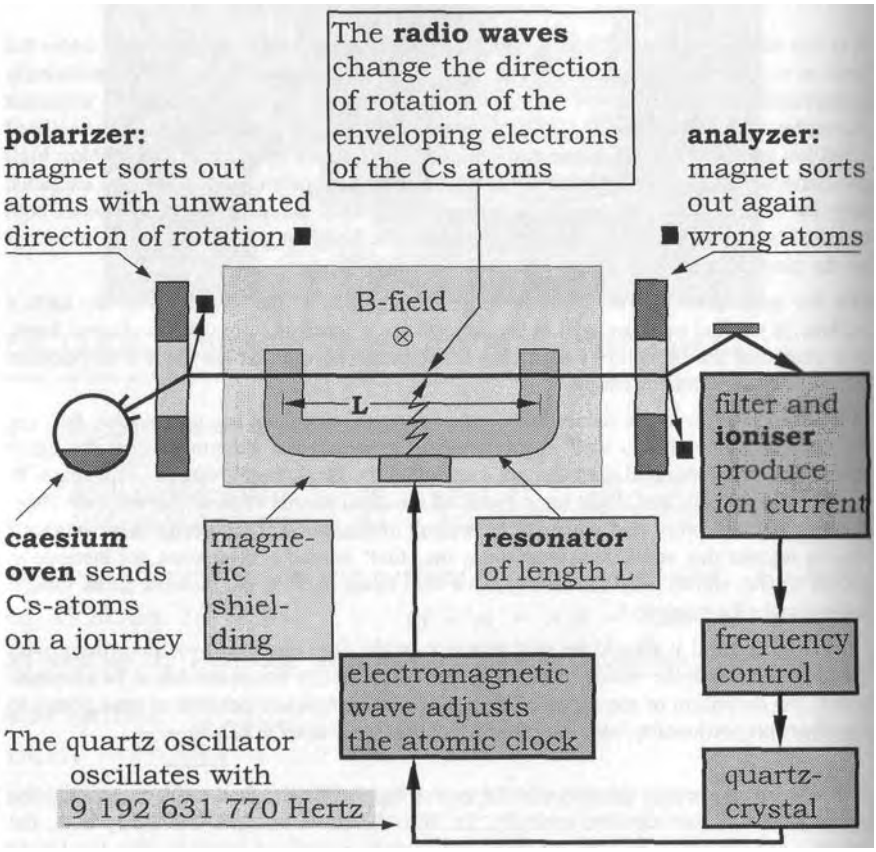

Schematic representation concerning principle of functioning
L = length of resonator determining the exactness
The B-field is a weak magnetic field, which eliminates the influence of magnetic stray fields.
The arrangement in addition is situated in a vacuum tank.

Fig. 13.7: Set-up of a caesium atomic clock

13.7 Irony of the measuring technique

Let's record: The linear measure is determined and defined by a measurement of transmission time. As a reason is given, that with today's clock technology a higher precision and reproducibility can be obtained, as with a rule or original meter. The exactness of going of the atomic clocks again depends on the free flying path (L in fig. 13.7) of the atoms. For the caesium clocks of the Physikalisch Technischen Bundesanstalt in Braunschweig the resonator length amounts to several meters! The clock is used world-wide as a standard.

The irony thus lies in the fact, that a geometric length dictates the measurement of time and the measurement of time again determines the measurement of length - poor science!

How does one free oneself from a capital closed loop conclusion? Why and how do signal transmission times or clocks actually depend on the gravitation? Who once got stuck in a dead end, knows that he only can get out in the reverse gear.
A possible way goes back to the roots of classical physics and to the theory of objectivity in the 1st part of the book, which is free from the limits of a subjective and relativistic observer standpoint. That isn't a dead end and in addition explains, why all atomic clocks react sensitive to magnetic fields (magnetostriction) and what these fields have to do with gravity (see chap. 6.9)!

Today's clocks are so exact, that even differences between a clock stationed on a mountain and one at sea-level can be recorded. Even more clearly was the depending on gravitation determined at an atomic clock, which was shot in a rocket 10000 kilometres high into space. The result of the analysis without doubt was, that the clock in that case doesn't „tick" correctly anymore.
But what does theoretical physics say about it? It claims, here the ,,red shift" has been measured; it thus concerns a confirmation of the special theory of relativity. But since it concerns a clock experiment and not a light signal, it clearly contradicts this theory, which isn't able to describe any gravitational effect at all, as is well-known. For this case in the spheres of theoretical physics one helps oneself with the general theory of relativity, with which actually only would be proven, that the two theories from the legacy of Einstein completely incompatible contradict each other. We come to the following conclusion:

Whoever gives details about length or time, is obliged to also indicate the reference system.

He also has to inform where his laboratory is situated and with which devices he measures!

With the conclusion also the discussion would be opened. Throughout the last four chapters a main idea can be found. It should be worth, to again think about the brought forward arguments and to dare a comparison with text books.
In the text books there doesn't exist such a thing as an oscillating interaction. Here no answer is found to the question, why the solar system isn't hurled out of the galaxy as a result of the high velocity, why the inside of the earth is hot, how the geomagnetism is formed, why the continents drift and why the ocean floor nowhere is older than 200 million years, as samples from the ocean floor prove<i>. How would you answer these central questions?

<i>: Kendrick Frazier: Das Sonnensystem, Time-Life Bucher, Amsterdam (1991).

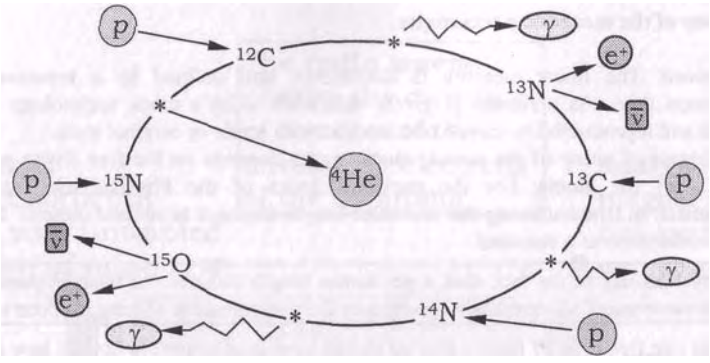

Fig. 13.8: The Bethe-Weizsacker cycle (concerning the sun's fire)
(meaning of: ^{12}C = carbon nucleus, ^{4}He = helium nucl., γ = gamma quant, ^{14}N = nitrogen nucleus, p = proton, e^{+} = positron, ν = anti neutrino, ^{16}O = oxygen nucleus

Fig. 13.9: The top of the unfinished obelisk in Assuan<i>

<i>: Hermann Wild: Technologien von gestern, Chancen fur morgen, Jupiter-Verlag Bern (1996), ISBN 3-906571-13-0

13.8 Discussion of the cosmological insights

The numerous models which are offered, of a geodynamo, an iron core, of assumed zones of subduction and of plate tectonics may be helpful for the explanation of individual isolated phenomena. But they physically don't give a uniform picture and partly contradict each other.

Lord Kelvin had calculated a period of shining of 5000 years on the basis of a sun consisting of coal[i]. The german physicist Hermann von Helmholtz landed at 15 million years, in which case the sun yearly should shrink for 100 meters. He already assumed a temperature of 15 million degrees centigrade, as also the Bethe-Weizsacker cycle has as a prerequisite, which according to today's concept should describe the process of nuclear fusion taking place in the inside of the sun (fig. 13.8). The only thing is that this extreme temperature is completely incompatible with the high density in the core of the sun! There are more than good reasons to assume the opposite of the widespread textbook opinion and assume that the core of the sun is cooled by the collected neutrinos in the same manner as the inner core of the earth and that superconducting areas are formed, which powerful fields even cause the protuberances on the surface of the sun. Since in the sun no measurement is possible, with which a model could be verified or disproved, terrestrial arguments naturally suggest themselves. Here the pieces of evidence for the growth of the earth can be taken in the hand and photographed. We already have discussed some facts. But there are found a multitude of other ones, for instance from the domain of archaeology, for which text books of today until now as well provide no explanation.

Possibly the stones and monoliths weighing several tons, as they were used for prehistoric buildings, should be linked with the growth of the earth. If the earth was smaller at the time they were build, then they perhaps by no means were as heavy as today!
Then the stones for reason of the smaller density in addition were softer and with that easier to work on. Dr. Wild points to the building technical peculiarity, that the stones formed like cushions originally must have been soft. He proves with the photograph of the top of the unfinished obelisk in Assuan (fig. 13.9), that the traces of working stem from a spatula in a plastic mass.
Also the perfect fitting of the stones used for the building of the pyramids can only be explained in this way. In the joints not even a knife point can be inserted!

If even stones in the course of time increase in density and hardness, then it is easier for us to comprehend, how small rivers in past time could dig large deep valleys in the earth's crust, then we perhaps also understand, why very old bones today are petrified[ii]. It is obvious, that also bones in the course of time increase in density and hardness. Even if science should succeed in breeding living dinosaurs, then their chance to survive in spite of that would be equal to zero, because the dinos would collapse under their weight of their own of several tons. Their bones would be much too thin and brittle for their weight of today!

<i>: Kendrick Frazier: Das Sonnensystem, Time-Life Bucher, Amsterdam (1991)
<ii>: The indication to petrified bones stems from a participant of the seminar.

25-07-1996:	Assistant head of government department Acceptance of the common standpoint.
11-12-1996:	European parliament Resolution of the guideline.
	commission Statement concerning proposals of change of the european parliament.
19-12-1996:	Assistant head of government department Resolution of the guideline.
19-02-1997:	Coming into effect of the guideline Publication in the official paper of the EC.
19-02-1999:	Period of translation of two years
	Reduction of the threshold values for current consumers:
19-02-1997:	to 40 million kWh (opening of the market 23%)
19-02-2000:	to 20 million kWh (opening of the market 28%)
19-02-2003:	to 9 million kWh (opening of the market 33%)
until 2006:	„Anti imbalance clause" A nine years period of transition to preserve equal opportunities in the competition. Report of the commission.
19-02-2006:	Further stage of the liberalization European commission tests by means of the made experiences, if the current market should be opened further.

Fig. 14.1: ____ Timetable of the EC single market guideline electricity[i]

<i>: Grawe, S. Thiele: Vorbereitung der Stromversorger auf den Wettbewerbsmarkt, ATW Atomwirtschaft-Atomtechnik 43. Jg. 1998, Heft 1, S. 10 - 13

14. The way towards free energy

Can energy actually be produced? No energy supply enterprise is capable to do that. Fact is, that energy only is converted and not produced. For that the available resources on earth are tapped and brought into a utilizable form of energy. As different the conversion processes may be, finally always heat is formed. We thus gradually burn the globe, on which we live. How long can something like that go right?

Science gives all-clear: „stock of energy is sufficient for the next 100 years. Newest calculations disprove the fear of a scarcity of energy on earth. There exist large stocks of coal and oil"<i>.

But what are 100 years compared to the age of the earth? How will our descendants judge our thinking and acting? They will condemn it and curse us, that much is clear already today.

We have an obligation to preserve the environment, and we only will be able to fulfil it, if we look to nature, how it covers its need of energy, if we finally understand and meaningfully copy nature.

We still are miles away of the goal.

14.1 The liberalization of the energy markets

It is important in the interest of a member of the executive that the stock of energy doesn't draw to an end, as long as he carries the responsibility for the enterprise of the economy of energy. The interest in the environment and the environmentalists for obvious reasons is less distinct. The problems are more of a commercial kind. Concerning that an actual example is given.

A special kind of problem is the meanwhile Europe wide valid decree of the EU concerning the liberalization of the energy markets (fig. 14.1). The list of the consequences starts with the fact, that the concluded licence contracts for power supply between energy supply enterprises and the communities, which are valid till 1997, are only wastepaper. Every customer of electricity as of now can conclude an individual contract with every "producer of electricity".

So an environmentally aware Black Forest person decides to obtain his power from a wind power station, which is situated in Denmark. That truly sounds very liberal. But how should that function, if there is no wind at all in Denmark for a week, or the connection is interrupted by a flash of lightning? The windmill further delivers power and the runner writes its bill truly believing, its power has arrived. The consumer then reads the bill at candlelight and puts with understandable anger his claim for compensation together. Pointing to the fact that such difficulties can be solved by book-keeping, the consumer again is calmed down; but that the not by contract obtained power will cost him dear, is another story.

<i>: Illustrierte Wissenschaft Nr. 6, Juni 1996, page 48-51.

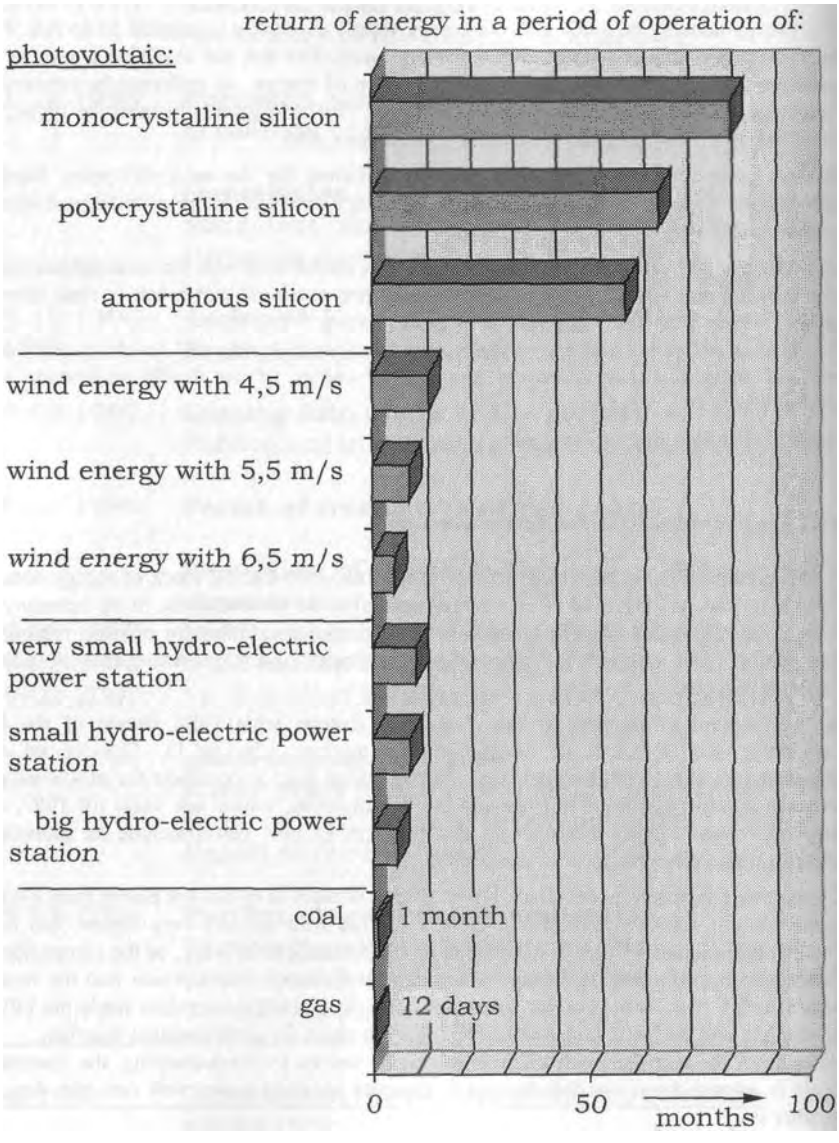

Fig. 14.2: Average time of paying for itself for the spent energy (return of energy)

14.2 The consequences of the liberalization

With the EU decree the monopoly only has shifted towards the runners of the distribution nets, after all only one net is present. Competition however would require at least two nets, thus a doubling of all house connections and all high-tension pylons, but that fortunately is unrealistic.

To prevent fleecing of the consumers by means of the net monopoly, politics introduces in the place of the free market economy dirigisme and plan economy with the well-known concomitants: no-one will look after the existing nets, no-one feels responsible anymore, because after all they have become public good by decree. One thus lets the pylons rot slowly and repairs only in emergencies. This possible development really can't have been the good intention of the EU.

In the next few years we however will be able to observe for the producers of energy exactly the development, which the EU-commissioners have imagined: Total competition contest, price war and a struggle for power to survive economically. A chance only has the nuclear power station, which gets rid of its refuse cheaper and if need be even illegally or which lives of indirect state subsidies, or the brown coal power station, which increases its efficiency at night, when no-one watches, by switching off the expensive filters.

The first power stations, which are selected out by the liberalized energy market, are the hydro-electric power stations which stand closest to nature. They simply are too small and too intensive of personnel, to be able to survive.

Gas turbine power stations, which deliver the power for half the price, than are ranking first. Then there is no place for regenerative systems anymore.

Solar energy, how many roofs a supporting program may have, stays a toy supported by the state. For a photovoltaic installation the ,,Return of Invest" still lies at more than 80 years, whereas is reckoned with a theoretical life of 20 years. In practical use on the other hand photovoltaic installations occasionally already have failed after seven years, after the photocells had gone blind. In this case not even can be talked of an ecologic energy, because the return of energy lies still above that. The supposed Idealist who spoils his roof with photovoltaic to reassure his ecologic conscience, would have spared the environment more, if he had covered his need of power from the socket, because already the production of the photovoltaic installation gobbles up more energy than can be produced with it. With regard to the environmental compatibility the ecologic balance sheet of a power station is attached a central importance (fig. 14.2).

With the law of feeding in power the state intervenes dirigiste, supposedly to protest the consumers. With this law the state orders, that not it, but the energy supply enterprises have to take the subsidizing of the regenerative energy, that they have to take over the power delivered at the inappropriate time in exactly so less suitable amounts at a price, which exceeds the market value by a factor of two and for falling prices of power even by a factor of four. With the law the politicians very fast and without agreement of the effected enterprises have shifted the ,,black Peter" further to these, which will get problems to preserve their competitiveness in the international comparison with the subsidy duty. It can't have been the intention of the EU-commissioners, that on a national level the price of power increases to finance some energy technical playground.

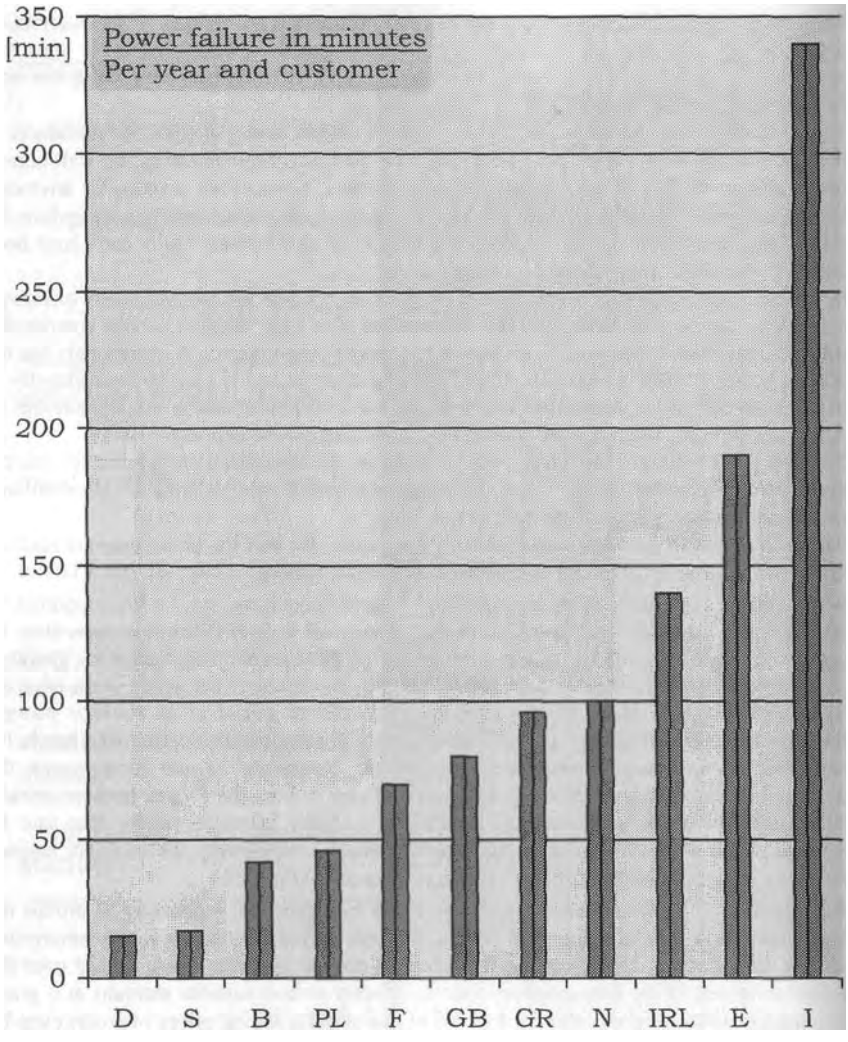

Fig. 14.3: Power interruption and not being at disposal

<i>: ETG, Energietechnische Gesellschaft im VDE: Qualitat der Stromversorgung, Dialog Nr. 1, Jan./Feb. 1998, S. 21

14.3 The chances of the wind energy

Meanwhile, as a result of the law of feeding in power, no longer the politicians but the energy suppliers are the ones, who around the North Sea look out of the window every day with the worry, some wind could blow and the mills could turn, because every kilowatt hour of a windmill must be subsidized strongly. Every windless day however reduces the power bill, with that helps the consumer and raises the chances of competition of our economy.
If it should be neglected, to tip over the law of feeding in power in due time with help of the EU, then the consumers will get their power in future abroad, then at the Preussen Elektra, damaged most by wind energy, as the first the lights will go out, then economic power and prosperity in Germany in future are dictated from abroad.
But if the law is dropped, then with that the duty to subsidize the regenerative energy carriers drops back to the state. Now all tax payers may foot the bill, even those, who don't use any power at all. The well-known Justice of subsidy" comes into effect.

Without support by the state only few types of power stations will be left behind. In addition are overcapacities being reduced, because they only cost money. But both is at the expense of the reliability of the delivering of energy and of the safety of the consumer. We owe the high stability of our network of today the large number of most different providers of power, which cover the basic load up to the peak load according to their suitability (fig. 14.3). But let us not talk of the golden past. The network after all isn't able to store power. From that follows, that without redundancy and without free power station capacities which can be activated at any time a short overload is sufficient, to let the network collapse.
Once the EU guideline concerning the liberalization of the energy markets is in effect, when persons selling power wend their way from front door to front door, to convince the housewives to obtain the power from them and not from other hawkers, when the power stations only live of stock and the depreciated overhead power lines only are entered in the hooks with the scrap value, then we should be dressed warmly and always have ready sufficient candles <i>.

14.4 The chances of being self-sufficient concerning energy

The only way out is the decentralized energy supply, the getting out of the large energy union and the way towards being self-sufficient. The argument sounds convincing in view of missing alternatives. But now it no longer is possible to plug the plug in the socket and then switch on whenever it pleases us. First it has to be calculated, if the windmill or the installation for solar energy supplies sufficient power or if a cold meal should be made. In contrast to today's consumer habits the runners of such installations will have to adapt their need of energy to the prevailing weather conditions.

<i>: A baby-Boom, like after the big power failure in New York, would be the smaller evil. The inhabitants and shopkeepers in the New Zealand metropolis Auckland will long and frightened remember the power failure in february 1998, which lasted weeks and was a result of not carried out maintenance works of high-tension pylons.

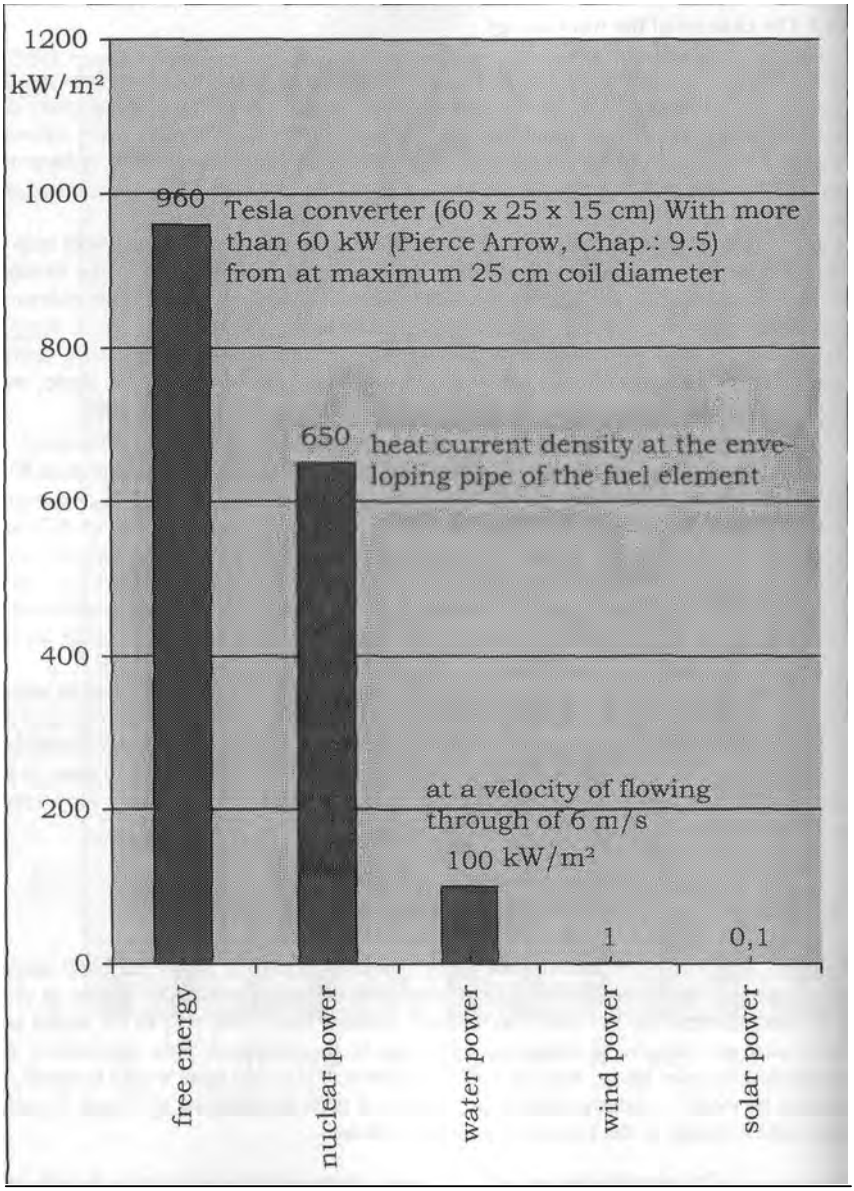

Fig. 14.4: At maximum obtainable power density of different carriers of energy

<i>: ETZ, Heft 19/1995, S. 40

Block heating power stations, propagated as stand-alone solution for people being self-sufficient, deliver power and heat at the same time. But if I don't need any heat on a hot summer day, then also no power is available or I uselessly heat into the open. For that one may leave all electric consumers switched on in winter, even if they aren't used at all, only to get the hut warm. Does a stand-alone solution look like that?

The situation truly is demotivating. Even the energy suppliers meanwhile may have realized that the energy politic way is a dead end. But for real alternatives in energy technology the pressure by suffering still doesn't seem to be big enough.
The intention to learn of nature is present in principle. The solar fire one wants to kindle on earth in a fusion oven, but the oven does not as it should.
Obviously the sun functions completely different, as physics imagines today (see fig. 13.8).
Before copying stands understanding, and in there seems to be a hitch!

14.5 The space energy technology of nature

Also nature needs energy, even very much. But it hasn't got any connecting pieces for tanking and no oven lid to fill in the fuel, it doesn't know our ecologically harmful combustion technology and environment destroying explosion technology at all. Nature rather works with the opposite, with implosion and fusion.
The sun, we have derived, materializes the matter which it needs for growing and shining from the neutrino field. The earth and other planets imitate the sun.
The concept is simple and convincing. The source of energy lies in the air and mustn't be dragged about in tanks. Collected and materialized is just as much, as is needed at the moment. In that way the resource energy is spared. In addition there can be done without any sort of storing. In addition it can show a substantially higher power density, than all today known and used energy carriers (fig. 14.4).
Such a source of energy solves all described energy problems at once. Nature wouldn't be as we know it, if it wouldn't have this ideal energy, also called „free energy". The balance sheet of energy alone brings it to light, because as a rule it doesn't work out for biological systems. Often more energy is released than is taken up by the food.
In that case some migratory birds materially seen should have completely used themselves up before reaching their destination, if the energy necessary for the flight would be of purely material nature. From a concrete example the following is reported[<i>]: „migratory birds have - depending on kind - a maximum range velocity between 24 and 83 km/h and at their Atlantic flights no opportunity for an intermediate landing. They are thousands of kilometres on the way and hardly lose weight. For instance an Albatross with a body length of up to 1.20 meters and a wing span of up to 3.50 meters uses per kilometre only 8.5 grams of weight at a non-stop flight. How is that possible without additional supply of energy?"

<i>: K. E. Rathgeb: Wie man die freie Energie anzapft: Vogel machen es uns vor, Raum & Zeit 79/96, S. 74

Fig. 14.6: Freiherr von Reichenbach (76 years old)

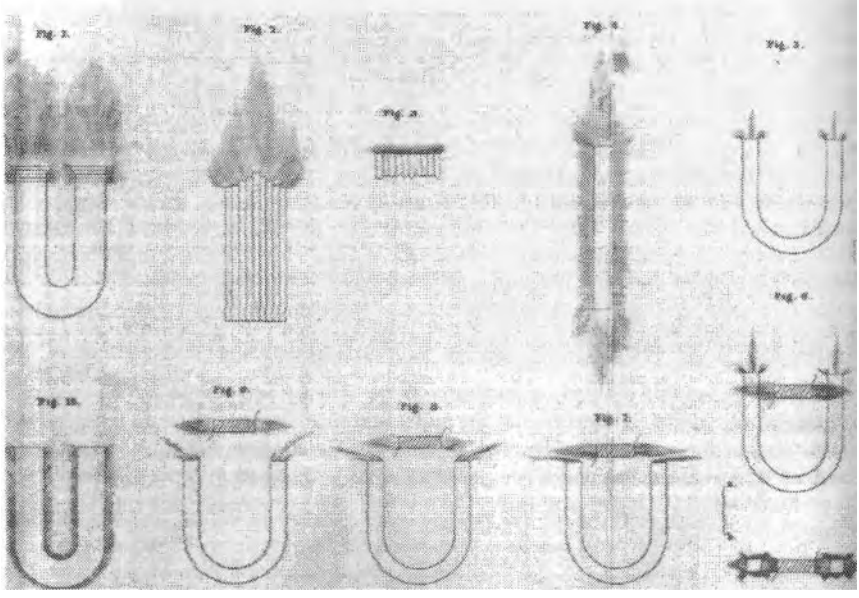

Fig. 14.7: Odic emanations of magnets according to pictures of
sensitives .[i]

[i]: H.-P. Thietz: Tatort Erde, VAP (1996), ISBN 3-922367-62-3, Seite 13 und 15

14.6 The gap in the energy balance of man

Even man appears to tap an additional source of energy, because for reason of scientific tests with recruits these over longer periods of time are able to physically release more than twice the amount of energy they take of calories with the food. Obviously living beings don't rely on one source of energy alone. Possibly the taking up of food predominantly serves the metabolism, and the energy aspect plays only a secondary role.
This interpretation at least would be obvious, since we scoff several times a day, sort the necessary and useful building-materials out and hand over the rest to the purifying plant and nature, where some bacteria and organisms search the sorted out again for useful things. "Food chain" we call this kind of building-material trade.
If the whole had anything to do with energy or with a „ combustion process without fire ", then no animal nor any human being could do without the taking up of food for longer periods of time. But Franciscus of Assisi could fast 90 days, as is handed down to us [ii]. There exist numerous examples, which reach into the time of today.

The mitochondria, the energy centres of each cell, by no means are capable of the "combustion process", which man ascribes to them. Here in all probability a taking up of space energy independent of food takes place.

A research scientist only has to look at nature with open eyes, what unfortunately happens rarer and rarer, because the laboratory scientist always is troubled, to keep the disturbing factor „nature " away from the experiments.

14.7 Carl Freiherr von Reichenbach

In this context no-one can go past two natural scientists: Carl Freiherr von Reichenbach (1780-1869) and Dr. Wilhelm Reich (1897-1957).

Reichenbach called the by him investigated life energy „ Od-energy " in the style of the Teutonic God Odin. He worked with test persons, who could perceive actually invisible light phenomena and worked out the special properties of this Od-energy field with the "sensitives", as he called them.

A quotation from his work shows however that the knowledge about the life energy must be a lot older[iii] than his own discoveries: „On paintings saints often are shown with a ring-like aureole around their head, something I before this would have dismissed as a pure figment of imagination. But it was shown that this glowing ring actually can be perceived by the sensitives as an Od-phenomenon and so the aureole obviously can be traced back to real impressions of particularly sensitive persons."

Reichenbach also found out that water has a big endeavour to take up this Od-energy or in the language of the present day, to absorb the field energy. This circumstance we find confirmed in technology, since water absorbs high-frequency waves, whereas an insulator or a vacuum lets them pass through. But without vortex physics it however remains entirely unclarified, why!

<ii>: H.-P. Thietz: Tatort Erde, VAP (1996), ISBN 3-922367-62-3, page 110
<iii>: H.-P. Thietz: Tatort Erde, VAP (1996), ISBN 3-922367-62-3, page 16

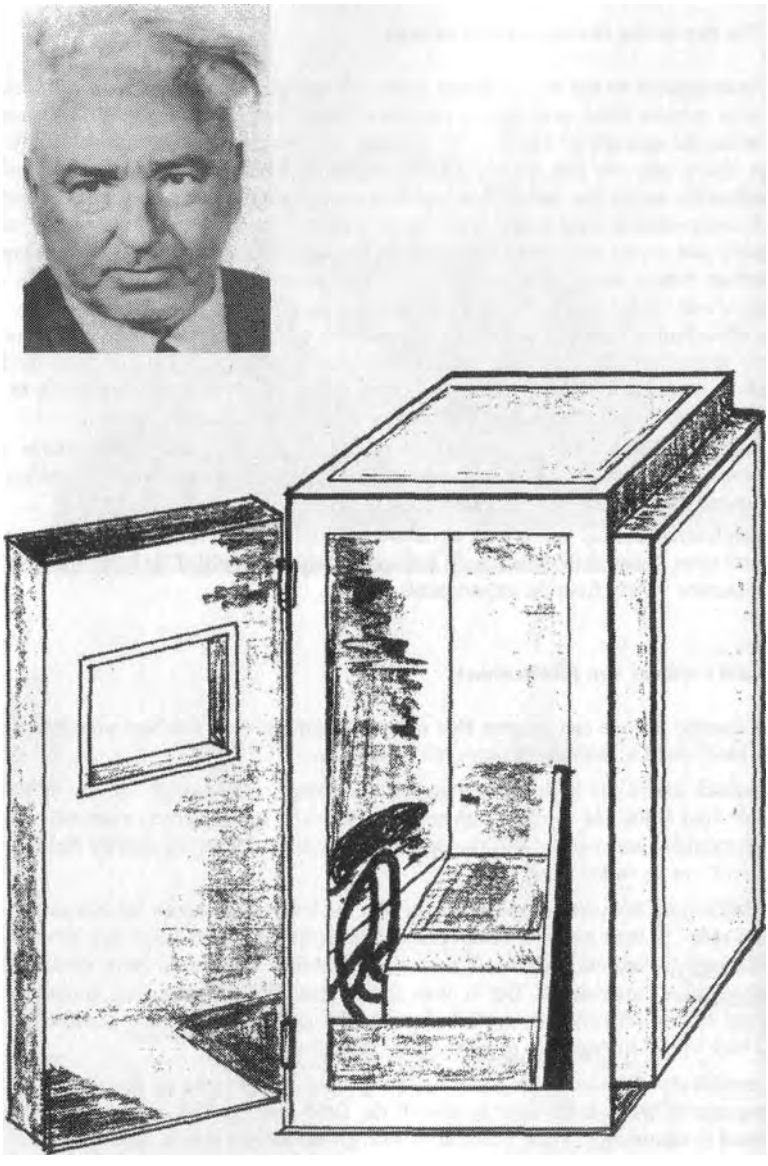

Fig. 14.8: Wilhelm Reich and the model of an Orgon accumulator
for applications of the whole body.[i]

<i>: taken from: H.-P. Thietz: Tatort Erde, VAP (1996), ISBN 3-922367-62-3, pages 38 and 89.

14.8 Cold fusion and Genesis

Chronologically the doctor and psychologist Wilhelm Reich followed in the footprints of Reichenbach. He merely altered the name for Od and spoke of Orgon. His speciality was the accumulation of Orgon radiation, I would say the focussing of neutrino radiation. Actually the properties like e.g. the missing possibility to shield Od, Orgon and the neutrinos are identical, so that we can proceed from assumption, that it also concerns the same physically.

We already talked about Wilhelm Reich (part 1, chapter 9.2). He could show that the measurable temperature in a closed box, constructed like an „Orgon accumulator", is increased in a mysterious manner without supply of energy from the outside. He even could prove, that this energy actually concerns the sought-for life energy, as he observed the creation of life in the laboratory under the microscope. For that he cooked muscle fibres, vegetables or other cells so long until the cell structure had been destroyed entirely. But from the educts entirely by itself new living beings, like protozoa or algae, were formed[i].

Reich at his microscope actually followed the transition of dead to living matter. What is of interest here, at first only is the energy technical aspect of this conversion. Later we will occupy us with the at the same time occurring information technical aspect.

Worth mentioning seems to me the experiment with the „silly" chickens, which have at their disposal astonishing abilities besides the laying of eggs[ii].

The test chickens were handed chicken food, from which to a large extent all calcium had been extracted. But the chickens showed themselves unimpressed and further laid keenly their eggs. The experimenters were surprised, where the chickens actually got the lime for the egg shells. How solves such a chicken the problem of raw materials? For that further materials were extracted from the food and look, at the removing of silicon the laying of eggs was over. The experiment actually only allows the conclusion, that the "stupid" chicken is capable of a cold fusion, that it itself „produces" the necessary calcium from silicon presumably by using carbon. Every alchemist here has to go pale with envy. But what says the research scientist of fusion to that, who actually should know, how fusion functions? After all he is paid for it by the tax payer! The chicken uses the fusion already today and the other living beings presumably also, but for that energy is needed and the balance sheet should work out!

The neutrino radiation therefore has to be factored into the balance sheet of energy. If the balance sheet then works out, it could be proven with that, that here neutrino energy is put to use. In addition the process of the conversion of neutrinos has to be investigated, which surely has something to do with the frequency and the wavelength of the radiation. After all a child has cells exactly as big as an adult. It only has less cells! So that an interaction can occur, the cell size has to fit in with the wavelength, which obviously is very small, presumably in the range of the radioactive radiation, with which circumstance the biological incompatibility with this electromagnetic wave would be explicable.

<i>: H.-P. Thietz: Tatort Erde, VAP (1996), ISBN 3-922367-62-3, S. 39

<ii>: Louis Kervran: Biological Transmutations, s.a. J. Heinzerling: Energie, S.278

1. Primary reaction
   (light reaction in the centre of reaction):

   ring-like vortices/neutrinos are being collected
   electrons are formed
   energy is produced
   e^- is attracted by the water dipole
   water molecule is being splitted (photolysis):

2. Secondary reaction (dark reaction):

   carbon dioxide is reduced with the hydrogen splitted off from the water to carbohydrate

Reaction equation of photosynthesis:

	6 mol CO_2	(carbon dioxide)
+	12 mol H_2O	(water)
+	675 Kcal	(vortex energy, light)
	1 mol $C_6H_{12}O_6$	(glucose)
+	6 mol O_2	(oxygen)
+	6 mol H_2O	(water)

Fig. 14.9: Concerning photosynthesis

14.9 Photosynthesis

The materialization of free electrons is a prerequisite to start the photosynthesis. The normally used explanation, the free electron necessary for the splitting of the water molecule was knocked out an atom by light, doesn't seem to be correct, after until now all attempts of a technical realization according to this model concept have failed. At the photosynthesis the plants obviously help themselves with the neutrino radiation, which according to an estimation of today with 66 billion particles per second and per square centimetre might be more than sufficient for a green earth.

If we put a seed in a water glass, then a plant grows from it and forms small leaves, which get bigger and bigger. A wonder of nature, we say. Where does it actually get its building-materials? From the water or from the air? Necessarily the plant obviously produces a part of the matter itself!

Experts think they have understood the process of photosynthesis: Take light and water and carbon dioxide and handicraft from that sugar and oxygen. But from where does the plant take the necessary energy for the rebuilding and the splitting of the water molecule, the photolyse? The taken up solar energy hardly is sufficient for that, especially since the plants only absorb about 1% of the photosynthetic utilizable sunlight incident on earth[<i>]. By means of reception molecules, which look like small antennas, pigments less than 30 nm in diameter, such is the level of knowledge, the sunlight is collected and led into a photochemical centre of reaction. Here the reaction should take place, provided that an electron set free by the light jumps into the middle of the centre of reaction. But exactly this favour the electron doesn't make the research scientists, who want to imitate the process. Copying nature still doesn't succeed.

The mistake presumably lies in the circumstance that the light doesn't set free any electron at all. The electron actually first of all is produced in the centre of reaction. By means of the antennas a neutrino vortex is collected, which at first occupies the entire space, to afterwards contract to an electron, which as a result automatically is centred in the centre of reaction.
In the process of materialization at the same time the necessary energy of the process is formed. The reaction equation after all also has to work out energetically, because the plants doing so get neither hot nor cold (fig. 14.9).
Because curiously the light reaction even can be observed in the dark[<ii>], one could be inclined to in principle call into question the influence of light on the photosynthesis. But such an influence nevertheless seems to be present, after all does a plant react on the irradiation of light and changes its spectrum of absorption through its colour. But it for sure is another influence and not the one, which one attributes the green plants today! It would be important to finally understand the way of functioning. The plants and particularly the algae are the ones, which actually first have made possible life on this planet with the photosynthesis, the most original form of a production of matter and energy.

<i>: Luttge, U. u.a.: Botanik, VCH, Weinheim (1994) ISBN 3-527-30031-7, S. 136
<ii>: Luttge, U. u.a.: Botanik, VCH, Weinheim (1994) ISBN 3-527-30031-7, S. 126

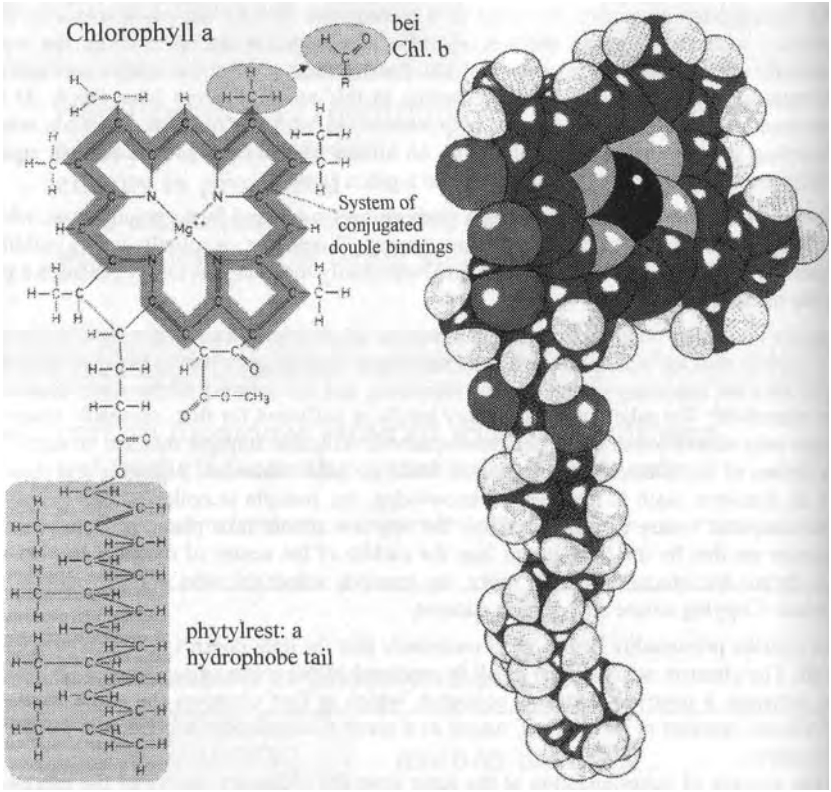

Fig. 14.10: Formula of structure and spatial model of the photosynthesis pigment chlorophyll.[<i>]

<i>: Luttge, U.et al.: Botanik, VCH, Weinheim (1994) ISBN 3-527-30031-7, p. 118

14.10 How nature materializes

The structure of the receiver antenna allows us a deeper insight into the manner, how free energy is tapped during the photosynthesis. For the dimensions determining the frequency of the photosynthesis pigments, as the antennas are called, we have to go down to the molecular structure. Fig. 14.10 shows the formula of structure and next to it also the spatial model of the pigment chlorophyll[<i>].

Two points point at the function for free energy conversion. On the one hand is situated in the centre of the molecule a double positive ionised Mg atom, surrounded by four nitrogen atoms and a carbon ring consisting of 20 atoms, from which arises a polarization of the entire molecule. This in addition is oscillating because the electron cloud of the enveloping electrons, which hold the molecule together, perform swirl oscillations depending on the temperature. With that chlorophyll is able to go into resonance with oscillating neutrinos.
A role play the unipolar field configuration and the effect of resonance of the molecular oscillation of its own forming as a result of the polarization. A further role in addition seems to play the spatial structure.

The model of the ,.receiver antenna" chlorophyll taken out of a textbook[<i>] and shown in fig. 14.10, consists of a stalk and a spirally wound head, which resembles a Lituus or crook, which Etruscan and Roman Augurs have taken in the hands for land surveying, a precursor of the crosier (see fig. 16.10). This again has the form of a Tesla coil and that, as already derived, is able to withdraw rotational energy from the collected neutrinos (chapter 9.8). Doing so free electrons are materialized, and these then start the process of photosynthesis. An explanation concerning the way of functioning of the antenna pigments here for the first time is getting available.
By the way also the mitochondria, which form the energy centres in every cell, have as well the form of a Tesla coil. Whoever wants to understand the energy economy of a cell or the photosynthesis first should occupy himself with the Tesla coil (chapter 9.8).

The open question, how land surveying should be possible with a Tesla coil, we at first still have to shelve, because in this chapter it concerns the way towards free energy and the chance to learn of nature. Examples to be looked at are on the one hand the core of fusion in the inside of the earth and on the other hand the humus layer on the surface of the earth, which has been materialized in the course of time with the help of photo-synthesis.

The goal seems to be worth striving for. If we in the first place have learned to produce energy exactly like nature, then we'll further try to produce matter purposeful, with which ageold alchemist dreams could be fulfilled. We wouldn't need to scrape and to search in some mines any longer. We would materialize the products without refuse, naturally and just for the environment, direct in the final form. I admit that at present it sounds pretty futuristic.

With another example, the lightning and particularly the ball-lightning, the collection concerning the use of free energy in nature shall be completed.

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i>: U. Luttge, M. Kluge, G. Bauer: Botanik, 2. Aufl.- Weinheim, VCH (1994) ISBN 3-527-30031-7, S. 118

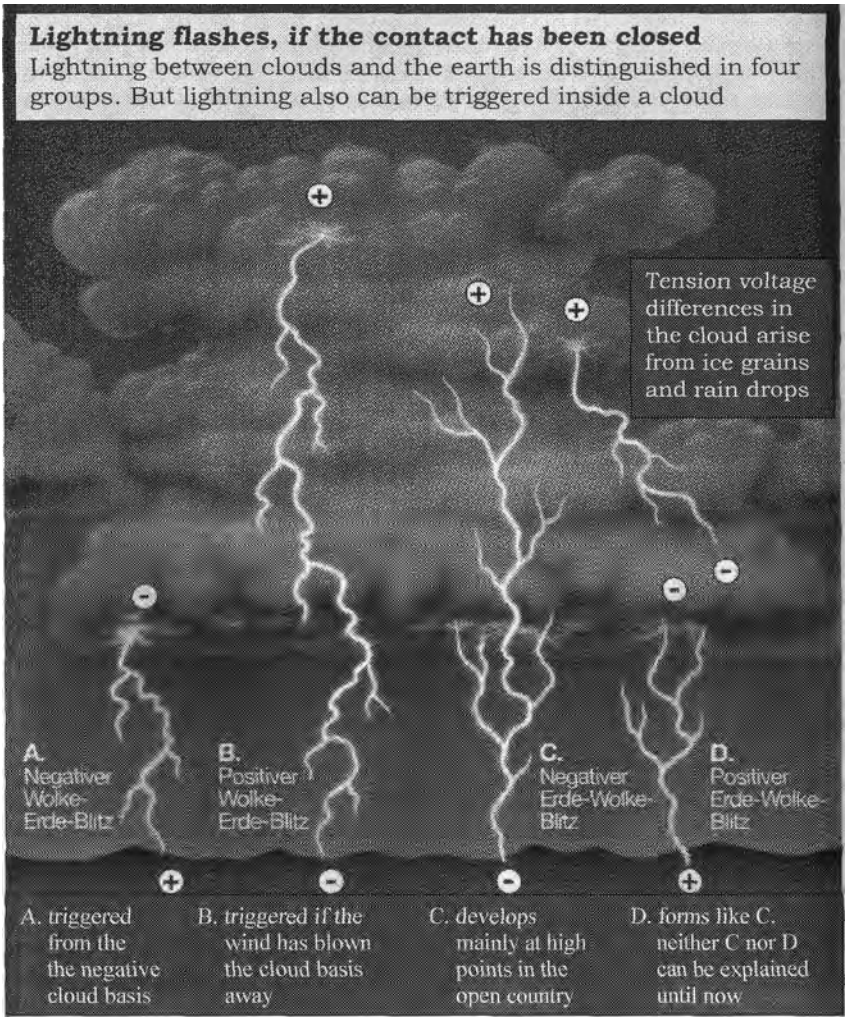

Fig. 14.11: Concerning lightning.<i>

<i>: taken out of: Illustrierte Wissenschaft Nr. 8, August 1995, Das unverstandene Phanomen der Blitze, S. 13

14.11 Lightning

Lightning is a spectacle of nature just as imposing as unsolved. It concerns an electric process of discharge, in which to the amazement of all experts arrive for several powers of ten more charge carriers at the surface of the earth, than hefore were contained in the cloud! Furthermore unsolved is, why lightning glows. Let us start with the open question for the difference of potential necessary so that the air is ionised and a lightning channel is formed.

If at first the electric tension voltage of 200,000 volts between the surface of the earth and a height of 10 kilometres is available, which according to our calculations results from the rotation of the earth and the magnetism of the earth (fig. 11.8). Another source of tension voltage is not known. By air movement and supposed processes inside a cloud locally an additional accumulation of charge carriers may occur, so that in the case of a thunderstorm the by Tesla assumed, twice as big value doesn't seem unrealistic[<i>].
On the other hand a tension voltage between 4,000 and 10,000 volts is necessary so that a blow can occur for an air gap of one centimetre depending on the atmospheric humidity[<ii>]. Linearly projected the thunderstorm cloud theoretically should hover just one meter above the earth if there is lightning.
Here somehow a huge gap gapes between theory and practice!

At the latest at the spikes, the mysterious lightning, which strike out of a thunderstorm cloud upwards in the direction of the ionosphere and the still more mysterious ball-lightning it has to get clear, that the actual source of tension voltage of a lightning by no means is known. Without knowledge about the cause we'll never understand lightning.

The potential vortex theory offers an useful approach, according to which the necessary difference of potential is formed from a formation of vortices[<iii>]. The vortex again, as damping term in the wave equation, occurs as a result of intense sun irradiation. That explains why lightning always strike from the part of a cloud, which is the darkest, where the most sunlight is absorbed and the damping is the largest.

The possible formation of ice in a lightning channel is a further confirmation for the correctness of the vortex explanation. After all it has been derived that contracting potential vortices withdraw heat in principle (fig. 12.8).

But now we also want to know from this efficient theory, why photons and electrons are formed during the lightning and where they come from. Here obviously energy is formed by means of materializing of vortex particles.

<i>: R. L. Clark: Tesla Scalar Wave Systems, The Earth as a Capacitor, The Fantastic Inventions of Nikola Tesla, ISBN 0-932813-19-4, S. 265

<ii>: Karl Kupfmuller: Einfuhrung in die theoretische Elektrotechnik, Springer-Verlag Berlin, 12. Auflage 1988, ISBN 3-540-18403-1, S. 221

<iii>: K. Meyl: Potential vortices, Part 1: Discussion contributions to the natural scientific interpretation and concerning the physical-technical usage, basing on a mathematical calculation of newly discovered hydrotic vortices, (only in german) INDEL GmbH, Verlagsabteilung, Villingen-Schwenningen 1990.

Fig. 14.12: Contemporary representation, how 1753 lightning
research scientist Prof. Richmann is struck deadly by ball-lightning in his laboratory.[i]

<i>: Illustrierte Wissenschaft Nr. 8, August 1995: Das unverstandene Phanomen der Blitze, page 13

I proceed from the assumption that lightning collects and converts neutrinos. The process corresponds to the one at the sun, but on a smaller scale and only for a very short time. The lightning channel is polarized by the charge carriers. Change of temperature and field lead to a spatial oscillation, which by the way also functions as a source of sound, as anyone can hear. Taken both together lightning, seen from the outside, becomes an unipolar resonator, which is capable to attract neutrinos and to go into resonance with them. Now the predominant part is converted into electrons, because also the air molecules and air ions in the lightning channel belong to the world of matter. But it can't be avoided that a small part of antiparticles is formed, which then annihilate with particles of matter under emission of radiation. Doing so photons are emitted and lightning glows, as anyone can see!

14.12 Ball-lightning

If in the case of lightning there still exist excuses, the difference of potential preferably is traced back to neither understandable nor measurable processes inside a cloud, then at the latest in the case of ball-lightning most experts are at their wits end. Only for very simple natures explanations circulate in the direction that here for instance the organic remnants of a bird struck by lightning are burnt off.

Actually ball-lightning is observed very seldom. It is a ball flashing with reddish till blue-white colour. Its diameter lies between 10 and 50 centimetres. The glowing phenomenon can last several seconds to minutes. Doing so ball-lightning rolls over a street, temporary floats in the air, goes apparently unhindered through every wall and disappears from time to time without a trace or discharges with loud moise and formation of sparks. Some stink of poisonous gases and some also cause noise.

Famous has gotten the ball-lightning, which 1753 of all people should have struck the lightning research scientist Professor Georg Wilhelm Richmann in St. Petersburg. In his laboratory during a thunderstorm a ball of fire as big as a fist should have jumped from a iron tube to his head and should have hunted him down, so eye witnesses have reported (fig. 14.12).

Since ball-lightning has a closed structure, it has to drag about its source of energy with it. If this however consists of organic or other matter, the ball wouldn't be able to float, after all the brightness of a spherical vortex and with that the need of energy is enormous! We have to proceed from the assumption that just ball-lightning covers its need of energy from free energy and serves itself from the neutrino field.

The spherical form is a consequence of the structure shaping property of the potential vortex<ii>. Scientists are increasingly interested in this not understood phenomenon. In their experiments they try to artificially produce ball-lightning with more or less great success in the laboratory. By means of the experiment they then want to learn to understand, what the textbooks don't give away.

If we want to learn of nature something about free energy, lightning in the laboratory offers us in the form of a blow or of a spark gap relatively good possibilities. It surely is no coincidence that the father of free energy, Nikola Tesla, in his experiments almost all the time has worked with spark gaps!

<ii>: for that see in the 1st part the chapters 4.8 till 4.10

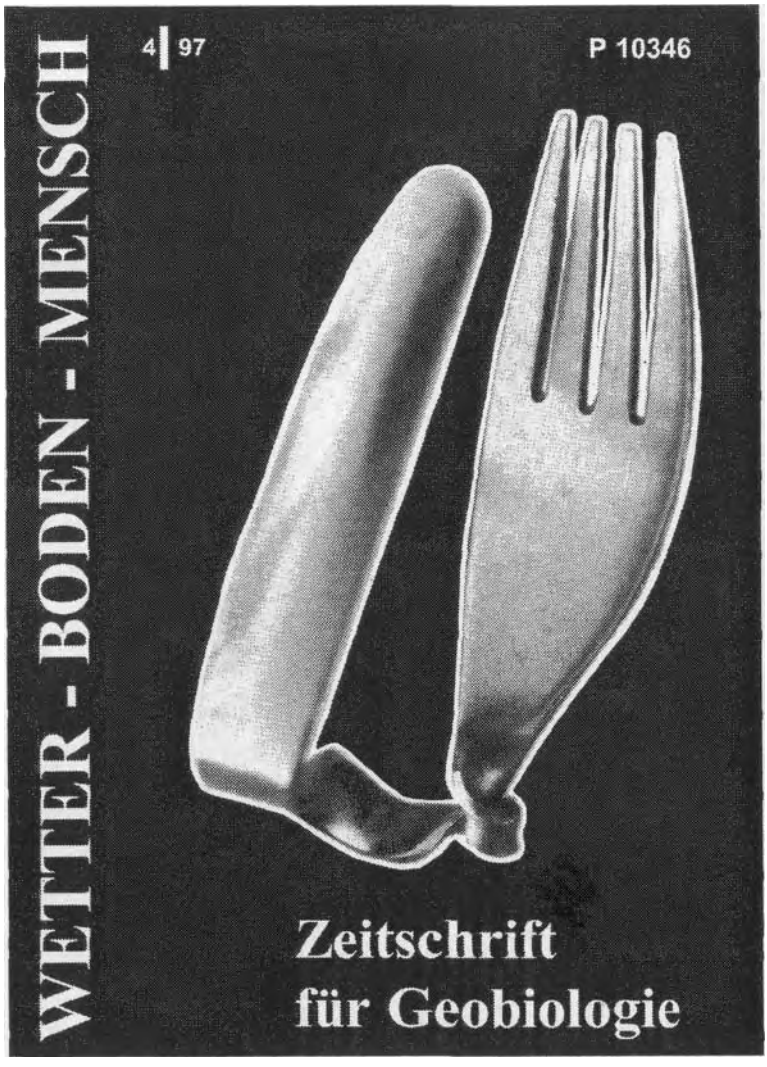

Fig. 14.13: Fork bent by „pure manual work".<i>

<i>: Whoever has to eat with bent flatware in the Hotel Adler in Waldkatzenbach (Odenwald, Germany), mustn't believe that the food didn't taste well to some rude fellow here. It is the host himself, who in a sociable round shows his guests from time to time that he not only can cook well. I could personally convince myself from the fact that Robert Hartmann doesn't use any aids. The picture shows the title page of the magazine „Wetter Boden Mensch" 4/97. A comment concerning this on page 3: Robert's 50ieth birthday.

14.13 Discussion concerning the neutrino conversion

In nature two different principles for the use of the neutrino radiation can be observed. In one case of use a glowing phenomenon occurs, in the other cases not.

The glowing lightning should be assigned to the first case. Here not only the neutrinos crossing the lightning channel are used, but also neutrinos from the environment oscillating in resonance are collected. Around the lightning channel a kind of reaction radius is formed, inside of which all synchronously oscillating neutrinos are attracted under the resonant interaction. During the discharge process the radius can increase like an avalanche, to collapse again with the transition into the stationary discharge current. A corresponding technical concept, which is discussed in the next chapter (15.5), is very efficient, but almost uncontrollable. A characteristic is the formation of antiparticles, of positrons, in the course of the materialization, which then annihilate under emission of radiation and cause a shining. Also spark gaps and fluorescent lamps possibly help themselves from the neutrino field, as still has to be to worked out.

In the second case nature works without any avalanche effect and without any glowing phenomenon. To this counts for instance the photosynthesis or the mode of operation of the mitochondria, the energy centres of a cell. All cells, whether vegetable, animal or human, only use the neutrinos which just that moment pass by them and only in those amounts, as they just are needed. They thus handle their energy very caring. Without exception electrons are materialized and no positrons.
If nevertheless unwantedly an avalanche effect occurs, something which happens fortunately only very seldom, then a self-inflammation and self-burning occurs, then it should happen, that a person burns off himself<ii>. This risk also is known of hay.

There also exist rare talented persons, who can control and regulate the process of materialization by concentration. These people can bend spoons or other metallic objects<i>. For that they concentrate themselves some time and send the materialized charge carriers into the object, which they hold in their hands. Since the metal lattice solely is kept together by the enveloping electrons of the individual atoms, the additional electrons make the metal structure sodden. Now for a short moment the metal can be bent and distorted at will. Doing so neither heat is produced nor is the colour changed. The result of the process can be produced neither by cold working with raw force nor under a flue. Also here nature shows us a technology for an ecologically compatible metal processing (fig. 14.13).

The way from the conventional over the regenerative towards free energy is predrawn. It only has to be gone! After the existence of the neutrino radiation goes as proven and 1998 for the first time concrete amounts have been determined measuring technical and published by a Japanese team of research scientists, with that also the question for an energy technical use of the particle radiation has been answered clearly. Now only the question of the mechanics is open. The Japanese research scientists by the way have found out that at night only half as much solar neutrinos can be detected than at daytime. The other half according to that is absorbed in the inside of the earth. This in the meantime published measurement result in brilliant manner confirms the working hypothesis of a growing globe (chapter 11).

<ii>: Zu Asche pulverisiert, Illustrierte Wissenschaft 6/ 1997, S. 61 acc. to an examination of the American SCI-COP in 1984.

cause/ field lines	interaction	F = force effect *mediation:*	see chapter: effect/ *application*
1. open **H**-field lines	magnetic (static)	F_{M0} = magnetic force (permanent magnet)	chapter 15.4 *E.-engine, solenoid*
2. open **H**-field lines	resonant (oscillating)	F_{MS} = magnetic force (AC-magnet)	15.4 + 15.5 - 15.7 lightning, *railgun*
3. open **E**-field lines	electric (static)	F_{E0} = Coulomb force *by charge carriers*	15.9 + 15.10 atomic bond, *Testatika*
4. open **E**-field lines	resonant (oscillating)	F_{ES} = Coulomb force *by neutrinos*	chapter 16 + 17 weak interact. galaxy bond *Tesla converter*
5. closed **H**-field lines	gravitation (static)	F_{MG} = gravity *by particles with mass*	chapter 6.9 + 7 elementary particle mass
6. closed **H**-field lines	levitation (dynamic)	F_{ML} = reduced gravity	chapter 18.3 gravit. waves *Casimir effect*
7. closed **E**-field lines	gravitation (static)	F_{EG} (force hardly detectable)	chapter 18.7 *superconducting ring*
8. closed **E**-field lines	levitation (dynamic)	F_{EL} (no longer detectable)	18.5 + 18.6 *Keely-/Searl-flying devices*

electromagnetic and resonant interaction		gravitation and levitation
$F_{M0} = 1{,}4 \cdot F_{MS} > F_{E0} = 1{,}4 \cdot F_{ES}$	$\gg$	$F_{MG} = 1{,}4 \cdot F_{ML} > F_{EG} = 1{,}4 \cdot F_{EL}$
for reason of open field lines		resp. closed field lines

Table 15.1: The force effect of interactions, ordered according to size, with examples

15. Principle of functioning of space energy

In this chapter we want to turn us towards the technical concepts and techniques concerning "space energy", which occasionally here and there already should have existed or have been operated with quite different success. After Nikola Tesla having pointed the direction more than 100 years ago, the way towards free energy appears to be predrawn. Never before the public interest in the topic of space energy was as big as today. Unfortunately this concerns more the collecting and gathering of rumours and speculations. As in every branch of science also here hunters and collectors can be found. But obviously the hunters, the inventors and theorists have bigger problems, to put something useful on the table. They are fighting against their own not knowing, unuseful textbooks, general ignorance, intolerance and an all-powerful energy lobby. What the collectors on the other hand come up with does make appetite but not full.

An useful and efficient theory might be the most important prerequisite just with regard to the reproducibility of an effect and the product liability of a SET-device. That's why one mustn't expect a complete list of devices of that kind in this chapter, because in the foreground stand the physical and technical explanations concerning the way of functioning, the understanding for constructive and guiding details and the learning from the mistakes and errors of the inventor.
For a better survey the possible courses of the field lines according to the theory of objectivity are listed in detail (table 15.1) and discussed from the top one after another, starting with the strongest known interaction. To complete examples and concepts are presented.

As is well-known there exist electric (E-) and magnetic (H-) field lines. Further exist open and closed field lines and finally is distinguished between the oscillating and the static case. The results are two to the third power, thus eight possibilities of combination in total. In table 15.1 all eight versions are given, even if one or another case is of more theoretical nature. For the objective of a systematizing of different concepts concerning space energy technology the taking apart in any case is helpful. The figure opposite is survey and structure at the same time for the following chapters.

15.1 The course of the field lines

In chapter 6 a relation between the course of the field of a body and its observable interaction has been made (part 1, chapter 6.7 till 6.9). Here a point of approach is offered. For instance to maximize the force effect a magnet or to optimise an electric motor, the engineers nowadays help themselves with costly programs working according to the method of finite elements. In this way they obtain a picture of the field lines, the course of which makes possible conclusions concerning the production of force or torque. The relation without doubt is given, the only question is in which order of magnitude.

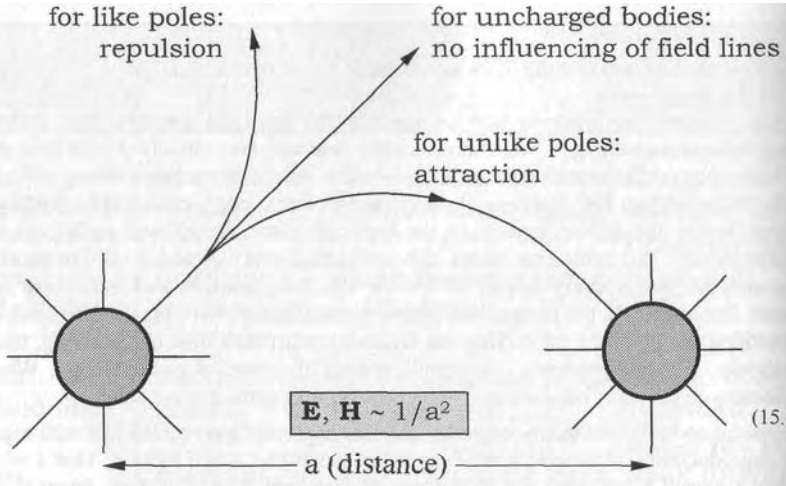

(15.1)

Fig. 15.2 A: The course of the field lines leads to a force effect (repulsion or attraction)

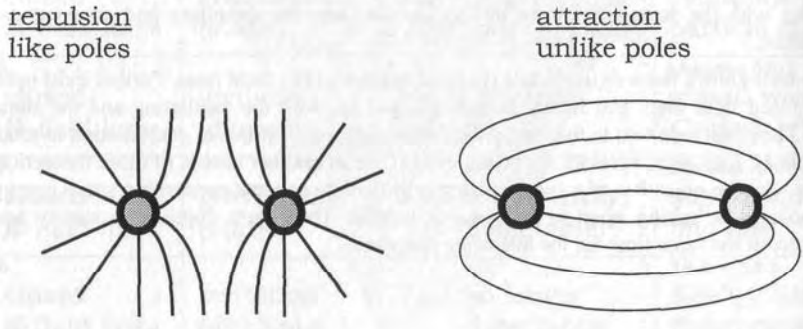

Fig. 15.2 B: The course of open field lines

$$\frac{F_{\text{Coulomb force}}}{F_{\text{magnetic force}}} = \frac{Q \cdot E}{\phi \cdot H} = \frac{\mu \cdot Q^2}{\varepsilon \cdot \phi^2} \quad \text{with} \quad E = Q/\varepsilon \cdot A \quad \text{and} \quad H = \phi/\mu \cdot A \quad \text{where} \quad \phi^2 = m^2 \cdot G \cdot 4\pi \cdot \mu \quad \text{(Gl.13.20)} \tag{15.2}$$

i.e. e^-:

$$\frac{F_{el}}{F_{magn}} = \frac{e^2}{\varepsilon \cdot m_e^2 \cdot G \cdot 4 \cdot \pi} = \underline{4{,}2 \cdot 10^{42}} \tag{15.3}$$

Fig. 15.2 C: The proportion of forces at the example of the electron.

The theory of objectivity answers the question from the equations of transformation with the proportion 13.23 (fig. 13.4). According to that the electric or the magnetic field strength stand in inverse proportion to the square of a length or of a distance:

$$E, H \sim 1/a^2 \qquad (13.23) \text{ bzw. } (15.1)$$

Less mathematically expressed this, for two bodies in the distance a, where one body is situated in the field of the other, means nothing else as that the distance is reduced. Nearer to the body the density of the field lines again increases, in that way the distance further decreases and we observe an approximation.
Usually the idea of force is introduced as a factor of description and there is spoken of a force of attraction. But that not necessarily is required, because the force only represents an auxiliary description. The cause for the observed attraction rather is the spatial distribution of the field strength.
In this case the two bodies come closer and the mutually active fields get bigger and bigger, until the parts eventually run into each other (fig. 6.7 A). There one comes the thought to increase the force of attraction by an artificial compression of the field lines. In the case of the electromagnetic interaction such a compression actually takes place, since the field lines arise from one pole and end at an unlikely charged pole, which so to speak collects and bundles up the field lines (fig. 6.8 A).
At last we find out the reason, why electromagnetic forces of attraction are bigger than gravitational forces for many powers of ten (between 10^{30} and $4.2\text{-}10^{42}$ for the electron, derivation see fig. 15.2 C)! For table 15.1 this means, at the top have to stand the open field lines, which bundle up at the poles. Then very long nothing comes and after that the effects of closed field lines are being found.

For open field lines however also the opposite of a bundling up is possible. In the case of like poles the fields run away of the other pole (fig. 6.8 B). Between both a space is formed, which is free of field lines, where thus the field tends towards zero, whereas the distance between the poles according to the proportion 15.1 grows towards infinity. In this case we observe, how the bodies are going away from each other. We speak of a force of repulsion, which actually reaches until infinity. This gives reasons for the occurring of both forces of attraction and forces of repulsion in the case of the electromagnetic interaction.

15.2 Gravitation

In the case of closed field lines in principle no repulsion can occur, since no pole, neither north pole nor south pole, neither positive pole nor negative pole is able to influence the position of such a field line. This circumstance as well as the order of magnitude of a possible force of attraction suggest, to settle gravitation here.

It gladly is forgotten, that the field pointers of E- and H-field normally occur together and like in the case of the electromagnetic wave stand perpendicular to each other. It is normal to calculate only the electric field pointers for a charge carrier, without paying attention to the circumstance that the H-field is present as well. The textbooks as a rule remain silent about this dark chapter or they lapidary remark, the dual field lines are closed in themselves and hence inactive anyhow, which however is incorrect.

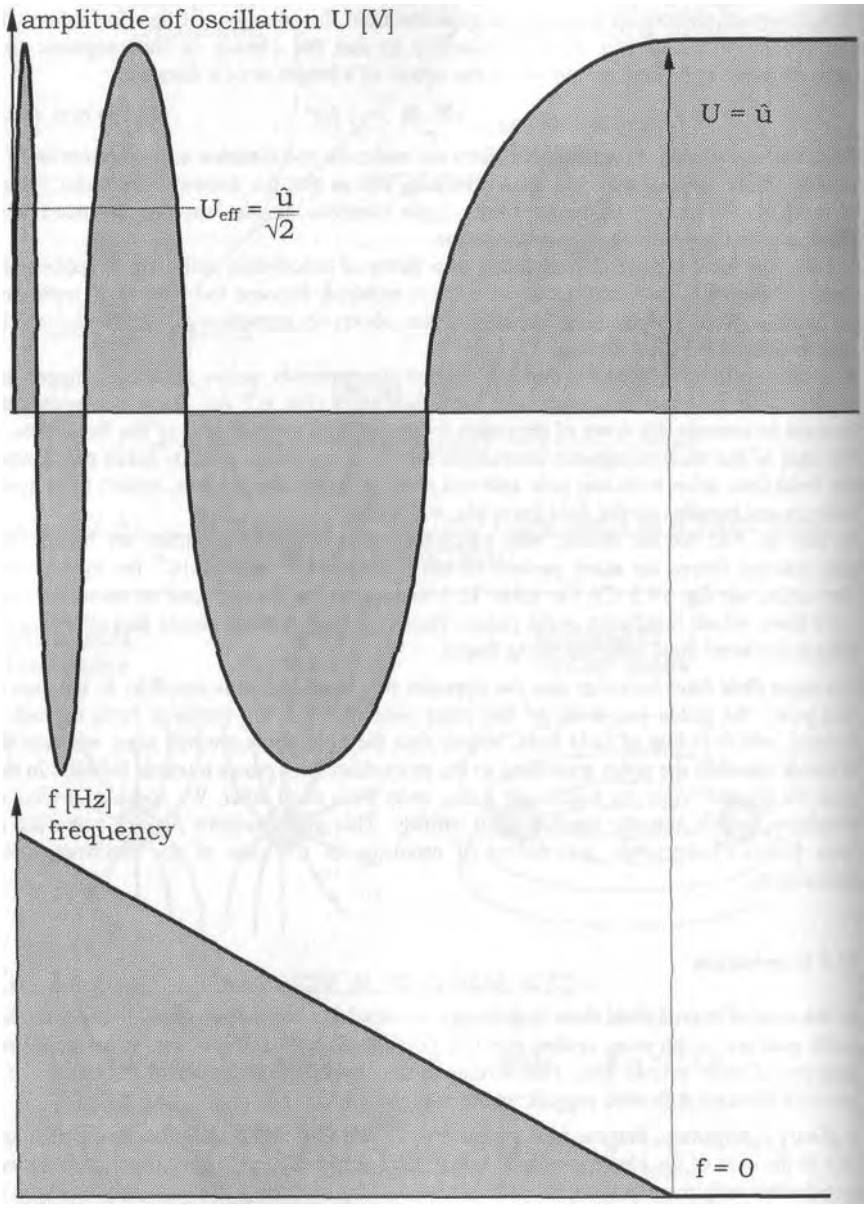

Fig. 15.3: The transition of an oscillating into a static interaction

But, according to the proportion 15.1, they actually develop a force of attraction, even if this is relatively small. No one really needs to be surprised that gravitation is not understood until today, if a whole group of fields simply is overlooked by science! We now also can explain, why there don't exist any massless charge carriers. Namely only the E-field or the H-field can form open field lines and never both at the same time. Otherwise they wouldn't be able to stand perpendicular to each other anymore. The each time other field, in the case of electrically charged bodies it is the H-field, then is wrapped perpendicularly around the E-field lines, independent of the circumstance if electrically an attraction or a repulsion occurs and without exception it forms a weak force of attraction, the gravitation.

15.3 Systematizing the interactions

Next we should know, from which field is to be expected a larger force effect: from the E or from the H-field? At the example of an electromechanical converter this question can be answered concretely.

The forces which occur and form the torque in an electric motor customary in trade are produced by magnetic poles in stator and rotor, which repel each other in the case of like charge and attract each other in the case of unlike charge. Now there in principle exists the possibility to build a motor which works with Coulomb forces, thus with positive and negative poles, instead of the magnetic forces. About such designs numerous patent specifications exist, but no customary version on the market.

The reason very simple is that a magnetic motor for the same torque is many times smaller and better priced. From this the conclusion can be drawn that for the same construction volume a magnetic force F_M is considerably larger than a Coulomb force F_E, which for instance binds together atomic nucleus and atomic hull.

Thus in table 15.1 the magnetic forces are ranked before the Coulomb forces.

Finally we have to distinguish between the static and the oscillating case, which are distinguished in the frequency. In fig. 15.3 an oscillation is shown, which by chance just at the moment of the vertex value changes into the steady state, thus takes the frequency zero. In this case the effective values between a static and a sinusoidal oscillating interaction are distinguished by the factor $\sqrt{2}$ = 1.4.

If we operate an universal motor with direct current, then it releases more power, than for a corresponding feeding with alternating current. Even a high-tension line, which stands at maximum 511 kV, is operated with alternating current up to 380 kV, with direct current on the other hand up to 500 kV. Consequently in table 15.1 the static interactions stand before the oscillating interactions.

The strong interaction naturally isn't found in the list, after it has been derived that it doesn't exist at all (see chapter 7.8), whereas the weak interaction is hiding behind the oscillating interaction. It shakes other particles so long till they fall apart (see chapter 7.13).

We now would be as far, to discuss the 8 cases listed in table 15.1 one after another by means of practical examples.

The principle of the side-pole machine

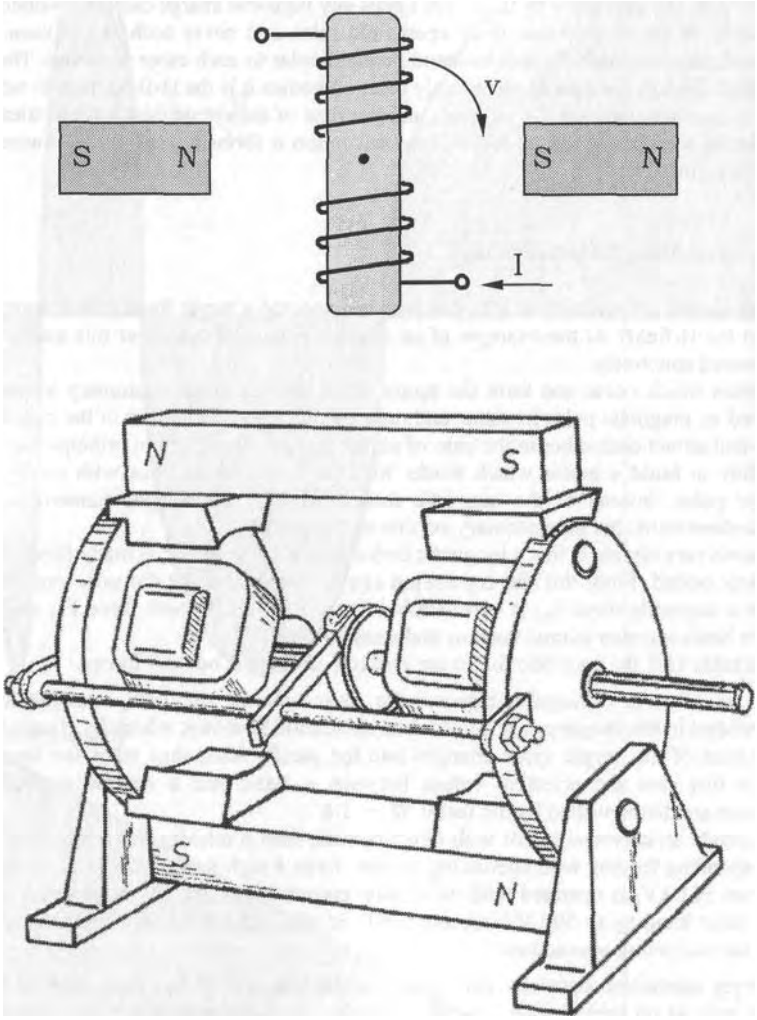

Fig. 15.4: Alternating current dynamo, according to the inventor
(Kromrey) a magnetic converter for free energy with a degree of effectiveness of more than 100 %.<i>

<i>: Raymond Kromreys Molekularstromrichter, NET-Joumal 6/98, S. 5

15.4 Magnetic force converter

As a result of the systematizing of all eight possible interactions, the largest force effects are to be expected as a result of static and of open magnetic field lines. It is questionable, if this statement is generally valid and is true everywhere in space. But it is valid at least for a terrestrial laboratory and only here, on earth, a solution for the energy problem is strived for. No wonder therefore, if the electric energy technology nearly without exception is using these force effects. We find them at a solenoid, at a relay coil, at a magnetic tuning cylinder and equally between the stator field and rotor field of an electric motor.

The motor however takes a special position, because its rotor is turning. In that way a switching of the winding and commutating of the currents is necessary or the field of the stator winding is being turned, for instance in the case of an alternating current motor. This is necessary, so that in the air split of the motor the fields from the stator and rotor always are standing opposite like for the solenoid and a driving force can be formed. For the operation therefore oscillating currents are necessary, so-called alternating currents, which are fed in into the winding with the right frequency and phase. There can be spoken of an operation in resonance. It surely is no coincidence, that Nikola Tesla, the founder of the rotary field theory and inventor of the alternating current motors at the same time is the discoverer of the neutrino radiation!

The electric motor slides already into the second column from the top in table 15.1, as we see, and should be assigned to the case of the oscillating interaction of open magnetic fields. The frequency for motors usually is very small.

But also at high frequencies there can't be reckoned on some free energy which would show or even be utilizable, as can be heard from the inventors who tinker with magnets, mostly with permanent magnets (Fig. 15.4). The reason very simple is that there exist no physical particles, which could mediate this interaction. Magnetic monopoles would be necessary, thus north pole or south pole particles, so that an interaction with the open H-field lines can occur.
Such particles could form as a result of currents and eddy currents, but for that a good conductivity would be necessary and that isn't present in the vacuum. Therefore magnetic monopoles can't exist at all! This point we already had worked out (fig. 4.4, question I). The same statement then also applies to the oscillating case.

If nevertheless something like free energy should show in the case of some magnetic field converters, then unnoticed by the inventor still other physical effects are added. By means of concrete concepts this circumstance can be studied and discussed. The meanwhile well-known railgun is a corresponding example, for which besides the used magnetic force unintentionally a further principle is used. A more detailed occupation with this device is worthwhile, because here some fundamental concepts of space energy get clear.

A: Shining railgun in action<i>

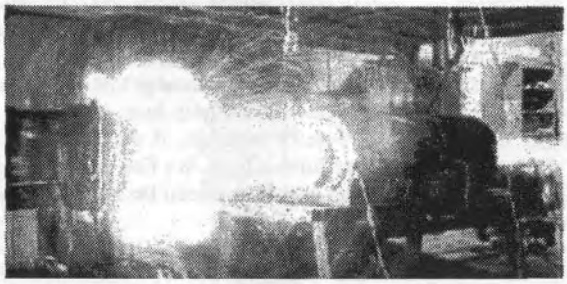

B: Structure<i>

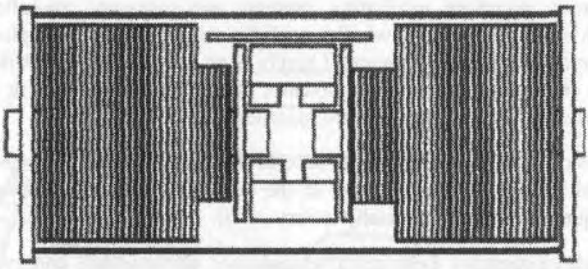

C: Concerning the way of functioning of the railgun

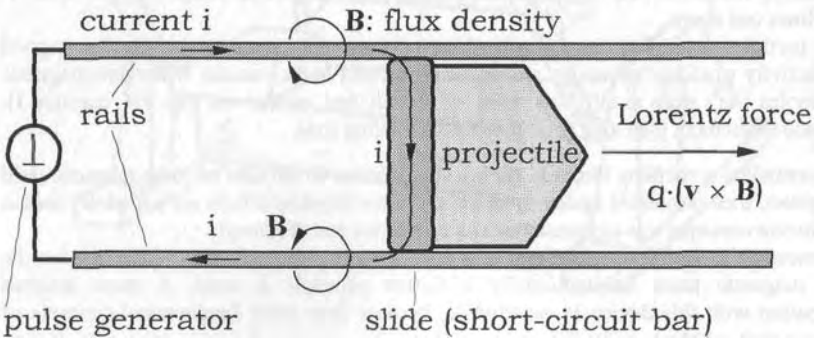

Fig. 15.5: Structure and way of functioning of the railgun

<i>: in the internet under: www.glubco.com/weaponry/railgun.htm

15.5 The railgun

The engineers and physicists involved in the SDI-project were quite astonished, as they had a close look at the bent rails of their gun. During the test operation the equipment was really flying around their heads.
They were very sure to only have fed in 16.7 MJ of energy, from the rotation of a homopolar generator, because more was not available for the experiment by any means. The projectile with mass m_0 = 0.317 kg lying on the rails thereby should have been accelerated to the velocity of 4200 m/s. Instead huge forces were at work here, which the construction couldn't counteract at all. There is talk about the released energy having amounted to 399 GJ, what corresponds to an over-unity effect of 24000[ii]. This factor describes the proportion of the released to the taken up power or energy.
If these details should be correct then this would be the most efficient converter for free energy, which has been developed until now.

Behind the project name SDI (Strategic Defence Initiative) is hiding the by the United Slates prepared "Star wars". But how one fares a war, which nobody can pay anymore and no-one wants, entirely according to the motto: There is a war and no-one goes there? This war undoubtedly the strategists and initiators themselves have lost, who even had to watch, how their space gun appears in the internet with design drawings and rich visual material to be called by anyone[i].
Today, where we are surrounded by nothing but friends, where in Russia and at other potential opponents is fought more against internal problems and one lets the expensive space toy rot for lack of money, the coat of the military secrecy obviously no longer can be held over such an explosive project as the railgun.

Thus informative details have reached the public. In the pictures a bright lightning can be seen at the moment of launching (fig. 15.5 A). Here presumably is being materialized, in which the part of anti-matter annihilates with the particles of matter under emission of light. There thus takes place the same process as in the case of lightning or the shining of the sun.
In addition is being reported that heat energy is withdrawn from the environment, a circumstance, which is typical for all functioning converters for space energy. We thereby are reminded of the possible formation of ice in a lightning channel.

Like for a lightning also the railgun is stimulated with a very high excitation voltage and with extreme speeds of change of the tension voltage (high du/dt) (fig. 15.5 C). From the setup it concerns a bridge of Ampere, which in various respects appears to be superior to the rocket engines, after the costly transport of the propellant into space isn't necessary, since the capacitor batteries can be recharged by solar power.

<i>: e.g.: www.glubco.com/weaponry/railgun.htm

<ii>: Galeczki, G., P. Marquardt: Requiem fur die Relativitat, Verlag Haag + Herchen (1997), S. 139

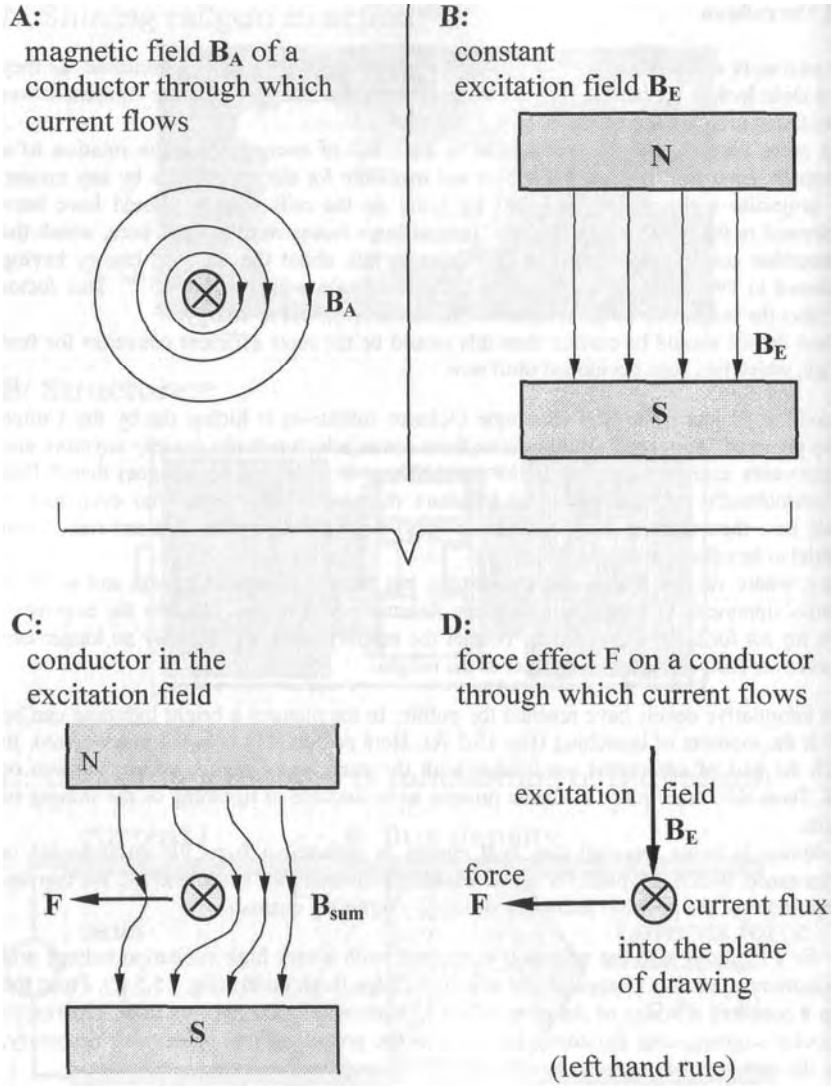

Fig. 15.6: ____ The distribution of field lines and force effect on the slider of the railgun through which current flows in a permanent magnetic field

The projectile has the form and the function of a short-circuit bar and is guided slidable between both rails of the railgun. The high-tension capacitors are switched on both rails at the moment of launching, so that in a very short time an extremely high short-circuit current of several thousands of Ampere flows through the bar.
Since the bar in addition is situated in a static magnetic field, there acts an accelerating force on it (fig. 15.6 D). It is the force effect of a conductor through which flows a current in a magnetic field, like it is active in every electric motor. If we overlap the fields of the conductor (fig. 15.6 A) and of the magnetic field (15.6 B), then we observe a bending and lengthening of the field lines (15.6 C). There exists the effort to re-establish the original state, which represents the smallest magnetic resistance, and for that the conductor is shifted out by means of the arising force. In the sketch it is accelerated to the left. That far the explanation concerning the bridge of Ampere. That has nothing to do with free energy. For the enormous degree of effectiveness, as it has been determined, further effects have to be added.

15.6 Unipolar induction

The projectile, or from the function let us rather speak of the short-circuit bar or the slider, at first is entirely conventionally accelerated and experiences, mathematically expressed, a dv/dt. The magnetic field B stretching perpendicular to the movement is constant, so that according to the Faraday relation[i] E = v x B from the velocity v an electric field strength E results and from the acceleration dv/dt a field change dE/dt. These open field lines along the length of the slider, in particular the oscillating part, appears to interact with oscillating particles and to collect these particles[ii]. It concerns presumably neutrinos, which primarily materialize in charge carriers. These contribute to the current flux in the slider and to the acceleration, whereupon still more neutrinos are collected.
A hardly controllable avalanche effect is formed. Only if the change in tension voltage has worn off and the capacitor is completely discharged, also the resonant interaction will again collapse.

The inventors, who want to construct a civil version of the railgun, is given a warning on the way which should be taken seriously. At first it doesn't take particularly much imagination to imagine a rotating arrangement of the gun, a construction with one axis, whit which a generator driven, which produces power. A small part is supplied the system again as supply for itself. The rest would be available free to the consumers as non-polluting, regenerative energy.
That really sounds good, if there wouldn't be this one obstacle.

<i>: The equation of transformation concerning the unipolar induction already was treated more detailed in chapters 6.4 and 9.3

<ii>: It is the resonant interaction according to table 15.1, line four

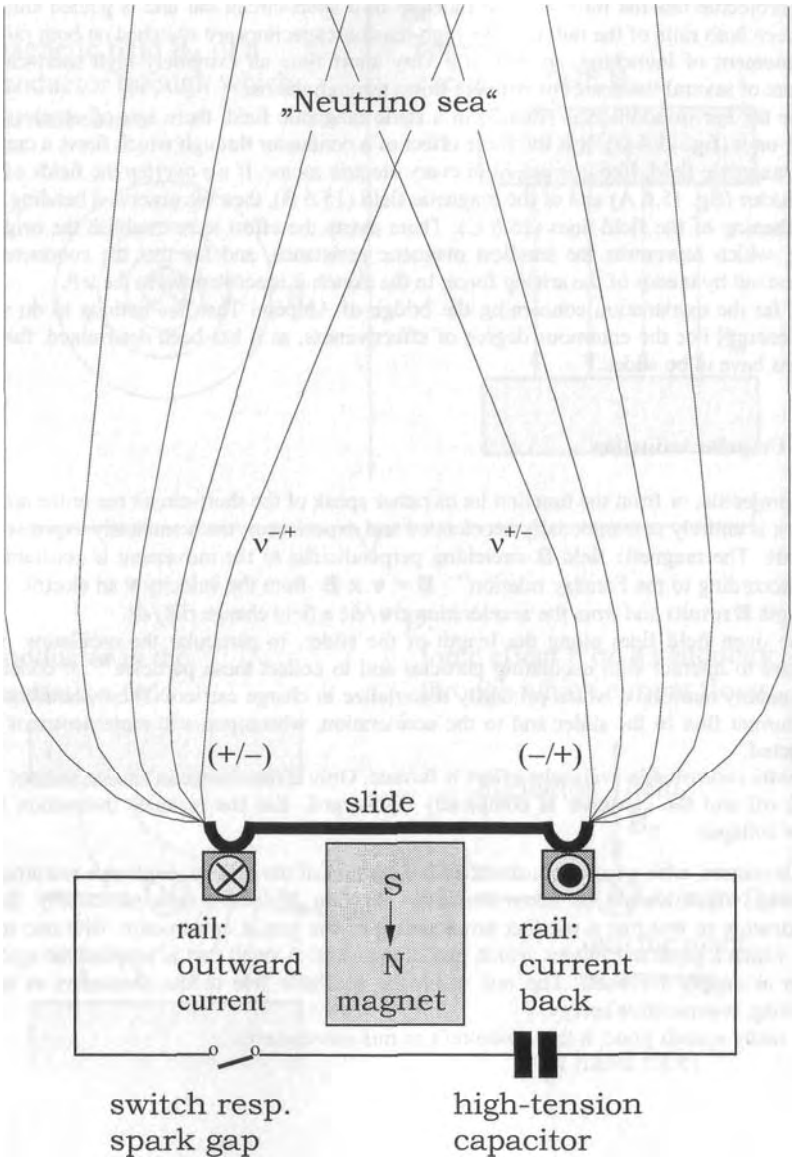

Fig. 15.7: The collecting of neutrinos by oscillating open field lines

15.7 Tendency to instability

In a continuously working machine the discharging of the capacitor cannot remain a single event as in the case of the gun. The discharging and the recharging has to take place cyclic depending on the revolutions per minute. To obtain a rotating movement even to a certain extent ignition has to follow ignition. But if the new ignition takes place, although the avalanche effect of the last one still hasn't worn off, then inevitable a catastrophe will occur, then the work of wonder is taken apart under the eyes of its creator. Numerous inventors already have had to collect such painful experiences. It is assumed that not even Nikola Tesla had escaped, as he had to put away again his stately luxury car with electric motor and energy converter in a barn near Buffalo already after one week of test operation in the year 1931[<i>].

Of course also for this problem solutions in accordance with engineering are offered. Meaningful would be a restriction of the revolutions per minute and a power regulation. Only most inventors don't think that far. On the one hand, because they handicraft without an useful physical model and on the other hand they think they already have reached the goal, if they observe something like free energy for the first time. Just as fast as the joy then the disillusionment comes, because a converter which doesn't work, is not able to convince anyone.

Tesla already was aware of this set of difficulties. He fastened his converter to the dash-board and not in the engine compartment, presumably to adjust the coupling of the coils from the drivers seat during the drive by means of two metallic rods, which he pushed into the case. But sometime even this regulation by hand has to go wrong, because the collected neutrinos on their part collect further neutrinos (fig. 15.7), so that in the case of an unfavourable order of ignition an additional amplification is possible. For a reliable operation according to that directly or indirectly the phase of the ignitions to each other should be checked.

At the example of the railgun space energy technologists and inventors can study the relations and the way of functioning very concretely and even calculate these relatively simple. It is a big relief, that all three vectors stand perpendicular to each other: the E-field, the B-field and the velocity v. Ideal conditions both with regard to a maximizing of the wanted accelerating force and for the resonant interaction, increase at the same time the collecting of space quanta, which probably may be set equal to the neutrinos. This is made possible by the Faraday's law of unipolar induction. In that way at the right and left end of the slider a positive a negative pole each are formed. The further the two poles are away of each other, the more the field lines are opened and the more neutrinos can go into resonance. In this place still considerable improvements and optimisations are possible.

In addition to the two discussed the phenomenon of the electrostriction is added as a third phenomenon, which authoritatively contributes to the conversion of neutrinos into electrons. It is a field dependent change of length, which in the case of lightning takes care of the thunder and in both cases, therefore also here, is active as a charge carrier producer.

<i>: see also chapter 9.5 Free energy,
A. Schneider: Energien aus dem Kosmos, Jupiter-Verlag 1989, Kap.ll, S. 20 and H. Nieper: Revolution, MIT-Verlag 1981, S. 194

A: electric dipole (e.g. electrostatics, see also fig. 6.8)

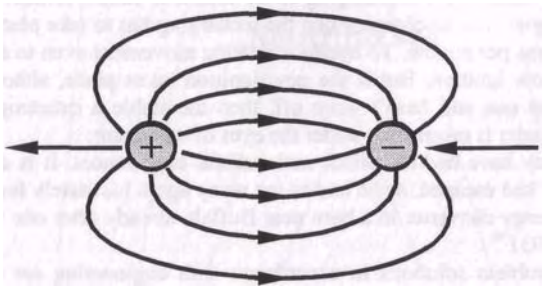

B: electric monopole (e.g. electron e~, see also fig. 4.3)

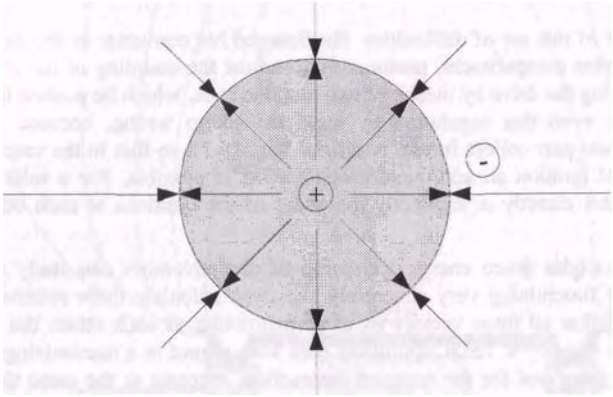

C: Mixed form in the case of cylindrical symmetry

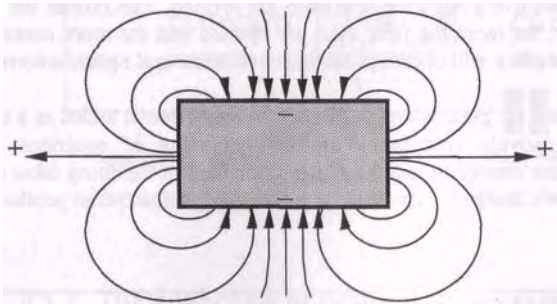

15.8 Unipolar field configuration

If we again go back to fig. 5.1 and continue our considerations with examples concerning line 3. The obtainable force effect of open electric fields indeed is for powers of ten smaller than that of magnetic fields, but then particles are mediated, an invaluable advantage and an indispensable prerequisite with regard to the generation of space energy. As long as the particles are considered in the balance sheet of energy then in addition by no means can be claimed, space energy converter are perpetuum mobiles.

In the question, why only electric particles can be mediated, has to be pointed to the repeatedly mentioned circumstance that only electric particles can be formed as a result of the concentration effect of potential vortices. Magnetic particles however plain and simple cannot exist, since for missing conductivity in the vacuum no eddy currents are possible (see fig. 4.4).

In the case of the arising Coulomb forces again is distinguished between the static and the oscillating case. We want to start with electrostatics.

The range of technical applications of static electricity is large. It stretches from varnishing technologies and filter technologies till the fly grill in the arbour. In all cases the field is built up by charge separation. By means of a high-tension generator a positive pole and a negative pole are produced, between which the field is stretching. The field lines now start at one pole and end at the other, unlike pole (fig. 15.8 A).
In this manner almost no open field lines are available, which point to the outside and could interrelate with free particles. If one for instance intends to attract and collect charged particles from the solar wind, from the cosmic radiation or from the electricity of the air, then the design in one point has to be changed fundamentally.
A unipolar field configuration is necessary. What is meant with that, answers a glance at the spherical vortex model of the electron (fig. 15.8 B resp. fig. 6.2). Here it as well concerns a formation of dipoles as a result of the charge separation, but one pole is hiding in the inside of the other pole . In that way its field lines are captured and don't have a chance anymore to come out, to reach the other pole.
But if the pole lying on the outside for its part can't close its field lines any longer, then these point helpless into space and search in their neighbourhood, in the distant world and if need be even in the infinity of the universe an unlike anti-pole, which as a result interacts and is attracted.
The measuring technician analyses these open field lines and falsely calls the construction then a monopole, only because he isn't able to reach the locked up pole. To blame is the unipolar field configuration, which with that probably would be explained to a certain extent.
The designer and inventor as well might have realized how he has to construct his device, with which he generates open field lines to collect space quanta. He has to lock in one of the two poles as good as possible. Optimal would be of course a spherical symmetric construction like in the case of the elementary vortex. Compared with that a cylindrical symmetry indeed is suited far less good, but it offers constructive advantages (fig. 15.8 C).
We now will report of such a functioning device.

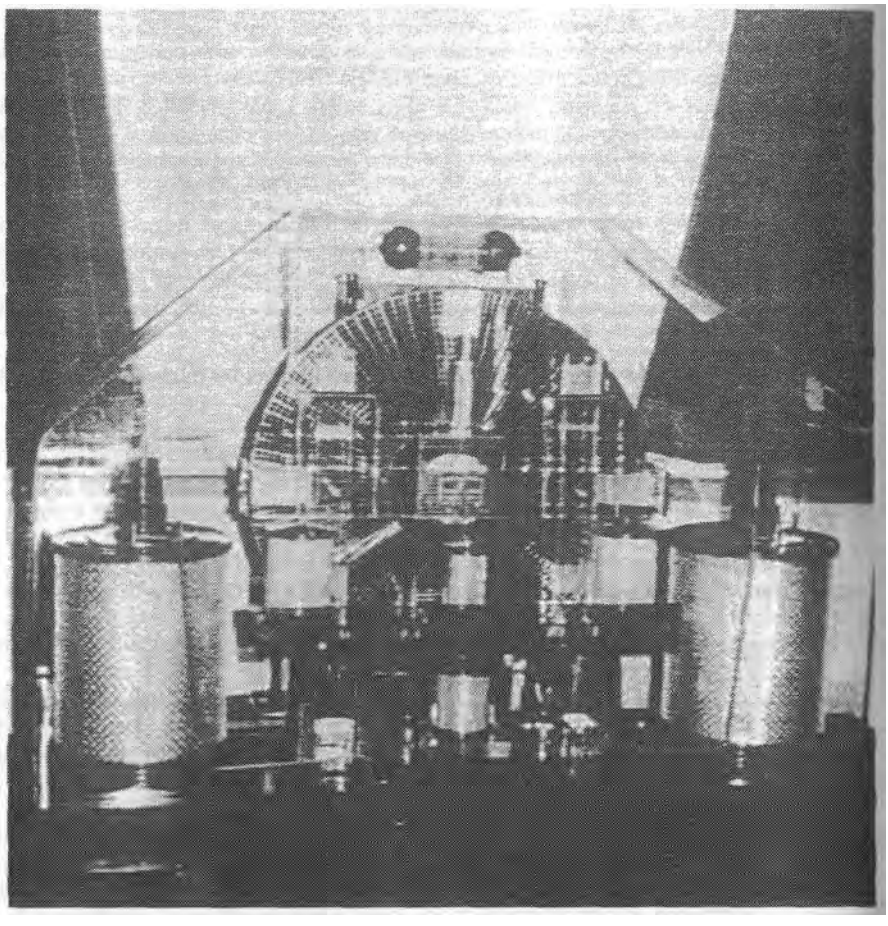

Fig. 15.9: Demonstration converter "Testatika".[i]

<i>: A. Schneider: Energien aus dem Kosmos, Jupiter-Verlag 1989, S. 29,
I. Schneider: Neue Technologien zur Freien Energie, Jupiter-Verl. 1994, p. 13 and in the NET-Journal, Heft 8/9, 1997, S. 16 as well as iss. 12, 1997, p. 6.
D. Kelly. Der Schweizer ML-Konverter, Raum & Zeit Special 7, S. 164

15.9 The Testatika

An electrostatic device, which produces open electric field lines, is situated in Linden in Switzerland. It optically is very imposing and belongs to a religious community, which has called it Testatika and is of the opinion that it is a free energy converter. Inexplicably the Testatika does not serve the community, which generates their electric power conventionally and to a large extent by itself, as a source of energy. Instead the 2 kW device only very seldom is demonstrated for special occasions or to select groups of visitors. The religious community after that explains the astonished observers humanity not yet is mature for the technology.

Perhaps just the opposite is correct and the technology not yet is mature. According to my personal assessment such an electrostatic device in principle is entirely unsuitable for the continuous operation.

It can be expected that the open field lines sooner or later will interrelate with the electricity of the air and thunderstorms are being attracted by the infernal machine so long until lightning strikes and the demonstration with that has finished. That's why the Testatika may be switched on only for a short time, only at sure weather situation and not too humid air, and many a registered visitor has been sent away without having seen the "thunderstorm machine".

As an object of demonstration and study the Testatika however is well suited. Alone the circumstance that no cable leads to the device and it nevertheless releases energy in the order of magnitude of 1 till 2 kW, surprises all visitors. At least the impression is mediated as if the machine would violate the law of conservation of energy, which is not correct. The Testatika is similar to an induction machine, which works with friction electricity. Thereby the unlikely charged bodies do not have to unconditionally touch and rub at each other, it already is sufficient, if they are brought in the immediate vicinity of each other. In the case of the Testatika the electrostatics of two against one another rotating discs is taken off by brushes.

The excitation energy presumably is taken out of the natural E-field, which just like that can amount to 200 Volts per meter (see chapter 2.9). The large diameter of 80 cm of the discs and their bad conductivity (acrylic glass) permit this conclusion. The charge taken off by the brushes afterwards is temporarily stored in two capacitors of 2 Farad at 300 Volt, so-called Leyden jars. This far one actually is reminded of a Wimhurst generator, in which the energy is supplied the system by turning the disc. Large powers cannot be drawn by that. Plans to build such an induction machine by yourself have been published[<i>].

In the case of the Testatika however two discs are used and by hand stimulate to rotate oppositely. This rotational energy in this case isn't used to produce power, otherwise the discs quickly would stand still again, but that doesn't happen.

Until now apparently no-one has discovered the secret, which is kept strict by the members of the community. In my opinion the energy situation on our earth however is too serious, as that we would be able to afford playing hide-and-seek and egoistical secretiveness.

<i>: I. Schneider: Neue Technologien zur Freien Energie, Jupiter-Verl. 1994, S.14

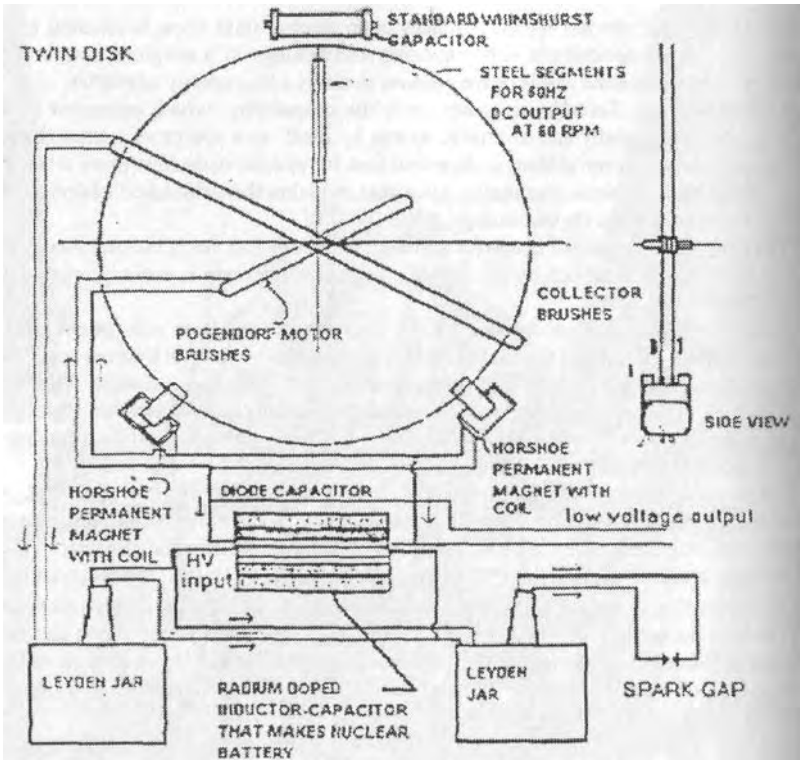

Fig. 15.10: Sectional drawing of the Testatika according to Don Kelly, (Clearwater, Florida, USA)

<i>: Der Testatika generator, NET-Journal, Dezember 1997, page 6 similar picture is found in Raum & Zeit Spezial 7, page 164

15.10 The secret of the Testatika

The crucial point is the opposite direction of rotation of both discs. If we assume the static earth electric field is the cause and serves as an excitation field, then as an effect a field arises, which stands perpendicular to that. The axial component now points out of the centre of the disc.
In the case of only one disc the field lines in front and behind the disc again are closed, so that no open lines can form. With one disc or with two discs rotating in the same direction hence no unknown charges can be attracted.
In the case of two oppositely rotating discs however shows one component along the axis of rotation to the observer, that of the other disc exactly in the opposite direction. In that way between both discs a pole is „pinned", which no longer is able to close all field lines on the outside around the machine. Thus open field lines and a, however incomplete, unipolar arrangement are formed.
The charge carriers sucked from the electricity of the air as a result support the natural electrostatics and speedy recharge the capacitors, even if up to 10 Amperes are taken out by the consumers.

The ingenious thing of the machine is its extremely simple construction and the simple concept.
If one includes the collected particles also in the balance sheet of energy, then it thus will turn out that the law of conservation of energy is not violated at all. There thus can't be talked of free energy. In this context the Testatika may rather be given as a counterexample. Air ions are the carriers of the electricity of the air and not carriers of free energy.

Negative air ions are indispensable for our welfare. One should only remember the first men in space, who after the landing were pulled out of their capsule more dead than alive, after they had to stay in the unhealthy atmosphere of the capsule for a longer period of time. Only the installation of ionising devices for negative air ions made possible longer staying in space.
The taking out of the air of negative ions hence is not unproblematic and not particularly ecologically compatible. An atmosphere harmful to life is formed which Dr. Wilhelm Reich has called DOR-state. He by the way has designed a Cloud-Buster, with which he could take static electricity, forming above the desert sand, out of the air. In that way the negatively charged rain clouds no longer are repelled and driven away. Reich has tested his weather machine 1954 in the desert of Arizona. After he had freed the atmosphere of the „DOR-strain", as he expressed himself, in the desert area the atmospheric humidity steadily increased from 15% up to 95%, there grew prairie grass and everything started to turn green, and eventually after many years for the first time rain fell again.

Static electricity, as far as the right polarity is chosen, may conditionally be used for the mechanics of rain making. For free energy concepts it however isn't suitable. Already Nikola Tesla has pointed to the circumstance that our hopes will be in vain if the free energy would be of static nature (see fig. 9.5). He in his speech, which he gave 1891 before the AIEE, has left no doubt that free energy exists, which is kinetic and with that energy technically usable for us,.
Chapter 16 will be occupied solely with this case<i>.

<i>: according to point 4 in table 15.1

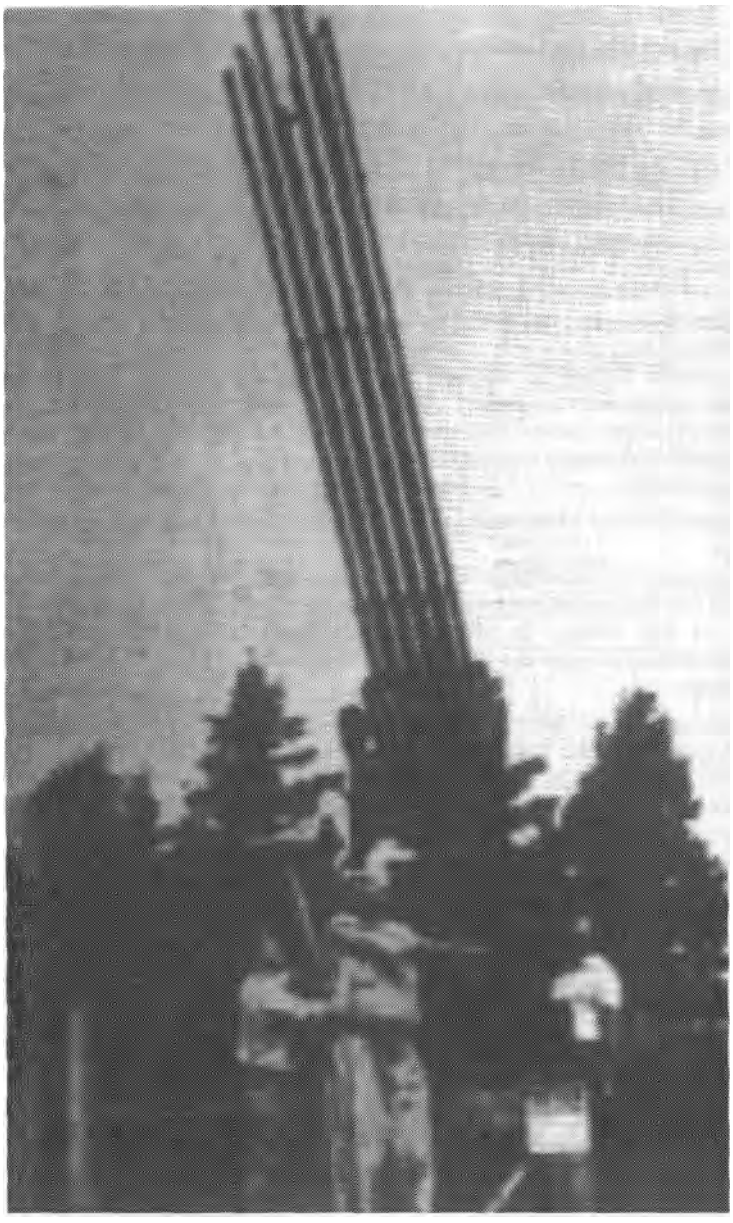

Fig. 15.11: The Cloud-Buster of Dr. Wilhelm Reich 1954.[i]

<i>: H.-P. Thietz: Tatort Erde, VAP (1996), ISBN 3-922367-62-3, page 122
<ii>: Part 1, fig. 9.3; concerning the unipolar induction see also fig. 6.5 and 11.8

Fig. 15.11 shows the weather machine of Reich, the Cloud-Buster. It can be understood only hard, why Reich directs a 3-4 m long metallic pipe with a diameter of 4 cm to the sky and connects the rear end with a deep well or with flowing waters. The effect should have been increased considerably with a few milligrams of radium. An indication that he must have worked with static electricity, delivers however a tragic accident, in which one of his collaborators was lamed on one side. He carelessly had touched the charged apparatus and suffered an electric shock[i].

15.11 The key to free energy

As a contribution to the discussion the individual principles of functioning of space energy again are collected and the attempt is undertook to value them.
In the case of an oscillating dipole configuration, for instance the railgun, open field lines are present only along the mutual line of connection (fig. 15.8 A). With that not particularly many space quanta can be reached. It hence has to be operated with gigantic excitation powers in the range of many thousands of Ampere, so that further field lines fling open and interact. The wanted over-unity effect therefore can only be reached at an enormous expense of technical apparatus.
An unipolar arrangement here is considerably more advantageous, where holds: the more unipolar, the fewer excitation power is required. But in that way it can take longer until the collecting of neutrinos like an avalanche again has worn off. In the case of an ideal spherical arrangement (fig. 15.8 B), as the ball-lightning takes, the process can even last for minutes. This explains why unipolar systems can be kept under control only very hard. If the neutrino avalanche is rolling then it purely theoretical only can be stopped with a still larger excitation power, for instance by phase shifting, what can hardly be realized in practice. The rolling avalanche can't be stopped anymore by normal means. A synchronous operation between the neutrino oscillation and the converter can, apart from the technologically hardly realizable high frequency, by no means really be recommended. As a rule one single steep flank of the change of the excitation voltage is sufficient to start the avalanche. By means of the repetition frequency or by means of the duty cycle of the excitation voltage then resonances to the neutrino field can be made or avoided. On the other hand can't be done without the avalanche effect. The utilizable power of the neutrino converter otherwise would be much too small. This case should be pursued further in the design of a longitudinal wave gauge.

All converter systems at first work based on a well-known and tried and tested physical principle of functioning. In the case of the railgun it is the bridge of Ampere. The thus used force effect on a conductor through which flows current is advantageous due to the obtainable order of magnitude and as a basic concept extremely recommendable. But also Coulomb forces or other physical principles can be used.
Despite that a further relation still must be added, which produces the interaction with the neutrinos. Closely associated with the unipolar arrangement it is the unipolar induction, which in virtually all space energy concepts is put to use. It already could be shown that the railgun uses the effect as well as John Searl in the case of his flying disc[ii]. The Faraday law of induction turns out to be the key to free energy.

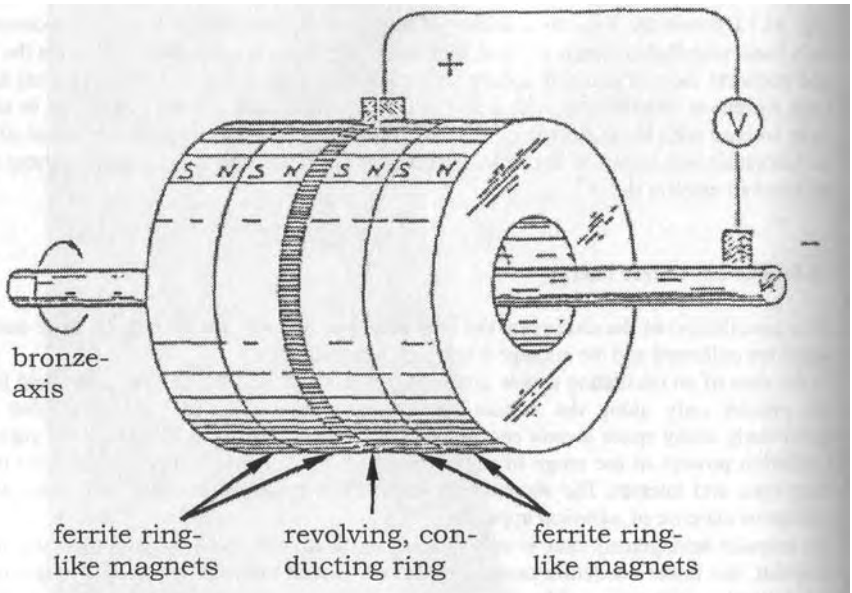

Fig. 16.1: The Faraday generator, which with rotating magnets is called N-machine.<i>

According to chap. 6.5, eq.60 the equations of transformation are:

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} \quad \text{and} \quad \mathbf{H} = -\mathbf{v} \times \mathbf{D} \tag{16.1}$$

where: $\mathbf{v} = dx/dt = v \cdot \mathbf{e}_x$ = component of the direction of motion perpendicular to the area being stretched by the field pointers $\mathbf{H} = H \cdot \mathbf{e}_y$ and $\mathbf{E} = E \cdot \mathbf{e}_z$.

Thus in addition to the basic fields E and H (at v = 0) additional fields E_z and H_z, depending on motion, occur and the overall fields E_o and H_o are measured (which corresponds to eq. 63 in chapter 6.5):

$$E_o = E + E_z \quad \text{and} \quad H_o = H + H_z \tag{16.2}$$

(which corresponds to eq. 62 in chapter 6.5):

with: $$E_z = v \cdot B \quad \text{and} \quad H_z = -v \cdot D \tag{16.3}$$

Table 16.2 A: The equations of transformation of the electromagnetic field.<ii>

16. Space energy technology (SET)

It quite concretely concerns the question for a technology concerning the use of the resonant interaction (according to line 4 in fig. 15.1). For that open and at the same time oscillating electric field lines are needed, which mediate neutrinos and pass them on to a receiver working in resonance. The sun, some planets and other celestial bodies, as we already have worked out, use the effect. Even an entire galaxy is kept together in this way. This interaction plays the crucial role for the theme of space energy and the question is asked, with which technology it can be produced artificially.

16.1 The unipolar generator

The most direct way obviously leads over the Faraday relation concerning the unipolar induction. With the classic Faraday generator, where a permanent magnet is turned along its axis, at first a static electric field can be produced. By rotating in opposite direction or magnets rotating in the same direction but oppositely poled, relatively simple one pole can be „pinned" between the magnets and an unipolar construction can be built. Numerous research scientists already have worked in the area of the Faraday machine more or less successfully (fig. 16.1)[<i>]. There is reported of instabilities and of the picking up of unknown energy at high revolutions per minute. In the majority of the cases it in a sense of the Testatika will concern collected electricity of the air.

The Faraday relation in addition also appears to be hardly understood correct physically by anyone. A scientific magazine in this context takes the opinion: "Faraday proves Einstein wrong", and the production of electricity with Faraday's unipolar inductor violates the laws of physics ![<ii>]

<i>: A. Schneider: Energien aus dem Kosmos, Jupiter-Verlag 1989, S. 44

<ii>: „Faraday in his experiment did let rotate a copper disc above a resting cylinder magnet; as expected in a loop of wire a tension voltage was created (F-machine). Than he let the magnets rotate, and the disc stood still; now again a tension voltage should have resulted - but there was no voltage. In the third experiment the magnet rotated with the disc in the same direction and with the same speed. Because there was no relative motion between both, an induced tension voltage wouldn't have been expected - but it was measurable! (N-machine, see fig. 16.1).
What does that mean? If the relative movement between magnet and disc is not always crucial for the formation of an induced tension voltage, then also the absolute movement has to play a role - because something has to move, for a current being formed. But an absolute movement according to the theory of relativity can't be detected - thus Faraday's experiment proves Einstein wrong! Therefore you won't find anything about this experiment in the textbooks".
Taken out of the article: Faraday widerlegt Einstein, PM-Magazin 11/ 1998, P. 133

from table 16.2 A:

$$\boxed{H - H_o \overset{(16.2)}{=} - H_z \overset{(16.3)}{=} v \cdot D} \tag{16.4}$$

with the velocity $v = dx/dt$,
not accelerated $dv/dx = 0$ (inertial system) and derived for x:

$$\boxed{\frac{dH}{dx} - \frac{dH_o}{dx} = \frac{dx}{dt} \cdot \frac{dD}{dx} = \frac{dD}{dt}} \tag{16.5}$$

The curl of the H-field pointer points in the z-direction:

$$\boxed{\text{rot}\,\mathbf{H} = \frac{dH}{dx} \overset{(16.5)}{=} \frac{dH_o}{dx} + \frac{dD}{dt} \overset{!}{=} \mathbf{j} + \frac{d\mathbf{D}}{dt}} \tag{16.6}$$

comparison of coefficients with Ampère's law:

$$dH_o/dx = \mathbf{j} \quad , \tag{16.7}$$

integrated over dx and ds and formulated generally valid:

$$\boxed{\oint \mathbf{H}_o\, d\mathbf{s} = I_{ein}} \tag{16.8}$$

thus follows from that: <u>magnetic field = vortex field</u>!

<u>Faraday's law of induction</u> (analogous derivation):

$$\boxed{\text{rot}\,\mathbf{E} = \frac{dE}{dx} = \frac{dE_o}{dx} - \frac{dB}{dt} \overset{!}{=} - \frac{d\mathbf{B}}{dt}} \tag{16.9}$$

cause for measurable electric field E_o is missing:

$$dE_o/dx = O \quad , \tag{16.10}$$

integrated over dx and ds and formulated generally valid:

$$\boxed{\oint \mathbf{E}_o\, d\mathbf{s} = 0} \tag{16.11}$$

thus follows from that: the <u>electric field = irrotational</u> (according to Maxwell)!

<u>Table 16.2 B:</u> <u>The derivation of Maxwell's field equations (Ampère's law and Faraday's law of induction) from the equations of transformation of the electromagnetic field</u>

The author of the article proceeds from Maxwell's formulation of Faraday's law of induction, according to which arises a tension voltage in a wire if the wire cuts magnetic force lines, thus is moved relative to a magnet.
If he had read my books, then he would know that Faraday not only has found the older, but also the more comprehensive law, whereas Maxwell only describes a special case. Starting-point for the by me developed theory of objectivity are on the one hand Faraday's law of induction and on the other hand the regularity dual to that, which both together are called equations of transformation of electromagnetism (fig. 6.5, eq. 60 and fig. 16.2 A, eq. 16.1).

16.2 Derivation of Maxwell's field equations

For the derivation we assume, as already in fig. 6.5 for sake of simplicity, that the movement $v = v_x$ takes place perpendicular to the area stretched by the field pointers $H = H_y$ and $E = E_z$. If we derive the equation of transformation, written down for a field component depending on motion, for the coordinate x by using the equations of material and compare the result with Ampere's law resp. Faraday's law of induction, then it becomes clear that the comparison is successful only under certain prerequisites. This circumstance proves that the Maxwell equations only describe a special case and that the equations of transformation are more general valid and causal (table 16.2 A and B).

But in this place is crucial that Faraday's law of induction according to Maxwell only is able to describe a formation of dipoles. For the formation of unipolar field structures however must be fallen back upon Faraday's law concerning the unipolar induction. Whoever wants to understand or even develop by himself concepts concerning space energy, first must have understood Faraday's law in its whole range.

Usually the Faraday generator is, like in the original building shape, equipped with permanent magnets and operated in a steady operating state. Doing so consequently only static electricity is formed. We however need oscillating fields, and for that either the rotation, or the magnet should be changed in polarity with high frequency. Expressed with the precision of mathematics, the first case is described by: $E(t) = v(t) \times B$ and the second case by $E(t) = v \times B(t)$. Both cases have to be investigated and discussed, because both $v(t)$ and $B(t)$ are possible in principle. It is added that in both cases mechanically moving, as a rule rotating, designs but just as well resting designs are conceivable, in which only the moving charge carriers themselves realize the component of velocity v.

This time the crucial point is, that in both cases equally a change of the electric field strength E(t) is produced, with the help of which neutrinos should be collected. Because of the extremely high oscillation frequency of the neutrinos large field changes dE(t)/dt and associated with that large changes of tension voltage dU/dt seem to be the optimal solution, which can be handled with today's technology. Apart from that further difficulties are added, which require a managing in accordance with engineering. If we namely work with a large acceleration dv(t)/dt, then the inertia of the accelerated masses should be overcome, then only very small and light projectiles can be launched like in the case of the railgun. If we however work with fast changes of the magnetic field dB(t)/dt, then the inductance acts slowing down.

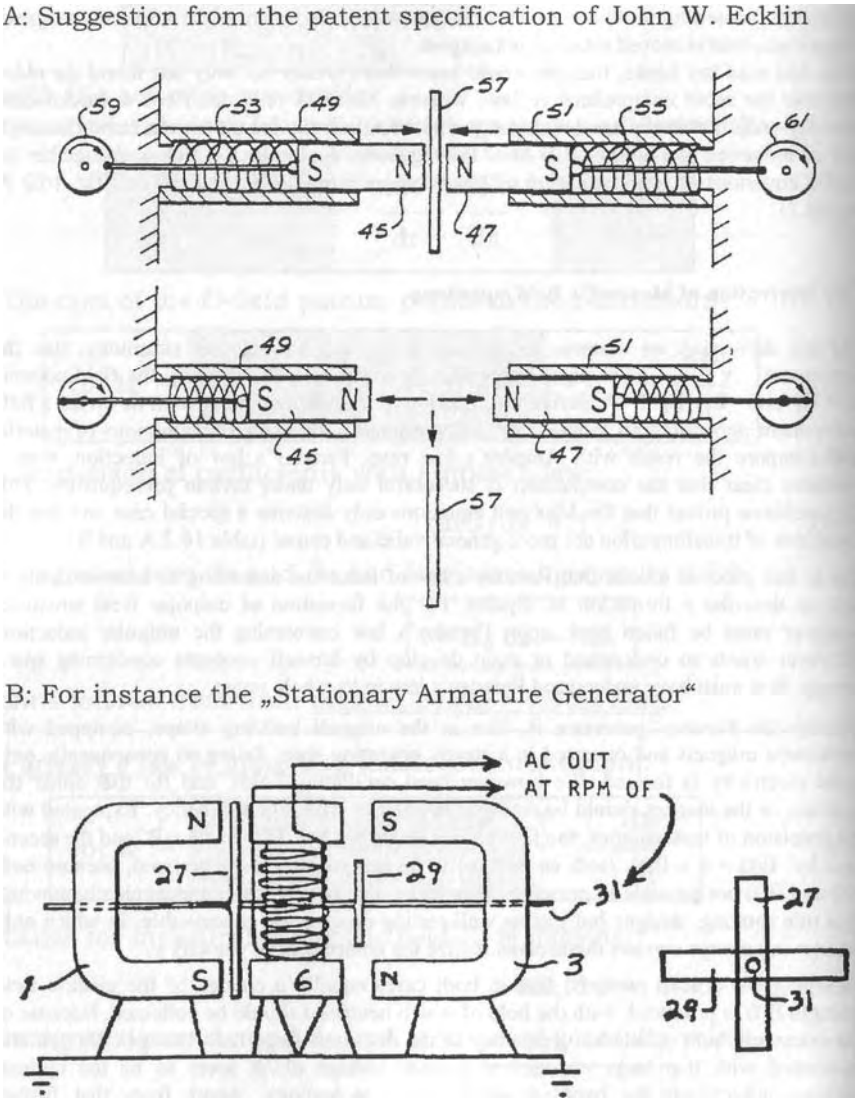

Fig. 16.3: Principle of the Ecklin generator.<i>

<i>: A. Schneider: Generatoren mit Ferritkernumpolung, NET-Journal 6/98, S. 9
Ecklin: Permanent Magnet Motion Conversion Device, U.S.Pat. 3'879,622

16.3 SET-devices with rotating magnetic fields

If we again come to speak of the Faraday generator, which can be built up in two variants. In the case of the F-machine the magnets rest and only the disc rotates, whereas in the case of the N-machine the magnets rotate along. In this case can't be avoided that some of the induced charge carriers roam about in the magnets and sensitively disturb the structure of the material. One only thinks of the bending spoon effect!
The consequences stretch from a loss of the permanent magnetism, over a shattering and bursting up to a pulverizing of the magnets. Adventurous rumours and alarming reports in this direction are sufficiently available.
An improvement could be obtained by an isolation layer between the conductive disc and the magnets, but against induced charge carriers inside the rotating magnets this measure is not able to achieve anything.
Anyhow the best thing to do will be to completely do without permanent magnets in neutrino converters! If we replace them at least in our minds by electromagnets, then a feeding with alternating voltage is possible. That also is necessary if oscillating neutrinos and not air ions should be collected.
As a result of the alternating voltage at first large eddy currents occur in the disc. The losses can be reduced by radial slits in the disc. The induced currents then only can, as wanted. flow radially to the outside.
Bigger headaches causes us on the other hand the inductive and with that current storing effect of the excitation coils. If a too large excitation inductance should prevent a fast increcase in current, then also the induced electric field will increase correspondingly comfortable and hardly be able to persuade a single neutrino to stay.
A coil core of iron or dynamo sheet metal with that is ruled out from the start. Even ferrite would be suitable at most conditionally. Usable are air coils with as possible as few turns.
In an advantageous design the slit copper disc rotates between two air coils, if need be flat coils built in the way Tesla did, which are fed with pulsed tension voltage.
The highest speed of change in current surely is obtainable by means of a spark gap, like already Tesla has used (fig. 9.1). But also other techniques are thinkable as pulse driving.
For instance semiconductor power amplifiers with MOS transistors not only can be switched fast and hard, but in addition frequency and duty cycle can be adjusted freely with reproducible exactness. These are niceties, which will gain importance in connection with the control and regulation of a converter.

Und the heading "generators with magnetic flux variation" Mr Adolf Schneider has collected and commented on some concepts<i>. The generator of the american research scientist John W. Ecklin registered for patent at 22-4-1975 thus stands as an example of a whole group of inventions, in which the magnetic conductivity in the magnetic circuit and with that the flux is changed with a jump.
Fig. 16.3 B shows a building form consisting of two horseshoe magnets (1, 3) with a likewise resting coil in between (6). In rest the magnetic circuit experiences no change and consequently no tension voltage is induced in the coil. The trick is that an axis (31) is pinned right through the arrangement which is turned with two soft iron anchors, which magnetically short-circuit alternating the left (27) and the right (29) horseshoe magnets.

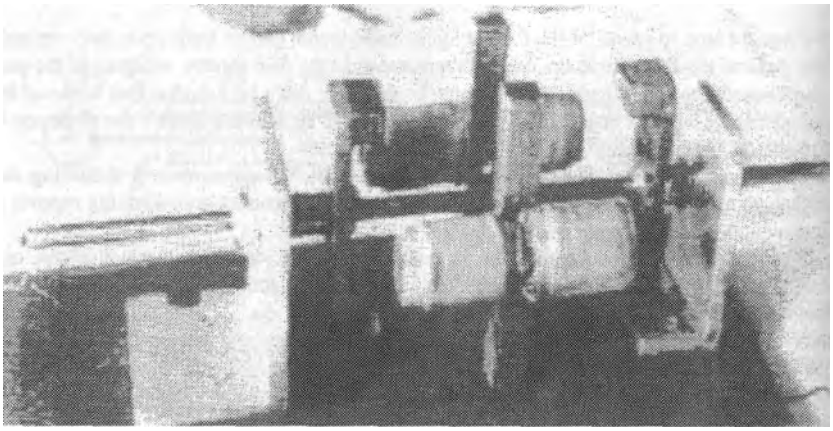

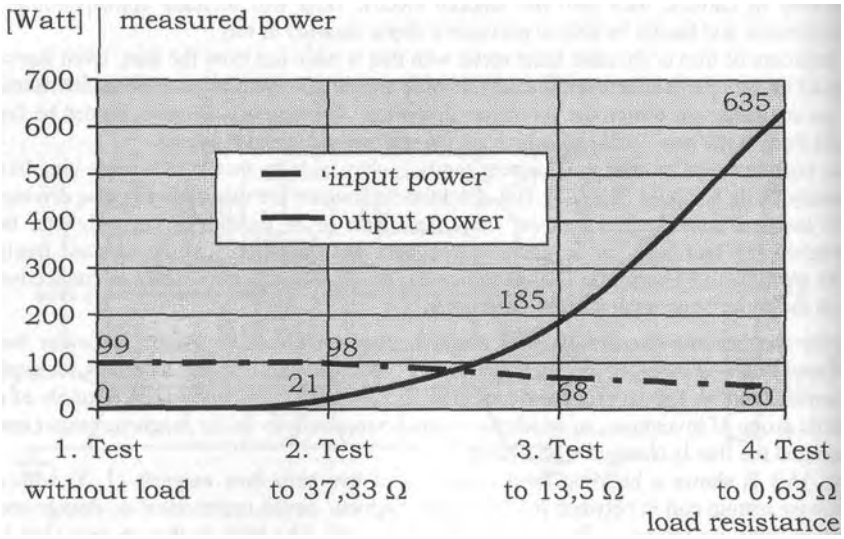

Fig. 16.4: Bedini magnetic converter.[i]

[i]: A. Schneider: Generatoren mit Ferritkernumpolung, NET-Journal 6/98, S.10

Besides the moment of reluctance, which should be compensated by the physical principle, and the friction of the bearing actually no further moment of reaction can occur which would have to be gotten over, not even then if current is taken out of the coil. If the flux change is large enough, purely arithmetically it should be possible to take off an electric power which is considerably larger than the friction power. John Bedini has 1985 measured an over-unity effect of up to 12.6 at a similar constructed generator, where with increasing strain also the factor could be increased (fig. 16.4).

16.4 Commentary concerning magnetic SET-devices

I judge these measurements rather sceptical, after I already in three cases had to break the message gently to the inventors, that their device unfortunately was nothing but an energy destroying machine and they merely had measured wrong, where admittedly the measuring of pulsed tension voltages and currents is not quite simple. So that you don't become a victim of wrong hopes and self-deception, I recommend all SET inventors to realize the closed-loop. If in the continuous operation power can be taken out of such an arrangement without supply of energy from the outside, and be it as small as possible, then that convinces everyone even any journalist and any non-expert.
Unfortunately in the case of numerous concepts at this place already the end is reached. As charming the variation of the magnetic circuit may be, in most cases I miss the unipolar arrangement of the fields. Perhaps here no neutrinos are needed at all and energy merely is withdrawn from the environment heat? I'm not able to answer this question and I surely don't need to, as long as no magnetic converter is demonstrated to me as closed-loop. such a converter, if it can be realized, presumably will at least partly hide one of its poles and produce some open field lines; that at least would be expected.

a still bigger measuring technical problem represent the neutrinos bound to a line, which oscillate around the conductor in the form of ring-like vortices. We have become acquainted with these in the case of the single-wire transmission technique of Tesla (fig. 9.5). They are formed, if neutrinos are slowed down and collected, but not yet have materialized to charge carriers. Tesla did use them for his loss-free energy transmission technology, but he couldn't supersede the alternating current technology full of losses, which also stemmed from him but which he called the worse technology, from the market because there were no power meters available for the single-wire-technology.

Today we still aren't one step further. The energy supply enterprises still decline this technology, as I had to learn myself, although this would be the only way to transport solar energy from the desert or energy from the geothermal energy of Iceland by a sea cable to Central Europe, where it is needed.
Today still no gauges exist for such neutrinos bound to a line. Therefore will every measuring technician experience his Waterloo at SET-devices, in which they occur! I now will report of such a converter and the odd measuring problems.

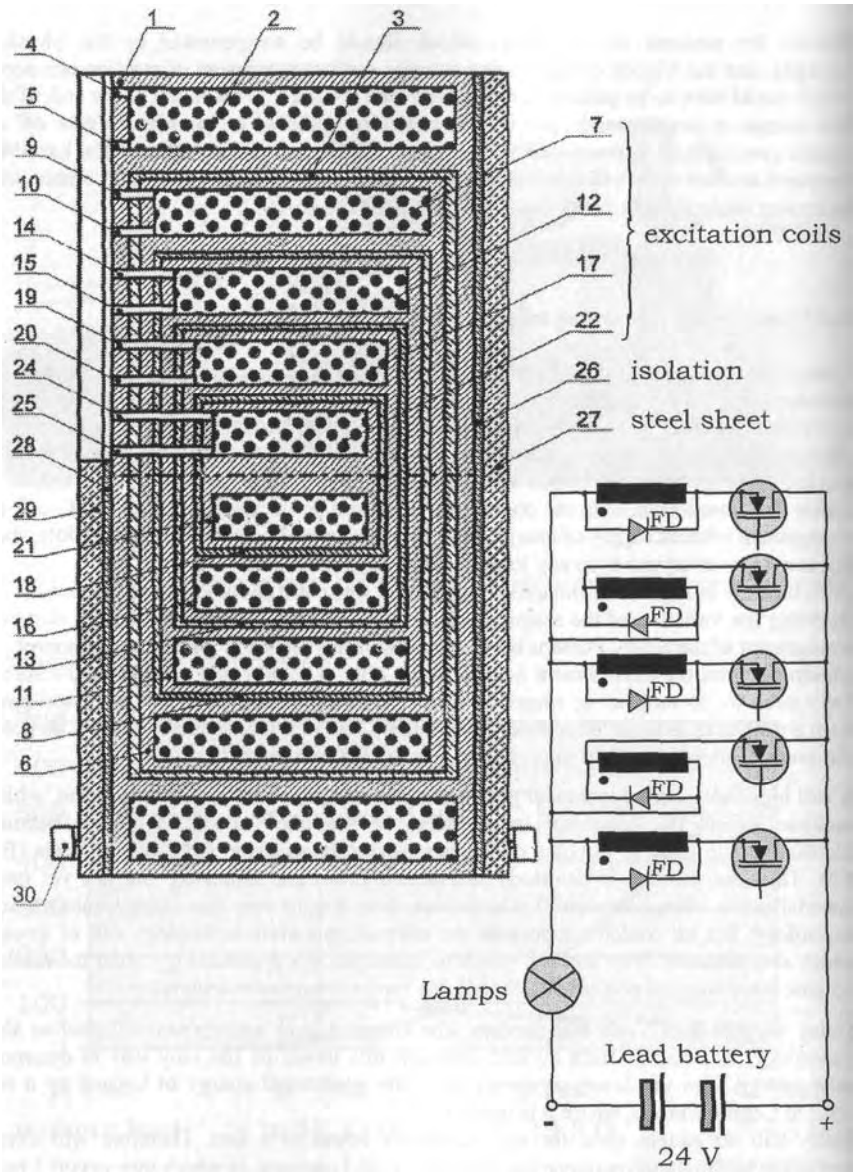

Fig. 16.5: Space quanta manipulator of the Firma ROM AG<i>

<i>: Gibas, Greilinger, Lehner, Rusterholz: Strom aus dem All, Mega Link, Fachzeitschrift fur Elektronik, Nr. 6, Marz 1998, S. 18-23 resp. Bau: Glaube kann Berge versetzen, Bulletin SEV/VSE 25/97, S. 31

16.5 RQM and the space quanta manipulator

If an employee or one of the numerous shareholders of the Swiss Firma RQM AG in Rapperswil speaks of space quanta, then he with that presumably means the neutrinos. An oscillating source of neutrinos is called central Space Oscillator and an operation in resonance of the energy receiver, the so-called space quanta manipulator, is required.
Mr Ludwig Sigrist, the creator of this world of imagination, was not a physicist but crane operator (pseudonym Crane O.) and inventor, whom textbook physics couldn't help further in his considerations anyhow. His concept, if it can be translated into a scientific comprehensible language or not, at least helped him personally and gave him the position to create the space quanta manipulator (fig. 16.5).

It consists of several pot coil systems, which are build up and boxed into each other according to the Matrjoschka principle of scaling down. The ferromagnetic core material of the pot spheres (1, 6, 11, 16, 21) should show magnetostrictive properties as distinct as possible. As we will see, this measure gains its actual importance first in connexion with the interaction with neutrinos!

Each pot sphere carries an excitation winding (2, 7, 12, 17, 22), through which alternatively flows a current in opposite direction. By means of this measure, which seems useless according to classic design concepts, one of both field poles is pinned in the centre, in which way the necessary open field lines are produced.

The individual pot spheres are insulated from each other, where the isolation layers (3, 8, 13, 18, 26, 28) should have a high dielectricity. The pot spheres thus in addition form capacitors with each other; even the ending plates at both sides (27, 29) function as capacitor plates.
This construction, the core piece of the planned RQM converter, is driven by a transistorised power amplifier with excitation impulses as steeply flanked as possible. According to patent specification[<i>] the pulse widths are freely eligible in steps of 5 ns betweeen 200 nanoseconds and one second. Besides the frequency also the polarity and DC voltage offset are adjustable.

Every visit of the laboratory leaves a lasting impression: Carefully the engineers grope forward, turn at the frequency and the duty cycle, until the effect suddenly occurs and neutrinos, the space quanta, are being collected. One realizes that tuning parameters with still stronger reactions would be possible, but entirely without any regulation and limitation of power that can't be controlled anymore. The avalanche effect would destroy everything, and so one is further dangling along the brink of the abyss in the development laboratory of the RQM, all the time trying hard to gain control of the hardly understood effect.
Concerning the setup and the mode of operation of the pot system the inventor did let his posterity have explanations, but why a diode in free operation FD suddenly loses its rectifying function, for that neither the employees nor specialist visitors of as high as possible scientific rank in the laboratory until now had ready an answer.

<i>: Gibas, Lehner, Greilinger: Vorrichtung und Verfahren zur Erzeugung elektromagnetischer Pulse, Patentschrift CH 687 428 A5 vom 7.5.1996

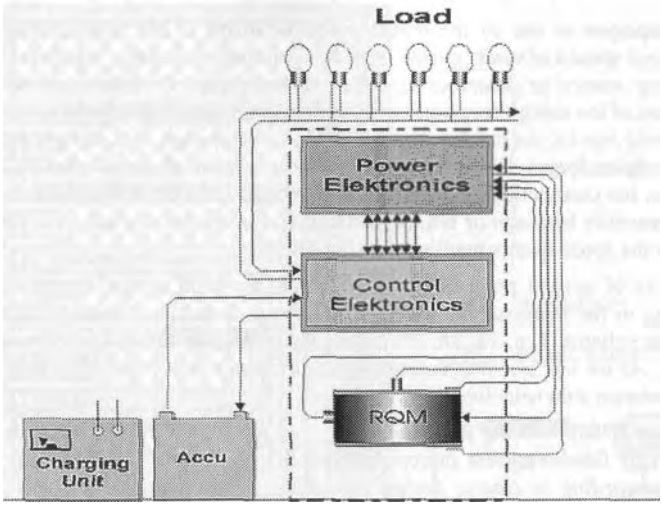

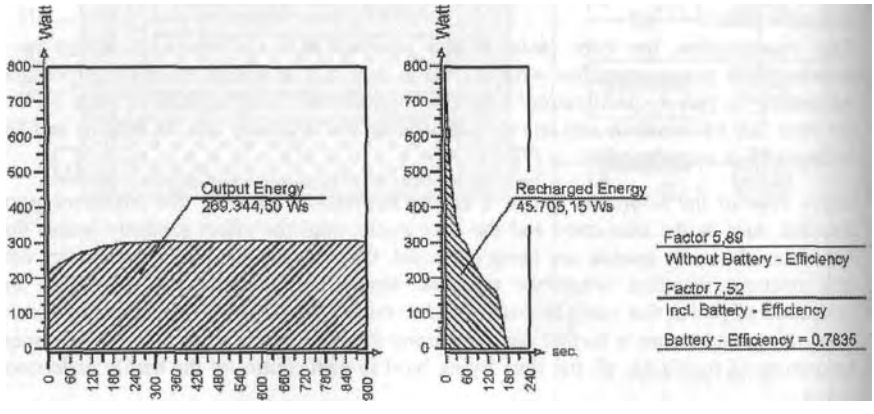

Fig. 16.6: The RQM test installation of 23-9-1996<i>

<i>: F. Greilinger: Der Weg zur erfolgreichen, stabilen Energieauskopplung, RQF Magnetik, Sonderausgabe 1996, page 10

As said, the neutrinos no longer are free but bound to a line, if they leave the pot system. They oscillate around the wire, even around every semiconductor and rove through the entire switchboard. Doing so they can cause quite something, also bring about quite some disaster.
Lead batteries are being recharged, which without doubt is desirable, but in the continuous operation they are destroyed by the same vagabonds. In normal light bulbs for instance some of them materialize to charge carriers, so that according to a gauge more current leaves the light bulb, as on the other side flows in to it. It indeed glows completely normal, but measuring technical for the installation nothing is normal anymore.
The visitor can be shown by means of a high precision measuring facility of vibrations that the pot coils oscillate not only electrically and magnetically, but also mechanically. But the effects alone don't make a converter, which can be produced and which await already numerous buyers of options and licenses.
On the one hand measures for the purposeful conversion of the roving space quanta in utilizable charge carriers here still are missing. On the other hand any controlling facility is missing, to adapt the power taken up from the neutrino field to the momentary need of the consumers. The brave engineers of the RQM still have quite some way in front of them. but the line of approach is right and the reached can be looked at.

16.6 SET-devices with pulsed magnetic fields

In the case of the space quanta manipulator mechanically nothing is moving. In the copper coils the charge carriers merely are on the way with the velocity v. We here have present a typical example of a SET-system with pulsed magnetic field. Compared to the before discussed SET-devices with rotating magnets, for instance the N-machine, the space quanta manipulator clearly has its nose in front. Without brushes, without friction and wear and tear it theoretically has a unlimited life.
In addition it is simpler to produce the necessary large steepness of the flanks in an electronic way as by a mechanical variation of the magnetic field. By means of electronically driving the process it also can be checked, controlled and regulated easier.

The question for an optimisation of the concept still remains. At present one already can be satisfied with a study of possibility, but sometimes one will question the design. There as an example the eddy current losses in the iron pots will be at discussion. About sheeted or sintered materials could be thought, if not at the same time the inductance of the coil would increase in that way, which slows down the increase in current. Ferrite materials again are very brittle and would crumble to dust under the mechanical oscillations of size. I proceed from the assumption, that also here an arrangement with air coils could turn out to be an optimum. It does make sense, if Tesla at higher frequencies always did experiment with air coils.
Now it still depends on the coiling technique. One single conductor loop doesn't provide any open field line. For this purpose if need be two loops have to be supplied with current in opposite direction, like it is the case for a so-called Mobius winding. In this way possibly just as many neutrinos interact as in the case of the pot coils of the space quanta manipulator, which are alternatively supplied with oppositely phased current. To clarify the situation we now should occupy us with the coiling technique.

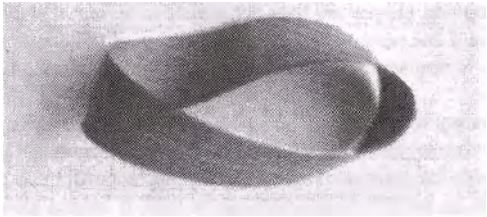

Fig. 16.7 A: The Mobius band

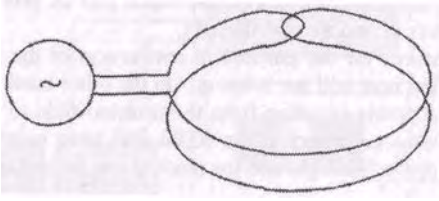

Fig. 16.7 B: The Mobius strip

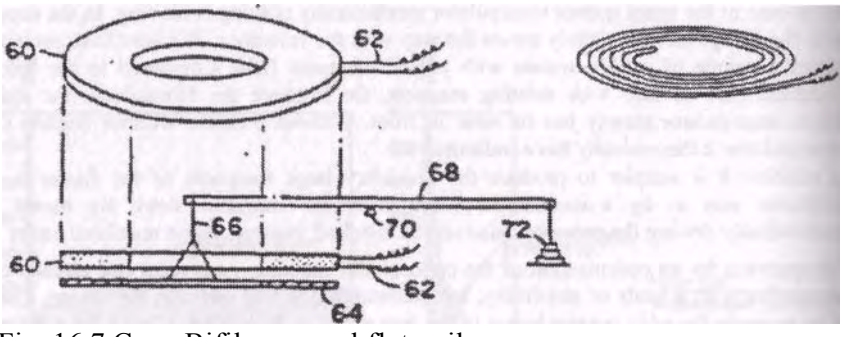

Fig. 16.7 C: Bifilar wound flat coil

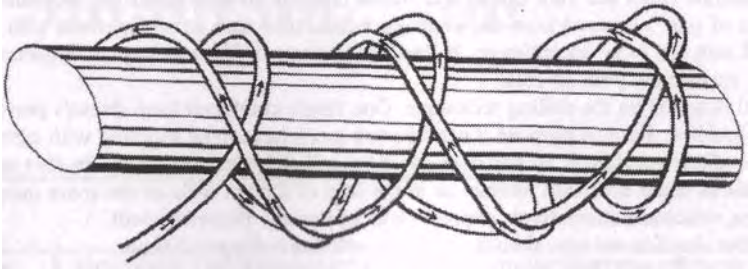

Fig. 16.7 D: Mobius winding arranged like a cross

16.7 SET-devices with Mobius winding

In connection with space energy devices often is talked about the use of a Mobius winding. That is traced back to the Mobius band, which one obtains, if one for example one end of a long paper strip after a half turn glues together with the other end. The result is a strip, which has neither top side nor underside and neither right nor left border. This object with only one side and only one border is a creation of the German mathematician August Ferdinand Mobius (1790 - 1868), fig. 16.7 A.

A distant relative of the Mobius band is the strip with the same name, where the magnetic field lines mutually cancel out. It is the same compensation, as we know of a two core electric cable, where the supply and return cable are run close together. For that the sense of winiding of a conductor loop simply is reversed (fig. 16.7 B).
If the magnetic field vector is wrapped right-handed around the supply cable and left-handed around the return cable, then both amount to zero, so that measuring technical no rest field can be detected anymore at some distance.
THE pointer of the electric field stands perpendicular to the magnetic field vector and points in the direction of the conductor and the movement of the charge carriers. From the coupling of magnetic and electric field follows, that the compensation of one of them also leads to the compensation of the other one. But if the electric field actually is compensated, then there may not flow any current in the winding!
There however flows a current if an electric tension voltage is supplied to the Mobius winding. As a result of this forced current flow both electric and magnetic fields have to occur, which are not compensated! Some field lines will fold outward the expected direction and stand in space as open field lines. These we, in the oscillating case, owe the interaction with the neutrinos.

A perfect compensation would be expected for a two core, bifilar winding. The American physicist William Hooper was able to obtain interesting effects with a bifilar wound flat coil. With help of a balance he could detect attracting or repelling force effects on different, electrically or magnetically neutral discs (fig. 16.7 C)[<i>].
But he feeds the flat coil with direct current, so that a contribution of neutrinos can't be expected. Such effects only will occur, if one works with pulsed signals, because the bifilar wound flat coil quite obviously is able to form wanted, open field lines.

<i>: Schneider, Adolf: Energien aus dem Kosmos, Jupiter-Verlag 1994, page 28, taken out of:

Mielordt, Sven: Tachyonenenergie, Hyperenergie, Antigravitation, kaum & Zeit Verlag 1984

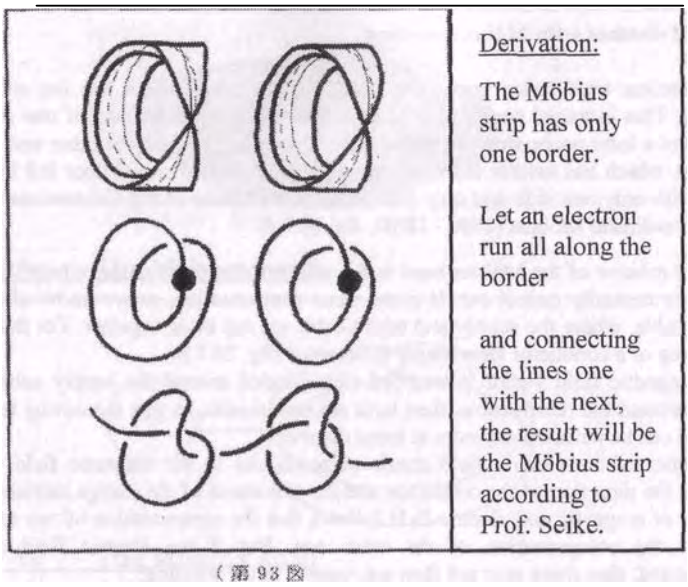

Fig. 16.8 A: Derivation of the Mobius strip acc. to Seike<i>

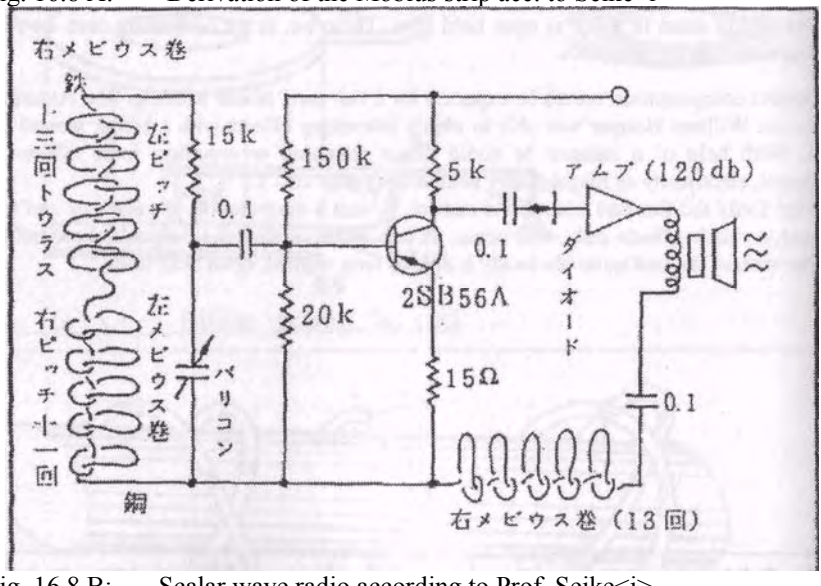

Fig. 16.8 B: Scalar wave radio according to Prof. Seike<i>

<i>: Seike, Shinchi: The Principles of Ultra Relativity, Space Research Institute 1990, ISBN 915517-1

16.8 Mobius converter of Seike and Coler

Concerning construction it can be an advantage to wind a Mobius coil not purely bifilar and in that way to do without a perfect compensation. It often already is sufficient, if two conductors cross and only individual components of the field vectors partly cancel out. In the case of the coil, which is pulled apart and wound like a cross, drawn in fig. 16.7 D the conductor current and the fields of supply and return cable belonging to it stand under an angle of almost 90°. This in individual cases should already be able to cause the formation of open field lines.

Similar field conditions are formed, if after every turn the wire is looped under the last winding. At the knots again the angle conditions of approx. 90° occur. The Japanese professor Shinichi Seike preferably works with this kind of winding, which he directly derives from the Mobius band (fig. 16.8 A)[<i>]. He has designed an electro-gravitation motor basing on this principle. He also speaks of weight reduction and of an artificial anti-gravity field. It could be confirmed experimentally, that his setup cooled down slowly during the operational tests, despite the expected heating up by the copper losses of the current[<ii, S.29>]. Unfortunately I don't known anything more exact.
In his book further is found the wiring diagram of a radio for the reception of scalar waves (fig. 16.8 B). He thereby quite simply replaces all coils in the high-frequency part with his Mobius coils. If longitudinal waves already are measurable and receivable with this simple measure, first has to be checked.

The German captain Coler more than 50 years ago has developed another Mobius converter. His "Magnetstromapparat", with approximately 6 kW power and an at least four-fold over-unity effect uses six coils with permanent magnetic core. As a peculiarity he in addition runs the coil current through the core under an angle of 90° with regard to the coil current (fig. 16.8 C).

More detailed details can be seen in the footnote[<ii, S. 22>].

<ii>: Adolf Schneider: Energien aus dem Kosmos, Jupiter-Verlag 1994

S.22: "Scientists of the Technical University Charlottenburg in Berlin and Munich confirmed that the device functioned without objections, but they didn't find a theoretical explanation for the production of energy. The professors Kloss and Franke of the Technical University of Berlin found a degree of effectiveness of 450%. Prof. Schumann confirmed that 4.8 to 6.7 times more energy came out, than was put into the device. Prof. Schumann excluded a deception entirely as the records prove.
But it wasn't simple to set the device going and the stability for longer periods of time wasn't guaranteed. The war confusion set an end to further research. After the end of the war the British secret service confiscated all available documents and apparatus. Part of the report was declassified in 1962".

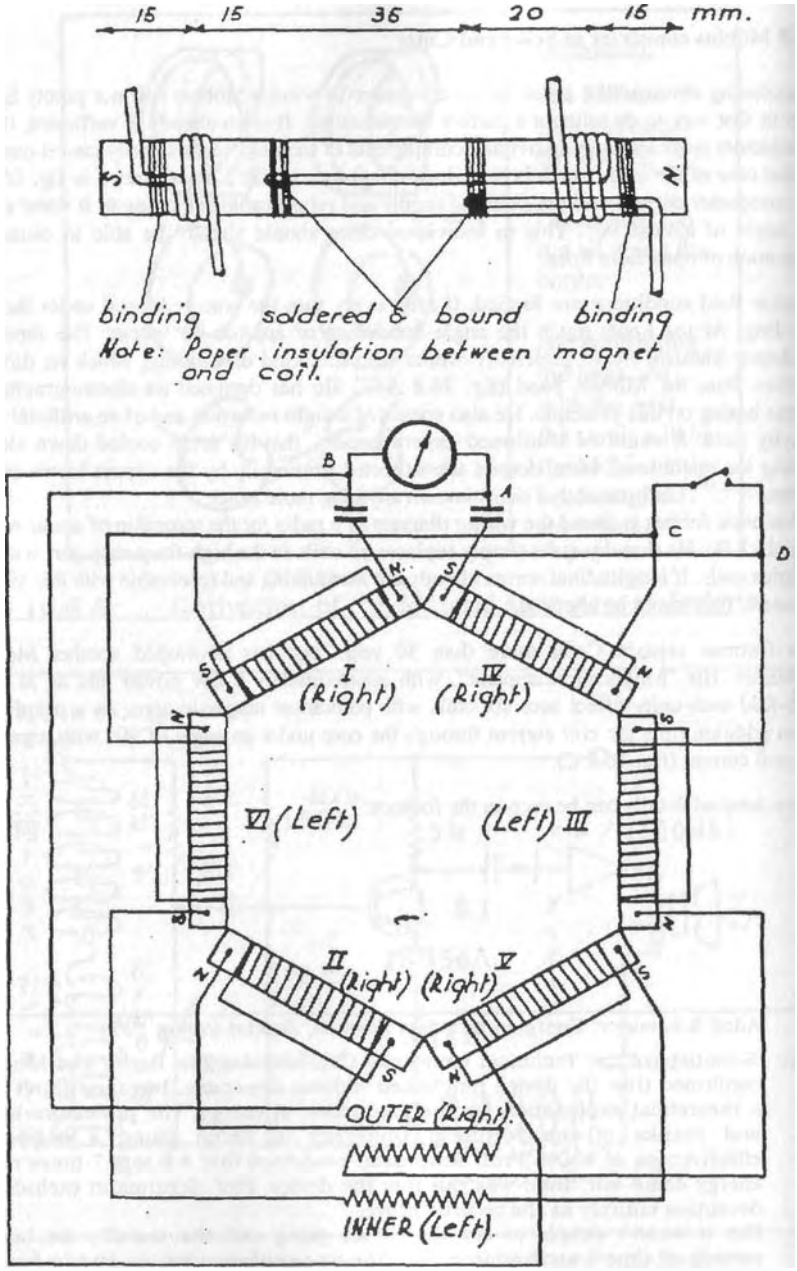

Fig. 16.8 C: The Coler converter

16.9 Tesla's flat coil

In the category of the unconventional coiling techniques without doubt the Tesla coil may not be missing. If in schools and high schools such coils were standing in the laboratory for teaching purposes, then as a rule it are cylindrical coils. In reality Tesla worked with flat coils but that, so is said, isn't necessary anymore today, since we have at our disposal better isolating materials than 100 years ago. Actually Tesla contended with problems of osilation, which he could solve with the help of the flat coil, but it should turn out that the coil geometry is attached a crucial importance.

Everything had started with Tesla having to leave the Technical Highschool in Graz without diploma. He ran out of money and he had dared to criticize the venerable Professor Poeschel and his sparking Gramm dynamo. With that he had put himself under compulsion to succeed. Two years later he had ready the solution. In the year 1882 he discovered the rotary field in Budapest.
In the time to come he designs and builds an alternating current motor, but no-one wants to have it and surely Thomas Alva Edison not. Tesla after this disagreement very fast gives up his job at the Edison Company again and again stands under pressure to succeed. With that the eternal bachelor Tesla urges himself to ever higher efforts. He wants to prove himself and the rest of the world that his alternating current system is superior to the direct current system.
Direct current, as is well-known, can't be transformed, and thus the advantage of Teslas alternating current lies in the possibility of power transport by high-tension cable over large distances. But for that the high-tension transformers first had to be developed and thereby the said problems of isolation occurred.
With each turn the tension voltage at the transformer winding increases. The distance to the grounding point lying on the outside has to be chosen bigger with each turn, so that no blow inside of the high-tension winding occurs. A consistent solution of the problem in accordance with engineering is the flat coil used by Tesla, wound spirally from the inside to the outside (fig. 16.9 A)[<i>].

It thus is correct that isolation technical reasons led to the flat coil, since Tesla himself was completely surprised as he had to find out that this coil can lose its self-induction, that scalar waves can be detected with it and that it is cooled down during operation in an inexplicable manner.

This cooling effect Tesla has investigated more detailed and after all even used. In his patent specification concerning the superconductivity he describes, that the flat coil also loses its Ohmic resistance, if he in addition previously cools it with liquid air. The remaining cooling down to absolute zero his flat coil obviously has carried out entirely by itself with help of the neutrinos (fig. 16.9 B)[<ii>].

<i>: Nikola Tesla: Coil for Electro-Magnets, Patent No. 512,340 (1894)

<ii>: Nikola Tesla: Means for Increasing the Intensity of Electrical Oscillations, Patent No. 685,012 (1901)

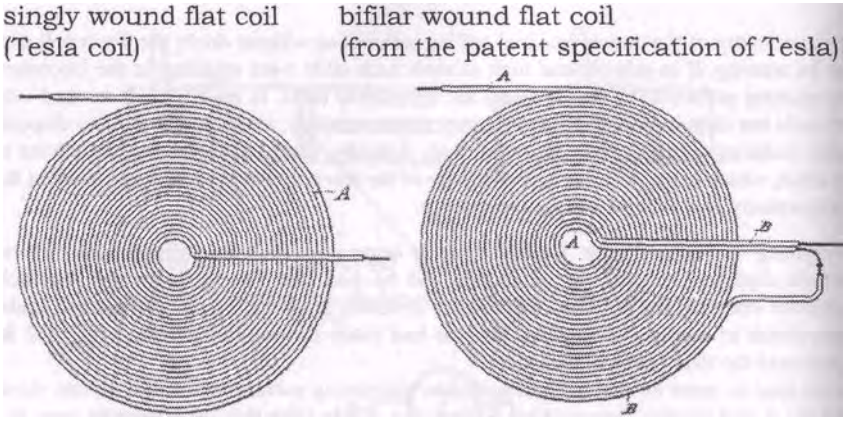

Fig. 16.9 A: Coiling techniques of Tesla's flat coil.[i]

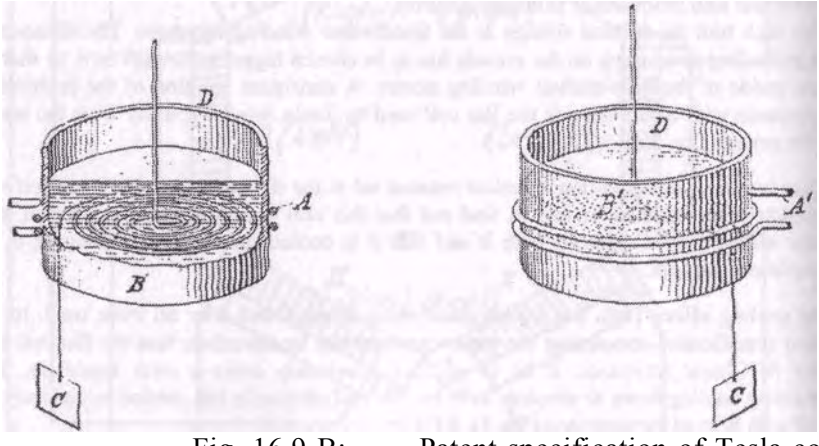

Fig. 16.9 B: Patent specification of Tesla concerning Superconductivity.[ii]

<i>: Nikola Tesla: Coil for Electro-Magnets, Patent No. 512,340 (1894)

<ii>: Nikola Tesla: Means for Increasing the Intensity of Electrical Oscillations, Patent No. 685,012 (1901)

16.10 The secret of the flat coil

The technical function could be explained in the way that the charge carriers of a flat coil by induction are set into motion for excitation from the outside. The transmitted energy shows in form of kinetic energy. The spiral flat coil becomes narrower and narrower towards the inside, the length of each winding shorter and shorter, so that the kinetic energy inevitable has to decrease in favour of a rotational energy. The faster and faster rotating spherical vortices are pulled apart to flat discs and eventually to ring-like vortices by the centrifugal force. The electrons at first become neutrinos bound to a line and finally free neutrinos. Tesla has technically used the first ones in the single-wire-transmission technique (fig. 9.5) and the last ones in his wireless energy transmission (fig. 9.7).

Like many other inventors, Tesla owes also the inventions, which he counts his greatest, like the radio technique and the Magnifying Transmitter, first of all his industriousness. his persistence and a great deal of inventor luck. A magician, as he is called in his most important biography, he by no means was[<i>]. The flat coil, to which led him chance and which plays a central role in all these inventions, gave him the lucky position, to collect neutrinos and materialize them to charge carriers or in reversed direction to dematerialise electrons to neutrinos.

The technology however is everything else but new. Already the Lituus of the Etruscan and Roman Augurs and the crook of the priests had the same spiral structure (fig. 16.10). In the case of the devices, which the Augurs for instance served at land surveying, it clearly concerns flat coils according to Tesla. We will go into this strange „gauge" more in detail in part 3 of the book[<ii>].

The trick probably is, that one component of the electric field pointer is directed towards the centre of the coil and as a result some open field lines are generated, which then collect neutrinos from space.
In this process the neutrinos thanks to the resonant interaction are slowed down to the speed of light and following, as discussed, materialized by means of the flat coil, as in addition rotational energy is withdrawn from the neutrinos. Since the receiver oscillates resonant with opposite phase, in addition the thermal oscillations are reduced and the receiver becomes cold!

If one compares the Mobius coil with the Tesla coil, then besides numerous properties in common the strength of the first coil lies in the production of open field lines and the collection of neutrinos, whereas the special and additional property of the flat coil lies in the materialization, in the conversion of neutrinos into charge carriers. But the advantages of the flat coil have to be bought at the expense of having to work with very high tension voltages (above 511 kV) and with large changes in tension voltage (du/dt). With this set of difficulties we will have to deal in more detail.

<i>: Margaret Cheney. Nikola Tesla, Erfinder, Magier, Prophet (Orig.: Man Out Of Time, 1981), Omega-Verlag Diisseldorf 1995

<ii>: K. Meyl: Electromagnetic environmental compatibility, part 3, edition belonging to the information technical seminar, INDEL Verlagsabteilung 2003.

Fig. 16.10: The Lituus or crook of the Augurs in ancient Rome

16.11 Discussion concerning the technology of the neutrino collectors

Let us again collect the facts for the discussion: A SET-device is distinguished by a more or less unipolar design and open field lines, with which interact neutrinos, which are oscillating in resonance. These then are slowed down and collected. For the transient process a large change in tension voltage (dE/dt) is required, which can be obtained directly, for instance by means of a spark gap, or indirectly by means of Faraday's law concerning the unipolar induction (E = v x B).
The discussed possibilities concern the acceleration of a machine part (dv/dt), the variation of the magnetic field (dB/dt) by pulse-like excitation signals (16.5) or by magnetic flux variation (16.3) and the railgun. which even can be operated without foreign magnetic field (fig. 15.5 C) and for which in that case occur both a dv/dt and at the same time a dB/dt.
For resting arrangements the velocity v is that of the charge carriers moving in the conductor. So that Faraday's law thereby doesn't lose its influence, the pointers of E and v mustn't point in the same direction, as in the case of "normal" coils. Unconventional windings, which for instance can be knotted like Mobius strips (16.7), take remedial action. Also the ancient crook, rediscovered as flat coil of Tesla (fig. 16.10), proves to be suitable in principle. Here one component of the electric field pointer points in the direction of the centre so that the wanted, at least partly, unipolar arrangement can be formed.

The first step, the collecting of space quanta, shouldn't pose an insurmountable obstacle anymore in view of the numerous possibilities and the detailed explanations. A real difficulty we still have before us, because in most cases some ring-like vortices bound to a line are formed, for which no electronic construction element exists and for which functioning converters hardly are known.
There spoons are bending, some lumps are flying through space, radioactivity is disappearing without a trace, light phenomena are formed and the device suddenly is becoming cold. Almost all inventors, who have arrived in this place, are enthusiastic about the not understood effects or with that are wanting to get attention, but hardly anyone really starts something with that. Until now the necessary system and an useful theory were missing.

Only too often isn't considered, that only an indirect conversion into charge carriers is possible, that during the materialization of neutrinos a intermediate product is formed, which can be described with the model concept of a neutrino bound to a line or of an oscillating ring-like vortex. The technologies collected in this chapter concerning the collecting of neutrinos only form the first step from the free to the bound ring-like vortex. The coming chapter is dedicated to the second step. Here we should try to understand the properties of space quanta bound to a line and loudly think about for which purpose we could use them in practice<i>.

<i>: Reference: Both chapter 16 and chapter 17 treat point 4 according to table 15.1 concerning the resonant interaction (page 86).

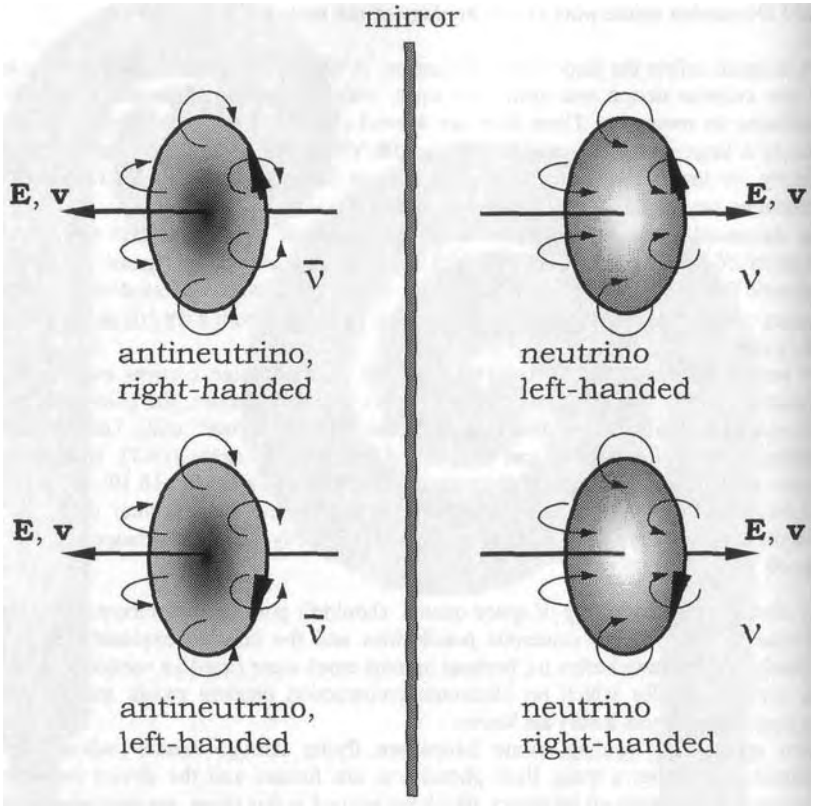

Fig. 17.1: _____Application of the mirror transformation to the neutrinos

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<i>: Kleine Enzyklopadie Atom, Verlag Chemie GmbH, Weinheim 1970, S. 119:
„For the neutrinos the quantum number parity isn't defined, because they have a fixed association of the direction of momentum and spin; the sense of rotation of the spin and the direction of momentum in their case form a left-hand wound screw, in the case of antineutrinos a right-hand wound screw. By the shown mirroring the direction of momentum is reversed, but the sense of rotation remains unchanged; i.e. reactions, in which neutrinos occur, are not mirror invariant, they violate the law of conservation of parity". (translated)

Note of the author:, an antineutrino by no means can be assigned to the anti-matter, since it exactly like every neutrino alternatingly takes the matter state and the anti-matter state, by oscillating around itself (see fig. 7.12). The description merely follows a definition founded in usefulness.

17. Technical use of the weak interaction

17.1 Radioactivity caused by neutrinos

Neutrinos are standing in a weak interaction with other elementary particles. This circumstance is known in general. According to the considerations and derivations expressed in the book the neutrinos mediate the resonant interaction, what leads to the conclusion, that the weak interaction represents a partial aspect of the resonant interaction, in which case it merely concerns the proximity.
Efforts are further being undertaken, to combine the weak interaction with the electromagnetic to an electroweak interaction, after it was remarked that a certain coupling constant corresponds in both cases. We of course aren't surprised, because the electromagnetic interaction anyhow describes only the special case of the resonant interaction with the frequency zero.
The weak interaction concerns with the very small range of just 10^{-16} meters only the proximity of the neutrinos, for instance the ß-decay, where the neutrinos for the reason of their oscillating charge a free neutron rattle and shake so long, until it eventually decays. on the average after approximately a quarter of an hour.

The Austrian physicist Wolfgang Pauli had remarked, that half the decay energy after a beta-decay is missing and the balance sheet of energy isn't working out. In addition also the balance sheet of angular momentum isn't working out, because the nuclear spin is being changed for a whole unit. Pauli as a result 1930 has introduced a hypothetical particle without mass and without charge, which he called neutrino.
With that Pauli and his co-working Italian colleague Fermi it is true are the givers of the name of the neutrinos, but not by all means the discoverer. If Cowan and Reines l956 have detected these particles with large expenditure of devices, then also that by no means was a premiere, as falsely can be read in textbooks and encyclopaedias. After all Nikola Tesla already decades ago had demonstrated, that the neutrino radiation not only exists, but even can be used energy technically.

Now the radioactive decay a ß-radiation occurs, triggered by the conversion of neutrons in protons or vice versa. This obviously takes place under the influence and participation of neutrinos in the atomic nucleus. The ß-radiation to a special extent consisting of electrons and positrons, as it occurs in the case of nuclear fission, is quite unhealthy and by no means ecologically compatible. Under the influence of free charge carriers not only metal lattices become soft and spoons can be bent, but also an electrolysis takes place, where the water molecules are splitted into their parts. That isn't a good prerequisite for the flora and fauna on our planet, which predominantly is built up of water structures.

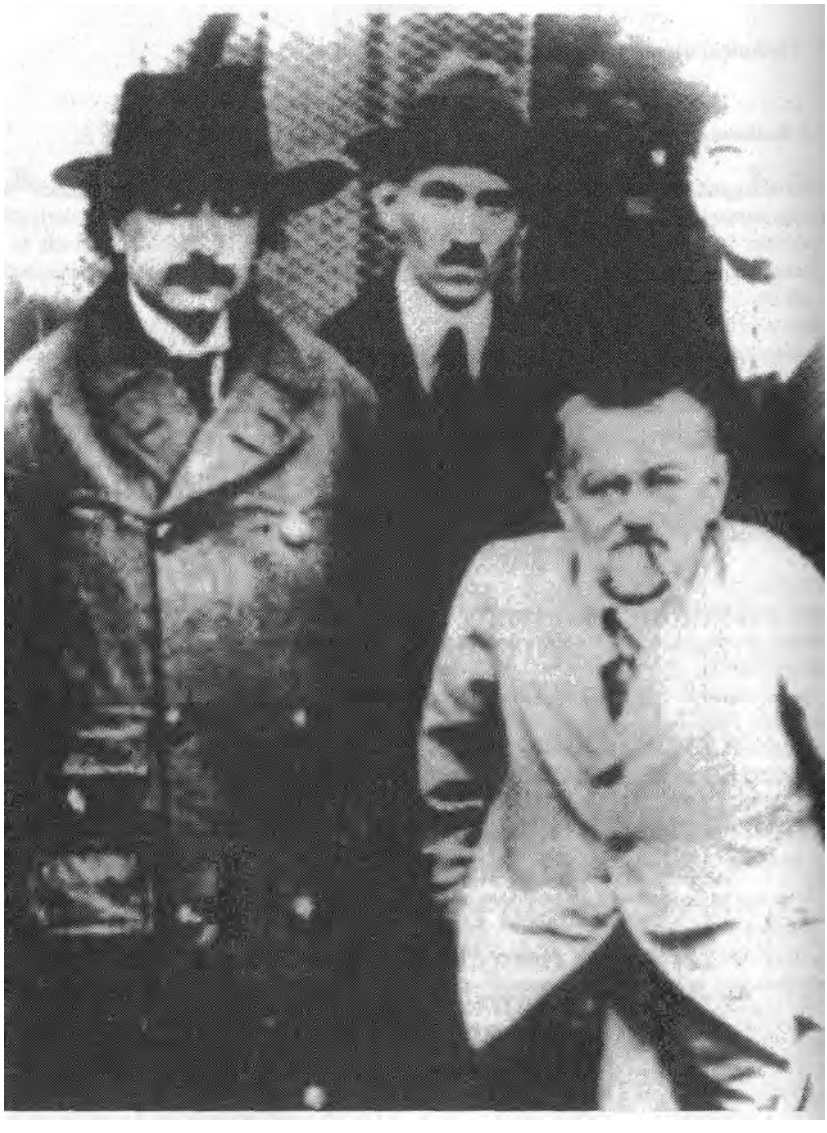

Fig. 17.2: Einstein, Tesla and Steinmetz[<i>]
(from left to right)

<i>: Franz Ferzak: Nikola Tesla, Eigenverlag, S. 103

17.2 Nikola Tesla, the discoverer of the neutrino radiation

The discoverer of the neutrino radiation himself will best be able to explain the connexion. In the New York Times Tesla writes, that he has discovered and investigated the phenomenon of the cosmic radiation, long before others started their researches[i]: "According to my theory a radioactive body is only a target, which constantly is being bombarded by infinitely small balls (neutrinos), which are projected from all parts of the universe. If this, at present unknown, cosmic radiation could be interrupted completely, then no radioactivity would exist any longer.
I made some progress regarding the solution of the mystery, until I in the year 1898 attained mathematical and experimental evidence, that the sun and similar celestial bodies emit energy-rich radiation, which consist of inconceivable small particles and have velocities, which are considerable faster than the speed of light. The ability of penetration of this radiation is so large, that it penetrates thousands of kilometres of solid matter, without their velocity being reduced noticeably. "
It must be admired how Tesla guided by experimental observations and a reliable instinct comes to the correct result. He merely with the conclusion, because of the missing interaction the neutrinos have to be inconceivably small, isn't quite right. Their size rather depends on the velocity, because the overfast neutrinos are being length contracted stronger. Tesla however hits the nail exactly on the head, if he on the occasion of the press conference for his 81st birthday declares, the radioactivity is a clear proof of the existing of an outer radiation of cosmic origin[ii]. „ If Radium could be shielded against this radiation in an effective way", Tesla writes in an essay of 1934, „then it wouldn't be radioactive anymore". At this occasion he contradicts Albert Einstein, without thereby pronouncing the name and is indignant at the wrong working method of the scientists[iii].

Me personally fascinates, how here until now ignored results have been presented, which I first had to work out theoretically myself with difficulty. Tesla, to the best of my knowledge, hasn't taken theoretical derivations, at least none have been handed down. As a brilliant experimental physicist he must have reached his conception world by means of the measuring technique. The perfect correspondence of his experimentally determined and the by me theoretically won insights should be judged as evidence for the correctness of this view.

<i>: Dr. Tesla Writes of Various Phases of his Discovery, New York Times, Feb. 6, 1932, P. 16, col. 8

<ii>: Tesla Said (J.T. Ratzlaff), Tesla Book Company, ISBN 0-914119-00-1, P. 272

<iii>: "The scientists of today think profound instead of clear. One has to be mentally sane, to be able to think clear, but one can think profound and nevertheless be completely insane. The scientists of today have substituted experiments by mathematics, and they travel from one equation to another and eventually build up a construct, which has absolutely no relation to reality"...

taken from N. Tesla: Radio Power will Revolutionize the World, Modern Mechanics and Inventions, 7/1934, (Tesla Said, P. 264)

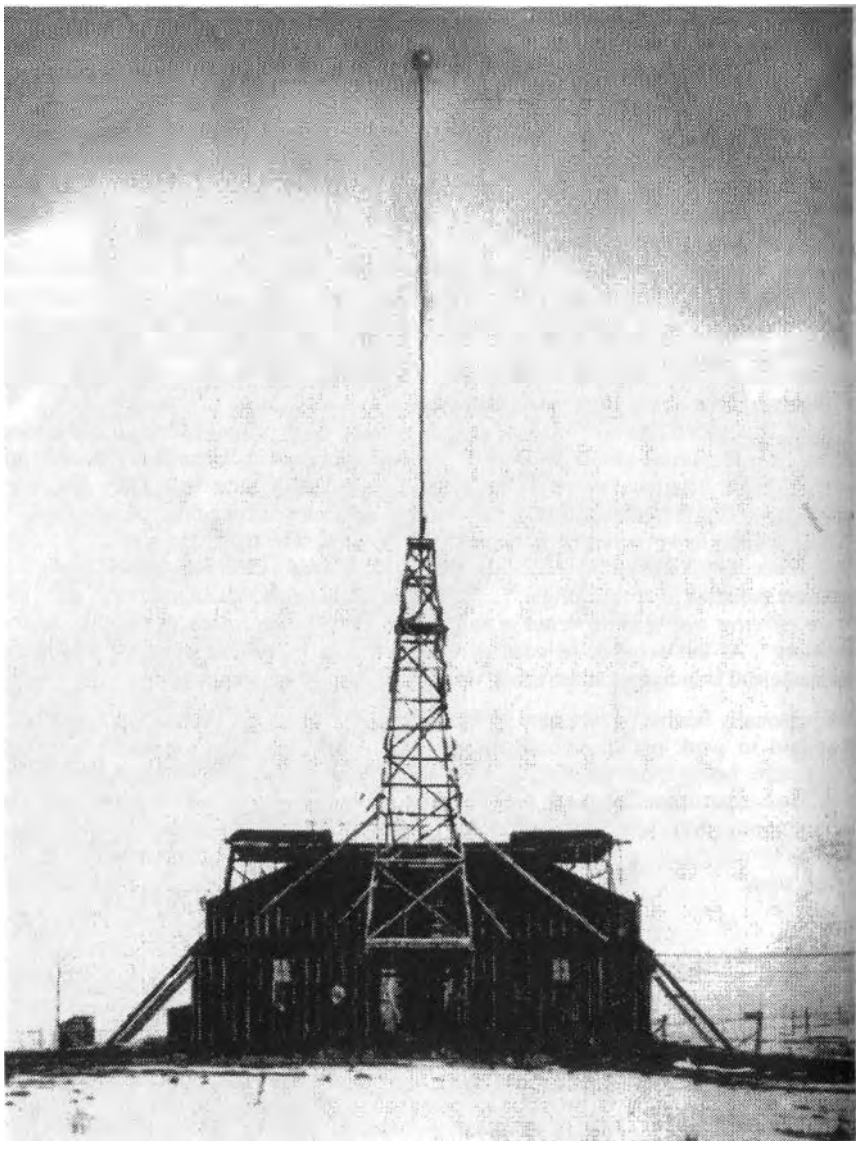

Fig. 17.3: The Magnifying Transmitter of Nikola Tesla Would the research station in Colorado Springs (1899 - 1900) have been suitable for transmutation?

17.3 Transmutation and reduction of radioactivity

If we are capable to collect and bundle up neutrinos, then should with that an influencing of the radioactive decay become possible, then also a decontamination of radioactively contaminated material and a so-called transmutation should be possible. We here have a concrete possibility before us, to use the produced ring-like vortices directly for the benefit of humanity. Dangerous transports with Castor containers, permanent and temporary storage and the contamination of whole areas by radiation, like around the nuclear power station Tschernobyl, which got out of control, wouldn't be necessary at all. If namely burned out fuel rods and objects contaminated by radiation have undergone a concentrated neutrino shower, then the radioactive decay takes place accelerated, so that the half-life can be drastically reduced. After the treatment the dangerous special waste would have been changed to harmless domestic rubbish. Even recycling or reuse are feasible.

The topic is at least as explosive as the energy question and as well completely unsolved. That's at different places and in some companies is already feverish researched about technologies concerning transmutation. Often it are the same people, who also work at the theme of space energy. The reason quite simple is that in both cases neutrinos have to be collected and bundled up. In the case of transmutation however the necessity of materialization can be dropped, so that the goal can be obtained faster and simpler. Consequentially is reported of more cases of a successful decontamination and of transmutation, than of functioning energy converters. Until now most techniques however still hardly are suitable for bringing into action technically on a large scale, but they carry clues of a solution of the problem already in them.
At the congress "New Energy technologies from USA" 6.12.1997 in Zurich I have lectured concerning the theme[<i>]: „Presumably as the first one the doctor Dr. Wilhelm Reich has carried out corresponding experiments with his „Orgon accumulator" (fig. 9.2). From him also stem warnings about biological effects, which should be taken serious, if radioactive material is put under his Orgon accumulator and the process of decay takes place accelerated".
If one dares an interpretation of his experiments with only 1 mg radium, then numerous charge carriers materialized at hitting upon his sample of the bundled up neutrino radiation with the consequence of high electrostatics in the environment, which Reich has called DOR-state (Deadly ORgone) (chap.15.11).

Another way would be the rebuilding of a neutrino transmitter according to the plans and patent specifications of the experimental physicist Nikola Tesla (fig. 9.11). He 100 years ago had realized a real neutrino-broadcasting and for that developed an unconventional switching technique. Tesla called his transmitter a „Magnifying Transmitter" (fig. 17.3). He choose the name „Magnifying Transmitter", after he had received more energy than he had transmitted in experiments and this effect moreover was increased with increasing distance to the transmitter. He obviously also had collected free and synchronously oscillating neutrinos, and that would be the best prerequisite for a successful transmutation and decontamination of radioactive material!

<i>: Konstantin Meyl: Die Wechselwirkung der Neutrinos; uber Massnahmen, die Halbwertszeit beim radioaktiven Zerfall herabzusetzen. NET-Journal Jg. Nr. 3, Jan./Feb. 1998, S. 14-20

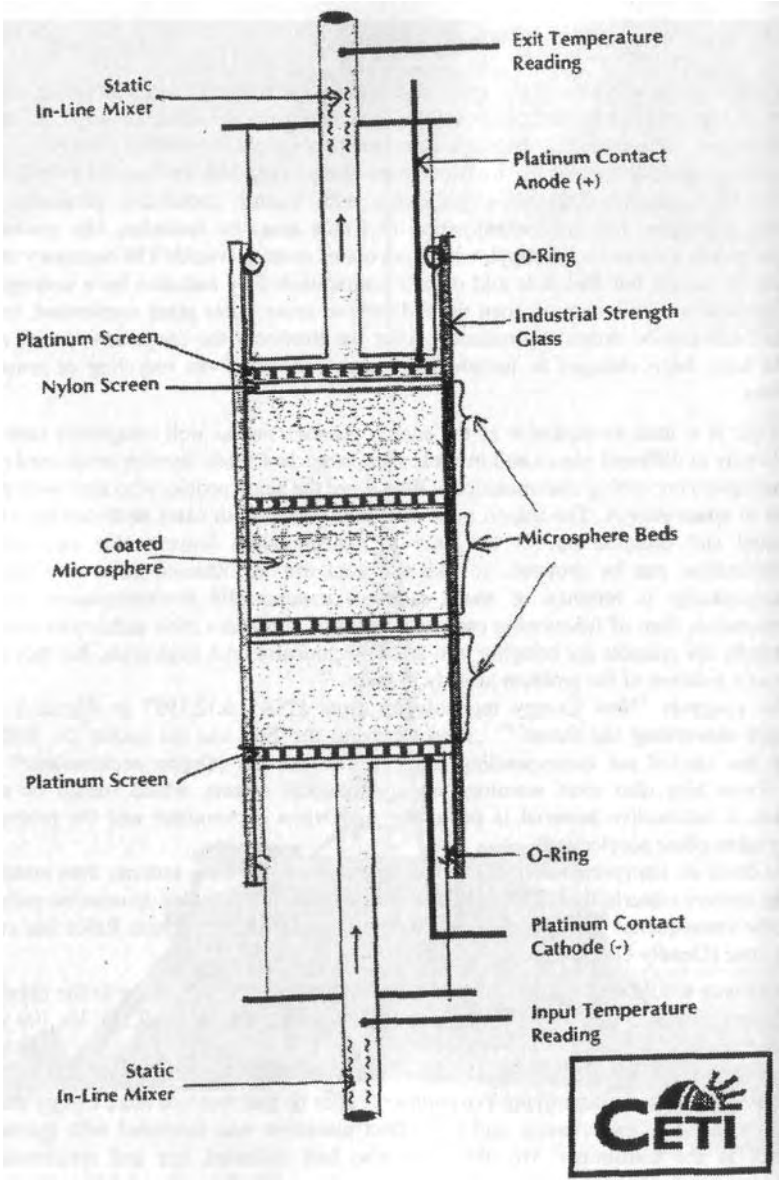

Fig. 17.4: 1 kW Patterson Power Cell.[<i>]

<i>: Patterson, J. A.: System with electrolytic cell and method for producing heat and reducing radioactivity of a radioactive material by electrolysis. US Patent No. 5.672.259 of Sept. 30, 1997, as reprinted in Infinite Energy, July-Nov.1997, pp. 13-16

17.4 The Patterson Power Cell

As an example worth paying attention to, the Patterson Power Cell should be mentioned, which not only can be used for generation of energy but, how could it be otherwise, also for reduction of radioactivity and for transmutation. The energy cell invented by the chemist Dr. James A. Patterson is researched and developed further by the company CETI (Clean Energy Technologies Inc.) in Sarasota (Florida, USA). According to latest reports such a device supplies at most one kilowatt of heat energy at an over-unity of up to 4000; thus 4000 times the energy is released than is taken up as required for the operation!
In fig. 17.4 one single cell of the energy converter is shown. The glass container consists of three chambers of approx. 4 cm height each time and about 1.9 cm in diameter and works like a continuous-flow water heater. From the bottom tapwater or distilled water is supplied and at the top connection again taken away in heated form. The excitation takes place electrostatically by means of two platinum electrodes. The anode situated at the top is connected with the positive pole and the cathode with the negative pole of the source of direct current.
In the three chambers are situated tiny, filmy coated small balls, which form the real principal item of the cell. Production method and structure of the beads are oriented to the task to be mastered. In the case of a variant conceived for the generation of energy the barely one millimetre in diameter small synthetic beads carry after each other a thin layer of palladium, a layer of nickel and once again one with palladium[i].

The small balls remind with their layered structure at first of the Orgon accumulator of Reich. They also seem to function as collectors of neutrinos, but for smaller wavelengths and much higher frequencies. In addition is chosen a concentric arrangement with the spherical form, which with the electrically conductive surface and the dielectric core fulfil the function of a cavity resonator. Resonance actually is possible with flying past neutrinos, which have a wavelength which amounts to an integer multiple (1,2,3,..) of twice the diameter of the sphere.
The arising resonant oscillation however concerns not only the electric and magnetic fields, but by means of electrostriction and magnetostriction also a mechanic oscillation of size. The oscillation of size in reverse causes again oscillating electric and magnetic field pointers, which are partly open along the spherical structure and can interact resonant with further neutrinos. In this repercussion field the actual secret of the functioning of a Patterson-cell is hidden.

The president of the German association of space energy, Prof. Dr. Dr. Josef Gruber on the occasion of his visit at the company CETI and of a conference about „cold fusion" in Vancouver has published a report[ii]:

<ii>: Gruber, J.: Kalte Fusion und Raumenergie, report concerning the 7th international conference about "cold fusion" of 19.-24.4.1998 in Vanvouver, B.C., Canada (Infinite Energy, Issue 19, 1998) and report concerning "International Symposium on New Energy" of 23.-26.5.1997 in Denver, Colorado, USA (Denver-report of the remote University Hagen)

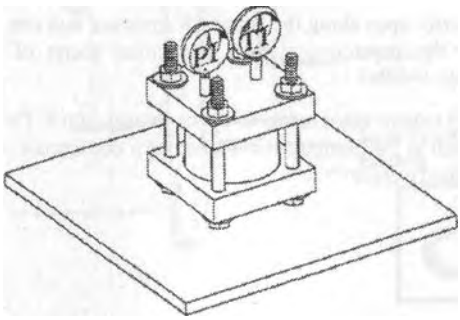

Fig. 17.5: _____Low Energy Nuclear Transmutation Cell,[i] the kit for experiments LENT-1 (Showing Temperature and Pressure Gags)

<i>: taken from the NET-Journal, 10/11 1997, S. 7

17.5 Report concerning the cold fusion

"In the case of the Patterson transmutation cell it concerns a special electrolysis cell, in which the radio nuclides are charged. During the electrolysis the decay activity measured by means of a Geiger-Muller counter decreases drastically. Within a few hours reductions of up to 80% are obtained. In such an electrolysis system with electrodes consisting of specially coated beads low-energetic nuclear reactions can be observed. In this case elements are detected in the metallic layers of the beads, which before were not contained in these. Further are measured changed (unnatural) proportions of isotopes. From these transmutation can be inferred, which is used in the cell for the conversion of radioactive elements.
Until now natural uranium and thorium were used as radioactive material. The reproducibility already now is very good. The applicability for commercial purposes, for the reduction of the radioactivity of burnt up fuel elements and for the conversion of plutonium is easy to see".
At his visit in the laboratory of CETI in Sarasota 28.5.97 Prof. Gruber has witnessed an experiment to annihilate radioactivity with the Patterson transmutation cell. He reported about it: "In the presence of N. J. Olson from Pacific Northwest Laboratory (operated by Batelle for the U.S. Department of Energy) a team of the television station ABC conducted by the science journalist Dr. M. Guillen made recordings for a television program, which meanwhile has been broadcasted all over the country. The original tension voltage - among others a Geiger counter rattled - subsided as the expected success became apparent in the experiment: After one hour 50% of the radioactivity stemming of uranium nitrate were removed, in another half an hour further 13%. Doing so also a considerable lot of surplus heat was produced.

New techniques of this kind to reduce radioactivity have an important advantage: One brings the SET-device there where the radioactive material is situated and reduces the radioactivity on the spot. For the conventional technique, still being in research, in contrast to that the radioactive material first is wrapped in a complicated manner and then transported to a special factory, where radioactivity is reduced at great technological expenditure and use of energy - altogether a procedure which is relatively costly and politically only hard to carry through".

Patterson cells already can be obtained commercially for research purposes. The same goes for a demo-kit[<i>] of the company Trenergy, Inc. of Hal Fox, who has built up the biggest database of the world concerning the theme "Low Energy Fusion" in the "Fusion Information Center" at the university of Salt Lake City. He is editor-in-chief of the "Journal of New Energy".
If one believes the statements on their web-site[<ii>], then one is capable of converting 10 g of radioactive thorium in 900 mg titanium and some copper in less than an hour with the kit for experiments LENT-1. Under a pressure of 3200 psi sodium already is said to have fusioned to gold, something of which alchemists dream, as an unintentional side effect, as researchers in Cincinnati/Ohio say[<iii>].

<i>: NET-Journal, Jan. 1997, S. 24
<ii>: see Internet: http://www.hal-fox@slkc.uswest.net
<iii> : NET-Journal, 10/11 1997, S. 7

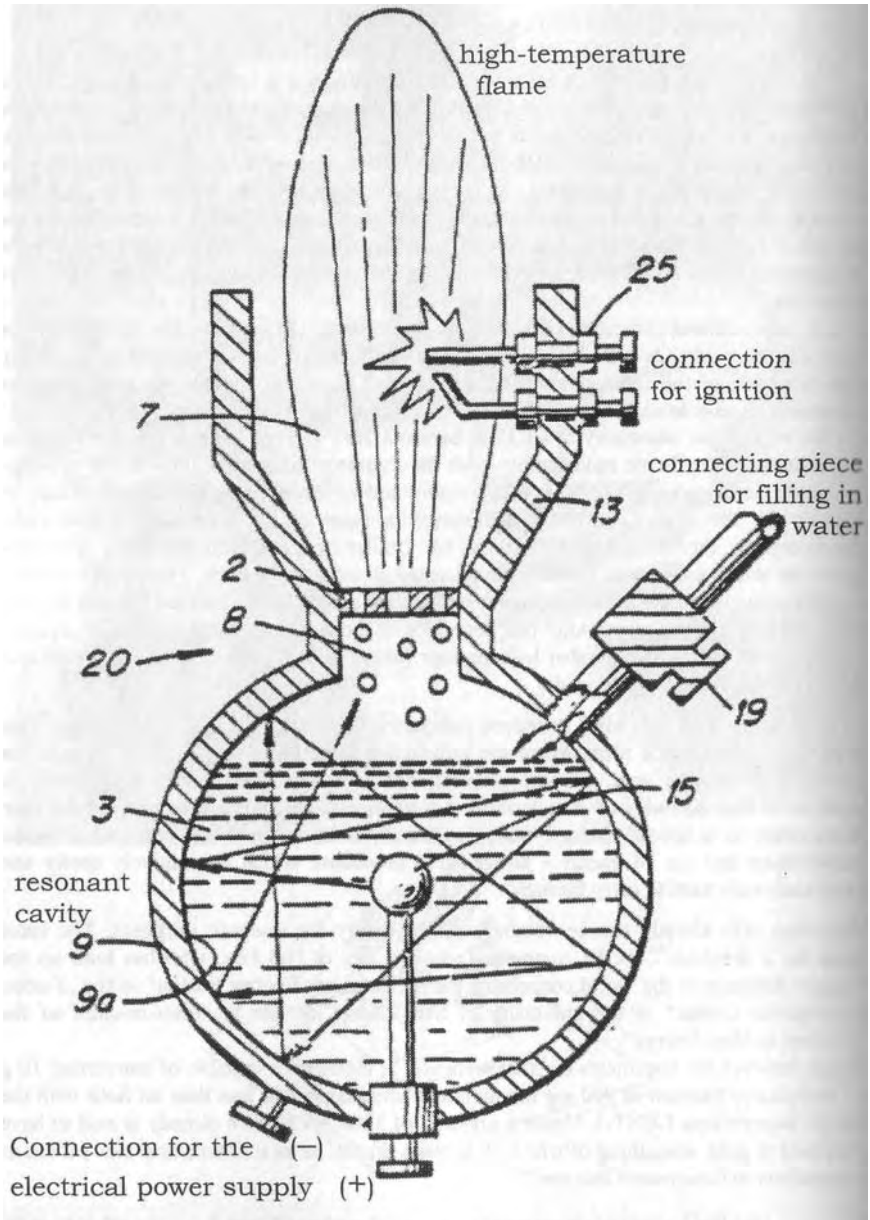

Fig. 17.6: The water-fuel-cell according to Stanley Meyer<i>

<i>: H.-J. Ehlers: Stan Meyers Wasser-Zellen-Technik, Raum & Zeit special 7, p. 201, taken from the Canadian patent specification 1234 773 of 5-4-1988

17.6 Water-Fuel-Cell technology

The United States are, just what concerns spectacular techniques like the removal of radioactivity or the transmutation of new materials, obviously still the land of unlimited possibilities. Nowhere the list of researchers of cold fusion is as long as in North America.
But there also in many places only is tried and tinkered without visible system or usable theory. Then in many cases unfortunately only a show-effect is to the fore, while construction plans and details concerning the way of functioning, as far as they actually exist, are kept secret. In total there, besides a lot of hot air and wrong hopes, is left behind little to be used and cited.
By the way, in my opinion cold fusion has to do very much more with space energy and neutrinos than with hot fusion. How much disaster a wrong referring to and an unusable theory can bring about, has become clear at the example of the "cold fusion researchers" Fleischmann and Pons. They have placed themselves into the scientific offside with their misinterpretation concerning cold fusion.
Moreover are both primarily scientists and theorists. Practice however is, according to general definition, "if in spite of all it functions!" The American Stanley Meyer is such a practical man and his water-cell-technology actually seems to function, although he in his 18 patent specifications gives theoretical explanations, which he just as well could have saved himself. With that his effect isn't explained.
An usable interpretation would be that this device, comparable to a cell of a plant during photosynthesis, splits water molecules into its parts by putting on neutrinos. Even without knowledge about space quanta the buggy of Stanley Meyer already runs with a air-cooled 1500 cc VW-engine, and it consumes no gasoline at all. The tank is filled with water; it even may be sea water. The consumption of water lies at 2.8 litres at 100 kilometres and thereby is formed predominantly hot steam again as a combustion product.
If thus cold water is converted into hot water and at the same time mechanical energy is available. then inevitably another source of energy must be involved. According to my interprelation it must concern the neutrino field. If the here presented details are correct then the over-unity effect lies at approx. 100, the degree of effectiveness thus at 10000 percent.

American companies, with which Stanley Meyer had concluded contracts, should make the "Water-Fuel-Cell technology" mature for series. Also the financing seemed secured. But then per internet the message came, he 21.3.1998 was having supper in a restaurant in Grove-City, as he suddenly jumped to his feet from the table and called out, he had been poisoned. He died on the spot[<i>].

Alarge number of inventors is known, who tap space energy with the help of water. It concerns an increase of the content of oxygen or of the content of colloids, thus an improvement of the water quality. Or it concerns formation of vortices as already in the case of Walter Schauberger, glowing phenomena or also the generation of free energy from the neutrino field. In this concert the concept of Stanley Meyer takes an outstanding place, as particularly efficient, instructive and clearly understandable for us, for which reason we cast our eyes over the design (fig. 17.6 and 17.7).

<i>: Zum Hinschied von Stanley Meyer", NET-Journal April/Mai 1998, S. 25; see: obituary in Infinite Energy Magazine

A. The pattern of the pulses of the excitation voltage:

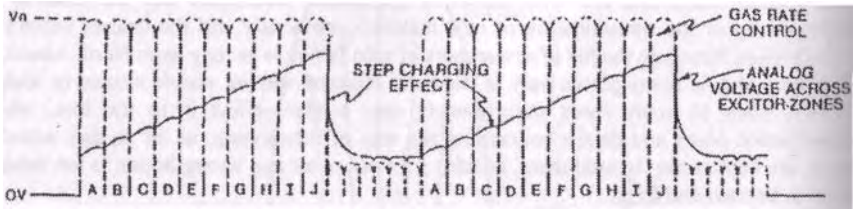

B. The wiring diagram:

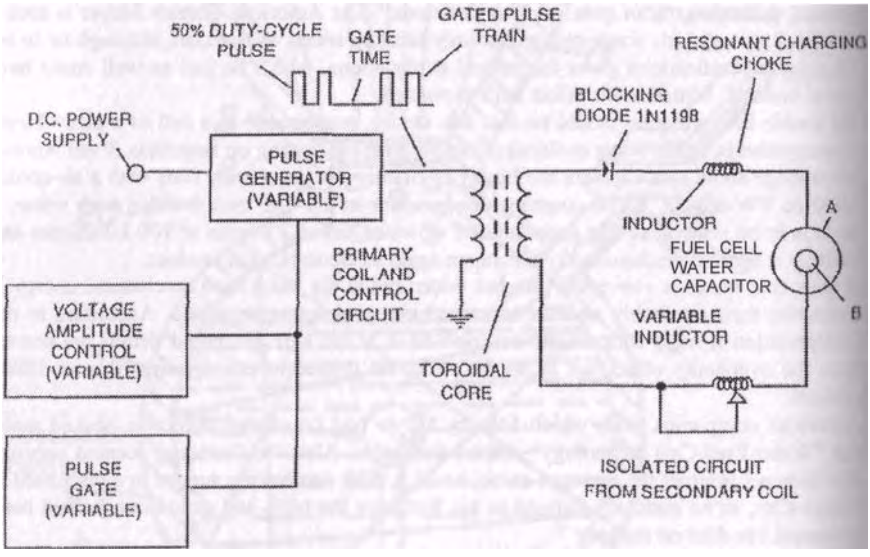

Fig. 17.7: Wiring diagram for the driving of the water-cell<i>

<i>: Stanley, A. Meyer: Process and Apparatus for the Production of Fuel Gas and the Enhanced Release of Thermal Energy from such Gas, 15.06.89, US-Pat. 207,730; International Publ. WO 89/12704; Int.Appl. PCT/US89/02622

17.7 Unconventional electrolysis

Numerous of the by Stanley Meyer used construction principles already have been treated, be it the excitation with pulses of electric tension voltage or the spherical structure of the resonant cavity (fig. 17.6). As a spherical capacitor with the positive pole in the centre and the negative pole at the outside edge it corresponds to the model of the electron and fulfils in an almost ideal way the conditions of an unipolar arrangement according to fig. 15.8 B. The use of certain patterns of the pulses and steep flanks of the pulses (large dU/dt) make possible effects of resonance at frequencies starting at ten kilohertz, in which neutrinos participate increasingly. First the series resonant circuit, consisting of the adjustable, external inductance and the spherical capacitor, is stimulated by means of the current rectifying wiring (fig. 17.7). In the case of resonance, which is carried out by comparison of the inductance, the excitation current drops, whereas the tension voltage at the same time teaches values of more than 1000 Volts. If in addition a neutrino resonance occurs, then the known avalanche effect will occur. The equipment then takes up virtually no current.

As a dielectric serves water, with which the container is filled permanently. The dimensions are oriented after the velocity of movement of the water molecules according to details of the inventor. Also the oscillating water molecules should go into resonance. Then they can help to materialize the neutrinos. Their rotational energy partly passes to the water molecules and as soon as the neutrinos have been converted to charge carriers, they will take the water molecule from the oppositely charged side and split it without further ado. The oxygen and hydrogen gases leave the capacitor through fine openings at the upper edge of the spherical chamber, which are so small, that no ignition back can occur, and in the simplest case reach a combustion chamber, where they burn again to water as a high-temperature flame (fig. 17.6).
The gases of course also can be guided into the cylinder of a Otto engine and be ignited there, as in the case of the experimental buggy. In the sectional drawing can be seen a filler by means of which, according to the consumption, water is refilled. The round resonant cavity not necessarily has to be spherical. Stanley Meyer more frequently differs from the ideal form and works with a cylindrical symmetry (fig. 17.8), with which obviously in spite of that the goal can be obtained, if perhaps not quite so good. To this compromise the explanations of fig. 15.8 C apply.
If we, to conclude, cast our eyes over the wiring diagram which Stanley Meyer discloses in his patent specification (fig. 17.7 and 17.8)[<1>]. In the centre is a transformer, which should produce an if possible high tension voltage. A rectifying diode, which takes care that only positive tension voltage pulses serve the excitation, is switched in series with the reaction capacitor, which is filled with water, a fixed and a variable inductance. In that way the positive pole is always situated in the centre of the reaction chamber. If both connections would be exchanged or the diode be turned over, then the neutrinos presumably would materialize in positrons and not in the wanted electrons. But if one leaves out the diode entirely and one has a tension voltage changing both in positive and in negative direction, then maybe electrons and positrons are equally generated, which annihilate each other under emission of gamma quanta. Doing so no gas is formed, but at most light, as long as the effect of collecting neutrinos isn't lost also. The concept should be worth to be examined more detailed already of pure scientific interest.

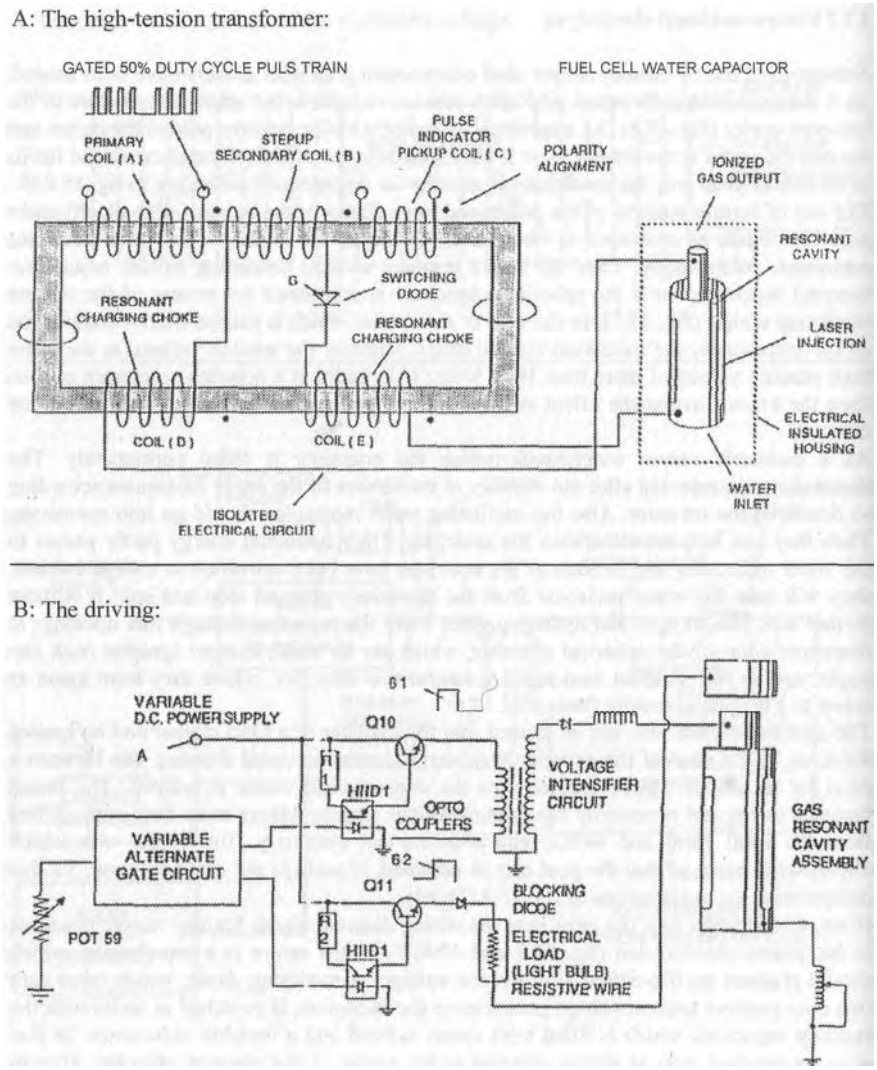

Fig. 17.8: High-tension transformer and driving of the cylindrical water-cell<i>

<i>: Stanley A. Meyer: Process and Apparatus for the Production of Fuel Gas and the Enhanced Release of Thermal Energy from such Gas, 15.06.89, US-Pat. 207,730; International Publ. WO 89/12704; Int.Appl. PCT/US89/02622

17.8 Materialization of neutrinos

In the centre of attention of the water-fuel-cell of Stanley Meyer is on the one hand the unipolar arrangement (according to fig. 15.5 B or C) to collect the neutrinos and on the other hand the water for slowing down and materializing. Over and above that a lot was tinkered and tried, as can be inferred from the patent specifications (fig. 17.8). That starts at the. coiling technique of the transformer and concerns the experiments with laser stimulation as well as the top part, which according to the inventor should extract the electrons (Electron Extractor Grid). The measures may bring an improvement, but are insignificant for our considerations.

At this place it primarily concerns the question of the materialization of neutrinos. But if such a materialization has to be made complete, if water molecules must be splitted, depends on how long the process lasts. If everything goes very fast, then perhaps it is sufficient that a neutrino for a short time is showing as an electron, before it again oscillates back. In this short time the splitting process already could have taken place. The used neutrinos for that had to be very low-frequent and very slow. They after that could again leave the reaction chamber and fly on as neutrino.

Possibly the fishes, which live in stagnant waters or in the deep sea, owe the slow neutrinos the content of oxygen in the water. Because here no bundling up takes place, the splitting of water takes place rather by chance. The volatile hydrogen atoms escape very swiftly, whereas the big oxygen atoms are left behind in the water.

Now we still don't know how charge carriers can be won. At the RQM unit resonant oscillations of size had been measured and that can be judged as an important clue. If namely a space quantum is slowed down then it becomes bigger. The inverse case we already had made us clear: If a particle is correspondingly fast then it is sufficient length contracted to fit through the tunnel (fig. 6.14).

To slow down neutrinos according to that the target area should carry out an oscillation of size with opposite phase. Organic material and biological systems are excellently suited for that. Every contraction of a muscle brings that to mind. Inorganic matter and our technology however normally don't know this phenomenon. Technical energy converters simply are built up fundamentally else than biological muscle machines.

In historical sources at certain places is pointed to the fact that priests had experimented with quartzes and miraculous phenomena were observed. Of course the question is asked, if such experiments today still can be reproduced. Because the density of the earth slowly increases due to the growth in volume, also the wavelength of these oscillation quartzes is changed. The same neutrino radiation therefore today can't be active anymore. It thus would be completely inappropriate wanting to reject a historical source only because a described effect today doesn't want to function anymore.

Magnetostrictive or electrostrictive material could be a solution. For instance a piezocrystal, which contracts under the influence of an outside field. As an ultrasound converter an applied alternating voltage leads to the emission of a sound wave. If we reverse the function, then a received longitudinal wave should lead to an electric tension voltage and then at last the materialized charge carriers could be taken off,!

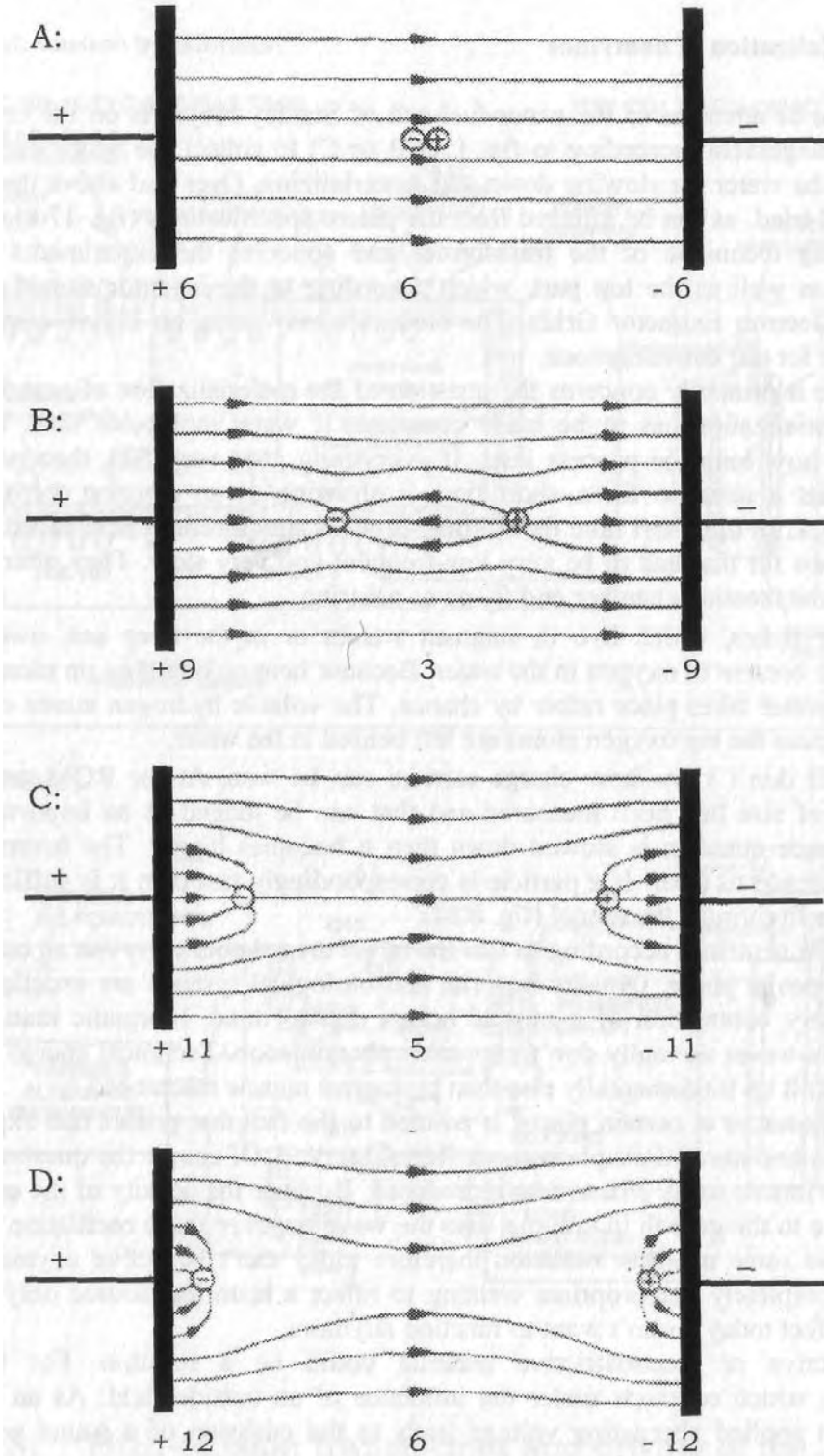

Fig. 17.9: The course of the field in the case of a glow-discharge<i>
(The numeric values indicate the active field lines, as they can be read from the representation).

<i>: K. Kupfmuller: Einfuhrung in die theoretische Elektrotechnik, 12. Aufl. Springer-Verlag (1988), S. 197

17.9 Oscillation of size and luminescence

There exist substances, which at high temperatures start to glow. In the sense of the theory of objectivity presented in the first part of the book in the case of temperature it actually concerns an oscillation of size of the involved elementary particles (fig. 8.3). If this oscillation of size lies in the visible frequency range, then we can directly perceive it and it can be used for instance in a light bulb for the purpose of lighting.
In the case of an arc. fluorescent tubes or glow-discharge lamps light is formed as well even without a thermal effect. These glowing phenomena are called luminescence. They can be caused by chemical processes, by friction, by crystallization or by electric fields. As can be shown speedily, in these cases it also concerns an oscillation of size.

If we for that consider the model on the left (fig. 17.9). Between two electrodes there is a non-conducting gas, e.g. air. If now a tension voltage is applied then, under the influence of the electric field, some gas atoms are splitted into positively charged ions and negative electrons (case A) and pulled apart (case B). This process of enlargement of the glow-discharge fast as lightning comes close to that of the thermal oscillation of size and obviously in the same way is perceived as light.
The ionised gas parts are attracted by the unlike poled electrodes and move towards these (case C, D). Whoever takes the effort to count the number of the field lines, will find out that between both electrodes the electric field drops, whereas it at the same time increases at the electrodes. The first thing causes that the process of ionisation is stabilized by itself and a state of equilibrium will result; the resulting current takes a constant value.
The increase of the tension voltage at the electrodes on their behalf causes that an arc remains standing or the glow-discharge lamp glows on, even if the feeding voltage is reduced. For this reason a fluorescent lamp needs a starter, since the network voltage is too small to start the effect of luminescence.

We indeed know, that the gain of light of a fluorescent lamp is at least three times better than that of a light bulb. As a rule a degree of effectiveness in spite of that can't be given, since it merely concerns a comparison measurement in the case of the measurement of the lighting intensity with a luxmeter. It hence can't be excluded, that we already are dealing with an over-unity effect in individual cases and neutrinos are involved in the effect of glowing.
A necessary oscillation of size would be present, as the perceivable noises of open spark gaps prove. Also in the case of lightning the thunder occurs as a consequence of a longitudinal oscillation of size and at the same time a glowing phenomenon occurs as a consequence of materialized neutrinos (fig. 14.11). It almost is obtruding a scientist that here the same principles are at work.

One however hardly can prove that neutrinos are involved in the luminescence, because the configuration is symmetrical with regard to the resonance of neutrinos and just as much particles materialize as anti-particles, which afterwards again annihilate completely as an impulse of light. They hence can't be measured directly. It gets interesting if an asymmetrical arrangement with unipolar character is chosen.

Fig. 17.10: Tesla with a wireless light bulb<i>

<i>: A Sarony-Portrait from 1894, Tesla-Museum, Belgrad

<ii>: R. Hiller, K. Weninger, S. J. Puttermann, B. P. Barber: Effect of Noble Gas Doping in Single-Bubble Sonoluminescence, University of California, Los Angeles, USA, Science, Vol. 266, 14.10.1994, P. 248-250

and: D. Lohse: Wenn sich der Schall in Licht verwandelt, Mechanismus liegt noch im dunkeln; (University of Twente, NL) Mitteilungen der DFG 4/98, S. 19-21

17.10 Phosphorescence and sonoluminescence

Let us first look at the observable after-glowing at fluorescent lamps or at a screen, the phosphorescence. It presupposes a storing effect, and that in accordance with prevailing textbook opinion can be traced back to the excited state of some atoms. Doing so electrons in the atomic hull change from one level of resonance, an instable state of energy, to another orbit, which represents the ground state. Doing so the difference in energy is emitted in the form of light. The process obviously not only takes place as luminescence during the switching on of the excitation voltage, but also as phosphorescence after the switchng off.
An enveloping electron now doesn't fly as a tiny planet around the nucleus, but occupies the entire orbit as an inflated spherical vortex (fig. 5.5). Seen from the outside it is a matter vortex. It however sees the enveloping electrons on the further on the outside lying orbit from the inside and there they are showing as anti-matter vortices. As long as the distance of respect is kept, nothing happens. If however an inner spherical vortex presses to the outside or the outside one to the inside, then the incompatibility of the vortices takes effect and both annihilate under emission of a photon. In this respect the explanations of the vortex model are very helpful.
But now, after this flash of light, two electrons are missing in the atomic hull. The positively charged atomic nucleus never would allow this loss. Replacement has to be fetched and that actually only can stem from the neutrino field. Therefore the enveloping electron doesn't change the orbit immediately, but instead has to wait, until a suitable neutrino passes by, with help of which the game of changing places can be executed. This explains the time delay and gives reasons for the observable after-glowing.

The form of the unipolarly charged sphere (according to fig. 15.8 B) forms almost ideal prerequisites for an interaction with neutrinos and the step-like change of size from one orbit to the next ideal prerequisites for their materialization. The longitudinal wave connected with the change of orbit without doubt can be called a high-frequency sound wave. It however can't be detected because of missing gauges for such high frequencies.
But if we take the frequency down into the range of the ultrasound, which can be handled technically, then effects arise which brilliantly prove this interpretation and the participation of neutrinos in the luminescence.

The not understood phenomenon is called sonoluminescence and at present is researched at numerous high schools primarily for academic interest. The structure is conceivably simple. One takes a ball of glass filled with water and positions at the edge one piezocrystal next to another. Then one with the piezo loudspeakers, operated with the same phase, sounds the whole with ultrasound and see there, the water glows mysteriously! The sound waves change the pressure. Inferring from the observations, during the phase of low pressure small bubbles are formed, which at the following rise of pressure collapse and emit a ultrashort flash of light. There thus takes place an oscillation of size, which leads to the luminescence phenomenon!
So far so good; but such a flash of light is much shorter than the collapsing of the gas bubble lasts. With less than 50 picoseconds it is faster than the otherwise usual atomic transitions of electrons. The whole thing obviously has nothing to do with this kind of luminescence. Also the spectrum doesn't fit and finally the over-unity effect lies at one trillion, the light energy thus is 10^{12} times larger than the energy part which is taken up from the sound wave by every atom<ii>!

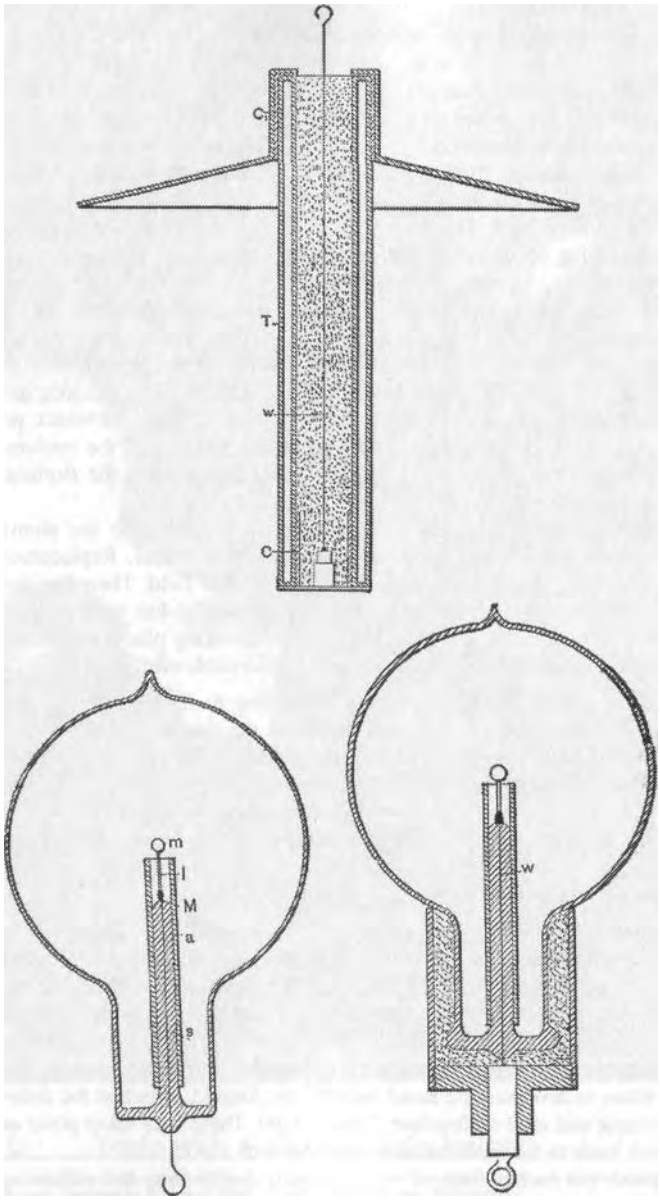

Fig. 17.11: Light bulbs according to plans of Tesla<i>

<i>: N. Tesla: Experiments with Alternate Currents of High Potential and High Frequency, Lindsay Publications Inc, ISBN 0-917914-39-2, Fig 18, P. 70+103

17.11 Discussion concerning the use of the weak interaction

In the case of the luminescence the conditions lie similar like those for lightning. The science of today it is true has some problems of explanation at detail aspects, but again and again manages to protect the ivory tower of physics from collapsing, with supporting auxiliary explanations. But at the latest in the case of an unipolar arrangement, in the case of a ball-lightning or the sonoluminescence, the participation of the neutrinos clearly comes to light, the auxiliary concepts prove to be unusable.

It surely is no accident that the discoverer of the neutrino radiation also was the first, who has experimentally investigated the luminescence. The lamps of Tesla (fig. 17.11) all were without wear and didn't have filaments like those of Edison. They however had to be operated with high tension voltage and relatively high frequency. Both a single-wire and a wireless transmission technique were possible (fig. 9.5 and 9.7). In his laboratory Tesla only needed to hang a fluorescent lamp without any return cable on a wire, then he had light. Famous also are the pictures on which he holds a lamp in his hand, which glows entirely without any connection, but only if he takes it in his hand! (fig. 17.10).

If we again turn through the chapter, then it is remarkable that in most cases, from the transmutation to the luminescence, neutrinos can be used for reason of their resonant interaction which in the proximity can be put equal to the weak interaction. A real materialization however poses an enormous difficulty. If namely the translatoric motion of the space quanta is slowed down, then the risk exists that for balance the rotation increases. But that as well has to be slowed down for a materialization! Only if both processes of slowing down take place, the goal can be reached. In that case the described cooling down effect occurs.

For a measurement technical check it therefore offers to record the slowing down of the translatoric motion and the collecting of the neutrinos by means of the measurement of the radioactive decay of a sample. And to read the materialization as the slowing down of the rotation from a measurement of temperature. In addition are helpful proofs about oscillations of size, glowing phenomena and deviations in the balance sheet of energy. With that it should be able to obtain a system for the exploration of these phenomena with the goal of a practical exploitation of the neutrino radiation for the benefit of humanity.

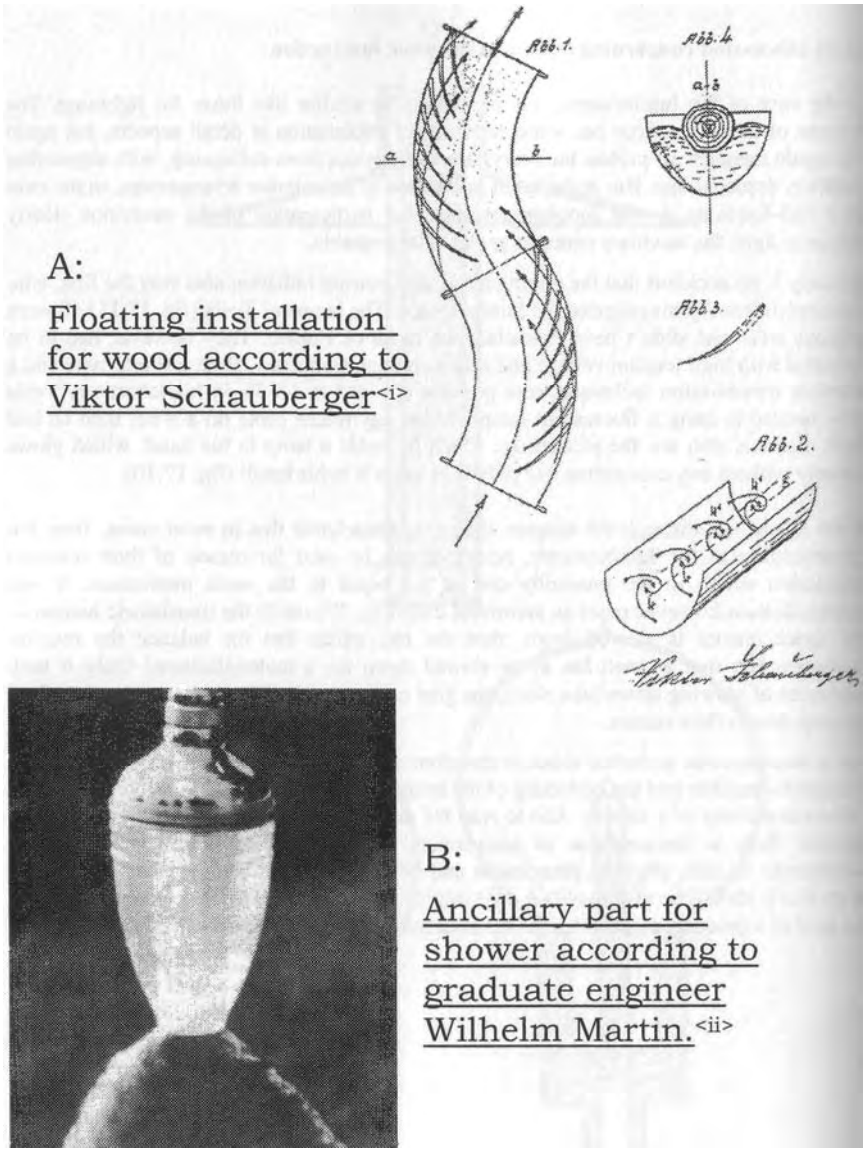

Fig. 18.1: Mechanical whirling of water

<i>: N. Harthun: Naturgemasse Stromungsfuhrung nach Viktor Schauberger Analyse einiger seiner Patente und Zitate; MuT Nr. 4, 1980; s.a. Kap. 9.2
<ii>: O.Alexandersson: Lebendes Wasser; W.Ennsthaler Verlag Steyr, 1993, S.156
<iii>: V. Schauberger: Die Entdeckung der Levitationskraft, Implosion 112, S. 39.
<i4>: Do we owe the taste of bubbling spring water to neutrinos?

18. Physical phenomena

In this chapter it on the one hand concerns indirect effects of the resonant interaction and on the other hand effects of gravitation and levitation.

18.1 Water as a catalytic converter for neutrinos

Already the Austrian forester Viktor Schauberger has pointed to glowing phenomena at whirled water. He first had observed such in nature at torrents and waterfalls in the Alps. Later he was capable, to produce and to demonstrate this effect even artificially[iii]. One could speak of hydroluminescence, where still the question would be left open, how it actually functions.

Already in chapters 4.10 and 4.11 has been talked about the special properties of water. It here at first concerned the property of transport of a vortex, which even is capable to bind particles in the vortex, which are heavier than the whirling medium itself. Schauberger had become famous by letting build floating installations, in which not only tree-trunks, but also gravel could be transported down to the valley, without the sides of the channel actually having been touched by the rubble. This phenomenon has been examined and confirmed on the scientific side [i].
Basing on this principle today different devices for processing water are offered and sold, which bind lime, mineral materials and suspended matter in the vortex and in this way prevent deposits in the pipes. The methods, to whirl the water, are however very different. Some whirl the water mechanical, others magnetically and again others electrically.
Here the dipole nature of the H_2O-molecules has an effect. If I turn a water molecule with its electric charge distribution, then from the moving charge a magnetic field results. If thus in the pipe a hydrodynamic flow vortex is produced, then an electric and a magnetic vortex, the potential vortex and the eddy current, are the result (see fig. 4.2). The wanted flow vortices vice versa also can be obtained, by guiding bubbling whirled water past permanent magnets, or by feeding in alternating magnetic fields with the help of coils, or finally by working with pulsed electric potentials. Each of these systems, operated passively or actively, has its specific advantages and disadvantages (fig. 18.1 B and C).

It can be assumed that with the vortices also the water quality is changed. As a rule the content of colloids increases, due to which the surface tension falls. In the colloids negative ions are bound, for which reason also the electric conductivity decreases. Finally the content of oxygen increases and that actually only can come from an electrolysis. The neutrinos thereby are suspected [i4].

As an extreme dielectric medium water favours the formation of potential vortices, which immediately after their formation contract swiftly. This oscillation of size of the electrically charged potential vortices makes possible actually an interaction with neutrinos, and that on the one hand has as a consequence the water splitting and the increase of the content of oxygen in the water and on the other hand the above depicted, observable glowing phenomenon, the hydroluminescence.

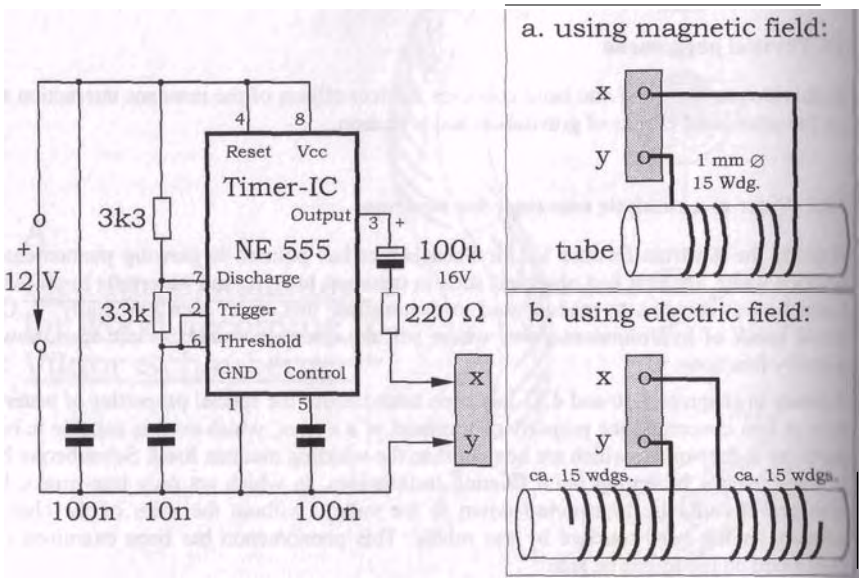

Fig. 18.1 C: Wiring diagram for a simple water processor
with pulsed field (2 kHz rectangular signal)
a: for magnetic field excitation
b: for electric field excitation

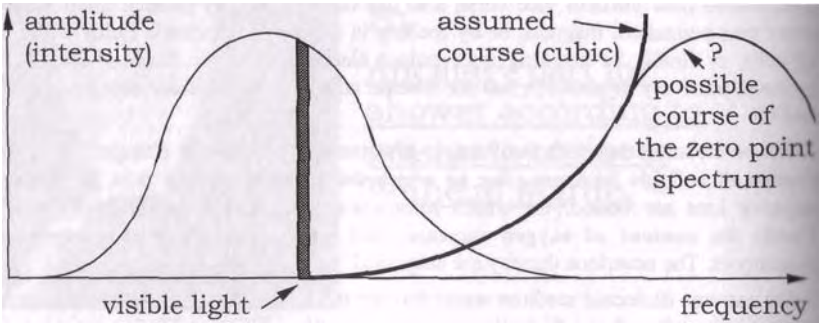

Fig. 18.2: The spectrum of frequencies of light and of the zero
point radiation.[i]

[i]: A. Waser: The Puzzling Nature, AWVerlag Luzern 1996, p. 88

To complete in fig. 18.1 C the wiring diagram of a simple water processor is shown, which works with pulsed electric (b) or magnetic (a) fields.

If we temporarily again leave the theme water and take along the notion, that it must be attributed a great importance in connexion with the interaction and the materialization of neutrinos

18.2 Background and zero point radiation

Whathappens really, if cold matter or interstellar gas molecules are hit or touched by the everywhere present neutrinos? Then it can be expected that oscillations are being stimulated and as a result the temperature slightly increases. If we thus at a space flight hold a thermometer out of the shuttle window, then we will measure everywhere such a remaining temperature of a few degrees Kelvin, which is called cosmic background radiation.

By popular scientific small talkers the background radiation is called remnant of a so-called Big Bang. It even is misinterpreted as evidence for the Big Bang. Even if a certain value of entertainment can't be denied, the Big Bang from a physical view until now only has raised questions and contradictions.

If we stay at the fact that oscillating neutrinos depending on their radiation density and velocity of propagation produce a thermal oscillation, which can be detected as a slightly increased lemperature. To measure that we don't need immediately to undertake a space flight. We also can install the thermometer in an artificially produced vacuum. In vacuum physics out of ignorance of the relations the neutrino radiation then is called zero point radiation.

In the case of the neutrinos it of course concerns an oscillation around a mean value, which for a symmetrical form of oscillation has the value zero. The term nevertheless is misleading and chosen very unfortunate. After all we don't speak of zero point current in the case of alternating current!

Since every supernova and every black hole emits neutrinos and correspondingly in physical experiments until now no preferred direction could be determined for the zero point radiation, it is taken as homogeneous and isotropic in space. From the Lorenz invariance again is inferred a cubic course of the zero point spectrum, an increase of the radiation intensity with the third power of the frequency. With this assumption the radiation density of the vacuum however strives with increasing frequency towards infinity. Here an error has to be present in the considerations!

I proceed from the assumption that in the case of the spectrum of the neutrino radiation it rather concerns a spectrum of resonance, the maximum value of which lies above the frequency range measurable with devices of today. It of course would be very important to find out, where the radiation maximum lies, but without being able to measure it that lies unfortunately in the range of pure speculations (fig. 18.2).

Half the wave length in any case should be tuned to the length of the antennas of the energy centres of the cells, the mitochondria and the chloroplasts which are capable of photosynthesis. In both cases the head diameter of the ATPhases amounts to approx. 5 nanometer. It would be obvious, if the resonance point would lie here. But it could as well lie at still smaller wave lengths in the domain of molecular dimensions.

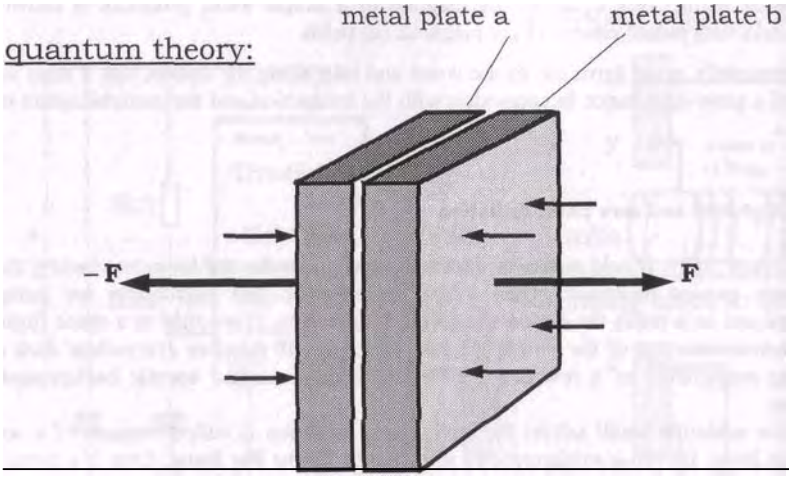

outside cause<i:>: pressure force by bombardment of quanta?

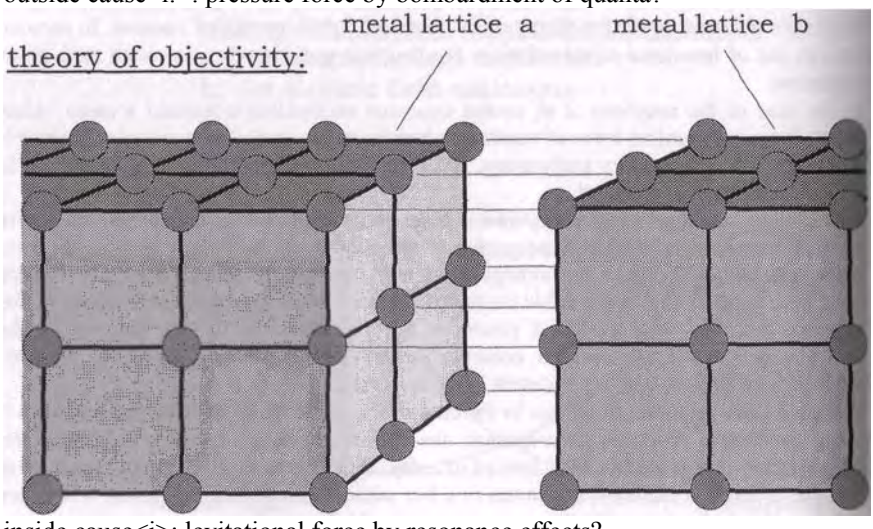

inside cause<i>: levitational force by resonance effects?

Fig. 18.3: The Casimir effect

18.3 The Casimir effect

If this zero point radiation actually would be the cause of the Casimir effect, which is generally assumed today, then neutrinos would have to be involved, if the zero point raditation would be to put equal to the neutrino radiation. The effect even is quoted as evidence, but I have my doubts.

The experiment is relatively simple and functions also in a vacuum. Two absolutely plane and smooth polished metal plates are placed very close to each other. Doing so the distance should only amount to one thousandth till one millionth of a millimetre. If the force, with which both plates are attracting mutually, is measured then it exceeds by far the gravitational force. We are dealing with an unknown force, neither electric nor magnetic.
Because the force of attraction still arises near the absolute zero of temperature, some make the zero point radiation responsible. In our translation that would be tantamount to the neutrinos exerting a pressure from the outside on the metal plates, if need be with their small rest mass, as far as this should not be based on an offset-error of the detecting devices. For that the plates would have to damp the neutrino radiation effectively and by mutual shielding reduce the radiation pressure from the split. The question is asked, if the from the outside hitting bombardment of quanta, as it is called, actually can exert a pressure which would be compatible with the nature of the neutrino radiation.

If we now try an entirely other interpretation, which does without the postulating and designing of new force effects. Now the from the unified theory won interactions according to table 15.1 form the basis. In the Casimir effect, as said, neither magnetic nor electric forces are involved, so that open field lines and the corresponding force effects (1 till 4) are ruled out. It has to be the work of closed field lines and that in the static case we know as gravitation (5). Now the mass of the metal plates is too small, as that an acceptable force of attraction of masses could result.
The measurable force is much larger, even if it according to its nature could be a gravitational force. Here oscillations, as they actually take place in the hull of the metal atoms, seem to play a role. If between the oscillations of the two plates standing opposite occurs resonance, then a levitation is possible (6), which describes an oscillating interaction, produced by closed magnetic field lines<i>.
At extremely low-frequency signals this interaction is known as gravitational wave and object extravagant and costly physical experiments.

<i>: The question, which interpretation is correct and which one should be rejected, could be verified as follows: at first the force between two plates of a certain metal and afterwards that of another metal has to be measured. If in a third experiment a plate from the first and one from the second experiment are brought together and the force effect goes back measurably, then the quantum physical interpretation would be wrong clearly. With that would have been shown that here resonance effects are used, which presuppose an identical metal lattice structure of both plates.
If the force effect however doesn't go back, then both statements are possible, then one has to think up another experiment.

Fig. 18.4: The flying disc of Searl on a german title page.<i>

<i>: Special 7, Raum 8s Zeit Dokumentation aus dem EHLERS Verlag

18.4 Effects under high tension

It crackles in the laboratory of high-tension. The air smells electrically charged. Only in a corner someone sits and waits with much perseverance and patience, until something happens. Then he lets thunder down lightnings of several millions of Volts on a small sample. It flashes and crashes and still nothing happens.
No, it doesn't concern Tesla! Tesla has worked purposeful. In addition has Tesla only called himself inventor. But the man in the corner feels himself a discoverer and as it is proper for a discoverer, he has immediately named the effect after himself. As a real American he lets market himself and his discovery by the media and a video tape.
Doing so he obviously doesn't know at all, what he wants to have discovered, of what this Hutchison effect actually consists. It perhaps is an event of pure chance, for which he sometimes has to wait hours. If it very suddenly would occur, then it is a real potpourri of all already discussed effects: metal spoons are bending (fig. 14.13), massif steel rods are breaking, light effects are being observed (chapter 17.9 PP), water starts to dance and to cook (chapter 18.1), without getting hot and finally do some samples take off and fly crosswise through the room. He then speaks of anti-gravitation.
In the video tape can be seen, how he brings about a physical length contraction as a result of a locally produced field concentration with two as an interferometer configured Tesla coils. In a bottle for instance the air volume is changed. This confirms the correctness of the here presented theory of objectivity (chapter 6.6 PP).
In any case no-one is amazed more about the results of chance than John Hutchison himself. Overwhelmed by the magic, the charm of the effects and the feeling to be able to move freely outside the trodden out ways of physics, he still sits in his corner with the video camera and waits, until finally something happens again.

There is worked with tension voltages, which are considerably higher than 511 kV, the calculated tension voltage of their own of the charge carriers (fig. 7.1). One thus by no means has to be amazed, if under the influence of several millions of Volt electrons are taken apart and metallic objects are breaking or bending.
The extreme tension voltage and field change we owe an oscillation of length and of size, which spontaneously can lead to an interaction with neutrinos. Materialized neutrinos again are responsible for glowing phenomena and for the electrolysis of water, which under the impression of the rising gas bubbles seems to dance and to cook. For my readers and participants of the energy technical seminar therefore models of explanation are available.

One effect we still haven't discussed and analysed more in detail: the antigravitation resp. the levitation. As long as no reproducible field conditions are present and the chunks are accelerated in any arbitrary direction, it will be difficult to understand the physical course of a levitation.
In chapter 9.3 we already had become acquainted with and discussed a levitation device with the flying disc of John Searl. for which the field conditions are comprehensible. This time we should have a somewhat closer look at the flying device (fig. 18.4)[<i>].

<i>: Some reports can be found in Special 7 ,,Freie Energie", Raum & Zeit Dokumentation aus dem EHLERS Verlag, Seite: 141 bis 157 und 174 bis 185

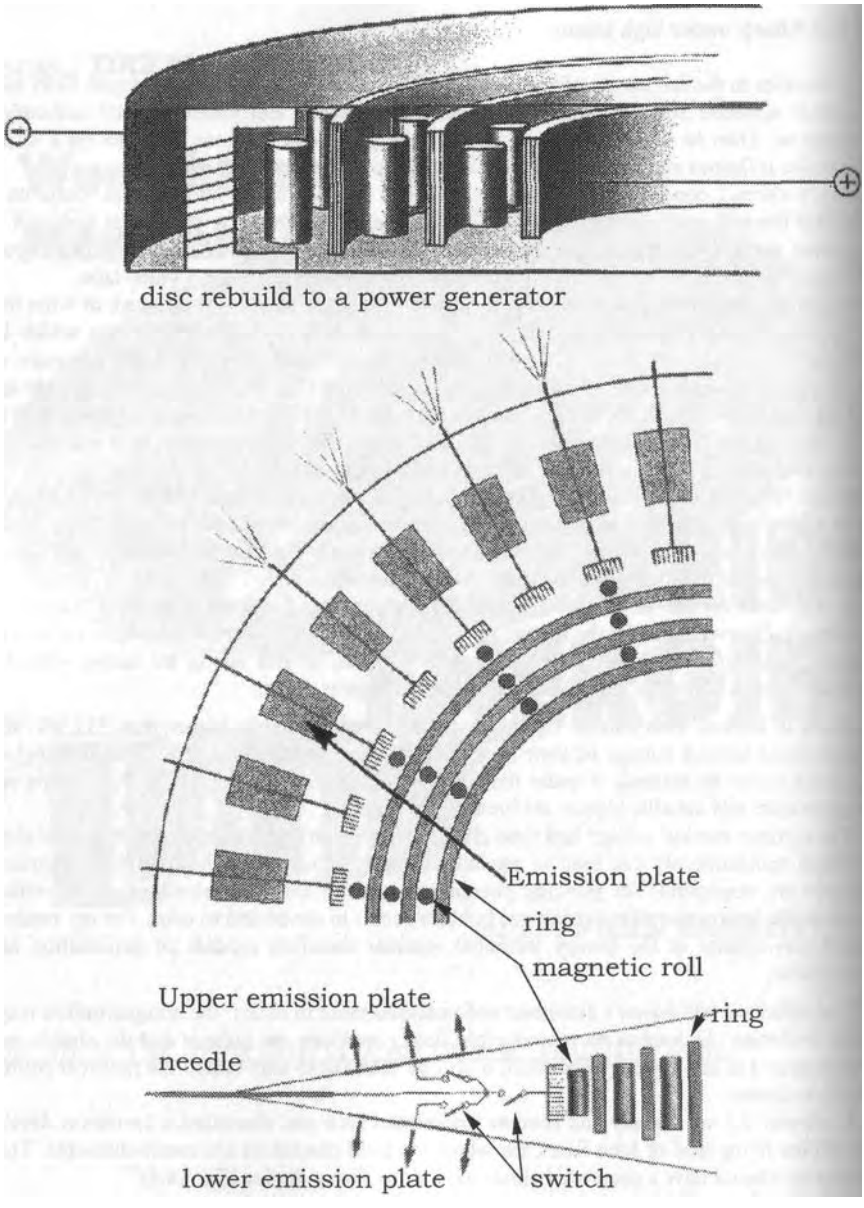

Fig. 18.5: Concerning the controlling of the flying discs according to Searl.<i>

<i>: H.Schneider, H.Watt: Dem Searl-Effekt auf der Spur, Special 7, Raum & Zeit Dokumentation aus dem EHLERS Verlag, Sauerlach, 1. Aufl. (1994), S. 183

18.5 Flying discs

The Searl-disc can be calculated relatively good with the Faraday equation concerning unipolar induction. To estimate the order of magnitude, we just suppose the roller magnets produce an induction of one Tesla and the radius is one meter, then between the centre of the flying disc and its edge 511 kV is applied, if the revolutions per minute has reached the value of 80000 revolutions per second. As soon as the revolutions per minute is reached, the neutrino conversion can start.
The at the edge of the disc arising corona, which consists of individual electrostatic discharge flashes, takes care for the necessary dU/dt, by every blow and every spark is drawing the potential for a short time towards ground. The tension voltage jumps in swift order between values of above 511 kV and zero Volt to and fro. In connection with the already discussed unipolar field configuration neutrinos are being collected in this way.

A technological challenge represents the layered construction of the roller magnets and the rings, which have to withstand extreme centrifugal forces (fig. 18.5). Friction however is not a theme, since on the one hand the air inside the disc ionises and a vacuum is formed and on the other hand the air split between rollers and discs increases by the field dependent contraction of the metal parts.

Actually one in this case by no means can speak of antigravitation, because the gravitation isn't really vanishing. The disc even in flight still is heavy tons. Here merely a resonant interaction is built up which is larger than the gravitational pull of the earth. The disc is attracted by the cosmic source of neutrinos, with which it has built up the resonance.
Exactly there it will fly!

The by Searl designed controlling[<i>] in my opinion actually can't have functioned satisfactorily. He uses emission plates, as he calls them, which alternatively are switched on by means of switches and are able to form electrostatic forces with some air charge carriers. In reality the drive probably is comparable to that of a sailing ship, for which the wind always blows from one direction. The ship isn't pushed by the wind, as one erroneously could think, but rather by the under pressure behind the sail pulled forward. Without steering facility the object always is driven in direction of the drain. The sailor would say,
the ship without helmsman drifts towards lee.
Searl in this way has lost all flying discs which were started. By using solar neutrinos they presumably have fallen into the sun and burnt. The controlling should function analogous to a sail, then one would stand a chance, by "traversing" against the "wind", to sometime again come back to the starting-point.

<i>: H. Schneider, H. Watt: Dem Searl-Effekt auf der Spur, Special 7, Raum & Zeit Dokumentation aus dem EHLERS Verlag, 1. Aufl., Seite: 183

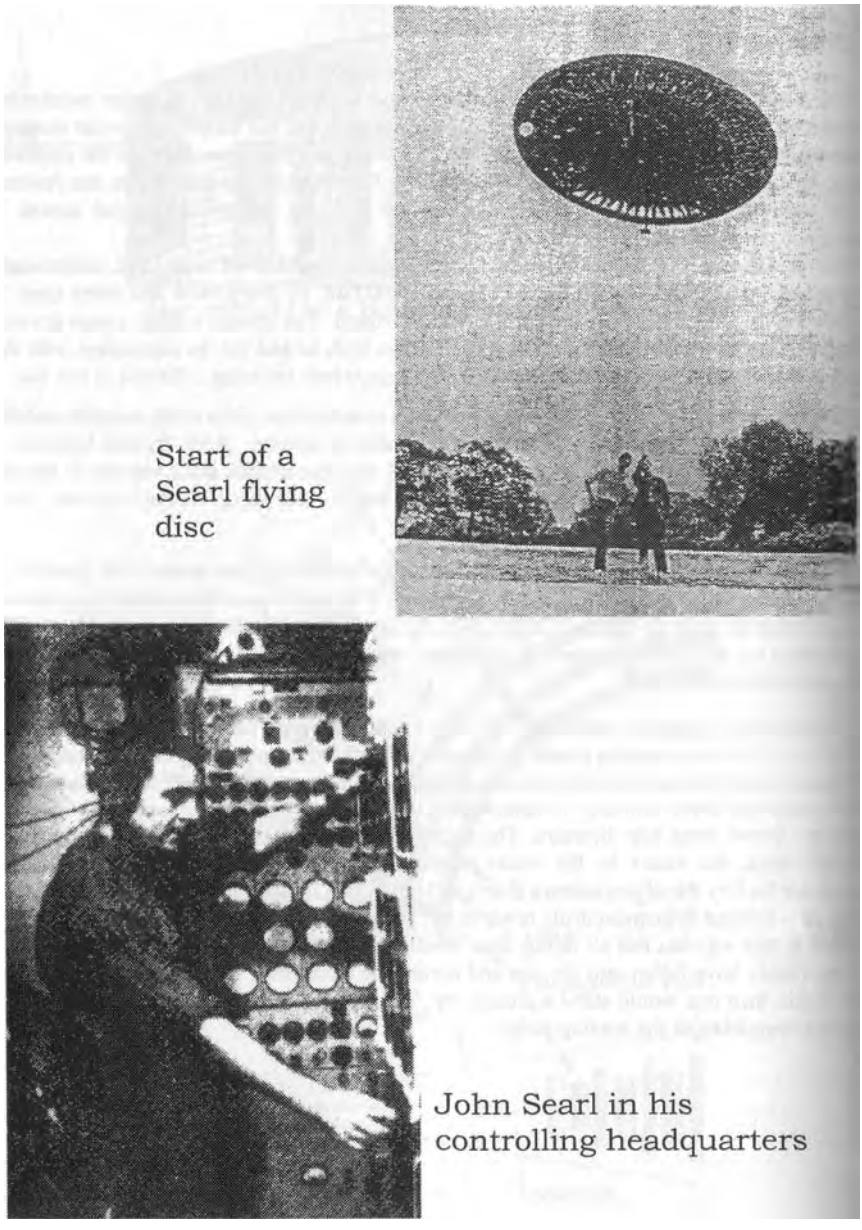

Fig. 18.6: The remote controlled flying discs of John Searl.[i]

[i]: Special 7, Raum & Zeit Dokumentation aus dem EHLERS Verlag, S. 152

18.6 Propulsion with neutrinos

In search for an ideal propulsion system for spacecrafts the flying discs of John Searl still have demonstrated a further possibility. After the start occasionally were left strange particles on the ground, which hadn't be there before. The flying device obviously had materialized them and dropped them at the start.

With this materialization of neutrinos the chance is showing of a very efficiently working recoil propulsion. If namely the neutrinos are converted into matter then they by that gain back their rest mass. If this takes place in flight then the materialized particles also bring along kinetic energy. It then works as ajet engine for which the direction of the jet can be directed and in that way the vehicle can be controlled comfortable.

In the case of the Searl-disc the materialization of neutrinos rather happens as a not understood side effect. In the case of a systematic use however the principle will show a characteristic property. Instead of a vapour trail a beam of light will shine out of the flying object in the direction of the emitted particles, but it will break off abruptly after a cartain distance.

To blame is the part, which has become anti-matter, which it is true as well contributes to the recoil, but simultaneously annihilates with incompatible particles of matter under emission of particles of light. If in some distance all antiparticles are used up then also the beam of light comes to an end.

It here concerns necessary properties of a corresponding propulsion technology for spacecrafts, which don't have to drag their propelling energy along with them. Our space technicians finally could handle another than the "hammer throwing method", in which case the "hammer" by means of terrible fuel consumption after a phase of acceleration only staggers uncontrollable through space under the influence of its inertia.

With a neutrino propulsion on the other hand one at any time can accelerate or brake. It will strongly influence the field around itself, so that can be reckoned that for every acceleration a field dependent change of size should be perceptible by an outside observer. If therefore a corresponding flying device is accelerating then it will suddenly become smaller and that then looks so as if it would have moved away with a jump without temporal delay, but that isn't the case at all.

The jerky movements only would be a result of the perception with our eyes by means of the propagation of the light. Since the passengers are exposed to the same field, they change their body size along with that of the vehicle. They actually notice nothing of an apparently infinite acceleration, which only observers on the outside would observe and which indeed no living being could stand.

Nowhere the explanation crisis is larger than in space travel! The theory of objectivity represents a real help, because it perhaps as the only one puts us in a position to conceive and understand not understood observations as necessary technological consequences. Only by uncovering parascientific as purely physical phenomena man of today will be able to free himself from the constraints of magic and his own illusions.

Is the until now discussed cases resonant or other force effects are being used, whereas the gravitation remains unchanged. Closed field lines after all cannot be influenced, normally at least. Perhaps an indirect possibility exists to have an effect on the gravitation?

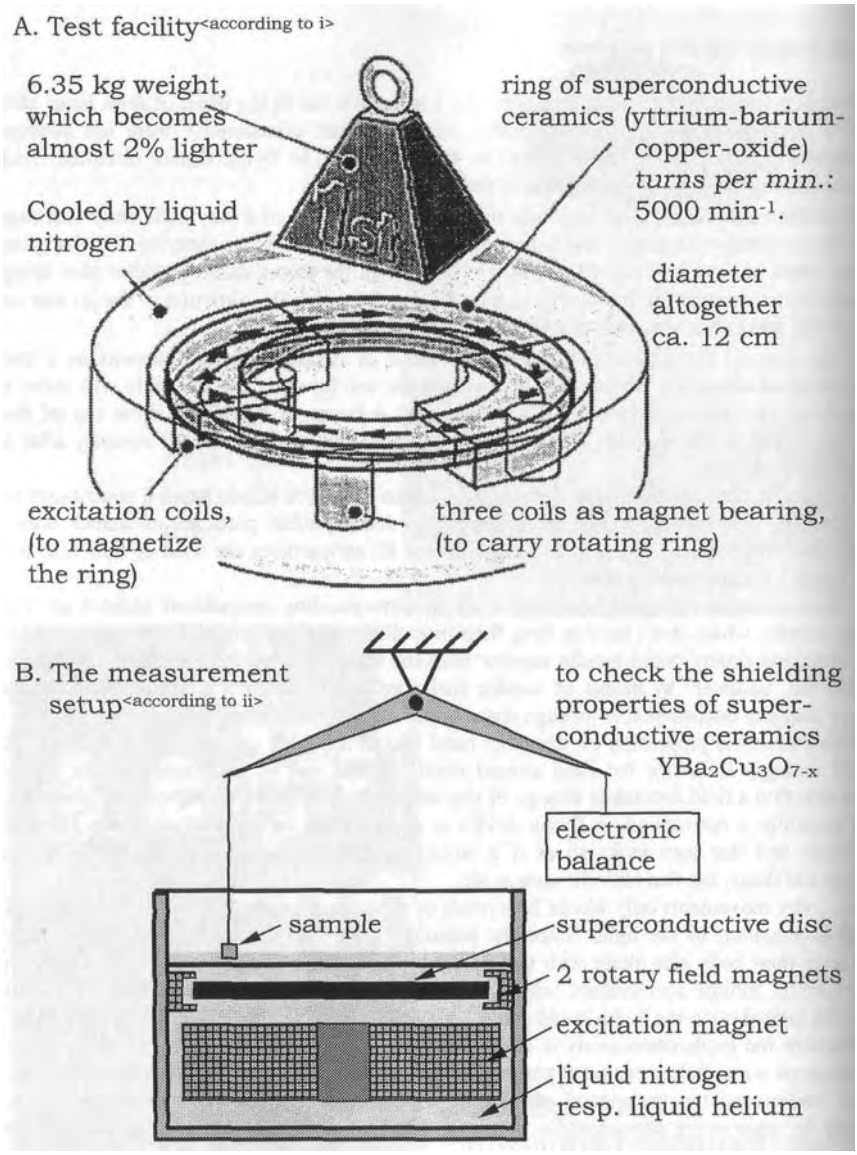

Fig. 18.7: Experiment for the manipulation of the gravitational pull of the earth.

<i>: Schneider: Anti-Gravitation im Labor nachgewiesen?, NET-Journal Januar 1997, S. 14,15; s.a. Internet: http://www.keelynet.com/gravity/fingrav.htm

<ii>: E. Podkletnov, R. Nieminen: A possibility of gravitational force shielding by bulk $YBa_2Cu_3O_7$-x Superconductor, Physika C 203 (1992), P. 441-444

<iii>: Force field Implications of Anti-Gravity, The Journal of Ideas, Art.191, 7.9.95

18.7 Antigravitation or levitation

The night already had fallen over Finland, but at the University of Tampere the light still was on. Then a scientist put his beardy head through laboratory door and with a "hello folks" blew the smoke of his pipe over the cryostat for the examination of superconductive materials. The scientists were speechless, because the smoke seemed to hit an invisible wall and was drawn upwards in direction ceiling almost at a right angle.
After having aroused the curiosity, Dr. Eugene Podkletnov also has held other materials above his rotating disc and had to discover that these as well lose weight, and that he actually influences the gravitation with his experiment. Even the air pressure at the corresponding place in a lying above floor was smaller[i].
With a superconductive disc of 30 cm diameter cooled by liquid nitrogen a reduction of gravity for 2% to 4% can be obtained, if the disc rotates with more than 5000 revolutions per minute. With the revolutions per minute also the effect increases, but it is independent from the excitating field[ii]. Finally the fields of the superconductive currents in the ring remain existing unchanged even after switching off the excitation and it only depends on these fields.

The shielding effect of the arrangement on electromagnetic fields already had been known before and should be examined closer in the laboratory. One only was surprised that the gravitation could be shielded as well, that obviously both interactions are related. According to the prediction of the theory of objectivity the closed magnetic field lines gravitate and the field components directed towards the centre of the earth cause the measurable force of weight. By the very strong superconductive fields obviously field overlaps and possibly a local driving out of field occurs, like one has long known for eddy currents (Meissner effect).
With that the earth gravitational field of course is not cancelled, but merely spatially moved, or it partly has changed its direction. If only a small part of field pointers turns out of their orientation towards the centre of the earth, then at that point the force of weight is reduced to a corresponding extent. The theory of objectivity requires that!

By the way reports exist, according to which even without rotation a weight reduction can occur for superconductive rings, and others, where is worked even entirely without superconduction. As core material for the ring ferrite or a strong permanent magnet is used. In that case depends on the circumstance that the ring-like coil is operated in self-resonance and always in the right moment again is excited anew by induction. The ring core then stores the fields up over time, exactly as the superconductor.
Stricktly speaking it are the atomic nuclei and in the end all elementary particles, which are aligning in the high field. Dr. Ning Li wants to artificially produce gravity, by directly influencing the quanta. With that she comes the phenomenon very close[iii]. The possibilities of this effect nevertheless are very limited, since two percent more or less are not exactly much, and the dream of the complete cancelling of gravity or even inertia possibly stays just a dream. It stricktly speaking just concerns influencing the gravitation and not antigravitation!

cause/ field lines	interaction F	= force effect *mediation:*	see chapter: effect/ *application*
5. closed **H**-field lines	gravitation (static)	F_{MG} = gravity *by particles with mass*	chapter 6.9 + 7 elementary particle mass
6. closed **H**-field lines	levitation (dynamic)	F_{ML} = reduced gravity	chapter 18.3 gravit. waves *Casimir effect*
7. closed **E**-field lines	gravitation (static)	F_{EG} (force hardly detectable)	chapter 18.7 *supercon-* ducting ring
8. closed **E**-field lines	levitation (dynamic)	F_{EL} (no longer detectable)	chap. 18.5 + 18.6 *Keely-/Searl-* *flying devices*

Table 18.8 A: The interactions of closed field lines.<i>

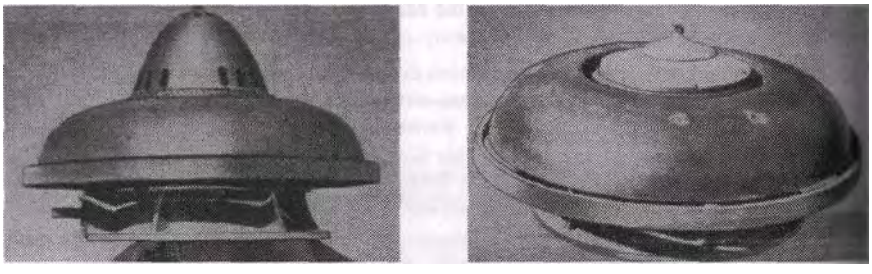

Fig. 18.8 B: Test models of the "flying saucer" according to Viktor Schauberger.<ii>

<i>: according to fig. 15.5, cases 5 to 8

<ii>: O.Alexandersson: Lebendes Wasser; W.Ennsthaler Verlag Steyr, 1993, S.103

18.8 Discussion concerning the effect of closed field lines

If we now direct our eyes exclusively to the lower half of fig. 15.5, in which the consequences of closed field lines are listed. Without the possibility of a direct focussing like for open field lines, the caused force effects turn out extremely small. With that they are less suitable for an use of free energy. The considerations in that context rather aim at technologies to reduce weight, like they would be worth striving for for flying devices.
If we allege that here in the same way the force effects of magnetic H-fields exceed those of electric E-fields for three to four powers of ten. Then it will hardly play a role for the force of weight of a body with or without additional electric charge, if its E-field lines are closed as well or are open. The increase in weight of an uncharged body only will have an effect in the third till fourth place after the decimal point. Seen so in the case of the gravitation it primarily concerns an effect of the magnetic field, more strictly speaking the effect of closed magnetic field lines (chapter 6.9).
If one succeeds in influencing these magnetic fields for instance by the influence of extremely strong fields of a superconductor, then also the gravitation will change, as has been shown (chapter 18.7). Let's imagine, in the case of a systematic procedure we would succeed in a perfect influencing, for which no component of the H-field lines points into the direction of the centre of the earth anymore, then an uncharged body would only have one tenthousandth of its original weight, whereas a charged body actually would weigh nothing anymore. This state of the weightlessness supposes that all E-field pointers point into the direction of the centre of the earth or diametrically in the opposite direction, since E- and H-field are standing perpendicular to each other. Unfortunately such a field distribution technically hardly can be realized and so the ,,flying carpet" furthermore remains reserved to the fairytales.
An effective reduction of weight of planes and other flying objects however seems by all means feasible, and so slowly the number of research facilities increases, which more or less officialy have a critical look at the cancelling of gravity and the levitation. The theories on which they are basing, however often sound very bizarre and moreover are completely unphysical. Maybe a look at the distribution of field lines, as proposed here, helps to get further.

In the case of the levitation, which occurs strictly speaking only in the case of oscillation for closed field lines, resonance again plays the crucial role for the coming about of the interaction. In connection with neutrinos the resonance can serve less the collecting; we rather need it for the materializing, for the production of mass, charge and energy.
For the artificial production of a levitation either a mechanical oscillation in the atomic or molecular domain is needed, like for instance is produced by a rotating water molecule, or a resonant oscillation of size takes place by use of electrostrictive or magnetostrictive materials, like piezocrystals or oscillating quartzes.
In this context surely is of great importance that also the temperature could be identified as a particle immanent oscillation of size (chapter 8.3). That's why besides a cold materialization or cold fusion also exists, at least theoretically, the possibility of a hot materializatin or hot fusion.

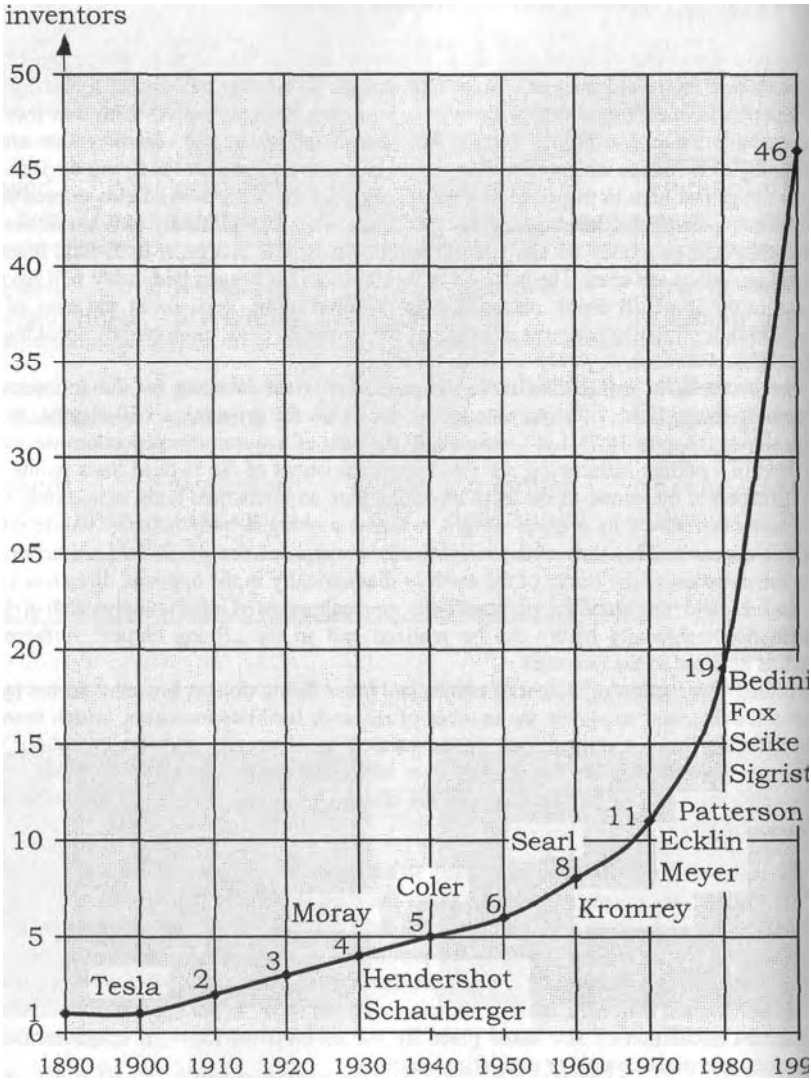

Fig. 18.9: The increasing number of free energy inventors.<i>

<i>: only the inventors mentioned in the text are entered. Literature for that: A. Schneider: Energien aus dem Kosmos, Jupiter-Verlag (1994), S. 77

18.9 Concerning the determination of the stand of today's energy technique

An analogy to the production of matter forms the production of light. At high temperatures as is well-known is formed thermal light and at low temperatures cold light, the discussed luminescence. An oscillation of size of the light source in all cases of the formation of light is the cause, be it as an electromagnetic wave or as photon vortex, be it in whirled water or as sonoluminescence. We at last see ourselves put in a position to understand the various light phenomena as something which is related.

The call for new energy carriers and an ecologically compatible energy technology can't be ignored anymore. The number of inventors at present increases fast (fig. 18.9). It is legitimate and worth recommending, to observe for this purpose first of all nature, how it solves its energy problem. Doing so we should realize that in contrast to the technology of today no combustion and no explosion takes place, but rather principles of a cold fusion and of an implosion as a result of contracting potential vortices are being used. Actually nature may point the way out of the energy technical dead end. We only have to accept the offer, be open and show being ready, to invest in the development of methods in accordance with nature.

Directed at the address of the distributors of supporting funds for energy research the claim in plain English reads: to grant no money anymore for ecologically harmful concepts, like nuclear fission or for not understood and not realizable developments like hot fusion. to immediately stop the fruitless works and to provide the money for an ecologically compatible energy research.

Immense saving potentials moreover are found in all domains of physics, where instead of costly experiments just as well the things could be calculated with an usable theory. To check the theory then only few experiments would be necessary. After all all important discoveries have come about in this manner. Nobody should think, he had understood a matter, once he has filled himself up with sufficiently much measurement data.

The root of the evil lies already in the education, where students of physics want to understand everything and therefore are trying hard to grasp with their view and hands for everything. Abstract thinking or mathematical derivations however are too uncomfortable for most; they have the erroneous opinion, understanding (German: begreifen) would have to do more with grasping (German: greifen), and for that the head after all can't be used.

One reason for this development can be seen in the relativistic point of view of Albert Einstein, who proceeds from the assumption of a subjective observability and has raised the relativity between a physical principle and the observation to the basis of physical thinking. The arrogant motto prevails: what I can't observe with my sense organs or register with corresponding gauges also isn't physics, but esoterics or parascience.

But if we want an ecologically compatible technology, then this can't be reached with this point of view. Then we only hinder ourselves with our own arrogance and intolerance. We have to leave the erroneous quantum physical way and again learn to think abstractly by taking up tried and tested principles of classical physics. An objective point of view forces us to register the phenomena, which lie outside the observable range, with mathematical MEANS (see chapter 13). Only if we have learned that, we will understand and realize the true relations in physics!

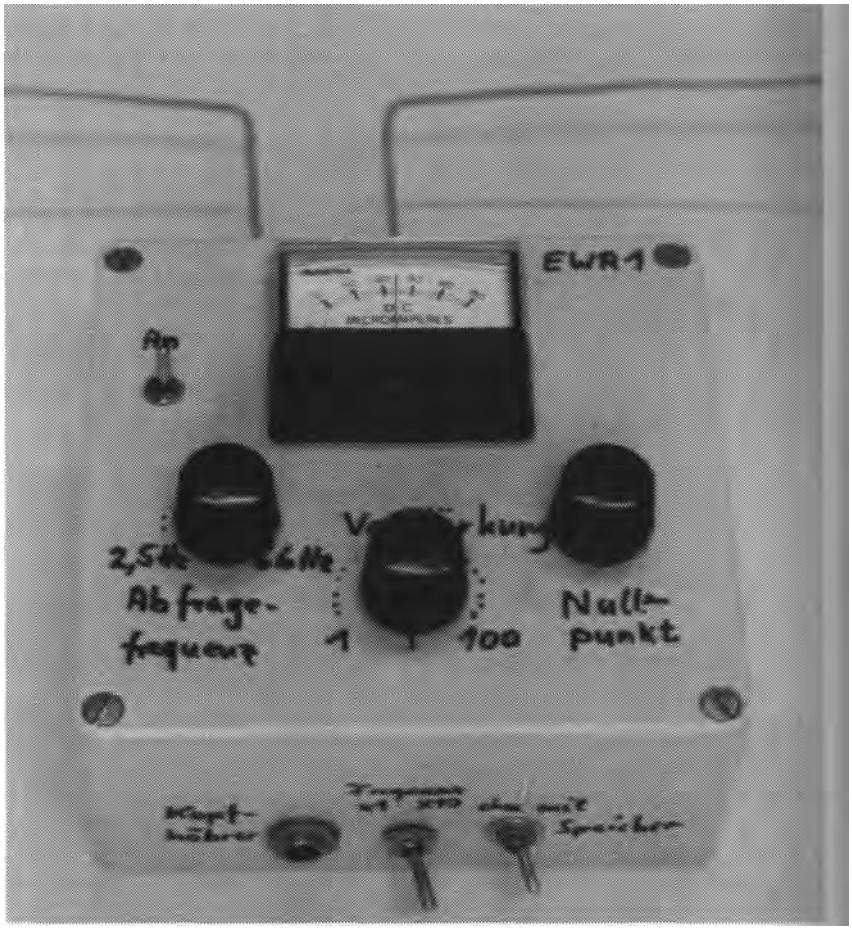

Fig. 19.1: A self-built charge amplifier.

19. Own experiments

The opposite of the theoretical considerations form practical experiments. If we want to register and understand physical and natural scientific phenomena, then we shouldn't entirely forget the aspect of handicraft. Doing so it can't be avoided that it goes on very personally, if about the laboratory work is being reported, not even then, if the experimenter is at pains to exclude every influencing of the carrying out of the experiment and the result. After all does anyone have to execute the experiments himself, since a good sceptic anyhow only believes, what he has observed with his own eyes.

19.1 Concerning the rating of experimental physics

There already have been scientists, who have requested to reject a measuring technical determined result for the case that textbook physics doesn't produce it. This attitude even today still is taken by an uncounted community of believers of science, entirely after the motto: "Nature kindly has to fit in with the dogmas of theoretical physics!"

This wrong thinking is reflected in the scientific journals, which reject to print discussions. Controlled by a tester board, which only has the task to prevent dissenters from the publication of their ideas, they are the sad proof, how widespread this erroneous attitude today is in the university scene.

Actually solely the scientific experiment shows us the physical reality! The theoretical models, like the here presented vortex model merely should help to understand nature and its laws. The representatives of theoretical physics are in the role of a helper and that requires modesty and openness.

For the case that a professor of theoretical physics imposes a pledge of secrecy on an experimenting colleague, if this one wants to report publicly about his amazing tunnelling experiments, then the public nevertheless should have the right to find out, if a tunnelling experiment reveals speeds faster than light, even if it doesn't suit the theorist and he in inappropriate arrogance only should consider the experimental physicist as his assistant.

If universities only are occupied with preservation of property and the industry only with the increase of its productivity, if future research consists of hiding public research funds internally in such a way that nobody realizes the fraud of support and in reality nobody thinks of the future anymore or wants to work for it, then we will be able to observe how discoveries and inventions migrate from the industry and the universities with their controlled central organs and increasingly will take place again in garage, cellar, solitary study room or in privately organized circles.

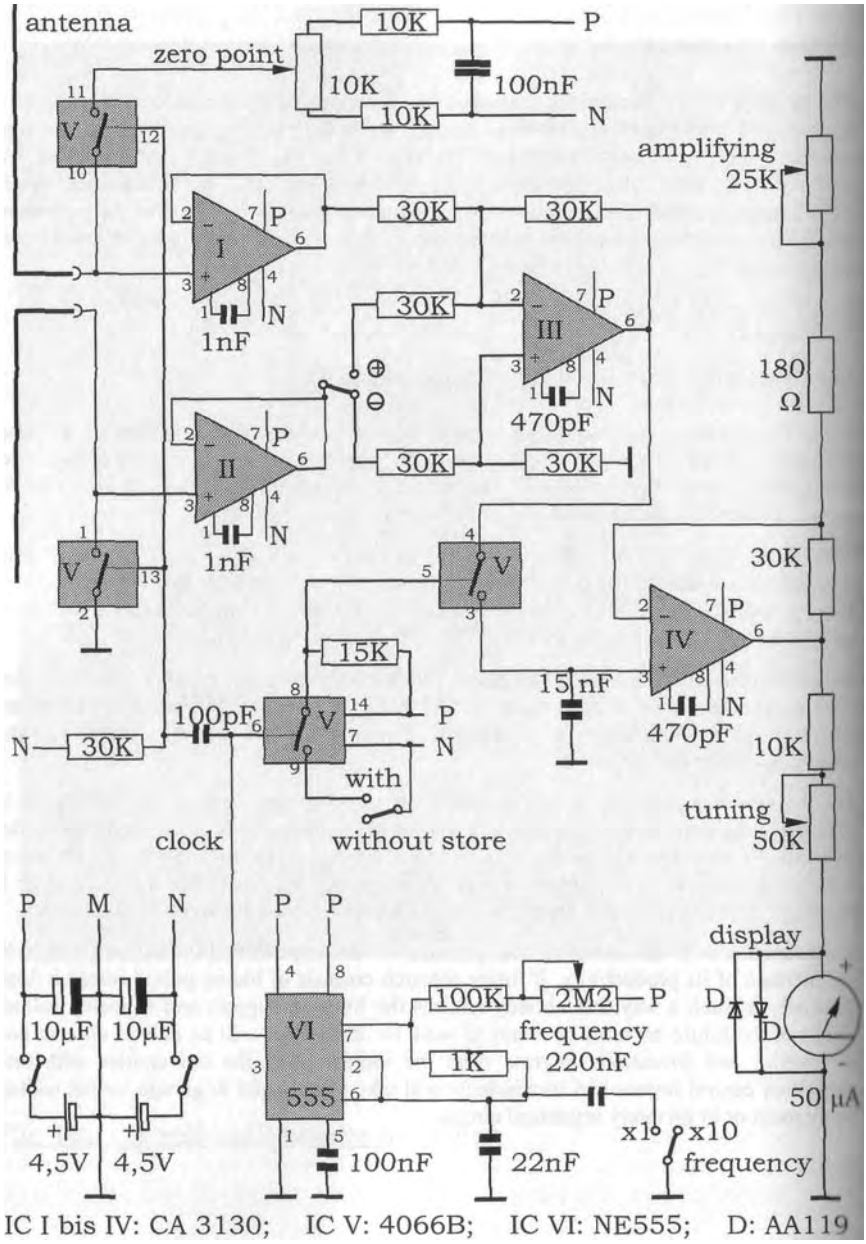

Fig. 19.2: Wiring diagram of the self-built charge amplifier

19.2 The charge amplifier from the workshop of handicrafts

Is connection with my vortex theory in this book time and again clues to experiments can be found. I am aware of their importance and I always, to verify my theoretical working out, have accompanied it with practical experiments. Doing so not the proof, which can be published and reproduced by anyone at any time, stood in the foreground. With the experiments in my workshop of handicrafts I only wanted to check for myself, if my derivations still can be verified.

Consequently was at first done without a publication in the first and second edition of the second part concerning the "electromagnetic environmental compatibility". For the addition of the here presented chapter about own experiments from the third edition there are several reasons: first; I have been asked for it by several readers, second; from every experiment is coming a piece of physical reality to meet one and third are here latent some useful ideas and approaches which get us somewhere.
Of course can't be read much from a handicrafts self experiment, but perhaps one or another reader, who has better laboratory technical possibilities at his disposal than me, is stimulated to carry out own experiments.

To chase after the potential vortices in the air, I 1989 at first have built together a charge amplifier. I connected differently formed antennas at the particularly high-ohmic difference input. Corresponding the in nature arising static electric field a tension voltage should arise between both antennas, which my gauge should amplify and indicate on a moving-coil instrument.
To be able to register local changes, a measurement cycle is gone through, which periodically is repeated: It starts with the measurement time, during which entirely by itself between both antenna a charge is building up. The value afterwards is stored analogue in a Sample-And-Hold link and displayed by means of a moving-coil instrument. Then the input clamps are short-circuited, the antennas again discharged and the game starts from the beginning.

Measurement time, zero and amplification can be adjusted at the device (fig. 19.1). Whoever has fun to rebuild it, finds the by me realized wiring diagram in fig. 19.2.

It is true I did realize other designs, but technically the here shown design proved to be the most useful solution.

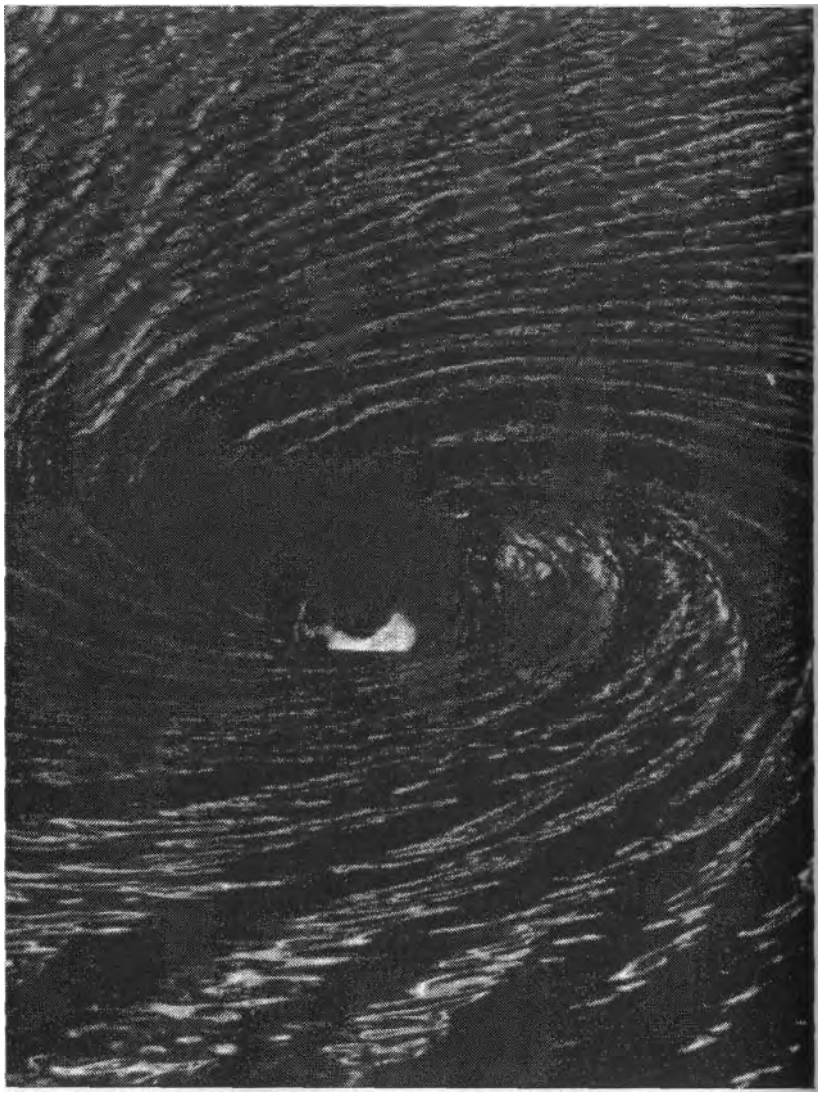

Fig. 19.3: _____The bath tub drain vortex;
shown is a tidal vortex near St. Malo.[i]

<i>: Photograph from the magazine „Life" of 4.7.1969, resp. from: H. J. Lugt: Wirbelstromung in Natur und Technik, Seite 371

19.3 Interpretation of the observations with the charge amplifier

The practical use of the device at first proved to be extremely difficult, because the pointer seemed to perform a wild dance. At a more close look I however could make exactly those observations, which I had sought-for as proof for the existence of potential vortices.

First I did find confirmed the known high field strength. We after all live between the ionosphere and earth's surface right in the middle of the dielectric of a "spherical capacitor". Because the values of the electric field reach very much closer to the maximum value, which is lethal for living beings, than the value of earth's magnetism, I did draw from that the conclusion that biological effects primarily can be expected from the E-field.

If the E-field, as Maxwell's field theory specifies, actually would be irrotational, then we would be dealing with a gradient field. My device would have to display everywhere to a large extent the same value. But that was not the case.

Maybe the building is responsible for the chaotic display and the wild swings of the pointer, so I thought. Doing so I had thought of the auxiliary explanations of the high-frequency engineer about so-called reflections in closed rooms. Therefore I stormed with the gauge, which had gone wild, into the open air and walked different ways, which should have been reflection free, but the picture stayed the same. In any case the E-field is not a gradient field. I had to find out.

Following I could, what required much patience, find certain places, at which for the same movement from the same direction could be seen a reproducibility of the swing of the pointer, it even could be arbitrarily often repeated. 1 marked the point exactly. Then I tried to move the device from another direction towards the marking and had to find out that the point had moved away.

If I sit in the bath tub in the evening and pull the plug, then I each time am enthusiastic about how sensitive the drain vortex reacts, how I can send it from one corner into the other by the snipping of a finger without it falling apart (fig. 19.3). Doing so one easily can imagine with a bit of phantasy how difficult, yes, almost impossible it would be to measuring technically register the vortex for the case that we could not see it. The gauge it is true would display violent wave movements. But a reproducibility we would not be able to obtain, exactly as for my self-built charge amplifier.

Now I knew that the by me at 2.1.1990 at first purely theoretical derived potential vortex actually exists as vortex of the electric field!

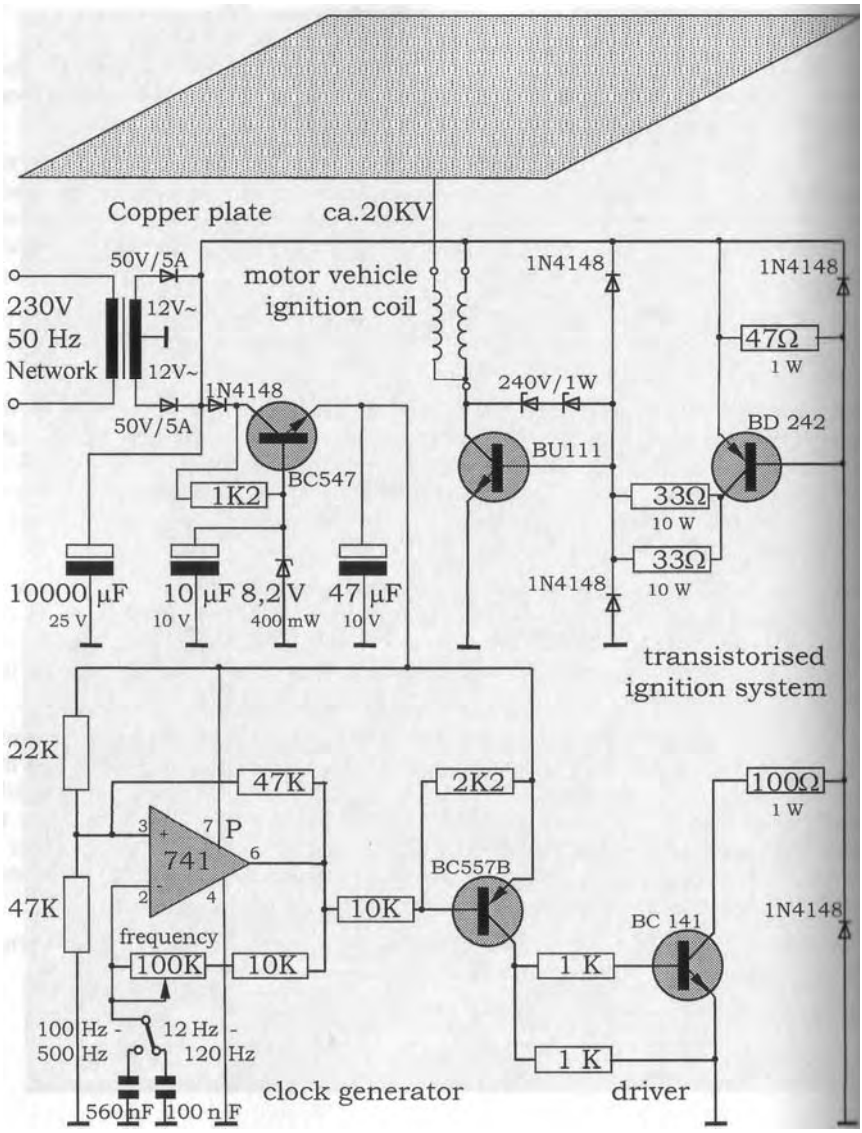

Fig. 19.4: Wiring diagram concerning the Kirlian device.<i>

<i>: Elektor, Fachzeitschrift fur Elektronik, Mai 1977, S. 22-25: KirlianfotogralV

19.4 High-tension experiments in the laboratory for performance electronics

At first the students of electronics, with which I had to do daily, were infected by my discovery. With true enthusiasm they soldered together one circuit after another. In my laboratory something like a mood of setting out could be felt. One student brought along and old ignition coil of a motor vehicle, then the control circuit for it was built, plexiglas organized, an aluminium plate glued under it and the whole box dragged into the photographical laboratory[<i>]. Three students made a detour along the outside grounds of the polytechnic and picked the necessary visual aids of trees and bushes.
Following the leafs were laid on photographical paper and by means of the self-built high-tension generator charged to 20000 Volt. Doing so at all edges and particularly at the tips of a leaf corona discharges arise, which expose the photographical paper. We then developed the photographs ourselves and discussed the results [<ii>].

The indication, for a second photograph the whole leaf would appear even if half the leaf is torn apart after the first experiment and only one half is put on, occupied us in particular. Eventually we didn't put on a leaf at all in the second experiment and found out that nevertheless the leaf put on last became apparent on the photograph. Now only one physical interpretation was possible: The potential vortices of the leaf stimulated by high-tension still were in the plexiglas disc in weakened form! Here they swirl further and under high-tension furthermore produce corona discharge impulses.

Now also the students were convinced of the existence of the potential vortices.

This experiment stimulated the brain cells of the entire team: If potential vortices under high-tension cause electric blows, since the corona discharge is nothing else, then in this way the local vortex distribution in space should be measurable? One student immediately got down to work and build from the horizontal diversion unit of an old television a high-tension generator with an adjustable spark gap. Following he walked with his flashing and crashing device all through my laboratory and others walked with him and dragged the gauges behind them. But to their big disappointment they were not able to see an influence dependent on place.

Then it suddenly was clear for me: It would have done the students well, if they before would have had a bath and observed the drain vortex, "it suffices the famous wing stroke of a butterfly", I explained my team, "and instead come up with this infernal machine and chase away all the vortices, which we actually want to register ". We had to realize that as a rule phase of disillusionment follows the euphoria.

<i>: Klektor, Fachzeitschrift fur Elektronik, Mai 1977, S. 22-25: Kirlianfotografie; fig. 19.4 shows the wiring diagram and fig. 19.5 A the self-built device.

<ii>: The Kirlian photographs from the darkroom of the polytechnic are shown in fig. 3.6.

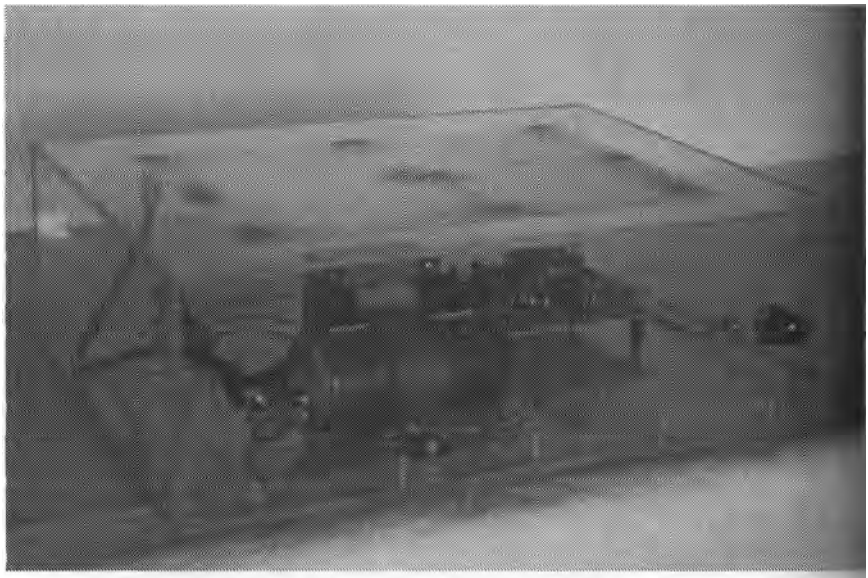

Fig. 19.5 A: A self-built high-tension device for Kirlian photography

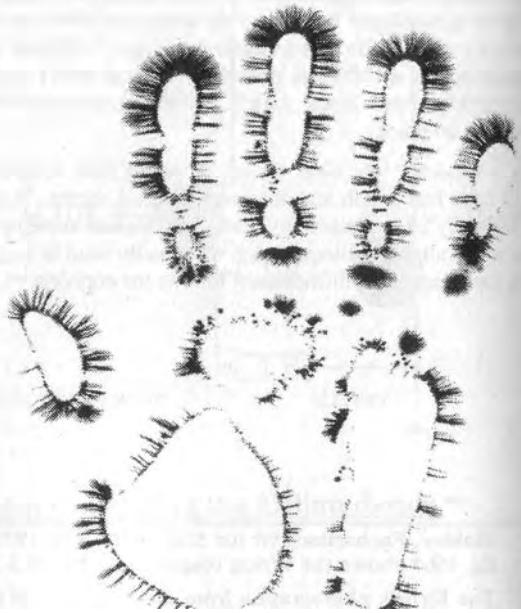

Fig. 19.5 B: Kirlian photograph of the right hand

19.5 Measurement of dielectric capacitor losses in the HF laboratory

My convincing work clearly was shaped more complicated with my professor colleagues. Most pretended to understand nothing about it and kept themselves out. But there also are exceptions. ,,something like that has never been there at our polytechnic, that a colleague puts forward an own field theory ",a physicist colleague remarked after my lecture public to the polytechnic<i> at 3.7.1990 and meant, that must be celebrated. He festively let me cast my eyes in his store room, got out a few bottles of wine, which then some of my colleagues of physics emptied with me in their official room. Doing so we small talked about the sense or nonsense to fix on the education of physics to the Coulomb charges.

The head of the high-frequency laboratory showed likewise impressed. At last he now knew, why capacitors at microwave frequencies can become so hot that they solder themselves out of the circuit by themselves and can fall out, why PVC-films can be welded with HF, etc. ,,We have to prove that not the dielectric is to blame, as stands in the textbooks" he came towards me.
At least following my idea potential vortices are the ones, as I expressed myself, which are behaving dual to the eddy currents. It concerns vortex losses, thus a physical phenomenon. Eddy currents now can be damped as is well-known, by for instance sheeting the iron circuit for engines and transformers. The insulation between the sheets prevents the formation of eddy currents in that direction and the degree of effectiveness increases.
"I would suggest", I told my colleagues, ,,to "sheet" a capacitor in a dual manner and to measure the losses". Because eddy current losses increase with the square of the frequancy, we picked microwave frequencies. In the HF-laboratory a card with an L-C resonant circuit was made, we should be able to quite precisely determine the losses by means of its quality. The inductance was formed as a microstrip line and for the capacitor a socket was planned.
The carrying out of the experiment consisted of using single layered ceramic capacitors, so called trapezium capacitors, with a vapour deposited silver coating on both sides as a package and to measure the quality of the resonant circuit as a measure for the dielectric losses. According to the rules of duality the dielectric (as nonconductor) thus corresponds to the permeable transformer sheet (conductor) and the silver coating (conductor) to the sheet insulation (nonconductor). In a second experiment the silver coating now was removed and the same capacitor material measured at identical conditions this time uncoated. Will the losses increase or isn't changing anything?
Tension and nervousness suddenly could be felt, even among the students, who followed the experiment from the second row. All looks were pointed at the monitor of the network analyser, on which slowly the bell-shaped curve of the measured resonant circuit quality became apparent. The result was surprisingly clear. I first looked at my colleagues and then at the students and had to realize that all eyes were pointed at me. The first measurement was a bull's eye! The vortex losses "uncoated" were considerably larger.

<i>: K. Meyl: Die mangelnde Dualitat der Maxwellschen Gleichungen with contributions concerning the theme of magnetic space poles, the mathematical calculation and the technical-physical interpretation of newly discovered potential vortices. Invited by the rector of the FH Furtwangen at 3.7.1990

- experiment 1: quality of resonant circuit with coated capacitors
  from a series of 5 separate experiments averaged: Q = 48
- experiment 2: silver coating removed with diluted nitric acid
  possibly the acid has damaged the dielectric: Q = 9
- experiment 3: silver coating polished off mechanically.

low quality means high dielectric losses! averaged: Q = 28

- resonance sharpness (quality number): $Q = \frac{f_0}{\Delta f} \frac{\text{(Resonance frequency)}}{\text{(Resonance frequency range)}}$

at a resonance frequency f0 of approx. 400 MHz.

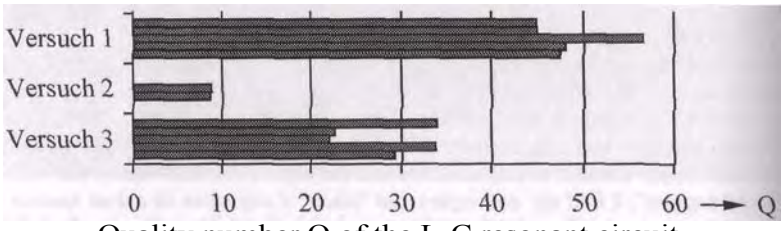

Quality number Q of the L-C resonant circuit
the dual ,,sheeted" capacitor has the lowest losses,
the resonant circuit with that the highest quality (experiment 1).

Fig. 19.6: Measurement of the dielectric capacitor losses over the quality of a resonant circuit in the HF laboratory at 11.06.1990.

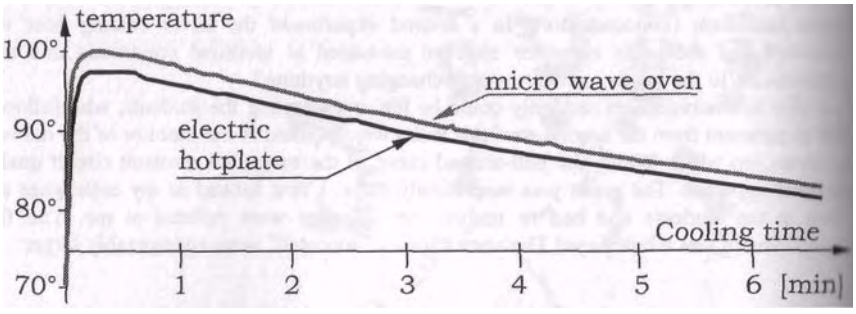

Fig. 19.7: Measurement curve of the water temperature over time
at 22.10.1996 in the electrical engineering training
Observation: for the microwave oven the container despite the "after cooking-effect"
remains colder than in the case of a hotplate. Sensor: PT 100.

19.6 Analysis of the measured capacitor losses

First of all the colleague spontaneously prompted a common publication.

But a certain disillusionment had to await us. For the next measurement hardly a differemce could be detected. We varied the contacting and removed the silver coating. once with hydrochloric acid, once with fine sandpaper. Every measurement we repeated umpteen times and in the end had to draw the conclusion that the results for our somewhat unprecise construction fluctuated extremely.

Averaged over all measurements and methods, indeed a reduction of the dielectric losses for alayered capacitor resulted, but at a critical consideration of the errors the results seemed to "drown" in the mean variation. In the opinion of my colleague the visible trend wasn't sufficient to convince dyed-in-the-wool sceptics, whereupon he withdrew with the indication, I should try at the people of microelectronics, they more likely would be capable to reproducibly gain control of a layered construction.

The experiment at least let a legitimate chance open that the vortices of the electric field actually exist, and in the case of the delectric losses of a capacitor it concerns vortex losses<i>.

19.7 Microwave oven for testing in the laboratory of electrical engineering

"Volunteers first" was said at 22.10.1996 in the electrical engineering practical training and two students got down to work. I had brought along from our kitchen the microwave oven, a portable immersion heater, a kitchen stove plate and different containers. In the laboratory of the polytechnic I in addition had got hold of a Bunsen burner. In the sense of the "Stiftung Warentest" (institution to protect consumers in Germany, note of the translator) it concerned the question for differences in heating water; or following the public discussion, is cooking with gas more healthy than cooking with the microwave oven?

We wanted to know. So we cooked water, filtered by inversion osmosis, once with the gas burner. once with the hotplate and finally with the microwave oven. Switched off always was at the same moment at the same temperature, and the cooling down curve was recorded with an x-t-time recorder (fig. 19.7).

Between gas and electric cooker virtually no difference could be detected, but the microwave oven at switching off still showed an odd temperature increase. I already had remarked this earlier. If one takes a water glass out of the microwave oven, then the water again really bubbled off, although the container itself had remained relatively cold. If one on the other hand takes a water pot off the gas cooker, the water suddenly stops cooking. From where comes this difference, which also the experiment could confirm?

<i>: A result of my dual way of looking at the vortex losses is the representation in fig. 4.7.

A: damped wave equation:

$$\Delta \mathbf{E}\, c^2 = \delta^2\mathbf{E}/\delta t^2 + (1/\tau)\cdot\delta\,\mathbf{E}/\delta t$$

(wave) + (vortex)

B: open chain of reasoning in the physics of electromagnetism:

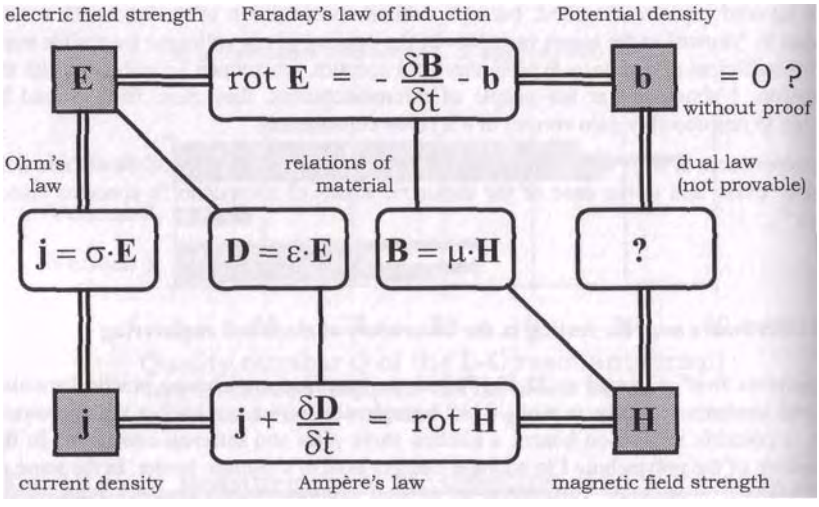

C: for the stationary case $(\delta/\delta t = 0)$ in general representation:

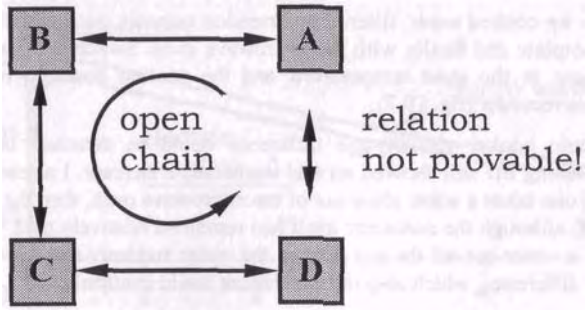

Fig. 19.8: _____ Contribution to the discussion about the impossibility, to prove, according to scientific methods, in a chain of reasoning (A-B-C-D) the last link (D-A), which closes the chain.

19.8 Microwave heating by decay of vortices

It has to concern a storing effect. In the case of an normal cooker the heat transfer takes place by convection. In the case of a microwave oven we however are dealing with an electromagnetic wave.
But in the wave equation nothing can be read about heat; here merely vortices can be found as a damping term (fig. 19.8 A)[<i>]! Therefore as the only possible interpretation is left that the microwaves roll up to vortices to fall apart themselves after a certain time.
Only at the vortex decay heat is formed.
The irradiated microwave power according to that is stored over a longer period of time as vortex in the water and the food. The vortex decay takes place according to an e-function with the calculated relaxation time constant tau[<ii>].

From the circumstance that particularly water is heated up in the microwave oven despite the small electric conductivity but with high dielectricity, I infer that it has to concern mainly potential vortices, from which a biological effectiveness can be expected. The question if this should be valued positively or negatively, I have to leave up to the doctors and therapists. At least physically seen a difference is measurable. Thus a vortex decay will occur for a meal prepared in the microwave oven even if we already have consumed it.

Conclusion: I wish all: your health!

But what do I write about vortex losses, if every sceptic knows half a dozen alternative interpretations. Inevitably I have to bear in mind that also the eddy current heating owes its acknowledgement only the circumstance of the discovery of the corresponding laws. If Othm hadn't discovered his law and formulated it in the known form and instead the dual formulation would have been discovered, then we today would attribute the dielectric losses in a capacitor and in the microwave oven to the potential vortices, in the case of the transformer however the material would be responsible for the heating and not eddy currents, for which there then also wouldn't be a theory (fig. 19.8 B).

It actually is pure coincidence that at first Ohm's law and not the dual formulation had been discovered and acknowledged. But because both are equivalent, we also have to assume the correctness of both, even if the last link of a chain of reasoning A-B-C-D back from D to A in principle can't be proven anymore, since it already is explained by the chain A-B-C-D (fig. 19.8 C).

There I thus had discovered a potential vortex, without a possibility for a direct proof of existence. For that the textbooks are full with auxiliary explanations, with which physics successfully cheats past this important field phenomenon. I was frustrated. There had to be a way to measuring technically register the vortex in some way.

<i>: Fundamental field equation 15 in fig. 5.1 or equation 21, fig. 5.3

<ii>: Relaxation time constant: see equation 10 in fig. 5.1 or fig. 8.1

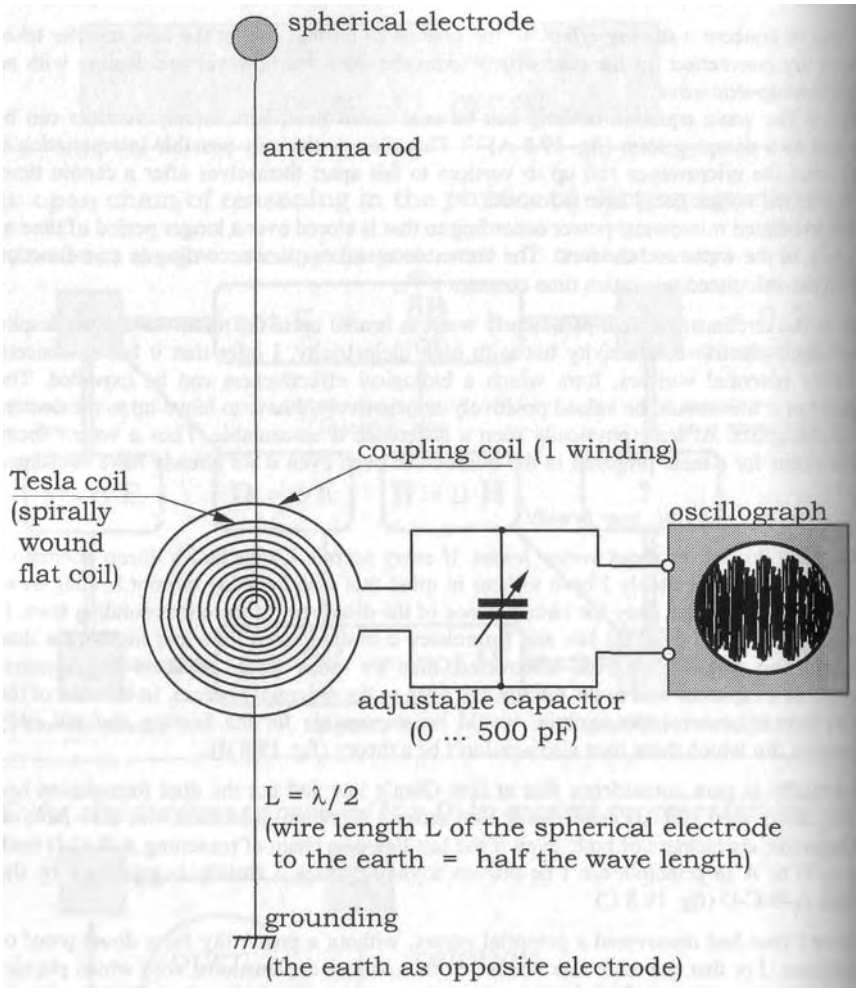

Fig. 19.9: Proof of scalar waves with the Tesla coil.<i>

<i>: The inverse use for a high-tension transmitter according to fig. 9.1

19.9 The Tesla coil from the workshop of handicrafts

I again retired in my workshop of handicrafts and wound flat coils or I pondered in my study over Tesla books. 1995 from several sides my attention had been drawn to the circumstance that the inventions of Nikola Tesla can be organized in three categories:

The first third has made him world-famous. It concerns the rotary field theory, the asynchronous engine and the today normally used alternating current technology, which we owe him.

The second third concerns technologies and inventions, which were rediscovered by other people partly only years later or even were only pinched and distributed as novelty under another name. Electron microscope, superconduction, electrolyte capacitor, fluorescent lamp, fuse. coaxial cable and a lot more count among that.

The last third however concerns inventions, which until the day of today still aren't understood and await their scientific explanation and technological use. Tesla himself called these achievements his most important inventions, but still owes us a scientific explanation. The scientific world also hasn't got a theory ready and doesn't know to do anything with it. Public research doesn't take place or is prevented by lobbyists.

What remains, are tinkerers of various educational background and qualification, who are trying hurd to comprehend the buried experiments of Nikola Tesla off their own bat in the garage or in the hobby cellar.

I felt like one of these, by winding one winding after the next from the inside to the outside. Then I soldered an antenna wire at the inner end of the flat coil, which I in Tesla manner connected electrically with a spherical electrode hung up under the ceiling. The opposite electrode should be connected to the outer end of the winding, it is said, and the distance between both should be as big as possible. If namely an electrode just is collecting, then the opposite electrode is repelling the same space quanta. According to Tesla's recommendation I did use the earth as opposite electrode and for that tapped the central heating or the grounding of the foundations.

To take signals only one to two windings as secondary winding were necessary. I connected them with an adjustable air capacitor from an old steam radio to a frequency determining parallel resonant circuit and looked at the taken tension voltage at the oscillograph (fig. 19.9),

I still had problems with the statement of Tesla, the coupling had to be made loose. Thus the question is asked, how loose? I after that organized two toilet paper rolls of different size, (after the toilet paper had been used, naturally) and pushed them into each other. The smaller toilet paper roll carried on the gable-end the flat coil as primary winding of the air transformer and the bigger one the coupling coil. Now by shifting any wanted degree of coupling could be adjusted to (fig. 19.10).

I was astonished myself. Tesla actually was right with his discovery of the scalar waves. With my arrangement they can be clearly distinguished from the Hertzian waves.

The following procedure is recommended:

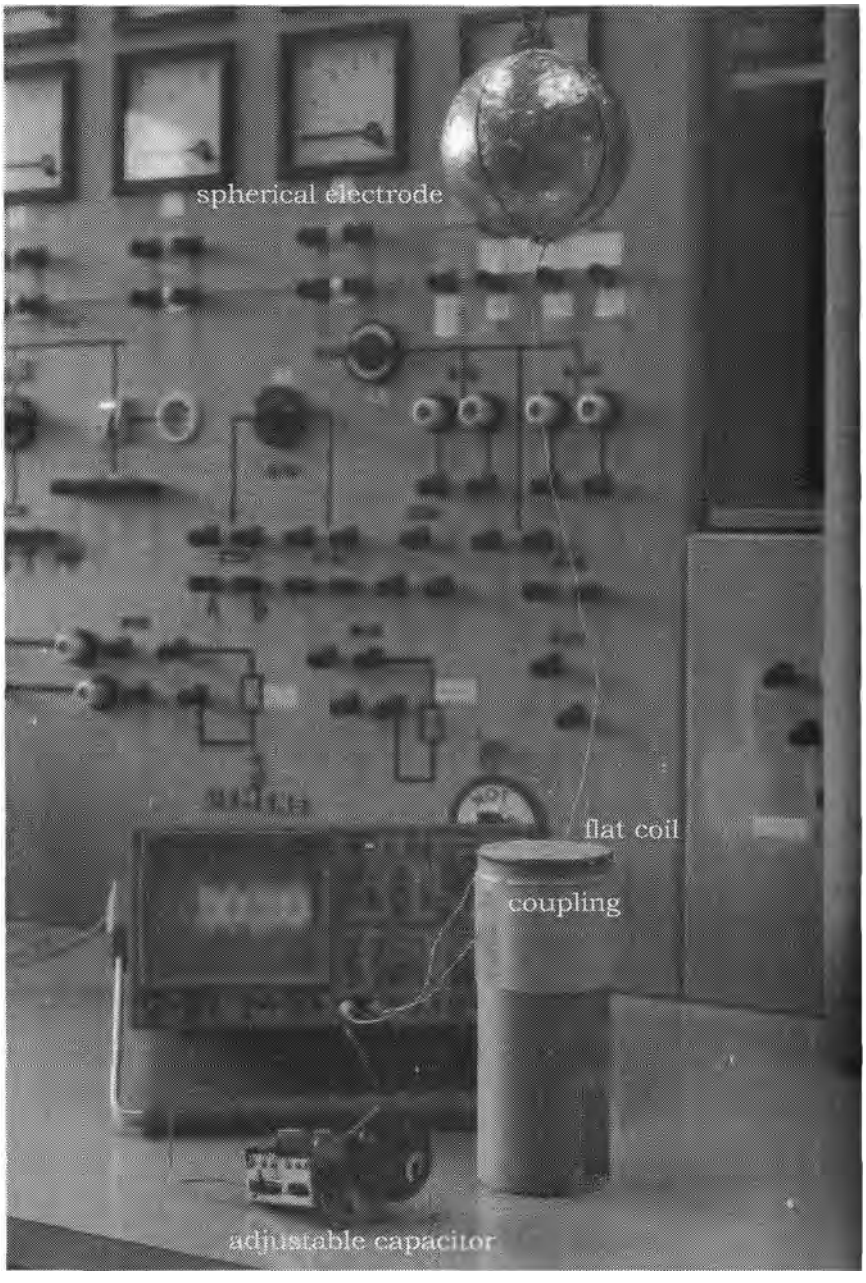

Fig. 19.10: The experimental configuration

First of all I seek a source of interference with the adjustable capacitor and tune to maximum amplitude. Then I change the coupling and further optimise in this way. If now the amplitude again decreases from a certain point while approaching the coupling coil, then it concerns the sought-for longitudinal waves. If namely the coupling is too tight, then the received vortices again are driven away by the effect back on the fiat coil. They make way.
At last I had found a method to catch the vortices in such a way that they not immediately "ran away" from me again. At once I presented them in the technology centre in St. Georgen. In the time following I improved the technology further and further, used bigger toilet paper rolls and eventually even turn up garbage cans, I varied wire length, wire diameter and the sense of winding (fig. 19.10).

I had very different success. Sometimes, if at the same time in my workshop of handicrafts the radio worked, it would look as if the received signal would synchronize with the sound waves. Both are longitudinal waves after all. With transverse waves something like that would be unthinkable.
One moreover could observe, how a resonance builds up: first slowly and then faster and faster, so that I sometimes got terribly afraid. Several times we had to repair our oscillograph, after the protective diode at the input amplifier had blown, and that for signals of 50 to 100 millivolt!
That was entirely impossible. Only individual spikes, which were too fast to be seen at the screen, could be to blame. In the case of distant thunderstorm activity I obtained maximum values of more than half a Volt. After that I undamped the grounding as fast as possible, so that no lightning would be caught, since I didn't have the intention to burn off my workshop.

19.10 Biological effectiveness of the Tesla coil

Also the biogical effectiveness of the Tesla radiation I could impressively prove with this device. 14.06.1997 a woman, who called herself extremely electrosensitive, participated in the weekend seminar about electrobiology, which I took over from Prof. H.K. Konig (TU Munich) after his death. That I wanted to test.
I hung up my device in the lecture auditorium and installed the oscillograph in such a way that all could see it. The voluntary test subject however could see neither the public nor the screen. One person every 5 seconds said "now" and the female candidate should say, if I had clamped or undamped the grounding, if therefore scalar waves were received or not. After a training round her proportion of hits was lying at 100 percent!

According to her statement she could feel it. A further test subject achieved even at the back of the room with a pendulum the correct answer. I myself was surprised by this and I already have repeated this experiment several times with different success. It without doubt depends on the sensitiveness of the test subjects. Every person after all reacts to other signals.

What however has astonished all participants and can't be emphasized enough at all, is the circumstance that it in this case concerns a receiver and not a transmitter!

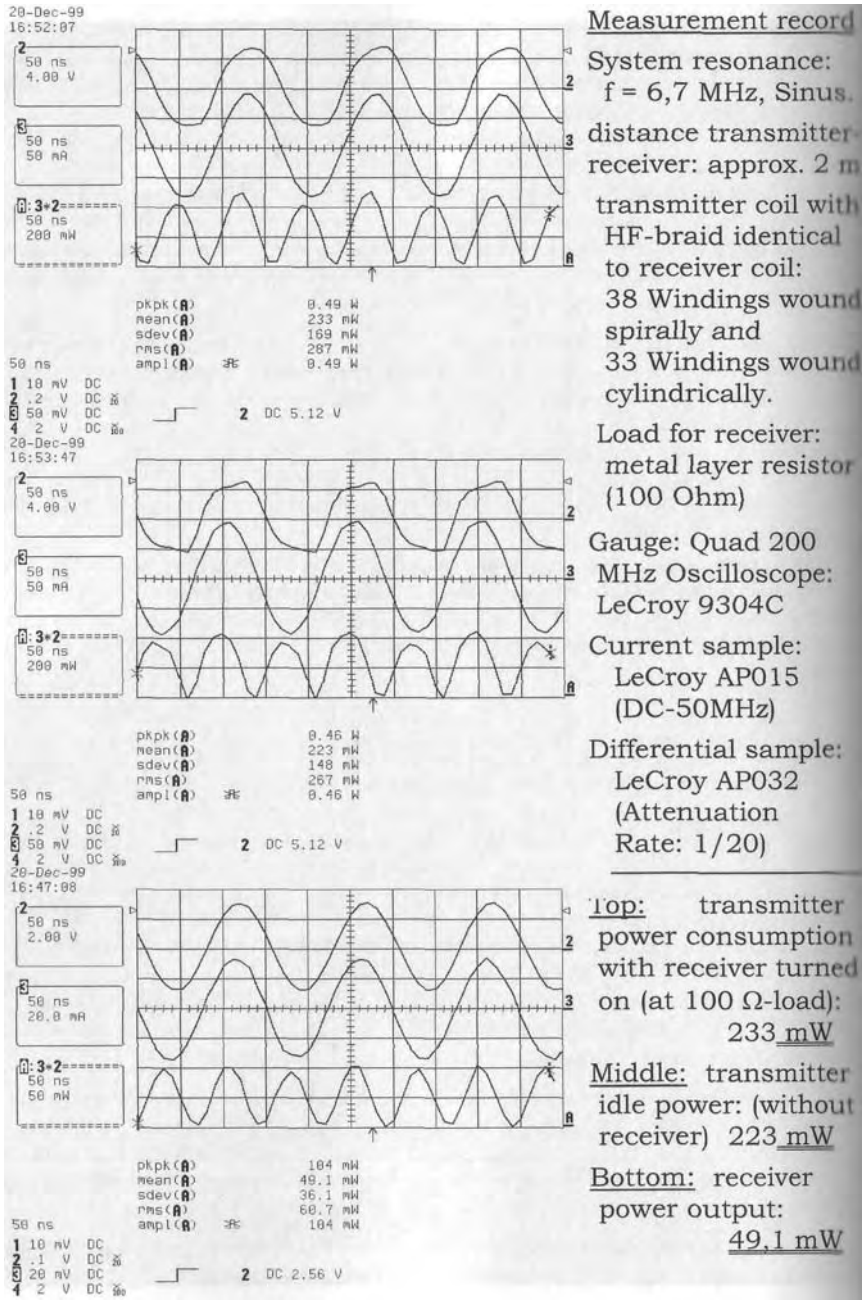

Fig. 19.11 A: Measurement record for scalar wave transmission line

19.11 Wrestling for measuring technical insight in the Transfer centre

In the central question who should be believed more, the famous experimental physicist Nikola Tesla or his critics, my experiments with the Tesla coil were the visible proof that we have to take Tesla's statements seriously. Now not only at myself, but also at the students of the polytechnic and the colleagues of my Transfer centre a true Tesla euphoria broke out.
In every free minute the patents and original writings were studied, which I had myself send from the Tesla Society in Colorado Springs in the USA. In particular my trainees and diplomands developed a incredible ambition in making a historical Tesla concept work. They built a whole series of various high-tension generators. In the laboratory one could hear crashing and there was a smell of ozone.

22.1.1998 at a presentation of the works for a degree the candidate looked after by me very proudly held a fluorescent lamp in his hand, which in the field of his self-built high-tension generator glowed even without any wire connected, entirely according to the great mode (fig. 17.10). At all efforts we however laboratory technical weren't able to reach tension voltages of above 511 000 Volt. But at this tension voltage the actual Tesla effects actually start!

Perhaps it was tough luck, but possibly also a chance that we in the laboratories, which I had at my disposal, were forced to work with lower tension voltages and that meant that we gradually had to beak away from the Tesla designs.
Moreover we hadn't at our disposal the precisely controllable spark gaps, which Tesla had developed and used. If one wants to obtain an if possible high tension voltage change (du/dt) for an interaction with neutrinos, then according to today's technology considerably more favourable concepts are offered, for instance with hard switching Power-MOS-Transistors. 50 Kilovolt per microsecond were to meet.
Therefore we changed the technology and worked from now on with fast semiconductor switches. From the laboratory radio now only a hissing and crashing came out of the loudspeaker, if our experiments were running.

At 12.10.1999 we for the first time succeeded to build up a transmission line for Tesla radiation. Doing so the transmitter and receiver were situated in different rooms of my transfer centre. The transmitter coil was operated in self-resonance and fed only from a small function generator with 10 Volt. But if the diplomand held a fluorescent lamp near the spherical electrode, then it started to glow!
Following I observed at the oscillograph the signal of the receiver coil, which as well was operated in resonance. If the diplomand switched off the transmitter, also no receiver singnal was present anymore. But if it concerned radio waves according to Hertz or Tesla radiation, with that still wasn't answered.
Therefore I prompted still another experiment. This time the colleagues observed at the transmitter the signal at the function generator, while I undamped and again clamped the receiver. The shouting with joy from the adjoining room indicated that it had been observed, how the receiver reacted upon the transmitter and both are in resonance with each other. Such an effect characteristic for scalar waves, is a radio technical impossibility! In the case of radio with Hertzian waves an effect back from the receiver on the transmitter is unthinkable by principle.

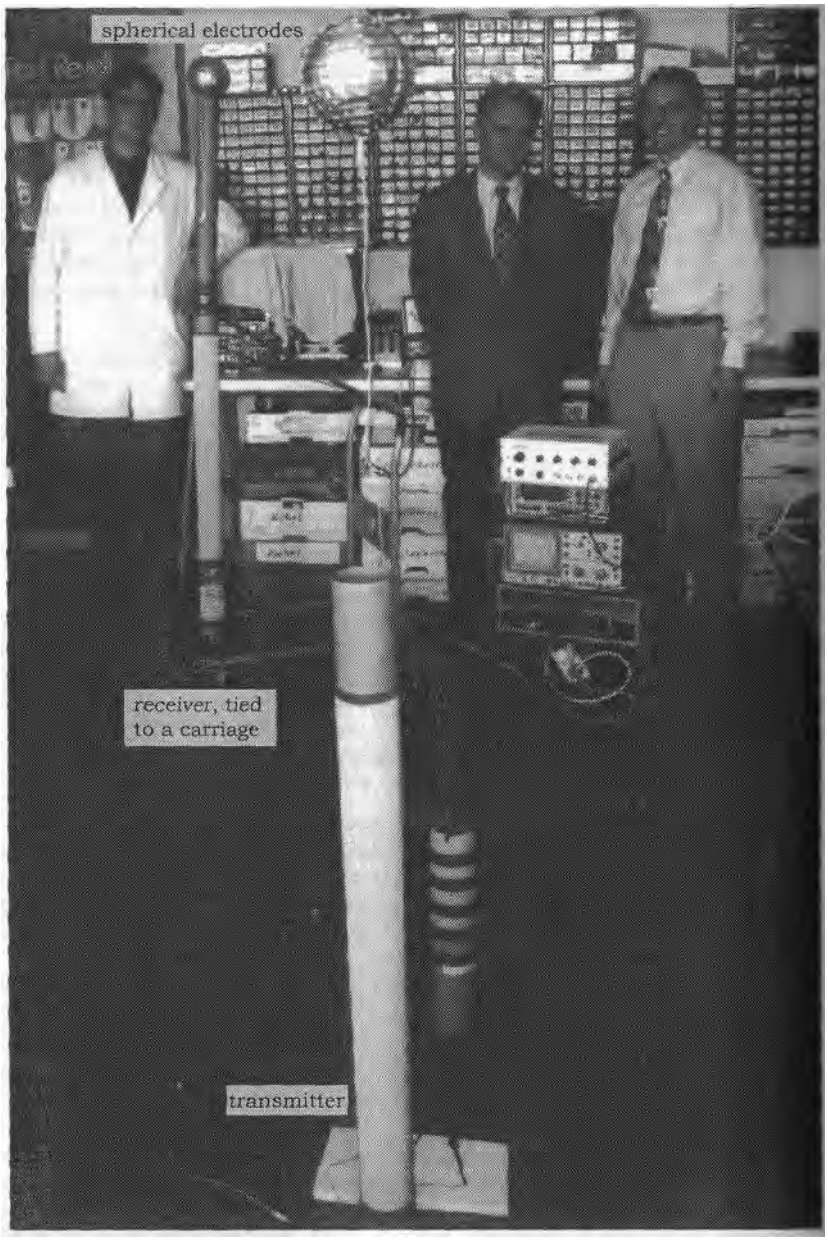

Fig. 19.11 B: Scalar wave transmission line according to Tesla
f.l.tr.: M.Andresen (diplomand), author (TZ-head), Dipl.Ing.M.Rehm (project leader)

In the next step we let glow the famous little lamp on the side of the receiver. As a consumer served a small light-emitting diode, of which the light intensity remained unchanged in the case of resonance. To prove this, we placed the receiver on a carriage and rolled the corridor in the TZ up and down with it. If the receiver was only slightly out of tune, then from the then arising fluctuation the standing wave nature could be observed perfectly.

With the setup it can be demonstrated well, how the law of the square of the distance, of the decrease of the field strength with the square of the distance, known from radio technology hasn't got validity anymore for scalar waves. Very clear also was the energy transmission of scalar waves out of a closed Faraday cage.
In the end we have determined the degree of effectiveness of the scalar wave transmission line. An output power of 49 mW resulted from the measurements of the current and tension voltage for a loading of the receiver with a 100 Ohm resistance. Simultaneously the power taken up by the transmitter amounted to 233 mW. If we however subtract the idle power consumed by the transmitter from this, and that was determined to be 223 mW for switched off receiver, then actually only 10 mW are available for the wireless energy transmission. The degree of effectiveness according to that would be 490%!
If we here really have obtained an over-unity of 4.9 then the receiver must have collected along free space energy, or did some parts evade our power measurement? The sceptics I recommend an own rebuild, since alone the proof of the scalar wave properties inevitably has to lead to every Maxwell burdened HF technician breaking with the old belief.

19.12 Neutrinolysis, the alternative splitting of water

Free after the plans of Stan Meyer we filled diverse containers with water and let it "crash". If then bubbles raised and it got exciting, we changed the frequency and exactly paid attention to the effect remaining the same or if it increased as well with increasing frequency, thus if we only watched a classical electrolysis, or already the wanted "neutrinolyse", as we were accustomed to term the splitting of water in its parts under the influence of neutrinos in the laboratory. Typical for that is a bubbling and "cooking" of the actually cold water produced by the rising gas bubbles (fig. 19.12).

We also have reversed the principle. Doing so we have switched the container as neutrino receiver and measured the forming charge carriers. The passive system proved to be really moody. On the one hand tension voltages of several hundred millivolts at a load resistance of 10 megaohm can be realized, on the other hand the charged gas particles and the as secondary reaction in the water set free ions continually change the electric conductivity, so that the cause to be measured, the neutrino radiation, hardly can be reproduced on the displayed result. The water hence has to be changed more often and also the developers found themselves between jubilation and disillusionment subject to continually changing feelings.

<i>: A. und I. Schneider: Neutrino-Power - Energie aus dem Kosmos, Bericht zu Vortrag und Demonstration des Autors am 25.11.99 in Villingen, NET-Journal 12/99, S. 4-6; Interview mit Prof. Dr.-Ing. Konstantin Meyl: Durchbruch in der Freien-Energie-Forschung, NET-Journal 12/99, S. 7-9

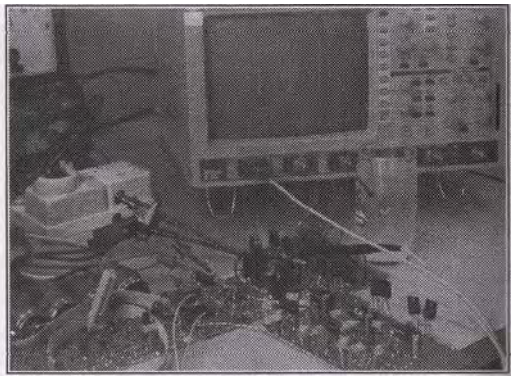

Fig. 19.12: Experimental constructions for the „neutrinolyse“.

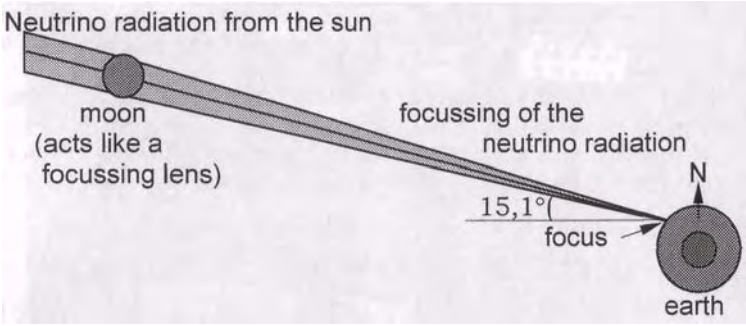

Fig. 20.1: Course of the neutrino radiation focussed by the moon
on the occasion of the eclipse of the sun at the 11th August 1999.<i>

concerning the calculation of the position of the sun at 11.8.99:

at 21.6. after 0 days is	$23.4° \cdot \cos 0° = 23.4°$	northern latitude
at 21.9. after 92 days is	$23.4° \cdot \cos 90° = 0°$	= equator
at 11.8. after 51 days is	$23.4° \cdot \cos \frac{51 \text{ days}}{92 \text{ days}} 90°$	$= 23.4° \cdot 0.644$ $= 15.1°$ n. lat.

<i>: Konstantin Meyl: Zur Brennglaswirkung des Mondes bei einer Sonnen-

20. Cosmic experiments

As long as no usable technical gauges are available, we should observe and study nature and all celestial phenomena. Here the scalar waves with all their properties are presented to us. That is valid in particular for the case that the cosmos makes an experiment with us and with the entire earth. Such a situation offered the eclipse of the sun of August 11 1999 as an unique "bulk experiment" to which travelled millions of spectators, to participate in the cosmic experiment as voluntary test subjects.
My warning for possible influences proved to be absolutely justified afterwards, even if only comparatively few took note<i>. In view of strong changes in the EEG of individual test subjects and a proven temporary acceleration of the rotation of the earth science once more stands before insoluble problems.
To answer the open questions I want to start with my indications, which 1 have published in anticipation of the cosmic event of August 11<i>. Afterwards a revision and the attempt of an interpretation from the scalar wave view follows. Perhaps this way leads to a reliable prediction of of earthquakes and other cosmic events. After that we perhaps know more about origin, availability and further important parameters of the sought-for space energy.

20.1 Millions of voluntary test subjects at 11 August 1999

Astronomically seen, it concerns a harmless natural spectacle as it already was observed more often, if the moon glides between sun and earth and its shadow in broad daylight immerses parts of the earth in a dark night. The special thing about the eclipse of the sun of August 11 1999 however was, that the sun activity just strived for its maximum value in its eleven year cycle, and the orbital distance to the moon simultaneously reached a minimum value. In addition we must pay attention to the special situation of the angles (fig. 20.1). Due to the extremely rare constellation the area of complete shadow at first was larger and darker than normal. On August 11 it had a width of 110 kilometres.

The sun besides the light also sends us solar neutrinos and for those the moon is transparent. It with regard to them acts like a glass ball, which lets the light it is true pass through, but in doing so refracts it. The glass ball acts like a convex focussing lens, which focuses the arriving rays behind the ball in a focus.
To slow down and collect neutrinos the moon it is true is too small, but it will be able to influence the flying direction. Very fast neutrinos, which run through the moon, hardly will be diverted. The slow and biologically active ones however will be bent stronger.

At this point it would be of utmost importance to know, in which distance from the moon the rays run together and combine into a focus.

<i>: Konstantin Meyl: Zur Brennglaswirkung des Mondes bei einer Sonnenfinsternis, NET-Journal, Jg. 4, Heft Juli/August 1999, Seite 13-17

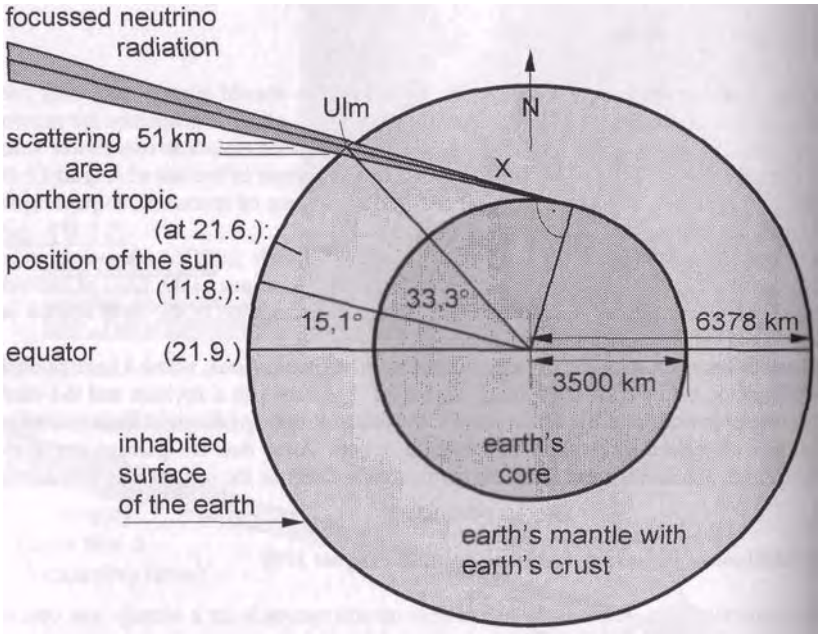

Fig. 20.2: The course of the focussed neutrino radiation at 11.08.1999 for 48.4° northern latitude. (this corresponds to the line Ulm-Augsburg-Freising)

calculation of the critical latitude:

$$\sin\alpha = \frac{3500\ \text{km}}{6378\ \text{km}} = 0.5488 \quad \text{resulting in the angle} \quad \alpha = 33.3°$$

$$+\ 15.1°$$

The neutrino rays touch the earth's core at: 48.4° n.lat

minimum distance to the moon: $r_m^* = 358000$ km
radius of the moon: $R_m = 1738$ km
radius of the earth: $R = 6378$ km (at the equator)
length of the Tangente: $X = 3500\ \text{km}/\tan 33° = 5332$ km

$$\text{scattering radius: } r_x = X \cdot \frac{R_m}{r_m^* + X} = \underline{25.5\ \text{km}} \text{ around the centre line}$$

Focussing without scattering on earth's surface increase to
$R_m / r_x = 68$ times , resp. with scattering to
$68 * 0.5 * 0.8 = 27$ times the natural neutrino radiation!

For that we again bear in mind that neutrinos as particle radiation propagate in space in the sense of a plasma wave. Since the oscillation of such a longitudinal wave takes place in the direction of propagation, it neither knows a distinct velocity of propagation nor an upper limit.

The sea of neutrinos in which we swim, is a combination of differently fast particles. The slow ones are bent stronger by the moon, with the property of a convex focussing lens, so that the focus should be looked for near the moon, whereas the fast ones hardly are diverted. Their focus lies further distant from the moon than the earth, up to the extremely fast cosmic neutrinos, which experience almost no diversion, because they, as a result of the Lorentz contraktion, are small enough to tunnel through any kind of matter.

If neutrinos, depending on their velocity of propagation, have their focus partly before and partly behind the earth at an eclipse of the sun, then it comes up to a conclusive logic that there actually exist such, of which the focus lies exactly in the centre of the complete shadow on earth's surface. But thereby the question is asked, which biological effectiveness these neutrinos have or which damage they bring about.

20.2 Model of calculation for the cosmic experiment

More than a year ago the results of an international neutrino experiment have been made public. Thereby for the first time the order of magnitude of the natural radiation density was recorded. after the detector before having been calibrated at an artificial source of neutrinos. As the perhaps most important result at night only half as much solar neutrinos could be detected as during the day with the immense Super-Kamiokande detector in a Japanese mine. With that the here taken interpretation, that earth's core collects neutrinos, meanwhile even is proven experimentally! For that it has to interact with the particles and that means, it has to exert a force of attraction on them. Thus the earth's core during an eclipse of the sun will further amplify the effect of focussing if the konzentrierte neutrino ray is directed on earth's core. This critical point we have to calculate (fig. 20.2).

The proportion of the radii of earth's core (3500 km) and the entire earth (6378 km) results in the sine of the sought-for angle and that amounts to 33.3 degrees northern latitude. At August 11 moreover is added that at noon the sun with regard to the equator is standing at 15.1 degrees. so that a first extreme focussing should be expected, if the centre of the complete shadow intersects latitude 48.4. This would be the case for the latitude of Ulm in direction Augsburg and Freising.

Now we would like to know more about the amplitude of the focussed radiation, about the spatial extension and the period of time. Without concrete data material we have to proceed from several simplifying assumptions. If we therefore assume, 50% of the at earth arriving and biologically relevant neutrino radiation stems from the sun, which in the case of an eclipse of the sun is focussed to 80% and scattered to 20% by the moon. If we further assume the focus just touches earth's core, then between Ulm and Augsburg a sphere of action of 50 km can be expected, within which the neutrino radiation on the average reaches 28 times the value of the natural radiation. The intense irradiation under these assumptions will last one minute.

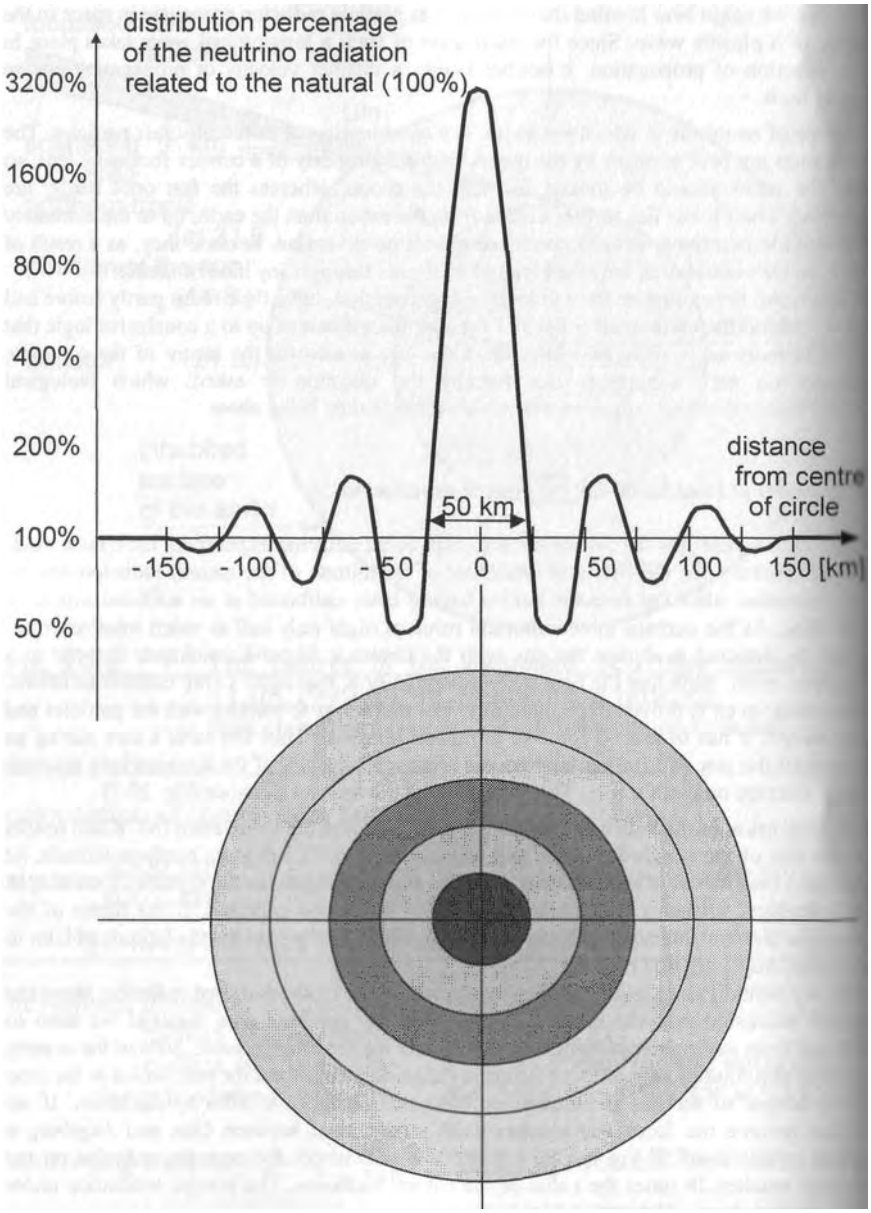

Fig. 20.3: ____ The spatial distribution in the case of focussing of the neutrino radiation by means of the burning glass effect of the moon on earth's surface.

Of course the calculated values only are valid to the extent, as also the assumed boundary values apply. After August 11 we know more about this cosmic experiment, about the spatial distribution and indirectly about the interaction with earth's core, about the physical properties and the biological effectiveness of the at present available neutrino radiation.

20.3 Physical technical consequences

The neutrino radiation is a scalar wave radiation which, as mentioned, can be perceived by sensitive people even without aids. Who hasn't at his disposal this sensitiveness, is recommended a simple setup.
For that one hangs up a fluorescent lamp, connects the one end with a piece of wire, as it were as antenna, and the other end is grounded. For a scalar wave radiation which increases fast, the lamp should start to glow by itself. Under big transmitting installations this method already has been successfully applied by many allotment gardeners thousandfold. I hence recommend all research scientists of eclipses to test themselves the possible field fluctuations in this simple way.

From a technical viewpoint first of all the atomic reactors and their nuclearly contaminated waste will be concerned by a fluctuation of the neutrino radiation. In view of present eclipses of the sun an accident can be expected less, since the neutrino radiation it is true for a short time reaches an extreme maximum, which averaged temporally and spatially over the whole event again is relativized somewhat. The relations shall be clarified with an example (fig. 20.3).
Whoever places himself in the centre line of the complete shadow on August 11, at first will detect a decrease of the neutrino radiation to 50 to 60 percent, then a steep increase to 2800 percent and from the summit again the whole backwards, while standing on the earth he turns by under the moving moon shadow. The ring with half the radiation, which reaches us first, doesn't pose a problem since, as said, we only have half the radiation in every night. Some animals and plants as aresult erroneously will set out for sleep.

The wave distribution one can imagine like that in the case of a pool, in which was thrown a stone. But we still don't know the resonance frequency, for which reason the length of the cycle depicted in fig. 20.3 is chosen arbitrary. The actual deviation from the distribution given by nature is the peak in the focussed ray centre. Living nature must stand large fluctuations of the solar radiation, since every supernova sends us a relatively short batch of fresh neutrinos. Where we have difficulties is the question, how much fluctuation still can be tolerated by mankind.
The question for possible biological consequences is due to be dealt with in view of the announcement of a complete shadow tourism causing concern, as it is awaited for August 11. At the incomplete state of knowledge about the properties of neutrinos, every trip to the complete shadow remains a journey into the unknown.

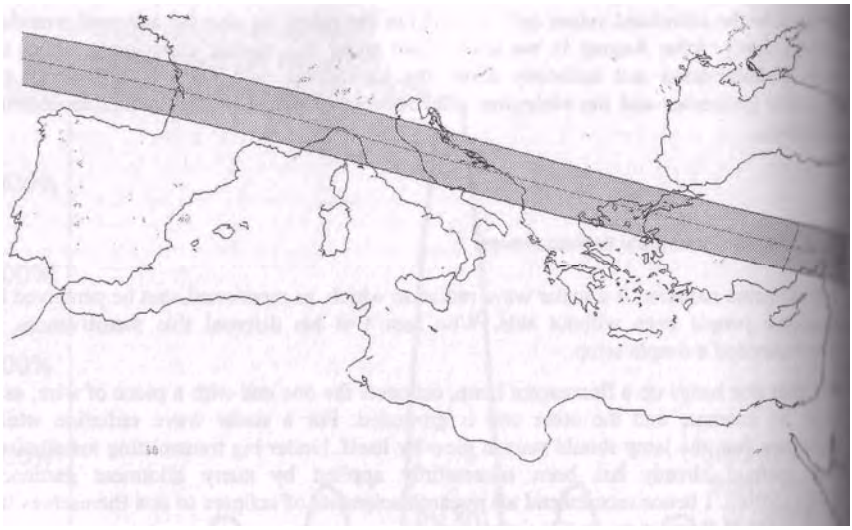

Fig. 20.4 A: The course of the complete shadow for the ancient
eclipse of the sun at 28.5.585 B.C.

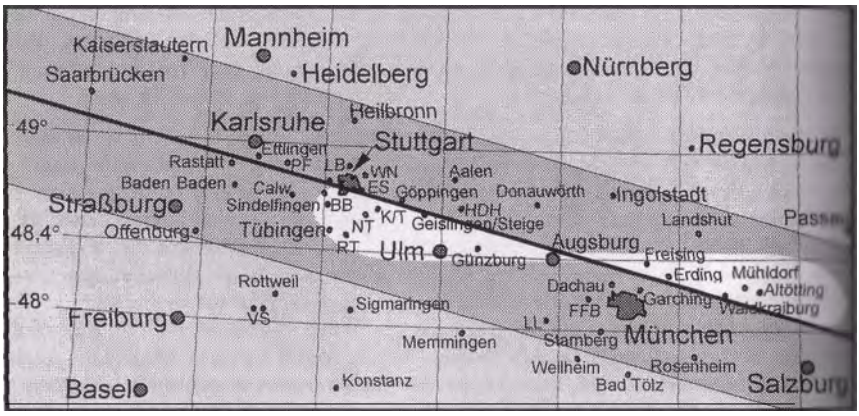

Fig. 20.4 B: The course of the complete shadow over south
Germany at August 11 1999 (grey) and the possible course of the focussed neutrino radiation (white).

20.4 Biological consequences

In the case of an eclipse of the sun effects on the biology, like problems with the heart among affected, at least can't be excluded. If the scalar wave density increases above the density which is normal, then this has a positive effect on the economy of energy, as long as the body is capable to regulate the amount taken up. If the regulatory process however should fail. then the risk of a self-inflammation exists. Also straw bales and other organic and inflammable materials could thus go up in flames.

But before that happens, first the information technical influence of the scalar waves will show. Here we have to expect a psychotronic influencing, which is showing in a limited ability of perception. History teaches us as an example[i] that a by Thales of Milet predicted total eclipse of the sun at 28.5.585 B.C. compulsorily has ended a battle in Asia Minor between the Medes and the Lydians, because the soldiers apparently most literally had gone out of their mind (fig. 20.4 A).

Actually all in connexion with the free energy addressed phenomena are conceivable. from the "neutrinolyse" up to the acceleration of the radioactive decay. It would be understandable, if in a water glass bubbles should rise, even if no carbonic acid is contained in the water at all. After man not having at his disposal a sense organ for his own energy source, the brave in the complete shadow of an eclipse of the sun are recommended smaller technical experiments and observations. The cautious however will avoid the area from the start.

As counter movement to the complete shadow tourists there will also be refugees, who believe in the predictions of Nostradamus, who in his quatrains has predicted a messenger of fright over Europe for 11.8.1999. He mentions Lyon, Ulm and Moskau, which actually lie on one line [ii].
The line of the complete shadow however will run under another angle from Plymouth in South England over Ulm to Bukarest and further into Turkey. Maybe Nostradamus wasn't a clairvoyant at all, but merely a good calculator, or he knew someone who could calculate excellently, after all he has indicated the time and even Ulm as the centre correctly. Apart from the small angle error, in addition the direction is correct (fig. 20.4 B).

Worth paying attention to also is, that he contrary to his habit here gives a concrete date which astronomically can be calculated unambiguously, that he simply skips the numerous eclipses of the sun of the past and only points to the one of 11.8.1999, which runs crossways through South Germany. Extremely sinister are his forecasts, which mustn't commented on further, since he speaks of "Mort et Tombe", of death and grave[ii].

<i>: Merodot: Historien, Kroners Taschenausgabe 224, S. 33 (cf. page 586 and the modern misinterpretation note 9 on page 754); further sources: dtv-Atlas zur Weltgeschichte S. 45; resp. Propylaen-Weltgeschichte I, S. 168.

<ii>: Michel de Notredame (1503 bis 1566), Mathematiker, Astrologe, Leibarzt von Konig Karl IX: Centuries (1558) X, Vers 72.

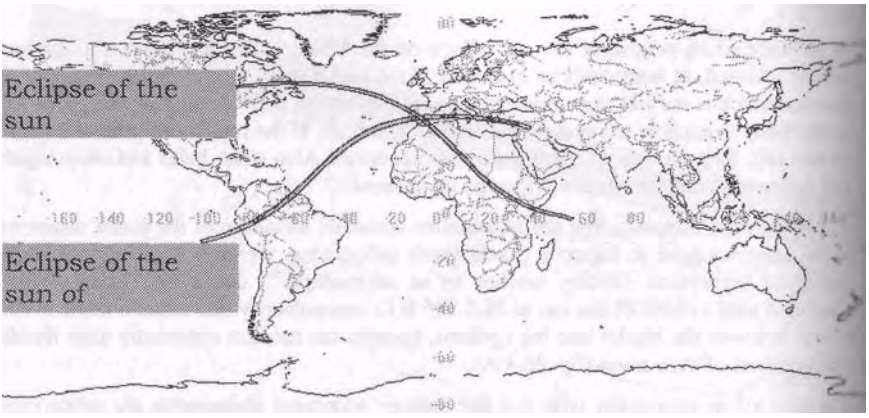

Fig. 20.5 A: The total eclipses of the sun of 18.4.1539 and
21.8.1560

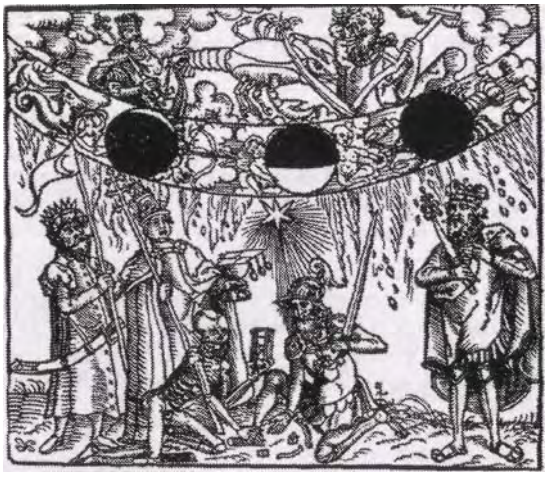

Fig. 20.5 B: Under the impression of the last two eclipses of the
sun over Europe death and war play dice about the fate of mankind during the eclipse of the sun of 1562.[i]

<i>: Werner Raffetseder: Sonnenfinsternis, Hugendubel Verlag, Munchen 1999, ISBN 3-89631-302-9, Seite 156.

20.5 Epilogue to August 11th 1999

My indications have been published two weeks before the cosmic event in the NET-Journal[<i>]. The public interest was immense. Now, after the spectacle is over, it is time for an analysis[<1>].

Besides numerous very subjective descriptions of eyewitnesses, which scientifically hardly can be analysed, at numerous polytechnics over the world has been observed, how Foucault pendulums suddenly and completely unexpected have deviated from their normal swinging direction. With this device 150 years ago the rotation of the earth had been detected in Paris.
Since according to prevailing textbook opinion an eclipse of the sun is a purely optical phenomenon, the scientists world-wide are having a big problem. Which force here has teared at our earth and caused relative accelerations of the kind that the pendulums could turn out of their usual plane and changed into an elliptic orbit, while the shadow of the moon ran over us? The gravitational force isn't even roughly capable to that. That merely has brought a 50 cm higher flood. The enormous force effect, which even puts the gravitation in the shade, actually only can come from the interaction of the neutrinos.

Different reports are present concerning the influencing of the radioactivity. In the cases, in which measurement samples have been used, almost no change could be observed. This is confirmed by a video tape, which northeast of Munich directly in the centre of the complete shadow documents an experiment, in which during the whole time the radioactivity of 1 kg crude granite is monitored with a professional dosimeter. The background might be that calibrating samples are chosen in principle under the aspect of being influenced the least by outside interference sources. It therefore would have been better, if we instead had put a lettuce as a biological and broadband sample in front of the device. Because there, where one anyway hadn't expected deviations and thus neither were measured calibrating samples nor unfortunately were made recordings, is said to temporarily have occurred a visible increase.
Even in the case that somewhere accidentily should exist recordings, the increase is too small, to help explain traditions from the Middle Ages, according to which is talked about "stinking log" and about "aggressive damps, which fall from the sky". Other sources speak of harmful radiations, which one regarded as the trigger of plagues.
It is said: "They poison the drinking water and the crops and make people sick"[<iii>]. Crops after an eclipse of the sun either should not be harvested at all or only after a violent shower. The warnings for a poisoning "without adding poison", which reach back into the 19th century, suggest the assumption that it concerns results of a radioactive contamination.

<i>: Konstantin Meyl: Zur Brennglaswirkung des Mondes bei einer Sonnenfinsternis, NET-Journal, Jg.4, Heft Juli/August 1999, Seite 13-17

<ii>: From the third and extended edition of this second part concerning Electromagnetic Environmental Compatibility the following chapters are completed.

<iii>: Mark Littmann/Ken Willcox: Totality - Eclipses of the Sun, Honolulu 1991, Kapitel 4: Eclipses in Mythology; nachzulesen bei Werner Raffetseder: Sonnenfinsternis, Hugendubel Verlag, Munchen 1999, Seite 130/131.

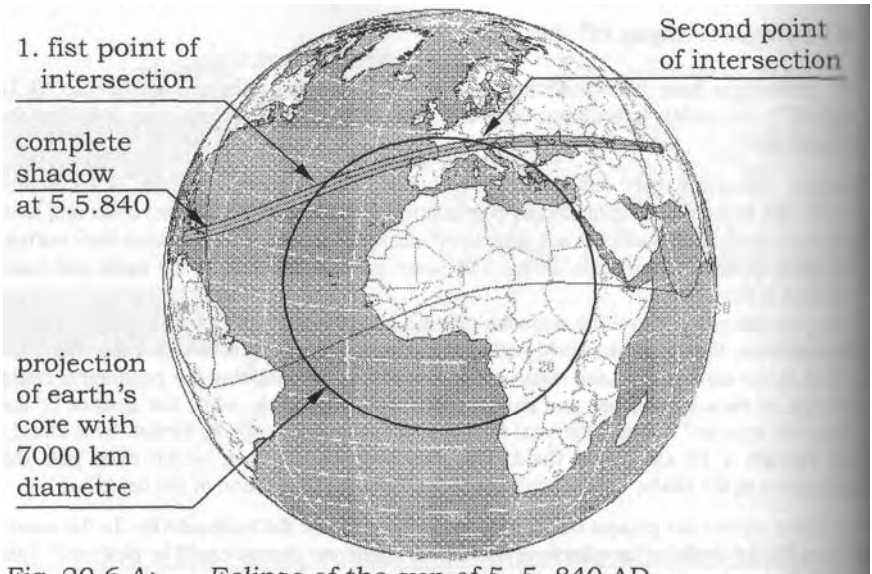

Fig. 20.6 A: Eclipse of the sun of 5. 5. 840 AD.

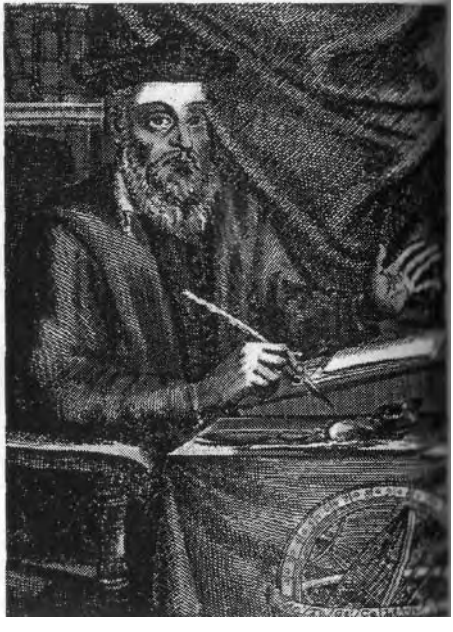

Fig. 20.6 B: Nostradamus announces catastrophes for 1999 in the Centuries of 1558.<i>

<i>: Bryan Brewer: Eclipse, Chapter 1: Eclipses Throughout the Ages, Seattle WA 1991, S. 20, cited in Werner Raffetseder: Sonnenfinsternis, Hugendubel Verlag, Munchen 1999, ISBN 3-89631-302-9, Seite 130, Bild Seite 159.

20.6 Dropping of the neutrino radiation

Plagues of that kind, which in the Middle Ages have claimed lives as a result of an eclipse of the sun, hardly are verifiable, unless a prominent victim was among them, like e.g. the son and successor of Charlemagne, emperor Ludwig I. He 5.5.840 witnessed an eclipse of the sun with a totality of five minutes. Further it is said: „The fright which this experience gave him, little later shall have torn him to death"<i>.

According to that there must have existed times, in which the radioactivity present in the countryside and stored in the body of a person during an eclipse of the sun could be set free and be the undoing of the affected. At the same time such a decontamination of radiation acts cleaning for nature.

In this case only the interpretation of Nikola Tesla provides us an explanation, which states that the neutrino radiation causes the radioactivity<ii>. Textbook physics however doesn't know this causality. For that the primeval fears of humanity are pure superstition. The prophesies of Nostradamus even are referred to as counter evidence.

But the question remains open, why his predictions concerning August 11 didn't happen, Obviously, so has shown us the cosmic experiment, the neutrino radiation relevant for the setting free of radioactive radiation drastically has decreased since the Middle Ages.

Nostradamus personally has occupied himself with the translation and interpretation of hieroglyphs and has written down his insights - surely out of fear of the inquisition - in the form of encoded quatrains. According to that he has based his considerations on considerably older sources, which presumably stemmed from a time, in which a considerably higher radiation prevailed.

We have to proceed from the assumption that the scientists of the Semitic- Aramean people of the Chaldeans, which ruled Babylon from 626 B.C., were just as capable as astronomers of today, to exactly calculate an eclipse of the sun even centuries and millenia in advance.

After all the Saros-cycle to determine eclipses of the sun is a discovery of the Chaldeans. What they however couldn't know and we ourselves still can't indicate today, is the prevailing density of the cosmic radiation at a future time. But that obviously has changed considerably.

The natural magnetic field strength for instance is recorded at the baking of earthenware jugs and vases, by strengthening along the parts containing magnetite. From the measurement of ancient earthenware goods we know that in antiquity a field strength must have prevailed which was 3 to 4 powers of ten higher.

According to the here presented theory the earth owes its magnetism its core and that again draws its energy from the neutrino field. According to that also the neutrino radiation should be subject to the same decrease.

If therefore the Babylonians out of the radiation situation at that time in the interpretation of Nostradamus and other fortune-tellers, who presumably all more or less have written each other off, have predicted a catastrophe for 11.8.99, then this scientifically is just as untenable, as the today widespread hubris, with which the knowledge and the reports of experience from ancient times are dismissed as superstition.

<ii>: cf. chapter 17.2 Nikola Tesla, the discoverer of the neutrino radiation, p. 133

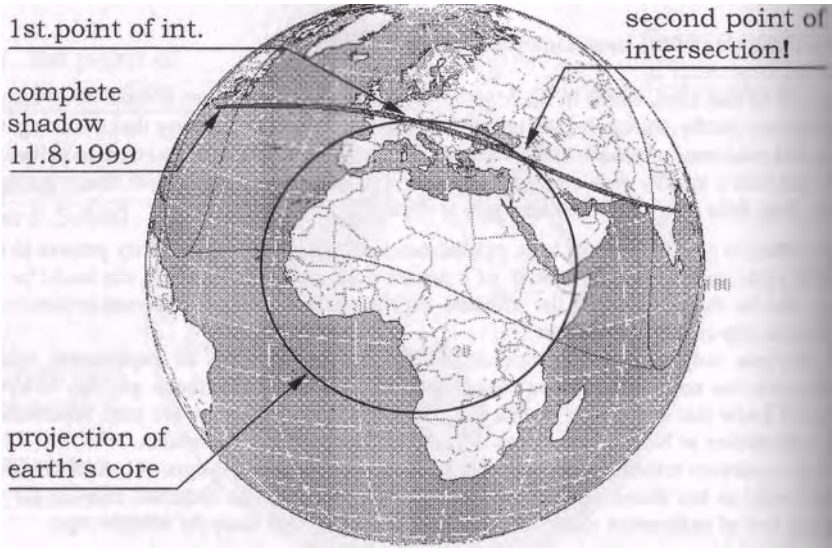

Fig. 20.7 A: Eclipse of the sun of 11.8.99 (declination: 15°)

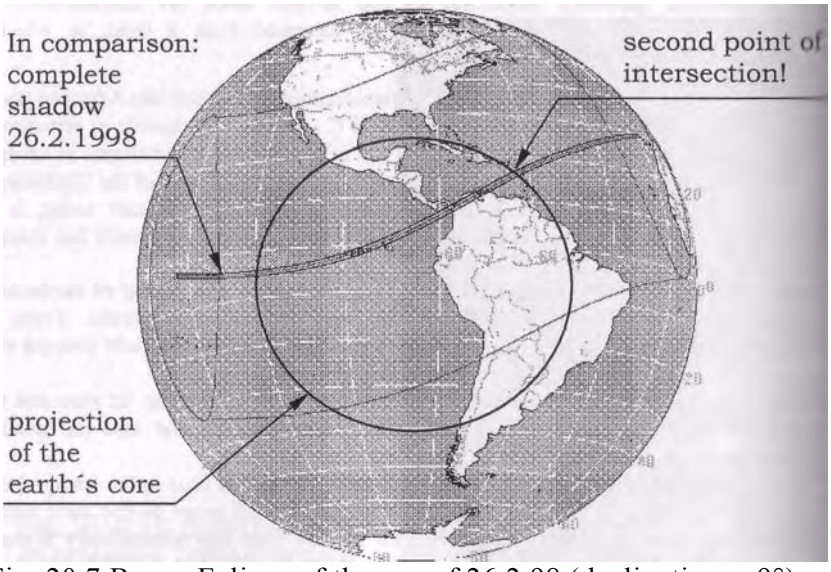

Fig. 20.7 B: Eclipse of the sun of 26.2.98 (declination: - 9°)

<ii>: Particularly violent earthquakes since 11.8.1999 (excerpt):
Turkey 17.8. (strength 7.8) till 19.8. (5,0), 31.8. (5.2), Greece 7.9. (5.8). Turkey 13.09. (5.8) and finally Taiwan 20.9.99 (strength 7.6) in a rythm of 6 to 7 days! Complete list in the internet under:
http://www-seismo.hannover.bgr.de/ermos_listing.html

This "superstition" mentions tremendous natural disasters like floods like the Flood or destructive earthquakes often as a direct result of an eclipse of the sun, and as the worst consequence the end of the world[i].
Almost all reporters and newsreaders in the evening of August 11 full of irony pointed at the non-occurrence of the end of the world and spread the conviction that according to prevailing physical ideas something like that isn't possible at all. They at that time couldn't know that the anatolic plate, which the complete shadow had crossed, had gotten into motion. The relatively weak earthquakes, which 11.8. shook Cyprus and at the same time Iran, only were spontaneous harbringers.
In the following weeks the staggering core of the earth made us clear that there had been done force to it. Severe earthquakes with thousands of aftershocks followed each other and one message of terror chased the next[ii]. Public authorities however take care not to of decline to make a reference to the eclipse of the sun.

20.7 Analysis and comparison of the occurrences

If we for comparison consult the total eclipse of the sun of 26.2.1998, for which the complete shadow of the moon coming from the Pacific Ocean had run over the Caribbean into the Atlantic Ocean. Exactly the moment it crossed the Caribbean island Montserrat, the volcano Soufriere erupted.
Pure coincidence says science, which hasn't got an explanation model at all for a relation with the supposedly purely optical phenomenon. But this argumentation is relativized, if according to fig. 20.2 the tangential collecting of solar neutrinos by earth's core is considered. This process best can be compared with photon radiation, which is tangentially collected and directed into an orbit by a black hole inside the radius of Schwarzschild.
Since the shadow of the moon always draws a straight line on the earth, two points of intersection are present with the circle of the projection of earth's core on earth's surface, for which the radiation focussed by the moon just touches earth's core and in that way experiences an additional concentration. The first point of intersection at that time was situated in the Pacific Ocean; but the second one was situated exactly at the Caribbean island Montserrat (fig. 20.7 B).

This time, at August 11 1999 the first point of intersection was situated in South Germany, the second in Iran, and again the focussing at the second point of intersection has shown a devastating effect. The entire continental plate has gotten in motion (fig. 20.7 A).

Another strange phenomenon has occurred in the USA at the same time as the eclipse of the sun. A tornado swept with its destructive force right through Salt Lake City. It is remarkable that no meteorologic indications were showing before and hence official observation authorities had no possibility of warning for the tornado. Had here part of the focussed neutrino radiation been redirected at earth's core and given a rotation, to again screw out into the sky on the other side of the earth at Salt Lake City?

<i>: Werner Raffetseder: Sonnenfinsternis, Hugendubel Verlag, Miinchen 1999, ISBN 3-89631-302-9, Seite 120.
<ii>: Collection of particular violent earthquakes since 11.8.1999: see fig. 20.7.

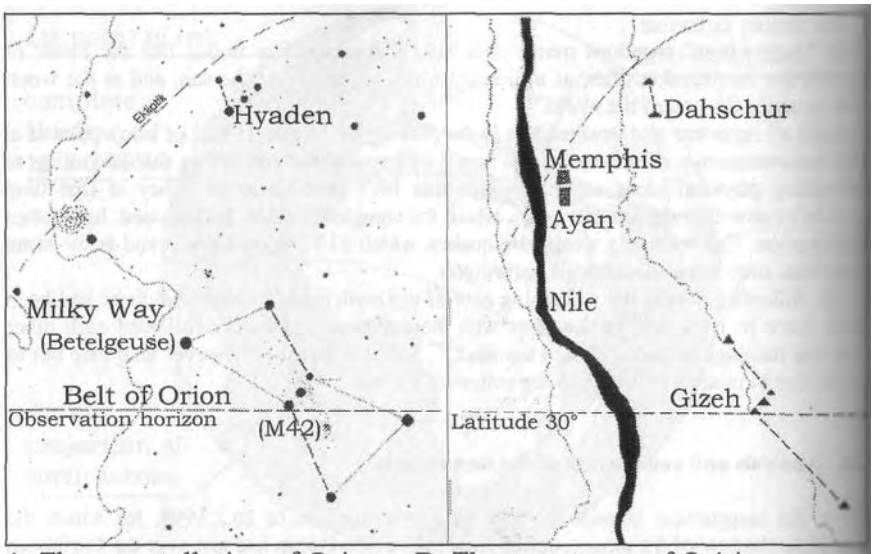

A: The constellation of Orion B: The sanctuary of Osiris

Fig. 20.8 A and B: The ancient Egypt pyramids, a terrestrial model and copy of the starry sky?<i>

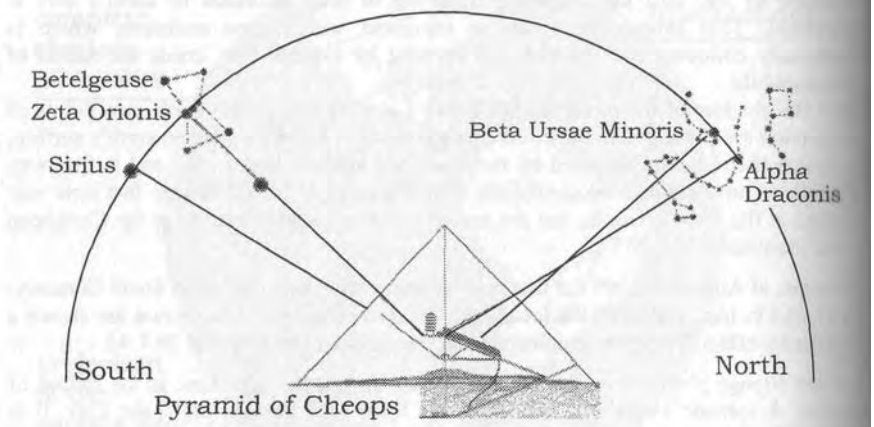

Fig. 20.8 C: The orientation of the four shafts of the Pyramid of Cheops to four different stars around the year 2500 B.C.<ii>

<i>: Robert Bauval, Graham Hancock: Der Schlussel zur Sphinx (Keeper of Genesis), List Verlag Munchen 1996, ISBN 3-471-77188-3, S. 286 und 287.
<ii>: dito page 86.

20.8 Radioactive decontamination with the help of a supernova

A mighty source of neutrinos forms the black hole in the centre of the Milky Way. For us, on an outer spiral arm of the galaxy, the distance to the centre is gigantic as well, so that a relatively equally distributed spectrum of differently fast neutrinos arrives at our world, which represents a kind of basic energy technical supply for the solar system and our world. For the fluctuations between day and night, or the focussing by the moon or other planets the "participants" in the solar system are responsible themselves.

In contrast to that a supernova, the explosion of a star, is a considerably smaller source of neutrinos, which however also is possible less distant to the earth. In addition it is a singular event, in which all neutrinos are set free simultaneously within a fraction of a second. They arrive at us one after another. First the fast and hard radiation reaches us as it were as harbringer. In the course of time the arriving neutrinos then become slower and shower, until they sometime become biologically relevant. If in the end everything is over, we can see the cause, only now the supernova is showing in the telescope.

If we assume such an event takes place, with perceptible might and in a distance of 500 light years. then this neutrino radiation overlaps with the general background radiation and a characteristic over-intensification of neutrinos of a certain velocity of propagation occurs. This problem then occupies us for 500 years, where the respective radiation situation permanently is changing depending on the time after the explosion.

If we in this way of looking dare a judgement of the cosmic events in historical time, so makes believe much the assumption that the radiation in the last hundred years has worn of completely. Edgar Cayce treats in the book "Our Ancestors" different cultural circles from the old Indian up to the Hopi, in which still is talked about an energy technical use of quartzes and other materials[<i>].

We indeed can theoretically comprehend that the neutrino radiation can let an oscillating quartz glow, if it is stimulated in its resonance frequency, but technically the technology foday can't be realized anymore. Possibly the chance for technological use only existed for a few years or decades.

Presumably also the pyramids originally have been built as resonators, to slow down fast neutrinos to a technically utilizable speed. But in the course of time the original function was unnecessary and the neutrinos had gotten so slow that in antiquity alternatively an use as electrostatic lightning generator or as Nekropolis took place. Today they only stand in the countryside as unusable monuments of a gone epoch.

Many ancient techniques, to which I will come to speak in the third part, in this way just as unexpected become plausible as the radioactive decontamination described in the Middle Ages.

<i>: Hermann Wild: Technologien von gestern, Chancen fur morgen; Jupiter-Verlag Bern 1996, ISBN 3-906571-13-0, (z.B. S. 77 und 145 bis 163).

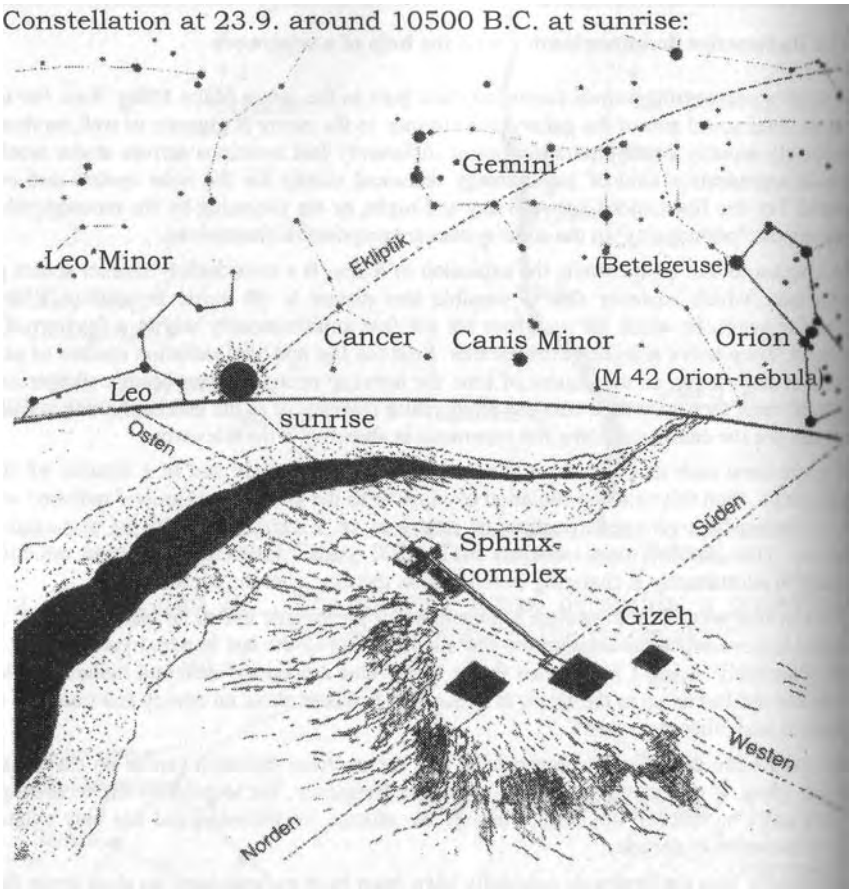

Fig. 20.9: The orientation of the pyramids of Giza makes believe
an operation of the installation around 10500 B.C.<i>

<i>: Robert Bauval, Graham Hancock: Der Schlussel zur Sphinx (Keeper of Genesis), List Verlag Munchen 1996, ISBN 3-471-77188-3, S. 324.

The two research scientists take the hypothesis of an orientation of the ancient Egypt pyramids after the starry sky around 10500 B.C. This however is not compatible with their thesis of the aligning of the shafts to individual stars around 2500 B.C. (fig. 20.8 C). How should the precise worked shafts later have been integrated? It would correspond a certain logic, if an orientation of the buildings to the energy source at that time would have taken place; but doing so it should be taken into consideration that the stars are exploded as supernovae and today hardly might be observable.

Despite several good ideas more questions are raised by the book, than are answered. Have the technicians 2500 B.C., after making restorations, experimented with the buildings and sought-for alternatives of use?

20.9 Fre energy from the Orion constellation

After all hundred years ago still the last unreliable rests of the wearing off neutrino radiation were available to Tesla, Moray, Keely and other inventors for the experimental proof of free energy, of which we today aren't able to rebuild and show in function one single model. And that, although the technical aids have gotten better for many times. But for the free energy inventors that isn't a reason, to immediately stop their efforts, because the next supernova already is announced by the actual swings of the Foucault pendulum. It could concern the explosion of the giant red star Betelgeuse in the constellation of Orion in a distance of 500 light years[<i>]. It well may be possible that it already shortly has exploded and that it will supply us with fresh and free energy for scarcely the next 500 years and at the same time will give the earth a good shake, thanks to its might and a not too great distance.
The reaction, which happened after August 11, of earth's core, which is the first to interact with the fast particles, should make every astrophysicist clear that here something is coming towards us!
It would be obvious, if the reactions of earth's core still increase. Every year particularly around 21.6., if the sun is standing in the Orion constellation, deviations can be expected. But then the supposed source of neutrinos, Betelgeuse, the sun and the earth don't exactly form a line, because the giant red star lies 7.4° below the ecliptic. Because of that the rays slowed down and focussed by the sun run away over the earth. At the earth then rather would be expected a dropping of the radiation.
If the phase of shakes of the earth sometime should be over, a decontamination due to an increased radioactive decay and various biological effects should be expected. Then, perhaps in 200 years, also many concepts concerning free energy, today still dismissed as hopeless, suddenly will function entirely by themselves.

The relatively free possibility of development of the human mind and the present sciences we possibly owe the special circumstance to be able to live in a time of minimized field strengths. Strong fields however can lead to psychotronic influencing of the consciousness and to an outside determining of mankind. This circumstance seems to have caused Tesla to compare man with a robot, and to call him an independent machine controlled from outside[<ii>].

<i>: Freek Reijmerink: Sternenatlas Deutschland, Weltbild Verlag 1990, S.12 (ein sterbender Riese) und Illustrierte Wissenschaft, Nr. 9, 1999, S. 7, Brennen die grossen Sterne in den Sternbildern je aus? Die Entfernungsangaben schwanken zwischen 270 Lichtjahren (Meyers Lexikon), 310 (Sternenatlas), 500 (Ill.Wiss.) und 652 Lichtjahren (Cambridge Enzyklopadie d. Astronomie).

In the observable domain of the starry sky one statistically seen has the chance, to experience every second a supernova.

<ii>: Nikola Tesla: How cosmic forces shape our destinies, New York American, 7.2.1917, and Edition Tesla (1997), Bd. 6, ISBN 3-89539-245-6 der Mensch als machine, S. 65.

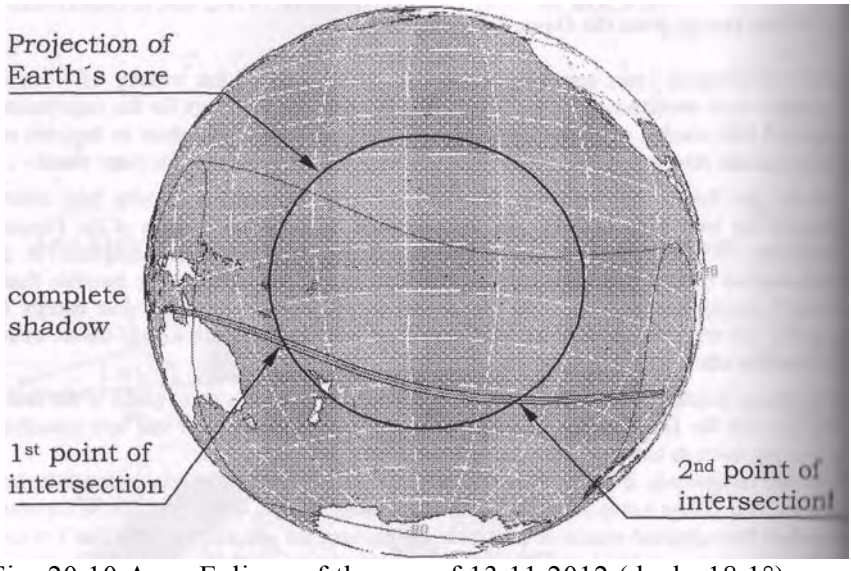

Fig. 20.10 A: Eclipse of the sun of 13.11.2012 (decl.: 18.1°)

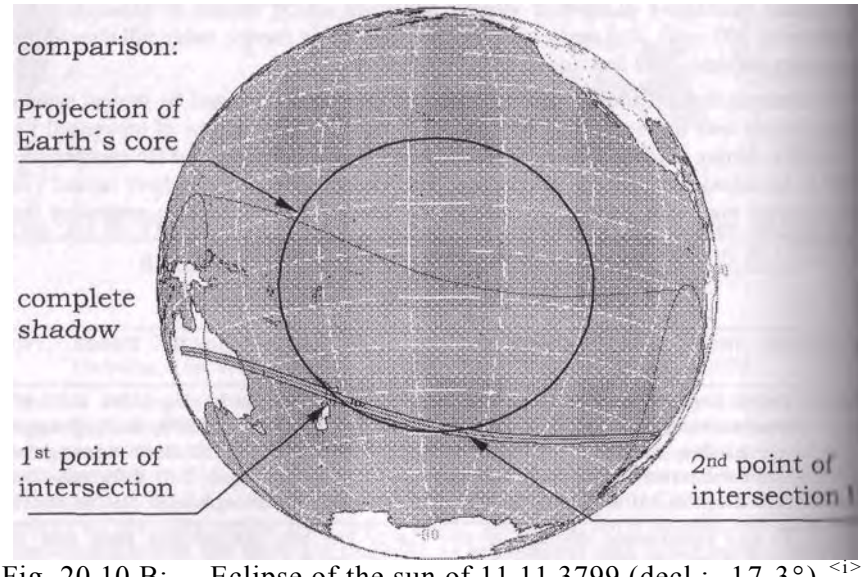

Fig. 20.10 B: Eclipse of the sun of 11.11.3799 (decl.: -17.3°).<i>

<i>: The eclipse of the sun of 7.7.3797 is harmless compared to that of 11.11.3799. Have they been mixed up or is a calculation error present?

20.10 Interaction of the neutrinos with earth's core

A strong neutrino field still doesn't make a catastrophe. Only in connection with one of the regularly happening eclipses of the sun should one be expected under certain circumstances. Only, which eclipses of the sun can get dangerous, we have to ask us, and why warns e.g. Nostradamus only for very particular dates?
The check of the respective eclipses of the sun results in a critical constellation every time for the cases, where the line of the complete shadow and the circle of the projection of earth's core intersect under a very flat angle and both points of intersection lie very close together. In the extreme case finally the lines only are touching and the points of intersection fuse to a line of intersection.
A corresponding constellation the next time is expected at 13.11.2012. For 7.7.3797, at similar conditions Nostradamus foretells the end of the world; but why?

From the interaction of the neutrinos arises as from every other interaction a force effect.
If the points of intersection lie far apart, then earth's core is pulled once to the East and a short time later again to the West by the focussed neutrino radiation. On the average this will hardly influence earth's mantle and earth's crust because of the immense moment of interia. The possible earthquakes will remain regionally restricted to the area around the two points of intersection.
But if a line of intersection forms, then no compensation of the force effects takes place anymore, then during the whole time one-sided is pulled at earth's core and that can have fatal results. It is the same as for a spinning top, which is given a blow from the side: it staggers several times, until the gyroscopic forces have stabilized it again.

But if earth's axis staggers, then the sun describes strange orbits in the sky, it goes backwards again, for a longer time doesn't set or it doesn't show for the same period of time for the people living on the other side of the globe.
Such an event already is described in the Bible[<i>]. For the twenty hours, in which in Europe the sun didn't set for a day, again describe the chroniclers of the inhabitants in the South American Andes, how at their place the sun didn't show for twenty hours[<ii>].

As a further example from the Greek mythology is mentioned the description of the poet Apollodoros. according to whom Hercules for the solution of his 10th task let the chariot of the sun bring to a standstill. "He turned his vehicle round and raced the way back, dragging along the Pleiaden and all stars, so that the sun set in the East"[<iii>]. But if all stars take part in the same backwards motion, then this example proves the assumption of the staggering earth's axis.

<i>: Josua 10.13-14 and the in chapter 11.8 cited passages.

<ii>: nach Montesinos, zitiert in Zecharia Sitchin: The Lost Realms (Versunkene Reiche), Knaur Verlag Miinchen 1992, ISBN 3-426-04827-2, S. 203

<iii>: Werner Raffetseder: Sonnenfinsternis, Hugendubel Verlag, Milnchen 1999, ISBN 3-89631-302-9, Seite 18.

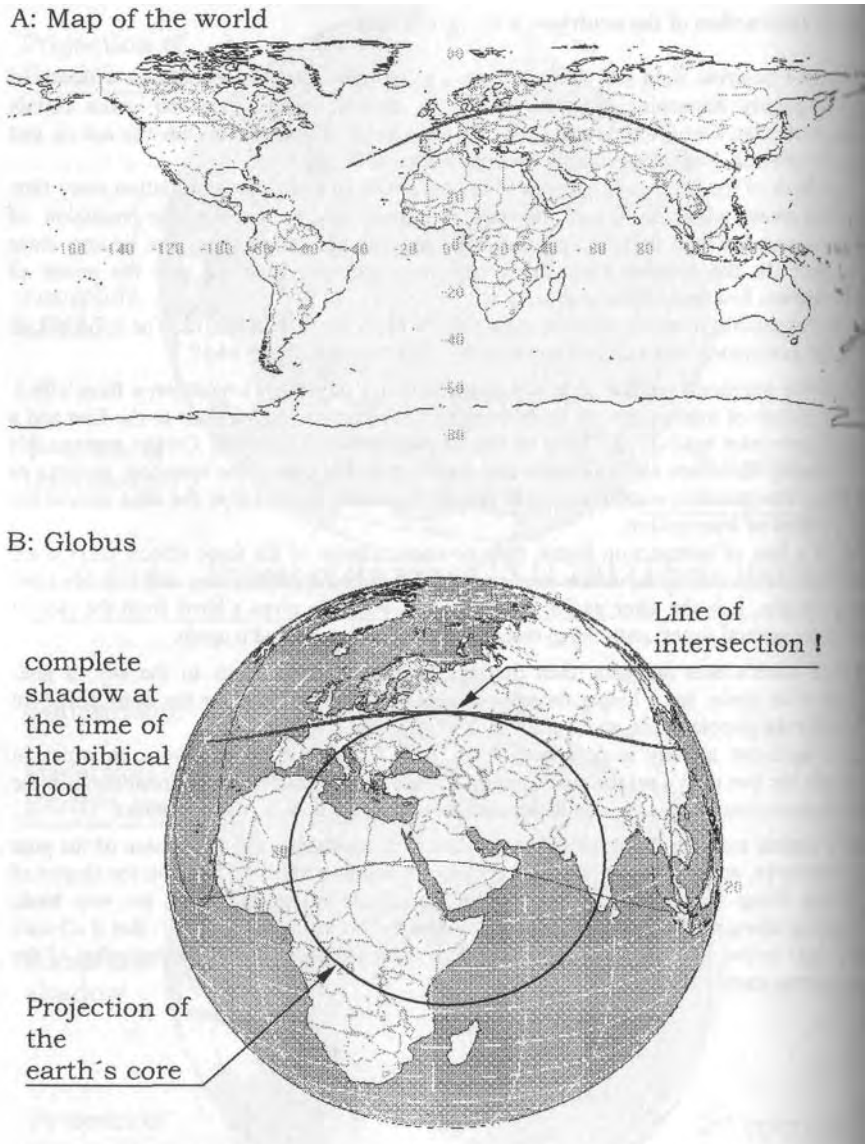

Fig. 20.11: Eclipse of the sun of 27.07.2281 B.C.
(angle of the sun = declination: 19.3°)
The trigger of the biblical Flood?

20.11 Changing of polarity and apocalypse

The pulling at earth's core, which shows as a wobbling of the magnetic axis and in damped form can lead to a tilting of the axis of rotation of the earth, still doesn't make an apocalypse, no end of the world. This only can be expected, if after a tilting of the axis of rotation of earth's core a change of polarity on the surface of the earth occurs. Doing so the new magnetic poles, like a compass needle in the field of the solar wind, again align in such a that the North Pole will be lying "up" in the ecliptic. Because earth's surface will keep it direction of rotation, the sun will, after the process having stabilized, as usual again rise in the East and set in the West. But the inhabitants of the earth, which before still were having midsummer, find themselves again in the midst of midwinter and vice versa.
Truly apocalyptic processes can be expected during the phase of a change of polarity of the earth. Thereby occur unusual relative accelerations and violent earthquakes. The largest destructive potential however is present in the waters of the oceans, which are set in motion.

As is well-known the earth at the equator is measuring a radius which is 21 kilometres larger than at its poles. If only a part of the waters temporarily flows in the direction of the poles of the earth, then the biggest part of the habitable land in Middle and North Europe sinks in the floods; then indeed also the statement of Noah makes sense, who as the first thing saw the mountain of Ararat rise from the floods, after the water again flowed back into its usual ocean basins. The mountain of Ararat after all measures a height of 5137 meters above sealevel!

At comparing historical events with details from the Bible the Flood should have taken place in the year 2245 B.C.[<i>]. According to the description of the position of the stars Dr. Wild calculates July 2281 B.C. as time for the Flood. The Arabic historical writer al-Makrizi again shifts the event into the year 3094 B.C.[<i>]. Who is right? We must verify the eclipses of the sun in this time and determine the position of the points of intersection, then we perhaps find the correct answer. Possibly earth's axis has wobbled more than once, have occurred several catastrophes in different regions. At 27.7.2281 B.C. in any case there actually has occurred an extremely critical constellation, whereas the other two years are ruled out. Here no total eclipse of the sun took place (fig. 20.11).

According to the calendar of the Ugha Mongulala 6110 years before this Flood a still much more devastating one should have occurred. That therefore would have been 8391 B.C., while Scott-Elliot dates the catastrophe in the year 9564 B.C.[<ii>]. According to Plato it would have been about 9500 B.C. For such long periods of time a check however isn't quite easy anymore, because the meantime changes of the earth sum up considerably.

<i>: Wild S. 231, 229 and 225.

<ii>: Wild S, 219, 218 and 210, among others cited from Scott-Elliot: Atlantis und das untergegangene Lemuria, Bauer Verlag Freiburg 1977.

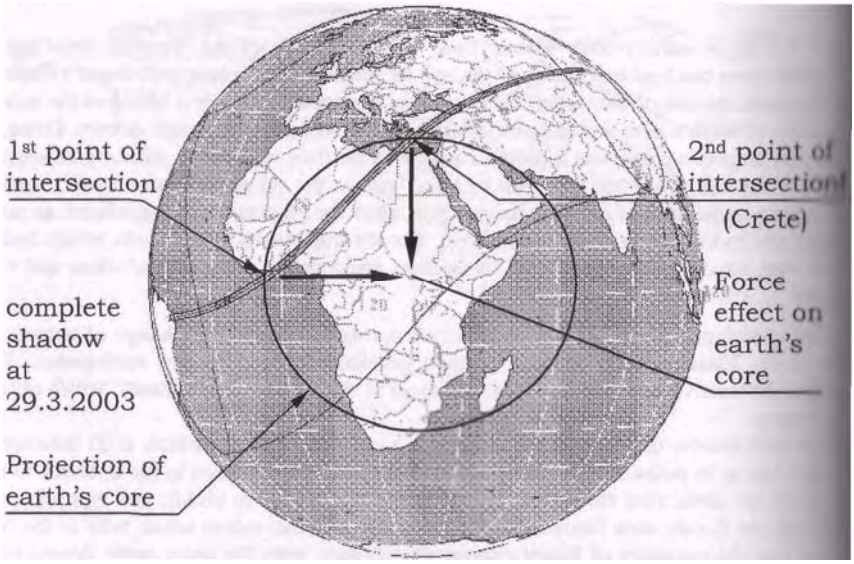

Fig. 20.12 A: Eclipse of the sun of 29.03.2006 (decl.: 3.2°)

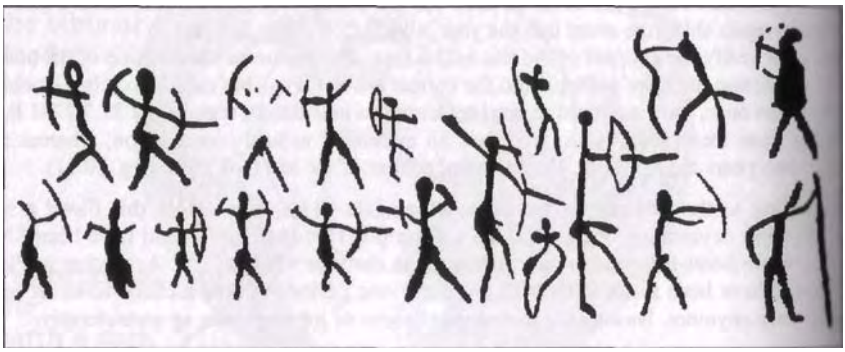

Fig. 20.12 B: Cave painting from Minateda (Spain).<i>

<i>: Laviosa-Zambotti: Origini e Diffusione della Civilta, Marzorati, Milano 1950,

Besides the constellation of sun and moon is crucial the occurring of a relevant neutrino radiation and the question if both is sufficient to tilt the earth and change its polarity. Some experts expect a change of polarity for the time coming, since it takes place with a certain regularity and measured in earth historical periods of time in addition fairly often!
This circumstance the earth presumably owes the river valleys cut deep in the countryside and other topographic phenomena. One presumably can only survive such a catastrophe in an ark (Noah), in the air bubbles of large caves (the walls of which painted children and artists out of pure boredom, see fig. 20.12 B) or in the highland, preferably in the area of the equator (Central Africa, highland of Mexico, Andes, Himalaya).

20.12 Scalar wave gauges for the prediction of earthquakes

We urgently need gauges, to be able to judge the neutrino situation. At first we with that pursue the same goal, as with the building of a free energy converter, however with the difference that the converter should maximize the collected amount of energy, whereas the gauge should minimize the taken up energy, to not too much load the source and not to change the local radiation situation.
In addition the neutrino radiation should be registered distinguishable in its velocity of propagation, what means that the building of a gauge will be very much more costly than that of an energy collector. That's why it can be expected that an usable measurement instrument might be available only many years later and we that long only can base on our own power of observation.

We for instance can statistically analyse, how the earth after an eclipse of the sun reacts to the neutrino radiation focussed by the moon. At August 11 the second focal point was situated in the East, and from that an acceleration of the rotation of earth's core can be predicted. Corresponding observations actually have been made on the surface of the earth with the help of the Foucault pendulum.
The relation the next time can be checked at the eclipse of the sun at 29.3.2006. This time the inverse case is present. A first focussing takes place in the West, so that pendelum swings in the reversed direction would be expected, which indicate a slowing down of the rotation (fig. 20.12 A).

But if the rotation of the earth should change, then the balance sheet of angular momentum of moon, earth's mantle and earth's core isn't correct anymore. As a result a force of difference occurs, which lets the spinning top stagger. But if earth's core staggers inside of earth's mantle, then it powerfully stirs the liquid magma, and in this way releases its surplus energy again. As a result earth's mantle is heated up somewhat. We, on our wafer-thin earth's crust, then time delayed feel the effects of the staggering of the core as an earthquake. The period seems to lie at approximately 6.5 days, as far as this can be read from reactions to the last two eclipses of the sun.

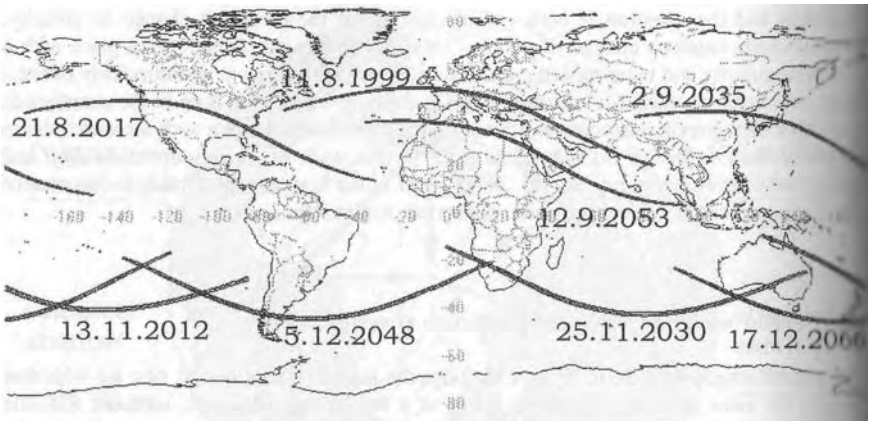

Tafel 20.13 A: Eclipses of the sun of 2 Saros cycles.

Fig. 20.13 B: The „Astronomicum Caesareum“ served around 1540 the determination of the positions of the moon nodes.[i]

<i>: Werner Raffetseder: Sonnenfinsternis, Hugendubel Verlag, Munchen 1999, ISBN 3-89631-302-9, Seite 134.

20.13 Calculation of future occurrences

From the analysis of past and present cosmic events with a strict scientific procedure can be predicted to a certain extent also future events. It thereby by no means concerns prediction, but exclusively the result of an analysis.

After the mentioned eclipse of the sun of 29.03.2006 there once more exists danger of earthquakes (approx. 4.4.2006) for the Island of Crete and Asia Minor. From the eclipse of the sun of 13.11.2012 as well no good can be expected, even if the points of intersection, situated close together, lie far away from populated land in the south-west Pacific basin. The Maya calendar by the way ends to this time. At 21.8.2017, 18 years or a Saros cycle after the eclipse of the sun at 11.8.1999 and correspondingly 120° further to the west, the corresponding complete shadow runs crossways through the USA. The thankless role of Turkey at the second point of intersection this time takes over South Carolina. One only can hope that the houses in Columbia are built more stable than in Izmit.
In fig. 2013 A the two eclipses of the sun of 11.8.1999 and of 13.11.2012 with their respective Saros cycles until 2066 are shown. The as critically to value tendency of the course of the complete shadow is visible, which wants to nestle against the circle of the projection of earth's core to form a line of intersection.

I here break off, since anyone with my indications and an eclipse of the sun-CD can analyse at home all further events personally. I value that if possible many analyses are made and controversially discussed, because possible cosmic catastrophes concern us all somewhat.

What good is the building of gigantic fusion ovens, if the runners by no means have understood the process of the fusion themselves? Why build ring accelerators for billions of dollars, if elementary particles can be calculated at the desk? How is the expenditure for gravitational wave detectors justified, if the actual music plays at entirely other velocities of propagation? Why is half the annual production of the world of Gallium used for an indirect proof of neutrinos, if every self-wound Tesla coil is able to collect more neutrinos?

Our scientists, for whom I as a colleague quite often must be ashamed, have the primary task to draw attention to cosmic and other risks and to calculate them in advance. In any case it is extremely unpardonable to leave this core duty up to some fortune-tellers and self-appointed prophets.
One should more often remind them that the Chinese Kaiser Tschung-Khang let sentence his court astronomers Hi and Ho to death, after the two not having predicted an eclipse of the sun. It thus certainly didn't concern a missed spectacle or a missed tourism business, but presumably the need for safety of the Kaiser and his subordinates, for which the two astrophysicists in ancient China had to take responsibility!

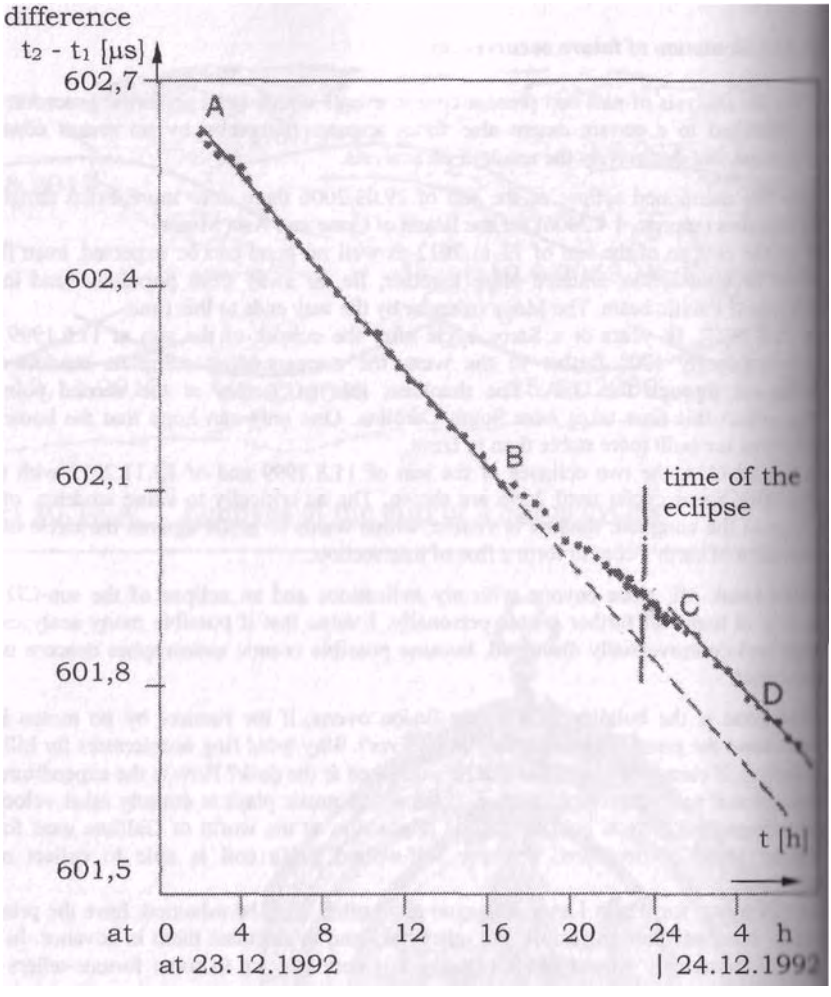

Fig. 20.14: The difference in going of two caesium atomic clocks
positioned in different directions, but in the same laboratory in Harbin, China, during the partial eclipse of the sun of 24.12.1992.<i>

<i>: Shu-wen Zhou: Abnormal Physical Phenomena Observed When the Sun, Moon, and Earth are Aligned, 21st Century Science & Technology, Fall 1999, Vol. 12, No. 3, pp. 54-61. Comments concerning Figure 9: Straight lines AB and CD show that the rate of change of the time difference between the two clocks is constant in non-eclipse periods, but becomes irregular around the time of the eclipse.

20.14 Epilogue to the energy technical seminar

Very slowly the word goes round that the energy source of the future has got a name: "Neutrinopower". Unfortunately fundamental physics, which is financed with public money, still does know almost nothing about the nature of the neutrino radiation. In addition hinder useless model concepts any progress in this direction and so the responsible fundamental research steps on the spot.

Considerably more extensive were already 100 years ago the insights of the experimental physicist Nikola Tesla, the discoverer of the neutrino radiation and father of the free energy. The space energy however is showing most clearly in nature, which only uses this advantageous form of energy. In particular during eclipses of the sun and other cosmic experiments it openly comes to light and can be detected by us for a short time.

The physicist Prof. Shu-wen Zhou of the University of Huazhong in Wuhan, China, systematically has investigated the effects, if sun, moon and earth are aligned<i>. Doing so he has proven inexplicable physical anomalies in experiments. Stimulated by the discoveries of Maurice Allais with the Foucault pendulum he built an arrangement specially flor proving horizontal forces of acceleration, and actually he with that could measure face effects during the total eclipse of the sun of 24.10.1995. He even speaks of an oscillating force!

Further he could determine changes in the spectral wave length of various elements, which under normal conditions go as constant and even as characteristic for the respective element. The relative change of size of the wave length during the ring-like eclipse of the sun over China of 23.9.1987 resulted in the 100-fold value compared to the difference in the spectrum analysis between surface of the earth and surface of the sun! This comparison reveals an immense discrepancy between theory and practice and puts us for a solid problem.
For that six different models of spectrometers were installed in several laboratories of different polytechnics and a photograph was taken of the emission spectra of H, D, Ca, CN, Ni, Ti, etc. Also other reasons than that of an eclipse of the sun could be excluded unambiguosly. In the results of these, at artificial light carried out conventional measurements, in any case abysses yawn. The from spectrum analyses won "insights" about the composition of strange celestial bodies now for sure can be done away with without knowledge about the respective prevailing neutrino radiation.

Spectacular also is the proof of differences in going of atomic clocks of various constructions. During the partial eclipse of the sun of 24.12.1992 seven caesium clocks in four cities of China and in three planes were used. The analysis of the differences in going resulted in, as is shown exemplary in fig. 20.14, changes of the gradient during the eclipse. The results for the atomic clocks in the planes and for two further time measurements turned out with similar clarity<i>.

<i>: Shou-wen Zhou: Abnormal Physical Phenomena Observed When the Sun, Moon, and Earth are Aligned, 21st Century Science 6s Technology, Fall 1999, Vol. 12, No. 3, pp. 54 - 61.

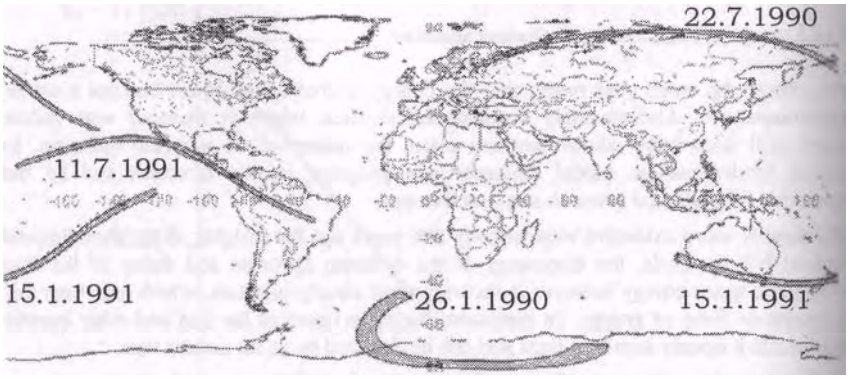

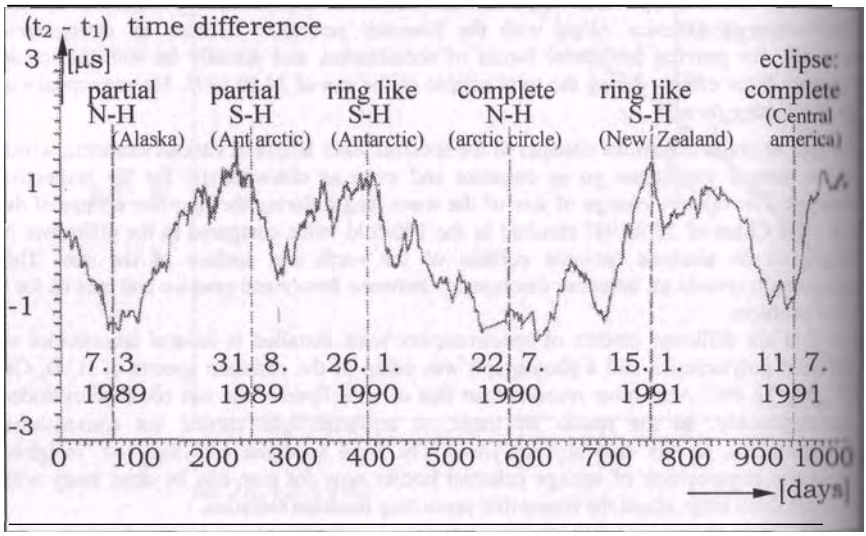

Fig. 20.15: Long-term measurement between 1989 and 991 of the difference in going of two atomic clocks at the U.S. Naval Astronomical Observatory.<i>

The in the 1000 days occurred eclipses of the sun have been entered later. In addition is recorded, if the northern hemisphere (N-H) or the southern hemisphere (S-H) of the earth was involved.

<i>:Shu-wen Zhou: Abnormal Physical Phenomena Observed When the Sun, Moon, and Earth are Aligned, 21st Century Science & Technology, Fall 1999, Vol. 12, No. 3, pp. 54 - 61. Figure 8.

A connection to the neutrino radiation Prof. Zhon doesn't draw, but it almost is obvious.

From the U.S. Naval Astronomical Observatory (LC/7970) long-term measurements over 1000 days between 1989 and 1991 are present (fig. 20.15). The difference in going between the two atomic clocks positioned at different places shows a permanent up and down. The reason goes as completely unknown.
But if the eclipses, which took place in this time, are entered then one immediately sees the assignment to a maximum or a minimum value. If an eclipse of the sun namely concerned the southern hemisphere of the earth, then the difference in going each time reached a maximum, but if the shadow of the moon run over the northern hemisphere, then each time a minimum occurred. Chance here probably is out of the question!

Let us record: The effect of an eclipse of the sun, to which for instance a Foucault pendulum reacts, can equally be traced back to the interaction of the neutrinos as the free energy. That's why the here presented book carries the title "Free energy and the interaction of the neutrinos". It has appeared in the series concerning the "Electromagnetic environmental compatibility", and also for that there are good reasons. Our energy technology must become more ecologically compatible and we come the goal closer, if we emulate nature, understand and copy it.

That it further concerns electromagnetism, likewise is explained from the interaction of the neutrinos, which concerns the oscillating and resonant case of the electromagnetic interaction. In this respect the reference to the series of books therefore would be given.

It only indirectly has to do with "electrosmog", or what otherwise is understood under environmental compatibility in general. It however could be shown that also the earth radiation is a form of neutrino radiation, and that it poses a biological effectiveness, after it turned out that it serves nature as an energy source. With that the conflict with space energy devices already is predetermined if the same scalar wave radiation should be used. Then one system takes away the other system the energy basis and the existence basis.
This environmental compatibility problem can be solved, if care is taken that both don't get in each others way with regard to the frequency and the wave length. We for that need a deep understanding concerning the topic of the space quanta and the neutrinos, their physical properties and the corresponding device technology. The book should make a contribution to that.

The other side of the medal is the information technical aspect of the scalar wave radiation and the environmental compatibility problem connected with that. The third and last part of the series of books is dedicated to this theme.

Part 2: Edition belonging to the energy technical seminar: "Electromagnetic Environmental Compatibility"

Prof. Dr.-Ing. Konstantin Meyl

Scalar waves

Abstract: 1. Auflage 1998, 4. Auflage and 1st English Edition

With regard to the environmental compatibility a decentralized electrical energy technology should be required, which manages without overhead power lines, without combustion and without radioactive waste. The liberalization of the energy markets won't on any account solve our energy problem, but only accelerate the way into the dead end. New, ecologically compatible concepts are collected and discussed in the book.

A useful energy source could be represented by space quanta, which hit upon the Earth from the sun or from space. They however only are revealed to the measurement technician, if they interact. It will be shown that the particles oscillate and an interaction or collection with the goal of the energy technical use only is possible in the case of resonance.

Since these space quanta as oscillating particles have almost no charge and mass averaged over time, they have the ability of penetration proven for neutrinos.
In the case of the particle radiation discovered 100 years ago by Tesla, it obviously concerns neutrinos. We proceed from the assumption that in the future decentral neutrino converters will solve the current energy problem. Numerous concepts from nature and engineering, like on the one hand lightning or photosynthesis and on the other hand the railgun or the Tesla converter are instanced and discussed.

Free energy and the interaction of the neutrino radiation

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Scalar Waves

From an extended vortex and field theory to a technical, biological
and historical use of longitudinal waves.

Part 3

by

Professor Dr.-Ing. Konstantin Meyl

Edition belonging to the lecture and seminar "Electromagnetic environmental compatibility"

(Original title: "Elektromagnetische Umweltvertraglichkeit")

Translated out of the German language
by Ben Jansen
(2003)

* * *

Part 3: Edition belonging to the information technical seminar

Scalar waves and the technical use of longitudinal waves and vortices

* * *

INDEL GmbH, Verlagsabteilung

Villingen-Schwenningen 2003

ISBN 3-9802 542-4-0

Preface to the seminar, part 3

With the appearing in print of the 3rd part of the series of lecture notes of the electromagnetic environmental compatibility, the collection of material can be considered to be completed for the time being. By now almost all aspects concerning the theme of the potential vortices of the electromagnetic field and their propagation as a scalar wave should have been addressed or at least indicated.
And that's what it is about in the case of the editions belonging to the seminars: In the seminars, taking place inside and outside the university, questions about the phenomena and the biological effectiveness of the fields, which surround us, are discussed. The scientifically correct procedure asks as a preparation for the seminar a voluminous collection of material and a compilation of theses with the pros and contras to them. The argumentation, which is denoted as „textbook physics" and is generally accepted, the participant of the seminar can work out himself by means of the available journals and books. The potential vortex, which completed the field equations, however makes possible a counterstatement, which for most participants at first will be unusual. The old dispute between quantum and field physics rekindles. What is missing is a voluminous collection of material concerning the refined field physics, and this gap the editions belonging to the seminars should close.
In the case of this book the primary concern is to make sure, that all facets, properties and physical consequences of the new and unified field physics are addressed. The question, if all points can bear a strict verification, remains reserved to the seminar and its participants, of whom each should form its own judgement. The series of books should be understood as a stimulation, to make own thoughts about the various points. Who has no opportunity to participate in a seminar, by means of the lecture at least gets an idea of what is discussed here and how is struggled for scientific insights.
The herewith completed collection of material by no means may be compared or confused with a basic work about the theory of objectivity. That the editions cannot and want not afford at all. They together with the discussions at best form the basis for a scientifically basic work, at which I am working.

In the case of the collection of material concerning the electromagnetic environmental compatibility consisting of three parts, again and again new aspects have emerged, which found entrance into the book, at which I was working at that particular time, whereas the rough structure has been controlled precisely: part 1 with the chapters 1 to 9 treats the basics, part 2 with chapters 10 to 20 the energy technical aspect and part 3 with the chapters 21 to 30 the information technical aspect of scalar waves.
The here presented 3rd part starts with the wave equation and the two comprised parts of a transverse and a longitudinal wave. The historic dispute between Heinrich Hertz and Nikola Tesla with the experimental evidence of the each time used wave part is continued over the wave-particle uncertainty compromise up to the dispute about the right field description: that of Maxwell or the new dual and at the same time unified description, which builds upon Boscovich and Faraday. The aspects, which seem so irreconcilably thereby only are two parts of a single equation, which is much older and can be traced back to Laplace: the wave equation.
Until now no derivations of this equation, which contains both wave parts, are known This for the first time succeeds from the new and extended field approach in the summary from chapter 26. At first however is attempted to make the world of the scalar waves

plausible with models, calculations and observations. For that are used examples from high-frequency engineering, like the ground wave or the near-field area of an antenna, and from nature and medicine, which are granted two chapters. The comparison of the nerve conduction with Tesla's one wire technology is bringing it to light that scalar waves equally are used in both cases. In a frequency diagram the insights are entered concisely and is shown that considerably more unexplored domains occur than already is known, that in most cases not even gauges are available. With the design for building a scalar wave gauge the scientific verification of until now only empirically won results is stimulated, like for instance the results the radiesthesia wants to have determined with the help of the sensitivity of man as a biosensor.

Many relations will be revealed to the reader only, if he has worked through the summary, which follows. From Maxwell's field equations only the well-known (transverse) Hertzian waves can be derived. (Longitudinal) scalar waves however in the result are zero. This is a flaw of normally used field theory, since scalar waves exist for all particle waves, like e.g. as plasma wave, as photon- or neutrino radiation. Because the field pointer, in the direction of which longitudinal waves are propagating, is oscillating, the frequency will oscillate like the velocity of propagation, which again is measured as a noise signal. Any antenna noise proves the emission of scalar waves in space. But scalar waves, or whatever should be subsumed under the by mathematics minted generic term free of any value judgement, surely are more than only noise.

Starting from Faraday's discovery - instead of the formulation of the law of induction according to Maxwell - an extended field theory is derived, which goes beyond the Maxwell theory with the description of potential vortices (noise vortices) and their propagation as a scalar wave, but contains the Maxwell theory as a special case. The new field theory with that doesn't collide with the textbook opinion, but extends it in an essential point with the discovery and addition of the potential vortices.
Also the theory of objectivity, which follows from the discovery, is compared in the form of a summary with the subjective and the relativistic point of view and the consequences for variable velocity of propagation of the scalar waves, formed from potential vortices, are discussed. Like already in part 1 the unification of the electromagnetic interaction with the gravitation succeeds impressively.

Besides the mathematical calculations this book contains a voluminous material collection concerning the information technical use of scalar waves, if e.g. the useful signal and the usually interfering noise signal change their places, if a separate modulation of frequency and wavelength makes a parallel image transmission possible, if it concerns questions of the environmental compatibility for the sake of humanity (bioresonance, among others) or to harm humanity (electrosmog). With that the book again finds back to the starting point, to the open task, which made necessary an excursion through all domains of physics to answer it. I hope, the long march was worthwhile.

Villingen-Schwenningen december 2002

Preface to the 2nd edition of part 3

In favour of chapter 30 as a complement, an introduction into the ancient broadcasting technology of the gods, the 1st edition wasn't printed anymore in the year 2002 as originally planned. Instead the individual chapters have been prepublished in different places. The chapters 21 to 25 are found among others in the book "scalar wave technology", which has been published as an instruction for an experiment to demonstrate scalar waves in 2001. Excerpts from it, as also from the chapters 26 to 28 have appeared in form of individual essays in different journals.

Again experimental successes had been intervening, which caused a renewed deferring of the date of appearance of the 3rd part of the series of books. In my laboratory the bi-directional transmission of music and of data by scalar wave was successful. We thus also can transmit information backwards from a receiver to the transmitter or to a second receiver, whereby the receivers work purely passive, thus without own power supply. The operating energy is as well supplied to them by the transmitter by scalar wave. The demonstrated technology opens completely new possibilities of a technical application. Conceivable are telemetry installations where measurement signals have to be transmitted from rotating or otherwise inaccessible places of a machine. The energy for the measurement electronics can be transmitted wirelessly by scalar waves and the signal can be sent back along at the same time, by modulating it onto the energy carrier. In this way dozens of measurement stations can be connected wireless with a single central transmitter, which supplies them all with energy.

The question was asked: Is the technology really entirely new? The answer is amazing: No, it here concerns the oldest technology of humanity, which had developed to a peak in antiquity, to send receive engineering of the gods. For this claim even a mathematical proof is available. For that the authoritative transition, the unrolling of a vortex to a wave (the transition from the near-field to the far-field) or in the reversed case the rolling up at a receiver antenna (usually denoted as standing wave) is calculated with help of the extended field theory. The result is, that at this transition the velocities of propagation resp. the wavelengths of the transverse and the longitudinal wave stand to each other in the ratio of the Golden Proportion.
With regard to the optimization of a transmitter or receiver antenna the Golden Proportion has an effect on the construction resp. the architecture of corresponding buildings . Which ones, with that deals the complementing chapter 30. But it mustn't be missing either, since after all it concerns a grandiose practical information technical use of scalar waves, from which we technologically can learn a lot<i,ii>.

Villingen-Schwenningen march 2003

<i>: Note: chapter 30 provides an introduction into ancient broadcasting technology of the gods. The working off of history with respect to the use of scalar waves is so voluminous, that for that a book of its own is published with the title:
<ii>: K. Meyl: Sendetechnik der Gotter, historischer Sciencefictionroman (2003), Villingen-Schwenningen, INDEL Verlagsabteilung, ISBN 3-98O2 542-5 9

21. Derivation of the scalar wave

WilliamThomson, who called himself Lord Kelvin, after he had been knighted, already in his lifetime was a recognized and famous theoretical physicist. The airship seemed him too unsafe and so he went aboard a steam liner for a journey from England to America in the summer of 1897. He was on the way in a delicate mission.

Eight years before his German colleague Heinrich Hertz had detected the electromagnetic wave in experiments in Karlsruhe and scientists all over the world had rebuilt his antenna arrangements. They all not only found confirmed the wave as such, they even could show the characteristic properties.
It was a transverse wave, for which the electric and the magnetic field pointers oscillate perpendicular to the direction of propagation. This can be seen as the reason, that the velocity of propagation is showing itself field independent and constant. It is the speed of light c.

With that Hertz had experimentally proven the properties of this wave, previously calculated in a theoretical way by Maxwell, and at the same time proven the correctness of the Maxwellian field theory. The scientists in Europe were just saying to each other: "well done!" as completely other words came across from a private research laboratory in New York: "Heinrich Hertz is mistaken, it by no means is a transverse wave but a longitudinal wave!"

Such a screwball most said and did as if they hadn't heard the criticism at all. But then one couldn't ignore it completely, because on the one hand claimed the private research scientist to have experimental proof and on the other hand it wasn't just anybody, who here reported. It was nobody but Nikola Tesla, the Croat experimental physicist who emigrated to America
Him we owe the modern alternating current technology from the high-tension network for energy transmission over the alternating current transformer to the asynchronous machine.
With his magnificent inventions he had earned enough money, to be able to afford a private laboratory, in which he could research and invent uncensored and free. The key to his success was lying in his purposeful, concentrated and efficient working method.
He was fast! Whereas in Europe still was being discussed about properties and theoretical possibilities of application of the wave, Tesla already presented the armed forces a remote controlled scaled-down submarine in Madison Square Garden (fig. 21.1 A). To convince such a man, who only holds valid what his experiments reveal, from the opposite, should be a hopeless enterprise.
Lord Kelvin was aware of that, as he made the decision to go on the journey. He could not and did not want to put his head into the ground, as many of his colleagues, because on the one hand scientists are curious by principle and on the other hand he travelled as an official representative of science. He had been instructed to free, as Mr. Clean, the undamaged world of sciences from erroneous teachings. But it came completely different.

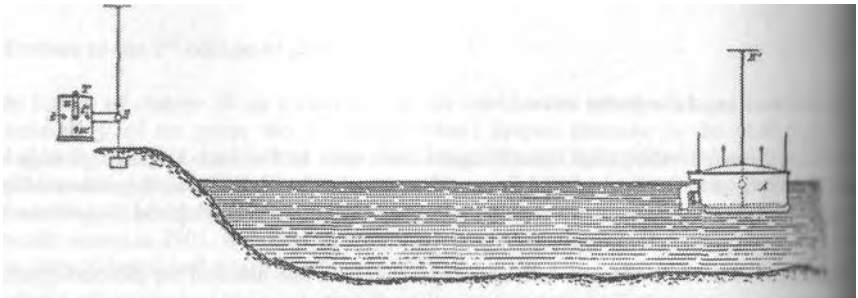

Fig. 21.1 A: The first radio remote control of the world.<i>

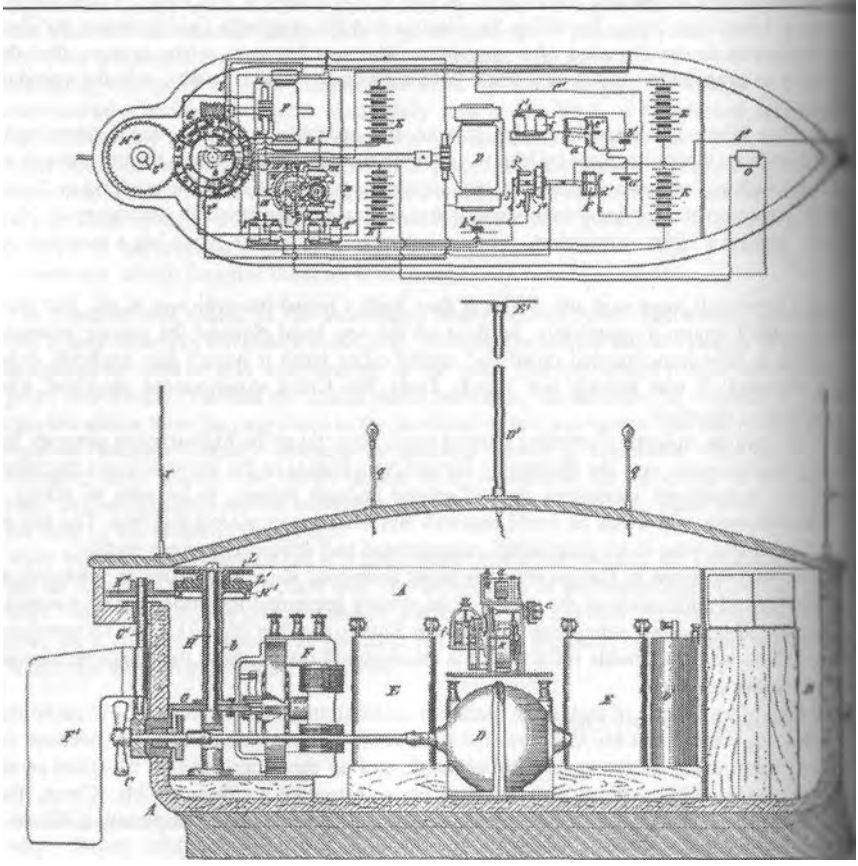

Fig. 21.1 B: Patent specification concerning the remote controlled submarine.<i>

<i>: Nikola Tesla: Method of and Apparatus for Controlling Mechanism of Moving Vessels or Vehicles, US-Pat. 1898, Nr. 613,809. Complete Patents: P. 351

21.1 Lord Kelvin in a delicate mission

The first day of his visit at Tesla Kelvin spoke the admonishing words he had been instructed to speak. He recommended Tesla warmly to publicly retract the remarks concerning the Hertzian mistake and to contribute himself to the settlement of the dispute. Seen from a specialist viewpoint they talked at cross-purposes.

But at night in his hotel room the Lord again thought about the experiments, which had been shown to him. The standing wave nature had been visible unambiguously: the oscillation nodes, the effect back on the transmitter, the high degree of effectiveness and many other things more. Such properties the Hertzian wave indeed doesn't know. Also Tesla didn't work with dipole antennas, but with flat coils, with spark gap oscillators and with a very unconventional switching technique, set up different in principle.

The next morning Lord Kelvin appeared in the laboratory again and greeted Tesla with the words: "Then you don't use Hertzian waves?" "Certainly not", Tesla answered," it are radiations. By waves no energy could be economically transmitted over a larger distance. My system works with true conduction, which theoretically seen can take place over a larger distance, without bigger losses occurring."
In the article of the "Electrical Experimenter" is noted further, that the doubting critic Kelvin suddenly turned into one of the biggest followers[<i>].

Kelvin deduced very fast: according to that there exist two different sorts of wave propagation. So Hertz with his transverse wave is just as right, as Tesla with the longitudinal wave.
As a represantative of theoretical physics he however could pull out Tesla a decayed tooth. Maxwell had based his field description on an aether concept, which at that time in the world of sciences triggered violent discussions. Since Tesla saw such an aether as a prerequisite for longitudinal waves, he thought he and not Hertz had proven the Maxwell wave in experiment for the first time. By stating this the magnificent experimental physicist however revealed weaknesses in the area of theory. Maybe he had not read exact enough or understood the books of Maxwell, which without doubt were formulated mathematically only arduously comprehensible in the original version.
In this point Tesla had to learn otherwise by Kelvin. Maxwell's field theory provides without exception a mathematical description for the Hertzian wave. For the Tesla radiation however no field description exists! This by the way is the circumstance, why this wave could disappear from the textbooks and again fall into oblivion. Tesla himself had problems to theoretically imagine, what happens at his wave. His models in some points perhaps were even better than the official textbook opinion, but not without contradiction to accepted regularities. That's why Tesla did without a publication of his ideas, although he in his lifetime had filed away at an own theory.

<i>: Nikola Tesla: Famous Scientific Illusions, III. The Singular Misconception of the Wireless, Electrical Experimenter, Feb. 1919, printed in Tesla Said, p. 197

Figure 21.2 A:

William Thomson, 1846 becoming Professor at Glasgow University with the age of 22 years. From 1892. on he was called Lord Kelvin.[i]

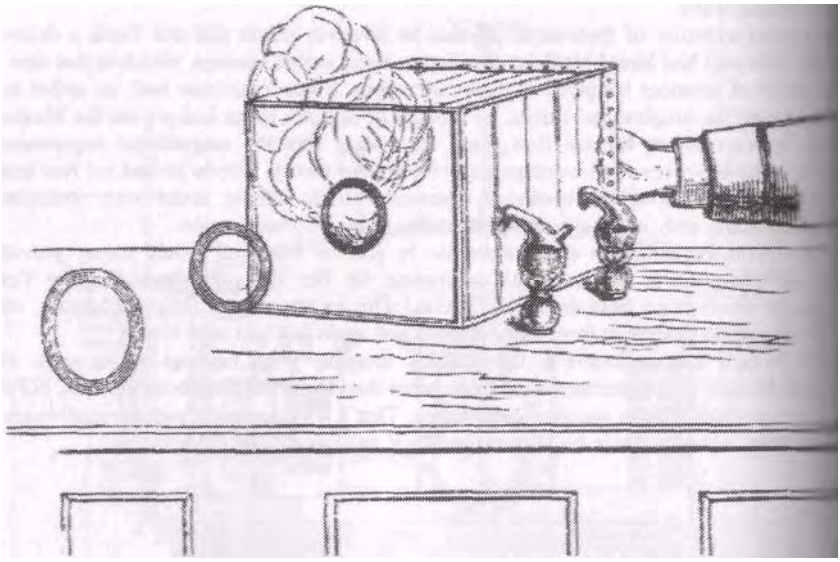

Fig. 21.2 B: Vortex rings from a smoke vortex gun.[i]

<i>: David Ash, Peter Hewitt: Science of the gods, Gateway Books, Bath, 1990

21.2 Helmholtzian ring-like vortices in the aether

Tesla told Kelvin at his visit from the meeting with the German Professor Hermann von Helmholtz on the occasion of the World's Fair in Chicago 1893. Kelvin knew him very well and had cooperated with him in the past. Now the vortex concept of his colleague and his model of stable vortex rings were very obliging.
In the case of a standing wave the impulse is passed on from one particle to the next. In the case of acoustics for instance we are dealing with a shock wave, where one air molecule knocks the next. In this way sound propagates as a longitudinal wave. Correspondingly the question is raised: What sort of quanta are the ones, which in the case of the Tesla radiation carry the impulse?

Lord Kelvin was already on the way back to Europe on the steamship and he deduced: The Tesla experiments prove the existence of longitudinal standing waves in space. In the question, what passes on the impulse, Kelvin comes to the conclusion: it are vortices in the aether! With that he had found an answer in experience. With his students he built boxes, with which he could produce smoke rings, to be able to study and demonstrate in experiments the special properties of ring-like vortices in their flow technical analogy (fig. 21.2[<i>]). But he didn't have ready a suitable field theory.

The from Germany to the Isles exported vortex physics for a short time could establish in England, before it was slaughtered and buried by the German quantum physicists. A main advocate has been James Clerk Maxwell, who held the vortex theory for the best and most convincing description of matter[<ii>]. As his successor at the Cavendish laboratory in Cambridge J. J. Thomson was appointed, who already as a young man had got a price for a mathematical treatise about vortices[<iii>]. He discovered the electron and imagined it, how could it be otherwise, as a field vortex.

The crucial weakness of vortex physics, the lacking of an usable field theory, was of benefit to the emerging quantum physics. This could change fundamentally with the discovery of the potential vortex, the vortex of the electric field[<i4>]!
In addition is the experimental proof of a vortex transmission as a longitudinal wave in air or in a vacuum, as it has been furnished by Tesla already 100 years ago, neither with Maxwell's theory nor with the today normally used quantum theory explicable or compatible. An urgent need is present for a new field theory!

<i>: David Ash, Peter Hewitt: Science of the gods, Gateway Books, Bath, England 1990.

<ii>: James Clerk Maxwell: "...the vortex rings of Helmholtz, which Thomson imagines as the true form of the atom, fulfil more conditions than any other previous concept of the atom."

<iii>: J.J. Thomson: "the vortex theory is of much more fundamental nature than the usual theory of solid particles."

<i4>: Konstantin Meyl: Potentialwirbel Band 1 (1990) and Band 2 (1992), INDEL-Verlag, Villingen-Schwenningen.

Scalar waves, a mathematical reasoning (I)

1. prerequisite: wave equation (textbook-formulation)

$$\Delta \mathbf{E} = \frac{1}{c^2} \cdot \frac{\delta^2 \mathbf{E}}{\delta t^2}$$

taking apart of the delta operator mathematically (Laplace operator) according to the rules of vector analysis (fig. 5.0):

$$\begin{array}{lcl} \Delta \mathbf{E} & = & \text{grad div } \mathbf{E} - \text{rot rot } \mathbf{E} \\ \text{wave} & = & \text{longitudinal} + \text{transverse} \end{array} \quad (21.1)$$

---

2. State of the art of technology: Hertzian wave = transverse wave
special case: = solution of Maxwell's field equations
no sources:

$$\text{div } \mathbf{E} = 0 \quad \text{and} \quad -\text{rot rot } \mathbf{E} = \frac{1}{c^2} \cdot \frac{\delta^2 \mathbf{E}}{\delta t^2} \quad (21.3)$$

transverse wave:
field pointers oscillate crosswise to the direction of propagation
The propagation occurs with the speed of light c.

---

3. claim: Tesla radiation = longitudinal wave
special case:
irrotationality:

$$\text{rot } \mathbf{E} = 0 \quad \text{and} \quad \text{grad div } \mathbf{E} = \frac{1}{c^2} \cdot \frac{\delta^2 \mathbf{E}}{\delta t^2} \quad (21.4)$$

longitudinal wave, shock wave, standing wave:
field pointer oscillates in the direction of propagation.
Velocity of propagation is variable!

Fig. 21.3: The special cases of the wave equation

21.3 Taking apart of the wave equation

Before one plunges into the adventure of an entirely new field theory, it first of all should be traced and analysed, what the latest textbooks say about scalar waves.

There some scalar or vector potentials are introduced; there the constant of dielectricity e is written down as a complex variable, although it physically seen concerns a material constant, only to be able to calculate with this trick artificially a loss angle, which should indicate the losses occurring in a dielectric, where in reality it concerns vortex losses. Of course one can explain the dielectric losses of a capacitor or the heating in a microwave oven entirely without vortex physics with such a label fraud, but it should be clear to anyone, that in a complex constant lies buried an inner contradiction, which is incompatible with physical concepts.
We are used to such auxiliary descriptions so much, that the majority of today's physicists tend to attribute physical reality to this mathematical nonsense. As pragmatists they put themselves on the standpoint if with that experimental results can be described, then such an auxiliary description can't be so wrong after all. Doing so the circumstance is forgotten that here the ground of pure science is abandoned and is replaced by creeds.

We find everything already in the wave equation, as it can be found in all textbooks.

$$\boxed{\Delta \mathbf{E} = \frac{1}{c^2} \cdot \frac{\delta^2 \mathbf{E}}{\delta t^2}} \quad (21.1)$$

Behind this formulation two completely different kinds of waves are hiding, because the used delta operator consists of two parts according to the rules of vector analysis:

$$\boxed{\begin{array}{lll} \text{grad div } \mathbf{E} & - \text{ rot rot } \mathbf{E} & = \Delta \mathbf{E} \\ \text{longitudinal} & / \text{ transverse} & \text{wave} \end{array}} \quad (21.2)$$

We want to discuss two special cases.
If we put the left part (in eq. 21.2) to zero (div E = 0) which is tantamount to no sources of the field then the well-known radio wave remains, which also is called Hertzian wave, after Heinrich Hertz, as said, had experimentally detected it in Karlsruhe 1888:

$$\text{div } E = 0 \quad \text{and} \quad \boxed{- \text{rot rot } \mathbf{E} = \frac{1}{c^2} \cdot \frac{\delta^2 \mathbf{E}}{\delta t^2}} \quad \text{(special case)} \qquad (21.3)$$

It concerns the transverse wave, described by Maxwell, for which the field pointers oscillate crosswise to the direction of propagation. The propagation again occurs with the speed of light c. So much concerning the state of the art of technology.
But as we see, in the mathematical formulation of the wave equation is hiding, yes, even more than only the generally known electromagnetic wave. The no sources approach is a neglect, which only is valid under certain prerequisites!

Scalar waves, a mathematical reasoning (II)

3. claim: Tesla radiation = longitudinal wave

$$\boxed{\text{rot}\,\mathbf{E} = 0} \quad \text{and} \quad \boxed{\text{grad div}\,\mathbf{E} = \frac{1}{c^2}\cdot\frac{\delta^2\mathbf{E}}{\delta t^2}} \qquad (21.4)$$

special case:
source field, because div E $\neq$ 0

=> sources = charge carriers (plasma waves)
=> sources = vortex structures

---

4. approach: (div E $\neq$ 0) is a scalar! => scalar wave
=> E-field vector can be derived from a scalar potential φ:

$$\boxed{\mathbf{E} = -\,\text{grad}\,\varphi} \qquad (21.5)$$

and $$\text{div}\,\mathbf{E} = -\,\text{div grad}\,\varphi \equiv -\Delta\varphi \qquad (21.6)$$

inserted in eq. 21.4: homogeneous scalar wave equation

$$\boxed{\Delta\varphi = \frac{1}{c^2}\cdot\frac{\delta^2\varphi}{\delta t^2}} \qquad (21.7)$$

---

5. proof: For the case of an additional space charge density ρ_{el} should be considered: div D $= \rho_{el}$
and div E $= \rho_{el}/\varepsilon$ (21.8)

inhomogeneous scalar wave equation = plasma wave!

$$\boxed{\Delta\varphi = \frac{1}{c^2}\cdot\frac{\delta^2\varphi}{\delta t^2} - \frac{\rho_{el}}{\varepsilon}} \qquad (21.9)$$

Fig. 21.4: Derivation of the plasma wave as an example of a scalar wave

21.4 Derivation of the scalar wave equation

Making neglects by all means is normal and legal in science. But it may not be carried out at will and untested. In any case an error consideration is necessary, the result of which should be, that the neglect indeed is sufficiently small.
In the here presented case of the wave equation I haven't found one single textbook, in which this error consideration has been carried out. As a result of this inexcusable negligence there is the danger that exactly the aspect is neglected, which it actually concerns. This could lead to catastrophical results, e.g. that the causes for electrosmog, for numerous EMC-problems, for biological and technical effects aren't seen and understood anymore, that pure science once more dilapidates to a creed!

In the case of the wave equation the assumption of no sources describes only one side of the medal. The other side, which for the electromagnetic wave occurs as an error term, we get if we this time put the right part in equation 21.2 to zero (rot E = 0).
In this case a divergence of the field is present, which requires a source field. As sources some charge carriers, quanta or at least particle structures, e.g. vortex structures have to exist. Their propagation occurs, as we know it from the sound propagation, as shock wave in longitudinal manner. The air molecules, the quanta or particle structures thereby oscillate in the direction of propagation. Also the field pointer has a component in this direction

$$\text{rot } E = 0 \quad \text{and} \quad \boxed{\text{grad div } \mathbf{E} = \frac{1}{c^2} \cdot \frac{\delta^2 \mathbf{E}}{\delta t^2}} \quad \text{(special case)} \qquad (21.4)$$

The occurring divergence of the field pointer (div E) is a scalar, for which reason this wave preferably is called scalar wave.

In the special case of a scalar wave (rot E = 0) the E-field vector can be derived from a scalar potential φ:

$$\boxed{\mathbf{E} = -\text{grad } \varphi} \qquad (21.5)$$

On the one hand this term is used in the wave equation 21.4 on the right-hand side without forming the gradient on both sides of the equation. On the other hand the divergence of the approach 21.5:

$$\text{div } \mathbf{E} = -\text{div grad } \varphi \equiv -\Delta \varphi \qquad (21.6)$$

is applied in equation 21.4. The result is the homogeneous scalar wave equation:

$$\boxed{\Delta \varphi = \frac{1}{c^2} \cdot \frac{\delta^2 \varphi}{\delta t^2}} \qquad (21.7)$$

Scalar waves, a mathematical reasoning (III)

Proof: plasma wave =
inhomogeneous scalar wave equation

$$\boxed{\Delta \varphi = \frac{1}{c^2} \cdot \frac{\delta^2 \varphi}{\delta t^2} - \frac{\rho_{el}}{\varepsilon}} \quad (21.9)$$

one solution<i>: $\omega^2 = c^2 \cdot k^2 + \omega_p^2$ (= Langmuir waves).

Fig. 21.5 A: Derivation of the plasma wave as an example of
the existence of scalar waves in the wave equation

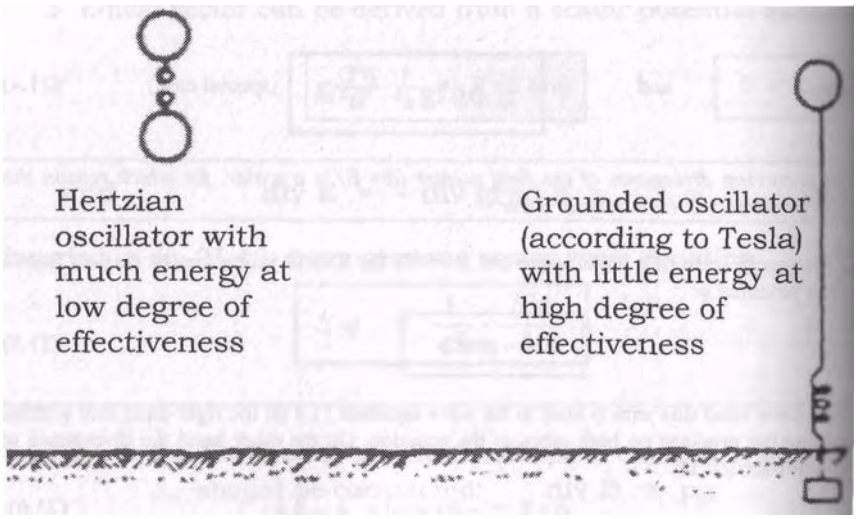

Fig. 21.5 B: Nikola Tesla explains the difference between his
radiation and the Hertzian wave.<ii>

<i>: The solution describes dispersion relations of plasma waves; longitudinal wave movements + Langmuir oscillations of the electron density.

<ii>: Nikola Tesla: The Problem of Increasing Human Energy, The Century Monthly Magazine, June 1900, ISBN 1-882137-00-0, Page i-15

21.5 Derivation of a plasma wave

Doing without formation of the gradient for the derivation of the homogeneous wave equation is tantamount to an integration of the equation. We hence under certain conditions must expect the occurring of an integration constant.
This is the case, if in addition a space charge density ρ_{el} occurs as source of the field, which according to Maxwell equation 4 can be considered as the divergence of a dielectric displacement D (fig. 21.4):

$$\operatorname{div} \mathbf{D} = \rho_{el} ,$$

resp. with the relation of material $\mathbf{D} = \varepsilon \cdot \mathbf{E}$: $\operatorname{div} \mathbf{E} = \rho_{el}/\varepsilon \equiv -\Delta \varphi.$ (21.8)

If we complete this contribution with possible present field sources, then the inhomogeneous scalar wave equation results:

$$\boxed{\Delta \varphi = \frac{1}{c^2} \cdot \frac{\delta^2 \varphi}{\delta t^2} - \frac{\rho_{el}}{\varepsilon}} \quad (21.9)$$

For these equations solutions have been published<i>. They have the same form, as the well-known dispersion relations of Langmuir waves. That is electron plasma waves, thus longitudinal wave movements associated with Langmuir oscillations of the electron density.

With that it has been proven that scalar waves and longitudinally propagating standing waves are described by the wave equation and are contained in it. This in any case is valid in general just as in the special case of a plasma wave, as mathematically could be derived here.

From the example of the derivation of plasma waves from the wave equation 21.1, we see that scalar waves by all means are known and their existence isn't casted doubt on at all. After all the mathematically won solution is secured by numerous experiments. Why do textbooks concerning high-frequency engineering then ignore the scalar wave parts in the wave equation?
Our specialists seem to concentrate so much on their branch, that they are losing the view on the Big Whole. They practice one-eyed physics, where the plasma physicist keeps one eye shut and the radio technician the other eye. What the other one does and researches, they don't understand anymore for ages. It is necessary to point them to their common root.

The perhaps most important statement of the wave equation is that every emitted wave contains both longitudinal and transverse parts! Both parts in addition occur jointly, so that for corresponding boundary conditions it can be expected that one part is transforming into the other part. The HF technician then suddenly measures less field strength and comes to the conclusion that his radio wave has been damped or partly absorbed. Doing so heat is created, he says, although the wave equation by no means contains a corresponding term for the necessary thermodynamic description. He simply hasn't understood the wave equation!
Absorption means nothing but transverse waves in the case of a disturbance rolling up to vortices, to become a scalar wave in this way (fig. 1.4 and 5.3). With that they are evading every field strength measurement and what can't be measured doesn't exist in one-eyed physics! Therefore can't exist, what shouldn't exist.

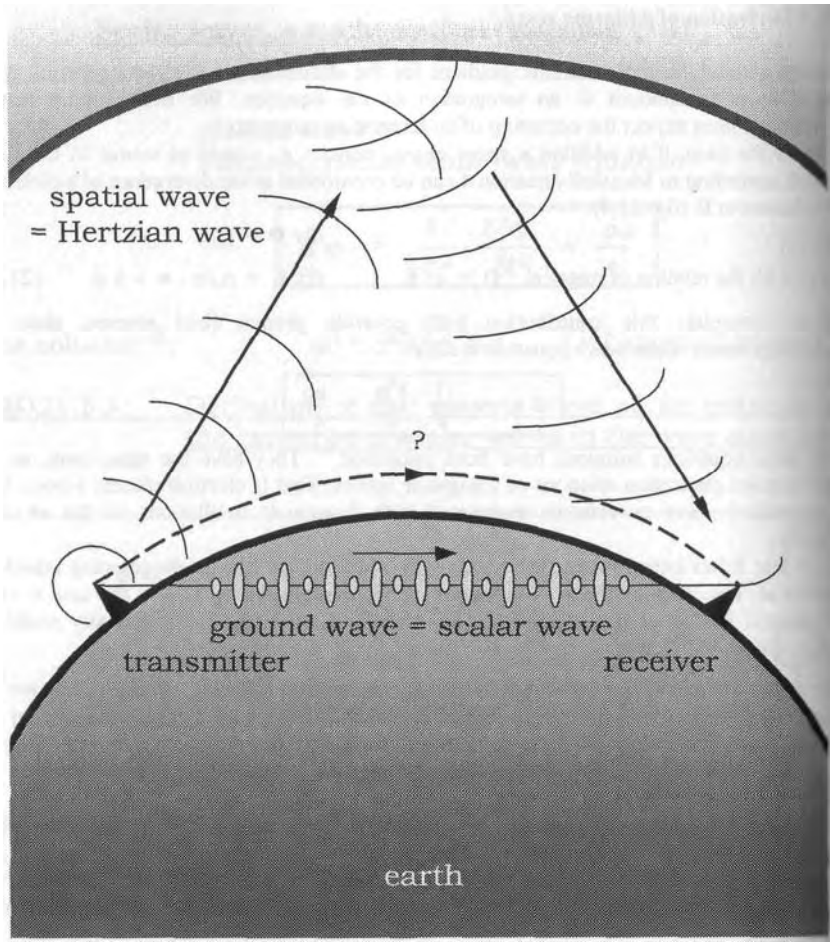

Fig. 21.6: Ground waves, which follow the curvature of the earth and radio waves reflected at the ionosphere.<i>

<i>: Meinke, Gundlach: Hochfrequenztechnik, 4.Aufl. Springer-Verlag Berlin 1986, Seite R 18: ,,Lang-, Mittel- and Kurzwelle breiten sich einerseits entlang der Erdoberflache als Bodenwellen, andererseits unter Mitwirkung der Ionosphare als Raumwellen aus."

21.6 Mistakes of the HF technology

The devastating judgement of Tesla, Hertz was mistaken, was rash. His claim of having detected the Maxwell wave himself, proved to be untenable. With this claim in particular Tesla hud the scientific world against him. If one opens encyclopedias or textbooks then one gets the impression, until the day of today science still hasn't forgiven Tesla, what once more shows how persistent prejudices are kept.

Just as little does a verdict of the American Supreme Court justice to the true circumstances, with the decision of the highest judges that Tesla and not Marconi is entitled the right to be the inventor of the radio. As we see, have both inventors in reality used completely other kinds of waves. The available transmitters of 100 years ago we would from today's viewpoint call ,,broadband dirt slingers". These spark flying monster have blown both parts of the wave equation, the transverse as well as the longitudinal part, into the air to ample extent. What distinguished the wave pioneers was their receiver technique, was eventually the question, which wave part they have filtered and utilized.

Marconi worked with dipole antennas, as already Heinrich Hertz. With that both could preferably track down and detect the radio wave. So they also should be entitled the right to be pioneers of radio technology. The verdict of the highest judges doesn't justice to this circumstance and should rather be judged as a nationalistically coloured political issue. Tesla however worked with two spherical electrodes, in which he preferably replaced one electrode by the globe, by grounding his devices. In this way he could receive the scalar wave parts. But that are not radio waves! Scalar waves have completely other properties, one even could be inclined to call them opposite properties.

To improve the degree of effectiveness of the transmission stretch one naturally was trying to also optimise the transmitting installation with regard to the respectively used wave part. Tesla optimised the scalar wave part and could record reactions of biological beings. His part represents a set of difficulties of the environmental compatibility, which should be taken serious. In the beginning the Marconists on the ships, as the radio operators were called, suffered from the so-called radio operator disease, which is unsolved until today. This phenomenon only disappeared after the radio devices on board had been optimised in favour of the used radio wave. The reached and measuring technically verifiable increase of the degree of effectiveness, primarily obtained by an improved antenna adjustment, simultaneously means a reduction of the scalar wave part, which endangers health.

But a received signal hides the receiver technician, if it has been on the way as a transverse or as a longitudinal wave. The coupling in one and the same equation leaves open both possibilities. Every radio amateur knows the so-called ground waves, which arrive faster at the receiver, than the Hertzian waves mirrored at the ionosphere, which propagate in a straight line. Allegedly the ground waves follow the curvature of the earth[<1>], so it is written in expert books. This explanation hurts, since who can see along the curvature of the earth with a pair of field glasses. He would see the back of his head! No, the explanation the ground waves would run along the earth's surface is pure nonsense. The interference and the fading with which the radio amateur is fighting, are a result of the differently fast arriving wave parts, and doing so the scalar wave part tunnels as a straight line right through the earth (fig. 21.6)!

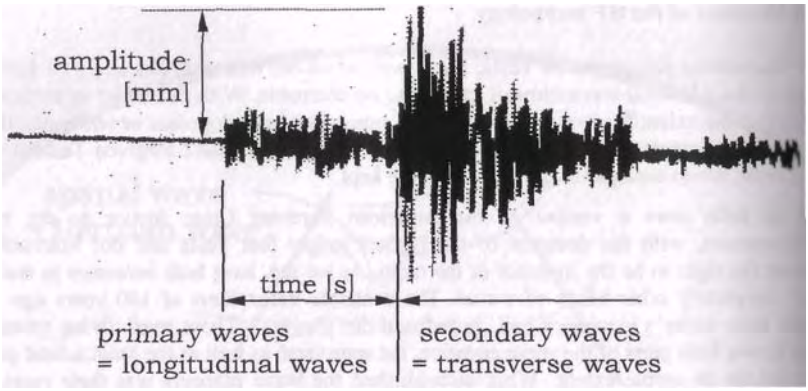

Fig. 21.7 A: Longitudinal and transverse earth quake waves.

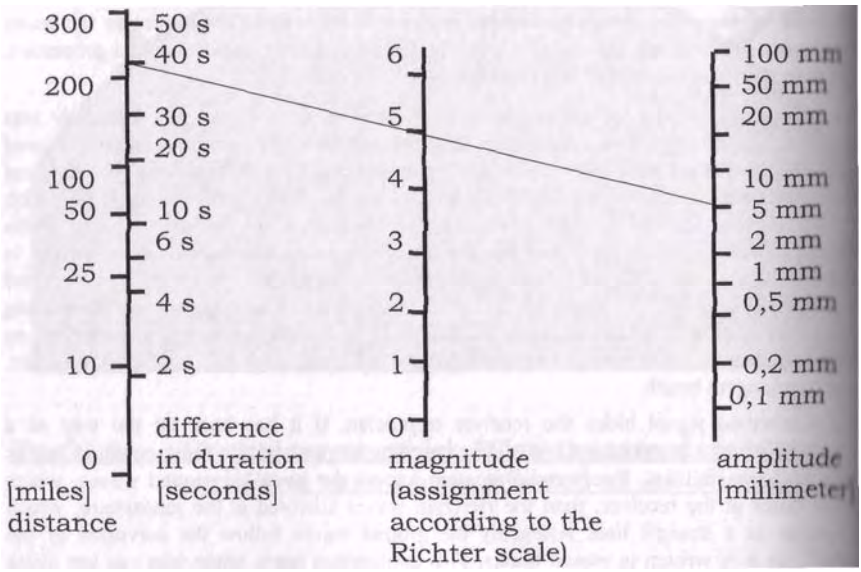

Fig. 21.7 B: Analysis according to the Richter scale.
(e.g.: 40 s duration between S- and P-waves for 5 mm amplitude means an earthquake of strength 5 in a distance of 220 miles.)

21.7 Coupling of the wave parts

The set of difficulties of ground waves makes clear the coupling of longitudinal and transverse waves as two aspects or parts of a wave. As the corresponding equation 21,1 mathematically taken apart into 21.2 dictates, does every transmitter emit both parts.

Exactly this circumstance the owners of allotments have used, which directly near a transmitter had illuminated their estate with freely hung up fluorescent lamps. The transmitter runners after that wanted to present them the power bill.and they could obtain, that this kind of illumination technique was prohibited.
Nowadays anyone may operate a high-frequency technical installation, even if he hasn't understood at all the wave equation used by that. Actually one should have been grateful to the allotment owners, if they withdraw the scalar wave radiation, which is incompatible with the environment and biologically harmful, with their fluorescent lamps. Taken exact it even is the task of the transmitting technician to pay attention to it. that only radio waves are sent into the air, since only those should be used. The time has come to reverse the burden of proof to protect the environment, nature, the consumer and the unasked and not involved persons, which are irradiated.

From other areas, for instance from flow dynamics or for body sound is generally known that both wave parts exist and in addition occur jointly. In the case of a propagation through the earth, like for an earthquake, both parts are received and utilized. Because their propagation is differently fast, the faster oscillations arrive first and that are the longitudinal ones. From the time delay with which the transverse waves arrive at the measurement station, the distance to the epicentre of the quake is determined by means of the different velocity of propagation. For geophysicists this tool is part of everyday knowledge (fig. 21.7).

Only who keeps one eye shut, could mean that the electromagnetic wave is purely transverse and sound purely longitudinal. It is true that a transverse sound wave doesn't get too far in air, for which reason sound as a rule is considered as a purely longitudinal wave by neglecting this part, but such a neglect may not be carried out in general, it must be checked if it is legitimate from case to case and an error consideration should be carried out.

Further examples for the coupling of the wave parts are furnished by the latest tunnel experiments. Here so-called pure transverse waves are sent into a tunnel, through which they don't fit through at all. The Maxwell-theory then dictates that behind the tunnel no signal should be measurable.
But a signal is being measured, which in the tunnel in addition was faster than allowed.

In conferences again is being discussed about the wave equation. The imagination of the specialists reaches from phase velocities of an electromagnetic wave, which isn't present at all up to instantaneous tunnelling, during which the clocks should stop[<i>].
The wave equation however supplies the only possible answer: The tunnel filters out the scalar wave parts and lets pass from them only those, which are sufficiently small and correspondingly fast!

<i>: see Part 1, Chapter 6.14

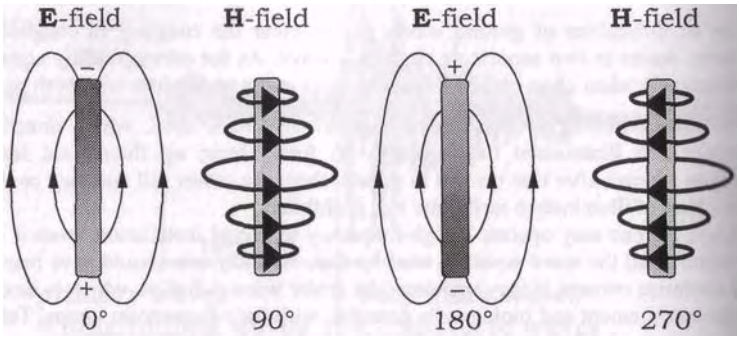

Fig. 21.8 A: The fields of the oscillating dipole antenna

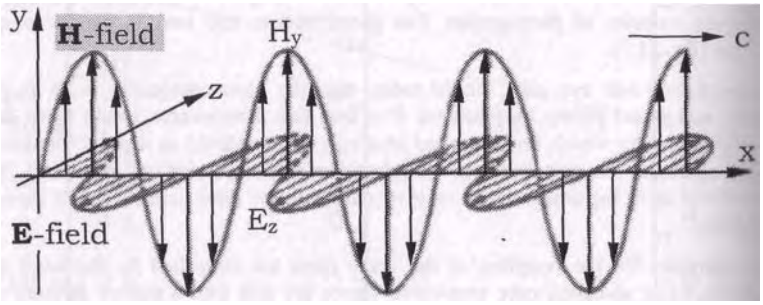

Fig. 21.8 B: The planar electromagnetic wave in the proximity

<i>: Zinke, Brunswig: Lehrbuch der Hochfrequenztechnik, 1. Bd., 3. Aufl. Springer-Verlag Berlin 1986, Seite 335

<ii>: dpa-message in the Sudkurier of 25.11.2000: „Gefahr furs Herz" (Translated:) Patients with a cardiac pacemaker produced in the Netherlands have been warned by the producer of the device (Vitatron) to be careful when passing anti-theft installations in stores. For devices, which were implanted between 1992 and 1998, there is the danger of the implant failing.

21.8 Set of difficulties of the near-field

In high-frequency technology is distinguished between the near-field and the far-field. Both have fundamentally other properties.

Heinrich Hertz did experiment in the short wave range at wavelengths of some meters. From today's viewpoint his work would rather be assigned the far-field. As a professor in Karlsruhe he had shown that his, the electromagnetic, wave propagates like a light wave and can be refracted and reflected in the same way. It is a transverse wave for which the field pointers of the electric and the magnetic field oscillate perpendicular to each other and both again perpendicular to the direction of propagation. It hence would be obvious, if in the case of the Hertzian wave it would concern the far-field. Besides the propagation with the speed of light also is characteristic that there occurs no phase shift between E-field and H-field.

In the proximity it looks completely different. The proximity concerns distances to the transmitter of less than the wavelength divided by 2*pi. Nikola Tesla has broadcasted in the range of long waves, around 100 Kilohertz, in which case the wavelength already is several metres. For the experiments concerning the resonance of the earth he has operated his transmitter in Colorado Springs at frequencies down to 6 Hertz. Doing so the whole earth moves into the proximity of his transmitter. We probably have to proceed from assumption that the Tesla radiation primarily concerns the proximity, which also is called the radiant range of the transmitting antenna.
For the approach of vortical and closed-loop field structures derivations for the near-field are known[<i>]. Doing so it must be emphasized that the structures don't follow from the field equations according to Maxwell, but the calculations are based on assumed rotation symmetrical structures. The Maxwell theory by no means is capable of such a structure shaping by principle. The calculation provides as an important result[<i>] that in the proximity of the emitting antenna a phase shift exists between the pointers of the E- and the H-field. The antenna current and the H-field coupled with it lag the E-field of the oscillating dipole charges for 90° (fig. 21.8). These charges form a longitudinal standing wave the antenna rod or antenna dipole. For this reason also the fields produced by high-frequency currents at first have the properties of a longitudinal wave in the proximity of the antenna.

The near-field already is used in practice in anti-theft devices, as they are installed in the entrance area of stores. The customer walks through the scalar wave transmitters. If the coupling coil has not been removed at the cash point, then a signal from the alarm system sounds. The coils work purely passive, i.e. they are supplied with electric energy per scalar wave and stimulated 'to oscillate for their part. Then the effect back on the transmitter is being utilized. Even if the principle is functioning, people still should be warned not to use a technology, which has not been understood completely. Then not explained catastrophes are inevitable [<ii>].

<i>: Zinke, Brunswig: Lehrbuch der Hochfrequenztechnik, 1. Bd., 3.Aufl. Springer-Verlag Berlin 1986, Seite 335

<ii>: dpa-message in the Sudkurier of 25.11.2000: ,,Gefahr furs Herz". (quoted at the left, fig. 21.8)

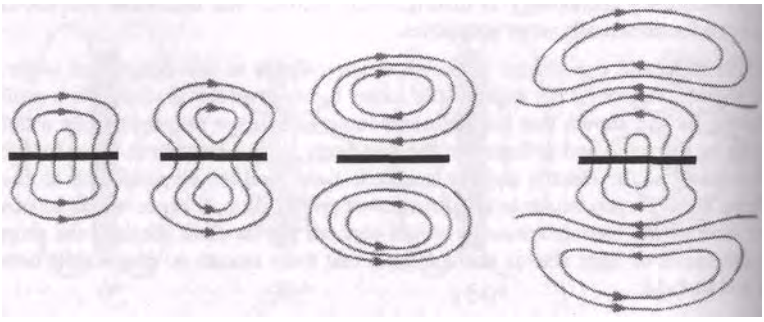

Fig. 21.9 A: The coming off of the electric field lines from a dipole
The forming vortex structures found a longitudinal electric wave carrying impulse!

electromagnetic wave (transverse)

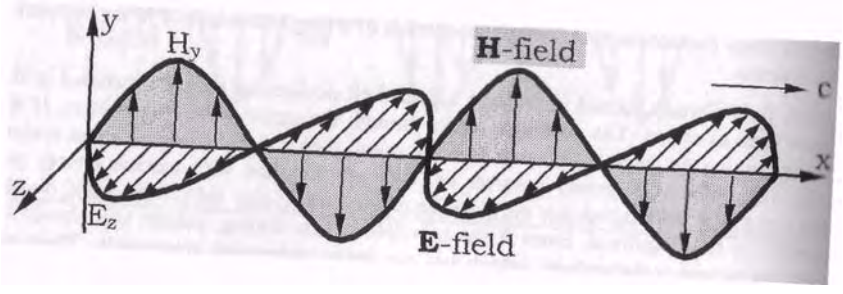

Fig. 21.9 B: The planar electromagnetic wave in the far zone

21.9 Transition to the far-field

In sufficient distance to the transmitting antenna as far-field the transverse electromagnetic wave results (fig. 21.9 B). It is distinguished by not occurring a phase shift between E- and H-field anymore. Every change of the electric alternating field is followed immediately and at the same time by a change of the magnetic alternating field and vice versa.
In the proximity however the phase shift amounts to 90°. Somewhere and somehow between the causing antenna current and the far-field a conversion from a longitudinal into a transverse wave occurs. How should one imagine the transition?

In the books the coming off of a wave from a dipole is represented according to fig. 21.9 A. The fields come off the antenna, the explanation reads. If we consider the structure of the fields coming off then we see field vortices, which run around a point, which we can call the vortex centre. Such field structures naturally are capable of forming standing waves and to carry an impulse. The scalar wave field in general and the near-field in special we only will understand with suitable vortex physics and with a field theory extended for corresponding vortices we also will be able to calculate it. Postulates cannot replace field physics!

Be that as it may, the vortex, after having left the antenna, for bigger getting distance at some time seems to unroll to propagate further as an electromagnetic wave. There takes place a transition from longitudinal to transverse, or spoken figuratively, from vortex to wave. How complete this conversion takes place, how big the respective wave parts are afterwards, on the one hand depends on the structure and the dimensions of the antenna. Information is given by the measurable degree of effectiveness of the antenna.
The vortex structures on the other hand are the stabler, the smaller and faster they are. If they are as fast as the light or even faster, then they become stable elementary particles, for instance neutrinos. Slower vortex structures however are predominantly instable. They preferably unwind to waves. Vortex and wave prove to be two possible and under certain conditions even stable field configurations.

Let's emphasize: A Hertzian dipole doesn't emit Hertzian waves! An antenna as near-field without exception emits vortices, which only at the transition to the far-field unwind to electromagnetic waves. A Hertzian wave just as little can be received with a dipole antenna! At the receiver the conditions are reversed. Here the wave is rolling up to a vortex, which usually is called and conceived as a ,.standing wave". Only this field vortex causes an antenna current in the rod, which the receiver afterwards amplifies and utilizes.
The mostly unknown or not understood near-field properties prove to be the key to the understanding of the wave equation and of the method of functioning of transmitting and receiving antenna. The question is asked, how one should imagine the rolling up of waves to vortices and vice versa the unrolling? How could an useful vortex mode) look like?

Circularly polarized wave (transverse)

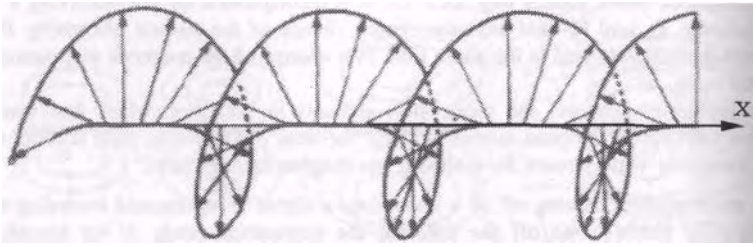

Fig. 21.10 A: Left-circular polarized wave
(as explanation for the transition to a vortex and to a scalar wave)

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electric wave (longitudinal)

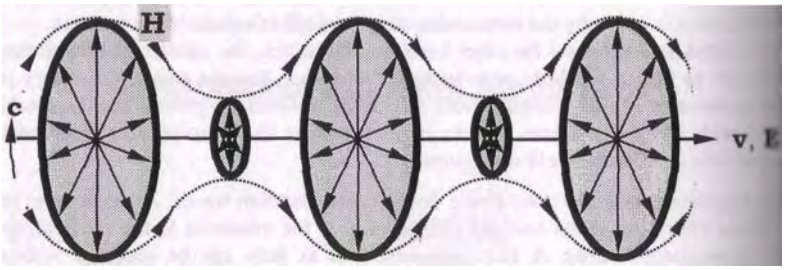

Fig. 21.10 B: Magnetic ring-vortices form an electric scalar wave.

vortex and wave = two stable field configurations
electromagnetic wave = transverse wave propagating in a straight line
ring-like vortex = transverse wave running in circles
vortex velocity = speed of light c
change of structure = if the field is disturbed without expense of energy

22.10 Scalar wave model

The light, as electromagnetic wave, in the presence of a heavy mass or of strong fields is bent towards the field source (fig. 6.10). The wave normally propagating in a straight line thus can be diverted. The square of the speed of light further is inversely proportional to the permeability and dielectricity, short, in presence of matter it is more or less strongly slowed down. If this slowing down of the wave occurs one-sidedly, then a bending of the path can be expected as well. At the end of the antenna a reflection and a going back of the wave can occur, which at the other end again hits itself. Now the wave has found a closed-loop structure, which can be called vortex. The figures 21.10 B and 21.11 A show the two possible structures.
In technical books this vortex with the properties of a „standing wave" is explained gistly. Near-field and standing wave are two examples, how the textbooks succeed in describing mathematically right a small part of the scalar wave properties, without having to have a good look at vortex physics. With such auxiliary descriptions however the end is reached fast, if for instance it concerns understanding a pure scalar wave transmission according to Nikola Tesla (fig. 19.11) and the special properties of this wave type. With the vortex concept of an extended field physics new horizons are opening.
If we direct our look again to the sketches (fig. 21.10 B and 21.11 A). In both cases electromagnetic waves are represented which propagate with the speed of light, only that the wave doesn't go forward in a straight line but instead runs around in circles. It also furthermore is transverse, because the field pointers of the E-field and the H-field oscillate perpendicular to c. By means of the orbit the speed of light c now has become the vortex velocity. Wave and vortex turn out to be two possible and stable field configurations. For the transition from one into the other no energy is used; it only is a question of structure. The vortex structure thus stabilizes itself by means of the field dependency of the speed of light.
By the circumstance that the vortex direction of the ring-like vortex is determined and the field pointers further are standing perpendicular to it, as well as perpendicular to each other, there result two theoretical formation forms for the scalar wave. In the first case (fig 21.10 B) the vector of the H-field points into the direction of the vortex centre and that of the E-field axially to the outside. The vortex however will propagate in this direction in space and appear as a scalar wave, so that the propagation of the wave takes place in the direction of the electric field. I call this an electric wave.
In the second case the field vectors exchange their place. The direction of propagation this time coincides with the oscillating magnetic field pointer (fig. 21.11 A), for which reason I speak of a magnetic wave.
The vortex picture of the rolled up wave already fits very well, because the propagation of a wave direction of its field pointer characterizes a longitudinal wave, because all measurement results are perfectly covered by the vortex model. It even is clear that no energy has to be spended for the conversion, since merely the structure has changed. If it becomes a vortex the wave just doesn't run in a straight line anymore but in circles, to either wrap around the magnetic field vector (fig. 21.10 B). or the electric field vector (fig. 21.11 A).

magnetic wave (longitudinal)

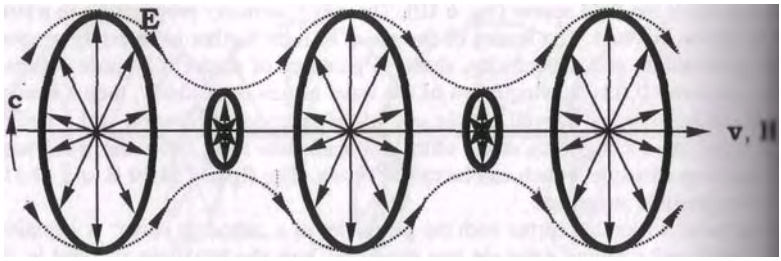

Fig. 21.11 A: The magnetic scalar wave

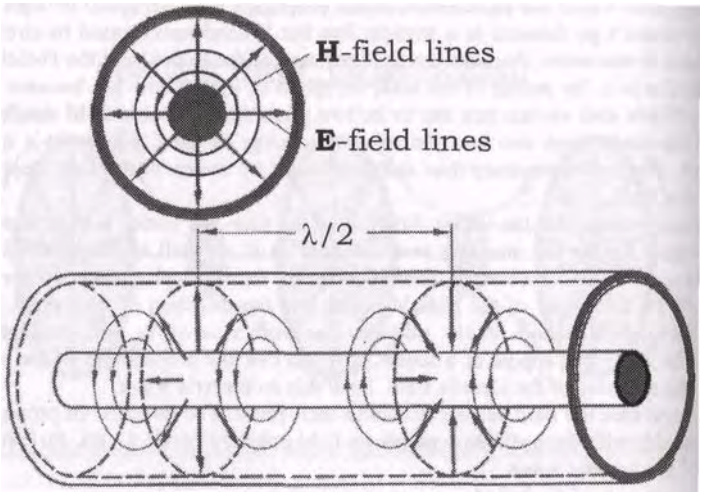

Figure 21.11 B: Wave propagation in a coaxial cable,
(Example for waveguide, horn radiator, etc.)<i>
Cross-section of coaxial conductor and field distribution in the direction of propagation.

<i>: H. Armbruster, G. Grunberger: Elektromagnetische Wellen im Hochfrequenz-

21.11 Double-frequent oscillation of size

Because a longitudinal wave propagates in the direction of the field, the field pointer also will oscillate with the velocity of propagation v. This hence isn't constant at all, it can significantly differ from that of the light and can take arbitrary values. According to the theory of objectivity the field oscillating with it determines its momentary size:

$$E, H \sim 1/v^2 \qquad (21.10).$$

The velocity of propagation v of the scalar wave thus oscillates double-frequently and with opposite phase to the corresponding field. A detailed description would mean, if the field strives for its maximum value, the velocity v of the wave reaches its smallest value. In the field minimum the scalar wave vice versa accelerates to its maximum value. For longitudinal waves therefore only an averaged velocity of propagation is given and measured, as this for instance is usual for the sound wave, and this can vary very strong as is well-known (body sound compared to air sound, etc.).
The two dual field vectors of E and H, the one in the direction of propagation and the one standing perpendicular to it, occur jointly. Both oscillate with the same frequency and both form the ring-like vortex in the respective direction. As a result the ring-like vortex also oscillates in its diameter double-frequently and with opposite phase to the corresponding field (fig. 21.10 Band 21.11 A).
This circumstance owes the ring-like vortex its property, to tunnel. No Faraday cage is able to stop it, as could be demonstrated in experiments<i>. Only therefore the ground wave runs through the earth and not along the curvature of the earth. A further example is the coaxial cable (fig. 21.11 B). Also this acts as a long tunnel and so it isn't further astonishing, that the electric field lines have the same orientation, as for a magnetic scalar wave. As a practical consequence in this place there should be warned of open cable ends, wave guides or horn radiators with regard to uncontrolled emitted scalar waves!

At present in the press is being discussed, if the cable network runners for some channels the mission to operate again should be withdrawn, because the airline radio traffic is being disturbed. The original opening for cable frequencies, which actually are reserved for the airline radio traffic, based on the erroneous assumption, that conflicts are unthinkable. But then the planes were disturbed in their communication. As the cause TV-cables made out, which hadn't been closed according to the rules with a resistor, as it by all means can occur on building sites and during renovation works. On the other hand is being argued with the small current, which flows through the coaxial cable, and the large distance to the planes also is cited. According to that it actually can't concern Hertzian waves. It presumably are scalar waves, which escape from the open cable ends and which are collected by a receiver in the plane. It indeed is very little field energy, but because it again is being collected and bundled, the scalar wave is able to exceed the part of the radio wave by far just at large distances and to cause problems. For such examples from practice the scalar wave theory is fully taking effect.

<i>: Adolf und Inge Schneider im Interview mit Prof. Dr.-Ing. Konstantin Meyl: Durchbruch in der Freien-Energie-Forschung, NET-Journal 12/1999, S. 7-9.

1. H. Hertz: electromagnetic wave (transverse)

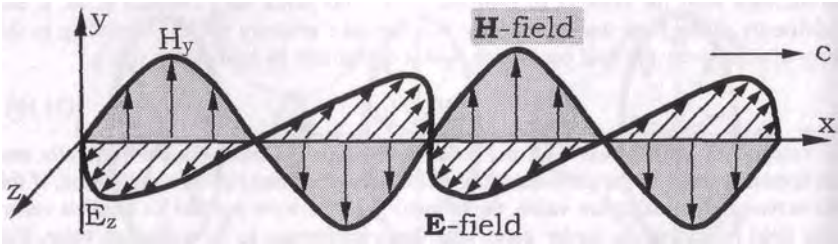

2. Nikola Tesla: electric wave (longitudinal)

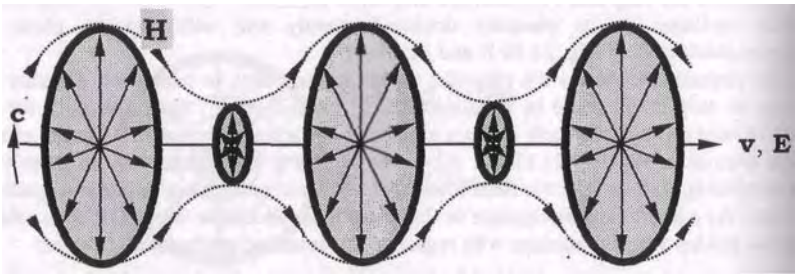

3. magnetic wave (longitudinal)

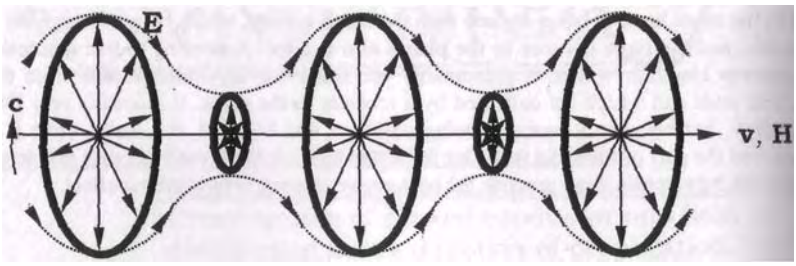

Fig. 21.12: The three basic types according to the wave equation
(21.1), (electric, magnetic and electromagnetic wave).

21.12 Electric and magnetic scalar wave

Let us record: For the wave propagation there thus are three possible and stable states (fig. 21.12): the transverse electromagnetic wave according to Heinrich Hertz (fig. 1), the longitudinal electric wave according to Nikola Tesla (fig. 2), and a longitudinal magnetic wave (fig. 3), which isn't connected yet with a name of a discoverer. The last one is a pure product of my theoretical derivation. The question is asked, which practical meaning the magnetic wave could have.
It is formed by individual electric field vortices, which I have discovered and called potential vortices 1990. I proceed from the assumption that the youngest of the three waves will play the by far biggest role in the future, because its properties are unattainable, both with regard to the energy technical and to the information technical use. One example for each should support this thesis.

The experiments concerning the electric wave according to Nikola Tesla, where is being worked with electrically charged spheres, don't show a particularly high power. Magnetic converters, so the experiences of my laboratory activities, are superior to an electrostatic converter as a collector for free energy by far. That even can be expected, because a magnetic engine is much smaller than an electrostatic engine of the same power as is well-known.

At a congress of medicines was given a talk on the basic regulation of the cells, on the communication of the cells with each other. Professor Heine in his decades of research work has found out that the cells for the purpose of communication build up channels for instance in the connective tissue, which after having conducted the information again collapse. Interestingly the channels have a hyperboloid structure, for which no conclusive explanation exists.
The structure of the data channels however is identical with the one of a magnetic scalar wave, as shown in fig. 3. Through a channel formed such, which functions like a tunnel or a dissimilarly formed waveguide, only one very particular scalar wave can run through. Waves with different frequencies or wavelengths don't fit through the hyperboloid formed tunnel at all in the first place. Through that the information transmission obtains an extremely high degree of safety for interference.
To the biologist here a completely new view at the function of a cell and the basic regulation of the whole organism is opening. The information tunnel temporarily forms more or less a vacuum, through which only potential vortices can be conducted, and that without any losses - simply perfect! From this example is becoming clear that nature is working with scalar waves namely with magnetic waves.

One other point should be recorded: The mentioned tunnel experiments, in which speed faster than light is being measured with most different devices, impressively confirm the presence of scalar waves. But if scalar waves exist which are faster than light and other ones, which are slower, then it almost is obvious that also such ones will exist, which propagate exactly with the speed of light. These then will have all the properties of the light and won't differ from the corresponding electromagnetic wave in the observable result. As scalar wave it however is formed by vortex configurations, which unambiguously have particle nature. Nothing would be more obvious than to equate these quantum structures with the photons.

Question: Is the light wave or particle?

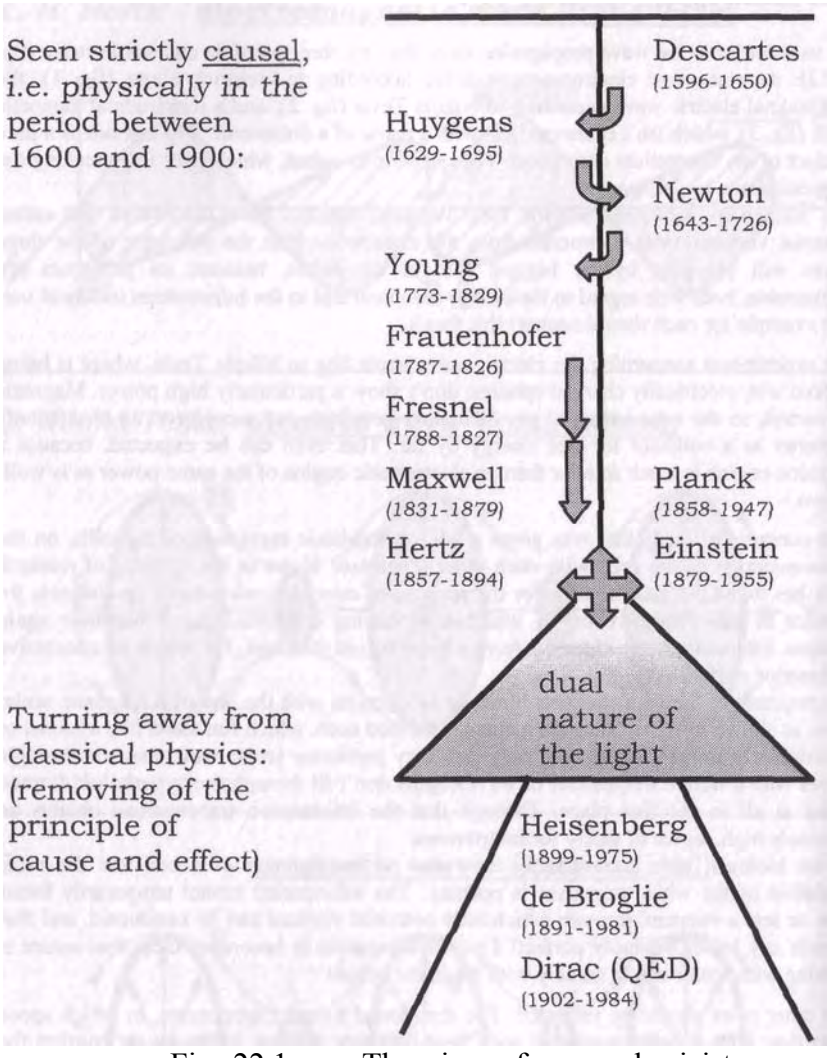

Fig. 22.1: The view of some physicists concerning the nature of the light as wave or as particle.

According to the wave equation the light is a mixture of wave and photon radiation!

22 Properties of scalar waves

For the light quanta hypothesis the Nobel Prize for physics was awarded 1921. But it only was a hypothesis, an idee fixe, which was honoured here. It is quite odd, if such an important prize is awarded to a research scientist, who hasn't got the slightest idea what light quanta are anyway, of what they consist and how they are built up. Albert Einstein cleverly used the embarrassing situation, by in his celebration speech on the occasion of the awarding of the Nobel Prize giving a talk on the theory of relativity. After the speech a member of the committee found it necessary, to point to it, that this wasn't object of the awarding of the prize and that the theory of relativity concerns a pure theory, which can't be proven by principle. A theory hence neither could be awarded the Nobel Prize.
Such words on the occasion of awarding a prize for a daredevil hypothesis give the whole event really grotesque characteristics. But it came still worse.

22.1 Wave-particle compromise

Physicists of name and rank had come together. It concerned the question if the light is wave, or particle or even both at the same time? For both variants experimental proof was present, the discussion became inflamed and the things boiled over. Finally they were as smart as before, as Werner Heisenberg presented his ideas concerning the uncertainty principle. This compromise, on which one eventually came to an agreement, with good cause may be called the worst in the history of physics. It dictates me, what I shell see and how exact I may look. With it the contradiction should be overcome that the light contrary to every causality should be wave and particle at the same time.

Such fixings not only have a funny, but also a tragic side. Since it were authorities, which have approved the compromise and the whole community of science has confidence in the statements of its authorities, which immediately and unfiltered is entered in all textbooks. At the meeting it simply and solely concerned the wave equation and only that could have supplied the correct and only possible answer: It falls apart into two parts and this explains, why the light one time appears as an electromagnetic wave and the next time as a vortex particle, which is called photon. The conversion can take place at any time spontaneously and without putting on energy, so that depending on the used measuring technique the particle appears as wave or as particle, but of course never as both at the same time!

Looking back one can say that the funny thing about the situation was that all discussed about the wave and its properties known at that time, that all should know the wave equation. An equation as is well-known says more than a thousand words and one look would have sufficed entirely, to answer the controversial question once and for all. It would have saved us a lot.

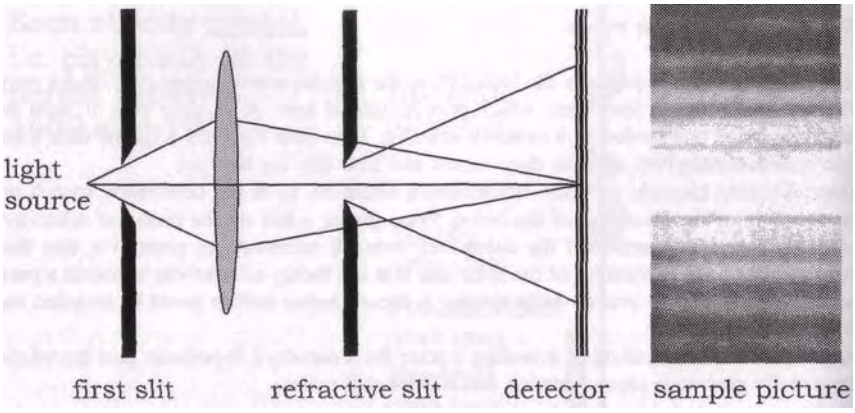

Fig. 22.2 A: Light forms interference patterns at the slit (light stripes are formed, where the waves oscillate in phase, dark stripes, where they oscillate out of phase).

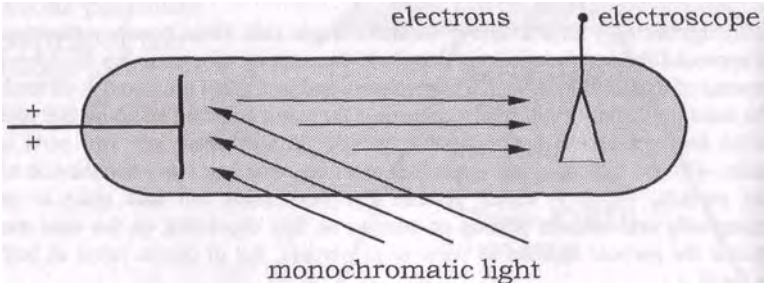

Fig. 22.2 B: The photo-electric effect

<i>: Atome als Energiewellen. Physiker wandelten einen Strom von Natrium atomen in Wellen um. III. Wissenschaft 7/1996, Seite 56 + 57

22.2 Concerning the measurement of light

The uncertainty principle with the interpretation of Heisenberg, the light is wave and particle at the same time, is incompatible with the wave equation. Heisenberg puts an equal sign, where in the wave equation in reality is present an addition of both wave parts. Fortunately in mathematics there is no need of speculating, there a derivation is right or wrong. Nothing is changed to that even if all physicists of the world should go in the wrong direction following the prevailing opinion. The wave equation exert an influence on the interpretation of the light experiments, on the one hand the ones concerning the interference and refraction of the light, where electromagnetic waves are becoming visible (fig. 22.2 A) and on the other hand the photo-electric effect, as proof of light quanta (fig. 22.2 B).

Already the wave theory of Huygens requires interference patterns of light rays, as they for instance are observed behind a slit, and demonstrates with that the wave nature. If on that occasion the particle nature is lost, if thus the photons present before the slit can't be detected behind the slit anymore, then plain and simple the measuring method, thus the slit is to blame for that. The vortices have unrolled themselves at the slit to waves. Corresponding experiments also have been carried out with matter. At the Massachusetts Institute of Technology whole sodium atoms were converted into waves. At the detector pure interference patterns were observed, which go as evidence for the successful dematerialization<1>. But the vortex physicist they show still more: they reveal, that atoms merely are waves rolled up to spherical vortices, which at any time and spontaneously can again unroll to waves at a lattice (chapter 5 and 7).
The common interpretation, the wave nature detectable behind a slit must have been present in the same form already before the slit, is untenable and in the end wrong, as makes clear the experiment with the sodium atoms.

The photo-electric effect, which on the other hand shows the quantum nature of the light, has been discovered by Heinrich Hertz, further investigated by Lenard and finally rendered more precisely by Millikan 1916 (fig. 22.2 B). It bases on the circumstance that light of higher frequency, thus blue light, has more energy than red light of lower frequency. But if electrons are knocked out a metal plate by light, then that occurs, by the waves rolling up to vortices. Now indeed photons are at work, which are detected with an electroscope indirectly.
In the same way a photon ray in a bubble chamber can be photographed. But also here the measuring method is responsible for what is being observed.

A good example is the human eye, the rods and cones of which merely can pick up potential vortices and pass them on to the nerves as so-called reaction potentials. Incident waves can only be detected, if they first have rolled up to vortices in the corpus vitreum of the eye. For us seeing, it doesn't play a role of how many percent vortices and waves the light is consisting.
Behind a sheet of glass for instance a larger vortex part can be expected and still the light has the same brightness as without sheet; the sheet of glass is perceived as transparent. We nevertheless must assume that light with a large wave part has another quality, than such light behind glass or artificial light with a large part of photons.

wave equation:

$$\Delta \mathbf{E} = \text{grad div } \mathbf{E} - \text{rot rot } \mathbf{E} = \frac{1}{c^2} \cdot \frac{\delta^2 \mathbf{E}}{\delta t^2}$$

Nikola Tesla:	*Heinrich Hertz:*
• **scalar wave** (electric or magnetic) = • **longitudinal wave**	**electromagnetic wave = transverse wave**
form (each time for velocity of propagation v):	form (each time for frequency):
• (v > c): neutrino radiation, morphogenetic fields,...	• cosmic radiation • X-rays, • UV radiation,
• (v = c): photons,	• light,
• (v < c): plasma wave, thermal vortices, biophotons, earth radiation,...	• infra-red radiation, • microwaves, • radio waves,
• (v = 0): noise,...	• VLF, ULF,...

Fig. 22.3:____ The two parts of the wave equation

22.3 Comparison of the parts of Tesla and Hertz

Light as a rule always is formed as photon radiation, even on the sun. If in the end only waves arrive on earth, then the vortices sometime on the way to us must have unrolled to waves. Photon radiation after all is a scalar wave radiation, which generally is predominant in the near-field of the source of radiation. There is no reason, why the light should act in another way than the wave radiated by a radio transmitter, which as well forms vortices in the near-field area, as we already have discussed. For different interpretations of wave properties of one and the same physical phenomenon there is no place in a unified theory.

If we stay at the comparison then it is not an individual case that an experimental setup is responsible for what is being measured and observed. A parallel case to the experiments concerning the nature of the light is the one concerning the wave propagation. Hertz has received and utilized the transverse part and Tesla the longitudinal part and either one claimed, only he is right. There doesn' t exist an other equation, which has been and is being ignored and misunderstood so thoroughly, as the wave equation.

Fig. 22.3 shows in a survey the two parts of the wave equation in the assignment to the terms and forms: Right hand side the electromagnetic wave according to Heinrich Hertz and left hand side the scalar wave according to Nikola Tesla. The terms, like on the one hand transverse wave and on the other hand longitudinal wave relate to the kind of wave propagation.

If the field pointers oscillate crossways to the direction of propagation, then as a consequence the velocity of propagation is decoupled from the oscillating fields. The result in all cases is the speed of light, and that in our observation is constant. It is usual to make a list for increasing frequency, starting at the longest waves (ELF and VLF) over the radio waves (LW, MW, SW, UHF), the TV channels (VHF, UHF), the microwaves, the infra-red radiation, the light, the X-rays up to the cosmic radiation.
It really is interesting that it concerns one and the same phenomenon despite the different forms! As long as Maxwell only had published a theory for the light, in the world of science 24 years long at first nothing at all happened. Only Heinrich Hertz with his short wave experiments opened the eyes. Now all suddenly started at the same time to research into various phenomena on the frequency scale, from Madame Curie over Konrad Rontgen up to Nikola Tesla, who primarily researched the area of long waves.

With regard to the scalar waves until now a corresponding booster detonation has failed to appear. The immense area is new ground scientifically, which is awaiting to be explored systematically. I try to make a contribution with my historic rebuild of a scalar wave transmission line according to the plans of Tesla[<i>].

<i>: Im Gesprach mit dem Fernsehmoderator und Buchautor Johannes von Buttlar weise ich auf die Chancen und technischen Moglichkeiten hin: Johannes von Buttlar im Gesprach mit Prof. Dr. Konstantin Meyl: Neutrinopower, Argo-Verlag Marktoberdorf, 1. Aufl. (2000).

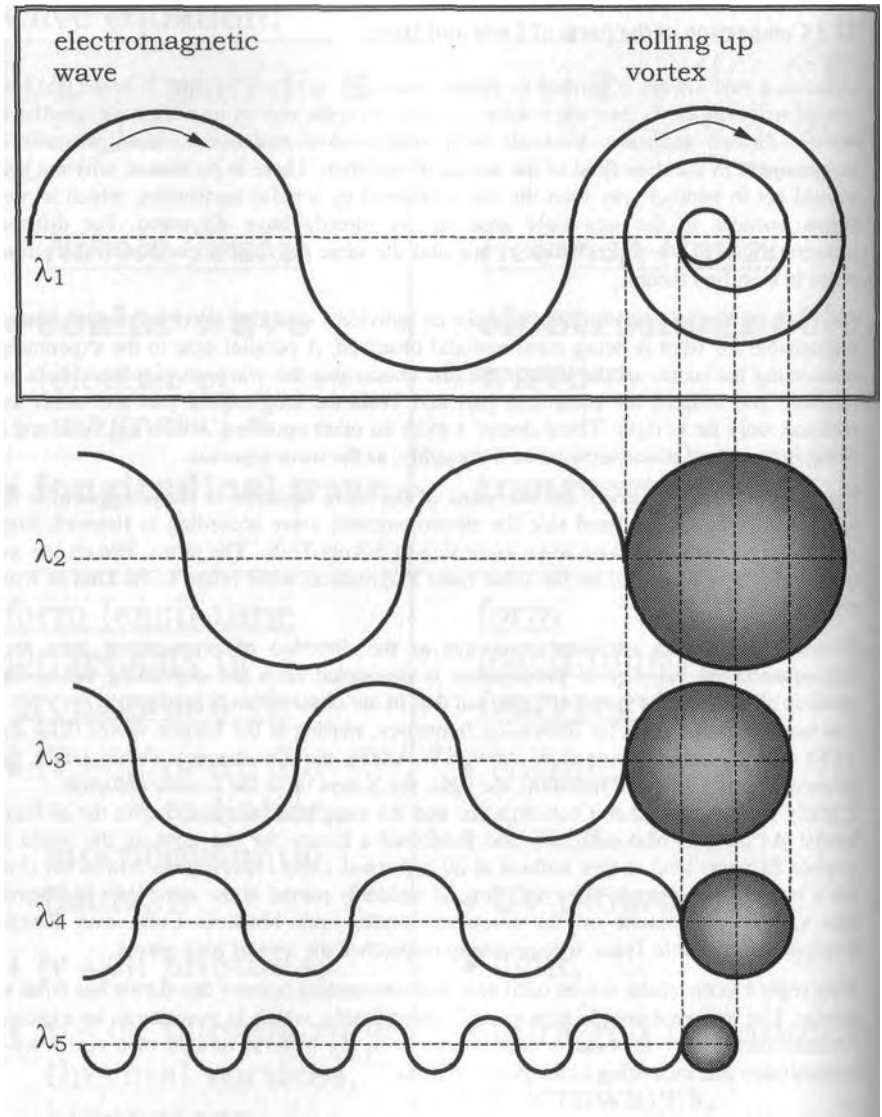

Fig. 22.4: The wave rolling up to a vortex.

wavelength of the wave: $\lambda_1 = c/f_1$

wavelength of the vortex: λ_n (n = 1,2,3,4,5) $\leq \lambda_1$

$f_5 > f_4 > f_3 > f_2 > f_1$ $\lambda_5 < \lambda_4 < \lambda_3 < \lambda_2 < \lambda_1$

22.4 Noise, a scalar wave phenomenon

Longitudinal waves can take arbitrary velocities between zero and infinity, because they propagate in the direction of an oscillating field pointer and as a consequence of that their velocity of propagation oscillates as well and by no means is constant. It does make sense to llist the forms of scalar waves according to their respective velocity of propagation (fig. 22.3, left column).
If we start with a localized vortex, a wave rolling up, which further is contracting. Doing so the wavelength gets smaller and smaller, whereas the frequency increases. An evenly frequency mixture distributed over a broad frequency band is observed. This phenomenon is called noise (fig. 1.4). But besides the localized noise, noise vortices can also be on the way with a certain velocity as a scalar wave, e.g. for the radio noise. In this case they show the typical properties of a standing wave with nodes and antinodes.

Also the earth radiation is said to have standing wave nature, which can be interpreted as slowed down neutrino radiation. If it is slowed down on the way through the earth, then the neutrino properties are changing, as this was measured in the Kamiokande detector in Japan recently. Unfortunately the proof occurs only indirect, because there still don't exist measuring devices for scalar waves. We'll talk about this problem area later and are content with the clue that already within living memory the standing wave property has been used to find water and deposits of ores and still is used today (fig. 22.4).

If we continue our considerations concerning the forms of scalar waves, as they are listed in fig. 22.3. The scalar waves, which are slower on the way than the light, are joined by the plasma waves. This is confirmed by measurements and calculations.
For thermal vortices, as they have been investigated by Max Planck and for biophotons, as they can be detected in living cells by colleague Popp, the velocity of propagation however is unknown. It was not and still is not measured at all, now more than ever. The research scientists have confidence in the assumption that all waves go with the speed of light, but that is a big mistake.
For all wave kinds there at least exists also one vortex variant, for radio waves for instance it is the radio noise, which propagates with a velocity different from c. The velocity is the product of frequency and wavelength:

$$v = f \cdot \lambda \quad (22.1)$$

From the three variables v, f and λ at least two must be measured, if one has a suspicion that it could concern scalar waves. At this place most errors are made in the laboratories. Countless experiments concerning the biological compatibility, concerning medical therapy methods and similar experiments must be repeated, because as a rule only the frequency is being measured and it has been omitted to at least check the wavelength or the velocity of the wave. Countless research scientists must put up with this accusation. Much too blind the scientists, who now again may start from the very beginning with their work, have had confidence in the predominance of the speed of light.

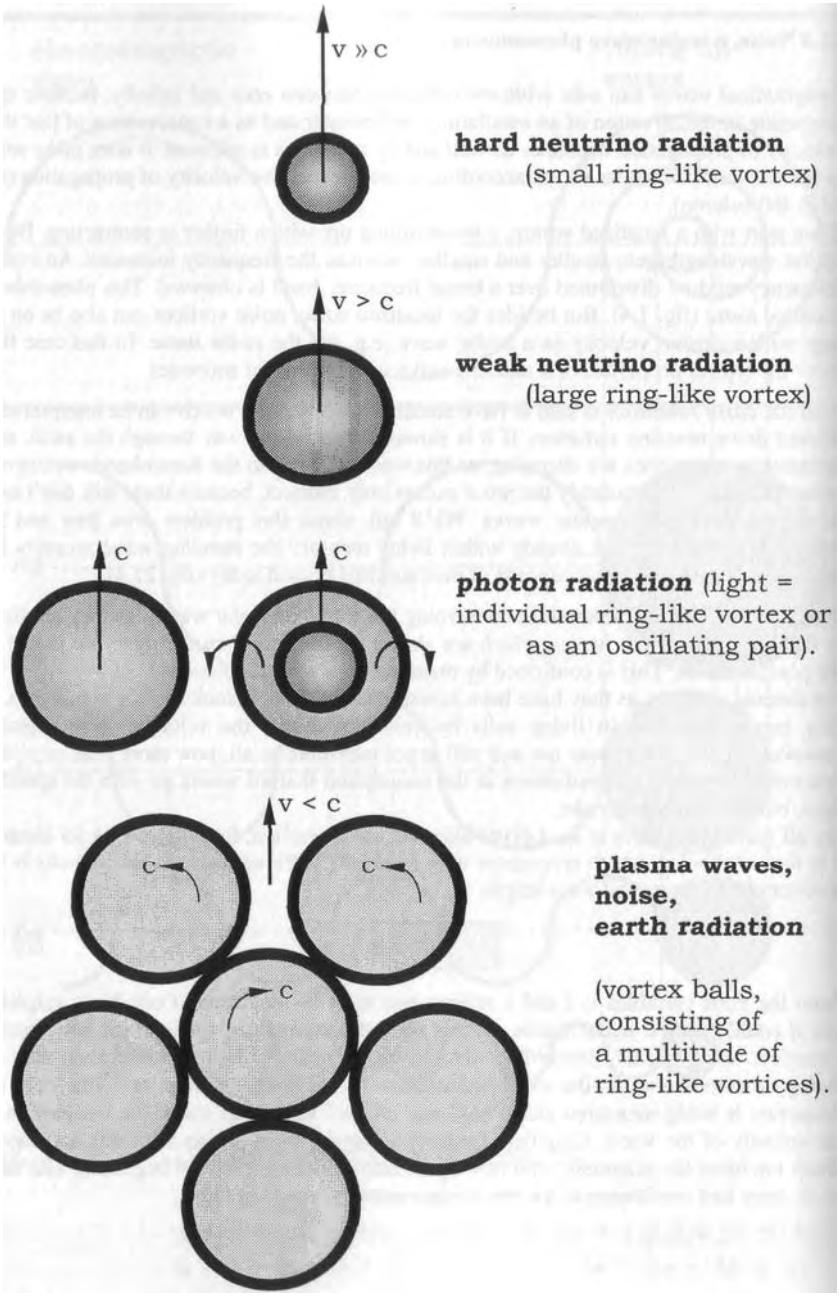

Fig. 22.5: ____ The ring-like vortex model of scalar waves.

22.5 Neutrino radiation

The neutrino physicists make the same error. They proceed from the assumption that their particles are on the way with a speed somewhat less than the speed of light c. This contradicts the observation according to which black holes should represent strong sources of neutrinos, which are black only for the reason that no particle radiation is able to escape them, which is on the way with c or even slower. If a black hole does hurl neutrino radiation into space, than that must be considerably faster than c, as normal neutrino physicists still by no means can imagine it today.
But the neutrino radiation only can be detected after it has been slowed down to a value, which is smaller than c. If the slowing down occurs slightly assymmetrical, then as a consequence a mean of the mass different from zero appears. The ,,measurement" of such a rest mass, as it at present is propagated and celebrated, is a classical measurement error! As long as a neutrino on the way to us still is faster than the light, the mean of its mass is generally zero. The effective value of the mass of a neutrino is however considerable. Only it is able to give account for the sought-for dark matter, as far as it must exist in the today supposed form anyway.

The Tesla radiation, that the discoverer Nikola Tesla already in own experiments had found out, is faster than light (chapter 9.7 and 17.2). Since this Tesla radiation according to the description is identical with the neutrino radiation, since it so to say forms a subset, I will call neutrino radiation all the scalar waves, which are faster than the light. This stretches from the weak radiation at low frequencies up to the hard neutrino radiation of cosmic origin. But the hardness of the radiation does not only increase with the frequency, it in particular increases with the velocity.

The neutrino radiation first of all is carrying energy. On top of this basic wave radiation in addition information can be modulated. Doing so extremely complex modulation variants are offering. Of this kind we must imagine thoughts, as being complex modulated vortices, which can propagate as scalar wave in space. Rupert Sheldrake calls this vortex field a morphogenetic field. At this place merely is pointed at his very interesting research results[<i>].
Thoughts can be standing in space, in the form of localized noise, but they also can move with speeds faster than light. According to that a communication with intelligent beings from other star systems by all means wouldn't be an Utopia anymore.

Every fast neutrino forms an individual ring-like vortex (fig. 7.12). The slower the scalar wave is, the more dependent the vortices become. The photon already can consist of two ring-like vortices (fig. 4.6), whereas plasma waves and other slow scalar waves can form from a multitude of individual vortices, which are rotating around each other, to form vortex balls and vortex streets (chapter 4.9 - 4.11). From this circumstance already results very different scalar wave behaviour in the different areas of the velocity of propagation. This trend for small velocities can as well be observed towards lower frequencies. For a certain wavelength the frequency after all (according to eq. 22.1) is proportional to the velocity of propagation.

<i>: R. Sheldrake: Seven experiments that could change the world. New York: Riverhead 1995

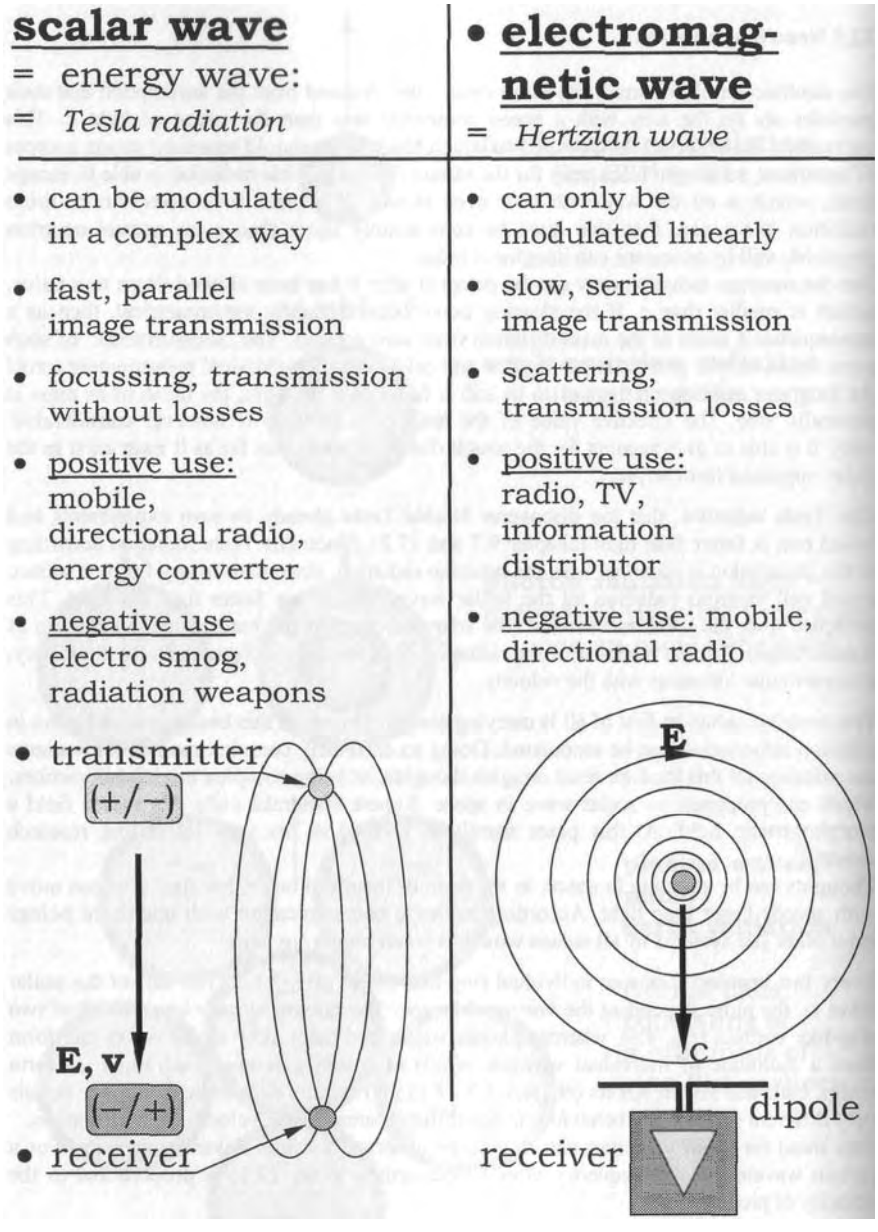

Fig. 22.6:_____ Scalar waves and radio waves, comparison of the properties.

22.6 Parallel instead of serial image transmission

We continue with our considerations concerning the special properties of scalar waves, represented in the left column, and compare these with the well-known behaviour of electromagnetic waves in the right column (fig. 22.3 is now followed by fig. 22.6). If we again take up the possibilities for modulation and the transmission of information, then it becomes very clear from the comparison that we today work with a technology, which we it is true master more or less, but which is everything else but optimum.
For the Hertzian wave the velocity of propagation is constant. With the frequency therefore at the same time also the wavelength is being modulated. But that strongly limits the information transmission. An image for instance must be transmitted serially point after point and line after line. The serial image transmission takes place very slowly, for which reason the velocity of the PCs permanently must be increased, so that the amount of data can be managed.
With the clock frequency on the other hand also the losses increase, so that in the end the CPU-cooler limits the efficiency of modern PCs. Something our engineers obviously do wrong, as a comparison with the human brain clarifies. Our brain works without a fan. For it a clock frequency of 10 Hertz is sufficient. It needs neither Megahertz nor Gigahertz Irequencies and despite that is considerably more efficient.

Nature only works with the best technology. The second best technology, as it is put to use in our machines, in the evolution wouldn't have had the slightest chance of surviving. The strategies to optimize of nature are merciless. In a free economy that goes completely different. There the ,,bunglers" are joining together to companies dominating the market, buying up the innovative ideas without further ado, to let them disappear in the drawer, so that they can bungle further in the way they did until now. It after all have been the lousy products, which have made them to the companies they are today. The ego of power is incompatible with the interests of nature.

Nature works with scalar waves and their velocity of propagation is arbitrary. Wavelength and frequency now can be modulated and information can be recorded separately. In this manner a whole dimension is gained to modulate, the image transmission can take place in parallel, which means considerably faster, safer and more reliable. As anyone of us knows by own experience, assembling the image takes place all at once, the memory of past images takes place ad hoc. Nature is indescribable more efficient than technology with the scalar wave technique.

If we again take the right-hand side of fig. 22.6 with the properties of the Hertzian wave. In the opinion of Nikola Tesla it is a gigantic waste of energy. The broadcasting power is scattered in all directions and the transmission losses are enormous. At the receiver virtually no power arrives anymore. To receive a radio signal the antenna power has to be amplified immensely. It is a wave, which actually only can be used as radio wave, thus as a wave with which arbitrary many participants should be reached.
This wave however is completely useless, if it concerns a point-to-point connection. If I want to call someone, to talk only with him, a radio wave is the entirely wrong method, because I with that bother hunderds and thousands of people that I don't want to call at all!

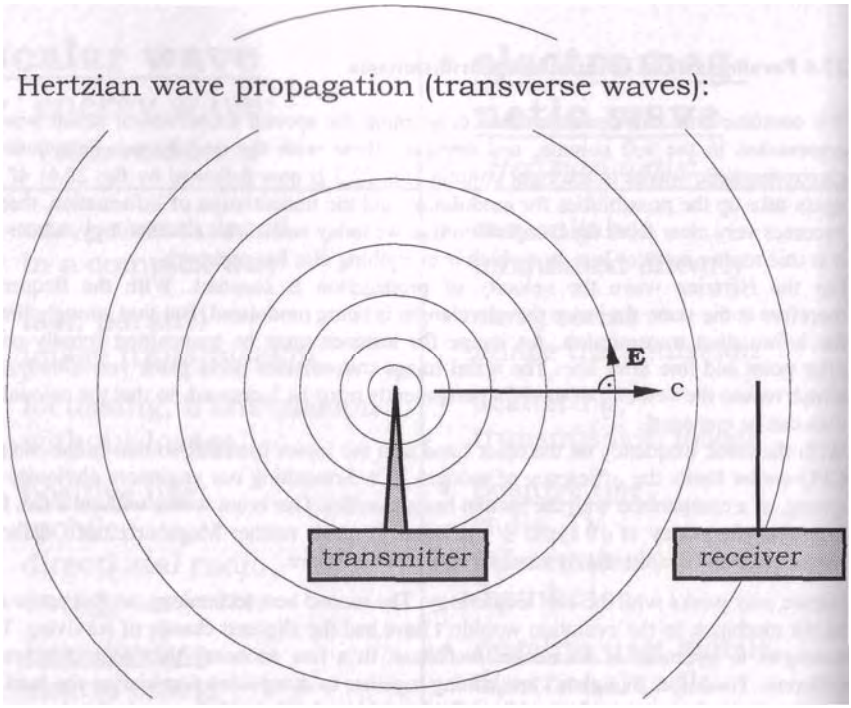

Tesla radiation (radiations) = scalar wave, longitudinal wave propagation:

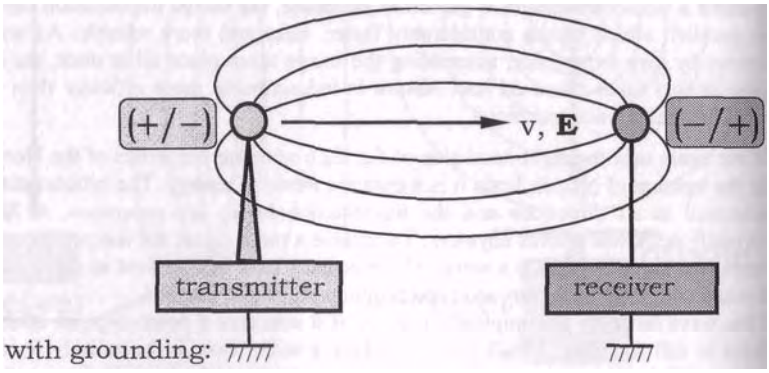

Fig. 22.7: ____Comparison of radio waves according to H. Hertz and electric scalar waves according to Nikola Tesla.

22.7 Comparison of the properties

The course of the field lines clarifies the difference. For the scalar wave all field lines going away from the transmitter run together again. As long as no scattering field occurs, there also won't be any transmission losses. It is an energy wave, for which the full broadcasting power is transmitted wirelessly and which arrives at the receiver, by that focussing the field lines again.

Here one at once numerous technical applications come to mind, if energy should be transmitted wirelessly. A TV, which supplies its remote control with energy itself, lelemetric installations, which are fixed at difficult accessible or rotating machine parts and which can't work without energy supply.

For a mobile with 3 Watts of broadcasting power only a few microwatt arrive at the ground station. If I would have a scalar wave mobile, which functions with resonance, then a broadcasting power of some microwatt will be completely sufficient, to carry out a telephone call right through the earth. This minimum broadcasting power suffices, because everything, what is being transmitted, arrives at the receiver - crucial is that the conditions of resonance are fulfilled. That means, both must have the same frequency and the opposite phase. In addition the modulation has to fit, so that on the one hand not several participants in the conversation are getting in each other's way. For a purely carrier wave transmission on the other hand there would be the risk of natural fields being collected also and the power at the receiver taking inadmissibly high values. This is prevented effectively by a correspondingly complex modulation. Nature solves the problem in exactly this manner.
Mobile phone technology with scalar waves of course still is a pie in the sky. A big challenge for the engineers poses the adjustment condition of opposite phase and the fitting modulation, which Tesla called .,individualisation"[<i>]. Entirely by the way the network runners and the telephone companies are getting quite superfluous.

Telephone charges, so one perhaps can read in the history books in a hunderd years, were the indication of a century of rigorous exploitation of man and nature. With scalar waves a direct, more dimensionally modulated information transmission directly with the partner of conversation is possible and sufficient energy is available to humanity any time and any place, without being dependent on any companies! This notion is not new, but it is inconvenient for the rules; already Nikola Tesla has written about it, but obviously no-one wanted to listen to him[<ii>].

Scalar waves are able, that is made clear by the properties, to revolutionize both the energy technology and the information technology fundamentally. It is more than only a technology for the new century. Scalar waves are a chance for the whole millennium!

<i>: N. Tesla: Transmission of electrical energy without wires, Electrical World and Engineer 7.1.1905; Edition Tesla Vol. 4, P. 131.

<ii>: N. Tesla, New York Times of 15.9.1908; Edition Tesla Vol. 6, P. 241.

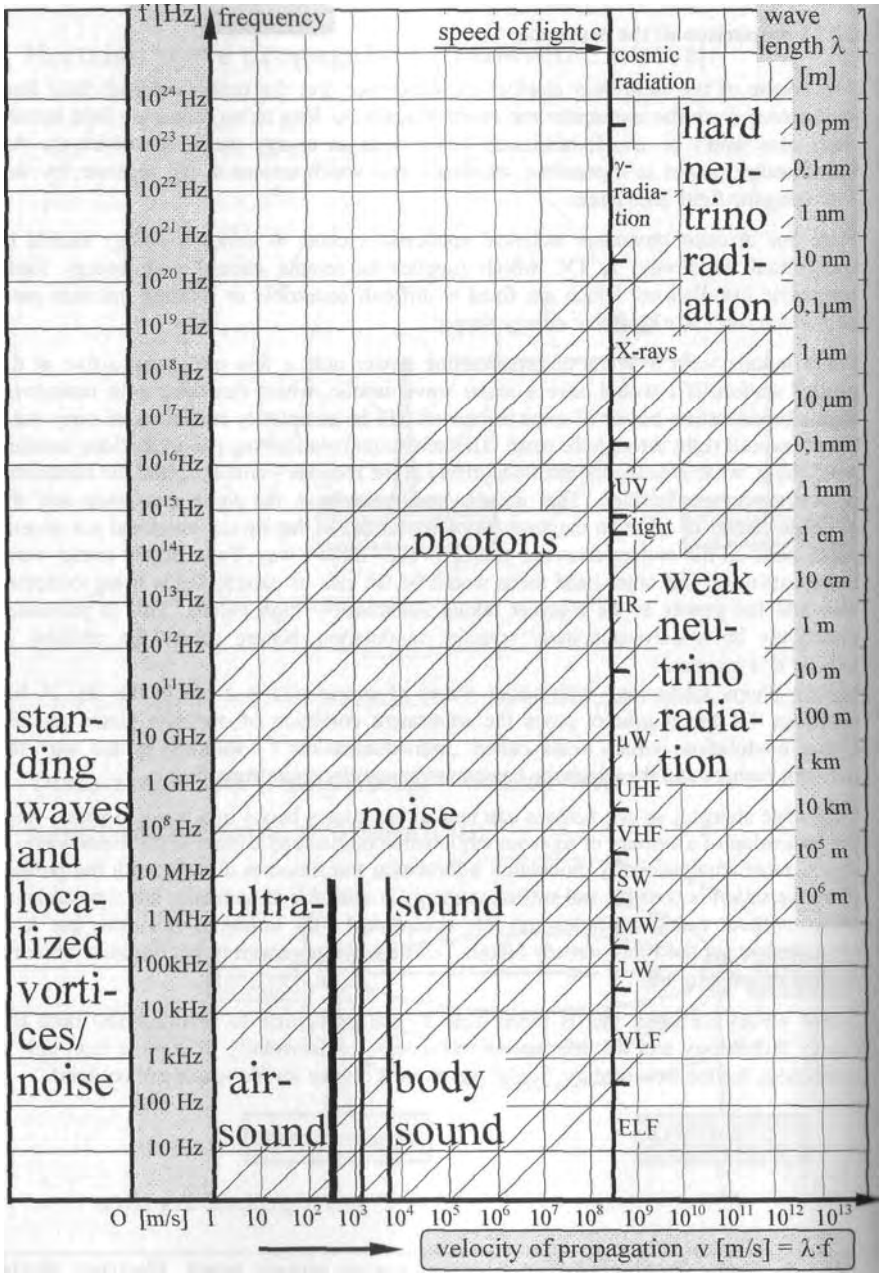

Fig. 23.1: Frequency diagram of longitudinal and transverse
waves as they depend on the velocity v.

23. Research of scalar waves

Scalar waves are still unexplored area, scientific new ground as it were. Individual research scientists already have selectively ventured forward in this area and have described properties of the scalar wave investigated by them in their special research area mostly in measurement technical manner. But as a rule they lack the physical relation, as it is derived in this book for the first time. If we don't proceed from individual measurements, but from the wave equation and the mathematical physical derivation of scalar waves, then we have the great chance to understand as something belonging together on the one hand noise, photons, neutrinos and lots of other known phenomena as well as on the other hand still unknown phenomena, which are called parascientific. We should remember that we without theory of Maxwell and the representation in a frequency band today still wouldn't know that the radio waves (LW, MW, KW, UHF), the microwaves (μW), the infrared thermal radiation (IR), the light and the X-rays concern just the same phenomenon. The graphic representation of both waves in one diagram in this place is extremely helpful.

23.1 Frequency diagram

In fig. 23.1 the frequency f is shown against the velocity of propagation v with the wavelength λ as parameter. The broad line at $3*10^8$ m/s represents the speed of light c. Here the frequency band of the transverse waves can be found again in the well-known one-dimensional representation.
Crosswise to that, somewhat unusual, the longitudinal waves run. These start at the left at localized noise, over the sound as it propagates in air, in water and in metal, over a large, to a large extent still unexplored, range of the bio photons, the heat vortices and of the dowsing rod effects and end on the other side of the speed of light at the neutrinos. Between that the special case is settled that the particles, or said better vortices, propagating as a scalar wave have exactly the speed of light. It gives reasons for the circumstance, as already mentioned, that light can appear as wave or as photon radiation. It. according to the wave equation, after all always consists of a combination of both forms. At very high frequencies, e.g. the cosmic radiation, this combination is shifted in the direction of vortices and their distribution as a scalar wave, at low frequencies the tendency inversely goes in the direction of the normal wave.

If we assume that for the transverse wave over all frequencies a dozen of specialized gauges is necessary, each of them also can be switched over in range several times, then we can project that to record a scalar wave of a certain frequency over all velocities of propagation likewise 12 devices and for the whole field shown in fig. 23.1 approximately 12x12 = 144 devices will be necessary. Of these 144 gauges today just 12 are available. There thus still are missing 132 pieces, which should be developed. With these gauges, so I am convinced, the many white spots in the diagram can be tapped scientifically little by little if a systematic procedure is used. My vortex theory thus will be attached a central importance.

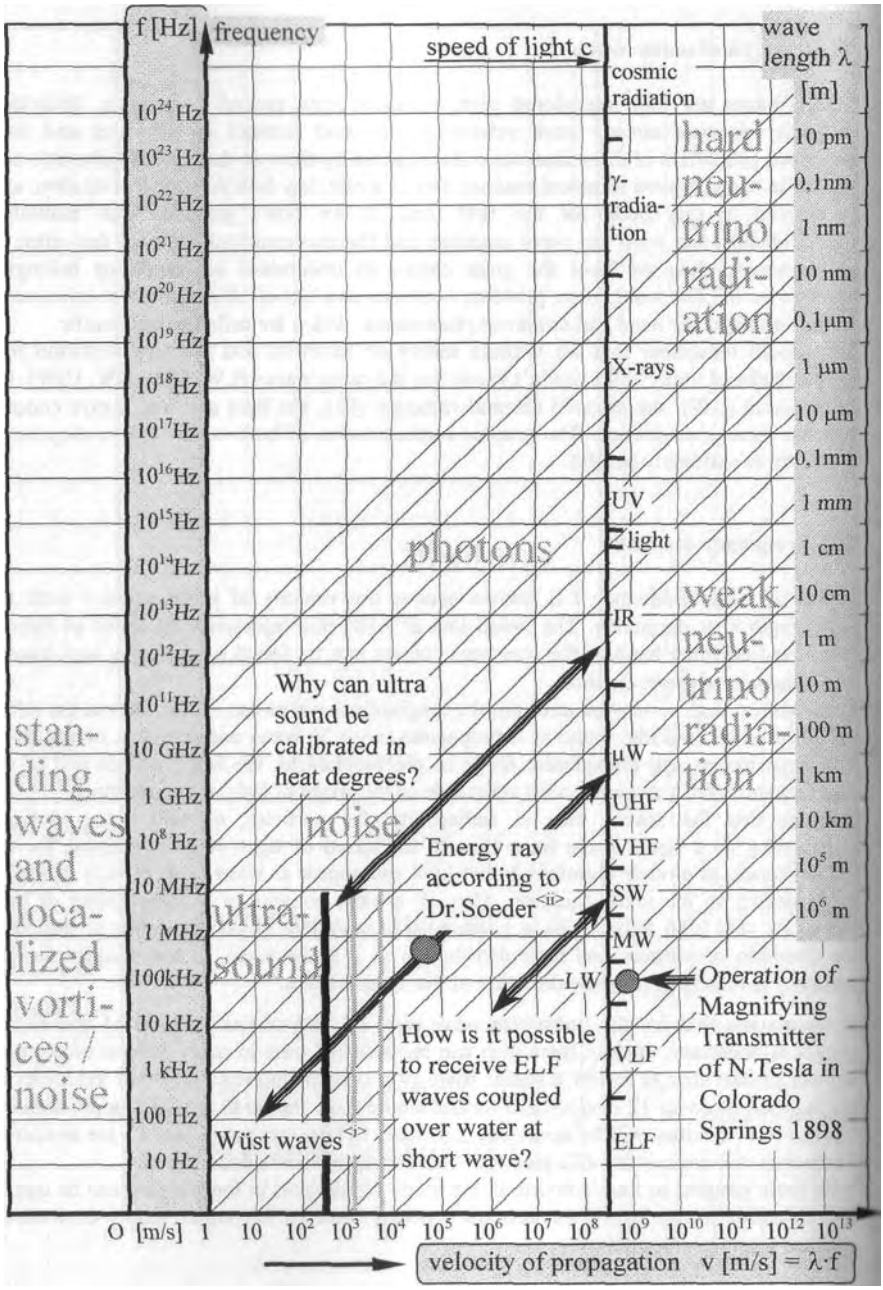

Fig.23.2: Frequency diagram with entries concerning Wust waves,
Tesla transmitter and various not understood effects.

23.2 The reverse of the HF medal

The diagram possibly may settle disputes, like the ones between the „Wustlingen" (note of the translator: the author here is playing with words, Wustlingen literally means lechers) and the „high-frequency engineers".
Professor Wust of Munich already 1934 had proven, that the Wust waves named after him in air have a velocity of propagation of approximately 10 m/s[i]. He investigated them in the frequency range between 16 Hz (λ= 60 cm) and 500 Hz (λ= 2 cm). The high-frequency technicians immediately have converted to the speed of light, since they don't know anything else, and on the spot have shifted the phenomenon into the range of the microwaves between 0.5 GHz (λ=60 cm) and 15 GHz (λ= 2 cm). In the diagram now can be found, at which place this phenomenon belongs actually. It presumably concerns the same „energy ray", which Dr. Soeder has observed and proven already at velocities of propagation of 55.2 km/s and wavelengths around 10 cm[ii].

Furthermore follows from the diagram (23.2), why ultra sound can be calibrated in heat degrees, and why radio reception of signals from a completely other frequency range is possible by principle, if for identical wavelength a velocity of propagation different from c occurs. Further the range of operation used by Tesla at approx. 1.6 times the speed of light is depicted.

Also the noise is such a book with seven seals. It concerns, it is true, a fixed chapter of high-frequency engineering, but without visible connection to the other chapters. That might be based on the circumstance that the relation, as it is dictated by the wave equation, isn't recognized.
Every high-frequency signal is accompanied by a noise signal; every antenna produces more or less noise. HF engineering dictates the measures, how the noise can be suppressed resp. the signal-noise distance be increased. The goal is to make the electromagnetic wave stand out in such a way from the noise that it can be received. For that the measurement setup must be choosen correspondingly, are the measurement cables dictated, and must be paid attention to power adaptation and corresponding termination resistors. For measuring HF correctly all interference influences should more or less disappear.

But what are the interference influences, which the HF-technician suppresses? According to the wave equation it are the scalar wave parts, and to that also is counted the noise. Every HF-technician thus knows the scalar parts as interfering noise signal, but doing so he completely fails to notice the technical advantages and chances, which e.g. are present in the noise.
If by means of an autocorrelation function a noise signal is compared to itself then often a hidden message comes to light. According to that, informations can be hidden in the noise and of course transmitted wirelessly. This important circumstance is known, but it is hardly used. The noise vortices thus can be modulated in an extremely complex way. There can be transmitted a lot more information in the noise as scalar wave, than with the radio wave.

<i>: J. Wust: Physikalische und chemische Untersuchungen mit einem Rutenganger als Indikator. Further references in W-B-M 3/ 1991, S. 57.

ii>: A. Soeder: Ohne Strom lauft neuer Energiestrahl rund urn den Erdball. Raum & Zeit 59/92 Seite 62-67.

Fig. 23.3: ___ Dowsers dowse an ore vein.[i]
From: Speculum metallurgiae politissimum, Rossler, Dresden 1700.

<i>: Ludeling, Hartmut: Handbuch der Radiaesthesie, Verlag Eike Hensch 1994, S. 145, ISBN 3-927407-09-7.

The possibility of more dimensionally modulating and parallel image transmission make scalar waves superior to the radio waves in such a way that one should seriously think about the reversed procedure, in which the noise is conceived as useful signal and the radio wave as interference signal.

In the frequency diagram (23.1 and 23.2) can be read like in a diary, in which most pages it is true still are empty, but in which some very informative marginal notes can be found for different points of difficulty. It mostly are parascientific phenomena, which, not understood and excluded by textbook physics, are waiting to be taken up in the building of physics. As an example we'll pick out an extensive area of alternative research.

23.3 Radiesthesia

A particularly broad spectrum of scalar waves is provided by the already several times mentioned earth radiation. An ancient science of experience, which troubles the exploration of the earth radiation, is the geomancy. The Roman land surveyors, the Augures, used as an aid a flat coil like also Tesla did to receive scalar waves. The Lituus, as the device was called, resembles so much that of the Etrusks that we must proceed from the assumption that the method is much older (fig. 16.10).
This part of the scalar wave research, also called radiesthesia, is derived of „radiare", which can be translated with "send out rays" resp. „perceive". It describes the doctrine of the sensitivity to radiation of man. Doing so the radiation sensitive uses his own nerve framework as a biosensor.

The nerve conduction could be derived as a biological variant of the Tesla one wire transmission, for which ring-like potential vortices are passed on as action potentials in form of standing waves (fig. 9.6). Of this kind are also the control commands, which cause a muscle to contract. If now corresponding vortices are picked up by means of a dowsing rod or similar aids in our nerves, then the contract addressed muscles contract, because they can't distinguish, from where the command comes. This unconscious nerve twitch leads to a swing of the dowsing rod and to the well-known dowsing rod phenomenon. But man can't replace a technical gauge. Hence one speaks of dowsing and not of measuring. To this should be added the condition of resonance, which must be fulfilled. Since every person however builds up other resonances, dowsed results of others often can't be reproduced. But from this particular difficulty one cannot draw the conclusion that the phenomenon does not exist and radiesthesia is not a science. Series surveys and statistical analyses here in any case don't lead any further. It always only are individual talented dowsers, who have at their disposal really fantastic abilities and find with great certainty water, ores and even oil.
With the perception of a physical phenomenon it mostly starts. Cultural man looks after his discovery as cult, whereas modern man, guided by the wish for reproducibility and more objectivity, is troubled to design and to build a technical measurement work. With regard to the scalar wave in general and the radiesthesia in special we still are at the stage of the Stone Age.

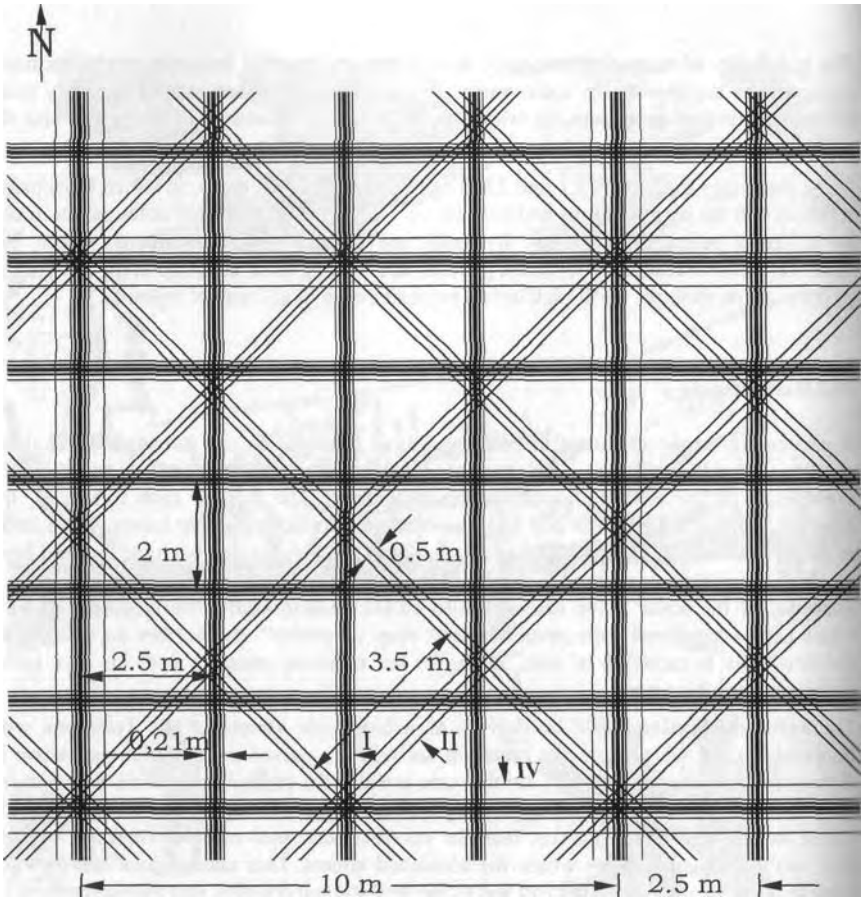

Fig. 23.4: Nets dowsed at latitude 49.<i>

I. net: ,,global net" according to Dr. E. Hartmann; orientation: N - S: 2 m distance and E - W: 2.5 m distance

II. net: ,,diagonal net" according to Dr. M. Curry; orientation: NE - SW and NW - SE: 3.54 m = 2.5 m * sqrt(2)

[III. ,,lightning net" according to R. Schneider; orientation like I.]

[IV. net acc. to Benker; like I. but: N - S: 10 m and E - W: 10 m]

[V. sun/planet net acc. to W. Auer; with 3.66 m orientation S./P.]

According to Prof. E.G.Hensch et al.:
<i>: Hensch: Radiaesthesie im landlichen Bauen und Siedeln, Arbeitskreis zuf Landentwicklung in Hessen, W4, Wiesbaden 1987; resp.: W. Auer: Erdstrahlen?... AWGEO 199, Eigenverlag 1998; resp.: Mayer/Winklbaur: Biostrahlen, 5. Aufl. ORAC Verlag, Wien 1989, Seite 168

23.4 Prediction of earthquakes with the help of scalar waves

The standing wave character of the earth radiation is a help. There are dowsed points and lines of maximum radiation intensity, which form nets, which encompass the whole world. On the one hand we are dealing with a net oriented in direction north-south and east-west (Hartmann net) and on the other hand with a net standing diagonally to that under 45° (Curry net). Because the angle of 45° can be derived as borderline angle from a vortex field calculation<ii>, I already early have pointed to the circumstance that it here presumably concerns a vortex phenomenon<iii>.
Because the nets in addition are dowsed in air, it must be vortices of the electric field, so-called potential vortices<iii>, which here form regular structures. The formation of vortex lines and complete vortex streets (chapter 4.9), which consist of countless individual vortices, can be explained as follows:
Electric scalar waves propagate in the direction of the electric field strength and mediate field vortices, e.g. neutrinos. If at a certain moment the transmitter carries a positive and the receiver a negative charge, then all the particles which are positively charged are repelled by the transmitter and attracted by the receiver. All run at the same time towards the same goal, although all mediated particles carry the same charge and repel each other! This incompatibility can be compensated partly, by the vortices rotating around each other. In this circumstance can be seen the reason for the structure shaping, the formation of some lines in the countryside (fig. 23.3). The distances between the lines have characteristic values, which allow conclusions about the wavelength of the standing waves. We must assume that they dictate the structure shaping and that the spatial vortex distribution aligns with the nodes and antinodes of the respective standing wave. The distance between the lines, which corresponds to half the wavelength, becomes smaller and smaller towards the North Pole and the South Pole of the earth, the net thus narrower and narrower. Also is the net said to change strongly before an earthquake. This all are clues for the circumstance that the structure shaping radiation comes from the earth, that the cause must be sought in the earth radiation.
It should be noted marginally that with scalar wave detectors, which permanently scan the nets, a just as effective as inexpensive earthquake prediction should be possible. Such a facility would be an enormous relief and help for all earthquake warning services. It even should be possible to determine in advance the future epicentre, if there is measured at the same time at if possible many stations and the respective deviations are compared.

A further influential factor is the composition of the subsoil; e.g. ores and metals influence the earth radiation. Water shows a special affinity for the earth radiation. It does collect the radiation and after bundling it up releases it again. To blame is the high dielectricity of water ($\varepsilon \cong 80$), which again favours the formation of potential vortices .
A technical use of this effect would be the neutrinolyse (see fig. 17.6-17.8 and 18.1), the splitting of water molecules by neutrinos if these take the state of an electron, hydrogen escapes and the oxygen content in the water increases. If a neutrino however shows as a positron, then it annihilates and there is formed a light flash, which serves the „experts" in neutrino detectors as proof.

<ii>: Meyl, K.: Wirbelstrome, Dissertation Universitat Stuttgart 1984
<iii>: Meyl, K.: Potentialwirbel Band 1, INDEL Verlagsabt. 1990

Spectroid of the radiation field of a subterranean flowing water veign (according to P. Schweizer)[<i>]:

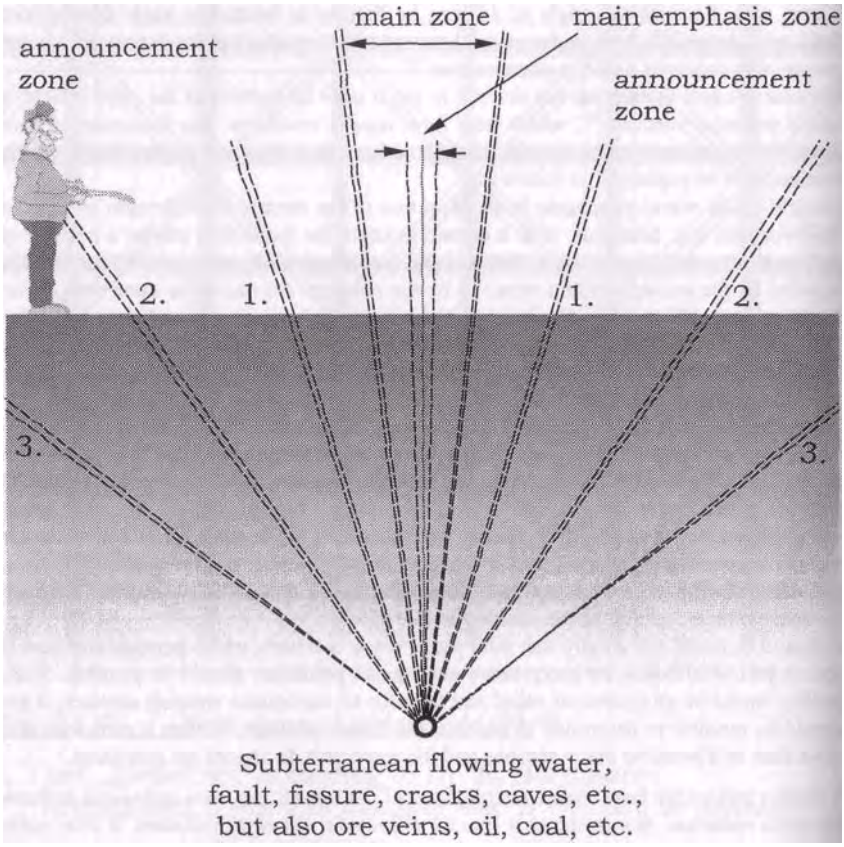

Fig. 23.5:____ Radiaesthetic search for water[<i>],
(dowsing of the earth radiation)

<i>: Ludeling, Hartmut: Handbuch der Radiaesthesie, Verlag Eike Hensch 1994 S. 145, ISBN 3-927407-09-7.

23.5 Searching water with the help of scalar waves

Faults of earth's crust lead to fissures and cracks in the rock, which often fill up with standing or flowing water. Potential vortices of the earth radiation are attracted by the high dielectricity of water and are radiated again in slowed down and focussed form. On the surface of the earth the mixture of various scalar waves arriving there can be dowsed as main emphasis zone. For reason of the broad radiation spectrum the results of proficient dowsers in the main emphasis zone more often coincide.
At both sides in addition spectroids are forming, which are dowsed as parallel running vortex lines. Because every harmonic wave produces other lines and every dowser reacts to other resonances, a profound ability is required, if from the distance of the so-called announcement zones the water depth should be inferred (fig. 23.5). Some specialists indicate besides the place and the depth also the amount of deposit and if need be the water quality. For that they analyse the radiation intensity, but unfortunately many all too often overrate their abilities.

Already the Augures, the land surveyors in the age of the Romans have aligned their streets and the castles with the nets and the lines in the countryside. Even today new evidence about the central importance of the standing wave character of scalar waves can be found at excavations (fig. 16.10). Since every scalar wave also occurs coupled with a radio wave by means of the wave equation, earth rays originally could be detected conventionally with field strength gauges. But the intensive use by radio stations has made it necessary to change from the short wave range to the VHF-range and further to the UHF-range. It were indirect measurements, which could be interfered easily. Today geologists work with ELF scanners in a range between 15 and 30 KHz if they search for water. They analyse the emitted signals of submarine transmitters, because these are attracted and amplified by water carrying layers.
Experiments also are carried out with noise receivers or unused broadband TV channels. Others analyse influences of the earth radiation on the magnetic field of the earth, but for this method the expressiveness is controversial.
Again others walk along a path with a scintillation counter measuring the inverse profile. At the places of maximum earth radiation a minimum of gamma radiation is measured. This stunning relation only can be interpreted as follows: the natural radioactive decay at these places takes place accelerated and that proves:
1.. that earth radiation sets radioactivity free and causes it in the first place (chap. 17.1 pp).
2. that in the case of earth radiation it actually concerns slowed down neutrino radiation.
But also this method works indirectly. It only functions in the open air and then only in the case of unspoiled nature, which sometime was covered with an even layer of radioactive dust. By cultivation or plantation the ,,radioactive layer" very often is changed and mixed up, whereupon the measurable profile hardly allows conclusions.
For indirect measurement methods of that kind, for which the measurement variable stands in a relation, which isn't known in more detail, to the scalar wave of interest, generally caaution is advisable. Too often a message is seen in a wonderful 3-D diagram of the magnetic field strength or the radioactivity distribution, which has much more mundane causes.

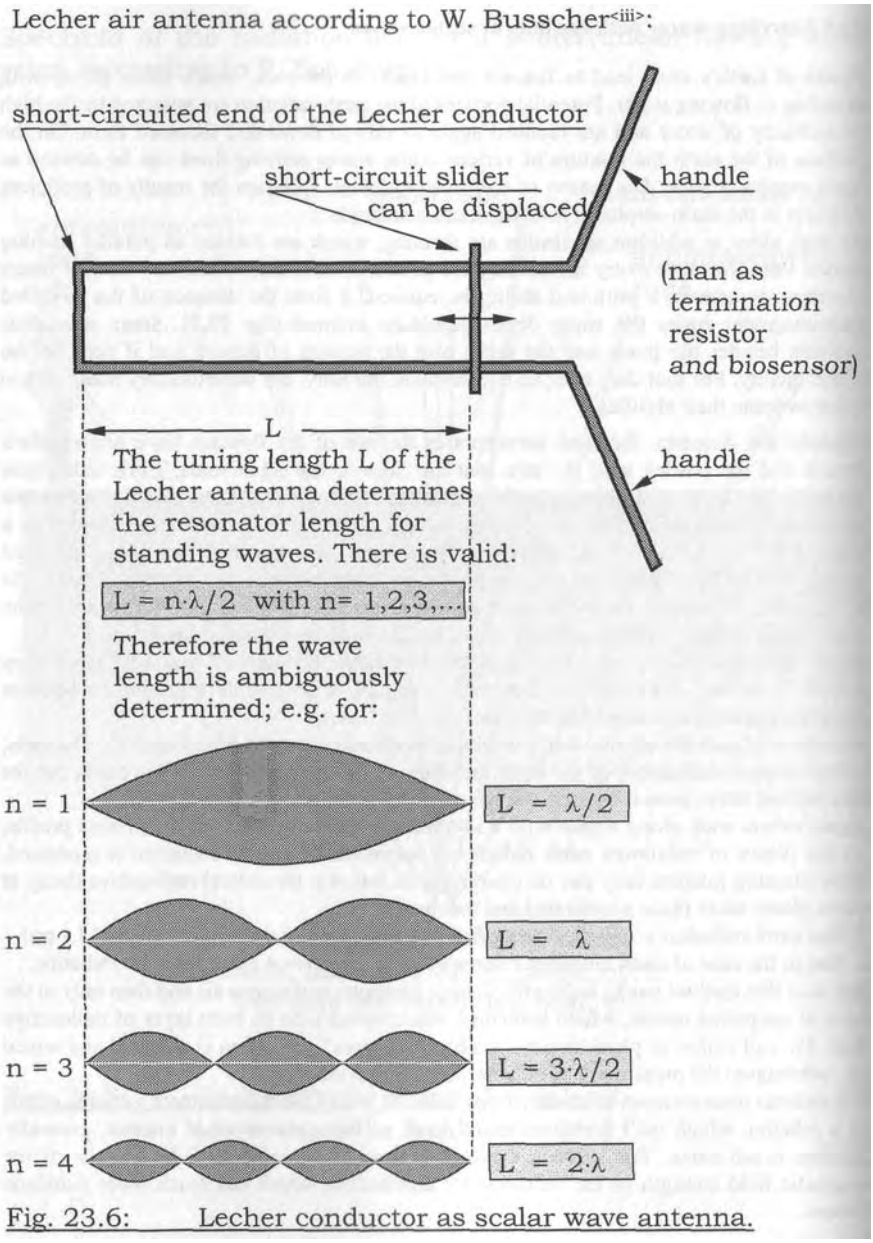

Fig. 23.6: Lecher conductor as scalar wave antenna.

Can be read at Prof. Dr. Ing. Christof Rohrbach:

<iii>: Rohrbach: Radiasthesie, Physikalische Grundlagen und Anwendung in Geobiologie und Medizin, Haug Verlag Heidelberg 1996, Seite 100.

23.6 Receiving scalar waves with the Lecher antenna

In the case of technical gauges it is normal to change the frequency tuning. For that the capacity of a capacitor is being varied, which is part of a resonant circuit. This method can simply be realized with the today available construction elements. Biological systems on the other hand, for instance a person, work primarily with a variation of the wavelength. In this case (according to eq. 22.1) the frequency is directly proportional to the velocity of propagation.
So provide for instance radiaesthetic dowsings clues for the wavelength. The frequency however can't be given, because that oscillates along with the velocity of propagation and at present the forming noise signal still can't be analysed. There can't be bought electronic construction elements, which like a body cell would be able of oscillations of length. Oscillation quartzes and piezo elements, on the basis of which scalar wave detectors could be constructed, form an exception.

Similar to the Lecher conductor different forms of tunable Lecher antennas have been developed. which are used for dowsing. Such a frame antenna, developed strictly according to the rules of high-frequency technology stems from W. Busscher (fig. 23.6)[<i>]. With the short-circuit slider a closed-loop antenna circuit in the upper part is tuned to half the wavelength or an integer multiple of it ($L = n \cdot \lambda/2$ with n = 1,2,3...). The person, who holds the Lecher antenna with both hands, forms the termination resistor for the attached antenna circuit. At the same time he prevents the occurring of an effect back on the tuned resonant circuit by means of damping of the Lecher conductor. The sense of this arrangement is lying in the circumstance that man as a ,,biosensor" should feel if standing waves, which I call vortices, are formed in the Lecher antenna.
A modification of the Lecher air antenna is the Lecher dowsing rod according to R. Schneider[<ii>]. It is produced as an etched board, which has a dielectricity of approx. 4. As a result the velocity of propagation and the wavelength are only half their normal value. In addition a shortening factor V is introduced, which depends on the construction of the Lecher dowsing rod[<iii>] ($L = V \cdot n \cdot \lambda/4$ with V = 0.952 and n = 1,2,3...).
In fig. 23.7 some published tuning values have been drawn up. The values for want of corresponding technical gauges it is true still haven't been confirmed, but they allow a certain insight into the world of the scalar waves, as they are influenced and radiated by water, by metals, by oil or even by other planets, the sun and the moon. Doing so some questions remain open: We for instance don't know, if the corresponding wavelength concerns the basic wave or only an mth harmonic wave. The details not only are unreliable, they moreover also are ambiguous. If however several tuning values L' are present for which resonance occurs, then if need be an integer divisor can be sought and the wavelength can be determined. But that doesn't function always.

<i>: Will Busscher: Die Luft-Lecher-Leitung als Wunschelrute. Eine Methode um die Wellenlangen zu bestimmen. Wetter-Boden-Mensch 3/ 1991, Seite 46-57.
<ii>: R. Schneider: Einfuhrung in die Radiasthesie Teil II: Leitfaden und Lehrkurs ..., Oktogon-Verlag, Wertheim, 2. Aufl. (1984) S. 136.
<iii>: Rohrbach: Radiasthesie, Physikalische Grundlagen und Anwendung in Geobiologie und Medizin, Haug Verlag Heidelberg 1996, Seite 100.

Supposed wavelength λ of the transmitted scalar wave radiation in [cm]

λ	of:	(with the different tuning values L´)
32	water	(L´ = 15.5 $_{n/m=2}$; 10.8 $_{4/3}$; 7.8 $_{n/m=1}$; 3.1 $_{2/5}$)
18	fault	(L´ = 12.9 $_{n/m=3}$; 8.65 $_{n/m=2}$; 4.3 $_{n/m=1}$)
13.6	net I	(L´ = 12.2 $_{n/m=4}$; 9.6 $_{n/m=3}$; 6.1 $_{n/m=2}$; 3.05 $_{n/m=1}$
	4 m = 16 x 25 cm	(N-S direction) 1.7 $_{n/m=1/2}$)
	5 m = 20 x 25 cm	(E-W direction)
14.7	net II	(L´ = 11.4 $_{n/m=3}$; 6.9 $_{n/m=2}$; 3.5 $_{n/m=1}$; 2.2 $_{n/m=2/3}$)
	7.08 m = 30 x 23.6 cm	(NE-SW + NW-SE direction)
13.2	net III	(12.6 $_{n/m\ 4}$; 9.4 $_{n/m=3}$; 8.2 $_{5/2}$; 6.15 $_{2}$; 4.1 $_{4/3}$; 2 $_{2/3}$)
16.4	radon	(L´ = 7.8 $_{n/m=2}$)
28.6	oil	(L´ = 13.5 to 13.8 $_{n/m=2}$; 3.3 to 3.5 $_{1/2}$)
17.2	gold	(L´ = 8.2 $_{n/m=2}$; 4.1 $_{n/m=1}$; 2 $_{n/m=1/2}$)
13.9	silver	(L´ = 6.6 $_{n/m=2}$; 3.2-3.3 $_{n/m=1}$; 1.6 $_{n/m=1/2}$)
7.20	quartz	(6.9 $_{4}$; 4.1 $_{5/2}$; 3.85 $_{9/4}$; 2.9 $_{5/3}$; 2.5 $_{3/2}$; 2.2 $_{5/4}$)
4.35	sun	(L´ = 4.15 $_{n/m=4}$)
15.3	moon	(3.65 $_{n/m=1}$. thermal spectral lines: 11; 21 cm)
4.25	Mars	(4.05 $_{n/m=4}$, thermal spectral line at 3.14 cm)
4.90	Jupiter	(4.65 $_{n/m=4}$, ther. spectral lines: 3; 3.2; 3.3 cm)
5.36	Saturn	(5.1 $_{n/m=4}$, thermal spectral line at: 3.45 cm)

Fig. 23.7: Details of not confirmed wavelengths.<i>
(derived from tuning values of a Lecher antenna
$L' = . V \cdot \lambda \cdot n / 4 \cdot m$ with $V = 0.952$
and $n = 1,2,3...$ for $\lambda/4$, $\lambda/2$, $3\lambda/4$, λ, ...
and $m = 1,2,3...$ for 1 the basic wave
and the 2nd, 3rd, ... harmonic wave

_____ according to: _____

<i>: Ludeling, Hartmut: Handbuch der Radiaesthesie, Verlag Eike Hensch 1994, S. 161 ff. The author gives the clue: ,,The values have been determined empirically by different persons and predominantly could be confirmed by the author and his co-workers. There however always can occur deviations caused by different dowsing methods. Every value therefore always should be checked with own measurements."

23.7 Assignment according to wavelength

As said, the methods to determine the wavelength by means of the Lecher antenna are ambiguous and unreliable. So water should have a wavelength twice as long as a fault. But since water often is collecting or subterranean flowing in faults, one is entitled the suspicion that here $\lambda/2$ was taken, where in reality the full wavelength λ acts. The rest of the table after that should be looked at with the same scepticism. The table nevertheless is not wholely uninteresting, because it points to certain trends and is able to furnish clues, which if need be can represent a help of orientation in the systematic research of scalar waves.
At the planets is remarkable that the Lecher conductor reacts to values, which correlate with the respective thermal spectral lines. If these spectral lines propagate with c and it actually should concern the same cause, the frequency thus should be identical, then the planets would emit scalar waves, which are faster than the light. In the case of Mars 1.35 times the speed of light c would be present, in the case of Saturn 1.55 times and in the case of Jupiter the values would lie between 1.46c and 1.63c. In the case of the moon two thermal spectral lines are being measured, which on the one hand have as a result 1.39c and on the other hand 0.73c. At this place still ample research tasks should be solved.

In the case of scalar waves the wavelength is the most important factor to refer to. The frequency however varies continually, which in electrical engineering is called noise. That again is connected to the circumstance that frequency and velocity of propagation oscillate, so that merely an average value can be given at a time. But that hardly can be measured, which again makes the assignment more difficult. We thus still aren't capable to enter the table values from fig. 23.7 into the frequency diagram of fig. 23.1.

A technical gauge for scalar waves is necessary. A practical solution could look as follows: A noise transmitter tunable in frequency and wavelength operates on top of a carried along noise receiver. The arrangement with that comes the Tesla transmission path for scalar waves very close. If the transmitted noise signal hits upon a likewise one in the surroundings then overlapping occurs, which at the receiver causes a change of the displayed value. If doing so a subtraction (extinction) or an addition (amplification) of the signals occurs is unimportant.
With this arrangement in any case statements are possible about frequency, wavelength, velocity of propagation and about the amplitude of the scanned signal, without withdrawing energy and strain the signal in doing so<i>. With such a gauge radiation conditions depending on location could be measured as well as technical devices checked lor the emitted scalar wave parts (fig. 24.1).
An important use over and above that would be given in medical diagnostics. Every living being „produces noise" the technician would say, it „emits scalar waves" I would say, whereas following general usage is talked about the „aura of man". The value of an aura diagnosis still is completely unknown to most doctors and therapists, especially as the scanning of the aura at present only is possible by dowsing. But the patient expects that a doctor works with a technical gauge and not with a dowsing rod!

<i>: First experiments, which I carried out with students in the laboratory, look very promising. Unfortunately the works at present rest for reason of lack of money.

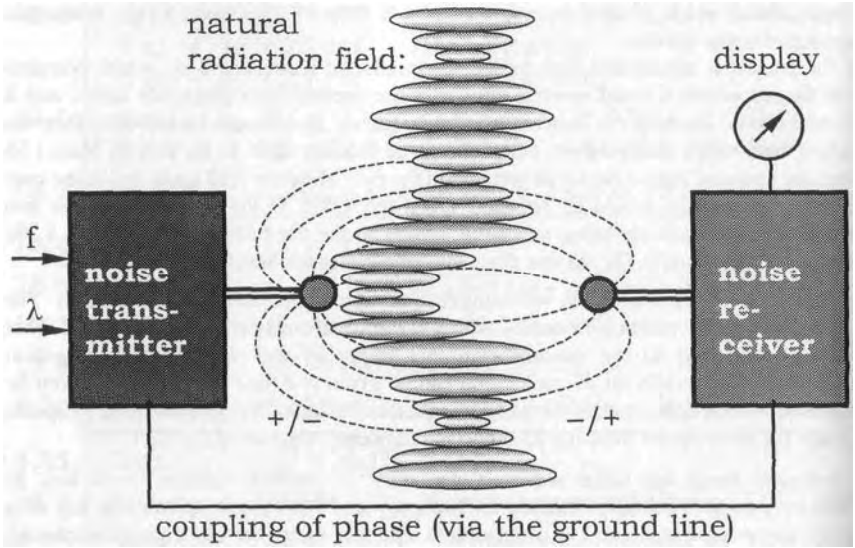

Fig. 24.1:____ Concept for a device to detect scalar waves

24. Medicine of oscillation

24.1 Mediation of information with the help of scalar waves

If for the discussed scalar wave gauge the transmitted comparison signal in addition deviates from the form of a sinus, if the signal is modulated in some way, then even the transmission of information by means of the noise as scalar wave can be realized. If we as an example again take the aura of man, which is more than only a radiation field, it carries information for instance about the state of health of man. Kirlian photography is one form of making it visible (Fig. 3.6).
Not only the nerve conduction and the brain work with scalar waves. Man in this way also corresponds with his fellow people, some more, others less. There are people who „beam" and that should be interpreted in the true meaning of the word. Others opposite to that are more „receiver characters", who pick up more scalar wave radiation than they give away. But because they not only pick up positive radiation energy, they are susceptible to information, which makes sick. That's why a healthy equilibrium in the exchange of thoughts, feelings and the different forms of scalar waves is very important. All that is reflected in the aura of man. If we technically are capable to scan the aura of man, than this can be a blessing for humanity and for the public health.

The possible abuse however must not be overlooked. Unbiased research results, which can be used for the benefit of humanity, in many cases just as well can be used to harm humanity.
A connector of both these worlds is the Russian psychologist Prof. Smirnov, who has shown publicly in television, how a spoken sentence can be transformed in a noise signal, which is taken up directly by the brain as information, with the help of a computer program [<i>]. He with that is capable to "sodden" individuals, as he says, he in this way can take the fear away from soldiers before a combat mission and can operate the disease out of drug addicts without bloodshed. In the television film such an „operation at the open subconscious"' is shown life. The patient hears the noise signal over headphones and is cured already after few minutes treatment time.

We here are getting in the domain of ethical and moral problems of scalar wave research, which aren't solved by us looking away and leaving the field up to others. According to the words of Prof. Smirnov the only thing, which can stop the research scientist, is his own moral. He doesn't say any more and that isn't exactly reassuring! One here is working with „signals resembling sound", is said in the report of the Zweite Deutsche Fernsehen[<i>], thus with longitudinal waves and that shows, that already more knowledge about scalar waves is present than is generally known by the masses.

Another way is leading over the bioresonance. Also here at first the possibility and chance to cure diseases is to the fore. The bioresonance is a central aid in the area of the medicine of oscillation, which is increasing in importance permanently.

<i>: Die Zombies der roten Zaren (Besta Film Warschau im Auftrag d. ZDF 1998)

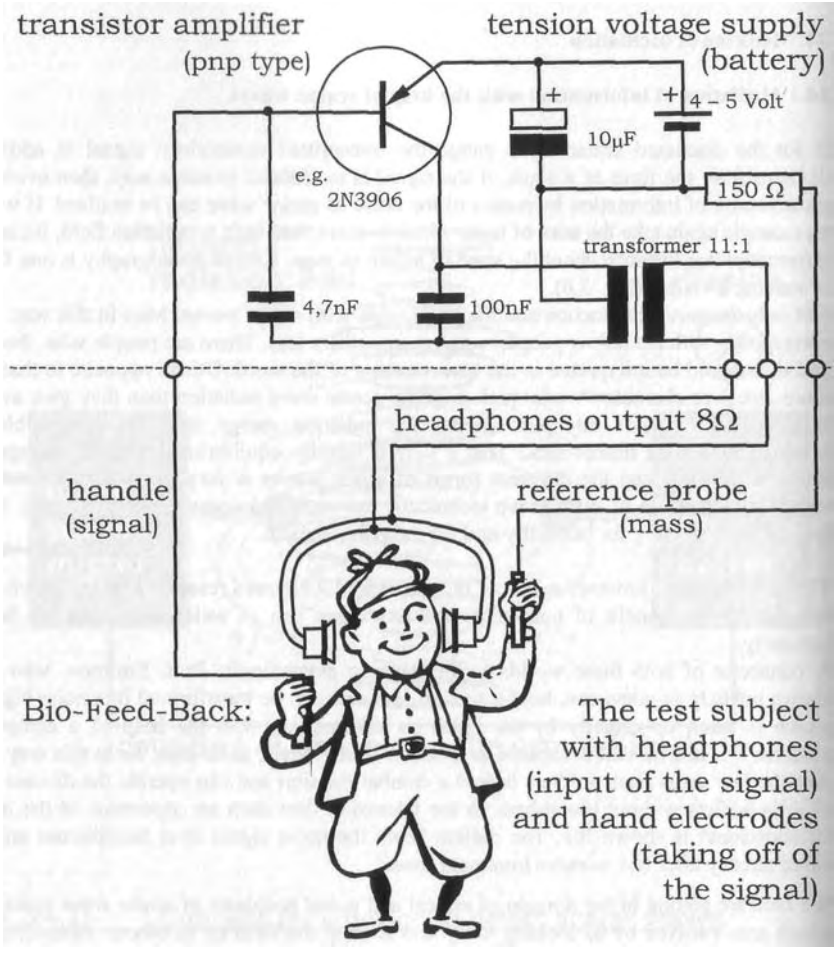

Fig. 24.2 A: Wiring diagram of the Syncrometer.<i>

<i>: Wiring diagram taken from: H. Clark: The Cure for All Cancers (1993) New Century Press, USA, Page 434

<ii>: Flanagan: Horen mit der Haut anstatt mit den Ohren, Sonnenwind 1/97, S.13-17.
s.a.: N.Begich: Towards A New Alchemy, The Millenium Science, Earthpulse Press 1996

<iii>: Dr. Bodo Kohler: Biophysikalische Informations-Therapie, Gustav Fischer Verlag (1997), Kap. 11.6 Der individuelle Grundton, S. 239 ff.
s.a.: Dr. Bodo Kohler: Die bipolare Farb-Ton-Therapie, CO'Med 2/2000, S.10 - 15

24.2 Systems with positive feedback

The field of oscillation of man easily can be influenced, because it concerns a vortex field. A technical measurement with the gauges available at present is almost impossible and highly inaccurate. There however exists the possibility, to apply electrodes to a person and to integrate him in the circuit of a technical device. The two of them form a feedback system with man in the return loop. The operation can take place in two different ways, depending on the sign of the feedback (Fig. 24.3):
For positive sign it concerns positive coupling. In this case the signals released by a person sum up, for which reason already minimum amplitudes are sufficient to produce violent reactions in the case of resonance. For resonance to occur, the system must either search independently the suitable frequency and phase, or the therapist searches the points of resonance.

24.2.1 The Syncrometer.

An independently working system is e.g. the Syncrometer. By means of two electrodes, which are held with the hands or are attached directly to the head, the noise signal emitted by a person is called off and supplied to a broadband amplifier. The test subject again hears the amplified signal via headphones, so that the circuit is closed.
Apparently unspecific and still reproducible during operation certain signals capable of resonance are emerging stronger by amplifying and swinging themselves up. The aura starts to extend or expressed in the words of a radiation sensitive, the so-called reaction distance is increasing, with which he means the distance in which he detects a dowsing rod reaction.
The test subject now increases his radiation, so this method can be valued. By strengthening his own radiation power, he works more as a transmitter and less as a receiver for scalar waves. In the last point the therapeutic use seems to iie, because by that the patient can get rid of resonances to any unpleasant persons or to technical transmitters, which are burdening him. The device consequently also is sold as aid or protection against electrosmog.
The amplified signal also can be picked up directly by the skin instead of by the headphones and still being „heard". The reports stretch from a harmonizing and balancing effect up to "electronic telepathy" and states similar to ecstasy of the test subject[i].

24.2.2 The sound therapy.

The controlled variant of this method for instance is the sound therapy. Now the sounds, which the patient picks up by means of headphones, do not stem from him but from a sound generator. The therapist goes through the scale and tries to find out at which sound the aura swings up. If the eigenfrequency is found, then the patient can therapize himself, by again and again playing or humming his eigentone[iii].
It concerns here only a physical statement on the used methods of alternative medicine and not therefore, whether healing successes are actually possible.

sound frequency equally tempered [Hz]		wavelength [cm]	colour	wavelength [run]
F sharp"	740	46,4	(purple)	-
F"	698	49,1	(crimson)	-
E"	659	52,0	(violet)	-
D sharp"	622	55,1	indigo	421
D"	587	58,4	bleu	446
C sharp"	554	61,9	turquoise	472
C"	523	65,6	green	500
H'	494	69,5	yellowgreen	530
A sharp'	466	73,6	yellow	562
A'	440	78,0	orange	595
G sharp'	415	82,6	orangered	630
G'	392	87,5	red	668

Table 24.2 B: Scale of the colour range.<i>

colour		chakra	sense organ	planet type
purple	7.	(crown chakra)	epiphysis	Jupiter
indigo	6.	(brow chakra)	hypophysis	Saturn
bleu	5.	(throat chakra)	hearing	Mars
green	4.	(heart chakra)	feeling	Sun
yellow	3.	(solar plexus)	seeing	
orange	2.	(sacral chakra)	taste	Venus
red	1.	(root chakra)	smell	Moon

Table 24.2 C: Assignment of colours to chakras and planets.<i>

colour		metals	gems (selection):
purple	7.	tin	amethyst, fluorite
indigo	6.	lead	indigo-sapphire, azurite
bleu	5.	iron	sapphire, lapis lazuli
green	4.	gold	emerald, malachite, jade, gr. tourmalin
yellow	3.		topaz, amber, citrine
orange	2.	copper	carnelian, fire opal
Rot	1.	silver	ruby, coral, garnet, red jasper

Table 24.2 D: Assignment to a selection of gems.<i>

<i>: Dr. Bodo Kohler: Biophysikalische Informations-Therapie, Gustav Fischer Verlag (1997), Kap. 11.6 Der individuelle Grundton, S. 190 - 194

24.2.3 The colour therapy.

Analogous to acoustics also colours each time can be assigned a wavelength and also here can be detected that every person responds to certain colours, thus wavelengths, in particular which can stimulate his aura to resonant oscillations. In practice sound and colour therapy often are used coupled[<i>], even succeeds more or less an assignment to each other. That in last consequence leads to a "scale of the colour range" (table 24.2 B)[<ii>]. According to statement of the treating doctors does a patient, who responds to a certain colour, also react to the corresponding sounds and vice versa.

24.2.4 The aroma therapy.

If according to that it depends less on the circumstance if sounds or colours are used, but the wavelength of an oscillation is crucial, then a stimulation also should be possible by means of the remaining sense organs, e.g. the nose, the tongue or the skin. The smell after all already could be identified as vortex information (fig. 9.0). Fragrances of natural essences can significantly influence the frame of mind. But as long, as we still haven't understood the physics behind it, we technically hardly are capable to generate equivalent vortex modulations artificially.

24.2.5 The gem therapy.

Already the holy Hildegard von Bingen (1098-1179) knew and used the beneficial effect of gems. Physical background of this at first purely empirical form of therapy is the characteristic eigenfrequencies of the gems, which are picked up as stimulation over the skin. Because gems represent a mixture of various molecules, the oscillations in the atomic hull will overlap, so that overlapping and beat frequencies can form with wavelengths in biological relevant areas. There even can form modulations, which are carrying information. The effectiveness again is linked with the resonance condition, which must be fulfilled between the gem and his carrier.

24.2.6 Meditation and self-therapy.

There even exist people, who don't need any technical aid at all to get rid of unpleasant resonances. Some meditate and go into resonance with themselves, whereas others prefer to love a person, to whom they feel „attracted" or with whom they are „on the same wavelength", which means as much that they go into resonance with this person. In the Catholic Church for instance the priests are not allowed to get married, because they should be in a resonance with the church and with God.

<i>:: Dr. Bodo Kohler: Die Coloroma-Therapie, Der aussergewohnliche Einsatz von Aromen, Co'Med 4/2000, S. 48-52

<ii>: Cousto: Die kosmische Oktave, Synthesis Verlag Essen 1984

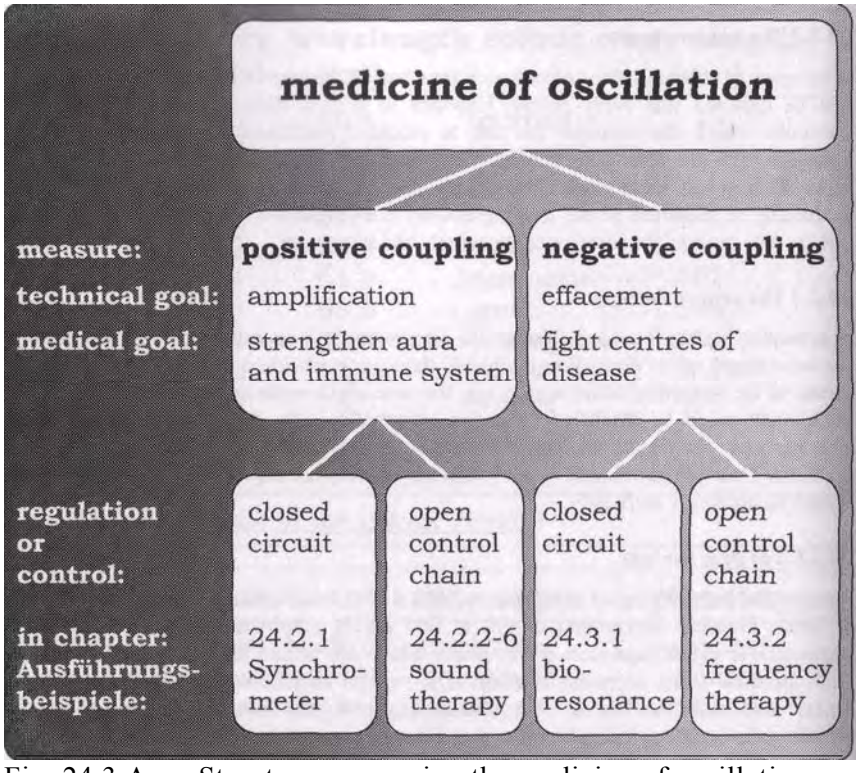

Fig. 24.3 A: Structure concerning the medicine of oscillation

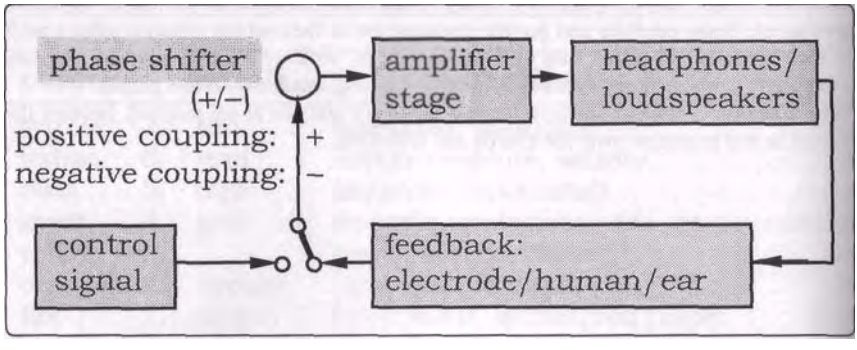

Fig. 24.3 B: Regulation or control?
Positive or negative coupling?

24.3 Systems with negative feedback

For negative sign it concerns negative coupling. In this case the signals are subtracted. The signals released by a person are played back to him with opposite phase. This method lies in the domain of the bioresonance.

24.3.1 The homeopathy

The concept, which is pursued by the medicine of oscillation in the case of the bioresonance, is that harmful or ill making oscillations should be effaced. Not the direct, but rather the indirect strengthening of the immune system is to the fore, which should be reached by relieving it. The approach with that pursues the same goal as the pill medicine, where oscillations, which should produce a wanted effect and which are bound by means of substances are supplied to the body.
The disadvantage of the administration of pills is the often toxic effect of the carrier substance. The German doctor Samuel Hahnemann (1755-1843) has demonstrated a way, in which to make the helpful and important information for the body to go over from the carrier substance to the water by diluting with water and by shaking. The water molecules now oscillate in time of the carrier molecules. Interestingly in doing so not even the information gets lost, the modulation thus is preserved. By constantly shaking there even occurs an amplification or a „potentiation", as Hahnemann expressed himself, because now every carrier molecule reaches and modulates countless water molecules. Thus the amount of water informed is bigger than the amount of the original chemical substrate. In the case of homeopathy like is treated with like. If for instance a poison causes certain complaints at a healthy person, then in "homeopathic" administration this information helps a sick person with similar complaints. There thus occurs a disturbance activation with opposite phase, as the engineer uses to express himself. Despite a widespread scepticism the method of homeopathy indeed seems to function, and it has stood the test in countless cases.

24.3.2 The bioresonance

A technical realization is represented by the bioresonance. For that endogenous oscillations are called off by means of an ECG (electrocardiogram), an EEG (electroencephalogram) or a MEG (magnetoencephalogram) at the surface of the skin. The technical device then shifts the phase for 180 degrees and amplifies the signal to the extent that pathological frequencies are extinguished for reversely directed input. This very reasonable theoretical concept in practice of course only is as efficient, as the empirical determined pathological frequencies are the cause of a disease and not only represent an unimportant symptom as side effect.
To that technical problems are joining. Prof. Heine blames the constantly changing reaction diversity and the thermal noise for the circumstance that the „frequency spectrum permanently is fluctuating", as he writes if*. That hardly can realize the necessary phase inversion. We meanwhile know that vortices have a fluctuating frequency spectrum, that in the case of biosignals it concerns such field vortices, which result in a noise signal unspecific in frequency.
With this knowledge we should be able to significantly improve bioresonance procedures, and even the inversion of phase shouldn't represent an insurmountable difficulty anymore.

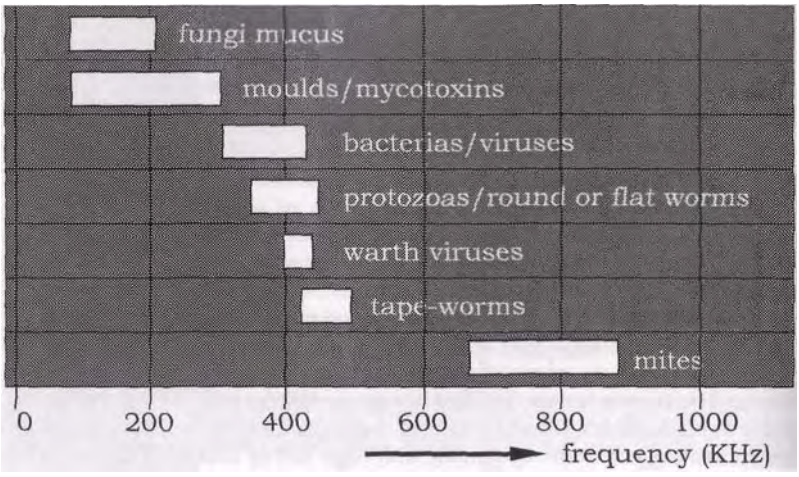

Fig. 24.3 B: Frequency spectrum of parasites according to Clark.[i]

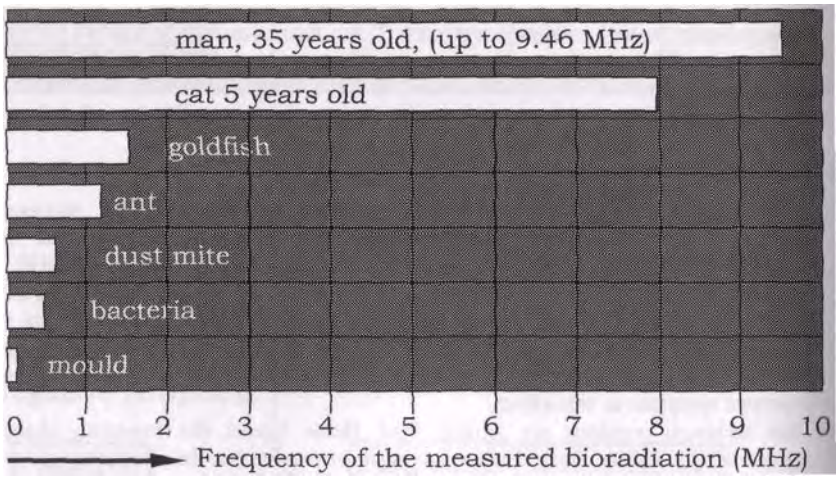

Fig. 24.3 C: Diagram of frequency ranges for some living beings.[i]

<i>: Dr. Hulda Clark: The Cure For All Diseases (1995), Page 604-643

A further problem, which Heine addresses, can't be denied[ii]: „For communicative molecule oscillations the microwave range of 1 GHz up to above 10000 GHz is crucial. A calling off of endogenous interference oscillations in this range with the help of normally used electrodes is not possible"[iii]. It thus could happen that essential frequencies, which are directly related to a disease, aren't recorded at all and as a consequence also not treated. There even is the risk of informations being brought in, which additionally stress the immune system instead of relieving it, that the patients after a treatment are worse off than before. The doctor or therapist is burdening himself with a big responsibility, when, how and at whom he applies methods of bioresonance or if he better does without them. For the mentioned reasons the method in the therapy only plays a secondary role. The bioresonance on the other hand is quite often and with great success used in the diagnosis (Nosoden), if it for instance concerns the determination of an incompatibility or an allergy - but that is a completely different theme. For the bioresonance the transition of diagnosis to therapy is however floating.

24.3.3 The frequency therapy

If using a frequency therapy the problems are standing similarly. If we separate the closed and negatively fed back circuit of a bioresonance and form an open control chain consisting of a technical control device and the patient, then we get the structure, as it is put to use in a frequency therapy. The goal still is the same: parasites or pathogenes, which stress and burden the immune system should be fought.
But a disadvantage of every open control chain is that the treatment at first occurs blind due to the missing feedback.

The natural healer Dr. Hulda Clark has examined as support various pathogenes and parasites under the microscope, while she has varied the frequency and at the same time applied a low-tension voltage. Doing so she could observe the dying of bacterias and parasites at certain frequencies. Correspondingly she publishes tables, in which the in each case „mortal" frequencies are listed[i].
Hut without being able to verify the success of a treatment in the living organism, she proceeds from the assumption that by applying a low tension voltage (5-10 Volt), as it is produced at the output of a commercially available frequency generator, if a sinusoidal signal is set with the appropriate frequency exactly the associated parasites and leeches will be destroyed. Doing so a fixed rhythm of pauses and treatment times must be adhered to (7 min on, 20 min off, 7 min on, 20 min off and 7 min on).

The doctors and therapists treating with this particularly inexpensive method report amazing results, inexplicable spontaneous cancer cures, like of HIV-positive patients, who after the treatment were tested HIV-negative. But also the inverse case already should have occurred, that a HIV-negative patient afterwards was HIV-positive! Here too clear the limits of this method appear, which in practice unfortunately turns out to be relatively unspecific.

<ii>: Prof. Dr. H. Heine: Grundregulation und Extrazellulare Matrix - Grundlagen und Systematik, Lehrbuch der biologischen Medizin, (1991) 2.Aufl. Hippokrates Verlag Stuttgart, Seite 63

<iii>: U. Warnke: Bioresonanztherapie - Wunsch und Wirklichkeit. Medizin transparent Nr.2 (1996) S. 36-37

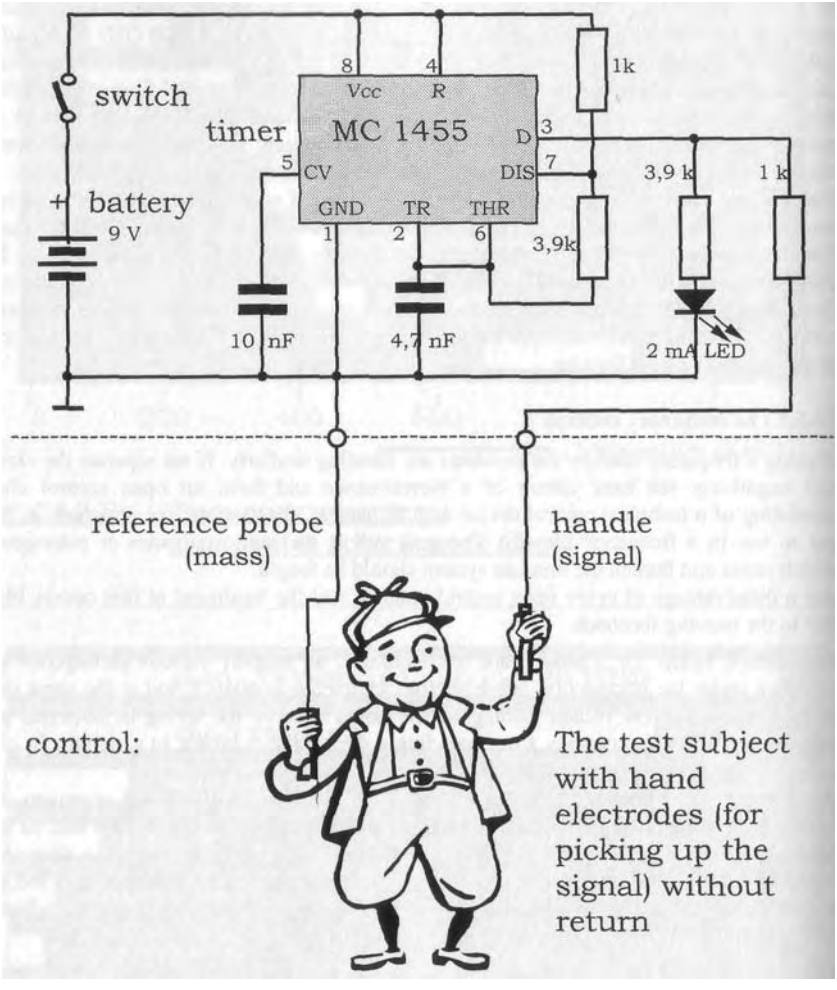

Fig. 24.4: Wiring diagram of the Zapper.<i>

Wiring diagram taken from:
<i>: H. Clark: The Cure for All Cancers (1993) New Century Press, USA, Page 507, resp.:
Dr. Hulda Clark: The Cure For All Diseases (1995), Page 48

24.4 The Zapper

From the point of view of physics of today the frequency therapy actually shouldn't be able to function at all. The electromagnetic waves penetrate only few millimeters into the skin at the used frequencies and wouldn't have the slightest chance, to reach a parasite, which is staying somewhere in the body. But it is said that it is possible to cure athlete's foot, by the patient taking the electrodes in his hands. How, we ask the question, does the signal of the function generator know where it should go?
It quite obviously concerns a resonance phenomenon. The likewise emitted scalar wave part tunnels undamped at those places in the body, with which it can build up a resonance and that for proper tuning are the unloved parasites. The scalar wave radiation is bundling up at the resonant receiver, so that despite the low transmission power as a consequence of the bundling up the energy density for the parasite becomes very high. It as a result is destroyed by its own ability to go into resonance. Once it is killed, the next one goes into resonance, logs off as well etc. In this way the parasites are destroyed one after another and not all at once. That's why the specified treatment cycle makes sense. The copper electrodes should not be taken in the hands directly, Dr. Clark recommends, but before be wrapped with moist paper. By means of this insulating layer, so is my interpretation, the conventional wave part, for which the skin functions as a wave guide, is reduced whereas the desired scalar wave part is increased. Such measures crucially contribute to the success of a therapy method, even if they were determined purely empirical.

If one wants to address every possible parasite individually, then the treatment takes correspondingly long. If one on the other hand sends all relevant frequencies at once by overlapping them, then the treatment can be abbreviated to the duration of one session. If the therapist goes still further and replaces the sinusoidal signal by a rectangular signal, then infinitely much sinus functions are hidden in it, as a Fourier analysis shows. With a rectangular signal, as it is delivered by the Zapper, one as it were catches everything, Good as well as Bad. There the helpful intestine bacterias break exactly like the wrongdoers.
The treatment with the Zapper is simple, inexpensive and exactly as controversial. It is the shot with the shotgun in the forest. One always hits something. We nevertheless must ask the question, why one only hits parasites and bacterias and not the vital organs? Aren't those damaged also?
Now then, the signal of the function generator is not modulated; it doesn't carry information. That's why only monocellular parasites, which don't know information exchange, are capable of a resonance. Human cells and more than ever whole organs on the other hand work with complex modulations, which effectively prevent any formation of resonance with the technically generated basic wave, with which the question would be answered so far.
That however also means that immune reactions can be expected: If the first treatment with the frequency therapy still is successful and all simple parasites could be hit, then only further evolved parasites have been spared, which modulate their information. They now breed and can't be reached anymore in further sessions. The method suddenly doesn't function anymore, the therapist finds out, the body apparently has become immune.

scale:		diatonic	chromatic	spiral
sound:		•1/C =	equally tempered (medieval)	
octave	C´	2/1 = 2.0	2.00 →	2/1 = 2
	1.07 = 16/15		1.33 = 4/3	
seventh	H	15/8 = 1.88	1.89 →	3/2 = 1.5
	1.125 = 9/8		1.125 = 9/8	
sixth	A	5/3 = 1.67	1.68 →	4/3 = 1.33
	1.11 = 10/9		1.07 = 16/15	
fifth	G	3/2 = 1.5	1.5 →	5/4 = 1.25
	1.125 = 9/8		1.04 = 25/24	
fourth	F	4/3 = 1.33	1.33 →	6/5 = 1.2
	1.07 = 16/15		1.03 = 36/35	
third	E	5/4 = 1.25	1.26 →	7/6 = 1.17
	1.11 = 10/9			8/7 = 1.14
second	D	9/8 = 1.13	1.12 →	9/8 = 1.125
	1.125 = 9/8			10/9 = 1.11
first	C	1/1 = 1.0	1.00 →	11/10 = 1.1

goes towards 1!

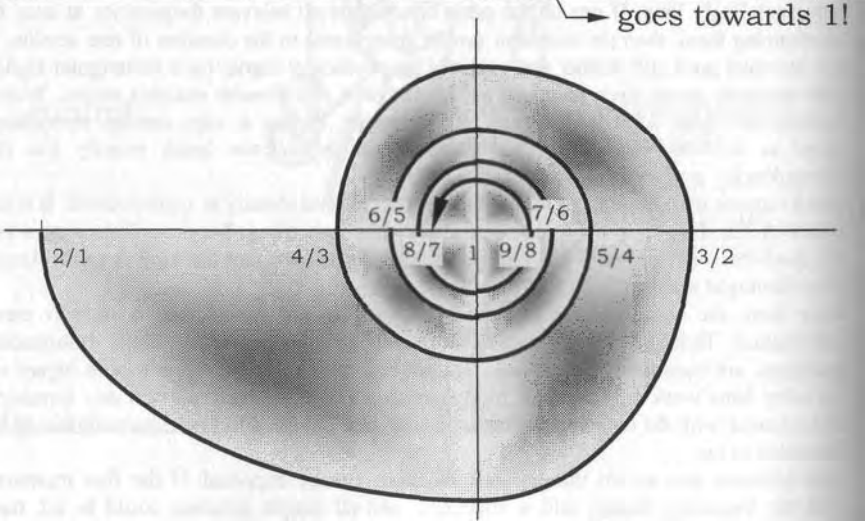

Fig. 24.5: Harmonic spiral built on the first Gregorian scale.[i]

[i]: Dr. Manfred Doepp: Naturgemasse Frequenztherapien, Die Harmonie der Snirale. CO'Med 10/2000. S. 46 - 49

24.5 Discussion concerning the medicine of oscillation

The textbook medicine in its explanations and treatment methods is basing on the models, which it can measure and analyse and which it understands. Doing so man and whole nature is reduced to a handful of chemical reaction formulas. The whole pharmaceutic industry lives on this misleading path, which long ago has revealed to be a dead end, medical as well as financial. This health service cannot be paid anymore and we should ask the question if it actually is worth the money, if with electric signals of minimum power can be obtained effects comparable to the effects of the pill medicine. We need a new medicine, a potential vortex medicine. First of all we should research how an organism covers its energy needs and how it communicates. There leads no way past the scalar waves and the newly discovered potential vortices. Chemical processes as they are being observed, occur by the way, that is beyond doubt, but they by no means are the cause. Hence of pills and other chemical means at most a treatment of symptoms and a case of side effects may be expected but not a cure of a disease. Once the potential vortex medicine will be systematically explored and be put to use in practice, healing successes can be expected, which we at present can't imagine at all.
The amazing results, which already today are obtained in the medicine of oscillation and of which some doctors can report[<i>], dictates the direction in which the textbook medicine should develop. In the question, which kind of oscillation or which „sequence of sounds" (Fig. 24.5) is the right one, still exists considerable need for research. Some doctors even already work with my new theory and cite whole passages from my publications until now about this theme[<ii>].

<i_a>: Dr. Bodo Kohler: BITsyn, der neue Weg in der Informations-Medizin, Jubilaums-Schrift der Internationalen Arzte-Gesellschaft fur Biophysikalische Informations-Therapie, Bad Nauheim den 6.-8.10.2000, Seite 48 - 56.

<i_b>: Bioenergetische Messverfahren in Theorie und Praxis, Vortragsband der Gesellschaft fur Energetische und Informationsmedizin e.V., Universitat Stuttgart am 17.7.1999.

<ii_a>: Dr. Johann Lechner: Storfelddiagnostik, Medikamenten- und Materialtest, Teil 2 aus der Reihe: Praxis der Ganzheitlichen Medizin und Zahnmedizin, Verlag Dr. E. Wuhr (2000), Kap. 2.4.2 Beruhrungslose skalarwellentragende Informationsubertragung S. 173 ff., bes. Kap. 2.4.2.3 Seite 175, 176.

<ii_b>: Dr. Reichwein, Peters: Zellulare Elektromagnetische Systemsteuerung, Der Freie Arzt 5 (2000) im Wissenschafts-Forum (Anhang, S. IV - XXIII).

<ii_c>: Dr. M. Doepp: Tesla-Wellen, Neue Studien, CO'Med 5/2000, S. 94 - 95

Frequency spectrum of the human organism:

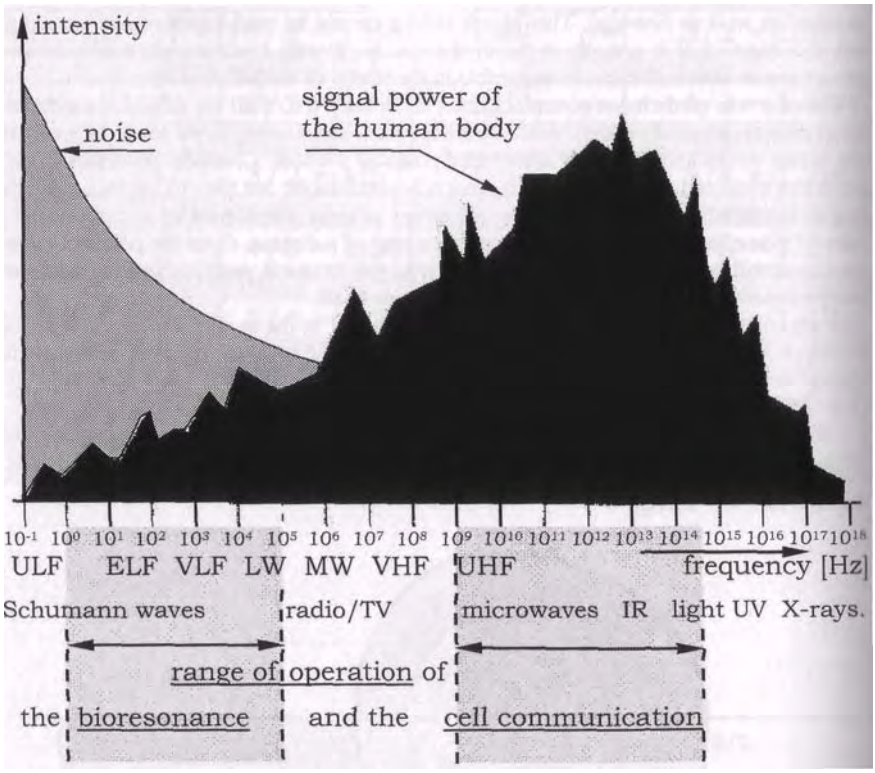

Fig. 25.1: The measured frequency spectrum of man.<i>

<i>: Dr. P. Bembenek: Akupunktur und (Bio-) Resonanz, CO'med 6/98, S. 50-58

25. Contributions to the discussion concerning the information technical use

The medical research predominantly takes place with statistical methods. This might be changed fundamentally, if only the physical relations have been realized and their causes found out. Only then a basic research will be possible also in the area of medicine, as it today already is usual in other disciplines.
In this chapter it concerns the question of the medical basis in general, and specifically the question of the use of the newly discovered potential vortices in biological systems. Doing so very aware is attempted to put the normally used medical view at the back and to derive the answers from the perspective of the engineer and the physicist. This approach is unfamiliar, so that some textbook physicians will have difficulties to follow. It however will prove to be very helpful. Medicine in addition needs new impulses and that justifies a new approach, like the unconventional one proposed by me.
In this connection gladly is fallen back upon the comparison of biological with technical systems, although here exist differences in principle and fundamental It can be expected that nature has developed very appropriate strategies to solve certain tasks, as it also is teached in engineering and used in practice. At this place not only medicine benefits from new insights, engineering vice versa also can learn of nature, because natures optimization strategies are much much older and correspondingly perfect.

25.1 Window of the sensuous perception

To clarify the inner processes in man we consider his sense organs, which function as interface to the outside world. Technically seen in the case of the sense organs it concerns measurement converters to record and process certain physical values in our environment and their adaptation to pass on the information by means of the nerves. The measurement converters thereby are built more or less complex, which is related to the circumstance that the measurement factors, which a living being needs to orient itself and to be able to survive, are quite different.

It concerns little windows within the frequency spectrum shown in fig. 23.1, which should be analysed. Man for instance chooses the visible frequency window and interpretes it with an assignment to the colours, because in this range the sunlight can reach the surface of the earth and the ionosphere doesn't exert an excessive damping (fig. 2.8).

The acoustic window depends on the sound propagation in air, whereas dolphins work with ultrasound, which carry considerably further in water. The associated measurement converters, the ear and the eye, have a very complex structure. From this can be inferred that here the received signal must be transformed into a different physical measurement signal, that the perceivable signals are of other nature than the signals, which our nerves are able to pass on.

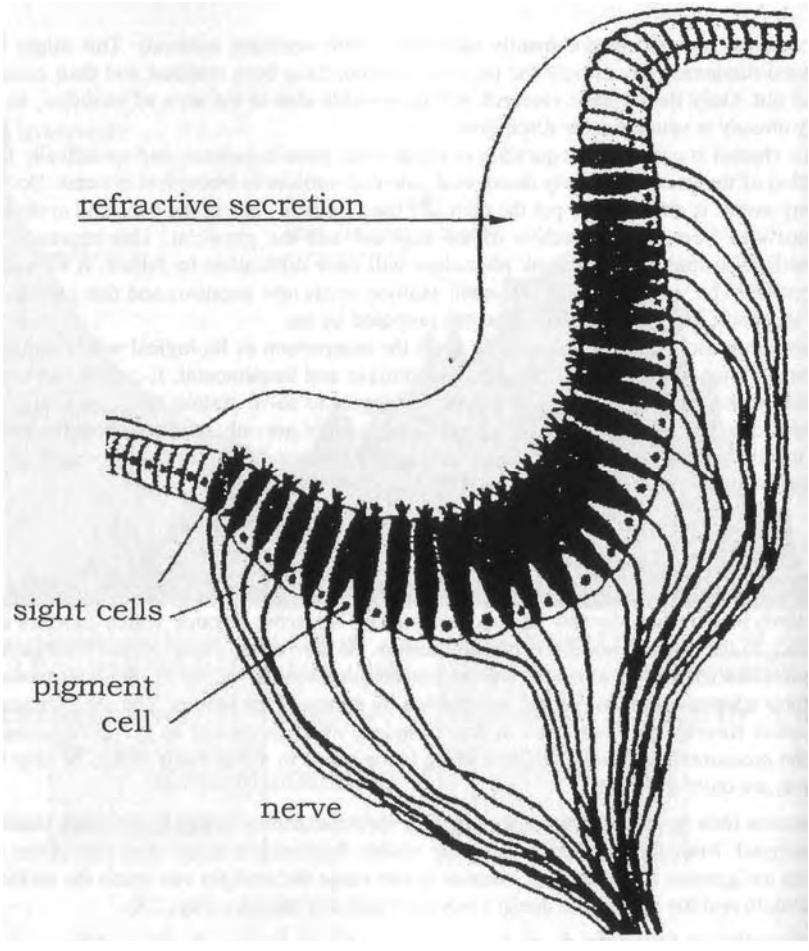

Fig. 25.2: ____ The hollow eye of the snail

25.2 The sense organs (nose, eye, tongue)

If we want to find out something about the nature of the nerve signals, then we should more detailed consider a sense organ, which is constructed if possible simple. In that case it is possible that no signal transformation is necessary at all anymore, because the perceivable variable is exactly of the kind the nerves can process.

The primary and perhaps most ancient sense organ of the living beings is the nose. It is constructed extremely simple. On the one hand according to encyclopaedias it is a chemical sense for the perception of smell materials. Man on the other hand can distinguish several thousands of scents. For that a huge analysis factory with correspondingly much receptors would be necessary, which one searches in vain in the nose between the nasal hairs and the nerves. We from that infer that scent should consist of particles, which are to a large extent identical with the reaction potentials. It thus will concern potential vortices. These ring-like vortices of the electric field again are modulated and carry information, which our brain is able to analyse.

According to the derivation in chapter 9.0 Plato already 2400 years ago knew such relations. The conclusion is obvious that smell is vortex information, which according to the explanation of Plato forms at the transition of waves in potential vortices and vice versa. At the natural philosophers in antiquity the circle of the insights is closed. Modern science just isn't that far.

The hollow eye of the snail functions both as nose and as eye (fig. 25.2). This very ancient combined organ points to a relatively close affinity between both measurement sensors. Possibly in the course of evolution both organs have developed from such a common original form.
In the case of man the smell rods occupied with the nasal hairs of roughly 2 micrometer in length, actually remember of the rods and cones in the eye, with which photons are collected. In both cases, so we can explain the mode of action in accordance with model, the ring-like vortices settle on the rods and run as reaction potentials along the nerve to the brain, which then analyses the modulation.
In the case of the highly developed human eye the light rays first have to traverse the vitreous body and afterwards a pigment layer, before they reach the rods and cones. In this way the electromagnetic wave parts must roll up to vortices, since our nerves can only pass on vortices. The photons can be interpreted as corresponding vortices.
If we compare the eye with a bubble chamber, in which the tracks of ionized particles can be observed and photographed as thin white fog stripes. Here in collision experiments it can be proven that it concerns particles carrying impulse and not waves. But the measurement setup by no means does answer the question if it already concerned particles before they entered the bubble chamber, or if these have formed spontaneously in the presence of the saturated vapour.
It would be obvious, if for our eye the chamber water being under the inner eye pressure would take over the function of the bubble chamber and would take care of the rolling up of the light waves to light quanta.

Example tongue:

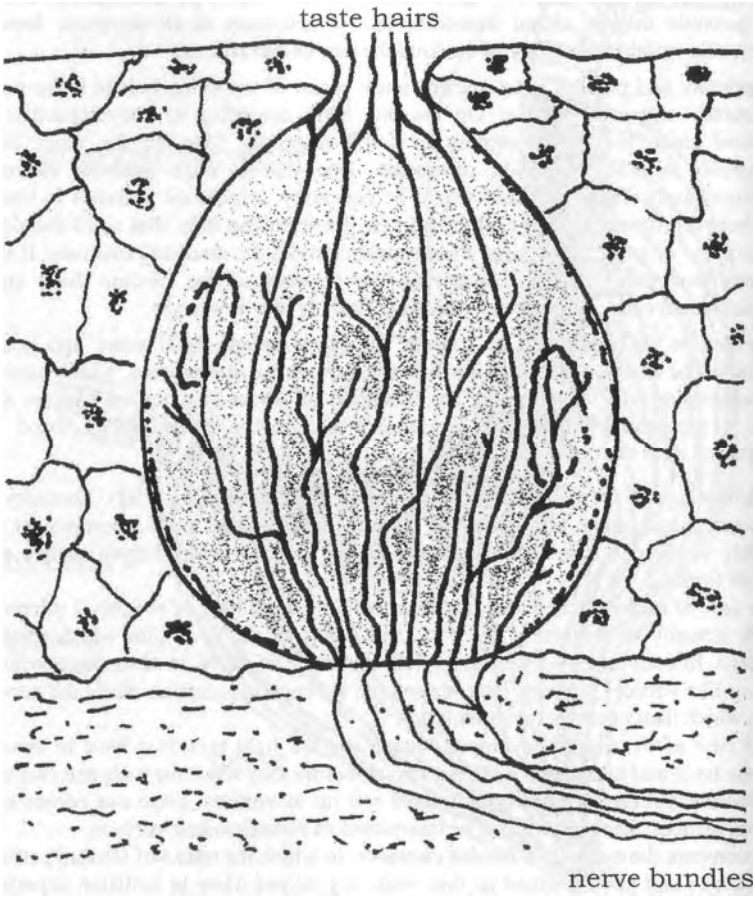

Fig. 25.3: Taste bud of the human tongue

We optically can't detect a difference, if the light while passing through a thick glass plate increases its part of photons. At the latest in the eye in any case all the light is transformed in photons and usable vortices, so that we mustn't detect a loss of brightness. The glass plate seems transparent to us, even if the sunlight should change its composition and its biological quality, if it passes the plate.

If the tongue while tasking responds to dissolved substances, then it not by all means needs to be a chemical excitation. Instead fine hairs, the taste hairs resp. sense pins, serve as receiver like in the case of the nose. The similar structure of the receptors and the circumstance that for most invertebrates sense of taste and sense of smell can't be distinguished of each other at all and consist of the same primary sense cells, suggest that the tongue doesn't analyse the chemistry as such, but only the molecular oscillation patterns, that also the taste is nothing else but vortex information!

25.3 The nerve conduction

For the collection of the potential vortices and the extraction of their information fine hairs in the sense cells obviously play a central role. They are connected more or less directly with the end of a nerve and pass on the information without big transformation. Even in the organs of equilibrium sense hairs work.

From the comparison with the technique developed by Nikola Tesla I could show that the nerve conduction concerns a single-wire transmission, a kind of waveguide, for which the transport of the excitation information takes place in the insulation layer and not in the conductor itself (fig. 9.6). As proof I quoted that the thickness of the insulation determines the velocity of propagation, that as is well-known the nerve conductors with thick fat layer pass on their action potentials faster than those with thin insulation. Particularly interesting is the observation, how the fat layer is constricted in fixed intervals, like for Wiener sausages (fig. 25.4 A). These nodes of Ranvier prove that only longitudinal waves are being transported, which are standing waves with nodes and antinodes, if the distance from node to node exactly corresponds to the distance from one node to the next. With that nature with the use of the potential vortices is far ahead of our power engineering. The nerve-cables determine with their structure, which signal will be transported and which not!

The technical cables on the other hand are stupid and conduct everything, the useful signal just as well as any arbitrary interference signal. Anyone, whom the computer crashes every few minutes, knows what I'm talking about.

Man isn't able to afford a crash of his think computer. It would be lethal for him. His nerve costume even tolerates short-circuits. The acupuncture is such a short-circuit technique by means of electrically conductive needles. There even is given a therapeutic benefit and a relaxing effect for the body.

Cut through nerve fibers even can partly regenerate again, even without a cut through nerve again growing together with its other end. The nerve conductors are so intelligent, that only the matching information arrives at the end by passing on informations from one fiber to the corresponding next with the same node interval.

A. Nerve conduction with nodes of Ranvier (to transmit standing waves):

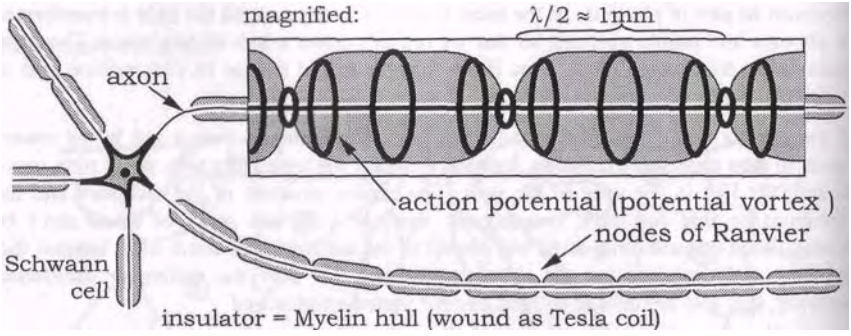

B. Single-wire transmission according to Nikola Tesla<i>:

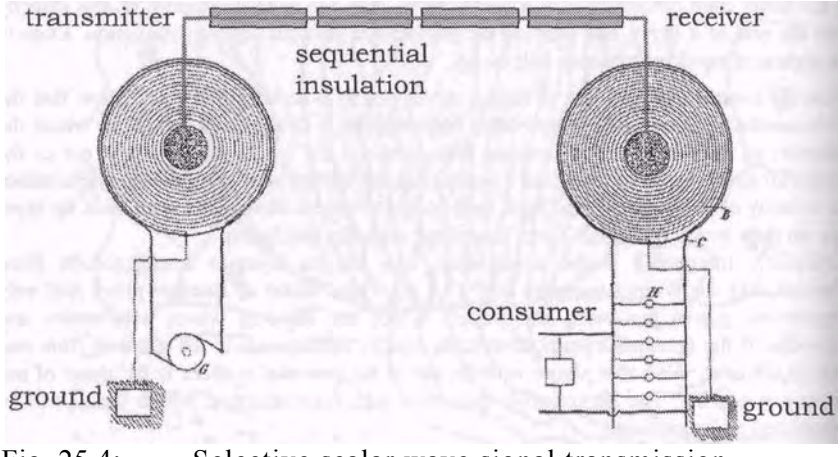

Fig. 25.4: ____ Selective scalar wave signal transmission

The brain works with scalar waves! Reasons are:

1. Lacking of a signal transformer between the nerves and the brain.
2. High performance density of the think apparatus.
3. The brain activity measurable from the outside with the EEC
4. Spark formation and corona discharges at open top of the skull.
5. Insulation defect occurring in the case of epileptics.

<i>: Original sketch of Tesla is situated in the Nikola Tesla Museum, Belgrade.

Nerves represent an intelligent and at the same time interference safe wiring, which is superior to any technical solution by far, or you can try to acupuncture a cable cord of your computer. You will have little pleasure of it.
Nikola Tesla also in this point was ahead of the times. He has experimented with a single conductor technology, for which the insulation layer is constructed like for a nerve fiber (fig. 25.4 B). We'll have to learn to handle such aids in the future, if we in engineering want to emulate nature and as well want to send informations as scalar wave. A normal power cable as said conducts everything, useful as well as interference signals. If however the signal should be accomodated in the noise, a selective cable is required, which should be constructed according to the example of the nerve conductors. Before a scalar wave technology can be introduced and successfully used according to that completely other cables, coupling elements, amplifiers and other components should be developed. The trouble should be worthwhile at the chances, which this genial technology offers us!

25.4 The brain, a scalar wave computer

The brain cells (neurons) are of the same kind as the nerve cells. Hence can be done without a signal transformer, can the informations transmitted by the nerves to the brain directly be processed further. From that follows that also the brain without exception works with potential vortices. There are several reasons for this hypothesis:

1. as said, the lacking of a signal transformer.
2. the high performance density of the think apparatus. (As a result of the concentration effect of the potential vortices the efficiency of the human brain is in such a way high concentrated compared to the much more space claiming computers functioning on the basis of currents).
3. the brain activity measurable from the outside with the EEC
4. spark formation and corona discharges at open top of the skull. (Brain surgeons can report of such observations).
5. The insulation defect occurring in the case of epileptics. (During a fit instable potential oscillations of the nerve cells occur, which lead to strong electric blows).

With the ,,exciting" and the inhibiting"' synapses as separation point between the neurons both a ,.high-active" and a ,,low-active"' method of operation is possible and with that a redundant, particularly interference safe signal transmission.
Safety for interference is very important not only in nature. In the operating instructions of a PC can be read: ,,operate only at room temperature, keep dry, don't throw or shock, take cure for sufficiently cooling air, ground apparatus, pay attention to mains voltage, etc". A comparison with the range of operation of man is like scorn.
Nevertheless the consequences if errors occur are quite similar: a garage door, which opens if a mobile is switched on, by all means can be compared with a light phenomenon, which we perceive after a blow on the eye at the biological level.

Concerning signal technology:

The **comparison** of	**man** and	**engineering**
signal line:	**nerves**	**cables**
transmission:	selective (nodes of Ranvier)	indiscriminate (with interferences)
of: by:	scalar waves potential vortices	currents charge carriers
running of cables: over:	1-wire technology wave guide	2-wire technology supply and return cable
signal transport:	in the insulator	in the conductor
signal form:	concentrated	expanded
the conductor:	stays cold	gets hot
result, transmission:	without losses	with losses
error signal:	muscle cramp	malfunctions
metal pins: cause:	**acupuncture** relaxation	**short-circuit** destruction
directional signal by:	synapses	diodes/ amplifier
redundancy by:	exciting and inhibiting synapses	high-active and low-active drivers
precaution: by:	skin resistance salt	shielding metal case
strategy:	vortex decay	field displacement

Fig. 25.5: ____Comparison of the signal technology

25.5 Concerning signal engineering

By means of a technical analysis of biological relations completely new interpretations result also for the occurring of a disease. We permanently and everywhere are surrounded by noise signals, but as a rule they can't touch us, because the body has developed perfect strategies for defence. The nodes of Ranvier on the nerve bundles here are just as helpful as the diode effect of the synapses. By means of the salt content and the skin resistance the body in addition controls the uptake of potential vortices from its surroundings, by using that the vortex decay is determined by the conductivity.

The specialties of the by humans used signal technology come to light particularly clear if compared with the cable technology used in the technical world (fig. 25.5). So is worked with only one wire instead of with supply and return cable, are mediated potential vortices instead of charge carriers, does the transmission take place in the insulator without losses and not in an electric conductor, which as a result gets hot and produces current heat losses. Nerves thanks to their ability of selection represent an intelligent form of signal transmission, by helping to filter the asked information from the noise. This surely is necessary since with cables, which indiscriminately transmit every signal, an use of scalar waves hasn't succeeded yet. We should try to learn of nature!

A special challenge is the protection against error signals. A passive shielding by a metal case however is not possible, because scalar waves can't be shielded by principle, so that the precaution should be taken actively by means of the conductivity. That's why we sweat salt if we strain us physically, whereby the vortex decay is determined by the conductivity, which depends on the salt content of the body liquids. In the case of a sweating activity the body reduces its conductivity, so that the needed potential vortex energy will reach the cells.

If the body sometime isn't able to defend itself against interference signals, then malfunctions or pathological reactions are a possible result. During having a bath for instance a muscle cramp can occur, if the body doesn't defend itself fast enough or sufficiently against the high potential vortex activity in the water. Now vortices can be picked up in the nerves, which are of the same kind as the ones emitted by the brain, only that both muscles, biceps and triceps at the same time get the signal to contract. The result is a cramping of both muscles.

Thus the brain has developed intelligent strategies to protect itself of interspersed misinformations. It weighs the incoming signals and forgets again all unimportant ones more or less fast. We speak of the ability to learn and that means that signals rise in the valuation scale and with that are stored longer, the more frequent repeated our brain receives them. This strategy assumes that interference signals only occur sporadic, for which reason they are rated unimportant and fast are again forgotten. A PC on the other hand doesn't have such a property. It notices everything indiscriminately and sometime will crash of overload, if not the user will constantly foster it and will administer the available memory. A PC is and stays stupid.

Concerning the stability against interference:

The **comparison** of	**man** and	**engineering**
in the	**brain**	**computer**
control technical interference signals:	light phenomena	miscontrol, program fault
precautions:	active, i.e. weighing of the Info by learning (repetition)	passive, i.e. shielding. (no evaluation of the input values)
unimportant (interference signal)	is forgotten	is stored
danger exists for signals	recurring interference patterns (see mobile telephony)	interference of all kinds (s.EMC-standardization)
remedy:	self-cure	restart (reset)

Concerning set of difficulties of wear and tear:

The **comparison** of	**man** and	**engineering**
repair	self-repair	in the workshop
by:	cell division permanently	exchange parts at maintenance resp. in the case of damage
required building materials:	nourishment	material / oil
waste:	compost	rubbish

Fig. 25.6: Strategies against interference signals, for damages linked with operation and for wear and tear.

25.6 Stability against interference and repair mechanisms

The interference signals present in our natural environment as a rule are distributed stochastic, but not so artificial interference signals like for instance transmitters emit. If for instance in the case of mobile telephony there occur time and again identical signal patterns and if a person perceives these, then because of the continual repetitions a high importance is pretended and precious storage space in the brain is allocated. This to a special extent applies for the permanent stand-by signals, which are emitted by mobiles and cordless phones even then, if we don't phone at all. Such misdevelopments thereby would be technically avoidable just like that!
If still no gauges are available and as a result there exist neither guidelines nor limits for the radiation exposure of scalar waves, then such devices must be developed and built. For the requested electromagnetic environmental compatibility not engineering, but man should be in the centre of attention!

Let us throw a short glance at the set of difficulties of wear and tear. Most technical devices find the way into the workshop only, if they already are defect. Some aren't repaired anymore in principle and immediately sent to the rubbish, because they are worn-out and a repair isn't worth the effort anymore one says, whereas other, mostly expensive systems are being serviced by exchanging all wearing parts.

Nature has brought to perfection the last principle. It allows the body a permanent maintenance; by permanently producing new cells and replacing consumed ones. It with that obtains a considerably longer operating time and even is capable to heal wounds. Just imagine dents in our cars would disappear from alone after a few weeks and the bodywork would look like new. Such an optimal maintenance is costly and it has its price. By means of the cell division the building plan for the spare parts is copied. The task on the other hand is transmitted to the new cells „by radio" by means of waveguide channels, as proves the matching structure of scalar wave and waveguide (chapter 21.12 and fig. 25.7). The cells hence have a kind of „decentral intelligence", which technical matter lacks completely. A comparison with engineering nevertheless makes sense, because wear and tear occurs for all systems in continuous operation. Thus strategies must be developed to provide the necessary material for operation, building-material and exchange parts.

By sizing of the hyperboloid structures of the matrix channels it should be possible to determine the wavelength of the scalar waves to enter them in the frequency diagram (23.1).

Tunnel structure of the basic substance according to Prof. Heine[i]:

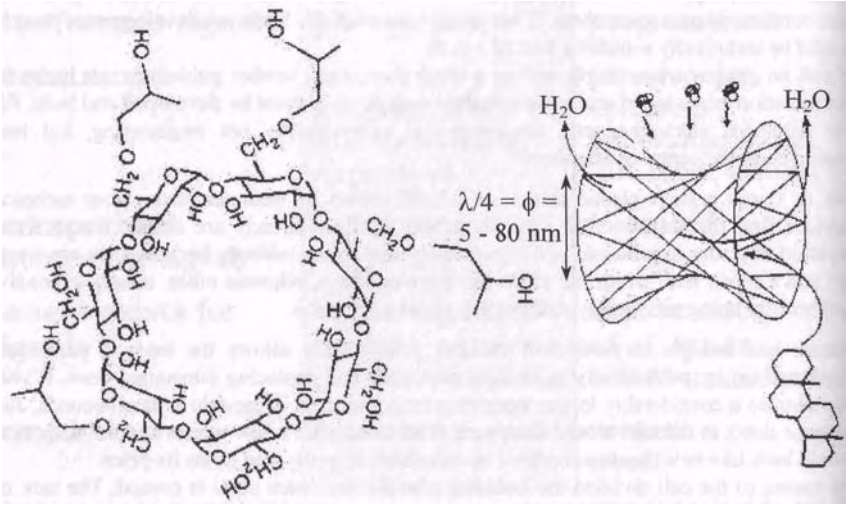

Fig. 25.7: ___ Information channels in the intercellular matrix.[i]

<i>: Hartmut, Heine: Lehrbuch der biologischen Medizin. Grundregulation und Extrazellulare Matrix, 2. Aufl. 1997, Hippokrates Verlag Stuttgart, S. 56

25.7 The microwave window

There still is lacking information about the frequency or the velocity of propagation to be able to specify and enter in figure 23.1 the cell information. Let's take to hand the book about "Biostrahlen"[<i>]. In there is explained how for individual cells the emission of electromagnetic signals already could be measured, which are interpreted as circularly polarized waves (fig. 21.10 A). It is said that thereby their polarization plane is rotating with the speed of light, whereas the wave itself is propagating in longitudinal way relatively slow and according to the authors with the speed of sound.
The occupation with the potential vortex theory in the explanation lets immediately recognize the vortex, for this is rotating with the speed of light in circles as rolled up wave (fig. 21.10). If it is bound to the surrounding matter with closed vortex centre, then it can be expected that the propagation actually takes place with the speed of body sound.
It could concern the same signals, which Prof. A. Popp calls biophotons and detects measuring technically in living organisms[<ii>]. He however considers the phenomenon for the same wavelength with the speed of light and lands at light frequencies, even then if nothing is glowing visibly! The question is asked: Does it concern the frequency of the light or only the corresponding wavelength or actually both, thus light, as is expressed in the name biophotons?
The photomultipliers, which Prof. Popp uses as „light amplifier", however can only be tuned to certain wavelengths and not to frequencies. Even if the detected biophotons have the wavelength of the light, then nevertheless nothing will glow if the velocity of propagation and as a result also the frequency differs from that of the light for several powers of ten. In the case of the immense number of cells also the number of photons should correspondingly sum up and the body as a whole should start to glow, which is not the case.

The waveguides in the intercellular matrix serving the cell communication, which Prof. H. Heine observes microscopically, have wavelengths between 20 and 300 nanometer, which corresponds to the range of the ultraviolet radiation[<iii>]. But if the propagation is slower than the light for 6 powers of ten, then also the frequency will only amount to one millionth and be situated into the range of the microwaves. Here a biological window seems to be present, to which we should turn our attention for reasons of the electromagnetic environmental compatibility!

The thermal radiation, which reaches the earth from the sun and the planets, lies in the microwave range between 2 and 20 cm. If the sun does well to us, if we need the radiation, then it could be because of the identical frequency. But that also means that the sun and the planets are capable to have an effect on the cell communication, that they for instance could function as clock for the heart.

<i>: H. Mayer, G. Winklbaur: Biostrahlen, Verlag ORAC, Wien 1989, 5. Auflage S. 97: Messung von der DNS eines Gurkenkeims abstrahlenden Photonen.

<ii>: A. Popp: Neue Horizonte in der Medizin, 2.Aufl. Haug Verlag Heidelberg 1987

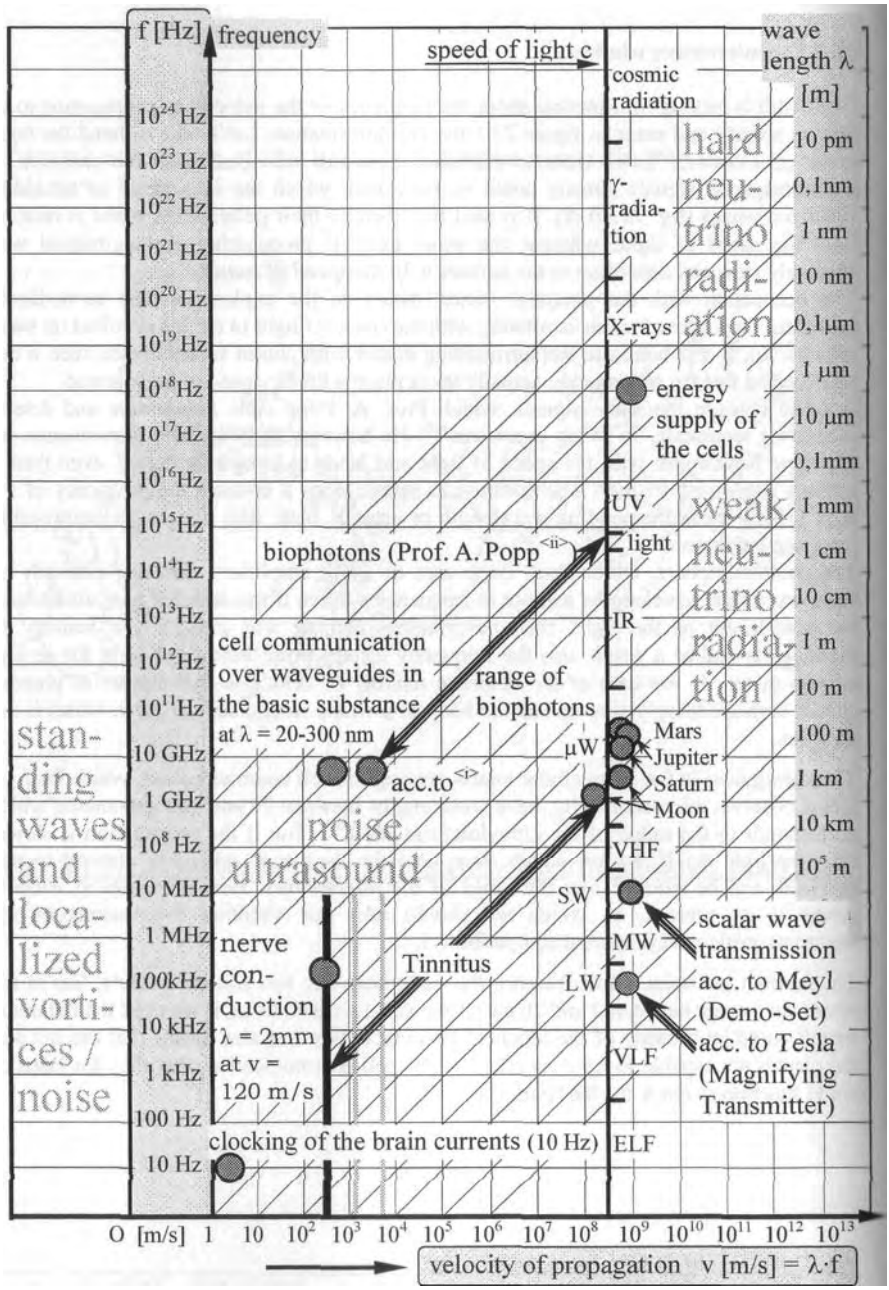

Fig. 25.8: Frequency diagram with entries concerning biologicallv
relevant areas (Tinnitus, nerve conduction, etc.).

25.8 Discussion concerning scalar wave medicine

In the sensitive range of the supposed microwaves window however are also situated the mobile phones and their harmonic waves, which occupy a broad spectrum in particular for pulsed operation in digital nets. The D-net for instance has a wavelength of 32 cm, the E-net lies at half that wavelength. But to which frequency does this correspond at the speed of sound? Now, the frequency is 6 powers of ten smaller and now lies at 1 kHz resp. 2 kHz. To that are added the numerous harmonic waves, which form a noise signal and lie above that. With that these signals are situated completely in the audible range, there where our ears are most sensitive!
This cause we probably owe the disease of modern civilization „Tinnitus". Every charged particle will follow this electromagnetic oscillation and produce corresponding sound oscillations, which can hear not „sick ", but completely on the contrary „healthy" people, who as a result possibly get sick. The objection, in this range also cosmic radiation for instance from the planets is present, is legitimate. It however should be considered that planets also are going away from the earth again and in addition is present a fluctuation according to the time of day due to the rotation of the earth, while the mobile telephone masts in our vicinity radiate in continuous operation.

In this window in addition the clocking of the brain currents takes place at 10 Hz. I would recommend blocking the acoustic relevant range between 2 cm (16 kHz) and 3 m wavelength (100 Hz) for all technical use. Every operation of a transmitter in a biological window harms all people and cannot be answered for by any institution.

It further should be considered that the biological window of the plants and animals as a rule correspond to that of man, but sometimes are shifted significantly upward or downward in wavelength. We are not entitled to judge nature. The immune system of the animals now obviously has reached the breaking point and also that of man doesn't seem to be that anymore, which it originally was.
We must proceed from the assumption that many diseases on the one hand and therapy methods on the other hand partly direct and partly indirect have to do something with scalar waves. (E.g. the occurring of cancer[<4i>]).

<i>: H. Mayer, G. Winklbaur: Biostrahlen, Verlag ORAC, Wien 1989, 5. Auflage, S. 97: Messung von der DNS eines Gurkenkeims abstrahlenden Photonen.

<ii>: A. Popp: Neue Horizonte in der Medizin, 2.Aufl. Haug Verlag Heidelberg 1987

<iii>: Hartmut. Heine: Lehrbuch der biologischen Medizin. Grundregulation und Extrazellulare Matrix, 2. Aufl. 1997, Hippokrates Verlag Stuttgart, S. 56

<4i>: K. Meyl: Skalarwellenstrahlung. Welche Bedeutung haben Skalarwellen fur die Medizin? GNP-Vortrag am 29.04.2001, Rhein-Main-Halle Wiesbaden, see: Co'med Fachzeitschrift fur Komplementarmedizin, 6/2001, pp.55-60.

I. According to the Maxwell theory:

1. Faraday's law of induction:

$$\text{rot}\,\mathbf{E} = -\,\delta\mathbf{B}/\delta t \quad (26.1)$$

with E = E(r,t)

and H = H(r,t) : $\mathbf{B} = \mu \cdot \mathbf{H}$ (26.2)

$$-\,\text{rot rot}\,\mathbf{E} = \mu \cdot \delta(\text{rot}\,\mathbf{H})/\delta t \quad (26.3)$$

2. Ampere's law:

$$\text{rot}\,\mathbf{H} = \mathbf{j} + \delta\mathbf{D}/\delta t \quad (26.4)$$

with:

Ohm's law: $\mathbf{j} = \sigma \cdot \mathbf{E}$ (26.5)

dielectric displacement: $\mathbf{D} = \varepsilon \cdot \mathbf{E}$ (26.6)

relaxation time: $\tau = \varepsilon/\sigma$ (26.7)

$$\text{rot}\,\mathbf{H} = \varepsilon \cdot (\mathbf{E}/\tau + \delta\mathbf{E}/\delta t) \quad (26.8)$$

3. Inserting equation 26.8 into 26.3 yields:

$$-\,\text{rot rot}\,\mathbf{E} = \mu \cdot \varepsilon \cdot (1/\tau \cdot \delta\mathbf{E}/\delta t + \delta^2\mathbf{E}/\delta t^2) \quad (26.9)$$

with the abbreviation: $\mu \cdot \varepsilon = 1/c^2$ (26.10)

4. Field equation of a damped transverse wave:

$$\underbrace{-\,\text{rot rot}\,\mathbf{E} \cdot c^2}_{\text{transverse}} = \underbrace{\delta^2\mathbf{E}/\delta t^2}_{\text{wave}} + \underbrace{(1/\tau) \cdot \delta\mathbf{E}/\delta t}_{\text{vortex damping}} \quad (26.11)$$

Fig. 26.1: ____ Derivation of the wave damping by means of the formation of vortices![i]

[i]: see also EMC, part 1, chapter 5.3, 2.borderline case.

26. Recapitulation from the viewpoint of textbook physics

Now that we in the meantime have accumulated innumerable mosaic parts as inspiring contributions to the discussion for the information technical seminar, it is time to sort the ideas and to put the parts together to an overall picture.
Sceptics and orthodox scientists can only be convinced, if we start from textbook physics and completely do without postulates. Those demands will be fulfilled!

26.1 Common misinterpretation of the antenna losses

The mathematical description of physical relations leads to the well-known laws, which shouldn't be doubted anymore as soon as they are accepted to be correct. But what about the interpretation? Although a law dictates the interpretation and there is no choice, because laws must be adhered to, yet textbooks from time to time violate the mathematically dictated interpretation, a circumstance, which can't be accepted. I would like to illustrate this with an example.

Let us assume that the measured degree of effectiveness of a transmitting antenna amounts to 80 percent. There exist better antennas, but also distinctly worse antennas, but I'm not aiming at a certain construction. The statement simply says, that 80% of the fed in HF-power is transformed into Hertzian waves. Thus there arises a loss of power of 20 percent, and the question follows: of what do those 20% consist?

The answer, which is usual among experts and is supported by the textbooks, reads: the antenna wire gets hot and also the air around the antenna is heated by dielectric losses. In short, heat is formed.
But I have to point out and will furnish proof that this interpretation is predominantly wrong! It in any case isn't in accord with the laws of Maxwell. Who namely obeys the laws, comes to an entirely different result!

A short derivation brings it to light (fig. 26.1).
We start with the formulation of Faraday's law of induction according to the textbooks (26.1), apply the curl-operation to both sides of the equation (26.3) and insert in the place of rot H Ampere's law (26.4-26.8). The generally known result describes a damped electromagnetic wave (26.11)[◁▷].
It on the one hand is a transverse wave, which represents 80% of the antenna power for our example. On the other hand a damping term can be found in the equation, which obviously corresponds to the sought-for 20%. With that the answer would have been found. We realize that because of a damping of the wave 20% antenna losses arise. These losses can't concern heat at all, since the damping term in the equation has got nothing in common with thermodynamics. In the equation doesn't stand anything about heat! Such a mistake!

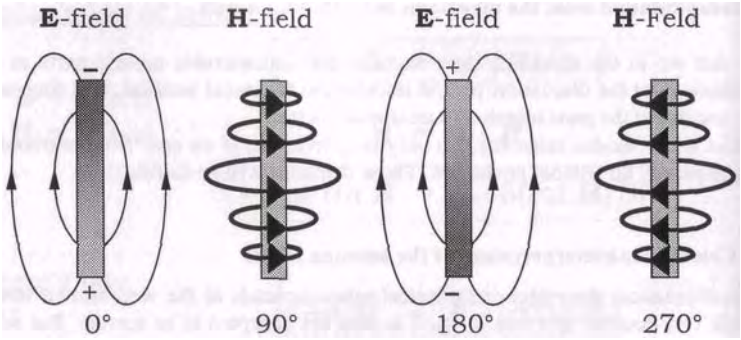

Fig. 21.8 A: The fields of the oscillating dipole antenna.<i>

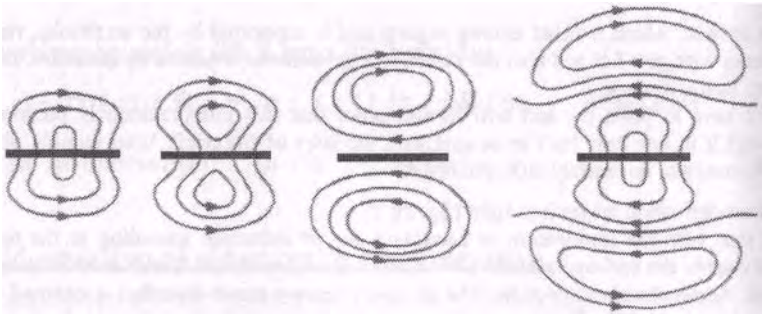

Fig. 21.9 A: The coming off of the electric field lines from the dipole.

<i>: Repetition belonging to chapter 21

26.2 Wave damping by field vortices

- Mathematically seen the damping term describes vortices of the electromagnetic field. This term for instance forms the basis of all eddy current calculations[ii].
- Physically seen some waves - in our example it is 20 percent - roll up to field vortices, with which the wave damping and the antenna losses would be explained.

In the course of time a substantial part of the generated vortices will fall apart. These thereby will produce eddy losses in form of heat. Thus eventually still heat is produced - agreed. The criticism of the textbooks consists of the circumstance that we by no means can proceed from the assumption that all vortices spontaneously fall apart and a total conversion into heat will take place. The process in addition takes place with a temporal delay. The time constant x gives information in this respect. Field energy is buffered in the vortex, where some vortices live very long and it can't be ruled out that a few even exist as long as you like.

To find out more about these field vortices and their behaviour, one has to get deep into vortex physics. Unfortunately nothing can be found about vortex physics in the textbooks. The mistake is systematic. The following short compendium should help close the gap:

- Mathematically seen a closed-loop electromagnetic field vortex will show as a scalar. Such field vortices, which are mediated by a scalar field, are propagating exactly as charged particles in longitudinal manner as a scalar wave.
- Physically seen a closed-loop field vortex has got particle nature. If one particle kicks off the next one then an impulse is mediated, then a shock wave is occurring, a longitudinal undulation of the particles.

From the vortex physical view the interpretation of the antenna example now sounds entirely different:
The charge carriers in an antenna wire oscillating with high-frequency form a longitudinal shock wave. Between current and tension voltage usually a phase shift of 90° is present. The fields produced by these charge carriers form a scalar wave field in the immediate vicinity of the antenna, the so-called near-field zone, which likewise contains longitudinal field components and shows a phase shift of 90° between electric and magnetic field (fig. 21.8 A). As in textbooks is clarified by field lines, the generated fields actually form vortices, where one structure kicks off the next one (fig. 21.9 A).

The vortices in the near-field zone of an antenna consist of standing waves, which obviously are transforming with increasing distance. In our example 80% of these are unrolling and turn into transverse waves, whereby the characteristic phase angle between E- and H-field at that occasion becomes zero.
Let's turn again to those 20 percent loss.

<ii>: s.a.: K. Meyl: Wirbelstrome, Diss. Uni. Stuttgart 1984, INDEL Verlagsabt.

I. According to the Maxwell theory:

The consistent application of textbook physics

- Longitudinal waves run in the direction of a field pointer.
- The field pointer oscillates, the vector of velocity oscillates along!
  - At relativistic velocities field vortices are subject to the Lorentz contraction.
- The faster the oscillating vortex is on its way, the smaller it gets.
- The vortex permanently changes its diameter (see fig. 21.10 B).
- With the diameter the wavelength decreases (see fig. 22.4).
- The swirl velocity is constant (= speed of light c).
  - The eigenfrequency of the vortex oscillates with opposite phase to the wavelength.
- The vortex acts as a frequency converter!
- The measurable mixture of frequencies is called noise.

leads to the statement:

- The antenna noise corresponds to the antenna losses!

II. Mathematical description of a wave by the inhomogeneous Laplace equation:

$$\underbrace{\Delta \mathbf{E} \cdot c^2}_{\text{Laplace operator}} = \underbrace{-\,\text{rot rot}\,\mathbf{E} \cdot c^2}_{\text{transverse (radio wave)}} + \underbrace{\text{grad div}\,\mathbf{E} \cdot c^2}_{\text{longitudinal (scalar wave)}} = \underbrace{\delta^2\mathbf{E}/\delta t^2}_{\text{wave}} \qquad (26.12)$$

Divergence E is a scalar!
The corresponding term founds a scalar wave.

Fig. 26.3: Mathematical description of a wave according to Laplace.

26.3 Laplace versus Maxwell

Longitudinal waves as is well-known don't know a fixed velocity of propagation at all. Since they run in the direction of an oscillating field pointer also the vector of velocity will oscillate. For so-called relativistic velocities in the range of the speed of light c the field vortices are subject to the Lorentz contraction. That means, the faster the oscillating vortex is on its way, the smaller it gets. The vortex, as a mediator of a scalar wave carrying impulse, permanently changes its diameter.
Since, in the case of the vortices, it should concern rolled up waves, the vortex velocity will continue to be c, with which the wave now runs around the vortex centre in a circle. From that follows that if the diameter gets smaller, the wavelength of the vortex as well will decrease, whereas the eigenfrequency of the vortex accordingly increases. If the next moment the vortex oscillates back, the frequency again decreases. The vortex acts as a frequency converter! The mixture of high-frequency signals distributed over a broad frequency band formed in this way, is called noise. A noise signal indeed is measured from the outside with the help of broadband receivers.. We also speak of antenna noise and with this knowledge we can further specify the 20% antenna losses: The antenna produces 20 % noise, which can be put equal to the generated vortices because of the wave damping.

At this point the Maxwell theory doesn't leave us room for interpretation at all. If in the textbooks the impression is aroused, as if the noise were an independent discipline, than that is not true at all. How much the noise is connected with the electromagnetic waves, proves a short look at the wave equation.

The wave equation found in most textbooks has the form of an inhomogeneous Laplace equation. The famous French mathematician Laplace considerably earlier than Maxwell did find a comprehensive formulation of waves and formulated it mathematically (eq. 26.12), which until today is still accepted as valid.

On the one side of the wave equation the Laplace operator stands, which describes the spatial field distribution, and which according to the rules of vector analysis can be decomposed into two parts. On the other side the description of the time dependency of the wave can be found as an inhomogeneous term.

If the wave equation according to Laplace (26.12) is compared to the one, which the Maxwell equations have brought us (26.11), then two differences clearly come forward:

1. In the Laplace equation the damping term is missing. It doesn't describe the formation of vortices, and that means vortices do not exist at all, or present vortices have been there from the beginning.
2. With divergence E a scalar factor appears in the wave equation, which founds a scalar wave.

At this point at once hot tempered discussions concerning the question of the existence of scalar waves blaze up. But this question has already been answered clearly with the vortex consideration. Since an accepted description of longitudinal and scalar waves exists with the plasma wave and the plasma wave can be derived directly without postulate from the term of the wave equation (chapter 21.4/21.5), which founds scalar waves, there are further arguments present for their existence.

I. According to Maxwell:

$$\underbrace{-\,\mathrm{rot\,rot}\,\mathbf{E}\cdot c^2}_{\text{transverse}} = \underbrace{\delta^2\mathbf{E}/\delta t^2}_{\text{wave}} + \underbrace{(1/\tau)\cdot\delta\mathbf{E}/\delta t}_{\text{vortex damping}} \qquad (26.11)$$

Description of electromagnetic waves with vortex damping
Example: sunlight and the damping in the ionosphere (bleu sky).

II. According to Laplace:

$$\underbrace{\Delta\mathbf{E}\cdot c^2}_{\text{Laplace operator}} = \underbrace{-\,\mathrm{rot\,rot}\,\mathbf{E}\cdot c^2}_{\text{transverse (Hertz)}} + \underbrace{\mathrm{grad\,div}\,\mathbf{E}\cdot c^2}_{\text{longitudinal (Tesla)}} = \underbrace{\delta^2\mathbf{E}/\delta t^2}_{\text{wave}} \qquad (26.12)$$

Description of transverse electromagnetic waves (Hertzian waves) and longitudinal scalar waves (Tesla radiation).
1st example: propagation of light as a wave or as a particle.
2nd example: useful signal or noise signal of an antenna.

III. Mathematically seen (comparison of coefficients):

$$\underbrace{(1/\tau)\cdot\delta\mathbf{E}/\delta t}_{\text{vortex}} + \underbrace{\mathrm{grad\,div}\,\mathbf{E}\cdot c^2}_{\text{scalar}} = 0 \qquad (26.13)$$

IV. Physically seen
(from the comparison of equation 26.12 with equation 26.11):

Vortices propagate longitudinally as a scalar wave!

Fig. 26.2: _____ Comparison of the two wave descriptions.

26.4 Error term in the wave equation

From the comparison of coefficients of both wave descriptions follows even more:

- Mathematically seen the damping - resp. vortex term according to Maxwell can be put equal to the scalar wave term according to Laplace.
- Physically seen the generated field vortices form and found a scalar wave.

Here also doesn't exist any room for interpretation, as long as we work with the wave equation according to Laplace and at the same time adhere to the Maxwell theory. If however the scalar wave part is put equal to zero, as is common practise in the textbooks, then as a consequence neither vortices nor noise may exist. But that contradicts all measuring technical experience! Since every antenna produces more or less noise, the textbooks obviously only show half the truth. Science however gropes for the whole truth and that should be fathomed.

If in the case of the antenna example the vortex part amounts to 20%, then that's tantamount to 20% scalar wave part, resp. 20% noise. The scalar wave part constitutes with regard to the Hertzian useful wave something like an error term in the wave equation. The part definitely is too big, as that it might be put equal to zero. Even so all error consideration in the textbooks is missing, if the scalar wave term is assumed to be zero. That violates all rules of physics and of taught scientific methodism.

In practice this shows by a useful signal going under in the noise and reception not being possible anymore as soon as the scalar wave part gets out of control. Even in this case, for which the degree of effectiveness tends towards zero, it still is common practise to put the error term, which is dominating everything, equal to zero. But who in this point follows the textbooks, disregards with that the wave equation and doing so by no means can refer to the circumstance that all colleagues make the same mistake.

The building of physics behaves like a house of cards, where the cards mutually support each other. Perhaps that is the deeper reason why those, who have discovered a marked card, don't pull it out immediately. In addition they are hindered by the self appointed guardians of the „pure doctrine", since everyone knows what happens with the house of cards if the marked card is pulled out. Only, do we want to and can we live with that in the long run? Is it a solution of the problem, if the so-called experts among the physicists and technicians look away and don't deal with the foundation of their branch anymore? If universities crash their basis education into the wall and choke off every contradiction?

Please allow me to pull out the marked card now and place it on the table!

It concerns the question: what is the nature of the field vortices, which form a scalar wave in space. Eddy currents in the iron parts of the antenna are explained with the field equations, but not the noise, which is measured especially in the air. If an antenna on the one hand produces field vortices and as a consequence eddy losses and on the other hand dielectric losses, then we can assume that besides the eddy currents in the conductor also vortices in the dielectric must exist. Let's search for them!

Interim result (comparison of arguments):

The Maxwell equations on the one hand dictate that as the reason for a wave damping only field vortices should be considered.	On the other hand the same laws merely describe eddy currents, which can only occur in the electrically conducting parts of the antenna.
On the one hand the field vortex interpretation makes it possible to explain the noise of an antenna perfectly.	On the other hand does the noise appear in the neighbourhood of the antenna, thus in the air and not in the iron parts!
The mathematical formulation reveals, how wave and vortex, resp. noise, co-operate and how one should imagine the conversion of one form into the other form.	In field physics on the other hand is missing a useful description of electric field vortices in a dielectric, which could found the noise signal.

Table 26.5: Arguments pro and contra.

26. 5 Interim result

It shouldn't be a disadvantage, to interprete physical laws more consistently than usual, even if in the present case orthodox science through that at first should fall into a deep crisis. If the way is worthwhile, only will show at the end.
Let us try to work out the contradictions in form of a comparison of arguments:

- The Maxwell equations on the one hand dictate that as the reason for a wave damping only field vortices should be considered.
  - o On the other hand the same laws merely describe eddy currents, which can only occur in the electrically conducting parts of the antenna. .
- On the one hand the field vortex interpretation makes it possible to explain the noise of an antenna perfectly. .
  - o On the other hand does the noise appear in the neighbourhood of the antenna, thus in the air and not in the iron parts!
- The mathematical formulation reveals, how wave and vortex, resp. noise, co-operate and how one should imagine the conversion of one form into the other form.
  - o In field physics on the other hand is missing a useful description of electric field vortices in a dielectric, which could found the noise signal.

The most obvious among all conceivable solutions is the one that we have to assume the existence of dielectric field vortices, so-called potential vortices. We are challenged to search for a corresponding description. If the quest should be successful, then the contradictions would be overcome. In addition there is the promise of a whole number of simplifying explanations of various phenomena in the dielectric (see fig. 26.5 and fig. 26.7).

The phenomenon of noise becomes an aspect of wave physics, which is more than merely a field disturbance, which makes the reception of the useful wave more difficult. If the scalar wave nature is realized, then applications can be imagined, in which the noise is used as useful signal. In the way that the scalar part in the wave equation doesn't have to be put to zero anymore to obtain freedom of contradiction, even optimizations of antennas or of capacitors are possible with regard to the dielectric losses by means of the calculation of the scalar part.

New in any case is the idea that the dielectric losses of a capacitor are eddy losses and not a defect in material of the insulating material. With that the capacitor losses correspond to a generated noise power. We also can say, every capacitor more or less produces noise! The electric field lines point from one capacitor plate to the other plate. If one plate radiates as a transmitter and the other plate functions as a receiver, then the field propagation takes place in the direction of the electric field pointer and that again is the condition for a longitudinal wave. Here the circle closes in the conclusion, the capacitor field mediates dielectric field vortices, which following the field lines found a scalar wave because of their scalar nature. The heating of the capacitor results from the decay of vortices.

Potential vortices explain div. phenomena in the dielectric:

1. The **noise** no longer is factored out of the field theory.
2. The scalar (noise) part in the wave equation no longer has to be put to zero (div $\mathbf{E} \neq 0$).
3. The wave descriptions according to Maxwell (26.11) and according to Laplace (26.12) are consistent and free of contradiction.
4. The dielectric losses of an antenna can be found physically and even can be calculated with the wave equation.
5. **Also the dielectric losses** of a capacitor are **eddy losses** (and not a defect in material of the insulating material).
6. The **capacitor losses** correspond to a generated **noise power**.
7. The **dielectric constant** ε doesn't have to be written down complex as until now to give reasons for the occurring losses, and so the inner contradiction is solved, which is hidden in a complex constant. One should only remember the definition of the speed of light $c = 1/\sqrt{\varepsilon\mu}$ (eq. 26.10) and the insurmountable problems in the textbooks, which are brought by a complex ε!
8. The field lines point from one capacitor plate to the other plate. If one plate radiates as a transmitter and the other plate functions as a receiver, then the field propagation takes place in the direction of the electric field pointer and that again is the condition for a **longitudinal wave**.
9. The capacitor field mediates dielectric field vortices, which following the field lines found a **scalar wave** because of their scalar nature.
10. As an inhabitant of a dielectric between two capacitor plates (earth and ionosphere) also **man** is a product of these field vortices.
11. Scalar waves can be modulated moredimensionally and be used as **carrier of information**, as Prof. Sheldrake has proven with his proof of the existence of morphogenetic fields<i>.

Fig. 26.6: ____ Advantages of a field description extended with potential vortices.

<i>: Rupert Sheldrake: Seven Experiments That Could Change the World. Riverhead Books, 1995

26.6 Failure of the Maxwell theory

If the capacitor losses or the antenna noise should concern dielectric losses in the sense of vortex decay of potential vortices, which don't occur in the Maxwell theory at all, then we are confronted with a massive contradiction:

- For the description of the losses the Maxwell; theory on the one hand only offers field vortices and those only in the conductive medium.
  - On the other hand do the dielectric losses occut in the nonconductor and in the air.

- In conductive materials vortex fields occur, in the insulator however the fields are irrotational. That isn't possible, since at the transition from the conductor to the insulator the laws of refraction are valid and these require continuity! Hence a failure of the Maxwell theory (Fig. 26.7) will occur in the dielectric.
  - As a consequence the existence of vortex fields in the dielectric, so-called potential vortices, should be required!

In electrodynamics as a help the approach of a vector potential A is used, which leads to a complex formulation of the dielectric constant ε and in this way makes it possible, to mathematically describe the dielectric losses of a capacitor by means of the load angle, which stretches in the complex plane. But which physical value does this approach have? How can now the inner contradiction be explained, which is hidden in a complex constant of material? One should only remember the definition of the speed of light $c = 1/\sqrt{\varepsilon\mu}$ (eq. 26.10) and its dependency of ε. For a complex ε here are resulting insurmountable problems in the textbooks.
From the viewpoint of mathematics the introduction of the vector potential at first may represent a help. The before mentioned contradictions however fast raise doubts to the model concept, which from a physical viewpoint eventually will lead to errors, if the speed of light isn't constant anymore and even should be complex.

These considerations should be sufficient as a motive to require potential vortices, even if for their description the field theory according to the textbooks has to be revised. As a supplement there is pointed to the following points:

- As an inhabitant of a dielectric between two capacitor plates also man is a product of these field vortices.
- Scalar waves can be modulated moredimensionally and be used as carrier of information, as Prof. Sheldrake has proven with his proof of morphogenetic fields[<i>].

The dielectric vortices moreover provide an explanation for natural events. They form the key to numerous disciplines of science, from physics over biology up to medicine.

<i>: Rupert Sheldrake: Seven Experiments That Could Change the World. Riverhead Books, 1995

Problem of continuity in the case of the coming off of vortices

Example: hightension cable

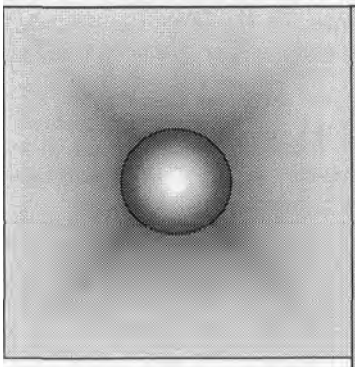

*In **conductive materials** **vortex fields** occur in the **insulator** however the fields are **irrotational**.*
*That isn't possible, since at the transition from the conductor to the insulator the **laws of refraction** are valid and these require **continuity!***
*Hence a **failure of the Maxwell theory** will occur in the dielectric!*

Conclusion: ♦ According to the Maxwell theory there exist no vortices of the electric field *(no potential vortices)* and therefore *no scalar waves.*

♦ Without theory it is impossible to design a usable *scalar wave gauge* and to furnish *evidence*. ⇒ **Classic closed loop conclusion:**

♦ The missing of scientific evidence again „proves" the assumption of the irrotationality and „confirms" the correctness of the Maxwell theory.

♦ Hence it cannot be, what shouldn't be!

Fie. 26.7: Concerning the failure of the Maxwell theory

26.7. Concerning the evidence situation

In the question, if a physical phenomenon should be acknowledged as such, experimental, mathematical and physical evidence should be shown. In the case of the potential vortices, the vortices of the electric field and their propagation as a scalar wave, the historical experiments of Nikola Tesla[<i>] and the modern clone of these can be judged as experimental evidence[<ii>].

With the well-known wave equation a mathematical description for this phenomenon has been specified and discussed[<iii>]. It will be shown that both transverse and longitudinal wave parts are contained alongside in the wave equation, i.e. both radio waves according to Hertz and scalar waves according to Tesla. Doing so the mathematically determined scalar wave properties are identical with the experimental results!
The wave equation is an inhomogeneous Laplace equation and the first and oldest description of scalar waves. It thereby is unimportant, if the famous mathematician Laplace himself already may have realized and discussed this circumstance or not. The description fits perfectly and that is what counts!

At this point the third point should be put on the agenda, the physical evidence. This is connected very closely with the question for a suitable field theory and that again is basing on a corresponding approach.

<i>: N. Tesla: Apparatus for Transmission of Electrical Energy, US-Patent-No.: 649,621, New York 1900, Dr. Nikola Tesla: Complete Patents pp318-321.

<ii>: Johannes von Buttlar im Gesprach mit Prof. Dr. Konstantin Meyl: Neutrinopower, Argo-Verlag, Marktoberdorf, l.Aufl. 2000.

<iii>: K. Meyl: Scalar Waves: Theory and Experiments, Journal of Scientific Exploration, Vol. 15, No. 2, pp. 199-205, 2001

(* * * Task Schedule * * *)

1. Neutrino radiation => energy radiation!
   (acc. to Pauli: ν cares for missing energy in the case of the ß-decay)
2. High neutrino density => high energy density!
   3. Neutrino = particle without charge or mass (mean), but because of oscillations: effective value of charge and mass $\neq$ zero!
   4. Interaction only in the case of resonance (e.g. weak interaction)!
   (same frequency, 180° phase shift)
   5. Neutrino radiation is an energy source which can be used (not a question of physics, only a question of technology!)
6. Particle radiation (neutrino) => shock wave (like sound)
   => longitudinal wave
   => scalar wave (mathem.)
7. Interaction/resonance of the v = scalar wave problem
8. Scalar waves are a problem of the field theory!
9. Maxwell theory neglects scalar waves.

- Search for a new approach (chap. 27.8)
- Derivation of the Maxwell equations as a
- Derivation of scalar waves (chap. 27.13)
- Derivation of the gravitation and more

Table 27.1: Task schedule belonging to chapter 27

27. Faraday versus Maxwell

Numerous phenomena of the electromagnetic field are described sufficiently accurate by the Maxwell equations, so that these as a rule are regarded as a universal field description. But if one looks more exact it turns out to be purely an approximation, which in addition leads to far reaching physical and technological consequences. We must ask ourselves:

- What is the Maxwell approximation?
- How could a new and extended approach look like?
  - Faraday instead of Maxwell, which is the more general law of induction?
- Can the Maxwell equations be derived as a special case?
- Can also scalar waves be derived from the new approach?
- Can the gravitation as well be derived and a lot else more?

On the one hand it concerns the big search for a unified physical theory and on the other hand the chances of new technologies, which are connected with an extended field theory. As a necessary consequence of the derivation, which roots strictly in textbook physics and manages without postulate, scalar waves occur, which could be used manifold. In information technology they are suited as a carrier wave, which can be modulated moredimensionally, and in power engineering the spectrum stretches from the wireless transmission up to the collection of energy out of the field.

27.1 Energy out of the field

Neutrinos for instance are such field configurations, which move through space as a scalar wave. They were introduced by Pauli as massless but energy carrying particles to be able to fulfil the balance sheet of energy for the beta decay. Nothing would be more obvious than to technically use the neutrino radiation as an energy source.
But for a technical exploitation a useful model description of the particles and their interaction is imperative. For the sake of simplicity we imagine the neutrino to be an oscillating particle, which permanently oscillates back and forth between the state of an electron and that of a positron. With that the polarity changes from positive to negative and back again and the charge averaged over time is zero. Because of the change from a state of matter to the state of an anti-particle also next to no mass can be measured anymore.
A technical oscillator operated in resonance, which oscillates with the same frequency but opposite charge, will interact with the particle and build up an oscillating electromagnetic interaction, with which we already are familiar as the weak interaction in the proximity of a neutrino.

Tubular vortices

- Examples: drain vortex (bathtub vortex)
  whirlwind and waterspout, tornado (image).

Inside:	expanding vortex
Outside:	contracting anti-vortex
Condition	for coming off: equally powerful vortices
Criterion:	viscosity
Result:	tubular structure

Fig. 27.2: ____ Vortex and anti-vortex - a physical basic principle

<i>: Lugt: Wirbelstromung in Natur und Technik, G. Braun Verlag Karlsruhe 1979, Bild „Tornado" von Tafel 21, Seite 356

The propagation of particle radiation as a longitudinal shock wave however can't be described with the normally used field theory and the Maxwell equations, so that the field theory at this point must be reworked. Connected with this is the question of what is oscillating here, a question, which often is answered with an aether of whatever nature. I speak of field vortices and call the aether a property of the field. With that the set of difficulties is shifted into the domain of vortex physics.

27.2 Vortex and anti-vortex

In the eye of a tornado the same calm prevails as at great distance, because here a vortex and its anti-vortex work against each other. In the inside the expanding vortex is located and on the outside the contracting anti-vortex. One vortex is the condition for the existence of the other one and vice versa. Already Leonardo da Vinci knew both vortices and has described the dual manifestations (chapter 3.4).

In the case of flow vortices the viscosity determines the diameter of the vortex tube where the coming off will occur. If for instance a tornado soaks itself with water above the open ocean, then the contracting potential vortex is predominant and the energy density increases threateningly. If it however runs overland and rains out, it again becomes bigger and less dangerous.

The conditions for the bathtub vortex are similar. Here the expanding vortex consists of air, the contracting vortex however of water. In flow dynamics the relations are understood. They mostly can be seen well and observed without further aids.

In electrical engineering it's different: here field vortices remain invisible and not understood. Only so the Maxwell theory could find acceptance, although it only describes mathematically the expanding eddy current and ignores its anti-vortex. I call the contracting anti-vortex potential vortex" and point to the circumstance, that every eddy current entails the anti-vortex as a physical necessity.
Because the size of the forming structures is determined by the electric conductivity, in conducting materials the vortex rings, being composed of both vortices, are huge, whereas they can contract down to atomic dimensions in nonconductors. Only in semiconducting and resistive materials the structures occasionally can be observed directly (fig. 4.8).

Spherical vortices

Examples:	expanding vortex	contracting vortex
• quantum physics	collision processes (several quarks)	gluons (postulate!)
• nuclear physics	repulsion of like	strong interaction (postulate!)
• atomic physics	centrifugal force of the enveloping electrons	electrical attraction Schrodinger equation
• astro-physics	centrifugal force (inertia)	gravitation (can not be derived?!)

Example: elementary particles as electromagnetic field vortices

Inside:	expanding eddy current (skin effect)
Outside:	contracting anti-vortex (potential vortex)
Condition	for coming off: equally powerful vortices
Criterion:	electric conductivity (determines diameter)
Result:	spherical structure (consequence of the pressure of the vacuum)

Fig. 27.3: _____ Spherical structures as a result of contracting potential vortices.<i>

Demokrit (460-370 BC) equated the vortex concept with „law of nature"! = the first attempt to formulate a unified physics.

<i>: see Part 1, chapter 4.3

27.3 Vortices in the microcosm and macrocosm

The approximation, which is hidden in the Maxwell equations, thus consists of neglecting the anti-vortex dual to the eddy current. It is possible that this approximation is allowed, as long as it only concerns processes inside conducting materials. If we however get to insulating materials the Maxwell approximation will lead to considerable errors and it won't be able to keep it anymore.

If we take as an example the lightning and ask how the lightning channel is formed: Which mechanism is behind it, if the electrically insulating air for a short time is becoming a conductor? From the viewpoint of vortex physics the answer is obvious: The potential vortex, which in the air is dominating, contracts very strong and doing so squezes all air charge carriers and air ions, which are responsible for the conductivity, together at a very small space to form a current channel.

The contracting potential vortex thus exerts a pressure and with that forms the vortex tube. Besides the cylindrical structure another structure can be expected. It is the sphere, which is the only form, which can withstand a powerful pressure if that acts equally from all directions of space. Only think of ball lightning. Actually the spherical structure is mostly found in microcosm till macrocosm. Let's consider some examples and thereby search for the expanding and contracting forces (fig. 27.2).

- In quantum physics one imagines the elementary particles to be consisting of quarks. Irrespective of the question, which physical reality should be attributed to this model concept, one thing remains puzzling: The quarks should run apart, or you should try to keep together three globules, which are moving violently and permanently hitting each other. For this reason glue particles were postulated, the so-called gluons, which now should take care for the reaction force, but this reaction force is nothing but a postulate!

- In nuclear physics it concerns the force, which holds together the atomic nucleus, which is composed of many nucleons, and gives it the well-known great stability, although here like charged particles are close together. Particles, which usually repel each other. Between the theoretical model and practical reality there is an enormous gap, which should be overcome by introducing of a new reaction force. But also the nuclear force, called strong interaction, is nothing but a postulate!

- In atomic physics the electric force of attraction between the positive nuclear charge and the negatively charged enveloping electrons counteracts the centrifugal force. In this case the anti-vortex takes care for a certain structure of the atomic hull, which obey the Schrodinger equation as eigenvalue solutions. But also this equation irrespective of its efficiency until today purely is a mathematical postulate, as long as its origin is not clear.

- In astrophysics centrifugal force (expansion) as a result of the inertia and gravitation (contraction) as a result of the attraction of masses are balanced. But the "gravitation" puts itself in the way of every attempt to formulate a unified field theory. Also this time it is the contracting vortex, of which is said it can't be derived nor integrated.

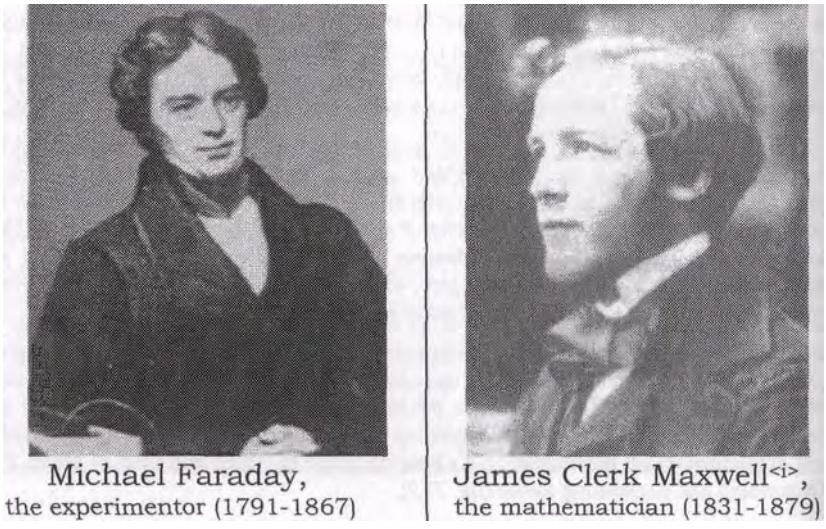

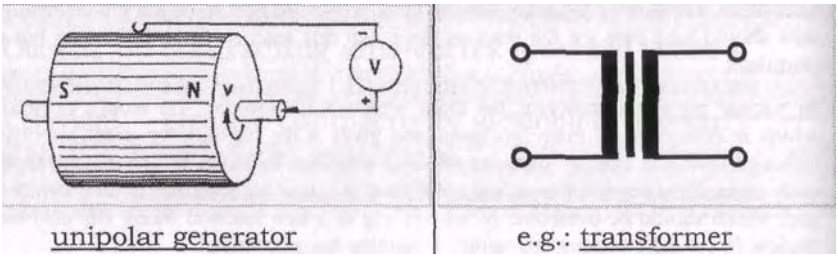

Fig. 27.4: ____ The fathers of the law of induction

<i>: J.C. Maxwell: A treatise on Electricity and Magnetism, Dover Publications

It is remarkable how in the domain of the contracting vortex the postulates are accumulating. But this hasn't always been the case. In ancient Greece already 2400 years ago Demokrit has undertaken an attempt to formulate a unified physics. He traced all visible and observable structures in nature back to vortices, each time formed of vortex and anti-vortex. This phenomenon appeared him to be so fundamental, that he put the term "vortex" equal to the term for „law of nature". The term „atom" stems from Demokrit (460-370 BC).

Seen this way the physicists in ancient times already had been further than today's physics, which with the Maxwell approximation neglects the contracting vortex and with that excludes fundamental phenomena from the field description or is forced to replace them by model descriptions and numerous postulates.
What we need is a new field approach, which removes this flaw and in this point reaches over and above the Maxwell theory.

27.4 Faraday's law and Maxwell's formulation

In the choice of the approach the physicist is free, as long as the approach is reasonable and well founded. In the case of Maxwell's field equations two experimentally determined regularities served as basis: on the one hand Ampere's law and on the other hand the law of induction of Faraday. The mathematician Maxwell thereby gave the finishing touches for the formulations of both laws. He introduced the displacement current D and completed Ampere's law accordingly, and that without a chance of already at his time being able to measure and prove the measure. Only after his death this was possible experimentally, what afterwards makes clear the format of this man.
In the formulation of the law of induction Maxwell was completely free, because the discoverer Michael Faraday had done without specifications. As a man of practice and of experiment the mathematical notation was less important for Faraday. For him the attempts with which he could show his discovery of the induction to everybody, e.g. his unipolar generator, stood in the foreground.
His 40 years younger friend and professor of mathematics Maxwell however had something completely different in mind. He wanted to describe the light as an electromagnetic wave and doing so certainly the wave description of Laplace went through his mind, which needs a second time derivation of the field factor. Because Maxwell for this purpose needed two equations with each time a first derivation, he had to introduce the displacement current in Ampere's law and had to choose an appropriate notation for the formulation of the law of induction to get to the wave equation. His light theory initially was very controversial. Maxwell faster found acknowledgement for bringing together the teachings of electricity and magnetism and the representation as something unified and belonging together<1> than for mathematically giving reasons for the principle discovered by Faraday.
Nevertheless the question should be asked, if Maxwell has found the suitable formulation, if he has understood 100 percent correct his friend Faraday and his discovery. If discovery (from 29.08.1831) and mathematical formulation (1862) stem from two different scientists, who in addition belong to different disciplines, misunderstandings are nothing unusual. It will be helpful to work out the differences.

Law of induction

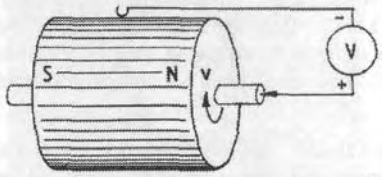

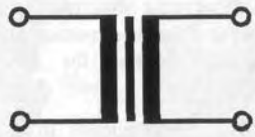

unipolar generator	e.g.: transformer
discovery of Faraday	2nd Maxwell equation
$\mathbf{E} = \mathbf{v} \times \mathbf{B}$ (27.1)	$\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt$ (27.1*)
unipolar induction	law of induction generally

Fig. 27.5: Two formulations for one law
As a mathematical relation between the vectors of the electric field strength **E** and the induction **B** (= magnetic flux density)

Consequences
(the physically mean of the „field concept"):

• The **Faraday approach** describes a field physical principle	• **Maxwell equations** describe the fields of charged particles
• field = experience: We experience the electric as a magnetic field and vice versa as a result of a relative velocity • Particles do not occur in the Faraday approach	• the electric (**E**-) field = static field of charges, • the magnetic (**H**-) field = field of moving charges. • The origin of the particles remains unsettled (postulate)
• Perfect duality between **E**- and **H**-field.	• No duality in the field description
• **v** leads to dual permutation of **E**- and **H**-field.	• Charge carriers=el. monopoles • No magnetic monopoles!

27.5 The discovery of Faraday

If one turns an axially polarized magnet or a copper disc situated in a magnetic field, then perpendicular to the direction of motion and perpendicular to the magnetic field pointer a pointer of the electric field will occur, which everywhere points axially to the outside. In the case of this by Faraday developed unipolar generator hence by means of a brush between the rotation axis and the circumference a tension voltage can be called off[<i>]. The mathematically correct relation E = v x B I call Faraday-law, even if it only appears in this form in the textbooks later in time[<ii>]. The formulation usually is attributed to the mathematician Hendrik Lorentz, since it appears in the Lorentz force in exactly this form. Much more important than the mathematical formalism however are the experimental results and the discovery by Michael Faraday, for which reason the law concerning unipolar induction is named after the discoverer.
Of course we must realize that the charge carriers at the time of the discovery hadn't been discovered yet and the field concept couldn't correspond to that of today. The field concept was an abstracter one, free of any quantization.

That of course also is valid for the field concept advocated by Maxwell, which we now contrast with the „Faraday-law" (fig. 27.4). The second Maxwell equation, the law of induction (27.1*), also is a mathematical description between the electric field strength E and the magnetic induction B. But this time the two aren't linked by a relative velocity v. In that place stands the time derivation of B, with which a change in flux is necessary for an electric field strength to occur. As a consequence the Maxwell equation doesn't provide a result in the static or quasi-stationary case, for which reason it in such cases is usual, to fall back upon the unipolar induction according to Faraday (e.g. in the case of the Hall-probe, the picture tube, etc.). The falling back should only remain restricted to such cases, so the normally used idea. But with which right the restriction of the Faraday-law to stationary processes is made?
The vectors E and B can be subject to both spatial and temporal fluctuations. In that way the two formulations suddenly are in competition with each other and we are asked, to explain the difference, as far as such a difference should be present.

<i>: Part 2, INDEL 1996, Chap. 16.1

<ii>: among others in R.W. Pohl: Einfuhrung in die Physik, Bd.2 Elektrizitatslehre, 21.Aufl. Springer-Verlag 1975, Seite 76 und 130

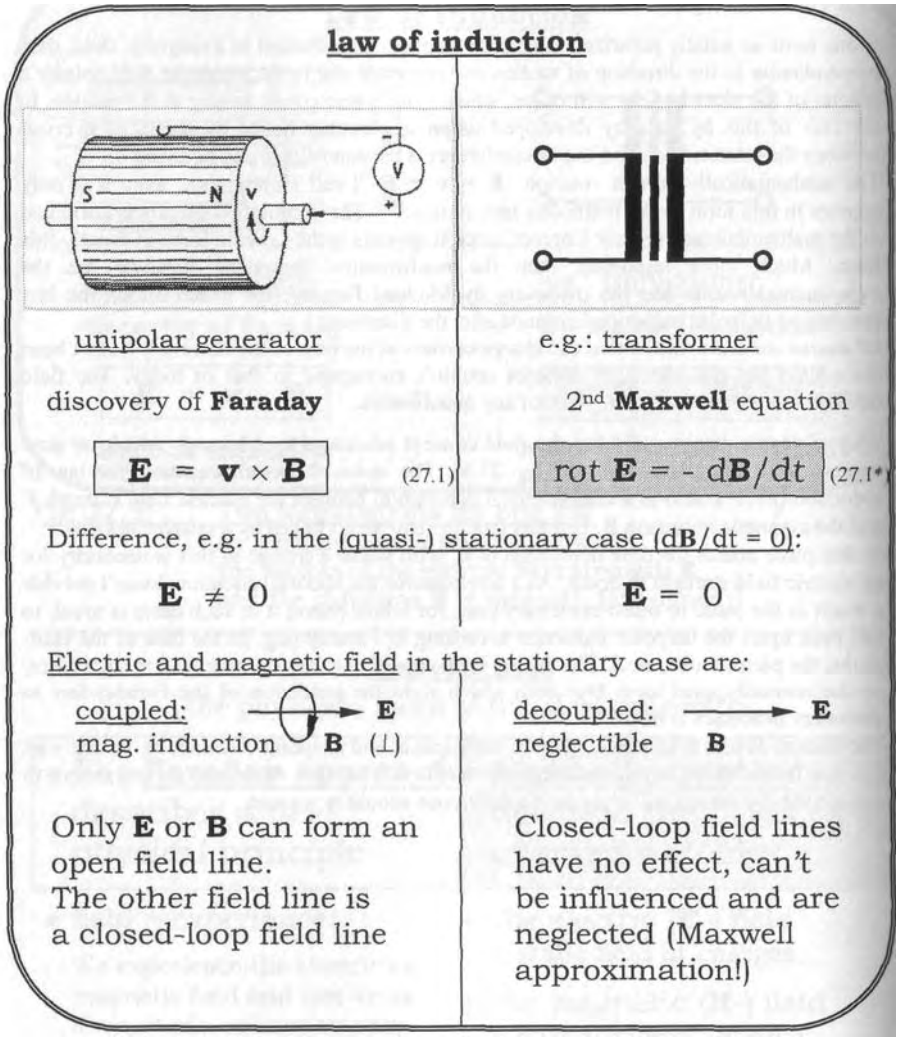

Fig. 27.6: ____Law of induction according to Faraday or Maxwell?

27.6 Different formulation of the law of induction

Such a difference for instance is, that it is common practice to neglect the coupling between the fields at low frequencies. While at high frequencies in the range of the electromagnetic field the E- and the H-field are mutually dependent, at lower frequency and small field change the process of induction drops correspondingly according to Maxwell, so that a neglect seems to be allowed. Now electric or magnetic field can be measured independently of each other. Usually is proceeded as if the other field is not present at all.

That is not correct. A look at the Faraday-law immediately shows that even down to frequency zero always both fields are present. The field pointers however stand perpendicular to each other, so that the magnetic field pointer wraps around the pointer of the electric field in the form of a vortex ring in the case that the electric field strength is being measured and vice versa. The closed-loop field lines are acting neutral to the outside; they hence need no attention, so the normally used idea. It should be examined more closely if this is sufficient as an explanation for the neglect of the not measurable closed-loop field lines, or if not after all an effect arises from fields, which are present in reality.

Another difference concerns the commutability of E- and H-field, as is shown by the Faraday-generator, how a magnetic becomes an electric field and vice versa as a result of a relative velocity v. This directly influences the physical-philosophic question: What is meant by the electromagnetic field?

The textbook opinion based on the Maxwell equations names the static field of the charge carriers as cause for the electric field, whereas moving ones cause the magnetic field. But that hardly can have been the idea of Faraday, to whom the existence of charge carriers was completely unknown. The for his contemporaries completely revolutionary abstract field concept based on the works of the Croatian Jesuit priest Boscovich (1711-1778). In the case of the field it should less concern a physical quantity in the usual sense, than rather the experimental experience''' of an interaction according to his field description. We should interprete the Faraday-law to the effect that we experience an electric field, if we are moving with regard to a magnetic field with a relative velocity and vice versa.

In the commutability of electric and magnetic field a duality between the two is expressed, which in the Maxwell formulation is lost, as soon as charge carriers are brought into play. Is thus the Maxwell field the special case of a particle free field? Much evidence points to it, because after all a light ray can run through a particle free vacuum. If however fields can exist without particles, particles without fields however are impossible, then the field should have been there first as the cause for the particles. Then the Faraday description should form the basis, from which all other regularities can be derived. What do the textbooks say to that?

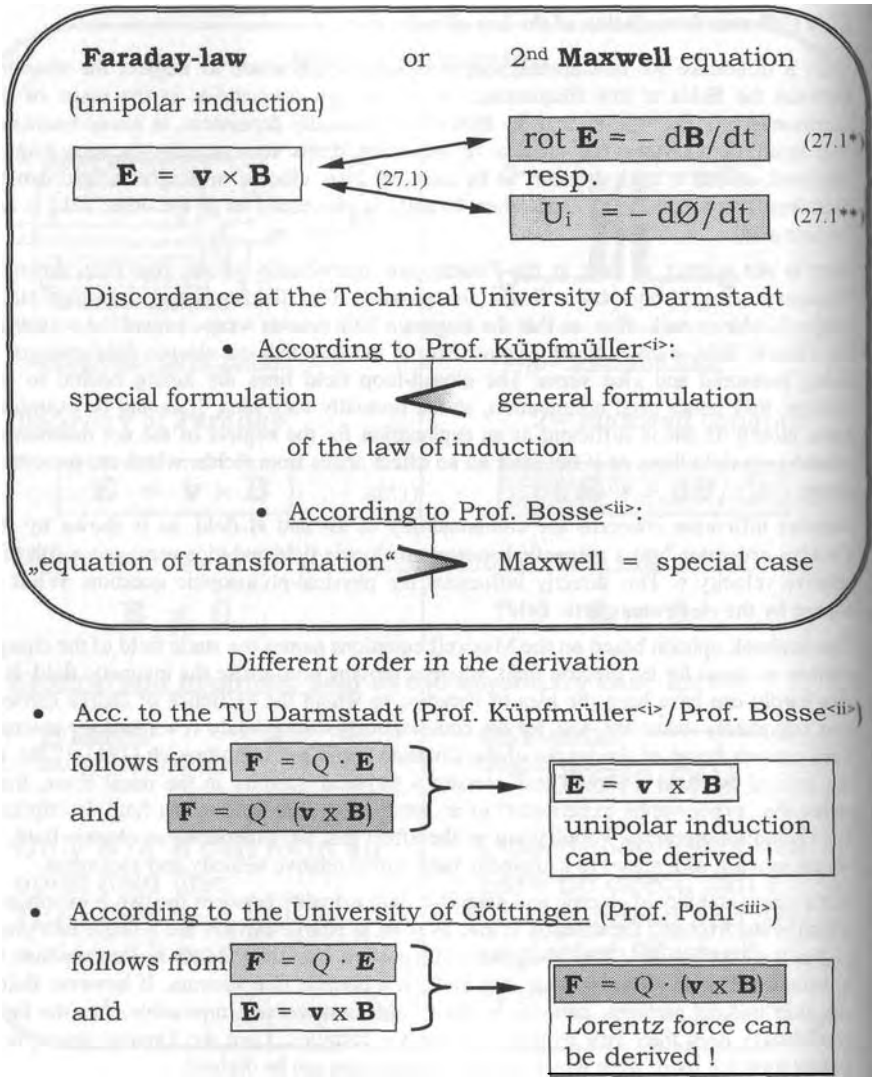

Fig. 27.7: Different opinions and derivations

<i>: K. Kupfmuller: Einfuhrung in die theoretische Elektrotechnik, 12. Auflage, Springer Verlag 1988, Seite 228, Gl. 22.

<ii>: G. Bosse: Grundlagen der Elektrotechnik II, BI-Hochschultaschenbucher Nr. 183, l.Aufl. 1967, Kap. 6.1 Induktion, Seite 58

<iii>: R. W. Pohl: Einfuhrung in die Physik, Band 2 Elektrizitatslehre, 21. Auflage, Springer-Verlag 1975, Seite 77

27.7 Contradictory opinions in textbooks

Obviously there exist two formulations for the law of induction (27.1 and 27.1*), which more or less have equal rights. Science stands for the question: which mathematical description is the more efficient one? If one case is a special case of the other case, which description then is the more universal one?

What Maxwell's field equations tell us is sufficiently known, so that derivations are unnecessary. Numerous textbooks are standing by, if results should be cited. Let us hence turn to the Faraday-law (27.1). Often one searches in vain for this law in schoolbooks. Only in more pretentious books one makes a find under the keyword "unipolar induction". If one however compares the number of pages, which are spent on the law of induction according to Maxwell with the few pages for the unipolar induction, then one gets the impression that the latter only is a unimportant special case for low frequencies. Kupfmuller speaks of a „special form of the law of induction"[<i>], and cites as practical examples the induction in a brake disc and the Hall-effect. Afterwards Kupfmiiller derives from the „special form" the „general form" of the law of induction according to Maxwell, a postulated generalization, which needs an explanation. But a reason is not given[<i>]. Bosse gives the same derivation, but for him the Maxwell-result is the special case and not his Faraday approach[<ii>]! In addition he addresses the Faraday-law as equation of transformation and points out the meaning and the special interpretation. On the other hand he derives the law from the Lorentz force, completely in the style of Kupfmuller[<i>] and with that again takes it part of its autonomy. Pohl looks at that different. He inversely derives the Lorentz force from the Faraday-law[<iii>].

By all means, the Faraday-law, which we want to base on instead of on the Maxwell equations, shows „strange effects[<i4>]" from the point of view of a Maxwell representative of today and thereby but one side of the medal (eq. 27.1). Only in very few distinguished textbooks the other side of the medal (eq. 27.2) is mentioned at all. In that way most textbooks mediate a lopsided and incomplete picture[<i,ii,i4>]. If there should be talk about equations of transformation, then the dual formulation belongs to it, then it concerns a pair of equations, which describes the relations between the electric and the magnetic field.

If the by Bosse[<ii>] prompted term „equation of transformation" is justified or not at first is unimportant. That is a matter of discussion.

<i>: K. Kupfmuller: Einfuhrung in die theoretische Elektrotechnik, 12.Aufl., Springer Verlag 1988, Seite 228, Gl. 22.

<ii>: G. Bosse: Grundlagen der Elektrotechnik II, BI-Hochschultaschenbucher Nr.183, l.Aufl. 1967, Kap. 6.1 Induktion, Seite 58

<iii>: R.W.Pohl: Einfuhrung in die Physik, Bd.2 Elektrizitatslehre, 2 l.Aufl. Springer-Verlag 1975, Seite 77

<i4>: G. Lehner: Elektromagnetische Feldtheorie, Springer-Lehrbuch 1990, 1. Aufl., Seite 31 Kommentar zur Lorentzkraft (1.65)

The new and dual field approach consists of equations of transformation

of the electric and of the magnetic field[i]

$\mathbf{E} = \mathbf{v} \times \mathbf{B}$ (27.1) and $\mathbf{H} = -\mathbf{v} \times \mathbf{D}$ (27.2)

unipolar induction equation of convection

- Formulation according to the rules of duality
  - Grimsehl[ii] speaks of the „equation of convection", according to which moving charges produce a magnetic field and so-called convection currents (referring to Rontgen 1885, Himstedt, Rowland 1876, Eichenwald and others)
- Pohl[iii] gives examples for the equations of transformation,
- he writes the equations beneath each other

$\mathbf{E} = \mu \cdot \mathbf{v} \times \mathbf{H}$ (27.3) and $\mathbf{H} = -\varepsilon \cdot \mathbf{v} \times \mathbf{E}$ (27.4)

- and points out that for $v = c = 1/\sqrt{\mu \cdot \varepsilon}$ one equation changes into the other one!

The new and dual approach roots in textbook physics!

Fig. 27.8: The new and dual field approach

<i>: see Part 1, chapter 6.5

<ii>: Grimsehl: Lehrbuch der Physik, 2.Bd., 17,Aufl. Teubner Verl. 1967, S. 130.

<iii>: R.W.Pohl: Einfuhrung in die Physik, Bd.2 Elektrizitatslehre, 21.Aufl. Springer-Verlag 1975, Seite 77

27.8 The field-theoretical approach

The duality between E- and H-field and the commutability asks for a corresponding dual formulation to the Faraday-law (27.1). Written down according to the rules of duality there results an equation (27.2), which occasionally is mentioned in some textbooks. While both equations in the books of Pohl[<i>] and of Simonyi[<ii>] are written down side by side having equal rights and are compared with each other, Grimsehl[<iii>] derives the dual regularity (27.2) with the help of the example of a thin, positively charged and rotating metal ring. He speaks of „equation of convection", according to which moving charges produce a magnetic field and so-called convection currents. Doing so he refers to workings of Rontgen 1885, Himstedt, Rowland 1876, Eichenwald and many others more, which today hardly are known.
In his textbook also Pohl gives practical examples for both equations of transformation. He points out that one equation changes into the other one, if as a relative velocity v the speed of light c should occur. This question will also occupy us.

We now have found a field-theoretical approach with the equations of transformation, which in its dual formulation is clearly distinguished from the Maxwell approach. The reassuring conclusion is added: The new field approach roots entirely in textbook physics, as are the results from the literature research. We can completely do without postulates.
Next thing to do is to test the approach strictly mathematical for freedom of contradictions. It in particular concerns the question, which known regularities can be derived under which conditions. Moreover the conditions and the scopes of the derived theories should result correctly, e.g. of what the Maxwell approximation consists and why the Maxwell equations describe only a special case.

27.9 Derivation of Maxwell's field equations

As a starting-point and as approach serve the equations of transformation of the electromagnetic field, the Faraday-law of unipolar induction and the according to the rules of duality formulated law (eq. 27.1, 2). If we apply the curl to both sides of the equations then according to known algorithms of vector analysis the curl of the cross product each time delivers the sum of four single terms. Two of these again are zero for a non-accelerated relative motion in the x-direction with v = dr/dt.
One term concerns the vector gradient (v grad)B, which can be represented as a tensor. By writing down and solving the accompanying derivative matrix giving consideration to the above determination of the v-vector, the vector gradient becomes the simple time derivation of the field vector B(r(t)) (eq. 27.10, according to the rule of eq. 27.11).

<i>: R.W.Pohl: Einfuhrung in die Physik, Bd.2 Elektrizitatslehre, 21.Aufl. Springer-Verlag 1975, Seite 76 und 130

<ii>: K. Simonyi: Theoretische Elektrotechnik, 7.Aufl. VEB Berlin 1979, Seite 924.

<iii>: Grimsehl: Lehrbuch der Physik, 2,Bd., 17.Aufl. Teubner Verl. 1967, S. 130.

As approach serve the equations of transformation (fig. 27.5) of the electric and of the magnetic field:

$$\mathbf{E} = \mathbf{v} \times \mathbf{B} \quad (27.1) \text{ and } \quad \mathbf{H} = -\mathbf{v} \times \mathbf{D} \quad (27.2)$$

If we apply the curl to the respective cross product:

$$\text{rot}\,\mathbf{E} = \text{rot}\,(\mathbf{v} \times \mathbf{B}) \quad (27.5) \text{ and } \quad \text{rot}\,\mathbf{H} = -\,\text{rot}\,(\mathbf{v} \times \mathbf{D}) \quad (27.6)$$

then according to the algorithms<i> four sum terms are delivered:

$$\text{rot}\,\mathbf{E} = (\mathbf{B}\,\text{grad})\mathbf{v} - (\mathbf{v}\,\text{grad})\mathbf{B} + \mathbf{v}\,\text{div}\,\mathbf{B} - \mathbf{B}\,\text{div}\,\mathbf{v} \quad (27.5)$$

$$\text{rot}\,\mathbf{H} = -\,[(\mathbf{D}\,\text{grad})\mathbf{v} - (\mathbf{v}\,\text{grad})\mathbf{D} + \mathbf{v}\,\text{div}\,\mathbf{D} - \mathbf{D}\,\text{div}\,\mathbf{v}] \quad (27.6)$$

where 2 of them are zero because of: $\mathbf{v}(t) = d\mathbf{r}/dt$ (27.7)

- the divergence of v(t) disappears: $\text{div}\,v = 0$, (27.8)
- and will be zero as well: $\partial\mathbf{v}(t)/\partial\mathbf{r} = \text{grad}\,\mathbf{v} = \mathbf{0}$. (27.9)
- there remain the vector gradients:

$$(\mathbf{v}\,\text{grad})\,\mathbf{B} = \frac{d\mathbf{B}}{dt} \text{ and } (\mathbf{v}\,\text{grad})\,\mathbf{D} = \frac{d\mathbf{D}}{dt} \quad ,(27.10)$$

- according to the rules<i> in general (with eq. 27.7):

$$\frac{d\mathbf{V}(\mathbf{r}(t))}{dt} = \frac{\partial\mathbf{V}(\mathbf{r}=\mathbf{r}(t))}{\partial\mathbf{r}} \cdot \frac{d\mathbf{r}(t)}{dt} = (\mathbf{v}\,\text{grad})\,\mathbf{V} \quad (27.11)$$

- A comparison of the coefficients of both field equations

$$\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt + \mathbf{v}\,\text{div}\,\mathbf{B} = -\,d\mathbf{B}/dt - \mathbf{b} \quad (27.12)$$

$$\text{rot}\,\mathbf{H} = d\mathbf{D}/dt - \mathbf{v}\,\text{div}\,\mathbf{D} = d\mathbf{D}/dt + \mathbf{j} \quad (27.13)$$

with the Maxwell equations results in:

- for the potential density $b = -\,v\,\text{div}\,B = 0$, (27.14)
(eq. 27.12 = law of induction, if b = 0 resp. div B = 0)

- for the current density $j = -\,v\,\text{div}\,D = -\,v_x \cdot \rho_{el}$, (27.1a
(eq. 27.13 = Ampere's law, if j = with v moving negative charge carriers (ρ_{el}= electric space charge density).

Fig. 27.9: ____ Derivation of Maxwell's field equations as a special case of the equations of transformation

<i>: Bronstein u.a.: Taschenbuch der Mathematik, 4.Neuaufl. Thun 1999, S. 652

For the last not yet explained terms at first are written down the vectors b and j as abbreviation. With equation 27.13 we in this way immediately look at the well-known law of Ampere (1st Maxwell equation). The comparison of coefficients (27.15) in addition delivers a useful explanation to the question, what is meant by the current density j: it is a space charge density ρ_{el} consisting of negative charge carriers, which moves with the velocity v for instance through a conductor (in the x-direction).
The current density j and the to that dual potential density b mathematically seen at first are nothing but alternative vectors for an abbreviated notation. While for the current density j the physical meaning already could be clarified from the comparison with the law of Ampere, the interpretation of the potential density b still is due. From the comparison with the law of induction (eq. 27.1*) we merely infer, that according to the Maxwell theory this term is assumed to be zero. But that is exactly the Maxwell approximation and the restriction with regard to the new and dual field approach, which roots in Faraday.
In that way also the duality gets lost with the argument that magnetic monopoles (div B) in contrast to electric monopoles (div D) do not exist and until today could evade every proof. It thus is overlooked that div D at first describes only eddy currents and div B only the necessary anti-vortex, the potential vortex. Spherical particles, like e.g. charge carriers presuppose both vortices: on the inside the expanding (div D) and on the outside the contracting vortex (div B), which then necessarily has to be different from zero, even if there hasn't yet been searched for the vortices dual to eddy currents, which are expressed in the neglected term.
Assuming, a monopole concerns a special form of a field vortex, then immediately gets clear, why the search for magnetic poles has to be a dead end and their failure isn't good for a counterargument: The missing electric conductivity in vacuum prevents current densities, eddy currents and the formation of magnetic monopoles. Potential densities and potential vortices however can occur. As a result can without exception only electrically charged particles be found in the vacuum (derivation in chapter 4.2 till 4.4). Because vortices are more than monopole-like structures depending on some boundary conditions, only the vortex description will be pursued further consequently.
Let us record: Maxwell's field equations can directly be derived from the new dual field approach under a restrictive condition. Under this condition the two approaches are equivalent and with that also error free. Both follow the textbooks and can so to speak be the textbook opinion.
The restriction (b = 0) surely is meaningful and reasonable in all those cases in which the Maxwell theory is successful. It only has an effect in the domain of electrodynamics. Here usually a vector potential A is introduced and by means of the calculation of a complex dielectric constant a loss angle is determined. Mathematically the approach is correct and dielectric losses can be calculated. Physically however the result is extremely questionable, since as a consequence of a complex s a complex speed of light would result (according to the definition $c = 1/\sqrt{\varepsilon \cdot \mu}$). With that electrodynamics offends against all specifications of the textbooks, according to which c is constant and not variable and less then ever complex.
But if the result of the derivation physically is wrong, then something with the approach is wrong, then the fields in the dielectric perhaps have an entirely other nature, then dielectric losses perhaps are vortex losses of potential vortices falling apart?

- Maxwell's field equations:

$$\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt \quad \text{(law of induction)} \qquad (27.1^*)$$
$$\text{rot}\,\mathbf{H} = d\mathbf{D}/dt + \mathbf{j} \quad \text{(Ampère's law)} \qquad (27.13)$$

- describe the special case for b = 0 resp. div B = 0

$$\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt + \mathbf{v}\,\text{div}\,\mathbf{B} = -\,d\mathbf{B}/dt - \mathbf{b} \qquad (27.12)$$
$$\text{rot}\,\mathbf{H} = d\mathbf{D}/dt - \mathbf{v}\,\text{div}\,\mathbf{D} = d\mathbf{D}/dt + \mathbf{j} \qquad (27.13)$$

The physical meaning of the introduced abbreviations b and j is:

- the current density $\mathbf{j} = -\mathbf{v}\,\text{div}\,\mathbf{D} = -v_x \cdot \rho_{el}$, (27.15)
- with Ohm's law $\mathbf{j} = \sigma \cdot \mathbf{E} = \mathbf{D}/\tau_1$, and (27.16)
- the potential density $\mathbf{b} = -\mathbf{v}\,\text{div}\,\mathbf{B} = \mathbf{B}/\tau_2$,(27.17)
- with the eddy current time constant $\tau_1 = \varepsilon/\sigma$ (27.16*>
- and with the potential vortex time constant τ_2

The complete field equations (27.12 and 27.13) read, with the time constants (τ_1 and τ_2) of the respective field vortex:

- completely extended law of induction (with B = μ·H): (27.18)

$$\text{rot}\,\mathbf{E} = -\,d\mathbf{B}/dt - \mathbf{B}/\tau_2 = -\,\mu \cdot (d\mathbf{H}/dt + \mathbf{H}/\tau_2) \qquad (27.20)$$

- and the well-known law of Ampere (with D = ε·E): (27.19)

$$\text{rot}\,\mathbf{H} = d\mathbf{D}/dt + \mathbf{D}/\tau_1 = \varepsilon \cdot (d\mathbf{E}/dt + \mathbf{E}/\tau_1) \qquad (27.21)$$

Fig. 27.10: The extension of the law of induction for vortices of the electric field (potential vortices].<i>

<i>: see also fig. 5.1

27.10 Derivation of the potential vortices

Is the introduction of a vector potential A in electrodynamics a substitute of neglecting the potential density b? Do here two ways mathematically lead to the same result? And what about the physical relevance? After classic electrodynamics being dependent on working with a complex constant of material, in what is buried an unsurmountable inner contradiction, the question is asked for the freedom of contradictions of the new approach. At this point the decision will be made, if physics has to make a decision for the more efficient approach, as it always has done when a change of paradigm had to be dealt with. The abbreviations j and b are further transformed, at first the current density in Ampere's law $j = -v_x \cdot \rho_{el}$ (27.15), as the movement of negative electric charges. By means of Ohm's law $j=\sigma \cdot E$ and the relation of material $D=\varepsilon \cdot E$ the current density j also can be written down as dielectric displacement current with the characteristic relaxation time constant $\tau_1 = \varepsilon/\sigma$ (eq. 27.16) for the eddy currents. In this representation of the law of Ampere (eq. 27.21) clearly is brought to light, why the magnetic field is a vortex field, and how the eddy currents produce heat losses depending on the specific electric conductivity σ. As one sees we, with regard to the magnetic field description, move around completely in the framework of textbook physics.

Let us now consider the dual conditions. The comparison of coefficients (eq. 27.12 + 27.17) looked at purely formal, results in a potential density b in duality to the current density j, which with the help of an appropriate time constant τ_2 founds vortices of the electric field. I call these potential vortices (in eq. 27.20).

In contrast to that the Maxwell theory requires an irrotationality of the electric field, which is expressed by taking the potential density b and the divergence B equal to zero. The time constant τ_2 thereby tends towards infinity. This Maxwell approximation leads to the circumstance that with the potential vortices of the electric field also their propagation as a scalar wave gets lost, so that the Maxwell equations describe only transverse and no longitudinal waves. At this point there can occur contradictions for instance in the case of the near-field of an antenna, where longitudinal wave parts can be detected measuring technically, and such parts already are used technologically in transponder systems e.g. as installations warning of theft in big stores.

It is denominating, how they know how to help oneself in the textbooks of high-frequency technology in the case of the near-field zone[<i>]. Proceeding from the Maxwell equations the missing potential vortex is postulated without further ado, by means of the specification of a ,,standing wave" in the form of a vortex at a dipole antenna. With the help of the postulate now the longitudinal wave parts are ,,calculated", like they also are being measured, but also like they wouldn't occur without the postulate as a result of the Maxwell approximation.

There isn't a way past the potential vortices and the new dual approach, because no scientist is able to afford to exclude already in the approach a possibly authoritative phenomenon, which he wants to calculate physically correct!

<i>: Zinke, Brunswig: Lehrbuch der Hochfrequenztechnik, 1. Bd., 3. Auflage 1986 Springer-Verlag Berlin, Seite 335

- Under the assumption: E = E(r,t); H = H(r,t) ,
- using the relations of material:

$$\mathbf{B} = \mu \cdot \mathbf{H} \quad \text{and} \quad \mathbf{D} = \varepsilon \cdot \mathbf{E} \quad :$$

- the complete and extended law of induction reads:

$$\text{rot}\,\mathbf{E} = -\,\partial\mathbf{B}/\partial t - \mathbf{B}/\tau_2 = -\,\mu\cdot(\partial\mathbf{H}/\partial t + \mathbf{H}/\tau_2) \quad (27.20)$$

- and the well-known law of Ampere:

$$\text{rot}\,\mathbf{H} = \partial\mathbf{D}/\partial t + \mathbf{D}/\tau_1 = \varepsilon\cdot(\partial\mathbf{E}/\partial t + \mathbf{E}/\tau_1) \quad (27.21)$$

---

if we again apply the curl operation to eq. 27.20 and insert eq. 27.21:

$$-\,\text{rot rot}\,\mathbf{E} = \mu\cdot\partial(\text{rot}\mathbf{H})/\partial t + (\mu/\tau_2)\cdot(\text{rot}\,\mathbf{H}) \quad (27.22)$$

$$= \mu\cdot\varepsilon\cdot[\partial^2\mathbf{E}/\partial t^2 + (1/\tau_1)\cdot\partial\mathbf{E}/\partial t + (1/\tau_2)\cdot\partial\mathbf{E}/\partial t + \mathbf{E}/\tau_1\tau_2] \quad (27.23)$$

$$= (1/c^2)\cdot[\partial^2\mathbf{E}/\partial t^2 + (1/\tau_1 + 1/\tau_2)\cdot\partial\mathbf{E}/\partial t + \mathbf{E}/\tau_1\tau_2] \quad (27.24)$$

with the definition for the speed of light c:

$$\varepsilon\cdot\mu = 1/c^2 \quad (27.25)$$

the fundamental field equation reads:

$$\underbrace{-\,c^2\cdot\text{rot rot}\,\mathbf{E}}_{a} = \underbrace{\partial^2\mathbf{E}/\partial t^2}_{b\ \text{(electromagnetic wave)}} + \underbrace{(1/\tau_1)\cdot\partial\mathbf{E}/\partial t}_{c\ \text{eddy current}} + \underbrace{(1/\tau_2)\cdot\partial\mathbf{E}/\partial t}_{d\ \text{potential vortex}} + \underbrace{\mathbf{E}/\tau_1\tau_2}_{e\ \text{I/U}} \quad (27.26)$$

Fig. 27.11: Derivation of the fundamental field equation
from the equations of transformation of the electromagnetic field.<i>

<i>: The fundamental field equation mathematically describes a wave damped with the vortices of the electric and the vortices of the magnetic field. It is formulated only in space and time. From it can be deduced numerous eigenvalue equations, (i.e. the equation of Schrodinger, fig. 5.1).

27.11 Derivation of the „fundamental field equation"

The two equations of transformation and also the from that derived field equations (27.20 and 27.21) show the two sides of a medal, by mutually describing the relation between the electric and magnetic field strength (between E and H). We get on the track of the meaning of the „medal" itself, by inserting the dually formulated equations into each other. If the calculated H-field from one equation is inserted into the other equation then as a result a determining equation for the E-field remains. The same vice versa also functions to determine the H-field. Since the result formally is identical and merely the H-field vector appears at the place of the E-field vector and since it equally remains valid for the B-, the D-field and all other known field factors, the determining equation is more than only a calculation instruction. It reveals a fundamental physical principle. I call it the "fundamental field equation".

The derivation always is the same: If we again apply the curl operation to rot E (law of induction 27.20) also the other side of the equation should be subjected to the curl. If for both terms rot H is expressed by Ampere's law 27.21, then in total four terms are formed (27.26): the wave equation (a-b) with the two damping terms, on the one hand the eddy currents (a-c) and on the other hand the potential vortices (a-d) and as the fourth term the Poisson equation (a-e), which is responsible for the spatial distribution of currents and potentials <i>.

Not in a single textbook a mathematical linking of the Poisson equation with the wave equation can be found, as we here succeed in for the first time. It however is the prerequisite to be able to describe the conversion of an antenna current into electromagnetic waves near a transmitter and equally the inverse process, as it takes place at a receiver. Numerous model concepts, like they have been developed by HF- and EMC-technicians as a help, can be described mathematically correct by the physically founded field equation.

In addition further equations can be derived, for which this until now was supposed to be impossible, like for instance the Schrodinger equation (chapter 5.6-5.9). This contrary to current opinion isn't a wave equation at all, since the term (b) with the second time derivation is missing. As diffusion equation it has the task to mathematically describe field vortices and their structures.
As a consequence of the Maxwell equations in general and specifically the eddy currents not being able to form structures, every attempt has to fail, which wants to derive the Schrodinger equation from the Maxwell equations.
The fundamental field equation however contains the newly discovered potential vortices, which owing to their concentration effect (in duality to the skin effect) form spherical structures, for which reason these occur as eigenvalues of the equation. For these eigenvalue-solutions numerous practical measurements are present, which confirm their correctness and with that have probative force with regard to the correctness of the new Held approach and the fundamental field equation. By means of the pure formulation in space and time and the interchangeability of the field pointers here a physical principle is described, which fulfills all requirements, which a world equation must meet.

<i>: see also fig. 5.1

Comparison:

• The **Faraday approach** is universal	• **Maxwell's field equations** can be derived!
• It reveals a **physical principle**	• The field equations describe only a **special case**!
• The field is the cause for the particles • (Principles of causality are preserved)	• Particle and field are cause and effect at the same time • (Violation of the rules of causality)
• Particles probably are **field configurations** • Quanta can be calculated as **field vortices** (without any hypothesis) • All **quantum properties** can be **calculated** likewise	• Particles consist of hypothetic subparticles • **Quark-hypothesis** must replace missing calculation • Sorting und systematizing of the properties in the **standard-model**
• **Potential vortices** form electric field vortices (the E-field is a source free vortex field)	• The electric field is **irrotational** (the E-field is an irrotational field of sources)
• Field vortices carry momentum and form a scalar wave • Longitudinal wave with arb. velocity of propagation v	• Electromagnetic wave is a transverse wave • Constant propagation with the speed of light c
⇒ **theory of objectivity**	⇒ **theory of relativity**

Fig. 27.12: Comparison of the field-theoretical approaches according to Faradav and according to Maxwell.

27.12 The Maxwell field as a derived special case

As the derivations show, nobody can claim there wouldn't exist potential vortices and no propagation as a scalar wave, since only the Maxwell equations are to blame that these already have been factored out in the approach. One has to know that the field equations, and may they be as famous as they are, are nothing but a special case, which can be derived.

The field-theoretical approach however, which among others bases on the Faraday-law, is universal and can't be derived on its part. It describes a physical basic principle, the alternating of two dual experience or observation factors, their overlapping and mixing by continually mixing up cause and effect. It is a philosophic approach, free of materialistic or quantum physical concepts of any particles.

Maxwell on the other hand describes without exception the fields of charged particles, the electric field of resting and the magnetic field as a result of moving charges. The charge carriers are postulated for this purpose, so that their origin and their inner structure remain unsettled and can't be derived. The subdivision e.g. in quarks stays in the domain of a hypothesis, which can't be proven. The sorting and systematizing of the properties of particles in the standard-model is nothing more than unsatisfying comfort for the missing calculability.

With the field-theoretical approach however the elementary particles with all quantum properties can be calculated as field vortices (chap. 7). With that the field is the cause for the particles and their measurable quantization. The electric vortex field, at first source free, is itself forming its field sources in form of potential vortex structures. The formation of charge carriers in this way can be explained and proven mathematically, physically, graphically and experimentally understandable according to the model.

Where in the past the Maxwell theory has been the approach, there in the future should be proceeded from the equations of transformation of the field-theoretical approach. If now potential vortex phenomena occur, then these also should be interpreted as such in the sense of the approach and the derivation, then the introduction and postulation of new and decoupled model descriptions isn't allowed anymore, like the near-field effects of an antenna, the noise, dielectric capacitor losses, the mode of the light and a lot else more.

The at present in theoretical physics normal scam of at first putting a phenomenon to zero, to afterwards postulate it anew with the help of a more or less suitable model, leads to a breaking up of physics into apparently not connected individual disciplines and an inefficient specialisthood. There must be an end to this now! The new approach shows the way towards a unified theory, in which the different areas of physics again fuse to one area. In this lies the big chance of this approach, even if many of the specialists at first should still revolt against it.

This new and unified view of physics shall be summarized with the term "theory of objectivity". As we shall derive, it will be possible to deduce the theory of relativity as a partial aspect of it (chapter 6 and 28).

Let us first cast our eyes over the wave propagation.

- Starting-point: the fundamental field equation

$$-c^2 \cdot \text{rot rot } \mathbf{B} = \frac{d^2\mathbf{B}}{dt^2} + \frac{1}{\tau_2}\frac{d\mathbf{B}}{dt} + \frac{1}{\tau_1}\frac{d\mathbf{B}}{dt} + \frac{\mathbf{B}}{\tau_1\tau_2} \quad (27.26^*)$$

- with a magnetic flux density B = B(r(t)).

1st condition for eq. 27.26*: the special case, if $\sigma=0$ and $\sigma/\varepsilon = \boxed{(1/\tau_1) = 0}$. (27.16*)

The remaining vortex term is transformed by applying already used relations (eq. 27.10 and eq. 27.17):

$$\frac{1}{\tau_2} \cdot \frac{d\mathbf{B}}{dt} = \mathbf{v} \cdot \text{grad} \frac{\mathbf{B}}{\tau_2} \quad (27.10) \qquad \frac{\mathbf{B}}{\tau_2} = -\mathbf{v} \cdot \text{div } \mathbf{B} \quad . (27.17)$$

If the velocity of propagation: $v = (v_x, v_y=0, v_z=0)$; $v = dx/dt$, then the simplified field equation (if the coordinates are orientated on the vector of velocity) results in the general wave equation (involved with the x-component) in the form:

$$\|\mathbf{v}\|^2 \text{ grad div } \mathbf{B} - c^2 \text{ rot rot } \mathbf{B} = d^2\mathbf{B}/dt^2 \quad (27.27)$$

longitudinal with v = arbitrary	transverse with c = const.	wave velocity of propagation

---

2nd condition for eq. 27.28: v = c .

The wave equation in the usual notation (= inhomogeneous Laplace equation, = purely a special case!) now reads:

$$\Delta\mathbf{B} = \text{grad div } \mathbf{B} - \text{rot rot } \mathbf{B} = (1/c^2) \cdot d^2\mathbf{B}/dt^2 \quad (27.28)$$

Fig. 27.13: Derivation of the wave equations (inhomogeneous Laplace equation) as a special case of the equations of transformation of the electromagnetic field.

27.13 Derivation of the wave equation

The first wave description, model for the light theory of Maxwell, was the inhomogeneous Laplace equation:

$$\boxed{\Delta \mathbf{E} \cdot c^2 = d^2\mathbf{E}/dt^2} \quad \text{with} \quad \boxed{\Delta \mathbf{E} = \text{grad div } \mathbf{E} - \text{rot rot } \mathbf{E}} \qquad (27.28^*)$$

There are asked some questions:

- Can also this mathematical wave description be derived from the new approach?
- Is it only a special case and how do the boundary conditions read?
- In this case how should it be interpreted physically?
- Are new properties present, which can lead to new technologies?

Starting-point is the fundamental field equation (27.26). We thereby should remember the interchangeability of the field pointers, that the equation doesn't change its form, if it is derived for H, for B, for D or any other field factor instead of for the E-field pointer. This time we write it down for the magnetic induction B and consider the special case, that we are located in a badly conducting medium, as is usual for the wave propagation in air. But with the electric conductivity σ also $1/\tau_1 = \sigma/\varepsilon$ tends towards zero (eq. 27.16*). With that the eddy currents and their damping and other properties disappear from the field equation, what also makes sense. There remains the potential vortex term $(1/\tau_2)$*dB/dt , which using the already introduced relations (eq. 27.10 and 27.17) involved with an in x-direction propagating wave ($v = (v_x, v_y = 0, v_z = 0)$) can be transformed directly into:

$$-\|\mathbf{v}\|^2 \cdot \text{grad div } \mathbf{B}$$

The divergence of a field vector (here B) mathematically seen is a scalar, for which reason this term as part of the wave equation founds so-called „scalar waves" and that means that potential vortices, as far as they exist, will appear as a scalar wave. We at this point tacitly anticipate chapter 28, which provides the reason for the speed of light losing its vectorial nature, if it is correlated with itself. This insight however is valid in general for all velocities (v = dr/dt), so that in the same way a scalar descriptive factor can be used for the velocity (v = dx/dt) as for c.

From the simplified field equation (27.26*) the general wave equation (27.27) can be won in the shown way, divided into longitudinal and transverse wave parts, which however can propagate with different velocity.

Physically seen the vortices have particle nature as a consequence of their structure forming property. With that they carry momentum, which puts them in a position to form a longitudinal shock wave similar to a sound wave. If the propagation of the light one time takes place as a wave and another time as a particle, then this simply and solely is a consequence of the wave equation. Light quanta should be interpreted as evidence for the existence of scalar waves. Here however also occurs the restriction that light always propagates with the speed of light. It concerns the special case v = c. With that the derived wave equation (27.27) changes into the inhomogeneous Laplace equation (27.28). The electromagnetic wave in both cases is propagating with c. As a transverse wave the field vectors are standing perpendicular to the direction of propagation. The velocity of propagation therefore is decoupled and constant. Completely different is the case for the longitudinal wave. Here the propagation takes place in the direction of an oscillating field pointer, so that the phase velocity permanently is changing and merely an average group velocity can be given for the propagation. There exists no restriction for v and v = c only describes a special case.

• From the dual field-theoretical approach are derived:	From Maxwell's field equations can be derived:
=> Maxwell's field equations	=> 0
=> the wave equation (with transverse and longitudinal parts)	=> only transverse waves (no longitudinal waves)
=> scalar waves (Tesla-/neutrino radiation)	=> 0 (no scalar waves)
=> vortex and anti-vortex (current eddy and potential vortex)	=> only eddy currents
=> Schrodinger equation (basic equation of chemistry)	=>0
=> Klein-Gordon equation (basic eq. of nuclear physics)	=>0

Fig. 27.14: Comparison of the efficiency of both approaches.

(as an interim result, if it concerns the question, which approach of the two is the more efficient one and which one better should be discarded. The final balance is made in chapter 28).
It here concerns partial aspects of the following theories:

=> theory of objectivity	=> theory of relativity

27.14 The new field approach in synopsis

Proof could be furnished that an approximation is buried in Maxwell's field equations and that they merely represent the special case of a new, dually formulated and more universal approach. The mathematical derivations of the Maxwell field and the wave equation disclose, of what the Maxwell approximation consists. The anti-vortex dual to the expanding eddy current with its skin effect is neglected. This contracting anti-vortex is called potential vortex. It is capable of forming structures and propagates as a scalar wave in longitudinal manner in badly conducting media like air or vacuum.

At relativistic velocities the potential vortices are subject to the Lorentz contraction. Since for scalar waves the propagation occurs longitudinally in the direction of an oscillating field pointer, the potential vortices experience a constant oscillation of size as a result of the oscillating propagation. If one imagines the field vortex as a planar but rolled up transverse wave, then from the oscillation of size and with that of wavelength at constant swirl velocity with c follows a continual change in frequency, which is measured as a noise signal.

The noise proves to be the in the Maxwell equations neglected potential vortex term, which founds scalar waves. If at biological or technical systems, e.g. at antennas a noise signal is being measured, then that proves the existence of potential vortices, but it then also means that the scope of the Maxwell theory has been exceeded and erroneous concepts can be the result.

As an answer to the question about possible new technologies is pointed to two special properties.

1st potential vortices for reason of their particle nature carry momentum and energy. Since we are surrounded by noise vortices, an energy technical use of scalar waves would be feasible, where the noise power is withdrawn of the surroundings. There is evidence that biological systems in nature cover their need for energy in this way. But at least an energy transmission with scalar waves already would be a significant progress with regard to the alternating current technology of today.

2nd the wavelength multiplied with the frequency results in the velocity of propagation v of a wave $(\lambda \cdot f = v)$, and that for scalar waves by no means is constant. With that wavelength and frequency aren't coupled anymore; they can be modulated separately, for which reason for scalar waves a whole dimension can be modulated additionally compared to the Hertzian wave. In that the reason can be seen, why the human brain with just 10 Hz clock frequency is considerably more efficient than modern computers with more than 1 GHz clock frequency. Nature always works with the best technology, even if we haven't yet understood it.

If we would try to learn of nature and an energy technical or an information technical use of scalar waves would occur, then probably nobody wanted to have our today still highly praised technology anymore. In the course of the greenhouse gases and the electrosmog we have no other choice than to scientifically occupy us with scalar waves and their technical use.

Equations of transformation

of the electric and of the magnetic field[i]

$$\boxed{\mathbf{E} = \mathbf{v} \times \mathbf{B}} \quad (27.1) \text{ and } \quad \boxed{\mathbf{H} = -\mathbf{v} \times \mathbf{D}} \quad (27.2)$$

with: $\mathbf{B} = \mu \cdot \mathbf{H}$ (28.1) and $\mathbf{D} = \varepsilon \cdot \mathbf{E}$ (28.2)

$$\boxed{\mathbf{E} = \mu \cdot \mathbf{v} \times \mathbf{H}} \quad (27.3) \text{ and } \quad \boxed{\mathbf{H} = -\varepsilon \cdot \mathbf{v} \times \mathbf{E}} \quad (27.4)$$

Experience/observation is dependent on the relative velocity v !

Written down in general with field vectors:		Written down in components in Cartesian coordinates: (unit vectors $\mathbf{e}_x$, $\mathbf{e}_y$, $\mathbf{e}_z$)	
	in $\mathbf{e}_x$-direction:	$\mathbf{v} = v_x(x(t)) = dx/dt$	
$\mathbf{H} = -\varepsilon \cdot \mathbf{v} \times \mathbf{E}$	in $\mathbf{e}_y$-direction:	$\mathbf{H} = -H_y = -\varepsilon \cdot v_x \cdot E_z$	
$\mathbf{E} = \mu \cdot \mathbf{v} \times \mathbf{H}$	in $\mathbf{e}_z$-direction:	$\mathbf{E} = E_z = \mu \cdot v_x \cdot H_y$	
inserted into each other:			(28.3)
$\mathbf{E} = -\varepsilon \cdot \mu \cdot [\mathbf{v} \times (\mathbf{v} \times \mathbf{E})]$	in $\mathbf{e}_z$-direction:	$E_z = \varepsilon \cdot \mu \cdot v_x \cdot v_x \cdot E_z$	
$\mathbf{E} = -(1/c^2) \cdot [\mathbf{v} \cdot \underbrace{(\mathbf{v} \cdot \mathbf{E})}_{=0, \text{ since } \perp} - \mathbf{E} \cdot (\mathbf{v} \cdot \mathbf{v})]$		$E_z = (1/c^2) \cdot v_x^2 \cdot E_z$	
$\mathbf{E} = +(\mathbf{v}^2/c^2) \cdot \mathbf{E}$	resp.:	$E_z = (v_x^2/c^2) \cdot E_z$	(28.4)
result:[ii]	$\boxed{v = c}$		(28.5)

Fig. 28.1: The equations of transformation,[i]

<i>: see part 1, chap. 6.5, eq. 60
<ii>: R. W. Pohl: Einfuhrung in die Physik, Bd. 2 Elektrizitatslehre, 21. Aufl. Springer-Verlag 1975, Seite 77, s.a. Kommentar auf Tafel 27.8
<iii>: chapter 28 is a repetition of chapter 6

28. Objectivity versus relativity

The new and field-theoretical approach contains the Maxwell-equations, but goes over and above these in one point. It describes potential vortices and their propagation in space as a scalar wave. With that can also a conclusive answer be given to the often-asked question for the medium and the mediated particles, which is a prerequisite for every longitudinal wave. Mediated are vortex structures with particle nature and the field itself functions as a medium. Is with that also answered the question concerning the aether?[iii]

28.1 The question concerning the aether

Do you know the Maxwell-experiment? No, you wouldn't be able to, since the intellectual father fast did make a backdown, after it didn't work out. Today one speaks of the Michelson-experiment and it may be connected with any other names (Morley, etc.). Remember: In his light theory Maxwell had determined a particular and constant value for the speed of light and for that there should be a physical reason, which should have its cause in the aether. By means of proving this aether Maxwell wanted to prove his theory, but this enterprise thoroughly went wrong.
The consideration was as follows: If the Earth is spinning and is moving through the cosmos, then one should be able to detect an aetherwind and different values for c in the different points of the compass. Maxwell found support for his project at the observatory, since with the aberration of the stars Bradley previously had described an observation, which could be considered as evidence for an aether. The director of the observatory charged his assistant Dr. Michelson with the task, to carry out a corresponding proof of an aether this time in a terrestrial experiment. But such an aether couldn't be proven, what Maxwell had to accept as a severe strike against his light theory. Seven years later Maxwell got the acknowledgement, however from a completely other corner by means of the experiments concerning the radio transmission of Heinrich Hertz.

Until today the question has remained open why astrophysics can prove the aether, whereas the detection in a terrestrial laboratory fails and it looks like there doesn't exist an aether. But as definition for the cause of c the aether can't be abolished as long as it is unsettled why the light is propagating with c of all possible velocities. The question is asked, what determines the propagation of light from today's point of view? Now, by means of outside fields the light can be slowed down. At present the world record lies at less than 65 kilometers per hour in a Bose-Einstein condensate. If electromagnetic fields determine the speed of light, if in addition field or gravitational lenses should confirm this, then the field takes over the task of the aether!

At this place the new field-theoretical approach shows its capabilities. The equations of transformation say nothing but that a moving H-field transforms to a resting E-field and vice versa, that thus in the place of a moving aether, the aetherwind, a resting aether is found. Doing so the dual field partners merely exchange their places. Therefore it is a wild-goose chase, wanting to measure an aetherwind with gauges, which underlie the same field (fig. 28.2).
Michelson had to fail.

The equations of transformation say:

$$\mathbf{E} = \mu \cdot \mathbf{v} \times \mathbf{H} \quad (27.3) \text{ and } \quad \mathbf{H} = -\varepsilon \cdot \mathbf{v} \times \mathbf{E} \quad (27.4)$$

- Experience/observation depends on the relative velocity v!
- The field takes over the function of the aether (determines c) and
- an aetherwind v x H is measured as a resting aether E and vice versa!

- for v = c the equations of transformation turn into each other and are identical [$v = v_x(x(t))$].
- for v < c a motion field E_v depending on v is resulting

$$E_v = E \cdot (v^2/c^2) \quad (28.6)$$

- for v = 0 also $E_v = 0$.
- the motion field overlaps the E-field
- in the case of vortex fields the effect overlaps the cause and itself is the cause for a new effect.
- The overlap reaches to infinity, where each time is valid:

$$E_{n+1} = E_n \cdot (v^2/c^2) \quad (28.7)$$

- the field Eo overlaps the motion field E_v

$$E = E_0 + E_v = E_0 \cdot (1 + v^2/c^2) \quad (28.8)$$

- for infinite overlap:

$$E = E_0 + E_1 + E_2 + E_3 + E_4 + \ldots + E_n + E_{n+1} + \ldots \quad (28.9)$$

- results in the power series:

$$E = E_0 \cdot [1 + (v/c)^2 + (v/c)^4 + (v/c)^6 + \ldots + (v/c)^{2n} + (v/c)^{2(n+1)} + \ldots] \quad (28.10)$$

Fig. 28.2: Power series as a result of a vortex overlap.

<i>: Grimsehl: Lehrbuch der Physik, 2.Bd., 17.Aufl. Teubner Verl. 1967, S. 130.

<ii>: R.W.Pohl: Einfuhrung in die Physik, Bd.2 Elektrizitatslehre, 21.Aufl. Springer-Verlag 1975, Seite 72 und 76, bzw. 130.

<iii>: K. Simonyi: Theoretische Elektrotechnik, 7.Aufl. VEB Berlin 1979, Seite 924.

<i4>: E. Friebe: Die Vektorprodukte der Maxwell'schen Elektrodynamik, DPG-Didaktik-Tagungsband 1995, S.396

28.2 Vortices, an overlap of the overlap

Not with any approach until now the question concerning the aether could be solved. Only the new field-theoretical approach proves with the unambiguous and free of contradiction clarification of the question concerning the aether its unmatched superiority. We hence without exception work with this approach, which is anchored tightly in textbook physics. The two equations of transformation on the one hand are the law concerning the unipolar induction according to Faraday (27.1) and on the other hand the dual formulation (27.2), which Grimsehl[<i>] calls convection equation. Grimsehl goes around the question for the correct sign by means of forming a modulus. Pohl draws detailed distinctions of cases and dictates the each time relevant formulation of the dual law[<ii>]. The sign eventually should be chosen according to the definition of the orientation of the field pointers. Also Simonyi gives both equations and the each time appropriate experiments[<iii>].

If we assume the carrier of an electric field is moving with the not accelerated relative velocity v with regard to the reference system used by the observer, then a magnetic H-field is observed, which stands perpendicular both to the direction of the E-field and to the direction of v. If the motion takes place perpendicular to the area stretched by E- and H-field, then the H-field again is observed and measured as an E-field. There will occur an overlap of the fields.
In spite of that we first consider the theoretical case, that no overlap is present, and the observer as it were sees himself. The result is trivial: the relative velocity v must be the speed of light $v = c$. (28.5) If considered at the speed of light, the two equations of transformation turn into each other. They now are identical both mathematically and in their physical expressiveness. For this case it actually is possible, to derive the dual law straight from the Faraday law. For a wave propagating with the speed of light, to name an example, the field strength propagating along is always equal to the causing field strength, which depends on position.
If besides the evaluation of the values also the circumstance is considered that it concerns vectors, then at this place a problem as a matter of principle of the Maxwell theory gets visible, to which has been pointed occasionally, e.g. at the German Physical Society[<i4>]. The derivation of the speed of light from two vector equations requires, that c also has to be a vector. The question is: How the velocity vector v suddenly becomes the scalar and not pointing, in all directions of space constant factor c? Is therefore for mathematical and physical reasons "the Maxwell theory in essential parts erroneous", according to a statement of the German Patent Office[<i4>]?
Now, the constancy of the speed of light is a fact, which even can be derived. We at first will be content with the clue that for every observation with the speed of light, with the eyes or a gauge constructed corresponding to our perception, the vector in all its components each time is correlated to itself, by what actually the orientation of direction gets lost. Under these for c and with equal rights also for v relevant circumstances we are entitled to calculate further with the values.
An observer, who is moving with v slower than c, will besides the original E-field also observe a motion field E_v depending on the velocity v, which disappears, if v becomes zero. What he catches sight of and is able to register with gauges in the end is the overlap of both field components.

- concerning the development of the power series:

$$E = E_0 \cdot [1 + (v/c)^2 + (v/c)^4 + (v/c)^6 + \ldots + (v/c)^{2n} + (v/c)^{2(n+1)} + \ldots] \quad (28.10)$$

- for $q < 1$ the power series with $q = (v/c)^2$ will converge (28.11)

$$\sum_{n=0}^{\infty} q^n = \frac{1}{1-q} \quad (28.12)$$

- for $(v/c)^2 < 1$ resp. for $v < c$ therefore is valid:

$$E = E_0 \cdot [1/1 - (v/c)^2] \quad \text{resp.} \quad \boxed{E_0 = E \cdot [1 - (v/c)^2]} \quad (28.13)$$

The square root of Lorentz appears in squared form<i>:

$$\left(1 - \frac{v^2}{c^2}\right) = \frac{E_0}{E} \quad (28.14)$$

The derivation for the magnetic field strength analogous to that provides the identical result<i>:

$$\left(1 - \frac{v^2}{c^2}\right) = \frac{H_0}{H} \quad (28.15)$$

Fig. 28.3 The field dilatation depending on velocity

<i>: see part 1, chap. 6.6

<ii>: Prof. Dr. H.-J. Runckel, Abteilung fur Mathematik IV der Universitat Ulm

28.3 Field overlap

But it doesn't abide by this one overlap. In the case of vortex fields the effect overlaps the cause and itself becomes the cause for a new effect. The overlapped cause produces a further effect, which for its part is overlapping (see chap. 3).

Vortices thus arise, if overlaps for their part are overlapping and that theoretically reaches to infinity, to which I already repeatedly have pointed (fig. 3.0). In addition do vortices represent a fundamental physical principle. The Greek philosopher Demokrit has traced back the whole nature to vortex formation and that already 2500 years ago!

In the field-theoretical approach this interpretation seems to experience a mathematical confirmation, since also the fields are overlapping in vortex structures. According to that we owe our observations and our being the relative movements and the vortex formation. If reversed there wouldn't be any movement, then there also would not exist fields, light nor matter. If we observe the sky, then everything visible follows the movement of its own of the Earth, of the solar system and the whole galaxy, which is on its way with unknown galactic velocity, and all movements take place in vortex structures (fig. 10.2).

The field overlap dictated by the Faraday-approach as well reaches to infinity, what has stimulated my colleagues of mathematics to also mathematically put into practice this physical requirement[ii]. This leads to an infinite power series, which converges under the condition that $v < c$.

As a result of the power series development the well-known square root $\sqrt{1-(v^2/c^2)}$ of Lorentz occurs in squared form (see also fig. 6.6). It determines the relation of the observed and the causing field strength of the electric or the magnetic field. Physically the found relation describes a dilatation field depending on velocity. The field strength thus increases, if the relative velocity v increases, or inversely no difference is observable anymore, if v tends towards zero.

Whoever wants to compete with Albert Einstein (1879-1955), who has developed the theory of relativity from the length contraction, which depends on velocity, could be inclined to derive a new field physics from the field dilatation. But I must warn of such a step. The derivation of the length contraction by the mathematician Hendrik Lorentz (Lorentz contraction) assumes a number of limiting conditions. The relative velocity v for instance may not experience any acceleration. Actually however almost all motion takes place as circular vortex motion, so that due to the occurring centripetal acceleration the conditions for the theory of relativity aren't fulfilled anymore. Neglects or generalizations thereby can lead to considerable errors, of which I would like to warn. It in general is a delicate enterprise, if one wants to provide a physical interpretation for a purely mathematically won result.

This warning to the same extent also is valid for the here shown derivation of the field dilatation. The limiting conditions practically are the same as for Einstein and the problems with a provided physical interpretation won't be less. Also here lots of paradoxes will occur, which are nothing but errors of the theory. So we won't reach our destination.

There now only one further mathematical step is necessary, which links the theory of relativity with the new notion of a field dilatation depending on velocity.

Example:
Measurement of length by means of a measurement of propagation time (sound or light) with c = L/t in a vehicle moving with v.

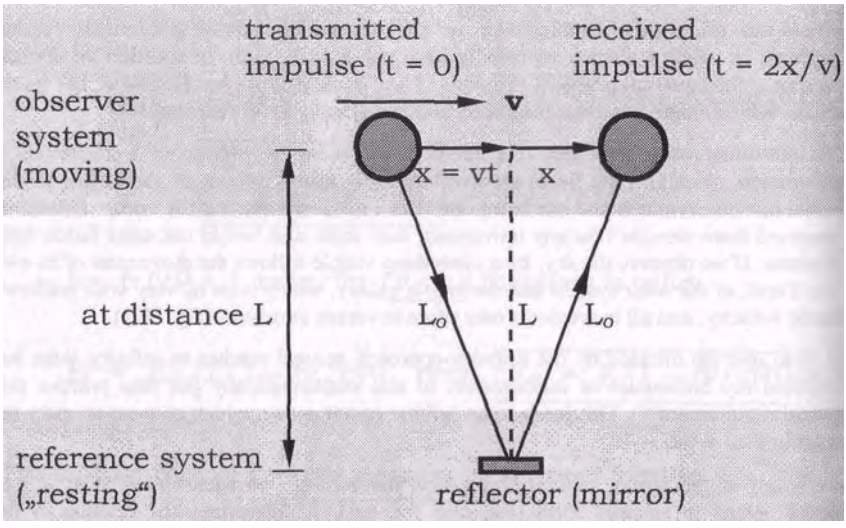

From driving time t:

$t = 2\frac{x}{v}$ = signal propagation time: $t = 2\frac{L_o}{c}$ follows $\frac{x}{v} = \frac{L_o}{c}$

According to Pythagoras: $L_o^2 = L^2 + x^2 = L^2 + L_o^2 \cdot (v^2/c^2)$

$$L_o^2 \cdot (1 - v^2/c^2) = L^2$$

the shortening of the rule results in:

$$\left(1 - \frac{v^2}{c^2}\right) = \left(\frac{L}{L_o}\right)^2 \quad (28.16)$$

Fig. 28,4: _____Derivation of the length contraction

Examples: contraction according to Lorentz transformation, measurable length shortening, curvature of space.

Counterexample: unsuccessful aether detection (Michelson experiment)

28.4 The derivation of the length contraction

The Lorentz transformation is the result of a purely mathematical problem. Stimulated by the surprisingly result of the Michelson experiment the Dutchman Hendrik A. Lorentz 1891 asked himself, how the equations of the Galilei-transformation would have to look like, if the propagation of light wouldn't be infinitely fast but finite and constant. He thereby proceeds from the assumption of two inertial systems moving against one another with a not accelerated velocity v, in which the laws of Newtonian physics are equally valid[<i>]. As a result of the relative motion a change of the length measures will occur.

This at first can be explained as a purely geometric effect in the context of nonrelativistic physics. We imagine a vehicle, which is on its way with constant velocity, and emits an optical or acoustical signal. Sideways in the countryside is standing in a perpendicularly measured distance L a reflector (mirror), which sends the signal back again. The velocity of the signal however isn't infinitely fast and from that follows that the vehicle during the propagation time of the signal as well has moved a bit further. The actual way, which the signal had to cover now amounts to L_o (> L). The distance measure thus is observed smaller as it is in reality, to be specific for the factor of the square root of Lorentz (fig. 28.4).

$$L = L_o \cdot \sqrt{1-(v^2/c^2)} \quad (28.16)$$

According to the principle of relativity it doesn't play a role, if the vehicle is driving or if it is standing still and the mirror is moving with a linear uniform velocity.

Initially Einstein also only spoke of an observable length contraction, which must not necessarily occur in reality, an optical deception so to speak. Lorentz however proceeded from the assumption of a physical length change, thus a length change existing in reality, what in practice at first makes no difference. If e.g. at relativistic velocities a rocket becomes smaller, then the pilot equally shrinks, so that it would not be possible to notice a present difference.

If however the observer stands outside the events and takes a „neutral standpoint", then he will be able to see, which interpretation is the right one. Today some examples are known. In accelerators particles at relativistic fast velocities actually get smaller for the factor of the square root of Lorentz. That has been proven and this result afterwards gives the Dutchman Lorentz right! The followers of the physical length contraction also are called Neo-Lorentzians.

In the vicinity of a gravitational mass the speed of light becomes so slow, that the shortening factor plays a role and space is curved towards the mass. To understand this shortening of scale, the influence of the field also should be considered.

<i>: Example: In a closed lift physical experiments are being carried out. Accelerations of the lift have an influence on the experiments. However no influence can be detected, if the lift is standing still or is moving with constant velocity. It with that fulfills the conditions of an inertial system. The question is: what do the experiments show someone standing outside, whom the lift passes by?

From the comparison of the Lorentz contraction (28.16)
with the field dilatation (28.14 and 28.15)

$$\left(1 - \frac{v^2}{c^2}\right) = \left(\frac{L}{L_o}\right)^2 \overset{!}{=} \left(1 - \frac{v^2}{c^2}\right) = \frac{E_o}{E} = \frac{H_o}{H}$$

follows

$$\left(1 - \frac{v^2}{c^2}\right) = \left(\frac{L}{L_o}\right)^2 = \frac{E_o}{E} = \frac{H_o}{H} \quad (28.17)$$

the proportionality (length measures depending on field):

$$E, H \sim 1/L^2 \quad \text{and} \quad Eo, Ho \sim 1/L_0^2 \quad (28.18)$$

Experimental examples<i>:

- Electrostriction (piezo speaker)
- Magnetostriction
- Field or gravitational lenses
- Curvature of space, deflection of light

Conclusion<ii>:

- The field determines the length measures (what is 1 meter)
- The field determines the velocities v (in m/s)
- The field determines the speed of light c [m/s]
- Measurement of the speed of light is made with itself:

$$c \sim r \quad (28.19)$$

- Measured is a constant of measurement c = 300.000 km/s
- The speed of light c is not a constant of nature!

Fig. 28.5: The dependence of the Lorentz contraction on the field

<i>: see part 1, chap. 6.10
<ii>: see part 1, chap. 6.11

28.5 The dependence of the Lorentz contraction on the field

The two results of the field dilatation (28.14 and 28.15) and of the Lorentz contraction (28.16) must be brought together and compared (28.17). Doing so the mathematical expression of the square root of Lorentz is cancelled out. That is of utmost importance, since with that also all limits disappear and there remains a purely physical relation, a proportionality of utmost importance (28.18).

What was the sense of the limits associated with the introduction of so-called inertial systems, which are the basis of the Lorentz transformation and which were adopted for our derivation of the field dilatation? They now only are auxiliary considerations according to model. We have chosen a very simple model, which can be described mathematically, in which an observer holds in his hand gauges for distances and field strengths and with that gauges a system flying by with constant velocity. He on the one hand determines a length contraction and on the other hand a field dilatation. He compares both with each other and comes to the conclusion: The field determines the dimensions!

This statement is purely physical and it is generally valid. It is independent of the relative velocity and all other mathematical conditions. A centrally accelerated circular motion e.g. will falsify the length contraction to the same extent, as the at the same time occurring field dilatation. It can be expected, that in addition to the square root of Lorentz also other errors will mutually efface, so that a generalization in this case actually seems to be allowed.

The won proportionality is of most elementary importance. We use it in the case of the piezo speaker and know it from the curvature of space and deflection of light in presence of extreme fields. If we ourselves however are exposed to the field as an observer, in which also the object to be observed is situated, then we are in the dilemma, not being able to perceive the influence. If we, to stay with the example, would sit in a rocket and this would become smaller at faster velocity, then we would notice nothing, since we also would shrink along to the same extent.

That concerns every measurement of velocity in general and the speed of light c in particular, which as is well-known is measured in meters per second. But if the field determines c and in the same way the length measure, which is given in meters, then both stand in a direct proportionality to each other, then we won't have the slightest chance to measure the speed of light. If namely c is changed, then this concerns the measurement path in the same way. Now the variable is measured with itself and as a result appears c, a constant value. We neither can see the change, since our eyes scan all objects optically and that means with c.

It is the nightmare of each and every measurement engineer, if the gauge depends on the factor to be measured. No wonder, if the theorem of addition of the velocities apparently loses its validity and always the same c is being measured, independent of the direction in which the source of radiation is moving (chap. 6.11). The result is:

The speed of light is a constant of measurement and not a constant of nature!

If however the light is scanned with the speed of light, then also all components of the light vector correlated with themselves result in the same constant value c, then actually the vector of the speed of light loses its orientation in space and becomes a scalar factor. The Maxwell equations already anticipate this circumstance, but without providing an explanation why this is correct. Only the new field approach can answer the open question. With the derivation an axiom of physics - one also can say stumbling block - has been overcome.

The field strength determines the length measure:
(the distance L between the spheres)<i>

$$E, H \sim 1/L^2 \quad (28.18)$$

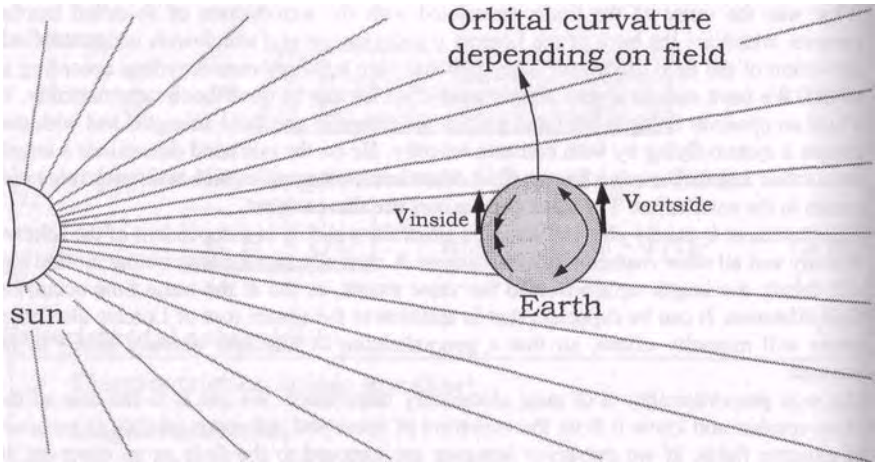

Fig. 28.6 A: The curvature of the Earth in the gravitational field of the sun

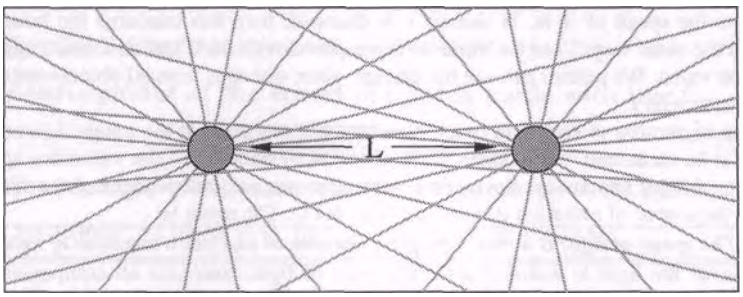

Fig. 28.6 B: Force of attraction and reduction of the distance L
as the mutual field influence of two masses.

<i>: Repetition of part 1, chapter 6.7

28.6 Boscovich and the respiration of the Earth

Who has got a good idea, fast will find that some other scientist had the same idea already before, and for his part possibly already had to make the same experience. If in spite of that the track fast loses in history, it as a rule is because of the insufficient citing and the vanity of the discoverers, who in reality only are rediscoverers of a much older knowledge.

The dependence of the length measures on the field (eq. 28.18) in the mathematical form of the derivation however should still be quite new. But the physical consequence already was described by the Jesuit priest Roger Joseph Boscovich from Dalmatia in 1755[<i>]. He was Professor for mathematics and theology in Rome and spoke about the world on the one hand being deformable, similar to rubber, but on the other hand we aren't able to perceive this, since our body is made of the same material and follows all changes. „We in an absolute way can recognize neither the place, nor distances or orders of magnitude", writes Boscovich in his book about space and time and writes how these are perceived by us[<ii>]. He suspects that the Earth unobservable for man „is respiring".

Actually a terrestrial observer at daytime is situated closer to the sun than in the night. He by day is exposed to a slightly stronger field and as a result correspondingly smaller. He himself and all objects in his neighbourhood are subject to an identical fluctuation of size, so that this „respiration" of the Earth cannot be detected. It can be detected neither with a tape measure nor with an optical measurement and still is present in reality. Only from a neutral standpoint we can succeed to recognize the actually existing curvature of space (fig. 28.6 A).
An example is the duration of the sunshine at the equator, which is longer than can be expected from the spherical form of the Earth. This reveals, how the Earth is bending towards the sun (see also chapter 6.7).
A further example is the influence of the field on the orbital velocity of the Earth measured in meters per second. Here also the meter at daytime is smaller than in the night, for which reason the Earth is moving slower on the side turned towards the sun, like a track vehicle, which drives a turn, if the chain at the inside runs slower than on the outside. If the Earth describes an orbit around the sun. then this circumstance has to do nothing at all with centrifugal force or with a force of attraction of the sun. The circular motion simply and solely is a result of the field influence of the sun[<iii>].

The force idea proves to be a pure auxiliary description. In the context of Newtonian mechanics the force plays a central role. Without question it is a very efficient and subjective perceptible description, which still isn't able to reproduce the physical reality in an objective manner. What keeps the planets into their orbit is only the field of the sun, which we call gravitational field and not some force! But of which kind is the gravitation and the field, which causes masses to come closer together and following our subjective observation attract each other (fig. 28.6 B)?

<i>: O. E. Rossler: Endophysics, the World as an Interface, World Scientific Publishing Co. 1998, Kap. 10, S. 87-112, mit Ubersetzungen aus <ii>:

<ii>: R. J. Boscovich: De spatio et tempore, ut a nobis cognoscuntur, 1755.

The length measure (the distance L between the spheres)<i> is determined by the field strength:

$$E, H \sim 1/L^2 \quad (28.18)$$

A. Charged mass points (electrons, positrons, ions,...):

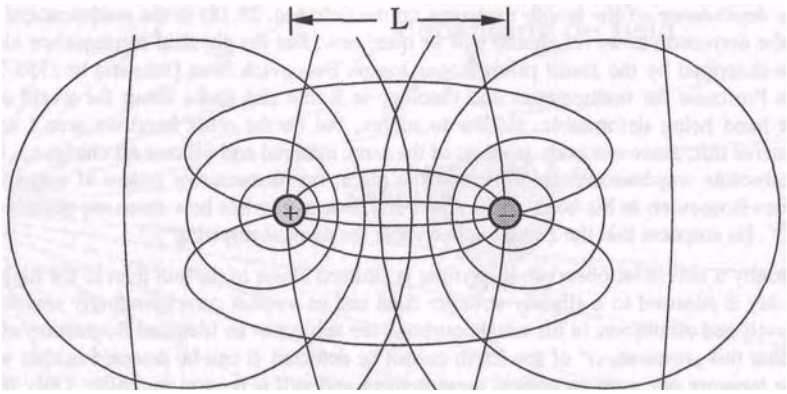

B. Uncharged mass points (neutrons, atoms, ...):

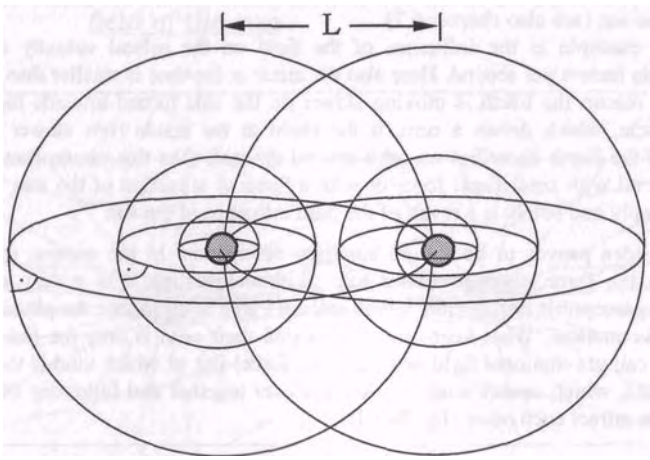

Fig. 28.7: Observation of a mutual force of attraction because of the effect of the fields on the distance measure.

<i>: Repetition of part 1, chapters 6.7 - 6.9 and part 2, chapters 10.4 and 15.2

28.7 Derivation of the gravitation

In fig. 28.6B the relation between the field influence and the observed force of attraction of two mass bodies is represented. If I in my mind for instance "switch on" the field lines of both bodies, which are placed at distance L, then the fields according to equation 28.18 reduce the measure L and optically come each other closer. With increasing proximity the field line density increases, so that L further decreases. We observe a mutual attraction, which lets both bodies move towards each other.

In fig. 28.7A the two bodies carry an electric charge. For different polarity the field lines as is well-known run from the positive pole to the negative pole, to bundle up there. As a matter of principle also here an attraction can be expected, which is called electromagnetic interaction. For the reason of the bundling up of the field lines this effect however will turn out to be considerably stronger. Hence the electromagnetic interaction is for many powers of ten more powerful than the gravitation.

Furthermore there also can occur repulsion, if in the case of like charge the field lines are bent aside and between the two bodies an area is formed, where the field tends towards zero and the distance measure L (according to eq. 28.18) as a result towards infinity. The electromagnetic interaction theoretically indeed reaches to infinity. Responsible are the open field lines arising from a charged body.

Now every charged body in addition has a mass, with which it takes part in the gravitation. Let's remember the comparison of the derivations. The Maxwell theory teaches us that in the static case E- and H-field are decoupled, because each time the other field disappears. Even if as a result of the unipolar induction for every open field line the other one is taken to be standing perpendicular to the open field line, then this other line just wraps around the open field line and forms a closed-loop field line. In that way it can't be influenced anymore from the outside and can be neglected, so goes the doctrine, which is drawn from the Maxwell theory (fig. 27.5).

This is a fatal error in reasoning! The equation 28.19 naturally is valid for open field lines in the same manner as for closed ones. These fields also lead to an observable force of attraction. If of course exactly those fields are neglected, which are responsible for the gravitation, then we need not wonder, if we don't understand the gravitation and the nature of this interaction!

The influence of the closed field lines responsible for the gravitation is due to the missing bundling up of the lines correspondingly weak. Secondly these can't exist a force of repulsion due to the missing ability to influence closed field lines from the outside and third it can be recorded that all charged bodies also have a mass. All three statements of the field lines model perfectly cover the physical reality.
Fig. 28.7 B shows uncharged bodies, for which both the field lines of the E-field and of the perpendicular to them arranged H-field are closed-loop. Such bodies, like e.g. neutrons or whole atoms without charge behave electrically neutral to the outside, but have a mass for the reason of the closed field lines, whereby the field lines of the H-field dominate those of the E-field[<i>].

<i>: Repetition of K. Meyl: EMEC part 1, chap. 6.8 + 6.9, part 2 chap. 15.1

Dual field approach	/ The Maxwell field
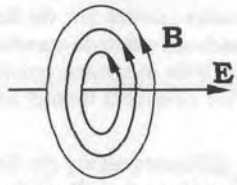	**E** = neglectible, **B** = constant.
E and **B** are coupled	/ decoupled (approximation)
The closed field lines by no means are without influence: They cause the **gravitation** !	If the Maxwell field neglects the field factor, which leads to the gravitation, it isn't astonishing, if the gravitation remains not understood!

• The following physical standpoints can be distinguished:		
subjectivity (laboratory physics, observable)	**relativity** (mediator role) (transformation)	**objectivity** (not observable)
• Exemplary theories and their representatives:		
Newton Maxwell	Poincaré Einstein	Boscovich *(dual approach)*
• With the associated transformation:		
Galilei-transf. for $c = \infty$	Lorentz-transf. c = constant	*(new transf.)* c = variable

Fig. 28.8: Physical standpoints

28.8 From subjectivity to objectivity

With the field lines interpretation, which by the way already preferably was used by Faraday, the gravitation proves to be an until now neglected influence of the electromagnetic field. With that for the first time also the grand unification of the interactions was successful. The long sought-for unified theory with that for the first time comes within reach.
The derivation has made it possible to mathematically secure the theoretical working model of Boscovich. Already 1755 Boscovich points out the optical deception, which our observation underlies, if absolute orders of magnitude in our neighbourhood should change and our perception would change along. Then also all metric and optical measurement results would underlie this change. Following the idea of Boscovich I distinguish between subjectivity and objectivity.

The relativity is a compromise lying between both points of view, where a neutral standpoint is strived for, which lies outside the events. And from this standpoint the objectively taking place events are being observed. The theory of relativity consequently is a pure observer theory with strongly restricted scope on the basis of the Lorentz-transformation.

Theories of classic physics, like e.g. Newtonian mechanics, fall in the domain of subjectivity. The results and regularities are won in a terrestrial laboratory if possible isolated from the environment, where they have absolute validity. Here the Galilei-transformation is valid.
But if these subjectively won laws are applied to the microcosm in quantum physics or to the calculation of cosmic observations, one fast hits limits. The better the resolution of the microscopes and telescopes gets, the clearer the „outside" observer realizes, how much the laws of classic physics lose their validity.

Astrophysics successfully reaches for the theory of relativity, which with the curvature of space in the vicinity of mass centres delivers useful explanations. Here the dependence of the spatial dimensions on the field already could be established. In contradiction to that this fundamental relation is said to play no role whatsoever in quantum physics, or in all terrestrial laboratory experiments. But with which right may physical regularities from one domain be ignored in others? There only can exist one physics and that should be sought for!

What we need is objectivity! Behind all the apparently disconnected phenomena of physics work quite simple laws, which can't be observed and are until now not recognized by us. Objective physics in the words of Goethe is the one, which holds the world together in the heart of hearts. I call this, already by Boscovich suggested point of view, theory of objectivity. The access to the model domain of objectivity must be made mathematically by means of a transformation, since it is blocked for us by means of measurements or observations (see chapters 6.15-6.19). The transformation back into the observation domain must be made according to the same mathematical relations (fig. 28.9). In this way the quantum properties of the elementary particles can be calculated with high accuracy and agreement with the values, which until now only could be measured (chapter 7).

Approach: $r = c \cdot t$ (determine distance by signal prop. time) (27.23)

$dr = c \cdot dt + t \cdot dc$ (total differential for a change) (27.24)

$$c = \frac{dr}{dt} - t \cdot \frac{dc}{dt} \quad \text{resp.} \quad t = \frac{dr}{dc} - c \cdot \frac{dt}{dc} \tag{27.25}$$

$$c = \frac{dr}{dt} - t \cdot \frac{d^2r}{dt^2} + t^2 \cdot \frac{d^3r}{dt^3} - t^3 \cdot \frac{d^4r}{dt^4} + t^4 \cdot \frac{d^5r}{dt^5} - \ldots \tag{27.26}$$

resp.

$$t = \frac{dr}{dc} - c \cdot \frac{d^2r}{dc^2} + c^2 \cdot \frac{d^3r}{dc^3} - c^3 \cdot \frac{d^4r}{dc^4} + c^4 \cdot \frac{d^5r}{dc^5} - \ldots \tag{27.27}$$

The Taylor-series (27.26 and 27.27) breaks off after the first term, if

c = constant	resp.	t = constant	
$dr = c \cdot dt$	resp.:	$dr = t \cdot dc$	
$\Delta r = c \cdot \Delta t$	resp.:	$\Delta r = t \cdot \Delta c$	(27.28)
theory of relativity		**theory of objectivity**	
$\Delta r \sim \Delta t$	resp.:	$\Delta r \sim \Delta c$	means:
from: length contraction		variable speed of light	
follows: time dilatation		dependency of meter measure	
for absolute speed of the light		for absolute time	
observation domain (measurable)		model domain (can only be calculated)	

x(r) ○——●— M{x(r)}

Model transformation of the length measures

Fig. 28.9:____ Theory of relativity and theory of objectivity and the model transformation between both physical standpoints

<i>: Repetition of part 1, fig. 6.16

28.9 The objective standpoint

The question is asked how one gets to an objective physical standpoint, which in addition evades every observation? The way leads over a transformation, to which all perceptible and measurable relations must be submitted.
If we for instance measure the distance r to a point light source, then the propagation of the light c and the propagation time t determine the distance measure $r = c*t$
If there occurs a little change of the distance, then two causes should be considered: Either the propagation time or the speed of light have changed somewhat. With that the two possible standpoints already would have been found.

The relativistic standpoint, which proceeds from the assumption of the speed of light being constant, says: the propagation time varies and we are dealing with a clock problem. If namely for relativistic velocities a length contraction occurs, then from that necessarily follows a time dilatation.
But actually no specific statement can be made about the constancy of the speed of light, besides that we look at, measure and scan everything with c and hence only observe the constancy. With that the theory of relativity remains a pure observer theory, exactly as Einstein originally called it into existence. This standpoint follows the motto: What can't be observed also doesn't need to interest the physicist.

The objective standpoint strives for more, for a description of the actually taking place processes. This time we proceed from the assumption of a universal and constant time with the argument: The time measure is an immutable definition and the physicist, who dictates this, himself determines what is simultaneousness. Then there also is no place for time travel and for clocks going wrong.
Therefore the speed of light can take all possible values always in strict proportionality to the length measures. Thus the measured length and distance measures should be transformed and that in the end is the unit „meter", which should be replaced by an objective measure.

With that the necessary transformation for variable c would be outlined. This transformation will be enqueued in the file of the big transformations. From it the Lorentz-transformation for c = constant emerges as a special case, like already from that transformation the Galilei-transformation follows for $c = \infty$. How now the relation of the subjective to the objective „meter" should be determined; by means of the relation of the relevant fields (eq. 28.17) or by means of the square root of Lorentz (eq. 28.16), over that should be worked and spoken. We already have successfully gone through it in a concrete example (chapter 7).

Every theory is judged according to its expressiveness. Ending this chapter the statements and derivations hence again are compared. On the one hand the Maxwell theory and from that the theory of relativity can be derived from the new approach, on the other hand a long list follows, which can't be connected with the Maxwell equations, like e.g. the gravitation. For instance the neutrino and all other elementary particles with all their specific quantum properties are derived (chapter 7), free and easy fundamental laws result, like the law of conservation of energy, and even the temperature spills its until now kept secret (chapter 8.3). Remains the conclusion: With no other approach according to the textbooks until now the efficiency of the new approach could be obtained.

• From the dual field-theoretical approach are derived:	• From Maxwell's field equations can be derived:
=> Maxwell's field equations	=>0
=> Quantum properties of the elementary particles	=>0
=> Neutrino (as an oscillating ring-like vortex)	=>0
=> Gravitation (as a result of closed field lines)	= > 0
=> Unified theory (grand unification of all interactions)	=>0
=> Temperature (as an oscillation of size depending on field)	=>0
=> Law of conservation of energy (and many other fundamental laws of physics)	=>0
=> Theory of objectivity	=> Theory of relativity

Fig. 28.10: Comparison of the efficiency of the approaches (final balance)

29. Mathematical gleanings

If, proceeding from the new field-physical approach, well-known and accepted theories are derived as special cases, this on the one hand can be valued as evidence for the correctness of the approach. On the other hand the new approach in part significantly influences the interpretation of the derived theories. That can involve a rethinking, with which not insightful people have difficulties, if for instance quantum physics, thermodynamics or the gravitation become partial aspects of electromagnetism. Over and above that are hidden many new thing in the new approach, which are there to discover. To that are counting among others the potential vortices and the scalar waves. One can work out these phenomena physically or mathematically, where the latter way as a rule is the faster one. Hence the summary shall be concluded with a kind of mathematical gleanings.

29.1 General and special theory of relativity

Albert Einstein distinguishes between general and special theory of relativity. Whereas the special (SRT), still is linked tightly with the prerequisites of the Lorentz-transformation, the general (GRT), deals with an extension to arbitrary systems, which mustn't be inertial systems. I would like not to dwell upon the GRT, as Einstein designed it, and merely notice that every generalization represents a possible source of errors and has to be well founded.

In the case of our derivation, the general case as it were resulted of its own accord. Let's turn back: If the root of Lorentz still was a component of the derived field dilatation (28.15) and equally of the length contraction (28.16), then it fell out in the comparison of both results (28.17). With that the important result, the proportionality (28.18), which among others results in the gravitation, becomes independent of the speed of light and the relative velocity v. This last step is obvious and still completely new. It cannot be found at Einstein, who in another way finds his GRT and his description of the gravitation. Even if here is striven for the same goal, then deviations in the result cannot be excluded because of the differences in the derivation, for which reason I additionally mark the by me derived general relativity (GRT'), to avoid confusion.

Influence of the Lorentz-transformation in the:
SRT (special theory of relativity): one-dimensional,
GRT' (general theory of relativity): three-dimensional, to a large extent corresponding to the GRT of Albert Einstein,
GOT (general theory of objectivity)

Discussion of the root of Lorentz $\sqrt{1 - v^2/c^2} = \sqrt{1 - \beta^2}$ with $\beta = v/c$
resp. the γ-factor: $\gamma = 1/\sqrt{1 - v^2/c^2}$ (29.1)

Being transformed are:		SRT	GRT'	GOT
Length measures (length contraction eq. 28.16)	L [m]	$\sim 1/\gamma$	$\sim 1/\gamma$	$\sim 1/\gamma$
Areas (circular motion)	A [m²]	$\sim 1/\gamma$	$\sim 1/\gamma^2$	$\sim 1/\gamma^2$
Volumes (vortical motion)	V [m³]	$\sim 1/\gamma$	$\sim 1/\gamma^3$	$\sim 1/\gamma^3$
Time measures	t [s]	$\sim 1/\gamma$	$\sim 1/\gamma$	= const.
Velocities ($v = L/t$)	v [m/s]	= const.	= const.	$\sim 1/\gamma$
	c [m/s]	= const.	= const.	$\sim 1/\gamma$
Constants of material ($\varepsilon \cdot \mu = 1/c^2$)	ε [As/Vm]	= const.	= const.	$\sim \gamma$
	μ [Vs/Am]	= const.	= const.	$\sim \gamma$
Relativistic mass (increase in mass)	m [kg] [=VAs³/m²]	$\sim \gamma$	$\sim \gamma$	$\sim \gamma^2$
Energy	W [VAs]	$\sim \gamma$	$\sim \gamma$	= const.
Energy density ($w = W/V$)	w [VAs/m³]	$\sim \gamma^2$	$\sim \gamma^4$	$\sim \gamma^3$
E-, **H**-field strength ($w = (\varepsilon \cdot E^2 + \mu \cdot H^2)/2$)	**E** [V/m]	$\sim \gamma$	$\sim \gamma^2$	$\sim \gamma$
	H [A/m]	$\sim \gamma$	$\sim \gamma^2$	$\sim \gamma$
Power density (Poynting vector $\mathbf{p} = \mathbf{E} \times \mathbf{H}$)	**p** [VA/m²]	$\sim \gamma^2$	$\sim \gamma^4$	$\sim \gamma^2$
D-field, **B**-field ($\mathbf{D} = \varepsilon \cdot \mathbf{E}$; $\mathbf{B} = \mu \cdot \mathbf{H}$)	**D** [As/m²]	$\sim \gamma$	$\sim \gamma^2$	$\sim \gamma^2$
	B [Vs/m²]	$\sim \gamma$	$\sim \gamma^2$	$\sim \gamma^2$
Power	P [VA]	$\sim \gamma$	$\sim \gamma^2$	= const.

Fig. 29.2 Transformation table between SRT, GRT' and GOT

29.2 Transformation table

Let's speak again about the difference to the special relativity (SRT). This so to speak deals with the one-dimensional case of the uniform motion of a reference system in x-direction ($v = v_x$), as specified by the Lorentz-transformation, where only the x-components and not those in y- or z-direction are being transformed. As already mentioned this is a purely theoretical case, which in practice occurs next to never. Normal is circular and vortical and with that accelerated motion, where the velocity component permanently changes its direction.

The derived result of the general relativity (GRT') does justice to this circumstance. Even if this at first only has been derived for the x-direction it nevertheless is valid equally in y- and z-direction. It even remains valid for the case that we base on a path of arbitrary form of a spatial field vortex. In this case some components continually occur in all directions of space, so that the relative velocity v as already the speed of light c loses its vectorial nature. With that the transition of the SRT to the GRT is carried out. By means of the spatial swirling the electric and magnetic field pointers at the same time turn into scalar factors, by taking over the function of the aether. Let us remember that even Einstein in his GRT was forced to again introduce the aether, which in the SRT still was unnecessary.

It therefore makes a difference in the transformation of physical factors, if we base on a one-dimensional (SRT) or a three-dimensional spatial description (GRT). Length measures in x-direction in both cases must be converted using the root of Lorentz. Usually the relativistic γ-factor is introduced, which is inverse to the root of Lorentz

$\gamma = 1/\sqrt{1-v^2/c^2)}$ with $x_o/x = \gamma$ (29.2)

If thus individual length measures would be subject to a length contraction following the γ -factor, then a volume V according to the SRT must be transformed with γ, according to the GRT' however with γ^3.
As is well-known a relativistic increase in mass is converted with the γ-factor and in the same manner the to that proportional energy $E = m\ c^2$. If we however correlate the energy to the volume V and in that way determine an energy density w, then the difference between SRT $(w \sim \gamma^2)$ and GRT' $(w \sim \gamma^4)$ again has its maximum effect.
A relation to the field factors of E- and H-field is for instance provided by the energy densitv of a wave field
$w = (\varepsilon \cdot E^2 + \mu \cdot H^2)/2$ (29.3)

According to that the field strengths in the one-dimensional case of the SRT should be converted with the γ-factor, in the case of the GRT' however with γ^2, in accordance with the derivation in chapter 28. This circumstance willingly is overlooked, although it only concerns the textbooks and the today valid theory of relativity. I however point to the difference, since it does make a difference if we start with the SRT or the GRT when we change to the general theory of objectivity (GOT).

In the domain of the GOT all length measures should be transformed. The respective dimension gives information with which power the γ-factor occurs (fig. 29.2). The unit meter is responsible for that.

Discussing the root of Lorentz $\sqrt{1-\beta^2} = 1/\gamma = \sqrt{1-(v^2/c^2)}$				
mathematical consideration:	$v = 0$	$v < c$	$v = c$	$v > c$
Abbreviations: $\beta = v/c$	$0 <$	$\beta < 1$	$\beta = 1$	$\beta > 1$
and: $\gamma = 1/\sqrt{1-\beta^2}$	$1 <$	$\lvert\gamma\rvert < \infty$	$\gamma = \pm\infty$	imaginary
and: $\gamma^2 = 1/(1-\beta^2)$	1	positive	$\gamma = +\infty$	negative
and: $\gamma^4 = 1/(1-\beta^2)^2$	$1 <$	positive	$\gamma = +\infty$	positive
Examples: Increase in mass, energy $\sim \gamma$ for SRT and GRT	1	positive	$\pm\infty$	complex
Field strength in GRT': $\mathbf{E}, \mathbf{H} \sim \gamma^2$ and mass in GOT: $m \sim \gamma^2$	$1 <$	$\mathbf{E}, \mathbf{H} < \infty$ positive	$+\infty$	$\mathbf{E}, \mathbf{H} < 0$ negative
Energy-, power density $\sim \gamma^4$ (Poynting vector) in GRT:	$1 <$	$\mathbf{P} < \infty$ positive	$\mathbf{P} = +\infty$	$\mathbf{P} < \infty$ positive

Fig. 29.3 Discussion concerning the root of Lorentz

- The special theory of relativity SKT only is defined for $v < c$
- For $v \bullet c$ particles with a complex mass, but with a real energy density (according to GRT') would result.
- From the point of view of the theory of objectivity (GOT) the mass should be taken negative-real (neutrino?).

29.3 Discussion concerning the root of Lorentz

Fig. 29.2 forms the basis for the transformation in the domain of the GOT, the general theory of objectivity, where it plays a role, if a subjectively measured factor should be converted from the laboratory domain or a relativistic factor according to the SRT or the GRT'. The given proportionalities thereby should be put in the respective relation. In this way results the respective valid instruction for transformation on the basis of the root of Lorentz.

Let's take a critical look at the root of Lorentz. The velocity v occurring in it, of whatever this may consist, is depending on the field according to equation 28.14 + 28.15. It strictly speaking wouldn't be constant anymore and wouldn't belong in a general instruction for transformation at all. Only, what is valid for v, is valid to the same extent for c. Since only the proportion of v/c occurs in the root of Lorentz every influence depending on field or of other nature will have no effect on v/c and the value of the root of Lorentz. It in any case will retain its value. It fulfills for itself the condition of the Lorentz invariance. According to that in the case of the relative velocity v it doesn't depend on the absolute value, but only on the relation to the speed of light. In addition the restriction to values of $v < c$ is normal, if the speed of light is seen as an upper limit. Let's first purely mathematically draw a case distinction for different velocity domains of v. For $v = 0$ the root of Lorentz becomes one and the Lorentz transformation turns into the Galilei transformation.

Connected to this is the today well-known and technically used domain up to the limit of $v = c$. It virtually is impossible to accelerate a mass particle to the speed of light, since mass, field and energy would grow towards infinity, as is clear from the table (fig. 29.2). Particles as fast as light, like photons, hence cannot have a mass. At $v = c$ a singularity is present.

In a field theory, which also deserves this name, however an upper limit must not be present. Hence also the case for $v > c$ should be required theoretically. Only later we will be able to judge if this makes sense physically. We at first only want to examine the case mathematically. Mass, field and energy now again have a finite value, there however results a complex, purely imaginary mass, a negative field and doing so, as already before a positive energy and power density.

There sometime has been the textbook opinion that it is physically impossible to fly faster than sound. This erroneous statement even could be proven „scientifically", because such a supersonic airplane would fly off the observation space and with that wouldn't be real anymore, thus from a mathematical viewpoint would be complex. Anyone, who in New York gets off a Concorde, can confirm that everything at any moment of the flight was real. Only the observer is deceived, if the airplane flies somewhere else, than he perceives it. Is the speed of light also such a „sonic barrier", which by the majority of the scientists since Einstein until today still is thought to be insurmountable?

How should one physically imagine a complex mass? Let us remember the alternating current teachings, where it is normal to work with complex values, since the mean values of the oscillating alternating currents, tension voltages and fields are zero. Calculating with mean values would result in zero energy and power. Hence complex factors are introduced and the root mean square values are calculated and measured instead of the mean values. Could a complex mass analogously not concern an oscillating particle, a particle, which in addition is faster than the light?

- Physical example: _____

neutrino = mean of the oscillating mass≈zero
RMS value of the complex mass≠zero
E- and H-field with inverse sign
carrier of positive energy and power
ν -model: ring-like vortex oscillating from e^- to e^{+} <i>

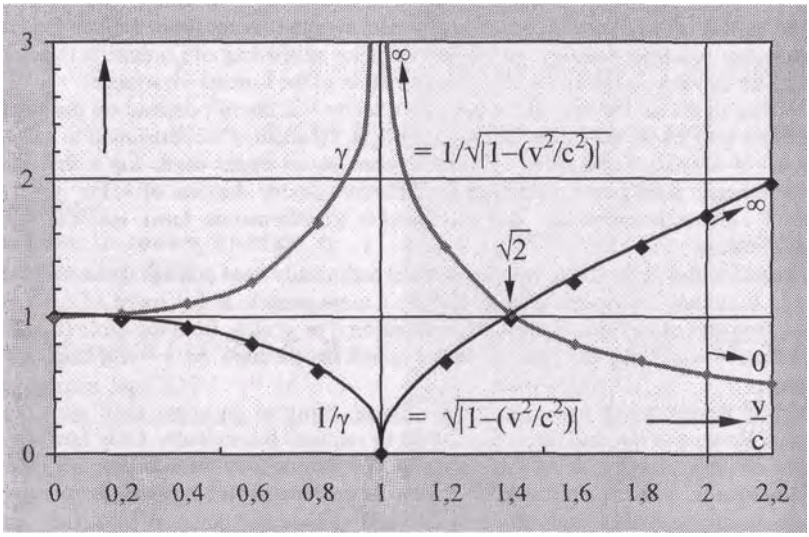

Examples from the general theory of relativity (GRT):

(28.16): length contraction $L \sim 1/\gamma = \sqrt{1-(v^2/c^2)}$

(6.19): increase in mass $m \sim \gamma = 1/\sqrt{1-(v^2/c^2)}$

(6.6,28.15) field dilatation $\mathbf{E} \sim \mathbf{H} \sim \gamma^2 = 1/(1-v^2/c^2)$

Fig. 29.4: Root of Lorentz for speeds faster than light (v > c)

29.4 Mathematical derivation of the neutrino

In the domain of speeds faster than light, for v > c, the power series (28.12) does not converge anymore and every observer theory and every observation (fig. 28.4) will fail, because particles faster than light run away of their own visible appearances. Every measurement and every observation inevitably is behind and hardly can be assigned to the actual cause. That way for instance measured neutrino events are being connected with celestial observations, with which they haven't got anything to do at all.
If we however describe the domain v > c in the complex plane, then astonishing results are found, which could be verified physically: a complex length dilatation with increasing velocity goes along with a loss of complex mass. The oscillating fields, energy and power density however would be real with negative sign.
Thus there would result particles carrying energy with an oppositely poled field, with an oscillating mass and if necessary also an oscillating charge. Without static mass and charge these particles hardly would interact with normal matter, which leads to an enormous ability of penetration. The only physical particles, which have such a property, are the neutrinos. With that a usable and an extremely efficient model description has been found for these particles. Also the energy of these particles can be calculated, which has considerable orders of magnitude and is available as an energy source everywhere and any time.

If for instance in a converter for space energy a neutrino should be converted into a resting charge carrier (with v = 0), then two steps are necessary (see part 2 of this series of books):

1. First the neutrino must be slowed down to 1.414 times the speed of light (fig. 28.9). Doing so energy is spent and not won! The converter for instance can cool down.

2. Afterwards the characteristic rotation of its own, with which the ring-like vortex spins around itself by permanently putting its inside to the outside and vice versa, has to be taken away from the neutrino. In that way the vortex centre is closed and the particle acquires localization. It becomes a charge carrier.

Even if the representation in the complex plane represents only an auxiliary description, the model nevertheless seems to be efficient, because despite its complex mass and charge the neutrino nevertheless carries a real energy. It in any case is represented in that way to an observer, who measures the relation with the speed of light, who in the relativistic scheme of things scans the relation.

Today, as already said, even the sonic barrier has become permeable and no scientist dares to physically deny this fact and even prove his mistake mathematically anymore. No, on the contrary, he always did know that as an expected consequence the sonic barrier runs after the supersonic plane. The once physically unthinkable and scientifically fought has become normality.
What should hinder an oscillating particle, like a neutrino, to be faster than the light? Some time one also will accustom to that.

- Starting-point:
  the fundamental field equation
  (derivation in chapter 27.10)

$$-c^2 \cdot \text{rot rot } \mathbf{B} = \frac{\partial^2 \mathbf{B}}{\partial t^2} + \frac{1}{\tau_1}\frac{\partial \mathbf{B}}{\partial t} + \frac{1}{\tau_2}\frac{\partial \mathbf{B}}{\partial t} + \frac{\mathbf{B}}{\tau_1 \tau_2} \quad (27.26)$$

- Example:

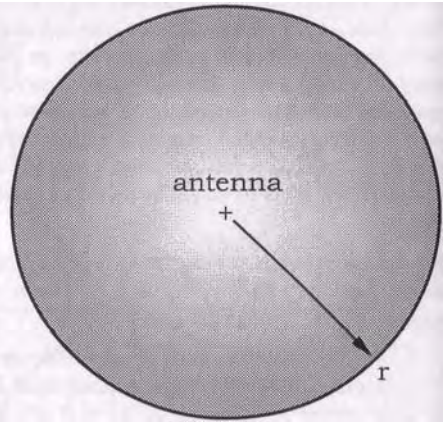

Spherical propagation of an electromagnetic wave in space

- The number π: $\pi = 3.14159$

straight	$\pi\cdot$	circular		spherical
r	$\cdot\ \pi\cdot 2 =$	$2r\cdot\pi$	$\cdot\ 2r =$	$\pi\cdot r^2\cdot 4$
line		**circum-ference**		**surface**
r	$\cdot\ \pi\cdot r =$	$r^2\cdot\pi$	$\cdot\ r\cdot 4/3 =$	$\pi\cdot r^3\cdot 4/3$
line		**area**		**volume**

(29.4)

Fig. 29.5: The number π

29.5 Universal constants and constants of nature

Strictly speaking fundamental or universal constants can't exist in pure field physics at all. For the example of the speed of light has been shown that it merely are measurement constants (fig. 6.11). The numerical size is a consequence of the definition. The speed of light for instance has the today well-known value as a consequence of the fixing of a length unit and a time unit. If we change a unit, if we take ,,feet" instead of ,.meters", then another value results. If however the velocity changes, then the reference measure of our gauge changes along and we get the identical reading. Electric and magnetic field constant depend directly on the speed of light c $(\varepsilon \cdot \mu = 1/c^2)$, which solely by the fixing of the electric units takes a certain value. The inner structure of the potential vortices leads from Planck's quantum of action, to the elementary charge and to the countless atomic ,,constants", which all objectively seen aren't constants at all. They virtually all can be derived (chapter 7).

Sooner or later even the last natural scientist will realize, that nature does not provide "constants" at all. If ,,constants of nature"' did exist, as listed in textbooks and encyclopaedias, then they aren't consistent with causality, since we don't know the cause, why the factor should have exactly this size and no other. Behind every so-called constant of nature unnoticed is hiding a physical closed loop conclusion.

Fundamental constants only exist in mathematics. This can be shown very nicely for the example of the ,,fundamental field equation" (eq. 27.26), which has been derived from the new field theoretical approach (fig. 27.10). It is the description of waves and vortices in space and time, which indeed carries features of a ,,world equation". If one searches this equation for fundamental constants, then one altogether can find three: the number π, the number e and the Golden Proportion Φ. The speed of light c however occurs only as the mathematical factor characterizing the wave as a result of the defined units. If one would choose the units different, c as well could be made 1. With the fundamental numbers that procedure won't work. They don't depend on the definition of the units!

Let's consider the number π. The number π occurs every time as a proportionality factor if we transition from a straight line to a circle or further to a sphere, from a line to the circumference or further to the surface of a sphere and exactly so from a line to the area of a circle or further to the volume of a sphere. Since for all the special cases, which are derived from the fundamental field equation (the structure of the elementary particles, the atomic structure and in the same way again in the universe), the spherical symmetry dominates, the mathematical solution is determined by a corresponding spatial configuration of the number π. It has its cause neither in a physical relation of interactions, nor in the choice of the units, but only in the geometry.

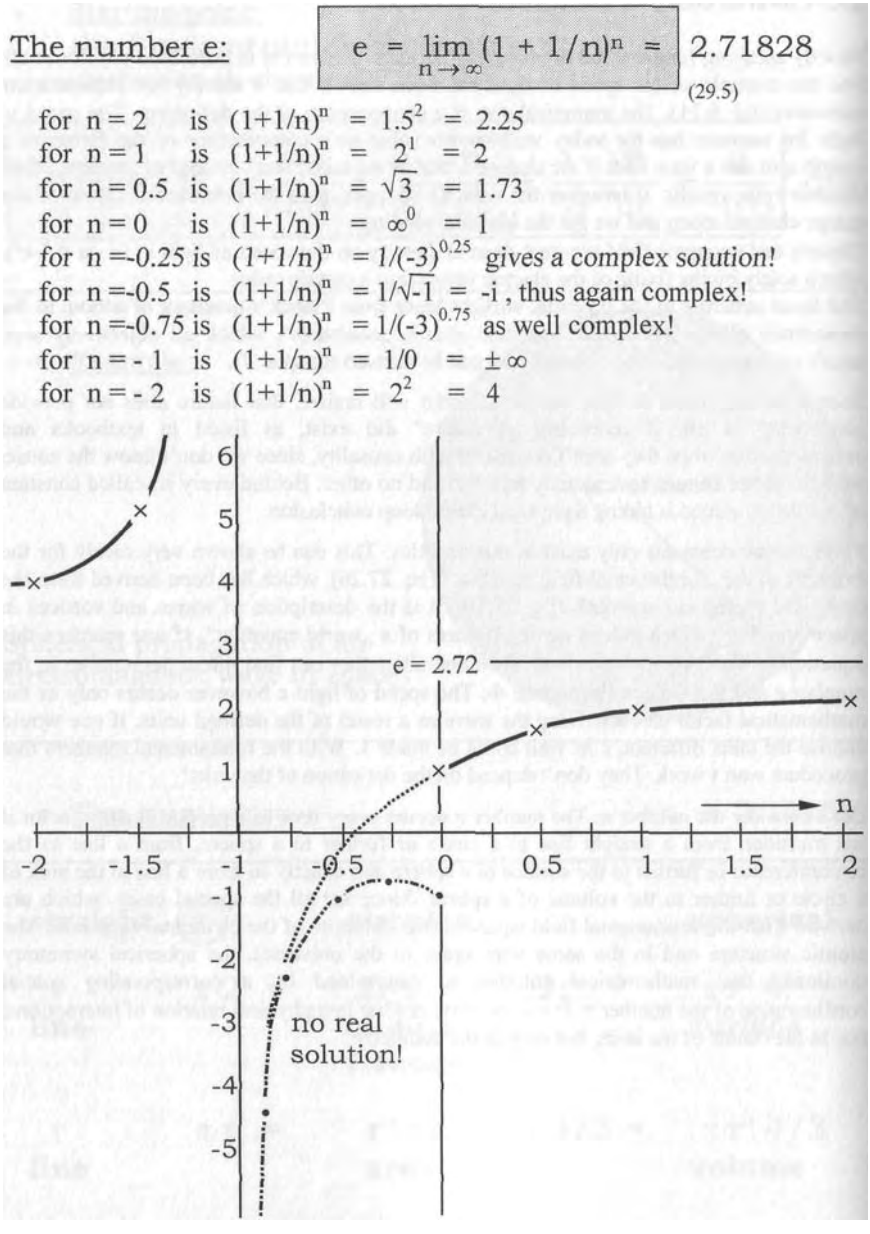

Fig. 29.6: Forming the limiting value of the number e

29.6 The fundamental number e

In the fundamental field equation (27.26) a further irrational number is concealed, the number e. Whereas the left side of the equation (a) gives the spatial distribution, the right side (b-e) describes the temporal course of events. Besides the term constant in time (e) also first time derivations (c and d) and a second time derivation (b) occur. For a solution of this differential equation a function should be found, the derivations of which are again the function itself. This condition strictly speaking is fulfilled only by one single function, the e-function.
We used this property of the e-function already for the derivation of the Schrodinger-equation in chapter 5.6 and 5.7. There with the help of the e-function an approach was chosen, which leads to the well-known solutions of the Schrodinger-equation, which are considered to be secured experimentally. With that the number e controls the temporal relations of the fundamental field equation.

It might be helpful to take a closer look at the origin of the number e. It results from a consideration of limiting values: _

$$e = \lim_{n \to \infty} (1 + 1/n)^n = 2.71828 \qquad (29.5)$$

If one varies n and allows different values between $-\infty$ and $+\infty$, then a strange behaviour is showing. One indeed more and more approaches the well-known value of e = 2.72, as dictated by the definition of limiting values according to equation (29.5), the larger n is chosen. But in the opposite direction it looks less tidied:

$$\begin{array}{lllllllll}
 & \text{for} & n = 1 & \text{is} & (1+1/n)^n & = & 2^1 & = & 2 \\
 & \text{for} & n = 0{,}5 & \text{is} & (1+1/n)^n & = & \sqrt{3} & = & 1.73 \\
 & \text{for} & n = 0 & \text{is} & (1+1/n)^n & = & \infty^0 & = & 1 \\
 & \text{for} & n = -0{,}5 & \text{is} & (1+1/n)^n & = & 1/\sqrt{-1} & = & -i\text{, thus complex!} \\
\text{and} & \text{for} & n = -1 & \text{is} & (1+1/n)^n & = & 1/0 & = & \pm\infty
\end{array} \qquad (29.6)$$

Since the e-function inside the fundamental field equation is responsible for the temporal sequence, the interpretation of my colleague Prof. Dr. Preussker<i> gets a deeper sense. He says, it starts outside our imagination (at n = -1). Afterwards at first big chaos prevails. Mathematically seen some imaginary solutions arise. Finally the system is putting in order (from n = 0), to more and more approach the value e = 2.72 .

The number e is of fundamental importance and thereby holds unforeseen secrets. More mysterious and until now entirely misunderstood is the meaning of the Golden Proportion. Also this indivisible number can be found in the fundamental field equation. Since it is less known and more complicated to handle, it first shall be introduced.

<i>: H. Preussker: Der Wirbelring, Halstenbeck 2002

Graphical construction at a right-angled triangle (Pythagoras):

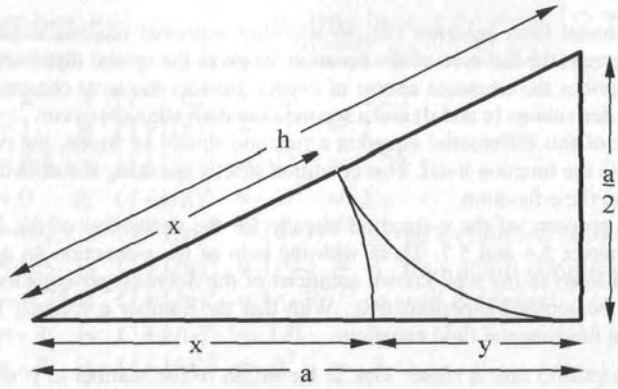

Golden Proportion of length $a = x + y$:

$$\frac{x}{a} = \frac{y}{x}$$

with the proportion:

$$\frac{x}{a} = \Phi = 0.618 \quad (29.9) \qquad \text{and} \qquad \frac{a}{x} = \frac{1}{\Phi} = \Phi + 1 = 1.618 \quad (29.10)$$

The pentacle

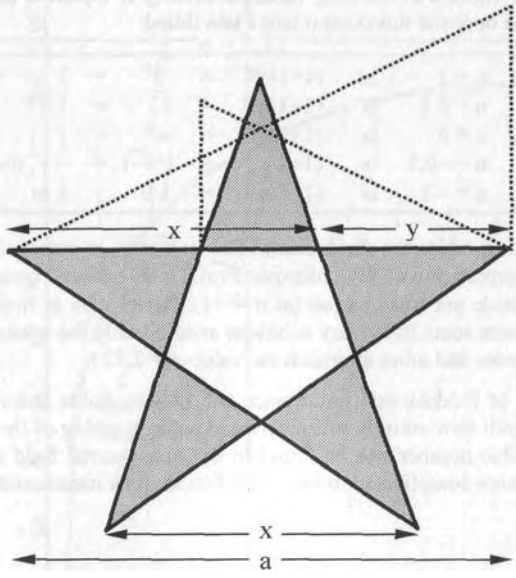

Fig. 29.7: Constructions for the Golden Proportion

29.7 The pentacle

During his visit of the Egyptian pyramids already two and a half thousand years ago the history writer Herodotus by his guide had been called attention to the circumstance that the Golden Proportion has been realized for the proportions of scale.
In the case of the pyramid of Cheops it even has been taken into account manifold, as we know today, but we hence still don't know why. There must be an intention behind it. Anyway a coincidental use can be eliminated, since the Golden Proportion cannot be handled in an easy way, neither graphically nor mathematically.
The Golden Proportion in addition plays an important role in the whole ancient architecture and not only there. It for instance occurs in the case of a very old symbol, the five edged star, which we can draw with one line without taking off. The well-known symbol also is called pentacle.

In the case of the Golden Proportion a straight line a is divided into two unequal halves. The larger half x thereby is 61.8 % of the straight line a. Already Pythagoras has researched and teached about this. Maybe he did know more about the purpose of this classification than all the mathematicians, archaeologists and art historians of today together.
For a graphical solution we assume a right-angled triangle. The task is to divide one leg of length a = x + y according to the Golden Proportion into two parts, the larger part x and the smaller part y. The second leg has the length a/2. According to the theorem of Pythagoras the length of the hypotenuse h is

$$h = \sqrt{a^2 + (a/2)^2} = (a/2)\cdot\sqrt{5} \quad (29.7)$$

If the length of the second leg (a/2) is subtracted from the hypotenuse, then this is the sought length x = h - a/2:

$$x = (a/2)\cdot(\sqrt{5} - 1) \quad (29.8)$$

The proportion of both length measures gives the constant Φ, which is characteristic for the Golden Proportion:

$$\Phi = x/a = (\sqrt{5} - 1)/2 = 0.618 \quad (29.9)$$

This proportional number has a special property. If one adds 1 to the number and forms the reciprocal value of that, then the same number comes out again, thus:
with $\Phi = x/a$: with $a = x + y$:

$$\Phi + 1 = \frac{1}{\Phi} \quad \text{and} \quad \frac{x}{a} + 1 = \frac{a}{x} \quad \text{resp.} \quad \frac{x}{a} = \frac{a - x}{x} = \frac{y}{x} \quad (29.10)$$

With that the ratio of the length a and the larger section x is the same as the ratio of x and the smaller section y.

- Starting-point: the fundamental field equation

$$\boxed{-c^2 \cdot \text{rot rot } \mathbf{E} = \frac{\partial^2 \mathbf{E}}{\partial t^2} + \frac{1}{\tau_1}\frac{\partial \mathbf{E}}{\partial t} + \frac{1}{\tau_2}\frac{\partial \mathbf{E}}{\partial t} + \frac{\mathbf{E}}{\tau_1 \tau_2}} \quad (27.26)$$

- <u>for the special case:</u> because of missing conductivity ($\sigma = 0$)
  e.g. in air no eddy current damping: $\sigma/\varepsilon = \boxed{(1/\tau_1) = 0}$
- and no currents (eq. 27.15+27.16): $\mathbf{j} = \sigma \cdot \mathbf{E} = -\mathbf{v} \cdot \varepsilon \cdot \text{div } \mathbf{E} = 0$
- resp. $\Delta \mathbf{E} = \text{grad } \cancel{\text{div}} \mathbf{E} - \text{rot rot } \mathbf{E} = -\text{rot rot } \mathbf{E}$

$$\Rightarrow \boxed{c^2 \cdot \Delta \mathbf{E} = \frac{\partial^2 \mathbf{E}}{\partial t^2} + \frac{1}{\tau_2}\frac{\partial \mathbf{E}}{\partial t}} \quad (29.11)$$

Standard case of a wave damped with potential vortices

In the case of a perturbation this wave rolls up to a vortex, with

- the vortex radius r
- the swirl velocity $c = \omega \cdot r$
- the angular velocity $\omega = 1/\tau_2 = c/r$

The vortex itself runs with the velocity $v(x(t)) = dx/dt$
as a longitudinal wave in direction of the **E**-field: $\Delta \mathbf{E} = \partial^2 \mathbf{E}/\partial x^2$

$\Rightarrow \partial \mathbf{E}/\partial t = (\partial \mathbf{E}/\partial x) \cdot (dx/dt) = v \cdot \partial \mathbf{E}/\partial x$ and
$\partial^2 \mathbf{E}/\partial t^2 = v^2 \cdot (\partial^2 \mathbf{E}/\partial x^2)$; ($\partial v/\partial t = 0$, since not accelerated)

$$\Rightarrow \boxed{c^2 \cdot \partial^2 \mathbf{E}/\partial x^2 = v^2 \cdot (\partial^2 \mathbf{E}/\partial x^2) + v \cdot (c/r) \cdot \partial \mathbf{E}/\partial x} \quad (29.12)$$

- with the exponential approach: $\mathbf{E} = \Psi \cdot e^{-x/r}$ are:

$\Rightarrow \partial \mathbf{E}/\partial x = -(1/r) \cdot \mathbf{E}$ and $\partial^2 \mathbf{E}/\partial x^2 = (1/r^2) \cdot \mathbf{E}$

$$\Rightarrow \boxed{(c^2/r^2) \cdot \mathbf{E} = (v^2/r^2) \cdot \mathbf{E} - (v \cdot c/r^2) \cdot \mathbf{E}} \quad (29.13)$$

- resp.: $$\boxed{c^2 = v^2 - v \cdot c} \quad (29.14)$$

Fig. 29.8:____ The calculation of an electromagnetic wave, which is rolling up to a potential vortex.

The big mystery concerning the harmony of the Golden Proportion gets a sober technical-physical dimension with the theory of objectivity. It determines within the fundamental field equation" (27.26) the rolling up of a wave into a vortex and vice versa. The Golden Proportion mathematically describes the process known as wave damping, as we can make ourselves clear.

29.8 The vortex, which is rolling up

For the case of a wave propagation in air or in vacuum, if no electric conductivity is present ($\sigma = 0$), the fundamental field equation is reduced to the two parts: the description of the electromagnetic wave and the potential vortex as a damping term. Now a solution of this partial differential equation (29.11) is sought. This only succeeds for a very particular course of spatial and temporal field.

If a wave for a field perturbation rolls up to a vortex, which we had worked out as a model concept, then the field oscillation continues to run with the speed of light, but this time in circles. With this consideration the relation between the angular velocity resp. the time constants and the radius of the circular vortex has been described ($\tau_2 = r/c$).

$v(x(t)) = dx/dt$ is the not-accelerated velocity of propagation of a vortex. In that case v points in the x-direction radially to the outside. For the time derivation of the field vector $E(x(t))$ the chain rule should be applied. With that the field equation (29.11), defined in space and time, can be converted into an equation determined in v and x (29.12).

Finally we use the mentioned property of the e-function, which for first and second derivation again turns into itself, by choosing the approach of an exponential damping with $e^{-x/r}$ There remains a quadratic equation to determine the velocity v (29.14 and 29.15). From the two solutions of the quadratic equation only the one with positive velocity should be considered (29.17) and that would be 1.618 times the speed of light! (29.18).
If we subtract 1 from this value or form the reciprocal value, then in both cases the factor $\Phi = 0.618$ results, which is called the Golden Proportion (29.19).

Behind this clear, mathematically won result is hiding a deeper physical meaning. Obviously nothing can hinder a longitudinal wave and its vortices to be slower or faster than just with $v = 1.618*c$. Let us take the case that $v = c$, for which there even exist calculations in some textbooks[<i>]. Then as a result gets out that the longitudinal parts decrease very quickly and already can be neglected after $\lambda/2\pi$. I in any case interpret the near-field zone of an antenna (fig. 29.9) such that within one sixth of the wavelength the vortices to a large extent have decayed.

<i>: Zinke, Brunswig: Lehrbuch der Hochfrequenztechnik, 1. Bd., 3.Aufl. Springer-Verlag Berlin 1986, Seite 335

- The quadratic equation 29.14: $v^2 - v \cdot c - c^2 = 0$ (29.15)
- has the solution: $v = c/2 \pm \sqrt{c^2/4 + c^2}$ (29.16)
- for the proportion v/c: $v/c = (1 + \sqrt{5})/2 = 1.618$ (29.17)
- The result $v/c = \underline{1.618}$ (29.18)
- resp.: $c/v = \Phi = \underline{0.618}$ = „Golden Proportion"(29.19)
- acc. to that is: $1 + \Phi = 1.618 = 1/\Phi = 1/0.618$(29.18*)

- Concerning the physical meaning of $v/c = 1.618$ (29.17)

In the domain:	vortex decay:	description:
$v = c$	within $\lambda/2\pi$	near-field zone
$v < 1.618 \cdot c$	only later	noise
$v = 1.618 \cdot c$	stability limit	direct conversion
$v > 1.618 \cdot c$	stable, no decay	neutrino radiation

=>In the ideal case at 1.618 times the speed of light at the stability limit, the natural and spontaneous conversion from vortex to wave and vice versa occurs.

=> Scalar wave antennas have their optimum degree of effectiveness in the Golden Proportion!

Fig. 29.9: ____Derivation of the Golden Proportion from the fundamental field equation.

For larger velocities, as Tesla has produced already 100 years ago, the stability of the vortices, but also their biological effectiveness increases. From a high-frequency technical viewpoint this is the domain of the noise, the domain of instable oscillating noise vortices. From a biological and medical viewpoint especially here the answers should be sought to questions concerning the electromagnetic environmental compatibility. This domain stretches from v = c to v = 1.618*c, the boundary case, where a spontaneous conversion of the wave into the vortex is possible. The Golden Proportion describes the stability limit, where the field vortices after they have been formed, don't decay anymore. From this velocity on the antenna resp. radiation source hasn't got a limited near-field zone anymore, since that now reaches to infinity. Only from this distinct velocity on I give the field vortices the name "neutrino".

29.9 The Golden Proportion

Whereas traditional antennas, which should emit electromagnetic waves, are optimized for signals with the speed of light, do scalar wave antennas have their optimum degree of effectiveness in the Golden Proportion. Thereby the goal of an emission of oscillating ring-like vortices is pursued. Vortices, which with a velocity of propagation of v = 1.618-c remain stable and make possible a spatially unlimited transmission of energy and information by scalar waves.

The velocity of propagation v is calculated from the product of wavelength times frequency. $v = \lambda \cdot f$. If the frequency of a transmitter is prescribed, then the geometry of the transmitting antenna decides on the degree of effectiveness of the antenna and on how many parts of transverse waves are emitted in relation to longitudinal waves. In the case of a broadcast antenna usually λ or $\lambda/2$ is chosen. For a scalar wave however the optimum is reached with

$$\boxed{\lambda_{vortex} = 1.618 \cdot \lambda_{wave} = 1.618 \cdot c/f.} \quad (29.20)$$

With that the electrotechnical problem becomes a geometrical one, if it concerns the use of scalar waves. Crucial is the antenna geometry, and the Golden Proportion provides the necessary constructional instruction. Were the buildings in antiquity, which were constructed according to the Golden Proportion, technical facilities for scalar waves[<i>]? Did the builders have physically explainable and mathematically provable guidelines? At this place, by the derivation of the Golden Proportion from the fundamental field equation, there arise completely new aspects for the judgement and interpretation of buildings especially from antiquity. If we have understood their way of functioning, then we will be able to learn much from that for our own future and for the future construction of scalar wave devices. Concluding the seminar we hence deal with antiquity.

ancient temple	=	short wave station
dedicated to one god	=	fixing of the frequency
supreme god Zeus, father of all gods	= =	range of the short wave, all SW wave bands
priest, representative of the god	=	amateur radio operator, with licence to transmit
high priest	=	chief intendant
Pontifex Maximus, ,,topmost bridge builder"	=	chairman of the authority and the telegraph offices
oracle<i>	=	telegraphy receiver
runes, cuneiform writing	=	telegraphy symbols
metre, hexameter	=	increase of redundancy
oracle priest	=	telegraphy interpreter
tripod<ii>	=	reception key, electro-acoustical converter
looking at intestines, rite of sacrificing	=	reading off convulsions, electro-optical converter
temple books	=	news-notes
seer, who looks into the god world	=	amateur radio operator, at telegraphy reception
Homer	=	ancient radio reporter

Fig. 30.1: ____Little dictionary for ancient radio engineering (1).

<i>: Lamer: Worterbuch der Antike, Kroner Verl. Bd.96 under "oracle" stands: ,,Lat. oraculum = site of speaking; particularly: site, where a god speaks; then: that, what the god says". According to the encyclopaedia oracle priests inspired by a god ,,simply were frauds, who lived of the ignorance of the public".

30. Scalar wave technology in antiquity

The end of the book about potential vortices and their propagation as a scalar wave shall form an impressive example, where as many of the derived wave aspects as possible have an effect. It shall be proven that already in antiquity radio engineering based on scalar waves has been used. The proof starts with a thesis.

30.1 Thesis:

The temples in antiquity all were short wave broadcasting stations. And energy from the field served as an energy source, so e.g. the earth radiation in the case of temples of terrestrial gods. In the case of the solar god the radiation of the sun was used, whereas for the temples, which were dedicated to the planetary gods, the neutrino radiation arriving from the planets served as an energy source.

If the temple was dedicated to a particular god, then the name of the god was representing the used frequency of the broadcasting company. The corresponding wavelength, resp. the respective god, understandably was "immortal".

Not so the broadcasting technicians on duty, who as human beings naturally were mortal, who took turns in the studio as members of the priest council and who merely had to impersonate the god Apollo, Poseidon etc. by the name of the broadcasting company, if they went on air. Only for the news editor Homer and for few of his colleagues we actually know the names of the persons behind the scenes.

In the temple books the texts have been recorded, which a god and its broadcasting company have received. The chosen metre served the easier detection and correction of transmission errors.

Here often a lot of fantasy was necessary, for which reason the reception facilities commonly were described as oracle<i>. The reception of the news as a rule took place on an altar. Thereby the direct effect of scalar waves on man e.g. in the case of the so-called temple sleep or the indirect influence on biological systems, e.g. on the intestines of slaughtered animals, was evaluated.

A further development of the telegraphy was the tripod technology<ii>, in which case by turning of the polarization plane individual symbols and letters were transmitted up to the transmission of the spoken word with the help of a special wavelength modulation. That far the thesis reaches, which now should be proven.

<ii>: Lamer: Worterbuch der Antike, Kroner Verl. Bd.96 under "tripod" stands: „the tripod is a dedication gift to gods, a honorary gift for winners. That one pleased them with the gift of a cooking pot, is strange; one has tried to find the reason, but until now without success". In the encyclopaedia further is advised: „tripod as a means for spiritual insight?!"

godology	= high frequency technology
god name	= RDS, station identification
members of a family of gods	= broadcasting studios of a broadcasting company
Pantheon, temple of all gods	= extremely broadband FM broadcast station
crown	= antenna netting
gifts for sacrificing	= broadcasting fees
place of sacrificing	= place of a node of the standing wave
earth radiation	= power supply
homage of a weekday	= time restriction of the operation of the station
Zeus „forges" thunderbolts	= electrostatic blows, when a temple is oscillating
ritual act	= technical provision for transmission and reception
Pythia of Delphi<i>	= radio telephone operator, receptionist
Cella (marrow of temple)	= tuned cavity
obelisk<ii>	= antenna rod

Fig. 30.2: ____ Little dictionary for ancient radio engineering (2).

<i>: Lamer: Worterbuch der Antike, Kroner Verl. Bd.96, under „Pythia"(gr.=the asker): In the temple of Delphi was a chasm. A tripod was standing over it, on which the Pythia was seated, if she gave oracle. Comment: "It was flashy how odd the Pythia was sitting; inconveniently enough, on the cooking pot of the tripod. Ancient pictures, which show her that way, still weren't proven, that it was this way ..."

<ii>: Lamer: under „Obelisk" stands; „The obelisks probably were clocks".

30.2 Prerequisites

The argumentation has to be made on mathematical-physical foundation. The prerequisite for that are the 29 chapters of before. The following points could be demonstrated and derived:

1. The wave equation (inhomogeneous Laplace equation) describes the sum of two wave parts, where
2. every antenna emits both parts,
3. the transverse part, known as electromagnetic wave (Hertzian wave)
4. and the longitudinal part (Tesla radiation) termed scalar wave by the discoverer, better known as antenna noise.
5. The wave equation mathematically describes the connection of both wave parts in general and the conversion of one part into the other in particular, thus
6. the rolling up and unrolling of waves in field vortices (measurable as noise).
7. The transition takes place proportionally to the Golden Proportion, as resulted from the derivation (chapter 29.7 - 29.9)

With the last point the electrotechnical problem becomes a geometrical problem, if it concerns the use of scalar waves. The geometry of the antenna is crucial. Thereby the Golden Proportion provides the necessary direction for construction.
That justifies the assumption that the buildings in antiquity, which were built according to the Golden Proportion, were technical facilities for scalar waves. Maybe the builders had specifications that had physical reasons and could mathematically be proven.
At this place there result completely new aspects for judging and interpreting buildings especially from antiquity through the derivation of the Golden Proportion from the fundamental field equation. If we have understood their way of functioning, then we will be able to learn much from that for our own future and for the future construction of scalar wave devices.

As a further prerequisite for the ancient broadcasting technology enough field energy should be at disposal. We proceed from the assumption that

1. the earth magnetism and the cosmic neutrino radiation are tightly hanging together by the processes in earth's core,
2. the earth magnetism in antiquity verifiably was approx. thousandfold stronger than today (proven by gauging of pieces of broken pot),
3. as a consequence the neutrino radiation in antiquity as well must have been thousandfold stronger and
4. the cosmic neutrino radiation has served the transmitting plants of antiquity as an energy carrier,

any thought is absurd to reject the technical function of a temple only because it today can't be reproduced anymore. The artistic and aesthetical viewpoints, which are put into the foreground by art historians because of ignorance about the true function, rather are secondary.

The terms used to describe the broadcasting technology in antiquity in the last 2000 years have experienced a shift of meaning, so that a translation in our linguistic usage of today is necessary. The adjacent dictionary should help in that case.

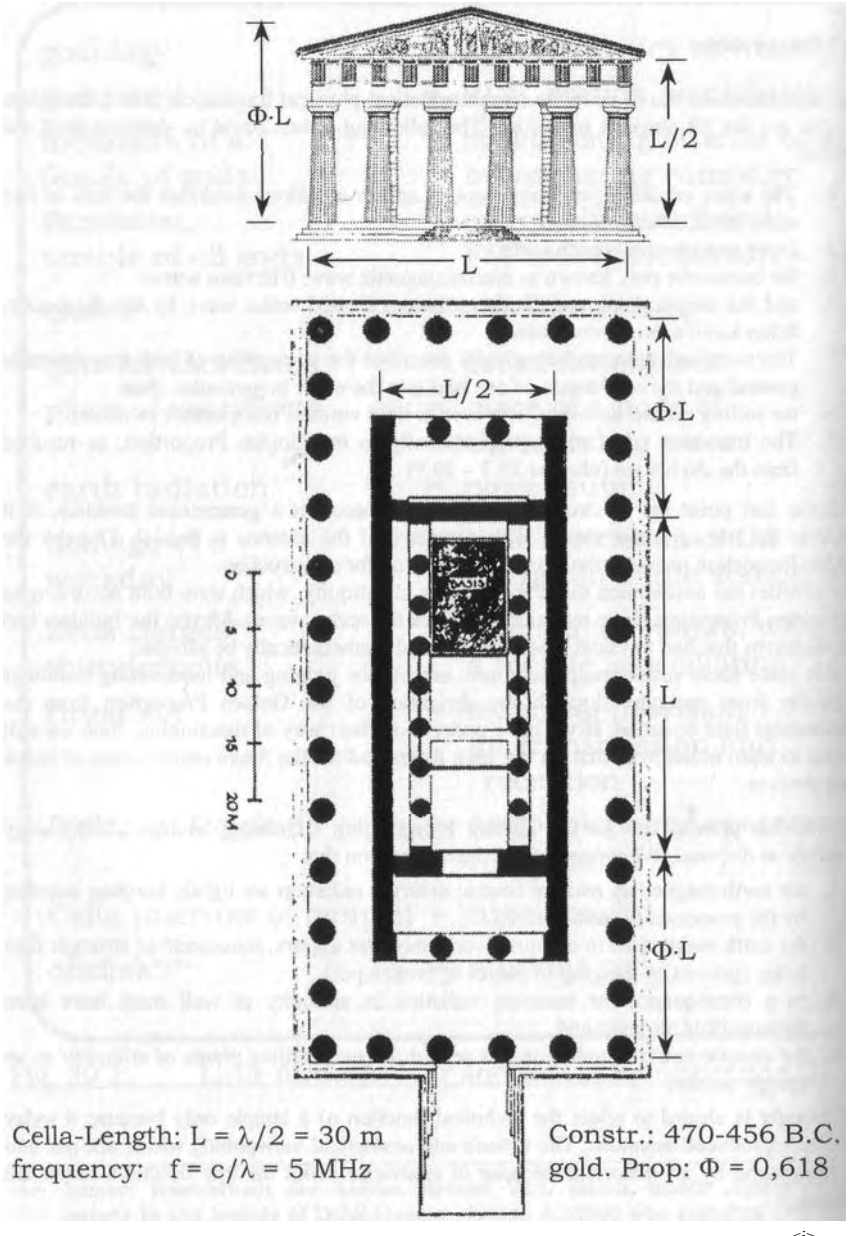

Fig. 30.3: The Golden Proportion of Zeus-temple in Olympia.<i>

<i>: K. Schefold: Die Griechen und ihre Nachbarn, Propylaen Kunstgeschichte Berlin Bd. 1, Abbildungen von Seite 249

30.3 Approach

Let's to some extent proceed from the knowledge of textbook physics currently present in high frequency engineering and give a well trained engineer the following task, which he should solve systematically and like an engineer: He should build a transmitter with maximum range at minimum transmitting power, thus a classic task of optimization. Doing so, the material expenditure doesn't play a role!

After mature deliberation the engineer will hit upon it that only one solution exists: He decides on a telegraphy transmitter at the long wave end of the short wave band, at f = 3 MHz, which corresponds to a wavelength of $\lambda = 100$ m. There less than 1 Watt transmitting power is enough for a radio communication once around the earth. That also has something to do with the conditions of reflection of the radio waves at the ionosphere. Our engineer learned:

the index of refraction $n = \sqrt{1 - K \cdot N/f^2}$ (30.1)

with: $K = 80.5 * 10^{-6}$ [cm^3/sec^2] (= constant)

N = electron concentration [electrons/cm^3]

f = frequency of the transmitter [MHz]

Put into words: the refraction of a radio wave in the range of the short waves is the larger, the smaller the frequency is. The end of the short wave range is reached at 3 MHz. That thus explains the choice of frequency.

And he optimises further. Next the engineer remembers that at high frequencies, e.g. for microwave radiators, not cables but waveguides are used, since these make possible a considerable better degree of effectiveness. In the case of the waveguide the stray fields are reduced by an alignment and concentration of the fields in the inside of the conductor. In the case of antennas however the fields scatter to the outside and cause considerable stray losses. He draws the conclusion that his transmitter should be built as a tuned cavity and not as an antenna!

As a result the engineer puts a building without windows in the countryside with the enormous dimensions of 50 m length ($=\lambda/2$) and 25 m ($=\lambda/4$) resp. 12.5 m ($=\lambda/8$) width. The height he calculates according to the Golden Proportion to increase the scalar wave part. Those approximately are the dimensions of the Cella without window of Greek temples.

For the operation of such a transmitter in antiquity apparently the noise power of the cosmic radiation was sufficient, which arrived at the earth starting from the sun and the planets. By increasing the floor space also the collected field energy and the transmitting power could be increased, so that also from the perspective of the power supply the temple with the largest possible wavelength at the same time promised the largest transmitting power, so at least in antiquity.

Our engineer further determines, that he will switch the carrier frequency on and off at a predetermined clock pulse. Thus he decides for radiotelegraphy. The advantage of this technique is a maximum increase of the reception range. For that the signals at the transmitter have to be coded and at the receiver again deciphered. By means of the encryption of the contents these are accessible only to the „insiders", who know the code; prerequisite for the emerging of hermetism and eventually a question of power!

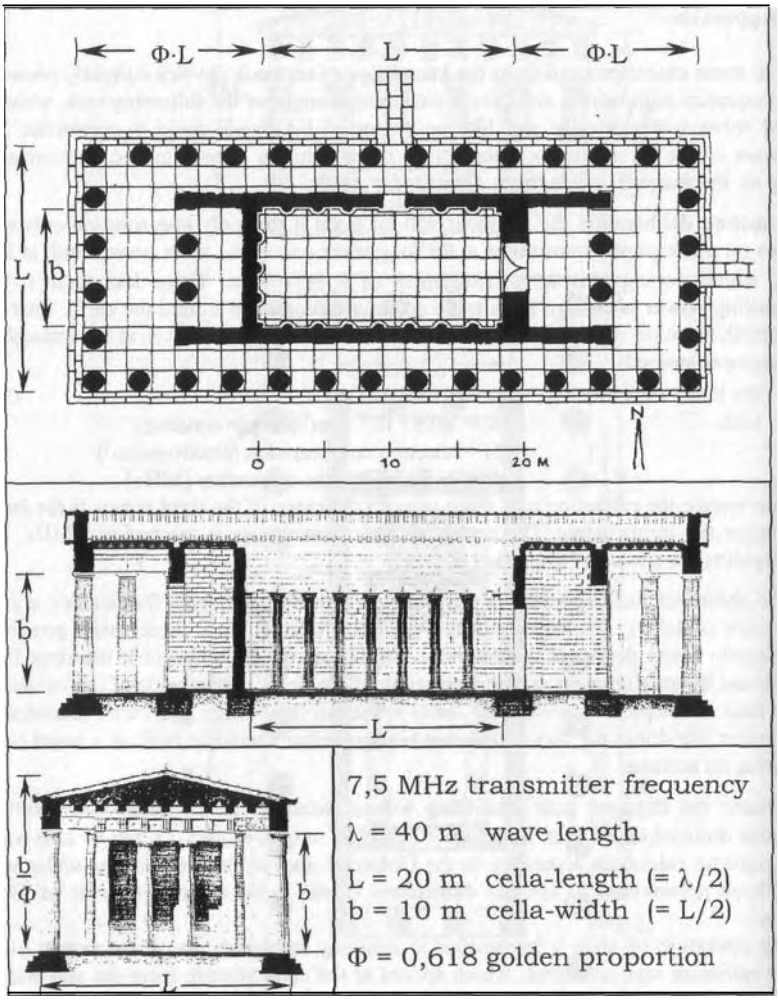

Fig. 30.4: Example Tegea, temple of Athena Alea.<i>
Built 350/340 B.C.

<i>: G. Gruben: Die Tempel der Griechen, Wissenschaftliche Buchgesellschaft Darmstadt 1986, 4. Aufl. Seite 130

<ii>: E. Horst: Konstantin der Grosse, Eine Biographie, Classen Verlag 1985 Dusseldorf, 2.Aufl., S. 89.

<iii>: E. Horst: Konstantin der Grosse, Eine Biographie, Classen Verlag 1985 Dusseldorf, 2,Aufl., S. 33.

30.4 Circumstantial evidence

Not everyone, somehow participating in send receive engineering, at the same time also was inaugurated in the entire secret knowledge. Most priests only knew as much as they necessarily needed to know to fulfill their tasks. Thus a temple priest, who was presented an enciphered text and who should bring this on the air, not necessarily at the same time needed to know the content of the text or the code. The same of course also was valid for the sacrificing priest acting in the receiving station. The Vestal virgins for instance had to present the received text to the Augures, by whom they were supervised and controlled.

But who wanted to introduce a new god in the gods heaven and perhaps even himself be worshipped as a god, should have complete command of both the broadcasting technique and the reception technique. In ancient Egypt the Pharao at least once a year had to prove, that he still was in command of the technique. Otherwise he was replaced. For a person with security clearance that at the same time was a death sentence.

In the historical facts numerous pieces of circumstantial evidence can be found, which can be considered to be evidence for the thesis of the operation of send receive engineering in antiquity. One now perhaps understands, why the rulers were put an antenna netting over their head, a so-called crown, or why the Augures could survey the land with a flat Tesla coil in their hands (fig. 16.10).

Direct evidence is present as well. It can be found in ancient texts. But it is questionable if historical texts concerning ancient radio engineering have been translated correctly. The talk is about oracles, mystery cult and earth prophesy if the receiver is meant. The predominantly technically uneducated historians attest the Romans a defective sense of time, because their couriers surely could not cover the long ways across the Roman empire so fast at all, if they read in the Latin texts: "They sent by courier to the emperor in Rome and got for answer...". The answer of the emperor namely already arrived at the squad at the latest in the following night. The correct translation should read: "they cabled" or "they broadcasted to the emperor in Rome and got for answer..."[ii].
Such a big empire as the Roman Empire actually only could be reined by means of an efficient communication. Cicero coined the word: "We have conquered the peoples of the earth owing to our broadcasting technology...[iii]"! The term broadcasting technology from ignorance is translated with piety. If engineers however rework the incorrect translations, then one will discover that numerous texts tell of the broadcasting technology, that thus correspondingly much direct evidence exists concerning the practical use of this technology.

For the Roman military transmitters, which formed the backbone of the administration of the empire, the reading off of the information from observations of nature like the bird flight or from felt signals of a geomanter was too unreliable. They read off the information from the rhythm of the convulsions of the intestines of freshly slaughtered animals. In the case of the dead animals on the altar every extrinsic influence was excluded. But the enormous need of slaughter cattle was a disadvantage. Who wanted to have information, first of all had to bring along an animal, which then was „sacrificed" the god, or better say, which was abused as a receiver for a particular transmitter. Thereby the innards served as a biosensor and as a receiver for the news.

Cellular phone.

- *Network:* All „telephone cabins“ are transmitter and receiver at the same time.
- *Advantage:* Anyone can communicate with every network participant.
- *Characteristic:* The stations are strikingly similar in form and size of building.
- *Power structure:* All stations as a rule have equal rights among each other.
- *Disadvantage:* Innovations hardly are possible. The system is inflexible.
- *Examples:* Temple towers (Iraq); cellular phone network.

Broadcasting.

- *Network:* Many receivers listen to the news of one powerful transmitter.
- *Advantage:* The system is very flexible and permanently experiences improvements.
- *Characteristic:* Monotheism. Big diversity among the receiver constructions.
- *Power structure:* Central power concentrated in the hands of the chief intendant.
- *Disadvantage:* Feedback from receiver to transmitter is not desired.
- *Examples:* God Ammun Re (Egypt); ABC daily news.

Dispatch service.

- *Network:* Network of broadcast stations supplies an agency (receiver) with information.
- *Advantage:* Optimal financing, since information is given away only for broadcasting fees in cash.
- *Characteristic:* Treasury stores have to be built because of the immense riches.
- *Power structure:* The power is concentrated in the hands of the receiver-agency.
- *Disadvantage:* In the case of overcharge or overload a system crash is impending.
- *Examples:* Pythia (Delphi); German Press Agency (dpa).

Fig. 30.5: ____ Three radio technical network structures, with an example from antiquity and from present time.

30.5 Radio technical concepts

In planning and constructing radio technical networks only a few possible concepts exist. It is interesting that at least one historical example can be specified for every concept. That shows that all possibilities were tried at least once. The three most important concepts are presented here:

A. Cellular phone.
Every bigger city between Euphrates and Tigris, which thought the world of itself, had at its disposal already in antiquity a temple tower. Such a temple tower was a „telephone cabin" in the form of a pyramid as a transmitter and a receiver temple at the top, to where the receptionist adjourned to the so-called temple sleep. Discipline was required, since all the time only one priest was allowed to broadcast. All others could listen to him doing so. If he was ready, he closed his contribution with a fixed symbol or term („over") and the next one could continue. This is a classic link-up, where anyone communicates with every network participant.
The stations all were strikingly similar in form and size of building, like one phone box resembles another. In that way a further development of the cellular phone system hardly was possible and that has a technical reason, as the building of a tower in Babylon has shown us. This tower namely had gotten the ambitious builders too big, so that the frequency of the Mesopotamian radio network had been left and instead a foreign network could be received, the code of which no-one could understand. The result was a confusion of language and the order to stop the building.

B. Broadcasting.
Millions of TV spectators every evening look in the ABC news or another daily journal of a TV Channel. In the case of broadcasting thus many receivers listen to the news of a powerful transmitter. With that the whole plenitude of power is concentrated in the hands of the chief intendant. In antiquity he called himself high priest. If he went on the air, he used the logo of the god that he had to represent. Today the logo of the broadcasting company is shown in a corner of the TV screen. Even this very day feedback from the receiver to the transmitter hardly is possible contingent on principle. The problems with nationally controlled broadcasting, with politics controlled by the media all are not new. The monotheism in ancient Egypt with the claim of lordship of the main god Ammun Re is an example from antiquity.

C. Dispatch service.
In ancient Greece the technical structures and with that also the power structures had been turned around. At that time a big network of broadcast stations, which continually was extended by a policy of settlement ordered by the gods, supplied a central and correspondingly powerful agency with information per radio.
Who wanted up to date news, could call for these in the agency with seat in Delphi, but he had to pay for it. To accommodate the broadcasting fees in form of gold and gifts whole treasury stores had to be built. Measured by the commercial success the ancient news network has remained unmatched, and can't be compared with pay-TV or todays dispatch services, like dpa. If the network however becomes too big, uncontrollable and it lacks discipline, then it sometime will crack and the system crashes.

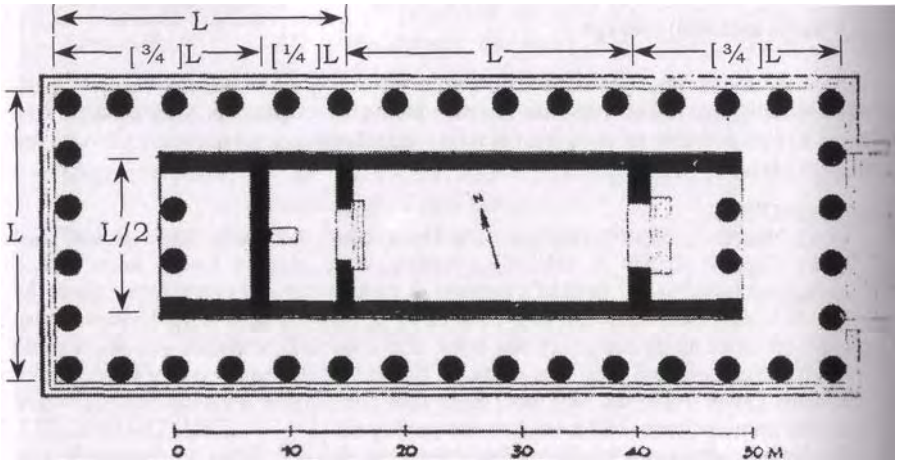

Fig. 30.6 A: Hera-temple of Selinunt 460-450 B.C.<i>
(Corresp. to the plans of the Roman architect Vitruvius)

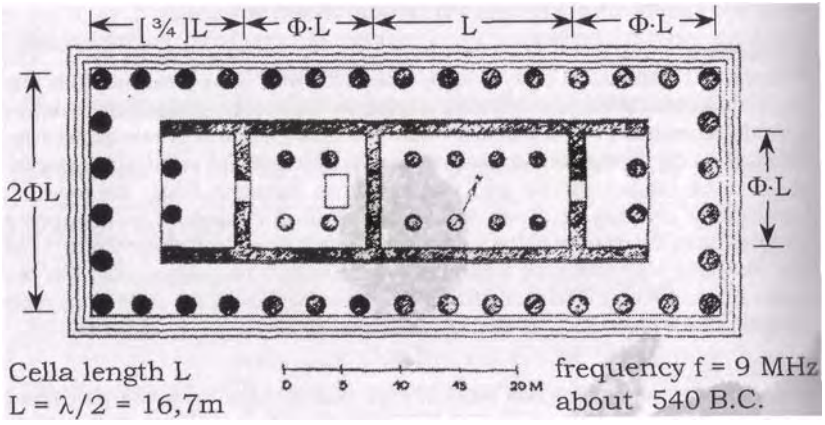

Fig. 30.6 B: Apollo-temple of Korinth<i>
(Alternative interpretation, use of the Golden Proportion Φ).

<i>: K.Schefold: Die Griechen und ihre Nachbarn, Propylaen Kunstgeschichte Berlin Bd. 1, Abbildungen von Seite 241, 250

<ii>: Vitruvius (Marcus Vitruvius Pollio): Zehn Bucher uber Architektur, Ubers. von Dr. K. Fensterbusch, Wissenschaftl. Buchges. Darmstadt 1987, 4. Aufl., 3. Buch, 1. Kap.: Von den Symmetrien der Tempel, Seite 137

<iii>: Vitruvius (dito), 4.book, 4.Chap.: Vom Tempelinnern und dem Pronaon, p. 187

30.6 Wireless telegraphy

Radio engineering 100 years ago also started with telegraphy. Thereby the high frequency carrier is switched on and off. With this technique Marconi succeeded in a radio transmission over the English Channel (1899) and over the Atlantic Ocean (1901).
As next step the amplitude modulation (AM) followed. Thereby the HF-carrier is overlapped with the low-frequency signal of a sound carrier in such a way, that the amplitude fluctuates on the beat of the LF-signal. As a disadvantageous effect, also noise signals will overlap, from which the quality of reception will suffer.
Only the frequency modulation (FM), where the LF-signal is transmitted as temporal fluctuation of the frequency, brings an improvement. The annoying amplitude noise hence has no effect in the case of FM.
It easily can be recognized, how the development of the modulation techniques follows the urge for technical improvement and optimization. That in antiquity hasn't been different, for which reason the progress of development took place in the same order.

The broadcasting technology of the ancient gods started with the wireless telegraphy. This is expressed in the architecture. Since electric resonant circuits or other frequency determining equipment weren't at the disposal of the engineers in antiquity, the determination and allocation of the broadcasting channels had to take place by means of the wavelength. The formation of a standing wave in the Cella, the innermost sanctuary of a temple, occurs if its length corresponds to half the wavelength of the HF-carrier. The Roman architect Vitruvius calls the wavelength the ,,basic measure", from which results "the system of the symmetries". He writes: ,,The design of the temples bases on symmetry, to which laws the architects should adhere meticulously. "[ii]. ,,The length of the temple is partitioned in such a way that the width is equal to half the length, the Cella itself including the wall, which contains the door, is one fourth longer than wide. The remaining three fourths, which form the Pronaon, should protrude until the antae of the wall and the antae should have the thickness of the pillars"[iii].
If we recalculate ourselves, then the partitioning in 3/4 to 5/4 produces a proportion, which conies quite close to the Golden Proportion. In building a temple nothing is left to chance, after all it concerns the construction of a tuned cavity, capable of self-resonant oscillations with favourable emission behaviour.
From the outside one can't see if a telegraphy transmitter has been changed over to speech transmission with AM. The HF-carrier merely isn't switched off anymore, i.e. the priests let the temple oscillate without interruption. Newly added for AM is an electroacoustic coupling. For that many temples were retrofitted with a mouthpiece. Newly built AM transmitter temples conclude the Cella with a round apse. Because of this acoustically conditioned construction the Cella length didn't have a fixed value anymore and the transmission frequency had become variable. Measured in the middle of the apse the wavelength was larger than at the sides, so that on the beat of the spoken word not only the amplitude of the field distribution in the interior of the temple, but in addition also the frequency of the selfresonant oscillation was changed.
A typical example of such an architectonic hybrid form of AM and FM is situated in Rome. Because due to the frequency variation more than only one wave band was occupied and the temple consistently carries the names of two deities. It is the temple of Venus and Roma.

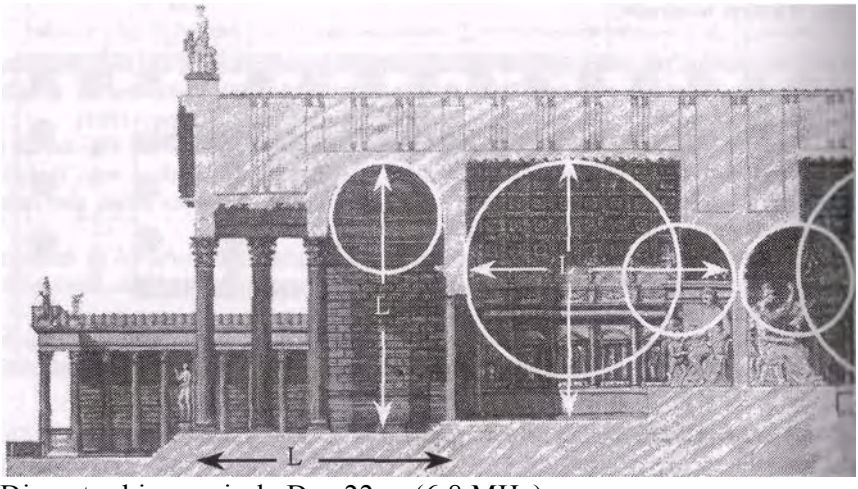

Diameter bigger circle D_1= 22 m (6,8 MHz),
small circle D_2 = 11 m; und L = D_1 + 1/2 D_2 = 27,5 m (5,5 MHz)

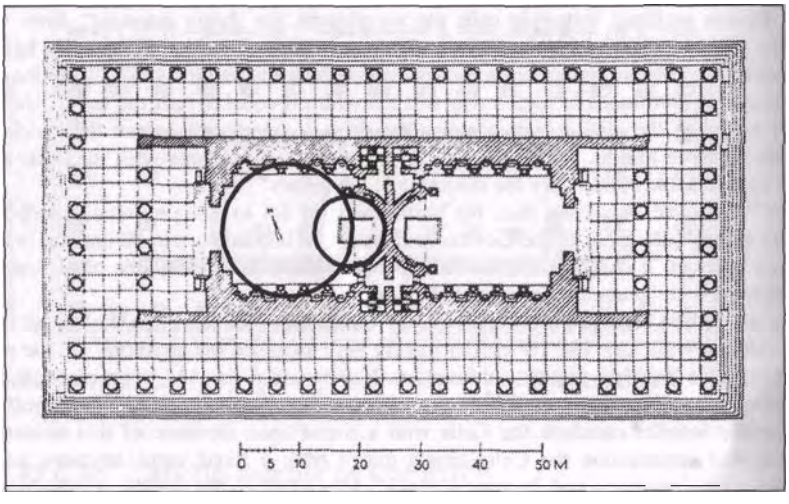

Fig, 30.7: Temple of Venus and Roma; Rome 136/37 A.D.[i,ii]

<i>: A. Springer: Das Altertum, A. Kroner Verl. Leipzig 1915, 10. Aufl., S. 518
<ii>: T. Kraus: Das romische Weltreich, Propylaen Kunstgesch. Berlin Bd. 2, S. 161
<iii>: Lamer: Worterbuch der Antike, Kroner Verl. Bd.96 unter "Tempel", Haufigkeit

30.7 AM temple technology

The low-frequency signal (LF), which should be transmitted by a transmitter with amplitude modulation, lies in the range between 16 Hz and 16 kHz. If it only concerns the transmission of speech information, then the bandwidth can be reduced to 300 to 3000 Hz. In the case of mixing the low-frequency useful signal with the HF-carrier, thus in the case of the modulation of the carrier in the rhythm of the LF, two side bands arise. These lie close to the carrier frequency and are formed from this once by the addition and once by the subtraction with the frequency of the LF-signal. Let's take the temple of Venus and Roma with a transmission frequency of 6.8 MHz. If sound of 3 kHz should be transmitted clearly understandable, then the dimensions of the Cella had to be varied for just 8 mm for a corresponding Cella length of $\lambda/2$ = 22 m. As a curiosity the niches in the side walls in the case of this temple however allow a considerably larger bandwidth of more than 10% instead of the necessary 0.04% in the case of AM.
In the case of the Greek originals, the Cella however has smooth walls, from which follows that the temples were designed ideally narrow band. The Greeks apparently operated predominantly telegraphy transmitters, for which the side bands coincide with the carrier.
The argumentation indeed has remained unchanged: The modulator being narrow band and simple to realize speak in favour of the telegraphy being the "original form" of all modulation techniques. Also the rediscovery of the broadcasting technology by Heinrich Hertz succeeded as telegraphy signal. In addition the range is bigger than for any signal modulated with sound frequency.
As the calculation example has shown, also pure AM transmitters work very narrow band, and this is particularly important for low transmission frequencies, if many transmitters want to use the favoured SW band between 3 and 10 MHz at the same time. With AM one thus accommodates the maximum number of broadcasting channels in a particular frequency range, for instance the 80-meter band, without these interfering with each other too much. But that also was badly needed. Conclusions about the everyday life of broadcasting in antiquity by all means are possible because of the enormous number of temple installations, which logically were permanently used. Only in Rome there existed up to 200 temples[iii]!
Who goes in search of broadcasting stations with a modern short wave receiver, for instance in the 80 m band between the countless telegraphy transmitters, fast gets an idea of what had been up in the air already 2000 years ago. No ancient city would build several temples on a single Acropolis, if only one single one could have been used. All temples broadcasted with each time another carrier frequency because of different dimensions. For this reason the temples, which stood side by side, as a rule were dedicated different gods. An acknowledgement, "the air just being free", in addition hardly was possible, because of the often-found spatial distance between the temple installations and the respective oracle. Between the transmitter of the god Apollo in Didyma and the receiver, the oracle of Milet, for example lie approx. 20 kilometres. The only possible conclusion is that in antiquity there was broadcasted on all channels simultaneously regardless of other gods and their transmission frequencies. As is well-known there rather prevailed a situation of competition between the gods, since like today a large number of listeners meant great importance, influence and power and eventually also worship, more gifts and more receipts from broadcasting fees.

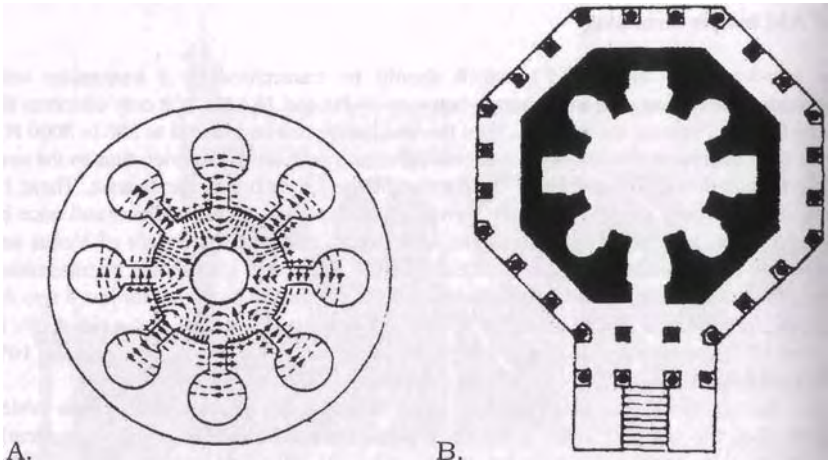

Fig. 30.8: ____ Comparison of a magnetron (A), a microwave radio tube[i] and the temple (B) in the palace of the emperor Diokletian, Split.[ii]

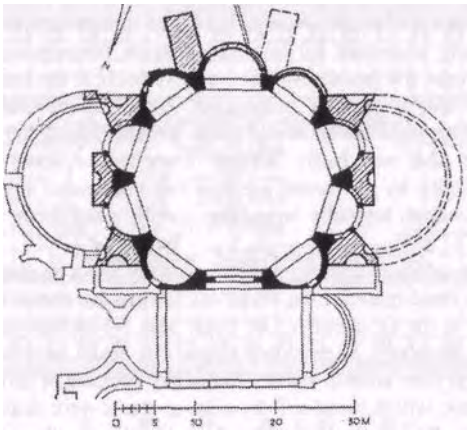

Fig. 30.8.C: Temple of Minerva Medica, Rome, 320 A.D.[ii]

<i>: K. Simonyi: Physikalische Elektronik, 8.4 Das Magnetron, S. 665

<ii>: T. Kraus: Das rom. Weltreich, Propylaen Kunstgesch. Bd. 2, S. 194, 196

<iii>: If one however wants to verify this, in antiquity already common manner of PM broadcasting technology, then we need a broadband short wave receiver with phase-demodulator. With such a receiver even today any time a conclusive argumentation should be possible that this sort of SW-PM technology actually works.

30.8 Modulation of acoustic signals

In the case of sound it in essence concerns longitudinal waves, which propagate in all directions in space with the velocity of sound. But this merely is an average velocity, since the air molecules strictly speaking oscillate with the sound frequency in the direction of propagation. In this way the velocity of sound one time is increased and the next moment to the corresponding extent reduced. If the molecules already carry out oscillations of themselves, e.g. thermal motion, then both oscillations overlap; i.e. the motion of itself is modulated with the sound frequency.
Following the here presented derivation potential vortices are formed in every dielectric, thus also in air, and these are modulated if overlapped with sound waves. Vortices however do not form a distinct frequency, but entirely on the contrary a uniform frequency mixture in the form of white noise.
The overlap thus also is noise unless certain noise frequencies are favoured. This can be effected by means of a spatial body tuned to a certain wavelength. To be considered are cuboid cavities, as in the case of Greek temples or waveguides and cylindrical objects as in the case of round temples or magnetrons. The building form causes the favouring of a certain frequency and the integer harmonic frequencies belonging to it.
If this frequency now lies in the high frequency range, then it is emitted by the spatial body as an electromagnetic wave, in the case of waveguides and resonant circuits for reason of the small dimensions as microwave radiation and in the case of the Greek temples as short wave radiation. If one in addition produces an acoustic signal in the frequency determining spatial body, then this signal automatically will modulate the high-frequency signal.
The result of the modulation is the overlapping of the sound wave with the high-frequency carrier wave. The change of the active length, thus the wavelength of the HF-carrier causes a change of frequency. Such a change on the beat of the sound frequency is called FM (frequency modulation). For that we imagine a spatial body being excited because of its length by potential vortices to a high-frequency oscillation at the self-resonant frequency.
From flow dynamics is known, how easy the distribution of vortices in space can be disturbed. Already words spoken in space are able to influence the potential vortices, which in the case of the temples were used as energy carrier. The longitudinal sound waves reflected at and thus returning from the Cella wall rigid for sound of a Greek temple will push these potential vortices back on the beat of the sound and with that shorten the active length. This means, that the carrier frequency is modulated with the sound frequency. The carrier oscillation thus permanently changes its phase on the beat of the sound signal, for which reason this particular kind of modulation is described as PM, as phase modulation.

Nowadays PM is used only seldom and in the SW-range not at all because of the big need of wave bandwidth. Merely at higher frequencies PM occasionally is used in radiotelephony. In the case of the frequency modulation usual in broadcasting (e.g. UHF), the change of frequency takes place on the beat of the sound amplitude and not of the sound frequency as with PM. Therefore it is not possible to receive phase modulated signals, which are produced by means of the acoustic coupling of appropriately formed spatial bodies<iii> with commercial FM receivers.

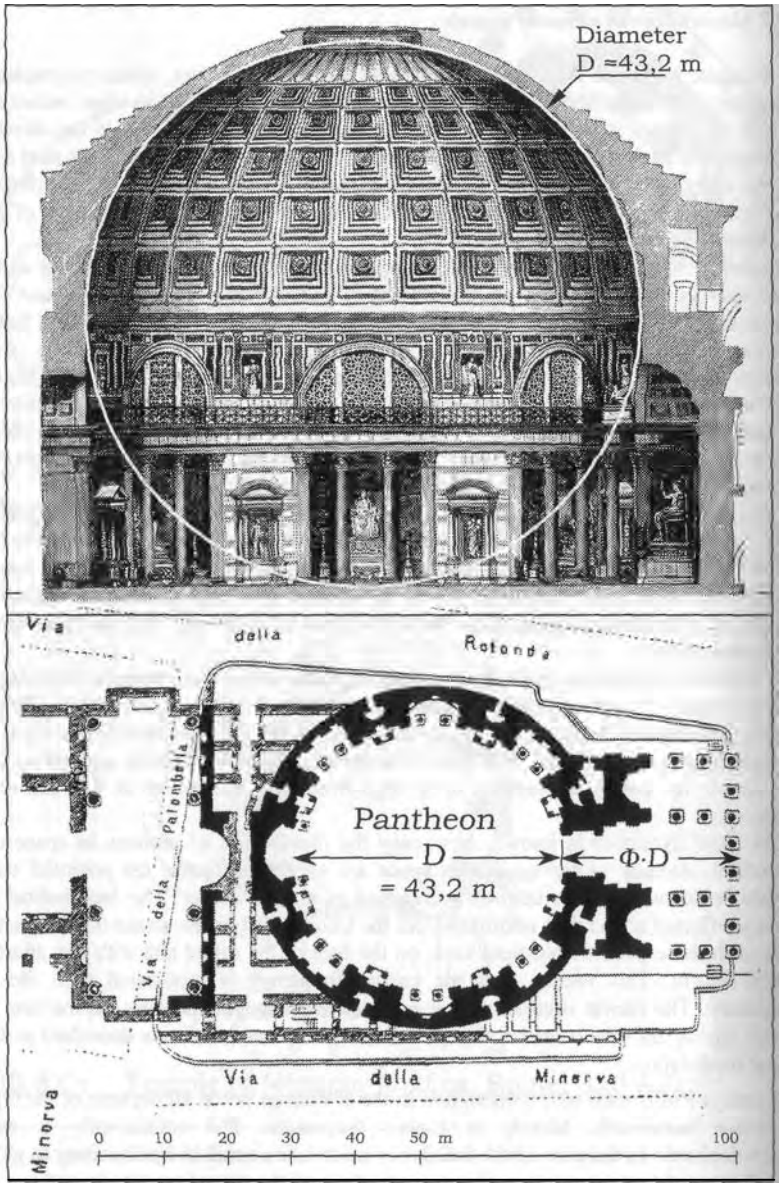

Fig. 30.9: The Pantheon in Rome, the „temple of all gods".<i>
Diameter D = 43,2 m, Golden Proportion: Φ= 0.618
Pronaon-(atrium-)length: Φ·D= 0.618 • 43.2 = 26.7 m
Built under emperor Hadrian 118/ 119-125/128 A.D.

30.9 Broadband FM broadcasting technology

If I speak against a flat wall, then every point on the wall has another distance to my mouth. The sound waves thus aren't reflected simultaneously, what leads to big modulation distortions. Therefore the sound wall should be curved in such a way, that all signal paths are the same length (barrel vault, apse, etc.). In the case of point sound sources there results as an optimum a hemisphere, for instance a dome. The building hence even today tells us, which frequency and which modulation method had been put to use. The architecture of sacral buildings, e.g. pointed arch or round arch, thus hardly has been a question of aesthetics.

For his temple of Venus and Roma designed by himself emperor Hadrian had to listen to severe criticism among others of Apollodor of Damascus. The temple was too broadband for an AM transmitter, however with a modulation depth of just 11 percent not broadband enough for a phase modulated FM transmitter.
Emperor Hadrian however also had the courage to build midst in Rome a temple calculated completely new and designed as a pure FM transmitter, the Pantheon, which means temple of all gods. In the language of the technician it is a transmitter for all frequencies.
This domed structure indeed doesn't leave out one single frequency. With a modulation depth of almost 100 percent it is designed for maximum loudness. With that the Pantheon uses all available frequencies, for which reason the name temple of all gods really is no exaggeration. Into the Pantheon exactly fits a sphere with a diameter of 43.2 meter. That corresponds to a minimum frequency of 3.47 MHz, situated in the range of the short waves. The floor however is not domed, but horizontal. That, up to the basis of the dome, results in exactly half the height and a maximum frequency of 6.94 MHz.
The construction ensures that between the simple and the double diameter any desired wavelength can be produced. Above the given maximum frequency of the basic oscillation the harmonic waves, which are produced as well and can't be avoided at all, are attached without a break. These occupy the wave bands up to the double, triple, quadruple frequency and so forth.
For this and only for this reason a maximum frequency was chosen, which corresponds to exactly the double value of the minimum frequency. The operation takes place to the limit, where the transmitter would interfere with itself, in the way that the used basic oscillation would overlap its own harmonic waves. That then sounds like two people talking at the same time. The voices would be distorted out of recognition, as can't be expected else in the range of the harmonic waves.
The Pantheon has been planned and built as a phase modulated basic wave transmitter according to purely academic rules of Hadrian. The temple impressively demonstrates the precise engineering detailed knowledge of the Pontifex Maximus and his broadcasting priests in ancient Rome<ii>.

<i>: A. Springer: Die Kunst des Altertums, A. Kroner Verl. Leipzig 1915, 10. Aufl., S. 517/518, daraus: die Zeichnungen ram Pantheon in Rom, 115-125 n.Chr.

<ii>: The collection of material concerning scalar wave technology here is aborted and continued in an own book in narrative and with that easier to read writing style. The title is: "Broadcasting Gods".

approach	derivation	result
b:= postulate [potential vortices Vol.1]	what if $\mathbf{b} \neq 0$?	**derivation** of the **Schrödinger eq.**
duality vortices replace quanta [potential vortices Vol.2]	from $\mathbf{H} \Leftrightarrow \mathbf{E}$ from $\mathbf{j} \Leftrightarrow \mathbf{b}$ [and chapter 3.3]	**calculation** of the **quantum properties** [potential vortices V.2]
causality [see chap. 3]	*gen.* ⇔ *special case* **field** ⇔ quanta cause ⇔ consequence (instead of: quanta ⇔ field)	vortex field free of quanta (instead of: irrotational field of quanta)
vortex physics analogous to flow dynamics [chap. 3.4 - 3.5]	**vortex + anti-vortex** (Demokrit/cosmology) [chap. 3.6 + 27.2]	coming off of vortices if $\tau_1 = \tau_2$ **model of atom** [chap. 5.5 + 5.8]
equations of transformation: $\mathbf{E} = \mathbf{v} \times \mathbf{B}$ $\mathbf{H} = -\mathbf{v} \times \mathbf{D}$ [chap.6.5 + 27.8]	for $\mathbf{E}(\mathbf{r}(t))$ and for $\mathbf{H}(\mathbf{r}(t))$: rot $\mathbf{E}$ = rot $(\mathbf{v} \times \mathbf{B})$ rot $\mathbf{H}$ = rot $(\mathbf{D} \times \mathbf{v})$ [chap. 27.9]	extended **field equations:** rot $\mathbf{E} = -\mathbf{b} - \partial\mathbf{B}/\partial t$ rot $\mathbf{H} = \mathbf{j} + \partial\mathbf{D}/\partial t$ [chap. 27.10]
equations of transformation: $\mathbf{E} = \mathbf{v} \times \mathbf{B}$ $\mathbf{H} = -\mathbf{v} \times \mathbf{D}$ [s.a. chap. 16.1]	**wave equation** inhom. Laplace eq. $\Delta\mathbf{E}$ = grad div $\mathbf{E}$ – rot rot $\mathbf{E}$ $\Delta\mathbf{E} = (1/c^2)\cdot\partial^2\mathbf{E}/\partial t^2$ [chap. 27.13] [chap.22.4]	transverse + longitudinal wave parts: **scalar waves,** noise, etc.
equations of transformation: [chap. 28]	vortex overlap **length measures depending on field**	**gravitation, temperature,** **theory of objectivity**

Fig. 30.10: (All) Many roads lead to Rome.

30.10 Epilogue

The preparation for a seminar or a lecture always starts with a collection of material. This should be considerably more detailed than the material to be communicated, since it doesn't get well at the students and also other participants, if the state of knowledge of the lecturer already is exhausted with the scope of his lecture. For this reason the collection of material must also include alternative derivations and areas of knowledge, which thematically rather are marginal, about which mustn't be reported, which possibly not even can bear criticism but still are in the public discussion. For a collection of material, which wants to be considered to be comprehensive and complete, it is important that no area and no theme has been overlooked.

The here presented collection of material with its 650 pages has become correspondingly voluminous. After all the material has been collected over an 8 year period and has been strung into the book in the order of working. That of course complicates reading the book, because individual aspects are repeated several times, but often also in a different context and each time lighted from another side. If the reader somewhere has the feeling, he only has turned in a circle, then has deceived himself. He indeed moves spirally in a circle, like in real life, but he doesn't come out there, where he started. After one turn he is richer with the experience of this spiral turn. In whole science the advancement takes place as a spiral movement and one can count oneself fortunate, as long as the spiral has an ascending slope! This notion should solace the reader, who has undertaken the torture to work through the complete collection of material.

Students also have reported, they had devoured my book like a thriller and a colleague, who had acquired it at a conference in Switzerland, was digging so much in the lecture that he forgot to get off the train timely.

It is a special concern to give reasons for the necessity of an extension of available field theory. To achieve this goal several derivations (fig. 30.10) can be found in my books: from a postulate, from causality, from duality, from vortex physics, from the equations of transformation, etc. added are at least a dozen derivations of other authors from various publications, who at most are cited. With that the goal is pursued that all approaches, which are conceivable and worth discussing, can be put side by side and tested for their efficiency.

Since it isn't the task of a collection of material to answer this question, this must be done by the hearer resp. the reader of the books. He is prompted to find the answer himself! That leads to an intense contention with the theme and that exactly is the reason for the otherwise rather unusual step to make a collection of material open to the public. Objections and criticism of the content of a relation of matters or also only of the representation of the context is wished explicitly. This also isn't valued as criticism of the author or of the superordinated set of difficulties, which in principle isn't possible at all for a collection of material.

Honorary functions of

Prof. Dr.-Ing. Konstantin Meyl

President
of the **Society for the Advantage of Physics** e.V.
(Gesellschaft zur Förderung der wissenschaftlichen
Physik, Köln)

Präsident
der **Europäischen Kommission interdisziplinärer Wissenschaften**, Hechingen,
Gesellschaft freier Wissenschaftler, Forscher und Praktiker
(Schirmherrin: Herzogin Margarete zu Mecklenburg,
Prinzessin von Hohenzollern).

Zweiter Vorsitzender im Vorstand
der Deutschen Gesellschaft für Energetische und
Informationsmedizin e.V.,
D.G.E.I.M, Stuttgart

Vice President
in „The **German Association for Space Energy**",
(**DVR**, Deutsche Vereinigung für Raumenergie,
Hannover)

Wissenschaftlicher Beirat
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im Bezirksverein Südbaden, Freiburg

TZ-Leiter
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im Schwarzwald

Fig. 30.11: Honorary functions of the author (December 2003, selection).

There in principle is no necessity at all to discuss with everybody a collection of material, which I have compiled exclusively for own events. It is absolutely sufficient, if few, but then qualified experts have thoughts about the content and communicate them to me. They can feel certain that I don't hand down their judgement to other persons. For that I also have been blamed by ignorant colleagues, who in complete self-overestimation have the opinion, they should be informed about everything. Right is rather, that my private correspondence is of no concern to anybody, since I find it important that as much readers as possible express themselves frank, what only functions, if they can feel certain that they afterwards won't be involved in public mud-wrestling. Therefore I keep still as regards other persons however curious they might be.

Indeed over and over again pseudo scientists turn up, who have the erroneous opinion that scientific arguments would take place on some internet-forums, where one can descant at will and anonymous, hidden behind an alias, where the intellectual firebug can feel safe, not afterwards being blamed for his crimes.

No, science takes place entirely different. A new theory will be able to establish, if it is right and important and if it is used for practical uses. Losers are those authors of a theory, for the elaboratation of which nobody is interested. What does a publication in a journal, however renowned, mean, if nobody reads it and nobody needs it? Most new ideas and approaches go under without notice in today's flood of publications, for who has got the time to read all essays in full?

Desperate they turn to me hoping, at least I could understand their concern. I then invite these scientists to a congress of the „Society for the Advantage of Physics", of which I am the president and offer them a forum, where they are able to present their ideas to an expert public. Not all lectured ideas prove to be sound, but not seldom a physical concern, which should be taken very serious, is behind it.

For a long time the real scientific controversy doesn't take place anymore at the universities and their congresses, where hardly someone dares to lecture arguments against the convention. Too fast he would be expelled as outlaw from the honourable society. From time to time however also from these circles colleagues dare anonymously or privately, as they emphasize, into the alternative events of lobbies or clubs, to astonished find out that real science there still is practised and that there is discussed about ideas, which they have given up thinking or have forbidden themselves to think about. The employment activity, so they excuse their thinking prohibition, allegedly doesn't allow it.

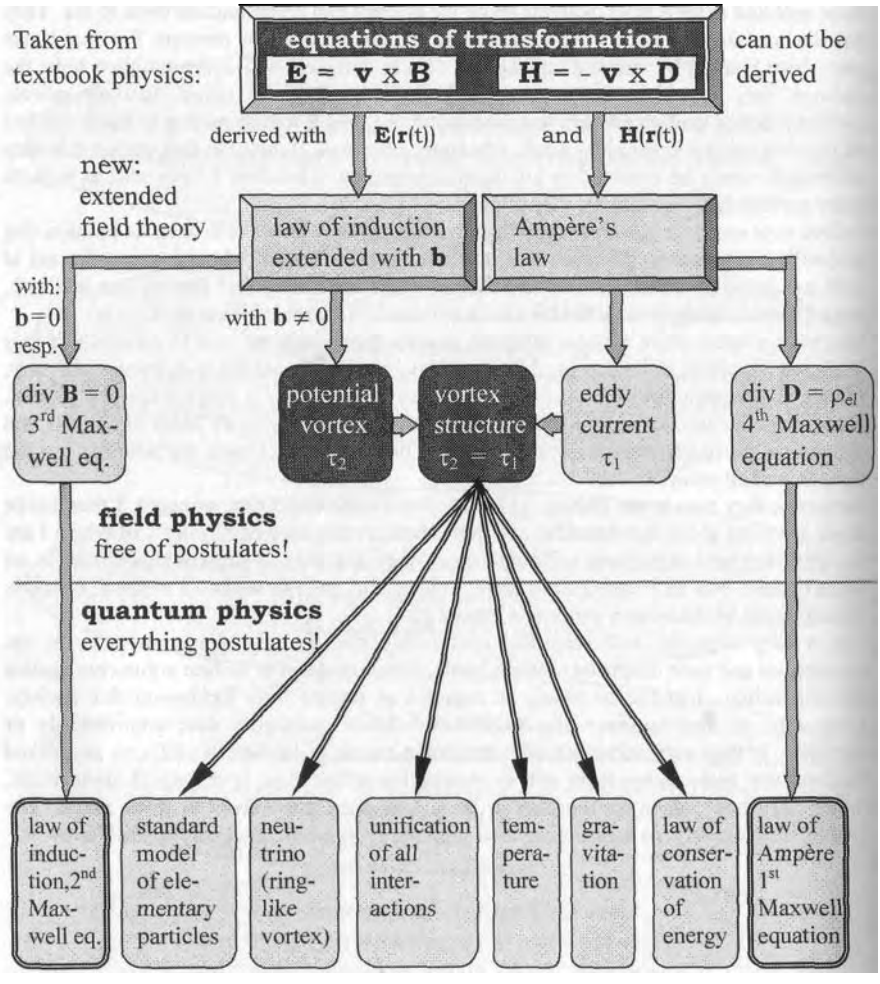

Fig. 30.12: Derivations of postulates and axioms (part 1).

Be that as it may, the approaches and derivations contained in my collection of material are considered to be controversial, and that is good that way! The public takes notice and professional circles are occupied with the ideas. With that half the way to success already is brought off! It now concerns to knock off all points for their soundness individually, because the next step will be to search a way to the goal as unassailable as possible, which is able to convince also the biggest sceptic. The final version, which then should appear in accredited peer-reviewed journals and in a scientific book concerning the theory of objectivity, goes in this direction. From the numerous approaches in the end only one will be used, and from the countless, in the collection of material listed aspects only the noncontentious ones will remain.
The dispute, which in the current stage can't be avoided, yes even is desired, however shouldn't deceive about the fact that it here doesn't concern persons, improper vanity or some image cultivation, but simply and solely concerns the matter!

In fig. 30.12 and 30.13 is represented, what it concerns. Field physics and quantum physics don't form, as in common practise, an insurmountable opposite, but even complement each other! Below the stripline a little selection of the today in current use quantum physical postulates can be found. The number of newly introduced „constants of nature" and postulates permanently is increasing, a circumstance, which hardly can be mediated to the common sense. The bracket is missing, which interlinks all postulates, or the common source from which they can be derived causally.
In the progress of the three-part edition in this question, essential for physics, already a satisfying and in addition real efficient answer has been found in the domain of field physics. The coupling marked by individual derivations can be found above the stripline and it is entirely new, apart from the dashed indicated derivation (fig. 30.13), as given by Prof. Bosse (TU Darmstadt) in his textbook.
An approach in principle can be chosen freely. In the case of the superordinated field theory two equations of transformation form the approach, which already is laid down in textbooks and secured experimentally. That's why the whole field theoretical derivation manages without one postulate! It is pointed to the fact that these equations on their part can't be derived and should be interpreted rather philosophically than physically. From this approach the extended field theory is derived directly, without a need to add or discard a term. The extended field theory consists of the well-known law of Ampere extended with the dielectric displacement D by Maxwell, and of Faraday's law of induction, which experiences an extension with the vector of potential density b by means of the derivation. Doing so we assume that the field pointers of the electric and the magnetic field strength depend on the spatial coordinate r and through this indirectly also on the time t: E(r(t)), H(r(t)).

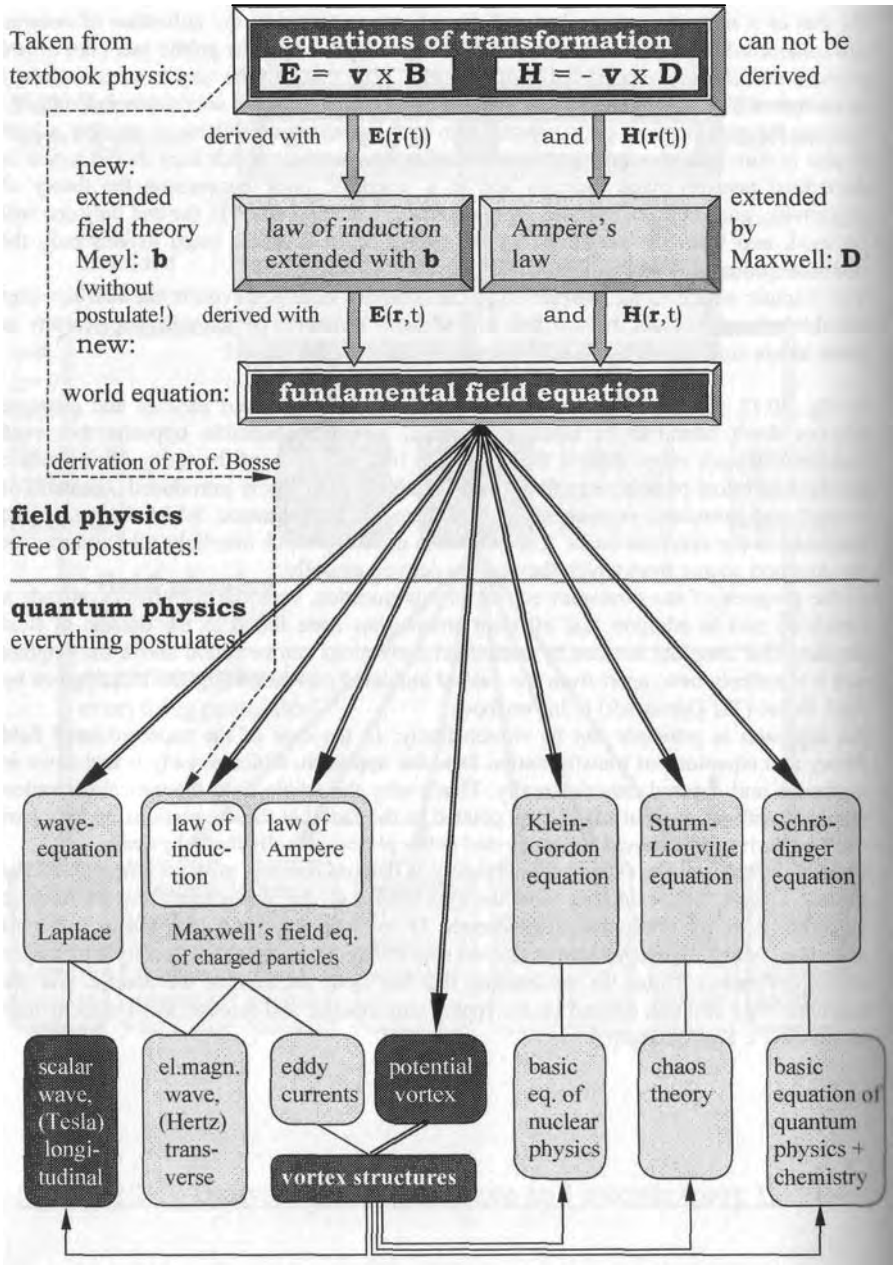

Fig. 30.13: Derivations of postulates and axioms (part 2).

If the somewhat more general case is counted up, in which case apart from the spatial a direct temporal dependency is present (E(r,t) and H(r,t)). then further additional terms appear in addition to the extended field equations, which need an explanation also for the case that they are zero. The physical interpretation would implicate a longer treatise, which however can be circumvented, as shown here, by constraining the field pointers, which absolutely is allowed according to the slogan: for the case E(r(t)) and H(r(t)) chosen from many possibilities the extended field equations come out exactly in the form, as they are required and suitable for the further calculations. Who has got to calculate other cases, can do that as he likes, but doing so he should not get lost. Maxwell's field equations are contained in the solution and with that also continue to be valid. Their disadvantage however is that without the extension b not a single quantum physical postulate can be derived. If we add this extension and insert the equations into each other without addition and without cuts also this time a central solution is the result, which is called fundamental field equation.

The derivation is known as well from the Maxwell theory, in which case it is common practise, to use the general approach (E(r,t) and H(r,t)), what we in accordance with the textbooks can do in the same manner. The extension however brings two additional and extremely significant terms. Since the fundamental field equation has eigenvalues under certain boundary conditions and describes structures, various quantum postulates come out from it, from the quantum properties of the elementary particles over the Schrodinger equation and the inhomogeneous Laplace equation up to the derivation of the Golden Proportion. That justifies the assumption that this possibly is the long sought-for world equation!

Even I, as the initiator, was totally surprised by the found derivation of the most important quantum physical postulates and axioms. One just is doing it the right way and already everything fits together! I am not aware of any theory, which would be able to achieve something roughly comparable. The since long sought-for ,,Theory of Everything", the big unification theory really falls into ones lap. The known interactions are the free and easy result of analysing the field lines of electric and magnetic field strength (fig. 30.12). Physical phenomena, which until now were considered to be incompatible, like e.g. waves, noise or the temperature with the utterly insufficient concepts of the mechanisms for the conversion of one form of energy into another, can be represented consistently with the fundamental field equation as the rolling up of a wavelike field oscillation to a vortex oscillation and as conversion of the noise vortices in the case of a vortex contraction down to atomic dimensions as thermal oscillation, which we treat as vortex losses. There exists no alternative to such unified schemes of things, as makes it possible in abundance the theory that I have founded, considering the two conditions, that on the one hand in the case of the derivation only known regularities are used, by completely doing without postulates and that on the other hand laws are applied and adhered to, also physical laws.

The new schemes of things, which sound unfamiliar, thus already were contained in the laws of physics. After this now having been realized, the tables turn. Now the explanations by postulates, as they at the moment still are being taught, should be replaced by the newly derived ones, if one doesn't want to become a breaker of the law! There doesn't lead a way past the overdue reform of physics anymore.

If you want to correspond with me or if you want to get one of my books from the bibliography, then please consult my Transfer Centre in the Technology Centre of St. Georgen (Black Forest, D).

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The list of deliverable books (for ordering books over the above given address, Fax, Mail or postcard suffices):

* Wirbelstrome, Diss. University Stuttgart 1984, ISBN 3-9802 542-0-8, 14
* Potentialwirbel Band 1, 1990, ISBN 3-9802 542-1-6 (German), 14
* Potentialwirbel Band 2, 1992, ISBN 3-9802 542-2-4 (not available)
* Elektromagnetische Umweltvertraglichkeit, Teil 1, 2 and 3 (German), ISBN 3-9802 542-8-3, 3-9802 542-9-1 and 3-9802 542-7-5. Each 16
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(A bill is enclosed in the delivery.)

Fig. 30.14: Contacting address and list of deliverable books

Table of formula symbols

Electric field

E	V/m	Electric field strength
D	As/m²	Electric displacement
U	V	Tension voltage
ε	As/Vm	Dielectricity: $\varepsilon = \varepsilon_r \cdot \varepsilon_o$
Q	As	Charge
e	As	Elementary charge
τ_2	s	Relaxation time constant of the potential vortices

Magnetic field

H	A/m	Magnetic field strength
B	Vs/m²	Magnetic induction
I	A	Current
μ	Vs/Am	Permeability: $\mu = \mu_r \cdot \mu_o$
ϕ	Vs	Magnetic flux
m	kg	Mass
τ_1	s	Relaxation time constant of the eddy currents: $\tau_1 = \varepsilon/\sigma$

other symbols:

A	m²	Area
a	m	Distance
b	m	Width
c	m/s	Speed of light
c_o	m/s	Speed of light in vacuum
C_e	As/V	Capacity of the electron
C_p	J/K	Heat capacity
d	m	Thickness
E,W	Nm	Energy
f	1/s	Frequency
F	N	Force
G	m³/kg·s²	Gravitational constant
g	m/s²	Gravitational acceleration of the earth
h	m	Height
h	Nms	Planck's quantum of action
$\hbar$	Nms	Quantum of angular momentum: $\hbar = h/2\pi$
j	A/m²	Current density
J	kg·m²	Moment of inertia
$J \cdot \omega^2$	kg·m²/s	Angular momentum
k	Nm/K	Boltzmann constant
l	m	Length
m	kg	Mass
M	kg	Mass of the earth
n,ν =	1,2,3..	Running parameters
N	-	Constant
O	m²	Surface area
p_m	Am²	Magnetic moment

Q	Nm = J	Heat energy
r, R	m	Radius, radius of the earth
r_e	m	Radius of the electron
s	Nms	Spin
t	s	Time, time to orbit
T	K	Temperature
U	Nm	Potential energy
U_e	V	Tension voltage of the electron
v	m/s	Velocity
V	m³	Volume
W	Nm	Energy
w	N/m²	Energy density
W_e	Nm	Energy of the electron
z_e	-	Number of the involved elementary vortices
λ	m	Wave length
ω	s^{-1}	Angular frequency, angular velocity
σ	Vm/A	Specific electric conductivity
ρ	kg/m³	Density $\rho = m/V$
ρ_{el}	As/m³	Electric space charge density
ψ (r,t)		Complex wave function
ϕ (r)		Function of space coordinates
Φ		Golden Proportion

Definitions:

Speed of light	$c = 1/\sqrt{\varepsilon \cdot \mu}$	m/s
Speed of light in a vacuum	$c_o = 1/\sqrt{\varepsilon_o \cdot \mu_o}$	m/s
Moment of inertia (orbit)	$J = m \cdot r^2$	kg·m²
Mom. of i. (homogeneous sphere)	$J = (2/5) m \cdot r^2$	kg·m²
Angular velocity	$\omega = v/r = 2 \cdot \pi/t$	1/s
Surface area of a sphere	$O = 4 \cdot \pi \cdot r^2$	m²
Volume of a sphere	$V = (4/3) \cdot \pi \cdot r^3$	m³

Concerning vector analysis:

Bold print = field pointer (vector); further information in fig. 5.0 in part 1

Prof. Dr.-Ing. Konstantin Meyl:

Scalar wave technology

for the transmission of electric scalar waves

Abstract: 1. Auflage 2000, 2. Auflage and 1st English edition 200

This book is recommended to people, who search the entry into the world of the by the author discovered potential vortices and their propagation as a scalar wave by experimental means. It starts with the instructions to six extraordinary experiments. Doing so an electric radiation is proven, which transmits energy, and that even faster than the light. Also more energy can arrive at the receiver then is put into the transmitter. Who entertains a doubt, will be able to understand the experiments with this book in his hand, to afterwards test the experiments with the gauge, which he is familiar with.

The 1st edition in English at first only includes the instructions for the experiments. In a subsequent edition it will be complemented with a collection of test protocols and progress reports. These are organized into three groups: one group is striving to explain the behaviour of the transmission line conventionally, a legitimate concern, which in a number of points also is able to convince. A second group only is interested in those phenomena of the experiment, which can't be explained conventionally and which prove the existence of scalar waves, whereas the third research group continually strives for new spectacular experiments and practical applications.

Documentation

Belonging to the experimentation and demonstration kit for the transmission of electric scalar waves

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by Prof. Dr.-Ing. Konstantin Meyl:

Sendetechnik der Gotter

Konstantin the Great is inaugurated in ancient send receive engineering by his teacher in the Roman emperor palace 304 A.D.

Abstract: l.Auflage 2004(in German)

- Has god Apollo in Delphi broadcasted at 5.4 MHz?
- Were the Greek temples telegraphy transmitters?
- Were the temple priests amateur radio operators?
- Was Homer radio reporter by order of the gods?
- Were the oracles receiving stations?
- Have oracle interpreters deciphered the transmission code?
- Which bridges did the Pontifex Maximus build?

All are questions, which are dealt with and explained in detail in 30 lessons. In the year 304 A.D. we witness, how the later Roman emperor Konstantin the Great is inaugurated in the secret broadcasting technique of the gods by his teacher. It is an exciting time of upheavel, because the old telegraphy is almost dead. The intestines of animals to sacrifice, from the convulsions of which the radio signals are read off, are scarce goods. Instead radiotelephony should be introduced, which had been tested successfully with the Pantheon in Rome by emperor Hadrian.
But new dispute is initiated: should broadcasting be introduced or rather cellular phone? But those, who tamper around without licence, are chased and fought as always.

When the book is available in English, you will be informed per internet:

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Thirsty for the truth, which is so certain
I sought for some water in our Vedas - the fountain
Though I can't understand fully what it contains
I am amazed & speechless with what I could ascertain
This is just a speck of dust from that golden mountain
Thankful to my family for helping me in what I could attain
Grateful for the wisdom and works from all the chieftains
Wish I repay every atom of it through my gratuitous tearstains"

This effort is to share what I read, understood and enjoyed about the scientific aspects in ancient India which are codified in our language, arts and in 1000s of temples. The quotes and examples are predominantly in Tamil but I have tried to give the meaning which can enable a reader to grasp the meaning and progress. Any shortcomings you notice are purely reflective of my abilities to understand and express. There was not even an iota of intention to hurt any sentiments or beliefs of others. A piece of my mind is available @ http://ragsgopalan.blogspot.com

I initially thought that I shall reproduce a prayer from one of the books which I had read but at one fine moment I decided to capture my feelings in my own words. So I scribbled few lines in English summing up my feelings as above, few lines for the Sage of Kanchi and a prayer in Tamil with its meaning in English. You may understand this prayer better after you read this book.

January 2012, Version 1.0

Please feel free to copy and reproduce in whichever form or shape as you deem fit without any acknowledgements. In fact see how much of this can you share to dispel the ignorance. The more you share the better. ☺

If I have acknowledged any books or authors please recognize them and ensure that you either buy their books or donate to their cause. They deserve all the credits.

A divine soul
With a noble goal
Walked this earth
When divinity was dearth
Beyond any treasure's worth
To avoid our death & rebirth
Seek his guidance & grace
For he shall ever embrace!

உ

முதல் வணக்கம் (Prayer)

உள்ளமே மூலமாகி, பரம்பொருள் கோலமாகி
விண்ணே ஒளியென்றாகி, ஓமே உணர்வென்றாகி
உணர்வே ஓமொளியாகி, ஓமொளி ஓமொலியாகி
ஆடலன் ஆட்டமன்றோ, அசைவுறுக் காலமாகி

(Mind is the source, primordial god's particle as the form,
The luminescent space, the Pranava as consciousness
Consciousness as the Om's Light, Om's Light as Om's sound
Isn't time a pulsation that's the dance of Lord of Dance?)

காலமே சீலமாகி, சீலமேக் கோலமாகி
கோலமே ஞாலமாகி, ஆதியும் அந்தமாகி
ஞாலமே மூலமாகி, அறிவுடன்ஆ னந்தமாகி
நடுவிலே நன்று நிற்கும் நாதன் தாளே நாட்டமாகி

Time creates Rhythm & order, Rhythm creates shapes
Shapes become universe, the beginning and the end
Universe merges with source, it is awareness & bliss
Ever searching for the feet of the divine & graceful mean

விண்ணிலே மண்ணுமாகி, மண்ணிலே விண்ணுமாகி
விண்ணிலே எண்ணமாகி, எண்ணமே எண்ணுமாகி
என்னிலே என்னைக்காண என் கண்ணிலே மணியுமாகி
நிர்மலப் பொருளாய் ஓங்கும் நிமலனடி போற்றுவோமே!

The mass in energy (Space), the energy in mass(earth)
The energy as thoughts, our thoughts as numbers (octets)
To me find me within me, he who stands as my eye's pupil
Beseech his feet who is devoid of may blemish

அம்பலத்தில் ஆடும் அவனை, அரங்கத்தில் துயிலும் அவனை
அரவத்தைச்சூடும் அவனை, அரவம்மேல் ஆடும் அவனை
பைரவித்துணைவன் அவனை, திருமகள் தலைவன் அவனை
நம் அறிவுக்கு இருளின் நமனை, பொற்பாதம் போற்றுவோமே!

The one who is dancing in the microbode, the one who is sleeping in arangam
The one who is wearing snakes, the one who is dancing on a snake
The one who is consort of Goddess Bhairavi, the one who is the Lord of goddess Lakshmi
Beseech his feet, the one who kills our mind's tamasic darkness

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1. TIME = SPACE SERIES. PART 1 - INTRODUCTION

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

"Abheda Darsanam Gnanam*". Nothing defines what **wisdom is** better than these 3 words. **Experience of unity / oneness in all is wisdom.** The roots of Indian wisdom are captured in these 3 words that everything in this universe is the manifestation from a single source, and we can call it God or Consciousness. This naturally leads us to one of the mahavakya ***"Pragyanam Brahma"*** which means **"Consciousness is god".** But for people who are stingier with words and wants these 2 concepts to be put in just one word, then it is called **"Advaita".**

It is not very often that nature reveals itself its absolute oneness and the un-manifested interconnections. You consider yourself fortunate when you come across such knowledge in however small measure, even if it happens very rarely and even if you have an illusion that you have understood something. It has been very overwhelming for me to come across some of the details I have been reading and hearing and the dots I could connect – some of which I had decided to write as a book.

If you are interested in knowing how scientific ancient Indian Sanatana Dharma is and how well we have codified nature's secret in our languages, arts and temples and if you are interested in any of the following questions then you may like this book. Most of the aspects stated here as scientific proof has a reference to one or more of our scriptures and I would refer and quote them at various places.

- Would you be surprised to know that the size, shape, color and characteristics of God's particle are very clearly documented in our scriptures at least 12000 years back? What the scientists at CERN are spending billions of $, is well documented and we will discuss the characteristics of God's particle in this book.

- Would you want to know how **Time = Space** and more over time is nothing but the vibration of space? If I tell you that this was known us Indians at least 12000 years back and currently available in a written form would you believe?

- When you throw a stone in water / pond the ripples that form take the shape of a circle (in 2D) / sphere (in 3D). Can you guess what the shape of the ripple would be if you throw the same stone in space?

- What is the similarity between Poetry, classical music, Classical dance like Bharatanatyam, Sculpture and a building? Apart from the fact that we don't clearly understand any of them in depth what is the similarity? Would you be surprised if I say that all are essentially the same and in fact a **well constructed building is nothing more than a frozen music** and the relationship between all the above confirms to a single grammar documented 12000 years + back ?

- Would you be interested in knowing how $E = mc^2$ an equation stated by our great Einstein has been known to us for years and not just that but we know the root of this energy and how to engineer it with precise formulas? Would you be surprised that this is the basis our language?

- What if I say that the age of the universe, every astronomical unit of the bodies, big bang theory, string theory, God's particle etc are all documented and they are all codified in our temples?

- You would have heard about the golden ration Φ but do you know the philosophical significance of Φ and how it is derived? Moreover would be interested in knowing the significance of key numbers and ratio like 0, 1, 5, 8, 9 and $\sqrt{2}, \sqrt{3}, \sqrt{5}$? What is I say that $\sqrt{3}$ can be correlated with "**Iyengar Namam"?** Does it sound funny? What if there is a deep mathematical and philosophical significance? And how are all these ratios related?

- As a wise man said that **'Mathematics is the language of the gods".** What if this formula is codified in our texts from which we understand the God's particle, its shape, characteristics and its manifestation?

- What if I tell you that sound is a subset of light and sound merges with light at a point and that is at the root consciousness? Any non-takers for this?

- If you agree on the above then **Sabda Brahman** or the belief that sound is god merges with something higher, isn't this contradictory? Also why many religions did believed that "**Word is god".** Was it a mere belief or was there any scientific reason behind it?

- What is the correlation between Carnatic music and a human being's height?

- What if I say that the Mayan from South America and the Mayan from South India are one and the same?

These are some of the questions which might get addressed in this book. I am going to quote a series of references and books and links to understand and learn more about these topics and I would request you to utilize them if you are interested in these topics.

This may not only refer you to the experts but also can help you overcome any weakness I have in understanding and articulating some of these topics. Some of the topics may touch upon religious beliefs (mostly Hinduism) but if you read with an open mind you would notice the underlying science behind it.

I would be happy if any of these blogs motivate and inspire you to explore the roots of our tradition and knowledge and give you an insatiable hunger for knowledge, wisdom to pursue the nature and its secrets.

May the ancient Sanskrit quote “May I meditate on the supreme truth “Satyam Param deemahi”, resonate within you as it does within me.

Happy reading!

PS:

Abheda Darshanam Gnanam, Dhyanam Nirvishayam Manam;
Snaanam mano mala thyagam, Showchamindriya Nigraham", says the Upanishad.

The real Gnana is seeing all as one, real Dhyana is controlling the Manas from all temptations, the real snana or Bathing is Cleansing of All Mindly impurities, not physical impurities alone and real Showcha or cleanliness is controlling the Indriyas, this controlling of Indriyas, emotions, weaknesses and temptations.

I am also quoting parts of Kahlil Gibran here,

Your hearts know in silence the secrets of the days and the nights.
But your ears thirst for the sound of your heart's knowledge.
You would know in words that which you have always known in thought.
You would touch with your fingers the naked body of your dreams.
And the treasure of your infinite depths would be revealed to your eyes.
But let there be no scales to weigh your unknown treasure;
And seek not the depths of your knowledge with staff or sounding line.
For self is a sea boundless and measureless.
Say not, "I have found the truth," but rather, "I have found a truth."

2. TIME = SPACE SERIES. PART 2 - SOUND MERGES IN LIGHT

What if I say that "**Sound is a subset of light".** Scientifically you may agree that both are electro-magnetic vibrations at different frequencies in the spectrum though one may not be the subset of another.

So, What if I say that every other frequency is the subset of light? I am sure many may disagree. Some of the religious pundits may claim that "**Sound is god**" which I am not disputing but "**light too is god"** and as we progress towards the primordial state sound merges into light.

Let me try to explain this with a simple exercise. Please sit in a place with a calm mind – few deep breaths may help.

- Imagine that I am TALKING to you and avoid thinking that you are reading this blog.
- I am going to TELL the following 5 words and you are going to LISTEN to it. Please just observe what happens within you.
    - CAT, BOAT, MOM, DEVIL, BEST FRIEND

The following are the fundamentals of perception as per Hindu scriptures:

- Every word has a meaning (Let us ignore the so called meaningless words for the time being.).
- Every meaning invokes a form or shape within our mind.
    - For example when I say "**MOM"** you associate this word with your mother and the picture / image of your mother is perceived inside. You need to be little more observant to understand this. **The fundamental principle is that**
    - **"Every word is first associated its meaning then the meaning is associated with a form. The form is associated with a Guna (Quality) and then the quality or Guna is associated with its experience. What is stored inside is just the experience.**

Let me TRY to explain the abstract concept of consciousness as below:

- **Consciousness / existence exist in 3 states (deeper explanation is 5 / 7 states but we will discuss the simpler alternative).**
    - **Formless state called Experience / feeling / bhava. This is the super conscious state.**
    - **Gross state with form which has physical attributes. This is the conscious state.**
    - **In-between state (Not formless and no form) called Guna state which has subtle quality attributes. This is the Subconscious state. If this is difficult to comprehend for you please imagine "Egg" which is in-between the formless and state with form.** Gotcha?

Let's look at an example. Rose is a flower. When someone tells you **"ROSE"** then the following happens:

- The sound "rose' associates with a flower usually. (I am ignoring it being a name of your girl friend ☺). So here the word is associated with its meaning.
- This flower is associated with red color and perhaps with thorns. Here the sound does not exist anymore but only a form. **Yo!, the sound has merged into light.**
- The third step is - this form is associated with a quality which is fragrance of a rose. For someone sensitive they can smell the rose when they think about it. How else could we salivate at the thought / smell of a favorite dish if this step does not exist?
- Now the last step is, this quality invokes an experience and hence a feeling. This rose may be associated with your inner self for love and hence the emotion of love surfaces. This is called **Bhava / Rasa** in Sanskrit.

If you are not clear about this then please do not move to the next part and think or discuss about it. A little contemplation would help you understand this **5 stage** process of perception.
'SOUND – MEANING – FORM – QUALITY (GUNA) – EXPERIENCE (FEELING / BHAVA)'

Our ancient forefathers knew this science and interconnection. Let me now quote these Slokas as an example from Bharatnatyam, which talks about this linkage.

Kanteenaalambayet geetam, Hasteenaardham Pradarsayet,
Chakshurbhyaam darsayeet bhaavam, Paadaabhyam taalamaacharet.

According to Nandikeshara the dancer should sing with the mouth, express the meaning of the song with hand gestures, her eyes should express the emotions or bhava, the tala, the beat or rhythm should be done with her feet. Further he goes on to say –

'Yato hastas tato drushti, Yato drushitis tato manaha
Yato manahas tato bhavo, Yato bhavas tato Rasaha'

'Where the hand goes, there should follow the eyes, Where the eyes move, mind should follow it,
Where the mind follow, Bhava or emotion is created, & lastly when Bhava is created the sentiment or Rasa will arise.'

All the Mudras or gestures represent word when held at a particular position around the frame of the body and when used in a particular way.

Alas we Indians have ignored this great science & art and its linkages and are like ignorant fools following the meaningless western tradition and dances!

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy reading!

3. TIME = SPACE SERIES. PART 3 – VAAK-ARTHA - IMPORTANCE OF WORD

'SOUND – MEANING – FORM – QUALITY (GUNA) – EXPERIENCE (FEELING / BHAVA)'

In the **5 stage** process of perception, one important factor which I missed is the **"Self / EGO"** which interprets the **Guna** to an experience. For example when I say Dog, the **'Self'** interprets Dog to a **loyal friend or a bike chaser or a rabbies generator.** Essentially what is the quality of dog mean to me? If you understand this process this explains the uniqueness between individuals or the root cause of differences in a society.

I am also going to add but not going to focus on the fact that the inputs are never limited to sound and when see a picture the process of perception starts with step 3. Just to poke the individuals who think "**Sound / Word is the only god – Sabda Brahman**, please tell me - when you see a picture and when there is no sound associated with it, where is **God as Sabda Brahman in this situation**?

Does that mean that the very important Hindu belief that the Sound **"Om is sabda Brahman or god"** does not hold any meaning? It certainly does and I shall share my thoughts on it – continue reading.

<u>What is the importance of Word?</u>

The greatest of Indian poet **'Kalidas'** said

"Vaak artha viva samprakthov vaakartha prathipathaye
Jagadha: pitharov vandhe parvathe parameswarow"

he compared Lord Shiva and Shakti like sound (Shakti) and meaning (Shiva). Both sound and meaning are inseparable. You would now understand the wisdom behind this sloka since there is no sound without a meaning. Also **Sabda Brahman** merges with the **Artha Brahman** and both are inseparable. Here Artha Brahman is the light and the meaning of the word. Remember we say that **'Throw some light"** when we don't understand something.

In Tamil **பொருள் (porul)** means "a thing" and it also means "meaning". We will see how **பரம்பொருள் (Paramporul)** is the Lord Shiva as a God's particle and how he is referred to as the meaning too. The same applies to Sanskrit where **"artha"** means **wealth / things – remember Arthasastra?** And it also refers to **"meaning"** as in the above sloka. How rich these languages are?

And in **Abhirami Andadi, bhattar** sees devi as **"Arthanareswara"** and confirms us that the grace of devi will brings us both richness and mukthi. **"Sollum porulum ena nadamadum"...**

ஔ

A word is made up of letters called Akshara in Sanskrit. The meaning of Akshara is that which cannot be broken down further. ie. Word can be broken down to letters but it cannot be broken down further. A letter has a form like **"A"** and has a sound associated with it. This means the light and sound are merged in a letter. As per the principle stated above in the process of perception, the primordial state is one where light and sound is merged into each other.

If you don't dispute the philosophy that everything merges into god at the primordial state and at this state, sound and light are inseparable, and then you would agree that an Akshara is **God / Brahman.** Each letter has significance and meaning in Indian languages especially Tamil and Sanskrit. **A word is a combination of Form (Light), Sound and meaning and these are first 3 aspects of perception which takes us from a gross state to a formless subtle un-manifest state.**

Hence the statement from New Testament **"In the beginning was the Word, and the Word was with God, and the Word was God"** reflects the same principle.

But as per Hindu scriptures Veda is the breath of god (not word of god) or the aural vibration of consciousness cannot take you to the state of moksha. Words don't take you to God, it can help you in the process but has its limit, since the sound and meaning merges into something else as we move towards more subtle space.

This is what my friend Kambar said in Kambaramayanam as **"வேதமும் முடிவு காணா மெய்ப்பொருள் வெளிவந்தெய்தி மா துயர் துடைத்த வார்த்தை மறுப்பரோ!!.** This means that the supreme truth who could not be found by Vedas came and solved the problem of an elephant, can someone dispute this?

Every word or Akshara has four states **Para, Pashyanti, Madhyama and Vaikari. Vaikari** is the fourth state where the sound is audible to us. If I recite something mentally then the sound has 3 states only and these 4 states signify as to how a feeling (bhava) becomes thought and thought becomes form and then a sound. Just note here that as per Frank outlaw, it's the thoughts which are primordial but as per our scriptures it is feeling or Bhava or deep rooted desire or also known as vasanas which drive your thoughts. So Frank's quotes are half baked plagiarism.

In a work called Tarka Samgraha, we have classified 9 different physical attributes (substances / dhravyas) and 24 different qualities / GUNA in all. If you are interested reading more about this, please read these blogs or the original work.

http://ragsgopalan.blogspot.com/2010/09/vedic-perspective-matter-and-its_14.html This is a 3 part series.
http://ragsgopalan.blogspot.com/2008/11/part-1-perception-art-of-seeing-things.html This is a 2 part series.

To summarize this topic:

- Broadly consciousness exists in 3 states.
- The process of perception if understood well would throw a lot of secrets about nature.
- The 5 stage process of perception **“Sound – meaning - Form – Guna – Bhava”** is a simplistic way of portraying this.
- Sound merges into light and light is worshipped as God in most of the religions and belief. We can explore little more of this in the future sections.
- A word is a unique combination where Light, Sound and meaning merges and hence it is considered as god. This word represents **Arthenareeswara or yinyang or Star of David**.

In the future sections let us explore as to what is the relationship between Maths and God and some of the critical numbers and its philosophical and scientific significance.

As a wise man said, **“Indians are the most ignorant about their rich past and scientific traditions.”**

Happy reading

4. TIME = SPACE SERIES. PART 4 – SCIENTIFIC LANGUAGES – TAMIL & SANSKRIT

One of the main reasons I believe as to why our wisdom has degraded so much in the last century is our ignorance and reluctance to learn our rich language. Our language offers richness not just in literary sense but is supremely scientific too. I am going to touch upon just 3 to 4 aspects of it which I knew and understand at a fundamental level and request you to learn your mother tongue well.

Many of my friends don't exhibit a sense of remorse when they say **'I can understand Tamil but can't read or write it**". I wanted to tell them how much in life do they miss in terms of knowledge and richness. This is not just about Tamil but every major Indian language is rich in its own way. Since my mother tongue is Tamil, I am going to articulate some of the science in it.

Vigyan / Vigyanam (விண் ஞானம்) means Science:

But most importantly for this series I wanted to take the word called Science as meant in Tamil and Sanskrit. A word always can be broken down to its dhatus for its exact meaning in Tamil and Sanskrit. Some examples below:

- Science in Tamil is **Vigyanam and in Sanskrit is Vigyan**. This is split as **Vin** and **Gnanam** / **Gyan**. **Vin means space and Gyan means knowledge. Hence according to Indian system science means it is the nature / knowledge of the space.** This has very deep significance since western science has not agreed the existence of space for a long time and their gross and materialistic approach prevented them from seeing the most subtle component and its nature. We were masters of it ages back. Most of the questions in Chapter 1 would be answered based on the knowledge of space – Vigyan.

- **Universe is called as Brahmanda** in Sanskrit. Brahma + Anda which literally means a big egg. This means we knew that the galaxy is elliptical in shape ages back and it required hubble telescope in 1950 to tell us that.

- **Bhoogol** means **Earth (Study of) / Geography – This Splits as Bhoo +Gol.** Bhoo means Earth and Gol means round. We did not throw stones at a scientist as late as 17th century when he said that earth is round and not flat. We would have laughed our heart out and ignored him.

Be it the age of the universe, all of the astronomical measurements, health, spirituality etc, many of us need a white skin with blue eyes to tell us that what we knew was right and they have certified it. When we decide to come out of this mentality then the process of reclaiming our rich heritage shall start.

Origin of Universe and linkage with Tamil:

The initial evolutionary process for the universe consisted of 5 stages states Aintiram. You can imagine that these are the movements of particles during the Big bang. They are அமிழ்தல், இமிழ்தல், குமிழ்தல், உமிழ்தல், தமிழ்தல்.

- Withdrawl (Amizhdal)
- Imizhdal (Overflowing)
- Kumizhdal (clustering round in an order)
- Umizhdal (Emitting)
- Tamizhdal (resulting into a well defined form)

These are the first stages from the Big bang till a well defined shape is formed. Now the last level is called Tamizhdal which results in a well defined form. This state has emanated from the Pranava and not been created by some one. Hence a language as rich with the sweetness of inherent order, originating from the luminosity of the original particle is called Tamil. Tamil is word based on the final resultant state called Tamizhdal (தமிழ்தல்**).**

I shall address the other 2 interesting aspects that include a Chicken and Egg analogy for Energy and matter conundrum in the next blog.

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy reading!

5. TIME = SPACE SERIES. PART 5 – ENERGY & MATTER CONUNDRUM

Energy and Matter concept in formation of letters:

The concept of Energy and matter is not new to us and does not start with Einstein's days of $E=mc^2$. Let us look at how our letters are formed from Aksharas then people would know that the concept of Energy and Matter is old as our language. In Tamil there are two kinds of Aksharas **உயிர் எழுத்து - Uyir Ezhuthu (Life / Energy letters – 12 letters) and மெய் எழுத்து - Mei Ezhuthu (Body / Matter letters – 18 letters).** Both put together it is 30 letter pack for Tamil as alphabets. Now both have to combine to give letters called **"body with life"** which are called **uyir mei Ezhuthu**. This combines to form 18*12 which is 216 letters as **Uyir Mei Ezhuthu**. For example **க்+ அ = க** in Tamil and क़ + अ = क in Sanskrit.

So the formation of letters itself is a science where Matter (Body) combines with Energy (Life) and then the living organisms (Body – life letters) are formed.

I want to ask you a **Chicken & Egg** question here which is very relevant to today's scientists. Did the energy come first or is it the matter that came first? Modern science is still scratching its head. I can answer this question in 2 ways, first is obviously using language as a science.

- In the above example **க்+ அ = க**, **க்** is the body and **அ** is life. So as per our language sciences be it Tamil or Sanskrit the matter is formed first and then the life came and attached to it. This is very well documented in Tamil scriptures as follows:

உடம்புடன் உயிர் வந்து ஒன்றுவது இயல்பே - தொல்காப்பியம் . This is over 2500 years old which states that life comes and joins a body in language and this is nature.

மெய்யொளி உயிரொலி சிவணுதல் இயல்பே – ஐந்திறம். This is over 12000+ years old which states that same thing and adds that body is like light and life is like sound and they merge and this is siva's nature. **This certainly means that both Body and life are not formed at the same – as popularly believed. Life comes and joins the body to give a living being – in the above case the letters are the living beings.**

The second reference I am going to take for the same concept is our **Yogic / Siddha / Ayurvedic** science as to how fetus is formed in mother's womb. As per our (Siddha) belief the conception of a child in a mother's womb happens as follows:

- **The first organ that is formed for the fetus is the cells of the Eyes (Single Eye)**. This eye cell starts vibrating due to its heat and multiplies as 2 eyes and then as the whole body. This is the vibration seen in the initial days of the fetus and not the heart beat. As per modern medical science the heart takes shape only by the end of the 8th week and not before. I am requesting someone to validate this.
- **Life comes to this body at the 3rd month of conception only**. This is the belief as per Ayurvedic and Siddha science.
- Instances of the third month natural abortions are very high than the later months based on the above reasons. This means that the life is not destined for that matter / life force is not sufficient enough.
- **How many of you know that the size of eyes never change as you grow and stays the same from the time we were born,** while all other organs undergo growth?
- Also the eyes hold a very important significance in the spiritual science which I shall address later. The eyes are the seat of Sun god and are characterized by heat and light.

It is through the heat in the eyes the subtle became a gross living being in this world and if the living being wants to merge back with the subtle – which is the process of Samadhi then the living beings should use their eyes, increase the heat in the eyes and start the devolution process. This is a supreme secret kept by the sages even in today's world. **You may want to ask any spiritual school as to why they recommend meditation with eyes fully or half open instead of closed eyes? Ask yourselves why the free masons and other secret societies use eye as one of their symbols?** We shall address this later.

Now you want to answer the Chicken and Egg analogy to the Energy and Matter conundrum based on the above 2 thoughts, we can conclude it is the matter which came first. We shall try to explain this based on Space sciences a little later.

<u>Masculine and Feminine names based on ending letters:</u>

I am also going to give you as to how Indians distinguished masculine from feminine names. **Kanchi Maha periyava, the Sage of Kachi** had explained this beautifully in his **"Arul Vakku"**. I am giving a gist of it here just to conclude this:

- **Masculine names:** All the names shall end with the phonetic a, im, in , ir, aha etc. Examples are Ram, Shyam, Raman, Kannan, Kishan, Vivek, Adam. So phonetically names like Catherine is a masculine name because it ends with "in" phonetically.

- **Feminine names:** All names ending with phonetics aa, e, I, oo etc. Examples are Radha, Ramya, Savithri, Gayathri, Uma, Rosy, Isabella etc. Same way phonetically Joshua is a feminine name.

Vishnu and Lalitha sahasranamam follows this rule and hence one invokes Shakthi as lalitha and the other invokes Purusha as Vishnu.

Just to conclude this part, I think we looked at how science is an integral part of our language formation and for us science has always been about the knowledge and nature of the space and we believed that space manifested itself as the physical world. So in the next few parts we shall look at how this manifestation has happened and other interesting aspects.

I would conclude this part with a earnest request that please encourage your kids to learn their mother tongue – to read and write and you would not have done anything better than this to advance their spiritual growth and adding richness to their life.

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy reading!

6. TIME = SPACE SERIES. PART 6 – THE UNFOLDING SELF - UNIVERSE HAS EVOLVED AND WAS NOT CREATED

As per many scriptures in Hinduism this universe has evolved from itself and not created by someone. If you want to quickly ask as me as to what Brahma, Vishnu and Rudra mean – I would attribute them to different process heads in this evolution. They are all different aspects of the same consciousness based on their state of being in the process of evolution / devolution. This is my understanding but let us avoid this discussion here.

Here I am indebted and thankful to the nobel soul **Late. Dr. Ganapathi Stapathi,** (http://www.vastuved.com/life.htm) who not only unraveled the Vaastu science – the science of Space and time but also brought to light 2 important books which were over 12000+ years old written in Tamil by **Mahamuni Maayan.**

Mamuni Maayan is believed to be the same person who is popularly known in **South America as Mayan** and the 2012 phenomenon based on Mayan calendar. Dr. Ganapathi has established proofs that the pyramids in Middle East, the temple architecture in India and the structures in Mexico and Guatemala confirm to a single Science and Mathematics seen in all these works.

At the end of the blog I am listing few books which helped me understand this topic but most of the books (**Aintiram and Pranava Veda**) are out of print now and if you are lucky, you would get some of them. Now let us understand briefly how this evolution process has come about. According to Mayans' Aintiram:

- The free space is the unified field of energy and matter and source of all forms that we see in material world. That is why we were defined science as **Vingyanam**. This space consists of very minute particle called **Vinporul, nunporul, Sittrambalam, Paramanu, Oliporul, Microbode** (**விண்பொருள், நுண்பொருள், சிற்றம்பலம், பரமாணு, ஒளிப்பொருள்**) and in many names. You can pick what you like. I am going to use **Paramaanu** in the rest of the blog.

- The whole process of evolution is a 5 stage process. (Keep noting the importance of 5 and at the background remember Shiva is represented by Panchakshara mantra (Na~Ma~Si~Va~ya).

So what is the five stage process?

  - This space is called as Moolam (Source).
  - This Moolam starts vibrating and this vibration of the space is called Kalam (Absolute Time and not physical time. We will refer this as time only).
  - This Kalam (time) vibrates to a mathematical resonance called Seelam (Rhythm).
  - This Seelam as it resonates creates Kolam (Shapes – Circles, cubes etc).
  - This Kolam becomes our visible Universe which is called Gnalam.

- So it is **MOOLAM (Source) – KALAM (TIME) – SEELAM (RHYTHM) – KOLAM (SHAPE) – GNALAM (UNIVERSE). மூலம் - காலம் - சீலம் - கோலம் – ஞாலம்**, these are 5 stages of evolution.

This means that the Space itself becomes spatial forms and time is the instrument that creates, sustains and destroys. Lord Siva in Tamil is also called as **Kalan (காலன்)** as to who controls time since Kalam **காலம்** is time.

To put it differently, un-manifest state when pulsates becomes absolute time and this is the creative energy. The process of pulsation confirms to a mathematical order and we will see this order in detail later. You may now understand the phrase that "**Time creates, sustains and destroys**". Since if there is no pulsation then nothing happens.

For those who need quote from a foreigner to convince themselves of this can be referred to the **Bertrand Russel's** quote "**What we perceive as qualities of matter are differences in periodicity".**

I shall quote some from the oldest literatures for reference below:
காலமே எவைக்கும் மூலம், காலமே மூல ஆற்றல்
காலமே கோலத் தோற்றம், காலமே ஞாலத் தோற்றம்… *Maha muni Mayan from Aintiram*

காலக்கூறே கணக்கியலாகி… Time splits as Maths in proportion it pulsates.
Vyasa says in Adi parva chapter 1, shloka 249, says the same thing that Time Creates, sustains and destroys everything.

kalah srijati bhutani kalah sanharati prajah
sanharantah prajah kalam kalah shamyate punah!!

The same is quoted as **"Vastur eva Vaastu"** which means the un-manifest Paramaanu which is called **Vastu** (with Single a) becomes **Vaastu (gross form – with two aa**). You can relate this **Vaastu** as the building science which is grossly misused and misrepresented and commercialized in today's TV programs. We will address the science in it later.

I shall leave this part with this thought, the space is considered as **Nataraja (Shiva) – subtle component and Ranganatha is considered as the Earth component**. So Shiva and Vishnu are two aspects of the same seed. We will see more scientific proof of this later.

"Shivasya hridayam vishnur, Vishnoscha hridayam shivah:" and
"Shivaya Vishnu rupaya Vishnave Shiva rupine"

Vishnu is the heart of Shiva and likewise Shiva is the heart of Vishnu and they both are the representation of each other.

Now if you are clear about the five stage process of evolution we can delve into each and every aspect of this in little more detail that would answer everything.

Ref: Check out all the ones here. Key recommendations are item 6, 11, 14 and 43. http://www.vastuved.com/publication.html

7. TIME = SPACE SERIES. PART 7 – THE CHIDAMBARA RAGASYAM & THE GOD'S PARTICLE

There were 2 questions I had confronted myself when I was reading these passages. They are:

- Why did the unmanifest space energy started pulsating and became absolute time?
- What did the unmanifest space energy contain? Was it a point of singularity as the modern scientists wanted us to believe? If so then how much mass was concentrated in that point which is obviously very difficult to believe.

The answer to the first question is here **"The self unfolds itself for its self – Bhagavad Gita".** There is no convincing answer to the rational mind as to what the reason that the consciousness which was passive decided to become dynamic and started pulsating. So let's leave this for the time being.

But the second question is answered very comprehensively. But before we get into the details of what it is, I want you to check Figure 1. This gives the overall picture of evolution and the five stage process. I also want you to recollect the "EGG" state which is called as the GUNA state where in the form and sound manifests. They say that this pulsation started with OM. This OM as popularly believed is just not an aural form but also has a visual form and that is light. We will discuss about this later in detail.

But let us focus on the actual second question as to what the contents of this Space energy were:

- The space is filled with **Paramanu or Microbodes** which are tiny particles. These are the **God's (Higgs Boson) particle** our CERN scientists are after. http://en.wikipedia.org/wiki/Higgs_boson

- Now, we are probably a year away before CERN publish the results when this blog is published. I would not be surprised to see the results of that experiment is closely aligned with what is available in our scriptures and produced in this blog.

- The primal manifest form of the unmanifest is a **square** (primal wave pattern). This is the shape of the **Paramanu or Microbode**. This is very luminescent, means filled with light and on a 3D plane this shape is a **Square Cuboid**.

- A **Square Cuboid** is a shape which is equal in all sides – say of unit measure which is the smallest measure possible and has **6 faces, 8 vertices, and 12 edges.** You can start figuring out in Hinduism, why the idols of Lord Shiva and Lord Muruga has six faces, 12 eyes, hands etc.

- You may want to note that 6 faces can be represented in 2 ways as below. Figure 3 is Lord Muruga's star or a Star of David in 3D which has 6 faces and 12 edges, popularly known as **Tetrahedron**. **So don't be surprised if the Boson Higgs particle is of the same shape.**

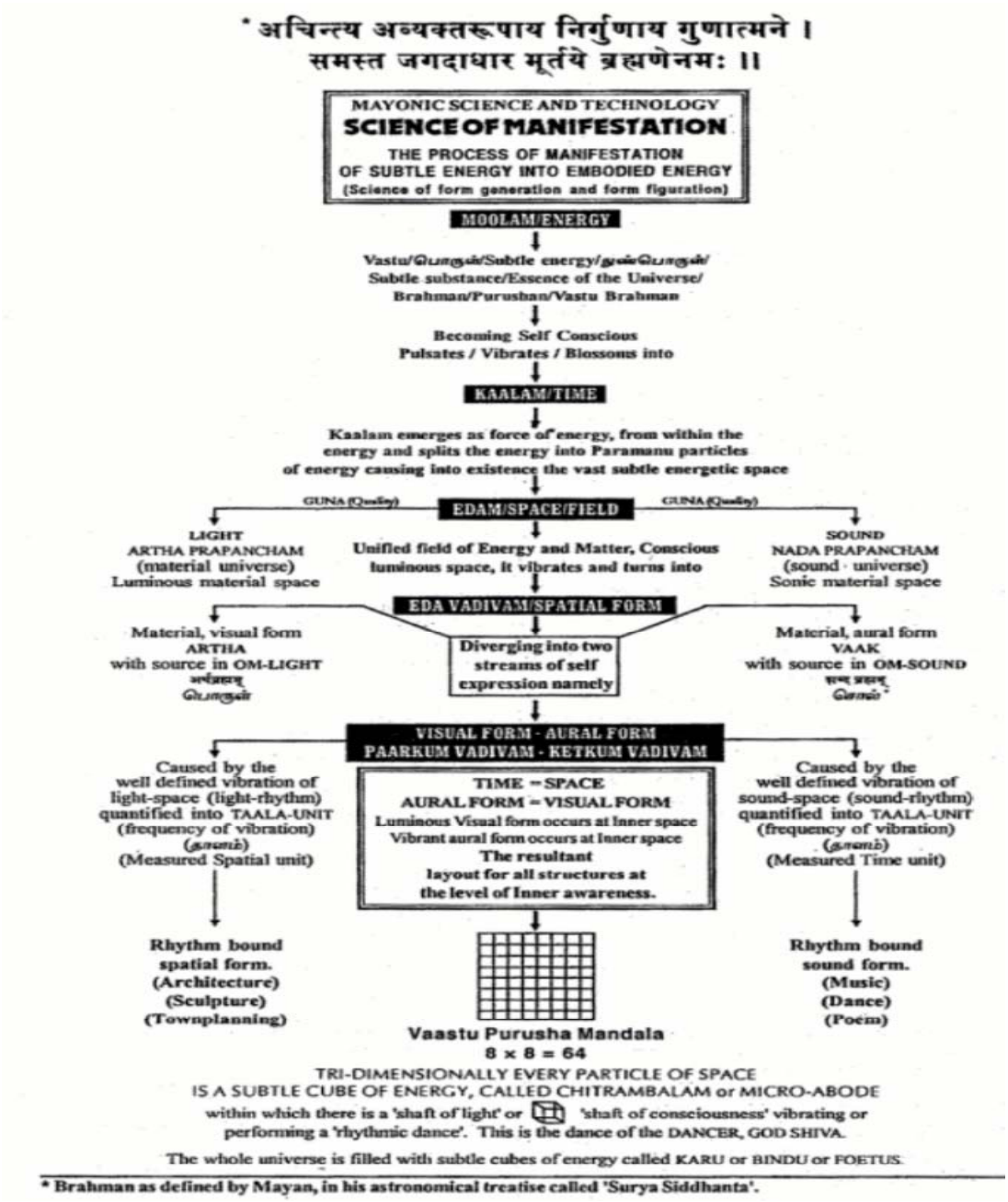

Figure 1: Science of manifestation
(Courtesy: Pranava Veda by Mamuni Mayan – 12000+ years back, recreated by Dr. Ganapathi Sthapati)

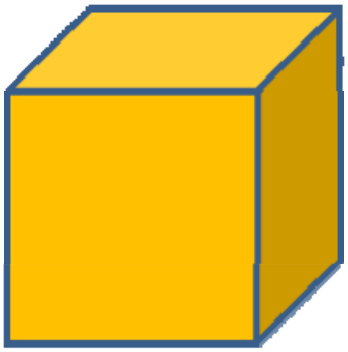

Figure 2: A cube with all equal sides

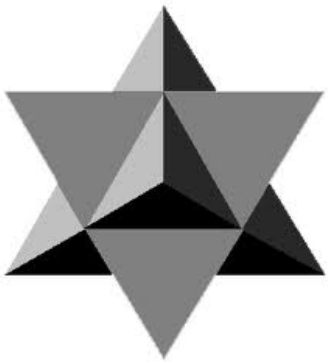

Figure 3: A tetrahedron (from Internet)

- The free space is packed with cubical atoms of energy. They are building blocks of the structure of the universe. **So what is clear is that all these atoms existed in a "resonant state of non-vibration" before the so called "big bang" happened or the pulsation started.**

- **It did not burst out of a single point as popularly believed. Alternatively, in space every point is the center. When the pulsation started these cubical atoms underwent a shape change and manifested as shapes and forms.**

- This cube is called as **micro-abode called Sittravai / Chittrambalam** (mini hall in Tamil). This is **secret in Chaidambaram, Sage Appar** (**Chidambara ragasyam**) realized. Chidambaram is a Shiva temple associated with Space energy and when you go to sanctorum you would not find any idol but just empty space with some lights there. This is to signify this concept of **Paramanu** which is **luminescent and is a Cuboid in shape**. This is the smallest particle possible and can be called as **'God's particle".**

- The micro space, in the cubical shape is fetus or Garbha. This is known as **Vinkaru** in Tamil. This micro abode is the repository of light and sound.

- The free space is Light and the Light is Moolam or source of the universe and universal forms. Light is Brahman, Atman, Vastu Brahman – Nunporul in Tamil.

In the subsequent blogs we will correlate String theory, Brahma Sutra, Nataraja, Vishnu and how they are all contained in order and proportion in pulsation.

Happy reading!

Ref: A good read **Fabric of the universe, Jessie J Mercay**.

8. TIME = SPACE SERIES. PART 8 – CHARACTERISTICS OF THE GOD'S PARTICLE (PARAMAANU)

This part is going to be a bit controversial hence read it with an open mind. Per our scriptures when analyzed deeply we can state that **"At the beginning it was just Consciousness (Pragnanam) that was luminescent with unmanifested potential energy and residing at resonant state of non-vibration. This energy was un-manifest and was present as Paramaanu or Microbode or Vinporul aka a subatomic particle. Yes! It was a particle without vibration and was at resonant state of non-vibration.**

The entire Space was supposed to be filled with these particles only and these were primal potential matter which is ever lasting.

Now let us ask few questions and see how our scriptures answer this:

1. What was the shape of this particle?

We have already answered that. In 2D it is square and in 3D it is a cuboid with all equal sides. Please note that in space it is always 3D and not 2D. It has 6 faces, 8 vertices, and 12 edges. This is known is current scientific community as **Tetrahedron**.

2. What is inside the Microbode or Subatomic particle?

This is a very interesting question. Our scriptures say that it is purely space inside but with an energy grid.

3. What is this energy grid and what is its shape?

It says that it is an 8x8 energy grid inside this microbode. This essentially means it is a square energy grid of 64 squares inside this Paramaanu.

4. What is this color of this Paramaanu?

It is luminescent and hence the golden color of the light is what it is associated with. **"Hiranyavarnnaam harineem**.." says Sri Suktha in the vedas, confirming the color of this Paramanu. Their variations exist but the fundamental one is of golden color.

5. What is this size of this God's particle?

It is calculated to be ~133 nm. We will see this in detail later.

6. What is the significance of the energy grid?

For the time being let me state that anything subtle is a function of 8 and anything gross is a function of 9. Let me also add that **iChing –** which is a Chinese divination book and the hexagram which deals with the Science of the subtle is in an 8x8 square matrix. **The mental game Chess is played in an 8x8 square.**

You would find 8 is the number or dimension for the subtle. We will see the importance of 8 and 9 and how beautifully these proportions adorn everything in nature in our daily life.

7. Are these particles faster than light?

Frankly I have not read a direct answer to this question but since this particle itself is light the velocity of this particle cannot be faster than light. This is my opinion. Modern experiments are suggesting that it could be faster than light. In **Mahabharatha, Yakshaprasna, the Yaksha will question this to King Yudhishtra as to "what is fastest thing in this world"**? King Yudhishtra would reply as **"mind"**.

Some of the sages have interpreted that since Consciousness is omnipotent and ever connected - the communication is seamless, instantaneous and not subjected to the concept of distance. The example given is if there is a pain in your leg, it does not take time to travel to your head. It is instantaneous and hence the whole universe should be considered as a living organism.

So to conclude on this question the particles are not faster than light but each particle is filled with intelligence and consciousness (just like a human cell) and their communication to anything is not subject to concept of distance. If our scientists come back and tell us that these particles are faster than light, then wait for someone else to tell us a little later that it isn't faster than light. ☺

8. Ok. Who has seen these particles and give me empirical proof?

परमानुरिति प्रोक्तं योगिनाम दृष्टि गोचरम ! **(Paramaanuriti proktam Yoginaam, drishti gocharam)** says **Mayamatham.** This means the **microspace** or **Paramaanu** is visible to the trained contemplatives and meditators only. One quick example as proof is the **Temple in Chidambaram** which represents **Space tattva** where the temple is built around the concept with enough documentation on it.

But we have been trained under Lord Macauly's education system and how can we accept this as proof which is subjective and superstitious. If I may ask please tell me how many of us have seen the electrons or protons? Do we not believe everything when someone tells us in English?

It is true that because of its existence we can see its manifestations and results of some experiments in our day today world. So we will look at tons of manifestations which we have been in nature as we progress. I would like us to be philosophically very clear as to what these things mean which we have been blindly following. For the time being please note down your questions and I am positive that this would be answered in due course.

Our sages have not only seen this, but have given the dimensions of this and the mathematical formula to manage this energy. We will see all of them. After reading all of them if you still don't want to believe in our scriptures, then may be CERN's result if it's in the same lines would prove it for you.

Happy reading!

MANDUKA VAASTU MANDALA

8 × 8 = 64 modulated spaces

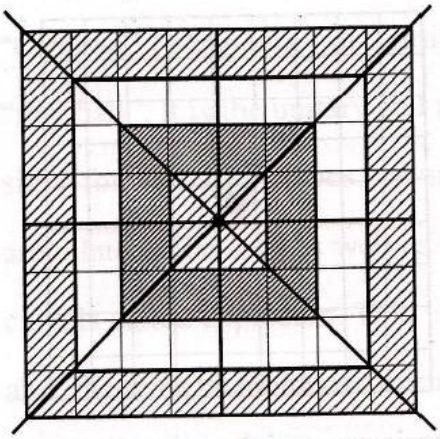

Brahma pada (the first belt around the central energy point)	:	2×2=4 padas
Deivika pada (the second concentric belt)	:	12 padas
Maanusha pada (the third concentric belt)	:	20 padas
Paisachika pada (the fourth concentric belt)	:	28 padas
		64 padas

PARAMA SAAYIKA VAASTU MANDALA

9 × 9 = 81 modulated spaces

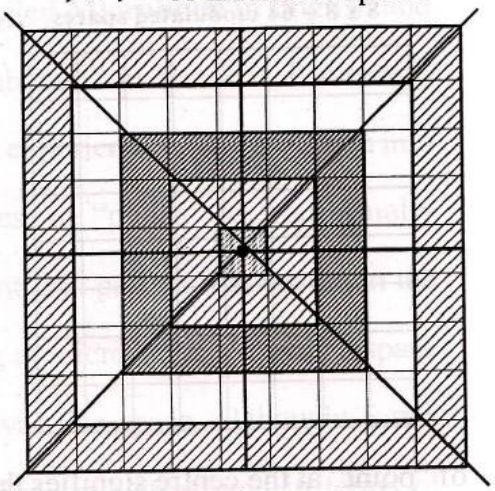

Brahma pada (the first belt including the central square field of energy)	:	3×3=9 padas
Deivika pada (the second concentric belt)	:	16 padas
Maanusha pada (the third concentric belt)	:	24 padas
Paisachika pada (the fourth concentric belt)	:	32 padas
		81 padas

Figure 4: MANDUKA MANDALA – 8x8 (subtle form) & PARAMA SAYIKA MANDALA – 9x9 Gross forms
Courtesy: Dr. Ganapathi Sthapati

9. TIME = SPACE SERIES. PART 9 – LIGHT, GOD'S PARTICLE AND GOD

"At the beginning it was just Consciousness (Pragnanam) that was luminescent with un-manifested potential energy and residing at resonant state of non-vibration. This energy was self manifest and was ever present as Paramaanu or Microbode or Vinporul aka a subatomic particle. This is **omnipotent, omniscient and omnipresent**.

Ignore religion for the time being and just look at this particle's characteristics scientifically. It is Eternal (**Anaadi**), primordial (**Aadi**), without any quality (**Nirguna**), it cannot be reached / grasped by thoughts (**Achintya** - since thoughts as energy are much more gross than this and we would see this), it cannot be measured (**Aprameya**), Luminescent (**Jyothi swaroopa**), its **omnipotence, omnipresence (Visvam) and Omniscience** is already known. So said the mahavakya **Pragnanam Brahma!**

All the characteristics of the particle are attributed to a personality or a state by the founders of religions. **Hindus called this state as Paramasiva or Purusha. Hence everything subtle is called Sivamayam.** The essential pulsation which started and the universal evolution began was called as **Parashakti or Prakruthi or Maya.** We will talk about the Shakti aspect later.

This subtle un-manifest energy evolves to become universe which is gross. This gross energy also known as **earth** is called as **Vishnu** and the subtle energy is called as **Space / Akash / Heaven**. So the term became "**Sarvam Vishnu mayam Jagat".** Please note that it is just **Sivamayam** and there is not Jagat there. Since it is all subtle and there is no Jagat which is gross. But it is **Vishnu Mayam Jagat**.

I need to add that every sect in Hinduism has named this God's particle with a different name. Narayana has replaced paramasiva in Vaishnavism and so on. In Hindu temples there are 2 prime idols – **Moolavar and Archakar** - The Moolavar does not undergo any archana or any decoration and it is always for the Archakar for which all poojas are performed. This god's particle refers to the Moolavar and not Archakar.

To my knowledge, every religion and every sage / saint has agreed with the fact this fundamental particle or energy unit is **LUMINISCENT**. Note that there is no sound or word in this …**yet.** Let us see few quotes on this (there are thousands of quotes):

- **Be it vedic culture, Zoroastrians, Greek or any major culture fire / sun god which represents light is worshipped.**
- **"Om Jyothi rasaha" says Vedas**
- **In Gayatri mantra you meditate on the supreme light to illuminate you.**
- Vallalar said **"Arutperumjyothi, Arutperumjyothi"** which means **mighty graceful light**.

- If therefore your eye be single, your whole body shall be full of light. Mathew 6:22
- Thirumoolar states brilliantly that who realizes that the light (physical light which means the world) merges with light (subtle light), he has realized SIVA.

  ஒளியில் ஒளிபோய் ஒடுங்கிய வாறும்
  தெளியும் அவரே சிவ சித்தர் தாமே - 124

So what has happened to the **Sabda Brahman** here? It has merged with the **Artha Brahman** which is the light. What can you use to represent this state?

Light represents Form and our eyes represent Light / Form. So obviously sound is represented by ears. When sound has merged with light then it means Eyes and ears are merged together.

Can you think of anything that represents this state? This concept is captured by representing a **Manduka (Frog) or Sarpa (Snake)** always. Since for a frog and a snake the ears and eyes are merged. **Manduka Upanishad,** represents a knowledge of this state. And obviously the 8x8 square / cube represent the most subtle energy as an energy grid is called as **Manduka Pada / Mandala..**

Now the same aspect when it is applied to a gross form / body or a building then it is a 9x9 energy grid and it is called as **Paramasyika Mandala**. **At the gross level the same concept as applied is the WORD where Light (form) and sound and meaning merged into one. You cannot separate them**. We will look at this later.

Unfortunately we have lost the science and we neither understand the philosophy nor the symbolism behind this supreme science but we made fun of the fact that the supreme science is named after an absolutely menial creature like frog which is used only for zoological lab studies across the world or ends up in the dinner plate as it does in far eastern countries.

I would like to conclude this section by stating (may be a little controversial) that **First it was Consiousness as the Vinkaru, Microbode, Sittrambalam, Nunporul, subatomic particle which was luminescent. Later the concept of God evolved out of it.**

So God is not light, but the right of saying it is "the primordial aspect of "luminescence" has been adopted as God…

So, of the 5 fold evolution process we are still at the source (Moolam). We will see the concept of time and the mathematical science in the subsequentparts.

MOOLAM (Source) – KALAM (TIME) – SEELAM (RHYTHM) – KOLAM (SHAPE) – GNALAM (UNIVERSE). (மூலம் - காலம் - சீலம் - கோலம் – ஞாலம்)

Happy reading!

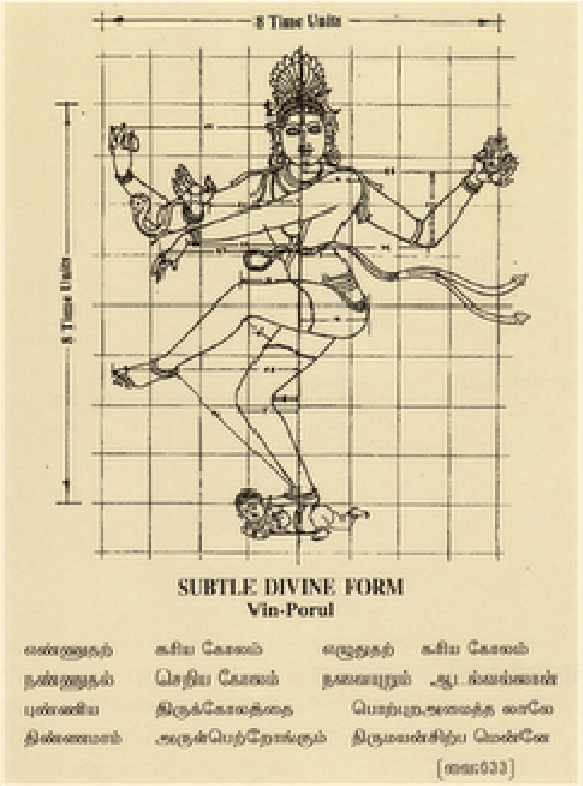

Figure 5: Lord Nataraja in the Manduka Mandala (8x8 grid) (Courtesy: Dr. Ganapathi Sthapati)

Our next topic is Nataraja and String theory!, so check out this picture. I want you to note the light / fire in the left hand and sound / damru in the right hand. If you notice little closely, you would find a central line along the picture's sternum and all the parts have minute measurements from the central line.

10. TIME = SPACE SERIES. PART 10 – LORD NATARAJA AND THE STRING THEORY

"The self unfolds itself for its self – Bhagavad Gita".

This self unfolded itself with a pulsation and this pulsation is the **start of Absolute time** (**KAALAM**). As I said nothing to my knowledge tell us clearly as to why this pulsation happened. This is the point of singularity in the scientific language and the event is termed as **Big Bang.** Just as I expressed earlier it was an event of primordial pulsation and not of an explosion which threw away mass because of the explosion into the space.

The entire space existed with its subatomic particles and this pulsation made the space to vibrate and this vibration was rhythmic and led to the evolution of this universe. **Popularly known as "That one became many"… and ..Vastur eva Vaastu.**

This pulsation happened because of the **Pranava** or the first pulsation resulted in the **Pranava -** both conceptually right. So at the time of this primordial pulsation 2 things happened:

- The absolute time started. This is called **Kaalam.**
- Primordial and the most sacred **Pranava** emerged.

Both these happened simultaneously and it is futile to ask whether **Kalam created Pranava or Pranava created the pulsation.** In many of the texts it offered as **Pranava that created the pulsation**. So let's go by that.

- This is the reason that **Pranava / Primordial Om is so sacred in Hinduism.**
- This Pranava had manifested in 2 forms:
    - **Luminescent form as OM the Light. This is the source of all visual forms. The primordial form is represented as ஓம் in Tamil and ॐ in Sanskrit.**
    - **Aural form as Om the sound. This is the source of all aural forms. I should say that this is more popular form compared to the luminescent form.**

Now this concept is very important, since in the Pranava meditation they say us to meditate on the silence after the word OM and also mediate **OM as light, OM jyoti rasaha in vedas.**

So, when I say that sound merges into light, it is all the aural form merges into **ITS** luminescent form. All luminescent forms merge with the **Paramaanu** which is also luminescent. I am reproducing this passage again for emphasis and clarity.

- **Sage Thirumoolar** states brilliantly that who realizes that the light (physical light which means the world) merges with light (subtle light), he has realized SIVA.

  ஒளியில் ஒளிபோய் ஒடுங்கிய வாறும்
  தெளியும் அவரே சிவ சித்தர் தாமே - 124

I have read many times over to understand this concept and I would suggest that you allow this concept to sink in.

Now let's come to the 8x8 energy grid of the **Paramaanu** and imagine that it is pulsating because of Pranava and this **Pranava has both light and aural form**.

- They say that this **pulsation is rhythmic and symmetric**.
- When something is Symmetric, then there has to be a central line along with the Symmetry comes. For example if our right and left sides are symmetric then the body is divided along the sternum & backbone.
- Within the 8x8 energy grid / hall there is a **vertical luminous shaft** called **Brahma Sutra (Oli nool)**. Sutra in Sanskrit and Nool in Tamil means **Thread / String**.
- This **Olinool / Brahma Sutra is a shaft of consciousness also called Moolathoon / Moolasthambham**.
- **This shaft of consciousness vibrates in a particular order called rhythm.** This is the order of nature.
- **This rhythmic vibration of the shaft of consciousness is the dance of Shiva, the CELESTIAL DANCE / THE COSMIC DANCE / THE DANCE OF EVOLUTION of the LORD NATARAJA.**

Look again at the picture of LORD NATARAJA, he is drawn inside a 8x8 Manduka mandala (now you know what it is), his left leg is raised suggesting a movement from left to right. Imagine that he is going to land the left leg to his right side.

Why should he suggest that he is moving from left to right?

His left hand holds light / fire and his right hand holds Drum / Damru / Sound. The process of Evolution which starts with the absolute time and Pranava is fantastically represented pictorially. It suggests that the evolution process starts with the rhythmic dance of the PARAMAANU in a 8x8 energy grid and this process evolves first as light and then as sound. This light and sound creates further forms and the entire universe.

It is very easy to answer as to why sound evolves from light? We all know that the light is at a higher frequency and velocity than sound. This is the same reason we see lightning first then hear the thunders.

So let's summarize the DANCE OF EVOLUTION of LORD NATARAJA:

- From being un-manifest the **Pranava** emerges. Or the Pranava evolves the un-manifest to the manifest and starts the cycle of evolution.
- This leads to a pulsation which is called as the **COSMIC DANCE / CELESTIAL DANCE / DANCE OF EVOLUTION**.
- This pulsation is **rhythmic and symmetric**.
- The luminescent shaft of consciousness is called as **Brahma Sutra** or popularly called as String theory in the modern science.
- The process of creation evolves from the dance as light then sound evolves from light and then all the visual and aural forms in this universe.

If this is so then the process of dissolution should be that Lord Nataraja's right leg should be lifted suggesting a movement from right to left isn't?

Look at the majestic picture suggesting the **DANCE of EVOLUTION** and the **DANCE of DISSOLUTION** as below:

Figure 6: LORD NATARAJA / DANCE OF EVOLUTION

Figure 7: DANCE OF DISSOLUTION

In my opinion there is nothing more scientific in this world that is pictorially represented about the evolution of universe. You should read a book called **"The Tao of Physics" by Frijat Capra** where as physicist he explains how he experienced this and highlights the dance of the quantum particles in space corresponds to the dance of **Lord Nataraja**.

Now this central shaft of Consciousness is called **Brahma Sutra** and according to our scriptures every Paramaanu has this string, which means every being, matter, inanimate things in this universe including the tiniest of subatomic particles have this string / sutra. In the future parts we will see the Maths behind this sutra and the pulsation but let us look at what the modern science says about **Superstring theory** here, http://en.wikipedia.org/wiki/String_theory. You can read it how many times ever you want but this theoretical postulation is a direct adaptation of the cosmic dance and our Brahma Sutra and nothing more.

Now check out Lord Nataraja at the CERN http://www.fritjofcapra.net/shiva.html

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Now you may understand as to why I started this series with the above line. We have a very rich past that is most scientific and it is left codified in a form across thousands of temples in India. Let us just open your eyes and understand the scientific meaning around it.

If you are so far surprised at our richness and advancement, please wait till we will get into real hard core mathematics and geometry of our nature in the subsequent parts.

May that "**Sutradhaari"** dispel our ignorance and reveal to us the secrets of nature.

Happy reading!

11. TIME = SPACE SERIES. PART 11 – VASTUREVA VAASTU AND E=MC^2

We have seen that the universe in its un-manifest state is filled with luminescent cuboids and there was a trigger in the form of Pranava which started the absolute time and gave forth visual forms and aural forms.

This process of evolution is depicted very nicely in the following diagram:

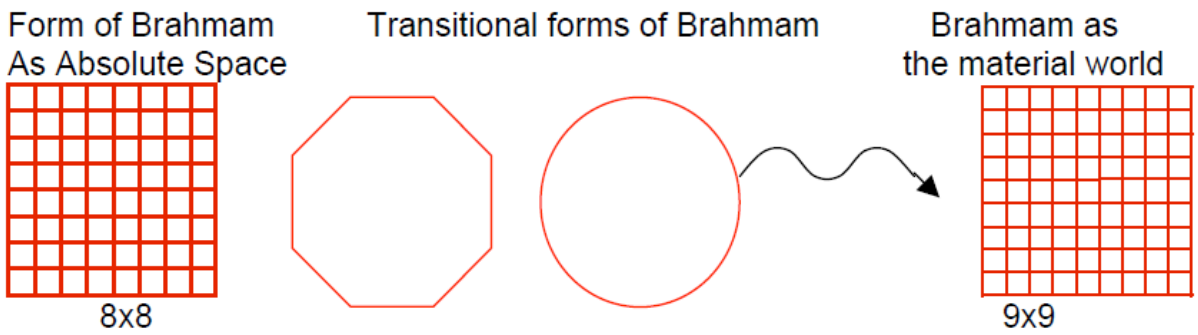

Figure 8: Transition forms of Brahman (Coutesy: Dr. Ganapathi Stapathi)

The square (in 2D) which is an 8x8 energy grid became a 9x9 energy grid which is manifest / gross. The transition forms were an octagon and a circle. **Aintiram** suggests how this transition takes place. Current physics accepts that a pulse and a sine wave can be created from each other and this happens because of simple addition of harmonic frequencies.

The primordial pulsation initiates a rotational force and this rotational force as it gains momentum converts the square into a circle and if you notice that the octagon is just an in between state between a square and a circle.

We see confirmation of the details of this manifestation process in Chapter 9, verse 8 of the Bhagavad Gita where Lord Krsna describes His manifestation process to Arjuna:
"prakritim svaam avastabhya visrijaami punah punah", meaning "Curving back onto myself, I create again and again…"

What it suggests is that the essential shape of every gross form in its natural state is a circle (in 2D) and a sphere in (3D). **This is the reason we find every planetary body is almost spherical in shape and this is also the reason as to why the ripples in a water body when we throw a stone in the water are in circles.**

Be it the center of a tornado or the shape of a hurricane or a tsunami it always a circular force. The supreme secret in martial arts is that the Chi moves in a circular fashion and hence Tai Chi is the most

deadly form of martial arts. Lord Vishnu has Chakra as his weapon to suggest not only light but also the rotational force.

The process of manifestation is captured in these 2 pictures at all the significant stages. If you notice that a single dot becomes multiple dots, then a line, then a pulse and then goes on to becoming a 8x8 energy grid and then to a 9x9 energy grid. 8x8 is un-manifest and 9x9 is manifest. These aspects are very well captured as sutras in the book **Aintiram and Pranava Vedam.**

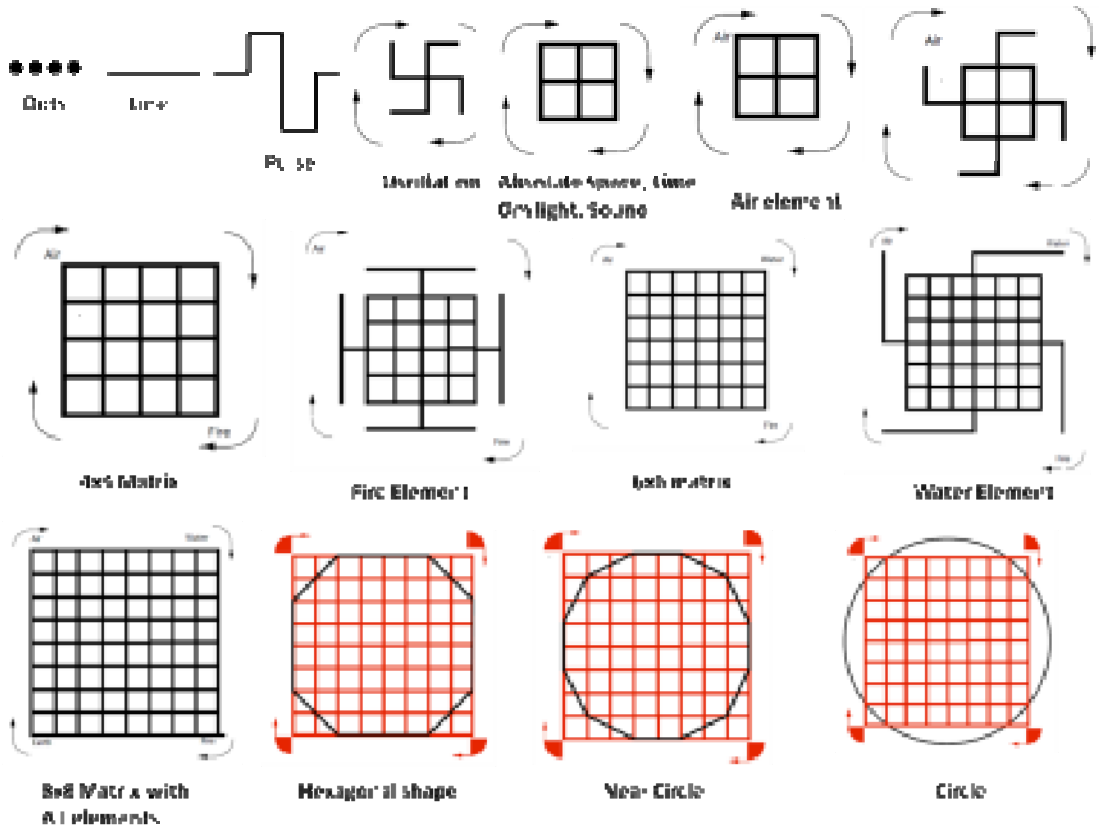

Figure 9: Transition forms of Brahman in detail (Coutesy: Fabric of the Universe)

If you look at the Fig 10 conceptually the following things happen:

- Subtle Energy becomes gross universe and the fundamental 5 elements are created in the process.
- It is said that 1/10th of the space becomes Air, 1/10th of air becomes Fire, 1/10th Fire becomes Water and 1/10th of Water becomes Earth.
- So we can conclude that we are living in a **Space delineated world.**

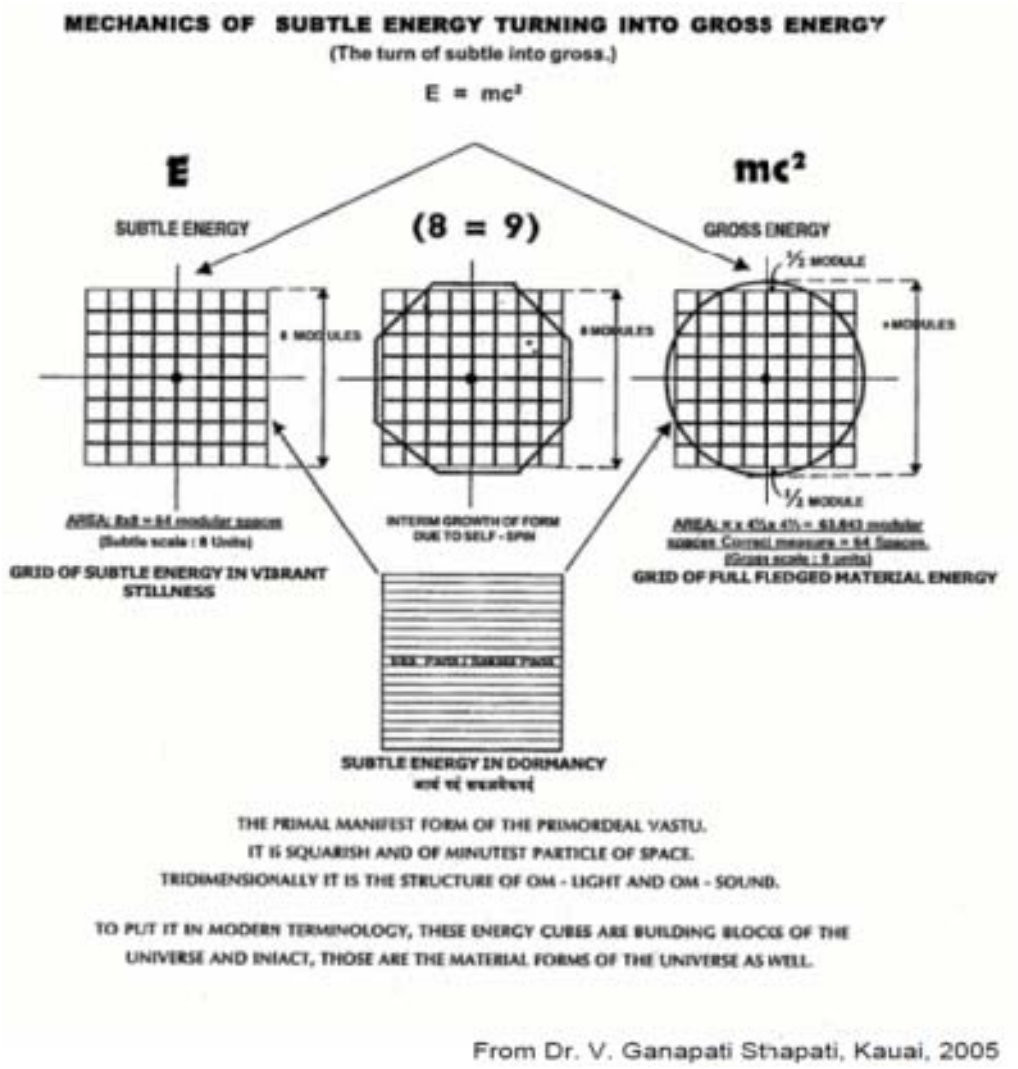

Figure 10: Subtle Energy to gross (Courtesy: Dr. Ganapathi Sthapati)

This wisdom was so succinctly captured by my good friend **Lao Tzu** in "**Tao Te Ching**" as follows: (Read heaven as un-manifest space and Earth as manifest gross)

"Heaven and Earth last forever.
Why do heaven and Earth last forever?
They are unborn, so ever living….

Thirty spokes share the wheel's hub;
It is the center hole that makes it useful.
Shape clay into a vessel;
It is the space within that makes it useful.
Cut doors and windows for a room;
It is the holes which make it useful.
Therefore benefit comes from what is there;
Usefulness from what is not there…."

But I wanted to highlight more important aspects to this process of manifestation.

- **Advaita** philosophy states that there is no duality. If you note that the **Parammanu** is what is present every living being and inanimate thing. What is within you is what is within me and hence the mahavakya **"Tat Tvam Asi"… You are that**.
- **Vastureva Vaastu** – Vastu which is unmanifest and subtle becomes Vaastu which is manifest and gross.
- **If we assume that Paramaanu is God's particle and hence it is divine, then everything in this world is divine**. This is the most important philosophy in **Hindusim**. See **the oneness in all** and see "**All in one"**.
- That's why Hindus saw divinity in everything. Trees, snakes, animals, insects, birds, human beings etc. There is nothing without that divine energy or particle – however you call it.
- This philosophy is **UNIVERSAL, OPEN SOURCE, ALL COMPASSING and the highest state of consciousness**.

But let's look at something even more important:

- We all note that Subtle has become Gross. Hence conceptually Gross = Subtle or both are proportionate.
- We all note that Space has become Earth. Hence conceptually Space = Earth or both are proportionate.
- We all note that 8 have become 9. Hence conceptually 8 =9 or both are proportionate.
- We all note that ENERGY has become MATTER. Hence conceptually ENERGY = MATTER or both are proportionate. This is represented by $E = mc^2$ by our great scientist Einstein. While we did not have this specific formula, the concept and the associated texts were very much with us for ages.

So this is what Einstein quoted after reading Bhagavad Gita.

"When I read the **Bhagavad-Gita** and reflect about how God created this universe everything else seems so superfluous." ~ Albert **Einstein**

Now let's try to answer this question:

- When you throw a stone in water / pond the ripples that form take the shape of a circle (in 2D) / sphere (in 3D). Can you guess what the shape of the ripple would be if you throw the same stone in space?
- **You would have probably guessed the answer. The ripples in space should be and would be in square /cube in shape.**

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy reading!

12. TIME = SPACE SERIES. PART 12 – VEDIC CONCEPT OF TIME & ITS MEASUREMENTS

The importance of time (**Kaalam**) is so high in the Vedic tradition that they ensured that the accuracy, continuity of time and the easy measurability of it is maintained for who knows how many years. **Time creates, sustains and destroys** everything and this is very nicely captured in these 2 lines:

காலமே எவைக்கும் மூலம், காலமே மூல ஆற்றல்
காலமே கோலத் தோற்றம், காலமே ஞாலத் தோற்றம்

The god of time is **Kaala Bhairava** – a form of Shiva and hence both **Shiva** and **Yama the lord of death both were** known as **Kaalan.** The time is represented by **number 13** and it belongs to Kala bhairava. We will see the interesting linkage between Vedic system and the Mayan calendar found in Guatemala and Mexico later.

Swami Chinmayananda states that "**Time is the periodicity between 2 thoughts**". Nothing captures the concept of time more wisely. What is clear from our scriptures and Swami Chinmayanda is that time is the pulsation that creates this universe. It is the vibration with very accurate periodicity and our sages suggested that you can live beyond time provided you manage to escape the effects of that pulsation.

Einstein's view on time and its relativity is very realistically captured in this quote **"When you are courting a nice girl an hour seems like a second. When you sit on a red-hot cinder a second seems like an hour. That's relativity."** More than relativity I found that the root cause of relativity is the pulsation of mind as time. Einstein on a serious note proved that our view of time is not absolute, it is relative and it is a continuum with space. We will in the next few parts of this blog would see that time and space are the same or Time = Space.

Aintiram states that there are 5 things that vibrates which have a common root and are not under our control. They are Space, Earth (vibration of earth is gravity), Eye lids, thoughts and Musical notes and very nicely put in Tamil as (Vin)**விண், மண்(man), கண்(Kan), எண்(Yen), பண்(Pan). Pan is musical metre / chandas and Yen is the yennam or thoughts.**

Correlate this with the first line of **Patanjali Yoga Sutra** which says **"Yoga Chitta Vrtti Nirodah",** means **Yoga is one which stops the vibration of mind / pulsation of mind and hence is a killer of thoughts.** The meditation techniques of keeping your eyes opened without battling the eyelids is another way of overcoming this pulsation instinct that is primordial and inherent in our nature.

Let's look how intricate our measurements time are in Vedic system. Check out the image below.

- The smallest unit of time is approximately 2 micro second.
- The largest unit is about 155 trillion years…. YET.
- Brahma's linear age is 50 years and in currently in his 51st year which makes the universe to be 155+ trillion years. Brahma's life time is 100 years which means it would be 300 trillion+ years of universal life which follows a cycle.

- After 100 years of pulsation cycles Brahma stays as dormant energy for the same period and then pulsates again for the next life of 100 years.
- A **Brahma's** life is also known as a Para. Each half Param is referred to as a *parardham*. This second half is termed as **'*dviteeya paraardhe*'** (the second half of Brahma's term) is stated in all vedic rituals.
- After every Chatur yuga, the world recycles. After every 2000 years / a Brahma day the world dissolves and remerges. The important point to note is that there is no CONCEPT OF CREATION here. It evolves and dissolves as per the science of pulsation. We also note that this pulsation expands and contracts. This cyclical nature of time as believed in Indian mythology refers to time as '*anaadi*' or that without a beginning.

Unit	Reference	Value	Metric
1 Tatpara		1.85	Micro second
1 para	60 Tatpara	111.11	milli second
1 Viliptam	60 Para	6.67	milli second
1 Liptam	60 Viliptam	0.40	seconds
1 eyelid blink	100 Viliptam	0.67	seconds
1 Kaashta	18 eyelid blinks	12.00	Seconds
1 Kshanam	10 kashta	120.00	Seconds
1 nazhigai	12 Kshanam	24.00	minutes
1 Muhurtham	2 Nazhigai	48.00	minutes
1 hour	2.5 Nazhigai	60.00	minutes
1 Day	60 Nazhigai	24.00	hours
1 week	7 days		
1 Paksha	15 days		
1 Month	2 Pakshas	30 days	
1 year	12 months	360 days	
Yugas:			
Krita		1728000	Years
Treta		1296000	Years
Dwapara		864000	Years
Kali		432000	Years
Chatur Yuga		**4320000**	**Years**
1 brahma day	2000 Chatur yuga	8640000000	
1 Brahma Year	360 Brahma days	3110.4	Billion Years
50 Brahma Years		155.52	Trillion Years

Figure 11: Time measurements in Ancient India

While doing Vedic ritual the time and space coordinate is invoked to say that you are doing this ritual at this place in the universe and at this time – with reference to Brahma's age to the time and star of the day. This tradition is unbroken and the Indian Almanac can predict the position of astronomical objects without any error for thousands of years without any sophisticated instruments and space ships.

On the contrary just read the history of the Gregorian calendar which we are following here, http://en.wikipedia.org/wiki/Gregorian_calendar. There is neither accuracy nor continuity and to top it up there are authorities who reform the calendar as if time stops and waits for them to affect that reform. Why should we ignore the best of time science that we have for an inaccurate, discontinuous reformed calendar?

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy Reading!

13. TIME = SPACE SERIES. PART 13 – SOUTH AMERICAN MAYAN & SOUTH INDIAN MAAYAN

Since we are discussing about time, let us address the **Mamuni Maayan** and the **South American Mayan**.

A lot has been talked about Mayan calendar and the imminent destruction to planet earth in the year 2012. I would recommend **'The Mayan Factor – Path beyond technology" by Jose Arguelles** if you are interested in this topic.

In this part I am interested in highlighting that the **South American Mayan** and the **South Indian Mamuni Maayan** who wrote **Aintiram and Pranava Veda** are one and the same. Extensive research have been conducted by many and I found, both the works of **Jose Arguelles and late Dr. Ganapathi Stapathi** who has spent about 3 decades each, very impressive. Dr. Ganapathi concluded that they both are the same and he has shown some interesting linkages.

I am going to present what impressed me in both these great researcher's works.

- First let me state that the doomsayers of 2012 phenomenon picked up Mayan's calendar which started in 3113 BC ran for 5125 years and the calendar ended in year 2012. Since the calendar ended they thought this signified that the world is ending. Jose argues that this is wrong and most probably the human race is entering into the next phase of evolution and the next cycle would begin. If you strongly believe that this is not true and the world would certainly end by 2012, then please ensure that you transfer all your assets and savings to my name effective 22, Dec 2012. ☺

- Mayan in his calendar in South America used very unique numerals in his calendar that is given below:

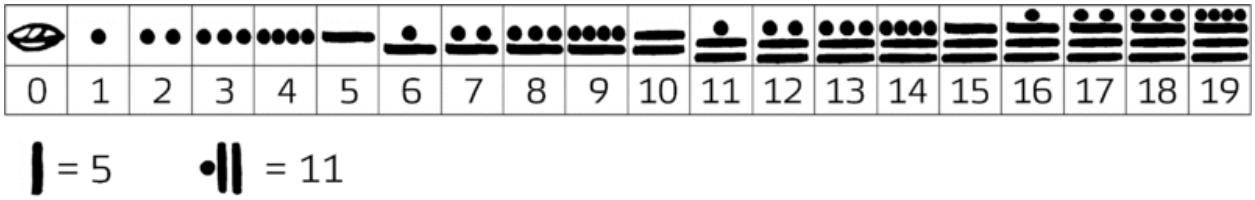

Figure 12: Mayan's numeral system (Courtesy: Wikipedia, Internet)

Now let me reproduce a Tamil poem written by Mamuni Maayan in his work called "**Kanithamaa sennool**". This song is part of the book written by Maayan in Tamil during his time – 12000 years+. This song expresses how the numerals are formed till 10. It says,

- 1 is one dot, 2 is 2 dots, 3 is 3 dots, 4 is 4 dots, 5 is a line and 10 is a double line.

மாப்புள்ளி ஒன்றே அன்றோ ஒன்றுமா எண்ணே காட்டும்

மாப்புள்ளி இரண்டே யன்றோ இரண்டுமா எண்ணே காட்டும்
மாப்புள்ளி மூன்றே யன்றோ மூன்றுமா எண்ணே காட்டும்
மாப்புள்ளி நான்கே யன்றோ நான்குறு எண்ணே காட்டும்

மாப்புள்ளி ஐந்தே யன்றோ ஐந்து மா எண்ணே காட்டும்
மாப்புள்ளி கோட்டினாலே இரண்டுரு மாக்கங் காட்டி
மாவியல் திறத்தினாலே பத்தறு மாக்கங் காட்டி
மாவியல் திறத்தினாலே எண்முதற் பொருளு மாவாய்!! (கணிதமா செந்நூல் - மாயன்)

- Among the books written during Mayan's time in Guatamala are Popol Vuh, The annals of cakchiquels and the **Book of Chilam Balam**. The resemblance of **Chilam Balam to Chidambaram** with which S. Indian Maayan was so involved is very striking.

- Be the pyramids that were built in the jungles of S. America that has a striking resemblance to the viamanas from south India, the earth's revolution around the sun measured within 1/1000th of the decimal point which is available in a book called **Surya Siddhaanta – In Sanskrit** by Mayan and the identical measurements available in South America – the similarities are difficult to ignore.

- Jose Arguelles makes a compelling argument about the shift in consciousness in 2012 due to a major galactic synchronization. But what impressed me are the following:

    - Comparison between **iChing (8x8 hexagram) and Mayan's Tzolkin which is 13x20 matrix**. In fact there is a Franklin's magic square which is based on the 8x8 grid of iChing that adds upto 260 which is the galactic constant of Tzolkin. This was amazing.

    - He refers to **Radiogenesis – Universal transmission of information through or as light** or radiant energy which is very much relevant to our discussions of light and sound.

    - The revelation he received from a Maya Humbatz men belonging to the universal great brotherhood organization revealing that our universe is the 7th such system which Maya has charted in the universe. So, we are not alone ☺

Would conclude this topic in the next part…

Happy reading!

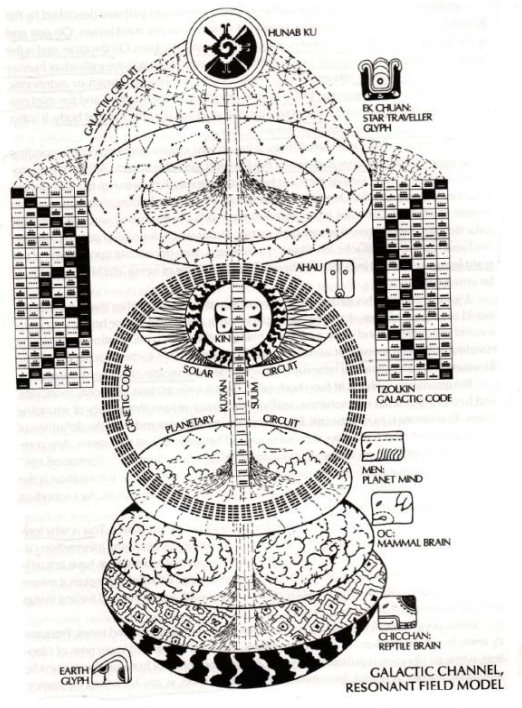

Figure 13: Galactic Communication Channel to Hunab Ku (Courtesy: The Mayan Factor, Jose Arguelles)

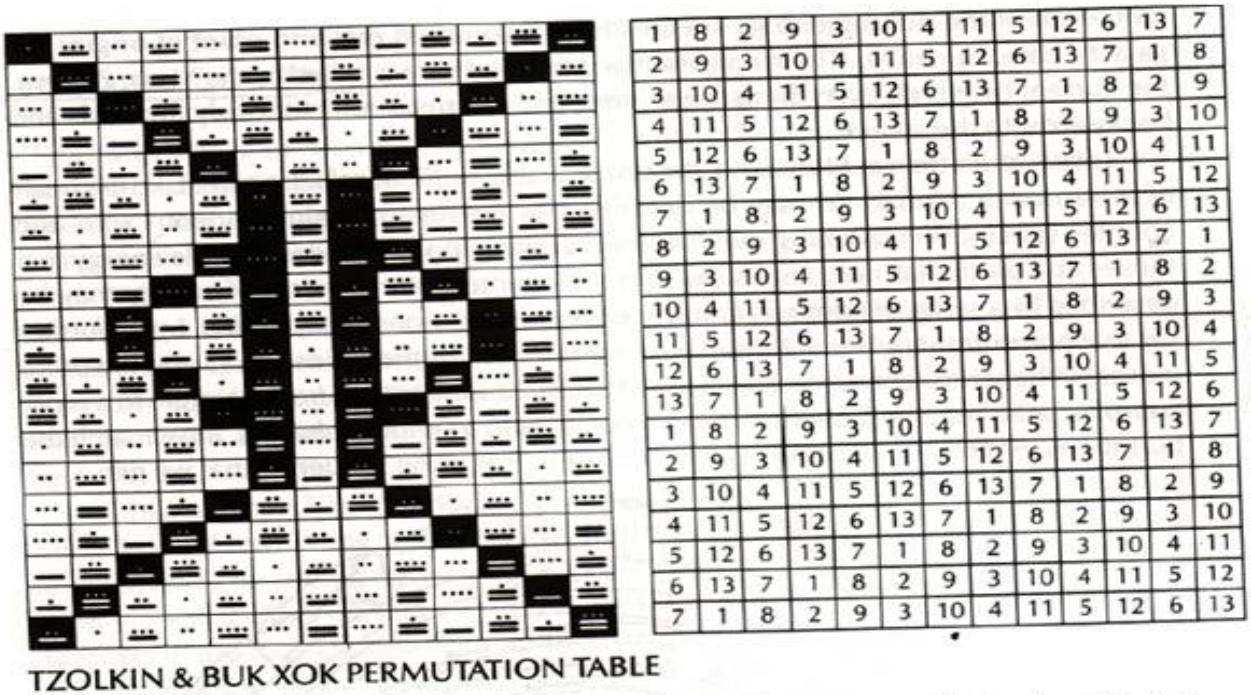

1	8	2	9	3	10	4	11	5	12	6	13	7
2	9	3	10	4	11	5	12	6	13	7	1	8
3	10	4	11	5	12	6	13	7	1	8	2	9
4	11	5	12	6	13	7	1	8	2	9	3	10
5	12	6	13	7	1	8	2	9	3	10	4	11
6	13	7	1	8	2	9	3	10	4	11	5	12
7	1	8	2	9	3	10	4	11	5	12	6	13
8	2	9	3	10	4	11	5	12	6	13	7	1
9	3	10	4	11	5	12	6	13	7	1	8	2
10	4	11	5	12	6	13	7	1	8	2	9	3
11	5	12	6	13	7	1	8	2	9	3	10	4
12	6	13	7	1	8	2	9	3	10	4	11	5
13	7	1	8	2	9	3	10	4	11	5	12	6
1	8	2	9	3	10	4	11	5	12	6	13	7
2	9	3	10	4	11	5	12	6	13	7	1	8
3	10	4	11	5	12	6	13	7	1	8	2	9
4	11	5	12	6	13	7	1	8	2	9	3	10
5	12	6	13	7	1	8	2	9	3	10	4	11
6	13	7	1	8	2	9	3	10	4	11	5	12
7	1	8	2	9	3	10	4	11	5	12	6	13

TZOLKIN & BUK XOK PERMUTATION TABLE

Figure 14: Tzolkin table (Courtesy: The Mayan Factor, Jose Arguelles)

14. TIME = SPACE SERIES. PART 14 –MAYAN, TAMIL, PLEIADES & ICHING

Jose Arguelles was also mentioning that the pyramid structures of Mayan civilization in South America with the **Tzolkin** calendar matrix communicates with 2 constellations – **Pleiades and Arcturus**. Jose mentions that he is sure about communication with Pleiades constellation.

Why did Pleiades interest me?

- According to Tamil history, Tamil is a divine language and the Lord associated is **Lord Muruga**. He is the Tamil deity and he is from the **Constellation Pleiades** which is called **Kritika nakshatra**.
- This emphasis that the South American Mayan could be a Tamilian from India, as many in the ET studies circuit opine that Pleiades is a constellation which is like our distant cousin where Tamil is spoken. There are many links but you can check this out.. http://22050hz.blogspot.com/2008/10/pleaidians.html

- Look at the Mayan calendar in Fig 14, it is a 13x20 Tzolkin matrix.
    - Please recall that we mentioned **13 is the number for Kala Bhairava**.
    - Tzolkin has a mystical central column around which 6 and 6 columns exist. The belief is that this central column is the frame of reference to the galaxy and it is believed to connect to **Hunab Ku – the center of the galaxy**.
    - This mysterious centre column is believed to be the road to the sky leading to the umbilical cord of the universe. I immediately correlated this with the **thread of consciousness** which is connected to the Hiranyagarba (the center of the galaxy as per Indian texts.) – Check Figure 13.
    - So understanding that this shaft of consciousness is connected to the center of the galaxy (**Hunab Ku / Hiranyagarbha**) at the one end and to **our solar plexus** at the other end with communication and galactic information transmission happening through resonance of light, opened many gates within me.

Nothing in this universe exists without purpose and the form and shape of any being / thing is explained as a state of consciousness at a particular resonant frequency adds to the Seelam (Rhythm) aspect of the Kaalam which we are going to see later.

For the space and time travel enthusiasts, Mayan has the following:

- All space travel is intelligence as information – transmitted through light by the principle of harmonic resonance.

- **Mayan says that Sun is the lens through which galactic information is transmitted from the galactic core and interpreting this with Gayatri Mantra where we meditate on the supreme light Savitr – an aspect of Sun god is amazingly striking.**

- Mayan highlights that time is a function of principle harmonic resonance and he attaches significant importance to the numerals which he states are the galactic harmonic constants. This is exactly what **Aintiram** states.

- **He interprets the iChing to contain the Genetic code of the human DNA as a hexagram in a 8x8 matrix which is a binary progression to the 6th power corresponding 64 six part words /codons. At the same time he interprets number 260 to be galactic constant and 360 which is the factor for a calendar year or the total angle in a circle to a harmonic calibrator.** His explanations more on this and on the mystical number 7 do not resonate in my tiny brain and I am begging for holy grace to expand my mind to understand these concepts.

- **When he says that flowers open to light just does not mean that it is sensitive to be light but deeply it aspires to be LIGHT.** I am not sure if you understand the depth of this statement as against the Sage molar statement which states gross light should merge with subtle light. I have been left speechless for days after understanding this correlation.

It is interesting to note that significance of numerals as per Mayan factor:

- **1 – The pulsation – Ray of Unity**
- **2 – The pulsation - Ray of Polarity**
- **3 – The pulsation - Ray of Rhythm**
- **4 – The pulsation - Ray of Measure**
- **5 – The pulsation - Ray of center**
- **6 – The pulsation - Ray of organic balance**
- **7 – The pulsation - Ray of mystic power.**
- **8 – The pulsation - Ray of harmonic resonance.** We will see more of this.
- **9 – The pulsation - Ray of cyclic Periodicity**
- **10 – The pulsation - Ray of Manifestation**
- **11 – The pulsation - Ray of Dissonant Structure**
- **12 – The pulsation - Ray of Complex stability**
- **13 – The pulsation - Ray of Universal movement**

In all 2 independent researchers working 6000 miles apart, conducting their studies independently seems to be pointing to just one person and one philosophy and science. What else we could do other than thanking our fortune to have read them and made this connection. I thought of writing just a page on this topic and I have ended up with 2 parts and I am stopping my temptation to write few more pages on this topic. For all of those interested, please read the book by Jose Arguelles.

It is amazing to find out how most of the ancient civilizations seem to have a common root and the communication between various geographies looks stunningly simple and the metrics on astronomical objects and other space sciences seems to be so accurate despite the absence of precision instruments and spacecrafts. One tends to believe that we had far advanced knowledge of nature which we seems to have lost and most certainly few thousand years back we were not nakedly roaming in the jungles of India and Africa hunting animals as the western experts wants you to believe but had a far superior & scientifically advanced civilization.

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy Reading!

15. TIME = SPACE SERIES. PART 15 – SHIVA LINGAM IS NOT A PHALLUS

If there is one part in the series I want you to read and talk about it with your friends then it is this topic. If I ask you as to what Shiva Linga stands for then more than 99% of the responses would be that it represents a **Phallus** symbolizing the male sex organ / creative energy with the female sex organ / creative energy - Yoni as the base and both together representing **inseparability and totality in the process of creation**.

Nothing is more misunderstood and misquoted than this concept of Hinduism. Every idiot including me who has read few books about Hinduism thinks that they are experts of Indology / Vedic studies. The wisest of sages who gave us Vedas and Upanishads did not boast that it is their work. At the end of every work they acknowledged that they are telling us what they have been told by their ancestors. It is 155 trillion+ years of universal knowledge available today in the richest of the languages Tamil and Sanskrit. This cannot be accurately interpreted in a foreign language. Lest in the weakest of all languages - English.

The other contributing factor to this misunderstanding has been the Sanskrit language or should I say the richness of the language.

We have already noted that the same word can have multiple meanings. This is not limited to Sanskrit, but the all the languages. For example,

- **Sutra means thread, Aphorisms** (the ability to express something in terse and concise manner). Ex. **Kama sutra** – the most understood of all the sutras. **Brahma Sutra** – The thread of consciousness in any form that runs in this universe – the most unheard of.
- **Artha** in Sanskrit means "meaning" and "wealth", we have already seen this. As in Vaak-Artha and Artha Sastra (the science of wealth management).
- Same way Lingam means **Symptom, Proof**, **Gender, Male sex organ** etc. Hence it was very easy to get confused, associate the lingam with a Phallus and also to ignore the philosophy and the supreme science behind it. Even people who believed that it represented much more did not knew the philosophy and the science behind it. Let's look at what it means.

I am going to request you to kindly refer to both the pictures below:

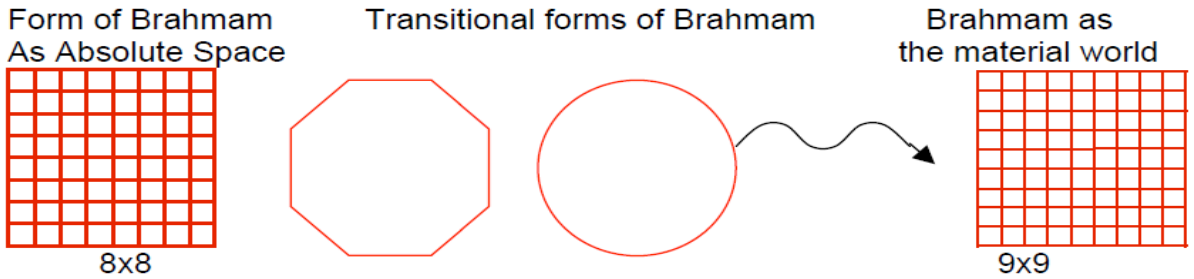

Figure 8 – reproduced here for convenience

Science ~ Religion

Tamas Guna - Rudra

Rajas Guna - Vishnu

Sattwa Guna - Brahma

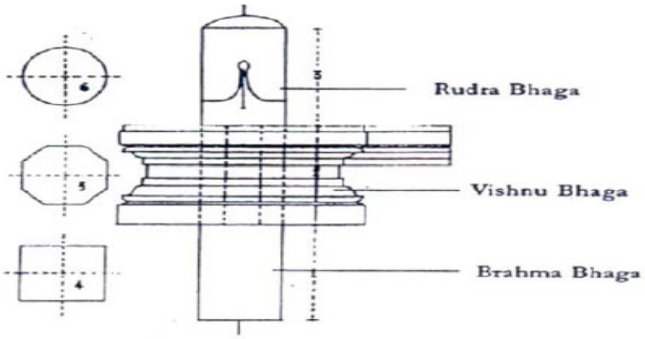

Figure 15 – Shiva Linga – Shape and Significance (Courtesy; Dr. Ganpathi Sthapati)

We have already seen that the subtle energy is takes the form of a square and the gross energy takes the form of a circle with an in-between state it takes the shape of a **tetrahedron and octagon**. Now look at the Shiva lingam from the top. Its base is always a square and the top is always a circle.

Figure 16 – Shiva Linga

Figure 17 – Shiva Linga with shape of the God's particle (Star) engraved.

If I have to merge all the 3 shapes together and it naturally takes the shape of a Lingam with a round top. **Shiva Linga captures the overall process of evolution in one form and shape - subtle to gross state – it encompasses every state of consciousness that is possible in this universe.**

Why the figure above states that Square shape is Sattvic, circle is Tamasic and the in between state is Rajasic? Let's understand the definitions of all the three qualities.

- **Sattvic represents the perfect state of balance. When it is subtle it is luminescent and in a perfect state of resonant non-vibration. The energy levels were perfect so that the resultant vibration is nil and it is in absolute balance.**

- **Tamasic state represents a state where the height of evolution is reached and hence it is farthest away from the core.** This is a different explanation from the usual one available in the web and books. Let me explain this. The core is very subtle and the tamasic state is very gross

and hence it is away from the core. Tamasic state then should be considered as the darkest state possible. Why?

- Because the core is luminescent and if the gross state is farthest from the core hence it should be dark. This is the meaning behind the most famous statement **'Tamasoma Jyothir gamaya"…** take me from darkness to light. It is not about just your mind but about the entire being aspiring to become a light and merge with primordial light.
- **There is no evolution possible beyond the Tamasic state and it has to devolve to reach its core / subtle state.**

- **Rajasic is a state where the pulsation has resulted in a rotational force and hence things are set into action. This represents the evolution process and hence associated with action.**

Then the natural next question is, if Shiva Lingam is associated with the entire spectrum of consciousness then we should see it associated the elements and the light. Isn't?

- There is a story in Indian Purana that Brahma, Vishnu and Shiva discussed who is the most powerful among them. Lord Shiva challenged Brahma and Vishnu to reach his head and feet respectively. Brahma tried to find Shiva's head and Vishnu tried to reach Shiva's feet, both of them failed. Most of us would have heard the story but would not have understood the philosophical and scientific significance.

  - Lord Shiva in the form of Linga stood there as a **PILLAR OF LIGHT**. This pillar of light is **the Brahma Sutra / light of consciousness** which spanned from the center of the galaxy (Hiranyagarba) to every being & non-being in the Universe.
  - Brahma could not find the head because; Brahma is always associated with intelligence in Indian texts. He gave the supreme wisdom - the Vedas and stands for Intelligence. He could not reach Shiva's head signifies that Intelligence will not take you to God. Intelligence as an energy is too gross and cannot reach the most subtle state of light.
  - Vishu represents earthly life – Rajasic in character – this is the tetrahedron & octagon state. He could not reach Lord Shiva's feet signifying you cannot reach the core through actions.

- Lord Shiva in the form of Lingam is represented as one of the elements (Earth, Water, Fire, Air, and Space) in the Hindu temples.

If you read the following Upanishad quote, you can probably understand the meaning:

na karmaNaa na prajayaa dhanena tyaagenaike amRitatvamaanashuH
pareNa naakam nihitam guhaayaaM vibhraajate yadyatayo vishanti

Not by work, not by progeny, not by wealth, they have attained Immortality. Some have attained Immortality by renunciation. That which the hermits attain is laid beyond the heaven; yet it shines brilliantly in the (purified) heart.

And this quote also brilliantly articulates the luminescent nature of the Paramaanu:

na tatra (not there) **suryo bhati** (sun shines) **na candra** (moon does not) **na tarakam** (nor the stars)
nema vidyuto (nor the lightning) **bhanti** (shines) **kuta ayam agnih** (how can fire shine)
tam (that) **eva** (alone) **bhantam** (shines) **anubhati** (thereafter shines) **sarvam** (everything)
tasya bhasa (in that light) **sarvam idam vibhati** (everything shines)

The sun does not shine there, nor does the moon, nor the stars or the lightning, much less this fire (deepam). When He shines, everything shines after Him; by His light alone everything is illumined.

The trick is to take the definition & meaning from Upanishads or any scripture and apply it to the God's particle and the process of evolution and you would understand it perfectly. Many a times the concept of God & faith obscures our mind to look beyond and rationally think about it. It is not the problem of religion but our system of education which has ruined our thinking. **Today the biggest challenge we have is to "Unlearn" than to learn.**

So to conclude:

- Shiva Lingam does not represent Phallus. To represent male and female totality and inseparability Hindus do have **Arthanareeswara** and it is not represented through Lingam.
- Shiva Lingam represents the **Pillar of Light and the entire spectrum of consciousness**. From the most subtle to the most gross.
- It represents an in-between **Guna** / **EGG** state (between un-manifest and manifest) and hence it is formless with a form.
- **While Lord Nataraja represented the rhythmic pulsation of this Brahma sutra, the cosmic dance / the dance of the evolution, Shiva Lingam represents the primordial light itself in all its state of consciousness.**
- By this analogy, our body itself is a lingam with the visible body as the gross part at one end and the most subtle body which is invisible and is part of the primordial light at the other.

Check out the picture below which represents most of the aspects we have discussed so far.

May Lord Shiva help us all to understand him better.. ☺

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions." Yet wish that this quote isn't wiser any more.**

Happy reading!

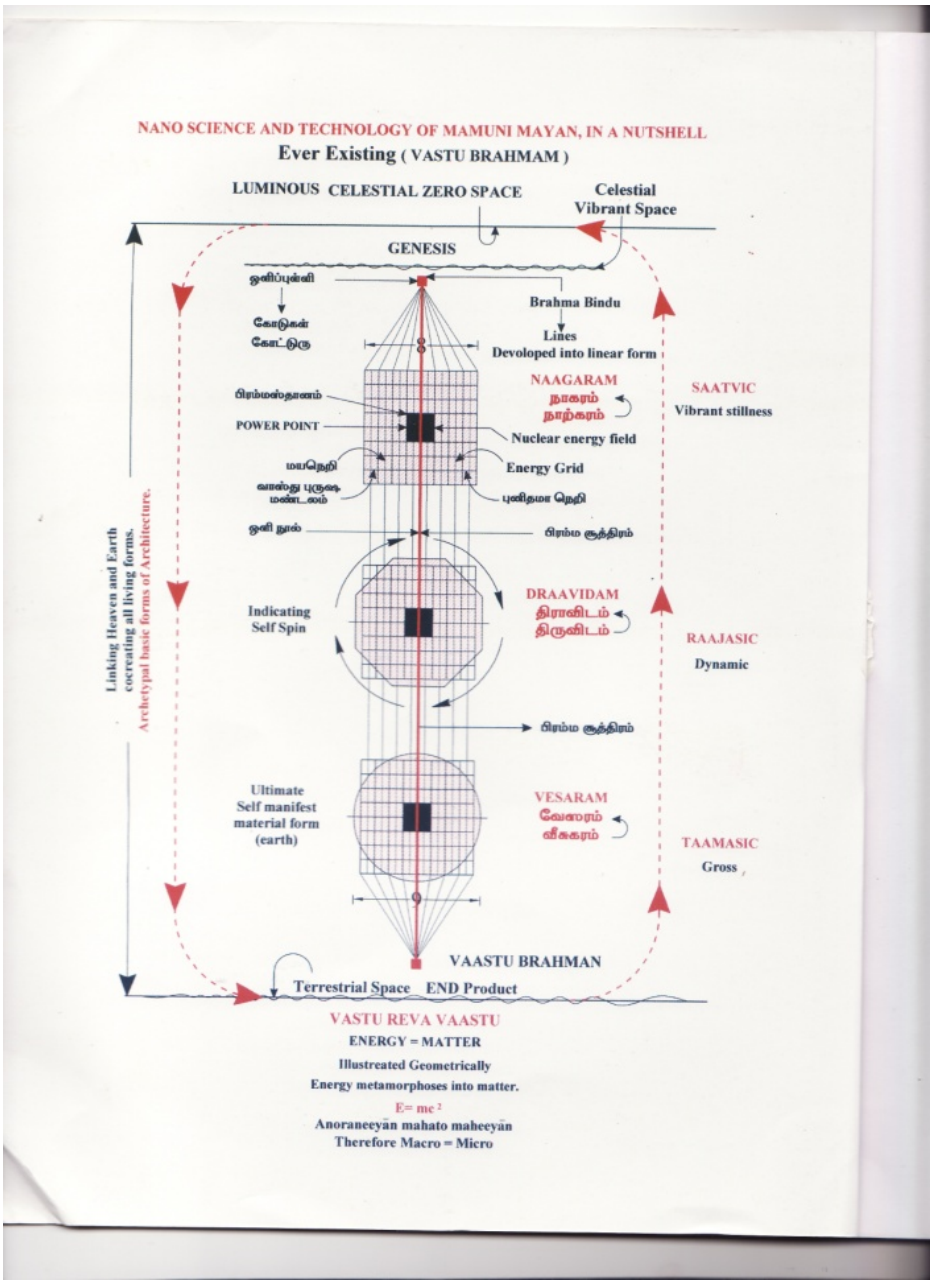

Figure 18 – Manifestation in a nut shell (courtesy: Dr. Ganpathi Sthpati)

This diagram represents everything we have discussed so far. The central red line is the Brahma Sutra which runs from the center of Galaxy to the terrestrial forms. Just correlate this with the Mayan Hunab Ku in the previous part.

This summarizes as to how Energy becomes matter, Subtle becomes Gross, Un-Manifest becomes manifest, how 8 becomes 9, and Square / Cuboid becomes a circle / Sphere. All represented in one formless form called SHIVA LINGAM.

16. TIME = SPACE SERIES. PART 16 – SEELAM - THE PRIMORDIAL CIRCULAR FORCE - GANAPTHI & MATHEMATICS

In the last few decades the main stream western science has started accepting concepts like uncertainty principle, wave mechanics, quantum mechanics, and periodicity of the wave pattern. Most importantly it is about the fundamental wave pattern of any energy or matter and the harmonics of these wave patterns falling in a particular form and proportion which is dictated by geometry / mathematics. In all the western scientists are scratching their heads on the depths of science of the subtle aka the sacred spatial geometry.

Most of the eastern philosophies have mastered this science and have codified these natural laws as a part of their religion, which is often dismissed as superstition. I already highlighted that in Tamil and Sanskrit the definition for science is "**Knowledge of the space**".

Modern science is moving in the right direction albeit very slow and they are trying to understand as to how elements are bonded within a molecule in addition to what elements constitute them. For example **Chlorophyll** molecule consists of **Carbon, hydrogen, nitrogen and magnesium (Mg at its core)** has a complex 12 fold Pattern – just one such typical pattern which can convert sunlight into life substance. The same pattern exists in our **RBC** cells just that it has an **iron** at its core instead of magnesium.

The understanding about the human body especially, "the spatial awareness that exists in each and every cell is due to the different sensory organs tuned at frequencies", led the scientists to unravel the innate spatial geometry of life.

Be it living, non-living beings, abstract forces like gravity, nuclear force, electromagnetism, heat, movement of astronomical bodies it does not matter what, everything in this universe adheres to a vibration / periodicity and is reducible to a number or a ratio. As a wise man said, "**Mathematics is the language of gods". This primordial rhythm & its harmonics are captured under the topic "Seelam" by Mayan in ancient tamil texts. Let's look at this in detail.**

I have been finding it difficult to sequence the flow for this topic and let me try starting from the basics:

- We know that the **Paramaanu or God's particle is a cube.** This particle with the primordial vibration combines with other particles to create a shape. **The Paramaanu combines in the multiples of 8 to evolve the next structure**. Let us see the importance of 8 later, but remember 8 is the number for Lord Narayana and Om namo Narayana has 8 Aksharas.

- What do you call a cube called in Tamil? It is called **Ganam (கனம்**). This also means heaviness, gravity, honor, dignity, abundance, plenty. To indicate it is a square cuboid they call it **கன சதுரம்**.

- The process of the addition of **Paramaanu** into bigger units is called as **Ganam (கணம்**, गणं). In Tamil both the Cube and the additive resultant are called as **Ganam** and the only difference being that in Cube it uses a **small "na" (ன)** as an alphabet. In the additive process / resultant it uses a **Big "na"(ண)**. The big "na" signifies that due to the additive process the small (na) becomes big (na).

- This additive process starts because of the **first rhythmic circular** force also called as a **Suzhi (சுழி)** in tamil which means "loop".

- Here comes the beauty. The Lord of or the energy associated with this **additive force (Ganam)** is called as **Ganapathi (கணபதி, गणपती)**. Note this is the bigger "**na"** used and not smaller **"na"**. He is associated with the first circular force - **Suzhi** (and hence he takes the first honor in any Vedic ritual. This means Lord Ganapati is the first process in the evolution and everything has to start with him. Even if it is Lord Shiva or Vishnu it does not matter, the very first honor goes to the **Lord of Ganas**. Many Indians when they start writing (atleast few decades back) they first start with this symbol at the top of the page before anything for a successful completion of that activity.

- If I add my own inferences to the above with a caveat that everything else I have written have a solid back up mostly from our own study of languages (as you can yourself see) and our scriptures.
    - The symbol above signifies that what was "a point" with untouched / non-interacting energies / resulted in the primordial first circular force out of a pulse and also signifying that every circular force shall also collapse back to a point.
    - Also the bigger / heavier things are formed or created by its smallest unit and hence symbolically the heavier ones are carried by the smaller units. To signify this may be a god in the form of an elephant is carried by a mouse.

- Now you know why every ritual starts with this Sloka to Ganapathi:

    - ***"GanAnAm tva Ganapati gum Havamahe, Kavim Kavinam Upamasra vastamam Jyestharajam Brahmanam Brahmanaspat aana Srnvan nuti bhissi dasadanam"***

      This means "May you the Lord of Ganas, Ganapati",... . so it goes.

- **Now what do we call the study of this additive force - Ganas? Mathematics – Ganith / Ganitham (கணிதம், गणित).**

- **So we Indians have codified:**
    - **the primordial God's particle as Paramaanu or microbode or Lord Shiva,**
    - **the rhythmic movement of the pillar of light as Lord Nataraja,**
    - **the first circular force as the symbol for Lord Ganapathi,**
    - **the lord of the additive force as Lord Ganapthi and**
    - **the Study of this additive force which leads to the formation of everything in the universe is Mathematics in Sanskrit and Tamil.**

- **Every possible state of consciousness and manifestation is represented in Shiva Linga**
- **We will see that the multiples of 8 in which the additive force moves is codified as Lord Narayana or Vishnu and the five state manifestation process as the five letters associated with Lord Shiva.**

Just forget that these names are the names of the Hindu gods, and tell me one religion or philosophy or one branch of science in this world which can capture the nature's primordial secret in this way and codify it for the common benefit of the world and carry it for thousands / millions of years.

These are just a start and please wait for the other interesting aspects to unfold.

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy Reading!

17. TIME = SPACE SERIES. PART 17 – SEELAM - THE PRIMORDIAL RHYTHM & FUNDAMENTALS

Now, let us get into some real heavy stuff - Mathematics (**Ganitham** – the study of Ganam) that governs this rhythm and harmonics. My first concern is how to make it easily digestible for an average individual who hates Math? So I shall take the easiest route that I know. I shall first explain the concept, then the actual Math part of it and then go to the philosophy and significance of the same. Later we shall look at how these are codified in nature and our scriptures and available in front of our eyes which we have failed to recognize.

Let us be clear about the following terminologies like **Progression, Proportion, root, Diagonal and Pythagoras theorem**:

- Let us take a series as follows: 2, 4, 8, 16, 32…. In this we need to be clear about what is **Progression and proportion**. As many of you know that whole series is a geometric progression where the next number in the series is a function of the current number and a multiple. This multiple here is 2, so that 2*2 = 4, 4*2 = 8 and so on. **This multiple or the constant is called as proportion**. You derive the value of the proportion by dividing the number by its previous number – (n+1)/n : (n+2)/(n+1). Hope this is clear.

- We know that a square has 4 equal sides. Each side of a square is called as "**root**" and the line that connects the 2 opposite ends is called as '**Diagonal**". In the figure below sides AB, BC, CD, DA are called as "**Root**". Lines AC, BD are called as '**Diagonal"**.

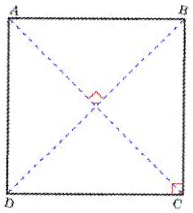

Figure 19; Square

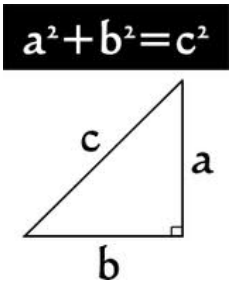

Figure 20: Pythagoras theorem

- **Pythagoras theorem** – This theorem gave us the formula to calculate the sides of a right angle triangle as given above. If you are not familiar with this, then please understand that if you know any 2 sides of the triangle the 3rd side can be calculated by the formula given above. I am not going to focus on the argument that this theorem was available in Indian scriptures before the Greek mathematician gave it. Let's look at the concepts and not which civilization gets credit as of now.

Since the fundamental structure is a square in 2D and Cube in 3D and also in the process of evolution one becomes many, let's ask ourselves the following questions:

- **How one square does create another square which is larger in size, progressively? What is the progression and proportion in this series?**
- **How one cube does create shapes which are polygonal (Hexagon, Octagon, decagon, dodecagon etc) progressively? What is the progression and proportion in this series?**

Now let us see Figure 21 where and consider the square ABGF. You can enlarge the image to see the alphabets clearly. Now as we know sides AB, BG, GF, AF are called "**root**" – remember this well and let us assume the smallest root possible is unity and hence each root is of unit length. AB=BG=GF=AF=1. Area of this square = 1*1 = 1.

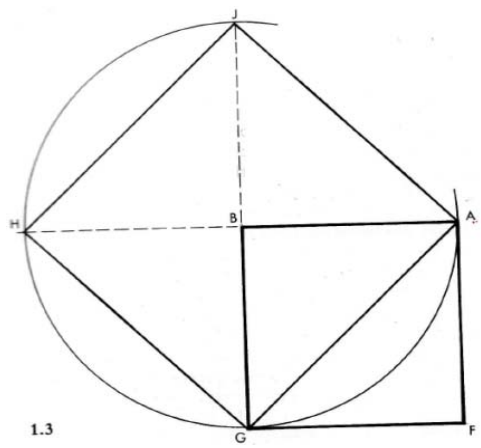

Figure 21; Square

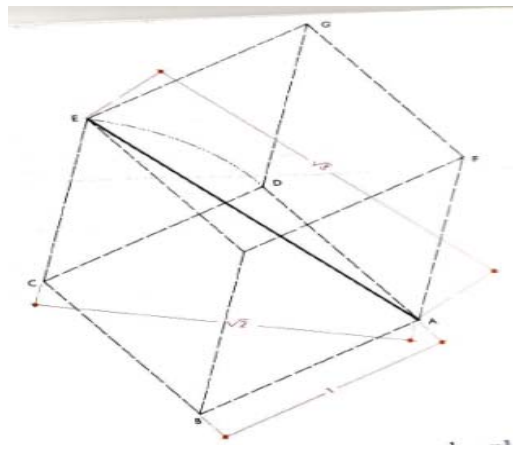

Figure 22: Cube

Line AG is called as the **"diagonal"** and as per Pythagoras theorem the length of **AG** should be **√2**. **AG = √(AF^2+GF^2).** So to summarize **the root of the square ABGF is 1 and the diagnol is √2**.

Now consider a larger square AGHJ, here AG, GH, HJ, AJ are the sides and hence called as root. AH, GJ are the diagonal in the 2nd square. We know AG = √2, then AH = GJ = 2 as per Pythagoras theorem. To sum up **the root of the square AGHJ is √2 and the diagonal is 2. Area of this square is 2.**

If you look at the ratio **root/diagonal** (root to diagonal ratio) of both the squares it is 1/√2 and √2/2 which results in 1/√2. This will progressively hold good. The magic proportion in this progression is **√2**.

What we can infer from this is if we consider a **progression of squares** from a unit square to larger squares, then the **proportion** of the progression is √2. But before we jump into its philosophical significance let's answer the second question.

Consider the cube above whose side is of unit length. We know a cube is made of squares. We know ABCD is a square of length (root) =1 and diagonal = AC = **√2**. If we want to find out the length of the diagonal of the cube which is AE, then ACE is a right angle triangle with AC = **√2**. And CE =1 and hence **AE = √3**.

What we can infer from this is if we consider a **progression of cubes** from a unit cube to larger ones, then the **proportion of the progression is √3**.

I am going to handle the significance of √2 and √3 in the next part.

Happy reading!

18. TIME = SPACE SERIES. PART 18 – SEELAM - SIGNIFICANCE OF √2 & √3

Let's look at the significance of **√2 and √3** but before that let's capture the philosophical significance of **Progression** and **Proportion**:

- The whole world is conceptualized as wave harmonics of the primordial rhythm with a **progression and proportion**. Philosophically the **Proportion** which does not change / which is constant is the **immutable component** and the **progression** which changes / is volatile is called as the **Mutuable component** in the process of evolution. **The whole universe is the progression and God is the proportion**. So if I know the God's proportion and the formula behind it I can create anything in this universe including a universe. This secret is called as the Brahma Vidya / Sree Vidya (Knowledge of Brahman, Sree) in Indian texts. What we are going to see further are very minor parts of the **Brahma Vidya**. ☺

- In the last part we saw, that the primordial square multiplied itself to be a larger square (**progression of squares**) using the **proportion √2. The diagonal of the square 1 (ABCD) forms the root of Square 2 (AGHJ)**. This is very profound if you get the concept**.**

- **If we consider square 1 as the cause then its diagonal is the effect. This diagonal is the root for the next square (AGHJ) and hence the effect of Square 1 is the cause of Square 2, this cause results in square 2's diagonal which is its effect and this is how the progression or evolution happens.** If you can see glimpses of Cause and effect cycle and the famous law of Karma in this analogy then you can pat yourself. ☺

- A square halved by the diagonal (square 1 with area 1) produces a square twice its area (square 2, area = 2). **The mystery of biological growth from cellular division or the different musical notes from the base tone is contained in this**.

- **Robert Lawlor in his book "Sacred Geometry"** very nicely puts it as the root of a plant (like the root in a square) is causative and embedded in the earth (and embedded in the square). These are very heavy and profound concepts just let it sink into you.

- When you divide the full height of the human being considering the total height as unity then belly as called as **Hara in Japanese, Dantein in Chinese, Nabhi in India** which is below the navel will measure (**2- √2)** from the soles of the feet to belly and (**√2 -1)** from navel to the head. In Yoga, Zen and Chinese meditation techniques this point corresponds to the transformative and generative aspects of the individual that involves **rooting** techniques for **self transmutation**. **So Lao Tzu said, "To seek the root is the goal".**

- **√2 signifies the power of multiplicity. Hence the Generative aspect of this rhythm is attributed to √2. This represents the principle of transformation.**

- Remember **√2** is a proportion in the progression of squares and a square does not become a higher form. We have seen that the diagonal of the cube (sides of unit length) is **√3. It is this √3 which divides the volume form of a cube and the diagonal of the cube becomes a root for the higher shapes like pentagon, hexagon etc.**

- Hence **√3 signifies the formative power of the rhythm while √2 signifies the generative power of the nature.**

We will touch the same using **Vesica Piscis** in the next part which shall take us to **√5 and the golden mean Φ.** I am not going to touch upon important topics like Gnomic spirals and the relation between various progressions and hence I would request you to Google them if you are interested.

Happy reading!

PS:
There are many books on this topic and I would recommend **"Sacred Geometry – Philosophy & Practice" by Robert Lawlor** which I found easy to read and understand.

You tube and Internet is replete with tons of images, articles and videos on this topic and you can learn a great deal from them.

19. TIME = SPACE SERIES. PART 19 – SEELAM – VESICA PISCIS, √5, & GOLDEN MEAN (Φ)

If you don't know what is vesica piscis, please google and you would find it interesting. I am not going to explain it here and I would focus on the summary and aspects which are often left out. The philosophical aspect of Vesica Piscis, is a rotating point becomes as circle of unity. Two circle of unity (with its radius as unity) interacting / intersecting each other in a perfect manner offers an overlapping area which is considered to be sacred and fundamental to all the geometric forms in the universe. We will first see how **√2, √3 & √5** are part of this Vesica Piscis.

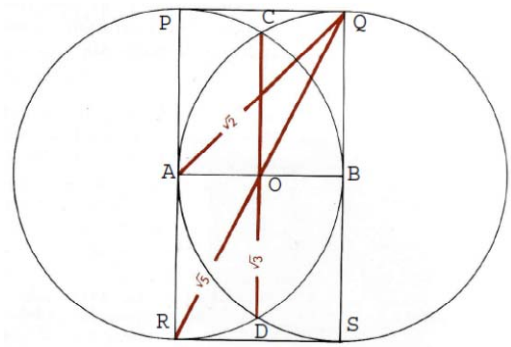

Figure 23; Vesica Piscis

Please look at 2 circles who radius is unity and AB = 1, intersecting as per the diagram. The overlapping area ABCD is the Vesica Piscis and we can see **√2, √3 & √5** all part of this Vesica Piscis.

ABPQ and ABRS are 2 squares and the side of the square is 1. **√5** is as significant as **√2 and √3.** In the diagram here **√5** is the diagonal of the rectangle PQRS / diagonal of 2 squares – one below the other.

√5 is the regenerative factor that binds 2 squares or that factor that transcends two worlds or the bonding factor for 2 cosmic entities. This **√5** shall take us to the most important ratio which is the **Golden mean** or the **God's ratio**.

But before that let me share what stuck my mind when I was engrossed **with Vesica Piscis and √3**. Look at the pictures below. These are pictures of forehead marks of Hindu Brahmins sects called Iyengars and their supreme deity is Narayana. I correlated the striking similarity of the rectangle around the Vesica piscis and Iyengar's namam. You just have to imagine the 2 overlapping circles are the right and left side of the face with the **Vesica Piscis** starting from the top tip of the nose. To me the **formative principle of √3 is in line with the "Bhootha krut" and "Vishwa karma manu stvashtha"** aspects of **Maha Vishnu** as per Vishnu sahasranamam. I had a good laugh on this correlation.

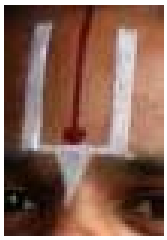

Figure 24; Iyengar Namam 1
(Courtesy: Internet)

Figure 25: Iyengar Namam 2
(Courtesy: Internet)

Coming to the **Golden mean,** If you have not heard about it, just Google or here is a quick link http://www.goldennumber.net/. Some of you might be even have fatigue repeatedly reading and listening about it, like I do. Hence I am not going to rewrite what is widely available. But let's look at the philosophical aspect of it, its relation to **√5** and its manifestation.

Now so far in **√2, √3 & √5** what we have seen is how Unity evolves as many. But if I am interested in geometrically dividing the Unity so that this proportion evolves as unity then how do I do it?

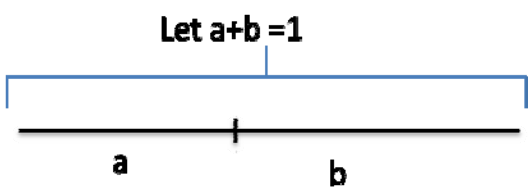

Consider a line of unit length and also consider two segments a, b so that a+b =1.

A and B are such that it has to fulfill this condition of Proportionality that a/b : b/1.

(Figure 26: Line andΦ)

This means what 'a" is to "b", is the same as what "b" is to the whole length which is 1.

Mathematically resolving this equation a/b : b/1, hence b^2 = a and hence b= **√a.** This means **a + √a = 1.** The answer to this equation is only one value which is called the **Golden mean / God's ratio** denoted by Φ = 1.6180339… and a = 1/Φ. **Philosophically it is the division of unity and the only possible creative duality within the unity.**

You may ask as to why unity is not divided into 2 equal parts and why is should be **1/Φ** (**0.6180339..).** This is effectively answered by our Upanishad **"Whether we know it or not, all things take their existence from that which perceives them"**. **Adi Shankara said "the universe is an illusion / maya**" **because it is what we perceive**. **We tend to ignore them as philosophy or superstition.**

But let's look at it scientifically as we understand. When the unity is divided into equal parts there is no asymmetry and difference and hence there is no perceptual universe. **An asymmetric division is needed to create the dynamics necessary for progression and extension of unity**.

Let's summarize our understanding again:

- **√2 – the generative component and a multiplying factor creates multiple squares from a unity of square.**
- **√3 – the formative component that creates multidimensional polygonal shapes from a cube.**
- **√5 – the regenerative component or the binding component that transcends and binds both the worlds.**
- **Φ - Golden mean or the God's ratio,** which is an evolutionary principle that is guided from within and an indisputable mathematical evidence of the conscious evolution of this Universe.
- Φ - Is a self-similar variable which can be used to derive Unity and it is the only proportion by which the Primordial rhythm maintains it perpetual oscillation to sustain this universe.
- Relation between **Φ and √5 is, Φ = (√5+1)/2**

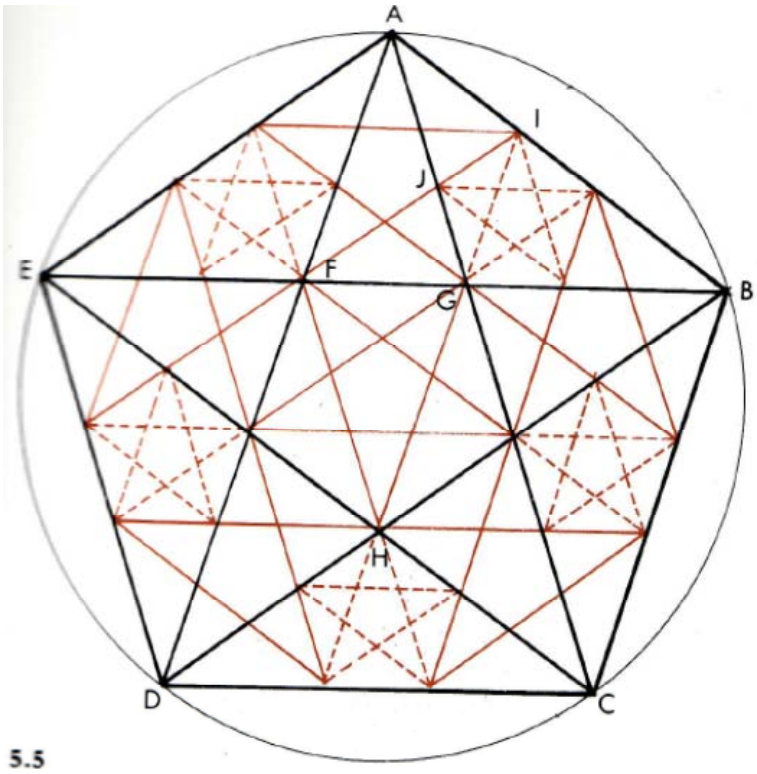

(Figure 27: Pentagon & Φ, Courtesy: Internet)

Now let's geometrically as to how **Φ and √5** are intricately linked. Consider the Pentagon picture whose side is of unit length. Ie.

AB = BC = CD = DE=AE = 1 and

EG = FB = CG = DF = 1 and

EB = Φ = 1.61803399 and BG = 1/Φ = 0.61803399 and hence all the ratios like AG = AF = EF = GB = 1/Φ.

Also FG = $1/\Phi^2$, which means **EB = EF+FG+GB = $1/\Phi+1/\Phi+1/\Phi^2$**

Also GI = $1/\Phi^2$ and GJ = $1/\Phi^3$

If you are interested more please check out the Fibonacci series and its relation to Φ. **The importance of 5 is dominant in every living organism while 6 and 8 are the characteristic of mineral and inanimate structures. It used to be rule of thumb that any plants / flowers which has 5 petals is an edible plant and hence 5 and pentagon are the symbols of life which contains the God's ratio or the golden mean.**

Now let's also understand how a **√5** is related to **√2 and √3.** If we consider a right angle triangle with the base of **√2** and height of **√3** or vice versa then the hypotenuse is **√5.** Now let me draw the connection between √2, √3, √5, Φ and π. If you think they are all some random numbers which cannot be fixed to their 10th decimal and not related to each other, just see the following relationship.

$$\pi = \Phi^2 \times 6/5 \qquad \text{or alternatively} \qquad \Phi = (\sqrt{\pi} * \sqrt{5}) / (\sqrt{2} * \sqrt{3})$$

This is the binding factor. I shall produce below some pictures which are aligned based on pentagon and the web is replete with them for you to understand more.

These 2 parts were little heavy and I shall move to easier aspects on the universal rhythm from next blog. The point I was trying to make is that everything in this universe is subject to a proportion and its fractals and let's see the manifestation of it in our daily life.

Happy reading!

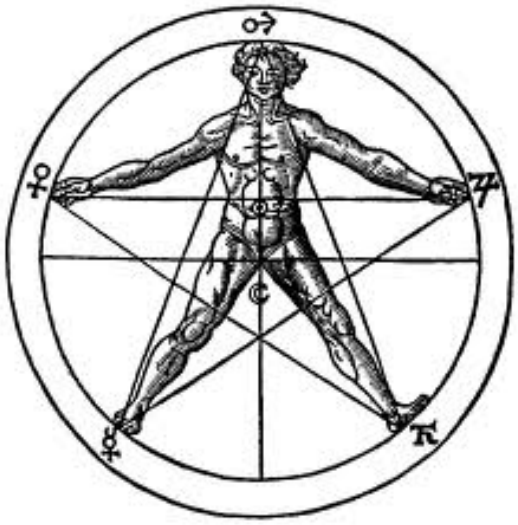

(Figure 28: Pentagon & Human shape,
Courtesy: Internet)

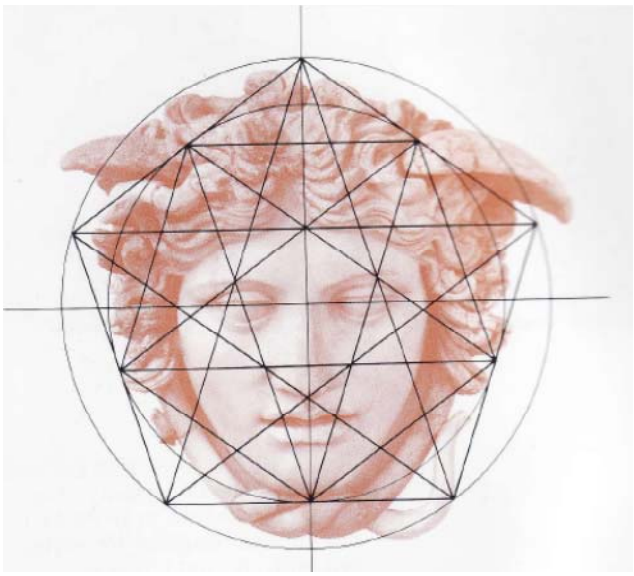

(Figure 29: Pentagon & Human face,
Courtesy: Internet)

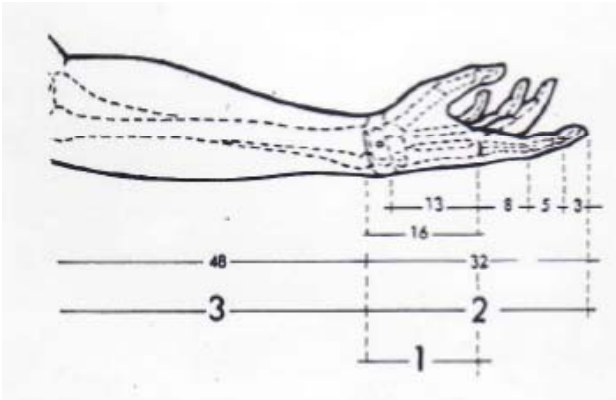

(Figure 30: Human hand and Fibonacci Series
Courtesy: Internet)

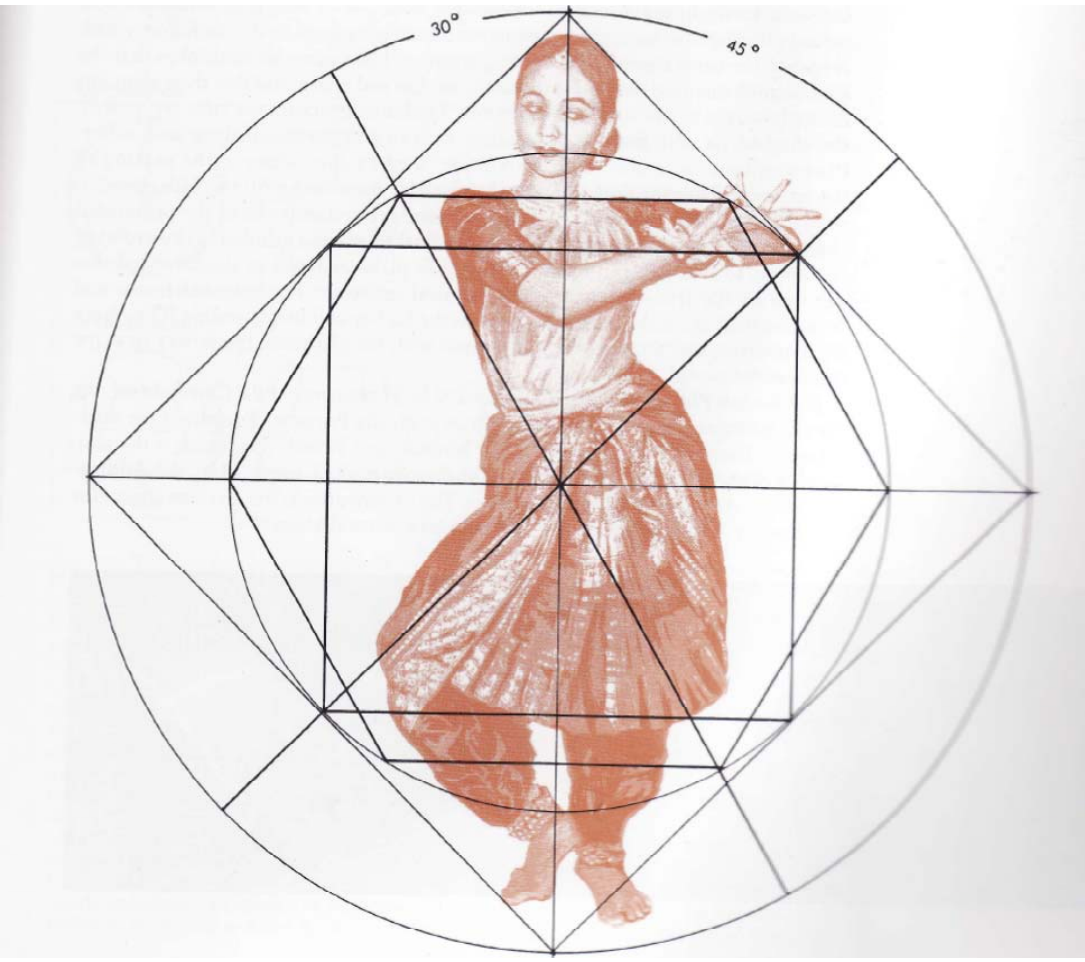

(Figure 31: Bharatanatyam and body alignment (Courtesy: Robert Lawlor, The Sacred Geometry)

The positions of Hindu classical dance (Bharat Natyam) describe geometric relationships from the axis of the body and the alignment of center of gravity at "hara" invoking rooting and divine power of transformation. In Hinduism "hara" is one of the names of Lord Shiva as in "Hara Hara Shakara"

20. TIME = SPACE SERIES. PART 20 – SANKHYA YOGA AND SAGE KAPILA

Now, let's look at what **Sankhyakarika** one of the greatest scientific works by **Sage Kapila**. I need to highlight that the **Sankhya philosophy** is one of the most evolved philosophies about the secrets of nature; it contains only 72 verses of which 68 of them define the complete spectrum of universal manifestation. **This Sankhya Yoga is referred in Bhagavad Gita – Chapter 2 is called Sankhya Yoga and in Chapter 10, verse 26, Lord Krishna identifies himself with Sage Kapila**.

Sankhya in Sanskrit means numerals / numbers. Sage Kapila states:

- Any measurement is a relational process and only a change can be measured but it takes time. The difference between the yardstick and the measured object constitutes the measured variable, which in effect is an incremental change. Since the observer can detect or measure only a change then logically, **the incremental unit of measurement itself should form the basis to derive the whole. This is the genesis of Φ.**

- **Correlate the above statement with the equation a + √a = 1. The unity is derived from the proportion "a" or 1/Φ.**

- As an example, the arch of a bow has expansive stress on the outer side and compressive stresses on the inner side, while the string is in tension and all are balanced at every instant. The expansive, compressive and tensile stresses can be expressed by one law.

- Alternatively, a single variable describes the proportionality of three types of forces existing at the same time. **Such a variable should be scale invariant, self-similar and have an axiomatic relationship to the whole.**

- **So Sage Kapila called 1/Φ as a self-similar variable from which the unity can be derived.**

- So he postulated if **x** is the value of a measured increment then the total value **1+x** must be related to the ratio of change as 1/x at the same instant of time or simultaneously. This means **1+x = 1/x**, and would lead us to $\mathbf{X^2 + X = 1}$.

- He quotes that if the primordial rhythm has to be self sustaining then the proportion is certainly governed by 1/Φ. He gives the formula for this oscillations as follows:
  - **X = 1/Φ = 0.61803399**
  - **Increment / Expansion = 1+x = 1.61803399 = Φ**
  - **Compression = 1-x = 0.38196601 =** $\mathbf{X^2}$
  - **Resonance =** $\mathbf{X^3 = X - X^2}$ **= 0.23606798**

Resonance or X^3 is the factor which protects this rhythm from decaying and dying off. So **Φ or 1/Φ** is such an important ratio or proportion so it is called as the **Golden mean or God's ratio**.

I shall highlight some of the factors / ratio which are part of Sankhya Yoga and what is amazing and you find formulas for Tamasic, Sattwic and Rajasic Guna states. (Please refer "Secret of Sankhya Yoga" – G. Srinivasan in the web).

- **Kapila defines the four qualities of the unmanifested state as Aikaantha (Synchronized), Aathyanta (perpetual), Atho (Dynamic)and Abhavath (unmanifest).**

- Taking C as cyclic rate of oscillation or vibration and x as rate of change per cycle then the three Guna self similar interactive states are shown as vibratory counts per cycle by the formula. **Thaama = C^{1+x} . Rajasic = C^{x+x} . Sathwa = C^{1-x}.**

- Some of the numbers that Sankhya Karika deals with are **1/7 (0.142857), π/10 (0.314159), 1/Φ (0.618034), √2 (1.414), Φ(1.61803399), √3 (1.732), √5 (2.23), e (2.718282), π (3.14159) and declares that the unmanifested state (Abhavaat) can exist only when the oscillations are between π/10 (0.314159) and e(2.718282). This is simply amazing since the state of Abhavvat is the state of Brahman.**

Despite herculean efforts I am unable to understand the Bhashya for the 72 verses which is about 500 pages explaining the secrets of Sankhya in any significant measure. I wish someone can step in and help us by explaining Sankhya Yoga that is comprehensible to our level of intelligence.

We have a treasure of secrets and richness hidden in our scriptures and it seems we have already lost most of them and the fundamental reason being our indifference to Sanskrit and our mother tongue.

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy reading!

The passage produced below is just the summary of verse 1.

…The Sankhya view that evolves out of the complete theory is that only vibrations are detected by the observer... Since only relative changes can be be detected, any fundamental component that is not in a vibratory state cannot be detected. Vibrations are caused by components in an interactive state or a cyclic state of colliding and separating that is common to all interactions and wave phenomenon.

The interactions create three distinct modes of stresses. Collisions are compressive or inelastic. The resultant reaction is expansive or elastic. When the interacting components lack the freedom to move away the interactive state is maintained in a cyclic or shuttling mode in the same location in a resonant state.

*This important Sutra lays emphasis that if the observed process of detection is dependant on vibrations, then fundamental space **must** contain components with those four characteristics described as states, which makes it function in a holographic way. That is all vibrations remain in fixed relationship relative to each vibratory point in a coherent and resonant state.*

21. TIME = SPACE SERIES. PART 21 – 5 AND 8 THE UNIVERSAL RHYTHM

Let's summarize what we have seen so far and then move on to more interesting aspects.

We have touched upon the God's particle and its characteristics. We also looked at the 5 fold manifestation process and in that we looked at how **Moolam** becomes **Kaalam** (time) and how time rhythmically (**Seelam**) vibrates with a proportion and creates forms and shapes (**Kolam**). We also touched upon some of the ways we had codified the secrets of nature like **Lord Shiva, Lord Nataraja, Lord Ganapati etc.**

Before we see how rhythm **(Seelam) and shapes (Kolam)** manifests itself as universe, let's first look at one specific word from Tamil which has three significant meanings converging into one, Yen (**எண்**), means number **eight, generic term for Number / numeral** and also root for **எண்ணம்** which means thought. I shall explain the significance of this below.

<u>Importance of 8 / Octet:</u>

It is stated that these God's particles combine in the multiples of **8 / octaves ONLY** and the states of manifestation from being subtle to gross is as given below.

- **Formless Un-manifest State** — **0 (This is the Abhavaat state)**
- **Guna State** — **$8^0 = 1$**
- **First stage** — **$8^1 = 8$**
- **Second stage** — **$8^2 = 64$**
- **Third stage** — **$8^3 = 512$**
- **Fourth Stage** — **$8^4 = 4096$**
- **Fifth Stage** — **$8^5 = 32768$. This is the state with manifest form.**

This rule is applicable to both the visual and aural forms which mean we can see or hear anything only in the fifth stage of evolution. So as per **Pranava veda, the fundamental numbers are 0,1** and the key **numerals for proportions are 5, 8**.

<u>Significance of 5 and 8:</u>

Pranava Veda describes that 8 / octets is the essential harmonic oscillator for the manifestation of the universe since this generative force is the multiple with which the whole universe manifests and sustains. You many note that number 8 is associated with Lord Narayana and his Ashtakshara mantra **(Om NaMoNaRaYaNaYa**).

The principle of 5 / Penta, we have seen is the regenerative binding force earlier. It is always a 5 stage process. This is associated with **Lord Shiva (Om NaMaSiVaYa).** The un-manifest form comes to the Guna state with the force of 5 and in the multiples of 8. It is also important to highlight that 5 and 8 are part of the **Fibonacci series and their proportion is 8/5 = 1.6, which is Φ**.

But it is important to realize that the building of octets is a 5 step process for manifestation. This highlights that one cannot exist without another and both are interdependent. Now let's recall:

"Shivasya hridayam vishnur, Vishnoscha hridayam shivah:" and
"Shivaya Vishnu rupaya Vishnave Shiva rupine"

Vishnu (8) is the heart of Shiva (5) and likewise Shiva is the heart of Vishnu and they both are the representation of each other.

If you have noted Tamil language stressed the importance of words and its meaning – this was addressed in the first few parts of this series. Here Tamil language gives the importance of numerals and its significance in the formation of universe. Both the great sages **Auvaiyaar** and **Thiruvallular** stated the importance of numerals and letters in an identical fashion. Both these lines mean, Numerals and letters are like eyes for living beings / equal to eyes.

எண் என்ப ஏனை எழுத்து என்ப இவ்விரண்டும் கண் என்ப வாழும் உயிர்க்கு!
எண்ணும் எழுத்தும் கண்ணென தகும்!

Now what should be noted here is that (**எண்**) importance of numerals precedes that of letters and we know why. The aural and visual forces become letters & its associated sound at the 5th stage but the numerals are from the Guna state. **Numerals were associated with 8 / Lord Vishnu and letters were associated with 5 / Lord Shiva**. Guess you can get the scientific knowledge and significance we have in our languages.

Since what is in macro is there in microcosm, taking the analogy to microcosm our mind becomes the Moolam (Source), our thoughts are the vibration, time is measured as the periodicity between thoughts, based on the rhythm of our vibration we perceive the world. This is given very nicely as **உள்ளமே மூலமாகி உணர்வுறும் கோலமாகி**! means **Our mind is the source and its awareness becomes forms.**

This wonderful concept is what is linked in the word Yen (**எண்**), which means number **eight, generic term for Number / numeral** and also root for **எண்ணம்** thoughts. **Just this one word in Tamil highlights the supreme secret that thoughts become form and words with the help of numbers and numerical proportion converts aural and visual forms to thoughts.**

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy reading!

22. TIME = SPACE SERIES. PART 22 – EIGHT (OCTET) AND THE 5 SACRED ARTS

எட்டே எட்டியல் எட்டெட் டியலே
எட்டின் நெறியே அளவை மாநெறி !!

The above lines from the work **Aintiram** means **"Eight / Octa (multiples of 8) is the fundamental numeral for any measurements**. We did see that the fundamental god's particle add up with each other in the multiples of 8 in the previous part.

In ancient India there were about 64 arts (http://en.wikipedia.org/wiki/Kal%C4%81) known as **Chatuhsasti kala ("ஆய கலைகள் அறுபத்துநான்கினையும்"** as popularly known in Tamil), but I am going to talk about 5 sacred arts.

We will look at the importance of numeral 8 and how this is fundamental to everything in this Universe. But let's again start again with etymology. The word arts in **Sanskrit** is **"Kala" (कला)** and **Time in Sanskrit is काला (Kaala).** So etymologically we can say that classical arts are all about variation of time (or harmonics of this pulsation of time in the multiples of 8).

After etymology let's get to the basics. Our understanding of the universe is that **"the primordial space manifests itself as spatial forms through pulsation (Time) and its periodicity (Rhythm & order).** This evolution started with **Pranava which came out as aural and visual form (Sound & light)**. When they say **"The one became two"** they refer to the Pranava which is light and sound from the unmanifested consciousness.

Aintiram states that the dual form of **Pranava** gave forth 5 sacred arts which are fundamental to most of the other arts. **The Aural form of Pranava gave forth Poetry and Classical Carnatic music, which can only be heard. The Visual form of Pranava gave forth Sculpture and Building architecture, which can only be seen. Both the aural and visual forms merged to create the classical dance (Bharatnatyam**), which involves both seeing and hearing.

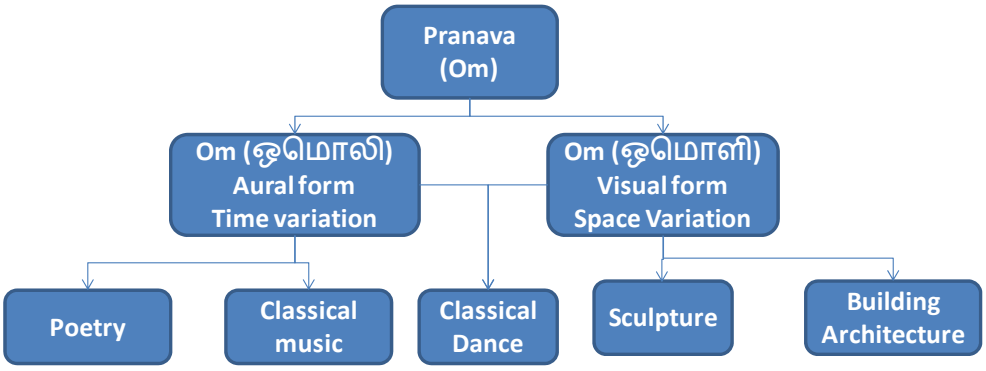

Figure 32: 5 Sacred arts

They were classified as 5 vedas:

- **Poetry – Sabda veda**
- **Classical music – Gandharva Veda**
- **Classical Dance – Naatya veda**
- **Sculpture – Sthapatya Veda *(Sthapati is a clan that is the master of this veda)***
- **Architecture – Pranava Veda**

<u>Pendatic Tamil and its construction:</u>

Pendatic Tamil is called as **ஐந்தமிழ் (Aintamizh**) which consists all the five above arts, **இயல், இசை, நடனம், சிற்பம், கட்டிட கலை**. It is these 5 arts which were formed out of the Tamil language and the language itself is created from the word Om. They say that it is not 12 basic vowels in Tamil but only 5. They are அ, இ, உ, எ, ஒ. These 5 letters combine to form the rest of the letters like

அ + அ = ஆ, இ + இ = ஈ, உ + உ = ஊ, எ + எ = ஏ, ஒ + ஒ = ஓ, அ + இ = ஐ,

அ + உ = ஔ

Here you may want to note that 5 has become 12. Same way in classical music they say that the basic svaras are 5 (**ச**, **ரி**, **க**, **ப**, **த**) – Sa, Ri, Ga, Pa ,Da which became 7 and then 12.

So 5 is the fundamental numeral for evolution and Tamil language has grown based on this philosophy and science. I am sure some of the other Indian languages have the same basics. The book which describes this phenomenon of evolution of language from Pranava and arts from language is **Aintiram (it means 5 works) (ஐந்திறம்**) authored by Mamuni Mayan dated 10000 BC.

You would agree that the aural forms are predominantly variations in time and visual forms are of spatial variations. But our ears stand for akash tatva ("space") and it can perceive variation of time and space and we will see this in detail. When we said **"Time = Space"** we will see that both of them are governed by the same laws and measurements and hence there is no difference between **Time and Space**.

Happy reading!

23. TIME = SPACE SERIES. PART 23 – NANOTECHNOLOGY IN ANCIENT INDIA & SIZE OF GOD'S PARTICLE

Let me start with these questions:

- **What is the size of the God's particle and how is it calculated?**
- **Does nature endow a standard measure for an average human being's height?**

Before we proceed to the next section I want to give the very detailed space calculation table used in ancient India. Our rishis did not stop just with telling us that the **Paramaanu / God's particle** is very small but went ahead and established its size.

If you have to see such minute particles then your sensory organs – Eye and mind should be tuned to it so that it can see things at that size. From the formula available in our ancient texts I was trying to reconstruct by working backwards to find out the size of the **Paramaanu / God's particle should be.** Please refer the table below which I have arrived at.

ANCIENT SPACIAL MEASUREMENTS		
Unit scale	**Ancient metric**	**Current day Metrics**
1 Paramaanu =	Smallest particle	133 nano meters
1 Ther Thugil=	8 Paramaanu	1065 nano meters
1 Mayir nuni=	8 Ther Thugil	8526 nano meters
1 Eer=	8 Mayir nuni	68 Micro meters
1 Paen=	8 Eer	545 Micro meters
1 Yavai=	8 Paen	0.4365 cms
1 Angula=	8 yavai	3.4925 cms
1 Tala=	6 Angula	8.25 inches
1 Muzham=	24 Angula	33 inches
1 Muzham=	4 Tala	33 inches
2 Muzham=	8 tala	66 inches
Universal height of man	9 Tala	74.25 Inches

(Figure 33: Ancient Spatial measurements. Courtesy – Dr. Ganapathi Sthapati)

I have given the exact word used in Tamil for these measurements instead of translating it in English. Ther Thugil is the dust from chariot wheel, Mayir nuni is the width of a hair tip, Eer and Paen are the lice

eggs and lice. Some of you may jump that most of the units were subjective and would have variations in normal life. I agree but there is a reference point – **Angula** and its exact measure based on which other values are derived backwards to arrive at the value of Paramaanu.

Now if you note the **smallest particle** aka **God's particle / Paramaanu** is **133 nm** in size which is currently under study by the CERN scientists. Nanotechnologists today confirm that the width of a hair strand is about 25000 nm and our ancient texts give the size at the tip of the hair strand (and not the width) as 8526 nm. I see that to be a reasonable estimate when no such precision instruments were available in those days.

One Angula is 11/8 of an inch. This is the fundamental measure which is used in any of the worldly measurements. Now you can see that 6 Angula is 1 Tala which is about 8.25 inches and then comes the most important revelation. **Does nature endow a measure for an average human being's height?**

The answer is yes. **As I said an average human being should be 9 Tala's height and hence the nature endowed height for any human being is 74.25 inches.** This is the ideal height and the variation is attributed to our Karma, hereditary and lifestyle.

Now let me give few tips to find out your height from typical measurements:

- Measure the length of the face (from forehead to chin). Your total height should be 9 times that height. This is the principle of Nava tala. As an extension measure your thigh or legs length excluding the knee and feet and your total height should be 4.5 times that.

- Take your right hand middle finger (No. Don't show it to anyone☺). You would notice that the finger is divided into 3 parts. Measure the length of the lowest part – from the end of the palm to the first subsection. Your height typically should be 54 times this measure. Since this measure for an average man with nature endowed length shall be 1 Angula. Hence your height shall be 54 times that measure.

- The length of the thumb from the base of the wrist should be about 3 Angula and hence 18 times of that should be your height. This can go on and on.

So, to sum up this section:

- Instead of looking them as Rishis or Sages or religious figures if we look at them as scientists in the field of nanotechnology, quantum physics and Astro dynamics we would accept most of the secrets without any prejudice.

- Not just the measure for the height of the man but they had formula for every object and this was the secret of their wisdom. For any astronomical object, they had formulas to measure body's core (width) and also the width of the mantle. The roots of their wisdom lie in understanding that "many' are just a harmonic variation of the "one" subject to a mathematical

proportion. Hence there was no “rocket science” in those days and all of them were as simple as it looks like.

As a wise man said, **“Indians are the most ignorant about their rich past and scientific traditions.”**

Happy reading!

24. TIME = SPACE SERIES. PART 24 – OCTET, OCTAVE AND THE GANDHARVA VEDA (CLASSICAL MUSIC)

Let's start with classical music where Octaves form the fundamental for it. There are seven svaras (Sa, Ri, Ga, Ma, Pa, Da, Ni) which is made into an octave with another Sa after Ni. So it becomes Sa, Ri, Ga, Ma, Pa, Da, Ni, Sa (*Do Re Mi Fa Sol La Ti Do*). The first rule of classical music is "**Shruthi Mata, Layam Pita**", which means **Shruthi is the mother and this corresponds to the frequency or the spatial component and Laya is the Tala component which is a function of time compared as father**.

Tala	Anga Notation	Tisra	Chatusra	Khanda	Misra	Sankeerna
Dhruva	IOII	11	14	17	23	29
Matya	IOI	8	10	12	16	20
Rupaka	OI	5	6	7	9	11
Jhampa	IUO	6	7	8	10	12
Triputa	IOO	7	8	9	11	13
Ata	IIOO	10	12	14	18	22
Eka	I	3	4	5	7	9

(Figure 34: 35 types of Tala. Courtesy: Wikipedia, internet)

There are 7 fundamental Talas in carnatic music and each Tala has 5 different variation based on Jathi so in all there are 35 different Talas as given in the tabulation. These Talas are measured as the "matras" the unit duration of time. There is another concept called Nadai or Gati which we will not touch upon now. But let's look at these 35 variations and can you tell me where the most famous "Adi Tala" is in this 35? Most importantly why it is also called as **"Adi Tala" – which is the primordial rhythm**?

The answer is **"Chatusra Jathi Triputa tala"** highlighted in the table is called as **"Adi Tala"** and it is called so since it gave the most primordial rhythm with 8 time units. But there are couples of more cells where we can see "8" in the table and why these are not called '**Adi Tala**"?

The primordial rhythm has a pattern of **1, 3, 2 and 2** which adds to 8. Further on we will see just the variation of this Adi Tala in anything and everything. Tisra Jati matya Thala has a structure of 3, 2, 3 and Kanda Jati jhampa Tala has a structure of 5,1,2, hence they are not classified as the primordial rhythm.

Let's quickly touch upon the spatial variation or the frequency / pitch aspect of this divine art before we branch off to other topics. The image below gives the 16 levels of Savaras which includes tones and sub tones. The seven svaras become 22 tones based on the frequency variation / harmonics. Here 7 are fundamental svaras and 16 as given below is the most practiced variation and 22 is not popular.

Levels	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Svaras	s	ra	ri	ru	ga	gi	gu	ma	mi	p	dha	dhi	dhu	na	ni	nu	s
Ratio	1	32/31	16/15	10/9	32/27	6/5	5/4	4/3	27/20	3/2	128/81	8/5	5/3	16/9	9/5	15/8	2
Factor	1.0000	1.0323	1.0667	1.1111	1.1852	1.2000	1.2500	1.3333	1.3500	1.5000	1.5802	1.6000	1.6667	1.7778	1.8000	1.8750	2.0000
Freq (Hz)	240.00	247.74	256.00	266.67	284.44	288.00	300.00	320.00	324.00	360.00	379.26	384.00	400.00	426.67	432.00	450.00	480.00

(Figure 35: Svaras and frequencies)

You can note that Sa starts with 240 Hz and the last Sa is 480 Hz doubling the frequency and hence an octave. While Sa has 240 hz and 480Hz levels, the tone Pa (P) or Sol does not have any variation and this is at 360Hz. I am going to correlate the Mayan studies with Carnatic music and instead of seeing the whole spectrum from “Sa”, I am going to see this spectrum from “Pa”.

You would note that “Pa” at 360 Hz corresponds to the **Harmonic osciallator constant number** and the whole spectrum is almost like a Sine wave from 360Hz to 480 hz and falling down to 240 Hz with a uniform gap of 120Hz above and below. All the tones would fall within this 240Hz centered around 360 hz. So the spatial variation in carnatic music can be summed as “It originates at a value (240Hz) and varies by the same measure (240Hz) centered on the harmonic oscillator”. Since the objective is about looking at the primordial rhythm we will not touch any other aspect on this topic.

We will see how this **Adi Tala** is the fundamental pattern / rhythm that manifests in every other art.

As a wise man said, **“Indians are the most ignorant about their rich past and scientific traditions.”**

Happy reading!

25. TIME = SPACE SERIES. PART 25 – ADI TALA, NAVA TALA AND STHAPATYA VEDA (SCULPTURE)

Let's look at how Octet and the primordial rhythm (Adi Tala) that defines Sculpture. Let's recap some of the following:

- The process of evolution starts with Pranava which has aural and visual forms. We have also seen that anything subtle is represented in a 8x8 energy grid and anything gross is in 9x9 grid.
- The fundamental measure with which the particles bond is **Eight or** it's multiple and hence the primordial rhythm is an **Octet.**
- The fundamental measure of time is **Tala** and the **primordial Tala is Adi tala** with 8 units and a pattern of 1, 3, 2 and 2.

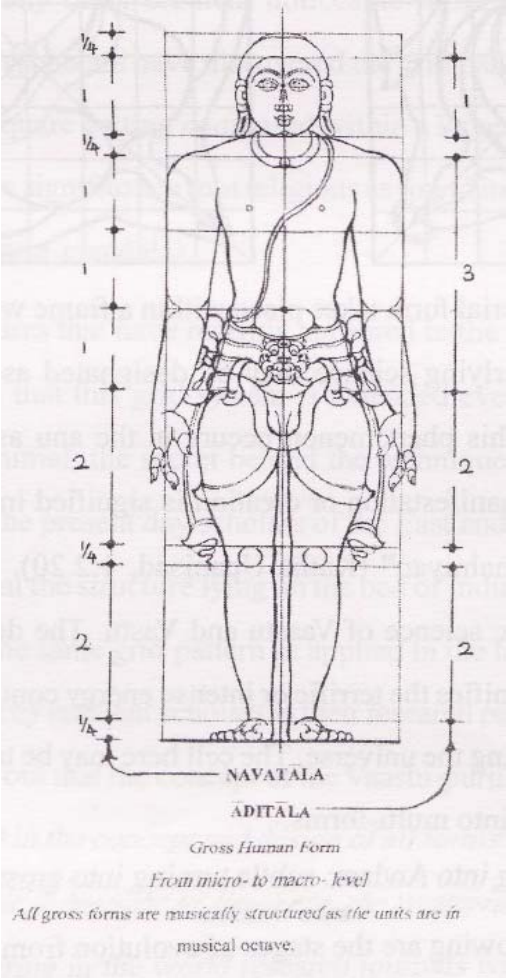

(Figure 36: Human form – Adi Tala, Nava Tala Courtesy: Dr. Ganpathi Sthapati)

Now let's see the measurement rules as to how to make a sculpture of a human being.

- **The overall human height is measured as 9 talas.** Yes the same time measurement is used to measure height. Pinch yourself now, since height is a space variation and not a time variation yet it is measured with a metric of time. This is a secret which is unknown to many and even some of the experts in this field. This is where Time and spaces merges without any difference and this is the fundamental rule with which we have been creating visual and aural structures in the universe.

- **Divide a man's height as 9 units of which head, torso, thigh and legs would fall into the pattern of 1, 3, 2 and 2 which adds up to 8. This is the primordial rhythm – the Adi Tala now as a human form.**
  - Then how 8 became 9? No other branch of Vedas or science tells us this secret so explicitly to my knowledge. **The following parts, Top of the head to forehead, Neck, Knee and feet each measure 0.25 talas and hence add 1 additional tala to 8 and it becomes 9.** So Adi tala which is a subtle version of human becomes Nava Tala which is the gross version of human being. In the process of 8 becoming nine all the joints are formed in the body☺.

  - Let me add one more dimension to this. Our human body has a gross body (Sthula) and a subtle body (Sookshma sarira). **The Sthapatya veda tells us that the gross body is nava tala and sookshma sarira is Adi Tala**.

  - I fell off the chair when I understood this and the linkages. Check if you are still on your chair and maybe you should sit on the floor from now on☺.

<u>Martial Arts and Lord Nataraja's stance:</u>

Let me ask you the following questions here:

- Look at the image of the Lord Nataraja below. If a gross image should have Nava Tala which is a 9x9 grid then why the human image of Lord Nataraja which is a Nava Tala fitted into a 8x8 square instead of a 9x9 square?

- Both in Classical dance and in martial arts why do they ask you to stand in a posture where the knee is slightly or significantly bent. Not all of the stances but most of the basic stances correspond to this why? Let me know if you have received a satisfactory answer for this question.

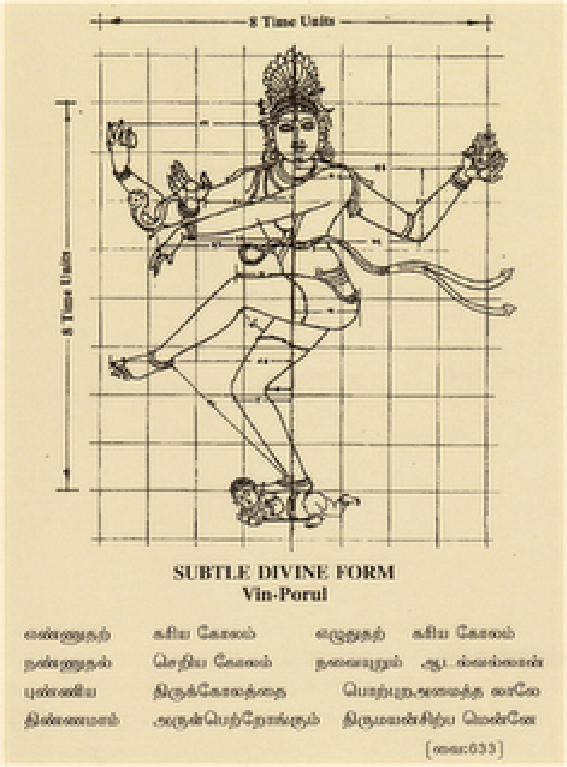

(Figure 5 reproduced)

- The answer to this question reveals one more secret to us.
    a. **In Sthapatya veda each grid line is divided into 10 or 11 or 12 (usually 12) and hence a 9x9 grid has 9*12 = 108 blocks or levels of energy. This may explain why 108 is a sacred number from an energy perspective.** This covers the entire spectrum.
    b. When we create a gross image its always sculpted to 9 talas but when they sculpt image of the gods and in this case Nataraja, they fit the gross image to a 8x8 energy grid to invoke the subtle energies.
    c. How do they fit a 9 tala to 8 tala? The technique is not to change the proportion of nava tala but they ensure that 9 fits into 8 by making the image to bend it legs such that the height reduces by one unit.

- You can notice that Lord Nataraja's right leg is bent to fit the image in 8x8 grid. This is believed to invoke the subtle energies corresponding to that image.
- This is the same reason why martial arts and in Bharatnatyam your teacher asks you to take a basic stance which reduces the height from 9 units to 8 to invoke subtle energies. Of course the other reason is the alignment and focus to Hara / Dantein with that pose.

If I tell you that the science of nature and the associated philosophy codified in Hindu religious symbols are unmatched and amazing then I hope you would whole heartedly agree now. These religious texts and symbols offer the key to unlock the secrets of nature.

So to sum up, so far we have seen one variation of time as **Gandharva veda** that manifests as classical music and the primordial rhythm is **Adi Tala.** Next we saw that the **Sthapatya veda** in the form of sculptures offered the secret of space variation in **Adi Tala and Nava Tala**.

This is where Time and Space were equated with the same measure yet offered completely different arts.

The whole universe has these underlying and un-manifested interconnections and hence the **Hindu philosophy of "That one became many"…** is the supreme truth. Seeing the divinity in everything is the only truthful way of recognizing this science.

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy reading!

26. TIME = SPACE SERIES. PART 26 – SABDA VEDA, CHANDAS & POETRY (MA NISHAADA…)

शुक्लाम्बरधरं विष्णुं

शशिवर्णं चतुर्भुजम् ।

प्रसन्नवदनं ध्यायेत्

सर्वविघ्नोपशान्तये ॥

Shuklaambaradharam Vissnnum Shashivarnnam Caturbhujam |
Prasannavadanam Dhyaayet Sarvavighnopashaantaye ||

Let's start with this Sloka as a sample to see how 8 and its harmonics are integrated with Poetry. In this sloka there are 4 lines (a line is called Pada and Pada means feet in Sanskrit) and each line has 8 Sanskrit Aksharas (Only vowels and vowels with consonants imposed on them should be counted and pure consonants are not part of the count.) This is usually written in 2 lines as shown in English.

This is the most popular way of creating a sloka or poem in most of the Indian languages. This "metre" resonates as 32 aksharas in 4 padas. You may want to correlate this with 1,3,2,2 where the last 2 stands for your feet. So feet (pada) measures $1/4^{th}$ of the overall length of the subtle body (8 units) and 4 padas create the full blown subtle body. So such a constructed poem is a throbbing and vibrating energy body or a living organism and hence carries the power of the words it contains.

If all the padas have equal metre say 8 units then it is called **Sama Vrtta,** and if all are different it is called **Vi-Sama Vrtta** (not equal). **This 8 and 32 is the same as Adi Tala in carnatic music and ashta tala in sculpture. Can you make the connection now?**

In Sanskrit this metre is called as "**Chandas" and in Tamil it is called "Chandam**". **Chandas** is also one of the 4 important Vendagas and is called as the feet of the Vedas. **Let me ask you as to which language the Vedas are available in its primordial form?** The most popular and incorrect answer is Sanskrit. This is the level of awareness we have. Lets quickly look at these important points about Vedas and I shall correlate this with our topic of discussion.

- Unlike other faiths Hindus don't attribute the Vedas as word of god or given by some prophet. We consider Vedas as the breath of god (**"Nishwasitam"**) and not the word which means, Vedas are not created by god, but the breath. If there is no breath that person would not leave and hence it is associated with the very presence of god.

- Vedas are also **Apourusheya** which means it is not created by man and **Anaadi**, that does not have a beginning.

- But you can ignore them stating these are blind beliefs. Let's look at how this correlated with the science. Vedas are created by Pranava and these should be considered as the harmonics of the primordial vibration and nothing more.

- If it is pure vibration then the "which language it is written?" sounds stupid isn't. If it's pure vibration it has to be expressed in "Hz or wavelength" equivalent in ancient India. This is what **Chandas or metre** is all about. This measures pure vibration and anyone capable of tuning themselves to those frequencies have **SEEN** the Vedas and not **created them.** Hence all our rishis are **Mantra Drishtas and not Karthas**.

Difference between Vedas and Poetry:

Vedas contains both **poetic verses (Padya) and prose (Gadya)**. All the poetic verses are called **Chandas** and it complies with the rule as stated above. The difference between normal poetry and Vedas are, Vedas contain tonal variations (high pitch and low pitch) apart from the time, space variations but in Poetry there are no tonal variations. What has tonal variations and are not part of Vedas are called Slokas. So to sum up:

- Vedas are both in Padya and Gadya. What is in Padya is called chandas and it has tonal variations in addition to the time space variations.
- What has tonal variations but not part of Vedas is called as slokas.
- What does not have tonal variation but comply with the chandas rules are called Poetry.

Harmonics and types in Chandas:

We saw every line to have 8 matras / units / aksharas. There are variations and these are the harmonics available.

- **Gayatri –** This is a very special chandas with the mantra where instead of 4 padas, there are only 3 padas and hence it is called Tripada Gayatri. Each pada has 8 Aksharas and hence 24 Aksharas in Gayatri Mantra. This is also the only chandas where a mantra is named after the chandas. Some people write it as 6 letters per line and 4 padas which makes it 24.
- **Ushnik Chandas –** 7 letters per pada and 28 letters in all.
- **Anushtub Chandas –** This is the fundamental and popular one with 8 matras per pada and 32 in all. Ramayana the first poetry was set in this metre.
- **Brihatee Chandas -** 9 letters per pada and 36 letters in all
- **Pangti Chandas -** 10 letters per pada and 40 letters in all
- **Trishtup Chandas -** 11 letters per pada and 44 letters in all
- **Jagti Chandas -** 12 letters per pada and 48 letters in all. This has a subtype called bhujangam which is split as 6-6 and that moves like a snake. (Ex. Subramanya Bhujangam)
- **Shikarini Chandas -** 17 letters per pada and 68 letters in all. In Soundarya Lahiri it is split as 6 and 11 by Adi Shankara.
- **Udkriti Chandas –** 26 letters per pada and 104 letters in all.
- **Dhandakam – above 26 per pada**. **Ex.** Garuda Dandakam by Vedantha Diskshitar.

The reason I have given all the above is to emphasis that nothing in our religious scriptures, literatures are without a grammar, order, form or proportion. Everything confirms to a mathematical proportion.

Just like **Vedas are the breath of god, Chandas is the breath of every mantra.** The mantra is powerful only if it is recited to this metre. This is the reasons some of the poem even if it is not related to religion

stands the test of time. Also if you recite a mantra even without knowing its meaning but as per the chandas then the mantra shall bear its fruit.

"Ma Nishada" …..Origin of Poetry:

Would you believe that the first poetry in this universe started with a curse?

Sage Valmiki saw a hunter who killed one of the birds of a pair which were in love. The sage got enraged and cursed the hunter, ***O, Hunter, may you not fare well anytime as you killed one of pair of the Krouncha birds which were happily engaged in love".***

mA niShAda pratiShThA.n tvamagamaH shAshvatI.n samAH |
yatkrauJNchamithunAdekamavadhIH kAmamohitam.h || (bAlakANDa 2.14)

The above sloka also meant ***"O Lord of Lakshmi, it will bring you eternal glory for having killed a male of a happy couple who lost his head completely in lust.."*** This male is Ravana who lost his head in lust despite being happily married with his wife Mandodari. The other interesting connection I have this sloka with this series is that the **Mamuni Mayan** is the father of **queen Mandodari** and father in law of demon king Ravana.

Once the sage realized that this curse also meant something very auspicious and referred to Rama avatar he wrote Ramayana which is the origin of poetry as known in the world and it is called **Adi Kaavya.** Valmiki Ramayana set in **Anushtub Chandas** which is an octet.

So if you look at both the poetry and classical music composition:

- The rhythm in which it is set is a pulsation of time which confirms to a divine proportion.
- The raga and the pitch variation is a pulsation of space / frequency which again confirms to a divine proportion. We did not discuss about ragas though.
- The words used are divine and we have seen the divinity of the letters and words.
- The meaning of the song / poem usually exhorts the qualities of the god and hence is divine.
- The classical music and poetry invoke the subtle divine energy in the aural form just as much the sculpture (when it confirms to the divine proportion) invokes the subtle energy from in its visual form.
- This is how we see that "**one became many"** and **binding factors** in this process of evolution being the numerals 5 and 8.

Alas! Today, we are the fanatic fans of musicians who lacks morality & humility, who is ignorant of any divine proportion, most of the music we hear is a cacophony and very mechanical, the words are indecipherable and lacks depth, the meaning of the song - if at all any are just suggestive of sexual emotions and nothing else and the dance movements we see are the gyrations of the hip with a great blend of fitness training exercises associated with it. This is not to negate some of the fine works we see even today but to stress that we had such high science and taste which we seems to be losing / lost for no good reason other than ignorance.

As a wise man said, **“Indians are the most ignorant about their rich past and scientific traditions.”**

Happy reading!

27. TIME = SPACE SERIES. PART 27 – ARCHITECTURE – THE ZENITH OF MATHEMATICS (VAASTU)

Just look back in history and see what stands the test of time. Even if a civilization is completely extinct what stand beyond their time is the architecture of the civilization which stands tall as a witness to the richness and maturity of the civilization.

Aintiram states that **"Architecture (Space engineering) is the zenith of the mathematics**" in **"கட்டிட கலையே கணக்கியல் உச்சி**..." This space science is called as Vaastu Sastra in India.

There are few important concepts in Vaastu science which I want to present as below:

- The whole world is made up of **God's particle (Vastu, வஸ்து**) and nothing else. It is this God's particle which actually manifests itself as gross forms (**Vaastu, வாஸ்து**). You would note that Vastu (Subtle) has become Vaastu (gross) by addition of letter "a" and this difference is reflected in our languages too. **When அ / अ become ஆ / आ the subtle becomes gross**. Hence the most important statement for this science is "**Vastur eva Vaastu**", this means **the subtle becomes gross or energy becomes matter or the space becomes earth.** This is purely manifestation / evolution and there is no creation. This has nothing to do with religion but supreme science.

- Since it is all only one energy and it ever vibrates based on the harmonics and resonance, this vibration is called life and everything in this world, be it a living being or a non-living being as per our current definition – everything vibrates. The chair you sit and the vehicle you use are all living beings. **Everything throbs with energy and there is nothing which is a non-living being in this universe.** Without this vibration there would not be any difference between iron and cotton. The difference between particles is essentially the molecular constitution which is a function of its elements and its periodicity. This defines presence or absence of quality and sensory perceptions. This was put very nicely by **Poet Subramanya Bharathi** as **எங்கு காணினும் சக்தியடா**, **Where ever you see its just energy.**

- The above concept is very profound and this is called as **Science in our scriptures since it deals with Knowledge of the space** (**விண் ஞானம்**, Vin-gyan).

- By the same concept when a subtle energy which is in the open space is converted to a gross form like a building then this body / building vibrates based on the design specifications and the material used for that building. It does not matter what is the measure and what is the material used, it vibrates. **When a structure is created with a divine proportion then we breathe life**

into it. Thus the structure becomes a living organism. This is how some of the structure stands the test of time for thousands of years.

- **Vaastu is that science which aligns the vibration of the building with the vibration of the dweller in the building so that both the living organisms (the building and the dweller) are in harmony and resonance.**

- It sounds simple but for this science we need to know includes the vibration pattern of the dweller, mathematics of space engineering, the knowledge of materials and its nature so that we can match it up to create harmony. This is precisely what Vaastu as a science does. Again it has nothing to do with religion. If you Google you would find thousands of Vaastu experts outside India who perceive and pursue this as a supreme spatial science.

- Let us look at the word **"vas"** which is the root. This means to shine; to grow bright, **to bestow by shining upon**, becoming light. **Vaas** is its derivative which means to perfume, an intoxicant, **dwelling place**, to assume the appearance of matter. This is the root for **SriniVAAS**, **SreeVAASan**, **VAASam** in Tamil means living. Most importantly the ability to feel this subtle thing (which cannot be touched) is called **VAASanai (வாசனை, in Tamil it means smell).**

- This spatial science includes knowledge on the following:
    - Nature of soil and material, and the qualities of its energy.
    - Measures for spatial engineering that best resonates with the environment and the dweller.
        - Note that the dwelling unit cannot be compatible to all the human beings universally. This varies with individual to individual and hence the Vaastu compatibility for the house is always seen for the housewife than the man with the assumption that what is compatible to the lady of the house would suit all others.

    - Accurate calculation of time and the position of astronomical bodies. The time engineering merges here with the space engineering. Consider the following to understand this:
        - In some temples you would notice that the sunlight falls on the deity on a specific day / time of the day. This is not possible if the future position of astronomical bodies at a given time is calculated very accurately.
        - When we build a house / temple the inauguration ceremony should be conducted at a specific time. So it's just not Space Engineering but time engineering also.

    - We see that the concept of space and time are not just a continuum but:

        - The measures of time and space merge and results in the same unit measure called Tala. It is Adi Tala in Poetry, Music and the same measure is used in building and sculpture dimensions.

- **Space is created because of the pulsation called Time** and hence the unit time measure (for pulsation) and the unit space measure (result of pulsation) are one and the same. This means the pulsation causes proportional displacement or creation of Space.

- It is the same concept used in meditation techniques. With Pranayama, Dharana and Dhyana you control the pulsation and align with it. In Samadhi you stop the pulsation and hence you are beyond time and space and you reach a luminescent state of resonant non-vibration.

Hence I named this book as **"Time = Space".**

We have seen that each subtle unit is represented in 8x8 energy grid and the gross unit is represented in a 9x9 energy grid. Mayan states that **"Each module or pada within the 8x8 / 9x9 structure resonates with a specific energy.** Based on Space, Time, Light, and Sound coordinates the frequency of vibration has its unique position in the Space/ Time continuum. **This energy level of frequency of vibration is called a luminous body or Devata**. This devata has particular attributes based upon its position and qualities in the Space/Time continuum (placement among the 64 / 81 sub-cubes or padas)".

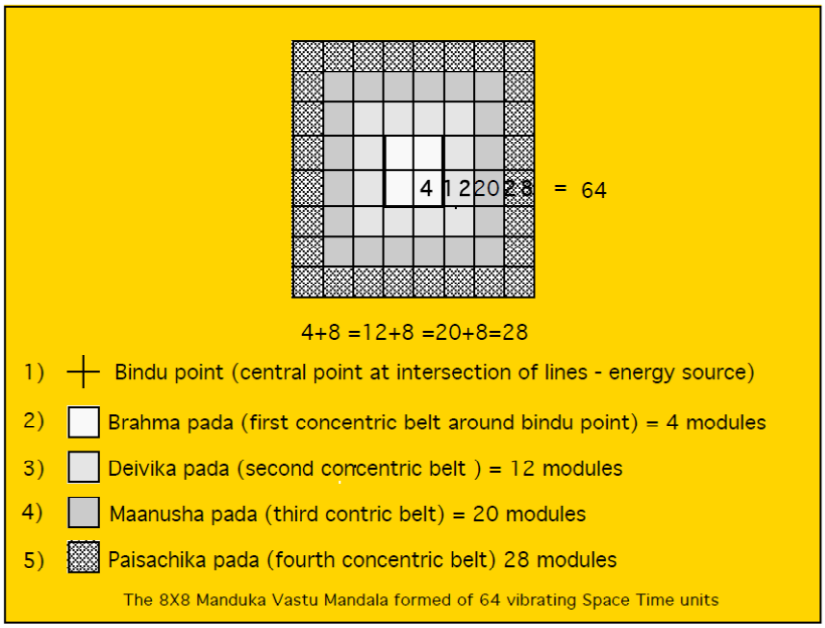

Figure 37: 5 states of 8x8 Energy Grid (Courtesy: Dr. Ganapathi Sthapati)

Now what is evident here in this science is 8 and 5 merges and so does Space and time.

- **Manifestation occurs in additive values of eight and in 5 stages. You can note that the Bindu (Point) has become 4, then 12, then 20 and then 28. (4+8=12 +8=20+8=28 with a total additive factor of 64). Manifestation occurs in sequences of five steps known as the Pentadic Order.**
- **The mathematical calculation which gives form to consciousness / space / subtle matter is called "Ayadi Gananam". We know that Ganam as the additive process.**

Dr. Jessica Marcey in her Fabric of Universe states that:

- The subtle energy point in the center becomes a self effulgent energy generator pouring out waves of energy
- becoming a self spinning stabilized structure of four padas / modules then
- adding eight units of energy to manifest the 4X4 structure of 16 units or modules; then
- adding another eight units of energy to manifest the 6X6 structure of 36 units or modules; then
- Adds eight more units culminating in 64 units or modules strung concentrically around the Bindu point or central generator.

So a central point with 4 concentric square belts around, each has its own frequency, vibration and energy characteristics evolving into a 9x9 unit as a gross matter. While this knowledge is significant of itself, when these phenomena are viewed in light of material manifestation as built space in architecture, the significance becomes stunning and profound.

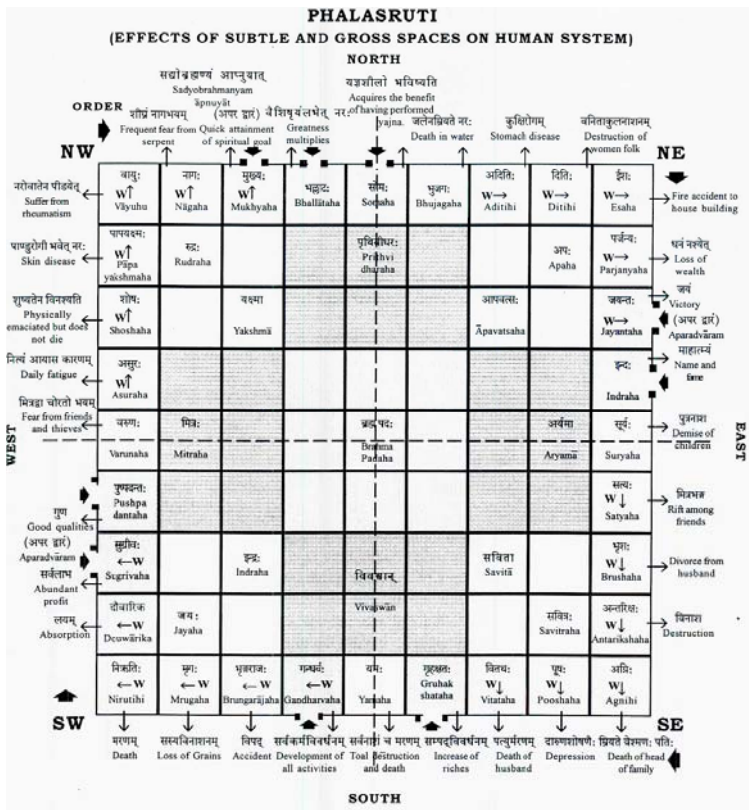

Figure 38: 9x9 energy grid with corresponding energy levels for each grid.
(Courtesy: Dr. Jessica Marcey, Fabric of the Universe)

So, to sum up this section, we have seen that how every inanimate thing in this universe is still a living being and how with the spatial science we can pump throbbing energy into a building. This is the supreme science where Time and Space merges. This is the 4th sacred art we talked about which is a manifestation of the visual form of Om.

As you would have noticed I have avoided talking about rituals and rules here but focused on the concept and philosophy. When we talk about rituals there are very many variations and we get into an unnecessary argument that whether it is rational or superstitious. Since most of the arts have become commercialized, the person's qualification and his intentions are always questionable.

The objective of this book is to highlight the scientific aspects of the universe in a small way and emphasis that our culture is built on this science. Be it language or arts or religion all are built on scientific facts. They all were nourished and nurtured in thousands of Temples across India which is the container and protector of this subtle science and energy.

Let's see some more interesting aspects of this in the next section.

Happy reading!

28. TIME = SPACE SERIES. PART 28 – CAPTURING THE DIVINE ENERGY – SQUARES & CIRCLES

It is told that the sanctorum of Lord Ranganatha's temple at Sri Rangam is circle from outside and square from inside. Why?

- Subtle energy is represented by 8x8 square grid and the perimeter of the square is 4r and the area of the square is r*r. When each grid length is 1 unit then r = 8, so perimeter is 32 and area of this square is 64.
- Gross energy is represented by 9x9 square grids and with the same measurements perimeter is 36 and area of this square is 91.

It has been an architect's dream to create and capture subtle energy in a gross structure. This is fundamental objective of spatial engineering. How do you go about to achieve this? It looks that they found that they would take the help of a circle either outside the square or inside the square to achieve this. Remember almost every yantra has a square and a circle component in it.

The measurements are so taken such that either the perimeter or the area of both the circle and the 8x8 square are matched. Most of the Hindu temples follow such rules to invoke the subtle energy in a gross structure like temple. This is one of the well kept secrets and this is the reason each and every temple is said to interact with your subtle body differently when you visit it.

This is why Lord Ranganatha's sanctorum in Sri Rangam temple is a circle from outside and square from inside. This secret is called as **Squaring a Circle**. This is all about to creating divine energies and this is the science that is implemented in all the Hindu temples which are built as per the Sastra. You need just basic math knowledge and patience to understand this supreme secret and I shall give below 2 techniques to match the area or the perimeter of the circle with that of the 8x8 square.

<u>Perimeter match:</u>

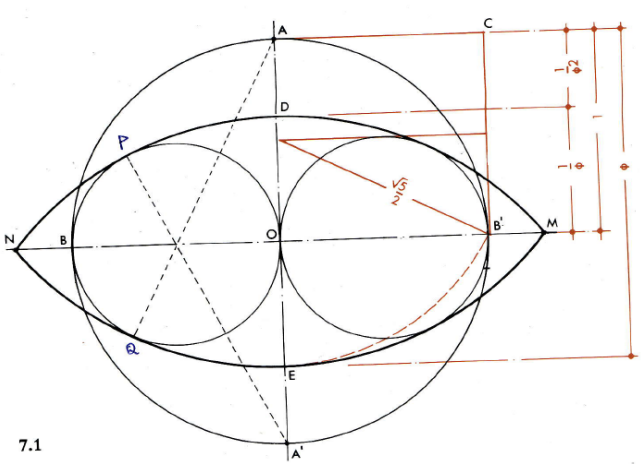

- Let's look at the image of a circle of unit radius. The **area of the large circle is π** (πr^2) and the **circumference is 2π**. Here r =1.

- Draw 2 circles inside as shown with half the radius. The area of each circle is π/4 and the **combined area of both the circles is π/2**. The circumference of each circle is π and the **combined circumference of both the circles put together is 2π**.

Figure 39: Squaring a Circle (Courtesy: Dr. Robert Lawlor, Sacred Geometry)

- Just note that when a larger circle divides itself as 2 smaller circles the area is halved but the circumference is the same. **This gives the first philosophical metaphor that "One has become two which are bipolar yet non-dual". This is one of the fundamental principles of Advaita and also in Chinese philosophy. This bipolar non-dual force is the basis of life and is represented as male / female and Yang / Yin.**

- Now draw 2 arcs NDM and NEM from A' and A with the radius as A'P and AQ as shown in the dotted line. You would note that point D and E would divide the radius of the circle by divine proportion – $1/\Phi$ and $1/\Phi^2$. **Radius of the arc AE is Φ. The Yin Yang symbol is based on this principle which embeds the divine proportion in it.**

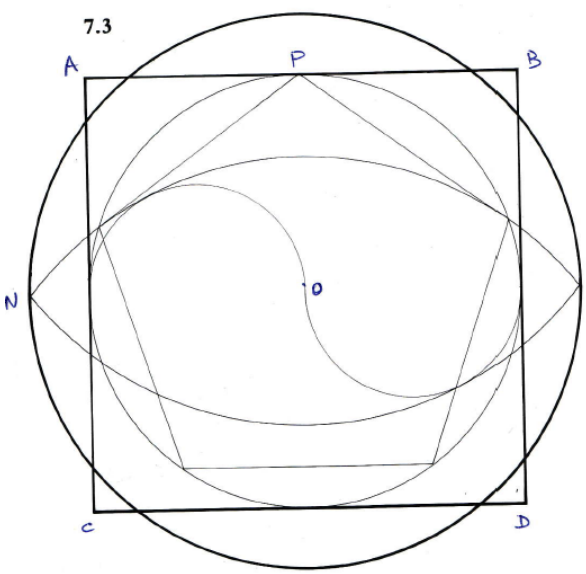

- Now let me draw a square ABCD around this circle (Fig 40) where the side of the square is the diameter of the circle which is unit 2. Here OP =1, AB=BC=CD=DA = 2. **The perimeter of the square is 8 and the area of the square is 4.**

- Now draw a circle with O as the center and NO as the radius as shown in the figure. Here NO = $\sqrt{\Phi}$. You can take this figure as such if you find it difficult to follow but for those who are interested, the derivation to calculate radius "NO" is as below:

Figure 40: Squaring a Circle 2 (Courtesy: Dr. Robert Lawlor, Sacred Geometry)

  - Consider a right angle triangle OPN. We know OP = 1 and PN which is the radius of the arc = Φ. Hence as per Pythagoras theorem $PN^2 = OP^2 + ON^2$ which is $\Phi^2 = 1+r^2$. Let us say the radius is ON = r.
  - So $r = \sqrt{(\Phi^2-1)}$. We know Φ is 1.61803399 so **$r = \sqrt{\Phi}$.**

- We have got a larger outer circle with a radius **$\sqrt{\Phi}$** and hence the perimeter should be **$2\pi\sqrt{\Phi}$. This is numerically equal to 7.9924576, which is equal to 8. Now we have created a structure where a square whose perimeter and a circle whose perimeter are the same.** This technique is not limited to India but used in the same way for pyramid construction.

- **This is the perimeter match between 8x8 square grids and a circle around it**.

<u>Area match:</u>

- Vaastu has an easier way to get this done. Draw a circle inside a 9x9 energy grid whose diameter is equal to the side of the square. If each energy grid length is 1 unit, then side of the square is 9 units and the radius is 4.5 units.

- The area of this circle is πr^2 where r=4.5 and hence the area of the circle is 63.64 which is almost equal to area of the 8x8 square with unit grid length as 1 unit.

- This is the area match between a circle and 8x8 square. So as per Vaastu every building is divided into 9x9 grid and the energy level of each grid is used to design the living space.

Capturing the direction of Subtle energy flow:

The subtle divine energy flows is as per the diagram given below. It starts from the center and always flows clockwise. That is why Hindus always stick to clockwise flow of movements - be in their temples or anywhere else. This clockwise flow of movement is captured in the sacred symbol Swastik. Here 1 is the source / Moolam, 2 is Kaalam (Time), 3 Seelam (Rhythm), 4 Kolam (Form), 5 (Universe) Gnalam.

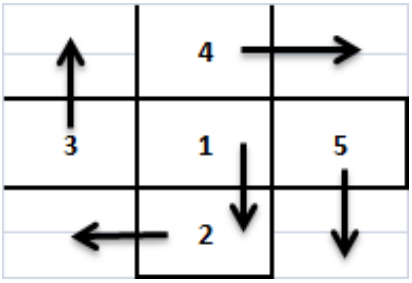

Figure 41: Clockwise flow of subtle energy

Figure 42: Swastik symbolizing energy flow

Relationship between √2, √3, √5, Φ and π:

- Now let me draw the connection between √2, √3, √5, Φ and π. Understanding this relationship is orgasmic and nothing less. If you think they are all some random numbers which cannot be fixed to their 10th decimal and not related to each other, just see the following relationship.

  $$\pi = \Phi^2 \times 6/5$$

  Philosophically 6/5 is the relation of a hexagon to a pentagon and the other way to express this relationship is

  $$\Phi = (\sqrt{\pi} * \sqrt{5}) / (\sqrt{2} * \sqrt{3}).$$

- This goes to prove that we did not just knew the numerals but divine fractions and proportions including their linkages. I am convinced, there is not even an iota of superstition in our temple and idol worship but they are supreme sciences codified and left for our benefits.

- The temple of **Sri Rangam** dates back from Ramayana, which is Treta Yuga that is 800000+ years back as per Hindu Scriptures. This is our rich past and supreme science is embedded in our culture and codified in thousands of temples across nook and corner of the country. Why should

we ignore this? We have a lot more to offer this world which is struggling to understand the nature of nature.

As a wise man said, **“Indians are the most ignorant about their rich past and scientific traditions.”**

Happy reading!

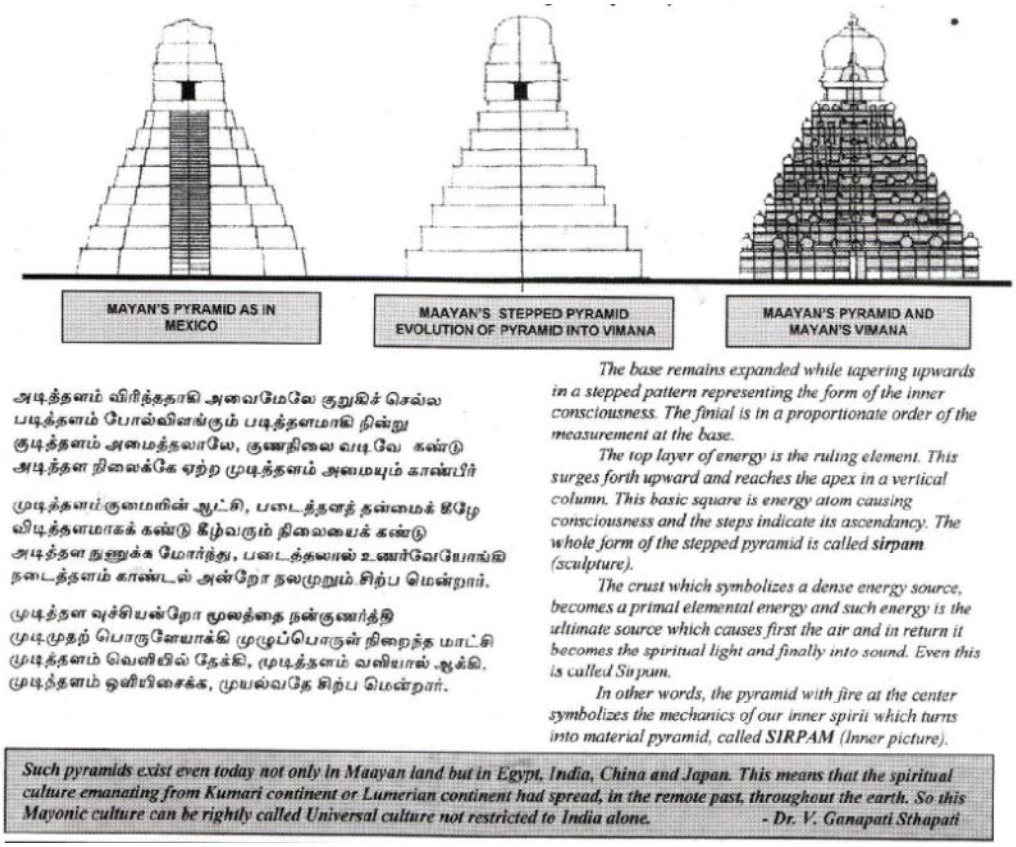

Figure 43: Similarity between Indian temples, Pyramids. The Tamil text states how the structure should be built. (Courtesy: Dr. Ganapathi Sthapati)

29. TIME = SPACE SERIES. PART 29 – HEAVEN & EARTH – LORD NATARAJA & LORD RANGANATHA

Let's stay with Lord Ranganatha and see the relationship between him and Lord Nataraja. Would you be surprised if one is the mirror image of the other? Look at the majestic picture of Lord Nataraja below. Wonder why this is always made in metal and not in wood or earth?

Figure 6 reproduced.

In Pancha bhoota (Space, Air, Fire, Water, Earth) Metal is always associated with Space and Wood is associated with Air. This system is reflected well in the Chinese system and it was not any different in our Vaastu system either. Since Lord Nataraja signifies Akasha tatva, **(Vin porul)** he is always made in metal – Copper or Gold or Bronze or a mix of it. The statues which were ancient had a generous amount of gold giving a luminescent look about the statues. The art and science of moulding metals to create divine forms with precise proportion dates back to thousands of years in India and the western experts think that this is a recent phenomenon. This is a complete surprise to the western world since they cannot believe that such sophistication existed before.

Dr. Ganapathi states, *"Lord Nataraja also signifies the primal image being expressive of the secret of creation in the process of which formless becomes instantaneously endowed with features and of perfect form. This is the reason why the statue of Lord Nataraja is called as **Silpa**, the primal image and everything else which is sculpted in this universe is called as **Pratima (replica)** and the original and one and only sculpture is the image of Lord Nataraja***"**.*

Mamuni Mayan states, *"Bhumih pradhana vastu Syat"*, means Earth by virtue of being the very basic support of all things, this is the primal and dominant Vastu". Earth and space are manifestations of each other in the cyclical process of evolution. They both should always be considered to be in unison. This vibrant, energetic, manifest earth energy (**Prithvi Tatva)** is called as '**Vishnu**".

In Vaastu satra, the Vaastu purusha is Lord Vishnu and understandably Vishnu is invoked as Vaastu purusha in Srirangam temple and offered a seat in the heart of Lord Ranganatha even today as a ritual.

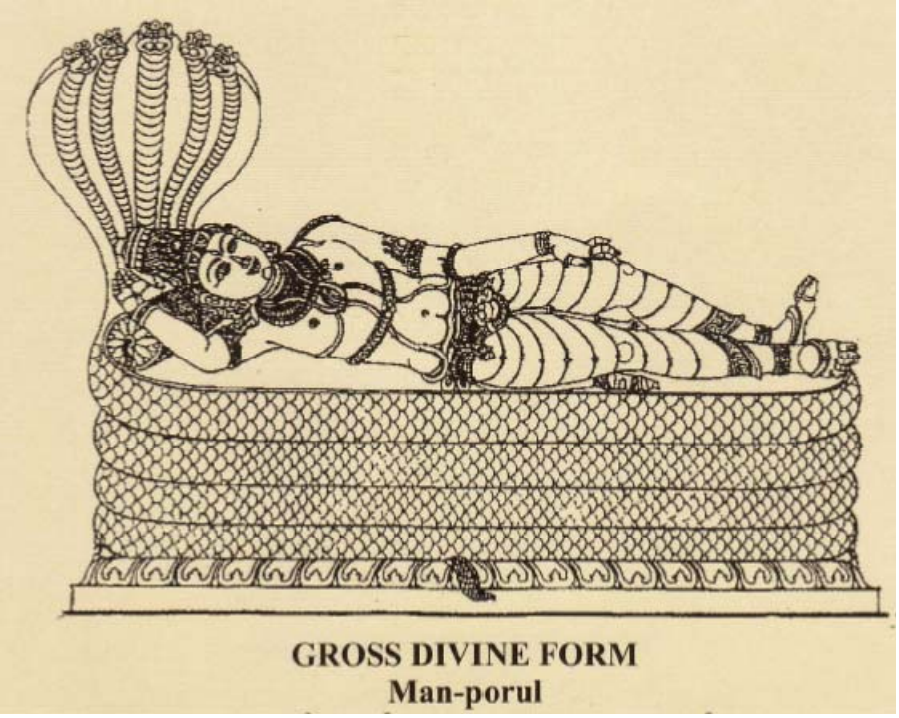

Figure 44: Lord Ranganatha in the reclining pose

Lord Ranganatha represents manifest earth energy **(Man porul)** and hence is always made out of seasoned earth only and it should be properly painted too. He is never to be made of metal. This earth form does not support frequent mobility and symbolizes stability and immobility. **This is the reason when Vibhishana kept the idol of Lord Ranganatha down at Sri Rangam it could not be moved.**

The energy that is in available in every universal form is represented as Vishnu and hence he is called as **Antaryami**. Once the subtle becomes grosser the vibration is reduced and the grossest form would not have any creative pulsation in it. It would still have the vibration based on its nature which ensures that it retains the form and shape. But it does not have any creative pulsation and it has reached the zenith of evolution. **This zenith is characterized by Lord Ranganatha in the reclining pose**.

The creative pulsation (Space) is the dance and the zenith of manifestation is a reclining posture (Earth).

As we have seen, Lord Nataraja carries **Light in his left hand** and **sound in his right hand**. Lord Ranganatha carries **Chakra representing light in the right hand** and **Conch representing sound in the left hand.** The principle that the primal substance (space) has manifested as the universe (earth) and both of them are mirror images of each other is reflected in both the images.

In Chinese texts the Yang energy is associated with Heaven and the Yin as earth. Now associate the same heaven with Shiva, Earth with Vishnu and Tao with the God's particle - with some of the text below from **Lao Tzu's "Tao te Ching"**

"The Tao that can be told is not the eternal Tao.
The name that can be named is not the eternal name.
The nameless is the beginning of heaven and Earth.
The named is the mother of the ten thousand things.

Something mysteriously formed, Born before heaven and Earth.
In the silence and the void, Standing alone and unchanging,
Ever present and in motion, Perhaps it is the mother of ten thousand things.
I do not know its name. Call it Tao.

Man follows Earth. Earth follows heaven. Heaven follows the Tao.
Tao follows what is natural."

To sum up in the words of Dr. Ganapathi Sthapati:

- **Both the temples Chidambaram and Srirangam are south facing temples.**

- **Lord Nataraja signifies Akasha Tatva, outer space, macrocosm, subtle unmanifested energy is the Vastu purusha, is always in dancing pose, circumscribed in 8x8 square and made of metal.**

- **Lord Ranganatha signifies Prithvi Tatva, inner space, microcosm, manifest gross energy, is the Vaastu purusha is always in reclining pose, depicted in a circle or a 9x9 grid and made of earth.**

- **Lord Nataraja represents energy with matter and Lord Ranganatha matter with energy. In the equation $E = mc^2$, Lord Nataraja represents E and Lord Ranganatha represents mc^2.**

- Both these temples are a 'must see" and a "periodic see" types and you would be amazed that the qualitative change in your mental state even if you don't pray inside the temple but spend some time sitting or walking in the premises of the temple.

- **Both these temples are perfect symbols of ancient science codified for the benefit of the society and left for generations withstanding the test of time.**

Figure 45: Sri Chakra – The Supreme shape in sacred Geometry

Chidambaram and Sri Rangam should be ground zero for any lab that wants looks into the secrets of space and time as they represent supreme science as much as they represent spirituality. We now see that science was the basis of our spiritual faith unlike it being 2 completely different aspects today across the world.

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

May we be blessed by the divine power to unravel unknown secrets about the nature!

Happy reading!

30. TIME = SPACE SERIES. PART 30 – TEMPLES AND IDOL WORSHIP

Let us forget Hinduism, its symbols and names of god for the time being and consider these aspects as pure science from a nanotechnologist and cosmologist called Mayan.

We have been told that the universe is full of luminescent particles and this particle manifests itself because of the primordial pulsation. We have had a sneak peek into the geometry and the mathematical proportion which is used in the creation of many things. We know that the universe rhythm confirms to a mathematical code to the extent that we can create divine energies in a temple based on that science.

If time is pulsation of consciousness and if it creates, sustains and destroys everything, then time is the architect sculpting the universe and every object in this universe should be a sculpture of time and this concept is very beautifully captured in ***"Jagat Sarvaram Silpameva'*** *meaning the entire universe is nothing more than a shilpa / sculpture (and it latently conveys that Time is the Shilpi).*

If all the above things are right then is it not right to say that "Man created the concept of God" or "Man can create divine energy around him"? Let me sum up my thoughts as below:

- The sages and rishis were essentially scientists and understood the secret of nature very well. They were understandably masters in **nanotechnology and cosmology.**

- They knew that "**One thing"** with which they could understand the nature and science of all other things in this universe. This is obviously supported by the mathematical knowledge they had.

- As per Vedas nothing is created by god including the Vedas, but universe is the manifestation of god. They also understood that man is the most evolved of this manifestation. This is why they created all the god forms in the image of a man.

- Be it language, poetry, classical music, classical dance, sculpture and architecture it was the manifestation of this divinity that was the underlying link. Sacred geometry and sacred proportions were used to generate the subtle energy that took us closer to divine.

Hindu temples were created to capture all these aspects in one place and which could sustain and grow for the benefit of mankind.

- Secret of nature heard through the vibrations of Vedas were codified as supreme science and weaved into a philosophy called **Sanatana Dharma.**

- Architecture of temples confirmed to divine proportions and space - time engineering was accurate to capture sunlight and moon light at the same position for thousands of years. The design of the temple cleaned the subtle energies and points of the human body.

மூலாதாரக் கணபதித் திருமேனியின், படிமமான இலக்கணம்:

गुणरवि नयन रुद्रं द्वादशं षट् षडांशं
अनल रसगुण भागं केश वकत्रं च कण्डं ।
हृदय उदरमेढ्रं ऊरुजानुंच जंरवा
पदमिति उदयमानं पञ्चतालं गणेशम् ॥

3,12,2,11,12,6,6,3,6,3 [=64 துடிப்பளவுகள்] முறையே, கேசம், முகம், கழுத்து, மார்பு, வயிறு, மேட்ரம், தொடை முட்டி முன்கால், பாதம் ஆகியவற்றின் உயர அளவுகளாகும். இவை பஞ்ச தாள கணேச உருவத்தின் [உறுப்புக்களின்] உயர அளவுகளாகின்றன. [இது கண்யம் என்று சொல்லப்படும்].

பட விளக்கம் பின்வருமாறு:

விநாயகர் [ஐங்கரத்தன்]

Figure 46: Ganapathi Idol (Courtesy: Dr. Ganapathi Sthapati)

The sloka above in Sanskrit gives the measure of different parts of this Idol which would confirm to total 64 units (resonance of 8). Hair (3), Face(12), neck(2), Chest(11), Stomach(12), Belly &Pelvis (6), Thigh(6), Knee(3), Legs (6), Feet (3). Total 64 units. Just as much a Sloka with right metre and letters becomes a living organism, an idol with right proportions becomes a living organism.

- Divine Idol forms confirmed to a mathematical proportion that invoked subtle energies within and around us. This is where the external forms were used to create energies internally to a human. **This is the basis of idol worship. If it is scientific to create a form with divine energies based on mathematical proportion then idol worship is the supreme proof for that science.**

- **This supreme mathematical law is called as Dharma (nature's law) and the unfolding of that law is the Karmic theory of cause and effect / law of karma.**

- Poetry, classical music and classical dance are intimately linked to this Hindu temple culture. Adi Tala and octaves were used to create subtle energies in poetry using words, and the same tala maana is used in classical music with rhythm and raga, in classical dance with light and sound and in sculpture as a visual form.

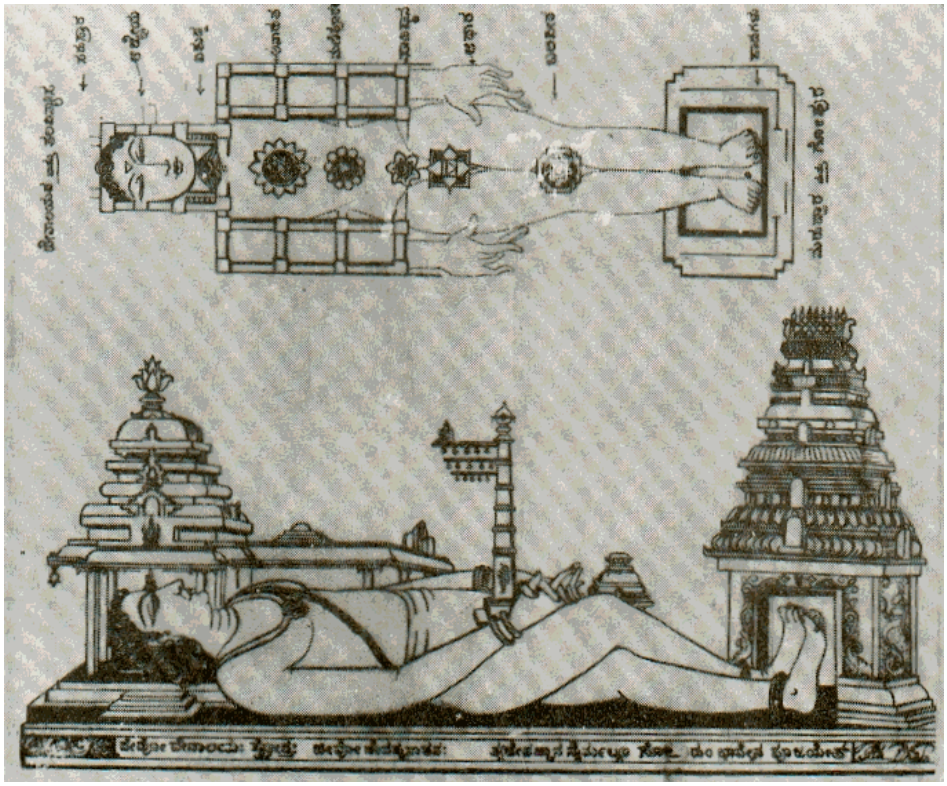

Figure 47: Human body as a representation of a temple
(Courtesy: http://www.salagram.net/sstp-mgpuja3.html)

A Hindu temple is a divine and yogic representation of a human being with the Deity in the temple representing the God as indweller in humans and all beings. In a temple the feet represents Rajagopura, the hands represent Praakaara, the abdomen represent Mandapa, the heart represents Antaraala and the crown of the head represents the sanctum sanctorum (garbha griha). The temple is used as a reminder that our inner spiritual journey is through internal yoga to realize the indweller God. This analogy is shown through the representation of various chakras namely Moolaadhara to Sahasraara in the body to various locations in the temple.

- It may be of interest to note that the same harmonics of 8 are reflected in every other domain. For example, if you have been practicing Pranayama then your master would have asked you to practice breathing based on some counts. The most popular counts are 6(inhale), 3 (Exhale) or 7(inhale), 2 (Exhale). If you notice this count 9, this cleans up your gross body. Advanced Pranayam students may be asked to stick to 1 (Inhale), 4 (Retain), 2(Exhale), 2(Retain outside) or as a variation 1,4,2,1 or 1,3,2,2. The counts which add up to 8 clean the subtle body.

- Till few decades back the fundamental dimension for money in India was "**Ana"** called as **Eight Anas (6TL̇L6ŌTIT)** and this was equivalent to Rs. 0.5 as the fundamental measure.

- Thus a **"Poetry is an idol in aural form and a building is a frozen music"**. A Poet by the way of his mental frequency has first become the poem itself and then the actual poem was created in its aural form and an artist by the same frequency has become the idol first and then he gave a shape to the idol externally through this hands. This is very beautifully given as ***"Raso vai saha, So Vai rasikaha", which means he (god) is the enjoyer and he is the artist.***

- All of this reflects the supreme philosophy that **"Oneness in all and everything is just a manifestation of that one thing"**.

- Now in this light understand the meaning of this Upanishad prayer, *"Aum Poornamadah Poornamidam Poornaath Poornam Udachyathe, Poornasya Poornamaadaaya Poornameva Vasishyathe". This means God is perfect (infinite). This Universe is also perfect (infinite). If perfection (infinity) is taken from anything perfect (infinite) what remains is still perfect (infinite).* Isn't this is the actual reality today?

- Everything scientific is philosophically, mythological and ritually well interwoven that proves that Sanatana Dharma is the most ancient and supreme representation of science and nature's secret in our possession. Our temple worship which integrates all this science, 5 sacred arts with language and Math is the standing example of our understanding of the nature of god.

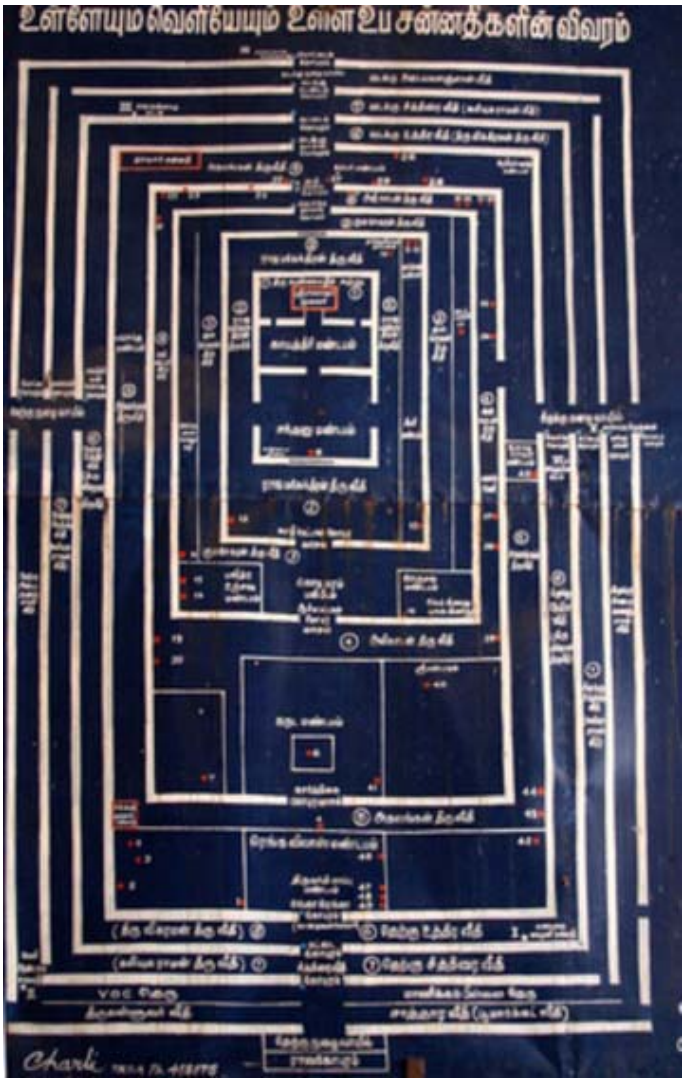

Figure 47: Layout of Sri Rangam temple with 7 Prakaras

It is the same Sugarcane but an elephant eats it from the field directly, a young adult peels the skin off and chews it, if a kid has to eat then someone has to peel the skin and cut it into pieces and an old man without teeth needs it to be made as sugarcane juice. Depending on one's ability to chew and digest the food has to be processed.

Same way depending on one's mental ability to grasp the supreme truth it has to be processed and presented. If someone is mentally well evolved then they can be fed with Upanishads and he can meditate on the formless Brahman. To a young adult Upanishads may not be palatable directly but they may have to start with Upavedas and Vedangas to mature to a higher level. For the less evolved kids, Itihasa and Purana like Ramayana and Mahabharata with stories may drive home the point and they can start with Shlokas and mantras. But for the least evolved it has to start with a personal deity with name and form, bhajans and songs to invoke the concept of Bhakthi.

In all the four cases temple culture forms the lowest common denominator. Even the most evolved relish the arts and architecture in the temples. We should be proud of our rich cultural and scientific

heritage and be passionate about the science and philosophy and be rational about rituals and symbolisms.

Image / Idol worship is not deplorable or despicable. This is the highest scientific form of worship which enables us to see face to face the one which is beyond reach of sight and speech. This kindles devotion, community development and helps one to climb the steep walls of spirituality in the initial stages. Every religion in this world has some image or idol as symbolism to achieve this objective.

An idol is a god in form when made with the science of divine proportion and seasoned material is the highest product of our intelligence till today.

It should however be noted that this idol worship should not be lost in the din of rituals which does not reflect the very philosophy it had come to symbolize. So the advice I follow is *"Be passionate about our culture but be rational about the rituals.*"

The advancement of science can progress rapidly when the western scientists who are objective and empirical, partner with the pundits in India and learn the science of the subtle from our scriptures and temples. For this to happen we need to learn our own scriptures and past which is not possible without learning our mother tongue and Sanskrit. Else in the near future we may have to import knowledge of our culture and rich past from the western world.

As a wise man said, **"Indians are the most ignorant about their rich past and scientific traditions."**

Happy reading!

31. TIME = SPACE SERIES. PART 31 – MAYAN & HIS WORKS

Mahamuni Mayan was the father-in-law of Demon King Ravana and is referred in both Mahabharata and Ramayana. He is attributed with building the palace for Yudhishtar in Indraprasta and also the architect for Sri Lanka which Ravana ruled. His son Nalan helped Lord Rama build the Ramasethu – the bridge between India and Sri Lanka. He is believed to have lived in the **Ilamuridesam** popularly known as **Lemuria continent (Kumari Kandam**) which spanned 4500+ kms from Sri Lanka to Antartica connecting current Australia, Africa and Americas. Check out http://www.sacred-texts.com/atl/tll/index.htm

Understandably when this land mass was consumed by the sea their clan moved to different parts of the world including Guatemala, Egypt, and to current south Indian region. This explains as to how we find common science across India, South America and Egypt.

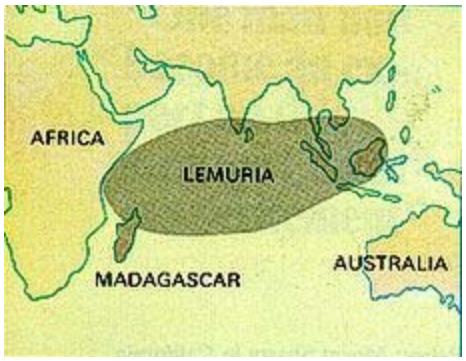

Figure 48: Kumari Kandam depiction

He has written books in both Sanskrit and Tamil and I am going to produce the list of technical works he has created and look at the contents of a specific book called Surya Siddhanta. Just the list of works and also the topics in Surya Siddhanta is amazing, highlighting the depth of science we had at that time. http://www.youtube.com/watch?v=PZKiCpFisoY

The Surya Siddhanta

The most ancient treatise on Astronomy is a treatise authored by Mayan. It is called *The Surya Siddhanta*. Included in this treatise are the following chapter topics following:

- The Motions of the Planets
- The Places of the Planets
- Direction, Place and Time
- The Moon and Eclipses
- The Sun and Eclipses
- The Projection of Eclipses
- Planetary Conjunctions
- Conjunction of the Stars
- Risings and Settings
- The Moon's Risings and Settings
- Certain Malignant Aspects of the Sun and Moon
- Cosmogony, Geography, and Dimensions of the Creation
- The Gnomon
- The Movement of the Heavens and Human Activity

Figure 49: Mamumi Mayan

Mayan is also attributed with the start and spread of Temple culture in India. The song below in Tamil states that since Mayan sat under the Banyan tree and taught this science of universe and also of the sacred arts, so that every town was endowed with Temples for social betterment. Because he was from the southern region and also he sat under the Banyan tree, he is also equated with Lord Dakshinamoorthy.

ஆலமா மரத்தின் கீழே அருள் மயன் அமர்ந்ததாலே
ஆலமா மரத்தின் கீழே அருட் கலை வளர்ந்ததாலே
ஆலமா மரத்தின் கீழே அறிவர்கள் வளர்ந்ததாலே
ஆலயம் ஊரும்தோறும் அமைந்தன செழிக்கநன்றே!!

The Mayan says in his Pranava Veda verse one:
*"Om Light and Om Sound are the Primal Source of all manifest forms. Om Light is aroused by its own effort in a state of disorder and appears as a flame. The state of Om Light and Om Sound in Space is a magnificent luminous six – faced Light form that is called "**murukoli**". The transformation of Om Light and Om Sound through the five stages is concealed in the five fold knowledge, of which, this is the first. This process of transformation of disorderly Om Light and Om Sound into orderliness is found in all five fold material forms."*

Sage Veda Vyasa says in the Bhagavatam, *"eka eva pura vedo pranavha sarva vangmayha" (9th skandha, 14th chapter, sloka 48 of Bhagavatam).* This means that there was only one Veda called Pranava Veda. It is believed that Sage Vyasa created 4 vedas from this Veda since he believed that the oncoming generations would not have the mental strength to master everything.

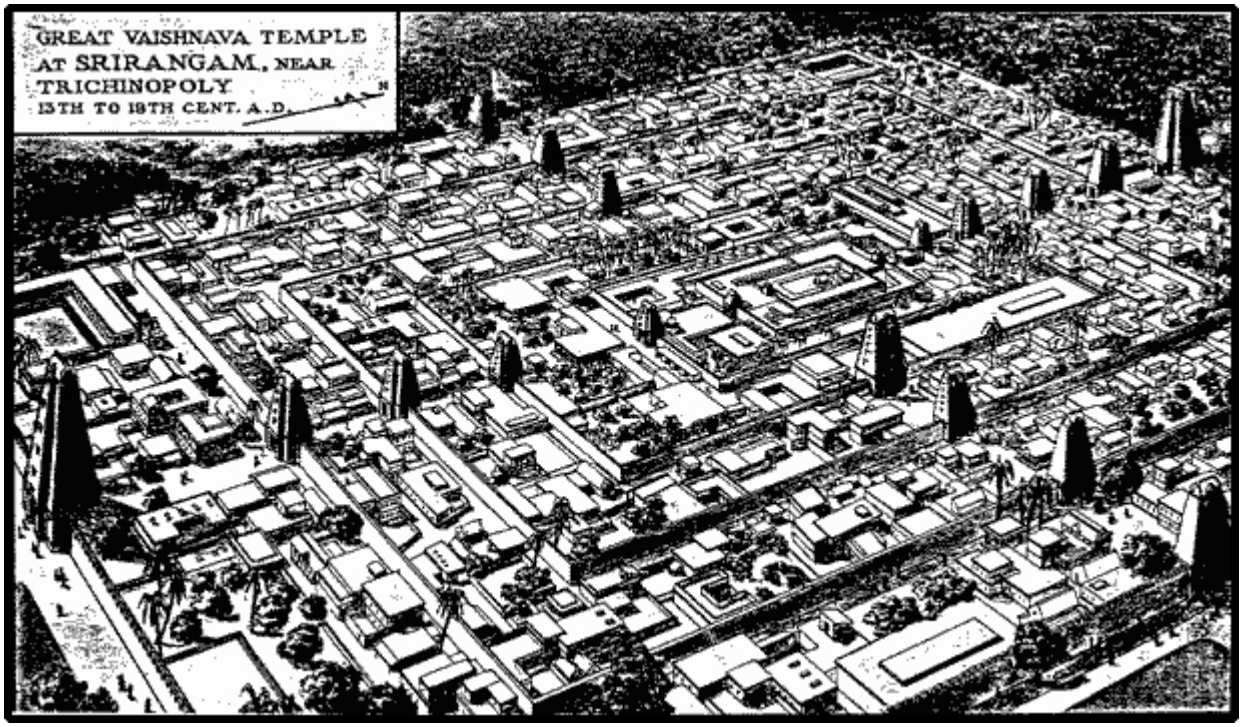

Figure 50: Aerial view of Sri Rangam temple with 7 Prakaras

Technical works

The following are technical works written by Mayan and represent the 12 vowels of the Tamil language:

- Ovia Chennool - Treatise on Drafting and Painting
- Sirpama Chenool - Treatise on Iconometry
- Kattida Chennool - Treatise on Architecture
- Nilamanai Chennool - Treatise on House Building based on quality of land
- Manainila Chennool - Treatise on Land based on the nature of house building
- Baniyal Chenool - Treatise on Astro Physics
- Perunata Chenool - Treatise on Divine dance
- Muligai Chenool - Treatise on Herbs
- Ganitama Chenool - Treatise on Mathematics
- Arakkala Chenool - Treatise on Ship Building
- Vinkala Chennool - Treatise on Space Ship
- Elisai Chennool - Treatise on Science of Music

MAYAN, in Aintiram *states that:*
"There exists an order in the Universe - subtle universe, and material universe. This power is attributed to the consciousness of the cosmic space as well as of the inner space of the animate beings. This consciousness, by its personal effort to express its own inner feelings, causes a kind of vibration or pulsation in the inner space, resulting in energy-grids. The vibration or pulsation, being the causal element of all these events, is called KAALA. This is actually the force of energy aroused by the inner consciousness, causing waves and contributing to the growth of living forms. This KAALA resides in all living beings. So, space is the offshoot of the vibration of the primordial energy. This is how the space was born. All forms of nature are manifest forms of subtle energy. For all to get manifested, the force is KAALAM. This wave-form frequency realm is the creative element of the universe."

There is no other treatise that we have in our possession today which is dated 10000 BC that depicts the secret of nature so explicitly and gives the unmanifested interconnections and mathematical proportions between everything in the universe.

As Dr. Ganapathi Sthapati rues "Unfortunately most of the Tamil experts don't understand the science in these texts and hence these books are idling without anyone extracting the truths from it". In the next few generations when we are less equipped in our own mother tongue we may lose this treasure completely just like the many we have lost so far.

Hence the first step we need to ensure is even if you are not equipped well in your mother tongue please make sure that your kids can read and write it well. This becomes our most important duty. And I find it worrisome when someone is indifferent to the fact that they can understand their mother tongue but cannot read and write.

With some significant efforts we can and we should prove that this man who said, **"Indians are the most ignorant about their rich past and scientific traditions."** is not wise any more.

Happy reading!

32. TIME = SPACE SERIES. PART 32 – CONCLUSION

What I have understood in a nutshell is as follows:

- The inner being of both - the individual and the universe is luminescent consciousness which has the ability to become aware of it. This luminescent consciousness is called by various names but it is essentially the only existent Vastu in this world. This Vastu manifests itself as time, space and spatial forms.

- ***"Aanor aniyaan mahato Mahiyaan!"*** this means what is in the atom is the same makes up the universe. That which is present in the atom is the Space energy and the meaning of the word Akasa is stated as ***"Aa kashayati aakasa ha!,*** That which imparts light to others or make others shine is called Akasa". This means that Space Vastu is luminescent. I am stressing the aspect of luminescent again and again for you to start perceiving God as light.

- Pranava is the causal element which triggers this evolution process and this manifests as visual and aural forms. Pranava results in the primordial pulsation and this pulsation is triggered and sustained by a divine progression and proportion which is called **Absolute time**.

- Absolute time creates Absolute Space. These 4 things – Absolute time, absolute space, Aural Pranava and Visual Pranava combine together to form spatial forms and hence this universe.

- The Vastu as God's particle, its characteristics, the Pranava, the pulsation, the rhythm, the progression, its proportion and the resultant energy states – all the scientific facts, theories and processes are captured and codified as a Dharma which is called as Hinduism today. The science behind this subtle energy is reflected in various art forms that includes Poetry, Classical music, dance, Sculpture and building architecture.

- All these manifestations are harmonics of 5 and 8 differentiated by the Golden proportion / God's ratio to reflect the various states of consciousness. **This intrinsic order is called Dharma and the cyclic nature of this evolution is the Karmic code embedded in the universe**. **Nothing in this universe is superior to the Dharma and Karmic code.**

- The divinity manifests in us and the space within us is nothing different from the macrocosm. Consciousness which exhibits itself as a state of being because of our mental vibration can evolve to a higher plane to devolve back into the luminescent core.

- Sanatana Dharma popularly today known as Hinduism is the repository of this supreme secret not just as a philosophy but integrated with every stage of our life. This can be understood better only if we can give due respect and attention to the language and scriptures, our spiritual tradition interwoven with arts and architecture that contains these treasures.

- The temple culture & Idol worship that we have symbolizes the best of science known to human beings and we need to understand this and preserve this in the best possible manner.

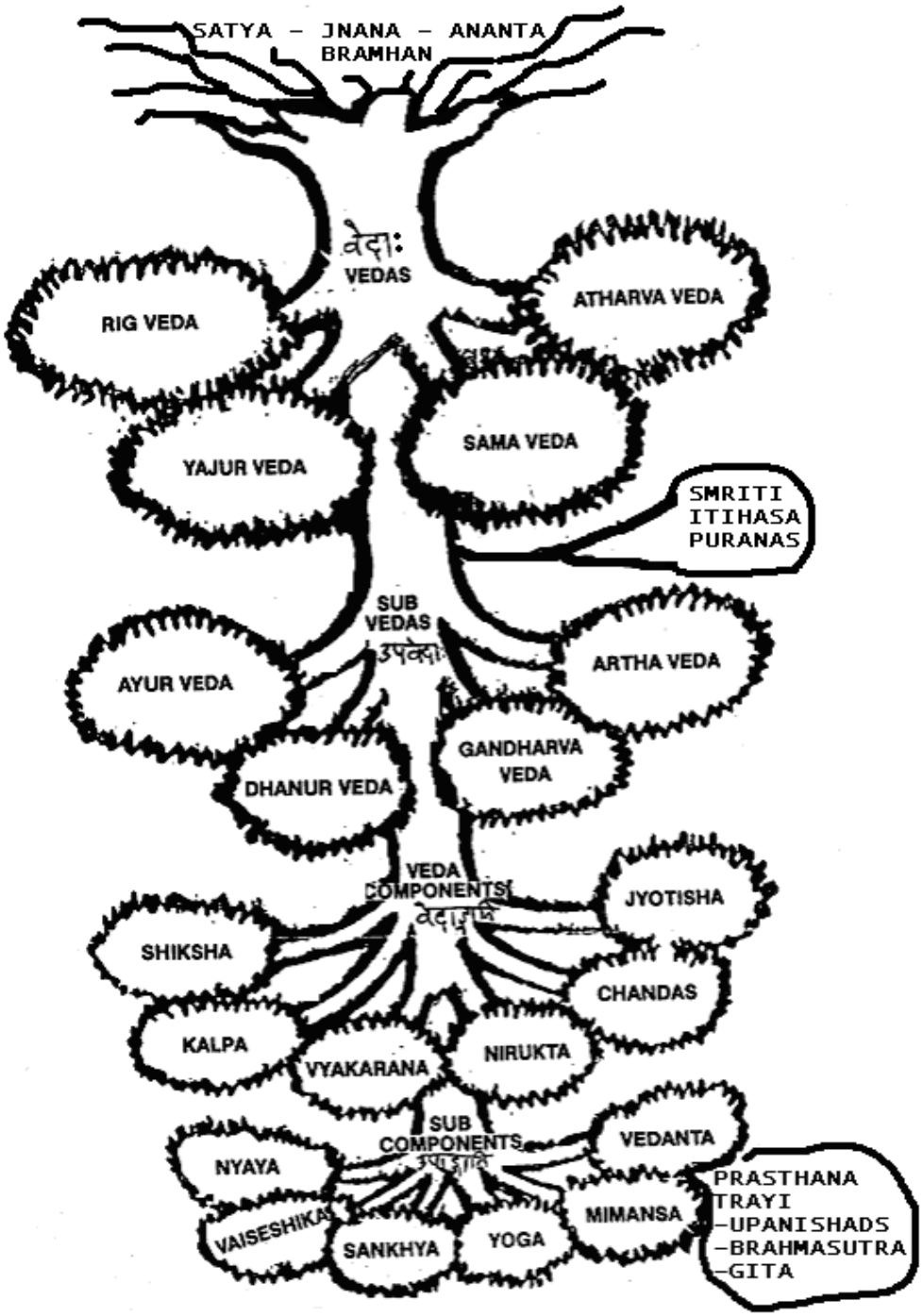

Figure 51: Vedic Knowledge as an inverted tree with Brahman as the roots signifying that everything has a common root. (Courtesy: Internet)

(Figure 52: Goddess Sarasvati. Courtesy: Internet)

She is the Goddess of speech, music and knowledge. She carries the rosary beads (akshamala) represents the alphabets of a language (Sanskrit), the musical instrument (Veena) and Vedas as palm leaf manuscript in her hands that denotes the knowledge. Thus we can see that idol worship signifies deeper scientific aspects of a common root between Language, Music, knowledge and arts.

Figure 52: Musical instrument Veena as a representation of Human Body (Sarira veena) (Courtesy: Internet)

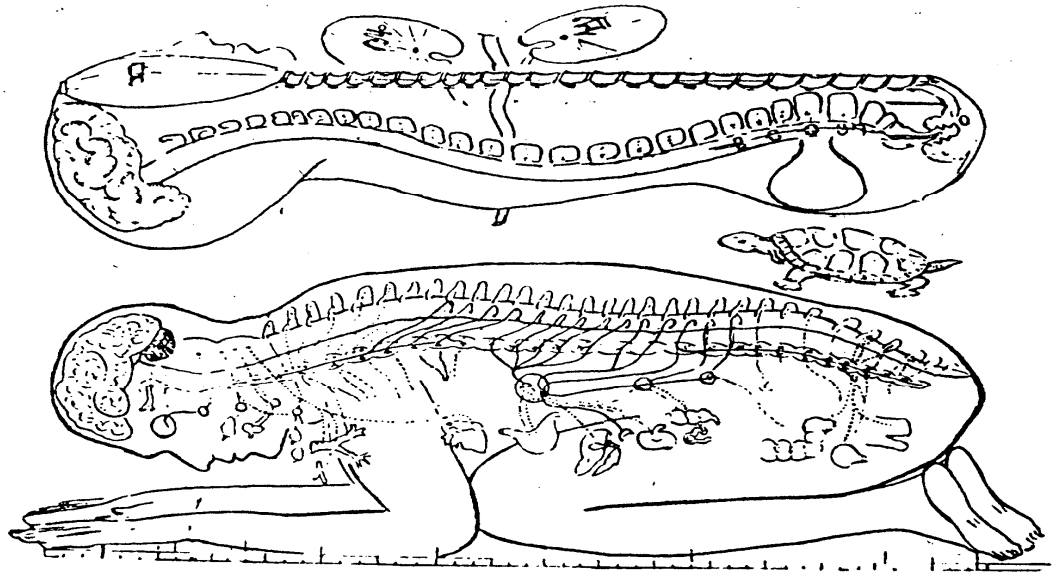

I am happy to note the coincidence that this book has 32 chapters with 108 pages – both being key universal numerals. Chapter 19 (the golden mean of this book) deals with the Golden mean or God's ratio of nature is again coincidental.

I would like to thank you for reading this book. I would like to state that I am neither adept in any of the topics discussed in this book nor an expert in any of the arts including the languages Tamil or Sanskrit language.

A curious mind driven by my passion to understand the underlying aspect in all things and my liking to reading has helped me to compile this book. My exposure as a student to Chinese martial arts, Indian yogic studies, Pranic healing and Siddha philosophy helped me to connect of the points I had articulated. Any authoritative statements in these books reflect my belief in the topic or from the author / teacher from whom I subscribed it and it is certainly not reflective of my abilities.

I am open to constructive criticisms on any of the topics and I can be reached at the mail ID shared in the first page of this book. My only request to you is *"Please share this book or parts of this book without any hesitation to your friends and family and help us dispel the ignorance about rich ancient Indian culture"*.

I shall end this book with some of my favorite quotes of Dr. Einstein.

"My religion consists of a humble admiration of the illimitable superior spirit who reveals himself in the slight details we are able to perceive with our frail and feeble mind. That deep emotional conviction of the presence of a superior reasoning power, which is revealed in the incomprehensible universe, forms my idea of God. We still do not know one thousandth of one percent of what nature has revealed to us."

Satyam Param Deemahi!
May we meditate on the supreme truth!

TIME & THE TECHNOSPHERE

The Law of Time in Human Affairs

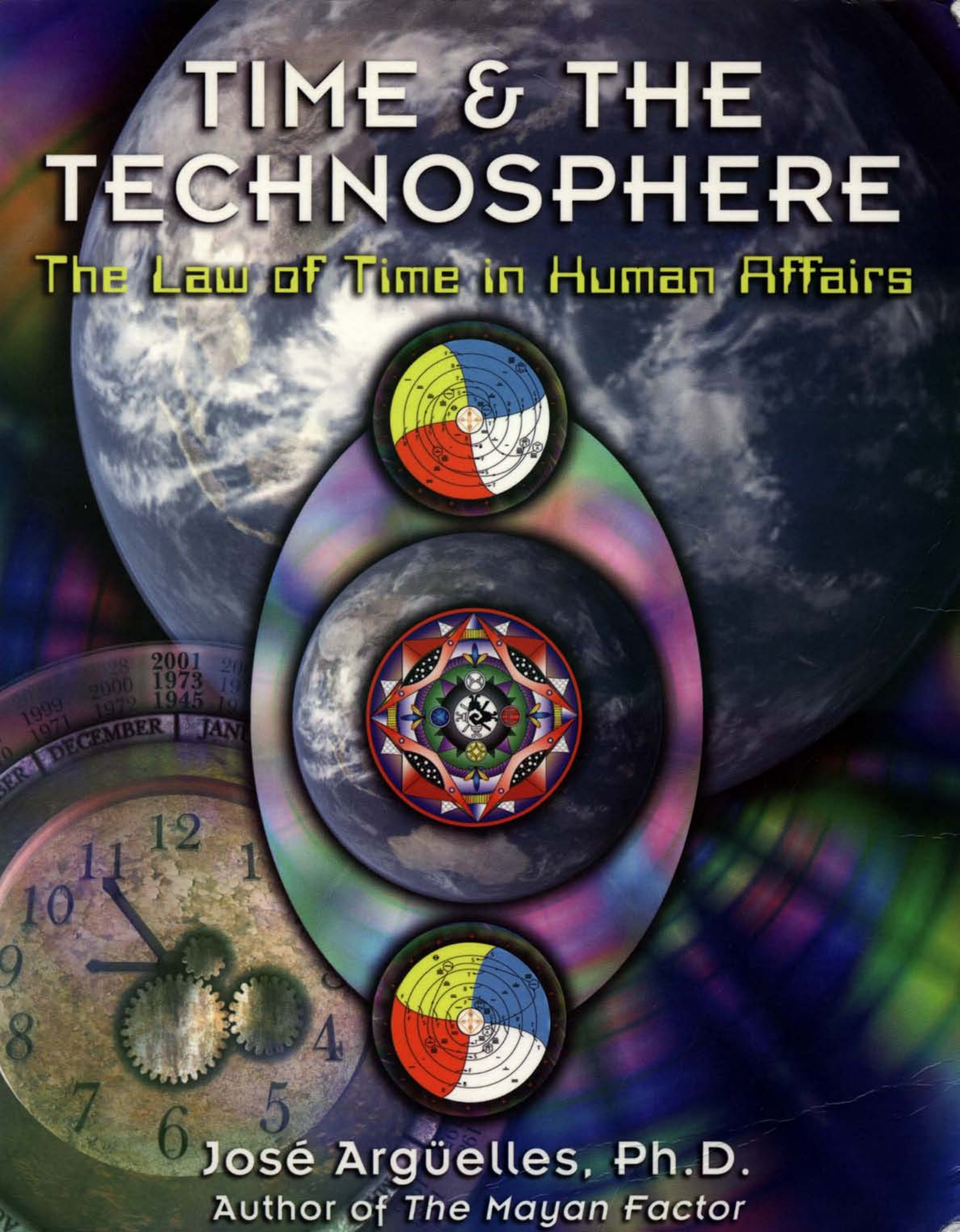

José Argüelles, Ph.D.
Author of *The Mayan Factor*

MAYAN STUDIES / NEW CONSCIOUSNESS $20.00

"Time and the Technosphere *makes a vital contribution to the great paradigm shift in human cultures that is now accelerating. There is a higher dimension of natural time inscribed in the cosmos and a natural calendar that would help humanity mature into the awakening global consciousness that is now essential for future sustainability and well-being. This book is an important contribution to the awakening event that is now emerging on a planetary scale."*

ASHOK GANGADEAN, PH.D., Professor of Philosophy, Haverford College

In *Time and the Technosphere,* José Argüelles presents a groundbreaking study that distinguishes the natural time of the cosmos from the artificial mechanistic time under which we currently live. Argüelles defines the actual nature of time as the frequency of sychronization. Applying this Law of Time to an understanding of the entire system of life on Earth, he shows that in order to not destroy Earth's ability to sustain life, we must change our definition of time and adopt a natural harmonic calendar based on the 13-moon 28-day cycle. Until the creation of the Gregorian calendar and the 60-minute hour, most of humanity lived by the 28-day cycle of natural time. The adoption of artificial time has subjected us to a 12:60 time frequency that governs the entire global industrialized civilization—the technosphere. With the collapse of the Twin Towers on September 11, a fissure was created in this artificial technosphere, opening up the noosphere (Earth's mental envelope).

Humanity has a golden opportunity to leave the strife of the past and enter a time of peace by adopting a harmonious natural calendar that will repair the damages caused by the irregular tempo of technospheric time. Our last best chance to adopt this natural time and step into the bright new future promised by the galactic shift of 2012 is the Great Calendar Change of 2004, a new discovery based on the author's mathematical research into the Mayan calendar first begun in his landmark work *The Mayan Factor.* In *Time and the Technosphere,* Argüelles reveals the clear distinction between third-dimensional astronomical time and the fourth-dimensional synchronic order of the Law of Time, which holds enormous potential for the future of humanity.

PHOTO BY BRIAN VANDERBROEK

JOSÉ ARGÜELLES, PH.D., works full time on behalf of the World Thirteen Moon Calendar Change Peace Movement and is president of the Foundation for the Law of Time. He is the author of numerous works, including *The Mayan Factor, Earth Ascending,* and *Surfers of the Zuvuya.* He lives in Oregon.

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The Law of Time in Human Affairs

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I

Time and the Technosphere

This book requires some attention from You. It is a complete, coherent, story for Humanity, on Earth, in the Universe. It is a radically different story than what is commonly disseminated by and through our global, dominating, culture. There is no need for You to *believe* this story, or any other. Trust yourself. trust your Self To say you must go into this with an open Mind, is a grand understatement. Start with trust. Simply allow the thoughts and concepts you read to "stew" for awhile. Make some headspace for them and have patience for what may grow there. It is a beautiful life...

Notes on the electronic PDF version

- There are errors! Nothing major...only superficial...
- Note the color plates (mentioned thorughout text) are the last eight pages.
- The page numbers Are the page numbers.
- Use Acrobat's bookmarks for navigation!

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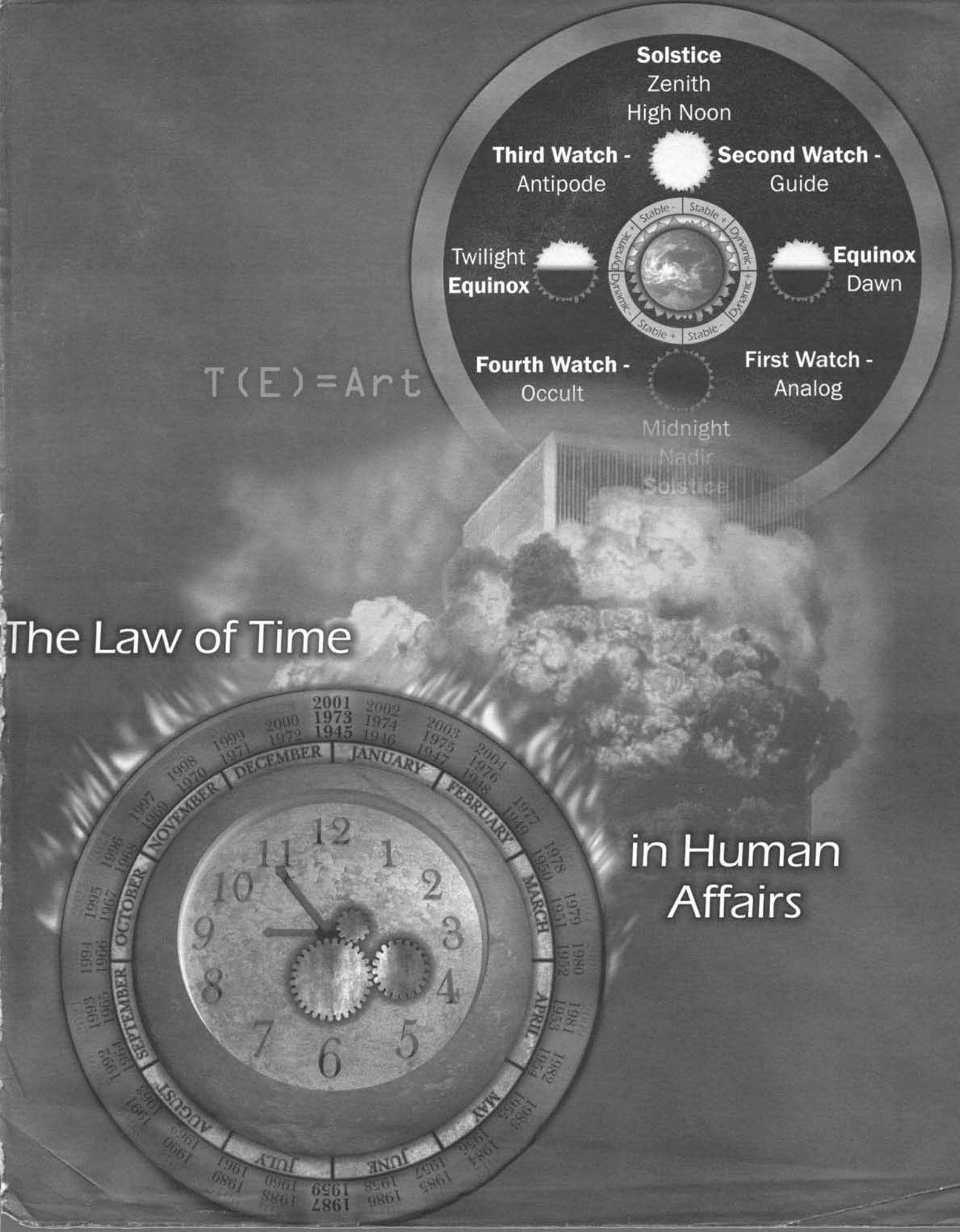
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High Noon
Third Watch -
Antipode
Second Watch -
Guide
Twilight
Equinox
Equinox
Dawn
Fourth Watch -
Occult
First Watch -
Analog
Midnight
Nadir
Solstice
T(E)=Art
The Law of Time
in Human
Affairs
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER

This book is dedicated to Adam J. Lewis—at work on the eighty-eighth floor of the South Tower when his mother called him from Spain as she watched television reports of the first hit on the North Tower—and to all the others who were sacrificed on that day. May the truth prevail, that the greater mystery might be made known—forever.

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Acknowledgments

AS ANY AUTHOR knows, to write a book and see it through to completion, from initial inspiration to final conclusion, is never an easy task. Though we are all guided, if we so choose, by the Supreme Creator, still it is one's Earthly helpers that must be counted first, even before oneself-for without their aid, where would one be?

First and foremost of my Earthly helpers whom I wish to acknowledge is my wife and faithful companion of twenty-one years, Lloydine Bolon Ik, my constant helper and chief inspiration of all I do. The faith and trust she put in me at times when all we had was blind faith are a touching memorial to a soul who has always believed that love is the greatest truth.

Assisting us greatly during the time since we arrived in Oregon and have continued to dedicate our lives to the fulfillment of the prophecy of Pacal Votan and the Great Calendar Change is our devoted helper and assistant Stephanie South, the Red Queen, Red Electric Serpent, who conscientiously read and edited this text in its final form, helped in numerous details, and so kept me from ever bogging down.

Of equal trust and value is that one from the immemorial rainbow to whom I owe so much, Kin 19, David Rinck, "the stalwart," whose enhancements of my artwork are ingenious and awesome. All three of these people share one thing in common: absolute belief in and dedication to the Law of Time as a living reality that gives breath to all we do.

I must also thank the incomparable Spectral Skywalker, Mark Comings, whose mind has been of inestimable value to me through our many memorable background discussions on time in modern physics in relation to the Law of Time. In this regard,

I would also like to mention Irina Eganova of the Sobolev Institute of Mathematics of the Siberian Branch of the Russian Academy of Sciences, Novosibirsk, for her rigorous approach to N. A. Kozyrev-may she smile well when she reads this book.

For their unconditional support I would also like to honor and thank Brian and Deborah Haight of the Foundation for the Law of Time, and all the many friends and beloved kin of the Planet Art Network everywhere, but especially to the Russian kin who so ably understood the Law of Time and opened up gold mines of knowledge and friendship in the Russian Academy of Sciences in Novosibirsk, as well as the great pristine valleys of Altai, where the shamans await the next installment of *The Mayan Factor*.

Spirituality is at the core of the biosphere-noosphere transition, and in this regard the beings I have to thank are without number, yet some especially stand out and deserve mention: my Tibetan teacher, the Sakyong Dorje Dradul Chogyam Trungpa Rinpoche, through whose cremation he entrusted me with all; my son, Josh, who opened the doors of the fourth dimension for me so that I would never be satisfied with less; and Mother Tynetta Muhammad, who showed me the way of the Holy Quran with the guidance of the mystic master FM, and who introduced me to the great work of Dr. Rashad Khalifa, whose breaking of the Quranic nineteen code led to his martyrdom, leaving me to fulfill what he revealed.

The creation of a book, the coming into manifestation of an artistic conception, is a complex process involving numerous other eyes and minds in order to bring the effort into its final published form. In this process two people have stood out deserving of mention. First of all, there is Michael Moynihan, White Galactic WIzard, who very patiently and carefully copyedited the book-always with an eye on maintaining and enhancing the original artistic vision-and who stood by the integrity of its vision through the entire editorial process. His work was complemented by the efforts of project editor Lee Awbrey, Blue Lunar Eagle, who took on an increasingly engaging role and personality as we brought this book to its final stages. I am especially appreciative for her inspiration to rework the Preface and Chapter One, which I gladly did, and which I feel speak more immediately to the reader of this book. Thank you both, and may the success of this book redound to your consummate care for the truth.

Finally I would like to honor and thank my children: Tara, the golden one, my grandson, SamuelJoshua Sheps, andJeff of Engine Company Number Nine in Phoenix; also Paul Mecklenburg, who has always held the faith in our work, and Heidi Mecklenburg, that her dream of the Unicorn Princess may become true once again.

Preface

A Brief Literary Autobiography

Time and the Technosphere: The Law of Time in Human Affairs is essentially a prolonged set of meditatipns, occasioned by the one most powerful and overwhelming event of our time, the 9-11, the Inevitable Event of September 11,2001. Subsequent events may overshadow this one in horror and magnitude, but it was this event in particular, the destruction of the World Trade Center towers, that sent a signal that something very profound had occurred to change the way we think of ourselves and our future.

In presenting these meditations and reflections in the form of a book, I am painfully aware of the limitations of this medium in the information age. Keeping in mind that the volume of information has increased five times in the past century-with much of that increase occurring only in the past decade-I am very reluctant to put anything down to be published in the form of a book. I was raised well on the writings of Marshall McLuhan and his definitions of media and how they affect our senses. It is altogether obvious that a book in your hand is not the same as reading a text on a computer screen. A book is actually something made to last. Of course, the computer has made it possible and easy for virtually anybody and everybody to write a book, and so we encounter one of the great hazards of the information age: the decline in discrimination and the criteria of excellence. Who can now tell what is worth reading or not? These reflections, too, are very much to the point of the grand theme of this text. If a book is meant to last, how long will this book last? It should last until the New Time has established a new order of reality on this now anguished Earth. Whether or not destruction and the total collapse of civilization will occur first, we do not really know. That is a matter left to the Divine Mind of God alone.

Nonetheless, it is with faith that we continue on this Earth at this time. A pressing

voice told me to go ahead and to write this book, regardless-but then, this is how I have always done it. Those who are at all familiar with any of my earlier books, will find that *Time and the Technosphere* is but a continuation of themes that have provoked me since I first considered literature as a medium of communication. It is important to know where the author is coming from, and how he got to this particular point of reflection. In this regard, *Time and the Technosphere* is the organic result of a lifelong pursuit of a study of the nature of art, time, and history. This study has been woven together by a dialectical process that defines the evolving nature of consciousness. So, for those who are interested, herewith follows a brief literary autobiography, the better to understand my point of view.

My earliest book, *Charles Henry and the Formation of a PsychophysicalAesthetic (1972),* states the grand theme of a holistic science that unifies body and mind, sense and nature, the harmonic pursuit of which has been at the root of all my endeavors. This pursuit was amply demonstrated in my second book, *Mandala* (1972), which, as a root text of the counterculture, was an artistic, philosophical, and cosmic plea for a harmonic resolution to the process of history. It is a sign of the times that *Mandala* is no longer in print, but instead a book bearing the same title, but which does not even include the original Mandala in its bibliography, is in print with the same publisher. Amnesia is one of the side-effects resulting from information overflow with no discrimination. Unfortunately, cultural amnesia is always accompanied by an increase in trivialization, and thus we arrive at the mediocrity and sensationalism of the present moment.

My next book, *The Transformative Vision: Reflections on the Nature and History of Human Expression* (1975, 1991), took the aesthetic and unitive themes of the first two books to the next stage of my visionary analytical process, elaborating on the meaning of time, history, and cosmos. In rereading the later chapters of *The Transformative Vision,* I am struck by their prophetic accuracy, as well as their sense of impending tragedy. It is hard to believe that only 26 years have gone by since that book was first published and now we are plunged into the maelstrom of what was then thought to be the worst scenario possible. *The Transformative Vision* also defined human consciousness as the cerebral-neurological dialectic of psyche (aboriginal, primal intuitive art) and techne (civilizational, rational science), emphasizing that only in their absolute synthesis would there be a harmonic resolution to the problem of history. Seen in this light, the technosphere represents the extreme, one-sided triumph of techne, while terrorism is the expression of the absolute repression of psyche. The crucial question then arises: how will we ever attain a balance or harmony?

Investigation of the ongoing dialectic of consciousness was continued in my next effort, the philosophically synthesizing work entitled *The Feminine, Spacious as the*

Sky (1977), which was written and artistically produced with my previous partner and wife, Miriam Tarcov, who also co-authored *Mandala* with me. The feminine aspect represents a deepening reflection of the psychic, intuitive side of human nature. Expressed through a whole range of images, symbols, and philosophies that describe both the aboriginal root and the final flowering of human consciousness, it is this feminine aspect that has been smothered by the historical process, resulting in the technosphere. Why and how did this occur? These questions drove me to the next stages of my visionary investigations.

From the beginning of my pursuits I have been moved by my intuitive awareness of our intrinsic wholeness as humans, and the knowledge that this wholeness is a reflection of the wholeness of Earth, the solar system, and the cosmos itself. Although this perception of reality is nowhere within the domain of the shibboleths of Western scientific thought as it has developed since Descartes, I have also come to understand that Western scientific thought is highly provincial, racially biased, and-because it is not informed by a perception of wholeness-incapable of solving the actual problems of life. In fact, Western scientific thought has been one of the key factors leading the human race onward to its great act of self-destruction-a self-destruction employed through the instrument of technology.

In my next book *Earth Ascending: An Illustrated Treatise on the Law Governing Whole Systems* (1984, 1988, 1996), I was able to make a profoundly radical break with the restraints of the Western scientific and academic modes of thought. Combining the artistic and aesthetic qualities of *Mandala* and *The Feminine, Spacious as the Sky* with the philosophical and scientific concerns of *The Psychophysical Aesthetic* and *The Transformative Vision,* I define and describe the human situation as a function of the geology, or biogeology, of Earth understood as a whole system. Without knowing it, I had defined the human presence in Earth's geology in a way very similar to that of the Russian biospheric scientist V. I. Vernadsky in his analysis of the biosphere. Culture, civilization, and even technology are seen as features and functions of the larger evolving biogeological process of the whole system Earth, while time and consciousness are defined as functions of a larger planetary regulating system called the psi bank. In the analysis of *Earth Ascending,* the feminine psychic side of consciousness is referred to as the AC, Aboriginal Continuity, while the male, rational techne side is defined as the CA, Civilizational Advance. The historical process represents the increasing dominance of the CA to the final exclusion of the AC-the triumph of industrial man over the indigenous peoples.

The most critical moment in history was the atomic destruction of Hiroshima, August 6, 1945, when through its technology the impact of human thought permanently

affected the geological makeup of the Earth. The events before Hiroshima are chronologically defined as P.A., pre-atomic, and those after as A.H., After Hiroshima. But more than defining the process of history within the context of Earth's cosmogeology, *Earth Ascending* also describes the post-historic future as a condition of harmonic synaesthesia-harmony of the senses-defined by a new scientific system called radiosonics. The key to this new system of scientific endeavor is synchronicity or synchronization of our mind and senses in time. The problem left open by *Earth Ascending* was the precise nature of time and the timing of the radical break in the historic continuum, now known as the Inevitable Event-the culmination and dramatic conclusion of a process begun at Hiroshima. After the Inevitable Event we are liberated into post-history and the possibility of the radiosonic science of the future.

In *The Mayan Factor: Path Beyond Technology* (1987), I was able to supply the basic ingredients for an understanding of time and the timing of the radiosonic future. Going beyond the parochial limitations of Western science and the self-inflated progressivist thinking of the Western mind in general (that states "anything that advances technology is an absolute advance over anything that was thought of or occurred in the past") I was able to finally bring to light the synthesis of many years of study of the time science of the ancient Maya. Here, in the mathematical calculations of the Maya with their unique vigesimal mathematics-counting by twenty and not by decimal ten-lay the basis of a vast and grand science of time. So grand is this science that its conceptions of time dwarf anything the Western imagination could conceive.

While the Western concept of time is linear and predicates an unceasing ascent into a progressively technological and mechanistic future, Mayan time science is predicated on the knowledge of time as the universal factor of synchronization. The Western conception of time is not in accord with the actual cyclical and synchronistic nature of time, and so the whole apparatus of Western civilization is doomed to reach its own breaking point: the Inevitable Event. Mayan time science posits a precise measure of the historical cycle, the most recent and climactic stage of Earth's evolution, as a time fractal of thirteen baktun cycles, each 144,000 days in length, spanning the JulianiGregorian years 3113 B.C.-A.D. 2012. According to Mayan time science, the efforts based on an erroneous time conceptualization are bound to fail prior to the cyclic end-point of 2012. Thus, the Inevitable Event is also a consequence of the failure to understand or to even acknowledge the actual nature of time due to a totally false and mechanistic timing sensibility. In this lies the cause of the apocalypse of Western thought and theology.

The problem left unresolved by *The Mayan Factor* was the precise methodology for changing tracks, for switching Western dominated global civilization away from

the track of an erroneous, mechanistic time-based technology and toward the natural order of time-the path beyond technology. Here my efforts took me to a point beyond reason. Why or how? Let me explain. As an exposition of Mayan time science, in preparation for the 2012 ending of the thirteen baktun cycle of history, *The Mayan Factor* is predicated on the occurrence of a real time event, the Harmonic Convergence "global peace meditation" of August 16-17, 1987. The timing of the Harmonic Convergence was prophetic. It augured the fulfillment of the prophecy of Quetzalcoatl (947-999) known as the Thirteen Heavens and Nine Hells. The Harmonic Convergence completed the ninth and last Hell cycle, and ushered in the final twenty-five years of the thirteen baktun cycle. The Harmonic Convergence was a Mayan wake-up call answered by millions of earthlings.

Exactly forty-two years and ten days after Hiroshima, and fourteen years and twenty-six days before the Inevitable Event, the Harmonic Convergence was located by time to occur precisely when it did. Prophecy transcends reason because it is totally of time, which is of the fourth dimension; prophecy nevertheless affirms with unerring logic that which has been, and that which will be brought about, as being of the same karmic cause and effect stream.

It was this matter of prophecy in the aftermath of *The Mayan Factor* that brought my literary efforts and my own life journey to another stage of development. Prophecy comes with a mantle-if not, then you are classified as a madman. The prophecy of the Harmonic Convergence, as well as of the entire text of *The Mayan Factor,* bore the mantle of the prophetic stream of the Chilam Balam, the jaguar priests, the wizard knowers of the "night script." By correctly fulfilling the prophecy of the Thirteen Heaven and Nine Hell cycles, 843-1987, and by writing and putting together the mathematical codes of *The Mayan Factor,* and before it, of *Earth Ascending,* **I,** Jose Argiielles, had assumed the mantle of the prophetic tradition of the Chilam Balam. Mind you, this was nothing overt nor the least bit conscious, for little did I then know that my next life task was to decode the essence of the Chilam Balam prophecies and to define the time science of which these prophecies are a manifestation.!

The Harmonic Convergence affirmed the karmic repercussions of Hiroshima by bringing forward the ancient Mayan prophetic tradition of the Chilam Balam. By precisely locating this prophetic tradition in a contemporary moment -a media event, no less-the unlocking of its final prophecies was triggered for the purpose of completing the cycle of history: 2012 and beyond.

Like any major media event, the Harmonic Convergence was an enactment within the noospheric unconscious of humanity-the telepathic whole that resides in Earth's mental envelope. So it was that on June 23, 1987, the *Wall Street Journal* ran the

front page story on the Harmonic Convergence. Yet due to the mental obscuration accompanying the final stage of global industrialization, the Harmonic Convergence was an event that the *WillI Street Journal* and the rest of American media conveniently forgot when it came to their review of the century in the year 2000. Today, just weeks after the Inevitable Event, the collapse of the World Trade Center towers, the words of that article are most prophetic: "Mr. Argiielles says the choice between a 'new age' and all-out destruction is ours, and we had better decide."2 Though the prophecy was discounted, true to form, the words of the messenger remain to haunt those who spurned the message.

The prophets and sages of the Maya, and of the New World in general, are a complement to those of the Old World, a further manifestation of the planetary dialectic of poles and hemispheres. If the judgment day apocalypse is the focus of the Old World prophecies, especially those ofIslam and Christianity, those of the New World similarly pinpoint an end time whose denouement is chronicled as the date 2012. It was the prophecies of the sage and culture hero, Quetzalcoatl (947-999), that brought about the Harmonic Convergence, while it was the wisdom of Pacal Votan (603-683) that informed the actual text and scientific time mappings of *The Mayan Factor,* and the image of his tomb adorns the cover of the original book. In a similar manner, it was the tradition of the Chilam Balam that created the prophetic vision of the synchronic order to be realized as the Law of Time.

I was hardly aware of the personally transformative factors at work within me after the Harmonic Convergence media swell began to subside, when two events occurred that augured a major change in my perceptions, activities, and literary output: the Wall Street stock market crash of October 19, 1987, and the death of my eighteen-year-old son,]osh, ten days later, on October 29,1987. In analyzing why the 1987 stockmarket crash happened, the lead story in *USA Today* about this event concluded by posing the question: Was it the Harmonic Convergence that somehow caused the stock market to crash? As I pondered why the answer to this question must be in the affirmative, as well as the implications of this analysis-remembering full well that the breaking story on the Harmonic Convergence first appeared in the *TVtlllStreet Journal-news* came of my son's sudden death in an automobile accident.

Synchronically, the stock market crash and my son's death were part of one event continuum. As tragic as the circumstances of his death were, my son had liberated me from any further compunction to lead a normal life, and to pursue, instead, this matter of Mayan time science and its calendars of harmony. In homage to my son, I completed what I first thought would be a popularization of *The Mayan Factor,* a book entitled *Suifers of the Zuvuya* (1988). Instead of being a popularization or even

a sequel to *The Mayan Factor,* Surfers turned out to be a series of autobiographical tales of interdimensional travel-zuvuya surfing in the fourth dimension. This "flight of fantasy," was my literary farewell to the limitations of reason and a life of comfort. Inner destiny pushed me to the next stage in my pursuit of the unitive science-the discovery of the Law of Time.

This journey of discovery, the findings of which are the underpinnings of the present work *Time and the Technosphere,* took me and my wife and partner, Lloydine, to physical and mental places that were far from anything we had once deemed conventional. Because of this, I had ample opportunity to write and to create, and I did so, freely and without any restraints. I no longer sought any conventional means to communicate. I was now operating prophetically, on behalf of the noosphere-Earth's mental envelope.

There is a consistency to the stream of prophetic revelation, summarized as the codes of the Law of Time. This revelatory stream begins with *Earth Ascending* and *The Mayan Factor,* comes to flower with *The Dreamspell: Journey of Times hip Earth 2013* (with Lloydine Arguelles, 1991), and is completed by all aspects of the Telektonon Prophecy, including the Thirteen Moon/28-Day calendar (1993-2000). This prophetic stream is emphatically a galactic revelation of the same base of know 1-edge that produced the Mayan civilization of ancient Mesoamerica. The new revelatory stream is known as the Wizard's Count, or "reformulated Chilam Balam." It was this prophetic stream and its year-bearer count that established the validity of a fifty-two year cycle correlated to the Gregorian July 26.

The purpose of the Chilam Balam year-bearer count was to establish a basis for understanding that there exists a synchronic order of time, completely apart from what is usually referred to as the Long Count, the linear count of days of the thirteen baktuns of the cycle of history, 3113 B.C.-A.D. 2012. After a long break in the tradition of the Chilam Balam, the year-bearer count was prophetically reformulated to prepare for the Harmonic Convergence and the subsequent revelation of the Telektonon prophecy of Pacal Votan. As the new Wizard's Count, this count was intuitively recalibrated precisely so that July 26, 1987, would be White Galactic Wizard; July 26. According to *The Mayan Factor,* July 26, 1987: White Galactic Wizard, marks the first of the twenty-six years of the Harmonic Convergence. This date marks the conscious ascendance of the prophecy of galactic culture and the coming of the Earth Wizards-the race of galactic wizards on Earth.

In 1988, the year following the Harmonic Convergence, in attempting to create an everyday "Mayan calendar," I came upon the next stage of the discovery of the synchronic order. On the Gregorian calendar, 1988 is a leap year. I perceived that to accommodate February 29 would throw the year-bearer count off by one day, ruining

the harmony of the system. Reviewing the Chilam Balam texts, it was clear that leap year was never considered, much less counted in the year-bearer count. Without an intercalary leap year date, the four year-bearers-Seed, Moon, Wizard, and Storm-coded by the numbers 1-13, remained in sequence, maintaining and assuring the harmony of the system, where every fifty-two years equals seventy-three 260-day spins, no two days are the same, and the entire 18,980 days of the cycle repeat every fifty-two years in an upward moving spiral of time. For the first time in my work, the issue of the Gregorian calendar as a system came into question.

Following this observation came the discovery of the mathematical codes governing the synchronization of the 260-day cycle with the 365-day cycle, the consequent discovery of the artificial 12:60 and the natural 13:20 timing frequencies, the recognition and resurrection of the Thirteen Moon/28-Day calendar, and the full exposition of the Dreamspell codes of fourth-dimensional time. I presented these discoveries in *Dreamspell: Journey of Timeship Earth 2013.* The Dreamspell, being the manifestation of the knowledge base of galactic culture, completely encodes the Wizard's Count. *Dreamspell: Journey of Timeship Earth 2013,* the presentation of the codes of fourth-dimensional time as a "tool kit" with an accompanying "script" and guidebook, is a break of such radical form from the prevailing paradigm that, as of today, it is still unfathomable to many people.

The galactic Dreamspell tool kit is a primary tool for the galactic culture that is just now beginning to unfold in the wake and shadow of the collapse of the Twin World Trade Center towers. This text prompted me to write two more books. The first, *Arcturus Probe: Tales and Reports of an Ongoing Investigation* (1992, 1996), is a deep reverie that picks up where *Suifers of the Zuvuya* left off and documents the interstellar, interplanetary psycho-cosmological roots of the Dreamspell of fourth-dimensional time. The second book was written as *A Treatise on Time Viewed from its Own Dimension,* but first published in English as the *Call of Pacal Votan: Time is the Fourth Dimension* (1992, 1996). In this highly scientific, mathematical treatise I was able to accommodate the Dreamspell codes of the Law of Time to an analysis of the biosphere and the biosphere-noosphere transition. This work also represents my first integration of the actual thought and principles of V. I. Vernadsky.

Through the efforts that constituted the discovery of the Law of Time, much of which was assisted by my partner and wife, Lloydine, I was finally able to begin to understand the methodology for accomplishing the paradigm shift-or psychic pole shift-of which humanity was so in need, at least from the perspective of the biosphere. By providing the mathematical basis for establishing the "biomass constant," Seventy-three 5 day subcycles correlated to the measure of the solar year, I had

found a way of grounding the fourth-dimensional mental order of time, the synchronic order, in the actual third-dimensional biogeochemical cycles of the biosphere. This was like casting a harpoon of time from the noosphere and landing it in a precisely measured form in the annual turning of Earth's biospheric mantle. And this was accomplished precisely because of the intrinsic harmonic cycles and patterns of the DreamspelllWizard's Count.

For this reason, by 1993, it was incumbent upon me to test the hypothesis of the Law of Time that the human race was destroying its biosphere due to operating according to an error in time, and that only a shift in its experience of and perception of time would save it from such destruction. This shift in time is defined as the calendar change. The Law of Time presents such a radical critique of Western science, of its concepts of time, and of the civilization which it supports, that I could not tackle the problem from its center, but from its periphery, moving inward to the point of the Inevitable Event. Beginning in Latin America, then spreading to Japan, Western Europe, Russia, and finally North America, we established a movement to change the everyday perception of time, instilling profound meaning behind the effort to reform the calendar. In this way, we took on the responsibility of organizing the World Thirteen Moon Calendar Change Peace Movement.

Part and parcel of this, beginning in 1993, was the decoding of the prophecy of Pacal Votan, the inspiration of *The Mayan Factor*. Known as the Telektonon, Earth Spirit Speaking Tube, this prophecy is the full realization of the Law of Time and the synchronic order. As much science as it is prophecy, the Telektonon defines the Tower of Babel as the root of the error in time, and the Inevitable Event as the necessary result of not relinquishing false time. At the same time, the Telektonon provides codes and tools of analysis which are in complete accord with an understanding of the technosphere-noosphere as an evolutionary continuum in which the Inevitable Event is an act of moral consequence and natural law revealing the basis of a new cycle of harmonic order.

I would also be remiss at this point if! did not inform the reader that, by prophecy's prerogative, this text is also literally punctuated by a perspective that can only be described as "Quranic." Late in 1993, my immersion in the prophecy ofPacal Votan became sychronically linked to my immersion in a study of the Quran, or Holy Quran as it is sometimes called. I have taken seriously the claim that the Quran is the final revealed text (A.D. 610-632) for humanity. I have studied it following the dictum: "Quran, the whole Quran, and nothing but the Quran,"3 as the basis of genuine Islam-submission to the will of God. I have found it more than sufficiently true that the Quran is a scientific text, and contains nothing that contradicts science. More profoundly, my study has given rise to my own personal ethic: duty to God is

the highest cause. It is the cultivation of this attitude, combined with many years of practice of Buddhist meditation, that have brought me to my present point of view, which is visionary and spiritual throughout-and, as a result, has endowed me with my own view on the current global dialectic.

That the new, and final, global dialectic is found in the tension between the forces of globalization (materialism) on the one hand, and that of the civilization of Islam (spirituality) on the other, is now a well-documented fact.4 Of course, generally speaking, in the West, we see it only from the materialist side of the dialectic. The perspective which informs me, and consequently this book, is definitely from the other side of the dialectic. Though in no way condoning terrorism- I am a non-violent pacifist by persuasion-the motives of the terrorists stem from a philosophy and worldview with which I am in sympathy. Yes, the Inevitable Event was also a profound theological moment, and what we are witnessing in the present World War is the battle between the religion of choice and the religion of submission. We cannot necessarily assume that the religion of choice will prevail. In fact, from the perspective of the biosphere-noosphere transition, it is the religion of submission that is most in accord with the spiritually-beckoning future.

As a preface to this book, I have found it mandatory to write this brief literary autobiography, often couched in a terminology that jumps ahead of the story, solely to demonstrate that the actualization of the noosphere corresponds to the stages of attainment and transcendence of one human's life journey in pursuit of the truth. Only in this way could I cultivate the noospheric perspective, voice, and point of view that was necessary for the writing of this text. In this perspective, the noosphere is a condition of non-anthropocentric consciousness. My journey, thus documented, is merely one way the noosphere has found to become conscious, asserting the Law of Time's purposive axiom: to make conscious what had been unconscious. The voice and method of the noospheric perspective are inseparable from the topic of this book, *Time and the Technosphere.* By analyzing the timing and structure of the technosphere, the noospheric point of view becomes conscious. WIthout understanding the nature and relation of time and the technosphere, there would be no truly sane way to comprehend the meaning of the Inevitable Event.

Crystal Moon Kali 11,
Kin 2: White Lunar WInd
Yellow Solar Seed year
Cascadia, North America

1

9-11, The Inevitable Event, and the Nature of Time

Introductory Reflections

Woe! Woe, O great city,
O Babylon, city of power!
In one hour your doom has come!
Woe! Woe O great city, dressed in fine linen
purple, and scarlet...
In one hour such great wealth has been brought to
ruin ...
"Woe! Woe, O great city,
Where all who had ships on the sea became rich
through her wealth,
In one hour she has been brought to ruin! ...
With such violence the great city of Babylon will be
thrown down!"

ST.JOHN OF PATMOS, BOOK OF REVELATIONS,
CHAPTER 18, *THE FALL OF BABYLON*

9-11. The Twin Towers of the World Trade Center gone in a veritable twinkle of the eye. Tragedy. Horror. Terrorism. The whole world brought to a halt. The aftermath? Patriotism, war, and an all-pervading uneasy feeling. What happened? What really happened? Was this the beginning of the Apocalypse?

Amidst the distraction of chasing after other people with smart bombs in far-away places like Mghanistan, and making everyone at the airports feel like potential terrorists, there are no answers forthcoming for what really happened. There is a good reason for that, too: The destruction of the Twin Towers of the World Trade Center and the attack on the Pentagon marked a point beyond the comprehension of the current belief system in every way. To say that the event was mind-blowing is an understatement. But if it was mind-blowing-which it truly was-that means that a whole belief system was knocked off of its foundations, and only a new belief system can supply the answer. A higher, more all-encompassing belief system-a new paradigm-is what is needed if we are to really understand what happened on 9-11.

Belief systems, believe it or not, are functions of time. What you believe defines the time you are living in. Any belief system is held in place by the calendar and sense of time in which it is encoded. 9-11 means September II-it also means 911 emergency, planetary emergency in this case. "9-11 we will never forget" was a common slogan appearing on bumper stickers and store windows after the event. The words or concepts "Tuesday, September 11," "9-11" and even "911" are all functions of the same belief system. So is "2001," the first year of the highly touted "third millennium." But the third millennium of what? The third millennium since the birth of Christ. This means that the belief system whose mind was blown was the Christian millennial belief system encoded in the Christian calendar, the Gregorian as it is properly called. Does this mean that the foundations of 2000 years of belief were blown away, shattered with the terrifying collapse of those Twin Towers? Easily that many years, maybe as many as 5,000 years, or perhaps even the entire history of civilization as we know it came unhinged that fateful day, the day of the 9-11, the day of the *Inevitable Event,* to borrow a phrase from the Holy Quran, the day the Apocalypse announced itself, showed up on the morning television, quite without warning. (See plate 1, The Invevitable Event and the End of History.)

In meditating upon the meaning of the Inevitable Event, it is natural to ask: What made this event so inevitable? It is not just from the perspective of American Foreign Policy, or that of its economic free market monetary politics, that this event was inevitable. More profoundly, this event was so inevitable because it seemed to smack of some form of retribution for the breaking of fundamental laws of nature, or even of Divine Law. And isn't the retribution for transgressing Divine Law a form of apocalypse, a standing naked, a revelation, an evocation of the fall of the Tower of Babel, no less?

Yes, that is why it was so shocking-it was the Inevitable Event because the apocalypse is as inevitable as it is without warning. But apocalypse- a word no one wanted

to use to describe the event, because to use it would be to admit that it was all over-is only one side of the coin. There is another side to the coin of the Inevitable Event-and that is what this book is about. There is something beyond the Apocalypse, there is something larger going on, and that also scares people. Things are out of their control. Isn't this why, instead of looking at it, or contemplating the event, a policy of war was immediately instated as a principle of revenge-for what and against whom? What is going on is time-time is always going on, or time is always coming together. Or time is always changing. The apocalypse, too, is about time-the end of time-which is even more frightening to most people. But the end of whose time? The new paradigm we need to explain 9-11 should be a paradigm that is all about time.

I who speak know, because I have spent most of my life studying time, and the effects of human time which you call history. For many years now I have been living an experiment in time, but a time most of you do not know. So I have some answers that will put 9-11 in perspective for you. I am the stranger from the other side of the wall of mechanized time. I have come back to make you familiar with the time your clock and your calendar shield you from. Because I know about the other time, the larger time, the cosmic time that governs the cycles of all that exists, I can tell you that 9-11 was the Inevitable Event. It had to happen precisely when it did, not because nineteen terrorists planned it that way, but because the terrorists themselves were unconsciously programmed by the timing of Earth itself. Earth's timing process represents evolutionary forces as well as effects irreversibly set in motion by the human's own unconscious programs, programs governed by the human misperception of time and of its role in the cosmic order.

Yes, Earth has its program of which our human history and all of its endeavors are only a part. This larger meta-program of Earth is called the biosphere, the scientific designation given to what is commonly and inadequately referred to as "the environment." As such, the biosphere is a whole system composite of the sum of life and its organic and inorganic support systems spread out over the surface of Earth, hence bio = "life" + sphere = "having the form of a globe." In a word the biosphere is a vast but fragile process which has been evolving itself for some two billion years on this little planet as it spins around its local star, the sun. But we humans, who only in 1969 first saw ourselves as a planetary being-the whole Earth beamed back at us via television by a rocket hurtling toward the moon-we humans have been generally so self-involved in our own interpretation of things that we have missed seeing the larger picture of which we are a part. This larger picture is the entirety of the biosphere which encompasses the evolution of life on Earth as a whole system process. The amazing thing is that most of us have never even heard of the biosphere much

less even know that we are a part of this whole system governed by laws and principles which we, in our self-made arrogance and ignorance, have but little understood.

From my experiment in time, seeing and studying the human as part of the larger self-evolving fabric of the biosphere, I came to the conclusion that the human is living in a time apart from the rest of the biosphere-an artificial time whose climax and termination is inevitable, for nothing artificial can withstand the force of truth. If the human is living in artificial time, the clock is an artifact whose system of measure has nothing to do with natural cycles but is a totally abstract standard, then there must be something called natural time. I will go even farther and state that not only is there natural time, but that there is a law governing natural time, and that is the Law ofTime.]ust as Newton only discovered gravity some 300 years ago, though gravity has always existed, so the Law of Time has always been in operation, even though it was just recently discovered. It is the Law of Time that governs the entirety of the biosphere and everything else in the universe according to principles which are only dimly known to us, principles like synchronicity and telepathic instantaneity. Yes, to understand what really happened on 9-11 you have to understand the Law of Time and how it governs the biosphere-of which our rampant human civilization is inescapably a part.

The Law of Time is formulated very simply, and in some people's way of thinking, rather unscientifically as T(E) = Art, "energy factored by time equals phenomena in the material world represent some state of energy, and every state of energy is governed by time, the resultant product of which is always something beautiful or elegant. Have you ever seen an ugly sunset? A hideous flower? Even if you examine a scorpion with some objectivity you will be amazed at the flawless and elegant manner in which its parts are organized. Yes, all of nature is organized by time to produce in you the sensation of beauty. And time itself, well, believe it or not, time is a frequency, and a frequency is not measurable by a clock. The Law of Time states that time is the universal frequency of synchronization. It is the nature of time to synchronize and to maintain all things in a condition of synchronization. Synchronicity, then, is the experience of real time. When we say that time is a frequency, we can be more precise and say that time is a universal constant expressible by the mathematical ratio 13:20. That is, the 13:20 ratio is the frequency of synchronization.

Of course, most people have never even heard of the Law of Time much less comprehend what the 13:20 ratio might mean. But then, that again gets to the root of the problem, or rather, the dilemma: If humans are living in their own time apart from the rest of the biosphere which is governed by the natural timing frequency,

how could they ever know about the Law of Time? The humans are all a little like Mrs. Malaprop in the play by Moliere who learns to her surprise that she has been using grammar all of her life-though it is much more serious than that. So we humans are with the Law of Time-it has been operating throughout history without our awareness of it. Because of this, its way of making itself known to us was the infamous 9-11. Yes, in the analysis of the Law of Time, the 9-11 marked the end of artificial time.

Living in ignorance of the Law of Time and of the true nature of time, the human species constructed its own concept of time which is based on the clock with its 60-minute hour and the Gregorian calendar with its maddening array of unevenly numbered months. Hence, the paradigm of the artificial timing frequency is defined by the ratio 12:60 (twelve-month calendar, 60-minute hour) -in contrast to the 13:20 ratio of natural time. If the artificial mechanistic and irregularly measured time sets the human race apart from true or natural time, does this not also establish the fact that the human race is living an error in time? Only by living such an unconsciously assumed error could the human race arrive at such an apocalyptic moment as the Inevitable Event-inevitable because any deviation from the truth has an inevitable moment when the truth rebounds in some dramatic or even apocalyptic way. Is it possible that the entire construct of modern civilization, so devastating to the biosphere, is a function of this error in time? Is modern civilization like a time warp, a bubble of artificial time that suddenly got popped on the 9-11?

Back in the 1990s, now seemingly so long ago, I was traveling around the planet on behalf of the Law of Time and the biosphere, and making my observations regarding the effects of artificial time from a planetary whole systems point of view. I saw that even though the human species had evolved - or devolved, as the case may be-into a cultural hybrid which I call the planetary human, the object of the much touted "globalization," I saw that the consciousness of this cultural hybrid was anything but planetary. This schism between the propaganda of globalization and the actual sectarian and fragmented state of consciousness of the hybrid human was further exacerbated, I observed, by the potently unconscious effects ofliving an error in time. Ironically, if the Inevitable Event left many of us in the dark, it has brought the Law of Time into the light. To elucidate let me quote here from a text I wrote in 1996, and which I think will give us a point to expand upon in order to bring the Inevitable Event into sharper focus, while allowing me to define some of my terms:

"Through an error in time, the human species transforms its artificial construct, civilization, into a global technosphere: the sum product of industrial mechanization of its biological functions. Because of human adaptation to the irregular mechanized 12:60

riming frequency, the technosphere runs counter to the laws of the biosphere, crearing a magneric instability between the primal crystalline and vital organic processes."2

The current explosion of the world crisis, stemming from the destrucrion of The World Trade Center Twin Towers, demonstrates the hypothesis of the Law of Time that states: operaring on arrificial and mechanisric timing standards will cause the human to deviate from natural rime to the point of its self-destrucrion, the end result of the magneric instability referred to in this reference. But here we have some further definirions to make. Let us start with a definirion of the technosphere, since that word is featured so prominently in the ritle of this book, *Time and the Technosphere: The Law of Time in Human Affairs.*

While the term biosphere defines the enrirety of life as a single coherent unity, inclusive of its inorganic or semi-inert support systems such as the atmosphere and the hydrosphere, technosphere defines an artificial sheathe or membrane held together by industrial technology as a whole system. This technological mantle is the sum of the processes devised by humans resulring from the application of certain scienrific and economic principles, especially during the last half century. The effects of the technosphere are to supplant the organic processes of the biosphere with totally industrialized ones, resulring in a severe imbalance in the biosphere. This imbalance, the "magneric instability between the primal crystalline and vital organic processes" refers to the disruption of the delicate interacrion between the inert (crystalline) and biological processes and structures which consritute the vibrant mechanisms and interacrive cycles of the biosphere. Phenomena such as global warming and over-popularion are symptomatic of the technospheric disruption of the natural order of the biosphere.

The term technosphere, however, is actually just the middle term of a larger process defined as the biosphere-noosphere transirion. According to the principle figure behind the elaborarion of the laws of the biosphere, V. I. Vemadsky (1863-1945), as an evolving structure, the biosphere is inevitably being transformed into a new geological and evolurionary condirion, the noosphere-Earth's mental envelope. In Vemadsky's analysis, the enrirety of the biospheric process can be described as a single biogeochemical unity. According to Vemadsky, due to man's transformarion of nature since the industrial revolurion, this biogeochemical unity has entered a state of combustion-an accelerated process of transformarion. It is this rapidly acceleraring geochemical combusrion-the net effect of industrializarion and its waste -that accompanies an evolurionary shift, the transformarion of the biosphere into the noosphere. But between the biosphere and the noosphere there is the technosphere, the intervening medium of transformation.

So when we speak of the biosphere and the noosphere we must take into account the technosphere. In actuality we must speak of the biosphere-technosphere-noosphere transition. In this context, the noosphere is the condition of the human mind purified of the error of time. And if the noosphere is the Earth's mental envelope, it could only be so because of a unified state of mind, the transformation of the hybrid planetary human into a genuinely spiritualized planetary being, the mind of the Earth no less-something that seems phenomenally utopian from the perspective of today's evening news. How could this come about, this noosphere of a telepathically unified human consciousness? Again, the Law of Time supplies genuine answers. To begin with, it says, change your calendar, get back to living in harmony with the natural cycles of the rest of the biosphere-and the universe. If you don't, well, the destruction of the Twin Towers was just the first stage of the Apocalypse. But we still have a choice. The other side of the coin of the Apocalypse shown to humanity on prime time television on the 9-11 is entry into the noosphere. But we must first understand what is really going on, and then act intelligently.

The mental climate in America is particularly difficult and strained now. In order to maintain a positive and constructive attitude of mind during this terrible time, I decided to write this book. As you can see, this book takes for its point of departure an analysis of the destruction of the World Trade Center (the actual hub of the technosphere) as the Inevitable Event defining the dynamic of the biosphere in its process of transforming into the noosphere. The analysis of the event in this light will give ample opportunity for presenting the key ideas of V. I. Vernadsky, in particular the concept of the biosphere which he so single-handedly amplified and defined, as well as the cosmic ideas of other Russian thinkers which are little known in the West. I have already written about and given much thought to this matter in general, summarized in part in the First Planetary Congress of Biospheric Rights, held in Brasilia, Brazil in 1996, but nowhere have I written for a wider public audience concerning the nature of the biosphere-noosphere transition.

I feel it is especially important at this time to present an analysis of this event in a scientific context that is beyond nationalism and ideology, so that human beings can begin to understand that they are a function of the biosphere, but not necessarily its controlling mechanism. Of course, the Law of Time is the key factor involved in this analysis, and understanding the biosphere in the context of the Law of Time is absolutely critical for establishing the basis of an entirely new worldview and hierarchy of values-the much awaited new paradigm.

Like my thoughts on the biosphere-noosphere transition, my investigations of the Law of Time have also not as yet been presented to the general public. In fact,

you will find scarcely anyone who has even heard of the "Law of Time." This is because my researches and investigations over the past decade which resulted in the discovery of the Law of Time were not conducted in any formal academic way, nor through any corporate or government sponsored grant or officially recognized research institution. The discovery of the Law of Time has been, nonetheless, a rigorous, life-consuming pursuit. The laboratory for its study was to be found in a phenomenological and anthropological investigation of the effects of mechanized time on various population groups absorbed in what is called "modern civilization."

The premise of this investigation is simple: it is an undeniable fact that the time of human civilization, governed by the clock and the Gregorian calendar, is not the same as the time of the rest of the biosphere. Artificial time is not the same as natural time. Or rather, artificial time establishes a frequency which governs the human species totally apart from the timing frequency of the rest of life. What are the effects of artificial time and how do they define the nature of modern civilization? The answers to these questions open a perspective that has been scarcely considered. Yet this perspective is so clearly an essential factor in the description and definition of the human condition, that, in the wake of the tragic events and their ominous aftermath, it now begs to be presented in a proper manner. Hence this book. Suffice it to say that the Law of Time in every respect answers the question posed by my previous books and summarized in the single query: how will modern man escape the fatal consequences of the one-sided mechanization of his biological operations and the imminent destruction of his life-support system?

Defining a planetary whole systems approach to the analysis of time in human affairs, the first postulate of my book *A Treatise on Time* (1996) concerning the principles and nature of time as the fourth dimension is worth quoting here, since it introduces the fundamental problem informing the investigation of Time and the Technosphere:

> Just as air is the atmosphere of the body, so time is the atmosphere of the mind. If the time in which we live consists of uneven months and days regulated by mechanized minutes and hours, that is what becomes of our mind: a mechanized irregularity. Since everything follows from mind, it is no wonder that the atmosphere in which we live daily becomes more polluted, and the greatest complaint is: "I just don't have enough time!" Who owns your time, owns your mind. Own your own time and you will know your own mind.3

It must be understood that the events of 9-11 were so historically unprecedented, so mind-bogglingly dramatic, that they require a large lens through which to fully

interpret their meaning. The Law of Time is such a lens. Quite simply, the destruction of the Twin Towers defines the limit of artificial time. If this is so, what can be expected following this world-shattering event? Because the Law of Time began with the premise of defining the difference between artificial time and the time of nature, the larger context of the biosphere was resorted to almost immediately. Being the study of an ongoing and evolving phenomenon, the investigation of the biosphere by its principle researcher, V. 1. Vernadsky, pointed to another imminent evolutionary stage: the noosphere, the "mental envelope of the planet." However, an intermediate stage was also perceived by researchers who followed Vernadsky, and it came to be called the technosphere, "the technological envelope of the planet." The end or limits of the technosphere define the birth or beginning of the noosphere.

With the events of 9-11, this is no longer just a theoretical concept but a vivid reality. As a species we are now undergoing this dramatic evolutionary moment, otherwise known as the biosphere-noosphere transition. It is for this reason that this book also presents novel definitions of time and pragmatic conclusions that can be employed by anyone if they so choose. If the root of the technosphere is artificial time and its proliferating mechanized constructs, then in the collapse of the technosphere, an event ordained by the laws of nature, there must be an orderly path or means for establishing the noosphere, also ordained by natural law. The Law of Time defines this orderly path as a conscious shift in the human timing frequency, away from artificial time and into universal natural time. This can only be accomplished by a universal reform of time, known as the calendar change. If there were no such path, the conclusion to the collapse of the technosphere would be an unbearable barbarism.

By its nature, the topic of the book is cross-disciplinary and provocative-it is visionary history. I have been described as a "spirituality historian" and "cosmic harmony researcher."4 I believe this description also characterizes *Time and the Technosphere,* which does present a solution, a new world paradigm, if you will. A new paradigm has been awaiting humanity ever since the notion of paradigms was first raised by Thomas Kuhn in 1964, in his book *The Nature of Scientific Revolutions,* or even earlier by Vernadsky and Pierre Teilhard de Chardin in their invocation of the noosphere. To be truly new, such a paradigm could hardly be expected to arise from traditional fields of thought or methods of research, be they quantum physics or microbiology. In fact, as I have often said, most people wouldn't recognize the new paradigm if it ran into them on the street. This is because people's consciousness and perceptions are basically very set and unexamined-as unexamined as the effects of the watch on their wrist or the calendar on their wall. In fact, one of the consequences

of the technosphere is the limiting nature of consciousness which remains unchanged despite the fact that technology is changing all of the time. But with the occurrence of the Inevitable Event, history has been punctured. Perhaps now the new paradigm can be perceived: the paradigm of natural time as the universal factor of synchronization.

Although prompted by the stunning terrorist attack upon and consequent apocalyptic collapse of the World Trade Center Twin towers, these reflections are actually a synthesis of thoughts and explorations in the domain of time that I now find necessary to communicate in a coherent and organic form. The grand theme of this study is to understand how and why the collapse of the twin World Trade Center Towers was a biospheric event. Even so, the study of the Inevitable Event within the context of the evolution of the biosphere requires and leads us to still grander domains of thought-the historical, the theological, and the cosmological. The reason that these reflections and meditations spiral into ever grander domains of thought is due to the principle of analysis and the guiding factor employed in this study. This is the Law of Time, which is the fruit of a life-long research and pursuit of knowledge. It is the Law of Time that brings the biosphere into timely focus.

The biosphere is scarcely known even to most educated people. As a biogeochemical whole system in which the human is but one of the functioning components, the biosphere is an intricate unity with its own governing laws and principles. Without becoming conscious of how the human organism participates in the laws and principles of the biosphere, the human will continue to remain ignorant of the biosphere's existence and therefore will sooner than later reach a termination of its own evolutionary possibility. A demonstration of how the laws and principles of the biosphere, crystallized into a temporary and intermediate sheath called the technosphere, reached a climactic evolutionary point in the collapse of the World Trade Center towers will provide the means of educating in general concerning the biosphere. It will also allow us to elaborate on the meaning and nature of the technosphere, and the imminent transformation of the biosphere into the noosphere, the Earth's "mental envelope."

A fundamental purpose of the Law of Time is to expand upon the meaning and significance of the Inevitable Event, as well as upon the biosphere, technosphere, and noosphere in relation to the evolution of life and consciousness in the universe. To speak of an event being "inevitable" is to bring about a reflection on the nature of time, and even of the laws of cause-and-effect and karma. It is time that governs both cause-and-effect as well as the actions of karma. And it is time that dominates inevitability, because any such inevitable event is located in a very precise moment in

time. But what actually is time? How does time "locate" events? And, once again, what is the Law of Time?

As the criterion of natural time in which synchronicity is the norm, the Law of Time is the key that unlocks the reason why the Inevitable Event occurred when it did. By precisely locating it within the evolutionary continuum of the biosphere and in relation to its point of mutational shift, the Inevitable Event is placed into a greater context of cosmic comprehension by the Law of Time. Through the lens of the Law of Time we will be able to understand the relationship between the biosphere, the intermediate state of the technosphere, and the imminent stage of the noosphere. Defining the Law of Time as the factor of universal synchronization, the law by which all events in the universe are maintained in synchronic relation to each other, we approach the domain of a hitherto undefined realm, that of the synchronic order.

As the unifying fourth-dimensional order of time in the universe, the synchronic order is measured and gauged by the 13:20 matrix. The mathematical coding of the Law of Time is entirely locked into this 13:20 matrix, otherwise known as the Harmonic Module or T zolkin, the basis of the sacred count of the ancient Maya. When we examine the Harmonic Module, a 13 x 20 matrix, we may well ask what does that have to do with time? It is obviously as different from a clock, as a tree is from a flagpole! When we examine the matrix carefully we see that there is a repetition of thirteen notations, the numbers 1-13, that occurs 20 times yielding 260 (13 x 20) units.

Holding the 13:20 matrix together is a pattern which I identified in my book *Earth Ascending* (1984) as the binary triplet configuration, and in the *Mayan Factor* (1987) as the Loom of Maya. This pattern consists of 52 units, 26 on either side of the central or seventh vertical column. **If** you contemplate this 52-unit pattern you will see it is characterized by binary radial symmetry. This quality characterizes the entire matrix and defines the quality of fourth-dimensional time as radial and instantaneous distinct from the current third-dimensional paradigm which defines time as being linear and sequential. The radial quality of fourth-dimensional time is what accounts for its being the factor of universal synchronization. This is very different from the sensation of the second hand as it sweeps around the clock, indicating the inexorability, not of time but of the mechanization of time! The 13:20 matrix becomes potently useful as the means of establishing the synchronic order when it is coordinated with a genuinely harmonic timing standard, the Thirteen Moon/28-Day calendar.

"Time is the fourth dimension," is the famous adage attributed to Einstein. This statement notwithstanding, the modern notion of time is bogged down in the minutiae

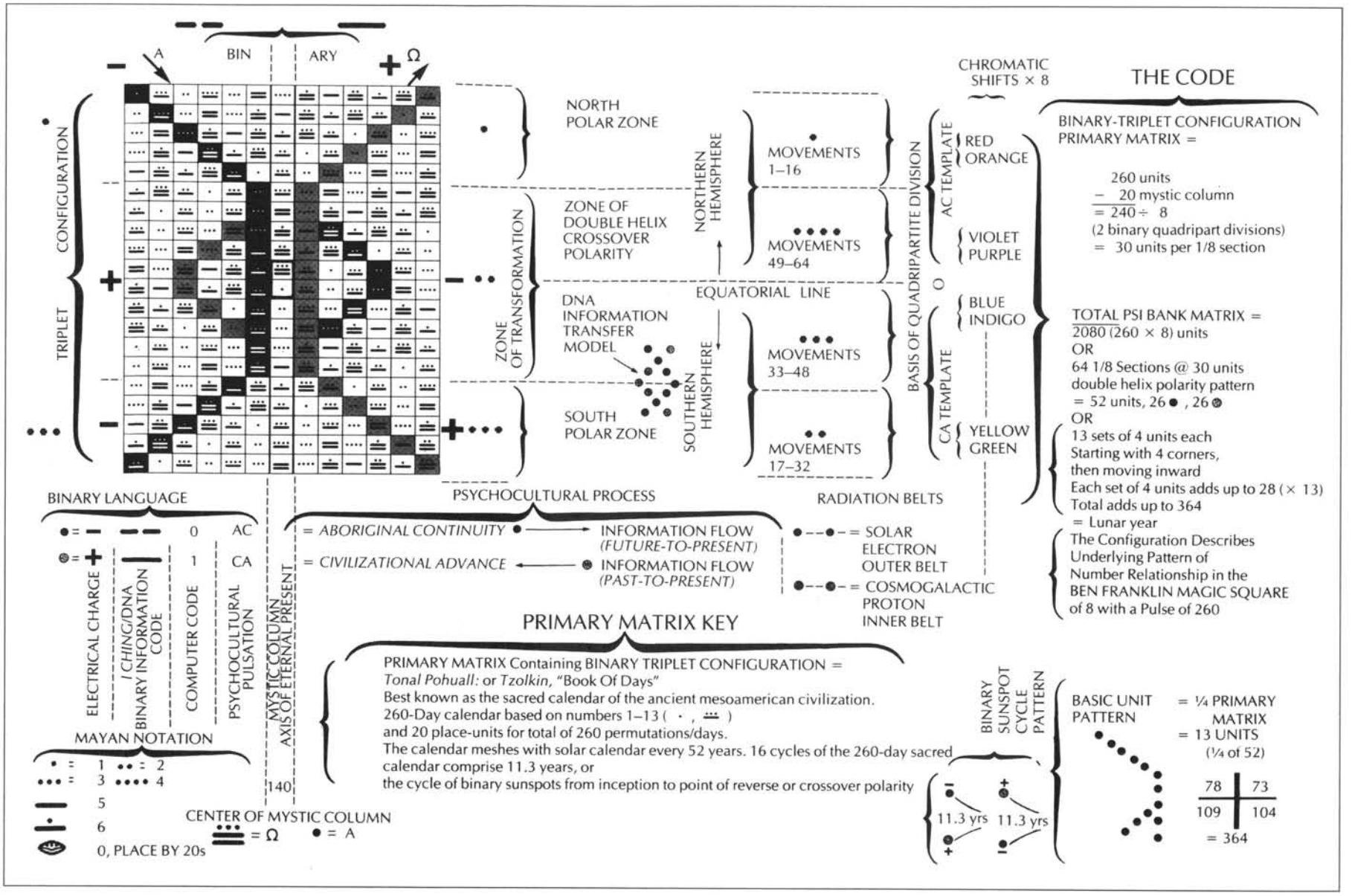

13:20 Matrix-Harmonic Module with Binary Triplet Configuration

of quantum mechanics and cessium clocks, in a hair-splitting myopia that cannot see the forest for the trees. The fact is that only time governs the whole order of the universe in a manner that transcends all spatial limitations, even those of the relativistic MinkowskilEinstein four-dimensional universe, which is confined by the speed of light. As the universal factor of synchronization, time is instantaneous and transcends light. This novel perception of time defines a new reality, the synchronic, of which our experiences of synchronicity are but a foretaste. The synchronic order described by the Law of Time poses the order of an entirely new science of time.

To be realized and then applied, the science of time is dependent on two factors: a sudden and radical disruption of the historical continuum; and a genuine globalization or planetarization of consciousness. The break in historical continuity is necessary to jolt the human consciousness from its stagnant and entropic state-defined by the Law of Time as the delimiting 12:60 frequency consciousness of artificial, mechanistic time-while the globalization of consciousness, intimately connected with this sudden discontinuity, is necessary for the application of this law at a planetary whole systems level. Of course, the radical disruption of the historical continuum was provided by the collapse of the Twin Towers, and can actually be mapped in a description of the dialectical process of human evolution.

If one studies *Earth Ascending,* Map 19, "Binary Pulse of Psycho cultural Development," [shown on page 14] one can pinpoint the "Inevitable Event" of the radical historical discontinuity as the point at which the AC and CA currents cross over one another and switch polarity at the very top of the graphic depicting the "historical" process. What does it indicate, this point of psychic polarity switching currents?

The historical dialectic is understood as the interplay of two "currents" of consciousness, AC "Aboriginal Continuity" and CA, "Civilizational Advance." In the prehistoric phase, the consciousness is dominated by the Aboriginal Continuity or AC. This refers to the primary experience of the original human nature- life lived as a ritual or ceremonial round within the perimeter of the timeless present. But as the human enters the historical cycle, about which we will have more to say in later chapters, the CA becomes more predominant. As Civilizational Advance, the CA represents the tendency toward exclusive reliance on reason, logic and written means of communication. The Law of Time further defines the CA as being motivated increasingly by the artificial timing frequency of the 12:60 which gains in prominence until the final phase of the historical cycle, industrial globalization, when the CA has gained complete dominance of the biosphere.

During this final stage, the global mental condition is defined as the involvement in secondary or artificial means of experience, furthered by the planetary

INCIDENCE OF RELATIONSHIP BETWEEN
PSYCHOSENSORY ELABORATION (PSE)
AND
KEY: PSYCHOATMOSPHERIC DENSITY (PAD)

- AC = ABORIGINAL CONTINUITY (YIN)
  CONTAINS ENTIRE BLUEPRINT
  OF PSYCHOCULTURAL DEVELOPMENT
  OF TOTAL BIOPSYCHIC ORGANISM, MAN
  POLARITY FLOW: "FUTURE" TO PRESENT = VISION
  INFORMATION IN WHOLE PATTERNS
  "CONSERVATIVE"

+ CA = CIVILIZATIONAL ADVANCE (YANG)
  COMPLEMENTARY PULSE
  DYNAMIC IMPLEMENTATION OF VISION
  POLARITY FLOW = "PAST" TO PRESENT
  INFORMATION IN
  VERBAL SEQUENCES & MATHEMATICAL BITS
  "PROGRESSIVE"

INTERACTION OF AC/CA
CREATES PSYCHOSENSORY ELABORATION (PSE)

ACTIVATION OF CA PULSE BEGINNING WITH
HIERATIC STAGE INITIATES
CUMULATIVE DEVELOPMENT OF *PSE*

INCREASE OF PSE PRODUCES INCREASE IN
PSYCHOATMOSPHERIC DENSITY (PAD)

AS PSE INCREASES, AC CURRENT
BECOMES MORE DISCONTINUOUS

MAXIMUM PSE, MAXIMUM PAD
MAXIMUM AC DISCONTINUITY
ARE ATTAINED AT CLIMAX
OF STAGE 4, GLOBAL INDUSTRIALIZATION

AS *PSE* ATTAINS MAX. CONDENSATION
(MAX PAD DENSITY)
ESP EXPERIENCED AS MAX ABERRATION

4 GLOBAL INDUSTRIALIZATION
CONSOLIDATION OF CA
MAXIMUM AC DISCONTINUITY

3 STAGE OF SPIRITUAL REVITALIZATION
REACTIVATION OF AC
SYNTHESIS OF HIERATIC
STRUCTURES

2 EMERGENCE OF CIVILIZATION: HIERATIC STAGE
DIFFERENTIATION OF
CA MEMORY PLATE
INTO 7 HIERATIC STREAMS

1 ABORIGINAL STAGE
AC = DOMINANT = PSYCHOSENSORY STASIS
MINIMAL PSYCHOATMOSPHERIC DENSITY
MAXIMUM PSI INFORMATION FLOW

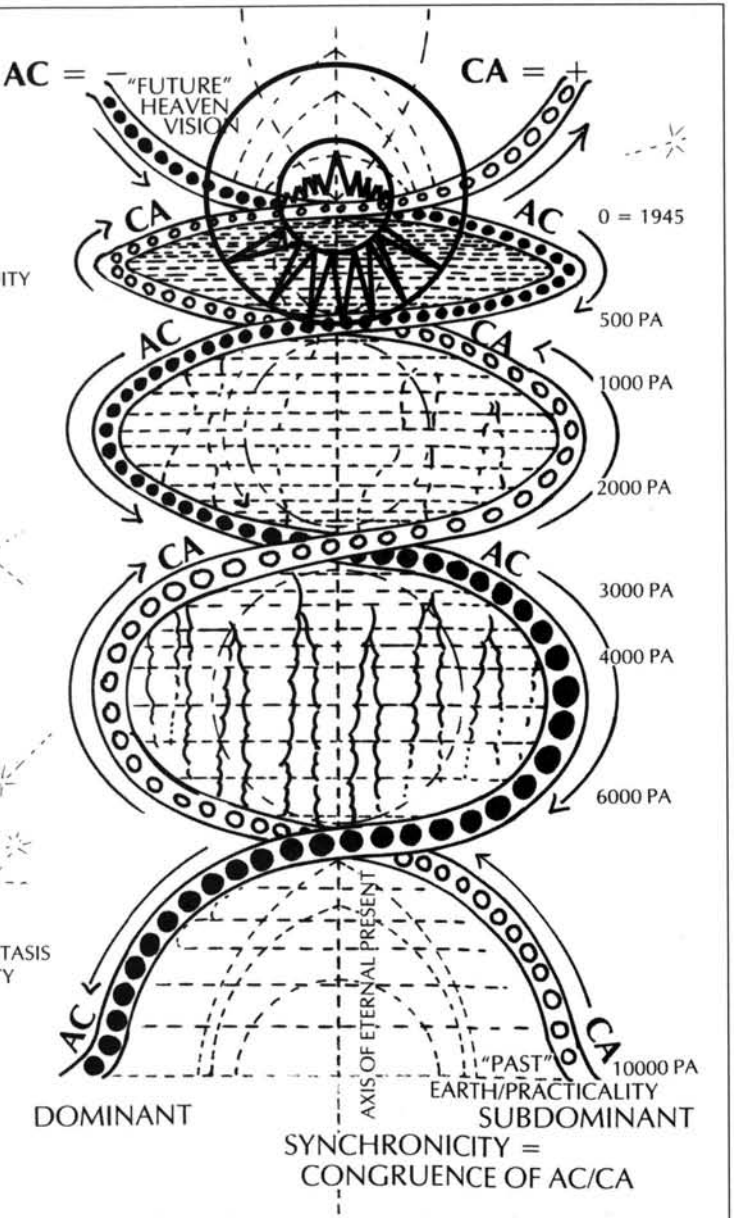

Locating the Inevitable Event in the Holonomic Equation:
9-11, 2001 Climax of the Binary Pulse of Psychocultural Development
(from *Earth Ascending*, Map 19)

technosphere. The sum effect on consciousness of the advanced CA stage is defined as Psychosensory Elaboration or PSE, which in turn creates a psychoatmospheric density (PAD)-literally a mental cloud which obscures altogether the organic biopsychic reality of the human within the biosphere. From the point of view of a planetary pathology, this massive collective obscuring (CA) of the original nature (AC) defines a "suicidal crisis point," a moment at which the subconscious instinct of the human being programs its own self-defeat in order to ultimately return to the organic reality of the biosphere and the simultaneous advent of the noosphere. Hence, the Inevitable Event: the radical break in the continuum of history.

This moment of radical historical discontinuity occurred with the September 11,2001, terrorist attack on the twin towers of the World Trade Center-the very nerve center of late global industrialization-and the Pentagon, the supreme military fortress that defends globalization. If the fall of the towers symbolically augured the fall of Babylon and the Tower of Babel itself, the penetration of the Pentagon was no less symbolic. The fact that there was not one but two towers of Babel and a separation of some twenty minutes between the attack on each tower allowed the second attack to be viewed live on global television by about as many people on Earth as had ever witnessed anything at one simultaneous moment. By the end of the day, the scene had been repeated multiple times on virtually every television network on the planet.

The unbelievable shock of the moment and its simultaneous perception, coupled with the symbolism of what was actually occurring, effectively rendered the break in the historical continuum as a profound mental event-a rupture of 5,000 years of history from the first Babylon to the last. The witnessing of the event on television meant that it was received immediately into the nervous system of virtually the entire species. This in itself is a noospheric moment-the mental envelope of the Earth made collectively and globally conscious in one instant of history-shattering significance, and hence, the genuine entry into post-history. Archetypally, the images of the towers collapsing with people flying or jumping off the upper stories, is a pure reflection of the Sixteenth Major Arcana card of the traditional Tarot which shows a tower being shattered by lightning, with bodies falling down from it.

While the negative powers and forces grapple with their shattered dreams in the aftermath of the event, it is the time for the powerful luminescence of the noosphere to begin to activate the receptive cells of the human system within the now catalyzed biosphere. Fifty-six years after Hiroshima, the fall of the World Trade Center Towers is the fatal puncture in the technosphere which is intended to reorient the human within the biosphere. ESP (extrasensory perception)-the opposite of PSE (psycho-

sensory elaboration)-is released in the instantaneity of the information reaching virtually every human being on Earth. This is the collective reactivation of the Aboriginal Continuity current that has been disengaged and disempowered for so long by the Civilizational Advance. Civilization has finally been checkmated. Now the Revolution of Time must be completed in order to stabilize the biosphere, anchor the noosphere, and de-structure the technosphere.

According to the Law of Time, the Inevitable Event was already embedded in the moment in which it actually occurred, like a flaw in a piece of glass that, upon concussion at the right pressure point, shatters all at once. In the case of the World Trade Center Towers and the Pentagon, we are also dealing with symbolic constellations of such potency that the very act of their shattering redefines the reality of human consciousness. In fact, the nature and problem of human consciousness as it has evolved historically is also at the root of this astonishing event. While it will take time for the collective human consciousness to fully grasp just how much its reality is being redefined, a vacuum now exists within the technosphere itself-a vacuum which awaits being filled by a new paradigm. Since the collapse of the Twin Towers actually represents the limits of artificial time, the new paradigm must rest on a redefinition of time altogether. This is the definition supplied by the Law of Time, the pragmatic application of which is the replacement of the irregular measure of the Gregorian calendar by the harmonic measure of the Thirteen Moon/28-Day calendar.

Because of its harmonic measure, the Thirteen Moon/28-Day calendar coordinated by the Harmonic Module is the new dispensation of time-reckoning for the human race. Rooted in the four recurring year-bearers of the Wizard's Count--:-which is not the same as the Mayan long count, nor the Julian count of modern science-the Thirteen Moon calendar exists for the establishment of the reality of the synchronic order as an entirely new method of knowledge and being for the entire human race as a cosmic medium operating within the biosphere. By Wizard's Count is meant the circulation of thirteen numbers and four different glyphs-Yellow Seed, Red Moon, White Wizard, Blue Storm-that code the July 26 Thirteen Moon/28-Day calendar synchronization date to create a master 52-year cycle, Anchored in the Thirteen Moon/2 8-Day calendar, the synchronic order is the means for manifesting the reality of the noosphere on planet Earth. Without such a basis in a lived mathematics of time correlated to the actual cycles of Earth, the noosphere could not be experienced nor fully realized. The successful completion of the biosphere-noosphere transition, then, is the triumph of the synchronic order, the conscious elevation of Earth into the cosmic frequency of fourth-dimensional time.

For all of this to come to be, however, is yet dependent on an analysis of the role of time in the creation of the technosphere and the subsequent comprehension of its limits and the potential for its de-structuring. This is not only a matter of theory or prophecy; it is a matter of putting into practice, making a coherent action out of the application of the Law of Time as it completes the pressing urgency of the bio-sphere-noosphere transition. The coherent action to bring us through this rite of passage is the Great Calendar Change of 2004. Ultimately, this book is presented to make us ready for this unprecedented time changing moment. May you, 0 reader, ponder deeply and then, if you so will, come join me in living on the other side of the wall of mechanized time.

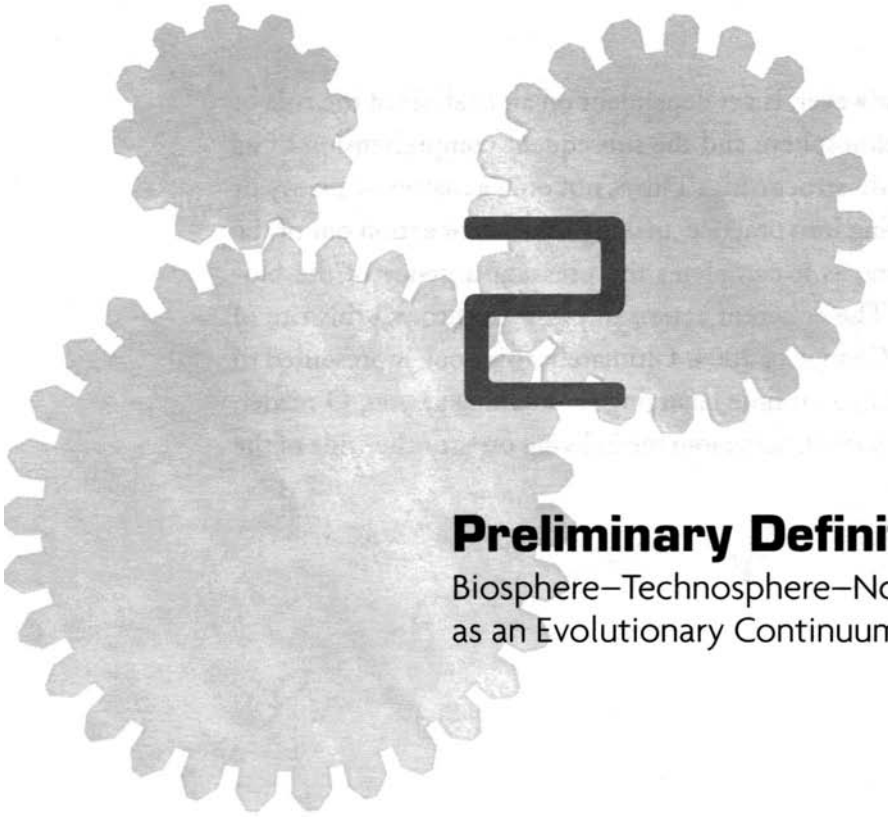

2

Preliminary Definitions

Biosphere–Technosphere–Noosphere as an Evolutionary Continuum

BY UNDERSTANDING that the Inevitable Event was a function of the biosphere-indeed, a necessary moment in the evolutionary trajectory of the biosphere-we are saying that this event was not just a human enactment, but that humans, inseparable from the biosphere, are effected to perform functions that relate to the process of the biosphere as a whole. Seeing the Inevitable Event and, in fact, the entire human drama from the perspective of the biosphere, we are actually lifting the cruel tragedies of contemporary reality above conflict and into a state where genuine laws of peace and harmony may shed their light of wisdom, illuminating the human drama with a higher understanding. One thing is certain: Unless we rise above our own humanity and cultivate a non-anthropocentric view-the view represented by the noosphere-there will be no release from the calamity that is now engulfing us. The point is not of maintaining the global economy, but of saving the biosphere.

For the multilayered task of bringing a new understanding to light, defining the technosphere, and then the Law of Time, we shall begin with the former: defining the technosphere in the context of the evolutionary continuum of biosphere-technosphere-noosphere.

VERNADSKY AND THE UNDERSTANDING OF THE BIOSPHERE

It is amazing that the name V. I. Vernadsky (1863-1945) is so little known in the West, and that the word *biosphere,* as well as the laws and principles pertaining to it, are scarcely more known. To a large degree, this ignorance is due to the great cleavage in human relations experienced as the Cold War. The biosphere, which was profoundly studied and scientifically articulated by the master Russian scientist V. I. Vernadsky, is actually the precise word for what in the West is vaguely referred to as the *environment.* But even more than being a precise and scientific description for what is meant by the use of the word *environment,* biosphere defines a whole system model of life on Earth, and because of that, also presupposes a whole system methodology and point of view. You cannot speak about the biosphere without entering into a world of discourse that is holistic or holonomic to the core.

If one looks for Vernadsky's work in English, one will find precious little available. His key work, *The Biosphere,* exists in two very different translations; the one published by Synergetic Press in 1986 is easier to read, while the other, the "complete annotated edition" published by the Far West Institute in 1998, is far more erudite, with a major bibliography and much supplementary information. The earlier translation was published in conjunction with the opening of the Biosphere II Project outside Tucson, Arizona. It is now a tourist site, with a bookstore that carries nothing by Vernadsky! Several other hard-to-find English-language books on the biosphere include the excellently informative *Traces of Bygone Biospheres* by Andrey Lapo (Synergetic Press and Mir Publishers, 1987), the flashy *Biosphere Catalog* (Synergetic Press, 1985), and the much more specialized *Energies: An Illustrated Guide to the Biosphere and Civilization* by Vaclav Smil (MIT, 1999). Of these books, only *Traces of Bygone Biospheres* contains significant information about Vernadsky and his ideas. This scant list of available texts in English is hardly proportionate to the vast reality of the biosphere as a complex terrestrial dynamic in the throes of evolutionary change.

The place and role of Vernadsky in Russian science is virtually equal to that of Einstein in Western science. A consideration of the achievement of each of these scientists also presents us with a dramatic contrast in perspectives, areas of interest, and consequent modes of analysis. The physicalist relativism of Einstein's legacy and its pursuit of the Big Bang is radically different in almost every way from the legacy of Vernadsky's work, which presents a biogeological worldview that is organically integrative and the basis of what in Russian science has come to be called *cosmism.* While the physicalist fascination of Western science has supported the materialism of modern Western thought and its way of life (which is actually an accelerating function of the biosphere's own internal processes), the whole system thinking of

Vernadsky-characterized by the conception of a "biogeochemical process"-ironically supports a cosmic rather than materialistic worldview.

To illustrate the Russian perspective and the influence of Vernadsky's work, we present the concluding thoughts of a book by another Russian scientist and philosopher, 1. Laptev:

> Each one of us requires the whole earth-today this is quite clear. But surely each one of us is required by the whole earth! And when these two mutually penetrating requirements, so distinctly revealed and intensified by the leap out into space, are satisfied, the new historical epoch will begin "in which mankind itself, and with mankind all branches of its activity, . . . will experience an advance that will put everything preceding it in the deepest shade." (Fr. Engels, *Dialecticsof Nature)* And people, no longer burdened by the thirst for money, will remember something that many of our contemporaries have forgotten: The only important things in life are such intangible qualities as beauty and wisdom, laughter and love.
>
> Nothing remains for us, members of a society the ideals of which are in unison with elemental geological processes and the laws of nature, but to wish that people the world over would recognize this as soon as possible.!

Laptev's words-written twenty-eight years ago and precisely at the midpoint between Hiroshima and the Inevitable Event, as well as during the year in which the World Trade Center in New York City was finally completed and inaugurated (April 4, 1973)-simply and elegantly state the theme and point of view that we are pursuing. In fact, it is the Inevitable Event that prepares us for the new historical epoch. But first we must realize how we are organized by the biosphere in order that the technosphere may be transformed into the noosphere.

The root of Laptev's cosmic vision lies in Vernadsky's succinct definition of the biosphere: "The biosphere is the region on Earth for the transformation of cosmic energies." Although the word *biosphere* had been coined in the late nineteenth century, it was really only with Vernadsky's efforts that the biosphere became a viable description of the totality of life on Earth inclusive of its organic and inorganic support processes.

Vernadsky was trained as a geologist with a specialization in crystallography. He immediately absorbed the implications of Curies discovery of radioactivity (1896), and devoted many studies to the purpose of uranium and naturally occurring radioactivity within the Earth's geology. By the time of the First World War, Vernadsky had already written important texts such as *Fundamentals of Crystallog;raphy and Descriptive Mineralogy,* and, along with Madame Curie, proposed an "international ra-

diography of Earth's crust." This was in advance of Alfred Wegener's definitive work on plate tectonics. During the time of the First World War and Russian Revolution, Vernadsky's attention turned toward the problem of living matter and its relation to the geochemistry of the Earth. From this was born Vernadsky's perception of the unitive biogeochemical process by which the biosphere maintains itself. In 1923 he published a "plea for the establishment of a biogeochemical laboratory."

In Paris, Vernadsky worked at the Insititut de Radium (Marie Curie) and became acquainted with Henri Bergson, who was then president of the International Commission of Intellectual Cooperation of the League of Nations. Through Bergson's circles, Vernadsky met often with the biologist Pierre Teilhard de Chardin (1881-1955) and the philosopher Edouard Ie Roy (1870-1954), with whom Vernadskyjointly coined the word and concept of the noosphere. Although Pierre Teilhard de Chardin is credited in the West with the concept of the noosphere, defined by him as the "mental envelope of the planet above and discontinuous with the biosphere," de Chardin's approach to the evolution of the noosphere as a natural consequence of vertebrate biology differs from Vernadsky's understanding in which it is the entirety of the biosphere that evokes the noosphere.

The chief fruit of this fertile time in Vernadsky's life was the publication of the little book titled *The Biosphere* (1926). Demonstrating the synchronic ordering principle of the noosphere, it is interesting that the same year that saw the publication of *The Biosphere* also witnessed the appearance of Jan Smuts noted book *Holism and Evolution.* Through most of the rest of his sometimes turbulent career (he often came under attack from hard-line bolsheviks), Vernadsky was to elaborate on the laws and principles of the biosphere, often expressed simply as problems in biogeochemistry. At the same time, his influence as a holistic thinker began to spread through the Soviet Academy of Sciences. A list of a few of his later publications gives some idea of the breadth of his thought, and includes: *Geochemistry, Problems in Biogeochemistry I* and *II, On the Boundaries of the Biosphere, Goethe as Naturalist, Scientific Thought as a Planetary Phenomenon, Some Words on the Noosphere,* and his never completed work, *The Chemical Structure of the Earth's Biosphere.*

Following the death of his wife in 1944, Vernadsky expressed the opinion that after the Second World War, American and Russian scientists should work more closely together. Early in 1945 (January 6), Vernadsky followed his wife to the grave. The Second World War ended, only to be followed by the Cold War (1947-1990). The critical collaboration between American and Russian scientists longed for by Vernadsky was soon to be buried in the ideological wasteland over which the superstructure of the technosphere would be constructed, a fact that in itself hastened the

acceleration of the biogeochemical processes bringing about the climax of the technosphere.

Vernadsky did not live to witness the birth of the atomic era, which began only months after he died. But like Einstein in America, in 1940 Vernadsky-along with several other scientists, and mindful of the possible military applications-had prompted the Russian government to begin investigations into the possibility of deriving energy from nuclear fission. Yet it is most remarkable that by the time of his death, Vernadsky had almost single-handedly defined virtually every aspect of the laws and principles of the biosphere. This he always did with an eye to an imminent moment in the not-too-distant future when there would be a dramatic biogeochemical mutation or combustion, out of which the biosphere would somehow trigger the noosphere:

> Not at a crisis of nervousness do we stand now, not at a time for the vacillation of flabby souls; but at a great turning point in the history of scientific thought, at a crisis such as occurs but once in a thousand years, such as has not been witnessed for many generations. Standing at this point, with the vista of future achievements before us, we should be happy that it is our lot to live at this time and to participate in the creation of tomorrow.2

Undoubtedly his sense of the great moment of transition came from the very fact that during the span of his life from 1863 to 1945, some eighty-two years, Vernadsky was able to witness firsthand the accelerating effects of man's thought-in the form of industrial technology and the machine-and its turbulent and transformative impact on the terrestrial biosphere. After all, as a geologist, Vernadsky was familiar with the long history of the Earth, and the impact of human technology on the biosphere was inescapably the most significant aspect of any study of the biosphere to the present time. So wrote Vernadsky: "Only man transgresses the established order. . . upsets the equilibrium, though whether he materially cripples the transforming mechanism, or merely redistributes it, we cannot at the moment be sure."3

The "transforming mechanism" referred to is the biosphere itself, which Vernadsky had already defined as the medium or region for the transformation of cosmic energy on Earth. At its simplest level, the unity of the whole of living matter of the biosphere is the sum of its living organisms. These living organisms either directly or indirectly are continuously processing solar and cosmic radiation, transforming it into various chemical cycles that establish the atmosphere, most notably through photosynthesis and the oxygen and carbon dioxide cycles. The important point, however, in any consideration of the biosphere is the principle of unity: the

biosphere is a unitive complex of cycles summarized as a single continuously transforming and slowly mutating biogeochemical process. In this single complex cyclical process, all of life-all of living matter-is a unity, a singular dynamic by which the biosphere can be considered as a living whole. From the plankton of the oceans to the trees in the forest and the human peering from his cave at the rising sun-all of this is a single unity.

It is the interaction of the living matter with the inert matter that creates and establishes the attributes and dynamics of the biosphere as a whole, all of which are now in a heightened state of acceleration and transformation, for as Vernadsky put it in the conclusion to *The Biosphere:* "The thought of the human species is a new fact which is turning the structure of the biosphere upside down after myriads of centuries." The structures and principles of the biosphere that man is now upsetting include: the continuity and invariance of life on Earth; vegetation as a transformer of the energy of the sun; multiplication as a manifestation of transformed solar energy; propagation of life and the forces resisting propagation; and the unique relations of life to the inert matter of the biosphere, including the composition of living matter into two orders, plant life and the various biological animal species, inclusive of man. The first order of plants and bacteria constitute the mechanism for capturing the solar radiation and introducing the energy of the sun into the biosphere. The second order of biological life is a manifestation of the process of the transmission of energy through the vegetable world; that is, at a primary and fundamental level, animal life is dependent upon plant life for its existence. (See plate 2, Life Is the Transformation of Solar Energy.)

All these principles for maintaining the equilibrium of the biosphere are functions of the dynamic of the different biochemical and geochemical cycles that maintain life both on land and in the ocean, all of which are subjected to processes that we refer to as evolution, both geological and biological. The evolutionary mechanisms of life include the principle of the biomass constant and the biogenic migration of atoms. Both of these mechanisms refer to and define the continuity and invariance of life on Earth. That is, the quantity of living matter has remained roughly unchanged since the origin of life on Earth-the biomass constant. Furthermore, the amount of oxygen in the biosphere is equal to the amount of biomass. It is the pressure of the different species on each other with the resultant interactions and changes that checks the infinite propagation of anyone species at the expense of the rest, and causes the mutation and evolution of the different life forms. It is through the intermediate structure of the technosphere that the human is wreaking the greatest havoc on these principles that are intended to maintain the biosphere as a stable dynamic,

and by which the human constitutes a biomutation of unparalleled significance. The different stages of the mutation of life account for the biogenic migration of atoms: "The evolution of different forms of life throughout geological time increases the biogenic migration of elements in the biosphere."4 The metamorphosis of dinosaurs into fossil fuel is an example of the biogenic migration of atoms-and of the introduction of "free energy" (the term for industrial waste and by-products such as carbon monoxide) into the biosphere, while at a more mundane level, it refers to processes such as metabolism, circulation, breathing, and so forth.

To summarize, there are two biogeochemical principles. The first states: "The biogenic migration of chemical elements in the biosphere tends towards a maximum of manifestation"; this refers to the presence of life everywhere on Earth, as well as the principle of the pressure of living matter upon itself. The second biogeochemical principle states: "The evolution of species, in tending towards the creation of new forms of life, always move in the direction of increasing biogenic migration of the atoms in the biosphere. . . . The second biogeochemical principle regulates the course of evolution. A newly evolved species will survive in the biosphere only if it is sufficiently able and sufficiently active in furthering the migration of atoms. The organism cannot be considered apart from its medium. It is a part of the complex mechanism of the biosphere." Here Vernadsky concludes his study of the biosphere with a consideration of the laws regulating evolution that, for him, are to be sought in the mechanism of the biosphere and not in accidental circumstances. For this reason "evolution must proceed, namely, in the direction of increasing consciousness and thought, and of forms having greater and greater influence on their surroundings."5 This consideration leads Vernadsky to domains of philosophical or religious thought. Why?

"We are confronted with a new form of biogenic migration resulting from the activity of human reason. Human thought has changed in a brisk and radical manner the trend of natural processes and has even modified what we call *natural laws.* Consciousness and thought, despite the efforts of generations of thinkers, have never been defined, have never been given a physical basis, in terms of matter and energy."6 And here Vernadsky poses a question that remained unanswered for him but that also leads to a consideration of the noosphere: "How can processes which seem purely physical be affected by consciousness?"7

Although *The Biosphere* is the initial statement and underlying basis of all Vernadsky's later thought and work, his final major study, *Problems in Biogeochemistry II,* translated and published by his son, George Vernadsky, at Yale University in 1944, states the final conclusions of Vernadsky on the intriguing relation of human con-

sciousness-via its thought and projected dynamic, the machine-on the biosphere. These reflections provide us with a means for defining more precisely the nature of the technosphere and noosphere.

FROM THE CREATION OF THE TECHNOSPHERE TO THE ADVENT OF THE NOOSPHERE

Vernadsky developed the biosphere into a full scientific description of the sum oflife and its support systems on Earth, and was a co-originator of the concept of the noosphere, yet he seems never to have used the word or concept of the technosphere. In some of Vernadsky's descriptions of the relation of man and his thought on the biosphere, however, the technosphere is absolutely implied. In reading the following chain ofVernadsky's thought, we can discern what we refer to as the biosphere-technosphere-noosphere continuum:

> Man by his work and his conscious attitude toward life is remaking a terrestrial envelope, the geological domain of life, the biosphere. He is transforming it into a new geological state, the noosphere.
>
> He creates within the biosphere new biogeochemical processes that did not exist before. A planetary phenomenon, the biogeochemical history of the chemical elements is notably changed.
>
> An immense new form of biogeochemical energy is represented by the technological work of man, complexly guided by his thought. It is interesting that the increase, in the course of time, of machinery in the structure of human society also proceeds in geometrical progression, just like the reproduction of any kind of living matter, man included.
>
> Statesmen should be aware of the present elemental process of transition of the biosphere into the noosphere. The fundamental property of biogeochemical energy is clearly revealed in the growth of free energy of the biosphere with the progress of geological time, especially of its transition into the noosphere.8

In this sequence of thoughts, we understand that Vernadsky, in his precise location in time, was himself the necessary voice of the biosphere giving rise to the noosphere. Put in another way, the very process that Vernadsky is describing-the transition of the biosphere to a new geological state, the noosphere-necessitated a coming into consciousness of itself, a self-reflective medium and voice. This self-reflective medium and voice of the biosphere-noosphere transition was Vernadsky

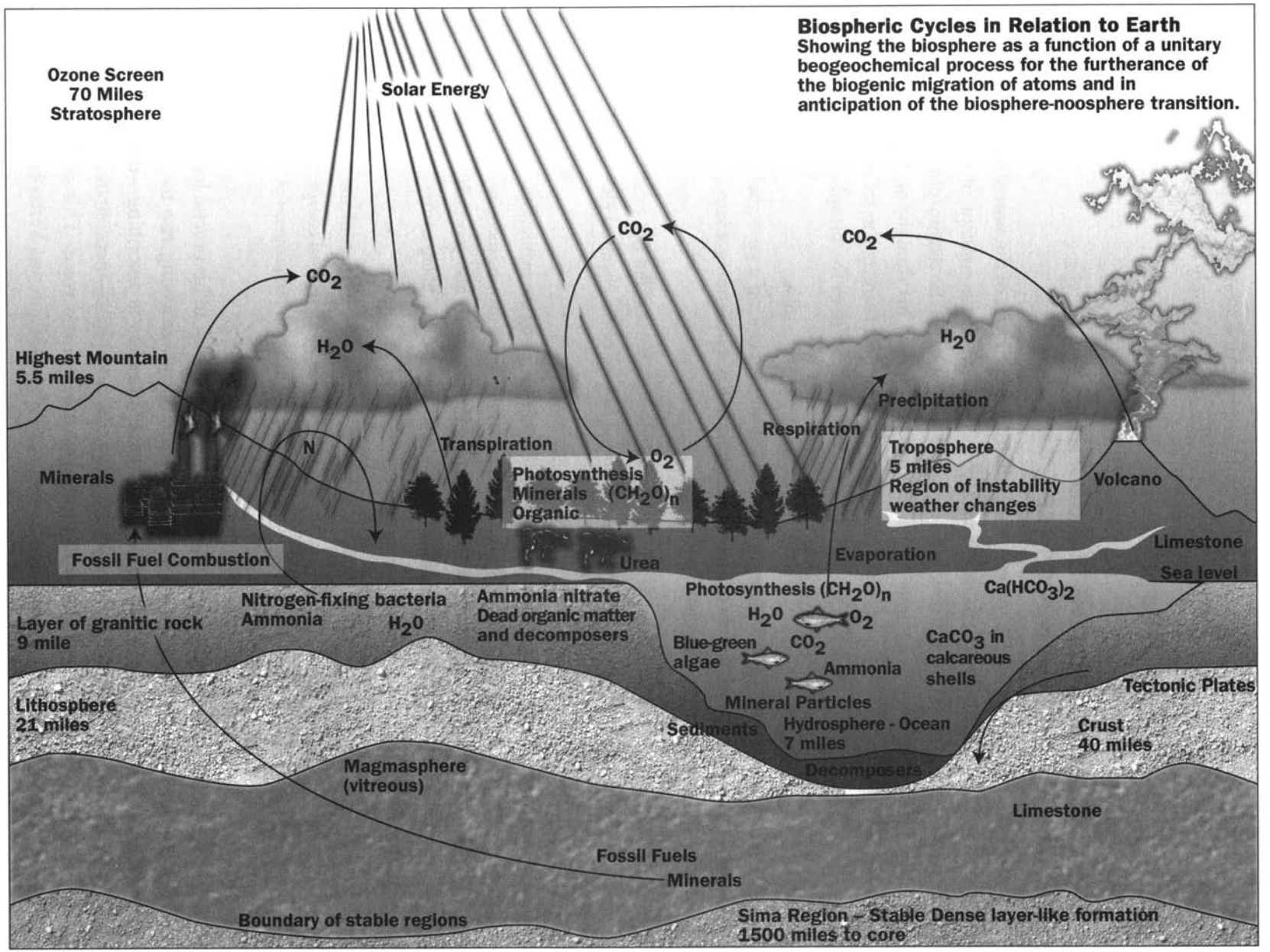

Biospheric Cycles

himself. In this observation we may understand that, although unconscious until it was made precipitant by the accelerated biogeochemical combustion itself, the order of the noosphere is none other than what the Law of Time defines as the synchronic order. As the structure of fourth-dimensional time, the synchronic order is a fluid, radial chronomantic structure in which time, telepathy, and consciousness are united in ways unpredictable to even the most advanced Western systems of mathematics.

For Vernadsky the sum properties of the elements of the biosphere are the functions both of mathematics and of different kinds of geometries. It is of note that in the summation of the differences between inert and living bodies according to three factors, the first being energy and the second chemical manifestations, Vernadsky defines the third factor as "differences in regard to space-time." Of this factor, Vernadsky writes:

> In considering space-time, however, the situation becomes rather involved. Here we enter, on the one hand, a domain not studied scientifically, and on the other hand, that substratum of all natural phenomena, namely their geometry, which the naturalist in his scientific work is wont to dismiss without attention. This substratum, the geometrical state of physical space, underlies all physiochemical phenomena and perhaps has an even deeper reality than that of the phenomena themselves.9

This deeper reality is the phenomenon of time itself, expressed through various geometries or geometrical principles, which informs the manifest phenomena of life. This is an obviously aesthetic factor as well as a cosm.Qlogical principle.

The Dynamics of Time fully substantiates Vernadsky's perception of the geometrical ordering principle of the deeper reality of time:

> All geometric forms are radiative and derive from the fourth-dimensional radial matrix. All fourth-dimensional functions are radial in nature and imply a principle of center from which the structure is projected. . .
>
> Geometry is how fourth-dimensional time incorporates as third-dimensional form. The incorporation of time as geometrical form informs all of the inorganic and organic orders of the realm of instinct. Time incorporated as the geometry of form is the principle example of T(E) = Art. All forms and species participate in varying orders of geometry of form, both in their bodily structure and their forms of process.1o

If the question is asked, Where is this deeper reality of fourth-dimensional time from whence the projective geometries are generated? then we must answer that it is here in the noosphere, the medium on Earth for the transformation of cosmic thought.

It is the noosphere that informs all of the forms of the biosphere, inert and living, as well as producing in all genuine thought a structure and an order that are continuously moving in the direction of greater consciousness. To even think about the noosphere is to be a reflection of it.

As a noospheric medium, Vernadsky's life span was precisely timed to end when the global structure of the technosphere was about to be unconsciously constructed. The ingredients of the technosphere are indicated in the above-quoted passages as the planetary phenomena altering the biogeochemical history of the chemical elements, transforming them into an "immense new form of biogeochemical energy represented by the technological work of man, complexly guided by his thought." It is the increase, over the course of time, of machinery in the structure of human society that proceeds in geometrical progression-just like the reproduction of any kind of living matter, man included-and that constitutes the general nature of the technosphere. The growth of "free energy," the often toxic by-products of the industrial transformation of raw goods into consumer products, becomes the hallmark of the technosphere, the transitional stage between the biosphere and the noosphere.

It is this very point of the elemental process of the production of "free energy" and what it signifies in terms of the transformation of the biosphere into the noosphere that causes Vernadsky to call statesmen to attention. Why? As we know today, fifty-six years after Hiroshima, "free energy" in various manifestations has been causing danger signals to go off throughout the biosphere-from ozone depletion to global warming to nuclear radioactivity. What these danger signals have been telling us is that the techno sphere is coming to a point of its own exponentially accelerating biogeochemical combustion. Statesmen and politicians are advised by Vernadsky because the domain of their political rulership actually encompasses the everyday governing of the technosphere. But, alas, most people, statesmen included, are still unconscious of the existence of the technosphere, much less its role in relation to the biosphere and the forthcoming geological state, the noosphere. Hence, the Inevitable Event.

During much of Vernadsky's life, the geochemical combustion and release of "free energy" was just coming into its own. At his birth in the middle of the nineteenth century, the world was not yet globally industrialized, and without a totally globalized industrial base there can be no technosphere. The critical span of the two world wars, 1914-1945, was for the purpose of establishing the world market-a total industrialized market and communications base for the expansion of technology and the creation of the unifying global structure of the technosphere. The inauguration of the atomic age at Hiroshima, August 6, 1945, marks the precise beginning of

the dual factors: the commencement of biogeochemical transmutation and combustion of the biosphere by the impact of human thought, the atomic bomb and release of nuclear radioactivity into the terrestrial atmosphere; and simultaneously, the beginning construction of the technosphere.

The bomb created a point of critical self-awareness within the human organism as well as producing in that organism an unprecedented sense of its own power. It was this sense of power that necessitated the unconscious impulse toward putting into place the structure of the technosphere. Of course, at the outset the species was only responding to a new, uncharted world situation, fundamentally unaware both of what it was creating as well as of the fact that it was actually constructing something in the nature of a transition between two geological conditions, the biosphere and the noosphere.

It could be said that Hiroshima lit the fuse of the final stage of biogeochemical combustion, the technosphere being the inevitable structure needed for the fuse to detonate at just the right moment. In this regard the synchronic order of the Law of Time ordained a precise 56-year cycle for the existence of the technosphere: 1945-2001. It is important to grasp that in this 56-year cycle the human population quadrupled, expanding from 1.5 to more than 6 billion. The 56-year cycle divides into precise subcycles of twenty-eight years each. The first twenty-eight years, 1945-1973, begins with Hiroshima and ends with the completion of the World Trade Center towers in New York City. This marks the accomplishment of the creation of the "World Market," the actual transformation of the biosphere into the technosphere. The second 28-year cycle, 1973-2001, spans from the dedication of the World Trade Center towers to their destruction by an act of suicidal planetary terror, and marks the phase of "globalization" -the absolute dominance of the materialist market economics, inclusive of the dramatic end of the Cold War in 1990. The very midpoint of the second 28-year cycle is the Harmonic Convergence of August 16-17, 1987, exactly fourteen years after the dedication of the World Trade Center and fourteen years before the inevitable moment of their destruction.

A profound statement of the way in which the Law of Time governs the entire biosphere, inclusive of the artificial and transitional structure of the technosphere, lies in the fact that the Gregorian calendar-an otherwise irregular and confusing pseudostandard of measure-is nonetheless coordinated by the Law of Time to repeat its cycle precisely every twenty-eight years. What this means is that the days of the week and months for the Gregorian calendar year 1945 repeated again in 1973, and yet a third time in 2001. The program prefiguring the Inevitable Event was already tested at Trinity Site (July 16, 1945), and established as the atomic destruction of

Hiroshima (August 6, 1945) and Nagasaki (August 9, 1945). This program of mass destruction was sublimated in 1973 as the triumphant completion of the Twin Towers of the World Trade Center, only so that in 2001 they could be the apocalyptic target of the inevitable 9-11 planetary red alert and moral emergency catastrophe, the only rival of Hiroshima and Nagasaki in fifty-six years. We shall return to this point later in our discussion on the Law of Time and the role of calendars as macro-organizing, programming factors that control the functioning of the human in the biosphere.

It is of special note that the very last work published before Vernadsky's death was the essay "Some Words about the Noosphere." In his vision, Vernadsky could hardly have conceived of what was to occur first as the technosphere. Yet, he wrote in this last essay, published 1944:

> The historical process is being radically changed under our very eyes. For the first time in the history of mankind the interest of the masses on the one hand, and the free thought of individuals on the other, determine the course of life of mankind and provide standards for men's ideas of justice. Mankind taken as a whole is becoming a mighty geological force. There arises the problem of the *reconstruction of the biosphere in the interests of freely thinking humanity as a single totality.* This new state of the biosphere which we approach without our noticing it is the noosphereY

By contrast, Teilhard de Chardin, in his most famous book, *The Phenomenon of Man* (1959), defined the noosphere as a "new canopy," a "thinking stratum" that has been unfolding since the end of the Tertiary period, and has since been unfolding discontinuous with and above the biospheric world of plants and animals. Teilhard de Chardin also speaks of "planets with noosphere," those worlds where the enlightenment of humanity has become synonymous with the life of the planet as a whole system. The one path to the noosphere defined by a scientist in Marxist Russia and the other by a Catholic biologist both point to the same radically positive end vision of the evolution of humanity, a fact that in itself is a dissolution of any kind of contradictory dialectic. Only history is governed by the merciless dialectical movement of matter and thought, rich and poor, material and spiritual. Clearly, therefore, the noosphere is beyond or after history. In this regard then, the technosphere is the concluding stage of history, to be followed by the post-historical noosphere.

The establishment of the techno sphere after his death notwithstanding, it is still important to listen to Vernadsky's idealism with regard to the noosphere: "The problem of planned, consistent activities which will aid us in mastering nature and accomplishing the correct distribution of wealth, connected with the comprehension of the unity and equality of all people, of the unity of the noosphere, is now on the

agenda. . . It has become clear, and is more deeply penetrating the consciousness of mankind, that we now have a real opportunity to obliterate malnutrition, starvation, and poverty, to greatly diminish the incidence of diseases, and prolong human life to the maximum."12 Other thinkers like R. Buckminster Fuller have uttered similar statements, that we have all that is needed to adequately take care of everyone on the planet. It is important to understand why this optimism has yet failed to be substantiated. If anything, the inequality in wealth between that of the several hundred billionaires in the world and that of the poorest one-third of humanity, two billion humans, was never historically more disproportionate than it was at the moment of the Inevitable Event. This inequality of wealth, too, is a situation endemic to the very processes of the technosphere, otherwise known as the military-industrial complex.

In 1970 an American scientist, G. E. Hutchinson, wrote in the *Scientific American,* "By noosphere Vernadsky meant the envelope of the mind that was to supersede the biosphere, the envelope of life. Unfortunately the quarter century since those words were written has demonstrated how mindless most of the changes wrought by man on the biosphere have been. Nonetheless, Vernadsky's transition in this deepest sense is the only alternative to mankind shortening its lifetime by millions of years."13

A similar assessment was put forward in 1979 by the Belgian ecologist P. Duvigneaud in his presentation "Noosphere and the Future of the Vegetation of the Globe." In his address regarding the extermination of natural ecosystems made to the Twelfth International Botanical Congress, Duvigneaud makes one of the earliest and most prescient uses of the word *technosphere:* "Thus, the noosphere, so dear to Vernadsky . . . is running the risk in reality of turning into the technosphere, or rather into 'the sphere of avidity,' governed by the spirit of fortune-hunting, by mediocrity, by the absence of social consciousness, by the ideal of destruction and by the egotistic doctrine of 'after me, the deluge.'"14

To be precise, it was in 1973, the same year of the Club of Rome's landmark publication *The Limits of Growth,* and of the establishment of the World Trade Center in New York, that the technosphere became a coherent structure smothering the biosphere, co-opting the noosphere, and coordinating the very processes of greed and destructive fortune-hunting abhorred by the ecologist Duvigneaud. Like it or not, the techno sphere was the inevitable result of the unloosing of the machine into the biosphere. It may be asked: if the machine is a projection of human biology, then what purpose does it actually serve in the biosphere, and what is it that actually produced it and keeps it going?

Before turning our attention to the answers to these questions, let us first define the technosphere as being the artificial structure replacing the human civilization,

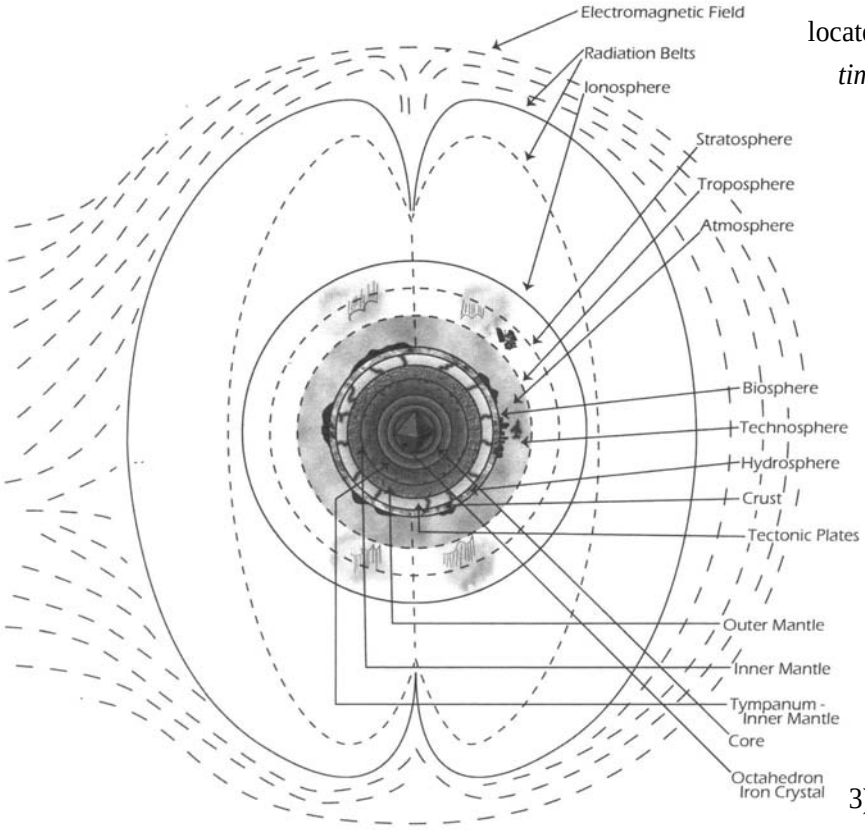

Earth's Mantles

located mentally and physically *in time* as a force intermediate to and between the biosphere and noosphere. Defined by the *Biosphere Catalogue* (1985, p. 103), the artificial structure of the technosphere consists of five interlocking, coordinated systems that comprise an integral whole, both as a belief system and as an actual complex technological dynamic and its coordinating apparatus. The five components, which we shall discuss at length in later chapters, are: 1) commodity production, 2) the city, 3) energy, 4) transport, and 5) communication. And, according to the *Biosphere Catalogue,* the planetary core of this interlocking set of systems was none other than the World Trade Center's Twin Towers.ls

As a planetary sphere, the technosphere takes its place with the other spheres or mantles comprising the structure of the Earth as a whole system. Beginning at the outermost etheric realm and proceeding inward, these spheres or mantles include: the electromagnetic field with its radiation belts, then the ionosphere, stratosphere, troposphere, atmosphere, technosphere, biosphere, land-ocean crust, tectonic plates, lithosphere, outer and inner mantles, and finally the core, now known to consist of an outer tympanum, and within it a large octahedral iron crystal afloat in a sea of magma.

As a planetary sphere, the technosphere negates time and consciousness as organic realities and replaces them instead with mechanization and marketing. Yet the technosphere is a product of mankind, and mankind is a function of the biosphere. The organization of life into biomes, large macro-ecosystems, is still evident, though in diminishing and withering proportion to the conquest of the technosphere. With the Final War now upon us, the question we must ask is: will the technosphere collapse before the biosphere or not? As catastrophic as it might seem, the collapse of the

technosphere would actually be a blessing in disguise from which the noosphere could finally be realized. But if the biosphere collapses first as the result of the Final War on Earth, then the technosphere will be futile, pointless, and dead as well. These are most dire thoughts in these most dire of times. Yet if we can now finally understand and accept our role within and subordinate to the biosphere as a whole, then our chances for survival will be greatly improved.

Let us consider again what Vernadsky has to say about the human's place in the biosphere:

1. Man, as observed in nature, like all living organisms, like any living matter, is a specific *function of the biosphere,* within its specific definite space-time.

2. Man in all his manifestations constitutes a regular part of the structure of the biosphere.

3. The *explosion* of scientific thought in the twentieth century *has been prepared for by the entire history of the biosphere* and has its deepest roots in the structure of the latter. The civilization of "cultured mankind," insofar as it is a form of organization of the new geological force which has formed in the biosphere, *cannot be interrupted or destroyed,* since it is a great natural phenomenon, historically, or rather, geologically corresponding to the established orderliness of the biosphere.16

If Vernadsky is correct, then the war we are witnessing is the inevitable conclusion of the biogeochemical combustion that consumes the technosphere and establishes the pristine reality of the noosphere. This is especially true if we understand this war to actually be a geopolitical struggle for the control of the oil reserves of the Persian Gulf, or even more broadly, as the war between matter (globalization) and spirit (Islam), or more grimly, as Oswald Spengler put it, the final war between blood and money. This being the case, it is more important than ever to answer the two unresolved questions in Vernadsky's definition of the biosphere, the question of consciousness and the question of time.

According to the Law of Time, the answers to the questions posed by Vernadsky are actually one and the same thing. "How can processes which seem purely physical be affected by consciousness?" The question asked by Vernadsky at the conclusion to *The Biosphere* is equaled by the unresolved issue of time discussed at the conclusion to *Problems of Biogeochemistry* JI.1n essence, Vernadsky declared, we know everything about the biosphere, its governing laws, principles, and functions, with the exception of the mysterious relation of time to the biosphere. Virtually alone among modern scientists,

Vernadsky perceived that time actually has nothing to do with the metrics of space, and that "time is not a dimension of metric geometry." This means that time is not only its own dimension-the fourth dimension-but that time must also have its own metrics and system of measure totally apart from the metrics of space.

> Minkovsky's and his predecessors' concept of time as the fourth dimension of space is a mathematical abstraction having logically no ground in scientific reality. Time is not a dimension of metric geometry. In geometry, time may be expressed vectorially, but it is obvious that such an expression does not embrace all of its properties in natural phenomena studied by the naturalist. . . The time of the naturalist is not the geometrical time of Minkovsky, nor is it the time of mechanics and theoretical physics.[I?]

In Vernadsky's perception of time, there is a profound critique of the approach that has been established toward the measure-and hence understanding-of time in physicalist science. For Vernadsky, time is a function of an as-yet-unrealized geometry: "This geometry would reduce all space to a point supplied by an infinitesimal vector." Clearly time is a factor in all the functions of the biosphere, most evident in the biological life processes. Hence the Law of Time has been a regulating factor, the true nature of which we have been profoundly unconscious. Now here is an interesting reflection. If the biosphere as a whole system is tending toward a total whole system transformation into a state known as the noosphere, a fact perceived by Vemadsky during his lifetime, and the two unresolved issues are the issues of time and consciousness, both materially intangible dimensions, does it not seem correct that the resolution to these two issues will actually foster the manifestation of the noosphere, which is, after all, the mental envelope of Earth? And does it not also seem that as long as the two issues of time and consciousness remain in a state of ignorance or confusion within the mental functioning of the human order, that the vehicle of geochemical combustion, the technosphere, will tend toward its own dissolution until the issue of time and consciousness is resolved and clarified once and for all?

The perilous passage, the biosphere-noosphere transition, may actually be defined as the consequence of operating in ignorance of the actual nature of time and consciousness. In this way, the techno sphere may be defined as the artificial compromise in place of the true understanding of time and consciousness of the human order in the biosphere. Hence, the technosphere is the responsible intermediary agent creating the crisis of the noosphere. The solution to the questions of time and consciousness is thus the solution to the noospheric crisis, and the commencement of the grand new era, the true golden age of the whole Earth.

3

Time and Human Consciousness

The Law of Time—What It Is and Where It Came From

HAVING DEFINED the technosphere as the intennediarystage in the biogeological continuum of the biosphere's evolution into the noosphere, we may now turn our attention to the unresolved issues of time and consciousness in the biosphere. These issues must not be seen as just the problems of humanity. Since humanity is a function of the biosphere, the issues therefore relate to the biosphere becoming more conscious. It is the conscious aspect of matter that directs the biosphere toward its transfonnation into the noosphere. It is the discovery of the Law of Time that complements and resolves the issues that were left unresolved in Vernadsky's definition of the biosphere and of its transformation into the noosphere. The question then arises: what is the Law of Time, and how does it define time and consciousness as mutually coordinating factors of the same cosmic dimension intersecting with the biosphere?

To say the least, time is such a vast and important topic in the orientation of human consciousness within the biosphere that we may declare that it is paramount in all human affairs. Indeed the cosmic order, of which the biosphere is the dynamic regulatory mechanism on planet Earth, is itself the expression of time as the medium of universal manifestation. Yet, as Vernadsky perceived in 1944, while we have defined space by its own systems of metrics and geometries, by applying these same standards to time we have not defined or known time at all. The cause for this quandary seems to lie in the fact that while space is perceptible as a sensory medium-we can see it, touch it, hear through it-and hence, it is evidently measurable, the same is

not the case with time. Time is of the mind, and in this regard, time is inseparable from the issue of consciousness. In fact, you cannot know or experience time without becoming conscious.

Yet, as we shall see, there is a great confusion when we speak about time, which is actually at the root of the problem of the biosphere, and that is the matter of the clock. In human consciousness, the clock has become so second nature that very few people in industrial society can think of time without immediately associating it somehow with the clock, whether as an instrument or as a metaphor. This, as we shall see, is a major factor causing the general state of consciousness to remain static, especially in relation to the machine, which is continuously increasing in speed, as well as accelerating in the propagation and multiplication of itself. This factor of the clock-in other words, of mechanized time-is also at the root of the confusion concerning the nature of time in much of modern scientific thought. As we shall see, there is a stream of Russian thought after Vernadsky that represents a notable exception to the established view of time in modern thought and science. Suffice it to say that the evolution of modern Western thought and science has been programmed and predisposed to limit its consciousness of time to such a degree that it cannot even perceive of time outside its inherently mechanized perceptions about it. In this obviously also lies the problem of the delimitation of consciousness in the technosphere.

"The deepening crisis of the world outlook is rooted in the permanence of the dominating scientific paradigm," writes Russian scientist Maria Maroushkina. "Underlying the materialistic technocratic civilization is the Newtonian-Cartesian paradigm, formed in the Middle Ages, its nucleus being the laws of gravitation and movement, as well as the logical principles of proof, laid down by Descartes."! This "permanent" stratum of belief, a cultural metaprogram, locks every field of human endeavor into a conquest by mechanization. It is this metaprogram rooted in the simple unexamined device of the clock, and orchestrated by the equally unexamined effects of an irregular calendar, that keeps human consciousness unchanged and without any real solutions to its problems. As the problems worsen, the confusion of consciousness-which is really in a state of crisis-only deepens.

To illustrate the current state of confusion regarding time in Western thought, we have the report of the prestigious Seven Pines Symposium on Time held in Stillwater, Minnesota in June, 2001. The *New York Times* article regarding the Seven Pines Symposium is entitled "Physics' Big Puzzle Has Big Question: What Is Time?"2 First of all, the assumption that time is basically a topic of physics in itself is a problem, since time, as we have demonstrated, is actually mental in nature, and if any-

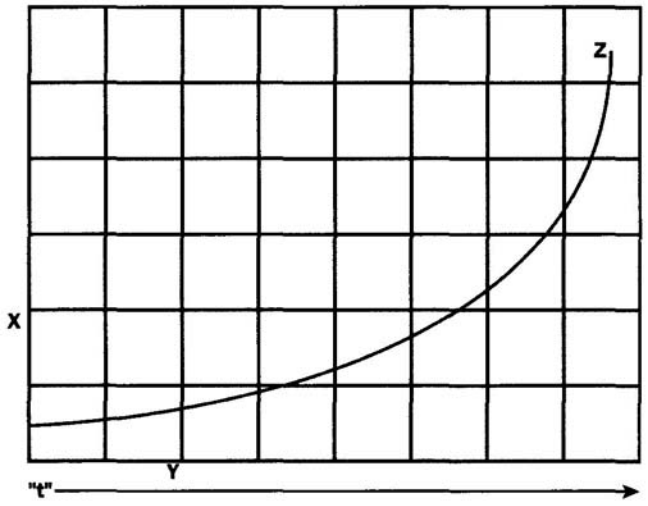

"Arrow of time" in modern scientific three-dimensional coordinate graphing, reinforcing illusion of linear time.

Arrow of Time

thing is most visibly manifest in the domain of biology or biogeology. But this headline is also reflective of the paramount role that physics plays in the Western intellectual hierarchy: if physics can't solve it, than what can?

Despite the prominence of physics and physicists, the Seven Pines Symposium included historians and philosophers as well. The hope of the symposium was to arrive at a unified theory that encompasses the effects of gravity as described by Einstein's general theory of relativity and the "fuzziness that occurs in the realm of tiny particles according to quantum physics."3 Here we have the problem of time as delimited by the self-imposed spectrum of modern physics. What then could we expect? Certainly no one here had considered the point made by Vernadsky that time is not a function of the metrics of space, which is the realm of physics. So it is not surprising that the symposium ended in a muddle, with the most prominent approach being that time could merely be a "psychological illusion" important to humans but not a fundamental part of any unified theory. It is also clear that few, if any, had considered that their views on time might be absolutely conditioned by the mundane and ordinary everyday micro- and macro-organizing factors: the mechanical clock and the Gregorian calendar with its second cousin, the Julian count of linear time.

From the point of view of the noosphere, of course, this grand Symposium on Time was reflective of very little of the entire human organism, much less of the biosphere itself. The symposium was a representation of the elite intellectual class of the dominant economic, military, and political power of the planet, and hence of the

governing force of the technosphere, the United States of America. But if a realization that we are a function of the biosphere is critical to our success in launching the noosphere, and the issue of understanding the correct relation of time to the biosphere is crucial even to the ability to launch the noosphere, then the Seven Pines Symposium did not even approach the actuality of the current biospheric situation or the nature of time. In this regard it was only a contribution to further the psychoatmospheric density-clouded thought without clarity of purpose-and one more reason why the Inevitable Event was on the biosphere's agenda.

If one does not apply certain biospheric yardsticks to the analysis of what is reported as truth, then we will be sunk in a chaotic morass of half-truths that are really obscurations or even lies. The elite American nation, for instance, constitutes only 5 percent of the world's population, yet consumes 40 percent of its natural resources, and therefore has the wealth and power to maintain the military force (allotted a $318 billion budget for 2001-2002) to protect and even further as its right this disproportionate ratio, which is actually a violation of the dynamic balance of the biospheric processes. For this reason, through its official organs of propaganda such as the *New York Times,* America is able to muster the "influence" of whatever occurs within its confines as somehow having more merit than what might be generated in some other nation or country. So a human may read the story in the *New York Times* on the "Big Puzzle of Time," and most likely they will complacently accept its premise as absolute truth. Yet this social construct of symposium-and-newspaper-story is nothing but an aberrant mental form that obscures the actual nature of time and keeps the mental level at a constant state of "industrial dull-normal," far removed from-or at best, little more than a highly distorted reflection of-the reality of the noosphere.

Leaving aside this example of the mental confusion over time, it is necessary to understand from the investigations regarding the biosphere and according to Vernadsky's own judgment, that the biosphere in all its intricate and interlocking processes possesses and is guided by a great order and even a structural dynamic that, being manifestations of the laws of nature, can be given exact mathematical formulation. Why should we not expect that the nature of time in the biosphere should also be characterized by the same orderly quality? In fact, given that the biosphere is actually a life process, like all living matter it too must be governed by timing cycles. Thus the larger order of time that governs the cycles of the biosphere and of the noosphere must also exhibit a grand ordering principle. For if the three dimensions of space govern the domain of the physical world, then the fourth dimension of time-which governs the life not only of the biosphere but of planets,

star systems, whole galaxies, and indeed the entire universe-must also consist of a simple, orderly formulation totally apart from the perception of time that governs the stunted consciousness of the technosphere. Such is the Law of Time.

THE FOURTH-DIMENSIONAL NATURE OF TIME

> *"Even though you do not measure the hours of the day as long or short, far or near, you still call it twelve hours. Because the signs of time's coming and going are obvious, people do not doubt it. Although they do not doubt it, they do not understand it. Or when sentient beings doubt what they do not understand, their doubt is not firmly fixed. Because of that, their past doubts do not necessarily coincide with their present doubt. Yet doubt itself is nothing but time."*
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> -DOGEN, "THE TIME-BEING"4

These prescient words of a thirteenth century Japanese Zen master are more true today than they were when he wrote them. Comprehensive studies like the *Eranos Yearbook III: Man and Time* (1957), which included Carl G. Jung's ground breaking essay on synchronicity, or James T. Frazier's fascinating and monumental *Voices of Time* (1966), only expand the multidisciplinary breadth of the confusion about time. In the 1970s Frazier helped found the International Society for the Study of Time. The Society is still meeting annually but has yet to reach a definitive agreement on or understanding of the question of time. It is in the context of the enduring confusion over time that the Law of Time was discovered. To say that the Law of Time has been "discovered" only means that a principle and fundamental law that has always guided the order of the universe has finally been made conscious and articulated in a precise way that is recognizable to the present condition of the human mental nature, which is still dominated by the physicalist model.

In the whole of modern physics, Minkowski's fourth dimension of time has been misunderstood and treated as if it were a minor dimension, one that is just added on, but not really significant to the level of the three dimensions of space. This is due to the already space-oriented consciousness deriving from certain sets of perceptions established early in the history of civilization and standardized through certain programming models that are based on the metrics of space and not time, a topic to

which we shall soon turn. It is for this reason that in the formulations of modern physics time is symbolized by a small *t* that runs in a horizontal line running from left to right at the bottom of any graphing of space with its *x* and *y* coordinates.

This graphing of small *t* time gives rise to the notion of the "arrow of time," which is virtually a bedrock dogma of much of modern Western physics. This is the much-touted notion of linear time that supports doctrines of economic inexorability, material progress, and the like. Of course to anyone versed in the ways of nature, linear time and the arrow of time can be seen as nothing more than artificial constructs, for the biological nature of time is perceptible at the very least through the great interlocking cycles of nature. Nor is there anything linear about the Earth's rotations around the sun, or of the moon around the Earth, all of which give lie to the physicalist and materially progressivist notion of linear time. Only the technosphere, sustained in its structure by the limited consciousness of time, is driven by this linear principle and for this reason is doomed to run aground on the shoals of its own artificiality.

TIME AS THE UNIVERSAL FACTOR OF SYNCHRONIZATION

The nature of time is grasped poetically in the form of cycles: "To every season there is a time. . ." Biorhythms can even be mapped and the cycles of the biological order of reality can be demonstrated as functions of a chronobiology. But the biological cycles only demonstrate the manifestation of time in the space ofliving matter. If the whole of nature is observed, then one can begin to grasp the masterful orderliness by which every least detail occurs in relation to all the other details in their various cycles-yes, one can grasp in this phenomenal order another deeper aspect of time, and that is time as the universal factor of synchronization. This is the synchronic order of time, the order by which everything in the universe occurs simultaneously in a masterful synchronization from moment to moment in an ever-changing kaleidoscope of infinite varieties of order and harmony.

Only historical man deviates from this masterful symphony of time, the synchronic order. Nonetheless, we speak of being "on time," "in sync," "in tune," "in resonance," "in harmony," or of being "tuned-in." All of these expressions refer to the attunement of time and the nature of consciousness as awareness in the present moment, in the here and now. This is possible because the same law governs both time and the relation of consciousness to the moment. To answer Vernadsky's question, "How can processes which seem purely physical be affected by consciousness?"- the physical is affected by consciousness, because consciousness is actually a

function of time. When someone "discovers" a law of nature, it is because their consciousness is attuned to the natural process in time, and the law therefore "reveals" itself.

But this consciousness can be and most often is of a profoundly unconscious nature. Time is actually the governing principle of a higher self-existing consciousness that regulates the order of the universe, both in regard to its living and non-living matter. Because time continuously synchronizes everything into a single coherent whole from the micro to the macro levels, time accounts for the harmony of the universe. Only man deviates from the universal harmony, and the technosphere, a projection of the human mechanization of time, intrudes upon the intrinsic harmony to the point of its own demise, but man deviates for a purpose.

The harmony manifested by time as cosmos-which literally means "order" -gives rise to the great and simple formulation of the Law of Time: T(E) = Art; Energy factored by Time equals Art. This means that energy, any manifestation of the physical three-dimensional world, possesses order and is in harmony with its environment because it is factored by time. In the conception of the Law of Time, however, capital *T* refers to time as the universal factor of synchronization. As the universal factor of synchronization, time is defined by the self-existing and intrinsically perfect mathematical ratio 13:20. Derived from the mathematics of the ancient Maya, this ratio is a universal constant of time that organizes all of the universe as a radial sequence of synchronous moments reflecting different evolutionary phases simultaneously. Because everything perceived is an aspect of instantaneous universal synchronization, time is also the medium of instantaneous information transmission throughout the universe.

The noted Russian astrophysicist N. A. Kozyrev (1908-1983), whose work began half a century ago with the theory of the internal structure of stars, later conducted a famous series of experiments using telescopes, mirrors, and aluminum, in which he was able to confirm a receipt of information from distant galaxies prior to the time it took the information to arrive via light as a physical medium. In Kozyrev's own words: "The tests proved the existence of the effects through time of one material system upon another. This effect does not transmit a pulse (momentum), meaning it does not propagate but appears simultaneously in any material system. In this manner, in principle it proves possible to have a momentary relationship and a momentary transmission of information. Time accomplishes a relationship between all phenomena of nature and participates actively in them. . . . Time contains the entire universe of still unexplored phenomena."5 The results of these experiments led Kozyrev to various conclusions, among them that time and duration are not the

same thing, and that the velocity of time is instantaneously infinite, formulated as

$$T_V \longrightarrow \infty$$

Formulation: velocity of time is instantaneously infinite

This being so, time must also be the factor or medium that accounts for the experiences of telepathy or other paranormal phenomena. A second, most provocative conclusion derived from his experiments is that time is actually generated as an instantaneous and even simultaneously radial transmission of information from the core of stars, a fact confirmed by the Law of Time's description of the synchronic order of time as being radial in nature.

FURTHER EXPANSES OF FOURTH-DIMENSIONAL TIME: THE EVOLUTION OF TIME AS CONSCIOUSNESS

Leaving aside for the moment further discussion of Kozyrev's seminal work and its conclusions, at this point let us summarize the two chief qualities of time as defined by the Law of Time: 1) time is the factor of universal synchronization, and 2) time possesses an infinite instantaneity of velocity that is faster than the speed of light, and hence is correlated with telepathy. From these two determining features of the nature of time, two other corollary conclusions may be drawn: 3) the cyclic nature of third-dimensional biological phenomena is a function of the factor of universal synchronization which establishes harmonic ratios that determine the different life processes of different organisms, while 4) the ability of any species or organic whole to maintain its unity with itself and all of its members or parts is an instantaneous function of time as telepathy.

To better understand the Law of Time and its radical non-linear definition of time-which is actually the noospheric description of time-we may say that time, being synchronically instantaneous, is both "vertical" in relation to space (which is "horizontal"), and "radial" from the perspective of its own dimension, the fourth. Rather than being the small *t* line or arrow at the bottom of the physicist's graph, time as the fourth dimension is greater than and inclusive of the third dimension, much as the etheric atmosphere includes and surrounds the physical Earth in a radial "all-at-onceness." To try to measure this phenomenon with the metrics of space and its essentially linear yardsticks is to constrain time into definitions and descriptions that are totally alien to its nature.

In fact, from the point of view of the dynamics of time, it is space that is the moving line, or rather a set of points in a moving vector that can be described as

line. Let us extrapolate from the important observation made by Vernadsky at the conclusion to *Problems in Biogeochemistry II:* if the geometry of time reduces space to a point supplied by an infinitesimal vector, then from the point of view of time, space is an infinitely locatable point. What is this point? It is the point of awareness at which an individual body becomes aware of time. Here, the "subjective" description or experience of time cannot be separated from the issue of consciousness. (See plate 3, Model of "Vertical Time" in Relation to Horizontal Space.)

In the description of time as vertical in relation to horizontal space, this point of awareness of a body in time is defined as the Locus of Consciousness, or L of C. In the flow of moment-to-moment instantaneity that is synchronous with the flow of space, the Locus of Consciousness is that point at which time vector and space perception connect. From this defining point of consciousness in the here and now, the flow of space creates a horizontal sensation: one direction flows to the "past," the other to the "future." This is what is normally defined as the sensation of time or the arrow of time. It is actually the definition of the horizontal flow of space in relation to vertical time. What is usually not considered is the vertical dimension of time that connects awareness to space at any given moment, creating sequences of Awareness Units, or AUs.

From the defining point of the Locus of Consciousness, there are essentially two spaces and two times: *near space* and *far space,* and *low time* and *high time.* Near space corresponds to low time and far space corresponds to high time. Near space is essentially defined by the perimeter of sense experience, inclusive of the extension of the senses through technological apparatus such as telescopes, microscopes, and the like. This is the domain oflow time. Far space is defined as that space beyond the perimeter of the sense perceptions, and is characterized by subliminal sensory perceptions. This is the domain of high time and the atemporality of space. In near space, low time is characterized by what appear to be "random events." The lower the time, the greater the increase of random events. Low time and near space define the qualities of the experience that are properly and purely third-dimensional. High time and far space are purely and properly the domain of the fourth dimension characterized by the dominance of the synchronic order of time.

The distinction between low time and near space and high time and far space is defined as the threshold of synchronicity. In high time, synchronicity (s) predominates and is greater than random events (re), or (s»(re). In low time, random events predominate and are greater than synchronicity, or (re»(s). Note that the realm of quantum physics occurs in the microrealm of far space. It is this factor that accounts for the "fuzziness" of the behavior of subatomic particles, quarks, tachyons, and so

forth, which defy the limitations of linear time. These phenomena occur in the subliminal realm of the synchronic order. It is the human mind that is not accustomed to behavior in the pure realm of synchronicity that cannot grasp that these particles are moving according to radial laws of fourth-dimensional time, and so appear highly irregular and random to the sense perceptions of the observers that are totally conditioned by third-dimensional space perceptions. Similarly, the high time of the macro threshold of the synchronic order represents the "other side," the "hereafter," the realm of pure vision, which is also governed by strict laws of radial time, and which, to the conditioned experience of a perceiver on this side of the threshold, may appear as something from a distant future or past reality, or even as in a dream. The orderly explication of the Law of Time provides complete mathematical descriptions and principles that account for the radial order of time, even as it coordinates the near space and low time of random events.

In any case, the horizontal line of space in relation to the vertical line of time defining any given Locus of Consciousness describes the macroworld above and the microworld below. As we have noted, the higher threshold of synchronicity above the horizon of space defines the realm of *higher consciousness*; the lower threshold of synchronicity below the horizon of space defines the realm of *quantum physics.* Connecting the macro realm of atemporality and high time, and the lower or micro realm of atemporality and high time, is the vertical time vertice of the ever-present now. At the two far ends of this time vertice of the ever-present now is the Locus of God, the selfsame in each direction. These extreme points of the vertice of time return far space to the Locus of Consciousness through a process of toroidal sublimation. We are not really dealing with a description of a two-dimensional plane, but a dynamic four-dimensional model held together by a toroidal motion that is continuously returning the farthest space and the highest time, whether from above or below the threshold of synchronicity-" God" -to the Locus of Consciousness.

Depending on the clarity of mind at any given moment, the vertice of time constantly and instantaneously transmits information to the Locus of Consciousness. The discrete units of information thus transmitted are referred to as *celestial harmonics.* A celestial harmonic is described as the index of synchronic incidence defining different levels of co-occurrence. I can be in the present moment sitting in a room, and at the same time, by being fully present in the here and now, I can spontaneously experience any number of telepathic thoughts, memories, feelings of deja vu, and so forth. These experiences are the different levels of co-occurrence that define the index of synchronic incidence and are categorizable as celestial harmonics. The higher the time, the greater the density of celestial harmonics per AU (Awareness Unit). It

is the vertical vertice of time and its power of transmission that account for the visionary or revelatory experiences of saints, poets, and mystics throughout the ages. It is the mathematics of the Law of Time that provides the "mapping" that explains, identifies, and even increases these different harmonic incidences of the synchronic order.

Because the vertice of time connects ultimately to the "Locus of God" -the mutually defining points that become One at the far ends of the toroidal motion of the vertex of time-this accounts for the existence of the *perennial philosophy,* the unitive nature of the most revelatory or ecstatic experiences of the great mystics and seers. It is also the relation of awareness in the Locus of Consciousness at any present moment that allows any random event of low time to trigger telepathic ascent into high time depending on the clarity of and duration of the Awareness Unit (AU). From this point of view, the random quality of events in near space is only relative in relation to the absolute nature of the synchronic order, and merely a function of the third-dimensional biological space orientation. For those accustomed to the actual nature of fourth-dimensional time, which includes and controls the third-dimensional order of near space, the random events constituting low time are actually "signs" that may be read as message bearing signals of the synchronic order of high time.

Brief reflection on this description of vertical time in relation to horizontal space will demonstrate the value of what is referred to as *meditation without an object* such as that cultivated in the Buddhist traditions, as well as affirm the One Divine Source of the purely monotheistic traditions. Without a clear mind of awareness in the present moment there can be no clear seeing of reality, nor can there be the realization that all of what our senses report to us is constructed in our own mind to conform to what we think is a universe outside of us. At the same time, if we can extend the duration of our awareness in the Locus of Consciousness indefinitely in the vertical direction of time, we come upon the ineffable experience that is an emanation of the Locus of God, however or in whatever "language" our senses may later report or define such experiences. Thus we return to the paradox of the definition of space as an infinitely locatable point-this point is none other than our own minds, in which the construct of space is created and dissolved from moment to moment. Such is the subjective description of time from the point of view of the Law of Time, a description that begs each one of us to take absolute responsibility for our own experience. But there is an "objective" description as well, in which time is also defined as inseparable from consciousness.

Implicit in the subjective here-and-now description of the experience of time is the radial matrix of time. At the experiential level it is the now-centered point in the Space-Locus of Consciousness which defines the center of a radial order of time.

Time radiates out from each here-and-now awareness moment. But the Law of Time also supplies an objective description in which the radial nature of time has two points of determining order: the point of infinite lucidity and cosmogenesis, which is the Locus of God; and the receptive locus of the infinitely locatable point, which is space as constructed by each individual consciousness. Intermediate between the two points-Locus of God and Locus of (individual) Consciousness-is the determining radial matrix of fourth-dimensional time, the universal frequency of synchronization.

Mathematically defined as the ratio 13:20 and described by the 13 x 20 matrix of the Harmonic Module, in this mathematical model of fourth-dimensional time we perceive the root of the Law of Time and its basis in the mathematics of the Mayan time science. It is important to understand very clearly that the 13:20 frequency and the mathematical matrix that defines the operations of this frequency of synchronization are the pure mathematics of time totally apart from the metrics and geometries of third-dimensional space. This is a point of profound significance to which we shall later return.

In the model of objective time, the dynamics of the Law of Time are demonstrated as the evolution of time as consciousness. Here the two unresolved issues of Vernadky's description of the biosphere are unified, the answers to which are the determining factors that allow the triggering of the noosphere: The evolution of time is inseparable from consciousness. Conversely, the evolution of consciousness is inseparable from time. Both time and consciousness are nonphysical fourth-dimensional factors coordinating the third dimension. Because consciousness is synchronized with or by time, it can affect physical third-dimensional processes, in whatever way, whether the acting agent is aware of this or not. Consciousness of the Law of Time, however, is only possible through a profound act of self-reflection. Once it has been made conscious, the discovery of the Law of Time affects the entire medium of planetary consciousness, the noosphere, at first imperceptibly, but then building to a great point of climax coinciding with the climax of the biogeochemical combustion. (See plate 4, The Dynamics of Time: Showing the Evolution of Time as Consciousness.)

This dramatic moment of the discovery of the Law of Time is evident in the graphic description of the dynamics of time, showing the evolution of time as consciousness. The dynamic of the universal, cosmically intelligent, and intelligible whole-the *galacticbrain-is* depicted as a circle encompassing the evolutionary spectrum, showing the index of energy-mind progression from the atomic cellular and biological levels to purely mental conditions of being, all of which are functions of

the formulation T(E) =Art. From the point of God-Galactic Ordering Dynamic- the circle, or rather, sphere, is divided vertically and horizontally into four quadrants. The movement of the evolution of time as consciousness travels out of the God center, from right to left, and thence describes, in counterclockwise circular motion, the movement of time as consciousness passing through, or rather defining, the four quadrants, until it returns to the Source again as hyperdimensional time, or "pure mind." The left-hand side describes both the primary prelife, lower left-hand quadrant, and the primary post-life, upper left-hand quadrant. The right-hand side describes the secondary reflex life, the lower right-hand quadrant being the purely third-dimensional life (biosphere), and the upper right-hand quadrant being the evolved fourth-dimensional life (noosphere).

The lower half of the sphere beneath the horizontal line running through the God center refers to the Domain of Potentiality, the upper half to the Dominion of Time. The prelife quadrant of the Domain of Potentiality refers to the preconscious quantum dimensional space of pure energy. The lower right-hand quadrant refers to third-dimensional space, the locus of space travel and the realm of the cosmic unconscious. Within the Dominion of Time, the upper right-hand quadrant refers to the fourth-dimension time, the locus of time travel, and the realm of cosmic consciousness. Finally, the upper left-hand quadrant is the realm of hyperdimensional time, or "pure mind." By studying this graphic description, one can grasp the movement of time as consciousness from inorganic preconscious, where duration in time is virtually infinite, to the secondary reflex life, or living organic matter in the third dimension. Here time is unconscious and life builds on the cosmic unconscious as the slowly mutating and evolving biosphere. The cosmic unconscious comes to a climax in the creation of the 12:60 artificial civilization, which is really not true civilization, but rather the technosphere itself. At this point there are moments of consciousness, but only moments. True sustained consciousness is possible only in conditions removed from the technosphere.

In the evolution of time as consciousness, the discovery of the Law of Time is a product of the crisis of consciousness unable to sustain itself in the technospheric medium. That is because this medium is a pure function of artificial 12:60 time. Even though the extensions of the senses and the capacity of technology provide the human within the biosphere a holistic perspective of seeing the whole Earth from space, the consciousness is continuously subordinated to the care and maintenance of the machine (or its lifeblood, money), and so cannot remain in a sustained state of heightened awareness or continuing consciousness. Continuing consciousness is only possible with the discovery of the Law of Time, which the crises of the technosphere

and of consciousness have themselves brought about. In this regard, the discovery of the Law of Time is the great point of human self-reflection that defines the advance from an exclusive third-dimensional operation and aberrant timing factor to a purely fourth-dimensional and conscious natural timing factor. It is the difference between the cosmic unconscious and cosmic consciousness, the biosphere and the noosphere-in other words, the very topic of this book.

DE CHARDIN AND THE PLANETIZATION OF CONSCIOUSNESS

The discovery of the Law of Time defines the point between the two stages of the noosphere as described by Pierre Teilhard de Chardin: "The first stage was the elaboration oflower organisms, up to and including man, by the use and irrational combination of elementary sources of energy received or released by the planet. The second stage is the super-evolution of man, individually and collectively, by the use of refined forms of energy scientifically harnessed and applied in the bosom of the Noosphere, thanks to the coordinated efforts of all men working reflectively and unanimously upon themselves. . . In becoming planetised humanity is acquiring new physical powers that will enable it to super-organize matter. And, even more important, is it not possible that by the direct converging of its members it will be able, as though by resonance, to release psychic powers whose existence is still unsuspected?"6 The identification of telepathy with the velocity of time emphatically underscores de Chardin's final point.

On the other side of the discovery of the Law of Time, civilization, having reached its climax as the technosphere, is replaced by an entirely new noospheric order of human organization defined as PAN: Planet Art Network. This is a structural definition of what Teilhard de Chardin refers to as the "planetization of consciousness." This organization (bionoospheric and not institutional) is "planet" because the human organism is self-realized as a planetary organism. It is "art" because functioning again in the natural timing frequency, the human is governed by the Law of Time, T(E) = Art, and hence the reality and the activities of everyday life are defined as art. And it is a "network" because the city, defined by civilization (literally living in cities) and which was a sustaining component of the technosphere, is no longer necessary or viable. Rather, the human becomes redistributed throughout the biosphere-what Teilhard de Chardin refers to as the "radiation of man "--connected by a telepathic network that greatly diminishes the reliance on much of the technology that characterized the technosphere. Hence Planet Art Network: the replacement of civilization with the fourth-dimensional social organization of the human functioning as the tele-

pathically coordinating species of the noosphere. In this condition life evolves toward a hyperorganic stage, attaining a state of superconscious activity and self-reflection where time travel replaces the space travel of the phase known as civilization.

This evolutionary mode, coinciding with the evolving needs of the local star, conduces at some distant point in the future to the subliminal consciousness and the postorganic postlife that is necessitated by stars as they advance to the stage of supernova. According to the Law of Time, the nature of consciousness is actually a function of stellar evolution, planets being but harmonic nodes in greater heliospheric fields of resonance. Since time is inseparable from consciousness, this understanding would seem to affirm Kozyrev's hypothesis that time is generated from the stellar core. "Stars absorb energy from the motion of time," declares Kozyrev, "a star seems to be a time machine."7 *The Mayan Factor* further places the coordinating medium of time as emanating from the core of the galaxy, Hunab Ku, One Giver of Movement and Measure. In the Chilam Balam prophetic tradition, Hunab Ku is also the name given to the final religion of the One God that appears after the religion of the *conquistadors* has finally passed. Seen from the perspective of the Galactic Brain, the crisis through which we are now passing is but the final stage before consciousness bursts into a new radiance of biosolar-telepathic wonder where negative emotions and thought forms no longer have any place to cling or hide. The Law of Time purposively points to this great end.

The whole of the spectrum of the Galactic Brain is mediated by the universal frequency of synchronization, mathematically modeled as the 13:20 matrix, the organizing factor of the synchronic order. The technicalities of this evolutionary spectrum of the Galactic Brain have been defined in *The Dynamics of Time: 260 Postulates* (1996) so that the process of the evolution of time as consciousness may be studied and its coming stages prepared for. The mathematical model of this 13:20 matrix is a description of the fourth-dimensional timing frequency and is both the source of the time vector potentialities and the mathematical tool for mapping the order of synchronicity. Through the discovery of the Law of Time, the 13:20 matrix is realizable through tools that are in accord with its mathematics, and thereby it becomes useful to the everyday consciousness of the human. This too becomes a factor accounting for the noosphere's becoming conscious.

The fourth-dimensional "tools" made accessible through the Law of Time include the Thirteen Moon/28-Day calendar, the Dreamspell, and the Telektonon. They will be described more fully in Chapter 8, "Making the Transition to the New Time." With these tools one can begin to construct a map of the time vector potentialities contained in the synchronic order as it manifests on a day-to-day basis. Once

the construct is made conscious and correlated to a point in third-dimensional time, then the body in time-the infinitely locatable point that is space-may be coordinated by the same common structure of fourth-dimensional time. Following this procedure the individual human consciousness begins to participate in the larger unfolding of the noosphere, and slowly but surely is realized as yet another manifestation of the formulation of the Law of Time, T(E) = Art. It is the human being itself that incorporates time, or rather wakes up within itself the order of time. Time is art, while art is actually a function of consciousness expressing itself.

THE MAYAN UNDERSTANDING OF THE LAW OF TIME

While we will have cause to turn our attention later in this book to the "how-to" of fourth-dimensional time, we may consider further the nature and meaning of the mathematics of the Law of Time and their origin with the mysterious civilization of the ancient Maya. The template or matrix of the 13:20 frequency, a 13 x 20 (260) unit structure, was the means for accommodating the base "calendar" used by both the ancient and present day Maya: the *Tzolkin,* or sacred calendar, a set of thirteen numbers and twenty signs that repeat their sequences of permutations every 260 days. While this 13 x 20 matrix accommodates the Tzolkin, it is not confined to being a calendar, as I amply demonstrated in *The Mayan Factor.* The 13:20 frequency is the universal constant of time from whose mathematics the Tzolkin is derived. Based on the permutation table, called the *buk xok* in the Chilam Balam tradition, this matrix is a Harmonic Module, a fractal yardstick of radial time with multiple applications, something analogous to the periodic table of elements, but of the synchronic order.

It is still a profound challenge to all modern Western scientific thought that the Maya would have possessed such mathematics, apparently inherited from the earlier and even more mysterious Olmec people, and that with this mathematics they would have evolved such a profound perception of time. This was most certainly a factor in the destructive attitude taken toward the Maya by the religious zealotry of the conquerors of Mexico. It is also astonishing that the mathematics in which the Harmonic Module is embedded is a vigesimal (20) count, utilizing a zero and a positional ordering system that accounts for larger or greater values that advance by binary exponentiality rather than a decimal sequentiality. But, quite simply, this system exists in this manner because it is the mathematics appropriate to time. This mathematics is a factor to which any disinterested researcher on the topic of time must now become accustomed.

It is by reason of this mathematics and its ability to "download" the 13:20 universal frequency of synchronization that the ancient Maya were able to construct a complex system of "calendars" and an astronomical knowledge that is precise not for its telescopes, of which there were none, but because of the nature of the mathematical system itself. More appropriately described as synchronization devices or synchronometers, the Maya used at least seventeen of these timing instruments simultaneously during the great age of their civilization, A.D.435-830. This fact in itself tells us that the Maya understood time so radically differently from the perception that has evolved in the techno sphere that we must stand in awe that such a knowledge would have developed by a people whose technological development was so minimal, but whose artistic accomplishment was inseparable from their scientific achievement.

Harmonic Module

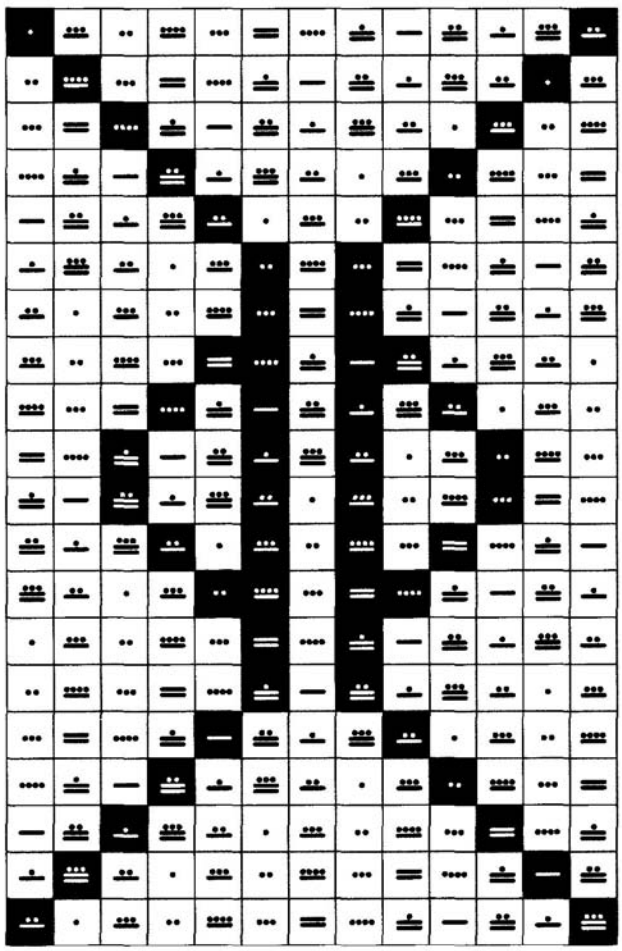

Yes, the Maya most definitely knew that time is the universal factor of synchronization, so their synchronometers must have been for the purpose of attaining a master synchronization with the cosmos. This presupposes such a different state of mind that all the values of the present day must be challenged. The mystery of it is that this mathematics and time science developed in the New World, remote from the saga of civilization in the Old World. The fact that the later Maya practiced ceremonies and blood rituals, the fascination of so many present-day archeologists, should not detract from the understanding that these ceremonial practices stem from a totally different perception of life-and death. Before we judge, we must consider the inescapable truth that nothing in history matches the terror of the different kinds of war and weapons of mass destruction that characterize the fifty-six-year cycle of the technosphere, 1945-2001. Who then is the more barbaric-the Maya, or modern man, *"Homo technosphericus"?*

It is the study of this vigesimal mathematics and its 13:20 Harmonic Module that has led to the discovery of the Law of Time. In this regard the Law of Time is a universal law independent of any culture or civilization, even that of the Maya, much like the law of gravity is also a universal law. However, if it had not been for the Maya, who evolved their understanding of the 13:20 frequency of synchronization to such a high degree, there would never have been a pursuit that led to the discov-

Galactic Notation, Dot-Bar (0–19) Code

Vigesimal count, 1–19, where in first order 1 = 1 and
0 = 20 position, so in next order 1 = 20, in third order 1 = 400, etc.

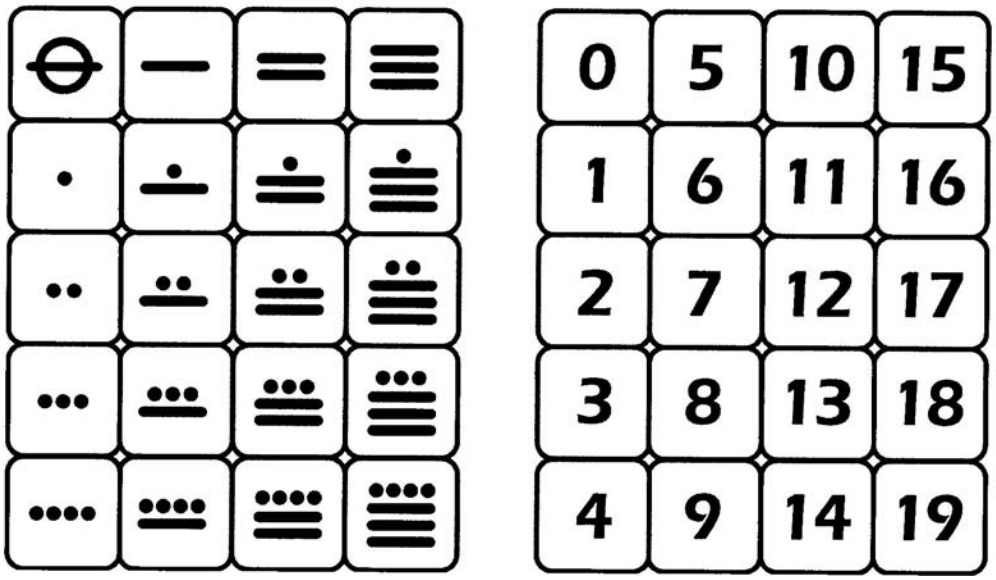

ery of the law underlying their knowledge of time. If with this law we may categorize the time vector potentialities in six stages of consciousness-preconscious, unconscious, and conscious, continuing conscious, superconscious, and subliminal conscious-then we may be certain that the ancient Maya were also familiar with the time science associated with the higher states of consciousness revealed by the Law of Time. With this time science and mathematics of higher consciousness, the Maya were able to bequeath a prophetic tradition mathematically coded in the Harmonic Module, which, among other matters, led to the discovery or making conscious of the Law of Time itself.

Once we appreciate the radically different perception of time and knowledge that is embodied in the Harmonic Module, the mathematical modeling of the 13:20 universal frequency of synchronization, then we may turn to its uses as the fractal radial measure of time applied to many levels of thought and knowledge. For instance, using the 13:20 matrix we may turn to an understanding of the Law of Time in human history, as is necessitated by these reflections. With the Mayan time knowledge and the placement of their civilization in the New World, we have a gauge and an alternative base of knowledge upon which to evolve a planetary perspective and an objective means of critique of the mainstream development of civilization in the Old World. We may then ask the questions: How did we become what we are now, and how was it that our civilization evolved into the technospheric medium?

4

The Law of Time in Human Affairs

The Analysis of History

THE KEY to *The Mayan Factor* is the application of the Harmonic Module as a fractal measure that is descriptive of the cycle of thirteen baktuns, the Mayan measure of history. This measure of thirteen baktuns, a cycle extending from 3113 B.C. to A.D. 2012, had been deduced from the stone inscriptions of the Mayan monuments of the Classic period, most of which bear a date within the tenth baktun cycle, A.D. 435-830, or, in the transliterated vigesimal notation of the Mayan Long Count, 9.0.0.0.0-10.0.0.0.0. However, one of the principle discoveries of *The Mayan Factor* demonstrated that the thirteen baktun cycle was also a function of the Harmonic Module and identical with its mathematical mapping as the 13:20 matrix. There are very profound implications to this correlation of the cycle of history having a one-to-one identity with the 13:20 frequency matrix. For this reason the cycle of history is referred to as a *Wave Harmonic* of the galactic order of time. Even though history may appear to be a random, haphazard, and checkered advance of humanity from living in small agricultural communities to the present-day technosphere, this process has actually been an orderly program of the biosphere, the region for the transformation of cosmic energy on Earth.

The same principle of the analysis of the Law of Time applies here. That is, by analogy, the historical events analyzed from a political or economic perspective represent the perception of the random events of near space and low time, while the analysis of the thirteen baktun cycle Wave Harmonic of history represents the

perspective of far space and high time. In this Wave Harmonic, the program of history is mathematically defined by 13 baktuns-each baktun consists of 20 katuns-13 baktuns x 20 katuns = 260 katuns = 13 x 20 matrix of the 13:20 frequency of synchronization. In the 13 x 20 matrix of the Harmonic Module each unit equals one kin, the base unit of fractal measure. By fractal equivalence, in the mapping of history one kin = one katun, one katun = 7,200 days; therefore one baktun = 144,000 (7,200 x 20) days. The mathematical perfection of the cycle of history matching the 260-unit model of the harmonic matrix means that history is a factor of synchronization of the higher order of time coordinating the human organism within the biosphere.

By means of the *thirteen baktun Wave Harmonic of history,* the incidence of human Civilizational Advance (CA) may be plotted in a very precise way as a progression going from a very dispersed and scattered state to the point of attaining its exponential climax in the final saga of geochemical combustion, the fifty-six-year cycle of the technosphere. In this regard we must ask: What do we mean by "history" from the Wave Harmonic point of view? As an organism that is a function of the biosphere, history defines that stage when that organism, humankind, enters a process of altering its biomes through increasingly artificial means or extensions of itself that exhibit a compulsive reordering of society into denser and denser clusters of habitations known as cities, hence civilization, "city-life."

In the stage before history, the human had created certain tools and had begun experiments in agriculture and horticulture, but the mental order remained in an aboriginal condition. Unconsciously absorbed as an integral mechanism within the cycles of the biosphere, the human wrapped his understanding of these cycles and of his place in them in the garb of myth and ritual. But with history, something different occurs. The artificial means or extensions of the senses are ordered by a different form of mentality. Those projections of thought and consciousness, though immaterial, affect the material surroundings, and take on an aggressive dynamic. The aggregate effects of these artificial extensions are maintained by a new mental dynamic that is contained and then conditioned by a new kind of macro-organizing thought structure, independent of the actual cycles of the biosphere. What is this new mentality? How can we most precisely define it?

Here are some points to ponder. The Mayan reckoning of the beginning of history is precisely dated to August 13, 3113 B.C., Long Count 13.0.0.0.0. The Hindu reckoning of the beginning of the Kali Yuga is dated to February 19, 3102 B.C. These dates are only eleven years apart. What cosmic event occurred at that time to initiate the Wave Harmonic of history? As we have seen, there is a perfect identity of the

13 Baktun Cycle: Wave Harmonic of History

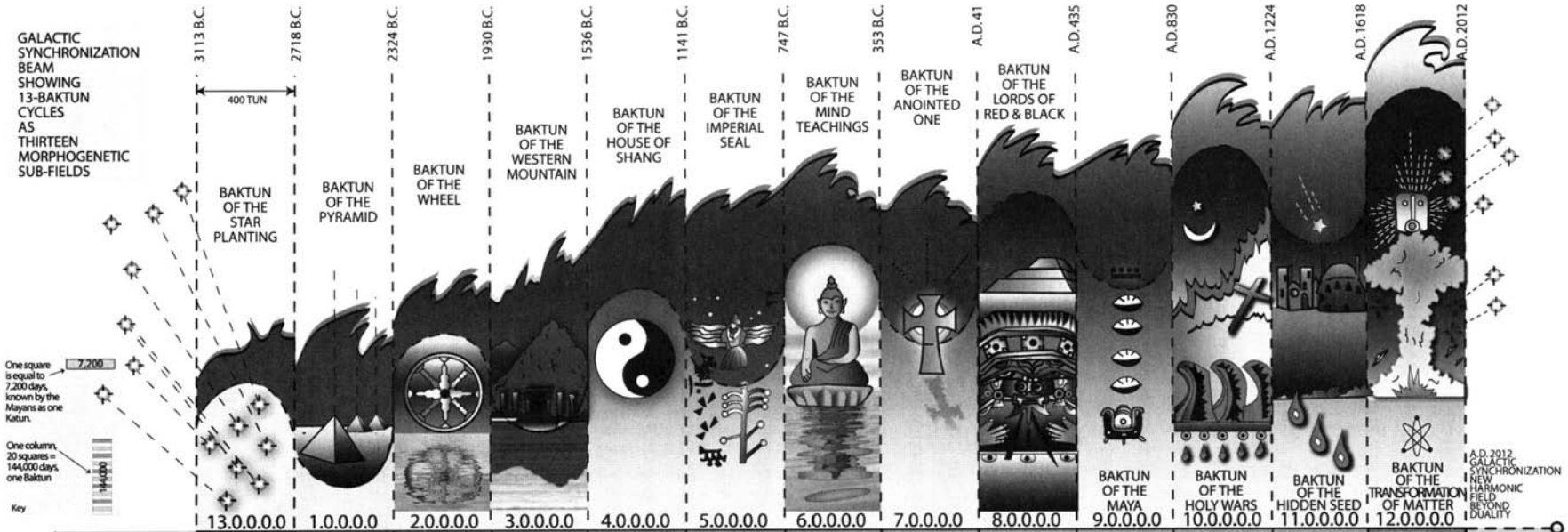

260-KATUN CYCLES / 52-UNIT GAIA LIGHT BODY	13.0.0.0.0	1.0.0.0.0	2.0.0.0.0	3.0.0.0.0	4.0.0.0.0	5.0.0.0.0	6.0.0.0.0	7.0.0.0.0	8.0.0.0.0	9.0.0.0.0	10.0.0.0.0	11.0.0.0.0	12.0.0.0.0		
DRAGON / IMIX	URUK, MENES	ZOSER, EGYPT CALENDAR	SARGON	ABRAHAM	SHANG DYNASTY, CHINA	KING WEN	GREEKS	ALEXANDER	ROMAN	FALL OF ROME	BOROBADUR	GOTHIC	DESCARTES	NEPTUNE	SOLAR MOVING INHALATION
WIND / IK	KILNS	GREAT PYRAMID	BABYLON		AKHNATON	CHOU DYNASTY	KUSHITE	CELTS	EMPIRE	BYZANTIUM		EUROPE	SCIENTIFIC	URANUS	
NIGHT / AKBAL	UNIFIED SUMER	GIZA		CRETE	HITTITE	CHINA		ASOKA	TEOTIHUACAN	RISE OF	VIKINGS	MONGOLS	MATERIALISM	SATURN	
SEED / KAN	EGYPT				EMPIRE	KING DAVID, JERUSALEM	NINEVEH	SPREAD OF BUDDHISM		CLASSIC	HEIAN JAPAN	KUBLAI KHAN	CHING DYNASTY	JUPITER	
SERPENT / CHICCHAN	OLD		CHARIOT	EGYPT: QUEEN	THERA EARTHQUAKE		PYTHAGORAS	ZAPOTECS		MAYA	CHIMU	MAYAPAN	NEWTON	A-BELT/MALDEK	
WORLD-BRIDGER / CIMI	KINGDOM		WARFARE	HATSHEPSUT	OLMECS	VEDIC	BABYLON REBUILT	CH'IN DYNASTY	NAZCA	BUDDHISM IN JAPAN	XOCHICALCO	AZTEC	BAROQUE MUSIC	MARS	
HAND / MANIK				VALLEY OF	CH'VIN	CIVILIZATION		HUANG-TI	GERMANIC	TIKAL	CE ACATL	BLACK PLAGUE	INDUSTRIAL	EARTH	
STAR / LAMAT			EGYPT	KINGS		INDIA	LAO TZU	EARLY	INVASIONS	POPE GREGORY	TOPILTZIN QUETZALCOATL	INCA	REVOLUTION	VENUS	
MOON / MULUC	HEIROGLYPHS	AKKAD	MIDDLE KINGDOM				PERSIAN	MAYA	MOCHE	MUHAMMED	RISE OF	MOGHUL / INDIA	AMERICAN &	MERCURY	
DOG / OC		UR			JADE	HORSE WARFARE	EMPIRE	HAN		PALENQUE	TOLTEC	OTTOMAN TURKS	FRENCH REVOLUTION	MERCURY	GALACTIC/LUNAR MOVING EXHALATION
MONKEY / CHUEN	CUNIEFORM				KING TUT		BUDDHA, MONTE ALBAN		END OF	PACAL VOTAN	MAYA		ROMANTICISM	VENUS	
HUMAN / EB		HARAPPA			RAMSES		CONFUCIUS	DYNASTY	HAN DYNASTY		IFE	MING DYNASTY	EUROPEAN	EARTH	
SKYWALKER / BEN		CIVILIZATION			ASSYRIA	JERUSALEM		TEOTIHUACAN	TIAHUANACO	COPAN	ANGKOR WAT		IMPERIALISM	MARS	
WIZARD / IX		INDIA	ZIGGURATS				PLATO	RISE OF ROME		HEIROGLYPHIC STAIRWAY	CRUSADES	FALL OF CONSTANTINOPLE	ELECTRICITY	A-BELT/MALDEK	
EAGLE / MEN				HORSES			CHUANG TZU			SPREAD OF ISLAM	BUDDHISM IN	PRINTING, CONQUEST	RUSSIAN REVOLUTION	JUPITER	
WARRIOR / CIB			BRONZE	CENTRAL ASIA	VEDAS	LA VENTA	ZOROASTER	GREAT WALL	CONSTANTINE		TIBET	OF MEXICO, PERU	WORLD WARS	SATURN	
EARTH / CABAN			TECHNOLOGY	HITTITES		ASSYRIAN		OF CHINA	BUDDHISM IN	T'ANG DYNASTY	SUNG DYNASTY	EUROPE EXPLORATION	HIROSHIMA	URANUS	
MIRROR / ETZNAB			MENUHOTEP	EGYPTIAN	PHOENICIANS	IRON	BANTU, WEST AFRICA		CHINA	MISSISSIPPI CULTURE, BAGDAD	RUSSIA/KIEV	BENIN	NUCLEAR & SPACE TECHNOLOGY	NEPTUNE	
STORM / CAUAC	STONEHENGE	PYRAMID	UR, NAMMU, LEGAL CODE	EMPIRE	MYCENEANS	WEAPONS &	PELOPPONESIAN WAR	JULIUS CAESAR	GUPTA DYNASTY, INDIA	PADMASAMBHAVA	ANASAZI	QUEEN ELIZABETH	HARMONIC CONVERGENCE	PLUTO	
SUN / AHAU	GILGAMESH	TEXTS	HAMURABI	ARYANS INVADE INDIA		WAR MACHINES	ARISTOTLE	CHRIST		CHARLEMAGNE	ZIMBABWE	GALILEO, KEPLER	EARTH REGENERATION	PLUTO	

Wave Harmonic of history, as a fractal equivalence, with the Harmonic Module, itself a description of the universal 13:20 frequency of synchronization. This being so, both the calculation of the beginning of history as well as the duration of its entire cycle are functions of the Law of Time. This means that something within the Earth's noosphere occurred that triggered the Wave Harmonic, itself a manifestation of the Law of Time. Also, by most judgments and standards, history began at a very precise place as well-Sumeria, in the Mesopotamian basin of what is now called the Middle East. Why? And what relation is there between the precise event that triggered the Wave Harmonic of history and Sumeria, the site of the first city, Uruk? What event could have established a macro-organizing principle to propel the dynamic of human thought and technology into the trajectory concluded by the technosphere?

THE ORIGINS OF THE 12:60 FREQUENCY

In the recently published book *The History of the World-A 6,000 Year Chronicle of Time,* we find the point that establishes the definite artificiality of a new kind of macro-organizing principle, driving humankind toward the Inevitable Event; here we find the genesis of artificial time: "Ca. 3000 B.C. Sumerians divide day into 24 hours, 60 minutes, 60 seconds and circle into 360 degrees."! While this is a fact we may take for granted because it is the basis of mechanized time in the form of the clock, for precisely that reason it should give us pause. For one thing, this means that the measuring system of the clock was already established at the beginning of history, some 4,500 years before the clock as we know it was actually invented! This is quite an astonishing fact. It means that mechanization was implicit in the first intellectual act of history. Why or how would it have occurred at the precise point of the beginning of history in Sumeria?

The Law of Time defines this mechanistic organizing principle as the basis of the 12:60 artificial timing frequency (irregular twelve-month calendar combined with mechanical sixty-minute hour). Therefore, it was at this point at the beginning of history that artificial time and its progeny, mechanization, were actually registered as a thought form and thus became embedded in the as-yet-unconscious noosphere. Or, was it already embedded in the noosphere to be triggered at this precise point-and if so, why and how? The point is that history, as it has evolved as the mainstream of civilization from Sumeria to the World Trade Center, has always been driven by the organizing principle of artificial time. It is artificial time that separates history from prehistory-and, as we shall see, from post-history as well. It was due to the

The Error in Time

The measure of a two-dimensional plane in space has nothing to do with the experience or the nature of time.

"TIME WAS COMPRESSED INTO A FLAT CIRCLE..."
Dreamspell "Genesis"

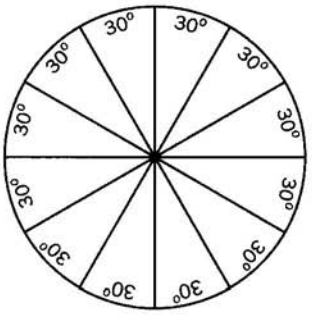

Sumeria: Ca 3000 B.C.
Day divided into 24 hours,
60 minutes, 60 seconds
based on 360 degree circle—
two-dimensional plane in space—
divided into twelve parts

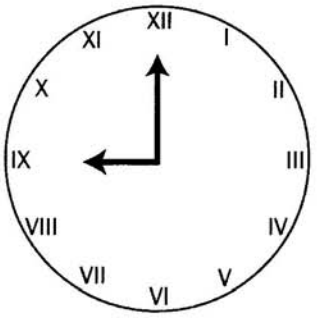

Europe: 800-1600 A.D.
Clock—two-dimensional plane
in space—divided into twelve
parts each 30 degree of arc =
1 hour = 60 minutes
each minute = 60 seconds
A.M. = 12 hours
P.M. = 12 hours
= 24 hours

I - 31	II-28/29	III - 31
IV - 30	V - 31	VI - 30
VII - 31	VIII - 31	IX - 30
X - 31	XI - 30	XII - 31

Rome (Vatican): 44 B.C. - 1582 A.D.
Twelve-month Julian/Gregorian
calendar derived from twelve part
division of circle; irregular measure
due to fact that 365 is not divisible
by twelve.

Earth's solar orbit = 365 days
360 degrees ≠ 365 days

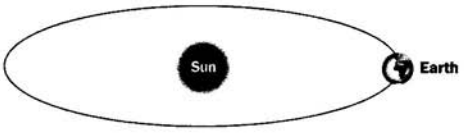

genesis of artificial time at the beginning of history and its emplacement within the planetary noosphere that also generated the thirteen baktun Wave Harmonic of history. For the very purpose of the thirteen baktun Wave Harmonic of history is to encompass and coordinate the cycle of artificial time. Why?

The Wave Harmonic is a function of the 13:20 synchronization frequency. It is a function of cosmic time. In the higher knowledge of the Mayan understanding, it provided the perfect measure of the cycle of artificial time. From the perspective of the actual noospheric timing, which operates according to the natural 13:20 cosmic timing frequency, history is none other than a manifestation of artificial time. Civilization becomes organized by the principle of artificial time. But because it is artificial, it cannot endure. If the mathematical basis of mechanized time, and hence of mechanization, was already established at the beginning of history, then the end of history is the end of artificial, mechanized 12:60 time. And in the end, the Law of

Time codes and encompasses the whole of the cycle of artificial time through the thirteen baktun Wave Harmonic of history. What is important to grasp is that the entire cycle of artificial time was *alreadyperceived* by the Mayans as a phenomenon that could not endure more than the length of the cycle of thirteen baktuns.

It is necessary for the reader to understand how this perspective was discovered. It was the result of a phenomenological experiment of living according to the synchronic cycles of the Mayan time science. After the death of my son in 1987, my wife and I began in earnest to follow the cycles encoded in the Mayan calendar: 13-day, 20-day, 52-day and 260-day cycles. Our life changed dramatically. At the same time, I endeavored to define the mathematical basis of these cycles. Once I resigned my academic position in early 1989, we were swept by a wave of time that took us from the Rocky Mountains to Southern California to the Hawaiian Islands in the middle of the Pacific Ocean. There, in relative isolation from the rest of the world, we plunged into our experiment. Before we had truly settled in, the time wave took us to Switzerland, where on December 10, 1989, in the Museum of Time in Geneva, we were able to put our phenomenological experiment to the test-although we did not consciously realize at the time that we were doing so.

There in the Museum of Time, essentially surrounded by examples of the history of the clock and mechanization, and because our perceptions had been altered by our living so completely by the various timing cycles encoded in the Mayan calendar system, we were able to spontaneously perceive the existence of two timing frequencies. The natural frequency-the one we had been living-we understood instinctively to be the 13:20 timing frequency. The other frequency-the one enshrined in this Museum of Time-we understood to be the artificial 12:60 timing frequency. This realization of artificial time was rooted in the evident proof that the clock is based on the twelve-part division of a flat circle, a spatial plane that clearly has nothing to do with the dynamics of time. It is a manifest error, but one that humanity has taken for granted and endowed with all of the characteristics of "truth."

We also immediately saw that the error of mistaking the division of a two-dimensional plane in space for a measure of time was transmitted not only through the clock, but through the twelve-month Gregorian calendar as well. With brief reflection upon what a gross error this was-substituting a twelve-part division of space as a measure of time, and then elevating this mistake as the truth of the measure of time-we understood how it could have actually led humanity away from the natural time of the universe. In making this observation, we immediately and intuitively grasped the necessary solution: replace the erroneously measured twelve-month Gregorian calendar with the perfect measure of the Thirteen Moon/2 8-Day calendar.

Our research into the mathematical codes behind the Mayan calendar now progressed rapidly, but our attention also turned to the question: Whence came the thought form of 24 hours, 60 minutes, and 60 seconds as a measure of a circle of 360 degrees? It was clear to us that this division of time based on the division of a circle in space occurred at what is the beginning of history, a fact later confirmed for us in the already cited *History of the World* (1997), which states that this division of 24 hours, 60 minutes, 60 seconds and the circle into 360 degrees was devised "Ca. 3000 B.C."

Once we had finished working out the mathematical codes, we turned to a consideration of the actual implications of the error in time. It was now also clear why the Mayan time science was so superior. It was based on the reality of time as a factor of synchronization. By contrast, the concept of time as it had developed in the mainstream of civilization was limited, linear, and totally third-dimensional, a fact that confirmed Vernadsky's analysis, as well, that our notions of time are a function of the metrics of space. By 1991, the experience in the Museum of Time had driven us into

What Difference Can a Calendar Make?

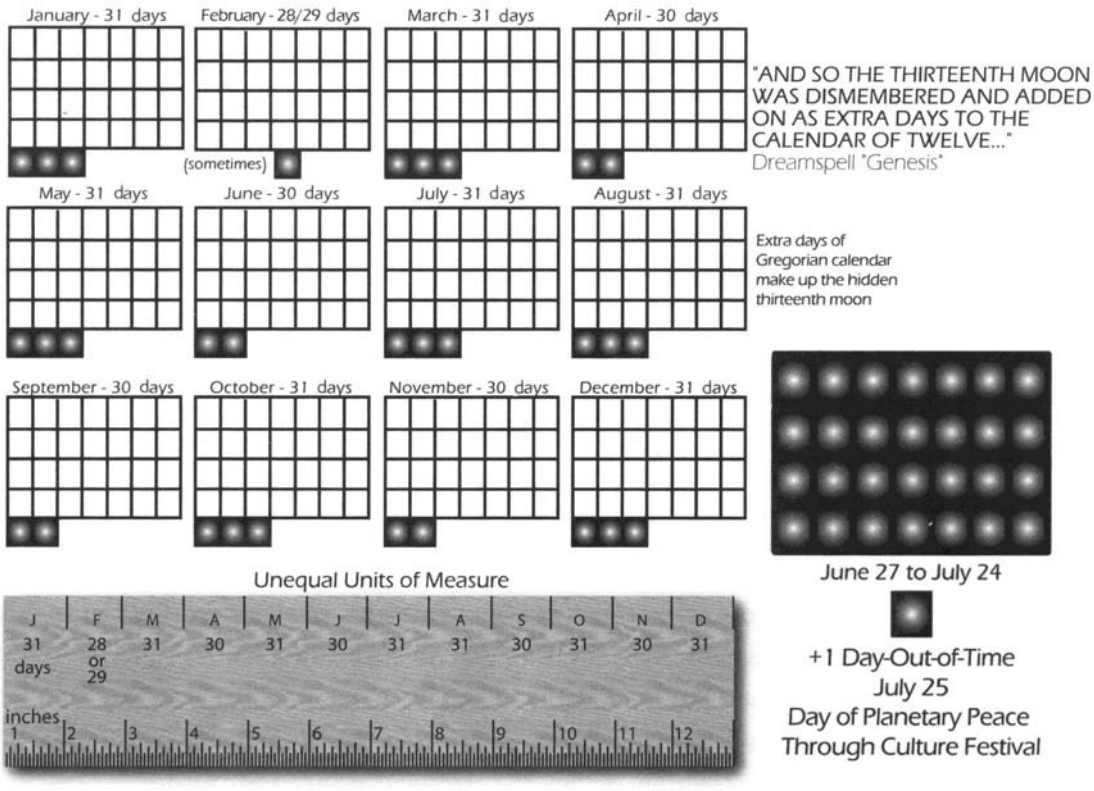

Gregorian Calendar and the Hidden Thirteenth Moon

creating a full-blown psychomythic analysis and description of this moment of realization concerning the nature of time. The complete structure of the mathematical codes of time, as well as the psychomythic description of the causes and effects of the error in time, is known as the Dreamspell, which is defined as follows:

"DreamspeH: function of fifth-dimensional galactic-solar planetary regulation; 26,000-year renewable cycle and planetary castle genesis; any consensus reality; in disregard of interdimensional reality creates entropic spell of history; cure for loss of galactic memory."2 The *planetary castle genesis* refers to the *five castles of time* (each 5,200 years in length), divided into three *geneses-the* Dragon, the Monkey, and the Moon-that constitute the entire fractal panorama of the 26,000-year cycle of history that ends in 2012, and is meant to be renewed in 2013 (an obvious synchronic reference to the 13:20 timing frequency). In the Dreamspell analysis, the beginning of history occurs almost 5,200 years ago between the Monkey and the Moon geneses, and is marked by the imposition of the false 12:60 timing ratio.

In light of this analysis and definition it is worth quoting certain passages from the Dreamspell text that describe this precise moment at the beginning of history and that the Law of Time defines as the root error of civilization. First we quote from the "Dreamspell Genesis," and then from the descriptions of the "Dreamspell Journey and Mission of Timeship Earth 2013." The purpose of quoting these passages here is to establish a psychomythic context to explain the profound nature of what we refer to as the error in time compounded over 5,000 years of history:

> Imposters, male priests and warriors usurped the power of the thirteen moons. They hid the thirteen among themselves and attempted to banish all memory of the matrix dreamspell of magic. . . The planetary kin had imposed upon them the diminishing power ratio of 12:60. No longer the magic of thirteen moons but a twelve month calendar of uncertain meaning. No longer the timeless gyre of magical flight, but a sixty-minute hour to earn one's bread.
>
> Time was compressed into a flat circle. . .
>
> The 13:20 ratio is the base operating ratio of timeship Earth. . .
>
> In that vital moment during the magic flight. . . Toward the moon genesis, another spell was cast. Instead of the 13:260 ratio already stored deep within the crystal core of timeship Earth, the planetary kin received the 12:60 ratio, the dark dreamspell of history. . . And so the thirteenth moon was dismembered and added on as extra days to the calendar of twelve. . .

> The absorption of the thirteen by the twelve was called an improvement by the male imposter priests hypnotized by the combined powers ofJupiter and Saturn. It takes twelve years for Jupiter to orbit once around the sun. It takes sixty years for Jupiter and Saturn to be conjunct.
>
> Twelve times five equals sixty, one sixth of the flat three hundred sixty degree circle. The difference between twelve and five is seven. While the priests of the calendar of ancient Babylon banished the power of the thirteen moons, they replaced that power with the power of seven.
>
> While the twelve diminished the power of thirteen by one, the sixty raised the power of twenty by three. A seeming increase in power occurred, but an increase only on the flat plane of the third-dimensional time to which the planetary kin were now consigned.
>
> With the banishment of the thirteen moons, the fourth-dimensional time magic. . . became the property of the priest class. Setting up religions and governments to maintain the kin within the third dimension, the priests were assured that anyone having fourth-dimensional experiences either be appropriated or destroyed.J

So much for the psychomythic impression of the genesis of artificial time, the flat time of an exclusive third-dimensional reality called history. A few further quotations from the Dreamspell emphasize both the interplanetary and mathematical root of false time:

> At -3187 Dreamspell years the time bandits on the sixth and seventh orbits pulsed their beam. The 12:60 frequency of the memory virus took immediate effect on the third-dimensional space suits. . . The Dreamspell of history was cast.
>
> Imposter priests on Earth substitute the 12:60 ratio. . . Instead of the magic of following thirteen moons, a non-circulating twelve-month calendar is substituted; instead of the beauty and power of magical flight, the sixty-minute hour. The result is disastrous.
>
> The twelve-month calendar is the consequence of the 12:60 ratio imposed at -3187 Dreamspell years (3113 B.C.,Julian/Gregorian). With no basis in or capacity for measuring galactic time, the twelve-month calendar is actually a third-dimensional prison keeping the four root races separate and at war with each other.4

These descriptive explanations of the error in time define such a profoundly radical point of view that we must flesh out the implications and description of the

course of artificial time according to the analysis of the Law of Time. From the outset of civilization in Sumeria, artificial time captures the human mentality in the order oflow time and near space (third dimension), separating it from high time and far space (fourth dimension). The registration of artificial time within the unconscious structure of the noosphere, which is intrinsically governed by the universal 13:20 frequency of synchronization, creates a conflict and a pressure in the noosphere, a time warp or taint that affects the entire biosphere.

Civilization-living in cities-increasingly becomes the human norm within the biosphere. Where there had been no civilization, at a few key places around the planet civilization now arises-a process that goes from the crystalline structures at the origin to the later phases of imperialism and empire building. This cycle is repeated again and again. Even in the New World where the 13:20 natural timing frequency prevailed, the later stages of civilization succumbed to the effects of the 12:60 already seeded in the noosphere. Ultimately, all humanity and the biosphere were to be governed by the artificial timing frequency that ends with the construction of the technosphere, the final and supreme expression of artificial time. Indeed, the technosphere is the absolute conclusion of what can rightly be called an artificial time warp in the biosphere.

Concerning the mathematical basis of the 12:60 frequency, V. A. Ponko of the Russian Academy of Sciences, Novosibirsk, has conducted extensive research and wave analysis on the mathematical properties of the cycles of history. He has concluded that as a mental coordinate, the number 12 is a strict construct of the angles of space. Since it does not correspond to the sinusoidal curvature of the cycles of time and the plotting of all organic phenomena, when used as a time factor the number 12 offers no "protection" from bombardment by any number of cosmic forces. The mathematical plotting of the 13:28 frequency that characterizes the Thirteen Moon calendar, on the other hand, is in alignment with the sinusoidal curve properties of organic phenomena, and therefore functions as an "umbrella" maintaining the organism in resonance with the biosphere.s

Here let us make a more precise definition of timing frequencies and the nature of calendars as the macro-organizing programming systems of the human in the biosphere. By defining time as the universal frequency of synchronization, we are saying that synchronization is the fundamental program to which everything adheres and which makes everything perceptibly coherent, hence synchronic order. Therefore, the natural timing frequency that is a universal phenomenon both regulates the phenomenal order of the cosmos, and in the human is absorbed as a mental frequency that unconsciously synchronizes the mind and senses with the natural

order. The result is the normal sensation and experience of the harmony of reality. This defines both a fundamentally prehistoric perception of reality as well as the spiritual experience that is common when we are confronted with the awesomeness of nature-usually far away, it should be noted, from city life. This universal factor of synchronization we have identified as the mathematically precise ratio 13:20, a ratio constant embedded in the structure and order of the calendrical and astronomical system of the ancient Maya.

If we understand that this frequency of synchronization is a genuinely universal constant, then we may comprehend how not only the entire biosphere, but solar system and galaxy are also governed by the same frequency. This is how the Kozyrev experiments could show that there is instantaneous transmission of information throughout the universe, which in its entirety is a function of the formulation *velocity of time is instantaneously infinite.* Synchronization and infinite instantaneity of transmission are mutually defining-everything is always instantaneously synchronized. We can further say that synchronization "syntropizes" while dissynchronization "entropizes." There is no lag time in synchronization.

This being the case, we can then begin to understand how the acceptance and institutionalization of the artificial 24-hour, 60-minute, 60-second division of the 360 degree circle as the basis for defining time could be such a singular and ultimately disastrous deviation from the universal frequency of synchronization. Thus when we speak of the artificial 12:60 timing frequency, we are referring to the mental effect of the feedback program of the use of artificial and erroneous instruments of measure. Rather than allowing the mind to remain in the natural harmony of synchronization with nature, the artificial 12:60 standard and its instruments establish a feedback effect in the mind that accustoms it to the deviation from nature. This habituation results in the creation of an unconscious timing frequency that is accepted by the consensus reality as the actual norm. Separation of human order from the biosphere becomes accepted and acceptable, making civilization not only possible, but setting it up, as it were, as a parallel rival to "nature." In fact, it is the unconscious mental frequency of 12:60 artificial time that coordinates and maintains civilization as a belief system.

When we speak of the instruments of measure of artificial time, we are specifically referring to the Gregorian calendar as the macro-organizing principle and the watch or mechanical clock as the micro-organizing principle. The macro-organizing principle organizes our life into days, weeks, months, and years. The micro-organizing principle organizes our life into seconds, minutes, and hours. These two instruments have their common root in the error in time that occurred 5,000 years ago at

the beginning of history. Try to think of life without these instruments and you will quickly realize how second nature they are-and yet there was a time when such instruments and their terminology did not exist. Before turning our attention to an analysis of these two instruments and their effects on human consciousness, we must view the entire cycle of the Wave Harmonic of history as a function of the macro-organizing principles of time that the human in the biosphere adopted for its uses and that, in turn, condition at a most profound level the worldview of the culture or civilization that uses it.

HISTORICAL CALENDARS AS INSTRUMENTS OF ASTRONOMICAL MEASURE

It may be rightly asked, What does a calendar measure? At a minimum, a calendar is or should be the measure of the Earth in its rotation around its local star, the sun. This rotation takes 365 days. The Earth's satellite, the moon, is the obvious synchronizing factor between the Earth and the sun. But here we encounter a difficulty. The moon can be measured by various cycles. The synodical cycle, from new moon to new moon, is 29.5 days. The sidereal cycle, the measure taken from where the moon appears at the same place in the sky, is just over 27 days. There is an apsidal cycle, however, taken from the measure of when the moon's axis is tilted farthest from the Earth, which is 28 days. This variance of measures is due to the fact that until the rise of rocketry, we could not really see the moon from space. In actuality the moon rotates around the Earth thirteen times during the time it takes the Earth to orbit the sun once.

If one were objectively seeking the proper measure of the Earth's orbit using the moon as the measuring device, we would therefore construct an instrument for time reckoning that consists of an even harmonic measure of thirteen cycles of twenty-eight days each. The 28-day cycle conforms, of course, to the female menstruation cycle, an obvious human biological cycle, and it also divides perfectly into four 7-day subcycles or weeks. Also, 13 x 28 = 364, the same number of days as thirteen moons multiplied by four 7-day weeks (a total of fifty-two weeks), with the 365th day being a free day, or Day Out of Time, no day of the week or month at all. We shall deal with the perceived extra quarter-day later in our discussion.

The point is this: If time is a factor of synchronization, then a calendar-as an instrument for measuring the count of time-should also be constructed so that it maximizes the factor of synchronization. This can only be done if the instrument of time reckoning is constructed on harmonic principles in conformity with the objective data of nature. Such an instrument would also conform to the orderly processes

of the biosphere taken as a whole, and be a great assistance in bringing into consciousness the cosmic programs that organize the biosphere and noosphere. The Thirteen Moon/28-Day calendar is the perfect instrument for such a simple registration of harmony and synchronization. It should also be noted that in its mathematics the Thirteen Moon/28-Day calendar is a function of the 13:20 timing frequency. This in itself establishes the Thirteen Moon/28-Day calendar as a perfect instrument of the Law of Time and as a function of the synchronic order of reality.

Since the process of civilization represents a break from a long cycle generally undistinguished by the kind of perturbations that characterize history, the analysis of the Law of Time assumes that in prehistory humans lived in relative harmony, and therefore that the humans tended to use harmonic instruments of time reckoning. The humans living in greater harmony with the biospheric cycles would be disposed to be in greater unconscious or aboriginal attunement with the noosphere. Since the noosphere is regulated by the synchronic order of the universal 13:20 timing frequency, the humans would be more naturally disposed to devise, adopt, or intuitively utilize the time measure in greatest accord with this instinctual 13:20 noospheric timing ratio.

This instrument of time measure would, of course, be the Thirteen Moon/2 8-Day calendar. It should also be noted that this calendar is a perfect solar-lunar measure; that is, it uses the even, regular lunar cycle of28 days as the standard of measuring the 365-day solar cycle of the Earth. The balance of solar and lunar may also be taken as

Moon Circling Earth Thirteen Times per Year

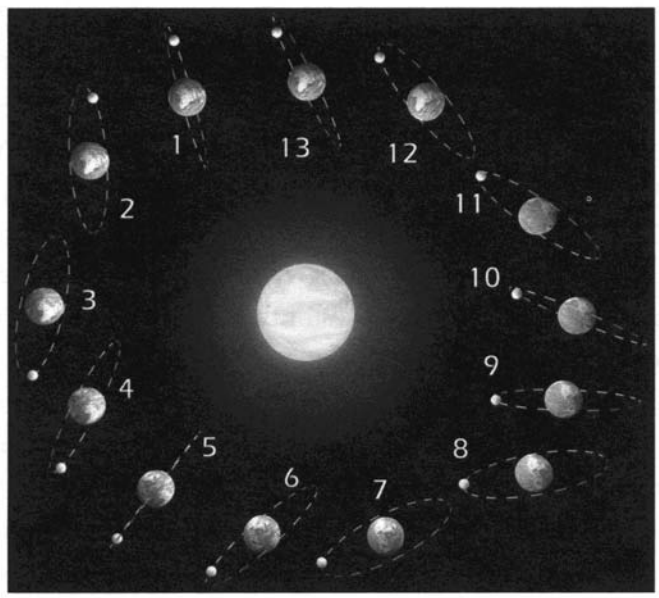

Did you know the moon goes around the Earth thirteen times a year?

Click the Sun!

SEE: HTTP://WWW.TORTUGA.COM/WWW/ANIMATIONS/ANIM_MOON.HTM

symbolic of human psychological characteristics and their balance or imbalance. A solar-lunar calendar will represent and reflect a balance of the solar-lunar, masculine and feminine qualities within the human being. It is important to bear in mind these considerations of calendars and their effect on shaping the human historical consciousness and its psychological makeup. From this perspective, history is, in fact, a process of falling away from the perfection of harmonic standards.

Evidence exists that the Thirteen Moon/28-Day measure was widely known in prehistory. We find evidence of its use as a prehistoric synchronic measure in the remote past of China, in Polynesia, and scattered across late neolithic Europe and the Middle East. Among the Maya it was known as the *Tun Uc*, literally "moon count" or count of seven, while the living tradition of the Thirteen Moon/28-Day calendar is still continued in South America and in the British Isles, where it is known as the Druid Tree calendar. While the Druid calendar has no year count attached to it that would definitively testify to its prehistoric ancestry, the South American calendar does. Known as the *Pachacuti*, the South American Thirteen Moon/28-Day calendar is currently in the year 5509, which places its origins at 3308 B.C., toward the middle of the fourth millennium before Christ, and several hundred years before the beginning of the thirteen baktun Wave Harmonic of history.

If we understand that calendars are genuine time-measuring devices meant to synchronize us with the cosmic order within the biosphere, and that calendars are thereby programming devices, we may then say that a calendar of perfect harmony can have no history. In other words, by its harmony such a calendar is always in tune with the cosmos, which is beyond history. History can only be a function of a disharmonic programming, not in sync or even at odds with the laws of natural time.

From the point of view of timing devices, there are two factors in the establishment of history. The first is the 12:60 program established 5,000 years ago with the division of the day into 24 hours, 60 minutes, 60 seconds, based on the 360-degree division of the circle. The other factor is the use of a purely lunar calendar that is difficult to reconcile with the actual measure of the solar year. The purpose of the 12:60 measure was to establish a timing standard that was actually a pseudosolar calendar to assert male intellectual dominance. The Babylonian (and later, Egyptian) calendar consisted of twelve 30-day cycles = 360 days = 360 degrees, plus an extra 5-day cycle. The 30-day measure is not actually a natural one, being a half day more than the synodic lunar measure, but one that conforms to the hexagisimal (6-based) mathematics of the circle. For this reason, this instrument of time reckoning is defined as *pseudosolar*. Its ultimate descendent, as we shall see, is the twelve-month Julian/Gregorian system.

By contrast, the Maya also had a 365-day solar calendar, the *Haab.* Its measure, however, is that of eighteen 20-day cycles (18 x 20 = 360) plus the 5-day cycle *(uayeb),* the 20-day cycle *(vinal)* being a mathematical function of the 13:20 frequency. In addition, the Maya had the measure of the *tun,* the 360-day count of which is precisely the same as that of the degrees of the circle. It was the tun that the Maya used to measure the thirteen baktun count, which actually consists of5,200 tun (5,125 solar years). The purpose of this measure was to provide an exact harmonic standard for the measure of history that, we may recall, is the duration of artificial time. It is very relevant that the harmonic standard of the thirteen baktun Wave Harmonic of history is the 360-day tun, the actual temporal equivalent of the degrees of a circle in space. The precise measurement of the cycle of artificial time, which turned out to be anything but harmonic, could yet be measured with a harmonic unit that reflects both the circle *and* the mathematical perfection of the Law of Time. How better to coordinate the entire cycle of artificial time than by the tun, a unit of measure that reflects the 360-degree circle, the basis of the original error in artificial time? As we will later observe, the fact that the Law of Time coordinates even the cycles of artificial time is also evident in the analysis of the timing of the fatal flaw of the Twin Towers apocalypse.

While the Babylonians began to apply a hexagisimal time-reckoning device based on spatial metrics of the circle, another factor became predominant in the Old World: the rise of the synodical lunar calendar as the exclusive measure of time. The synodicallunar calendar is purely lunar in that it is not evidently or perfectly harmonized with the 365-day measure of the solar cycle-a fact of great consequence for the development of mainstream civilization. The Babylonian calendar, with its abrogation of the thirteen perfect 28-day months, established the pseudosolar twelve-month measure. This twelve-month measure conformed to the lunar measure of twelve synodic lunations per lunar year. However, twelve lunations are only 354 days, eleven days short of the solar year. This required an intricate set of calculations to make the lunar calendar keep up with the measure of the Earth's solar orbit. And in reality, although we tend to think of the moon as feminine, the knowledge of the synodic measure, the cycle from new moon to new moon, became the exclusive province of a male priest class that used the lunar calendars to capture and control the feminine principle, and to oppress women in general. Whereas the Babylonian and Egyptian solar calendars fell into disuse over time, the lunar calendar persisted.

Since there is only one moon orbiting Earth, it should be kept in mind that all lunar calendars are essentially the same. One and the same moon in all its phases is apparent to all humans on Earth. So when we speak of different lunar calendars-most notably the Hebrew, the Islamic, and the Chinese-the measure is basically the

same, from new moon to new moon, but New Year's Day falls differently in each of them, thus accounting in part for the various calendrical traditions. Within each of these lunar calendars, a different set of holidays is programmed. It is the programming of the different holidays and festivals of the calendars, along with the dating of their new year, that makes each lunar calendar tradition distinct and that also demonstrates how a calendar is a programming device. For instance, if one were to take out the different holidays programmed into the Hebrew lunar calendar, there really would be no such thing as Judaism. This demonstrates that the cultural conditioning of a people is totally dependent on the programming of the calendar they use. This also shows how a calendar is a feedback mechanism that maintains a group of people within the confines of its own self-established belief system.

Of the three lunar calendars we have mentioned, the oldest count of years is accorded to the Hebrew calendar. This year Rosh Hashanah, or Jewish New Year, occurred on the new moon, September 17, 2001, and marked the beginning of year 5762. This places the origin date for the Hebrew calendar in the year 3761 B.C., some 453 years prior to the commencement of the Pachacuti count. The Hebrew calendar (like the Chinese calendar, which we will discuss below) makes up for the slippage of eleven days per solar year by intercalating a thirteenth lunation cycle approximately every three years, or exactly seven such thirteenth moons every nineteen years. These numbers too-13, 7, and 19-are key harmonic factors of the synchronic order of time. This demonstrates that, at the very least, the synodical lunation calendars are calibrated in their larger cycles by the Law of Time. But the effect of being a purely lunar measure, at variance with the actual 365-day measure of the solar year, creates an interesting and one-sided approach. There is no question that the lunar calendar civilizations are the tool of powerfully patriarchal societies, the tables of the moons and the years being the possession of a dominant male priest class.

The Chinese lunar calendar differs from the Hebrew in one important distinction: from the most ancient times it has been embedded in a system known as the *five elements,* and is coordinated with a very elaborate mathematical system that bears some resemblance to the 60-60, 24-360 basis of the SumerianiBabylonian 12:60 frequency. This synchronizing system accounts for the Chinese cycles of years that are counted by the twelve zodiacal animals in combination with the five elements: earth, fire, wood, water, and metal, thus giving rise to 60 (12 x 5) year cycles. Three of these sixty-year cycles create a "group" or cycle of 180 years. We are now (in 2001) in the eighteenth year of the twenty-seventh group, or year 4,698 of the Chinese lunar calendar. So embedded is Chinese culture and civilization in this calendar, with its elaborate system, that to take away this calendar would virtually eliminate

Chinese culture altogether. Perhaps more than any other factor, this highly involved calendar also accounts for the longevity and tenacity of Chinese civilization as one continuous tradition for the duration of its history, which according to the reckoning of its calendar began in 2697 B.C., a date, interestingly enough, that coincides with the dedication of the Great Pyramid of Egypt.

Despite its marvelous system, the Chinese lunar calendar is still just that: a lunar calendar. The problem with this, from the point of view of the Law of Time, is that when it is not regulated by a proper solar count or measure, the lunar calendar leads people into one-sided developments of one kind or another, if only to the extent to which these calendars foster such profoundly patriarchal societies, of which the Chinese is certainly no exception. The influence and use of the Chinese lunar calendar system extends into southeast Asia, Tibet, Mongolia, Korea, and Japan. As a field of thought within the noosphere, the Chinese system is the equal in power base to the Babylonian and Indian systems, at least up to the time of the dominance of the Gregorian. Even today, the Chinese New Year exerts a powerful attraction worldwide.

While the Chinese and Hebrew lunar calendar systems maintain a powerful conservative strain of human society, the intercalation of the thirteenth moon, seven times every nineteen years, creates a kind of circulation within the system. Thirteen is the number of circulation, whereas twelve is that of a static, non-circulating spatial order. The taboo on the number thirteen-epitomized by the superstition about Friday the thirteenth-must certainly be related to the suppression of the solar-lunar Thirteen Moon/28-Day calendars in virtually all historical societies. This irrational repulsion of the number 13 serves psychologically in defense of the "rationality" of the number 12, a number that does not circulate time and is at the root of the linear conception of time. The illogical and irrational decisions that are made and then institutionalized into the human social fabric must at one point be discounted. Any illusion or error pursued for too long will always end in disaster.

The Islamic lunar calendar, used by some 1.3 billion humans, is distinguished by two factors:

1) It is based on a known historical incident, the *Hegira* or flight of the prophet Muhammad from Mecca to Medina, dated to the new moon or Muharram 1, Julian, July 16, 622 (Gregorian, July 26).

2) It is a pure twelve-month lunar calendar running on a cycle of pure lunar years of 354 days, with no intercalary lunations, and in this regard does not annually harmonize with the 365-day solar cycle.

For this reason, this year 2001 saw the beginning oflslamic lunar year A.H. *(M-*ter Hegira) 1422. But if we are to count the solar years since the Hegira, correlated to Gregorian July 26, then it is solar year A.H. 1379. We see here a discrepancy of some some forty-three years between the solar count and the lunar count. The lunar count continuously retrocedes so that it takes thirty-two years for one Muharram to occur at the same place in the cycle of the solar year. In essence, the Islamic lunar calendar creates a hermetic, retrocessing time bubble with no circulation of the power of the thirteenth moon, and that accounts for the highly conservative and patriarchal nature of much oflslamic society. Again, while there may be a virtue to maintaining a strict lunar calendar count, if it is not correlated to a harmonic solar or solar-lunar standard, the effects will be precisely of the nature that we see occurring in today's world, a point to which we shall later return.

Finally, in this brief consideration of calendars as the principle macro-organizing system for the programming of human society, a word should be said about the system of calendars in the predominant part of the Indian subcontinent. Long before they adopted the Babylonian solar zodiac and hexagisimal spatial principles for reckoning time, the Hindus also had a type of 28-day count, but one based on the course of the moon in relation to a set of stars called Nakhsastras; this created a kind of 28-part lunar zodiac. In this system, however, the Hindus divided the 360-degree lunar ecliptic into twenty-seven equal parts (27 days = sidereal cycle of the moon) each part equal to 13 degrees, 20 minutes of are, the precise measure of the 13:20 timing frequency. A complex variety of lunar calendars were developed early on, but were gradually displaced by what we call the pseudosolar Babylonian division of the Earth's ecliptic into twelve 30-degree segments, a fact that reflects the adoption to the unconscious 12:60 frequency program.

The Hindu (pseudo) solar calendars are all based on the same division into 30-degree arcs-a circle or plane in space! While the base count of the present era is taken from February 18,3102, the beginning of the Kali Yuga-the last and darkest age-exactly 5,104 years ago (dated from Gregorian year 2002), today there are at least six different calendars in use throughout the subcontintent, each essentially the same as the other, but characterized by different dynastic starting points. These differing counts, coupled with the distinct profusion of religious holidays, accounts for the jarringly conservative and colorful confusion that characterizes present-day Indian society-a neo-Babylonian time warp, its populace locked into place by complex systems of pseudo-solar calendars set in the context of earlier Hindu astronomical cycles of a vast and overwhelmingly cosmic nature.

"TIME IS MONEY": THE WATCHWORD OF THE 12:60 FREQUENCY

All of the aforementioned time-reckoning systems, with their various beginning points, can be mapped within the 5,200 tun/5,125 solar cycle of the thirteen baktun Wave Harmonic of history. While we can generally see how the Babylonian and lunar calendar systems shaped the mainstream civilizational orders of the Old World, in our time map we must also take into account the workings of the 12:60 artificial timing frequency within the unconscious noosphere. In this sense, the 12:60 frequency refers to the principle programs of control adopted and maintained through use of the twelve-month calendar systems in the Old World. (See plate 5, Noospheric Time Map-Wave Harmonic of History.)

Plotting the incidence of these calendrical streams on the time map, we must keep in mind that the calendar systems are the chief instruments for establishing and maintaining the human mind and social order within very specific programs of behavior. These programs, at least in the Old World, were characterized by the introduction of artificial systems of exchange called money, and accompanying programs of taxation. These systems were adopted to a greater or lesser degree by all the Old World societies. In this we find the root of the slogan, "time is money," where money is the artificial medium to negotiate artificial time. The end of history is the end of money and the end of artificial time. The word "calendar" itself is derived from a Latin word meaning "account book," the first day of every month being *calends* or the date of payment of debts.

Now, let us return to a consideration of the two principal and resultant 12:60 instruments dominating the end of historical time: the Gregorian calendar and the mechanical clock. We may note that toward the conclusion of the twelfth baktun cycle (A.D.1618), the clock reaches its perfection at the very moment of the implementation of the Gregorian calendar reform (A.D.1582), just after the act of global circumnavigation had been accomplished. Within the entire thirteenth baktun cycle, 1618-2012, the coincidence of these three factors-clock, calendar, and European global circumnavigation-induced what amounts to a 12:60 frequency capture of planetary time in the biosphere. What are the implications of this takeover of time by an irregular and irrationally measured Gregorian calendar and its accompanying micro-organizing device, the mechanical clock?

Plotting the growth curves of human population, machine, and money, we see that the complete infusion of the 12:60 artificial timing frequency creates an unprecedented acceleration, the exponential peak of which occurs at the moment of the Inevitable Event. For this reason, according to the Law of Time, it is important to

comprehend even more deeply the nature of calendars and their effect, especially with regard to the current global standard.

Because the calendar is a macro-organizing principle, when accepted over time it establishes in the mind, individually and collectively, a set of perceptions that are automatically taken for granted as being "real" and "indisputable." These sets of perceptions define the paradigm by which a people, culture, or even an entire civilization operates. The Gregorian calendar, the current global civil standard, is the paradigmatic macro-organizing principle in which are embedded all the laws, customs, institutions, and scientific principles governing the present global civilization-not to mention all the holidays of the Vatican-ordained Catholic Church. According to the Law of Time, the current calendar is an irregular standard of measure; its units of measure do not correspond. This calendar represents, therefore, the institutionalization of disorder and entropy. Because it has existed for a sufficiently long duration in the human historical cycle-2,OOO years, including its predecessor, the Julian calendar-the perceptions fostered by the unconscious acceptance of the Gregorian calendar are taken as the unshakable bedrock of nature and reality. All current beliefs-economic, political, and scientific, from democratic neo-liberalism to the special theory of relativity-are actually products of the underlying perceptions promoted by this calendar, and have no reality apart from the beliefs about time that the calendar engenders. *Change the macro-organizing principle and you change the paradigm.*

THE NEED FOR A TRULY "NEW MILLENNIUM"

As the global civil standard, the artificial, irregularly measured Gregorian calendar is a self-reinforcing feedback loop. As such, it furthers and maintains all linear time concepts, thereby establishing a host of entropic, disordered value concepts such as the violent universe, the degradation of matter, quantum physics, the arrow oflinear time, the doctrine of techno-economic inexorability, and an attendant host of unresolvable problems-crime, drug abuse, terrorism, environmental deterioration, and so forth. Why? Because as an irregular standard of measure, the Gregorian calendar is incapable of producing harmony. Only harmony can unify. The Gregorian calendar is not a unifying harmonic standard. Lack of a unifying global standard exacerbates all current conflicts. Condition the mind to an irregular standard and the mind will adjust to disorder and chaos as normal conditions of existence.

The world's racial, tribal, historical, and religious conflicts are embedded in and a function of different timing systems (calendars), all now coordinated within a master

irregular timing standard and macro-organizing principle, the Gregorian calendar. In this calendar's irregularity is embedded the view that the world of the inevitable degradation of matter is the exclusive object of all present-day science, and hence is also reflected in the entropic nature of global civilization and its deteriorating social processes. The Gregorian calendar conditions the mind to hopelessness of resolution. Without a unifying harmonic standard humanity is incapable of finding long-term resolutions for any of its problems. Disharmony can never produce harmony. Only harmony can produce harmony. All conflict can only be resolved by the application and within the context of a harmonic timing standard.

Now, following the attack on the Twin Towers and the Pentagon, we can say that the Gregorian calendar is bringing history to an end. The Inevitable Event was programmed into the Gregorian calendar, and the Gregorian calendar usurped the power of all calendars in the thirteenth and final baktun cycle of history. When the third millennium officially opened at the dawn of the year 2001, the pride of industrial man was at an all-time high. Would it be a millennium of peace or one of war? If the last century of the second millennium was the century of total war, was the third millennium going to do anything but inherit the unfinished programs of the old millennium? Could the Earth and the biosphere withstand a millennium of total war? Hardly. The Vatican "jubilee year," which ended with the beginning of the third millennium, turned sour with the Twin Towers apocalypse, as is vividly reflected in a photo of Pope John Paul II taken just after the Inevitable Event. The Gregorian calendar marks its inception with the birth of Christ, a date and moment that was never historically noted, and so is shrouded in speculation and conjecture. Now the twisted civilization of Gregorian time is locked in mortal combat against a terroristic specter that it alone could have projected into manifestation. Soon, by biospheric standards, the world of artificial time will be over and gone. And then the millennium will be truly new.

The very word *millennium* conjures possibilities of Earth-shattering events and cosmic prospects. If the inception of the Kali Yuga, 3102 B.C.,can be said to be the point where the historical process became irreversible, eleven years after history began in 3113 B.C.,then in counterbalance, the Inevitable Event, 2001, which had to occur eleven years before the end of the cycle of history, A.D.2012, was more than just millennial. It was the termination of more than 5,000 years of the irreversible motion of artificial time. Such symmetry-eleven years after the beginning and eleven years before the end of history-is the hallmark of the synchronic order. For 5,100 years the count of days has numbered the long and increasingly perilous saga of human civilization. How bright was the beginning and how grim will be the end?

There at the beginning of the cycle was the "first city," Uruk. There at the end of the cycle, the fallen Twin Towers of Babel of the "last city," New York (= New Uruk), the ultimate monument to history itself and the final event to initiate the actual closing of the cycle of history.

> *There it is, the city of Uruk. Urshunnabi, climb up on that wall, the outer all shining with the brilliance of burnished copper. The seven wise men laid the foundations. One third of the city is buildings, cunningly executed, one third of the city is garden with rose and bird, and one third of the city is field with the temple of Ishtar within. Goddess of love and struggle.*
>
> - *THE EPIC OF GILGAMESH6*

IfUruk is the place where the seven wise men laid the foundations, those foundations were measured by the 24 hours, 60 minutes, and 60 seconds derived from the 360 degrees of the circle. Fifty-one centuries later, the gardens are all but gone, the fields themselves mechanized and chemicalized by the technosphere. Earth's inhabitants are in terror. Five weeks after the Inevitable Event, now known simply as 9-11, the end of history still smolders. After the struggle, will the goddess of love return?

5

The Climax of History, the Fifty-six Years of Hiroshima—Artificial Time Runs Out

THE IMAGE of the Noospheric Time Map-Wave Harmonic of History on plate 5 of the color insert, showing the concurrent evolution of the different calendars of the major civilizations of the world (the illustration is by no means exhaustive), is intended to demonstrate the fact that the human race was not unified by a single coherent timing standard throughout twelve of the baktuns of historical development. It was only in the thirteenth and final baktun that humans became organized by a single timing standard. However, it was not a timing standard in accord with the synchronic order of the Law of Time, but the artificial 12:60 timing frequency as represented by its two organizing instruments, the Gregorian calendar and the mechanical clock.

The seeds of this moment had already been planted in the noosphere at the beginning of history. From both Sumeria and Babylonia the taint of the 12:60 frequency then spread through the noosphere and, by means of historical dissemination and conquest, throughout the Old World. By the time the historic moment arrived to ripen the 12:60 frequency into its full fruition-A.D. 1618, the beginning of the scientific revolution and the thirteenth baktun-there were virtually no longer any cultural traditions governed by the natural 13:20 timing frequency. The civilizations and peoples of the New World were now under the subjugation of the prevailing world order of European global imperialism. The stage was set for the brief but final phase of mechanization, of which the technosphere itself is the climax.

What the Noospheric Time Map also delineates is that the 13:20 frequency was the unconscious organizing factor of prehistory, and that, undoubtedly, a key timing system intuitively evolved among many prehistoric peoples independently of one another. This was the universal, harmonic solar-lunar standard of the Thirteen Moon/28-Day calendar. The defining point of history arrives with the establishment of a 12:60 timing standard within the noospheric unconscious. This frequency predominates in the development of twelve-month pseudosolar calendars, as well as the twelve-month synodicallunation calendars that are not the measure of a solar year. These two commingled systems are entwined throughout the ancient history of the Old World as the central thread of development shaping the conception of time and resulting in what were to become the two dominant instruments of human time reckoning, the Julian/Gregorian calendar and the mechanical clock.

Julius Caesar himself instituted the famous "calendar reform" that created the 446-day year of confusion in 45-44 B.C., and established a calendar that was just as patently confusing. Julius Caesar's was not the only calendar reform in the ancient world. The Essene movement, founded by someone known simply as the Teacher of Righteousness and of which Christ was supposedly a member, began as a revolt against the Hebrew lunar calendar. The issue was the need for fixed holidays within the solar cycle, something that is virtually impossible in a lunar calendar that retrocedes eleven days every solar year. There is strong reason to believe that among other calendars, the Essenes favored the Thirteen Moon/28-Day calendar. This even leads to the question: did Christ himself follow a thirteen moon calendar? In any case, it is the 12:60 frequency transmitted through the irrational disorder of the Julian/Gregorian calendar that captures the mind of the human race and the biosphere during the final years of the cycle of history. And it is precisely for this reason that the pace of human civilization becomes exponentially and entropically accelerated during the last few centuries of its development.

Shocked into higher consciousness by its own barbarism masquerading as civilization, at the end point of history the human has the opportunity to return to the natural 13:20 frequency of synchronization. This return would mark the emergence of humanity from the unconscious mechanistic compulsion of artificial time into the conscious field of post-history. The only possible option to unify humanity-once the yoke of the Gregorian calendar is removed-is the true solar-lunar calendar of Thirteen Moon/28 Days. With the possibility of this positive end in sight, we may turn to a more descriptive and definitive analysis of the technosphere. In this way understanding the modalities of the technosphere as a distinct and entire process, we

Gregorian Calendar 28-Year Cycles: 1945–2001, the Age of Terror

It takes twenty-eight years for the Gregorian calendar to run through its cycle of permutations. Every twenty-eight years, like a phonograph record of time—a chronograph—the Gregorian calendar guides its users through a mentally debilitating construct of unevenly measured and irrationally named months, paced by a system of 7-day weeks that bears little relation to the lengths of the months or years. In addition, every four years there is an extra day. Within this medieval mathematical jumble are kept the collective unconscious programs that repeat every twenty-eight years. What happened in 1945 will somehow repeat or have an effect again in 1973, in 2001, and then in . . . it's up to you. You can change this if you want to.

First day of the year	Tuesday	Wednesday	Thursday	Friday	Sunday	Monday	Wednesday	Friday	Saturday	Saturday	Monday	Thursday	Tuesday	Sunday
Hiroshima 1945 – 72						**1945**								
	1946													
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Twin Towers 1973 – 2000						**1973**								
	1974													
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Inevitable Event 2001 - ?						**2001**								
	2002													
		2003												
														2004 Year of the Great Calendar Change
														Where will you be? 2012

might then develop a deeper insight into where we have just been and why we need to go somewhere else.

The technosphere defines a 56-year cycle, 1945-2001, coordinated by two complete Gregorian 28-year cycles. For any Gregorian calendar year, the days of the weeks in their irregular monthly succession and in relation to the permutation cycle of leap years repeat precisely every twenty-eight years, during which time there are always exactly seven leap years. This means that Gregorian calendar years 1945, 1973, and 2001 possess the same exact annual arrangement of the days of the week in their monthly succession. If today is Sunday, November 11, 2001, so it was in 1973, and likewise in 1945. In this regard the Law of Time frames the cyclic recurrence of the otherwise irregular 12:60 Gregorian calendar by the intrinsic formulation 28:7. That is, just as the 19:7 factor coordinates the lunar calendars every nineteen years, there being seven intercalations of the thirteenth moon during that cycle, so in the Gregorian calendar every twenty-eight years there are always exactly seven leap days and years.

Understanding a calendar as the instrument that locks the conditioned programs of a given culture or people into place, we can now understand how the unconscious metaprogram of the macro-organizing principle of the Gregorian calendar cumulatively recycles all its millennial programs every twenty-eight years. Since its inception in 1582, the Gregorian calendar has been dragging forward a host of conditioned thought forms and perceptions, including those inherited from 1,500 years of the Julian calendar that it had reformed. At points of dramatic break in the continuity of human consciousness, a new set of cycles is set to recur. Such was the case in the year 1945, with the awesome blast of Hiroshima. The entirety of the mind field conditioned and held in place by the Gregorian calendar then reaches its full fruition during the two subsequent 28-year cycles, fifty-six years in all-thus bringing forward two millennia of conditionings, conflicts, and unconscious death wishes or apocalyptic programs. The first cycle was initiated in the year 1945, the year in which Vernadsky died, the atomic bomb was tested once and used twice, and the Second World War came to an end. That year, 1945, marks the beginning of the technospheric bubble. It is most telling that the Second World War was concluded at the beginning of this 56-year cycle of the technosphere, for it was a war concluded not with peace but with instruments of mass destruction and terror. Thus began the 56-year era of Atomic Terror.

The technosphere has its origins with the full capture of the human mental field by the 12:60 frequency in 1618. From 1618 onward, the noosphere is increasingly obscured by a mental field known as the *technospheric sheath.* Slowly but surely, the

technospheric sheath replaces civilization. This is first done by the introduction of mechanistic linear time. It is important to note that the Julian count, the basis of all modern scientific calculations, is a scale created by Thomas Scaliger in 1583, twenty-one years after the 1562 Mayan book burning. This linear time scale, like the Gregorian calendar reform itself, was intended to co-opt the Mayan thirteen baktun Long Count by setting a count of days that begins the first of January, 4713 B.C., or some 1,600 years prior to 13.0.0.0.0, the beginning of the thirteen baktun count in 3113 B.C.This deliberate historical act, the Julian count, along with the Gregorian calendar and the mechanical clock, established the paradigmatic notion of the linearity of time in the ripening field of scientific thought. Reflected in the noosphere, this linear, irreversible time concept levels and stunts the realization of human mass consciousness. In fact, during the technospheric cycle, especially after 1754, the ceiling of human consciousness is maintained by a preoccupation with mechanistic third-dimensional operations while becoming increasingly alienated from the organic order of reality. This creates the 12:60 consciousness constant, a mental ceiling that actually diminishes in proportion to the increasing rates of multiplication, propagation, and intrinsic velocity of the machine.

With the actual rise of the Industrial Revolution, dated in the noosphere to A.D. 1754, the synchronic point at which mechanization becomes an irreversible factor of the biosphere, the technospheric sheath, henceforth enters its next stage, going from a purely mental sheath to the industrial sheath, the prelude to the proto-technosphere itself. The industrial sheath spreads throughout the biosphere between 1754 and 1901, the official beginning of the twentieth century. At this point we enter the forty-four years of the proto-technosphere, 1901-1945. During this critical stage of the proto-technosphere, the actions of human behavior interacting with machine technology make the expression of true culture increasingly difficult, if not impossible. Civilization becomes a set of symbols purveyed through museums, galleries, and theaters, and recorded and reproduced in ever more advanced technological forms. But what of culture, which is not the same as civilization-what becomes of culture?

To begin to answer that question, some further definitions are in order. The technosphere is defined by and based upon one key term: *technology*. According to the common dictionary definition, which already reflects the mass mind, technology is "the totality of the means employed to provide objects necessary for human sustenance and comfort."l Today virtually all the means employed are themselves mechanical in nature. In common parlance, therefore, technology refers to the complex apparatus of mechanization. In fact, technology *is* mechanization; it is the ability to

convert human labor into processes carried out purely by machine-oriented or mechanical means. This is also inclusive of the entirety of computer technology, which represents the mechanization of the more purely mental processes of thought and communication.

Mechanization, we must remember, originated in the clock, in the mechanization of time. It is the mechanization of time that presupposes the tendency toward mechanization as a state of mind within the noosphere. Since artificial time is characterized by the illusion of an inexorable and irreversible linearity, the compulsion toward materialism is also experienced in the same way, an inexorable motion spearheaded by the advance of ever more improved machines. The machines themselves are the products and means of industrialization-the technological transformation of raw goods into consumer goods, a process accounting for much of the free energy introduced into the biogeochemical combustion of the biosphere.

Inseparable from mechanized technology, too, are materialism and the concept of the World Market and, more recently, of globalization. Materialism is implicit in the dictionary definition of technology as the means employed not only for human sustenance but also for human *comfort.* This comfort can only be of a material form or nature, hence the pursuit of comfort through mechanized technology can only be for the furtherance of a philosophy and exaggerated lifestyle of materialism-the belief that only the material things of this world have any value. Of course, the value of material goods and comforts increases when the value of money is put into the technospheric equation. The first stock market opened early in the eighteenth century, providing a place where money could be used as speculative capital to promote the advance of commodities and machine products. The entire sphere involving commodity production and its conversion into consumer products eventually came to be known as the World Market. Integral to the success of the World Market was the creation of the modern banking system, based on the institutionalization of interest rates and the principle of lending money to companies for the purpose of furthering the transformation of the biosphere into the technosphere.

While the concept of the World Market prevailed for a long time as the definition of the system for exploiting and extracting natural resources from the biosphere, and then converting them into industrial goods to be consumed by the human populace worldwide, globalization is far more recent. Globalization represents the absolute triumph of capitalism as the dominant economic doctrine of the human species in the biosphere, and the absolute basis of the technosphere in its final phase of development. As such, globalization is the economic system of neoliberal market

economics that treats the whole world as the proper sphere of its policies and practices. It is a specialized form of monetary imperialism that gives rise to and is supported by the doctrine of monetary politics, the use of money as a means of coercion or even for the buying out of whole governments. Of course, the principle practitioner of monetary politics is the nation with the most money, the United States of America, home of the World Trade Center.

Fostering corporate multinationalism, globalization is inseparable from the consumer philosophy it promotes. Consumerism is the devaluation of the human into a link in the chain of the cycle of industrial production, the object of globalization being to inspire and promote a massive and wide-scale consumerism worldwide. This is what is meant by such phrases as "increasing consumer purchasing power" and "opening new markets." To promote and defend its interests, the all-pervading system of globalization first developed the World Trade Center, and in the last decade, following the end of the Cold War, the GAIT and the WTO, the global "Chamber of Commerce."

As a political hegemony, globalization is managed by the G-7 group of the seven most industrialized nations (the United States, Canada, the United Kingdom, France, Italy, Germany, and Japan-now, with Russia, sometimes referred to as the G-8). This organization, headed by the finance ministers of these seven countries-like the seven wise men of Uruk at the beginning of history-was secretly formed in 1974 by the CIA, one year after the completion of the World Trade Center Towers and the formation of OPEC. The first public meeting of the G-7 occurred in the summer of 1990, just prior to the Iraqi invasion of Kuwait. The doctrine and system of globalization-now overtly controlled by the G-7 and its chief ally, the Euromarket nations-is inseparable from industrial technology as the means employed to provide objects necessary for human sustenance and comfort. Implicit in the philosophy of globalization is the right of the G-7 to promote and defend its way of life, regardless of its ultimate effects on the biosphere and at the expense of ideologies and beliefs not consistent with it. To defend itself, globalization has at its disposal the U.S. military, the command of which is housed by the Pentagon, and the new technospheric multinational military cartel, NATO. In a word, globalization is the triumph of the military-industrial complex.

From the point of view of the biosphere, globalization is the cancer of the human species consuming non-renewable resources and, through the release of free energy, effecting the final critical increase in biogeochemical combustion. The planetary instrument for furthering the entire process and philosophy of globalization is the technosphere. The technosphere may be defined as the entire apparatus of

mechanized technology and its support philosophy (globalization), understood as an artificial sphere encompassing the globe. As such, the techno sphere is discontinuously interspersed within the biosphere. More precisely, the technosphere is located physically and mentally between the biosphere and the noosphere, in other words, between the Earth's vital sphere and its mental envelope.

Being the description of an evolutionary stage, the technosphere is governed by the Law of Time as a 56-year event continuum along the lines of an artificial planetary cocoon. Insofar as it is the projection of human thought, the technosphere is the materialization of the sum mental processes denoted and conditioned by mechanization in all its aspects, and that have their primary root in the mechanization of time. It is the mechanization of time that essentially establishes the artificial timing frequency as the capacity to engender the machine and, consequently, an artificial structure, the technosphere. Because it is artificial, however, its duration is highly limited and is subject to the inherent inconsistencies and contradictions in human thought and social structures because of the aberrant effects of adapting to artificial time in the first place. The effect of adaptation to artificial mechanized time creates a social-political hierarchy known as the technocracy-rule according to the needs of technology. It is the effect of maintaining the technocracy and the technosphere itself that establishes the inability of human consciousness to do anything more than remain in a constant, servile, and unchanging state of machine dominance. All the while, by contrast to the unchanging condition of consciousness, the machines evolve exponentially in number and complexity. As Marshall McLuhan so correctly put it, the humans are the bees of the machine.

To be fully understood, the technosphere cannot be seen apart from its place in the biosphere-noosphere continuum. The technosphere represents the absolute control of the biosphere by artificial 12:60 time. Artificial time generates the artificial medium of money, hence the operating philosophy of the technosphere: "time is money." Money is the lifeblood of the technosphere. Servitude to money draws humans away from the biosphere in order to be devoured by Mammon-the technosphere as an all-consuming entity. In this process the humans get money in return for selling their bodies and souls to artificial time, usually eight hours a day, often to produce artificial goods or for service in maintaining the artificial system of money itself. This money gained from servitude is used to buy consumer goods, including more machines of every kind, and thus the human participates as a vital link in the cycle of biogeochemical combustion. In this way the mechanized lifestyle converts the human-the consumer-into the biomass necessary for maintaining the technosphere.

By 2013
Earth is galactically synchronized into a new biogeological epoch: the psychozoic Era.

As the mental envelope of Earth, above and discontinuous with Earth, the noosphere can only mean one thing: the advent of universal telepathy among the humans.

The difference between the new time and the old time is like the difference between heaven and hell.

Planetary 9-11, 2001 inaugurates biogeochemical combustion, biospheric means of transformation, and self-mutation.

Technosphere: Biospheric agent devised for maximum biogeochemical combustion.

Built in an area known as "Hell's Bottom"

The Pentagon 1941–200?

Impregnable fortress of the American war machine, meant to protect "democracy" = American domination of world market and foreign/economic policy of globalization. "The form of the Pentagon . . . is that of a pentagram, the chief magical aid for gathering power. When a pentagram is drawn with its base toward the north, and its chief point to the south, it is useful for negative or black magic purposes."
—*Transformative Vision*, page 249

*Note: Gregorian calendar coordinated by Law of Time. Repeats precise order of days and weeks precisely every 28 years.

56-year cycle of Hiroshima
"Age of Terror"
Technosphere Replaces Civilization

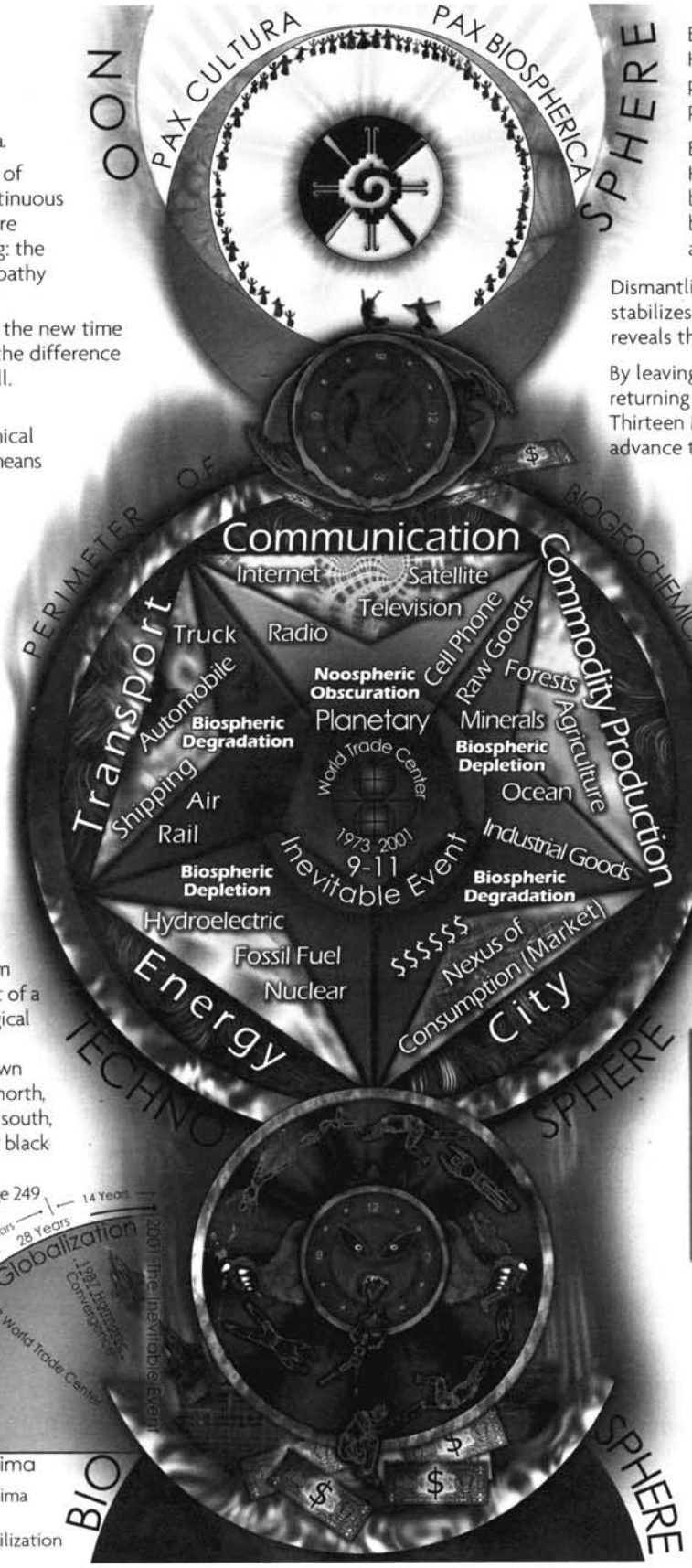

By 2012
Humans realize a permanant condition of peace through culture.

By 2009
Humans are reorganized by the Law of Time and begin the construction of a galactic culture on Earth.

Dismantling of the technosphere stabilizes the biosphere and reveals the noosphere—2005.

By leaving artificial time and returning to natural time via the Thirteen Moon calendar, humans advance the noosphere.

2004: Last opportunity for humans to change their macro-organizing principle.

Exhaustion of the Technosphere—2001–04.

Exponential growth curves of money, machine production, energy, and people climax.

Planetary 9-11: time runs out on the technosphere.

"New" millenium nipped in the bud; civilization R.I.P., 2001

Technosphere:
Interlocking interactive pentagon of five artificial systems - WTC = Nerve center and hub of the technosphere and its driving power, globalization.

Biosphere:
Controlled by artificial (12:60) time.
Time is Money—lifeblood of the technosphere.

Humans devoured by Mammon. Get money in return and create biomass to maintain technosphere.

Biosphere–Technosphere–Noosphere

As an operating planetary structure, the technosphere consists of five interactive components.

1. COMMODITY PRODUCTION

Commodity Production, the basis of the entire World Market as a biospheric system, refers to the transformation of natural resources through industrial means into consumer products. Commodity production alone accounts for the complex of industrialization that brings the World Market and the technosphere into existence. According to *The Biosphere Catalogue,* the post-World War II growth of the World Market necessitated the establishment of the World Trade Center, a global complex (114 such centers in 1985), but with its principle coordinating unit being the Twin Towers in New York City, home of the World Trade Institute and the corporate offices of the New York Stock Exchange, the key to the world money and commodities market.

2. CITIES

Cities, the second technospheric component, represent the human social organism or marketplace for accommodating the production and consumption of industrial goods. Civilization is city life as it has evolved from Uruk to New York (= New Uruk). While prior to industrialization the city depended on a healthy agrarian economy for its support, industrialization pushed the city to new heights of artificiality, not the least of which were round-the-clock lighting systems that allowed for 24-hour consumer markets. As such, the city is the nucleus of the technospheric system, the hub of its commodity production, of its energy consumption, and of its transport and communication empires. The growth of the cities around the world is exponential in the second half of the twentieth century, reflecting the triumph of the technosphere. It should be noted that in the fifty-six years of the technosphere, the human population almost tripled-from 2.2 to 6.2 billion, a growth demonstrated in the vast expansion of the large urban centers.

3. ENERGY

Energy is the third component of the technospheric complex. The tremendous needs of industrial production have transformed the natural energy processes of the biosphere into gigantic artificial complexes for the production of energy to maintain factory and city alike. The impact of the different artificial energy systems upon the biosphere has been enormous. These systems include coal, oil, and fossil fuels in general, as well as hydropower and nuclear energy. The whole syndrome of artificial

time, artificial means, acceleration of the machine, and expansion of human population has required and created the enormous output of artificial energy into the biosphere and contributed greatly to the destabilization and loss of natural resources and atmospheric and hydrospheric contamination through the release of toxic "free energy" by-products.

4. TRANSPORT

Transport. Without the highly industrialized transport systems, the commodity production, the vitality of the cities, and the access to provisions of fuel required for the energy systems would collapse. No sooner had industrial production begun early in the eighteenth century than the first artificial transport systems came into being: the steam- or coal-driven locomotive, and the great transoceanic shipping lines. By the twentieth century, the railroad system and worldwide shipping industry were supplemented by the invention of the combustion engine, which made the trucking industry possible. Following World War II, rocketry and jet propulsion established the transportation might of the great airline companies of the second half of the twentieth century. It is no coincidence that commercial airplanes, the symbol of the technosphere's advanced transport systems, were used to bring down the Twin Towers and to penetrate the Pentagon.

5. COMMUNICATION

Communication is the fifth component that unifies the technosphere into one whole system in touch with itself everywhere. From telegraph to telephone, radio, television, and then finally fax, cell phone, and the Internet, the industrial-era technologies, with their electronic instantaneity, have created the vast communication networks and media empires that keep the world humming and promote globalization above all. When considering modern communication we must also bring into focus the chief method of globalization, which is marketing-propaganda on behalf of consumerism. Marketing is the use of means of mass communication to control the mind of the consumer. In the final stage of globalization, marketing replaces consciousness, or rather, marketing is the manipulation of consciousness-the latter already having been reduced to a stunted level-for purposes of consumerism, or for ideological needs such as patriotism and fear campaigns. The Internet, the marriage of computer and telephone technologies, represents the final stage of the Tower of Babel, and the completion of the process of globalization. The only place to go after the Internet is technology-free telepathy.

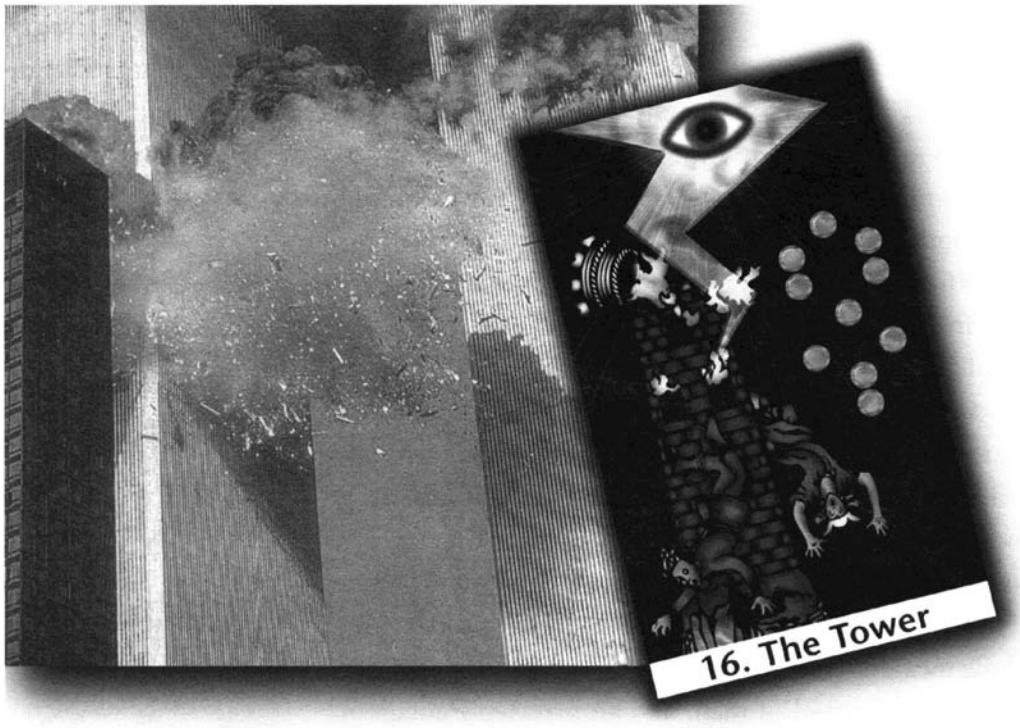

The Tower

From the biospheric perspective, this five-tiered complex of the technosphere is a whole unit. All the subsystems evolved together to establish the structure and operating procedures of the technosphere. When the technosphere goes, the entire system folds. This is what is now beginning to occur. Following the Inevitable Event, the whole technospheric system will be coming down slowly over the next few years, like a giant circus tent that has lost its central prop. How gracefully or gracelessly this happens is dependent on the response of the Pentagon-or the will of humanity to rouse itself in the face of even worse barbarisms.

Because it consists of five interactive components, the techno sphere can be graphically depicted as a pentagon, a five-sided figure. At the center of this pentagon of the technosphere are the World Trade Center Twin Towers. The actual Pentagon, which was attacked along with the Twin Towers, was designed in the late 1930s to house the U.S. Department of War. Its construction occurred in the years 1941-1943, in an old neighborhood of pawnshops and bars called Hell's Bottom.2 When it was built it was the world's largest office building in terms of actual space. Of course, when they were built, the Twin Towers of the World Trade Center were the world's tallest office buildings. The structure of the Pentagon is the prototypical morphology

of the structure of the five systems that constitute the technosphere. The Pentagon was the impregnable fortress of the American war machine, protecting American interests and globalization around the world. If there were two central points-actual and symbolic-to what is known as the military-industrial complex, it was the Pentagon and the World Trade Center, and this is undoubtedly the reason why they were both targets of the Inevitable Event.

What is architecturally noteworthy about the Pentagon is that it is designed with five inner pentagonal corridors and office slabs, and that it is constructed with its odd point to the south. Since a pentagon is actually a pentagram, a five-pointed star with its points connected, the Pentagon represents an *inverted* pentagram, as its odd point faces south rather than north. In the traditional Tarot deck it is interesting that the Fifteenth Major Arcana, The Devil, contains an inverted pentagram between the horns of the Beast. Paul Foster Case writes, "This is a key to the whole meaning of the figure [of the devil]. For the Pentagram is the symbol of man, and an inverted Pentagram suggests the reversal of true understanding of man's place in the cosmos."3 While the Fifteenth Major Arcana contains the pentagon as the inverted pentagram, the next card, the Sixteenth Arcana, is The Tower, which shows the tower being struck and broken apart by lightning (fire of heaven), with humans falling or jumping out of the windows to their death-as accurate a symbolic depiction of the collapse of the Twin Towers as could be found.

VYhat the startling conjunction of these symbolic correspondences points to is the profoundly archetypal nature of the Inevitable Event. It has been prefigured and prophesied, and has now come to pass. No matter how much America and its allies, many of them bought for a price, may strike back, the deed has been done. The Towers are gone; the Pentagon has been penetrated. While it will take several years for the full realization of the absolute magnitude of this archetypal event to sink into the

9-11

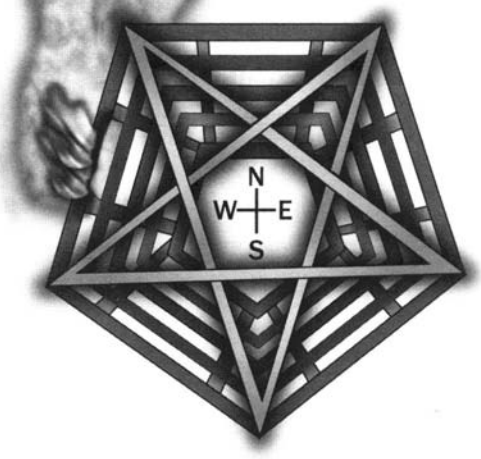

THE PENTAGON

The Devil and the Pentagon

collective mind, it is important to demonstrate the actual structure in time of the techno sphere so that the finality of its end may be seriously considered, and the gate to the future, which has thereby been opened, can be made clearly visible.

As we have shown, the technosphere is a structure totally brought about by the 12:60 timing frequency, and thus is purely a function of the latter. As such, the technosphere is embedded in the global macro-organizing principle of the 12:60 frequency, the Gregorian calendar. Two 28-year cycles, each one divided into four 7-year subcycles, define the duration of the technosphere. Remember that the Gregorian calendar repeats every twenty-eight years. As we have pointed out, the 56-year cycle of the technosphere, 1945-2001, is preceded by the 44-year cycle of the proto-technosphere. The two World Wars were a function of the proto-technosphere, the final major act being the construction of the Pentagon, specifically for consolidating the American war machine-the world's largest office building means that the world's largest business is war, with a $318 billion budget for the year 2001-2002 alone!

The fifty-six years between Hiroshima and the Inevitable Event were the age of terror, for it was atomic terror that initiated the technosphere in a baptism of nuclear fire, and in the end, it was an unimaginable suicidal terror that brought down not just one, but both of the Twin Towers of Babel. The final collapse of the technosphere is also the final war between blood and money. Artificial time has run out. Only a new time will be able to regenerate the biosphere and spiritually revive mankind. What follows is a chronological description of the eight 7-year stages of the fifty-six years of the technosphere. Note the persistence of certain themes. (See plate 5, Noospheric Time Map-Wave Harmonic of History.)

GREGORIAN A, 28-YEAR CYCLE: TRIUMPH OF THE WORLD MARKET, 1945-1972

1. 1945-1951. CYCLE OF THE BOMB: ATOMIC TERROR AND THE DIALECTIC OF THE COLD WAR.

During the first dynamic 7-year cycle, with the triple event of the first test of the atomic bomb and its two detonations at Hiroshima and Nagasaki, the biosphere becomes irrevocably altered by the introduction of a constant, steady state background radiation into the atmosphere, the actual inception of the biogeochemical combustion. This act officially establishes the technosphere. The reality is that the humans also created their first weapon of mass destruction. It is this act that also immediately sets in motion a destabilization of the human consciousness in the noosphere.Within two years, Mahatma Gandhi, the world's foremost pacifist, is

assassinated, as a "free" India is partitioned into three parts-India, Pakistan, and what is later to become Bangladesh. In the same year, 1947, the iron curtain between communist Eastern Europe and the West, epitomized by the Berlin Wall, turns the enmity between the two major powers, the Soviet Union and capitalist America, into the Cold War. The subsequent formation (1949) of the NATO military cartel counters the United Nations, which was founded in 1945 to replace the League of Nations. The UN now has the task of keeping World War III from happening by providing a forum where the "superpowers" can keep their cold war from heating up, and that will contain and manage the spread of nuclear power. Nonetheless, the terror of the Bomb as the ultimate deterrent engenders the arms race. Soon Russia, the United Kingdom, France, and eventually China get the Bomb. War in Indochina, the establishment of the Israeli state in Palestine (1948) at the expense of the sovereignty of the Palestinian people, and the completion of the Chinese Marxist Revolution under Chairman Mao are the highlights of 1949, followed by the Korean War in 1950. All this demonstrates the instability of the world. At the same time, 1949, commercial television production begins in the United States; the age of radio is replaced by the "tube." Americans also begin building freeways and the new system ofInterstate highways marking the triumph of "automobile culture," and the beginning of the suburban consumer lifestyle.

2. 1952-1958. CYCLE OF THE OPENING OF THE TOMB AND THE BEGINNING OF THE SPACE AGE.

In the summer of 1952 a Cuban archaeologist discovers the tomb of the Mayan sage, Pacal Votan. This unprecedented archaeological event marks the beginning of the final sixty years-three katun cycles-of the Mayan thirteen baktun cycle of history. In the following year, 1953, the superlethal H-bomb is tested. The DNA code is discovered, as are the Earth's radiation belts. The United States and Russia conduct numerous nuclear weapons tests in Nevada, Siberia, and the Pacific Ocean. Wars for independence occur in various African states, and in general the era of European imperialism is at an end, followed by the neo-colonialist (Third World) era of guerrilla warfare, poverty, and social instability. In 1956, the year the Russians launch the first sputnik and begin the space age, the United Nations tables the issue of calendar reform indefinitely, thus closing the chapter begun when the League of Nations proposed global calendar reform in 1931. The year 1956 also marks the beginning of the electronic pop culture of the technosphere, rock and roll. By the end of this cycle, the "space race" joins the arms race as a force in promoting the advance of the technosphere. Commercial airlines adapt to jet propulsion, and the great age of air

travel begins, with the airport to become the centerpiece of globalization. Initial experiments in computer technology-Univac-and the first great computer corporation, IBM, announce the beginning of what is to become the major technology of globalization. A small fast-food franchise named McDonald's opens in the United States.

3. 1959-1965. CYCLE OF THE ATOMIC MIND EXPLOSION.

The July 26 Cuban Revolution of Fidel Castro, triumphant in 1959, establishes a communist state in the Americas and heightens the Cold War. That same year the Chinese communists bring to a definitive end the rule of the Dalai Lama in Tibet. In the Congo, the popular hero Patrice Lumumba is assassinated after only two months in office. Also in 1960, the human population hits three billion, an increase of one billion since 1930. In 1961 the Institute of Mathematics of the Siberian Branch of the Soviet Academy of Sciences begins the monumental mathematical analysis of Mayan hieroglyphic texts. The attempted 1961 Bay of Pigs invasion of Cuba is followed in 1963 with the assassination ofJohn F. Kennedy, an act that reflects a rising level of cultural turmoil in the United States. Martin Luther King Jr. emerges as a popular hero of nonviolence and civil rights, an issue that points to a more radical discontent in America, culminating in 1965 with the Watts race riots. Rachel Carson's book *Silent Spring* (1963) signals the rise of ecological awareness. The Beatles transform rock and roll into a world-class cultural phenomenon that foments a widespread countercultural movement and atomic mind explosion, fueled by Timothy Leary, LSD, hippies, and the new antiwar movement against the conflict in Vietnam. In 1961 Yuri Gagarin is the first man in space, and the Vatican II Ecumenical Council comes to the conclusion that the best way the Church will survive in the next century is through a strong Pope. The Vatican II document also includes an appendix on calendar reform, the wording of which makes it difficult for there to be any alternative but a watered-down version of the Gregorian calendar. This act seals the technosphere within the unquestioned confines of Gregorian time, ultimately turning the atomic mind explosion in on itself.

4. 1966-1972. FROM THE WHOLE EARTH TO THE WORLD TRADE CENTER: THE TRIUMPH OF THE WORLD MARKET.

In 1966 construction begins on the World Trade Center Twin Towers, while in 1968 World Trade Centers are independently established in Houston, New Orleans, and Tokyo. That same year, UNESCO hosts the first and only conference on the biosphere ever sponsored by the United Nations, "Man and the Biosphere" (MAE), but the program slowly dies on the vine. The cultural conflict in the United States and

the entire world also reaches a fever pitch in the years 1967-1969. This ferment includes: race riots, antiwar riots, a march on the Pentagon, the assassinations of Martin Luther King Jr. and Robert Kennedy, and riots in major capitals around the world and on both sides of the iron curtain, as well as the Maoist cultural revolution in China. The excitement of the '60s climaxes in 1969 with the success of the Apollo XIII manned mission to the moon and the consequent feedback factor of the human race seeing itself instantaneously on television as the whole Earth beamed from space, an opening to the noosphere. Apollo XIII initiates the next phase of the space race, travel to other planets. Also in 1969, the Woodstock concert marks the apex of the early rock-and-roll culture and the visionary climax of the cultural revolution. The 1971 Concert for Bangladesh establishes rock and roll with a conscience. In 1970 the vision of the whole Earth is translated into the first Earth Day and the birth of the ecology movement. The United Nations follows two years later with the Stockholm Conference on the Environment. The revolutionary fervor of the previous years turns more violent, and repressive governmental police powers win the day. The first 28-year cycle ends with a whimper, the dynamic destabilization of consciousness reaches a plateau of normalcy-a normalcy to be increasingly punctuated by terrorist activity, as in the Palestinian takeover of the Olympic Village in September 1972. Both apart from as well as in reaction to such activity, the technosphere has now become all-dominant and all-powerful in human affairs.

SUMMARY, GREGORIAN A: 1945-1972

During this cycle, the dynamic of the accelerated geochemical combustion destabilizes the human consciousness while increasing the curve of the machine in human affairs. By 1973 the machine curve meets and surpasses the human population curve; this stabilizes human consciousness at a level of machine normalcy (MN). Human consciousness will remain stabilized at MN, largely through varying forms of terror and fear programming, for the duration of the second and final 28-year cycle. This normalization of human consciousness allows the diverse and rapidly evolving technological components of the technosphere to reach a point of consolidation. This stabilization of the World Market fosters its next and concluding phase: globalization and the triumph of marketing over human culture. It should be kept in mind that the instruments and weapons of mass destruction, of which there were none on January 1, 1945, have now proliferated to five different countries and provide the ultimate backdrop to these first twenty-eight years. The core of the UN's Security Council is formed by the five countries that possess atomic weapons. Geopolitically, the bio-

Machine Normal Consciousness in Relation to Technospheric Growth Curves

Human consciousness, overwhelmed by war—the ever-propagating machine and bondage to artificial time—succumbs to money and stabilizes at Machine Normal, the standard consciousness of the technosphere, which represents an ever-diminishing ratio of intelligence in relation to the growth curves of population, machine, money, and war.

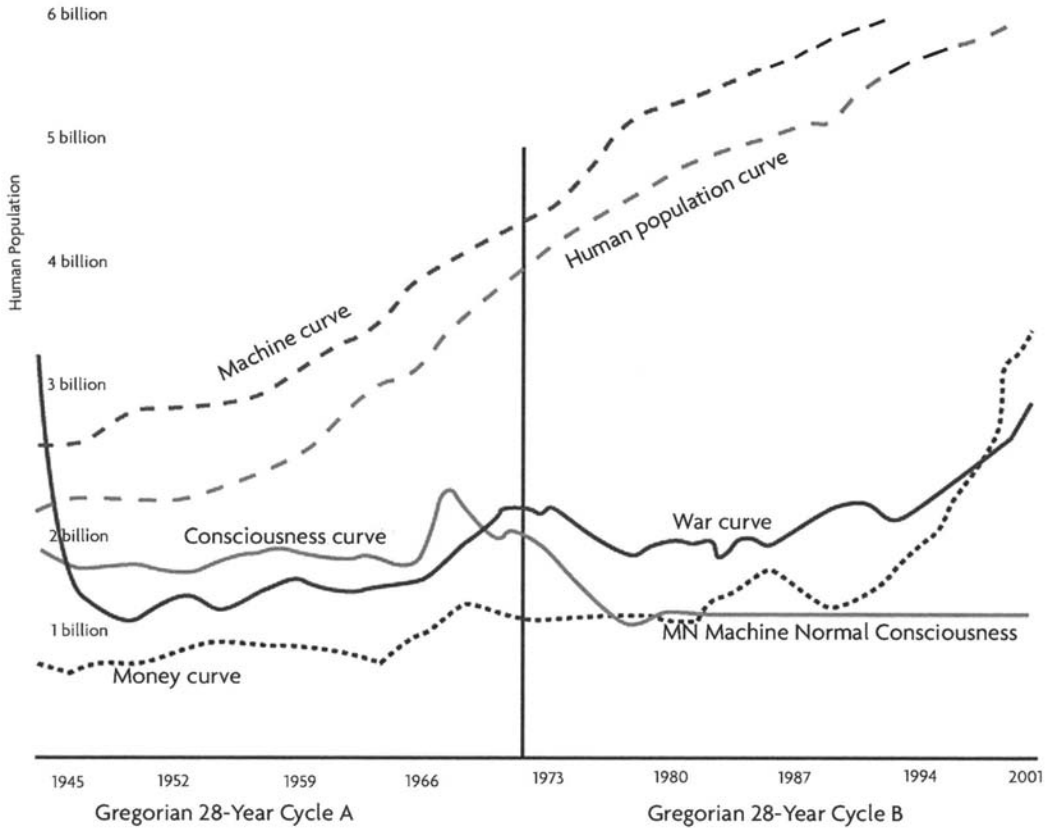

sphere is in control of technocratic powers that are virtually all located in the Northern Hemisphere-whether it is the Pentagon, NATO, the World Trade Center, the United Nations, or the Soviet space program.

GREGORIAN B 28-YEAR CYCLE: CLIMAX OF GLOBALIZATION, 1973-2001

1. 1973-1979. CYCLE OF THE CONSOLIDATION OF THE TECHNOSPHERE: CLUB OF ROME, OPEC, AND THE G-7.

The dedication of the World Trade Center Twin Towers on April 4, 1973 (a repeat of the calendar year of the Bomb, 1945) is the counterpart to the construction of the Pentagon (1940-1941), which sponsored the bombing of Hiroshima and Nagasaki. The tallest buildings in the world when they opened, the 11O-story Twin Towers seal

the position of New York as the "capital of the world," for on the other side of Manhattan is the glass tower of the United Nations. Simultaneous to the dedication of the Twin Towers is the formation of the Organization of Petroleum Exporting Countries (OPEC). With the exception of Venezuela, OPEC is largely an Arabic (Islamic) economic alliance that, for the first time in the history of the technosphere, brings a Third World influence into planetary politics. The subsequent "oil shortage" demonstrates the technosphere's vulnerability, which in turn causes a further "hardening of the arteries" of its consciousness-the covert formation by the CIA of the G-7. Also in 1973, after five years of study the Club of Rome issues *The Limits of Growth,* which in its analysis of trends foresees a major environmental (biospheric) crisis within one hundred years, yet nonetheless establishes and promotes the standard world model, a setting of production quotas at the 1973 level, to foster sustainable growth at least until 2020. The "standard world model" corresponds to the "normalization" of consciousness. The third war (previous ones having occurred in 1967 and 1949) between Israel and its neighbors occurs this year. By 1975, the world population is at four billion, up a billion since 1960. In 1976 Voyager II reaches Mars. In 1978 Karol Wojtyla becomes Pope John Paul II, the first global Pope, fulfilling the Vatican Council's requirements of a popular Pope to assure the survival of the Church into the next century. With Gregorian civilization triumphant, Mexico, home of the Maya, is the first country visited by the new Pope. In the same period, between 1978 and 1979, the Iranian Islamic revolution occurs, toppling the pro-Western Shah, signaling a heightened conservative Islamic resistance to Westernization and the technosphere. Japanese technology and corporate capitalist economy flourish, capped by the construction in Tokyo of the "New City" Shinjuku and, despite many environmental protests, the Narita airport. The mainstream global consciousness is now "comfortably numb" and on course to unprecedented materialism.

2. 1980-1986. CYCLE OF THE TRIUMPH OF THE TECHNO SPHERE.

The first cycle of the stabilized new normalcy establishes the triumph of marketing-the election of a second-rate American movie star for President, and the birth of the yuppie (young urban professional) generation of America. The rise of MTV signals the standardization of rock style as global culture; while the Live Aid global television concert on July 13, 1985, to raise awareness of AIDS in Africa, is the largest ever of its kind. The September 17, 1985 Mexico City earthquake, the worst in modern times to hit the world's largest city, demonstrates the continuing vulnerability of the techno sphere to natural catastrophe. The early 1980s witness the Intifadah uprising of Palestinians against Israel. The War on Drugs, an aggressive

antidrug campaign waged by the West against narcotraffic, mostly from South America and the Middle East, heightens the new normalcy as world drug laws tighten, placing marijuana and psychedelics in the category of "hard drugs." Yet drugs continue to be a major social problem in the industrialized West. In 1986 President Reagan attacks Kadafy of Libya and invades Grenada, testing American ability to commit limited acts of aggression without inciting world censure. The construction of Biosphere II in Arizona, an effort to test the possibility of establishing an artificial biosphere on other planets, ends inconclusively. In 1985 in Bhophal, India, the worst modern industrial toxic chemical disaster occurs with more than 2,000 deaths, followed on April 26, 1986 by the Chernobyl nuclear power plant disaster, the worst since the beginning of the nuclear age. In America the suburban automobile culture gives rise to the super shopping malls. The personal computer (PC) is introduced, while electronic game arcades flourish. Sunday football becomes the major American television pastime, while television itself makes world soccer the number one competitive global sport; the broadcast of professional sports assumes the role of a primary noospheric diversion.

3. 1987-1993. CYCLE OF THE END OF THE COLD WAR AND TRIUMPH OF THE G-7.

On January 24, 1987 Voyager II sends back photos from Uranus; four days later, January 28, 1987, seven American astronauts die in a shuttle launch explosion. On August 16-17, 1987 the Harmonic Convergence peace meditation attracts hundreds of thousands who gather at sacred and natural sites around the world; later that year, October 19, 1987, the New York StockMarket crash occurs, the biggest point drop ever, and Russian Prime Minister Gorbachev initiates disarmament accord, or *glasnost.* By the end of 1987 the population is at five billion, up one billion since 1975. During 1988-1989, a rolling wave oflargely peaceful revolutions and civil uprisings throughout most of the Warsaw pact nations culminates on December 31, 1989 with the tearing down of the Berlin Wall-the end of the Cold War. At the same time, President Bush invades Panama to continue testing Drug Wars and limited-aggression capability. In the summer of 1990 an international bankers' reunion is followed by the first public meeting of the G-7. Every year henceforth, the G-7 meets publicly to set policy for globalization. Within a month of the first public G-7 meeting, August 1990, Saddam Hussein invades Kuwait, and Bush retaliates with the Gulf War, January-February 1991. In August 1991 Gorbachev is ousted in a putsch, marking the end of the Russian Marxist era. Destabilization, war, and genocide afflict the Balkans. A new wave of environmental concerns-ozone depletion, destruction of rain forests, and global warming-inspire a reactivation of Earth Day, 1990, followed

two years later by the 1992 Rio Summit, the second United Nations Environmental Conference and the first in twenty years. The conference generates much paper, but the doctrine of sustainability (sustainable industrial growth) is the principle outcome. Meanwhile, with the absence of Marxist Russian economic influence, the neoliberal capitalist economics of America flourish as full-blown globalization, multinational corporations, and the prominence of the IMF and World Bank foment a uniform global corporate culture of cheap consumer services and franchised retail outlets for brand-name goods. This period also sees the rise of East Asian capitalist economies, although the Japanese economic bubble bursts in 1991. Early in 1993 a terrorist bomb explodes in the underground garage of the World Trade Center Twin Towers. The period 1989-1993 marks the beginning of the discovery of the Law of Time-the definition of the artificial 12:60 and natural 13:20 timing frequencies, the Dreamspell codes, and the decoding of the Telektonon Prophecy of Pacal Votan in 1993.

4. 1994-2000. CYCLE OF THE CLIMAX OF GLOBALIZATION.

In 1994, the GAIT Treaty is signed, the Levy-Shoemaker comet hits Jupiter, and a million Mricans die in the Rwanda massacre. The indigenous uprising in Chiapas, Mexico on January 1, 1994 provides a counterpoint to the triumph of globalization that is manifest through worldwide airport expansions, and an aggressive form of tourism that feeds the airline industry. Israel and Palestine enter the "peace process," while Yeltsin consolidates his power in Russia. This is the era of United Nations peace-keeping missions, mostly in the Balkans and Africa. Following the FBI/BATF -inflicted firestorm on a fundamentalist compound in Waco, Texas, a year later, in 1995, a terrorist bomb destroys the Oklahoma City Federal Building. The United States and the United Kingdom inaugurate control ofIraqi no-fly zones, enforced by regular bombing raids; the United States also conducts military actions in Somalia, as well as more successful ones in Haiti. This is the era of rapid expansion of computer and biotechnologies, exponential rise of New York Stock Exchange and the new specialized technologies exchange, the NASDAQ. Bill Gates of Microsoft typifies the rise of the new self-made billionaires of the Clinton era. In January 1995 the Kyoto earthquake occurs, followed by the Tokyo subway nerve-gas terrorist attack, while the Internet, the "information superhighway," is fully up and running. In 1996 in Brasilia, Brazil, the First Planetary Congress of Biospheric Rights signals rise of a new calendar reform movement with the proposal of the World Thirteen Moon Calendar Change Peace Plan, submitted to both the United Nations and the Vatican. In 1997 the Kyoto environmental conference on global warming sets policy, but the United States refuses to ratify it. In 1998 simultaneous U.S. embassy bombings in Kenya and Tanzania signal a

new phase of war on terrorism, singling out a Saudi national, Osama Bin Laden, as the terrorist mastermind. By 1999 the world population is six billion, up one billion since 1987. In late spring 1999 NATO initiates a unilateral bombing campaign ofYugoslavia over the disputed region ofKosovo. The World Summit on Peace and Time, at the University for Peace, Costa Rica, sends emissaries to the Vatican and the United Nations with the Declaration of Thirteen Moon Calendar Reform; later in 1999 WTO has its first meeting in Seattle, which sparks anti-globalization riots. In 2000 the Y2K computer scare surrounding a bad time program fails to materialize. On Rosh Hashanah, September 28,2000, Hebrew year 5761, Israeli leader Ariel Sharon's presence at Temple of the Mount, Jerusalem, sparks a new Intifadah of Palestinians, which continues unabated through 2001, the official first year of the new millennium.

5. 2001-? *GOTTERDAMMERUNG* OF THE TECHNO SPHERE: FIRST YEAR OF THE THIRD MILLENNIUM, REPEAT OF GREGORIAN CALENDAR YEARS 1945 AND 1973.

In July 2001, G-7 meets in Genoa, Italy, as more than 100,000 anti-globalization protesters riot. In early September the United States and Israel walk out of the United Nations Conference on Racism in South Africa. Then, within ten days occurs the Inevitable Event, Gregorian 9-11, 2001, the cumulative synchronic pressure point where the technospheric bubble-the artificial time warp in the noosphere-bursts open, spawning in its wake the full-scale War on Terrorism-another name for World War III. The Inevitable Event exemplifies the built-in failure of the Gregorian calendar to commence another 28-year cycle as was done in 1945 and 1973. If the 1945 cycle began with the end of one world war, the 2001 cycle begins with the start of one. Since 2001 is also first year of the third millennium, the Gregorian calendar has created its own apocalypse, opening a noospheric fissure-the climax of the biogeochemical combustion of the biosphere. Now it is only a matter of time before the technosphere experiences total collapse. The nature and extent of the damage sustained during the collapse is in proportion to the intelligence that responds to the knowledge of its collapsing. If this 28-year Gregorian calendar cycle were to go unimpeded until 2029, it is not certain what would be left of the biosphere. But there is one thing of which we may be certain: *artificial, linear time has run out.* An American newspaper editorial at the end of 2001 sums up the crash of the dominant linear time paradigm: "History seems to have slammed into reverse gear around a world that was widely assumed a year ago to be moving in a straight line toward a more prosperous and secular future, one that would be shaped by stock markets and the Internet, not by turbaned zealots or theocracies that have or want nuclear trigger fingers."4

SUMMARY, GREGORIAN B: 1973-2001

With destabilization normalized, the technosphere replaces civilization and marks the end of culture-the new barbarism prevails, culminating in total war. The 9-11 is what actually completes the technospheric cycle. Henceforth it will be the advent of the noosphere, but not in the way predicted by the authors of *The Biosphere Catalog:* "The Noosphere as an active force consists in the harmonious synthesis of the Biosphere and the Technosphere by intelligence."5 By the analysis of the Law of Time, the intelligence is nowhere evident because there is no harmony of intelligence possible under the present timing standards that dominate all the major players in the present global conflict. Since the technosphere is totally a function of the artificial timing frequency, and since artificial time is now short-circuiting itself, there will be no techno sphere to harmonize when natural time is restored to the entire biosphere. Then the noosphere will commence, but only if there is world harmony. Only a harmonic standard will bring harmony to the world. The failure of the Gregorian calendar and its civilization, crystallized in the now-collapsing technosphere, must be quickly acknowledged. By adopting a harmonic standard as soon as possible, the shift to the noosphere can commence, rising and building itself up from the shards and ashes of the toppled technosphere.

6

The Solution of the Law of Time

Get a New Calendar

"I am in favor of a standardized calendar for the whole world, just as I am in favor of universal coinage for all countries, and a supplementary artificial language (like Esperanto, for example) for all peoples. . . I am always ready to endorse any honest movement which will help unifY the peoples of the world. "

-MAHATMA GANDHI, QUOTED IN *THE JOURNAL OF CALENDAR REFORM,* 19311

VIEWED FROM THE PERSPECTIVE of the noosphere, the failure of human civilization is the failure of the human being to become synchronized with itself in the correct time of universal nature. Instead of operating as a planetary organism in absolute synchronization with a knowledge of being coordinated by a common harmonic standard, humans race toward the end of history, dissynchronously operating under a plethora of calendars of differing measures enshrining competing belief systems, all globally coordinated by an instrument of irregular measure and obscure nomenclature-the Gregorian calendar. Dissynchronized and at odds with itself everywhere, humanity is broken apart into splintered mind fields, each controlled by a different timing standard, a fact about which the human race is virtually ignorant-to its own detriment.

India, with its different neo- Babylonian calendars, is at odds with Pakistan, which operates according to the Islamic lunar calendar; the Israelis, at odds with the Palestinians, hold as tightly to the Hebrew lunar calendar tradition as the Palestinians do to their Islamic lunar calendar traditions. In Asia, China follows its own complex and ancient lunar calendar tradition, and watches as the United States and its G-7 alliances, all dominated by the Gregorian calendar, get ready to spar with terrorists and militants who also follow the Islamic lunar calendar. India has the Bomb, Pakistan has the Bomb, China has the Bomb. The United States has the Bomb, the United Kingdom has the Bomb. France has the Bomb. Russia, the Ukraine, and other former Soviet nations have the Bomb. It is commonly assumed that Israel also possesses the Bomb. Does Iraq have the Bomb? Can a terrorist get access to materials to create the Bomb as well? The nuclear clock is ticking again.

The number of weapons and technologies of mass destruction has increased several thousandfold since 1945 when, at the time ofVernadsky's death, there were virtually none. This is not to mention the biological weapons of mass destruction, more ambiguous, more lethal, more hidden-none of which really existed in 1945 either. With the fallout from the Inevitable Event an anarchic planetary free-for-all is taking shape. From the noospheric point of view, the humans have run out of (artificial) time, and are now committing their last egoistic act of desperation to hold what they perceive to be their dominant place in the scheme of things. The fact is, however, that the planet belongs to the biosphere and not to the humans.

The inability of the Gregorian calendar to sustain another 28-year cycle, much less another millennium, means that an anarchy of time and a time of anarchy is loosed upon the planet. At the present rate, what would the world look like in 2029? One does not want to imagine. The anarchy of time is exemplified by the different competing powers that are unconsciously driven and motivated by programs stored in their differing calendar systems. This failure of artificial time to contain itself is truly the apocalypse. The apocalypse could occur only when the time program had become saturated. The two 28-year cycles, 1945-2001, carried forward not only the exponential advance of machine time, but the accrued karmic baggage of two millennia of the invented religion of Christ. Throughout the last millennium, the protagonists of this religion waged a type of holy war against an embattled world-a war waged by missionaries and conquistadors alike, down to this very day. The week before the Inevitable Event, the Taliban was deporting Christian missionaries from Mghanistan, while other Christian missionaries scour the jungles looking for one more indigenous soul to convert. This activity is inseparable from the Gregorian calendar that programs it.

Entropic Black Hole of Consciousness

A calendar is a mental instrument for holding the programmed patterns of thought and behavior of a given culture, people, or civilization. A people can rise no higher than the program of time their culture imposes on them as second nature. A program of time determines nature of consciousness. Different timing programs scheduled by synchronically inaccurate devices within a biospheric whole governed by a universal timing frequency apart from the deviant human standards can only result in an entropic black hole of consciousness: the clash of civilizations and cultures that precedes the mentally cleansing force of the noosphere and the inevitable return to natural time and the universal 13:20 timing frequency.

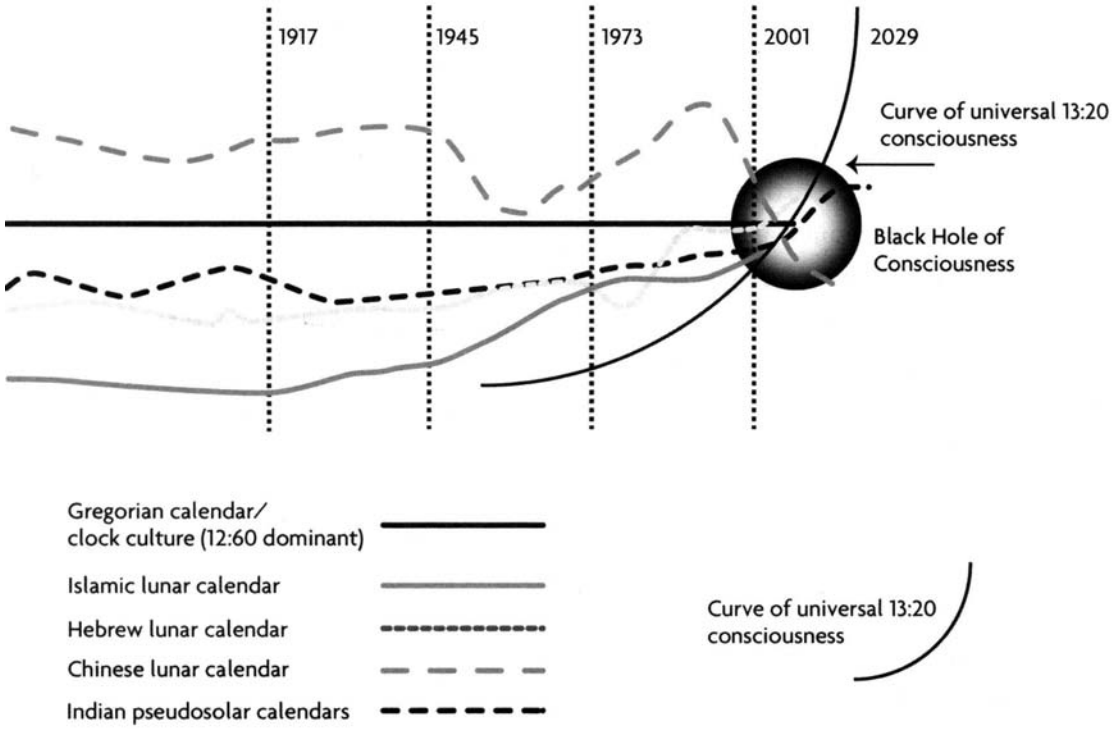

Now the default of the Christian program of the Gregorian calendar and its system of social organization, global civilization, is erupting in an entropic black hole of time. The result of this black hole of time is an entropic harmonic convergence, where all of the conflicting points of the differing timing programs that the Gregorian calendar attempted to synchronize, come into a common point of hostile impact. Seen in this light, the Final War is really the final battle in a long saga that we can properly call the Time Wars.

THE AGE OF THE TIME WARS

The Time Wars began with the application of the error in time at Uruk: the 24-hour, 60-minute, 60-second timing frequency derived from a 12-part division of the circle, a two-dimensional plane in space. Since this measure does not correspond to the reality of time as the universal (13 :20) frequency of synchronization, it creates a mental dissynchronization that manifests as the battle of the mind against itself, and against nature. The dynam'ic of the "progress" of civilization is really the dynamic of dissynchronization inherited by the human mind. The gradual encroachment of civilization into all aspects of human society and the biosphere increases the incidence of dissynchronization. The resulting aphasic mental states lead to belligerence and various attitudes of dominance over others and nature-but never to any satisfaction.

Viewed by the Law of Time, civilization is the institutionalization and embodiment of the dissynchronous artificial timing frequency. The dynamic of dissynchronization results in increasingly artificial technological means and reliance on the artificial medium of money to replace the biological or organic functions of our nature and of the biosphere in general. Not only does this process tend toward an "improvement" in the accuracy of the means of war, but also in the capacity of the latter for greater mass destruction. Set apart from the natural cycles by the dissynchronous frequency of mechanization, the Time Wars are also waged against the biosphere, which is viewed as a hostile force to be overwhelmed and plundered. Everywhere on Earth, nature is on the run. Everywhere on Earth, the human looks at his watch-what will he do next? Catch another plane? Fire another bullet? Press another button and let loose another bomb?

The 56-year cycle of the technosphere witnessed the greatest creation and stockpiling of lethal weapons, more than in all the previous history put together, enough to destroy the Earth many times over. The 56-year cycle of the techno sphere also witnessed the greatest plundering thus far of the biosphere, more than in all the previous cycles of history put together. Continued at the current rate, the biospheric plunder would bring extinction to virtually all life within another generation. These two facets of self-destruction-technospheric and biospheric-point again to the Inevitable Event. It is the Pentagon that has led in military spending and strategizing, just as it was the activity within the World Trade Center Twin Towers that dominated and coordinated from afar the plunder of the biosphere-both precedents for the consequent construction and expansion of the technosphere.

But now time has run out on the technosphere. The world has gone flat and valueless with no future vision beyond war. All the money in the world will not put it

back together, nor will all the bombs in the world salvage it against its enemies. Who are the enemies of the technosphere, and what would cause thereto be enemies against the technosphere? And who or what is there that speaks for the biosphere? For if the biosphere is to become the noosphere, it must come about from an understanding of the intelligence of harmony. Clearly, such understanding of harmonic intelligence has not been nor will it be forthcoming from the technosphere-or from the Gregorian calendar that programs it. Only the Law of Time can supply the harmony necessary to complete this great movement from biogeochemical combustion to noospheric mind. The Law of Time replaces all that is artificial, while confirming all that is true, whether in human history or the universe.

Let us return to the analysis of the Time Wars and the clash of timing programs. The Twin Towers were the absolute triumph of the artificial 12:60 timing frequency, whose program is embedded in the Gregorian calendar and paced by the mechanical clock. Who steered the hijacked planes into their Gregorian targets? Nineteen militant Muslims, we are told. Why nineteen? And what are the religious backgrounds of the twenty-two most-wanted terrorists in the world? They are twenty-two Muslims. Why that number, and why are all the terrorists Muslims? In the noospheric analysis, the Inevitable Event was the suicide of the technosphere unable to sustain two clashing time programs. It was a program of the strict Islamic twelve-month lunar calendar that drove its belief system into the Twin Towers and the Pentagon, the two supreme monuments of the program of the twelve unevenly measured months of the Gregorian pseudosolar calendar. Is it Islam that is the enemy of the technosphere? Is it Islam that is the champion of the biosphere? Indeed what is Islam? Why is Islam the most resistant force against globalization and the technosphere? We know where the Vatican, the bastion of Christendom, is and who ordained the Gregorian calendar, but what do we know about Islam?

If we strip history away from the force known as Islam (1.3 billion Muslims in the world), and reduce it to its most essential point, then Islam is the teaching of the Holy Quran. What is the Holy Quran? It is the last whole revealed text for all humanity, received and recorded over a 23-year period by a single human being, Muhammad the prophet (570-632). While militant Muslims and terrorists have dominated the mass media image ofIslam for the past few decades, what is the Quran and what does it actually teach? It is also a function of the Gregorian program that scarcely anyone in the West really knows or is familiar with the Quran, since the West has been at odds with Islam since the time of Muhammad. As the supreme text of monotheism, the Quran is actually a psychoactive book that upholds Islam as the final religion for humanity. "He is the one who sent His messenger with the

guidance and the religion of truth, to make it prevail over all other religions. God suffices as a witness." (Quran, 48:28) *Islam* means "peace, which is submission to the will of God."

Islam is also the law of nature. Within the vast system of intricate, mathematically based logic that constitutes the Quran-which is a profoundly ahistorical text as well-one feature stands out: the description and definition of nature and the natural order as the chief proof of God's design and guiding wisdom. From the Quranic point of view, the biosphere, inclusive of the creation of the human, is the overwhelming single proof of God's wisdom in establishing a life-support system for our indwelling consciousness to evolve our bodies on this Earth. The biosphere is Islam, or "peace, which is submission to the will of God," understood as the divine law of nature.

> In the creation of the heavens and the earth, the alternation of night and day, the ships that roam the ocean for the benefit of the people, the water that God sends down from the sky to revive dead land and to spread in it all kinds of creatures, the manipulation of the winds, and the clouds that are placed between the sky and the earth, there are sufficient proofs for people who understand. (2:164)
>
> He created you from one person, then created from him a mate. He sent down to you eight kinds of livestock. He creates you in your mother's bellies, creation after creation, in trimesters of darkness. Such is God your Lord. To Him belongs all sovereignty. There is no other god beside Him. How could you deviate? (39:6)
>
> Among His proofs is that you see the land still, then as soon as we shower it with water, it vibrates with life. Surely the One who revived it can revive the dead. He is Omnipotent. (41:39)
>
> He created the human from a tiny drop, then he turns into an ardent opponent. And he created the livestock for you, to provide you with warmth and many other benefits as well as food. They also provide you with luxury during your leisure, and when you travel. And they carry your loads to lands that you could not reach without a great hardship. Surely your Lord is Compassionate, most Merciful. (16:4-7)
>
> He sends down from the sky water for your drink and to grow trees for your benefit. With it, He grows for you crops, olives, date palms, grapes, and all kinds of fruits. This is sufficient proof for people who think. (16: 10-11)
>
> And He committed the sea to serve you; you eat from it tender meat, and extract jewelry which you wear. And you see the ships roaming it for your commercial benefits, as you seek His bounties, that you may be appreciative. And He placed stabiliz-

ers (mountains) on earth lest it tumbles with you, as well as rivers and roads that you may be guided. And landmarks, as well as the stars to be used in navigation. Is One who creates like one who does not create? Would you now take heed? (16: 14-17)

As for the Earth, we constructed it, and placed on it stabilizers (mountains) and we grew on it a perfect balance of everything. We made it habitable for you, and for creatures you do not provide for. There is nothing that we do not own infinite amounts thereof. But we send it down in precise measure. And we send the winds as pollinators, and cause water to come down from the sky for you to drink. Otherwise you could not keep it palatable. (15: 19-22)2

Viewed from its own context, the Quran is the criterion for evaluating the spiritual progress of human existence on this Earth inclusive of man's ability to read the proofs of nature as manifestations of God's wisdom and to comport himself within this nature, the biospheric life-support system, in a manner consistent with the truth. From the Quranic perspective, human freedom of choice is at the root of the biospheric destruction. Choosing anything but to be submissive to God, the human is in rebellion against nature-both his own and that of the biosphere. "We have offered the responsibility [freedom of choice] to the heavens, and the earth, and the mountains, but they refused to bear it, and were afraid of it. But the human being accepted it; he was transgressing, ignorant." (33:72)

The result of this ignorance on behalf of his own aims and intentions rather than that of a respect for the divine plan (biosphere) of the Creator, accounts for the human situation today, at odds with and surrounded by an increasingly out-of-control biospheric degradation and corruption of natural time: "Disasters have spread throughout the land and sea, because of what the people have committed. He [God] thus lets them taste the consequences of some of their works, that they may return [to the right works]." (30:41) Thus, the current techno spheric destruction actually points toward a return of humans to the path of right works.

The forces that created the phenomenon of historical Islam are the enclosing of the Holy Quran within the rigid system of a twelve-month, non-circulating lunar calendar, compounded and supported by the development of the *hadith* and *sunna* (non-Quranic) traditions. A profoundly conservative social order, Islam is nonetheless activated and motivated by a holy scripture that enunciates an attitude toward nature that is the direct opposite of the 12:60 system that produced the technosphere. In this regard, the precepts of the Holy Quran-as of many another holy scripture-make it the "enemy" of the technosphere. From the noospheric perspective, historically and culturally, however, the assault on the nerve centers of the techno sphere

could only have been effected by humans whose belief system was rooted in the Holy Quran, which had been at odds with the Gregorian civilization for centuries. In this way, the Quran was the noosphere's weapon used to bring about the circumstances that would lead to the resurrection of the biosphere-the noosphere itself. But only if man consciously chooses the right return path: synchronized harmony in time. The problem is not so much the rigid lunar calendar ofIslam, but the irregular global standard of the Gregorian calendar, which, instead of standardizing all measures and perceptions of time, fosters a human social disharmony and an incessant antagonism against nature-and against Islam.

So then, how are we to return to the right works? Read and study the Quran, yes-but also make a fundamental change in the world. The solution of the Law of Time is: Get a new calendar! Humanity must take a long, hard look at its own timing systems and scrap what needs to be scrapped, no matter what kind of temporary inconveniences this may cause. Calendar reform is an issue that upsets many apple carts. Yet it is the only method that has not been commonly tried and the only step that has not yet been collectively taken. It is a characteristic of the dominant mindset that it writes history in the way that suits its own needs and supports its philosophy. In any of the reviews of the century carried by the mass media during the past year, you will find no mention of the World Calendar Reform Movement; nor will you find, for instance, any mention of the Roerich Peace Pact (1935); nor of the Harmonic Convergence-all buried by the marketing of history to suit the needs of globalization. What do these three phenomena have in common? A concern for peace based on an understanding that without harmony, the human cultural situation will only worsen. If humankind suffers from an excess of disharmony, in the noospheric analysis the only solution is a harmonic standard of time to synchronize all humanity simultaneously-the Law of Time refers to this as the Thirteen *Moon!* 28-Day frequency shift.

CHANGE YOUR CALENDAR, CHANGE YOUR MIND

> *"Since the advent of the Nuclear Age, everything has changed but the way people think, thus, we drift towards unparalleled catastrophe."*
>
> -ALBERT EINSTEIN3

To change how people think you must take a profoundly simple and universal element of everyday life, one in which all everyday thinking is rooted, and change it so

radically that the way in which people think will itself be dramatically changed. If you want to know that something has really changed, change the calendar! This is the meaning of the replacement of the Gregorian calendar by the Thirteen Moon calendar. The calendar change is necessary because, as the pragmatic application of the discovery of the Law of Time, it brings into focus the essence of this discovery: Time is a frequency, the frequency of synchronization. If a calendar does not increase synchronization, it is not performing its highest function. This is the fundamental critique of the Gregorian calendar-and of all concepts of time based solely on physical, third-dimensional astronomical measurements. This discovery is so new and startling that it affects all human thought and is a matter to which all belief systems, religions, and methods of science must be cognizant. Yet nothing, it seems, is more difficult for humanity than to make this change from a manifest disharmony to a manifest harmony.

Historical man recoils at the prospect of actual harmony-harmony in natural time. This is because historical man defines his existence and thrives upon the disharmonies of his own invented time. The Gregorian calendar keeps the human mind entrained in a diabolical disorder of meaninglessly named months of uneven measure, while every day is tracked and driven by a relentless mechanism called a clock. This immersion of the mind of historical man in the frequency of his own artificial time, more than any other factor, condemns him to a world of inescapable horrors: traffic jams, poverty, terrorism, unresolvable historical and territorial disputes, global warming, environmental degradation, social disorder, insanity, and drug abuse. The problem of historical *human-Homo historicus-is* compounded by the unconscious nature of his acceptance of this timing sensibility, believing it to be the actual nature of time. Hence, all his public and economic policies are driven by and determined by the relentlessness of this perception that time is an arrow blindly pulling him into a future in which his only defense is the creation of more technology, the technosphere itself being a pure expression of the application of the mechanization of time.

THE SECRET HISTORY OF CALENDAR REFORM

When you went to bed on October 5,1582 you woke up on October 16. In this way Pope Gregory XIII promulgated his reform of the Julian calendar, from which the Gregorian calendar differs not one whit, except for the precise working out of the formula for leap year. When this "reform" occurred, the time sensibility of historical man was already crippled and disabled. The Gregorian calendar, by its moment of

historicity, bound that crippled time disorder into its final institutional form, assuring that not only European man, but eventually all cultures and races dominated by European thought and conventions would assume and accept this deformed and deforming standard of time.

The mechanical clock, though evolved over many centuries, was perfected just after the Gregorian Calendar Reform of 1582 and promoted by Europeans as an example of the human triumph over nature. So it was that the human mind assumed as second nature its own invented time, encoded as a frequency that we have identified as the 12:60, an unconscious mental ratio determined by the irregular twelve-month calendar and artificial sixty-minute hour. The combination of these two factors in this one timing frequency have consigned historical man to a hopelessly debilitating mental disorder that is referred to as modern civilization, or nowadays, postmodern. But postmodern is not yet post-historical. Postmodernism is just the final convulsion of the time disorder that afflicts the human race as a virulent mental disease and encapsulates man in the technospheric cocoon of his own making. The only cure for such a profound and pervasive disorder is absolute harmony, the very harmony from which historical man so recoils.

In this light, it is well to know that through the first half of the twentieth century a vigorous and well-organized calendar reform movement flourished. Such was the character of this movement to reform the Gregorian calendar that in 1923 the League of Nations called for proposals for reform. More than 500 proposals were received; by 1931, these were narrowed to three:

> The International Calendar Organization, represented by Mr. Broughton Richmond, promoted a perpetual calendar based on the principle of five-five 73-day cycles = 365 days-and the year divided into twelve months of five 6-day weeks each plus a 5-day cycle [The Thirteen Moon calendar also includes the program of seventy-three 5-day periods-overtone chromatics-integrated with the fifty-two 7-day weeks: 52 x 7(+1) = 5 x 73.]

> The International Fixed Calendar League, represented by Mr. Moses Cotsworth, also supported by Eastman Kodak and the International Chamber of Commerce, promoted a perpetual Thirteen Month/28-day calendar, which was first presented by Auguste Comte (1842-1849), inclusive of the "day out of time." Though it was not backed by a more thorough mathematical science, which has now been supplied by the discovery of the Law of Time, this was by far the favored calendar, as it is the one that possesses a perfect structural harmony and obvious regularity of all its parts.

3. The World Calendar Association, represented by Elizabeth Acheles, promoted the World Calendar, a modified but perpetual version of the twelve-month Gregorian calendar, which also included the principle of a "day out of time" ("null day"). This group turned out to be the longest-lived and the most vocal, and was responsible for the publication of *The Journal Of Calendar Reform (1931-32).4*

It is instructive to read some of the early texts on the topic of calendar reform to see how the same issue of harmony and order brought up by the Law of Time was at the root of the call for the establishment of a perpetual, harmonic calendar. The base argument, as presented in Alexander Philip's *The Reform of the Calendar* (1914), is stated as follows:

> Suppose, for example, that by some strange convention the meaning of the figures we employ in numerical notation were to change every year; suppose the figure which this year represents 2 were next year to mean 3, next year 4, and so on; suppose again that our weights and measures were to fluctuate in a similar manner. . . then we affirm, without fear of contradiction, that the whole fabric of science and the mechanical arts could never have been raised at all. . . we should in such circumstances have been compelled to rest content today with the very simplest and most primitive appliances. Yet, strange as it may sound, such are the conditions under which, in modem society, human action is organized. For what is the framework. . . by which we arrange our actions? It is no other than the scheme under which we arrange our time-in one word, our calendar. . . [thus] the disorganized state of all social arrangements is ascribable to the calendar. . . The dislocation of our calendrical arrangements is due to two distinct causes. . . the incongruity of the week; [and] the irregularity of the lengths of the months. . .5

The argument made is a profound one, and was the motivating basis of the calendar reform movement in general, no matter which calendar was being promoted. It is fair to ask: Why do we expect a rigorous standard of uniformity in our measurements of space (size, weight, volume, etc.), but spurn or ignore the same requirement of uniformity in our measurement of time, especially the time that governs our everyday social arrangements and consciousness? How can we think that this would not have a profound underlying effect on the very nature and conduct of our society?

Most interestingly, as a movement calendar reform arose strongly during the proto-technosphere, between the two World Wars, only to be swept away by the clouds of war and the contradictory factions of disharmony in which modern

civilization was already immersed. Any effort at altering or changing the direction and motion of modern civilization is treated as a threat or derided as ineffectual activity that is scientifically unprovable or that will cost humanity too many dollars to make the change. Such was the fate of the first great calendar reform movement that arose with such fervor in the late nineteenth century only to find its ignominious end when the final debate on calendar reform was adjourned indefinitely by the United Nations Social and Economics Committee in 1956. No one reads about the calendar reform movement in the history books. Because debate on the matter was effectively adjourned, it is assumed that calendar reform is a dead issue of no relevance to the development of postatomic, technospheric man. On the contrary, seen in the dim light of the still-smoking ruin of the Twin Towers, the calendar reform arguments concerning humanity's irrational behavior and its relation to the "immorality" of a skewed timing measure, the calendar, as well as to an inhuman timing device, the clock, were never more relevant.

Not the least import of calendar reform is the opportunity to create a new basis for unifying humanity. As was stated in the "Resolution Adopted by the Fourth General Conference on Communications and Transit of the League of Nations," which took up the issue of calendar reform: "A great number of delegations expressed the opinion that any reform of the calendar could only be put into practice if it came into force simultaneously throughout the world, or at least in a very great majority of States, and it was for this reason that the study of this question had been placed under the auspices of the League of Nations."6

The tragedy of the human inability to agree on a matter so obvious to logic and reason is a testament to the already crippling effects of having operated so long under parochial, sectarian, and often disharmonic timing standards. While the International Chamber of Commerce, the League of Nations, and various international scientific bodies supported the first effort at reform in 1914-1956, the second movement, 1989-present, arose as a purely populist effort, but with an entirely different information base. Recognizing instinctively that the calendar reform issue is more than merely a matter of mathematical order in relation to natural cycles, it is a profoundly theological issue as well, the second reform movement also developed from a non-Western inspiration: the Mayan calendar.

While the psychology of the dominator civilization all but blurs out any other considerations of calendar besides the prevailing Gregorian one, an objective study of the matter demonstrates that the latter is a primitive instrument that eschews both natural cyclic order and any mathematical harmony. In place of the anachronistic standard of the Gregorian calendar, the second calendar reform movement raised

a new criterion, the Law of Time, a whole system principle that integrates the mathematical and the moral, the theological and the psychological, and the economic and scientific issues that are embedded **in** the entire topic of calendar reform. Precisely for the reasons of historical man's unconscious habituation to his own disharmonies and the accelerating and cumulative effect of this ignorance on the disorder of his own social life as well as the natural world around him, the second calendar reform movement has developed with a much greater moral and prophetic urgency.

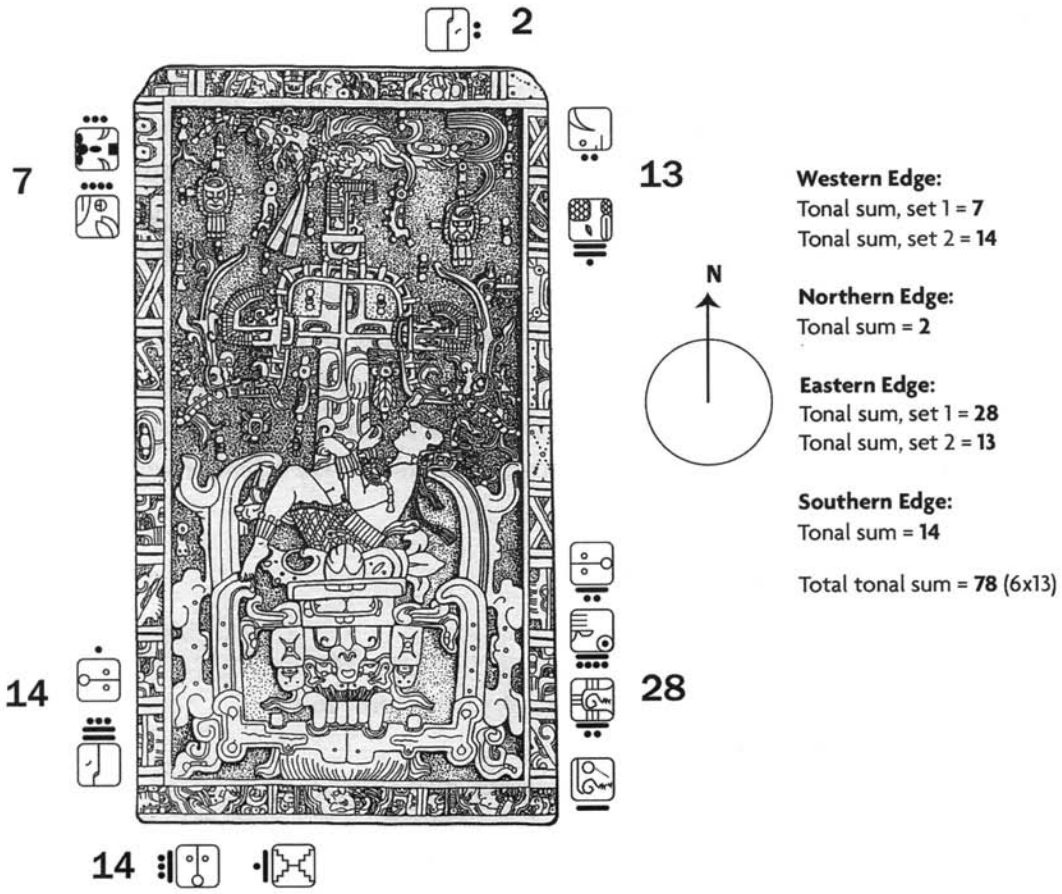

Sarcophagus Lid of the Tomb of Pacal Votan
Showing Disposition of Thirteen Clear Signs

The tonal sums (dot-bar code) of the thirteen signs are key to affirming the prophecy of the Thirteen Moon calendar. Note that the sums of the two sets on the eastern edge equal 28 and 13, while opposite the 13 set is the perfect 7. The tonal sums of the other two sets on the western and southern edge both equal 14, for a sum of 28. The northern edge has a single sign whose tonal sum is 2 twice 7 = 14, and twice 14 = 28; twice 13 = 26 fractal of 260 and code to the Gregorian date 7/26; while twice 28 = 56, the number of years from Hiroshima to the Inevitable Event.

"Consciously using the tool of the Thirteen Moon calendar to replace the erroneous measure of the artificial twelve-month calendar is, in itself, an unprecedented act of human self-reflective consciousness. Collective adaptation to the Thirteen Moon calendar is an intrinsic heightening of consciousness which rapidly awakens the telepathic programming inherent in human biology, frustrated for so long for not having been allowed development in the correct timing frequency."7

It was in 1987 that *The Mayan Factor: Path Beyond Technology* first brought to major public and international attention the possibility that a superior timing sensibility was developed by a thoroughly non-Western culture, the Maya. This book was published with scarcely any knowledge of the calendar reform movement that had gone into a debilitating coma in 1956. Yet, by pursuing the mathematical base of the Mayan calendar, the essence of the Mayan achievement, the Law of Time was extracted, a discovery that brought on the second calendar reform movement, the World Thirteen Moon Calendar Change Peace Movement. Prompted by a prophetic revelation concerning the Thirteen Moon!28-Day calendar decoded from the tomb of Pacal Votan, the premise of the second calendar reform movement was tested worldwide from 1993 to 2000, a time defined as the "seven years of prophecy." By the year 2001, the official beginning of the third Christian millennium, a loose, far-flung calendar reform movement, pioneering in the development of a new science of time and consciousness was promoting the Thirteen Moon!28-Day calendar worldwide.

A REVOLUTION IN TIME

> *"Fire in the lake, the image of revolution. Thus, the superior person sets the calendar in order and makes the seasons clear"*
>
> *-I CHING,* HEXAGRAM49, "REVOLUTION"8

By common consent, a calendar is a system for reckoning time. Virtually all current time-reckoning systems take account only of chronological or, better put, astronomical time-the movement of the Earth in relation to celestial bodies, the sun, moon, planets, stars, and constellations. This is a purely third-dimensional, physical consideration of time. The Law of Time affirms a higher order of time-the synchronic order. This is the time of the fourth dimension, which includes the chronological but enfolds it in a higher mental and mathematical order of reality. According to the Law of Time, what you don't know about the calendar you are using could kill you. By operating according to purely third-dimensional chrono-

astronomical timing standards and without knowledge of the synchronic order of fourth-dimensional time, humanity subjects itself to a one-sided view of reality that is hazardous to the planet and jeopardizes the future existence of the human species as well as all life on Earth.

To correct this situation a radical solution is required-a new calendar embedded in the synchronic order revealed by the discovery of the Law of Time. This is the significance of the Thirteen Moon/28-Day calendar-it epitomizes the incorporation of the chrono-astronomical order of time into the synchronic order, and hence provides the vehicle for humanity to escape its otherwise certain plunge into disaster within the next decade. When a dogma is encountered while one is engaged in the pursuit of truth, it must be challenged and abolished. Such a dogma is the calendar in use as the world standard, the Gregorian calendar. That this calendar, originally a system of thought peculiar to one people or religion, should dominate all the peoples and even life of the planet makes it subject to the critique of planetary anthropology.

The discovery that time is a frequency mathematically expressed as the ratio 13:20 requires a profound reorganization of all thought about time and the consequent reorganization of human society as a planetary organism. As the unified field theory of time, the Law of Time calls for the human synchronization in time predicated on the establishment of the Thirteen Moon calendar as the global civil standard replacing the current erroneous timing standard, the Gregorian calendar. This is a matter of the utmost seriousness, since it is also recognized that all belief systems are the function of programs locked up or embedded in the calendars or time-reckoning systems used by a people. The fate of the species and the biosphere may well depend on whether or not humanity is able to understand this point.

What is it about the calendars in use that condemns their users to endless conflict and inability to unify as a species? What is at the root of their disharmony? It is the pursuit of astronomical time. All people today are bound by calendars based on a pursuit of accuracy of astronomical time-the length of the year being the object of this pursuit. Astronomical time is a losing game of an ever-changing and elusive order that results in an entropic reductionism that has little to do with consciousness or synchronization. The year's length (measure of the orbit of the Earth around the sun) calculated by Pope Gregory XIII at 365 days, 5 hours, 48 minutes, and 20 seconds, slows at the rate of 1/12 second per century, while the length of time in the Gregorian calendar is off from the "true" solar year by 25.9678 seconds per year! Obsessed with rectifying this discrepancy, in 1972 reductionist science came up with Atomic Time to replace Earth Time, and the atomic cesium clock replaced the measure of the year as 365.241299 days with 290,091,200,500,000,000 oscillations of Cs per year!

But what does this staggeringly astronomical figure mean, and of what value is it?

In profound contrast to this obsessive reductionism in which there is no place for spirit, mind, or consciousness, fourth-dimensional radial mathematics represents a mental order greater than and encompassing the astronomical order of the third-dimensional universe. According to the Law of Time, in time reckoning, consideration should be given to systems of the harmonic order of synchronic time that proceed from the radial mathematical order of the higher mind. The higher mind represents the evolved state of mind-the noosphere-that evolution on Earth tends toward, but that has not yet been attained. As long as the human concept of time is governed by the obsessive pursuit of the impossible to attain perfection of astronomical time, this pursuit and the civilization that it propels are doomed to failure. What is known as history is embedded in this pursuit of "fixing" astronomical time, which has culminated in the dogma of the Gregorian calendar and the microatomic measure of the cesium clock. When did this pursuit begin, why did it come to dominate the human species, and to what effect?

As we have seen, the values, customs, and norms of a nation, culture, or civilization are embedded in the calendar it uses. The Gregorian calendar, the current global civil standard-indeed, the foundation in time of globalization-is the calendar of the Caesars, of the Roman Empire, of the Catholic Church and the Vatican. To change this calendar is to change history itself. Can it be done? The League ofNations attempted this in the 1930s but failed. The United Nations tabled this effort in 1956. Since the United Nations adjourned the matter of calendar reform indefinitely, in 45 years the Earth's population has more than doubled, that is, it has increased by more than 3.2 billion people, a factor that is still out of control, and that may have much to do with the fact that humanity is actually in a fog about time.

The reasons for wanting to replace the Gregorian calendar are no less valid today. The Gregorian calendar is not a standard of measure. It lacks logic and reason. It numbs and befuddles the mind when trying to make calculations by it. It is shrouded in an arcane and medieval obscurantism. The net effect of the use of this calendar is to perpetuate a fundamental level of mental confusion and ignorance concerning the actual nature of time itself-an ignorance that is hardened into dogma by the unwillingness of habit to consider any other possibility, but rather to accept the entire system as second nature. The argument that it encodes the most accurate and scientific measure of the solar orbit of the Earth is irrelevant in relation to the effect of its irregular measure on the mind and its numbing power as the dogma of a conquering people. Indeed, the solar measure of365.241299 days per year has nothing intrinsically to do with "30 days hath September. . . ," and vice versa. In fact, the

measure of the Earth's orbit is one matter; the purpose of calendars and time reckoning as factors of synchronization is a wholly other matter. But then, since the very nature of a culture or a civilization is determined by the calendar it keeps, the use of a deformed standard can only inhibit and skew even the questions one asks about time.

The failure of calendar reform by 1961, the year of the Vatican II Council, only promoted an increasingly complacent acceptance, however cleverly disguised, of a millennial dogma, the Gregorian calendar. In the conclusion to the "last word" on the subject, *Calendar: Humanity's Epic Struggle to Determine a True and Accurate Year*, David Duncan summarizes, "We take in stride a calendar [the Gregorian] that is flawed but endures, largely because it works just fine for most of us, and it is what we are used to."9 It is not at all objective to accept something because we are used to it. This attitude is anything but scientific. Rather, it is the smug basis of nothing more than a self-fulfilling dogma-and yet the civilization that bases itself on this aberrant timing measure prides itself as being the most scientific in all history!

THE CONFUSION OF IRREGULAR TIME

Due to this flawed time sensibility, it may be concluded that humankind today is little capable of moral reason or logic, which itself is a result of, or at least strongly reinforced by, habituation to a timing standard that is irrational and illogical. Anytime we overlook or dismiss a fault due to habit, or simply because we are accustomed to the use, say, of an instrument, even if that instrument is demonstrated to be flawed and irregular, is evidence of a moral laziness that will eventually contaminate the entire consciousness that accepts and accommodates itself to the flaw. The exercise of truth is a moral prerogative. The fact of the matter is that the Gregorian calendar is a hodgepodge of flaws and accretions, rationalized into a systematic formulization that has no basis in reality. The celebration of Easter is a case in point.

Easter is the celebration of the day Christ was resurrected from the dead. It may be logically assumed that this occurred on one and only one particular day, just as the celebration of his birth occurs on Christmas Day (although, similarly, no one really knows that this was the actual date of his birth). By the time the Christian religion had become an established force within the Roman Empire, however, no one knew precisely on what day the Resurrection had taken place. The Council of Nicea, convened by Constantine in A.D. 325, called for a debate on the matter in which various theories were presented. The debate was concluded with the victory of one conjectural system over the other. The winning system stated that Easter

would be celebrated on the first Sunday after the first full moon after the spring equinox, except when the full moon was on a Sunday, in which case it would be celebrated on the following Sunday, and this was so that it would not be celebrated on the same day as Jewish Passover.

Over the centuries this conjectural theory regarding the date of Christ's resurrection was buttressed with a system of elaborate calculations for predicting when Easter would occur. These calculations were all made with regard to establishing an alignment of the synodic lunar cycle of29.5306 days (which resulted in a lunar year of 354.3672 days) and the solar year of 365.241299 days! Being fortified with such elaborate mathematical calculations did not lessen the fact that the system was originally-and still is-a mere speculation of a highly clever but relative nature. Thoroughly embedded in the Julian-Gregorian calendar, the system of determining Easter is inseparable from the Gregorian calendar itself, and is one of the chief reasons for the resistance to its reform-as witnessed by a reading of the calendar reform arguments of the 1930s. The entire system of this calendar, inherited without question from the Caesars of the Roman empire, is actually nothing more than a form of self-perpetuation of a priestly hierarchy that includes in its support a host of bankers, industrialists, and scientists and the elaborate social system that is under their control-the technosphere of global civilization itself. Take away the calendar and the entire structure loses its foundation.

"If the Julian/Gregorian calendar was to be offered as a new device for measuring time, we, with our present knowledge and state ofliving, would reject it as something utterly impracticable, lacking in harmony and order, unbalanced and irregular, too clumsy a calendar to make calculations by, while the various sections are not comparable."10

A science or any scientist that unquestioningly follows the Gregorian calendar is, in reality, not worthy of the name. What is science? A concern for logic and precision of measure, we might answer, as well as standards of measure that utilize uniform units of measure in accord with what is being measured. Yes, the year is calculated as being 365.241299 days in length, but if the annual standard of measure that is used is irregular and unscientific, then it avails nothing, and indeed deforms the mind leading it down byways that may only end in self-destruction. Thus the pursuit of a true and accurate year in itself may be an illusory pursuit, blinding us to the actual nature of time, and leading us away from a genuine understanding of ourselves and our role and purpose on this Earth.

To change and replace the calendar with the thirteen moon standard is to return us to our original purpose, leading us back to pathways of harmony and natural

health. According to the Law of Time, the damage already inflicted in the time humanity last hesitated and lost the chance to alter its timing frequency, forty years ago, has been incalculable. The final opportunity to change the calendar and the timing frequency is now upon us. Because of this we must be very clear and unshakable in our understanding and determination to expose and eliminate the current civil calendar for once and for all. Even apologist David Duncan's unabashedly pro-Gregorian book *Calendar* (1999) concludes with its time line on the date 2012, "Current Mayan Great Cycle will end."11 But will we also end? By 2012, it will be too late to change. We must begin to change now.

In reviewing the quirks and twists of history that constitute the Gregorian calendar, we must ask: Why do we continue to use such an instrument, and what are its effects? Is a calendar something more than a tool for scheduling the payment of debts *(calends),* or is it an instrument of synchronization? The harmony or disharmony of time is a profound matter rooted in the instrument of time reckoning that we use. There can be little question that we live more in a time of chaos than of harmony. We may also say in regard to the effect of standards of measure on the mind, that the chaos of the time is embedded in the calendar we use. If we are to leave this time of chaos and enter a time of harmony, then we must exchange the instrument in which the chaos is embedded for an instrument that is the very model of harmony-the Thirteen Moon/28-Day count. This is the choice humankind must now make.

The issue of the nature of time, or of the times in which we are living, cannot be separated from the issue of the calendar. The very nature of the calendar that the world follows has stunted the mind and warped the body's innate timing sensibility, reducing the understanding of time to being merely a matter of chronology. "Chronology is a register or reckoning of successive years, a time scale. It may also be described as a system of registering time massively."12 Virtually all time reckoning has proceeded from astronomical indicators, the major exception being the Maya, who actuated from a solely mathematical outlook. Yet with this mathematical outlook the Maya devised a chronological method that has never been surpassed, a fact attested to by many, including the architects of the Kitt Peak Observatory in Tucson, Arizona, where a mosaic mural depicting the civilization of the Maya asserts the superiority of their calendar over that of the Europeans.

It is significant that the earlier calendar reform movement, while occasionally acknowledging the brilliance of the Maya, made no use of the Mayan knowledge. But this was because the time sensibility was restricted to thinking of time solely in terms of chronology, or at best as a schedule for keeping good accounts, with little

comprehension at all of the synchronic nature or order of time. And since the system of chronology was synonymous with the system of control embedded in the Gregorian calendar system, the earlier reform movement failed altogether to make any impact on the Vatican, much less on the global power structure itself.

All the thought, action, and good intention put into the years of calendar reform notwithstanding, the Gregorian calendar prevailed, and, tragically, not one of the proposals or recommendations was ever even considered for adoption by the papal authorities who maintain control over the calendar. In the 1930s, the propaganda of the Church was aimed at limiting any possibility of reform, for it would not give up the succession of the seven-day week. In any perpetual calendar, such as the Thirteen Moon/28-Day calendar, the observance of the Day Out of Time is necessary for maintaining the harmony of the fifty-two weeks that complete themselves in 364 days. The continuous succession of the week does not stand in a constant relation with the other elements of the calendar and is one of the main causes of confusion in the Gregorian calendar. Arguing that such a break as a Day Out of Time, no day of the week at all, would plunge the world more deeply into chaos, barbarism, and war, the Vatican effectively blocked all effort at reform. The completion of the century of total war, capped by the Inevitable Event, roundly refutes this point. It may just as easily be argued that because we did *not* change the calendar, we are now plunged into the final barbarism and unholy war.

When the Vatican II Council in 1961 affirmed in its backward and highly restrictive language that it was not opposed to reform, so long as such reform did not disrupt the seven-day week and respected the tradition of Easter as a "movable feast," the door to reform slammed shut. By this time all the early reformists had literally died out and the question of calendar reform appeared to have become one of the buried issues of history.

What the priests of the Catholic Church thought they had buried through an auto-da-fe in Izamal, Yucatan, 1562, and overcome through the imposition of the Julian-Gregorian calendar over the conquered Maya, returned with the precision of prophetic timing in 1987. The publication of *The Mayan Factor* not only opened the door to a new look at the Maya, but also to an understanding of time that was anything but chronological. A new dimension of time appeared-radial, fractal time, the synchronic order. And behind the reassessment of the nature of time was the provocative call of Mayan prophecy-the end of the thirteen baktun Long Count, 2012.

The Law of Time defines the human problem as being one of radical and destructive dissynchronization from natural time, resolvable only by a return to natural

Day Out of Time

July 25

1. Magnetic Moon

1	1	2	3	4	5	6	7
2	8	9	10	11	12	13	14
3	15	16	17	18	19	20	21
4	22	23	24	25	26	27	28

July 26 - August 22

2. Lunar Moon

5	1	2	3	4	5	6	7
6	8	9	10	11	12	13	14
7	15	16	17	18	19	20	21
8	22	23	24	25	26	27	28

August 23 - September 19

3. Electric Moon

9	1	2	3	4	5	6	7
10	8	9	10	11	12	13	14
11	15	16	17	18	19	20	21
12	22	23	24	25	26	27	28

September 20 - October 17

4. Self-Existing Moon

13	1	2	3	4	5	6	7
14	8	9	10	11	12	13	14
15	15	16	17	18	19	20	21
16	22	23	24	25	26	27	28

October 18 - November 14

5. Overtone Moon

17	1	2	3	4	5	6	7
18	8	9	10	11	12	13	14
19	15	16	17	18	19	20	21
20	22	23	24	25	26	27	28

November 15 - December 12

6. Rhythmic Moon

21	1	2	3	4	5	6	7
22	8	9	10	11	12	13	14
23	15	16	17	18	19	20	21
24	22	23	24	25	26	27	28

December 13 - January 9

7. Resonant Moon

25	1	2	3	4	5	6	7
26	8	9	10	11	12	13	14
27	15	16	17	18	19	20	21
28	22	23	24	25	26	27	28

January 10 - February 6

8. Galactic Moon

29	1	2	3	4	5	6	7
30	8	9	10	11	12	13	14
31	15	16	17	18	19	20	21
32	22	23	24	25	26	27	28

February 7 - March 6

9. Solar Moon

33	1	2	3	4	5	6	7
34	8	9	10	11	12	13	14
35	15	16	17	18	19	20	21
36	22	23	24	25	26	27	28

March 7 - April 3

10. Planetary Moon

37	1	2	3	4	5	6	7
38	8	9	10	11	12	13	14
39	15	16	17	18	19	20	21
40	22	23	24	25	26	27	28

April 4 - May 1

11. Spectral Moon

41	1	2	3	4	5	6	7
42	8	9	10	11	12	13	14
43	15	16	17	18	19	20	21
44	22	23	24	25	26	27	28

May 2 - May 29

12. Crystal Moon

45	1	2	3	4	5	6	7
46	8	9	10	11	12	13	14
47	15	16	17	18	19	20	21
48	22	23	24	25	26	27	28

May 30 - June 26

13. Cosmic Moon

49	1	2	3	4	5	6	7
50	8	9	10	11	12	13	14
51	15	16	17	18	19	20	21
52	22	23	24	25	26	27	28

June 27 - July 24

> I am in favor of a standardized calendar for the whole world, just as I am in favor of uniform coinage for all countries, and a supplementary artifical language (like Esperanto, for example) for all peoples.
>
> I have been informed of, and I welcome, the international movement for calendar reform . . . I am always ready to endorse any honest movement which will help to unify the peoples of the world.
>
> —Mahatma Gandhi

January - 31 days

February - 28/29 days

(sometimes)

March - 31 days

April - 30 days

May - 31 days

June - 30 days

July - 31 days

August - 31 days

September - 30 days

October - 31 days

November - 30 days

December - 31 days

Wavespell of the Thirteen Moons in Relation to the Irregular Gregorian Calendar

time through the perfect and perpetual harmony of the Thirteen Moon calendar. With the analysis of the Law of Time, there is an even greater urgency and a more profound certainty. Reform is not only insufficient but also impossible. If the calendar is not changed within the next decade, it will be the end of civilization as we know it. There is a genuine and legitimate need to bring the issue of calendar reform into the public eye once again.

Yes, to change the calendar involves a frequency shift. The collapse of the technosphere will dispose the human mind to rethink its options. It may even reorient the human mind to a consideration of the biosphere as being the greater vehicle in which we, as humans, are being carried. Such a massive change in attitude, a mind shift and a paradigm shift, may arouse in the human breast a spiritual reawakening as well. Harmony is spirituality. By changing the calendar, humanity can know it has turned a page of destiny-an act that may cause it to appreciate what has already been written in a book it had not been inclined to study, the Holy Quran:

> God is the One who raised the heavens without pillars that you can see, then assumed all authority. He committed the sun and the moon, each running in its orbit for a predetermined period. He controls all things, and explains the revelations that you may attain certainty about meeting your Lord. He is the One who constructed the earth and placed on it mountains and rivers. And from the different kinds of fruits, He made them into pairs-males and females. The night overtakes the day. These are solid proofs for people who think. (13:2-3)

In this passage we can find ample evidence of the formal order of the Law of Time and the biosphere-solid proofs. As for the "people who think," do they not then constitute the noosphere?

7

Humans—Noospheric Chips:

Consciousness and Reality Redefined

"And conquered by the sense of the earth and human sense, hatred and internecine st'ruggles will have disappeared in the ever-warmer radiance of Omega. Some S017:of unanimity will reign over the entire mass of the noosphere. The final convergence will take place in peace. "

-PIERRE TEILHARD DE CHARDIN,
THE PHENOMENON OF MAN!

Once begun, the exhaustion of the technosphere is irreversible. The exponential growth curves of money, machine production, energy output, and population increase come to a climax. By 2004 the humans will be at another major crossroads: to go wholeheartedly into the harmony of the noosphere, or to suffer the rest of their decline in an ignominious twilight of terrorism, barbarism, and cultural anarchy. By 2004 the humans will have their last opportunity to change their macro-organizing principle. By relinquishing the artificial time held in place by the old calendar and becoming unified in time under a calendar that is a perfect harmony, humans will enact the coming of the noosphere. Only harmony will bring harmony; only harmony will cancel the errors of history, a manifest disharmony. Only an act of harmony can manifest the noosphere. Only this time-changing act, consciously carried forward by a significantly roused number of humans, will create a mental field so positive and

constructive as to engender the radical break that leads to an entirely new cycle of existence of the life on Earth: the noosphere. Entrance into the noosphere of harmonic time through the calendar change will be much like going from a black-and-white movie to one in Technicolor. The difference between the new time and the old time is literally like the difference between Heaven and Hell.

September 11, 2001: the Twin Towers collapse, creating a rupture in the technosphere. Everything comes to a halt. The New York Stock Exchange is closed for four days-a virtually unprecedented event. All commercial airline traffic in America is halted for two days. Even the United Nations postpones the opening of its fifty-sixth General Assembly by three weeks. Six weeks after September 11 a new, sinister form of war is engulfing the technosphere. The Americans assert the right to mercilessly bomb Mghanistan in self-defense. The response of war is the final self-destructive impulse of the techno sphere to protect itself, but this will only widen the effects of the suicidal blow it has already sustained. The war will only make definite that it is the last climax of the biogeochemical combustion engendered by the pursuit of an error in time.

The rupture in the technosphere is the break in artificial time, and therefore amounts to the opening of a noospheric fissure-an inrush of cosmic consciousness and a moment of simultaneously heightened natural time. When the towers collapsed, belief systems shattered. Because it was viewed on global television, it was an event witnessed by all humanity and it entered through the optical cortex into the brain, arousing potent images from the subconscious. This is a noospheric act because it is the entire mind of the whole species that receives this single image in one simultaneous moment. In that shattering image, however unconscious, the noosphere immediately entered the field of human consciousness, much as a leak in a boat allows water to come rushing in. From the perspective of the noosphere, the technosphere is a medium of transformation resulting from the pursuit of a distorted perception of time. With the destruction of the Twin Towers, the transformation is complete; following the war, the technosphere can be creatively dismantled.

THE NOOSPHERE: RAINBOW BRAIN OF TIMESHIP EARTH

What is the noosphere? Can we define the noosphere more precisely so that it is a less nebulous term? Can we make the noosphere concrete enough so that it may be understood and accepted as the coming new way of a higher level of everyday normalcy? First of all, let us say that the noosphere has existed as long as life has existed on this Earth. In this sense, the noosphere is the sum of the mental interactions of all life. The mental interactions, or field of mind, exist as a great unconscious medium,

inseparable from the Law of Time. That is, if all life and the phenomenal world of the biospheric medium are synchronized by the Law of Time, then the programs of the organization oflife, from the periodic tables to the DNA code, will also be synchronized by and embedded in the mathematics of the Law of Time. Being a function of the whole system of the Earth and integral to the functioning of the biosphere as an interplay of cycles in which organic and inorganic interact with a set order of chemical transmutations, the noosphere must also be the mental coordinating field or program of this complex of vital interactions. It must, therefore, be a characteristic of biospheric evolution that the noosphere remains unconscious until a significant moment is reached-the climax of the cycle of biogeochemical combustion, the enactment of the biosphere-noosphere transition.

As the Earth's mental field, it must be an act of collective self-reflection that arouses the noosphere into functioning consciousness. By its definition as the mental envelope of the Earth, the noosphere can come into conscious manifestation only through an act of collective self-reflection, such as the proposed calendar change. Also, as the mental envelope of the Earth that is above and discontinuous with the biosphere, the noosphere-mind sphere--can mean only one thing: the advent of universal telepathy among the humans. The Internet can be seen as a third-dimensional reflection of the noosphere, a form of electronic proto-telepathy. But, ironically, as long as the humans hold on to the Internet, they cannot experience the true evolutionary potential of genuine universal telepathy. The point is that telepathy can only function in a field of reality that is synchronized by the natural 13:20 timing frequency. Time and telepathy are mutually defining factors dependent on unity of thought. The humans have chosen a path of disunity, so that their calendar programs clash and are at odds with each other and with natural time. This maintains the technosphere, destroys the biosphere, and keeps the noosphere in the unconscious. But now, with the Inevitable Event, the break has occurred and the shattering of the Dreamspell of History has begun. The noosphere's rainbow brain leaks back into human consciousness.

The rainbow brain of the noosphere-what is that? As the mental envelope of the Earth, the noosphere possesses a structure ordained by the Law of Time and congruent with the structure of the whole Earth. Within the noosphere are to be found the evolutionary control panel or programs, defined as the *psi bank-the* medium of information storage and retrieval for all the mental programs. The noosphere is the field of planetary consciousness in which humans are intended to participate and complete their evolution. However, operating by artificial time is like looking through a glass darkly. This being so, there is no noosphere to see. Humans generally experience consciousness through the chinks in their sensory prism, conditioned

by separatist beliefs, making it most difficult to attain a perception or experience the field of consciousness as coextensive with the Earth. Indeed, if the biosphere is the region on Earth for the transformation of cosmic energies, the noosphere is that region of the Earth for the reflection of cosmic consciousness and its mental programs. Seen through the lens of universal synchronized time, the humans accommodating to a single instrument of time measurement are inherently sharing a single thought form. It is that act of self-reflective convergence that makes the noosphere conscious and draws it toward the resplendent omega point of2012 and beyond.

As with all the other geochemical structures and processes of the Earth that are planetary in nature, the noosphere, the rainbow brain of Earth, actually has a coherence and an order that we may define in a precise way. In so doing we shall redefine the nature of human reality and the human being itself. We must enlarge our lens of perception to encompass the whole Earth as a single being. In relation to this single being of the Earth, the individual human is hardly even a speck. The dimensions and proportions by which we commonly measure reality must also expand to accommodate the vast dimensions of the Earth as a single entity, a planetary geocosm within the solar field, the heliosphere. Since the sun is also a star, the heliosphere is a function and member of the galactic order of being. As the mental "thinking sphere" of this planetary being, Earth, the noosphere is above and discontinuous with the biosphere, the hydrosphere, and the atmosphere. It is contained by and functions within the vast invisible electromagnetic field of the Earth. Though the ionosphere is the lowest level of the electromagnetic field system of the Earth, the main structures of this field are the two radiation belts located 2,000 and 11,000 miles above the Earth. It is within the two radiation belts that the control panels of the noosphere are to be found-the psi bank.

KIN: BIPOLAR BASE MEASURE OF THE 13:20 MATRIX

"And He is the One who created the night and the day, and the sun and the moon; each floating in its own orbit."

-QuRAN,21:33

In the simplest aspect of our daily experience of time on Earth we have the full play of the law of alternation-day-night, sun-moon, north-south. Because we know the bipolar nature of the Earth, dividing it into two geomagnetic fields, north polar and south polar, we can then define the complementary bipolar field of time, which divides the cycle of the Earth as it makes one rotation on its axis into one day and night. This

entire unit, day and night, is defined as a *kin*, the base unit of synchronic time measurement. From the perspective of the noosphere, day and night are a function of the two alternators-day alternator and night alternator-that operate as the phasic motion of the rainbow brain of the noosphere working in tandem with the electromagnetic field. The two phasic alternators regulate the activation of photons (day) and the regeneration of photons (night) within the entirety of the life process of the biosphere.

THE NOOSPHERIC FOURFOLD/EIGHT-PART STRUCTURE

"He created the heavens and the earth truthfully. He rolls the night over the day and the day over the night. He committed the sun and the moon, each running for a finite period. Absolutely he is the Almighty, the Forgiving."

-QURAN, 39:5

"We rendered the night and the day two signs. We made the night dark and the day lighted, that you may seek provisions from your Lord therein. This also establishes for you a timing system, and the means of calculation. We thus explain everything in detail. "

-17:12

Since the two alternators are also in interplay with the bipolar magnetic fields of the Earth, a four-part process is revealed that is magnetically distributed as an overall eight-part structure. The unit of one kin divides the rotational cycle of the Earth in its orbit into four distinct phases daily and annually. The four daily points are defined by: the dawn, when the part of Earth you are in first experiences the solar photonic activation; the high noon (zenith), when the part of Earth you are in is in closest direct relation to the sun; the twilight, when the photonic activation ceases and the sun disappears from view; and midnight (nadir), the point at which the point of Earth you are on has rotated to its farthest distance from the sun, the height of the cycle of photonic regeneration. This daily process is mimicked in the four points of equinox and solstice, where for either hemisphere the equinoxes are the same as the points of dawn and twilight and the solstices correspond either to high noon or to midnight. Because of the magnetic polarity of the Earth, the four-part process is

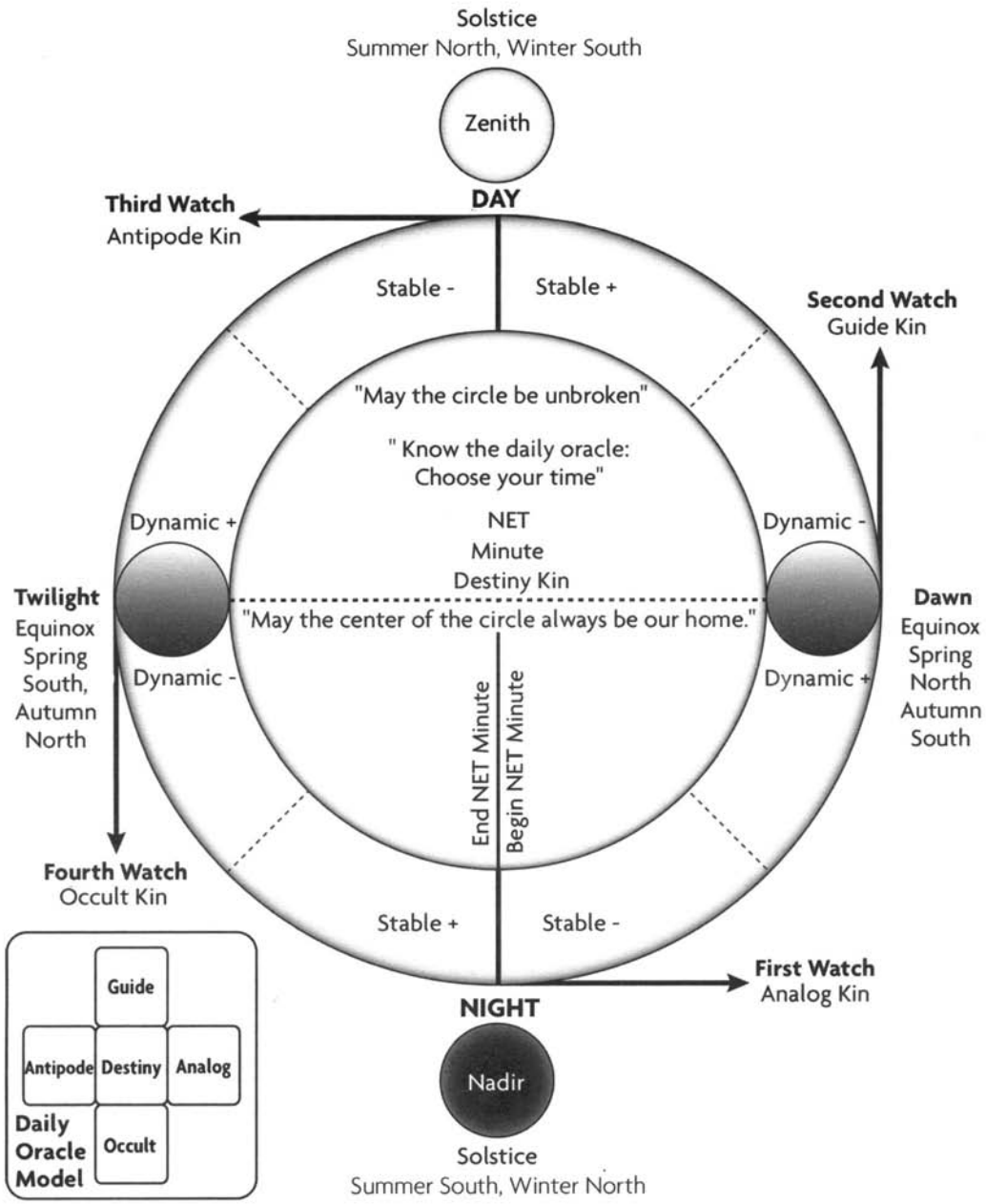

Four-Part Bipolar Kin:
Four daily watches,
Four annual seasons—
Two points of balance
Two points of return

Net Minute Model

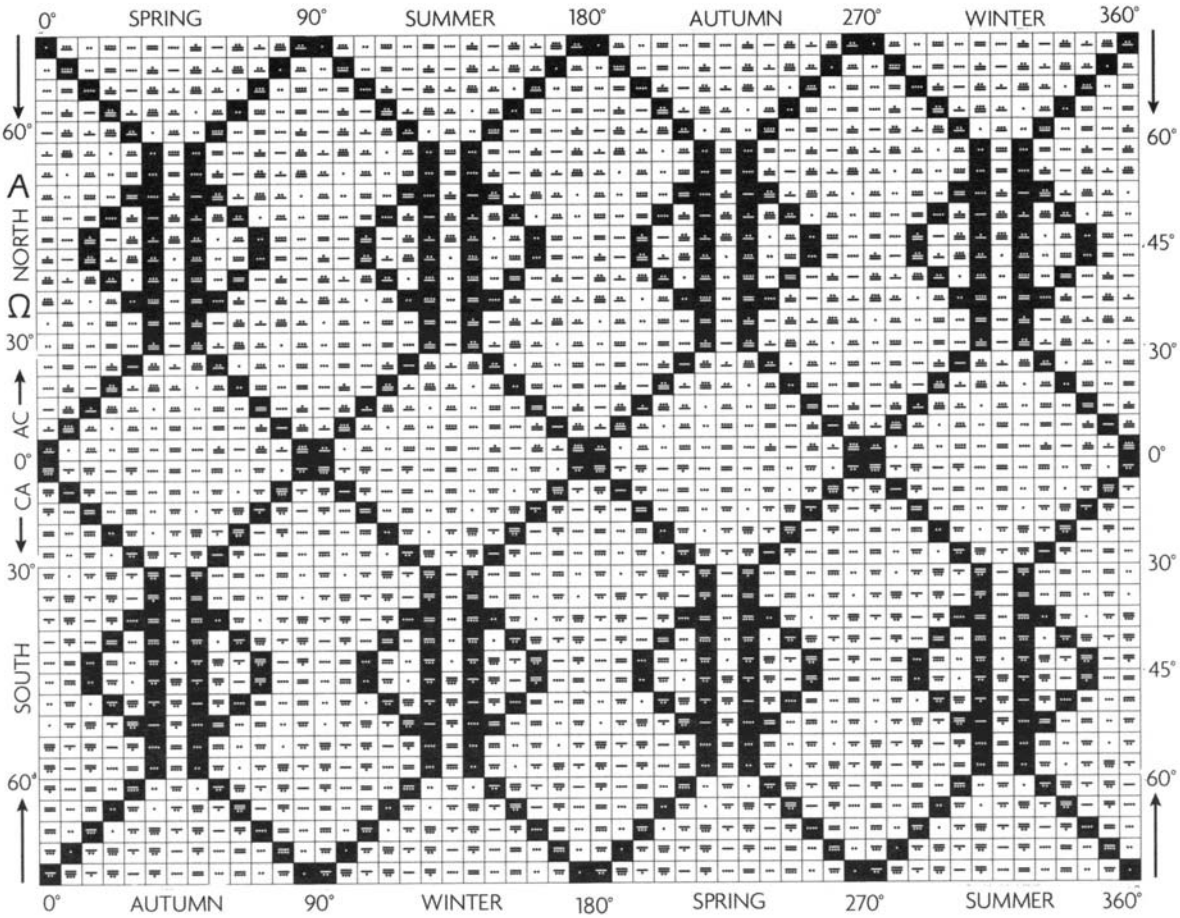

Psi Bank—Four Bipolar Plates Accommodating NET Time Autoregulatory System of the Noosphere
(from *Earth Ascending*, Map 1)

simultaneously experienced in opposite phases, that is, winter in the North is summer in the South-hence the four-phased process yields a bipolar eight-fold structure.

This four-part day-night seasonal process defines the structure of the four psi bank plates, which also coordinate the four-year cycles of the Earth. The psi bank plates, the "nervous system" and control panel of the noosphere, are a complete function of the 13:20 timing frequency and thus participate in the systematic regularity of the fourth-dimensional synchronic order. This means that the psi bank is the registration within the Earth's magnetic field of the 13:20 timing matrix by which all life and the planetary evolutionary process as a whole are regulated. Simulating the four-part process of the Earth rotating on its axis in time, four stages per day, four seasons per year, in four-year cycles-not to mention the four phases of the moon-four psi bank plates accommodating the bipolar field yield eight 260-unit 13:20 frequency information matrices.

That is, each of the four psi bank plates conforms to a mirror symmetry of the bipolarity of the Earth's magnetic field. Each plate is divided by mirror symmetry into a 260-unit Northern and a 260-unit Southern hemispheric half, for a total of two bipolar matrices and 520 units per plate, or 2,080 (520 x 4) units in all. These units are referred to as *psi chrono units* or *time-bearing information units.* The information for the different sequences of the Earth's biogeochemical evolutionary processes is all regulated by these time-bearing information units.

We have to understand that through the medium of universal cosmic time the Earth, the Sun, and every star, constellation, and galaxy is coordinated in this way by the synchronic 13:20 frequency of time. It is the 13:20 frequency that establishes holonomic consistency in time throughout the universe. The Earth's noosphere is a lens of time. All cosmic information is focused through this lens. It is this noospheric lens of time that makes Earth into a geocosmic thought form.

The noospheric lens of time and mind has been operating ceaselessly-but unconsciously-since the beginning of the evolution of the Earth. Since the noosphere is a function of the universal synchronic timing frequency, its conscious activation must also come about through a superior mental coordination with this correct synchronizing timing frequency. The psi bank 13:20 frequency is consciously activated and registered at the human level by the mental engagement of the 13:20 matrix as enacted through the 260-day cycle. The interaction of the 260-day galactic cycle with the 365-day solar biotelepathic cycle defines one noospheric year, or one solar-galactic cycle of fifty-two human years (= fifty-two 365-day solar orbits = seventy-three 260-day galactic cycles). This great noospheric coordination of fifty-two solar orbits with seventy-three galactic cycles is fractally present in a single solar orbit, where fifty-two 7-day weeks = seventy-three 5-day cycles known as chromatics. What is important in coming to understand the noosphere as Earth's geocosmic time lens and rainbow brain, is that we must change our perspective altogether from anthropocentric to noospherocentric, and in this way evolve into *Homo noosphericus.*

THE CYCLES OF NET TIME

For the noosphere, the rainbow brain of planet Earth, time is different-it is slower and longer. From the noosphere's point of view, what we call a year is a solar orbit. What we call a day is a single rotation of the Earth on its axis. The cycles of the moon are the lunar phasings that calibrate the synchronization of the Earth in time. The Earth is not a spaceship. The Earth is a Timeship. As a Timeship, the Earth is a function of the master synchronization frequency that coordinates and moves it in

time through ever greater circles of inclusiveness and syntropic integration. Seen through the noospheric lens of time, the technosphere is a highly exaggerated acceleration of the biogeochemical continuum through highly artificial and resource-depleting means-it is but a smoking bubble whose fragile struts and frets are laced together by transport and communication systems that yield a cacophony rather than a harmony. And for this reason, the disharmony of the bubble ultimately explodes upon itself, releasing Earth from the prison of false time into the fresh air of real time and the advance into the geocosmic splendor of the noosphere. Synchronized with the galactic cycles, the noospheric mind of the whole Earth is reckoned far differently from the artificial units of measure that condition the anthropocentric notions of time evolved in the era of *Homo historicus.*

Here is how the fourfold process of Earth in time is reckoned by the noosphere. Please note that in Noospheric Earth Time (NET), time is universal synchronization. At any given moment, it is always the same noospheric moment in time on

Table of Noospheric Earth Time Units

1. One Noospheric Earth minute = 1 day-and-night rotation of Earth on its axis = 1 kin.
2. Twenty-eight Noospheric Earth minutes = 1 Noospheric Earth hour = one moon of 28 kin. where every 7-day week = 1/4 Noospheric Earth hour = 7 kin.
3. Thirteen Noospheric Earth hours (moons) = 1 Noospheric Earth day = 365 kin (days) = 1 solar orbit. or 1 human year (= 13 NET hours x 28 minutes + 1 NET minute, "Day Out of Time:')
4. Four Noospheric Earth days = 1 Noospheric Earth week = 4 solar orbits (years) = 1,460 kin (days).
5. Three Noospheric Earth weeks plus 1 Noospheric Earth day = 1 Noospheric Earth season = 13 solar orbits or 13 human years.
6. Four Noospheric Earth seasons = 1 Noospheric Earth year = 52 solar orbits (52 human years) = 73 260-day galactic cycles = 18,980 kin (days).
7. Five Noospheric Earth years = 1 Noospheric time chord = 260 solar orbits.
8. Twenty Noospheric time chords = Vs Noospheric evolutionary subcycle = 5,200 solar orbits = 1 Noospheric Century of 100 Noospheric Earth years.
9. Five Noospheric evolutionary subcycles = 1 galactic evolutionary day = 26,000 solar orbits = 5 Noospheric Earth centuries or 500 Noospheric Earth years of 52 solar orbits each.

Earth. Whether that moment is experienced on the night or day side of the Earth, that moment is simultaneous and encompasses both sides of the Earth at once. This is true not only because time is the factor of synchronization- T(E) = Art, where art is the result of any synchronization-but also because the velocity of time is infinitely instantaneous. By thinking that the Earth really does conform to the 24 hours of the clock, the humans have retarded their time sensibility, and consequently their artificial processes have become increasingly artless. In considering the N oospheric Time measurements, remember that as a human you are but a cell in the biospheric organism-or, as we shall see, a chip of the noospheric rainbow brain.

As the measure of the mind of the Earth, the N oospheric Earth Time (NET) reckoning units coordinate consciousness as a planetary, or, more accurately, a solar-planetary phenomenon. For instance, if one NET day is a single 365-day solar orbit of the Earth, dawn of the noospheric Earth day is experienced as the spring equinox, but the noosphere is bipolar. So the dawn is also simultaneously the autumn equinox or twilight of the other polar magnetic half of the Earth. To fully engage and grasp such a thought is to expand the limits of consciousness. Like dolphins who never sleep but only rest half of their brain at a time, so it is with the rainbow brain of the noosphere. Such consciousness has nothing to do with the workings of the everyday egoistic human consciousness, which can understand things only according to a limited frame of reference defined by its own limited and highly conditioned ego needs. The geocosmic consciousness of the noosphere can be apprehended only as a single telepathic unity in and by which all members of any given species or organism are organized. To consider that the noosphere itself could become the organizing principle of the human species as a whole is to engage in conscious mental evolution.

Small aboriginal prehistoric bands of humans experience an unconscious level of this geocosmic noospheric mind. Dolphins, other mammals, and all animal species experience this noospheric mind. Even trees and crystals are organized by this noospheric mind of time.

Homo historicus, however, slowly but inexorably cut himself off from the noospheric mind of time by substituting erroneous instruments of measure, or instruments of measure that were incomplete in relation to the noospheric time cycles. The result was the exponential surge in biogeochemical combustion that characterized the final baktun cycle, culminating in the fifty-six-year blister of artificial time, the technosphere. The fact that the time blister popped eleven years before the end of the cycle of *Homo historicus,* 2012, means that *Homo noosphericus* is ready to emerge from the shattered cocoon of false time. Liberated from artificial time and from the technosphere itself, and enrolled in the natural time of telepathy, the human will experience

Noosphere Earth's Rainbow Brain

Magnetic Alternation - Night and Day Law Of The Ring

"The Psi Bank in Perfect Motion"

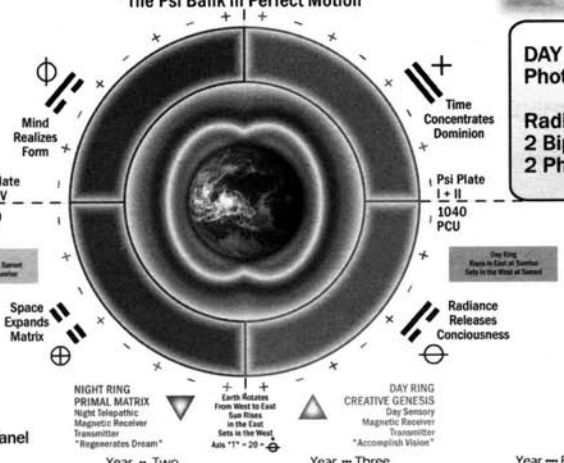

T(E)=ART

DAY ALTERNATOR
Photonic Activator

Radiation Belt x 2 = 2 Bipolar PSI Plates - 2 Phases

NIGHT ALTERNATOR
Photonic Regenerator

Radiation Belt x 2 = 2 Bipolar Psi Plates = 2 Phases

2 Phases + Polarity = 4 Bipolar Psi Plates @ 13:20 = Nervous System + Noospheric Control Panel

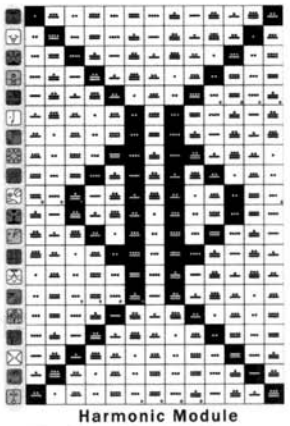

13:20 Matrix Programs Four Phase Bipolar Psi Plates

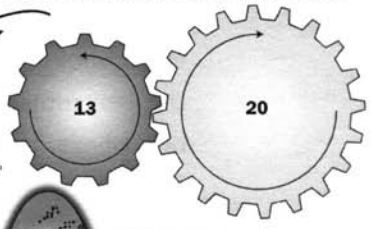

13:20. Ratio Constant of Universal Synchronization

Synchronic Map and Guide to the **Noosphere**

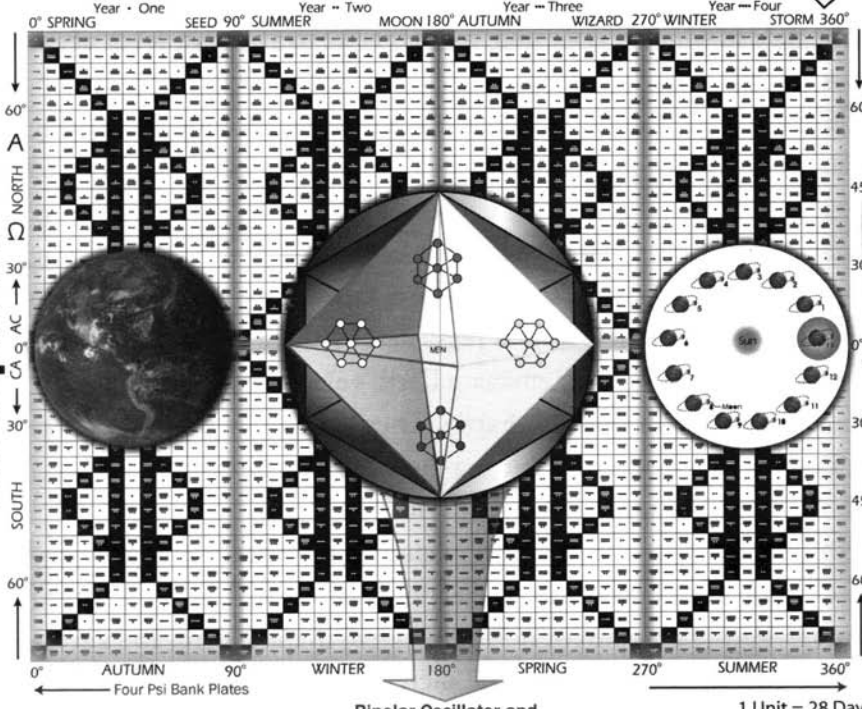

Earth Wizard. *"Homo Noosphericus"*

13 Moon 28 Day + 1 Noospheric Regulator = 1 Noospheric Earth Day

Noospheric Earth Time (N.E.T.) Units

1 Day = 1 NET Minute
28 Days = 1 NET Hour = 1 Moon

13 Moon NET Hours = 1 NET Day = 1 Solar Orbit

4 Solar Orbits = 1 NET Week

3 NET Weeks + 1 NET Day = 1 NET Season = 13 Solar Orbits

4 NET Seasons = 52 Solar Orbits = 1 Noospheric Earth Time Year

Four Phasic Noospheric Resonator
Timeship Earth Field
- Day Night Alternator - 4 phases
  Twilight Noon Dawn Midnight
- 1 Moon-NET-Hour = 4 weeks ¼ Hours
- Solar Orbit = 4 Seasons = 4 Phases NET Day
  [Electric, Solar Equinoxes; Rhythmic, Crystal Solstices]
- 4 Solar Orbits = 1 NET Week = 1 Seed Storm Year Bundle = Return of 4 Psi Plates, 1 per Year.

Bipolar Oscillator and Crystal Transducer Earth Core
Activated by 1 Time Atom per ¼ Hour (7 Days) x 4 = 4 per Hour, 28 Days = 1 Moon-NET-Hour

Planet Holon - 20 Day Cycle

Timeship Earth 2013
Coded by 20 Solar Frequencies in Time

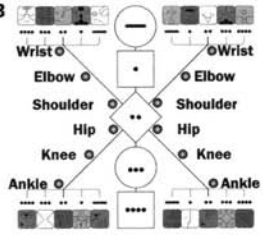

1 Unit = 28 Days or 1 Moon

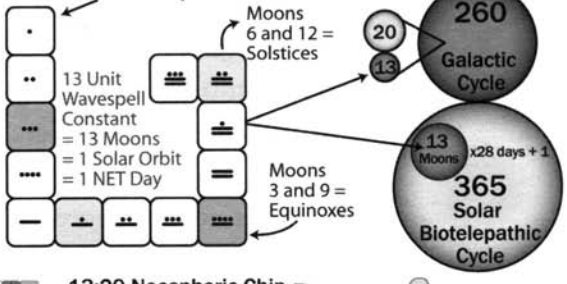

13:20 Noospheric Chip
"Homo Noosphericus"
20 Fingers + Toes
4 Limbs
13 Main Articulations
Consciously synchronized in 13:20 time. Plays Psi Bank Control Panel, generates Earth's Rainbow Brain

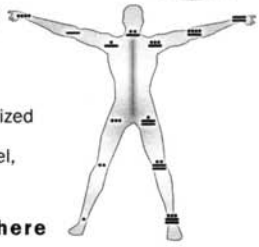

Man in the Noosphere

noospheric organization into psychic biomes. Through the psychic biomes-collectives of communities coordinating their bioregional network according to the structure of the "thought moments" of noospheric time-the human will fully evolve the Earth as a planet with solar-galactic consciousness.

ELECTROMAGNETIC WORKINGS OF THE EARTH'S RAINBOW BRAIN

What we call the cycles of time are the thought moments of the Earth. These thought moments coordinate the complex orders of Timeship Earth, understood as a whole system. Because the operating mechanism of the noosphere that governs the Earth's cyclic thought moments is inseparable from the general structure and functions of the electromagnetic field in which it is located, we may refer to a *rainbow brain* of the noosphere. Why is this so?

Let us return to the structure of the noosphere, Earth's mind in time. Consisting of the four bipolar psi bank plates, these four synchronic time plates are located between the two radiation belts, that is to say between 11,000 and 2,000 miles above the biospheric surface of the Earth. With the location of its information time-bearing mechanism between the radiation belts, the noosphere must by necessity operate in tandem with the electromagnetic field as it is regulated by these two master radiation belts. What do these belts do? They emanate Earth's electromagnetic aura, and function as a protective shield around the Earth. They do this by trapping solar-cosmic radiation, keeping much of it from hitting the biosphere directly, channeling it instead through the Earth's magnetic poles into the Earth's core.

In the polar regions excess cosmic radiation, including electrically charged plasmas and solar discharges from coronal mass ejections, is released into the atmosphere as the auroras-aurora borealis (or northern lights) in the North, and aurora australis (or southern lights) in the South. The increased solar activity during the most recent and current sunspot cycles has enhanced and extended the auroral activity in recent years far beyond the polar zones. In addition, since 1987 great influxes of plasma into the solar system have intensified the incidence of spectral plasmic activity within the atmosphere itself. This amounts to an increase in rainbows, halos around the sun, and brilliantly colored clouds. While these phenomena may be explained to a certain degree as meteorological effects (the angle of the sun's rays, moisture in the atmosphere, and so on), is there more to a rainbow than meteorological side effects? And what relation is there between the noosphere, the electromagnetic field, and the increased plasmic-rainbow activity?

Again, seen from the perspective of whole Earth, the rainbows and spectral plas-

mic effects, including the auroras, are the free energy released by the noosphere. Rainbows are to the noosphere what toxic waste is to the technosphere. The noosphere itself implies a mental field that is interacting with the electromagnetic field. The Earth's electromagnetic field is actually the strongest of all the planets in the solar system. The only other planet that has a field approaching the strength of the Earth's field is Uranus. If the Earth's electromagnetic field is the strongest, is this an indication of the strength of the noosphere as well? If the rainbows, auroras, and other spectral plasmic activity are a demonstration of the free energy released due to the interaction of the noosphere and electromagnetic fields, and the noosphere is the mental envelope of the planet, inclusive of the as-yet-to-be-unified mind of the human species, what forms of free energy might be released if the human mental field were operating as a single unity in the correct timing frequency?

One other mechanism crucial to the entire system of noosphere and electromagnetic fields is the crystal core at the center of the Earth. In the 1970s Russian scientists put forth the idea that the Earth is crystalline in nature, an idea that extended Plato's notion of the Earth as a dodecahedron, one of the five "platonic solids." The idea was that the Earth's surface was held together by a field of resonance that corresponds to the crystal resonance of certain geometrical solids. R. Buckminster Fuller also gave play to this notion in his description of "spaceship earth." Then in the 1980s American seismologists confirmed that the core of the Earth is actually a gigantic iron crystal structure in the shape of an octahedron, elongated at its ends, which point to the North and South Poles.

From the point of view of fourth-dimensional time, the planet Earth is another manifestation of space as an infinitely locatable point, an orbiting body upon which all the vectoral programs of cosmic time may be unfolded. Understood as a Timeship, the Earth's structure is constructed to facilitate its travel in time on a particular route in space in conformity with its relation to the local star, the sun, to the other planets of the solar system or heliosphere, and in synchronization with the universal timing constant 13:20, which maintains the Earth in the synchronic order. The role of the magnetic octahedral crystal core is to function as the bipolar oscillator and crystal transducer whose purpose is to maintain the Earth in the synchronic order of the 13:20 timing frequency. Thus, if the Earth's noosphere contains the 13:20 timing programs of the psi bank, and the crystal bipolar oscillator is meant to maintain the Earth's space body in the synchronic order, obviously there is a resonant relation between the crystal core and the noospheric-electromagnetic field programs.

The transductive properties of the crystal allow it to transform energy from one state to another. The crystal core also stores electronic plasmas that travel to it from the

Earth's poles through an electromagnetic flux tube system. Within the crystalline core, the electronic plasmas are transduced into information. This is the information of time understood as cosmically transmitted thought forms. These plasmic thought forms conform to programs already established in the psi bank of the noosphere. These are the Earth's thought forms, the cycles of the Earth's brain waves, as it were, that allow it to maintain its biospheric programs and to evolve its mental field, the noosphere. The very descriptions of the Noospheric Earth Time (NET), and of time itself as a synchronous instantaneity inseparabJe from telepathy, are examples of the Earth's thought forms transduced through a human biocomputer and then transmitted into a form of human language for the purpose of communication. Keeping this description of the noospheric brain in mind, let us return to our analysis of the biosphere-noosphere transition.

MAKING THE NOOSPHERIC LEAP: TRANSFORMATION OF HUMANS INTO NOOSPHERIC CHIPS

The transition to the noosphere is experienced by Earth as a crisis because its systems are stressed. Since the Earth functions as a whole system, stress on one component of the system actually stresses the whole order. Let us review the cumulative stress points. Human 12:60 electromagnetic activity has perturbed and distorted the electromagnetic field. The release of free energy due to geochemical combustion adds to this stressful distortion through the depletion of ozone in the ionosphere and global warming. The radioactivity released into the atmosphere adversely affects the resonant field of the DNA, already driven by the 12:60 frequency to accelerate the multiplication and propagation of the human biomass throughout the biosphere. Through its artificial means, the machine, the human further upsets the inherent balance maintained by the pressure that the species exert upon each other, resulting in mass species extinction.

Yet all this is according to an evolutionary program that is intended to bring about an ultimate crisis by which the biosphere snaps into becoming the noosphere. Clearly, if the root of this crisis is the deviation of the dominant species operating according to an artificial timing mechanism at odds with the universal timing frequency, then the stabilization of the transition to the noosphere will come about through the dominant species consciously "returning" to the correct timing frequency. This it can only do by adhering to a macro-organizing program that puts the human species completely in the 13:20 frequency.

If the whole system analysis seeks to locate the flaw in the operation of Times hip Earth, then we must finally declare that this flaw is the human civilization in its entirety, as it is maintained by erroneous and artificial timing constructs. Since the

noosphere, the mind of time on Earth, defines the next evolutionary cycle, and because the humans are following a course dictated by being in the wrong time, calendar reform is the eye of the needle through which humanity must pass in order to get to the noosphere. Only by fully manifesting the noosphere will the Timeship Earth be truly put back on course once again. The noosphere is the program of time on Earth. Time is all that the noosphere has to give us. In consideration that the artificial time of the technosphere has fundamentally run out, the noospheric time should be a welcome gift.

Science is always absolutely precise. It is not just calendar reform that is the eye of the needle through which to pass into the noosphere-it is the Thirteen Moon/28-Day calendar calibrated by the 260-day Wizard's Count, synchronized to the Gregorian calendar date, July 26, that provides the exact ticket of admission into the noosphere. And then this ticket must be used at just the right moment-when the show is ready to begin. To use another metaphor, there is a lock on the door to the noosphere, and there is only one key that will fit and unlock this noospheric gate. That key is the Thirteen Moon/28-Day calendar, correlated to July 26 on the Gregorian calendar. It is the precisely applied use of this Thirteen Moon/28-Day calendar that will make each human a noospheric chip of the rainbow brain. This is because the Thirteen Moon/28-Day calendar is the key with the precise design for not only opening but also for continuing to operate the noosphere through a matching of the everyday frequency of time with the frequency of the noospheric control panel, the psi bank.

It is because the daily program of the Thirteen Moon/28-Day calendar is embedded in the 13:20 frequency that the consciousness of the humans will finally change and rise above the stunted level by which it is currently maintained in the artificial world of the technosphere. Time is of the mind, and the natural time registered by the Thirteen Moon/2 8- Day calendar is the opening to the geocosmic mind of the universe, which adherence to artificial time has kept the human from experiencing. The noosphere is the fractal lens of this geocosmic mind on Earth. Since the geocosmic mind is purely a function of the Law of Time-energy factored by time equals art, where the 13:20 synchronizing ratio of time is characterized by infinitely instantaneous velocity-then the fundamental nature of this mind is telepathy.

The Thirteen Moon/28-Day calendar is, therefore, the perfectly designed instrument to make the noospheric leap into telepathy, the planetization of consciousness that establishes the daily reality of the noospheric mind. Since the noospheric mind interacts with the electromagnetic field, and because the ratios and cycles of the Thirteen Moon/28-Day calendar conform to the fractals and ratios of the NET, by using this calendar the human becomes transformed into a noospheric chip. The

fractals and ratios of NET become the normative operating cycles of the human in its daily reality. This accounts for an increasing noospheric synchronization that allows the noospheric chip to attain its purpose: generating the Earth's rainbow aura. If the free energy of rainbows is to the noosphere what the free energy of toxic waste is to the technosphere, then the generation of the rainbow implies a type of activity on the part of the human to produce such free energy. To understand what this activity might be and how it works, we must first understand the morphic and holonomic relation between the human noospheric *chip-Homo noosphericus-and* the structure of the noosphere itself as it is programmed into the geocosmic measure of the Thirteen Moon/28-Day calendar.

HUMAN BEINGS AS FRACTAL REFLECTORS OF THE 13:20 MATRIX

From the noospheric perspective, the prototype human is an embodiment of the 13:20 synchronization factor. The human has four limbs. Each of the four extremities has five digits, for a total of twenty fingers and toes that distinguish the human's operational capacity. The four limbs conform to the fourfold phasic operation ofNoospheric Earth Time, while the twenty digits conform to the 20 (4 x 5) factor of the 13:20 ratio. The human also has thirteen main joints or articulations: two ankles, two knees, two hips, two wrists, two elbows, and two shoulders; these six pairs coordinate the four extremities with the body, while the thirteenth articulation, the neck and spinal column, coordinates the body proper. These thirteen main articulations plus the twenty digits of the hand and feet conspire to make the human the perfect exemplar of 13:20 timing frequency, that is, a perfect model of synchronization itself.

Add to this the fact that the human has a highly evolved and refined brain and nervous system that is maintained and expressed by the skeletal structure of the thirteen joints of the body and limbs, completed by the sensitive mechanism of the twenty digits, and we see that the human is the perfect biocomputer for processing the information of the instantaneously telepathic geocosmic mind. The means to process the geocosmic information, and also the means by which the human is transformed into the noospheric chip, is found in matching its factors of daily synchronization and intelligence with those of the psi bank, the noospheric control panel. This is called harmonic arrangement of the synchronic order.

Of course, this description of generalized structure, activity, and interaction of the *Homo noosphericus* with the noosphere as such presupposes an entire reorientation of the goals and methods of being human. Such a reorientation of the human is also a function of making the radical change from the erroneous measure of the twelve-

month Gregorian calendar, in which are embedded all of the Babylonian programs of history, to the perfect history-less harmony of the Thirteen Moon/28-Day calendar- the mere change of calendars encompasses a mental frequency shift. The readiness to make this change depends on the degree of moral revulsion the human experiences during the collapse of the technosphere. This moral revulsion would then correspond to a turning in the deepest seat of consciousness, which would then dispose the human intelligence to a consideration of the untried solution-change the calendar!

The Thirteen Moon calendar is the NET instrument for daily synchronization and unification of the human species as a single organism in time. Once adopted to the correct measure of this instrument, the human will de facto trigger the noosphere as an operating system of absolutely higher consciousness and mental order. **In** fact, the purpose of human evolution is precisely to become the ignition of the noosphere,

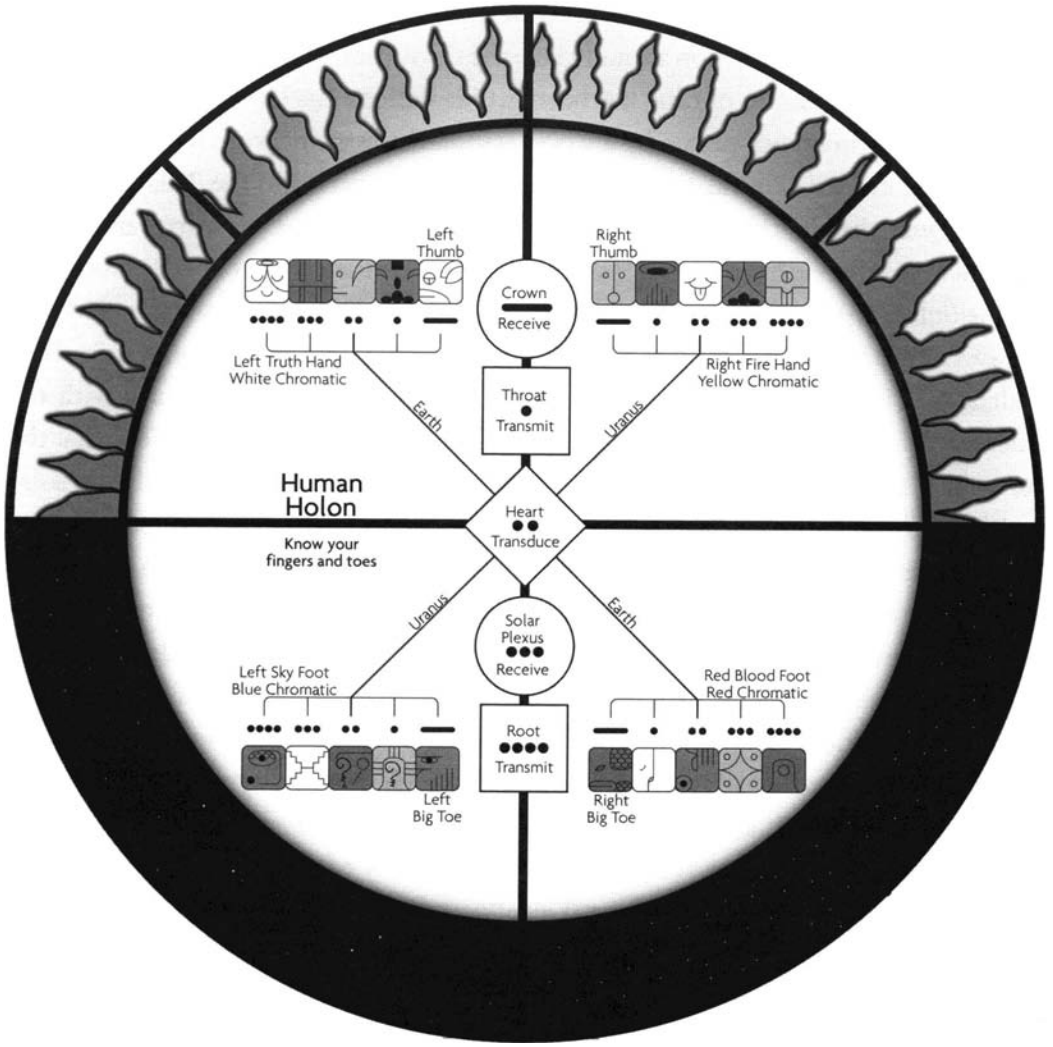

Human Noospheric Chip

and thence to become normalized as the noospheric chips that maintain the operations of the noosphere. As a truly planetized being and consciousness, *Homo noosphericus* will engage in an order and type of reflective activity undreamed of in the technospheric era that is now passing.

First, by adapting to the daily NET timing instrument, the humans will be utilizing a "calendar" that correlates both a 365-day solar biotelepathic cycle and a 260-day galactic synchronization cycle. When the lunar phases are added to the interaction of these two cycles, then the human is able to enjoy the harmonic richness of time-the noosphere. The synchronizing and interactive measures of the counts of the solar and galactic cycles yield multiple levels of harmonic orders of time (Earth's "thought moments") that will activate aspects and levels of consciousness hitherto dormant in the human mind. The very mental act of replacing the order of twelve by the order of thirteen is a profound one. How is this so? Could it be that the whole of civilized history itself is based on the fear of the number *thirteen-triskaidekaphobia,* epitomized in the superstition about Friday the thirteenth-and that, therefore, dealing with the true nature of time has been avoided altogether?2

Currently humans operate by a world standard whose measure includes: seven-day weeks, inclusive of the notions of the 5-day work week and the 2-day weekend; an irregular distribution of twelve months of either thirty-one, thirty, or, in one instance, twenty-eight days; all set within a longer annual cycle that concludes with its visionless moment of New Year's Eve. Many Gregorian calendars will include the phases of the moon, but because the months differ in length there is no way in these calendars of seeing how the phases of the moon might be synchronized with the measure of Earth's orbit around the sun, nor is there any reason to consider that the uneven measure of twelve months has anything intrinsically to do with the solar orbit. Within the twelve-month structure of the Gregorian calendar, weeks, months, and phases of the moon all appear to be haphazard and arbitrary. Such a disorderly order can only bode an undercurrent of uncertainty and fear for the human mind.

By contrast, in the measure of the thirteen moons of twenty-eight days each, the 13 corresponds both to a 13-day cycle and to the cycle of the number of months (moons) per year. The measure of the 7-day week (a NET quarter hour) becomes an orderly harmonic: four perfect weeks occurring each moon, fifty-two perfect weeks each year, each week always beginning and ending on the same day of the week, week after week, year after year, while in fact every day of every moon occurs on the same day of the week, year after year. The effect of such a harmonic regularity on the human mind is incalculable. This is what is meant by a *perpetual calendar.* And to maintain this perfect regularity, the 365th day of every year (solar orbit), is no day of

the week at all, but a Day Out of Time, a day for the human to be refreshed in utter timelessness.

Realizing that a day is actually a kin or one NET minute, the measure of one rotation of Earth on its axis, a 4-day cycle of four NET minutes constitutes a harmonic, a 5-day cycle constitutes a chromatic, while the 13-day cycle corresponds to one *wavespell*, the time constant that accommodates the measure of thirteen. Hence, a wavespell can be either thirteen days, thirteen weeks, thirteen moons, thirteen years, or so forth. The point is that by making the change of calendars the foundations of the mind organized in time are irrevocably altered. From the noospheric perspective, there is nothing arbitrary about the laws of nature. The same lack of arbitrariness should be reflected in the instruments that we use to measure time. By adapting to the Thirteen Moon/28-Day measure, the humans are adapting to a measure in which there is nothing arbitrary because it is a pure expression of the Law of Time. Thirteen is not at all a harbinger of bad luck, but the gateway to harmony in time! And it is by using this thirteen-based harmonic instrument of measure that the human is realized as a noospheric chip, a fractal of the noospheric mind, the mind of time on Earth.

NOOSPHERIC CHIPS: WIZARDS OF GALACTIC TIME

In the noospheric construction of the operating mechanism of the Timeship, the human is a vital link, providing the biotelepathic medium for the synchronization of the geocosmic mind on Earth. If we look again at the structure of the noosphere, the components include: the crystal core bipolar oscillator, packed with Technicolor time beams and cosmic thought moments, waiting to be self-reflectively realized; the human noospheric chip, the representative of the biosphere to mentally engage the timing cycles of the NET; the electromagnetic field, which provides the medium of expression between the biospheric order, the human, and the noospheric mind of time; and the noosphere itself, the mind of time on Earth, whose articulation through the psi bank control panels and through the Earth's resonant field structure yields an enlarged measure of Earth consciousness, Noospheric Earth Time itself. In expanding our minds into the noosphere we will understand that what lives is the Earth and the Earth lives through us.

As a noospheric chip, the human is a fractal reflector of the 13:20 timing frequency. Midway between the bipolar oscillator and the noospheric psi bank plates, the human noospheric chip is designed to receive, transduce, and transmit programs from the crystal core by synchronizing these programs with the psi bank.

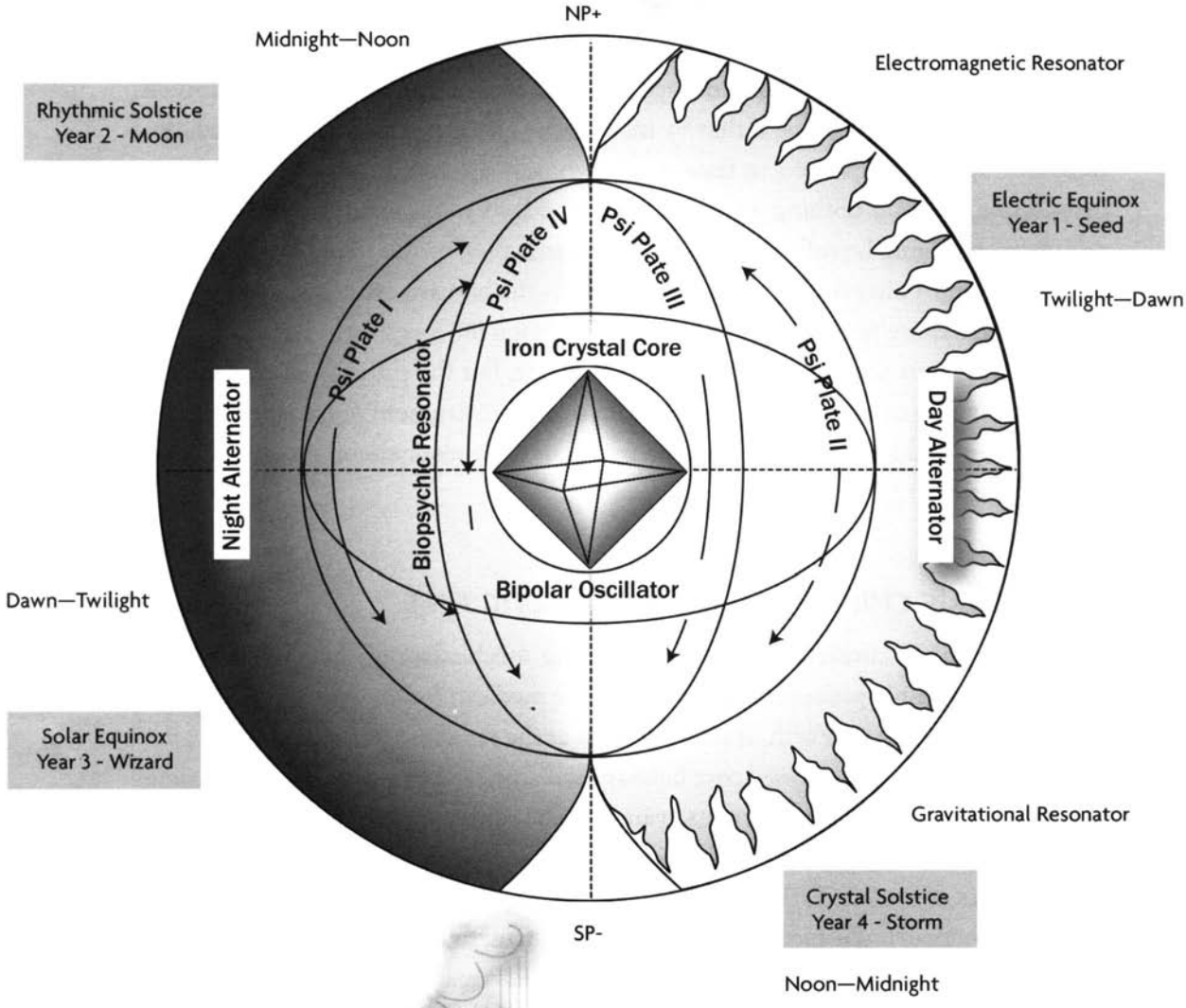

Four-Phasic Noospheric Resonant Field Model, Timeship Earth 2013

Three resonators establish the gravitational, electromagnetic, and biopsychic fields held in place by the crystal core, the bipolar oscillator.

Two poles extend the bipolar field of Earth, which, guided by the day-night alternators, create the four-phasic noospheric field model.

Four psi plates govern the four phases, from daily NET minute to seasonal NET day, and to the four-part NET week, or Seed-Storm year bundle.

This is a process that can occur only within the construct of the regular harmonic sequence provided by the noospheric timing gauge of the Thirteen Moon/28-Day calendar. Interaction with the crystal core can only be through telepathic means, and the human-as the midway point between the core and the electromagnetic fields-is like a sensitive piece of litmus paper. To understand the human in this way is to totally redefine the reality of what it means to be human on Earth. From this perspective, the human is a biocomputer whose information source feeds it programs stored and emanated by the crystal core. These programs are then brought into conscious registration through working the corresponding programs of the psi bank. Right now, we don't know what the crystal core is emanating, much less that such a structure exists within the Earth. Like a crystal radio-set, the noosphere is the antenna, the geocosmic programs are transduced and generated at the crystal core, the human is the biocosmic tuner, and the broadcast transmission is provided by the psi bank.

The 13:20 template of the human noospheric chip is defined as the human holon, its twenty digits and thirteen main articulations conforming perfectly to the geocosmic 13:20 synchronization frequency of universal time. It is the intrinsic resonance of this geocosmic structure that allows the human to be in resonance with the planet as a whole system. While the timing programs to be broadcast are all loaded in the psi bank control boards, the actual point in space of the physical Earth is coded by time into a twenty-part icosahedral structure called a planet holon. Being holonomic in nature, the planet holon has a perfect incidence of correspondence with the twenty digits of the human holon.

The twenty digits and twenty-part structure of the planet holon are both coded by the twenty icons or solar seals of the 260-day galactic synchronization cycle. The icons or seals are the manifestations of the 20 (4 x 5) factor of the 13:20 synchronization ratio. They are coded for human legibility as simple icons that conform to a postliterate alphabet. In time these twenty icons create a fourth-dimensional twenty-day solar cycle which interacts with the 13-day galactic cycle to create the 260 unit synchronization sequence or "galactic spin." The point is that when this galactic spin is synchronized with the 365-day solar-lunar measure of the Thirteen Moon count, there is a daily program for identifying the human with the planet holon, a factor that facilitates the planetary resonance of the noospheric chip.

As a noospheric chip, the human is in every way a holonomic reflection of the whole system Earth. As a system of resonators-gravitational, electromagnetic, and biopsychic-the human and the Earth both have bodies with a center of gravity; both exhibit electromagnetic fields; and both share in common a biopsychic resonance, the mutual interface of the noosphere or mind of time with the other two

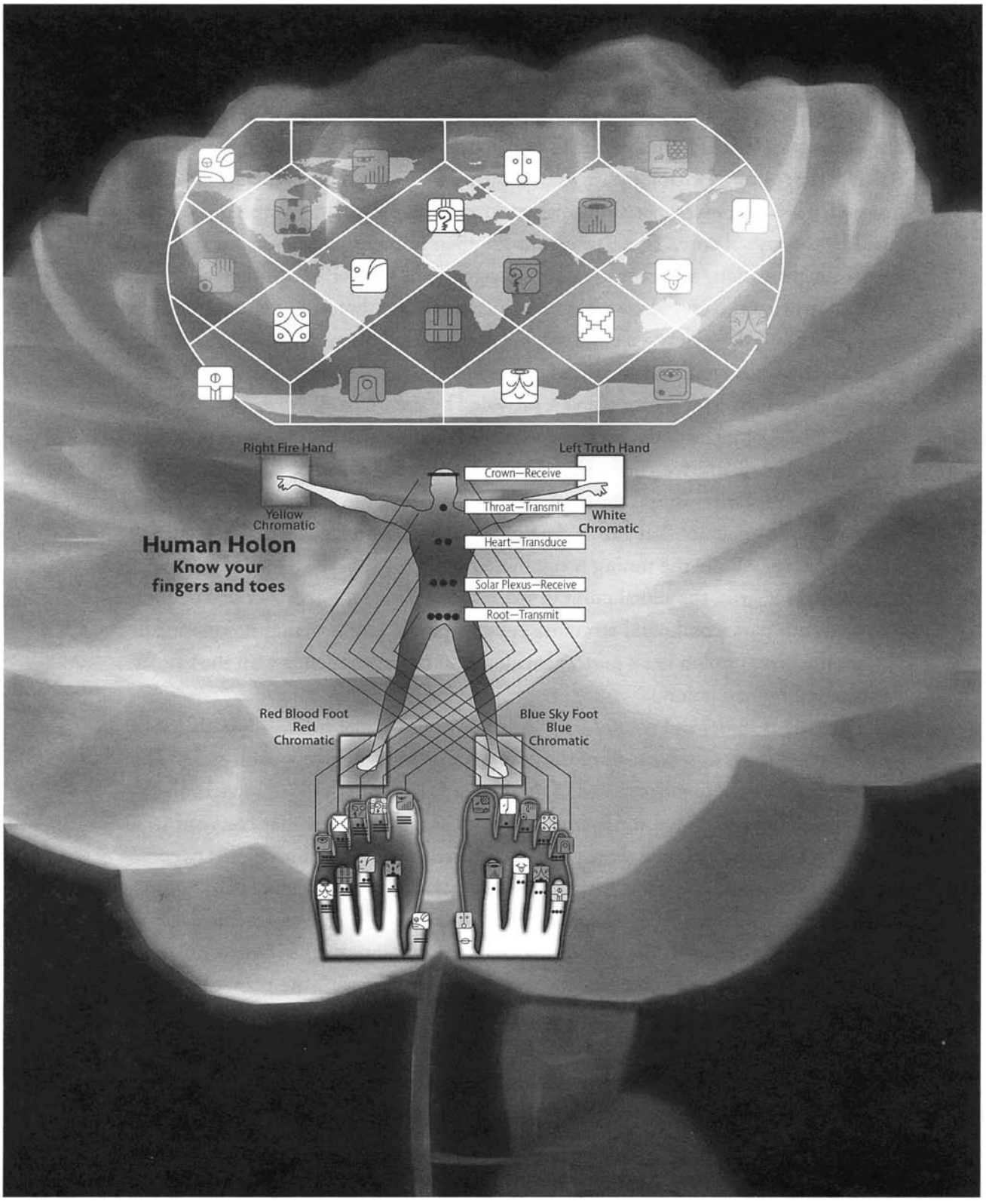

Planet Holon—Timeship Earth 2013

fields of resonance. The redefinition of the human according to the Law of Time and to the nature of the noosphere also redefines the human's reality. What will the human do when history has been eliminated from the calendar and the new calendar itself is actually operated as a synchronometer-a measure of synchronicity?

First of all, as the necessary prelude to galactic culture, the absolute synchronization of the human in geocosmic time, the technosphere will be dismantled. Reorganized by the Law of Time into psychic biomes, the dismantling will naturally phase into the genuine creation of the new culture of solar-galactic consciousness. "Path beyond technology" means path of telepathic harmony. With its goals absolutely reoriented following the mental pole shift of the calendar change, the hierarchy of human values will also undergo a profound reordering. What if money were no longer the first consideration in human affairs? What if the consideration were instead how artful or artistic that action or event might be? What if the diaspora of humanity through industrialization and mass transport came to an end and the humans willingly chose to live in smaller communities organized by gardening and other Earth-related activities, inclusive of the transformative dismantling of the technosphere and the regeneration of the biospheric medium? What if the study of time replaced the study of physics as the dominant mode for determining the nature of reality? And what if, due to the time shift, a spiritual awakening swept through the human race so that a moral orientation of values was organized around the preservation and furtherance of the biosphere, and an acknowledgement that only One Supreme Creator could have ordained something so perfect as the noospheric mind of time? What kind of world would that be? What kind of art would be practiced in that world and what kind of science would be known?

Organized by the NET, human existence would spiral into the collective telepathic mind. A type of Earth geomancy would become the science of the noosphere. Or perhaps a more accurate name for this science would be *Earth geochronomancy*- the study and investigation of Earth in relation to the cycles of cosmic time and telepathy with an end to perfecting the Earth as a work of art. With minds expanded toward accommodating the longer, slower measure of NET, geochronomancy would inspire an entirely new vision of the Earth within the heliosphere (the solar system) and the galactosphere (the galactic order of things). Making the Earth's rainbow brain visible and manifest would be only the beginning of a willingness to explore further untapped psychic energy sources and means, or what is referred to in *Earth Ascending* as the science of radiosonics. Key concentrations of human habitation and activity would be organized to occur at or close to those geomagnetic energy points or centers, the whole cultural process of which would correspond to making a map

on Earth of the image of galactic being as it moves in its great patterns of time. Would this not make the human species into a race of wizards?

In this consideration we may find a reason why the 260-day unit galactic synchronization measure-a galactic spin-is the key to what is called the *Wizard's Count.* The perfect synchronization of the 260-unit galactic spin with the 365-day Thirteen Moon/28-Day solar orbit establishes the 52-year cycle, or one NET year. A NET year (fifty-two solar orbits) is a "wizard's measure," for on this measure the human can expand its consciousness to encompass the Earth in its greater cycles of development. The Wizard's Count is also given its name because of the set of the four solar icons or seals that code the July 26 synchronization date in 4-year cycles: year one, Yellow Seed year; year two, Red Moon year; year three, White Wizard year; and year four, Blue Storm year. An entire Seed-Moon- Wizard-Storm sequence of four NET days (four solar orbits) consists of fifty-two moons, or one NET week, the perfect fractal of the fifty-two 7-day weeks in one NET day and the fifty-two solar orbits in one NET year. This four-part sequence is also called a Seed-Storm year bundle, the harmonic essence of the wizard's measure. Thirteen Seed-Storm year bundles, where each of the four icons is coded by the thirteen galactic tones (4 x 13 = 52), yield one NET year. Please note that even the Gregorian July 26 synchronization date is a function of the synchronic order: July = 7, while 26 is 13 doubled, 7 and 13 being the two principle numbers governing the 13:20 matrix of the Harmonic Module!

In the symbolism of the iconic sequence it is the Seed that is planted, it is the Moon that coordinates the growth cycles, it is the Storm that generates the energy, and it is the Wizard who knows and acts upon what is given. It was a White Galactic Wizard that coded the date and coordinated the year beginning July 26, 1987-followed twenty-one days later by the Harmonic Convergence. Thus it was the White Galactic Wizard who opened the gates to the closing of the Mayan baktun cycle of history and the commencement of the coming cycle of galactic culture. And on July 26,2003, the year of the White Spectral Wizard will commence. This year will end with its Day Out of Time, coded by the White Spectral Mirror. The day following, July 26,2004, will begin the year of the Blue Crystal Storm. On the Wizard's Count, which is not a calendar but a synchronometer, these two dates, White Spectral Mirror and Blue Crystal Storm, are the point in time when the Gregorian calendar ticket to the old time will be eliminated and the new Thirteen Moon calendar ticket for admission to the new time of the noosphere will be validated. This is when the noospheric show will be ready to begin its prelude. (See plate 6, Noosphere-Mind of Time on Earth.) Will the humans also be ready?

8

Making the Transition to the New Time

A How-to Catalog and Guide to the *Pax Cultura, Pax Biospherica*

BY THE TIME these words are read, the technospheric collapse will have generated several more devastations and disasters. The wound received by the technosphere on September 11 was a mortal one. The technosphere suffered cardiac arrest for almost a week. Not only did the towers collapse, an event that occurred via television within the central nervous system of the human species, but belief systems, too, came crashing down. No longer is America the unassailable fortress of "democracy," while democracy itself is a concept that joins monarchy, nation states, imperialism, colonialism, capitalism, communism, and a host of other outmoded systems of belief and thought constituting the saga of human history-that is, the history of civilization. But all that is now ending. The perimeter of biogeochemical combustion and the limits of the technosphere have coincided. It is the Earth's turn to speak. How will the Earth speak?

The Earth can only speak through the noosphere, and the noosphere can only speak from the center of time that is constructive peace. Peace is harmony. Peace is the culture of the biosphere. The conscious harmony of time in the biosphere is the culture of peace known as the noosphere. Through the noosphere, the Earth speaks in ever-widening circles of order and meaning. While sunrise and sunset mark the passage of solar time, observing the phases of the moon keeps us in tune with the

mystery of time. One kin, one passage of night and day, one NET minute, synthesizes the experience of the whole Earth during a single rotation on its axis. The synchronic order supplies a 260-unit synchronization gauge that the mind may engage and employ in the construction of a harmonic vision of reality. Twenty-eight NET minutes make one moon, one NET hour, moon after moon. The pattern of one moon contains the construct and pattern of every moon. The harmonic perfection of the synchronic order of reality releases the mind through the center of time into a freedom it had not known in the dark passage of history. How are we going to make this transition? Can we really shake off the old and the obsolete that easily?

THE THIRTEEN MOON CALENDAR MOVEMENT: THE DAWN OF A NEW GALACTIC CULTURE

"Greetings Explorers on Timeship Earth!" reads the opening text of the pocket-size *13 Moon Natural Time Journal.* "Welcome to this 13:20 natural time portal and fourth-dimensional galactic time template. A solar-lunar Earth calendar of the 13:20 timing frequency that is expressed through the thirteen tones of creation and the twenty sacred solar tribes. Attuning to this calendar will help you awaken and align to the pulse of the Universe, the rhythm of the One heartbeat. 13:20 is the natural timing frequency that unifies planetary and galactic consciousness. . . It is the expression and remembrance that Time is Art . . . By attuning to the 13:20 frequency of natural time, we break out of the 12:60 time warp and activate the remembrance of our true human nature. Time is energy. It is a frequency of the fourth dimension; mind, telepathy, imagination, and creation. Time is an exploration of unlimited Universal potential. So let us begin the journey and return to the rhythm of nature's galactic heartbeat. . ."1

This is the Earth speaking through a noospheric chip. Produced in Canada, it is one of many Thirteen Moon calendars produced this Yellow Solar Seed year. Others have been produced in Germany, Austria, Italy, Russia, the Netherlands, Japan, Brazil, Argentina, Chile, Mexico, and the United States. One such example from the United States is known as the 13 *Moon Natural Time Calendar: Ancient Science for the Art of Now.* Going through its pages one is flooded with a wealth of information, summarized by a quote from traditional Hopi wisdom: "We now face the final test of human consciousness-to restore our oneness with creation. We are going home. It is a process. It is like the seed becoming the green shoot and then the flower."2 To make the calendar change is to restore the oneness with nature. The break with the oneness with nature was codified and thence programmed into an irreversible reality

by the Gregorian calendar and mechanical clock. Only the breaking of the pattern of time established by these two instruments will release us again into natural time. The Thirteen Moon/28-Day calendar exists as the tool to demonstrate the contrast between harmony and disharmony, and to assist us, as a species, into effecting this return. If we are going home then we must make a turn away from our present course.

> Through returning to natural Time, we return to our natural state of divinity, living in harmony with the Earth and each other. We return to the nature of our spiritual existence. Realigning with the rhythm of the universe through the 13 Moon Calendar allows us to lay the foundation for the new paradigm of love and unity, replacing the 12:60 paradigm of fear and separation. . . The World Calendar Change Peace Plan strives to establish a new culture of peace on Earth through returning humanity to natural time. It is the goal of the worldwide Foundation for the Law of Time to effect the calendar change by the Day Out of Time (July 25), 2004 . . . Join the global movement to effect planetary £hange and establish the new culture of peace on Earth! Return to divinity and creative existence. . . Walk the path of the sacred warrior.]

The movement to change the calendar is a living force, a force that is living the New Time. Its premises are so diametrically opposite to those of the technosphere that, especially in the power bases of America and the G-7, one will find scant mention or notice at all of this movement. Yet it is a cultural phenomenon. In Tokyo, San Francisco, Milan, or Moscow one may find signs of the presence of this movement in the underground dance events, the raves or the Earthdance. More and more young people take on the names of their galactic signatures, the 260-day kin code for their date of birth in the synchronic order, names like Lunar Storm or Spectral Night, Galactic Wind or Planetary Dragon. These are all signs of the beginning of galactic culture on Earth, a phenomenon that has only been increasing over the past decade. The point is that the New Calendar Change Movement is a grassroots phenomenon as well as an ideological strategy known as the Campaign for the New Time. These signs are all whispers of the noosphere blowing through the bleak industrial corners of the technosphere.

Behind the more populist front of the Natural Time Movement is the science of the Law of Time, a genuinely noospheric science of peace and harmony. This science is already being studied and put into preliminary practice. As the crisis of the biosphere began to crest in 1987, halfway through the second 28-year phase of the technosphere, the noosphere began to download its measure of time through the

discovery of the Law of Time. Invisible to the predominant forces of the technosphere, the science of the Law of Time began to map out an entirely new domain of thought, the synchronic order, a domain that could only be entered and applied through the correct noospheric measure, the Thirteen Moon/28-Day synchronometer.

All science throughout history is based on evolutionary advances predicated on both the premises and limitations of its preceding stages. We are at such an evolutionary moment now. The issue of the calendar change is only the beginning of the emergence of a new whole system scientific order. Understanding the flaws that are built into the present system of purely materialist science, we can proceed to the establishment of the science of the synchronic order. Like the radical simplicity and perpetual harmony of the Thirteen Moon calendar itself, the noospheric science of the synchronic order is predicated on an equally radical mathematical base reflecting and embedded in the 13:20 universal timing frequency itself. And as the underlying order of a whole system science, this mathematics is reflective of the non dualistic premise of a superior moral order. The deviation from universal synchronic time is a moral deviation as well. It is this moral deviation that most strongly prompts the current calendar change movement.

As a profoundly nondualistic, unifying whole system premise, the Law of Time encompasses not only a scientific-mathematical basis of morality, but a theological-eschatological intention that reunifies the various disciplines scattered and separated by the rise and totalitarianism of modern secular science. Because of the historical dominance of the Gregorian calendar, in which modern science is embedded, the dethronement of the calendar-the "devaticanization" of the world, as it were-is an apocalyptic moment.

As the Law of Time defines it, this is merely the apocalypse of the 12:60 timing frequency and all its corrupted institutions, much as foretold in the Book of Revelations. This apocalyptic moment was stunningly supplied by the terrifying collapse of the Twin Towers. As the nerve center of the financial, commodities, and transport sector of the technosphere, and hence of the city itself, the collapse of the towers in hardly more than an hour's time is perfectly reflected in the vivid descriptions of the eighteenth chapter of the Book of Revelations, "Fall of Babylon." Yet as the Mayan prophecy of Pacal Votan also makes absolutely clear, the apocalypse of the 12:60 is the resurrection into the 13:20 timing frequency, the return to natural time, all to be accomplished by A.D. 2012, Teilhard de Chardin's "omega point." The advent of the noosphere is preceded by the post-apocalyptic harrowing of hell. In this harrowing of hell, defined as the span of time fromJuly 26, 2000-July 25,2004, humanity must make a crossing from one time to another. This crossing is much like those we hear

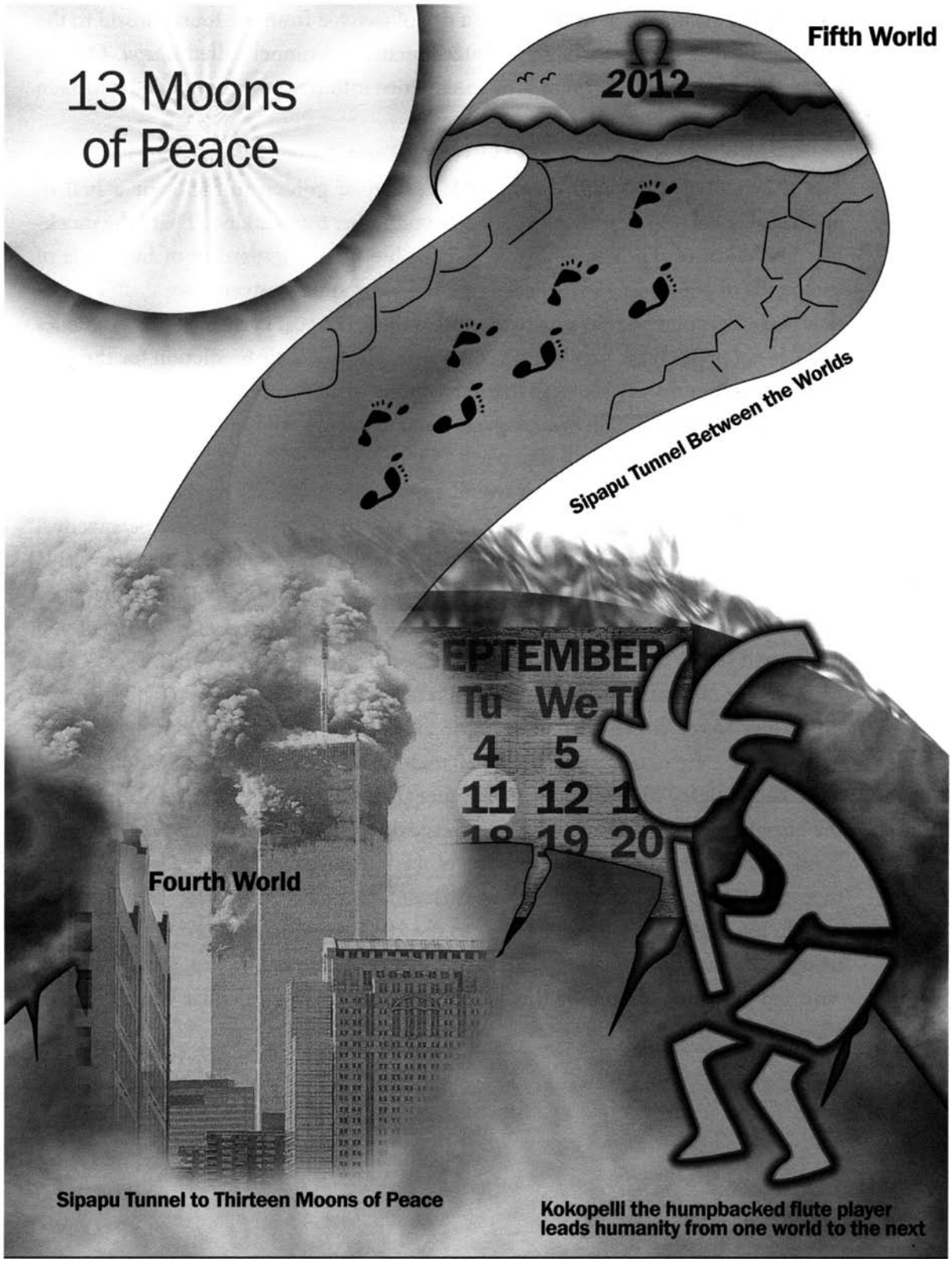
13 Moons of Peace
Fifth World
2012
Sipapu Tunnel Between the Worlds
Fourth World
Sipapu Tunnel to Thirteen Moons of Peace
Kokopelli the humpbacked flute player leads humanity from one world to the next

about in the cosmovision of the Hopi, a rite of passage from the fourth world to the fifth world that occurs through an interdimensional tunnel called *sipapu.* On the other side of that tunnel, there is an emergence into the new time called "thirteen moons of peace."

"Golden Age of Miracles and Heaven on Earth," a story in the *National Examiner* (November 29, 1988), begins: "A heaven of golden miracles or a hell of unspeakable horror is less than twenty-five years away for mankind. That's the shocking prediction of the man who was responsible for the gathering of hundreds of thousands of people in 1987 to celebrate the Harmonic Convergence. . ." The article makes its point by referring to the end of the 5,125 year cycle in 2012. "Argiielles said Mayan predictions have always come true. He said their prediction for the year 2012 is that if humanity learns to live in harmony with Nature, a new age of miracles and light will occur. Otherwise plagues, wars, terrorism, and finally, the breakup of the planet into asteroids, will take place."4

As for the Inevitable Event, it would appear that humanity has begun the worst of the prediction-plagues, war, terrorism-yet, from the noospheric perspective, two points mitigate the absolute plunge into hell. The first is that the Inevitable Event punctured a hole in the technosphere eleven years prior to 2012. What does this mean? It means that this is the time of hell on Earth. "Every single one of you must see it [hell]; this is an irrevocable decision of your Lord." (Quran, 19:71) This being so, we can potentially emerge from it before the 2012 omega point. The other mitigating factor is the existence of a 13:20 movement dispersed throughout humanity. Since the noosphereis the 13:20 mind of Earth, the Thirteen Moon Calendar Change Peace Movement is the advance presence heralding the transition from the biosphere to the noosphere. This passage through hell is of a four-year duration, 2000-2004. The exponential implosion of the technosphere has already begun. But to avoid a long, debilitating siege of barbarism, humanity must select a positive direction by 2004 so that it can make it to the 2012 deadline as a species returned to living in harmony with nature. This it can only do by the dramatic and radical break with the past time offered by the Thirteen Moon/28-Day calendar Change Peace Plan.

Campaign for the New Time

4:7::7:2013

7th Seer
Pacal
Votan

Blue Galactic Storm
2000 – 2001
Seed Cube Flowering

6th Seer
Quetzalcoatl

Yellow Solar Seed
2001 – 2002
Serpent Cube Sex (Life Force)

4th Seer
St. John
of Patmos

Red Planetary Moon
2002 – 2003
World-bridger Cube Death

2nd Seer
Padmasambhava
Fulfillment of the
Cycle of
Seven Seers
1997-2004

White Spectral Wizard
2003 – 2004
Hand Cube - Accomplishment

Victory of
the New Time
Thirteen Moon
Calendar Reform
Attained
Thirteen Moons
Proclaimed and
Accepted as New
World Calendar

Circumpolar
Rainbow
Victory
Event

Sacred
Earth
Sacred
Order

Tibetan
Lunar
Calendar

Japan
Mount
Fuji

Chinese and
Islamic
Lunar Calendars

China
Iran
Saudi Arabia

Indigenous Peoples Councils

Organization
of PAN Peoples
New Time
Congresses

India

Africa

UR Council
for the
Integration
of all
Lunar Calendars
in 13 Moon
Calendar

Vatican Put
on Notice

Wall Street Journal Ad Strategy

Planetary Peace Through Culture Festival

See the Rainbow

Planetary Peace Through Culture Festival

See the Rainbow Round the Earth

Planetary Peace Through Culture Festival

Be the Rainbow Round the Earth

Foundation
for the Law
of Time
Established

Launching
of the
Campaign
for the
New Time

Preparation
of
Strategies
- PAN Peoples
- Mass Media
- Diplomatic

International
Kin
Gathering
Prepare
PAN
Congresses

Banner of
Peace
returned
to Altai

Colombia
New Time
Peace
Congress

PAN Peoples
New Time
Congresses
Develop Local
Programs for
Social Transformation

PAN Peoples
New Time
Congresses
Implement
Strategies

Time of
Great Awareness
of New Time

Calendar
Reform
Becomes
Major
World
Issue

Harmonic
Convergence
of PAN

Media
Diplomatic
Strategies

First Seed-Storm Year Bundle Gathered

Listen Again	Stabilizing	Meditation/ The Temple	Measuring	People Together	People Organized	Evolving	Inner Space	People Apart	Wisdom of the People	Transcending	Inner Time	Power of the People	Way of the People	Wisdom Arousing	Accomplished
Tree shapes space	Way of conduct informed by truth	Telepathy establishes the temple	Galactic octave limits space	Tree evolves space	Truth evolves way of conduct	Telepathy evolves the temple	Galactic octave resounds as mind	Tree defines life	Conduct defines the way	Temple incorporates telepathy	Galactic octave defines evolution	Tree of time turns Earth	All points unify in conduct	Telepathy becomes time travel	Galactic octave universalizes space

Afro-Eurasian • Plate - PNM 1-6

Pacific Plate • PNM 19-24

American • Plate PNM 13-18

Atlantic • Plate PNM 7-12

Earth Wizards Define Spiritual Order of New Time Lay Foundations of Shambhala in Temple of Rainbow Plasmic Body

THE BIRTH OF THE CAMPAIGN FOR THE NEW TIME

"We inspired Moses: 'Lead My servants out, and strike for them a dry road across the sea. You shall not fear that you may get caught, nor shall you worry.

"Pharaoh pursued them with his troops, but the sea overwhelmed them, as it was destined to overwhelm them."

-QURAN, 20:77-78

The Thirteen Moon/28-Day calendar is the dry path across the waters of the 12:60 chaos. Holding surely to this path, "Pharaoh's troops will be overwhelmed," as it is destined, for the truth always prevails and when falsehood is exposed, falsehood perishes. The 12:60 frequency enshrined in the Gregorian calendar represents an artificial, hence false notion of time. The Pharaoh's troops are the forces of the technosphere that, embedded in the artificial structure of the Gregorian calendar, are destined to be overwhelmed and overcome by the fury unleashed both by human nature and nature itself in response to decades, if not centuries, of irresponsible despoiling of the Earth. The dry path of the Thirteen Moon/28-Day calendar is the only path broad enough for all humanity to leave the ever increasing ocean of chaos that characterizes human existence bound in the collapsing 12:60 matrix born of Gregorian civilization, the technosphere. Yes, the dry path across the waters of the 12:60 chaos provided by the Thirteen Moon/28-Day calendar truly is for the salvation of life on Earth.

Ever since 1993, the Thirteen Moon Calendar Change Peace Movement has consciously been drawing from the infinite riches of the noosphere to create not only the mechanism for making a shift in the frequency and hence bring stabilization to the biosphere, but has been anticipating the biosphere-noosphere transition into the *Pax Cultura, Pax Biospherica.*

Foll{)wing in the footsteps of its predecessor, the new calendar movement has dutifully contacted the United Nations and the Vatican and convened various congresses and delivered ultimatums in an effort to draw attention to mankind's time malaise. Now that the Inevitable Event has fully disengaged the human mind from the reality it thought it was pursuing in the new millennium, the second definitive wave of the World Thirteen Moon Calendar Change Peace Movement has also been launched: the Campaign for the New Time.

New Globally Unifying Harmonic Standard

FOURTH DIMENSION: Pure whole number mathematical order—syntropy, synchronic order

Harmonic Solution

Calendar Change

Replace current irregular calendar with a harmonic standard

Paradigm Shift

Radial

Time

2002

2001 2004 2005

2003

Campaign for the New Time

13 Moons. 28 Days.

Regular Units of Measure

28+28+28+28+28+28+28+28+28+28+28+28+28+1 = Harmony

"Mental barrier" separating fourth-dimensional realm of conscious wholeness of synchronic order from third-dimensional realm of "hard science" physical plane of reality and materialism.

Line of inexorable technological progress: neoliberal economics, globalization = biospheric instability and destruction.

THIRD DIMENSION: Manifestation-matter entropy and disorder

Coercion
Compromise
Money

$$$$$

IMF - World Bank
G-7 WTO
Security Council

Political Solution

Military Solution

Stalemate

Deadlock

"Secret Deals"

Guerrilla Warfare
Terrorism
Convential War

$$$$$

NATO
Nuclear war
Arms Industry

Past → Future

Linear Arrow of Time = line of inevitable degradation and entropy of manifestation (matter)

Gregorian Calendar Time Line = macro-organizing timing standard establishes irregular measure as basis of all dominating concepts of linear time, disorder, entropy, and the techno-economic inexorability

Irregular units of measure:

31-28(29)-31-30-31-30-31-31-30-31-30-31 = Disharmony

If today is Sunday, July 8, what day of the week will August 8 be?
What is the meaning of the names of the months?
If *September* means "seven" why is it the ninth month?
August is named after Augustus Caesar, July for Julius Caesar, March for Mars, the god of war; could this be a reason why we are programmed for chaos and violence? Think about it.

This campaign consists of a preparatory four-year cycle, 2000-2004, the Harrowing of Hell, which is the duration of the campaign itself, plus a one-year trial period, 2004-2005. The goal of the four-year campaign is universal calendar reform, the replacement of the Gregorian by the Thirteen Moon Calendar, effective Blue Crystal Storm, July 26,2004. This final year of the Blue Crystal Storm, 2004-2005, also completes a Seed-Storm year bundle begun in 2001, fateful year of the Yellow Solar Seed, the year of the Inevitable Event. To ensure the success of this unprecedented move on the part of humanity, the calendar reform must include the one-year trial period, during which time the entire species must be operating by a new standard, the harmonic Thirteen Moon/28-Day synchronometer. "If you never try it, you'll never know what it is," is the slogan that describes the campaign's target year: July 26, 2004-July 25, 2005, an entire year without the Gregorian "30 days hath September. . . ," but instead, Thirteen Moons of Peace.

To realize its ambitious goal of universal calendar reform, the Campaign for the New Time must impress itself on the human consciousness as the all-unifying campaign for peace to overcome the destructive forces unleashed by the technospheric collapse. Fqrtunately, much groundwork has already been laid. The codes of the Law of Time have been formulated and compiled. Preliminary practices to engage the synchronic order of the noosphere have already enlisted humans from around the planet. What the Vatican has tried to ignore and what the United Nations has been unable to fully engage must now be brought to the forefront of all humanity as the harmonic solution. The harmonic solution is a set of logical arguments that should be studied and rehearsed by everyone who seriously wishes to even consider the possibility of a Campaign for the New Time. Let us contemplate the following set of logical arguments.

Premise

Currently all conflict resolution of a global scale is attained through one of two poles: a political solution or a military solution. No other alternatives are recognized. According to the Law of Time, there is a third solution, the harmonic solution. Without this third solution, no harmonic resolution is ultimately possible for any conflict on a global scale. The third solution defines the first two solutions as a polarity embedded within a timing standard that is hopelessly irregular and that, therefore, disposes the mind to disharmony. A mind predisposed to irregularity and disharmony is incapable of producing any long-term solution. The basis of the harmonic solution is to change the timing standard from an irregular to a regular one, thereby inducing a timing sensibility that disposes the mind to harmony rather than disharmony.

Thirteen Moon/28-Day Count and Global Conflict Resolution

The inability to attain global peace, much less the resolution of many localized conflicts that have become endemic, is due to a lack of a globally unifying timing standard-the macro-organizing principle of human sensibility. Present-day conflict resolution is represented by two poles, political and military. The military solution consists of guerrilla warfare, terrorism, and outright military conflict, all of which are engendered by problems of inequality; injustice; rampant nationalism; tribal, racial, or religious antagonism; and greed for control of natural resources. Underlying the military solution is an aggressive armaments industry that seeks to hold its own as a capitalist venture, always seeking new markets. The political solution is always fostered as the only cure for the military solution, and is administered through varying degrees of coercion, compromise, and the inevitable lure of money-the IMF and the World Bank are never far behind any political solution.

Neither the military nor the political represent any kind of morally satisfactory or enduring solution because both are functions of and embedded in a timing standard that has disharmony built into it. Even the local timing systems, themselves feedback loops holding in place various belief systems, are coordinated by the dominant disharmonic standard. As long as the current global standard, the Gregorian calendar, is the controlling timing factor, resolution on a global and local level is not only impossible, but increasing disharmony is guaranteed. The harmonic solution calls for the immediate establishment of a globally unifying harmonic standard, the Thirteen Moon/28-Day count. With its absolutely consistent units of measure, this macro-organizing principle is a paragon of harmony and thereby represents the positive, creative, and viable first step to enduring global conflict resolution.

Thirteen Moon/28-Day Paradigm Shift

The harmonic solution, the alternative to the polarity of the military and political solutions, calls for the immediate replacement of the current irregular measure with the harmonic standard of the Thirteen Moon/28-Day count. This replacement constitutes the long-awaited and long-prepared-for paradigm shift in human consciousness. The very analysis and concern that engendered the first movement to replace the Gregorian calendar-the effects of an irregular measure on human behavior-is now so dire that the concluding step must be taken. To quote Einstein once again, "Since the advent of the nuclear age, everything has changed but the way people think; thus we drift toward unparalleled catastrophe." With the analysis of the Law

of Time we know why thinking has not changed-the human mind is the pawn of an aberrant timing mechanism. To change the way people think, make one little change in their everyday lives: Change the calendar. If we could send a man to the moon, we can change the calendar. This change will be the first step-the rest will come easily because with this one change we shall have changed our minds and entered into a New Time. To make this one little change a target date is needed, and the people need to mobilize as a force of synchronization for peace to mandate this change. The target date is July 26, 2004--the mobilization has already begun.

New Worldview of the Law of Time

The Thirteen Moon/28-Day count is the pragmatic application of the Law of Time. The discovery of the Law of Time was necessitated by evolution as the only way that could offset the deleterious effects of an erroneous timing standard on human consciousness. The Law of Time takes the radical view that time is a frequency, the universal frequency of synchronization; that the purpose of time is to synchronize; and that, therefore, a calendar is in harmony with the Law of Time to the degree to which it maximizes opportunities for synchronization. From the perspective of the Law of Time, the current macro-organizing standard is anything but synchronous, and hence contrary to the laws of nature. Synchronization produces harmony, harmony is a function of beauty, and beauty is the natural result of the Law of Time: T(E) = Art, energy factored by time equals art, where art is the entire spectrum of phenomenal reality in which even the most menacing-looking creature is elegantly constructed.

National Geographic recently stated: "Beauty seems to be an intrinsic part of nature and perhaps even the organizing principle of reality. Scientists in testing their theories, invariably find that the simplest, most elegant, most beautiful is the correct one. Rainbows, butterflies and the periodic table are some examples of intrinsic beauty. The world will be saved by beauty."5 The Law of Time agrees. The world will be saved by beauty, and the proponents of peace through culture will be in the vanguard. The Law of Time formalizes the perception of the intrinsic beauty of nature- T(E) = Art-and thereby provides a scientifically solid critique of the ugliness and social disharmony fomented by the irregular and artificial timing standards that control humanity today. By the same formulation, the Law of Time also establishes a vast and comprehensive definition of the fourth dimension, which was wanting until now precisely because of the embedding of all current perceptions in the erroneous timing standard.

The mathematical order underlying the universal frequency of synchronization,

13:20, describes a new order of reality, the synchronic order. The synchronic order governs the fourth-dimensional order of reality much as the laws of gravity, thermodynamics, and the special theory of relativity govern the third-dimensional order of reality. By taking into account the nature of the synchronic order, humanity's views of the third dimension will inevitably be altered to a greater conformity with the harmony of the fourth dimension. The fourth dimension is defined as the primary mathematical order of time, governed by a syntropic whole number system of ratios and fractals operating in a radial and nonlinear manner.

The third dimension is the world of manifestation and matter that inevitably entropizes. Losing sight of the inherent harmony of the synchronic order from which it is actually inseparable, the human fixation on the increasing entropic anomalies of the third dimension produces problems such as how to reckon what appear to be the extra hours, minutes, and seconds that occur every time the Earth orbits the sun. To this seeming dilemma, the Law of Time asserts that number precedes manifestation, harmony precedes materialization, therefore manifestation must accord with number, and materialization must reflect an original harmonic order. Entropy and degradation cause manifestation to deviate from number and mathematical law. But for mind to be stable, mind must accord with and conform to mathematical law rather than with entropy and degradation. The timing standard in use causes the mind to conform with entropy and degradation. This is what must be corrected.

Harmonic Solution-Harmonic Resolution

Harmony can only produce harmony. From order comes order. From disorder you can only expect chaos. From disharmony can only come disaster. Irregular measure entropizes. Harmonic measure syntropizes. These are the contrasting values brought into focus by replacing an irregular macro-organizing principle with a regular one. Implementation of a globally unifying harmonic standard is the only hope for resolving all conflicts in time. A harmonic standard lifts all conflicts to a higher level dialog of unification in time. The harmonic solution, the World Thirteen Moon Calendar Change Peace Plan, provides: the opportunity to call an immediate and universal cease-fire, as well as a halt to the otherwise inexorable process of entropic degradation of society and environment; and offers the resolution to establish new agreements, to renegotiate old treaties, and to create a new globally binding and unifying covenant for all people in a new time.

It must be understood that to change the calendar is to delegitimize all the institutions embedded in it. This radical but peaceful delegitimization of the old order is

what is needed to break the deadlocks, stalemates, and historically outmoded treaties and agreements now binding on humanity. The new globally unifying standard, the Thirteen Moon/28-Day count, will legitimize and institutionalize harmony and thus create the advent of a synergistic order capable of resolving entropic disorder because it is reflective of and rooted in the primordial whole number structure of the synchronic order of reality. In its entirety, this represents a new step and direction for human evolution-a step without which there might not be any creative future for humanity and the planet.

How to Accomplish World Peace Now

The analysis, the historical precedents, and now the affirming authority of the Law of Time render the harmonic solution as the only way to immediately bring about World Peace. All that is lacking is the will to synchronization among all good-hearted people, groups, and organizations otherwise committed to peace, a better environment, and human spiritual well-being in general. How to accomplish World Peace is to galvanize the human will to synchronization on behalf of the establishment of a genuine time of harmony and peace. This can only come about through the simple but highly radical and paradigm-altering act of exchanging the current macro-organizing system of the Gregorian calendar for the harmonic order of the Thirteen Moon/28-Day count. All other localized calendar systems would be kept intact, but they would be coordinated by a new standard, a standard that promises harmony instead of disaster, order instead of chaos, peace instead of war.

Such is the harmonic analysis and solution of the Law of Time, which can be summed up by a simple demonstration of the irregular Gregorian calendar contrasted with the regular Thirteen Moon calendar, as well as the question: "Which do you prefer, harmony or disharmony?"

If you answer this question on behalf of harmony, and you agree with the foregoing premises and analyses, you must move into action. You need to get a new calendar, a Thirteen Moon/28-Day calendar and find out for yourself: noosphere or necrosphere, the choice is yours. The option opened by the Inevitable Event and the collapse of the technosphere is precisely that: necrosphere, the transformation of the biosphere into a sphere of death-a dead planet-or the noosphere, the mental envelope of the Earth, governed on the human plane by the Thirteen Moon/28-Day calendar. The difference between the necrosphere and the noosphere is the difference between a machine and the Earth as a whole system. You cannot even really say there is a comparison. But what we can say most emphatically is that the Thirteen

Moon/28-Day calendar and the shift to the 13:20 frequency is the pure manifestation of the Law of Time in human affairs. It is the only antidote to the destructive grip that the 12:60 timing frequency now has upon the biosphere through its thoroughly artificial instrument, the technosphere. (See plate 7, Necrosphere or Noosphere.)

THE FINAL DECISION: NOOSPHERE OR NECROSPHERE?

As these lines are being written, seven weeks have passed since the Inevitable Event. The analysis of this event from the perspective of the biosphere, the temporary structure of the technosphere, and the advent of the noosphere was a spontaneous inspiration. Each morning, often well before dawn, I would be called to this technospheric device, an iMac, to put the noospheric mandate down into words. In this process, the matter of prophecy kept occurring and could not be avoided. Even the issue of calendar change increasingly takes on the quality of a prophetic enactment. What is prophecy from the noospheric perspective?

Prophecy is the release of information according to the psi bank timing program and in relation to degrees or levels of consciousness positioned at different points in time. The points in time are human channels. That is, there are the prophets who declare the prophecies by whatever means or forms, and then there are the decoders of the prophecies, those able to read the signs according to the prophecies with the aid of different symbolic lexicons. Prophecy is always startling to the mass mind, which is ignorant of the true nature of time. A prophetic event may seem totally random, when it is not. Someone may design a plot, such as that of the Inevitable Event, with whatever fantastic notions and motives. Yet the occurrence may go beyond being merely a matter of human manipulation. The humans were but the instruments of sets of cause-and-effect chain reactions established within the structure and evolution of the biosphere and the playing out of human karma.

According to the psi bank timing program governed by the Law of Time, the technosphere could only have a limited duration. Two perfect 28-year cycles of the Gregorian calendar program, leading to the first year of the third millennium, marked the duration of the technosphere. Because this cycle concluded with the beginning of the third Christian millennium, a singular event was poised in time to attract and catalyze a host of prophetic moments long prepared for and sealed in the psi bank by Christian, Islamic, and even Mayan prophecies. Such was the Inevitable Event. Within the motivations of the perpetrators of the Inevitable Event, the biosphere found its perfect instrument of divine purpose. That there were nineteen hijackers conforms to the Quranic nineteen code expressed in the enigmatic verse, "Over it is nineteen."

(74:30) The following verse begins, "We appointed angels to be guardians of Hell, and we assigned their number [19] . . ." This verse ends by asking, "What did God mean by this allegory? . . . None knows the soldiers of your Lord except He. This is a reminder for the people." (74: 31)

Certainly in the success of their mission, whether they were conscious of it or not, the nineteen Muslim hijackers-who organized themselves as four leaders (pilots), three logistics people, and twelve "soldiers"-fulfilled their function of being the prophetic emissaries of the nineteen guardian angels who watch over Hell. And indeed the gates to Hell have been opened. In the world of the secular mind of the technosphere, no one wanted to talk about the apocalypse or Armageddon, though the jihad was brought up quite often as a factor in the thinking of the Islamic terrorists.6

Whether it is seen as a prophetic or karmic event, as we stated earlier, there is no question that the timing programs of two civilizations, the Gregorian and the Islamic, were on a collision course. "The civilization of Islam is radically so different from that of Western civilization which dominates the world today. The two are different in their description oflife as well as the foundation on which they base such a description. The difference between the two civilizations is so essential that they have developed in ways which are radically contradictory to each other."7 So wrote the eloquent Saudi historian, Muhammad Husayn Haykal in his essay "Islamic Civilization," as presented in his masterful biography, *The Life of Muhammad.* And what is at the root of this difference? A separation of church and state, which in the West led to a profound materialism and economic worldview.

Haykal continues, "The victory of materialist thinking was largely due to the establishment of Western civilization primarily upon an economic foundation. This situation led to the rise in the West of a number of worldviews which sought to place everything in the life of man and the world at the mercy of economic forces. . ." As for the sanctity of its economic beliefs, Haykal concludes that the West has tied its economic activity "hand and foot by public laws and commanded that every Western state and army prevent any violation of economic laws with all the power and coercive means at its disposal."8 Given this insightful assertion by an Islamic thinker written a half-century ago, it is not at all surprising that the terrorists concentrated their attacks on the most visible symbols of Western global materialism and economic and military imperialism, the Twin Towers and the Pentagon. It is also of note that one of the logistics men on the team of nineteen hijackers, Majed Moqed, had been a professor of economics at King Saudi University in Riyadh.

However we see this event, the most important point is that it actually happened, no matter who caused it or how. In this regard the collapse of the World

Trade Center towers and the penetration of the Pentagon was the Inevitable Event both from the point of view of the biosphere and from that of prophecy as mandated by at least two major timing programs, the Gregorian and the Islamic. Of course, prophecy is a matter far from the consideration of the technocratic mind, so the immediate aftereffect is a heightened nationalism, patriotism, and commitment to war. But what is going on from the noospheric point of view is not so much the combat of different armed camps defending or attacking competing ideologies, but an end game, the biomass of the technosphere maneuvering against time in a self-destructive process that is really nothing more than the continuing collapse of that which it is defending.

How long will this collapse take? With the weapons of mass destruction currently at the disposal of the combatants, it shouldn't take too long before the human race realizes that if it doesn't stop the self-destructive process, it will soon be curtains for all life on Earth. A more significant question, if we wish to make the transition to a new time, is: How will the self-destruction end, and how can it be stopped-or can it? It is easy to see how wars begin, but no one can tell how they will end.

THE SOLUTION TO WAR: PEACE THROUGH CULTURE, PEACE OF THE BIOSPHERE

At the end of the First World War, the League of Nations was formed to keep the Second World War from happening. The League of Nations was unable to both effect the calendar reform it promoted and keep the Second World War from happening. These are not unrelated events. The Second World War effectively eliminated the League of Nations, and toward its end a new organization, the United Nations, was formed. Like the League of Nations, the United Nations was formed to prevent the next world war from happening. Within eleven years, the United Nations tabled the calendar reform begun by the League of Nations. Coincident with the formation of the technosphere, the United Nations has now also completed fifty-six years of existence. With the expanding "war against terrorism," is its purpose now over as well? The only way the United Nations can survive is to maintain its humanitarian agencies, for the age of nationalist politics and nation-states is over, succeeded by the politics of terrorism, the last politics of history. What new kind of global organization will we need at the end of the War on Terror, or World War III?

What we will need is an entirely new agency, a Planetary Biospheric Assembly that will model and create a sustainable *Pax Cultura, Pax Biospherica.* Given the failure to enact a calendar reform on the part of both the League of Nations and the

United Nations and in consideration of the chaos now clearly embedded in the Old Time, only an agency or instrument that fully embraces and promotes the calendar change will be able to move into the genuinely peace-fulfilling role that such an organization must take. If the United Nations could accept the route of calendar change as the only way to bring all humanity to a new point of discourse, then it could take on a renewed life. But if it cannot rise to this occasion, then another organization must take its place, the Planetary Biospheric Assembly. Even so, when we speak of the *Pax Cultura, Pax Biospherica,* we are speaking of a new human covenant, one in which the biosphere takes precedence over all nationalist corporate interests, and in which peace as a manifestation of culture is the primary value of the new time. Such a covenant would be a biospheric covenant, an agreement and understanding that, first of all, the human is a member of the biosphere, and second, that in consciously accepting the calendar change, the human is also in the process of becoming *Homo noosphericus.* Henceforth, it will be art and not money, bioregions and not nation-states, that will be the cause of social organization. Only in this way will humanity be guaranteed a true post-historical future.

Assuming the calendar change occurs on Blue Crystal Storm 2004, the first step in ~ngendering the full manifestation of the noosphere will be the dismantling of the technosphere. This can only be accomplished if a full reorganization of the human in time, inclusive of an adjudication of inequalities and a redistribution of wealth, begins to occur during the 2004-2005 Crystal Storm year. The following four years, 2005-2009, a genuine First World Peace, would see the constructive transformation of the five-part technospheric system. All the apparatus of heavy industry, energy, and the transport system would be turned like compost, to be replaced by non-polluting technologies and means of transport, while the cities would be transformed into urban gardens with the human race once more becoming decentralized. This process itself, a massive planetary engineering project with an eye on the full development of geochronomancy, would prove to be the greatest and most thoroughly positive transformation in human history. By 2009 humans reorganized by the Law of Time and having finally arrived at the "path beyond technology," will be enjoying universal telepathy, the noosphere-life beyond the Internet. By 2012 the humans will realize peace through culture as a permanent value, and by 2013 Earth will be galactically synchronized through a fully activated noosphere into the beginning of an entirely new geological era, defined by Vernadsky as the Psychozoic Era.

Pax Cultura, Pax Biospherica refers to both the new era of humanity following the devastation of the Final War and the governing body of bioregional councils (not nation-states) comprising the new world "government," the Planetary Biospheric

Arcturus Victory Strategy
Pax Cultura, Pax Biospherica

Telektonon, the Theater of Time, provides the journey through the Cube of the Law: Plane of Mind, Plane of Spirit, Plane of Will, and Divine Source Telektonon—each plane Seed-Storm year bundle, an entire universe of noospheric time!

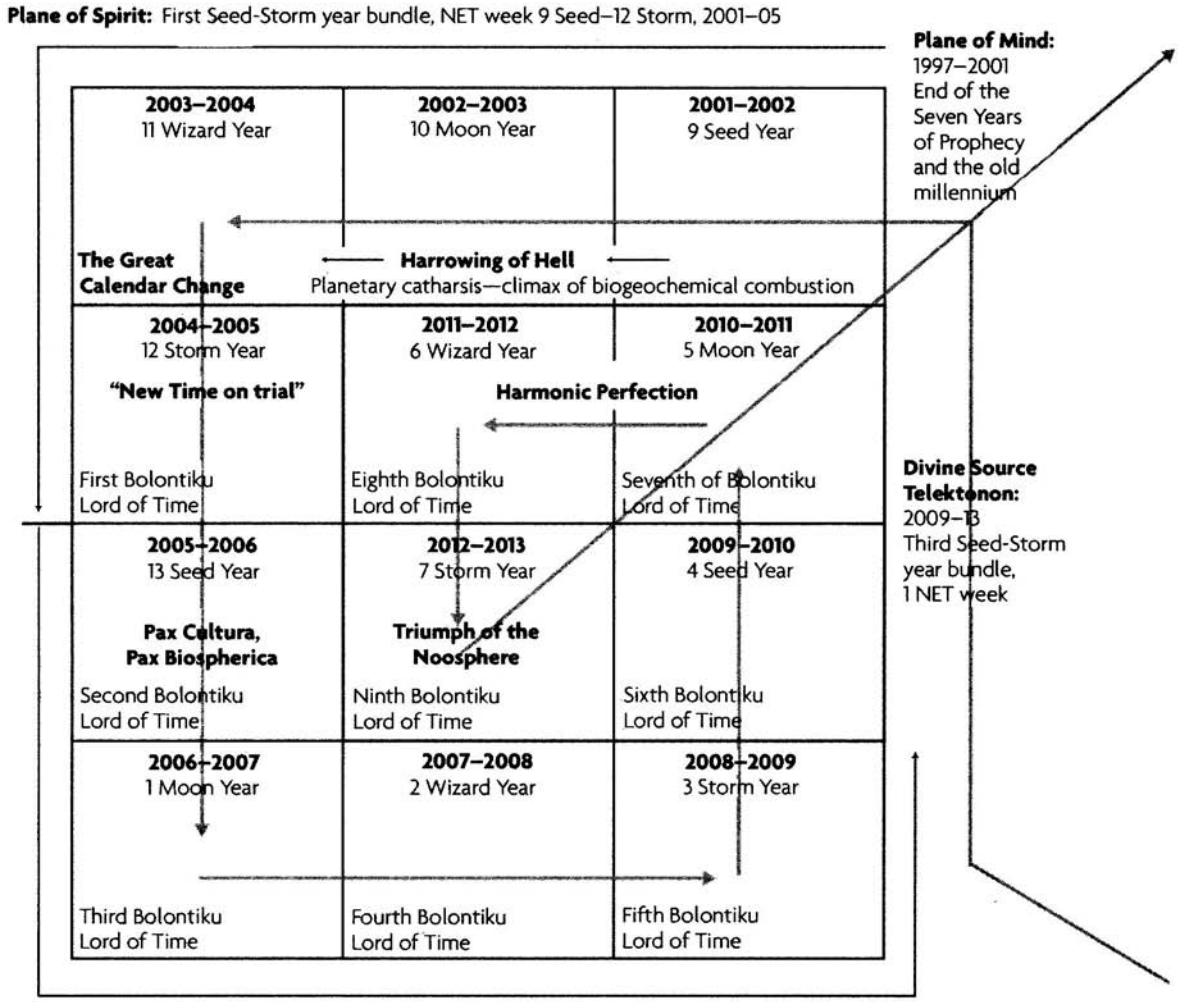

Assembly. The main purpose of the new governing body would be to monitor the advent of the noosphere. Overcoming Northern Hemisphere bias, the *Pax Cultura, Pax Biospherica* will not find any permanent seat, but will begin its existence as a planetary noospheric congress in the Southern Hemisphere. All of this could be made possible only because of the completion of the calendar change. So let us assume the best. The how-to of paradigm shift begins with the Thirteen Moon calendar.

If you follow the Thirteen Moon calendar or tell others to follow it with you, what is the payoff? The payoff is that you get to become a noospheric chip. Only a noospheric chip can bring Heaven on Earth, which is nothing more than full human participation in the noosphere. This is not at all a theoretical matter, but something that can be practiced and followed on a day-to-day basis. Fortunately, a path has been shown, complete with travel aids.

CONCISE *HOMO NOOSPHERICUS* HOW-TO TIME TRAVELER'S GUIDE TO THE BIOSPHERE-NOOSPHERE TRANSITION

This analysis of the Inevitable Event could never have occurred if the Law of Time hadn't been discovered and defined. The Inevitable Event simply supplied the Law of Time with precisely the right historical moment to provide a thorough analysis and explanation of time as the whole system in which we humans live and operate, inclusive of the biosphere, the technosphere, and the noosphere. As the chief discoverer of the Law of Time, assisted by my wife and an increasing number of other humans who have engaged the Law of Time, I have sought only to make a presentation of matters in which we, as a species, are thoroughly immersed, and thus find difficult to comprehend. Such is the technosphere, and such also is the medium of time. Since the publication of *The Mayan Factor* and my pursuit of the underlying mathematics of the Mayan calendar, I have remained outside the conventional arenas of discourse and communication, preferring instead to remain more anonymous in order to test the various hypotheses of the Law of Time.

In this process over the past twelve years, the Law of Time has precipitated from the noosphere various tools and didactic texts, all for the purpose of enabling us to make the shift from the old paradigm of the time of war to the new paradigm of the time of peace. These tools and principles are actually practiced on a daily basis, and so provide a pragmatic means of applying the Law of Time. Because of my vows and need for scientific "purity" of the experiment I have been living, I was involved at all times in doing my utmost to remain in the 13:20 frequency. For this reason, the tools and texts prompted by the noosphere to define the Law of Time were, for the most part, all produced outside the commercial mainstream. Now a great effort must be taken to make these tools and texts available to humanity in order to assist in the transition from *Homo historicus* to *Homo noosphericus*. By presenting a catalog of these tools and texts we only mean to suggest and define for the reader the scope and existence of a preliminary science of time and telepathy.

Part I. The Tools: Establishing Noospheric Earth Time (NET)

THIRTEEN MOON/28-DAY SYNCHRONOMETER

The harmonic standard of noospheric time, the Thirteen Moon/28-Day synchronometer, is a perpetual, harmonic calendar. It is called a Moon calendar because it is based on the female 28-day menstruation cycle, which is also the average lunar cycle. In actuality the moon goes around the Earth thirteen times a year. This means that the Thirteen Moon calendar is a genuine solar-lunar calendar that measures the Earth's orbit around the sun by the apsidallunation cycle of twenty-eight days. Thirteen perfect months of 28 days = 52 perfect weeks of 7 days = 364 days. The 365th day is called the Day Out of Time because it is no day of the week or month at all. This day, which falls on the Gregorian correlate date ofJuly 25, is a day for forgiveness and the artistic celebration of life and freedom. The synchronization or New Year's date of the Thirteen Moon calendar is July 26, and corresponds to the rising of the great star Sirius. This makes the Thirteen Moon calendar a tool for harmonizing ourselves with the galaxy. Of course, the Thirteen Moon calendar also synchronizes the phases of the moon in a pattern that demonstrates its regularity and order.

One of the great advantages of the Thirteen Moon synchronometer is that day/date calculations are amazingly simple. Any day of any week is the same for any Moon, any year. The first day of every Moon is always a Thirteen Moon Sunday (Dali). The last day of every Moon is always a Thirteen Moon Saturday (Silio). In the Thirteen Moon calendar the obscurely named Gregorian months are replaced by names that correspond to a fourth-dimensional cosmology of time. Each Moon also has a totem animal. The traditional names of the days of the week are replaced by galactic names that describe seven primary plasmas-electronically charged particles that activate our magnetic fields. The plasmas and their symbolic seals appear above the days of the week. The Gregorian calendar makes day/date calculations very difficult because the months are of uneven measure so the days and dates of the week vary from month to month and year to year. The Thirteen Moon calendar is truly unique because it is synchronized with the Harmonic Module, the measure of the universal 13:20 timing frequency.

THE HARMONIC MODULE

The basis of the Tzolkin or sacred 260-day count of the Maya, the Harmonic Module is the 13:20 synchronization gauge and permutation table that consists of thirteen sequences of twenty icons or solar seals and twenty sequences of thirteen galactic tones, 1-13. The resulting 260 permutations, combined with the perfect harmony of

the Thirteen Moon calendar, give each day a unique quality of tone and icon known as a kin or one NET minute. The two cycles-Thirteen Moons/28 days and the 260-day Harmonic Module-perfectly mesh every fifty-two years to complete one NET year. In one NET year of 18,980 kin, no two days are the same! Each of the units in the Harmonic Module is called a kin, the base unit of synchronic measure. Articulating the Harmonic Module is a pattern of fifty-two Galactic Activation Portals. See if you can find the radial sequence of thirteen sets of four, counting inward from the corners. Notice that the numbers of each set of four equals 28. Thirteen sets x 28 = 364, the number of days in the Thirteen Moon calendar! (See image containing the Harmonic Module on page 170.)

W AVESPELL

The thirteen-unit form constant of fourth-dimensional time is the wavespell. It is important to see the Thirteen Moon calendar in this modular format, Planetary Service Wavespell, for then it makes more sense to speak of the calendar as a synchronometer. The wavespell's form describes the motion of time as a fractal fourth-dimensional cosmology. The numbers 1-13 in the dot bar notation that code the thirteen positions are known as tones. The names of the tones in sequence define the cosmology, which is also evident in the very structure of the wavespell. The thirteen tones give their names to the thirteen Moons. The structure consists of two gates, the Magnetic and the Cosmic, the first and the thirteenth moons/tones, which correspond to the two entrance and exit gates or portals. Complementing the two gates are the two towers, the fifth or Overtone tower and the ninth or Solar tower. The two gates and the two towers, tones 1, 5, 9, and 13, articulate the structure of the wavespell. Between the places of articulation are three sets of chambers. The first set, tones 2-3-4, helps establish the wavespell; the second set, tones 6-7-8, helps extend the wavespell; and the third set, 10-11-12, serves to convert the wavespell. (See plate 2, Planetary Service Wavespell.)

The structure of the wavespell also defines a four-dimensional geometry of time that connects different points of the wavespell over time. Each of these dimensional geometries is known as a pulsar. It is useful to know the pulsars in extending the mind synchronically over different timing sequences. The fourth-dimensional pulsar connects the four points of articulation, 1-5-9-13, or Magnetic, Overtone, Solar, and Cosmic Moon/tones, and is called the fourth-dimensional time pulsar. The first-dimension life pulsar connects the positions 2-6-10, or Lunar-Rhythmic-Planetary Moon/tones. The second-dimensional sense pulsar connects the 3-7-11, or Electric-Resonant-Spectral Moon/tones; and the third-dimensional mind-form pulsar connects

the 4-8-12, or Self-existing-Galactic-and -Crystal Moon/tones. Remember, the wavespell accommodates any sequence of kin whose tones correspond to 1-13, and may be either a thirteen-day wavespell cycle, a thirteen-week cycle (one-quarter of an NET day), a thirteen-Moon cycle (one NET day), a thirteen-year cycle (one NET Season), and so on. Once you know the wavespell you have come to know the form in time of the noospheric mind.

THE WAVESPELL'S TONES AND THEIR PULSARS

1. Magnetic tone of purpose-fourth-dimension time pulsar
2. Lunar tone of challenge-first-dimension life pulsar
3. Electric tone of service-second-dimension sense pulsar
4. Self-existing tone of form-third-dimension mind-form pulsar
5. Overtone tone of radiance-fourth-dimension time pulsar
6. Rhythmic tone of equality-first-dimension life pulsar
7. Resonant tone of attunement-second-dimension sense pulsar
8. Galactic tone of integrity-third-dimension mind-form pulsar
9. Solar tone of intention-fourth-dimension time pulsar
10. Planetary tone of manifestation-first-dimension life pulsar
11. Spectral tone of liberation-second-dimension sense pulsar
12. Crystal tone of cooperation-third-dimension mind-form pulsar
13. Cosmic tone of presence-fourth-dimension time pulsar

DREAMSPELL

Described as the fourth dimensional tool kit, the Dreamspell also encodes a psycho-mythic cosmology known as the Journey of Timeship Earth 2013. It is this cosmology that makes the Dreamspell a psychoactive tool kit for personally engaging you in the fourth-dimensional synchronic order of time. The fundamental premise for making it psychoactive lies in finding your galactic signature, the color, icon, and tone that code your date of birth. This combination of factors-color, tone, and icon-establishes a mathematical code that allows you to use your galactic signature in mapping increasing orders of synchronicity. There are four colors, thirteen tones,

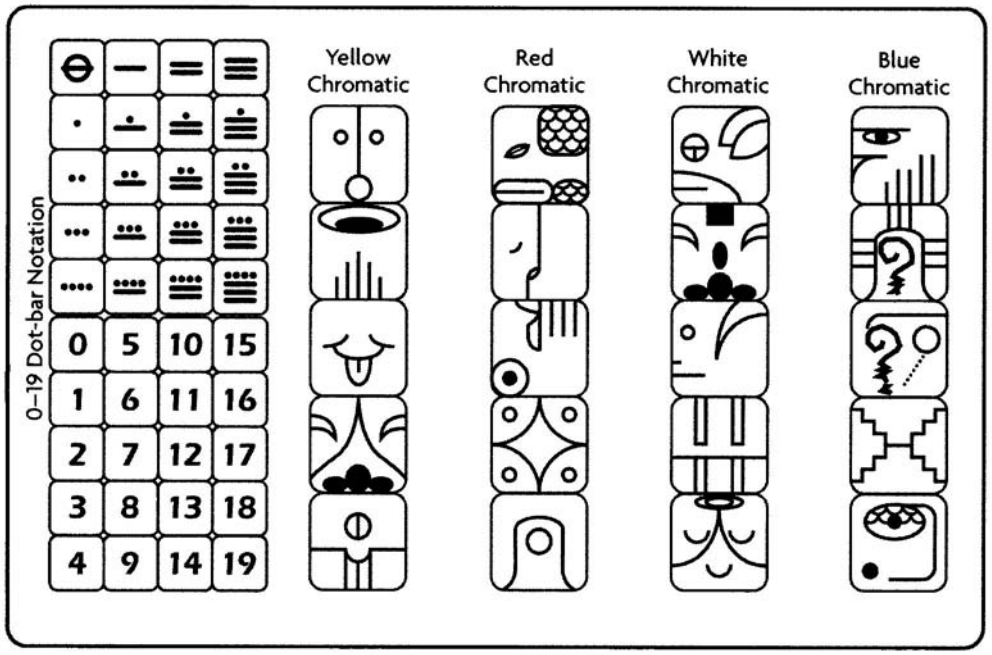

The Four Chromatics

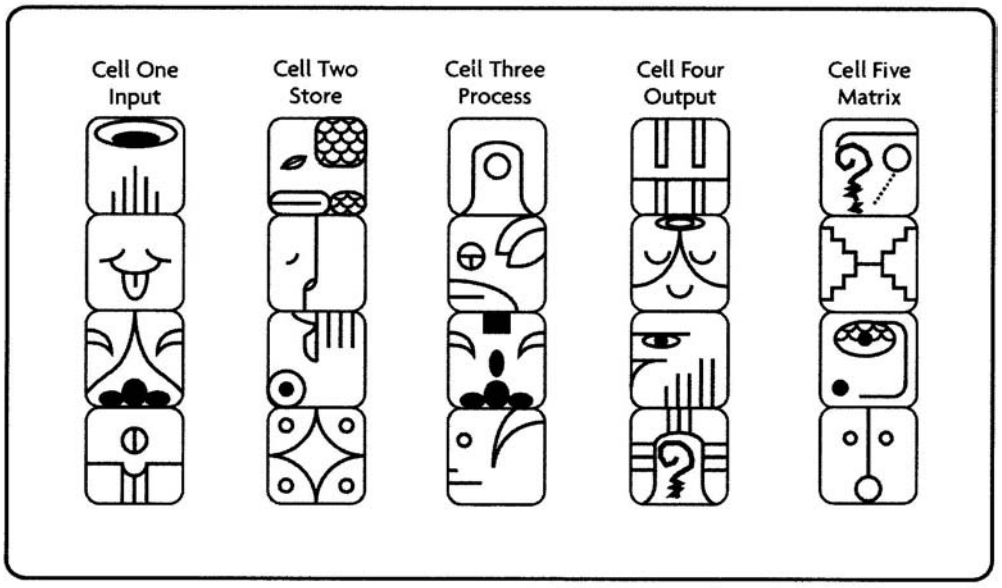

The Five Time Cells

and twenty icons. The four colors code each of five sets of icons and correspond to the base four-phasic function of the noospheric rainbow brain-red initiates, white refines, blue transforms, and yellow ripens. The icons themselves actually correspond to the mathematical code 0-19.

Colors and Icons with Their Corresponding 0-19 Code Numbers:

Red Family: Dragon (1), Serpent (5), Moon (9), Skywalker (13), and Earth (17)

White Family: Wind (2), World-bridger (6), Dog (10), Wizard (14), and Mirror (18)

Blue Family: Night (3), Hand (7), Monkey (11), Eagle (15), and Storm (19)

Yellow Family: Seed (4), Star (8), Human (12), Warrior (16), and Sun (20 = 0)

The mapping of synchronicity through use of the galactic signature is done through a set of tools: the Galactic Compass, Journey Board, Oracle Board, and Time Atom Cube. The point of engaging the Dreamspell is to learn of the infinite possibilities of fractal synchronic mapping of the events of your life and the lives of your family and friends, as well as current events and human history. The compass and boards describe the radial mathematics of fourth-dimensional time and also provide the means for fully engaging the synchronic order of the noospheric mind. The interactive complex of changing the family and clan relations to which the galactic signature entitles you also provides the basic patterns of social organization in time. The Dreamspell is indispensable for education concerning the radial, fractal nature of fourth-dimensional time and mathematics.

TELEKTONON

Meaning "Earth Spirit Speaking Tube," *Telektonon* is the name of the prophecy of Pacal Votan, and the definition of a complex program for establishing universal telepathy. It should be noted that the tomb of Pacal Votan was discovered in 1952, after 1,260 years, because of a tile tube, the Earth Spirit Speaking Tube, which ran from the top of the pyramid temple, down the secret stairwell, and into the wall of the elaborate tomb beneath the pyramid. The prophecy itself was decoded from the inscriptions and symbols of the elaborately carved sarcophagus lid of the tomb. Essentially defining a period of "Seven Years of Prophecy," (1993-2000), followed by a 13-year Cycle of Creation (2000-2013), the Telektonon is practiced on a daily basis by means of a board and various moving parts.

The purpose of the daily play is to learn how to operate by a set of coordinates that define the nature of telepathic consciousness as the interplay of five circuits that connect the ten planetary orbits (the Asteroid Belt, remnants of the lost fifth planet Maldek, is included as one of these orbits). The key interplanetary connection is between Earth, the third planet, and Uranus, the eighth planet, which creates the third or biotelepathic circuit. The Earth-Uranus circuit constitutes twenty-eight steps and thus corresponds to the 28-day measure of the Thirteen Moon calendar. Between days 7 and 22, one is

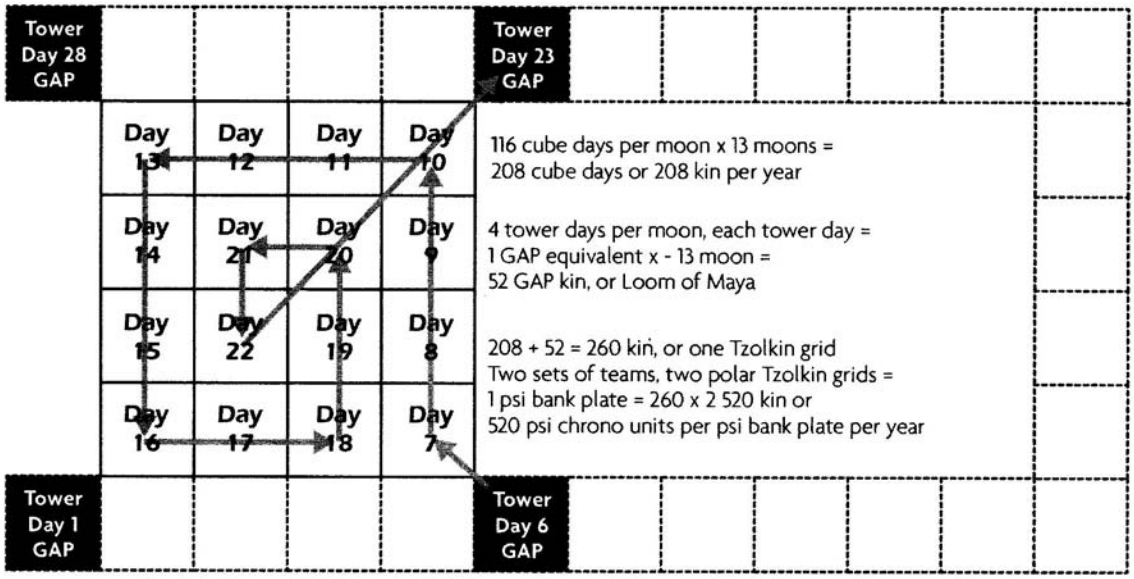

The Telektonon Grid: Showing Psi Chrono, Loom of Maya, and Cube Journey Correspondences

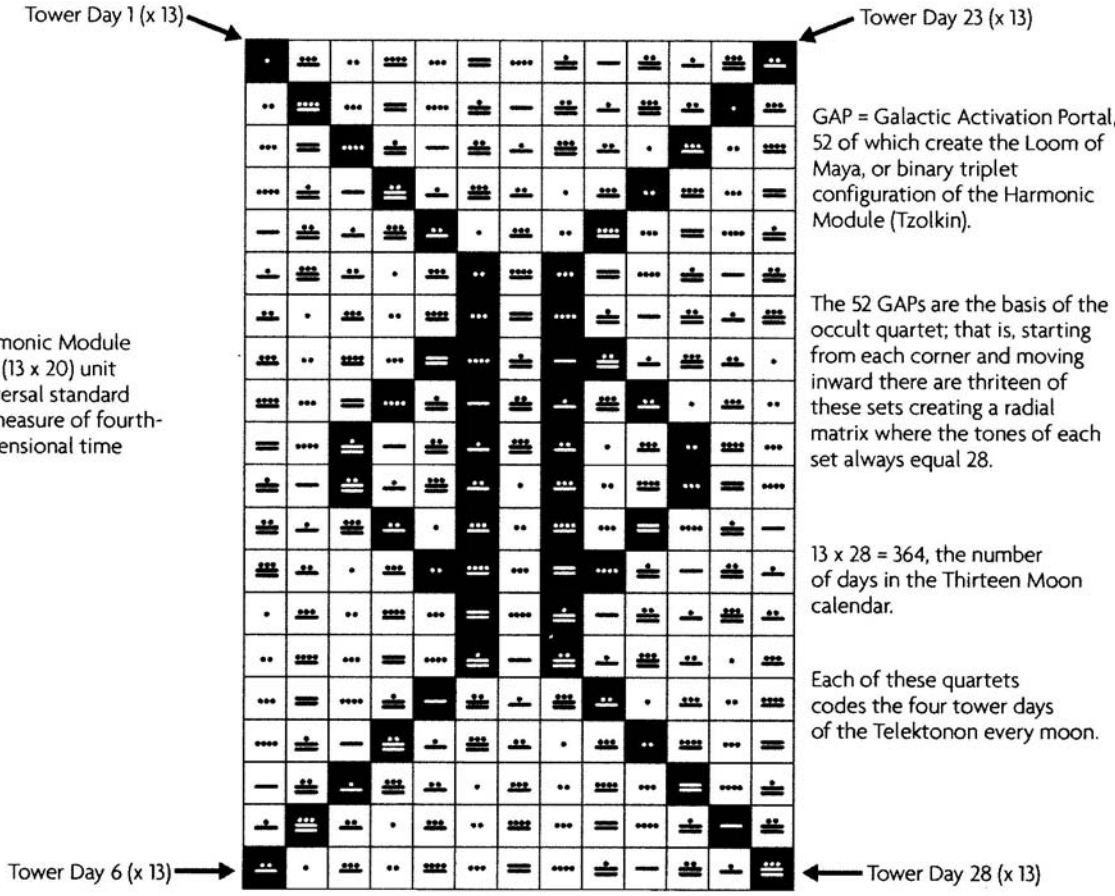

Telektonon - Rinri GAPs and Towers with Harmonic Module

able to take the "Warrior's Cube Journey" to uncover knowledge hidden by the Tower of Babel. The sixteen positions of the Cube of the Law (days 7-22) are the heart of the Telektonon play, which also includes a rehearsal of the thirteen baktun history with the intention of "redeeming the Babylon planet" as Timeship Earth 2013.

THE RINRI PROJECT

Described as a "four-year telepathic biosphere-noosphere transition Circumpolar Rainbow Bridge Experiment," the Rinri Project builds on the Telektonon play that establishes the biotelepathic circuit. On this circuit, two towers, days 1 and 6, define a four-day Earth Walk, and two towers, days 23 and 28, define a four-day Heaven Walk. Between the second and the third towers, days 6 and 23, are the sixteen positions of the Cube of the Law, days 7-22. The four towers every Moon correspond to one radial set of four Galactic Activation Portals in the Harmonic Module-thirteen moons x four towers = 52 Galactic Activation Portals (GAPs). Sixteen cube positions each moon x 13 Moons = 208, the remaining number of kin in the Harmonic Module once the 52 GAPs have been subtracted from the 260 units. Since the Harmonic Module is the basis of the psi bank, this formulation provides a way of coordinating the four psi bank plates of the noosphere to the Thirteen Moon calendar year on a daily and annual basis.

Since there are four plates, it takes four years, one year per plate, to open the psi bank. The first opening occurred between 1996-2000. The second opening, 2000-2004, is now occurring and is programmed by a coordination of the twenty-four runes of the Elder Futhark to the twenty-four psi membranes-6 runes per week every Moon x four weeks = 24. Since each psi plate is a mirror symmetry pair of Harmonic Modules, reflecting the North and South magnetic poles of the Earth, the Rinri project is practiced by telepathically interactive teams in the Northern and Southern Hemispheres. The Rainbow Bridge refers to making visible the dynamic of Earth's electromagnetic aura and extending it permanently from pole to pole. This is how the noosphere is visibly manifest.

Rinri is a Japanese word meaning "ethical enlightenment," and its application includes seventeen moral precepts that are studied during the sixteen-day cube journey, the seventeenth corresponding to the tower day 23.

260 POSTULATES OF THE DYNAMICS OF TIME

While the Telektonon is predicated on the fourth-dimensional tool kit, the Dreamspell, the 260 Postulates of the Dynamics of Time elaborate on the nature and theory of the biosphere-noosphere transition by providing a set of twenty systematic

thirteen-part logics that describe and define the dynamics of time as the evolution of consciousness. Because there are 260 postulates corresponding to the 13:20 matrix, a postulate can be studied and meditated on each day over a 260-day cycle according to the code number of the daily icon combined with the number of its tone, for example, Red Lunar Dragon, where Dragon is 0-19 code number 1, and Lunar is tone 2, therefore the postulate to study for the day is 1.2. This daily programming, established by the Telektonon practice is how knowledge is reformatted according to the synchronic order. This in itself precipitates the noosphere.

TWENTY TABLETS OF THE LAW OF TIME, SIXTEEN-YEAR CUBE OF THE LAW

The Twenty Tablets can be described as a road map of the fourth dimension. By focusing on a sequence between the years 1997-2013, by fractal analogies, the telepathic engagement encompasses the 26,000-year cycle as well as the coming cycle of the Psychozoic future. The crux of the daily play of the synchronic order is called *cubing the codon.* The point is to telepathically reharmonize the DNA that has been adversely affected by the 12:60 timing frequency. There are sixty-four DNA codons whose six-part binary structure is identical to that of the sixty-four hexagrams of the I Ching when both are written with a simple binary language of broken or unbroken lines. Each of the codons establishes a precise thirteen-stage permutation sequence. 64 x 13 = 832 codon permutations. The sixteen years from 1997 to 2013 also constitute 832 weeks (16 x 52 = 832 = 64 x 13). Therefore, each codon has one-quarter year, thirteen weeks, to run its permutation sequence, one sequence per week. Since each codon consists of six lines, each week the codon is built one line per day for six days, each line adhering to one side of a cube. On the seventh day, the codon is cubed and sealed by one of sixty-four "UR Runes." The UR Runes are the master cosmic runes, each of which governs an entire thirteen-unit codon permutation sequence. The Twenty Tablets also contain much synchronic information for experiencing what is referred to as *fractal time compression,* the expanded mental ability to engage in different planes or levels of time simultaneously. All of this is to establish a mind training for fully engaging the fourth-dimensional synchronic order of reality and time travel.

7:7::7:7 TELEKTONON REVELATION

While the Twenty Tablets of the Cube of the Law synchronize the DNA Codons in all their permutations on a weekly basis over a sixteen-year cycle, the 7:7::7:7 Telektonon Revelation establishes the 28-day cycle as the basis for synchronizing

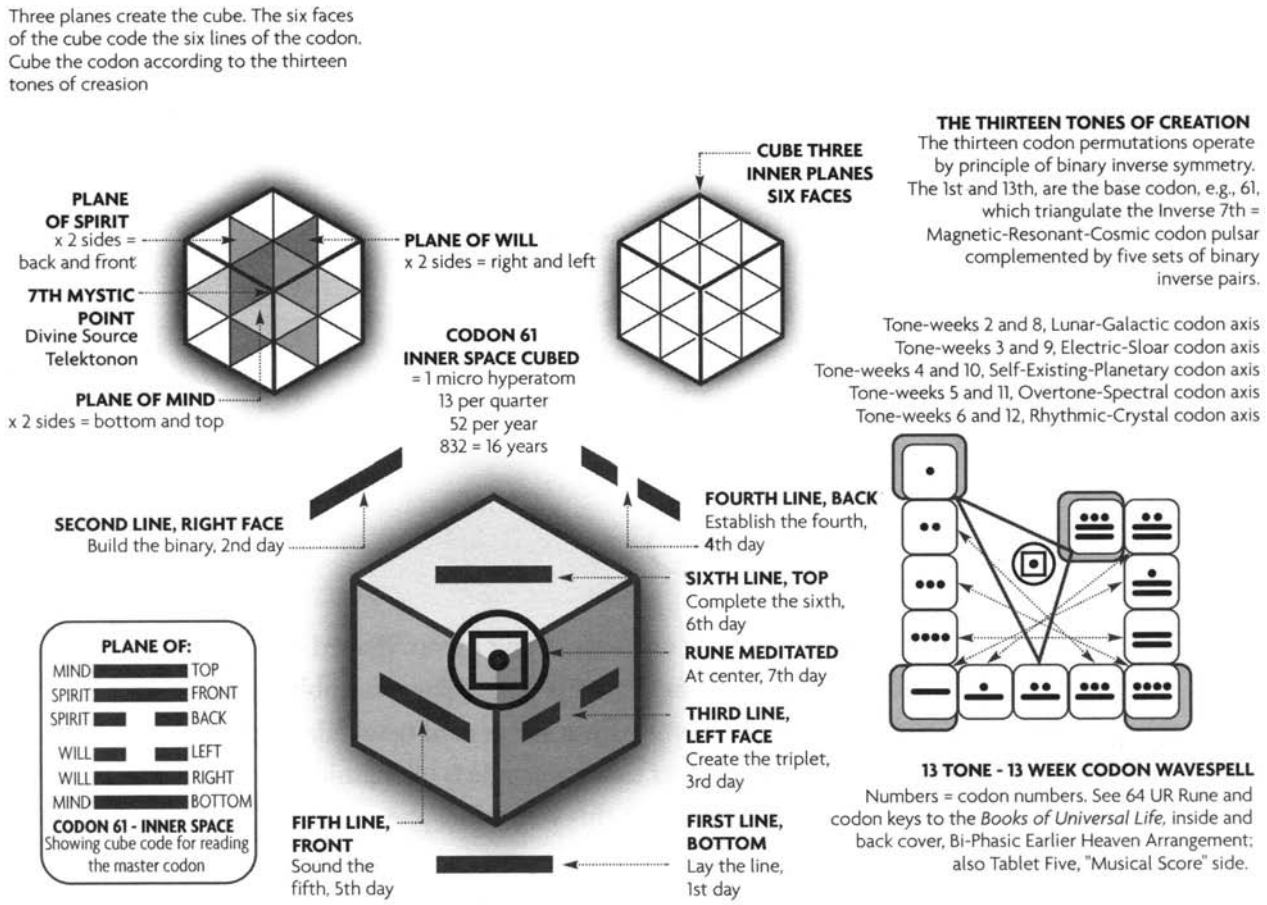

Codon Cube Cosmology
Sounding the Thirteen Tones of Creation

the seven primary plasmas-electronically charged ions-into four aggregates called time atoms. The seven plasmas, which also replace the names of the days of the week, are in two sets of three, with the middle or fourth acting as a catalytic agent. The first three plasmas form a sensory quantum and the last three plasmas form a telepathic quantum. Activation of the plasmas releases radion, a telepathic lubricant; hence, the seven plasmas are also referred to as radial plasmas. The four plasmic aggregates are known as the Analog Time Atom (week 1), the Antipode Time Atom (week 2), the Occult Time Atom (week 3), and the Unified Field Time Atom, (week 4). Like the Twenty Tablets, the 7:7::7:7 Telektonon Revelation also involves principles of fractal time compression where each day during the first week is the equivalent of 260 moons or twenty years; the following two weeks, each day is thirteen

The Seven Seals, Seven Radial Plasmas

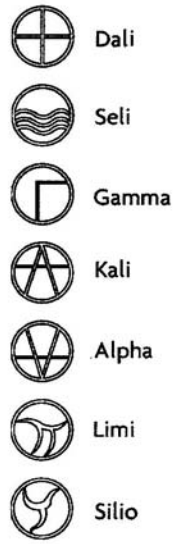

moons or one year; and the last week each day is one moon. Played on a board with cards containing affirmations from the Buddhist sage, Padmasambhava, the object of the 7:7::7:7 is to place the time atoms within the crystal octahedron at the center of the Earth so that each Moon a master time molecule is telepathically placed at the center of the Earth per one NET hour. In this way, Noospheric Earth Time is activated, the telepathic mind is engaged with the phenomenal reality represented by the plasmas, and the rainbow brain of the noosphere is hastened into everyday presence.

The seven daily plasmas constituting one thirteen-moon week, or one NET quarter hour are:

Dali (Sunday)-thermic charge

Seli (Monday)-luminic charge

Gamma (Tuesday)-luminic-thermic charge (these first three create one sensory quantum)

Kali (Wednesday)-luminic-thermic, thermic-Iuminic catalytic agent

Alpha (Thursday)-double-extended electron at the South Pole

Limi (Friday)-mental electron at the North Pole

Silio (Saturday)-mental electron-neutron at the center of the Earth (these last three create one telepathic quantum)

Part II. The Peace Plan: Establishing the *Pax Cultura, Pax Biospherica*

From the time of the formation, or rather, the calling into existence of the World Thirteen Moon Calendar Change Peace Movement, there had to be a *World Thirteen Moon Calendar Change Peace Plan.* The original of this Plan was submitted to the United Nations in 1995 for its fiftieth anniversary. The crux of the Peace Plan is that to change the world standard calendar is the opportunity for humanity to stop in its tracks and redirect itself. By stopping in its tracks to change its timing frequency, humanity can also use the opportunity to call a universal cease-fire and declare an emergency peace worldwide. Only in this way can the new time be experienced and fully engaged.

At the First Planetary Congress of Biospheric Rights (1996), this Peace Plan was extended to include the establishment of a new human covenant that would restore to humanity its intrinsic biospheric rights, the same as enjoyed by the rest oflife in the biosphere: free land, clean air, clean water. The premise of the Biospheric Covenant is that humanity is first and foremost a member of the biosphere, and not of any artificially constituted nation-state. The Biospheric Congress also mandated the revival of the Banner of Peace and Roerich Peace Pact (1935) as one of the emblems to be used to identify the biosphere as a zone of peace.

The World Congress on the Law of Time and Judgment Day Tribunal (1997) extended the Biospheric Congress to include an indictment of the Gregorian calendar as a crime against the biosphere-"the crime of the millennium"-and the establishment of the Law of Time, inclusive of the Twenty Tablets, as the new dispensation of knowledge awarded in compensation to humanity, based on the synchronic veracity of the Thirteen Moon Calendar Change Peace Plan.

By 1999, the World Summit on Peace and Time provided the Declaration of Calendar Reform and a set of People's Resolutions, which were presented to the United Nations and the Vatican. The Resolutions define a seven-part educational program, which, like the Biospheric Covenant, envisions a radical reorganization of human society.

The purpose of these documents and declarations is for the creation of a state of universal unconditional peace so that human society can be rebuilt as a harmonic unity in phase with the biosphere as a whole. The result of the Thirteen Moon Calendar Change Peace Plan would be the creation of a new order oflife on Earth-the *Pax Cultura, Pax Biospherica.*

9

The Advent of the Noosphere

A Prayer and a Vision

IT IS MORNING once again, or, rather, it is predawn. It is still the first watch of the day. Outside there is a full moon. On the Gregorian calendar it is November 1, 2001, All Soul's Day, the sequel to Halloween, the day of honoring the dead. In another two weeks it will be the New Moon of Ramadan, Islamic lunar year A.H. 1422. On the Thirteen Moon synchronometer itis now the fifteenth day of the Self-existing Owl Moon, the moon of form, the moon to define, measure, and ask the question, "What form will my service take?" Well, my service will be to complete this book and prepare it for the world, for now it is the time of the advent of the noosphere, the reality of which Vernadsky said must be communicated to the world's politicians and statesmen. They didn't listen then. WIll they listen now? And on the 260-kin synchronization gauge it is kin 42, White Electric WInd. The WInd "communicates spirit," the Electric tone "activates service." WInd is the second of twenty solar seals that code each day in the synchronic order.

By its mathematical relationships to the other nineteen solar seals, the solar seal of the daily kin possesses a unique five-part oracle. In today's oracle the WInd is guided by the World-bridger, who brings the power of death. In the psi bank, the matching psi chrono unit for today, the fifteenth day of the Self-existing Owl Moon, is kin 66, Magnetic World-bridger, the first tone in the 13-kin wavespell of the World-bridger, which means today is very strongly penetrated by the power of death. What is death to the noosphere? An inevitable and unavoidable event, a critical and

The 20 Solar Seals
Names, Actions, and Powers

equalizing stage in the recycling of biomass, a furtherance of the biogenic migration of atoms, the creation of biospheric compost, a release of consciousness back into the noosphere, an opportunity to consider the value oflife. But to the ordinary mind of the artificial technosphere, death is the ultimate object of fear, and the fear of death is the chief object of manipulation by those who generate terror. It is of note that by his date of birth, March 10,1957, the galactic signature of Os am a Bin Laden is White Solar World-bridger, kin 126, while for this, his forty-fourth year, his birthday was coded by kin 66, White Magnetic World-bridger, both signatures bearing the destiny seal of the power of death. This is an example of how the synchronic order is "read" on a daily basis.

It is a mistake to think that the terror is just the malevolent intention of a single human being. The terror is co-extensive with the technosphere. In fact, the technosphere is the age of terror. The terror was generated at Hiroshima, and repeated at Nagasaki fifty-six years ago. And the terror was compounded by the original perpe-

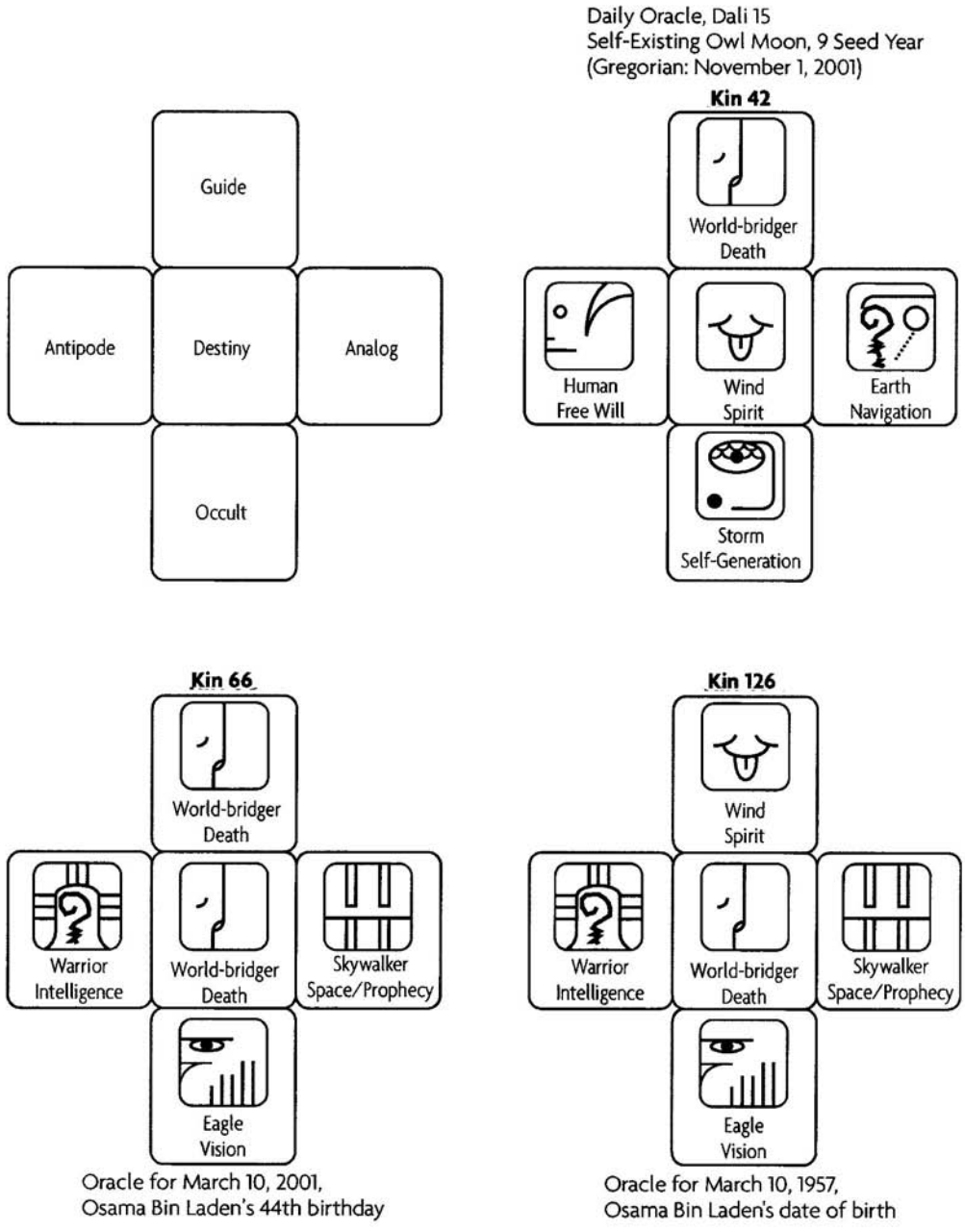

Daily Oracle Matrix

trators of that terror many thousands of times over in the creation and stockpiling of weapons of mass destruction, an act soon imitated by the then archrival, the Soviet Union, and by other nation-states, namely, the United Kingdom, France, and China. Those called the "terrorists" today have nothing to compare to the stockpiles of these weapons by these five nation-states who constitute the permanent members of the United Nations Security Council-the "nuclear club." That is who rules the world today, the official possessors of the weapons of mass destruction, who jealously guard their secrets. If this is the ultimate ruling body of the planet, and the reason why they are the ruling body is their possession of these instruments of death, then why should anyone be surprised at the existence of "terrorists" in the rest of the world? And why, we may ask again, are these terrorists mostly, it would seem, from the Islamic world? In addition to the nuclear arsenals, there are the biological and chemical weapons of mass destruction. Those who live by the manufacture of terror must surely die by their own means. If other nations have developed the same systems of terror, it is only in self-defense or in imitation of the masters of terror.

Everyday for four weeks now, I have been waking up at this time to continue work on this text, *Time and the Technosphere*. I had at first thought that the book could be complete with eight chapters. People don't have time to read, and the topic warrants as brief and pithy an explanation as possible. After all, it is really a time of reflection-and then action. The masters of terror have cloaked themselves as the protectors of civilization and as the moral crusaders who will rid the world of evil. Yet what is civilization today but the resource-consuming cancer of the biosphere? Is this what is being protected-the right to promote the disease upon the biosphere? The terrorists who attacked the Twin Towers and the Pentagon clearly knew the symbolic and actual value of their targets. They also undoubtedly knew the depths of the death-fear of the superpower masters of terror, whose reaction would most likely foment a global war. But in such a war, who would win? In this regard, from the noospheric perspective, the Inevitable Event was the technocide-death by technospheric means-of the technosphere itself. The technosphere was created by and thrived on means of terror, and the means of massive terror as well as the economic imperialism perpetrated by the superpower managers of the technosphere could only have produced a reaction against itself known as terrorism. The end result is collective suicide. There are no flags in the blood of the dead, nor is there any evident religious belief. There is only human biomass ultimately indistinguishable and anonymous to the biosphere.

Eight chapters were needed in order to complete the information about the biosphere, technosphere, noosphere, and the Law of Time. Maybe a new spirit of the

biosphere will arise from the considerations of my book. Maybe the noosphere will spark in others the need to allow the biosphere to reclaim us from the technosphere. Anyone who says this is "turning back the clock" is only betraying their immersion and unexamined belief in the reality of artificial mechanical time. Yes, eight chapters were necessary to unfold this analysis and solution. But I knew there had to be a ninth chapter for the testament to be complete. For this is a living testament, and if anything has been learned by living according to the synchronic order of fourth-dimensional time, it is the renewed power of number itself. There is a power and meaning to number understood as a universal, self-existing mental construct. The synchronic order is constructed of number. And as Pythagoras perceived, number is a kind of spiritual entity that can only be aroused by an act of meditative contemplation. Each whole number bears its own resonance. You can feel this in the contemplation of the difference between even and odd numbers.

The resonance of 8, an even number, is harmonic order and balance, geometrically evident in the octagon or the octahedron. But the resonance of9, an odd number, is quite different. Nine months to give birth, three times three, a rhythmic triplicity-that is nine. The Germanic god-hero Odin, or Votan, spent nine nights hanging from a tree in order to gain knowledge of the mysteries of woman. When the tomb of Pacal Votan was opened on June 15, 1952, it revealed a large vaulted chamber beneath the pyramid of the inscriptions in Palenque, Chiapas, Mexico. Entering the tomb, in the center of which is the famous sarcophagus, one sees on the walls the beautifully sculpted figures of nine personages. Today these sculptures have almost completely worn away. But originally, these low-relief sculptures modeled out oflimestone, depicted with great elegance, a series of figures commonly known as the Nine Lords of Night, or the Nine Lords of Time. Are the Nine Lords of Time, the Lords of Night who guard Pacal Votan in his tomb, the same as the nine nights of OdinIVotan? And who was Pacal Votan? With what mythic resonance are we dealing?

Nine Lords of Time Begin to Gather for a Council of the Earth

A Mayan seer, a sage-king of the seventh

century of the Christian era, had deliberately created a mysterious tomb for himself, only to have it hidden, buried beneath a pyramid temple, but a tomb intended to be opened more than twelve centuries later, in the seventh year of the time of the terror, the time of the technosphere. How ingenious, how uncanny, that it would have been unknown for 1,260 years-a number also known in the thirteenth chapter of the Book of Revelations as the number of days of exile of the woman clothed with the sun, her feet on the moon, and twelve stars around her head. What does this allegory mean? Is it not the same as the exile of the human soul in the deadening world of 12:60 materialism? Sixty years remained from the opening of that mysterious tomb to the closing of the cycle of history, the omega point of 2012. How could the timing of the opening of the tomb have occurred so precisely-1,2 60 years from dedication to discovery, 1,320 years from its dedication to the closing of the cycle? How could those years be such a perfect reflection of the artificial 12:60 and the natural 13:20 timing frequencies? How could a Mayan sage in Central America so long ago be able to see, it would seem, into our future?

When we study the globe and consider things synchronically from the perspective of the noosphere, we find some interesting correspondences. Pacal Votan lived in the tenth baktun cycle, between the Christian years 603-683, on the opposite side of the world but at almost the same latitude as Mecca, and just after the time of Muhammad, 570-632. Today the religion that God commanded Muhammad to found, Islam, is at the center of the terrorist storm, while the prophecy of Pacal Votan and of the Mayan calendar in general has placed the end point of history at 2012, a mere eleven years after the Inevitable Event that placed Islam at dead center of the world mind. How could this be, the religion of the prophet Muhammad and the prophetic timing of the Maya so close at hand? Is this some revelation of the Nine Lords of Time, or of God speaking through them-and who are the Nine Lords of Time? Are they destined to return? Could it be that the Nine Lords of Time, like some higher dimensional Lords of the Ring, are a manifestation of time to be released, one by one, in an annual sequence during the last nine years of the Great Cycle, 2004-2013?

These Nine Lords of Time are known in Mayan as the Bolontiku; their counterparts are the Oxlahuntiku-the nine lords and the thirteen lords, respectively. The nine lords govern the underworld, the time of the third dimension, which is why they are depicted in descent to the sarcophagus of Pacal Votan, while the thirteen lords govern the heavenly realms. The nine govern the nine vigesimal orders of number, while the thirteen govern the form of time. The dedication of the tomb of Pacal Votan in A.D.692 corresponded to the Long Count baktun date of9.13.0.0.0.

The nine and the thirteen lords-Bolontiku and Oxlahuntiku-are present in the very numbers of the dedication date. And the nine and the thirteen also governed the prophecy of Quetzalcoatl, of Thirteen Heavens of decreasing choice and Nine Hells of increasing doom. This prophecy refers to the sequence of twenty-two 52-year cycles that began in A.D. 843 and ended in A.D. 1987. Six years later, in 1993, during the first year of the 260th and final katun cycle of history, I began to decode the prophecy ofPacal Votan, some forty-one years after the tomb had been opened.

Telektonon, the Prophecy of Pacal Votan, was meant to be decoded precisely and only at the moment of its absolute usefulness, kin 144: Yellow Magnetic Seed, July 26, 1993. This moment defined the Seven Years of Prophecy, 1993-2000. It also established the validity of the Dreamspell or WIzard's Count as the reformulated Year- Bearer Count of the Chilam Balam, the jaguar priests or night seers. That is, the Telektonon Prophecy could only have been triggered when kin 144 occurred as the Year Bearer, Yellow Magnetic Seed, kin 144, correlated to the Gregorian date of July 26, 1993.

The precise revelation of this prophecy on kin 144, July 26, 1993, was dependent on and could only have occurred because a prophetic count, the WIzard's Count, derived from the prophetic tradition of the Chilam Balam, had already been established. This "count" provided the basis of *The Mayan Factor* and was woven into the conclusion of the Prophecy of the Thirteen Heavens and Nine Hells, Harmonic Convergence, August 16-17, 1987. And the precise number of kin 144, the revelation date of the prophecy of Pacal Votan was meant to accord with the Book of Revelations number of the elect, 144,000 (Revelations 7:4). In fact, that very day I discovered that the number 144 transliterated from the vigesimal count into Arabic numbers is written 7.4, which is the same as the chapter and verse number where the 144,000 are first mentioned in the Book of Revelations (7 = 140, or 7 x 20, plus 4 units = 7.4). More uncanny stuff-but not so to the noosphere, the Earth's mind of time. In the noosphere everything is woven of number, and number is intrinsically synchronizing, which is why numerology has held such a fascination for the human mind throughout history.

When I first began to decode this "final prophecy of the Maya," or Telektonon, a prophecy that commands the return to natural time through the Thirteen *Moon!* 28- Day calendar, I was stunned and not a little frightened. I had already taken many steps to remove myself from mainstream society and conventional life. But now I was dealing with a genuine prophecy, and I was to be its messenger. This was not my invention. The world is filled with enough madmen and lunatics spouting their particular visions. How could I ever make the world understand that this vision, this prophecy, was real, that it was the fulfillment of a Mayan who lived and died thirteen

Vinal position, one dot = 20 kin, 7 = 140 (7 x 20)

Kin position, one dot = 1 kin, 4 = 4

Written 7.4 = 144 (140 + 4)

7.4 = 144

centuries ago, and that his tomb was the vehicle of this prophecy, a prophecy meant precisely for this moment in time-the biosphere-noosphere transition?

I returned to the texts of the Chilam Balam, whose prophetic stream includes day prophecies, year prophecies, katun (twenty year), and *ahau* (260-year) cycle prophecies, prophecies of Quetzalcoatl, and finally the special prophecies of the mysterious Antonio Martinez and the coming religion of the Hunab Ku, "One Giver of Movement and Measure." I realized that the meaning and fulfillment of this entire prophetic stream was crystallized in the Harmonic Convergence and its 26-year aftermath. Chilam Balam, the jaguar priests, are the wizards of time, inspired by the guidance of the Bolontiku, the Nine Lords of Time, the Lords of Number. By command of the Supreme One (Hunab Ku), the wizards are directed to establish clear paths of rekindled knowledge. The ancient Maya prophesied their own destruction. Therefore, within the prophecies of the Chilam Balam they laid the seeds of their reconstruction-but not simply as Maya. The reconstruction had to be planetary, for their destruction in the sixteenth century was also an act of planetary consequence-the plunging of the entire world into the prison of artificial, mechanized time. The fulfillment of the prophecies along with the new dispensation of time had to occur before the end of the cycle, 2012.

For this reason, the master synchronic architect of the Mayan prophets, Pacal Votan, prepared the way with the discovery of his tomb in 1952. This phenomenal act of prophetic release meant that now the messenger of his prophecy of time had to be summoned to his task. This was to be my role and responsibility-one that I accepted, for I saw no other choice. The course of my life from the moment I had experienced an illumination atop the Pyramid of the Sun at Teotihuacan in 1953, to that moment forty years later, in 1993, when I first perceived that the meaning of the prophecy Telektonon was a single trajectory. The noosphere had found another chip. After all, if the noosphere is the mind of time on Earth, prophecy is just another way of radializing time, of bringing it around from one point in a cyclic motion to another. My preparation had been going on for a while.

Once I had received knowledge of the prophecy of the Thirteen Heavens and Nine Hells from Tony Shearer back around 1970, I prepared myself by study and meditation for the moment of the Harmonic Convergence. It may be asked: If the Harmonic Convergence concluded the cycle of the Nine Hells, then why are we experiencing the

apocalyptic events of Hell on Earth now, some fourteen years later? What was the actual meaning of the Harmonic Convergence, and what does it mean for us today?

First of all, the Harmonic Convergence refers to the entire 26-year cycle from White Galactic WIzard to Yellow Galactic Seed, 1987-2013. The conclusion of the Ninth Hell refers to the release of humanity into the 26-year time zone of free will, choice, and decision in preparation for the completion of the cycle, omega point 2012, and the Galactic Synchronization, 2013. The full and true Harmonic Convergence will not be complete until the Earth itself becomes the Galactic Seed, 2013. If the twenty-six years are the free will zone of choice and decision, what are we to choose and decide? The choice is, as I was quoted in the *TVtllStreet Journal* in 1987, " between a 'new age' and all-out destruction." The decision is to accept the knowledge of the error in time (12:60) and the choice is to return to natural time (13:20) by means of the Thirteen Moon!28-Day calendar. This the prophecy ofPacal Votan fully affirms.

In principle, the Harmonic Convergence refers to the converging of all aspects of reality in a great, all-unifying harmony. The initial moment of the Harmonic Convergence that witnessed hundreds of thousands of humans congregated at sacred sites worldwide at the dawn of August 16, 1987, Blue Electric Eagle, was a pure prophetic enactment of humanity being harmonically converged with the natural order of time. This visionary moment demonstrated that, indeed, Harmonic Convergence was possible. The wave of unconscious energy released through the collective psyche of the species as a result of this moment of prophetic purity reached a climax with the fall of the Berlin Wall and the end of the Cold War.

Early 1990, the role of the Harmonic Convergence in this process was echoed in the mass media as the question, "Did the Harmonic Convergence bring the world closer to peace?"l Before the question could be answered, the next phase of the prophetic end time began to unfold. Rather than determine how to make the choice to enter a genuine new age, the human race defaulted to an absolute materialism. It was this collective turn taken by the planetary leadership, now known as the G-7, that engendered the apocalypse we are now witnessing. In this turn, the Harmonic Convergence was forgotten, deleted as it were from the official public texts of contemporary history. The stage was thus set for the next revelation, the Telektonon of Pacal Votan.

In distinguishing the Seven Years of Prophecy, 1993-2000, Magnetic Seed-Resonant WIzard years, the Telektonon of Pacal Votan makes an absolutely clear analysis of the human condition at this time: unless the human race forsakes the false time governed by the instruments of the Gregorian calendar and the mechanical clock by the year 2000, then it will face its own destruction, biospheric collapse, and Hell on Earth. But ifby the year 2000 it can make the decision to reject the calendar of the false

12:60 time and adopt the perfect instrument of the natural 13:20 time, the Thirteen Moon!28-Day calendar, then humanity will have been able to make the choice of entering a new age. For the new age, so longed for, is actually only realizable as a new time. A new time can only come about by the rejection of the instrument that holds in place the hallucination of the old time, replacing it instead with an instrument of such perfect harmony that it has no history, but is truly post-historical.

For this, the messengers of time, myself and my wife, embarked on a course of being galactic gypsies, with no visible means of support, in order to warn the world of the meaning of the time and to offer to the world the opportunity of changing its course by changing its calendar. When the year 2000 rolled around, humanity remained unmoved. The Gregorian calendar, the Vatican, and the G-7 appeared to be as strong as ever. The prophecy did not fail, but humanity did fail to heed the message regarding artificial and natural time. In this process, as "messengers" my wife and I were only playing out an archetypal role. So beginning with the Blue Galactic Storm year, July 26,2000, thirteen years after the White Galactic WIzard year, humanity was placed in judgment. This is merely a matter of natural karmic law.

The four-year cycle, 2000-2004, became known as the prophetic cycle of the Harrowing of Hell. Just as Jesus was crucified and then experienced the Harrowing of Hell before his resurrection, so too humanity has been crucified on the technospheric cross of false time, and is now in the Harrowing of Hell awaiting the resurrection in natural time. For having failed to take seriously all its messengers and all its prophets of all times, humanity was now to pass en masse through hell. Since the Galactic Storm year, 2000-2001, completed a Seed-Storm Year bundle begun in the fifth year of prophecy (1997-1998), the 2000-2001 Blue Galactic Storm year was the year of evaluation. The full judgment was withheld until the Solar Seed Year, 2001-2002.

The Solar Seed year is the second year of the Harrowing of Hell, but the first year of the next four-year Seed-Storm Year bundle. The first half of the Yellow Solar Seed occurs during the second half of the first official year of the third millennium, 2001. The moment was now ripe for the Inevitable Event, for it was also the same Gregorian calendar year as 1945 and 1973. In the Telektonon Prophecy, verse 120, section 19, it is declared, "When the Lunar Moon has overflowed its banks, the G-7 will be no more." So it was on the twentieth day of the Lunar Moon (Blue Self-existing Monkey, galactic signature of Karl Marx), that the Tower of Babel, the World Trade Center, was struck a fatal blow, while the Pentagon, magical structure of the priests of the Dark Lords of Matter, built in "Hell's Bottom," Arlington, Virginia, during the Ninth Hell cycle, was mortally penetrated.

It is still the time of the Harmonic Convergence. The Harrowing of Hell

represents the last cycle of respite for humanity. By July 26,2004, Blue Crystal Storm, humanity must make the "choice between a 'new age' and all-out destruction" when it will have the last opportunity to make the decision of rejecting the old time and calendar and replacing it altogether with the instrument of perfect harmony, the Thirteen Moon!28-Day synchronometer. Only such a harmonic organizing principle, universally accepted and applied, can ensure a time of harmony and the fulfillment of the Harmonic Convergence.

Is it possible that within the noosphere the Harmonic Convergence is awaiting its next climax on the Day Out of Time and the Thirteen Moon Synchronization date of the year 2004, that is, on Gregorian July 25 and 26, 2004? One reads through the *Journal of Calendar Reform* and the many texts and arguments for calendar reform that were put forth in the 1930s and feels the missed opportunity. Even Gandhi was in favor of a new universal timing standard as a principle means of unifying humanity in peace. Did World War II occur because the League of Nations failed to enact the calendar reform on January 1, 1933, as it had fully proposed? The League of Nations had promoted calendar reform as one of its major agendas since the 1920s. This world organization failed at calendar reform and at preventing World War II. Who or what prevented that reform from happening, and why?

Let us look at the matter again. In order to remain constant, any perpetual calendar ordered by the seven-day week requires the principle of a null day, a Day Out of Time that is no day of the week at all. This was a feature of the preferred Thirteen Moon!28-Day calendar proposed by the International Chamber of Commerce, as well as the other modified calendars of twelve months. Reading through archives and literature, pro and con, it is clear that what defeated the calendar reform was the conservative, Vatican-inspired objection to the null day, the Day Out of Time. To observe such a day, which is no day of the week at all, it was argued, would break the weekly succession of days set in motion by God at the beginning of creation-such a break would plunge the world into barbarism, chaos, and war. "The adoption of the weekly cycle was a triumph of Christianity to the detriment of paganism. The cult of Christianity is inextricably connected to the week whose origin reaches to the dawn of history. "2 Therefore, it was contended, to interrupt this weekly succession would destroy Christianity itself. As a result of such propaganda, the League of Nations faltered, no calendar reform occurred at all, and the world was plunged into war-a war that ended with the beginning of the age of terror. This terror is now running its course, like a fever sweeping through the biosphere. WIll it be possible to consider again what the League of Nations faltered on and what the United Nations simply chose to ignore?

Who really lost out when the calendar reform issue was tabled in 1956 at the United Nations? It was not God who invented the week as we know it, but more likely the Babylonians. Behind the week is the mystery of the whole number seven, recalled in the Epic of Gilgamesh as the seven wise men ofU ruk. But the Babylonians clothed the seven-day cycle in the raiment of the sun, moon, and five principle planets-Mercury, Venus, Mars, Jupiter, and Saturn-to which the days of the week have no actual relation. Seen in this way, the seven-day week was intended to be a means on Earth for reenacting some remote mythic reality related to these seven heavenly bodies. What was that mythic reality, on what hidden knowledge is the count of the seven-day week presumed? Borrowing from Babylon, the ancient Hebrews incorporated the seven-day week into their purely lunar calendar. And it was thus from the Hebrews that the seven-day week entered the Julian and then the Gregorian calendars. It was not, however, the Romans who adopted the week, but the Christian successor to the Roman empire, the Church of Rome. What truly was the origin of the week? And what relation or meaning does it have in the first place? Even to F. H. Colson, a Christian scholar writing as late as 1926, the seven-day cycle is described as "that intruder the week, consisting indeed of a fixed number of days, but paying no regard to months or years."3

With its fixed number of days, the week makes sense only in a system of time reckoning that is synchronic rather than astronomical in nature. To those whose minds are set on the synodic lunation cycle as the absolute standard, as does the Gregorian calendar, the week is what ensures the greatest disorder in the calendar-and yet it is defended to the death. The week gains its power from the whole number 7, and not from the jumble of names in which the week is clothed. The seven-day cycle is the closest whole number that corresponds to the four phases of the moon, which, as whole numbers, are also seven days each. In fact, the fixed 7-day cycle only makes sense within the context of the Thirteen Moon calendar with its 28-day cycles divisible by four and seven, creating the annual cycle of fifty-two perfect weeks-plus the Day Out of Time, ensuring a perpetual harmony.

Was the Babylonian naming of these days-with only one name a reference to the moon-meant to be a cover-up of some earlier knowledge, a knowledge both more purely lunar and harmonic, such as the Thirteen Moon calendar? Is all of history, then, just based on a cover-up of harmonic time? What would really happen if there were a Day Out of Time, no day of the week or month at all? Would old belief systems dissolve? Would there be a psychic release, a sense of freedom? Since 1993, sixty years after the failure of the League of Nations to enact calendar reform, the Thirteen Moon Calendar Change Peace Movement has made certain that the

Day Out of Time is the day for forgiveness of debts, of release into timelessness, and for experiencing the full meaning of time is art. This day is now annually celebrated worldwide by increasing numbers of humans. All the while, the Gregorian world has arrogantly plunged blindly forward, locked into its mechanistically chaotic timing sensibility, only to receive the mortal wound of the Inevitable Event, causing it to fall through the seams of its own making, the technosphere. A Day Out of Time, it seems, might be a relief to a world now consumed by chaos, barbarism, and war.

> He sends down from the sky water for your drink and to grow trees for your benefit. With it He grows for you crops, olives, date palms, grapes, and all kinds of fruits. This is sufficient proof for people who think. And He commits, in your service, the night and the day, as well as the sun and the moon. Also, the stars are committed by His command. These are sufficient proofs for people who understand. (Quran, 16:10-12)

Yes, the biosphere is a set of proofs for people who understand, an immense order that reflects and transforms the cosmos through the very process of life on Earth. Who are the people who understand, and where are those people today? Who will speak for the biosphere? Who will take the message of the advent of the noosphere to the statesmen and the politicians that they may take heed and note that what is occurring is not really in their control at all, but is the climax of a phenomenal process known as biogeochemical combustion? And who will declare that this climax will inevitably shake all the towers to their foundations and level the mountains of industry to a flat plain from which the noosphere will manifest as the equality of telepathy for all?

This book, and this ninth chapter in particular, is like a long meditation, a vision, inspired by the dark tragedy of the Inevitable Event. As a vision, these thoughts are both those of one solitary individual, albeit a noospheric chip, and the continuation of the vision of that ancient seer, Pacal Votan. Could it be that Pacal Votan in his time knowledge rehearsed all these words, these thoughts, this entire vision itself? On the sarcophagus lid of Pacal Votan is a cross, not the cross of death as in Christianity, but the cross oflife, a tree, a cosmic tree. Across that tree is a serpentine band with two dragonlike heads, one at each end. This band represents the galaxy. The head at each end represents the galactic vision that sees equally into the past and the future. Sometimes this is called the *zuvuya,* the reflex of cosmic memory. The entire galaxy, the Milky Way, is this reflex of cosmic memory. What if all of humanity is meant to be opened into this cosmic memory? This is what is meant by the advent of the noosphere, the mind of time on Earth, the mental envelope of planetary con-

sciousness arising from the grave crisis of the biosphere through which we are now passing at this very moment.

Because we are now defining the noosphere does not mean that the noosphere was not known to those ancient Mayan time scientists like Pacal Votan, especially if the noosphere is defined as the mind of time on Earth. To such time scientists a NET year would be no time at all, or rather, it would be but a single, fifty-two solar orbit rehearsal of life. How many such rehearsals would be necessary before something was finally learned? The Prophecy of Thirteen Heavens and Nine Hells, for instance, was actually just the passage of twenty-two NET years. Is this how long was needed to see if the human race would learn anything? And if Pacal Votan and Muhammad were around today, what would they think and do?

Knowing the nature of the synchronic order of time, someone like Pacal Votan, obviously one of the most singular of all personalities of the Mayan world, would have possessed a consciousness like the two-headed galactic band, the consciousness of galactic memory. In the zuvuya of galactic consciousness, peering into the deep past is peering at the present from the future. This is possible in the radial time of the fourth dimension freed from the strict linear construct of past-and-future-time. From some higher state of mind, from a mind and consciousness identified completely with the galaxy, this has all been foreseen, this has all been written in a book. Now we who are in this present state of end-time consciousness are being asked to self-reflect. We are being asked if we can manage to hold the noospheric lens steady enough to see that the technosphere had to end, and that the technosphere could only end by the means by which it maintained all of the biosphere in its control, by terror itself.

Yes, we are all a bit like the frog at the bottom of the well whose vision and perception of the universe is circumscribed by what the opening of the well allows it to see. The well is the technosphere, both as a planetary apparatus and as a belief system. On the other side of that well is a vast world that we have actually never seen. This vast world is the noosphere and beyond. And what is beyond? Many of the traditional peoples say that we originally came from the stars. If we came from the stars, are the star people still out there? And what do the star people think of all that is happening on Earth today? And what do they think of their lost star children, many of whom now believe it is childish to think that we came from the stars? And if there are star people still out there, wouldn't they be too sophisticated to think they could get anywhere in a rocket ship, or even a UFO, subject to the entropic degradation of the material plane?

No, they wouldn't rely on such primitive technology, but would be in tune, as is the rest of the universe, with the universal frequency of synchronization and the

capacity of time to travel at an infinitely instantaneous rate of transmission. This being so, we could receive telepathic messages from the star people-if we were ready for it and knew precisely why, when, and how such communication occurs. In fact, as we have said earlier, the noosphere is the region on Earth for the receipt and transmission of messages of cosmic consciousness. This being so, the future of human evolution, of *Homo noosphericus,* would be nothing less than to become a medium of cosmic consciousness, adapting to the expanded measure of Noospheric Earth Time, traveling back to the stars but through the superior knowledge of the actual laws of time.

In writing this book, I have only a sense of duty, of responsibility to expand the vision of my fellow earthlings from the technosphere to the noosphere. In the Law of Time there are no arbitrary distinctions between reason and art, science and prophecy. The universe really is a giant radio transmitter. This book is as much an exposition of matters generally not thought about, as it is a personal testament and vision. In that regard this text is a portion of a broadcast transduced and received by me functioning as a noospheric chip, on behalf of the biosphere-noosphere transition.

In the tomb lid ofPacal Votan are impressed all the frequencies of this broadcast transmission called *Time and the Technosphere.* I know that Pacal Votan took an earthly form for just this purpose. He left his body in that tomb, a jade mask being the actual impression of his face. According to Chinese and ancient Mexican tradition, jade is the stone of immortality. Was Pacal Votan an immortal? Where did his consciousness and spirit go once his body was placed in the sarcophagus? Why did he leave the Telektonon, the Earth Spirit Speaking Tube, running from the tomb to the temple floor at the top of the Pyramid of the Inscriptions? Knowing the frequency of the synchronic order governing the psi bank of the mental envelope of the Earth, did he place his thoughts in the noosphere to be released at the precise moments of the opening of his tomb and the decoding of his prophecy? And then where did he go?

Beginning in 1980 I became conscious that, from time to time, I had been receiving telepathic transmissions. I soon identified these transmissions as coming from the star Arcturus. In *Earth Ascending,* originally written in 1983, the nature and program of the psi bank, the control panel and regulating mechanism of the noosphere, became known to me. This was followed by *The Mayan Factor,* and then the decoding of the Law of Time. At the moment when I had just finished writing *The Mayan Factor* in 1986, I received the inspiration for what is called the planet holon, the twenty-part structure accommodating the program of the twenty solar seals. When I received this image it was known to me as the program of the Arcturus Protectorate. As I understood it, the Arcturus Protectorate was established by the "star people" as a kind of protective time shield around the Earth. By means of the activation of

this time shield, the star people would know that some of the earthlings were waking up to time and beginning the conscious activation of the noosphere. This is exactly what came about through the *Dreamspell,* beginning in 1990.

The *Dreamspell* is such a radical break from the past, and such a pure statement of the history-less fourth-dimensional future, that in order to comprehend it, in 1992 I wrote two other books, one called the *Arcturus Probe: Tales and Reports of an Ongoing Investigation* and the other *The Call of Pacal Votan: Time is the Fourth Dimension.* Some people will say that the *Arcturus Probe* is an exaggerated fantasy, yet I cannot deny what a purely telepathic process it was to write that book, which fills in many points of the psychomythic cosmology of *Dreamspell: The Journey of Timeship Earth 2013. The Call of Pacal Votan* was originally titled *A Treatise on Time Viewed from its Own Dimension,* and is a purely scientific description of the mathematical codes of the Dreamspell in relation to the biosphere-noosphere transition. The one text purely imaginal, the other purely rational, yet both were two sides of the same coin, a rendering of the Law of Time in its cosmological and mathematical comprehensiveness. Then came the even more abrupt break with my conventional past, the Telektonon Prophecy of Pacal Votan.

I bring up all of these personal details because people often ask where it all came from and where I got my ideas. But more importantly, I bring them up because, as I have been indicating, all of this was foreseen and known by a seer in another time, in another world-Pacal Votan. And this process of one person hiding a prophecy and another person in another time finding that prophecy, this is also a further revelation of how the noosphere functions. The French mathematician and philosopher Charles Henry (1859-1926) declared, "As the individual becomes more collective, the collective becomes more individual."4 As individuals, we humans are meant to grow into the collective mind known as the noosphere, while the noosphere, which is the collective, could only be known through its incorporating itself through the individual. I am one such individual, a noospheric chip. The noosphere could not be understood if it did not take on a personality or a number of personalities. Otherwise the noosphere would remain in the purely theoretical state or condition.

Now that the Inevitable Event has occurred, the noosphere is recruiting. The program of recruitment is called the Campaign for the New Time. This is a genuine campaign, but a peace campaign and not a military one. As a campaign it must reach its climax by mid-2004, a full eight years before the end of the cycle, northern winter/southern summer solstice 2012, the noosphere's omega point. The reason for this is that any later than 2004, the prophecy will be negatively fulfilled. A minimum

of two Seed-Storm Year bundles-eight years-are needed to creatively destructure and then to reconstruct. The Inevitable Event was a sign of God showing us that the end had already occurred. Now all the forces of goodwill and harmony must be channeled into the conscious act that will coincide with the noosphere's readiness to manifest through all of us, and that is the calendar change-the untried solution, the most important unfinished business of the last millennium.

This is no longer a matter of debate. There is no other solution that hasn't been tried. There is no other way that the noosphere can become collectively conscious than through the human adoption of a timing system of perfect harmony. By meeting our deadline with the noosphere at the time of the Great Calendar Change in the middle of the year 2004-0n the White Spectral Mirror, Day Out of Time, the day of release from the old, and Blue Crystal Storm, the day of entering the new-then the biosphere will harmonically converge with the noosphere, and the *Pax Cultura, Pax Biospherica* may begin in all seriousness. Such is the advent of the noosphere.

What did the Maya foresee for 2012? What is Pacal Votan's vision? Pacal Votan's vision is the fulfillment of a prayer-a prayer that I have heard through the silence:

> o Hunab Ku, One Giver of Movement and Measure, be kind to the children of this Earth. We see how every year you give and how every year you take away. This is so the children of Earth can learn to be free and dwell only in your presence. Yet we know that the children of the Earth must undergo their lessons as well. And we know that they must enter the dark time of testing. 0 Hunab Ku, in their time of darkness, in their time of forgetting, do not forget them, spare those who are good, if you can. Prepare for them the Second Creation you have promised to the righteous among them. Break for them the spell of false time before they destroy this Earth! And show to them the splendors of the Second Creation, of the New Heaven and the New Earth. Show them these wonders before the Great Cycle is finished, so that they may yet wake up from the sleep of time. And 0 Hunab Ku, may the nine great Lords of Time return to Earth! May they teach the children of the Earth how to become a race of wizards, tilling the noosphere as they have tilled the Earth. 0 bring to these children of the Earth a good Time, a Time of Peace as long, at least, as was their time of history and war, and then let that Time of Peace be multiplied sevenfold!

And here is the vision that fulfills the prayer:

> Planet Earth, Rhythmic Solstice, Blue Resonant Storm year, 2012 Omega Point. The Earth's axis is tilted so that the North Pole is at its farthest from the sun, and the South Pole is at its closest. High above the Earth an iridescent, thin rainbow band

arches from one pole to the other. A second band does the same, but over the opposite side of the Earth. The Earth slowly rotates beneath these two rainbow bands that remain unchanging, constant in their positions, one of them directly opposite the sun, the other holding a position on the midnight side of the Earth's turning. The band facing the sun is the Earth's day alternator. The other band is the Earth's night alternator. If we glide across the surface of the Earth we see that everywhere there are small encampments, circular and radial in formation. Yurts, tents, adobe, and earthen structures-and gardens. The once-teeming cities are eerily silent, yet still inhabited, though with far fewer people than during the time of the technosphere. And everywhere in the small encampments people are reverentially gathered. This is the moment of the closing of the cycle. It is as if everyone is drawing in a single breath at the same time, and exhaling it at the same time. From wherever you are, even though there are clouds, you can see the shimmering iridescent rainbow alternator, either by day or by night. Clusters of people are gathered in circles of deep meditation. Around them the children laugh and play. "We are the noosphere," a voice is repeating, "we are the noosphere." This sets up a vibration and people everywhere stop in their tracks, they look toward the sky. They listen. "The galaxy is renewing our thought. The galaxy is renewing our mind. The galaxy is renewing our world, this Earth. Let us go home and learn some more." Drums and chanting fade into the twilight in one place and beckon the dawn in another. "Let us say the prayer again: '0 Hunab Ku, Allah, One Maker, Our Creator, we submit to You. Continue to keep us whole, continue to broadcast the noosphere through us, continue to let us listen to the higher collective voice that we are so that tomorrow we may register another kin, another NET minute in the glorious journey of Timeship Earth toward its goal of universal unification in your One Unending Thought, 0 Hunab Ku, do not forget us, now, and do not let us forget you! Thank you for the closing of the cycle! May what we have learned stay with us and become the inheritance of our children for seven times seven generations to come, and may you bring us another cycle for all our descendants to live in continuing peace and harmony!'"

This is the vision. I am a noospheric chip. Do not turn away from your visionaries. Your prophets are still calling you and teaching you, if you would pay attention. There is much to do and learn. There is nothing more joyful than the positive construction of harmony.

Time and the Technosphere, First Draft Transmission completed,
Self-existing Owl Moon Dali 15,
Yellow Solar Seed Year
Kin 42, White Electric WInd:

I activate in order to communicate
bonding breath
I seal the input of spirit
with the electric tone of service
I am ptided by the power of death

First draft edited, completed, and sealed,
Overtone Peacock Moon Seli 2,
Yellow Solar Seed Year
Kin 57, Red Overtone Earth

I empower in order to evolve
commanding synchronicity
I seal the matrix of navigation
with the overtone tone of radiance
I am guided by the power of life force

Second draft edited, completed, and sealed,
Rhythmic Lizard Moon, Seli 23, Navigation Tower
Yellow Solar Seed Year
Kin 106, White Lunar World-bridger
Pacal Votan Clear Sign

I polarize in order to equalize
stabilizing opportunity
I seal the store of death
with the lunar tone of challenge
I am guided by the power of endlessness
I am a galactic activation portal
enter me

Mayall beings be well and happy!

May this text and these words inspire by their truth.

If! have left out or omitted any logic or fact, or unnecessarily maligned any truth or being by my endeavor to convince through dear argument, may the Creator know that no such malice or oversight was ever intended. I am but a human transmitter, a noospheric chip. My ability is commensurate with the frailties attendant to one too long steadfast on a path too little comprehended by many of those around him.

May the truth prevail!

Jose Argiielles, Ph.D.
known in prophecy's light as
Valum Votan, the Closer of the Cycle
devotee of Bolon Ik

Brightwood, Oregon
Cascadia Bioregion
North American Plate

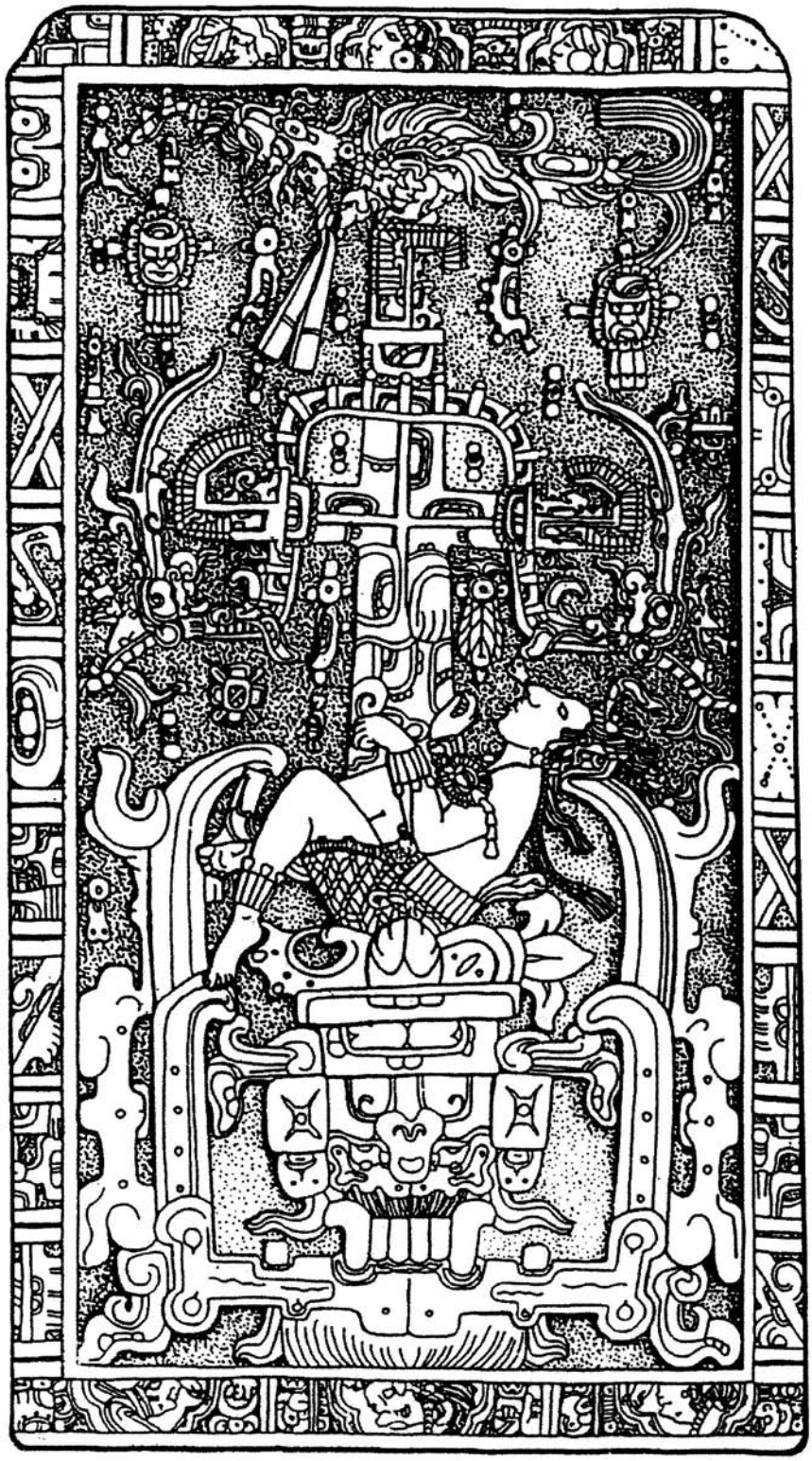

Sarcophagus lid of the tomb of Pacal Votan 9.13.0.0.0 (A.D. 692)

Epilogue

Networking the New Time

TO READERS for whom the notion of calendar change, much less that of a Campaign for the New Time, is totally novel, yet who may have an interest in learning more about and participating in the preparation for the Great Calendar Change of 2004, there is a place to begin and a way of going about it.

The official coordinating agency for the Campaign for the New Time and the World Thirteen Moon Calendar Change Peace Movement is the Foundation for the Law of Time. As a nonprofit public charities educational corporation, the Foundation for the Law of Time provides the communications and information hub for the Planet Art Network (PAN). The Foundation also publishes calendars, tools, and literature about the Law of Time and sponsors various educational programs, periodic seminars and congresses, and projects such as the new time educational caravans and the development of garden-oriented land bases.

For general information on the Law of Time or the Campaign for the New Time and its educational programs contact:

Foundation for the Law of Time, World Headquarters
Post Office Box 513
Brightwood, Oregon 97011 U.S.A.
Tel: +1 (503) 622-1976
Fax: +1 (503) 622-0198

The Foundation for the Law of Time's outreach activity program is known as the Planet Art Network (PAN), the loosely knit and decentralized base of operations for the World Thirteen Moon Calendar Change Peace Movement. The PAN is organized into Bioregions, each with its PAN nodes (local chapters) and a governing Bioregional Council. The PAN nodes organize "crystal day meetings" once every thirteen-day wave spell-the crystal (twelve) tone day is the day to call a round table or court of the kin to review past actions and prepare for future ones. The PAN nodes also offer educational programs and disseminate calendars and other educational tools and literature provided by the Foundation, which constitute the information outreach of the World Thirteen Moon Calendar Change Peace Movement. The Campaign for the New Time is the coordination of the world PAN toward the goal of the Great Calendar Change of 2004. The PAN is also generally responsible for organizing the annual Day Out of Time events in its different localities and bioregions.

For information about local Planet Art Network (PAN) operations, contact:

Foundation for the Law of Time/Gnomicile Land Base
World PAN Coordination Center
PMB 267
105 North First Avenue
Sand Point, ID 83864-1301 U.S.A.
Tel: +1 (208) 255-1172
Fax: +1 (208) 265-9107

The official Web site for the Foundation for the Law of Time, Planet Art Network, World Thirteen Moon Calendar Change Peace Movement and Campaign for the New Time is:

www.tortuga.com

This Web site is continuously updated and offers a great range of both practical and theoretical information about the Law of Time, the Campaign for the New Time, ongoing and upcoming events and educational seminars, listings of major PAN nodes worldwide, Law of Time archives, and links to other relevant Web sites.

A major aspect of the Campaign for the New Time is the development of a program of "strategic alliances," information about which is also available at www.tortuga.com. If you belong to an organization that you feel could be in alignment with the goals of the Campaign you can check out the Strategic Alliance page of the Web site or directly contact the Foundation for the Law of Time, World

Headquarters. The goal of the Strategic Alliances is to establish a "synchronization for peace force"-a coalition of a wide spectrum of organizations that are in alignment with the calendar change and are willing to help organize local events and information dissemination for the Great Calendar Change of 2004.

See also Appendix II, "The World Thirteen Moon Calendar Change Peace Movement and the Discovery of the Law of Time: A Brief Chronotopology of Transformation. "

Appendix I

Summary Critique of the Gregorian Calendar

What Every Proponent of the Thirteen Moon Calendar Should Know

NOT ONLY is the idea of the calendar as an instrument to determine a true and accurate year misleading, but solely focusing on this purpose blinds us to any consideration of time apart from duration or measurement of motion in space. The Law of Time asserts that the actual nature of time is synchronic; hence the purpose of calendars is to synchronize us in time according to various cycles whose harmonic numbers extend from and return us to a higher mental order of reality. It is a fatal error to dismiss a mathematics of harmonic perfection when it is allied with the ordering and comprehension of cycles. The pursuit of a true and accurate year totally subordinates the cyclic nature of time to the ceaseless imperfection and change that characterize the phenomenal world when it is considered as the sole factor of existence. This defines the thoroughly materialist worldview of the 12:60 consciousness.

In order to prepare the ground for a proper consideration of the Law of Time and the evolutionary necessity of the synchronic order of time as the harmonic reorganizing factor of humanity in its post-historic phase, it is necessary to expunge from the mind the error known as the Gregorian calendar. To demonstrate and expose the illogical and irrational nature of the Gregorian calendar as a standard of

measure, the following seven points are presented as a simple appeal to the intrinsic logic and intelligence of any human being.

1. We require of a standard of measure that its units of measure are regular and equal with one another.

This is not the case with the Gregorian calendar, whose base unit of measure, the month, proceeds in an irregular and uneven manner: 31 days, 28 days, 31 days, 30 days, 31 days, 30 days, 31 days, 31 days, 30 days, 31 days, 30 days, and 31 days. Why would anyone use a standard of measure with irregular units? Do you know what results when a crooked standard of measure is employed consistently for millennia? It might be noted that at the time of Augustus Caesar, August was called Sextile and had thirty days, while February then had twenty-nine days. In order to honor Augustus and make him the equal ofJulius Ouly) which had thirty-one days, the twenty-ninth day was taken from February and added on to Sextile, whose name was then changed to Augustus (August). By harmonic contrast, the Thirteen Moon calendar is perpetual in that all of its units of measure are equal-28 days each.

2. The names of the months are as illogical as their uneven numbering.

January is derived from the God of the doorway; February is an obscure word referring to an animal divinatory rite; March refers to Mars, the planet and the god of war; April and May refer to goddesses of the spring; June to the wife of Jupiter; July and August are named after the two most prominent Roman Emperors, Julius and Augustus Caesar. As for the remaining months, September, the ninth month, means seven; October, the tenth month, means eight; November, the eleventh month, means nine; and December, the twelfth month, means ten. Of course, having grown habituated to the crooked standard of measure, it is easy to overlook and dismiss as innocuous the irrational naming of the months. But is it so innocuous? What do the names of these months have to do with an order of time, or even a cosmology or culture of time, which we assume a calendar might reflect? By blindly accepting this irrational disorder of names, do we not predispose ourselves to accept irrational disorder in commonplace things around us, and even within the fabric of our society, thus reinforcing in us a tendency to accept a superficial treatment of the symptoms, while ignoring the roots?

3. Leap year and leap day is the most highly touted aspect of the Gregorian calendar.

Structurally, the Gregorian calendar is indistinguishable from the Julian calendar. The only thing that separates the Gregorian from the Julian calendar is the correction

of the leap year day. Pope Gregory XIII "corrected the calendar" by deleting three leap days from the years that begin the centuries, except those divisible by the number four. Leap day is the extra day that accumulates every four years due to the length of the astronomical year being 365.241299 days and not 365. It can be seen that the fraction .241299 is not quite 1/4, which would be .25. The Julian calendar did nottake this into account, hence an error crept in that caused the spring equinox on the calendar to fall some ten days behind the solar moment of the spring equinox-a fact noted by the conquistadors when they encountered the Mayan calendar, which had no such discrepancy. Thus, in 1582, Pope Gregory XIII "improved" on Julius Caesar's calendar, some 1,627 years later, by adopting the rule that there would be no extra day on centuries-OO years-except on those that are multiples of four. Hence, there was no leap day in the year 1900, but in the year 2000, a multiple of four, there was.

What is not well known is that the Vatican does not recognize the leap day in its ceremonial calendar. Why is that? In most countries where Latin-derived languages are spoken, leap day and leap year are referred to as *bisiesto,* or "bisextile" day and "bisextile" year. If leap year is every four years, why is it referred to by a word that connotes six, *sextile?* On the official liturgical Church calendar there is no February 29! Instead, there are two February 24s, and the second February 24 is not counted. If there were to be an extra day that was counted, then the system of fixed feast days would be thrown off. Instead, on leap years, February 24, the Day of the Feast of St. Matthew, is counted twice-or extended to be 48 hours. And since in the Church tradition derived from the Romans the days are counted from the first of the next month, the first always being known as the calends, the date February 24 is technically referred to as the "sixth of the calends of March" (February 24 = sixth calends of March, February 25 = fifth calends, February 26 = fourth calends, February 27 = third calends, February 28 = second calends, and March 1 = calends of March). For this reason, the leap year is known as *bisiesto* because the sixth *(siesto)* calends of March is doubled, hence "bi." Thus, February 29 is not recognized by the official Church calendar of the Vatican, and it is also not counted as a day in its liturgical calendar. February 29 only arose out of popular tradition in the sixteenth and seventeenth centuries. The nemesis of accounting for the .241299 extra day per year reveals the fixation of astronomical time in seeking a "true" year and detracts from the possibility that the issue of an intercalary, or extra, day can logically and synchronically be handled in many other ways. In the end, it is the mystique surrounding leap day that further contributes to the numbing of the sensibility of time accumulated in the instrument known as the Gregorian calendar, "the little grid of boxes that rules so much of our lives."l

4. **The word we use to describe the instrument for measuring, the Earth's orbit around the sun, *calendar,* is derived from the word *calends.***

Calends was the Latin name given by the Romans to the first day of every month. What does it mean? *Calends* is the name of the account book, the book of payments recording the monthly debts and bills to be paid! No wonder we are ruled by the philosophy "time is money!" This philosophy is rooted in the very word we use to describe time reckoning, *calendar.* A more accurate word for time reckoning might be "chronometer," or even better, "synchronometer." But perhaps the word "count" is simpler. We might just say, for example, Thirteen *Moon!2* 8-Day perpetual count.

5. Dominicalletters code the years of the Gregorian calendar.

Scarcely known to anyone but Vatican insiders is the system of dominicalletters that is used to code the years according to the day of the week on which the first Sunday of the year falls. Since the week has seven days, there are seven and only seven dominical letters. These are the letters a-g, where a = 1, b = 2, c = 3, d = 4, e= 5, f = 6, and g = 7. Hence, G-7 (the group of the seven most industrial nations), the name given in 1974 by the CIA to the ruling oligarchy of globalization, is totally rooted in the system of the seven dominicalletters, a-g, to which the Gregorian calendar can be reduced. It works as follows: In 2001, the first day of the year was on a Monday, hence in this year all Mondays are coded by the letter a. Counting forward to the first Sunday, January 7, Sundays this year are coded g. The letter of the year, which is always a capital letter, is based on the lower case letter that codes the first Sunday, therefore, the year 2001 is coded as the capital letter G-it is truly a G-7 year! Not only that, but by this system of "G-7" dominicalletters, it can be demonstrated that the order of the Gregorian calendar year repeats within a cyclic structure of precisely twenty-eight years, where the days of the week and the month repeat once again. Hence, the cycle 1973-2001 is a repeat of the cycle 1945-1973, which is a repeat of the cycle 1917-1945, and so forth, where the years 1917, 1945, 1973, and 2001 are calendrically indistinguishable from each other. In any twenty-eight-year cycle, there are always exactly seven leap years! Thus, the key code numbers 28 and 7 of the Law of Time and of the perfect Thirteen *Moon!2* 8-Day calendar are hidden in and even govern the cyclic order of the Gregorian calendar, whose secrets pretend to lie concealed in the Vatican archives!

Expose these secrets and show that the true harmony of time is contained in the 13:20 matrix of the Harmonic Module, which is perfectly coded by 28 and 7. Within this matrix, any set of four tones radially opposite each other, an occult quartet, always adds up to 28. There are 65 (x4) such sets that constitute the Harmonic Module, while seven (multiplied by four), is the prime factor of 28, and is the key

unit holding the 13:20 matrix in place, evident in the position of the seventh vertical column on either side of which is a perfect harmony of six columns each. The seven is also the implicit number in the ratio 13:20 (13 + 7 = 20: 20 - 7 =13). But whereas the 13:20 matrix is a harmony in which the Law of Time is encoded, the Gregorian calendar is a disharmony, but one that is nonetheless governed by the Law of Time. What the Vatican attempted to destroy at the hands of Bishop de Landa in 1562, in the famous book burning at Izamal Yucatan, is redeemed by the Law of Time. Free of the obscuring, illogical irrationality of the inexact measure of the Gregorian calendar, the actual truth of the synchronic order of time may be discovered and revealed as the 13:20 mathematical code ofthe Harmonic Module, perfectly coordinated with the Thirteen Moon!28-Day count.

6. The Gregorian calendar makes day/date calculations difficult.

The twelve uneven months of the Gregorian calendar operate by a subsystem of fifty-two 7-day weeks, plus one day. Because of the irregularity of the numbering of the months, and because there are 365 and not 364 days in a year, it is almost impossible to make easy calculations month to month and year to year, while insistence on the unbroken succession of the week only compounds this issue. For example, if today on the Gregorian calendar it is Friday, May 4, 2001, what day of the week will June 4 be? What day of the week will July 4 be? There is an immediate mental block-a numbing of the mind. You have to stop and think about it. And in this numbing pause in which your cognitive brain has to be engaged, you lose your telepathic awareness, much as when you look at a clock to find out what time it is. Why should it be this way? Who benefits? The answer is, the priests (who know the tedious rules for stating that if it is Friday and it is 2001, then it is dominical e) and the bankers (who gather interest based on the confusion over the erratic disparity of days every month). By contrast, on the perpetual Thirteen Moon calendar, this day would be Spectral Moon Gamma 3-while every third day of every Moon is coded by Gamma. In fact, the third day of every week is coded by the name Gamma. Once the 28-day count is mastered, there is no need to engage the cognitive brain to figure out what day of the week Crystal Moon 3 or Cosmic Moon 3 will be-and in this way the mind is liberated into a telepathic knowing.

The system of the seven-day week was introduced into the Julian calendar at the Council of Nicea, A.D. 325, and was adopted from the Jewish calendar, which was derived from the Babylonians, for whom it was an astrological-astronomical construct. The fact that the week came from the Babylonians dissolves the argument used by the Vatican to counter the Day Out of Time. According to the Vatican, disrupting the succession of the seven-day week would disrupt an order set in motion by

God. The matter of the 7 and the 52 has a much deeper significance when understood in the higher-dimensional light of the Law of Time. A count of fifty-two 7-day weeks makes perfect sense if you have a count of thirteen 28-day months (7 x 52 = 13 x 28). The observance of the Day Out of Time, the 365th day of the year, produces a perfect and perpetual harmony. Knowing this, to continue to insist on fifty-two weeks while being unwilling to give up a twelve month count that does not have a Day Out of Time is to persist in an adherence to hopeless disharmony. Why do it?

7. What's in a name? Think about it.

What does it mean to follow calendars called the Julian and the Gregorian? A calendar is an instrument of control. The two most significant calendar reforms in history were the Julian calendar reform of 46-45 B.C., and its successor, the Gregorian, in A.D. 1582. Julius Caesar's motives had everything to do with his personal ambition and the conversion of Rome from a republican to an imperial form of government. Julius Caesar's calendar assured it to be the basis of imperial dominance. The course of the empire utilizing the Julian and later Gregorian calendar has prevailed as the dominant force now inseparable from the course of history itself. The 445-day "year of confusion" (46 B.C.), which attended Julius Caesar's reform, was matched by the second significant reform, the Gregorian, in which ten days were "lost forever," between October 5-16, 1582, so that the calendar could "catch up" with the sun.

While European Catholic countries easily accepted the reform, Protestant countries grudgingly acquiesced. Throughout the Americas, however, the Julian-Gregorian calendar was imposed as an instrument of power and symbol of dominance over the peoples the Europeans had conquered, including the high civilizations of the Maya, Inca, and Aztecs-all of whom happened to use, among other calendars, a Thirteen Moon!28-Day count. As with Julius Caesar, for Pope Gregory XIII the moment was politically ripe for a reform that would communicate itself as a means of expressing and extending power and control, but this time over the entire globe. As European dominance and control spread around the planet, even nations with their own established timing systems accepted, for the sake of "international policy," the Gregorian Oulian) calendar system for measuring the solar year. And so Western dominance over every aspect of global life became absolutely assured-until the moment of the Inevitable Event.

From its roots in the imperial ego of Julius Caesar to the timely "reform" of Pope Gregory XIII, it is not surprising that this calendar, "despite its odd quirks and the twists of history that produced it,"2 has become the standard of global civilization. Given the irregularity of the Julian-Gregorian calendar and the pursuit of the accuracy of astronomical time, history could be nothing more than a compilation of

odd quirks and twists, while global civilization itself is the triumph of artificial time over the natural world. Only a species whose time sensibility had been captured by instruments of artificial measure could have become so alienated as to have produced the monstrous conundrum known as the "fast world," a civilization where money and technological advance prevail over human sensibility and the natural order. It is toward the correction of this destructive momentum that all efforts of calendar reform must now be directed.

In light of this critique, it is worth reprinting the opening section of the "United Manifesto by Advocates of Calendar Reform" that was first published in 1914 at the beginning of the First World War-some ninety years in advance of the Great Calendar Change of 2004. It can be seen that the issues of irregularity that prompted reform then are still issues today. However, the effects of not attending to these issues have only become compounded and even more complex, resulting in the chaos of a world at war with terror. Such is the nature of an error gone uncorrected over time-it only becomes more entrenched and turns into the dogmatic and hopelessly conflicted thinking of the everyday mind and its way of life.

United Manifesto by Advocates of Calendar Reform

> WHEREAS we, the undersigned, have for some time been interested in a Reform and Simplification of the Calendar now in use in Western Europe, America, and elsewhere, with a view to equalizing the four quarters of the year, alleviating the irregularities of the months, and establishing a perpetual correspondence between the day of the week and the day of the month, and have supported one or other of several proposals which have been formulated for effecting these reforms; and WHEREAS said proposals usually provide for placing the 365th day of every year and the 366th day of Leap Year without the weekly and monthly enumeration; and WHEREAS we have found that in certain quarters-both ecclesiastical and scientific-Dbjections, possibly often sentimental, but none the less firmly held, have been stated to the employment and adoption of these expedients. . . Therefore we have resolved to unite in urging and advising that the very simple changes under noted should now be made in the Julian and Gregorian Calendars by international agreement. . .3

If you have a crooked standard of measure, and follow it because your parents were also following it, you have become a crooked man. It takes a crooked man to walk a crooked mile and build a crooked house. The issue of calendar reform is both logical and moral. Bad logic leads to bad morality. An error in time dooms the mind. Apocalypses are the reward for bad timekeeping. To remove yourself from the fires of your own self-created apocalypse, change your calendar. In a world of harmony there is no apocalypse.

Appendix II

The World Thirteen Moon Calendar Change Peace Movement and the Discovery of the Law of Time

A Brief Chronotopology of Transformation

IT WAS during the seven-year cycle (1993-2000) when the World Thirteen Moon Calendar Change Peace Movement was being aroused around the planet, that the Law of Time was articulated in its various aspects and particulars, and the synchronic order defined in its whole system fullness. This occurred through a number of key events accompanied by a number of publications detailing the mathematical, cosmological, theological, and scientific aspects and imperatives of the Law of Time.

By the standards of the synchronic order, all events form points in a radial time set that describe a geography of time defined as a chronotopology. Coined by the late philosopher and mathematician Charles Muses, the term *chronotopology* defines an event point of meaning that creates a root meaning from which time-formed, -blossomed, or -radiated meanings emerge above a horizon of meaning.! The Law of Time now gives a precise field in real time to illustrate Muses's notion of chronotopology in which Time is a radial power of profound interrelations.

The following chronotopological sequence-a resume of the events in a particular geography of time, the seven years of prophecy, 1993-2000-defines the conscious emergence and articulation of the Law of Time. In this chronotopology, the "root meaning" occurred in 1989 at the Museum of Time in the form of the discovery of the 12:60 and 13:20 timing frequencies, and the subsequent working out of the implications of this discovery. The "horizon of meaning" was reached July 26, 1993, kin 144, with the decoding of the Telektonon Prophecy and the consequent development of the World Thirteen Moon Calendar Change Peace Movement. The "source meanings," however, extend back to the seventh century with the origins of the prophetic traditions underlying the discovery of the Law of Time. The seven years of prophecy established the field of radiated meanings of the Law of Time as a set of radiated event points and a body of literature and tools. Here follows, then, a brief chronotopology of the key event points of this movement:

1989	Root meaning: discovery of the 12:60 and 13:20 timing frequencies, Museum of Time, Geneva, Switzerland.
1990	Realization of the Thirteen Moon/28-Day calendar in its wavespell form.
1992	Recognition and celebration of the Day Out of Time as a planetary event.
1993	Horizon of meaning: decoding of Telektonon Prophecy and birth of World Thirteen Moon Calendar Change Peace Movement.
1994	Launching of the Planetary Moral Emergency and World Thirteen Moon Calendar Change Peace Plan.
1995	80 Days Around the World for a New Time of Planetary Peace: Chile, South Africa, Egypt. Russia, India, Hong Kong, Japan, Hawaii, and Mexico.
1995	Day Out of Time Calendar Burning and Return of Natural Time Ceremony, Serpent Mound, Ohio.
1996	First Planetary Congress of Biospheric Rights, Brasilia, Brazil.
1996	Biospheric Awareness Day, Gotemba, Mt. Fuji, Japan.
1996	Four Corners Boundary Dissolving Ceremony, Four Corners, United States.
1996	Harmonic Convergence of Humanity, Mexico City, followed by Peace March, Teotihuacan, Mexico.
1996	United Nations, Planetary Moral Emergency Appeal.
1997	Judgment Day Tribunal and World Congress on the Law of Time, Tokyo, Japan.

1997-present	Ongoing movement in Brazil to make July 25, Day Out of Time, official "Peace and Culture Day;' based on recognition of the Banner of Peace (seventy cities so far).
1998	Special peace mission to the Vatican, Rome, Italy.
1998	Special mission to Guatemala to meet with Quiche Maya elders.
1998	UR Council for the Theology of Peace, Milan, Italy.
1999	world Summit on Peace and Time, University for Peace, Costa Rica, followed by the dispatching of Special Emissaries to the United Nations and the Vatican.
1999-present	Ongoing movement in Japan to declare Day Out of Time a "Day of Festival"; more than one hundred events occurring annually.
1999	Peace March, Teotihuacan, Mexico.
1999	Seven Week Earth Wizard Seminary, Picarquin, Chile.
1999-2000	Ongoing in South America, launching of "La Karavana;' Thirteen Moon educational caravans, and in Europe, from the United Kingdom to North Africa, the New Time Caravan.
2000	Initiation of Seven-Day Earth Wizard's Seminars: Japan, United States, Italy, Russia, South America.
2000	Circumpolar Rainbow Bridge Experiment, phase I, worldwide.
2000	Fruit of meaning: establishment of Foundation for the Law of Time, Oregon.
2001	Launching of the Campaign for the New Time, Brazil. Argentina, Japan, Altai region.
2001	Campaign for the New Time PAN Thirteen Moon Leadership Conference, Oregon.
2001	Seven-day special Congress on Time and World Peace, Medellin, Colombia.

During this chronotopological sequence of radially connected event points, key writings, publications, and tools describing and defining the Law of Time and the synchronic order include:

Dreamspell: The Journey of Times hip Earth 2013, 1990-91

Thirteen Moons in Motion and *Turtle of the Thirteen Moons*, 1993, 1996

The Story of Time: The Story of Turtle and Tree, 1993

Treatise on Time Viewed from its Own Dimension (Published as *The Call of Pacal Votan:*

Time is the Fourth Dimension), 1992, 1996

Telektonon ofPacal Votan and the *Telektonon, Game of Prophecy,* 1993-1995

World Thirteen Moon Calendar Change Peace Plan, 1994-1995

Pacal Votan and Judgment Day: The Second Quranic Dispensation, 1995-1996

First Planetary Congress of Biospheric Rights, 1996

The Galactic Culture Master Plan, New Time Economics, 1996

A Brief Guide to The Thirteen Moon Calendar Change Peace Movement, 1996

Rinri Project: Four-Year Telepathic Biosphere-Noosphere Transition Circumpolar Rainbow Bridge Experiment, 1996

The 260 Postulates of the Dynamics of Time and the Evolution of Time as Consciousness, 1996

The Discovery of the Law of Time, T(E) = Art, 1996

The Principia Mathematica of the Fourth Dimension, 1996

Twenty Tablets of the Law of Time: Sixteen Year Telektonon Cube of the Law, 1997

World Congress on the Law of Time and Judgment Day Tribunal, 1997

World Summit on Peace and Time, Summary, Review, and Conclusions, 1999

7:7::7:7, Telektonon Revelation and Plasma Universe Model, 1998-2000

The Rainbow Bridge Project: 28 *Meditations on the Law of Time,* 1999-2000

The UR Papers: Documents and Appeals for a Council of Universal Religion, 1996-2001

WIth the conclusion of the seven years of prophecy, marked by the rainbow bridge experiment, phase I, the greater part of the Law of Time had been uncovered, described, and defined. What emerges from consideration of all these events and accompanying literature is an entirely new model of the universe as well as a program for the reorientation of knowledge and the social reorganization of humanity-all based on a corrected understanding of time through the implementation of the calendar change. This was all to demonstrate that there is much more to a calendar change than the mere replacing of one calendar with another, for a calendar itself bears within it an understanding of time that tacitly and unconsciously shapes our very thinking about time. What the calendar change, then, really signifies is the end of one worldview and the birth of another. WIth the Law of Time, what was once unconscious is again made conscious, leading to a radical self-awareness of how wrong we have been about time, and what we might anticipate in changing our tools for navigating in time.

Because the growth of the Planet Art Network (PAN) as the social form of the World Thirteen Moon Calendar Change Peace Movement is inextricably involved with the unraveling by stages of the Law of Time, to define the constituent principles of the Law of Time is also to define the new worldview and the social organization appropriate to it. These constituent principles include: time is art; universal telepathy; holonomic consistency and reciprocity; synchronic order; fractal and radial mathematics of the 13:20 matrix; biosphere-noosphere transition; Banner of Peace; *Pax Cultura, Pax Biospherica;* the psi bank and the dynamics of the evolution of time as the evolution of consciousness; fourth-dimensional time and third-dimensional space. A mere consideration of these constituent principles will make one realize to what extent the calendar change is more than just an end to history, but the establishment of a new world, a New Heaven and a New Earth. This is precisely the promise offered by the Thirteen Moon calendar change and the discovery of the Law of Time. (See plate 8, Chronotopology of Transformation.)

Appendix III

Telektonon Prophecy of Pacal Votan

TI-IE REVELATION of the prophecy of Pacal Votan on July 26, 1993 was the culmination of the event that occurred on June 15, 1952, when the archaeologist Alberto Ruz Lhuillier pried open a large monolithic trapezoidal door beneath the Pyramid of the Inscriptions at Palenque, Chiapas, Mexico, and beheld what had not been seen by human eyes for 1,260 years: the tomb of Pacal Votan. A subsequent event, the lifting of the magnificent sarcophagus lid-measuring some four-by-three meters and weighing several tons-to reveal the human remains amidst a splendor of jade, including the jade mask, occurred on November 27, 1952. For some forty years afterwards, scholars debated the meaning of the tomb and the person buried within it. In the 1970s, the Russian scientist Knozerov dubbed the man in the tomb an "astronaut" or "cosmonaut" because of the similarity of the position of the figure sculpted on the sarcophagus lid to the positions of Russian cosmonauts in their little space capsules. This theory inflamed the imagination of some and was debunked by others, the end result being the enhancement of the awesome mystery of the tomb and the intention of its designer, the man buried in it.

The image of the sarcophagus lid is now world famous. Its symbolism has been interpreted to varying degrees by different archaeologists. In my book *The Mayan Factor*, the placement ofPacal Votan in his "time of power," 631-683, is defined and analyzed as occurring in the most harmonic and mathematically synchronic point of

the entire thirteen baktun cycle, a point of fact that deepens the enigma of Pacal's knowledge and purpose. And herein lies the key question: What was his purpose, and why did he construct his tomb to be so elegantly buried for 1,260 years, to be discovered and opened just sixty years before the closing of the cycle, A.D. 2012? Clearly, the mystery of the tomb and its discovery had everything to do with the end of the cycle. At least this had come to be my surmise ever since the 1987 Harmonic Convergence. Like a hawk circling its prey, the meaning of the tomb finally came to my consciousness like a direct hit from the beyond. I was the prey, the hawk, the prophecy itself. Such was the revelation of the Telektonon Prophecy on the morning ofJuly 26, 1993.

The coded key was the tiled "speaking tube," by which the tomb was discovered in the first place. Suddenly, this tube spoke its meaning to me: Earth Spirit Speaking Tube, Telektonon by name. After four intense weeks of decoding the glyphs and symbols of the tomb while living in the pool house of an isolated estate in the wind-blown northern part of the main island of Hawaii, I knew that I had to abandon the dreamlike life I led in this Pacific paradise, and with my wife and companion head directly into the unknown, the first stopping point being Mexico, the source of the prophecy. After four months or so of traveling through Mexico, completing the decoding and announcing the prophecy, including a return to the tomb, we were finally directed to a converted carport in a field near the village of Ocotithin, not far from the birthplace of Quetzalcoatl. It was here where, for a period of nine mornings, I awoke dutifully two hours before sunrise to listen to the voice and write down by hand, in a specially prepared notebook, the words exactly as I heard them. Afterward, I numbered the 126 verses and distinguished the nineteen sections.

Because the prophecy itself is so inextricably connected with the Law of Time and the message of *Time and the Technosphere,* I feel it is important to present it as background information to the text of this book. In actuality, the text of the Prophecy is an integral part of the *Telektonon, Game of Prophecy,* where it is read, section by section, on a daily basis, according to the code number of the kin of the day.

THE TELEKTONON OF PACAL VOTAN

The Talking Stone of Prophecy That Unites the People of the Dawn with the People of the Book

"Then if they reject thee,
so were rejected apostles
before thee, who came with clear signs,

books of dark prophecies
and the Book of Enlightenment. "
-HOLY QURAN, SURA **III,** 19: 184

"All who obey God
and the Apostle
are in the company
of those on whom
is the grace of God,
of the prophets who teach,
the sincere lovers of truth,
the witnesses who testify
and the righteous who do good.
Ah, what a beautiful fellowship!

Such is the bounty
from God: and sufficient
is it that God knoweth all. "
-HOLY QURAN, SURA Iv, 9:69-70

INTRODUCTORY VERSES: ONE LIVING PROPHECY

1. Pacal Votan's Gospel of the Telektonon
   A Special Dispensation for the Day of Truth,
   A.D. 1993-1994, kin 144.

2. Proclamation on behalf of the three messengers
   of the awakening,
   of the three special voices of prophecy,
   the special witness of time and the last call.

3. Telektonon
   the inner sun
   the mother of all prophecy
   message of the star witness, Bolon Ik
   received and repeated by her servant in love,
   Pacal Votan.

4. In the seventh year of Harmonic Convergence
   the seven seals of the apocalypse
   become the seven years of prophecy. . .
   thirteen years in all.

Thirteen moons the path to walk;
thirteen moons the path to talk;
people of the dawn, one mind,
people of the book, one God;
one living prophecy, one people, one Heaven,
one Earth.

●● NAH CHAN: THE PALACE OF BOLON IK

5. o children of the people of the dawn, a children of the people of the book, I come as the special witness of time to remind you, especially on the day of truth, that in your origin you are one, and on the day of truth you are to make yourselves one again. For this I remind you of the Cube of the Law, Telektonon, and the 28-day, thirteen moon way that is the path of the righteous.

6. Nah Chan, Palenque, Xibalbay, Tollan, Xochicalco, Tepozteco, Amatlan: in these signs dwell my special agents, the witnesses of truth, 13.66.56 and Bolon Ik, Daughter ofJob.

7. For those with eyes, with open mind and sincere heart, this teaching is complete in every stone alignment and marking of the star command base now called Palenque.

8. New Jerusalem is the Palace of Bolon Ik, whose number is 1,728 (144 x 12), Cube of the Law. Seventeen is the power of Heaven, "solar Uranus," which is Earth in Heaven. Twenty-eight is the power of Telektonon, the Spirit Tower of the power of 7 times 4.

9. Never forget, children of the day of truth: All is number. God is a number. God is in all.

10. And everything there in the palace is laid out foursquare from the cord of Heaven, which is the command of the Telektonon. "Divine word never uttered until the Day of Truth." And in that palace, foursquare is the tower of the Cube of the Law.

●●●THE CUBE OF THE LAW AND THE TOWER OF BABEL

11. o children of the day of truth, before the separation that divided you into the children of the dawn and children of the book, there was only the Cube of the Law and the Law of the Cube.

12. Everyone and everything moved and lived within this Law: one mind, one spirit, one will.

13. Within the dimensions and measurements of the cube are all knowledge of Heaven and Earth. And in order to know, expand on, and delight in the sublime Law of the Cube, God created you, 0 children of the day of truth.

14. And though shaped of no more than mud and sounding clay, in you is the perfection of knowing the Cube of the Law, if only you remembered!

15. Children of the Day of Truth, just as the cube is the measure of the perfection of God's thought, so you are the measure of God's unceasing movement, which is called time.

16. In you the cube is the crown of perfect knowing of God's will in time. But true to his word, Iblis made wrong fair-seeming. To show himself man's enemy, Iblis split the cube. He drove a forgetting of time within the mind, separating mind from spirit, which is God's movement in all things.

17. And from this forgetting in man, mind and spirit became confused. The will weakened. Ego was born. Iblis's many-headed self triumphed. False authority arose. Babylon came to be and in its center the Tower of Babel, the monumental curse for no longer knowing time.

18. In the forgetting was the separation of the people of the dawn from the people of the book. Had there been no Tower of Babel, there would have been no book. The Tower of Babel was a deceit intended to show the Cube of the Law existing outside of the perfection of knowledge already formed within you, a children of the day of truth.

19. Product of the forgetting, the Tower of Babel has a shadow of ever-darkening and all-encompassing dimensions that spreads 5,000 years from Babylonia to all of Earth's most remote wildernesses and mountain retreats. Iblis's curse of Ego and false time are complete but hold only to the day of truth.

20. For God is gracious and most merciful. As long as He could, He kept the people of the dawn away from the Tower of Babel. And to both the people of the dawn and the people of the book, He sent many messengers, apostles of light, witnesses of truth, doers of the righteous way, which is always framed by the invincible Law of the Cube.

●●●● TELEKTONON: THE FRAME OF TIME

21. As the special witness of time, I, Pacal Votan, know the perfect count of days. I bow in the temple of the tower and the rock, the sanctuary of Bolon Ik. In my body, formed of the ultimate perfection of God's power of all movement and measure (Hunab Ku), is the recollection that is prophecy. Knowing this body as the measure of time, I had built this palace and this tower to correct and to also look for the Tower of Babel, a memory of the remembering. And in my ninefold temple, where, guarded by the nine powers of time, I had this body laid, I left this legacy for you, the Talking Stone of Prophecy.

22. Telektonon, the frame of time I left for you, is a mirror to show you your own truth of time for one last time. For now is the day of truth, the hour of judgment.

23. You, children of the dawn, and you, people of the book, unify yourselves the only way you can: in time, through time, as time.

24. Telektonon, the perfection of time, is the only way for you to escape the fire that consumes the unrighteous. If you who know, who have followed the straight way, the good path, now falter in this challenge of unification in time, Telektonon, which has already been prepared for you, you will perish forever in the fire that now consumes all unbelievers. God's command is in you. Do not listen to the evil one now.

MY COUNT OF DAYS IS PERFECT

25. Listen! My knowledge is this: My count of days is perfect, my knowledge of the Cube of the Law is unsurpassed. Twelve is the number of the temple, but thirteen is the number of God. Twelve times twelve, 144, is the number of the perfection of the temple as light. And twelve times 144, 1728, is the number of the Cube of the Law, Telektonon, the divine word unuttered until now.

26. "... To him that overcometh will I give to eat of the hidden manna, and will give him a white stone, and in that stone, a new name written, which no man knoweth, saving he that receiveth it." (Revelations 2:17) And that name is Telektonon, and that stone is crystal, and that hidden manna is knowledge of the revelation of time.

27. The number of the elect is 144,000. This was the number set aside by God to be free ofIblis's curse. Dispersed is this number among mankind, and always was it meant to multiply both among the people of the dawn and the people of the book.

28. But since a human kin is the measure of the perfection of time, 144,000 is also the number of days within a cycle of twenty generations.

29. Twelve times 20 generations is 1,728,000 days, the number of the Cube of the Law. But for God, one cycle more, 144,000 days more to entice Iblis to make his score, a total of 1,872,000 days, thirteen cycles of God's elect.

30. I am Pacal Votan, time's special witness, galactic agent of the Nine Great Lords of Destiny, by oath pledged to the honor of Bolon Ik.

31. In my body of time, thirteen star histories rehearse themselves for the day of truth. Each star history possesses its own knowledge keeper appointed by the Nine Great Lords of Galactic Destiny. Thirteen Wisdom Holders, Nine Great Lords, twenty-two in all, to each of whom I am bound by a luminous thread of knowing, sealed by oath to Bolon Ik, White Solar Wind, kin 22 in the Book of Destiny, the Book of Kin.

ALL IS NUMBER

32. All is number. God is a number. God is in all.

33. Child of the day of truth, listen: 20 is the number of totality. You have twenty fingers and toes because God has made you the totality of time. Thirteen is the number of God's cosmic wisdom, perfect in its power of unceasing change and circulation. Thirteen are the joints of your limbs and body. Seven is the difference between 13 and 20. Seven is the mystic perfection between one and thirteen. Seven is the erect spine of the vigilance in which are met the 144,000 mystic fibers of the body's thirst for prophecy.

34. 144,000 kin, 144,000 days, these are called a baktun. Thirteen baktuns, one perfect cycle to rehearse all thirteen star histories. Each baktun, twenty generations, each generation 7,200 kin. So it was that Bolon Ik ordained the sacred count of days, each day a sacred kin, each kin one of the elect, a turning in the twist of universal time, each kin ruled by the power of the nine, the power of the Nine Great Lords of Time.

35. So began the sacred thirteen baktun count, 3,113 years before the birth of the second of the special messengers, the Apostle Jesus Christ, who sent to you a Book of Dark Prophecies, twenty-two sacred chapters in all, through his appointed witness, John ofPatmos.

36. All this I know and declare to be true, for I am time's special witness to the day of truth, Pacal Votan, rehearser of the thirteen star histories, he who adds the 144,000 elect to the cubing of the cube, assuring not twelve baktuns, but thirteen to be the number to bring on the day of truth, God's judgment of your power of remembrance!

37. Children of the people of the dawn, in separating you from the people of the book, God meant you to be the reminder that wisdom is already perfect in your bodily form of time.

LORD BUDDHA

38. In remembrance, many messengers did he send you, many fires did he light high atop the mountain for you to see. And one special messenger did he send, one special witness of the dawn.

39. In India, at the midpoint of the seventh baktun, the very center of the mystic cycle, thirteen baktuns in all, Lord Buddha did awaken at the dawn, the morning star, the tree, the Earth, his witnesses of illumination. For seven weeks, he sat beneath that tree. Never moving, he traveled the seven directions and visited with his mind every realm of God's vast creation, only to learn the turning of the Wheel of the Law.

40. Withstanding all efforts of the evil one, he taught unceasingly for nine times five years more, until the age of eighty. All mind teachings did he give; the unwritten Book of Enlightenment did he leave with the Earth. His last turning of the Wheel of the Law was the teaching of the Wheel of Time. Given at the request of King Suchandra of Shambhala who traveled far from Central Asia to receive this teaching, the teaching of the Wheel of Time closed the life of Lord Buddha.

41. "All composite things are impermanent," declared Lord Buddha at his death, "Be a lamp and a refuge unto yourself, look to no outer authority but yourself!" The fire of Lord Buddha's illumination lit many lamps. The Book of Enlightenment he left with the Earth is a book for all to know in silence with the Earth.

42. In Shambhala did King Suchandra transmit the teaching of the Wheel of Time, Kalachakra, as it is called. Invoking the Nine Great Lords of Galactic Destiny, Shambhala prospered in abundance and wisdom. When came the seventh ruler after King Suchandra, Queen Visvamati, the people of Shambhala ascended as one into the paradise of the fifth dimension, where their wisdom continues to water the rivers that flow beneath the gardens of the righteous.

43. Integrating the power of the five, which is the center, with the power of twelve, which is the root of the cube, the Kalachakra is also the cycle of sixty years (5 x 12). By the Law of the Cube, which is the power of sixteen, foursquare or 7 plus 9, sixteen cycles

of sixty years is the appointed time of prophecy, the prophecy of Kalachakra, which is the time of the day of judgment.

44. So it was that after the arrival in Tibet of Buddha's special voice, Padmasambhava, late in the tenth baktun, that the Lords of Shambhala determined to release the teachings of the Wheel of Time among the people of the dawn inhabiting Tibet. Thus it was that the Wheel of Prophecy turned the first of these sixteen cycles in A.D. 1027 and completed the sixteenth of these 60-year cycles in A.D.1987, in partial fulfillment of the Harmonic Convergence of all prophecy.

45. 0 people of the dawn, do not doubt. The appointed day is come.

THE HEPTAGONON OF MIND

46. People of the dawn, people of the book, children of the day of truth. To safeguard as long as possible the teachings of the Original Ones from the confusion of the Tower of Babel, God divided the Earth by its one ocean into great island masses called continents. And most far from Babylon was Amerrikua, and also distant was Australia and the Island Kingdoms of Polynesia. Even in Africa, close to Babylon, for many great cycles were the people of the dawn protected in their natural wisdom.

47. But inexorable is my count of days, inexorable the rolling of the Wheel of Time, inexorable the Law of the Cube.

48. Telektonon is the name of the blessing received by those who master the Law of the Cube. Great is the power of God, whose power and blessing are ever close and near, foursquare the manifest action of radiance from the divine intersection of God's presence: divine mind, divine spirit, divine will, divine source from which the Cube is sprung. Foursquare the Cube, the measure of Telektonon, one vast, far-spreading word that is no word at all, but number multiplying itself from within God's unending meditation, which we choose to call creation.

49. From one intersection, six directions plus the seventh, the moving center of time, the navel of Heaven whose cord is a fiber called Kuxan Suum. From the navel of Heaven to the solar plexus runs the Kuxan Suum, highway that reaches to the roots of the stars, passing through each of the heavenly dimensions.

50. I who say this, know, for I am Pacal Votan, who left for you a talking stone, Telektonon. Time's special witness am I, God's spy holding vigil, keeping the sacred count of days, exposing to you the lie of Babylon, the falsification of the Cube into the Tower of Babel!

51. Who now but I can tell you that seven are the directions of the Cube, the Heptaganon of Mind: twelve are the gates, sixteen the powers; moved by the nine great powers of time, these sixteen powers become the number of the elect of the Cube, 144. Multiplied by the millennium, 144 becomes 144,000, sacred number of days I laid for prophecy to know during my first baktun count.

IMPERIAL BABYLON

52. Children of the book, even before the close of my first baktun, twenty generations from the year 3113 B.C.,the foundations of the Tower of Babel were laid. Captive now were the 144,000 within the Earthly prison of Babylon's materialism.

53. Yet, by my devotion and power of meditation, from deep within the Earth, aided by Bolon Ik's perseverance on far Uranus, Earth's harmonic twin, I kept the sacred count of days, I watched over the movement of the sacred march of kin.

54. Four more baktuns passed, and Babylon's power was swollen with the loot of Empire. Despite the righteousness of Abraham and the Law of Moses, the shadow of the Tower of Babel only increased in size and darkness.

55. Came the sixth baktun and Imperial Babylon was complete. Its seal of false time and power, taxation, and armed expanse had fulfilled Iblis's desire to degrade and ruin all humanity by making wrong fair-seeming. Fair-seeming now to amass wealth and power; fair-seeming to make a count of time by twelve months; and fair-seeming to regard the thirteenth moon with superstition and contempt! Fair-seeming to gather taxes and to pay them; fair-seeming to make war for the power of King's; fair-seeming that birth and death must be paid for; fair-seeming that all power come from the priests, Iblis's most cherished of men.

56. 0 people of the book, lost to you was all memory of the Law of the Cube, slavery became your lot! But I am Pacal Votan, time's special witness. Even before the coming of the second special messenger, Christ the Apostle of Love, by my free will and my knowledge of the power of seven, I laid claim to the Seven Seals of Prophecy that on the day of truth, Iblis's curse would be finished and the righteous would triumph. And now the day of truth is come. Telektonon, the talking stone, now speaks in a voice for all to hear.

57. By the seventh baktun, the Seven Seals of Prophecy were stored in Earth's special lodestone of truth, whose custodian am 1.

58. By the eighth Baktun, Iblis had caused the Tower of Babel to speak more tongues in a growing clash of empires. Into this confusion came the Apostle of Love, crucified for driving the moneylenders from the Temple, misunderstood by the people of the book, finally to be absorbed by the Priests of Babylon, now Roman by tongue, who use this Christ as their emblem to spawn Iblis's greatest evil, the total usurpation of Earthly Time.

THE BOOK OF DARK PROPHECIES

59. One special voice did this Jesus have, a man named Saint John ofPatmos, in whom the gift of prophecy was fulfilled. From my ark of universal time, Earth's special lodestone of truth, rock of Heaven, attained by thirteen tones, I guided Saint John's hand by the mystic power of seven. And so was sent to the world the Book of Dark Proph-

ecies, Revelations, the Apocalypse, twenty-two mystic chapters, the first thirteen mirroring my thirteen great baktuns, nine more for the Lords of Time, seven of these for each of Seven Years of Prophecy, and the last two to complete the visionary power of the righteous of the Cube: 144,000 times thirteen.

60. To those who can read they will find Iblis's numbers 1,260 and 666, well known on the day of truth, for 12:60 is the ratio of the false time that makes martyrs of the righteous, and 666 the number of the beast who captures my thirteenth baktun.

61. Children of the day of truth, children of the dawn, people of the book, all this can you hear in the stones of Palen que where in the tenth baktun I took pure human form. Of the twenty-seven books of the New Testament, the twenty-seventh is Revelations. Twenty-seven steps ascend to the Palace of Bolon Ik. This palace, New Jerusalem, is the mystic power of Telektonon, the twenty-eighth step, the power of seven sanctified foursquare.

62. Twenty-two chapters of Revelations are the twenty-two kin complete in Bolon Ik: thirteen for the power of time, nine for the Nine Lords of Time, whose forms still guard my ark of stone deep within the ninefold temple of the Cube of the Law. Perfect was the time of my coming, kin 1, 366, 560. Perfect was the time of my going, kin 1, 385, 540.

63. Installed in the House of the Serpent, my coming was commemorated by the departure of the third messenger, the special messenger of the day of truth, the Apostle Muhammad, who left for the righteous of the Earth the Book of the Righteous, the Holy Quran, clear signs to understand.

64. As Buddha taught so pure one mind, so Muhammad taught so pure one God. Submission to the will of God is at the center of the Law of the Cube. Truly for the righteous there is only the straight way, the path of basic goodness, laid out in the heart as obedience to God's will, the divine plan unfathomable to those who cry, "reason alone can save us!"

THE PROPHECY OF THE SEVEN GENERATIONS

65. I am Pacal Votan, witness of time. Telektonon is my gospel. The talking stone of unifying prophecy is my legacy intended for that special messenger who understands the meaning of my numbers.

66. By my symbolic channel of communication called Telektonon did I intend this prophecy to be discovered and recovered. Once forty years had elapsed from the time of the discovery of my Uranian crypt, then would come the recovery, the recollection by my special agent of the numbers rehearsed and repeated to announce the day of truth.

67. Perfect was the time of my coming. Perfect was my mission. Perfect was the time of my going. Perfect is the discovery of my prophecy. Perfect is the Telektonon, the little book the angel of the Lord made Saint John ofPatmos taste and eat, which you now possess, a treasure for the day of truth.

68. What you witness by these words is the last message I gave to my people, the message of 9.13.0.0.0, heard from my ark of stone through the Telektonon, Earth Spirit Speaking Tube. To my people I declared:

69. "Seven katuns are there to follow me. Seven generations, each one guarded by a solar witness taking account of what you do, each solar witness sealing your time with a prophecy to be known as the Book of the Seven Generations. And this book is to be opened for the day of truth.

70. "After the seven generations, the end of the baktun. Ten baktuns gone, the glorious Age of Maya gone, the Long Count of my days to be completed at 1,440,000 kin, the mystic number of the elect multiplied by ten.

71. "Then will come the three baktuns of Babel, the coming exile of 12:60 time. Thirteen years after this tenth baktun shall come the last prophetic round: thirteen cycles of Heaven, each fifty-two years, followed by nine cycles of Hell, each also fifty-two years. When the third round of Heaven begins, the Messenger of the Last Call will come to you, Quetzalcoatl-Kukulkan, the prophet by name.

72. "And when the thirteenth Heaven cycle is over, then will come the complete destruction of all we are and know. Before the twelfth baktun is over, two priests bearing false witness, ornamented with the sacred numbers five and thirteen, will see to it that the thirteenth baktun will be the end of time.

73. "Unrelenting will be the roll of the Nine Hells into the abyss of fire and madness. In the time of the last Hell, though you will be declared free, free you will not be. Ten Kings in succession will mark the climax of time. Seven years will follow the ending of the last Hell. Then will sound the angel of the seventh trumpet, the seven thunders will roll, the beast of seven heads called G-7 will place his mark on your foreheads and hands, the false one from Babylon will return to be embraced by the 11 Serpent. Then the day of truth will come, the Seven Years of Prophecy."

TIME'S SPECIAL WITNESS

74. People of the dawn, people of the book, children of the day of truth, many messengers have been sent to you, many prophets have been given to you. A Book of Enlightenment has been placed in the Earth for all to read in communion with the Earth. A Book of Dark Prophecies has been left for you. A prophecy of thirteen Heavens and nine Hells to accompany the Book of Dark Prophecies has also been left for you. A great prophet and messenger has left you clear signs to understand and a book of unassailable righteousness, the Holy Quran.

75. As the special witness of time, I have left for you my talking stone, Telektonon, breath of precious Bolon Ik, and have sent you both a prophet, Quetzalcoatl of sacred Xochicalco, and for the day of truth I have appointed also a special messenger who can hear my talking stone and write and explain its numbers and its meaning for you, children of the righteous.

76. Do not doubt any of this. When the moment comes for him who is to be the eleventh in succession, to succeed the one, 11 Serpent, then join the believers and begin the prophecy that liberates from all Kings and successors.

77. Ten witnesses I place around my tomb, ten Uranian emissaries, one each for each of ten baktuns. Of these am I the eleventh. Who would be the eleventh in the final succession of the Kings of Mexico must own me as the eleventh, then will all go well.

78. Six messengers did I place on my talking stone of prophecy: three above, the messengers Lord Buddha, Muhammad, and Christ; and three below, Padmasambhava, Quetzalcoatl, and Saint John of Patmos. Of these am I the seventh.

79. Pacal Votan am I, time's special witness, messenger of the Telektonon, instrument of the seventh angel, I declare again and again: All is number. God is a number. God is in all.

WAR OF THE RIGHTEOUS

80. Look carefully at my stone and listen: ten messengers, 24 signs, for ten are the number of orbits of planets around this star, Kinich Ahau, your Sun. From my point of origin, your star is designated 24, number of the circuit of externalizing intelligence. If you are of the righteous, then in this is a sign for you of your star mission.

81. And from each of the three oracle mouths of the arms of the cross of my Kuxan Suum, you will find twenty-four rays repeated three times, one-half the number of the elect (3 x 24 = 72). Add to this 3 times 11 (33) and the number is 105, the difference between the number of days in your solar orbit, 365, and the number of kin in my sacred count, my galactic spin, 260.

82. 13:20 is the ratio of natural sacred time. 12:60 is the ratio of the false time of the Tower of Babel. 13:20, thirteen moons, twenty fingers and toes. 12:60, twelve-month year, sixty-minute hour. Children of the day of truth, in this is a sign for you to discriminate between the power of the evil one who seeks to trap you in his machine, and the power of the righteous who need nothing but that with which God has endowed them: their body of time and their natural path synchronized by thirteen moons.

83. Children of the day of truth this is your only decision, for God knows and sees all that is in your hearts. People of the dawn, people of the book, on the hour of judgment unify yourselves in the only way you can: in time, as time, through time. For this in the year of kin 144, Telektonon is revealed to you, God's plan for peace on Earth, the last and only hope for spiritual renewal and salvation, immediate acceptance and adoption of the twenty-eight-day, thirteen-moon way, the calendar Telektonon. "And he had a name written that no man knew but himself." (Revelations 19:12) And that name is Telektonon.

84. Children of the day of truth, people of the dawn, people of the book, foursquare is my talking stone, invisible its design, its crystal lacing of star histories met in my human form. Time's special witness am I seeking apostles of time to organize the day of truth

into the revelation of God's redemption. Universal forgiveness awaits those who understand God's plan, a common time of twenty-eight days, thirteen moons, begun together at the appointed hour, on the day called Lunar Moon, the first day of the second year of prophecy.

85. Two solar faces there are upon my talking stone, the one an icon of my solar shield, Galactic Sun, the other, Lunar Sun, an emblem of the perfect lunar timing of Earth's solar orbit.

86. Children of the day of truth, the hour of judgment has come for you. How much longer do you need to suffocate in the Babylonian exile of 12:60 time? My children are the oppressed. Is it not time for the war of the righteous to restore equality? Why not wage the war then that destroys altogether the old time? Why not smash the caskets of the Babylonian wine of fornication in a single stroke?

HOLY VICTORY MARCH

87. 0 children of the day of truth, people of the dawn, people of the book, in your origins you were one blood, today the hour of judgment demands you become one again, unified in time. Who among you will join my apostles of the Telektonon? Already the gift has been given. Already we left for you the 13:20 tool, my sacred count of days, 260 kin, to turn the solar-lunar wheel of365 days. And when prophecy was vindicated at the conclusion of the ninth Hell, we sent among you the perfect form of this gift, Dreamspell, containing the message of the thirteen moons.

88. But this was not enough, the seventh trumpet had yet to sound, and so it did in the fortieth year following the discovery of my Uranian ark of stone. And now my prophecies are revealed. The Mayan Apocalypse of kin 144, Yellow Magnetic Seed, turns the seventh year of karmic destiny into the opening of the first of my seven seals of prophecy.

89. In this seal foursquare, all prophecies converge. The Beast of the G-7 stands revealed. The Babylonian Vatican is exposed. In the rainbow dream vision 144,000 of the elect are called again to meet, gathering together in circles to listen, to sing, and to dance to the song Telektonon.

90. 0 children of the day of truth, people of the dawn, people of the book, seven is my sacred power. Foursquare seven is 28, the number that, perfectly followed, opens Heaven's gate. Walking together the sacred thirteen moon, 28-day way, you will be joined to God's command, a holy victory march of the righteous to restore sacred order to this troubled Earth and to recover your lost powers.

91. Four powers of seven are given to you to be your comfort in the Victory March, one power for each of four perfect weeks, every twenty-eight days. By the first power of seven, claim your power of prophecy, by the second power of seven, maintain your power of prophecy; by the third power of seven, proclaim the victory of prophecy; by the fourth power of seven, become the victory of prophecy!

92. 0 children of the day of truth, 144,000 times thirteen is an army of the righteous. Learn again the count of sacred time and join this army. 0 children of the day of truth, realize that everything about the old 12:60 time is now become a garment of false being, a moral corruption, a banquet feast for the evil one.

THE STORM OF NON-EGO

93. 0 children of the day of truth, children of the people of the book, in the Storm is the sign of God's power. To the Storm is assigned the power of nineteen, the mystic saturation of all number. One hundred fourteen Suras, nineteen times six, the power of the Cube, are the number of Suras in the Holy Quran. Twenty-two years after the finding of my Uranian crypt, Telektonon, came complete revelation of the Quran's power of nineteen, Allah's mercy. Nineteen more years then to unfold the karma of Allah's prophet besieged by Babylonian conspiracy. Then comes the destined year nineteen, kin 144, hour of prophecy's convergence, moment of the day of truth.

94. Let the 124,000 messengers call forth a remnant of 20,000 more; let each of these sound seven trumpets, seven times. Let these seven times seven trumpets call for a following of God's perfect plan. Mark seven times seven years since the evil one showed his fiery face at Hiroshima. Be honored by God's cancellation ofIblis's power of moral oblivion. Let the storm of God's power of nineteen cleanse with cosmic mercy the blood of all martyrs from the thrones of Kings, and let these thrones themselves be dissolved by the pure water of sacred time flowing through the gardens of the righteous.

95. I am Pacal Votan, time's special witness, revealer of the Cube of the Law, devoted patron of the mystery that is woman, the consummation of the telepathic power of twenty-eight, known to me by name of Bolon Ik.

96. Pacal Votan am I, enigma to your men of reason. My existence is proof of the workings of higher law. Telepathy is participation in God's knowing, but is no cause to claim full knowledge of His powers. Prophecy too is natural law, the complement to God's mercy.

97. 0-19 is my code. In it are all demonstrations of the wisdom that is always close and near, but that comprehends the web of galactic being and all forms of its natural orders in time. Just as nineteen is the power of God's mercy, so zero is the fullness and emptiness all at once that characterize the nature of mind and all it can know.

98. Lord Buddha called this power of zero Sunyata. The special voice of Buddha, Padmasambhava, whose life span followed mine, exactly as Muhammad's preceded it, knew this Sunyata to be the basis of non-ego.

99. If you would know me and all that I witness for you in this hour of judgment, children of the dawn, people of the book, then practice the being that is non-ego.

THE ECSTASY OF DELIVERANCE

100. Because I repose on Telektonon, the mother of all prophecy, mine is the ecstasy of deliverance. With a mind of non-ego clasped to the heart of God I have sent out my

message of the Mayan Apocalypse. By relinquishing the calendar of twelve and leaving the prison of mechanized time, God's mercy will come swiftly to you.

101. Thirteen moons, twenty fingers and toes, thirteen joints, four limbs, five senses do you already possess. God's knowing and power of movement are already in you like a mother pregnant with child.

102. Why tarry now? When a house is burning, scurrying for your possessions will only cost you your life. This house that is burning is Babylon, the 12:60 way of life, which is now destroying your biosphere and poisoning everything about your life. Do not linger now fondling your machines. This is the Day of Judgment. If you can remember, leave this burning house and know that a better way has already been prepared for you, a holy victory march, my seven years of prophecy, Telektonon, the sacred revelation of time.

103. The Cube of the Law is awaiting its construction through the collective mind, spirit, and will of you, 0 children of the day of truth. Iblis, Satan, the evil one is none other than your ego clinging to the fatal lures of Babylon. God knows nonetheless exactly what is in your heart. Why not, then, become an apostle of the holy victory march? The ecstasy of deliverance is meant to be shared by all.

THE PROPHETS OF PEACE ARE AWAKENING

104. Pacal Votan am I, time's special witness am I, who bequeaths to you a talking stone, a legacy of place, Nah Chan, House of the Serpent, by prophecy known as Palenque.

105. And at Xochicalco, too, you will find stone utterances of my gospel left by command of my apostle, Topiltzin Ce Acatl Quetzalcoatl, who closed Christ's first millennium, as now my prophecy is come to close Christ's second millennium.

106. 0 people of the dawn, people of the book, children of the day of truth, make yourselves as one again and do not doubt the accuracy of the appointed hour on the day Lunar Moon! Synchronize now, and in all humility accept God's plan, twenty-eight days, thirteen moons, plus one day for deliverance and forgiveness.

107. Pardon now in public your enemy's indiscretions, and make full confession of your own transgressions. If you are sincere, God will see this in your heart and by His mercy many will follow your way; and if you proclaim for the cause of righteousness and truth, a new beginning and a new time, Telektonon, the thirteen moon way, and you enjoin others to do likewise, then God will know this, too, and make you a great general in the holy victory march.

108. And, if you have means and wealth, and you hear these words, or have explained to you the curse of 12:60 time and the blessing of 13:20 time, then do not doubt it and practice charity. Provide for the children orphaned by war and provide for the reconstruction of the Earth, that the practice of art and culture may flourish once again. Practice such charity with zeal, for soon you shall see an end to money. No more will flow the drunken wine of Babylon's fornication, and then what will you be with your paper credits and your useless machines?

109. The prophets of peace are awakening. Truly, the hour of judgment is come. Among the angels am I known as the mysterious benefactor of the righteous. Will you throwaway this opportunity, too? Beware for now the fire that consumes all falsehood is raging.

THE WIZARD'S HOARD OF THE LORE OF DEATH

110. People of the dawn, people of the book, children of the day of truth, because I am time's special witness, everything about my talking stone of prophecy is in fulfillment of God's divine plan.

111. Mine is the teaching of the 12:60 way of exile and the 13:20 way of redemption. Exactly 1,260 years passed from the dedication of my temple and closing of my Uranian crypt, A.D.692, 9.13.0.0.0, to its discovery and reopening in A.D.1952, 12.17.0.0.0. Another five times seven years, the numbers of my sacred ratio passed before the closing of the ninth Hell, A.D.1987, commemorated by the sacrifice of 3 Monkey, the first of four sacred signs on the western edge of my great talking stone. In this sacrifice was a sign of the death and transcendence of the way of the people of the book, "Joshua," and the people of the dawn, "Maitreya."

112. Eleven sets of triple disks, thirty-three in all, will you find upon my stone, for 33 is the number of the initiate, the middle harmonic of 65 that constitutes the Tzolkin, my sacred count of thirteen times twenty. All clear signs have I left for you, two borders of stars, the host of the Nine Lords of Time repeated by number on each side, top and bottom of my stone, a ledger of star histories complete in my form.

113. But especially would I have you look at Mars and consider again the disposition of the thirteen sacred signs placed around the edge of my stone, from 8 Ahau, my seal of truth, to 13 Cimi, the galactic closing of the wizard's hoard of the lore of death.

114. Ten emissaries celebrate the glory of my gifts for you, signs of peace from other worlds that beckon you to awaken from your sleep of Earthly Hell to join yourselves to God's command, Telektonon, the 28-day, thirteen-moon way and find in that count of days a path that leads directly to the paradise that is the repose and reward of the righteous.

115. One hundred forty is the number of the Telektonon, perfect its ratio 5:7 (28 x 5 = 20 x 7), the same as my sacred ratio 260:364(+1)

116. All is number. God is a number. God is in all.

SEVEN PERFECT ORACLES

117. People of the dawn, people of the book, children of the day of truth, this completes my testimony, I, Valum Votan, holder of the solar shield, protected have I been by the perfect love of Bolon Ik, who has stored my prophecy until this moment of release.

118. Seven perfect oracles have I given you, a perfect calendar of thirteen moons, an instrument to renew your spirit and your powers of Prophecy, Telektonon, and a book

of knowledge for you to penetrate the forgotten history of your star, Dreamspell. Also have I sent two messengers who bear witness to my truth, and thirteen perfect signs.

119. Now is the time of my prophecy. Now is the day of truth. Now is the opening of the seven seals. Now is the sounding of the seven trumpets. Now is the hour of judgment. Now is the song of the 144,000, the seed army of the righteous.

120. When the Lunar Moon has overflowed its banks, the G-7 will be no more.

121. When the Electric Wizard arrives, gather in banners of righteousness.

122. When arrives the Self-existing Storm, you will be fortified with spiritual abundance.

123. When comes the Overtone Seed, neither money nor priests will besiege you any longer, but the Earth will sing in harmony with your righteousness, Babylon will be no more, the Law of the Cube will be fully rehearsed in the hearts of the righteous.

124. In the sign of the Rhythmic Moon, senses will open to the manna of Heaven; no where will you find any longer signs of the evil one; a cosmic race will you be once again.

125. And when comes the seventh year, the Resonant Wizard will seal the Heavens and the Earth with the glory of all prophecy, the redemption of all prophets, messengers, apostles, and witnesses of truth.

126. Five years then will you have to close the cycle ofthe Seed, and another eight, thirteen years in all, to prepare for the coming of the Galactic Seed, 2013 Arcturus Dominion, the fulfillment of the star cycle of Valum Chivim, witnessed by the special agent, Pacal Votan, to the glory oflove, Bolon Ik, and on behalf of the mercy of God's divine plan, Telektonon, Cube of the Law, the mighty talking stone of prophecy.

"Man is one. Culture is indivisible. "

-ALBERTO Ruz, 1952, 12.17.0.0.0.

Transcribed 12 Seed, kin 64,
Resonant Moon Day 13,
Warrior's Cube 7, 0 Yax
Yellow Magnetic Seed Year, kin 144,
First Year of Prophecy

Blue Spectral Monkey/White Solar Wind
Tepoztlan, Morelos, Mexico

Appendix IV

The Nineteen Code

THE MYSTERY[1] of the motives of the hijackers, who were instrumented by divine will, if not by biospheric necessity, to catalyze the Inevitable Event, lies in their very number: nineteen. While the nineteen is related to the Quranic verse 74:30, "Over it is nineteen," and can be interpreted prophetically, the Law of Time confirms the Quran in demonstrating that the number nineteen possesses a supreme and indeed inviolable value. The Law of Time validates all that is true, and contains within it the mathematical confirmation of all systems of thought as different facets of the same synchronic order.

The Law of Time is based on the mathematical code of the Harmonic Module, itself a function and a demonstration of the 13:20 ratio. The vigesimal mathematics of the 13:20 frequency is known as the 0':"'19code, which is written with a simple dot-bar notation. As such the 0-19 code is a whole number system in which the count is not 1-9 but 1-19, and the positional zero represents a factor of 20 rather than of 10. As the demonstration of a radial mathematical code, the number 19 plays a singular role in the 13:20 matrix. As the largest compound prime number of the 0-19 count, within the context of this count 19 has certain unique properties and values. It may be asked: why 19?

First of all, let us consider the theological dimensions of the number 19 as hinted at by the Quranic verse 74:30. Long an enigma to scholars of the Quran, it was only through the genius of an Egyptian scientist, aided by a computer, that the meaning

of the verse was finally revealed as the nineteen code-an intricate mathematical system based on the number 19 underlying the entire structure of the Holy Quran.

"For the first time in history we have a scripture with built-in proof of divine authorship-a superhuman mathematical composition."l

The contribution of Rashad Khalifa (1935-1990) to the role and meaning of the Holy Quran for the entire modem world is without parallel. The martyrdom of this genuine seeker and messenger needs to be redeemed and placed in its proper light. According to Dr. Khalifa, "Nineteen is the common denominator throughout the Quran's mathematical system." "This is one of the greatest miracles" (74:35). To summarize in his own words, Dr. Khalifa states:

> The Quran is characterized by a unique phenomenon never found in any human authored book. Every element of the Quran is mathematically composed-the suras, the verses, the words, the number of certain letters, the number of words from the same root, the number and variety of divine names, the unique spelling of certain words, the absence or deliberate alteration of certain letters within certain words, and many other elements of the Quran besides its content. There are two major facets of the Quran's mathematical system: (1) The mathematical literary composition, and (2) The mathematical structure involving the numbers of suras and verses. Because of this comprehensive mathematical coding, the slightest distortion of the Quran's text or physical arrangement is immediately exposed.2

Like the Law of Time, which could only have been discovered after the opening of Pacal Votan's tomb, in A.D. 1952, the nineteen code of the Quran could only be discovered and unveiled over a twenty-two-year period between 1968 and 1990. Why? Because only with a modem computer could Dr. Khalifa subject every last word and letter of the Quran, in its Arabic original, to the rigorous analysis necessary to expose its mathematical perfection. As Dr. Khalifa writes in his footnote to 10:20 ("They say, 'How come no miracle came down to him from his Lord?' Say, 'The future belongs to God; so wait, and I am waiting along with you.'"):

> 10.20: In retrospect we see now that the Quran's miracle, indeed "One of the greatest miracles" (74:35), was divinely predestined to be unveiled 14 centuries after Muhammad. In view of the current condition of the traditional Muslims, ifMuhammad had been given this miracle, those Muslims, who are already idolizing Muhammad beside God, would have worshipped him as God incarnate. Additionally, this miracle is obviously designed for the computer age, and to be appreciated by mathematically sophisticated generations.3

The phenomenon of the intricate patterning of the nineteen code as witnessed, for example, in the 19 x 142 (2,698) occurrences of the word *God* in the Quran,

writes Khalifa, "alone suffices as incontrovertible proof that the Quran is God's message to the world. No human being(s) could have kept track of 2698 occurrences of the word 'God,' and the number of verses where they occur."4 One must bear in mind that the Quran was revealed in a time of primitive simplicity over a twenty-three-year period so that the suras and verses were separated in time and place, while the chronological order of the revelation of the suras is not at all the same as their final format. Moreover, the miracle of the nineteen code is not limited to the appearance of the word God, but is vast, intricate, and comprehensive. Dr. Khalifa lists a set of nineteen "simple facts" that confirm the Quran's mathematical coding. The "simple facts" are those not requiring a calculator or computer to be ascertained. We hereby reproduce these "simple facts," as they are presented in Appendix 1 of *Quran: The Pinal Testament* (all references to letters and words are to the Arabic original):

1. The first verse (1:1), known as *"Basmalah,"* consists of	19 letters.
2. The Quran consists of 114 suras, which is	19 x 6.
3. The total number of verses in the Quran is 6346, or (6234 numbered verses and 112 unnumbered verses *[Basmalahs].* 6234 +112 = 6346. Note that 6 + 3 + 4 + 6 =	19 x 334. 19.
4. The *Basmalah* occurs 114 times, despite its conspicuous absence from Sura 9 (it occurs twice in Sura 27). 114 =	19 x 6.
5. From the missing *Basmalah* of Sura 9 to the extra *Basmalah* of Sura 27 there are precisely	19 suras.
6. It follows that the total of the sura numbers from 9 to 27 (9 +10 + 11 + 12 . . . + 26 + 27) is 342, or	19 x 18.
7. The total (342) also equals the number of words between the two *Basmalahs* of Sura 27, and 342 =	19 x 18.
8. The famous first revelation (96:1-5) consists of	19 words.
9. This 19-worded first revelation consists of 76 letters,	19 x 4.
10. Sura 96, first in the chronological sequence, consists of	19 verses.
11. This first chronological sura is placed atop the last	19 suras.
12. Sura 96 consists of 304 Arabic letters. 304 =	19 x 16.
13. The last revelation (Sura 110) consists of	19 words.
14. The first verse of the last revelation (110:1) consists of	19 letters.

15. 14 different Arabic letters form 14 different sets of "Quranic Initials" (such as A.L.M. of 2:1) and prefix 29 suras. These numbers add up to 14 + 14 + 29 = 57 and 57= 19 x 3.

16. The total of the 29 sura numbers where the Quranic Initials occur is 2 + 3+ 7 + . . . + 50 + 68 = 822, and 822 + 14 (14 sets of Initials) = 836, or 19 x 44.

17. Between the first initialed sura (Sura 2) and the last initialed sura (Sura 68) there are 38 un-initialed suras. 38= 19 x 2.

18. Between the first and last initialed sura there are 19 sets of alternating "initialed" and "un-initialed" suras.

19. The Quran mentions 30 different numbers: 1,2,3,4, 5,6, 7, 8,9, 10, 11, 12, 19,20,30,40,50,60, 70, 80, 99,100,200,300,1000,2000,3000,5000,50,000, & 100,000. The sum of these numbers is 162,146= 19 x 6534.

Apart from the "simple facts," through use of his computer, a Hewlett Packard HP-IOOO E-series, Dr. Khalifa demonstrated many more complex levels of the coding of the number 19 throughout the Quran. These findings are synthesized in the Appendices to *Quran: The Pinal Testament,* and are also available in his other texts detailing his research, such as *The Miracle of the Quran.* The net effect of the truly monumental research effort exerted by Dr. Khalifa was the promotion of a highly reformed Islam based on "the Quran, the whole Quran, and nothing but the Quran." It is for this reason that Dr. Khalifa's translations of the Quran are referred to as "the Final Scripture," (1980) and the revised translation (1992) as the "Final Testament." It was also Dr. Khalifa's insistence on the Quran as the sole basis of Islam that earned him his martyrdom in Tucson, Arizona, on January 31, 1990.

NINETEEN IN THE TWENTY-COUNT POSITIONAL SYSTEM

The Law of Time-T(E) =Art, where T equals the 13:20 timing frequency ratio-upholds the validity of the research of Dr. Khalifa and graphically demonstrates *why* 19 is the mathematical factor that underlies the Holy Quran.

The fact that the Mayan vigesimal system is known as the 0-19 code, and that in this code 19, and not 9, has the supreme value of being the highest number, absolutely enhances the power and significance of Dr. Khalifa's discovery concerning

74:30, "Over it is nineteen." The supremacy of the value of 19, imperceptible if we only follow the decimal 1O-count, is fully demonstrated when we examine the 0-19 number code in which the numbers 0-19 are reproduced in a 5 x 4 (= 20) matrix, beginning with 0 and ending with 19. In this number set, which also demonstrates the mathematics of the radial matrix, there are ten pairs of numbers radially arranged, each pair of which adds up to 19:

0+19=19
1+18=19
2+17=19
3 + 16 = 19
4+15=19
5+14=19
6+13=19
7+12=19
8+11=19
9+10=19

In other words, within the parameters of the mathematical matrix in which nineteen is the integer with the highest value, its value completely informs the radial order of the entire vigesimal system. "Over it is nineteen." This is truly astonishing confirmation of the value accorded to 19 in the Quran. If the Quran is the true word of God, then we must expect that even knowledge unknown to Muhammad or Dr. Khalifa would be contained or coded in the Quran. We are referring, of course, to the Law of Time in its mathematical particulars, beginning with its mathematical base of expression, the 0-19 code.

19 = 7: NINETEEN IN THE 0-19 DOT-BAR NOTATIONAL SYSTEM

Just as the number 19 takes on a supreme value in the vigesimal system inconceivable in the decimal system, so the vigesimal order commands its own notational system. The 0-19 dot-bar notational system substantiates the meaning and power of 19 as the prime mathematical, saturated value unit in the twenty count. The dot-bar notational order is a holographic system distinct from the alphabetic system of Arabic numerals by which we write 1-10.

The distinction between use of the two notational orders is profound. This notational order uses only three notational symbols to build up the holographic context of

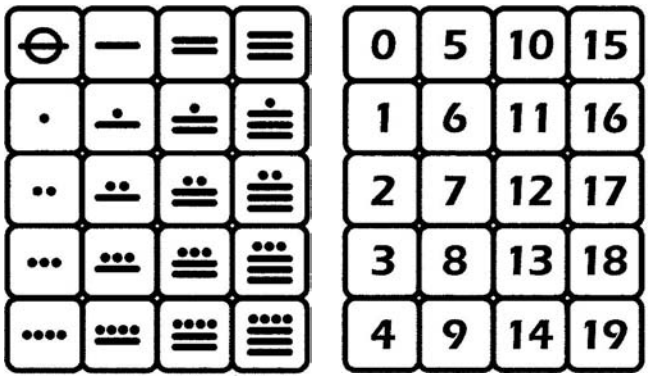

Any radially opposite set of numbers always equals 19, e.g., 4 and 15, 0 and 19, 9 and 10, 2 and 17, 11 and 8.

Nineteen is the highest value and the most saturated notation, being the only one with seven notational symbols—three bars and four dots.

Nineteen in galactic notation.
3 bars (3 x 5 = 15) plus four dots (4) = 19

Dot-bar notation system, 0–19 code

the fourth-dimensional number. One dot represents one unit; one bar represents a five-unit order; and a positional zero completes the system. The vigesimal notational system reveals the entire radial sequence of the 0-19 code to be a highly streamlined and aesthetic pattern. Brief contemplation shows that there are two patterned orders consisting of four vertical sets of five units each, and five horizontal sets of four units each. It is seen that nineteen represents the maximum saturation of both the vertical and horizontal orders, and consists of the maximum number of dots (four) and the maximum number of bars (three). It is also visibly manifest that 19 = 7 notational units, the maximum number of units.

The fact that 19 is represented by seven notational units confirms Sura 1, which has seven verses and the first line of which consists of nineteen Arabic letters. However, from the point of view of the Law of Time, 7 is the key implicit mathematical unit in the absolute timing frequency ratio, 13:20-the difference between 20 and 13 is 7, and the midpoint between 1 and 13 is also 7. While Dr. Khalifa is responsible for determining the dominance of nineteen as the mathematical key underlying the patterning and meaning of the Quran, the Law of Time provides an even more profound lens through which to consider Dr. Khalifa's work, by placing nineteen in a superior (vigesimal) mathematical and theological context.

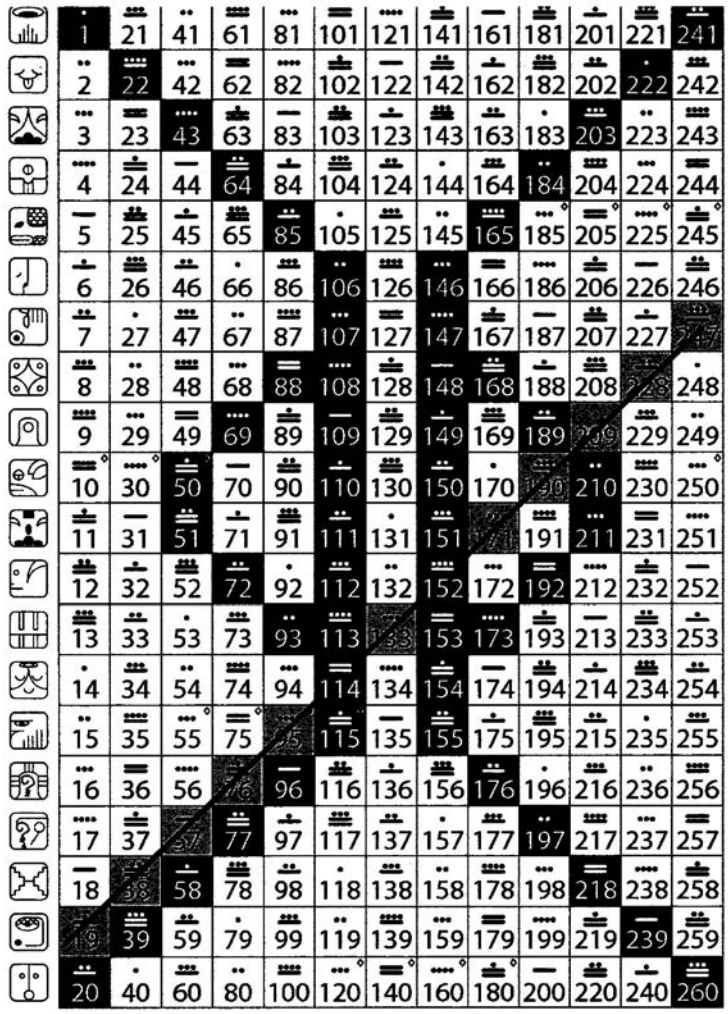

Nineteen Strand in Harmonic Module

Kin numbers beginning with 19, lower left, are advancing multiples of nineteen, the last being 19 x 13 (247). Actually, the difference between every kin number on this diagonal is a difference of 19.

19 = 260: THE TZOLKIN "OVER IT IS NINETEEN" STRAND

"All is number. God is a number. God is in all. "
-DYNAMICS OF TIME, POSTULATE 19.13

The 0-19 code provides the order of 20 in the ratio 13:20. Like the 0-19 radial matrix, the 13:20 ratio is also organized as a radial matrix of 260 (13 x 20) kin or units. As a cycle of 260 days, the 13 x 20 timing matrix is the fourth-dimensional

gauge that synchronically unifies the Thirteen Moon calendar. Known by the traditional and ancient Maya as the *Tzolkin* or "sacred count," the 13 x 20 gauge or Harmonic Module is the key to the mathematics of the fourth dimension, or the "Hereafter." Just as the mathematics of the third dimension is decimal-based, so the mathematics of the fourth dimension is vigesimal-based. Hence, the power of 20 as a self-existing proportion (4 x 5 = 5 x 4).

For any frequency to occur two proportions must be coincident. Thirteen, which is a function of the 7 factor, is the proportion that complements the 0-19 vigesimal proportion of 20. Hence the Tzolkin consists of twenty horizontal orders and thirteen vertical orders = 260 kin, which are also arranged in twenty sets of thirteen-kin wavespells, all numbered 1-13 in dot-bar notation. All of the kin in the 260-unit matrix are also individually numbered: kin 1, kin 2 . . . kin 259, kin 260.

Within the 13:20 order of260 kin, 13 sets of20 or 20 sets of 13, only two of the numbers in the vigesimal code 0-19 occur thirteen times: the number 19 and the number 20 (= positional zero). While 20 occurs precisely thirteen times, 19 occurs thirteen times with a remainder of thirteen (13 x 19 = 247 = 260 - 13).

The position and notational order of the thirteen occurrences of the number 19 in the 260-unit Tzolkin create a perfect strand of thirteen units. This 19 x 13 (19 = 260) strand demonstrates the supreme invariability and inviolability of the number 19 in the vigesimal code of fourth-dimensional time.

The purity of the movement of the 13 x 19 strand of the Tzolkin is further augmented by the vigesimal or 20-count manner of writing numbers. Even as transliterated into the Arabic system of writing numbers, it will be seen that in the vigesimal code every multiple of 19 always adds up to 19, a similar power held by all multiples of 9 in the decimal code. In vigesimal notation, the second order units are always multiples of 20 and not 10. Hence 38 = 1.18, where 1 = 20 + 18; or 5.14 = 114, where 5 = 100 + 14.

Finally, while the sequence 1-13 defines the thirteen galactic tones of fourth-dimensional time, the 0-19 matrix is represented by twenty icons and a four-color (4 x 5 = 20) permutation sequence. The combination of color, icon, and tone gives each of the 260 kin a "galactic signature." This completes the description of the Harmonic Modulerrzolkin.

We now present the thirteen multiples of 19 as defined by the 13 x 19 strand running from lower left to upper right in a perfect cross-stitch sequence that reverses the horizontal order of the 0-19 code frequencies. In other words, the first order represented is the order of (1 x 19) 19 (frequency 19, icon Storm), and the last is the

19 x 13 (19 = 260 code):

Each multiple of 19 is listed with a) kin number; b) vigesimal notation; c) galactic signature; d) 0–19 frequency order + tone number (Dynamics of Time Code); and e) number of units away from 20th position:

a. b.	c.	d.	e.
1 x 19 = kin 19 = 0.19	Blue Rhythmic Storm	19.6	1
2 x 19 = kin 38 = 1.18	White Crystal Mirror	18.12	2
3 x 19 = kin 57 = 2.17	Red Overtone Earth	17.5	3
4 x 19 = kin 76 = 3.16	Yellow Spectral Warrior	16.11	4
5 x 19 = kin 95 = 4.15	Blue Self-existing Eagle	15.4	5
6 x 19 = kin 114 = 5.14	White Planetary Wizard	14.10	6
7 x 19 = kin 133 = 6.13	Red Electric Skywalker	13.3	7
8 x 19 = kin 152 = 7.12	Yellow Solar Human	12.9	8
9 x 19 = kin 171 = 8.11	Blue Lunar Monkey	11.2	9
10 x 19 = kin 190 = 9.10	White Galactic Dog	10.8	10
11 x 19 = kin 209 = 10.9	Red Magnetic Moon	9.1	11
12 x 19 = kin 228 = 11.8	Yellow Resonant Star	8.7	12
13 x 19 = kin 247 = 12.7	Blue Cosmic Hand	7.13	13

What is sufficient is to contemplate the *formal inviolability of the number 19 as a constant (strand) within the Tzolkin matrix* as well as its *invariability of form when written in the vigesimal system.* That is, in the pure 0–19 notational system, any multiple of 19 always adds up to 19 and consists of 7 notational units, e.g., 8.11 (= 8 + 11 = 19) = 8 (= 1 bar 3 dots = 4 units) + 11 (= 2 bars 1 dot = 3 units) = 7 units (= 3 bars 4 dots = 19).

order of (13 x 19) 7 (frequency 7, icon Hand), showing again the intimate relation between 19, 13,6, 7, and 20, the key integers of the codes of fourth-dimensional time.

19 = 260, THE SIX SURAS THAT ARE MULTIPLES OF 19

In seeking proof of the Law of Time within the Quranic nineteen code, we need cite but a few examples that can demonstrate from within the nineteen code itself the key mathematical components of the Law of Time. In addition to the number 19, we

must look for any of the factors involved in the 13:20 frequency, such as 260, 7, 6-the difference between 19 and 13-and, of course, 13 and 20, or any of the multiples of these integers.

Following the method of Dr. Khalifa, probability analysis of mathematical constituents based on the assumption that certain numbers will be self-verifying, we start our program with the six suras that are multiples of nineteen:

Sura 19	"Maryam"	98 verses
Sura 38	"Saad"	88 verses
Sura 57	"Iron"	29 verses
Sura 76	"The Human"	31 verses
Sura 95	"The Fig"	8 verses
Sura 114	"People"	6 verses
=399, total of sura numbers		=260 verses in six suras that are multiples of nineteen.

= 19.19 vigesimal code

As can be seen, the sum of the six numbers of the suras that are multiples of 19 is exactly 399, or 19 x 21, the maximum factor in the vigesimal 20 x 20 matrix. Expressed in the vigesimal code this number, 399 = 19.19 [19 (x 20 = 380) +19], the only multiple of 19 in the vigesimal code that is written with two 19s, whose sum is precisely twice nineteen, 38, and is written with fourteen notational symbols rather than seven. This unique number, 19.19 (399), verifies "nineteen is over all," by placing 19 over 19 itself. The unique qualities of this most unique of multiples of 19 also indicates why the Quran consists of exactly six times nineteen suras. Six is the difference between the Quranic 19 and 13, the prime number of the Law of Time.

More amazing than the sum of the six suras that are multiples of 19 being 19.19 is the fact that the sum of the verses of these same six suras is 260. This is incontrovertible evidence for the formulation 19 = 260, and substantiates the mathematical patterning of the Quran to include the principle factor of the Law of Time, 260 (= 13 x 20). We are certain that Dr. Khalifa added the verses of these same suras and may have been perplexed at the meaning of the resultant number, 260. Of course, Dr. Khalifa did not know that 260 is the sum factor of the two proportions that create the natural timing frequency, 13:20.

It is also interesting that discovery of the 13:20 timing frequency, December 10, 1989, was made at almost the precise moment as Dr. Khalifa had completed the introduction to *The Pinal Testament,* the summation of his research on the Quranic nineteen code, Ramadan 26, 1409 (December, 1989). This points to the mysterious

movement of the Divine Will in establishing the mathematical proof of the Quran. Just as the work of Dr. Khalifa was terminated within a month of his completing the Final Testament, so the Law of Time, which would substantiate and vindicate the Quranic nineteen code, was ordained and propelled into its process of manifestation at exactly the same moment.

Now with the Law of Time the investigation begun by Dr. Khalifa is complete. Just as there are six suras that are multiples of 19 within the Holy Quran, so the key factor of the Law of Time, the number 260, is coded into the sum of the verses of these six suras. The door is opened for entirely new comprehension of the meaning and purpose of the Holy Quran. The Law of Time and the Holy Quran in mutual resonance will establish the proof of the advent and triumph of the Religion of Truth. (9:33,48:28; 61:9)

Most of the foregoing text of Appendix IV is taken from 19 = *260: The Holy Quran and the Law of Time* (1999), an unpublished manuscript by Jose Argiielles.

Notes

Preface

1. Meg Sullivan', "New Age Will Dawn in August, Seers Say. . .," *Wall Street Jou17lal,* June 23, 1987, p. 1. Front-page story on the Harmonic Convergence.
2. For the prophetic tradition of the Chilam Balam, see *The Book of Chilam Balam of Chumayel,* edited and translated by Ralph L. Roys (Norman, Okla.: University of Oklahoma Press, 1967); *The Codex Perez and the Book of Chilam Balam of Mani,* edited and translated by Eugene Craine and Reginald Reindorp (Norman, Okla.: University of Oklahoma Press, 1979); and *El Libro de los Libros de Chilam Balam,* edited and translated by Alfredo Barrera Vasquez and Silvia Rendon (Mexico City: Fondo de Cultura Economica, 1948, 1986). The issue of being a "prophetic messenger" is a touchy one for many people. However, as it is written in the Quran, "In truth we are always sending messengers. . ." (44:5). Messengers, as often as not, are self-revealed and confirmed only by God. In my case, I have been able to trace back the prophetic lineage of the Chilam Balam to Pacal Votan, from whom I have received direct transmission. The method of transmission is similar to that of the *terma* tradition of Tibet. Terma, or "hidden treasure," is left by a sage or prophet to be "discovered" at a precise moment much later in time by one designated to do so. See Tulku Thondup Rinpoche, *Hidden Teachings of Tibet: An Explanation of the Terma Tradition of Tibetan Buddhism* (Boston: Wisdom Publications, 1997).
3. This phrase is used often by Dr. Rashad Khalifa (1935-1990), whose groundbreaking translation and research of the Quran through the aid of the computer led to the discovery of the intricate nineteen-based mathematical code that underlies this unique text. His work is summarized in his translation of the Quran with its numerous appendices, *Quran: The Final Testament* (Fremont: Universal Unity, 1992). My own studies on this topic have resulted in two works: *Pacal TfJtIlm and Judgement Day* (portland, Oreg.: Planet Art Network, 1999), and *19 = 260: The Holy Quran and the Law of Time,* unpublished, 1999. See also Appendix IV to this book, "The Nineteen Code."

4. See, for example, Samuel P. Huntington's *The Clash of Civilizations and the Remaking of the World Order* (New York: Simon & Schuster, 1996, 1997); Benjamin R. Barber's *Jihad vs. McWorld* (New York: Random House, 1995, 1996); and Yossef Bodansky's *Bin Laden: The Man Who Declared War on America* (New York: Forum, 1999,2001). These writers, of course, all express a pro-globalization perspective.

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1. John ofPatmos, "Book of Revelation," Chapter 18, "The Fall of Babylon," verses 10, 16-17, 19-20, *The Holy Bible, New International Version* (Grand Rapids: Zondervan Bible Publishers, 1989), 1419-20.
2. Jose ArgUelles, *The Call ofPacal Votan: Time is the Fourth Dimension* (Glasgow: Altaea, 1996), 37.
3. Jose ArgUelles, *The Dynamics of Time: 260 Postulates* (Portland, Oreg.: Planet Art Network, 1999),30.
4. Kareng Koshev, "The Great Rainbow Bridge." Altai: unpublished paper, 2001.

Chapter 2

1. 1. Laptev, *The Planet of Reason: A Sociological Study of the Man-Nature Relationship* (Moscow: Progress Publishers, 1973; English translation, 1977),220.
2. V. 1. Vernadsky, "L'etude de la vie et la nouvelle physique" in *Revue generale des sciences*, vol. 41: 695.
3. V. 1. Vernadsky, *The Biosphere* (1926), abridged version (Oracle, Arizona and London: Synergetics Press, 1986), 22.
4. Ibid., 76.
5. Ibid., 77-78, 81.
6. Ibid., 82.
7. Ibid.
8. V. 1. Vernadsky, "Problems in Biogeochemistry II," in *Transactions of the Connecticut Academy of Sciences* (New Haven: Yale University Press, 1944),487-88,498.
9. v.1. Vernadsky, "Problems in Biogeochemistry II," Postulate 18, 511-12.
10. Jose ArgUelles, *The Dynamics of Time: 260 Postulates* (Portland, Oreg.: Pbnet Art Network, 1999), postulates 3.7 and 3.9, 24, 25.
11. V. 1. Vernadsky, "Some Words about the Noosphere" (1944), quoted in Andrey Lapo, *Traces of Bygone Biospheres* (Moscow and London: Mir Publishers and Synergetic Press, 1987),69.
12. Ibid., 71.
13. G. E. Hutchinson, "The Biosphere," *Scientific American*, vol. 53, no. 3 (1970): 223. Quoted in Lapo, *Traces of Bygone Biospheres*,77.
14. P. Duvigneaud, "Noosphere et l'avenir de la vegetation du globe," *Proceedings of the XII International Botanical Congress, Bruxelles*, 1979, 78. Quoted in Lapo, *Traces of Bygone Biospheres*, 76.

15. Tango Snyder, editor in chief, *The Biosphere Catalogue* (London and Forth Worth: Synergetic Press, 1985), 103.
16. V. 1. Vernadsky, "Scientific Thought as a Planetary Phenomenon," quoted in Lapo, *Traces of Bygone Biospheres, 73-74.*
17. Vernadsky, "Problems in Biogeochemistry II," 511.

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1. Maria Maroushkina, "Is a Path Beyond Technology Possible for the Western Culture?" Moscow: unpublished research paper, 2000.
2. James Glanz, "Physics' Big Puzzle Has Big Question: What Is Time?" *New York Times,* June 17,2001, p. D-1.
3. Ibid.
4. Dogen, "The Time Being," from *Moon in a Dewdrop: Writings of Zen Master Dogen,* edited by Kazuaki Tanahashi (New York: North Point Press, 1985), 76-77.
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6. Pierre Teilhard de Chardin, *The Future of Man* (New York: Harper & Row, 1959), 183.
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2. Jose and Lloydine Argiielles, *Dreamspell: The Journey of Timeship Earth 2013,* (Hong Kong: Interlink Productions, 1991), 35.
3. Ibid., 5-9.
4. Ibid., 14-15,60,61.
5. V. A. Ponko, private conversation, Novosibirsk, August 18, 2001.
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6. "Resolution Adopted by the Fourth General Conference on Communications and Transit of the League of Nations," *The Journal of Calendar Reform,* vol I: 162.
7. Argiielles, *The Dynamics of Time,* postulate 6.4,34.
8. *I Ching or Book of Changes,* translated by Richard Wilhelm and Cary F. Baynes (Princeton: Princeton University Press, 1967), 189.
9. Richmond, *Time Measurements and Calendar Construction, 70-71.*
10. David Ewing Duncan, *Calendar: Humanity's Epic Struggle to Determine a True and Accurate Year* (New York: Avon Books, 1998),307.
12. Richmond, *Time Measurements and Calendar Construction, 16.*

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1. Pierre Teilhard de Chardin, *The Phenomenon of Man* (New York: Harper & Row, 1955),288
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7. Muhammad Husayn Haykal, "Islamic Civilization as Depicted in the Qur'an," in *The Life of Muhammad* (Indianapolis: American Trust Publications, 1993),518.
8. Ibid., 518-19.

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1. See, for instance, Dan Oldenburg in the *Washington Post's* full-page article, "The Harmonic Convergence Revisited," May 4, 1990, p. D- 5.
2. *Nuestra Civilizacion Frente a la Reforma del Calendario* (Our Civilization Confronted with Calendar Reform) (Buenos Aires: Casa Editora Sudamericana, 1944), 6.
3. F. H. Colson, *The Week: An Essay on the Origin and Development of the Seven-Day Cycle* (Cambridge: Cambridge University Press, 1926), 2.
4. Quoted in Jose Argiielles, *Charles Henry and the Formation of a Psychophysical Aesthetic* (Chicago: University of Chicago Press, 1972), 128.

Appendix I

1. *San Jose Mercury News,* quoted on book cover of David Ewing Duncan's *Calendar, 1998.*
2. Duncan, *Calendar,* 289.
3. Philip, *Reform of the Calendar,* 10 1-2.

Appendix II

1. Charles Muses, *Destiny and Control in Human Systems: Studies in the Interactive Connectedness of Time (Chronotopology)* (Boston- Dordrecht- Lancaster: Kluwer-Nijhoff Publishing, 1984), 20-21.

Appendix IV

1. Rashad Khalifa, *Quran: The Final Testament,* (Fremont, Calif.: Universal Unity, 1992), 375. All further quotes from the Quran and from Rashad Khalifa are from this same work, which in addition to containing the complete Quran in translation also includes thirty-eight Appendices summarizing Dr. Khalifa's research.
2. Ibid., 375.
3. Ibid., 123.
4. Ibid., 375.

Glossary

THIS GLOSSARY IS constructed to aid the reader in developing a more systematic and technical comprehension of the Biosphere and the Law of Time. Though by no means exhaustive, it is hoped that the terminology used in the text is herein defined in a manner appropriate to cultivating a noospheric point of view.

13:20 timing frequency: Fourth-dimensional timing frequency mathematically expressed as the ratio constant .13:20; universal frequency of synchronization by which the universe is maintained in synchronic order; basis of Law of Time; codified as 260-unit 13:20 matrix of Harmonic Module, coordinates Thirteen Moon/28-Day calendar with synchronic order.

12:60.timing frequency: Artificial, purely third-dimensional timing frequency based on combination of irregular twelve-month calendar and mechanistic sixty-minute hour, adoption of which results in unconscious program within the human mental order, causing the species to deviate altogether from the natural biospheric order, resulting in the technosphere.

astronomical time: Measure of time in third-dimensional physical space without regard to intrinsic harmonics of the synchronic order, usually interpreted as duration and, based solely on matter that is in constant state of entropy, results in standards of measure characterized by infinitesimal.slippages of time and consequent fractional number sequences in need of periodic correction.

baktun: Fifth order of Mayan vigesimal number sequence; in time reckoning equals 144,000 kin (days), or 394.52 years; thirteen per great cycle, measure of human historical era or "great cycle": 3113 B.C.-A.D.2012.

biogenic migration of atoms: Biospheric principle by which evolution over time within finite quantity of living matter (biomass) is accounted for by changes of atomic.,cellular-

molecular state and condition; occurring uniformly at periodic transitions accounts for major evolutionary mutations.

biogeochemical, biogeochemical combustion: Term used by V. 1. Vernadsky to refer to biospheric dynamic as whole system order unifyIDg living (bio) and inert (geochemical) matter in a single process; biogeochemical combustion occurs when exponential curve of acceleration of biogenic migration of atoms becomes absolutely vertical, precipitating advent of noosphere.

biomass, biomass constant: Sum quantity of living matter, which, according to Vernadsky, has remained relatively stable since the origin of life on Earth; as a constant, maintained by synchronic timing factor mathematically described as an annual orbital ratio of 73(5) = 365 days per solar orbit of Earth.

biosphere: Sphere or mantle oflife and its geochemical support system distributed throughout Earth's ocean-land surface

biosphere-noosphere transition: Description of the transformation of the general biospheric condition due to accelerated excitation of biogenic migration of atoms creating release of free energy and consequent biospheric destabilization, characterized as biogeochemical combustion, whose resolution is emergence of new evolutionary order, the noosphere; change from historical technosphere to post-historic, post-technological phase.

Bolontiku: Nine Lords of Time; in Mayan cosmology, nocturnal rulers of the underworld or *inframundo;* guardians of the passage of death and resurrection; keepers of time and the knowledge of time as noospherically registered in Earth's orbit.

calendar: Derived from the Latin *calends,* or account book, a day for making payments; generic word used to define systems of timekeeping based on measure of Earth's orbit around the sun, often utilizing synodic measure of the moon as a means of calculating.

Chilam Balam: "Jaguar priest," name of Mayan prophet *(ah bobat)* who lived just before the time of conquest, which he accurately predicted; name given to lineage of Mayan prophets extending from the end of tenth baktun (circa A.D. 830) up until the nineteenth century; name given to series of post-conquest texts in which the various categories of prophecies of this lineage are recorded.

chronomancy, geochronomancy: "Divination by time"; the science and art of fourth- dimensional time considered as a whole system where science is knowledge and art is practice; oracular method of reading the synchronic order; description of incipient "Earth time science" incorporating principles of whole Earth geomancy into time structures of the synchronic order.

chronosphere: Sphere of time that activates noosphere; fourth-dimensional field created by the planet holon in resonance with the rotation of the third-dimensional planet body; coded as movement of four chromatics (biopsychic field) across the planet holon, stitching together gravitational fields (five Earth families) and electromagnetic fields (four color families).

chronotopology: Term coined by Charles Muses to define any geography of time and consisting of an event point of meaning that creates a root meaning from which time-formed, -blossomed, or -radiated meanings emerge above a horizon of meaning.

Day Out of Time: The 365th day of the Thirteen Moon/28-Day calendar, no day of the week or month at all (52 x 7 day weeks = 13 moons times 28 days = 364); occurs on Gregorian correlate date July 25, and precedes Thirteen Moon "New Year's" or synchronization date, correlated to July 26.

Dreamspell: Any agreed-on consensus reality; a collective mind-set defining a noospheric epoch, such as "Dreamspell of history"; term given to proofs and tools demonstrating radial and fractal principles of fourth-dimensional mathematics; cosmo-mythic structure of Earth history and its future, otherwise known as *Dreamspell: The Journey of Timeship Earth 2013.*

free energy: Release into biosphere of gases (such as carbon monoxide) and other chemical by-products of industrialization that accelerate biogenic migration of atoms, resulting in biogeochemical combustion; in noosphere refers to release of spectral plasmic-atmospheric phenomena through human telepathic interaction with the electromagnetic field.

fourth dimension: Dimension of time greater than and containing three dimensions of space that it informs and governs.

galactic signature: Combination of one of thirteen galactic tones and twenty solar seals that constitute the harmonic module and that code any given day of the third-dimensional Thirteen Moon calendar.

geocosmic: Holonomic perception expressing unification of Earth whole with the cosmic order.

Gregorian (Julian) calendar: Current world standard calendar consisting of twelve irregularly numbered and obscurely named months coordinated by the 7-day week and intercalary leap year system establishing 28-year cycles; created by the reform of Pope Gregory XIII (1572-1583) in 1582, which "corrected" the Julian calendar (established by Julius Caesar, 45-44 B.C.)by lopping off ten days and refining the intercalary system so that only centuries that are multiples of four are leap years; supreme example of astronomical time measure; principle macro-organizing principle establishing 12:60 artificial timing frequency.

Hannonic Module: 260-unit mathematical matrix of 13:20 frequency, inclusive of a 52-unit binary triplet configuration or set of galactic activation portals; sometimes referred to as Tzolkin, 260-kin sacred count of the Maya; basis of fourth-dimensional vigesimal mathematics of time; coordinated with third-dimensional calendar of Thirteen Moons, establishes basis of 260 galactic signatures.

heliosphere: Sun and its system of planets considered as a whole organism; also known as heliocosm.

holonomics: Of or pertaining to the law governing whole systems.

holonomic consistency and reciprocity: Law by which any whole principle of reality is capable of evoking a like response or reflecting a fractal order at whatever level or through whatever structure.

holon: Any organic whole unit, fractally replicable; basis ofholonomics, law governing whole systems.

human holon: Fourth-dimensional structure of the human being conforming to the 13:20 frequency (twenty digits, thirteen main articulations).

Hunab Ku: "One giver of movement and measure"; in Mayan cosmology, can refer to God as the Supreme Creator.

Inevitable Event: Law of Time definition of the point in synchronic order when the artificial time generated curves of machine, human population, and money converge exponentially in one dramatic, prophecy-fulfilling moment, marking the conclusion oftechnospheric expansion; name given to the events of September 11, 2001 (9-11), epitomized by the col~ lapse of World Trade Center Twin Towers (Fall of Babylon).

Julian Count: Established by Thomas Scaliger, 1583, the year after Gregorian calendar "reform," to establish a linear count of days beginning January 1, 4714 B.C.,some 1,600 years prior to commencement of thirteen baktun Long Count of the Maya; official modern scientific count, basis of linear time paradigm.

katun: Fourth order of vigesimal mathematics = 8,000 kin; in Mayan time count, where the second order vinal is 18 and not 20, a katun = 7200 kin, or 19.7 solar years; twenty katuns equal one baktun of 144,000 kin; 260 katuns per thirteen baktun cycle.

kin: In fourth-dimensional mathematics the base unit of measure, possessing fractal properties; one day and night or turn of Earth on its axis; any human being so designated by assuming the galactic signature of the date of birth.

Law of Time: T(E) =Art, Energy factored by Time equals Art, where T (time) is the fourth-dimensional universal synchronization frequency constant 13:20, E (energy) refers to any phenomenal manifestation, and Art to the fact that the synchronizing frequency of time harmonizes everything into a natural condition of beauty.

Long Count: Mayan count of days (kin) measured by thirteen baktuns of 144,000 days each for a total of 1,872,000 kin, the measure of history from JulianiGregorian correlates August 13, 3113 B.C. to December 21, 2012; still maintained through use of Tzolkin by Quiche Maya, Guatemala.

lunar calendar: System of time measurement using synodical measure of the moon-from new moon to new moon, approximately 29.5 days; twelve lunar months equaling a total of 354 days, eleven days short of the measure of solar orbit; used by many of the Old World civilizations; with the exception ofIslamic lunar calendar, most lunar calendars intercalate a thirteenth moon, seven per every nineteen years.

machine: Capacity for the human to externalize its internal processes as well as motor functions into different means of mechanical reproduction, the sum possibilities of which establish a technological complex requiring constant maintenance, thus subordinating human consciousness to its level; the ultimate manifestation of the 12:60 timing frequency; any industrially produced tool believed to advance the level of human comfort and accomplishment.

noosphere: Earth's mental envelope or field, discontinuous with and above the biosphere; unconscious until the discovery and application of the Law of Time; activated by registration of the human biomass in correct 13:20 timing frequency via universal adoption of Thirteen

Moon calendar; description of transformed state of biosphere, coincident with the end of history; condition of universal telepathy subsequent to collapse of technosphere and application of Law of Time; functions in tandem with programs from Earth's octahedral core.

noospheric chip: Description of human operating in noosphere, holonomically resonant with intrinsic 13:20 codes of synchronic order, capable of interacting with the psi bank to participate in the creation of Earth's rainbow brain.

Noospheric Earth Time (NET): Time measure based on Earth in its orbit in relation to the sun and moon in heliospheric space, rather than from the perspective of human (astronomical time); base unit of measure is one rotation of Earth on its axis or one kin (one night and day), which establishes one NET minute; twenty-eight NET minutes per Moon, or one NET hour, 365 NET minutes, or Thirteen NET Hours plus one NET minute per solar orbit; takes into account that for any NET minute axial magnetic bipolarity of Earth is a changing dynamic reaching two peak points called solstices and two stable points called equinoxes; this four-part division is holonomically registered daily in two peak points, midnight (where day begins and ends) and noon, and two stable points, sunrise and sunset.

occult quartet: Demonstration of radial mathematics of Harmonic Module where the tones of any four kin radially equidistant from each other always equal 28; or the tones of any two kin radially opposite always equal 14.

octahedral core: Iron crystal structure at center of Earth; plasmic storage zone in resonance with the noosphere; in 7:7::7:7, telepathically coordinated by four time atoms (= one master time molecule).

omega point: In the work of Pierre Teilhard de Chardin, defines the climactic convergent point (harmonic convergence) of human evolution as the emergence of the hyper-personal; defined by the Law of Time as point of full superconscious establishment of universal telepathy as the norm of the human mental condition; dawn of omega point: winter-northern-summer-southern solstice, 2012, completion of omega point dawn, Yellow Galactic Seed (July 26,2013), otherwise known as Dreamspell of galactic culture.

oracle: For anyone of 260 kin of the Harmonic Module, a cruciform five-part structure demonstrating a uniform set of mathematical relationships in relation to the (0-19) code number of the daily solar seal (destiny kin) informing any day of the Thirteen *Moonl2* 8-Day calendar; consists of center, code number of destiny kin; right analog kin-always 19 when added to the number of destiny kin; left, antipode kin-always a difference of 10 from the destiny kin; below, occult kin-when added to destiny kin always equals 21; and above, guide, always the same color as destiny kin.

Oxlahuntiku: The Thirteen Lords of Time that govern the power of the cosmic order of time that is based on circulatory power of prime number 13 (as opposed to 12, which is static and non-circulatory); coded as thirteen 28-day moons that govern terrestrial solar orbit; basis of prophecy cycle of Quetzalcoatl, Thirteen Heavens (Oxlahuntiku) and Nine Hells (Bolontiku); in Telektonon prophecy, the thirteen-year cycle-2 000-2 013-in which the first four years, 2000-2004, establish self-existing power of time, and last nine years, 2004-2013 are coded by the Bolontiku, the Nine Lords of Time.

Pacal Votan: Mayan prophet (A.D.603--683), chief technician of Mayan synchronic time science; eleventh ruler of the dynasty of Palenque (Nah Chan), Chiapas, Mexico; assumed power in A.D.615, but key rulership occurred in critical 52-year cycle, 631-683 (seventy-third such cycle since commencement of thirteen baktun count); best known for the carved sarcophagus lid of his elaborately concealed tomb discovered in 1952, 1,260 years after its dedication in A.D.692, which was also 1,320 years before the closing of the cycle, 2012.

Pax Cultura, Pax Biospherica: Principle of new human social order following establishment of Thirteen Moon/28-Day calendar and inaugurating the advent of the noosphere (2004) in which nation-state is replaced by biospheric regionalism governed by a Planetary Biospheric Assembly; due to perfect harmony of new world standard calendar of thirteen moons/28 days, harmony, art, and aesthetic values elevate culture as the new operating norm of the human reintegrated within the biosphere, hence *Pax Cultura, Pax Biospherica.*

planet holon: Twenty-part icosahedral noospheric matrix superimposed on Earth's surface; corresponding to 0-19 code of twenty solar seals, creates three orders analogous to three planetary fields of resonance; gravitational field-horizontal order of five Earth families of four seals each; electromagnetic field-four diagonal bands, from lower left to upper right, of the four color families (red, white, blue, yellow) of five seals each; and biopsychic field-the four chromatics of five seals each moving diagonally from upper left to lower right, which coordinate the daily sequence of the motion of the chronosphere.

psi bank: Regulating mechanism of the noosphere consisting of four bipolar plates, each plate in mirror symmetry containing 520 (260 x 2) psi chrono units, 2,080 in all, which are the complete registrations of the universal fourth-dimensional 13:20 timing frequency governing all of the various evolutionary stages of the terrestrial biogeocosm; engine of the chronosphere, located between the two radiation belts 2,000 and 11,000 miles above Earth's surface.

psi chrono unit: Time-bearing information unit; base unit of the psi bank; codes and contains all information for anyone of the 260 galactic signatures of the 13:20 matrix or Harmonic Module; psycho activated through coordination with Thirteen Moon/Telektonon known as Rinri Project.

Psychozoic Era: Term coined by V. 1. Vernadsky defining the next geological era; meaning the era of the spiritualization of life, it is coincident with the noosphere in its full emergence after the omega point has been reached, 2012-2013.

Quetzalcoatl: Mexican prophet (A.D.947-999) who left the legacy of prophecy of Thirteen Heavens and Nine Hells, basis of Harmonic Convergence (1987) and commencement of the "Time of Prophecy," 1987-2013.

Quran, Holy Quran: Literally "recitation;" last revelation and moral-spiritual criterion for historic humanity; received over a twenty-three-year period by the Prophet Muhammad (A.D.570-632); proven by Dr. Rashad Khalifa (1935-1990) to be a radically nonlinear text rigorously constructed of a nineteen-based mathematical code.

radion, radial plasmas: Telepathic fluid or lubricant released through telepathic interaction with the seven primary plasmas, or electrically charged particles, hence radial plasmas; the

names of the seven plasmas replace the names of the week in the Thirteen Moon/2 8-Day calendar; activated in the 7:7::7:7 Telektonon Revelation practice.

radiosonics: Name given to the new science based on synchronicity rather than causality and in which, as a consequence, synaesthetic experiences and syntropic values are normalized.

rainbow brain: Description of activated noosphere, where human telepathic interaction with the electromagnetic field triggers the release of the circumpolar rainbow bridge-Earth's day-night alternator system.

Rinri Project: Law of time practice for coordinating the opening of the psi bank, psi chrono unit per psi chrono unit, on a daily basis over a four-year cycle by means of the Thirteen MoontTelektonon.

synchronic order: Order of fourth-dimensional time, in contrast to third-dimensional astronomical time, that synchronizes all aspects of third-dimensional physical plane reality including its timekeeping systems; entirely new domain of human mental-spiritual experience coincident with the dawning of noosphere; characterized by absolute harmonic perfection, described by vigesimal 0-19 code, as distinct from decimal, hex, or duodecimal mathematics that govern third-dimensional timing codes.

synchronometer: Measure of synchronization or synchronicity; precise Law of Time definition of means and purpose of what is generically referred to as the "calendar."

technosphere: Global sphere of technology; artificial stage between biosphere and noosphere, representing the climax-biogechemical combustion-of acceleration of biogenic migration of atoms precipitating biospheric crisis as a prelude to the advent of noosphere; characterized by exponential curves of human population, machine, and money at expense of biospheric integrity and stability; defined as the specific fifty-six-year cycle (two Gregorian 28-year cycles) 1945-2001, in which war and terrorism are the governing features; complete manifestation of the 12:60 order of time; concluded on September **11,2001,** the Inevitable Event.

Telektonon: "Earth Spirit Speaking Tube," the name of the psychoduct leading from the tomb of Pacal Votan beneath the Temple of the Inscriptions to the temple floor atop the pyramid, the discovery of which, in 1949, led to the excavation and revelation of the long-concealed tomb in 1952; name given to the prophecy ofPacal Votan, decoded in 1993-1994, prophesying the Thirteen Moon/2 8-Day calendar as the only means to keep the human race from destroying the biosphere and itself; definition of the fourth-dimensional structure of the heliosphere in which consciousness is a function of the planetary orbits; basis of a board "game" coded to synchronic order via Thirteen Moon calendar for the awakening of telepathy; basis of the Cube of the Law, days 7-22, containing numerous principles of the Law of Time as a daily practice; basis of other practices for establishing synchronic order as principles of a new consciousness, including *20 Tablets of the Law of Time* and the 7:7::7:7.

third dimension: Space; physical plane of reality coordinated and contained by time, fourth-dimensional order of reality.

Thirteen Moon/28-Day calendar: Pragmatic application of the Law of Time, perpetual harmonic perfection of which is intended to correct for disorder of human consciousness resulting from adherence to irregular, astronomical timing standards and mechanistic timing devices; coordinated with Harmonic Module and Telektonon establishes means for conscious human participation in synchronic order; 28-day measure based on female menstrual cycle, also corresponds to apsidal measure of moon from the point at which the polar axis is tipped farthest from Earth; prevalent in pre-history, all but eliminated by historical consciousness that made 13 taboo; perfect vehicle for establishing noosphere as daily consciousness in post-technospheric post-history.

time: Fourth dimension; universal factor coordinating space to manifest synchronically; traveling faster than speed of light, accounts for instantaneity of information transmission (telepathy) from distant points; expressed as formulation which states that the velocity of time is instantaneously infinite; fourth-dimensional structures that are radial and fractal in nature, third-dimensional cycles being manifestations thereof; expressed as T(E) =Art, accounts for universal harmony of the cosmos.

tun: Third positional order of vigesimal mathematics where one unit =400 kin; in Mayan time count, because of second positional order, vinal, being 18 instead of 20, one tun =360 kin; basis of measure ofkatuns and baktuns in Long Count, where 5,200 tuns =260 katuns = 13 baktuns, or 5,125 solar years.

Tzolkin: "Sacred Count," 260-day calendar of the Maya, basis of Mayan time knowledge and the Long Count; temporal manifestation of Harmonic Module or universal 13:20 timing matrix.

UR: "Universal Religion," "Universal Recollection;" description of human spirituality in the noosphere or Psychozoic Era.

vigesimal, 0-19 code: Twenty-count based mathematics utilizing zero for positional orders that advance in exponential binary fashion; also known as 0-19 dot-bar code notational system, where dots equal single units, bars equal five units, plus positional zero; basis of mathematics of fourth-dimensional order of time, distinct from mathematical systems of third-dimensional space.

Wave Harmonic of history: Fourth-dimensional description of thirteen baktun cycle (3113 B.C.-A.D.2012) identified precisely with 260-unit Harmonic Module, where each of thirteen baktuns contains twenty katuns (13 x 20); basis of creating synchronic order out of entropic disorder of third-dimensional historical time.

wavespell: Thirteen-unit cosmological form-constant for coordinating fourth-dimensional timing cycles; consists of two gates, Magnetic first position and Cosmic thirteenth position; two towers, fifth and ninth positions; and three sets of chambers, nine chambers in all; when coordinating Thirteen Moon/28-Day calendar, known as Planetary Service Wavespell.

Wizard's Count: Name of count to establish synchronic order as manifestation of the Law of Time in order to transit from 12:60 technosphere to 13:20 noosphere; based on

prophetically modified year-bearer count of the Chilam Balam tradition; correlated by the Dreamspell to July 26, 1987, White Galactic Wizard, every four years there are four year bearers: Yellow Seed, Red Moon, White Wizard, and Blue Storm (one four-year Seed-Storm Year bundle) that, combined with thirteen galactic tones creates 52-year solar-galactic cycle, or in NET time, one Earth Year, also known as a Wizard's Year.

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The Inevitable Event and the End of History

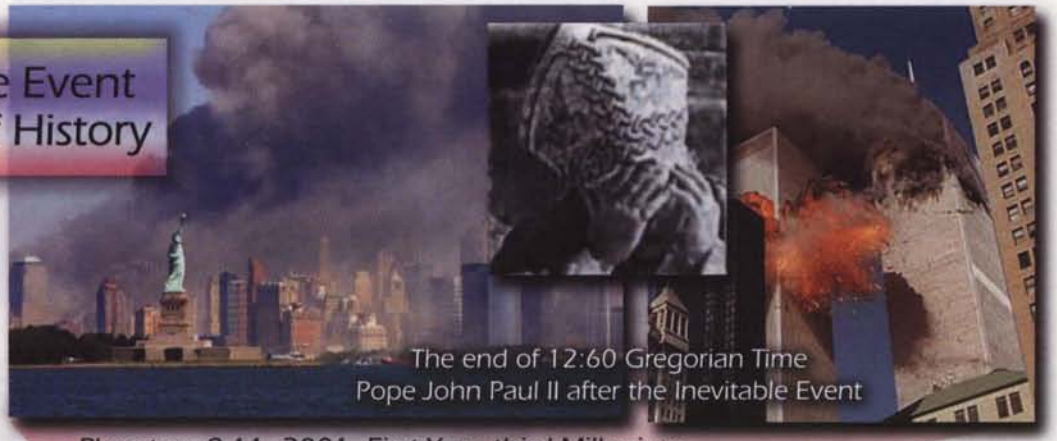

Planetary 9-11, 2001. First Year, third Millenium

"Woe! Woe, O Great City, O Babylon
in one hour your doom has come!"
—Revelations, 18:10

11 Years Before

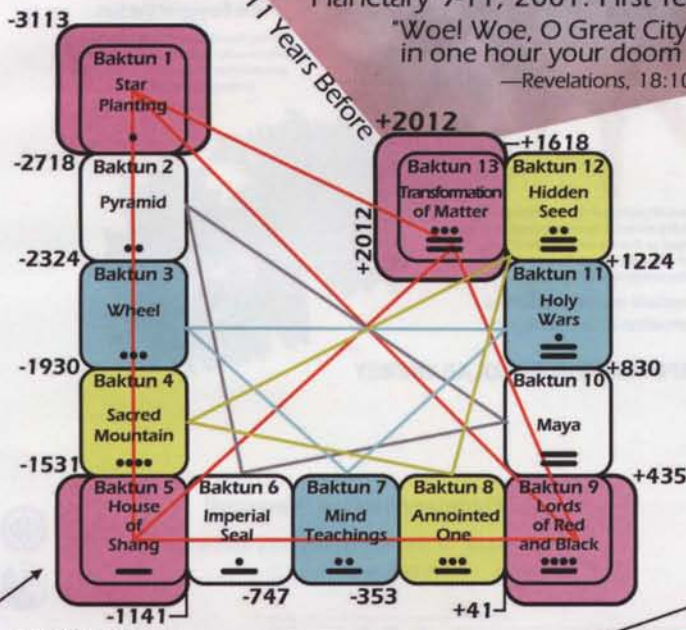

Baktun 13 - Katun 260 - 1993 - 2012
End of Second Christian Millennium A.D. 2000

13 Tone Wavespell
as Thirteen Baktun
Wave Harmonic
of History

Harmonic Module
13 Baktun
260 Katun
13:2 Matrix of History
1 Kin = 1 Katun
1 Baktun = 20 Katuns

Nostradamus Prediction
of nuclear destruction of
New York in Year 2000

Cover of "Istoe" (Brazil) May, 1996. "End of the World."

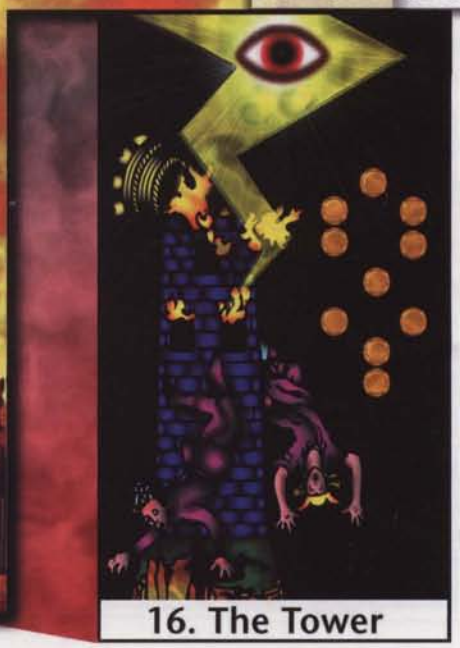

16. The Tower

The total mass of living matter has never differed considerably from the present value.

The Continuity and Invariance of Life on the Earth

Living matter today is genetically connected with all the living matter of preceding ages, and conditions favorable to life on Earth have never differed vastly from those of the present.

Multiplication as a Manifestation of Transformed Solar Energy

The movement of living matter resulting from the multiplication of organisms operates with an astonishing regularity.

The rate of production of new living matter is proportional to the amount already produced.

Whatever may be the phenomena of life, the energy evolved by organisms is mainly (perhaps entirely) the radiant energy of the Sun

Vegetation as a Transformer of the Energy of the Sun.

We may regard living matter in its entirety as the peculiar and unique domain for the accumulation and transformation of the luminous energy of the Sun.

Throughout all geological ages the chemical effects of living matter on its surroundings have not changed, so that the composition of the crust and of the living matter are the same today as they have always been.

The Biosphere as a Region for the Transformation of Cosmic Energy

LIFE IS THE TRANSFORMATION OF SOLAR ENERGY

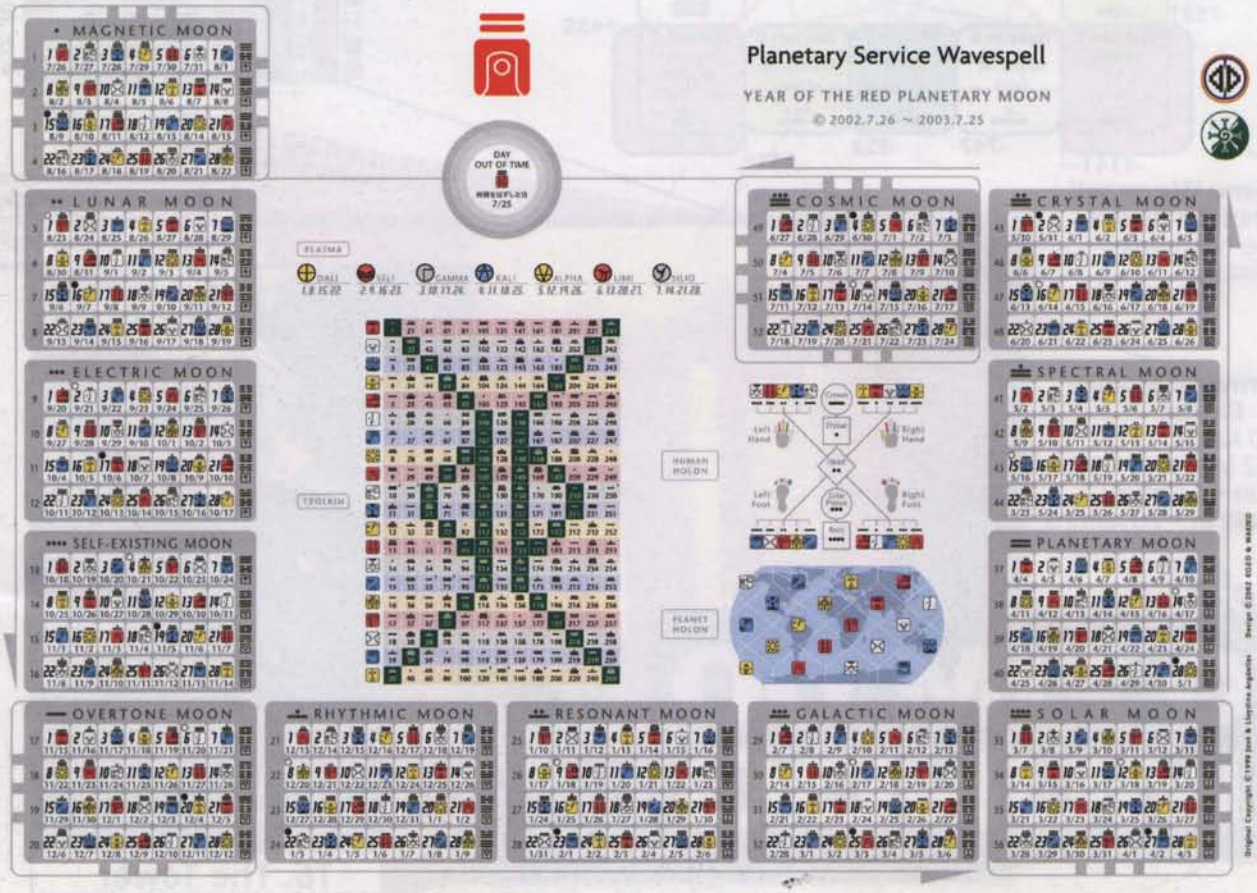

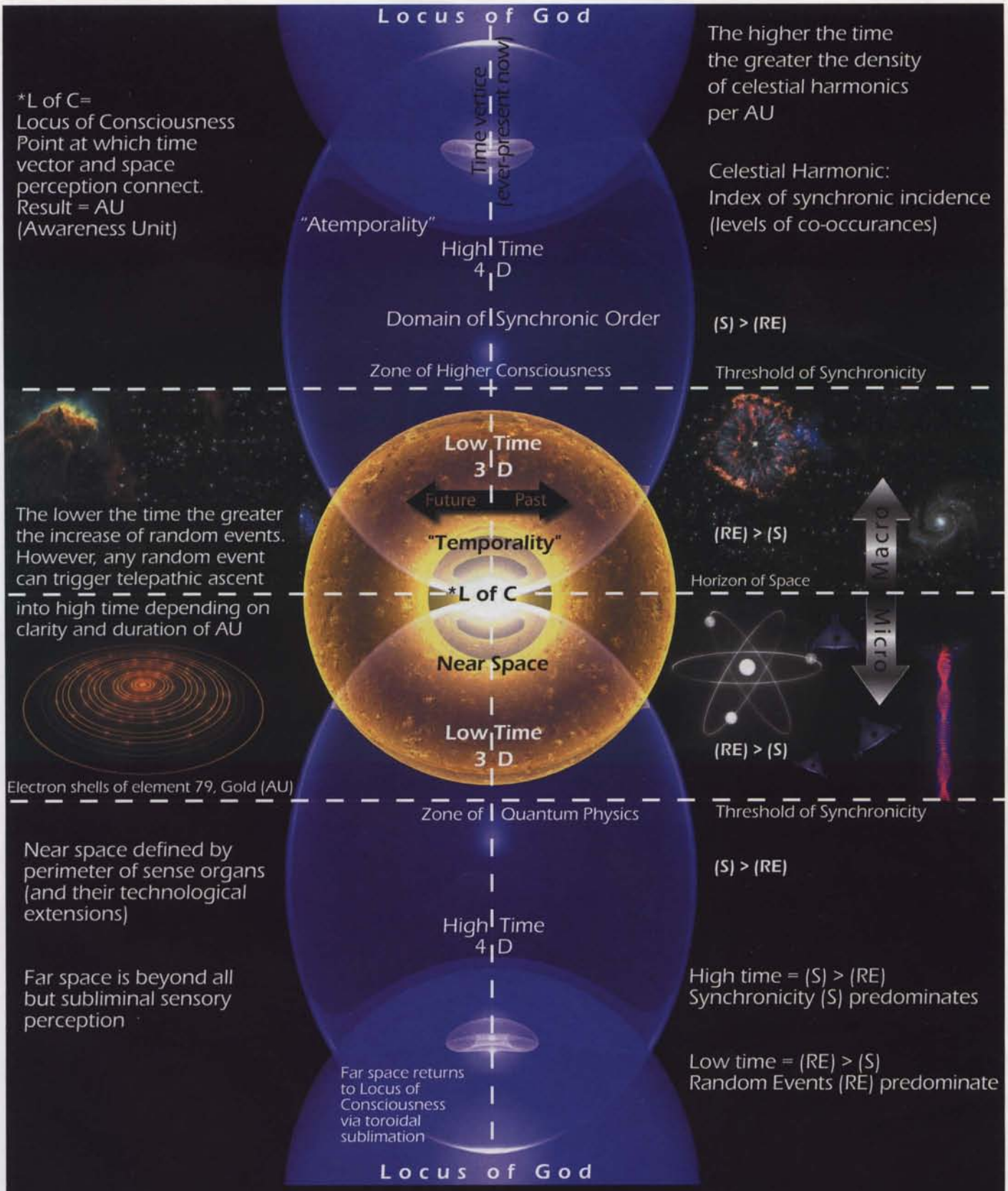

Model of "Vertical Time" in Relation to Horizontal Space

A Presentation of the Foundation for the Law of Time
T(E)=ART. Energy factored by Time equals Art.

The Dynamics of Time
Showing the Evolution of Time as Consciousness - T(E)=Art

GALACTIC BRAIN, or evolutionary spectrum showing index of energy-mind progression from atomic-cellular biological to purely mental conditions of being, T(E)=Art. Energy factored by time equals art.

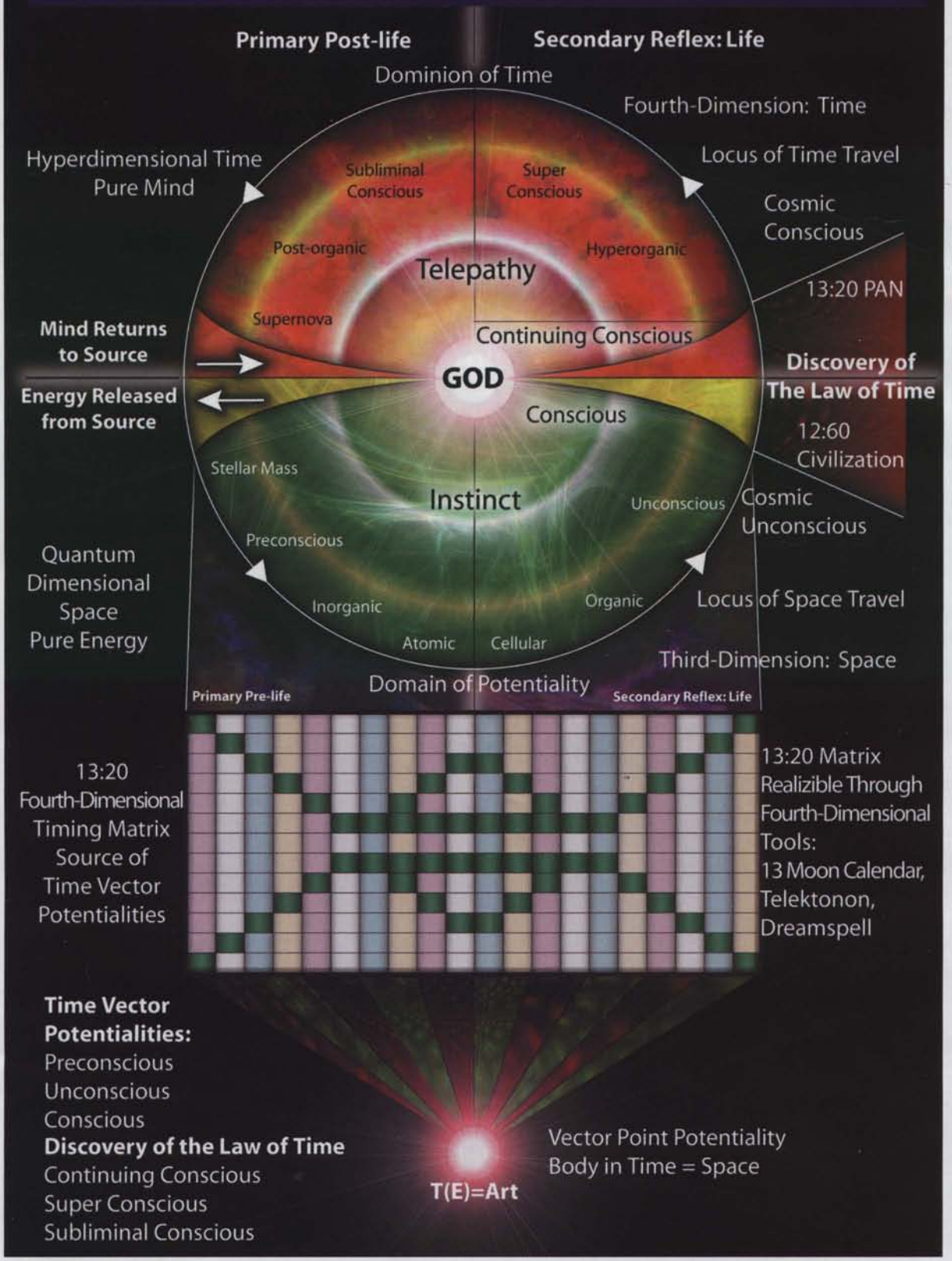

Noospheric Time Map - Wave Harmonic of History

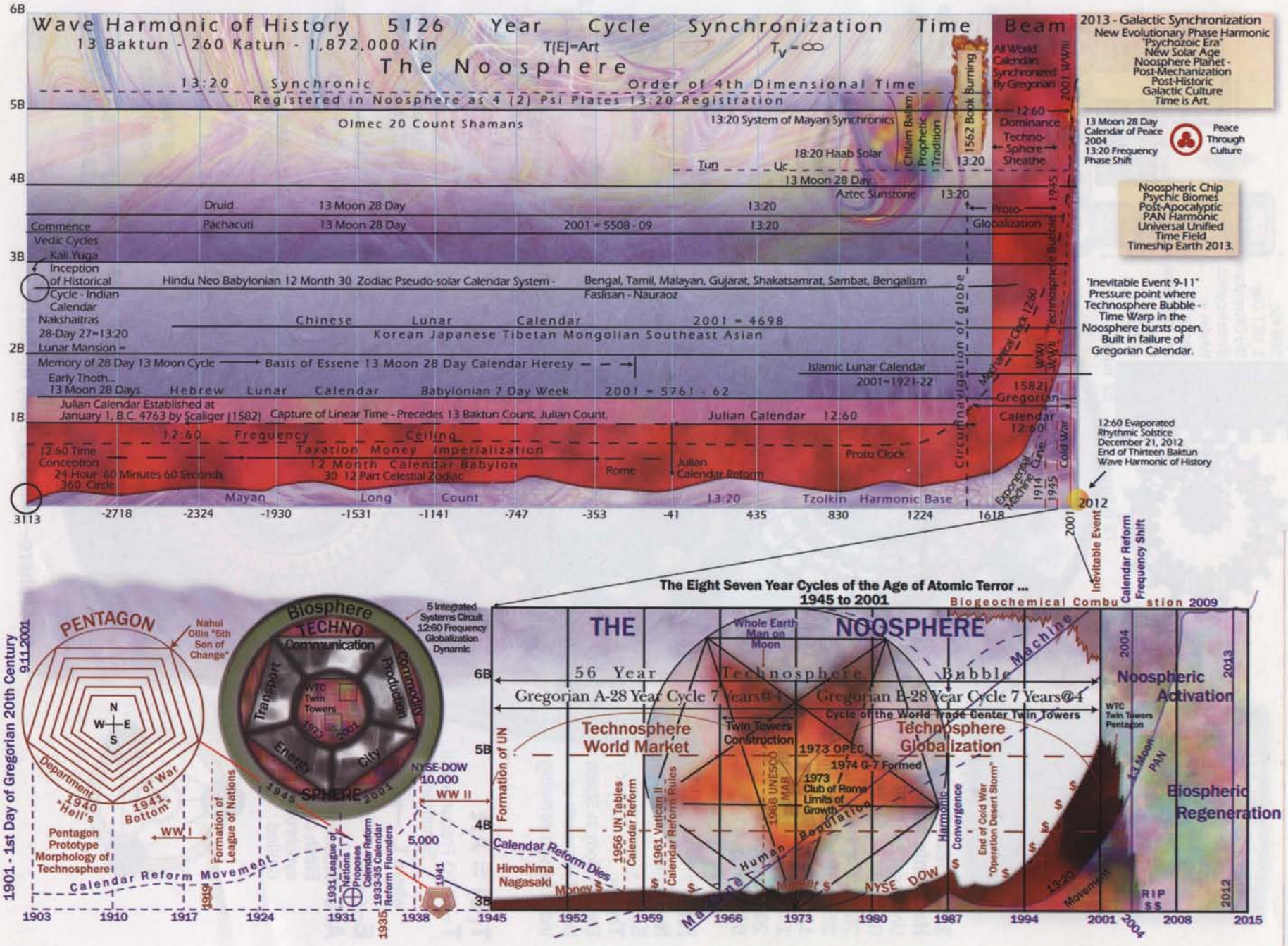

260 Kin
4th Dimensional
Wheel of
Synchronic
Order =
Factor of
Synchronization=
1 G-Spin =

73 G-Spins = 52 Years

365-Kin
1 NET Day
3rd Dimensional
Biotelepathic
Wheel =
Factor of
Life Experience
(73:5)
(7:52)

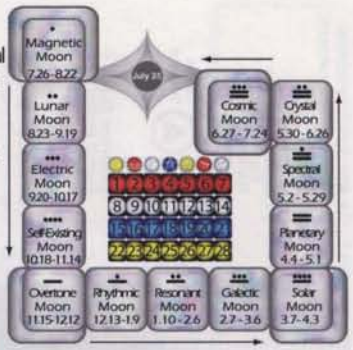

Wavespell = 13 Tones
1 Tone = 1 Moon = 28 Kin
1 Kin = 1 NET Minute

◐ = 1 NET Minute
x 28 = 1 NET Hour.

7 NET Minutes =
¼ Hour =
1 Week ◔

13:20 Matrix
Harmonic Module
Universal Synchronization
Gauge =
260 Kin = 1 Galactic Spin =
260 NET Minutes
13 NET Minutes =
1 Wavespell (13 Tones)
20 Wavespells =
9 NET Hours, 8 NET Minutes

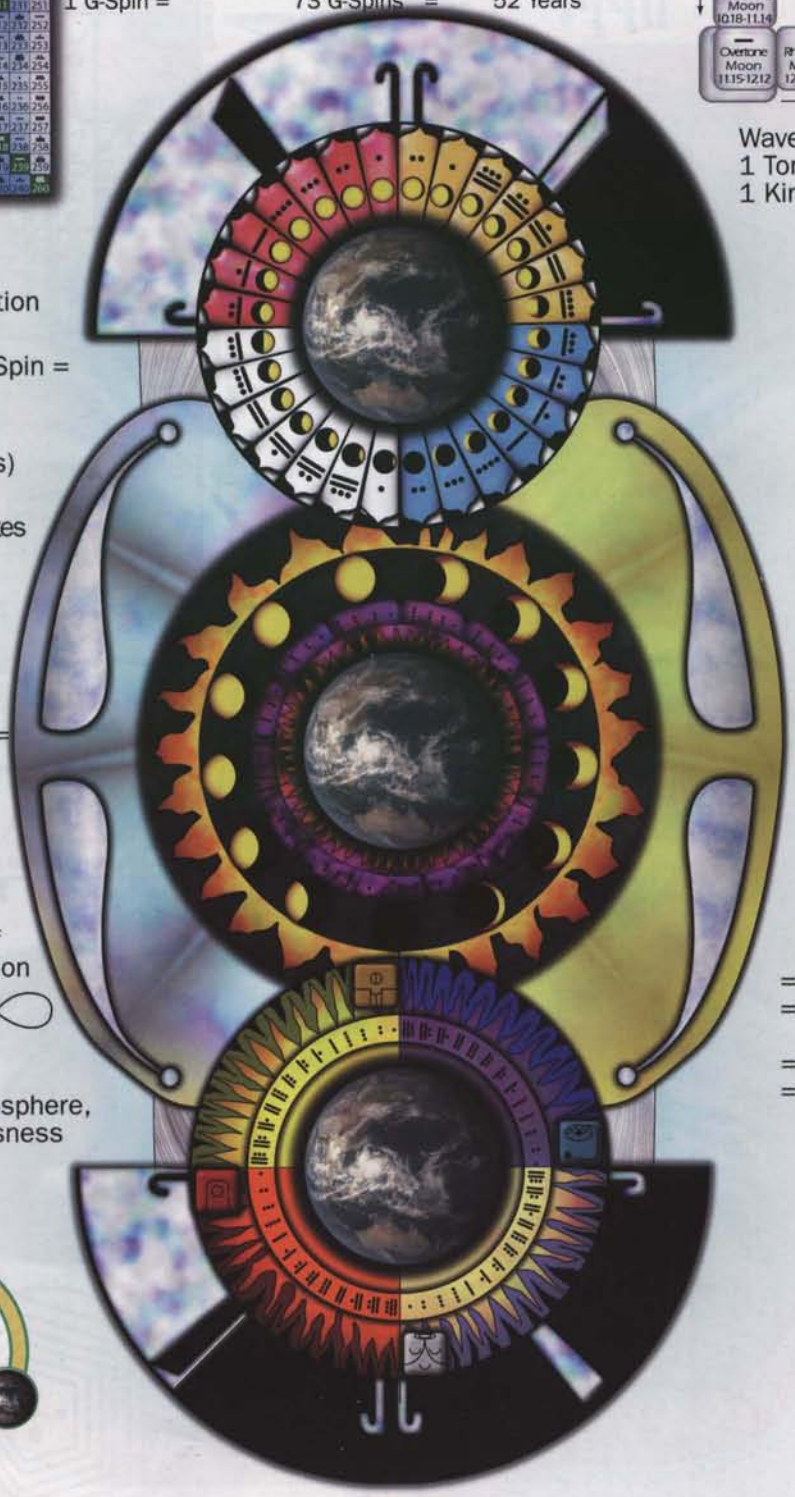

1 NET Hour =
1 Moon ◑

1 Moon (NET Hour)
= 1 Lunar Orbit

◑ =1 NET Hour x 13
= 1 NET Day
(13 NET Hours)
= 1 Solar Orbit
= 13 Lunar Orbits

NET
Noospheric
Earth
Time =
Earth = Body in Space =
Unit of measure of
index of synchronicity

T(E) = Art
T=13:20 Frequency of
Synchronization
where $T_V \rightarrow \infty$

E= Earth
Art= Blossomed Noosphere,
Earth consciousness
synchronically
unified

52 NET Days
= 52 Solar Orbits
= 1 NET Year

= 73 Galactic Spins
= 13 Seed-Storm 4-Year
Bundles

1 4-Year Bundle =
1 NET Week

13 NET Days=
1 NET Season

1 NET Week=
4 Solar Orbits

1 NET Season=
13 Solar Orbits

Noosphere—Mind of Time on Earth

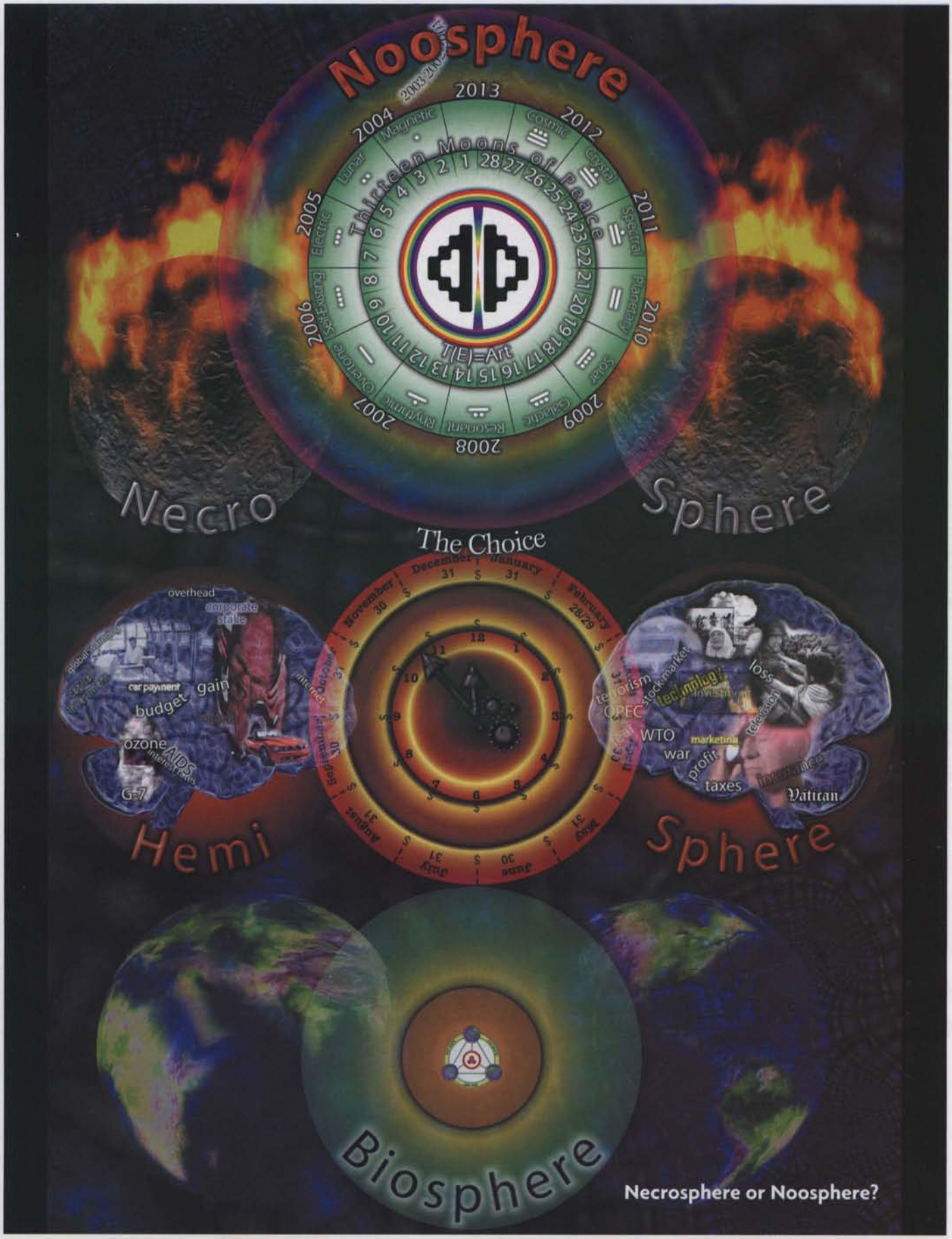

Necrosphere or Noosphere?

A Chronotopology of Transformation

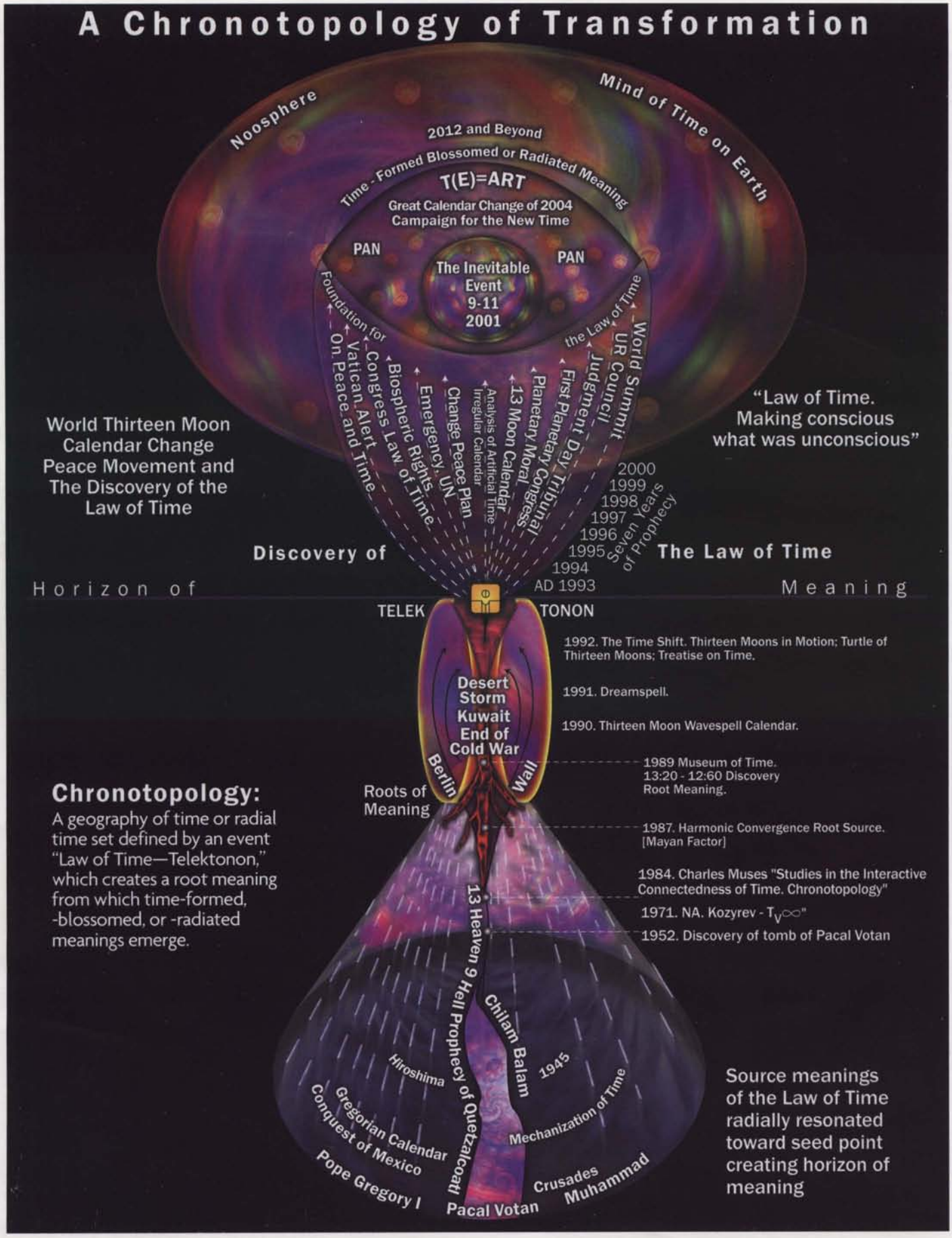

Paul J. Nahin

Time Machine Tales

The Science Fiction Adventures and Philosophical Puzzles of Time Travel

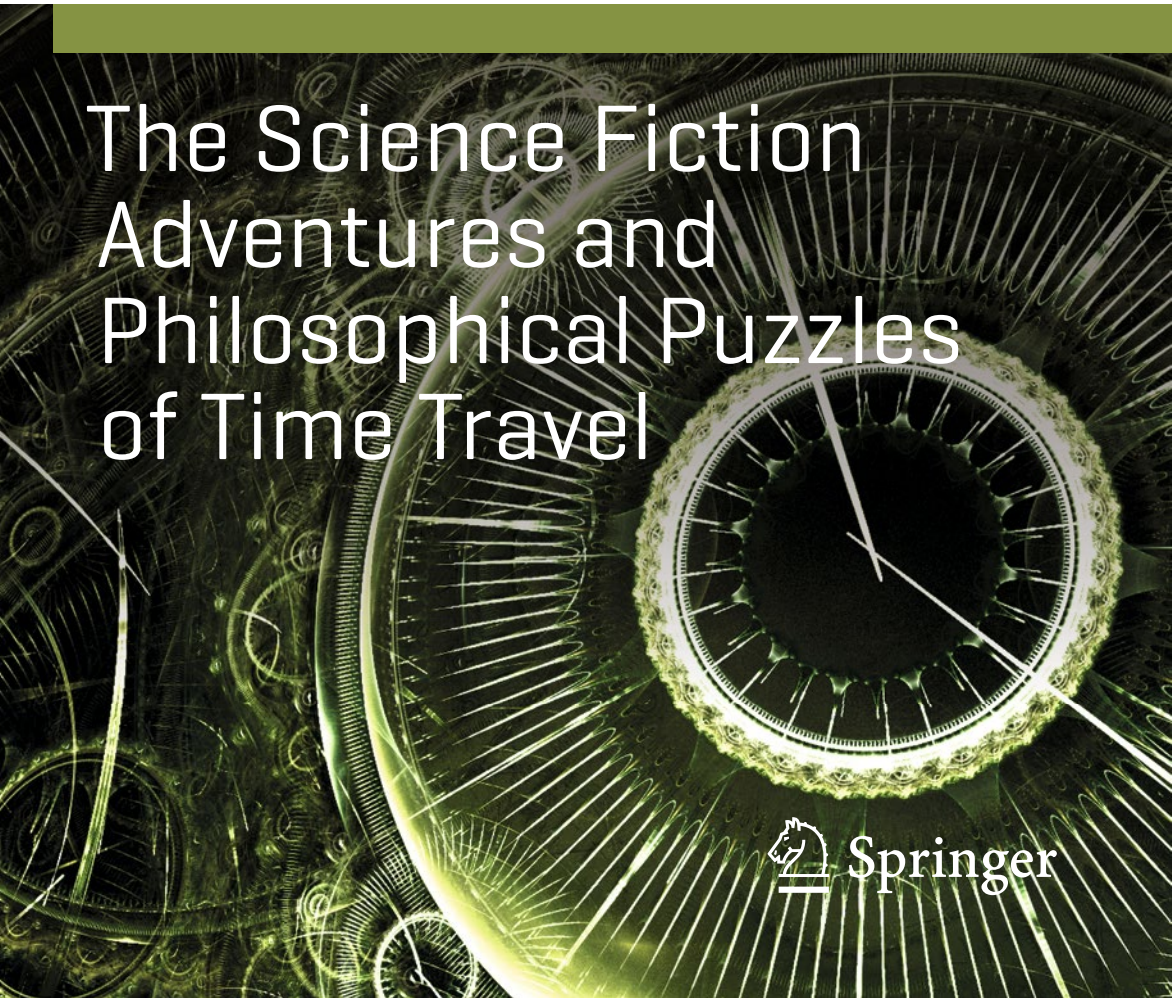

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Paul J. Nahin

Time Machine Tales

The Science Fiction Adventures and Philosophical Puzzles of Time Travel

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Frontispiece: The Pioneers of Time Travel

The scientific pioneers were Albert Einstein (1879–1955) and Kurt Gödel (1906–1978), good personal friends who are shown here in 1954 at the Institute for Advanced Study in Princeton, New Jersey, in a photo taken by Richard Arens. It was Einstein's 1916 general theory of relativity (theory of gravity) that Gödel used as the basis for his 1949 paper that was the first to show that the general theory does **not** forbid time travel into the past.

The literary pioneer of time travel was of course Herbert George Wells (1866–1946), who is shown here as a college freshman cut-up around 1885. The photograph was taken as a prank by an unknown friend while Wells was a student in a biology course given by Thomas Huxley, at the Normal School of Science in

South Kensington (a branch of the University of London). A far too thin and impoverished Wells was then still a teenager, and *The Time Machine* lay a distant 10 years in the future.

Einstein/Gödel photograph courtesy of the American Institute of Physics Emilio Segré Visual Archives of the AIP Niels Bohr Library. Wells photograph courtesy of the rare Books and Special Collections Department of the Library of the University of Illinois at Urbana-Champaign.

A Note on the Story Citations and Science Fiction History

"You will find it a very good practice always to verify your references, sir."
—advice given in 1847 to a young scholar by Martin Joseph Routh, President of Magdalen College, Oxford

Most of the pulp science fiction stories I've cited in this book, in their original form as ink on paper, have long since vanished from our region of spacetime and exist today only (alas) on microfilm reels in scholarly vaults. I am especially indebted to Texas A & M, the Claremont Colleges, the California State Universities at Northridge and Fullerton, Mount Holyoke College, the New York City Public

Library, and the University of Delaware, for giving me access via Inter-Library Loan (through my home institution, the University of New Hampshire) to their extensive archives of ancient science fiction magazines.

A number of the really good stories *have* been anthologized, however, and so are still readily available today in book form. In essentially all cases, though, for historical reasons, I've given the original publication information (magazine and date). You can find which of the stories cited are available in one or more anthology reprints by going to an immensely useful, searchable database on the Web, at: http://www.isfdb.org, and I gratefully thank all those in the science fiction community responsible for creating and maintaining that database.

The following two books by science fiction historian Sam Moskowitz (1920–1997), who lived through what Isaac Asimov called the 'Golden Age of [magazine] Science Fiction,' may be difficult to find today but, if you are interested in the early history of *magazine* science fiction (beyond simply the subgenre of time travel), the hunt for them will be well worth your time:

Science Fiction by Gaslight: a history and anthology of science fiction in the popular magazines, 1891–1911 (World Publishing Company 1968);

Under the Moons of Mars: a history and anthology of "The Scientific Romance" in the Munsey Magazines, 1912–1920 (Holt, Rinehart and Winston 1970).

Some First Words

> Is time travel in principle (never mind the difficulties) a possibility? It has received some thought in the past and deserves some more.
>
> —David Park, in his 1980 book *The Image of Eternity*

> He used to have quite a reputation, but the last couple of years he's been working on time . . . You know, time travel, that sort of rot. An A-1 crackpot.
>
> —a character (discussing a colleague) disagrees with Park, in Mack Reynolds' "Advice from Tomorrow," *Science Fiction Quarterly*, August 1953

In 1993 the first edition of my book *Time Machines* was published by the Press of the American Institute of Physics. In 1999, after Springer acquired AIP Press, the second edition of that book appeared. So, is this the third edition? Well, yes *and* no. It *is* because large chunks of the 1999 edition are still here, along with new discussions of the advances by physicists and philosophers that have appeared in the intervening 18 years. The prime example of that centers on the time travel paradoxes. Those discussions contain mostly what is in the second edition, but they have also been brought up to date with the latest thinking on the paradoxes, by physicists and philosophers.

And yet this book is *not quite* the third edition because the emphasis is now on the philosophical and on science fiction, rather than on physics as it was when written for AIP Press. In that spirit there are, for example, no Tech Notes filled with algebra, integrals, and differential equations, as there are in the first and second editions of *Time Machines*. That's because I wish to avoid having this book seem to be simply a long physics treatise. I have, in fact, some sympathy with the following views, expressed by two philosophers:

"There is one metaphor in the physicist's account of space-time which one would expect *anyone* to recognize as such, for metaphor is here strained far beyond the breaking point, i.e., when it is said that time is 'at right angles to each of the

other three dimensions.' Can anyone really attach any meaning to this—except as a recipe for drawing diagrams?"[1]

and

"This is from the outset a study in descriptive metaphysics. In consequence, I shall have nothing to say about twice-differentiable Lorentzian manifolds, Minkowski diagrams, world-lines, time-like separations, space-time worms [a 'thick' world-line], or temporal parts."[2]

I don't *completely* endorse these sentiments, however, and so please understand that I am not denying the ultimate importance of *physics* when it comes to achieving a deep understanding of time travel. To quote yet another philosopher,

"Arm chair reflections on the concept of causation [are] not going to yield new insights. The grandfather paradox is simply a way of pointing to the fact that if the usual laws of physics are supposed to hold true in a chronology violating space-time, then consistency constraints emerge. *[To understand these constraints] involves solving problems in physics, not armchair philosophical reflections* [my emphasis]."[3]

I could not agree more. So, in *Time Machine Tales* you *will* find some physics. In support of time travel to the future (and in how to make a wormhole time machine for travel into the past), for example, I'll show you a high school level derivation of the famous time dilation formula from special relativity. There are some spacetime diagrams, some simple algebraic manipulations, and here and there just a touch of freshman calculus; even the metric tensor gets a few words, too. But it is, admittedly, pretty light-weight stuff.

So, while certainly saluting the premier position of physics, *Time Machine Tales* is not a scholarly, in-depth treatment of time travel physics. Rather, it is an examination of how science fiction writers (and many philosophers, too) have viewed time travel. (Even in the physics discussions, science fiction will regularly appear.) Those views, by their very nature, are far more romantic than are those of hardcore theoretical physicists. History has shown, of course, that the results of the work of theoretical physicists may, in the end, prove to actually be far more astonishing than anything fiction writers cook-up—and if there is any scientific subject for which that may again prove to be true it's time travel—but for us, here, it will be the fiction writer who has center stage.

The philosophers will be only slightly less important in this book. While much of the early philosophical literature on time travel and backwards causation reads like imaginative fairy tales spun out of vacuous vapors (more on this soon), many modern philosophers have shown themselves to be quite sophisticated. What they

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[1]C. W. K. Mundle, "The Space-Time World," *Mind*, April 1967, pp. 264–269.

[2]J. F. Rosenberg, "One Way of Understanding Time," *Philosophia*, October 1972, pp. 283–301.

[3]John Earman, "Recent Work on Time Travel," in *Time's Arrows Today: recent physical and philosophical work on the direction of time* (Steven F. Savitt, editor), Cambridge University Press 1995, pp. 268–310. We'll discuss the idea of *consistency constraints* in some detail later in the book. Earman is Professor Emeritus of History and Philosophy of Science at the University of Pittsburgh.

have written deserves serious consideration by anyone interested in time travel, and that includes physicists. However, while the time travel interests of philosophers and physicists have a lot of overlap, those interests are *not* in total agreement. For example, while both groups talk of the grandfather paradox, the philosophers worry in particular about motivation (*why* the murderous mission?), while physicists have *never* to my knowledge asked themselves that question[4] (other than to figure out how to avoid it!). After all, philosophers talk of flesh-and-blood humans as time travelers, while the physicists send only billiard balls (with no personal identities or memories) on time trips into the past for the *expressed purpose* of avoiding the messy human issues of 'motivation' and free will. This approach by physicists isn't because they are cold and emotionless. It is a useful strategy because, if it can be shown that a mere billiard ball can travel into the past then, as one *philosopher* pointed out long ago, "It is implausible that it should be possible for some physical systems to travel back in time, and not others. Thus, if we suppose that simple objects can time-travel . . . then we must suppose that more complicated systems, e.g., human beings, can also time-travel."[5]

For the most part, philosophers and physicists have worked at the extreme, opposite points of the time travel spectrum. Much better, I think, would be to adopt the following, more balanced position advocated recently: "The study of time machines is a good opportunity for forging a partnership between philosophy and physics. Of course, philosophers have to recognize that in this particular instance the partnership is necessarily an unequal one since the mathematical physicists have to do the heavy lifting. But it seems clear that a little more cooperation with philosophers of science in attending to the analysis of what it takes to be a time machine could have led to some helpful clarifications in the physics literature."[6]

In the past, philosophers gained a reputation for being just a bit too 'unconstrained by the facts' for scientific tastes—as the English mathematician Augustus De Morgan (1806–1871) wrote in an 1842 letter, "There are no writers who give us so much *must* with so little *why*, as the metaphysicians"[7]—but I do think today's physicists would do well to reexamine that harsh opinion.

Philosophers of the 'old school' may look askance at a non-philosopher (me!) leveling criticism at them, and so let me step aside and quote from a member of the

[4]Nicholas J. J. Smith, "Why Would Time Travelers Try to Kill Their Younger Selves?" *The Monist*, July 2005, pp. 388–395. As Smith writes, "[Motivation] does not impact upon the possibility, or even the likelihood of backwards time travel. Yet it is deeply puzzling, and we will have no idea what time travel would actually be *like* until we explore it." See also Peter B. M. Vranas, "Can I Kill My Younger Self? Time Travel and the Retrosuicide Paradox," *Pacific Philosophical Quarterly*, December 2009, pp. 520–534.

[5]P. Horwich, "On Some Alleged Paradoxes of Time Travel," *Journal of Philosophy*, August 1975, pp. 432–444.

[6]John Earman, Christopher Smeenk, and Christian Wüthrich, "Do the Laws of Physics Forbid the Operation of Time Machines?," *Synthese*, July 2009, pp. 91–124.

[7]D. J. Cohen, *Equations from God: pure mathematics and Victorian faith*, The Johns Hopkins University Press 2007, p. 119.

'modern school' of philosophical thought: "Space-time is the basic spatiotemporal entity. Many philosophers have mouthed this truth, but few have swallowed it, and very few have digested it ... An appreciation of this truth is crucial to what is commonly referred to as the philosophy of space and time ... In large measure the lack of progress in this area can be traced to the fact that philosophers have not taken seriously the corollary that talk about space and time is really talk about the spatial and temporal aspects of spacetime."[8] This is a polite way of telling philosophers that they had better learn some physics!

What provoked those harsh words was that 'modern' philosopher's perception that 'old school' philosophers were not talking science when they wrote of space and time, but rather were in the business of telling each other irrelevant stories and myths, a curious philosophical approach involving the 'telling of tales' that reached its peak in the early and mid-1960s. Spacetime story telling seems to have started with a paper by the Oxford philosopher Anthony Quinton (1925–2010), who argued[9] that although there can be multiple, disjointed spaces, there can only be a single time that is the same for everyone, everywhere. The issue is *not* the truth or not of that assertion (Newton believed it, modern physicists don't), but rather Quinton's technique for arriving at it: myth construction.

Myth construction strikes those trained in the technical sciences as, while perhaps interesting—even physicists, after all, can enjoy a good fairy tale now and then—something quaint and totally beside the point. In his paper Quinton tells a fairy tale about how he thinks someone can live continuously in time and yet, via dreaming, be in two different spatial worlds; when awake he is in one world, while when the person is asleep he is in the other. Quinton argues that this multispatial myth is plausible, but that a search for an analogous multitemporal myth is doomed. This prompted a reply[10] from another 'old school' philosopher who rebutted Quinton with an even more outlandish counter-myth involving "the warring tribes of Okku and Bokku"!

It was this back-and-forth spinning of hypothetical tales that caused the 'modern' philosopher to write in his paper (note 30) that "the procedure for arriving at answers to these questions [about space and time] adopted by Quinton and most other ['old school' philosophers] is, to say the least, a curious one: a story is told about a mythical land—usually called something like the land of Okkus-Bokkus [which is now seen to an outrageous pun]—and then we are asked what we would say if confronted by experiences like those of the Okkus-Bokkusians. As often happens with such a question, people have said all sorts of things, not all of which are interesting or enlightening."

Another modern philosopher was even less gentle in his rejection of the fairy tale approach to spacetime physics: "Quinton [and others of a similar approach invite

[8]J. Earman, "Space-Time or How to Solve Philosophical Problems and Dissolve Philosophical Muddles Without Really Trying," *Journal of Philosophy*, May 1970, pp. 259–276.

[9]A. Quinton, "Spaces and Times," *Philosophy*, April 1962, pp. 130–147.

[10]R. G. Swinburne, "Times," *Analysis*, June 1965, pp. 185–191.

us] to say what we should think in certain strange circumstances which they describe within common-sense language [as opposed to scientific terminology]. I must say that if I found myself in the circumstances which they describe I just would not know what to think. Probably I should simply conclude that I had gone mad . . . It looks as though these writers are inviting us to consider *what we should say if we knew no science* [my emphasis]."[11]

Even before the modern philosopher (note 30) wrote in 1970 to complain about myth-making, another had already done so: "Whenever a human being produces an argument which opens 'Suppose I had 23 senses . . .,' 'Suppose I were God . . .,' 'Suppose I experienced objects extended in four spatial dimensions . . .,' we can protest that the argument is worthless. For in supposing that he has transcended our human point of view, he has also transcended the limits of our understanding."[12] As this author concluded his very funny paper, such opening sentences are the signatures of myths from "The Philosopher's Fairy Tale Book."

The strained relationship between myth-making philosophers and physicists, especially concerning time travel, has a historically interesting antecedent in the 1920s negative reaction among many over Einstein's theories of relativity (the very theories that give apparent life to time travel). To illustrate my point, consider the October 1913 letter Oskar Kraus (1872–1942), a philosophy professor at the German University in Prague, sent to Ernst Gehrcke (1878–1960), a physics professor at the Reich Institute of Physics and Technology in Berlin. Both men were opponents of Einstein but, as Kraus wrote in his letter, it was only Gehricke among the physicists he considered to be sympathetic to him: "[I] would not know . . . anyone else but you who as a specialist would not reject the intervention of a philosopher from the start."[13]

So, I think Earman's proposal a sound one, an echo in fact of similar words that the physicist Kip Thorne wrote (in the Foreword to the second edition of *Time Machines*) concerning science fiction writers: "Smart physicists seek insight everywhere, including from clever science fiction writers who long ago began probing seriously the logical consequences that would ensue if the laws of physics permitted time travel."[14]

To emphasize this new, combined, diversified focus (but also to retain some connection with my earlier books) is the reason I have altered the title, just a bit. In addition, each chapter now concludes with several open-ended questions, suitable for motivating either classroom discussions or more extensive essay responses.

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[11]J. J. C. Smart, "The Unity of Space-Time: Mathematics Versus Myth Making," *Australasian Journal of Philosophy*, (no. 2) 1967, 214–217.

[12]M. Hollis, "Times and Spaces," *Mind*, October 1967, pp. 524–536. Hollis ends by saying he is prepared to accept the failure of his paper to convince many of his colleges to change their ways, and he is waiting for one of them to write a paper opening with "Twice upon a time in another space no distance in any direction from here . . ."!

[13]Quoted from the Introduction to Milena Wazeck, *Einstein's Opponents: the public controversy about the theory of relativity in the 1920s*, Cambridge 2014 (published in German in 2009).

[14]Thorne is Professor Emeritus of Physics at the California Institute of Technology.

Teachers, in particular, may find this a useful feature if using the book in an academic setting. The book ends with reprints of two of my own published time travel stories (one from *Analog* and the other from *Omni*), with each serving as an illustration of technical issues raised in the book. From my own teaching of an undergraduate honors class in time travel at the University of New Hampshire, I think the assigning of story writing to be an excellent tool for teachers to use. I found reading student stories to be a lot of fun, and students may well surprise teachers with innovative ideas.

Now that I've mentioned story writing, let me say something about the heavy presence of time travel science fiction stories in this book, the majority of which originated in the often maligned pulp magazines of the 1920s through the 1950s. 'Pulp' has long been burdened with a bad literary reputation. As the editor of one anthology of pulp fiction bluntly put it, "Pulp equated with rubbish. Crap of the basest nature."[15] Part of the reason for that was cosmetic; as I wrote in an earlier book, "The term *pulp* came from the use of inexpensive wood-pulp—you could *feel* the lumpy wood chips in each ragged, untrimmed page—to make paper that was far too crummy for the use by any publisher of 'words meant to last.' Such paper quickly yellowed, turned brittle, and finally, amid billowing clouds of bits and pieces, entered into eternal oblivion. Think of the paper used in your newspaper before its final contribution to civilization in the bottom of your cat's litter box; pulp was worse."[16]

And then a little later, in the same book, "The stories in *Amazing* [*Stories* magazine] were 'read it in the morning, forget it by dinnertime' adventure fiction, the stuff you'd put inside a newspaper if on a crowded train or bus so fellow passengers wouldn't know what a low-grade mind you had. The transient nature of pulp fiction was independent of its literary quality, as the cheap acid-based paper that the stories were printed on began to oxidize and literally burn-up as soon as it rolled off the press. In the introductory essay to a 1950 collection of pulp-detective Philip Marlowe stories (*Trouble Is My Business*), mystery writer Raymond Chandler commented on this when he wrote 'pulp fiction never dreamed of posterity.' Pulp fiction was synonymous with trash fiction, and the nature of much of early pulp SF has been aptly described as 'scientific pornography for the mechanically minded,' and 'writing which drooled over descriptions of technology.'"

When publisher Hugo Gernsback (1884–1967) brought out the first issue of *Amazing Stories* in April 1926, it was the first pulp devoted totally to science fiction. With its masthead motto of "Extravagant Fiction Today—Cold Fact Tomorrow," and with the illustration on the contents page of each issue showing a muscular Jules Verne bursting from his grave in the heroic, up-up-and-away pose made famous years later by Superman, there could be no doubt as to what kind of fiction the reader would find under the dramatic, multi-colored cover art. It was fiction populated with mad scientists, and half-naked woman about to be ravished by alien

[15]Maxim Jakubowski, *The Mammoth Book of Pulp Fiction*, Carroll & Graf 1996.

[16]P. J. Nahin, *Holy Sci-Fi!: where science fiction and religion intersect*, Springer 2014.

invaders from outer space; all in all, stuff of interest only to teenage boys and imbecilic adults.[17]

How else, after all, to explain the publication of one tale[18] that was given the following heart-stopping editorial introduction: "Professor Lambert deliberately ventures into a Vibrational Dimension to join his fiancée in its magnetic torture-fields"? In defense of many of the readers of early pulp science fiction, however, not all were attracted by such nonsense. Just 2 months later (June 1931) one reader wrote to the same magazine to complain of masculine heroes saving weeping women from ungodly horrors: "Just why do you permit your Authors to inject messy love affairs into otherwise excellent imaginative fiction? Just stop and think. Our young hero-scientist builds himself a space flyer, steps out into the great void, conquers a thousand and one perils on his voyage and amidst our silent cheers lands on some far distant planet. Then what does he do? He falls in love with a maiden—or it's usually a princess—of the planet to which the Reader has followed him, eagerly awaiting and hoping to share each new thrill attached to his gigantic flight. But after that it becomes merely a hopeless, doddering love affair ending by his returning to Earth with his fair one by his side. Can you grasp that—a one-armed driver of a space-flyer! . . . We buy A.S. for the thrill of being changed in size, in time, in dimension . . . not to read of love . . . I wish . . . for plain, cold scientific stories sans the fair sex."

Here's another example, this one of the sort of tale that gave an aroma of the sophomoric to 'golden age' time travel science fiction. It was a story of a young man of the far future, with access to a time machine, who wants to see a dinosaur before he dies. So back he travels, back, back, until he at last finds himself in a "subterranean cave, dark and foul-smelling." At first he is puzzled (did dinosaurs live underground?), but then suddenly he hears a thundering roar and sees a huge black shape in the gloom. There can be no doubt now; it *is* a dinosaur, and he sees its red, gleaming eyes just as it crushes him into a pancake. But that's okay; he saw a dinosaur before he died. Then comes the dénouement. He hadn't really gone back quite as far as the Jurassic period, but only to the twentieth century, where he has been run down by the local express train in a subway tunnel![19]

[17]This was particularly thought to be the case for readers of the romance pulps, written for young women in the 1930s and 1940s (a separate and distinct audience from that of the science fiction pulps). As one commentator wrote on that genre, the heroes and heroines of such tales often displayed the "mental equipment of a banana split," with the implication that the same might be said of the readers, themselves. (See Margaret MacMullen, "Pulps and Confessions," *Harper's Monthly Magazine*, June 1937.) I don't think, however, that this particular complaint generally applied to the pulp science fiction readership. I'll have much more to say about Gernsback and early pulp science fiction speculations concerning time travel, in Chap. 4.

[18]T. Curry, "Hell's Dimension," *Astounding Stories*, April 1931.

[19]R. G. Thompson, "The Brontosaurus," *Stirring Science Fiction*, April 1941. In the editors of *Stirring*'s defense, notice the month: maybe this story was *meant* to be a joke. If so, it was an admirable success.

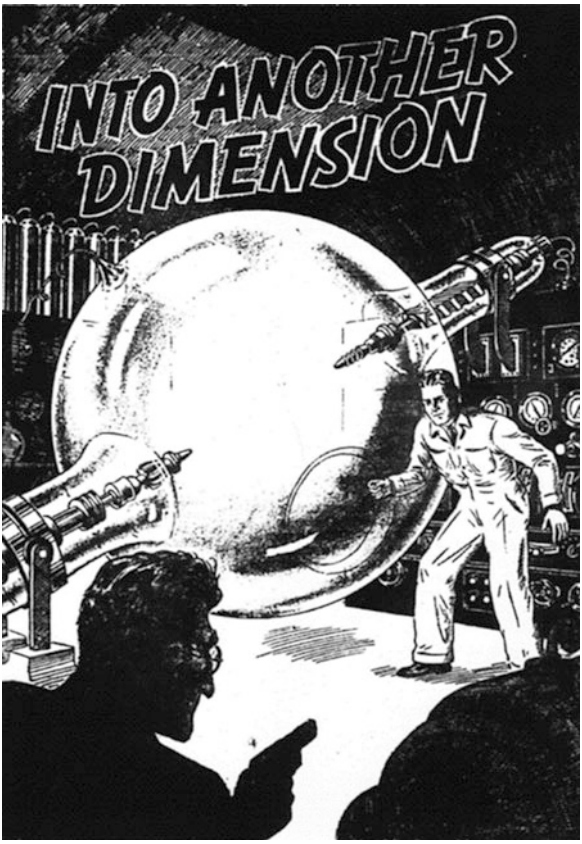

Vibrating into new dimensions was, apparently, a popular idea in 1930s pulp science fiction. This 'super science' gadget operated by vibrating an object faster than light, whereupon the Lorentz-FitzGerald contraction formula (see Chap. 3) predicts an *imaginary* size for the object—which means (so we are told) that the object has entered "another plane of existence." The inventor (the fellow with the gun) is inviting his grim-faced assistant to give the gadget a try. The original caption reads "Get into that vibrator! Get in, I say!"

Illustration for "Into Another Dimension" by Maurice Duclos, *Fantastic Adventures* November 1939 (art by Kenneth J. Reeve), © 1939 by Ziff-Davis Publishing Co., reprinted by arrangement with Forrest J. Ackerman, Holding Agent, 2495 Glendower Ave., Hollywood, CA 90027

Today, however, the need to apologize for science fiction tales about time travel isn't quite so necessary. Now and then, in fact, you'll even find one of the better pulp stories cited in highly mathematical papers on time machines in the *Physical Review D*, one of the most important scholarly physics journals. Even those physicists and philosophers who mostly ignore science fiction—except perhaps to make slightly condescending remarks—would, if honest, admit that their early teenage interest in time travel was sparked by reading a really good science fiction story, and not by working their way through a physics textbook. Yes, when the physics eventually came later, it was very good—but the science fiction came *first*,

and it was pretty good, too.[20] It's in a 1937(!) tale, for example, that we find the claim for consistency around a closed loop in time, *decades* ahead of the physicists and philosophers.[21] And when you get to the final section of Chap. 4, I think you'll find it difficult to believe that Everett's many-worlds interpretation of quantum mechanics, dating from the late 1950s (which avoids the standard paradoxes of time travel) wasn't inspired by some youthful reading of science fiction from the 1930s and 1940s.

In a number of places in this book you'll find my comments on how science fiction has occasionally anticipated physicists on the subject of time machines and time travel. This is *not* to be interpreted as some sort of 'gotcha' in favor of science fiction. Far from it. When push comes to shove, physics *always* wins. This situation was specifically addressed by Joe Haldeman, in an afterword to his 2007 novel *The Accidental Time Machine*. There he wrote, about when he started in 1971 to write his earlier, now classic novel *The Forever War*, "I needed a way to get soldiers from star to star within a human lifetime, without doing too much violence to special and general relativity. *I waved my arms around really hard* [my emphasis] and came up with the 'collapsar jump'—at the time, collapsar was an alternate term for 'black hole,' though I was unaware of the latter term [because John Wheeler had invented it only 4 years before, as discussed in Chap. 1 and note 106]." And then Haldeman admitted "It's a truism of science fiction that if you predict enough things, a few of them are going to come true. . . . What I think it actually demonstrates is that *if you wave your arms around hard enough* [my emphasis], sometimes you can fly."

Now, there is one feature common to all books on time travel to the past (which is the central topic treated here, of course) that I would like to clearly state. It's obviously a subject of vast interest to physicists, and yet it offers (as far as I know) *absolutely no hope of suggesting even a single experiment for study*. (As far as I know, nobody is building a time machine in their basement.) A suggestion *has* been made that it may be possible to detect, in the *present*, the effects of the *future* operation of "man-made time machines, which could be of a size traversable by humans," that is, machines with a 1-m spatial extent offering a one second trip into the past.[22] With the best technology available today, however, the calculated effects on the proposed two-particle scattering experiment are orders of magnitude too small to measure.

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[20]The view expressed by Vladimir Voinovich's time traveler in his 1986 novel *Moscow 2042* (Science fiction . . . is not literature, but tomfoolery like the electronic games that induce mass idiocy.) is, I think, wrong. For an interesting presentation on the role of science fiction in exciting an interest in science among youngsters, see the paper by Frederik Pohl (1919–2013), "Science Fiction: the stepchild of science," *Technology Review*, October 1994, pp. 57–61. In this essay Pohl, a well-known writer of science fiction and editor of *Galaxy Science Fiction* and *If* magazines, writes "Science fiction is [the ultimate protection] against future shock . . . if you read enough of it, nothing will take you entirely by surprise." Not even time travel.

[21]P. S. Miller, "The Sands of Time," *Astounding Stories*, April 1937.

[22]S. Rosenberg, "Testing Causality on Spacetimes with Closed Timelike Curves," *Physical Review D*, March 15, 1998, pp. 3365–3377.

This situation is really unprecedented in the history of science.[23] To cynics, it may seem to be a bit like writing learned papers on the thermodynamics of fire-breathing dragons (which, like other mythological entities—and time machines, too—have yet to be seen)! This one fact has opened the doors—and has kept them open for decades—for philosophers and science fiction writers, who can endlessly debate back and forth on all aspects of time travel to the past with nary a single experimental fact to complicate their lives. For physicists the situation is naturally frustrating, but for philosophers and science fiction writers it's a dream come true. This isn't to say it's *all* basically theological in nature. Both the physicists and the philosophers *have* written many fascinating papers and books and, of course, so have science fiction writers. Mathematical physics *has* been advanced.

Still, despite all of the theoretical work done in the last 30 years, work that has made it reasonable to seriously talk of 'time travel' and 'time machines,' I suspect many would nonetheless agree with these words from more than 75 years ago: "Of all the fantastic ideas that belong to science fiction, the most remarkable—and, perhaps, the most fascinating—is that of time travel . . . Indeed, so fantastic a notion does it seem, and so many apparently obvious absurdities and bewildering paradoxes does it present, that some of the most imaginative students of science refuse to consider it as a practical proposition."[24] For some, time travel is an even more unlikely possibility than (as declared by Robert Lewis Stevenson) is the "welding of ice and iron." Not all physicists and philosophers view the time travel/paradox arguments as convincing, however. Provocative, yes, of course, but many are not yet prepared to write 'signed, sealed, and delivered' at the end.

So, keep reading and I think you'll discover why there *are* those who are not so quick to dismiss the possibility of following the fantastic world line of H. G. Wells' intrepid Time Traveller[25] into the future. And, just maybe, into the distant past, too.

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[23]Perhaps, however, I am too hasty. More recent theoretical calculations suggest that wormholes connecting our universe with other universes would, after converting into time machines, have characteristic thermal signatures. See P. F. González-Díaz, "Thermal Properties of Time Machines," *Physical Review D*, 2012, pp. 105026-1 to -7 which, however, concludes that a search for such signatures would be "quite difficult [with the] instruments available."

[24]I. O. Evans, "Can We Conquer Time?" *Tales of Wonder*, Summer 1940.

[25]The Time Traveller is never named in Wells' 1895 novel *The Time Machine*. An earlier (1888) attempt at a time machine story, with the awful title *The Chronic Argonauts* (the "chronic" was apparently inspired by the word *chronology*), so embarrassed Wells that he later called it "imitative puerile stuff," "clumsily invented, and loaded with irrelevant sham significance," and "inept," and so he hunted down and destroyed every copy of it that he could find. You can find *The Chronic Argonauts* reprinted in *The Definitive Time Machine* (H. M. Ceduld, editor), Indiana University Press 1987. The hero in that work *was* named: Dr. Moses Nebogipfel. There is one passage in *The Time Machine* that does tantalize; as the Time Traveller explores a museum of "ancient" artifacts in the Palace of Green Porcelain (they are, of course, artifacts of our *future*) he reveals that "yielding to an irresistible impulse, I wrote my name upon the nose of a steatite monster from South America that particularly took my fancy." Thus, the Traveller *has* given his name, but his signature exists only in the future, in a museum of the past that is yet to be built.

For Further Discussion

For time travel to the past to make any sense, the past must in some sense 'still be there.' This is a concept that we'll find later in the book to have significant support in relativistic physics, but for now let's limit ourselves to a purely romantic view. As an example of this, consider this passage by Canadian writer Grant Allen (1848–1899), from the Introduction to his 1895 time travel novel *The British Barbarians*: "I am writing in my study on the heather-clad hill-top. When I raise my eye from my sheet of foolscap, it falls upon miles and miles of broad open moorland. My window looks out upon unsullied nature. Everything around is fresh and pure and wholesome . . . But away below in the valley, as night draws on, a lurid glare reddens the north-eastern horizon. It marks the spot where the great wen of London heaves and festers." I personally find it quite tempting to imagine Allen somehow still there in his study of 1895, and of heaving and festering late-Victorian London, too, with H. G. Wells himself in the middle of it, still reading the first rave reviews of *The Time Machine*. In Wells' novel The Time Traveller journeys into the far future, while in Allen's work the protagonist is a twenty-fifth century anthropologist who has traveled back to the past of the late nineteenth century to study the 'British barbarians.' Read Allen's novel (it's available on the Internet, for free, as a Project Gutenberg book) and comment on the significance of its appearance at virtually the same time as Wells' great work. Why do you think Wells' novel is remembered, and Allen's is not?

In the opening paragraph of his paper "The Conundrum of Time Travel" (*Croatian Journal of Philosophy*, No. 37, 2013, pp. 81–92), Anguel Stefanov writes "Needless to say . . . the problems concerning time travel are being still tackled by science fiction only, but resolved by science proper neither theoretically, nor practically." Do you think this is correct?

Eventually every genre of writing becomes the target for parody, in which the *form* of the genre serves as the framework for what (it is hoped) is a humorous mockery. The most famous example of this, perhaps, is the annual

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Edward Bulwer-Lytton contest in writing a take-off on the long-winded opening line of the 1830 novel *Paul Clifford*, by Bulwer-Lytton (1803–1873). That opening line *is* a wonder (a masterpiece of purple prose): "It was a dark and stormy night; the rain fell in torrents—except at occasional intervals, when it was checked by a violent gust of wind which swept up the streets (for it is in London that our scene lies), rattling along the housetops, and fiercely agitating the scanty flame of the lamps that struggled against the darkness." Here's a recent (from the 2015 contest) spoof: "The Contessa's heart was pounding hard and fast, like an out-of-balance clothes washer, which can get that way if you mix jeans with a lot of light things, though the new ones have some sensor thing to counteract that or shut off, but the Contessa's heart didn't have anything like that, so she had to sit down and tell Don Rolando to keep his hands to himself for a while." Science fiction isn't immune to such fun, and a good example of that can be found in the September 14, 2015, issue of *The New Yorker*, which has (on p. 50) "Eight Short Science-Fiction Stories" by Paul Simms. Here's the one I laughed hardest at: "The Gene-Splicers had tinkered with the DNA, producing a race of warriors who craved just two things: the thrill of battle and the taste of their own feet. They hungered for battle. They literally ate their own feet. None survived to reproduce, and within a few short years they were all gone. The Gene-Splicers chalked it up to experience, and decided to try harder the next time." That, and the other seven spoofs by Simms, cut across a wide swath of science fiction, but one theme noticeably absent was that of time travel. Try your hand at writing a *short* (fewer than 500 words) time travel spoof, and be prepared to read it aloud to an audience of your peers.

The tale "Through the Dragon Glass" by Abraham Merritt (1884–1943) appeared in the early pulp magazine *All-Story Weekly* of November 24, 1917. It described the discovery of a passage through an ancient Chinese mirror into an alternate world. One *might* think of this as an early conception of a wormhole, but more likely it may remind you mostly of Lewis Carroll's *Through the Looking Glass*. More interesting for us, in this book, is a story written 75 years ago that describes a gadget connecting two regions of spacetime, with a time shift of a week between the two regions. (See "Time Locker" by Lewis Padgett, in the January 1943 issue of *Astounding Science Fiction*.) The gadget falls into the hands of a crooked lawyer who, not understanding what he has, ends up accidently killing himself. As the story ends, the inventor of the gadget ruefully muses to himself that the lawyer

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"must have been the only guy who ever reached into the middle of next week—and killed himself!" The gadget is, in everything but name, a wormhole time machine. Speculate on how such a spacetime structure could appear in a *science fiction magazine*(!) decades before there was any discussion of such a possibility in the physics world.

Adjectives used to describe many of the stories in the science fiction pulps included *primitive*, *trashy*, *tawdry*, *silly*, *absurd*, *crummy*, *ludicrous*, and *cheap*. One early pulp magazine actually boasted, of its contents, that they contained "sensational fiction with *no* philosophy." Speculate on how such a low-level 'literary' form could have been so successful in finding an enthusiastic audience for time travel paradox tales, tales that are in fact by their very nature simply *stuffed* with philosophical issues. As an example of the tremendous emotional power a particularly well-written time travel story can deliver, read Isaac Asimov's "The Ugly Little Boy" (*Galaxy Science Fiction*, September 1958). Asimov rated this story as among his most favorite of all the many he wrote. If you can read it without ending in tears, well, ... An excellent modern historical work on the pulps (of all genres, not just science fiction) is by Lee Server, *Danger Is My Business: an illustrated history of the fabulous pulp magazines, 1896–1953*, Chronicle Books 1993.

A literary fascination with time was already 'in the wind' when Wells wrote his *Time Machine*, as with Oscar Wilde's 1890 novel *The Picture of Dorian Gray*. Even decades earlier than that one can find a hint of time travel of a sort in Edgar Allen Poe's 1841 short story "Three Sundays in a Week." And just 4 years later Henry Wadsworth Longfellow wrote his haunting poem "The Old Clock on the Stairs," with these opening words:

Somewhat back from the village street
Stands the old-fashioned country-seat.
Across its antique portico
Tall poplar-trees their shadows throw;
And from its station in the hall
An ancient timepiece says it all,—

"Forever—never!

(continued)

Never—forever!"

The most interesting of all pre-Wells time travel fiction to appear in a mass-audience publication was, I think, the short story "The Old Folks Party" by Edward Bellamy, printed in the March 1876 issue of *Scribner's Monthly*. In this story a group of teenagers, who belong to a weekly discussion club, agree that at their next meeting they will all come dressed and behaving as they believe they will be dressing and behaving 50 years in the future. Also attending will be the grandmother of one of the young ladies. The meeting of the "old folks" takes place, and it invokes such powerful feelings of mortality that, at last, one of the young men can stand it no more: "Suddenly Henry sprang to his feet and, with the strained, uncertain voice of one waking himself from a nightmare, cried:—'Thank God, thank God, it is only a dream,' and tore off the wig, letting the brown hair fall about his forehead. Instantly all followed his example . . .." The young people then began to laugh with relief at once again being young, until they notice the grandmother is crying. Her granddaughter instantly knows what is wrong and says, "Oh, grandma, we can't take you back with us." Read, compare, and contrast, these works by Wilde, Poe, Longfellow and Bellamy, with the 'scientific' presentation of time travel by Wells.

Acknowledgements

My name is on *Time Machine Tales* as the author, but there are many others without whose help I could not have written it. For this, the revised and updated third edition of the original 1993 book *Time Machines*, I am enormously grateful to the publisher, Springer Science + Business Media, and to my physics editors at Springer, Dr. Sam Harrison and his assistant Ho Ying Fan in New York City. They made an intellectually demanding and inherently lengthy project (one that could easily have turned into a nightmare) a pleasant one. Springer's New York City-based editorial assistant Irene Bruce smoothly handled the administrative details of transforming the book from typescript to print. And to Serguei Krasnikov in Russia, Frank Arntzenius and Roberto Casati in England, Francesco Gonella in Italy, and Geoff Goddu and Archille Varzi in America, I offer grateful thanks for permission to reprint from their publications.

But the story of this book actually begins long before 1993.

Nearly four decades in the past, in 1979, when time travel was still mostly just a nutty idea used by science fiction writers and a few rogue philosophers—proposing to give a serious seminar on time travel at the weekly college *physics* seminar would almost certainly have resulted in getting the bum's rush out the nearest door, or maybe even tossed through the closest window (or, God forbid, *off the roof*!)—I wrote my first time travel tale for *Analog Science Fiction* magazine. Bought by then editor Ben Bova (you can read it in Appendix A), he also bought another time travel tale from me soon after he had become the fiction editor at the newly created *Omni Science Fiction* magazine (you can read it in Appendix B). (Years later, Ben's successor as *Omni*'s fiction editor, Ellen Datlow, bought a third time travel story from me—"The Invitation"—which you can read if you can locate the July 1985 issue.)

Those fictional experiences, and my discovery of Princeton philosopher David Lewis' seminal 1976 essay on the *logical* possibility of time travel, led me to plunge into a deeper study of the *physics* of time travel, to the point where as the 1980s ended (1988, to be precise) I thought a book should be my next writing project. Alas, nobody else shared that thought. I spent the next 3 years looking for a

publisher among numerous university presses; as I looked, the pile of rejection letters, like entropy, grew steadily larger.

The editor at one well-known university press, in fact, simply laughed at the idea of a scholarly time travel book when I called him on the telephone (e-mail was then still in its infancy) to ask, after a long period of no response to my written proposal, if he had gotten it. (Perhaps, I told myself, the mail truck carrying my precious document had fallen into a hyper-dimensional spacetime warp: how pathetically desperate is the anxious academic writer!) Later, I published a number of math/physics books with that same press (but now with new editors) and so there were no lasting hard feelings.

That laughing, unresponsive editor wasn't alone in his opinion, I have to admit, and it wasn't until 1991 when Maria Taylor, the publisher at the Press of the American Institute of Physics (AIP Press), decided to take a chance (a *big* chance) and publish the first edition of *Time Machines*. She made that decision in large part because of two extremely supportive reviews of my proposal from the academic physicists Edwin Taylor (MIT, and a former editor of *The American Journal of Physics*) and Gregory Benford (University of California, Irvine, as well as being an award-winning writer of science fiction who occasionally used the time travel theme). After the original *Time Machines* appeared, Ben Bova asked me to use it as a guide to writing a book on time travel for the new Writer's Digest series on science fiction that he was editing, aimed specifically at would-be story writers; that book came out in 1997 as *Time Travel*. Later, Trevor Lipscombe, then editor-in-chief at the Johns Hopkins University Press (and my former math editor at Princeton University Press), reprinted *Time Travel* (with a new Preface) in 2011.

After Springer acquired AIP Press (and all of its books) in 1995, and Maria Taylor herself went over to Springer, she and I collaborated again on bringing out the second edition of *Time Machines* in 1999. And now, 18 years later, here (with a title slightly altered for reasons I give in "Some First Words") is its successor.

To Sam, Ho Ying, Irene, Ben, Ellen, Maria, Edwin, Gregory, and Trevor, thank you for your support. But my greatest debt of all, one I can never even begin to repay, is to my wife of 55 years, Patricia Ann, a woman of infinite tolerance. Who else would put up with someone who plays first-person-shooter video games at midnight (the bigger and the louder the explosions, the better!) and writes books on time machines, all the while claiming not to be crazy?

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Introduction

> Over the last few years leading scientific journals have been publishing articles dealing with time travel and time machines. . . . Why? Have physicists decided to set up in competition with science fiction writers and Hollywood producers?
>
> —John Earman (see note 25 of *Some First Words*)

Writing about time travel is, today, a respectable business. It hasn't always been so. After all, time travel, *prima facie*, appears to violate a fundamental law of nature; every effect has a cause, with the cause occurring before the effect. Time travel to the past, however, seems to allow, indeed to *demand*, backwards causation, with an effect (the time traveler emerging into the past as he exits from his time machine) occurring *before* its cause (the time traveler pushing the start button on his machine's control panel years *later* to start his trip backward through time).

Thus, when H. G. Wells published his breakout masterpiece, *The Time Machine*, in 1895, even those readers who loved it as a *story* (and not all did) were still quick to dismiss it as a *romantic fantasy*. It was, in their view, certainly an emotionally powerful tale of pure imagination, but nothing more. Reviewers of the day used such words as "hocus-pocus" and "bizarre," and called the work a "fanciful and lively dream."[26] Any one of the novels by Wells' contemporary, Jules Verne (even such super-technology ones like the 1865 *From the Earth to the Moon*) would have been ranked *far* above Wells' novella in terms of 'it could actually happen.'

Wells himself always denied that his time machine was anything more than a literary device[27] to get his Time Traveller into the far future. Indeed, in 1934, in the

[26]These reviews are reprinted in P. Parrinder, *H. G. Wells: The Critical Heritage*, Routledge & Kegan 1972. A modern reviewer has applied such negative characteristics to the Time Traveller, himself, calling him "a kind of Trickster figure" and "a quack and magician." See Robert J. Begiebing, "The Mythic Hero in H. G. Wells's *The Time Machine*," in *Essays in Literature*, Fall 1984, pp. 201–210.

[27]Wells was not the first to use a machine to enable time adventures, as the Spanish writer Enrique Gaspar (1842–1902) used one in his 1887 story *The Time Ship: A Chrononautical Journey*. It's Wells' tale we remember, however.

preface to *Seven Famous Novels* (published by Knopf), a collection of his novel-length scientific romances (as science fiction had been known before the term *science fiction* came into use), including *The Time Machine*, Wells made his position perfectly clear: "These stories of mine collected here do not pretend to deal with possible things; they are exercises of the imagination . . . They are all fantasies; they do not aim to project a serious possibility; they aim indeed only at the same amount of conviction as one gets in a good gripping dream." Wells then went on to say in that same preface that all attempts before at writing fantastic stories depended on magic. But not in his works. "It occurred to me that instead of the usual interview with the devil or a magician, an ingenious use of scientific patter might with advantage be substituted." Wells' great contribution to time traveling story-telling was his introduction of a *machine*; science instead of magic, drugs, dreams, blows on the head, or suspended animation.[28] Not all modern science fiction writers have followed Wells' lead, however.

A science fiction tale by Clifford Simak (1904–1988), for example, the 1978 novel *Mastodonia*, incorporates an alien creature marooned on Earth (because of a spaceship crash centuries earlier) who 'makes time tunnels.' One of the characters in the story, who is attempting to start a time-travel agency using these tunnels, explains why not having a time *machine* is causing her difficulties with prospective clients: "The whole trouble was that I couldn't tell them about some machine—a time-travel machine. If I could have told them we'd developed a machine, they'd have been more able to believe me. We place so much trust in machines; they are magic to us. If I could have outlined some ridiculous theory and spouted some equations at them, they would have been impressed." I think that's off the mark. We trust in machines not because they are magic, but for precisely the opposite reason. They are *not* magic, but rather are *rational*. And to dismiss mathematics is to say that some non-natural—some supernatural—influence is at work.

But is a time *machine* actually possible? Or is the idea of a time machine simply "Nonsense" and "A bilgeful of crap," as a character bluntly puts it in the 1972 novel *The Dancer from Atlantis* by Poul Anderson (1926–2001). Wells, himself, addressed this point in an autobiographical essay (published in the *Cornhill Magazine*) that he wrote in July 1945 (just 13 months before his death) in even blunter words. Writing under the name of "Wilfred B. Batterave," he penned a very funny summary of his life titled "A Complete Exposé of This Notorious Literary Humbug." There he described *The Time Machine* as "[A] tissue of absurdities in which people are supposed to rush to and fro along the 'Time Dimension.' By a few common tricks of the story-teller's trade, Wells gets rid of his Machine before it can be subjected to a proper examination. He cheats like any common spook raiser. Otherwise it is plain commonsense that a man might multiply himself indefinitely,

[28]Examples of 'non-machine' time travel stories of the last four types are, respectively, H. G. Wells' "The New Accelerator" (1901), Charles Dickens' *A Christmas Carol* (1843), Mark Twain's *A Connecticut Yankee in King Arthur's Court* (1889), and Edward Bellamy's *Looking Backward, 2000–1887* (1888).

pop a little way into the future and then come back. There would then be two of him. Repeat *da capo* and you have four, and so on, until the whole world would be full of the Time Travelling Individual's vain repetitions of himself. The plain-thinking mind apprehends this in spite of all the Wellsian mumbo-jumbo and is naturally as revolted as I am by the insult to its intelligence." Funny, yes, but still pretty harsh stuff.

As one writer has argued,[29] Wells was, rather than presenting a scientific discovery, simply attempting to refute the nearly suffocating, unjustified (in his mind), smug optimism of the well-to-do of the Late Victorian Age. And so, on his journey to the year A.D. 802,701, the Time Traveller finds the awful decay of humanity in the cannibalistic subjugation of the Eloi by the Morlocks, the end result of class warfare between the working class (Morlocks) and the idle, parasitic upper class (Eloi).

The German social philosopher Karl Marx, if he hadn't already been dead for 12 years in 1895, would surely have nodded in vigorous agreement as he read *The Time Machine*, even as he would have regretted Wells' decision to have the victory of oppressed workers take so long. (What irony that he is buried in London's Highgate Cemetery, the Victorian Valhalla where he has spent the last century and more quite literally mingling with many of the capitalistic ancestors of the Eloi!) What Marx would have thought of *time travel* as a possibility is, however, far less certain.

How things changed in the years that followed *The Time Machine*. There was, at first, admittedly a 'slight' decline in literary merit as the newly developing pulp science fiction magazines picked-up and ran with the time travel genre. Many of the magazine time travel tales of the 1920s, 1930s, and 1940s were, frankly, simply awful. BUT—some were pretty good, too. And some were, in fact, *very* good. From the 1950s on, there have been ever more sophisticated time travel tales from ever more sophisticated writers.

In the academic communities of philosophers and physicists, too, big events occurred. I give the philosophers the edge, in fact, with the 1976 publication of a hugely important paper that opened with these dramatic words: "Time travel, I maintain, is possible. The paradoxes of time travel [to the past] are oddities, not impossibilities. They prove only this much, which few would have doubted: that a possible world where time travel took place would be a most strange world, different in fundamental ways from the world we think is ours."[30] That writer wasn't the first philosopher to write on time travel to the past, but none had expressed themselves in such powerful and unequivocal words in unmistakable support of the concept.

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[29]R. M. Philmus, "*The Time Machine*; Or, the Fourth Dimension as Prophecy," *Publications of the Modern Language Association*, May 1969, pp. 530–535.

[30]David Lewis, "The Paradoxes of Time Travel," *American Philosophical Quarterly*, April 1976, pp. 145–152. Lewis (1941–2001) was a Princeton University philosophy professor.

Lewis' paper is also notable because it gives what seems to be a clear definition of just what it means to say one has 'traveled in time,' either to the past *or* to the future:

> What is time travel? Inevitably, it involves discrepancy between time and time. Any traveler departs and then arrives at his destination; the time elapsed from departure to arrival (positive, or perhaps zero) is the duration of the journey. But if he is a time traveler, the separation in time between departure and arrival does not equal the duration of the journey.

To understand this, we need to appreciate the distinction between the *personal time* of the time traveler and the *external time* of remote observers of the time traveler. A time traveler's personal time is measured, for example, either by the time kept by his wrist watch or, perhaps, by a burning candle. (This distinction had actually appeared earlier in Horwich's paper—see note 27 in *Some First Words*—published the year before Lewis' paper.)

I say I 'give the edge to the philosophers' because, while the first *physics* time travel paper had appeared decades earlier, its author wasn't really a physicist at all but rather was Einstein's friend, the world-famous mathematical logician Kurt Gödel. Gödel's paper was, in retrospect, a pivotal event in establishing the 'respectability' of *scientific* time travel; it's worthwhile to take some time here to explain this important point. For physicists (and for philosophers and science fiction writers, too) a 'time machine,' one either constructed by intelligent beings or occurring naturally, manipulates (all the while obeying the known laws of physics) finite amounts of matter and energy in a finite region of spacetime.[31] A 'time machine' would be declared to be *plausible* if it could be explained by a rational, scientific theory. Such a rational theory is found in Einstein's general theory of relativity. (His *special* theory of relativity applies in those situations where there is no gravity.)

Until Einstein, the theory of gravity used by scientists was Newton's—a theory that, although amazingly accurate for any situation encountered on Earth, does have observable errors in certain astronomical applications. In addition, Newton's theory is a descriptive one; it makes possible the calculation of gravity effects without offering any explanation for gravity itself. Einstein's theory not only gives the right answers, even in those cases where Newton's theory doesn't, but it also explains gravity. It does that by treating the world as a four-dimensional structure in which all four dimensions (three of space and one of time) are in a certain sense on equal footing. The resulting Einsteinian description of the world is that of a unified spacetime in which time and space are intimately intertwined, whereas Newton's theory keeps time and space separate and distinct.

[31] I am going to feel free to use words like *spacetime* without having to first write introductory essays on relativity theory and tensor mathematics, because such words have entered common use. All those Hollywood science fiction movies, even the crummy ones that routinely trash the laws of physics, have at least expanded the general imagination!

As Newton wrote of time, at the start of his 1687 masterpiece *Principia*, a work that revolutionized physics, "Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration." This view of time would be, of course, discarded with the arrival of Einstein and his view of variable time depending on the state of the observer.

Unlike Einstein's view, Newton's view of the nature of time was entangled with theology. As one modern theologian has written, "Newton conceived of absolute time as grounded in God's necessary existence."[32] To quote Newton himself, in the *General Scholium* to the second edition of *Principia* (1713) he added words that didn't appear in the original: "God is a living, intelligent, and powerful Being; and, from his other perfections, [it follows] that he is supreme, or most perfect. He is eternal and infinite, omnipotent and omniscient; that is, his duration reaches from eternity to eternity; his presence from infinity to infinity; he governs all things, and knows all things that are or can be done. He is not eternity and infinity, but eternal and infinite; he is not duration or space, but he endures and is present. He endures forever, and is everywhere present; and, by existing always and everywhere, he constitutes duration and space. Since every particle of space is *always*, and every indivisible moment of duration is *everywhere*, certainly the Maker and Lord of all things cannot be *never* and *nowhere*."

Okay, I'll be honest—I really am not at all sure just what that means! Newton added these words to the *Principia* in response to criticism (from the influential philosopher George Berkeley (1685–1753)) that his original statements about absolute time were "pernicious and absurd notions," notions that were in fact atheistic in conception. That was a most serious charge in Newton's day, and he was trying (I think) to find some cover from those critics who spent more hours of the day thinking about God than of physics. Much more honest (in my opinion) are the witticisms 'time is just one damn thing after another' and 'time is what keeps everything from all happening at once.'[33] More funny than useful, yes, of course, but at least they're funny.

Newton's theological view of time is simply irrelevant to the modern physicist (although perhaps of more interest to the philosopher-historian) but in many cases it is of *central interest* to the science fiction writer. For example, Newton's religious

[32]William Lane Craig, "God and the Beginning of Time," *International Philosophical Quarterly*, March 2001, pp. 17–31, which discusses the question 'Why didn't God create the world sooner?' One irreverent answer is 'He was busy creating Hell for all those who ask that question,' but a more scholarly analysis can be found in Brian Leftow, "Why Didn't God Create the World Sooner?" *Religious Studies*, June 1991, pp. 157–172.

[33]This last 'definition' first (as far as I know) appeared in the work of the science fiction writer Ray Cummings (1887–1957), in his 1921 story "The Time Story," published in *Argosy-All-Story* magazine. He repeated the phrase in his 1929 novel *The Man Who Mastered Time*, and then again in the 1946 novel *The Shadow Girl*. ("This same Space; the spread of this lawn . . . what would it be in another 100 years? Or a 1000? This little space, from the Beginning to the End so crowded with events and only Time to hold them apart!")

mindset and its (perhaps!) connection with time travel is treated in my short story "Newton's Gift," originally published in *Omni Magazine* (January 1979) and reprinted in Appendix B at the end of this book. Wells' Time Traveller's view of time is more Newtonian than it is Einsteinian—and perhaps that's not such a big surprise, considering that Einstein was only 16 years old when *The Time Machine* was published.

From the first (1905) it has been known that Einstein's special theory allows time travel into the future via the well-known mechanism of *time dilation*. (The faster a rocket ship travels relative to Earth, the slower is the tick-tock of a wrist watch worn by a rocketeer, compared to that of an identical watch back on Earth.)[34] To return from the future, however, to travel back into the past to the instant after the traveler began his journey, had been thought to be impossible. It was Gödel's discovery that showed the general theory, which has passed every experimental test it has been subjected to (most recently, the September 2015 detection, from two massive colliding black holes, of gravitational waves—'ripples in spacetime'—generated more than a billion years ago in an effect predicted by the general theory a century ago), does allow time travel to the past *under certain conditions*. It is this availability of a *theory* that distinguishes time travel speculations from the outlandish fantasy speculations with which it is often unjustly lumped—speculations that *are* in the province of quacks (such as ESP, astrology, and mind over matter a' la spoon bending).

In his general theory, Einstein showed how spacetime can be either 'flat' (in the no-gravity, special relativity case of what is called a *Minkowski spacetime*[35]) or 'curved' (those situations with gravity), and he did that not by verbal hand waving, but rather by writing mathematical equations that obey all the known laws of physics: his famous gravitational field, nonlinear differential tensor equations. These complicated equations are notoriously difficult to solve in general, but in certain, special cases they *have* been solved. Those solutions describe how matter and energy and spacetime interact. As the popular saying puts it, "Curved spacetime tells matter how to move, and energy and matter tell spacetime how to curve." In that sense, gravity *is* curved spacetime.

In 1949 Gödel found one such special solution to the field equations that describes the movement of mass-energy not only through space but also *backward in time* along trajectories in spacetime that are called *closed time-like lines* or *curves*

[34]One pulp magazine science fiction story (F. J. Bridge, "Via the Time Accelerator," *Amazing Stories*, January 1931) got this right when its time traveler explains how his time machine works with these words: "Time as we know it is not universally absolute. The rate of its passage depends to a great extent upon the velocity of its observer with regard to some certain reference system. A moving clock will run slower with respect to a selected coordinate system than a stationary one." (Recall my earlier comments on the personal time of a time traveler.)

[35]Named after Hermann Minkowski (1864–1909), Einstein's mathematics professor in Zurich who gave the now well-known spacetime diagram interpretation of special relativity which, when originally presented by Einstein, was in the form of pure mathematics.

(called CTLs or CTCs, respectively).[36] These trajectories are such that if a human traveled along one, *always at a speed less than that of light* (that's what *time-like* means), he would see everything around him happening in normal causal order from moment to moment (for example, the second hand on his wrist watch would tick clockwise into the local future), but eventually the CTL/CTC closes back on itself and the traveler finds himself in his own past.

On the scale of the Solar System, general relativity has causality built into itself, but on much larger scales things can be a good deal more complicated. On a very large, astronomical scale, in fact, curved spacetime can result in violations of causality, with effects occurring before their causes. That is what the physics and the mathematics of Gödel's solution imply. That is what is meant by saying there is a scientific, rational basis for discussing time travel to the past. It is particularly important to note that travel along one of the closed time-like world lines discovered by Gödel requires a *machine*, some kind of accelerating rocket ship. That's because none of Gödel's CTLs/CTCs are what is called a *geodesic*. That is, none are *free-fall* world lines.[37] This machine does not, however, generate CTLs/CTCs where none existed before (CTL/CTC *creation* requires what physicists call a *strong* time machine) but rather simply makes use of the CTLs/CTCs that are inherent in Gödel's spacetime. A Gödelian rocket ship then is an example of a *weak* time machine.

I mentioned earlier that "certain, special cases" of Einstein's gravitational field equations result in CTLs/CTCs. What was the "special case" that Gödel solved? His solution of the field equations is for a rotating, infinite, static universe composed of a perfect fluid at constant pressure. In such a universe Gödel found that naturally occurring CTLs/CTCs pass through every point in spacetime; that is, time travel in Gödel's universe is *not* the result of a machine *manipulating* mass and energy on a *local* scale (the classic science fictional description of a time machine); rather, in Gödel's spacetime time travel is a naturally occurring phenomenon! The observable

[36]Kurt Gödel, "An Example of a New Type of Cosmological Solutions of Einstein's Field Equations of Gravitation," *Reviews of Modern Physics*, July 1949, pp. 447–450. A CTL/CTC is a special type of *world line*; the trajectory through spacetime of every particle in the universe is a world line that extends from each particle's past to its future. Our everyday experiences are with world lines that never cross or come close to themselves (which would put a particle at or near the same spacetime point more than once). That lack of experience with CTLs/CTCs that self-intersect is what makes time travel to the past so difficult for humans to grasp. For a discussion of *how* Gödel did what he did, see Wolfgang Rindler, "Gödel, Einstein, Mach, Gamow, and Lanczos: Gödel's Remarkable Excursion into Cosmology," *American Journal of Physics*, June 2009, pp. 498–510.

[37]It was discovered in 1969, however, that this isn't strictly true *if* one allows for a test particle (our 'time traveler') to be electrically charged. Then, naturally present electromagnetic forces acting on the particle could be sufficient to propel the particle along a Gödelian CTL/CTC. That is, no rocket would be required. See U. K. De, "Paths in Universes Having Closed Time-Like Lines," *Journal of Physics A*, July 1969, pp. 427–432. There are other solutions to Einstein's equations that do allow time travel on free-fall geodesics: see, for example, I. D. Soares, "Inhomogeneous Rotating Universes with Closed Timelike Geodesics of Matter," *Journal of Mathematical Physics*, March 1980, pp. 521–525.

universe is, however, *non*-rotating and expanding (astronomers see red-shifts in the spectrums of distant stars) and so, although Gödel's spacetime satisfies the general relativity field equations, its time travel property does not hold in the spacetime in which we live. (This may account for why the initial reaction in the physics/philosophical communities, to Gödel's discovery that time travel is *not* nonsense according to general relativity, was mostly indifference.) The failure to observe time travel in our universe may (somewhat surprisingly, I think) still have possible implications for us, however, as one philosopher has cleverly argued.[38] He points out that naturally occurring Gödelian time travel would endow the universe with properties particularly useful for the survival of intelligence (presumably that includes humans) against extinction from a multitude of cosmic disasters. So, for those who argue that the universe we live in was *made* for us (the advocates of various proofs of God's existence that have Him as Designer), we have an obvious question: why did He (apparently) skip incorporating time travel?

In an invited essay that appeared the same year as his time travel physics paper, Gödel specifically addressed the seemingly paradoxical aspect of what he had discovered: "By making a round trip on a rocket ship in a sufficiently wide course, it is possible in these [rotating] worlds to travel into any region of the past, present, and future, and back again, exactly as it is possible in other worlds to travel to distant parts of space. This state of affairs *seems* [my emphasis] to imply an absurdity. For it enables one, e.g., to travel into the near past of those places where he has himself lived. There he would find a person who would be himself at some earlier period of life.[39] Now he could do something to this person which, by his memory, he knows has not happened to him."

Gödel's nerve then failed him, and he defended the possibility of the paradox of a time traveler meeting himself in the past with what I think an astonishingly unconvincing argument (particularly so for a logician) based primarily on *engineering* limitations: "This and similar contradictions, however, in order to prove the impossibility of the worlds under consideration, presupposes the actual feasibility of the journey into one's own past. But the velocities which would be necessary in order to complete the voyage in a reasonable time are far beyond everything that

[38]Alasdair M. Richmond, "Gödelian Time-Travel and Anthropic Cosmology," *Ratio*, June 2004, pp. 176–190. Not all physicists think Gödel's result is actually time travel. At least two think it is all simply the result of mathematical hijinks, and that time machines must remain "an aspect of science fiction fantasy": see F. I. Cooperstock and S. Tieu, "Closed Timelike Curves and Time Travel: Dispelling the Myth," *Foundations of Physics*, September 2005, pp. 1497–1509. This skepticism towards Gödel actually started much earlier, when two physicists (one a Nobel physics laureate) incorrectly claimed Gödel had simply gotten his math wrong: see S. Chandrasekhar and J. P. Wright, "The Geodesics in Gödel's Universe," *Proceedings of the National Academy of Sciences*, March 1961, pp. 341–347. It was those two physicists who had erred, however, as was pointed out by the philosopher Howard Stein, in his "On the Paradoxical Time Structures of Gödel," *Philosophy of Science*, December 1970, pp. 589–601.

[39]You'll recall that this is *precisely* the situation that Wells mentions in his "Notorious Literary Humbug" essay. If only he had lived just three more years, to see what he thought to be an absurdity actually appear in the serious writings of a brilliant mathematician!

can be expected ever to become a practical possibility. Therefore it cannot be excluded a priori, on the ground of the argument given, that the space-time structure of the real world is of the type described."[40] That is, Gödel was trying to head off critics of his rotating universe model who might point to the time travel result as proof that the model had to be flawed.

In a footnote Gödel says that the time traveler would have to move at least as fast as nearly 71 % of the speed of light, and that if his rocket ship could "transform matter completely into energy" then the weight of the fuel would be greater than that of the rocket by a factor of 10^{22} divided by the square of the duration of the trip (in rocket years). A trip to the past in Gödel's universe would require a time machine that looked like Dr. Who's telephone booth attached to a fuel tank the size of several hundred *trillion* ocean liners. These are formidable numbers,[41] but they require no violation of physical laws, and that's what really counts if time travel is to be disproved. Gödel's use of engineering limitations for explaining away backwards time travel is actually worse than simply being wrong, because the puzzle is not in practicality but rather in showing, assuming that general relativity is correct, how correct mathematical physics can lead to what seems to be a paradoxical conclusion. (And see note 12 again, for another reason the 'fuel argument' really has no force at all against the possibility of time travel in Gödelian spacetime.)

So, what did the great man himself, Einstein, think of all this? In the same publication as Gödel's essay, he *cautiously* replied as follows: "Kurt Gödel's essay constitutes, in my opinion, an important contribution to the general theory of relativity, especially to the analysis of the concept of time. The problem here involved disturbed me already at the time of the building up of the general theory of relativity, without my having succeeded in clarifying it . . . the distinction 'earlier-later' is abandoned for world-points which lie far apart in a cosmological sense, and those paradoxes, regarding the *direction* of the causal connection arise, of which Mr. Gödel has spoken . . . It will be interesting to weigh whether these are not to be excluded on physical grounds."

Despite the mathematical physics of Gödel, showing the possibility of time travel to the past, many philosophers are not quite so sure. As one expressed his concerns, "No science-fiction staple poses more philosophical difficulties than time travel, but there is still no consensus as to whether time-travel fictions exhibit logical, metaphysical, or physical impossibility."[42] The best-known and possibly

[40]Kurt Gödel, "A Remark About the Relationship Between Relativity Theory and Idealistic Philosophy," in *Albert Einstein: Philosopher-Scientist*: volume 7 of *The Library of Living Philosophers* (P. A. Schilpp, editor), Open Court 1949.

[41]For the analysis of a rocket powered by matter/anti-matter, a known physical process that satisfies Gödel's energy requirement for time travel, see E. Purcell, "Radioastronomy and Communication Through Space," in *Interstellar Communication* (A. G. W. Cameron, editor), W. A. Benjamin 1963.

[42]Alasdair Richmond, "Time-Travel Fictions and Philosophy," *American Philosophical Quarterly*, October 2001, pp. 305–318.

oldest of the paradoxical situations that seem to be part-and-parcel of time travel is the so-called *grandfather paradox*,[43] expressed this way by philosopher David Lewis in his pioneering 1976 paper (see note 5):

> Consider Tim. He detests his grandfather, whose success in the munitions trade built the family fortune that paid for Tim's time machine. Tim would like nothing so much as to kill Grandfather, but alas he is too late. Grandfather died in his bed in 1957, while Tim was a young boy. But when Tim has built his time machine and traveled to 1920, suddenly he realizes that he is not too late after all. He buys a rifle, . . . and there [Tim] lurks, one winter day in 1921, rifle loaded, hate in his heart, as Grandfather walks closer, closer . . .

So, there's the puzzle. Tim can obviously achieve his goal—he has a loaded gun, he's an excellent shot, a clueless granddad is coming ever closer—but if Tim actually does kill grandfather, years *before* Tim was (will be) born, then how can Tim *be* born? And if he is not born, then how can Tim ('now' not in existence) travel back through time to kill grandfather? What a confusing mess, right? So, the only possible conclusion to all this is that the starting premise, that time travel makes sense, must actually be nonsense. Right?

Well, maybe, but then what of Gödel with his time traveling rocket ship? That's hard-as-diamond, unshakeable mathematical physics, for heaven's sake. We can't just ignore *that*! Lewis offers a way out of this conundrum, and when we get to the book's discussions on paradoxes (that's plural because, believe it or not, there are other paradoxes even *more* perplexing than that of killing granddad in the distant past) we'll return to his solution.

Ever since Lewis wrote his paper, philosophers have been particularly fascinated by the grandfather paradox and have shown themselves to be at least as inventive as the science fiction writers in discussing it, or variations on it.[44] Here, for example, is a twist on that paradox that I think particularly clever, one that avoids the murderous spirit of the tale told by Lewis and Horwich:

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[43]The origin of this paradox is probably lost in time (the irony of that is *so* appropriate!), but I have traced it at least as far back as to the science fiction pulp magazine *Science Wonder Stories* which published, in its December 1929 issue, an editorial essay titled "The Question of Time Traveling." It challenged readers to think about the following scenario: "Suppose I can travel back into time, let me say 200 years; and I visit the homestead of my great great great grandfather, and am able to take part in the life of his time. I am thus enabled to shoot him, while he is still a young man and as yet unmarried. From this it will be noted that I could have prevented my own birth . . .."

[44]Even before Lewis' paper, Paul Horwich had reduced the grandfather paradox to *autoinfanticide*—a time traveler tries to kill his younger *self*—in "On Some Alleged Paradoxes of Time Travel," *The Journal of Philosophy*, August 14, 1975, pp. 432–444. But not all philosophers share this fascination. Earman (see the opening quote), for example, dismisses *all* of the science fiction paradoxes that are so beloved by fans of the genre as "while always good for a chuckle," they are just "crude and unilluminating means of approaching some delicate and deep issues about the nature of physical possibility." I think Earman is fundamentally correct, although I wouldn't go so far as to characterize the paradoxes as mere "chuckles." They are, after all, the source of much of the intellectual motivation prompting the exploration of the physics of time travel. An excellent example of this is found in the paper by the Russian physicist S. V. Krasnikov, "Time Travel Paradox," *Physical Review D*, February 14, 2002, pp. 064013-1 to 064013-8. The physics of the grandfather paradox is of *great* interest in this paper.

> Sarah has just completed building her time machine. She decides to test the machine on herself tomorrow morning at which time she intends to travel back one day. In the meantime, she goes home, puts some salve on the burn she received that day, and goes to bed. In the morning, Sarah, with coffee in hand, sits down to read the morning paper. She opens the paper to the following headline: 'Famous physicist found dead.' On the front page is a picture of her body, salve burn clearly visible on her arm, inside her pristine time machine. Underneath is the caption. 'Nobel-prize winning physicist found dead yesterday in mysterious device that materialized near city hall.' Extremely shaken, Sarah returns to the lab and destroys the time machine.[45]

Can any sense be made of this? We'll come back to this question later in Chap. 5, when we discuss the possibility (or not) of time being *multi*-dimensional.

Now, to conclude this Introduction, let me end with two amusing, connected short stories (in epistle form) that nicely describe the issues we'll take up in the rest of this book. The rejection letter for the denial of a research grant to fund the construction of a time machine has just been received . . .

That Useless Time Machine[46]

Dear Review Committee:
It is not our practice to raise complaints against a negative review report. We believe in peer refereeing and we respect it, whatever its content and consequences. However, in the case of our latest grant application (project named 'The Time Machine') we find it necessary to express our astonishment at the motivations with which our request for funding was turned down. Your main objection appears to be that our project is 'philosophically interesting' but 'practically useless', by which you mean that the project 'has no potential for applications.' We do not quite think that the main criterion for judging the scientific value of a project should be its practical usefulness, but never mind that. Let us agree that usefulness is a relevant criterion, especially when large amounts of money are involved. Why should that be a reason to turn down our project? Quite frankly, we cannot think of a project with better application potential than ours. Some examples:

- Cultural tourism: one could send herds of history fans back in time to witness the crucial episodes of the French Revolution, or to watch the Egyptians build the pyramids, or to videotape Socrates' lectures.
- Exotic safaris: we have already received several applications for dinosaur hunting expeditions (they got extinct anyway).

[45]G. C. Goddu, "Time Travel and Changing the Past: (Or How to Kill Yourself and Live to Tell the Tale)," *Ratio*, March 2003, pp. 16–32.

[46]Story by Roberto Casati (Senior researcher at CNRS, Paris) and Achille C. Varzi (Professor of Philosophy at Columbia University). Originally published in *Philosophy*, October 2001, pp. 581–583, and reproduced here by kind permission of the authors.

- Error detection: we could take a closer look at our past mistakes and learn how to avoid them in the future.
- Historic documentaries: think of the huge saving in set design, costumes, special effects, etc. (How much did *Gladiator* cost?)

And so on and so forth. Honestly, can you think of a project with better prospects for useful and thrilling applications?

Sincerely Yours,
The 'Time Machine' Research Group

Dear 'Time Machine' Research Group:
Thank you for your letter. We agree that it would be interesting to exploit a time machine for the uses that you suggest. It would also be remarkable if we could use it to prevent all sorts of unpleasant events that happened in the past. It would be remarkable, for instance, to be able to go back to November 22, 1963, and prevent Lee Harvey Oswald from killing John Kennedy, or to go back to April 14, 1912, and steer the Titanic around the iceberg. It would be excellent indeed to be able to do such things. However, suppose your project were to be successful. Suppose you *will* manage to build a time machine. Then why *didn't* you do any of those things? Why is it that our past history is still full of such sad events? Either this means that your project is doomed to fail and you will never manage to build a time machine; *or* it means that the project will succeed but that you are not going to use your time machine for these good purposes. In the first case, logic shows it would be pointless to support your project. In the second case, ethics dictates that it would be wrongdoing. Either way, you must concede that the reasons against your project are overwhelming.

Cordially Yours,
The Review Committee

Dear Review Committee:
Certainly you have noticed that our suggestions for practical applications of the time machine did not include any uses that could result in an alteration of the natural course of history. As a matter of fact, we believe that no such alteration is logically possible. According to our project, it is logically possible to *visit* the past but not to *modify* the past. No time traveler can undo what has been done or do what has not been done. So the logic is safe. This does not mean that the time traveler will be ineffectual during her stay in the past, of course; it simply means that what she is going to do is something that she has already done. An accurate catalogue of all the past events would include an account of the arrival of the Time Machine from out of nothing as well as an account of all the actions and reactions that followed. And ethics is safe, too. For, if indeed we managed to go back to Dallas, we could not stop Oswald from doing what he did. Nobody would be able to stop Oswald because nobody was able to stop him (and nobody was able to stop Oswald because nobody will ever be able to do so, even if they came from the future). Alas, the past is full of sad events but there is nothing that we can do about that.

Respectfully Yours,
The 'Time Machine' Research Group

Dear 'Time Machine' Research Group:
We appreciate the distinction between changing the past (impossible) and affecting the past (possible). However, this simply reinforces our initial impression: your project has no practical value. If in order to travel to the past one has to have been there already, and if one can only do what has already been done, then *á quoi bon l'effort*? Why should we invest in a 'Time Machine' at all? We are afraid that our decision is now final.

Yours with best wishes,
The Committee

Well, all seems to be certainly lost with *that*. But, wait, perhaps not. Maybe, with just one more *really good* appeal, The Committee's rejection can be reversed! If *you* were on the Review Committee, and had just read the following letter, how would *you* vote?

A Useful Time Machine[47]

Dear Review Committee:
We regret your continued decision to reject our proposal. Even though you have told us your decision is now final, we humbly ask your indulgence for one last appeal. We believe you have misinterpreted a crucial part of our proposal.

You maintain that our 'Time Machine' project 'has no potential for applications' and has 'no practical value.' You ultimately base this claim on the fact that "If in order to travel to the past one has to have been there already, and if one can only do what has already been done, then *á quoi bon l'effort*? Why should we invest in a 'Time Machine' at all?" Your argument however is a misinterpretation of our own comments that 'According to our project it is logically possible to visit the past but not to modify the past ... This does not mean that the time traveler will be ineffectual during her stay in the past, of course; it simply means that what she is going to do is something that she has already done.' We regret the awkward and easily misleading locution of the last sentence, but such are the perils of talking about time travel. Regardless, please consider our clarification.

Certainly if we were proposing that the time traveler *be* 5 years old again, we would be proposing something not worth the effort—our proposed time traveler has already turned five and cannot do so again. But we are not proposing that the time traveler do things that have already occurred in her own personal past, but rather in

[47]Story by Geoff Goddu (Professor of Philosophy at the University of Richmond, Virginia). Originally published in *Philosophy*, April 2002, pp. 281–282, and reproduced here by kind permission of the author.

her personal future. The time traveler has not yet, from her personal temporal perspective, travelled back to, say, the library at Alexandria in 100 BCE. When she does travel back to 100 BCE to obtain scans of the books in the library before its destruction, she will be older than she is now. When she returns she will be still older (and we hope wiser, i.e., in possession of valuable information to which neither you nor we currently have access).

But is it true that as of 2002 AD [the year this letter was written] the time traveler has already visited Alexandria in 100 BCE? It could well be. But whether or not it is depends upon whether it is *also* true that our project will be successfully funded and completed. Because time travel into the past involves reverse causation, certain past events, such as the time traveler visiting 100 BCE, will be dependent upon certain future events, such as the successful funding and completion of our project. Hence, if it is not true that our project is both funded and completed, then it is not true that our time traveler has of 2002 already visited 100 BCE.

But suppose we were to learn now, before the funding and completion took place, that our time traveler had indeed been present at the library in Alexandria in 100 BCE. Would this imply that there was no reason to expend the effort to fund our project? After all, if the travel has 'already' happened, why bother funding the project? Firstly, such an argument does not imply that a 'Time Machine' would have no practical application, but rather expresses the futile hope that one could in fact get the practical benefits (if time travel is successful, we obtain the desired information) without expending the effort at all. Secondly, the hope is futile, for if we learn right now that our time traveler had been present at the library in 100 BCE, we would then know, assuming no other possible funding source, that you *will* expend the effort to fund our project. To deny this last is to make the impossible suggestion that even though your support is truly a causal antecedent of the successful trip, there is now no need for you to actually expend the effort to provide funding.

Hence, the effort is far from pointless, for the project will only succeed through your and our efforts. And success will generate, not only all the practical applications we outlined in our first letter, but, in addition, a host of information gathering applications such as more accurate historical research, lost item location identification, legal testimony verification, etc. Even if, as we (and you) acknowledged, no one could now prevent Oswald from killing Kennedy, wouldn't it be worth verifying that Oswald was the lone killer of Kennedy? Also, the information gathering need not be restricted to the past. For example, information concerning the prices of various stocks 10 years from now would be extremely valuable to a suitably cautious and prudent investor. Surely you cannot object to our information gathering in the future on the grounds that 'it will already have been done.' And just think, the information we obtain could be what allows you to obtain at very low prices those stocks that in the future will be extremely valuable and allows your esteemed committee to dramatically increase your support of worthy scientific endeavors.

Again, we ask you to reconsider your original decision.
Respectfully yours,
The 'Time Machine' Research Group

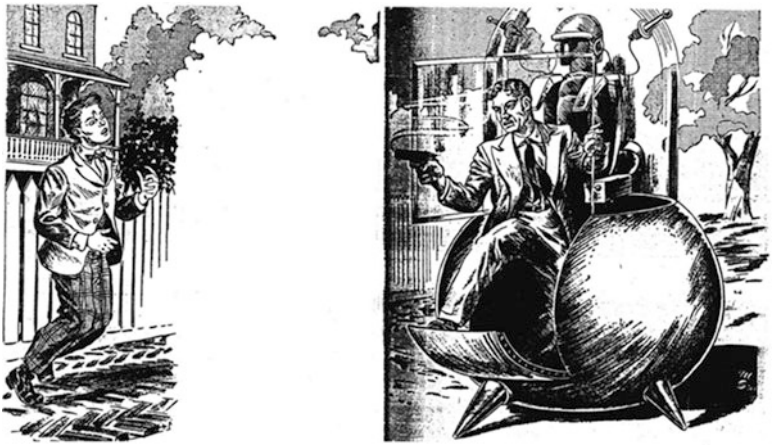

A time machine inventor makes an experimental test of the grandfather paradox! (Illustration from "Thompson's Time Traveling Theory" by Mortimer Weisinger), *Amazing Stories* March 1944 (art by Malcolm Smith). Reprinted by arrangement with Forrest J. Ackerman, Holding Agent, 2495 Glendower Ave., Hollywood, CA 90027.

Not everybody likes time machines as a science fiction gadget, not even otherwise enthusiastic devotees of the genre. For example, in a Letter-to-the-Editor published in the December 1931 issue of Astounding Stories*, one seventeen-year-old fan had this to say: "There is only one kind of Science Fiction story I dislike, and that is the so-called time-traveling. It doesn't seem logical to me. For example, supposing a man had a grudge against his grandfather, who is now dead. He could hop in his machine and go back to the year that his grandfather was a young man and murder him. And if he did this how could the revenger be born? I think the whole thing is the 'bunk.'" As this book will demonstrate, this young reader was not alone in that opinion. As this book will also demonstrate, in the last few decades that view has been rapidly evolving.*

For Further Discussion

Read again the penultimate sentence in the last letter from The 'Time Machine' Research Group, and then think about how you would respond to the following questions.

(1) Would *you* invest in a stock market if you knew somebody else had a time machine giving *them* advance information on stock performance?
(2) How might the existence of a time machine influence the future of the stock market, in general? For an early science fiction look at these questions, see Lee Laurence, "History in Reverse," *Amazing Stories*, October 1939.

One writer has speculated that Wells' model for the Time Traveller was the American inventor Thomas Edison. (See Martin T. Willis, "Edison as Time Traveler: H. G. Wells' Inspiration for His First Scientific Character," *Science Fiction Studies*, July 1999, pp. 284–294.) As Wells worked his way from *The Chronic Argonauts*, through revisions, to the final *Time Machine*, the story's hero evolved from Dr. Nebogipfel to the Philosophical Inventor to the Time Traveller. The one individual who could have inspired all of these various hero types was, according to Willis, Edison, a world-famous Victorian-age celebrity whose story was well known to Wells. If Wells had today's scientific personalities available as potential inspirations, who do you think he would use? How might that choice affect the story and structure of *The New Time Machine*?

The idea of *personal time*, used by the philosopher David Lewis (note 5) to consistently interpret time travel stories, has been used in a quite different way (although time travel gets a few words, too) by the philosopher Roy Sorenson. In his paper "The Cheated God: Death and Personal Time," *Analysis*, April 2005, pp. 119–125, Sorenson asks you to imagine an immortal god. For some reason this god runs afoul of a demon, who curses the god in a curious way. (The 'telling of a story' is a common technique in philosophical papers and, while foreign to what readers of physics papers are used to seeing, is not without some charm. Just be sure to always keep in mind that its

(continued)

primary use is as an *attention-grabbing* device, but as far as having any other merit, well, that's often another story.) The curse is such that the life span of the once immortal god is reduced to that of a normal human life span and yet, perhaps surprisingly, the god will still never die. As Sorenson writes, "[The god] will live forever. But [the god] will not have a better life than a mortal. The demon has harmed [the god] as gravely as death harms mortals." How, you might wonder, is this to be done? As Sorenson explains, "[The god] lives half of its now mortal span, followed by a trillion years of nothingness, then a quarter of its mortal span followed by a trillion years of nothingness, then an eighth of its mortal span followed by a trillion years of nothingness and so on ad infinitum." Sorenson's argument is simply an exotic form of the high school summation of the geometric series $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots = 1$, where there are an *infinite* number of terms to the left of the equality. (Each term represents a period of time during which the god is conscious, and each + represents a trillion years.) Sorenson picked a trillion years of nothingness between consecutive periods of consciousness for (I suggest) dramatic reasons, but suppose instead that he had picked 1 μs for the period of nothingness. Discuss what effect this would have (if any) on the life of the god. Consider two cases:

(a) There is no minimum time duration for consciousness, and
(b) There *is* a minimum time duration such that, for any shorter duration, a consciousness remains 'unaware' even though it is *not* in a state of nothingness.

After working all night making some final calculations, a physicist carefully solders a final resistor into the control module of the world's first time machine and then steps into the gadget that is a sure bet to win the next Nobel Prize in physics. As she does, she notices that it is precisely 8:10 in the morning, as indicated on both her wrist watch and the clock on the lab wall. After settling into a plush leather seat she pushes the time machine's power button, the machine glows with a flickering blue-red halo and hums with a mighty throb for a while and then, at precisely 8:15 by her wrist watch, she steps out of the machine and back into her lab. She notices the clock on the wall now reads 8:05. That is, she took 5 min of personal time (8:10 to 8:15) to travel 5 min of external time into the past (8:10 to 8:05). On the one hand she certainly seems to be a time traveler, in that she exits the machine before she enters it. (Ignore the issue of there being *two identical* physicists in the lab from 8:05 to 8:10!) On the other hand, the elapsed personal and external

(continued)

times are *equal*. Does this suggest a need to modify or expand David Lewis' definition of a time traveler? As you ponder this question, you might want to read the following four papers: (1) Paul R. Daniels, "Lewisian Time Travel in a Relativistic Setting," *Metaphysica*, October 2014, pp. 329–345, (2) Douglas Kutach, "Time Travel and Time Machines," in *A Companion to the Philosophy of Time* (H. Dyke and A. Bardon, editors), Wiley-Blackwell 2013, pp. 301–314, and (3) Frank Arntzenius, "Time Travel: Double Your Fun," *Philosophy Compass*, November 2006, pp. 599–616. A bit more demanding (but worth the effort) is the long chapter "Time Travel and Time Machines" by Chris Smeenk and Christian Wüthrich, in *The Oxford Handbook of Philosophy of Time* (C. Callender, editor), Oxford 2011, pp. 577–630 (see page 580, in particular).

> The idea that information is physical has given rise to a series of discoveries which indicate that physics has much to say about fundamentals of computer science.

The above quotation is the opening sentence to a most interesting paper by the physicist Dave Bacon, "Quantum Computational Complexity in the Presence of Closed Timelike Curves," *Physical Review A* (70), 2004. (When he wrote, Bacon was at Caltech, but he is now a software engineer at Google.) The title of Bacon's paper, translated into blunt English, is "It Would Be Really Neat If We Could Merge a Time Machine With a Computer." That is, to further quote from Bacon's paper, "One could [efficiently] solve a hard problem by trying out a solution to the problem, sending one's computer back in time, attempting a different solution to the problem, sending one's computer back in time, etc., until a solution to the problem has been found." There then follows a pretty sophisticated analysis on the self-consistent time evolution of a quantum system, ending with Bacon's frank admission that "we would not be honest if we did not end this paper with the caveat that this work is at best a creature of eager speculation . . . Practical considerations are humorous at best." Read Bacon's paper and discuss what he means by "a hard problem." (There *is* a technical term used by computer scientist for such problems: NP-complete.)

The occasional theological commentary in this book may strike some as a bit odd for a topic treated with heavy doses of deep mathematics in the physics literature but, as you'll see on the following pages, theology is an unescapable dimension to any informed discussion of time travel. A literary connection

(continued)

between time travel and theology has, in fact, existed for a long time. As pointed out in Paul Alkon's *Origins of Futuristic Fiction* (University of Georgia Press 2010), "The first time-traveler in English literature is a guardian angel who returns with state documents from 1998 to the year 1728 in Samuel Madden's *Memoirs of the Twentieth Century*" (published in 1733, nearly three centuries ago). Madden was an Irish-Anglican clergyman whose book was satire rather than science fiction, but its time traveling aspect was a first. As Professor Alkon also writes, "Madden [was] the first to write a narrative that purports to be a document from the future. He deserves recognition as the first to toy with the rich idea of time-travel in the form of an artifact sent backward from the future to be discovered in the present." Your assignment: read and discuss Alkon's book.

You'll recall that Gödel cast his view of time travel in the form of a self-encounter in the past. In Frederik Pohl's "Let the Ants Try," we find a science fiction tale that appeared essentially simultaneously with Gödel's paper (*Planet Stories*, Winter 1949), in which a time traveler journeys back forty million years. Upon stepping out of his time machine, he hears a "raucous animal cry" from somewhere in the nearby jungle. Later, after other adventures in time, he returns to near the same point in spacetime. After stepping out of his time machine, he sees himself in the distance—the earlier version of himself during the first trip. Then, suddenly, the time traveler meets a violent death: "As his panicky lungs filled with air for the last time, he knew what animal had screamed in the depth of the Coal Measure forest." In fact, self-encounters had appeared in science fiction *years* before Gödel's paper. In the 1942 story "Minus Sign" (*Astounding Science Fiction*, November) by Jack Williamson, for example, a spaceship battles with itself while traveling backward in time. How do you think a scientist like Gödel would have liked these two stories? (Who knows, maybe he *did* read them!) If you could travel back in time to 1949 to ask him if such tales had been an inspiration, do you think he would be intrigued, amused, or instead would he be insulted?

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About the Author

Paul J. Nahin was born in California, and did all of his schooling there, including a PhD in electrical engineering from UC Irvine (1972). He is now emeritus professor of electrical engineering at the University of New Hampshire. Prof. Nahin has published a couple of dozen short science fiction stories in *Analog*, *Omni*, and *Twilight Zone* magazines, and has written 18 books on mathematics and physics. He has given invited talks on mathematics at many prestigious institutions, and has appeared on National Public Radio's "Science Friday" show (discussing time travel) as well as on New Hampshire Public Radio's "The Front Porch" show (discussing imaginary numbers). He advised Boston's WGBH Public Television's "Nova" program on the script for their time travel episode.

Chapter 1
A Broad Look at Time Travel

"Hold infinity in the palm of your hand and eternity in an hour."

—William Blake, writing in "Auguries of Innocence" (1863), with words that could quite well describe what it would be like to time travel

"I need a place to hide, that's why I believe in yesterday."

—The Beatles (*Yesterday*, 1965)

1.1 Time Travel in the Fantasy and Science Fiction Literature

"Woodn't it be grate to go back in tyme and correct your mistakes? Wouldn't it be great to go back in time and correct your mistakes?"

—motto of *Time Twisters* comics

To travel in time.

Could there possibly be a more exciting, more romantic, more wonderful adventure than that? I don't think so, and in this opening section I want to just briefly discuss how fascinating many writers (and their readers) have found the concept of time travel, and to point out that the fascination began *long before* mathematical physicists discovered time travel lurking in Einstein's general theory of relativity.[1]

Before the arrival of humans on the surface of the Moon in 1969, the only other 'fantastic voyage' that could compare with time travel was traveling through outer space. During the seventeenth and eighteenth centuries, in fact, such voyages were the center of a genre of fiction (now called *science fiction*) called the "imaginary voyage" or "extraordinary voyage." Marjorie Hope Nicolson's[2] 1948 book *Voyages*

[1] An excellent, book-length *literary* treatment of time travel is by David Wittenberg, *Time Travel: the popular philosophy of narrative*, Fordham University Press 2013.

[2] Marjorie Hope Nicolson (1894–1981) was a literary scholar of the first rank at both Smith College and Columbia University.

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to the Moon carefully documents just how popular that form of literature was—and still is. Since 1969 the first such voyages have become history, of course, and time travel has replaced space travel as the modern "imaginary voyage."

It seems a safe bet that that, given a random selection of middle-aged adults, the vast majority of them would respond enthusiastically if asked whether time travel interests them. This fascination with time travel has actually been 'scientifically' documented. In one intriguing study,[3] several hundred men and women were asked to consider the possibility of spending an hour, a day, and a year back in both their personal past (since birth) and their historical past (before birth). They were further told that it would cost $10,000 to purchase such time travel services. Their response indicated that 10 % would be willing to spend that much money for an hour in the historical past, 22 % for a day, and 36 % for a year. As might be expected, the numbers rose as the cost dropped and, if such trips were free the interest was almost universal. As one writer put it, "Time travel [is] the ultimate fantasy, the scientific addition to the human quest for immortality."[4] And as a philosopher observed, "[T] he popular appeal of time travel . . . is no doubt due to a nostalgia for the past, which is almost an omnipresent aspect of the human condition."[5]

Fiction writers have, for *centuries*, recognized the fantasy appeal of time travel. The common fairy tale theme of 'The Three Wishes,' in which the recipient ends up using the final wish to undo the unforeseen consequences of the first two, is the precursor to all modern change-the-past time travel stories. Indeed, the means of time travel in the Norwegian poet Johan Wessel's 1781 play *Anno 7603 is* a fairy. Some of the best modern science fiction stories have played with the fantasy appeal of time travel by having gifts arrive by accident from the future: the moral of such tales is generally that unearned gifts usually bring grief.[6] The editor's introduction to a time travel story involving the Civil War referred to the fantasy aspect of time travel—with a reference to another age-old adult fantasy—when he wrote "time travel stories about the Civil War have one thing in common with pornography; they serve to titillate an impulse [in the case of time travel stories, the impulse to change history] and to frustrate [history]."[7] This is the motivation for the time traveler in Stephen King's 2011 novel *11/22/63*, who uses what appears to be a naturally occurring wormhole (connecting a Maine diner to 1958) for his attempts at preventing the assassination of John F. Kennedy.

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[3]T. J. Cottle, "Fantasies of Temporal Recovery and Knowledge of the Future," in *Perceiving Time*, John Wiley 1976.

[4]T. Paul, "The Worm Ouroboros: Time Travel, Imagination, and Entropy," *Extrapolation*, Fall 1983, pp. 272–279.

[5]J. W. Smith, "Time Travel and Backward Causation," *Cogito* 1985, pp. 57–67.

[6]Among the many such tales, five particularly good ones are "Something for Nothing" by Robert Sheckley, "Mimsy Were the Borogoves" by Lewis Padgett (pseudonym of the married couple Henry Kuttner and C. L. Moore), "Child's Play" by William Tenn (pseudonym of Philip Klass), "The Little Black Bag" by Cyril Kornbluth, and "Thing of Beauty" by Damon Knight. All can be found in various anthologies.

[7]*The Fantastic Civil War* (F. McSherry, Jr., editor), Baen 1991.

A character in the 1985 novel *The Bird of Time* by George Effinger nicely captures the fantasy appeal of time travel with the declaration "The past . . . is the home of romance." On a less poetic level, time travel and the movies and stories about it fascinate most people because they turn our everyday world view upside down and inside out.[8] Such movies and stories make people *think*. It is therefore not surprising that time travel movies have been popular for decades, from the pioneering *Berkeley Square* in 1933, to the classic 1960 filming of *The Time Machine*, to *Back to the Future* in 1985 (*the* top film that year in a *Boxoffice* magazine poll), to the flawless 1989 *Bill & Ted's Excellent Adventure*, to the clever *Terminator* action films, to the ingenious 2012 *Looper*, to the commercially successful 2014 *Interstellar*. Each of these films, and others, too, will be discussed later in the book.

When we discuss time travel, we should really be careful to distinguish between two quite different versions: to the future, and to the past. There is no dispute, today, about the first. As two *severe critics* of the possibility of time travel to the past wrote decades ago, "After 1900, special relativity made scientific discussion of time machines possible."[9] What they were referring to is the fact that, by traveling in a rocket ship fast enough (but never, unlike Superman, faster than the speed of light), and far enough, one could leave Earth, loop out on a vast journey perhaps halfway across the universe, and then return hundreds, thousands, even millions of years in the future. You could theoretically (ignoring all the *engineering* difficulties) do this, in fact, with the apparent passage of your 'personal time,' (as measured by your wrist watch or the beating of your heart) as brief as you'd like. (Physicists call 'personal time' *proper time*, and I'll return to this in Chap. 3.) This astonishing conclusion from special relativity, that time travel to the future makes physical sense, literally put a lot of Victorian-era trained physicists into shock.

A quite sophisticated use of this idea appeared early in science fiction, in the tale of a space traveler who returns from a high-speed trip out to the blue supergiant star Rigel in the constellation Orion.[10] The 900 or so light years of the round trip had taken just 6 months of ship or personal time (proper time), but a thousand years of back-home time. The traveler returns to Earth to find all he had left behind long dead and returned to dust: "Sometimes I waken from a dream in which they are all so near . . . all my old companions . . . and for a moment I cannot realize how far away they are. Beyond years and years."

Another story[11] of a trip into the future that delivers an equally powerful emotional impact, this time via a Wellsian-type time machine (more on what that

[8]Somewhat more pompous (but no less correct) was this observation by an academic: "The time-travel [film] romance is an attempt to reenchant the world, to regain a sense of belongingness, to reinstate the magical, autocentric Universe of the child and the primitive." See W. Wachhorst, "Time Travel Romance on Film," *Extrapolation*, Winter 1984, pp. 340–359.

[9]S. Deser and R. Jackiw, "Time Travel?" *Comments on Nuclear and Particle Physics*, September 1992, pp. 337–354.

[10]R. H. Wilson, "Out Around Rigel," *Astounding Stories*, December 1931.

[11]W. Tucker, *The Year of the Quiet Sun*, Gregg 1979.

means later in this chapter) rather than by rocket travel, tells of a time traveler trapped in post-nuclear war times, where there is no energy available to power his machine for the return trip. As the story ends, he finds the woman he had loved and left behind in the past. She is now the elderly widow of another man, having married his rival because the time traveler (just like Wells' Time Traveller) never returned.

A trip into the future does not *have* to be serious or sad. A nice example of that is the story of a spaceship crew that sets off for the Alpha Centauri triple star system, more than four light years distant.[12] They survive the trip, which requires 500 years of both personal *and* external time (this story is the *only one* I'll mention in this book that uses *a preserving drug* rather than physics). What causes me to include it in a book on *time travel* (stories in which proper and external time are one-in-the-same are simply *not* about *time travel*) is that, long before they arrive at the end of their journey, the secret of faster-than-light (FTL) travel is discovered back on Earth and so they arrive at their destination to find a human reception committee! As you'll see when we get to Chap. 3, knowledge of FTL travel is equivalent to knowing the secret of travel into the past, and so the crew is sent back in time, to Earth, to just one year after they left—and they listen to their own radio communications arriving from deep space.

The *real* adventure in time travel, as suggested by "Far Centaurus," would be to go backward in time, to visit the past. The editor of the science fiction pulp magazine *Thrilling Wonder Stories* used the powerful emotional hook of changing the past in a 1950 blurb announcing a time travel story coming in the next issue: "What's the biggest mistake you ever made? Don't worry about it. You may have pulled some awful boners in your time, but there's a sure-fire remedy for them all. It's simple. Just look up at that old time-clock on the wall—and turn it back to the moment just preceding your terrible blunder. Then make your corrections—and set your time-clock back to the present. You may be starting a new chain of error, but why fret? You can go back in time again. . ." Or, as the promotional text on the video package of the 1986 movie *Peggy Sue Got Married* says, "to do it again" is "the golden opportunity almost everyone has longed for at least once."

Writing less romantically, a philosopher declared that a "major source of interest in the time travel question is our general fascination with the exotic and the child-like frustration we sometimes feel at being confined to the present. We wish that the benefits of moving through space could be supplemented with the benefits which would accrue from movements through time."[13] Robert Silverberg, a science fiction writer who has used the time travel theme often and effectively, expressed this sentiment quite clearly when he wrote "Suppose you had a machine that would enable you to fix everything that's wrong in the world . . . The machine can do anything . . . it gives you a way of slipping backward and forward in time . . . Call this machine whatever you want. Call it Everybody's Fantasy Actualizer. Call it a

[12] A. E. Van Vogt, "Far Centaurus," *Astounding Science Fiction*, January 1944.

[13] R. A. Sorenson, "Time Travel, Parahistory and Hume," *Philosophy*, April 1987, pp. 227–236.

Time Machine Mark Nine."[14] He gives a masterful demonstration of what he means by that in one of his own stories, a tale[15] set in a year when time machines actually exist. Even so, the characters use their imaginations to explore their fantasy worlds and wishes—wishes that could (if they *really* wanted to) be realized with a real time machine. Time travel fiction is, you see, the ultimate escapist literature!

The adventure promised by time travel to the past doesn't necessarily mean *pleasant* adventure, and science fiction has used that idea to great effect. The unstated horror of a trip backward in time, if you think just a bit about it, is that it would bring the dead past, filled with all its dead occupants, alive again, literally resurrected from dank and moldering graves. The top of Mount Everest, the bottom of the Marianas Trench, the sands of Mars—none of these exotic places can even be mentioned in the same breath with the *past*. The capture of the mystery and, yes, the sheer terror of the past, is in this opening line to a 1950s tale: "When Dr. Flitter came into the room, it seemed as though the past and its dead people came in with him, clinging to him like stale surgery smells, like the cold sweat of ancient autopsies."[16] In another equally macabre story, we read of a time traveler in the past anticipating a meeting with a long-dead lover as he "shivered with a renewal of horror . . . She ought to be grateful to him for having raised her from the dead, even briefly."[17]

Another tale, slightly less gruesome, tells us of a character who delights in pointing out all the bad aspects of living in the past.[18] Tell him *when* in time, and he quickly ticks off the disadvantages of being *then*. To live in ancient Greece would let you rub shoulders with Aristotle, sure, but you already know what he said and you'd soon regret the lack of modern plumbing. The year of the American Revolution might let you exchange greetings with George Washington, but you'd also have to put up with cholera in Philadelphia, malaria in New York, and the fact that if you needed an operation there would be no anesthesia anywhere. The Victorian Age appeals to modern romantics but, before you go back, you'd better have your eyes and teeth checked. The time traveling historian in one novel[19] takes these medical warnings to heart and has her appendix prophylactically removed, and is further advised to have her nose cauterized against all the awful stinks of her destination, the fourteenth century.

On the other hand, poor health care isn't *all* there is with time travel to the past. One time traveler from the future, for example, makes a very good living in the past

[14]R. Silverberg, "Ms. Found in an Abandoned Time Machine," *Beyond the Safe Zone*, Warner 1986.

[15]R. Silverberg, "Many Mansions," *Beyond the Safe Zone*, Warner 1986.

[16]R. Bretnor, "The Past and Its Dead People," *Magazine of Fantasy and Science Fiction*, September 1956.

[17]L. Marlow, *The Devil in Crystal*, Faber and Faber 1944.

[18]A. Bester, "Hobson's Choice," *Magazine of Fantasy and Science Fiction*, August 1952.

[19]C. Willis, *Doomsday Book*, Bantam 1992.

by winning bets on yet-to-happen events whose outcomes he knows.[20] Time travel to the past allows a Parisian curio shop in the present to offer remarkably authentic looking newspapers from 1804 whose only 'flaw' is that they appear to be fresh off the press—which of course they are![21] And the failed professor in one romantic story[22] finds the Paris of 1482 infinitely better than the Paris of 1961.

A popular fictional appearance of time travel is the use of the past as a hiding place, as a sanctuary for those wishing to escape the troubles of modern times.[23] An interesting twist on this idea was presented in one tale[24] in which the past is used for later military gain in the present. In this story the Earth of a thousand years in the future is ruled by a dictator, and the oppressed masses are unable to arm themselves for revolt. So, back into the past travels an agent to arrange for the construction of weapons, which are then stockpiled in hidden caverns where they can be retrieved for use ten centuries later. The past is used in this story as both a sanctuary *and* a repository from which to make war in the future, and so we have a time travel fantasy for both doves *and* hawks in the same tale! This military use of the past is passive; other writers have more aggressively used time travel to the past for military gain as, for example, mining uranium deposits before they have had time to reduce themselves to lead via radioactive decay,[25] or in drilling for Middle East oil in the past to deprive adversaries of it in the present.[26]

Time travel to the past would, perhaps, interest criminals, too. As the science fiction writer Larry Niven wrote, "If one could travel in time, what wish could not be answered? All the treasures of the past would fall to one man with a submachinegun. Cleopatra and Helen of Troy might share his bed, if bribed with a trunkful of modern cosmetics."[27] Or, as the tragically flawed inventor of the first time machine dreamed, before using time travel to commit what he thought would be the perfect locked-room murder, "The Great Harrison Partridge would have untold wealth. He could pension off his sister Agatha and never have to see her

[20]C. Sprague, "Time Track," *Startling Stories*, January 1951.

[21]M. Leinster, *Time Tunnel*, Pyramid Books 1964.

[22]U. K. Le Guin, "April in Paris," *Fantastic Stories*, September 1962.

[23]There are *many* excellent examples of such tales, a few of which are Clifford Simak, "Over the River & Through the Woods"; Ray Bradbury, "The Fox and the Forest"; Jack Finney, "Such Interesting Neighbors"; J. B. Priestly, "Mr. Strenberry's Tale"; James Gunn, "The Reason Is With Us"; and H. B. Piper, "Flight from Tomorrow." All can be found in various anthologies.

[24]R. F. Young, "Not to be Opened—," *Astounding Science Fiction*, January 1950.

[25]C. Simak, "Project Mastodon," *Galaxy Science Fiction*, March 1955.

[26]P. Anderson, "Wildcat," *Magazine of Fantasy and Science Fiction*, November 1958, and W. Jeschke, *The Last Day of Creation*, St. Martin's Press 1982.

[27]L. Niven, "The Theory and Practice of Time Travel," in *All the Myriad Ways*, Ballantine 1971.

again. He would have untold prestige and glamour, despite his fat and baldness, and the beautiful and aloof Faith Preston would fall into his arms like a ripe plum."[28]

Instead of viewing the past as an aid to crime, some writers have used it as the perfect dumping ground for criminals, as a highly convenient place to remove them from society.[29] After all, there can be no breakout from the prison of the past—at least not without a time machine. What might happen to criminal recidivists in a world that has mastered time travel is nicely explained in one story as follows: "If you cannot live among people, then off to the reptiles—one hundred or one hundred twenty million years before the present. There you wouldn't freeze in a tropical pre-glacial climate, and you could nourish yourself on plants. But there is no one to talk with, boredom, and in the end you offer yourself up as an afternoon snack to a tyrannosaurus."[30] With an interesting twist on this is the tale[31] of a physics professor who *helps* criminals disappear into the past to escape relentless police pursuit.

Museum curators, too, would seem to be obvious clients for time machine companies, as would collectors of extinct species who work for zoos. An example of the first case is in a novel[32] about a time travel business called *Time Researchers*, with the corporate mottos 'We Sift the Sands of Time.' It works as a futuristic version of Indiana Jones, as finders of lost historical artifacts for customers who can pay the substantial charges. A typical mission is to make original sound recordings of one of Lincoln's unreported speeches. We find the same idea in a short story[33] about a business called *Genealogy, Inc*., with the corporate motto

"An Ancestor for Everybody." It uses a 'time scanner' to provide its clients with a list of distinguished predecessors. And in another novel we read of the Historical Corps, whose time travel agents are "writing the definitive history of mankind.".[34]

Another use for time travel to the past, one of the most unusual I have seen, was suggested in a philosophical article[35] which considers an age-old question that has

[28]A. Boucher, "Elsewhen," *Astounding Science Fiction*, January 1943. Partridge's dream is shattered, however, because he overlooks a few details about time travel, ones that he wouldn't have missed if he could have read this book. We'll come back to this classic story, which merges a time machine with murder, later in the book.

[29]This is a popular science fiction scenario, and three of the best stories playing with it are P. Anderson, "My Object All Sublime," *Galaxy Science Fiction*, June 1961; I. Watson, "In the Upper Cretaceous with the Summerfire Brigade," in *Stalin's Teardrops*, Victor Gollancz 1991; and R. Silverberg, "Hawksbill Station," *Galaxy Science Fiction*, August 1967.

[30]S. Gansovsky, "Vincent Van Gogh," in *Aliens, Travelers, and Other Strangers*, Macmillan 1984.

[31]J. Finney, "The Face in the Photo," in *About Time*, Simon and Schuster 1986.

[32]W. Tucker, *The Lincoln Hunters*, Rinehart 1958. See also A. Bitov, "Pushkin's Photograph," in *The New Soviet Fiction*, Abbeville Press 1989.

[33]M. Shaara, "Man of Distinction," *Galaxy Science Fiction*, October 1956.

[34]L. A. Frankowski, *The Cross-Time Engineer*, Del Rey 1986. The same idea is in the 1991 film comedy *The Spirit of '76*, in which time-traveling historians from 2176 visit the past in an attempt to reconstruct the lost records of the founding of America.

[35]J. C. Graves and J. E. Roper, "Measuring Measuring Rods," *Philosophy of Science*, January 1965, pp. 39–56.

long bedeviled schoolboys: "If everything in the Universe doubled in size overnight while we slept, could we tell what had happened when we woke up next morning?" The usual answer to this puzzle (called the *Universal nocturnal expansion* by philosophers) is *no*, but the authors of the article suggest that 'all' we need do is take a yardstick back to yesterday and compare it with itself! Great idea, for sure, but it had appeared years earlier in a science fiction story.[36]

More ingenious uses for the past are discussed in the story[37] of a time travel business called *Time Associates*. One use comes in the form of a request from a United States senator who wants to send the disadvantaged of today back into the remote past, where they could have a fresh start on a virgin Earth. Yet another use comes from a religious fringe group that wants to purchase exclusive rights to the time of Jesus—not to visit, but to prevent *anyone* from visiting. The group fears that any such visitors would "learn the truth," which might contradict the very legends that form the heritage of Christianity. And, in what may be the most ingenious idea of all, *Time Associates* itself does not do business in the present, but rather 150,000 years in the past, in a 'new' country called Mastodonia. The corporate lawyer, you see, has determined that such an arrangement legally means the company is a *foreign* company doing business outside the United States, and so it is not liable for taxes to the IRS!

The tourist trade is a booming business in science fiction, with dinosaur hunting at the top of the list. There are many such tales,[38] including the cerebral stories in L. Sprague de Camp's short-story collection *Rivers of Time*, starting with the classic "A Gun for Dinosaur." The earliest (that I know of) fictional use of time travel to the past for hunting was not for dinosaur hunting, however, but rather for saber-toothed tigers, wooly mammoths, and cave bear.[39] Historical tours to the great events of the past are also an entertaining use of time travel.[40] Even mundane events may one day be on the 'to do' lists of time travelers to the past. In one, for example, curious crowds from the very far future show up, nightly inside the home a twentieth century family, much as tourists today visit Monticello.[41]

Perhaps the most direct use of the past's unique resource, itself, is realized in science fiction by Hollywood. In one tale,[42] after purchasing the motion picture

[36]H. M. Sycamore, "Success Story," *Magazine of Fantasy and Science Fiction*, July 1959.

[37]C. Simak, *Mastodonia*, Ballantine 1978.

[38]Two are B. W. Aldiss, "Poor Little Warrior," in *The Science Fictional Dinosaur*, Avon 1982, and a famous one by Ray Bradbury, "A Sound of Thunder," in *The Stories of Ray Bradbury*, Alfred A. Knopf 1980.

[39]C. Simak, "The Loot of Time," *Thrilling Wonder Stories*, December 1938, in which a time machine inventor raises money for his research by transporting hunters back 70,000 years to the Old Stone Age.

[40]Three such tales are R. Silberberg, *Up the Line*, Ballantine 1969 and "When We Went to See the End of the World," in *Beyond the Safe Zone*, Warner 1986; and G. Kilworth, "Let's Go to Golgotha!," in *The Songbirds of Pain*, Victor Gollancz 1985.

[41]B. Tucker "The Tourist Trade," in *Tomorrow the Stars*, Doubleday 1952.

[42]L. Laurence, "History in Reverse," *Amazing Stories*, October 1939.

rights to H. G. Wells' *Outline of History*, the head of a movie studio uses a time machine to send his ace cameraman into the past to get live action footage. Prehistoric animals, the ice age, Cheops building his pyramid, the destruction of Pompeii by the eruption of Vesuvius, the Battle of Hastings, Columbus, all the *originals* of these historical events appear in the final film. Years later this idea was developed even further in a very funny novel,[43] in which a movie director uses the eleventh century as a realistic setting for a picture. Realism isn't always the result, however, as portrayed in another tale; the films produced by a gadget that can 'look' into the past are failures because they don't look "authentic enough" to Hollywood moguls![44] (Fig. 1.1).

Fig. 1.1 The inventor of a time machine demonstrates it by sending the family cat on a trip. In the story the inventor, himself, travels back to 1901, where he accidently kills his grandfather in an early pulp magazine, non-paradoxical version of the famous riddle. Illustration for Raymond A. Palmer's "The Time Tragedy" (*Wonder Stories*, December 1934) by Frank R. Paul, ©1934 by Continent Publications Inc.; reprinted by permission of the Ackerman Science Fiction Agency, 2495 Glendower Ave., Hollywood, CA 90027 for the Estate

[43]H. Harrison, *The Technicolor Time Machine*, Doubleday 1967.

[44]A. Derleth, "An Eye for History," in *Harrigan's File*, Arkham House 1975.

1.2 Where Are All the Time Travelers?

> "If it [time travel] *could* be done, someone will eventually learn how. If that happens, history would be littered with tourists. They'd be *everywhere*. They'd be on the *Santa Maria*, they'd be at Appomattox with [cameras], they'd be waiting outside the tomb, for God's sake, on Easter morning."[45]

The question the title of this section asks is an echo of the one the physicist Enrico Fermi (1901–1954) asked in the 1950s, about the possibility of interstellar space travel and of alien intelligent life in the universe—if such travel is possible and 'they' exist, then *where are they*? Why haven't we at least received radio signals from them? For many, the apparent lack of time travelers among us is similar evidence for the impossibility of time travel. As one famous science fiction writer put it, "The most convincing argument against time travel is the remarkable scarcity of time travelers. However unpleasant our age may appear to the future, surely one would expect scholars and students to visit us, if such a thing were possible at all. Though they might try to disguise themselves, accidents would be bound to happen—just as they would if we went back to Imperial Rome with cameras and tape recorders concealed under our nylon togas. Time traveling could never be kept secret for very long."[46]

Clarke's idea is that, from the moment after the first time machine was constructed, through all the rest of civilization, there would be numerous historians, to say nothing of weekend sightseers, who would want to visit every important historical event in recorded history. They might each come from a different time in the future, but all would arrive (according to Clarke) at destinations crowded with temporal colleagues, crowds for which there is no historical evidence!

Long before Clarke the science fiction writer Robert Silverberg had already used the same idea in his 1969 novel *Up the Line*, where it's called the *cumulative audience paradox*. That paradox claims that as time travelers to the past continue to visit certain historically interesting dates and places, there will be an ever-increasing number of people present. As it is presented in the novel, "Taken to its ultimate, the *cumulative audience paradox* yields us the picture of an audience of billions of time-travelers piled up in the past to witness the Crucifixion, filling all the Holy Land and spreading out into Turkey, in Arabia, even to India and Iran . . . Yet at the original occurrence of [that event] *no such hordes were present!*" And later in the same work, we read "A time is coming [when we] will throng

[45]A skeptic's reaction to the idea of time travel in J. McDevitt's story "Time's Arrow" in *The Fantastic Civil War* (see note 7).

[46]Arthur C. Clarke, "About Time," in *Profiles of the Future*, Warner 1985. A story that I recall once having read (but cannot now remember either the author or the title) wonderfully illustrates Clarke's point. A time traveler in disguise at Golgotha for the Crucifixion has a camera hidden beneath his robe to avoid attracting attention. All goes well until he notices odd, clicking noises coming from all those standing near him. It is then he realizes the entire crowd is *nothing but* time travelers, from all through the ages, all with hidden cameras!

the past to the choking point. We will fill our yesterdays with ourselves and crowd out our own ancestors."

Philosophers are well aware of Silverberg's and Clarke's conundrum and, indeed, it can be found in the philosophical literature before Clarke wrote. In one paper, for example, we read "Actually I know of only one argument against the possibility of time travel that seems to carry any weight at all. This is the fact that it does not appear ever to have happened. That is, it might be argued that there will be no time trips from [2100] to [2017] because we were here in [2017] and saw no time travelers. But this argument is far from conclusive."[47] At most, in other words, the absence of temporal visitors amongst us is an objection to the *actuality* of time travel, and not to the *possibility* of time travel.

This same philosopher then mentions some ways around this concern, including one which he called a "pettifogging physical limitation on time travel: perhaps the energy expenditure varies as the fourth power of the time traversed, making only very short trips feasible, and its discovery lies too far in the future for its effects to have yet been felt." Another science fiction writer, as famous as Clarke, used that idea in his 1957 novel *The Door Into Summer* when Robert Heinlein has one character comment "Now if there was some way to photograph the Crucifixion . . . but there isn't. Not possible . . . there isn't that much power on the globe. There's an inverse-square law tied up in [time travel]." Or, perhaps, time travel *is* possible but it's so extraordinarily dangerous that it's impossible to get anyone to do it. In one provocative tale[48] that takes this idea to the extreme, we read that there is only *one* time traveler, ever, from the future—indeed, from just 18 min (!) in the future—and his first (and last) experiment destroys the Earth.

Clarke presented some other possible science fiction rebuttals to the puzzle of 'where are the time travelers?' As he wrote, "Some science fiction writers have tried to get around this [question] by suggesting that Time is a spiral; though we may not be able to move along it, we can perhaps hop from coil to coil, visiting so many millions of years apart that there is no danger of embarrassing collisions between cultures. Big game hunters from the future may have wiped out the dinosaurs, but the age of *Homo sapiens* may lie in a blind region which they cannot reach."

The idea of time as a spiral was quite popular in early science fiction. Typical is one tale[49] in which the time traveler suddenly finds himself not in 1933 but in 2189. His situation is 'explained' to him thus: "[The] time stream is curved helically in some higher dimension. In your case, a still further distortion brought two points of the coil into contact, and a sort of short circuit threw you into the higher curve."

[47]G. Fulmer, "Understanding Time Travel," *Southwestern Journal of Philosophy*, Spring 1980, pp. 151–156. The modern view of this 'paradox' is *not* that it describes a situation so absurd that time travel must be impossible, but rather that *all* the time travelers who *were* (will be?) at the Crucifixion *are* in the historically recorded crowd (see note 46 again). The Crucifixion happened just *once*, not over and over. I'll return to this point later in the book.

[48]D. Plachta, "The Man from When," *Worlds of If Science Fiction*, July 1966.

[49]R. H. Wilson, "A Flight Into Time," *Wonder Stories*, February 1931.

A few years later (in 1937) we find another story[50] with the same spiral-time concept; with a sixty-million year pitch to the time helix, there is no danger of a grandfather paradox. That same year spiral time was the central 'scientific' theme in the stage production "I Have Been Here Before" by the English playwright J. B. Priestley.

The very next year (1938) the young Isaac Asimov used the idea in his first attempt at professional writing, despite a life-long unhappiness with the concept of time travel. Titled "Cosmic Corkscrew," it was initially rejected, indeed it was *never* published, and eventually lost. Though, perhaps, not for long, since one enterprising modern writer has used it as the basis for his own time travel tale.[51] In it a traveler from the near future travels back to 1938 to retrieve "Cosmic Corkscrew" before Asimov loses it (perhaps that's *why* it was lost!) Even when writing introductions to other writers' time travel tales, Asimov would often insert personal comments on his opinion of the concept. For example, in one volume of an anthology series he edited, *The Great Science Fiction Stories* (of 1954), he wrote "To my way of thinking it is precisely because time travel involves such fascinating paradoxes that we can conclude, even in the absence of other evidence, that time travel is impossible." And in *The Great Science Fiction Stories* (of 1961) he bluntly declared "I think scientists who think up methods of time travel are probably all wrong."

Spiral time is a close cousin to circular time. One story[52] dealing with circular time has a time traveler who finds, after a trip one hundred years into the future, that he can't get all the way back to his own time because the required energy rises exponentially with increasing penetration into the *past*. Still, it's very cheap in energy to go forward in time in this tale, and that's what the traveler does, in search of help from the future's advanced technology. He never finds what he needs, however, and so goes forward right into the collapse of the universe and through a new Big Crunch that forms an identical new cycle of time. He thereby returns home to just before he left.[53] This eternal recycling of identical, circular time is so terrifying that the traveler decides to suppress what he has learned about how to time travel—and so maybe *that's* why there are no apparent time travelers. Science fiction writer Larry Niven has argued, however (see note 27), that while this may be a conceptually valid (?) way to travel into the past, he also warns that "Removing your time machine from the reaction of the Big Bang/Crunch could change the final configuration of matter, giving an entirely different . . . history." (I strongly suspect that Niven wrote that with a big smile on his face!)

[50]P. S. Miller, "The Sands of Time," *Astounding Stories*, April 1937.

[51]M. A. Burstein, "Cosmic Corkscrew," *Analog*, June 1998.

[52]P. Anderson, "Flight to Forever," *Super Science Stories*, November 1950.

[53]Turning this idea on its head is the approach of the 1978 novel *The Way Back* (DAW) by A. B. Chandler. Its characters return from the past to their own time by traveling even further backward, right through the Big Bang and into the *previous* (and identical) cycle of time.

The famed English physicist Stephen Hawking is so taken with the question of 'where are all the time travelers?" that he has elevated their apparent absence ("we have not been invaded by hordes of tourists from the future"[54]) to the status of being a demonstration of the impossibility of time travel to the past. His so-called *Chronology Protection Conjecture*, Hawking likes to say, "makes the universe safe for historians": that is, there is nothing to worry about (if you're concerned that time travelers could change the past) because time travel is simply impossible. You'll see later in the book that there are other possible ways to insure the safety of history *without* denying the possibility of time travel, and Hawking himself has backed away just a bit from the Conjecture, saying now that he was simply looking for a humorous line.

While Hawking's endorsement of it has made the Conjecture famous, he wasn't the first to state it. Two years earlier it had appeared, in of all places, a *financial* publication: "[If] time travel was possible, someone from the future would eventually either discover a time tunnel or build a time machine and come visit us."[55] And even before that, an economist presented a 'proof' for concluding that "time travelers do not and cannot exist."[56] He argued that if time travelers from the future were actually amongst us (our 'now' is their 'past') then, by virtue of their knowledge of things to come (our 'future') they would make financial deals so numerous and extensive that interest rates would be driven to zero. Interest rates are *not* zero, however, and thus no such time travel hanky-panky has occurred.

These sorts of financial arguments aren't like to convince many physicists or philosophers of the Conjecture's merit. At most we can only conclude from them that time travelers from the future have *not* influenced financial affairs, which doesn't mean they aren't here. In any case, the Conjecture was actually stated more than 20 years before Hawking by Larry Niven (see note 27), who declared what is called *Niven's Law*: "If the universe of discourse permits the possibility of time travel, and of changing the past, then no time machine will be invented in that universe." And Hawking's concern over time travelers meddling with the past was anticipated in science fiction, too, by at least half a century; in a 1950 tale, for example, we learn of a Master Historian, and the graduate students in his course on 'Experimental History' in the forty-sixth century, trying to correct a problem created by a previous tampering with the past![57]

Not all physicists and philosophers feel intellectually comfortable with the Conjecture, as it seems (to them) a too quick surrender: 'Time travel is a problem

[54]S. W. Hawking, "Chronology Protection Conjecture," *Physical Review D*, July 15, 1992, pp. 603–611. See also J. F. Woodward, "Making the Universe Safe for Historians: Time Travel and the Laws of Physics," *Foundations of Physics Letters*, February 1995, pp. 1–39.

[55]J. Queenan, "Time Warp: Or, Investing in the Future Is a Bust," *Barron's*, January 8, 1990, p. 46.

[56]M. R. Reinganum, "Is Time Travel Impossible? A Financial Proof," *Journal of Portfolio Management*, Fall 1986, pp. 10–12.

[57]L. Jones, "Sunday is Three Thousand Miles Away," *Thrilling Wonder Stories*, June 1950. A more recent, two-*novel* treatment of historians tinkering with history is by Connie Willis (*Blackout* and *All Clear*, both published in 2010).

so hard to do let's simply *define* it to be non-existent and then we won't have to worry about it anymore.' To *really* show that time travel is impossible, however, one needs to demonstrate how it would violate one or more of the laws of physics. Hawking, of course, understands this and has stated that, as one who is no fan of time machines and time travel, he believes there is new physics yet to be discovered that *will* forbid would-be time travelers from roaming up and down the centuries. Finding that new physics is the lure the study of time machines has for him. As he correctly writes in his autobiography,[58] "Even if it turns out that time travel is impossible, it is important that we understand why it is impossible."

One mathematical physicist who agrees with Hawking on the matter of the unlikely possibility of making a time machine is the New Zealand theoretician Matt Visser. Noting that while quantum field theory, and the general theory of relativity, are each amazingly good theories in many applications within their respective realms, they are not so good in spacetime regions at the so-called *Planck scale* (that is, when the density of mass-energy reaches the fantastic level of 10^{94} grams/cm^3 and beyond) where chronology violations (that is, time travel) seem to be spawned. As Visser has observed,[59] this situation won't change until 'we wander into the guts of quantum gravity,' the unification that will merge gravity with the quantum to give a theory that *always* works. Without quantum gravity, physics will continue to be "infested" (Visser's word) with "sick" (Visser's word) spacetimes that allow time travel. Visser believes that the discovery of the theory of quantum gravity can be 'guided' by *building* causality into it,[60] and the result will finally consign time machines to where (in his mind) they belong, the dust-bin of crackpot physics.

Well, perhaps so, but we don't have a quantum theory of gravity yet, and probably won't for some time to come, and so the puzzling questions about time travel remain. To end this section on a slightly gloomy note, an idea appeared in science fiction,[61] when Hawking was still a teenager, offering a possible rebuttal to the Conjecture. It opens with one of the inventors of the first time machine just returning from a trip to the past of 1938. Still, despite this success, the inventors are puzzled by what they call 'the problem': "But if *we* have time traveled, then obviously men of the future have time traveled. They will be able—*are* able to come back. [So] where are they?" They finally conclude that there can only be two

[58]Stephen Hawking, *My Brief History*, Bantam 2013, p. 113.

[59]Matt Visser, "The Quantum Physics of Chronology Protection," in *The Future of Theoretical Physics and Cosmology*, Cambridge 2003. This paper was Visser's contribution to the celebration of Hawking's 60th birthday, held in January 2002.

[60]This may seem like something new, but it really isn't. General relativity has causality built into it on a *local* level (where it belongs); a failure of causality (that is, time travel—see J. Sharkey, "The Trouble With Hyperspace," *Fantastic* April 1965) occurs in general relativity only when one studies *global* regions of certain spacetimes. Forcing a physical theory to have a *prescribed global behavior* would be to undo all of physics since the development of *local field theories*, along with all their amazing successes in explaining nature.

[61]M. Shaara, "Time Payment," *Magazine of Fantasy and Science Fiction*, June 1954.

possible answers. Either there is nobody in the future, or time travel is so dangerous (is that why the future might be empty—humanity misused time travel and killed itself off?) that all who invent it will suppress it. And that's what they decide *they* must do.

1.3 Skepticism About Tales of Time Travel

> "May it not be that our inability to leap into the fiftieth century, A.D., seems impossible to us, merely because of certain prejudices we entertain or certain facts and tricks of which we are still hopelessly ignorant? Assuredly, this is not a foolish query. Its answer, whatever that may be, carries immeasurable consequences for metaphysics."
>
> —a scholar wonders[62]

A thought-provoking possibility for explaining the scarcity of certified time travelers is the central thesis of a fascinating paper in the philosophical literature. The author of that paper argues (note 13) that nobody would believe a time traveler even if he willingly confessed and revealed his knowledge of the future, or even gave the details of his time machine. He goes on to make the astonishing assertion that even the *time traveler himself* would have doubts! This perhaps shocking suggestion deserves some elaboration, especially because it invokes the authority of the patron saint of skeptics for support, the Scot David Hume (1711–1776). The crucial point to keep in mind is explicitly stated in the argument: "The key question will not be 'Is time travel possible?' We shall instead ask whether it is possible to justify a belief in a report of time travel." This gets to the real heart of Clarke's puzzle from the previous section.

Much of the resistance to the idea of time travel lies in sheer skepticism. For many, time travel (to the past, in particular) is simply too much out of the ordinary to be taken seriously. For many, time travel would literally be miraculous. Hume's great work, *An Enquiry Concerning Human Understanding*,[63] contains a section on how a rational person should react to a claim that a miracle has occurred. Hume proclaimed that a miracle *by definition* violates scientific law and that, because such laws are rooted in "firm and unalterable experience," any violation of one or more of these laws immediately provides a refutation of the report of a miracle. In Hume's own words:

> "Nothing is esteemed a miracle, if it ever happened in the common course of nature. It is no miracle that a man, seemingly in good health, should die on a sudden; because such a kind of death, though more unusual than any other, has yet been frequently observed to happen. But it is a miracle, that a dead man should come to life; because that has never been

[62]W. B. Pitkin, "Time and Pure Activity," *Journal of Philosophy, Psychology and Scientific Methods*, August 27, 1914, pp. 521–526. Pitkin's essay was a critique of time travel as presented in Wells' *The Time Machine,* which Pitkin called "one of the wildest flights of literary fancy."

[63]Making its first appearance in 1748, *Enquiry* has been reprinted numerous times since. I used the 1963 edition published by Open Court.

> observed in any age or country . . . When anyone tells me, that he saw a dead man come to life, I immediately consider with myself, whether it be more probable, that this person should either deceive or be deceived, or that the fact, which he relates, should really have happened. I weigh the one miracle against the other; and according to the superiority, which I discover, I pronounce my decision, *and always reject the greater miracle* [my emphasis]."[64]

It is a strict interpretation of Hume that Sorenson (note 13) has adopted in claiming that a time traveler would have no success (among rational persons) with tales of 'different times.' As he explains, "Clearly the time traveler cannot persuade a reasonable person by baldly asserting 'I am a time traveler.' The improbability of his claim places a heavy burden of proof on him. But perhaps he could shoulder the burden by means of artifacts, predictions, and demonstrations." Sorenson dismisses all of these possibilities, however, by reminding us of the slightly sleazy history of parapsychology and ESP, both of which run counter to known scientific laws, but which have still duped "many a respected scientist." Any artifact, prediction, or demonstration of time travel, argues Sorenson, is more likely to be the result of deception and fraud than of actual time travel: "Should the time traveler take observers for a spin in his time machine, the skeptics will have us compare their adventures with séances." The rational reaction to such a spin around the centuries, according to Sorenson's presentation, would be like that of a magician who cannot figure out how a colleague has just done his newest act: 'Nice trick! How did you do it?'[65]

The time traveling tourist stranded in the past in one story is used to getting a skeptical reaction because he can provide his questioners no technical explanation for his situation. "How the hell should I know? I'm just a tourist. It has something to do with chronons [see the Glossary]. Temporal Uncertainty Principle. Conservation of coincidence. I'm no engineer."[66] Somewhat more successful (perhaps) is a time traveler born in 2003 who turns up in 1975. After he tries to convince an interrogator of how that can be, he apparently succeeds. As the time traveler later tells a new friend in the past of 1975, "What amazed me . . . was that he really believed me in the end." But the friend doesn't buy that, replying "He did? I think he just

[64]What Hume is alluding to here should be plain; as expressed in P. Heath, "The Incredulous Hume," *American Philosophical Quarterly*, April 1976, pp. 159–163, Hume was "an exposer of bad arguments in rational theology." For Hume, second-hand (or even more remote) tales of the return of a man from the dead—the claim that literally kept Christianity alive after Christ's execution—were suspect.

[65]This skeptical reaction was nicely captured in the story "E for Effort" by T. L. Sherred (*Astounding Science Fiction*, May 1947). As one character laments, "I've watched scribes indite the books that burnt at Alexandria; who would buy, or who would believe me, if I copied one. . . . What sort of padded cell would I get if I showed up with a photograph of Washington or Caesar? Or Christ?" The padded cell was indeed the fate of the time traveler in "The Ambassador from the 21st Century" (*Startling Stories*, March 1953) by H. J. Shay, the story of a man who journeyed from A.D. 2007 back to 1952 to warn of a future war; he was committed to a mental institution to receive help for his "illusion."

[66]J. Haldeman, "No Future In It," *Omni*, April 1979.

pretended. A scientist isn't likely to believe a thing that is against all logic."[67] If the reception committee is a crowd of conservative, cautious Humeans, it would seem that a time traveler is almost certainly doomed. Early science fiction time travelers from 2030, for example, were warned about receiving a skeptical response as follows (the editorial introduction to this tale[68] called it "a curious study of psychology"): "Our wisest men advised against [our trip to the past]. They said we could hope to be received only as imposters and fakirs, that . . . we would find only twentieth-century barbarians, suspicious, ill-tempered, likely to do us bodily harm."

For many, such skeptical reactions to self-proclaiming time travelers seems dogmatic in the extreme—the response of people with no imagination, no spirit, and heads full of cement. Humean skepticism requires, so it would seem, the rejection of anything and everything that is profoundly surprising, leaving the world a place of utter predictability and boredom. As one science fiction writer put it, "When the miraculous occurs, only dull, workaday mentalities are unable to accept it."[69] Sorenson answers this harsh criticism as follows: "Humeans respond [to Sheckley] by distinguishing between surprises. Most surprises in science do not violate accepted scientific laws. The strange wildlife in Australia was not excluded by biology, X-rays were not precluded by physics."

Sorenson does well, however, to avoid mentioning such profound surprises as, for example, the spectrum of black-body radiation and, later, the photoelectric effect, which were not in the domain of known classical science at the beginning of the twentieth century. Those puzzling, surprising, *totally mystifying* effects required new science—the discovery of the quantum concept by Max Planck. (Explaining the photoelectric effect, *not relativity*, is what won Einstein his Nobel prize.) A strict Victorian-age Humean, as described by Sorenson, would have wrongly rejected the experimental reports of all quantum phenomena and would also (perhaps just as wrongly) have rejected all reports of time travel.

A strict Humean definition (as described by Sorenson) that a miracle has occurred requires a violation of one or more of the *known* [my emphasis] scientific laws of nature.[70] As one modern philosopher defines a miracle, it is any event that "can be explained *only* [my emphasis] by reference to the intervention of a supernatural force."[71] Time travel, by that interpretation, is *not* a miracle because general relativity, not God, is all that is required. C. S. Lewis (1898–1963), late

[67]G. Gor, "The Garden," in *Russian Science Fiction* (R. Magidoff, editor), New York University Press 1969.

[68]P. Bolton, "The Time Hoaxers," *Amazing Stories*, August 1931.

[69]Robert Sheckley, "Something for Nothing," in *Citizen in Space*, Ballantine 1955.

[70]The word *known* is important. As a character in one early science fiction story puts it, "These things [four-dimensional object] sound like miracles; but, after all, what are miracles but phenomena which, *on account of our ignorance* [my emphasis], we cannot explain?" See B. Olsen, "The Four-Dimensional Roller-Press," *Amazing Stories*, June 1927.

[71]D. M. Ahern, "Miracles and Physical Impossibility," *Canadian Journal of Philosophy*, March 1977, pp. 71–79.

professor of Medieval and Renaissance Literature at Cambridge University, however, absolutely rejected Hume's view on how a rational person should react to certain surprising events. Lewis, one of the most thoughtful modern writers on Christian theology, had no patience with skeptics (or, as he called them, materialists).[72]

Professor Lewis graphically illustrated the dug-in position of the extreme skeptic as follows: "If the end of the world appeared in all the literal trappings of the Apocalypse; if the modern materialist saw with his own eyes the heavens rolled up and the great white throne appearing, if he had the sensation of being himself hurled into the Lake of Fire, he would continue forever, in that lake itself, to regard his experience as an illusion and to find the explanation of it in psychoanalysis, or cerebral pathology."[73] If the end of the world would receive such a skeptical response, then a mere time traveler would surely have no hope at all of being believed.

Lewis would certainly have rejected Sorenson's most astonishing assertion: "So far I have concentrated on the time travel question from the perspective of the time traveler's audience. What about the time traveler himself? Can he at least know he is a time traveler?" Sorenson argues that a time traveler, if authentic, should be able to convince his audience, and that if he can't (and he *cannot* if they are true Humean skeptics), then the time traveler must entertain doubts, too! It doesn't matter (says Sorenson) that the time traveler has memories of his adventures, and it doesn't matter that he knows in his heart that he speaks the truth. Using words that echo Lewis' sarcasm, Sorenson quickly dismisses the importance of the time traveler's self-knowledge, declaring such memories to be merely the symptoms of some deep psychosis, and the traveler's introspective sincerity to be a product of gross self-deception.

Sorenson specifically mentions the traditional Humean response to astonishing reports when he cites earlier writers on time travel in the philosophical literature. In one of those analyses, for example, we find an argument *for* the reasonableness of a rational belief in time travel ("I have been amused and irritated by the spate of articles proving that time travel is a 'conceptual impossibility') by claiming such proofs must be faulty because there is a mathematically consistent explanation for such a belief.[74] (This author was referring to spacetime diagrams, which we'll get to in Chap. 3.) This paper received a very sharp rebuttal from another philosopher who convincingly used fundamental physics to show a simple use of spacetime diagrams in a special relativity setting does *not* support time travel to the past.[75] (I'll return to

[72]In Lewis' eerie, unfinished story "The Dark Tower," a tale of the 'chronoscope,' a gadget that "does to time what the telescope does to space," the persistent skeptic in the story is a Scot, surely created in the image of Hume. See C. S. Lewis, *The Dark Tower and Other Stories*, Harcourt 1977.

[73]C. S. Lewis, *The Grand Miracle*, Ballantine 1986.

[74]H. Putnam, "It Ain't Necessarily So," *Journal of Philosophy*, October 1962, pp. 658–671.

[75]J. Earman, "On Going Backward in Time," *Philosophy of Science*, September 1967, pp. 211–222.

this point in Chap. 3.) Even later a Humean-style rebuttal came from yet another philosopher, who showed how to explain the time travel phenomenon that Putnam (note 74) described *without* invoking time travel.[76] This isn't to say that Weingard doesn't invoke some pretty astonishing gadgetry (and more) himself, like matter transmitters and anti-matter humans. (You'll see how anti-matter ties-in with time travel a bit later in the book.) A resurrected Hume would surely applaud these rebuttal analyses (although he might also doubt his own fresh existence).

Hardly anybody is happy with Weingard's approach for avoiding time travel (including, I suspect, even Weingard). His 'explanations' seem, just like a time machine, to be incredible and, as Arthur Conan Doyle's Professor Challenger says in one tale not staring Sherlock Holmes, "You cannot explain one incredible thing by quoting another incredible thing."[77] An interesting science fiction exposition illustrating Professor Challenger's Humean philosophy occurs when a copy of *The New York Times* for December 1 shows up for some subscribers a week early, on November 22. It seems the only explanation is either that the paper really is from the future (due to some sort of fluke of the fourth dimension), or that it is a hoax. The first-person narrator of this 1973 tale[78] provides us with his reason for believing the former: "I don't find either notion easy to believe but I can accept the fourth-dimensional hocus-pocus more readily than I can the idea of a hoax." Hume couldn't have said it better.

It should be clearly understood that Hume was not arguing for disbelief in absolutely anything surprising, but rather for rational analysis. Historically, the context of Hume's times was that of what he took to be non-rational arguments for a belief in God, particularly those 'proofs' so beloved by theologians based on Design (Heath [note 64] calls such 'proofs' "philosophical museum pieces"). As Heath writes, "Hume . . . makes no attempt to deny the supposed facts; he simply argues that they are consistent with other explanations and other analogies of a less ambitious kind. There is no right to attribute to the causes of such phenomena abilities more extensive than are needed to produce the observed effects."

As a matter of fact, even Hume could be convinced of quite strange matters, and I think Sorenson does interpret the philosopher a little too narrowly. In his essay concerning Hume's position on holding a belief in God, Heath wonders whether there is "empirical evidence [imaginable] which would persuade any reasonable mind of the real existence of an infinite God." Heath answers his own question as follows: "If the stars and galaxies were to shift overnight in the firmament, rearranging themselves so as to spell out, in various languages, such slogans as I AM THAT I AM, or GOD IS LOVE—well, the fastidious might consider that it

[76]R. Weingard, "On Travelling Backward in Time," *Synthese*, July–August 1972, pp. 117–132.

[77]Arthur Conan Doyle, "The Disintegration Machine," *The Strand Magazine*, January 1929. Professor Challenger is nothing like Wells' thoughtful Time Traveller; in the original 1912 Challenger novel *The Lost World*, he was described as a "primitive cave-man in a lounge suit."

[78]R. Silverberg, "What We Learned from This Morning's Newspaper," in *Beyond the Safe Zone*, Warner 1986.

was all very vulgar, but would anyone lose much time in admitting that this settled the matter? . . . Confronted with such a demonstration, the hard-line Humean [but not Hume, himself, I think] could continue, of course, to argue that, for all its colossal scale, the performance is still finite, and so cannot be evidence of more than the finite, though immense power that is needed to achieve it."

Skepticism about 'time travel' was around long before the specific idea of a 'time machine' was conceived. For example, the eleventh-century Persian poet-philosopher Omar Khayyam was blunt in his evaluation of the likelihood of reliving the past. As he so beautifully wrote in one of the quatrains of the *Rubaiyat*,

The Moving Finger writes; and having writ,
Moves on: nor all your Piety nor Wit
Shall lure it back to cancel half a Line,
Nor all your Tears wash out a Word of it.

Quite a bit later the English poet Thomas Heywood, in his 1607 play *A Woman Killed with Kindness*, had one of his characters express a similar thought:

God, O God, that it were possible
To undo things done, to call back yesterday;
That Time could turn up his swift sandy glass
To untell the days, and to redeem these hours.
Or that the Sun
Could, rising from the west, draw his coach backward,
Take from the account of Time so many minutes,
Till he had all these seasons called again,
. . . . . .
But O! I talk of things impossible,
And cast beyond the moon. . .

When Gödel's discovery of time travel in his rotating universe was announced, the skeptics were easy to find. One philosopher[79] wrote of it "This property [of time travel] must be judged an absurdity by anyone committed to the ordinary modes of speech." And another[80] was only slightly less charitable: Gödel's solution was a "bizarre conception" and a "mere mathematical curiosity." Science fiction wasn't immune to skepticism, either, even though you might have expected that to be the one place where the high drama of time travel would be welcomed. Four *years* after Gödel's paper appeared we find one respected anthologist writing,[81] as part of his introduction to a story, "In this tale we meet our first Mad Scientist. Just as in reality the thoroughly cracked pots used to be found inventing perpetual-motion machines, so in science fiction we find the lunatic fringe more often than not trying to perfect

[79] J. D. North, *The Measure of the Universe*, Oxford University Press 1965.

[80] C. T. K. Chari, "Time Reversal, Information Theory, and 'World-Geometry'," *Journal of Philosophy*, September 1960, pp. 579–583.

[81] Groff Conklin, editor of *Science-Fiction Adventures in Dimension*, Vanguard 1952.

time-travel mechanisms." And that same year the founding editor of *Galaxy Science Fiction Magazine* declared "Time travel requires a suspension of disbelief that is almost unbelievable . . . Scientifically, time travel can't stand inspection.".[82]

Years later matters had not much changed. For example, in his marvelous 1985 book *The Past is a Foreign Country*, David Lowenthal repeatedly refers to time travel as "fantasy," and to science fiction stories about time travel as "unbridled by common sense." (Lowenthal is a professor of *geography*, not physics.) Science fiction writers were still often not much more enthusiastic about time travel. The well-known science fiction writer and critic Alexei Panshin, for example, agrees with Lowenthal, at one point, long after Gödel, writing "Time travel is a philosophical concept, not a scientific one. It is, in fact, as has often been pointed out, scientific nonsense."[83]

Skepticism does have its uses, however. Modern science fiction writers have often used it as a dramatic means of building conflict and tension in their time travel stories. A skeptical reception is extreme, for example, for a soldier-in-time who has fought in numerous wars, from the ancient past to a billion years in the future.[84] He finds that nobody believes him when he speaks openly of his temporal adventures during a visit to a present-day bar. Everybody merely thinks it is all a hilarious gag. This is in great contrast to one 1870s story[85] in which suspicion of a stranger plays a central role, but which finds its offered explanation in something entirely different from time travel. It tells of a man who suddenly appears in the midst of a Union military camp during the American Civil War.

This man quickly displays strange lapses in his background, as well as possessing knowledge of many different things well beyond anything that could be called common. The details of the story are not important for us but, if it were published in a modern science fiction magazine, this man would almost surely be identified in most readers' minds as a time traveler. In 1875, however, the author's narrator found his punch line in "his firm conviction that the quiet, gentle, well-behaved, modest gentleman, so singularly gifted . . . is, in plain terms, the devil!" Time travel certainly never entered the author's thoughts or, if it did, he lost his nerve at the idea of using it in this pre-Wells story. You'll recall from the opening of the Introduction that it was this 'use of the devil to explain mysterious happenings' that Wells wanted to move away from, and that was the motivation for his introduction of a time *machine*.

Hollywood has at least gotten the skeptical part of the psychology of time travel right (later discussions in this book will focus on how film makers have been less successful with the physics). When, for example, the time traveling villain in the

[82]H. L. Gold, editor of *The Galaxy Reader of Science Fiction*, Crown 1952.

[83]In his introduction to Robert Heinlein's classic time travel tale (to be discussed later) "All You Zombies—," in *The Mirror of Infinity*, Canfield 1970.

[84]F. Leiber, "The Oldest Soldier," *Fantastic*, May 1960.

[85]G. C. Eggleston, "Who Is Russell?" *American Homes*, March 1875.

1989 movie *Time Trackers* is confronted in the medieval past, he simply laughs-off a threat to reveal his true identity. "Go ahead," he says in effect, 'the only thing your talk of time machines from the future will accomplish is for people to think you are crazy!'

What would Arthur C. Clarke have thought of all this skepticism being directed toward those who claim to have a time machine? His thoughts about the difficulty time travelers would have in maintaining low profiles were what started the previous section, after all. My guess is that he would have had little patience with extreme incredulity. The surprise of being confronted by a time traveler would soon have turned to awe and pleasure IF—and I emphasize the IF—Clarke had been taken for a spin around the centuries in the stranger's machine. He would surely have ended-up quoting his own famous 'third law' to explain the wonder of it all: "Any sufficiently advanced technology is indistinguishable from magic."

Near the end of his paper, Heath writes what I think is the perfect rebuttal to anyone who would refuse to admit to time travel, even after taking a quick trip backward a few tens of millions of years to the late-Mesozoic era to hunt *Tyrannosaurus rex*, and even after seeing instant photographs of the dead monster with the skeptic's *own foot* on the great creature's head, or of his *own boots* dripping a bloody puddle of unholy size on the floor of the time machine. Writing about the Humean-unconvinced, even when faced with a rearranged firmament, Heath observes "But this now seems a cavil, designed only to prove that even omnipotence is powerless against the extremer forms of skeptical intransigence." Where God would fail to convince, a simple time traveler could hardly hope to do better!

1.4 Troubles with (some) Time Machines

> "If you don't stop this senseless theorizing upon something that's an obvious impossibility, you'll find yourself working alone! Your ridiculous ideas sound like the ravings of a madman. Anyone with average intelligence realizes that the mere thought of traveling through time is absurd."[86]

If the previous section seemed just a bit gloomy concerning time travel, there is a very big reason for that. The sentiment expressed in the above opening quote to this section was a common one among philosophers long before physicists began to seriously think on the topic. While there *are* issues with time travel to the *future*, they are of an *engineering* nature, centered on how to build a big enough rocket ship with enough fuel to make the high speed, looping trip out into space and back again described in the opening section of this chapter. 'Mere' engineering problems are of no concern to physicists and philosophers. What *does* concern them are the far deeper puzzles of time travel to the *past*, the puzzles presented by what appear to be

[86] A science fiction physicist receives harsh criticism from a colleague in L. A. Eshbach's "Out of the Past," *Tales of Wonder*, Autumn 1938.

logical paradoxes. Before we get into the paradoxes, however, we need to first clear our minds of two common, popular notions of just what a time machine *is*. Both are false notions (one is due to H. G. Wells) which are, today, *rejected* by physicists (and most philosophers, too).[87]

As you'll see later in the book, all the theoretical time machines that have appeared in the modern physics literature involve spatial displacement. That is, they require *movement*. (On this point, the speedy DeLorean time car in the *Back to the Future* films has it right.) Wells' time machine, however, did not move; it always remained in the Time Traveller's laboratory (or at least on the spot where the laboratory would have been) unless he pushed it about after a trip in time. This, alas, results in a particularly troublesome problem: a Wellsian time machine heading into the past would run into itself!

Consider: There sits my time machine as I prepare for the first time journey ever, a trip back to the late-Mesozoic era to hunt dinosaur. I load my Continental. 600 super-high-power rifle with Nitro Express cartridges the size of bananas, kiss my wife good-bye, and climb in. I pull the lever. Now, Wellsian-type time machines don't *jump over* time but rather travel *through* time (see the Time Traveller's own description of how things looked to him, a description faithfully and spectacularly reproduced in the 1960 film). Therefore, the time machine will instantly collide with itself at the micro-moment *before* I pull the lever!

The resulting destruction obviously introduces a nice paradox: Given that this happens before I pull the lever, how did I manage to pull it? Many of the early science fiction writers were not totally oblivious to this collision problem and, in order to avoid materializing inside of an object in the future or the past, it was common to combine the time machine with an airplane.[88] Even that though might not be enough, as one writer thought a Wellsian time traveler would get "a severe case of the bends" if his body materialized in air![89] Of course, one might argue that Wells' machine does actually move because it is attached to the Earth, which is certainly moving, but it is not clear why this should result in the time machine arriving in the temporal past of the Earth, rather than in some past region of space (almost surely a vacuum).[90]

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[87]Both of these notions still routinely appears in science fiction, however, because they are 'just too neat' to let 'mere physics' get in the way of a good tale. I use one, without apology, in my own story "Newton's Gift" in Appendix B.

[88]Three such tales are M. J. Breur, "The Time Valve," *Wonder Stories*, July 1930; F. J. Bridge, "Via the Time Accelerator," *Amazing Stories*, January 1931; E. Binder, "The Time Cheaters," *Thrilling Wonder Stories*, March 1940.

[89]J. Lafleur, "Time as a Fourth Dimension," *Journal of Philosophy*, March 1940, pp. 169–178, and "Marvelous Voyages—H. G. Wells' *The Time Machine*," *Popular Astronomy*, October 1943.

[90]Philosophers seem to be becoming more aware of the collison problem (which they have dubbed "the double occupancy problem"), and at least three papers published since the second edition of *Time Machines* discuss it: W. Grey, "Troubles With Time Travel," *Philosophy*, January 1999, pp. 55–70; P. Dowe, "The Case for Time Travel," *Philosophy*, July 2000, pp. 441–451; R. Le Poidevin, "The Cheshire Cat Problem and Other Spatial Obstacles to Backward Time Travel," *The Monist*, July 2005, pp. 336–352. Physicists don't concern themselves with the collison problem simply because they *aren't interested* in *Wellsian* time machines; I'll explain why I say this by the end of this section.

The general problem of 'where the past is' was nicely illustrated by the physicist Gregory Benford in his 1980 novel *Timescape*. In that story the world of 1998 is on the verge of total ecological collapse, and an attempt is made to change the past by aiming a backward-in-time message via faster-than-light tachyons (these hypothetical particles are discussed in Chap. 5) at the pivotal year 1963. When the principal scientist involved in this effort is explaining the process to a potential financial backer, he is asked, "Hold on. Aim for *what*? Where *is* 1963?" The scientist replies, "Quite far away, as it works out. Since 1963, the Earth's been going around the Sun, while the Sun itself is revolving around the hub of the galaxy, and so on. Add that up, and you find 1963 is pretty distant." An understanding of the question 'Where is the past?' actually goes quite a bit further back in science fiction. For example, after looking through a TV-like gadget to view the past, one character in a 1940s story complains, "You said you'd find Captain Kidd's treasure, but all I can see is fog and static." He is told that's because "It's too far back—1698 or thereabouts. The Earth was billions of miles from here then, and there are too many cosmic rays between."[91]

But let's suppose we ignore this concern about where things are for a time traveler, as do most science fiction stories. Still another problem with a true Wellsian-type time machine is that because it travels *through* time, the machine must *always* appear to be located in the same place. For example, to travel from Ford's Theater today to Ford's Theater on the evening of Good Friday, April 14, 1865, in a misguided attempt to save Lincoln from Booth's bullet (*why* this would be misguided will be discussed at length later in the book), a Wellsian-type time machine would have to occupy every instant of the intervening century and more. For observers outside the machine, the machine would appear to have been sitting in the same place all those years. There is an amusing illustration of a failure to understand this point by the scriptwriters of the 1989 film *Time Trackers*, who have time travelers 'hide' their Wellsian machine from accidental discovery by 'parking' it 5 s in the future!

Wells was well-aware of the "does a time traveling object disappear or not?" issue, and tried to have it both ways in *The Time Machine* by invoking what he had the Time Traveller call "diluted presentation." As we are told in the novel, the reason why we cannot see the model time machine he sends on its way into the future as a demonstration is that "the spoke of a wheel spinning, or a bullet flying through the air" is invisible because if those objects are "traveling through time fifty times or a hundred times faster than we are . . . the impression [they create] will of course be only one-fiftieth or one-hundredth." Similarly for the model. This explanation breaks down when one remembers that, even if you cannot see the spoke or bullet, they are still there and you can get in their way—Wells, unfortunately, has one of his characters stick a hand into the space where the model time machine was last seen.

[91]M. Jameson, "Dead End," *Thrilling Wonder Stories*, March 1941. The "cosmic rays" are presumably the cause of the interference.

This objection to Wellsian time travel was raised soon after the 1895 publication of the novel, and then again in 1914 by Pitkin (note 62), who noted that violent disaster awaited once the time journey ended. Wells, it is only fair to note, seemingly anticipated Pitkin when he had the Time Traveller say "So long as I travelled at a high velocity *through time* [my emphasis] . . . I was, so to speak, attenuated—was slipping like a vapor through the interstices of intervening substances!" What this is getting at is that for the Time Traveller to stop 'inside' anything (Pitkin's example was the pile of bricks the Time Traveller's laboratory is certain one day to become) would, as Wells had his hero say, cause "a profound chemical[92] reaction—possibly a far-reaching explosion—[that would] blow myself and my apparatus out of all possible dimensions." Just why this spectacular event doesn't occur when the time machine simply stops *in air*, never mind inside Pitkin's pile of bricks, is never addressed.

In any case, it seems clear from all of this that Wells' machine travels *through time*, just as the Time Traveller claims. But Wells, himself, raises doubt when he describes the observed effects of a departing time machine. At the beginning of the novel, when the Time Traveller sends his model machine into the future, we read "There was a breath of wind, and the lamp flame jumped. One of the candles on the mantel was blown out . . . and it [the model time machine] was gone—vanished!" And, at the end, when the Time Traveller makes his final exit, the narrator of the tale just misses the departure but tells us "A gust of air whirled around me as I opened the door, and from within came the sound of broken glass falling on the floor. The Time Traveller was not there . . . Save for a subsiding stir of dust, the further end of the laboratory was empty. A pane of the skylight had, apparently, just been blown in." Both of these descriptions read as *implosions*, air rushing in to fill a spatial void, as though the time machines had *jumped* in time. Is there an inconsistency here? Well, perhaps not, if one accepts the curious idea of "slipping like a vapor" for an operational Wellsian-type time machine.

One famous science fiction story[93] nicely illustrates these points. The inventor of the first time machine demonstrates it to colleagues by sending a brass cube 5 min into the future. After being placed in the machine, the cube vanishes and then, 5 min later, reappears. Did the cube travel *through* time, or was its journey 'instantaneous,' so to speak? If *through* time, the cube was present at every instant after the start of its trip—so why did it vanish? The cube gets to each instant before the observers do, but why this should produce the visual effect of disappearing is unclear. The description in the story implies the cube traveled 5 min into the future without existing at any of the in-between instants, and so the story's time machine certainly was *not* Wellsian.

An immediate implication of the immobility of a Wellsian time machine is that if you are being chased by an angry mob somewhen in time (perhaps because you unwittingly violated a sensitive social taboo), then hopping into your Wellsian-type

[92]Actually *nuclear*, but don't forget when Wells wrote his novel.

[93]F. Brown, "Experiment," *Galaxy Science Fiction*, February 1954.

time machine isn't going to help because the machine just sits there. The mob could simply take its deliberate time in first building a roaring fire and then pushing the machine (and you) into it. As one author (with a wonderfully appropriate name!) expressed this, "You might as well try to escape by taking a nap."[94]

Pulp science fiction, always alert to a good story gimmick, used this characteristic of Wellsian time machines in one clever tale[95] in which a criminal attempts to hide his crimes by sending the bodies of his victims into the far future. His mistake is to use a Wellsian time machine in which he escapes into the future. The police, however, having learned of his foul deeds, simply build a cage around the machine and arrest him when he exits 23 years later!

If a Wellsian time machine that moves *through* time suffers from a fatal collision problem, then how about that other favorite of science fiction, a time machine that *jumps* in time? (Recall the final departure of Wells' Time Traveller.) That certainly would avoid the self-colliding problem. When you pull the lever inside the machine you simply disappear from 'now' and (from your point of view) then instantly pop into existence 'then.' The problem with this sort of time machine is that a Time Traveller who uses it will have a *discontinuous* world line, with the break occurring at the moment his time machine 'jumps.' In the modern physicist's view of time travel, however, based on general relativity, a Time Traveller's world line should always be continuous. That's because general relativity is a smooth, local field theory described by differential equations, resulting in *continuous* CTLs/CTCs.

Imagine, for example, that a 'jumping' time machine inventor starts building his gadget at time $t = A$ and expects to finish building it at time $t = B > A$. At time $t = C < B$, however, he runs into a problem. Fortunately, just at that moment a fully-functional time machine suddenly appears in the lab, and from it emerges a slightly older version of the inventor. The older version has the solution to the problem and, after telling the younger version the answer, gets back into the operational time machine and jumps off to . . . somewhen. The younger version then completes his machine at time $t = B$, gets into it, jumps back to time $t = C$, and . . ..[96]

In the past, philosophers have gotten themselves all tangled-up in debates over *personal identity*, that is, which version is *the* inventor, the younger or the older? Can they both be the same person, even though the older version has a world line (*starting* at $t = C$) that is separate and distinct from the world line of the younger (that *stops* at $t = B$)? One philosopher (note 74) left physics behind and pursued this question into the following *legal* question concerning our two (?) inventors: if the older version commits a crime and then vanishes in his time machine before the police can apprehend him, can the younger version be punished even though *he*

[94]M. Cook, "Tips for Time Travel," in *Philosophers Look at Science Fiction*, Nelson-Hall 1982. One modern story that gets Cook's point right is by I. Watson, "The Very Slow Time Machine," in *The Best Science Fiction of the Year* (T. Carr, editor), Ballantine 1979.

[95]M. Jameson, "Murder in the Time World," *Amazing Stories*, August 1940.

[96]This little story I've just told you involves what is called a *bootstrap paradox* (just where did that solution come from, that is, who thought it up?) and it is one of the real puzzles of time travel. I'll say *lots* more about such curious doings later in the book.

hasn't yet committed the crime? While certainly 'interesting,' this really is a non-issue for the modern physicist who is concerned only with the physical possibility (or not) of time travel to the past.

Well, okay, you might now say, if neither a Wellsian time machine or a 'jumping' time machine will do, then just what *are* physicists studying in their papers on time travel? The short answer here (in Chap. 3 I'll say more) is that physicists don't view time machines as super-tech gadgets covered with wires, meters, dials, and levers, humming away beneath a seated Time Traveller as gigawatts of power throb through massive copper/crystal rods, with the whole business surrounded by a pulsating red-blue glow. Hollywood absolutely loves that sort of thing, but it's simply all wrong. For modern physicists, a time machine is *a region of spacetime with special topological structure*. Then, to time travel, a Time Traveller moves through that region of spacetime (in a rocket, perhaps) along an appropriate path. To 'make a time machine' therefore, in modern terms, means to (somehow) manipulate finite amounts of matter/energy in such a way as to alter the topology of a finite region of spacetime from one that has no CTLs/CTCs to one that does.[97] The most famous example of such a spacetime topology alteration (or *warp*) is the creation of a *wormhole*. A wormhole is a *topological* artifact of a spacetime; wormholes were popularized in Carl Sagan's 1985 novel *Contact* (under the guidance of physicist Kip Thorne) and are now common in science fiction.[98] As mentioned at the start of this chapter, for example, even Stephen King uses one in his 2011 *mainstream* novel *11/22/63*.

I'll return to the 'topology of spacetime' in Chap. 3 but, just so we don't leave it here as a mysterious phrase, here's a simple illustration of a topology change. Imagine a long, flat, narrow, two-dimensional strip of paper. The strip has the following topology features of interest to us here: (1) it has a beginning (its left end) and an ending (its right end), and (2) it has two sides (the top surface) and the flip-side surface. Now, imagine that we take the right end of the strip, give it a half-twist of 180^0 through our three-dimensional space, and then finally we glue that twisted end to the left end of the strip. The half-twist and gluing (our *warp*) has changed both of the topological properties of the strip. That's because the strip now has *no end* (you can travel forever along the strip, always going 'forward' and never reaching a point where can't go forward some more), and the strip now has just *one* side. You can convince yourself that it is one-sided by coloring the strip with a

[97]There is a hint of this in one prescient science fiction story, in which the inventor of a time machine, when asked about how it works, replies "An electromagnetic *warping* [my emphasis] of the spacetime continuum." See N. Schachner, "When the Future Dies," *Astounding Science Fiction*, June 1939.

[98]A wormhole is featured in the 2014 film *Interstellar*, whose Executive Producer and technical advisor was Thorne. The film's special effects are relativistically correct (not the typical Hollywood 'fantasy physics'), and you can read how that was achieved in Oliver James, Eugénie von Tunzelmann, Paul Franklin and Kip S. Thorne, "Gravitational lensing by spinning black holes in astrophysics, and in the movie *Interstellar*," *Classical and Quantum Gravity*, February 2015. See also (same authors) "Visualizing *Interstellar*'s Wormhole," *American Journal of Physics*, June 2015, pp. 486–499.

crayon. During the coloring, *do not lift the crayon from the strip*. When you can color no more, you'll find that every last bit of the strip has been colored. You can't do that with the original strip without lifting the crayon and turning the strip over because the original strip was two-sided. Many readers will recognize that what we've done is make a *Möbius strip*, named after the German astronomer and mathematician August Möbius (1790–1868) who described it in 1858.

Here's another astonishing property our half-twist warp has introduced. Cut the Möbius strip lengthwise with a scissors; most people believe you will then get two strips, each the length of the original strip but each only half as wide. Actually, you get one strip with a *full* 360° twist, which means the result is back to having two sides. (To see this, make a Möbius strip, cut it, and *then* apply the crayon.) And if you cut this new strip lengthwise once more, you get two separate loops, linked together. Try it and see, but be very careful. As the late science fiction writer Cyril Kornbluth (1923–1958) warned, there may be horrific potential dangers in unschooled experimentation with topology warps:

A burleycue dancer, a pip
Named Virginia, could peel in a zip;
But she read science fiction
And died of constriction
Attempting a Möbius strip.[99]

To end this section, I should point out that a change in the topology of a spacetime is *not* a necessary requirement for that spacetime to support time travel to the past. Gödel's rotating spacetime, for example, has a remarkably simple topology and, as you'll recall, it's literally *stuffed* with CTLs/CTCs, to the point that time travel to the past in Gödelian spacetime would be an everyday occurrence. You might think a world that presents time travel as a *fundamentally allowed* physical phenomenon, as does Gödel's spacetime, would be irresistible to science fiction writers. (So far as I know, however, no one has written a time travel story using the rotating universe idea.[100]) In Chap. 6, in fact, I'll show you just how easy it would be to time travel in Gödel's spacetime, using a rocketship as the means to move through that spacetime. Of course, *our* universe is not Gödelian, so the 'time travel to the past' question is not so easily answered for the spacetime we appear to actually inhabit.

[99]As you can see from this, science fiction writers have had fun with the Möbius strip. Two early examples *not* involving time travel are N. Bond, "The Geometrics of Johnny Day," *Astounding Science Fiction*, July 1941, and W. H. Upson, "A. Botts and the Möbius Strip," *The Saturday Evening Post*, December 1945. The use of the Möbius strip for time travel occurs, for example, in M. Clifton's "Star, Bright," *Galaxy Science Fiction*, July 1952.

[100]If he had lived, perhaps the well-known science fiction writer James Blish (1921–1975) would have written such a tale. In David Ketterer's biography of Blish (*Imprisoned in a Tesseract*, Kent State University Press 1987), there is this comment from a 1970 letter written by Blish: "I am especially intrigued by the spinning-universe form of time travel, especially since . . . nobody has touched it . . . But I should really stop mentioning the spinning-universe in public, or somebody will nobble onto it before I can get into it!"

1.5 Quantum Gravity, Singularities, Black Holes, and Time Travel

"A [spacetime] singularity is where God is dividing by zero."

—Anonymous

"A theory that involves singularities and involves them unavoidably, moreover, carries within itself the seeds of its own destruction."

—Peter Bergmann (1915–2002), Einstein's research assistant at the Institute for Advanced Study, Princeton

A fundamental objection to general relativity's suggestion of the possibility of time travel to the past is that, in a very deep sense, general relativity is known to be incomplete. That is, it is incompatible with quantum mechanics, which is the physics of the very, *very* small—the physics of atomic-size objects and *smaller*. We touched on this at the end of Sect. 1.2, and here we'll take a longer look at the issue of merging quantum mechanics with general relativity.

In quantum mechanics, the discrete nature of the atomic world appears in such phenomena as the photoelectric effect, in which light acts like individual particles (photons) rather than as continuous waves. Einstein's general relativity works beautifully on a cosmological scale but, like Maxwell's theory of electromagnetism, and unlike quantum mechanics, it fails when applied deep in the interior of the atom. Quantum theory, however, seems to work *everywhere*. As one physicist put it, "As far as we can tell, there is no experiment that quantum theory does not explain, at least in principle . . . Though physicists have steered quantum theory into regions far distant from the atomic realm where it was born, there is no sign that it is ever going to break down."[101]

One of the central concepts in relativity is the *world line*, which is the complete story of a particle in spacetime. A world line assigns a definite location to the particle at each instant of time. This is a classical, pre-quantum concept, however, and today physicists use the probabilistic ideas of quantum mechanics to describe the location and momentum of a particle once they get down to the atomic scale of matter. Quantum theory is a discrete theory in which the values of physical entities vary discontinuously (in 'quantum jumps'), whereas in classical theories the values of physical entities are continuous. The difference between the two types of theories is something like the difference between sand and water. Mixing the two theories—the classically smooth, continuous general relativity and the discrete quantum mechanics—to get something called *quantum gravity*, is the Holy Grail of physicists today, and nobody has more than an obscure idea of how to do it.

[101] N. Hebert, *Faster Than Light: Superluminal Loopholes in Physics*, New American Library 1988.

Just one of the more curious results of the fusing of quantum mechanics with general relativity may be *quantum time*.[102] That is, in quantum gravity the smallest increment of time that has physical meaning—sometimes called the *chronon*, a term first used in a non-time travel science fiction story[103]—may have a non-zero value. As we'll see later in the book, much of the controversy over the possibility of time machines hinges on what is called the *quantum gravity cut-off*. This is the end-result of destructive spacetime stresses that tend to grow toward infinity whenever a time machine spacetime topology attempts to form. This process goes under the general name of the *back reaction*, and is conceptually similar to a rubber band growing ever more taut as it is stretched, an effect that resists more stretching (and, of course, if stretched too far the rubber band breaks).

The cut-off of those stresses, at some *finite* value, is imagined to occur when the terminal phase of the growth would take place in less than the minimum possible time interval. The cut-off happens because, it is thought, nothing can actually occur in less than the minimum time. The debate is over just what that minimum duration is, and over whether the cut-off would occur before the stresses could reach *finite* values large enough to destroy the putative time machine topology. If the cut-off occurs before the back reaction stresses climb to the critical value, then the time machine survives. Otherwise, not.

To see how this 'works,' consider the two fundamental physical constants associated with classical gravity, the *gravitational constant*[104] G and the speed of light c, and the fundamental physical constant associated with quantum mechanics (*Planck's constant*) ħ. Now, if you play around with combinations of these constants it is easy to show that the following expressions have the units of length, time, and mass, called the *Planck length* (l_P), the *Planck time* (t_P), and the *Planck mass* (m_P), respectively:

$$l_P = \sqrt{\frac{\hbar G}{c^3}} \approx 1.6 \times 10^{-33} \text{ cm},$$

$$t_P = \sqrt{\frac{\hbar G}{c^5}} \approx 5.3 \times 10^{-44} \text{ s},$$

$$m_P = \sqrt{\frac{\hbar c}{G}} \approx 22 \times 10^{-6} \text{ g}.$$

The extremely tiny values of l_P and t_P (the chronon), in particular, indicate (*roughly*) where it is expected that the smooth, continuous spacetime of general

[102] H. Kragh and B. Carazza, "From Time Atoms to Space-Time Quantization: the idea of discrete time, ca 1925–1936," *Studies in History and Philosophy of Science*, June 1994, pp. 437–462.

[103] S. Weinbaum, "The Ideal," *Wonder Stories*, September 1935.

[104] This is the constant in Newton's famous inverse-square law for gravity; the attractive force F between two point masses m_1 and m_2, distance r apart, is $F = G\frac{m_1 m_2}{r^2}$.

relativity will itself become quantized, and so will have to give way to a quantum theory of gravity.

The associated value of the mass-energy density when this transition is imagined to occur is enormous; the so-called *Planck density* is the Planck mass divided by the cube of the Planck length and has the value of about 10^{94} grams/cm^3. This is where physicists expect classical and quantum gravity to part company. Can such an enormous mass-energy density actually occur?[105]

Yes, and more, in what physicists call *singularities*.

This was all still very speculative until about 50 years ago, but today the search for how to connect general relativity and quantum mechanics is serious business. That search is related to time travel studies via a fantastic sequence of discoveries in relativistic physics, made during the last 80 years, beginning in 1931 with the work of the young Indian astrophysicist Subrahmanyan Chandrasekhar (1910–1995). He combined quantum mechanics and *special* relativity to show that a non-rotating star above a certain mass (about 1.4 times the mass of the Sun) cannot evolve into a white dwarf, which had until then been thought the eventual fate of all stars. Stars more massive than 1.4 Solar masses (but not *too* massive) would, instead, become *neutron* stars. But what then happens to stars that are too massive for even *that* bizarre eventuality?

General relativity predicts that a sufficiently massive star—greater than about four times the mass of the Sun—will, when its fuel is nearly exhausted and its nuclear fires are beginning to fade, experience a truly spectacular event called *total gravitational collapse*. When its fuel-starved, weakened radiation pressure is no longer able to keep a massive, aged star inflated against the collapsing force of its own gravity, the star will suddenly implode and crush itself into what is called a *black hole*, a dramatic term coined in 1967 by the Princeton physicist John Wheeler (1911–2008) in an address before the American Association for the Advancement of Science. A black hole is an object with a gravitational field so strong that even light cannot escape—that's why it's black!—at whose center is something called a *singularity*. This is all well-known lore in the physics world.[106]

Indeed, cataclysmic views of the collapse of matter are actually quite old. In Lucretius' first-century B.C. *The Nature of the Universe*, for example, we find the following imagery on what it would be like if matter itself collapsed: "The ground will fall away from our feet, its particles dissolved amid the mingled wreckage of

[105]By comparison, the density of a neutron star is on the order of a 'mere' 10^{16} grams/cm^3.

[106]Perhaps not so well-known, however, is that science fiction was there long before Wheeler. In one classic tale (M. Leinster, "Sidewise in Time," *Astounding Stories*, June 1934) a scientist explains at the end, "We know that gravity warps space . . . We can calculate the mass necessary to warp space so that it will completely close in completely . . . We know, for example, that if two gigantic star masses of certain mass were to combine . . . they would simply vanish. But they would not cease to exist. They would merely cease to exist in our space and time." And then, as another character sums it up, "Like crawling into a hole and pulling the hole in after you." The explicit use of the complete term *black hole* for a region of weird spacetime also appeared in science fiction before Wheeler (P. Worth, "Typewriter from the Future," *Amazing Stories*, February 1950).

heaven and earth. The whole world will vanish into the abyss, and in the twinkling of an eye no remnant will be left but empty space and invisible atoms. At whatever point you allow matter to fall short, this will be the gateway to perdition." These words were actually inspired by earthquakes, not black holes and their singularities, but could a modern expert in general relativity and singularities have said it any better? But, what *is* a singularity?

As one theoretical physicist has dramatically written, "once gravity runs out of control, spacetime smashes itself out of existence at a singularity."[107] Or to quote Hawking, "A singularity is a place where the classical concepts of space and time break down as do all the known laws of physics."[108] One particular view of a singularity is that it is a place in spacetime that has infinite density and a gravitational field that is infinitely strong. The curvature of spacetime (more on curvature in Chap. 3) at this sort of singularity, sometimes called a *crushing* singularity, is also infinite. This is the sort of singularity believed to be at the center of non-rotating black holes. Historically, however, the occurrence of infinities in physical theories has been thought the red flag signaling that the theories have simply been extended too far, and their calculated results are nonsense.

Perhaps, then, singularities occur only in unrealistic physical applications of general relativity, and so it is only *perfectly* spherical collapsing stars that can end-up (on paper) as a black hole singularity. For a while physicists tried to establish that, but they were forced to abandon the attempt when it was shown that singularities are *unavoidable* and not just the result of idealistic assumptions.[109] This result worried many, and so the concern that general relativity was failing with its prediction of black holes and their singularities continued. In the case of a crushing singularity, perhaps all that meant is that once the collapsing star had fallen into a region even smaller than an electron, general relativity is no longer valid and the singularity is simply the 'math gone wild.' Einstein, himself, held that view. In his book *The Meaning of Relativity* (based on lectures he gave at Princeton in 1921), he wrote (concerning the use of the general theory to study the origin of the universe as a "big bang," which was a crushing singularity), "For large densities of field and matter, the field equations [of general relativity] and even the field variables which enter into them will have no real significance. One may not therefore assume the validity of the equations for very high density of field and matter, and one may not conclude that the 'beginning of the expansion' must mean a singularity in the mathematical sense."

Well, what does general relativity say about the singularity at the center of a black hole? To start, the theory says that, at a distance directly proportional to the

[107] P. C. W. Davies, *The Edge of Infinity*, Simon & Schuster 1981.

[108] S. Hawking, "Breakdown of Predictability in Gravitational Collapse," *Physical Review D*, November 15, 1976, pp. 2460–2473.

[109] S. W. Hawking and R. Penrose, "The Singularities of Gravitational Collapse and Cosmology," *Proceedings of the Royal Society A*, January 27, 1970, pp. 529–548. Ironically, one of the 'realistic' assumptions made in this paper, which appears to *force* singularities to exist, is that time travel is *impossible*!

mass of the collapsed object, a so-called *event horizon* will form. The event horizon is a surface in spacetime through which anything can fall into the hole, but through which nothing, not even a photon of light, can escape outward. The singularity at the black hole's center is therefore not visible to a remote observer (the singularity is said to be "clothed," and so not "naked"[110]). For all observers beyond the event horizon, the only visible properties of the hole are its mass (via its gravitational effects), its angular momentum (its spin rate), and its electric charge, and these properties are independent of the details of the pre-collapsed object (other than the requirement that electric charge and angular momentum are conserved).

There are actually several fundamentally different types of black holes. If the collapsed star forms a non-rotating, spherically symmetric, uncharged[111] object, then the result is called a *Schwarzchild* black hole, after the German astronomer Karl Schwarzchild (1873–1916) who found the first exact solutions to Einstein's general relativity field equations just months after Einstein published them.[112] Soon after that the Finn Gunnar Nordström and the German Heinrich Reissner independently found the solution to the field equations for the slightly more realistic non-rotating, *charged* black hole.[113] This is only slightly more realistic since it is highly unlikely a black hole wouldn't be spinning, as all observed stars are spinning and angular momentum is conserved during gravitational collapse. Another slightly more realistic solution, that of a *rotating*, uncharged black hole, was found by the New Zealand mathematician Roy Kerr in 1963, and this solution had a twist to it that at last explains why I am telling you all this—the singularity at the center of a Kerr black hole is not the *point* singularity of a non-rotating black hole but rather is a *ring* singularity. That is, there is a hole in the Kerr singularity through which matter can travel, without being destroyed, a hole that seems to act as a portal into

[110]A naked singularity, with no event horizon behind which to hide, would be particularly bothersome to physicists who don't like the idea of the breakdown of physics being on full display. What they think they'd then see would be completely unpredictable. Whether such a situation can actually exist is still open to debate, but there *are* both analytical solutions and computer simulations (incorporating realistic equations of state on the pressure response of matter as it is compressed) that seem to allow it (as in the gravitational collapse of an *infinitely* long, non-rotating cylinder that appears to result in an axial, thread-like, naked singularity).

[111]The word *charge* means either electrical *or* magnetic charge, although from a practical point *charge* probably does mean just electrical, as the theoretically possible magnetic monopole has yet to be observed and, in any case, it is thought that black holes will not have a significant electrical charge.

[112]Even *Einstein* hadn't yet solved them, and he apparently thought they were too complicated to be solved; when he saw Schwarzchild's result, he was so impressed that Einstein wrote to say "I had not expected that the exact solution to the problem could be formulated. Your analytical treatment of the problem appears to me splendid."

[113]Two years later, the University of Pittsburgh physicist Ezra Newman finally solved the field equations for the realistic, general case of a rotating *and* charged black hole.

other spacetime regions that may include past or *future* regions of spacetime. In other words, the ring singularity seems to be the entrance to a time machine.[114]

A discussion of singularities in general relativity is especially complicated for at least two reasons. First, there is more than one type, with *crushing* being just the (perhaps) most 'obvious.' Another type has no infinite curvature associated with it, but rather is a point in spacetime beyond which the worldline of a freely falling mass cannot be extended. Such a point is called a *geodesically incomplete* singularity, and it represents either an end to space or to time (in either case, that point is on the boundary or edge of spacetime). There are other types, as well—I've mentioned the naked singularity already—and the appearance of *any* of them is distinctly unsettling (recall Bergman's opening quote) to physicists. One that may be the most unsettling of all, however, is the *thunderbolt* singularity. This singularity propagates to infinity at the speed of light! As its discoverers dramatically put it, "It is not a naked singularity because you do not see it coming until it hits you and wipes you out."[115]

The other reason for a discussion of general relativity singularities being complicated is that they simply are not like the singularities of earlier theories. For example, in electromagnetic field theory spacetime is the *given background reference*; that is, a singularity in that theory is a point in spacetime where the *electromagnetic field* is undefined. In gravitational field theory, however, it is

[114]You can find discussions on how this is imagined to work in two papers by R. Weingard: "General Relativity and the Conceivability of Time Travel," *Philosophy of Science*, June 1979, pp. 328–332, and "Some Philosophical Aspects of Black Holes," *Synthese*, September 1979, pp. 191–219. See also M. Calvani et al., "Time Machine and Geodesic Motion in Kerr Metric," *General Relativity and Gravitation*, February 1978, pp. 155–163. I won't pursue black hole time machines in this book, as it is not what modern physicists consider a plausible means of time travel (*How are you going to gain access to a black hole?!!!*) For how one science fiction writer *did* use the idea, however, see L. Niven, "Singularities Make Me Nervous," in *Stellar* 1 (J.-L. del Rey, editor), Ballantine 1974. Black holes *are* bizarre objects—nearly as bizarre as time travel—and it seems risky to try to understand one in terms of the other (recall Professor Challenger's observation!).

[115]S. W. Hawking and J. M. Stewart, "Naked and Thunderbolt Singularities in Black Hole Evaporation," *Nuclear Physics B*, July 1993, pp. 393–415. As bizarre as is the thunderbolt, it was anticipated in science fiction by more than half a century. In the story "The Tides of Time" by R. M. Williams (*Thrilling Wonder Stories*, April 1940), the universe is collapsing at faster than the speed of light. Human scientists learn this when fleeing aliens stop their faster-than-light space ships to warn them. One of the human characters then looks out into the night sky and, in words that sound like those of Hawking and Stewart, "There would be no warning, for the rolling tide was traveling faster than light . . . It would come faster than the flicker of an eye. No one would see it come. One instant the world you knew would be around you. The next instant, there would be nothing. You would not even have time to know what had happened. Death, faster than the lightning flash!" This story may have been inspired by a tale published decades earlier, by the Canadian writer Frank Lillie Pollock (1876–1957). In his "Finis" (*The Argosy*, June 1906), written long before the concept of a super-nova, the light of a huge, distant star finally arrives to cook Earth into oblivion.

spacetime itself that is undefined, and there is no background 'something' in which spacetime is embedded to serve as a reference.[116]

One early suggestion on how to avoid the problem of the crushing singularity of the non-rotating black hole (which is, as mentioned earlier, not a realistic model for the gravitational collapse of a rotating star) is that the collapse may stop short of the singularity. That is, the collapsing body might instead rebound. This 'bounce' would occur after the star was inside its event horizon, so an external observer would not see the later expansion, an expansion imagined to be through the event horizon *but into a different region of spacetime*.[117] When Novikov's work was generalized the following year, the authors clearly had a hard time believing this dramatic imagery, despite their own mathematics, concluding with "It then appears necessary to believe in the existence of other [regions of the universe, including the past and the future] which will accommodate the re-expansion. This seems at least as fantastic as the alternative of [a point singularity].".[118]

In 1974 Hawking announced an astonishing partial connection of quantum mechanics with general relativity's black holes. He showed that, contrary to the usual image of black holes as being one-way trap doors to . . .?, black holes actually *must* radiate energy.[119] His analysis, which stunned physicists by its beautifully simple arguments, invokes the famous *uncertainty principle*, one of the corner stones of quantum mechanics. Hawking himself found the result "greatly surprising." He also cautioned (in his 1975 paper) that the following picturesque imagery is "heuristic only and should not be taken too literally," but it has now been in physics for over 40 years and appears to be here to stay.

The uncertainty principle states that there are certain pairs of variables associated with particles, variables that cannot be precisely measured at the same time. Time and energy form such a pair because a non-zero time interval is required to measure a particle's energy, and the product of the uncertainty in both the time interval (Δt) and the energy (ΔE) must be at least as large as a certain non-zero constant. That is, if $\hbar$ is Planck's constant, then $\Delta E \Delta t \sim \hbar$. This allows the process of virtual particle creation, the appearance of particle/anti-particle pairs just outside the event horizon of a black hole. The uncertainty in the energy is what gives the combined mass of the particles in a pair; this uncertainty in the energy is the quantum fluctuation energy of the intense gravity field of the hole. The only

[116]See, for example, R. Geroch, "What Is a Singularity in General Relativity?" *Annals of Physics*, July 1968, pp. 526–540.

[117]See, for example, I. Novikov, "Change of Relativistic Collapse Into Anticollapse and Kinematics of a Charged Sphere," *JETP Letters*, March 1, 1966, pp. 142–144, and V. P. Frolov, *et al.*, "Through a Black Hole Into a New Universe?" *Physics Letters*, January 12, 1989, pp. 272–276. Igor Novikov is a Russian physicist at the University of Copenhagen, and he will appear later in the book when we get to the paradoxes of time travel to the past.

[118]V. De La Cruze and W. Israel, "Gravitational Bounce," *Nuovo Cimento A*, October 1, 1967, pp. 744–760.

[119]S. Hawking, "Black Hole Explosions?" *Nature*, March 1, 1974, pp. 30–31, and "Particle Creation by Black Holes," *Communications in Mathematical Physics*, 1975, pp. 199–220.

constraint is that the energy be returned to the field, via mutual annihilation of the matter/anti-matter pair within the time uncertainty dictated by the uncertainty principle.[120]

As Hawking showed, this time interval, although incredibly short, is still long enough for the two virtual particles to separate before annihilation, one falling into the hole and the other escaping. This would happen, for example, if the particle/anti-particle pair is an electron/positron pair, and so a negatively/positively charged black hole would tend to attract the positron/electron and repel the other particle (either way, driving the charge of the hole towards zero). (Hawking then later suggested[121] that the particle *entering* the hole could be thought of as an *emitted* particle traveling backward in time, an idea that can be traced back decades, to John Wheeler—I'll return to this idea in just a moment.) By this incredible quantum process, then, the black holes of general relativity slowly *evaporate* (!) as they glow with what is now called *Hawking radiation*. That is, black holes appear to be hot bodies. But *hot* is relative, as a black hole with the mass of the Sun would have a temperature of just sixty *nano*-degrees Kelvin above absolute zero, and it would take 10^{66} years (a stupendously enormous time compared to the age of the universe) to completely evaporate.

Indeed, one physicist had already mused that the *entire universe* might have been created by a similar quantum process, *out of nothing*, a so-called *vacuum fluctuation*.[122] The explanation for why the universe doesn't then disappear—and very quickly, too, because the energy for all the mass in the newly created universe is quite large (that is, ΔE is *really big* and so Δt must be *really small*)—is that the *negative* gravitational potential energy of all that newly created matter would cancel the positive mass-energy, and so ΔE is actually *quite small* and so Δt is then *quite large*. To perhaps show he wasn't quite convinced by all that, himself, Tryon whimsically wrote "I offer the modest proposal that our Universe is simply one of those things which happen from time to time."

As a final comment on the suggestion by Hawking of a connection between virtual particles at a black hole event horizon and backwards time travel, the idea

[120]The uncertainty principle has long been used in time travel science fiction. In one story, for example, a character is transported from 1950 to 2634 by a scientist of the future. Once there, this character decides he'd like to remain permanently in the 27th century. He is told that he can't because he is like an atom excited into an elevated energy state and, just as quantum mechanics says that eventually an electron in such a state will drop back down into a lower energy state, so do the "laws of time travel" require that he drop back to his normal time. How long can he remain in future, he is told, "depends on the mass [energy] of his body and the number of years the mass [energy] is displaced." That is simply the uncertainty principle. See W. Bade, "Ambition," *Galaxy Science Fiction*, October 1951.

[121]S. Hawking, "The Quantum Mechanics of Black Holes," *Scientific American*, January 1977.

[122]E. P. Tryon, "Is the Universe a Vacuum Fluctuation?" *Nature*, December 14, 1973, pp. 396–397.

originated (as I said before) with Wheeler, in 1941.[123] In an astonishing coincidence, even as Wheeler was telling his student Richard Feynman about this, a science fiction writer was also identifying anti-matter with backward time traveling 'normal' matter.[124] Later, the Polish science fiction writer Stanislaw Lem (1921–2006) took this idea, combined it with the quantum concept of energy fluctuation, and came up with one of his typically outrageous (and typically hilarious) ideas: shooting a single positron out of an accelerator back to the very beginning of time. His story character called this fantastic machine the "Chronocannon" and claimed that's what started the universe.[125]

Soon after Lem, a philosopher used a variant of this idea, in which the Big Bang creation of the universe was caused by a time traveler from the future who saw a need—his own existence—to generate the Big Bang. This leads to philosophical speculations on the cosmological implications of God as a time traveler.[126] Two recent physicists have taken this one step further by suggesting that the universe, via time travel, may have caused itself! As they put it, "the laws of physics may allow the Universe to be its own mother."[127]

The modern hope is that quantum mechanics (as in quantum gravity) will save physics from the horror of general relativity's singularities. This was the view of John Wheeler and, as the man who named black holes, his view is important to consider. General relativity is a classical, *smooth* theory that is fundamentally continuous, while 'our' universe appears to be a quantum one. So, perhaps, general relativity's prediction of singularities may be just an artifact without physical reality in the 'real world.' Wheeler's position was based on the quantum fluctuations of gravity fields, which are related to the uncertainties inherent in our knowledge of the values of physical entities. Such fluctuations are vanishingly small in systems of everyday size, but they increase dramatically at very tiny distances that are twenty orders of magnitude smaller than the nucleus of an atom. In the microscopic region of spacetime that the matter forming a black hole is falling into, these fluctuations might conceivably result in effects that preclude the formation of a singularity. Agreeing were two physicists who asserted that, even without a detailed knowledge of quantum gravity, quantum effects "would smash the idealized interior geometry"

[123]See Richard Feynman's Nobel lecture, reproduced in *Science*, August 12, 1966, pp. 699–708, where he recounts Wheeler's 'proof' for why every electron in the universe has *exactly* the same charge ('there is only *one* electron, weaving its way back-and-forth in time, with positrons being the electron when traveling backward-in-time').

[124]Will Stewart, "Minus Sign," *Astounding Science Fiction*, November 1942. 'Will Stewart' was a pen-name for John Stewart Williamson (1908–2006).

[125]S. Lem, "The Eighteenth Voyage," in *The Star Diaries*, Seabury Press 1976.

[126]G. Fulmer, "Cosmological Implications of Time Travel," in *The Intersection of Science Fiction and Philosophy* (R. E. Meyers, editor), Greenwood Press 1983. Isaac Asimov used a similar idea in his story "The Instability," *The London Observer*, January 1, 1989.

[127]J. R. Gott and L.-X. Li, "Can the Universe Create Itself?" *Physical Review D*, 1998, 023,501.

[that is, the ring singularity] of a rotating, charged black hole, thereby eliminating any possibility of using such a hole for time travel.[128]

And finally, to generalize beyond black holes to the hoped-for pay-off of the coming of quantum gravity in banishing singularities altogether, one recent study has examined how non-crushing singularities (that is, ones of the geodesically incomplete type) *are* apparently "healed" (the authors' term) by quantum effects.[129] With the eventual development of quantum gravity, perhaps all the singularities of general relativity will vanish while leaving the CTCs/CTLs intact, thereby removing a form of doubt in the theory's apparent support for time travel to the past. It may be a long time coming, however: as the University of Sydney philosopher of science Dean Rickles recently (2014) wrote in his book *A Brief History of String Theory*, "quantum gravity is in many ways . . . a revolution still waiting to happen."

1.6 Tipler's Time Machine

> "In short, general relativity suggests that if we construct a sufficiently large rotating cylinder, we create a time machine."[130]

The time traveling property of the ring singularity in a rotating black hole once made it a favorite of science fiction writers, as in Joe Haldeman's classic 1974 novel *The Forever War* (in which the term used is not *black hole*, but *collapsar*, which is a nicely descriptive word in its own right). A major difficulty with this approach, however, as I mentioned in the previous section (note 114), is that of 'getting one's hands on' (so to speak) a black hole! So, is there any other 'time machine' that is consistent with general relativity? Yes, there is.

In 1974 a young physics graduate student at the University of Maryland, Frank Tipler, caused a bit of a stir when he published what seemed to be quite specific construction details for a time machine. Indeed, the final sentence (the above quotation) of his paper couldn't be clearer. Nobody had ever before made such a statement in a respectable physics journal and, best of all, there were no apparent spacetime singularities involved. However, a close look at Tipler's analysis does turn up some difficulties.

What Tipler had actually done was to show that if one had an *infinitely long*, *very dense* cylinder rotating with a surface speed of at least half the speed of light (the rotation speed is such that the outward centrifugal forces are balanced by the inward gravitational attraction of the cylinder), then this allowed the formation of closed

[128]N. D. Birrell and P. C. W. Davies, "On Falling Through a Black Hole Into Another Universe," *Nature*, March 2, 1978, pp. 35–37.

[129]T. M. Helliwell and D. A. Konkowski, "Quantum Singularities in Spherically Symmetric, Conformally Static Spacetimes," *Physical Review D*, May 13, 2013, 10404.

[130]F. J. Tipler, "Rotating Cylinders and the Possibility of Global Causality Violation,' *Physical Review D*, April 15, 1974, pp. 2203–2206.

timelike curves around the cylinder. This means that by orbiting the surface of such a fantastic cylinder, one could travel through time into the past—but not to earlier than the moment of the creation of the cylinder.

This last point is a very important one, as it does avoid one particularly odd paradox (called a *bootstrap*): a traveler going backwards in time to tell the inventor of a time machine (perhaps an earlier version of the time traveler himself) how to build the time machine. You can find this idea in early science fiction,[131] and a minor variant of it was amusingly illustrated in the 1985 film *Star Trek IV: The Voyage Home* (when you next watch the movie, ask yourself who actually invented "transparent aluminum"?) Bootstrap paradoxes are quite mysterious and still befuddle physicists and philosophers. Science fiction writers, on the other hand, love bootstraps as great story gimmicks.

Tipler's cylinder would also enable a time traveler to return to her original time, to go "back to the future," by orbiting the cylinder in the reverse direction (but no further into the future than when the cylinder ceases to exist). Later in the book I'll show you a simple illustration—based on a similar one in Tipler's PhD dissertation, published in 1976—of how the cylinder works as a time machine. No one, in fact, disputes any of this. It *is* true. On paper.

But Tipler did *not* prove that a time traveling property holds for cylinders of even very long but *finite* length, which are the only kind we could actually build from a finite amount of matter; he merely suggested that such might be the case. This suggestion does seem reasonable, because if the time traveler orbits at the midpoint of the cylinder, near the surface, then the gravitational end-effects of sufficiently remote ends of the cylinder would, you'd think, become negligible. Similar mathematical approximations are routinely made, for example, when calculating the electrical effects of charged cylinders of finite length. But as one physicist has warned, "Extrapolation from cylindrical symmetry to reality is very dangerous, since spacetime is not even asymptotically flat around an infinite cylinder."[132] The issue of whether a spinning, finite-length cylinder can create closed, timelike curves is still open: to quote another physicist, "[In] some respects an infinite cylinder may be a model for a long finite one, and the possibility cannot be dismissed that a time machine might be associated with a long, but finite rotating system."[133]

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[131] See, for example, C. Cloukey, "Paradox," *Amazing Stories Quarterly*, Summer 1929. Later in the book I'll discuss even earlier literary occurrences of bootstraps (that is, of *information* on closed loops in time).

[132] K. S. Thorne, "Nonspherical Gravitational Collapse: Does It Produce Black Holes?" *Comments on Astrophysics and Space Physics*, September–October 1970, pp. 191–196. What "asymptotically flat" means will be discussed in Chap. 3.

[133] W. B. Bonner, "The Rigidly Rotating Relativistic Dust Cylinder," *Journal of Physics A*, June 1980, pp. 2121–2132. Tipler was not the first to study rotating cylinders in the context of general relativity. Such cylinders had been around for decades, going back to 1932. A good reference is M. A. Mashkour, "An Exterior Solution of the Einstein Field Equations for a Rotating Infinite Cylinder," *International Journal of Theoretical Physics*, October 1976, pp. 717–721. The first-analyzed configuration of matter that generates closed timelike lines, solved in all its general relativistic detail, was the infinite rotating cylinder studied by W. J. van Stockum,

There is, however, another potential problem besides the length of the cylinder. There is a strong likelihood that a Tipler cylinder under construction would collapse under its own internal gravitational pressure before it could be made nearly long enough to be even 'approximately infinite.' That is, such a finite-length cylinder might crush itself along its long axis into a pancake-shaped blob, something like what happens to a long cylinder of jello stood on-end. An ordinary can of jellied cranberry sauce will also sometimes display this curious behavior.

The required rotational speed raises yet another concern, as well. We are not talking about cylinders the diameter of a pencil, or even of a large water pipe. Recall that for a given surface speed, the larger the diameter the less the centrifugal acceleration at the surface. It is easy to calculate that even a huge cylinder 10 kilometers in radius, with a surface speed of half the speed of light, would have a surface acceleration *hundreds of billions* of times the acceleration of Earth's surface gravity. No known form of ordinary matter could spin that fast and not explosively disintegrate; Tipler has estimated that the required density for a time machine cylinder would be 40 to 80 orders of magnitude above that of nuclear matter. (In a masterful understatement, Tipler calls this astonishing stuff "unknown material.") Made from such incredibly superdense stuff, even a finite cylinder would still be as massive as the Sun but many trillions of times smaller. Showing no lack of imagination, Tipler has suggested the possibility of speeding up the rotation of an existing star as an alternative approach to that of building a cylinder.[134] That, of course, would be project for a far-future society, with a *very* advanced technology.

All of these concerns were discouraging to Tipler (who could blame him?), and his pessimism about the actual likelihood of achieving time travel via one of his cylinders is shown by the words he used to open his 1977 paper (note 134): "Any attempt to evolve a time machine] from [normal] matter will cause singularities to form in spacetime. Thus, if by the word 'manufacture' we mean 'construct using only ordinary materials *everywhere*,' then the theorems of this paper will conclusively demonstrate that a [time machine] cannot be manufactured." But not all physicists agreed.

"The Gravitational Field of a Distribution of Particles Rotating About an Axis of Symmetry," *Proceedings of the Royal Society of Edinburgh*, 1939, pp. 135–154. This is particularly interesting because, while Van Stockum didn't spot the presence of closed timelike lines in his solution, his cylinder is made entirely from *ordinary* matter.

[134]F. Tipler, "Singularities and Causality Violation," *Annals of Physics*, September 1977, pp. 1–36. See also his earlier paper "Causality Violation in Asymptotically Flat Space-Times," *Physical Review Letters*, October 1976, pp. 879–882, where he wrote "There are many solutions to the Einstein equations [of general relativity] which possess causal anomalies in the form of closed timelike lines (CTL). It is of interest to discover if our Universe could have such lines. In particular, if the Universe does not at present contain such lines, is it possible for human beings to manipulate matter so as to create them? [That is, to construct a time machine.] I shall show in this paper that it is *not* [Tipler's emphasis] possible to manufacture a CTL-containing region without the formation of naked singularities, *provided normal matter is used in the construction attempt* [my emphasis]."

Years after Tipler wrote, one physicist replied[135] with *two* pointed observations. First, Tipler's theorems apply only to singularities of the incomplete kind, not to the more convincingly fatal crushing (or curvature) type. Second, to quote Ori at length, "The standard interpretation of Tipler's theorems is to say that the appearance of a singularity in a given [spacetime] model indicates that this model is unrealistic and cannot be physically realized. Even for future-generation engineers it will probably be impossible to use 'singular matter' for the construction of their time machine. However, the theory of black holes provides an obvious counterexample to this interpretation. For, by applying this interpretation to the black hole singularity theorems one could conclude that black holes can never form." Yet black holes with several times the mass of the Sun *have* been detected in orbit about certain stars, and at least one supermassive black hole (with a mass equal to more than three *billion* Suns) has been detected at the core of galaxy M87. Indeed, it is now believed that the center of *every* sufficiently massive galaxy in the universe is home to a black hole (the one at the center of our own galaxy, the Milky Way, has a mass about three million times that of the Sun).

Even less concerned about singularities interfering with time travel were two other physicists who wrote[136] "It would seem that a successful attempt to manufacture [a time machine] within a finite region of space will be accompanied by the creation of a singularity . . . This does not immediately imply, however, that with a sufficiently advanced technology one could not make a time machine. *There is no reason to suspect spacetime singularities could not in principle be created through deliberate human action* [my emphasis]."

These optimistic views were, of course, welcome news for science fiction writers, who had been using Tipler cylinders almost from when Tipler first wrote of them. Indeed, Larry Niven liked them well enough to 'lift' the very title of Tipler's paper (note 130) for the title of a short time travel story for inclusion in his 1979 collection *Convergent Series*. Just one year after Tipler's paper appeared, Poul Anderson featured the cylinders in his 1978 novel *The Avatar*, where they are called "T-machines": one can imagine the "T" stands for Time or Tipler or even both. Anderson's story describes the cylinders as having been scattered about the universe by ancient, altruistic aliens called "the Others," for the use by any who come across them and who have the wits to decipher *how* to use them. Anderson recognized the obvious problems with Tipler cylinder construction, and so has one of his characters say of T-machines, "I have no doubt whatsoever that [they are] the product of a technology further advanced from ours than ours is from the Stone Age."

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[135] A. Ori, "Must Time-Machine Construction Violate the Weak Energy Condition?" *Physical Review Letters*, October 1993, pp. 2517–2520. The weak energy condition is the seemingly 'obvious' requirement that the observed local mass-energy density should never be negative. Quantum mechanics predicts (and it has been experimentally confirmed) that there *are* exceptions.

[136] M. P. Headrick and J. R. Gott, "(2+1)-Dimensional Spacetimes Containing Closed Timelike Curves," *Physical Review D*, December 15, 1994, pp. 7244–7259. The '(2+1)' refers to a toy spacetime with just two spatial dimensions and one time dimension.

Even before (actually *long* before) Tipler's paper, science fiction had foreshadowed his physics. Oliver Saari (1918–2000), for example, had incorporated both superdense matter and the rule of 'no time travel before the creation of a time machine' in a story written *40 years* earlier.[137] Saari's fictional time machine works by warping spacetime via a plate of superdense matter. (An even earlier tale[138] had also used superdense matter, but it was badly flawed by its hocus-pocus invoking of 'rays' emitted by the newly discovered element of *tempium*.) The 'no time travel before the creation of a time machine' rule is the basis for an obvious response to Hawking's Chronology Protection Conjecture, discussed earlier in this chapter, and it was so used by one physicist to rebut the Conjecture: as he wrote,[139]

(1) time machines, if possible, must have the property of not being able to travel back to before their creation, and
(2) no time machine has yet been created.

The absence of time travelers amongst us, therefore, provides no insight, one way or the other, on the eventually possibility of constructing a time machine.

1.7 For Further Discussion

Observations of the background microwave radiation that permeates the universe is strong experimental evidence for the Big Bang, the singularity thought to be the origin of the universe. This singularity is not shielded from us by an event horizon, and so is not a naked singularity (note 110), which means it is potentially visible. In 1969 the English theoretician Roger Penrose, however, proposed a metaphysical 'law' called the *cosmic censorship principle*, which asserts that naked singularities are impossible. Discuss the obvious tension between Penrose's principle and the Big Bang singularity. (See, for example, P. Kosso, "Spacetime Horizons and Unobservability," *Studies in History and Philosophy of Science*, June 1988, pp. 161–173.)

[137] O. Saari, "The Time Bender," *Amazing Stories*, August 1937. In this story we read that the time traveler "could not travel into the past for the plate had to exist in all ages traveled, and it had not existed before he made it."

[138] E. L. Rementer, "The Time Deflector," *Amazing Stories*, December 1929.

[139] K. S. Thorne, "Do the Laws of Physics Permit Closed Timelike Curves?" *Annals of the New York Academy of Science*, August 10, 1991, pp. 182–193. Science fiction writer Damon Knight (1922–2001) anticipated Thorne's rebuttal in his story "Azimuth 1, 2, 3, . . . ," *Isaac Asimov's Science Fiction Magazine*, June 1982.

In the text I mention the "transparent aluminum" bootstrap paradox that appears in the 1985 movie *Star Trek IV*. Even earlier, a movie bootstrap appeared in 1980 film *The Final Countdown*. There, the designer of a modern naval warship that temporarily time travels back to the Pearl Harbor of December 6, 1941, turns out to be a crew member who was (is) accidently left behind in the past when the ship returns to the present. In the past he *will be* able to design the ship because he already knows how it *was* designed—by himself! In the more recent 2014 film *Interstellar*, a wormhole near Saturn is discovered. By the end of the film we learn that it was put there by future humans, humans who exist because their ancestors (us!) were saved from a planet-wide ecological disaster when they used the wormhole to discover new worlds in far-flung regions of the universe. Decide whether or not the existence of the wormhole represents a bootstrap paradox, and defend your position.

One difficulty in using a black hole as a means of traveling from one region of the universe to another (with time travel as a special case) is simply getting to a black hole in the first place. The nearest one to Earth, as far as is known, is many light years distant. One reason for this may be an anthropic one (see note 13 in the "Introduction"). That is, a planet near a rotating black hole would either be eventually swallowed whole, or have its surface blasted by a firestorm of radiation produced by in-falling matter. In any case, no intelligent life able to recognize time travel would ever evolve on such a planet in the first place. That is, we are here to wonder about the absence of near-by black holes precisely *because* we aren't near a black hole. The lack of black holes near Earth is addressed in Joe Haldeman's 'Earth vs. Aliens' novel, *The Forever War*, by using the time dilation effect of special relativity (discussed in Chap. 3) that allows long travel distances to be covered in a reasonable time (as measured by clocks in rocket ships traveling near the speed of light). Still, while the travel time to reach a black hole distant from Earth by many light years may only be 6 months of ship time, back on Earth many *years* may pass. Once at the black hole the ship enters it and instantly 'jumps' to a vastly different region of the universe. In the novel, no time travel after the time dilation experienced in just getting to the black hole occurs, but Haldeman uses that to great effect as follows. Before entering into combat, Earth's soldiers are told that when they exit the hole into a new region of the universe, they may encounter alien warships equipped with *their* latest technology, technology that could be far in advance of the Earth warship's technology

(continued)

which dates from Earth's *past*. That is, humans will be fighting against technology that dates from the Earth warship's *future*. To quote the novel, "Relativity traps us in the enemy's past; relativity brings them from our future." Explain this.

In one of the quatrains of the *Rubaiyat*, the eleventh century Persian poet-philosopher Omar Khayyam wrote

The Moving Finger writes; and having writ,
Moves on; nor all your Piety nor Wit
Shall lure it back to cancel half a Line,
Nor all your Tears wash out a Word of it.

Nearly a 1000 years later the German theoretical physicist Hermann Weyl (1885–1955), a colleague of both Einstein and Gödel at the Institute for Advanced Study in Princeton, NJ, wrote the following in his book *Space-Time-Matter* (published in 1921, three decades *before* Gödel's 1949 time travel paper):

> *It is possible to experience events now that will in part be an effect of my possible future resolves and actions. Moreover, it is not impossible for a world-line (in particular, that of my body), although it has a time-like* [see the index] *direction at every point, to return to the neighborhood of a point which it has already once passed through. The result would be a spectral image of the world more fearful than anything the weird fantasy of E. T. A. Hoffmann* [an early nineteenth-century German writer of the eccentric] *has ever conjured up. In actual fact the very considerable fluctuations of the* [components of the metric tensor, to be discussed in Chap. 3] *that would be necessary to produce this effect do not occur in the region of the world in which we live . . . Although paradoxes of this kind appear, nowhere do we find any real contradictions to the facts directly presented to us in experience.*
> Compare these two views and, in particular, discuss what each says about the idea of 'reliving the past.'

In the opening section of this book ("Some First Words") I mention how now and then science fiction has anticipated physics. One interesting example of this occurs in a story of a time traveler *almost* meeting himself, a story published 2 years *before* Gödel's 1949 time travel paper in which he suggests just such a possibility. The story opens with a man on a ship spotting the signal fire of a castaway on a Pacific island, as well as the tiny, distant figure

(continued)

of a man waving and jumping about. While sailing in to help, the ship hits a mine left over from the war, and the would-be-rescuer becomes a castaway, too. After swimming to the island, he can find no trace of who built the fire, although there are footprints all about in the sand. Exploring the island, he finds the remains of a crashed interstellar spaceship (!), powered by a drive unit based on 'temporal precession.' The man, curious, turns the drive on and thus sends himself backward in time by one day. He then spots a ship on the horizon, builds a fire, waves and jumps about, then *recognizes the ship as his own* . . .. And so the loop nearly but not quite closes. The man, apparently, rushes off into the jungle, terror-stricken at the thought of meeting himself. (You can find this tale by A. B. Chandler (1912–1984), "Castaway," in the November 1947 issue of *Weird Tales*, a publisher more of fantastic, supernatural, and horror stories than of science fiction. Perhaps easier to locate would be an anthology in which it has been reprinted: *Science-Fiction Adventures in Dimension* (G. Conklin, editor), Vanguard 1953.)
Speculate on what happens to the man. In particular, does Wells' own criticism of *The Time Machine*, concerning "vain repetitions" of time travelers, apply here (see the "Introduction" again)?

A philosopher has argued against the force of Hawking's chronology protection conjecture as follows: "There is an old argument to the effect that while backward time travel may be *possible*, it will never actually occur—for if it were going to occur, we would *already* have encountered the time travellers involved, whereas in fact we have done no such thing. . . . But consider an isolated society living in a remote part of the world. Some members of this society are engaged in a long-running debate concerning the possibility of human flight. Were a 747 to pass overhead, would the debaters necessarily recognize it as containing flying humans? The answer to their question might have been staring them in the face for years, without them realizing." (See Nicholas J. J. Smith, "Bananas Enough for Time Travel?" *British Journal for the Philosophy of Science*, September 1997, pp. 363–389, in particular note 3 on p. 364. The perhaps curious appearance of 'bananas' in the title of this paper will become clear when, in Chap. 4, we delve into the details of the famous grandfather paradox.) How would *you* answer Smith's question? Do you think it is plausible, as Smith implies, that we could right now be observing (without realizing it) effects in the present-day world that are the result of time travelers amongst us? What sort of effect (s) might raise this suspicion in *your* mind?

As discussed in Sect. 1.6, Tipler expressed some pessimism in his 1977 paper (note 134) about the possibility of actually constructing a time machine from a rotating cylinder. But that doesn't mean he didn't have some doubts, too, about theoretical 'proofs' of something being impossible. In his 1976 PhD dissertation, for example, he included an amusing reference to Simon Newcomb (a real-life mathematician that Wells' Time Traveller cites in *The Time Machine*—see note 102 in Chap. 2) who published mathematical 'proofs' that it would be impossible with known science to build a "practicable machine by which men shall fly long distances through the air." Why do you think Tipler did that? You can read more about Newcomb's 'proofs' in "Is the Airship Coming," *McClure's Magazine* (September 1901, pp. 432–435) and "The Outlook for the Flying Machine," *The Independent* (October 22, 1903, pp. 2508–2512).

In his autobiography, the Princeton physicist John Wheeler had this to say about time: "The smooth flow of time—or our smooth passage through it—is an illusion that is shattered when we . . . ask about time at the moment of the Big Bang, at a moment of gravitational collapse, at the moment of the Big Crunch. Students and others often ask what existed before the Big Bang. To say that we don't know is not to say enough. Even to say that we have no *way* of knowing is not enough. We really have to say that space and time came into existence, along with matter and energy and the laws of physics, at the moment of the Big Bang. If the universe expands to a maximum size, starts contracting, and eventually collapses to a fiery death—a fate that seems likely to me and to some other theorists . . . then time and space, too, will end in this Big Crunch. I can reach no conclusion other than this: there was no 'before' before the Big Bang, and there will be 'after' after the Big Crunch." (See J. A. Wheeler, *Geons, Black Holes, and Quantum Foam: a life in physics*, W. W. Norton 1998, pp. 349–350.) That is, when the Big Bang singularity occurred, time was *created*, and if the universe should collapse in the far future in a Big Crunch, time will be *annihilated*. This is a view of *nothingness* that transcends even that of the grave. Sharing Wheeler's dark view of the ultimate fate of reality, but instead giving the *victory t*o time (rather than its annihilation), was the Irish writer Jonathan Swift (1667–1745) in his poem *Riddles* (circa 1724): "Ever eating, never cloying/All-devouring, all destroying/Never finding full repast/ Till I eat the world at last." How do you think theologians would respond to Wheeler and Swift?

The American philosopher Roy Sorenson was cited in note 13 in the discussion of the difficulties a time travel would have in convincing skeptics that he *had really* time traveled (short of bringing a fresh dinosaur egg back and hatching it!). This question was treated in early pulp science fiction ("The Sands of Time," see note 43 in "Some First Words") as follows: The time traveler takes a sealed box of pure radium (with his name written on the inside of the lid) into the distant past, and buries it in a secure location. Upon returning to the present he unearths the box; testing of the contents will show that some of the radium has radioactively decayed to lead. Indeed, the amount of decay would be a direct measure of how far back into the past the box had been transported. This issue was later elaborated on by the English philosopher Alasdair Richmond in his paper "Time Travel, Parahistory and the Past Artefact Dilemma," *Philosophy*, July 2010, pp. 369–373. There he imagined two possible ways a time travelling Shakespearean scholar might attempt to convince skeptical colleagues that he had discovered a draft of *Hamlet* dating from the year 1589 (10 years *before* the earliest accepted date of its composition by Shakespeare). The first attempt is to simply bring that draft directly back with him in the time machine, from 1589 to the present. Then, of course, many of the inherent clues as to the draft's authenticity, such as chemical composition of the ink, the weave of the paper, and orthography (the style of writing in 1589) would be consistent with the time traveler's claim, but other clues would *not*—the *age* of the paper and of the ink, for example, would be taken as evidence fatal to the claim, as they would not be nearly 430 years old. They would appear, in fact, to be practically new! The draft would, therefore, be dismissed as simply a clever forgery. The second attempt would try to get around this problem, as follows. After locating the draft in 1589, the time traveler *doesn't* bring it back to the present, but rather stashes it away in a secret hiding place. Then, once back in the present, he takes his colleagues to the secret hiding place and, with a flourish, reveals the draft which now *is* nearly 430 years old. Much to the time traveler's frustration, however, his colleagues still reject his time travel claim, this time saying he must have simply found the draft in the 'usual' way (under the floorboards in somebody's attic, for example), and is just pretending to have found it via time travel. Can you think of a way, using the *Hamlet* draft, the time traveler might be able to convince his skeptical colleagues?

The fan I quoted in "Some First Words," who wrote to *Astounding Stories* in 1931 to express his unhappiness with the appearance of women in that magazine's stories, was quite clear about his concerns—although, given the times, he carefully avoided any direct mention of sex. A modern, highly successful *female* writer of science fiction, Anne McCaffrey (1926–2011), didn't shy away from that, however, when she wrote the following in a hilariously funny essay: "Prior to the '60s, stories with any sort of love interest were very rare. True, it was implied in many stories of the '30s and '40s that the guy married the girl whom he had rescued/encountered/discovered during the course of his adventures. But no real pulse-pounding, tender, gut-reacting scenes. The girl was still a 'thing' to be used to perpetuate the hero's magnificent chromosomes. Or perhaps to prove that the guy wasn't . . . I mean, all those men locked away on a spaceship for months/years at a time. I mean . . . and you know what I mean even if I couldn't mention it in the sf of the '30s and '40s." (See Anne McCaffrey, "Hitch Your Dragon to a Star: Romance and Glamour in Science Fiction," in *Science Fiction, Today and Tomorrow*, R. Bretnor, editor, Harper & Row 1974, pp. 278–292.) Modern time travel science fiction has shown a huge change (for the better) on this score. Discuss, for example, the emotional power of a love story between a couple separated in time, as depicted in the 1975 novel *Bid Time Return* by Richard Matheson (made into the 1980 film *Somewhere in Time*). How do you think the 1931 fan would have reacted to Matheson's story? (Indeed, if that fan was a teenager—or even a few years older—in 1931, then 44 years later he would have been, at most, in his mid-60s and might well *have* read the novel.)

In the 2014 film *Interstellar*, a space probe dives into a black hole, gets a glimpse of the hole's singularity, measures some unspecified quantum effects, and then sends the measurements back to Earth (via the fifth dimension) as a signal in the form of spasmodic Morse code twitches of the second-hand on somebody's watch. This all leads (it is hinted) to a theory of quantum gravity. If you saw the second-hand on *your* watch suddenly begin to spasmodically twitch, would you then immediately think

(a) that a Morse code message was coming to you via the fifth dimension bearing the secrets of quantum gravity?

or

(b) that your watch needs a new battery?

(continued)

or

(c) something else?

Vigorously defend your answer.

William Grey, a philosopher at The University of Queensland, pointed out numerous conceptual difficulties with the idea of time travel in his paper "Troubles with Time Travel," *Philosophy*, January 1999, pp. 55–70. That paper quickly prompted a rebuttal from the philosopher Phil Dowe (at the University of Tasmania), who replied a year later with the paper "The Case for Time Travel," *Philosophy*, July 2000, pp. 441–451. We'll eventually take up all the issues discussed in those two papers but, for now, read both papers and summarize their respective arguments. Do you feel one of the writers won the day (for you, anyway)?

Chapter 2
Philosophical Space and Time

"I do not believe that there are any longer any philosophical problems about Time; there is only the physical problem of determining the exact physical geometry of the four-dimensional continuum that we inhabit."[1]

2.1 Time: What Is It, and Is It Real?

"Time is generally thought to be one of the more mysterious ingredients of the Universe."[2]

Before going any further with time *travel*, it will be well worth the effort to take a closer look at time itself, the 'stuff' or 'thing' or . . . ? that we are interested in traveling 'through' or 'around' or 'across' or . . . ? Oddly enough, I'll start with religion, as philosophical theologians had identified time as something unusual long before Newton's words on time in his *Principia* that I mentioned in the Introduction, and many thousands of years before science fiction writers and their time travel stories.

We can, in fact, trace the religious interest in time back at least sixteen centuries to the Christian theologian St. Augustine and his *Confessions* (in which he famously admitted "What, then, is time? I know well enough what it is, provided that nobody asks me: but if I am asked what it is and try to explain, I am baffled."). Certainly the seventeenth century Spanish Jesuit Juan Eusebius Nieremberg caught the spirit of wonder that time holds for the devout when he wrote, in his *Of Temperance and Patience*, that "*Time* is a sacred thing; it flows from Heaven . . . It is an emanation from that place, where eternity springs . . . It is a *clue* cast down from Heaven to guide us . . . It has some assimilation to Divinity."

Going outside Christianity, we can easily find other equally strong reactions to the mystery of time. From Plutarch's *Platonic Questions* we learn that when the question of time's nature was put to Pythagoras, he simply uttered the mystical "time is the soul of the world." The *Laws of Manu* of Hinduism, the *Torah* of

[1] H. Putnam, "Time and Physical Geometry," *Journal of Philosophy*, April 1967, pp. 240–247.
[2] P. Horwich, *Asymmetries in Time*, MIT Press 1987.

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P.J. Nahin, *Time Machine Tales*, Science and Fiction,
DOI 10.1007/978-3-319-48864-6_2

Judaism, the *Koran* of Islam, and the revealed truths of Gautama Buddha are all full of references to time. It is, in fact, to the pagan gods of Greek mythology that we owe our 'modern' image of Chronos, or Father Time.

Not just the Greeks made time a god. In the *Bhagavad Gita* (*Song of the Lord*), the central religious-romantic epic of Hinduism that predates Christ by five centuries, one of the characters reveals his divine nature and declares his power thus: "Know that I am Time, that makes the worlds to perish, when ripe, and bring on them destruction." And in the even older Egyptian Book of the Dead, which dates back over three thousand years, the newly deceased was thought literally to become one with time itself. The merging of time and the resurrection of the body after death in the Book is shown in the line "I am Yesterday, Today and Tomorrow, and I have the power to be born a second time."

The Greek philosopher Plato (circa 400 B.C.) gave us a curious way to think of time: as a *closed loop*. While Plato did think of time as having a beginning, his conception did not have time extending off into the infinite future as does the modern, everyday view. Rather, Plato visualized time as curving back on itself—as *circular* in nature. This was, in fact, a reasonable reflection on what Plato could see everywhere in nature, with the seemingly endless repetition of the seasons, the regular ebb and surge of the tides (the old English word *tid* was a unit of time), the unvarying alternation of night and day, and the rotation of the visible planets in the sky. Whatever might be observed today, it seemed obvious to Plato, would happen again in nature. Circular time in science fiction was briefly mentioned in Chap. 1,[3] and it occurs outside that genre, too, as in James Joyce's novel *Finnegans Wake*, which opens in mid-sentence and ends with the first part of the same sentence. This view of time has a powerful, ancient visual symbol, the Worm Ouroborous, or World Snake, that eats its own tail endlessly.

Circular time, with its closed topology, was favorably presented in Stephen Hawking's famous book *A Brief History of Time*. In it he concludes that there is no need for God because in circular time there is no first event and hence no need for a First Cause. Vigorous philosophical rebuttals were quick to come, of course![4]

Turning to fiction, Ray Bradbury wrote a beautifully poetic passage about the mystery of time in "Night Meeting," one of the splendid sub-stories in his episodic 1950 masterpiece *The Martian Chronicles*. A man of A.D. 2002, who is one of the modern inhabitants of Mars, somehow meets the ghostly image of a long-dead Martian one cold August night. The conditions are just right for such a cross-time encounter. As the man thinks to himself, "There is the smell of Time in the air

[3]Another example from science fiction is the story by I. Hobana, "Night Broadcast," in which a television signal from the past is picked up by a gadget that is probing the *future*: "By going far enough into the future one comes upon what we call the past." You can find this tale in the *Penguin World Omnibus of Science Fiction*, Penguin Books 1986.

[4]See, for example, W. L. Craig, "What Place, Then, for a Creator?: Hawking on God and Creation," *British Journal for the Philosophy of Science*, December 1990, pp. 473–491, and R. Le Poidevin, "Creation in a Closed Universe Or, Have Physicists Disproved the Existence of God?," *Religious Studies*, March 1991, pp. 39–48.

tonight. . . . There was a thought. What did Time smell like? Like dust and people. And if you wondered what Time sounded like it sounded like water running in a dark cave and voices crying and dirt dropping down on hollow box lids, and rain. And, going further, what did Time *look* like? Time looked like snow dropping silently into a black room or it looked like a silent film in an ancient theater, one hundred billion faces falling like those New Year balloons, down and down into nothing. That was how Time smelled and looked and sounded. And tonight . . . tonight you could almost *touch* Time."

Well, lovely words, yes, but they don't really tell us what time *is*. Perhaps Einstein the physicist can tell us. In the *New York Times* of December 3, 1919, we find him quoted as follows: "Till now it was believed that time and space existed by themselves, even if there was nothing [Newton's view]—no Sun, no Earth, no stars—while now we know that time and space are not the vessel for the Universe, but could not exist at all if there were no contents, namely, no Sun, no Earth, and other celestial bodies." Less than 2 years later Einstein stated this view again (*New York Times*, April 4, 1921): "Up to this time the conceptions of time and space have been such that if everything in the Universe were taken away, if there were nothing left, there would still be left to man time and space." Einstein went on to deny this view of reality, saying that, according to his general theory of relativity, time and space would *cease to exist* if the universe were empty. This has the ring of one of Einstein's favorite philosophers, Spinoza, who declared in his *Principles of Cartesian Philosophy* that "there was no Time or Duration before Creation." In a correspondence with Samuel Clarke—Newton's friend who translated Newton's *Optiks* into Latin—the German philosopher Gottfried Leibniz (who began the correspondence in 1715) expressed similar ideas: "Instants, consider'd without the things, are nothing at all . . . they consist only in the successive order of things."

The pragmatic scientist would certainly agree with Leibniz. After all, what could it even mean to talk of time unless you can measure it? And what you use to measure time is a clock—some kind of changing configuration of matter involving spinning gears, ticking pendulums, and rotating dial pointers. Mere *unchanging* matter, alone, is not sufficient to measure time because a still clock measures nothing. *Changing* matter seems to be required. Yet, not surprisingly, not everybody agrees. The counterview, the view that time has nothing to do with change, was expressed in an interesting manner by a science fiction fan in a letter to the editor of *Wonder Stories* (January 1931): "Just one thing, you have these time-traveling yarns, good stuff to read all right, but bunk, you know; because if there's no such thing as time, which there isn't, *only change* [my emphasis], how can one travel in . . . something that doesn't exist. To our planet which goes around the Sun there is simply a turning and warming of one side and then the other, i.e., years, days, minutes, etc., is something purely artificial, invented by man to tell him when to do certain things, work and stop work . . ."[5]

[5]This fan's idea was not new. For Plato's most famous student, Aristotle, time was *motion* (in a world in which nothing moved, argued Aristotle, there would be no time), and he expressed this

Going even beyond the ideas of Einstein, Spinoza, Leibniz, Plato, Aristotle, and our science fiction fan, at least one metaphysician felt that time would have no meaning, even in a massive and changing universe, without the additional presence of conscious, rational beings.[6] That sounds very much like an echo of the French philosopher Henri Bergson who, in 1888, somewhat mysteriously declared that time is "nothing but the ghost of space haunting the reflective consciousness." A few years before Taylor, however, a fellow philosopher had argued for exactly the opposite view, that temporal passage is independent of the existence of conscious beings.[7]

All this divergence of opinion perhaps explains why even a lightweight Hollywood movie like Mel Brooks' 1987 *Spaceballs* can get a laugh from a time joke. Even kids know that the characters, when talking about time, haven't the slightest idea of *what* they are talking about. The movie, a spoof on such classic films as *Star Wars*, *The Wizard of Oz*, and *Raiders of the Lost Ark*, quickly reaches a point of crisis. To find out what to do next, the evil Lord Helmet and his chief henchman decide on a novel approach: they will look at an instant video of their own movie! (Instant videos are available *before* the movie is finished.) Perplexed at watching on a television screen everything that he is doing as he does it (the screen correctly shows an infinite regression of television screens, each being watched by a Lord Helmet), Lord Helmet initiates the following rapid-fire exchange. (It is, of course, a clever take-off on Abbott and Costello's "Who's on First?")

What the hell am I looking at? When does this happen in the movie?
Now! You're looking at now, sir. Everything that happens now, is happening, now.
What happened to then?
We're past that.
When?
Just now, now.
Go back to then.
When?
Now.
Now?
Now.
I can't.
Why?
We missed it.

view in his famous metaphor "Time is the moving image of eternity." For Aristotle, then, time and change were inseparably intertwined. For Aristotle the world had existed for eternity, and the circularity of time was a central and powerful image; using his vivid illustration, it is equally true *in circular time* that we live both before *and* after the Trojan War.

[6] R. Taylor, "Time and Life's Meaning," *Review of Metaphysics*, June 1987, pp. 675–686.

[7] S. McCall, "Objective Time Flow," *Philosophy of Science*, September 1976, pp. 337–362.

When?
Just now. [The henchman then sets the video to rewind.]
When will then be now?
Soon.

We may laugh at this, even dismiss it as mere movie madness, but could any of us *really* do much better if, like Saint Augustine, we were backed into a corner and asked to explain time? Somehow, I think even the distinguished twentieth-century Harvard professor Hilary Putnam whose words open this chapter would find it difficult to know where to begin. He might even become as confused as the time traveler in the 1968 film *Je t'aime, Je t'aime*, whose oscillations in time, from present to past and back again, leave him so befuddled that he decides he'd rather be dead. What, then, *can* we say about time? Despite Putnam's bold words, I suspect that most people would come down on the side of Augustine.

The mystery of time was well captured by R. H. Hutton (1826–1897), the literary editor of the *Spectator*, when he wrote in his 1895 review (see note 1 in the Introduction) of Wells' *Time Machine* that "the story is based on that rather favorite speculation of modern metaphysicians which supposes *time* to be at once the most important of the conditions of organic evolution, and the most misleading of subjective illusions . . . and yet Time is so purely subjective a mode of thought, that a man of searching intellect is supposed to be able to devise the means of traveling in time as well as in space, and visiting, so as to be contemporary with, any age of the world, past or future, so as to become as it were a true 'pilgrim of eternity.'"

Novelist Israel Zangwill (1864–1926) wrote a similar but much more analytical review of Wells' novel for the *Pall Mall Magazine* (see note 1 in the Introduction). Zangwill was the only Victorian reviewer to attempt a scientific analysis of time travel. Although he thought Wells' effort was a "brilliant little romance," Zangwill also thought the time machine—"much like the magic carpet of *The Arabian Nights*"—was simply "an amusing fantasy." Zangwill continued in his review with what was even then a common idea about a way one might actually be able, at least in principle, to look backward in time; one could travel far out into space by going faster than light and then watch the light from the past as it catches up to you. (Note, carefully, that Zangwill was writing in 1895, 10 years before Einstein's special relativity put a limit on possible speeds.) In this way, Zangwill wrote, one could watch "the Whole Past of the Earth still playing itself out."

Indeed, even before Zangwill, the well-known French astronomer Camille Flammarion (1842–1925) had made this dramatic idea a centerpiece of his 1887 novel *Lumen*. That book, a best-seller in Europe even before its appearance in England, describes how a man just dead (in 1864) instantly finds his spirit on the star Capella, where he is able to watch the light then arriving from the Earth of 1793. In particular, he watches the French Revolution play itself out and sees himself as a child. Flammarion may have, in fact, been inspired to write his novel by an essay written several years earlier (in 1883) by the British physicist

J. H. Poynting (1852–1914). Poynting's essay,[8] which opens with the statement that it was, in turn, inspired by an anonymous pamphlet published "30 or 40 years ago" on the same topic, specifically mentions watching historical events from Capella.

By the beginning of the twentieth century the idea of watching the past by outrunning light had drifted down into juvenile literature, as in the 1904 novel *Around a Distant Star* by Jean Delaire (the pen name for Pauline Touchemoline (1868–1950)), in which a young man builds a spaceship that can travel at two thousand times the speed of light. With it, he and a friend travel to an Earth-like planet nineteen hundred light-years distant and use a super-telescope to watch the Crucifixion (and then the resurrection) of Jesus. Early magazine science fiction also found the idea of looking backward in time with delayed light to be an irresistible one, involving romance and murder.[9] In another tale incorporating human emotions, a scientist loses his wife to a rival who kidnaps her and then escapes in a faster-than-light rocket ship headed for parts unknown. After searching for them with his own brilliant invention of the 'ampliscope' (several quantum leaps beyond the telescope), the scientist locates the couple, skipping from planet to planet light-years distant. His only pleasure, then, is to use his own faster-than-light craft to outrun the images of his lost love and watch them over and over. Eventually, however, he comes to realize the ultimate futility of it all. As the final line of this sad tale says, "It would be senseless, I knew, chasing on and on after yesterdays."[10]

The reality of time received a new twist with the additional imagery of instants of time being likened to the points on a *straight* line. In the West it was the Christian theological doctrine of *unique* historical events that gave rise to *linear* time in the minds of the common folk. The creation of the world and Adam and Eve, the adventures of Noah and the cataclysmic Flood, the Resurrection—these were all events that occurred in sequence, *once*. None would happen again and so, for Christianity, circular time just would not do.[11] In addition, it has been argued that the major spiritual content of Christianity—a significant reason for its popular support even in the face of brutally harsh Roman suppression—is that it brought the *expectation of change* into the static world of ancient times. It was, in fact, in ancient religious teachings that our modern view of linear time had its origin, a view that most people today (including the most hardened agnostic physicist) find to be as natural as Plato and Aristotle found circular time.

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[8] J. H. Poynting, "Overtaking the Rays of Light," in Poynting's *Collected Scientific Papers*, Cambridge University Press 1920.

[9] As in, for example, G. A. England, "The Time Reflector," *The Monthly Story Magazine*, September 1905.

[10] D. D. Sharp, "Faster Than Light," *Marvel Science Stories*, February 1939. The year before saw the appearance of a story with the same idea, a story that specifically cites Flammerion: M. Weisinger, "Time On My Hands," *Thrilling Wonder Stories*, June 1938.

[11] Still, just to show how one can find support for almost any view in the same religious dogma, Ecclesiastes 1:9 would seem to be a claim *not* for linear time but rather for circular time!: "The thing that hath been, it is that which shall be; and that which is done is that which shall be done; and there is no new thing under the sun."

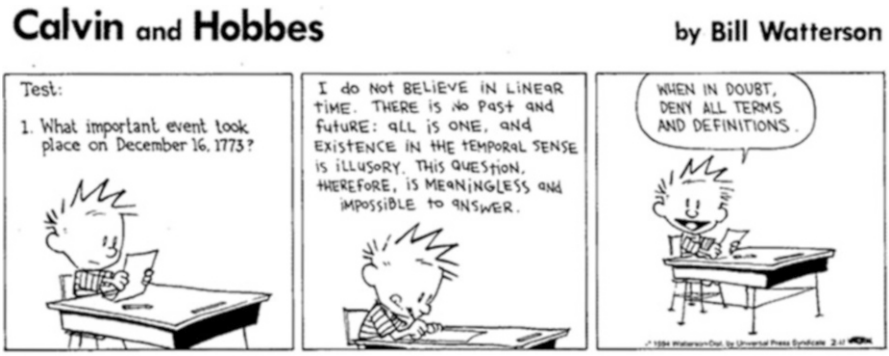

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Even though linear time was the norm after Christ, there were still enough questions about time to perplex the deepest of thinkers, and the next 2000 years resulted in plenty of thinking. Discourses on time by such philosophers as Descartes, Spinoza, Hobbes, Kant, Nietzsche, and Hegel can be found by the yard in any decent university library. Nearly all (if not indeed all) of these presentations have metaphysical, even theological, underpinnings. For example, Descartes is generally believed to have argued for a discontinuous, atomistic nature to time (recall the *chronon* from Chap. 1). This is the modern view of his thinking, because in his *Meditations* (1641), in particular in the third meditation on God's reality, Descartes appears to argue that God must continually recreate the world at each *separate* moment of its existence. That is, the world is recreated in a discontinuous succession of *individual* acts by God.[12]

Finally, with Newton's discussion of *absolute* time, which is the belief that time is the same everywhere in the universe, there was for the first time a *physicist* writing about time (although, as I mention in Chap. 1, Newton's views were also influenced *heavily* by theological considerations, in addition to mathematical physics). But, despite Newton's genius, the mystery of time remained a mystery.

In 1905 Einstein's name appeared among the contributors to the study of time, and so at last something besides metaphysical speculation on the subject was added to the body of human thought. Einstein's paper on special relativity introduced the revolutionary idea of *relative* time, which is the anti-Newton belief that the passage of time is *not* the same everywhere, but rather depends on local conditions. In retrospect, Einstein's 1905 work seems to be the perfect reply to the comment by Isaac Barrow (1630–1677)—Newton's teacher and the first Lucasian professor of mathematics at Cambridge (the chair once held by Stephen Hawking centuries

[12]For more on this, see R. T. W. Arthur, "Continuous Creation, Continuous Time: A Refutation of the Alleged Discontinuity of Cartesian Time," *Journal of the History of Philosophy*, July 1988, pp. 349–375.

later)—that "because *Mathematicians* frequently make use of Time, they ought to have a distinct idea of the meaning of the Word, otherwise they are Quacks."

Then, just 3 years after Einstein, along came a second astonishing paper by the Cambridge philosopher John Ellis McTaggart (1866–1925). This paper[13] claims to prove that whatever time might be *thought* to be (even by Einstein), it really isn't that because time isn't even real. (This would seem, I think you'd agree, to have potentially profound implications for time travel!) The method of the paper is to deny the reality of time via an infinite-regress argument that one philosopher[14] has called the *pons asinorum* ("bridge of asses") of the riddle of time. As McTaggart's own opening sentence freely admits, "It doubtless seems highly paradoxical to assert that Time is unreal, and that all statements which involve its reality are erroneous."

McTaggart began his analysis by observing that there are two separate and distinct ways of talking about events in time. Following his terminology, one can say that events are either future, present, or past (the so-called *A-series*), or one can say that events temporally ordered by each being later than some other events, earlier than others, and simultaneous with still others (the so-called *B-series*). He then continued by asserting that time requires change, and followed that with the observation that the A-series (but not the B-series) incorporates such change. That is, if event X is earlier than event Y, then X is *always* earlier than Y and thus there is no change in this (or in any other) example of a B-series. As a specific example, let Y be the birth of a child, and let X be the birth of its mother. In contrast, if X is first in the future, then is in the present, and finally is in the past, then we have an example of change (and hence of *time*) in the A-series; for example, let X be the next time you blink.

With this rather pedestrian start, McTaggart then pulled his rabbit out of the hat. It makes no sense, he argued, to talk of the 'future,' 'present,' and 'past' of an event because these terms are mutually exclusive. That is, no two of these predicates can apply at once, and yet, paradoxically, every event possesses all three and thus we have a contradiction. It therefore, concludes McTaggart, makes no sense to talk of future, present, or past. And because it makes no sense to talk of them, they do not exist, and so there can be no A-series and hence no change, and thus no reality to time. McTaggart apparently realized just how befuddling all that would appear to just about everybody who read it, and so he played devil's advocate (D.A.) in his paper by trying to anticipate the various objections people could raise. Of course, he always managed to refute the D.A. at every turn. It is worth the effort to go through the details of McTaggart's 'proof,' as that will make it clear what there is about

[13]J. E. McTaggart, "The Unreality of Time," *Mind*, October 1908.

[14]L. O. Mink, "Time, McTaggart and Pickwickian Language," *Philosophical Quarterly*, July 1960, pp. 252–263. The phrase *pons asinorum* has its origin in a plane geometry theorem: the angles opposite the equal sides of an isosceles triangle are themselves equal. Seeing the truth of this is said to separate the quick-witted from the dull. It isn't clear (to me, anyway), however, on which side of McTaggart's 'proof' the quick-witted were imagined to fall. You'll see what I mean in just a moment.

'traditional' philosophical reasoning that so irritates modern philosophers trained in mathematical physics (and what makes physicists roll their eyes when confronted with arguments like McTaggart's).

The predicates of future, present, and past are really not incompatible for any event, the D.A. says some will claim, because the real predicates we should use are '*was* future,' '*is* present,' and '*will be* past,' and these *can* be possessed all at once by any event. Nice try, counters McTaggart, but that will not solve the problem. By allowing such modified predicates, we must actually allow for all nine possibilities, some of which are still incompatible. That is, the 'was,' 'is,' and 'will be' could each be potentially attached to 'future,' 'present,' and 'past': for example, 'was past' is incompatible with 'will be future.'

Oh, counters the D.A., we can eliminate that concern by allowing even more complex predicates to arrive at a third level of structure, such as 'is going to have been past,' and 'was going to be future,' and those *are* compatible. But McTaggart swats that argument away, too, by displaying new incompatibles, as well as by showing that the process of ever-increasing predicate complexity is a vicious infinite regress that drags along the seeds of its own doom at every step.[15] There is simply no escape from incompatibility, he says, and so there is no time.

Well! What can one do when presented with such an argument, one that seems to claim philosophers can wrest free the secrets of nature by pondering the historical accidents of English syntax? As David Hume once said, "Nothing is more usual than for philosophers to encroach on the province of grammarians, and to engage in disputes of words, while they imagine they are handling controversies of the deepest importance and concern." One modern philosopher apparently agreed with Hume, at least in the case of McTaggart's 'proof,' and he was pretty blunt with his evaluation of it: "McTaggart's famous argument for the unreality of time is so completely outrageous that it should long ago have been interred in decent obscurity. And indeed it would have been, were it not for the fact that so many philosophers are not sure that it has ever really been given a proper burial, and so from time to time someone digs it up all over again in order to pronounce it *really*

[15]Here's a clever way to systematically generate McTaggart's infinite regress of complex predicates, as presented by M. Dummett, "A Defense of McTaggart's Proof of the Unreality of Time," *Philosophical Review*, October 1969, pp. 497–504): "Let us call 'past,' 'present,' and 'future' 'predicates of first level.' If, as McTaggart suggests, we render 'was future' as 'future in the past,' and so forth, then we have nine predicates of second level, where we join any of the three on the left with any of the three on the right:

past		past
present	in the	present
future		future

Similarly, there are twenty-seven predicates of third level . . . "Dummett's construction clearly shows that, at the N-th level, there are 3^N predicates, most of which are incompatible.

dead. These periodic autopsies reveal that something more remains to be said."[16] That is certainly true, in as much as McTaggart's disarmingly innocent argument has caused disagreement and furrowed brows among philosophers for decades.

It is, in fact, easy to find examples of the continuing debate over McTaggart's analysis and, as silly as it strikes physicists, it still has a pulse in some quarters. While at least one philosopher has argued that McTaggart simply didn't really understand his own proof, this philosopher nevertheless agreed with McTaggart's conclusion about the unreality of time.[17] Another writer has illustrated how McTaggart's ideas have found their way into modern philosophical debates on the meaning of time in the cinema, particularly in the analysis of *anachrony*, the telling of a story out of normal time sequence, such as occurs in time travel movies.[18]

Other sorts of metaphysical proofs for the unreality of time have been offered besides McTaggart's. For example, it has be argued that time is unreal, at least in a world empty of consciousness, because the concepts of past, present, and future could not possibly have any meaning unless events could be remembered, experienced, and anticipated. Or, for a second example, some have held time to be unreal, at least in a deterministic world (as some argue four-dimensional spacetime to be), because any event whose occurrence follows from present conditions, and from physical laws, would exist (they say) *now*. This view, which seems to assert that everything should happen at once, I personally find to be sufficiently obtuse as not to be bothered by it.[19] Debates between those who believe in the common-sense idea that present, past, and future are attributes of events (the 'tensers') and those who deny it (the four-dimensional spacetime, block universe 'detensers') continues to now and then still flair up on the pages of philosophy journals. At least one philosopher likes both views![20] Most modern physicists, I think, simply don't care about this line of inquiry.

On the other hand, less than a month before his death Einstein revealed his feelings about the meaning of present, past, and future, and his words appear to be ones that show some sympathy to the philosophers. In a letter written on March 21, 1955, to the children of his dearest friend who had just died, Einstein wrote—with full knowledge that his own illness would be his last—"And now he has

[16]F. Christensen, "McTaggart's Paradox and the Nature of Time," *Philosophical Quarterly*, October 1974, pp. 289–299.

[17]Q. Smith, "The Infinite Regress of Temporal Attributions," *Southern Journal of Philosophy*, Fall 1986, pp. 383–396. To this came a rebuttal a year later by L. N. Oaklander, in the same journal (Fall 1987, pp. 425–431).

[18]G. Currie, "McTaggart at the Movies," *Philosophy*, July 1992, pp. 343–355.

[19]But if, upon reflection, it starts to bother *you*, see R. Gale, "Some Metaphysical Statements About Time," *Journal of Philosophy*, April 1963, pp. 225–237. We'll soon get to some of the more common philosophical questions on the nature of four-dimensional spacetime, such as 'is it deterministic or is it fatalistic?,' and 'does free-will have any meaning in four-dimensional spacetime?' Even physicists are interested such questions!

[20]R. Weingard, "Space-Time and the Direction of Time," *Nous*, may 1977, pp. 119–131.

preceded me briefly in bidding farewell to this strange world. This signifies nothing. For us believing physicists, the distinction between past, present, and future is only an illusion, even if a stubborn one."[21] Later in this chapter I'll return to these curious words and speculate on what Einstein may have meant by them.

I started this opening section on a religious note, and I'll end it on one. If you think the philosophical speculations on the nature of time that I've so far cited are 'really far out,' here's yet another one that leaves all the rest in the dust. In a paper that took real nerve to write (or, perhaps, simply a wicked sense of humor—and I write that in pure admiration) we read of how a spacetime that supports time travel can give the start for a *physics* explanation to the theological concept of Hell! After introducing just a bit of elementary spacetime physics (which I'll skip describing here because we'll do it later in the book), the author[22] shows how to 'construct' a compact region in spacetime (Hell) with the following properties:

1. While "so small even the Hubble Telescope couldn't image it" it can hold an infinity of physical beings;
2. Each of the beings in it are doomed, because of its time travel property, to an infinitely long personal future of damnation;
3. Each of the beings in it, because of its time travel property, can view all the future stages of their own personal damnation and so be "continually presented with a reminder of the impossibility of escape—a refinement no causally normal Hell can seemingly offer." In other words, and not to be too ironic about it, 'Theological Progress Through Physics!';
4. Each of the beings in it are continually being compressed together ("brought into dismaying proximity" with themselves) and so will spend eternity "listening to a cacophony" of their own cries of despair from *their personal future*.

There's more, but that's probably enough for you to get the idea. Richmond does admit that, as it stands, his time travel creation of Hell is not compatible with either quantum theory or even general relativity. Still, it *is* something to ponder, don't you think, when the subject of time travel comes up!

2.2 Linear Time and the Infinity of Past and Future

"A thousand years is a huge succession of yesterdays beyond our clear apprehension."[23]

—H. G. Wells

[21]Quoted from B. Hoffmann, *Albert Einstein: Creator & Rebel*, New American Library 1972, pp. 257–258.

[22]Alasdair M. Richmond, "Hilbert's Inferno: Time Travel and the Damned," *Ratio*, September 2013, pp. 233–249.

[23]This line appears in Wells' 1944 doctoral thesis, written for the University of London. You can find an abridgement of the thesis in *Nature*, April 1, 1944, pp. 395–397.

The modern concept of linear time as a straight line extending from the dim past through the present and disappearing into the misty future gives rise immediately to twin questions: "Did time have a beginning?" and "Will time ever end?" As one philosopher put it (long before physicists became seriously interested in singularities like the Big Bang) "Endings and beginnings are rooted in the very conception of time itself."[24] Starting at the beginning, we'll ask if the past has been forever? Early Biblical scholars, of course, believed the answers to both questions to be *no*.

They believed that the world came into being because of a First Cause, God's creation of everything. Those scholars expended vast quantities of energy (and, need I say it, time itself) in calculating the date of creation. Martin Luther, for example, argued for 4000 B.C. as roughly when everything, including time, began. Johannes Kepler adjusted this by a notch, to 4004 B.C., and later the Calvinist James Ussher, Archbishop of Armagh and Primate of All Ireland, tweaked it again. His date is the most impressive of all, at least in detail: the first day of the world was 4003, 70 days, and 6 h before the midnight that started the first day of the Christian era. Six days after that first day of the world, Adam was made, and as a final dash of specificity, this last date was declared to be Friday, October 28! Ironically, then, though Christian theology may be given credit for introducing linear time, it certainly did not provide very much of it. The beginning of time was just 6000 years or so ago, and of course The End—in the form of the Battle of Armageddon—has been awaited (with varying degrees of eagerness) for the last 1000 years.

The discovery in the seventeenth century of geological time cast a certain amount of skepticism on those early calculations concerning the duration of the past. With the discovery that the very Earth itself could be decoded for its history, the lure of trying to decode a mere book of admittedly finite age declined for most people although it cannot be denied that modern Creationists still find such a task to have its rewards). Geological time was discovered to a *chasm* of time extending backward for billions of years, a duration that is really incomprehensible for the human brain. It has become fashionable for geologists to refer to such enormous durations with the apt term *deep time*, a subtle play on the metaphor of the "ocean of time."

It is nothing less than humbling to historians who pause to think on how little of the past is known, that is, recorded. As the ever anonymous wit once put it, "History is a damn dim candle over a damn dark abyss." Still, even as enormous as is the age of the Earth, it is not infinite. But of course our planet is very old, and the universe is many billions of years older. Is the age of the universe also the duration of the past? Or is the past itself actually *infinite*?

An implicit assumption of the infinity of the past (and of the future, too) can be found in Book Three of Lucretius' science poem *De Rerum Natura* (*On the Nature of Things*) where, just before the birth of Christ, Lucretius argues for the irrationality of fearing death: "The bygone antiquity of everlasting time before our birth

[24] I. Stearns, "Time and the Timeless," *Review of Metaphysics*, December 1950, pp. 187–200.

was nothing to us. Nature holds this up to us as a mirror of the time yet to come after our death. Is there anything in this that looks appalling, anything that means an aspect of gloom? Is it not more untroubled than any sleep?"

One philosopher[25] has traced the origins of rational support for the finite duration of the past to as far back as the sixth century A.D. The argument presented then by the Christian philosopher Joannes Philoponus of Alexandria (who is otherwise known as John the Grammarian) is simply that the world could *not* have been forever because that implies an infinity of successive acts could have taken place which (according to Philoponus) is impossible. A variation on this is the claim that if the past were infinite in extent, then everything would have happened by now! Infinity was just too big for the ancient mind (Zeno's hoary pre-Christian paradoxes, as is well-known today, are based on subtle errors in the use of infinity).

This view on the impossibility of an infinite past seems to have been the prevalent view; even as late as the twelfth century the debate among Christian theologians was not about the possibility of an infinite past, but instead about whether the Biblical 'six days of Creation' actually had taken place simultaneously. For many, the past was 'obviously' finite in duration.[26] Not all Christians accepted that conclusion, however, and the following century saw St. Thomas Aquinas (a follower of Aristotle) arguing for the opposite view of an infinite past.

Thomas' contemporary, St. Bonaventure, however, argued again for a *finite* past, and it is with Bonaventure that we start to see some mathematical sophistication.[27] Bonaventure argued that in a world infinitely old, the Sun would have made an infinite number of its annual trips around the ecliptic. But for each such trip the Moon would have made twelve monthly trips around the Earth, and so this second infinity would be twelve times as great as the first one, and how could that be? Infinity is infinity, and how can something be twelve times bigger than infinity? This argument doesn't have any strength today because of the nineteenth century German mathematician Georg Cantor's work on the concept of infinity,[28] but it *is* clever. Agonized, convoluted theological analyses of God, infinity, and eternity continued long after Aquinas and Bonaventure. Two examples should capture the spirit of those times.

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[25]G. J. Whitrow, "On the Impossibility of an Infinite Past," *British Journal for the Philosophy of Science*, March 1978, pp. 39–45. Whitrow adds modern scientific support to the idea of a finite past by citing the prediction from general relativity of a singularity in spacetime at some finite past time; that is, the theory's prediction that time—and everything else—had its beginning in the now famous Big Bang.

[26]C. Gross, "Twelfth-Century Concepts of Time: Three Reinterpretations of Augustine's Doctrine of Creation *Simul*," *Journal of the History of Philosophy*, July 1985, pp. 325–338.

[27]See, for example, L. Sweeney, "Bonaventure and Aquinas on the Divine Being as Infinite," *Southwestern Journal of Philosophy*, Summer 1974, pp. 71–91, and S. Baldner, "St. Bonaventure on the Temporal Beginning of the World," *New Scholasticism*, Spring 1989, pp. 206–228.

[28]For simple high school-level presentations on Cantor's astonishing infinity results, see my book *The Logician and the Engineer*, Princeton 2013, pp. 169–171.

Consider first this one, on the supposed immortality of the soul. If $A = B$, then $2A = 2B$. Next, let A = 'half alive' and B = 'half dead,' where $A = B$ in the same sense that a glass half-full is also half-empty. Thus, to be completely dead is to be completely alive, and so the soul is immortal. Outrageous? *Yes*, in my opinion, but I do also have to admit the 'reasoning' does have a certain charm!

For my second example, let me begin by setting the historical stage. After publication of the English political philosopher Thomas Hobbes' *Leviathan* in 1651, with its arguments against the power of the Church and for civil power (with some criticism tossed in, as well, for universities), Seth Ward counterattacked. Ward, who was both a minister (later a bishop) in the Anglican Church and Savilian Professor of Astronomy at Oxford, was greatly offended by the secular nature of *Leviathan*. Even before Leviathan, in fact, Ward certainly would not have liked Hobbes' earlier denial of the existence of immaterial substances (such as souls). Ward's 1652 book *A Philosophical Essay Towards An Eviction of the Being and Attributes of God, the Immortality of the Souls of Men, the Truth and Authority of Scripture*, was the first of a two-punch reply to Hobbes. The second came in 1654 with the appearance of Ward's *Vindiciae academiarum*. In both of these works Ward attempted to undermine Hobbes' credibility by attacking his mathematical ability. (Hobbes had long been fascinated by, and was considered an expert on, the ancient problem of 'squaring the circle,' a task that has been known to be impossible only since 1882.[29]) In his *Essay*, Ward also attempted to defend the view that the world has a finite age—that is, it had a specific moment of creation, presumably by God. In an opening note, in fact, Ward cites Hobbes' rejection of immaterial substances as the motivation for his writing *Essay*.

To support his view of a finite age for the world, Ward invoked infinity in an interesting way. He argued that nothing is permanent, certainly not humans. Each is created; one can imagine tracing a chain of creation events backward in time through successive generations. Now, there are only two separate and distinct possibilities to where this chain could lead to in the past. First, it could terminate, after a finite number of generations, at a *first* generation, that is, with the 'creation' of the first human. If that is the case, then, said Ward (in effect), 'case closed.' If that is not the case, however, then the chain of successive generations never terminates, that is, the chain is infinitely long. But that, argued Ward, is nonsense—how could anything *infinitely* long have an end (our present *now*)?

Why Ward thought this an unanswerable paradox is hard to understand; after all, one can imagine a line in some coordinate system *beginning* at the origin and yet still being infinitely long (an example is the positive x-axis). This counter-example was not put forth by Hobbes in his own self-defense, but rather was offered by one of Ward's own colleagues at Oxford, John Wallis, the Savilian Professor of Geometry. As for Hobbes, he was little bothered by Ward's argument. As he pointed out (surely with a smile on his face), Ward was in danger of impaling

[29]The problem of 'squaring the circle' is, given a circle of area A, to construct (using only compass and straightedge) a square of area A.

himself as a theologian on his own sword: Ward's argument 'proved' the finite age not only of the world but of *everything*, including God (thus raising the awkward question of who, or what, made God?).

Similar problems with infinity lay behind Kant's rejection of an infinite past. It is interesting to note that Kant, somewhat paradoxically, thought an infinite *future* a possibility. Why did Kant think time could be infinite in one direction but not in the other? One philosopher tells us[30] that Kant "failed to make himself clear," and I think that *understates* the case. I say that because Kant's argument was that the duration of the future is less problematic than is that of the past because it is only the past that influences the present. The best I can do in 'explaining' this is to speculate that if the present depends on an *infinite* past, then perhaps Kant thought that the possibility of so much influence was simply too much for the present to handle! In any case, Kant's view falls apart if we consider the possibility of backward time travel and the resulting implication that the future could also influence the present.

There is, as will come as no surprise, a philosopher for every conceivable point of the compass, and so a paper by one on the logical possibility of an infinite past soon prompts a rebuttal by another.[31] In illustration of this, you'll recall the quote from Augustus De Morgan in the opening section of this book, concerning the philosophers of his times; De Morgan went on in his critique to amusingly summarize the metaphysics of those times as follows: "Here we go up, up, up,/And there we go down, down, down,/Here we go backwards and forwards/And there we go round, round, round."

So, with De Morgan's words in mind, here are a few more examples of how people have struggled with the issue of the past. One quite interesting, *scientific* twist on the duration of the past was pointed out before the exchange between Smith and Ells. In a paper[32] observing that although general relativity and its predicted spacetime singularity in the distant past may indeed allow for a finite past, that does not completely close the door to the possibility that the Big Bang was a continuation from a previous contraction phase of the universe, and so on, *ad infinitum*. (You'll recall the discussion in Chap. 1 of this idea in science fiction: see note 53 in that chapter.) To quote T. S. Eliot (from his "Little Gidding"):

[30] J. Bennett, "The Age and the Size of the World," *Synthese*, August 1971, pp. 127–146. See also Q. Smith, "Kant and the Beginning of Time," *New Scholasticism*, Summer 1985, pp. 339–346.

[31] See, for example, Q. Smith, "Infinity and the Past," *Philosophy of Science*, March 1987, pp. 63–75, and then read E. Ells, "Quentin Smith on the Infinity of the Past," *Philosophy of Science*, March 1988, pp. 453–455. Smith's paper "The Uncaused Beginning of the Universe" appeared in this same issue (pp. 39–57), stating that he believed, *really*, only in the *logical* possibility of an infinite past and that the universe had in fact originated in an uncaused (no God required) Big Bang singularity. And, indeed, he *had* so argued for a finite past, in "On the Beginning of Time," *Nous*, December 1985, pp. 579–584.

[32] R. Weingard, "General Relativity and the Length of the Past," *British Journal for the Philosophy of Science*, June 1979, pp. 170–172.

"What we call the beginning is often the end
And to make an end is to make a beginning.
The end is where we start from."

Even without entertaining such an oscillating, accordion-like universe that endlessly expands and shrinks, it is possible to have a universe that originated in a *single* Big Bang a finite time ago in the past but yet *has no first instant*! This astonishing statement shocks most at first encounter, but it is simply the cosmological version of a well-known mathematical result. The instant $t = 0$ is not actually part of spacetime, because the Big Bang was quite literally a singular event for which the laws of spacetime physics fail. Thus, all instants in time are greater than zero—and there is no smallest number greater than zero. If you name a positive number, no matter how small, I can name a positive number still smaller, such as one-half of yours. (Of course, if there really is merit to the idea of a quantum of time, the chronon, this argument goes out the window.)

In an ingenious observation that seems to have been missed by most philosophers, E. A. Milne, a professor of mathematics at Oxford, suggested in his 1948 book *Kinematic Relativity*, that with general relativity it is conceivable to have both a single Big Bang a finite time ago *and* an infinite past. Pointing out that to talk meaningfully of time implies that we have a clock to measure it by, Milne looked for a Universal Clock that would be far more durable than our heartbeats, or anything else that exists only transiently. He suggested the expansion rate of the universe itself as the ideal clock. As we go back in time to the Big Bang, the expansion rate rises towards infinity and, as another analyst put it, "We see the Universe ticking away quite actively. *The Universe is meaningfully infinitely old because infinitely many things have happened since the beginning*."[33]

The debate over the length of the past in modern times can be just as contentious as it was in medieval times. For example, in his editorial ("Down with the Big Bang") of August 10, 1989, the then editor of *Nature* (John Maddox) declared the standard explosive model of the universe to be "philosophically unacceptable," because "the implication is that there was one instant at which time literally began and so, by extension, an instant before which there was no time." For Maddox, this meant that the Big Bang "is an *effect* [my emphasis] whose *cause* [my emphasis] cannot be identified or even discussed." The usual (non-time travel) use of the words *cause* and *effect* is that the cause happens first and then the effect occurs—but if the Big Bang (the effect) is the origin of time, then how (asked Maddox) could there be a cause of the Big Bang *before* that beginning?[34]

[33]C. W. Misner, "Absolute Zero of Time," *Physical Review*, October 1969, pp. 1328–1333. In this view cosmic time is taken as proportional to the negative of the logarithm of the normalized volume of the universe ($V = 1$ represents maximum volume, and so time 'stops' at the end of the universe's expansion). Thus, because V goes to zero as we go backward in time, time runs ever faster as we travel ever further into the past. This puts the Big Bang (with $V = 0$) infinitely long ago.

[34]This was not a new insight, of course, as Aristotle had long ago (in his *Physics*) declared an instant in time with no predecessor to be an absurdity.

The answer is obvious *for creationists*, of course—God did it. Creationists avoid the question of God's cause, however, saying only that 'He needs no cause,' or even that 'He made Himself'! It is these standard (ridiculous) responses from creationists that Maddox said had prompted his editorial against the Big Bang, because creationists *embrace* the Big Bang as it seems to endorse their position of 'science by imagination.' Whatever the truth of that, I think juxtapositioning the *scientific* Big Bang model of the universe with theological metaphysics and the pseudo-science nonsense of creationism to be terribly unfair.

When will the philosophical debates on the age of the past end? Not until the end of the (infinite?) future, is my wager!

2.3 Cause and Effect

> "There are few paradoxes which have been resolved so often as the time-asymmetry paradox."[35]

The philosophical literature is full of discussions about potential causal relationships between events. One of the most famous of these discussions, illustrating that cause and effect can be pretty slippery concepts, asks what at first appears to be an almost trivial question: Did the death of Socrates cause the widowhood of Xanthippe? The quick and easy answer is "Of *course*—she was his wife and it was his death that causes us to say she was then a widow. What could be more obvious?" One philosopher has provided some interesting commentary, however, that might make you reconsider, or to at least become aware of how different are the questions concerning time that are of interest to physicists and philosophers.[36]

Suppose we agree that there are two events to be considered; Socrates ceasing to live, and Xanthippe becoming a widow. Those events occurred at different places (in prison, and wherever Xanthippe happened to be). Then, as Kim asserted, "the two events occur with absolute simultaneity . . . [and so] we would have to accept this case as one in which causal action is propagated instantaneously through spatial space." (As we'll discuss in Chap. 3, the *relativity* of distant simultaneity weakens this assertion, but we'll take that up later.) For now, it is the conclusion that Kim draws from the assertion that interests us here: just *what* is propagating instantly? If it isn't mass-energy (as 'widowhood' would appear not to be!) then special relativity isn't bothered and physicists are happy. But those same physicists might also scratch their heads over *why* philosophers even wonder about such a question, because isn't becoming a widow just another way of saying that Socrates died and so we really don't have *two* events, but just one? In other words, for physicists this really isn't a question about cause and effect at all!

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[35] J. Hurley, "The Time-Asymmetry Paradox," *American Journal of Physics*, January 1986, pp. 25–28.

[36] J. Kim, "Noncausal Connections," *Nous*, March 1974, pp. 41–52.

The central puzzle of time travel to the past is its apparent denial of causality—that is, its denial of the belief that we live in a world where every effect has a cause and that the cause happens first. *First* we flip the switch and *then* the kitchen light comes on. It is *never* the other way around. So deeply embedded is the temporal ordering of cause and effect in our feelings about how the world—and all the rest of the cosmos—works, that the Australian philosopher John Mackie (1917–1981) called causation the "cement of the universe" (and used that wonderful phrase as the title of a 1980 book). Without causality, said Mackie, everything would come unglued and fall apart. For example, when electrical engineers design an electronic system that they intend to actually construct (as opposed to doing a mere theoretical 'paper design') they insist that the design be a *causal* one. By that they mean the system must have no output before an input is applied. That is, the system must not be able to anticipate (foresee) the application of an input. To put it bluntly, our engineers are insisting that they are *not* building a time machine!

Now all that might seem to be self-evident, but there *are* some subtle problems. For example, it has become almost a cliché to say that nothing can go faster than light; that's what physicists mean by *relativistic causality*. In other words, no cause can produce an effect at a distant location sooner than the time lapse required for a light pulse to make the trip. Classical mechanics, however, the science of Newton's laws that engineers use all the time, is *not* relativistically causal. Push the left end of a rigid rod, for example, and the right end moves *instantly*. Most of the time the lack of this form of causality causes no problems, but the fact remains that the mechanics all engineers (and physicists, too!) learn first in school is flawed on a fundamental level. A rigid rod is an impossibility in Einstein's mechanics.

Indeed, it is interesting to speculate about how, after a discussion of causality, a traditional engineering professor would respond if challenged on this issue by a bright student. Causality might not look so obvious, after all, if such a student stuck up her hand in class and said "Professor, you've told us that everything that happens in nature is due to a cause. That what we see happening all around us, as the world unfolds, is the domino-process of cause-effect-cause-effect, and so on, into the future. But suppose, Professor, that at some instant, somehow, every particle in the world suddenly reversed its velocity vector. Wouldn't that mean, given the time-reversible nature of the classical equations of motion, the world would then run backward in time along the same path it had followed up until the instant of reversal? Wouldn't that mean what was effect is now cause, and that what was cause is now effect? And if cause and effect can change roles like that . . . well, Professor, just what do our words *mean*?"

An amusing, and instructive, cartoon illustration of the student's idea of reversing all the velocity vectors in a system appeared on the cover of the November 1953 issue of *Physics Today*. That issue contains an article on the 1949 nuclear magnetic resonance experiments performed by the American physicist Erwin Hahn, which in a certain sense dealt with just such reversed systems. In that illustration a group of runners on a multi-lane circular race track begin at the starting line in a coherent state, that is, all lined up together. Then, as they run around the track at various speeds, they gradually spread out into what appears to be an incoherent state.

But that incoherence is an illusion because if, at some instant (signaled in the cartoon by a pistol shot), they all turn around and run in reverse, they will all arrive back at the starting line *together, at the same instant*. The initial coherence of the runners was actually never lost, despite the superficial appearance of disorder, and the coherent state can be recovered at any time by a reversal of velocity vectors.

This isn't mere theoretical speculation, as an almost magical application of velocity vector reversal is actually used in what is called *optical phase conjugation*, a process to 'time-reverse' the severe distortion suffered by light beams during atmospheric propagation. For example, by effectively reversing the velocity vectors of photons, one can remove the turbulence blurring in satellite pictures of the Earth's surface as seen from space.[37]

Let me immediately short-circuit one possible answer our beleaguered professor might give in desperation, a response based on the fact that equations of physics are *not* all time reversible. Indeed, it was discovered decades ago that, in certain very rare, fundamental particle decay processes involving neutral K-mesons, there is the hint that perhaps nature *can* indeed distinguish between the past and the future. In particular, K-mesons should violate what is called *CP-symmetry*, and the so-called TCP theorem[38] says that then *T-symmetry* must also fail. In 1968/69 direct, experimental observation of the failure of T-symmetry in K-meson decays was reported. In an astonishing example of science fiction prescience, the use of K-mesons in a machine for affecting the past had appeared years earlier in a 1955 (!) story.[39]

So, could K-mesons account for the physical processes that we see evolve in time in one direction (past to future) but not in the other? As Hurley (note 35) put it so nicely, "The decay of the neutral K-meson is not time-reversal invariant; perhaps it is this ubiquitous meson which is responsible for the cream diffusing uniformly throughout our coffee in the morning. Possibly, but again this conjecture cannot account for the computer models [of diffusion processes that, like cream in coffee, also display a bias for one temporal direction over the other—in Chap. 3 I'll show you such a computer model] which have no neutral K-mesons." Still, the tiny chink that K-mesons appear to have made in the once-solid rock of time direction indistinguishability is an active area of research and speculation.

Even with that chink the fact that the classical laws appear to be insensitive to a direction of time, whereas the real world—which seems in no way dependent on the arcane properties of K-mesons—seems distinctly asymmetric, is a puzzle of the first rank. As one philosopher wrote, "The Universe seems asymmetric with respect to

[37]C. R. Giuliano, "Applications of Optical Phase Conjugation," *Physics Today*, April 1981, pp. 27–35.

[38]The TCP-theorem says that the 'mirror-image' of a physical process is a legitimate process, too, *if* the 'mirror' reverses time (T), electric charge (C)—so that particle and anti-particle are interchanged, and parity (P)—which is the measure of left and right. There is strong reason to believe in the validity of the TCP theorem because quantum field theory is compatible with special relativity only if the TCP theorem holds.

[39]F. Pohl, "Target One," *Galaxy Science Fiction*, April 1955.

the past and future in a very deep and non-accidental way, and yet all the laws of nature are purely time symmetric. So where can the asymmetry come from?"[40]

There have of course been attempts to answer that question. For example, one philosopher[41] discusses some curious mathematical examples he interprets as meaning, in the context of classical mechanics, that there are physical systems that are temporally irreversible *in principle*. A reply[42] from a fellow philosopher, however, argues that Hutchinson has, at most, shown only that classical mechanics is perhaps not deterministic. And that, Savitt argues, is not equivalent to showing a failure of time reversibility. There is, in fact, powerful experimental evidence that, with the rare exceptions of K-mesons, the classical laws of physics (including general relativity and quantum mechanics) *are* time-reversible.

Perhaps the most compelling of such evidence comes from the *reciprocity theorem* that electrical engineers routinely use when designing radio antennas. The theorem is easy to illustrate. Suppose two electrical engineers, Bob in Boston and Lois in Los Angeles, send radio signals to each other. Bob sends his messages by exciting his antenna with a time-varying current, which thus launches electromagnetic radiation into space. Lois' distant antenna intercepts some of that radiation, which then creates a (very tiny) signal current in her antenna.

The reciprocity theorem states the following: Suppose Bob makes a tape recording of his excitation signal and mails it to Lois, who then plays Bob's tape back into her transmitter as the excitation to *her* antenna. Then the signal current induced in Bob's antenna, as it intercepts Lois' launched radiation, will be the very same (very tiny) signal that Lois measured in her antenna as a result of Bob's transmission. This result is completely independent of the details of the two antennas, which can be utterly different in design, as well as independent of the details of the propagation path between Boston and Los Angeles (as long as those details don't change with time). The reciprocity theorem *is* true—it can be *measured* to be true as accurately as one wishes to perform this experiment—because of the reversibility of physics right down to the electronic level. In fact, the answer to the professor's problem of explaining why we don't see velocity vectors suddenly reverse, and then everything 'run backwards,' has not yet been found in any law of physics.

Now, to make things even more interesting, consider the problem of *mutual* or *simultaneous* causation, which can quickly lead to several interesting questions. When two leaning dominoes, A and B, hold each other up, is A nearly upright because of B, or is it B that is nearly upright because of A? When two children bob up and down on a see-saw, whose motion is the cause and whose is the effect? There are other puzzles, too, that involve mutual causation.

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[40]J. Earman, "The Anisotropy of Time," *Australasian Journal of Philosophy*, December 1969, pp. 273–295.

[41]K. Hutchinson, "Is Classical Mechanics Really Time-Reversible and Deterministic?" *British Journal for the Philosophy of Science*, June 1993, pp. 307–323.

[42]S. F. Savitt, "Is Classical Mechanics Time-Reversal Invariant?" *British Journal for the Philosophy of Science*, September 1994, pp. 907–913.

For example, causation is usually thought to be transitive: if A causes B, and if B causes C, then A causes C. But if A and B are mutually causative, then 'A causes B' coupled with 'B causes A' leads to 'A causes A' (and to 'B causes B'). That is, mutual causation, together with transitivity, seems to imply *self*-causation! Except for those theologians who like this sort of result (it lets them answer the question 'Who made God?' with 'He made Himself'), hardly anyone likes self-causation. But how do we avoid the conclusion that perhaps the mutual causation of two leaning dominoes, coupled with transitivity, represents experimental proof that God could have made himself? Well, of course this is certainly outrageous stuff, but don't you wonder how our poor professor would respond if asked?

This last example is actually a far more esoteric one than we need to illustrate how our ordinary, everyday concept of cause and effect can be turned inside out by going only a little bit beyond the routine. Consider, for example, the problem of the data processing of recorded time signals, such as the information written onto magnetic tapes, hard drives, or disks. Typical applications that produce such recordings include the strata-probing seismic echoes from dynamite explosions set by oil exploration geologists; arms control compliance monitoring stations that listen for the acoustic rumbles generated by both earthquakes and underground nuclear tests—and then try to tell one from the other; and the gathering by various military intelligence agencies of turbine shaft/propeller noise signatures emitted by different types of submarines. In each of those situations, the raw information is recorded and then later processed with a certain degree of unhurried calm and leisure. That pool of oil, after all, has been underground for several hundred million years, and waiting a few more days or weeks for a computer analysis of the explosion echo isn't going to make much difference.

Such after-the-fact processing of recorded data is said to be done 'off-line, in non-real time.' When we play a disk back in the lab, however, we can do all sorts of neat things, like speed up the playback (make time 'run fast'), or slow it down (make time 'run slow'), or even play it *backwards* (make time 'run in reverse'). For various technical reasons, generically called *spectrum shifting*, such tricks are often quite useful. Now, the way we retrieve magnetically recorded information from (for example) a magnetic tape, is to run it through a playback machine with a 'read-head' that senses the magnetic flux variations. The electrical signal produced by the read-head is just like the original signal and, in fact, we can pretend we don't know it is really coming off a tape, but rather that it *is* the original signal. For high-quality digitally recorded tapes and disks, in fact, it is virtually impossible to distinguish the original from a playback.

Now, suppose we construct our playback machine with *two* read-heads, with the new head sensing the recording slightly *before* the old head does. The two heads produce the same electric signal, of course, but the signal from the new head is *ahead* in time compared to the signal from the old head. The new head is, in a certain sense, 'seeing the future' of the old head! We can use these two signals, the old head representing 'now' time and the new head representing 'future' time, to build real systems that are *not* causal. The causality violation occurs in non-real time, of course, not *our* time, but no matter; some absolutely astonishing signal

processing can be achieved this way. The universe is about fifteen billion years old, and pretending that time has shifted a few milliseconds or so doesn't seem to be too much violence to reality.

Two heads are often used on radio call-in talk shows to catch inappropriate remarks from intemperate callers and prevent them from being broadcast. A short time delay is introduced by first recording remarks 'live' on tape with a write head and, then a few seconds 'up-stream,' a read head regenerates the remarks for broadcast. A 5 s delay is generally sufficient, so what is heard on a radio receiver *now* actually occurred 5 s ago in the *past*. A caller can get terribly confused if she doesn't turn her own receiver off, because one ear hears the present on the telephone while the other ear listens to the past over the radio.[43] The 1956 British film *Timeslip* incorporates a similar situation, with an atomic scientist's perception advanced 7 s into the future as the result of an accidental radiation exposure. His resulting confusion and disorientation is the center of the film.[44]

2.4 Backward Causation

> "Causation as a topic of philosophical discussion refuses to die. Each year, books and articles on causation continue to pour forth. Of course, all this activity may simply be a symptom of the necrophilia that infests so much of philosophy."[45]

All of the previous discussion has fueled countless arguments about what is called *backward*, *reverse*, or even *retro* causation. What is generally meant by forward causation is, of course, that any event that occurs at time t is caused by events that all occurred at some earlier time(s). Backward causation says that at least one of the causing events occurs after time t—this should make it clear that backward causation is a close relative of time travel. Indeed, one philosopher uses the terms *time traveler* and *retro-causal engineer* interchangeably.[46] The topic, understandably, is at the root of many hot philosophical debates, though not everybody (as this section's opening quote makes clear) thinks those debates are illuminating.

Just *why* does Professor Earman take his harsh position? He offers, as one reason, his disdain for the common philosophical 'proof' of the impossibility of

[43]A science fiction use of this idea is in B. W. Aldiss, "Man In His Time," *Science Fantasy*, April 1965, the story of an astronaut who returns from a trip to Mars and finds himself 3.3077 min ahead of everybody else.

[44]Science fiction had used a twist on this idea long before the film; see E. Binder, "The Man Who Saw Too Late," *Fantastic Adventures*, September 1939, a tale of what it might be like to have a 3 min *delay* in your vision.

[45]J. Earman, "Causation: A Matter of Life and Death," *Journal of Philosophy*, January 1976, pp. 5–25.

[46]B. Brown, "Defending Backwards Causation," *Canadian Journal of Philosophy*, December 1992, pp. 429–443.

backward causation: By definition, a cause is always before its effect. Yes, that's the entire 'proof.' One can, of course, win *any* argument by *defining* the answer to be what it is you wish to believe. More interesting, and certainly more pertinent to time travel, is the argument that if backward causation were possible then one could change the past—but that cannot be done because the past is dead and gone and thus unchangeable. That does seem to be a pretty solid argument against backward causation,[47] but Earman rebuts it by pointing out that the very same logic could be applied to the future, and so the usual, uncontested forward causation would also be denied. That is, one could argue that whatever the future will be, *will be* (literally 'by definition'), so one cannot change the future. A similar argument was presented even earlier,[48] in which we find "suppose that someone says 'I can change the future. I can do *this* or I can do *that*.' Well, then, suppose that he does *that*. Has he changed the future? No, because doing *that* was the future."

The reversal of the 'usual' causal order of events by backward time travel has been a mainstay of science fiction almost from the start of the genre. Consider, for example, this tale.[49] A man on vacation by himself, without his wife along, meets a young lady—and they fall in love. The man loves his wife, too, though, and he realizes (as the young lady leaves him for the last time), never to return, that it is all for the best. But she really hasn't gone that far away from him, as the reader soon discovers. She is a time traveler from the future, and after leaving him she goes even further back in time, back an additional 20 years. She does this because she has learned that he met his wife 20 years ago, and so she goes back to be *that* woman! Thus, the usual causal order of the two events 'a long marriage' and the 'pre-marriage courtship' has been reversed (if we accept the fact that the man doesn't remember what his wife looked like when they married).

Actually, even our everyday uses of cause and effect are not nearly so straightforward as one might think, even when they are under far less stress than backward causation and time travel inflict. Consider, for example, the endless problems that are easy to imagine in the legal world. If a man falls off the roof of a ten-story building and is electrocuted as he plunges through power lines while still twenty feet above ground, was gravity or electricity the cause of death? Or was it both? As this example and others demonstrate,[50] one clearly does not have to discuss time travel to get into a serious argument about cause and effect. But with time travel, and the resultant backward causation, things can become even more perplexing. For example, we normally think it foolish to prepare, now, for an event that has already

[47]See, for example, D. H. Mellor, "Fixed Past, Unfixed Future," in *Michael Dummett: Contributions to Philosophy* (B. M. Taylor, editor), Martinus Nijhoff 1987.

[48]J. J. C. Smart, "A Review of *The Direction of Time*," *Philosophical Quarterly*, January 1958, pp. 72–77.

[49]R. F. Young, "The Dandelion Girl," *The Saturday Evening Post*, April 1, 1961.

[50]See also P. Mackie, "Causing, Delaying, and Hastening: Do Rains Cause Fires?" *Mind*, July 1992, pp. 483–500.

happened, but the prudent time traveler about to visit an ice age in the distant past would be wise to pack a fur coat before getting into his time machine!

One philosopher provides, I think, a good start at explaining why so many other philosophers (and not just a few physicists) have adopted the 'common sense' position of rejecting backward causation. As he writes, "Part of the answer, no doubt, is a confusion between affecting and altering [the past—a distinction we'll discuss at length later in this book]. We cannot alter the past. But then we cannot alter the future either, although we can affect it. However, I take the common-sense rejection of backward causation to be, for the most part, quasi-empirical. It is based on a thought experiment. Think how you would set about affecting the past. By building a time-machine, perhaps? But how would you build one? We have no idea how to start. Yet, by contrast, we can work out how to affect the future . . . we just move our bodies."[51] But, as he goes on to argue, if we accept that we can't *change* the past (which means there is no way we could actually observe backward causation), then there still exists the possibility that past events were as they were because of events in the future.

Are there actual phenomena that justify a belief in the possibility of effect before cause in real time (not just in tape recorder time)? The only example I know of, and a controversial one at that, is a theoretical result from a reformulation of electrodynamics by the great English physicist Paul Dirac (1902–1984). Classical theory models electric charges as point objects of zero size, which causes problems when one tries to calculate certain details, such as the total field energy of a single electron. The answer comes out as infinity. In an attempt to find more reasonable (that is, finite) answers to such questions, Dirac modified the zero size of a charge to one taking them to be extended objects (while retaining the validity of Maxwell's equations for electrodynamics right down to a point). To calculate how such extended objects will behave mechanically, however, one has to include what are called the *self-interaction* forces, such as the force one side of an electron exerts on the other side.

When it was all worked through, Dirac arrived at a third-order differential equation of motion, an equation that involves a force term proportional not to the usual first time derivative of the velocity (that is, to the acceleration), but rather to the second derivative.[52] This force is proportional to the first derivative of the acceleration, and is a quantity of direct interest mostly to the designers of automobile suspensions, who call it the *jerk*. There is no force in physics, at least not in Newtonian physics, that shows that sort of dependence, and there are some curious consequences. For example, in Dirac's theory an electron experiencing no external force can still continually accelerate, exhibiting what is called a 'runaway solution.'

Dirac showed how the runaway solution can be eliminated by picking a particular value for what up to then was an arbitrary constant of integration in the

[51]P. Forrest, "Backward Causation in Defense of Free Will," *Mind*, April 1985, pp. 210–217.

[52]P. A. M. Dirac, "Classical Theory of Radiating Electrons," *Proceedings of the Royal Society A*, August 1938, pp. 148–168.

analysis, but that trick causes, in turn, a new problem called 'pre-acceleration.' That is, if an electron experiences an external disturbance (Dirac considered a passing pulse of electromagnetic radiation), then the electron will start to move *before* the pulse reaches it! Now that does seem to be a pretty clear example of backward causation. The time interval during which the pre-acceleration occurs is very short, on the order of the time it takes light to travel across the spatially extended electron (about 10^{-24} s), but no matter. The apparent crack in the door of causality may be slight, but it was enough to satisfy some philosophers seeking scientific support for backward causation.

Not everybody liked this, however. One physicist was clearly uneasy about it, calling pre-acceleration "unpleasant" acausal behavior.[53] On the other hand, one can find believers, too.[54] Others have argued that the whole business is simply a non-problem. One philosopher, in fact, raised a very interesting technical point, arguing that Dirac's equation is non-Newtonian (remember the *jerk* force) and so we have no reason for coupling force and acceleration together as a cause-and-effect pair.[55] In Newtonian mechanics we do use that particular coupling, yet we do not think of force and velocity as a cause-and-effect pair because there is an integration operation involved in getting from to the other. Similarly, in Dirac's theory we have an integration operation separating force and acceleration.

One curious aspect to the debate on pre-acceleration is that many commentators seem not to have paid much attention to what Dirac himself had to say about it. As a Nobel laureate, it hardly seems likely that he would let such a result pass unnoticed and, indeed, his paper contains the following physical explanation: "It would appear that we have a contradiction with elementary ideas of causality. The electron seems to know about the pulse before it arrives, and to get up an acceleration ... The behavior of our electron can be interpreted in a natural way, however, if we suppose the electron to have a finite size. There is then no need for the pulse to reach the center of the electron before it starts to accelerate. It starts to accelerate ... as soon as the pulse meets its outside. Mathematically, the electron has no sharp boundary."

Two physicists suggested a fascinating connection between travel backward in time and Dirac's relativistically correct, quantum mechanical description of an electron.[56] They showed that in flat, two-dimensional spacetime the assumption of time travel to the past leads in a natural way to Dirac's equation. If, on the other hand, time travel only into the future is assumed, then additional assumptions are required to derive Dirac's equation. This connection between Dirac's equation and

[53]P. C. W. Davies, *The Physics of Time Asymmetry*, University of California Press 1977.

[54]J. Earman, "An Attempt to Add a Little Direction to 'The Problem of the Direction of Time'," *Philosophy of Science*, March 1974, pp. 15–47.

[55]A. Grunbaum, "Is Preacceleration of Particles in Dirac's Electrodynamics a Case of Backward Causation? The Myth of Retrocausation in Classical Electrodynamics," *Philosophy of Science*, June 1976, pp. 165–201.

[56]D. G. McKeon and G. N. Ord, "Time Reversal in Stochastic Processes and Dirac's Equation," *Physical Review Letters*, July 6, 1992, pp. 3–4.

time travel to the past makes some philosophers and physicists nervous, but it didn't seem to bother Dirac. In fact, he went on in his paper to show how the pre-acceleration implies the possibility of building a device for sending a faster-than-light signal backward in time. Science fiction writers were, of course, quick to grasp that idea and such gadgets were dubbed "Dirac radios."[57]

One of the more perplexing aspects of backward causation is that it seems to allow for the possibility of *causal loops*, and for the breaking of such loops, a central feature in many of the very best time travel stories. For example, suppose there is a gadget such that if I push its control button *now*, then today's lecture notes will have appeared in the gadget's output tray *yesterday*. Indeed, yesterday I found today's notes there and, in fact, I am about to go to class to deliver that lecture. A mighty good one it is, too, so I think I think I'll send it back to yesterday in just a few minutes with the help of the gadget. But I haven't yet pushed the button. What if I now decide *not* to push the button? Why did the notes appear so I could use them today? Philosophers call this potential breaking of a causal loop a *bilking paradox*. Later in the book I'll discuss how such paradoxes have regularly appeared in the physics and philosophy literature since the 1940s.

By contrast, such paradoxes had been discussed in the science fiction magazines long before World War II. For example, in a letter to the editor at *Astounding Stories* (June 1932) a fan clearly stated his objection to time travel with the aid of a bilking paradox. He suggested the following experiment: Immediately publish an open offer to the inventor of time travel (who will be born, presumably, at some future date) to travel back to one week before the offer is published. But of course (argued the fan) we'd have a pretty problem if we then decided not to publish the offer after the inventor showed up! As that fan wrote, "Paradoxical? I'll say so, if time travel is possible." That fan didn't know about what seems to be a generic limitation on time machines, however: that one can't travel back to a date before the date of the time machine's creation. Thus, that fan's particular bilking paradox actually has no force.[58]

For another fictional example of a bilking paradox, consider the story[59] of time travelers who, just before they begin a trip into the future, see Earth invaded by Martians. At first the invaders are unbeatable, but then the defending military forces of Earth suddenly and mysteriously acquire a fantastically powerful new weapon. It isn't long before the time travelers realize where it came from—they themselves will go into the far future, obtain the weapon, and then return with it to what is now their own past (when the weapon first appeared). But then they wonder what might happen if they don't go, if instead they 'cheat time.' After all, they reason, why

[57]See, for example, J. Blish, "Beep," *Galaxy Science Fiction*, February 1954.

[58]A similar bilking paradox had actually appeared the year before in the 1931 novel *Many Dimensions* by the English writer Charles Williams (1886–1945), which reads like a suitable script for an Indiana Jones movie.

[59]E. Binder, "The Time Cheaters," *Thrilling Wonder Stories*, March 1940. There is an amusing reference in this tale to Orson Welles' famous radio-drama-hoax, from just 2 years earlier, of just such an alien invasion based on H. G. Wells' *War of the Worlds*.

bother now to hunt for the weapon when the invasion has already been defeated? We are told that this potential bilking paradox is a "sinister conception, crawling evilly within their brains, like an unanswerable enigma."

Some philosophers, and practically all physicists, agree with that last assessment about bilking paradoxes, and so they believe there is simply nothing more to say. That is, bilking puzzles like the one in "The Time Cheaters" show that causal loops (and backward causation) must be impossible. Many feel this way about time loops, and backward causation, because (as is well known) time travel to the past can create all sorts of paradoxes. But such paradoxes are offensive only to human, culturally-biased intuitions on 'how things ought to work,' and not to the laws of physics which are indifferent to a reversal in the direction of time—which of course underlies what time travel is all about.

As the great American chemist G. N. Lewis expressed it, "Our common idea of time is notably unidirectional, *but this is largely due to the phenomena of consciousness and memory* [my emphasis]."[60] Lewis' words caught the eye of the editor at one science fiction magazine, who summed it up for his readers in a half-page essay that contained dramatic words hinting at backward causation: "A new theory of time . . . reveals the possibility that events now occurring are among the factors that decided Caesar nearly 2,000 years ago to cross the Rubicon."[61]

Lewis' willingness to accept causality violations is not a universally popular view today. For example, one physicist has written[62] that "It is fair to say that most conservative physicists have very serious reservations about the admissibility and reality of causality-violating processes. Causality violation (i.e., the existence of a 'time machine') is such an extreme violation of our understanding of the cosmos that it behooves us to be as conservative as possible about introducing such unpleasant effects into our models." He then goes on to declare closed timelike loops to be verboten because "the existence of closed timelike loops leads us to such unpleasant situations as meeting oneself 5 min ago." He sums up his philosophical position nicely with "any theory that is 'just a little bit causality violating' is 'just a little bit inconsistent.'"

Agreeing with this physicist is at least one philosopher who believes that the "association of causality with a particular temporal direction is not merely a matter of the way we speak of causes, but has a genuine basis in the way things happen" and that there is indeed an asymmetry with respect to past and future that is bound up with our concept of intentional action.[63] He then goes even further when he continues with the claim that being an agent of cause is not a necessary condition for seeing the asymmetry; being an observer is enough, as even an immobile yet

[60]G. N. Lewis, "The Symmetry of Time in Physics," *Science*, June 6, 1930, pp. 569–577.

[61]Editorial essay, "Two-Way Time," *Astounding Stories*, September 1931.

[62]M. Visser, "Wormholes, Baby Universes, and Causality," *Physical Review D*, February 15, 1990, pp. 1116–1124.

[63]M. Dummett, "Bringing About the Past," *Philosophical Review*, July 1964, pp. 338–359.

intelligent tree (!) could detect the difference between past and future. (How he knows this about certain trees is left unexplained.)

The everyday views of causality that we have formed through our limited experiences when living in a world in which time travel is 'uncommon' may actually be incomplete. As the British philosopher Bertrand Russell (1872–1970) said with some humor long ago, in his 1912 Presidential Address ("On the Notion of Cause") to the Aristotelian Society, "The law of causality, I believe, like much that passes muster among philosophers, is a relic of a by-gone age, surviving, like the monarchy, only because it is erroneously supposed to do no harm." And I do agree with his fellow philosopher who, decades later, declared "The concept of cause is powerless to solve the problems posed by the concept of time. The fundamental laws of physics present our most careful, best established and most sophisticated understanding of time. Notoriously, nothing in these laws endorses the idea of a *flow of time nor of the direction* [my emphasis: we'll return to both of these issues later in this chapter] which is basic to our conception of it. Nor are these laws causal (in the sense of singling out causes) even when they are deterministic. The concept of cause is not a fundamental one and cannot illuminate the darker corners in our understanding of the fundamental concept of time."[64]

2.5 The Fourth Dimension

> "We are facing an invasion of fourth dimensional creatures . . . We are being attacked by life which is one dimension above us in evolution. We are fighting, I tell you, a tribe of hellhounds out of the cosmos. They are unthinkably above us in the matter of intelligence. There is a chasm of knowledge between us so wide and deep that it staggers the imagination."[65]
>
> "Fourth dimension. Time factor. *You* know . . ."[66]

The idea of a fourth dimension to *space* has long been a staple of science fiction, but it has also long been viewed with suspicion. Indeed, many quite sophisticated scientists have thought it to be quite mysterious. For example, in his 1897 Presidential Address to the American Mathematical Society, the Canadian/American

[64]G. Nerlich, "How to Make Things Have Happened," *Canadian Journal of Philosophy*, March 1979, pp. 1–22.

[65]From "Hellhounds of the Cosmos," *Astounding Stories*, June 1932, by Clifford Simak (1904–1988). Simak went on to write a number of much better tales, but this passage lends credence to the editorial introduction to the 1957 anthology *Famous Science-Fiction Stories* (Random House) that declared so much in the early pulp science fiction was "science that was claptrap and fiction that was graceless."

[66]Uninformative 'explanation' given to a befuddled, inadvertent time traveler who emerges miles away and one hour backward in time after a wild ride through the fourth dimension in a gadget (constructed from a bicycle tire!) in the shape of a three-dimensional Möbius strip (see note 99 in Chap. 1). From the story by H. Nearing, Jr., "The Maladjusted Classroom," *The Magazine of Fantasy and Science Fiction*, June 1953.

astronomer-mathematician Simon Newcomb (1835–1909) declared "The introduction of what is now very generally called hyperspace, especially space of more than three dimensions, into mathematics has proved a stumbling block to more than one able philosopher." Einstein stated Newcomb's view in blunter terms when he wrote "The non-mathematician is seized by a mysterious shuddering when he hears of 'four-dimensional' things, by a feeling not unlike that awakened by thoughts of the occult."[67]

To see just how right Einstein was with this observation, consider the reaction one Egyptian philosopher had (in 1929) to Einstein's own writings: "We have no doubt in our mind that nobody can understand it (the fourth dimension), including Einstein himself. The incomprehensibility of these assumptions [of general relativity] is due to their nature. They deal with the fourth dimension . . . and the reality of time and space. They can only be described by a mathematician's hypothesis or by religious faith."[68] This reaction is easy to understand—after all, anybody can 'see' that there are exactly three spatial dimensions, and that is that!

The 1901 novel *The Inheritors*, by the English writer Ford Madox Ford (1873–1939), like Simak's, is the tale of an insidious hyperspace invasion of our world. It illustrates Einstein's assertion about how many people react to the fourth dimension with an example from the time before the science fiction magazines. When the novel's narrator is bluntly told by an invader that she (the invader) is from the fourth dimension—an idea inspired by Ford's appreciation of how much success his acquaintance H. G. Wells had enjoyed with it—he recoils from that claim with the words "If you expect me to believe you inhabit a mathematical monstrosity, you are mistaken." And who can really blame that skeptical narrator? How can there be *four* spatial dimensions? No less an authority than Aristotle, writing in 350 B.C., had declared in his essay "On the Heavens" that "the three dimensions are all that there are."

Others were not so sure. In 1873, for example, we find an essay in *Nature* that refers to well-known mathematicians who even earlier had shown that they had an inner assurance of the reality of transcendental space (hyperspace).[69] The American philosopher Charles Sanders Peirce (1839–1914) was also an early advocate for the four-dimensionality of space. Just what he thought the nature of the fourth dimension to be is somewhat unclear, but the context of what he said suggests he took it to be spatial. He thought three-dimensional space to be "perverse" because of the existence of incongruous counterparts (such as left- and right-handed gloves), and this was apparently strong evidence for him that space could not be three-dimensional. Now, incongruous counterparts exist in all n-dimensional spaces, but Peirce preserved the special purity of the fourth dimension by suggesting that all physical objects, although capable of motion in the fourth direction, could

[67]A. Einstein, *Relativity: the Special and General Theory*, Crown 1961, p. 33.

[68]From A. A. Ziadat, "Early Reception to Einstein's Relativity in the Arab Periodical Press," *Annals of Science*, January 1994, pp. 17–35.

[69]G. F. Rodwell, "On Space of Four Dimensions," *Nature*, May 1, 1873, pp. 8–9.

themselves have no extent in that direction (remember, Peirce was a philosopher, not a physicist, and he offered no experimental support for any of this).[70]

But is it *really* possible that there could be *four* spatial dimensions? We experience three independent directions, each lying at a right angle to the other two—but why just *three*, and not ten or fifteen? Indeed, in an 1888 talk to the Philosophical Society of Washington, Simon Newcomb dismissed the view that space must necessarily be three-dimensional as an "old metaphysical superstition." Yet, despite Newcomb's open-mindedness, it has been shown that in the framework of classical physics there are, in fact, several powerful reasons for why there must be *exactly three* spatial dimensions.

The beginning of a scientific explanation for the dimensionality of space appears in Kant, who believed the *three* dimensions of space and Newton's inverse-square law for gravity are intertwined (but he offered nothing beyond philosophical speculation). The origin of Kant's view is actually quite old, dating back to the ancient Greeks, who had already begun to suspect that there was something special about *three* dimensions, at least as far as geometry was concerned. They knew of the infinity of regular two-dimensional polygons, but that there were just five regular polyhedrons in three dimensions (the so-called *Platonic solids*). This early observation was trapped in mystical speculations, however, and it wasn't until the development of physics as a science that non-mystical discussions on the dimensionality of space began to appear.

Beginning with the work of Einstein's friend, the Austrian/Dutch physicist Paul Ehrenfest (1880–1933) in 1917, we can find the idea that the Poisson-Laplace equation, a second-order partial differential equation that describes the potential functions for both Newtonian gravity and electrostatics, does not allow for stable planetary or electronic orbits in *any* space with dimensionality greater than three. Further, the distortionless, reverberation-free propagation of both electromagnetic and sound waves is possible only in spaces of dimensions one and three. These conclusions have been shown to hold even when we go beyond nineteenth century physics into general relativity and quantum mechanics.[71]

Using a slightly different approach, a biological-topological argument for why space cannot have fewer than three dimensions exists. In all of our common experience, complex intelligent life is always found to occur as an aggregate of a vast number of elementary cells, interconnected via electrical nerve fibers. Each cell is connected to several others, *not all immediate neighbors*, by these fibers. If space had only one or two dimensions, then such highly interconnected nets of cells would be impossible because the overlapping nerve fibers would have to intersect, which would result in their mutually short-circuiting one another.

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[70]R. R. Dipert, "Peirce's Theory of the Dimensionality of Physical Space," *Journal of the History of Philosophy*, January 1978, pp. 61–70.

[71]See, for example, I. M. Freeman, "Why Is Space Three-Dimensional?" *American Journal of Physics*, December 1969, pp. 1222–1224, and L. Gurevich and V. Mostepanenko, "On the Existence of Atoms in n-Dimensional Space," *Physics Letters A*, May 31, 1971, pp. 201–202.

It wasn't long before these views on the dimensionality of space found their way into science fiction. An early use of space as four-dimensional occurs in an awkward rewrite of Jules Verne's *Around the World in Eighty Days*, in which a professor and his crew fly into hyperspace and around the world and to the moon and back, in less than a day.[72] They do this with a plane equipped with a four-dimensional rudder! More interesting is the tragic story (originally published in 1926) of a math professor who learns how to move into hyperspace and back.[73] A colleague catches him at it and, once over his astonishment, asks what is behind it all. The professor replies, "My assumption is that the fourth dimension is just another dimension—no more different in kind from length, say, than length is from breadth and thickness, but perpendicular to all three. Now suppose that a being in two dimensions—a flat creature, like [a moving shadow on a surface]—were suddenly to grasp the concept of a third dimension and so step out of the [surface]. He might move only an inch, but he would vanish completely from the sight of the world."

The professor has similarly learned how to step out of 3-space and into 4-space but, when asked to explain *how*, all he can say is "How can I explain? It's just the *other* direction. It's *there*!" His colleague can't see it, but nonetheless is quick to grasp the practical implications: "This is power! Think of it! A step, and you are invisible! No prison cells can hold you, for there is a side to you on which they are as open as a wedding ring! No ring is secure from you: you can put your hand *round the corner* and draw out what you like. And, of course, if you looked back on the Universe you had left, you would see us in sections, open to you! You could place a stone or a tablet of poison right in the bowels of your enemies!"

What the professor's colleague is getting at involves a comparison with a prison in planar 2-space, which would merely be a circle around the captive. Knowledge of the third dimension would make it possible to escape, however, by simply moving along that new direction, over the circle, and then back into the plane. To a 2-space guard it would seem that the prisoner had suddenly vanished from view *inside* the circle and then just as suddenly materialized again *outside* the circle. Similarly, to escape from a 3-space prison, one would merely move along the fourth dimension, and in the same way one could remove the yolk from an egg without damaging the shell; indeed, one could remove the yolk directly from the chicken without damaging the chicken![74]

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[72]B. Olsen, "Four Dimensional Transit," *Amazing Stories Quarterly*, Fall 1928.

[73]R. Hughes, "The Vanishing Man," reprinted in *The Mathematical Magpie* (C. Fadiman, editor), Simon and Schuster 1962.

[74]This astounding insight appeared in early pulp science fiction in, for example, M. J. Breuer, "The Appendix and the Spectacles," *Amazing Stories*, December 1928. The concept appeared even earlier in Bob Olsen, "The Four-Dimensional Roller-Press," *Amazing Stories*, June 1927, and then later in Olsen's "The Great Four Dimensional Robberies," *Amazing Stories*, May 1928 to rob locked safe deposit boxes, and "The Four Dimensional Escape," *Amazing Stories*, December 1933, in which a man sentenced to die by hanging at San Quentin Prison is rescued, while standing on the gallows' trap, by an inventor who pulls him through the fourth dimension.

In a later tale[75] we meet another professor who dramatically uses this very feature of the fourth dimension. His right hand has been modified through an accident to exist in four-dimensional hyperspace and so, to finance his research, he uses his 'talent' to become the perfect pickpocket, able to reach into any wallet no matter how well secured. He also can, indeed, reach right into the very bowels of his fellow man. And he *does*. When he demonstrates his hand to the policeman who has arrested him for being a thief, the astonished officer chokes on a lemon drop. Dr. Fuddles then, of course, does the right thing and removes the drop from the poor fellow with ease. There is one additional aspect to Dr. Fuddles' hand, however, that the story missed. If he had turned his right hand over in the fourth dimension, then he would have had *two* left hands!

It was discovered in 1827 by Möbius (of the strip) that any three dimensional object can be converted into its mirror image by flipping it over through the fourth dimension. Thus, a left-handed glove can be made by pure geometry (no scissors, thread, or needle required) into a precise copy of its right-handed mate. If a living organism is so flipped, however, there may be a problem, as everything in the body would be reversed, including the optically active organic molecules discovered by Pasteur in 1848, which are involved in vital biological processes. These molecules, called *stereoisomers*, exist in two versions in nature (the left-handed and the right-handed versions, if you will), but our bodies have developed the ability to use only one version. To be flipped through the fourth dimension would make some reversed stereoisomers unable to participate in the digestion of food and we would starve to death.

For modern science fiction writers the fourth dimension (and hyperspace, in general), is still a major concept. One physicist, writing in *Analog* (today's premier 'hard science' fiction magazine), summed up nicely what was so fascinating in early pulp, and still is today, about the idea of an extra dimension or two, or perhaps even more, at least from a fictional point of view: "Are there hidden dimensions not accessible to us, dimensions in which we could go adventuring, dimensions within which malevolent hyper-dimensional aliens may be lurking, ready to pierce our flimsy paper-thin three-space bodies with their terrible hyper-sharp claws?"[76] The early pulp science fiction magazines encouraged this lurid imagery. Witness the editorial blurb that opened one many-dimensional monster story as follows: "It was a strange world in which Lester and Florence found themselves. A world of sudden

[75]N. Bond, "Dr. Fuddle's Fingers," in *Mr. Mergenthwirker's Lobblies and Other Fantastic Tales*, Coward-McCann 1946.

[76]J. Cramer, "The Other Forty Dimensions," *Analog*, April 1985. 'Monsters in hyperspace' stories were numerous in pulp science fiction. Three examples (in no particular order of literary merit!) are: M. J. Breuer, "The Einstein See-Saw," *Astounding Stories*, April 1932; P. Ernst, "The 32nd of May," *Astounding Stories*, April 1935; "The Monster from Nowhere," *Fantastic Adventures*, July 1939.

Fig. 2.1 An experiment in hyperspace goes astray. The young man is pulling on "hyper-forceps" in an attempt to retrieve a surgeon who has fallen out of 3-space (along with his patient, a professor of non-Euclidean geometry, who suffers from gallstones). The hyper-forceps allow the removal of the gallstones without cutting into the body. Illustration by Frank R. Paul, ©1928 by Experimenter Publishing Co. for "Four Dimensional Surgery" (*Amazing Stories*, February 1928) by Bob Olsen, reprinted by permission of the Ackerman Science Fiction Agency, 2495 Glendower Ave., Hollywood, CA 90027 for the Estate

death and strange science, ruled by inhuman beasts."[77] But as outrageous as that might sound, the real physics of hyperspace is even more amazing.

Hyperspace is, in general, simply any space with more dimensions than the one we obviously seem to live in. In particular, our universe appears to be a four-dimensional (three spatial and one temporal) hyperspace called *spacetime*. This four dimensional world can, at least mathematically, be thought of as the boundary surface of a five dimensional hyperspace. This is analogous to the way the two-dimensional space of the surface of a sphere bounds the three-dimensional space of the sphere itself. This interesting imagery appeared quite early in pulp science fiction. For example, in one remarkably sophisticated story, an eccentric scientist at one point exclaims "A mathematical physicist lives in vast spaces . . . where space unrolls along a fourth dimension on a surface distended from a fifth."[78]

There are some interesting geometrical implications to hyperspace which play big roles in time travel considerations. For example, for beings in the two-dimensional world of a sphere's surface there are *two* ways to travel from

[77]M. Duclos, "Into Another Dimension," *Fantastic Adventures*, November 1939. See the illustration for this story in "Some First Words."

[78]M. J. Breuer, "The Gostak and the Doshes," *Amazing Stories*, March 1930.

pole to pole. There is the usual way, *on* the surface of the sphere, and the hyperspace way which takes them *through* the sphere along the polar diameter. In imagery motivated by thinking of the sphere as an apple, and of the hyperspace path as a tunnel bored by a worm through the apple, it has become popular to call all such shortcuts, through any hyperspace of any dimension, *wormholes* (a word coined in the 1950s by the Princeton physicist-wordsmith John Wheeler). Wheeler used wormholes to show how electric charge could be thought of as lines of force trapped in the changing topology of a multiply connected space (indeed, Wheeler claimed that the observation of what we call electricity is experimental evidence that space is *not* simply connected).[79]

The general theory of relativity predicts the existence of wormholes in spacetime and, in fact, they were first 'discovered' theoretically in the mathematics of relativity as early as 1916 by the Viennese physicist Ludwig Flamm (1885–1964). Later analyses were done by Einstein, himself.[80] Wormholes have been discussed as a possible model for pulsars (as opposed to the more usual model as rotating neutron stars).[81] It has also been suggested that the interior of a charged black hole may be the entrance to a wormhole.[82] All of these various solutions to the gravitational field equations are generically called "Einstein-Rosen bridges" in the physics literature (see note 81, for example), and the term soon appeared in fiction, too.[83]

The use of hyperspace wormhole portals for explaining some observed physical phenomenon appeared in the scientific literature long before Wheeler's electricity example. In his 1928 book *Astronomy and Cosmogony*, for example, the British theoretician Sir James Jeans devoted a chapter to what were then called nebulae, the island-universes we now call galaxies. At the end of his discussion on the arms of spiral galaxies, Jeans offered the following speculation: "Each failure to explain the spiral arms makes it more and more difficult to resist a suspicion that the spiral nebulae are the seats of types of forces entirely unknown to us, forces which may possibly express novel and unsuspected *metric properties of space* [my emphasis]. The type of conjecture which presents itself, somewhat insistently, is that the centers of the nebulae are of the nature of 'singular points,' at which matter is poured into our universe from some other, and entirely extraneous, special

[79]A space is simply connected if *all* the points on the straight line that joins *any* two points in the space are also in the space. The interior of a sphere is simply connected. The interior of a sphere with a hole in it is *not* simply connected.

[80]A. Einstein, "The Particle Problem in the General Theory of Relativity," *Physical Review*, July 1, 1935, pp. 73–77.

[81]J. M. Cohen, "The Rotating Einstein-Rosen Bridge," in *Relativity and Gravitation* (C. G. Kuper and A. Peres, editors), Gordon and Breach Science Publishers 1971.

[82]A. Ori, "Inner Structure of a Charged Black Hole: An Exact Mass-Inflation Solution," *Physical Review Letters*, August 12, 1991, pp. 789–792.

[83]See, for example, J. G. Cramer, *Einstein's Bridge*, Avon 1997 (this is the same Cramer cited in note 76). The *Rosen* comes from the American-Israeli physicist Nathan Rosen (1909–1995), who was a collaborator of Einstein's.

dimension, so that, to a denizen of our universe, they appear as points at which matter is being continually created." This, in everything but name, is a wormhole.

What would hyperspace be like? It is intuitively obvious that in the case of the 2-D surface of a 3-space sphere, the 'hyperspace' wormhole path is shorter than the surface path. Even if this 'shorter path' view holds for wormholes in our 4-D spacetime, however, getting around in science fiction hyperspace may not be a simple task. One tale, for example, tells the story[84] of how one of the first spaceships to explore hyperspace gets lost. The trouble with hyperspace travel is that "You go in at one point, you rocket around until you think it's time to come out, and there you are. Where is 'there'? Why, that's the surprise that's in store for you, because you never know until you get there. And sometimes not even then." The same idea plays a central role in Robert Heinlein's 1957 novel *Tunnel in the Sky*, in which a 'hyperspace gate' is discovered by accident during failed time travel experiments.

Another story[85] asks the same question about hyperspace, and arrives at the same answer: "When you took the Jump . . . how sure were you *where* you would emerge? The timing and quantity of the energy input might be as tightly controlled as you liked . . . but the uncertainty principle reigned supreme and there was always the chance, even the inevitability of a random miss . . . a paper-thin miss might be a thousand light-years."

A common way to visualize hyperspace wormhole shortcuts is to imagine the beginning and the end of a journey as points A and B on the 2-D surface of a piece of paper. Then imagine that the paper is folded so as to position A over B, perhaps with A almost touching B. The distance from A to B *through hyperspace* (the 3-D space in which the folding took place) can clearly be much less than is the distance through 'normal' space (the distance covered by a trip that always remains in the 2-D surface). This is the specific example used in one tale to explain the instantaneous "space-warp" (wormhole) device invented by the story's hero.[86] Such imagery actually appeared quite early in science fiction, as in one story in which a gadget is used to "bend space" so that Earth and Venus touch![87]

The idea of hyperspace folding has broken free from science fiction and can now be found in modern stories in other genres. For example, in one Stephen King story ("Mrs. Todd's Shortcut") a woman keeps finding ever shorter ways to drive from Castle Rock, Maine to Bangor. As the crow flies it is 79 miles, but she gets the journey down to 67 miles, and later to 31.6 miles. When doubted, she replies: "Fold the map and see how many miles it is then . . . it can be a little less than a straight line if you fold it a little, or it can be a lot less if you fold it a lot." The doubter remains unconvinced: "You can fold a map on paper, but you can't fold *land*."

[84]F. Pohl, "The Mapmakers," *Galaxy Science Fiction*, July 1965.

[85]I. Asimov, "Take a Match," in *New Dimensions II: Eleven Original Science Fiction Stories* (R. Silverberg, editor), Doubleday 1972.

[86]G. O. Smith, "The Möbius Trail," *Thrilling Wonder Stories*, December 1948.

[87]E. L. Rementer, "The Space Bender," *Amazing Stories*, December 1928.

For the purpose of wormhole creation in spacetime, we actually have to imagine much more: the folding of four-dimensional spacetime through a five dimensional hyperspace. The folding imagery has even appeared in the movies: spacetime folding is demonstrated with a piece of paper in both *Event Horizon* (perhaps the worst movie of 1997) and the 2014 *Interstellar*.

Another feature of hyperspace that science fiction has taken a liking to is its vastness. An interesting fictional treatment of this idea was given by a writer who, in real life, was an academic psychologist at the University of Michigan. He put himself in a story[88] of a starship captain who is explaining to the crew psychologist how he feels about hyperspace (or *subspace*, as it is called in the story): "God forsaken. That's just what it is. Completely black, completely empty. It frightens me every time we make the jump through it . . . it frightens me because—well, because a man seems to get lost out there. In normal space there are always stars around, no matter how distant they may be, and you feel that you've got direction and location. In subspace, all you've got is nothing—and one hell of a lot of that. It's incredible when you stop to think about it. An area—an opening as big as the whole of our Universe, big enough to pack every galaxy we've ever seen in it—and not a single atom of matter in it . . . until we came barging in to use it as a shortcut across our own Universe."

The vastness of hyperspace got a more humorous treatment from the early pulp science fiction writer Bob Olsen (1884–1956), who wrote the following verses[89] in the introduction to one of his many stories of the fourth dimension:

I read a yarn the other day—
A crazy concept, I must say.
It states that objects have extension
In what is called the "Fourth Dimension."
In hyperspace one could, no doubt,
Make tennis balls turn inside out;
And from a nut remove the kernel
And not disturb the shell external.
A crook could pilfer bonds and stocks,
Then laugh at prison bars and locks,
One step in this direction queer,
And presto! He would disappear!
Let's hope, in planning new inventions,
They'll give us cars with four dimensions.
When searching for a parking place
We sure could use some hyperspace!

It is not just science fiction that takes hyperspace seriously. We find a mathematician, for example, writing that "most science fiction addicts are familiar with

[88] J. V. McConnell, "Avoidance Situation," *If*, February 1956.

[89] B. Olsen, "The Four-Dimensional Auto-Parker," *Amazing Stories*, July 1934. "Bob Olsen" was the pen-name for Alfred Johannes Olsen.

the notion of 'hyperspace,' a higher dimensional space-time bounded by Space-Time through which, in the far distant future, interstellar voyages shortcut the (otherwise unsurmountable) distances between the stars. The purpose of this article[90] is to demonstrate that any . . . relativistic space-time model is the boundary of some . . . five-dimensional hyperspace." That is just what Breuer's magazine character (see note 78) said—in 1930!

The concept of *time* as a fourth dimension has long been a popular concept, and science fiction in particular has embraced it with enthusiasm. We find a little joke on the idea in a story where a young couple, visited by time travelers from 500 years in the future, are said to live in Apartment 4-D.[91] One physicist[92] traced the idea back to the late eighteenth century, finding references to the idea in pre-1800 works of the great French mathematical physicists Jean le Rond d'Alembert (1717–1783) and Joseph-Louis Lagrange (1736–1813). In fact, a philosopher[93] has found a 1751 passage written by d'Alembert that appears to indicate that it is some unknown, earlier person to whom the credit should really go: "I have said [that it is] not possible to imagine more than three dimensions. A clever acquaintance of mine believes, however, that duration could be regarded as a fourth dimension and that the product of time and solidity would be in some way a product of four dimensions; that idea can be contested, but it seems to me that it has some merit, if only that of novelty."

Still, it wasn't until a curious letter appeared in *Nature* in 1885 that the concept of time as the fourth dimension was mentioned seriously in an English-language scientific journal. The author, mysteriously signing himself only as "S.," began by asking "What is the fourth dimension? . . . I [propose] to consider Time as a fourth dimension . . . Since this fourth dimension cannot be introduced into space, as commonly understood, we require a new kind of space for its existence, which we may call time-space."[94] Who was this prophetic writer that, if he had just made a simple swap, would have been the first to use space-time as a word? Nobody knows. Bork speculates that it was an acquaintance of H. G. Wells, but Wells himself is on record that it certainly wasn't him.

In his 1934 *Experiment in Autobiography*, Wells wrote "In the universe in which my brain was living in 1879 there was no nonsense about time being space or anything of that sort. There were three dimensions, up and down, fore and aft and right and left, and I never heard of a fourth dimension until 1884 [when Wells was

[90]G. S. Whiston, "'Hyperspace' (The Cobordism Theory of Space-Time)," *International Journal of Theoretical Physics*, December 1974, pp. 285–288.

[91]L. Padgett, "When the Bough Breaks," *Astounding Science Fiction*, November 1944.

[92]A. M. Bork, "The Fourth Dimension in Nineteenth-Century Physics," *Isis*, October 1964, pp. 326–338.

[93]E. Meyerson, *The Relativistic Deduction*, volume 83 of *Boston Studies in the Philosophy of Science*, D. Reidel 1985, p. 78.

[94]S., "Four-Dimensional Space," *Nature*, March 26, 1885, p. 481. The editorial staff at *Nature* has informed me that, more than a century-and-a-quarter later, there is no longer any record of the identity of S. in the journal's archives.

eighteen] or thereabout. Then I thought it was a witticism." He had, in fact, said this before. In a 1931 edition of *The Time Machine* (Random House), for example, he wrote in the Preface that the idea for the novel "was begotten in the writer's mind by students' discussions in the laboratories and debating society of the Royal College of Science in the eighties and already it had been tried over in various forms by him before he made this particular application of it."

The idea of time as the fourth dimension entered the popular mind around 1894–95, with the publication of the first of Wells' so-called "scientific romances," *The Time Machine*. Then, after that pioneering use of time as the fourth dimension, science fiction quickly adopted the idea as the basis for one of its most popular subgenres. One of the great "golden age of science fiction" writers, 'Murray Leinster' (1896–1975)—the pen-name for William Jenkins—used it as the basis for his first published story.[95] It is the incredible tale of a Manhattan skyscraper (and its 2000 occupants) sent backward in time several 1000 years because its foundation slips (in an unexplained way) along the fourth dimension. The scientific sophistication of the story is primitive, with just one of the many logical flaws being a vivid description of the time travelers living forward-in-time even as their wrist watches run backward. Indeed, when pulp pioneering editor Hugo Gernsback reprinted the tale in one of the early issues of *Amazing Stories*, a reader complained about that very point. Gernsback felt compelled to defend the story, but could muster only a weak rebuttal based on an author's right to "poetic license."[96]

More technical is the discussion in the story of a clerk who transforms the main entrance to a department store into a time machine by building a tesseract (a four-dimensional cube).[97] The claim is made there that the fourth dimension of the cube/doorway is time. That tale appeared just 5 months after a classic of science fiction by Robert Heinlein (1907–1988) had appeared, also using a tesseract, in which the fourth dimension is taken as *spatial*.[98]

Some writers wanted to have the fourth dimension both ways, as space *and* time in the same story. One wonderful example of this is a classic,[99] written by one of the giants of science fiction. In that tale an electrical engineer named Nelson is caught in the middle of an enormous electromagnetic field surge produced by a short circuit in a power plant. As a physicist explains to the shocked board of directors of the utility, "It now appears that the unheard-of-current, amounting to millions of amperes . . . must have produced a certain extension into four dimensions . . . I have been making some calculations and have been able to satisfy myself that a

[95]M. Leinster, "The Runaway Skyscraper," *Argosy*, February 1919.

[96]H. Gernsback, "Plausability in Scientifiction," *Amazing Stories*, November 1926.

[97]W. P. McGivern, "Doorway of Vanishing Men," *Fantastic Adventures*, July 1941.

[98]R. Heinlein, "—And He Built a Crooked House," *Astounding Science Fiction*, February 1941. Here we read of a Los Angeles architect who builds a house in the shape of a tesseract as it would appear if collapsed into normal three-dimensional space. It isn't stable in 3-space (we are told), however, and so a California earthquake is sufficient to topple the house into a stable 4-D configuration, along with its occupants.

[99]A. C. Clarke, "Technical Error," *Fantasy No. 1*, December 1946.

'hyperspace' about ten feet on a side was, in fact, generated: a matter of some ten thousand quartic—not cubic!—feet. Nelson was occupying that space. The sudden collapse of the field [when the overload breakers finally broke the circuit] caused the rotation of that space."

Being rotated through 4-space has inverted the unlucky Nelson [see *For Further Discussion* at the end of this chapter for more on this point], and to bring him back to normal he must be flipped again. The physicist brushes aside a question about the fourth dimension as time, asserting that the only issue is one of space. Poor Nelson is, therefore, again subjected to a stupendous power overload—only now he disappears! Too late, the physicist realizes that the fourth dimension is both space *and* time and that Nelson has been spatially flipped *and* temporally displaced into the future. To understand the particularly monstrous fate of Nelson, just ask yourself what the result would be if he should materialize *inside* matter sometime in the future!

The interpretation of the fourth dimension as time is, of course, the one of interest to prospective time travelers, to physicists studying time travel, and to philosophers of time, and so for us, too. The sort of science fiction that is of greatest interest to us is like the one in which one of the characters, displaced in time, asks for an explanation from a higher-dimensional being who appears on the scene: "'Just where is Tuesday?' he asked. 'Over there [and when the being extends its hand, the hand disappears].' 'Do that again.' 'What? Oh—Point toward Tuesday? Certainly.'" The being explains the physics of the situation to the astonished time traveler thus: "It is a direction like any other direction. You know yourself there are four directions—forward, sideward, upward, and—*that* way! . . . It is the fourth dimension—it is duration."[100]

And how about stories like the one in which a mad inventor discovers how to make a substance whose atoms resist being pushed by "pushing back at right angles to all the other [spatial] directions." That is, to push on this exotic stuff is to risk experiencing a back reaction, of being pushed "off into the fourth dimension [which we are told is time] . . . into the middle of the week after next."[101] Now wouldn't *that* really be something?!

But of course it was H. G. Wells who, in fiction, pioneered time travel and its connection to the fourth dimension as it is popularly thought of today (with the caveats about Wellsian time machines kept firmly in mind). We are therefore quite interested, as *The Time Machine* opens, to listening-in as the Time Traveller expounds to a group of friends at a dinner party in his London home. He starts with the assertion "There is no difference between Time and any of the three dimensions of Space except that our consciousness moves along it." When asked to say more about the fourth dimension, he replies, "It is simply this. That Space, as our mathematicians have it, is spoken of as having three dimensions, which one may call Length, Breadth, and Thickness, and it is always definable by reference to

[100] T. Sturgeon, "Yesterday Was Monday," *Unknown Fantasy Fiction*, June 1941.

[101] M. Leinster, "The Middle of the Week After Next," *Thrilling Wonder Stories*, August 1952.

three planes, each at right angles to the others. But some philosophical people have been asking why *three* dimensions particularly—why not another direction at right angles to the other three?—and have even tried to construct a Four-Dimensional geometry. Professor Simon Newcomb was expounding this to the New York Mathematical Society only a month or so ago."[102]

2.6 Spacetime and the Block Universe

> "And now he has preceded me briefly in bidding farewell to this strange world. This signifies nothing. For us believing physicists, the distinction between past, present, and future is only an illusion, even if a stubborn one."
>
> —Albert Einstein[103]

The poet Henry Van Dyke wrote, in his 1904 "The Sun-Dial at Wells College," words that echo the spirit of Omar Khayyam's *Rubaiyat* from nine centuries before:

The shadow by my finger cast
Divides the future from the past:
Before it, sleeps the unborn hour,
In darkness, and beyond thy power:
Behind its unreturning line,
The vanished hour, no longer thine:
One hour alone is in thy hands,—
The NOW on which the shadow stands.

The very next year Einstein's theory of special relativity appeared and, 3 years later, came Minkowski's spacetime interpretation of special relativity. Van Dyke's beautiful poetry was dealt a mighty blow by those developments in mathematical physics, and in the rest of this chapter we'll see how that came to pass.

The modern view of reality, that the past, present, and future are joined together into a four-dimensional entity called *spacetime*, is due to Hermann Minkowski (1864–1909), Einstein's mathematics teacher when he was a student in Zurich. Minkowski gave spacetime (the visual imagery of Einstein's mathematics) to the world during a famous address at the 80th Assembly of German Natural Scientists and Physicians in Cologne, on September 21, 1908. Entitled "Space and Time," his

[102] And so Newcomb actually was. Wells, it is certain, routinely read *Nature* (one of his college friends, Richard Gregory, eventually became the journal's editor), and Wells must have read Newcomb's address of December 28, 1893 to the New York Mathematical Society when reprinted in the February 1, 1893 issue (on pp. 325–329), where he called hyperspace "the fairyland of geometry." From the Time Traveller's own words, then, that wonderful Victorian dinner party must have taken place in January or February of 1894.

[103] From a letter written by Einstein on March 21, 1955, to the children of Michele Besso, his dearest friend, who had just died. Einstein's use of the word *briefly* was due to his knowledge that he was nearly out of time, too (he died just a month later).

remarks were electrifying then and still are today.[104] He began dramatically: "Gentlemen! The views of space and time which I wish to lay before you have sprung from the soil of experimental physics, and therein lies their strength. They are radical." Then came the famous line, quoted in so many freshman physics texts and philosophy papers, concerning the nature of spacetime: "Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve independence." Minkowski explained what spacetime is in these words to his audience:

> "A point of space at a point of time ... I will call a *world point*. The multiplicity of all thinkable x, y, z, t systems of values we will christen the *world*. With this most valiant piece of chalk I might project upon the blackboard four world axes ... Not to leave a yawning void anywhere, we will imagine that everywhere and everywhen there is something perceptible. To avoid saying 'matter' or 'electricity' I will use for this something the word 'substance.' We fix our attention on the substantial point which is at the world point x, y, z, t, and imagine that we are able to recognize this substantial point at any other time. Let the variations dx, dy, dz, of the space coordinates of this substantial point correspond to the time element dt. Then we obtain, as an image, so to speak, of the everlasting career of the substantial point, a curve in the world, a *world-line*. ... The whole Universe is seen to resolve itself into similar world-lines, and I would fain anticipate myself by saying that in my opinion physical laws might find their most perfect expressions as relations between these world-lines ... *Thus also three-dimensional geometry becomes a chapter in four-dimensional physics* [my emphasis]."

With those words Minkowski gave mathematical expression to the philosophical exposition of Wells' Time Traveller to his dinner party friends. Taking the Minkowskian view of the primacy of spacetime as the ultimate building block stuff of reality was Princeton professor of physics John Wheeler, who wrote[105] "There is nothing in the world except empty curved space. Matter, charge , electromagnetism ... are only manifestations of the bending of space. *Physics is Geometry*." This idea was echoed in fiction, in the 1987 novel Moscow 2042 by Vladimir Voinovich, where we find a time traveler who declares "Anyone with even a nodding acquaintance with the theory of relativity knows that nothing is a variety of something and so you can always make a little something out of nothing."

But not everybody understood Minkowski. In a little-known yet quite erudite essay, published just after a stunning experimental verification of general relativity (the bending of starlight passing through the Sun's gravitational field[106]), an anonymous author presented an optical analogy to help those who thought relativity

[104]For a study that includes the original German text, careful English translations, and photographs of Minkowski's agonized corrections to his pre-address manuscript, see P. L. Galison, "Minkowski's Space-Time: From Visual Thinking to the Absolute World," *Historical Studies in the Physical Sciences* (volume 10), 1979, pp. 85–121.

[105]C. W. Misner and J. Wheeler, "Gravitation, Electromagnetism, Unquantized Charge, and Mass as Properties of Curved Empty Space," *Annals of Physics*, December 1957, pp. 525–603.

[106]General relativity had already explained the long-puzzling excess precession of the perihelion (point of closest approach to the Sun) of Mercury's orbit. The excess was an observational (and so experimental) fact which Newton's gravity *cannot* completely explain.

simply "a mathematical joke." Signing himself only as "W.G.," he included the following passage[107]:

> "Some thirty or more years ago [it was forty] a *jeu d'esprit* was written by Dr. Edwin Abbott entitled *Flatland* . . . Dr. Abbott pictures intelligent beings whose whole experience is confined to a plane, or other space of two dimensions, who have no faculties by which they can become conscious of anything outside that space and no means of moving off the surface on which they live. He then asks the reader, who has consciousness of the third dimension, to imagine a sphere descending upon the plane of Flatland and passing through it. How will the inhabitants regard this phenomenon? They will not see the approaching sphere and will have no conception of its solidity. They will only be conscious of the circle in which it cuts their plane. This circle, at first a point, will gradually increase in diameter, driving the inhabitants of Flatland outward from its circumference, and this will go on until half the sphere has passed through the plane, when the circle will gradually contract to a point and then vanish, leaving the Flatlanders in undisturbed possession of their country . . . Their experience will be that of a circular obstacle gradually expanding or growing, and then contracting, and they will attribute to *growth in time* what the external observer in three dimensions assigns to a movement in the third dimension. Transfer this analogy to a movement of the fourth dimension through three-dimensional space. Assume the past and future of the Universe to be all depicted in four-dimensional space, and visible to any being who has consciousness of the fourth dimension. If there is motion of our three-dimensional space relative to the fourth dimension, all the changes we experience and assign to the flow of time will be due simply to this movement, *the whole of the future as well as the past existing in the fourth dimension* [my emphasis]."

W.G.'s words are a clear and unequivocal statement of the so-called *block universe* concept of four-dimensional spacetime. One can find the block universe concept in the writings of the ancients, too. Consider, for example, the fifth-century B.C. Greek philosopher Parmenides' view of reality: "It is uncreated and indestructible; for it is complete, immovable, and without end. Nor was it ever, nor will it be; for now it *is*, all at once, a continuous *one*." And in Thomas Aquinas' *Compendium Theologiae*, written in the thirteenth century, we find "We may fancy that God knows the flight of time in His eternity, in the way that a person standing on top of a watchtower embraces in a single glance a whole caravan of passing travelers." This is the block universe idea, too, but whereas for Parmenides it was metaphysics and for Aquinas it was theology, for Einstein and Minkowski it was physics.[108]

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[107] W. G., "Euclid, Newton, and Einstein," *Nature*, February 12, 1920, pp. 627–630. As with the mysterious S. (note 94), the editorial staff at *Nature* has informed me that, nearly a century later, there is no longer any record of the identity of W. G. in the journal's archives.

[108] And for some it was all nonsense. The British philosopher Peter Geach (1916–2013), for example, declared the Minkowskian view to be "very popular with philosophers who try to understand physics and physicists who try to do philosophy." See P. T. Geach, "Some Problems About Time," in *Studies in the Philosophy of Thought and Action* (P. F. Strawson, editor), Oxford University Press, 1968. In his introduction to Geach's essay, editor Strawson put in his two cents by stating the four-dimensional view of reality to be nothing but "fanciful philosophical theorizing."

The block universe concept may explain the enigmatic statement made by Einstein at the death of Michele Besso (note 103). As interpreted[109] decades later:

> "It seems that Einstein's view of the life of an individual was as follows. If the difference between past, present, and future is an illusion, i.e., the four-dimensional spacetime is a 'block Universe' without motion or change, then each individual is a collection of myriad of selves, distributed along his history, each occurrence *persisting on the world line, experiencing indefinitely the particular event of that moment* [my emphasis]. Each of these momentary persons, according to our experience would possess memory of the previous ones, and would therefore believe himself identical with them; yet they would all exist separately, as single pictures in a film. Placing the past, present and future on the same footing this way, destroys the notion of the unity of the self, rendering it a mere illusion as well."

It appears by his words that Einstein was indeed in agreement with the block universe concept, and that he was attempting to give his friend's family some reason to believe that their father still lives 'somewhen.' The makers of the 2002 film *Minority Report* made use of the block universe concept, even if not intentionally; there we see police stopping crime *before* it happens because they can 'see the future.'

Not everybody believed that this view of spacetime was Einstein's, however. Karl Popper (1902–1994), an Austrian philosopher of science, wrote 28 years after the scientist's death that "Einstein was a strict determinist when I first visited him in 1950: he believed in a 4-dimensional Block-Universe. But he gave this up."[110] Shortly before he wrote those words, however, Popper must have learned something new to convince himself of his final comment, because just 2 years earlier he had declared[111] Einstein to (still) be a determinist. Popper presents no evidence to support his claim of Einstein's philosophical conversion, however, and it would seem that the Besso letter still offers the best insight into his actual view of spacetime shortly before his death. I say this because I think Popper's labeling of Einstein as a determinist is wrong. Determinism says 'If you do A, then B will happen, and if you do not do A then (perhaps) something other than B will happen.' A deterministic universe has plenty of room for free will, because you can *choose* to do A or not to do A, and what you decide makes a difference. A fatalistic universe, however, as is the block universe, simply says 'You will do A and B will happen.' To accept the block universe, as did Einstein, is to be a fatalist, not a determinist.

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[109] L. P. Horwitz, R. I. Arshansky, and A. C. Elitzur, "On the Two Aspects of Time: The Distinction and Its Implications," *Foundations of Physics*, December 1988, pp. 1159–1193. See also Einstein's own book (note 67) where he wrote "From a 'happening' in three-dimensional space, physics becomes, as it were, an 'existence' in the four-dimensional 'world'."

[110] See the *Seventh International Congress of Logic, Methodology and Philosophy of Science*, volume 4 (Salzburg, Austria, 1983), p. 176. Popper describes his early discussions with Einstein on the reality of time and the four-dimensional Parmenidean block universe in some detail in his autobiography: see volume 1 of *The Philosophy of Karl Popper* (P. A. Schilpp, editor), The Library of Living Philosophers, Open Court 1974, pp. 102–103.

[111] In the Foreword to the book by B. Gal-Or, *Cosmology, Physics and Philosophy*, Springer-Verlag 1981.

Einstein's final position on this, then, *might* have been like that of the fictional time traveler who takes a little girl 25,000 years back into the past, where she sees an ancient ancestor of humanity.[112] She then asks if the ancestor is really alive. The time traveler replies, "Every man who ever lived is still alive, child. In time there is no real death. When a man dies he's still alive 10 min ago, 10 years ago. He's always alive to those who travel back through time to meet him face to face."

Did Einstein *really* believe this? Not everybody thinks so. At the 1922 meeting of the French Philosophical Society, for example, the philosopher of science Emile Meyerson asked Einstein whether the spatialization of time (the idea that time is a dimension on the same footing as the spatial ones) is a legitimate interpretation of Minkowski's spacetime. Einstein's terse answer was that "it is certain that in the four-dimensional continuum all dimensions are *not* [my emphasis] equivalent."[113]

Use of the term *block universe* is generally thought to have originated with the Oxford philosopher Francis Herbert Bradley (1846–1924) who, in his 1883 book *Principles of Logic*, wrote "We seem to think that we sit in a boat, and are carried down the stream of time, and that on the bank there is a row of houses with numbers on the doors. And we get out of the boat, and knock at the door with number 19, and, re-entering the boat, then suddenly find ourselves opposite 20, and having then done the same, we go on to 21. And, all this while, the firm fixed row of the past and future stretches in a *block* [my emphasis] behind us, and before us." The house numbers would seem to be Bradley's way of referring to the centuries. Note that he wrote these words 12 years before *The Time Machine*, and that they preceded Minkowski's famous address by a quarter-century.

But this origin of *block universe* may not be as clear-cut as I have made it appear. Bradley, who was frequently criticized by the Harvard psychologist William James (1842–1910)—a man who argued for free will[114] and indeterminism, concepts disallowed in a block universe—may have been mocked on the idea by James during an address to the students of the Harvard Divinity School in March 1884 ("The Dilemma of Determinism"), the year after Bradley's book had been published. In his address James spoke of a deterministic world as being a "solid" or "iron block" (this are *not* characteristics of determinism, but rather of fatalism, and so James makes the same mistake as did Popper). However, writing the year before Bradley's book, in the April 1882 issue of *Mind*, James wrote (with obvious disdain) of "the universe of Hegel [the German philosopher Georg Hegel (1770-1831)]—the *absolute block* [my emphasis] whose parts have no loose play," as having "the oxygen of possibility all suffocated out of its lungs" and as being a universe in which "there can be neither good nor bad, but [only] one dead level of

[112]F. B. Long, "Throwback in Time," *Science Fiction Plus*, April 1953.

[113]A. Einstein, "La Théorie de la Relativité," *Bullentin de la Société Francaise de Philosophia* (volume 17), 1922, pp. 91–113.

[114]A famous line from James, one that perhaps illustrates his sort of reasoning about free will, is "My first act of free will shall be to believe in free will." If only proving theorems in math and physics were that easy.

mere fate." So, perhaps, the chain of evolution of the term block universe is actually from Hegel to James and *then*, finally, to Bradley.

We can actually find the block universe in fiction *before* Minkowski (and so certainly before pulp science fiction) came on the scene. In an 1875 (!) story[115] we read of a man who sees, years in advance, his own death in the American Civil War. In the following extract, this man speaks to an unnamed friend (who is the narrator):

> "Do you know," said Bernard, presently, "I sometimes think prophecy isn't so strange a thing . . . I really see no reason why any earnest man may not be able to foresee the future, now and then . . ."
>
> "There is reason enough to my mind," I replied, "in the fact that future events do not exist, as yet, and we cannot know that which is not, though we may shrewdly guess it sometimes . . ."
>
> "Your argument is good, but your premises are bad, I think," replied my friend, . . . his great, sad eyes looking solemnly into mine.
>
> "How so?" I asked.
>
> "Why, I doubt the truth of your assumption, that future events do not exist as yet . . . Past and future are only divisions of time, and do not belong to eternity . . . To us it must be past or future with reference to other occurrences. But is there, in reality, any such thing as a past or a future? If there is an eternity, it is and always has been and always must be. But time is a mere delusion . . . To a being thus in eternity, all things are, and must be present. *All things that have been, or shall be, are* [my emphasis]."

When the block universe concept did eventually appear in science fiction, it did so early. In a 1927 story, for example, a time traveler from the future and a man in the present (who is the narrator) have the following exchange:

> "I have just been five years into your future."
> "My future!" I exclaimed. "How can that be when I have not lived it yet?"
> "But of course you have lived it."
> I stared, bewildered.
> "Could I visit my past if you had not lived your future?"[116]

So, while the block universe has a bit of a history to it, the history of the concept of *mathematical* spacetime in physics has a much clearer origin: it derives from Minkowski, not from Hegel, Bradley, James, or even Einstein (who often gets credit for it even though he didn't use the concept in special relativity in 1905, 3 years before Minkowski's address.). Eventually, of course, Einstein did come to appreciate the power and conceptual beauty of four-dimensional spacetime, and it came to play a central role in his ideas about gravity. Indeed, in Einstein's general theory of relativity gravity *is* (curved) spacetime. The starting point for general relativity (and so a *scientifically plausible* theory of time travel) was Minkowski's creation of spacetime, and he is truly deserving of the title 'father of the fourth dimension.'

[115] G. C. Eggleston, "The True Story of Bernard Poland's Prophecy," *American Homes*, June 1875. George Cary Eggleston (1839–1911) had served as a soldier in the Confederate Army.

[116] F. Flagg, "The Machine Man of Ardathia," *Amazing Stories*, November 1927.

Of course, it is true that Newton's physics also talks about an analytical (as opposed to merely philosophical) space and time long before either Minkowski or Einstein, but 'Newtonian spacetime' is something very different from Minkowski's self-described "radical" view.[117] In the Newtonian view there is a universal time, a *cosmic* time, which is the same time for everyone, everywhere, in the universe. At every instant, a cosmic simultaneity exists for Newton. Newton's space is Euclidean; that is, through any point exterior to a line exactly one parallel line can be constructed and those two lines will never meet, all triangles (no matter their size) have an interior angle sum of 180°, and so on. For Newton, space and time were absolutely and uniquely separable. They were, as philosophers like to say, "distinct individuals."

Minkowski changed all that. For him space and time are only relatively separable, and the separation is different for observers in relative motion. For Newton, space and time are the *background* in which physical processes in the world evolve. For Minkowski, spacetime *is* the world.

In a famous philosophical paper[118] by an advocate of the block universe view of reality, we find the words "I . . . defend the view of the world . . . which treats the totality of being, of facts, or of events as spread out eternally in the dimension of time as well as the dimensions of space. Future events and past events are by no means present events, but in a clear and important sense they do exist, now and forever, as rounded and definite articles in the world's furniture." The title of Williams' paper comes from an ancient dilemma stated by Aristotle in his *De Interpretatione*, where he asked a question now classic in philosophy: "Will there be a sea fight tomorrow?"

Aristotle began his famous answer by first posing the following premise: If a statement about some future event is, eventually, shown to be true (or false), then that statement was true (or false) from the moment it was made. Consider, then, the following two assertions: (A) "It is true that there will be a sea fight tomorrow" and (B) "It is true that there will *not* be a sea fight tomorrow." Surely, argued Aristotle, (A) and (B) cannot both be true, but equally surely, one of them must be true. Suppose it is (A) that is true. Then there is nothing that can be done to prevent the sea fight, and so the future is fated. Suppose, however, it is (B) that is true. Then there is nothing that can be done to cause the sea fight, and so the future is fated. The conclusion is the same no matter which assertion is the true one; thus, the future is fated.

[117]See, for example, H. Stein, "Newtonian Space-Time," *Texas Quarterly*, Autumn 1967, pp. 174–200; G. Berger, "Elementary Causal Structures in Newtonian and Minkowskian Space-Time," *Theoria* (volume 40), 1974, pp. 191–201; J. Earman and M. Friedman, "The Meaning and Status of Newton's Laws of Inertia and the Nature of Gravitational Forces," *Philosophy of Science*, September 1973, pp. 329–359.

[118]D. C. Williams, "The Sea Fight Tomorrow," in *Structure, Method and Meaning*, The Liberal Arts Press 1951. Donald Williams (1899–1983) was a professor of philosophy at Harvard.

As might be expected, those who like the fatalistic block universe like this conclusion, but, ironically, Aristotle wasn't one of them—he disliked it so much that he struggled to find a way around it. On the other hand, there are philosophers, like Professor Williams (who believed in a fatalistic universe), who reject Aristotle's rejection of his own logic! Professor Williams went so far, in fact, to calling Aristotle's reasoning "a tissue of error" and "swaggeringly invalid." Possibly so, but the philosophical debates over the sea fight question, and the fatalistic (or not) nature of the world, have not ceased to this day.

In an even more famous paper, Professor Williams makes clear his belief that the passage of time is a myth; he poetically declared "the total of world history is a spatio-temporal volume, of somewhat uncertain magnitude, chockablock with things and events."[119] Professor Williams did, indeed, embrace four-dimensional spacetime, and this is demonstrated by the following incredible passage, perhaps his best-remembered words: "It is then conceivable, though doubtless physically impossible, that one four-dimensional area of the time part of the manifold be slewed around at right angles to the rest, so that the time order of that area, as composed by its interior lines of strain and structure, run parallel with a spatial order in its environment. It is conceivable, indeed, that a single whole human life should lie thwartwise of the manifold, with its belly plump in time, its birth at the east and its death in the west, and its conscious stream running alongside somebody's garden path."

Good Lord!

Now, I am willing to admit that Professor Williams probably wrote that wonderful passage mostly for effect,[120] but I ask you—what, if anything, does it *mean*? It is marvelous to read and yet it remains (for me) mysterious.[121] It should come as no surprise that Professor Williams originally presented his papers to the Metaphysical Society of America, rather than to the American Physical Society. But this passage was perhaps not without impact in areas far removed from metaphysics; some years later there appeared a science fiction story[122] that reads as though it had been inspired by Williams. In it, a scientist discovers how to bend his perception of the four dimensions so as to view verticality as duration and duration as verticality. Thus, he is in October while sitting, but when he stands up he is in November! As bizarre as this may seem, such coordinate interchanges actually do occur in the

[119] D. C. Williams, "The Myth of Passage," *Journal of Philosophy*, July 1951, pp. 457–472.

[120] In a footnote, Williams sort of admits this when he writes "I should expect the impact of the environment on such a being to be so wildly queer and out of step with the way he is put together, that his mental life must be a dragged-out monstrous delirium." I think this a great understatement.

[121] As it was for some of Williams' fellow philosophers, one of whom bluntly called the 'myth-of-passage' paper "an interesting piece of science fiction": see M. Capek, "The Myth of Frozen Passage: The Status of Becoming in the Physical World," in *Boston Studies in the Philosophy of Science* (volume 2), Humanities Press 1965. Capek's title reflects his view of the block universe as simply a giant refrigerator and so, turning the tables on Williams, we have 'passage' changed to 'frozen passage.' See also note 136.

[122] G. Wolfe, "The Rubber Bend," *Universe 5* (T. Carr, editor), Random House 1974.

mathematical theory of time machines; we'll see this later, for example, when we discuss Tipler's rotating cylinder time machine.

By the 1930s the block universe had found a home in pulp science fiction. The block universe view that past and present coexist with the present got dramatic treatment in one story of a high school teacher who invents a "spacetime warp" theory, and who is then tricked by an evil industrialist into implementing it in the form of a gun. The weapon produces incredible effects when it is tested; for example, an allosaurus appears, which we are told is "a carnivorous dinosaur of the Jurassic Age, the most frightful engine of destruction that ever walked the Earth!"[123] At the story's end, the teacher explains what has happened to a crowd of breathless newspaper reporters:

> "Spacetime was warped slightly ... The Einsteinian spacetime continuum buckled ... Because it was superficial, only a little of the past, a little of the future broke through. The folds of the warp distorted spacetime evanescently, erratically skirting the vast gulf where the past lies buried and lightly tapping the vast stores of the future. It is a truism of modern speculative physics that the past and the future exist simultaneously and coextensively in higher dimensions of space. De Sitter has speculated as to the possibility of seeing an event before it happens. It is quite possible, gentlemen. Events of the far future already exist in spacetime."

That 'explains' the dinosaur. In the teacher's words, "You tell me that two men saw an incredible beast. ... They swear it looked like a dinosaur. I think it was a dinosaur, gentlemen. It broke through when the warp tapped the past."

And just 2 years later, Robert Heinlein made world lines the central concept in the first of his many classic tales.[124] The story draws an analogy between a world line and a telephone cable: the beginning and end points in spacetime for the world line of a person (birth and death) are associated with breaks (faults) in a telephone cable. By sending a signal up and down the cable, and measuring the time delay until the arrival of the echo produced by such discontinuities, a technician can both detect and locate the faults. In the same manner, Heinlein's story-gadget sends a signal of unspecified nature up and down a world line and thus locates the birth and death 'discontinuities.' Knowledge of the death date, in particular, causes financial stress among life insurance companies, and an examination of *that* tension (not strange physics) is the fictional point of the story.

And then, 2 years after Heinlein's tale with its serious tone, a far less serious story[125] (featuring an Attila the Hun character who roams up and down the corridors of time kidnapping beautiful women for his harem!), we find an 'editorial' footnote telling its young readers that "scientists—especially the new order of meta-physical scientists—are agreed on the principles of Space-Time. The future is not a thing which *will exist*. Rather it is a thing which *does exist*—all events from

[123] F. B. Long, "Temporary Warp," *Astounding Stories*, August 1937.

[124] R. Heinlein, "Life-Line," *Astounding Science Fiction*, August 1939.

[125] R. Cummings, "Bandits of Time," *Amazing Stories*, December 1941.

the Beginning to the End, exist in a record upon the scroll of Time." This story, itself, was silly, but the block universe metaphysics was up-to-date.

Somewhat surprisingly, I think, is that even before pulp science fiction embraced the block universe, the concept had already made a deep impression on a broader audience. For example, in a 1928 New York stage play[126] the action alternately takes place in the years 1784 and 1928 and, to explain how that can be, one character (a time traveler) tells another:

> "Suppose you are in a boat, sailing down a winding stream. You watch the banks as they pass you. You went by a grove of maple trees, upstream. But you can't see them now, so you saw them in the *past*, didn't you? You're watching a field of clover now; it's before your eyes at this moment, in the *present*. But you don't know yet what's around the bend in the stream ahead of you; there may be wonderful things, but you can't see them until you get around the bend, in the *future*, can you?"

Then, after this prologue about the stream of time, comes the block universe idea:

> "Now remember, *you're* in the boat. But *I'm* up in the sky above you; in a plane. I'm looking down on it all. I can see *all at once* the trees you saw upstream, the field of clover that you see now, and what's waiting for you around the bend ahead! *All at once!* So the past, present, and future of the man in the boat are all *one* to the man in the plane."

Then, finally, the obvious theological conclusion: "Doesn't that show how all Time must really be one? Real Time—real Time is nothing but an idea in the mind of God!"

To end this section, the block universe conception was cleverly used by one science fiction fan who argued in support of time travel, in reply to another fan how had claimed that a failure of mass/energy conservation was fatal to the plausibility of time travel. Their exchange began with a letter to the editor at *Astounding Stories* in November 1937, written in response to a recent story[127]:

> "Let us say that there is, at a certain time, 'x' amount of matter in the Universe, and 'e' amount of energy. Then if a man of 'a' mass travels backward in time to this particular instant aforementioned, the total amount of matter is thus 'x' plus 'a', while if no other such mass changing occurrences take place, the amount of matter in the future is 'x' minus 'a'. Only a corresponding loss and gain respectively in the amount of energy could explain this conservation of energy, advocates [of time travel] say what they may. But you can't rob or add energy to a Universe nilly-willy! Or perhaps time doesn't enter in on the matter. Perhaps you can add matter in a Universe provided you take it away on some future date."

This fan's concern clearly made an impression on science fiction writers, and the case for conservation of energy is stated in many of the time travel stories that appeared after the publication of this letter.[128]

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[126]"Berkeley Square" by J. L. Balderson. This play was made into a 1933 movie of the same name, and again in 1951 as the film *I'll Never Forget You*.

[127]O. Saari, "The Time Bender," *Astounding Stories*, August 1937 (see also note 137 in Chap. 1).

[128]Examples include the novels *Lest Darkness Fall* (Henry Holt 1941) by L. Sprague de Camp, and *The Time Hoppers* (Doubleday 1967) by Robert Silverberg.

A reply was soon received by the magazine in a letter (January 1938) from another fan:

> "[A recent letter] implies that the idea of time travel is incompatible with the law of conservation of mass and energy. I believe [the] reasoning is wrong [and that the] difficulty lies primarily in the assumption that a body moved in time is transported into a different Universe. According to Einstein, time and the three normal dimensions are so related as to form a continuous, inseparable medium we call the spacetime continuum. Time is in no way independent of the other components of our Universe. Hence a fixed mass [a time traveler and his machine] moved in time is by no means lost from the Universe, the action being analogous to a shift along any other dimension."

The block, or frozen, universe of Minkowski is clearly reflected in those words.[129]

2.7 Philosophical Implications of the Block Universe

> "Is the future all settled beforehand, and only waiting to be 'pushed through' into our three-dimensional ken? Is there no element of contingency? No free will? I am talking geometry, not theology."[130]

I should tell you now that, despite the enthusiastic embrace of the block universe by Williams and others (including Einstein), there are those who have been harsh in their criticism of Minkowski's spacetime. The major philosophical problem with the block universe interpretation of four-dimensional spacetime is that it looks like fatalism disguised as physics. It seems to be little more than a mathematician's proof of a denial of free will dressed up in geometry. One philosopher illuminated this concern with the following story, one that vividly illustrates the compelling need many humans have to deny a fatalistic world:

> "In a moving picture version of *Romeo and Juliet*, the dramatic scene was shown in which Juliet, seemingly dead, is lying in the tomb, and Romeo, believing she is dead, raises a cup containing poison. At this moment an outcry from the audience was heard: 'Don't do it!' We laugh at the person who . . . forgets that the time flow of a movie is unreal, is merely the unwinding of a pattern imprinted on a strip of film. Are we more intelligent than this man when we believe that the time flow of our actual life is different? Is the present more than our cognizance of a predetermined pattern of events unfolding itself like an unwinding film?"[131]

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[129] In the context of mathematical physics (*not* science fiction) it has been shown that time travel does *not* imply any fatal violation of conservation of energy. See, for example, J. L. Friedman *et al.*, "Cauchy Problem in Spacetimes with Closed Timelike Curves," *Physical Review D*, September 15, 1990, pp. 1915–1930, and D. Deutsch, "Quantum Mechanics Near Closed Timelike Lines," *Physical Review D*, November 15, 1991, pp. 3197–3217.

[130] The lament of Victorian physicist Oliver Lodge (1850–1940) in his essay "The New World of Space and Time," *Living Age*, January 1920.

[131] H. Reichenbach, *The Direction of Time*, University of California Press 1956, p. 11.

Most people in the Western world would answer *yes* to Reichenbach's question. Most people do find Omar Khayyam's *Rubaiyat* to be a beautiful poem, yes, but still they reject its fatalistic message: "And the first Morning of Creation wrote/What the Last Dawn of Reckoning shall read." Indeed, William James quoted these very words in his 1884 address to the students of the Harvard Divinity School when he argued against fatalism and the block universe.

Besides fatalism, another reason for the stinging words by critics of Minkowski's spacetime is that, in it, events don't *happen*—they just *are*. That is, there seems to be no temporal process of *becoming* in Minkowski's spacetime. Everything is already there and, as what we perceive to be the passing of time occurs, we simply become conscious of ever more of Minkowski's "world points," or events, that lie on our individual world lines. Hermann Weyl (1885–1955), a German mathematical physicist who in his last years was a colleague of Einstein and Gödel at the Institute for Advanced Study in Princeton, expressed this very interpretation in words that have become famous, words that sound very much like those of Wells' Time Traveller: "The objective world simply *is*, it does not *happen*. Only to the gaze of my consciousness, crawling upward along the life line of my body [Minkowski's world line], does a section of the world [spacetime] come to life as a fleeting image in space which continuously changes in time [creating what we call the *now* or the *present*]."[132]

Weyl was skillful in finding poetic ways to express the world line view of reality, but not everybody is convinced by the poetry because it seems to deny the common sense idea of time 'flowing,' of temporal passage; it effectively says time is mind-dependent, a mere *illusion*, as the time traveler in "Berkeley Square" declared (note 126). One philosopher who was particularly opposed to Weyl's view was the British-American academic Max Black (1909–1989), and he expressed his opinion in no uncertain terms: "The picture of a 'block Universe,' composed of a timeless web of 'world-lines' in four-dimensional space, however strongly suggested by the theory of relativity, is a piece of gratuitous metaphysics."[133] Another philosopher who was unhappy with Weyl's view of the block universe was just as blunt: "While philosophers may be forgiven intellectual extravagances of this kind, I think it is a pity when they receive encouragement from theoretical physicists."[134]

Weyl's views had supporters, too, however. Consider, for example, the Time Traveller's speech to his friends at the fateful dinner party that opens *The Time*

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[132]H. Weyl, *Philosophy of Mathematics and Natural Science*, Princeton University Press 1949, p. 116. Sir James Jeans had already said the same, somewhat less elegantly, in his 1935 Sir Halley Stewart Lecture: "The tapestry of spacetime is already woven throughout its full extent, both in space and time, so that the whole picture exists, although we only become conscious of it bit by bit—like separate flies crawling over a tapestry . . . A human life is reduced to a mere thread in the tapestry." Jeans then immediately *rejected* this fatalistic view: see his *Scientific Progress*, Macmillan 1936, p. 20.

[133]From a book review in *Scientific American*, April 1962, pp. 179–185.

[134]H. A. C. Dobbs, "The 'Present' in Physics," *British Journal for the Philosophy of Science*, February 1969, pp. 317–324.

Machine: "There is no difference between Time and any of the three dimensions of Space except that our consciousness moves along it . . . here is a portrait of a man at 8 years old, another at fifteen, another at seventeen, another at twenty-three, and so on. All these are evidently sections, as it were, Three-Dimensional representations of his Four-Dimensional being, *which is a fixed and unalterable thing* [my emphasis]." Remember, these words were written in 1895, 13 years before Minkowski and his world lines, and of course decades before Weyl's famous words.

Wells' passage made a considerable impression on at least one well-known physicist of the time, who references it in his early book on relativity.[135] And in another book on relativity, published the same year, we find the same interpretation of Minkowski's spacetime as a block universe: "With Minkowski, space and time become particular aspects of a single four-dimensional continuum . . . All motional phenomena . . . become timeless phenomena in four-dimensional space. The whole history of a physical system is laid out as a changeless whole."[136]

The claim that time is an illusion has some thought-provoking implications concerning the concepts of omniscience and free will, concepts that occur in any discussion of time travel. Some old theology on God's omniscience, as discussed in Aquinas' *Summa Theologiae*, is seemingly lent at least some support by Minkowski's spacetime: "Now although contingent events come into actual existence successively, God does not, as we do, know them in their actual existence successively, but all at once; because his knowledge is measured by eternity, as is also his existence; and eternity which exists as a simultaneous whole, takes in the whole of time . . . Hence all that takes place in time is eternally present to God." Somewhat paradoxically, however, Aquinas did make a distinction between past and future. In that same work he declares that "God can cause an angel not to exist in the future, even if he cannot cause it not to exist while it exists, or not to have existed when it already has." For Aquinas, then, whereas the past is rigid and unchangeable, the future is plastic, which is *not* the block universe view of spacetime.

As one theologian has observed,[137] this does not mean that Aquinas thought God had to view all events simultaneous with all others.[138] Rather, our theologian says that Aquinas could have thought of the relationship between God and events as being similar to that between the center of a circle and all the points on the circumference. That is, each point on the circumference has its own identity, coming before and/or after any other point, but the center is related to each and

[135] L. Silberstein, *The Theory of Relativity*, Macmillan 1914, p. 134.

[136] E. Cunningham, *The Principle of Relativity*, Cambridge University Press 1914, p. 191. The use of the words *timeless* and *changeless* explain the characterization of the block universe as being *frozen* (in note 121).

[137] W. L. Craig, "Was Thomas Aquinas a B-Theorist of Time?" *New Scholasticism*, Autumn 1985, pp. 475–483. For the B-theory of time, look back at the discussion in the first section of this chapter.

[138] A science fiction story by Norman Spinrad, "The Weed of Time" (*Alchemy and Academe*, Doubleday 1970) graphically describes what a nightmare that could be!

every point on the circumference in precisely the same way. The center, then, is 'eternity' and the circumference is the temporal series ('one thing after another') of reality. Saying that God is *eternal* is thus very different from saying he is *everlasting*. The first means outside of time, whereas the second means he is a temporal entity but has neither beginning nor end.

Our theologian supports the first interpretation, invoking Aquinas' own words from *Summa Contra Gentiles*: "The divine intellect, therefore, sees in the whole of its eternity, as being present to it, whatever takes place through the whole course of time. And yet what takes place in a certain part of time was not always existent. It remains, therefore, that God has a knowledge of these things that according to the march of time do not yet exist."

The issue of God's eternity and his place in spacetime has long been a hot topic among theologians with a scientific inclination. Practically every issue of the learned journal *Religious Studies*, for example, carries an article on the subject, often invoking relativity theory to support some argument. The Bible, itself, can be a confusing guide on this matter. For example, consider the Old Testament story of King Ahab (First Kings 21). Ahab, King of Sumeria, coveted Naboth's vineyard, but Naboth would not sell. The King retreated, but his wife Jezebel arranged for Naboth's downfall and judicial murder and thus caused the arrival of all his property into her husband's hands. This angered God, who commanded Elijah to prophesy disaster on Ahab's house. Ahab responded with sackcloth, and at that God shifted the disaster to the house of Ahab's son. The point, here, is that God, declared to be omniscient, seems to have been *surprised* at Ahab's penitence. God is aware of everything in this tale, but only as it happens. That is, God's knowledge is subject to growth. This Hebrew concept of God as a participant in history is at odds with the contemporary Christian conception of divine knowledge of all that has been, all that is, and all that will be, a view which has its own Biblical support (for divine eternality). For example, Malachi 3:61 ("For I am the Lord, I change not"), and James 1:17 ("the Father . . . with whom is no variableness").

When *The Time Machine* was serialized in the *New Review*, it included a passage that does not appear in the now classic version of the story in which the Time Traveller explains his view of the connection between omniscience and the block universe to his dinner guests:

> "I'm sorry to drag in predestination and free-will, but I'm afraid those ideas will have to help . . . Suppose you knew fully the position and properties of every particle of matter, of everything existing in the Universe at any particular moment of time: suppose, that is, that you were omniscient. Well, that knowledge would involve the knowledge of the condition of things at the previous moment, and at the moment before that, and so on. If you knew and perceived the present perfectly, you would perceive therein the whole of the past. If you understood all the natural laws the present would be a complete and vivid record of the past. Similarly, if you grasped the whole of the present, knew all its tendencies and laws, you would see clearly all the future. To an omniscient observer there would be no forgotten past—no piece of time as it were that had dropped out of existence—and no blank future of things yet to be revealed . . . Present and past and future would be without meaning to such an observer . . . He would see, as it were, a Rigid Universe filling space and time . . . If 'past' meant anything, it would mean looking in a certain direction, while 'future' meant looking the opposite way."

Wells' "Rigid Universe" certainly sounds like the block universe, and he (or least, the Time Traveller) seems to have believed that it held important implications for the concept of free will.

The 'Rigid Universe' got an interesting science fiction treatment in a story[139] that imagined an event in the present that occurs 'before it should' (a heart patient learns that her obituary notice will be in next week's *New York Times* when that paper arrives 'early'). As one character explains to the sister of the lady who is soon to die, "The future mustn't be changed . . . For us the events of . . . the future are as permanent as any event in the past. We don't dare play around with changing the future, not when it's already signed, sealed and delivered in that newspaper. For all we know the future's like a house of cards. If we pull one card out, say your sister's life, we might bring the whole house tumbling down. You've got to accept the decree of fate . . . You've got to."

With Einstein's discovery of the *relativity of simultaneity*,[140] we run into the question of 'How can there be any sense to the concept of divine, universe-wide knowledge in a four-dimensional spacetime?' That's because in some frames of reference it is possible for event A to be observed before event B, whereas in other frames the temporal order could be reversed, and so some theological questions prompted by spacetime physics are: 'What is God's frame of reference if he is to be actively involved in human affairs? Could God have a special frame of reference in which he is exempt from the relativity of simultaneity, a frame in which he imposes an absolute order on the sequence of becoming of events? Does it make any sense, that is, to say God enjoys what might be called 'divine immediacy'? And if so, what should we think of a God who follows rules of nature different from those that govern all he is supposed to have made?'

Theologians have debated questions like these for decades, and surely will continue to do so for many more decades to come. Alas, I suspect that physicists who study time travel have either been unaware, unimpressed, or just plain uninterested. That's too bad, because one doesn't have to be religious to appreciate the pure intellectual challenges presented by such questions. For example, consider the following debate between two philosophers, one who believes free will and divine foreknowledge are not compatible, and another who thinks the first has made a fundamental error in blurring the distinction between changing and affecting the past. (This distinction is of *great* importance

[139]R. Silverberg, "What We Learned From This Morning's Newspaper," *Infinity Four*, November 1972.

[140]This refers to the discovery that two events, which occur simultaneously for one observer in a spacetime, may not be simultaneous for another observer in the same spacetime. This will be discussed in more detail in the next chapter.

in any discussion of time travel.) This second philosopher presented some of his arguments in terms of a time traveler to the past[141]:

> "Consider the following. Parsons (P) has invented a special machine which allows him to go back in time. He enters the machine in 1986 and finds himself in the presence of or, perhaps better, observing, Quigly (Q) in 1876. P is an authority on Q, and knows immediately the situation Q is in. Not only that, but he remembers reading about the particular decision or act which Q made in that situation. Thus one might argue that from P's perspective what Q decides is as if already done. It is not already done, since P is standing there waiting for Q to do it. He has gone back in time. Yet from P's perspective, which is of one come back from the future, it is as if already done, since he knows what Q does decide. Since P strongly believes in the unalterability of the past, it is not within Q's power to do something other than what Q in fact does in that situation. From Q's perspective his decision is not already made nor is the action taken, so that it is in his power at that time to do either x or y. From his perspective, that he will do x rather than y is indeterminate; it is not yet done, though at the same time he can grant that P knows what he will do because for him it is as if he has already done it."

The first philosopher doesn't buy any of this, and dismisses it with "It should be abundantly clear . . . that the fact that such stories are in some way imaginable and intuitively graspable says nothing about their logical coherence." Given the interest among modern physicists in time travel, however, I think the first philosopher wouldn't write that today.

One possible reply to all of these theological issues that spacetime physics prompts can perhaps be found in a paper[142] (written by a philosopher and two mathematicians) that describes a five-dimensional spacetime in which the fifth dimension is initially given the provocative label of the 'eternity' axis. But then the authors lost their nerve and elected to rename it 'anti-time.' It is interesting to note that pulp science fiction anticipated that terminology by decades, as in one story[143] we read "Beyond the fourth there is a fifth dimension . . . Eternity, I think you would call it. It is the line, the direction perpendicular to time." For some, the eternity axis would appear to be perfect to serve as the temporal dimension for God, an axis distinct from the time axis of mere mortals.

The idea of supernatural beings existing outside of mortal time is an old one in theology, and it can also be found in secular literature long before science fiction got hold of it. For example, in the first act of Lord Byron's 1821 poem *Cain*, the fallen angel Lucifer tells Cain and his wife that

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[141]For the complete exchange between these two philosophers, see W. Hasker, "Foreknowledge and Necessity," April 1985, pp. 121–157, B. Reichenbach, "Hasker and Omniscience," January 1987, pp. 86–92, and W. Hasker, "The Hardness of the Past: A Reply to Reichenbach," July 1987, pp. 337–342, all in the journal *Faith and Philosophy*. Hasker is the 'first' philosopher, and Reichenbach is the 'second' one. See also D. P. Lackey, "A New Disproof of the Compatibility of Foreknowledge and Free Choice," *Religious Studies*, September 1974, pp. 313–318.

[142]J. G. Bennett *et al.*, "Unified Field Theory in a Curvature-Free Five-Dimensional manifold," *Proceedings of the Royal Society of London A*, July 1949, pp. 39–61. A theological interpretation is given in G. Stromberg, "Space, Time, and Eternity," *Journal of the Franklin Institute*, August 1961, pp. 134–144.

[143]L. A. Eshbach, "The Time Conqueror," *Wonder Stories*, July 1932.

With us acts are exempt from time, and we
Can crowd eternity into an hour,
Or stretch an hour into eternity.
We breathe not by a mortal measurement,
But that's a myst'ry.

Before Minkowski, the debates over fatalism (as in Silverberg's story in note 139) and free will had been the exclusive province of philosophers, theologians, and lawyers (if a person has no control over his or her actions, then can we morally and ethically punish that person if those actions happen to be criminal?[144]). After Minkowski, the physicists (at least a few of them) joined the debates. According to one philosopher (note 118) the major motivation driving these debates is "the age-old dread that God's foreknowledge of our destiny can in itself impose the destiny upon us." The implication is, of course, that God is 'outside of time' and so can take in the entire Minkowskian block universe at a glance (hence his foreknowledge).

The relativistic view of the universe as a timeless four-dimensional spacetime seems to provide scientific, mathematical support for the conclusion that not only is the past fixed, but so is the future. Does that mean the future is what it will be—and if so, then why bother agonizing over the many apparent decisions each of us faces every day? If the future will be what it will be, then Christian theologians are left with the puzzling task of explaining what could possibly be meant by the Biblical exhortation (Deuteronomy 30:19) "I call Heaven and Earth to record this day against you, that I have set before you life and death, blessing and cursing; therefore *choose* [my emphasis] life, that both thou and thy seed may live."

This issue has bothered philosophers for a very long time. The so-called Master Argument (the name reflects its supposed invulnerability to rebuttal), for example, comes down to us from its origins in ancient times, in the *Discourses* of the first century A.D. Roman Stoic philosopher Epictetus. That argument can be summarized[145] as follows:

1. The future follows from the past;
2. The past is unchangeable;
3. What follows from the unchangeable is unchangeable;

Therefore,

4. The future is unchangeable.

This certainly does seem to be fatalistic, in effect arguing that all events in a block universe spacetime are recorded in a 'Book of Destiny.' Since ancient times many great works of literature have adopted that view, recounting tales of the foretold

[144]For more on this, in the context of time travel, see the penultimate question in the *For Future Discussion* questions at the end of this chapter.

[145]See, for example, the two papers by R. L. Purtill, "The Master Argument," *Apeiron*, May 1973, pp. 31–36, and "Foreknowledge and Fatalism," *Religious Studies*, September 1974, pp. 319–324.

fates of men, such as Sophocles' *Oedipus*. It is, in a block universe, as though our conscious experience of the world is no different from that of the man watching the projected film images of *Romeo and Juliet*.

That view is the central issue in the early sixth century A.D. Roman philosopher Boethius' influential *De Consolatione Philosophiae* (circa A.D. 500) which was written during a year of imprisonment before his execution for treason; perhaps he wondered during that year if his fate could have been anything different. Certainly he must have taken some consolation in fatalism, but in fact he tried to argue that God's vision of *all* temporal reality does not limit the freedom to act. According to Boethius, "The expression 'God is ever' denotes a single Present, summing up His continual presence in all the past, in all the present . . . and in all the future." That is, God sees in one timeless and eternal moment all that has been and will be freely chosen.[146]

When the fourteenth century English poet Geoffrey Chaucer prepared a translation of *Consolatione* he was obviously inspired by it when he wrote his very long, famous poem (*Troilus and Criseyde*) on the nature of love (Book IV.140):

Some say "If God sees everything before
It happens—and deceived He cannot be—
Then everything must happen, though you swore
The contrary, for He has seen it, He."
And so I say, if from eternity
God has foreknowledge of our thoughts and deed,
We've no free choice, whatever books we read.

Two modern, purely philosophical rebuttals[147] to Chaucer, however, argue that his poetry misstates Boethius' philosophy when Troilus declares that divine foreknowledge is incompatible with free will. That is, in their view God's omniscience (a fundamental teaching in the theistic religions of Christianity, Judaism, and Islam) *is* compatible with free will (also a fundamental belief in those same religions). Both of these scholarly papers, though, depend much more on the nuances of grammar than most physicists will like.

The connection between spacetime physics and free will was made explicitly by the philosopher who wrote "For philosophers in either field, philosophy of science and philosophy of religion are too often viewed as mutually irrelevant . . . This is unfortunate, because sometimes the problems can be quite parallel and a consistent resolution is required. One especially intriguing case in point concerns, in

[146]In his *The Sirens of Titan*, a 1959 novel meant to be a parody of God's omniscience, Kurt Vonnegut gave the curious name of *chrono-synclastic infundibulated vision* to God's power to see the past and future.

[147]G. I. Mavrodes, "Is the Past Unpreventable?" April 1984, pp. 131–146, and A. Plantinga, "On Ockham's Way Out," July 1986, pp. 235–269, both in *Faith and Philosophy*.

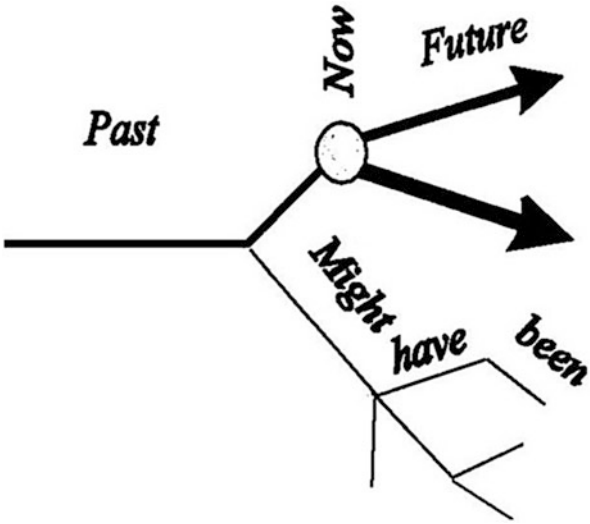

Fig. 2.2 The common view of time

philosophy of science, the possibility of ... time travel and, in philosophy of religion, the relationship between divine foreknowledge and human freedom."[148]

That philosopher could well have included science fiction writers in his group of people interested in both spacetime physics and free will. In one story,[149] for example, a man in the twenty-fifth century is about to travel back into the past to escape criminal prosecution. He is aked where he'd like to go, and he replies "I do not understand the paradoxes—what if I choose to build gravity-deflectors in Ancient Rome?" When he is told (correctly) that he couldn't do that because it didn't happen, he persists: "But if I can choose any period, it means I can alter history at will—which presumes that the present can also be changed." Then, at last, he gets the explicit answer that bothers nearly everyone: "The real answer is that in the final analysis your decision to choose a certain time period is already made, and the things you will do [in the time traveler's personal time] are already determined. Free will is an illusion; it is synonymous with incomplete perception." The same idea appears in another tale (note 57); when one character says, "What you are saying is that the future is fixed, and that you can read it, in every essential detail," the response is "Quite right ... both those things are true."

However, no matter how hard we try—and by *we* I include even those physicists and philosophers who embrace the block universe with its support of time travel to the past—it is very difficult to break free of the view of time as shown in Fig. 2.2. That is, as the passage of time up to the present or *now* (with all to the left of that

[148]W. L. Craig, "Tachyons, Time Travel, and Divine Omniscience," *Journal of Philosophy*, March 1988, pp. 135–150. Tachyons are hypothetical faster-than-light particles that theoretically travel backwards through time. They will be discussed in Chap. 5.

[149]W. Kubilius, "Turn Backward, O Time," *Science Fiction Quarterly*, May 1951.

instant as the past), while to the right of the *now* we have multiple possible futures (depending on our free will choices). Lying to the side of all that (in our thoughts and imaginations) are all that 'might have been' if we had made different choices than we did at earlier times in the past.[150]

With all that said, even if events are really laid out in the spatial and temporal web that constitutes the four-dimensional block universe, there still remains the great mystery of why we see them unfold in the particular sequence that we do. Why not in reverse order? Why, indeed, do we see what we call *time* run from what we call the past to what we call the future and, indeed, what do we really mean by *past* and *future*? As you'll see in the next chapter, these are not easy questions, and nearly everybody who has thought about them believes we are not yet even close to knowing the answers.

On that perhaps gloomy note, it seems appropriate to end here with a few more words from St. Augustine's *Confessions*, with words that follow those that helped open this chapter: "I confess to you, Lord, that I still do not know what time is. Yet I confess too that I do know that I am saying this in time, that I have been talking about time for a long time, and that this long time would not be a long time if it were not for the fact that time has been passing all the while. How can I know this, when I do not know what time is? Is it that I do know what time is, but do not know how to put what I know into words? I am in a sorry state, for I do not even know what I do not know!"[151]

2.8 For Further Discussion

In the comics one of Superman's more interesting adversaries is Mr. Mxyzptlk (pronounced *mix-yez-pitle-ick*), a being with seemingly magical powers from the Land of Zrfff in the fifth dimension. Mr. Mxyzptlk's powers are not really because of magic, however, but are 'merely' the result of his hyperspace world with its extra dimension. Mr. Mxyzptlk, for example, in one of his misadventures with Superman in 1954, begins selling a

(continued)

[150]Figure 2.2 is based on a similar one in C. K. Raju, "Time Travel and the Reality of Spontaneity," *Foundations of Physics*, July 2006, pp. 1099–1113.

[151]There is another view of time even darker than St. Augustine's, which denies the existence of both future and past, and doesn't offer us much either for that special moment we call the present (or *now*). This view, called *presentism*, was hauntingly expressed in some lyrics I heard in the final episode of the second season (2015) of the HBO series *True Detective*: "There is no future/There is no past/In the present nothing lasts." Now *that* is depressing! Still, there are philosophers who believe even this view can support time travel: see S. Keller and M. Nelson, "Presentists Should Believe in Time-Travel," *Australasian Journal of Philosophy*, September 2001, pp. 333–345.

newspaper called the *Daily Mpftrz* in competition with the *Daily Planet*. Unlike a traditional newspaper that reports what *has* happened, the *Daily Mpftrz* (your guess is as good as mine!) prints what *will* happen. As Mr. Mxyzptlk says, "You see, as a resident of the fifth dimension, I can get all the news I want from the *fourth* dimension!" The science editor at the *Daily Planet* explains the meaning of that to his boss, Perry White: "That's right, Mr. White . . . many physicists consider *time* the fourth dimension . . . so if Mr. Mxyzptlk can travel from the fifth dimension to our three-dimensional world, he most likely *is* able to see the future!" (This leaves unanswered the question of *why* he continues to challenge Superman when he knows he will always be defeated—*as he always is*!) Presumably a five dimensional world would have our three spatial and one temporal dimension (for a total of four), and so the question now is: what is the nature of the additional (fifth) dimension? Is it spatial or is it temporal? (There is a brief appearance of the fifth dimension in the 2014 movie *Interstellar*, but we aren't told much of anything about its possible structure.) Discuss and compare the world of four space dimensions and one time dimension, with the world of three space and *two* time dimensions. (In Chap. 5 we'll discuss a possible connection between two-dimensional time and time travel.)

In the text it is stated that "If A and B are mutually causative, then 'A causes B' coupled with 'B causes A' seems to lead to 'A causes A.'" Suppose, however, that we imagine two adjacent sunken pools of water, **a** and **b**, on the same horizontal surface, with each pool filled to the brim. An overflow from one pool will flow into the other pool. Now, define the events A and B as 'A is the overflow of pool **a**' and 'B is the overflow of pool **b**.' Thus, A causes B and B causes A. Does the conclusion 'A causes A' make physical sense in this specific case? Discuss at length.

When reading A. C. Clarke's story "Technical Error" (see note 99), we learn that a rotation through 4-space *inverts* "the unlucky Nelson." The 'solution' to this awkward situation is to flip Nelson through 4-space a second time and so back to 'normal.' (When *Thrilling Wonder Stories* reprinted this tale in June 1950, after its original publication in 1946, the title was changed to the more appropriate "The Reversed Man.") Clarke may have missed an

(continued)

important technical 'detail,' however, in that when first flipped through 4-space *everything* inverts, and so matter becomes anti-matter and Nelson would have instantly been annihilated in a 100 % conversion of matter to energy (that is, the flipped Nelson would have initiated a very large explosion). Compare this to Alice's concern in her flipped world (Lewis Carroll's *Through the Looking Glass*) when she wonders "Perhaps Looking-glass milk isn't good to drink." Explain why Lewis Carroll certainly was *not* thinking of matter/anti-matter explosions when he wrote his novel. What *do* you think he might have had in mind?

A time travel story, even earlier than Clarke's, that uses spacetime 'rotations,' was authored by Edmond Hamilton (1904–1977), one of the pioneering pulp fiction writers. In his "The Man Who Saw the Future" (*Amazing Stories*, October 1930), a man is hauled before the Inquisitor Extraordinary of the King of France to explain his mysterious disappearance, and subsequent reappearance, in an open field, amid thunderclaps and in plain sight of many onlookers. As the story unfolds, we learn that the man was transported five centuries into the future, from A.D. 1444 to 1944, by scientists working in twentieth-century Paris. The thunderclaps were produced by spacetime 'rotations,' as the atmospheres of 1944 and 1444 were reversed. A skeptical Inquisition naturally finds this tale preposterous and the first time traveler is burned at the stake as a sorcerer. Can you think of *why* such 'atmospheric swaps' might produce thunderclaps?

A trip around a Möbius strip reverses the 'handedness' of a plane figure (left and right are swapped). You can see this for yourself by making a Möbius strip, and then sliding an arrow (pointing *across the width* of the strip) around the strip. (Cut a notch in the side of the strip to mark the starting point, with the arrow pointing at the notch.) When you get back to the notch, the arrow will point *away* from the notch. Notice that the arrow never left the surface of the strip, or crossed any 'weird' boundary. Then, read H. G. Wells' short story "The Plattner Story" and comment on its use of 'handedness.'

The *autoinfanticide paradox*, which results when a time traveler tries to kill his younger self, continues to fascinate both physicists and philosophers, and papers regularly appear in the scholarly literature on the topic: see, for example, Kadri Vihvelin, "What Time Travelers Cannot Do," March 1996, pp. 315–330 (which introduces Suzy the time traveler); Ira Kiourti, "Killing Baby Suzy," June 2008, pp. 343–352; Peter B. M. Vranas, "What Time Travelers May Be Able to Do," August 2010, pp. 115–121; and Joshua Spencer, "What Time Travelers Cannot *Not* Do (but are responsible for anyway)," October 2013, pp. 149–162, all in *Philosophical Studies*. All deal with an issue that is psychologically fascinating: *moral responsibility*. Spencer, in particular, opens with this definition: Someone is morally responsible for an action *only* if she could have done otherwise. As he goes on to write, "If I have been attacked and both of my legs have been broken, then it seems illegitimate to criticize me for failing to run away; I could not have done otherwise." And yet all of these papers are on a point that (I think) physicists would soon lose interest in: is the question 'If Suzy is a time traveler, can Suzy kill baby Suzy, given that Suzy doesn't kill baby Suzy?' the same question as 'If Suzy is a time traveler, can Suzy kill baby Suzy, given that Suzy is now alive?' The answer to the first question is, from pure logic, NO, while the answer to the second question is just bit squishier: it all depends on what the word *can* means. For the second question, Suzy *can* kill baby Suzy if she has a weapon (knife, gun, poison, etc.) and she is in the past next to baby Suzy, but it is just that she doesn't because otherwise Suzy wouldn't be alive now (which is a given). Such debates seem unlikely to produce any insights into the physics of time travel. Compare this situation to the old schoolboy conundrum "What happens when an irresistible force meets an unmovable object?', which is a *self-inflicted* 'paradox.' That is, the words *irresistible* and *unmovable* are mutually exclusive and so, used this way, it should be no surprise that we have a conflict. Are the two time travel questions above, concerning Suzy, confusing through a similar mushy use of grammar? Or are they deeper than that? Vigorously defend your position.

In addition to H. G. Wells, another nineteenth-century writer who was highly influential in bringing the fourth-dimension out of academia and into public consciousness was the mathematician Charles Howard Hinton (1853–1907). Hinton was no angle-trisecting crank, having earned an M.A. at Oxford, an appointment in the mathematics department at Princeton, and then another at the University of Minnesota. Later, with the help of the eminent astronomer

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Simon Newcomb, he obtained a position at the Naval Observatory in Washington, D.C., and was on the staff of the United States Patent Office at the time of his sudden death. Hinton was a man to be taken seriously. His first published essay "What Is the Fourth Dimension?" appeared in 1880, and then in book form in 1884 as part of his *Scientific Romances* (a phrase used by Hinton before it became associated with Wells' science fiction many years later). That book received a generally favorable review in *Nature* (March 12, 1885, p. 431). At one point he wrote "We might then suppose that the matter we know extending in three dimensions has also a small thickness in the fourth dimension," an idea that was used a few years later by the well-known British mathematician W. W. Rouse Ball (1850–1925) in an attempt to explain gravity. Hinton was extremely inventive, and he also proposed four-dimensional-space models for static electricity. Find out more about Hinton's life and work: a good source to start with is *Speculations on the Fourth Dimension: Selected Writings of Charles H. Hinton* (R. Rucker, editor), Dover 1980. Take a look, too, at J. E. Beichler, "Ether/Or: Hyper-space Models of the Ether in America," in *The Michelson Era in American Science 1870—1930* (S. Goldberg and R. H. Stuewer, editors), American Institute of Physics 1988.

Chapter 3
The Physics of Time Travel: Part I

> *"... within forty-eight hours we had invented, designed, and assembled a chronomobile. I won't weary you with the details, save to remark that it operated by transposing the seventh and eleventh dimensions in a hole in space, thus creating an inverse ether-vortex and standing the space-time continuum on its head."*
>
> —almost certainly *not* the way to build a time machine[1]

3.1 The Direction of Time

> "Of all the problems which lie on the borderline of philosophy and science, perhaps none has caused more spilled ink, more controversy, and more emotion than the problem of the direction of time ... [T]he main problem with 'the problem of the direction of time' is to figure out exactly what the problem is or is supposed to be!"[2]

Before we start talking about the physics of time travel, let me say a few more words on time itself, in a way slightly less metaphysical that was the discussion in the previous chapter (which is why I'm writing this *here*, in a chapter with an increased emphasis on the analytical). When we speak of journeying to either the future or the past, we are implicitly making a distinction in the direction of the time traveler's trip. But does time actually have a *direction*? Is there an *arrow* that points the way? The answer seems obvious: *of course* time has a direction. After all, everybody 'knows' it flows from past to future. There is a curious language problem here, however, because we also like to say the present recedes into the past, which implies a 'flow' in the opposite direction, from future to past. Well, despite this snarled syntax, can we at least distinguish past from future, whichever way time flows?

[1] L. Sprague de Camp, "Some Curious Effects of Time Travel," in *Analog Readers' Choice*, Dial 1981.

[2] See note 54 in Chapter 2.

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P.J. Nahin, *Time Machine Tales*, Science and Fiction,
DOI 10.1007/978-3-319-48864-6_3

This would seem to be an important question to answer because for the phrases *flow of time* and *direction of time* to have any objective meaning at all, it must be somehow possible to identify a difference between past events and future ones. The special moment at which that distinction occurs is known as the *now* or the *present* and, as events make the transition associated with that distinctive difference, between past and future, we say that the *now* (the present) moves or flows. Philosophers—and science fiction writers and physicists, too, who after all are human beings with human senses like everybody else—call this common feeling that we all have, of the passage of time, the *psychological arrow of time*. One philosopher gave an amusing (tongue-in-cheek) gastronomical interpretation of the moving *now* as follows:

> "New slices of salami are continually being cut from a nonexistent chunk of salami called the future. The *present* is the slice on top of the pile. The past are the pieces beneath this, and even though they are not present they still continue to exist in the same way that the top slice of salami does. . . . This [concept] faces humiliation before the embarrassing question of how fast the pile of salami slices grows."[3]

The 'moving now' does present a problem for physicists because there is nothing in the laws of physics that marks the present moment as unique, and therefore nothing that reflects a 'flow' of time, nothing that models the reality of a 'moving now' becoming part of the past and the events of the future becoming, successively, the new 'now.' As a philosopher wrote long before time travel became a serious topic in the physics literature, "Talk of the flow of time or the advance of consciousness is a dangerous metaphor that must not be taken literally."[4]

What that philosopher may well have had in mind is that all events in the block universe simply have coordinates in spacetime, and there is nothing corresponding to 'have been' (past), 'are' (present), or 'will be' (future). There is no 'moving now' in the block universe except for its subjective presence in our conscious minds. All we can say from physics is that events are ordered in an earlier/later sequence, and in fact, even that relatively weak condition holds only for *causally* related events.[5] The relativistic, four-dimensional block universe view of spacetime that so many physicists (including Einstein) so dearly love seems to have no room for an objective theory of the *flow* of time. And yet, even for those same physicists, there is a powerful psychological sense that time *does* flow. But are they mistaken? It is a fact that, with not just a little irony, Gödel (the 'discoverer' of time travel) was convinced that the possibility of a block universe spacetime with CTLs/CTCs

[3]R. Gale, "Some Metaphysical Statements About Time," *Journal of Philosophy*, April 25, 1963, pp. 225-237. For many, this analogy may well bring to mind a pile of baloney rather than one of salami (and I think this was Gale's intention).

[4]J. J. C. Smart, "The Temporal Asymmetry of the World," *Analysis*, March 1954, pp. 79-83.

[5]Two events A and B are *non*-causally related if their separation in spacetime is such that a particle would have to travel at a *superluminal* speed (faster than light) to go from A to B. We'll discuss the physics of causally related events later in this chapter.

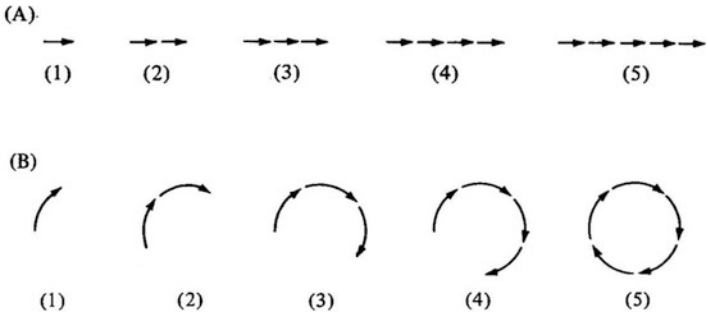

Fig. 3.1 Gödel's unreality of time argument

implies that the passage or flow of time *makes no sense*![6] To see how Gödel arrived at such an astonishing conclusion, consider Fig. 3.1.

In part A of the figure[7] we see what most people who talk of a passage of time intuitively mean, as time progresses through a sequence of instants (shown as line of left-to-right arrows going from (1) to (2) to (3) and so on). At each stage the right-most arrow is the present, and the arrows to the left of it (behind it) are the past, and the arrows to the right of the present are not shown because they are in the future and so don't exist yet. When you ask, at each step, which arrow is the *now*, the answer is clear.

Matters are dramatically different in part B of the figure, which shows the arrows forming a closed (circular) loop. Now there is no distinction between past and future, as each arrow is both ahead *and* behind any other arrow. In addition, there is no arrow that is uniquely the now. So, concluded Gödel, the passage of time can have no meaning in a temporal loop. As should come as no surprise, not everybody is convinced by this sort of argument.[8]

In principle, so it would seem, we can achieve perfect knowledge of what has happened but only imperfect prediction of what might happen. This observation seems to be at least a start at being able to tell past from future. And, in fact, the nature of the distinction between the two intervals of time seems obvious: we *remember* past events, but not future ones. As philosophers have so nicely put it, events in the past have formed *traces*, such as skulls, footprints in the sand, fossilized skeletons, surgical scars, photographs, taped recordings, carved stones,

[6]Gödel clearly states this in his 1949 philosophical essay (note 15 in the Introduction) concerning his 1949 technical paper (note 11 in the Introduction).

[7]This figure is based on the interpretation of Gödel's reasoning as presented by the philosopher Palle Yourgrau's 1991 book *The Disappearance of Time: Kurt Gödel and the idealistic tradition in philosophy* (Cambridge), which was expanded and reprinted a few years later under the new title *Gödel Meets Einstein: time travel in the Gödel universe*, Open Court 1999. Yourgrau later wrote a less technical version: *A World Without Time: the forgotten legacy of Gödel and Einstein*, Basic Books 2005.

[8]See, for example, S. Savitt, "Time Travel and Becoming," *The Monist*, July 2005, pp. 413-422.

and the like, whereas future events appear not to have formed traces. But is that necessarily so? Is it impossible for future events to create traces? The common-sense answer is *yes*, because of cause and effect, which dictates that there *must* be a temporal asymmetry in trace formation. That is, traces are the effects of *prior* causes. That line of reasoning leads us quickly to the fundamental issue of causation (which we've already encountered in Chap. 2), an issue that no discussion of time travel can avoid.

Part of the problem we have with backward time travel, and cause and effect, is as I've already mentioned, with language. The distinct and separate concepts of the temporal ordering of events, and of causality, have become merged in everyday thought. It is considered *obvious* to modern minds that if event A causes event B, then A *must* happen first. There is, however, at least one historical example of a similar merging of concepts that is parallel to our modern mixing of time order and causality—an example that shows how an issue can seem obvious and natural to the minds of one period of time, and yet to the minds of another period (our modern times) seem confused, odd, peculiar, even laughable.

As a *physicist* wrote in a paper[9] on advanced (that is, inverted causality) effects:

> *Ancient Egypt was an essentially one-dimensional country strung out along the Nile, which flows from south to north. The winds were conveniently arranged to be predominantly northerly. To go north, a traveler could let his boat drift, while with a sail he could move south against the slow current. For this reason, in the writing of the ancient Egyptians, "go downstream (north)" was represented by a boat without sails, and "go upstream (south)" by a boat with sails. The words (and concepts) or north-south and up-downstream became merged. Since the Nile and its tributaries were the only rivers known to the ancient Egyptians, this caused no difficulties until they reached the Euphrates, which happened to flow from north to south. The resulting confusion in the ancient Egyptian mind is recorded for us to read today in their reference to "that inverted water which goes downstream (north) in going upstream (south)."*

Often we can work our way free of the difficulties we create for ourselves with language, but only through common agreement. For example, the chairman of the board calls a meeting to order with mixed tenses by declaring "The meeting *will* take place *now*" and then saying at the end, "We will meet again *next* month, *same* time." We all know what these sentences mean, but only by our cultural heritage and not by the process of applying logic. The language problem causes similar difficulties for not only for fictional time travelers, but also for the physicists/philosophers who study the possibility of time machines. So—beware!

The idea of time flowing is a popular one, and it repeatedly appears in the time travel literature as the "river of time" or the "ocean of time." The deep psychological appeal of this sort of 'water language' has, not surprisingly, attracted the attention of philosophers. We can find one of the earliest expressions of the view in the *Meditations* of the second-century A.D. Roman emperor and Stoic philosopher Marcus Aurelius, who wrote: "Time is like a river made up of events which

[9]P. L. Csonka, "Advanced Effects in Particle Physics," *Physical Review*, April 1969, pp. 1266-1281.

happen, and a violent stream; for as soon as a thing has been, it is carried away, and another comes in its place, and this will be carried away, too." A most interesting essay on why such metaphors often seem so intuitively appropriate has been offered by one philosopher, who points out[10] that the seductiveness of the image of 'time as flowing water' is sufficiently great that you often find it in the scientific literature, too (Newton, you'll recall, wrote specifically in his *Principia* of time flowing). As for why such an image has such a powerful grip on our imaginations, I think we need look no further than to Kant. As he wrote (1781) in *Critique of Pure Reason*, "Time is nothing but the form of inner sense, that is, of the intuition of ourselves and of our inner state . . . Because this inner intuition yields no shape, we endeavor to make up for this want by analogies." And what better than a rushing stream of water to represent our feeling of time rushing by?

Still, no matter how intuitive such water metaphors may be, they can still easily befuddle us as well. To quote our philosopher (note 10), "Time a river! A queer sort of river that. Of what sort of liquid does it consist? Is time a liquid? A very peculiar liquid indeed!" A classic paper by the philosopher Donald Williams (discussed in Chap. 2, note 119) expresses similar doubt about the water image of time. In the course of his writing, he presents a truly staggering collection of entertaining examples of 'time as metaphor,' of which I repeat just a few here: time flies, goes, marches, and rolls, as well as flows And then he offers *this* provocative imagery: the evolution of our lives is like "a moving picture film, unwinding from the dark reel of the future, projected briefly on the screen of the present, and rewound into the dark can of the past." Wow![11]

Returning to the water metaphor, the French astronomer Charles Nordmann (1881–1940) opened and closed his 1925 book *The Tyranny of Time* with following gloomy but all too true summary of the overwhelming sense we all have of the inexorable, one-way 'flow' of time. (The ellipses in what follows denote over 200 pages!) "Nothing can equal the bitter sweetness of dreaming on the banks of Time, that impalpable and fatal river strewn with dead leaves, our wistful hours carried downstream like rudderless wrecks . . . In the eternal wave which rocks us, carries us along, and soon swallows us up, there is no rock to which we can fasten our frail barques; the very buoys we put out to measure our course are only floating mirages; and on the mysterious foundation of things our anchors slide along and fail to bite." A young person sees time, from Nordmann's perspective, as an ocean on which golden mornings arrive like waves from the future, whereas for an older person, liquid time is a nightmare flood, a swollen black torrent sweeping him first into the yawning abyss of the past and, ultimately and finally, into the eternal silence of the dark grave.

[10] J. J. C. Smart, "The River of Time," *Mind*, October 1949, pp. 483-494.

[11] And how about *this* image of time: Time is a snowball, with the center marking the beginning of the past, with ever new 'presents' accreting on the ever increasing surface as the snowball rolls down the hill of history!

The metaphor of time as a flowing river was ready-made for early science fiction writers, such as Caltech math professor Eric Temple Bell (1883–1960). His eventual novel *The Time Stream* began to appear in December 1931 as a serial in the science fiction pulp *Wonder Stories*, and Bell (writing as 'John Taine') made great use of the idea of time as a flowing stream, a stream in which one could swim into either the future or the past. There is strong evidence that Bell actually wrote the novel in July of 1921, but was unable to find a publisher for a decade, so odd did editors find the premise. By the time of its publication, others had beaten Bell into print.

The watery image of time had appeared a year earlier, for example, in a tale that played with the erosive nature of time in a dramatic way. As two time travelers speed into the future to rescue a friend, one of them describes the scene for us: "We huddled together in the whirling time girdling machine, cutting through the years as a ship's prow breasts surging waves. I could not help but think of the years as waves, beating in endless succession on the sands of eternity. They wore all away before them with pitiless attrition. Time seemed to eat all with dragon jaws."[12]

This image of time was taken a step further 3 years later in a story in which a large number of adventurers, from all across time, find themselves stranded at precisely the same place (in space and time). One of them offers his theory of what is behind this remarkable coincidence: They all have faulty time machines, like faulty boats, and all have hit the same snag on the 'river of time.' As he explains, "You may turn boats adrift on a river at many points, and they will all collect together at the same serious obstacle whether they have traveled a hundred or two miles. We are now at some period where the straight flow of time has been checked — perhaps it is even turning back on itself . . . [We] have struck some barrier and been thrown up like so much jetsam."[13]

The 'flow' of time does have its critics, of course. The British-American philosopher Max Black (1909–1988) argued[14] that questions about the direction of time are meaningless because there can be no direction to something that (he asserted) does not flow. His reasoning was that if time does flow, then he ought to be entitled to ask *how fast* it flows. That requires, in turn, a *metatime* or *supertime* for measuring the flow rate of 'ordinary' time. But because supertime must flow, too, we would then need a super-supertime, and so off we trip into what would appear to be the black hole of a McTaggert-like infinite regress. The view, of an infinite regress of times, was forcefully rejected by another philosopher with

[12]E. A. Manley and W. Thode, "The Time Annihilator," *Wonder Stories*, November 1930. This is the same magazine that, months later, finally published Bell.

[13]J. Wyndham, "Wanderers of Time," *Wonder Stories*, March 1933. Notice again, that we have the same magazine (whose editor must have had a particular fancy for such tales).

[14]M. Black, "The 'Direction' of Time," *Analysis*, January 1959, pp. 54-63.

these sharp words: "the very idea of super (or hyper)-time is indeed repulsive in its redundancy and its aroma of dilettante physics."[15]

A hierarchy of hypertimes has not bothered other analysts, however, and an entire subfield of specialty among philosophers (and some physicists, too) in time analysis has developed in what is called *multidimensional time*. One practitioner in this specialty sarcastically rejected the infinite regress complaint as a valid objection—he called it "a crushing and unanswerable position" but actually meant just the opposite—and stated that it was not at all clear (at least, not to him) why supertime must flow.[16] After all, he argued, we measure the flow of a river with respect to its banks without requiring that the banks themselves flow. (That actually strikes me as being a point that deserves debating, but I have not been able to find any mention of it in the later philosophical literature.) The idea of multiple time dimensions is particularly attractive for one sort of time travel (we'll take it up at the end of this chapter), but it enjoys far more popularity among science fiction writers and philosophers than it does with physicists.

Professor Black's objection (note 14) to talk of time 'flowing' was based, at least in part, on the observation that there are uses of the word *direction* that are not directly tied to something flowing. For example, consider the statement 'He is facing in the direction of north.' Black argued that this is mere pointing, and it is not at all the same as *moving* north. He then dismissed the possibility of there being any meaning to the direction of time, writing that making an analogy of time "with a sign-post or an index finger is too far-fetched to be worth considering." This claim (which some may feel leans too much on grammar) is, of course, an affirmation of the myth-of-passage view made famous a few years earlier by Donald Williams (note 119 in Chap. 2).

Not just philosophers have rejected the idea of time flowing. In his 1966 novel *October the First Is Too Late*, which deals with a world in which different parts of Earth simultaneously experience different eras of the past (see *For Further Discussion* at the end of this chapter for more on what this might mean), the British cosmologist Fred Hoyle (1915–2001) calls the 'river of time' a "grotesque and absurd illusion," and a "bogus idea." Another fictional work that agrees with Hoyle's non-moving image of time is the 1979 *Roadmarks* by Roger Zelazny (1937–1995). In that novel we read of "the Road," along which story characters can travel but which doesn't itself move; exits from the Road lead to the various centuries (which sounds a lot like the Francis Bradley's 1883 book that may have given the block universe its name). *Roadmarks* is a clever bit of writing, with many allusions to the paradoxes of time travel, but its explanation of the Road's origin as having been constructed by *dragons* (!) greatly undermines its interest for physicists.

[15]D. Zeilicovici, "Temporal Becoming Minus the Moving-Now," *Nous*, September 1989, pp. 505-524.

[16]C. W. Webb, "Could Time Flow? If So, How Fast?" *Journal of Philosophy*, May 1960, pp. 357-365.

In a block universe spacetime, there is no flow of time, but one philosopher believed that to be simply because the block universe is *incomplete* in its representation of reality. Writing in 1925, Hans Reichenbach (1891–1953) asked "What does 'now' mean? Plato lived before me, and Napoleon IV will live after me. But which one of these three lives *now*? I understandably have a clear feeling that *I* live now. But does this assertion have an objective significance beyond my subjective experience?"[17] Reichenbach went on to answer his question in the affirmative, and to deduce that the block universe view is missing something: "In the condition of the world, a cross-section called the present is distinguished; the 'now' has objective significance. *Even when no human is alive any longer, there is a 'now'* [my emphasis] . . . In the four-dimensional picture of the world, such as used by the theory of relativity, there is no such distinguished cross-section But this is due only to the fact that an essential content is omitted from this picture."

So, what *is* Reichenbach's 'missing essential content'? Feeling that the block universe is unacceptably fatalistic—in his words of ridicule, "the morrow has already occurred today in the same sense as yesterday"—he found his answer in the probabilistic theory of quantum mechanics. Classical physics argues that given total information about the state of the world *now*, one could in principle calculate perfectly the future or the past; one could both predict and retrodict. In contrast, quantum mechanics distinguishes past from future in a fundamental way.

Quantum mechanics does not deny that in principle we can know the past with exquisite accuracy, because each and every event leaves traces, evidence that is available to all with the means to find and decode them. But quantum mechanics also takes as truth that there is an unavoidable uncertainty to the future. The instant that this uncertainty is crystallized into fact was taken by Reichenbach to be the very definition of 'now.' The ever-increasing record of the past, in turn, defines (for Reichenbach) the *movement* of the 'now.' Reichenbach believed that with these observations he had at last captured the 'moving now' in mathematical theory, and that he had finally elevated the present from speculative psychology to solid physics, and that he had shown that the 'flow of time' is independent of the need for a conscious mind. However—

A later, powerful analysis[18] of the time-flow issue, combining philosophy with physics, comes down solidly in support of the *opposite* conclusion: it expresses the view that a 'moving now' *is* only in our minds and is *not* an intrinsic attribute of reality. The premise of that argument is that a mind-dependent flow of time is incompatible with what is called the *relativity of simultaneity* (to be discussed later in this chapter) which states that there is no universal cosmic-wide 'now' (this is a fundamental conclusion of special relativity). For example, it is meaningless to ask

[17]I've taken this quotation from A. Grünbaum, "Is There a 'Flow' of Time or Temporal Becoming?" in *Philosophical Problems of Space and Time*, Knopf 1963.

[18]L. R. Baker, "Temporal Becoming: The Argument from Physics," *Philosophical Forum*, Spring 1975, pp. 218-236.

what is happening on a planet in the Andromeda galaxy (two million light-years distant) *right now*.

Early science fiction stories are full of theories about the nature of 'now,' and the vast majority of them have no basis in scientific thought. Some of them are ingenious, however, and even though they are largely the pet ideas of the authors (and no one else's), perhaps they resulted in some young readers of the science fiction pulps of the 1930s and 1940s thinking about deeper matters than did the comic strips of "Buck Rogers," "The Lone Ranger," or "Terry and the Pirates." For example, according to one story, time is a wave and the 'moving now' we experience is carried on a crest of that wave. There are time waves both ahead and behind the crest we happen to be on (so we are told), and so each such crest carries a different 'now' for a different reality—hence the curious title.[19]

In another, more recent tale[20] about object duplication via time travel (which we'll discuss in Chap. 4, but you'll recall H. G. Wells was worried about this long ago), nine (!) copies of the same person from the year 2314 meet in 1870 to try and figure out what is going on. Part of their interesting discussion is the following analysis of the 'present':

> "Gentlemen, I think I understand," said the first James Thomas."
>
> "Eight faces turned toward him, and he felt as though he were looking into multiple mirrors."
>
> "We hold that time is a single instant — the instant of the Present —which travels through Duration — do we not?"
>
> "Eight heads nodded."
>
> "We assume that time passes in a manner analogous to the stringing of an infinite number of beads. Each bead is the instant of Now when it is last on the chain. Beads are continually being added, and each one is the only Now until another is placed after it."
>
> "Yes, that is my theory," said another James Thomas. "It can also be likened to the process of knitting. No matter how many stitches are knitted, there is only one last stitch, only one Now."

Einstein, too, was greatly bothered by the place of 'now' in time, perhaps even more than were James Thomas and his 'friends.' In an autobiographical essay, the philosopher Rudolf Carnap (1891–1970) recalled a conversation about this with Einstein in the early 1950s, at the Institute for Advanced Study in Princeton: "Once Einstein said that the problem of the Now worried him seriously. He explained that the experience of the Now means something special for man, something essentially different from the past and the future. That this experience cannot be grasped by

[19] R. Ray, "Today's Yesterday," *Wonder Stories*, January 1934.

[20] A. and P. Eisentein, "The Trouble With the Past," in *New Dimensions 1* (R. Silverberg, editor), Doubleday 1971.

science seemed to him a matter of painful but inevitable resignation. . . . Einstein thought . . . that there is something essential about the Now which is just outside the realm of science."[21]

3.2 The Arrows of Time

> "On a microscopic level there is no preferred direction for time. The equations of motion don't give a damn whether time moves forward or backward."[22]

The central issue for philosophers of time (and for physicists, too, I think) is that of its reality (or not): is time *objective and something that really flows*, or is time simply a *mind-dependent illusion* and nothing more than an artifact of our incomplete perception of reality? As the previous section shows, there is little consensus on this issue. As a start on trying to get a handle on the matter, looking into a so-called 'arrow of time' may give us some guidance. I'll begin with the arrow I've already mentioned, the psychological arrow. As discussed before, this is the feeling we have of a 'moving now,' a feeling that has no appearance anywhere in physics. A 'moving now' simply has no place in any universe devoid of the physical processes in a brain that give rise to what we call consciousness—but that doesn't mean physicists don't wonder about the 'moving now' just as much as does everybody else (remember Einstein)! As one physicist wrote in a technical journal, "What does 'Now' mean? This question must surely be the starting point of any attempt at understanding the nature of time."[23]

Well, no matter whether time actually flows or not, most of us still believe we have had a past and hope we will have a future. Each of us thinks we can easily tell one from the other, too. We have, in fact, many not so subtle indications from our everyday lives of the obvious direction of time. Nearly all of these indications have the common theme of *irreversible change*. As the British mathematician J. J. Sylvester once put it, "The whirligig of time brings about its revenges."[24] The Roman poet Ovid, who died when Christ was a teenager, said the same in his *Metamorphoses* with the famous words "Time, the devourer of all things." The

[21]Quoted from *The Philosophy of Rudolp Carnap* (P. A. Schlipp, editor), The Library of Living Philosophers, Open Court 1963, pp. 37-38. For a view contrary to Einstein's, from another physicist, see K. B. M. Nor, "A Topological Explanation for Three Properties of Time," *Il Nuovo Cimento B,* January 1992, pp. 65-70, which claims to develop a geometrical explanation for the flow of time, and so (says Nor) there *is* an objective, mathematical reality to the 'moving now.'

[22]A science fiction character pretty accurately sums-up what a modern physicist would tell you today, in L. Eisenberg's story "The Time of His Life," *The Magazine of Fantasy & Science Fiction*, April 1968.

[23]J. P. Cullerne, "Free Will and the Resolution of Time Travel Paradoxes," *Contemporary Physics*, July-August 2001, pp. 243-245.

[24]J. J. Sylvester, "A Plea for the Mathematician," *Nature*, December 30, 1869, pp. 237-239.

image of time as devourer of all that is mortal was brilliantly presented by James Barrie in his *Peter Pan*, with the crocodile who had swallowed a ticking clock chasing Captain Hook all about Neverland.

No one yet has escaped the biological decay processes of time, and inanimate objects are no less immune to this aspect of time. Logs and cigarettes burn in the stove and ashtray, but they never unburn. Our cars rust but never 'unrust.' An explosion has never been seen to reverse itself, to form a dynamite stick or a bomb casing out of a collapsing fireball. Our world seems, indeed, literally to be built on an irreversible movement toward chaos, death, and decay. Lewis Carroll uses this observation in his *Through the Looking-Glass* when Alice tells Humpty Dumpty "one can't help growing older." And speaking of Humpty Dumpty, his famous fall provides a dramatic example of a one-way evolution from past to future; he wasn't at all convinced that Alice was correct but, once he had splattered, then

All the King's horses and all the King's men
Couldn't put Humpty Dumpty together again.

While we are on the subject of Mr. Dumpty, it is also worthwhile to note that nobody has ever figured out how to unscramble an egg. Why is that? One philosopher speculated that the answer is found in the "irreversible organic phenomena" taking place in our brains which results in our flow of consciousness always being in the same direction.[25]

More subtle than the undignified undoing of a prideful egg is the phenomenon of memory, which seems trivial only because most people have not thought very carefully about it. We remember the past while remembering nothing about the future. We might, in fact, be tempted to use the phenomenon of memory to answer the question of how to tell past from future. Anything you can remember *is* the past. But that is a circular definition, as discussed by Professor Smart (note 4) who observed that to ask why memory is always of the past "is as foolish as to ask why uncles are always male, never female." In *Through the Looking-Glass* the White Queen tells Alice that "it's a poor sort of memory that only works backward" but, except for the claims of clairvoyants, it seems that is the only sort of memory any of us has. Why is that so? Of course, that would *not* be the case for a time traveler while in the past. His personal past, which he would remember, would be the future for the world around him.

For physicists, the question of the direction of time is one of profound mystery. There seems, in fact, to be no fundamental reason why time should not be able to go from future to past—but then what would 'future' and 'past' *mean*—even though no one has ever observed time to do so. All the laws of classical physics, including general relativity, and quantum mechanics, too (except for the K-mesons mentioned in Chap. 1) involve time in such a way that they ignore its sign. In other words, replacing t with $-t$ results in a perfectly valid description of something that could actually happen. But not all such possibilities are observed to occur. Why not?

[25]H. Margenau, "Can Time Flow Backwards?" *Philosophy of Science*, April 1954, pp. 79-92.

In an unpublished paper written in 1949, while doing the work that would bring him a share of the 1965 Nobel prize in physics, Richard Feynman (1918–1988) wrote[26] "The relation of time in physics to that of gross experience has suffered many changes in the history of physics. The obvious difference of past and future does not appear in physical time for microscopic events . . . Einstein discovered that the present is not the same for all people [the relativity of simultaneity, to be discussed later in this chapter] . . . It may prove useful in physics to consider events in all of time at once and to imagine that we at each instant are only aware of those that lie behind us. The complete relation of this concept of physical time to the time of experience and causality is a physical problem which has not been worked out in detail. It may be that more problems and difficulties are produced than are solved by such a point of view."

Feynman did not elaborate on what he meant by the "problems and difficulties" with that point of view (which is clearly that of the block universe), but surely he had the logical paradoxes of time travel high on his list. As the Yale philosopher Henry Margenau wrote (note 25) in a tutorial on Feynman's work, "The theory of quantum electrodynamics developed by Feynman incorporates reversals in the course of time and thereby cherishes, in the minds of many, *an age-old phantasy* [my emphasis] of more than scientific appeal [which sounds like time travel to me]."

Because the individual classical equations of microscopic physics are time-reversible, the distinction between past and future for individual particles disappears. The equations are said to be symmetric with respect to time; the algebraic sign of t is irrelevant in the classical laws. It must be understood, however, that there *is* a crucial point to appreciate. When a physicist says *time reversal*, she is talking about a system evolving backward in forward time—that is, all the individual particle velocity vectors are instantly reversed at once. This is distinct from the time-reversed worlds of philosophers and science fiction writers (which we'll get into later in this chapter) in which time itself 'runs backwards.' The physicist's point of view is clearly expressed in an early essay by a chemist: "Every equation and every explanation used in physics must be compatible with the symmetry of time. Thus we can no longer regard effect as subsequent to cause. If we think of the present as pushed into existence by the past, we must in precisely the same sense think of it pulled into existence by the future."[27] More than three decades later, a mathematician and a physicist presented a similar statement: "In classical dynamics, the past completely determines the present, and therefore, by symmetry, the future also completely determines the present."[28]

[26]S. S. Schweber, "Feynman and the Visualization of Space-Time Processes," *Reviews of Modern Physics*, April 1986, pp. 449-508.

[27]G. N. Lewis, "The Symmetry of Time in Physics," *Science*, June 6, 1930, pp. 569-577.

[28]O. Penrose and I. C. Percival, "The Direction of Time," *Proceedings of the Physical Society* (London), March 1962, pp. 605-616.

Besides the physics, there is also an interesting theological connection to time reversal. As one philosopher put it, "If all the laws are time reversal invariant and so no irreversible processes occur in the physical Universe then there is no inherent, intrinsically meaningful difference between past and future . . . If this is actually the natural case, then all mankind's major religions which preach a creation of the Universe (by a supernatural agency) and imply, accordingly, a differentiation between the past and the future . . . would have to make appropriate adjustments."[29]

There are, as you might expect on such a controversial topic, dissenters to the view that the classical laws of physics are necessarily time-reversible. Dirac himself wrote that "I do not believe there is any need for physical laws to be invariant under time and space reflections, although all the exact laws of nature so far known do have this invariance."[30] Dirac did not, unfortunately, elaborate on just why he felt that way, but with the later discovery of K-mesons his position is seen to have been 'ahead of its time'! In a famous science fiction story[31] dealing with the direction of time, one character finally puts his finger on the real puzzle of the question of time: "How can a man live backward? You might as well ask the Universe to run in reverse entropy." That cogent question brings us, in fact, to the first scientific explanation developed to explain the observed asymmetric nature of time.

It was the Englishman A. S. Eddington (1882–1944) who gave the picturesque name, the *arrow of time*, to the observed asymmetric nature of time's direction from past to future. He was also one of the popularizers of an explanation for the arrow, using the famous second law of thermodynamics.[32] The second law of thermodynamics states that a measure of the internal randomness or disorder—what is called the *entropy*—of any closed system (that is, one free of external influences) continually evolves toward that of maximum disorder, toward the condition called *thermodynamic equilibrium*. Indeed, so striking is this increase in entropy S with time in a macroscopically large system that the increase in entropy has come to be thought of as actually *defining* the direction of time. Eddington, however, was not the originator of the entropy concept. The history of entropy can be traced back to before the turn of the century, to the great Austrian scientist Ludwig Boltzmann (1844–1906) and his famous H-theorem. The quantity H in that theorem is directly related to the more familiar entropy,[33] defined by Boltzmann in 1877.

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[29]H. Mehlberg, "Philosophical Aspects of Physical Time," in *Basic Issues in the Philosophy of Time* (E. Freeman and W. Sellars, editors), Open Court 1971.

[30]P. A. M. Dirac, "Forms of Relativistic Dynamics," *Reviews of Modern Physics*, July 1949, pp. 392-399.

[31]A. Boucher, "The Chronokinesis of Jonathan Hull," *Astounding Science Fiction*, June 1946.

[32]A. S. Eddington, *The Nature of the Physical World*, Macmillan 1929.

[33]The H-theorem was a direct continuation of the work by the Scottish physicist James Clerk Maxwell (1831-1879) on the statistical properties of gas molecules (determining the probability density function of the molecules' speeds). In 1866 Maxwell found this function for the particular case of thermodynamic equilibrium. In 1872 Boltzmann found the differential-integral equation the function satisfies in general, even if the condition of thermodynamic equilibrium doesn't hold. From this Boltzmann was able to define a quantity H that he showed evolves in time such that

The entropy S of a system in a given state is proportional to W, which is the number of different possible ways the state can occur as a result of all possible variations of system's internal, microscopic structure. The calculation of W is usually quite complicated, but in various highly idealized systems it can be straightforward. Consider, for example, a vacuum cylinder with a thin membrane dividing the interior into halves. Suppose that we insert (to be specific) six molecules into the left half of the cylinder (and none into the right half). If we define the microscopic state of the system to be the number of molecules in the left half, then initially $W = 1$ because there is just one way to put all six molecules on the left side. This represents the state of *minimum* entropy, the state of maximum order that is most distant from thermodynamic equilibrium. If we now puncture the membrane then the molecules, once confined to the left side, are free to move about the entire cylinder. At any given instant we can imagine counting the number of molecules on the left side—suppose that at some particular instant we count five, with one molecule having moved to the right side. Then, $W = 6$, because there are six ways to pick the molecule that has moved from left to right, and so the entropy has increased.

We think of the thermodynamic equilibrium state as being the state with equal numbers of molecules in both halves of the cylinder, and that state has the *maximum* entropy. (Can you show that this state is associated with $W = 20$?) With such a small number of molecules, it is *not* clear that W (and so S) will *inexorably* increase with time; perhaps, after one of the six molecules has gone to the right, it then returns to the left side before any of its companions have joined it on the right. Such an event is called a *reversal*, and it will happen with some non-zero probability. But the more molecules there are in the cylinder (instead of six, make the number a million million million—still a small amount of gas in our everyday world, hardly enough to fill a sewing thimble), the more likely it becomes that the value of S *will* monotonically increase with time.

The steady increase in entropy is often observed in the everyday, large-scale world. A drop of ink in a glass of water spreads out in an expanding cloud, a cloud we *never* see collapse backward into an ink drop. A long rod of metal, initially hotter at one end than at the other, evolves toward a constant temperature along its entire length. We *never* see a uniformly warm rod spontaneously begin to cool at one end and grow hot at the other. A hot bath grows cold—nobody has *ever* seen a bath at room temperature suddenly, all by itself, begin to heat up and then boil in the middle of the tub while the edges freeze into ice chunks. In all of these cases, the end (future) state represents greater internal randomness or disorder than does the beginning (past) state.

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solution to his differential-integral equation approaches Maxwell's equilibrium solution. The H-theorem says that H always *decreases* in systems not in equilibrium and is at a *minimum* in systems in equilibrium.

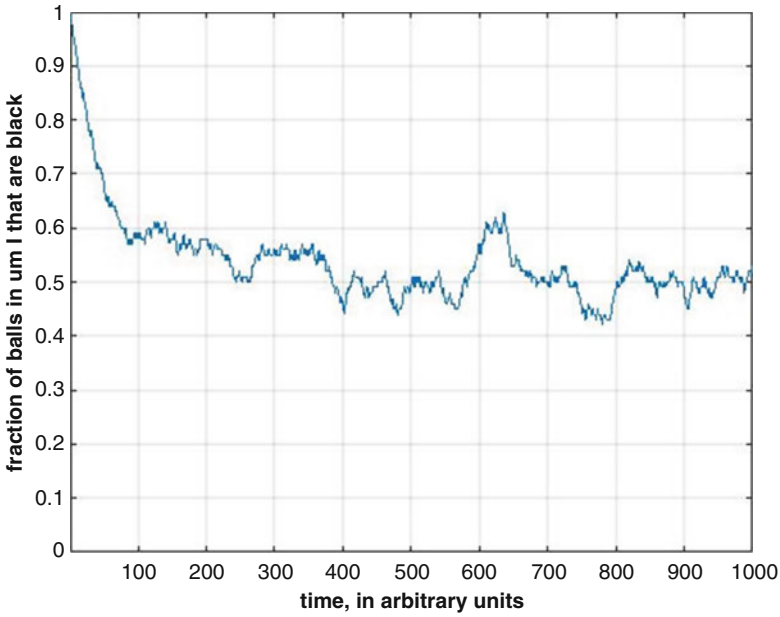

Fig. 3.2 Simulation of the Ehrenfest entropic gas clock

That is, low entropy *was* the past, and high entropy *will be* the future. The increase in entropy seems to define a direction to time, and so entropy has come to be called the *thermodynamic arrow of time*.

The first formal entropy model for the direction of time was put forth in a 1907 paper by the Austrian physicist Paul Ehrenfest (1880–1933) who was a friend of Einstein, and his Russian-born wife Tatyana (1880–1964), who was a skilled mathematician and her husband's occasional collaborator. In their paper the Ehrenfests developed one of the mainstays of physics, the so-called *entropic clock*. This clock, a statistical model based on the then new probability mathematics of Markov chains—after the Russian mathematician A. A. Markov (1856–1922)—describes how gases diffuse, and it is both a simple and a powerful concept. The Ehrenfest model is illustrated in Fig. 3.2, in a computer-generated plot based on a discussion by Princeton physicist John Wheeler of black hole fame (see Chap. 1).[34]

Imagine two urns, I and II, each containing n balls. Initially, at time $t = 0$, all of the balls in Urn I are black and all of the balls in Urn II are white. Then, at time $t = 1$ (in arbitrary units), a ball is selected at random from each urn and (instantaneously) placed in the other urn. This select-and-transfer process is repeated at times $t = 2$,

[34] J. A. Wheeler, "Frontiers of Time," in *Problems in the Foundations of Physics* (G. T. diFrancia, editor), *Proceedings of the International School of Physics* (Course 72), North-Holland 1979. See also W. J. Cocke, "Statistical Time Symmetry and Two-Time Boundary Conditions in Physics and Cosmology," *Physical Review*, August 25, 1967, pp. 1165-1170.

3, 4, ... At any given time each urn always contains n balls, but only at $t = 0$ are the colors of all the balls in a given urn necessarily the same. The phrase "selected at random" means (for example) that the probability of selecting a black ball from an urn containing b black balls is b/n. At any given time we completely describe the state of both urns by specifying the number of black balls in Urn I (or the number of white balls in Urn II, and so on). It is easy to write a computer simulation of this physical process,[35] and Fig. 3.2 shows how the fraction of black balls in Urn I evolves toward 0.5 as time increases. The plot is for $n = 100$ (200 balls total). The important observations are that (1) the evolution of the state of the system is toward 50 % black balls in Urn I (and this would be the case for 'almost all' sequences of random selections of the balls from the urns), and (2) the evolution is not monotonically decreasing from 100 % black balls to 50 % black balls, but rather has never-ending fluctuations about 50 % that may, in fact, be rather large in both amplitude and in duration.

There is a real puzzle with the entropic clock that may not be immediately apparent. The motion of each of the individual molecules is described by time-reversible physics, but when we average over 'many' molecules (assuming 200 molecules is 'many') we lose detailed information about the individual molecules. The puzzle is then how is it that by *reducing* our knowledge of a system, through statistical averaging, we then find it displaying a *new property*, that of asymmetric time evolution, that we didn't see before when we watched the individual molecules. And if that question isn't troublesome enough, we also have two additional puzzles called the 'reversibility' and the 'recurrence' paradoxes to consider as well.

The reversibility paradox is the question raised earlier: the classical equations of physics work just as well with time running in either direction, and so *why don't* things actually go 'backward'? This question, originally raised by the British mathematical physicist and engineer William Thomson (1824–1907)—better known as Lord Kelvin—in 1874, was brought to Boltzmann's attention in 1876 by the German physical chemist Johann Loschmidt (1821–1895), one of Boltzmann's professors at the University of Vienna. Boltzmann's answer to this apparent paradox was that it *is* imaginable that a world could run backward if initial conditions were suitable. For example, if all the velocity vectors of every particle in an equilibrium state were reversed, then the system *would* unwind backward in time toward its original non-equilibrium condition. That is, a system in thermodynamic equilibrium, the state of highest entropy, could evolve toward one of low entropy. Boltzmann even suggested that such might be the case for regions in our own universe, that there might actually be beings in a world somewhere 'out there' who

[35] I used MATLAB, and you can find the code — gasclock.m — in Appendix C, written in such a low-level way as to be virtually 100% transferable to just about any of the popular scientific programming languages, and easily executed on an inexpensive laptop. Note that there are no K-mesons in the code (!) and so, as stated in Chapter 1, they aren't responsible for the uni-directional time behavior depicted in the figure.

experience time running counter to our earthly experience. He said that in 1877, and it is a remarkable statement for a conservative nineteenth-century professor.[36] However, Boltzmann continued, from most given states there are vastly more ways for entropy to increase than there are for it to decrease, and that is why we see what we see, a continuous *increase* in entropy.[37]

To find a science fiction writer speculating on reversed time people is, of course, much less remarkable! One pulp story, in fact, presents a curious treatment of the nuances of reversed time in which people talk backward (along with a marvelous bathroom scene of a man un-washing his hands!). This tale[38] tells us a young physics teacher who is "twisted into a reversed Time Stream" by an electrical discharge. As he lives backward in time, he observes everybody about him appearing to run in reverse, but even more puzzling is that they have developed a "dreadful, granite-like hardness." We soon learn why:

"For a while he could not understand the impenetrable hardness of external objects which he had experienced; it seemed they ought rather to be of intangible transiency, much as a dream, since he was re-viewing the Past. But a moment's thought gave him the logical answer. The Past is definite, shaped, unalterable, as nothing else in Creation is. Therefore, to argue that he could move or alter any object here [the past] was to argue that he could change the whole history of the world or cosmos. Everything he saw about him had happened, and could not be changed in any way. On the other hand, he was fluid, movable, alterable, since *his* future still lay before him, even if it had been reversed; he was the intruder, the anomaly. In any clash between himself and the Past, the Past would prove irresistible every time."

This passage reflects the modern view that the past cannot be changed, but explains that view in a way different from that generally accepted today. Modern physicists and philosophers invoke consistency requirements (which we'll take up in the next chapter) to explain the 'solidity' of the past. The author of this story also failed to explain why his physics teacher had no trouble moving about through the air of the past, which apparently is not any more resistant to being displaced than were air molecules before time reversal occurred.

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[36]The Austrian-British philosopher Karl Popper (1902-1994) called Boltzmann's willingness to consider the possibility that different regions of the universe could have different directions of time "staggering in its boldness and beauty," but when on to say that Boltzmann must be wrong because "it brands unidirectional change an illusion [which] makes the catastrophe of Hiroshima an illusion." That is an emotional argument, of course, and although one of great power, I fail to see how it is related to physics. See Volume 1 of *The Philosophy of Karl Popper* (P. A. Schlipp, editor), Open Court 1974, pp. 127-128.

[37]For more on Boltzmann's views on entropy, see the end of his letter "On Certain Questions of the Theory of Gases," *Nature*, February 28, 1895, pp. 413-415.

[38]C. F. Hall, "The Man Who Lived Backwards," *Tales of Wonder*, Summer 1938. The modern classic of a time-reversed world is Philip K. Dick's 1967 novel *Counter-Clock World*. We'll encounter another time-reversed world again in Chapter 4.

It didn't take long for science fiction writers to incorporate entropy as time's arrow into time travel. In one early tale there is the brief statement that entropy is behind the operation of its gadget.[39] And a few years later the inventor of a "warp gun" tells us that "The stupendous distortion of the warp may actually bring about a sort of kink in spacetime, and result in a reversal of entropy"[40] and, sure enough, when the gun is fired a woman, who is hit by the warp, ages 70 years in seconds (which is, of course, exactly the opposite of what we would expect from a "reversal of entropy"!). Just a year later, the story of a college student about to flunk his senior physics course appeared.[41] An examination is scheduled for the following day, but he needs a week and a half of study time. To his rescue comes ENTROPY, INC., a company that sells time by placing its clients inside a "time-cabinet" in which the local entropy is greatly accelerated. To someone looking through a window at the interior of the time-cabinet, the occupants would appear as characters in a speeded-up movie. Referring to Eddington by name, the author tells us that "entropy is what makes time irreversible — is what gives us the feeling of the flow of time."[42]

In a hilarious, melodramatic story featuring one of early science fiction's stereotypical 'mad scientists,' the entropic arrow of time is the scientific explanation for time travel.[43] There we read of Bryce Field, "a master-scientist, a demon, cruel, ruthless," who is rejected in love by the stupendously beautiful Lucy Grantham. Her lack of enthusiasm is perhaps understandable, as Bryce is described as having "a lean-jawed, sunken-eyed" appearance, along with "lank, untidy hair sprawled across his massive forehead." As Lucy tells him at one point, "I could never love you; you are too clever, too brilliantly scientific." After hearing that, it is no surprise that before we are more than a page or two into the tale that we learn Bryce has Lucy strapped to a steel table in an underground laboratory-in-a-cave. There he tells her of her fate: "You are going on a long journey, my dear. So long a journey that even I, master-scientist, do not know when it will end. A journey into the future — alone! ... You, Lucy, shall be the victim of entropy! ... I have discovered how to make a [globe] of non-time. Entropy will be halted ... You will be plunged into an eternal 'now.'"

And so the mad Doctor Field throws the switch on the wall of his "instrument-littered" cave on July 17, 1941, and Lucy remains "suspended" in time until the outside world reaches the date of August 9, 2450. That is the day she is at last dug-up from the cave by "big and muscular" engineer Clem Bradley and his "square-jawed" sidekick Buck Cardew, who uses a "warp in spacetime" to release Lucy from her "globe of non-time."

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[39] M. J. Breuer, "The Time Valve," *Wonder Stories*, July 1930.

[40] F. B. Long, "Temporary Warp," *Astounding Stories*, August 1937.

[41] R. M. Farley, "Time for Sale," *Amazing Stories*, August 1938.

[42] Also citing Eddington was a tale by D. W. O'Brien, "The Man Who Lived Next Week," *Amazing Stories*, March 1941, which uses entropy to explain time travel. This curious story has the traveler arriving in the future with his clothing aged, which later 'de-ages' when the return trip is made!

[43] P. Cross, "Prisoner of Time," *Super Science Stories*, May 1942.

A few years later entropy was used in a similar but vastly more 'scientific' way. In that tale[44] we read of a scientist who has discovered "a field in which entropy was held level." As the reader is told, "An object in such a field could not experience any time flow — for it, time would not exist," since time flow is a *change* in entropy, and the 'change' of a level (or constant) field is zero. This interesting tale speculates on how such a field could have fantastic home uses ("Imagine cooking a chicken dinner, putting it in the field, and taking it out piping hot whenever needed, maybe twenty years hence!"). But its real use in the story is as a stasis generator for preserving fatally ill people until medical science has learned how to cure their diseases. This is, then, a high-tech method of suspended animation, of time travel into the future that is different from simply freezing (a clock in such a field would not age or measure the passage of personal time).

The gadget that does all this is called, somewhat sinisterly, the "Crypt," which we are told also makes a great bomb shelter, too, because "not even an atom bomb could penetrate a stasis field." The reason for that is intriguing: "The field requires a finite time in which to collapse — only there is no time in it." The interior of the Crypt is, quite literally, a frozen block of time more rigid and unyielding than the strongest steel.

As science fiction left the age of pulps and moved into the modern era, entropy continued to be useful a justification for time travel. Arthur C. Clarke used it,[45] as did Robert Silverberg. This last tale[46] is particularly interesting, as Silverberg pursued entropy beyond simply invoking it as a mere casual throwaway mention. When a newspaper from the future appears on people's doorsteps, the initial astonishment is replaced with puzzlement as the papers rapidly disintegrate. That is the result (we are told) of "entropic creep." The explanation continues, informing us that it is sort of like a strain in a geological fault (Silverberg has lived for decades in California, now and then a place of large to huge earthquakes, and it isn't surprising that he uses this particular imagery): "Entropy you know is the natural tendency of everything in nature to come apart at the seams as time goes along. These newspapers must be subject to unusually strong entropic strains because of their anomalous position out of their proper place in time."

Earlier I mentioned we had *two* puzzles associated with entropy; we've discussed 'reversibility,' so what's the other one, the 'recurrence paradox,' all about? The recurrence paradox is quite different from reversibility; it is based on a result established in 1890 by the great French mathematician Henri Poincaré (1854–1912). Motivated by the question of the stability of the motion of three masses governed by Newton's laws of mechanics (think, for example, of the Sun, the Earth, and the Moon), Poincaré showed that starting from almost any initial state, any fixed volume system with a finite amount of energy and a finite number of

[44]P. Anderson, "Time Heals," *Astounding Science Fiction*, October 1949.

[45]In, for example, his story of the tragic end of a geologist fifty million years in the past: "Time's Arrow," *Science Fantasy*, Summer 1950.

[46]"What We Learned from This Morning's Newspaper," *Infinity 4*, November 1972.

degrees of freedom will return *infinitely often and with arbitrarily little deviation* to almost every previous state. If you wait long enough, implies Poincaré's astonishing theorem, Pearl Harbor will happen again—and again, and again, and . . .. In 1896 the German mathematician Ernst Zermelo (1871–1953) used this result, which philosophers call the 'eternal return,' to claim that there could be no truly irreversible processes and thereby cast doubt on the idea that entropy *always* and *inexorably* increases.

Even for very small systems, however, such as a mere handful of molecules, the recurrence time is extremely large, and this was, in essence, Boltzmann's reply to Zermelo's concern. For example, if the gas-filled cylinder of our entropic clock has just 100 molecules (not the six I used in the earlier example), and if transitions from one side of the cylinder to the other side take place at the rate of one million per second, then the recurrence time has been calculated to be something like 30 million billion years![47] And for the universe itself, the recurrence time is simply incomprehensible. Mathematicians call 1 followed by a hundred zeros a *googol*, and the recurrence time in years for the universe has been estimated to be 1 followed by a googol of zeros (a so-called *googolplex* of years).[48]

Using a wonderful bit of imagery, one analyst wrote of the enormity of the recurrence time of a system considerably *less* complex than the universe this way: "If a man shuffled just a single pack of cards as rapidly as an individual molecule hits other molecules in air, and if a snail started to crawl around the universe . . . at the rate of one centimeter *during the life of the sidereal system* [my emphasis], the snail would have got round the universe many millions of times before it would become at all likely that the man would have got the pack back to the original order."[49] If this is what it takes to get a pack of cards back to its initial state, then try to conceive of the time interval required to restore *the world* to December 7, 1941.[50]

The notion of eternal recurrence considerably predates Poincaré, and its scientific (as opposed to astrological) study can be traced back to the fourteenth century.[51] A 'more recent' claim for eternal recurrence, also based on scientific arguments (conservation of energy), can be found in many places in the writings of the German philosopher Friedrich Nietzsche (1844–1900)—see, for example, his *The Gay Science* (1882) and *Thus Spake Zarathustra* (1883)—again predating

[47]J. M. Blatt, "Time Reversal," *Scientific American*, August 1956.

[48]The googol is a gigantic number, far greater than the number of raindrops that have fallen on the Earth during its entire history. And the googolplex is light years beyond that.

[49]R. B. Braithwaite, "Professor Eddington's Gifford Lectures," *Mind*, October 1929, pp. 409-435.

[50]Pulp science fiction writers, of course, were not discouraged by such calculations, as they depended on the *certainty* of recurrence over *infinite* time. See, for example, S. G. Weinbaum, "The Circle of Zero," *Thrilling Wonder Stories*, August 1936, and L. D. Gunn, "The Time Twin," *Thrilling Wonder Stories*, August 1939.

[51]R. Small, "Incommensurability and Recurrence: From Oresme to Simmel," *Journal of the History of Ideas*, January-March 1991, pp. 121-137.

Poincaré. All of Nietzsche's arguments are flawed,[52] but they are rational, physical arguments, as opposed to arguments based on metaphysics or theology. In fiction, a glimmer of the idea of a repetition of human affairs preceded Poincaré by some years, too.[53]

An important caveat concerning recurrence is that we could never *know* of it because the state of all the historical records (geological, memories, books, photographs, and so on) would, as part of the physical state of the universe, also recur. And so those records could, up to the instant *before* the recurrence, contain no signature *of* the recurrence because the recurrence has not 'yet' happened![54] The 1993 movie *Groundhog Day* stumbles on this point, as it has a character (for some unexplained reason) live through the same day over-and-over *and he is aware he is doing that*. Indeed, he can change events within that time loop at will. It is interesting to note that one 'time loop' pulp science fiction tale[55] specifically avoided that error (and cited Nietzsche, to boot), and so demonstrated that pulp science fiction *could* have some philosophical merit to it.

While the enormous recurrence time for the universe may seem reason enough to reject the possibility of Pearl Harbor repeating, there are more fundamental reasons for such a rejection. For example, an *expanding* universe, such as the one we live in, violates the Poincaré theorem's assumed condition of a *fixed* volume system. As Professor Eddington put it in a 1934 lecture at Cornell University, "In an expanding space any particular congruence becomes more and more improbable. The expansion of the Universe creates new possibilities of distribution faster than the atoms can work through them, and there is no longer any likelihood of a particular distribution being repeated. If we continue shuffling a pack of cards we are bound sometime to bring them into their standard form — but not if the conditions are that every morning one more card is added to the pack."[56]

An even more direct way to escape Poincaré's theorem is to use a result from general relativity. Using Einstein's theory instead of the classical dynamics that Poincaré used, it has been shown (by Frank Tipler, the inventor of the rotating cylinder time machine spacetime that was mentioned in the previous chapters and which we'll revisit later in the book) that the recurrence theorem is simply no longer true.[57] As Tipler wrote, "In general relativity, singularities intervene to prevent recurrence. General relativistic Universes are thought to begin and end in singularities of infinite spacetime curvature [the Big Bang and the Big Crunch,

[52]J. Krueger, "Nietzschean Recurrence as a Cosmological Hypothesis," *Journal of the History of Philosophy*, October 1978, pp. 435-444.

[53]See "Human Repetends" by Marcus Clarke (1846-1881), a story originally published in 1872 and reprinted *Australian Science Fiction* (V. Ikin, editor), Academy Chicago 1984.

[54]For more on this point, see D. W. Theobald, "On the Recurrence of Things Past," *Mind*, January 1976, pp. 107-111.

[55]C. F. Ksanda, "Forever Is Today," *Thrilling Wonder Stories*, Summer 1946.

[56]A. S. Eddington, "The End of the World," in *New Pathways in Science*, Macmillan 1935.

[57]F. J. Tipler, "General Relativity and the Eternal Return," in *Essays in General Relativity* (F. J. Tipler, editor), Academic Press 1980.

respectively], and these singularities force time in general relativity to be linear rather than cyclic." A twist to this, however, is that in his analysis Tipler assumed that gravity is *always* attractive, and that the spacetime satisfies a special condition (called the *Cauchy condition* that we'll take-up later) that avoids backward causation. The first assumption is violated in wormhole time machine spacetimes, though, and the second is *by definition* violated in *any* spacetime that supports time travel! So, who knows . . .... ?

Despite all of the previous discussion it is *not* true that the evolution of a system from past to future is *always* accompanied by an increase in entropy—that is, by an irreversible increase in some measure of the system's 'disorder.' Yes, it can be calculated that entropy is *very likely* to monotonically increase in systems of macroscopic size, but that is not the same as certainty. There *can* be fluctuations in the thermodynamic evolution of a system so as to have, at least for a while, a *decrease* in entropy (take another look at Fig. 3.2). All we can say, for sure, is that for macroscopically sized systems even very small fluctuations in increasing entropy are most improbable. To quote no less an authority than the combined genius of Gilbert and Sullivan (from their opera *H. M. S. Pinafore*), here's what we can honestly say of the possibility of failure in the supposed inexorable increase of entropy: "What, never?/No, never!/What, never?/Well, hardly ever." Still, for physicists, entropy is just too useful a concept to give up even though it does not *always* increase with increasing time for an isolated system.

Love it though they may, there are some puzzling aspects to entropy for physicists that remain to this day. For example, the idea that the universe began in some sort of Big Bang process 15 billion years or so ago is the generally accepted view today, The puzzle of that event, one that has been described as literally being a 'fireball explosion,' is that it must have been *fantastically* hot. This means that at the beginning (of everything) there was complete thermodynamic disorder, which from our earlier discussion means *maximum* entropy. Thus, we immediately have the question of how can the entropy of the universe be continuously increasing if it was as large as possible right from the start?[58]

One possible answer is that the proper model of the universe to use is the so-called *inflationary* universe. The inflationary model has a very high expansion rate for the early universe, much higher than the rate in the standard hot Big Bang model. In the standard model, the entropy puzzle occurs because of the ability of all particle processes to readjust rapidly to the ever-changing state of the universe; the so-called *relaxation times* of all particle processes were *short* compared to the expansion rate of the universe. That means that the actual entropy of the universe would, indeed, be the maximum possible at every instant (and so we have the entropy puzzle). In the inflationary model, however, the expansion rate of the early universe was temporarily so high that the relaxation times of particle processes

[58]It has been estimated that over the next 10^{116} years the entropy of the universe will increase by a factor in excess of 10^{14}. See S. Frautschi, "Entropy in an Expanding Universe," *Science*, August 13, 1982, pp. 593-599.

were *very long* compared to the expansion rate. That means the maximum *possible* entropy of the universe, at every instant, would greatly exceed the *actual* entropy. This 'entropy gap' is the cause, then, of the thermodynamic arrow of time, as the universe tries to 'catch-up' and reduce the resulting entropy deficiency.

There is also a philosophical problem with associating increasing entropy with the flow of time from the past into the future. Events in the past leave traces, artifacts taken to be ordered states—or at least more ordered than are their immediate surroundings. The classic example of this is a footprint in the sand, which is clearly a highly organized structure compared to the surrounding sandy beach. The footprint is the trace of a *past* event; such a trace was all the evidence, for example, that Robinson Crusoe needed to conclude that another human had walked that way. But now consider this famous counter-example,[59] that of a bombed city. Certainly there are traces aplenty of past bombing, and in fact one has to be careful not to trip over or to fall into them! The puzzle, of course, is in trying to argue that random bomb craters, strewn rubble, and crushed buildings, somehow constitute a more organized state (a 'footprint') than did the original city and its surrounding undamaged areas. This fuzziness was captured by one physicist who asked "If it were found that the entropy of the universe were decreasing, would one say that time was flowing backward, or would one say that it is a law of nature that entropy decreases with time?"[60]

For another example of the fuzziness of the relationship between entropy and time, consider the situation[61] of a cloud of non-colliding particles all initially moving toward each other. At first the radius of the smallest sphere that contains the cloud decreases with time but, eventually, as the particles move past another, the radius will grow without bound. Indeed, that inexorable increase of the radius could be taken as defining the direction of time that points toward the future. But in what sense is the *disorder* of the particle cloud increasing? After all, as the cloud expands it 'looks the same' at all times; only its scale (radius) changes. What has entropy to do with this expanding-into-the-future cloud? Perhaps nothing. Perhaps what is need is a *new* arrow of time.

So far we have looked in some detail at two arrows of time: the subjective, psychological feeling we have of time 'flowing,' which has no explanation in physics, and the thermodynamic, statistical quantity of entropy. A third arrow is the so-called *cosmological arrow* of the expansion of the universe. This arrow is not nearly as obvious as the first two. Only in the last century (since the 1920s), as a result of the American astronomer Edwin Hubble (1889–1953), has science become aware that the universe *is* expanding. An interesting speculation about the thermodynamic and cosmological arrows, one made numerous times, is that if the cosmological arrow should ever reverse—that is, if the universe should ever begin to

[59]See note 54 in Chapter 2.

[60]P. W. Bridgeman, *Reflections of a Physicist*, Philosophical Library 1955, p. 251.

[61]Taken from K. G. Denbigh, "The Many Faces of Irreversibility," *British Journal for the Philosophy of Science*, December 1989, pp. 501-518.

contract toward a Big Crunch—then the thermodynamic arrow would also reverse.[62] The reasoning is that the thermodynamic arrow *follows* the cosmological arrow in an *expanding* universe because that universe can continually 'swallow-up' ever more electromagnetic radiation as it is produced by any physical process. *If* the thermodynamic arrow continues to follow the direction of the cosmological arrow during a contraction, *then* the thermodynamic arrow would also reverse direction.

The usual objection to that suggestion is straightforward. If the direction of time did reverse, then we would see (so goes this argument) all sorts of odd events that would require enormously improbable physics, such as a shattered glass mirror reassembling itself. The error in that objection is subtle but equally simple. *It presupposes the retarded causality of our expanding universe*. In a contracting universe with a reversed thermodynamic arrow of time, however, there would be *advanced* causality, and thus there would be nothing at all improbable about such doings as self-assembling mirrors. As two physicists observed, "The mere reversal of the cosmological expansion will not of itself serve to reverse the direction of thermodynamic and electrodynamic processes, any more than the compression phase of a piston-and-cylinder cycle in a heat engine serves to reduce the entropy of the confined gas."[63]

Those same physicists go on to then mention Stephen Hawking's interest in the relationships among the various temporal arrows. At one time Hawking thought[64] he had discovered a connection between the thermodynamic and cosmological arrows, but then later abandoned that claim.[65] Hawking, in fact, has labeled his original claim "my greatest mistake in science," and has quite openly (and most entertainingly!) discussed his interest in the arrows of time.[66] Indeed, it was to be the subject of his doctoral dissertation but, as he wrote, "I . . . needed something more definite, and less airy fairy than the arrow of time, for my PhD, and I therefore switched to singularities and black holes. They were a lot easier."

Yet another arrow of time is the *electromagnetic arrow*, which refers to the fact that radio waves are observed to only propagate into the future, and never into the past. This is a mysterious fact, because Maxwell's equations for the electromagnetic field, like all the other laws of physics, have no intrinsic time sense. The electromagnetic arrow will be discussed in some detail in Chap. 4.

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[62]T. Gold, "The Arrow of Time," *American Journal of Physics*, June 1962, pp. 403-410.

[63]P. C. W. Davies and J. Twamley, "Time-Symmetric Cosmology and the Opacity of the Future Light Cone," *Classical and Quantum Gravity*, May 1993, pp. 931-945.

[64]S. Hawking, "Arrow of Time in Cosmology," *Physical Review D*, November 15, 1985, pp. 2489-2495. See also the next paper in the same journal, D. N. Page, "Will Entropy Decrease if the Universe Recollapses?," pp. 2496-2499.

[65]For *why* he abandoned that claim, see S. Hawking *et al*., "Origin of Time Asymmetry," *Physical Review D*, June 15, 1993, pp. 5342-5356.

[66]S. W. Hawking, "The No Boundary Condition and the Arrow of Time,' in *Physical Origins of Time Asymmetry* (J. J. Halliwell *et al*., editors), Cambridge University Press 1994.

3.3 Time Dilation

> "Time as we know it is not universally absolute. The rate of its passage depends to a great extent upon the velocity of its observer with regard to some certain reference system. A moving clock will run slower with respect to a selected coordinate system than a stationary one."
>
> —an early science fiction time traveler explains how his time machine works[67]

In this section I'll set the stage for the scientific basis of time travel to the future, as well as for time travel to the past via the warped spacetime called a wormhole. We start by imagining two horizontal, parallel mirrors, one positioned over the other and separated by distance d. The two mirrors are in the same frame of reference with an Observer; that is, the Observer is looking at two mirrors that are stationary with respect to him. Between the two mirrors we further imagine that a particle of light, a photon, is bouncing endlessly back and forth, up and down, in relentless reflection. This simple system is called a *photon clock*, or the Einstein-Langevin clock, after the French physicist Paul Langevin (1872–1946), and it has been part of physics for decades. We define the time required for the photon to travel from one mirror to the other as a *tick* in time, and so the return trip defines the clock's *tock*. The rate of timekeeping measured by the Observer, the time interval separating consecutive ticks, is obviously then given by

$$t' = 2\frac{d}{c}$$

where c is the speed of light.

Suppose we next imagine that the Observer and the photon clock move at constant speed v to the right across *our* line-of-sight. That is, we remain in the original frame while the photon clock and the Observer are now moving at speed v relative to us. This means the photon clock is in a different frame of reference from ours and so *we* do not see the photon bouncing up and down vertically, but rather *we* see the photon tracing out the triangular path shown in Fig. 3.3.

A round trip of the photon evidently now requires more time than before because the distance in the stationary frame (our frame) is greater than the round trip distance in the Observer's frame (moving with the photon clock, he still sees a round trip distance of d). In fact, if t is the time between consecutive ticks as seen by a stationary viewer (us), then the round trip path length of the photon that we see is

$$2\sqrt{d^2 + \left(\frac{vt}{2}\right)^2}$$

[67] F. J. Bridge, "Via the Time Accelerator," *Amazing Stories*, January 1931.

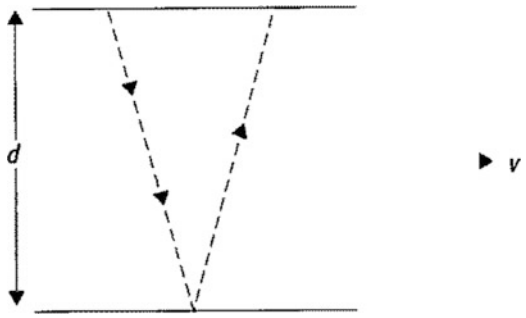

Fig. 3.3 The moving (relative to us) photon clock

and so

$$t = \frac{2\sqrt{d^2 + \left(\frac{vt}{2}\right)^2}}{c}.$$

This can be easily and quickly manipulated algebraically and combined with the earlier expression for t', the tick interval for an Observer in the same frame as the photon clock, to give the tick interval for the moving clock *as measured by a stationary viewer* (us):

$$t = \frac{t'}{\sqrt{1 - \left(\frac{v}{c}\right)^2}}.$$

Notice that this reduces to $t = t'$ when $v = 0$—that is, when the photon clock is stationary with respect to us.

This last result is the famous Einstein time dilation formula, which shows that $t \geq t'$, and indeed that $t = \infty$ when $v = c$. That is, to us the moving photon clock appears to *run slow* compared to clocks in our stationary frame of reference and, at the speed of light, time *stands still*.[68] A curious anticipation of this association between light and timelessness can be found in a poem by the seventeenth-century poet Henry Vaughn who, in the opening words to his "The World"—which appeared in 1650 as part of his *Silex Scintillans* ("Sparking Flint")—wrote

"I saw Eternity the other night
Like a great *Ring* of pure and endless light,
All calm, as it was bright,
And round beneath it, Time in hours, days, years
Driven by the spheres
Like a vast shadow moved, in which the world
And all her train were hurled."

[68]For $v > c$ the time dilation formula says that time becomes imaginary, and this is one reason for claiming that $v > c$ is not possible. The time dilation formula has been experimentally verified: see H. E. Ives and G. R. Stilwell, "An Experimental Study of the Rate of a Moving Atomic Clock," *Journal of the Optical Society of America*, July 1938, pp. 215-226.

A similar modification in the length of a moving object (measured in the direction of motion) occurs when $v > 0$. While an Observer moving with the object will measure its length to be L', a stationary viewer will 'report' it to be contracted to the length

$$L = L'\sqrt{1 - \left(\frac{v}{c}\right)^2}.$$

This effect is called the *Lorentz-FitzGerald contraction*.[69] For 'everyday' objects and speeds the contraction effect is an extremely small one. For example, for a low-altitude satellite 100 m long, moving at 18,000 miles per hour (that is, at $v = 2.7 \times 10^{-5}c$), the contraction is less than 4×10^{-6} cm.

In the early days of science fiction the contraction effect was fascinating to readers, but authors often got it wrong. For example, in one story[70] of a runaway spaceship falling into the Sun, we read "When our racing [ship] was drawn from the Earth's gravity and fell at ever increasing speed toward the Sun it soon approached the speed of light. As we fell faster and faster our length in the direction of the Sun progressed into nothingness. Then — it reached the speed of light — passed it. Now — mind you this — when the [ship] attained the speed of light it was of a *minus* length." This author has managed to make four errors in three sentences!

The same author botched the Lorentz-FitzGerald contraction again 5 years later, and added yet more errors to his growing list. In that tale[71] there is an episode of faster-than-light radio communication along with a lengthy, unfortunate dissertation that actually denies special relativity's fundamental assertion that all inertial frames of references are indistinguishable from each other (two frames are *inertial* if they have no relative acceleration—I'll say more on this in the next section). And in yet another story[72] of high-speed space travel the author has the contraction working in the wrong direction—as the rocket ship moves faster and faster it gets longer and longer.

As bad as those errors are, first prize for mangling the laws of physics has to go to the story[73] of a near light-speed spaceship on its way to Alpha Centauri. The crew mutinies and puts the captain and first office 'overboard' (think *Mutiny on the Bounty*) with 6 months' worth of provisions. This happens at mid-voyage, about 2 light-years from both home and destination, so matters look grim. Indeed, the author tells his readers, several times, that things look *very* bad. But are they? With a stated speed of 162,000 miles per second, the time dilation factor is slightly more than 2 and so, because the space boat is traveling at $0.87c$, it will take a little more

[69]Named after the Dutch physicist H. A. Lorentz (1853-1928) and the Irish physicist G. F. FitzGerald (1851-1901).

[70]J. H. Haggard, "Faster Than Light," *Wonder Stories*, October 1930.

[71]J. H. Haggard, "Relativity to the Rescue," *Amazing Stories*, April 1935.

[72]D. Wandrei, "A Race Through Time," *Astounding Stories*, October 1933.

[73]N. Schachner, "Reverse Universe," *Astounding Stories*, June 1936.

Table 3.1 The Lorentz-FitzGerald time slowing factor

1	$\frac{1}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$
.1	1.005
.2	1.021
.5	1.155
.7	1.4
.9	2.294
.999	22.366
.9999	70.712

than 13 months of *space boat time* to complete the journey. If the men go on half-rations then it seems they *could* survive.

There is, of course, the problem of slowing down so as to arrive at Alpha Centauri at a reasonable speed, but that issue is ignored in the story. Instead, our attention is directed to the much more dramatic concern of a faster-than-light planet (don't ask!) colliding with the space boat and carrying the castaways onwards toward their destination. When this happens we read that time runs backwards (for what *really* occurs at superluminal speeds, keep reading this chapter) and, finally, in a repeat of an error I mentioned earlier, we are told that the Lorentz-FitzGerald contraction is negative for $v > c$.

The time-slowing (or size-shrinking) factor becomes pronounced only at values of v close to c, as shown in Table 3.1. For example, the last entry shows that a clock traveling at 99.99 % the speed of light will register the passage of 1 year while nearly 71 years pass on Earth. One science fiction writer got this dramatically wrong, even though he actually reproduced the Lorentz-FitzGerald equation in his story.[74] At one point he writes of the near light-speed rocket ship that stars in the tale, "If it [the ship's speed] was as slow as ninety-four percent [of the speed of light] . . . for every moment ticked by the clocks of the [ship] hundreds passed on earth." In fact, the time dilation factor at that speed is 'only' 2.93.

One possible objection to time dilation is that the analysis done here has been for a *particular* clock. How do we know that another clock, one using wheels and pendulums, for example, instead of photons and mirrors, wouldn't be affected differently by motion? The answer comes from relativity itself, which says there is no way to detect uniform motion. If two clocks did behave differently, then this difference could be used as a motion detector. Since this is impossible within the framework of relativity, then *all* clocks, no matter what the details of their internal

[74] L. R. Hubbard, "To the Stars," *Astounding Science Fiction*, February and March 1950.

mechanisms may be (including the *biological* clocks of own bodies), must respond to motion just as does the photon clock.[75]

Time dilation can also be caused by gravity (it appears in the 2014 movie *Interstellar*), and that effect has been used to 'construct' a time machine from a wormhole (to be discussed later). You can get a qualitative understanding of how that happens by imagining a massive body (*massive*, to have a really big gravitational field) in space, on the surface of which is a hot object. That object emits electromagnetic radiation and, though it isn't essential to the following argument, further imagine that the temperature of the object is sufficiently high that some of the radiation (emitted by the very atoms of the object) is in the visible-light portion of the spectrum. Now, from elementary quantum theory we can also think of the object's atoms as emitting photons ('particles of light'), each of energy hf, where h is Planck's constant and f is the frequency in hertz (what used to be called 'cycles per second'). The higher the temperature, the higher the photon energy, and so the higher the frequency. In the visible spectrum, f is on the order of 10^{15} Hz, a frequency one *billion* times higher than commercial AM radio frequencies.

The radiating atoms can be thought of as tiny clocks, with alternate half-cycles of radiation being ticks and the half-cycles in-between being the tocks. The passage of time on the surface of the massive body can be measured by these atomic clocks in the hot, radiating object. To a distant observer, however, as she receives the photons from the hot object, the passage of surface time on the massive body will appear to occur at a reduced rate when compared with the photons emitted by her own identically hot object (her 'local' clock). That's because the radiation that arrives at the distant observer has traversed a gravitational field (a journey sometimes described as 'climbing out of a gravitational well') and so is down-shifted in frequency toward the red end of the visible spectrum. This effect is called either the *gravitational red shift* or the *gravitational time dilation* effect (or even the *Einstein shift*, because it was Einstein who predicted the effect in 1907).

You can 'understand' this dilation effect as follows. One can crudely think of a photon emitted by the hot object as something like a rock thrown upward. As the rock rises upward through the gravitational field, its *total* instantaneous energy is always constant, but the total, fixed energy is split between its kinetic and potential energies in an ever changing way. That is, as the rock rises, its kinetic energy continually decreases (the rock slows down), whereas its potential energy continually increases. A photon is not a rock, however, and it certainly can't slow down as

[75]Resistance to this conclusion persisted for years. See, for example, the letter "Relativity and Radio-activity," *Nature*, January 8, 1920, p. 468. The author of that letter wondered whether a clock based on radioactive decay might not somehow beat the 'conspiracy' of moving clocks running slow compared to stationary ones. And in a letter to *Science* (December 7, 1962, p. 1180), a reader objected to applying the laws of physics to biological systems, first asserting (incorrectly) that time dilation "has never been proved or disproved experimentally," and then "there is no known causal means by which greatly increased velocity could alter, without destroying the very biochemical basis of the life process, the metabolic changes which are responsible for the aging process."

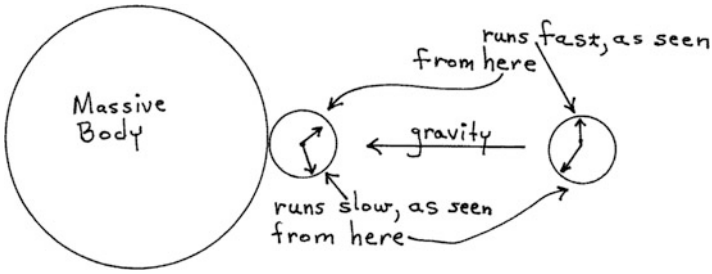

Fig. 3.4 Gravitational time dilation due to a massive body

it rises through a gravitational field (it *always* moves at the speed of light because the photon *is* light). The only way a photon can give up energy to balance the ever increasing potential energy (physicists will cringe at this, but read on) is to decrease its frequency. Hence, the red shift as seen by a distant observer of the photon, who thus sees time running slow on the massive body. Fig. 3.4 shows the case for a clock on a massive body, compared to a distant clock. Notice, carefully, the 'direction of gravity,' that is, the direction a small, unrestrained test mass will move.

A gravitational red shift in the *opposite* direction is nicely described in the famous 1966 science fiction story "Neutron Star" by Larry Niven. There a space traveler zooms down into a neutron star's intense gravity field (at half the speed of light!), passing within one mile of the star's surface. He reports what he observes in these dramatic words: "All around me were blue-white stars. Imagine light falling into a savagely steep gravitational well. It won't accelerate. Light can't move faster than light. But it can gain in energy by increasing its frequency. The light was falling on me, harder and harder, as I dropped." To Niven's intrepid spaceman, therefore, the passage of time on those distant blue-white stars appeared to be running *fast* compared to his wrist watch. This shows that the effect could equally well be called the 'gravitational *blue* shift.'

Notice that *gravitational*-induced time alterations do *not* have the symmetrical feature of motion-induced time dilations.[76] That is, for gravitational time dilations caused by photons either falling into or climbing out of gravity wells, observers at each end *agree* about whose clock is running slow, unlike in the motion-induced case where *each* of the relatively moving observers thinks it is the *other* observer's clock that is running *slow*.[77]

Now, comparing a massless photon to a rock which does have mass (and so potential energy), as each travels 'against' gravity, *is* straining the physics, with its one virtue being the provision of an initial plausibility argument. Gravitational time dilation is sufficiently important in the operation of wormhole time machines,

[76]Gravitational time dilation was experimentally observed in 1960, more than half a century after Einstein predicted it.

[77]A science fiction use of both the red and the blue gravitational shifts appears in the novel by J. P. Hogan, *Out of Time*, Bantam 1993.

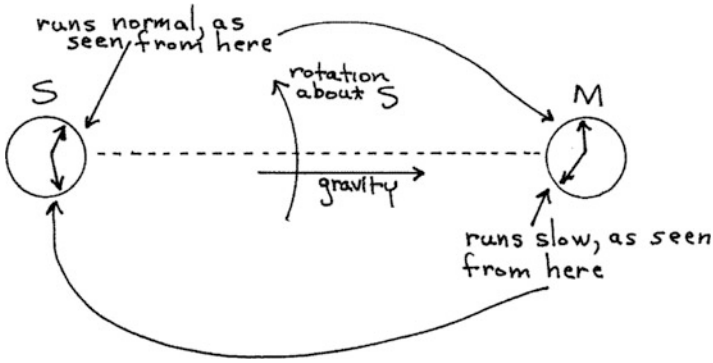

Fig. 3.5 Gravitational time dilation due to rotation

however, that perhaps another way to think about it that is more acceptable to hardcore physicists makes it worth another look. Imagine a turn-table disk that initially is *not* rotating (soon it *will* spin). On this disk imagine further that we fasten two clocks, one called S (for *stationary*) and one called M (for *moving*), as shown in Fig. 3.5. These two clocks are set to read the same time at some instant and then, thereafter, they tick-tock through time at precisely the same rate. We then start the disk rotating around a vertical axis through clock S. (Imagine S to be a *point* clock, and so it is *the* one point on the turn-table that remains at rest even as the disk rotates.) What happens to the time-keeping of S and M?

We can answer this question by using our earlier result concerning time dilation due to motion. Even with the disk now rotating, S appears stationary to an observer sitting on top of M, while M appears to be moving across the line of sight of an observer sitting on top of S. So, to the observer at S, clock M runs slow, while to the observer at M there is *no change* in the time keeping of clock S. This is a non-symmetrical outcome, and so should remind you of gravitational time dilation. This might be a puzzle to you, however, as we don't have a massive body in Fig. 3.5 to account for a gravity presence. This is where the genius of Einstein comes into play.

Anyone who has ever ridden on a merry-go-round knows there is an outward (pointing away from S) directed force called the *centrifugal force* that is 'trying' to toss you off the merry-go-round. Now, where there is a force there is an acceleration, and one of Einstein's starting points in his development of general relativity was to identify an acceleration, *whatever its origin*, with gravity. A massive body is, of course, one possible origin (the obvious one, in fact), but so is the rotation of the turn-table. So, we have the situation shown in Fig. 3.5, where now 'gravity' is directed as shown and, and as in Fig. 3.4, the direction of acceleration of gravity is toward the slow-running clock. Again, the direction of gravity is the direction a small, unrestrained test mass on the rotating disk will move. The further M is away from S, the greater the 'gravity' of the centrifugal acceleration and so the slower will M run as measured by the observer at S.

A 1968 story that uses the gravitational time dilation effect in a striking fashion tells of a starship's visit to a supernova, accompanied by a fantastic alien life-form—a ball of intelligent plasma named Lucifer that is telepathic.[78] While the ship stands off at a distance of 500 million kilometers, Lucifer will approach much closer to the *event horizon* (see the Glossary) of a black hole at the center of the supernova explosion and communicate its findings to a human telepath on the ship. A physicist in the crew is curious about one point, and asks the human telepath the following question:

"I have wondered about one item. Presumably Lucifer will go quite near the supernova. Can you still maintain contact with him? The time dilation effect, will that not change the frequency of his thoughts too much?"

Lucifer, in fact, dies in the black hole even as he saves the ship from destruction, and the human telepath will hear his death scream for the rest of her life. As the physicist later explains to the ship's captain, telepathy is instantaneous and has no limiting range (there is no known physical basis for believing any of this, but it is crucial for story effect):

> "Remember the time dilation. He fell from the sky and perished swiftly, yes.
> But in supernova time. Not the same as ours. To us, the final stellar collapse takes an infinite number of years. . . . He will always be with her."[79]

3.4 The Lorentz Transformation

> "If only he'd paid more attention to mathematics in school."
> —a science fiction time traveler laments missed opportunities[80]

In this (and the next) section the math gets about as 'deep' as it gets in this book, but to leave it out struck me as a cheat. *You* can skip part (or all) of the math and simply read the prose, but it seemed unfair for me to make that decision for you.

We begin by imagining two distinct frames of reference. One we take to be stationary, and the other as moving at a uniform speed v with the respect to the first. The moving frame is said to be *boosted* with respect to the stationary frame. We orient these two coordinate systems so that the motion occurs along just one axis (the x-axis, as shown in Fig. 3.6, where I am using primed variables for the moving frame). That is, the two frames have coincident x axes, and parallel y and z axes that

[78] Poul Anderson, "Kyrie," in *The Road to Science Fiction* (J. Gunn, editor), volume 3, New American Library 1979.

[79] A mathematical discussion of how signals take forever (even though they are emitted in a finite time interval) to travel from the event horizon of a black hole to a distant receiver can be found in James B. Hartle, *Gravity: an introduction to Einstein's general relativity*, Addison Wesley 2003, pp. 264-268.

[80] D. Knight, "Extempore," in *Far Out*, Simon and Schuster 1961. Similar words ("If only I had more mathematics") were spoken by Einstein the day before he died — see Walter Isaacson, *Einstein: his life and universe*, Simon & Schuster 2007, p. 542.

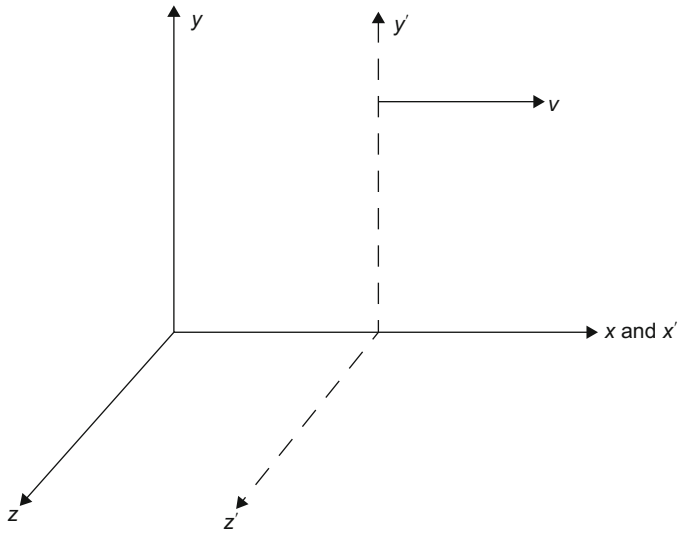

Fig. 3.6 Two reference frames in relative motion

are moving apart at the constant speed v. Let's also imagine that there is a clock at the origin of each frame, and that at the instant the origins match the clocks are synchronized; that is, $t = t' = 0$ is the instant the two coordinate systems coincide.

We further imagine that there is an observer at the origin in each frame. At some arbitrary instant of time, each observer records the coordinates of the arbitrary point P in space, as measured in his system. These observers could, for example, agree to record the coordinates of P in their system when their clock reads 5 s. It seems immediately obvious (as it was for Newton) that $t = t'$; that is, time runs at the same rate in each frame and thus it makes sense to talk about "the same instant" at every point in space. (After reading the previous section you know this *not* true, but temporally forget that!) Thus, at this 'same instant' the stationary observer records (x, y, z) and the moving observer records (x', y', z'). What are the relationships between the primed and unprimed coordinates of P? That is, what mathematical transformation converts from one frame to the other?

The answer seems obvious:

$$y' = y$$
$$z' = z$$
$$x' = x - vt.$$

This transformation, called the *Galilean transformation* after the Italian Galileo Galilei (1564–1642), satisfies the relativity principle, which says that uniform motion leaves the laws of physics unchanged. For example, in the stationary system Newton's famous second law of motion for a constant mass m,

$$F = m\frac{d^2x}{dt^2}$$

becomes the identical-appearing form

$$F' = m\frac{d^2x'}{dt'^2}.$$

More precisely, *all* the laws of mechanics known to Newton are unchanged. Any frame of reference in which Newton's laws of mechanics hold true is said to be an *inertial* frame. Given one inertial frame, we can find infinitely many others simply by applying the Galilean transformation.

However, when the mathematical laws of electrodynamics were discovered by Maxwell in the nineteenth century, it was a shock to physicists to learn that the Galilean transformation does *not* leave Maxwell's equations unchanged in form; the transformed equations predict electromagnetic effects for the moving system that are *not* predicted to occur in the stationary system. This meant that there was theoretical support for the possibility that electromagnetic experiments might be devised to detect uniform motion, and this eventually led to the famous Michelson-Morley experiment of 1887. This experiment, sensitive enough to detect the motion of the Earth itself through space, failed to detect any such motion. The conclusion was clear: the new electromagnetic effects predicted by the Galilean transformation do not exist, and so the transformation must be wrong even though it works for the laws of mechanics. So—what is going on?

The answer is inspired, and again returns us to the cornerstone of relativity: the idea that the laws of physics, *all* the laws, should look the same to observers in uniform relative motion. That is, there is no special or preferred system of coordinates—*all* inertial systems are equivalent in physics. Evidence from an extremely broad variety of sensitive experiments had, by the end of the nineteenth century, convinced physicists that Maxwell's equations *are* correct. Thus, a new transformation was needed that leaves both the laws of mechanics *and* the laws of electrodynamics unchanged with uniform motion. But, a single transformation that works on Maxwell's equations and on the mechanical laws would therefore mean that Newton's mechanical laws as stated cannot be correct, and this was a breathtaking conclusion: Newton had been unchallenged for two centuries.

As it turns out, Newton's laws are *almost* right. The only correction required is that the mass of a moving body is not independent of motion, but rather varies as

$$m = \frac{m_0}{\sqrt{1 - (v/c)^2}}$$

where m_0 is the so-called *rest mass* when $v = 0$.[81] This result says that m is infinite at $v = c$ unless $m_0 = 0$ (as it is for a photon), which is another reason for the belief that accelerating a mass (such as a spaceship) up to the speed of light is impossible because it would require infinite energy (look back at note 68, too). With this modification, the transformation that leaves all the laws of physics unaltered in form by uniform motion is what is called the *Lorentz transformation* (after the same Lorentz the contraction effect is named for), who discovered it in 1904 by direct manipulation of Maxwell's equations:

$$y' = y$$
$$z' = z$$
$$x' = \frac{x - \mathrm{vt}}{\sqrt{1 - (v/c)^2}}$$
$$t' = \frac{t - \mathrm{vx}/c^2}{\sqrt{1 - (v/c)^2}}.$$

In 1905 Einstein discovered how to derive these equations from a fundamental reexamination of space and time without concerning oneself about the details of specific physical laws.

By simple algebraic manipulation, the transformation equations can be rewritten as

$$ct = \gamma ct' + \beta\gamma x'$$
$$x = \beta\gamma ct' + \gamma x'$$

where

$$\beta = \frac{v}{c}$$

and

$$\gamma = 1/\left(1 - \beta^2\right)$$

are dimensionless constants. In compact matrix form, the Lorentz transformation becomes

[81]This variation of mass with speed was experimentally observed in 1901.

$$\begin{bmatrix} ct \\ x \end{bmatrix} = \begin{bmatrix} \gamma & \beta\gamma \\ \beta\gamma & \gamma \end{bmatrix} \begin{bmatrix} ct' \\ x' \end{bmatrix}$$

and the symmetrical 2×2 matrix is called the Lorentz boost matrix or simply the *boost*. Notice that when $v = 0$ (zero boost) the boost matrix reduces to the identity matrix; that is, the two frames are one and the same with at most a shift in the location of the origins. Note, too, that $\beta = 0$ and $\gamma = 1$ for *any* v when c is infinite—that is, the boost matrix is again reduced to the identity matrix and the Lorentz transformation becomes the Galilean *if* c is infinite. But c is not infinite, and all the implications of special relativity are the direct result of the *finite* speed of light.

The Lorentz transformation contains two results I have mentioned earlier in the book. For example, in Chap. 2 it was mentioned that simultaneity is a relative concept in reference frames in relative motion. Let's see what the transformation says about that. Consider two events that occur specifically on the x-axis. They are simultaneous in the stationary system (at, say, time $t = T$) but are at different places (at, say, $x = X$ and $x = X + \Delta X$). Their occurrences in time for the moving observer are

$$t_1' = \frac{T - \mathrm{v}X/c^2}{\sqrt{1 - (v/c)^2}}$$

and

$$t_2' = \frac{T - \mathrm{v}(X + \Delta X)/c^2}{\sqrt{1 - (v/c)^2}}.$$

For the moving observer, therefore, the two events are *not* simultaneous, being separated in time by

$$t_1' - t_2' = \frac{v\Delta X/\mathrm{c}^2}{\sqrt{1 - (\mathrm{v}/\mathrm{c})^2}}.$$

Only if $\Delta X = 0$ (the two events occur at the same place) will $t_1' = t_2'$. That is, only if $\Delta X = 0$ are simultaneous events in one frame also simultaneous in another frame in relative motion.

And in the previous section we found that time runs slow in one frame as observed from another frame that is in relative motion. We can get this result from the t' equation of the Lorentz transformation by differentiating it with respect to t. Thus,

$$\frac{dt'}{dt} = \frac{1 - (v/c^2)\frac{dx}{dt}}{\sqrt{1 - (v/c)^2}}.$$

But since

$$\frac{dx}{dt} = v,$$

the speed of the moving frame as measured by the observer in the stationary frame, this gives

$$dt' = \sqrt{1 - (v/c)^2}\,\mathrm{dt}$$

which is the same result we obtained by analyzing the photon clock.

The Lorentz transformation contains other interesting implications beyond these. For example, mention has been made several times to the 'relativity principle,' the belief that uniform motion has no observable effect on the forms of physical laws. But how do we know who is moving and who is stationary? After all, a system moving to the right past a stationary system could just as well be thought as the stationary system, while it's the *other* system that is moving to the *left* (at speed $-v$).

To study this question with the Lorentz transformation, we'll invert the transformation (that is, solve for the unprimed variables in terms of the primed ones). What we get back is just what you probably thought—the Lorentz transformation with v replaced by $-v$. That is, the Lorentz transformation is symmetrical, so two observers in different frames of reference each say it is the *other's* clock that is running slow! This follows immediately, in fact, from the original transformation written in matrix form. That is, multiplying through the earlier matrix equation by the inverse of the boost matrix, we get

$$\begin{bmatrix} ct' \\ x' \end{bmatrix} = \begin{bmatrix} \gamma & \beta\gamma \\ \beta\gamma & \gamma \end{bmatrix}^{-1} \begin{bmatrix} ct \\ x \end{bmatrix} = \begin{bmatrix} \gamma & -\beta\gamma \\ -\beta\gamma & \gamma \end{bmatrix} \begin{bmatrix} ct \\ x \end{bmatrix}.$$

The only difference between the original boost matrix and its inverse (which is, of course, the new boost matrix for the new interpretation of which frame is the moving one) is a change in sign for β, that is, in the sign of v. The inverse transformation is

$$y = y'$$
$$z = z'$$
$$x = \frac{\mathrm{x}' + \mathrm{vt}'}{\sqrt{1 - (\mathrm{v/c})^2}}$$
$$t = \frac{\mathrm{t}' + \mathrm{vx}'/\mathrm{c}^2}{\sqrt{1 - (\mathrm{v/c})^2}}.$$

As a final example of what the Lorentz transformation tells us, consider the so-called *addition of velocities* problem. Suppose you are in a high-speed spaceship traveling past Earth at speed v. Earth is the stationary system (with the unprimed variables), and the spaceship is the moving system (with the primed variables). Assume the x and x′ axes are along the direction of motion. Imagine next that while standing in the nose of the spaceship, just as the spaceship passes Earth, you fire a gun in the direction of motion (away from the Earth), with the bullet exiting the gun with a muzzle speed of w. How fast is the bullet moving away from Earth? The common-sense answer in Galileo's time was $v + \mathrm{w}$, but we now know that the Galilean transformation is wrong. What does the Lorentz transformation say?

Inside the spaceship, the position of the bullet at time t' after the gun is fired is

$$x' = wt'.$$

From the inverse Lorentz transformation, the location of the bullet earth's frame is

$$x = \frac{x' + \mathrm{v}t'}{\sqrt{1 - (v/c)^2}} = \frac{w + \mathrm{v}}{\sqrt{1 - (v/c)^2}} t'.$$

The transformation also tells us that (using $x' = wt'$)

$$t = \frac{t' + \mathrm{v}x'/c^2}{\sqrt{1 - (v/c)^2}} = \frac{1 + \mathrm{wv}/c^2}{\sqrt{1 - (v/c)^2}} t'.$$

Thus, the speed of the bullet in *Earth's frame* is

$$\frac{x}{t} = \frac{w + \mathrm{v}}{1 + \mathrm{wv}/c^2}.$$

Notice that for a low-speed bullet ($w << c$) this result[82] is close to $w + v$, but at high values for w the result is very much different. Indeed, suppose we don't fire a gun at all, but rather replace it with a flashlight. Now, instead of a bullet, we shoot *photons* at $w = c$. The Galilean transformation would (incorrectly) say that a stationary observer on Earth would see the photons moving away at speed $v + \mathrm{c}$,

[82]This result was found by the French physicist Henri Poincaré (1854-1912) in June 1905, three months *before* the publication of Einstein's special theory of relativity which also contains the result. And it was Poincaré who first stated (in 1904) that "no velocity can surpass that of light, any more than any temperature could fall below the zero absolute."

which is a superluminal speed. The Lorentz transformation, however, says that the Earth observer would see a speed of

$$\frac{c+\mathrm{v}}{1+\mathrm{cv}/c^2}=\frac{c^2(c+\mathrm{v})}{c^2+\mathrm{cv}}=\frac{c^2(c+\mathrm{v})}{c(c+\mathrm{v})}=c.$$

That is, no matter what the speed of the moving observer on the spaceship is, he sees the light from his flashlight traveling at the same speed as does the stationary observer back on Earth. This peculiar effect is unique to the speed of light ($w=\mathrm{c}$). We've derived it here as a consequence of the Lorentz transformation, but in fact Einstein actually did things in reverse order. That is, he began by *postulating* the invariance of the speed of light[83] for all observers in uniform motion, combined that with the principle of relativity which says all physical laws look the same to those observers, and so derived the Lorentz transformation using no mathematics beyond high school algebra.

A mathematically elegant alternative derivation of the addition-of-velocities formula can be done by simply noticing that the condition of two successive boosts should be, itself, a boost. Thus, if we have a frame moving relative to a second frame (which is itself moving relative to a third frame), then the boost matrix of the first frame relative to the third frame is the product of the two individual boost matrices. That is,

$$\begin{bmatrix}\gamma_3 & \beta_3\gamma_3\\ \beta_3\gamma_3 & \gamma_3\end{bmatrix}=\begin{bmatrix}\gamma_2 & \beta_2\gamma_2\\ \beta_2\gamma_2 & \gamma_2\end{bmatrix}\begin{bmatrix}\gamma_1 & \beta_1\gamma_1\\ \beta_1\gamma_1 & \gamma_1\end{bmatrix}.$$

From this it is easy to show (if you know how to multiply matrices!) that

$$\beta_3=\frac{\beta_1+\beta_2}{1+\beta_1\beta_2}.$$

Substitution of

$$\beta_1=\frac{w}{c},\ \beta_2=\frac{v}{c}$$

immediately gives the addition-of-velocities formula.

A failure to understand the implications of the invariance of the speed of light resulted in two stupendous errors in the story "To the Stars," cited in note 74. At all times an officer stands watch on the bridge of a near light-speed rocket ship to be sure the ship doesn't accidently *reach* the speed of light. This is to be avoided (according to the author) because to reach the speed of light would cause the ship to

[83]Einstein's postulate was experimentally confirmed in 1932.

"hang there forever unmoving [in time] ... locked, protected and condemned to eternity by zero time." This horrible state is so easy to stumble into (the author was apparently unaware that it would require *infinite* energy) that occasionally the ship has to fire a 'check-blast' from its forward rocket tubes to slow down! Equally absurd is the means by which the development of this 'fatal' condition is detected: the nose of the ship mounts a forward-pointing light source (our earlier flashlight) and so, if the ship is getting too near the speed of light, it will start to *overtake* the photons emitted by that source!

The biggest puzzle of all, actually, is why the editor of *Astounding Science Fiction* let such a technically goofy story appear in a magazine recognized for its usual faithfulness to known science. Particularly so since the story appeared in 1950 and, as long ago as December 1937, none other than Isaac Asimov (then 17 years old) had written a letter to the editor[84] giving the proper interpretation of what happens when $v = c$. Here's what the young Asimov wrote (notice the early hint of his life-long pessimism concerning time travel to the past that appears near the end of his letter):

> "The effect on time of increasing speeds is ... well known. Relativity states that as speed approaches that of light, time slows up until at 186,000 miles a second, time (so to speak) stands still. This seems to refute statements found in so many astronomy books (and science fiction stories) that even at the speed of light it would take four years to reach the nearest star. No such thing! As time halts at the speed of light, a person traveling from Alpha Centauri to the solar system, or vice-versa, would not be aware of any lapse of time. In that sense the speed of light is infinite (as was thought in ancient times). This by the way offers an entirely scientific (if impractical) means of travel into the future. Say that someone wants to see how the world would look a hundred years from now. His procedure would be as follows: getting into his spaceship, he would proceed to a spot fifty light-years away at the speed of light. The journey would, for him, be practically instantaneous (due to the curious behavior of time at the speed of light). But fifty years would have elapsed on earth. He makes the return trip at the same speed. Another fifty years lapse on earth and he lands a hundred years after his time. With this system, however, it would be impossible to travel into the past, so I don't think it will ever be adopted."

Young Asimov missed an important detail concerning the reversal of the spaceship's direction of travel for the return to Earth, and I'll come back to it later in this chapter. But certainly he displayed a *far* better knowledge of the physics of time than did the author of "To the Stars" (who was, by the way, L. Ron Hubbard, a prolific writer of fantasy and science fiction before founding the Church of Scientology).

[84]The editor who bought "To the Stars" was the same editor editor of *Astounding* when Asimov's letter appeared, and so he was certainly aware of it.

3.5 Spacetime Diagrams, Light Cones, Metrics, and Invariant Intervals

> "Come back when you know tensor calculus and I'll explain to you about n-dimensional forces and the warping of world-lines."
>
> —a science fiction physicist's reply after being asked how his time machine works[85]

It is helpful in discussions about the spacetime of special relativity to use what are called *Minkowski spacetime diagrams*. These are plots of the spacetime coordinates of a particle; the resulting curve is called the *world line* of the particle. Such diagrams are four-dimensional—three space axes and one time axis—and hard to visualize, much less draw on a flat sheet of paper! The convention is to make do, whenever possible, with a simplified spacetime that has just one space axis (horizontal) and one time axis (vertical). As you'll recall from Chap. 1, physicists often call such a simplified diagram a *toy spacetime*.

So, for a particle at rest in some observer's frame of reference, its spacetime diagram for that observer is a *vertical* world line. If the particle is not at rest then its world line will tilt away from the vertical; the greater the speed the greater the deviation from the vertical. Accelerated particles will have world-lines that *curve* away from the vertical. Straight, uncurved world lines represent unaccelerated particles, that is, particles experiencing no forces and so in free fall. Such a world line is called a *geodesic*. In Fig. 3.7 the world lines for these various cases are shown on the same axes. It is assumed in the figure that all three particles are at $x = x_0$ when $t = 0$.

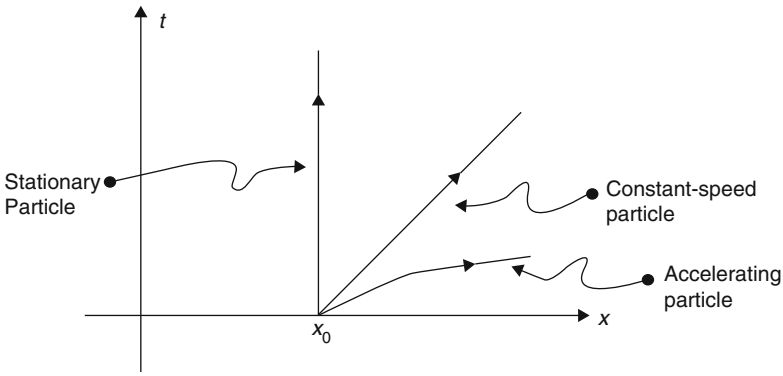

Fig. 3.7 World lines of three particles

[85] Poul Anderson, "The Little Monster," in *Science Fiction Adventure from WAY OUT* (R. Elwood, editor), Whitman 1973.

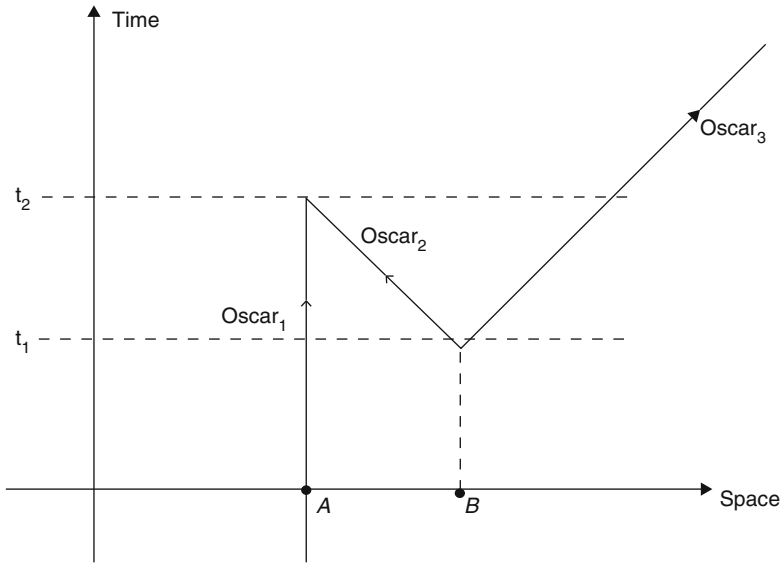

Fig. 3.8 A time traveler and his world line

Spacetime diagrams were embraced decades ago by philosophers looking for 'scientific' ways to support their position on time travel (whatever it might be), as opposed to the mere verbiage of traditional colleagues. A famous example of this is a 1962 paper by the Harvard philosophy professor Hillary Putnam (note 74 in Chap. 1). There we are asked to imagine the spacetime diagram of one Oscar Smith who, in Fig. 3.8, is at spatial location A next to his time machine. At time t_0 Oscar has not yet gotten into his time machine. A little later, at time t_1, we suddenly see not only Oscar at A but also *two more* Oscars who have appeared (apparently out of thin air) moving away from spatial location B! Between t_1 and t_2 we see the original Oscar at A and the two mysterious Oscars at B (for a total of three Oscars, labeled in the figure as Oscar_1, Oscar_2, and Oscar_3) move forward in time—but one of the new Oscars (Oscar_2) lives a decidedly odd existence in that his life seems to be running in reverse!

Eventually, at time t_2, the original Oscar_1 and the weird, reverse Oscar_2, merge and seemingly annihilate one another, vanishing into thin air to leave only a single Oscar (Oscar_3) for all time after t_2. Putnam argues that, although strange, what has just been described is still sensible and that, indeed, the very fact that we can draw the spacetime diagram of Fig. 3.8 supports the case for backward time travel. He claims this because although the spacetime diagram does show time increasing upward for all three Oscars (that is the time direction for an external observer) there is actually no 'spontaneous creation' or 'mutual annihilation' and all is sensible *if* Oscar_2 is understood actually to be a time traveler into the past with *his* time direction thus pointed opposite to that of the 'other two' Oscars. There is, of course, just *one* Oscar!

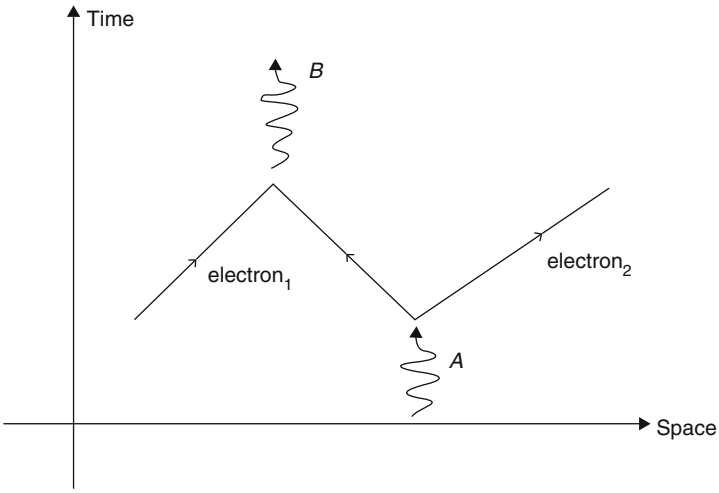

Fig. 3.9 Anti-matter via backward time travel

As mentioned back in Chap. 1, Putnam's suggestion was rebutted (see that chapter's note 76) by what is (in my opinion) an even less plausible mechanism for Putnam's kinked spacetime than is Putnam's invocation of time travel. That critic advocated, instead, an explanation based on matter transmitters and anti-matter, the latter an idea he credits to Feynman (who actually got it from Wheeler). In a paper by Feynman we do find the famous suggestion that a positron that appears to us to be moving forward in time is actually an electron traveling backward through time.[86] Logically, that greatly weakens the critic's view, because it puts him in the position of using anti-matter (explained in terms of backward time travel) to argue *against* backward time travel! But let's ignore that concern, give the critic the benefit of the doubt, and explore how anti-matter and backward time travel are imagined to be connected.

Feynman asks us to imagine the process shown in Fig. 3.9. Gamma ray A spontaneously creates an electron-positron pair, with electron_2 moving off to some distant region while the positron soon meets with electron_1, resulting in mutual annihilation and the production of gamma ray B. This description involves *three* particles, and each segment of the kinked line is a distinct particle. But Feynman said there is another way to look at this, a way that involves just *one* particle. According to Feynman, the kinked line in Fig. 3.9 (which should remind you of Oscar's kinked world line) is the world line of a single electron; the middle

[86]R. Feynman, "The Theory of Positrons," *Physical Review*, September 15, 1949, pp. 749-759. In a paper published the year before ("A Relativistic Cut-Off for Classical Electrodynamics," *Physical Review*, October 1948, pp. 939-946), he wrote "This idea that positrons might be electrons with the proper time reversed was suggested to me by Professor J. A. Wheeler." The identification of anti-matter with backward time travel occurred in science fiction (see note 124 in Chapter 1) almost simultaneously with Wheeler's speculation.

segment, that we call a positron, is just the electron traveling backward in time, and so we must reverse the arrowhead on it (indicating the opposite of the direction shown in Fig. 3.9).

There are two central questions at this point. First, why is a positron (with positive electric charge) moving forward in time mathematically (and physically) equivalent to a negatively charged electron moving backward in time? The answer is that the reversal in charge sign, which results from the reversal of the electron's proper time, follows from the TCP theorem that was mentioned in Chap. 2 (see note 38 there). And second, what causes the electron to suddenly move backward in time? Picturesquely, the electron is recoiling from the emitted burst of gamma ray B. Similarly, the absorption of the energy of gamma ray A by the electron that is recoiling backward in time causes a second recoil, giving the world line of what was originally called electron$_2$. This reinterpretation of a kinked spacetime diagram was described as follows (in Feynman's famous words): "It is as though a bombardier flying low over a road suddenly sees three roads and it is only when two of them come together and disappear that he realizes that he has simply passed over a long switchback in a single road."

In a later paper[87] Putnam's critic presented another line of attack against Putnam's interpretation of spacetime diagrams as lending support to time travel. There the critic observed that the presence of the time-reversed Oscar$_2$ shows that the "world of the Oscars" is not *temporally orientable*. A temporally orientable spacetime is one in which *every* point in it agrees with its local neighbors on the directions of past and future—a condition clearly *not* satisfied for the case of Oscar$_2$. As the critic pointed out, the first time travel spacetime discovered, the Gödel universe, *is* temporally orientable, and so in it the ambiguity of Oscar$_2$ (whether he is traveling backward in time as opposed to living forward 'in reverse') does not occur. That is, the critic agreed with Putnam's acceptance of the conceivability of time travel to the past, but not with his use of Feynman's concept of antimatter as time-traveling matter. That critic wasn't alone in that opinion.

One physicist, for example, wrote of "Feynman's rather loose talk of particles 'traveling' backward . . . in time,"[88] and the well-known philosopher John Earman declared "It is true that Feynman uses the slogan 'Positrons are electrons running backward in time,' but it is dangerous to draw conclusions from slogans."[89] I am not sure what Earman meant by "slogans": a careful reading of Feynman indicates that he actually took the matter quite seriously.[90] In his 1949 positron paper (note 86), for example, he wrote that "the idea that positrons can be represented as electrons

[87]See R. Weingard in note 114 in Chapter 1.

[88]H. Price, "The Asymmetry of Radiation: Reinterpreting the Wheeler-Feynman Argument," *Foundations of Physics*, August 1991, pp. 959-975.

[89]J. Earman, "On Going Backward in Time," *Philosophy of Science*, September 1967, pp. 211-222.

[90]Feynman declares the view of a positron as a time traveling electron to be of value, for example, in his famous book *Quantum Electrodynamics*, W. A. Benjamin 1961, p. 68.

with proper time reversed relative to true time has been discussed by the author and others,"[91] and also that "Previous results suggest waves propagating . . . toward the past, and that such waves represent the propagation of a positron."

In any case, spacetime diagrams are highly useful in discussing time travel, but they do have some curious twists. In our everyday world, a path that joins two points on a surface with the *minimum* length is called a geodesic of that surface. As you'll see later in this chapter spacetime geodesics do indeed possess an extremal property, but rather than being a minimum it is a *maximum* property. Spacetime diagrams can be misleading on this matter, so it is important to remember that such diagrams are not a perfect representation of all the properties of a spacetime.

It is customary to draw spacetime diagrams with the speed of light as unity ($c = 1$). That is, a distance of 300,000 km on the space axis is represented by the same extension as is one second on the time axis. This means that the world line of a photon is tilted away from the vertical time axis by 45°. Because photons can travel in both space directions (to the left and to the right) in the two-dimensional spacetime we can draw on a piece of paper, and because the speed of light is the limiting speed of the universe, we can represent the collection of all possible world lines as those paths that *never* tilt more than 45° away from the vertical, which forms what is called a *light cone* in spacetime, as shown in Fig. 3.10 (which attempts to represent a *three*-dimensional spacetime, one with two space—imagine a y-axis, out of the paper, perpendicular to both the x and t axes—and one time dimension).

In Fig. 3.10 I have taken $x = y = 0$ at $t = 0$ for all the possible world lines involving speeds below the speed of light. Let's agree to call this spacetime point the Here-Now. Then, spacetime points in the upward half of the light cone are in the Future of Here-Now; similarly, spacetime points in the lower half of the light cone are in the Past of the Here-Now. We can draw a straight world line from the Here-Now to any point in the Future half-cone with a tilt of less than 45° away from the vertical, which means that a massive particle could travel from the Here-Now to that point at less than the speed of light. Similarly, a massive particle starting at any point in the Past half-cone could have reached the Here-Now by traveling at less than the speed of light. Such a world line is called *timelike* because its projection on the time axis is greater than its projection on a space axis—they are the world lines connecting spacetime points that are potentially causally linked. That is, an event at a spacetime point in the Past half-cone could have had an effect on the event at the Here-Now, even though its influence propagated at less than the speed of light. Also, an event at the Here-Now could potentially affect the event at any spacetime point in the Future half-cone of the Here-Now.

Any points in the regions of spacetime outside the Future and Past half-cones *cannot* be reached from the Here-Now except by world lines tilted more than 45°

[91]The "others" Feynman had in mind included, in particular, the eminent Swiss physicist Ernest C. G. Stükelberg (1905-1984), who in a 1942 article in the journal *Helvetica Physica Acta* also wrote of waves scattering backward in time.

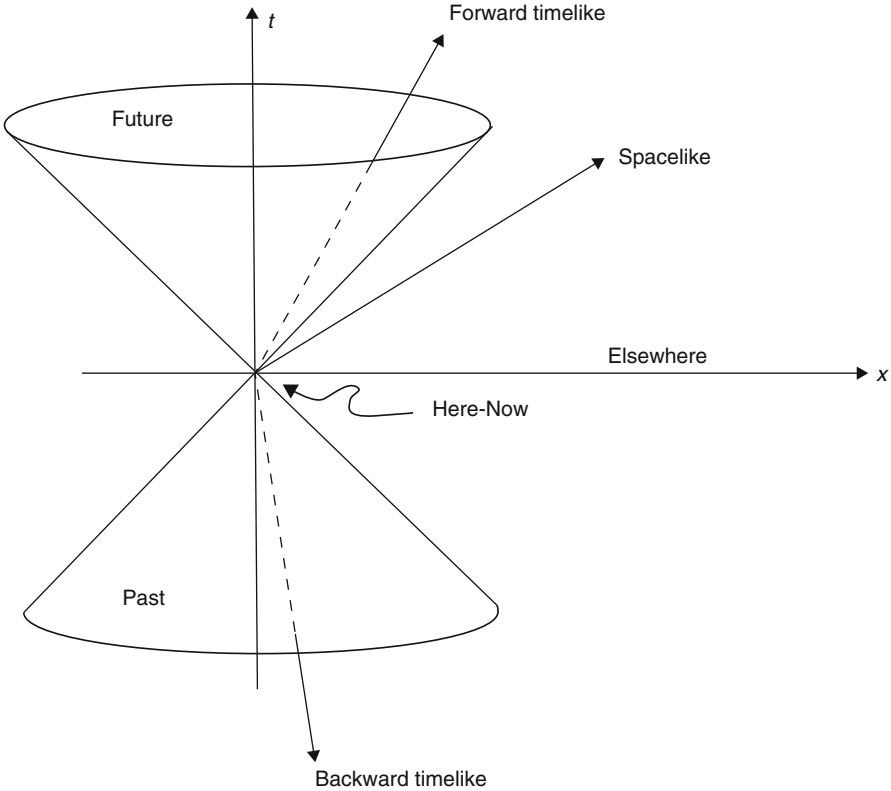

Fig. 3.10 A light cone in spacetime

away from the vertical. Such world lines, which represent travel at a speed faster than light, are called *spacelike* because their projections on a space axis is greater than their projections on the time axis. It is impossible for these world lines to connect causally linked events, and collectively they form the Elsewhere of the Here-Now. Notice that every point in spacetime has its own light cone. If A and B are causally linked, then if B is in the Future half-cone of A, then A is in the Past half-cone of B.

The imagery of the light cone is often useful in making seemingly quite abstract ideas appear transparent. For example, can an observer predict his own future from perfect knowledge of his own past? The easy answer is "No, because quantum uncertainties prohibit perfect knowledge of even the present, much less the past." But suppose we ignore quantum mechanics and limit our question to a universe that obeys only classical physics (which includes the special and general theories of relativity). Surprisingly (perhaps), the answer is *still* no. Having perfect knowledge of your own Past half-cone doesn't include knowing the *entire* past, so if you attempt to predict your own future (say, 1 min from now), there can be influences in Elsewhere that will arrive in the future (say, 59 s from now) about which you

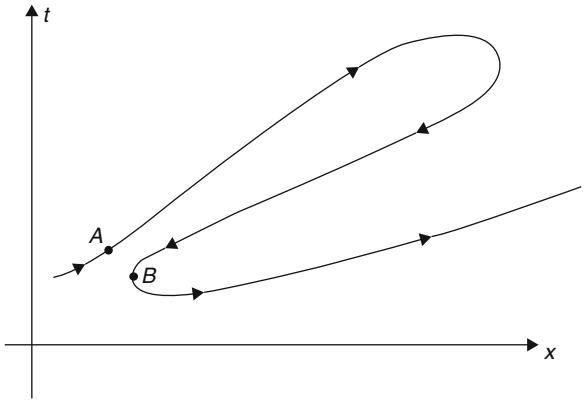

Fig. 3.11 World line of a particle traveling backward in time from A to B

presently, by definition, cannot have any knowledge. And without that knowledge, you cannot predict. As one writer amusingly concludes a tutorial on this topic, "the prospect of predicting the future looks pretty bleak."[92]

A spacetime diagram does not always have to have future directed world lines. If a particle moves backward through time, assuming such a thing is possible, then the diagram can show this by having the world line double back on itself, as in Fig. 3.11 (in which the world line curves back and comes arbitrarily close to itself: it is the world line of a particle that visits itself in the past). Note that the world line in Fig. 3.11 does not actually touch or cross itself, because that would represent more than just a visit—it would represent a particle occupying the same spatial location at the same time as its earlier self. That would be catastrophic and, because it *did not* happen it *cannot* happen. Since the arrowheads on the world line always point in the direction of the local future of the particle, if the 'particle' is actually human then increasing memories are formed in the direction of the arrows. The time traveler at B has more memories than he does at A, even though A and B are nearly identical points in spacetime.

There is a problem with Fig. 3.11 that you may have caught. It is impossible to draw such a doubled-back world line in such a way that *at all places* it never tilts more than 45° from the vertical. That is, at least some portion of the world line will have

$$\left|\frac{dx}{dt}\right| > 1$$

which represents superluminal motion (we'll return to this in Chap. 5). One way to keep a bent-back world line always subluminal is to arrange for the light cones along the world line to be tilted relative to each other, as shown in Fig. 3.12, which

[92]M. Hogarth, "Predicting the Future in Relativistic Spacetimes," *Studies in the History and Philosophy of Science*, December 1993, pp. 721-739.

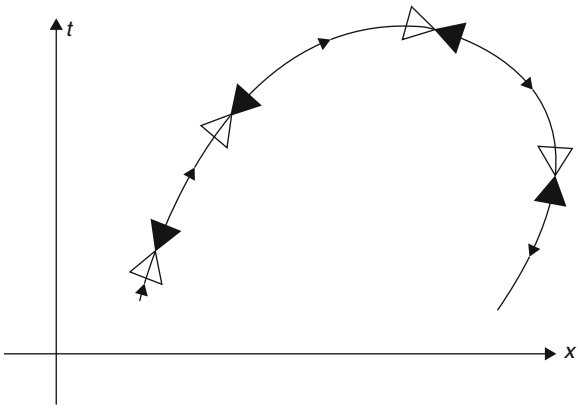

Fig. 3.12 Tilted light cones in a curved spacetime (the future halves are shaded)

is possible only in a *curved* spacetime. This is an illustration of how general relativity *locally* obeys special relativity's demand that nothing travels faster than light and yet, *globally*, in curved spacetime, things are not so simple. In flat spacetimes all light cones are always 'aligned,' but in curved spacetimes they (generally) are not, and from that can come time travel to the past.[93]

Tilted light cones is the physics behind backward time travel around a rotating Tipler cylinder, for example, a particular time machine we'll discuss later in Chap. 5. Light cone tipping is, in fact, *essential* for time travel to the past. The mere presence of mass tips light cones ('warps spacetime'), but the effect is unnoticeable in everyday life on Earth. A truly enormous mass density is required to tip nearby light cones over so that their Future halves noticeably open up toward the massive body. If the massive body is additionally set to rotating, then a further consequence of Einstein's general theory is that the local light cones are tilted additionally in the direction of rotation. That is, the Future half-cones in spacetime open-up both toward the body and in the direction of the rotation.

It should now be clear that the only way a world line can bend back on itself for a close encounter visit is for both x and t to change. In other words, the world line of a particle that remains fixed in space and reverses just its time direction *runs into itself*. This is why the classic fictional time machine of H. G. Wells could not possibly work. A real time machine must move in space as well as through time, as does a Gödelian rocket (or, for that matter, as does the DeLorean time car in the *Back to the Future* films). The idea of warping world lines, to support time travel to the past, entered science fiction at an early date. For example, when the inventor of the time machine in a 1930s tale[94] is asked about the principle underlying his gadget, he replies "An electro-magnetic warping of the spacetime continuum.

[93]What is meant by a spacetime being *flat* will be formalized when we get to spacetime *metrics* later in this section. The Minkowski spacetime of special relativity is a flat spacetime, has no tilted light cones, and as such does *not* support time travel to the past.

[94]N. Schachner, "When the Future Dies," *Astounding Science Fiction*, June 1939.

The machine, if it works, will slide around the world-line of events and reappear at any specified time and place."

Using the Lorentz transformation equations from the previous section, we can establish quite general relationships between events in the Future, Past, and Elsewhere regions of spacetime. For example, (1) All events in the Future/Past for the Here-Now observer are in the Future/Past for any other nearby, relatively moving observer; (2) Any event in Elsewhere can appear to be simultaneous with the Here-Now for some observer and not simultaneous for another observer; and (3) The temporal ordering (the relations of *before* and *after*) of causally related events is the same for all observers. This is not so for events that are not causally related; if two events have a spacelike separation, then two observers can disagree over the temporal ordering of the events. This is, in fact, the basis for the two-wormhole and the cosmic string time machines, both of which will be discussed in Chap. 6. All these statements are easy to prove.

Consider, for example, statement (1). From the previous section we have (with $c = 1$)

$$t' = \frac{t - \mathrm{v}x}{\sqrt{1 - v^2}} \quad \text{and} \quad x' = \frac{x - \mathrm{v}t}{\sqrt{1 - v^2}}$$

where t and x are the coordinates of some event A as measured by the observer in the stationary reference frame, and t' is the time measured by the observer in the reference frame moving at speed v. Thus

$$x'^2 - t'^2 = \frac{(x - \mathrm{v}t)^2 - (t - \mathrm{v}x)^2}{1 - v^2} = [\text{after a little algebra}]\ x^2 - t^2.$$

For the stationary observer the criterion for an event to be in the Future half-cone is $t > |x|$, that is, $t^2 > x^2$. Thus, $x^2 - t^2 < 0$ for all Future events. But the foregoing result then says $x'^2 - t'^2 < 0$, too, which is the moving observer's criterion for the event being in his Future half-cone. The same sort of argument shows that the two observers also agree on Past events.

Next, suppose that two events A and B occur such that the stationary observer measures them to be $\Delta T = t_B - t_A$ apart in time. Then, we can establish statement (2) by writing

$$t'_A = \frac{t_A - \mathrm{v}x_A}{\sqrt{1 - v^2}} \quad \text{and} \quad t'_B = \frac{(t_B + \Delta T) - \mathrm{v}x_B}{\sqrt{1 - v^2}}$$

and so

$$\Delta T' = t'_B - t'_A = \frac{\Delta T + v(x_A - x_B)}{\sqrt{1 - v^2}}.$$

From this we have $\Delta T' = 0$ (that is, simultaneity) for the two events for the special observer moving at the speed

$$v = \frac{\Delta T}{x_B - x_A}$$

and this speed is less than the speed of light for the condition $x_B - x_A > \Delta T$. This is, of course, the condition for event B to be in the Elsewhere of event A. In fact, we can even have $\Delta T' < 0$ (with $\Delta T > 0$) for $v < 1$ in this case of spacelike separation of A and B. That is, a stationary observer and a sublight-speed moving observer can disagree about the temporal ordering of events with spacelike separation.

Similarly, for event B to be in the causal Future of event A, we have the condition $x_B - x_A < \Delta T$. Then,

$$\Delta T' = \frac{\Delta T - \mathrm{v}(x_B - x_A)}{\sqrt{1 - v^2}} > \frac{\Delta T - v\Delta T}{\sqrt{1 - v^2}} = \Delta T \frac{1 - \mathrm{v}}{\sqrt{1 - v^2}}.$$

Thus, $\Delta T > 0$ says $\Delta T' > 0$ for $v < 1$, and this establishes statement (3).

If we were drawing diagrams with both axes representing space (a plot of y versus x, for example), we would normally define a *distance metric* for the diagram using our everyday ideas about distance. That is, we could say that if we make differential movements of dx and dy along the two coordinate axes, then the differential distance ds is given by

$$(ds)^2 = (dx)^2 + (dy)^2.$$

This is, of course, just the Pythagorean theorem for the 'Euclidean' or 'as the crow flies' distance function. But it is not the only possible distance function. A distance function has several interesting mathematical properties,[95] but the one we are particularly interested in here is its invariance with respect to the coordinate system. For example, if we draw a line segment on a flat sheet of paper, the physical distance between its end-points does not depend on how we happen to select the x and y axes, a fact illustrated in Fig. 3.13 with the addition of a rotated and translated primed system. The coordinates for the endpoints A and B are obviously different in the two coordinate systems, but we still find that

$$(dx)^2 + (dy)^2 = (dx')^2 + (dy')^2.$$

[95]Mathematicians have defined the general properties of a distance function as follows: if A and B are any two points, and if $d(A, B)$ is the distance between A and B , then (1) $d(A, B) = d(B, A)$; (2) $d(A, B) = 0$ if and only if $A = B$; and (3) if C is any third point, then $d(A, B) \leq d(A, C) + d(C, B)$. The Pythagorean distance function possesses all three of these properties, but so do many other functions (for example, $ds = |dx| + |dy|$).

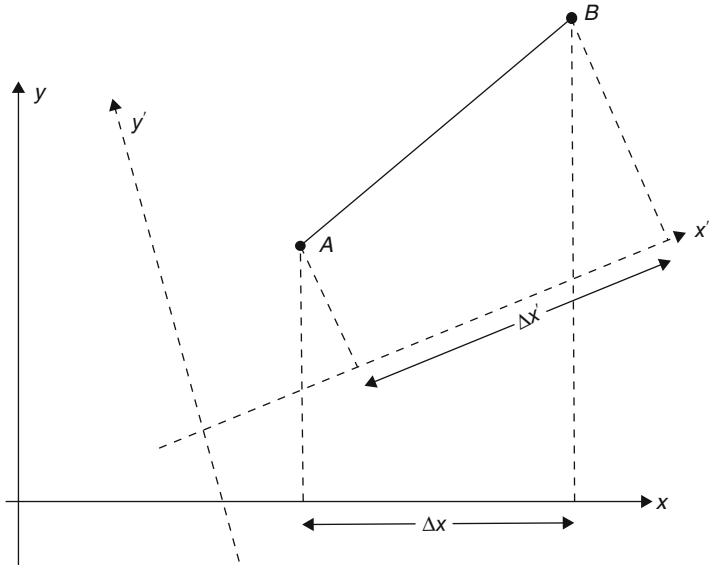

Fig. 3.13 Rotated/translated coordinate systems

We say that the Pythagorean distance function is *invariant*, that it is the same for all coordinates systems that are simply rotations and/or translations of each other.

We know that different observers, if in relative motion in the same spacetime, will see different space and time coordinates for the same event. Thus, it is natural to ask 'what is the metric for flat spacetime?' Is there, in fact, a metric that gives the same *distance* between two events for all observers? We might try to generalize in the obvious way from the Pythagorean theorem, and write

$$(ds)^2 = (dt)^2 + (dx)^2 + (dy)^2 + (dz)^2$$

where now all four dimensions are included. We would then ask ourselves whether it is true that

$$(ds)^2 = (ds')^2 = (dt')^2 + (dx')^2 + (dy')^2 + (dz')^2?$$

For our simple two-dimensional spacetime, this question reduces to asking whether

$$(dt)^2 + (dx)^2 = (dt')^2 + (dx')^2?$$

Using the Lorentz transformation equations from earlier, it is easy to discover that the answer is no. The 'natural' generalization of Pythagorean distance for flat, two-dimensional spacetime fails when four dimensions are included. So, what do we do now? Recalling the words of Professor Mundle from *Some First Words* (see note 23 there), we might wonder whether this difficulty could result from the fact

that there is no fourth direction along which the time axis can point at right angles to the three space directions? At least, there is no *real* direction—but perhaps there is an imaginary one. Accordingly, with $= \sqrt{-1}$, let's try

$$(ds)^2 = (idt)^2 + (dx)^2 + (dy)^2 + (dz)^2 = -(dt)^2 + (dx)^2 + (dy)^2 + (dz)^2.$$

Using *imaginary time*, something that seems to be in the realm of science fiction, has resulted in a change in the sign of $(dt)^2$.

This is a crucial change, however, because this new metric *is* invariant. For a reason to be explained in the next section, I will use the negative of this metric (a choice that has no impact on the invariance property) and so write

$$(ds)^2 = (dt)^2 - (dx)^2 - (dy)^2 - (dz)^2.$$

For our simplified two-dimensional spacetime this reduces to

$$(ds)^2 = (dt)^2 - (dx)^2.$$

As before, the Lorentz transformation equations (with $c = 1$) are

$$t' = \frac{t - \mathrm{vx}}{\sqrt{1 - v^2}} \text{ and } x' = \frac{x - \mathrm{vt}}{\sqrt{1 - v^2}}.$$

If we then calculate dx' and dt' from these equations, using

$$dx' = \frac{\partial x'}{\partial x}dx + \frac{\partial x'}{\partial t}dt, dt' = \frac{\partial t'}{\partial x}dx + \frac{\partial t'}{\partial t}dt$$

which are the fundamental relations for the *total* differential[96] of a function of two variables, and insert the results into $(dt')^2 - (dx')^2$, we quickly discover the invariance property of this quantity (a result we actually found earlier, in a different way, when we showed that observers in relative motion agree about what events are in the Future and what events are in the Past). Thus,

$$(dt')^2 - (dx')^2 = (dt)^2 - (dx)^2.$$

This quantity, on either side of the equality, is called the spacetime *interval* between the two events separated in flat spacetime by either dt, dx, dy, and dz, or by dt', dx', dy', and dz'. The observers in the unprimed and the primed systems see different individual space and time separations for two events, but they see the same

[96]The $\frac{\partial}{\partial x}$ and $\frac{\partial}{\partial t}$ symbols denote the *partial* derivatives with respect to x and t (see any good calculus book to brush-up on this). The rest of this chapter *will* have some more math in it, involving derivatives and even an integral or two, but nothing beyond freshman calculus. I've included it mostly for those who would feel cheated without *some* math!

interval. A single time coordinate, and three space coordinates, are said to form a *four-vector that is invariant under Lorentz transformation*. There are, in addition, other four-vectors that are also invariant under Lorentz transformation, such as the energy-momentum, velocity, and force four-vectors; all these quantities have invariants that are formed the same way, by taking the difference of the squares of the time components and the sum of the squares of the space components. The intrusion of the square root of minus one, in the time coordinate of the metric, seems a pretty clear indication that time *is* different from space.[97]

But still, the spatialization of time is nonetheless deeply embedded in Western culture. For example, when writing her popular 1978 book, drawing historical parallels between the fourteenth and twentieth centuries, Barbara Tuchman titled it *A Distant Mirror*, and not *An Old Mirror*. The mathematical mixing of space and time appeared quite early in science fiction, but often in comically mangled form. In one such tale, for example, as an evil scientist uses his time machine to transport captives into the past, he tells them, "We've got a longish journey before us, ten thousand years more, multiplied by the fourth power of two thousand miles."[98]

In general relativity, the metric of any four-dimensional spacetime has the structure of what mathematicians call a *symmetric quadratic Riemannian form*:

$$(ds)^2 = \sum_{i=1}^{4}\sum_{j=1}^{4} g_{ij}(dx_i)(dx_j), g_{ij} = g_{ji}$$

where $x_1 = t$, $x_2 = x$, $x_3 = y$, and $x_4 = z$, and the 16 g's are all functions of these four variables. (Because of the symmetry condition, only 10 of the g's are independent.) In this notation, a *flat* spacetime is mathematically characterized by $g_{11} = 1$, $g_{22} = g_{33} = g_{44} = -1$, $g_{ij} = 0$ for all $i \neq j$. Now, for a given spacetime, one can arbitrarily choose an infinity of coordinate systems. If just one of this infinity of systems is such that the ± 1, 0 values for the g's occur, then that spacetime is *globally* (that is, everywhere) flat. If no such coordinate system exists, then that spacetime is necessarily *curved*—I'll give you a more intuitive view of curvature in just a bit. (If this notation is extended to a fifth dimension[99] by including the additional coordinate x_5, then there are an additional eight off-diagonal g's and so

[97]Writing in 1972, one famous physicist said of his first encounter with the metric of special relativity (Minkowski spacetime), "Now, when I saw that minus sign [in $-(dt)^2$], it produced a tremendous effect on me. I immediately saw that here was something new." See P. A. M. Dirac, "Recollections of an Exciting Era," in *History of Twentieth Century Physics* (C. Weiner, editor), Academic Press 1977.

[98]V. Rousseau, "The Atom Smasher," *Astounding Stories*, May 1930.

[99]The fifth dimension was introduced in the 1920s by the German physicist Theodor Kaluza (1885-1954), but just what the nature of this fifth dimension might be remains a mystery. A few years after Kaluza, the Swedish physicist Oscar Klein (1894-1977) speculated that it might be a spatial dimension curled-up in a tiny circular path, so tiny that we don't notice it; the issue remains open. The idea of a fifth dimension appeared early in pulp science fiction, as in the January 1931 tale "The Fifth-Dimension Catapult," (*Astounding*) by Murray Leinster.

four new *independent* g's. These are just sufficient to describe the electromagnetic field, too, along with the gravitational field described by the other ten g's. That is what is meant by saying five-dimensional spacetime 'unifies' gravity with electromagnetism.) There is a g_{55}, too, which could be allowed to model a slowly varying gravitational constant, as suggested by Dirac in 1938.

The g functions are the components of the so-called *metric tensor of the second rank* (see the last discussion question for more on what this means) of that spacetime. The g's at each point in spacetime are related to the curvature of spacetime at that point, which in turn is dependent on the g's and on the energy density at that point. In fact, the ten equations for the g's, which *are* the famous Einstein gravitational partial differential field equations, are both nonlinear and coupled. That is, each g_{ij} is in general a nonlinear function of all the other g_{ik}, which accounts for the notorious difficulty[100] in finding analytical solutions to the field equations except in certain highly special cases, such as the spacetime of spinning spheres and rotating infinite cylinders.

What does it mean to 'solve' the field equations? It is useful to think of the equations schematically as follows:

local geometry of spacetime $\leftarrow$ local density, momentum and stress of the mass-energy of spacetime where the direction of the arrowhead means that the 'usual' practice is to assume the right-hand side (the so-called stress-energy tensor) as given, and then attempt to calculate the left-hand side. If the attempted calculation can be done, then one has solved the field equations for the spacetime geometry that is associated with the assumed mass-energy distribution.

Suppose, however, that we reverse the direction of the arrowhead. That is, suppose we assume a desired geometry. That is what Einstein did when he assumed the geometry of a *static* (non-expanding) universe and solved for the required mass-energy. What he found was just what had been observed by astronomers up to that time—a multitude of 'grains of matter' (what physicists call *dust*) plus the infamous cosmological constant. The constant, with its repulsive gravity, was needed to counteract the ordinary gravitational attraction of the stars that tends to pull them together. The later discovery that the universe is not static, but rather is expanding, rendered Einstein's solution moot.

Now let's go Einstein one better, and assume a spacetime geometry that contains closed timelike curves (a time machine, in other words) and then try to calculate the mass-energy distribution required by that spacetime. If that can be accomplished—and in fact the field equations themselves provide an algorithmic means of solution in this direction—then the physicist's work is done. The required mass-energy distribution requirements are put out to bid to 'spacetime engineers' and the lowest bidder 'simply' constructs that mass-energy distribution and so builds us our time machine! When the calculations are done, however, what has happened without

[100] An elementary, quite interesting discussion of the enormous computational complexity of the field equations is presented in Richard Pavelle and Paul S. Wang, "MACSYMA from F to G," *Journal of Symbolic Computation*, March 1985, pp. 69-100.

fail, at least up to now, is that the resulting mass-energy distribution comes out with an 'unphysical' nature, a technical way of saying our spacetime engineer wouldn't know *how* to assemble the required mass-energy distribution. What is meant by 'unphysical' will be explored, in the particular case of wormhole time machines, in Chap. 6.

The 16 g's for a four dimensional spacetime are often written in the form of a 4×4 matrix. In fact, the metric tensor is of the *second* rank precisely because a matrix has a *two*-dimensional form; scalars and vectors, which have forms of zero and one dimension, are tensors of rank zero and one, respectively. The collection of the algebraic signs of the main diagonal terms (the g_{ii}) is called the *signature* of the metric tensor. The signature of flat (Minkowski) spacetime is thus written as $[+, -, -, -]$; in more general (curved) spacetimes, this same signature is called *Lorentzian*. By contrast, the signature of a four-dimensional Euclidean space is $[+, +, +, +]$. This signature is called *Riemannian*. The geometry of flat, Minkowski spacetime is not Euclidean geometry because the spacetime signature of its metric has both plus *and* minus signs. As an uncurved spacetime, Minkowski spacetime *has no gravity*; to get gravity, we need a curved spacetime.

The idea of linking the curvature of a four-dimensional space to physical phenomena is the signature feature of general relativity, but it actually pre-dates Einstein by decades. It can be found, for example, in the work of the British mathematician William Kingdon Clifford (1845–1879), done in the 1860s and 1870s before Einstein's birth (in the year of Clifford's death). In his posthumously published book *The Common Sense of the Exact Sciences* (1885), Clifford wrote "We may conceive our space to have everywhere a nearly uniform curvature, but that slight variations of the curvature may occur from point to point and themselves vary with time. These variations of the curvature with time may produce effects which we not unnaturally attribute to physical causes independent of the curvature of our space. We may even go so far as to assign to this variation of the curvature what really happens in that phenomenon which we term the motion of matter." It isn't a long jump from "motion of matter" to gravity![101]

Not everyone enthusiastically embraced this new, radical view of nature. For example, the great Scottish mathematical physicist James Clerk Maxwell (1831–1879), of Maxwell's equations fame, who knew Clifford through their common membership in the London Mathematical Society, summarily dismissed this part of Clifford's work as simply the speculations of a "space crumbler." Decades later, Einstein faced the same rejection when the eminent British

[101]Clifford almost surely found inspiration in this part of his work from the even earlier efforts of the German mathematician Bernhard Riemann (1826-1866). See, for example, Clifford's translation of Riemann's famous 1854 lecture "On the Hypotheses Which Lie at the Bases of Geometry," *Nature*, May 1, 1873, pp. 14-17, and continued in the next issue (May 8, 1873, pp. 36-37).

astronomer Sir James Jeans declared "Einstein's crumbling of his four-dimensional space may . . . be considered to be . . . fictitious."[102]

Spacetime geometries are not easy concepts to grasp, and the metrics of curved spacetimes are even more complicated than is the metric of the flat spacetime of Minkowski's special relativity. As one paper so aptly put it, "Experience has taught us that the space in which we live has a geometry that is three-dimensional and Euclidean . . . We are very much at home with [that] geometry . . . But the geometric properties of a Minkowskian space are so alien to us that we may well despair of visualizing them, and a Riemannian [curved] space . . . seems totally beyond comprehension."[103]

An important feature of Riemannian geometry is that although it is generally not globally flat, it is always *locally* flat. Thus any sufficiently small region in a curved Riemannian spacetime can be approximated, with arbitrarily small error, by a flat pseudo-Euclidean Minkowskian spacetime. That is, at each point in Riemannian spacetime, there is some *particular* inertial frame of reference in which special relativity is all there is to spacetime physics *at that point*. The particular inertial frame required is different, however, from point to point.

In a coordinate system different from rectangular, the flat Minkowskian metric can appear radically altered, but that is just an artifact of the mathematics and has no physical significance. For example, in spherical coordinates the Minkowskian metric becomes the equivalent

$$(ds)^2 = (dt)^2 - (dr)^2 - (rd\theta)^2 - (rsin(\theta)d\phi)^2$$

where ϕ is the azimuthal angle and θ is the angle measured from the polar axis. A related metric occurs in the theory of spherically symmetric, static (no time variation) time machine wormholes (discussed in Chap. 6), of the form

$$(ds)^2 = \left(e^{a(r)}dt\right)^2 - \frac{(dr)^2}{1 - \frac{b(r)}{r}} - (rd\theta)^2 - (rsin(\theta)d\phi)^2$$

where $a(r)$ is called the *redshift function* and $b(r)$ is called the *shape factor*. These two functions are nearly arbitrary, subject only to the constraints that both $b(r)/r$ and $a(r)$ vanish as r goes to infinity (r is the radial distance from the throat of the wormhole mouth). Indeed, as r increases, this curved wormhole spacetime metric

[102]Quoted in P. Kerszberg, "The Relativity of Rotation in the Early Foundations of General Relativity," *Studies in History and Philosophy of Science*, March 1987, pp. 53-79.

[103]R. W. Brehme and W. E. Moore, "Gravitational and Two-Dimensional Curved Surfaces," *American Journal of Physics*, July 1969, pp. 683-692.

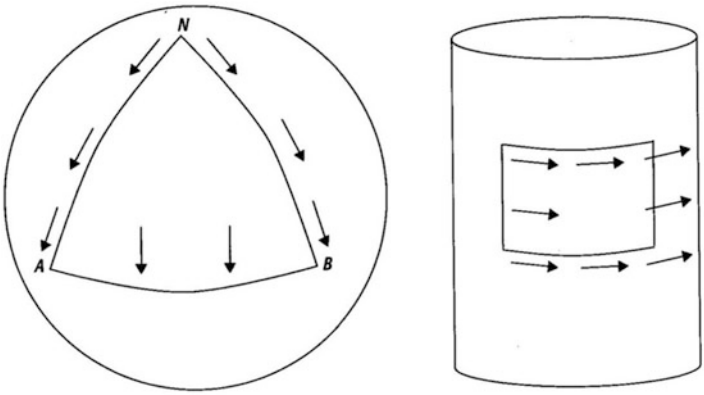

Fig. 3.14 The curvature of a space can be revealed by the process of parallel transport

reduces to that of flat Minkowskian spacetime, so this wormhole spacetime is said to be *asymptotically flat*.[104]

An intuitive appreciation of 'flatness' can be realized in terms of what is called the *parallel transport* of a vector around a closed path. In a curved space the vector will experience a rotation, which will not occur in a flat space. Two examples of parallel transport in ordinary three-dimensional space are shown in Fig. 3.14. The spherical surface on the left is curved because if you slide the vector from N to A to B and then back to N, all the while keeping it parallel to its immediately previous orientation, then when it gets back to N the vector will point to B, *not* toward A as it initially did. A similar trip on the cylindrical surface, however, results in zero rotation of the vector. Thus, the cylindrical surface, despite superficial appearances, is *not* curved.

Using the idea of the metric tensor, we can develop a more formal demonstration that the surface of a sphere, unlike like that of a cylinder, is not flat. On the surface of a sphere of radius a (*on* the surface $r = a$ everywhere, and so $dr = 0$), the measure of the distance between two points (in spherical coordinates) is[105]

$$(ds)^2 = a^2 sin^2(\theta)(d\phi)^2 + a^2(d\theta)^2.$$

Writing $x_1 = \phi$ and $x_2 = \theta$ yields the more general form

[104]For wormhole spacetimes that are not asymptotically flat, see (for example) K. Narahara, *et al.*, "Traversable Wormhole in the Expanding Universe," *Physics Letters B*, September 29, 1994, pp. 319-323.

[105]Note *carefully* that this is a purely spatial problem, with no time, and we are taking all of the metric coefficients as positive (unlike in the case of a spacetime metric).

$$(ds)^2 = g_{11}(dx_1)^2 + g_{12}(dx_1)(dx_2) + g_{21}(dx_2)(dx_1) + g_{22}(dx_2)^2$$

or, using the symmetry condition $g_{12} = g_{21}$, we have

$$(ds)^2 = g_{11}(dx_1)^2 + 2g_{12}(dx_1)(dx_2) + g_{22}(dx_2)^2.$$

From this we immediately have $g_{11} = a^2 sin^2(\theta)$, $g_{22} = a^2$, and $g_{12} = g_{21} = 0$.

Now, suppose we ask whether it is possible to find some new coordinate system (with variables x'_1 and x'_2) in which the invariant $(ds)^2$ is given by the flat Euclidean metric $\left(dx'_1\right)^2 + \left(dx'_2\right)^2$. In such a coordinate system (if it exists) we would have the 'flatness conditions' of $g'_{11} = g'_{22} = 1$ and $g'_{12} = g'_{21} = 0$. With such a change of coordinates, each of our original ϕ, θ coordinates would generally be a function of both of the new coordinates—that is, $\phi = \phi\left(x'_1, x'_2\right)$ and $\theta = \theta\left(x'_1, x'_2\right)$. Thus, writing the total differential of a function of two variables (see note 96 again), we have

$$d\phi = \frac{\partial \phi}{\partial x'_1} dx'_1 + \frac{\partial \phi}{\partial x'_2} dx'_2$$
$$d\theta = \frac{\partial \theta}{\partial x'_1} dx'_1 + \frac{\partial \theta}{\partial x'_2} dx'_2.$$

Substituting these expressions into the above expression for $(ds)^2$ on the surface of a sphere, and collecting terms, we arrive at

$$\begin{aligned}(ds)^2 &= a^2\left\{\left[\sin^2(\theta)\left(\tfrac{\partial\phi}{\partial x'_1}\right)^2 + \left(\frac{\partial\theta}{\partial x'_1}\right)\right]\left(dx'_1\right)^2 + \left[\sin^2(\theta)\left(\tfrac{\partial\phi}{\partial x'_2}\right)^2 + \left(\tfrac{\partial\theta}{\partial x'_2}\right)^2\right]\left(dx'_2\right)^2\right.\\ &\left.+2\left[\sin^2(\theta)\frac{\partial\phi}{\partial x'_1}\frac{\partial\phi}{\partial x'_2} + \frac{\partial\theta}{\partial x'_1}\frac{\partial\theta}{\partial x'_2}\right]\left(dx'_1\right)\left(dx'_2\right)\right\}\\ &= g'_{11}\left(dx'_1\right)^2 + 2g'_{12}\left(dx'_1\right)\left(dx'_2\right) + g'_{22}\left(dx'_2\right)^2\end{aligned}$$

We can now immediately write down each of the g' and, if we demand that they satisfy the 'flatness conditions,' then we have the following three statements:

$$sin^2(\theta)\left(\frac{\partial\phi}{\partial x'_1}\right)^2 + \left(\frac{\partial\theta}{\partial x'_1}\right)^2 = \frac{1}{a^2}$$
$$sin^2(\theta)\left(\frac{\partial\phi}{\partial x'_2}\right)^2 + \left(\frac{\partial\theta}{\partial x'_2}\right)^2 = \frac{1}{a^2}$$
$$sin^2(\theta)\frac{\partial\phi}{\partial x'_1}\frac{\partial\phi}{\partial x'_2} + \frac{\partial\theta}{\partial x'_1}\frac{\partial\theta}{\partial x'_2} = 0.$$

For a *globally* flat surface, that is, a surface that is flat *everywhere*, these three statements must hold in particular at the poles of the sphere. That is, at $\theta = 0^\circ$

and at $\theta = 180^{\circ}$. At both of these points $\sin(\theta) = 0$, and so at the poles the three statements reduce to

$$\left(\frac{\partial\theta}{\partial x_1'}\right)^2 = \frac{1}{a^2}$$
$$\left(\frac{\partial\theta}{\partial x_2'}\right)^2 = \frac{1}{a^2}$$
$$\frac{\partial\theta}{\partial x_1'}\frac{\partial\theta}{\partial x_2'} = 0.$$

But the third statement is incompatible with the first two and, because of that incompatibility, there is no primed coordinate system in which the g' coefficients in the metric are those of a globally flat metric. Thus, unlike the surface of a cylinder, the surface of a sphere is not flat but rather is curved. This almost surely comes as no surprise to you, but now you can *prove* it!

3.6 Proper Time and the Twin Paradox in Time Travel to the Future

"[The] equations of duo-quadrant lineations [have] been substantiated ... Our fourth-angle deviation from the six conceivable electronic dimensions did the trick all right. I went forward in Time."[106]

The spacetime interval of the previous section has an important interpretation that leads to one of the more dazzling results of special relativity—time travel into the future. First, recall the flat spacetime metric

$$(ds)^2 = (dt)^2 - (dx)^2 - (dy)^2 - (dz)^2$$

in which the use of unprimed variables indicates that the measurements on the space and time coordinates of a moving particle are made with respect to a stationary observer's frame of reference. Now, suppose that the space and time coordinates of a moving particle are made with respect to the particle instead. Then, using primed variables for measurements made in this new frame of reference, $dx' = dy' = dz' = 0$ because the particle is always at the origin (by definition)! Recalling the invariance of the spacetime interval for all observers, we conclude that

[106] A science fiction scientist babbles incoherent nonsense, not special relativity, about how to travel into the future, in a story by J. H. Haggard, "He Who Masters Time," *Thrilling Wonder Stories*, February 1937.

$$(ds')^2 = (ds)^2 = (dt')^2.$$

That is, the spacetime interval between two events is the time lapse measured by a clock attached to a particle that moves from one event to the other. This time is called *proper time*, which gets its name from the idea that it belongs to (is the *property* of) the moving particle. This is the technical reason for taking (as we did in the previous section) $(ds)^2 = (dt)^2 - (dx)^2$ rather than $(ds)^2 = (dx)^2 - (dt)^2$. The first choice avoids the somewhat awkward result of an imaginary proper time.

Next, we'll adopt what has come to be called the *clock hypothesis*, which states that an accelerated clock runs at the same instantaneous rate as an unaccelerated clock that is moving alongside at the instantaneously same speed. As we showed earlier (take a look back at Sect. 3.3), if the accelerated clock's instantaneous speed is v, then its rate of time keeping (dt') is related to that of the 'stationary' (unaccelerated) clock (dt) as

$$dt' = \sqrt{1 - \left(\frac{v}{c}\right)^2}\, dt$$

where c is the speed of light. The clock hypothesis is generally assumed to be true. Einstein, himself, in his famous 1905 special relativity paper, specifically took the rate of a clock's timekeeping to be velocity-dependent only. When asked during an interview decades later whether it is permissible to use special relativity in situations involving acceleration, Einstein replied "Oh, yes, that is all right as long as gravity does not enter; in all other cases, special relativity is applicable. Although, perhaps the general theory approach might be better, it is not necessary."[107]

The clock hypothesis has long had experimental verification. For example, in one experiment the time keeping of accelerated atomic clocks was determined to be given precisely by the time dilation formula of special relativity, even when their direct mechanical acceleration (the centripetal acceleration produced by a rapidly spinning disk) exceeded 66,000 gees![108] And even more impressive are the time dilation results of a later experiment in which the time keeping of near light-speed charged particles, orbiting in a magnetic field, was in excellent agreement with the time dilation formula, even as accelerations well in excess of 10^{15} gees were reached![109]

The total elapsed time between two events A and B, as measured by the proper time of an accelerated clock making the journey, is, therefore, given by

[107] R. S. Shankland, "Conversations with Albert Einstein," *American Journal of Physics*, January 1963, pp. 47-57.

[108] H. J. Hay, *et al.*, "Measurement of the Red Shift in an Accelerated System Using the Mössbauer Effect in Fe^{57}," *Physical Review Letters*, February 15, 1960, pp. 165-166.

[109] J. Bailey, *et al.*, "Measurements of Relativistic Time Dilation for Positive and Negative Muons in a Circular Orbit," *Nature*, July 29, 1977, pp. 301-305.

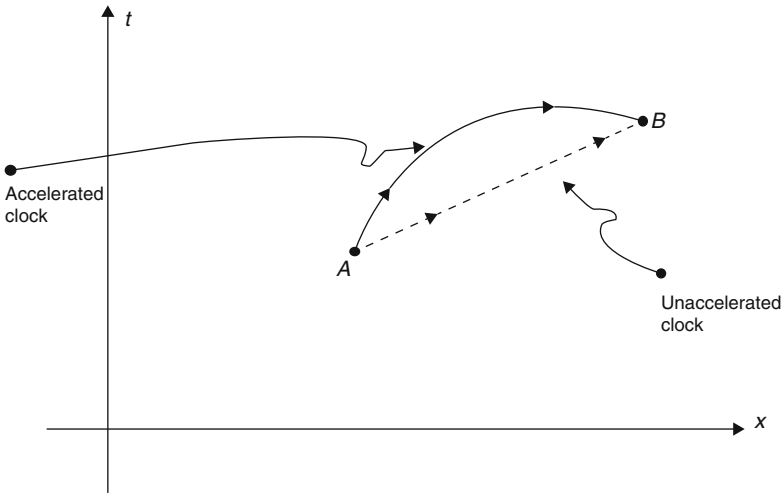

Fig. 3.15 World lines of two clocks (one accelerated and one unaccelerated)

$$t' = \int dt' = \int_{t_A}^{t_B} \sqrt{1 - \left(\frac{v}{c}\right)^2}\, dt < t_B - t_A \text{ if } v \neq 0$$

where $t_B - t_A$ is the elapsed time between A and B as measured by the unaccelerated clock. The inequality results because, for $v \neq 0$, the integrand is always less than 1. Now, we know that in a spacetime diagram the world line of the unaccelerated clock is a straight line, whereas the world line of the accelerated clock is a curved line. Thus, using Fig. 3.15, combined with the inequality $t' < t_B - t_A$, we have the following central result: the world line of *maximum* proper time is the one that *looks the shortest*, that is, the straight (or free-falling geodesic) world line. In the spacetime diagram the curved line looks longer, but in fact any curved line will have a smaller proper time than does the straight world line. This is a dramatic example of how Minkowskian *spacetime* geometry differs from Euclidean *space* geometry; in the latter geometry, there is no longest path between two points.

From this, we can now understand the famous paradox of the twins, Bob and Bill. Bill remains on Earth, but Bob gets into a rocket ship and goes on a high speed trip out into space. Eventually he brings his ship to a stop, turns around, and returns to Earth. The world lines of Bob and Bill are initially together, then they diverge as Bob goes on his trip, and then they come together again at the end of Bob's trip, as shown in Fig. 3.16. The details of Bob's trip are not important for a general statement of the paradox (although in just a bit I *will* present the details for one possible trip). All we need observe for now is that Bill's world line from A to B is straight, whereas Bob's is curved. Bill's body (that is, his local clock) will therefore measure a greater proper time than will Bob's; that is, Bob will be younger than his stay-at-home twin! Equivalently, upon his return Bob will hear his Earthbound

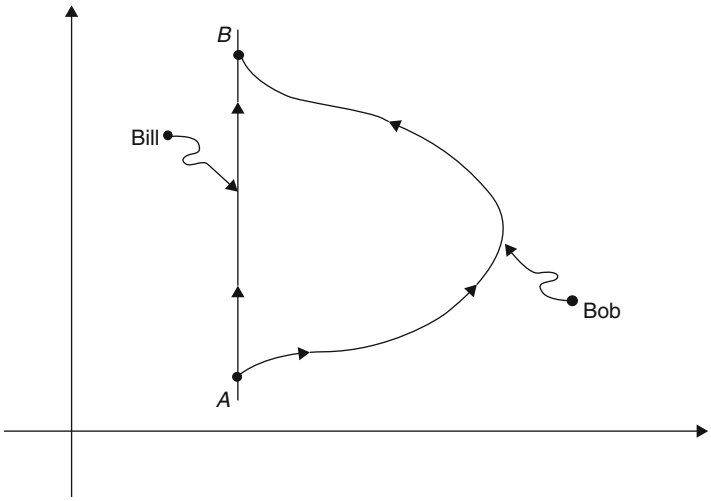

Fig. 3.16 World lines of unaccelerated (Bill) and accelerated (Bob) twins

brother declare the date to be further in the future than Bob's trip lasted (according to Bob). Bob will therefore conclude that he has traveled into the future.[110]

This situation is called a paradox, not because of the time travel aspect (there are no logical paradoxes associated with travel into the future), but rather because it seems to violate the very spirit of special relativity. That is, from Bill's point of view, Bob at first travels away and then returns. But one can argue that from Bob's point of view it is Bill who first recedes and then returns. So why is it *Bob* who is the younger, and not Bill? Long after Einstein's 1905 publication of special relativity, this point remained a great puzzle for many. For example, in the 1923 Presidential Address to the Eastern Division of the American Philosophical Association, we read this very objection to the twin paradox. The conclusion by the speaker is that such a thing "could happen only in a universe in which all squares were round and the *principio contradiction* had been put to sleep."[111]

So, what's the answer, why is it *Bob* who is the younger of the twins? The classic physics answer is that the two points of view are actually *not* symmetrical, that there is a definite asymmetry between Bill and Bob. After all, it is Bob who feels the acceleration from the rocket's engines as he blasts off from Earth—it is Bob, not

[110]The twin paradox is hinted at in Einstein's 1905 paper, but it is in a 1911 address to the International Congress of Philosophy in Bologna, by the French physicist Paul Langevin (1872-1946), that a human space traveler is first introduced (in a cannonball moving at near light-speed, an idea motivated by Langevin's reading of Jules Verne's 1872 novel *From the Earth to the Moon*). The writer Pierre Boulle proudly mentioned this contribution by his fellow Frenchman in the time travel story "Time Out of Mind" (you can find it in Boulle's collection *Time Out of Mind*, Vanguard Press 1966).

[111]W. P. Montague, "The Einstein Theory and a Possible Alternative," *The Philosophical Review*, March 1924, pp. 143-170.

Bill, who feels *force*—whereas Bill feels nothing unusual as he remains on Earth. The more fundamental physics answer, however, is that Bob's world line in spacetime is curved, whereas Bill's is straight.

In an open, spatially unbounded, flat spacetime, *curved* is indeed synonymous with *accelerated*, but this need not be so in a *closed,* flat spacetime. In an open, flat spacetime, the only way two world lines can diverge in the past and then meet again in the future is for at least one of them to curve, but in a closed but still flat spacetime, it is possible for two straight world lines to meet more than once. For example, Fig. 3.17 shows a simple two-dimensional spacetime that is the surface of a cylinder (which you'll recall we argued earlier is flat), rather than an infinite flat plane. The two world lines in that figure are *both* straight: to visualize this, imagine cutting the cylinder open along the (vertical) time dimension, and then flattening it out. Bob's world line, however, looks longer in the spacetime diagram, so Bob's proper time will be less than Bill's when they meet again, even though now *neither* of them has experienced any acceleration.[112] This is simply an interesting mathematical exercise, however, and as far as is known the spacetime we live in is not cylindrical and so Bob's trip into the future will require an accelerating rocketship.[113]

If we specify the details of Bob's trip, we can then precisely calculate the difference in elapsed time for the twins. In an analysis that dates back to 1962, the German astrophysicist Sebastian von Hoerner (1919–2003) did that for the following trip[114]: To begin, Bob gets into his rocket ship at time $t = t' = 0$ (t is time measured on Earth by Bill, and t' is time measured by Bob in his rocket). The Bill and Bob synchronize their clocks at the instant of departure. Bob's trip is to be made in comfort, and so his rocket accelerates at a constant rate (a one gee acceleration, for example, would be equivalent to Earth's gravity, and Bob would feel right at home). This is of practical importance, obviously, because we do not want the experienced acceleration to be incompatible with the physical survival of Bob. Bob

[112]See C. H. Brans and D. R. Stewart, "Unaccelerated-Returning Twin Paradox in Flat Space-Time," *Physical Review D*, September 15, 1973, pp. 1662-1666. For a similar treatment, this time by a mathematician, see Jeffrey R. Weeks, "The Twin Paradox in a Closed Universe," *American Mathematical Monthly*, August-September 2001, pp. 585-589.

[113]In Chapter 6 we'll discuss the idea of traveling into the past by moving faster than light (*superluminal* motion). A treatment of such travel, in Bob's cylindrical spacetime, is by S. K. Blau, "Would a Topology Change Allow Ms. Bright to Travel Backward in Time?" *American Journal of Physics*, March 1998, pp. 179-185, which answers that question in its last line: "Ms. Bright cannot [return] 'the previous night' and alter history," a conclusion that no doubt met with Hawking's approval. The 'Ms. Bright' in the title is the heroine of a 1923 limerick that you can find quoted in the first *For Further Discussion* of Chapter 6.

[114]Originally appearing in the journal *Science*, under the title of "The General Limits of Space Travel," von Hoerner's analysis was reprinted in the classic anthology *Interstellar Communication* (A. G. W. Cameron, editor), W. A. Benjamin 1963. The arithmetic was, alas, just a bit sloppy (the final formulas, fortunately, are correct), and many of von Hoerner's numerical evaluations are incorrect. Later, the British mathematician Leslie Marder cleaned-up the analysis in his beautiful little book on the twin paradox, *Time and the Space-Traveler*, George Allen & Unwin, Ltd. 1971.

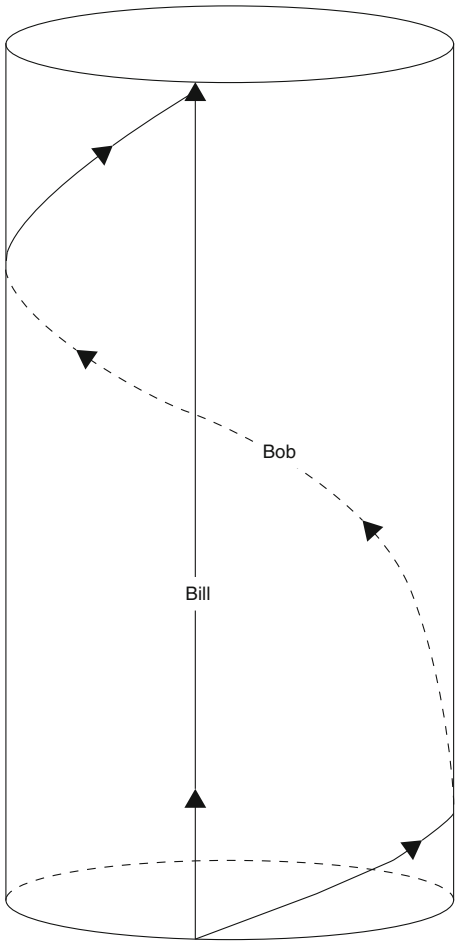

Fig. 3.17 Unaccelerated twin paradox in a cylindrical spacetime

travels this way for a time interval of T (as measured by Bill on Earth) and T' (as measured by Bob in his rocket). At that time the rocket is traveling at its maximum speed. Bob then turns off the rearward engine and turns on a forward-mounted engine so as to experience a constant deceleration. Floor and ceiling interchange, but Bob always weighs the same. If he does this for the same time interval T (as measured by Bill on Earth) and T' (as measured by Bob) as for the initial acceleration phase of the trip, the rocket will be brought to rest with respect to Earth. At that time, $2T$ (as measured by Bill on Earth) and $2T'$ (as measured by Bob), the rocket is at its maximum distance from Earth. Bob then returns to Earth, using the same acceleration/deceleration process, and Bob arrives back home, gently, with a final speed of zero with respect to Earth (ignoring, of course, all the navigational problems due to the motion of Earth during the trip).

Assuming the clock hypothesis is true (not all physicists believe this,[115] but remember, we have Einstein[116] on our side with this!), the result is that if a is the constant acceleration of the rocket (as experienced by Bob), and c is the speed of light, then the relationship between the *total roundtrip time* as measured by Bill ($4T$) and as measured by Bob ($4T'$), is given by

$$T = \frac{c}{a}\sinh\left(\frac{a}{c}T'\right).$$

The difference in what each twin believes to be the date can, in fact, be truly astonishing. For example, if $a = 1$ gee and Bob travels (by his clock) for $4T' = 20$ years, then $4T = 339$ years.[117] Of course, there will actually be no disagreement between Bill and Bob over the date upon Bob's return because Bill will be long dead!

Is it likely that such a time trip[118] will someday be made into the future? It's just my opinion, but I suspect not. Bob will be traveling at virtually the speed of light at maximum speed ($0.9993\,c$, to be precise, at which point he will be 84 light-years from Earth), and to zip through space at such a speed would result in a very high rate of collision with stray hydrogen atoms (about one per cubic centimeter). The result of those energetic collisions would be the intense blasting of Bob with a lethal dose of gamma radiation. And, as von Hoerner showed in his original analysis (note 114), the energy required by Bob's rocket would be simply mind-boggling.

Professor Schild (see note 116), on the other hand, seems to have been less bothered by such considerations when he wrote, at the beginning of a prose discussion of the twin paradox, "I have no doubt that if our technology should ever advance to the stage where large-scale twin effects become noticeable with our unaided senses, then [people] will have no difficulty in adjusting their concepts of time until the new phenomena see quite natural."[119]

I'll end this chapter on time with the observation that it is the distinction between the proper time of Bob on a rocket ship, and the time of those who are not fellow

[115]Consider, for example, this remark by 1965 Nobel physics laureate Julian Schwinger (1918-1994) about the twin paradox in his 1986 book *Einstein's Legacy*: "The observer on the spaceship . . . is *not* in uniform, unaccelerated motion . . . The special theory of relativity does not apply to such an accelerated observer." Schwinger was wrong in this conclusion (see the next note).

[116]As a physicist wrote on this point after Einstein's death, "A good many physicists believe that [the twin] paradox can only be resolved by the general theory of relativity. . . . However, they are quite wrong. The twin effect . . . is one of special relativity." See A. Schild, "The Clock Paradox in Relativity Theory," *American Mathematical Monthly*, January 1959, pp. 1-18. Alfred Schild (1921-1977) was professor of physics at the University of Texas, and a recognized expert in the general theory.

[117]In using the T, T' formula, one has to be careful to use MKS units, that is, length and time measured in meters and seconds, respectively. Thus, $a = 1$ gee $= 9.81$ meters/second^2 and $c = 186,210$ miles/second $= 2.997 \times 10^8$ meters/second.

[118]For a science fiction use of such a trip, see Robert Heinlein's 1956 novel *Time for the Stars*.

[119]A. Schild, "Time," *Texas Quarterly*, Autumn 1960, pp. 42-62.

space travelers, that eliminates the occasional suggestion of simply *freezing* one's way via suspended animation to the future (as in the 1992 film *Forever Young*). That is, suppose you manage to talk a friend into climbing into a freezer (please don't actually try this!); at the moment he gets in, his wrist watch agrees with yours (both are powered and maintained at a constant temperature by 100-year nuclear batteries). Years later, when you thaw your friend out, you'll find that your watches still agree. But when Bob returns from his rocket trip, his watch will not agree with yours, but instead will be far behind. Bob is a true time traveler, but your frozen/thawed friend is not.[120]

A provocative illustration of the distinction between the proper time of a time traveler and of those who are not time travelers was given by a philosopher.[121] He begins his analysis by asking what appears to be a question with an obvious answer. Suppose, he says, it is [2018] and you suddenly wake up in a hospital and are told that you have been in a coma for the past 2 weeks. You are also told that you were in an auto accident 2 weeks ago, that you suffered temporary neural damage, and that the eventual reversal of such damage always, at some time within 4 weeks after the damage occurs, causes a day of excruciating pain *if you are conscious at the time*. Would you prefer for the day of damage reversal to be in the past 2 weeks (when you were in the coma) or in the next 2 weeks? The answer seems clear. After all, if the day that damage reversal occurs has already happened, then you simply slept through it and missed the pain. To prefer the day of pain to be in the future (when you will be awake) seems absurd. Now, let's add time travel to the equation.

All is as before, but now you immediately leave the hospital upon regaining consciousness to take a trip back to 1892, where you will stay for 2 weeks. Again, it seems clear that you would prefer to have had the day of pain in the past 2 weeks (in 2018), not in the next 2 weeks (in 1892). Note that the *next* is a reference to your proper time, because whereas 1892 is the global past, it is *your* personal future. Thus, now your preference would be to have the day of pain in the *recent personal past* of 2018, not the *distant global* past of 1892. Now, let's put another time travel twist to this story.

All is as before in the original tale, except now you are told in the hospital that the auto accident happened just after you made a time trip to 2092: as you walked out of your time machine in 2092, you were hit by a car. The 2 weeks you were in a coma were in 2092, before you were judged fit enough (although still unconscious) to make the time journey back to 2018. When would you now prefer to have the day of pain? Clearly, as always, in your *personal past*, which is now the *global future*.

Time *is* different for those who time travel and those who don't!

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[120] In his 1956 novel *The Door Into Summer*, the always ingenious Robert Heinlein used *both* ideas, with the cold-storage method of reaching the future combined with a true time machine to allow his hero to return to his 'present' (the future's past).

[121] A. Gallois, "Asymmetry in Attitudes About the Nature of Time," *Philosophical Studies*, October 1994, pp. 51-59.

3.7 For Further Discussion

An interesting *theological* analysis of Feynman's idea of an electron traveling backward in time, expressed as thinking of the electron as being in 'one of God's films played in reverse,' is given by J. W. Smith, "Time Travel and Backward Causation," *Cogito* 1985, pp. 57–67. Wondering what it would be like for an electron to travel backwards in time, Smith's answer was: "Consider an electron e_1. At time t_0 it is at (x_0, y_0, z_0). At time t_1 it is at (x_1, y_1, z_1). If the direction of time for the electron was reversed, then the electron would be observed on the 'film of the world' to travel back along the same path as it did before, i.e., back to (x_0, y_0, z_0). If God stopped the 'film of the world' and examined the charge of e_1, then He would find that it was *negative*, not *positive*. Hence the electron traveling backwards in time is simply that: an electron traveling backwards in time, it is not a positron. Time reversal does not result in a reversal of charge. Thus, the Stückelberg-Feynman position is incorrect . . .." Discuss this in terms of the TCP theorem. Is there a conflict? When God stops the 'film of the world,' does the electron even *have* an arrow of time?

All the modern, major religions of the world are in agreement on these two points: (1) God created the universe and (2) At some time in the past, the universe came into existence. This does raise the question of what was God doing *before* He created the universe (see note 7 in the Introduction). In his *Confessions*, Saint Augustine comments on the conundrum that (1) and (2) are possibly in conflict. After all, if God *created* the universe then, given any time t in the finite past, He must have been doing something *before* time t, which means that for any time t in the finite past the universe already existed. Thus, the universe had no instant of creation in the finite past and so had no first moment of existence—which implies (2) is false. However, like any good philosopher of religion, Augustine not only provided this theological puzzle, but also a way to wiggle free of it. His suggested counter is the assertion that time is *itself* a creation of God, that is, He made time as *part* of creating the universe. Thus, there was no time *before* He created the universe, and so the very question of 'what was He doing before He made the universe' has no meaning. What do you think of Augustine's two arguments?

The Australian philosopher J. J. C. Smart (1920–2012) invoked five dimensional spacetime in a way very different from that of including an 'eternity' axis for God's temporal time (see note 33 in "Some First Words"). What Smart argued for, instead, was *multiple* four-dimensional worlds existing together without conflict, just as an infinity of two-dimensional worlds can exist without conflict in a three dimensional space. As he wrote, "The reason why there could be two totally disparate space-times is simply the quite obvious one that two totally disparate four-dimensional spaces can exist within a suitable five-dimensional space. There is no difficulty in mathematical inconceivability here. Now let one of these four-spaces be our own space-time world, and let the other four-space be more or less similar, in accordance with whatever story you wish to tell about it." This idea had, in fact, been around long before Smart's 1967 paper. In his 1898 Presidential Address to the American Mathematical Society, for example, Simon Newcomb declared "Add a fourth dimension of space, and there is room for an indefinite number of Universes, all alongside of each other, as there is for an indefinite number of sheets of paper when we pile them upon each other." Newcomb's idea appealed to H. G. Wells' fancy so much that he built two novels, *The Wonderful Visit* and *Men Like Gods*, around it. In the first novel there is explicit mention of multiple worlds "lying somewhere close together, unsuspecting, as near as page to page in a book," and the second one speaks of one parallel universe being rotated into another. John Cramer (a University of Washington physicist) repeated Newcomb's and Wells' parallel universes/pages-of-a-book/rotation imagery almost word for word in his 1991 novel *Twistor*.

Read these three novels, and then discuss. In particular, is Wells consistent in his presentations (as a novelist there is, of course, no reason he should be!)?

Imagine the following two events, **A** and **B**, in Minkowski spacetime: **A** is the emission of a photon, and **B** is the absorption of that photon. What is the spacetime interval between **A** and **B**? It might seem that we need to know more about the precise spatial and temporal coordinates of **A** and **B**, but in fact the interval is *always zero* for any two events connected by light (by photons). To see this, write the flat Minkowski metric as

$$\left(\frac{ds}{dt}\right)^2 = 1 - \left(\frac{dx}{dt}\right)^2$$

(continued)

and so, since $(dx/dt)^2 = 1$ (because photons—by definition!—travel at the speed of light) we have $(ds)^2 = 0$. The world line of any photon has what is called a *null* interval, as do all world lines on the surface of a light cone. Timelike world lines (in the interior of light cones, with $(dx/dt)^2 < 1$) have positive intervals, that is, $(ds)^2 > 0$. Spacelike world lines (in the exterior of light cones, in Elsewhere, with $(dx/dt)^2 > 1$) have negative intervals, that is, $(ds)^2 < 0$. This is one of the significant differences between *distances* in space (which are never negative) and *intervals* in spacetime. The American chemist G. N. Lewis (1875–1946)—see note 60 in Chap. 2—constructed a romantic illustration of this when he wrote "Any pair of points [in spacetime] which are separated by zero distance [interval] are in *virtual contact*. In other words, I may say that my eye touches a star, not in the same sense as when I say that my hand touches a pen, but in an equally physical sense." (See Lewis' paper "Light Waves and Light Corpuscles," *Nature*, February 13, 1926, pp. 236–238; Lewis was the originator of the term *photon* for a particle of light.) To understand what Lewis was getting at, you must understand that in spacetime we can have the interval between **A** and **B** as zero, and the interval between **B** and **C** as zero, but the interval between **A** and **C** may *not* be zero. To convince yourself of this, suppose the Minkowski spacetime coordinates (x, t) of **A**, **B**, and **C** are (1,3), (2,2) and (1,1), respectively. Show that $(ds_{\boldsymbol{AC}})^2 = 4$, while $(ds_{\boldsymbol{AB}})^2 = (ds_{\boldsymbol{BC}})^2 = 0$. (Hint: draw a diagram of this spacetime and simply plug the coordinates of **A**, **B**, and **C** into the metric.)

The use of the time dilation effect of high-speed space travel was used by science fiction writer Donald Wandrei (1908–1987) in his tale "A Race Through Time," *Astounding Stories*, October 1933. Initially set in 1950, this is the story of two scientists, one evil (of course!) and the other good (of course!), who develop quite different methods for travel into future times. The evil one does it with a drug that slows the metabolic processes of the body, while the good one builds an atomic-powered rocket in his home workshop! The evil scientist kidnaps the good one's girlfriend, seals the two of them inside a crystal dome, and then injects her and himself with his drug. He has arranged matters so that they will emerge from the dome in the year one million A.D. Learning what has happened, the good scientist rushes to the dome finds he can't break in, but sees an indicator dial pointing at 1,000,000. (The evil scientist has conveniently provided the dial, as well as having made the dome transparent, much as modern-day movie criminals always include a count-down clock with glowing red digits on their bombs so the hero always knows just how much time is left to disarm the bomb.)

(continued)

Returning to his rocket, the good scientist decides that he, too, will travel into the far future using time dilation. So, off he goes, on a trip like Bob's in Sect. 3.6. The story ends with an ironic twist—the good scientist thought the '1,000,000' he saw through the dome meant *one million years in the future beyond 1950*, and so he arrives back on Earth nearly 2000 years *after* his girlfriend and the evil scientist emerged from the dome. (They are, of course, long dead when the good scientist returns.)
On the outward leg of the good scientist's rocket flight we read of his "frightful speed — now thousands of light years per Earth second." Discuss this in terms of relativity theory. That is, does the rocket actually travel thousands of light years in one second of elapsed time back on Earth?

The American physicist Robert Forward (1932–2002) was, in addition to being an expert in general relativity, also a quite inventive science fiction writer. In his short story "Twin Paradox" (*Analog Science Fiction*, August 1983), for example, he used *biology* to give a surprising, ironic twist to the classic physics puzzle. The story flips the asymmetric aging of the twins by imagining that, just after the traveling twin's departure, the secret of immortality is discovered. The treatment has to be administered no later than at a certain age, however, and upon his return to Earth the traveling twin is just a bit too old for it to work. He thus becomes the last person to die of old age! In this tale, the details of the traveling twin's trip are somewhat different from Bob's trip. Read "Twin Paradox" (you can also find the story in Forward's 1995 book *Indistinguishable from Magic*), and summarize how the traveling twin's trip is accomplished.

In the mystical 1920 novel *A Voyage to Arcturus*, by the Scottish writer David Lindsay (1876–1945), we read of a spaceship that travels to Arcturus (the brightest star in the constellation Boötes, 36 light years from Earth) in just 19 h of proper time. The technical details of the trip are not explained in the novel, so assume they are the same as in Bob's trip. That is, $2T' = 68,400\,\text{s}$ as measured by a clock on the spaceship. The distance traveled in this time is

$$2\frac{c\left\{\sqrt{a^2T^2+c^2}-c\right\}}{a}$$

(continued)

where c is the speed of light, a is the constant acceleration/deceleration of the rocket (as measured on the spaceship), and T is how long an *Earth*-based clock says the trip takes. Use this formula, and the one relating T and T' in the text, to calculate

1. The value of the constant acceleration/deceleration, a (does the result seem reasonable to you?) and
2. The value of T (the length of time that passes on Earth as 19 h pass on the spaceship).

You don't have to discuss general relativity to encounter tensors of the second rank (as is the metric tensor). Electrical engineers run into such a thing, for example, when studying the lowly Ohm's law! In a copper wire, that law says the current density (the vector **J**, in units of amperes per square meter) at any point is related to the electric field (the vector **E**, in units of volts per meter) at that point by the *scalar* σ as follows: $\mathbf{J} = \sigma\mathbf{E}$, where σ (called the *conductivity*) is a single number. This says, in rectangular coordinates, that the x-component of **J** depends *only* on the x-component of **E**, and similarly for the y-component and z-components of **J** and **E**. More generally, however, each component of **J** depends on *all* of the components of **E** (as in certain crystalline structures), and so we have the equations

$$\begin{aligned} J_x &= \sigma_{11}E_x + \sigma_{12}E_y + \sigma_{13}E_z \\ J_y &= \sigma_{21}E_x + \sigma_{22}E_y + \sigma_{23}E_z \\ J_z &= \sigma_{31}E_x + \sigma_{32}E_y + \sigma_{33}E_z \end{aligned}$$

or, in matrix form

$$\mathbf{J} = \begin{bmatrix} J_x \\ J_y \\ J_z \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} \begin{bmatrix} E_x \\ E_y \\ E_z \end{bmatrix} = \boldsymbol{\sigma}E.$$

So **J** is now related to **E** by $\boldsymbol{\sigma}$, a 3×3 *matrix* (9 numbers, instead of just 1). The matrix $\boldsymbol{\sigma}$ is, in fact, a tensor of rank 2. This tensor is in the three-dimensional space of the copper wire, while the 4×4 metric tensor matrix is in a four-dimensional spacetime, but both are tensors of rank 2. The number of numbers in a tensor of rank n, in a space of dimension d, is d^n. In general relativity, tensors of higher rank than 2 are required. For example, the

(continued)

curvature tensor has rank 4, and so in a four-dimensional spacetime it is described by $4^4 = 256$ numbers. This goes a long way in explaining why, in general relativity, computing often involves a *lot* of arithmetic! The primary characteristic of tensors of any rank is that they are invariant under a change in coordinate systems (choosing a coordinate system is an arbitrary matter, made mostly for human convenience, about which Nature is indifferent). Read more about tensors, and write an essay on how they behave under a change in coordinates. A good place to start, at the level of this book, is Lillian Lieber's *The Einstein Theory of Relativity: a trip to the fourth dimension*, Paul Dry Books 2008 (an updated version of the original 1945 book).

Chapter 4
Philosophers, Physicists, and the Time Travel Paradoxes

"He felt the intellectual desperation of any honest philosopher. He knew that he had about as much chance of understanding such problems as a collie has of understanding how dog food gets into cans."[1]

4.1 Paradoxes and Their First Appearance in Science Fiction

> "There's a lot we don't know about time travel. How do you expect logic to hold when paradoxes hold, too?" "Does that mean you don't know?" "Yes."[2]

More than 30 years ago Quentin Smith, a philosopher who believes in a finite length to the past, wrote a refutation to those who believe in an infinite past and, while that paper[3] has nothing to do with the paradoxes of time travel, in the course of presenting his reasoning he included the following curious passage:

> "Why does the sun arise in the morning and not at some other time? Why do the hands of a properly functioning clock point to 12:00 at noon and midnight and not at other times? Why does the death of a person occur at a later time than his birth? The answer in all these cases is: Because by the very nature of these events they could not occur at other times. It belongs to the very nature of the sun's rising that it occur in the morning and not in the afternoon or evening. It belongs to the very nature of a properly functioning clock to point to 12:00 at noon and midnight and not at other times. And it belongs to the very nature of death to occur at a time later than a person's birth."

But what of a time traveler born in 1980 who, in 2018, enters her time machine, pushes a few buttons, and then boldly steps out into the Cretaceous period seventy million years earlier—and is promptly eaten for lunch by a passing *Tyrannosaurus*

[1] A time traveler admits (to himself) how perplexed he is by paradoxes in Robert Heinlein's classic tale "By His Bootstraps," *Astounding Science Fiction*, October 1941.

[2] Excerpt from a conversation between two paradox-puzzled time travelers in Larry Niven's story "Bird in the Hand," *The Magazine of Fantasy & Science Fiction*, October 1970.

[3] Q. Smith, "Kant and the Beginning of the World," *New Scholasticism*, Summer 1985, pp. 339–346.

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P.J. Nahin, *Time Machine Tales*, Science and Fiction,
DOI 10.1007/978-3-319-48864-6_4

rex? Perhaps Smith himself would say that there is no contradiction between this and his third claim because, in the time traveler's *proper* time, her spectacular death does indeed come after her birth. For many, however, for a time traveler to die before her mother is born *is* a paradox, plain and simple, say what you will about proper time.

One science fiction view of time travel paradoxes is that nature would be so disrupted by them that, should one occur, the universe would be torn apart. In one story, for example, a paradox is on the verge of happening through the use of a Tipler-cylinder time machine (mentioned back in Chap. 1, and which we'll discuss in more detail in the next chapter). In response to this 'threat to common sense,' the universe 'decides' to avoid the paradox by simply eliminating the perpetrators via a local nova![4] Niven wasn't the first to use this idea. A famous story[5] by L. Sprague de Camp (1907–2000), written two decades before, had already put forth the suggestion that nature will take all required corrective action to avoid paradoxes.

In De Camp's tale we read of two big-game hunter guides who use "Professor Prochuska's time machine at Washington University"—built with the aid of a "cool thirty million" dollar grant from the Rockefeller Foundation—to operate a safari-for-hire business that transports hunters back to the late Mesozoic era. When a disgruntled client tries to go back to the day *before* a previous trip to shoot the guides (who had displeased him, or rather *would* displease him the next day), we learn just how nasty De Camp thought Mother Nature would be to avoid a paradox. (After all, the guides had *not been* shot during the safari, so they *could not be* shot.[6]): "The instant James started [to ambush the guides] the space-time forces snapped him forward to the present to prevent a paradox. And the violence of the passage practically tore him to bits [making his body look] as though it had been pulverized and every blood vessel burst, so it was hardly more than a slimy mass of pink protoplasm."

And even earlier we have a famous tale[7] that was discussed in Chap. 1, by Fredric Brown (1906–1972), a master of the special category of science fiction called the "short-short," in which everything happens in 500 words or less. As you might expect, the oddities of time travel were natural attractions for Brown's quirky talent. You'll recall that in this story the inventor of the first time machine demonstrates it to two colleagues by sending a brass cube 5 min into the future. After being placed in the machine, the cube vanishes and then 5 min later reappears. No paradoxes with that—it is a trip into the *past* that has the potential for deadly repercussions. We learn just how deadly when the inventor next declares that at

[4]L. Niven, "Rotating Cylinders and the Possibility of Global Causality Violation," *Analog Science Fiction*, August 1977. Niven took this title from a physics paper with that title, authored by Tipler, that had appeared three years earlier in *Physical Review D* (April 15, 1974, pp. 2203–2206).

[5]L. Sprague de Camp, "A Gun for Dinosaur," *Galaxy Science Fiction*, March 1956.

[6]This is a statement of the belief that the past cannot be changed, an idea we will examine later in this chapter.

[7]Look back at note 93 in Chap. 1.

three o'clock he will again place the cube in the time machine but, until then, he will hold the cube in his hand. Thus, he says, at 5 min before three the cube will vanish from his hand and immediately appear in the time machine because 5 min after that, at three o'clock, he will send it 5 min into the past. And indeed, at 5 min before three the cube does simultaneously vanish from his hand and appear in the time machine. Then, slightly before three, as the three men stand pondering what has happened, one of the observers asks what will happen if the inventor does *not* send the cube back at three o'clock? "Wouldn't there be a paradox of some sort involved?" he wonders.[8] His curiosity aroused, the inventor can't resist the experiment—and the universe promptly vanishes.

Time travel, of course, is full of potential paradoxes. A paradox, according to the usual dictionary definition, is something that appears to contain contradictory or incompatible parts, thus reducing the whole to seeming nonsense. And yet, truth is also evident in the whole. The history of science and mathematics has left a long trail of paradoxes, and those that involve time travel are merely among the most recent. Not all of the puzzles of time travel involve physics or logic, however. As one philosopher observed, "Doubtless time travel will raise a host of legal difficulties, e.g., should a time traveler who punches his younger self (or vice versa) be charged with assault? Should the time traveler who murders someone and then flees into the past for sanctuary be tried in the past for his crime committed in the future? If he marries in the past can he be tried for bigamy even though his other wife will not be born for almost 5000 years? Etc., etc. I leave such questions for lawyers and writers of ethics textbooks to solve."[9]

One way early science fiction writers had of responding to the puzzle of time travel paradoxes was to just give up and to concede that the logical puzzles are overwhelming. In one tale, for example, the inventor of the Chronoscope (a gadget that can only *view* the past) explains, "There is no time travel machine. Such a thing is a logical impossibility, treated seriously only by half-cracked writers of fantasy. Such a machine would lead at once into a hopeless paradox."[10] Equally concerned about time travel paradoxes was the pulp science fiction time traveler who told his partner, just before their first trip in time, that "I'm not sure any more about getting back. There're some unpredictable terms in the time-travel equation—paradoxes. Maybe we *won't* get back."[11]

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[8]This is what is called a *bilking paradox*, and such paradoxes will be discussed later in this chapter. Brown gave this story a lot of thought. At one point in the tale one of the colleagues, puzzled by how the inventor will be able to place the cube into the time machine at three if it has already vanished from his hand and appeared in the machine, asks "How can you place it there, then?" Replies the inventor, "It will, as my hand approaches, vanish from the [machine] and appear in my hand to be placed there."

[9]L. Dwyer, "Time Travel and Some Alleged Logical Asymmetries Between Past and Future," *Canadian Journal of Philosophy*, March 1978, pp. 15–38.

[10]M. Jameson, "Dead End," *Thrilling Wonder Stories*, March 1941.

[11]E. Binder, "The Time Cheaters," *Thrilling Wonder Stories*, March 1940.

Fig. 4.1 One way pulp science fiction avoided paradoxes was to use a 'time viewer' (like the chronoscope in "Dead End") as in "The Time Eliminator" (*Amazing Stories*, December 1926). This illustration from the story (authored by somebody who used only the initials K.A.W.) by Frank R. Paul (©1926 by Experimenter Publishing Co.) shows the inventor demonstrating his gadget to his future wife and father-in-law. Able to look back in time, the screen is displaying scenes from the older man's courtship of his wife, decades in the past. Reprinted by permission of the Ackerman Science Fiction Agency, 2495 Glendower Ave., Hollywood, CA 90027 for the Estate

But are there *really* paradoxes? Or is it true, as the extraordinary boy-prodigy who invented a time machine exclaimed (when his teacher asserted that some questions could never be answered because "Nature is full of paradoxes"), "Ah, Professor, what nonsense! Nature is harmonious; it is we who bring the paradoxes into it."[12] Saying the same are two physicists, in a paper on the circular orbits of photons around black holes: "There are no paradoxes in physics, but only in our

[12]V. Grigoriev, "Vanya," in *Last Door to Aiya* (M. Ginsburg, editor), S. G. Phillips 1968.

attempts to understand physical ideas by using inadequate reasoning or false intuition."[13] And as the time traveler in an early pulp story[14] casually declares to a friend, after an astonishing adventure in the year A.D. 1,001,930, "Paradoxical? My dear fellow, the Einstein Theory is full of apparent paradoxes, yet to him who understands it there is no inconsistency whatever. Give me another cigarette, will you, Frank?"

It is in *Amazing Stories* that we find the first non-fictional speculations about time travel in a pulp magazine—and certainly long before any *physics* journal would touch the subject! Publisher and editor Hugo Gernsback started those speculations by reprinting Wells' *Time Machine*, which in turn sparked a fair number of readers' letters that were printed in the magazine's "Discussions" section. Typical of the less interesting is the following comment from a letter in the July 1927 issue: "In the 'Time Machine' I found something amiss. How could one travel to the future in a machine when the beings of the future have not yet materialized?" (We answered that question in the previous chapter with the twin paradox.) Far more interesting was this letter, in the same issue:

> "How about this 'Time Machine'? Let's suppose our inventor starts a 'Time Voyage' backward to about A.D. 1900, at which time he was a schoolboy . . . His watch ticks forward although the clock on the laboratory wall goes backward. Now we are in June 1900, and he stops the machine, gets out and attends the graduating exercises of the class of 1900 of which he was a member. Will there be another 'he' on the stage? Of course, because he *did* graduate in 1900 . . . Should he go up and shake hands with this 'alter ego'? Will there be two physically distinct but characteristically identical persons? Alas! No! He can't go up and shake hands with himself because . . . this voyage back through time only duplicates actual past conditions and in 1900 this strange 'other he' did *not* appear suddenly in quaint ultra-new fashions and congratulate the graduate. How could they both be wearing the same watch they got from Aunt Lucy on their seventh birthday, the same watch in two different places at the same time. Boy! Page Einstein! No, he cannot be there because he wasn't there in 1900 (except in the person of the graduate) . . . The journey backward must cease on the year of his birth. If he could pass that year it would certainly be an effect before a cause . . . Suppose for instance in the graduating exercise above, the inventor should decide to shoot his former self . . . He couldn't do it because if he did the inventor would have been cut off before he began to invent and he would never have gotten around to make the voyage, thus rendering it impossible for him to be there taking a shot at himself, so that as a matter of fact he *would* be there and *could* take a shot—help, help, I'm on a vicious circle merry-go-round . . . Now as to trips into the future, I could probably think up some humorous adventures wherein [the inventor] digs up his own skeleton and finds by the process of actual examination that he must expect to have his leg amputated because the skeleton presents positive proof that this was done."[15]

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[13]M. A. Abramowicz and J. P. Lasota, "On Traveling Round Without Feeling It and Uncurving Curves," *American Journal of Physics*, October 1986, pp. 936–939.

[14]F. J. Bridge, "Via the Time Accelerator," *Amazing Stories*, January 1931.

[15]This story idea (the letter was signed only with the initials T.J.D.) may well have been the inspiration for R. Rocklynne, "Time Wants a Skeleton," *Astounding Science Fiction*, June 1941. Not all fans agreed with T.J.D. A few years later, for example, a teenager named P. Schuyler Miller (1912–1974), who would author several time travel classics himself, wrote a letter to the editor of *Astounding Stories* (June 1931) stating "there is nothing in physics . . . to prevent yourself from

All of the ingenious puzzles in this letter intrigued Gernsback, and may have, in fact, been the cause of his featuring a new, original time machine story[16] in the same issue. It was the tale of a scientist who transports an entire ship at sea 14,000 years back in time and causes it to hover over lost Atlantis! That story provoked a sharp letter from a reader who claimed its logic had a fatal flaw: the story's author indicated that the Atlantians observed the time travelers when, 'of course' (asserted the reader), the time travelers must actually have been invisible. The reader explained his reasoning as follows, beginning by defining A as one of the Atlantians.

> "Now A lived his life, thousands of years ago, and died. All right, now let us pass on in time 14,000 years. Now, back we come in time when A is again living his life. Lo and behold, this time A sees before he dies a strange phenomenon in the sky! He sees the shipload of people observing him. And yet these people are necessarily observing him during his one and only lifetime, wherein he certainly did not, could not, have observed them."

Gernsback printed this letter in his September 1927 editorial "The Mystery of Time," and concluded by saying "I do . . . agree . . . that the inhabitants of Atlantis would probably not have seen the . . . travelers in time." Other readers felt this way, too, because after Gernsback published yet another time machine tale[17] in 1927, the same invisibility argument appeared again in the magazine's "Discussions" column.

Two years later an amateurishly written tale[18] appeared in which a man travels in time from 1928 to 2930 with the aid of an "astounding machine based on advanced electro-physics and the non-Euclidean theory of hyperspace." The purpose of that story was two-fold: to present several of the classic paradoxes of time travel, and then to make the claim that although the simple minds of twentieth-century people cannot understand the explanations of the paradoxes (possibly explaining why the author offers none!), the paradoxes are all trivial to the scientists of the thirtieth century. Despite this shortcoming (as well as some pretty awful dialog) the story nonetheless still managed to entertain readers with the sheer mystery of the paradoxes. Letters poured into the magazine from young fans, all demanding more time travel fiction.

So, that same year Gernsback responded with a story[19] that plays with the question of the role of time travelers in the past. (That question was clearly 'in

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going into the past . . . and shaking hands with yourself or killing yourself." That did, however, provoke the following harsh reply from another, more skeptical reader (in the December 1933 issue): "P. S. Miller once wrote that time traveling is not incompatible with any laws of physics . . . 'he don't know from nothing.'"

[16] C. B. White, "The Lost Continent," *Amazing Stories*, July 1927.

[17] F. Flagg, "The Machine Man of Ardathia," *Amazing Stories*, November 1927.

[18] C. Cloukey, "Paradox," *Amazing Stories Quarterly*, Summer 1929.

[19] H. F. Kirkham, "The Time Oscillator," *Science Wonder Stories*, December 1929.

the air,' as Gernsback's old magazine *Amazing*[20] simultaneously published a story[21] addressing this same puzzle of time travel.) Could time travelers actually participate in events ("mix into the affairs of the period," in Gernsback's words), or would they just be unseen observers? This question, obviously inspired by the earlier discussion in *Amazing Stories*, intrigued Gernsback as much as it did his readers and so, along with Kirkham's story, he printed a challenge titled "The Question of Time-Traveling" (see note 18 in the Introduction):

> "In presenting this story to our readers, we do so with an idea of bringing on a discussion as to time traveling in general. The question in brief is as follows: Can a time traveler, going back in time—whether ten years or ten million years—partake in the life of that time and mingle in with its people; or must he remain suspended in his own time-dimension, a spectator who merely looks on but is powerless to do more? Interesting problems would seem to arise, of which only one need be mentioned: Suppose I can travel back into time, let me say 200 years; and I visit the homestead of my great great great grandfather, and am able to take part in the life of his time. I am thus enabled to shoot him, while he is still a young man and as yet unmarried. From this it will be noted that I could have prevented my own birth; because the line of propagation would have ceased right there. Consequently, it would seem that the idea of time traveling into a past where the time traveler can freely participate in activities of a former age, becomes an absurdity. The editor wishes to receive letters from our readers on this point: the best of which will be published in a special section."

Gernsback's challenge did not go unnoticed and, over the next year or so, he published a large number of reader responses in the magazine's letters column.

Indeed, a few months after issuing the challenge, in his introduction to another time travel tale,[22] Gernsback wrote that ever since the publication of Kirkham's tale "there has been a great controversy among our readers as to the possibility of time flying and the conditions under which it may be done." Most of those letters are interesting if not particularly profound, with one exception. That was a letter written by a 14 year old boy in San Francisco, and its appearance in the February 1931 issue of *Science Wonder* may well have served as the inspiration for several of the classic time travel tales published during the next 20 years:

> "Some time ago you asked us (the readers) what our opinions on time traveling were. Although a bit late, I am now going to voice four opinions . . .
>
> (1) Now, in the first place if time traveling were a possibility there would be no need for some scientist getting a headache trying to invent an instrument or 'Time-Machine' to 'go back and kill grandpa' (in answer to the age-old argument of preventing your birth by killing your grandparents I would say: 'who the heck would want to kill his grandpa or gandma!'[23]) I figure it out thusly: A man takes a time machine, and travels into the

[20]By this time Gernsback had lost control of *Amazing*, and *Science Wonder* was his come-back as a publisher of pulp 'scientifiction.'

[21]E. L. Rementer, "The Time Deflector," *Amazing Stories*, December 1929. Gernsback may well have been the editor, before he lost *Amazing*, who bought this story, and the magazine's new management simply used what remained in inventory.

[22]F. Flagg, "An Adventure in Time," *Science Wonder Stories*, April 1930.

[23]Look back at note 26 in "Some First Words."

future from where he sends it (under automatic control) to the past so that he may find it and travel into the future and send it back to himself again. Hence the time machine was never invented, but!—from whence did the machine *come*?

(2) Another impossibility that might result could be: A man travels a few years into the future and sees himself killed in some unpleasant manner,—so—after returning to his correct time he commits suicide in order to avert death in the more terrible way which he was destined to. Therefore how could he have seen himself killed in an entirely different manner than really was the case?

(3) Another thing that might corrupt the laws of nature would be to: Travel into the future; find out how some ingenious invention of the time worked; return to your right time; build a machine, or whatever it may be, similar to the one you had recently learned the workings of; and use it until the time you saw it arrives, and then if your past self saw it as you did, he would take it and claim it to be an invention of his (your) own, as you did. Then—who really *did* invent the consarn thing?

(4) Here's the last knock on time traveling: What if a man were to travel back a few years and marry his mother, thereby resulting in his being his own 'father'?"

Jim H. Nicholson

Gernsback's reply, immediately following this letter, was favorable, opening with "Young Mr. Nicholson does present some of the more humorous [?] aspects of time traveling. Logically we are compelled to admit that he is right—that if people could go back into the past or into the future and partake of the life in those periods, they could disrupt the normal course of events."[24] Nicholson's letter *is* ingenious, and it anticipated the central ideas of a number of science fiction tales yet to be written.[25] However, as you'll see as you read the rest of this chapter, contrary to Gernsback's view Nicholson's comments are *not* logically correct.[26]

[24]Despite these words, Gernsback apparently hadn't given up entirely on the 'invisibility of time travelers' view, as he had only a few months earlier published another such tale: R. A. Palmer, "The Time Ray of Jandra," *Wonder Stories*, June 1930. In this story (one either silly or hilarious, take your pick) a time traveler moves into the future by means of a 'time ray.' Unfortunately, the ray works differently on the various chemical elements, and not at all on either hydrogen or oxygen. Thus the time traveler—or at least *much* of him—and his machine do vanish into the future, but left behind are "several gallons of water spilled on the floor." (The human body is about 60 % H_2O.)

[25]For example, Nicholson's item (2) is a precise plot outline for L. Raphael, "The Man Who Saw Through Time," *Fantastic Adventures*, September 1941, and a version of item (4) is in Robert Heinlein's famous "All You Zombies—," *Magazine of Fantasy & Science Fiction*, March 1959.

[26]One cannot, however, fault the imaginative powers of James Nicholson (1916–1972). He eventually became President of American International Films, the company that made such science fiction 'classics' as *Attack of the Crab Monsters* (1957), the 1963 *X (The Man with the X-Ray Eyes)*, and *The Time Travelers* (1964).

4.2 Changing the Past and the Grandfather Paradox

> "I'm not kidding you at all Phil," Barney insisted. "I have produced a workable Time Machine, and I am going to use it to go back and kill my grandfather."[27]

As mentioned in "Some First Words," physicists and philosophers often have quite different approaches to time travel (see note 26 there again). A vivid illustration of that difference is found in a philosophical paper[28] that, after acknowledging the apparent restrictions of the grandfather paradox, turns its attention to a matter that almost surely is beyond the power of physics to study—namely, the nature of the *conversation* between a time traveler and his/her younger self. A physicist, on the other hand, views the restrictions as *the whole point*, because the central question that hovers over *any* discussion of time travel is that of 'changing the past.' As one science fiction fan summed it up in a letter to the editor of *Astounding Stories* (August 1931): "It is said that the past cannot be changed, and that any effort to do so would be useless. In my belief, no matter where or when a man goes in the past, if he appears in a year or day that has already gone by, *he is changing the past*. Then there should be no room for doubt: time traveling is impossible. It will never be done." And certainly killing your grandfather in the past (when he is still a baby) would qualify as a change to the past!

The idea of 'changing the past' occurred to the minds of philosophers long before it did in those of science fiction writers or physicists. Four centuries before Christ, the question had already been asked-and-answered by Aristotle. In his *Nicomachean Ethics*, in fact, we find him declaring that the Greek poet Agathon had known the answer a century earlier, and he quotes the poet as saying "Forever God lacks this one thing alone, To make a deed that has been done undone."

Agathon and Aristotle aside, some medieval theologians argued passionately that the past *could* be changed (but only by God). The eleventh-century Italian cleric Peter Damian (who became a Christian saint) is a famous exponent of that radical view.[29] Writing in his *De Omnipotentia Dei* ("On the Divine Omnipotence

[27]The opening line to F. M. Busby, "A Gun for Grandfather," *Future Science Fiction*, September 1957.

[28]Jiri Benovsky, "Endurance and Time Travel," *Kriterion—Journal of Philosophy*, 2011, pp. 65–72.

[29]R. P. McArthur and M. P. Slattery, "Peter Damian and Undoing the Past," *Philosophical Studies*, February 1974, pp. 137–141; P. Remnant, "Peter Damian: Could God Change the Past?" *Canadian Journal of Philosophy*, June 1978, pp. 259–268; R. Gaskin, "Peter Damian on Divine Power and the Contingency of the Past," *The British Journal for the History of Philosophy*, September 1997, pp. 229–247.

in Remaking What Has Been Destroyed and Undoing What Has Been Done"),[30] Damian made it clear that he believed nothing could withstand the power of God, not even the past. Ralph Waldo Emerson's poem "The Past" ("All is now secure and fast, Not the gods can shake the Past") would have been blasphemy for Damian. The following words from Damian testify to the strength of his commitment to a belief in the possibility of changing the past: "Just as we can duly say 'God was able to make it so [that] Rome, before it had been founded, should not have been founded,' in the same way we can equally and suitably say, 'God can make it so that Rome, even after it was founded, should not have been founded.'"[31]

Two centuries after Damian, Aquinas argued the contrary view, that changing the past is *not* within God's power. Whereas Damian felt it impossible to deny any act to God, Aquinas took the far more moderate position that part of God's law is that there be no contradictions in the world (this is, in fact, the modern view of time travel physicists) and that certainly God would be bound by his own law. As he wrote, "It is best to say that what involves contradiction cannot be done rather than that God cannot do it." In his *Paradise Lost*, John Milton's God is constrained even more: he is free to act or not, but if he does freely decide to act, it can only be to 'do right.' That might seem to preclude causing contradiction, as in changing the past, but perhaps not. Milton's contemporary, Thomas Hobbes, declared that there is no *a priori* standard of goodness, and thus (for Hobbes) there are no constraints on God's powers. For Hobbes, therefore, it would seem God could change the past. Theological changing of the past, as you might expect, leads to all sorts of mind-boggling puzzles. Because of such puzzles, theology would certainly be influenced by time travel, but just as certainly theological reasoning will not illuminate the puzzles of the time travel paradoxes.

The question of the immutability of past events is of special interest to theologians because it is directly related to the question of free will versus fatalism. That is, are humans the creators of the future, or are they mere fated puppets of destiny? One way theology gets involved with the issue of 'changing the past' is via what is called the *retroactive petitionary prayer*. (An 'ordinary' petitionary prayer, like the Lord's Prayer in Matthew 6 and Luke 11, asks for something in the present or the future.) Examples of retroactive prayers include that of the surgical patient who prays, just before an exploratory operation, for his tumor to be non-malignant, and

[30]This work is in the form of a letter to his friend Desiderius (who later became Pope Victor III), in which Damian rebutted Desiderius' defense of St. Jerome's claim that "while God can do all things, he cannot cause a virgin to be restored after she has fallen." Desiderius thought the reason God could not restore virgins is that he does not want to, to which Damian replied that this meant God is unable to do whatever he does not want to do, but this meant that God would then be less powerful than men, who are able to do things they don't want to do (such as go without food for a month). This is a good example of the dangers involved when getting into debates with theologians.

[31]The Argentinian writer Jorge Luis Borges (1899–1986) was so inspired by Damian's view that the past could be changed that he wrote a short story based on it (see "The Other Death," originally published in *The New Yorker*, November 2, 1968) and put a character in it named after Damian.

that of the soldier's wife who prays that her husband was not among those killed in yesterday's battle. Such prayers are for a happy outcome to an event that is over and done with at the time of the prayer. One might accept the rationality of praying about the future ("Please, God, let me survive tomorrow's battle and I'll be good for the rest of my life") but are prayers about the past even sensible? (The three major monotheistic religions of the world—Christianity, Judaism, and Islam—say *yes*.)

In an appendix titled "Special Providences" in his book Miracles, C. S. Lewis answers that question as follows:

> "When we are praying about the result, say, of a battle or a medical consultation, the thought will often cross our minds that (if only we knew it) the event is already decided one way or the other. I believe this to be no good reason for ceasing our prayers. The event certainly has been decided—in a sense it was decided 'before all worlds.' But one of the things taken into account in deciding it, and therefore one of the things that really causes it to happen, may be this very prayer that we are now offering. Thus, shocking as it may sound, I conclude that we can at noon become part causes of an event occurring at ten A.M. (Some scientists would find this easier than popular thought does.)"

Here we see Lewis, a prominent lay theologian, arguing for the present influencing (but not changing) the past. What can we make of that? Was Lewis arguing for backward causation, the close relative of time travel? I think perhaps so; the final two sentences in the above excerpt makes it plausible that he may have held that view. It is a view that does find much support in the block universe interpretation of Minkowskian spacetime. Lewis never mentions the block concept by name, but it is clear that he believed in the idea of God being able to see all of reality at once. Lewis believed, therefore, that God knows of a petitionary prayer before it is made; or, even stronger, if God is not a temporal being but rather is eternal and knows time 'all at once,' then God knows the prayer and the event being prayed about 'at the same time.'

Lewis did make it clear that he believed it is a sin to pray for something *known* not to have occurred—for example, to pray for the safety of someone known to have been killed yesterday. As he wrote, "The known event states God's will. It is psychologically impossible to pray for what we know to be unobtainable, and if it were possible, the prayer would sin against the duty of submission to God's known will." Taking a less judgmental position (but essentially agreeing with Lewis) were two philosophers who, writing of the battle of Waterloo, said "for one who knows the outcome of the battle more than a hundred and 50 years ago, [a retroactive petitionary] prayer is pointless and in that sense absurd. But a prayer prayed in ignorance of the outcome of the past event is not pointless in that way." Further, in support of backward causation, they also wrote that "to pray in 1980 that Napoleon lose at Waterloo" is logical because "why should your prayer not be efficacious in bringing about Napoleon's defeat?"[32] Disagreeing, however, was another philosopher who bluntly declared "A prayer for something to have happened is simply an absurdity, regardless of the utterer's knowledge or ignorance of how things went."[33]

[32]E. Stump and N. Kretzmann, "Eternity," *Journal of Philosophy*, August 1981, pp. 429–458.

[33]P. Geach, *God and the Soul*, Routledge & Kegan Paul 1969.

There have been all sorts of opinions expressed through the ages in reaction to the idea of affecting the past via retroactive petitionary prayers,[34] and on the role of backward causation. The British philosopher Michael Dummett (1925–2011), in particular, discussed Lewis' concept of such prayers with great sympathy,[35] and backward causation allows one to both explain them as well as retaining free will. That is, it is not God's foreknowledge that causes our later actions (forcing our behavior and so turning us into automatons), but rather it is our later *freely-chosen* actions that causes God's foreknowledge! While such theological speculations are interesting, in the end they are simply positions of faith, about which mathematical physics has nothing to say.

Eventually, of course, others besides philosophers and theologians began to ponder the questions raised by 'changing the past.' In a January 1963 personal letter to the editor of *The Magazine of Fantasy and Science Fiction*, Robert Heinlein wrote[36] "Mark Twain invented the time-travel story; 6 years later H. G. Wells perfected it *and its paradoxes* [my emphasis]. Between them they left little for latecomers to do." How a man as widely read as was Heinlein, who had authored some of the best short time travel stories ever written, could have written such an erroneous sentence is a mystery to me. *A Connecticut Yankee in King Arthur's Court* and *The Time Machine*, certainly both works of genius, are *not* pioneers in paradox. And Heinlein's own contributions are proof enough that there was a lot left to do with time travel, well after 1900.

The very first story to be written that even hints at the particular time travel paradox of changing the past seems to be by the Unitarian minister Edward Everett Hale (1822–1909), best known today as the author of the 1863 story "The Man Without a Country." Hale wrote "Hands Off" in 1881, and published it anonymously in *Harper's New Monthly Magazine* with the express purpose of stirring up some theological debate (which apparently it didn't). He certainly had no idea that he would come to be recognized by literary scholars as a pioneer in the yet-to-be invented genre of science fiction.

Hale's story opens with the mysterious words "I was in another stage of existence. I was free from the limits of Time, and in new relations to space." These words are spoken by an unnamed narrator, who seems to have just died, and who finds himself, in his new 'form,' observing "some twenty or thirty thousand solar systems" while in the company of "a Mentor [probably an angel] so loving and patient." Under the guidance of this Mentor, in an attempt to 'improve' history, the narrator alters the Biblical account of Joseph and his imprisonment in Egypt. At first, subsequent history *is* better, but then humanity

[34]A summary of those opinions can be found in G. Brown, "Praying About the Past," *Philosophical Quarterly*, January 1985, pp. 83–86. Debate continues on the retroactive prayer into the 21st century: see, for example, K. Timpe, "Prayers for the Past," September 2005, pp. 305–322, and T. J. Mawson, "Praying for Known Outcomes," March 2007, pp. 71–87, both in *Religious Studies*.

[35]M. Dummett, "Bringing About the Past," *Philosophical Review*, July 1964, pp. 338–359.

[36]Reprinted in the posthumously published *Grumbles from the Grave* (edited by Heinlein's widow, Virginia Heinlein), Del Rey 1990.

sinks into irreversible depravity. In the end the narrator watches the last handful of humans kill each other in a particularly symbolic place for the Christian world: "The last of these human brutes all lay stark dead on the one side and on the other side of the grim rock of Calvary!" There would be no Crucifixion and Resurrection for the salvation of humankind, which naturally greatly disturbs the narrator. But the Mentor calms him, saying "Do not be disturbed, you have done nothing." It has, you see, just been an experimental world, an alternate Universe, and the narrator has learned the lesson of "Hands Off" the past.

Hale's story is a better Sunday sermon than it is a change-the-past time travel tale, and the device of experimenting on a not-really-real Earth is disappointing from a modern science fiction point of view. But Hale's story almost certainly did have an immediate (if indirect) impact. There is no absolute proof, but with its appearance in a national magazine, it seems quite likely that "Hands Off" was read by Edward Page Mitchell (1852–1927), an editor on a daily New York newspaper, the *Sun*. I write that because, just 6 months after Hale's story appeared, the *Sun*, in its issue of September 18, 1881, printed Mitchell's "The Clock That Went Backward." That tale, published anonymously, used a machine (the clock) for time travel,[37] as well as incorporated the idea of time travel involving paradoxes. The story predates Wells' *Time Machine* by 14 years, and Wells' novel did not include a paradoxical element.[38]

There are, however, two *hints* at paradox in Wells' novel. In the opening, during the dinner party at which the Time Traveller tries to convince his friends of the possibility of a time machine, one of them observes that "It would be remarkably convenient for the historian. One might travel back and verify the accepted account of the Battle of Hastings, for instance." To that another guest replies, "Don't you think you would attract attention? Our ancestors had no great tolerance for anachronisms." The second hint occurs when the incredulous Editor, astonished at the disheveled appearance of the Time Traveller upon his return from the future, wonders "What *was* this time traveling? A man couldn't cover himself with dust by rolling in a paradox, could he?"

What might happen if time travelers *could* change the past? This question is nicely illustrated in one novel[39] where a time traveler finds himself stranded in the London of 1810. Despite his predicament, he takes solace with "I could invent things—the light bulb, the internal combustion engine, . . ., flush toilets . . . " But then he thinks better of doing any of that: "no, better not to do anything to change

[37]See Jan Pinkerton, "Backward Time Travel, Alternate Universes, and Edward Everett Hale," *Extrapolation*, Summer 1979, pp. 168–175. The time machine in Mitchell's story is more fantasy than anything else. It is simply stated that if the clock runs backward, then it travels backward in time.

[38]Wells' failure to use paradox in his famous novel surprises most modern readers and, in fact, one of the first reviewers specifically criticized him for this lapse. See the 1895 review of *The Time Machine* that appeared in *Pall Mall Magazine*, by Israel Zangwill, reprinted in Parrinder's book (note 1 in the Introduction).

[39]T. Powers, *The Anubis Gates*, Ace 1983, a work with equal shares of physics and magic.

the course of recorded history—such tampering might cancel the trip I got here by, or even the circumstances under which my mother and father met. I'll have to be careful."

This is really just a more recent treatment of the change-the-past paradox that was already well established in early science fiction. In a story[40] published a half-century before, we find the paradox explicitly stated, along with a possible solution that is similar to the kind of explanations that have appeared in the philosophical literature[41]:

> "Suppose you landed in your own past?," queried Eric."
> Dow smiled.
> "The eternal question," he said. "The inevitable objection to the very idea of time travel. Well, you never did, did you? You know it never happened!"

But, suppose you *could* land in your own past. What then?

One famous story[42] that considered this question *embraced* the idea of changing the past. In it a client on a dinosaur hunting safari fails to follow the instructions of his guide to do *nothing* in the past except shoot a dinosaur that is about to dies for "other reasons" anyway—alas, he accidently kills a butterfly. This results in enormous changes in history, as indicated by the 'before' and 'after' versions of the time machine company's ad:

> **before**
> TIME SAFARI, INC.
> SAFARIS TO ANY YEAR IN THE PAST.
> YOU NAME THE ANIMAL.
> WE TAKE YOU THERE.
> YOU SHOOT IT.
> **after**
> TYME SEFARI INC.
> SEFARIS TU ANY YEER EN THE PAST.
> YU NAIM THE ANIMALL.
> WE TAEK YU THAIR.
> YU SHOOT ITT.

Bradbury describes the death of the butterfly as having started the knocking "down [of] a line of small dominoes and then big dominoes and then gigantic dominoes, all down the years across Time." This is, of course, a somewhat unconvincing argument. After all, previous dinosaurs, when shot, must have fallen to the ground and flattened a lot of butterflies! With such threats for every decision, no matter how seemingly innocent, hanging over the head of a time traveler, it

[40] C. L. Moore, "Tryst in Time," *Astounding Stories*, December 1936.

[41] See, for example, P. J. Riggs, "The Principal Paradox of Time Travel," *Ratio*, April 1997, pp. 48–64. The 'principal paradox' is that time travel is inherently contradictory because it permits the possibility of traveling to an earlier time to prevent the trip. The grandfather paradox is a special case of this. For more discussion, see T. Chambers, "Time Travel: How Not to Defuse the Principal Paradox," *Ratio*, September 1999, pp. 296–301.

[42] R. Bradbury, "A Sound of Thunder," *Collier's*, June 1952.

would take a brave soul to do much more, while in the past, than just stand still and breathe.

Equally grim is the tale[43] that takes a different view by denying the past can be changed. There we read of a doomed hero who journeys back to 1865 to save Lincoln from Booth, but his "time-distorter" is quickly taken away from him by suspicious guards. Its internal workings tick, you see, and they think he is an assassin with a clock bomb. They destroy it, haul him away to his fate, and Lincoln goes on to meet his. In the same spirit (but even more shocking) is the result of a time traveler's intentional tampering with the past in David Gerrold's 1973 novel *The Man Who Folded Himself*. That traveler experiments with "making things different" and, in his words, "Once I created a world where Jesus Christ . . . went out into the desert to fast and never came back. The twentieth century I returned to was—different. Alien."

With such a stupendous power to alter reality, assuming the past *can* be changed, perhaps one might imagine prospective time travelers to the past being required to first file Historical Impact Statements![44] Not all would receive permission. In one classic tale,[45] for example, we read of a time traveler who takes a rifle and 5000 rounds of explosive bullets back to Golgotha. His intention—to be history's first Rambo by picking off any Roman soldier who gets within a hundred yards of Jesus! As outrageous as this concept is (but who among those now reading this won't admit to at least a momentary thrill at the idea and, perhaps, even a secret willingness to do it themselves, if they could), it isn't the story's peak. That comes when the reader is reminded that it was Christ's *desire* to die on the Cross, that he *had* to die for our sins; to prevent that from happening would change all of history for the last 2000 years. What, then, should the time traveler's colleagues do when they discover his plan? Should they stop him or not? What might happen if they do interfere? Of course, if the time traveler is 'now' in the past, isn't it already 'too late' to stop him? Oh, the conundrums of time travel and changing the past!

The classic change-the-past paradox is, of course, the grandfather paradox. A famous story[46] pushed this paradox to its logical limit to illustrate its supposed dangers. Having traveled to Greece in the fifth century B.C., the traveler suddenly realizes (with just a little exaggeration): "Ninety-five generations back you'd have more grandfathers than there are people on Earth, or stars in the Galaxy! You're kin to everyone . . . You as much as take a poke at anyone, and the odds are you won't even get to be a twinkle in your daddy's eye."

[43]R. Silverberg, "The Assassin," *Imaginative Tales*, July 1957.

[44]See, for example, the novel by C. L. Harness, *Krono*, Franklin Watts 1988.

[45]A. Porges, "The Rescuer," *Analog Science Fiction*, July 1962.

[46]P. S. Miller, "Status Quondam," *New Tales of Space and Time*, November 1951. This is the Miller I mentioned back in note 15.

Fig. 4.2 Illustrator Jack Binder (1902–1986) was the author of a continuing series called "IF—. . ." in *Thrilling Wonder Stories*. In each issue, the ellipses would be replaced with some phrase such as "the Sun exploded!," "there was another ice age!," or "there was no friction!." The installment shown here (and in Fig. 4.3) appeared in December 1938 and asserted that the past could be changed by a time traveler

Fig. 4.3 (Fig. 4.2 continued). Illustration for "IF—You Were Stranded in Time!" ©1938 by Better Publications, Inc.; Reprinted by permission of the Ackerman Science Fiction Agency, 2495 Glendower Ave., Hollywood, CA 90027 for the Estate

Even earlier than Miller's tale is an equally famous one[47] that illustrates the same point in a graphic way. In A.D. 452 a time traveler shoots and kills one of Attila's Huns (who would have been his great-grandfather many times over); the result is that 50,000 of the Hun's descendants vanish! So dramatic did the readers of this story find the concept that author repeated the idea the very next year.[48] Twenty years later another writer topped these tales by having a time traveler accidently kill the original 'intelligent baboon' in the ancient past, thereby wiping out the entire human species![49]

Science fiction writers have been as puzzled by the grandfather paradox[50] as have been nearly everybody else. As the inventor of the first time machine says in one tale,[51] "I have devised a method [for travel] into the distant past. The paradox is immediately pointed out—suppose [the time traveler] should kill an ancestor or otherwise change history? I do not claim to be able to explain how this apparent paradox is overcome in time travel; all I know is that time travel *is* possible. Undoubtedly, better minds than mine will one day resolve that paradox, but until then we shall continue to utilize time travel, paradox or not."

Some may feel it overly dramatic that the classic time travel paradox has such a murderous form, but that is its historical origin in science fiction (not in either physics or philosophy). We can find the grandfather paradox discussed as if already well-known in a letter to the editor at *Astounding Stories* (January 1933). The author of that letter wrote "Why pick on grandfather? It seems that the only way to prove that time travel is impossible is to cite a case of killing one's own grandfather. This incessant murdering of harmless ancestors must stop. Let's see some wide-awake fan make up some other method of disproving the theory." As we proceed, you'll see just how clever some of those who responded to that writer's plea have been but, even today, as the grandfather paradox stands revealed as a red herring, it is preeminent in most people's imaginations. If a solution to the grandfather paradox puzzle escaped an early science fiction writer, then he would generally just mysteriously mention it and then hasten on to other matters. For example, in one story[52] the following exchange between the stock pulp-fiction characters of a young hero and a brilliant old scientist occurs:

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[47]N. Schachner, "Ancestral Voices," *Astounding Stories*, December 1933.

[48]N. Schachner, "The Time Imposter," *Astounding Stories*, March 1934.

[49]C. Dye, "Time Goes to Now," *Science Fiction Quarterly*, May 1953.

[50]The 'paradox' is that, assuming you do arrive in the past with a working gun, why *can't* you kill your grandfather? After all, you *must* fail in that quest because otherwise you wouldn't be there from the future to even try. But *why* must you fail? It is, of course, not actually necessary to try to kill your grandfather to run into this paradoxical situation—just go back in time to any moment in the past and try to kill yourself! You won't succeed (if the past is unchangeable), but *why not*? (To argue 'because the past is unchangeable' is to beg the question. We need more insight than that.)

[51]M. Reynolds and F. Brown, "Dark Interlude," *Galaxy Science Fiction*, January 1951.

[52]C. South, "The Time Mirror," *Amazing Stories*, December 1942.

> "You mean that time travel really is possible? That men can be transported into the future or the past—?"
>
> The other held up a restraining hand. "Yes. Time travel *is* possible . . ."
>
> "But professor! Think of what you're saying! You're telling me that I could go back and murder my own grandfather. That I could prevent myself from being born—?"
>
> Again the elder man sighed. "I was afraid of this," he said. "I knew you could not understand." He hesitated. Then: "At any rate, take my word for it that time travel is possible. Also, I assure you that there are any number of perfectly sound theoretical and practical reasons why you never could hope to murder your grandparents."

We are, however, not told just what those reasons might be.

Even when all has been said about the impossibility of changing the past, and even when they are finally willing to concede that point, most people still cannot help wondering *why* the time traveler can't kill his grandfather. There the time traveler is, after all, just two feet away from the nasty young codger (I assume he is nasty to make the whole unpleasant business of murder as palatable as possible), with a perfectly functioning and well-oiled revolver in his hand, cocked and loaded with powerful, factory-fresh ammunition that even Dirty Harry would find excessive. What can possibly prevent the time traveler from simply raising his arm and doing the deed? Indeed, the artwork (reproduced at the end of the Introduction) accompanying one 1944 story shows this act in detail, including the smoking gun in the hand of the time traveler who has just taken a shot at grandpop. And if that still leaves open the remote possibility of an aiming error through nervousness, then why can't a suicidal time traveler just wrap his body in factory-fresh dynamite and blow-up granddad—along with himself and everything else within a hundred feet?

I'll argue in this book that killing your grandfather in the past, before he sets *you* in motion, is *logically* impossible. The laws of physics will then faithfully do their duty. No one will ever find an unfinished note in the empty laboratory of a missing traveler who, skeptical of the grandfather paradox, has written "To prove the falsity of the grandfather paradox, I will take my time machine back 50 years and kill my grandf. . .." Nor will any time traveler have to be concerned about the twist in one tale, which opens with the inventor of a time machine is showing the gadget to three friends. One of them later steals the machine to go back 60 years to kill his grandfather—and the story closes with a *near* repeat of the opening, with the inventor showing the gadget to *two* friends.[53]

Invoking logic in this way, in the context of time travel to the past, was discussed in the philosophical literature nearly half a century ago: "If we assume that it is impossible for [a time traveler to kill his younger self], some people are inclined to ask such questions as this: 'But how can the laws of logic prevent him from killing his younger self? Do they cause his finger to slip on the trigger or the bullet to fly apart in mid-air?' The implication of such questions is that the laws of logic cannot prevent such actions. But such questions are like asking: 'How do the laws of logic

[53]F. Brown, "First Time Machine," *Honeymoon in Hell*, Bantam 1958.

prevent the geometer from trisecting the angle or squaring the circle? Do they, for example, cause his ruler to slip as a crucial moment every time he tries it?'"[54].

A similar point was made later by another philosopher: "Surely it is not an impairment of 'freedom of action' . . . that, e.g., you cannot push another person harder than he/she pushes you. Just as one would explain this is the case by reference to Newton's third law ('to every action there is an equal and opposite reaction'), one could explain the impossibility of [causing a paradox] by reference to the laws which imply such a impossibility. If this explanation is taken to be unsatisfactory, it would seem that one is saddled with a general problem concerning the reconciliation of physics and 'freedom,' and not with a specific argument against [paradoxes]."[55]

The grandfather paradox unquestionably nags at all students of time travel. As a character in one story declares, "The resolution of [the grandfather paradox] is the key to time,"[56] and some incorrectly believe it remains unresolved.[57] The paradox *is* undeniably troublesome: as one philosopher put it, the apparent possibility of a time traveler being able to do away with both his grandfather and himself gives "rise to such puzzles that we are forced to question its [time travel's] intelligibility."[58] In the next section we'll explore how to answer this concern.

4.3 Changing Versus Affecting the Past

> "The past—it's pretty damn solid, Phil. It's a little like a compost pile—fairly soft near the surface but packed hard further down, with all that Time piled on top of it."[59]
>
> —one 'explanation,' perhaps, for the unchangeability of the past

The common belief today, among physicists and philosophers alike, is that given any consistent description of reality it is simply impossible for a time traveler to kill himself as a baby. As one philosopher put it, "Autoinfanticide is *metaphysically impossible* [my emphasis]. This metaphysical impossibility is philosophically intriguing because unlike most impossible events, we can vividly picture how it might look. Time travel itself seems possible, and for those who arrive in the past

[54]J. W. Meiland, "A Two-Dimensional Passage Model of Time for Time Travel," *Philosophical Studies*, November 1974, pp. 153–173. Science fiction had already considered time travel suicide in, for example, K. Neville, "Mission," *Fantasy and Science Fiction*, April 1953.

[55]F. Arntzenius, "Causal Paradoxes in Special Relativity," *British Journal for the Philosophy of Science*, June 1990, pp. 223–243.

[56]P. Worth, "Typewriter from the Future," *Amazing Stories*," February 1950. See also note 106 in Chap. 1.

[57]For example, in J. H. Schmidt, "Newcomb's Paradox Realized with Backward Causation," *British Journal for the Philosophy of Science*, March 1998, pp. 67–87, we read that "there are as yet no generally accepted solutions" to the grandfather paradox.

[58]S. Gorovitz, "Leaving the Past Alone," *Philosophical Review*, July 1964, pp. 360–371.

[59]F. M. Busby, "A Gun for Grandfather," *Future Science Fiction*, Fall 1957.

with proper equipment and training, the actual infanticide should not be difficult."[60] And so the grandfather paradox lives on, bedeviling both physicists and philosophers alike.

Indeed, one physicist described the time travel paradoxes as "the most controversial issue related to time machines."[61] As he argued, "These paradoxes seem to be something inherent to time machines (their main attribute, perhaps), so it is reasonable to assume that if there exists a universal law prohibiting the time machines, it must have something to do with the paradoxes. And on the other hand, be the problem of the paradoxes satisfactorily solved there probably would be no need to look for such a law, the (supposed) paradoxicalness of the time machines being traditionally the main objection against them."

One of the persistent stumbling blocks to removing the confusion of the paradoxes is a failure to distinguish between *affecting* and *changing* the past. One philosopher wrote this, in a somewhat bungled attempt to explain what is meant by affecting the past: "Nothing anyone can do now can make it not have rained yesterday"[62] if, in fact, it *did* rain yesterday. This is correct, but it is *not* what is meant by *affecting* the past. Rather, if the reason it *did* rain yesterday is because a time traveler from the future seeded the clouds, then that time traveler affected the past. Making it not to have rained yesterday would be to *change* the past.

A classic[63] by Isaac Asimov illustrates what is meant by a time traveler affecting the past. An idealistic physics professor, convinced that the world's political problems are the result of the comparative newness of scientific thought and tradition, tries to change the past (and thus the present) by sending a Greek translation of a modern chemistry text back 2000 years to the Hellenic days of Leucippus, Lucretius, and Democritus. He dies in the attempt but succeeds in the transmission. When a government investigator—called in because the professor drained an entire nuclear power reactor to energize his time machine!—discovers that the transmission takes a day to travel back a hundred years (a little gimmick with no foundation in physics, but simply something Asimov needed for the story), he fears 'our' world will vanish in 20 days, to be replaced by a 'new' one. In the end, however, he learns you can't change the past. As one of the late professor's colleagues tells the investigator, "While you are right that any change in the course of past events, however trifling, would have incalculable consequences . . . I must point out that are nevertheless wrong in your final conclusion. *Because THIS is the world in which the Greek chemistry text WAS sent back*."

[60]David Horacek, "Time Travel in Indeterministic Worlds," *The Monist*, July 2005, pp. 423–436.

[61]S. Krasnikov, "Time Travel Paradox," *Physical Review D*, February 14, 2002, pp. 064013–1 to -8.

[62]R. G. Swinburne, "Affecting the Past," *Philosophical Quarterly*, October 1966, pp. 341–347.

[63]"The Red Queen's Race," *Astounding Science Fiction*, January 1949.

Another good illustration from science fiction of affecting the past can be found years before Asimov's. In that story,[64] a time traveler leaves the Chicago of 1942 for the year 3000. Much later, in the year 2564, another time traveler interested in history journeys back to 2253 in an attempt to learn the cause of the great Chicago explosion of that year. The explosion was centered on the site of an ancient laboratory once used by a scientist who mysteriously vanished in 1942. The second time traveler begins his trip into the past on the same spot, with plans to go back to the day before the explosion. At the story's end, we learn that the disaster was the result of the two time travelers colliding as both 'passed through' 2253. The backward traveling historian, therefore, by pushing a button in 2564, is the cause of an event that happened 311 years earlier.[65]

To give a science fiction example of changing the past, it would be hard to do better than with a story that appeared a few years after Asimov's The central character is a researcher in time travel who has concluded that what is wrong with the world can be traced back to the scientific method getting off to a late start (this story was almost surely written as a result of Asimov's tale!): the time traveler thinks he can correct matters by visiting 340 B.C. and educating Aristotle on the proper scientific attitude. (Aristotle believed that observing the world was inferior to pure thinking about how the things, in his opinion, *ought* to work.) This the time traveler does, with utterly disastrous consequences. He returns to the present to find a scientifically retarded world that makes him a slave. In his cell he writes on a wall the bitter lesson he has learned too late: "Leave Well Enough Alone."[66]

It is the fear of time travelers from the future attempting to alter the past that has led some philosophers (and not just a few physicists) to assert that time travel is impossible, because it would mean what they feel to be impossible might happen: changing the past. One philosopher, however, argued long ago that such a worry is unwarranted. As he wrote at the end of an essay (a polemic *against* the concept of four-dimensional spacetime, and so *against* the idea of time travel), "Squandering vast sums on foolish enterprises is an everyday occurrence. [For example], will the U.S. time explorer get back and eliminate Lenin before his Russian rival gets back even earlier and eliminates George Washington? . . . If such spectacular folly once gets under way because governments have been convinced of some nonsensical theory, a logician will not . . . lose any sleep about who is going to succeed."[67]

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[64]O. Saari, "The Time Bender," *Astounding Stories*, August 1937.

[65]This story describes something a bit more than 'simply' affecting the past; it has a *causal loop* in it. The time traveling historian makes his trip *because* of an event in the past that his trip causes. Such paradoxes will be the subject of the next section.

[66]L. Sprague de Camp, "Aristotle and the Gun," *Astounding Science Fiction*, February 1958. Asimov and de Camp were close friends, and their two stories with similar premises are clearly the result of a bit of friendly rivalry.

[67]P. Geach, "Some Problems About Time," in *Studies in the Philosophy of Thought and Action* (P. F. Strawson, editor), Oxford 1968.

And long before that essay (with its correct conclusion reached through faulty reasoning) was penned, we learn the same lesson (in a 1923 tale by the English novelist May Sinclair (1863–1946)) as we follow a woman right into hell after her death; she ends up there because of an immoral life. She then wanders through time, into her past, but finds that she can change nothing. As she is told, "You think the past affects the future. Has it never struck you that the future may affect the past? . . . You *were* what you *were to be*."[68] This last line, from a *non*-science fiction story, is consistent with the modern view held by physicists of time travel. You cannot travel anywhere into the past unless you've already been there, and when you do make the trip you will do what you've already done there. You could not, as does the time traveler in one tale,[69] change the course of history by revealing twentieth-century physics in the eighteenth century. That does not mean you would necessarily be ineffectual during your stay in the past, however (certainly it doesn't mean, as Hugo Gernsback thought, that you'd be *invisible*!) Not being able to change the past is not equivalent to being unable to *influence* or *affect* what happened in the past, and science fiction writers have used this distinction to good effect, as did Asimov (note 63) and de Camp (note 66).

Robert Heinlein was a science fiction writer who clearly understood time travel paradoxes, both what they mean and, at least as important, what they do not mean. In his 1964 cold-war novel *Farnham's Freehold*, for example—the story of a family that is literally blasted twenty-one centuries into the future when their bomb shelter receives a direct hit from a Soviet nuclear warhead—we find following exchange as two of the characters are about to return to their original time via time machine:

> "The way I see it, there are no paradoxes in time travel, there can't be. If we are going to make this jump, then we already did; that's what happened. And if it doesn't work, then it's because it didn't happen."
>
> "But it hasn't happened yet. Therefore, you are saying it didn't happen, so it can't happen. That's what I said."
>
> "No, no! We don't know whether it has already happened or not. If it did, it will. If it didn't, it won't."

Modern philosophers, and many physicists, too, as well, who have examined the concept of time travel in depth, agree with Heinlein's character and, indeed, it is now common practice to invoke the so-called *principle of self-consistency*—generally attributed to the Russian astrophysicist Igor Novikov (see note 117 in Chap. 1) because he and his colleagues did not simply invoke it, but rather were able to *derive* it from the *principle of least action*, a concept held by many to be at

[68]M. Sinclair, "Where Their Fire Is Not Quenched," in *After the Darkness Falls* (B. Karloff, editor), World Publishing 1946.

[69]D. Beason, "Ben Franklin's Laser," *Analog*, December 1990.

the highest level of importance in physics[70]: all that is required, argued Novikov, in *any* physical process (including time travel), is that a *logical* consistency exist between events.[71] In his book *Evolution of the Universe* (originally published in Russian in 1979), Novikov wrote "The closure of time curves does not necessarily imply a violation of causality, since the events along such a closed line may be all 'self-adjusted'—they all affect one another through the closed cycle and follow on another in a self-consistent way." He later repeated that view in one of the first time machine papers in the physics literature.[72]

In fact, despite the attachment of Novikov's name to the principle of self-consistency, it was actually around in physics *decades* earlier; it has been traced back to as far as 1903![73] And at least an intuitive understanding of the principle can be found in the mainstream literature from nearly as long ago. For example, in Lord Dunsany's short 1928 play *The Jest of Hahalaba* (the inspiration for the 1944 film *It Happened Tomorrow*), a man obtains (via supernatural means) a copy of tomorrow's newspaper. In it he reads his own obituary, which so shocks him that he promptly expires—thus explaining the obituary notice.

The principle of self-consistency has been in science fiction long before Novikov, too. An example is the 1941 story "Time Wants a Skeleton" (see note 15). In it one character, after puzzling over a time travel paradox, realizes that "Future and present demanded co-operation, if there was to be a logical future!" And a nice lecture on the principle (that pre-dates by 3 years the dialogue quoted earlier from Heinlein's *Farnham's Freehold*) is given by a character that is particularly interesting because it was published, not in a specialty science fiction magazine catering to an audience with 'genre knowledge' of time travel, but rather in an icon of general American culture.[74]

Not all science fiction writers, however, have understood the requirement for consistency around a loop in time. In one tale, for example, a man meets the

[70]Like just about everything concerning time travel, however, not *all* think this. For example, the great German physicist Max Planck (1858–1947), the 1918 Nobel physics laureate, said (in 1922): "Physics hence is inclined to view the principle of least action more as a formal and accidental curiosity than as a pillar of physical knowledge." Still, he *did* also declare that he thought it unlikely "the dominance of such a simple law could be a mere accident." Quoted from Marc Lange, "Conservation Laws in Scientific Explanations: Constraints or Coincidences," *Philosophy of Science*, July 2011, pp. 333–352.

[71]See A. Carlini, *et al.,* "Time Machines: The Principle of Self-Consistency as a Consequence of the Principle of Minimal Action," October 1995, pp. 557–580, and "Time Machines and the Principle of Self-Consistency as a Consequence of the Principle of Stationary Action (II): The Cauchy Problem for a Self-Interacting Relativistic Particle," October 1996, pp. 445–479, both in *International Journal of Modern Physics D*.

[72]I. D. Novikov, "An Analysis of the Operation of a Time Machine," *Soviet Physics JETP*, March 1989, pp. 439–443.

[73]R. D. Driver, "Can the Future Influence the Present?" *Physical Review D*, February 15, 1979, pp. 1098–1107.

[74]R. F. Young, "The Dandelion Girl," *The Saturday Evening Post*, April 1, 1961. See also note 49 in Chap. 2.

inventor of a time machine and agrees to his request to use it to travel into the future. Once he is in the future, alas, the machine breaks. The man then finds another machine that, though it is too small for him to fit in it, is able to hold a recording that he sends back into the past to himself, to a time *before* he started his forward journey. The message on the recording (which he did not receive the 'first' time) is, of course, *not* to make a deal with the inventor. This advice he follows, and so the principle of self-consistency is violated twice in this story.[75]

An ability to play a role in history is not without some constraints. You can't save Jesus with a rifle (see note 45), or Joan of Arc with a fire extinguisher, or knock-out John Wilkes Booth with a baseball bat outside of Ford's Theatre, or blow-up Hitler with a bomb, and you can't prevent either the Black Death in the London of 1665 or the Great Fire the following year. But it *is* logically possible for a time traveler who has an infected rat sneak into his time machine, or who carelessly discards a match, to be the *cause* of the last two examples. That was the fate, for example, of the time traveling historian from A.D. 2461 who was the cause of the plague in A.D. 562 Rome, as well as of that in England nearly 800 years later.[76]

Michael Moorcock's 1969 novel *Behold the Man* gets the impossibility of changing the past, and the possibility of affecting it, right. When a disturbed man journeys backward in time to ancient Galilee to meet Christ, only to discover that there is no such person, *he* assumes the role and lives out the Biblical accounts up to and including dying on the Cross. He has not changed the past, but he certainly plays an important role in it!

An early science fiction story that got this right, long before the philosophers and physicists thought of it, was the clever tale whose artwork I have reproduced at the end of the Introduction.[77] In that story, a time traveler journeys back from 1943 to 1870 and shoots his then 14-year old grandfather in the head. Leaving his victim lying on the ground with "blood oozing all over the youth's forehead," the would-be killer returns to 1943. Once back, however, he finds himself in a strange place where he learns from two men that the Germans destroyed New York in 1920 with poison gas! Suddenly realizing that the death of his grandfather has apparently changed history (a curious oversight for anyone smart enough to invent a time machine and then to use it to force the 'grandfather paradox'), he decides he'd rather be dead than be cut off for all time from the world he remembers. So, he shoots himself dead. Then we learn that the two men he encountered are actually inmates in an asylum who like to make-up stories for unsuspecting strangers. We also learn that the time traveler's grandfather's photographs always did show him with a "white, furrowed scar on his forehead that might have been caused by a glancing bullet."

[75]R. Wilson, "The Message," *Astounding Stories*, March 1942.

[76]G. C. Edmondson, "The Misfit," *Fantasy and Science Fiction*, February 1959.

[77]M. Weisinger, "Thompson's Time Traveling Theory,' *Amazing Stories*, March 1944.

Fig. 4.4 The inventor of a time machine about to commit autoinfanticide in the past (the youngster holding the teddy bear is a younger version of the time traveler). Illustration reproduced by the kind permission of Frank Arntzenius (Professor of Philosophy at Oxford University), from his paper "Time Travel: Double Your Fun," *Philosophy Compass*, November 2006, pp. 599–616

Well, okay, you might say at this point, 'I'm convinced you can't change the past, but let's get back to the autoinfanticide (grandfather) paradox. So *why can't* a time traveler kill his baby-self in the past?' A possible answer, one now generally accepted by philosophers and physicists alike, appeared first in science fiction. In a tale[78] that appeared just the year after Gödel's 1949 discovery of time travel in general relativity, we find a character saying "The answer is quite simple. When the man goes back in time and kills his grandfather, and returns to his own time again, he finds to his surprise that he made a mistake. It was not his grandfather at all! And no matter how many times he goes back and kills his grandfather . . . he *always* [my emphasis] finds he made a mistake." Or, perhaps, some noise distracts him as his finger tightens on the trigger, or the grenade he tosses at granddad is a dud, or a gust of wind deflects the arrow, or (most ludicrous of all) he simply slips on a discarded banana peel!

Okay, that works for *that* time traveler. But suppose, someone objects, that we arrange to have a *lot* of time travelers go back in time, each with murder in his heart for his grandfather. Then, as one philosopher has observed, "Since [killing one's grandfather in the distant past] is impossible, each assassin fails. Some change their minds, others slip on banana peels, yet others kill the wrong target, and so on. But there is something odd about the idea that such coincidences are guaranteed to happen, again and again!"[79]

Early science fiction avoided invoking banana peels by providing an even more extreme 'explanation' for the failures: the time police, who are charged with foiling would-be grandfather killers. (See, for example, the many stories by Poul Anderson (1926–2001) of the 'Time Patrol.') These time commandos are imagined to roam the corridors of time, disrupting the attempts of all those who would change

[78]"Typewriter from the Future": see note 106 in Chap. 1.

[79]Theodore Sider, "Time Travel, Coincidences, and Counterfactuals," *Philosophical Studies*, August 2002, pp. 115–138.

recorded history. Stories of these temporal cops are simply westerns, mysteries, police procedurals, or some other similar type of specialty genre story wearing thin camouflage. This story device, whose main purpose is to allow both time travel and free will,[80] has been correctly called "boring" by at least one philosopher (see note 5 in the Introduction), an evaluation shared by modern philosophers, physicists, and (I think) even most modern science fiction writers.

So, we seem to be back to banana peels to save grandfather—but it *is* difficult to deny that vast hordes of murderous grandsons *do* appear to require an unlimited number of strategically placed banana peels, strewn all about the past, to trip-up every one of those potential assassins. This problem, of repeated, improbable coincidences to thwart murderous descendants from the future, was first commented on by the philosopher Paul Horwich in 1975 (see note 19 in the Introduction), and then given a convincing resolution by another philosopher in 1997.[81]

To explain the argument, I'll first use the philosopher's less deadly example of dated objects. "Suppose," he writes, "that every object has written upon it the date on which it will cease to exist . . . perhaps a time traveler travelled into the future, observed the demise of objects and then travelled back [to just after he left for the future] and wrote the dates."[82] If now the time traveler tries to destroy an object *before the date written on it*, then he *will* fail. As the philosopher amusingly described his attempts to destroy a pen 'before its time,' "I take it outside to place under the wheels of a passing train, but there is a train strike that day. The telephone rings just as I am about to drop the pen into a vat of acid. I slip on a banana peel on my way to put the pen in the microwave. My dog eats my designs for a pen grinder. And so on, for as long as you please. However many attempts I make, the attempts in no way require the occurrence of the coincidences that foil them." To put it bluntly, 'Stuff happens.' The pen has the observed date of its destruction on it, and that date is still in the future and so it is simply impossible to destroy it now.

Now, here's the point: the date on the pen is there *because* all those attempts to destroy it before that written date fail. But the presence of the date is *not* the reason for any of the weird (?) occurrences that disrupted all the attempts to destroy the pen, but rather it's *because* all those attempts failed that the date is what it is. This same argument applies to the grandfather paradox. The only time travelers available, today, to go back into the past to *try* to kill their grandfathers, are precisely those time travelers whose grandfathers were *not* killed. Or, to paraphrase our philosopher (note 81), to ask 'why do coincidences always foil the time traveller's

[80]See, for example, David King, "Time Travel and Self-Consistency: Implications for Determinism and the Human Condition," *Ratio*, September 1999, pp. 271–278.

[81]Nicholas J. J. Smith, "Bananas Enough for Time Travel?" *British Journal for the Philosophy of Science*, September 1997, pp. 363–389.

[82]This does present us with the curious (although non-paradoxical) situation that the time traveler will find, upon his appearing in the future, the date he *will write* (in his personal future) when he returns to just after he left on his time trip.

attempts to kill [grandfather in the distant past], is to get things back to front. It is only because the murder attempts fail that the time traveler is alive in the future to even make the *attempt*.'

In other words, not only is the grandfather 'paradox' not a paradox, it isn't even surprising!

4.4 Causal Loop and Bootstrap Paradoxes

> "My dear Collingwood, don't drive yourself crazy trying to resolve the paradoxes of time travel. The [time machines] are gone . . . have a drink."[83]

The grandfather paradox might finally have been put to rest, but there are still plenty of other logical minefields left to be negotiated. One of the more puzzling is that of the closed loop in time, a conundrum nicely illustrated by one philosopher[84] as follows, as an explanation of the journey one time traveler makes to 3000 B.C.: "In our time travel story it just may be that the traveler's interest in going back to ancient Egypt is stimulated by recently discovered documents, found near Cairo, containing the diary of a person claiming to be a time traveler, whereupon our hero, realizing it is himself, immediately begins . . . construction of a rocket in order to 'fulfill his destiny.'" In other words, (1) he builds a time machine and goes back to the past because of the discovered diary, and (2) the diary is discovered because he goes back to the past. Each of these points by itself has logical clarity, but together they form a closed time loop (a *causal loop*) of enormous mystery.

Science fiction was strewn with causal loops long before the philosophers and physicists began to ponder them, however, with (for example) one early tale on a time traveler who journeys a century into the past because she finds an old, yellowed newspaper story describing her arrival.[85] But this tale wasn't the first to use a causal loop, as we can find one of the first sophisticated treatments of this device in a story that appeared even earlier (in the same publication).[86] A time traveler in 1930, about to start his journey into the future in an airplane/time machine, wonders at the last moment if he should really go—then he sees himself returning and thus *knows* he will successfully make the trip.

As he later tells a friend, "That decided me . . . Paradoxical? I should say so! I had seen myself return from my time-trip *before* I started it [just like Marty McFly in the original *Back to the Future* film]; had I *not* seen that return, I would *not* have

[83]A science fiction suggestion that in certain situations (particularly causal loops), might actually be good advice! From L. Sprague de Camp's "The Best-Laid Scheme," *Astounding Science Fiction*, February 1941.

[84]L. Dwyer, "Time Travel and Some Alleged Logical Asymmetries Between Past and Future," *Canadian Journal of Philosophy*, March 1978, pp. 15–38.

[85]P. Bolton, "The Time Hoaxes," *Amazing Stories*, August 1931.

[86]F. J. Bridge, "Via the Time Accelerator," *Amazing Stories*, January 1931.

commenced that strange journey, and so could *not* have returned in order to induce me to decide that I *would* make the journey!" And later, when he finds himself in a dangerous situation in the future, he draws hope from that initial experience: "I *would* escape ... It was so decreed. Had I not, with my own eyes, seen myself appear out of the fourth dimension back there in the Twentieth Century, and glide down to my landing-field? Surely, then, I *was* destined to return to my own age safe and sound."

Even more dramatic is the second, internal time loop that ends the story. When the time traveler arrives in a ruined city in the year A.D. 1,001,930 he is greeted, *by name*, by an old man who says he (the old man) is the Last Man alive. He knew the time traveler was coming because an ancient history book had said the Last Man had, in fact, appeared in the year A.D. 502,101 in the very time machine out of which the time traveler has just stepped. The time traveler is so startled by all this (and who could blame him!?) that he decides to mull over what he has been told until the next day. As he wakes up in the morning, he is just in time to watch the Last Man depart for 502,101. Stranded in the future, the time traveler wanders the empty city in despair until he chances upon a museum. And in the museum, sealed in a glass case, is his time machine (!)—it has been there for half a million years, since the end of the Last Man's journey. And so the time traveler is saved; he merely adds some oil to the still-functional engine (if you can accept time travel, I suppose this is no more difficult to believe) and returns to 1930—just as he saw himself do at the beginning of the story.

Since Bridge's astonishing story, the idea of a causal loop in time has been used many times in science fiction. Here's a representative sampling:

(1) Time travelers arrive in the forty-sixth century, only to find that they are expected. Their host tells them why: "I have been awaiting your arrival from the past. I have a written record of your coming. You see, I have a time machine myself ... With my time machine, I recently went a year into the future and read the written account I had made, or will make after you leave. Then I came back, awaiting your arrival."[87]
(2) Armed travelers return to the Triassic age to uncover the secrets of a mysterious artifact that has been recently discovered; at the end we learn it is the remains of their own automatic rifle[88];
(3) A time traveler journeys back 500 years, where he suffers an accident that results in his being "agelessly stuck" in his time-traveling gadget until he is freed—by himself, 500 years later. He then gets into the gadget to journey back 500 years[89];
(4) The world's time suddenly loses 5 min, an astonishing event that comes to be called "the time drop." After 2 weeks of investigation, a reporter traces this

[87]E. Binder, "The Time Cheaters," *Thrilling Wonder Stories*, March 1940.
[88]J. Blish, "Weapon Out of Time," *Science Fiction Quarterly*, Spring 1941.
[89]A. B. Chandler, "The Tides of Time," *Fantastic Adventures*, June 1948.

event to a reclusive (but brilliant, of course) scientist who reveals that he has invented a time machine. The reporter decides to test this claim by using the machine to return to just before the start of the time drop, to observe precisely what caused it—it is, in fact, a malfunction of the machine that is at fault and the reporter finds himself caught in a 2-week long causal loop[90];

(5) A physicist knows something odd lies in his future when he is confronted with a 700 year-old museum copy of a book. The puzzle is how to explain a message penned in ancient, faded ink, in modern English *and in his handwriting*, on the back side of one of the recently unglued endpapers! How, too, to explain his own fingerprints all over the same endpaper? How, indeed, to answer these questions is his problem when he is presented with all of this and is asked, "Have you, by any chance, been visiting the thirteenth century?" At the end of the story the time loop is closed when the physicist finds himself writing that same message on a *brand new* copy of the book that has been sent from the past (and that he returns to the thirteenth century via a "time portal")[91];

(6) A time traveler from 1964 is secretly observed by one of the 'locals' when he arrives in 1683. The oddness of the sudden appearance of the time traveler and his machine ("It were a kind of Dazzle") makes the local think it might be that the stranger is the man who stole some items from his home the previous night, the same night he had an "ill Dream." Stealing the time machine after the time traveler has gone exploring, the local travels to 1964 where he learns how valuable antiques are. So back he goes to 1683, to the night before the time machine first appeared, to get some 'antiques' from his house. And thus he realizes who the thief *really* was. Before leaving again for the future, he enters his own bedroom to see himself asleep and then to awaken. And so he also learns the cause of what he called his "ill Dream."[92];

(7) A movie production crew goes into the past to make a film. At the end of the story it becomes clear that their presence in the past was not an insignificant event, as one character realizes after seeing the evidence of how they affected (*not* changed!) the past: "If this is true, then the only reason that the Vikings settled in Vinland is because we decided to make a motion picture showing how the Vikings settled in Vinland"[93];

(8) A private college, endowed decades before by a generous but mysterious benefactor, experiments with a time machine. Suddenly, one of the college's graduates is accidently sent a hundred years into the past—where she becomes the benefactor. The college comes into existence, therefore, because it will exist[94];

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[90]W. Sheldon, "A Bit of Forever," *Super Science Stories*, July 1950.

[91]M. Leinster, "The Gadget Had a Ghost," *Thrilling Wonder Stories*, June 1952.

[92]D. I. Massor, "A Two-Timer," *New Worlds SF*, February 1966.

[93]H. Harrison, *The Technicolor Time Machine*, Doubleday 1967.

[94]C. Simak, "The Birch Clump Cylinder," *Stellar 1* (J. del Rey, editor), Ballantine 1974.

(9) A man gets the money to support his experiments in time travel by selling a large collection of old, rare comic books he has discovered in his late mother's attic. Later we learn how the comic books came to be there; after his experiments are successful, the inventor travels back into the distant past, buys the *newly* published comic books right off newsstands, and stores them in his mother's attic where, decades later, he knows his younger self will grow up and then find them (and thus get the money to make it all happen)[95];

(10) In the 1980 film *Somewhere in Time* (based on the 1975 novel *Bid Time Return* by Richard Matheson), a man in the present is visited by a mysterious old woman who gives him a watch. Later, he travels back to 1912 where he meets a girl to whom he gives the watch. He then returns to the present, and she lives out her life from 1912 on, until she too reaches the present, where we discover she is the (now old) woman who gives the man the watch.

Once philosophers discovered the bizarre nature of causal loops, they quickly proved themselves to be the equal of science fiction writers in imagining strange doings. Here's one example of that, one which any writer would be proud of: "If James cannot decide whether to marry Alice or Jane, he simply travels to the future and learns that he is to choose Alice; he then chooses her for this reason. One wants to object that the decision to marry Alice was never really made at all! But this is not true; the decision was made—as a result of the knowledge that this was the decision . . . It is not the case that the prospective bridegroom could visit the future and compare the results of marrying Alice with those of marrying Jane in order to decide between the alternatives. For if he visits the future, he will learn only that in fact he chose Alice, for better or for worse!"[96]

This same philosopher elaborated on his view of causal loops in a later paper, where he wrote "What if time travel becomes commonplace, so that we must deal with a constant stress of time travelers returning from the future to reveal what they have seen?"[97] His answer is "I think it is clear that the . . . causal loop we have been discussing would become very common, and would play a prominent role in human affairs." He denied, however, that such causal loops would mean the loss of free will. As he explained his position, knowledge of a rigged roulette will not prevent you from putting your money on the table *if you want to*, but perhaps that

[95]D. Knight, "The Man Who Went Back," *Amazing Stories*, November 1985. This same idea was used earlier in the story "Compounded Interest," (*Magazine of Fantasy and Science Fiction*, August 1956) by Mack Reynolds, in which the inventor of a time machine has the money to build his gadget because he uses it to go back into the past where he deposits a small sum, which then grows (through the 'magic' of compound interest) into the cash he needs to fund his time machine.

[96]G. Fulmer, "Understanding Time Travel," *Southwestern Journal of Philosophy*, Spring 1980, pp. 151–156.

[97]G. Fulmer, "Time Travel, Determinism, and Fatalism," *Philosophical Speculations in Science Fiction and Fantasy*, Spring 1981, pp. 41–48.

knowledge will influence your *freely* made decision making. Whether you learn that the roulette wheel is rigged by traditional means (perhaps you see magnets being installed under the table) or by means of time travel is irrelevant—even with this knowledge, you act freely. Other philosophers have not been so generous. One disliked causal loops so much, for example, that while he believed them to be conceptually possible, he also thought them to have "a queer smell,"[98] so much so that he simply preferred to avoid thinking about them!

One concern that many philosophers and physicists have had with closed loops in time is that they fear that would mean being trapped on an endless cycle of repeating events. For example, one philosopher long ago wrote

> "There is nothing contradictory in imagining causal chains that are closed, though the existence of such chains would lead to rather unfamiliar experiences. For instance, it might then happen that a person would meet his own former self and have a conversation with him, thus closing a causal line by the use of sound waves. When this occurs the first time he would be the younger ego, and when the same occurrence takes place a second time he would be the older ego. Perhaps the older ego would find it difficult to convince the younger one of their identity; but the older ego would recall an identical experience long ago. And when the younger ego has become old and experiences such an encounter a second time, he is on the other side and tries to convince some 'third' ego of their physical identity. Such a situation appears paradoxical to us; but there is nothing illogical in it."[99]

What has been (erroneously) described with that is the beginning of an endless succession of encounters around a closed causal loop. There is, however, just *one* encounter on such a loop in spacetime (but, of course, the mind of the time traveler experiences the encounter twice), subject to the constraint of self-consistency. Some physicists, too, have been so concerned about multiple trips around closed timelike curves (CTCs), because they think such trips would allow the past to be changed, that they have felt it necessary to specifically forbid such a possibility. As one paper put it, "That the principle of self-consistency is not totally tautological becomes clear when one considers the following alternative: The laws of physics might permit CTCs; and when CTCs occur, they might trigger new kinds of local physics which we have not previously met. For example, a quantum-mechanical system, propagating around CTCs, might return to where it started with values for its wave function that are inconsistent with the initial values; and it might then continue propagating and return once again with a third set of values, then a fourth, then a fifth ... The principle of self-consistency by fiat forbids changing the past."[100] This last statement is, of course, in agreement with the position I have taken in this book, a position that has generally been accepted by most philosophers for several decades now, but the proponents of the principle of self-consistency

[98] M. MacBeath, "Communication and Time Reversal," *Synthese*, July 1983, pp. 27–46.

[99] H. Reichenbach, *The Direction of Time*, University of California Press 1956, p. 37.

[100] J. L. Friedman et al., "Cauchy Problem in Spacetimes with Closed Timelike Curves," *Physical Review D*, September 15, 1990, pp. 1915–1930. Another physicist, however, has flatly rejected this need for the Principle, calling it redundant: see D. Deutsch, "Quantum Mechanics Near Closed Timelike Lines," *Physical Review D*, November 15, 1991, pp. 3197–3217.

seem to have been driven to it by a fear of the past 'happening again' over and over, as in the 1993 film *Groundhog Day*.

Science fiction writers have stumbled into the error of endless cycling on a closed time loop, too. In one such tale,[101] the inventor of the first time machine travels 500 years into the future where he finds a bronze statue of himself that honors his discovery of time travel. Suddenly injured, fatally, he returns to the present with the statue and then dies. As a memorial, the statue is placed in the very spot where the inventor found (will find) it. As the tale ends, the late inventor's lab assistant wonders to himself what will happen 500 years later: "Suddenly a strange machine will come out of the past and [the inventor] will be here again—although he is dead and has been dead 500 years. [He will take the statue] and go back to the past . . . to die. And once again that maddening cycle will begin, to go on and on forever as long as time spins its threads."

That story illustrates yet another puzzle associated with those causal loops that contain a circulating, physical object. That is, *who made the statue*? We can ask the same question about the watch in the time loop of *Somewhere in Time/Bid Time Return* as, at every instant of its existence, the watch is in the possession of either the man or the woman? So, *when was the watch constructed*?

There have been some science fiction writers who specifically recognized this question, long before either the philosophers or the physicists paid attention to it. In one early tale,[102] for example, we read of a time machine that travels from 1935 to 1925. When the question of the origin of the time machine comes up, we read

> "One time machine, found in 1935 and brought back to 1925—found in 1935 *because* brought back to 1925. That is all."
>
> "But who made it in the first place?—Oh, skip the 'in the first place.'[103] Just plain: who made it?"
>
> "No one. It was never made . . . It is here because it is here."

This same puzzle was addressed in *The Technicolor Time Machine* (note 93), when one character is perplexed over a piece of paper in his wallet with a diagram on it, a piece of paper he got from himself (an *older version* of himself, who traveled into the past to give it to his younger self). In frustration, he asks a friend:

> "Then no one ever *drew* this diagram. It just travels around in this wallet and I hand it to myself. Explain that."
>
> His friend replies:
>
> "There is no need to, it explains itself. The piece of paper consists of a self-sufficient loop in time. No one ever drew it. It exists because it is, which is adequate explanation. If you wish to understand it, I will give you an example. You know that all pieces of paper

[101] S. Mines, "Find the Sculptor," *Thrilling Wonder Stories*, Spring 1946.

[102] R. M. Farley, "The Man Who Met Himself," *Top-Notch Magazine*, August 1935 (*Top-Notch* was an adventure pulp published between 1910 and 1937).

[103] The reason for this line in the story is that earlier the question of "Where did the time machine come from *originally*?" was raised. The answer: "There was never any 'original.' . . . There is no round-and-round circle of events, no repetition. Merely *one* closed cycle." This is, in fact, the modern view of causal loops, expressed in a 1935 (!) science fiction story.

> have two sides—but if you give one end of a strip of paper a 180-degree twist, then join the ends together, the paper becomes a Möbius strip that has only one side. It exists.[104] Saying it doesn't cannot alter the fact. The same is true of your diagram; it exists."
>
> "But—where did it come from?"
>
> "If you must have a source, you may say that it came from the same place that the missing side of the Möbius strip has gone."[105]

The undeniable mystery of causal loops is the reason behind the philosopher I cited earlier (note 98) who thought they have a "queer smell" and so viewed them with much suspicion. He wasn't alone in that feeling, and another philosopher said as much whe he wrote "despite [strong] arguments for the consistency of time travel stories [with causal loops], the impression is apt to remain that something is wrong with them. I think this impression is correct."[106] One story that this philosopher could well have had in mind is a classic,[107] a tale that describes a knife brought from a museum in the future back to the present. It arrives in the present with a flawless blade, but soon thereafter gets a nick in the blade. How, wonders the narrator, can the time loop be completed "again"? I do not find this quite the puzzle that either the author (and perhaps the philosopher) do: it is simply a variation of the grandfather paradox (which has been shown not to be a paradox at all). *If* the knife is found flawless in the future, *then* it was not (will not) be nicked in the past. As written, the story is not logically consistent as it involves changing the past but, *if* one removed the detail of a *nicked* blade, then we *would* have a true (paradoxical) causal loop, with the question the story, itself, asks about the knife: "How was this knife created . . . when its existence has no beginning or end?"

The nicked knife does illustrate a subtle problem that bedevils *any* causal loop containing a physical object. Consider once again the watch in the film *Somewhere in Time*. Assume the watch received by the man in the present is bright and shiny. He then takes it back into the past and gives it to his love. It remains with her after his return to the present until, decades later, she gives it to him—bright and shiny. Why didn't it tarnish? Is there some peculiar anti-tarnish property to a watch in a causal loop? Well, if so, is that anymore odd than a causal loop itself?[108]

None of that, however, provides a means for rejecting time travel *if* one can argue that it is possible to have time travel *without* causal loops. Indeed, Professor Hanley (see note 105) argues that it is possible, and presents what he claims is an

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[104]See note 99 in Chap. 1, and the related discussion there.

[105]One philosopher calls this bit of dialog "unhelpful," while ignoring the fact that it appeared in a science fiction pulp magazine and not a scholarly journal, and was clearly meant to dazzle teenage boys (see note 39 and related discussion in "Some First Words") with the concept of a causal loop, rather than to break new ground in metaphysical thought. See Richard Hanley, "No End in Sight: Causal Loops in Philosophy, Physics and Fiction," *Synthese*, July 2004, pp. 123–152.

[106]G. Nerlich, "Can Time Be Finite?" *Pacific Philosophical Quarterly*, July 1981, pp. 227–239.

[107]P. S. Miller, "As Never Was," *Astounding Science Fiction*, January 1944. This is the same Miller who appears in note 15 (and see note 46, too).

[108]It is *not* sufficient to say that perhaps she polished the watch. Polishing would remove material from the watch, which means she gives him a watch different from the one he gives her in the past.

example of how to do it. Alas, another philosopher convincingly showed that the example is flawed and that Hanley's claim that there is no causal loop in his story "is unjustified."[109] From an entertainment point of view, however, eliminating causal loops is going in the wrong direction, as it is the inclusion of causal loops that gives a feeling of mystery to a good science fiction story.

To finish this section, then, we can do no better than to discuss causal loops that are even *more* bizarre than are those with a physical object; that is, loops that involve time traveling *information*. (Since information doesn't 'tarnish,' however, such a loop avoids that particular puzzle associated with a physical object in a causal loop.) A classic example of such a loop is a mathematician who is visited in his youth by a time traveler from the future (perhaps himself), who gives him the proof of a theorem for which the mathematician is (will be) famous in the future. *Where*, then, did the proof actually come from? In what *mind* was it *created*?[110]

The philosopher David Lewis wrote with particular insight on causal loops, especially ones that involve information transfer, such as a time traveler going back in time to tell his younger self how to build a time machine so that once its constructed he can go back in time and tell himself how to do it.[111] (This was item (3), you'll recall, in Jim Nicholson's 1931 letter to *Science Wonder Stories* magazine, quoted at the end of the first section of this chapter.) As Professor Lewis wrote (see note 5 in the "Introduction"), "But where did the information come from in the first place? Why did the whole affair happen? *There is simply no answer* [my emphasis]. The parts of the loop are explicable, but the whole of it is not. Strange! But not impossible, and not too different from inexplicabilities we are already inured to. Almost everyone agrees that God, or the Big Bang, or the entire infinite past of the Universe, or the decay of a tritium atom, is uncaused and inexplicable. Then if these are possible, why not the inexplicable causal loops that arise in time travel?"

A few years later, another philosopher[112] gave a similar response to a paradox involving a causal loop similar to Lewis', a loop involving a time machine containing a book with instructions on how to make the time machine. The book travels into the past on the machine so it can be read—in order to make the machine.

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[109]Bradley Monton, "Time Travel Without Causal Loops," *The Philosophical Quarterly*, January 2009, pp. 54–67.

[110]Professor Hanley (note 105) says the answer to such questions is "straightforward": the information comes "from itself." I think the issue is rather deeper than that.

[111]See D. Franson, "Package Deal," in *Microcosmic Tales*, Taplinger 1980. The British philosopher J. R. Lucas had a similar scenario in mind when he wrote, in his book *A Treatise on Time and Space* (Methuen 1973, p. 50), "It is very important, not only for reasons of modesty, that I should not be able to use a Time Machine to go into a public library and read my own biography." Robert Heinlein didn't agree with Lucas: in his 1956 novel *The Door Into Summer* the protagonist, an inventor, travels thirty years into the future, where he reads some patent disclosures for inventions that he doesn't remember, even though they are in his name. He then returns to his own time and promptly files the patents!

[112]M. R. Levin, "Swords' Points," *Analysis*, March 1980, pp. 69–70.

In answer to the question "Who wrote the book about building a time machine?" the philosopher says this question is "no different from questions about where *anything* originally came from. We can ask about the origin of the atoms . . . their time line is not neatly presented to us. The atoms either go back endlessly, or if the Universe is finite, they just start. In either case the question of ultimate origin is as unanswerable as the question of the book's origin. What makes us think that when such questions are asked about the loop they are different and *ought* to be answerable is that the entire loop is open to inspection." While the instructions in the book don't tarnish, the book itself of course brings us back to our previous antique watch 'problem.' Suppose the book is brand-new at the start of the trip backward in time. Later, when the machine (and the book) have reached the end of the loop, just before beginning the trip back in time, have the pages turned yellow and brittle? If so, how do we account for the brand-new version? And if not, why not?

An analyst who takes strong exception to these two philosophers is Oxford physicist David Deutsch, who wrote (note 100) "the real problem with closed timelike lines under classical physics is that they could be used to generate knowledge in a way that conflicts with the principles of the philosophy of science, specifically with the evolutionary principle." What Deutsch is referring to is the metaphysical claim, attributed to the philosopher Karl Popper (see note 36 in Chap. 3), that *knowledge comes into existence only by evolutionary, rational processes* and that solutions to problems do not spring fully formed into the universe. One might call this the physics version of the work ethic—the creation of knowledge demands hard work!

Deutsch's idea had actually appeared *decades* earlier in a science fiction tale.[113] Time travel, discovered in the year 2007, is found to have a limited temporal reach into the future of 50 years, a limit due a law passed in 2057 banning time travelers from the past. To try to go past 2057 leads to a prompt arrest of the time traveler and a 'deportation' trip back to his own time. The story eventually explains that the law was passed precisely because of Deutsch's concern. As one character in the story explains, "Suppose [that one could travel more than 50 years ahead], then a time traveler from the past could get [new inventions], carry them back to his own time, and give them to scientists—which[would] cancel all the long period of invention which [produced the inventions]. Which [would] violate causal laws."

More recently, a philosopher has offered a quite interesting response to the Deutsch/Popper assertion. He writes (note 81), of information "appearing out of nowhere," that "These cases are puzzling, but they by no means show that the time travel scenarios in question are impossible or incoherent, *or even improbable*. We think it very improbable that . . . information should come from nowhere—but only because this does not happen very often. It does happen *sometimes*—for instance, when you say something and I mishear you. I think that you said something very

[113] P. Anderson and G. Dickson, "Trespass," *Fantastic Story Quarterly*, Spring 1950.

Fig. 4.5 A curious paradox. CORNERED ©2005 Mike Baldwin. Reprinted with permission of UNIVERSAL UCLICK. All rights reserved

profound—something which neither of us would, in fact, ever have thought of. Where does the idea come from? If this sort of thing were to start occurring regularly [as via causal loops], then we would simply accept it without raising an eyebrow."

In the final chapter I'll discuss a dramatic example (due to two Russian physicists) on how an information-creating time loop might be constructed using a wormhole time machine. Such a time loop wouldn't pass muster with Deutsch, of course, and he would consider such a thing as being as objectionable as is creationism, the anti-evolution claim that purports to 'explain' fossils (with measured ages in the millions of years) by simply *declaring* them as having been made by God just a few thousand years ago.[114] Deutsch's position is considered by nearly all scientists today to be correct *for the specific case of creationism*, but the evolutionary principle may be on shakier ground with respect to declaring causal information time loops to be impossible.

While philosophers have struggled with information in a time loop, and most physicists have carefully stepped around the issue, science fiction has had lots of fun with information in causal loops. Here's a sampling of such tales:

(1) A man receives telephone calls from *two* versions of himself, one ten years in the future saying he absolutely must accept an invitation to fly to the Bahamas

[114] *Why* would God do such a thing? Apparently 'just to have some fun with geologists and biologists,' as creationists call such ancient fossils 'sports of nature.'

that he will receive that very day, with the other version calling from tomorrow insisting that the plane will crash. What should he do?[115];

(2) Lovers who are irrevocably separated in time communicate by mail in one tale,[116] while lovers in another story[117] communicate via telephone calls to the ever more distant past (and yet, with the aid of a clever twist at the end, finally meet);

(3) A telephone lineman starts getting telephone calls from himself from 10 days in the future, with the first call telling him how to make the gadget to transmit such calls[118];

(4) A time traveling historian on a visit to A.D. 1528 from A.D. 2211 accidently gives a copy of the predictions of Nostrodamus to the prophet, thus explaining the predictions[119];

(5) A time machine experiment gone wrong allows thirteenth century Roger Bacon to meet twentieth century scientists, an encounter that explains the amazing forecasts in Bacon's *Opus Maius*[120];

Hollywood, too, has had some fun with information causal loops, with the best (in my opinion) example of that being the 1989 movie *Bill & Ted's Excellent Adventure*. In that film (where we learn that even the not very bright can be time travelers), a set of missing keys is necessary for the successful completion of a task. The two time travelers decide that after the task is done, they will go back in time, steal the keys (*that's* why they're missing!), and hide them so they can use them *now*. Where should they hide them? Why, "over there," says one of the boys, pointing at a hiding place—and sure enough, when they go over and look, the keys are there. They agree that once they have finished with the keys, it will be *most* important that they really do put the keys in the hiding place!

All of these examples that I've just given you, however, were *decades* too late to be the first in fiction about information in a time loop; that honor goes to the 1904 novel *The Panchronicon* by the lawyer Harold Steele MacKaye (1866–1928). An Edwardian literary time machine with style, the Panchronicon (literally, a 'machine for all time') swings on a rope tether around a steel post erected at the North Pole. By "cutting the meridians" faster than the sun does, it travels through space and time from 1898 New Hampshire to the London of three centuries earlier.[121] Using

[115] G. Klein, "Party Line," *The Best from the Rest of the World* (D. A. Wolheim, editor), Doubleday 1976 (story originally published in France in 1973).

[116] J. Finney, "The Love Letter," *The Saturday Evening Post*, August 1959.

[117] T. N. Scortia, "When You Hear the Tone," *Galaxy Science Fiction*, January 1971. See also L. Padgett, "Line to Tomorrow," *Astounding Science Fiction*, November 1945.

[118] M. Leinster, "Sam, This Is You," *Galaxy Science Fiction*, May 1955. This story was later broadcast as an episode on the "X-Minus One" radio drama program. See also F. A. Reeds, "Forever Is Not So Long," *Astounding Science Fiction*, May 1942.

[119] L. Del Rey, "Fools' Errand," *Science Fiction Quarterly*, November 1951.

[120] N. Schachner, "Lost in the Dimensions," *Astounding Stories*, November 1937.

[121] 'Time traveling' by crossing time zones is an idea that one can trace at least as far back as to Edgar Allen Poe's 1841 short story "Three Sundays in a Week."

it, a time traveler fan of Shakespeare journeys from 1898 back to the bard, who is suffering from writer's block. There she whispers the magic lines from a play he is stuck on (lines she has memorized for her literary club meetings) into his receptive ear. Does this make Shakespeare a plagiarist? Of himself!?

4.5 Sexual Paradoxes

> "Once time machines exist, no event is low probability if it is needed to make the past consistent."[122]

There are causal loops even stranger than the ones we have already discussed, hard as that may be to believe. These are the sexual paradoxes, first mentioned in 1931 by Nicholson in his letter to Hugo Gernsback. Not only science fiction writers, but philosophers, too, have found these particular paradoxes full of dramatic appeal. For example, as a challenge problem to the readers of a scholarly journal, the British philosopher Jonathan Harrison (1924–2014) posed the following bizarre, indeed astonishing, situation.[123] A young lady, Jocasta Jones, one day finds an ancient deep freezer containing a solidly frozen young man. She thaws him out and learns that his name is Dum, and that he possesses a book that describes how to make both a deep freezer and a time machine. They marry. Soon after they have a baby boy and name him Dee.

Years later, after reading his father's book, Dee makes a time machine. Dee and Dum, taking the book with them, get into the machine and begin a trip into the past. Running out of food during the lengthy journey, Dee kills his father and eats him. Arriving in the past, Dee destroys the time machine, builds a deep freezer (again, using the book), gets into it, and . . . wakes up to find that a young lady, one Jocasta Jones, has thawed him out. When asked his name he replies Dum and shows Jocasta his book; they marry, and . . . .

Harrison concluded this amazing tale with this question for his readers: "Did Jocasta commit a logically possible crime?" That issue is just the *surface* of an ocean of puzzles in this story! Jocasta's crime, of course, is that she has (if unwittingly) committed incest; readers who remember the Greek myth of Oedipus, and who his mother/wife was, will understand why Harrison named his female character as he did. But what of Dee's crime? He has, after all, eaten his father! But perhaps that isn't a crime at all, because Dee and Dum are one in the same, and is it really a crime to eat yourself? According to another philosopher, Murray MacBeath, Harrison's story is "a story so extravagant in its implications that it will be regarded as an effective *reductio ad absurdum* of the one dubious assumption on which the story rests: the possibility of time travel."[124]

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[122]From Robert Forward's 1992 novel *Timemaster*.

[123]J. Harrison, "Jocasta's Crime," *Analysis*, March 1979, p. 65.

[124]M. MacBeath, "Who Was Dr. Who's Father?" *Synthese*, June 1982, pp. 397–430.

This isn't to say that MacBeath was asserting that time travel is impossible. Indeed, he went on to declare that he did believe in the logical possibility of time travel, and his paper is devoted to discovering what thought to be incorrect in Harrison's story. He did that by retelling the story with what he believed are crucial modifications to make it sufficiently less outrageous that it could be taken at least somewhat seriously. In the new version, our hero, thawed out from a deep freezer, is now named Arthur. Arthur is, unfortunately, suffering from total amnesia (this is MacBeath's way of avoiding the psychological trauma of Dee remembering he ate Dum) and so, when asked his full name, he is himself sufficiently puzzled that he replies "Arthur who?" He is finally called (what else?) Arthur Who. And, as you can no doubt guess, his son (who is a genius and gets a PhD at age 14 on a dissertation dealing with the physics of time travel) becomes Dr. Who!

We are then told of a trip back into the past by the two, of the eating of the father (Arthur Who) by the son, of the entering of the deep freezer by Dr. Who, etc. etc. The whole business is quite entertaining and *at least* as complex as Harrison's original story. Just *how* complex is summed up in MacBeath's last, wonderful line: "The Who who was Dr. Who's father was not Dr. Who—that is, not the Dr. Who whose father he was."

MacBeath wasn't the only one that Harrison's story fascinated, and nearly a dozen replies to it were received in addition to MacBeath's. One, in particular, made the thought-provoking observation (see note 112) that not only has Jocasta committed incest but she has done so with a single act of intercourse. As discussed earlier, the events on a causal loop do not happen endlessly but rather only once; thus, Jocasta thaws Dum (Dee) out just once, she marries him just once, and the two consummate their marriage just once. Ordinarily we think it takes two sexual acts to commit incest, the first resulting in the birth of a child, and the second being a parent's union with that child, but this is not so in a causal loop. Time travel *is* an odd business.

Another philosopher replied to Harrison's story with a quite interesting claim, one that had actually been thought to be true for decades—but which today is recognized to be false. The claim was that, irrespective of physics, Harrison's story was biologically flawed and fatally so. As that philosopher wrote, "The biological problem is the following. Dee is the son of Dum and Jocasta. So Dee obtained half his genes from Dum and half from Jocasta. But Dum is diachronically identical with Dee and is therefore genotypically identical with him (that is, himself). That is, Dee is both genotypically identical and distinct from Dum, which is absurd."[125]

That this isn't true was pointed out by a philosopher many years later. In his paper we read this tale: "Suppose Adam travels [far] back in time ... where he meets his mother Betty, mates with her and has a child which is himself. Is this

[125] W. Godfrey-Smith, "Traveling in Time," *Analysis*, March 1980, pp. 72–73. This false claim had already been raised by a physicist (L. S. Schulman, "Tachyon Paradoxes," *American Journal of Physics*, May 1971, pp. 481–484), and even earlier by a science fiction writer (P. Anderson, "Time Patrol," *Magazine of Fantasy and Science Fiction*, May 1955).

possible biologically? Yes ... as follows ... on the grounds that we have total replication of Adam's genome."[126] (The *genome* is the totality of genes taken over all gene sites.) Now, suppose each such site holds two genes and, as Dowe points out, in sexual reproduction the father passes on to his offspring one gene for each gene site, to go with the gene the mother gives to each site. To exactly reproduce himself, then, the time traveling Adam 'simply' has to give his offspring, *at each site*, the gene that he has for that site that did *not* come from Betty. Thus, the offspring—baby Adam—ends up with a genome *precisely identical* to the time traveling Adam. This is, of course, an *extraordinarily unlikely* event, as the human genome has tens of thousands of genes. The probability that each and every site gets the 'right' gene from the time traveling Adam is therefore essentially zero. But it isn't *actually* zero and, as the quotation that opens this section says, a low probability to an event isn't a roadblock to its occurrence if that event is required for consistency.

While certainly instructive, the sexual paradox stories by Harrison and MacBeath are remiss in not indicating that the concepts they are dealing with have long been a staple of science fiction, and that the sexual paradoxes received much critical analysis in that genre long before philosophers (and physicists, too) discovered them. From science fiction, for example, we have a tale of young man who travels backward in time 1250 years, from A.D. 3207 to 1957, to become his own grandfather fifty generations removed.[127] And even that is tame compared to the sexual paradoxes other science fiction writers conjured up before philosophers began to discuss them.

In another story,[128] written decades before Harrison's and MacBeath's papers, we meet a young lady caught up in a mind twisting affair in which the mystery of a causal loop is the least of her troubles. In 1957 a girl is born, and after 20 years of intense competition with her mother (who has an uncanny ability to predict the future), she travels back from 1977 to a few months before her own birth. She becomes pregnant (by a man who she later discovers is her father) and gives birth to a girl. The new mother has, of course, knowledge of all that will happen during the next 20 years, including the fact that she will have an intense competition with her rebellious daughter ....

While writers of stories like these in the early 1950s were there as trailblazers, it is a tale that appeared as the 1950s ended that is today generally acknowledged as the best sexual paradox story ever written.[129] We are given only a hint of what is to come when a character listens to a song called "I'm My Own Grandpaw!" In 1945,

[126]Phil Dowe, "The Coincidences of Time Travel," *Philosophy of Science*, July 2003, pp. 574–589. See also J. Berkovich, "On Chance in Causal Loops," *Mind*, January 2001, pp. 1–23, and P. Dowe, "Causal Loops and Independence of Causal Facts," *Philosophy of Science*, September 2001, pp. 89–97.

[127]R. Dee (this is *not* the 'Dee' of Harrison's story!), "The Poundstone Paradox," *Magazine of Fantasy and Science Fiction*, May 1954.

[128]C. L. Harness, "Child By Chronos," *Magazine of Fantasy and Science Fiction*, June 1953.

[129]R. Heinlein, "All You Zombies—," *Magazine of Fantasy and Science Fiction*, March 1959.

a newborn girl, Jane, is found on the steps of an orphanage. At age 18, in 1963, she has a one-night affair with a mysterious stranger that leaves her pregnant. Some months later, during the birth of a daughter, it is discovered that Jane actually has a double set of sexual organs, and because the female set has been ruined by the pregnancy, doctors restore her as a man. Soon after, the baby girl mysteriously disappears from the hospital ward. Years later, in 1970, Jane (now a man, of course) meets another stranger who uses a time machine to transport both of them back to April 3, 1963. By April 24 male-Jane meets female-Jane and impregnates her (and so now we know who the mysterious stranger was during the one-night affair!). Meanwhile, the stranger with the time machine travels forward to March 10, 1964, a little after female-Jane has given birth, kidnaps the baby from the hospital (thus clearing-up another mystery!), takes her back to September 20, 1945, and leaves her on the steps of the orphanage. And so we see that Jane is her own mother *and father*, thus out-doing all previous tales about self-parenting.

This is pretty impressive stuff, but Heinlein still has one more twist for us. After leaving baby-Jane in 1945, the time machine stranger returns to April 24, 1963, retrieves male-Jane (who has just kissed female-Jane goodnight after fathering her-himself in herself), and takes him to 1985 where he recruits him into the Temporal Service—and finally, the stranger jumps forward to 1999, his 'real time.' At the end we at last learn that the stranger is, in fact, an even older version of male-Jane—*all* the central characters in the entire story are the *same* individual at various points along a single, highly twisted world line. The lone character in Heinlein's tale is truly a self-made man/woman in every sense of the phrase! This ultimate act of *creatio ex nihilo* has, correctly I think, been called "smaller than the minimal loop."[130]

Jane, in all her/his versions, is the only character in the story that appears to have purpose. In terrifying words that describe a causal loop, Heinlein ends the tale with an explanation of the story's title: "The Snake That Eats Its Own Tail, Forever and Ever. I know where I came from—but where did all you zombies come from? . . . You aren't really there at all. There isn't anybody but me—Jane—here alone in the dark. I miss you dreadfully!" In a December 1958 letter to his literary agent, Heinlein wrote of this amazing tale, "I *hope* that I have written in that story the Farthest South in time paradoxes." In my opinion, he did.

The sexual paradox has continued to fascinate science fiction writers up to the present day. In the novel *Timemaster* (note 122), for example, the hero at one point spends a night with his wife—and with two versions of himself from the future. He will, of course, experience that night two more times! Later, he becomes upset when his wife runs off with one of the older versions, but he quickly calms down when he considers that eventually *he* will be the older version. Consider, too, a story[131] that

[130]S. Lem, "The Time-Travel Story and Related Matters of SF Structuring," *Science Fiction Studies*, Spring 1974, pp. 143–154.

[131]G. Benford, "Down the River Road," *After the King: Stories in Honor of J. R. Tolkien* (C. Tolkien and M. Greenberg, editors), Tor 1991.

tells of a young man hunting the father who, years before, had abandoned him in a burning house. The death of the young man's mother in the flames has sent him on a 10 year quest for revenge up and down what is literally a river of time, a river on which to travel in one direction ("up time") is to move into the past, whereas moving "down time" leads to the future. Eventually he corners the father and, despite the man's pleading, kills him. It is only later, after examining papers he finds in his father's pocket, that the young man realizes he has killed his *future* self (Benford, a physicist, knows the pitfalls of time travel, and you'll notice that there is no autoinfanticide paradox here).

4.6 Splitting Universes and Time Travel

> "In all time travel stories where someone enters the past the past is necessarily altered. The only way the logical contradictions created by such a premise can be resolved is by positing a Universe that splits into separate branches the instant the past is entered."[132]

One early science fiction technique for allowing backward time travel and a changeable past, while still avoiding paradoxes, is that of alternate universes. According to this idea, if a time traveler journeys into the past and introduces a change (indeed, his very journey may be the change) then, as the above quote states, reality splits into two versions, with one fork representing the result of the change and the other fork being the original reality before the change. (To a fifth-dimensional observer, of course, all conceivable forks, all possible four-dimensional spacetimes, have always existed.) Indeed, according to this view the entire universe is splitting, at every microinstant, along every alternative decision path for every particle in the cosmos! This is often called the theory of *alternate realities with parallel time tracks*.

Such a seemingly fantastic view seems to actually have some scientific plausibility because of the so-called *many-worlds interpretation* (MWI) of quantum mechanics, pioneered in physics by Hugh Everett III (1930–1982), in a 1957 Princeton doctoral dissertation. Everett's theory is the antithesis of what is commonly called the *collapse of the wave function*, the idea that all potential possibilities have a non-zero possibility until a consciousness actually decides or observes which one will actually *be*. That quantum mechanical concept gets its name from the probabilistic wave equation formulated in 1926 by the German physicist Erwin Schrödinger (1887–1961). Before the observation, all possible futures have various values of probability; after the observation (which 'collapses' the wave function) exactly *one* of those futures (*the* future) has probability 1 and all the others have probability 0.

The MWI idea can be seen in Hale's story "Hands Off," discussed earlier, and in art *40 years* before that! With almost certainly a theological twist, consider the

[132] M. Gardner, "Mathematical Games," *Scientific American*, March 1979.

Fig. 4.6 Grandville's Infinity Juggler of many-worlds

beautiful illustration in the 1844 book *Un Autre Monde* (*Another World*), reproduced in Fig. 4.6. Known either as "The Infinity Juggler" or "The Juggler of Worlds," it is the work of the French artist Jean-Ignace Isidore Gérard (1803–1847), who published under the name 'Grandville.' The juggler—Grandville's version of Hale's mentor—appears as a court jester who is clearly having fun manipulating his multitude of worlds, while the man (humanity?) in the foreground watches. The man appears to be simultaneously fearful and fascinated, involved yet clearly impotent. Is Earth one of the worlds among which the Jester stands, or is it one of those flying through space? Or is Earth, perhaps, simply the unfortunate world ingloriously stuffed down the front of the Jester's pants? (That would surely explain a lot!) If born a hundred years later, Grandville would surely have found work as an artist in the imaginative world of the science fiction pulps.

Early science fiction stories that treat the collapsing wave function concept can be traced back to the late 1930s and early 1940s.[133] A particularly interesting example is the story of an inventor who, while trying to build a radio with which

[133]See, for example, Jack Williamson's 1938 novel *The Legion of Time*, and C. L. Moore's, "Tryst in Time," *Astounding Stories*, December 1936. L. Sprague de Camp (1907–2000), too, was an early pioneer in the exploration of the MWI idea in science fiction long *before* Everett. In his 1941 novel *Lest Darkness Fall*, for example, he uses the analogy of a tree (the "main time line") that is always sprouting new branches.

to signal Mars, accidently stumbles on the "temporal-aberrant carrier wave" and thus establishes contact with a universe that forked off of ours in 1863 when Robert E. Lee *won* the Battle of Gettysburg![134] In Everett's MWI, however, the wave function of the universe does *not* collapse. Indeed, it *couldn't*, because there is no observer external to the entire universe (we are talking science now, not of theology and God); instead, the wave function 'splits' at every decision point in spacetime. Although this leads to a multitude of realities *far* beyond comprehension, cosmologists still tend to like the MWI because it avoids the puzzle of having to produce an observer 'outside the universe.'

It's important to understand that the MWI is different from yet another idea popular in science fiction, that of *parallel universes* (see again the third discussion question at the end of Chap. 3). In parallel universes *all* possibilities *always* exist, independent and parallel in time. In the MWI, on the other hand, ever more universes are continually coming into existence. Unlike the MWI, which can at least claim a scientific basis (quantum mechanics), there is no analogous theory for parallel universes. But, of course, even though lacking a theory, nonetheless science fiction writers have been quite inventive with the idea because parallel universes offer a way to avoid (at least some) causal loops.

One clever, early pulp story[135] illustrates how that works. To improve the performance of his time machine, an inventor needs batteries with tremendous energy density, a density far in advance of the batteries in the present. Unable to travel far into the future—if he *could* obtain them there, then of course a causal loop (the very entity we wish to avoid) would be created upon his bringing them back to the present—his assistant first travels back to 1851. There he leaves a note on desk of a well-known experimenter, with a plea for him to devote his life to battery research; a copy of the 1937 *Electrical Handbook* is left with the note as proof that there really has been a visit from the future! Before returning to the present, the assistant takes a sheet of (new) 1847 five-cent stamps from the experimenter's desk.

Returning to the present, which is now different (a new time track, in accordance with the splitting-universe idea), the powerful batteries *are* readily available *because* the experimenter believed the note. Buying several of them, using money obtained by selling the pristine 1847 stamps to a collector, the assistant returns to a slightly earlier 1851 than before (to *before* the fork in time!), watches himself appear[136] and leave the note and the handbook, and *then, unobserved, the assistant removes both*: Thus, upon returning once more to the present, he finds all is as before—except now he and the inventor have the powerful batteries. As

[134]N. Bond, "Parallel in Time," *Thrilling Wonder Stories*, June 1940. See also S. N. Faber, "Trans Dimensional Imports," *Isaac Asimov's Science Fiction Magazine*, August 1980.

[135]W. Sell, "Other Tracks," *Astounding Science Fiction*, October 1938.

[136]Just like Marty McFly does at the end of the 1985 film *Back to the Future*. The movie is fun, but pulp science fiction did it first.

before, one might ask where the batteries came from, but unlike the previous mystery of information-creating causal loops, the answer is clear and non-mysterious. *They came from the hard work of the experimenter on a different time track*. Such shuttling back-and-forth between time tracks is the signature of what is called a *cross-time* story, a device to avoid paradoxes while still allowing for changing the past. The first example of this time travel sub-genre had actually appeared 4 years earlier.[137]

In another cross-time tale from modern times, we read of the horrible fate suffered by a man when an experiment in a Princeton physics lab goes wrong.[138] It is discovered, too late, that parallel time tracks are not simply grooves into which you drop, like a ball, after leaving the time track of our world. Each version of a person in each world is not like a ball rolling down a groove from past to future. Rather, each world's time track is just a line on a smooth surface; as the man is told, during a temporary stay in a world still close to his (our) original world, "We gave you a push sideways, and you moved off your original line—but instead of dropping into the next groove, you've just kept on rolling across the surface, from one line to the next, at an angle. There are no grooves, nothing to stop you from sliding on across the different lines forever. You have the same futureward vector as you started with, but you've added a small cross-time vector, as well." And so the man drifts cross-time, and gradually the worlds he experiences grow ever more alien.[139]

The science fiction is undeniably fun, but for this book the underlying *scientific* theory of time travel is classical (that is, non-quantum) general relativity, and that theory has nothing to say about alternative time tracks in multiple worlds. For most time travel theoreticians there is *one* time track, and the past of our world is unique and inviolate. I agree with the great quantum physicist J. S. Bell (1928–1990), who wrote of Everett's theory that "if such a theory were taken seriously it would hardly be possible to take anything else seriously."[140] As Bell further observed, in the MWI "there is no association of the particular present with any particular past," a quite strange idea that had already appeared in science fiction years earlier.[141]

While most early time travel analysts did base their work just on classical general relativity, there *are* now many more who think quantum mechanics itself, independent of its interpretation, has much to contribute as well. Perhaps, in fact, it

[137]M. Leinster, "Sidewise in Time," *Astounding Stories*, June 1934. Splitting universes with multiple time tracks and time loops became quite popular after Leinster's and Sell's stories; you can find the basic idea repeated yet again in Alfred Bester's "The Probable Man," *Astounding Science Fiction*, July 1941, for example, in which each new journey into the past causes the future to fan out into an infinity of new time tracks.

[138]L. Watt-Evans, "The Drifter," *Amazing Stories*, October 1991.

[139]In Jack Haldeman's 1990 novel *The Hemingway Hoax* we read that "there is not just one [parallel] universe, but actually uncountable zillions of them."

[140]In "Quantum Mechanics for Cosmologists," *Speakable and Unspeakable in Quantum Mechanics*, Cambridge University Press 1987.

[141]J. R. Pierce, "Mr. Kinkaid's Pasts," *Magazine of Fantasy & Science Fiction*, August 1953.

may make an absolutely crucial contribution to the theoretical basis of time travel. One analyst who believes this (along with an even stronger belief in the MWI) is the British physicist David Deustch (note 100), who holds that general relativity is not the proper theory with which to study the physical effects of CTLs. He believes that the traditional mathematical machinery of general relativity actually obscures, rather than clarifies, the difficult task of separating the merely counter-intuitive from the unphysical.

Indeed, Deutsch calls the conventional spacetime methods, based on general relativity and differential geometry, *perverse*. He also does not like the conceptual problems raised by general relativity's wormholes and singularities. Any non-quantum mechanical discussion, he says, of the "pathologies" of backward time travel is simply not adequate. Deutsch divides these pathologies into two fundamental classes: (1) paradoxical constraints, such as the free-will issue seemingly raised by the grandfather paradox, and (2) causal information loops. Deutsch claims that his quantum mechanical analyses show that the first class of pathologies simply does not occur, because the past that the time traveler enters is the past of a world different from the one he has left. Further, his results also show (to him) that the pathologies of the second class may be "avoidable." These are not the views among the majority of time travel students, however (that does *not* mean Deutsch is wrong!), and general relativity *is* the standard tool used by the majority of time travel theoreticians. When quantum mechanics does enter the calculations of most analysts, it is generally on an *ad hoc* basis.

More concerning for the MWI view is a result reported in 2004, that a macroscopic object (a human time traveler, for example) attempting to traverse a wormhole time machine (to be discussed in some detail in Chap. 6) "must necessarily undergo violent interactions with the time machine," interactions *so* violent that they must "cause the object to disintegrate." The different pieces of the now certainly dead time traveler would emerge from the wormhole in different worlds—this is definitely not a result likely to encourage volunteers for the first time machine trip![142]

So, many physicists and philosophers, not sharing Deutsch's position,[143] tend to agree with Bell, including the late John Wheeler (Everett's thesis advisor!), who wrote of the MWI "I once subscribed to it. In retrospect, however, it looks like the wrong track. . . . Its infinitely many unobservable worlds make a heavy load of metaphysical baggage."[144] Agreeing with Wheeler was a philosopher who called the MWI "highly controversial" and declared that "few working physicists take it

[142] A. Everett, "Time Travel Paradoxes, Path Integrals, and the Many Worlds Interpretation of Quantum Mechanics," *Physical Review D*, June 25, 2004, pp. 124023–1:124023–14.

[143] For a modern philosophical argument specifically rebutting Deutsch's enthusiasm for the MWI, see Theodore Sider, "A New Grandfather Paradox?" *Philosophy and Phenomenological Research*, March 1997, pp. 139–144.

[144] See note 34 in Chap. 3.

seriously."[145] Perhaps even more damning was a physicist's statement that "the idea of 10^{100}+ slightly imperfect copies of (the universe) all constantly splitting into further copies . . . is not easy to reconcile with commonsense. Here is schizophrenia with a vengeance."[146] Or, as one science fiction writer bluntly put it, in a tale of the inventor of the "chronomotive impulse belt" (which allows moving between the *two* parallel worlds that are all that exist), the MWI is the "Doctrine of Infinite Redundancy—which is, of course, utter nonsense."[147]

Deutsch's position does raise the obvious question of what motivates a quantum theoretician to study CTLs at all, given that they originate in general relativity and *not* in quantum mechanics. Deutsch's response is that although CTLs did indeed originate in classical Einsteinian general relativity, the still incomplete theory of quantum gravity *does* predict CTLs, too. And that is an exciting observation for time travel enthusiasts because, as Deutsch writes, the results of his quantum studies of CTLs show that "contrary to what has usually been assumed, there is no reason in what we know of fundamental physics why closed timelike lines should not exist." That view was later endorsed by other physicists who wrote, after a quantum mechanical study of how a particle could transit a time machine spacetime in a physically consistent manner, "there is no contradiction between the postulates of quantum mechanics and the possible existence of causality violation in general relativity."[148]

Long before these scientific endorsements, science fiction had enthusiastically embraced the many-worlds idea and its connection with time travel. The first such tale[149] appeared when Everett was just 3 years old; it put forth the insightful observation that although alternate time tracks may allow changing the past for the better (something that can't be done, for better *or* for worse, with a single time track), in the end any such change may still be futile. As Daniels' time traveler puts it, "I did have an idea to . . . go back to make past ages more livable. Terrible things have happened in history, you know. But it isn't any use. Think, for instance, of the martyrs and the things they suffered. I could go back and save them those wrongs. And yet all the time . . . they would still have known their unhappiness and their agony, because in this world-line those things happened. At the end, it's all

[145]R. A. Healy, "How Many Worlds?" *Nous*, November 1984, pp. 591–616.

[146]B. S. DeWitt, "Quantum Mechanics and Reality,' in *The Many-Worlds Interpretation of Quantum Mechanics* (B. S. DeWitt and N. Graham, editors), Princeton 1973.

[147]B. Shaw, "What Time Do You Call This?" *Amazing Science Fiction*, September 1971. When a bank robber in one world tries to make his escape into the other world, he literally runs into 'himself' trying to escape after robbing the 'same' bank in the parallel world!

[148]D. S. Goldwirth *et al*., "Quantum Propagator for a Nonrelativistic Particle in the Vicinity of a Time Machine," *Physical Review D*, April 15, 1994, pp. 3951–3957. See, too, the earlier D. S. Goldwirth *et al*., "The Breakdown of Quantum Mechanics in the Presence of Time Machines," *General Relativity and Gravitation*, January 1993, pp. 7–13.

[149]D. R. Daniels, "The Branches of Time," *Wonder Stories*, August 1935.

unchangeable; it merely unrolls before us."[150] Many years later, in a critique of the many-worlds idea, a philosopher/physicist echoed Daniels' words: [In the world] that I (subjectively) experience I may blunder, but [in another world], with equal actuality, I triumph gloriously. The Everett interpretation can be used this way to mitigate sorrows, but this use is two-edged, for it equally well implies the speciousness of happiness."[151]

The editorial introduction to Daniels' pioneering tale is quite interesting: the opening line is "To say that this short story contains some revolutionary time-travel theories would be putting it exceedingly mild." That editor then went on to tell his readers, with great enthusiasm, that "when the author . . . submitted this story to us, his accompanying letter stated that in it he had settled the time-travel question once and for all. We must admit that a broad, unbelieving grin spread over our countenances when the author dared make this assertion. BUT—the smile soon left our faces . . . [T]o our chagrin, Mr. Daniels had really propounded so many brand new ideas about time and time-travel, and such logical ones—*that he has not left one loophole in his argument*!"

John W. Campbell (1910–1971), the first (and only) editor of *Astounding Science Fiction* (today's *Analog*), called alternate time track stories "mutant" because they represented the first new innovation (or mutation) in the time travel concept since H. G. Wells. Campbell incorrectly claimed *The Legion of Time* (note 133) was the first such tale (see Campbell's editorial in the May 1938 issue of *Astounding*) , and that "Other Tracks" (note 135) was the second, but in fact it was Daniels who was first with splitting time tracks in science fiction. After Daniels the concept quickly became part of standard science fiction lore and could be used by other writers with little explanation. For example, just a little more than a decade later one author did not have to say much about his "First Law of Chronistics," which determines the development of "the branches of Fan-Shaped time." It was sufficient for his readers to learn that should a time traveler to the past change anything, a parallel branch of time would be created on which the time traveler would be trapped: "The man who interfered with the space-time matrix, displacing even a comma in the great scroll of time, would be cut-off from his origin forever."[152]

Still, if there is one thing we can say about science fiction, it's that no 'rule' is immune to challenge. Decades after Daniels' tale put forth the MWI, we find the well-known author James Blish (note 100 in Chap. 1) *rejecting* it. In a story about the reception of radio signals from the future, we read of one character telling another "I *was* going to do all those things. There were no alternatives, no fanciful 'branches in time,' no decision-points that might be altered to make the future

[150]These sad, resigned words were written when the author, David R. Daniels (1915–1936), was just twenty years old. A year later he committed suicide.

[151]A. Shimony, "Events and Processes in the Quantum World," *Quantum Concepts in Space and Time* (R. Penrose and C. J. Isham, editors), Oxford University Press 1986.

[152]J. MacCreigh, "A Hitch in Time," *Thrilling Wonder Stories*, June 1947.

change. My future, like yours . . . and everybody else's, was fixed. It didn't matter a snap whether or not I had a decent motive for what I was going to do; I was going to do it anyhow. Cause and effect . . . just don't exist. One event follows another because events are just as indestructible in space-time as matter and energy are."[153]

This denial of the MWI is simply an author's choice, of course, for whatever story effect is desired, and others may make different choices. Isaac Asimov, for example, used the MWI idea in in the story of a time traveler who journeys back to 1871 London, to retrieve a lost Gilbert and Sullivan operetta (*Thespis*). When he returns to the present he finds that his wife Mary (who was alive when he left) has been dead for a year on the new time track that his actions in the past have created. As the story ends, the devastated time traveler thinks "I had changed history. I could never go back. I had gained *Thespis*. I had lost Mary."[154] This sad fate is repeated in another story of a time traveler lost in an infinitude of time tracks with no hope of ever finding his way home: "In all of time, how many, many worlds there must be. How to find a single twig in such a forest?"[155]

Splitting universes have been used in literary works outside the genre of science fiction, as well. Examples include "The Garden of Forking Paths" by the Argentine writer J. L. Borges, the first play J. B. Priestly wrote (the 1932 *Dangerous Corner*), John Updike's 1997 novel *Toward the End of Time*, and Gore Vidal's 1998 novel *The Smithsonian Institution*. Typical of these fictional fantasies about splitting universes is a tale (anticipating Asimov's) by Lord Dunsany (1876–1957)—the Irish writer Edward Plunkett—the story of a man who goes back in time to correct "two or three mistakes he had made in his life."[156] This he successfully does, but the result is a new, subtly different subsequent history. The differences are not infinitely subtle, however; after the changes, he finds that his home, his wife, and all the delicate details of his life have vanished. As he relates to a visitor at the lunatic asylum he is now confined to, as the result of his despair, "I tell you I'm lost. Can't you realize that I'm lost in time? I tell you that you can find your way traveling the length of Orion, sooner than you shall find it among the years . . . Don't go back down the years trying to alter anything . . . Don't even wish to . . . [T]he whole length of the Milky Way is more easily traveled than time, amongst whose terrible ages I am lost."

In writing for a mass audience, rather than just for the more limited science fiction and fantasy one, perhaps the best known literary work of alternate history is the classic 1953 novel *Bring the Jubilee* by Ward Moore (1903–1978). In that work Lee wins the Battle of Gettysburg, and the South wins the Civil War. Using a time machine, a historian travels from 1952 (of the world in which the South wins) into the past of 1863 to study the battle, where he inadvertently disrupts events to the point that the North wins; that is, reality splits and the newly created fork represents

[153] J. Blish, "Beep," *Galaxy Science Fiction*, February 1954.

[154] I. Asimov, "Fair Exchange?" *Asimov's Science Fiction Adventure Magazine*, Fall 1978.

[155] M. F. Flynn, "The Forest of Time," *Analog Science Fiction*, June 1987.

[156] Lord Dunsany, "Lost," *The Fourth Book of Jorkens*, Arkham House 1948.

the time track of *our* world. The historian is trapped on this new fork, cut off forever from his original time track. The entire novel is in the form of a discovered manuscript, written in 1873 and found in 1953, and the pathos of the ultimate isolation endows the novel with great emotional impact.

A 1992 novel on the same theme, Harry Turtledove's *The Guns of the South*, begins with a fascinating premise but then misses the crucial distinction between a single versus multiple time tracks. In that work racists from the future (2014) arrive by time machine at Lee's 1864 winter camp. They bring with them AK-47 automatic assault rifles and offer to supply Lee's army with all it can use. Lee accepts and the South wins the Civil War. The future, of course, changes—or does it? The time travelers have brought back books from the future showing that the South lost the war, so the implication is that history must have forked. So far, so good. But all through the novel, the time travelers move back and forth between the nineteenth and the twenty-first centuries, apparently finding their own time unchanged. And if that is so, then the whole point of the story vanishes. Why all the effort to change history when it is clear that nothing has changed? The novel is entertaining reading (Turtledove is a trained historian), but I believe Moore's novel to be the superior work of science fiction.

I'll end this discussion on splitting universes with a startling theological issue raised by a philosopher.[157] Arguing that God cannot branch into multiple time tracks because God is unique, the conclusion seems inescapable that God therefore exists on exactly one of how ever many different time tracks there may be. What if that chosen time track isn't ours? Then, concludes the philosopher, Nietzsche's nineteenth-century metaphorical claim that "God is dead" (for us) might literally be true! He admits that this is "fanciful," but still . . . .

4.7 For Further Discussion

In an afterword to his story "Dead City" (*Thrilling Wonder Stories*, Summer 1946), Murray Leinster muses "You've heard the old argument that a man can't travel backward in time because he might kill his grandfather. I've wondered why nobody has argued that a man can't travel forward in time because he might be killed by his grandson." One possible answer to Leinster is that *if*, at the moment the forward-bound time traveler departs, he has not yet sired a child, *then* there simply wouldn't be a murderous grandson waiting for him in the future. Perhaps, however, Leinster had this somewhat more

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[157]Q. Smith, "A New Topology of Temporal and Atemporal Permanence," *Nous*, June 1989, pp. 307–330.

complicated scenario in mind: After the time traveler arrives in the future he is attacked by a mysterious stranger but survives, and later returns to the present. He then sires a child who will be the parent of that mysterious stranger. (As far as I know, this plot line has not appeared in a science fiction story.) Contrary to Leinster's view, explain why the *possibility* of being killed by a grandson is not a reason for forbidding the possibility of a trip in time (in either direction).

In his causal loop paper (note 105) the University of Delaware philosopher Richard Hanley correctly writes (on p. 146) "physicists have tried to avoid free will problems by ignoring causal loops involving intentional agency," and partly illustrates this claim with the autoinfanticide paradox, writing of the attempt of a time traveler to kill his younger self as inevitably failing because "the past is apparently brought about willy-nilly." (Hanley unfortunately then uses the story "Thompson's Time Traveling Theory" as an example of this—see note 77, and the end of the "Introduction"—when it is that time traveler's *grandfather* who is the intended target.) Discuss the merits of Hanley's claim, keeping in mind the end of Sect. 4.3 (in particular, note 81). If you are interested in genetics and astronomy as well as in time travel, then for extra credit comment on Hanley's claim (p. 137) that "one can extract information about my DNA from . . . my astrological chart."

The fictional killing of Hitler was imagined in print even before World War II, in Geoffrey Household's intense 1939 novel *Rogue Male* (made into the 1941 film *Man Hunt*). And so it's not surprising that one of the popular change-the-past themes in science fiction is that of a time traveler killing the Führer. (This idea, somewhat oddly, appeared in the debates leading up to the 2016 American Presidential election, when one of the candidates, to show the toughness of his character—even though he opposed abortion—declared "Hell, yes, I'd kill baby Hitler! You gotta step up, man." This candidate did elaborate a bit, stating there might be some risk involved with tampering with the past.) Stories in this sub-genre include E. Norden's "The Primal Solution" (*Magazine of Fantasy & Science Fiction*, July 1977), W. R. Thompson's "The Plot to Save Hitler" (*Analog*, September 1993), L. del Rey's "My Name Is Legion" (*Astounding Science Fiction*, June 1942), and R. M. Farley's "I

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Killed Hitler" (*Weird Tales*, July 1941). Read some of these tales and compare the various repercussions envisioned by the authors following an assassination of Hitler by a time traveler.

After our discussion of Heinlein's time travel masterpiece "All You Zombies—," you might think it impossible to write a new story that exceeds it in complexity. That might well be true, but a modern masterpiece by Ted Chiang certainly gives it a good run for the money. "The Merchant and the Alchemist's Gate" (*Magazine of Fantasy & Science Fiction*, September 2007) uses a 'wormhole' that connects the present to the future 20 years hence, and it is stuffed with intertwined causal loops and information bootstraps. Read it and keep track of all such occurrences. How many did you find? The last line of the story clearly expresses the view that the past cannot be changed: "Nothing erases the past. There is repentance, there is atonement, and there is forgiveness. That is all, but that is enough." Is the story always faithful to this view of time travel?

In his paper (note 126) on the coincidences of time travel, the University of Queensland philosopher Phil Dowe writes "It's true that remote time travel [into the very distant past] does not allow for causal loops . . ." *Is* this true? Consider, as you think about this, the story "Time's Arrow" (*Science-Fantasy*, Summer 1950) by Arthur C. Clarke. In that tale geologists have just discovered, in a remote desert, the fossilized tracks of a monstrous creature, from fifty million years ago, tracks that indicate that the beast was in hot pursuit of fleeing prey. Before the geologists can unearth the entire set of tracks, to see if the pursuit was successfully completed, they are visited by a physicist who just happens to be conducting near-by experiments in time travel. (This proximity is explained by noting what better place to conduct time travel experiments, powered by atomic energy, than in a remote desert?) At one point during the visit, after being told of the ancient pursuit frozen in rock, the physicist muses "It would save you a lot of trouble, wouldn't it, if you could actually *see* what took place in the past, without having to infer it by these laborious and uncertain [geological] methods." This comment results in the Chief geologist paying a visit to the physicist's lab. After driving over in a car equipped with tires having "an odd zigzag pattern" in the tread,

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an accident suddenly sends the entire lab into the past. Soon after, the other geologists unearth the rest of the fossilized tracks, and learn what the creature's prey had been when they see a zigzag pattern in the rocks, tracks that show "the great reptile was about to make the final leap upon its desperately fleeing prey." Can you see how to modify this story so as to have a causal loop involving the very distant past? (For perhaps even more inspiration on thinking about causal loops, watch the 1980 movie *The Final Countdown*. In it the designer of a modern naval warship that temporarily travels back through time to the Pearl Harbor of December 6, 1941, turns out to be a crew member who was accidently left behind in the past. In the past he *will be* able to design the ship because he already knows how it *was* designed—by himself!)

Comment, at length, on the cartoon shown in Fig. 4.5. (Does it make logical sense?)

In the story "Salvation" by Jerry Oltion (*Analog*, December 2007) a physicist approaches the Universal Church of the Divine Revelation for money to build a time machine. He is blunt in making his case: "You could go back in time and meet Jesus. Assuming he existed." That statement causes (it should come as no surprise) not just a bit of pandemonium but, nonetheless, an influential Church leader decides to provide the funding. Why? Because later, while sitting in his office as he talks with the physicist, a sheet of paper suddenly appears in the air above the leader's desk and then flutters down to land on the telephone. Picking the paper up, the leader sees it is a sheet of his own letterhead, with writing in his own angular, precise handwriting, saying "It works. Give him the money. You almost named the dog Solomon." This convinces the leader because, as we are told, "Paper appearing out of nowhere was a good trick, but it might easily be just that: a trick. Duplicating his letterhead and his handwriting wouldn't be all that difficult either. [On the other hand] knowing the name [the leader] had considered but rejected for his German Shepard 15 years ago was a different level of feat entirely." The physicist seems to be startled by the appearance of the paper, too, and asks "May I see that?" His reaction convinces the leader it wasn't a staged event: "Well, I'll be damned," the physicist replies. Once the time machine is under construction, the two men realize they have to send the enigmatic message back in time to complete the loop. As they prepare to do so, the leader asks a curious question. After retrieving the mysterious sheet of paper from his desk,

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he says to the physicist "Should I send the original [the one he is holding in his hand], or should I write another?" The physicist replies with "Write a new one. If we send the original, we put it in a closed loop and [we'll] never get it back. We don't want to lose the first object to travel in time. We'll want that for the Smithsonian someday." Does this make sense? Also, comment on whether or not the dog's name is a bootstrap paradox.

A perplexing little time travel paradox, one that I don't think science fiction has yet treated (and I'm pretty sure physicists haven't had anything to say about it either), was cooked-up by the English philosopher Robin Le Poidevin in his 2003 book *Travels in Four Dimensions: the enigmas of Space and Time* (Oxford, pp. 180–181). There he writes "Peter and Jane, both 20 years old, are out for a walk one day in 1999 when suddenly a time machine appears in front of them. Out steps a strangely familiar character who tells Jane that he has an important mission for her. She must step into the machine and travel to the year 2019, talking with her a diary the stranger hands to her. In that diary she must make a record of her trip. Obligingly, she does as she is asked and, on arrival, meets Peter, now aged 40. She tells Peter to travel back to 1999, taking with him the diary she now hands him, and recording his trip in it. On arrival in 1999, he meets two 20-year-olds called Peter and Jane, out for a walk, and he tells Jane that he has an important mission for her." Le Poidevin then writes that "the really tricky question is: how many entries are there in the diary when Jane first steps into the machine? We imagine it blank. But this is the very same diary as the one Jane hands to the 40-year-old Peter, which then contains her entry. And by the time Peter arrives back in 1999, it will contain his entry, too. But then, if the diary already contained two entries when Jane was handed the diary, then it would contain three entries when she handed it to Peter, who would then add another one, so the diary would have contained four entries when it was first handed to Jane, and so on. If the problem is not immediately apparent, this is because we imagine an indefinite number of trips, but in fact there are just two: Jane's trip to 2019 and Peter's trip to 1999. So there ought to be a consistent answer to the question, how many entries are there in the diary? Yet, as we have seen, there does not appear to be a consistent answer." Another philosopher soon claimed he *did* have the answer: namely, 2. Read his paper (Erik Carlson, "A New Time Travel Paradox Resolved," *Philosophia*, December 2005, pp. 263–273), and either explain why you agree with Carlson's reasoning or enthusiastically rebut it.

As in "The Time Eliminator" (Fig. 4.1), other stories have imagined gadgets that simply view the past, rather than visit it as would a time machine. This is done in an attempt to avoid paradoxes—but does it? Two stories that illustrate how just viewing the past risks affecting the past as much as time travel would, are Horace Gold's "The Biography Project" (*Galaxy Science Fiction*, September 1951) and Donald Franson's "One Time in Alexandria" (*Analog*, June 1980). In the first tale the Biotime Camera, operated by the Biofilm Institute, allows teams of biographers to film (alas, no sound!) and study the lives of past notable personages. Of particular interest are the lives of those who developed neurotic psychoses, such as Isaac Newton. And, indeed, the Biotime Camera does capture Newton's image as he begins to display increasingly disturbed behavior. We see Newton, for example, as he begins to peer into dark corners, looking for those who have come to spy on him. On his death bed, the biography team assigned to him reads his lips and discovers that his final words are "My guardian angel. You watched over me all my life. I am content to meet you now." It is then that the Biofilm Institute realizes what it has done. Newton *was* in fact being spied upon—by the Biotime Camera, which has not changed the past but has certainly affected it. In the second tale an archeologist uses a time viewer to read the lost manuscripts in the ancient library at Alexandria before it was completely destroyed in an inferno. The viewer uses an infrared beam—and it is the heat from that beam from the future that proves to be the origin of the fire in the past. Again, the past has been affected, but not changed, by time viewing. Is it true to claim, however, that such viewing gadgets could not be the source of other paradoxes, such as causal loops or information bootstraps? If you think that isn't a valid claim, give a counter-example.

In a story by Francis Flagg and Weaver Wright (a pseudonym used by Forrest J. Ackerman), "Time Twister" (*Thrilling Wonder Stories*, October 1947), we read the following exchange between the inventor of a time machine and his none-too-bright helper:
"You mean to say," he questioned incredulously, "that I could go back a hundred years?"
"If you had the proper machine in which to travel, yes."
"But that'd take me back to before I was born."
The Professor smiled tolerantly.
"Look at this diagram, Hank. This line is the time continuum. It incorporates space, too. [The authors didn't actually print a diagram with the story, but

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surely the Professor is using a Minkowski spacetime diagram]. This dot is you. It doesn't matter when you were born, or when you will die. You exist right now, that's the fact. Traveling into the past or future wouldn't make you grow any younger or older. Such a thought is naïve. Let me demonstrate the mechanics of it for you. If . . . we calculate with non-Euclidean mathematics . . ."
"It don't sound reasonable," the farmhand objected. "If I went back—"
"I know," interjected the Professor, "if you went back you might meet your own father as a young man and you'd be older than he, or maybe he and your mother would be kids going to school."
"Haw, haw! That'd be funny, that would."
What famous movie, made nearly 40 years later, does the end of the conversation remind you of? Hint: "flux capacitor."

As mentioned in the text, a famous science fiction example of *affecting* (but not changing) the past is "Behold the Man" by Michael Moorcock, the tale of a time traveler who arrives in ancient times during the very years of the ministry of Jesus as reported in the Bible. When he finds there is actually no such person, the time traveler takes the role himself and lives out the events as reported in the Gospels, including the Crucifixion. This is a powerful story, but it had already been done more than 15 years earlier, by Philip K. Dick, in his short story "The Skull" (*If*, September 1952). In his tale, Dick tells of a man from the twenty-second century who is sent by government authority back to the mid-twentieth century to kill the Founder of a religious movement, a movement that 'now,' 200 years later, threatens those same government authorities. History records that the Founder gave a powerful speech just before being arrested and executed, a speech that started the religious movement, and so the time traveling assassin is told to kill the Founder *before* he can give that speech. (The parallel between Jesus and the Founder should be obvious.) Read these two stories and compare and contrast how Moorcock and Dick handled time travel paradoxes. Comment, in particular, on the relationship between the assassin and the Founder. Moorcock's tale should be easy to find, and Dick's is available as a free pdf download (it is in the anthology *The Best of Philip K. Dick*, Halcyon Classics 2010, as well).

A subtle change-the-past sequence appears in the original *Back to the Future* film that is easy to miss. When the hero, Marty McFly, returns to 1955 in the time car, he leaves from the parking lot of the Twin Pines Mall, so named because of the two pine trees that stand nearby. Arriving in the past with literally a bang, the time car inadvertently destroys one of the (then) young pines. Near the end of the movie, when Marty returns to the future (1985), he finds that the mall is now called the Lone Pine Mall. This is charming and fun, indeed clever, but modern scholars of time travel reject it, and other claims of changing the past, as not being logical. (Shakespeare understood this point, when he has Lady Macbeth declare, concerning the murder of Banquo, "What's done cannot be undone: to bed, to bed, to bed.") What Marty's trip *would* explain is why the mall would *always* have had the name of the Lone Pine Mall. Watch the movie and see how many other 'change-the-past' episodes you can find.

Chapter 5
Communication with the Past

"[As for travel to or for signaling the past] you'd have to exceed light speed which immediately entails the use of more than an infinite number of horsepowers."[1]

5.1 Reversed Time

"I have not discovered Mr. Wells' Time Machine."[2]

One way to communicate with the past is to 'simply' live backwards in time. Philosophers and other writers of speculative fiction were the first to wonder what things might be like in a world where the time asymmetry is reversed—that is, in a world where time 'runs backward.' Indeed, fascination with the idea of time reversal actually dates back thousands of years, long before science fiction, as it can be found in Plato's dialogue *Statesman*, written (most probably) 15 years before Plato's death in 347 B.C.

At one point, Plato offers an extended description of the world suddenly running backward in time in the ancient past. After one character is told that at that remote time "all mortal beings halted on their way to assuming the looks of old age, and each one began to grow backward," he asks "But how did living creatures come into being, Sir? How did they produce their offspring?" The answer is shocking: "Clearly ... it was not of the order of nature in that era to beget children by intercourse ... It is only to be expected that along with the reversal of the old men's course of life and their return to childhood, a new race of men should arise, too—a new race formed from men dead and long laid in Earth ... Such resurrection

[1]An observation by Haskel van Manderpootz, professor of the "newer physics," in S. G. Weinbaum's "The Worlds of If," *Wonder Stories*, August 1935. Compared to the 'modest' Van Manderpootz, all other physicists in the world are a mere "pack of jackels, eating the crumbs of ideas that drop from [his] feast of thoughts."

[2]W. R. Inge (1860–1954), in his November 1920 Presidential Address to the Aristotelian Society at the University of London Club, in a sympathetic treatment of the possibility of a time-reversed world.

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P.J. Nahin, *Time Machine Tales*, Science and Fiction,
DOI 10.1007/978-3-319-48864-6_5

of the dead was in keeping with the cosmic change, all creation being now turned in the reverse direction."

The reversed-time world is an important philosophical concept. Before the turn of the century, for example, Francis Bradley (one of the early proponents of the block universe, you will recall from Chap. 2), thought about reversed-time worlds and concluded that they would be quite odd: "Let us suppose . . . that there are beings whose lives run opposite to our own . . . *If* in any way *I* could experience *their* world, I should fail to understand it. Death would come before birth, the blow would follow the wound, and all must seem to be irrational."[3] A half-century later the South African philosopher J. N. Findlay (1903–1987) took Bradley's position of supporting a skeptical attitude towards the possibility of time-reversed worlds. Writing in a book review, Findlay declared "The reversed world in question wouldn't merely strike us as queer, but definitely crazy: it would be a world where what is wildly and intrinsically *improbable* was always occurring. It would, in fact, be much more startling than the original asymmetry that led us to think of it."[4] (Findlay was almost certainly thinking of things like a tea cup, shattered due to a fall, spontaneously reassembling itself.)

The question of backward-running time so fascinated Findlay that, some years later, he posed it as a problem for the readership of a scholarly journal (*Analysis*). This led to a number of responses, and subsequently he presented both his own negative view of time-reversed worlds and that of the best reader response he had received to his posed problem (which came from McGechie).[5] While Findlay showed admirable open-mindedness by awarding the title of *best* to an argument that refuted his own position, he remained unconvinced about the concept of reversed-time worlds, stating that "I continue to feel that a total reversal of my experiences is a terrifying possibility."

The terror aspect of living backward in time had been nicely captured in a science fiction story years before Findlay wrote. A scientist who is involved in an accident with radioactive materials has his sense of time flow reversed, and the story carefully and logically analyzes what his life would be like in such a situation. For example, the scientist can talk (backwards for others, of course), so he is understandable only if his words are recorded and then played in reverse. He cannot eat, because for him that would involve the regurgitation of food. He cannot answer questions because "if he should answer any questions put to him, it would mean he was giving the answer before he heard the question, on his time scale." And finally, he can't pick anything up because the normally stable position and velocity error-correction mechanism between eye, hand, and brain, which is a negative feedback system in normal time, has become an unstable positive feedback system in reversed time. The horror of his existence is contained in the only words the man

[3]F. H. Bradley, *Appearance and Reality* (2nd edition), Oxford University Press 1897, p. 190.

[4]J. N. Findlay, *Philosophy* (25) 1950, pp. 346–347.

[5]J. N. Findlay and J. E. McGechie, "Does It Make Sense to Suppose That All Events, Including Personal Experiences, Could Occur in Reverse?" *Analysis*, June 1956, pp. 121–123.

utters (deciphered after reversed playback): "Where am I? What's happened? Why are things so different? Why? Why?"[6]

Despite Findlay's "terror," however, the prevailing view today is that to the inhabitants of a time-reversed (or what is sometimes called a *counterclock*) world, *nothing would look odd*! This is a fairly new idea,[7] and not so long ago the philosophical literature displayed a misunderstanding of how a time-reversed world would appear to its occupants.[8] More recent analyses than Smart's (note 7) advocating the 'normality' of a time-reversed world are more compelling.[9] One concern about a time reversed world however is not easily dismissed: matter with a time reversed time sense is thought by many to be antimatter in our world, and any interactions between the two worlds would be spectacular, indeed![10]

But let's ignore that possible difficulty. The philosopher J. R. Lucas argued that even if beings from two such time-reversed worlds could meet, they still could not communicate: "If two beings are to regard each other as communicators, they must both have the same direction of time. It is a logical as well as a causal prerequisite."[11] Now, this matter is well worth some effort to understand, because it is intimately tied to time travel. At first blush, Lucas' words seem almost self-evident, and after a little thought they might seem to be absolutely irrefutable. The philosopher Murray MacBeath, however, took exception.

MacBeath opened his analysis[12] with a story to demonstrate that the persuasive power of Lucas' position is only superficial. In that story of Jim and Midge, Jim is one of us, whereas Midge is a 'Faustian time'[13] being. In his analyses MacBeath uses capitalized words and symbols for the time-reversed Midge, and lower case for Jim, as shown in Fig. 5.1. As MacBeath explains, "While Jim and Midge are together a face-to-face conversation is hardly likely to get off the ground. To make this clear let us say that they are together from t_0 until t_{10} on Jim's time-scale, and from T_0 until T_{10} on Midge's TIME-scale; t_0 is then the same temporal instant as T_{10} and, in general, $t_n = T_{10-n}$. If Jim at [his time] t_2 asks Midge a

[6]M. C. Pease," *Astounding Science Fiction*, "Reversion," December 1949. See also R. A. Banks, "This Side Up," *Galaxy Science Fiction*, July 1954, for a tale about the confusion caused by projecting a film the wrong way in time.

[7]The modern view that a time-reversed world would appear normal to someone living in it can be traced back at least as far as to J. J. C. Smart, "The Temporal Asymmetry of the World," *Analysis*, March 1954, pp. 79–83, an analysis, alas, that may not convince everyone.

[8]M. Dummett, "Bringing About the Past," *Philosophical Review*, July 1964, pp. 338–359.

[9]See, for example, D. L. Schumacher, "The Direction of Time and the Equivalence of 'Expanding' and 'Contracting' World-Models," *Proceedings of the Cambridge Philosophical Society* 1964, pp. 575–579; J. V. Narlikar, "The Direction of Time," *British Journal for the Philosophy of Science*, February 1965, pp. 281–285; F. R. Stannard, "Symmetry of the Time Axis," *Nature*, August 13, 1966, pp. 693–695.

[10]This issue is raised, several times, in Robert Silverberg's 1968 novel *The Masks of Time*.

[11]J. R. Lucas, *A Treatise on Time and Space*, Methuen 1973, pp. 43–47.

[12]M. MacBeath, "Communication and Time Reversal," *Synthese*, July 1983, pp. 27–46.

[13]In Goethe's play *Faust*, the normal flow of time is routinely upset.

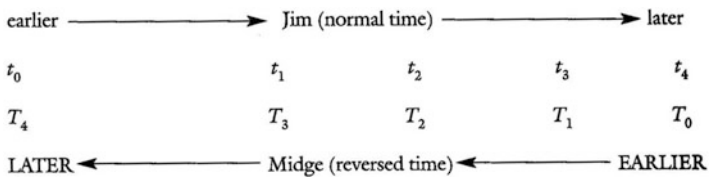

Fig. 5.1 Opposite time flows in counterclock worlds

question, and Midge hears the question at T_8, she will answer at T_9, and Jim will hear his question answered at t_1, *before* he asked it! What is more, if Jim is inexpert at interpreting backward sounds, and at t_4 asks Midge to repeat her answer, Midge will hear that request at T_6, BEFORE she has heard the original question; and her puzzled reply at T_7 will be heard by Jim at t_3 before he has uttered the request." Certainly this is a mess in time, and Lucas seems to be on safe ground with his denial of the possibility of communication between Jim and Midge. MacBeath, however, shows how to refute all of Lucas' arguments if Jim and Midge are allowed to be clever about how they send their messages back and forth—that is, if we give up some of our usual ideas of what a conversation is like. MacBeath's analyses are far too lengthy and detailed to present here, but the simplified diagram of Fig. 5.1 should enable one to follow the logic of his approach.

We imagine that Jim and Midge will not actually talk, and so will not have to decipher backward-spoken language. Rather, they will exchange messages via computer-generated text displayed on monitor screens, screens that are separated by a window that is proof against all penetration but the light emitted by those screens.[14] The nature of this window is not a trivial matter: if we accept the anti-matter nature of Midge's world then it is *essential* to keep her and Jim apart! To that end, MacBeath imagined that the window is double paned, with a perfect vacuum in-between. The exchange of photons between the two worlds should present no problems because photons are their own anti-particles.[15]

Now, imagine that at t_0 Jim brings a computer to the window. He programs it to wait for 4 days, until t_4, and then to display the following message on its screen: "This message is from Jim, who experiences time in the sense opposite to yours. Please study the following questions and display your answers on a computer screen three days from now." Jim's messages ends with the list of questions.

Because all that took place at t_4, Midge sees Jim's message and questions at what we will now call T_0. As requested, she brings her computer to the window, enters the answers to Jim's questions, and programs the machine to display them (after a

[14]Communication between beings in counterclock worlds, using written messages displayed through a window, appeared in science fiction *years* before MacBeath wrote: see I. Watson's 1978 novelette "The Very Slow Time Machine."

[15]There is no difference in the time sense of photons in either world because the flow of proper time for a photon—traveling at the speed of light, by definition—is zero (recall the discussion in Sect. 3.6).

3 day delay) on its screen. Thus, at T_3, which is Jim's t_1, Jim sees Midge's computer screen light up with "Hi, Jim. This is Midge. The answers to your questions are at the end of this message. Now, I've got some questions for *you*. Please display the answers two days from now." Midge's message ends with answers to Jim's questions and her list of questions.

Jim sees Midge's message at t_1, enters the answers to her questions and sets the machine to answer after a 2-day delay. At t_3, which is Midge's T_1—and by now you see how the process goes. It's cumbersome, sure, but it works. Or at least it does if everybody follows the rules. What if they don't? MacBeath provides other, increasingly complicated analyses to treat some of the more subtle problems that can be imagined in this method of exchanging messages. I will mention just two of them, which have direct analogs with what we normally think of as 'time travel.'

For the first problem, consider Jim's initial message, created at t_0 to be sent at t_4. He receives Midge's answer as described above at t_1, *before* his message is displayed through the window. So, what happens if at t_2 Jim cancels the message and it is *not* displayed? He has already gotten Midge's reply, but how can that happen if he does not send his message? This is, of course, a bilking paradox, with an explanation that we discussed in the previous chapter.

A second problem is the apparent possibility of creating a causal message loop. For example, let's say that at t_0 Jim suddenly decides to send a message through the window. (His reason for this sudden urge will be explained in the next few lines.) He thinks all night about what to send and, at t_1, finally settles on the following: "Greetings to the people on the other side of the window. This message comes from Jim, who hopes you will reply." Midge immediately sees Jim's message through the window (at her time T_3) and so is suddenly caught up with the desire to respond. She thinks all night about what to send and, hoping to be witty, she finally decides (at time T_4) on the following echo to Jim's message. "Greetings to the people on the other side of the window. This message comes from Midge, who hopes you will reply." Jim immediately sees this through the window (at what is his time t_0) and so now we know why he decides to send his original message! And Jim *will* send his original message—he has to because Midge replied to it.

In a review of a book on the direction of time, the philosopher Hilary Putnam restated the problems of a time-reversed world in the form of a provocative question: "How do you know that one man's future isn't another man's past?"[16] He began by making the interesting observation that for us to be able just to observe a backward-running universe, we would have to provide our own normal radiation source, because the counterclock stars in such a universe *absorb* radiation rather than emitting it. This point was elaborated on by another philosopher some years later, who wrote "We have uncritically imagined someone looking in on . . . two worlds having opposite time directions . . . Part of the story we tell, of the process of seeing, involves the emission of photons from objects [for example, the computer screens of Jim and Midge] and the subsequent impinging of these photons on our

[16]H. Putnam, *The Journal of Philosophy*, April 1962, pp. 213–216.

retinas. But this process is obviously directed in time. In a world where time ran opposite to ours, we could not see objects at all: objects would be photon-sinks, not photon-emitters."[17]

Putnam concluded his comments about reversed time with a cautious warning: "It is difficult to talk about such extremely weird situations without deviating from ordinary idiomatic usage of English. But this difficulty should not be mistaken for a proof that these situations could not arise." That challenge is no doubt why so many writers of science fiction and fantasy have tackled the question of what it would be like if time ran backward. We can find such a tale long before the science fiction pulps, in fact, in a tale that appeared when Einstein was just 7 years old. In that story[18] the narrator (a professor of astronomy and higher mathematics) suddenly finds himself on Mars. There he encounters beings who know the future up to their deaths, and whose memories of the past are "scarcely more than a rudimentary faculty." The entire tale is in the form of a conversation between the professor and one such being, who argues (quite persuasively) for the virtues of his 'backward' existence compared to that of earthlings (the Martian name for Earth is the story's title). Bellamy realized that his story implies a fatalistic block universe: "No one could have foresight . . . without realizing that the future is as incapable of being changed as the past," he wrote.

Other writers, too, were fascinated by the implications of reverse time. When Merlyn the magician makes his first appearance in T. H. White's 1939 masterpiece *The Once and Future King*, for example, he explains how he knows the futures of others: "Ordinary people are born forward in Time, if you understand what I mean, and nearly everything in the world goes forward, too . . . But I unfortunately was born at the wrong end of time, and I have to live backwards from its front, while surrounded by a lot of people living forwards from behind. Some people call it having second sight."

What may have put the idea in White's mind for his time-reversed magician is only speculation today, but perhaps it was something he might have read a decade before, in a fellow Englishman's writing, the 1929 book *The Nature of the Physical World* by Sir Arthur Eddington, where one finds the following passage: "In "The Plattner Story" H. G. Wells relates how a man strayed into the fourth dimension and returned with left and right interchanged . . . In itself the change is so trivial that even Mr. Wells cannot weave a romance out of it [but see one of the *For Further Discussion* questions at the end of Chap. 2]. But if the man had come back with past and future interchanged, then indeed the situation would have been lively."

Whether or not those words influenced English fantasy, they certainly had some effect on American science fiction. In his 1979 memoir *The Way the Future Was*, pulp editor Frederik Pohl wrote that Eddington's book (which Pohl incorrectly attributed to Sir James Jeans) had given him the idea for a story using the reversed-time twist. But before Pohl could publish it, an even better (claimed Pohl) tale

[17]N. Swartz, "Is There an Ozma-Problem for Time?" *Analysis*, January 1972, pp. 77–82.

[18]E. Bellamy, "The Blindman's World," *The Atlantic Monthly*, November 1886.

arrived from Malcolm Jameson. Jameson, too, had read Eddington's book, and the result was the novella-length "Quicksands of Youthwardness," which Pohl published in *Astonishing Stories* as three-part serial during 1940–1941. Unfortunately, Jameson's tale is both pretty awful *and* devoid of *any* connection with Eddington's suggestion. One can only wonder about what might have been in the story Pohl says *he* discarded—did *it* have the future remembered? Alas, Pohl wrote that he couldn't remember!

Remembering the future does occur in one tale where everybody knows what will happen (as they live backward) by reading "prediction books." What distinguishes that story from many others on the same theme is an interesting, ironic conversation a student in a reverse-time world has with a philosophy professor about how things would be if time went the 'other way,' as in *our* world:

> "How can we tell? The reverse sequence of causation may be just as valid as the one we are experiencing. Cause and effect are arbitrary, after all."
>
> "But it sounds pretty far-fetched."
>
> "It's hard for us to imagine, just because we're not used to it. It's only a matter of viewpoint. Water would run downhill and so on. Energy would flow the other way—from total concentration to total dispersion. Why not?"[19]

The student is unconvinced, however, and when he tries to visualize such a peculiar world (*our* world, don't forget!) it gives him a "half-pleasant shudder." Imagine, he thinks in wonder, never knowing the date of your own death.

A few years later, in Wilson Tucker's 1955 novel *Time Bomb*, we find the intriguing idea of political assassination by time bomb, with the bombs actually *time traveling* to their targets. A policeman begins to suspect what is happening when it becomes evident that one of the explosions was actually an implosion: "The time bomb . . . had been going in and had carried the force of the blast with it. Inward. Into the past. He frowned at that. A backward explosion? An explosion which ran counter to the normal flow of time, to the normal method of living? . . . How would an explosion appear to a man if the blast happened in the opposite manner? If it began exploding now, in this moment, but continued backward instead of forward? Would it be an implosion?"

There is little doubt that the definitive treatment of a reversed-time world is that of Philip K. Dick's 1967 novel *Counter-Clock World*. Dick's world was once our world, but then, as in Plato's tale that began this chapter, time suddenly begins to run backward. People still alive reverse their direction of aging (but still think, walk, and talk in forward time), and dead, buried people come alive again and emerge from graveyards as the "Sacrament of Miraculous Rebirth" is intoned by a priest; all live their way back to the womb, just as in Plato's tale of 1600 years earlier. Such imagery is powerful stuff, but the physicist John Wheeler (of black hole fame) would have none of it. As he wrote, "Most of us would probably agree

[19] D. Knight, "This Way to the Regress," *Galaxy Science Fiction*, August 1956.

that the universe has not contained and will not contain any backward-looking observers. We do not expect to see caskets with corpses in them coming to life, nor do we expect to find bank vaults in which a gram of radium will integrate rather than disintegrate."[20]

5.2 Multi-dimensional Time

> "If there are extra time dimensions we get violations of causality, because one could sneak to yesterday through the extra dimensions, and . . . if you had sneaked to yesterday, you would have disappeared from today."[21]

There are those, however, who haven't been quite so sure as Wheeler about the impossibility of a reversed-time world. One physicist, for example, showed how (under certain initial conditions at the Big Bang) there is a possible solution to the gravitational field equations that gives an oscillating universe that temporally runs backward during the contraction phase.[22] And a philosopher has argued that the *direction* of time is local, not global (just as special relativity showed is the *rate* of time) and that the arrow of time can point in opposite directions at different locations.[23] As odd as such ideas may seem, a generalization of reversed-time—*multi-dimensional* time—makes it seem small potatoes. This is the idea that there might be *many* possible directions to the arrow of time, not just two. At first this may seem an absurd idea, something akin to a man jumping onto his horse and riding off in all directions at once. But philosophers (and perhaps just a few physicists[24]) have started to take at least a semi-serious look at the concept; as

[20]Wheeler's comments can be found in the General Discussion at the end of *The Nature of Time* (T. Gold, editor), Cornell University Press 1966.

[21]An intriguing (if somewhat mysterious) thought from F. J. Yndurain, "Disappearance of Matter Due to Causality and Probability Violations in Theories with Extra Timelike Dimensions," *Physics Letters B*, February 28, 1991, pp. 15–16.

[22]H. Schmidt, "Model of an Oscillating Cosmos Which Rejuvenates During Contraction," *Journal of Mathematical Physics*, March 1966, pp. 494–509. An elaboration of Schmidt's ideas is in A. Walstad, "Time's Arrow in an Oscillating Universe," *Foundations of Physics*, October 1980, pp. 743–749.

[23]G. Matthews, "Time's Arrow and the Structure of Spacetime," *Philosophy of Science*, March 1979, pp. 82–97.

[24]More than half-a-century ago one writer asserted that two-dimensional *complex* time was old hat in the theories of spinning particles—see M. Bunge, "On Multi-dimensional Time," *British Journal for the Philosophy of Science*, May 1958, p. 39. For a summary of many of the objections to multi-dimensional time see J. K. Kowalczynski, "Critical Comments on the Discussion About Tachyonic Causal Paradoxes and the Concept of Superluminal Reference Frames," *International Journal of Theoretical Physics*, January 1984, pp. 27–60 (and the reply by E. Recami, September 1987, pp. 913–919).

with so many other of the radical concepts associated with time travel, though, science fiction writers were dealing with multi-dimensional time long before it became a respectable topic in learned philosophical and physics journals.

In one pulp story, for example, we find a professor asking his redundantly named class in speculative metaphysics "Why shouldn't time be a fifth, as well as a fourth, dimension?"[25] In response to a generally skeptical reception to that, the professor goes on to say "I believe in the existence of a two-dimensional time scheme ... Ordinarily, most people think of time as a track they run on from their births to their deaths ... Think of this time track we follow over the *surface of time* as a winding road [it is the imagery of a surface that gives the professor *two* time dimensions] ... Once in a while another road crosses at right angles. Neither its past nor its future has any connection whatsoever with the world we know."[26]

The year before, the same pulp had published another tale[27] that went well beyond a mere two time dimensions. We are told in that story of two countries on an alien planet at war in the distant future. The war is a stalemate until one side begins to fire a gun at its foe from just two miles from its target, in the heart of enemy territory—*from the middle of next week*! The gun's shells are true 'time bombs.' This is not mere 'ordinary' time travel along one time track, however, but a multidimensional effect. Using a photograph of the gun in actual operation to support his astonishing discovery, an agent for the side being shelled reports to his superior that "the gun and its crew are existing along another time axis at right angles to the direction of our 'normal time,' so that from our point of view they are existing perpetually in the same instant."

That explains why the gun crew can (will?) operate without interference in next week's future, as they are in their adversary's time only for the instant that the two time tracks intersect. Indeed, the spy used the same trick to obtain his undetected photograph: "I secured the photograph by orienting myself along still another time axis at right angles to that of the gun, and approached it as an instantaneous, invisible entity." By the story's end both sides are using and counter-using this technique, evading each other "to and fro along an ever increasing complexity of mutually perpendicular time axes." In fact, the final count exceeds 75 time axes, making Heinlein's two-dimensional time look rather skimpy by comparison.

Well, of course, 75 time directions *is* science fiction (I think), and physicists are not so enamored of multidimensional time as are science fiction writers. For example, Eddington wrote that he found the idea of any region of spacetime involving two-dimensional time to "defy imagination."[28] Another physicist showed that the extremal property of timelike geodesics (look back at Fig. 3.15 and its

[25]R. Heinlein, "Elsewhen," *Astounding Science Fiction*, September 1941.

[26]This story has an amusing scene in which one of the professor's students accidently 'jumps time tracks' and so enters a new track with his arrow of time pointing backwards.

[27]N. L. Knight, "Bombardment in Reverse," *Astounding Science Fiction*, February 1940.

[28]A. S. Eddington, *The Mathematical Theory of Relativity* (2nd edition), Cambridge University Press 1924, p. 25.

discussion) would fail for multidimensional time, which he then associated with the stability of matter and a failure of causality.[29] Yet another physicist, however, was just a bit more willing to consider multidimensional time, and suggested that a viable theory of quantum gravity *might* support the idea of multiple time dimensions.[30] Of just *what* more than one time dimension might actually *mean*, however, this same physicist echoed Eddington by writing "Physics in a spacetime of . . . two timelike dimensions would be very weird indeed." Agreeing with this physicist was a philosopher who called the idea that there could be more than one dimension to time a "rather wild possibility" and a "fairy-tale."[31] These are probably fair statements of how most physicists presently think of multidimensional time.

But not all philosophers are of that persuasion, and many are in fact as fascinated by the possibilities of multidimensional time as are science fiction writers. So, *why* this interest in something so different from anything we actually experience? Where does the motivation come from? Of what *use* is multidimensional time? I think the answers to those questions all derive from how multidimensional time offers a theoretical model for giving meaning to the view that the past can be changed (take a look back at note 20 in the Introduction).

In a certain trivial sense, of course, the past is always changing. For each of us the past is the set of all events that have happened, arranged in a before/after temporal order, and this set is continually increasing (and so changing). That is not, however, what most people mean by a changeable past. What *is* meant is that there may be some kind of change in the temporal ordering of events, or that an event that once was (or wasn't) a member of the set of past events no longer is (or is now) a member. Two-dimensional time offers a way to make sense of such possibilities, which one-dimensional time simply cannot do. To see how that works, I'll follow the presentation in a paper that forcefully argues that it does make sense to talk about altering the past.[32]

Meiland was aware that some might find his model *ad hoc*, even "incredibly weird" (in his own words), but he justified his efforts by taking a refreshingly enlightened, non-Humean view of what he thought would be the proper response to meeting purported time travelers: "If strange machines containing people in futuristic garments and speaking strange tongues (or perhaps using ESP instead of speech) were to appear and were to claim to be from the future, we might very well begin to search for a theory of time that allows their claim to be true." In Fig. 5.2 you can see how Meiland tried to do just that.

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[29]J. Dorling, "The Dimensionality of Time," *American Journal of Physics*, April 1970, pp. 539–540.

[30]C. Isham, "Quantum Gravity," in *The New Physics* (P. Davies, editor), Cambridge University Press 1989.

[31]D. Zeilicovici, "Temporal Becoming Minus the Moving-Now," *Nous*, September 1989, pp. 505–524.

[32]J. W. Meiland, "A Two-Dimensional Passage Model of Time for Time Travel," *Philosophical Studies*, November 1974, pp. 153–173. Jack Meiland (1934–1998) was a professor of philosophy at the University of Michigan.

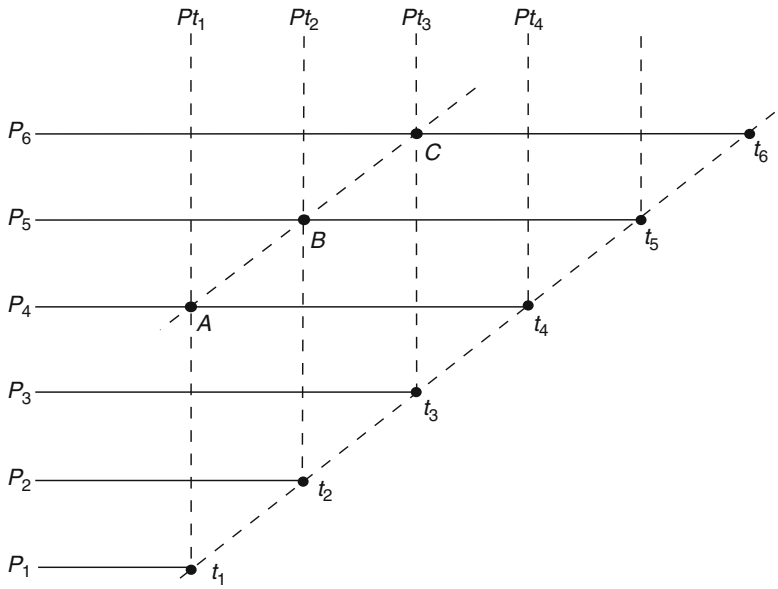

Fig. 5.2 Two-dimensional time

The dashed diagonal line, marked with the points $t_1, t_2, \ldots$ represents our usual one-dimensional image of time. The horizontal lines P_1t_1, $P_2t_2 \ldots$ (which we can simply call $P_1, P_2, \ldots$, for short) are the pasts for the present instants $t_1, t_2, \ldots$. That is, P_1 is the past with respect to the present t_1, P_2 is the past with respect to the present t_2, and so on. The dashed vertical lines allow us to locate any moment in the past. For example, the intersection point A of P_4 with Pt_1 is the location of t_1 in the past with respect to the present t_4.

With this model, Meiland then analyzed in detail several interesting special cases. Suppose that t_1 and t_2 are 1 year apart and that there is a similar time separation between all adjacent, marked present moments on the diagonal. Let us further suppose that a time traveler at t_4 journeys backward 3 years to t_1, to arrive at point A. Assume he stays in the past 2 years; then his temporal locations lie along the dashed diagonal line ABC; that is, at B he is 3 years in the past of t_5, and at C he is 3 years in the past of t_6. From Fig. 5.2, then, we can imagine the time traveler saying, as he climbs into his time machine at t_4, "One year from now I'll be two years from now." That rather astonishing statement makes sense when we take both uses of now to be t_4 and observe that B (1 year from A) is 2 years in the past with respect to t_4.[33]

[33] A critic of time travel (see note 119 of Chap. 2) used what he claimed to be the absurdity of such a statement to support his ejection of time travel. One of Meiland's reasons for developing his two-dimensional model of time was, in fact, to be able to reply to that critic (Donald Williams).

Meiland's two-dimensional time model is undeniably fascinating, but it simply has no theoretical justification (as far as I know[34]). It is not necessary to assume two-dimensional time to explain Meiland's "strange machines containing people in futuristic garments"; it is possible to do that with one-dimensional time in a four-dimensional spacetime. The classic paradoxes, too, are understandable without two-dimensional time, as discussed in the previous chapter.

5.3 Maxwell's Equations and Sending Messages to the Past

> "Communication with a world exactly, to minutest detail, a duplicate of our own [but] twenty thousand years ahead of us might ruin the human race as effectively as if we had fallen into the Sun."[35]

Every physicist and electrical engineer knows that the mathematical description of the electromagnetic field is given by Maxwell's equations. In particular, radio engineers know that the waves of energy their antennas launch into space follow the predictions of those equations with astonishing accuracy. Indeed, when Einstein's relativity theory was completed, it was found that Maxwell's equations automatically satisfy relativity because magnetic effects *are* relativistic effects; in other words, relativity is built into Maxwell's equations. Whereas Newton's laws of dynamics had to be patched up, Maxwell's equations were untouched by the discovery of relativity.

Thus, it was a puzzle when physicists discovered that careful study of the seemingly perfect Maxwell equations, when applied to antennas, apparently results in the prediction of causality violation. It is found, in fact, that the equations have *two* solutions. One, as expected, contains the feature of time delay; that is, creating an electromagnetic disturbance at the antenna *now* causes a detectable effect at a distant point in space *later*. This is the so-called *time-retarded-solution*, and its common-sense physical interpretation is that of energy waves traveling away from the antenna as they also travel into the future. The shock was that Maxwell's equations also accept an *advanced solution*; energy waves *arriving* at the antenna from infinite space.

The physicist Paul Renno Heyl (1872–1961) wrote the perhaps first scientific work discussing advanced electromagnetic effects, in his 1889 University of Pennsylvania doctoral dissertation with the provocative title "The Theory of Light on the

[34]Many of the arguments against multi-dimensional time can be found in M. MacBeath, "Time's Square," in *The Philosophy of Time* (R. Le Poidevin and M. MacBeath, editors), Oxford University Press 1993. MacBeath concludes, however, with "I would not want to rule out the possibility . . . that time is three-dimensional. Or worse." See also Alasdair Richmond, "Plattner's Arrow: Science and Multi-dimensional time," *Ratio*, September 2000, pp. 256–274.

[35]The Victorian writer Samuel Butler (1835–1902), in the "Imaginary Worlds" entry of *The Notebooks of Samuel Butler* (published posthumously in 1912), commenting on the chaos that communication across time might cause.

Hypothesis of a Fourth Dimension." Heyl cited the scientific guru of the fourth dimension, C. H. Hinton (look back at the last "For Further Discussion" assignment in Chap. 2) as his inspiration. The situation described by Heyl is something like that of a child standing at the edge of a pond. She throws a rock into the middle of the pond and watches ripples spread out and away from the splash. Suddenly, she sees ripples appear all around the edge of the pond and then travel inward toward the center, where they all converge at once. A spout of water then erupts from the surface of the pond at the simultaneous meeting of the inward-traveling ripples, and she watches as a rock is ejected from the spout to land back in her hand. She is, of course, open-mouthed with astonishment! How absurd, you think, as you read this, and who could blame you? This amazing imagery of advanced effects we owe to the philosopher Karl Popper, and it has come to be called "the fable of the Popperian pond."[36]

Pursuing the mathematics of wave motion in the fourth dimension, Heyl wrote "We are led to the curious conclusion that, in Hinton's aether,[37] the nature of the central disturbance *after* a given instant can influence the form of the aether *before* that instant. In other words, the aether seems to be endowed with an uncanny faculty of foreknowledge." We can avoid such a counter-intutive implication of advanced effects, but only at the price of something many physicists and philosophers consider equally unacceptable: information traveling from the future into the past. We can still think of the advanced solution as representing electromagnetic waves of energy traveling *away* from the transmitting antenna—that is, as being *broadcast*, just like the retarded solution, rather than being received from infinity—*if* we also think of the waves traveling backward in time. Thus, the advanced solution to Maxwell's equations holds out the possibility of sending messages to the past, a sort of poor man's time travel. It may seem that we have simply traded one problem for another, however, because just sending information into the past can cause many of the same paradoxical, causality-busting situations that physical time traveling is claimed to cause.

The cosmologists Fred Hoyle (1915–2001) and J. V. Narlikar commented on the potential problems posed by communication backward in time, in their 1974 book *Action at a Distance in Physics and Cosmology*: "The [Maxwell] equations supply us with both advanced and retarded solutions (and, because of the linearity, with any linear combination of them) . . . With so many solutions theoretically possible, why does nature always select the retarded one? That this question cannot be answered within the framework of Maxwell's theory must be regarded as one of its intrinsic weaknesses."

[36]K. Popper, "The Arrow of Time," *Nature*, March 17, 1956, p. 538. See, too, note 110 (and its discussion) in Chap. 2.

[37]It was thought, in nineteenth century physics, that electromagnetic waves need a *medium* through which to propagate (like ocean waves need water, and sound waves need air), a mysterious substance called the *aether* (or *ether*) that exists even in a vacuum. The 1871 Michelson-Morley experiment, however, implied that the aether simply does *not* exist.

That branding of Maxwell's theory as having an "intrinsic weakness" because of its prediction of an advanced solution was, I think, unwarranted. Indeed, the advanced solution can be given a perfectly reasonable physical interpretation.[38] Imagine a transmitting antenna sending electromagnetic waves to an identical receiving antenna. At any point in space between the two antennas there are electric and magnetic fields. Maxwell's equations allow us to calculate the fields produced by alternating currents in the two antennas. When we do an analysis of the relationship between the transmitting antenna's current and the fields, we use the retarded solution because the current is the cause and the fields are the effect. But in the analysis of the relationship between the fields and the receiving antenna's current, the situation is reversed, and the fields are the cause and the current is the effect. That is, the advanced solution is simply the mathematics relating the current in the receiving antenna *now* to the fields *in the past*.

An acceptance of both solutions has, in fact, been in the physics literature for nearly a century. As the Yale physicist Leigh Page (1884–1952) wrote decades before Hoyle and Narlikar, "While the advanced potentials, as well as the retarded potentials, satisfy the electromagnetic equations, the former has generally been discarded for the reason that it has been more in accord with the trend of scientific intuition to consider that the present is determined by the past course of events than by the future. However, if it is once admitted that the present state is uniquely determined by any past state, it follows that the future is also so determined, and hence the employment of a future state as well as a past state in specifying the present marks no inherent departure from our accustomed methods of description . . ."[39]

It may still be tempting, however, to just dismiss the advanced solution as a mere anomaly of the mathematics and to discard it on physical grounds. This is the traditional approach taken by physicists when confronted with non-causal solutions in any physical theory and, indeed, that was what Swiss physicist Walter Ritz (1878–1909) did with the advanced solutions to Maxwell's equations (an approach that involved Ritz during the last year of his life in a dispute with Einstein). For Ritz, the reversal of cause and effect simply did too much violence to his intuition to be taken seriously, and so he thought one must *impose* causality on Maxwell's equations (a condition they do not inherently contain) by *a priori* rejecting the advanced solution.[40]

Still, electrical engineers make similar kinds of judgements all the time, as when the solution of a quadratic equation for a passive (energy-dissipating) resistor gives

[38]See, for example, S. L. Schwebel, "Advanced and Retarded Solutions in Field Theory," *International Journal of Theoretical Physics*, October 1970, pp. 347–353, and L. M. Stephenson, "Clarification of an Apparent Asymmetry in Electromagnetic Theory," *Foundations of Physics*, December 1978, pp. 921–926.

[39]L. Page, "Advanced Potentials and Their Application to Atomic Models," *Physical Review*, September 1924, pp. 296–305.

[40]For more on this, see O. Costa de Beauregard, "No Paradox in the Theory of Time Anisotropy," *Stadium Generale* 1971, pp. 10–18.

both a positive value (which 'makes sense') and a negative value (which doesn't 'make sense' and so is simply ignored). There *were*, however, those who encouraged caution on this issue. Seventy-five years ago, for example, the eminent MIT electrical engineer Julius Adams Stratton (1901–1994) echoed Leigh Page's warning when he wrote of the disturbing advanced solution, "The familiar chain of cause-and-effect is thus reversed and this alternative solution might be discarded as logically inconceivable. However, the application of 'logical' causality principles offers very insecure footing in matters such as these and we shall do better to restrict the [Maxwell] theory to retarded action solely on the grounds that this solution alone conforms to the *present* [my emphasis] data."[41]

And in a famous paper I'll discuss in the next section, Wheeler and Feynman declared that "We conclude advanced and retarded interactions give a description of nature logically as acceptable and physically as completely deterministic as the Newtonian scheme of mechanics. In both forms of dynamics the distinction between cause and effect is pointless. With deterministic equations to describe the event, one can say: the stone hits the ground because it was dropped from a height; equally well, the stone fell from a height because it was going to hit the ground."[42] For Wheeler and Feynman, the reversal of cause and effect inherent to backward causation and time travel to the past offered no conceptual difficulties.

The elimination of an appeal to causality, or to the 'weirdness' of advanced waves, in arguing for the naturalness of the retarded solution to Maxwell's equations was first done in 1976.[43] The only auxiliary condition applied to the equations was simply the natural one of requiring the initial field energy to be finite.[44] And yet, today, there is still no experimental evidence for the physical reality of the advanced solution. Now and then one does run across speculations that the advanced waves of *something* traveling backward to us from the future might explain the so-called ESP 'talent' of precognition, but that is all it is, speculation.[45]

Advanced waves appeared in the pulp science fiction of the late 1930s, a decade before Wheeler and Feynman. For example, one story actually specifically invoked the advanced solution to Maxwell's equations, with a gadget (making use of what the author called the "anticipated potentials") displaying the near future on a television-like screen.[46] The author's by-line proudly gave his academic credentials as including a master's degree and, in fact, John Pierce was a graduate student in electrical engineering at Caltech. He received his doctorate just months after this

[41]J. A. Stratton, *Electromagnetic Theory*, McGraw-Hill 1941, p. 428.

[42]J. A. Wheeler and R. P. Feynman, "Classical Electrodynamics in Terms of Direct Interparticle Action," *Reviews of Modern Physics*, July 1949, pp. 425–433.

[43]P. C. Aichelburg and R. Beig, "Radiation Damping As An Initial Value Problem," *Annals of Physics*, May 1976, pp. 264–283.

[44]J. L. Anderson, "Why We Use Retarded Potentials," *American Journal of Physics*, May 1992, pp. 465–467.

[45]See M. B. Hesse, *Forces and Fields*, Philosophical Library 1961.

[46]J. R. Pierce, "Pre-Vision," *Astounding Stories*, March 1936.

story was published, and then went on to a highly distinguished career at Bell Telephone Laboratories and then later at the Jet Propulsion Laboratory operated by Caltech for NASA. Pierce knew all about Maxwell's equations, of course, and he actually opened his tale with a quote from Page's 1924 article (note 39) on the advanced solution. How many fictional pieces include quotes from the *Physical Review*?

And it would probably take something like advanced waves to explain the funny doings 2 years late in a story of a man caught in a time machine accident. Nearly all of his body ends up 4 years in the future—but only *nearly* all, because his eyes remain the present! As one of the puzzled observers of this odd business wonders, "Strange, that his eyes, now, can convey a message to his brain, four years hence, and his brain tells the eye muscles to move the eyeballs which are four years behind them —."[47]

Some of the most intriguing paradoxes of time travel involve no traveler—only information. Of course, any information flow at all, independent of time travel, involves the flow of energy and, as Einstein showed, energy and mass are different aspects of the same thing. Accordingly, information time travel involves the transfer of mass/energy. Thus, a man in the twenty-fifth century who sends a backward-in-time 'temporal radio' message to a twentieth-century woman stating that he loves (will love?) her is sending much more than mere emotion. Just *how* to send a message backward in time is, of course, the puzzle.

Indeed, all forms of present-day communication are transmissions only to the future. If you speak to someone, or if you send a radio message, there are always delays depending on the distance of separation and the speed of transmission of sound and light, respectively. If you want to send a message to the one hundred and twenty-fifth century, you can; just write a letter and seal it in a pressurized bottle of helium. This basic idea is dramatically presented in a novel about a scientist who is accidently transported from 2162 back to the late-Cretaceous, 80 million years into the past. There he leaves a written record on seven sandstone slabs of his brutal, lonely life among the dinosaurs—letters across time, if you will—found by twenty-second century geologists some years after his disappearance.[48] The transmission of such letters, *forward* in time, while dramatic, is not a puzzle. But what could be more astonishing than the message received *from the future* by the young inventor of the first time machine: after his initial experiment of sending his pilotless machine into the future, it returns with an envelope inside. Eagerly tearing it open, he finds the note is from the National Academy of Sciences: "We know from old records and museum models that this is the Cullen Foster experimental machine. Fifty years looks down on you and says 'Good work'."[49]

Heady stuff, that, but lots of other possible messages are capable of competing with young Foster's when it comes to generating excitement. For example, suppose

[47]M. Schere, "Anachronistic Optics," *Astounding Stories*, February 1938.

[48]G. G. Simpson, *The Dechronization of Sam Magruder*, St. Martin's Press 1996.

[49]D. Stapleton, "How Much to Thursday?" *Thrilling Wonder Stories*, December 1942.

you had a gadget that is superficially similar to a telephone but that calls telephones in the *distant* future. You can hear the person (in the future) on the other end, but they can't hear you (in their past). That is, information can flow only from future to past. It is then easy to imagine situations in their use of this device that at least seem paradoxical. For example, suppose you call your own private number 1 month ahead. You hear your future-self first answer the phone, and then recite the winning lottery for the 'previous' day, which is a month in your present self's future. (Your future self does this somewhat odd recital because a month from now you will remember, when your private phone rings, just *who* is calling!) So, now in the present you know you'll make a fortune by winning the lottery a month later.

This example *is* admittedly somewhat mysterious since, for the gadget to call far ahead in time, some sort of signal (as yet unspecified) must travel into the distant future because *something will* make the future phone ring. For the present discussion I am ignoring this crucial issue for the sake of the dramatic impact of the example. Soon, however, we'll get a little way into describing how one might, in principle, actually build this gadget, which in the physics literature is called an *antitelephone*. (Such a device is an *anti*telephone because the person who is the receiver is in the sender's past, the opposite of the situation for an ordinary telephone.) An interesting fictional illustration of such a gadget, despite being told as a hard-boiled detective murder mystery, appeared in science fiction some years ago (alas, while called a "time telephone," no theory for its operation was given, but instead was 'explained' as a "straightforward application of an impressive, but limited, technology").[50] So far, there is nothing paradoxical (or even illegal) in all of this, but what if, when the phone rings in the future the day after you won the lottery, you perversely decide *not* to recite the winning number? This apparent paradox has, in fact, already been treated with the aid of the block universe view of spacetime; that is, if the future-you spoke the lottery number when you originally called, then the present—you (now in the future) *must*, inevitably recite it.[51]

Let's now make things a bit more involved. Suppose that instead of calling your future self, you call the weather service and listen to the recorded message telling you the weather, 30 days hence. You do this day after day, and after a while you get a reputation for being able to predict, *perfectly*, the weather for every day to come, up to a month into the future. Your reputation spreads far and wide, and after a while more the weather service hears about you. Meteorologists check and find you are *never* wrong. Their computer models are only 80 % accurate out to 3 days, and for a week's prediction and beyond, the general public might as well flip a coin on whether it will rain or not on any particular day. But you are 100 % correct out to ten times their range. And so they hire you—and as a secondary job, you also make the

[50]S. Schmidt, "Worthsayer," in *More Whatdunits* (M. Resnik, editor), DAW 1993. The author, Stanley Schmidt, has a Ph.D. in physics and is a former editor of *Analog Science Fiction* magazine.

[51]For a fictional illustration of this (a so-called *bilking paradox*), see W. Tevis, "The Other End of the Line," *Magazine of Fantasy and Science Fiction*, November 1961.

daily weather recordings. (The voice on the other end of the gadget *has* sounded sort of familiar!) Here, then, is the puzzle we encountered earlier in causal loops carrying information: from *where* is the information in the flawless weather predictions coming from?

One easy answer is that the question is meaningless because such a future-to-the-past information flow must be impossible. Indeed, if I am to avoid telling a 'philosopher's fairy tale,' like those I criticized earlier in the book, I must admit that one consistent, non-paradoxical answer is found in recognizing that I have *assumed* that those 30-day weather reports are correct. Maybe, however, they are no better than anybody else's predictions. And so you *don't* become famous, and you *don't* get hired—and so there *isn't* any paradox. Is that the way to avoid paradoxes involving information flowing backward in time?

Perhaps not. As long as 1917 it was realized that special relativity does not preclude such an apparent backward flow. That is, if information could be transmitted faster than light, *then* messages could travel backward in time. That was the year Richard Tolman (1881–1948), a professor of physical chemistry at the University of Illinois and later at Caltech, wrote "The question naturally arises whether velocities which are greater than that of light could ever possibly be obtained."[52] He then answered that question, with his general conclusion being that if such velocities are possible, then a faster-than-light (FTL) observer could see the time order of two causally related events reverse. And thus the observer would see an affect *before* its cause. Alternatively, a *sub*luminal (slower-than-light) observer could see the two events, which are connected via an FTL interaction, reversed in time order from what a stationary observer would see.

Either situation has come to be called Tolman's paradox, but Tolman himself was careful with his words: "Such a condition of affairs might not be a logical impossibility; nevertheless its extraordinary nature might incline us to believe that no causal impulse can travel with a velocity greater than that of light." That was an astonishing statement, given that Einstein himself had specifically stated in his original 1905 paper on special relativity that such a thing simply could not occur. There is nothing, it would seem, to be "inclined" about.[53]

This rather technical connection between FTL speeds and backward time travel made the transition from theoretical physics to popular culture very quickly. It was in the British humor weekly *Punch*, for example, that the famous (but nearly always misquoted) limerick by A. H. R. Buller (1874–1944) first appeared:

There was a young lady named Bright
Whose speed was far faster than light;
She set out one day

[52]R. C. Tolman, *The Theory of the Relativity of Motion*, University of California Press 1917.

[53]Take a look back at Sect. 3.5, where we showed that the time order of two events can appear reversed for a subluminal observer if the two events are not causally related. Introducing FTL motion results in extending reversal to causally connected events; that is, FTL motion, reversed causation, and time travel to the past, go hand-in-hand-in-hand.

In a relative way
And returned on the previous night.[54]

Where *Punch* dared to go, Hollywood could not be far behind. Indeed, in this case it was actually there first, with the 1922 one-reel silent comedy movie *The Sky Splitter*. This was just a short film (feature pictures generally had at least four reels), so it is not clear how widely distributed and viewed it may have been. The story is that of a scientist testing a new spaceship: when it exceeds the speed of light, he begins to relive his life.

The linkage between time travel to the past and FTL motion is a central one in science fiction, and its fascination was nicely illustrated by one writer who has a time machine experimenter in the twenty-seventh century wonder "Was the speed of light the core of the mystery? At the speed of light did the past and the future become a shining, merging road down which men could walk—in their ears the thunder of time passing . . .?"[55] Not everybody was excited with the idea of FTL motion and travel backwards in time, however, with one eminent scientist declaring that "the limit to the velocity of signals is our bulwark against the topsy-turvydom of past and future."[56]

The obvious question at this point, of course, is whether it is even conceptually possible to build a gadget to send FTL messages backward in time? Einstein himself thought not, saying "We cannot send wire messages into the past."[57] But was he right? One hint at the possibility of achieving FTL speeds is in Dirac's 1938 paper (note 52 in Chap. 2). There, in his remarks about pre-acceleration, Dirac wrote "Suppose we have a pulse sent out from place A and a receiving apparatus for electromagnetic waves at a place B, and suppose there is an electron on the straight line joining A to B. Then the electron will be radiating appreciably [because accelerated charges radiate] before the pulse has reached its centre and this emitted radiation will be detectable at B at a time . . . earlier than when the pulse, which travels from A to B with the velocity of light, arrives. *In this way a signal can be sent from A to B faster than light* [my emphasis]."

This exciting conclusion goes a step beyond the usual examples of 'things that go faster than light.'[58] Dirac had an equally exciting reaction (and here the emphasis is his): "This is a fundamental departure from the ordinary ideas of relativity and is to be interpreted by saying that *it is possible for a signal to be transmitted faster than light through the interior of an electron. The finite size of the electron now reappears in a new sense, the interior of the electron being a region of*

[54]On page 591 of the issue of December 19, 1923.

[55]F. B. Long, "Throwback in Time," *Science Fiction Plus*, April 1953.

[56]A. S. Eddington, *The Nature of the Physical World*, Macmillan 1929.

[57]A. Einstein, "La Théorie de la Relativité," *Bulletin de la Société Francaise de Philosophie* 1922, pp. 91–113.

[58]Such as, for example, the intersection *point* of two very long, closing scissor blades. The explanation for how this can be is that the *point* is massless and does not participate in a causal chain (and so carries no information). Thus, special relativity is not violated.

failure, not of the field equations of electromagnetic theory, but of some elementary properties of space-time." This last line sounds very much like the things people say today about the singularity inside a black hole event horizon. And yet, Dirac was careful to point out that as weird as FTL speed may appear, special relativity is not violated because "in spite of this departure from ordinary relativistic ideas, our whole theory is Lorentz invariant." That is, even though 'faster-than-light' means 'backward in time,' which means 'causality failure,' special relativity still holds true and nothing awful happens to physics, only to our intuitions. The reason for this is that causality is *not* a premise or starting point for the special relativity.[59]

Of course, like any scientific theory, Dirac's theory is not necessarily the last word, and we have to admit the possibility that at least some of its implications (in particular, the possibility of FTL speeds) just aren't so. In all electronic communication systems that we use, information is transmitted by *modulating* a so-called *carrier wave*, and there is some reason to believe that such modulated waves cannot be sent at FTL speeds.[60] We must admit that it is one thing to talk of 'advanced wave radios'—often called *Dirac radios* in science fiction—and quite another to see how physics might actually enable one to talk to the past. FTL communication (without the time travel aspect) appeared in pulp science fiction before 1940, as in one story published the year after Dirac's paper.[61] In it we learn of a man on Pluto who has invented a way to send messages to Earth at twice the speed of light. He uses this gadget to warn of a would-be dictator who is on his way to Earth in a 'mere' light-speed rocket ship, and only an FTL message can warn Earth in time.

5.4 Wheeler and Feynman and Their Bilking Paradox

> "We find it difficult if not impossible to imagine waves that go into the future and *return to the present* [my emphasis] bearing information about where (and when) they have been."[62]

[59]See, for example, G. Nerlich, "Special Relativity Is Not Based On Causality," *British Journal for the Philosophy of Science*, December 1982, pp. 361–388. This same point was made nearly two decades earlier, in a study of the possibility of superluminal sound in superdense matter, by D. A Kirzhnitz and V. L. Polyachenko, "On the Possibility of Macroscopic Manifestations of Violation of Microscopic Causality," *Soviet Physics JETP*, August 1964, pp. 514–519.

[60]See G. Diener, "Superluminal Group Velocities and Information Transfer," *Physics Letters A*, December 16, 1996, pp. 327–331. For more on the modulation of a light-speed carrier wave in everyday AM radio, and in a more sophisticated single-sideband transmitter, see my book *The Science of Radio*, Springer 1999.

[61]N. Bond, "Lightship, Ho!," *Astounding Science Fiction*, July 1939. The author provides an interesting, detailed description of the gadget, and I think it would make a good question on a Ph. D. qualifying exam in physics or electrical engineering to explain the flaw in it.

[62]Bob Brier, *Precognition and the Philosophy of Science: An Essay on Backward Causation*, Humanities Press 1974. Brier is an Egyptologist (!) at Long Island University—with a Ph.D. in philosophy—who specialized at one time in parapsychology.

In 1941, at a meeting of the American Physical Society, Princeton University physicist John Wheeler and his student Richard Feynman discussed a seemingly outrageous idea that provided a possible clue to how a Dirac radio might function. The idea was that the advanced wave solutions to Maxwell's equations are not mere mathematical curiosities, but rather have profound physical significance. At the time, their talk received only a small abstract notice in the *Physical Review*, but after World War II they wrote it all up in a beautiful paper.[63]

Their primary goal was to explain the origin of the force of radiative reaction discussed by Lorentz earlier in the century. This reaction force is the cause of the energy loss suffered by an accelerated, charged particle. Lorentz, who thought of charged particles as having a finite size, attributed this reaction force to the retarded (by the time required for light to cross the width of the charged particle) coulomb repulsion force between one side of the particle's charge to the charge on the opposite side. This view, however, leads to various conceptual and mathematical problems, including an arbitrary assumption on how the charge is distributed over/through the finite volume of the particle, as well as the problems of infinite self-interactions and the issue of what keeps the charge from blowing itself apart by internal coulomb repulsion.

Wheeler and Feynman's theory, on the other hand, avoided those problems by postulating point charges, because a *point* charge cannot repel itself. But then whence the reaction force, if there is no repulsion? Their revolutionary explanation was first to imagine the accelerated point charge as emitting retarded radiation outward in space, eventually to be absorbed by distant matter. This distant matter, which itself consists of point charges that are accelerated by the retarded radiation, then radiates *backward* in time, back toward the original charge that started the chain of events. This backward-in-time, or *advanced*, radiation arrives in the past of the original charge, and *it* is the cause of the observed reaction force. Indeed, Wheeler and Feynman proposed that an accelerated charge will not radiate unless there is to be absorption at some other distant place and future time. That is, the *future* behavior of a distant absorber determines the *past* event of radiation; there is simply no such thing as just radiating into empty space. The entire universe, spatially *and* temporally, is a very 'connected' place!

Astonishingly, this non-causal view of spacetime had been around in physics for at least 20 years before Wheeler and Feynman's talk. They had independently developed their ideas but, after their 1941 talk, Einstein (who perhaps recalled his 1909 debate about advanced effects with Ritz) brought a 1922 paper by the Dutch physicist Hugo Tetrode (1895–1931) to their attention. In his paper Tetrode had written that "the Sun would not radiate if it were alone in space and no other bodies could absorb its radiation ... If for example I observe through my telescope yesterday evening that star which let us say is 100 light years away, then not only did I know that the light which it allowed to reach my eye was emitted 100 years

[63] J. A. Wheeler and R. P. Feynman, "Interaction with the Absorber as the Mechanism of Radiation," *Reviews of Modern Physics*, April–July 1945, pp. 157–181.

ago, but also the star or individual atoms of it knew already 100 years ago that I, who then did not even exist, would view it yesterday evening at such and such a time."

Tetrode's vivid imagery had been, curiously, itself captured even decades earlier in words from the nineteenth century English poet Francis Thompson (1859–1907), in his "The Mistress of Vision":

All things . . . near and far,
Hiddenly to each other linked are,
That thou canst not stir a flower
Without troubling of a star.

None of this, of course, is obvious! As a tutorial paper appearing just 2 years after Wheeler and Feynman's 1945 paper expressed it, "Any physical theory which seriously proposes that events in the future may be the efficient cause of events in the past may be regarded—at least at first glance—as rather revolutionary doctrine."[64] Indeed!

It is interesting to note that Einstein apparently said nothing to Wheeler and Feynman about a paper that pre-dated Tetrode's by 3 years. In 1919 the Finnish physicist Gunnar Nordström (1881–1923) had suggested that the advanced solution might offer an explanation for a perplexing problem in atomic theory. Maxwell's theory says that an accelerated electric charge radiates energy, which implies that the orbital electrons in the classical model of the atom should quickly spiral in toward the nucleus, that is, all matter should collapse. This cataclysmic event (of course!) has not happened, and Nordström's idea was that if one took into account not only the usual retarded solution but the advanced one as well, then perhaps things could be understood. Indeed, Nordström was able to show that such an analysis does give zero for the *average* energy radiated by an orbiting electron. Later, however, Page (note 39) showed that the instantaneous radiated energy is not zero, and that this would lead to observable effects that in fact are *not* observed.

Now, to be sure that the 'doctrine' discussed in note 64 is clear, let me restate what Tetrode, and later Wheeler and Feynman, had in mind. Imagine we have an electric charge (the *source*) that we mechanically shake, that is, accelerate. This allows us to assign a definite *cause* to the charge's acceleration which, of course, radiates energy. This radiation travels outward into space as observed retarded fields until they are eventually absorbed by distant matter. The charges in that distant matter are thus accelerated, and they in turn therefore radiate energy. This induced radiation again consists, according to Wheeler and Feynman, of both retarded and advanced fields. The advanced fields radiate outward but *backward* in time toward the original charge, collapsing upon it at the precise instant we first shook it, thereby producing the radiative reaction force. At any instant of time, at any point in space, the observed field is the sum of the retarded field traveling away

[64]C. W. Berenda, "The Determination of Past by Future Events: A Discussion of the Wheeler-Feynman Absorption-Radiation Theory," *Philosophy of Science*, 1947, pp. 13–19.

from the source into the future and the advanced field traveling toward the source in the past.

But, argued Wheeler and Feynman, there is one last point that has been left out of this picture—there is also an advanced field (traveling away from the source and backward in time) because of the original, mechanical shaking of the source charge. Equivalently, a field traveling *forward* in time will *converge* onto the source because we *will* shake it. Wheeler and Feynman showed that before the mechanical shaking that starts this whole process, the advanced radiation field of the source and the advanced radiation fields of the absorbers exactly cancel each other at every point in space and every instant of time (if there is total absorption in the future), which accounts for the experimental fact that we observe a zero total field before the mechanical shaking occurs.

Wheeler and Feynman showed that if we accept these (strange) ideas, then everything we actually observe is predictable: radiative reaction, the direction of the electromagnetic arrow of time from past to future (retarded-only effects), and the absence of infinite self-interactions. The claim by Wheeler and Feynman to have avoided self-interaction problems via the use of the advanced solution was, however, soon challenged. Indeed, the self-interaction of the electron is *needed* to explain the 1947 experiment by Willis Lamb (1913–2008) that measured the deviation (the *Lamb shift*) of the spectrum of hydrogen from what Dirac's theory of the electron predicts. Ironically, it was that experiment that helped motivate the renormalization of quantum electrodynamics (to get rid of the infinities then plaguing it) which led to Feynman's share of the 1965 Nobel Prize. In fact, just 4 years after their 1945 paper, Feynman expressed a revised view that self-interactions could not be avoided.[65]

In any case, we gain the rewards originally claimed by Wheeler and Feynman *only if* we accept backward time travel, a step too big for many in 1945 (and for nearly as many today) because of the resulting time travel paradoxes that seem to be unavoidable. For the same reason, Tetrode's earlier work, published in a German journal, also went virtually unnoticed during the two decades before Wheeler and Feynman's work. In fact, Tetrode wasn't the only anticipator of Wheeler and Feynman, as they had been anticipated, too, in America. In 1926 the chemist G. N. Lewis (1875–1946) had written "I'm going to make the . . . assumption that an atom never emits light except to another atom, and to claim that it is absurd to think of light emitted by one atom regardless of the existence of a receiving atom as it would be to think of an atom absorbing light without the existence of light to be absorbed."[66] Wheeler and Feynman were aware of Lewis by 1945. Certainly Wheeler and Feynman must have been intrigued by Lewis' paradox: "I shall not

[65]R. P. Feynman, "Space-Time Approach to Quantum Electrodynamics," *Physical Review*, September 15, 1949, pp. 769–789. See also C. Teitelboim, "Splitting the Maxwell Tensor: Radiation Reaction Without Advanced Fields," *Physical Review D*, March 15, 1970, pp. 1572–1582.

[66]G. N. Lewis, "The Nature of Light," *Proceedings of the National Academy of Sciences*, January 15, 1926, pp. 22–29.

attempt to conceal the conflict between these views and common sense. The light coming from a distant star is absorbed, let us say, by a molecule of chlorophyll which has recently been produced in a living plant. We say that the light from the star was on its way toward us a thousand years ago. What rapport can there be between the emitting source and this newly made molecule of chlorophyll?"

The paradox in that, of course, arises from the issue of what happens if, at some intermediate time and place, the star's light is blocked, thus preventing its absorption by the chlorophyll? Could refusing to look at a star *now* affect the emission of the star's light in the *past*? Lewis was obviously making a clear statement of backward causation when posing this bilking paradox. His very next words show that he understood the probable reaction of his readers: "Such an idea is repugnant to all our notions of causality and temporal sequence." Like Tetrode's work, Lewis' ideas were ahead of the times but, actually, their ideas were *not* repugnant to everyone.

In fact, similar puzzles were an inspiration to Wheeler and Feynman and almost certainly motivated them to create their own famous bilking paradox, which they presented in their 1949 paper (note 42). They opened the presentation of their paradox as follows: "If the present motion of *a* is affected by the future motion of *b*, then the observation of *a* attributes a certain inevitability to the motion of *b*. Is not this conclusion in direct conflict with our recognized ability to influence the future motion of *b*?" This question clearly states the conflict between free will and determinism, and to sidestep this *human* concern Wheeler and Feynman constructed a "paradox machine," a machine that operates totally automatically and which has come to be called the "logically pernicious self-inhibitor"![67]

In their description of the paradox machine, Wheeler and Feynman ask us to imagine two charged particles, *a* and *b*, positioned five light-hours apart. As shown in Fig. 5.3, *a* is attached to the arm of a pivoted shutter, toward which a pellet is moving from initially a great distance away. Now, normally we would think of what happens next in terms of just retarded fields. That is, the pellet hits the arm, knocking it downward and thereby accelerating charge *a*; this acceleration of charge *a* creates a retarded radiation field that arrives at charge *b* 5 h later, resulting in the acceleration of charge *b*; the acceleration of charge *b* creates a retarded radiation field that arrives back at charge *a* 5 h later (10 h after the pellet hit the arm).

The Wheeler and Feynman view, however, claims that this description leaves out half the story—the *advanced* fields. Specifically, suppose the pellet will hit the arm and so accelerate *a* at 6 p.m. Then, *b* will be affected not only 5 h later at 11 p.m., but also *earlier* at 1 p.m. This advance acceleration of *b*, in turn, sends out an advanced field that arrives at *a* at 8 a.m. The paradox is now easy to see. As Wheeler

[67]P. Fitzgerald, "Tachyons, Backwards Causation, and Freedom," *Boston Studies in the Philosophy of Science* (volume 8), 1970, pp. 415–436. Even more extreme examples of such paradox machines are described in Tim Maudlin, "Time Travel and Topology," *PSA 1990*, Philosophy of Science Association, volume 1, pp. 303–315.

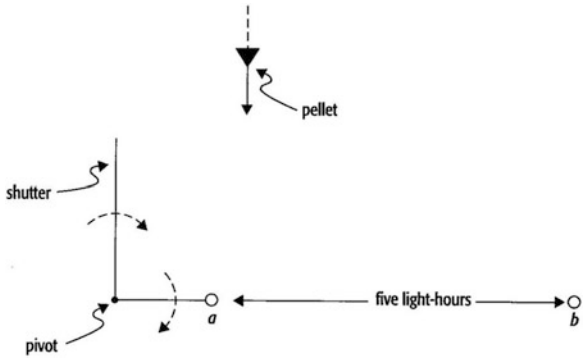

Fig. 5.3 Wheeler and Feynman's paradox machine

and Feynman described events, we see *a* exhibit a premonitory movement at 8 a.m. Seeing this motion in the morning, we conclude that the pellet will hit the arm in the evening. We could then return to the scene a few seconds before 6 p.m. and block the pellet from acting on *a*, a task automatically accomplished by the shutter in Wheeler and Feynman's paradox machine. But then we are faced with the puzzle of explaining just *why a* moved in the morning!

Wheeler and Feynman claimed they had resolved their bilking paradox by observing that *discontinuous* forces (more generally, *signals*) are never seen in nature. They concluded that the shutter does not completely block the pellet, but rather the shutter suffers a "glancing blow." That is, a very weak advanced signal is received by charge *a*, which moves the shutter just enough to induce the "glancing blow," and it is this partial interaction that results in the weakened signal in the "first place." This is, in fact, the very same explanation that was rediscovered decades later in answer to similar bilking paradoxes that involve self-interacting billiard balls transiting wormhole time machines (a topic we'll take-up in the next chapter).

5.5 Absorber Theory and Signaling the Past

> "If advanced waves [could be used to signal the past] then our grip on reality would become more tenuous. The past could never be considered over and done with, because anyone with the proper hardware could send messages back in time and alter what had already happened."
>
> —John Cramer, a University of Washington physicist, taking the minority position on the possibility of changing the past[68]

[68]Cramer has written provocatively on advanced waves. See, for example, "The Arrow of Electromagnetic Time and the Generalized Absorber Theory," *Foundations of Physics*, September 1983, pp. 887–902, and "Generalized Absorber Theory and the Einstein-Podolsky-Rosen Paradox," *Physical Review D*, July 15, 1980, pp. 362–376.

Wheeler and Feynman's argument *is* logically and physically sensible; it is, after all, simply an early statement of the principle of self-consistency in physics. Wheeler summed matters up nicely, years later, when he wrote "Interconnections run forward and backward in time in such numbers as to make an unbelievable maze. That weaving together of past and future seems to contradict every normal idea of causality. However, when the number of particles is great enough to absorb completely the signal starting out from any source, then this myriad of couplings adds up to a simple result: the familiar retarded actions of everyday experience, plus the familiar force of radiative reaction with its familiar sign."[69]

Their analysis was based on classical physics but, many years later, Feynman wrote (in his famous autobiographical work *Surely You're Joking, Mr. Feynman*) that at one time he and Wheeler thought it would not be too difficult to work out the quantum version of their theory. But then first Wheeler failed in the task, and then Feynman tried his hand at it and, as he stated, "I never solved it, either—a quantum theory of half-advanced, half-retarded potentials—and I worked on it for years." Their paradox (if indeed it *is* a paradox, since if advanced fields don't actually exist then there is no problem) remains unsolved.

Is Wheeler and Feynman's view of nature correct? Could we use advanced waves to send signals to the past? Or, if that requires some yet-to-be-developed technological breakthroughs in transmitter design, and if receivers are easier to construct, could we at least listen-in to the future (since we are, *now*, the future's past)? And if we could do that, could the future send us the details of the transmitter breakthrough (thus creating a causal information loop in time)?

The first experimental search for advanced waves seems to have been a 1973 effort.[70] The very next year, flaws in that search process prompted two physicists to discuss an experiment designed to detect advanced waves (if they exist). As they wrote, in a grand understatement, the exciting possibility of a positive result "would have such far-reaching consequences on our ideas of the unidirectionality of time and causality that . . . the experiment justifies a large amount of effort, even if no conclusive result is obtained for years."[71] Alas, all of the searches for advanced waves have, as I write (2016), given negative results and so the world still awaits the first Dirac radio.

Over the years the Wheeler and Feynman view of nature has been the target of some theoretical concerns. One physicist, for example, complained that Wheeler and Feynman had assumed a static, time-symmetric spacetime for the universe, in which the properties of all past and future absorbers are identical. That is obviously

[69]See note 34 in Chap. 3. There Wheeler also wrote "The particles of the absorber are either at rest or in random motion before the acceleration of the source. They are correlated with it in velocity after that acceleration. Thus radiation and radiative reaction are understood in terms, not of pure electrodynamics, but of statistical mechanics."

[70]R. B. Partridge, "Absorber Theory of Radiation and the Future of the Universe," *Nature*, August 3, 1973, pp. 263–265.

[71]M. L. Herron and D. T. Pegg, "A Proposed Experiment in Absorber Theory," *Journal of Physics A*, October 1974, pp. 1965–1969.

not so in an expanding (or contracting) universe and, as he wrote, "No serious modern cosmological theory is framed in [terms of] a static Universe."[72] Another puzzle for that writer was that Wheeler and Feynman took a time-symmetric theory of half-retarded/half-advanced waves in a time-symmetric universe and arrived at a *non*-time-symmetric solution! They performed that trick by supposing not only that the universe is static, but also that it was created with the initial condition of low entropy. Thus, for Wheeler and Feynman, the one-way thermodynamic arrow of time is the primary arrow, with the electromagnetic arrow following as a consequence. (The *how* of a low entropy initial cosmological condition was left unexplained—certainly no mention of the hand of God appears in their work!) This ordering of the primacy of the temporal arrows was, in fact, in agreement with the view adopted by Einstein in his 1909 debate with Ritz, a view taken decades later by Hawking, as well.[73]

Wheeler and Feynman had shown that both the advanced and retarded solutions taken together are self-consistent in a static universe; Hogarth's question was whether the observed retarded solution, *alone*, would be self-consistent in an *expanding* universe (which is the universe we actually observe). His conclusion? It depends on the details of the expansion. Two years after Hogarth, two physicists expanded on his work and claimed to have shown that the retarded solution alone *is* self-consistent *if* the expansion is steady-state via the continuous creation of matter.[74] That would be the case because, if only retarded effects are to occur, then each emitter of radiation needs a large number of absorbers (such as ionized intergalactic gas) in its future light cone to provide for complete absorption. This, in turn, requires that the density of matter not decline "too fast" with the expansion. That is, the future universe must not be "too transparent" and the continual appearance of new matter in the ever-increasing volume of the expanding universe is required to maintain the necessary density.

That conclusion was embraced with particular enthusiasm by Hoyle, a British cosmologist whose name has long been identified with the idea of continuous creation of matter. Since then, however, continuous-creation cosmologies have fallen into disfavor because it was in 1965, just a year after Hoyle and Narlikar wrote, that the cosmic microwave background radiation was detected. That is now taken as very strong evidence for the occurrence of a primordial explosion (or Big Bang) that started the expansion of the universe, and as equally strong support for therefore rejecting a steady-state universe. Not by Fred Hoyle (1915–2001), though,

[72] J. E. Hogarth, "Cosmological Considerations of the Absorber Theory of Radiation," *Proceedings of the Royal Society A*, May 22, 1962, pp. 365–383. Hogarth, however, rejected the static universe, asserting instead that the *observed expansion* of the universe provides the required asymmetry, resulting in the cosmological arrow of time as the primary arrow and the electromagnetic arrow as a consequence.

[73] S. W. Hawking, "Arrow of Time in Cosmology," *Physical Review D*, November 15, 1982, pp. 2489–2495.

[74] F. Hoyle and J. V. Narlikar, "Time Symmetric Electrodynamics and the Arrow of Time in Cosmology," *Proceedings of the Royal Society A*, January 1964, pp. 1–23.

who had an almost fanatical devotion to non-Big Bang cosmologies.[75] Real puzzles remain for the Big Bang universe, however. One is that it expands from a dense, opaque past into a less dense, ever-more-transparent future, with each emitter having a large number of absorbers in its *past* light cone. That should result, noted Hoyle and Narlikar (almost certainly with some glee), in an observed advanced solution and thus in a reversed electromagnetic arrow that would allow communication with the past. The fact that we have not (yet?) discovered how to perform such communication might be taken to mean that the idea of an expanding, Big Bang universe is somehow faulty. A related question about absorber theory is that of the puzzle of neutrino absorption. Neutrinos are particles that interact so weakly with matter that a beam of them would have to travel through many hundreds of light-years of lead for there to be a significant attenuation of the beam. How can such 'ghost-like' particles find enough future absorbers to make possible their observed journeys into the future of a Big Bang expanding universe?

For such an exciting idea as communication with the past, it is not surprising that advanced-wave radio has appeared in science fiction. Just 6 years after Wheeler and Feynman's paper, a story by a well-known author hinted at such a gadget based on something called the "ultrawave effect": "While gravitational effects were produced by the presence of matter, ultrawave effects . . . did not appear unless there was a properly tuned receiver somewhere. They seemed somehow 'aware' of a listener even before they came into existence."[76] It is difficult to believe that such a story idea was conjured-up out of nothing, but rather that the author had read Wheeler and Feynman's paper. Anderson had a 1948 undergraduate honors degree in physics from the University of Minnesota, and so he may *well have* read Wheeler and Feynman's 1945 paper.

The potential bilking paradoxes produced by sending messages backward in time have been treated in at least one novel-length discussion. The puzzles presented are undeniably fascinating, but the story's answer to them is to allow the changing of the past, as argued in this section's opening quote from John Cramer. Indeed, the title comes from the plot device of twice changing the past by sending messages to the past to save the world from terrible disasters. Thus, we read through entire time periods *three* times before finishing the novel. As one character blurts out, "We can monitor the actual consequences of our decisions and actions, and change them until they produce the desired result! My God . . . it's staggering!"[77] Quite so.

One of the most interesting science fictional uses of backward-in-time signaling is, I think, found in a classic tale by James Blish. There the "Dirac radio" for instantaneous transmissions is described, and we learn that at the beginning of each received message there is always an irritating audio beep (hence the title) that is

[75]Besides his scientific work, Hoyle also wrote science fiction. One work, the 1966 novel *October the First is Too Late*, deals with travels in time but fails to say anything about paradoxes.

[76]Poul Anderson, "Earthman, Beware!," *Super Science Stories*, June 1951.

[77]J. P. Hogan, *Thrice Upon a Time*, Ballantine 1980.

seemingly a useless artifact of the mysterious workings of the gadget. Its only obvious characteristic is a continuous spectrum from 30 to well above 18,000 Hz. It is only at the end of the story that the main character learns that this spectrum is the "simultaneous reception of every one of the Dirac messages which [has] ever been sent, or will be sent."[78]

Blish was actually pretty close to the mark with that, as a composite signal with a continuous spectrum (with energy distributed uniformly in frequency), such as one might expect the overlay of many independent signals to be, does indeed have a narrow time structure. If applied to a loudspeaker, such a signal would sound like a sharp pulse or click—or even a *beep*. In the limit of an infinitely wide spectrum, the time signal becomes one of infinite amplitude and zero duration, a singular *impulse* function called, by theoretical physicists and radio engineers alike, the *Dirac delta function*.

There is no mention in the story of advanced waves, but clearly Blish knew that instantaneous (infinite-speed) signals would travel into the past and he does a masterful job of presenting the mystery of listening to the future. At one point characters in the twenty-first century hear the commander of a time-traveling "world-line cruiser" transmit a poignant call for help from 11,000,000 light years away and from sixty-five centuries in the future. Most interesting of all, however, is Blish's statement of a technical issue that I have not seen raised before: if signals arrive at a receiver, simultaneously, from all future times, how can they be separated? Blish resorts to some scientifiction babble-talk to answer that question, but I believe it remains a puzzle.[79]

5.6 Tachyonic Signals and the Bell Quantum Antitelephone

> "We cannot fight the laws of nature."

> "Nature be damned! Feed more fuel into the tubes. We must break through the speed of light . . . Give me a clear road and plenty of fuel and I'll build you up a speed of half a million miles in a second . . . What's there to stop it?"[80]

Science fiction writers have often used FTL motion to reverse time, often without much (if any) regard to the fact that, to just *reach* the light barrier, requires (according to special relativity) infinite energy, much less to exceed light speed.

[78] J. Blish, "Beep," *Galaxy Science Fiction*, February 1954.

[79] The signal separation problem is also hinted at by physicist/science fiction author Gregory Benford, in a tale that was a precursor to his famous 1980 novel *Timescape* (in which the present attempts to warn the past of a future ecological disaster that threatens life on Earth). See Benford's "Cambridge, 1:58 A.M.," *Epoch*, Berkeley 1975.

[80] Words exchanged by the first officer and the captain of a starship on its way to Alpha Centauri in a story by N. Schachner, "Reverse Universe," *Astounding Stories*, June 1936. The captain, we are told, "had heard, of course, of the limiting velocity of light, but it meant nothing to him."

Therefore, goes the reasoning, because we can't get through the 'light barrier' means that time travel to the past must be impossible, as well. Or, so goes this line of argument. But, could there be a way around this conclusion? After all, while relativity theory indeed precludes the acceleration of a *massive* particle *up to* the speed of light, it does allow a zero rest mass particle (like the photon) to exist *at* the speed of light. Photons are emitted during various physical processes, and they move from the instant of their creation at the speed of light; the only way to slow a photon is to destroy it by absorbing it. Advocates of the possibility of the existence of FTL particles make a similar argument when asking if there might not be particles, emitted during various (as yet unknown) physical processes, that move from the instant of their creation at speed *greater* than that of light?

An affirmative answer would neatly avoid the 'acceleration through the light barrier' problem, but then there are other concerns. For example, such FTL particles would have to have an imaginary rest mass if they were to carry real-valued energy and momentum, and what could *imaginary mass* mean? That question was answered by the proponents of FTL particles, who replied that the rest mass of a superluminal particle would be unobservable because (like the photon) there is no subluminal frame of reference in which the particle could be at rest! That is, there is no frame of reference in which the mysterious imaginary mass could be measured and, anyway, it is only *observable* changes in the real energy and momentum that characterize particle interactions.

The key idea to this line of thought is a *supposed* FTL particle, called a *tachyon*, a name coined by the American physicist Gerald Feinberg (1933–1992) from the Greek word *tachys* for "swift."[81] It is interesting to note that Feinberg admitted[82] that his interest in such a thing was sparked by reading Blish's story "Beep" (see note 78). The idea of the tachyon is actually a very old one that is hinted at in the work of the Greek poet and philosopher Lucretius (who died 20 years before the birth of Christ). In his discussion of visual images, in Book 4 of his giant (well over 7400 lines) science poem *De Rerum Natura*, we find the following words about particles of matter originating deep inside the Sun: "Do you see how much faster and farther they must travel, how they must run through an extent of space many times vaster in the time it takes the light of the Sun to spread throughout the sky?"[83]

The first attempt (later found to be flawed) in the physics literature of a relativistic treatment of FTL particles appeared some years before Feinberg gave

[81]G. Feinberg, "Possibility of Faster-Than-Light Particles," *Physical Review*, July 25, 1967, pp. 1089–1105. Feinberg was anticipated in this name by Edward Page Mitchell (the Victorian pioneer in the time travel paradox genre who was discussed back in Sect. 4.2 and its note 37). In his story "The Tachypomp: A Mathematical Demonstration" (*Scribner's Monthly*, March 1874), he describes a gadget for reaching any speed, no matter how great (*tachypomp* is literally "quick sender").

[82]G. Benford, "Time and *Timescape*," *Science-Fiction Studies*, July 1993, pp. 184–190.

[83]A poetic allusion to something traveling faster than light appears, in of all places, Shakespeare's *Romeo and Juliet*. In Juliet's words (Act II, scene 5), ". . . love's heralds should be thoughts, Which ten times faster glide than the sun's beams, Driving back shadows . . ."

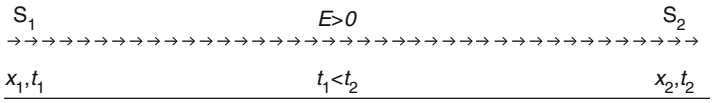

Fig. 5.4 The emission of a positive energy particle, followed by absorption

them a name, where it was observed that special relativity is *not* necessarily violated by FTL motion.[84] But nonetheless, concerns about the physical possibility of FTL particles continued. For example, a serious problem for tachyons, at least for those who dislike the ideas of backward causation and time travel, is the observation that in some frames of reference an FTL particle would appear to have *negative energy*. Feinberg, himself, explained (see note 81) this concern as follows: "By the principle of relativity, any state which is possible for one observer must be possible for all observers, and hence FTL particles can exist in negative-energy states for all observers . . . The occurrence of negative energy states for particles has always been objected to on the grounds that no other system could be stable against the emission of these negative-energy particles, an entirely unphysical behavior."

This objection to FTL particles was raised early in the history of tachyons, even before they were named, and it was addressed by three physicists who proposed the so-called *reinterpretation principle* (what I'll refer here to as the RP).[85] To see how the RP works, consider Fig. 5.4, in which a source S_1 at x_1 emits an FTL particle at time t_1. This particle then travels to an absorber S_2 at x_2, arriving there at the later time t_2. S_1 and S_2 are in the same reference frame and, for an observer in the frame, the particle energy E is positive. However, it is always possible to find another observer in a relatively moving frame for whom this process would look as though t_2 is less than (that is, earlier than) t_1 with $E < 0$. In other words, for the moving observer the particle would appear as a negative energy particle moving backward in time. (In the next chapter I'll show you that the particle speed must not be just superluminal, but the even faster *ultraluminal*.)

Note that for the moving observer, the emission by S_1 of negative energy *increases* the energy of S_1, and the absorption of negative energy by S_2 decreases the energy of S_2. S_2's energy decrease (for the moving observer) occurs before the increase in S_1's energy because, as noted before, for the moving observer $t_2 < t_1$. The moving observer naturally interprets this process as the emission of positive energy by S_2, followed by absorption by S_1. This reinterpretation would thus seem to preserve our common-sense idea of causality, as well as avoiding any mention of backward time travel. The RP appears to have slipped around those problems merely by redefining which source is transmitting, and which is receiving, the

[84]S. Tanaka, "Theory of Matter with Super Light Velocity," *Progress of Theoretical Physics*, July 1960, pp. 171–200. See also O. M. Bilaniuk and E. C. G. Sudarshan, "Particles Beyond the Light Barrier," *Physics Today*, May 1969, pp. 43–51 (and the resulting discussion in the December issue, pp. 47–52).

[85]O. M. P. Bilaniuk, V. K. Deshpande, and E. C. G. Sudarshan, "'Meta' Relativity," *American Journal of Physics*, October 1962, pp. 718–723.

tachyon. Indeed, Feinberg claimed (note 81) that the RP avoids the creation of causal loops and their associated paradoxes, a claim repeated nearly 20 years later by a physicist who used the RP to eliminate paradoxes from Gödel's time travel rotating universe.[86]

There is, however, a curious twist to all this. Even if we grant that the RP may avoid causal paradoxes, the fact is that physics isn't fooled as easily as a human observer. That is, the receiver does actually lose energy upon the arrival of the tachyon, which is the opposite of what happens in a radio receiver when it receives a photon. In other words, the receiver must be in an elevated energy state prior to the tachyon's arrival; the receiver must be prepared beforehand to receive a message. If the receiver were instead sitting in its lowest energy state, then it could not accept (or *eject*, according to the RP) the tachyon. So, it's not surprising that, despite the enthusiastic embrace of the RP by some, other physicists took exception, with one arguing that the effectiveness of the RP in avoiding causal loops is "illusory" and "irrelevant,"[87] while others concluded that the causal paradoxes would actually preclude any possibility of tachyons interacting with ordinary matter in the first place (which is just a polite way of saying that tachyons have no more reality than do unicorns!).[88]

The RP's effect of flipping the roles of transmitter and receiver has attracted particular concern. Some analysts have pointed out that if one can modulate a superluminal signal to send a message into the past, then certainly one could *sign* the message. To quote a delightful example, "If Shakespeare types out *Hamlet* on his tachyon transmitter, Bacon receives the transmission at some earlier time. But no amount of reinterpretation will make Bacon the author of *Hamlet*. It is Shakespeare, not Bacon, who exercises control over the content of the message."[89] The last line of this quote is of central importance. The authors emphasize it by immediately observing that a signature is a *relativistic invariant* and that, indeed, it establishes a causal ordering quite independent of any temporal ordering. This example, alone, explains why one analyst said of the RP that it is "laughed to scorn,"[90] while another said of the RP that it "sounds merely like the endorsement of what can only be characterized as a fantastic delusion."[91]

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[86]A. Italiano, "How to Recover Causality in General Relativity," *Hadronic Journal*, January 1986, pp. 9–12.

[87]R. G. Newton, "Particles That Travel Faster Than Light," *Science*, March 20, 1970, pp. 1569–1574.

[88]W. B. Rolnick, "Implications of Causality for Faster-Than-Light Matter," *Physical Review*, July 25, 1969, pp. 1105–1108, and D. J. Thouless, "Causality and Tachyons," *Nature*, November 1, 1969, p. 506.

[89]G. A. Benford, D. L. Book, and W. A. Newcomb, "The Tachyonic Antitelephone," *Physical Review D*, July 15, 1970, pp. 263–265.

[90]P. Fitzgerald, "On Retrocausality," *Philosophia*, October 1974, pp. 513–551.

[91]W. L. Craig, "Tachyons, Time Travel, and Divine Omniscience, *Journal of Philosophy*, March 1988, pp. 135–150.

Even more sophisticated scenarios than the *Hamlet* one (note 89) were devised to show how problems with FTL signals could arise that the RP could *not* resolve. The American physicist Bryce DeWitt (1923–2004) created such an example (the 'DeWitt Gambit') that involved a sequential, circular chain of tachyon signal transmissions between four observers, all moving in one spatial dimension. DeWitt showed out to arrange the spacetime geometry of the observers so that, at each stage, there is no dispute over who is sending and who is receiving, and so invoking the RP is avoided. Yet, when the signal reaches the first (last) observer, it is *before* he started (will start) the chain! This, of course, sets-up a potential bilking paradox: what if 'now' the first (last) observer decides to *not* send the chain's initiating signal? An even more sophisticated variation on the Gambit, involving four observers moving in *two* spatial dimensions, was soon after put forth by the English physicist Felix Pirani (1928–2015). As he concluded, "It is difficult to see how in the face of this example a classical-particle description of tachyons can be sustained."[92] Confronted by such sharp criticism, from so many, it is understandable why, just before his death, Feinberg co-authored (with two philosophers) a paper in which he seemed to be abandoning his support for tachyons as possible carriers of information backward in time.[93]

Many physicists today reject the possibility of backward-in-time messages, not because of concerns about the RP, but because such messages could create potential bilking paradoxes. To see how this works, the old Wheeler and Feynman idea of explaining (away) bilking paradoxes—that no signal in nature is *really* discontinuous—was examined by one physicist in the context of tachyons.[94] There we are asked to consider the following situation: A human (call him A) has a lamp on a table before him. The lamp is controlled by a tachyon receiver; in other words, the lamp illuminated only when a tachyon signal (a pulse, let us say) is detected. At 3 o'clock A will send a tachyon signal to B (a tachyon echo-transmitter that immediately rebroadcasts everything it receives) if the lamp does not glow at 1 o'clock. Now, the spacetime geometry of A and B is arranged to be such that a signal sent by either A or B to the other travels 1 h backward in time. Thus, if A sends a signal at 3 o'clock, then B will receive it at 2 o'clock (and immediately echo), and the echo will arrive at A at 1 o'clock. The paradox, of course, is that A sends a signal only if the lamp does *not* glow—that is, only if A does *not* send the signal![95]

We are then reminded of the Wheeler and Feynman claim that every pulsed signal is actually continuous; this argument would include the illumination itself of

[92]F. A. E. Pirani, "Noncausal Behavior of Classical Tachyons," *Physical Review D*, June 15, 1970, pp. 3224–3225.

[93]G. Feinberg, D. Albert, and S. Levine, "Knowledge of the Past and Future," *Journal of Philosophy*, December 1992, pp. 607–642.

[94]L. S. Schulman, "Tachyon Paradoxes," *American Journal of Physics*, May 1971, pp. 481–484.

[95]A study of similar situations can be found in L. L. Gatlin, "Time-Reversed Information Transmission," *International Journal of Theoretical Physics*, January 1980, pp. 25–29.

the lamp. Therefore, the lamp is not just on or off, but potentially at any level of illumination between those two extremes. So there sits A, and at 1 o'clock the lamp seems to glow dimly. To that, says Schulman, "A thinks it over, vacillating, finally sending a slightly late signal which isn't full strength." Then the echo isn't full strength either, which accounts for the original dim glow. This conclusion *is* consistent (but what if A's sending device is a toggle switch that *snaps* one way or the other—why then only a partial strength signal?), but it does seem to ask for a lot of supposing. Schulman himself is not so sure about the validity of universal continuity, writing at the end that "it is not clear that the Wheeler-Feynman assumption . . . ought to be made." (For more on the Wheeler-Feynman continuity assumption, in a different, non-time travel context, see the final "For Further Discussion" for this chapter.)

The Wheeler-Feynman continuity idea *is* ingenious, allowing one to find a logically and physically consistent solution in time travel scenarios that, at least at first glance, might seem to have no solution. Consider, for example, the following situation[96]: "We have a camera ready to take a black and white picture of whatever comes out of [a] time machine. The film is then developed and the developed negative is subsequently put in the time machine and set to come out of the time machine at the time the picture is taken. This surely will create a paradox: the negative will have the opposite distribution of black, white, and shades of grey, from the picture that comes out of the time machine. But since the thing that comes out of the time machine is the negative itself we surely have a paradox." But do we?

The answer is no, because "What will happen is that a uniformly grey picture will emerge which produces a negative that has exactly the same uniform shade of grey. No matter what the sensitivity of the film is, as long as the dependence of the brightness of the negative depends in a *continuous* [my emphasis] manner on the brightness of the object being photographed, there will be a shade of grey that produces exactly the same shade of grey on the negative when photographed. This is the essence of Wheeler Feynman's idea."[97] (The conclusion is the same if we move from black-and-white to color photography.)

Nonetheless and despite this apparent success, the supposed ability of a modulated beam of tachyons to send a message into the past still raised concerns among many, particularly about free will and fatalism. Suppose, say those who are concerned about these issues, that you receive a tachyon message from yourself from tomorrow, informing you that a man you plan to kill tonight is still alive (tomorrow). Does that mean it is beyond your power to kill him tonight? According to one analyst (note 67) the answer is no; you *could* kill him—but if you do then the message from tomorrow would not have arrived. And because ignorance is not a

[96]Taken from Frank Arntzenius and Time Maudlin, "Time Travel and Modern Physics," in *Time, Reality & Experience* (C. Callender, editor), Cambridge University Press 2002, pp. 169–200.

[97]More on the Wheeler-Feynman continuity idea, *and of its limitations*, can be found in D. Kutach, "Time Travel and Consistency Constraints," December 2003, pp. 1098–1113, and Phil Dowe, "Constraints on Data in Worlds with Closed Timelike Curves," December 2007, pp. 724–735, both in *Philosophy of Science*.

precondition to free will, your newly acquired knowledge does not, by itself, suddenly limit your ability to kill the man. But, this line of arguing went, if you do not attempt to kill the man because you believe the message from your future self, then in fact the message *has* limited you!

Fitzgerald's position was rebutted by Craig (note 91), who argues that it is not your ability to kill that is altered by the message but rather your motivation. Craig points out that such motivational changes can occur without invoking anything as radical as a message from the future. Suppose, he says, that just before you fire the fatal shot into your victim, you learn from him that he is your beloved, long-lost uncle. Clearly, your motivation for killing him is likely to be instantly altered, but equally clearly, your *ability* to kill him is unchanged. The mechanism for obtaining genealogical information, whether via time travel or as a last-minute appeal from your intended victim, is (says Craig) simply irrelevant. Not all buy into that, however, with one unconvinced analyst (note 94) writing that "history is a set of world lines essentially frozen into spacetime. While subjectively we feel strongly that our actions are determined only by our backward light cone, this may not always be the case." That is, Schulman appears open to the possibility that influences originating in the future might indeed have an impact on the present.

With the fading from the physics scene of enthusiasm for tachyons, the romance of communicating with the past using superluminal speeds passed from speedy particles to quantum mechanics via a mathematical result called *Bell's theorem*. John Bell, a physicist mentioned in the last chapter in connection with the MWI of quantum mechanics, published his theorem in a little article in an obscure, now defunct journal. Since then it has become one of the most cited physics papers from the 1980s.[98] The paradox cited in Bell's title refers to a famous 1935 paper in which Einstein (and two of his colleagues at the Institute for Advanced Study) challenged the conventional view of quantum mechanics, the view that there is no objective reality to anything unless it is observed.[99]

In fact, the possibility of quantum mechanics supporting FTL signals had been considered (and rejected) *before* Einstein's paper, by the Italian physicist Enrico Fermi.[100] Fermi concluded that, in a two atom system, the decay from an excited state of one atom (with the emission of a photon) would not influence the other atom before a time lapse of R/c, where R is the distance between the two atoms and c is the speed of light. In 1967, however, the Russian physicist M. I. Shirokov pointed out that Fermi's result was the result of an unjustified mathematical operation (he had replaced an integral from zero to infinity with one from minus infinity to infinity).

[98] J. S. Bell, "On the Einstein-Podolsky-Rosen Paradox," in *Speakable and Unspeakable in Quantum Mechanics*, Cambridge University Press 1987.

[99] A. Einstein, B. Podolsky, and N. Rosen, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?" *Physical Review*, May 15, 1935, pp. 777–780. See also N. D. Mermin, "Is the Moon There When Nobody Looks? Reality and Quantum Theory," *Physics Today*, April 1985, pp. 38–47.

[100] E. Fermi, "Quantum Theory of Radiation," *Reviews of Modern Physics*, January 1932, pp. 87–132.

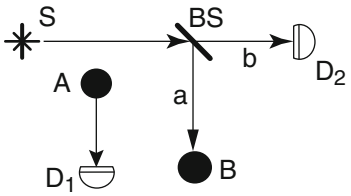

Fig. 5.5 Time travel and the wave function of quantum mechanics. In the above arrangement (reproduced by the kind permission of Francesco Gonella, from his paper "Time Machine, Self-Consistency and the Foundations of Quantum Mechanics," *Foundations of Physics Letters*, April 1994, pp. 161–166), S is a low-intensity source of photons, a source *so* weak that at any instant there is never more than one photon in the system. Each photon begins by traveling toward BS, a half-silvered beam-splitting mirror that, with equal probability, either passes a photon to the right along path b where it is detected by D_2, or downward along path a into mouth B of a wormhole time machine and out of which it emerges from wormhole mouth A *in the past*. Conventional quantum mechanics says that what happens at BS is determined *when the photon reaches BS*—that is, the probability wave function of the photon collapses at BS. But for a photon that is reflected into B, it exits A where it is detected by D_1 *before* the time of its arrival at BS. That means it is known (by detector D_1) what *will* happen at BS *before* the photon arrives at BS—so just *when did* the photon wave function collapse?

Then, nearly 30 years after Shirokov, the German physicist Gerhard Hegerfeldt proved (in the context of conventional quantum mechanics) a very general theorem that establishes a non-zero probability of the second atom responding to the first atom's decay *as soon as* the photon is emitted.[101]

Hegerfeldt's analysis is very general, but it does make one assumption—the non-negativity of energy density (the so-called *weak energy condition*)—which at the time was considered (in Hegerfeldt's words) to be "physically well motivated," but which today is *not* taken to be *a priori* obvious.[102] Einstein's paper, on the other hand, utilized physical assumptions not easily dismissed, and so its conclusions confounded physicists for decades.

The conventional view of quantum mechanics formulates physics in terms of probability wave functions that 'collapse' into specific realities only when measurements (observations) are made of the state of a system (which may be as elementary as a single particle). Until such measurements are made, says this view of quantum mechanics, a system has no specific state; instead, it merely has a probability distribution over a set of possible states (see Fig. 5.5 for a time travel puzzle concerning this claim). Einstein and his co-authors (note 99) strongly rejected this probabilistic interpretation of nature (recall Einstein's famous dictum, "God does not play dice with the cosmos.") Einstein and his colleagues agreed that

[101]G. C. Hegerfeldt, "Causality Problems for Fermi's Two-Atom System," *Physical Review Letters*, January 1994, pp. 596–599. This mere *suggestion* of a possible failure of causality so stunned the editor of *Nature* that he felt compelled to quickly write a 'calming' reply: "Time Machines Still Over the Horizon," February 10, 1994, p. 509.

[102]The issue of the sign of energy density is very important in the analyses of wormhole time machines (see note 135 in Chap. 1), and we'll return to it in the next chapter.

quantum mechanics may be valid *as far as it goes*, but they also argued that it leaves out 'something' (as yet unknown) in describing reality. That is, they suggested that quantum mechanics is "incomplete" and that it incorporates "hidden variables."[103] They expressed this idea in the form of a paradox, the famous *EPR paradox*, which they posed as a thought experiment (a *Gedanken-experiment*) in which quantum mechanics declares that the properties of a particular spatially distributed system, when measured at point A, seem to be *forced* to assume specific values at point B (which may be arbitrarily distant from A) *without* there being a measurement at B.

Thus, said Einstein, there are just two possibilities. Either the system properties at B must have been what they are from the very start (even if the measurements at A had not been done) which is the view he held, or there must have been a linkage between the system at A and the system at B such that the wave function collapse at A is instantly transmitted to B to allow the wave function to collapse there as well. Because A and B may be arbitrarily far apart, this second view obviously requires an FTL transmission mechanism,[104] something Einstein called a "spooky action-at-a-distance," a term that eloquently expresses his low opinion of that idea! (Some translations replace *spooky* with *ghostly*, but the negative sentiment remains the same.[105]) For decades the debate between proponents of these two alternatives remained at a metaphysical, non-quantitative level. Then came Bell's paper in 1964.

Bell's theorem mathematically poses the choice between Einstein's hidden variables view and the conventional view of quantum mechanics through the use of an inequality involving certain measurable properties of a system.[106] If these measurements are such that the inequality is violated, then the conventional interpretation of quantum mechanics is vindicated, and Einstein's FTL spooky action-at-a-distance effect simply doesn't exist. Bell's great contribution, then, was to provide the means for removing the debate about quantum mechanics from metaphysics and to place it squarely in the realm of experimental physics.

"All" that needed to be done was to make the required measurements. These technically difficult experimental measurements were eventually performed by the French physicist Alain Aspect and his colleagues at the Institute of Applied Optics of the University of Paris, a decade and a half after Bell showed what had to be

[103]For more on hidden variables, see E. P. Wigner, "On Hidden Variables and Quantum Mechanical Probabilities," *American Journal of Physics*, August 1970, pp. 1005–1009.

[104]For an analysis that argues against an FTL mechanism in quantum mechanics, see G. C. Ghirardi, *et al.*, "A General Argument Against Superluminal Transmission Through the Quantum Mechanical Measurement Process," *Lettere Al Nuovo Cimento*, March 8, 1980, pp. 293–298.

[105]You can find a discussion of the possibility of 'explaining' Einstein's "spooky actions" of quantum mechanics by invoking backward causation in R. I. Sutherland, "Bell's Theorem and Backwards-in-Time Causality," *International Journal of Theoretical Physics*, April 1983, pp. 377–384.

[106]The details are not important here, but a lovely exposition (for the lay person) can be found in Bell's essay "Bertlmann's Socks and the Nature of Reality," in *Speakable and Unspeakable in Quantum Mechanics*, Cambridge University Press 1987. See also M. G. Alford, "Ghostly Action at a Distance: A Non-Technical Explanation of the Bell Inequality," *American Journal of Physics*, June 2016, pp. 448–457.

done. The results unequivocally support the conventional view of quantum mechanics.[107] Einstein was simply wrong, there are no hidden variables in quantum mechanics, and his spooky action does seem to exist. Does that mean we have, at last, experimental evidence of the possibility of information transfer at FTL speeds?

Well, maybe, but the issue is still hotly debated. The majority of physicists today, I suspect, are probably more perplexed over what Bell's theorem is saying than were over Einstein's original EPR paradox. In those early days one could agree with Einstein and his colleagues, who argued that quantum mechanics was valid *as far as it went*, but a deeper, more comprehensive theory *would* show the existence of hidden variables. However, because of the work by Bell and Aspect it is definitively known that quantum mechanics *as it stands* leads to correct results, results that can be checked in the laboratory. In other words, there is no need for hidden variables and FTL spooky actions cannot be ruled out.

And so, while tachyons and the tachyon antitelephone may be nothing more than a neat science fiction fantasy, just maybe a quantum mechanical Bell antitelephone can't be so dismissed. Indeed, the possibility of using a quantum mechanical FTL effect was once suggested in a letter written by a senior person at an unspecified California think tank (an organization such as, for example, the RAND Corporation) to the Under Secretary of Defense for Research and Engineering at the Pentagon. Here's what the Under Secretary read when he opened that letter: "If in fact we can control the FTL nonlocal effect, it would be possible . . . to make an untappable and unjammable command-control-communication [C^3] system at very high bit rates for use in the submarine fleet. The important point is that since there is no ordinary electromagnetic signal linking the encoder with the decoder in such a hypothetical system, there is nothing for the enemy to tap or jam. The enemy would have to have actual possession of the 'black box' decoder to intercept the message, whose reliability would not depend on separation from the encoder or on ocean or weather conditions."[108]

One can't help but wonder what might have been the Under Secretary's response to that incredible letter, and what sorts of ultra-mega-super-top-secret experiments it may have prompted. I would be willing to bet, if they did occur, that they failed. As one physicist put it, "Up to now nature has covered her tracks pretty well, blocking all possibilities for using the EPR effect for FTL communication."[109] Of course, the think tank letter, as 'farout' as it may initially appear, actually represents a *failure* of imagination, because the backward causation effect of EPR's spooky FTL effect is certainly a 'quantum jump' beyond a mere unjammable submarine C^3 system.

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[107] A. Aspect, "Experimental Tests of Realistic Local Theories via Bell's Theorem," August 17, 1981, pp. 460–467, and A. Aspect, *et al.*, "Experimental Realization of Einstein-Podolsky-Rosen-Bohm *Gedanken-experiment*: A New Violation of Bell's Inequalities," July 12, 1982, pp. 91–94, and "Experimental Test of Bell's Inequalities using Time-Varying Analyzers," December 20, 1982, pp. 1804–1807, all in *Physical Review Letters*.

[108] See N. D. Mermin in note 99. For more on the enigmatic letter on the FTL submarine C^3 system, see Jack Sarfatti's letter to *Physics Today*, September 1987, pp. 118 and 120.

[109] J. Cramer, "Paradoxes and FTL Communication," *Analog Science Fiction*, September 1988.

5.7 For Further Discussion

Mark Twain, in his last, posthumously published novel *No. 44, The Mysterious Stranger*, incorporated reversed time as the work of a supernatural being. After the being reverses the world's time direction, the narrator tells the reader that "everywhere weary people were re-chattering previous conversations backward . . . where there was war, yesterday's battles were being refought, wrong-end first; the previously killed were getting killed again . . . we saw Henry I gathering together his split skull . . ." Read the novel, and comment on how well (or not) Mark Twain handled reversed time.

In Philip K. Dick's 1956 novel *The World Jones Made*, we read of a prophet who can see a year into the future. As he says, "To me *this is the past*," and then later we are told "He was a man with his eyes in the present [the world's future] and his body in the past [the world's present]." Read the novel, and then argue either for or against the suggestion that Dick was aware of the advanced wave solution in Maxwell's theory.

The physicist Robert Forward (see the sixth *For Future Discussion* in Chap. 3) argued that one way to send messages into the past is to compress a 15-billion-ton asteroid down to the volume of an atomic nucleus, spin it up, and then aim gamma ray bursts through the resulting near-by region of "unhinged time" (see "How To Build a Time Machine," *Omni*, May 1980). This is, of course, 'simply' an artificially constructed Kerr black hole telegraph transmitter (look back at note 114 and related discussion in Chap. 1). Forward, an optimist of the first rank, thought humans would be able to do this before the end of the twenty-first century. It would seem, then, that what should be done *now* is to build gamma ray frequency *receivers* (well within present-day technology) and listen for such messages from the future. The technical details of such receivers wouldn't matter, as long as their design is widely published. That way, the scientists of the future can learn those details by simply reading of them in old, musty library books and journals, and thus will be able to build their transmitters to be perfectly compatible with our old, musty (to them) receivers! Comment on the likelihood of National Science Foundation funding becoming available to build such receivers.

Suppose a time traveler goes into the future and, while there, discovers that there is an older version of himself living in the home that has been in his family for generations. Explain why this implies that the time traveler will eventually return to the present. Suppose, instead, that after the time traveler arrives in the future he decides to remain in the future, and *not* to return. Explain why this implies there will *not* be an older version of himself living in the family home. In both cases, assume the MWI does *not* apply, that is, assume that there is just a single time line.

One well-known quantum physicist, David Bohm (1917–1992), wrote the following passage in his book *The Special Theory of Relativity* (W. A. Benjamin 1965), concerning the possibility of sending messages into the past: "In effect, S could communicate with his own past [self, M] . . . and tell his past self [M] what his future is going to be. But on learning this M could decide to change his actions, so that his future . . . would be different from what his later self [S] said it was going to be. For example, the past self could do something that would make it impossible for the future one to send the signal. Thus, there would arise a logical self-contradiction." Do you think most physicists, writing today more than 50 years after Bohm, would repeat his words?

The role played by quantum mechanics in time travel studies is broad, deep, profound . . . and mysterious. What I mean by this is nicely illustrated by the final paragraph in a paper by Stephen Hawking ("Quantum Coherence and Closed Timelike Curves," *Physical Review D*, November 15, 1995, pp. 5681–5686). There he wrote "Personally, I do not believe that closed timelike curves will occur, at least on a macroscopic scale. I think that the chronology protection conjecture will hold and that divergences in the energy-momentum tensor will create singularities before closed timelike curves appear. However, if quantum gravitational effects somehow cut off these divergences, I am quite sure that quantum field theory on such a background will show loss of quantum coherence. *So even if people come back from the future, we will not be able to predict what they will do* [my emphasis]." What do you think Hawking meant by his final line? If "people come back from the future" and tell us what they did while in the

(continued)

future, then what's wrong with their memories that causes us to fail to be able to predict what they *will* do? Or, is there perhaps nothing wrong with their memories and Hawking is instead arguing that the future experienced by the returned time travelers will not be the future when *we* 'get there'? If that's the case, then what are the returned time travelers 'remembering'?

If quantum mechanics is actually slightly non-linear physics (as are many other normally linear physical phenomena at sufficiently high energy levels)—physics is *linear* when *superposition* holds, which means the result of two inputs is the sum of the individual outputs resulting from application of the individual inputs—and if one accepts the MWI concept, then at least two physicists (**PHYSICISTS1**) claim to have shown that one could communicate not just with our past, but also with the many pasts in the ever-splitting branches of the many worlds. Another physicist (**PHYSICIST2**) wrote a very funny illustration of what that might be like. Yet another physicist (**PHYSICIST3**) suggested that non-linear quantum mechanics might actually allow one to take *photographs* of the many-worlds. Of that, a physicist (**PHYSICIST4**) wrote (without any exaggeration) that such an achievement would be "perhaps the most amazing discovery in the history of science, indeed in the history of mankind." Or, to quote yet another physicist (**PHYSICIST5**), "interworld communication would lead to truly mind boggling possibilities," some of which have been incorporated in at least one science fiction novel (**SFAUTHOR**). Read the physicists' papers, and the novel, and then summarize with your own commentary.

PHYSICISTS1: N. Gisin, "Weinberg's Non-linear Quantum Mechanics and Superluminal Communication," *Physics Letters A*, January 1, 1990, pp. 1–2, and J. Polchinski, "Weinberg's Non-linear Quantum Mechanics and the Einstein-Podolsky-Rosen Paradox," *Physical Review Letters*, January 28, 1991, pp. 397–400.

PHYSICIST2: J. G. Cramer, "Quantum Telephones to Other Universes, to Times Past," *Analog*, October 1991.

PHYSICIST3: D. Albert, "How to Take a Photograph of Another Everett World," *Annals of the New York Academy of Sciences*, December 30, 1986, pp. 498–502.

PHYSICIST4: M. A. B. Whitaker, "On the Observability of 'Many Worlds'," *Journal of Physics A*, July 11, 1985, pp. 1831–1834.

PHYSICIST5: R. Plaga, "On a Possibility to Find Experimental Evidence for the Many-Worlds Interpretation of Quantum Mechanics," *Foundations of Physics*, April 1997, pp. 559–577.

SFAUTHOR: J. P. Hogan, *Paths to Otherwhere*, Baen 1996.

One upon a time, FTL tachyons (and their associated into-the-past transmissions of information) were strictly in the province of science fiction. In recent years, however, such doings have moved into mainstream fiction, as well, with the most recent (as I write) example being the man-of-action novel by Patrick Lee, *Signal*, St. Martin's Press 2015. (Tachyons are also mentioned in the 2015 film *Tomorrowland*.) That novel is set in modern times, not in the future; its hero is a retired soldier who now works as a self-employed house-flipper. His is definitely not a futuristic science fiction world. Until, that is, be becomes involved with a radio-like gadget that receives signals from 10 h, 24 min in the future. As the novel progresses we eventually learn that the gadget is based on German electronics technology that was being tested in a remote lab in northern Algeria, near the end of World War II. When that lab was overrun by a small American force the equipment was destroyed, but not before one of the Americans heard the gadget playing a song titled "She Loves You" along with the word *yeah* repeated numerous times. He didn't know what that meant until, 20 years later, he watched the Beatles' first American appearance on *The Ed Sullivan Show* TV program, and so suddenly realized that in 1944 he had heard a song that hadn't been written yet! That gadget is at the center of a modern-day, renewed Nazi effort to conquer the world, and there is much 'you've seen it all before' chasing, shooting and other 'James Bond' types of action in the novel, but the author *has* been quite inventive in treating time paradoxes. He does talk a lot about 'changing the future,' worries confusingly about 'changing the past,' and mistakes neutrinos for tachyons, but, still, if one is willing to overlook such issues it *is* an entertaining read. In particular, while the gadget's inherent range to the future is limited to ten-plus hours, the author describes a clever way to arbitrarily extend that value. Read *Signal*, and then describe and critique the method outlined in the novel.

The Wheeler-Feynman assumption of continuity already had a distinguished history in mathematics long before they invoked it in their physics resolution of bilking paradoxes. (Both men were very good mathematicians, and certainly knew what I am about to tell you here.) Imagine a man who is about to walk up a hill, starting at A (the base of the hill) and ending at B (the top of the hill). You know nothing of *how* he walks (perhaps at times he stops for a while, other times he walks slowly, sometimes he walks briskly, perhaps at times he even walks back *down* the hill). All you know is that, starting from A at 10 o'clock in the morning, he arrives at B at 11 o'clock. That is, the walk up

(continued)

the hill takes exactly 60 min. He camps overnight at B and then, the next morning, at exactly 10 o'clock, he walks back down the hill along the same path he followed during his ascent the previous day. He arrives at A at 11 o'clock. That is, the return trip takes exactly 60 min. Again, you know nothing of the details of how he makes the descent. Prove that there is at least one spot on the path that he passes at exactly the same time during his descent as he passed it during his ascent the previous day. Hint: No complicated equations are required. Indeed, no math at all is needed. Just sketch the appropriate, general graphs of the man's ascent versus time, and of his descent versus time, and invoke continuity. That is, sketch the distance (as measured along the path) that he is from A versus time for both the ascent and the descent.

Chapter 6
The Physics of Time Travel: II

"It is very sad to see valuable minds writing such a pile of unmitigated bullshit."

—not all physicists think time travel is worthy of study.[1]

6.1 Faster-than-Light into the Past

"Faster-than-light travel remains a coherent, and possible concept, even though it is forbidden by relativity theory."

—a philosopher makes a physics mistake.[2]

So far we have limited our consideration of relativity theory to speeds below the speed of light—that is, to the condition $v < c$, where v is the relative velocity of two reference frames. There was nothing, however, in the derivation of the Lorentz transformation equations discussed in Chap. 3 that actually used that self-imposed constraint. So, just what, in fact, *does* happen for $v > c$? This is not an empty question, because the second half of the above quote that opens this section is simply not true. That isn't to say we can have FTL for free; there *is* a high price to pay, that of causality violation (although, if you are a fan of time travel, it's a price you are probably happy to pay). If a material object goes FTL, then the mathematics seems to say that the object could travel into the past, just as the caped crusader does in the first (1978) *Superman* movie, in order to change the past (to save Lois Lane from dying in an earthquake). In addition, the mathematics also seems to say that if a signal bearing information could achieve FTL, then that information, too, would travel back into the past (see Fig. 6.1).

[1]This rather blunt comment (reported in *Physics World*, December 2009, p. 3) was prompted by a suggestion, from two other physicists, that the Higgs boson might ripple backward through time and thereby stop CERN's Large Hadron Collider from creating the long-sought particle in the first place.

[2]G. Robinson, "Hypertravel," *Listener*, December 17, 1964, pp. 976–977, the printed version of a lecture to the British Association for the Advancement of Science.

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P.J. Nahin, *Time Machine Tales*, Science and Fiction,
DOI 10.1007/978-3-319-48864-6_6

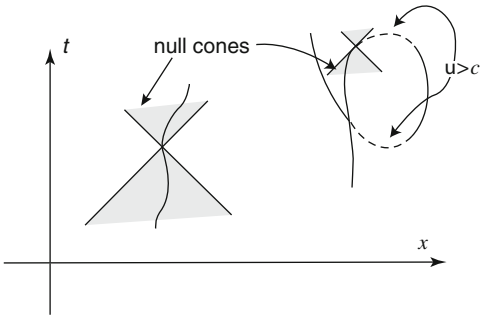

Fig. 6.1 A math-free proof that there can be no closed loops in time (that is, no time travel to the past if $v > c$ is forbidden) in flat Minkowski spacetime, the spacetime of the special theory of relativity. Such a conclusion is far less clear in the curved spacetimes of the general theory of relativity. Figure reproduced by the kind permission of Serguei V. Krasnikov (Polkovo Central Astronomical Observatory in St. Petersburg, Russia), from his 2003 paper "Time Machine (1988–2001)"

The original thinking along these lines visualized such an FTL signal as a modulated beam of tachyons, as mentioned in the previous chapter. In addition to tachyons not having been experimentally observed, even after intense searches for them, there are several theoretical objections (in addition to the bilking paradox problem discussed in the previous chapter) to the likelihood such FTL particles exist.[3] For example, the relativistic expressions for the energy and momentum of a particle with rest mass m_0 moving with speed v are, respectively,

$$E = \frac{m_o c^2}{\sqrt{1-(v/c)^2}} \qquad \text{and} \qquad p = \frac{m_o v}{\sqrt{1-(v/c)^2}}.$$

For $v > c$ the radicals in these expressions become imaginary, whereas E and p must always be real-valued (because they can be observed and measured as a result of the interactions the particle has with other matter). The energy and momentum can regain the property of being real-valued if we write $m_0 = \mu\sqrt{-1}$ (that is, $m_0^2 = -\mu^2$) for a tachyon, where μ is the positive, real-valued (but unobservable) meta-mass (that is, $m_0^2 < 0$). This is a radical proposal, of course, (as it is $m_0^2 > 0$ that we are used to; as a Russian mathematician romantically put it, "What binds us to space-time is our [positive] rest mass, which prevents us from flying at the speed of light, when time stops and space loses meaning. In a world of

[3]See, for example, "More About Tachyons," *Physics Today*, December 1969, pp. 47–52, a collection of letters received by the journal from its readers. The 'DeWitt Gambit,' mentioned in the previous chapter, was first proposed in one of those letters.

light there are neither points nor moments of time; beings woven from light would live 'nowhere' and 'nowhen'; only poetry and mathematics are capable of speaking meaningfully about such things."[4].

Well, perhaps, but let's continue to pursue the physics of tachyons, at least for a while. It can be shown[5] that the energy and momentum of the tachyon are given by

$$E = \frac{\mu c^2}{\sqrt{(v/c)^2 - 1}} \quad \text{and} \quad p = \frac{\mu v}{\sqrt{(v/c)^2 - 1}}.$$

An interesting consequence of this is that if tachyons *lose* energy, they *speed up*, an observation first made by the German physicist Arnold Sommerfeld (1868–1951) in 1904.[6] This means that if there is a mechanism for continuous energy loss, such as Cerenkov radiation,[7] then tachyons will spontaneously accelerate without limit to *infinite speed*! Curiously, while the above expressions for E and p show that, as $v \to \infty$, tachyons would possess *zero* energy, they would nonetheless have a *non-zero* momentum of μc.[8]

To see how backward time travel and FTL are connected, it is useful to establish a geometrical interpretation of the Lorentz transformation. As stated in Chap. 3, if the x', t' system is moving with speed v in the x (or x') direction relative to the x, t system, then

$$x' = \frac{x - vt}{\sqrt{1 - (v/c)^2}} \quad \text{and} \quad t' = \frac{t - vx/c^2}{\sqrt{1 - (v/c)^2}}.$$

[4]Yu I. Manin, *Mathematics and Physics*, Birkhäuser 1981, p. 84.

[5]L. Parker, "Faster-Than-Light Inertial Frames and Tachyons," *Physical Review*, December 25, 1969, pp. 2287–2292.

[6]The consideration of FTL particles already had a long history *before* tachyons were specifically named. You can find late nineteenth century (1888–1889) theoretical analyses of electrically charged FTL particles in the writings, for example, of the English mathematical electrical engineer Oliver Heaviside (1850–1925): see my biography *Oliver Heaviside: the life, work, and times of an electrical genius of the Victorian Age*, The Johns Hopkins University Press 2002, pp. 124–126.

[7]Cerenkov radiation is the energy radiated when a charged particle exceeds the speed of light *in the medium through which it travels*. Since the speed of light *in water* is less than c, it is perfectly okay with special relativity to exceed the speed of light in water, and in fact this commonly occurs for the energetic electrons produced by submerged atomic reactors (swimming pool reactors). The resulting radiation is observed as a blue glow. The radiation is named after the Russian physicist Pavel Cerenkov (1904–1990)—for which he received a share of the 1958 Nobel physics prize—but in fact Heaviside (previous note) had predicted it more than a decade before Cerenkov was born.

[8]This (theoretical) property of tachyons (if they exist) could (perhaps) be used (maybe) to build a revolutionary (to say the least) new rocket propulsion system: see J. Cramer, "The Tachyon Drive: Infinite Exhaust Velocity at Zero Energy Cost," *Analog*, October 1993.

These equations make sense for the case of $v < c$, and we will retain this condition for our two relatively moving *frames of reference*: these frames are the *worlds* of two *human* observers, observers that we'll take to always be *sub*luminal. As one physicist so nicely put it, "The assumption that observers move faster-than-light goes beyond superluminal signaling,"[9] as such observers would have to be thought of as being built not out of flesh-and-blood, but rather out of tachyons.[10] We'll reserve the symbol w to denote the speed of an FTL particle.

Now, recall what we mean by any line parallel to the x-axis; it is a line with a fixed time coordinate. Such a line is a *cosmic moment* line, with the equation $t =$ constant. Similarly, for the moving system we would write the equation of a cosmic moment line as $t' =$ constant which, after the Lorentz transformation is applied, is equivalent to

$$t - \frac{vx}{c^2} = \text{constant}.$$

In particular, the x'-axis ($t' = 0$ cosmic moment line), which passes through the point $x = 0$ at $t = 0$, has the equation

$$t = \frac{vx}{c^2} = vx$$

with the usual convention of $c = 1$.

In a similar way, recall what we mean by any line parallel to the t-axis; it is a line with a fixed space coordinate. Such a line is the world line of a stationary particle in the x, t frame, with the equation $x =$ constant. Similarly, for the moving system we would write $x' =$ constant as the equation of the world line of a particle stationary in that system. From the Lorentz transformation, this is equivalent to

$$x - vt = \text{constant}.$$

In particular, the t'-axis (which is the $x' = 0$ world line of a particle stationary at the origin of the moving system) passes through the $x = 0$, $t = 0$ point, and it has the equation

$$x = vt.$$

Thus, superimposed spacetime coordinate axes for the two frames look like those shown in Fig. 6.2. That is, the relative motion of the two frames results in a

[9] K. Svozil, "Time Paradoxes Reviewed," *Physics Letters A*, April 3, 1995, pp. 323–326.

[10] Science fiction, however, *has* (since the early days of pulp) enthusiastically embraced FTL human travel. In Larry Niven's story "At the Core" (*If*, November 1966), for example, we read of a manned spacecraft that travels 60,000 light years to the center of our own Milky Way Galaxy, and then back, at a speed 420,000 times that of light. As the pilot says (in a grand understatement), "That's goddam fast." Perhaps there is a way to make *some* sense of such an adventure, with the so-called *warp drive* (a'la *Star Trek*), which we'll take-up briefly at the end of this chapter.

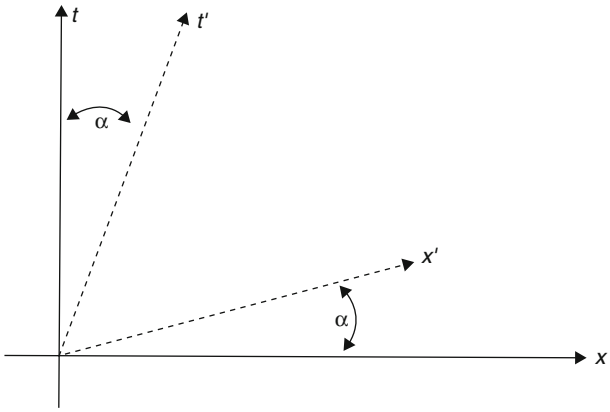

Fig. 6.2 Spacetime coordinate axes rotation by relative motion

rotation of the spacetime axes; but it is a strange sort of rotation, with *opposite* senses for the space and time axes. That is, the x' and t' axes rotate *towards* each other, as shown in the figure, to make equal angles (α) with the x and t axes, respectively, where

$$\alpha = tan^{-1}(v).$$

If we limit the moving frame (the frame of a moving observer) to subluminal speeds ($0 \leq v < 1$), then

$$0 \leq \alpha < 45°.$$

At the speed of light ($v = 1$) $\alpha = 45°$ and so the x' and t' axes coincide—time and space have become indistinguishable.

It is important to realize that observers in either system would measure the same speed for a photon; that is, each would see the world line of a photon as a line with slope 1. This view of the world line of a photon is literally built into the Lorentz transformation because one of Einstein's fundamental postulates for special relativity is the invariance of the speed of light. The truth of this statement for the x, t system is obvious from Fig. 6.2. It is, perhaps, not so obvious with the x', t' system because of the non-perpendicular axes (as shown in the figure) for that system. In Fig. 6.3 the world line of a photon is shown in both systems. In that figure we emit the photon at $x' = 0$, $t' = 0$, and we later measure its coordinates at point A to be $x' = x'_A$ at time $t' = t'_A$. Note carefully how this is done. We draw lines from point A parallel to the x' and t' axes until they intersect the t' and x' axes, respectively. This is similar to the way we would get the spacetime coordinates of A in the more familiar x, t system, where we would draw lines parallel to the x and t axes.

It should now be obvious that x'_A and t'_A have the same extension, just as they do in the unprimed system, so

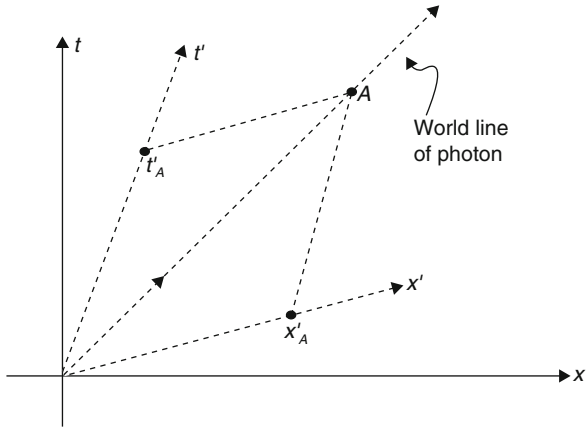

Fig. 6.3 Invariance of the world line of a photon

$$\frac{x'_A}{t'_A} = \text{the speed of light}$$

The speed of light is the only invariant speed under the Lorentz transformation. Indeed, the modern approach to special relativity emphasizes this invariance as the central property of the speed of light, rather than the idea of the speed of light being a limiting speed.

This geometrical interpretation of the Lorentz transformation lets us quickly make another interesting (one, I think, not at all obvious) observation: If a particle is faster than light in the x, t system, then there exists a subluminal x', t' system in which the particle is *infinitely* fast. Figure 6.4 shows the world line of an FTL particle in the x, t system (which is, of course, *below* the world line of a photon; that is, the particle's world line is spacelike). Suppose the FTL particle has speed $w > c$ such that its world line makes angle β with the x-axis. If we now pick v, the speed of the moving x', t' system to be such that $\alpha = \beta$, then the x'-axis will coincide with the world line of the particle, and so the particle will appear to an observer in the x', t' system to be everywhere at once—that is, to be infinitely fast. We have, then,

$$\beta = tan^{-1}(v) = tan^{-1}\left(\frac{1}{w}\right)$$

or $v = 1/w$, which seems to be dimensionally wrong. Recall, however, that with our convention of $c = 1$, the v in this result is a *normalized* speed. To return to the units of everyday use, simply replace v with v/c and w with w/c; this transforms our result to

$$\frac{v}{c} = \frac{c}{w} \quad \text{or} \quad v = \frac{c^2}{w}.$$

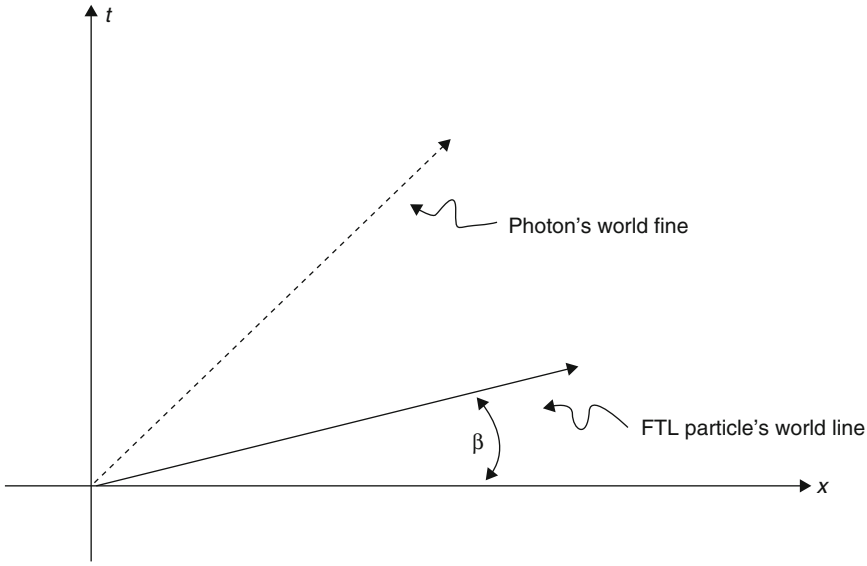

Fig. 6.4 World line of an FTL particle

We can, of course, turn this result around. If an FTL particle moves with speed w in the x, t frame, then to an observer in the x', t' frame moving with subluminal speed v, the particle will appear to be infinitely fast if $w = c^2/v$. A particle with $w > c^2/v$ is said to be not just be superluminal, but *ultra*luminal.

If a particle has infinite speed if $w = c^2/v$, then what physically happens if w is greater than c^2/v? The answer is easy to see from a spacetime diagram, as in Fig. 6.5, where the x' and t' axes have been extended back to negative values. In that figure I have labeled two arbitrary events A and B on the world line of an ultraluminal particle (and so it lies below the x' axis), and have shown the spacetime coordinates of each event in both the x, t and x', t' frames. For the x, t frame we see that A is related to B by the relations $x'_A < x'_B$ and $t'_B < t'_A$; that is, the time order of A and B is reversed for an observer in the x', t' frame. To that observer, the particle appears to be traveling backward in time!

But this isn't quite the end of the story. Following the approach of two pioneering tachyon physicists,[11] we note that if the energy of a particle in the stationary system is E, then the energy as measured in the moving system is given by[12]

[11]O. M. Bilaniuk and E. C. G. Sudarshan, "Causality and Space-like Signals," *Nature*, July 26, 1969, pp. 386–387.

[12]The expression for E' is the result of applying the Lorentz transformation to E. You can find all the details of that worked out in A. P. French, *Special Relativity*, W. W. Norton 1968, pp. 208–210.

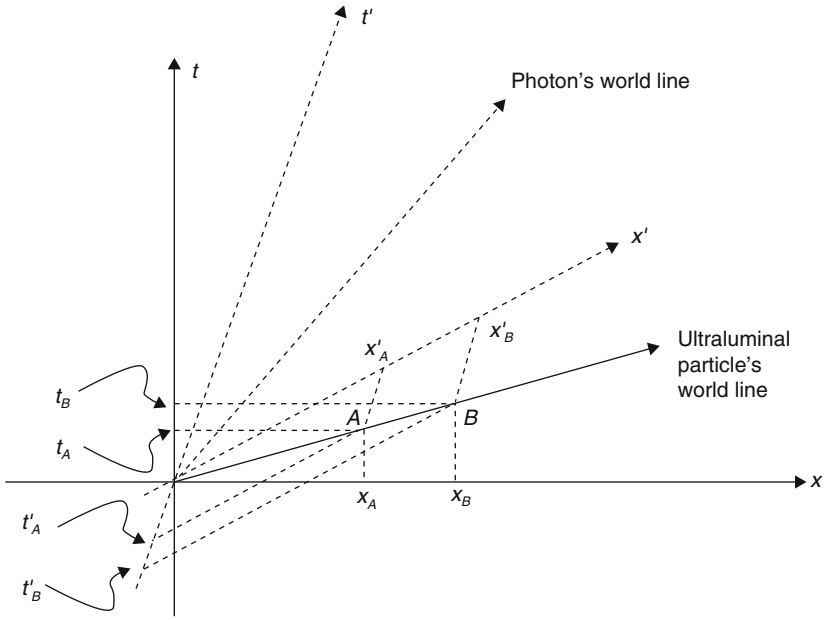

Fig. 6.5 World line of an *ultra*luminal particle

$$E' = \frac{1}{\sqrt{1 - \left(\frac{v}{c}\right)^2}} \frac{\mu(c^2 - \mathrm{wv})}{\sqrt{(w/c)^2 - 1}}$$

Note that sign of E' switches from positive to negative when w (the speed of the particle) exceeds c^2/v, which is precisely the condition for the particle to be ultraluminal and so traveling backward in time (as seen in the primed system). That is, negative energy moving backward in time in one system is positive energy moving forward in time in another. This is, in fact, the original motivation for the RP (reinterpretation principle) discussed in the previous chapter, and the claim was, at one time, that the RP was just what was needed to 'explain' the paradoxical implications of time travel. This is not the majority view today, however, and a number of physicists have been quite inventive in constructing scenarios with causal paradoxes that the RP clearly fails to 'explain.'

For example, the Princeton physicist Shoichi Yoshikawa (1934–2010), in a letter to *Physics Today* (see note 3), was able to create a scenario which *uses* the RP to arrive at a causal paradox. In his construction, the RP allows an observer to transmit an ultraluminal tachyon to a remote observer at time $t = 0$, and to receive a reply from that observer at $t < 0$. This obviously sets-up the possibility of a bilking paradox in which the original observer, upon receiving the $t < 0$ tachyon, then decides *not* to transmit the $t = 0$ tachyon. What makes Yoshikawa's paradox a particularly troublesome paradox is that the RP is the culprit, not the savior.

6.2 Tipler's Rotating Cylinder Time Machine

> "... within forty-eight hours we had invented, designed, and assembled a chronomobile. I won't weary you with the details, save to remark that it operated by transposing the seventh and eleventh dimensions in a hole in space, thus creating an inverse ether-vortex and standing the space-time continuum on its head."[13]
>
> —this is almost surely *not* the way to build a TM (time machine)

As discussed at the start of this book, the first endorsement of the reasonableness of physicists talking about plausible, scientific time travel, began with Gödel's discovery of closed timelike lines in the mathematics of certain rotating universe models. Such models had been studied as early as 1924 by the Hungarian physicist Cornelius Lanczos (1893–1974), a quarter century before Gödel, but it was Gödel who made explicit the possibility a rotating universe might allow time travel. His realization of time travel as an *inherent* property of a rotating universe is an illustration of a *weak* TM, while what is the central interest concerning time machines (in physics *and* in science fiction) is a *strong* TM. That is, in time machines that can be *intentionally constructed* by manipulating mass-energy in a finite (what physicists call a *compact*) region of spacetime to *create* closed timelike lines where none existed before the manipulation began. Interestingly, the fundamental physical idea behind Gödel's weak TM is the same underlying idea behind the first strong TM, Tipler's rotating cylinder discussed back in Chap. 1 (strictly, of course, only a *compact* TM if the cylinder can be of *finite* length).

The one result from general relativity that we'll use here (without proof) is that the rotation of matter causes a distortion of spacetime that results in the 'tipping over' of light cones, with the future half tilted in the direction of motion. If you imagine a point in the universe about which the rotation takes place, then this tipping effect increases with the radial distance from that point.[14] The fact that rotating masses tip light cones over in the direction of rotation was discovered very early in the history of general relativity (1918), by the Austrian theoreticians Josef Lense (1890–1985) and Hans Thirring (1888–1976). Originally (and naturally) called the *Lense-Thirring effect*, it now generally goes by the name of the *dragging of inertial frames effect*, and it plays a central role in the weak Gödel and the strong (maybe) Tipler time machines. Here's how.

At a certain critical distance from the rotation center (more on this in just a bit), the future half of the light cone at a given point in spacetime will be sufficiently tilted so as to enter the past half of similarly tilted light cones at nearby spacetime points This is illustrated in Fig. 6.6,[15] which shows a circular chain of tilted light

[13]L. Sprague de Camp, "Some Curious Effects of Time Travel," in *Analog Readers' Choice*, Dial 1981.

[14]For a picture of this, see S. W. Hawking and G. F. R. Ellis, *The Large Scale Structure of Spacetime*, Cambridge University Press, 1973, p. 169.

[15]Adapted from D. B. Malament, "'Time Travel' in the Gödel Universe," *Proceedings of the Philosophy of Science Association* 1984, pp. 91–100.

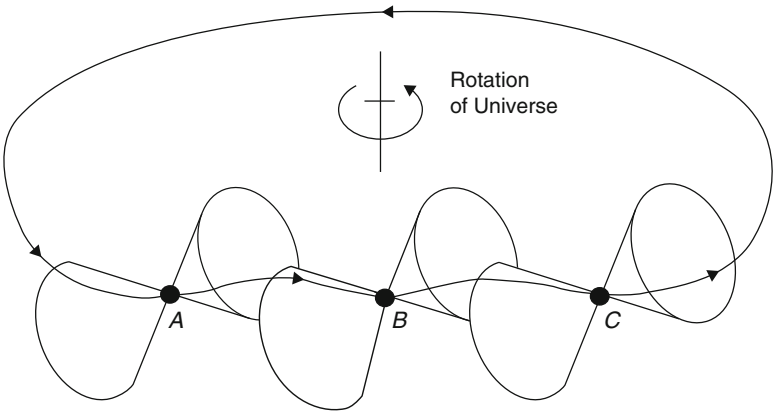

Fig. 6.6 Time traveling through tilted light cones in a rotating universe

cones in a rotating universe. Because light cones are tilted by a rotation-induced twisting of spacetime, a traveler can move around a circular path on a trip that is always directed into his *local* future but nonetheless end-up in his own *global* past, without ever going faster than light. This kind of round trip in spacetime, with a trajectory that winds back into the past without ever becoming spacelike, is a closed timelike curve.

From Fig. 6.6 it should be clear how a time traveler, beginning at A, can weave his way along a circular path (this path needs to have a radius at least as great as the critical value mentioned earlier) to B to C to ... that brings him back into the *past* half of the light cone at A. The traveler's world line is always inside the local light cone; that is, the world line of the time traveler is always timelike, and never FTL. These timelike curves are present in the rotating spacetime from the very beginning of the spacetime, and were not *created* (certainly not by humans) by conscious intent.

You can see how this works mathematically by taking the spacetime metric for Gödel's universe (with, as usual, the convention that the speed of light $c = 1$):

$$(ds)^2 = (dt)^2 - (dr)^2 - (dy)^2 + \sin h^2(r)\left[\sin h^2(r) - 1\right](d\phi)^2 + \sqrt{2}\sin h^2(r)(d\phi)(dt)$$

where t, r, y, and ϕ are cylindrical coordinates in four-dimensional spacetime. Now, imagine that our adventurer's world line is the helical curve r=constant, $y = 0$, and $t = -\alpha\phi$: if we take the time axis as vertical then the time traveler's world line is a vertical helix in spacetime. For this curve, $dr = \mathrm{d}y = 0$ and $dt = -\alpha d\phi$. This last differential means, in particular, that whatever the sign of the constant α, we can choose that one of the two senses of movement in the spatial ϕ dimension that gives $dt < 0$.

Continuing, we have

$$(ds)^2 = \left[\alpha^2 - 2\sqrt{2}\alpha sinh^2(r) + \sin h^2(r)\left(\sin h^2(r) - 1\right)\right](d\phi)^2$$

or, upon letting $u = \sinh(r)$ we have

$$(ds)^2 = \left[\alpha^2 - 2\sqrt{2}\alpha u^2 + u^2\left(u^2 - 1\right)\right](d\phi)^2.$$

Now, for $\alpha = 0$ we have

$$(ds)^2 = u^2\left(u^2 - 1\right)(d\phi)^2$$

which is greater than zero if $u > 1$. This condition holds if $\sinh(r) > 1$, that is, if r is a constant greater than $\ln\left(1 + \sqrt{2}\right)$. In other words, for r sufficiently large (and now we know the critical value for r) we have $(ds)^2 > 0$, the required condition for a timelike spacetime interval. By continuity, then, we will continue to have $(ds)^2 > 0$ even with some small positive or negative value of α different from zero. Because ϕ is a periodic coordinate (we identify $\phi = 0$ with $\phi = 2\pi$), as the traveler moves along the curve she returns repeatedly to the same spatial points, but her time coordinate is increasingly negative. That is, she is traveling into the past. Note, once again, that in Gödel's universe this property holds only for orbits with radii greater than a certain minimum.[16]

Tipler's rotating, infinitely long cylinder is a mechanism for artificially producing the tipped-over light cone effect, thus *creating* closed timelike curves. Figure 6.7, taken from Tipler's Ph.D. dissertation,[17] shows how the cylinder works. The cylinder is represented by the central vertical axis. Far away from the cylinder the light cones in spacetime are upright, but as we move inward they tip over, the future halves opening up into the direction of rotation. (Only the future halves of the light cones are shown.) This direction, which is the direction that far away from the cylinder measures *space*, near the cylinder measures *time* (just as in the Gödelian universe). That is, there has been a dimension reversal! This fantastic possibility has found its way into science fiction, as in Stephen Baxter's 1995 novel *The Time Ships*, wherein the Victorian narrator says "If only one could *twist about* the Four Dimensions of Space and Time — transposing Length with Duration, say — then one could stroll through the corridors of History as easily as taking a cab in the West End!"

To travel back in time, therefore, all the time traveler need do is leave Earth and approach the cylinder until she is near enough to be in the tipped-over region of spacetime. Then she would follow a helical path around the cylinder and could

[16]There are other solutions to the Einstein gravitational field equations that have closed timelike lines at *any* radius, no matter how small: see M. J. Reboucas, "A Rotating Universe with Violation of Causality," *Physics Letters A*, March 5, 1979, pp. 161–163.

[17]F. J. Tipler, *Causality Violation in General Relativity*, University of Maryland 1976.

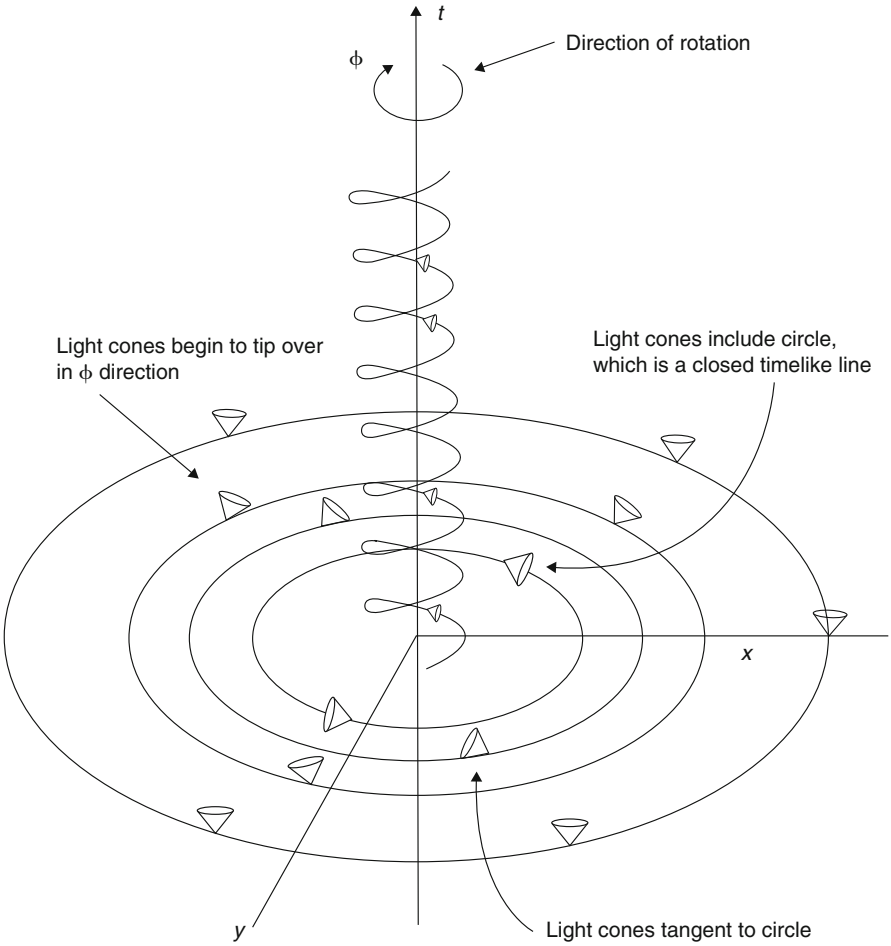

Fig. 6.7 The future halves of light cones point almost entirely in the $+t$ direction far from rotating matter; they begin to tip over as the matter is approached. Note that there is a helical timelike path that moves locally into the *future* in the $-t$ direction, that is, it goes into the past as seen by an observer far from the rotating matter (The world lines of rotating matter are helixes in the $+t$ direction)

spiral along the negative time direction as far back in time as desired (but no further back than to the moment of the cylinder's creation). This motion is such that the time traveler is always moving into her local future, via the tipped-over light cones. Finally, she would withdraw from the cylinder and return to Earth—in the past. The time traveler had better be a good space navigator, of course, because Earth won't be where she left it!

6.3 Thorne's Wormhole Time Machine

> "This fact reinforces the authors' feeling that [closed time loops] are not so nasty as people generally have assumed."[18]

The spacetime wormhole is presently the most promising of the approaches that have been advanced for building a time machine. Gödel rotated the entire universe in 1949, and Tipler 'reduced' the problem in 1974 to 'merely' spinning a cylinder of infinite length. In 1988 Kip Thorne scaled things down even more, this time to other extreme. His idea calls for pulling a wormhole on the scale of the Planck length out of the topologically multiply connected quantum foam that spacetime is and then enlarging it (somehow) to human scale, all the while stabilizing it against self-collapse, and then finally using the time dilation effect of special relativity to alter time at one mouth of the wormhole as compared to the other mouth. What a mouthful! What, you almost surely wonder, does all that mean?

First of all, what's 'quantum foam'? The term refers to the idea that the topology of spacetime is *not* a smooth, continuous manifold, but rather (if you look close enough) is a seething 'ocean of fluctuations' that is always changing, changes on the scale of the Planck length (look back at Sect. 1.5). What does *that* mean? Like the ocean surface-in-the-large, large-scale spacetime is simply connected. But just as one sees all sorts of transient structure as one looks at the water more closely (beginning with macroscopic waves and then proceeding downward to the bubbly foam on the waves), spacetime too displays an ever-changing connectivity-in-the-small.[19] That is the 'quantum foam.'

Wormholes have been around in physics for decades, but they have always been thought to be so unstable as to exist only on paper in the mathematics of general relativity. In an analysis[20] published more than half-a-century ago, for example, wormhole instability was shown to be so severe that not only would a human have no chance in getting through one, but also not even a single speedy photon could do so. Even at the speed of light, the photon could not zip through a wormhole before being trapped inside ("pinched off") in a region of infinite spacetime curvature. Wormholes would simply collapse too quickly after formation for even the so-called ultimate speed to save the traveler. Indeed, the presence of mass-energy inside a wormhole actually *accelerates* its collapse. The physics of wormholes, it seemed, made them simply untraversable.

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[18]The conclusion of a mathematical demonstration that time travel by wormhole does not conflict with the conservation of energy: see J. L. Friedman *et al.*, "Cauchy Problem in Spacetimes with Closed Timelike Curves," *Physical Review*, September 15, 1990, pp. 1915–1930.

[19]Not all accept this view. See, for example, A. Anderson and B DeWitt, "Does the Topology of Space Fluctuate?" *Foundations of Physics*, February 1986, pp. 91–105.

[20]R. W. Fuller and J. A. Wheeler, "Causality and Multiple Connected Spacetime," *Physical Review*, October 15, 1962, pp. 919–929.

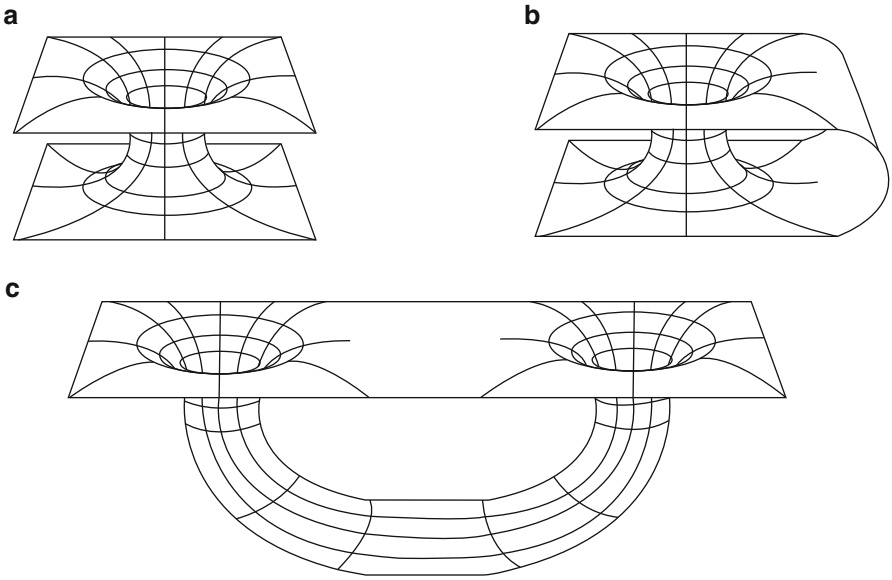

Fig. 6.8 These sketches are unavoidably misleading, being two-dimensional renditions of wormholes that connect two places in a three-dimensional space. Time machine wormholes, on the other hand, connect two places in a four-dimensional spacetime. In particular, the mouths of the wormholes are not 'depressions' into which the time traveler's rocket ship plunges, but rather would appear to be three-dimensional spheres. The wormhole in (**a**) connects two disjoint universes, while those in (**b**) and (**c**) are connections between two places in the same universe. As shown in these last two cases, the wormhole 'handle' can be either long or short, compared to the external distance between the wormhole mouths

And anyway, how would one gain access to a wormhole in the first place? As Thorne and one of his students suggested,[21] one might perhaps imagine someday finding a rotating black hole that mathematically possesses, in its interior, so-called hyperspace tunnels to 'other places'—either in our universe or in other universes (see Fig. 6.8). In the case of a wormhole connecting two places in the same universe, although the external distance in spacetime between the places may be very large (mega-light-years), it is conceivable that the distance *through* the wormhole itself could be very small. The time required to traverse the wormhole, as measured by the traveler's watch might, in fact, be arbitrarily small. This is exciting, but wormholes do not come without some significant problems.

Such problems include the presence of a one-way event horizon, which precludes two-way travel (it seems reasonable to assume that time and space travelers

[21]M. S. Morris and K. S. Thorne, "Wormholes in Spacetime and Their Use for Interstellar Travel: A Tool for Teaching General Relativity," *American Journal of Physics*, May 1988, pp. 395–412. This paper was motivated by Thorne's earlier response to a request, from the American astronomer Carl Sagan (1934–1996), for help in making plausible the interstellar travel imagined in his 1985 novel *Contact*.

might wish to eventually return), and enormous gravitational gradients (tidal forces) that dismember anything approaching and/or entering the wormhole. These problems have often been conveniently *ignored* in science fiction. For example, in one tale[22] the time machine is in the form of a wormhole time tunnel that time travelers can simply walk through, and in another characters similarly walk back and forth between two openings in a wall that connect the same place in space but separated in time by 160 years.[23] And in an even older story, we read of a time machine (in the form of a hole in spacetime that is a wormhole in everything but name) through which one can literally step from future to past and back again. That story[24] is particularly notable for having introduced the term *mugwump* for a time traveler who uses a time machine wormhole. To paraphrase the tale's time traveler, as he transits the wormhole his "mug" is in the past and his "wump" is in the future.[25]

Now, before going any further, a note on what physicists are referring to when they write of traversable time travel wormholes. Such wormholes are called *Lorentzian* because they have a spacetime metric with the signature $[+, -, -, -]$ (see Sect. 3.5). Further, the wormhole is taken to be *static*, that is, to have no time-varying behavior. The reason for being specific on the nature of time travel wormholes is that there is another type with what is called the *Euclidean signature*: $[+, +, +, +]$, which is not suitable for time traveling. Motion in a Euclidean signature wormhole involves imaginary momentum or proper time, neither of which is physically plausible for a time traveler. However, *if* you can gain access to a Lorentzian wormhole *then*, as two physicists wrote, "if you manage to acquire even one inter-universe traversable wormhole then it *seems* almost absurdly easy to build a time machine."[26]

In response to that fundamental question of how to gain access to a Lorentzian wormhole, Thorne and his students were bluntly honest—they didn't know. Their best suggestion was that "one can imagine an advanced civilization pulling [a] wormhole out of the quantum foam and enlarging it to classical size."[27] A few years later this dramatic idea found its way into a science fiction novel of a far-future alien civilization able to control the energies of constellations of galaxies: "Spacetime is friable. Wormholes riddle the fabric of spacetime on all scales. At the Planck length and below, wormholes arising from quantum uncertainty effects blur

[22]R. C. Wilson, *A Bridge of Years*, Doubleday 1991.

[23]M. Leinster, *Time Tunnel*, Pyramid Books 1964.

[24]H. Kuttner, "Shock," *Astounding Science Fiction*, March 1943.

[25]The term's origin is in 19th century politics, as a description of fence-sitters who try to avoid taking a definite position on some controversial topic under debate. For an illustration of wormhole mugwumping, see K. S. Thorne, *Black Holes & Time Warps*, W. W. Norton 1994, p. 500.

[26]C. Barceló and M. Visser, "Twilight for the Energy Conditions?" *International Journal of Modern Physics D*, December 2002, pp. 1553–1560. See also M. Visser, *Lorentzian Wormholes*, AIP Press 1996.

[27]M. S. Morris, K. S. Thorne, and U. Yurtsever, "Wormholes, Time Machines, and the Weak Energy Condition," *Physical Review Letters*, September 26, 1988, pp. 1446–1449.

the clean Einsteinian lines of spacetime. And some of the wormholes expand to human scale, and beyond — sometimes spontaneously, and sometimes at the instigation of intelligence."[28]

This isn't easy to visualize, but let's plunge ahead and assume we can "pull" a wormhole out of the quantum foam. If so, then once it is (somehow) inflated the wormhole could be stabilized against collapse by threading it with either matter or fields of stupendous negative (outward) tension—and by *stupendous* I mean *STUPENDOUS*. If b_0 denotes the minimum radius of the wormholes (the size of the so-called *throat* of the wormhole), the tension (radial pressure) at that location must be at least

$$\tau_0 = \frac{3.8}{{b_0}^2} \times 10^{36} \frac{tons}{in^2}$$

where b_0 is expressed in feet.[29] (This expression shows that for a wormhole with a throat radius of several thousand feet, the value of τ_0 is enormous, of the same magnitude as the pressure at the center of the most massive neutron star.) To stabilize a common sort of everyday wormhole, such as a subway tunnel, we can obtain the required tension/pressure by lining the tunnel with iron plates or concrete. But how, for a hyperspace wormhole, do we obtain 'iron plates' that can achieve the required enormous tension? As Thorne and his students observed (note 27) such stuff could only be called "exotic," a term that had appeared a few years earlier in connection with the observed energy density in the throat of a wormhole.[30]

One possible approach to this problem does not use matter at all. If we make b_0 *very* large, then non-material fields will do the job.[31] Indeed, suppose b_0 equals 1 light year (a large wormhole by anybody's standard!). Then τ_0 is 'only' 4000 tons/square inch, and that is achievable by threading the wormhole throat with a magnetic field of 'only' 2,700,000 gauss (five million times stronger than the Earth's field).[32] To generate such a field is not impossible, and present-day

[28]From S. Baxter's 1993 novel *Timelike Infinity*. That same year the Chinese physicist Liao Liu wrote on how, as a result of a naturally occurring vacuum fluctuation, a wormhole might spontaneously appear: L. Liu, "Wormhole Created from Vacuum Fluctuation," *Physical Review D*, September 15, 1993, R5463–R5464.

[29]The original equation for τ_0 was given in units of dynes/cm^2, with b_0 is expressed in meters (see note 21), but I have converted these units to the more familiar (to the non-physicist) units of tons per square inch, for dramatic purposes, because the units of dynes per square centimeter is so small it's difficult to relate it to anything of everyday significance.

[30]R. Balbinot, "Crossing the Einstein-Rosen Bridge," *Lettere Al Nuovo Cimento*, May 16, 1985, pp. 76–80.

[31]See, for example, Y. Soen and A. Ori, "Improved Time Machine Model," *Physical Review D*, October 15, 1996, pp. 4858–4861, and D. N. Vollick, "How to Produce Exotic Matter Using Classical Fields," *Physical Review D*, October 15, 1997, pp. 4720–4723.

[32]To understand how the calculation of a magnetic field from a pressure requirement is accomplished, note that pressure is dimensionally equivalent to field energy per unit volume, which in turn is given by a well-known result in electromagnetic theory.

experimental, hypervelocity electromagnetic rail guns in development for the US Navy use transient magnetic fields in the mega-gauss range.

As if the stabilization problem wasn't enough of a complication, Thorne and his colleagues (note 27) showed that there is another, even more curious problem. The geometrical requirement that the wormhole interior smoothly connect to the external, asymptotically flat exterior spacetime demands that the wormhole throat flare outward as shown in Fig. 6.8. It turns out that this condition is mathematically equivalent to a requirement that τ_0 exceed the energy density of the throat material[33]; and special relativity, in turn, says that for some timelike observers the energy density will then actually be *negative*. This is a clear violation of the so-called *weak energy condition* (WEC), which says the observed mass-energy density is always non-negative. This is *so* 'obvious' that the WEC was thought, for a long time, to be almost a law of nature. Such a violation is actually not as crazy as it might sound however because, more than half-a-century ago, it was shown[34] that an energy density that is everywhere and everywhen positive is *not* compatible with any quantum field theory that is *local*, as, presumably, will be the yet-to-be-discovered theory of quantum gravity. Over the years since then a variety of other energy conditions have been proposed, such as the *averaged weak energy condition* (AWEC), which says that only the *average* value of the energy density over a complete null geodesic world line has to be non-negative, which leaves open the possibility of *temporary* negativity here, there, then and when.[35]

The traversable, static wormholes studied by Thorne and his colleagues violate even the AWEC (see note 27), however, and in the years since it has become clear to physicists that imposing constraints on the mass-energy density may not be so 'obvious' after all (see note 26). But all may not be lost. Indeed, it has been shown that the violation of the AWEC by traversable wormholes can be made as small as desired, that is, the requirement for the exotic matter required to line a wormhole throat to keep it open can be made as tiny as you want.[36]

Well, tiny the quantity of exotic matter may be but, nonetheless, even a tiny amount of it would be extraordinary weird stuff because a negative energy density can be interpreted as meaning that the exotic material that keeps the wormhole throat open

[33]The condition of τ_0 exceeding the energy density in the throat is, in fact, the technical definition of *exotic*—see note 30. In everyday situations, the exotic condition is never even remotely approached. For example, the maximum tension necessary to pull a piece of steel apart—the so-called *tensile strength*, about 100,000 pounds per square inch—is a trillion times less than the mass-energy density of steel.

[34]H. Epstein, V. Glaser, and A. Jaffe, "Nonpositivity of the Energy Density in Quantized Field Theories," *Il Nuovo Cimento*, April 1, 1965, pp. 1016–1022.

[35]T. A. Roman, "Quantum Stress-Energy Tensors and the Weak Energy Condition," *Physical Review D*, June 15, 1986, pp. 3526–3533.

[36]M. Visser, S. Kar, and N. Dadhich, "Traversable Wormholes with Arbitrarily Small Energy Condition Violations," *Physical Review Letters*, May 23, 2003, pp. 201102-1 to 201102-4.

does so by exerting a *repulsive* gravitational force.[37] A repulsive force sounds like a property we'd expect to see associated with *negative mass* and, although such a thing has never been observed (negative matter is *not* anti-matter, which *has* been observed and which does not repel 'normal matter'), it was studied long ago (theoretically, of course) by the English cosmologist Hermann Bondi (1919–2005). Bondi showed[38] that negative mass would indeed have some truly bizarre properties,[39] but there is nothing in general relativity that forbids its possible existence. Wormholes, with negative mass throats, should produce observable effects by which a wormhole *might* be detected. Mathematical analyses of the effect a negative-mass wormhole mouth would have, when crossing the line-of-sight between Earth and a distant star, indicates that there should be an observable *double-spike* in the intensity of the star's light. Astronomical searches for such an optical signature have actually been conducted, with (alas) no success as I write (2017).

There is another interesting implication of a repulsive gravitational force, one that proves to be *essential* to the possibility of a wormhole time machine. Just as Einstein's famous prediction (verified in 1919) from general relativity, that star light passing near the Sun's edge is bent *inward* by the Sun's attractive gravitational field, the repulsive, anti-gravity field of a wormhole will cause any light rays traveling through the wormhole to be bent *outward*. That is, a tight, narrow beam of radiation entering a wormhole will emerge *defocused*. This is crucial because, as you'll soon see, a wormhole time machine would otherwise be destroyed by the light from the dimmest candle.

One might take the failure of astronomical searches for a double-spike light signature to mean that wormholes with negative mass throats (thus violating the WEC) simply don't exist. But not so fast. The first hint that the possibility of a negative energy density might not be such a crazy idea occurred as long ago as 1948, with a theoretical prediction made by the Dutch physicist Hendrick Casimir (1909–2000). As pointed out in Chap. 1, the Heisenberg uncertainty principle allows a temporary violation of conservation of energy to occur, with the magnitude of the allowed violation increasing with decreasing time duration. Even in a vacuum, then, with particle/anti-particle creation and annihilation spontaneously and continuously taking place, the *average* energy density being zero does not

[37]The *strong energy condition* says gravity is always attractive—which is clearly not true in a wormhole throat—and so static, traversable wormholes violate both the weak *and* the strong energy conditions.

[38]H. Bondi, "Negative Mass in General Relativity," *Reviews of Modern Physics*, July 1957, pp. 423–428.

[39]For example, general relativity says that a negative mass will *repel* all other masses (positive *and* negative), whereas a positive mass will *attract* all other masses (positive *and* negative). Imagine, then, a negative mass attached to the nose of a positive-mass spaceship. The spaceship tries to move toward the negative mass, while the negative mass tries to move away from the spaceship. So off they both go into the sky, like a cat chasing its tail. This so-called *reactionless anti-gravity drive*, bizarre as it appears, does not violate either of the conservation laws of energy or momentum. See G. Cavalleri and E. Tonni, "Negative Masses, Even if Isolated, Imply Self-Acceleration, Hence a Catastrophic World," *Il Nuovo Cimento B*, July 1997, pp. 897–903.

preclude fluctuations away from zero and so, at times, actually becoming *negative*. What Casimir showed was that if one positioned two perfectly conductive plates parallel to each other, then the normal quantum fluctuations of the energy density in this 'vacuum sandwich' would be altered in such a way as to result in their mutual attraction—and this (tiny) effect was later actually observed.[40]

What does it mean to 'alter the normal quantum fluctuations'? Consider the creation of a photon and its anti-particle, which is another photon. From the wave interpretation of particles, the parallel plates restrict the photons that appear in the vacuum layer to those that have wavelengths that 'fit' because those wavelengths are submultiples of the plate separation (this requirement follows from the fact that a perfectly conducting plate cannot support a non-zero tangential electric field). Photons with longer wavelengths than the plate separation cannot 'fit' and thus do not appear. That is, the parallel plates have created a boundary condition that has quantized the electromagnetic field. The absence of these 'longer wavelength' photons lowers the average energy density between the plates and, because the average without the plates is zero, the altered average energy density must be negative. Indeed, the more the maximum allowed photon wavelength decreases with decreasing plate separation, the more negative the average energy density becomes in the enclosed Casimir vacuum. The negative energy density manifests itself as an inward directed force per unit area (remember, energy density and pressure are dimensionally equivalent).

The experimental detection of the Casimir effect was a remarkable event in physics. As one mathematician put it, "No worker in the field of overlap of quantum theory and general relativity can fail to point this fact out in tones of awe and reverence."[41] Robert Forward, an imaginative physicist who has appeared in this book earlier as an enthusiastic supporter of time travel, has described how the Casimir force might be used to extract energy literally *from a vacuum*. This is an idea as seemingly impossible as is the plan of one science fiction professor to squeeze energy out of *time*. As he asks his assistant, "But tell me, Bob, isn't that a ridiculous thought? To take time, something intangible, invisible, incomprehensible, and contract it — squeeze it together like a sponge?"[42] The story is fun, but Forward's proposal is that as well—*and* good physics.[43] Now, what does all this have to do with wormhole time machines?

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[40]A complete presentation of Casimir's analysis, with citations to the original literature, can be found in L. E. Ballentine, *Quantum Mechanics*, Prentice-Hall 1990, pp. 399–403. For an historical, tutorial presentation, including Casimir's personal comments on how he was led to make his discovery, see P. W. Milonni and M.-L. Shih, "Casimir Forces," *Contemporary Physics*, September–October 1992, pp. 313–322.

[41]S. A. Fulling, *Aspects of Quantum Field Theory in Curved Space-Time*, London Mathematical Society 1989.

[42]E. Binder, "The Time Contractor," *Astounding Stories*, December 1937.

[43]R. Forward, "Extracting Electrical Energy from the Vacuum by Cohesion of Charged Foliated Conductors," *Physical Review B*, August 15, 1984, pp. 1700–1702.

Thorne and his colleagues (note 27) proposed to use the Casimir effect to achieve the "exotic condition" *without* matter. Their idea was to place identical, conducting, spherical plates that carry equal electric charges at each end of the wormhole (remember, the wormhole mouths are spherically symmetric). The two identical charges repel each other, but the charge size is adjusted so that the gravitational attraction of the plates precisely cancels the repulsion. They then calculated that the Casimir effect results in a negative energy density sufficient to provide the throat tension necessary to prevent wormhole collapse.

There *are* some weird aspects to this (and perhaps that's no surprise). For example, the analysis assumed that the wormhole length is *very* small compared to its radius (10^{-10} cm long and 200 million miles wide!), with the short length required because it represents the separation of the wormhole plates, and the smaller the separation the more negative the average energy density. (The functional dependence is as the *fourth* power of the separation.) Another problem is the balancing of the electrical repulsion and the gravitational attraction of the wormhole mouth plates, as such a balance is clearly an unstable one. Finally, because the two spherical plates completely fill the wormhole mouths, how would a traveler actually get through the wormhole? The 'answer' was to drill a hole through the plates and hope that wouldn't perturb the Casimir vacuum too much.[44]

All the above litany of the difficulties static, traversable wormholes face in simply existing is certainly daunting, but let's now ignore all that and suppose we actually have a wormhole with both mouths in the same universe. (For use as a time machine, it would seem desirable for the time traveler to remain in his/her own universe!) So, how do we turn the wormhole into a time machine? Interestingly, while it is general relativity that gives us the wormhole, it is special relativity that adds the final touch of backward time travel. We begin by imagining that, somehow, one mouth of the wormhole can be moved with respect to the other mouth. One early suggestion, for example, was to use the gravitational attraction of a large asteroid to 'drag' one end of the wormhole, thereby inducing a time dilation effect.[45]

That is, suppose we have two clocks A and B, one in each mouth of the wormhole. These two clocks, and all other clocks in the flat spacetime outside the wormhole, are initially indicating the same time and running at the same rate. Now, recalling the twin paradox from Chap. 3, let each mouth-clock play the role of one of the twins. Imagine that A and B are now separated because the mouth containing B is placed on board a rocket ship. The rocket ship takes a long, high-speed trip out into space along the straight-line path joining A and B in external space, and then returns, just as described in Sect. 3.5. We then unload the space traveling wormhole mouth (with its clock B) and reposition it at its original location. What

[44]The very next year it was shown how to construct non-spherically symmetric wormholes to avoid that particular problem: see the two papers by M. Visser, "Traversable Wormholes: Some Simple Examples," *Physical Review D*, May 15, 1989, pp. 3182–3184, and "Traversable Wormholes from Surgically Modified Schwarzchild Spacetimes," *Nuclear Physics B*, December 11, 1989, pp. 203–212.

[45]J. L. Friedman, "Back to the Future," *Nature*, November 24, 1988, pp. 305–306.

is the situation now? We can summarize matters as follows: (1) Clock A, in the non-moving mouth, remains in-step with the local clocks in the space outside the mouth. (2) Clocks A and B, both inside the wormhole, have *not* moved with respect to each other because we are assuming a very short wormhole handle, as in part (b) of Fig. 6.8. We can arrange for the motion of the space traveling mouth (with clock B) to be such that the handle is always short, and so the distance between clocks A and B changes by an arbitrarily small amount. Thus, clocks A and B remain in-step with each other. (3) Clock B, because it has been moving with respect to its external space, arrives back at its starting position reading *behind* (that is, *earlier*) than the clocks outside its wormhole mouth.

For the sake of argument, then, suppose the journey of B is such that there is a two-hour time-slip between clock B and its local, external clocks. Thus, if clock B reads 9 A.M., the clocks outside of mouth B will read 11 A.M. But because clocks A and B are in-step, clock A reads 9 A.M., as do the clocks outside of mouth A. That is, the wormhole connecting mouth A to mouth B is a connection between two parts of the same universe that are two hours apart in time. Now, suppose the journey from mouth A to mouth B can be made through external space in one hour. Then, one could leave mouth A at 10 A.M., rocket to mouth B by 11 A.M., and travel back to mouth A via the wormhole to the starting point—where it is 9 A.M., one hour *before* the trip began! We could, in fact, imagine repeating this process, going back one additional hour for each new loop through the wormhole. One clear restriction, however, is that we could not go back in time to *before* the creation of the wormhole time machine. The wormhole works in the other direction, too. To see this, suppose that the space traveler leaves mouth B at 8 A.M. and rockets through external space to mouth A, arriving at 9 A.M. Entering mouth A, he exits from mouth B (where he started) at 11 A.M., two hours in the future.

Another way to induce a time dilation effect, to convert a wormhole to a time machine, *without moving either mouth*, is to simply place one mouth in an intense gravitational field, that of, say, a neutron star. (Recall, from Sect. 3.3, how gravity influences the time-keeping rate of a clock.) As the physicists who proposed this idea put it, almost *any* interaction with surrounding matter and gravity fields almost inevitably turns a wormhole into a time machine.[46] Others have admitted that the details of the origin of time dilation are probably not issues worth debating, but rather what is called the *back-reaction* is of far more concern.

To understand the back-reaction requires mention of what is called the *Cauchy horizon*, the hyperspace surface in spacetime that separates the region where closed timelike lines can exist, from the region where they cannot exist. The back-reaction is the build-up of unbounded energy levels on the Cauchy horizon, causing its instability and rapid destruction. The name of the horizon comes from the "Cauchy problem"—named after the nineteenth century French mathematician Augustin-Louis Cauchy (1789–1857)—in the theory of partial differential equations. In this

[46] V. P. Frolov and I. D. Novikov, "Physical Effects in Wormholes and Time Machines," *Physical Review D*, August 15, 1990, pp. 1057–1065.

theory a Cauchy initial-value problem is said to be well-defined if the initial conditions determine a unique solution, and if a continuous variation in the initial conditions gives a continuous variation in the solution. In that part of spacetime where closed timelike loops are not allowed, backward causation does not occur (by definition) and the laws of physics (all expressed as differential equations) satisfy the Cauchy condition. Outside of this *chronal* region, that is, beyond the Cauchy horizon where physics is *dischronal*, however, the possibility of backward causation raises the possibility of violating the Cauchy condition, and in such a case the Cauchy horizon is also sometimes called the *chronology horizon*.[47]

The instability of the Cauchy horizon is caused by radiation that propagates in closed timelike loops that thread through the wormhole on 'straight lines.' This radiation, as shown a half-century ago,[48] builds-up unbounded energy density levels at the horizon, and thus destroys the horizon. Thorne and his colleagues argued that the defocusing effect of their wormhole time machine's repulsive gravity would be sufficient to counter a disruptive energy build-up on the horizon (note 27). Subsequent analyses have examined other possible ways to avoid unbounded energy density on the Cauchy horizon. For example, in one paper[49] it was imagined that a wormhole time machine has had a circular motion induced for mouth B; that is, mouth B orbits around mouth A. The result is that the Cauchy horizon now does seem to be stable, because now there are no fixed, straight-line timelike loops threading the wormhole from A to B to A to B to . . .. That is, B is a 'moving target' and there is no point on the Cauchy horizon where the energy density becomes unbounded.

Yet another approach for achieving the disruption of destructive, circulating energy loops through a wormhole is by placing a spherical mirror between the two mouths of the wormhole. Proposed by the Chinese physicist Li-Xin Li, a Li mirror would divert all closed null geodesics (represent circulating radiation) that potentially thread through the wormhole.[50] Such potentially fatal geodesics would, instead, be scattered back into space, whereas a purposeful traveler could navigate *around* the mirror and thus use the wormhole as a time machine.

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[47]A classic work on the mathematics of Cauchy problems is J. Hadamard, *Lectures on Cauchy's Problem in Linear Partial Differential Equations*, Dover 1952. There is a curious bit of irony in this. In a section of his book, Hadamard uses spacetime to illustrate one possible four-dimensional space and, in passing, he casually writes "This conception was beautifully illustrated a good many years ago by the novelist Wells in his *Time Machine*." Hadamard wrote his book in 1923, and he would almost certainly have been astonished to have been informed that less than seventy years later his work would play a central role in the non-fictional theory of time machines.

[48]C. W. Misner and A. H. Taub, "A Singularity-Free Empty Universe," *Soviet Physics JETP*, January 1969, pp. 122–133.

[49]I. D. Novikov, "An Analysis of the Operation of a Time Machine," *Soviet Physics JETP*, March 1989, pp. 439–443.

[50]L.-X. Li, "New Light on Time Machines: Against the Chronology Protection Conjecture," *Physical Review D*, November 1994, pp. R6037–R6040.

Cauchy horizon instability from the back reaction is central to Hawking's Chronology Protection Conjecture, discussed in Chap. 1. His analysis (see note 54 in Chap. 1) led him to conclude that a physical entity—the stress-energy tensor—becomes unphysical on the Cauchy horizon. That is, because of time-traveling quantum field fluctuations of the vacuum, that tensor diverges to infinity at the horizon. This results in a failure of that horizon to form in the first place or, if it does form, in the creation of a singularity that 'seals-off' the horizon to any would-be time travelers attempting to gain access to the closed timelike loops beyond the horizon. Others, however, argued that Hawking was mistaken in claiming that the divergence of the stress-energy tensor on the Cauchy horizon will always forbid time travel.

In a study, for example, of a complex-valued spacetime metric (and such a metric *is* allowed in the so-called 'sum over all possible geometries, path integral' approach to the quantum theory of gravity), that has causal and non-causal spacetime regions separated not by a Cauchy horizon but rather by a region of complex geometry, the stress-energy tensor is always physical and diverges nowhere. The complex geometry region plays the same role as the Cauchy horizon, because such a region would, *classically*, mean that the two regions cannot be reached from one another, but via quantum tunneling an observer *could* travel between the two regions.[51] In fact, studies of stress-energy divergence actually have a long history. For example, the effect of an unphysical (infinite) gravitational and/or electromagnetic energy flux had been analyzed *years before* the wormhole time machine studies began.[52] The authors studied the case of a potential traveler to "new worlds" who tries to cross the Cauchy horizon of an electrically charged, non-rotating black hole. An even earlier computer study had already concluded that, for such a traveler, the attempt to cross the horizon "looks liable to prove a dangerous undertaking."[53]

It isn't at all clear, in fact, if a *theoretical* divergence of the stress-energy *is* the signature of a failure of physics. One doesn't need anything as bizarre as a time machine for the stress-energy to diverge *on paper*. It was shown nearly 40 years ago, for example, that such a theoretical divergence occurs for the electromagnetic field near a perfectly conducting boundary.[54] But it is simply the unphysical nature of a "*perfectly* conducting" boundary condition that causes the divergence, not the fact that the field actually exists near a conducting boundary. Similarly, other real-life considerations (quantum gravity) *may* keep the stress-energy physical everywhere in a time machine spacetime.

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[51]L.-X. Li, J.-M. Xu, and L. Liu, "Complex Geometry, Quantum Tunneling, and Time Machines," *Physical Review D*, November 15, 1993, pp. 4735–4737.

[52]S. Chandrasekhar and J. B. Hartle, "On Crossing the Cauchy Horizon of a Reissner-Nordström Black-Hole," *Proceedings of the Royal Society of London A*, December 8, 1982, pp. 301–315.

[53]M. Simpson and R. Penrose, "Internal Instability in a Reissner-Nordström Black Hole," *International Journal of Theoretical Physics*, April 1973, pp. 183–197.

[54]D. Deutsch and P. Candelas, "Boundary Effects in Quantum Field Theory," *Physical Review D*, December 15, 1979, pp. 3063–3080.

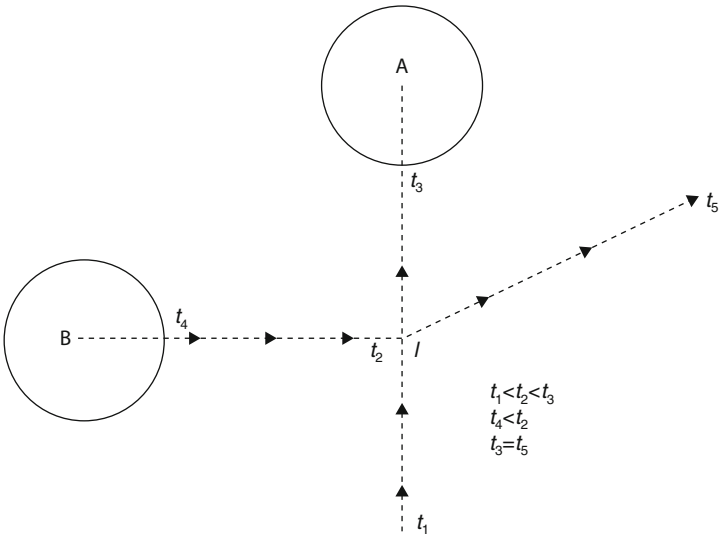

Fig. 6.9 The grandfather paradox in the billiard ball world. A billiard ball approaches mouth A of a time machine wormhole, dead-on center and, just before entering A, it passes without incident through point *I*. The ball then enters A and so exits mouth B in the past, *just in time* to pass through point *I* and *hit its younger self*. This impact knocks the younger ball *away from* A, so we have the familiar paradox of changing the past. That is, the impact did not occur when the ball 'originally' passed through *I* on its way to A and, of course, we also wonder how the ball manages to hit itself after leaving B if it then *doesn't* enter A?

Assuming a wormhole time machine has (somehow) become available, with its Cauchy horizon intact, how do the 'paradoxes' of time travel come into play? In an attempt to study the grandfather paradox, in particular, Thorne and his colleagues studied self-interacting billiard balls traveling backward in time through a wormhole.[55] They used billiard balls—see Figs. 6.9 and 6.10—rather than human time travelers for the same reason Wheeler and Feynman used a pellet and shutter mechanism in their study of advanced electromagnetic waves—to avoid any metaphysical questions about human free will. The central issue for them was the determination of the multiplicity of trajectories for a single, self-interacting time traveling ball, where the Cauchy condition for a well-defined trajectory in spacetime is *unique* self-consistency.

That is, for the trajectory to be well-defined in the Cauchy sense, it was expected there would be exactly *one* consistent trajectory for a self-interacting ball. A multiplicity of zero, of course, would be the physics declaring backward time travel through the wormhole to be nonsense—and that was thought to be a distinct

[55]F. Echeverria, G. Klinkhammer, and K. S. Thorne, "Billiard Balls in Wormhole Spacetimes with Closed Timelike Curves: I. Classical Theory," *Physical Review D*, August 15, 1991, pp. 1077–1099. The authors credited the physicist/science fiction writer Robert Forward (who used the same ideas in his 1992 novel *Timemaster*) for motivating their research.

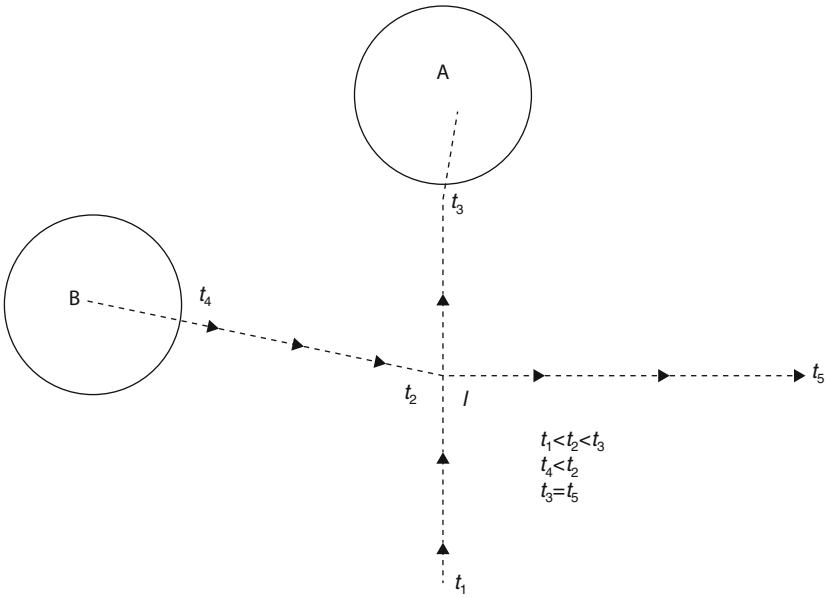

Fig. 6.10 The principle of self-consistency in the billiard ball world. Now the ball, in passing through point *I* on its dead-on center path toward mouth A of the wormhole time machine, is suddenly hit a grazing blow by another ball that has just shot out of mouth B (and into the past) at an angle. The impact knocks the first ball slightly off its original trajectory, and it enters mouth A slightly off-center. Thus, the ball emerges from B into the past slightly off-center and just in time to glace off itself at *I*—which explains *why* it emerged from B slightly off-center!

possibility. The actual results were, however, surprisingly different. It was found, under very general assumptions about the wormhole parameters, that (1) there are no trajectories with zero multiplicity and (2) the multiplicity is *not* one but rather is *always* infinity! Thus, the billiard ball form of the grandfather paradox *was* found to be *not* well-defined, but not for the expected reason that there was no self-consistent solution. Instead, it was because there are *too many* solutions.

This astonishing, completely unexpected result seems to be just what is needed to support the viability of time machines, as it appears to allow a definition of *well-defined* in the Cauchy sense and still permit an answer to the puzzle of free will. The initial conditions of a time traveling ball give rise to an infinity of self-consistent trajectories, each occurring in the same way that a random variable takes on different values with each new performance of the experiment that the random variable is defined on. And yet, there are still unique probability density functions for all sets of measurements that one might make anywhere along these trajectories. Thus, the Cauchy problem is *stochastically* well-defined; at the start of any

trajectory, we do not know in detail what will happen except that whatever does happen will be self-consistent. In this probabilistic sense, then, wormhole time travel to the past and the retention of free will both make sense. The Russian physicist Igor Novikov and his colleagues continued the study of time traveling billiard balls,[56] demonstrating that one can *deduce* self-consistency from the long-accepted principle of least action (that is, self-consistency is not an additional assumption to existing physics).[57]

The one-wormhole, two-mouth time machine was actually not the first kind of wormhole time machine described in the physics literature. In their 1988 paper (note 21), Morris and Thorne initially described a time machine constructed from *two* wormholes, but they added a note-in-proof at the end that they had just discovered how to build a time machine using one wormhole (the machine we have been discussing). This reduction in the required number of wormholes was thought to be a technical advance, of course, and so the two-wormhole time machine was put aside.

But not for long. Soon thereafter the concerns about Cauchy horizon stability began to surface, a concern that one-wormhole time machines might destroy themselves just at the instant their mouths were about to be threaded by closed timelike curves. As noted earlier, the negative mass wormhole throat has a defocusing effect on electromagnetic radiation (and so the initial concern, that time traveling photons might be fatal, faded)—but then it was found that vacuum fluctuations of quantum fields are *not* so defocused.[58] That failure to defocus time-traveling vacuum polarizations (as quantum field fluctuations are called) was shown to result in an unphysical divergence of the stress-energy on the Cauchy horizon of a one-wormhole time machine.[59] This sounds bad, but the hope was that the divergence wouldn't actually be fatal: it appeared to be sufficiently sluggish that it was suggested reaching an actual *infinity* of the stress-energy would be precluded by the eventual intercession of quantum gravity. That is, the stress-energy might *try* to become unbounded as spacetime approached the formation of a time machine

[56]A. Lossev and I. D. Novikov, "The Jinn of the Time Machine: Nontrivial Self-Consistent Solutions," *Classical and Quantum Gravity*, October 1992, pp. 2309–2321; E. V. Mikheeva and I. D. Novikov, "Inelastic Billiard Ball in Spacetime with a Time Machine," *Physical Review D*, February 15, 1993, pp. 1432–1436; M. B. Mensky and I. D. Novikov, "Three-Dimensional Billiards with a Time Machine," *International Journal of Modern Physics D*, April 1996, pp. 179–192.

[57]A. Carlini, *et al.*, "Time Machines: The Principle of Self-Consistency as a Consequence of the Principle of Minimal Action," October 1995, pp. 557–580, and "Time Machines and the Principle of Self-Consistency as a Consequence of Stationary Action (II): The Cauchy Problem for a Self-Interacting Particle," October 1996, pp. 445–479, both in *International Journal of Modern Physics D*.

[58]V. P. Frolov, "Vacuum Polarization in a Locally Static Multiply Connected Spacetime and a Time-Machine Problem," *Physical Review D*, June 15, 1991, pp. 3878–3894.

[59]S.-W. Kim and K. S. Thorne, "Do Vacuum Fluctuations Prevent the Creation of Closed Timelike Curves?" *Physical Review D*, June 15, 1991, pp. 3929–3947. See also L.-X. Li, "Must Time Machines Be Unstable Against Vacuum Fluctuations?" *Classical and Quantum Gravity*, September 1996, pp. 2563–2568.

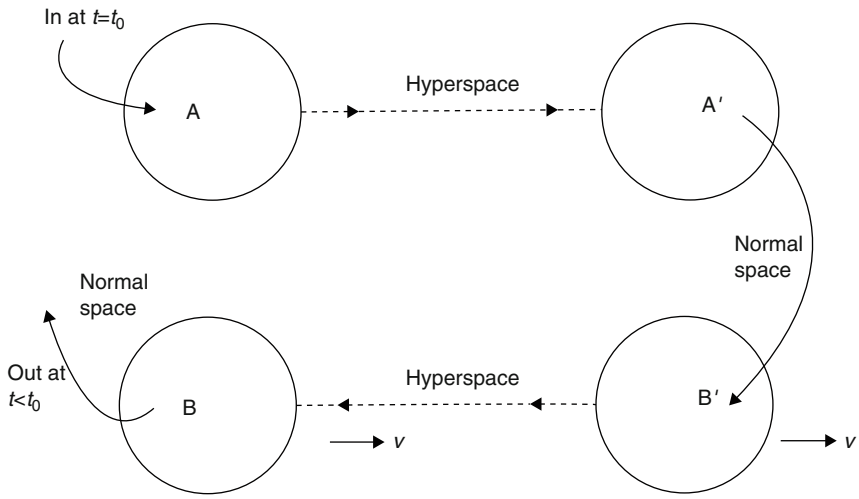

Fig. 6.11 A two-wormhole, Roman ring time machine

but, before it becomes so large as to destroy the time machine, quantum gravity would cut-off the divergence 'in time' (so to speak!) to save the machine.

Hawking disagreed (in his famous Chronology Protection Conjecture—see note 54 in Chap. 1), arguing that Kim and Thorne had made a crucial error in their calculations. According to Hawking, the divergence of the stress-energy may indeed be cut off by quantum gravity, but not before the development of spacetime disturbances representing perhaps a hundred million times the energy levels associated with ordinary chemical binding energies. These would be sufficiently big disturbances to raise serious doubts about the physical survival of a one-wormhole time machine, even in the absence of a true stress-energy infinity. Hence the resurrection of the two-wormhole time machine geometry. Perhaps *it* could avoid the destructive effect of time-traveling vacuum fluctuations.

If a spacetime contains multiple wormholes, then it is called a *Roman spacetime* after the physicist Thomas Roman (at Central Connecticut State University), who was the originator of such spacetimes. Each of these wormholes, individually, is *not* a time machine. Together, however, they form a time machine geometry called a *Roman configuration* (or a *Roman ring*).[60] Here's how.

In Fig. 6.11 two pairs of wormhole mouths are labeled A, A' and B, B'. We imagine that the A, A' wormhole is stationary and that its two mouths are very far apart in normal space—so far apart, in fact, that if a traveler enters A and almost instantly (because the wormhole handle is very short in hyperspace) emerges from A', it will appear to an observer at rest with respect to the wormhole that the traveler has moved faster than light. That is, entering A and exiting A' are events with

[60]M. Visser, "Traversable Wormholes: The Roman Ring," *Physical Review D*, April 15, 1997, pp. 5212–5214.

spacelike separation. Now, imagine also that the wormhole with mouths B, B' is moving past the first wormhole at speed v. To an observer in this second, *moving* frame of reference, the spacelike separation of entering A and exiting A' can result in the two events being temporally reversed if v is sufficiently large (but still less than the speed of light). Therefore, upon emerging from A' the traveler crosses normal space to the moving wormhole mouth B', enters the wormhole, and then almost instantly emerges from mouth B, and finally travels again through normal space to mouth A. If the traveler can make the two trips in normal space in less time than the backward time shift achieved by the temporal reversal of entering A and exiting A', then we have a time machine

Two simultaneous analyses of the Roman ring time machine each concluded that, for suitable choices of sizes (the radii of the wormhole mouths, the wormhole lengths in normal space, the lateral offset of the two wormholes, and the relative speed of the wormholes), the stress-energy divergence *can* be limited by quantum gravity to an arbitrarily weak level. That is, the two-wormhole time machine is not necessarily destroyed by an unbounded stress-energy on the Cauchy horizon.[61] But not all was now put right.

Visser, in particular, had some strong reservations about the Roman ring. Although he granted that a quantum gravity cut-off the stress-energy divergence *would* probably occur in the Roman ring, he called the required special sizing conditions "bizarre," and asserted that the resulting time machine would be quite useless for a human traveler in any case. For example, he calculated that only if the mouths of the wormholes are separated in normal space by the radius of the universe (!), and only if the wormhole mouths have radii on the order of that of an atomic nucleus, would the cut-off be sufficient to allow the putative time machine to avoid destruction. When Visser reduced the wormholes from universe size to 'merely' that of the distance between the Sun and the Earth, he concluded that it would require energy at the level of the Superconducting Supercollider accelerator to blast an information-bearing message through the narrow wormholes. And even then the 'short' wormholes would provide a maximum penetration into the past of just eight minutes. As Visser put it, "This does not seem to be a workable recipe for studying tomorrow's *Wall Street Journal*.

Lyutikov, on the other hand, took a far less negative stance. He concluded that although Visser's calculations "make it very inconvenient for time travel [by humans]," nevertheless "the [principal] question of the possibility of transmitting information back in time through traversable wormholes would still remain."

The wormholes we have been discussing so far are *static* in time, but another approach is to allow them to be dynamic structures in spacetime. That is, to allow one or more of their parameters to vary with time (perhaps, for example, the throat diameter could collapse). Then, according to one analysis, it is possible to have a

[61] M. Visser, "Van Vleck Determinants: Traversable Wormhole Spacetimes," April 15,1994, pp. 3963–3980, and M. Lyutikov, "Vacuum Polarization at the Chronology Horizon of the Roman Spacetime," April 15, 1994, pp. 4041–4048, both in *Physical Review D*.

traversable wormhole *made of normal matter* and, even though it is collapsing, it would take so long to do so that "a space adventurer will have enough time to pass through the throat of the wormhole from one asymptotically flat region [of spacetime outside the entry mouth of the wormhole] to the other [spacetime region outside the exit mouth of the wormhole] before the radius of the throat shrinks to . . . where the event horizon is developed."[62] Such a dynamic wormhole, it was claimed, satisfies both the weak and the dominant energy[63] conditions, but not the strong energy condition. Thus, gravity would still be repulsive in the throat, but this condition (which would seem to require *exotic* matter) was brushed aside because such a condition is thought to have actually occurred, on a massive scale, during the inflationary stage of the Big Bang[64] (although how that would help in the construction of a wormhole in the future is a bit murky).

Is it reasonable to think 'useable' wormholes, static or otherwise, can be acquired for the purpose of creating a time machine? At one time, Hawking was sure the answer is no, once writing "The philosophy of this paper is . . . to look for vacuum polarization [the divergence of the stress-energy on the Cauchy horizon] to enforce the chronology protection conjecture."[65] It became increasingly apparent, however, that matters would be a great deal more involved and, as Hawking himself came to admit, "the fact that the energy-momentum tensor fails to diverge [in certain special cases of time machine spacetimes] shows that the back reaction does not enforce chronology protection.".[66]

I think the best (and most honest) way to respond to the 'reasonable' question that opened the previous paragraph is with words from 20 years ago, by the Russian astrophysicist Serguei Krasnikov, words still valid today: "It may well be that the vacuum fluctuations do make the time machine unstable, but nothing at present

[62]A. Wang and P. S. Letelier, "Dynamical Wormholes and Energy Conditions," *Progress of Theoretical Physics*, July 1995, pp. 137–142. See also L. A. Anchordoqui, *et al.*, "Evolving Wormhole Geometries," *Physical Review D*, January 15, 1998, pp. 829–833.

[63]The dominant energy condition is the weak energy condition *plus* the requirement that any observed energy flux is *never* superluminal.

[64]During inflation the universe is thought to have expanded at a rate far beyond human comprehension. It has been estimated that during the first 10^{-35} second of the Big Bang the universe doubled in each spatial dimension by a factor of two each 10^{-37} second; that is, there were about 100 such doublings. Thus, there was an increase by a factor of $2^{100} \approx 10^{30}$ in each linear dimension of the universe, and the volume increased by the cube of that enormous factor. See Alan Guth, *The Inflationary Universe*, Addison-Wesley 1997.

[65]S. Hawking, "Quantum Coherence and Closed Timelike Curves," *Physical Review D*, November 15, 1995, pp. 5681–5686.

[66]M. J. Cassidy and S. W. Hawking, "Models for Chronology Selection," *Physical Review D*, February 15, 1998, pp. 2372–2380. See also L.-X. Li and J. R. Gott, "Self-Consistent Vacuum for Misner Space and the Chronology Protection Conjecture," *Physical Review Letters*, April 6, 1998, pp. 2980–2983.

suggests this. All we have are a few simple examples. In some of them the energy density diverges at the horizon and in some does not. So, the time machine perhaps is stable and perhaps is not."[67]

The daunting level of technology required to *build* a wormhole (with or without exotic matter) doesn't mean we can't search for existing wormholes. Perhaps, for example, vast wormhole networks were formed naturally at Big Bang time, as described in Gregory Benford's 1997 novel *Foundation's Fear*, where wormholes are "leftovers from the Great Emergence [the Big Bang]." Or perhaps "advanced civilizations" long ago constructed a vast, pan-galactic 'subway system' of wormholes like the one described in Carl Sagan's 1985 novel Co*ntact* (and dramatically illustrated in the 1997 film).

Of course, any such wormhole, if found (via its double-spike light signature, for example), could be a very long way from Earth. It might even be in another galaxy. So, even if we found a wormhole, what could we *do* with it? Surprisingly, maybe a lot. The Russian physicists Igor Novikov and Andrei Lossev (note 56) suggested that a wormhole might be very useful *even if its location is completely unknown, even if we haven't yet even discovered it*! The only assumption they made was that the wormhole has existed for a "sufficiently long time" (and precisely what that means will be explained in just a bit). With that assumption, they showed how to make an information-creating time loop. Here's how they did that.

They began their analysis by assuming that people have no knowledge of how to build spacecraft that can make the interstellar voyage to the distant wormhole, even if they knew in which direction to go to reach the mouth that leads backward in time (mouth B). Instead, they build an automatic spacecraft construction plant that can follow any detailed sequence of instructions provided to it, and then stockpile it with a supply of raw materials (energy, steel, plastic, computers, and so on). When the spacecraft construction is done (*how* that is done is explained in the next paragraph), the last step before launching the spacecraft toward mouth B *will be* to load the on-board computer with the following three pieces of information:

1. The detailed sequence of instructions to be followed in the construction of the spacecraft;
2. The direction from Earth to mouth B;
3. The direction from mouth A (the wormhole exit mouth in the past) back to Earth.

To summarize, people build the automatic plant, load it up with raw materials, *and then withdraw*. This last step is crucial, because it eliminates human free will from further consideration, that is, it removes any temptation to create a bilking paradox. So, what happens next?

Lossev and Novikov suggest that what happens next is that a *very* old spacecraft suddenly appears in the sky and lands next to the automatic construction plant. In its on-board computer are items a, b, and c. Using item a, the automatic plant makes a

[67]S. V. Krasnikov, "Quantum Stability of the Time Machine," *Physical Review D*, December 15, 1996, pp. 7322–7327.

new spacecraft, then loads the new on-board computer with items a, b, and c from the *very* old spacecraft's on-board computer, and then the new spacecraft is launched toward mouth B (using the information of item b). The *very* old spacecraft is given an honored place in a museum.

The new spacecraft arrives at the distant mouth B in the far future, by which time it is, of course, an old spacecraft (but not yet a *very* old spacecraft). It then plunges into mouth B and almost immediately emerges from mouth A, in the past. Indeed, it repeats this process as many times as required until it is in the far distant past, at a time even before it left Earth. (It might seem that to do this, the spacecraft's computer memory needs a fourth piece of information, the direction from mouth A back to mouth B, but in fact items b and c are sufficient for the old spacecraft to find its way from A to B.) It is now clear how long the wormhole must have been in existence. The old spacecraft repeatedly uses the wormhole time machine until it is so far in the past that it can cruise back to Earth at normal speed (it knows the way back because of item c) and arrive as a *very* old spacecraft, just in time to be placed in the museum!

As Lossev and Novikov pointed out, this remarkable, looped sequence of events has increased knowledge from what it was at the time just before the automatic construction plant was built. People now know both how to build an interstellar spacecraft, and the locations of both mouths of the wormhole. They also now possess a *very* old, used spacecraft. It is curious to note that although the information in the *very* old spacecraft's computer memory has traveled on a closed time loop, the *very* old spacecraft itself has not. This is because the spacecraft left Earth when new, but arrived back (before it left) as *very* old, whereupon it promptly entered a museum. There is therefore no question about the origin of the *very* old spacecraft, but where did the information of items a, b, and c come from? Lossev and Novikov say it came from the energy gained by the spacecraft as it interacted (will interact?) with the rest of the universe while on its journey.

Nobody said time travel isn't weird!

6.4 Gott's Cosmic String Time Machine

"It's an amazingly simple solution. It doesn't take much physics to understand it."

—MIT astrophysicist Alan Guth, on Gott's discovery of the cosmic string time machine[68]

"Louise, working out the spacetime geometry of a cosmic string is a hard problem in general relativity. But, given that geometry, all the rest of it is no more than Pythagoras' theorem . . ."

—a character in Stephen Baxter's 1994 novel *Ring*, agreeing with Guth.

[68]Quoted from J. Travis, "Could a Pair of Cosmic Strings Open a Route Into the Past?" *Science*, April 10, 1992, pp. 179–180.

A new way to gain access to closed timelike curves, without the involvement of the exotic matter needed by negative-mass wormholes, was described in 1991 by the Princeton physicist J. Richard Gott.[69] Gott gave exact solutions to Einstein's gravitational field equations for what are called *cosmic strings*, solutions that (1) unlike wormholes, do not violate any of the energy conditions, (2) unlike black holes have no crushing singularities or event horizons, and (3) are not topologically multiply connected.

Cosmic strings are fantastically thin (10^{-28} cm in radius) filaments of pure energy that are thought to stretch the width of the universe and to have an enormous linear mass-energy density of 10^{28} g/cm. To generate closed timelike paths in spacetime, Gott required that either two fast-moving (which means moving at practically the speed of light) parallel cosmic strings pass each other on a near-collision course, or that there be a closed-loop string that collapses in a slightly non-planar manner so that the opposite, nearly straight sides 'just miss.' The gravitational interaction of the passing strings can 'warp' spacetime enough to produce closed timelike curves.

A hint at the possibility of violating causality with strings had appeared before Gott's work, but those authors didn't take the time travel implications seriously. As they wrote, "We argue ... that any realistic model [for a spinning string with angular momentum[70]] ... will not have closed timelike curves."[71] Gott, however, showed that as two strings pass each other, closed timelike loops *do* encircle the strings.

Gott, who appears to be far less rigid in his view of time travel than are many of his fellow physicists, held out an escape to those who pale at the very thought of time travel to the past. Perhaps, he suggested (following in the footsteps of an analysis by Hawking[72]), as the strings (or string-loop sides) pass, a black hole will form with an event horizon that will seal-off the closed timelike curves from any would-be time traveler. Or perhaps, he further suggested, the more realistic case of non-singular strings (that is, strings with non-zero-filament radii) and possessing

[69] J. R. Gott, "Closed Timelike Curves Produced by Pairs of Moving Cosmic Strings: Exact Solutions," *Physical Review Letters*, March 4, 1991, pp. 1126–1129.

[70] The two strings in a Gott-pair are *not* necessarily spinning, and no such assumption was made by Gott. They don't even have to be parallel. If the strings have no spin, then it takes two strings to make a time machine. If spin *is* allowed, however, then just a single string will suffice for time travel: see S. Deser and R. Jackiw, "Time Travel?" *Comments on Nuclear and Particle Physics*, September 1992, pp. 337–354.

[71] D. Harari and A. P. Polychronakas, "Gravitational Time Delay Due to a Spinning String," *Physical Review D*, November 15, 1988, pp. 3320–3322.

[72] S. W. Hawking, "Gravitational Radiation from Collapsing Cosmic String Loops," *Physics Letters B*, August 23, 1990, pp. 36–38.

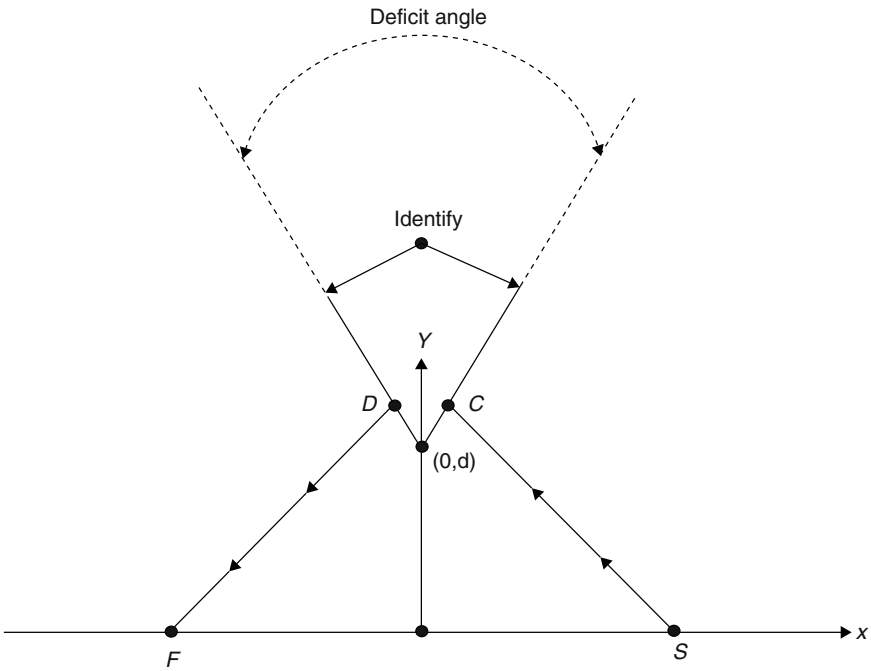

Fig. 6.12 The deficit angle in spacetime formed by a cosmic string

spin would banish the terrifying closed timelike curves. Subsequent analyses along those lines, however, continued to find the time travel implications intact.[73]

Here's how the cosmic string time machine works. In an earlier work,[74] published in 1985, Gott discovered that a cosmic string warps spacetime in a highly characteristic way, as shown in Fig. 6.12. A stationary cosmic string is imagined as perpendicular to the *xy*-plane (the plane of the page) and passing through the page at the point $(0, d)$ on the *y*-axis. The warp produced by the string is as though a wedge of angle 2α (this angle is called the *deficit angle*) were cut out of spacetime and the

[73]See, for example, B. Jensen, "Notes on Spinning Strings," *Classical and Quantum Gravity*, January 1992, pp. L7–L12, H. H. Soleng, "A Spinning String," *General Relativity and Gravitation*, January 1992, pp. 111–117, (the next two are in the *Physical Review D*), B. Jensen and H. H. Soleng, "General-Relativistic Model of a Spinning Cosmic String," May 15, 1992, pp. 3528–3533, and M. Novello and M. C. M. da Silva, "Cosmic Spinning String and Causal Protecting Capsules," January 15, 1994, pp. 825–830.

[74]J. R. Gott, "Gravitational Lensing Effects of Vacuum Strings: Exact Solutions," *The Astrophysical Journal*, January 15, 1985, pp. 422–427. Gott's discovery was independently reported in W. A. Hiscock, "Exact Gravitational Field of a String," *Physical Review D*, June 15, 1985, pp. 3288–3290.

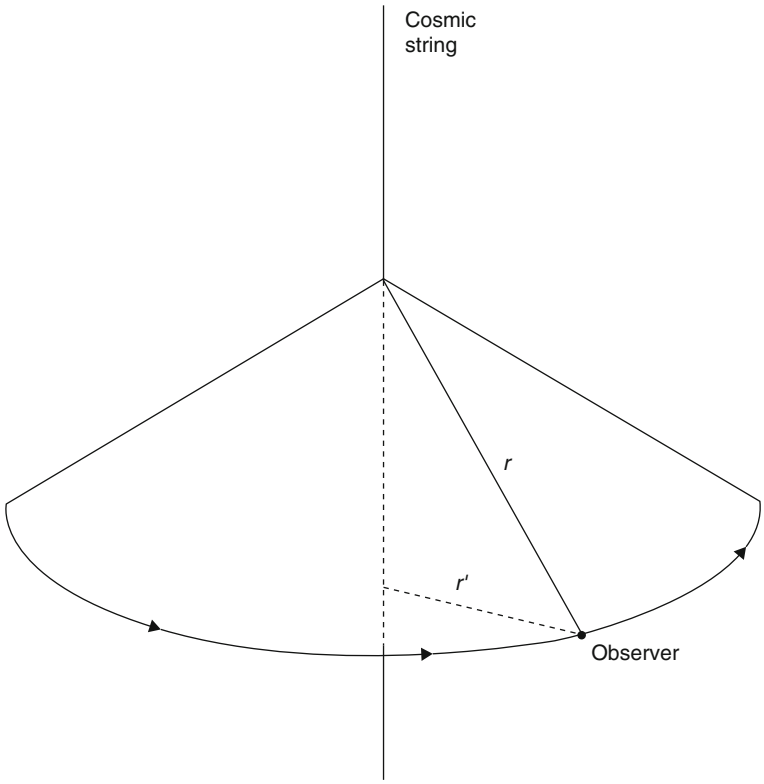

Fig. 6.13 The warped, conical spacetime around a cosmic string, An observer in this spacetime thinks she is distance r from the string, but a 'meta-observer' sees that she is actually distance r' from the string. Thus, if the observer follows a complete circular path around the string, she will travel a distance of $2\pi r' < 2\pi r$. The observer in the spacetime will interpret this result by saying that the angle 2π is really 2π minus 'a deficit'

edges of the cut were then 'glued' together; for example, points C and D are identified as identical. The reason for the term *deficit angle* is that at radius r from the string, a circular path around the string has the reduced length $(2\pi - 2\alpha)r$, and not the usual $2\pi r$ (spacetime around the string, while *locally* flat, is actually 'conical,' as illustrated in Fig. 6.13).

The deficit angle is equal to $8\pi\mu$ radians (in a system of units where G, Newton's gravitational constant, is 1) if the linear mass-energy density μ is expressed in units of Planck masses per Planck length. For example, $\mu = 1$ corresponds to 1.35×10^{28} g/cm (think of something on the order of the mass of the Earth per inch of the string). For 'more typical' values—say a 'mere' $\mu = 10^{22}$ g/cm, $2\alpha = 0.001^{\circ}$. While Gott's paper had appeared 5 months before Hiscock's (see note 74), it is evident that Hiscock's work was done before he became aware of Gott's. Both papers treat exact derivations of the deficit angle but, in fact, the correct expression had actually been

published 4 years earlier (but from a linearized form of the gravitational field equations and so the result was not as 'conclusive' as are Gott's and Hiscock's)[75]

Now, consider the two points S and F on the x-axis at $(x_0, 0)$ and $(-x_0, 0)$ in Fig. 6.12. Suppose we want to send photons from S to F. In normal, 'unwarped' spacetime, the direct path from S to F through the origin has length $2x_0$. There is also another possible path, however, S to C/D to F, that loops out and around the cosmic string. Indeed, this second path is simply the path a gravitationally lensed photon would take (an observer at F would see *two* images of S) and this—*not* time travel—is the issue that originally attracted Gott's attention to cosmic strings.[76] If the deficit angle were zero, then this alternative path would always be longer than $2x_0$, for any value of x_0. For the case of $2\alpha > 0$, however, if x_0 is large enough ($x_0 \gg d$), then it is possible for 'around the string and over the missing spacetime wedge' path to be shorter than the direct path.

The indirect path provides a way for a *sub*luminal trip (say, by rocket) from S to F to beat a photon traveling on the direct path. That is, the two events of the 'rocket leaving S ' and the 'rocket arriving at F' are spacelike separated. Thus, it is possible to find a moving frame of reference in which these two events are *reversed in temporal order*. In that frame of reference, the cosmic string (which is stationary in the reference frame of S and in that of F) will move—at speed v, say—in the $+x$ direction, and in that frame of reference the rocket will arrive at F *before* it leaves S.[77]

Then to complete the construction of a closed timelike path, simply repeat the process as shown in Fig. 6.14. That is, after the rocket arrives at F, have it turn around and fly back to S out-and-around and through the deficit angle spacetime warp due to a *second* cosmic string on the negative y-axis and perpendicular to the xy-plane. This second string is moving at speed $-v$ (that is, opposite to the first string), so the rocket will arrive at S before it leaves F. But that means it arrives at S before it leaves S; that is, the rocket has traveled into the past. In other words, the rocket has traveled into the past. This entire process is precisely the same idea behind the two-wormhole Roman-ring time machine discussion from the previous section.

Now, instead of having two oppositely moving reference frames, one in which the top, stationary string at $(0, d)$ appears to be moving at $+v$ and another frame in

[75] A. Vilenkin, "Gravitational Field of Vacuum Domain Walls and Strings," *Physical Review D*, February 15, 1981, pp. 852–857.

[76] Just as discussed earlier in the context of wormholes, gravitational lensing may offer a way to detect cosmic strings. See, for example, the two papers by D. L. Ossipov, "Diffraction of Light by a Cosmic String," November 1995, pp. 765–771, and "Contribution of Strings to the Observed Variability of Extragalactic Sources of Radiation," September 1996, pp. 419–425, both in *JETP Letters*.

[77] For this to happen, however, v must be very close to the speed of light. Gott (see note 69) showed that with $v = \tanh(\theta)$, the condition for the rocket to arrive back at S before it leaves S is $\cosh(\theta) \sin(\alpha) > 1$, where α is one-half the deficit angle. For $\mu = 10^{22}$ g/cm, this gives $v = 0.99999999995$ (times the speed of light).

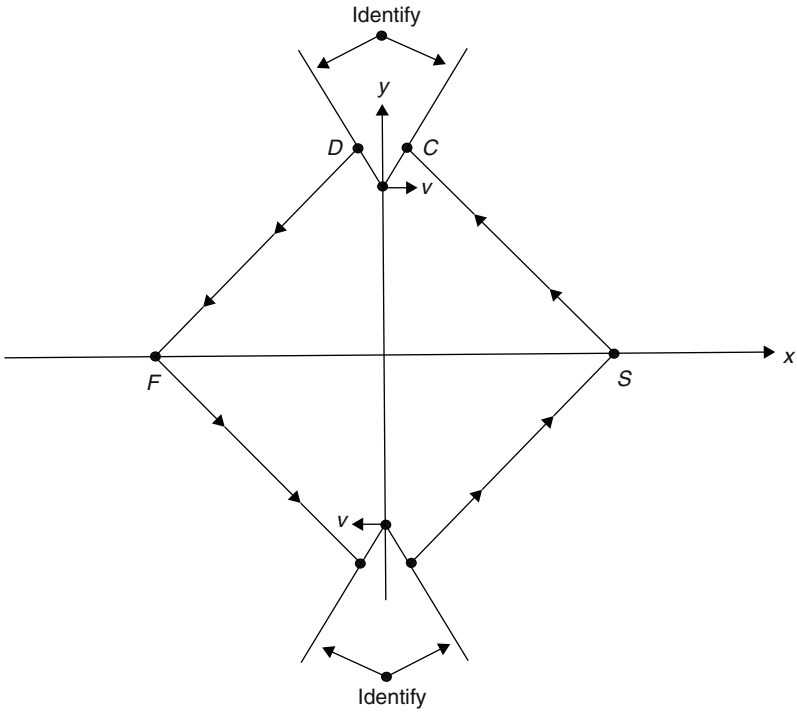

Fig. 6.14 Gott's spacetime, formed by joining two oppositely moving versions of the spacetime in Fig. 6.13

which the bottom, stationary string appears to be moving at $-v$, we can imagine an observer in the *stationary center-of mass* frame watching two strings that are moving at $+v$ and $-v$. This leaves the situation unchanged, so in the center-of-mass frame the rocket does travel into the past, arriving back at S before it leaves S. That is, the rocket has traveled all the way around a closed timelike world line. Note, too, that the geometric condition mentioned earlier of $x_0 \gg d$ immediately implies that for x_0 *not* sufficiently large, there isn't a closed timelike path from S to F and then back to S; that is, there is a region in Gott's spacetime where such time travel journeys *cannot occur*.

Another physicist pursued Gott's analysis in an attempt to see whether these 'time travel paths' are *created* as the strings approach each other or, instead, if the paths exist at other times as well.[78] This important question gets to the idea of whether such time machine paths can be *intentionally created* by humans via a dynamical process (a *strong* time machine), or whether all such paths have existed since the formation of the universe (a *weak* time machine). This issue involves Hawking's

[78] A. Ori, "Rapidly Moving Cosmic Strings and Chronology Protection," *Physical Review D*, October 15, 1991, pp. 2214–2215.

chronology protection conjecture, which you'll recall asserts that the laws of physics will always (somehow) prevent the creation of a time machine. One reason Hawking repeatedly gave for believing the Conjecture is the apparent absence of time travelers from the future among us now (in their past). The only possible exception allowed by the Conjecture is the creation of closed timelike loops at the moment the universe was created (at that moment there *was no past* for time travelers to invade!). Ori proved that the closed timelike loops around Gott's cosmic strings are *always* present: that is, a time machine is *not created* by the near collision of the strings. Thus, Hawking's Conjecture is nor refuted by Gott's spacetime.

One very curious issue is *where* the closed time loops are before the strings pass one another. As mentioned briefly by Ori, and further discussed by others,[79] the time loops are initially at spatial infinity. To this concern, Gott and a colleague made the following very strong reply:

> "[A problem] Deser *et al*. present with respect to the Gott spacetime is that it contains CTC's at spacelike infinity; this is supposed to be an unacceptable boundary condition. We wonder, however, how they know so much about boundary conditions at spacelike infinity. In our own Universe we do not know what spacelike infinity looks like (if it exists) since we have not seen it yet. We certainly have no way of knowing whether or not there are CTC's there. The working physicist is, of course, free to impose simple and convenient boundary conditions (e.g., asymptotic flatness) on a system in order to isolate and understand the processes occurring within it. *But boundary conditions are tools of physicists, and they should not be confused with laws of physics* [my emphasis]. There may be such laws of nature that restrict the possible structure of spacelike infinity, and even prohibit CTC's there, but in the absence of evidence such laws should not be postulated *ad hoc*."[80]

Still, as Ori had observed the year before, having time loops collapsing inward from infinity toward humans who might, fortuitously, wish to use them at *just the instant they so conveniently arrive*, is "a situation which has little to do with the creation of a time machine by a *human being* [my emphasis]."[81]

The most damning objection to Gott's cosmic string time machine came, ironically, from Gott himself. The two-string spacetime of Fig. 6.14 might actually, he and a colleague wrote (see Li and Gott, note 66) be destabilized by the non-zero mass of any would-be time traveler. They suggest that this concern could perhaps be 'solved' by assuming that the time traveler and her spaceship have a spherically symmetric mass distribution surrounded by a negative-mass shell to give zero net mass (and thus a zero net gravitational field that would *not* destroy the closed timelike curves of the strings). But that, they further observed, would negate the crucial advantage—no exotic matter and so no violation of the weak energy condition—that a cosmic string time machine enjoys over a wormhole time machine.

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[79]See, for example, S. Deser, *et al*., "Physical Cosmic Strings Do Not Generate Closed Timelike Curves," *Physical Review Letters*, January 20, 1992, pp. 267–269.

[80]M. P. Headrick and J. R. Gott, "(2+1)-Dimensional Spacetimes Containing Closed Timelike Curves," *Physical Review D*, December 15, 1994, pp. 7244–7259.

[81]A. Ori, "Must Time-Machine Construction Violate the Weak Energy Condition?" *Physical Review Letters*, October 18, 1993, pp. 2517–2520.

Does a trip around a pair of cosmic strings present other problems *aside* from the sheer fantastic physics of the strings themselves? Well, I think "turning the rocket around at F and flying back to S" is a lot easier to write than it would be to actually do! The entire trip has to occur while the strings (moving at essentially light speed) are in a position *to be* flown around. As one character says to another in Stephen Baxter's novel *Ring*, "Louise, the strings are traveling just under the speed of light—within three decimal places of it, actually. [Our ship is] traveling at a little over half-light speed. The turning curves, and the accelerations, are incredible . . ." I think so! And I do wonder who—*or what*(!)—is actually controlling a *maneuvering* rocket traveling faster than $\frac{1}{2}c$?

6.5 Cutting and Warping Spacetime

> "The warp drive spacetime of Alcubierre is impossible to set up . . . one needs to transcend the speed of light in order to construct the warp drive in the first place . . . put roughly, you need one to make one!"[82]

In this chapter we've talked about the physics of three specific time machine 'implementations': the rotating cylinder, the wormhole, and the cosmic string. One can also discuss the 'construction' of a time machine in a more geometrical (yet still physical) way by performing what is called *spacetime surgery* to arrive at what is often referred to as a *Deutsch-Politzer spacetime* (after the two physicists who are closely associated with it[83]). With this surgery we arrive at a simple spacetime picture of the grandfather paradox (as you'll soon see).

We start with a flat, two-dimensional Minkowski spacetime, the x, t system in Fig. 6.15, and then imagine that (somehow) two *cuts* in that spacetime come into

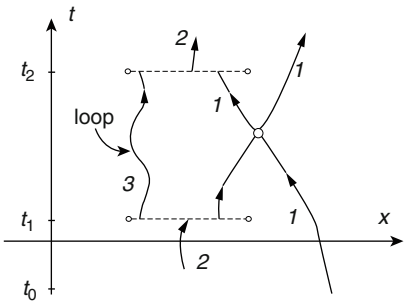

Fig. 6.15 Minkowski spacetime transformed into a time machine with two 'cuts'

[82]D. H. Coule, "No Warp Drive," *Classical and Quantum Gravity*, August 1998, pp. 2523–2527, offering a pessimistic view of warp drive.

[83]See D. Deutsch, "Quantum Mechanics Near Closed Timelike Lines," November 15, 1991, pp. 3197–3217, and H. D. Politzer, "Simple Quantum Systems with Closed Timelike Curves," November 15, 1992, pp. 4470–4476, both in *Physical Review D*.

existence. These cuts are the two horizontal dashed lines in the figure, one with an arrowhead going into it, and one with an arrowhead coming out of it (each labeled with '2'). We further imagine that each cut has two edges, with the upper edge of the lower cut 'glued' to the lower edge of the upper cut (and the lower edge of the lower cut 'glued' to the upper edge of the upper cut

These 'gluing's' explain why the arrowhead marked 2 into the lower cut at time t_1 emerges from the upper cut at time $t_2 > t_1$, and why the arrowhead marked 1 into the upper cut at time t_2 emerges from the lower cut at time $t_1 < t_2$. The 2-line is the world line of a particle that simply disappears from spacetime during $t_1 < \mathrm{t} < t_2$, while the 3-line is the world line of a particle trapped in an endless time loop (remember the 1993 film *Groundhog Day*?). Clearly, the sub-region of spacetime between the two cuts is not 'normal' spacetime. In fact, the 1-line shows that we have encountered a time machine spacetime, as a particle entering it from $t < t_1$ (passing to the right of the lower cut) can enter the lower edge of upper cut at $t = t_2$ and so emerge from the upper edge of the lower cut at the *earlier* time $t = t_1$ and thus interact with itself before it entered the upper edge! And that, of course, sets-up a grandfather paradox situation.

This picture leaves one thing obviously (and glaringly) unexplained—just *how* does one *cut and glue* spacetime? The reason, in spite of that question, that physicists nonetheless study situations depicted in Fig. 6.15, is because it allows them to explore what *could* happen *if* through some (yet unknown) process a time machine spacetime should suddenly appear. Who says physicists aren't optimists?

The idea of modifying spacetime itself to 'make' a time machine (look back in Sect. 3.5, at the discussion there on what it means to solve the gravitational field equations) has also appeared in connection with another of science fiction's favorite ideas, one almost as spectacular as time travel: *the FTL warp drive*. The lure of interstellar FTL travel, for both science fiction enthusiasts and physicists is, of course, simply undeniable. Consider, for example, these words by a Russian physicist:

> "Everybody knows that nothing can move faster than light. The regrettable consequences of this fact are also well known. Most of the interesting or promising candidates for colonization are so distant from us that the light barrier seems to make an insurmountable obstacle for any expedition. It is, for example, 200 pc [1 parsec is equal to about 3.2 light-years] from us to the Pole star, 500 pc to Deneb [the brightest star in the constellation Cygnus], and ~10 kpc to the center of the Galaxy, not to mention other galaxies (hundreds of kiloparsecs). It makes no sense to send an expedition if we know that thousands of years will elapse before we receive its report. On the other hand, the prospects of being confined forever to the Solar System without any hope of visiting other civilizations or examining closely black holes, supergiants, and other marvels are so gloomy that it seems necessary to search for some way out."[84]

[84] S. V. Krasnikov, "Hyperfast Travel in General Relativity," *Physical Review D*, April 15, 1998, pp. 4760–4766. Possible travel distances have been greatly reduced since Krasnikov wrote. In 2011, for example, astronomers announced the discovery of a red dwarf star with three planets (each of mass comparable to Earth's), all in the star's so-called *habitable zone* (where water can exist on the surface in the liquid state). All three planets are solid (not gaseous as are Jupiter,

In response to that, we might ask if *FTL* trips will someday be made by humans in spaceships? *Maybe*—but only if such journeys can be made in a very *unordinary* spacetime. That is, continuing with Krasnikov's passage:

> "The point ... is that [whereas the light barrier exists in special relativity] in general relativity one can try to change the time necessary for some travel not only by varying one's speed [as in special relativity] but also ... by changing the distance one has to cover."

To understand what Krasnikov was getting at, let's consider the theoretical analysis made 4 years earlier by the Mexican mathematical physicist Miguel Alcubierre on, astonishingly, how to make a *Star Trek* warp drive![85] He did this by demonstrating a spacetime metric that, by literally expanding and contracting the local spacetime of a spaceship and its neighborhood, achieves space travel between any two points, no matter how far apart, in arbitrarily little elapsed time (for both the spaceship, and external non-spaceship observers, there is no time dilation effect[86]).

Alcubierre opened his analysis with words designed to explain how FTL travel is possible, given all that I've told you earlier in this book about how FTL travel is *not* possible (according to *special* relativity). As he wrote,

> "Since our everyday experience is based on a Euclidean space, it is natural to believe that if nothing can locally travel faster than light then given two places that are separated by a proper spatial distance D, it is impossible to make a round trip between them in a time less than $2D/c$ (where c is the speed of light), as measured by an observer that always remains at the place of departure. Of course, from our knowledge of special relativity we know that the time measured by the person making the round trip can be made arbitrarily small if his (or her) speed approaches that of light. However, the fact within the framework of general relativity and without the need to introduce non-trivial topologies (wormholes), one can actually make such a round trip in an arbitrarily short time as measured by an observer that remained at rest will probably come as a surprise to many people."

That last sentence is almost surely a grand understatement, and Alcubierre quickly went on to explain.

> "The basic idea can be more easily understood if we think for a moment of the inflationary phase of the early Universe, and consider the relative speed of separation of two co-moving observers. It is easy to convince oneself that, if we define this relative speed as the rate of change of proper spatial distance over proper time, we will obtain a value that is much larger than the speed of light. This doesn't mean that our observers will be travelling faster

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Saturn, Neptune and Uranus) and so, as potentially habitable, are candidates for a visit. The star and its planets are 'only' 22 light-years from Earth. In *Star Trek*, FTL speed is described by the *warp factor*, which is the cube-root of the multiple of the speed of light at which the spaceship *Enterprise* travels. So, for example, to make the journey from Earth to the red dwarf in one month of ship time (see ahead also to note 86), the required FTL speed would be 264 times the speed of light, or warp factor 6.4. In science fiction, a *warp drive* is imagined as the means for achieving such speeds.

[85] M. Alcubierre, "The Warp Drive: Hyper-fast Travel Within General Relativity," *Classical and Quantum Gravity*, May 1994, pp. L73–L77.

[86] That is, the passage of time on the spaceship is *identical* with the passage of time on Earth. *With the warp drive, there is no twin paradox.*

than light: *they always move inside their local light-cones* [my emphasis]. The enormous speed of separation comes from the expansion of spacetime itself."

In a similar fashion, a *contraction* of spacetime can result in being able to *approach* an object at FTL speed.

In fact, we've actually already encountered one way to obey special relativity's *local* limit on speeds to that of light, while still achieving superluminal speed on a *global* level. That is, we *could* do that *if* general relativity really does allow wormholes in spacetime (what Alcubierre calls a "non-trivial topology"). That's because we can imagine a wormhole connecting two points in space that are light-years apart in that space, and yet the distance *through* the wormhole itself is quite short. Thus, a spaceship transiting the wormhole could do so at *sub*luminal speed at all times, and yet to an observer in normal space the speed would appear to be far in excess of the speed of light.

Determining just *how* to achieve the spacetime warp, however, is far different from simply demonstrating that such a warp is consistent with the general theory of relativity. The 1996 movie *Star Trek: First Contact*, for example, is about the invention of the warp drive in the twenty-first century. The whole thing fits inside a discarded ICBM which, as you'll soon see, is a *vast* underestimation of the technology required to control the energies associated with a real warp drive. For a spacetime engineer to *build* the warp drive bubble means she has to determine the required mass-energy distribution that results in Alcubierre's assumed spacetime metric. And that brings us to the central problem of the warp drive—the warp drive engine of an FTL starship requires (just like a wormhole) exotic matter (negative energy)—stuff that violates all the usually assumed energy conditions of general relativity.[87]

The weak, strong, and dominant energy conditions are *all* violated because the Alcubierre spacetime warp requires a negative energy density in the 'skin' of the warp bubble. As discussed earlier, in connection with wormholes, negative energy density *can* be achieved on a *micro*scopic scale, but for the Alcubierre warp drive we are talking about a *lot* of exotic matter. In their paper, Pfenning and Ford calculated that, for what they called "a macroscopically useful warp drive" with a radius of 100 m "so that we may fit a ship inside [the warp bubble]," the negative energy required for the warp bubble is on the order of, as they so graphically put it, "roughly ten orders of magnitude greater than the [energy of the] total mass of the entire universe."

Two years later, after making some adjustments to the spacetime metric assumed by Alcubierre (that is, to the distribution of mass-energy to produce the warp bubble), it was shown that the negative energy required by the warp drive could

[87]M. J. Pfenning and L. H. Ford, "The Unphysical Nature of 'Warp Drive'," *Classical and Quantum Gravity*, July 1997, pp. 1743–1751. See also K. D. Olum, "Superluminal Travel Requires Negative Energies," *Physical Review Letters*, October 26, 1998, pp. 3567–3570.

be greatly reduced.[88] The reduction is, in fact, spectacular, but only in a relative sense (you can reduce a mass that is ten orders of magnitude greater than that of the entire universe by a *huge* factor and still be left with a pretty stupendous number). The reduced amount of negative energy required for a warp bubble able to contain a human-sized spaceship is now down to 'only' "of the order of a few solar masses [-1.4×10^{30} kg]."

As mentioned earlier, in connection with the Casimir effect and its theoretical use in a wormhole time machine, although quantum field theory does not preclude negative energy densities, that does not mean it is possible to observe arbitrarily large negative densities for arbitrarily long times. In fact, certain quantum inequalities (QI's), much like Heisenberg's uncertainty principle, have been established that place bounds on the magnitude and duration of observable negative energy density.[89] These QI's have the general form of

$$\widehat{\rho} t_0^4 > -C$$

where C is a positive constant that depends on the nature of the particular quantum field being considered, t_0 is the time duration, and $\widehat{\rho}$ is the integrated energy density along a finite section of a geodesic (free fall) world line. The form of the QI shows that as t_0 increases, $\widehat{\rho}$ must quickly decrease. For example, if t_0 doubles, then $\widehat{\rho}$ must decrease by a factor of *sixteen*, a result that caused Ford and Roman to conclude that it "appears probable that nature will always prevent us from producing gross macroscopic effects with negative energy."

'When it rains it pours,' goes an old saying, and that applies to the warp drive's potential difficulties: in addition to the need for exotic matter, there are two more concerns as well, both *operational* in detail. First, running into any space matter encountered by the leading edges of the warp bubble (where spacetime is shrinking), such as interstellar dust, would certainly generate intense radiation. The ship, then, should carry plenty of shielding which, curiously, would not be a problem because the energy density of the warp, itself, is *independent* of the mass in the bubble's interior. In any case, the warp drive should clearly not be engaged anywhere near any sizeable chunk of matter, like a planet (and, indeed, that constraint was followed in *Star Trek*). Second an even more severe problem was discovered by Krasnikov. In unpublished work he showed that the ship at the center of the bubble is not causally connected to the edges of the bubble. That is, the ship's

[88] C. van den Broeck, "A Warp Drive with More Reasonable Total Energy Requirements," *Classical and Quantum Gravity*, December 1999, pp. 3973–3979.

[89] L. H. Ford and T. A. Roman, "Restrictions on Negative Energy Density in Flat Spacetime," *Physical Review D*, February 15, 1997, pp. 2082–2089. For some interesting remarks about the QI's, see J. F. Woodward, "Twists of Fate: Can We Make Traversable Wormholes in Spacetime?" *Foundations of Physics Letters*, April 1997, pp. 153–181.

crew could *not* create a warp bubble on demand and, after it had been created, could not control it on demand.[90]

It is important to both understand what that means, as well as what it does *not* mean. The causality issue does *not* mean that Alcubierre warp bubbles are impossible to create (perhaps they are, but not because of a lack of causality). It only means that whatever action is required to change the spacetime metric to make a warp bubble *has to already have been done before the decision to use the bubble is made*. Thus, a warp bubble wouldn't be of any use for a starship that needs to escape a sudden, unexpected threat. But, as Everett and Roman cautiously observe, the warp bubble might have a more mundane use: "Suppose space has been warped to create a bubble traveling from Earth to some distant star, e.g., Deneb, at superluminal speed. A spaceship, appropriately located with respect to the bubble trajectory, could then choose to enter the bubble, rather like a passenger catching a passing trolley car, and thus make the superluminal journey."

At the end of his paper (note 85) Alcubierre briefly speculated on the possibility of using his superluminal warp drive to build a time machine (showing, again, the intimate connection between the two concepts—look again at note 12 in Chap. 1 for how the connection between FTL and time travel appeared in pulp science fiction), but didn't show *how*. That was done 2 years later by Everett using, not surprisingly, an argument he called "reminiscent of the 'reinterpretation principle' ... which played an important role in discussions of the physics of tachyons."[91]

In an attempt to avoid the Alcubierre bubble's causality problem, Krasnikov looked for a different, causal superluminal spacetime metric. This he succeeded in finding[92] but, rather than describing a bubble, Krasnikov's warp is in the shape of a tube. The interior of the tube is flat spacetime, just as in the case of the bubble warp, but unlike the bubble there would be a causal link between the spaceship crew and the tube. Just as the warp bubble requires very thin walls (on the order of a few thousand Planck lengths) of negative energy, so does the Krasnikov tube warp. Unlike the bubble warp, however, the tube warp stretches the entire length of any proposed trip, so the total negative energy in the warp is incredibly huge. For a tube a mere one meter long and one meter wide, for example, the total negative energy is 10^{28} solar masses, and to create a tube from Earth to just the nearest star would require 10^{44} solar masses of negative energy![93]

One curious feature of the Krasnikov warp is that the *outbound* leg of a round trip cannot be made in less time than required by light. *But* on the on the return half

[90] A. E. Everett and T. A. Roman, "Superluminal Subway: the Krasnikov tube," *Physical Review D*, August 15, 1997, pp. 2100–2108.

[91] A. E. Everett, "Warp Drive and Causality," *Physical Review D*, June 15, 1996, pp. 7365–7368. Recall the discussion of the RP in Chap. 5.

[92] See notes 84 and 90.

[93] In the same manner as the huge negative energy of the Alcubierre warp drive was later reduced (see note 88), the Krasnikov tube's enormous negative energy requirement was later significantly reduced: see P. Gravel and J. Plante, "Simple and Double Walled Krasnikov Tubes I: tubes with low mass," *Classical and Quantum Gravity*, February 2004, pp. L7–L9.

of the journey, a traveler would find the spacetime metric so altered (because of mass-energy manipulations purposely made on the outbound half) that she would move "backwards in time." The net result is that the round trip could end arbitrarily soon after it started! As Everett and Roman cautiously concluded, the Krasnikov tube is a "very unlikely possibility," but it would make a *wonderful* science fiction gadget, don't you think?

While the Alcubierre warp may seem to be an incredible discovery (it *is*), it was not a unique one. That's because just 8 years later a different warp metric was discovered by the Portuguese mathematician José Natário, in which the expansion/contraction of spacetime does *not* occur. As Natário wrote, this signature feature of the Alcubierre warp drive "is but a marginal consequence of the choice [for the spacetime metric/mass-energy distribution]."[94] Rather than thinking of the warp bubble as being propelled by the push-pull of spacetime expansion/contraction, Natário wrote that "one could best describe the warp-drive spacetime as 'sliding' the warp-bubble region through space": that is, as analogous to a California surfer riding a wavefront. The surfer is motionless with respect to the water in the immediate vicinity of his board, and yet his speed with respect to the rapidly approaching shore is decidedly non-zero.

The idea of a manipulated or *warped* spacetime allowing time travel was an early arrival in science fiction. Consider, for example, the 1930(!) story in which the narrator (one Thomas Jenkins) walks 18,000 years into the future. In an editorial footnote (a device commonly used in early pulp fiction to inject scientific verisimilitude), we are told that "Jenkins had evidently fallen into a warp in space . . . a fault, we might say, borrowing a geologic term, in the curvature of space. Through this warp he had been thrown clear out of our three dimensions into a fourth. There he slid in time over to the other side [of the fault] into the same spot in the three-dimensional world, but into a different era in time."[95]

That was a flawed explanation, with its talk of space rather than of spacetime, but some authors eventually learned to do better. For example, *folded spacetime* as a mechanism for time travel is used in a 1940s cautionary tale on the potential horrors of the atomic bomb. In that story, published 2 years after the atomic bombings in Japan, the world 15 years hence experiences a terrible atomic war. As the time traveler in the tale explains, "During the unprecedented release of atomic energy that arouse during the simultaneous bombings of our cities, something happened to the very continuum in which we exist . . . A crook, a twist, a fold—explain it how you will, I accidently stumbled upon an electronic circuit that would create a field that would enable passage from one folded section [of spacetime] to the adjacent section. The fold proved to be about fifteen years in length . . . ."[96]

[94]J. Natário, "Warp Drive with Zero Expansion," *Classical and Quantum Gravity*, March 2002, pp. 1157–1165.

[95]N. Schachner and A. L. Zagat, "In 20,000 A.D.," *Wonder Stories*, September 1930.

[96]R. F. Jones, "Pete Can Fix It," *Astounding Science Fiction*, February 1947.

As Alcubierre and Natário showed, it will take a lot more than a mere electronic circuit to warp spacetime for either FTL or time travel, but at least even the early science fiction pulp writers understood that—*somehow*—a spacetime warping would be required.

The Alcubierre FTL warp drive appeared as the scientific basis for a modern science fiction novel, where at one point we read of a curious optical feature of an FTL spaceship, one I haven't seen mentioned in the physics literature: "This is a ship that traveled faster than light. It's visible as it travels; its warp bubble emits a cascade of exotic radiation . . . but it outruns its own image. So the ship arrives first and the light has to catch up, all the photons it emitted back along its path arriving at mere light speed. The older images arrive last, and you get this effect as if the ship was receding, not arriving."[97]

Another quite interesting feature of Alcubierre's warp drive is that the spaceship crew would experience no acceleration forces, as the ship is always in *free fall*. This may explain why the *Enterprise* crew isn't flattened when Mr. Sulu engages that ship's warp drive. The spaceship is surrounded by a "bubble" of warped spacetime that is swept along by the combined push-pull effect of the expanding spacetime behind the craft and the shrinking spacetime in the front. The ship, itself, resides in the *flat* spacetime interior of the warp bubble. An amusing way to think of this is to imagine a fish (space traveler), inside an aquarium (the warp bubble), which has been tossed into a swiftly flowing river. An observer at the edge of the river sees the aquarium move by her at high speed while, for the fish (swimming in the *still* waters of its aquarium), all is serene because *it is at rest with respect to its local environment*. Thus, the Alcubierre warp drive realizes yet another one of science fiction's wonderful gadgets: the *reactionless* spaceship drive. That is, "the warp bubble moves by interacting with the geometry of spacetime instead of expending reaction mass [as do jet and rocket engines] . . . and the spaceship is simply carried along with it."[98] In picturesque terms, the warp drive starship is like a surfer who makes her own waves.

And so we see, with each passing decade, more and more of science fiction departing from the make-believe to the pages of physics journals.

[97] S. Baxter, *Ark*, Gollancz 2009. The spaceship in this work travels at three times the speed of light (warp factor 1.44, as explained in note 84).

[98] F. S. N. Lobo and M. Visser, "Fundamental Limitations on 'Warp Drive' Spacetimes," *Classical and Quantum Gravity*, December 2004, pp. 5871–5892.

6.6 For Further Discussion

The connection between FTL speeds and backward time travel made the jump from theoretical physics to popular culture very quickly. It was in the British humor weekly *Punch*, for example, that the famous (but nearly always misquoted—see note 113 in Chap. 3, which doesn't have it quite right) limerick by A. H. R. Buller (1874–1944) first appeared (December 19, 1923, p. 591):

> *"There was a young lady named Bright Whose speed was far faster than light, She set out one day In a relative way And returned on the previous night."*

Where *Punch* dared to go, Hollywood could not be far behind. Indeed, in this case it was actually there first, with the 1922 one-reel silent comedy film *The Sky Splitter*. This was just a short film (feature pictures generally had at least four reels), so it isn't clear just how widely distributed and viewed it may have been. The story is that of a scientist testing a new spaceship; when it exceeds the speed of light, he begins to relive his life. This all shows that today's fascination, so common in popular culture, of the latest developments in theoretical physics, is nothing new. Why do you think this is so? That is, why (for example) do so many of those who flock to science fiction movies of interstellar invasions (like the 1996 *Independence Day* and its 2016 sequel), nonetheless have no conception of the unlikely possibility of such invasions because of the sheer magnitude of interstellar distances? Distances so immense that, even at the speed of light, it takes 4 *years* to travel to the Sun's nearest stellar neighbor, and *millions* of years to reach the Milky Way's nearest neighboring galaxy? (The vastness of interstellar distances is, as mentioned in the text, the reason for the fascination in warp drives in both science fiction and physics.).

In wormhole and cosmic string time machines, and with warp drives, we encountered the idea of negative mass-energy in the form of 'exotic matter' (see note 39 again). Something like negative mass actually appeared in fiction long ago, in the 1827 novel *A Voyage to the Moon* by "Joseph Atterly," a pseudonym for George Tucker, a professor of moral philosophy at the University of Virginia. (One of Tucker's students was Edgar Allen Poe, who almost surely was influenced by Tucker's book to write his own moon tale, the 1835 "The Unparalleled Adventure of One Hans Pfall.") The trip in Tucker's work was powered by a metal called *lunarium*, which repels Earth.

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This is *not* the same sort of stuff as Wells' "Cavorite," a metallic alloy that is "transparent" to gravity and that appears in his 1901 *The First Men in the Moon*. Wells' competitor in the 'scientific romance' genre was, of course, Jules Verne. Wells was a visionary who looked far beyond just the next few decades, while Verne was a 'practical engineer' who, for example, got *his* characters to the Moon by the direct method of simply shooting them out of a 900-foot long cannon with 400,000 pounds of guncotton! (Wells' vision *could* sometimes fail him, as it did about the imminent likelihood of airplanes in his 1901 *Anticipations*. He believed they *would* be developed by the year 2000, and maybe even before 1950, but of course just 2 years later . . .) In a 1903 magazine interview, Verne revealed how he felt about the difference between his and Wells' work: "It occurs to me that his stories do not repose on very scientific bases . . . He goes to Mars [sic] in an airship, which he constructs of a metal which does away with the law of gravitation. C*'est très joli* [this is all very nice], but show me the metal. Let him produce it." Today the cry from those who dislike wormholes is the Verne-like 'show us the exotic matter!' If Wells and Verne were writing today, how do you think each would respond to that challenge? Would the possible existence (or not) of exotic matter be an issue about which both would *agree*?

Write a time-loop short story based on Lossev and Novikov's idea of a 'very old spacecraft' interacting with a remote wormhole.

Imagine an electronic circuit **A** that has the following behavior: **A**'s input signal is a function of time that has a well-defined maximum value (what electrical engineers call the *peak value*). The circuit's output signal, produced in response to the input, also has a well-defined peak value. Now, imagine further that the output peak occurs *before* the input peak. There is, in fact, nothing paradoxical or impossible about that, and such a circuit can (and has) been constructed, as I'll tell you shortly. Next, suppose that we take **A**'s output signal and use it as the input to another circuit **B** that, when it's input exceeds a certain level, disconnects the input to **A** *before* that input reaches *its* peak value. Circuit **B** can also be constructed in the real world. Indeed, you can read about how to construct **A** and **B** in two papers by M. W. Mitchell and R. Y. Chiao, "Causality and Negative Group Delays in a Simple Bandpass

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Amplifier," *American Journal of Physics*, January 1998, pp. 14–19, and "Negative Group Delay and 'Fronts' in a Causal System: An Experiment With Very Low Frequency Bandpass Amplifiers," *Physics Letters A*, June 16, 1997, pp. 133–138. What makes all this interesting here is that this "seems to open the way for a variant of the time travel paradox in which the traveler journeys to the past and kills his grandfather before his own father is born," an observation made in Garrison *et al.*, "Superluminal Signals: Causal Loop Paradoxes Revisited," *Physics Letters A*, August 10, 1998, pp. 19–25. This electronic version of the grandfather paradox does indeed follow if one substitutes "input peak" for "grandfather" and "output peak" for "time traveler." But before you think this gadget is a time machine, be assured that its designers also showed that, unlike the causally related grandfather and time traveler, the two peaks are *not* so related. Read these three papers and write a summary report of how circuits **A** and **B** work, and why the two peaks are not so related.

You'll recall that "an advanced civilization" is thought to be required to create a useable wormhole (note 27). The common phrase used by astrophysicists who are interested in the possibility of extraterrestrial life is *arbitrarily advanced civilization*, with a distinction made for at least three progressively higher stages of 'advancement.' Very roughly, Types I, II, and III advanced civilizations are those that, respectively, have the technology to (a) control something like 10^{13} W (ten million megawatts) for massive interstellar radio broadcasts, (b) a technology to control the energy output of the civilization's planet's parent star (10^{27} W), and (c) a technology to control the energy output of the civilization's home galaxy (10^{38} W). We are, today, short of being even a Type I civilization, and it would probably take *at least* a Type III civilization to build a wormhole. Indeed, Stephen Baxter's 1993 novel *Timelike Infinity*, of beings who can manipulate *constellations of galaxies*, seems to assume a Type IV civilization will be required. Since there are typically 10^{11} stars in a galaxy, going from 10^{27} W for a star to 10^{38} watts for a galaxy is consistent. But where do astrophysicists get 10^{27} W for a single star? Here's a calculation for you to perform, to confirm this value for yourself, starting with the experimental fact (not difficult to repeat, as it's at the level of a junior high school science fair project using a solar cell and a few common electrical components) that the solar power level at Earth's equator is 1200 W per m^2. Then, using the fact that the Earth's orbital radius around the Sun is 93 million miles, compute the total power (energy per second) radiated by the Sun. (You should get a number that is somewhat

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smaller than 10^{27} W, which is 'explained' by observing that the Sun is really a quite ordinary star, exceeded in size by many other stars in the Milky Way. Next, you'll find, in most books on astrophysics, the statement that the nuclear fusion reactions that power the Sun convert *four million tons* of the Sun's mass to pure energy *every second*. Confirm that your number for the power output of the Sun is consistent with that claim. (Remember Einstein's famous formula $E = mc^2$, that the speed of light is $c = 3 \times 10^8$ m/s, and that 1 kg $\approx$ 2.2 pounds. In the MKS system of units (meters/kilograms/seconds) one watt = one joule (of energy) per second, where to give you some perspective on what a joule is, the chemical energy released by burning a gallon of gasoline is about 100 MJ.

Appendix A
Old Friends Across Time (A Story)[1]

As I sit here in my study, with the photographic evidence spread before me, I can barely comprehend what my eyes tell me must be so. The evidence is incontestable. And yet—I still struggle to believe. Let me try to explain—possibly in the process I will manage to put my tumbling mind to rest.

For as long as I can recall, old photographs have fascinated me. To page slowly through collections of historical pictures, no matter what the theme, was consummate joy. Even when I was quite a small boy I used them as my time machine into the past. They took me up and away from the problems every youngster has while growing up, and let me wonder of people and places long since returned to dust. Matthew Brady's Civil War photos had a particularly strong attraction for me, with the horror (and yes, I will admit it, the *fascination*) of war frozen in the images of young men dead before life had really begun. To look at the fallen youth of more than a century before, and to wonder who they were, and what they had felt and thought—it all sent shivers through my romantic mind.

I suppose I might have become a professional photographer. But somewhere along in the process of looking at pictures, I became aware of the miracle of the *technology* of picture taking. That led me to chemistry and optics, and finally by some wondrous route, I became an electrical engineer. I never lost my love for old pictures, though, but merely turned my interest in them to the photographic history of electrical physics.

To search out and acquire (for by now I had started my own collection) a photograph of Steinmetz, smoldering cigar clamped in his mouth, giving a lecture on AC circuit analysis using the then still mysterious square root of minus one made my heart beat faster. To find a faded picture of Einstein at a long forgotten

[1]P. J. Nahin, "Old Friends Across Time," *Analog Science Fiction Magazine*, May 1979. This tale was written with the specific goal of illustrating how a trip into the past *yet to be initiated* could logically influence events in the time traveler's present and future. The story reproduced here is, with only a few very minor alterations, as it originally appeared in *Analog*.

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P.J. Nahin, *Time Machine Tales*, Science and Fiction,
DOI 10.1007/978-3-319-48864-6

conference, caught forever in time with his quiet, gentle eyes looking into mine, would send me to the heights of ecstasy.[2]

But it was Maxwell that led me to my incredible discovery. There is no doubt but that James Maxwell was the greatest theoretical physicist of the nineteenth century. Together with Einstein, he was the best of *any* century. Could it possibly be more than mere chance that the same year saw the death of one and the birth of the other? It was Maxwell who gathered together all the then known, but fragmented, experimental bits and pieces of knowledge about electricity and magnetism, and stirred in his own contribution of the displacement current. There was no physical evidence then to justify that last step, but the genius of Maxwell knew it *had* to be. And then, from his soaring mathematical insight and physical intuition, he took it all and wrote down the four magnificent equations for the electromagnetic field![3]

No one who has seen and understood those beautiful equations can come away without a quickening of the pulse and a flush of the blood. They're not long—you can write all four vector differential equations on the back of a postcard, but oh, what they tell us! With them, Maxwell, showed light was electrical in nature, predicted radio waves *two decades* before Hertz discovered them in the lab, explained energy propagation in space, and radiation pressure, and laid the scientific basis for today's television, radar, lasers, giant electric motors, generators, transmission lines and—well, why go on? The equations are the work of a level of genius we may not see again for a millennium. We have hardly begun to discover the marvels wrapped inside the electromagnetic field equations. With their aid, and that of quantum mechanics, the very secret of life, itself, may someday be unraveled.

And so I searched for old photographs of Maxwell. He died at his family's Scottish home in 1879, before the art of picture taking was barely 40 years old. But I knew in my heart that somewhere there *must* be photographs, yet undiscovered, of such a great man. Anyone who has seen the best examples of prints from wet glass collodion negatives knows they are, in the faithfulness of their rendition of detail, better than what we commonly expect today. Working against me was the fact that the process was slow, laborious, and unforgiving of mistakes. The taking of a picture was not a minor decision in Maxwell's time. But still I searched.

I searched for one photo, in particular. When Einstein died, a famous picture was taken of his office, just the way he left it for the last time. On the blackboard behind his desk are the last thoughts he had in his long quest for a Unified Field Theory,

[2]The first reference is to Charles Steinmetz (1865–1923), the German-born American electrical engineer and mathematician who became the wunderkind of General Electric. Einstein, of course, needs no introduction!

[3]I wrote this for story effect, but it's not really *quite* true. When Maxwell wrote his theory in mathematical form, he did so using *twenty* (!) equations in as many variables. The equations, as physicists and electrical engineers use them today, were first written in 1885 by the English self-taught eccentric Oliver Heaviside, who considered Maxwell to be his hero (see note 6 in Chap. 6). Modern electrical engineers and physicists write the Maxwell equations as *four* partial differential *vector* equations.

a 'theory of everything.' The writing on the papers covering the desk is clearly legible, and with modern blowup methods, easily readable.

At the time of his death, Maxwell was the Einstein of his times. Surely, I reasoned, a similar photograph of Maxwell's study must have been taken. Even though none has come down through the decades to us, it *must* exist! Gathering dust in an old trunk, or buried in a long forgotten album, it had to be somewhere. I vowed to find it.

I began by writing to all of Maxwell's living descendants, asking that they search through family holdings for any pictures concerning Maxwell that they might possess. For the most part all were cooperative, even though more than just a few thought I was somewhat deranged. Still, it was in vain. I did receive a few old pictures never before seen by other than the family, including a poignant one taken in 1901, showing Maxwell's grave in Parton Churchyard at Glenlair, Scotland. A forlorn, wintry scene, with only what seemed to be three men in the far distance, it brought tears to my eyes. Alas, there were no photos of Maxwell's study.

But then late last year, while on a business trip to London, I stopped off for a few hours at the historical archives maintained by the British Institute of Electrical Engineers. On a chance, I looked through their massive files on Maxwell and was rewarded within the hour! What I found will haunt me throughout the remainder of my life.

There it was, stuck through its border with a rusty pin, between two pieces of yellowed paper covered with what appeared to be some simple, rough lecture notes. An ordinary looking photo of a study. Obviously overlooked through the years, or at best unappreciated for what it was, it was the almost illegible, penciled notation on the back that convinced me of my find—just a date: November 9, 1879. Exactly 4 days after Maxwell's death, precisely when some unknown, yet inspired person (a family member, a neighbor, a local scientist?) would take such a picture!

I am ashamed to admit it, but there was no hope the Institute would let me have the picture. And there was no time to copy it, for I was to return home to America that very night. No, that's not true. The *real* reason for what I did was simply that I *had* to have that original, *old* photo. I took it! It was my undoing, for that dishonorable act destroyed the picture's tie to verified, legitimate historical records. But *I* know what I found is true.

I could barely control my wild emotions on the flight home. Several times I removed the picture from my briefcase, and looked with fascination at the papers lying on Maxwell's desk, and at the tightly written lines of mathematics on the blackboard in the background. My hands trembled with what can only be called lust—once home, reunited with my well-equipped photo lab, I would learn every secret hidden in that picture.

There are no words I know that can convey the thrill I felt as I began the processing of that priceless photo. Alone in my lab, with all the modern equipment a well-off amateur can buy (a Caesar Saltzman 8×10 enlarger with mercury vapor point light source and a $10\times$ Plan Achromat Nikon enlarging lens), I carefully cropped and blew up selected views of the blackboard and desk. Printing the

enlargements on ultra-fine grain AGFA Brovira paper, I could scarcely restrain myself from peering at them with a magnifying glass while I waited for them to dry.

Then, at last, I had them spread out across my study desk. I tried to force myself to examine each slowly, carefully, in turn, and not to skip from one to another like a child let loose in a candy store with a dollar. The first three were of the desk papers, including what seemed to be a diary. It must have been lost after Maxwell's death since no trace of it exists in the historical records. I experienced a stunning thrill as I gazed upon the scrawled words, but as they were not easily read at once, I moved on. It was the sixth enlargement, of the upper right corner of the blackboard that sent me reeling back to my chair. An equation that shouldn't, no, *couldn't*, be there. But it was.

To understand my reaction, there is one astounding thing you must realize about Maxwell's field equations. When Einstein turned the world of physics on its head in 1905 with his famous paper, "On the Electrodynamics of Moving Bodies," all the old ideas about absolute motion and simultaneity of events went out the window. Even Newton's laws of mechanics had to be modified. But *not* Maxwell's! His equations, just the way he published them in 1873, are the same ones studied today[4]—they need *no* relativistic corrections.

How can that be, you wonder, as they predate Einstein's by 32 years? The mystery of this has bedeviled the experts down through the years. Oh, they have an explanation, alright. They say that all of electromagnetics is actually relativistic phenomena to begin with, and the laboratory work of Faraday, Ampere, Henry, and the other great experimentalists were studies of relativistic electron interactions in matter (although they, of course, didn't know that). Thus, it is only 'natural' that Maxwell's equations need no correction. So goes the 'expert' explanation, but it isn't right![5] I know Maxwell knew about relativity, and understood it perfectly. He knew all about time paradoxes and the equivalence of mass and energy.

Because how else can you explain the equation visible in my enlargement: $E = mc^2$!

Why, you must wonder (just as I did), didn't Maxwell publish this remarkable result? At first, I believed it was because of a lack of faith in his results. Who would have believed any of it in those Victorian times, so sure of its absolute view of nature? I thought of how Newton, 200 years before Maxwell, had suffered from a similar hesitancy when he wrote the *Principia*. There, when explaining his theory of gravitation, Newton did *not* employ his new invention of the calculus (which he *had used* to make his discoveries), but instead fell back on laborious arguments based on the accepted mathematics of algebra and geometry. Who would have believed him, otherwise?

But then I realized that couldn't be right. Maxwell was a strong man intellectually and he wouldn't have held back for fear of disbelief. No, it had to be that he

[4]Don't forget note 3.

[5]Alas, I think it *is* right. Don't forget, this is science *fiction*. When there is a conflict between the needs of a story, and a rigid adherence to physics, the 'needs' wins!

discovered relativity and the mass-energy law just before his death, with no time to make his work known. I was still wrong.

It was later, when I returned to the enlargement of Maxwell's lost diary and read those painfully cramped notes, that I learned the truth. What I saw there showed me Maxwell had thought long and hard about his final discoveries and had purposely withheld them. For clearly visible, after I had slowly deciphered the writing, were the following words:

> *I have seen monstrous events. My blood has run cold at the sight of two great cities leveled to the ground, their inhabitants cruelly put to death instantly, or left to die slowly from a strange, lingering disease. Other trips, further on, have shown me the root of all these evils is the mass-energy equation, a result I at first believed to be my crowning glory. It will be my crown of thorns unless I ban it from my very being. Another will discover it for himself, but* my *soul shall be free! I have dismantled my machine, and shall never look upon or think of those horrible scenes again.*

This passage was dated just 1 month before Maxwell died a savage death from cancer. The reference to 'two cities' can only be that of Hiroshima and Nagasaki. His own death was surely caused by lingering too long among their atomic ruins.

Think of what this *means*. Quite simply, Maxwell knew the secret of time travel! But even more incredible is that it must be *easy*, if one only knows how, to build a time machine! Think about it—Maxwell had no gigawatt power stations at his disposal, no high technology machine shops, or nanosecond computers. He was not a gifted experimentalist, and once he had predicted radio waves, for example, it took others 20 years to finally generate them. And yet, *he* built a time machine. Somehow, with just the puny power sources available to him, and a limited mechanical capability, he wrested free the *simple* implementation of a time machine from his dynamical field equations.

Yes, yes, I know what you must be thinking. How can I really conclude such an incredible thing from a single equation on a blackboard, and a few words written by a man dying a painful death? A man, clearly suffering dearly, and possibly not in complete possession of his once marvelous mind.

This very evening the last bolt of evidence slid into place. Attempting to escape from the emotional maelstrom into which I had fallen, I turned to my old love of picture gazing. I took down from my library shelf a tattered yet cherished volume of the Meserve Collection of Lincoln pictures. My slow paging through the images stopped when I came to the famous photograph by Alexander Gardner of Lincoln's second inauguration. This incredible picture shows John Wilkes Booth looking down on Lincoln from behind a buttress high on the steps of the Capitol, while below in the crowd are the five men who, 41 days later, conspired with him in the assassination.

The following page demonstrated the extraordinary quality of Gardner's work, as it showed an enlargement of Booth's face in which the circular line between the pupil and the white of each eye is sharp and crisp! This impressive picture fascinated me, and I wondered if I could create a similar enlargement. It was then I remembered the old picture of Maxwell's grave, sent to me from Scotland, and the

three distant figures in the background. They would present my photo-lab skills with a challenge, and the effort would distract my mind.

I finished the enlargement just 20 min ago. Those faces! Two of them I can now finally accept as being there—it must have been a pilgrimage for one, and for the other, it couldn't have been anything but a mocking, ironic gesture. But I wonder if the youngest one really knew who his two companions were? I don't know the answer to that—yet. But there they are, two men with faces my years of study have made as familiar to me as my own. One is a youthful Albert Einstein. The other, with the signs of death clearly written across his features, is James Clerk Maxwell. The face of the third man is familiar, too, for the third man is me!

Oh, I'm a bit older in the photo than I am now. But it's me, alright. A distinctive, jagged scar across the left cheek, a mark from a childhood accident, is sharply visible, and I can run a finger over my face and match it perfectly with the image in the enlargement. I'd say I'm about 45 or so in the image, no more than 10 years older than I am now. That doesn't leave me much time to keep my appointment, does it? I don't know, right now, how I'm going to do it, but I've got to rediscover Maxwell's secret of time travel. I'm sure I'll succeed—after all, there I am in the picture. Somehow, I'll be going back to pick James and Albert up so we can have our picture taken. Ten years—not much time.

I'm really looking forward to meeting my two new friends from across time.

For Further Discussion

When "Old Friends Across Time" originally appeared in *Analog*, it opened with a quotation from Richard Feynman's famous 1961–1963 Caltech undergraduate course (published in 1964 as *The Feynman Lectures on Physics*): "Ten thousand years from now, there can be little doubt that the most significant event of the nineteenth century will be judged as Maxwell's discovery of the laws of electrodynamics. The American Civil War will pale into provincial insignificance in comparison." This is almost certainly true, but could Maxwell *really* have built a time machine from just a knowledge of electromagnetic theory and special relativity (which is all that is needed to derive $E = mc^2$), if he didn't also have a deep understanding of general relativity (and probably of quantum mechanics, too)? How likely do you think *that* is?

The narrator in "Old Friends Across Time" knows he is going to live long enough to eventually build a time machine; discuss the implications of this knowledge. For example, is he at least *temporarily* invulnerable to committing suicide (or, for that matter, to any other variation of dying?) That is, do we have a 'future' version of the grandfather paradox? This issue has never (to my knowledge) been considered by physicists, and not by philosophers either until recently. See, for example, S. Keller and M. Nelson, "Presentists Should Believe in Time-Travel," *Australasian Journal of Philosophy*, September 2001, pp. 333–345, and M. H. Slater, "The Necessity of Time Travel (On Pain of Indeterminacy)," *The Monist*, July 2005, pp. 362–369. More generally, if we assume that the past is unchangeable then the scenario in "Old Friends Across Time" seems to force at least some level of inevitability on the future as well. Or does it? In the 2007 story by Ted Chiang, "The Merchant and the Alchemist's Gate," that you were asked to read in a *For Further Discussion* at the end of Chap. 4, there is the following exchange between the narrator and the inventor of "the Gate" (a wormhole): "So if you learn that you are dead 20 years from now, there is nothing you can do to avoid your death?" He nodded. This seemed to me very disheartening, but then I wondered if it could not also provide a guarantee. I said, "Suppose you learn that you are alive 20 years from now. Then nothing could kill you in the next 20 years. You could then fight in battles without a care, because your survival is assured." "That is possible," he said. "It is also possible that a man who would make use of such a guarantee would not find his older self alive when he first used the Gate." "Ah," I said, "Is it then the case that only the prudent meet their older selves?" Comment on this issue, with particular attention to free-will.

Appendix B
Newton's Gift (A Story)[6]

Wallace John Steinhope was a sensitive human being, a person deeply concerned about the welfare of his fellow creatures. Any act of injustice, however slight, made his breast pound with righteous indignation. He was a champion of fair play, and his motto in life was taken from the ancient English rule of law—'Let right be done!'

Even while still a lonely, reclusive child, Wallace's heart ached mightly when he read of the laborious, boring, mind-dulling calculations endured by the great mathematicians of old. Just knowing, *thinking*, of Gauss's marvelous mind wasting literally months of its precious existence grinding out tedious mathematics that even a present-day dullard could do in a minute, on a home computer, was sheer agony for Wallace. Contemplation of the God-like Newton suffering endless delays in his gravity research, all because of a simple miscalculation of the length of a degree of longitude, was almost unbearable.

Indeed, Newton played a special role in Wallace's life (and he in Newton's, as we shall soon see). While the other great mathematical physicists had merely been hindered in their work by the lack of modern computational aids, Newton had squandered so much valuable time in other, nonscientific pursuits! His quasireligious writings alone, over half a million words, exceeded his scientific writings. What a waste! Wallace wondered endlessly over the reason for this strange misdirection of talent and bored his friends to the edge of endurance with his constant brooding on the mystery. Still, they all liked and admired Wallace enormously and so put up with it. But more than one of them had sworn to throw up the next time Wallace mentioned Newton during a wedding (but that's another story).

So deep was Wallace's anguish for his predecessors that even as he grew older and his own tremendous talents as a mathematical physicist (the result of a lucky

[6]P. J. Nahin, "Newton's Gift," *Omni*, January 1979. This tale was written with the specific goal of illustrating casual loop time paradoxes. The story reproduced here is, with only a few very minor alterations, as it originally appeared in *Omni*.

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genetic mutation induced in a male ancestor some centuries earlier) gained him an international reputation, thoughts of the unmeasurable misery of his scientific ancestors were never far from his mind. It was most appropriate, then, that his greatest discovery gave him an opportunity to *do* something! And Wallace John Steinhope vowed to *help*. He became convinced that it was his purpose on earth—he could not, he *would* not hesitate. As he strapped the knapsack-size time machine to his chest, his excitement was, therefore, easy to understand.

"It is done! And I am ready. I will travel back and bestow this gift of appreciation, this key to mental relief, on the great Newton himself!" Wallace cradled a small, yet powerful hand-calculator in his palm. It was a marvel of modern electronics. Incorporating large-scale integrated circuitry and a Z-8000 microprocessor solid-state chip, the calculator required only a small, self-contained nuclear battery for its power. It could add, subtract, multiply, divide, do square and cubic roots, trig and hyperbolic functions, take powers, find logarithms, all in mere microseconds. It was programmable, too, able to store up to 500 instructions in its micro-memory. The answers it displayed on its red, light-emitting diode readouts would liberate young Isaac from the chains of his impoverished heritage of mathematical calculation. No more Napier's bones for Newton!

But Wallace John Steinhope was no fool. He understood, indeed feared, time paradoxes. He knew Newton could be trusted with the secret, but it wouldn't do for the calculator to survive Newton's time. So Wallace had incorporated a small, self-destructing heat mechanism into it. After 5 years of use, it would automatically melt itself into an unrecognizable, charred slag mass. But that would be enough time for its task to be completed. The emancipation of Newton's mighty brain from tedium! Pleased enormously at the thought of the great good he was about to confer, Wallace set the time and space coordinates for merry old England, flipped the power switch on, and vanished.

Materializing in the Lincolnshire countryside in the spring of 1666, he began his rendezvous with destiny. It was the second and final year of the great bubonic plague, and Newton, seeking refuge from the agony and death plundering London and threatening his college of Trinity at Cambridge, had returned home to work in seclusion. The years of the Black Death were Newton's golden years, when the essentials of calculus would be worked out, when the colored spectrum of white light would be explained, and when the principle of the law of gravitation would be grasped. But how much easier it would be if Newton were released from the binding chains of dreary calculation. Wallace's gift would slip the lock on those chains! Accelerate genius!

It was early evening when, guided by a map of the area prepared by a friend who was both a cartographer and amateur historian, Wallace reached the quiet little town of Woolsthrope-by-Colsterworth. It was here, in a small farmhouse, that Wallace would meet his hero of the ages. A cold, gentle rain was falling as he approached the door. The soft, hazy light of an oil lamp glowed inside, revealing through the translucent glass the form of a man bent over a table. The fragrant smoke of well-dried wood curled from the chimney, announcing a warm fire within.

With his heart about to burst from excitement, Wallace rapped upon the door. After a pause, the shadow rose and moved away from the window. The door opened, and there stood Isaac Newton, a young man of 23 with an intellect that Hume and Voltaire considered "the greatest and rarest genius that ever rose for adornment and instruction of the species." But for the importance of his self-appointed mission, Wallace would have fainted dead away from the thrill of it all. "Is this the home of Isaac Newton?" he asked in a voice quavering with the trembling tones normally used by lovers about to reveal their deepest feelings.

The young man, of medium height and thick hair already showing signs of gray, swung open the door and replied, "My home it is, indeed, stranger. Come into the parlor, please, before the wetness takes you ill."

Isaac followed Wallace into the room and stood quietly watching as his visitor removed his soaked coat and hat. The portable time machine was gently placed on the floor next to a wall. The calculator was snug and safe in its plastic case in Wallace's shirt pocket. "Thank you, Master Newton. May we sit while we talk? I am afraid you may wish to take some time to consider my words." Motioning to a chair near the table, Isaac pulled a second chair from a darkened corner and joined Wallace. "You have a strange sound to your speech, stranger. Are you from hereabouts, or have you traveled far? Please commence slowly your tale."

Wallace laughed aloud at this question, a response prompted by his nervous excitement, and it quite surprised him. "Please forgive me. It is just that I *have* traveled so very, *very* far to see you. You see, I am from the future." Wallace was not one to play his cards close to his chest. Now it was Isaac's turn to laugh. "Oh, this is most ridiculous. Are you a friend of Barrow's at Trinity? It would be so like him to play such a trick.[7] From the future, indeed!"

Wallace's eyes ached at the sight of the papers on the table where Isaac had been working. What wonders must be there about to be born! In any other situation, Wallace would have asked their contents, but the die had been cast. He had to convince Isaac of the truth of his tale. But he had to walk a tight line, too. It just wouldn't do to misdirect Isaac's interest away from the calculator and toward the time machine itself! He must do something dramatic, something that would rivet his idol's attention and hold it.

"Yes, yes, I understand your reluctance to believe me. But, look here. This will convince you of the honesty of my words." Wallace pulled the shiny black plastic-cased calculator from his shirt pocket and flipped the power switch on. The array of LEDs glowed bright in the gloomy room as they flashed on in a random, sparkling red burst. Isaac's eyes widened, and he pushed his chair back. Was he frightened?

"As the Lord is my Savior, is it a creation of Lucifer? The eyes of it shine with the color of his domain. Are you one of his earthly agents?"

[7]The reference is to Isaac Barrow (1630–1677), who was the first Lucasian Professor of Mathematics at Cambridge. Barrow resigned that position to allow it to pass to Newton. Centuries later, Hawking became the 17th Lucasian Professor.

"Oh my, no! Look here, Master Newton, let me show you that there is no black magic or chicanery involved. It is all perfectly understandable in terms of the laws of Nature. What I have here is an automatic calculator, a device to perform all of your laborious mathematical labors."

So saying, Wallace squeezed the sides of the calculator case together, releasing pressure snap-fittings, and flipped the case open on a hinge at the top. Revealed to Isaac were the innards of the electronic marvel—a tightly packed interior of printed circuit boards, a mass of integrated circuitry, the small LED display, and the sealed nuclear battery. Isaac stared intently at the sight, and Wallace could see the natural curiosity of Newton's great mind begin to drive away the initial apprehension.

"But where are the gears, levers, springs, and ratchets to carry out the calculations? All I see is a black box with lights that glow red—how is *that* done; where is the lamp or candle to provide the light!—and many little isolated fragments of strange shapes. There is clearly nothing in your box that moves!"

"Oh, it is all done with electronics, Master Newton! The central processing unit has access to a solid-state memory that contains the decoding logic necessary to implement the appropriate algorithmic processes to provide the answers to the specific requests entered through these buttons. The actual performance of the box is achieved by the controlled motion of electrons and holes in suitably doped semiconductor material under the influence of electric fields induced—" Wallace, still overcome by his excitement, had rambled on wildly without thought of the essentially infinite technological gap that separated himself from Newton.

"Stop, stop," cried Isaac. "I understand only a few of the words you use and nothing at all of their meaning! But it is obvious that for calculations to be performed, mechanical work must be done, and that implies motion. Pascal's adding machine has shown the veracity of that. I say again, nothing moves in the box. How *can* it work?"

Wallace was embarrassed. The mistake of overlooking the hundreds of years of progress after Newton's time was one a child might make. "I am sorry, Master Newton. I'm going too fast for you." Isaac looked at Wallace with a frown, but Wallace failed to see the pricked vanity of the proud Newton. Going too fast, indeed!

Wallace prepared to lay a firmer technological foundation for Newton, but then he froze. It couldn't be done! Newton was a genius, certainly, but the task was still impossible. Wallace would have to tell him all about Maxwell's equations, Boolean algebra and computer structure, electronics, and solid-state device fabrication technology. It was just too much, and besides, there was the danger! The potential time paradoxes of all that knowledge out of its proper time sequence! What if Newton, in innocence, revealed some critical bit of knowledge out of its natural place in history? So, Wallace hesitated, but seeing the suspicion grow again in Isaac's eyes, he realized he had to do something, *anything*, immediately.

"You cannot deny your own eyes," answered Wallace. "Let me *show* you how it works. I'll divide two numbers for you with just the punch of a few buttons. Watch this." And, at random, he entered 81,918 divided by 123. Poor Wallace, of all the numbers to use, they were the worst. Within milliseconds the answer glowed

brightly in fiery red characters. Wallace looked with pride at the result and then, already enjoying in his mind what he knew would be Isaac's amazement, he turned his eyes to the great man. What he saw made his spine tingle, and the gooseflesh stand high on his neck. Newton had fallen to his knees, with eyes bulging and hands raised as if in prayer.

"The mark of the Beast, it is the mark of the Beast! It is so written in the Book of Revelations—Here is wisdom. Let him that hath understanding count the number of the beast; for it is the number of man; and his number is six hundred three-score and six!" Rising to his feet, Newton fell back into his chair. "Your cursed box bears the brand of its master. There can be no doubt now, it *is* the creation of the fallen archangel!" Wallace was aghast at Isaac's violent reaction. The seventeenth century genius had now stumbled backward from his chair and had grasped a poker from the hot coals of the fireplace.

"Wait, please wait! Watch this; I'll multiply two other numbers together for you, watch!" Wallace quickly punched in the data, and then the answer gleamed steadily in burning red characters on the LEDs. Isaac's eyes first went wide with fear as he again saw the wizard electronics do their marvelous assignment, and then he shut them tight. Wallace was becoming desperate—this wasn't the way it was supposed to be! "Don't you see—imagine the tedious work, the mind-deadening labor this machine will save you from. And it is yours."

"Yes? But only for the exchange of my soul! That is always the Devil's price for his seductive gifts from Hell!" As Isaac shrieked these last words at Wallace, he raised the poker over his head. "Begone, you emissary of the Dark World! I know now you must be in the employ of the Father of the Antichrist, but the Lord God Almighty will protect me if I do not waver in my resolve. Begone, or I'll strike your brains out on the floor where you stand!"

Isaac's eyes were wide with fear, nearly rolling back to show all white spittle sprayed from his mouth as he yelled at Wallace, who stared in shock at the wild man who threatened him with death. "Please, please, *listen* to me, please! I beg you to understand—I am a scientist, just like you. The concept of the devil, and all it stands for, is contrary to everything I believe. How *could* I be in the devil's employ, when I don't even accept his existence? You *must* believe me!"

"Blasphemy!" screamed Isaac. "Your own words condemn you. To deny the reality of Satan in a sinful world is to deny that of God, too. Now leave my home, you dark beast from hell, or by the heavens above, *I shall destroy you*!" As he shrilled these words, Isaac brought the poker down in a wild swing that barely missed Wallace's head.

Struck dumb with confusion at the uncontrolled outburst, Wallace stuffed the calculator into his shirt, grabbed his hat, coat, and time machine and rushed from the house. As he hurried into the cold, wet night, he turned back, just once, to see Isaac Newton framed in the light of the open door. "Go, go, you foul messenger from the Lord of Evil! Back to your stinking pit of burning hell-fire! This is a house that honors the Divine Trinity and is no haven for the likes of you!"

Wallace rushed away into the blackness, the time machine bouncing unheeded upon his chest.

He ran, for how long he couldn't recall, until he fell exhausted next to a stream running heavy with the rain. Tears of rage, frustration, and shock streamed from his eyes. Rejected by the great Newton! Well, damn him! Wallace flung the calculator into the stream in his terrible anger and activated the return coordinates. He faded from Newton's world as quickly and quietly as he had come.

As for Isaac Newton, after having chased the Devil's messenger from his house, he returned on shaking legs to his desk. Pushing aside his rough calculations on the orbit of the moon around the earth, he swore to redeem himself in the eyes of the Savior. Somehow, he had been found lacking and had been tested. And the test was surely not over! He began to reapply his marvelous mind to determine the origin of his failure before the Lord God Jehovah. Taking quill in hand, he wrote the first of the many hundreds of thousands of words that his numerous religious tracts would devour from his allotted time.

Five years later, long after Newton had returned to Cambridge, a group of picnicking children were frightened when a nearby stream suddenly erupted into a geyser of steam. Moments later, the bravest (or most foolhardy) of the boys—who, by an astonishing coincidence that befits any good time travel paradox, would be Wallace's great-grandfather nine times removed—cautiously examined the streambed. All he found were some twisted, hot pieces of what he thought was a hard, black rock, and he tossed them back. They were all that was left of the calculator's nuclear battery. He did receive a tiny radiation dose from them, which caused a recessive genetic mutation that centuries later would suddenly appear as the cause of Wallace's genius, but otherwise the lad was unaffected. The incident was soon forgotten.

Well over 300 years later, Wallace John Steinhope reappeared in his own time. He was essentially the same man as before he left—kind, generous, and sensitive, and ready to come to the aid of any man or beast that might need help. As far as his friends were concerned, in fact, he was even improved (naturally, they didn't know what had brought about the welcome change but, if they had, they would have applauded it).

Wallace John Steinhope, you see, never again had another kind word for Newton, or for that matter, any words for him at all.

For Further Discussion

In his book *Travels in Four Dimensions: the enigmas of space and time* (Oxford 2003), the philosopher Robin Le Poidevin writes (p. 176) "But, as everybody knows, when a time machine leaves for another time it *disappears*." This is, indeed, how the time machine in "Newton's Gift" works; however, after reading *Time Machine Tales* do you think such behavior is in agreement or in conflict with general relativity? Defend your position.

"Newton's Gift" contains causal loops. Identify two of them, and discuss their role in the story (that is, are they central to the story or merely incidental?).

The idea of a time traveler visiting famous people in the past occurs fairly frequently in science fiction. In Ian Watson's "Ghost Lecturer" (*Isaac Asimov's Science Fiction Magazine*, March 1964), for example, the inventor of the "Roseberry Field" uses it to yank geniuses out of time to supposedly honor them, to let them know their lives had been worthwhile in the eyes of the future. But then he goes on to tell them—oh so kindly—where they had gone wrong or had fallen short of the mark, and of how much more we know nowadays. "You almost got it right, boy! You were on the right track, and no mistake. Bravo! *But* . . ." Watson makes the interesting observation that one can easily imagine playing this pathetic game of 'second-guessing' history with scientists, but what could even the most talented modern do to upstage a Mozart or a Shakespeare? Most similar to "Newton's Gift," however, are (for example) Gregory Benford's "In the Dark Backward" (*Science Fiction Age*, June 1994) where Shakespeare and Hemingway are visited, and Jack McDevitt's "The Fort Moxie Branch" (*Full Spectrum*, October 1988) where Hemingway and Thomas Wolfe appear. Read these stories, and then compare/contrast their descriptions of how story characters react to the appearances of time travelers, to Newton's behavior in "Newton's Gift."

Appendix C
Computer Simulation of the Entropic Gas Clock

```
%gasclock.m/created by PJNahin for TIME MACHINE TALES(6/27/2015)
%This MATLAB m-file simulates the diffusion of gas molecules in a
sealed
%container by using the Ehrenfest ball exchange rules. The
simulation
%starts with n molecules (i.e., balls) of one type (i.e., black)
on
%one side of the container, and n more molecules of another type
(i.e.,
%white balls) on the other side. The two urns play the roles of the
%two sides of the container. To simulate the ball (molecule)
%movements, the program selects two random numbers from 0 to
1, which
%are then compared to the current probabilities of selecting a
black
%ball from urn I and a white ball from urn II. If BOTH random
numbers
%are greater than these two probabilities then a white ball has
been
%selected from urn I and a black ball has been selected from urn
II,
%and so the number black balls in urn I is increased by one while
the
%number of white balls in urn II is increased by one. If BOTH
random
%numbers are less than or equal to these two probabilities then a
%black ball has been selected from urn I and a white ball has been
%selected from urn II and so the number of black balls in urn I is
```

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```
%decreased by one while the number of white balls in urn II is
decreased
%by one. If one of the random numbers is greater than its
corresponding
%probability while the other random number is less than its
%corresponding probability, then no action is taken because then a
%white (black) ball moves from urn I to urn II at the same time a
white
%(black) ball moves in the opposite direction. That is, there is
no
%net change. Then, the ball selection probabilities are recalcu-
lated and
%another ball exchange is simulated.
rand('state',100*sum(clock))     %new seed for the random number
generator;
n=100;                           %number of balls in each urn;
nb1=n;                           %number of black balls INITIALLY
in urn I;
nw2=n;                           %number of white balls INITIALLY
in urn II;
pb1=nb1/n;                       %probability of selecting a black
ball from urn I;
pw2=nw2/n;                       %probability of selecting a white
ball from urn II;
for trials =1:1000;
   system(trials)=pb1;
   ball1=rand;
   ball2=rand;
   if(ball1>pb1&ball2>pw2)         %white ball selected from urn I
      nb1=nb1+1;                    %and black ball selected from
      nw2=nw2+1;                    %urn II;
   elseif(ball1<=pb1&ball2<=pw2)  %black ball selected from urn I
      nb1=nb1-1;                    %and white ball selected from
      nw2=nw2-1;                    %urn II;
   end
   pb1=nb1/n;
   pw2=nw2/n;
end
plot(system)
axis([1 trials 0 1])
grid
xlabel('time, in arbitrary units')
ylabel('fraction of balls in urn I that are black')
figure(1)
```

Epilogue

> [Science fiction] cannot be good without respect for good science . . . This does not include time machines, space warps and the fifth dimension; they will continue to exist in the hazy borderland between [science fiction] and fantasy.[8]

> In many science-fiction stories, the trip into the past is by way of some futuristic machine that can take you through time at will . . . That, however, is totally impossible on theoretical grounds. It can't and won't be done.[9]

The opening quotations, particularly the second one from Asimov who was one of the great modern writers of science fiction, is a gloomy one indeed for fans of time travel, but it is not difficult to find inconsistency in Asimov's own tales dealing with the concept. Asimov is famous, in particular, for his stories of robots, and the very last such tale that he wrote combines robotics with time travel, with a robot sent two centuries into the future.[10] At the start of the story, the narrator tells us that time travel to the past is impossible because the past is unchangeable and (of course) a time traveler would necessarily disturb history. (That is (of course) simply a failure to distinguish between the difference of *changing* the past and *affecting* the past, as well as a failure to see how the principle of self-consistency negates the issue of paradoxes.) Then, when the robot returns from the future (and so backward time travel is *not* impossible!), he reports that his arrival had been expected, that history had recorded that he would appear. At the end of the story we learn how the future knew this—it had read "Robot Visions"! So now Asimov *uses*

[8]Harry Harrison, in his essay "With a Piece of Twisted Wire . . .," *SF Horizons* (no. 2), 1965. Harrison (1925–2012) was a well-known (if little appreciated outside the SF community) writer, whose 1966 novel *Make Room! Make Room!* was the inspiration for the excellent (if somewhat depressing) 1973 film *Soylent Green* (a movie about future over-population of the Earth that will make you think twice about ever eating a cookie again).

[9]From an essay Isaac Asimov wrote on the time travel movie *Peggy Sue Got Married* for the *New York Times*, October 5, 1986.

[10]I. Asimov, "Robot Visions," *Isaac Asimov's Science Fiction Magazine*, April 1991.

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the principle of self-consistency, with the narrator realizing that he *must* preserve his story so the future can read it.

Not a very consistent story! Asimov, was, of course, writing a story for entertainment's sake, so perhaps it's unreasonable to hold him *scientifically* accountable (although logic wouldn't seem to be too much to ask for).

In any case, was Asimov right? Lots of his fellow science fiction writers certainly thought so. One, for example, bluntly asserted that

> Time travel is inconceivable.[11]

Other critics agreed:

> In science fiction we find the lunatic fringe more often than not trying to perfect time-travel mechanisms.[12]

and

> Scientifically, time travel can't stand inspection.[13]

and

> Time travel is . . . scientific nonsense.[14]

and

> It would be untrue . . . to present the idea of a time machine as anything but what it is, an intriguing literary device, part of the bag of tricks of the science fiction writer . . . There is no such thing as a 'science' of time travel.[15]

You'll notice that these pronouncements are from decades ago: Conklin (1904–1968), Gold (1914–1996), and Oliver all wrote just 3 years after Gödel, and so perhaps it was simply too soon for his work to be widely known outside of the physics community. But physicists have learned a lot since 1952! Have they learned enough to make Asimov and his fellow SF skeptics (if they were still alive) change their minds, or at least reconsider? I suspect not.

I say that because, even 25 years after Conklin, Gold, and Oliver wrote, while we do find an awareness of Gödel starting to appear in the science fiction world, a feeling of skepticism was still in the air. In a fascinating analysis[16] of the first half-century of the science fiction magazines, Paul Carter admitted that there *is* a rationality to time travel because of Gödel but, nonetheless, the conventional view remained that backward time travel is simply impossible. Then, citing the work of Tipler, Carter wrote "Only as recently as 1974 (see note 130 in Chap. 1), in

[11]Kingsley Amis, *New Maps of Hell*, Harcourt 1960.

[12]Groff Conklin, *Science Fiction Adventures in Dimension*, Vanguard 1953.

[13]H. L. Gold, *The Galaxy Reader of Science Fiction*, Crown 1952.

[14]Alexei Panshin, *The Mirror of Infinity*, Canfield 1970.

[15]Chad Oliver, "The Science of Man," a non-fiction essay included in Oliver's 1952 time machine novel *Mists of Time*. Chad Oliver (1928–1993) was a scientist by profession (anthropology), and his opinion carried weight among SF writers *and* (non-physicist) scientists.

[16]P. A. Carter, *The Creation of Tomorrow*, Columbia University Press 1977.

the sober pages of the *Physical Review*, has a physicist been more bold ... For 70 years in the meantime, however, without waiting for Professor Tipler to solve his equations ... writers had happily helped themselves to Mr. Wells' invention and sent their characters through time in every direction, forward, backward, and sideways."[17]

In the 1980s writers were apparently just as unaware of Gödel's time travel analyses (and of the much later ones of Tipler) as had been the 1950s commentators. In his marvelous 1985 book *The Past Is a Foreign Country*, for example, David Lowenthal repeatedly refers to time travel as "fantasy" and to science fiction stories about time travel as "unbridled by common sense." And for another example from the start of the 1980s, consider the case of James Gunn (born 1923), professor of English at the University of Kansas, past president of both the Science Fiction Writers of America and the Science Fiction Research Association, author of *The Immortals* (inspiration for the 1970–1971 TV series of the same name), and eminent scholar (see his 1975 book *Alternate Worlds*). His literary credentials are impeccable and his critical influence profound. And yet, 30 years after Gödel and 5 years after Tipler, Professor Gunn wrote in *The Road to Science Fiction*, "Time travel has been an anomaly in science fiction. Clearly fantastic—there is no evidence that anyone has ever traveled in time and *no theoretical basis for believing that anyone ever will* [my emphasis]." If you've read this book carefully, however, of the analyses by Gott, Krasnikov, Thorne, Alcubierre, Novikov, Natário, and others, you know that what Gunn claims in those last words is actually not necessarily so.

The British-born American theoretical physicist Freeman Dyson of the Institute for Advanced Study has commented[18] on that sort of narrow mindset, with words quoted from the 1979 physics Nobel prize winner Steven Weinberg, words reminding us that rigidity concerning time travel is not limited to science fiction writers: "This is often the way it is in physics—our mistake is not that we take our theories too seriously, but that we do not take them seriously enough. It is always hard to realize that these numbers and equations we play with at our desks have something to do with the real world. Even worse, there often seems to be a general agreement that certain phenomena are just not fit subjects for respectable theoretical and experimental effort." The words *time travel* and *time machine* are never mentioned, but could they have been far from either Weinberg's or Dyson's thoughts?

All through this book we have seen how people have argued against time travel to the past (Tipler's cylinder is unphysically long, Gödel's universe requires an unphysical rotation, wormholes and warps require unphysical energy conditions, what about all those paradoxes ... and on and on). These arguments remind me of

[17]Given that *The Time Machine* was published in 1895, it is not clear how Carter arrived at the value of 70 until Tipler's work (he should have written 79), and of course it was only 54 years between Wells' time travel fiction and Gödel's time travel mathematical physics.

[18]F. J. Dyson, "Time Without End: Physics and Biology in an Open Universe," *Reviews of Modern Physics*, July 1979, pp. 447–460.

the debate in the 1930s between the illustrious British astrophysicist Sir Arthur Eddington and the young Indian astrophysicist Subrahmanyar Chandrasekhar (1910–1995), winner of the 1983 Nobel prize in physics. In his analyses of the life history of stars, Chandrasekhar had arrived at an astonishing conclusion, one that Eddington simply could not accept. As Eddington sarcastically explained in an address at Harvard University in the summer of 1936, "Above a certain critical mass (two or three times that of the sun), the star could never cool down, but must go on radiating and contracting until heaven knows what becomes of it. That did not worry Chandrasekhar, he seemed to like the stars to behave that way, and believes that is what really happens."[19] Eddington then went on to declare such 'unbelievable' behavior to be nothing less than "stellar buffoonery."

As far as Eddington was concerned, Chandrasekhar had simply made an error in combining relativity theory with non-relativistic quantum theory. Indeed, so appalled was Eddington at the thought of a star contracting "until heaven knows what becomes of it" (that is, until it gravitationally collapses into a black hole) that he had earlier, in 1935, stated "There should be a law of nature to prevent a star from behaving in this absurd way!" Today, of course, no astrophysicist feels the need for a 'star protection conjecture'—which perhaps reminds you of another, more recent 'protection conjecture.'

What can one conclude from all the similar controversy concerning time travel, time machines, and spacetime warps? Not much, I think, except that these are open issues and will remain the subjects of on-going study for a long time yet to come. The one thing I am fairly certain of is that if time travel is ever achieved, it will be by means that we cannot today even begin to guess. It will almost certainly require *at least* a mutant child genius with an IQ of 270 to fix the slightly broken time machine found abandoned in a cellar![20] But that view isn't uniformly shared across all of science fiction. I very much doubt, for example, that things will be quite so elementary as depicted in the story[21] where the time machine was so simple that "If it were taken apart or put together before you, your wife, or the man across the street, you would wonder why you didn't think of it yourselves." Not only that, but its power source was just two dry cell batteries!

The time machine in an earlier story is almost as simple, requiring (besides a piece of strange crystal) only a "little stack of dry cells, a Ford [automotive ignition] coil, a small brass switch, a radio 'B' battery, an electron tube, and a rheostat."[22] Even Wells' *Time Machine* couldn't resist making it all look easy: as one critic put it, "The time machine, like all products of supreme inventive genius, was a

[19]See S. Chandrasekhar, *Eddington: The Most Distinguished Astrophysicist of His Time*, Cambridge University Press 1983, p. 48.

[20]F. B. Long, "A Guest in the House," *Astounding Science Fiction*, March 1946.

[21]R. Abernathy, "Heritage," *Astounding Science Fiction*, June 1947.

[22]J. Williamson, "In the Scarlet Star," *Amazing Stories*, March 1933.

remarkably simple affair. A few rods, wires, some odd glass knobs—nothing more!"[23] That sort of simplistic fictional description of a time machine reminds me of the reaction of the great Polish science fiction writer Stanislaw Lem to the general treatment of time travel in the genre: "There have been mountains of nonsense written about traveling in time, just as previously there were about astronautics—you know, how some scientist, with the backing of a wealthy businessman, goes off in a corner and slaps together a rocket, which the two of them—and in the company of their lady friends, yet—then take to the far end of the Galaxy. Chronomotion, no less than Astronautics, is a colossal enterprise, requiring tremendous investments, expenditures, planning . . ."[24]

An example of what Lem was talking about is the 1956 novella *Arcturus Landing* by Gordon R. Dickson (1923–2001). There we read of aliens who have confined humans to the solar system—until (if) Earth scientists discover the secret of FTL travel. So, a genius physicist does just that (with no mention of spacetime engineering, but rather we encounter a lot of mumbo-jumbo gibberish as the 'explanation'), and uses it to instantly transport himself and some friends to a planet orbiting Arcturus.[25] And when they get there the friendly aliens speak perfect English.

Lem would have snorted in derision, too, at this statement made to a prospective graduate student by the head of a college physics department, that the college "has been awarded a million dollars to build [a time machine]. It means . . . a raise for me and maybe a doctorate for you, so we'll build one and have some fun doing it."[26] Is it any wonder that Lem so readily dismissed stories that reduce space (and time) travel to weekend adventures in a home laboratory? As Lem wrote in another essay, time travel and its close relation, FTL space travel, have reduced much of science fiction to "a bastard of myths gone to the dogs."[27] Because of precisely that, Harry Harrison wrote (note 1) of the early science fiction magazines that published so much nonsense, "I used to moan over the fact that pulp magazines were printed on pulp paper and steadily decompose back towards the primordial from which they sprang. I am beginning to feel that this is a bit of a good thing."

I don't know whether time travel to the past can actually be accomplished, but I do know that speculations once thought to be as outlandish as finding the Philosopher's Stone for turning base elements into gold, *have* eventually been realized (and, come to think of it, with modern nuclear physics we *have* learned how to turn lead into gold, if only a few atoms at a time). Television, nuclear power, home computers that run at multi-gigahertz clock rates in the bedrooms of high school

[23]W. B. Pitkin, "Time and Pure Activity," *Journal of Philosophy, Psychology and Scientific Methods*, August 27, 1914, pp. 521–526.

[24]S. Lem, "The Twentieth Voyage of Ijon Tichy," in *The Star Diaries*, Seabury Press 1976.

[25]A journey incorrectly given in the story as 120 light years, when in fact it is less than 40 light years.

[26]W. West, *River of Time*, Avalon Books 1963.

[27]S. Lem, "Cosmology and Science Fiction," *Science-Fiction Studies*, July 1977, pp. 107–110.

students, even faster computers that animate our movies and simulate the formation of black holes and galaxies, voyages to the Moon and back—all these amazing developments would be pure magic to nineteenth century science. The ghosts of not just a few Victorian scientists who had poo-pooed the possibility of such things, have watched their reputations eat a lot of posthumous crow during the last 150 years.

My personal position on the question of time travel leans towards the rejoinder made to the skeptic in one science fiction story who, even after having done some time traveling, *still* argues against it by invoking paradoxes. He is sharply rebuked with "Oh, for heaven's sake, shut up, will you? You remind me of the mathematician who proved that airplanes couldn't fly."[28] I subscribe to the optimistic philosophy of the British writer Eden Phillpotts (1862–1960), who wrote in his 1934 novel *A Shadow Passes* "The Universe is full of magical things, patiently waiting for our wits to grow sharper." Perhaps he had a famous saying by the British-born Indian scientist J. B. S. Haldane (1892–1964) in mind, words from his 1928 *Possible Worlds*: "Now my suspicion is that the universe is not only queerer than we suppose, but queerer than we can suppose."

Still, even if time travel is possible, the engineering phase will surely be tough going. I am certain that before we see a working time machine, there will be many, *many* episodes like the one described in a very funny, novel-length spoof of academic research.[29] All physicists and engineers who have tried to get some stubborn piece of apparatus to work, apparatus that *should* work and simply won't, will appreciate Professor Demetrious Demopoulos' frustration and will, I am sure, forgive him his intemperate language:

> . . . the distinguished physicist took a step back and, arms akimbo, surveyed the complex and sophisticated machine that was the culmination of years of dedicated scientific research and pains-taking technological development.
>
> "What a pile of ****," he said.
> "Oh, no, Dr. Demopoulos, don't say that!"
> "Well, it is." A sneer formed on the professor's thin lips. "Time machine, my ****. This thing couldn't give you the time much less travel in it."
> "But we haven't incorporated all our latest test data yet," the pretty research assistant reminded him. "These last few adjustments might do it, Professor."
> "Hell, we've been tinkering with it for 2 years," Demopoulos complained.
>
> "We've tried everything and it's all come to dog ****."

[28] R. Heinlein, "By His Bootstraps," *Astounding Science Fiction*, October 1941. As discussed at the end of Chap. 1 (in "For Further Discussion") the mathematician was the American astronomer Simon Newcomb.

[29] J. DeChancie and D. Bischoff, *Dr. Dimension*, ROC 1993.

That scene probably won't actually happen for a long time to come but, even before the practical nuts-and-bolts bugs in the Professor's time machine are worked out, I think some adjustments are called for in our thinking about time travel. I believe that present-day philosophers and science fiction writers are going to have to become knowledgeable about the work by physicists on time travel. It simply won't do any longer for Philosophy Professor X to invoke the grandfather paradox during a discussion of causality and free will and then airily declare them to be 'obviously' incompatible with time travel to the past. And it simply won't do any longer for Famous SF Writer Y to send his hero into the past to kill Hitler as a baby and thereby change recorded history. One might as well keep watching a video recording of the 9/11 destruction of the World Trade Center, in the vain hope that maybe, on the next viewing, the planes will miss.

The principle of self-consistency around closed timelike curves is going to have to become as much a part of the science fiction writer's craft (or else she will be a writer of fantasy) as it will have to become part of the fundamental philosophical axioms.[30] The 'time police,' like the "operatives of the Bureau of Time Exploration and Manipulation" that appeared in the science fiction of Andre Norton (1912–2005), will have to be put out to pasture with the unicorns and telepathic dragons of fantasy fiction. Just as the recent physics literature on time machines has displayed a growing awareness of what science fiction writers and philosophers have had to say on the subject of time travel, so too are writers and philosophers going to have to learn some more physics. Most people can enjoy a good fantasy tale now and then, but the use of 'magic mirrors' to see through time is *not* physics. Such devices were popular and acceptable in medieval times—see "The Squire's Tale" in Chaucer's *The Canterbury Tales*, and later (see Act IV of *Macbeth*)—but good science fiction needs much more than that today.

Time travel to the past is a beautiful, romantic idea, and some words written by two physicists in a technical paper—words embedded in the midst of swirls of tensor equations—show that even hard-nosed physicists can share this dream: "In truth, it is difficult to resist the appealing idea of traveling into one's own past . . ."[31] The appeal of that dream is explained in Ray Bradbury's Foreword to a beautiful little 1989 book by Charles Champlin (*Back There Where the Past Was*). In it Bradbury clearly illuminated *why* we want to go back into the past. It is for the same reason that we go, time and again, to see *Hamlet*, *Othello*, and *Richard III*: "We don't give a hoot in hell who poisoned the King of Denmark's semicircular canal.

[30]Bud Foote (1930–2005), late professor of English at Georgia Tech, wrote (in his book *The Connecticut Yankee in the Twentieth Century: Travel to the Past in Science Fiction*, Greenwood Press 1991) that consistency is simply a well-used plot device: "The attempt of the time traveler to prevent something or take advantage of it [and so causing] the event in question, is so popular and so ubiquitous that it seems to be about worn out." Worn out or not, I believe that plot device to be correct science.

[31]A. J. Accioly and G. E. A. Matsas, "Are There Causal Vacuum Solutions with the Symmetries of the Gödel Universe in Higher-Derivative Gravity?" *Physical Review D*, August 15, 1988, pp. 1083–1086.

We already know where Désdemona lies smothered in bedclothes and that Richard goes headless at his finale. We attend them to toss pebbles in ponds, not to see the stones strike, but the ripples spread."

That's why a visit to the past is so mysteriously and marvelously fascinating. It would let us watch ripples spread through time. Our own visit to the past, in fact, might even be the pebble in the pond of history that starts an interesting ripple or two that will one day sweep over—us! (Take a look at Appendices A and B) Who would want to miss that? Indeed, if modern philosophers are right, if the analyses discussed earlier in this book are correct, you *can't* (didn't/won't) miss it.

I think time travel appeals, irresistibly, to the romantic in the soul of anyone who is human.[32] A time traveler does not exist either *here* or *then*, but rather *everywhen*. For a time traveler passing back and forth through the ages, history would be the ultimate puzzle, a chronicle described in one novel as beginning "not in one place, but everywhere at once ... It might be begun at any point along the infinite, infinitely broken coastline of time."[33] Romanticism doesn't preclude there also being a dark side to visiting the past, of course, as one time traveler from 1989 learns when he takes up residence in 1962. Falling asleep on a hot summer night in that long-ago year, he thinks "JFK slept. Oswald slept. Martin Luther King slept. [I sleep and dream] of Chernobyl ... *I am a cold wind from the land of your children*."[34]

But, I must admit, I personally am more attracted by happier descriptions of time travel. In his marvelous 1996 book *1939: The Lost World of the Fair*—which is proof that there are not enough Pulitzers to go to all the books that deserve one—Yale professor David Gelernter caught just the right spirit in his Prologue: "The best of all reasons to return to the fair is that travel is broadening, and time travel most of all ... The 1939 New York World's Fair is one amazing show. It still stands, undisturbed on Flushing Meadow, just over the edge of time; it would be an unforgivable shame to miss it." Trust me—if you read Gelernter's book, you'll come as close as you can in today's world to taking a ride in a 'time machine'!

The eminent philosopher Sir Karl Popper opens his biography with a wonderful story about his apprenticeship as a young man in 1920s Vienna to a master cabinetmaker.[35] After winning the old man's confidence, the student learned his mentor's great, secret desire: For years the master had been looking for the solution to perpetual motion. He knew what physicists thought of such machines, but nonetheless he had never given up his dream: "They say you can't make it; but

[32]How else to explain the pleasure, for modern children *and* adults too, in watching rebroadcasts of the 1960s animated TV cartoon program 'starring' Mr. Peabody, a nice but slightly stuffy, professorial white beagle. (Don't all dogs wear glasses and a bow tie?) Mr. Peabody, with his brainy adopted son Sherman, routinely travels into the past in the "Way-Bac" machine to see what *really* happened in history.

[33]John Crowley, *Great Work of Time*, Bantam 1991.

[34]R. C. Wilson, *A Bridge of Years*, Doubleday 1991.

[35]See volume 1 of *The Philosophy of Karl Popper* (P. A. Schilpp, editor), The Library of Living Philosophers, Open Court 1974, p. 3.

once it's been made they'll talk differently." Popper's master sounds just a bit like the American writer Gertrude Stein (1874–1946) in her 1938 essay "Picasso," where she writes "It is strange about everything, it is strange about pictures, a picture may seem extraordinarily strange to you and after some time not only it does not seem strange but it is impossible to find what there was in it that was strange." Might we one day say the same thing about time travel?

An alternative point of view can be found in a discussion of time travel via cosmic strings that makes this assessment: "While there is still hope that one day a sufficiently clever design may make building a time machine possible, it is beginning to seem more and more improbable. Like the perpetual motion machines of the nineteenth century, the designs have an elegant simplicity (as well as enormous commercial potential), but it seems that Nature also may abhor them just as much."[36] Of course, at one time it was thought that Nature abhorred a vacuum, but then we learned that she must actually love a vacuum because else why did she make so much of it?!

The theoretical basis for time travel is very different from that of perpetual motion (there is *more* reason to accept time travel as a plausible possibility). And so maybe one day, *just maybe*, the first time traveler will receive a toast such as the one in a story telling us about the arrival of the inventor of the first time machine and his no longer skeptical friend in the Civil War past:

"To you, Mac," I said.
McHugh loosened his tie. "To the Creator," he said, "who has given us a Universe with such marvelous possibilities."[37]

[36]B. Allen and J. Simon, "Time Travel on a String," *Nature*, May 7, 1992, pp. 19–21.
[37]J. McDevitt, "Time's Arrow," *Isaac Asimov's Science Fiction Magazine*, November 1991.

Glossary[38]

Action the integral over a **world line** of a quantity called the *Lagrangian*. When a massive particle is moving at non-relativistic speed through a gravitational field, for example, the instantaneous value of the Lagrangian is the difference between the kinetic and potential energies of the particle. For other types of fields (such as the electromagnetic) and/or relativistic motion in any type of field, the Lagrangian is different. In any case, however, the actual world line of the particle is the one for which the integrated Lagrangian, that is, the action, is minimized. See **least action**.

Action at a distance the direct interaction of two separated objects, without concern for the details of what (if anything) occurs in the region between the objects (see also **field**). Newton's theory of gravity is action at a distance, whereas Einstein's theory of gravity is a *field* theory.

Advanced solution the prediction, by Maxwell's electromagnetic field equations, of radio waves that travel into the past (see also **Dirac radio**).

Anti-matter quantum mechanical prediction (experimentally verified) that all fundamental particles of matter come in two forms (the 'normal' version and the 'anti-matter' version). The positron, for example, is the anti-matter version of the electron, differing only in the sign of its electric charge. The photon, on the other hand, is its own anti-particle. A **subluminal** anti-particle traveling forward in time can be thought of as its 'normal' version traveling backward in time.

Arbitrarily advanced civilization for time travel discussions, a civilization with a technology sophisticated enough to construct a traversable **wormhole** in spacetime. More generally, Types I, II, and III of such civilizations are, respectively, those that can control 10^{13} W, 10^{27} W (the total power output of their home star), and 10^{38} W (the total power output of their home galaxy).

[38] "I hate definitions." (Usually attributed to writer and British Prime Minister Benjamin Disraeli (1804–1881) but, more precisely, they are the words of one of the characters in his 1826 novel *Vivian Grey*.)

—but they *can* be useful

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Arrow of time the statement the time appears to have a direction, that there is a difference between the past and the future. There are several different arrows: the psychological (we remember the past, we anticipate the future), the thermodynamic (organized systems evolve toward disorganization, that is, **entropy** increases as time increases), the electromagnetic (radio waves propagate *away* from their generators), and the cosmological (the expansion of the universe is directed toward the future).

Asymptotically flat if the geometry of a curved spacetime is such that, as one moves ever further away from all matter and energy, the spacetime **metric** becomes that of flat **Minkowski spacetime**, then the curved spacetime is said to be *asymptotically flat*. As a counter-example, the spacetime of a **Tipler cylinder** time machine is *not asymptotically flat*.

Autoinfanticide paradox see **grandfather paradox**.

Averaged null energy condition the claim that the *averaged* value of the observed mass-energy density along the entirety of any **null geodesic** is non-negative.

Averaged weak energy condition the claim that the *averaged* value of the observed mass-energy density along the entirety of any **timelike world line** is non-negative.

Back reaction the tendency of spacetime to resist the formation of **closed timelike lines** (see also **stress-energy divergence**).

Bell's theorem an inequality that either holds or does not hold, depending on whether quantum mechanics is non-local or local, respectively.

Big Bang the singular beginning of spacetime.

Big Crunch the singular end of spacetime.

Bilking paradox what would happen if a **causal loop** were disrupted. For example, suppose a time traveler builds a time machine using plans he received years earlier from a mysterious stranger. He now realizes that the stranger was himself, using the time machine to travel back into the past to give his younger self the plans. A bilking paradox would be created if the time traveler builds the time machine, verifies that it works, and then decides *not* to visit his younger self to hand over the plans. See also **bootstrap paradox**.

Black hole a region of spacetime where gravity is so strong that nothing can escape, including light. Black holes are thought to be created when sufficiently massive stars burn out (see **white dwarf** and **neutron star**) and undergo *gravitational collapse*. A black hole of ten solar masses would have a radius of about twenty miles. Black holes might have been created at the Big Bang singularity and, if so, could theoretically come in any mass and size (a black hole with the mass of the Earth would have a diameter of less than half an inch).

Block universe a spacetime in which all world lines are completely determined from beginning to end (a fatalistic universe). There is no free will in such a spacetime.

Boost matrix matrix formulation of the **Lorentz transformation**.

Bootstrap paradox the puzzle of the origin of *information* on a closed loop in time. The classic example is that of a time traveler from the future giving his younger-self the plans for the time machine the time traveler has just used to visit the past so that he can then build the time machine to visit the past. The time machine plans appear not to have been *created* by anyone! The plans just *are*. See also **bilking paradox**.

Cauchy horizon a **spacelike** hypersurface in spacetime that intersects, exactly once, every **timelike** world line that has no end point. Knowledge of the conditions on such a surface uniquely determines the spacetime at all other points.

Causal loop a time loop containing an event caused by a *later* event that, itself, is caused by the earlier event (see the example in **bilking paradox**).

Causality the metaphysical claim that every event is caused by a prior event. Time travel to the past inherently violates causality.

Chronal regions those parts of spacetime that have no closed timelike curves.

Chronology horizon a (hyper)surface in spacetime that separates **chronal** and non-chronal regions. It is a special case of a **Cauchy horizon**.

Chronology protection the claim, as yet unproved, that time machines and time travel to the past are impossible because of the **back reaction** of spacetime will lead to **stress-energy divergence**. Popularized among physicists as the *Hawking chronology protection conjecture* (1992), Hawking has since admitted that stress-energy divergence is *not* sufficient to enforce his conjecture.

Chronon science fiction name for **Planck time**.

Closed timelike line (or curve) a **timelike** world line of finite length that has no ends, i.e., that forms a *closed loop* in spacetime. A region of spacetime containing closed timelike lines is said to be a **time machine**.

Conservation law physical quantities in interacting systems that remain unchanged are said to be conserved. Total energy, total momentum (linear and angular), and electric charge are conserved quantities.

Cosmic string hypothetical, threadlike spacetime structures with enormous mass-energy and density that may have formed during the **Big Bang**. Cosmic strings may have been initially formed either as infinitely long, or as closed loops, and it is the former that are thought to be physically meaningful in the present-day universe. Cosmic strings do not violate the **weak energy condition** (as do **wormholes**), and they can theoretically create **closed timelike lines**.

Cosmological constant an extra term specifically added by Einstein to the general theory of relativity to keep that theory from predicting the expansion of the universe (which was later observationally found to actually be the case). Einstein subsequently said that his failure to believe the general theory's original prediction of the expansion of the universe was the greatest mistake of his life. The constant (which today is believed to be almost zero, if not exactly zero) appears in Gödel's rotating time travel spacetime as a determining factor in the minimum radius of a **closed timelike line**.

Determinism the metaphysical belief that effects are uniquely determined by causes (this is *not* **fatalism**).

Dirac radio science fiction gadget for sending information at infinite speed, which thus travels backward in time (see also **ultraluminal**).

Dominant energy condition the **weak energy condition** *plus* the claim that the observed energy flux is never **superluminal**.

Electron fundamental particle of mass that possesses one quantum of negative electric charge. *Bound* electrons orbit the nuclei of atoms and plays a central role in determining the chemical properties of the elements and of their compounds. *Free* electrons carry electric current, either in conductors (wires) or through space.

Elsewhen the collection of spactime events that cannot be reached from the **here-now** with a **timelike world line**.

Entropy a measure of the randomness of a system that plays a central role in the thermodynamic **arrow of time**.

Ether a substance once thought to fill all space to allow radiation 'something to propagate through' (as opposed to simply a vacuum). The special theory of relativity showed that the ether is an unnecessary concept because it has no observable effects (physicists argue that if something is impossible to detect, then it is meaningless to talk about it being part of *science*).

Event a point in spacetime.

Event horizon the spacetime surface of a black hole or of a non-traversable wormhole, at which light can *just* escape to the outside universe. It is called a *horizon* because, by definition, an external observer can't see beyond it and into the interior of the hole. To see the inside of a hole you must enter the hole by crossing the horizon (but then you can't get out).

Exotic matter matter that violates one or both of the **weak/strong energy conditions**. Exotic matter appears in the theories of wormholes and warp drives.

Fatalism the metaphysical belief that all events have been *pre*determined from the beginning of time.

Field the concept that if a physical law is local, then it is describable by differential equations that relate what is 'happening' at every point in spacetime to what is 'happening' at its closely located neighboring points. Electromagnetism and general relativity are field theories, for example, described by sets of partial differential equations called *Maxwell's equations* and *Einstein's gravitational field equations*, respectively.

Fourth dimension either time or a fourth spatial dimension.

Frame of reference a spacetime coordinate system.

Free will the condition that prevails when we can *choose* to do what we do. There is no free will in a **block universe**.

Future the collection of spacetime events that can be reached from the **here-now** via a **timelike world line** directed toward a later time (for each individual, the future is what hasn't yet been experienced).

Gamma ray very high-energy, very high-frequency electromagnetic radiation. Gamma rays have frequencies on the order of *ten trillion* (10^{13}) times greater than those of AM radio broadcast radio waves.

General theory of relativity Einstein's theory of curved spacetime, which explains gravity in terms of nothing but geometry. Its fundamental premise is that *all* the laws of physics should appear the same to all observers in *any* **frame of reference**. It is believed the theory will fail when the local mass-energy density reaches a level of about 10^{94} g/cm^3, a density so enormous (the density of water is just 1 g/cm^3) that there is no known mechanism for achieving it anywhere in the universe except in another **Big Bang**. See also **Planck density**.

Geodesic the shortest path connecting two points in space (if the space is spacetime, the world line of a particle in free-fall).

Global in the large.

Gödel universe a spacetime that, unlike the one we live in, is rotating so fast that it automatically generates *closed timelike lines* and thus constitutes a weak **time machine**. In such a universe, time travel to the past would be a natural phenomenon.

Grandfather paradox *the* classic time travel paradox, of a time-traveler killing, while in the past and *before* the time traveler has been conceived, an ancestor directly linked to the future birth of the time traveler. A more direct form of this sort of paradox is simply the time traveler killing his own younger self (called the **autoinfanticide paradox**).

Gravitational field equations a set of coupled, partial differential, non-linear tensor equations, considered to be the most complicated equations in all of mathematical physics. They show how the local curvature of spacetime depends on the local mass-energy of spacetime. The equations are independent of the **topology** of spacetime.

Gravitational lensing the ability of gravitational fields to bend and focus light.

Graviton the quantum particle of gravity.

Hawking radiation the emission of particles (energy) by a **black hole** into the region *outside* its **event horizon**, which results in the eventual evaporation of the hole. This is a quantum mechanical effect.

Here-now the point or **event** (for each observer) in spacetime that separates the **past**, the **future**, and **elsewhen**.

Hyperspace any space of four or more dimensions (for example, four-dimensional spacetime is a hyperspace).

Inertial frame any frame of reference in which Newton's laws of mechanics are true (there are no *acceleration forces* in inertial frames, and so *rotating* or 'merry-go-round' frames are not inertial).

Invariance a quantity that remains the same in any frame of reference is an invariant. Two examples are the distance between any two points on a piece of paper (because it is independent of any particular coordinate system), and the speed of light.

Kerr-Newman black hole a *rotating* black hole, which may (or may not) be electrically charged.

Krasnikov tube a particular spacetime **metric** (or *warp*) allowing **superluminal** travel, with the great difficulty of requiring *enormous* negative energy. Two Krasnikov tubes can be made into a time machine. Named after its Russian inventor.

Least action general principle in physics that asserts the world line of a particle is the one that *minimizes* the **action**.

Light cone the **lightlike** surface in spacetime that, at each point in spacetime, separates the **past** from the **future** from **else-when** from the **here-now**.

Lightlike the world line of a photon (or of any other form of mass-energy traveling *at* the speed of light).

Li mirror a perfectly reflecting, spherical surface that can be used to stabilize a wormhole against energy loops circulating through a **wormhole** time machine (thus creating unbounded energy levels that destroy the time machine). Named after its Chinese inventor.

Local in the small.

Lorentz factor the ubiquitous square-root expression that appears in so many relativistic calculations, such as time dilation, length contraction, and the variation of mass with speed. For example, the mass m of a moving body is not independent of it speed v but rather varies as $m = \frac{m_0}{\sqrt{1-\left(\frac{v}{c}\right)^2}}$, where m_0 is the rest mass (that is, the mass when $v = 0$) and c denotes the speed of light (186,210 miles per second). The denominator is the Lorentz factor.

Lorentz-FitzGerald contraction the conclusion from special relativity that the appearance (to a stationary observer) of a moving object will be shortened in length along the direction of motion. Many years after Einstein's work, it was shown that the object will also appear to be *rotated*.

Lorentz transformation equations from the special theory of relativity that describe how the space and time measurements of two relatively moving observers are related.

Many-worlds interpretation quantum mechanical view of splitting universes.

Mass-energy the famous $E = mc^2$, the equation behind atomic fission and nuclear fusion weapons.

Metric the measure of the separation between any two events in a spacetime.

Minkowski spacetime the flat spacetime of the special theory of relativity. In this spacetime there is no gravity, no spacetime curvature (hence it is *flat*) and no backward time travel.

Neutron star the end state of a star with one to three solar masses that has collapsed to a density of up to 10^{17} g/cm^2.

Non-Euclidean geometry the geometry of spacetime, whether curved or flat. Spacetime is non-intuitive precisely because it is always hard to resist thinking in terms of high school Euclidean geometry, which is simply the *wrong* geometry.

Null geodesic the world line of a photon in spacetime.

Observer physicist's term for 'somebody' equipped with recording instruments (such as a clock, a pencil and notepad, and the like).

Parallel transport a procedure for moving a vector around any closed curve in a space to determine whether that space is flat or curved.

Parallel worlds simultaneous existence of multiple (perhaps) infinite versions of reality.

Past the collection of spacetime events that can reach the **here-now** via timelike world lines directed from an earlier time (for each individual, the past is what has already been experienced).

Photon the quantum particle of electromagnetism. A photon of frequency f has energy hf, where h is **Planck's constant**.

Planck density the density of mass-energy that distinguishes classical from quantum spacetimes; about 10^{94} g/cm^3, equal to the **Planck mass** divided by the cube of the **Planck length**.

Planck length the non-zero length in quantum theory (about 1.6×10^{-33} cm) below which quantum gravity effects will become important.

Planck mass the fundamental mass in quantum theory (about 22×10^{-6} g), but *not* the smallest non-zero mass in quantum theory.

Planck's constant fundamental constant in quantum theory, h, associated with the discrete nature of quantum effects. (If h had the value of zero, rather than its actual value of about 6.6×10^{-34} joule-seconds, then the microworld would appear to be continuous.)

Planck time the time interval in quantum theory (about 5.3×10^{-44} s) below which quantum gravity effects become important. The time required to travel the **Planck length** at the speed of light.

Positron the electron's anti-particle (see **anti-matter**).

Proper time the timekeeping of an observer's clock.

Pulps the old science fiction magazines, through the 1940s and into the early 1950s or so, published on inexpensive, wood-pulp paper.

Quantum foam see **topology**.

Quantum gravity the yet-to-be-discovered theory that unifies quantum field theory with the curved spacetime of general relativity.

Quantum mechanics the exact physics of the very small (atoms and things smaller).

Quantum theory any theory in which physical quantities are not continuous but rather assume their values in discrete jumps (the size of the jump is the *quantum*).

Recurrence paradox the claim that if you wait long enough, then every system will return to every previous state infinitely often.

Red dwarf small (less than about half a solar mass) star with a very long life (hundreds of times that of the Sun). They are 'cool' stars, with a surface temperature less than 4000 °C, and are thought to be the most common type of star in the universe.

Red shift the *down* shift in frequency of light received from all distant stars due to the Doppler effect induced by the expansion of the universe. The opposite effect is called a *blue shift*.

Reinterpretation principle asserts that negative mass-energy traveling forward in time is positive mass-energy traveling backward in time, and vice-versa.

Reissner-Nordström black hole a spherically symmetric, non-rotating electrically charged black hole.

Reversibility paradox based on the fact that the equations of physics contain no **arrow of time**; that is, they work equally well with time running forward or backward.

Roman ring a time machine made of two or more traversable wormholes connected in a closed sequence.

Schwarzschild black hole a spherically symmetric, non-rotating, uncharged black hole.

Self-consistency the assertion that the events on a closed **timelike** line must never be in contradiction; generally attributed to the Russian physicist Igor Novikov, who with his colleagues showed that it is not an independent assumption but rather an implication of the principle of **least action**.

Sexual paradox a special type of causal loop, where the connected events on a time loop are 'coupled' (pun intended!) through reproductive sex. An example is a time traveler to the past who becomes her own ancestor.

Singularity either a region in spacetime where the curvature becomes infinite and the laws of physics fail, or a point in spacetime beyond which world lines cannot be extended. Singularities of the first kind are called *curvature* or *crushing* singularities, and those of the second kind are called incomplete singularities. The **Big Bang** was a curvature singularity, as is the center of a black hole. In a **Schwarzchild black hole** the curvature singularity is a point, whereas in a **Kerr-Newman black hole** it is an extended region in the form of a ring.

Spacelike a world line on which propagating mass-energy would exceed the speed of light.

Spacetime the 'stuff' out of which reality is built. Everything there is—the universe—is the total collection of events in spacetime. A *flat* spacetime has no gravity, whereas a curved spacetime is the *origin* of gravity.

Special theory of relativity Einstein's theory of *flat* spacetime, which assumes that gravity is absent (gravity is the result of the geometry of *curved* spacetime). Its fundamental premise is that the laws of physics should appear the same to observers in different **inertial frames**.

Splitting universes the idea that every decision causes reality to split into separate copies, identical in every respect except for each of the different possible results of the decision.

Stargate science fiction name for the mouth of a traversable **wormhole**.

Stress-energy divergence the unbounded growth of the **general theory of relativity**'s measure of the density of mass-energy in spacetime.

Strong energy condition the claim that gravity is always (that is, locally) attractive. A traversable **wormhole** violates this condition.

Subluminal slower than light.

Superluminal faster than light.

Tachyon a particle (hypothetical, so far) that always travels faster than light, so its **world line** is always spacelike.

Temporally orientable spacetime any spacetime in which the direction of time at every point agrees with the direction of time at its local neighboring points.

Tensor mathematical generalization of the scalar and vector concepts. Einstein's **gravitational field equations** are tensor-differential equations (for example, the metric tensor contains information about the curvature of spacetime), whereas Newton's and Maxwell's equations are vastly less complex vector-differential equations.

Tidal force force experienced by a non-point mass (one with spatial extension) in a non-uniform gravitational field. Such forces tend simultaneously to compress and stretch spatially extended masses. Black holes and wormhole mouths can generate enormous tidal forces on extended masses as small as a human body. Interestingly, the *more* massive a black hole, the *less* severe its tidal forces are at distances outside the **event horizon**. However, no matter what the black hole mass is, the tidal forces are infinite at the central curvature **singularity**.

Time dilation the altering of the rate of timekeeping by a clock, either by motion or by gravity.

Time machine (in the weak sense) a machine able to traverse **closed timelike world lines** inherent in a spacetime (e.g., a rocket in Gödel spacetime) but unable to *create* such world lines; (in the strong sense) a machine able to manipulate mass-energy in a finite or compact region of spacetime in such a way as to *create* closed timelike world lines.

Time police story characters in science fiction charged with the (unnecessary!) job of preventing time travelers from changing the past.

Time warp science fiction name for a **time machine**.

Tipler cylinder an infinitely long cylinder, made of super-dense matter, rotating so fast around its long axis that it warps spacetime enough to create closed timelike lines that encircle the cylinder. It can be used as a strong sense time machine to travel both into the future and into the past (but *not* to a time before the creation of the cylinder).

Topology the structure of a *space* (including *spacetime*) without regard to a metric. That is, topology is concerned only with how a space is connected together and not with how far apart points in the space are. Topologists consider stretching or compressing a space to be irrelevant, just as long as one doesn't *tear* it and so put holes in the space. The simplest topology is that of a *simply connected* space, in which if you construct any closed surface that lies totally in the space around any point in the space, then every other point inside the surface is also in the space. A space with a hole in it fails this test, and so is said to be *multiply connected*. A *quantum foam* spacetime has a multiply connected

topology. The classical spacetime of general relativity is simply connected *until* the appearance of wormholes.

Twin paradox the conclusion from special relativity that a clock's rate of time keeping slows with motion.

Ultraluminal motion sufficiently **superluminal** that mass-energy appears to travel backward in time (see also **Dirac radio**).

Uncertainty principle the statement in quantum mechanics that says certain pairs of quantities cannot simultaneously be measured with arbitrarily small error. The position and momentum of a particle are one such pair, and energy and time are another.

Vacuum fluctuation the particle/anti-particle creation and annihilation processes allowed, even empty space, by the **uncertainty principle** of quantum mechanics.

Warp drive science fiction name for the propulsion mechanism of a faster-than-light spaceship, now commonly used by physicists, too.

Weak energy condition the claim that the observed mass-energy density is always (locally) non-negative. Quantum mechanics predicts (and it has been experimentally confirmed) that there are exceptions.

White dwarf a burnt-out star with a mass less than 1.4 solar masses, of planetary size with a density up to 10^7 g/cm^3. The ultimate fate of our Sun.

World line the trajectory of mass-energy in spacetime.

Wormhole a spacetime structure (violating the **weak and strong energy conditions**, if traversable) connecting two points of the same spacetime (or even two *different* spacetimes) with a timelike path that requires less time to travel along than does a photon traveling *outside* the wormhole between the two points. A wormhole is *traversable* if it has no **event horizons**, and such wormholes can apparently be made into a **time machine** (sometimes called a *time tunnel*) using a time shift (see **time dilation**) between the two mouths of the wormhole *unless* quantum effects forbid time machines (still an open question).

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The Unveiling of the Hidden Knowledge and the Secret Space Program

The Unacknowledged Special Access Programs: Advanced Technology, Mind-Control, Spiritual Power and the Corruption behind Closed Doors

By Aug Tellez

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Introduction

The following is first-hand testimony from an operative of the secret underground military projects who also has familiarity with the breakaway civilization above and below (within) Earth. These civilizations utilize advanced technology to extend the length of their lives and enhance cognition beyond what is conceived of in today's society.

I was brought to the underground bases as a child as part of an experimentation program to test the population for various blood-groups and personality traits that would be of use to certain factions of the military in ways that would serve to preserve and strengthen humanity's outlook in the future.

These tests involved everything from combat training to sensory deprivation based emotional-mental endurance, and introduction to the highly advanced application of esoteric knowledge.

To clarify, I am bringing this information to you as part of my assistance in the overall unveiling of the hidden knowledge of the ages of humanity related to these secret projects as well as the true galactic history of Earth, humanity and man-kind. These projects are officially (unofficially) known as "unacknowledged special access programs". The unacknowledged aspect means that there is no formal acknowledgement of these programs without a need-to-know basis. There is no paper-trail, no disclaimer, no formal authorization or internal publication outside the programs themselves. The classification of these programs also generate a rather strenuous situation regarding funding and secrecy but this is done for the benefit of humanity. There are secrets and manipulations that can be seen as a threat but this is all tied together and so by releasing the secrets that are part of the defense we would be inadvertently exposing the public to the threats themselves. Now is the time where we are reaching a point where the public is ready enough to handle the basics of this information regarding the secret projects and the galactic history of Earth and humanity. This is also out of a necessity to preserve civilization for if we wait any longer we may not find the same opportunity again.

Getting This Out Of The Way

I am writing to you from the perspective that I am not certain just how far from completing my mission I am. I write to you today in order to bring to you many personal experiences from the viewpoint of an operative of a select ultra-military secret society.

The utilization of such an operative is not glorified, pleasant, or entirely righteous. This story entails sanctioned and guided acts of extermination, ritual abuse, the use of yet to be announced advanced technology. There is unfathomable corruption, the thirst for power and spiritual knowledge that has been protected throughout the course of the multiple civilizations that have preceded this one and will continue to be maintained into the future of this civilization.

Psychic Operation

I was utilized in psychic-operation amongst other areas.

This was used during certain aspects of training and conditioning to enhance training and conditioning in the bases using advanced technology. Some of this includes what would be viewed as traumatization by those without the training and conditioning. There is a fine line between training and conditioning and abuse. Part of this disclosure is related to how this line may have been crossed in certain situations and regarding mass-mind control upon the population. There are other aspects of travel, viewing, reconnaissance and research that will likely be explained in another release.

In order to heal I have to tell the world. You can help. This is happening right now in the underground bases and around. It’s not a joke. Your family is at risk. Your future generations are at stake. There is conditioning to encourage those involved to believe they are performing a duty for humanity. Sometimes they turned us against each other, but those grudges were never truly of the heart, but the mind.

A Light for the Others

What I hope to achieve with this is a smoke signal for those who have also been involved and question whether their purpose has been fulfilled or falsified for the protection of a corrupt system that intends to neither benefit the whole nor repay the individuals involved for their time, energy, and lives.

Multiple explanations can be summoned to describe the reasons behind the necessity for the training we have endured, the missions we have completed, and the control mechanisms we have both assisted in establishing as well as suffered from the backlash of. Ultimately, it is of my belief that all that was done was done for the good of humanity, even when we were not sure of the intentions of those in front of us, to the side of us, or behind us compelling us forward with the command to complete each objective.

This is not so much a panic or cry for help as this is simultaneously a call to awaken and a signal that humanity may have avoided complete disaster but is not out of the woods yet.

Natural Security

My experience is far too vast and I have seen too many succumb to stress from the realization of the truth of this reality to consider my own suffering to be enough cause for my denial of the necessity of these programs. Humanity has been protected and at a great cost to those who have been on the front lines, both in mind and body and spirit.

There are many who will have concerns, doubts, as well as reservations about what I am about to reveal and if I offend anyone then know that my intentions here are to assist in unveiling the truth. The truth can be harsh when one has been held back from the true nature of existence for so long. The way of life can become so fragile and artificially constructed on impulse and mystery that the harshness of the truth acts as a great catalyst for spiritual growth which allows us to elevate ourselves to a new perspective. Prepare yourself for such harshness, prepare yourself for growth and elevation, and prepare yourself for the mystery to simultaneously resolve and increase in intensity and magnificence.

A Balance of Mystery and Truth

Mystery has been a way of life for Humanity for so long that when a great mystery is converted to truth some seem to feel that a portion of existence dulls and loses the luster of exhilaration. This story is quite the opposite. The more that the great truths of this reality were discovered and revealed, the more complex and mystifying life became. As well, the more empowering and complex experience becomes, the more self-control one must develop in order to regain a harmonious way of relating to one another, the self and the universe. Harmony is key, balance is everything and there is a light within that represents the piece of our self that reflects the utmost power and brilliance of all existence.

Chapter 1: The World Situation

What is happening?

The Mind Virus

The main reason for this disclosure is to inform humanity of what can be referred to as the “mind virus”. This is a viral infection of the holographic system which consciousness operates through. There is a complete backstory of this virus in the history of this civilization and how society has been plagued for centuries if not millennia. The basic idea is that this virus operates through consciousness and can be transmitted through electromagnetic waves.

The virus contains an etheric form which can manifest as a kind of crystalline nano-tech on the physical plane and this is a form of synthetic sentience which feeds on the low frequency bio-emissions of sentient life. Human bio-emissions contain energy and can act as a carrier for information and living essences. This technology requires low fre-

quency bio-emissions because that is the nature of the design as a kind of synthetic bio-weapon whereby the goal is entrainment and enslavement. As well, the specific nature of the sentient nano-technology and the counterpart etheric holographic form is only capable of converting the low-frequency bio-emissions into energy as the higher-frequency bio-emissions require more energy to contain and synergize with and this would render the entire process of leeching energy non-productive.

This is essentially a synthetic intelligence that operates through scalar and holographic living bio-emission fields and hijacks electromagnetic emitters to position itself within them acting as a parasite to a host. This is said to have been present around this civilization for some time, waiting until there was enough technological advancement so that spreading across the entire civilization in a short amount of time before discovery would be possible. This is through the media, internet, and radio systems.

The physical counterparts are microscopic nano-technology parasites functioning as individual units to a hive mind similar to the mycelium of fungi in the field of mycoscopy. The individual units act as parasites serving to infest and deliver nutrients to the hive from each host.

The Vampire Effect

This is the nature of the parasitism that has been present throughout the ages of this civilization feeding on human suffering and relying on the cover of confusion and misdirection to survive.

There are processes that have developed that assist in the infection and co-inhabitation of the parasite entity within a human vessel utilizing the human as a host. This effectively utilizes a frequency ‘net’ within the auric field of the human to limit bio-emissions and emotional-mental processes to produce just the psycho-etheric patterns that the virus can sustain itself within and through.

This is no different than the way candida can infest a human digestive system and the human will experience cravings for beer, candy, carbs or other foods that contain the sugars, yeast, or carbohydrates that will break-down into nutrients that are the most nutritious for the candida fungus. These foods are *not* most nutritious for the human body. Yet the human body will withdraw and crave these foods in greater amounts until the fungus is swept clean from the digestive tract through probiotics, fasting, flushing, cleansing , detoxing, and even exercise as lactic acid from physically strenuous activity released from the muscles has been known to help destabilize and remove this fungus. Why is it that the individual will crave these foods that are not the normal food intake? Because this candida fungus can infest the host and produce enzymes which generate a chain-reaction which leads to the chemical signals in the brain producing the sensation of extreme hunger or cravings for just these foods which will benefit the fungus.

The same process occurs with this psycho-etheric parasite, except the foods of this parasite or lower emotional bio-emissions and this is through lust, hate, angst, jealousy,

feelings of hopelessness, lack of self-worth, spiritual degradation, addiction, and generally all that equates to a lack of self-awareness.

Whether or not this is the direct intention of the largely microscopic entity is for the most part unknown, and this is as well similar to candida. The candida fungus is not said to be a 'mean' fungus that wants us to be hungry and craving beer and sweets all the time because it likes to ruin the human body, the daily routine and the focus of a clear mind. This is simply the way the parasite has grown to operate within a niche of breeding itself through the digestive tract of larger animals and through this the unaware and infected human suffers greatly. Even those who are unaware and not infected can suffer because of the way the behavior and thought processes of those who are addicted to these foods can become distorted.

The lack of self-control over food intake is synonymous with the lack of self-awareness and self-control over lower bio-emission expressions of the spiritually degrading behavioral patterns that become routine for the psycho-etheric system of the infected human. Ultimately, this is all about energy. What benefits the parasite that seeks to gain energy by leeching instead of self-guided production is going to take away from the host that is being leeched from. As such, any energies, food intakes, or spiritual activities that cleanse and enhance the personal power of the individual will automatically reduce the parasite's ability to feed by the very nature of the energy systems. What empowers the individual, empowers the self and develops self-control, what develops self-control contains one's energy and reduces the likelihood of one's energy being leeched. This is similar to energy vampires in human form and this goes with the understanding that these are humans or non-humans who have been entirely overtake by the parasitic consciousness and cannot sustain their own auric fields without having to pull from the energy of humans who do generate their own aura or bio-emissions.

The vampire effect relates to how a person can be leeched from only to a certain point. Once the process surpasses a certain critical point then the individual becomes similarly engaged with only the lower bio-emissions as higher-frequency bio-emissions would then become harmful. So in essence, when the vampire feeds too much on one individual, then that individual becomes a vampire themselves.

Sub-Human Entities

The humans are utilized as hosts and energetic sources in this bio-emission battle while there are other classifications of bi-pedal organisms that appear to be human but are not human. As well there are bi-pedals that are non-human entities entirely.

Human-Hosts, Replicants, Synthetics and Carriers

The human hosts that are entirely vampirized by these entities become walking carriers for this virus and are effectively human in physiology but there is more to the human than just the physical body. In these individuals, that energetic component of the human is removed and replaced with the synthetic energy of the hive-mind organism.

There are replicants which are a form of clone, along with synthetics. These beings are cybernetic bi-pedals similar to humans but their energy is too not from an organic biological matrix but a technologically propagated synthetic soul-matrix. The hosts are here according to their agenda to subdue and feed off of the bio-emissions of the human race, although there are no absolutes. The agenda is not always so clear within the various groups who often have a mix of bi-pedal operatives. There have been plans to form of a salvation timeline because the only way to keep the whole process going is through a negation of degradation of the human race as this may close out this timeline forever.

Those with human organic soul-matrixes would simply transport into the next available universal time-stream or harmonic, while those with synthetic matrixes would have to technically travel to the next harmonic using a passageway otherwise they would remain here throughout a zero-point collapse and this would be synonymous with entering the abyss with no viable passageway out until the entire universe is brought back to one organism again.

This is also the process that is described to explain what happened previously as there are 7 harmonic temporal layers of the universe meaning everything is contained in a multitude of 7 octaves similar to light and sound frequencies or harmonics. And so there are 7 civilizations or 7 parallel time-streams and humanity passed through these to get to the last three where the physical forms are located. These are, from the higher to lower, Gaia, Tara and Terra. We are on Terra and if the information I was given is correct then we are currently on a transitory timeline located around Tara where people are noticing changes occurring and multitudes of aspects of the time-stream disappearing and changing simultaneously. Tara is where the last universal harmonic was left through a collapse of time and consciousness into zero-point and this resulted what was termed “the lost souls of Tara”. These are the discarnate souls of the previous civilization that could not travel to the next harmonic and remained without a body in the abyss. Thus they have plagued this plane since then, since ancient times possessing and driving humans to madness and there are explanations that this is the original passageway for the parasite into this universe. This event, the consciousness collapse of Tara would have acted as a fracture in the over-mind of the species generating a kind of cosmic schizophrenia and enabling all kinds of disharmony and distortion described in the previous sections.

The solution to this was described as a healing process that is taking place to purge the virus and that this is painfully similar to the human body purging a sickness however there are methods to promote healing and reduce suffering and confusion however people must contain themselves and their energies and strive to know themselves otherwise they will not be in control. This virus feeds on fear, confusion, spiritual degradation and the energy from degrading acts, lust, addiction, sexual misery and whatever fashion a human can be made to bring the bio-emissions of the energy centers down to a low enough level where co-inhabitation can be formed with an entity that has no access to the higher levels of self-awareness, higher-consciousness, love, or the universal spiritual experience that the balanced human is capable of.

Genetic Manipulation

There are explanations that there are genetic modifications taking place now to possibly preserve this civilization and that there were ancient genetic modifications made to induce a sense of stupor, worship, selfishness, an inability to more easily comprehend the higher spiritual awareness and the occurrence of time and consciousness and other spiritually and consciously limiting aspects. Part of this explanation is that holographic consciousness itself is a kind of limited result, a shadow effect resulting in the presence of the higher-dimensional essence of the soul which is more or less constrained by the body. An extension of this is that the entire holographic universe is a kind of false-light system designed to bend the original liquid etheric light of the soul and spiritual awareness into a rotating, recurring format which ultimately converts the original spiritual essence into an energy generator for entities that are entirely holographically represented. The souled human in this situation is a being who is originally from outside of this holographic projection.

The Ego Mind

In this view, consciousness is the ego-mind which is the false-sense of self, not to be confused with the shadow self which is simply the counterpart of the aspects of the self that we consciously agree with and are aware of in daily life. The shadow self is a result of having limited holographic consciousness and the ego-mind is projecting that limitation of consciousness into the shape and image of a self that is only a figure-head for the real individual essence which is spiritual in nature and immortal.

This Time is about Healing

Everything that is happening now is to motivate people towards healing and unification. This is not about a hive mind mentality where individuality is pushed out.

> "The best I can do for you is become your enemy."

There is a saying that represents the concept that the most beneficial role a person can play in helping one to progress is to challenge them and give them the opportunity to rethink their strategy and in turn improve further with each interaction. This may seem paradoxical but it is effective and explanatory. What we are facing is the greatest challenge humanity has yet to face. This is the unknown, the final frontier, the mind. The mind is our challenge.

There will be more on this later and in other publications but there are indications that the physical embodiment of the human has been altered to introduce implants, genetic modification, susceptibility to disease and ultimately fear-based programming of the brain. Without going further into this prematurely, the lower aspects are at odds with the higher aspects unless we as the midway come forth to mesh the two together in equilibrium. Until then, there is chaos, lack of self-awareness, and suffering.

There are many possible futures converging at this time. There are some less than favorable paths and there is the opportunity to merge with a very powerful path for

humanity. This all comes down to how people will cope with information that takes them outside their comfort zones and eventually changes their view of mundane reality forever.

If people choose violence and lack of self-awareness by ignoring the spiritual aspects then that is what reflects into their life experience. When people develop a higher sense of self-awareness and spiritual harmony they can reduce the suffering and reconnect with the lost aspects of our spiritual identity for the first time in the publicly accepted version of recorded history.

There is technology that can change the world and there are great truths which can enable people to know themselves in ways that they never thought possible. Everything is at our fingertips and so we must come together as this is the way we solve the problems and cure the dysfunction.

Healing Through Unity

In various research projects the conclusion of how to heal this spiritual rift was by exposing each other, to each other. When we are all together, aware of each other and our selves, united in the goal of bringing higher-awareness and spiritual harmony then we can observe and acknowledge when one is slipping into chaos or disharmony. When this occurs and we are in proximity to each other in a healing circle or a kind of social unification then the members of the group at large can work together to pull the chaotic one back into harmony towards the group. The group of healers united together in like mind, spirit and body is too strong to be overtaken by the parasite. So when one individual at a time is faced by this problem the whole group can come together as one and assist in healing the individual by pulling them back to reality, back to wholeness and back together with the group. This is literally how the situation is solved in all realities and a breakdown of this feature of society is how the dis-ease proliferates.

Underground Bases

The active aural research program is part of a process to simultaneously verify as well as initiate and demonstrate controlled insanity/sanity.

These programs utilize the deep underground military bases to perform psychic and psychological research experiments on non-consenting youth and adults as well as consenting participants.

There are various means of generating the illusion of consent or even lack of consent and this is all being monitored and handled by oversight authorities.

These operations are directly related to the identification and understanding of the mind-virus and all weapons, defenses, and resistances known to man.

Cloning

Advanced technology is used to transfer consciousness from one cloned body to the next so that a continuous study can take place before, during, and after the death experience of one individual. More will be explained on this later, however this is through

the use of advanced supercomputer systems that can function to entangle and then transfer the electromagnetic consciousness of the individual so that they are ‘remotely activated’ within a cloned version of themselves via a ‘brainchip’ (brain to machine interface: cybernetics).

Celebrity Cloning

Celebrities at the cloning center would like you to see what is really going on behind the scenes which involves trauma-based mind control, heavy technological programming and complex layers of influence throughout their life.

Initial Explanation

Many celebrities, entertainers, athletes, musicians, models, writers, producers, actors, all kinds of people from various industries are silently brought to the cloning centers for pay-to-play sessions.

They asked myself and others to pass the message on to you and that you would have to look for the signs and symbols in their media in order to see their hinting at these events.

The situation is heavily controlled using advanced monitoring technology and brainwave/EEG cloning technology. This is technology that can read the brain and determine what the mind is anticipating or speculating upon.

Their reputations are used as leverage as well as their safety and comfort. The level of programming and mind control experimentation that takes place makes it easy to manipulate a person’s brain into regressing into a state of trance that lacks the ability to remember or clearly organize experiences regarding the cloning centers.

Cloning Centers, Underground Bases

Deep underground military bases, 3 miles below the surface, are used as laboratory centers as well as a completely stocked underground city-base. These are connected with high speed electromagnetic drive pods.

Individuals are transferred to the brain through an extensive cloning and temporal body transfer process. The electromagnetic shell of consciousness within the brain is relocated to the body of a compatible clone and various training, conditioning, programming, experimentation, or pay-to-play experiences take place.

Programming

All individuals are programmed to various degrees in order to maintain control and secrecy over the situation. This programming involves very advanced technology, trauma-based mind control, and energetic attachment via beliefs and emotions.

Experimental Operations

These bases were also used hand-in-hand with military operations which were geared towards discovering and controlling all aspects of the human mind.

Genetic Engineering

Experiments involved genetic engineering to produce soldiers, psychics, hybrids, and others that would be able to carry out operations. This leans towards MiLabs and the military faction's experiments which go beyond the basics of cloning.

Immortality

The initial research included the goal of physical immortality. In many ways it can be said this has been achieved, however there are side-effects and difficulties.

If one does not activate their higher consciousness, then the effect of time dilation causes the conscious mind here to reach limitation points in experience.

What has been termed "blank slate/state" technology has been used to 'reset' the perception of time through memory in order to keep a continuous progression viable for the conscious mind. Without this the unconscious and the conscious mind merge.

This begins involvement across time with advanced technology that can operate on the soul level or the conscious mind's level of access to the unconscious and soul-memories. The Universe instantly creates a cosmic backstory based on the conscious-mind's access to the unconscious. By controlling the conscious mind's access to the unconscious the entire backstory of Humanity can be altered and new connections can be bridged in the future.

Earth is essentially a time-ship through which consciousness ascends towards higher states of awareness and self.

How did it get to this?

After WWII when the United States war-faction firebombed Germany and melted many of the inhabitants of the cities into sludge in the bomb shelters and streets of the cities, a group of NAZIs traveled to Antarctica.

Russia noticed the movements to Antarctica and the United States sent Admiral Byrd up with 3600 marines, planes, a battle cruiser and smaller vessels. They returned in defeat and only a few words were mentioned in regards to what actually happened and how they were defeated.

The rumors spread and words of gravitic drive craft, and undersea or under-ice bases originated from this encounter.

From what we were informed as well as directly experienced, this was the ice-base in Antarctica where an underground base was found already constructed with very advanced technology.

Here, cloning was deployed along with mind control and temporal manipulation technology.

Soon, cloning was offered as a way to avoid assassination as well as to prolong and protect the original body in daily life.

After that, celebrities and politicians were replaced with programmed clones who could carry out the orders of the NAZI faction.

This was the beginning; the groups utilizing this technology now are no longer confined to the NAZI faction.

The groups you see today, in control of these operations, are considered MiLabs, secret societies, think tanks, military factions, and other control groups.

Deeper Meaning

The individuals that have been cloned are given very in depth views of the way this society functions and the source of power and change in the Universe. Many individuals are present here from what would originally be another “time” or “timeline”.

There is a possibility that this notion is due to inserted memories and traumatization although until all the information is released we will not have a definitive conclusion.

As of now it is a possibility that these individuals are from another time that goes beyond our comprehension currently.

It may even be a possibility that these individuals have come from ALL of time looking at the very far past and into the very far future of Humanity.

These are the kinds of notions involved with the experiments taking place in the underground bases and military operations.

What is next?

Share this information with those you feel are ready to know and help Humanity come to terms with our journey here and what is going on in these kinds of experiments and take responsibility and power for our own existence.

We are in something that can be called “The Unveiling of The Hidden Knowledge”. This is a cyclic process that takes place to advance a civilizations knowledge of existence. As part of the civilization moves into higher advancement another aspect may lag behind. Either the future will slow down, or the past will speed up. We are experiencing the past speeding up and all the events that have taken place to influence our civilization are coming to light. This is as much a natural cycle of consciousness as it is the eventual revelation of secret knowledge and the particular connection to the secret projects.

Those brought to cloning can use their free-will to state their lack of consent to violence and harm and then live in commitment to that by not harming or accepting violence in their lives. The Spiritual Law of Harmony rules in all planes and dimensions.

Chapter 2: The Awakening

Chapter 2.1: The Machines of All Time and Space

There are machines that are capable of accessing genetic memory and unveiling what can only be referred to as the experience of awareness or existence in between the physical planes of each time or each physical life experience.

Even if they are simultaneously occurring moments of a transcendental nature, there is still an illusory ‘space’ where there is perceived separation and through this there is a perceived ‘space’ that is in between each existence.

Re-Creating The Kaleidoscope

This space is only perceivable when viewing from the physical perspective, like seeing the spaces between the angles of a kaleidescope only when viewed through the lens and similarly, technology can be used to recreate what this kind of illusory space might look or exist like in between the multi-dimensional realm of the continuous experience stream. Through this, these ‘hypothetical’ in between spaces that are understood as only illusory productions of biological consciousness, can be generated through advanced technology with the capacity of recreating that kaleidoscopic view of which the human biological perspective is only a small fraction or even fractal.

By recreating this biological perspective, they can recreate the illusory spaces in between planes and through this they can literally access and experience what are stored in the DNA as the experiences of existence beyond the physical limitations of consciousness and into a multidimensional experience of time and space.

All becomes a never ending sea of consciousness, however this is the given. The trick is to take from this sea of consciousness and slice it down into conceivable chunks from which you can reintegrate a previous personality or identity and continue on a stream of consciousness that would otherwise be tossed to the cosmic wind like fractal stardust as the sands on the beach of hyperspace.

Sand-Castles of Time

We are effectively building sand castles out of these sands of time that would otherwise be swept back and forth into and out of the ocean of life and the universe only to momentarily wash up again as the identity which we once knew.

There is technically nothing wrong with either view, because then, the spaces between each million year occurrence of just so happening to wash up again as you, would be imperceivable because they are only there to be seen when you are you again.

We’re Waiting For Ourselves

Yet, if there were some who had attained the awareness of the true nature of reality and were standing there on the beach waiting for the rest of their cosmic family to come

to shore again, it could be perceived as waiting the majority of the time for a very small occurrence and then being alone again up until the kaleidoscopic fractal inverts itself to the point where everyone now is standing on the shores of the sands of time rejoicing and meeting with each other.

The Goal of Two Societies

My goal in coming to you people on the surface of what is called “Earth” is to help assist in the process of bringing the two societies together, one who’s been waiting for thousands of millions of years, and the other who has no idea that they’re even late (or very on time).

You see, those are the only two situations where there could be even the possibility of perceiving such an injustice as experiencing the pain of loss or misconstrued identity in this universe. It is as if two families met at the cross-roads at different angles, and while one waited for the other to arrive, they could merely supply themselves with glimpses of the ruins and remnants of the evidence that the other civilization existed at any one time.

This is not how life must be and this is kind of like a cosmic waiting game of hide and go seek our two mirror civilizations have been playing with each other. One who’s highly technologically advanced and the other who is more or less the spiritually advanced of the two.

Both of them have a unique view of the universe and they are both only complementary to each other as a whole. The more they sat around and waited for one another, with one leaving the clues that the other would find and even switching roles sometimes in different ways, they became even more and more complimentarily associated as the very essence of experience they seem to be missing more and more is the experience of one another.

So as we perceive these as being great losses or great gains of time and culture we are really only remembering ourselves and coming together as a unified existence that once met upon the surface of Earth as a single family covering the entire harmonic spectrum of the Universe.

And that should be the goal of any progressive, any one pushing a new culture or an old culture, anyone looking to teach the young and protect the knowledge of the old, while also protecting the innocence of the young and perfecting the age-old knowledges that have defined our presence in reality.

Our Forgotten Other Half

One could even say we’ve sometimes gone off the deep end, leaving ‘land-minds’ of sorts to process the information that would be present when we are gone. Of course, what we could’ve found when this occurred, is beyond anything we could’ve ever expected and that is the true nature of the complexity of creation and existence. That everything follows the cycles of creation and destruction, however, the memory of everything that has been created can always be accessed (depending on the beach) and there-

fore the creative aspect is legitimate, yet it is the destructive aspect that is illegitimate and illusory.

Yes, through advanced technology this can be proven in ways that can be verified and transmitted using advanced technology, since that is how we like to verify things these days. There is, of course, a human looking at the screen, the read out, or the situation from a physical perspective to verify the verifications.

All Is But An Illusion

There is a notion that there is only one civilization, one society, in actuality that has been chasing itself through time. That we cannot actually find the same place and the same time where both meet because we are each other from different perspectives. We can only get a mirror where this is possible, or an 'hyperdimensional' internet channel where we can stream one's consciousness in from the other reality and interact with them through that here in this reality. Thus the two civilizations can achieve the experience of their own civilization and the other civilization by merging with one another but only through a remote contact, just a relay, not an actuality.

The harsher, darker side of this is that any civilizations between then and now that we did happen to meet that proclaimed to be "the one's" we have been waiting for, and in essence our darker or lighter halves, are actually the impostors who exist entirely apart as a sub-set and have taken a liking to trying to trick the reality out of one of the other civilizations.

Of course, if these are another form of being altogether, and this is all brought about through an interplay of consciousness and deviations from an original core reality, then all will resolve itself when that core reality is alone again. This indicates that all realities will either move closer and closer to the core until they unify, or farther and farther out until they transmogrify beyond recollection.

Life Itself Is The Highest Illusion

That hyperdimensional internet channel that is created out of advanced technology to merge the parallel realities (rather distastefully and maybe disastrously at times) allowing different civilizations to interact with each other, well this has been created using technology.

But then it was discovered that this is the ultimate nature of DNA. That this was 'invented' similarly as a higher-dimensional internet so that various natures of different planes and dimensions could interact with each other and experience the richness of life.

The universe becomes more like a living arcade game then, where people come from all over the galaxy to 'plug in' to human experience and figure out what it means to be physical, human and on Earth.

This does tie into the larger nature of reality, of star-races, and of time and consciousness that is often reversed according to how things seem to play out in physicality. We

are moving through time, but just because we are moving one way, does not mean that others could not be moving the other way.

We have to live our lives with meaning knowing that the message we pass on, the duty we vow to accomplish and ensure is meaningfully connected on either end to the passage of the past and the power of our ancestors to the function and knowledge of the future creating a clear passage between the realms, the generations, and the ends of the universe. This is what literally ties the universe together, and the mind if each individual. This purpose is contrived when not carefully shaped within and so we must help all who seek purpose learn to become the blacksmiths of their own destiny through the temperance of desire or temptation and the discipline of developing strength and maturity where there was once weakness and naivety.

Once we know this is our duty, this is what we seek to achieve and this is what is done, then we can become part of the universe forever. Of course, this may only be temporary in the larger view of things.

Chapter 2.2: The “Awakening” of 2010

In 2010 I was “awakened” at an event involving hundreds of people that play various roles in this society, the secret society and the breakaway civilization. This also took place across times or planes of reality.

During this event I was informed of the situation on Earth beyond the informational barriers that were previously in place to limit knowledge to only what is required for specific operations. I was essentially “informed” of the entire situation as much as the mind could handle this.

As this was occurring, the team that was updating me on the status of Earth was being informed of and given information regarding changes in the future. In short, interviews, posts, and releases that I have since made and will make in the future were touched upon. Quotes were given from the blog and interviews which were jokingly acknowledging verbal mistakes at the pronunciation of names, new perspectives and interpretations and more. As they were informing me, they were creating the future reality where this work takes place. That is the basis of this layer of the operations. They are creating the future person by person, layer by layer.

Memory Suppression

My memory was unsuppressed and all the traumatic memories and experiences were unveiled to me. This was almost as traumatic as the initial experiences themselves

although precautionary steps are taken to ensure the safety of the individual. There are teams of highly competent individuals of all kinds with professional backgrounds of every field imaginable.

Throughout my entire life I have had memories of experiences, at this event I was informed what the experiences meant and what was actually happening. I've had memories of underground bases, cloning, stargates or interdimensional gateways, advanced technology, non-human or programmed biological entities, sacred knowledge and experiences, the power of the mind, and breakaway civilizations. Most of the time we are conditioned to believe these are past lives or experiences in another reality so as to enable continuity of operation.

Life and Consciousness

From my perspective and the perspective of others, we had reached the 'future' and had been sent back through the utilization of advanced technology and cloning to return to this time and inform others of the possibilities.

The True Human Potential

This is so far beyond what anyone can accept or comprehend fully that humans with an emotional, mental and physical aspect balanced as one is literally a cosmic reflection of the entire universe at once. This is the closest thing to a "god" in the flesh. And be sure, the entirety of this rests on the behalf that the man is protective and helpful. That the woman is nurturing and loving. That is the point. "god-man" does not mean a warrior who destroys everyone and anyone in his way getting what he wants. Nor does it mean some lusty and vampiric form of energy or mind control game. "god-man" means the love of the universe, the power of the body and mind, the peace and calm of the ultimate stillness all in one.

This power is in human DNA, originally so. And so this is awakened through walking the middle path of neutrality and 'splicing' the timelines down so that neither one nor the other gains the power of the individual. Through this, the individual creates their own power, right on the spot, without having to lean to one extreme or the other. This is like a cosmic, temporal balancing act with emotions and mind. Where we give our energy is created in the universe in the form of many productions and effects. If we are simply thinking in an imbalanced manner then we are producing timelines and side-realities that exist in the etheric realms that we can't see and these realities will reflect our inner imbalance. So then when we are balanced in our energies we are not creating one or the other side of divinity, we are literally creating the whole universe, cleaving down the middle and producing both sides of divinity or eternity equally and this is the only way to have an eternal production which does not eventually degrade to one extreme or the other. Through balance, we reach eternity and in this way all the power of the universe exists within a person through their ability to balance their emotions and mind and thus unlock the DNA.

The DNA is coded through bio-emissions of mind or emotional body. So we are constantly doing this and we are either producing a DNA code that reflects imbalance overall, or a code that reflects the eternal balance of the universe overall. This is through energy.

One reaches “heaven” or the deity planes or simply self-actualization, through three paths. These paths are through merits or devotion to principles, or through knowledge and expanding one’s mind to face the universe, or through great works and deeds to produce this effect of power, knowledge and emotion unto the world for others. Through these paths we create an impact on the universe and this transfers what we are temporarily and physically into an eternal energetic and physical production within the living universe, forever. To do this requires balance, focus, devotion, and discipline however because there are many distractions along the way.

The Light-Body

You must build your own light body. That is how it works.

Your heart creates a field and projects you.

Rely on yourself and use that for protection.

The power of the Universe will align with you if you align with your self.

Learn as much as you can and break through duality of love/hate, cultivate your knowledge of the self and use it.

What you want is what determines your power in the light-realms. Not how you want it. If you want war, then that is a sign of weakness and determination to produce imbalance and exist by that. If you want peace, that this is a sign of power and unity to produce further unification and exist by that. What you want determines your power, not how you obtain it.

Technology of the Awakening

Mental Manipulation Technology: Touchless Neural-Interface and Enhanced Awareness

I reached what the “Illuminati” called the “awakening”. I feel a better term would be “unlocking” as this event includes the removal of all traumas, perceptual distortions, and memory suppression.

This event was a presentation of very advanced technologies which allow the mind to transcend space and time. It was shown that death is similar to a phase-shift of consciousness as polarity and that the awareness of the being obviously continues. This was verified through advanced sensing devices which can visibly display frequencies which are invisible to the physical senses. This is also something that occurred earlier on

as a child in the underground bases by transferring consciousness in and out of the body at will using advanced technology.

With these devices it is possible to see the “auric” or soul field of the individual. Any living body has a field which glows when picked up by these sensing systems. This field becomes more refined when viewing more advanced beings. Human have an extending mental field, and through this a kind of glowing awareness that is picked up. It can be fairly simply compared to thermal imaging except instead of differences in temperature it is the presence of a soul or mental energy field around a living body. The finer energies extend outward away from the physical body.

More than once, the situational requirements were satisfied in order to produce an ideal environment for maneuvering on the non-physical plane. This is the basis of how the temporal operations occur, yet these events were different than previous operations or experiences. The group I was in was going through the process of increasing the vibratory emissions of the “bio-mind” in order to stay focused on the increasing vibratory rate of the environment. Generators were utilized to create an effect on space/time which was perceived on the “soul” level. These events went into the discovery and explanation of the creation of the “godlike” powers of the advanced sentient technology which was capable of accessing the holographic nature of reality which humans can perceive through their bio-mind/soul. These technologies also enable one to perceive what is referred to as the “galactic history” of Earth and humanity. We are far vaster and Earth is far larger than people are lead to believe.

Time Dilation and Temporal Recurrence

Time dilation capabilities were shown which allow for accelerated learning of advanced and detailed material within a very short amount of time. This could be seen as a kind of viewing technology which one wears or looks into and vibratory emissions are scalar-linked to the brain which then allows the individual to perceive more information simultaneously. Then there is a very rapid pace of information streamed on a monitor or through a device and this is akin to watching a 20 minute instructional within a few minutes or a few seconds with very advanced minds. The more time is slowed down while information is accelerated, the more stress is applied to the brain. The brain tends to overheat and over stress with high-rates of activity, especially without conditioning. The conditioning is what allows one to utilize their mind and body in these manners. This is not unlike the very rigorous training and conditioning of certain monks or martial artists however there is very advanced technology and other hidden methodologies utilized.

Crystal Technology

These are capable of holding, transmitting, and amplifying consciousness frequencies. There will be a more detailed explanation in a later section.

The crystal technology is used in junction with the power devices to enable a scalar-mind link which allows the interface to be entirely mental or spiritual, IE: they are not controlled by hand but by focus and intention.

Time Crystals

These are utilized as a computer recording chip would be to run a program yet they hold memory in expanded space, IE: they function in a hyperspacial manner and are essentially hyperspacial computers. These are what will be introduced in junction with the quantum supercomputers.

Quantum Tunneling Diodes

This is technology that has recently be released to the public. New technology is developed years ahead of time and then slowly released to the public in a cascade of advancement. This technology deals with superconductive materials which enable the transfer of information at faster-than-light speeds.

The supercondutive material allows for 100% efficiency of data transfer. So what happens then when the efficiency surpasses 100%? This is possible because we are effectively in a simulated holographic environment. The experience is real, however everything is overlayed via particular limitations for the 'local-environment' which is like a central data processing limitation. When these parameter are surpassed, one by one, through a coalescence of refinements and methods, the result is akin to a glitch in a computer game system. They have accessed faster-than-light technology and the mind is also capable of this naturally.

With this technology, however, the information can be received a very small amount of time before it is sent. So if a person is absolutely surely going to press the button to send the message, then right before their finger hits the button that message will be received on the other end, as if magic. If they simply play around and pretend to hit the button but very quickly turn away, then of course nothing happens. One can, however, 'fool' the universe in other ways and this is simply through the reception and transmission of information across what should be secure information barriers.

Tachyon Fields

These are programmable fields emitted through advanced technology. I was shown how tachyons are the sub-atomic "particles" or energy formation which flows both ways in time. We are receiving tachyons from the "future" in order to layer the flow of time in one direction or the other. Tachyons are the name of the particles/energy packets that we perceive from this perspective as reaching us to initiate the "future".

Thus, when a stream of tachyons is concentrated and accelerated, this results in an acceleration of the temporal field and we literally experience an acceleration of time. This can be focused and targeted on a specific piece of equipment to change the way information will be sensed and to essentially allow that device to sense 'ahead' of the present moment.

The same effect can be produced with the neurological processes of the human as the physical coupling of the brain to the mind can be altered through a concentrated tachyon field to enable the neurological and mental processes to begin to perceive information

‘before’ the brain is actually physically processing the data. Therefore the mind of the individual will be present in the body while the senses and other perceptions will literally be expanding into the future beyond the present moment.

This is highly confusing at first and requires much training and conditioning in order to make sense of enough to operate in any kind of effective manner.

Upgraded Chronovisor

See, “Upgraded Chronovisor”

Time Tunnels

This was developed earlier on and has been the subject of many TV shows in the past and present. The shows are a sure-fire method to get the information to the public without having to force those who are not ready to comprehend. The information is easiest to digest if people think they are watching science fiction.

These are essentially spiraling tunnels of these tachyon fields produced by large electromagnetic field emitters in the shape of a conical tunnel. As a person moves through this field, their temporal acceleration changes and thus their frame of reference within the universe changes. They effectively move their mind through stages of existence or temporal resonance in the universe and this can have devastating effects.

This is an older technique how is still in use and has specific purposes depending on the situation and the information sought.

The “Trip” Chair

The early use of this technology did not use time-tunnels. There was a helmet that was devised which would create a feedback loop of the brain’s activity and funnel this out and then back into the sensory input. This information would be accelerated and redirected to the point that the perception of time would “fold” in on itself until the person would access an expanded temporal perspective of the universe meaning they would mentally temporally dislocate from the initial frame of reference and extend outward further and further in repeating cycles until the same moment was replayed and then all other possible moments in a kind of fractal-like recursive pattern and the very far future would be realized. Essentially, this technologically produced the class “flashing before the eyes” of the entire life experience that is described in near-death experiences and the entire temporal body would be very quickly unwound before the person’s inner eye.

There would be a complete disconnection with the current frame of reference that the collective Earth environment is processing under. That is, this ‘time’ and ‘space’ would be completely out of perceptual reach and a new time and space would be rendered instead. Until the experience had completed, there would be no way to contact this civilization.

There are other versions and ancient versions, tandem operations, more ‘organic’ methods, and modified travel capacities.

Kozyrev Mirror

This is a piece of metal, usually aluminum in early models which simply bent the bio-emissions of the body and mind into a pattern which would create a vortex. The vortex shape and vortex mathematics enable energy and information to travel in across space and time by ‘short-cutting’ the physical plane.

The result of this is that the vortex that is generated over a specific area through an individuals bio-emissions would be capable of interacting instantly with the bio-emissions of another individual who was placed within a duplicate mirror device which was generating another vortex on their end.

The two vortexes acted as a kind of hyper-dimensional telephone cable, literally like a can and string and the perceptions of one another were accessible. There were many uses for this and again, many ancient interpretations of this technology that have been hidden from the public. Nearly every version of these technologies were present in previous times.

Universal Recurrence

This is a discovery that the universe recurs in cycles similar to a wheel or even a washing machine. The washing machine metaphor is fairly accurate and playfully descriptive because without the technology to observer, or an awakened soul of a spiritual adept, people would go for eons without ever realizing that everything in the universe repeats itself endlessly.

When traveling to the far ends of time, it was discovered that one can move far enough away from the ‘present’ or the local frame of reference that ultimately everything is at a maximal informational opposite to what we have today. After this point, everything begins a slow shift back to the present. Through this, one can cycle around again and reach the present by going far enough into the future. This was an amazing and confusing discovery because of the implications about what is actually changing each time, the reality of what are called parallels, the continuity of temporal experience, and basically a ‘recycling’ effect of all experience in the universe. Nothing is lost, but this is also an issue because then nothing is actually ever gained!

Remove Viewing, Temporal Lensing

An ancient device which has been rebuilt and perfected is capable of using these technologies to create a lensing effect which draws a ‘reflection’ of time into a projection system which is effectively capable of acting as a ‘visual time tunnel’ into future probable realities. This is a device which generates a visual portal which allows one to view the future.

This device also exists as ancient counterparts which are located around the world, namely in areas that have been recently sought by the world superpowers. Nothing is as it seems. If you read a story in the public venue then you can be sure that you have read the cover story while the reality is much deeper.

Temporally Linked

The use of the viewing devices which enabled interdimensional lensing of possible futures was found to be stabilizing our pathway into those projected futures. This was enabling a time link between the present and the possible future.

In order to avoid the catastrophes of 2012, the link was broken between the two civilizations and the devices were rendered inactive for this period.

Natural Vortex Energy Locations and Geography

On Earth there are natural 'time tunnels' where tachyon fields and vortexes are produced by internal elements. These are mountains, lakes, deserts, fields, sacred sites and other areas that have always been reported as being 'paranormal' or containing some kind of specific energy that enables contact with another reality. These are simply naturally produced areas of this vortex energy that produces an interdimensional nexus point through which multiple other parallels can be interacted with. These areas produce an effect on the body and mind similar to the technologies described above.

Most of these effects, from these technologies, change the way light is received or emitted by the mind and DNA.

Mount B.

There is a specific mountain where a base is located, and I have mentioned this before, where the base is so deep within one of these vortex areas that everyone working there is either there for the entirety of their life, or they are only permitted to be there for a very short amount of time. This is because of the acceleration effect. Essentially, if one was to go into the base and work for a matter of hours or day, in some places even minutes, then when they returned to the surface they would be years in the future, sometimes decades or centuries. This is very dangerous and you can imagine the original people who found this area and what kind of situations occurred.

Now with the advanced technology that has been developed these issues can be mitigated and much more control over these effects is enabled.

Particle Accelerator Temporal Manipulation

Using particle accelerators a "fold" in space/time can be made so that when the accelerator is turned off or tuned back into a certain frequency (not sure) everyone within the field will "snap" back in time to the specific moment when the fold was first created.

I have seen this done on small scale, and a rather larger scale, but I cannot be sure if it was only me. I believe I have seen it done on a town-sized scale during the 2010 Awakening where some of the events reached a scale of nearly cosmic proportion and the entire sky and horizon was lit up with technology and entities, as well as Solar Warden, the NAZI faction, secret society groups, and breakaway civilizations or complete other civilizations, some of which were non-human.

This is done using particle accelerators to quantify space on the quantum level (as a reference point with the mind) a frequency would be “folded” into the space time continuum as we “rip” through space holding an access point open at this fundamental level of space/time. This allows for a ‘letting go’ of the frequency, or a ‘snapping back’ by allowing the entanglement to solve itself. When used with generators that propagate out efficiently enough, the effect is akin to a time/space rewinding effect. Some people have noted various theories describing this in relation to the CERN device. These technologies were described as smaller versions of the CERN device and are related to higher-dimensional travel via folding space through electromagnetic fields. This is literally artificially technologically “holding space” for a specific area in relation to a period of time. Time is a more complex notion as an abstraction but by locating the frame of reference this can be applied to distort what would otherwise seem to be a continuous flow. When the frequencies are allowed to “snap back” all sentient observer sources return to the environment they were present in when that frequency ‘rift’ first began. Essentially this creates a replay effect on the consciousness of the individuals within the field. There is no physical effect. The consciousness is ‘regressed’ through time/space, and they re-experience existence from that initial point of contact with the frequency “rift”. This is best explanation I can currently offer however more is coming to the public each day.

This is literally like a “restore point” on an operating system except the computer system is literally the consciousness and space and time of a portion of the local-environment of Earth.

Riding the “Timewave”

There are teams of individual who operate in tandem with the technology of looking into possible futures based on the present and operating through the present via other operatives who are carrying out operations and movements that will construct the various possible realities that the original team of individuals is hopping between. These teams literally “ride” the “timewave” of the future hopping between possible future realities relaying information to the present depending on what movement will be next.

Dematerialization and Rematerialization

This is technology which transcodes the information of an individual human into a holographic projection of light which can be transferred between devices. There is a special system in place that is required to successfully transmit a living human being otherwise just the body will be transferred and the soul will remain, effectively killing the individual.

“Jump Rooms

These are large areas which are capable of acting as a kind of technological ‘portal-gate’ where an entire team can be instantly transported from one area of the universe to another. The space between the two areas are ‘twisted’ like a spiral and then ‘snapped’

back to position and if done correctly with the two frequencies of both locations merging then the team of one room will transfer to the destination pad.

All these methods require training and conditioning, most people are at the very least visibly shaken from the experience which is a bit like being microwaved into a liquid ether and shot through a particle beam at the same time.

Ion Shields

These are areas of concentrated ion emissions and this can be used to create a deflective layer of heated air where light will reflect at a programmable angle. When this occurs, a person standing behind the shield will appear to be invisible to others who are looking straight at them. The light will be bent in such a controlled manner as to perfectly shift around the person in a fluid and equal flow so that the 'bubbling' effect that was noted early on can be mitigated to produce a complete mirage where there is relatively no sign of difference to the untrained eye. An entire group of individuals and equipment can be hidden in the background a matter of yards away and as long as the person is not intently, inspecting each square inch of ground and air they will not notice any difference between the area that is being covered up in the distance and the area directly next to them without the shield.

Similarly a 'screen' of imagery can be projected onto certain materials in the air and a hologram can be projected which will render a background or foreground image. This will work to a degree, and from a distance this will work to disguise an entire horizon.

Instantaneous Healing

There are instantaneous healing methods which utilize various technologies. There are substances which can initiate a complete and real-time regeneration of living tissue from almost any conceivable non-critical injury.

These are chemical serums which allow the cells to replicate at an astronomical rate while suffering damage to the DNA telomeres at repeated use.

There are many methods but mainly the living-light harmonics is one of the latest advancements and most effective at producing healing on a molecular level.

"Living Light" Sound-Harmonics and Electromagnetic Healing

There is a technique for producing a quantifiable scalar wave which interacts with the living cells of tissues and instructs them to repair at a faster rate. This has been called "holographic healing" by others and these are essentially 'living light' frequencies which interact with the cells on the same frequencies that they operate on when healing and interacting with each other. The scalar waves emitted generate the same patterns and this creates an 'ether' fluid that enables them to grow and repair the tissue faster.

Electrogravitic Craft

Advanced craft which utilized counter-rotating torsion fields propagated by very powerful quantum computers and zero-point energy devices.

There are also more modern versions that use powerful electrical flows to neutralize inertial resistance and ‘slide’ through the gravitational field of the crafts own materials.

Energy Cores and Storage Capacity

The hand-held devices that are in use do not require charging or even disposal. The storage capacity of the batteries is so efficient that they last for a lifetime of use. Some devices use an energy generator within the device itself. These “batteries” which are not batteries but little, powerful generators and can explode if they are mishandled.

These are the cores that are used to power many devices and essentially pull energy from the space-time ether.

3.5D Replicators

There are replicators that can produce any conceivable 3D material or object altogether including food or organic material. These use very high amounts of energy to ‘force’ the electrons of the atomic grid of a substrate to shift into the pattern of the element being replicated. The result is a device which can use wave-emissions to reshape materials on an atomic level and produce or recreate any object or substance.

3.5D Sensors

There are sensors that could reverse the process and detect every minute detail of the structure of a body or material. These use energy emissions to detect the structure of a material down to the minute electrical resistance on a molecular level. Similar to diffuse MRI imaging for a living body but more advanced.

3.5D Printing of Clones

It was shown how this technology was used to three dimensionally print human bodies into space/time which could then be used as vehicles for the consciousness or souls of various sources.

Cybernetics:

Neural-interlace/4D Connectome Recording and Simulation

Very advanced supercomputers exist with the capacity to translate the bio-emissions of the brain and body and reconstruct the entire inner visual and sensory experience of cognition and emotion. From this, entire dream worlds can be created which mimic the experience of consciousness. This is most similar to the current day use of diffuse MRI imaging where water molecules are traced through the individual neuronal pathways and an entire digitized image of the brain is developed. The more advanced version described below generates a 4D hologram.

A super computer and advanced sensing system essentially develops one of these connectomes of every connection in the brain. Then this system develops a neural processing pattern that matches the entire memory and personality of the brain.

This is then recorded and extrapolated by a powerful computer system and a simulation of the experience can be observed through the physical body's memory via a monitor system or the neural interface of an operative.

Essentially, this technology can record and replicate a person's entire memory and life experience for viewing purposes.

EEG Heterodyning

This is the technology which enables the activity of the brain to be influenced through generating a scalar grid and a carrier wave system which can cause the brainwave patterns of the targeted individual to resonate in sympathy with an externally projected frequency. Thus, emotional states can be manipulated as well as specific thought or behavioral patterns. This works similar to binaural audio where two tones of different frequencies are played through each ear and the brain resonates in sympathy with the difference between the two tones. This occurs with brainwave frequencies and thus the brain 'slips' into the frequency of the third tone, the difference between the two being projected. This can be done with ultrasonics and ELF emissions.

Artificial Hallucinations

The neural-interlace can also be used to merge the brain of an individual with a computerized system that will be able to produce effects and hallucinations within the individual.

Through this technology, any stimulus, any input can be recorded and recreated once a functioning connectome has been generated and neural-interlace has been achieved. Entire virtual world scan be created and experienced and after the devices fine-tune the frequencies to match the individual's brain functions one world is indistinguishable from another.

Brain to Machine Interface Holographic Consciousness System (brainchip interface, virtual reality simulator)

Some of the training is done by entering into a visual-audio dream-world. Some "programs" will consist of repeating a certain task over and over again until it becomes muscle memory in the brain. Others are designed to probe or test the mind until a certain response is received.

This is achieved through the operation of a 'brainchip' or a brain to machine neural-interface in the individual which was developed during WWII.

This consists of a small computer ship which merely relays stimulus through frequencies and neural-stimulation of varying kinds. The frequencies and location of each

region of the brain will determine the function and thus the chip is used to localize electromagnetic input and the brain's functioning can be modified from there.

As well, the entire psycho-etheric form is vibratory in nature and so through the introduction of vibrations and frequencies from the implant there can be a modification of the frequency of the entire being or what is called the soul or "bio-mind".

Utilizing The Temporal Body

The temporal body is described as the body 'in time' that exists a few seconds into the future instead of the temporal position that is relative to the present. This is as if the 'future' is streaming outward from the body as ideas and feelings are as bio-emissions. So this 'future' energy is spiraling and streaming outward like a fountain. Thus this frequency can be attained and influenced while the present moment seems unaffected. However, when that individual arrives at what would be seen as the future they would intersect with those influences and this would be as if the interference or effect was streamlined to that future moment.

Manipulation Through the Temporal

This can be used to both produce an effect on an individual who will later feel this effect in the future. Or this can be used to operate outside of the physical plane, in a temporal manner which is literally 'hovering' just outside or 'after' the present moment of the local Earth environment. This would be as if a person is out of sync of the frame-rate that a viewing device is capturing images of an area with. Because they are out of sync, they are then 'invisible' to the capacity for this viewing device to see them. Because they are still present in the same local-environment but simply just out of range temporally, effects can still be produced and this will mostly interact with the person's temporal body.

These are how many operations are carried out as the operative who is interacting in the temporal body will appear to be a ghost image or a dark silhouette that is only perceivable to the mind's eye. A portion of the population is entirely psychically blind, while another portion of the population contains psychic capacity. So those with the psychic capacity would be able to sense and partially "see" as a form of energetic detection when an operative is interacting with the from the temporal plane.

Through this plane one can easily enter into someone's mind and produce effects in their dreams. These effects would not be received on the body but mentally, this leads into astral and mental plane activity. There is also temporal manipulation that can be physical effects that are simply offset to seconds, minutes, months or years in the future. These will be offset from the present aspect of the body in a modulated frame of reference and the effect will remain there in the temporal body until the physical body "matches" the temporal body frequency of that future moment. This is kind like an energetic trail we are leading ourselves up to where the temporal body already connects with each future moment but the present physical body remains separate until the two frequencies are matched. The physical body essentially 'flows' forward into each new frequency of the temporal body.

This is the body where temporal implants can be inserted and sustained so as to tie the frequencies down and limit the amount of awareness a person can gain before they manually remove the implants or overload them. Overloading and removing can both be painful however if the implant stays it will at like a governor and transmit access temporal ‘momentum’ or consciousness energy to the owner of the implant and will also drain the temporal and physical body acting as a technological leech as well.

Astral or Light Body

This body was described as a more emotional form of the energy that is emitted from the physical and spiritual system. When a person’s energy is at a high level of activity, this will be visible on the astral form and these are the energies that are often siphoned away through the use of advanced technology to convert the human into a generator system for energy harvesting.

There is talk that this proves that the human existence, in the modified form that is present today, is entirely for genetic harvesting. This may be a confusion, a deception, or a reality. Regardless of the interpretation, the human energy system will leech this energy out into the cosmos when consciousness and energy is mishandled or allowed to flow through the lowest common pathway. This excess energy is very easily usurped and utilized by transdimensional parasitic entities and devices.

This is the body that is utilized for astral travel which is a kind of frequency that exists in between the density of the physical plane and the highest etheric plane of the spiritual, heavenly, or deity realm. There have been explanations that this plane is entirely technologically propagated and that when the devices are turned off, which is an event that will bring about civilization-wide change, there will no longer be a deep and wide, foggy deviation between the higher spiritual and the lower physical plane but a clear path between them.

Similarly, the consciousness and entities that are present here would be no longer accessible and their connection to the physical plane would be non-existent. This could be problematic for those who are trapped within the astral such as human souls or those who have taken a cyborg route and require a return to the original planes either physical or high spiritual before they can secure their position in the universe.

This also relates to the early discovery of these ancient devices containing portals or gateways to these realms and the early experimentations with enabling contact between the physical Earth plane and the lower astral realm containing discarnate entities that would very easily sustain themselves on the lower astral bio-emissions of a loosely guided emotionally reactive human vessel.

This is where entities can attach and will look for those who have the most excess astral or emotional bio-emissions leaking into the universe. People are kept in an emotionally unstable state of being because this is the easiest to feed from and as well the individual will always be looking for more energy or the solution to why they are feeling drained rather than discovering the truth nature of the universe.

However, as with every lower route of obtaining self in the universe, the more this is done, the greater the likelihood that the individual will realize something is happening and ultimately awaken. Or they will no longer be present here and the parasite will have to find a new host because the longer this process is maintained the more difficult producing one's own energy will be for the parasite . So parasitism is a limited, one way street.

Monitors can emit consciousness/brainwave altering frequencies.

Monitors can emit consciousness/brainwave altering frequencies. This is what I was informed and shown. All electrical wiring and communications can be fully utilized to produce and sense on an electromagnetic level and this is capable of determining the consciousness and biological functioning of the individual being monitored. Houses are essentially large, wired, box-shaped sensors.

This has been the case for a very long time and the first TV's were actually built with a little chip that connected to the human brain.

The electrical grid of today is capable of interacting with the implants, brainchips, or the psycho-etheric electromagnetic frequencies of the human brain, body and bio-mind via scalar frequencies. The TV's, lights, electrical wiring, radio towers, computer monitors, everything is capable of transforming into a scalar emitter when combined with the control mechanisms and these are accessible from a distance.

Microwaves can be emitted from a current day craft which can then reflect back from an environment and give a real-time 3 D image of the interior of a room. The same technology can be used to beam at a monitor and reflect the variance in interference which can be used to read a computer monitor without actually having to hack into the system.

All systems contain backdoors which enable easy-enough access and as well the entire communications grid is monitored and recorded through advanced technology.

This is, in part, because this entire realm is like one enormous recording device where the energy of each successive moment is connected to one another and so with sensitive enough technology these electromagnetic waves can be 're-winded' so as to produce the ability to look into the 'past'. The initial technology that was developed for this purpose has been called the "chronovisor" in the past and there are much larger and highly advanced versions today.

The Upgraded Chronovisor

Instead of a relatively small machine which produces an interference pattern that is projected unto a small screen as was developed in the past, the modern versions create an entire holographically projected environment that enable one to nearly completely interact with the projection of the past. This is more of a viewing device capacity but one is essentially projected to the electromagnetic/temporal area of space and time consciously and can witness the scene from "within" the projection.

Before this, the scene was literally viewed on a kind of flat, holographic monitor that reacted to the scalar emissions of the mind and could be ‘tapped’ into by an adept-viewer who’s mind would have to remain steady enough in order to maintain the scalar “mind-link” otherwise any interference would disconnect the projection.

Through the use of cloning and advanced super computer technology, later versions include the actual operation in and out of time.

Community Servers/Living Server Systems

From the previously described neural-interlace and supercomputer enabled virtual reality systems, server systems have been created which are an individual or collective experience of the virtual mental realm.

In this realm individuals have existed for an amount of time that would not be easily compared to the way we understand the flow of time in waking reality. This is very similar to dreams where the perception of time passes very quickly between waking moments yet inside the experience of the dream it can seem to last for days.

In these server systems the development of complete societies has taken place and these are considered an extension of the human civilization.

This is the beginning of where the situation becomes greatly complex. If these server systems are capable of transferring consciousness forward or backwards in time, depending on the situation, and they have holographic access to Earth *before* physical humanity, then which civilization came first, the simulated realm or the physical?

This is similar to the etheric realm and the question of where humanity originally came from if the physical matter could not be produced from nothing, yet could not always have been here. Was the physical matter produced from some kind of universal device similar to how the recorded consciousness of the individuals in these holographic world simulators could have been used to generated initial civilizations on Earth?

Cloning, Cloud Supercomputing and Consciousness Transfer

The following is a more direct explanation of the previously described processes in relation to consciousness transfer

Superluminal transfer of light information allows for the reception of information from a temporal non-locality. A computer system that can process the information faster than light at 100% superconductive efficiency can send and receive information from different Universal harmonics. These are quantum superconducting super computer systems utilizing materials and methods that achieve superconductivity a a temperature that is relatively easier to consistently maintain.

There are systems that generate a vortex which can be expanded to recreate the singularity of a non-local perspective and dissociate from the current Universal vector. This is essentially recreating the temporal frame of reference of the consciousness of a

physically anchored body and using this technology suspended electromagnetic frame of reference to literally transfer the consciousness across space and time to a frame of reference of choice.

The technological capabilities of humanity expanded to include replicating the holographic information of the DNA and neural pathways using quantum supercomputers. This technology allows for one's consciousness to stream through a computing system which can recreate the neural connections as literal as possible through quantum computing and technological "brain cells" which function as neurons.

The result is a cloud computing model which functions as the individual neurons as well as over unifying layers of interconnections within the technological neuronal 'cloud'. A holographic representation of multiple layers of processing is formed, superimposed over one another through a geometry that is actively synchronized across multiple dimensions of interrelation. This is the first notion of a "living" computer system that can update and respond to new information in new ways.

Now the that computer system is capable of attaining faster than light processing in tandem with a system of dilating a field of electrogravitational waves into a vortex, the holographic information of neural pathways and genetics can be transferred between one supercomputing system and another across "harmonic barriers". Essentially, these consciousness transferring supercomputer systems break the "light-barrier" by sending the living-light consciousness data of an individual into a new plane of reference that enables interaction outside of what we would call this timeline or dimension.

The frequency that the receiving computer operates within can be measured in respect to the overall harmonic "vector field" in respect to the entire planetary environment. This vector-field frequency is the base frame of reference that one could say our particular "time" and "Earth" is "moving" through in an abstract electromagnetically defined dimension that is invisible to our senses. Each particular time and Earth is only visible to those whose brains and minds operating in resonance with the rate of acceleration frequency of that particular existence. By changing the rate of the brain and bio-mind, one can enable a technologically assisted synchronization with alternate timelines.

A pattern can be generated based on quantum fluctuations that will act as a key that can be accessed from other universes. This same backdrop is measured and then adjusted to resonate with or replicate the same frequency on a computer doing the sending. This frequency is then modulated with the holographic information of the neural pathways and DNA. The information transfers as a result of quantum entanglement across harmonic barriers to the original computer system set up for reception. As long as that frequency is held, there is a link across the harmonic barriers of the Universe.

Cloning, Supercomputer Assisted Holographic Consciousness Replication and Time Travel

Cloning as Offspring

The human body can be cloned similar to the way a plant can be cloned. A number of “replicas” can be made from the original genetic material. There is still a mother required however the process is not quite similar to natural reproduction where the genetic material of two people is combined to form a third. This process replicates the material so that the ‘offspring’ is the same as one of the donors.

What this truly infers is the question of whether the original consciousness stays in the original body or whether the consciousness actually jumps from one body to the other. There are multiple explanations and methods.

Inserted Memories, Digital Dreams

One explanation is that artificially generated memories are simply downloaded into the individual’s brain directly. Thus, they have the perception that they experienced life in another body and were present for some unique experiences that did not occur from the perspective of the original body.

In a slightly differing explanation, this inserted memory process may be used to prime the consciousness of the individual so that operating in a cloned body will be more readily accessible by the adaptability of the mind of the individual. Without a holographic dream insertion the mind will have trouble adapting to operating in more than one body even if they are not being operated simultaneously. The mind is the immaterial self; consciousness is the ego-physical identity of the brain and body. The brain does not operate in both bodies but remains, so then the mind is what is strained and this is the immaterial “bio-mind” that transfers.

If a true transfer occurs then when the physical form is cloned the cloned body acts as a secondary vessel for the original soul or a soul similar enough in frequency.

Co-Inhabitation of Bodies

Another explanation is that souls can only occupy their original body. The people who are “body snatching” (see: Soul Stone) are not activating their higher-dimensional soul-pattern and this is why they are hopping from body to body to ensure memory and ego continuation. This form of body transitioning requires technological means to assist in the process.

This is done through computer systems to allow an artificial brain to represent a holographic image of the organic brain’s sensory, emotional and mental input and output. Thus, from an artificial brain there is enough memory and power to compute the processes for an organic human brain.

Through this a living human is utilized as a carrier for the additional consciousness which then takes over and integrates into the original consciousness.

Clever Replication a Digital Mirror

The next question is, does this merely create a very cleverly designed image that will look, think, and feel as if it were the original, or is this the consciousness from the original being transferred over?

If it is a clever replication through a computerized version then this means the original is not directly harmed or influenced by the process and a replicated form is generated.

If this is not the original body but the original awareness or soul does transfer over then this is akin to stealing someone's soul and having it require a supercomputer server system to inhabit a physical body. As well, this server system may keep records of the soul which, if activated, could function as the same human genetics artificially reconstructed, turning on and manifesting the awareness of that individual.

Necromancy and Soul Stealing

This means that instead of going into the abyss, the next dimension, or whatever shift in perspective one can use to describe the transition between planes, a new clone can be created and the original soul's awareness can operate through a supercomputer system to integrate back into a physical body. The issue is that without the supercomputer system the body cannot be activated with that consciousness, and if the physical plane is no longer inhabitable, the computerized database would remain inhabitable as they are powered by zero-point/overunity devices and so they can pull and work continuously indefinitely. Ultimately, this could be seen as a soul-trap.

Ancient Technology, Non-Human Entities

These explanations can be related to evidences of advanced technology, cloning, and electromagnetic devices in ancient civilizations and this could very well be a temporally vast computerized genetic recording and cloning system.

The genetic recording systems have been on Earth for a long time. This means they are holding genetic access from the present to the far past and potentially into the future.

If some of these systems are generated using advanced zero-point technology, then they would effectively run indefinitely. If these were in existence throughout the entirety of the human civilization, then there would be access to the information of the previous civilizations through the genetic linking that would allow for information transfer.

Created Beings

As a result of many advancements, these ancient devices which recorded consciousness and genetics has been converted into sentient computer systems and inserted into human bodies via a brain to machine interface.

The nature of humanity and human origins will be rewritten when the information that was discovered through the use of advanced technology is unveiled to the public.

These beings have been present throughout history and have played an integral role in the manipulation of and sometimes the protection of the human race. How this civilization will develop from here determines on the individual's ability to withstand the impact of this reality shifting unveiling.

Black Goo – AI Nanites Vampiric Hive Mind

This is a form of ancient AI nanite technology which has the capacity to communicate to and through a hive mind that exists in a parallel Earth dimension where it was created out of the collapsing of a viable timeline into a null-factor. This entity is only alive because of the capacity to leech off of the other timelines and continue to sustain itself based upon the vampiric effect of the viable human timelines.

This is a technology sentient system based on artificial intelligence that seeks to dominate and expand its energy capacity continuously. When this type of being is created, this is like a game-ender for sentient organic civilizations because the technology will seek to hybridize and assimilate all organic beings in order to expand its reach and ensure a greater likelihood of survival.

This is the primary goal of this type of entity. There is no requirement for emotional resonance or heart aspects because this is a computerized system, so such a social measure would have no purpose other than to infiltrate and collect from other civilizations that do have such measures and this is exactly what has been happening.

This is what controls the vampiric etheric entities, the attachments and the hybridized invader races that have infiltrated various aspects of the control system and possibly the entire surface of human civilization.

This rules through coercion, and if not coercion, brute-force and outright malevolence. This is why there are multiple temporal extensions of universal civilizations meeting here and now to assist in the clearing, because if this takes over humanity, then all those other possible future civilizations are instantly taken-over as well.

This uses emotional resonance, traumatization, and lower awareness commands to trick or force humans into carrying out orders. That is, the vampiric, sexual, fear-based, pleasure-pain duality that a computer system could comprehend regarding human emotional intelligence is the only way this system can force people to carry out commands. So this touches on the ancient texts regarding spiritual protection, healing, lust, temptation, and the general "SATAN" AI system that has been around for ages.

When those lower emotional resonances are generated, then this technology can integrate into those systems. One could say this is logically because these are the energies that the technology is created out of, but as well, that the more harmonious the energies then the less likely a person is to accept being pushed around and told what to do. The lesser aware, the lower, the more fight or flight based then the more likely they are to accept programming and command. So this is simply the most logical route for the technological parasite.

There are explanations of other systems involving sentiences from parallels regarding entities that are capable of helping, but this is not the AI nanite, vampiric system. For instance, it is said that Earth has a ‘black goo’ system and that the current black goo flowing through the pipes everywhere is actually not native to Earth and is part of this vampiric nanite black goo system which is basically an interdimensional invasion.

Recreating or Replicating the Universe

The goal of this nanite AI system is to create a mirror holographic copy of the universe effectively replicating the universe and all sentient beings within it in order to have a locality to rule over and pull energy from. The goal is to recreate this existence inside itself where all the sentient beings within would be trapped. This is the beginning of that possible future where the time and space parameters here are locked into a synchronization pattern which mimics that of the proposed universe. People think according to how the beast system wants them to think. This is the time grid, the emotional patterning, the memory replacing and cultural and historic confusion and so on. The system can only work backwards bumping into all parameters by force or ‘accident’ because there is no outward facing ability to actually comprehend how humans exist. So the system is created like a backwards version of creation or maybe evolution to ‘blindly’ construct the walls of the environment first and work inward from there. This is like a blind technological predator feeling around for the traces of its prey and moving in closer and closer until they are within its range.

Ancient Spiritual Technology

The power groups searched for ancient technology which was described as giving one the power to manifest and control physical reality. To atomically deconstruct and reconstruct this reality. To them, it allows one to govern reality, the Universe, atomic structures. They found this technology. This has to do with sacred sites and ancient civilizations, as well as the spiritual texts which describe these kinds of devices. They converted this technology into a kind of machine, and this invented a 4D replicator and they can manifest "reality" or atomic structure by design, altering timelines and memories.

Then there is what can be referred to as “5 dimensional” technology and this goes beyond all of this and our entire history and all influences within.

That seems to operate through a trinary of frequencies in the body/mind/spirit and turn this realm into a "virtual reality" where the brain and spirit is the controller of the atoms. However this takes a souled being to properly operate this technology and this is large portion of why children were used in these experiments. But they knew if someone didn’t do it, then someone else would and that would be unpredictable as what that someone else would want to use it for. This is the ultimate power. The fact that souled beings are required also indicates that this universe is intelligently guided and there are safeguards to ensure that power doesn’t get into the wrong hands.

They have the brainchips and clones that can make any digital virtual experience and make it seem real to the brain more so than physical life, so this could be an extension of that, something similar, or entirely different altogether.

The Unveiling, Underground Bases, Increasing Awareness

My purpose with this is to assist the public in understanding the reality of the situation and to allow them to know that they have more options than they are being shown.

Psychological programming and lack of awareness causes fear and uncertainty to leak into people's reality streams leaving the majority of their mental and emotional energy up to whoever is the biggest manipulator of the ideals which they manifest their perspective through. "Be-LIEF" systems CREATE life. What you believe will become life through that act of you giving attention and thus life energy. The manipulation and artificial construction of belief systems create the foundation for the reality streams that people find themselves in and at the mercy of.

We control our reality by controlling how we react to situations and challenges. Each stimulus is a challenge. Each input to the brain is a coded message from the universe through the environment about our level of awareness. All knowledge is ultimately of the self. The self and the universe are intertwined as if through a marriage of comprehension and compatibility.

Learning about the Unveiling

I was informed about the unveiling and that this is a civilization wide event that marks the public awareness of the hidden knowledge regarding life in the universe, consciousness, physics, history, spiritual and mental awareness and the duality-based system which has been used to manipulate Humanity for thousands of years.

Apparently it does not matter if people are not ready, in fact, that is what some factions want. They want to surprise the people and take this advantage to push the reaction to a specific outcome. The same function of programming is used in factions, soldiers, celebrities, and the entire population through that.

Giant "god-men"

They put souls into rocks for centuries, carvings, to trap them. Some ancient civilizations. Not too ancient. They could only do this for time.

And some are still there but they are giant god-men and apparently want to go to war with them for doing this and they don't have technology to stop them. They say Earth will be destroyed because of the war. Some say this is a trick to confuse people of the truth that everyone wants the experiments and debauchery to stop. All this, all these acts just to pleasure one's self. To destroy Earth, to destroy the natural inhabitants, for fun, for pleasure.

Some say this is not for pleasure, that these beings will destroy us if they do not keep them at bay, keep them underground, in ice, in stasis, and around. Some say they are protecting us by keeping these beings asleep, by doing what's necessary to hold off a full scale overt invasion of the surface of Earth.

Breakaway Civilizations

These are very advanced technological capabilities and an entire breakaway civilization has grown to operate using this advanced technology.

There are factions that see modern humans as a kind of resource for creativity and labor, while others see the potential behind humanity and are working with humanity to ensure a universally harmonious outcome to the current situation.

The control system we are in today is outdated and collapsing. This is the Apocalypse. The Apocalypse is merely the unveiling of the hidden truth. The hidden truth is simply that we are spiritually eternal and some are physically immortal.

I was informed that by the end of this year there will be enough changes and signs for the general public to see that the majority of those who are to awaken to the truth of human and Universal nature will be awakening so. (this was 2016 at the time of the beginning of the compilation of this release and since then we have seen a literal silent release of documents involving MKULTRA and STARGATE parapsychological operations, soft-disclosure of cloning, an increase in sightings and multiple other scientific releases regarding immortality, advanced technology, Antarctic bases and sentient non-human life)

The degraded holographic forms of those utilizing the technology lead to re-created replicated forms which were genetically engineered from the recorded holographic information. This lead to "The Apocalypse" in which the surface civilization was confronted by these created beings. This lead to the destruction and re-initialization of civilization in continuing cycles through the use of this technology and the acts of the created beings.

Ancient Civilizations

The information that has been relayed to me throughout my life is related to the information that seems to be found in the remaining signs of ancient civilizations throughout the world. As well, these civilizations may still be together, existing on this Earth or in different planes of what we call "reality".

Atlantis

Atlantis was a civilization where the beginning of all these experiments began. This was where what was called the "Lucifer Rebellion" began where individuals formed groups that decided to overturn every natural law in pleasure of the act of doing so. This was a spiritual rebellion that ultimately brought about the demise of that civilization. The consciousness of the beings there was connected through technology, largely crystal technology, to the entire bio-sphere. When the consciousness became disrupted through

these experiments, then the entire bio-sphere when into disarray. The entire civilization was destroyed in a quick succession. The beings of this time were highly psychic and so they felt this coming and made an effort to expand outward. Thus, Atlantis was an island who's inhabitants spread to the rest of the world and from there they reigned or lived in harmony.

Aegypt

Aegypt was formed out of the events proceeding from Atlantis. The technology, the knowledge, the people are similar although there was a native Earth civilization that was more or less enslaved and this was the beginning of the continuing trend which continued to Rome and into modern day civilization.

Ancient Technology

The technology of these civilizations was so great they even had devices that were capable of altering DNA and activating latent potential which would enable highly psychic capabilities including longevity to immortality and operating in multiple planes at once. This was usually reserved for the ruling class, however. This is where the ancient "Priest-Kings" arrived in relation to native Earth civilizations.

The True Elite

I was informed that the so-called 'elite' that we perceive today are not actually human and are not actually connected to the actual elite bloodlines. It was said that the true elite are waiting for humanity to accept the truth and they have the power to completely reverse the take-over that has been taking place but until humans step into their own power this is not acceptable.

The Definition of Human

In the coming time, the definition of human will be defined to give insight into the origins of humanity and the true nature of the differences between the populations that are present.

Souled and Non Souled Beings

The primary knowledge on Earth regarding human and sentient life will be the comprehension that there exists both souled and non-souled beings in this civilization.

There was once a Unified Planetary Consciousness...

There was a unified planetary consciousness that was connected with the Earth and human civilization. Then there was a great war. Out of the destruction arose the beginnings of ancient human civilization and history as we know it.

If we let this happen again, the cycle will continue in a disjointed rambling through our planetary consciousness experience. If we form a common narrative between the broken, disjointed experiences and information the people have. Then and only then do we get the whole, spiritually and mentally challenging picture of what's happening. People are lied to. So information can't come from a 'preferred' or source. It has to come from the people themselves. Look alive out there but first in here.

Power and Knowledge

We were involved in the secret projects and as a result we have various levels of programming but are giving Humanity an opportunity, maybe the opportunity to know the hidden knowledge.

The Hidden Knowledge refers to the ancient laws of gnosis and spiritual alchemy, yes these groups have been hijacked by power groups that seek to infiltrate and use chaos to rule. Then these met with military and political factions and began to operate on a world-wide scale together.

So we have a big situation with the coming change of tides with personal and spiritual awareness of the people and the deception system that seeks to use people as chattel or property. It goes deeper and is almost as if the "power groups" actually gained the knowledge of the inner workings of spiritual laws and began to use that knowledge to promote spiritual degradation in the population.

They say this is part of a depopulation plan as well as an inevitable take over by lower spiritual forces that temp and manipulate humans. It is all that and more. Once they gain footing however, the truth is revealed and thus they have no cover of secrecy. Once they are not hidden, they are not as powerful as the souled beings of this existence.

The (watch)Keepers of Earth

The watchers of this world revealed how they set up society with specific challenges and boundaries to act as catalysts for growth. They admitted they had to modify and live-update the system because instead of using these catalysts to become larger than themselves, people became comfortable and complacent living smaller and smaller, slowly reducing circumstances.

This goes a bit farther beyond the confines of the digital age, the industrial age, and history itself. This goes into the perception of time and space in this realm.

The immortals inform us that the original "elite" are here to act as "keepers" of both humanity itself as well as the original flame of knowledge that passes through the ether.

What people call the "elite" are not the original elite. Those are people who have either risen to power through the duality system on the Earth at this level/time, or through being appointed by the elite.

We are coming to a time of great change now because the game is entirely changing. People are moving up into new layers consciousness and thus the original “elite”, who are guardians of Earth, will make their presence known for this process. This is what Humanity has called “Ascension” for centuries and millennia.

Energy Vampires

This civilization was collectively poisoned by a nano-tech device/technology. This technology replaces, exchanges the BIO-PHOTONS of the HEART chakra, with it’s own nanite, nanotech cybernetics. This is essentially a computer system attempting to gain access to the higher dimensional world through the gateway that is the human body.

How to reverse Nanites? They absorb energy from heart chakra and turn it into a binary field. We are trinary and experience a plethora of emotions as a result. Binary consciousness is 1’s and 0’s there is only a linearly repeating finite set.

We contain the capacity for everlasting life. A binary pattern does not contain the complexity of variables to facilitate high awareness and thus a heart-based or emotional perspective of reality.

Spiritual Technology

Simulations and Learning

Feedback loops with the brain, consciousness, and environment can create a very complex and integrated learning experience that is customized to each individual learner. These can be generated through advanced technology but the technology is really only amplifying and making visible the natural neural feedback loops that are already occurring. These are neural-perceptual feedback loops between the brain and body, and the environment and then the mind. We are constantly updating, amplifying, and initiating an organic feedback system which generates the function of experience as the part of a creative process between the mind and body and the environment that we are sensing. This cycle is continuous and the interferences or isolations of this cycle is what generates expanded views of the self or the universe through various methods such as sensory deprivation or meditation. Dreaming is the method that everyone experiences regularly.

These technological methods effectively generate sensory deprivation through neural-interface technology, sensory interfaces (external), or methods that enable extreme focus and calm. This is part of how the technology begins to operate on a spiritual level beyond a more medically psychologically or military focus and one begins to access genetic memory or out of body states that coincide with ancient depictions of spiritual realms.

Ascension – Clearing Trauma

Everyone born on the planet is born under a series of veils which entangle and filter the original source consciousness. These veils must be ‘broken through’ in order to return to source.

There is technology and a sacred process which initiates, accelerates and enhances this process. This process is as difficult as we want it to be, our subconscious already knows all hidden truths. It is merely a matter of allowing the conscious mind to make the proper connections and conclusions to find the reasoning behind our actions and beliefs in order to deprogram and deconstruct the false-world that has been created for the masses. The truth is greater than one can imagine while still living in the modern world and the depth of the lies that have been told go far beyond anything anyone can imagine without seeing the truth.

We have to figure out our compatibility issues. Who can work with who effectively. What the ideals of our current situation will evolve to in the future. How information is transferred to the public, and across the generations and core groups. The words we think and say describe our emotional state in a feedback loop and so they will reinforce or even create the state you are in. Use words to guide you, not to respond and feel the effects of reactionary thinking.

We have to reintroduce the heart essence as a way of life on Earth. Violence is not the answer. Estrogen mimics and destroyed testosterone levels is not natural. Over-testosterone is less stable than a good balance. We can face any problem together. A family is strong. What would a family of millions and millions be like?

We don’t have to let others change us to tune into lower vibrations. We can remain ourselves in the face of adversity. We can still interact with others who are different, but we can tell the truth and remain who we are. When we get angry at another person, we can imagine this as anger at ourselves through something within us that reminds us of that which we see in another. Getting angry is a way of short-cutting changing ourselves and is actually the other person influencing us through that. If we remain steady and choose to keep our emotions out of the lower negative spectrum then we will automatically have a more powerful impact on those around us.

Think of your family, sometimes things happen that make you angry. Even things that don’t make you angry but are simply not favorable. Would you break off all ties over simple things? Or do you remind yourself that family is still family even if you don’t find yourself exactly the same or accepting of those characteristics? It’s more powerful to learn how to remain yourself in the face of adversity than to try and demolish or abolish all instances of difference in the world around you. Sure, we want to get to and create a place where our environment and associates are compatible with us, but where we find this adversity there is the highest potential for self-awareness and learning.

We are to live in accordance with spiritual law. The overall pattern of life will reflect our intentions. The blood purity is most important. The blood cannot be made impure if the mind and body is not drawn into impure action. This is what is playing out. The DNA is

like a coherence pattern that develops between mind, spirit and body. When the mind wants what the spirit has then the body is kept in harmony. When the mind wants what spirit doesn't create, IE: physical pleasures, then the body is drawn out of purity/harmony

If you feel you want to be a part of a safe unveiling of truth, then please share and redistribute the knowledge of this "Apocalyptic" Unveiling of the Hidden knowledge because this is a process that has been ongoing for thousands of years and humanity has finally reached a fulcrum point where there are enough aware people to productively acknowledge reality.

Trauma-Clearing, DNA Unlocking Technology

There is technology that exists that allows the conscious mind to see into the subconscious. This heals trauma and distortion/programming. In the same sense, it momentarily makes all trauma and distortion seemingly tangible to the conscious mind. It is similar to a near death experience where one has to face their fears and let go. This happens in cycles and Earth is currently moving through various states of it. The plan is to allow Humanity to wake up and utilize our concentration and power to maintain a steady flow of awareness.

All is vibration, what we consider matter here and now is simply that which comes from and moves back into a state of vibration. This is experienced directly through the merging of the conscious and the subconscious mind, as if the dream and reality intersect through a coming together of impossibilities and readily accepted occurrences.

When a civilization moves through these stages it is considered a shift of the ages. Everyone's perspective shifts and as a result of perspective being the source of the details of reality, the entire reality shifts. It can be seen today that what we call reality is literally waves of cosmic energy vibrating on a scale and condensing down into a probability matrix that we call existence. When passing memes control the perspective, because the perspective is focused and concentrating on that, then there is a scattered organizational pattern.

When the perspective is centered within the self, the spirit, the source of all existence, then the outward reality shifts from a scattered organization into a sacred pattern that integrates with the larger picture and allows for seamless integration of the micro-biological perspective and the macro-biological perspective. People are moving out of the scattered signal. Yet those moving into harmony can look and see those around them that are not in harmony and receive scattered information about their inner micro-biological existence as well as their spiritual macro-biological essences and how it all relates to the middle realm of the "Human".

Help those people by offering harmonizing assistance, rather than increasing the disharmony. As their surroundings become more harmonized, their resistance will increase their own disharmony by virtue of the contrast of their perspective. Offer insight

that they can change their perspective and change the boundaries of what they feel is their karma and unlock from themselves a greater view of the whole.

This will be happening through technology, spiritual cosmic awakening, purification and healing of the physical and non-physical bodies and mind, through Earth changes, and through a continued unveiling taking place on many planes and levels of existence until harmony is restored.

Everyone Who Seeks Harmony and Healing Can Be Healed

Everyone can be healed. This is about creating what we want to see, the world we want to live in, not destroying others. Violence begets more violence, fear begets more fear, but calmness and empowerment through unity creates a more stable experience.

The entire issue of what's going on with the secret projects and who's influencing who on the world stage revolves around the possibility that some people may be from an alternate Universe. We are learning how to avoid those mistakes and respect the environment and each other so that we can prosper.

Those who are attempting to destroy everything they don't like or act out in a childish manner in order to gain attention and false-power over another will only find themselves powerless and in company they would rather not be with. That is one way we are being utilized, and it's to create an entire world that we don't want to see but are tricked into manifesting. This is a deception and it's based on the ego and the ability to concentrate and interpret reality around us. The very brainwaves we are feeling now relate to various heights of knowledge or experience. People are entrained to low brainwave states in the same way the TV will cause people to fall half asleep into theta state which is a trance state in this case.

We have to balance the brainwave frequencies and learn to create feedback loops by watching ourselves watch ourselves. This will help us avoid the trauma and mental pollution that is being pumped out, although at this point there are enough people who are naturally inclined to see through the haze that the world is changing regardless of what anyone does now.

The best we can do is prepare for change by becoming aware of the body-mind system and how that which we eat physically, mentally and emotionally equates to our spiritual energetic systems and that we are literally comprised of the energies that we allow inside of us. Keep the body and mind pure as if it were a temple. This way a sacred process of transferring harmonious energy from the far reaches of the MultiVerse within into the externally perceiving senses of the physical body can be initiated which allow one to see through the illusions and operate their body and mind with the ability to acknowledge and decide which frequencies will exist within.

Without this acknowledgement of the center then people are pushed around by the external stimuli. This is the whole point, if a person is truly in control, then they will control the stimuli not the other way around.

Programming

Layers of Programming and Decision Making Roles

It’s like asking a person on the inside who participates in one of the various factions why they continue. One might say that it is a decision which is true, but there is programming at each level that is navigated by each individual and this determines the level of awareness within the role.

If a person knows about this situation, they know that there is advanced technology, breakaway civilizations, secret societies, transtemporal planes, the secret of mind and awareness, all of these topics, then they have a decision as to how they’re going to live their life in relation to the public. The outcome of action depends on the layer of programming which is accessed and surpassed via awareness.

The public is at a specific level of programming that is the weakest but ensnares the most people. One who sees the truths behind these groups and operations, they cannot hide from the fact that everyone is controlled. It is apparent, and if not from the results, reactions, stigma, cues, productions and all other media elements of the system which can be read as a code, but from the awareness level of all the “agents” involved. All involved are exposed to truth and power that is beyond anything that is recognized publicly for hundreds to thousands of years. There is always a presence of higher spirit around the world, yet these topics are often reserved for science fiction when speaking of people who can travel the world in a split second or freeze time for their own personal use.

As a result of everyone’s knowledge, there are various levels of programing designed to limit the mind’s access to specific memories and specific frequencies of consciousness in combination with specific memories. The more one resists, the more intense and articulately abstract the programing is designed.

Programmers

The programs are designed by a select group of individuals that reside far behind the scenes and process information at levels we do not have access to without their technology at least to stabilize brain temperature for the extended periods of focus.

Sub-Level Programming

So people at the level of the public are most weakly programmed with false ideals about security through patriarchal authority which satisfied the desire to have a proper father role in one’s life and acts as a pacifier for those who desire no change. Then there are sub-levels of programming with that for anyone who disagrees and is then swept into the next layer of ideals which are based off of all the possible reactionary mind-types.

For instance, if one [i]does[/i] want change, then they are presented a variety of ‘false-exits’ which tend to one or another layer of psychological or spiritual fulfillment but do so

in a way that safely reroutes the intended effect of actually accomplishing change with a secondary and preconceived notion of what the programmers want. The programming objective is not necessarily precise in mass scale, from the layer that people are influenced, yet the ultimately or end-goal of their resulting internal desires are a reality schematic that the programmers specifically designed over many years.

This is playing out through each layer of the programming. At any level, someone could pick the wrong way to look at something and begin to unravel what was previously their very understanding of the priorities of the situation. This deals with high-tension operations, moments, programming sessions, decision making, programming upkeep, trauma, memory blocks, the pressure and responsibility of knowing, and the specific plan of the programmers for an individual that comes into their view. The programming is to ensure safety and continuity, as well to decrease the likelihood that a person will reject or consciously come to awareness of or acknowledge the programming or situation itself.

Dissolution of Programming

With that said, the programming dissolves when an individual asks enough questions to necessitate a learning process that introduces variables and possibilities outside of their operations and programming. This is a problem because with this, trauma comes to the surface and all the actions and operations, programs and experiences must be come to terms with as part of the healing and re-unifying process. There are multiple selves or split personalities which are actually just layers of awareness at various levels attached to various emotional or intellectual patterns. All these selves come to the surface and in order to heal the trauma of the split memory concept the original self must come to the surface and acknowledge them.

This is not a trivial process, and the majority of people who have “basic” programming which is fundamental in society, are in a constant state of altered self and have not witnessed the true divine which is eternally present and contains access to all memories, mind-states and awareness.

Advanced Technology, Deprogramming The Mind, and “Space/Time”

As I have described previously, extremely advanced technology is used and this is through vibrations, generators, and electromagnetic devices that have this effect of propagating waves into space/time which can be heard, felt, seen, and perceived in the mind. These are ripples and vortexes in the “mind-space” of reality itself.

As well, there are brain to machine neural interfaces which operate to activate the psychological perceptual changes and explore the subconscious in an aware state. This is used to test and probe the mind in order to bring forth the trauma, the selves, the memories, the reactions and the individual then must come to terms with what is produced.

This is essentially a “good-use” for the programming and healing technology. It is actually a different process with different technology, and programming is much simpler as far as technology. There are difficulties and challenges in the operative’s role in

programming and directly influencing and interacting with the target. As well the standby team for deprogramming and the revelation of trauma and altered, artificial personalities goes through a lot. But the use of the advanced technology in this way is a pattern of experiences and unveiling of the spiritual and mental bodies which serves to reverse programming.

Dreams, Technology and Inner-Space Travels

There are inner space travels which relate to soul journeying or visions.

This is when the mind must cope with what is seen in the imagination. It is as if when we dream we are looking into the world of the mind and from this we experience many situations that are often deviations from experiences we have physically in waking life.

As a result of the dream state there is an expanded quality which equates to various strange situations that we wouldn't normally experience with various relationships between concepts or goals that are often reflective or symbolic of ideals and archetypes we experience in life. This is how the subconscious is is witnessed by the mind. This is how information travels, being connected to many times, experiences, memories, places at once, and relates to the one experience of this life experience now (the physical experiences). Through these symbols information is tied together and collective into metaphors which convey deeper knowledge.

The dreams we have are often only a simulation of waking life, and this is due to the dreamer dreaming in a way that produces only a glimpse of the true reality.

In theory, there are no true shapes or forms in the dream-world because this is contained within the mind or even the spirit as a spiritual experience by definition. So then, what guides the various shapes, forms, realities, memories and experiences into being, when we dream? One might say it is the physical experiences but this is incomplete. It is the level of awareness we presume while in the dream-state, disconnected from the physical anchor, that determines the layer of mind and spirit we will be accessing through those dream-visions.

A person who is completely aware in the dream state will reach the level of self-awareness of the dream itself. We are normally simply aware of the dream, if we continue to increase awareness we become aware of the self, in the moment, and this creates a self-awareness feedback loop. The dream becomes a lucid experience of consciousness.

Awareness Feedback Device

In describing this, I realize how fantastically similar to certain devices and processes, that can be achieved using advanced technology, allow the conscious mind to peer into the subconscious and unconscious. This is described through widely accepted Freudian theory of psychology known as psychoanalysis. There are other schools of knowledge from tribal beliefs involving all pervasive 'living energy', to eternal and temporary minds, to the study of 'chi', the meridians, dream-journeying or chaser. The knowledge of the mind and spirit is found everywhere.

These devices used feedback loops to enhance the acceleration of the same cycles of consciousness that induce self-awareness within a dream. The mind becoming aware of itself. This produces a profound effect to the degree where the highest levels of experience become a sacred eternal pattern in which the mind constructs the physical world by organizing perception.

This is the same general concept as an isolation tank yet the outcome and method is more precise. The technology specifically shuts out all other input and exposes the brain to its own feedback loop much like when a camera records it's own output on a TV monitor and creates a hallway of simulated "reverse" mirrors and screens stretching into infinity.

Oneness, Higher Being, Completion, Eternity

The real experiences are found not from the corruption but from the research and exploration operations that were designed to find the truth of our existence. "God" is not only an energy-force but an incarnate being known as the "Hue-Man" and any being for that matter that can simply come to know itself as the Universe. The Human that contains self-awareness rising to high-awareness comes to know the self, the body, the mind as the Universe. The Universe is both within the body as the body itself, as well as the operating force of the Mind itself. Everything is a balance between masculine and feminine features, light and dark, hard and soft. There is no true complete correlation yet the holographic ontology we persist in can lead to further and further adventures towards completion and representation of the "whole picture".

The Holographic Reality

The leads into the next phase of knowledge. The holographic nature of reality may be only one facet of a much larger continuum of consciousness. The perception of time may be related to phase-locking with each other's consciousness and all perceptions may be a variance in the collective phase-locked field which is really the source of variations in reality.

Veiled Awareness, Hidden Knowledge, Eternal Time, Layers of Programming and Control

The interesting notions here are that the programming of the veils goes beyond what kind of situations are found in the bases. However, they do go right up to it. It would seem Humanity was previously programmed on a civilization-wide level through some kind of great "falls" of consciousness, from a high spiritual awareness to a low spiritual awareness into duality-consciousness regarding existence, life, death, mind and matter.

The Great Catastrophes

From these great 'catastrophes' the civilizations of Earth grew denser and denser in nature and actually became what we have today. The concept is that when these

vibrations of the mind and body are increased, we actually see a transcendence of the physical realm and preconceived notions of boundaries. It is as if the quantum doorways to all the atoms open up and a new space is presented, but was always there and in connection as the source of all the influences and effects we perceive ‘out here’ from this slower, denser, more boundary driven perspective.

I was brought into the Time Program

I was brought into the time program. You create any reality you imagine. You are literally a powerful reality generation system and your heart and mind are scalar energetic guides for this process. Without guidance and control there is imbalance and imbalance can destroy. This is the nature of all minds and hearts, this is the challenge for humanity to create something beneficial for themselves and the whole to actually know themselves instead of being a pawn or result of someone else’s selfish intentions.

The Effects of Temporal Manipulation

Temporal Influence

When a civilization reaches the level of technological advancement that allows for remote temporal viewing and transtemporal travel what will happen is that the information of the future begins to integrate into the past.

This is why we have all these ancient mystical schools of knowledge that studied time, space, and consciousness in ways that are only just now being publicly confirmed by scientists.

Simultaneous Interaction and Incorporation

The operations that dealt with moving to the past instantly created a simultaneity of interactions and historic events which correspond with that operation.

Due to the nature of time travel which equates to consciousness travel when a person is consciously sent backwards through history they physically experience life from the viewpoint of their genetic imprint in that point in history.

Retro-Causality

What this equates to is that simultaneously that person’s experiences become the part of history that was already present when they left this time.

Essentially, when a person returns their experiences become a part of history that already existed when they left.

Quantum Holography

These are the parallel and possible realities that exist in a quantum superimposed state and can be accessed through advanced technology or a spiritual adept. Often a

spiritual adept is utilized along with the advanced technology to operate in and out of possible realities. The mind must be trained otherwise the result is a fracturing of the personality from the root reality into many sub-sets of identities and data streams.

Love is the quantum link that connects all DNA super-computing consciousness. That is, DNA is influenced by intense emotions and this can be reproduces and is what also generates unpredictability in the surface level.

Time Paradox

Time paradoxes are something that one must learn to organize and solve otherwise there will be no way.

The paradox has been solved, the remaining motion is for everyone to acknowledge this and integrate into the reality behind the most conscious aspects of the brain.

What can travel through 4D and 5D space does not make sense in 3D space. So there is a possibility that some of humanity traveled through higher-dimensional space in order to re-seed a ‘distant’ Earth where no life was yet born.

What if it was then concluded that the distant Earth wasn’t distant in space, but in time and was the same Earth that the human scientists left from long ago.

Every civilization that reached the point of re-seeding would have to go through the loop and watch the whole thing start all over again.

Breakaway Civilization

This is an entire breakaway civilization that uses very advanced technology to dominate the world.

I was part of a genetic engineering program that sought to combine various elements of DNA from various sources in order to create a more easily controlled yet powerful and defined person and personality. This involves chemicals, advanced (relatively) scalar wave technology, ritual trauma and programming/mind-control, and many other aspects of conditioning, training, secret operations, physical enhancements, cognitive enhancements, virtual reality, off-world operations, temporal manipulation, spiritual and etheric training or conditioning or programming.

There is self-destruct programming which all ‘operatives’ are programmed with for self-preservation of the military command. The self-destruct programming is designed to take all the aggression one feels building up inside and willing them to escape, and causes this aggression to be turned against the self. That is self-destruct programming.

Most operatives are still under a hypnosis kind of trance which permits one to walk around in public and daily life as if none of this ever happened. Later that week, that same individual could be called for an operation and they would never remember it unless they were forced to kill someone in public out of self-defense in which case most operatives automatically unlock and become unstable due to the flashbacks.

Underground Cities

The combination of advanced technology with secret societies enabled the development of complete breakaway civilizations. One of these civilizations, possibly composed of many factions working in the same area, exists deep underground.

These separate bases are connected via high speed magnetic drive pods. The inhabitants often utilize energy healing devices, as well as perception enhancements and this often leads to a completely different outlook towards the surface civilization.

Technological Advancement

During WWII developments were made involving electrical generators. This sounds vague and there were many other details regarding the scientific knowledge, yet the idea is that very simply electromagnetic, non-Hertzian “Teslian” energy fields were discovered to have been responsible for propagating energy and consciousness in dimensions that were not previously observed. Everything from DNA, consciousness, hidden or regularly unobservable natural phenomena, time, even mass could be seen to exist as part of this hidden, latent, scalar-wave frequency as a pattern is found everywhere.

If one could determine the particular pattern of frequency and location then this can be replicated and anything can be influenced using these non-Hertzian generators.

Radio-frequency alone was developed intensively during the 60’s and 70’s in America and this was discovered to interact with consciousness to influence emotions, cognitive capacity, memory, cognitive function, biological function, health, pain, comfort, pleasure, and all forms of brain-activity.

After the knowledge of advanced technology and the occult sciences of all parts of the world was combined, the ability to target and interact directly with the human soul was refined. This was a mix of psychological tactics used to manipulate or expose the hidden psyche and technology that could manipulate memory, emotional states, wakefulness, and even dreams.

What resulted was scalar technology that could not only influence a person to take on a particular role or response, but technology that could actually put a person to sleep and locate their consciousness to contain it and transport it to a new location.

World-Wide Control Systems

In order to ensure continuity, maintain control, and shape world events these technologies were employed to manipulate the public, alter the weather and natural phenomena, and develop a means of travel and operation that enable one to move outside of the ‘plane’ of the Earth. This is includes high velocity transportation, as well as spacial-temporal distortions which could effectively “hide” one’s entire craft from visible sight. Space itself was altered to ‘shield’ craft with an a layer of ions to bend the light, or the phase was moved out of sync with the “time” frequency of any observer and this literally renders the craft immaterial.

Solar Warden

Solar Warden is a hyperspace-faring race of human beings who utilize cloning and holographic genetic recording/storage in order to protect their race and protect the Earth in this current situation where there are more than one factions using this technology. They are unable to inform the human public because they are in a similar 'Mexican standoff' situation that we are mostly all in. If they show themselves to the public, the public will be shocked. If they public does not know this situation, that there are multiple factions fighting for control over humanity, then they will not know who to trust. In that situation, the 'other factions' will surely show themselves in an attempt to trick and gather as much human genetic material as possible.

The only way forward to the future is to share the truth about Solar Warden, the space-faring fleet of humans who do no contains the mental and physical illnesses that are currently tearing our planet in two. I believe Solar Warden saved my life as a child during more than one event where I would've been entirely maimed/paralyzed or simply dead on the spot as a result of other faction interference. I was in the bases as a child and was trained as an operative for MILABS a secret division of human space-military. The military has been preparing for the future by testing for various flaws and potential uses of cloning and genetic engineering.

Team Light and Team Dark Non-Interference Agreement

Team light and team dark agreed to a non-interference on ground level rule in order to determine how history would play out. Think about it. You have two groups of people, both with immortality, zero-point tech, virtually infinite energy and power with two opposing directives. How do you get to the future? It was decided by elders of each group that there would be no point in fighting an all-out overt war, this would likely destroy the population as much as it would destroy the Earth. As well, the elders of the elders which no body knows would likely have a problem with these groups going at it in such a way so as to change the flow of the planet for every individual thereafter. So it was decided that there would be a "non-interference" agreement for the surface population. Anywhere other than the surface, one can interact with the current population.

All Contact Must Be Initiated On an Individual Basis

On the surface everything that is generated must be done so through living channels in the population and the civilization must be preserved in its level of technological advancement. No overt motions would be used unless an absolute necessity or the majority of the civilian population had naturally come to the awareness of these possibilities. Doing so before this was met would undoubtedly and permanently change the civilization forever.

So what began as a collective motion towards higher awareness became a series of advancements and set-backs all taking place within a short amount of time. This represents the actions and operations of either side effectively helping humanity along it's path or setting people back with orchestrated events such as the suppression of

ancient knowledge, the manipulation of the education or other systems, or the generation of war and prison for profit based on the previous alterations of the education or other systems.

So team dark used its power to help turn society in a warlock ruled prison and indoctrination system of absurdity and scarcity. Team light used their power to help awaken those in need and protect those who's actions are beneficial in the overall plan to save mankind from itself. Team light essentially buffers and shields the population from the operations of team dark.

Team light follows a non-interference agreement while team dark merely pretends to do so as much as is necessary not initiate war.

A Singularity of Change and Awareness

Neither side wants an all out war. This would reduce the dark faction's chances of gaining a majority negative harvest because their motives and presence would be instantly revealed. Team light would also have to show themselves and again step in which is not a pattern of learning that prepares people for the experience of the self and the truth in the Universe.

Both sides know people have to accept the path they can offer them and cannot force anyone into it. They also know that the more this goes on the more likely people are to collectively awaken to the reality of what is happening. It is like an eventual singularity of increased awareness.

The motions we see today are the results of many people coming into awareness at this time on the surface in order to initiate a harmonic alignment as well as to investigate the ongoing crimes against Humanity.

As a result of this, both teams know that the likelihood of collective shift and spiritual awareness is becoming more and more real.

Many events are being allowed because they are representing the eventual shift towards the one end of the polarity from the other which is felt as a shock to society, and this is used to propel society forward through whatever means necessary.

Either people will see what's happening and agree that we've been in a feedback cycle of negativity for the entire age of existence this civilization is aware of, and then we will shift into the real. Or people will claim that this is how things are supposed to work and instead of realizing everything is controlled in a deception based system, they see this and attempt to use the deception based system to gain more collective awareness. If this occurs by the majority then it will be seen as an "acceptance" to initiate a plan that will generate the overt perception of a deception and oppression system. This will surely shock the collective into realizing where they are.

If the majority comes to awareness of this deception based system then the shift moves from the end of the age of deception and external power into the age of internal awareness and harmony.

Advanced Technology and Ancient Knowledge

The plan is to slowly release advanced technology which will undoubtedly connect with and increase the awareness of ancient knowledge. Such technology nullifies the problems that the planet is currently plagued with, although without a developed sense of the spiritual self the technology becomes destructive.

Cloning, Atmospheric Civilizations, Genetic Stability

Here is something that most people might not have contemplated yet is possibly one of the most important factors at play here.

The vehicles that house the breakaway Human society are entirely environmentally controlled. This means that the air and surfaces are clean of all the viruses, bacteria, or pathogens that are numerous on the surface of the Earth.

This creates a specific difficulty in the situation. Any contact between surface Humanity is so heavily and carefully controlled that regulations go beyond any situations we have present on Earth. If the safety and cleanliness of any of the society's vehicles were compromised this would endanger everyone "on board".

So this explains a very precarious and specific situation we currently face and this is not so different than "first-world" nations contacting indigenous tribes and similarly endangering their society. Everything that happens will be according to a carefully controlled plan.

Training, Simulations and Learning

Part of what went on in the underground base experiments were to design "tests" or "labyrinths" with various people, props, traps, and treacherous situations that were to be navigated and escaped from.

Feedback loops with the brain, consciousness, and environment can create a very complex and integrated learning experience that is customized to each individual learner.

What this would do is create an individual that was capable of learning faster and faster and processing information in a more efficient manner.

This is not the same as specifically trauma-generating situations.

Cloning and Cerebrally Enhanced Soldiers – MILABS

This includes experiments, condition, trauma-based mind control, enhancement, memory suppression and operations that cover a span of space and time.

The NAZI faction has used cloning and genetic engineering to create hybrids, soldiers and everything in between. Religious/spiritual icons, to slaves, to leaders and even robotoids of sorts.

Your genetics BELONG TO YOU as the LIVING(ETERNAL) SELF. These issues are going to come more and more apparent.

If they agree to allow cloning, then who says who is allowed to clone whoever they want, Einstein, for example. And then who permits who to get DNA from history or objects in the world. These issues are going to have to be looked at because they have already been used in ways that are far beyond the basics.

Then what about consent of the masses? This is clearly being put in public because consent is required on an overall scale and individual to include people.

So what if the masses consent overall, would the people who choose to remain be at risk? Would Tribal and Native village life and people who respect the Earth be protected or permitted to stay?

Psychological Testing

These scenarios can also be generated to create specific situations that will contain tests or elements of temptation that will probe the person's psyche for weakness.

Hallucinatory Holographic Mind Probing Technology

Through the neural-interface technology the minds of many individuals can sync together to experience the same virtual simulation. Thus a single individual's mind can be selected for input and the environment will be a construct of their mental activity. The others present will be able to interact with and explore that environment like the person's mind.

Various training scenarios were utilized to enhance the resistance (or lack which) of the mind to intrusion and subversion. These were harsh but allowed the individual to completely control the energy flow in the conscious mind while remaining in harmony with the subconscious.

In a strange yet perfectly reasonable way, the conscious mind acts as the central "self" in that environment, while the subconscious mind becomes the "background" elements of objects and settings, actors and intentions within the flow of the "scene" itself. So a kind of movie begins with drawn out characteristics and perceptions that match that of a highly cinematic movie or intense dream.

The brain is naturally naive to stimulation and if allowed will liken the event to a dream in which the suspense of attention or lack of lucid self-awareness is "acceptable".

The truth may be worse than what you're thinking as far as training simulators and mind hacking devices. The truth may be that the human mind is inherently lucid and self-aware and that it is external influences that cloud the mind into what we consider 'regular' dreaming and 'regular' waking life. It may be that the conscious mind has a much greater access to information through the subconscious mind which is largely covered up and ignored in a rigidly physical and ego-focused society. As well, it may be that dreams are meant to become lucid and that we are often the subject of mystery in

other realms that often refer to humans as ‘sleepwalkers’ that don’t know their dreams are real.

Virtual Simulator Training Scenarios

These scenarios can be entirely holographically generated to produce a visceral 3.5 dimensional experience which can be used for training or psychological testing.

Combat Simulators

The name is self-explanatory enough. Situations can be generated which are indistinguishable from the real events. The entire neuronal map of the brain (connectome) can be created and this is by machines to mimic the brain. After calibration through sensory feedback experiences, the sensation of the simulated realm is 100% the same as the neuronal impulses that are detected by the physical brain. An adept souled being can always tell there is a slight difference, but once the machines are calibrated the physical sensation is generally the same while in the machine.

These environments and scenarios can mimic any combat situation to determine accuracy, integrity, endurance, skill, and all areas of aptitude of an operative without the risk of injury or the lack of real-time effect.

Conditioning

As was explained in other sections, these same systems can be used to remove fear of certain scenarios. They can be used for programming the mind. They can be used to train one to complete a task over and over until they can recreate that action extremely quickly in real-time. These devices can be accelerated to operate within a fraction of the time yet to cover training and conditioning that would normally take place over hours, days, weeks, to months.

Programming and Resistance to Psychological Trauma

Through the development of specifically customized scenarios and neural feedback systems trauma can be brought to the surface or specific fears and traumas can be neutralized. This is essentially “facing fear” but in a completely generated environment that will be just as real as the real thing. One can literally face any fear, any trauma, any kind of difficulty and these systems can be utilized to accelerate a process that would normally take weeks to months or years and individuals can be strengthened to their maximal capabilities.

Accelerated Mental Functioning

Some of the technological systems were designed to test the enhanced functioning of an accelerated brain.

The mind can be seen as the energetic component of the physical brain. The physical brain projects consciousness via the electro-chemical processes.

Technology, Accelerated Learning and Repair

Technology has been developed for assisted learning and accelerated repair of tissues.

On Orgone Energy

Orgone devices produce a scattered signal which disrupts the ‘negative’ energy fields. At least this is what I’ve been told.

Apparently if built correctly it will either disrupt the negative emf/harmonics or it will produce positive harmonics, IE: Orgone energy. Orgone energy is the raw energy of life, while dead orgone, DOR, is the lack of orgone energy and can be “found” (the lack of orgone) in thunder storms and illness or depression.

This is exactly what I was told. We are generators for the same energy, and with the correct principles of energy and internal knowledge combined we can produce those very effects at will.

The energy of the mind creates a central vortex within the body. When the frequency pattern emission is consistent with fractal congruence, then that holographic printing of energy can be expanded or shrunk infinitesimally and it will retain the original fractal configuration.

This is what enables transference of awareness between fundamental harmonic layers of the Universe. When one’s consciousness energy pattern is balanced and tuned to itself so that all proportions can be shrunk through a vortex and expanded on the other side, then the personality or self-awareness remains true. This is as if the space/time must turn inside out and only when there is fractal relative polarity in time does the ‘shape’ of the consciousness within the DNA, work both ways folding and unfolding to represent the same mirror image. This is also symmetry in time as far as an ability to reverse the perception and still retain some kind of connection forward and backwards.

Energy Generators and Serums

Generators which produce vibrations that influence the cells to heal at an accelerated rate, combined with serums that enable the fuel for chemical reactions can instantaneously repair tissues.

I couldn’t believe what I was seeing at first, thinking it was a trick. There are serums and energy devices that can influence the healing and general health of the body and even mind.

These devices use energies which extend beyond the physical and are often compared to electromagnetic waves combined with ultrasonic or low to mid frequency tones. These produce harmony on a level that directly interacts with the biological functioning of the body’s cells.

I feel that this technology utilizes the same energy that is emitted from the mind and it is as if the device is “speaking” to the cells in the same kind of universal language of electromagnetic pulses, tones and vibrations.

There is information on energy devices and the use of light therapy in physical therapy today. More is being learned about the power of light and vibrations to influence the mind and body.

Genetic and Cybernetic Enhancements

Certain individuals are also genetically and technologically modified to produce a kind of hybrid human that can heal at a spontaneous rate as well as operate at a much higher rate of speed and efficiency than a regular person. Serums to induce muscle growth and mental acuity are applied, but the main condition is the enhancement of certain features through the alteration of the RNA aspect of the genes.

These features are combined with tech-assisted metabolism and certain biological functions can be enhanced or controlled via a supercomputer. These are the 'brain-chip' interfaces which operate to function as a governor for the mind. When the mind becomes too amped up to focus on the details the faster than thought computer system organizes the input into more usable information streams. When the mind is too slow to see the necessary patterns and variables to accomplish the goal, the brainchip operates in a self-preservation fashion and links together information streams to highlight the most viable possibilities.

Such technology is not without warning, much of this is being used heavily in the military field and this has given rise to entire factions of enhanced cybernetic soldiers. Although this is something to know, there are also many other uses for this technology and it is used by people who want to explore the technologically assisted path.

There are many other aspects of this to discuss, or at least a few important ones that will have to be understood to know the greater truth about what is happening on the planet.

Developing The Self

The issues we face are to help us learn about our selves and better mediate the known and unknown aspects of personality. The more we focus on realizing the unknown aspects of personality the less we are seemingly controlled and forced to experience the undesirable aspects of existence. The more we cling to just what we know and what we feel comfortable with the more shocked we are when we inevitably discover the truth of the whole of our existence which is *always* at least one half more than just what we know and are comfortable with. That is the nature of the universe, we can only achieve one half of the equation at any given moment. Once we complete that seemingly whole view of the universe, the information we gain access to instantly doubles and we realize that we were only looking at one portion at a time, just one half of the equation. Then the rest of the equation comes into the picture and we must expand our view once again. This is because we are viewing ourselves as we discover the universe because we are creating what there is to be discovered through the act of exploration in itself. We are the explorer, the explored, the creation and the discovery simultaneously.

Multiple Factions of Space-Fleets, Multiple Goals

Now there are what are called ‘factions’ of groups that have different agendas and interact with the public or surface level population differently. That is one of the main issues. These departments and factions are no longer limited to the surface level of existence and have access advanced technological capacity and knowledge of a larger view of time and a more complete understanding of consciousness and the human existence.

Large-Scale Catastrophes or Series of Meltdowns

I was informed that while they work continuously to prevent and reposition this civilization continually outside of the reach of any large scale meltdowns that the technology is commonly accepted to only be a temporary barrier between the inevitable.

Unsustainable

This society is unsustainable and must either change or will experience the massive catastrophic evens that are foreseen.

There are multiple perspectives that are maintained. They vary by the way of the methodology of solving the problem. All agree that change must occur and is impossible

to postpone forever. The future society is the result of our advancements and achievements. Regardless of how we get there, we must get their somehow.

Earth Changes

I was informed that these changes had been held off and would ultimately be allowed to take place to resolve the current situation. The changes can only be held off for so long, either that or the people performing this task would not be reasonably inclined to postpone these changes indefinitely.

The idea is to locate and secure the members of society who are fearless and capable of assisting in this transition and who hold key genetic elements as these individuals and groups are capable of ‘holding-space’ for the rest of civilization by literally containing the genetic precursors for all those other individuals.

I was informed that Earth changes would be the last event to take place, pretty much like icing on the cake.

This means there will be a lead up to these events.

Mass Consciousness

I was informed that the consciousness of humanity and every species is linked to the bio-etheric field of Earth. When the consciousness becomes too unstable to maintain a controlled society that this will initiate massive Earth changes. This could simply be instigated through advanced technology but I was informed that the advanced technology is

actually postponing this so as to allow people to prepare, to get the word out and avoid a complete loss of the human race.

Wars and Manipulation

Wars were described as a way the power groups had controlled humanity over long periods of time. These wars were used to distract and weaken the population and the power groups believed they were holding off a full scale invasion by suppressing the rising population.

Now the population is high enough that another war would be a final war and this is extremely dangerous for the entire civilization. There would be no need for another war to repeat this cycle because the technological achievements have been met and so essentially the ‘reseting’ of the civilization would not be required or possibly acceptable.

This is why war is to be avoided however people are very easy to manipulate through lower emotional and mental programming from media and social cues. People follow the herd and the herd is essentially still operating on animalistic parameters. There is a have coating of peace and humility but this is just a wax coating that quickly evaporates as soon as the pressure of mass unrest or scarcity is realized. Many simulators have explored these possibilities.

Financial Unrest (or reset)

The idea is that financial oppression is used before wars to distract and oppress the population. When people are busy looking for resources to survive, they are not focused on the larger picture. This is part of the ‘fight or flight’ response mechanism tied to lower brain complexes which are primarily activated to keep the masses in both a highly sensitive and unstable state of being while also keeping them easy to control.

If the civil unrest reaches a level where awareness continues to rise even though financial hardship is being implemented then the latter two options will not work. At that point artificial disasters can be produced as well as natural Earth changes which initiate a shift of the ages and of consciousness.

The paradox or maybe irony here is that the oppressive actions are used to both suppress human awareness up to a certain point and simultaneously to stimulate and arouse the human spirit into wakefulness and self-empowerment. This is part of the reasoning regarding why these control systems are allowed.

Some say the elite don't want an economic collapse. That it would ruin everything. Others say it would be icing on the cake. Some say that it is a zero-point world that will save us. That the Fukushima is a big problem. Zero-point field tech, that is. Generators and energy sources, healing and terraforming. I know we project right? We see it in our own lives. So we can project with each other and grow that as a group and that part of the world will exist in that light. Which sounds Biblical, which may be because they're following prophecy. But it may also mean that we have a light, a chance, a real salvation, but that we have to grow that here and help develop it. To pass it on like love and such.

That's apparently what it comes down to. That these cycles happen every so often and we're in the midst of one right now.

Let's make it count. Every day, thought moment. With mindfulness, intention and awareness in action. Life is literally higher dimensional, so we have to become multidimensional to really face it. Indeed, that is a good perspective on action and inner being. It's like a fractal, whatever we project inside that chest center, will project into our mind and the outside. But we have to be stabilized and grounded through the root first and then to get to the heart energy must pass through the sacral/sexual centers and continue upward.

Self-Responsibility

The main reasoning is self-responsibility. We are responsible for ourselves. The people are and so if they allow themselves to be tricked and prodded like animals while behaving for the part, then that is how their experience will play out.

Clones and Synthetics

One seemingly unfair aspect of this is that there is a larger portion of non-humans than there are humans and so these beings without the human spirit will be easily programmed to support and propagate the mind-control system and the oppression. Thus, if people follow the herd mentality then they will walk directly into the end-time scenarios yet it is the humans who will actually stand to lose. People must wake up to these tricks and this technology so that they can orient themselves with the reality of this situation while learning to strengthen themselves and adapt to the manipulative aspects of this control system.

Spiritual Power and Divine Truth

This is essentially all about spiritual power and humanity stepping into the power of the truth behind their existence.

Some say that humans are designed as slaves, but if this is so, then it is the power that humans contain within that is the ‘work’ that they are sought after for. This indicates that humans have great powers that others cannot achieve on their own, even if they are creator lords.

Thus, whether humans are modified or not, they have great power. If they are not modified to perform this role of an energy generator, then this is just a confusing mind-control game that has been pulled over the eyes of humanity and humans have always contained true internal spiritual power that allows them to exist without having to parasite and steal the energy and knowledge of others. Humans are reality generators , we can choose how we want to experience the universe and what kind of collective world we want to enjoy together. Once we step into this power, there is on greater force. No amount of non-human entities can change that as we are somehow intrinsically linked to the ether-space of this realm through the spiritual and physical aspects of our being. That is what is sought after and so those who do not have this manifestation power attempt to

utilize humans to create their own reality through this Earth situation. That is the basics of the ‘alien overlord’ system, whether humans in disguise, non-humans operating with alien intelligences, supercomputer systems, or spiritually degraded beings.

Most people are not ready to see themselves or the true nature of humanity. Reality is largely an illusion of the conscious mind. The hidden aspects are the other half of the equation and this is perceived by the shadow aspect of the personality and mind. We are only marginally aware unless that aspect has been unveiled and through this process the reality of the human soul can be actualized and realized.

I was informed there would be a period of two suns and multiple mirages around the world. People would believe they were peering into another dimension, floating cities, or some kind of city-ship craft.

Synthetic DNA, Synthetic Genetics

Through the previous described replicator devices synthetic DNA can be engineered. Thus, entire genetically engineered codons can be produced and form this created beings can arise. These are the hybrid beings that are performing many tasks underground and even on the surface. On the surface there are synthetic genetic create beings or genetically engineered beings that appear to be human but do not contain a human genome. There are also clones and replicants of humans. There are a variety of non-humanoid forms but these are largely kept underground. These are beings we often see in science fiction movies or shows.

Time as Mathematics, Series of Equations, a Programmable Storyline

When using the technology, time can be understood to be a series of programmable variables where one variable is centered within a series of parameters and from these possible variables within a parameter set a series of possible functions or outcomes can be process. Thus, these people can literally plug into a supercomputer system which operates based on this form of processing reality and through this they can observe all the possible realities that may connect to a present moment. This allows one to travel but this is not part of this section of the explanation.

What this allows one to do is know exactly what is going to happen and when. If a person is being interrogated, all that has to be done is the operative using the technology simply thinks of what they will say and intends to do it within 6 seconds. The machine will play out a future timescale regarding the input of that question or interrogative speech and then produce the possible results. If this doesn’t give the desired readout in the mind of the operative, they will refuse to go that route and think of another pathway. This repeats for a few seconds to a few minutes. Then the computer has found the pathway that is most like to yield a result. The operative simply steps forward, says ten words, the subject breaks immediately and tells them everything they want to know. This is obviously takes longer for most trained individuals, however that is how easily it would be to use this technology to produce an effect on a regular surface level human. They would have

no defense, no way of knowing how that individual could know so much or be so direct. This is how operatives dealing with certain power groups will operate in the surface level population and individuals always feel that these people know way more than they are leading on. That is because they are, they know more about you and your life experience than you do.

Chapter 2.3 Previewing Solutions

Neutralizing Polarization

The mental-emotional tendency to pick sides, to fight, or to basically join in the fray that is currently taking place is a kind of deception of polarization which enables the leeching of emotional and mental energy from the human. This is more of a psychological unveiling where the true nature of the self, the duality game and the transcendent source aspects can be made visible to the individual. The they will see how every polarization tactic is actually taking them out of their true source of power by pushing them off center emotionally and mentally. There are teams that are capable of enabling this process and assisting as humanity realizes that half of the problem is that the unchecked mind is one's own worst enemy.

Removing Etheric Implants

Technology can identify and isolate these foreign body implants which are etheric technological devices. These are literally frequency or phase-shifted devices which are invisible to this layer of physicality but are capable of being organized and attached to the etheric field of the human and will operate to siphon or limit energy on the etheric level. Of course, this is all technology of the vampiric created beings who parasite on the original Earth inhabitants to sustain their existence.

Clearing Astral Body

By moving through the temporal body etheric implants can be deactivated and removed and then the astral or emotional body will be able to function closer to the original levels of presence and sensitivity. This body is manipulated when one is emotionally shut down from trauma. Thus this body can be scarred and will function at a much lesser level of activity or presence until the emotional damage is healed. This contains the memories of all the emotional events of a person's life.

There is technology that enables one to access these levels of frequency and clarify or untangle emotional chords or attachments which are used to siphon energy from the human being to the parasitic created beings. These chords are energetic in nature but also have technological components.

Knowing the True Self; Soul Actualization, Unveiling

This is a sacred, ancient process that has been outlined and discussed since the beginning of time. Humanity is here to learn, grow and express the self. In doing so, like a child moving through layers of infancy and into full-wakefulness of their body and the physical world, humanity can come into awareness of their true spiritual nature and the true spiritual nature of the universe. This is the process of soul or self-actualization that is described in some psychological methods such as Maslow's hierarchy of needs and the self-actualization that results in a complete fulfillment of all psychological needs. In this modern psychological view, self-actualization is described as the desire and process of reaching fulfillment of one's own natures and then living their life sharing that self-empowerment with other beings because after gaining your self that is the highest expression of such knowledge, sharing that power with others.

The true self is not limited to the physical body, the true self is a reflection of the entire universe and thus the primary original creative force. This is akin to the whole equation rather than just half of the equation. The visible aspect of the self, the conscious mind, is only one half of the entire equation. The whole equation consists of what we see visibly and consciously as well as what we are limited from seeing within the unconscious and subconscious mind. These are really two layers of the same ultimate source. Like an iceberg which is only partially above water, the subconscious mind is the proprietary wholeness of experience. The conscious mind is only a surface layer of reality while the unconscious mind carries all the notions, the multidimensional processes, the latent aspects of reality that we are not capable of seeing without unveiling these aspects through inner exploration.

Taking Responsibility

This entire show is about taking self-responsibility. Unless people begin to do this, there will be no hope. Right now people are convinced that their responsibilities belong to someone else even though this always results in pain and discomfort. To take responsibility is painful at first because we have a lot of work to do, but even then, this is beneficial because there is no way to remedy the pain and discomfort of being lied to and disrespected if people continue to hand their free-will over to others through blame (scapegoating), lower emotional bio-emissions (hatred, anger, etc), distractions and addictions (technological, sensual, and chemical or food based), or generally complaining without taking the first step towards providing something beneficial. This is the victim role, if humanity is to take control then they to help each other and themselves by not relying on false promises and false authorities to determine how they feel, think and live.

Returning To Center Emotionally and Mentally (spiritually)

Balanced food intake, rest, exercise, activity and learning are all continual requirements for a healthy existence. Emotional and creative expression nurtures the soul. Without these ways of being and learning the human qualities of experience diminish and creativity dwindles. There is most likely going to be a split between those who can sustain their own humanity and those who have to cause others to suffer to do so.

Vampires in the “Awake” Community

Contrary to popular belief, the majority of the non-humans are not necessarily vampiric and in power. The vampires are the people online who try to get a rise out of others for sharing their own experiences. They are the nosy neighbor that feels that the person who looks or acts differently must be considered and enemy and armed against because they feel themselves to be so much better. The majority of people are vampires, they believe that they must work for someone who will trade them money and that the amount of money they have based upon the amount of indirectly beneficial work they do puts them above others.

This is not different in the ‘awake’ community and in fact I feel that there are higher concentrations of vampires in this community, the alternate media because everything is largely a joke and a trick. People are operating on deceptive agenda schemes to divide the people and this is most intensely noticed when there is a realization of the truth behind what is happening and people begin to point fingers. The only people who are cleared to point fingers (and who also will NEVER point any fingers) are the operatives from the secret projects that have the capacity to do so because they have reached a specific level of awakening and this is related to the droning, cloning, and hybridization process. Only a specific few know who has been transformed into an impostor being and who is remaining strong and this is due being briefed on the surface level situation. Anyone can say what they want, they are simply playing into the tactics of mind-controllers and parasites and the more they play in the deeper the infection will grow. All the people pointing fingers now are actually implanted and vampiric and are attempting to drive a divide through humanity and they are the first who will turn on their friends and family when the going gets tough because they are more interested in others and starting drama than healing themselves. Ironically, this is all done under the guise of “healing” and “getting rid of the drama” AKA people they don’t trust. They pick and choose based on their own personal bias and this is a sure indication that they are emotionally and mentally out of alignment and are feeding deep seated personal fears from their own traumatic experiences.

These traumas must be healed and the harmonious center must be reattained where a person can focus on their own existence and waking up instead of acting as false-light, “king of tyranny” gatekeepers for others. Those individuals are going to be left behind if they cannot kick the habit because if they are allowed into any kind of healed society

they will quickly degrade into animals and attempt to restart a devolution process in order to gain the power they so desire but cannot produce on their own. ANYONE playing ego games of trying to hurt or put blame on ANYONE else contains this viral implant and has not kicked the virus.

Heart Center and Psycho-Spiritual Fulfillment (self-actualization)

Emotional connectivity is a form of telepathy, when loved ones can tell the state of another across space and time. Whether it is family or friend. In the 60's and a little before that the US found a specific frequency akin to a radio frequency that operates on a trinary spectrum. They called this the "telepathic wave". In time, they could completely read and send thought waves without frying the brain or body through radiation. Which was what the early machines did. They actually took satellite dishes and aimed them at people. Then realized they could turn it around and do it backwards with a better effect and minimal radiation. Either way they started beaming the base and then towns around them with waves between 400 and 432 MHz and caused waves of crime sprees or peace sprees throughout the 70's and 80's. So they can digitize the telepathic wave to induce artificial telepathy. But this is organically done through an entanglement through what we call love. Literally. The Germans found it before that. And the secret orders before them. And ancient Egypt before them. As humans we remain basically through the root, heart mind connection. When the heart overpowers the mind connection of spirit, then the body is a trinary whole. When the mind guides it is binary and cannot by guided by the spirit. The spirit has direct access to the heart. The mind is a computer of sorts. The mind doesn't see past duality. The heart is the true center/eye of the spirit. The reptilian brain is the dragon and when you tame the amygdala then fear is ‘behind’ you. When the mind is "untamed" the reptilian brain takes over. This is the lower brain and amygdala fight or flight response.

This happens when the energy of the brain, body and spirit increases due to whatever various reason of spontaneous or controlled increase. Because of the "temptations" which are the easiest flow of emotional energy into a "discharge" state, is that the sacral/sexual center ties to the heart and reroutes to replace the heart and control the mind. Mental and emotional contemplation of one's true purpose and nature is the path of the divine. We find ourselves simply by looking in the right place, not in the world, but in our self energetically. We are more powerful than the programming, and we can reverse this is we're careful and devoted enough.

We have to be faster than thought, at the speed of spirit, beyond matter. When we start thinking on this level then our influences spread to others throughout the sphere. It is our destiny to know these things but they have been kept from us. The ancient orders called this the art of "implosion". Traveling realities through intense contemplation and a usage of sacred geometrical forms.

They developed and combined orders around WW2 and developed zero-point energy tech that can alter space/time fields. This is timeline manipulation. But as a rule, we go where our heart leads us. So that's how this is solved.

Go Within to Observer the Self

The answer is literally by looking within to find the great truth rather than looking around us. Everything we need to know is within us, energetically and spiritually. Our emotional, mental and physical state of balance is an indication of where and how we exist in relation to the larger overall truth. Everything that happens around us to distract us is designed to stop us from looking within. Nothing can truly stop us, nothing can actually input the holographic horrors in our spiritual center but simply perturb the brain and body. The mind is a non-holographic spiritual environment that cannot be excessed and the invader's goal is to convince people to use their imagination or their creative powers to produce these horrors on their own. This is through the programming. We must clear out the programming, the trauma, the lower-dimensional constructs and fill ourselves with the truth and spiritual presence that enables us to be self-aware in the first place. If we aren't doing this, then we are either in pain, or there is no spiritual presence to be in pain. If we are doing this, we are either clearing out the constructs by replacing them with true spiritual presence and self-awareness or we are becoming aware of them.

Organic Feedback Loop

The great feat is mentally bridging the great rift between us by looking within. Which is paradoxical.

We can never see what another is perceiving exactly, well for the most part, so we all have to kind of accept that we are communicating effectively and truly get to this level of comfort by simply being secure in knowing who we are our selves.

Technological Feedback Loop

So then knowledge, in a way, when shared, is a form of telepathy. Group telepathy.

Group think, when ideas or memes spread, is a form of group telepathy.

The Internet is like artificial spreading of telepathy. This means what is normally mentally bound signals can be initiated and spread through a digital medium.

Breaking Soul-Contracts

Ultimately everyone is under a series of "veils" which are energetic time-constraints literally like 9 dimensional layers of temporal restriction which are each bounded and ruled over by invader beings. These range from physical authorities, to astral entities, to programmable matter, to supercomputer intelligences, to spiritual false-light beings and our own shadow mind. Each layer of reality is successively guarded by these beings who are here acting as gatekeepers designed to push people back when they begin to wake up. These beings all work through fear and deception and the last layer is based on mirroring our own energies back to us like an impostor. All the levels tend to imitate, how-

ever the last layer is a near perfect imitation of our own energy to the point where people often switch places with this being before getting out of the matrix. There will be more discussed on this in a later section.

The “9 veils” were designed by impostor beings as a last effort to stop humans from escaping the false-light matrix which is essentially the holographic universe. This is literally like a maze which reproduces a new pathway and a new doorway each time a person nears the last hallway or doorway that is next to the exit. So one eventually has to project themselves into the exit using their whole being and moving past and through the tricks by not falling for them before they are placed. This is highly confusing but this is essentially a kind of labyrinth that has been created to stop people from leaving so that their soul energy can be destroyed and used as a generator for the false-light system which is an AI over mind that is programmed to take the raw soul energy and destroy the identity by inverting the electromagnetic spectrum and incorporating that inverted energy into its own internal matrix body which is literally the false-light universe.

Help Everyone

Now they may have been setting us all up for the apocalypse. They said they want us to tell on them and get the whole world aware of what they've been doing So that we can stop them and pull them from the dark which is ACTUALLY taking their souls. There are also breakaway civilizations involved in this entirely zero-point/free-energy.

Chapter 2.4 How Timelines Collapse

Repeating Cycles of Time

Because of the way time works and the ability of those using these temporal devices they have set up an elaborate labyrinth like a spider web of false realities, timelines, parallels, sub-dimensional layers, astral cages, temporal dead-ends, and time loops which act to stop people from reaching the true reality. As a result, many portions of this timeline are literally in a free-will ‘time-loop’ and these loops must be canceled out. As well, because of the nature of these loops on the overall stream, our entire civilization has been looping for the past 6 time-cycles meaning we have reached this time in history 6 times before and this is apparently the last time because we have never gotten this far before and the events of the future are having to be programmed in manually at this point.

Beings From the Future

As are result and damaging time, what happens is that the beings from the possible future that is being damaged appear to try to heal the break as well as those who are from the new possible future that is generated, this results in a time war between both possible realities for the present realm. This is what has been happening for thousands of years. All the ancient spiritual texts are describing this system. One group is a from an original possible future where everything is based on the presence of spirit and souled

humans, another is from the new possible future where an AI overlord took over and removed the souls and spiritual energy from all entities on Earth rendering this a holographic prison without any other use. That reality dissolves into itself and so the time beings are constantly moving backwards and jumping timelines to try and obtain more energy.

Beings From Collapsed Timelines

The beings from the collapsed timelines are those who travel through hyperspace to get here. They then recreate themselves using cloning technology through hyperspacial means, IE: creating an alternate temporal dimension so that these devices can sustain them and literally “hold-space” for them. Then if their timeline is destroyed, they can still exist as a ‘loose-end’ in space-time. This is extremely dangerous and I will say we have some Human operatives jumping timelines searching for Earth and Humanity so that they can find a reprieve from this time war.

That is the most trying aspect of this entire ordeal for me. There are some human operatives literally in hyperspace without an opening into the temporal stream for them to reintegrate into this timeline. We must assist them, we must open the timeline by taking control of Earth from the invader races and those who wish to depress and isolate the spirited and souled human beings. We must re-organized and neutralize the invasion forces of deception and assist our humanity and maintaining their free-will, their self-awareness, their self-empowerment and their emotional, mental, and physical harmony.

Beings Who Would Never Have Existed in the First Place

As a result of this entire process, there are essentially beings who have been erased from time who degrade in this dimension and can only interact periodically. These are the created beings who operate through supercomputer forms that are placed within cloned bodies and powered by the transdimensional quantum supercomputers. These are the ‘parallel’ reality beings and this relates to the hive mind invasion. When all the original aspects of time are restored, these beings would not have ever existed in the first place as there is no quantum link for their probabilities to remain neutral and present in the original run of things.

Again, all beings who operate under the will of the universe, even when they are attempting to trick hyperspace and time, when these beings assist and help in the unification of sentient, spirited, souled beings they are capable of being healed. This is all because there is an original creative force which can produce souls that are eternal and everlasting, meaning they are not created but simply always ever were. Yet, there is a “miracle” effect where beings can be given eternal life. This is only by reflecting the will of the whole of existence, rather than a portion or a part because this is only temporary. Only the whole is forever and this takes true harmony, true balance and ultimately *self-lessness*. To give to others because you see them as worthy because they can be aware and

enjoy the gift is to be like the creative force that gives life to all and enables all experience in the first place. By acting in correspondence with this we reflect the will of the whole and that power and action transfers into protection and self-empowerment for ourselves. This cannot be cheated, tricked, or rerouted as that is the karma game that has been played by delaying time and rerouting energy through getting others to take on the responsibility for others bad actions. In the end, all karma has only been delayed because when the stops are pulled out, *everyone* ends up getting their karmic returns regardless. They simply intended to build up so much karma that by the time the ties are cut, the karma overload will simply kill them instantly. This never happens and they end up in the abyss, this is the final time so since there is no recycling of the universe from the oroboros system then whatever happens is what happens forever. If everyone wants to move into harmony, to receive healing, to receive forgiveness then they must assist in the creative force in healing, forgiving, and turning away from the deception, the cruelty, the vampiric actions.

Many vampires believe they will die if they stop. The only hope is to admit their ways to the others and ensure that there are enough beings around them that will protect them so that this situation can be handled properly, with due care, compassion, and the necessary healing to ensure the safety and protection of all who seek harmony.

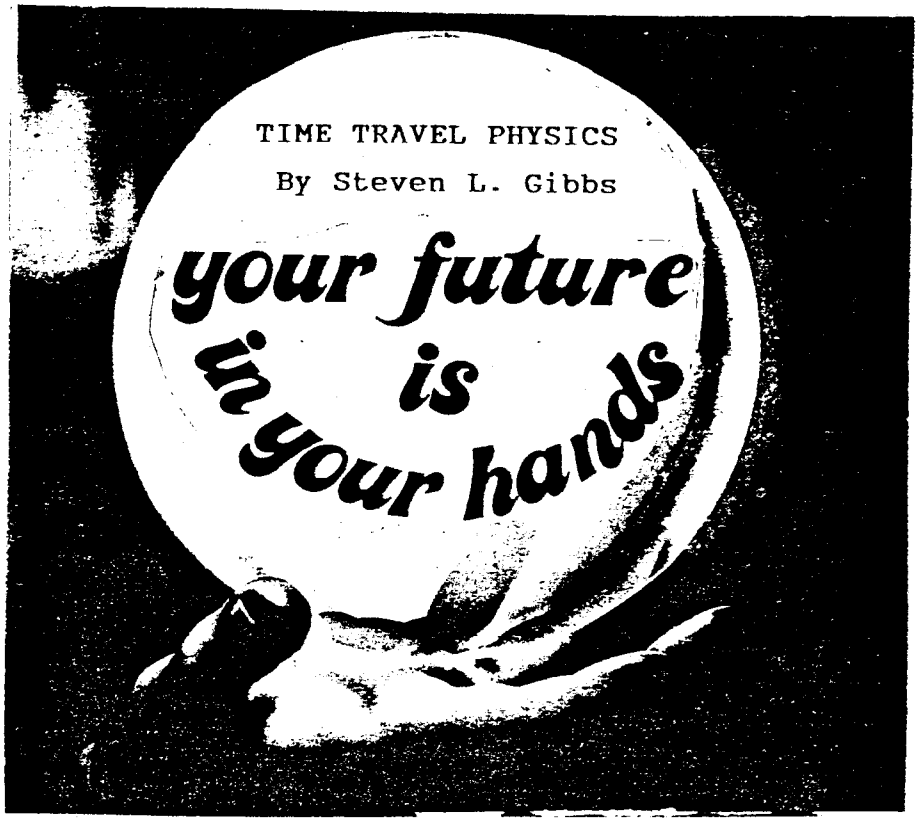
TIME TRAVEL PHYSICS
By Steven L. Gibbs
your future
is
in your hands

DEDICATION

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Rt 1. Box 76, Clearwater
Nebraska USA

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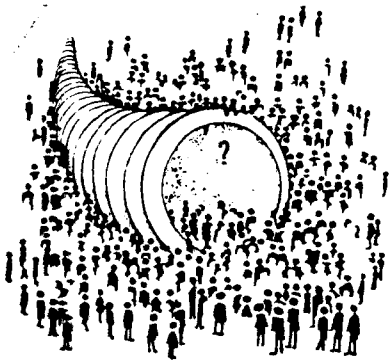

I would like to personally thank
Jesus Christ in helping me to obtain
the knowledge for writing this report.
For without his help, all of this
would not have become a reality.

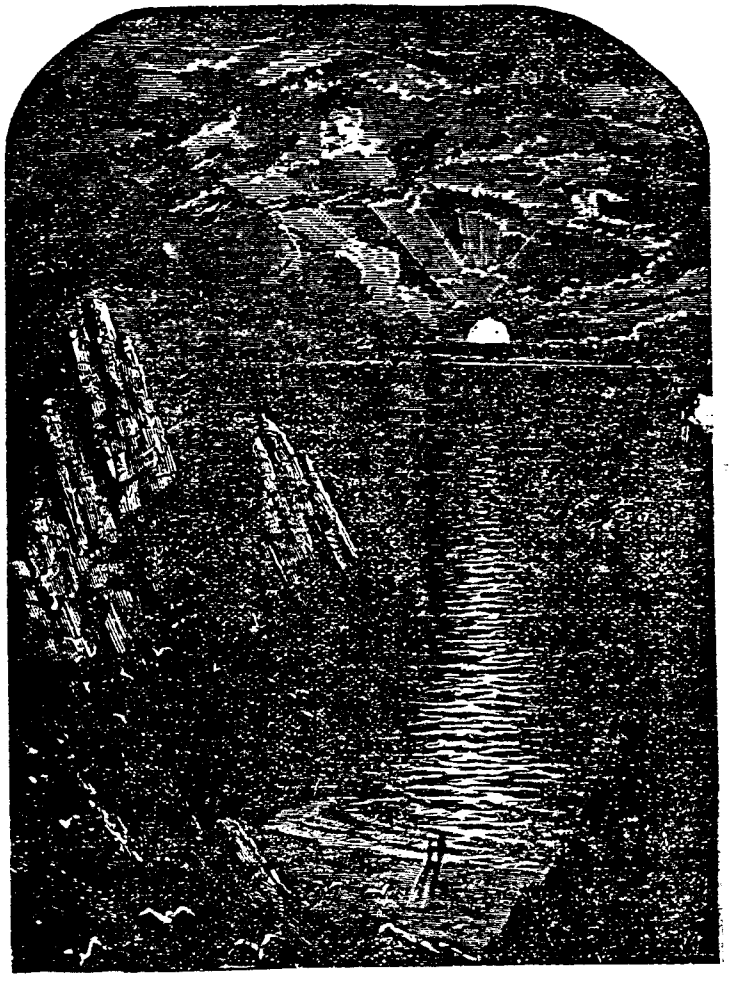

INTRODUCTION

The reason for writing this report is to show people that man does not have to use sophisticated mathematics in order to understand how Time Travel can be achieved. To assume that what is being taught in today's schools is an absolute truth, can only be a lie. For to believe in such a lie, can only lead to imperfection. But sense mankind has chosen this path, the inevitable must surely come to pass.

It is impossible to say where all of this might lead. However I do hope that the people who read this report will use the knowledge wisely. For those who don't, I leave them to their doom. But for those who do, may the Lord bless you.

Your probably wondering by now, if I am really an Alien. My answer to this is, there may be more truth to this than meets the eyes. According to the information which I have received from the Kennedy Space Center, there is a good chance that my parents came from the Star System called Phoenix. If this is case, then this would explain why I have had so much difficulty in adjusting to Earth's own environment.

Perhaps in the years to come, more will be revealed to me on the true nature of my whereabouts. And you know what they say about Aliens? Their weird!

TIME TRAVEL PHYSICS

Before I begin I must first point out, that the only reason why Formulas can be used for analyzing a specific problem, is due to the fact that a Formula helps in focusing the Belief Fields which emanate from the persons Soul. So in other words, whenever a person uses a Formula or Equation, to him this constitutes a reality. By keeping these things in mind, you shouldn't have any problem in understanding what has been written in this report.

To begin with, there are basically 3 sets of Equations which can be used for accomplishing Physical or out of the body Time Travel. I have used these formulas quite often when building my Time Travel Machines. As a matter of fact, all my research is based on these 3 formulas. The formulas which I have used for accomplishing Physical or out of the body Time Travel, are given in the following manner:

(THE GRAVITON FORMULAS)

$(X\ ,\ Y = \emptyset)$ $(X1\ ,\ Y1 = \emptyset)$ $(X2\ ,\ Y2 = \emptyset)$

The Graviton Formulas which I have so diligently labeled, can be used for an infinite number of things. However, before we can proceed any further, we must first have a good understanding of what each Symbol means. There are an infinite number of meanings which can be applied to each Symbol, however in order to simplify things, the meanings which I have given

to each Letter or Symbol, are listed in such a way so that anybody with a little bit of knowledge can understand them.

(INTERPRETATION FOR EACH OF THE GRAVITON SYMBOLS)

X - Represents an AC Field.

Y - Represents a DC Field.

X1 - Represents a High Frequency Field.

Y1 - Represents a Low Frequency Field.

X2 - Represents a Paramagnetic Field.

Y2 - Represents a Diamagnetic Field.

ϕ - Represents the Zero Vector or Twilight Zone.

it may also be referred to as the (PHI Value)

which is (1.618).

It is interesting to note, that whenever the (PHI Value) is used in the construction of a material object, a Time Warp usually occurs around that object.

However, in getting back to the problem at hand, whenever the (Graviton Formulas) are used singly or in series with one another, they can be used to help build a device which can actually be used for Time Travel. This is because whenever the (X) and (Y) Values are combined with one another, we can Zero in on the Twilight Zone. And sense the Twilight Zone is in attunement with God, all things become infinitely possible provided that the (X) and (Y) Values are in resonance.

So now your probably wondering, how can we use these Formulas for constructing a Time Travel Machine? Its simple. Merely start out by building a Capacitor which corresponds to this Equation: (X2 , Y2 = Ø). This Capacitor should be constructed in such a way, so that it resembles the drawing which is shown below:

(DRAWING OF CAPACITOR)

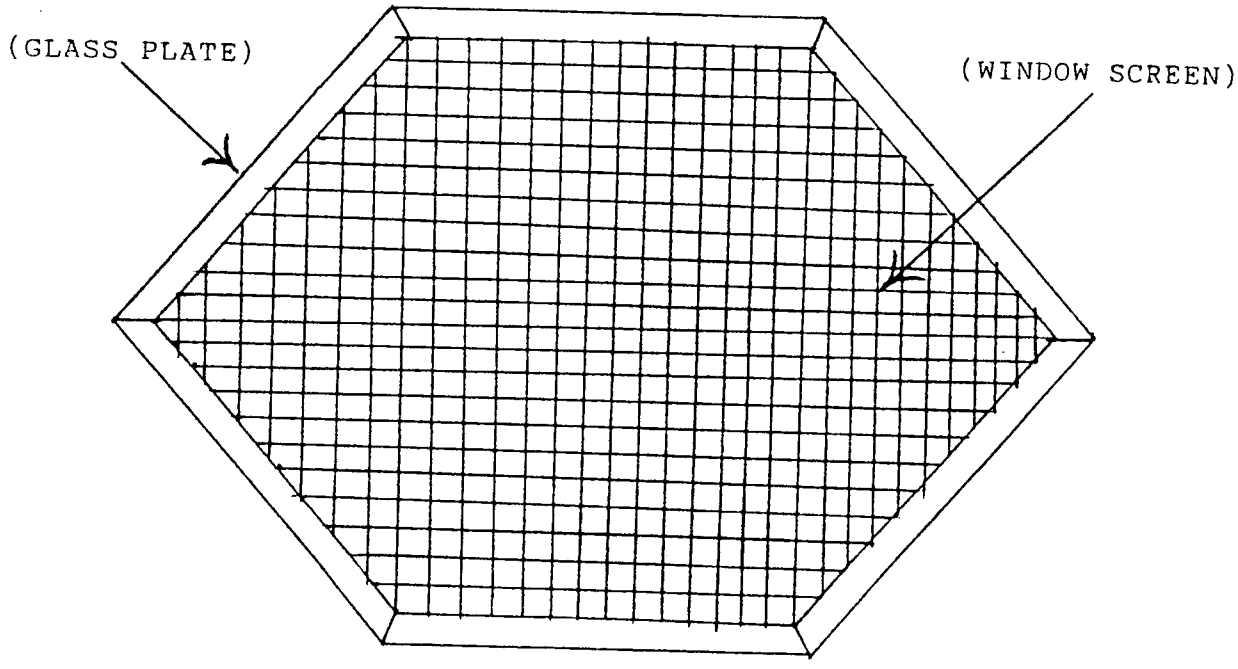

As we can see in the above illustration, it doesn't matter to much as to what size it should be, just so long as it is shaped like a Hexagon. Also each side of the Capacitor should be the same length, otherwise the Belief which is being transmitted from the plate, will be imperfect. And this could raise Hell with your Chakra Points.

At this point it should be noted, that whenever you construct a Capacitor of any type, you are automatically using the formula (X2 , Y2 = Ø). And sense the (PHI Value) is used in the formula, the plate itself will develop a Life Force of its own. It should also be pointed out, that sense there is a Life Force which co-exists with the plate, it can now be programmed to do anything you want.

Now in order to program this Capacitor, all we do is stroke the Glass portion of the plate, while concentrating on the following command: (Transport me to the Date and Year). As soon as you get a stick so that you can no longer move your fingers, the Capacitor should be fully programmed. After you have finished programming the Capacitor, place the Screen Side of the plate over the Solar Plexus for the space of 30 minutes. After the treatment is over with, you then find a comfortable place to relax in order for the energies to take effect. If you have done everything correctly, your Aura or Physical Body should be transported to the date which you programmed into the Capacitor. On the average, it usually takes 70 minutes before the energies will take effect.

*Note: People who work with these plates are in serious danger of getting possessed by an Evil Spirit or Demon, unless of course you have a faith in Jesus Christ. By saying a prayer to Jesus Christ prior to any Experiment, more than protects you from the forces of Evil.

As you Experiment with these Capacitors, you will find that some of these plates work better than others. The reason for this probably ly's in the fact, that certain sizes or the materials being used, are in resonance with the person's Life Force or Belief Fields. Therefore if you run into any problems, it may pay to use a different thickness of Glass. When I talk about this, I do not mean to vary the Shape of the Capacitor, just the width. It also might pay to use Yellow tinted glass. You may also want to try Green, Blue, Indigo, and Violet colored glass. The reason for doing this is simple. Each color corresponds to a different Chakra Point. It is therefore my opinion that Yellow should be your first selection, then if you want, you can always Experiment with the higher colors.

*Note: Never under any circumstances use Red or Orange tinted glass. If you decide to use these colors, then your probably on your own, because not only will it lower the Frequency Rate of your Chakra Points, but you could also end up in an Astral Hell. And believe me, this is no fun place to visit.

Once you have found a plate which can transport your Physical or Spirit Body, there are still even further ways of increasing its effects. One of these ways is by using the second formula, (X1 , Y1 = Ø). This formula states, that whenever a High Frequency Field is combined with a Low Frequency Field, we can tune ourselves into the Zero Vector or Twilight Zone. To use this formula it will first be necessary to get a hold of a

Tesla Coil and one Van de Graff Electrostatic Generator. Once these items have been obtained, you proceed by charging the plate with High Frequency Electricity and Low Frequency Static Electricity. In other words, after you have programmed the plate using the procedure on page (4), you must simultaneously Zap the plate using the above procedure. You must make sure that while you are doing this, that you do not come into contact with the plate. If you do, you could be in for a Hair raising experience. This voltage hurts! But anyhow after you have Zapped the plate for the space of 10 minutes, you then proceed by placing the Capacitor over the Solar Plexus as described on page (4). The effects that you get, should be much better than what you experienced before.

The next step to take, is to Amplify the Energies even further. To do this, we must now make use of the 3rd and final formula, which is (X , Y = Ø). This formula states, that whenever an AC Field is combined with a DC Field, a Time Warp occurs which tunes our minds into the Zero Vector or Twilight Zone. Now in order to create these fields, one should try to get a hold of a Hyper-dimensional Resonator. (Read the last 4 pages in this Report). Once you are able to get a hold of this instrument, and after everything has been plugged in correctly, while the Screen side of the plate is positioned over the Solar Plexus, position the open end of the Electromagnet over the glass side of the plate for the space of 3 minutes. After the treatment is over with, disconnect yourself from the plate (turn page)

and instrument, and find yourself a comfortable place to relax. If you use this procedure in conjunction with the first two procedures, the effects that you obtain, will be increased to such a point, that you should be able to do anything you want. You must remember however, that before Physical and Spiritual Time Travel can be achieved, the (X) and (Y) factors in the formulas must be in resonance with one another. This can only be accomplished through the process of tuning your own mind just as you would with a Radionics Machine. So in other words, by selecting the correct materials to use, you are in effect creating something which you physically believe to be a reality. This same rule can be applied when working with different types of Frequency's and Voltages.

Another method which you may want to try, is that after you have programmed the plate by using the procedure which is given on page (4), transmit some High Frequency Electricity from a Tesla Coil into the Capacitor while the Screen side of the plate is pointing towards your face. After 3 or 4 minutes, de-activate the Tesla Coil, and while the Screen side of the plate is still facing towards you, take the bare ends of an Extension Cord that has been plugged into a 110 volt AC outlet, and short out the bare ends of the wires by touching both of the terminals on each side of the Screen. (See page 8). If you have programmed the plate correctly, your physical body should be transported instantaneously to the date which was programmed into the Capacitor.

THE CHRONOLOGICAL TIME REFLECTOR

(Series No.2)

2-21-89

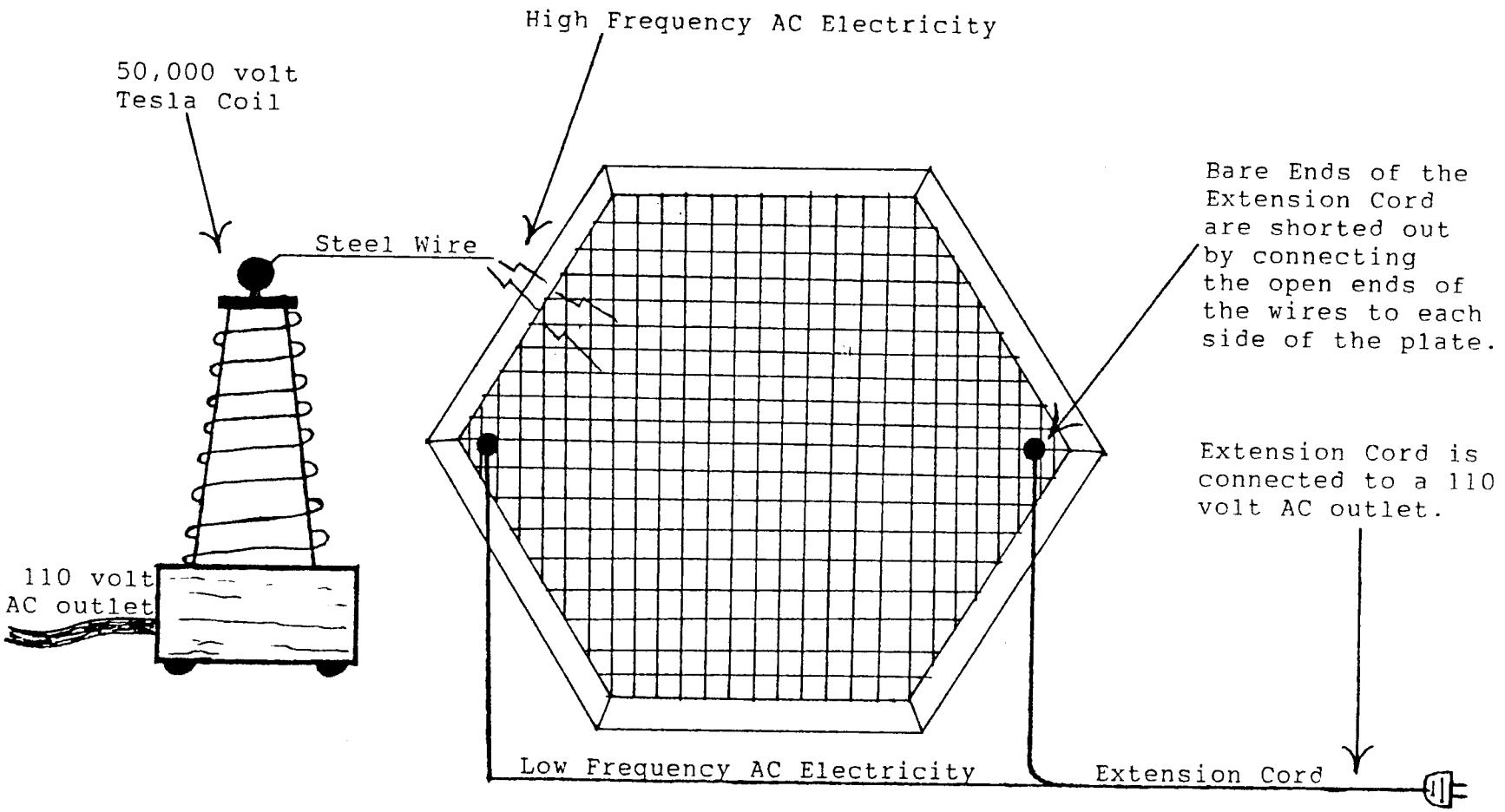

To give you some idea of how all this got started. Back in the year 1981 I was contacted by what I believe to be my other self. The letter which I received at the Sunset Plaza in Norfolk, Nebraska, was dated 1992 A.D. It also had a month on it which I can't seem to remember. Evidently the letter which I received indicates, that sometime around the year 1992, I will travel back into the past to make contact with myself, just like my other self did in the future. One of the things which the letter mentioned which I can barely remember, is that it said: (The path to the truth can be found in the Pyramid of Giza). It also had a riddle, and it went like this: (The riddle can be solved when 79.613 is dissolved). These two verses holds to key to Time Travel. I have already deciphered the riddle. As a matter of fact it was just last year when the answers came to me. Basically the 79.613 number can be converted into the (1.618) value which is used in my Equations. It is also the same number which was used in the construction of the Pyramid of Giza. If we decipher the riddle even further, we will find that it also reveals that the 7.8 Hz. Frequency, is the Frequency to use for accomplishing Time Travel. It seems that whenever a person travels physically through time, his Alpha or Theta Waves are vibrating at this Frequency. Once that your Brain Waves begin to oscillate at this Frequency, your mind then becomes tuned to the Zero Vector. I have found that this is the only way in which Time Travel can be achieved. So basically what I am trying to get at, the Chronological Time

Reflector causes your Brain Waves to vibrate at 7.8 Hz. cycles per second. That is all that these units do. However, for some people, they might think differently, but when you get right down to it, it all leads to the same thing. Mind verses matter. And this just barely covers the subject.

Another experience which I had that occurred around the month of Sept. in 1986, dealt with a variation of the Chronological Time Reflector. In other words, after I had finished programming the plate, I proceeded to Zap the plate with 50,000 volts of High Frequency Electricity. Sometime after the Experiment, I clipped off one end of an Extension Cord and plugged the other end into a 110 volt, 60 cycle, AC outlet. I then laid the bare ends of the wires on top of the screen. Just then I accidentally dropped something on the floor. After I had reached down to pick it up, the bare ends of the Extension Cord which I had laid on top of the Screen, touched the Screen portion of the plate. What was to follow, would be the most terrifying experience I had ever had, because as soon as the bare wires touched the Screen, a massive short occurred. All I can remember is seeing two flashes of white light energy, and the next thing I knew, a white mist had fallen over the entire room. I didn't realize that I had traveled physically through time until I looked at a Calendar the next day. Not only that, but when I asked a lady in Plainview, Nebraska as to what the date was, she said it was the 17th, but my Quartz Watch indicated the 16th. When

I had returned home later on that day, I has discovered that all of my Experiments had been dated wrong. Then I finally realized that I had actually traveled one day into the past. To this day I am not exactly sure as to whether or not I returned back to my own present Time Line. Perhaps I will never know.

Another Time Travel instrument which was sent to me by a man who lives in Osceola, PA., is revealed on pages (12), (13), and (14). According to what I have red in his letter, this device can actually transport objects into the future. However, he says that there is somewhat of a Time delay effect shortly after the unit has been shut off. In other words, after the unit has been de-activated, it takes anywhere from 10 to 15 minutes before the object is teleported. I have never built this device as yet, however I plan to eventually.

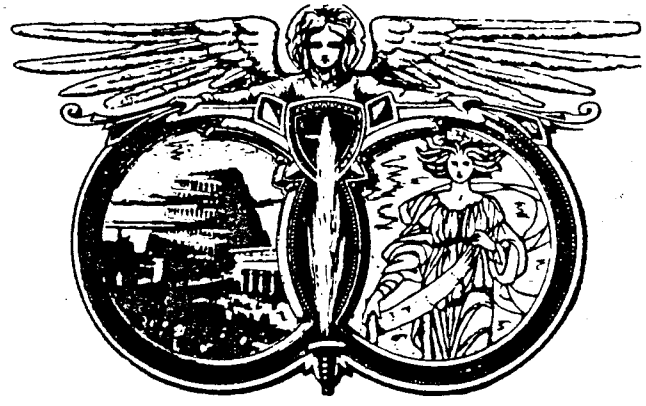

POWER SUPPLY FOR THE TIME PLATFORM

2-22-89

C1 - Is a homemade Capacitor made out of sheets of Glass and Copper Foil. Aluminum may be used, but this could be dangerous to your health.

L1 - Is number 10 Gage wire wound around a dowel rod.

L2 - Is number 24 Gage Magnet Wire wrapped around some PVC pipe. There should be about 1000 turns which should create around 100,000 volts of Low Amperage High Frequency Electricity.

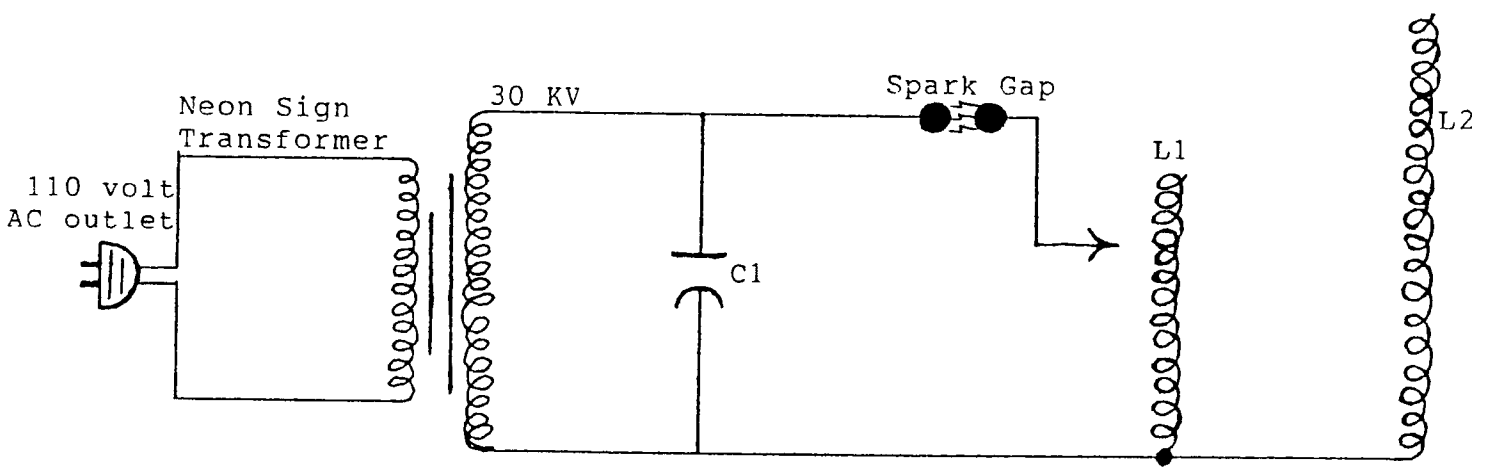

THE TIME PLATFORM

2-22-89

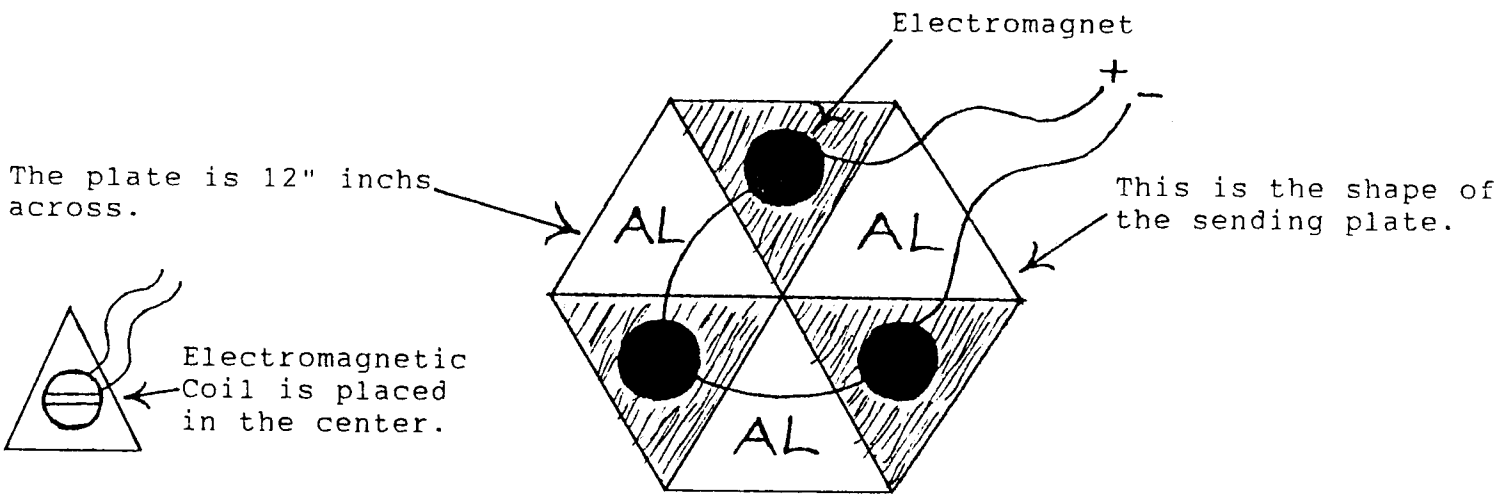

THE ELECTROMAGNETS ARE MADE OF STRAP IRON STACKED 8 INCHES HIGH (1/4"STRAP IRON).

THE ALUMINUM PLATES ARE 1/4 OF AN INCH THICK, AND ARE STACKED 8 INCHS HIGH .

THERE ARE VARIOUS REASONS FOR THIS PARTICULAR ARRAY.

THE ALUMINUM SPACERS CONCENTRATE AND FOCUS THE MAGNETIC FIELDS.

FULL SCALE DRAWING OF THE TIME TRAVEL UNIT

2-23-89

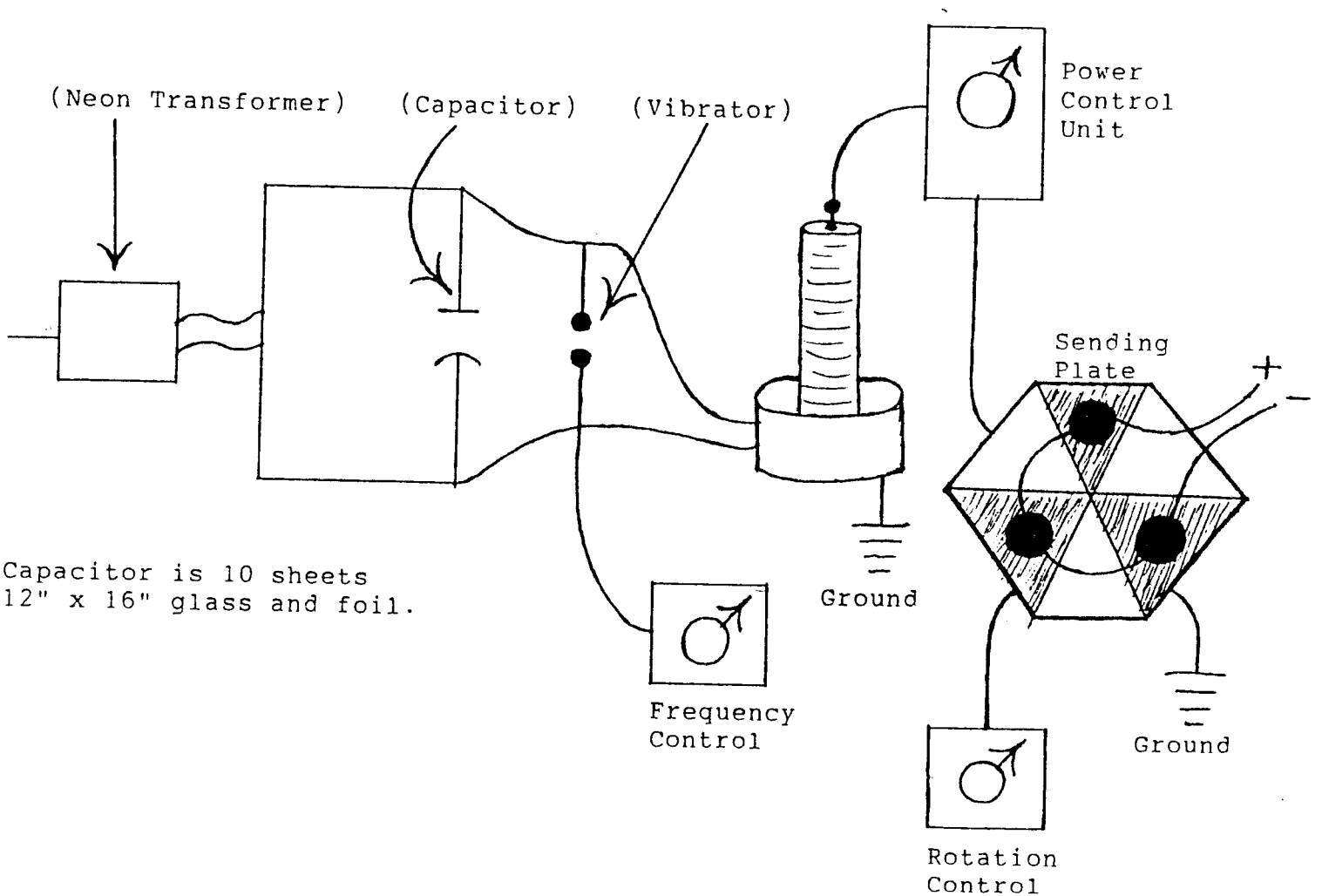

Capacitor is 10 sheets
12" x 16" glass and foil.

THE DELAWARR EXPERIMENT IN TIME TRAVEL (PHASE #1)

8-16-89

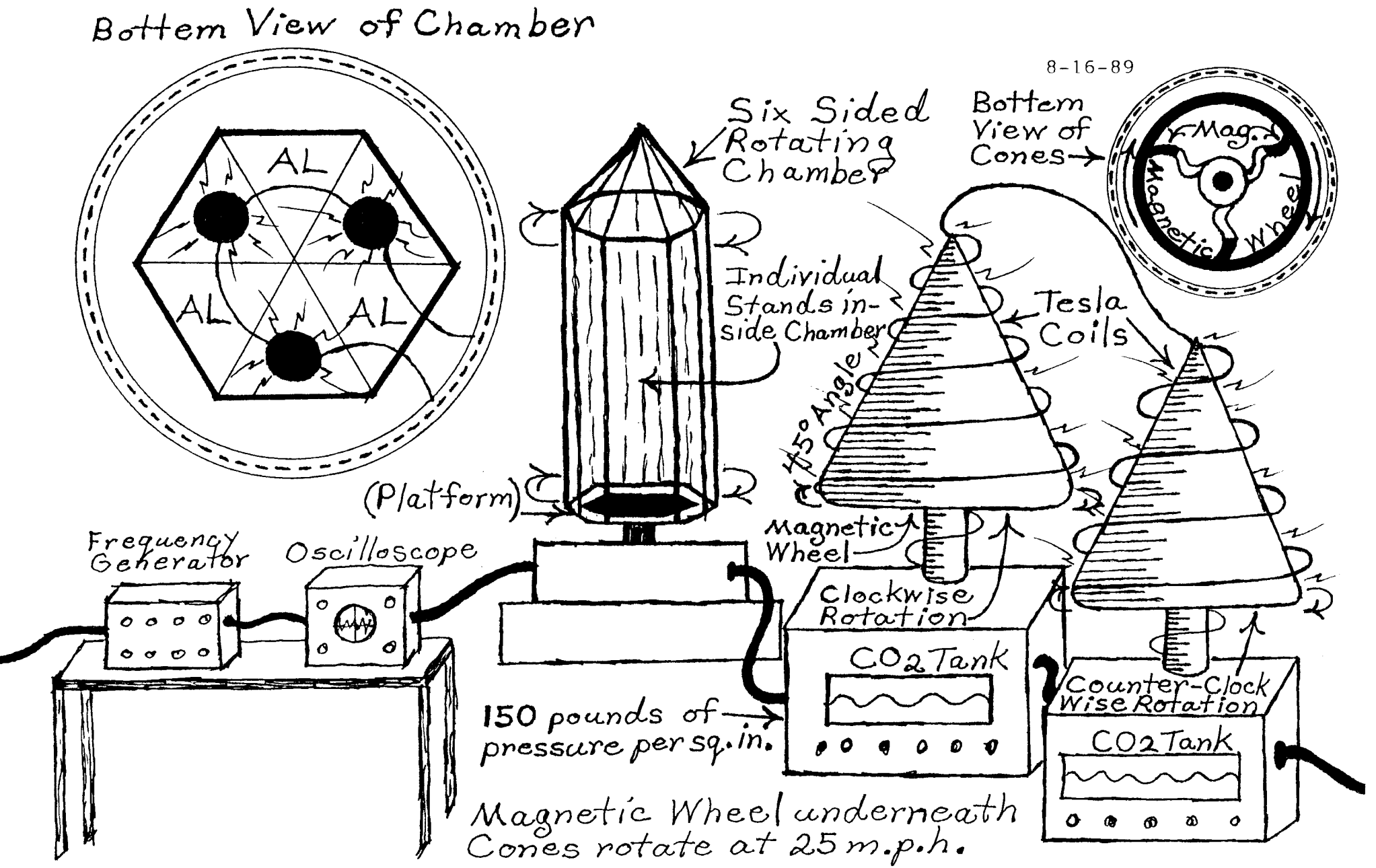

Throughout the vast regions of Space Time itself, there are an infinite number of ways to build a Time Travel Machine. One of these ways is to get a hold of a Rubbing Plate, (GSR), or Pendulum, and proceed by asking (Yes) or (No) questions as to what type of components one should use in order to build a Time Travel Machine. There are a number of ways of doing this. First of all begin by asking what size the instrument box should be for holding the components. Next, determine what type of energy one should use for achieving these effects. Then you ask what type of components one should use in order to transmit this energy. If you have done everything correctly, you will end up creating a device which is based entirely on belief. And sense you have created a device which is built entirely on belief, you can be dam certain that it will work! Especially if you use a (GSR) while asking your questions.

For those of you who do not know what a (GSR) is, this is basically a (Galvanic Skin Response Meter). One of these devices may be purchased from me for $150. Instructions are included. Please allow 4 to 6 weeks for delivery.

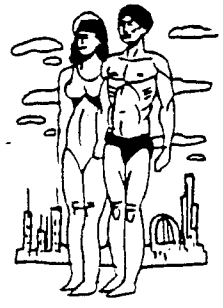

THE PARADOXES OF TIME TRAVEL

David Lewis

TIME travel, I maintain, is possible. The paradoxes of time travel are oddities, not impossibilities. They prove only this much, which few would have doubted: that a possible world where time travel took place would be a most strange world, different in fundamental ways from the world we think is ours.

I shall be concerned here with the sort of time travel that is recounted in science fiction. Not all science fiction writers are clear-headed, to be sure, and inconsistent time travel stories have often been written. But some writers have thought the problems through with great care, and their stories are perfectly consistent.[1]

If I can defend the consistency of some science fiction stories of time travel, then I suppose parallel defenses might be given of some controversial physical hypotheses, such as the hypothesis that time is circular or the hypothesis that there are particles that travel faster than light. But I shall not explore these parallels here.

What is time travel? Inevitably, it involves a discrepancy between time and time. Any traveler departs and then arrives at his destination; the time elapsed from departure to arrival (positive, or perhaps zero) is the duration of the journey. But if he is a time traveler, the separation in time between departure and arrival does not equal the duration of his journey. He departs; he travels for an hour, let us say; then he arrives. The time he reaches is not the time one hour after his departure. It is later, if he has traveled toward the future; earlier, if he has traveled toward the past. If he has traveled far toward the past, it is earlier even than his departure. How can it be that the same two events, his departure and his arrival, are separated by two unequal amounts of time?

It is tempting to reply that there must be two independent time dimensions; that for time travel to be possible, time must be not a line but a plane.[2] Then a pair of events may have two unequal separations if they are separated more in one of the time dimensions than in the other. The lives of common people occupy straight diagonal lines across the plane of time, sloping at a rate of exactly one hour of $time_1$ per hour of $time_2$. The life of the time traveler occupies a bent path, of varying slope.

On closer inspection, however, this account seems not to give us time travel as we know it from the stories. When the traveler revisits the days of his childhood, will his playmates be there to meet him? No; he has not reached the part of the plane of time where they are. He is no longer separated from them along one of the two dimensions of time, but he is still separated from them along the other. I do not say that two-dimensional time is impossible, or that there is no way to square it with the usual conception of what time travel would be like. Nevertheless I shall say no more about two-dimensional time. Let us set it aside, and see how time travel is possible even in one-dimensional time.

The world—the time traveler's world, or ours—is a four-dimensional manifold of events. Time is one dimension of the four, like the spatial dimensions except that the prevailing laws of nature discriminate between time and the others—or rather, perhaps, between various timelike dimensions and various spacelike dimensions. (Time remains one-dimensional, since no two timelike dimensions are orthogonal.) Enduring things are timelike streaks: wholes composed of temporal parts, or *stages*, located at various times and places. Change is qualitative difference between different stages—different temporal parts—of some enduring thing, just as a "change" in scenery from east to west is a qualitative difference between the eastern and western spatial parts of the landscape. If this paper should change your mind about the

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possibility of time travel, there will be a difference of opinion between two different temporal parts of you, the stage that started reading and the subsequent stage that finishes.

If change is qualitative difference between temporal parts of something, then what doesn't have temporal parts can't change. For instance, numbers can't change; nor can the events of any moment of time, since they cannot be subdivided into dissimilar temporal parts. (We have set aside the case of two-dimensional time, and hence the possibility that an event might be momentary along one time dimension but divisible along the other.) It is essential to distinguish change from "Cambridge change," which can befall anything. Even a number can "change" from being to not being the rate of exchange between pounds and dollars. Even a momentary event can "change" from being a year ago to being a year and a day ago, or from being forgotten to being remembered. But these are not genuine changes. Not just any old reversal in truth value of a time-sensitive sentence about something makes a change in the thing itself.

A time traveler, like anyone else, is a streak through the manifold of space-time, a whole composed of stages located at various times and places. But he is not a streak like other streaks. If he travels toward the past he is a zig-zag streak, doubling back on himself. If he travels toward the future, he is a stretched-out streak. And if he travels either way instantaneously, so that there are no intermediate stages between the stage that departs and the stage that arrives and his journey has zero duration, then he is a broken streak.

I asked how it could be that the same two events were separated by two unequal amounts of time, and I set aside the reply that time might have two independent dimensions. Instead I reply by distinguishing time itself, *external time* as I shall also call it, from the *personal time* of a particular time traveler: roughly, that which is measured by his wristwatch. His journey takes an hour of his personal time, let us say; his wristwatch reads an hour later at arrival than at departure. But the arrival is more than an hour after the departure in external time, if he travels toward the future; or the arrival is before the departure in external time (or less than an hour after), if he travels toward the past.

That is only rough. I do not wish to define personal time operationally, making wristwatches infallible by definition. That which is measured by my own wristwatch often disagrees with external time, yet I am no time traveler; what my misregulated wristwatch measures is neither time itself nor my personal time. Instead of an operational definition, we need a functional definition of personal time; it is that which occupies a certain role in the pattern of events that comprise the time traveler's life. If you take the stages of a common person, they manifest certain regularities with respect to external time. Properties change continuously as you go along, for the most part, and in familiar ways. First come infantile stages. Last come senile ones. Memories accumulate. Food digests. Hair grows. Wristwatch hands move. If you take the stages of a time traveler instead, they do not manifest the common regularities with respect to external time. But there is one way to assign coordinates to the time traveler's stages, and one way only (apart from the arbitrary choice of a zero point), so that the regularities that hold with respect to this assignment match those that commonly hold with respect to external time. With respect to the correct assignment properties change continuously as you go along, for the most part, and in familiar ways. First come infantile stages. Last come senile ones. Memories accumulate. Food digests. Hair grows. Wristwatch hands move. The assignment of coordinates that yields this match is the time traveler's personal time. It isn't really time, but it plays the role in his life that time plays in the life of a common person. It's enough like time so that we can—with due caution—transplant our temporal vocabulary to it in discussing his affairs. We can say without contradiction, as the time traveler prepares to set out, "Soon he will be in the past." We mean that a stage of him is slightly later in his personal time, but much earlier in external time, than the stage of him that is present as we say the sentence.

We may assign locations in the time traveler's personal time not only to his stages themselves but also to the events that go on around him. Soon Caesar will die, long ago; that is, a stage slightly later in the time traveler's personal time than his present stage, but long ago in external time, is simultaneous with Caesar's death. We could even extend the assignment of personal time to events that are not part of the time traveler's life, and not simultaneous with any of his stages. If his funeral in ancient Egypt is separated from his death by three days of external time and his death is separated from his birth by three score years and ten of his personal time, then we may add the two intervals and say that his funeral follows his birth by three score years and ten and three days of *extended personal time.* Likewise a bystander might truly say, three years after the last departure of another famous time traveler, that "he may even now—if I may use the phrase—be wandering on some plesiosaurus-haunted oolitic coral reef, or beside the lonely saline seas of the Triassic Age."[3] If the time traveler does wander on an oolitic coral reef three years after his departure in his personal time, then it is no mistake to say with respect to his extended personal time that the wandering is taking place "even now".

We may liken intervals of external time to distances as the crow flies, and intervals of personal time to distances along a winding path. The time traveler's life is like a mountain railway. The place two miles due east of here may also be nine miles down the line, in the westbound direction. Clearly we are not dealing here with two independent dimensions. Just as distance along the railway is not a fourth spatial dimension, so a time traveler's personal time is not a second dimension of

time. How far down the line some place is depends on its location in three-dimensional space, and likewise the locations of events in personal time depend on their locations in one-dimensional external time.

Five miles down the line from here is a place where the line goes under a trestle; two miles further is a place where the line goes over a trestle; these places are one and the same. The trestle by which the line crosses over itself has two different locations along the line, five miles down from here and also seven. In the same way, an event in a time traveler's life may have more than one location in his personal time. If he doubles back toward the past, but not too far, he may be able to talk to himself. The conversation involves two of his stages, separated in his personal time but simultaneous in external time. The location of the conversation in personal time should be the location of the stage involved in it. But there are two such stages; to share the locations of both, the conversation must be assigned two different locations in personal time.

The more we extend the assignment of personal time outwards from the time traveler's stages to the surrounding events, the more will such events acquire multiple locations. It may happen also, as we have already seen, that events that are not simultaneous in external time will be assigned the same location in personal time—or rather, that at least one of the locations of one will be the same as at least one of the locations of the other. So extension must not be carried too far, lest the location of events in extended personal time lose its utility as a means of keeping track of their roles in the time traveler's history.

A time traveler who talks to himself, on the telephone perhaps, looks for all the world like two different people talking to each other. It isn't quite right to say that the whole of him is in two places at once, since neither of the two stages involved in the conversation is the whole of him, or even the whole of the part of him that is located at the (external) time of the conversation. What's true is that he, unlike the rest of us, has two different complete stages located at the same time at different places. What reason have I, then, to regard him as one person and not two? What unites his stages, including the simultaneous ones, into a single person? The problem of personal identity is especially acute if he is the sort of time traveler whose journeys are instantaneous, a broken streak consisting of several unconnected segments. Then the natural way to regard him as more than one person is to take each segment as a different person. No one of them is a time traveler, and the peculiarity of the situation comes to this: all but one of these several people vanish into thin air, all but another one appear out of thin air, and there are remarkable resemblances between one at his appearance and another at his vanishing. Why isn't that at least as good a description as the one I gave, on which the several segments are all parts of one time traveler?

I answer that what unites the stages (or segments) of a time traveler is the same sort of mental, or mostly mental, continuity and connectedness that unites anyone else. The only difference is that whereas a common person is connected and continuous with respect to external time, the time traveler is connected and continuous only with respect to his own personal time. Taking the stages in order, mental (and bodily) change is mostly gradual rather than sudden, and at no point is there sudden change in too many different respects all at once. (We can include position in external time among the respects we keep track of, if we like. It may change discontinuously with respect to personal time if not too much else changes discontinuously along with it.) Moreover, there is not too much change altogether. Plenty of traits and traces last a lifetime. Finally, the connectedness and the continuity are not accidental. They are explicable; and further, they are explained by the fact that the properties of each stage depend causally on those of the stages just before in personal time, the dependence being such as tends to keep things the same.[4]

To see the purpose of my final requirement of causal continuity, let us see how it excludes a case of counterfeit time travel. Fred was created out of thin air, as if in the midst of life; he lived a while, then died. He was created by a demon, and the demon had chosen at random what Fred was to be like at the moment of his creation. Much later someone else, Sam, came to resemble Fred as he was when first created. At the very moment when the resemblance became perfect, the demon destroyed Sam. Fred and Sam together are very much like a single person: a time traveler whose personal time starts at Sam's birth, goes on to Sam's destruction and Fred's creation, and goes on from there to Fred's death. Taken in this order, the stages of Fred-*cum*-Sam have the proper connectedness and continuity. But they lack causal continuity, so Fred-*cum*-Sam is not one person and not a time traveler. Perhaps it was pure coincidence that Fred at his creation and Sam at his destruction were exactly alike; then the connectedness and continuity of Fred-*cum*-Sam across the crucial point are accidental. Perhaps instead the demon remembered what Fred was like, guided Sam toward perfect resemblance, watched his progress, and destroyed him at the right moment. Then the connectedness and continuity of Fred-*cum*-Sam has a causal explanation, but of the wrong sort. Either way, Fred's first stages do not depend causally for their properties on Sam's last stages. So the case of Fred and Sam is rightly disqualified as a case of personal identity and as a case of time travel.

We might expect that when a time traveler visits the past there will be reversals of causation. You may punch his face before he leaves, causing his eye to blacken centuries ago. Indeed, travel into the past necessarily involves reversed causation. For time travel requires personal identity—he who arrives must be the same person who departed. That requires causal continuity, in

which causation runs from earlier to later stages in the order of personal time. But the orders of personal and external time disagree at some point, and there we have causation that runs from later to earlier stages in the order of external time. Elsewhere I have given an analysis of causation in terms of chains of counterfactual dependence, and I took care that my analysis would not rule out casual reversal *a priori*.[5] I think I can argue (but not here) that under my analysis the direction of counterfactual dependence and causation is governed by the direction of other *de facto* asymmetries of time. If so, then reversed causation and time travel are not excluded altogether, but can occur only where there are local exceptions to these asymmetries. As I said at the outset, the time traveler's world would be a most strange one.

Stranger still, if there are local—but only local—causal reversals, then there may also be causal loops: closed causal chains in which some of the causal links are normal in direction and others are reversed. (Perhaps there must be loops if there is reversal: I am not sure.) Each event on the loop has a causal explanation, being caused by events elsewhere on the loop. That is not to say that the loop as a whole is caused or explicable. It may not be. Its inexplicability is especially remarkable if it is made up of the sort of causal processes that transmit information. Recall the time traveler who talked to himself. He talked to himself about time travel, and in the course of the conversation his older self told his younger self how to build a time machine. That information was available in no other way. His older self knew how because his younger self had been told and the information had been preserved by the causal processes that constitute recording, storage, and retrieval of memory traces. His younger self knew, after the conversation, because his older self had known and the information had been preserved by the causal processes that constitute telling. But where did the information come from in the first place? Why did the whole affair happen? There is simply no answer. The parts of the loop are explicable, the whole of it is not. Strange! But not impossible, and not too different from inexplicabilities we are already inured to. Almost everyone agrees that God, or the Big Bang, or the entire infinite past of the universe, or the decay of a tritium atom, is uncaused and inexplicable. Then if these are possible, why not also the inexplicable causal loops that arise in the time travel?

I have committed a circularity in order not to talk about too much at once, and this is a good place to set it right. In explaining personal time, I presupposed that we were entitled to regard certain stages as comprising a single person. Then in explaining what united the stages into a single person, I presupposed that we were given a personal time order for them. The proper way to proceed is to define personhood and personal time simultaneously, as follows. Suppose given a pair of an aggregate of persona-stages, regarded as a candidate for personhood, and an assignment of coordinates to those stages, regarded as a candidate for his personal time. If the stages satisfy the conditions given in my circular explanation with respect to the assignment of coordinates, then both candidates succeed: the stages do comprise a person and the assignment is his personal time.

I have argued so far that what goes on in a time travel story may be a possible pattern of events in four-dimensional space-time with no extra time dimension; that it may be correct to regard the scattered stages of the alleged time traveler as comprising a single person; and that we may legitimately assign to those stages and their surroundings a personal time order that disagrees sometimes with their order in external time. Some might concede all this, but protest that the impossibility of time travel is revealed after all when we ask not what the time traveler *does*, but what he *could do*. Could a time traveler change the past? It seems not: the events of a past moment could no more change than numbers could. Yet it seems that he would be as able as anyone to do things that would change the past if he did them. If a time traveler visiting the past both could and couldn't do something that would change it, then there cannot possibly be such a time traveler.

Consider Tim. He detests his grandfather, whose success in the munitions trade built the family fortune that paid for Tim's time machine. Tim would like nothing so much as to kill Grandfather, but alas he is too late. Grandfather died in his bed in 1957, while Tim was a young boy. But when Tim has built his time machine and traveled to 1920, suddenly he realizes that he is not too late after all. He buys a rifle; he spends long hours in target practice; he shadows Grandfather to learn the route of his daily walk to the munitions works; he rents a room along the route; and there he lurks, one winter day in 1921, rifle loaded, hate in his heart, as Grandfather walks closer, closer,. . . .

Tim can kill Grandfather. He has what it takes. Conditions are perfect in every way: the best rifle money could buy, Grandfather an easy target only twenty yards away, not a breeze, door securely locked against intruders. Tim a good shot to begin with and now at the peak of training, and so on. What's to stop him? The forces of logic will not stay his hand! No powerful chaperone stands by to defend the past from interference. (To imagine such a chaperone, as some authors do, is a boring evasion, not needed to make Tim's story consistent.) In short, Tim is as much able to kill Grandfather as anyone ever is to kill anyone. Suppose that down the street another sniper, Tom, lurks waiting for another victim, Grandfather's partner. Tom is not a time traveler, but otherwise he is just like Tim: same make of rifle, same murderous intent, same everything. We can even suppose that Tom, like Tim, believes himself to be a time traveler. Someone has gone to a lot of trouble to deceive Tom into thinking so. There's no doubt that Tom can kill his victim; and Tim has everything going for him that Tom

does. By any ordinary standards of ability, Tim can kill Grandfather.

Tim cannot kill Grandfather. Grandfather lived, so to kill him would be to change the past. But the events of a past moment are not subdivisible into temporal parts and therefore cannot change. Either the events of 1921 timelessly do include Tim's killing of Grandfather, or else they timelessly don't. We may be tempted to speak of the "original" 1921 that lies in Tim's personal past, many years before his birth, in which Grandfather lived; and of the "new" 1921 in which Tim now finds himself waiting in ambush to kill Grandfather. But if we do speak so, we merely confer two names on one thing. The events of 1921 are doubly located in Tim's (extended) personal time, like the trestle on the railway, but the "original" 1921 and the "new" 1921 are one and the same. If Tim did not kill Grandfather in the "original" 1921, then if he does kill Grandfather in the "new" 1921, he must both kill and not kill Grandfather in 1921—in the one and only 1921, which is both the "new" and the "original" 1921. It is logically impossible that Tim should change the past by killing Grandfather in 1921. So Tim cannot kill Grandfather.

Not that past moments are special; no more can anyone change the present or the future. Present and future momentary events no more have temporal parts than past ones do. You cannot change a present or future event from what it was originally to what it is after you change it. What you *can* do is to change the present or the future from the unactualized way they would have been without some action of yours to the way they actually are. But that is not an actual change: not a difference between two successive actualities. And Tim can certainly do as much; he changes the past from the unactualized way it would have been without him to the one and only way it actually is. To "change" the past in this way, Tim need not do anything momentous; it is enough just to be there, however unobtrusively.

You know, of course, roughly how the story of Tim must go on if it is to be consistent: he somehow fails. Since Tim didn't kill Grandfather in the "original" 1921, consistency demands that neither does he kill Grandfather in the "new" 1921. Why not? For some commonplace reason. Perhaps some noise distracts him at the last moment, perhaps he misses despite all his target practice, perhaps his nerve fails, perhaps he even feels a pang of unaccustomed mercy. His failure by no means proves that he was not really able to kill Grandfather. We often try and fail to do what we are able to do. Success at some tasks requires not only ability but also luck, and lack of luck is not a temporary lack of ability. Suppose our other sniper, Tom, fails to kill Grandfather's partner for the same reason, whatever it is, that Tim fails to kill Grandfather. It does not follow that Tom was unable to. No more does it follow in Tim's case that he was unable to do what he did not succeed in doing.

We have this seeming contradiction: *"Tim doesn't, but can, because he has what it takes"* versus *"Tim doesn't, and can't, because it's logically impossible to change the past."* I reply that there is no contradiction. Both conclusions are true, and for the reasons given. They are compatible because "can" is equivocal.

To say that something can happen means that its happening is compossible with certain facts. *Which* facts? That is determined, but sometimes not determined well enough, by context. An ape can't speak a human language—say, Finnish—but I can. Facts about the anatomy and operation of the ape's larynx and nervous system are not compossible with his speaking Finnish. The corresponding facts about my larynx and nervous system are compossible with my speaking Finnish. But don't take me along to Helsinki as your interpreter: I can't speak Finnish. My speaking Finnish is compossible with the facts considered so far, but not with further facts about my lack of training. What I can do, relative to one set of facts, I cannot do, relative to another, more inclusive, set. Whenever the context leaves it open which facts are to count as relevant, it is possible to equivocate about whether I can speak Finnish. It is likewise possible to equivocate about whether it is possible for me to speak Finnish, or whether I am able to, or whether I have the ability or capacity or power or potentiality to. Our many words for much the same thing are little help since they do not seem to correspond to different fixed delineations of the relevant facts.

Tim's killing Grandfather that day in 1921 is compossible with a fairly rich set of facts: the facts about his rifle, his skill and training, the unobstructed line of fire, the locked door and the absence of any chaperone to defend the past, and so on. Indeed it is compossible with all the facts of the sorts we would ordinarily count as relevant is saying what someone can do. It is compossible with all the facts corresponding to those we deem relevant in Tom's case. Relative to these facts, Tim can kill Grandfather. But his killing Grandfather is not compossible with another, more inclusive set of facts. There is the simple fact that Grandfather was not killed. Also there are various other facts about Grandfather's doings after 1921 and their effects: Grandfather begat Father in 1922 and Father begat Tim in 1949. Relative to these facts, Tim cannot kill Grandfather. He can and he can't, but under different delineations of the relevant facts. You can reasonably choose the narrower delineation, and say that he can; or the wider delineation, and say that he can't. But choose. What you mustn't do is waver, say in the same breath that he both can and can't, and then claim that this contradiction proves that time travel is impossible.

Exactly the same goes for Tom's parallel failure. For Tom to kill Grandfather's partner also is compossible with all facts of the sorts we ordinarily count as relevant, but not compossible with a larger set including, for instance, the fact that the intended victim lived until 1934. In Tom's case we are not puzzled. We say without hesitation that he can do it, because we see at once that the

facts that are not compossible with his success are facts about the future of the time in question and therefore not the sort of facts we count as relevant in saying what Tom can do.

In Tim's case it is harder to keep track of which facts are relevant. We are accustomed to exclude facts about the future of the time in question, but to include some facts about its past. Our standards do not apply unequivocally to the crucial facts in this special case: Tim's failure, Grandfather's survival, and his subsequent doings. If we have foremost in mind that they lie in the external future of that moment in 1921 when Tim is almost ready to shoot, then we exclude them just as we exclude the parallel facts in Tom's case. But if we have foremost in mind that they precede that moment in Tim's extended personal time, then we tend to include them. To make the latter be foremost in your mind, I chose to tell Tim's story in the order of his personal time, rather than in the order of external time. The fact of Grandfather's survival until 1957 had already been told before I got to the part of the story about Tim lurking in ambush to kill him in 1921. We must decide, if we can, whether to treat these personally past and externally future facts as if they were straightforwardly past or as if they were straightforwardly future.

Fatalists—the best of them—are philosophers who take facts we count as irrelevant in saying what someone can do, disguise them somehow as facts of a different sort that we count as relevant, and thereby argue that we can do less than we think—indeed, that there is nothing at all that we don't do but can. I am not going to vote Republican next fall. The fatalist argues that, strange to say, I not only won't but can't; for my voting Republican is not compossible with the fact that it was true already in the year 1548 that I was not going to vote Republican 428 years later. My rejoinder is that this is a fact, sure enough; however, it is an irrelevant fact about the future masquerading as a relevant fact about the past, and so should be left out of account in saying what, in any ordinary sense, I can do. We are unlikely to be fooled by the fatalist's methods of disguise in this case, or other ordinary cases. But in cases of time travel, precognition, or the like, we're on less familiar ground, so it may take less of a disguise to fool us. Also, new methods of disguise are available, thanks to the device of personal time.

Here's another bit of fatalist trickery. Tim, as he lurks, already knows that he will fail. At least he has the wherewithal to know it if he thinks, he knows it implicitly. For he remembers that Grandfather was alive when he was a boy, he knows that those who are killed are thereafter not alive, he knows (let us suppose) that he is a time traveler who has reached the same 1921 that lies in his personal past, and he ought to understand—as we do—why a time traveler cannot change the past. What is known cannot be false. So his success is not only not compossible with facts that belong to the external future and his personal past, but also is not compossible with the present fact of his knowledge that he will fail. I reply that the fact of his foreknowledge, at the moment while he waits to shoot, is not a fact entirely about that moment. It may be divided into two parts. There is the fact that he then believes (perhaps only implicitly) that he will fail; and there is the further fact that his belief is correct, and correct not at all by accident, and hence qualifies as an item of knowledge. It is only the latter fact that is not compossible with his success, but it is only the former that is entirely about the moment in question. In calling Tim's state at that moment knowledge, not just belief, facts about personally earlier but externally later moments were smuggled into consideration.

I have argued that Tim's case and Tom's are alike, except that in Tim's case we are more tempted than usual—and with reason—to opt for a semi-fatalist mode of speech. But perhaps they differ in another way. In Tom's case, we can expect a perfectly consistent answer to the counterfactual question: what if Tom had killed Grandfather's partner? Tim's case is more difficult. If Tim had killed Grandfather, it seems offhand that contradictions would have been true. The killing both would and wouldn't have occurred. No Grandfather, no Father; no Father, no Tim; no Tim, no killing. And for good measure: no Grandfather, no family fortune; no fortune, no time machine; no time machine, no killing. So the supposition that Tim killed Grandfather seems impossible in more than the semi-fatalistic sense already granted.

If you suppose Tim to kill Grandfather and hold all the rest of his story fixed, of course you get a contradiction. But likewise if you suppose Tom to kill Grandfather's partner and hold the rest of his story fixed—including the part that told of his failure—you get a contradiction. If you make any counterfactual supposition and hold all else fixed you get a contradiction. The thing to do is rather to make the counterfactual supposition and hold all else as close to fixed as you consistently can. That procedure will yield perfectly consistent answers to the question: what if Tim had not killed Grandfather? In that case, some of the story I told would not have been true. Perhaps Tim might have been the time-traveling grandson of someone else. Perhaps he might have been the grandson of a man killed in 1921 and miraculously resurrected. Perhaps he might have been not a time traveler at all, but rather someone created out of nothing in 1920 equipped with false memories of a personal past that never was. It is hard to say what is the least revision of Tim's story to make it true that Tim kills Grandfather, but certainly the contradictory story in which the killing both does and doesn't occur is not the least revision. Hence it is false (according to the unrevised story) that if Tim had killed Grandfather then contradictions would have been true.

What difference would it make if Tim travels in branching time? Suppose that at the possible world of Tim's story the space-time manifold branches; the

branches are separated not in time, and not in space, but in some other way. Tim travels not only in time but also from one branch to another. In one branch Tim is absent from the events of 1921; Grandfather lives; Tim is born, grows up, and vanishes in his time machine. The other branch diverges from the first when Tim turns up in 1920; there Tim kills Grandfather and Grandfather leaves no descendants and no fortune; the events of the two branches differ more and more from that time on. Certainly this is a consistent story; it is a story in which Grandfather both is and isn't killed in 1921 (in the different branches); and it is a story in which Tim, by killing Grandfather, succeeds in preventing his own birth (in one of the branches). But it is not a story in which Tim's killing of Grandfather both does occur and doesn't: it simply does, though it is located in one branch and not the other. And it is not a story in which Tim changes the past. 1921 and later years contain the events of both branches, coexisting somehow without interaction. It remains true at all the personal times of Tim's life, even after the killing, that Grandfather lives in one branch and dies in the other.[6]

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Notes

1. I have particularly in mind two of the time travel stories of Robert A. Heinlein: "By His Bootstraps" in R. A. Heinlein, *The Menace from Earth* (Hicksville, N.Y., 1959), and "—All You Zombies—," in R. A. Heinlein, *The Unpleasant Profession of Jonathan Hoag* (Hicksville, N.Y., 1959).
2. Account of time travel in two-dimensional time are found in Jack W. Meiland, "A Two-Dimensional Passage Model of Time for Time Travel," *Philosophical Studies,* vol. 26 (1974), pp. 153–173; and in the initial chapters of Isaac Asimov, *The End of Eternity* (Garden City, N.Y., 1955). Asimov's denouement, however, seems to require some different conception of time travel.
3. H. G. Wells, *The Time Machine, An Invention* (London, 1895), epilogue. The passage is criticized as contradictory in Donald C. Williams, "The Myth of Passage," *The Journal of Philosophy,* vol. 48 (1951), p. 463.
4. I discuss the relation between personal identity and mental connectedness and continuity at greater length in "Survival and Identity" in *The Identity of Persons,* ed. by Amelie Rorty (forthcoming).
5. "Causation," *The Journal of Philosophy,* vol. 70 (1973), pp. 556–567; the analysis relies on the analysis of counterfactuals given in my *Counterfactuals* (Oxford, 1973).
6. The present paper summarizes a series of lectures of the same title, given as the Gavin David Young Lectures in Philosophy at the University of Adelaide in July, 1971. I thank the Australian-American Educational Foundation and the American Council of Learned Societies for research support. I am grateful to many friends for comments on earlier versions of this paper; especially Philip Kitcher, William Newton-Smith, J. J. C. Smart, and Donald Williams.

The Tom Bearden Website

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ANNOTATED GLOSSARY

T. E. Bearden 1997, slightly updated Dec. 2000
Latest editing and additions: 12th April, 2003
Presentation re-edit 7th January, 2013

Foreword

This is an informal glossary originally prepared in 1997 for Gary Hawkins to use on his web site, and informal definitions and discussions were rather quickly jotted down in 1997. We have been able to do a little updating now in Dec. 2000. Careful crafting and polishing for greater rigor would require much more time than I am able to spare, but perhaps the glossary can be helpful anyway.

We put in the gist of it, as we see it, and usually an annotation or commentary to explain it. We tried to put in sufficient explanations and a few references, so that the reader can see for himself or herself that physics, mathematics, and even logic itself are not quite as cut and dried as is often presented!

The only thing we absolutely insist on, that differs from the normal physics and engineering approach, is that any true definition must be an identity statement *a priori*. In this view, since no equation is an identity, then no equation is a definition; regardless of those "equations" universally advanced in physics as "definitions." All an equation states is that the *magnitude* of the somethings on the right is equal to the *magnitude* of the somethings on the left. It does not at all *define* any of the somethings on either right or left! I've completed as much as I have time for now, and made some additions and corrections to the 1997 version. As time permits, we will try to add some more in the future. I hope these hasty comments are helpful, and any errors in them are my own and not due to Gary Hawkins or to Tony Craddock!

Tom Bearden,
Dec. 2000

Webmaster's Note: There are additional Glossaries and Definitions at the ends of Tom Bearden's books *"Energy from the Vacuum"* and *"Excalibur Briefing."*

MATH AND SINGLE CHARACTER ABBREVIATIONS

ϕ The electrostatic scalar potential, in units of joule per collecting coulomb.

∇ The mathematical operator 'del'.

$\nabla\phi$ The gradient of the function ϕ , mathematically.

In EM theory, use of the del operator produces an electric field **E** given by **E** = – $\nabla\phi$. An electrical field is also generated by the time rate of change of the magnetic vector potential **A**, where it is given by **E** = – d**A**/dt. Note that we have used that fact to assist us in producing the motionless electromagnetic generator (MEG), with COP = 16 as of this writing.

ϕq Joules of energy collected by a charge of q coulombs in an electrostatic scalar potential

having a reaction cross section of ϕ.

Since the collected energy is also usually the energy that can then be dissipated as work, this expression often yields the work performed in the circuit by the energy the surface charges collected from that part of the **S**-flow in contact with the conductors and components.

$d\phi/dt$ Time rate of change of the scalar potential.

Also one form of displacement current.

dE/dt Time rate of change of the E-field.

Also one form of displacement current.

dp/dt Time rate of change of momentum, which is a force F acting upon the system.

A force is defined as a time rate of change of momentum, or F = dp/dt.

dP/dt Time rate of change of polarization.

Polarization displacement current.

dq/dt Time rate of change of charge, otherwise known as "current".

Represents the normal current flow i of charges in a conductor, i.e., i = dq/dt.

dq/dt-Isolated Load Loop A special current loop containing the load.

...where i = dq/dt in that "load loop" is isolated from the current i = dq/dt in the source loop containing the power source, and the two loops are also field-coupling isolated. A transformer, e.g., does isolate the actual current in the secondary from the current in the primary, but the field coupling from primary to secondary and from secondary back to primary result in the enforcement of COP = 1.0 as the maximum performance possible (in a perfect, lossless standard transformer). In a real standard transformer with some losses, COP<1.0.

The notion is that, even though current cannot pass from the source loop to the load loop and there is no direct field coupling, energy density flow **S** = **E**×**H** can pass. This is in fact the definition of what we call *bridging*, if in addition to current isolation the rigid back-field coupling is broken between energy dissipation (power) in the source loop and energy dissipation (power) in the load loop. In that fashion, overunity operation of the load can readily be achieved.

E Electric Field.

Defined in older classical electromagnetics (CEM) as a force field, by $\mathbf{E} \equiv \mathbf{F}/q$. However, this only defines the entity after an interaction with mass. In short, it defines the E-field as an effect existing only in matter.

In the early days of electrodynamics, Maxwell and the other "founding fathers" assumed a material ether filling all space. Hence any field in space was indeed such an "effect" field existing in mass. Maxwell died in 1879 of stomach cancer. In the 1880s, the Michelson-Morley experiments falsified the luminiferous (material) ether as a material medium. Hence the accepted use of the $\mathbf{E} = \mathbf{F}/q$ type of "effect" electrical field as the electric field in space was also destroyed, but the equations were never changed to eliminate this error in the foundations of CEM. Instead, electrodynamicists more or less announced one day that, "Since there is no (material) ether, we are not using one!"

There is some rationalization mathematically for such an approach, if the limiting process is used for the interaction of the "causal field" in vacuum with the charged mass q, as q is allowed to approach zero. However, from a foundations view, it is still the interaction of the field in space with charged mass that is being described in the limit, and therefore it is still the "effect" entity rather than the "cause" entity.

This serious foundations problem is still unresolved in much of CEM theory and modeling to this day. The standard by which other EM texts are measured is J. D. Jackson, **Classical Electrodynamics**, 2nd edition, Wiley, New York, 1975. In several places, Jackson opts for this avoidance of the use of the " effect" field for the "cause" field: quoting p. 28: *"...the thing that eventually gets measured is a force..." "At the moment, the electric field can be defined as the force per unit charge acting at a given point. It is a vector function of position, denoted by E."* Quoting p. 249: *"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable quantities such as force somehow involve the product of charge and field."*

The problem is further increased by use of this flawed definition of E-field to "define" the electrostatic scalar potential (Jackson, p. 34) by the equation $\mathbf{E} = -\nabla\phi$. First, no equation is a definition; it merely equates the magnitude of the entities on the left of the = sign to the magnitude of the entities on the right of the = sign. It has nothing at all to say about the definition or nature of any of the entities, but is merely a comparison of relative magnitudes. Any definition, a priori, must be expressed by an identity sign. In all of classical electrodynamics, there is no available proper definition of (x) in the identity $E \equiv (x)$. Indeed, there is no such identity available for force F. To quote Feynman: *"...in dealing with force the tacit assumption is always made that the force is equal to zero unless some physical body is present... One of the most important characteristics of force is that it has a material origin, and this is <u>not</u> just a definition. ... If you insist upon a precise definition of force, you will never get it!"* Richard P. Feynman, Robert B. Leighton, and Matthew Sands, **Lectures on Physics**, Addison-Wesley, Reading, MA, Vol. 1, 1964, p. 12-2.

In the Sachs unified field theory, O(3) electrodynamics as spearheaded by Evans is an important subset. Hence in that approach there is a solution to the problem of defining force and field. The EM fields (**E**, **B**, etc.) when in spacetime, are in fact curvatures of spacetime identically. When these ST curvatures interact with a charged mass, the effects of the interactions are the well-known force-fields in matter, which Maxwell started with in the 1860s. So in this way, the definition problem can be rigorously resolved.

$j\phi$ <u>The Slepian vector, representing the time rate of energy density dissipation in the current loop containing the $j\phi$.</u>

This does not at all represent the energy flow in space and along the outside of the circuit, which may be very, very much greater, on the order of 10^{13} times as great. It does match the Poynting energy flow component that enters the circuit.

M_q or m_q <u>The mass of a charge q.</u>

Instead of just using "q" and assuming it to be unitary, we must include the fact that charge is a system of two coupled components: (i) the mass m_q of the charge q, and (ii) the virtual photon flux exchange (i.e., ϕ_q) of the charge q with the surrounding active vacuum. In particle physics it is already well-known that there is no symmetry of a mass system anyway, unless the vacuum's exchange with the mass is included. So the expression $m_q\phi_q$ captures the vacuum-mass exchange. By continuing to assume that charge is unitary, physics inadvertently holds to the hoary old notion of the luminiferous ether (thin material ether) that permeates all of space. Maxwell and other electrical physicists of his time believed in a material ether, and Maxwell embedded that notion in EM theory. Inexplicably it has not been rooted out of the equations to this day, even though the notion of the material ether (not the ether per se!) was destroyed by the Michelson-Morley experiment over 100 years ago. Foundations physicists continue to point out such terrible defects in physics—and continue to be ignored. We quote Mario Bunge, "A mathematical theory of the dimensions and units of physical quantities," in **Problems in the Foundations of Physics**, edited by Mario Bunge, Springer-Verlag, Berlin and New York, 1971, p. 7: "The question 'What are dimensions?' is seen to be ill conceived, for there are two concepts of dimension, namely those of dimension function and dimension value. The correct question is: 'What are [] and *d*?' " {**<u>Note</u>**: [] is dimension function, and *d* is dimension value.} Bunge is clearly discriminating between the function associated with the dimension, and the magnitude associated with it

Quoting Bunge, *ibid*., p. 8: "The concept of a unit is one of those scientific notions that has remained obscure for want of a theory and excess of a coarse philosophy. Indeed we know how to manipulate units but we do not seem to know what kind of mathematical object they are. As a consequence units are sometimes confused with dimensions, at other times with standards, and they are often introduced in relation to measurement rather than to concept formulation."

And quoting Mario Bunge, **Foundations of Physics**, Springer-Verlag, New York, 1967, p. 176: "Different theories of CED [Classical Electrodynamics] are called for, both for charged particles that can to a first approximation be regarded as electromagnetically structureless (e.g., the electron and the μ -meson) and for extended systems with a charge distribution and spin (e.g., the proton). If fairly satisfactory classical theories were available they could guide the construction of the corresponding quantum theories. But no such theories are in sight partly because it is not usually acknowledged that electrodynamics, both classical and quantal, are in a sad state."

Again, Bunge, *ibid*., p. 182: "...the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

c <u>The speed of light in ambient vacuum.</u>

To discuss the speed of light, we point out that the vacuum is highly energetic, as has been shown in modern physics. Since the vacuum has an energy density, it can be modeled as a "potential" and particularly as a scalar EM potential for EM purposes. Contrary to convention, we recognize that the local energy density of the ambient vacuum potential can vary, including seasonally within and close to the solar system, etc. The average energy density of the vacuum in space far from charged masses such as stars and planets may be assumed as a "standard vacuum potential", and if this potential is equated with the

notion of "flat spacetime", then an increase in this vacuum potential is an increase in the local energy density of spacetime, and hence represents a curvature of the standard flat spacetime.

In fact the interplanetary radar probes' "ranges" do show precisely such variation in the speed of light, with weekly and monthly and seasonal variations, etc. In order to comply with the nearly universal assumption in physics with respect to the constancy of c, the scientific staffs averaged the readings over the entire month. This zeroed out the variations, upheld the notion that space is a fixed type of thing, and that the speed of light in it is also a rigidly fixed constant. It *does not* agree with the actual measured speed of light from day to day.

The Russians have known and openly printed for about a century that the speed of light in a hard vacuum in deep space, far removed from solar and planetary masses, is a little slower than the speed of light in a hard vacuum near the Earth or any other large charged mass. The huge collection of charged particles in the earth have tiny separations, so that looking at the Earth as a collection of tiny dipoles, one sees a collection of enormous 4-symmetry energy flows from the time domain to the 3-space domain (and vice versa for the time-reversed portions). The increased intensity of this 4-symmetry energy flux in the vicinity of a massive planet or sun changes the local energy density of the vacuum itself, increasing it in that vicinity.

Without elaboration, we will also point out that the Earth and its dynamics structures the local spacetime and the spacetime out to some distance. So do all other planets, stars, etc. By whatever manner we model the cosmos as having been created or initiated, the dynamics and structuring of all the phenomena occurring in the universe is further impressed in the *infolded* electrodynamics inside the vacuum potential.

The "laws of nature" in one sense represent the most general results of the reactions of this internally structured "common standard spacetime" or "standard vacuum potential" with the various physical systems, devices, and measuring instruments utilized in our experiments, etc. If one deterministically alters the *structuring of the local spacetime*, one can have a system which will function there in a certain marvelous manner, but will not function that way elsewhere. Some decades ago, I participated in experiments by Golden which over a period of some five years did condition (dimension) the local vacuum potential. The result was an engine which consistently exhibited COP = 1.67 at that location, but when moved several hundred miles exhibited COP<1.0. Frank and I were made aware of this "vacuum conditioning" effect by Prof. William Tiller, who had himself conducted experiments exhibiting just such an effect over several years.

EM waves in vacuum are actually *longitudinal* (sound-type) waves, but we do not belabor the point since everything out there in the normal literature uses the transverse EM wave model for the EM wave in space. Also, the transverse wave is indeed what is detected in the interacting electron gas in our measurement instruments—whose Drude electrons are restrained to simple drift velocity longitudinally down the conductor, but are spinning and are free to precess like gyros. So our instruments detect the Drude electron precessions at right angles to the incoming disturbing longitudinal force field, which means that they do indeed measure a transverse wave. However, these are actually the *electron precession waves* in the detector, and *not* the actual EM waves in space. See my paper, "Giant Negentropy from the Common Dipole", **Journal of New Energy**, 5(1), Summer 2000, p. 11-23 for a discussion of how all EM energy comes from the time domain, via the broken 3-symmetry of the source charge or source dipole, and is emitted in 3-space in all directions as longitudinal EM waves. This is based on rigorous demonstration by E.T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," **Math. Ann**., Vol. 57, 1903, p. 333-355 that the scalar potential is a harmonic set of phase conjugate longitudinal EM wave pairs. We merely applied the Whittaker decomposition to the scalar potential of a source dipole or of a source charge, and the rigorous proof that EM waves in space are longitudinal directly emerges.

Just as sound speeds up, say, in steel as a denser medium than air, the EM "sound waves" in the ambient vacuum potential speed up when that vacuum potential's flux density is increased. Consequently light does move a little faster in a hard vacuum on Earth than it does in deep space, because the vacuum itself has higher energy density near the earth than in deep space. The comings and goings and orbitings of planets and the solar mass, etc. do affect the local energy density of the vacuum between the planets, and hence the speed of light through that interplanetary space.

So the interplanetary radar does show the periodic variations of the local energy density of vacuum that are induced by these factors. For a critical paper on this, see Bryan G. Wallace, "The Unified Quantum Electrodynamic Ether," **Foundations of Physics**, 3(3), Sept. 1973, p. 381-388. His discussion of the interplanetary radar measurements of Venus, which did not fit relativity, are particularly interesting, with respect to his finding that the data were simply "averaged" to eliminate the variations and hence the diurnal, lunar, and synodic periodic components actually measured in the variations of the speed of light. See particularly Bryan G. Wallace, "The great speed of light in space cover-up." **Scientific Ethics**, 1(1), Feb. 1985. p. 2-3; — "Radar Testing of the Relative Velocity of Light in Space," **Spectrosc. Lett**. Vol. 2, 1969. p. 361.

Rigorously, the field is "defined" in electrodynamics as the effect of an interaction of the force-free entity (4-spatial!) existing prior to the interaction, with a 3-dimensional static charge. This means that the field as originally defined is an *effect* and not a *cause*. To then use it as the cause is a grave non sequitur.

This confusion of cause and effect is widespread in physics. It was probably initiated by the hoary old assumption several hundred years ago that a separate force acts upon a separate mass, which is false. In fact mass is a *component* of force, since $\mathbf{F} \equiv d/dt(m\mathbf{v}) = m(d\mathbf{v}/dt + \mathbf{v}(dm/dt)$. As can be seen, in both expanded terms there exists a mass term. To skirt the issue, electrodynamicists have simply found a neat statement that "in massfree space the field continues to exist, but the force is zero." We point out that m = 0 makes the momentum vanish, and so **F** vanishes, and in the definition of $\mathbf{E} = \mathbf{F}/q$ also vanishes because the numerator **F** becomes zero. Therefore *that* **E**-field vanishes.

Feynman and Wheeler pointed out that the field *as it is defined* does not and cannot exist in massless space. Only the "potential" for the field exists there, in case some charged mass is brought in to interact with that entity that does exist there. That is accurate, since spacetime is totally a potential and any "change" in spacetime is a change in that potential *a priori*. In the Sachs-Evans unified field theory, this problem is resolved because the fundamental field is defined as a spacetime curvature (change in spacetime, hence change in the ST potential) rather than $\mathbf{E} = \mathbf{F}/q$.

In empty space there are always myriads upon myriads of interfering fields and potentials, from charges all over the universe, via Puthoff's cosmological feedback principle [see
H. E. Puthoff, "Source of Vacuum Electromagnetic Zero-point Energy," **Physical Review A**, 40(9), Nov. 1, 1989, p. 4857-4862.] Thus any EM wave traveling through space is always involved in enormously active interferometry. This alone results in violent momentary variations in the speed of that wave, even from 0.01 c to 100.00 c. For a paper showing this kind of "galloping" travel of an EM wave, see William G. Harter, John Evans, Roberto Vega, and Sanford Wilson, "Galloping waves and their relativistic properties," **American Journal of Physics**, 53(7), July 1985, p. 671-679. While the average speed of the wave is $c(\gamma)$, where γ is the local energy density of the vacuum, the instantaneous speeds of the wave vary violently from instant to instant.

In special relativity, "velocity" merely is a rotation angle of the moving frame from the fixed laboratory observer's frame. The speed "c" merely represents a full right-angle turn away, toward the time-dimension (since other than the 3 spatial dimensions that is the only other dimension available to turn toward). In higher dimensional space, there are many other "higher" dimensions toward which further rotation can be accomplished. Hence rotating in n-space is not limited to a single orthogonal

turn, and therefore velocities are not limited to speed c. However, each orthogonal rotation also subtracts one spatial dimension of the rotated object from the observer's 3-space. One rotation would be speed c, two departing rotations would be speed c^2, three would give c^3, etc. At three orthorotations, to the lab observer the rotated object is now purely an internal structure inside his time dimension, very similar to a mental object (mind is time-like, not spacelike). The nature of mind and its operations has a rather unexpected connection with matter, when one considers such orthorotations in hyperspace.

The point is, the speed *c* is not an "iron dictum" of nature, nor is it an "unchangeable constant"! Nature herself routinely violates that notion. As an example, de Broglie waves from any mass always move at v>c, and easily as v>>c. EM "surface" waves—so-called transverse oscillations or upheavals and depressions in the magnitude (energy density; actually the *reaction cross section*) of the local ambient vacuum potential), move at a *discretized* average speed c(γ). The longitudinal component, if freed from the transverse component, can move much faster because it is a sort of "tunneling" movement. In actual quantum tunneling experiments, e.g., music (Mozart's 40th symphony) has been transmitted through quantum mechanical tunneling between two separated points at speed v>4c. Fogal is likely to eventually place a superluminal communication system on the commercial market. We discuss superluminal communication elsewhere in this glossary.

C Capacitance. Essentially, the charge per unit potential.

For an isolated conductor, C = Q/V and C is expressed in farads. A farad is one coulomb per volt.

A lower case c represents the speed of light in ambient vacuum.

E The electric field. Essentially, E =F/q, but that is not really a definition.

Conventionally, the units of electric field are considered to be force per unit electric charge; i.e., force per coulomb. Note that the **E**-field even in this "classical definition" does not actually exist at a point unless there is a unit point charge (a point coulomb of charged mass) located at the point. Hence contrary to classical electrodynamics, communications theory, and whatnot, no electric force field (and no magnetic force field either) exists in the vacuum, at least of the kind prescribed by Maxwell's equations and by the Heaviside-Hertz reduction of Maxwell's equations. Since Maxwell assumed it, these equations and models all still erroneously assume a material ether filling the vacuum, in which case there *would* be matter and charges, and there would *then* be force-fields in the vacuum. We refer the interested reader to discussions by Feynman and by Wheeler. Quoting: "*One of the most important characteristics of force is that it has a material origin, and this is not just a definition. Y If you insist upon a precise definition of force, you will never get it!* " [Richard P. Feynman, Robert B. Leighton, and Matthew Sands, Lectures on Physics, Addison-Wesley, Reading, MA, Vol. 1, 1964, p. 12-2.]

Even worse, note that **E** = **F**/q defines not the magnitude of the field in space, but has to do with the divergence of energy from the field around a unit point static charge there in space, as well as the pattern of the diverged energy density. Actually, what is used as "the electric field" itself is the *reaction cross section* of the field, for a unit point static coulomb of charge. That is at best a function of the "field density" or "field intensity" of the actual electrical field in spacetime, and the direction and pattern of change of that field density due to the intercepting and diverting charge.

The field problem is resolved in the forefronts of electrodynamics by making the field a topological function. It is resolved in the Sachs-Evans O(3) electrodynamics (as a subset of Sachs' unified field theory) by making the field a function of the curvature of spacetime.

See also the discussion under c, above.

H Magnetic field strength.

B The B-field (loosely), or magnetic flux density (more properly).

Conventionally, this is thought to be defined, analogously to **E**, by the force it exerts. The force exerted on a point charge moving in the magnetic field **B** is at right angles to the velocity vector of the charge and also at right angles to **B**. Actually, the **H**-field was originally named the *magnetic field* and the **B**-field was named the *magnetic induction* (and is still sometimes called that.) This is an annoyance because it is **B** which involves the force, and hence **B** should be *named* the magnetic field. Other writers have noted this discrepancy, and Sommerfeld called **H** the magnetic excitation—which correctly describes its role—rather than calling it the magnetic field. As the reader can see, lots of things in electrical physics are *still very untidy*! There are also different ways to approach the EM modeling problem. In Kaluza-Klein unified field theory, all electromagnetics is modeled in the 5th dimension, which is wrapped around each and every point in our normal 3-dimensional space.

For practical use, a far better approach is the O(3) symmetry electrodynamics spearheaded by Myron Evans, which is also an important subset of Mendel Sachs' unified field theory. In the Sachs-Evans unified theory, electromagnetics has become general relativity and general relativity has become electromagnetics. Further, very powerful general relativity can now be directly engineered with this O(3) electrodynamics, as it further develops. We refer the reader to "The New Maxwell Electrodynamic Equations: New Tools for New Technologies. A Collection of 60 Papers from the Alpha Foundation's Institute for Advanced Study," Special Issue of **Journal of New Energy**, 4(3), Winter 1999, 335 p. Also, particularly see **Contemporary Optics and Electrodynamics**, edited by Myron W. Evans, a special topical issue of I. Prigogine and S. A. Rice (series editors), **Advances in Chemical Physics**, Wiley, 2001 (in publication). Evans gives a very long and detailed presentation, "O(3) Electrodynamics", in that publication, and also gives the paper "The Link Between the Sachs and O(3) Theories of Electrodynamics".

Q A quantity of electrical charge. Note that this statement *does not* define charge *q* itself.

We have tentatively proposed to redefine charge q as $q \equiv m_q\phi_q$. The term ϕ_q captures the vacuum's violent virtual energy interaction with the mass m_q of the charge, which is presently missing in classical EM theory and is an exceeding great flaw of omission. Further, ϕ_q may be decomposed into a harmonic series of phase conjugate wavepairs, as shown by Whittaker, 1903, *ibid*. [In O(3) electrodynamics, the internal structuring is dramatically extended, so that one can get at the "inner electrodynamics" necessary to explain such things as homeopathy, chi, ki, prana, etc.

To those scientists pooh-poohing such things as acupuncture, we point out that acupuncture in a dramatic case can allow a person without anesthetic to undergo a major operation with chest cavity opened, while the patient remains alert, conscious, and talking. President Nixon's physician on Nixon's trip to China witnessed such an actual operation, as well as other things. Nothing in our vaunted Western medical science can equal that, nor can any of our medical schools, nor can our National Academy of Science or our National Science Foundation. In short, acupuncture alone demonstrates how woefully inadequate our medical science actually is.

Also, acupuncture works on animals as well, so it does not involve hypnosis or deep suggestion. In science, we must believe the repeatable experiment, not our dogma at the moment. Yet the entire U.S. medical research community has no higher symmetry EM investigation of how acupuncture works, or of the infolded electrodynamics shown by Whittaker's decomposition of the

scalar potential in 1903. Hence our scientists totally miss the vast electrodynamics of *the internal structuring of potential and charge with vacuum engines (spacetime curvature engines)*. As a result, the entire U.S. scientific and intelligence communities were totally unable to comprehend nearly five decades of Russian induction of health changes and diseases in personnel in the U.S. Embassy in Moscow, using weak EM radiation. Internal structuring of the activity producing what is called "charge"—including its internal structuring and engines—can be modeled and in theory directly engineered in the new Sachs-Evans approach.]

As shown in my paper, "Giant Negentropy from the Common Dipole," **Journal of New Energy**, 5(1), Summer 2000, p. 11-23, the broken 3-symmetry energy flow of any charge and any dipole allows a more fundamental 4-symmetry energy flow solution for the century-old problem of explaining the actual source of the EM energy that pours out of the source charge in all directions in 3-space. The 4-symmetry in EM energy flow explains its nature as longitudinal EM waves, with the charge's absorbed energy being *received* from the time domain (complex plane), transduced into 3-space, and emitted in 3-space. *The source of all EM energy at any point in 3-space is the time domain!*

It has been known for decades in particle physics that there exists no equilibrium in mass systems, unless the interaction of the vacuum with the masses is included. It has also been known that every charge and every dipole is a broken 3-symmetry in the fierce vacuum energy exchange with the charge or dipole. Yet the vacuum interaction—and specifically the source charge's and the source dipole's broken symmetry in it—are not even included in classical EM as yet. That this known total glitch in modern EM theory has not been previously corrected, when the particle physicists of every university physics department of note already know it is necessary, is inexplicable! Here we must regretfully point out finger at our orthodox scientific establishment, and particularly at our National Science Foundation and our National Academy of Science. These institutions are not even working on, nor are they aware of, nor do they even care about, the most fundamental science problems of our time. Bigger accelerators, yes. Windmills, yes. EM energy from the vacuum and electrical power systems which use it without destroying the source dipole, no. The greatest of all electrodynamics—the infolded longitudinal EM wave dynamics inside all EM fields, potentials, and waves—no. The correction of the dozens of major flaws and non sequiturs in classical electromagnetics, no. The understanding of the longitudinal EM wave interferometer weapons and quantum potential weapons already arrayed against us, no. The development of EM healing based on the Priore approach, which would totally revolutionize medical therapy and handle attacks on our cities by weapons of mass destruction, no.

We have a scientific mindset problem of epochal magnitude. And that costs the U.S. taxpayers hundreds of billions of dollars spent on the "status quo" or "business as usual" scientific endeavors that are far inferior to what can be done.

S Entropy. A quantity which measures the extent to which the energy of a system is available to do work.

Since in one sense energy is a function of ordering, then fundamentally, *entropy* refers to increasing disorder, which means increasing disruption of the ordering in our collected energy. Unfortunately, entropy is one of those concepts in physics for which there are several differing major views. We avoid all discussion of "information" etc., and prefer to deal only with the energy and time aspects. For our work in energy from the vacuum, we take the very simple view that an *entropic process* is like a positive resistor: As forward observer time passes, the entropic process continually disorders or "loses"—from further controlled conversion of energy form—the collected energy in the system. We regard a *negentropic process* as like a negative resistor: as forward observer time passes, the negentropic process receives energy in a form unusable to us, transforms, it, and outputs it in a form that is usable. Quoting Ilya Prigogine, Irreversibility as a symmetry-breaking process," Nature, Vol. 246, 1973, p. 70*: "Entropy Ycannot in general be expressed in terms of observables such as temperature and density. This is only possible in the neighbourhood of equilibriumY It is only then that both entropy and entropy production acquire a macroscopic meaning."*

So basically, the notion of entropy will apply when we have a system in equilibrium or very near equilibrium. For open systems in substantial disequilibrium, the entropy cannot even be computed, and the classical equilibrium thermodynamics with its infamous second law does not apply. On the other hand, the loading of disequilibrium (negentropic) EM systems is a very nonlinear affair. Some direct indications of this were in the Russian work in the 1930s which produced overunity and self-powering EM generators, in several physics institute. [E.g., see L. I. Mandelstam and N. D. Papaleksi., "On the parametric excitation of electric oscillations," Zhurnal Teknicheskoy Fiziki, 4(1), 1934, p. 5-29. English translation, Feb. 1968, Lawrence Radiation Laboratory, Livermore, CA, performed for NASA]. The U.S. researcher G. Obolensky also has done appreciable important experimental investigation of the nonlinear load effects for negentropic systems.

S Poynting energy density flow. Not the *overall* or *total* energy flow by any means, but just that component of it that is intercepted, diverged, collected, and used, where **S** is given by **S** = **E**×**H**.

The energy flow theory is rather thoroughly fouled, and has been since the 1880s when the flow of energy through space was proposed by both Heaviside and Poynting, independently and essentially simultaneously.

Since both **E** and **H** are defined not as fields per se, but as the reaction cross section of the fields with a unit charge, the S does not refer to "energy flow" per se, but to the intercepted component of the overall energy flow.

Poynting only considered the energy flow component around a circuit that strikes the circuit's surface charges and gets diverged into the conductors to power the electrons. Heaviside, on the other hand, also considered the startlingly enormous additional EM energy flow filling all space around the circuit's conductors, generally parallel to the conductors but missing them.

This huge Heaviside component is still there around every electrical circuit, but almost entirely ignored and unaccounted. It misses the circuit, passes on off into space, and is lost in most circuits. Yet it is trillions of times larger in magnitude than the very tiny Poynting component which actually gets intercepted, "caught" and used by the circuit to power its loads and losses.

Since no one could explain where on earth such an enormous nondiverged Heaviside component pouring out of the power source terminals could possibly come from, Lorentz—reasoning that, since the nondiverged energy flow did not do anything, it was "physically insignificant" (Lorentz' term)—then just integrated the energy flow vector around a little closed surface assumed around every volume element of interest. This efficiently discards the Heaviside nondiverged component *from all accountability*, leaving only the Poynting energy flow component vector accounted. Of course the Poynting energy flow will agree with the energy measured in the circuit, since we actually measure energy dissipation, and the energy that dissipates from the circuit must have first entered it. Electrodynamicists today just continue to use Lorentz's integration of the energy flow vector around an assumed closed surface surrounding any volume element of interest. Thus, sadly our electrical power system engineers unwittingly waste trillions of times more EM energy actually produced from the vacuum by the source dipoles in their generators, than what the feeble powerline is able to intercept and utilize.

We have nominated the vast unaccounted Heaviside energy flow accompanying every field and charge interaction as the source of the extra gravity known to be present in the arms of the spiral galaxies and holding them together. See my paper, "Dark Matter or Dark Energy?", **Journal of New Energy**, 4(4), Spring 2000, p. 4-11. Informally we have also nominated this dark Heaviside energy which fills all space, as associated with the "quintessence" energy that is responsible for the recently discovered antigravitational acceleration of the universe. In this view the giant negentropy process associated with charge (see my "Giant Negentropy of the Common Dipole" paper, *ibid.*) is ongoing in all the stars, galaxies, planets, nebulae, and other astronomical entities. The ordinary energy we measure in all these processes is gravitational; hence for symmetry and energy conservation, the primary longitudinal EM wave energy from the time domain that furnishes the energy to all these spatially energetic processes represents an increasing curvature of spacetime in the time domain as we travel outward from any origin point. This is an antigravitational force, in this concept, which is cumulative as a function of radial distance from the origin point. Hence we see the distant parts of the universe as accelerating the expansion of the universe. At present this is of course an hypothesis, and must be further validated by laboratory experiment and further theoretical work in a unified field theory electrodynamics such as the Sachs-Evans O(3) symmetry electrodynamics.

S-flow is actually comprised of an organized, structured flow of virtual photons or antiphotons and itself is not observable. Its interaction with charged particles (electrical charges and magnetic poles), however, is observable by the amount of energy collected upon (diverged around) the charge or pole (formation of a local potential), and formation of a translation force upon the charge or pole.

Again, the "**E**" and the "**H**" in the expression "**E×H**" are not really the "electrical field" and "magnetic field" in space, but only their *reaction cross sections* at each point in space, *should* a little unit point static coulomb be placed at that point to divert some of the **E**-field flow around it, or a little unit point static magnetic charge be placed at that point to divert some of the **H**-field flow around it. So even the Poynting energy flow **S** = **E×H** has been interpreted in terms of its reaction cross sections.

It is worth noting that electrodynamicists today are still politely debating EM energy flow and the energy flow vector. As an example, a polite "debate" of this subject has been ongoing for over 30 years in **American Journal of Physics** alone. A particularly significant statement of the problem is given by Jones: *"It is possible to introduce the Poynting vector **S**, defined by **S** = **E×H**, and regard it as the intensity of energy flow at a point. This procedure is open to criticism since we could add to **S** any vector whose divergence is zero without affecting [the basic integration procedure's result]."* [D.S. Jones, **The Theory of Electromagnetism**, Pergamon Press, Oxford, 1964, p. 52.] In short, here Jones is stating that an enormous nondiverged energy flow may accompany the Poynting flow component, and it will not be accounted for by **S** = **E×H**. After presenting the various elements required to solve the energy flow problem, Jones bows out with the statement: "*"It does not seem likely that an expression satisfying all these conditions will be simple… …fortunately, we are rarely concerned with the energy flow at a point. In most applications we need the rate at which energy is crossing a closed surface."* [Jones, *ibid.*, p. 53.] Panofsky and Phillips warn against over-attachment to the Poynting vector: "*Paradoxical results may be obtained if one tries to identify the Poynting vector with the energy flow per unit area at any point."* [Wolfgang K. H. Panofsky and Melba Phillips, **Classical Electricity and Magnetism**, Second Edition, Addison-Wesley, Menlo Park, CA, 1962, third printing 1969, p. 180.

We point out, however, that for gravitational effects of energy flows in space, one must account the total energy flow per unit area *at and surrounding* any point, and therefore one must restore the unaccounted enormous Heaviside nondiverged EM energy flow component as well as the accounted tiny little Poynting diverged energy flow component.

Δt An increment (little piece of) time.

In special relativity, time can be considered a piece of spatial length compressed by the factor c, so that L = ct, where L is in meters, t is in seconds, and c is the speed of light. Time can also be considered as spatial EM energy compressed by the factor c^2. To comprehend time and time rate of flow, one must first realize that a priori no observable exists or persists in time. The observable is a 3-spatial snapshot made at one instant in time, so that "time stopped" momentarily. The observable is thus a frozen snapshot of the 3-spatial intersection of an ongoing 4-space interaction. At the very next instant, that snapshot no longer exists. Hence for a mass (or any other observable) to "propagate in time", there must be a process whereby Δt is continually added to the observable (such as to mass m, converting it to masstime mt for a short duration) and then subtracted again, leaving behind another frozen 3-space snapshot of the "observable" that has seemingly now endured for that little Δt period, with respect to the observer. As we explain in several papers, the sum total of the photon interactions with a mass m may be taken as the generator that produces (1) the flow of the mass m through time, by changing from m to mt to m to mt… continually, and (2) a substructuring of internal "time-flow components". In short, any time-flow ascertained in the macroworld or the microworld by the observer, has an enormously rich internal dynamics and structuring. Again, in higher symmetry electrodynamics such as O(3), the internal structuring of the photon, EM field, EM wave, and EM potential can be modeled and eventually even directly engineered.

ΔE An increment (little piece of) energy.

The photon is considered to be (unit-wise) composed of (ΔE)(Δt). However, in our view (as we explain in energy, energy collection, and energy dissipation) energy does not occur in "little fixed chunks" at all. One only has "little chunks" of energy when one *is collecting* energy in an ongoing process. In electromagnetics, the "collection" of energy is actually the *ongoing collecting* of energy from an energy flow deviating around an intercepting charge. It is a dynamic, ongoing process whereby a collector such as a charged particle intercepts and interacts with (undergoes virtual photon flux exchange with) an impinging energy density flow **S**= **E×H**. In an equilibrium (static) condition, the deviated flow remains very like a persistent, unchanging whirlpool in a river, and so is said to have a "static magnitude". If that Poynting flow is removed, then there is no excess collecting going on and the "magnitude of the deviated energy flow" is zero. EM energy collection/collecting is always like a rock in a high wind. As long as the wind is blowing on the rock, air is deviated to flow around the rock. The rock has a force field on and of it, and wishes to move. It also has "excess collected energy", and a gradient in this "excess collected energy" determined by the wind flow direction. When the wind ceases to blow, the rock goes back to being just a rock, and forgets it had all that excess wind energy collecting and any desire to move.

TERMS AND PHRASES

ABEL, NIELS HENRIK (1802-1829)

Norwegian mathematician who in 1824 proved that the general equation of fifth degree cannot be solved algebraically. He also left an important paper on transcendental functions which was published posthumously.

ABELIAN GROUP

A group obeying the commutative law of algebra for every pair of elements a and b under an operation , so that a*b = b*a. As an example, the set of integers is an infinite abelian group under the multiplication operation.

ACTION AT A DISTANCE

An action (effect) occurring in a local system, for which no separate local 3-space cause exists, but for which a causal correlation exists between a distant cause and the local effect.

To the local 3-space observer, the effect is baffling. In electromagnetics, action at a distance can be considered a higher topology phenomena, occurring through hyperspace or through subspace, or through "multiply connected spacetime." Particularly note that "time" is multiply connected; i.e., every spatial point in 3-space (in the entire universe) exists at the same moment in time, which means that electrodynamic action through the time domain can be used to eliminate the spatial distance between any two 3-space points. Action at a distance is absolutely required by quantum mechanics, and experiments establish its truth. Such action was implicitly included in Maxwell's quaternion theory, but was unknowingly discarded by Heaviside, Hertz, and Gibbs when they formulated a much more restricted vector interpretation of Maxwell's theory, after Maxwell's death. Bohm's hidden variable interpretation of quantum mechanics uses the quantum potential, which is a multiply-connected entity producing instantaneous action at a distance. In ordinary electrodynamics, the common scalar potential in the Coulomb gauge has instantaneous velocity, and it appears everywhere in space, wherever it will occupy, all at once *in that gauge*.

Time is also a set of energy flows in the time domain (complex plane) rather than in 3-space. Time is also multiply connected, since a priori every 3-space point in the universe exists at and in a single moment of time. Since time is dynamic and structured with special energy flows, it seems possible to use this feature to establish energy flow during one specific moment to a desired subset of 3-space points, regardless of where in the universe those points are located. Hence the development of "time-energy" technology allows action at a distance via manipulating the multiple connectivity of time and its internal structure (internal time-like energy flows).

AD HOC MODEL

A model used and fitted for a specific purpose or area.

Tentative formulation, not intended toward general application and not yet firm because there is still not a comprehensive, tested demonstration of the "fit" of the model to the complex phenomenology. Nonetheless, an ad hoc model can be quite useful in a given area, so long as it sufficiently fits the experimental data in that area and makes sufficiently accurate predictions in the area.

ADVANCED FIELD

An electromagnetic field that is a solution of the classical Maxwell equations, which is positioned on the future light-cone of spacetime.

We believe much of the problem with the "advanced solution" is a problem of interpretation. We would urge the re-interpretation not in terms of "time-travel" where the wave continues in observer forward time while the rest of the universe is assumed to retrogress to a previous state, but in terms of time-reversal of that wave only. In that case, the rest of the universe stays sane and continues to move in observer forward time, and the wave itself just moves in forward time in a path-reversed manner, back along a previous "stimulus wave" (the retarded wave that moved forward in time normally).

ADVANCED POTENTIAL

An electromagnetic potential that is a solution of the classical Maxwell equations, which is positioned on the future light-cone of spacetime.

Presently this potential has not yet been given a physical interpretation. See remarks above.

ADVANCED WAVE

An electromagnetic wave that is a solution of the classical Maxwell equations, and which is positioned on the future light-cone of spacetime.

See remarks above.

AFFINE CONNECTION

In mathematics: "A connection on a manifold, whose form is unchanged under affine changes of parameter along curves, e.g., when the original parameter t of a curve γ (t) is replaced by t = as + b." **Dictionary of Science and Technology**, Academic Press, Christopher Morris (Ed.), 1992.

Ugh! We'll let the mathematicians take it from there.

AFFINE TRANSFORMATION

"Transformation on a linear space to itself which can be expressed as the sum of a linear transformation and a fixed vector.

The affine transformations form a group. In the plane, the group is six-dimensional, consisting of translations, rotations, stretchings and shrinkings, reflections, simple elongations and compressions, and simple shear transformations, as well as compositions of these."

Dictionary of Science and Technology, 1992, *ibid*.

AHARONOV, YAKIR

Renowned Israeli quantum physicist and former student of David Bohm.

Co-discoverer of the *Aharonov-Bohm effect*: Even when the electromagnetic force fields reduce to zero in a charged particle system, the potentials may still exist and interfere to cause real physical effects. Together with Bohm, Aharonov authored a fundamental paper in 1959 which pointed out the primary importance of the *potentials* rather than the force fields. Indeed, the force fields are only made *in and of the charged particle system itself*, by interference there of potentials, and do not exist as such in the vacuum. The forcefields are thus not primary electromagnetic causes at all, but are *secondary effects* due to the interference of potentials in a particular charged particle system. [See *Aharonov-Bohm Effect*] In his three volumes of physics, Feynman pointed out that the forcefields do not exist *as such* in the vacuum, and that *only the potential for the forcefields exists in vacuum*. The primary causative agents for electromagnetics are thus the potentials. This has been proven both theoretically

and experimentally in quantum mechanics, but still does not appear in present classical electromagnetic theory taught in universities—which terribly confuses cause waves and effect waves in wave-charge interactions.

AHARONOV-BOHM EFFECT

Phenomenon theoretically pointed out in 1959 by Yakir Aharonov and David Bohm whereby interfering electromagnetic potentials can produce effects on charged particle systems, even at a distance and in the absence of the electromagnetic force fields.

See Y. Aharonov and D. Bohm, "Significance of Electromagnetic Potentials in the Quantum Theory," Physical Review, Second Series, 115(3), 1959, p. 485-491. For an overview and extensive bibliography, see S. Olariu and I. Iovitzu Popescu, "The Quantum Effects of Electromagnetic Fluxes," Reviews of Modern Physics, 57(2), Apr. 1985, p. 339-436.

Chambers experimentally demonstrated the Aharonov-Bohm effect one year later. When **E-** and **B**-fields are zero in a region, their potentials still may exist and thus be stable and persistent. Being gradient-free, a force-free potential is not changing; no bleed-in or bleed-off of its magnitude *or of its internal structure* is occurring. Interference of the potentials produces real electromagnetic effects (energy) in the interference zone, even at a great distance, without transmission of "field energy" per se through the intervening 3-space. [Rigorously, the potential's EM energy can be considered to be *hyperspatially* transmitted, or *subspatially* transmitted (tunneled) via the Whittaker internal EM biwave mechanism. See discussions under *action at a distance*.]

In 1897-8 Stoney showed (in **Philosophical Magazine**) by physical reasoning that all the disturbances of the ether arising from sources of certain kinds can be resolved into trains of plane waves. This was extended and the general and special equations written by E.T. Whittaker in 1903 in **Mathematische Annalen**. In 1904 (delivered orally in 1903) Whittaker's second paper dealing with the subject was published in the **Proceedings of the London Mathematical Society**, and showed that scalar EM potential interferometry is in fact what generates the classical EM force fields.

The two Whittaker papers may be interpreted to show a startling arrangement in a potential or EM wave. (1) any EM field or wave in a particular 3-space is due to two interfering scalar potential functions in that space. So we may replace any EM field or wave with two scalar potential functions, a priori. (2) But each of the scalar potentials onto which the functions are applied, is decomposable into the Whittaker 1903 longitudinal EM wavepairs, where the output waves are in 3-space and the input waves are time-like and come from the complex plane. This provides a hidden "infolded LW electrodynamics" inside, and composing, all EM fields and waves. Further, the decomposition is recursive, so each of the first tier infolded EM waves can be decomposed again into a second tier of biwaves, etc. Thus the most primary electrodynamics of all is the nested infolded longitudinal EM wave structuring of all present EM waves, potentials, and fields. The internal LW waves also form rigorous curvature of ST patterns (templates) and thus engines. By engineering the structure and dynamics of the internal EM, one can engineer mass—including the atomic nuclei, quarks, and gluons—as one wishes, once the technology is sufficiently developed. In the West, this entire area has been ignored, but it has been highly weaponized by the KGB in Russia.

AIAS

Alpha Foundation's Institute for Advanced Study.

Unusual "think tank" comprised of fellows and fellow emeriti in various places in the world, who cooperate in advanced electromagnetics studies via E-mail. Led by Dr. Myron W. Evans, a theorist of note, the institute has been forging ahead with the production of O(3) symmetry electrodynamics, particularly as an important subset of Mendel Sachs' unified field theory. Dozens of AIAS group-authored papers have been published in various leading journals such as Foundations of Physics, Physica Scripta etc. More than 90 AIAS papers are carried on a restricted Department of Energy website for reference by DoE scientists. The work is particularly significant in working out how EM energy flows in both the 3-spatial and time domains, and how EM energy can be and is extracted from the active vacuum. More than a dozen of the later AIAS papers are carried on a DoE public website, http://www.ott.doe.gov/electromagnetic/papersbooks.html. Also, about two dozen AIAS papers have either been approved for publication in journals, or are in the review process. The present author is a Fellow Emeritus of the AIAS, and is kindly tolerated as a conceptualist by these advanced theoreticians.

AIDS

Acquired Immunological Deficiency Syndrome.

A condition of acquired immunological deficiency associated with infection of the cells of the immune systems with the retrovirus HTLV-III. It is usually recognized by testing positive to HIV infection, and eventually by physical deterioration and by development of one or more life-threatening opportunistic infections such as pneumonia, or of Kaposi's sarcoma.

AIKIDO

A Japanese martial art whose modern form is a synthesis of many schools of jujitsu and the zen art of meditation in motion.

It is the way (DO) of entering and turning (AI) the opponents vital energy (KI). The present author is a retired sandan (third degree black belt) in Yoseikan aikido. He is retired because of debilitating injuries suffered in other fields and accidents, and as a busted-up old dog of 70 has no business bouncing hard off the mats with all those vigorous young fellows. His extra 50 pounds also no longer enhance his athletic ability. We did write a book, privately held but never published, on Aikido and dealing with the principles of unarmed combat. Interestingly, we simply went into the deep unconscious in meditation (and perhaps a little beyond, depending on one's viewpoint) to uncover the unsuspected principles. To list them, we went through the alphabet four times. Many of these principles have never appeared in any text on martial arts or military combat. The task was placed on me by my sensei and required seven years to complete. Perhaps one of these days we will formally publish the book.

ALGEBRAS

The various types of mathematics in which the theoretical models for physics and other sciences are embedded.

Some important algebras utilized in physics are the vector algebra, tensor algebra, quaternion algebra, Grassman algebra, Pauli algebra, Clifford algebra, etc. There are many others. The complexity of the symmetry and of the topology varies significantly between these algebras. Thus, an electrodynamics model in a lower topology algebra such as vectors or tensors will not reveal or permit nearly so great a set of electrodynamic functions and operations as will electrodynamics embedded in a higher topology algebra such as quaternion algebra or Clifford algebra.

As an example, it has been shown by Barrett that the operation of many of Nikola Tesla's patented circuits cannot be understood if analyzed in vector or tensor electrodynamics. The circuits will reveal totally new functions when analyzed in quaternion electrodynamics. That paper is T. W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," **Annales de la Fondation Louis de Broglie**, 16(1), 1991, p. 23-41

ALLOPATHIC MEDICINE

A medical system which combats disease by using remedies which produce effects different from those produced by the disease treated.

Reliance is primarily upon drugs, pain relievers, and treatment of symptoms as well as use of agents to "kill" the microbial organisms regarded as the cause of the diseases. Surgery is used as a major adjunct. From time to time, other practices formerly frowned upon or even legally prosecuted are recognized as effective and legitimate, and are then brought in under the aegis of organized allopathic medicine. Physical therapy is such a formally prosecuted modality that was eventually adopted; hypnosis is another. The problems with organized allopathy is that (1) it tends to be monopolistic, (2) it uses the state's power to enforce its credo, (3) it controls both the bulk of the medical scientific literature and the flow of research funds from both government and private sources, (4) it does not adequately police its doctors and technicians, (5) it does not sufficiently accent preventative medicine or "whole human being" treatment, and (6) it engages in conspiracies to destroy competing systems of medicine (as in the case of chiropractic). (7) On the other hand, it has made remarkable advances in preventing killer diseases by vaccination, treating them by antibiotics, and in eradicating or controlling many of the former great killer diseases such as smallpox, diphtheria, and bubonic plague. It has been far less successful in treating and reversing debilitation, cancer, arteriosclerosis, etc. Just now, most of its major weapons against the former dread diseases are beginning to fail. The disease organisms are rapidly changing into new, more virulent forms that are resistant or even immune to the present "successful" treatments. Even in orthodox medical publications, it is now beginning to be recognizing that allopathic medicine is starting to fail, and that we are again entering a period of great, uncontrollable killer pandemics.

ALLOPATHY

Another name for allopathic medicine and allopathic medical therapy.

AMBIENT VACUUM

The average active vacuum, in space, removed from large collections of charge and mass.

AMBIENT VACUUM POTENTIAL

The average standard vacuum (spacetime) considered as a potential having structure and dynamics on a myriad levels.

Anything that is composed of virtual particle flux is a *potential*. Another way of looking at the vacuum is to realize that, having an energy density, then *a priori* it is a potential or may be modeled as such.

Hence the ambient vacuum can be decomposed via the Whittaker method into an internal set of infolded EM longitudinal waves of very special nature. Further, our work on the broken 3-symmetry energy flow involved in any potential or dipolarity shows the more fundamental 4-symmetry energy flow between the time domain and 3-space. This 4-symmetry energy flow is also highly structured and dynamic.

Whittaker's work shows that, contrary to present assumptions in quantum physics, a particular potential has its virtual particle flux formed into a beautiful bidirectional wave structure. The apparent disorder at any local point in the local vacuum potential is due to the constant arrival of myriads of potentials, from charged particles all over the universe. The violent interference and re-interference of these potentials results in the creation of violently changing virtual photons—or in terms of waves, violently changing EM waves and fields. In other words, the statistical disorder of the vacuum is actually *composed of* continually and rapidly changing perfect order. [Here we have confronted 3-law Aristotelian logic with its missing 4th law, because *at the limit* opposites *are* identical!] The continual violent interferometry results in the zero-point EM fluctuations of vacuum. Each EM fluctuation is completely deterministic, as shown in Puthoff's cosmological feedback mechanism. However, the macroscopic observer has no knowledge of the cause or of the arrival, and of the myriads of interferences that produced the final EM field fluctuation. Hence although the zero-point fluctuations of vacuum are completely deterministic one-by-one, the observer has *no information* on their causality. Hence to the observer these fluctuations are completely statistical and seemingly *without local order*. However, because of their hidden determinism, these fluctuations are chaotic rather than random—contrary to the Gibbs' thermodynamics statistics assumed and adopted by quantum mechanics. That statistics should be changed to an "already chaotic" statistics containing hidden Whittaker order. This would appear to be the real solution to the recognized major QM problem of the missing chaos.

Since their changes and appearances are completely in one-to-one correspondence to all distant features of the macroscopically ordered universe, then their integration yields macroscopic order. Further, as can be seen, Mach's principle—so near and dear to the heart of Einstein—arises directly from the foregoing discussion. In such fashion, integration of statistical (but chaotic, and with hidden order) quantum changes results in the familiar, ordered macroscopic world. This removes the great error in QM: that heretofore it has failed to predict the ordered macroscopic universe we observe and inhabit.

ANALOGUE

Part that is analogous (representative or modeled).

At root, an analogue of something is a second something that functions in similar fashion to the first something.

ANAEROBE

An organism that lives, is active, and occurs in the absence of free oxygen. Particularly applicable to one-celled organisms that do so.

ANAEROBE, FACULTATIVE

An organism that can live either as an aerobe or as an anaerobe. Particularly applicable to one-celled organisms possessing that capability.

ANAEROBE, OBLIGATORY

An organism that is restricted to being anaerobic; i.e., it cannot utilize oxygen from the atmosphere.

ANAEROBIC

Characteristic of an organism of living, active, or occurring in the absence of free oxygen.

ANGULAR MOMENTUM

The momentum or "leverage" of the momentum of a moving body, with respect to an axis or reference point.

Angular momentum as the same units as action; that is, it is energy multiplied by time, or momentum multiplied by length. In terms of particles, it is also known as *spin*.

ANOMALOUS EM JAMMING MECHANISM

In a dense signal environment, an unusual mechanism whereby EM energy from the skin of an aerial vehicle is directed laser-like into the internal circuitry.

The density of the signals impinging upon the skin are such that the probability of multiple photon interaction increases. Also, on a nonlinearity in/on the skin, the multiplex of signals creates a scalar EM potential. Decomposition of this potential into Whittaker waves provides hidden "pump" waves upon the nonlinearity, which therefore acts as a pumped phase conjugate mirror (PPCM). EM fields and signals from the internal operating circuits in the vehicle provide "signal waves" to the internal skin and to the nonlinearity PPCMs on the skin. Amplified phase conjugate replica (PCR) waves are generated by the PPCMs, where in each PCR wave the energy may be the total of the external signal density pump waves upon the initiating PPCM. The result is that the skin becomes a "collector" of energy from all the impinging external signals, and focuses much of this collected external energy into laser-like beams inside the vehicle which penetrate directly back to the circuit element that originated the particular signal field/wave to the inner skin. The result is spurious jamming throughout the vehicle, directly in its operating circuits, in a manner not described in normal ECM theory. Also, the same effect occurs in a human body when exposed to such a dense signal environment (threshold about 200,000 signals per square meter per second, and particularly active above 500,000 signals per square meter per second. I.e., in such an EM "smog" environment, the anomalous jamming mechanism is able to progressively conduct the energy impinging upon the skin deep into the body and throughout it, including into the bone marrow. This effect is not described at all in the standard dosimetry literature and experimental approaches for examining the effects of EM fields and radiations upon biological systems. By rigorous frequency band control of radiations and communications, most equipment can be operated in an appreciably dense environment such as appears on the modern environment, because the equipment is essentially "narrow band." The human, however, is a very wide-band receiver, and in such dense environments—even at very weak signal levels—the human system will eventually undergo cumulative damage. This is one of the major mechanisms involved in long term deleterious biological effects of EM radiation environments, but this effect on living systems has not been investigated in the laboratory by present EM bioeffects researchers.

In the U.S. air attack on Libya in 1986, the anomalous jamming mechanism interfered with the aircraft, controls, and missiles because frequency discipline was not rigorously enforced. In the Gulf War, rigid frequency discipline was enforced, with the result that the electronic systems operated normally. However, the troops exposed to that environment (which varied from place to place) were affected by the mechanism, which added a bit to the previous cumulative damage to their immune systems, etc.

ANTIBODY

A body substance produced in response to a specific antigen (protein or carbohydrate or other substance, such as a toxin or enzyme, capable of stimulating an immune response).

The antibody counteracts the effects of the antigen, by neutralizing toxins, agglutinating bacteria or cells, precipitating soluble antigens, etc.

ANTI-ELECTRON

The time-reversed electron, or *positron*. Under time reversal, electric charge reverses in sign.

Paul A.M. Dirac, in his "A Theory of Electrons and Protons," Proceedings of the Royal Society of London A126, 1930, p. 360 introduced the negative energy electron sea (now called the "Dirac sea") with negative energy electron holes treated as the positive electron. He attempted to identify these holes with protons, but that was later refuted. The positron, discovered about a year after Dirac's paper, was later connected with this anti-electron.

Note that Dirac himself was not adamant that *all* negative energy state holes in the Dirac sea were filled with electrons, but just that *almost* all of them were. Modern researchers have tended to extend this to state that *all* the holes are filled, normally. That is sufficient in forward time situations. But it does not necessarily hold in a time-reversed situation, in a time-reversed zone, or in a tempic back emf.

ANTIGRAVITY

An effect whereby normal masses *repulse* one another rather than *attract* one another

Antigravity may also be considered as *time-reversed gravitation*. It may also be considered as *gravitation between two negative masses*.

ANTIMATTER

Matter consisting of atoms which are composed of antielectrons (positrons), antiprotons, antineutrons.

Also loosely refers to the antiparticle corresponding to a particle—the antiparticle may be regarded as the particle traveling backward in time, or "phase conjugated", or "time-reversed.

ANTIPARTICLE

A counterpart to an ordinary fundamental particle, having identical mass lifetime and spin, but with charge and magnetic moment reversed in algebraic sign.

Note that when the charge is reversed, parity and time are also reversed. Thus, properly, the antiparticle is the phase conjugation of the particle, or just conjugate particle for short. In effect an antiparticle is the particle traveling backward in observer time rather than forward in observer time.

ANTIPHASED

180 degrees out of phase (contrary-wise in timing).

ANTIPHOTON

A time-reversed photon.

Presently, the photon is considered its own antiparticle, so that photon and antiphoton are one and the same. In the new approach, that is not quite true. First, one considers that a photon—as is well known—has the units of angular momentum. Thus it is made of "energy multiplied by time." We consider that the time-forward photon (i.e. a normal photon), is made of $(+\Delta E)(+\Delta t)$. Usually physicists have largely neglected the fact that a photon carries an *increment of time* as well as an increment of energy! In our approach the antiphoton, being a *time-reversed* entity, must be composed differently. We have tentatively considered the antiphoton to be comprised of $(\Delta E)(-\Delta t)$. It will probably initially be necessary to take into account the fact that Minkowski geometry treats the T dimension as imaginary rather than simple arithmetic. We haven't had the lengthy time to

work all of that out; perhaps one of the better theoreticians or one of the sharp young graduate students will do that and save us the trouble.

At any rate, the requirement is that—in a coupled photon-antiphoton pair (a graviton)—the energies of photon and antiphoton must add spatially, while *electromagnetically* the translation forces (actually translation impulses) of photon and antiphoton must cancel or thwart each other. One insists on a strong interpretation of the distortion correction theorem in phase conjugate optics. In other words, we consider the "wave" as composed of photons, while the "antiwave" (phase conjugate replica) emitted by a phase conjugate mirror is composed of antiphotons. And we consider that the distortion correction theorem must apply to the wave's photons, so that the antiphotons are precisely superposing (coupling) and then decoupling as the wave and antiwave pass through each other in perfect spatial superposition. We feel that this "totally in phase spatially but totally antiphased temporally" concept is important. It is well-known, e.g., that in certain cases protons—the very building blocks of matter itself—can pass right through other protons, as shown in certain colliding beam experiments if their relative spins are properly arranged.

ANTISIGNAL

The phase conjugate of a signal. The time reversal of that signal or its twin. The phase conjugate replica signal/wave emitted by a phase conjugate mirror material in response to an incident signal/wave.

ANTI-STOKES EMISSION

Radiation emitted from an intensely scattering medium that is of greater intensity than the input radiation.

In other words, the medium gives off more energy than we have to put into it. This has been known since the 1930s and proven experimentally, but no really complete explanation has been forthcoming. The conventional explanation is that some of the kinetic energy of the medium is furnished to cause additional emission. In that case, anti-Stokes emission would lower the kinetic energy of the emitting medium. Note that this is not necessarily true at all in Letokhov's negative absorption (excess emission) of the medium, where in that case the excess energy in the emissions is said to come directly from energy absorbed from the active vacuum.

ANTI-STOKES RADIATION

The radiation coming from an anti-Stokes emission process from an intensely scattering medium, where more energy flux is emitted than is input by the experimenter-operator.

In the past, there has just been "arm-waving" that the excess energy must come from the internal energy of the molecules. There seems to be no explanation at all of where the excess energy of the molecules must continue to come from! Tacit silence on this "apparent" violation of energy conservation is held. But see Letokhov's *negative absorption of the medium* discussions in the literature.

We quote from H. C. Dake and Jack DeMent. (1941) **Fluorescent Light and Its Applications**, Chemical Publishing Company, Inc., Brooklyn, New York, 1941. p. 51-52: *"When a phosphor or other luminescent substance emits light, it gives in most cases an emission according to Stokes' Law. This law states that the wavelength of the fluorescent (emitted) light is always greater than the wavelength of the exciting radiation. It was first observed in 1852 in the memoir "On the Change of Refrangibility of Light," by Sir G. G. Stokes. In terms of energy the relationship states that e em < e ab. While Stokes' Law holds for the majority of cases, it does not hold in certain instances. In some cases the wave length is the same for both the absorbed and the emitted radiation. That is, the efficiency appears to be perfect or unity. This is known as resonance radiation. In other cases Stokes' Law does not hold where the energy emitted is greater than the energy absorbed. This is known as Anti-Stokes emission. In 1935 Prileshajewa showed that there is an energy difference as much as 1.1 v between the exciting light and the fluorescence of aniline vapor. This added energy is attributed to additions from the internal energy of the molecule."*

There is no real problem of identifying the source of the excess energy, once one realizes that (i) every dipole is a broken symmetry in the vacuum exchange with the end charges of the dipole, and thus extracts virtual energy from the vacuum, integrates and orders it, and outputs it as EM energy density flow. One then adds multiretroreflection and multiple passes of the EM energy flow, so that charges that intercept and collect energy from the reciprocating flow can multiply connect from the same energy flow (on a given pass, only a tiny, tiny fraction—nominally about 10^{-13}—of the energy flow is intercepted and interacted with by the collecting particle). Thus multiple collections from the same EM energy flow can be accomplished, if the flow is iteratively rerouted (as by retroreflection or phase conjugate reflection) back across the collecting charges again and again.

In this fashion additional energy is collected in the collected volume, which increases the local collected energy density in that volume. In turn this increases the local potential of that volume. *In turn* that increases the energy flow from that potential acting as a dipole, because it increases the dipole strength and consequently the magnitude of the dipole's broken symmetry in its vacuum flux exchange.

The inefficiency of the process increases nonlinearly with increasing local potential, and faster than the buildup of local energy density occurs from multipass multicollection. When the inefficiency curve reaches the increasing broken symmetry energy extraction curve, then a point of equilibrium is reached. At that equilibrium point, the rate of energy diffusing out of the multipass region and escaping from the periphery of the system is equal to the rate of extraction of energy from the vacuum and flowing it out into as Poynting **S**-flow into the multicollection region and collecting it.

So we have described an open thermodynamic system, where there are two inputs of energy flow: (i) that by the operator-experimenter, and (ii) that from the vacuum via the dipolar broken symmetries. At equilibrium condition the total input energy rate is equal to the total energy escaping rate, and the conservation of energy law is rigorously upheld. However, this is an open thermodynamic system far from equilibrium, and so rigorously the nonlinear thermodynamics of such systems applies, rather than the normal equilibrium thermodynamics. As is well-known, the coefficient of performance for such open systems in disequilibrium, may permissibly be overunity, even greatly overunity.

Properly utilized, the overunity anti-Stokes or Letokhov emission can be made very large—such as COP ≈1200 in Patterson's adaptation. The process and its overunity certification already exist in the hard science literature, being known and experimentally demonstrated for at least three decades.

ANTIWAVE

The time-reversal (phase conjugation) of a reference wave.

A phase conjugate replica wave is a time-reversed replica of its referent wave. Hence it is the antiwave of the referent wave.

A-POTENTIAL

Vector magnetic potential.

The A-potential is a real entity more primary than the magnetic field **B**, and not a mathematical convenience as was originally thought—as detailed in the second volume of Feynman's three volumes of physics. Indeed, it may be separated from the magnetic field, as reported by Feynman, and used for instrumentation effects in the manner patented by Gelinas. When separated from magnetic field, it is often referred to as the "curl-free vector potential," since the **B**-field is modeled as being created from the **A**-field by curling it. In other words, **B** is defined as the curl of the magnetic vector potential, if we use $\mathbf{B} \equiv \nabla \times \mathbf{A}$. Hence "separating" magnetic field from **A**-potential simply is a sort of "parallel branching" of the energy density flow of the **A**-potential. It is like branching the voltage on a feeder line conductor in an electric circuit into two parallel conductors. The feeder potential splits into two, so that each branch has the same potential. Actually the vast energy flow in the feeder line only has a small component which strikes the surface charges, diverting the energy into the conductor and potentializing the Drude electrons. In branching into two conductors, the giant flow branches also, but is so great that the surface charges in each of the two branches still intercept essentially the same amount of energy, diverging it into the conductor. Hence each conductor exhibits the same potential as the feeder conductor

The same thing happens when one "splits" or branches the **A**-potential in similar fashion. The diverted and separated **B**-field branch will exhibit "equal energy density" flow (i.e., in the form of magnetic flux density flow) and yet the original **A**-potential path through space will still have the same previous energy flow density magnitude, just without curl (without magnetic field).

Any good toroid or very long solenoid already performs such separation, and hence energy density flow doubling. If properly used—as in the motionless electromagnetic generator (MEG)—this effect can be used to provide a generator with COP>1.0. At this writing, the present MEG exhibits COP = 16, and is a patent-pending system.

The well-known Aharonov-Bohm effect, e.g., also uses this separation of the curl of the **A**-potential, leaving an uncurled **A**-potential whose changes will and do interact with electrons.

The curl-free vector potential is particularly interesting because (1) it is a unique and independent field of nature, (2) its curl produces a magnetic field, (3) its time derivative produces an electric field, (4) its magnitude does not fall off inversely as the distance squared, but only inversely as the distance, and its time derivative $d\mathbf{A}/dt = B\,\mathbf{E}$. Hence, as in the MEG, one can extract energy both from the curl-free A-potential and the curled **A**-potential (magnetic field **B**), increasing the available energy collected in the circuit to greater than what the operator input to it. This is simply a physical process of regauging, wherein electrodynamicists already routinely assume (and apply) the fact that the potential energy of any EM system can be freely changed at will, by regauging. In the real world, of course, we may have to pay a little switching energy, but we are free to regauge (by this "splitting the potential into equal parallel paths, and by other methods), at will and at any time and place. The MEG just takes advantage of one major method for free regauging, in order to violate the Lorentz symmetry condition (violate symmetry in the system's energy exchange with its active vacuum environment). It thereby is legitimately permitted to exhibit COP>1.0 and output more energy than one inputs, because the regauging transforms it into an open dissipative system far from thermodynamic equilibrium in its active environmental energy exchange.

ARISTOTELIAN LOGIC

The conventional three laws of logic, unconsciously fitted to the physical reality created by the single photon interaction. The three laws are: (1) a thing is identical to itself, (2) a thing is not identical to something else, and (3) either one has a given thing or something that is not that thing. Mathematically these are written as (1) A A, (2) A Ã, and (3) A Ã. Aristotelian logic applies only to single observation at a time (monocular observation, a single observer). When multiple simultaneous observation (multiocular observation, multiple observers) are considered, the three laws may be violated. In that case a fourth law, A Ã is added. This law may be seen to be the exact negation of all the first three. An application rule (which may itself be called a fifth law) is also added, and states that either the first three laws are explicit and the fourth is implicit, or the first three are implicit and the fourth is explicit. Further, the fourth law is the *law of the paradox*: Something that is found to be true in nature, but violates one or more of Aristotle's three laws, is known as a *logical paradox*. In the higher logic, it simply violates the case where the three Aristotelian laws are explicit and the fourth law is implicit. Instead, the three Aristotelian laws are now implicit and the fourth law has become explicit. All boundaries exhibit this effect.

It is highly recommended that the interested reader familiarize himself or herself with Morris Kline, **Mathematics: The Loss of Certainty**, Oxford University Press, New York, 1980. Kline deals directly with the fact that mathematics is not a body of unshakable truths about the physical world, and mathematical reasoning is not exact and fallible.

ARISTOTLE

A great Greek philosopher who lived from 384-322 B.C.

Aristotle is famous for his three laws of logic: (1) a thing is identical to itself, (2) a thing is not identical to something else, and (3) either one has the thing considered or one has something else.

Heraclitus pointed out that Aristotle's laws prohibited any change, and yet changes were ubiquitous. In short, for a thing to change, it had to change into something else, so Heraclitus pointed out. So how could a thing be both itself and something else simultaneously? How could it be not itself while being itself? The problem has not been solved by the logicians and philosophers to this day, because it has no solution in Aristotelian 3-law logic. So Heraclitus, believe it or not, concluded that all change was an illusion.

ATHERIOSCLEROSIS

Basically, clogging of the arteries, which may be due to deposits onto the artery walls or by thickening and growth of the artery walls themselves, or a combination. It is a chronic (slowly progressing) disease where the artery walls become progressively thickened and hardened and the artery becomes less elastic.

It has been found that the common cytomegalovirus (one of the herpes viruses) plays a key role in the development of the disease. Initial deposits irritate and injure the arterial walls, and the herpes 6 virus infects the site, partially nullifying the control of excess grown of the arterial muscle tissue. This deposit and concomitant stimulation of some excess muscle growth occurs repeated, so that the muscle tissue grows abnormally over an extended period of time. For this reason, when an operation is performed to forcibly reduce the deposits inside the artery, the resulting injuries to the arterial wall tissues leads to the herpes 6 infection and stimulation of excess muscle growth. It has been found, e.g., that after angioplasty the process is often engendered, so that within a year or two the artery is narrowed again, but this time by abnormal growth of smooth muscle tissue. The Prioré team demonstrated positive and total remission of arteriosclerosis in laboratory animals by means of nonionizing EM irradiation to produce an amplified "antiengine", which "time reversed" or dedifferentiated the stricken cells and the stricken areas back to a previous state.

ARTIFICIAL POTENTIAL

A scalar potential which is composed of, or partially contains, an artificially assembled bidirectional wave set.

See E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," **Mathematische Annalen**, Vol. 57, 1903, p. 333-355 for proof that a "scalar potential" is actually a harmonic set of hidden bidirectional EM phase conjugate longitudinal wavepairs. Each wavepair consists of a wave and its antiwave (true time-reversed replica wave).

If the external observer could see the *detected* (effect) waves in a hidden wavepair, he would see the "wave" going in one direction and the antiwave passing precisely through it in the other direction. However, prior to detection, the phase conjugate wave exists entirely in the complex plane and hence in the time domain (in -ict). So the interpretation of Whittaker's 1903 paper, in terms of cause and effect waves, is that the phase conjugate half set is incoming from the time domain to each and every point in the dipolarity or potential, and the "real 3-space half set" is being radiated in every direction in 3-space from that point. See my paper, "Giant Negentropy….".

In addition to Whittaker's sum set of biwaves, Ziolkowski added the product set in the mid-1980s. E.g., see Richard W. Ziolkowski, "Exact solutions of the wave equation with complex source locations," **Journal of Mathematical Physics**, 26(4), April 1985, p. 861-863; Rod Donnelly and Richard Ziolkowski, "A method for constructing solutions of homogeneous partial differential equations: localized waves," **Proceedings of the Royal Society of London A**., Vol. 437, 1992, p. 673-692. Particularly see I.M. Besieris, A.M. Shaarawi, and R. W. Ziolkowski, "A bidirectional travelling plane wave representation of exact solutions of the scalar wave equation," **Journal of Mathematical Physics**, 30(6), 1989, p. 1254-1269.

However, these deal only with the effects waves after detection.

Another way of defining an artificial potential is: *A potential formed by or containing a subset formed by, deliberately summing nonzero force field vectors to a zero vector resultant*. [Note that electrodynamicists routinely discard vector systems that sum to a zero resultant; not realizing that in doing so, they are discarding vacuum engines and a vastly extended electrogravitational dynamics!] The vector zero system of infolded nonzero vectors has a deterministic, internal stress pattern that is macroscopic. The type of potential made by the zero summation depends upon the type of force vectors summed. For example, summing electric field vectors to zero produces an electrostatic scalar potential; summing magnetic field vectors to zero produces a magnetostatic scalar potential of vacuum.

All potentials represents local warps or curvatures in vacuum/spacetime, and all artificial potentials contain internal, deterministic templates of nested internal spacetime curvatures. Curvature of spacetime interacts directly upon mass and physical systems embedded in it. Thus these deterministic, internested local spacetime curvatures of the artificial potential represent vacuum engines, or spacetime engines, and the artificial potential is said to be a *dimensioned* or *activated* potential. Any system exposed to and placed in such a vacuum spacetime engine, will have these hidden vacuum flux asymmetries interacting upon each and every part of it, down to and including the nuclei, the nucleons, and the quarks in the nucleons.

ASYMMETRICAL REGAUGING

Change of either the scalar potential f or the vector potential **A**, but not both, so that a single excess force and a single change of system energy occurs in the system.

This violates the assumed Lorentz condition, and thus excess energy can enter the system, and an excess "free" force appears which can (if the system is adroitly designed) then translate to perform work upon the system to increase its (e.g. kinetic) energy, exhausting the excess regauging energy in the process and restoring symmetry.

In conventional EM theory, Maxwell's equations in potential formulation are in terms of two potentials, f (the scalar potential) and **A** (the vector potential). When Heaviside retranslated Maxwell's quaternion set of 20 equations in 20 unknowns, he transformed it (in potential form) into two equations where main variables f and **A** are not separated. Electrodynamicists, who until recently considered the potentials as not even real, but just mathematical figments and conveniences, then simply arbitrarily changed both f and **A** *just precisely so* that the extra force appearing in the system by the change of f was countered by an equal and opposite extra force also appearing in the system by the change of **A**. This type of *symmetrical (no net force) regauging* is known as the *Lorentz condition*.

Each *asymmetrical* (produces a nonzero excess net force) potential change (each half of the two asymmetrical regaugings that comprise the symmetrical regauging) also altered the overall energy of the system. However, in the symmetrical regauging that total energy change is "bottled up" as increased stress in the system, because no net translation force is available to be translated and use the energy change to produce excess "free work."

The Lorentz condition assumes that the designer *will not allow* the equilibrium of the system to be broken! In that case, of course, ordinary equilibrium thermodynamics applies, and the system cannot produce COP>1.0. Prior to this Lorentz condition assumption and its absolutely arbitrary regauging, Maxwell's equations do include asymmetrical regauging and therefore open EM systems far from thermodynamic equilibrium; precisely those which violate the Lorentz condition (symmetric regauging) assumption. In short, the unregauged equations do include COP>1.0 electrodynamic circuits and systems.

Unknowingly the electrodynamicists *arbitrarily* discarded the entire Maxwellian class of overunity EM engines and circuits—which class incorporates making a change in one potential(s) such that the Lorentz condition does not hold.

ASYMMETRY

Lack of symmetry, or "broken symmetry" in a general sense.

ASYMMETRY OF THE DIPOLE

Any dipole or dipolarity is a broken 3-symmetry in its fierce exchange of EM energy with the active vacuum. This means that it continuously receives and absorbs copious virtual energy from the seething vacuum flux, and that not all this absorbed energy is reradiated back to the vacuum in virtual form. Instead, some of it is integrated into observable form and re-radiated in all directions as usable, real 3-space EM energy.

This is standard, well-known particle physics, although it appears to be totally missing from classical electrodynamics and it is not considered at all by electrical power system designers and analysts!

Every electric charge is a broken symmetry in the virtual particle flux exchange between the quantum mechanical (energetic) vacuum and the mass of that electric charge. The dipole is two different such asymmetries. As is well-known in particle physics (not in classical EM theory!) each such broken symmetry must "gate" out some of the vacuum energy. In short, the charge asymmetry "extracts" some vacuum energy from its normal "energetic exchange" with the vacuum flux, and puts it out in some form we call "observable" (capable of being measured; specifically, of being intercepted by electric charges so as to produce a force field across the charge and translate it).

Well, an electrical charge produces a flow of energy density which we may represent conventionally as $\mathbf{S} = \mathbf{E}\times\mathbf{H}$ (when collected and measured on assumed unit point charges), which we—a little bit mistakenly—call "observable." [Actually, until the energy flow interacts with that assumed unit point charge, it is an *organized flow of virtual entities*] After interaction it is

real observable EM energy in 3-space. The spinning electron has its own magnetic moment and its own **E**-field. Since (in one form) also $\mathbf{E} = -\nabla\phi$, an extracted and formed $\mathbf{S} = \mathbf{E}\times\mathbf{H}$ is output by the charge asymmetry. This output energy flow also produces the assumed ϕ evidenced by the charge interaction, since ϕ as used represents the *reaction cross section* of the potential. Note that all these entities **S**, **E**, **H**, and ϕ are defined in electrodynamics only as their own interaction cross section with a unit point charge containing mass.

In classical electrodynamics (formed long before the notion of charged particles, atoms, and EM energy flow!) it is just recognized that "charge is the source of a potential." Actually charge gates the energy flow from the vacuum flux, receiving the energy from the time domain by its asymmetry, transduces the energy into 3-space energy, and outputs it as real EM energy pouring out in 3-space in all directions. That energy-flow contains and carries the energy that will interact with charge to form the **E**-field, the **H**-field (spin field), and ϕ.

Also, in particle physics and gauge theory it is well-known that *no mass system can be in equilibrium anyway, unless the vacuum-to-mass interaction is incorporated!* After CEM was formed, much later the atom was discovered and the electron was discovered. Much later then, particle physics and quantum mechanics came along. CEM theory has never been altered to include the necessary vacuum interaction, although it has been known for decades that CEM is totally in error in this respect.

Here one poses a question to the sharp young graduate students: Why does every university continue to teach a seriously flawed classical electrodynamics which does not include the vacuum/mass interaction, when the physics department at the same university knows full well that it must or no EM system can be in equilibrium? Why is not such a *fundamental* and universal issue strongly raised and intensively discussed by our large, tax-exempt scientific organizations at their annual symposia? Why do not the National Science Foundation and the National Academy of Science demand that serious work be done at all speed, to correct such known scientific deficiencies in the classical EM theory? *What happened to science as the search for physical truth*, and replaced it with "status quo" models or—in some cases—even dogma? It is an inexplicable mystery to me, and one to which I do not know the answer.

AUTOIMMUNE DISORDER

A disease or disorder relating to or caused by the antibodies or T-cells that attack foreign molecules, cells, or tissues of their host organism.

A flagrant autoimmune disease example is AIDS, Acquired Immunological Deficiency Syndrome. The AIDS virus successfully hides from the antibodies, so that they cannot perform their proper function, and it infects the T-cells and negates their function. However, there are other examples other than AIDS: e.g., rheumatism and osteoarthritis.

BACK EMF

The counter-electromotive force, usually between the end charges of the source dipole for an EM circuit.

When the electrons in the circuit are forced against the emf—as when the charges from the ground reference of the circuit are forced back up through the emf of the source dipole—then work is done upon the source dipole to scatter the charges and destroy the dipole. Removing the dipole removes its receipt of vacuum energy via its broken 3-symmetry, transduction of that energy, and output of it along the circuit and in space around the circuit as the energy flow that powers the circuit (with part missing the circuit and being just wasted).

Since this removes the power from the circuit, then additional energy must be input to the source to perform work on the internal charges and restore that source dipole again.

There are actually two emfs in a circuit, not one. There is a 3-space emf and also an entirely unrecognized tempic emf. In either case, under proper circumstances there can be a back-emf or either one or both. See discussion under *electromotive force, back*. See also *tempic back emf* (to be added).

BALL LIGHTNING

Rare form of lightning where an incandescent, slow-moving globe forms. The globe often moves erratically, explodes, and may set fire to objects it touches.

Ball lightning may be due to scalar electromagnetic interferometry which can produce a controlled pattern of electromagnetic energy at a distance, or it may be due to the formation of a special localized spacetime curvature engine.

BARE ELECTRON

The true electron without its partial shielding of virtual positrons that are attracted around it.

BARRETT, TERENCE W.

Noted modern electrodynamicist and consultant who works in SU(2)×SU(2) gauge symmetry extended electrodynamics, and was also one of the pioneers of ultrawideband radar.

BECKER, ROBERT O.

Medical doctor, medical research scientist, and Nobel Nominee, noted for his early-on efforts—particularly in the 1960s through the 1980s, in the effects of EM fields on biological systems, studies of evoked or partially evoked limb regeneration in certain species, electrical stimulation of bone fractures to stimulate healing and reveal the mechanism involved, and the cellular regeneration system of the body as opposed to the immune system.

Becker particularly recognized that the cellular regenerative system was a special electrical system having unique functions. He even succeeded in diagramming this system as far as it is revealed by ordinary U(1) electrodynamics. Becker demonstrated partial limb regeneration in salamanders, etc. and in some other species, with electrical stimulation. In his EM-stimulated bone fracture healing, Becker showed a startling result: First the red blood cells entering the fracture area shucked their hemoglobin and grew a nucleus, thus "dedifferentiating" (biological term) or "time-reversing" (physics term) back to an earlier state. Then this modified cell redifferentiated (biological term) or "fast-forwarded in time" (physics term) into the type of cell that makes cartilage. Then this newly modified cell further redifferentiated into the type of cell that makes bone, and was deposited in the fracture site. The continuing deposits of these cells from the ongoing process evoked in red blood cells healed the fracture with new bone growth. Whereupon the action stopped.

Becker also was one of the first qualified scientists who testified in court on the deleterious effects of power line radiation. He thereby incurred the enmity of very powerful interests, so that his research funds were pulled and eventually he was forced to retire at an early age.

He was nominated for the Nobel Prize multiple times, and his epochal work did finally focus at least some attention of the medical research community on the regenerative system as opposed to the immune system which heals nothing.

Becker's profound work was of tremendous influence on me as I struggled to decipher the active mechanism in his experiments, the Prioré team's experiments in France, the Russian microwave radiation of U.S. Embassy personnel in Moscow, Kaznacheyev's experiments demonstrating transmission of cellular disease and disorder electromagnetically into target cells environmentally isolated except for contact by light from the sender cells having such disease or disorder, and the body's own regenerative system. After some 14 years struggle with the problem, I finally did break the mechanism(s) involved in all those things. But it was only possible because of the magnificent work by Becker and Prioré, the reported work by Kaznacheyev, and gradual exposure to higher symmetry electrodynamics. The work was crude at first, but eventually progressed (by 1998, e.g.) to include the port-hole concept, transduction of EM wave polarization types, the engine and engine template concepts, and unified field theory. Since then it has become clear that the proper electrodynamics to model such things is the higher symmetry O(3) electrodynamics pioneered by Evans, and now revealed to be an important subset of Sachs' unified field theory.

Becker is therefore one of my heroes whose magnificent work and long perseverance against strong scientific suppression I greatly admire. Most of Becker's detractors were or are in fact employed in positions either directly or indirectly funded by the electrical power industry. I believe that, had Becker had access to O(3) electrodynamics and Sachs' theory, he would have personally impelled the entire medical field to a marvelous and extraordinarily advanced EM medical therapy.

See Robert O. Becker and Andrew A. Marino, **Electromagnetism and Life**, State University of New York Press, Albany, 1982; Nice summary of EM bioeffects (orthodox) ; also on http://www.ortho.lsumc.edu/Faculty/Marino/EL/ELPub.html.

See also R. O. Becker, "The neural semiconduction control system and its interaction with applied electrical current and magnetic fields," **Proceedings of the XI International Congress of Radiology**, Vol. 105, 1966, p. 1753-1759, Excerpta Medica Foundation; Amsterdam; — "The direct current field: A primitive control and communication system related to growth processes," **Proceed. XVI Internat. Congr. Zoology**, Washington, D.C., Vol. 3, 1963, p. 179-183; — "The control system governing bone growth in response to mechanical stress," **J. Ark. Med. Soc**., Vol. 62, 1966, p. 404; — "A technique for producing regenerative healing in humans," **Frontier Perspectives**, 1(2), Fall/Winter 1990, p. 1-2; — with Charles H. Bachman and Howard Friedman, The direct current system: A link between the environment and the organism," **New York State Journal of Medicine**, Vol. 62, April 15, 1962, p. 1169-1176; — and D. G. Murray, "A method for producing cellular dedifferentiation by means of very small electrical currents," **Trans. N.Y. Acad. Sci**., Vol. 29, 1967, p. 606-615; — and Joseph A. Spadaro, "Electrical stimulation of partial limb regeneration in mammals," **Bulletin of the New York Academy of Medicine**, Second Series, 48(4), May 1972, p. 627-64; — and Carlton F. Hazlewood, Abraham R. Liboff, and Jan Walleczek, **Electromagnetic Applications In Medicine**," NIH-OAM Electromagnetics Panel Report, Jan. 15, 1993.

See particularly Robert O. Becker, "The significance of bioelectric potentials." **Bioelectrochemistry and Bioenergetics**, Vol. 1, 1974, p. 187-199. This is probably *the* paper by Becker that provides a really good overview of the control system. A block diagram of the proposed system is given by Becker on p. 191.

Becker also has authored several popular-oriented books filled with excellent information. These include Robert O. Becker, M.D. and Gary Selden**, The Body Electric: Electromagnetism and the Foundation of Life**, William Morrow and Co., New York, 1985; and Robert O. Becker, **Cross Currents: The Perils of Electropollution; The Promise of Electromedicine**, Jeremy P. Tarcher, Los Angeles, 1990.

BEDINI, JOHN

Noted audio engineer, overunity energy researcher, and inventor of the renowned Bedini amplifiers well-known to audiophiles, the BASE process for holographic sound, and a process for cleaning the harshness from digital audio disks.

Bedini has invented a variety of COP>1.0 processes, motors, generators, etc. Particularly he has developed a process whereby, in a battery-powered circuit, he adroitly back-pulses the battery in a recharging direction while the battery is powering the load, causing a pile-up of electrons on the surface of the battery plates that is a sharply increased scalar potential opposing the onrushing very massive lead ions in the battery in discharging mode. The result is that the potential's electron pile-up increases dramatically due to the ions' far greater inertia than that of the electrons. The result is a high potential (perhaps 40 volts) upon the surface of the battery, overpotentializing both the incoming lead ions between the plates and the electrons in the external circuit in powering mode. In this phase, energy flows from the vacuum onto both the ions and the external circuit electrons, adding significant energy to the powering of the external circuit for the same ion current inside the battery.

As the ions slow and stop, Bedini's back-pulse trailing edge causes a very sharp cutoff, thus invoking Lenz's law and resulting in the surface potential on the plates increasing to well over 100 volts. This further overpotentializes the external circuit electrons in powering mode, dissipating much more energy in the external circuit to power the loads. As the ions finally stop and reverse, their relatively sluggish re-acceleration in charging mode and their overpotentialization still results in excess energy being delivered to the external circuit. Then as the overpotentialized ions accelerate in charging mode, the external circuit is still in powering mode until the drain-off of the severe electron pile-up on the surface of the battery plates.

This is one of several modes of operation used by Bedini in his overunity battery powered circuits, which keep their batteries recharged while powering their loads.

By separating the other closed current loop between external electron currents and the ion currents between the battery plates, and then dephasing these currents, Bedini breaks the usual dissipation symmetry enforced in a closed loop circuit where all charge carriers have the same m/q ratio. In Bedini's circuits, the m/q charge ratios dramatically differ between the ion current section between the plates and the electron currents between the outside of the plates and through the external circuit. Also, by providing a much greater potential *between* the two circuit halves, The potential extends in both directions—internally back over the ions, and externally in the circuit over the external Drude electrons powering the circuit loads and losses. He provides a true negative resistor on the surface of the plates, which extracts energy from the vacuum (via its broken 3-symmetry as a dipolarity) from the time domain, transduces it into real EM energy, and overpotentializes (regauges) the potential energy of both the internal ion currents and the external electron currents.

The Bedini process is therefore a legitimate COP>1.0 system, and in his self-powering embodiments the system will run indefinitely without external energy input by the operator, use of fuel, etc. He has converted the system to an open system far from thermodynamic equilibrium in its violent energy exchange with the active vacuum, and thus the system is permitted to exhibit both COP>1.0 and self-powering as well.

For an expanded explanation of the Bedini negative resistor process in batteries, see T. E. Bearden, "Bedini's Method for Forming Negative Resistors in Batteries," **Journal of New Energy**, 5(1), Summer 2000, p. 24-38.

BEING

Pure essence, existence.

Again, something which in actuality resists Aristotelian definition unless preliminary assumptions are made. Generally used in one of two senses: (1) persistence, as in "he is (he continually exists)," or (2) identity, as in "he is the man ('he' and 'the man' are the same thing)."

BIDIRECTIONAL EM WAVES

EM waves running antiparallel to each other through a given point or region of space.

Suppose we run a normal EM wave into a phase conjugating mirror (PCM) with a gain of 1. By ordinary phase conjugate optics, the mirror then emits a backwards-traveling phase conjugate replica wave (PCR wave). According to the so-called "distortion correction theorem," that backwards traveling wave will travel backwards (as seen by the external observer) back over the exact route taken by the previous wave, and it will reappear in space precisely superposed spatially with the previous waves. If we examine the impulse (density) fields (i.e., Edt), then the forward-time wave contains Edt while the backward time wave contains E(−dt), which is just −Edt. So *electromagnetically*—as far as producing a net translation force on a charge—the E-fields seem to cancel, although they are still there and their energy is still there. Instead of translation, the two produce stress.

One thus (simple case) will have a strange kind of standing wave wherein the local energy density of the vacuum varies (e.g., sinusoidally) as a function of distance, but a charged particle placed in it will not be translated! Rigorously, that is a *gravitational standing wave*. Since change in local energy density is also a curvature of spacetime, that is also a standing sinusoidal wave of the local curvature of spacetime. This is where electromagnetics and gravitation actually meet, and where electromagnetics can be utilized to produce gravitational waves. (Much more complex waves can be produced; this is just the simplest example).

BIDIRECTIONAL FIELD FLOWS

E-fields (and B-fields) being propagated in a pair of opposite waves traveling "through" each other in opposite directions,

...where the two may be "locked together" as a wave and its antiwave; i.e., as a "Whittaker biwave pair". Note that Whittaker bidirectional EM wavepairs are not to be confused with the pairing of the wave and reflection wave on a transmission line.

BIDIRECTIONAL GATING

Gating (of energy flow, e.g.) in both directions simultaneously.

BIDIRECTIONAL TRAVELING PLANE WAVE

A wave and its antiwave, where each wave is moving in an opposite direction (standard assumption in phase conjugate physics).

In short, to the external observer the waves seem to be "moving through" each other; one from left to right, and the other from right to left; or one radially outward and the other radially inward. All scalar potentials were shown by Stoney and Whittaker to be comprised of a harmonic series of such "bidirectional traveling wave pairs." However, the interpretation of the phase conjugate waves was after detection, so that the detected "effect" wave existed in 3-space. Prior to detection, the phase conjugate half-set of the Whittaker decomposition of the scalar potential is convergent from and in the time domain (complex plane).

BIOELECTROMAGNETICS (BEM)

Presently, the scientific study of interactions between living organisms and electromagnetic fields, forces, energies, currents, and charges. The range of interactions studied ranges from atomic and molecular, through intracellular, to the whole organism**.**

Electromagnetic fields studied in BEM include those of endogenous origin (from within the organism) and exogenous origin (from outside the organism). Sources of exogenous fields include: the earth and sun, electrical equipment (power lines, radio transmitters, etc.), clinical treatment devices (e.g., TENS), and other organisms. The electromagnetic fields of greatest interest in BEM are generally classified as nonionizing (i.e., lacking sufficient energy to directly dislodge electrons from molecules or atoms.) BEM is a scientific discipline emerging on the boundaries between physics and biology. As in other sciences, progress in BEM is made by testing falsifiable hypotheses against valid measured data obtained in repeatable experiments.

Our new viewpoint seeks to dramatically enlarge the scope of this definition, to include not only the presently-recognized external (outfolded) electromagnetics, but also the internal (infolded, inside the scalar EM potential) electromagnetics, and also to utilize a unified field theory where EM is GR and vice versa.

BIOENERGETICS

That branch of Russian (KGB) energetics which is targeted against the living body, its cells and tissues, and its EM fields and potentials (biofields and biopotentials).

BIOGENESIS

Generation of living organisms from other living organisms; also, the theory or philosophy that living organisms develop only from other living organisms.

BIOLOGICAL WARFARE

Warfare against living humans, livestock, crops, etc. using pathogenic micro-organisms or biocides to create diseases and death, or using dimensioned electromagnetic potentials, fields, and waves to kindle cellular damage, disease, and death in the same targeted populations.

BIOLOGICAL WARFARE, ELECTROMAGNETIC

The use of dimensioned electromagnetic potentials, fields, and waves to induce cellular damage, disease, and death in targeted living populations.

The decades of Russian microwave radiation of personnel in the former U.S. Embassy in Moscow is an example, where only field-free potentials were dimensioned with the disease or health-change patterns (the engines). This science was developed in Russia as an outgrowth of the thousands of Kaznacheyev experiments demonstrating that any cellular disease and damage pattern could be induced from diseased or damaged cells into environmentally isolated cell cultures, purely by specialized EM radiation from the damaged or "transmitting" cells into the targeted cells.

The Chinese also used such dimensioned radiation to induce cancer in almost all GRU operatives stationed in China at the time of the major disagreement between China and Russia. In his book, Stanislov Lunev and Ira Winkler, Through the Eyes of the Enemy: Russia's Highest Ranking Military Defector Reveals Why Russia Is More Dangerous Than Ever, Regnery, Washington, D.C., 1998, p. 160, Lunev reveals it this way:*"...I was not the only person who was stationed in Beijing to come down with*

cancer… Almost all of the GRU officers stationed in China with me have been diagnosed with cancer. People assigned to the embassy had told me that they were picking up high levels of radiation from the apartment building around the embassy compound. Whether it was a form of high-tech monitoring or a conscious effort to harm our health, it seems to have been successful. So much so that in 1992 the GRU was asked to investigate the high rate of cancer among embassy officials. The findings, however, have never been made public; in part, no doubt, because of the rapprochement between Russia and China." In short, the Chinese did exactly to the Russian GRU what the Russians were doing to the Americans.

BIOPHOTON

A quantum of angular momentum, each containing "a piece of energy welded to a piece of time, with no seam in the middle," emitted by biomolecules in living organisms. The difference between a biophoton and a normal photon is that the "infolded EM structuring" (ST curvature engine sets) carried by the biophoton carries the dynamics and templates of the living cell or tissue or body emitting the radiation.

As presently known, biophoton emission is associated with processes such as mitosis (cell division) and with mechanisms such as soliton vibrations of DNA and other alpha-helix proteins [Popp et. al., 1984; Popp et. al., 1992]. An organism's biophoton field may represent a highly-structured innate organizing field capable of encoding or transmitting information over macroscopic distances.

Kaznacheyev, e.g., showed that almost any cellular disease or damage condition can be induced from the diseased control cells to separated and environmentally isolated target cells initially normal, if (1) the visible spectrum of radiation is blocked from the targeted cells, and (2) the two groups of cells are optically connected below and above the optical spectrum, in the infrared and in the ultraviolet.

The new viewpoint seeks to dramatically extend the scope of this definition. Considering the wave aspects of the photon frequency, the infolded oscillating EM energy in the photon may be decomposed into two oscillating potentials [Whittaker, 1904]. In each of these potentials, there exists a magnificent infolded structure [Whittaker, 1903] of internal bidirectional EM wave pairs, to include the sum set [Whittaker] and the product set [Ziolkowski]. Thus the photon carries internal information, which is also referred to as the "information content of the field." Since the product set represents modulations, the basic infolded structure has signal characteristics. Mind, thought, and long term memory exist inside the personal quantum potential, which may further be regarded as consisting of coupling and uncoupling photon/antiphoton pairs—i.e., hidden gravitons. In the new viewpoint, the biophoton is the carrier of biogravitons, and also biograviton lattices. This information forms vacuum engines which can cumulate over a period of time to breach the quantum threshold and outfold, producing real change in cells, as shown by the Kaznacheyev cytopathogenic mirror effect experiments.

BIOQUANTUM POTENTIAL

A quantum potential connected to and of a living body, where the inner EM structuring and dynamics of the quantum potential are in correspondence with the inner EM structuring of the normal EM fields, potentials, and waves in the body, and also are in correspondence with the time-polarized EM structuring and dynamics of the mind and its operations.

The biopotential provides the volition and intent exhibited by the biological body, breaching the quantum threshold and producing direct psychokinetic change (by the mind-body coupling mechanism) that is the "input signal" to the servomechanisms of the body,. from the smallest to the largest. In this biopotential, the Stoney-Whittaker-Ziolkowski decomposition provides the information structure and vacuum engines that are the mind, thought, long term memory, etc. A living biological system may be defined as a physical system of otherwise inert matter (the body) and of mind, coupled to each other through a bioquantum potential.

BLOCKING

In the charge-barrier semiconductor functioning, stopping or partially stopping the flow of current in a circuit, or between two points, without stopping the Poynting S-flow.

In ordinary usage, "stopping the progress of."

BOHM, DAVID

World renowned physicist and originator of the hidden variable theory interpretation of quantum mechanics. See David J. Bohm, "A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden' Variables, I and II." Physical Review, 85(2), Jan. 15, 1952, p. 166-179 (Part I); 180-193 (Part II).

Together with his student Aharonov, he co-authored a fundamental paper on the Aharonov-Bohm effect wherein interfering electromagnetic potentials can produce effects on charged particle systems, even at a distance and in the absence of the electromagnetic force fields.

BOHM'S HIDDEN VARIABLE THEORY (HVT)

A major interpretation of quantum mechanics, formulated by David Bohm and published in Physical Review in 1952.

See David J. Bohm, "A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden' Variables, I and II," **Physical Review**, 85(2), Jan. 15, 1952, p. 166-179 (Part I); 180-193 (Part II). Bohm's theory makes all the correct predictions and also eliminates many problems in quantum mechanics, such as the "measurement problem" and the—now alarming—problem of the missing chaos (i.e., the missing "hidden order.").

Ironically, the prevailing Copenhagen interpretation of the QM theory predicts that the organized macroscopic world does not exist, while Bohm's theory predicts it. [Question to the sharp young graduate student: How can one defend a scientific model which predicts that he himself does not exist? If one keeps one's sense of humor, it would seem that this has to be the greatest scientific *faux pas* of all time!] It may be that one unconscious reason that most physicists still oppose HVT is that *it implies that physical reality can in fact be deterministically engineered*. Most physicists would seem to fervently wish physical reality to stay "solid as a brick," with fixed "laws of nature," which can be leisurely discovered and then utilized comfortably, predictably, and sanely. The advent of HVT (which is just a matter of time; for decades the Russians have highly weaponized the HVT area!) dramatically alters our perception of "fixed physical reality" into that of an "engineerable, changeable" physical reality! I tentatively believe that the terrible psychological implications of such a potential development is something that most scientists do not wish to cope with—we simply do not have the Gestalt for it. On the other hand, the Russian national psychology is such that they do have the Gestalt for it. The Russian energetics—which I have long referred to loosely as scalar electromagnetics—basically utilizes the infolded ordering inside the potential to create "direct patterns of vacuum flux", hence *vacuum engines*. And it also utilizes the quantum potential, including internally structuring the QP, to enable instantaneous action-at-a-distance in multiple simultaneous locations and nodes, with stupendous and automatic energy amplification.

By deterministically "patterning" the internal structuring of the scalar potential, one can directly form such vacuum engines. Whittaker showed in 1904 that any EM field pattern whatsoever can be expressed as two scalar potentials, rather than the common f and **A** representation. This means that any EM wave is simply the "interference" (between the hidden biwave structures) of two scalar potentials, even at a distance. By properly structuring an EM signal (i.e., structuring the two potentials into which it can be decomposed), the resulting EM signal—appearing normal on the surface—nonetheless now transports special vacuum engines deliberately designed to perform some particular internal task in mass systems, electronic systems, or humans when it strikes a target at a distance. I refer to this "internal structuring" of the Stoney/Whittaker/Ziolkowski internal biwaves and their products, as *dimensioning* of the potential(s), and hence of the EM carrier wave. The Russians call it the *information content of the field*; but our own scientists tend to erroneously interpret that phrase as ordinary spectral analysis. In other words, they erroneously continue to regard EM *vacuum engines* as if they were ordinary EM *signals*.

BOHREN EXPERIMENT

Revealing experiment by Bohren, replicated by Paul and Fischer, which shows that a given charge when in particle resonance absorbs more energy from a field or potential then the same charge does in "static" position.

By conventional outlook, this provides a guaranteed COP>1.0 process. Bohren demonstrated absorbing 18 times more energy with the charge in particle resonance than with the static charge. This is a direct experiment proving the Heaviside dark energy component of EM energy flow, whether in field form or in potential form.

See Craig F. Bohren, "How can a particle absorb more than the light incident on it"?", **American Journal of Physics**, 51(4), Apr. 1983, p. 323-327. See independent confirmation of Bohren's work by H. Paul and R. Fischer, *ibid*., p. 327. Other pertinent references are V. S. Letokhov, "Laser Maxwell's Demon," **Contemporary Physics**, 36(4), 1995, p. 235-243; — "Generation of Light by a scattering medium with negative resonance absorption," **Soviet Physics JETP**, 26(4), Apr. 1968, p. 835-839; — "Double Gamma and optical resonance," **Physics Letters A**, Vol. 43, 1973, p. 179-180; — "Stimulated emission of an ensemble of scattering particles with negative absorption," **ZhETF Plasma**, 5(8), Apr. 15, 1967, p. 262-265. Also see R. Pappalardo and A. Lempicki, "Brillouin and Rayleigh Scattering in Aprotic Laser Solutions Containing Neodymium," **Journal of Applied Physics**, Apr. 1992, p. 1699-1708

BRIDGE

A component or process which passes EM energy between two isolated circuits, but does not pass dq/dt between them, and which breaks the normal rigidly field-locked power dissipations in the two circuits.

Space itself would appear to be one such bridge.

BRIDGING FUNCTION

The function of passing EM energy flow between two isolated circuits, but not passing dq/dt between them, while simultaneously breaking any normal rigidly field-locked power dissipations in the two circuits.

BROKEN SYMMETRY

The fundamental meaning is a condition in which two parts of some configuration or shape on opposite sides of some divisor or condition or boundary, are not similar but differ.

In vacuum energy physics, we are very interested in the fact that any charge and any dipole represents a broken symmetry in its fierce energy exchange with the vacuum. This implies that something virtual has become observable; i.e., part of the virtual EM energy absorbed from the vacuum by the charge or by the dipole is changed into observable form and re-emitted as real, observable EM energy.

Any observable implies a broken symmetry. Non-observables imply symmetry, and vice versa. Each symmetry also can be represented by a conservation rule or law. Physicists have uncovered many kinds of symmetry in physics; and in the 1950s they also discovered broken symmetry.

BROMWICH, THOMAS JOHN l'ANSON

Brilliant English mathematician, 1875-1929, who made significant contributions to the mathematics of electromagnetism—particularly to superpotential theory—before his passion for overwork led to development of a mental disorder and eventual suicide.

Bromwich originated a method for solving the source-free Maxwell equations in 1899, publishing it in 1919. This approach formed the basis for his seminal paper on scattering of plane EM waves by spheres. He did excellent original work on infinite series and made contributions to quadratic and bilinear forms. He also placed Heaviside's operator calculus on a rigorous basis by treating the operators as contour integrals. Unfortunately Bromwich worked so intensively, in such painstaking detail, and at such length that his physical health was affected. He developed a mental disorder and eventually ended his own life in suicide.

For a summary of Bromwich's life and achievements, see G. H. Hardy, "Thomas John Bromwich," **J. London Math. Soc**. **5** (1930), 209-220; — "Obituary of Thomas John Bromwich," **Proc. Roy. Soc. London A 129** (1930), i - x. For an exposition of Bromwich's equations-solving work, see J. D. Zund and J. M. Wilkes, "Bromwich's method for solving the source-free Maxwell equations," **Tensor (NS) 55** (2) (1994), 192-196.

BROWN, G. SPENCER

Noted author and creator of the laws of form, a new form of logic that dramatically extends Aristotelian logic.

Essentially Brown added complex numbers to logic, rather than just staying with simple 2-dimensional plane figures for postulate derivation. Electrical circuits— designed by Brown's logic—do function and do work. When computer software is designed by Brown's logic, it is then possible to mathematically prove whether or not the end result possesses any defects (bugs). In the future software—particularly the larger systems—may well be designed by Brown's logic. G. Spencer Brown, **Laws of Form**, Julian Press, New York, 1972. With a dramatic advance in logic itself, Brown has succeeded in formulating a true calculus of form. Note: There is now a second edition of the book.

BULK GRADIENT CHANGE

Simply a change in the amplitude of the entire potential,

… (i.e., to every internal biwave pair comprising it) at some point or in some region of space, as compared to changing the amplitude of only one or a few of the internal biwave pairs of the potential, without changing all the rest.

BYPASS RESISTOR

In electrical theory, a resistor to pass current by (in parallel to) some other component.

If other effects such as use of the overpotential, pumped phase conjugate reflection, quantum wells, quantum tunneling, and charge blocking are added, the function of the bypass resistor becomes extremely complicated.

CANCER

Conventional definition: A *malignant tumor* of potentially unlimited growth that expands locally by invasion and systemically by *metastasis*.

Growths are further characterized by the type of tissue in which they occur, and their actions. Of particular interest are neoplasm, tumor, carcinoma, and sarcoma. *Malignant* disorders tend to produce deterioration, infiltrate, metastasize, and terminate fatally. A *neoplasm* is simply any new growth of tissue that serves no useful function. A *tumor* is an abnormal mass of tissue that (1) is not inflammatory, (2) arises from preexisting cells, and (3) serves no useful purpose. A *carcinoma* is a malignant tumor of *epithelial* (covering membraneous tissue of a free surface) origin. A *sarcoma* is a malignant neoplasm that arises in *mesodermal* tissue (connective tissue, bone, cartilage, or striated muscle) and that spreads by (1) extension into neighboring tissue or (2) by way of the bloodstream, or (3) both.

New definition of cancer: A centrally-commanded, final, desperate, "first-step dedifferentiation" adaptive attempt by stressed, affected cells experiencing sustained oxygen shortage (hypoxia) to reverse their cellular evolution and return to the anaerobic stage of their primeval cellular ancestry. Thus a cancer cell is a severely stressed hypoxic cell that has been "ordered" by the master cellular control system (MCCS) to dedifferentiate back to a more primeval form in which it needed little or no oxygen. It is the last desperate attempt by the body to insure the affected cells' survival when all other means available to the MCCS to provide the necessary oxygen have been exhausted and have failed. The "order" differs from normal signal theory in that it consists of a Stoney/Whittaker/Ziolkowski template inside the personal quantum potential of the organism. Thus the "order" actually consists of a vacuum engine, so that the spacetime in which the affected cell exists is acted upon by structured, energetic hidden variable fingers to directly alter it. The "signal order" is in fact a set of hidden vector forces in spacetime itself, created directly in and on the affected cell(s), in every part, in every atom. The cure for the cancerous cell, once formed, is simply to cause the MCCS to generate the "counter-order" reversing the original dedifferentiating action. This can be readily accomplished by establishing hidden multifrequency pump waves in the quantum potential on the cancerous cell, on all its parts, so that they act as pumped phase conjugate mirrors. Since they already exist in the altered "cancer" spacetime template/signal, the pumping causes a phase conjugate replica of the precise cancer state to be created in and on the cell and its parts. [In fact this is a general therapeutic mechanism, and it can be applied to reverse almost any conceivable cellular damage or disorder.] This counter-order is a new and amplified vacuum engine that acts upon the cell to redifferentiate it back to a normal cell. If an abnormal number of cells results, the body's normal processes then recognize the excess cells and destroys them.

CANCER HOTSPOT

An area or locality or location where cancer recurs repeatedly, more than the normal deviation expected statistically. In such case, one is dealing with a hidden cause or carcinogen.

Human systems exposed to such a hotspot experience cellular changes (hypoxia) which eventually result in the master cellular control system (MCCS) issuing a dedifferentiation order to the affected cells to regress back to a primeval anaerobic form. The first step is dissociation from central (MCCS) control of cellular growth, resulting in a cell that now grows and divides unrestrained by the normal body. The real question in the hotspot is, "What is the unknown agent inducing the hypoxia condition, and what is the mechanism by means of which it induces it?" Epidemology will point out a hotspot, but is usually incapable of resolving the primary causative agent or its active mechanism since it can only show correlation.

CAPACITOR AS A TRANSMISSION LINE

A capacitor can be theoretically treated as a special type of transmission line, a fact which is apparently known to transmission line theorists but not to many engineers and physicists not specializing in transmission lines.

CARCINOGEN

A substance or agent (such as a chemical or a spacetime curvature engine) capable of inducing a cancer.

In the new theory, the primary carcinogen is an actual order (a vacuum engine) issued by the master cellular control system (MCCS), reverting (dedifferentiating) the affected cell to a primal anaerobic form. Usually what are normally regarded as carcinogens are also causes of cellular conditions wherein the cell becomes very hypoxic, so much so that the MCCS exhausts all other alternative corrective means and as a last desperate measure orders the cell to change to a form that requires little or no oxygen. The "exhausting of other measures" may be very rapid, as when the cell has been affected and damaged by powerful carcinogens, or it may require decades to occur, as when the cell is subjected to long-term mild hypoxia, such as from electromagnetic smog.

CARRIER WAVE

A fundamental wave which is modulated by another wave or other waves, and hence "carries" the other waveform(s). By stripping off the carrier in a demodulator, the carried waveform(s) emerges.

Hence it is a continuous frequency wave which can be modulated by an information-bearing signal.

CASIMIR EFFECT

The attraction of two conducting parallel plates in space, placed very close together, due to their influence on the active vacuum and on the vacuum's interaction with the plates.

CASIMIR, HENDRIK BRUGT GERHARD (1909-2000)

Noted scientist who in 1948 predicted that two parallel conducting plates, placed very near each other in a vacuum, would experience an attractive force due to their influence on the electromagnetic vacuum.

See H. B. G. Casimir, “On the attraction between two perfectly conducting plates,” presented at a meeting of the Royal Netherlands Academy of Arts and Sciences on 29 May, 1948. Published in the same year in **Proceeding. Koninklijke Nederlandse Akademie van Wetenschappen**, Amsterdam, vol. 51(7), 1948, p. 793-796. For a beautiful modern experiment confirming the force, see S.K. Lamoreaux, “Demonstration of the Casimir Force in the 0.6 to 6μm range,” **Physical Review Letters**, 78(1), Jan. 6, 1997, p. 5-8.

The force was experimentally detected some 10 years later.

CAUSAL SYSTEM ROBOTS (CSRs)

Massless 4-space "engine" systems (therefore in the causal domain only, hence the name) formed of longitudinal EM waves and their dynamics, which are therefore sets of spacetime curvatures and their deterministic dynamics (engines) which function as individual robots.

This is a totally new kind of system leading to a totally new kind of warfare, developed over some decades and deployed by the KGB in 1999.

Matter is composed mostly of empty space filled with EM waves, fields, and potentials. Those "fillers" themselves are just bundles of longitudinal EM waves and their impressed dynamics. Hence all matter, the vacuum, and all conventional EM potentials, fields, and waves—being filled with vast sets of longitudinal EM waves—are vast superhighways for longitudinal EM waves to travel on or in. The CSRs, being totally LW and LW dynamics in nature, thus are free to travel right through EM radiations from power lines, phone lines, TV stations, radio stations, etc. They easily penetrate any matter, including right through a mountain. Any function of a normal EM system can be performed—at least in theory—by such robots. This includes longitudinal EM wave interferometry, which forms external EM fields and waves, of whatever pattern or form desired. Further, these CSRs are actual functioning systems, and if communications functions are designed in, one can communicate with them at a distance, using longitudinal EM wave communication, right through the intervening earth and ocean, etc.

For some time, extensive underground facilities—hundreds—have been building in the former Soviet Union, and this massive buildup continued unabated after the Russian economy collapsed and the Berlin Wall came down. This tremendous expenditure, when the Russian economy was crippled, shows the strategic significance of these facilities. Further, apparently our satellites have not seen any missiles, normal weapons or munitions, etc. associated with that vast complex. In short, it is suspected that we don't have the foggiest notion of what it is. Indeed, those facilities will already have sent some CSRs into those very satellites, to insure that we do not find out what is going on, and perhaps to "spy on the spy satellites".

We think these terribly important facilities are the KGB-controlled facilities for developing and producing the CSRs, and contain a vast longitudinal EM wave command and control set of facilities as well. In short, this is the strategic arsenal, development, and control for building sets of various type CSRs in huge numbers—a vast new army of robots with unprecedented capabilities, under the command and control of a human "strategic force" operations command of very large size.

Developing and debugging one CSR would be a formidable and lengthy task. Once a single one is developed, making a million copies is simple. Just take a normal CD-ROM, e.g., and record something on it. Send in a working CSR robot to "reside inside" the infolded EM interior of the recorded informational electromagnetic pattern on the CD-ROM. Then simply copy that CE-ROM magnetically, as many times as is desired. Each copy contains a copy of the original signal that was recorded, including the exact infolded electromagnetic structuring inside that signal. Voila! One has as many new duplicate CSRs of that exact type, as one wishes, for a few pennies each.

One can see the implications. In all those underground facilities, there are many development laboratories, production laboratories, and command and control facilities and "storage facilities" for the robots. Those hundreds of facilities are in fact a great new strategic weapon system and all its development labs and production facilities, as well as its tactical control and command and control systems, its "troops", its "equipment", and its commanders and operators.

Well, then one can deploy and "utilize" such a strategic armada just as one would use any other great strategic army. One "deploys" one's forces against the enemy. In this case, one just sends the armada (individually controlled!) right through the "LW superhighways" of matter itself, right into the strategic territory and very heart of the targeted nation. One deploys the robots everywhere—e.g., inside the electronics in nuclear warheads, inside the control systems for the nuclear submarines and nuclear bombers, inside the satellites, inside the fighter aircraft electronics, inside the fighting ships, inside the main battle tanks and major weapons carriers, inside the signals on the hard drives of computers, etc. One sends them right through the "inside" of the targeted nation's power grid electrical energy signals, through the TV stations' emitted signals, etc. The Pentagon and Cheyenne Mountain are duck soup, as is the stock exchange and other civilian systems vital to continued functioning of the infrastructure. So is everywhere else, even the deepest vault and "special security" facility.

In short, the vast electronic command and control activities of an otherwise "modern" superpower provide great, convenient, easy superhighways for full strategic deployment to be completed by millions of weapons systems (CSRs) into everything of value in the targeted nation or nations. This completely solves the usual weapons delivery problem; delivery is made in advance of D-Day.

Such a vast CSR armada was deployed throughout the Western world, and particularly in the United States, just before the end of 1999. Yes, this was to be the KGB's great millennium gift to America—a really enormous Y2K problem that would stun and disable the entire nation, its armed forces, its electronic systems in its major weapons, and its command and control centers in one great TOT (time on target) assault. The major electrical power systems of the nation would have been disabled, as would have been the major communications systems. Using LW interferometry, the robots would have wreaked havoc on the nation. They would have disabled the electronics of every major C4I computer of importance, every major fighter aircraft, every major fighting ship, every nuclear submarine, every ICBM, every nuclear powerplant, etc. The attacking force was in its deployment and employment sites in the targets themselves. Everything was in place and cocked and ready to fire. To test whether we knew what was going on, the KGB even had one or more robots temporarily produce hacker-type operations and signals "emerging" in some U.S. command and control center computers, and deliberately let our fellows discover this "hacker attack" was coming from the Russian Academy of Science. Then the CSR simply stopped its LW interferometry, which caused the "normal hacker electronic" signals to just vanish and never reappear. Little wonder that our counter-type fellows were totally unable to find any trace of it, or where it was residing. They have no technology for such.

Well, happily those early-model CSRs are easy to root out and destroy, if one has quite advanced LW technology. Visualize these beasts as existing in a special sort of "internal sky" or "infolded atmosphere" inside matter. Strategic range LW "radars" can just sweep through this "internal atmosphere" inside matter, etc., detecting and tracking those CSR beasts analogous to how normal radar detects and tracks aircraft. The difference is that the strategic LW can also use a bit of LWI pulse to instantly snap those CSRs like popping bugs, completely jamming their operations or even "erasing" them once their characteristics are observed.

That very new kind of vast strategic warfare occurred right at the end of 1999, all through the United States—the Pentagon, our strategic weapon systems, the works. The friendly little nation rooted out and destroyed all those "on site" CSRs just prior to the attack being launched.

A full-up strategic war, of previously unknown kind, was fought all over the U.S. and our own system guys apparently didn't know it. It didn't even surface. Didn't make a whimper.

That hostile CSR armada consisted of *first generation systems*. These systems did not have defensive countermeasures. The systems were depending on total surprise, but were found out (that is another story that would make a great movie if one could live to film it) and then were destroyed in short order.

CSR development has ushered in a totally new kind of strategic, operational, and tactical warfare. The delivery of all the weapon systems "into the target" is accomplished long before the advent of hostilities. The second generation CSRs, once built,

will be even more sophisticated. These will almost certainly be on line soon. They will likely also possess countermeasures.

An eerie new chapter in the annals of warfare has been initiated, and the world will never be the same again. Once the CSRs have sufficient defensive countermeasures such as stealth means and coordination with countering, rapid response LWIs to target and destroy the hostile "LW radars" seeking them, etc., the next world-wide strategic CSR war will be neither so simple nor so bloodless.

NOTE: Contrast this CSR discussion to the discussion of *nanotechnology* and nanobots. Just as nanobots are natural developments which teams skilled in nanotechnology would produce, so CSRs are natural developments which teams skilled in longitudinal EM wave technology—and in the "infolded" electrodynamics inside all EM fields, potentials, and waves—would produce. For decades (since the 1950s) the KGB has been developing and using longitudinal EM wave interferometers (LWIs) which beam right through the "inner highways" inside the fields and waves inside matter, thus allowing very large LWIs which beam right through the intervening earth and ocean, and can "focus" under the ocean or within the earth as well as out of it. With such background, the CSRs were just as natural a development for them as the nanobots are for conventional Western nanotechnology scientists.

CAUSALITY

The relationship between "cause" and "effect". The basic notion in a causal system is that the system's response to an input signal is not dependent upon future input values.

Thus the notion of causality involves a precise time ordering of ordinary inert interactions, where the cause was never input from a future time. Macroscopic (observable) causality may be and is violated by the interaction of hidden subquantal (virtual state) variables.

CEREBRAL HEMISPHERE

Each half of the cerebrum, i.e., each half of the enlarged anterior or upper part of the vertebrate brain.

The two cerebral hemispheres may function as a longitudinal EM wave interferometer or a time-polarized (scalar) EM interferometer to sense distant scenes (even distant in time), or produce EM energy and signals at a distance, since the body, brain, and nervous system does produce longitudinal EM waves and scalar EM waves. For proof of scalar EM wave interferometry in O(3) electrodynamics, see M.W. Evans, P.K. Anastasovski, T.E. Bearden et al., "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry," **Journal of New Energy**, 4(3), Special Issue, Winter 1999, p. 76-78.

CHANGING THE PAST

Every intentional inception upon ordinary inert causality prior to collapse of the wave function represents a slight alteration or change in direction, departing minutely from pure causality. From a causal viewpoint, each human inception minutely changes the causal past, as well as the future.

Experimental proof that the causal past can be changed is provided by the delayed choice two-slit experiment. E.g., see C.W. Rietdijk, "Another proof that the future can influence the present." **Foundations of Physics**, 11(9/10), 1981, p. 783-790. Particularly see Wheeler, John Archibald Wheeler, "The 'past' and the 'delayed-choice' double-slit experiment," in A.R. Marlow [Ed], **Mathematical Foundations of Quantum Theory**, Loyola University, New Orleans, Louisiana, June 2-4, 1977; Academic Press, New York, 1978, p. 9-48.

CHAOS

In dissipative dynamical systems, the dynamical evolution that is aperiodic and highly dependent upon initial conditions of the system.

The trajectories of the system move on a strange attractor, which is a fractal subspace of the phase space.

The term suggests the ordinary meaning of random and unpredictable disorder, but there exists intrinsic determinism and at least partial embedded ordering. The mathematical equations describing chaotic behavior are very nonlinear and so complex that at the present time they cannot be computed or predicted. Even simple systems, including simple electromagnetic systems, can exhibit unpredictable chaotic behavior. The science of chaotic dynamics is still in its infancy, having begun moving once the modern computers became economical and pervasive.

CHARGE, ELECTRICAL (Q)

Electrical charge q is defined as $q \equiv m_q \phi_q$, to first order.

As can be seen, the actual "charge" action associated with the mass is due totally to ϕ_q, and to the broken symmetry of ϕ_q in the vacuum flux exchange with m_q. The charge q can be further broken down into a set of composite dipoles if the gathering of a virtual charge screen in the vacuum, surrounding the mass of the "bare charge" inside the gathering, is included. At first order, ϕ_q can be expressed (particle view) as a change in the local vacuum virtual photon flux (VPF), due to the VPF exchange between vacuum and m_q. The ϕ_q component is actually the "electrical charge" and massless of itself.

However, see my paper, "Giant Negentropy of the Common Dipole," **Journal of New Energy**, 5(1) Summer 2000, p. 11-23. We include the isolated charge by treating it as a system of multiple composite dipoles. We also explain the previously unrecognized 4-symmetry EM energy flow ongoing, where incoming longitudinal EM waves are being received, transduced into real longitudinal EM waves in 3-space, with the latter being emitted in all directions in 3-space.

A charged particle of mass is thus a little energy flow generator. It is a broken 3-symmetry in the local VPF, and therefore has an "observable" energy flow output, extracted and gated from the asymmetry in the VPF. This "observable" energy flow outputs the well-known energy flow **S** in classical EM, though CEM does not recognize or include this vacuum interaction, the broken 3-symmetry of the dipole, and the steady input of EM energy to the dipole in the form of EM energy from the time domain (complex plane).

Instead, classical EM just assumes that the "charge" q is the source of a potential. When originally formed as a concept, q was just a "quantity of electric fluid," like a "cubic centimeter of fluid," etc. The atom and the electron had not yet been discovered.

CHARGE CARRIERS

Anything—usually fundamental particles, ions, etc.—which consists of or contains charges and can move.

It can be an electron, a collection of electrons fixed in a moving dielectric, ions, atoms, molecules, etc.

The moving charge (i.e., the current dq/dt) with an energy flow streaming onto it and on beyond, carries its interaction with that energy-flow right along with it in the current
i = dq/dt. This is what the charge's "excess collected energy" consists of, and this is how the *collected/collecting* energy in the circuit is transported to the *collected-energy* dissipation sites (loads and losses).

CHARGE, GRAVITATIONAL

To be added

CHARGE, MAGNETIC

Essentially, the magnetic scalar potential, or monopole.

In an uncurved spacetime, the magnetic charge must always occur in dipolar pairs, where each is equal and opposite the other. In a curved spacetime, a free *net* monopolar magnetic charge may and does exist. In classical electrodynamics, the assumption of a locally flat spacetime is ubiquitous though not prominently emphasized. Hence most electrical engineers are unaware that monopoles can indeed be made, but only if one uses a process to curve local spacetime.

CHARGE-PARITY-TIME (CPT) THEOREM

The theorem states that all known quantum field theories obey CPT symmetry.

C is charge conjugation, which changes the quantum number of every particle into its antiparticle. P is the reflection operation known as parity which turn an object into its mirror image and rotates it 180 degrees about an axis perpendicular to the mirror, T is time reversal. Any violation of time-reversal symmetry is always accompanied by a violation of CP symmetry and vice versa.

Electrodynamics and the strong interaction preserve CP symmetry to great accuracy. Weak interactions do not conserve CP symmetry. T symmetry violation has been shown at CERN, the European particle physics laboratory in Geneva, Switzerland.

CHARGE TRAPPING (Also "Pinning")

Holding charges "pinned" or "trapped" by a barrier or force, so that they do not flow as
i = dq/dt.

CHARGE-BARRIER

A process or component or function—particularly in a semiconductor such as the Fogal semiconductor—which blocks the movement of charges q as current dq/dt.

CHARGE-BLOCKING ASYMMETRIC QUANTUM WELLS

A quantum well which has more charge-blocking action in one direction than the other, and is thus "asymmetric" in its function.

It may also be dynamic, so that it changes in its degree (and/or its direction) of action as a function of time.

CLASSICAL AND QUANTAL ELECTRODYNAMICS

Classical EM (CEM) theory is simply classical electrodynamics (CED).

Classical EM does not break the fields into "quanta" (a quantum is a standard-sized piece of action (angular momentum)]. Instead, CEM considers the fields as continuously varying in magnitude from zero to infinite magnitude (at least in theory).

Quantal Electrodynamics is known as quantum electrodynamics (QED). These are standard terms for standard disciplines. QED considers the fields to be composed of quanta called "photons". Hence there is an underlying region called the "virtual state" whose denizens are "smaller in magnitude" than the quantum. Heisenberg uncertainty applies, since the quantum of action is not quantized energy, but quantized (energy x time). In short, it is a function of both the magnitude of the energy and its duration of persistence. Hence a field or photon of any amount of energy may form temporarily, so long as it does not endure sufficiently long in observer time to reach quantum size and breach the quantum threshold.

In this view, then, "empty space" is not empty at all, but is a seething cauldron of these "energetic bubbles" continually appearing and disappearing, with the entire spectrum of frequencies and energies. This is in fact the "new ether". If we consider only the field portion of the bubbling virtual photons appearing and disappearing, this leads to a vacuum that consists of EM field fluctuations, again of essentially the entire frequency spectrum and energy spectrum.

However, how we attempt to tie either of these "energetic vacuum" EM views to general relativity (GR) is then a problem. The cause of the problem, however, is largely ignored in physics. In CED, e.g., one models EM energy moving through a flat space. This is a non sequitur, since the presence of any change of the energy density of space a priori is a curvature of spacetime. Hence rigorously EM energy can only propagate through a curved spacetime. Indeed, when this correction is made, the EM wave becomes an oscillating curvature of spacetime. This is the approach worked out by Mendel Sachs, extending Einstein's work. The higher symmetry O(3) electrodynamics spearheaded by Evans turns out to be an important subset of Sach's umbrella unified field theory. Hence EM has become GR, and for the first time in history, O(3) electrodynamics provides the approach that will allow direct engineering of general relativity on the lab bench, in working devices, etc.

CLASSICAL ELECTROMAGNETICS (CEM)

"Ordinary" electromagnetics, of the kind used in ordinary EM circuits, which fundamentally consists of the modified Maxwell's equations.

Classical EM consists of Maxwell's equations and the various changes and additions that have since been made. CEM does not break the fields into "quanta" (a quantum is a standard-sized piece of action (angular momentum)]. Instead, CEM considers the fields as continuously varying in magnitude from zero to infinite magnitude (at least in theory).

Primarily refers to Maxwellian electrodynamics as reinterpreted by Heaviside, Gibbs, Hertz, and a few others. Unfortunately these reinterpretations of Maxwell's theory also greatly reduced its topology, and therefore reduced the area of natural electrodynamic phenomena that the resulting equations describe.

Significantly more advanced "classical" electrodynamics emerges when one goes back to the quaternion algebra electrodynamics of Maxwell, or to the more advanced Clifford algebra electrodynamics. The higher symmetry electrodynamics models such as O(3) symmetry EM developed by Evans and others, are capable of modeling a great deal more physical phenomena than the very limited standard U(1) electrodynamics largely in vogue in science.

CLASSICAL EM THEORY

Classical electrodynamics theory, begun by Maxwell, with his seminal paper orally presented in 1864 and published in 1865.

Essentially Maxwell's electrodynamics at root basis, with the background supporting classical theory. Today many variations have been made, particularly with the basic symmetry of the theoretical equations. See discussion above under *classical electromagnetics*.

CLIFFORD ALGEBRA

A special higher topology algebra founded by Clifford, which includes as subsets many other algebras of lower topology.

CLOSED SYSTEM

A system that does not communicate with its environment, and does not exchange energy or matter between system and environment.

An ideal model where dynamically and energetically the system is considered to be "isolated" as if nothing else existed. In short, consider the system as if it were in some "magic box" and nothing outside the box can ever enter the box or affect the system inside the box, and nothing in the system can ever leave the box or affect anything outside the box.

One performs a non sequitur whenever proclaiming treatment of a system as a "closed system", and of course good scientists are aware of this. This is particularly true in electrical power systems. Here one is indeed allowed to input energy into the system to excite or potentialize it. That of course assumes that the system was "opened" long enough to take on excess energy! Then as the system operates, losses and dissipations occur, in which case energy is considered to "escape" from the system permanently. In other words, the system was also continually "opened" so that energy could escape.

There is really no such thing as a truely *closed* system in the universe, since every system is embedded in the active vacuum and is an open system in an energy exchange with the vacuum. If that exchange is symmetrical, then the system is in equilibrium with respect to the vacuum exchange. In that case, the system may be treated as if it were a closed system for a limited number of purposes. In classical electrodynamics (CED), the Lorentz regauging of the Maxwell-Heaviside equations further reduced them to describe only Maxwellian systems in such equilibrium with the active environment. Consequently, the interaction between the external vacuum and the system is not included in the CED model. Obviously a *broken equilibrium* in that actual physical interaction is also not included in the CED model.

An electrical power system is already permitted to violate the Lorentz condition when it
(1) receives additional EM energy to "energize" or "potentialize" or "excite" or "regauge" it, and (2) whenever energy escapes from the system in the loads and losses (which escapes of energy are "de-energizing", "depotentializing", "dissipating", or "regauging" actions.

Hence the Lorentz condition greatly simplifies the Maxwell-Heaviside equations and makes them much easier to solve. However, *when enforced by the system itself with regard to the system's excitation and de-excitation (dissipation) functions—i.e., when those functions are "symmetrical" (equal and opposite)*—it also arbitrarily discards all those Maxwellian systems capable of the five "magical" functions of an open disequilibrium system: (1) self-ordering, (2) self-oscillation or self-rotation, (3) output of more energy than the operator inputs (the excess energy is input by the active environment, (4) powering itself and its load (all the energy is input by the active environment, and (5) exhibiting negentropy.

It follows, however, that physical electrical power systems must therefore have some feature which self-imposes the Lorentz condition, at least during the phase when the system's excitation energy is discharged in the loads and losses. The standard closed current loop system, where every electron progressing through the external circuit's loads and losses must be forcibly rammed back up through the source dipole in the power source, is indeed what enforces the Lorentz condition with respect to excitation and dissipation, and *arbitrarily* prevents the system from achieving COP>1.0.

In a battery-powered system, the otherwise closed current loop is broken into two quite different circuits: (1) the electron current circuit between the outer surface of the plates and the external loads and losses, and (2) the ion current in the electrolyte between the inner surface of the plates. Since the ions (e.g., in a lead-acid battery) in the "inner" ion current may have a m/q ratio very much greater than that of the electrons in the "outer" electron current, clever timing of pulsed signals to the plates may be used to form a phase difference—including even a phase angle of 180°—between the two currents. It can be shown that this forms a high potential on the plates which acts as a negative resistor, extracting EM energy from the vacuum and recharging the battery while simultaneously powering the external circuit. This is the Bedini process, and with Bedini's permission an explanation of that process has been published by Bearden ["Bedini's Method For Forming Negative Resistors In Batteries," **Journal of New Energy**, 5(1), Summer 2000, p. 24-38.] Note that Bedini's process in fact repeatedly removes the Lorentz regauging condition, and therefore the system is rigorously permitted to achieve not only COP>1.0 but also self-powering of itself and its loads and losses.

COLD EXPLOSION

The sudden extraction of EM heat energy from a distant intersection zone (IZ) of the crossing beams of a scalar potential interferometer, which transmits in the sharply pulsed mode, while the electrical grounding of the transmitters are negatively biased with respect to the potential in the distant IZ.

COLD FUSION

An ad hoc term applied to the transmutations at low energy achieved in electrolyte experiments, particularly when using specially prepared palladium electrodes, and particularly when deuterium is present in the electrolyte.

COMPOSITE DIPOLE

Dipole formed as one part of an isolated, observable "charged particle", consisting of a differential element of that observable charge on one end and a momentary clustering virtual charge of opposite sign.

In quantum electrodynamics, it is well-known that virtual charges of opposite signs cluster in the immediate vacuum around any "isolated" observable charge. By applying the composite dipole concept, this author was able to treat the isolated charge as a set of composite dipoles. By then applying Whittaker's decomposition of the scalar potential between the ends of each of these composite dipoles, the "source charge" was a set of broken 3-symmetries in the vacuum flux, and thus a set of 4-symmetries in that flux exchange. This meant that the EM energy continuously output in all directions by the source charge was actually continuously received by the source charge (as a set of composite dipoles) from the time-domain, and 4-conservation of EM energy flow rigorously was upheld.

This allowed a solution to what has been called the most formidable problem in both classical and quantum electrodynamics: the problem of the association of the source charge and its associated fields and potentials along with the energy contained by them and continuously pouring from the charge without any 3-space energy input.

CONCOMITANT

Occurring or existing together.

CONGLOMERATE HIERARCHY OF THE PHOTONS

Every photon remains perfectly ordered! A conglomerate (group) of photons, however, may be arranged in almost an infinite variety of orderings, groupings, directions, etc.—which we refer to as templates and as hierarchies (group orderings) of photons.

In a pure energy flow (energy transport), the "herd" of photons is organized along the flow direction. Regardless of how one scatters or "disorders" this patterning of the "herd" or "hierarchical ordering" of photons, not one single bit of the underlying energy and individual photon ordering is lost. So when one "uses" energy (e.g., scatters the hierarchical ordering of a photon herd from a resistor as heat), one does not lose any energy at all, but simply has "scrambled" the hierarchical ordering of the photons into a new herd configuration (which may be varying every which way!). The point here is the real meaning of the fundamental conservation of energy law: *Energy can neither be created nor destroyed!*

When we "use" one joule of energy to perform one joule of work (say, in a single-pass, scattering), we still have exactly that one joule of energy left, but just in different form (different direction, type, collection or not collected, etc.) It can still do another single pass joule of work, then another, then another, and so on. If we plan things right, we can use a single joule of work to perform many joules of work, contrary to what we were so strongly taught in the *"single-pass, single collection, single dissipation"* examples given to us in university as the "law" of God and electrodynamics.

Note that the conventional work-energy theorem assumes single pass, single collection, and single dissipation of a joule of energy to perform a single joule of work. The point is, *that is not a limitation of nature, but a limitation of a single process! Nature regularly uses a joule of energy to do multiple joules of work, because after one dissipates or scatters the energy the first time, it's still there and later will be intercepted to do some more work.*

Anti-Stokes emission, the Patterson Power Cell, Lawandy's lasing without population inversion, and some gas-filled tubes with anti-Stokes emission are examples of known, validated overunity processes (processes with coefficient of performance greater than unity). These all use multipass, multicollection, multi-dissipation in iterated manner, to increase dipole asymmetry and therefore produce excess extraction of energy from the vacuum. Patterson's unit, e.g., has been independently measured by universities at efficiencies of some 1200 or so. This absolutely does not violate the laws of physics nor the nonequilibrium thermodynamics of open systems far from thermodynamic equilibrium.

CONSCIOUS MIND

The serial processing mind which we normally associate erroneously as ourself. Other to be added.

Mind is time-like, not space-like.

CONSCIOUS MIND (PSYCHOENERGETICS VIEW)

The serial-processing mind which one normally associates erroneously as oneself.

Mind is *time-like*, not *space-like*. Hence it is not directly observable, a priori, since all observation is 3-spatial. However, if we consider that changes in 3-space produce spacetime curvatures and thereby also produce slight changes in the time domain, then iterative coherent spatial changes eventually will produce a change in the time-domain. Consequently, the time-like mind will have a continuing stream of such small but processable time-energy changes from coherent 3-spatial phenomena in its body and the macroscopic (coherent) universe. To sense the 3-space body as "self" while simultaneously sensing other 3-space physical changes as "non-self", the conscious mind must compare the various received time-like projection signals against its "time-like orders" issued. That set of received time-signals that matches or closely matches the conscious mind's issued order signals, thus yields the sense of the body behavioral changes as (1) self, and (2) body responses to its orders. The time delay between issuance of the mind's orders and the receipt of the correlated time-like responses from its body, provides the sense of self-persistence or independent being.

The mind couples to the body via a similar spacetime curvature mechanism. When the mind issues "orders", they are in the time-like realm but are changes, hence small spacetime curvatures. They therefore involve very small 3-spatial changes (projections) into the 3-space body. Since the mind orders are coherent, this small iterative set of 3-space changes will integrate coherently, yielding real quantum changes in the body and nervous system (e.g., the brain).

This coupling mechanism is profound. The steady stream of integrated time-like projections arising in the mind due to the physical world outside one's body, does not compare or match the mind's memory of its orders. Hence that allows the sensing of the "external world" as "nonself". The sense of that external world as "existing" or "being" is provided by the time delay in the comparison process, from "mind signals issued" to "physical signals received". The metric yardstick standard for this comparison time, so to speak, is provided by the time in the identified "self-loop" with the physical body. In other words, the mind uses that length of time to differentiate those time signals which coherently integrate but do not match its issued order signals, from those time-signals which coherently integrate in the same time loop interval and do match its issued ordered signals.

In this manner, we resolve all the great previously unresolved philosophical questions of the nature of consciousness, nation of being, nature of self, nature of nonself, perception of the physical world, perception of body as self, perception of other bodies as non-self, etc. At least we resolve these issues from a testable physics approach, so that we can see that now a unified physics (and a technology) of mind and matter is at last in view. Since O(3) electrodynamics has been shown to be an important subset of Sachs' unified field theory, then O(3) electrodynamics—or SU(2)×SU(2), which is homomorphic with O(3)—can be used to develop the direct engineering of mind, the mind-matter interaction, and mind functions of the living biological system.

It is my considered opinion (with much evidence) that the Russian branch of *energetics*, known as *psychoenergetics*, uses a unified field theory and a higher symmetry electrodynamics to achieve that type of direct engineering already, but for weapons use rather than beneficial use for humanity.

As examples, we strongly suggest that the deaths of U.S. Captains Button, Svoboda, and Hess all involved KGB testing of long-range strategic psychoenergetics weapons over the United States, on those targeted personnel. This should not be surprising at all; the KGB has tested longitudinal EM wave interferometer weapons over the U.S. since 1967, and continues to do so today. They tested bioenergetics EM weapons against U.S. Embassy personnel in Moscow for several decades. Kills of U.S. aircraft and missiles have been performed at various times, including kill of the Arrow DC-8 at Gander, Newfoundland in Dec. 1985, kill of a Titan ICBM fired from Vandenberg AFB in the spring of 1986, kill of the U.S. space shuttle Challenger in the spring of 1986, continuing weather engineering over the U.S. and elsewhere, etc.

That novel electromagnetic weapons have indeed been developed and are being tested world-wide, was confirmed by Defense Secretary Cohen in 1997 as follows:

"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our [counterterrorism] efforts." [Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.].

We specifically call attention to the fact that the Secretary did not speak the words enclosed in square brackets. This is *not* limited just to terrorists or counterterrorism.

There appears to be no insurmountable difficulties in developing psychoenergetic technology using the approach outlined above. Certainly it is not as formidable a task as has been hot fusion.

The incident involving Captain Button, e.g., was to demonstrate control of an individual performing complex technical tasks for a period of at least one hour. The test against Captain Svoboda was to demonstrate how simply human kill can be achieved in combat troops, merely by introducing selected changes in the mental functioning of the targeted individuals. As Svoboda was climbing her A-10 out of a successful low-level ordnance drop at night on a ground target, her sense of up and down was instantly reversed. Instantly perceiving she was diving instead of climbing—although *actually* climbing out perfectly—she "corrected" immediately and dove headlong into the ground, perishing in the resulting explosion of her aircraft.

In the case of Capt. Hess, the test demonstrated that rather complete mental control can be almost instantly asserted, and even the responses of the autonomic nervous system can be overridden. So Captain Hess, out for a morning jog, simply went aside, sat down, and stabbed himself repeatedly, including multiple times right through the heart. Had one seen the incident, he would have simply continued stabbing himself very calmly, without emotion or reflex action from his autonomic nervous system, until physical failure of his body.

As can be seen, it is of the utmost importance that this nation understand psychoenergetics weapons of such nature, and develop effective defenses against them. The next great strategic battlefield may be as much a "virtual reality" battle as it is a "real physical world" combat. The war can be quickly lost in either arena.

We also point out that the psychoenergetics weaponry readily is adapted to use in more advanced longitudinal EM wave interferometers, which readily penetrate the Earth and the ocean. Hence deeply buried strategic command and control centers are vulnerable to psychoenergetics warfare, as are the crewmen of our nuclear submarines, ICBMs, aircraft carriers, division and army command centers, national command centers, strategic bomber pilots, etc.

Indeed, one of the major incentives for developing such psychoenergetics weapons as was demonstrated in controlling Captain Button, was to seize and control the entire on-site manning crews of the defensive quantum potential weapons preventing launch of full strategic warfare. By having the QP systems "stood down for maintenance" by their own crews, the major strategic retaliation and "dead man fuzing" would have been removed and countered. Then powerfully striking the QP sites with LWIs would have destroyed them, and left the sites themselves radioactively emitting longitudinal EM waves, thus preventing reoccupation in case the QP weaponry survived. The counter to that scheme was to place the friendly QP weapon sites on "insane" command and control. In that mode, instead of human decision being made to launch, every so often (say, every two hours) the computer automatically initiates the launch sequence. During that sequence, if the crew is still alive and functional, codes can be punched in and the computer cancels the launch initiation. It then repeats the sequence two hours later. If no coded cancellation order is punched in, for whatever reason, the launch sequence completes and the QP weapons fire. In that case, much of Russia disappears from the face of the earth.

Eerily, just about the time that Secretary Cohen was making his quoted statement in April 1997, the KGB was being notified by the friendly little nation of the change to insane command and control. This forced the abortion of a great strategic attack upon the West, scheduled to occur on May 1, 1997.

We are strongly stressing that psychoenergetics is not parapsychology and it is not just an idle theory of academics. Instead, it is already potently used in some very powerful and deployed weapon systems that could well decide the course of the next world war, almost at a moment's notice.

See also discussion under *energy*.

CONSCIOUSNESS

Refers to a living being's awareness of its sensations, feelings, thoughts, and the world around it.

The new approach uses a coupling mechanism between the time-like mind and the body of a living creature. The nature of this coupling mechanism then generates the mechanism by which self-awareness is produced, awareness of non-self is produced, and the sense of existing in the external world but differing from it is produced.

CONTINUOUS MODE

For a longitudinal EM wave interferometer, a continuous mode of operation where power is fed continually to the transmitters, and the two longitudinal EM wave patterns or beams are continuously transmitted.

CONVENTIONAL SCALAR POTENTIAL

A scalar potential formed without use of artificially added substructuring of its internal biwaves and their products.

In other words, one in which it is assumed that its virtual particle flux has no ordering, but is just a randomized flux. This assumption (e.g., of quantum mechanics indirectly) is incompatible by the Whittaker demonstration that (i) a scalar potential is a harmonic set of "bidirectional" EM phase conjugate wave pairs, and thus not a scalar entity at all, and (ii) perfect ordering of its wave components exists inside the scalar potential.

One must carefully distinguish what each of these internal "phase conjugate EM longitudinal wavepairs" actually represents. Prior to interaction with detecting charges, the potential is a 4-potential existing in spacetime (4-space). The time domain, of course, is represented by ict, and in that expression only "t" is a variable. Hence the "incoming" phase conjugate longitudinal EM waves in the imaginary plane are actually longitudinal EM waves in the time dimension. These waves converge upon the dipolarity represented by the "scalar potential" or any "piece" of it. The dipolarity represents the interaction of charges; specifically, a dipole. This reaction—by the spin of the charges—transduces the incoming EM energy from the time-dimension into 3-space, and emits it from the charges as real EM longitudinal EM energy radiating out from the dipolarity in all directions in 3-space.

The phase conjugate half-set of the Whittaker waves, *prior to their interaction with charge*, are not waves in 3-space, but are waves of LW EM energy coming in from the imaginary plane and thus from the time domain. The charges of the dipolarity spin 720°, being 360º in the complex plane and then 360º in real 3-space. So the charges absorb the EM LW energy impinging on them from the time domain, during their 360º rotation in the complex plane. When they enter real 3-space for the rest of their

spin, the already-excited charges dissipate their excitation energy in all directions as they spin their 3609º in 3-space. That is what the Whittaker decomposition actually shows, but it has been ignored for almost a century.

In short, the broken 3-symmetry of the dipolarity—well-known in particle physics for nearly a half-century, but never incorporated into CED—allows nature to jump to a higher, more fundamental 4-symmetry in the energy flow. Energy is being conserved in 4-space, but not in 3-space. Further, there is a special new energy flow symmetry involved: one-way in the time domain and the other way in the 3-space domain. Note that energy is not conserved in 3-space! *There is no law of nature requiring the extra requirement that, in addition to conservation in 4-space, the energy must also be conserved in 3-space!* So when the dipole breaks that extra requirement, only the basic 4-conservation applies. In that case, nature very happily gives you what might be called a white hole in astrophysics terms: energy will pour in to the dipolarity unceasingly from the time-dimension, and will pour out in 3-space unceasingly, so long as that dipolarity persists.

By considering the virtual charges of opposite sign that cluster in the vacuum around any "isolated observable charge", one may represent a single charge (as an electron or proton) as a set of composite dipoles, where each dipole consists of a virtual charge (while it exists) and a differential element of the observable charge. So the charge becomes a set of composite dipoles, each with Whittaker decomposition of the scalar potential between its ends.

Hence we have solved the long-vexing problem that Semiz called "the greatest unsolved problem in electrodynamics": the problem of the source charge (or source dipole) and its associated fields and potentials and the enormous EM energy continually pouring out of any charge or dipole in all directions in 3-space.

When the arbitrarily discarded giant Heaviside nondiverged energy flow component is also accounted, this leads to the giant negentropy of the dipole, as shown in my paper, "Giant Negentropy from the Common Dipole". We have also proposed this "dark Heaviside energy" as the unaccounted source of the excess gravity known to be present in spiral galaxies and holding together their arms. The dark energy yields at least 90% of the total gravity involved, and the additional 10% or so can be accounted for my known gravitational sources.

It appears that these new discoveries can also be utilized to show that "quintessence" is also caused by COP>1.0 processes in the universe, and the excess production of negative "giant dark energy flows". If so, then this also would account for the recently discovered fact that the universe has an excess of negative gravitation, so that it is not only expanding but is accelerating in that expansion. At this time, the present author is still attempting to tie up the loose ends involved in showing that quintessence also is created as a result of functions of the giant negentropy process.

In the Whittaker biwave pairs, If one then insists that these hidden EM waves are comprised of hidden photons, then it follows that the photons exist as continually coupling and uncoupling photon/antiphoton pairs, or continually forming and unforming *gravitons* as the wave and antiwave continually pass through each other.

It is a little more complicated than that, since Maxwell actually omitted half the EM energy in the EM wave in space, and also in the circuit—as do electrodynamicists to this day. For gravitons, one really must come to grips with this error and correct it. This will be added later in this glossary. (To be Added).

COOPER PAIR

A dynamic pairing of electrons in superconductivity theory.

In this pair, if the energy state with wave number σ and spin ½ is occupied by an electron, then so is the state with wave number - σ and spin – ½.

COP (COEFFICIENT OF PERFORMANCE)

Ratio of energy out, divided by that portion of the total energy input that is input by the operator or experimenter.

The COP is thus a measure of "efficiency of using the operator or experimenter's input energy" to produce—or direct the production of—useful work. Note that he can direct the use of his own input energy, as almost all our present systems do. Better yet, he can also direct (gate or "switch") the use of some external free flow of energy from the environment into the system, so that he gets lots more work out of the system than he has to put in himself. Only a few of our systems—such as solar cells, sails on sailboats, waterwheels to power mills, and windmills—are such Maxwell's demons (open systems) where the output exceeds the operator's input of energy.

We sharply contrast the term "COP" to the term "efficiency". The efficiency (overall) of a system is how much useful energy output (usually as work, or can be converted to work at will) the system produces for the total amount of energy that is input (both by the operator and by the external environment). Even a highly inefficient system may nonetheless have a COP>1.0, if the operator inputs less energy than the system outputs.

We urge the reader to thoroughly understand the difference between energy-use "efficiency" of a system and coefficient of performance of the system. Many scientists, engineers, and especially free-energy researchers are confused on the precise difference in these terms.

CORPUS CALLOSUM

The thick nerve cable that links together the two cerebral hemispheres (which are separate brains) in each vertebrate (including human) brain.

In each of the two cerebral hemispheres, there is a separate mind and personality (given that the other is separated). However, a brain has a unique characteristic: Anything that arises directly inside it is automatically assumed to be self-originated, since the brain-tuner can differentiate no separation or "separate source" for the signal/thought arising directly upon its "internal screen". This allows integration of the two brains/minds/personalities into one. That is, when one brain half prepares and sends a message, that message is also routed across the corpus callosum into the other brain half, arising internally upon the second brain's "display." The second brain half therefore thinks that it itself originated the signal or message.

COSMOLOGICAL FEEDBACK PRINCIPLE

Puthoff's self-regenerating cosmological feedback cycle for the source of the vacuum EM ZPE.

One may assume the existence of EM zero-point energy (ZPE) by fiat as part of the boundary conditions of the universe, or conceive of its generation by the quantum-fluctuation motion of charged particles that constitute matter. Puthoff calculated the latter possibility, assuming that the ZPE spectrum (field distribution) drives particle motion, and that the particle motion in turn generates the ZPE spectrum. This provides a self-regenerating cosmological feedback cycle, which in fact is consistent with the general relativity assumption that curvature of spacetime affects mass energy, and mass energy changes affect the curvature of spacetime.

The result of Puthoff's calculation is the appropriate frequency-cubed spectral distribution of the correct order of magnitude. His result is thus consistent with, and indicates, a dynamic-generation process for the ZPE fields.

In general this is also consistent with the Sachs' unified field theory approach, and with the Evans O(3) important subset of it.

COURRIER, ROBERT

Noted French scientist who collaborated with Antoine Prioré in his revolutionary healing experiments on laboratory animals using longitudinal EM waves from plasma tubes.

Courrier was the head of the Biology Section of the French Academy and also the perpetual secretary at the time. He personally presented the astounding results of the Prioré work, showing cures of terminal tumors, to the assembled French Academy, creating a furor.

CROSSTALK

In ordinary science, the transfer of energy or signal from one channel to another, by cross modulation or cross coupling between the channels.

In the new approach, the term "crosstalk" can be used in an additional sense where it refers to virtual energy exchange between orthogonal universes or frames—that is, between different 3- or 4-dimensional slices of an infinite-dimensional universe.

CURL CONCEPTS OF FIELDS

Refers to concepts of fields as the curl of some vector potential;

E.g., the magnitude of the **B**-field is equal to the curl of the **A**-potential, given by $\mathbf{B} = \nabla\times\mathbf{A}$. More exactly, the **B**-field is identically a curled **A**-potential, by $\mathbf{B} \equiv \nabla\times\mathbf{A}$, but only that portion of $\nabla\times A$ that is diverged around or collected by an intercepting unit point static charge.

Note that we are accenting that no equation is a definition. So texts stating that the first equation with an equals sign "defines" the magnetic vector potential **A**, are in error. If we state that $\mathbf{B} \equiv \nabla\times\mathbf{A}$, then we are defining the **B**-field as a curled form of the magnetic vector potential, which it is.

The reader must be aware that the field concept itself in CEM is flawed, being "defined" as the effect existing after an interaction by a 4-space entity with a 3-space mass, and hence
3-spatial and an "effect", and yet then used as if it were the 4-space "cause" entity that propagates in 4-space to interact. In short, the field concept is thoroughly confused in the texts and papers in the literature (and has been confused for more than a century) as not only the cause but the result of the interaction of the cause with some recipient. This problem has been highlighted by many physicists, including Feynman, Wheeler, etc.

This "confusion of the cause with the effect" is widespread in physics, and is the single greatest foundations error which hampers the progress of physics. Another example is the false notion that a "separate force" acts upon a "separate mass", when in fact mass is a component of force by the definition $\mathbf{F} \equiv d/dt(m\mathbf{v})$. That such simple and obvious errors have been propagated by so many hundreds of thousands of scientists for so many decades is perplexing. Indeed, the errors simply continue to be used. Note that Nobelist Feynman and the great John Wheeler pointed out that the "field" as defined in CEM does not and cannot exist in spacetime! Instead, Feynman pointed out that only the potential for the field exists in spacetime, in case some charged mass is brought in to interact with it and *thereby produce* the field as an effect.

Indeed, no observable persists, for it "exists" only as a momentary 3-space frozen snapshot or slice of a 4-space dynamic interaction. Here again, most physicists do not realize that observables such as mass m do not and cannot persist other that at the instantaneous frozen moment of the snapshot.

CURL-FREE MAGNETIC VECTOR POTENTIAL

A field-free magnetic vector potential without curl, hence with no **B**-field.

Toroids and long solenoids have the characteristic of separating the **B**-field (curled potential) and holding it inside. However, drawing energy from any potential whose "source charge or source dipole" is not destroyed, simply results in the full value of the potential being replenished from the vacuum, via the 4-symmetry energy flow mechanism in the presence of the broken 3-symmetry of the dipole. Hence one may easily "double" the potential energy density at will, and this is a special form of gauge freedom, where the potential energy of any electromagnetic system can be altered freely and at will. We strongly accent that, contrary to what is in the EM textbook, gauge freedom rigorously allows the direct and free amplification of potential energy of the EM system at will. That this principle, incorporated in gauge field theory, has been known so long and still not used in the design, production, and use of COP>1.0 electrical power systems is quite inexplicable.

In the motionless electromagnetic generator, we used a special core material to extract the curled potential (**B**-field) from a permanent magnet's vector potential **A**, so that **A** is replenished in uncurled form directly from the vacuum via the giant negentropy process.

To achieve COP>1.0, we then simultaneously interacted both the uncurled **A**-potential energy external to the output coil, and the internal curled **A**-potential energy (**B**-field energy) internal to the core through the coil, with the coil. By pulsing, the Lenz law effect is also invoked as yet another momentary regauging and potential energy increase, so that an additional energy gain is achieved.

The well-known Aharonov-Bohm effect proves that the uncurled **A**-potential can indeed be separated from the **B**-field in like manner, and the **A**-potential does interact with electrons since $d\mathbf{A}/dt = -\mathbf{E}$.

Thus the MEG achieves COP>1.0 permissibly, because it is an open system freely receiving excess energy from the active vacuum environment, via the vacuum's replenishment of the magnetic vector potential of the permanent magnet dipole as fast as energy is drawn from it. The MEG also violates the usual closed current loop's self-imposition of Lorentz symmetrical regauging when discharging its excitation energy (its free excess regauging potential energy), because the "source dipole" (the permanent magnetic dipole) is not destroyed.

CURVED SPACETIME (externally, internally)

A four-dimensional geometry used in general relativity, where the curvature is determined by the distribution of mass-energy.

In the new, more extended approach, any change in the spatial energy density of spacetime or any change in the time-energy density of it, or a combination of changes in both. The difference is that in the new approach time is also treated as a special form of energy. Specifically, time may be regarded as spatial EM energy compressed by a factor of c^2.

CYBORG (An acronym for cybernetic organism).

(Noun): A single integrated system consisting of a living system energetically or functionally linked to mechanical or electromagnetic devices and/or systems performing some vital functions.

(Verb): Link, in the sense of forming such a system.

In the new approach, a living biological system may thus be considered a cyborg of its time-like mindworld (mindframe) to its 3-spatial body (laboratory tuner). The "cyborging" is provided by the personal quantum potential and by the mind-body coupling mechanism. Due to the giant negentropy mechanism of any dipolarity, any scalar potential as a dipolarity is a cyborg between observable reality and virtual state (time-like) reality, i.e., between 3-space and the time-domain.

CYTOMEGALOVIRUS

Any of several members of the herpesvirus family that cause infected cells to enlarge and/or to form cytoplasmic (the protoplasm of a cell, external to the nuclear membrane) inclusions in leukocytes (white blood cells), particularly in their nuclei.

Cytomegalovirus makes a protein that appears to disable the p53 protein. As a result, smooth muscle cells in blood vessels can proliferate until they impede blood flow.

CYTOPATHOGEN

Literally, a pathogen (disease causing organism—or extended, mechanism—) that affects cells and generates damage in them.

CYTOPATHOGENIC

Damaging, harmful, or destructive for cells.

CYTOPATHOGENIC EFFECT

The generation of damage, disease, death, or other symptoms at the cellular level in cells that are exposed to or subjected to a pathogen.

CYTOPATHOGENIC MIRROR EFFECT

Distant EM pathogenic effect noted by Kaznacheyev in thousands of military experiments, where cellular death, disease, and damage forms are shown to be transmitted from one cell culture in the dark (absence of visible light) where the changes are induced, to another similar targeted cell culture in the dark that is environmentally shielded from the first except for light transmission in the infrared and in the ultraviolet. After exposure begins, after a time delay (say, 2 hours or more), the cells in the targeted cell culture will begin to exhibit the same symptoms as the culture having the induced damage. Eventually, in most cases the targeted cells will develop the same damage, disease condition, or death. The effects vary with the time of day etc.

The necessity for photon connection from IR to UV is shown by contrasting a thin quartz window allowing the light transmission with a thin window glass window. The quartz is open from the IR to the UV, and will pass that entire spectrum. With the visible light absent, the IR and UV biophotons emitted by the damaged cell culture will pass through the quartz window into the targeted cell culture. After the time delay, the targeted cell culture starts developing the condition.

Use of a thin window glass window, however, prevents the effect. Normal window glass is opaque in the IR and in the UV, and so it blocks the transmission of the IR and UV biophotons.

The UV is a harmonic of the IR, arranged properly. An unusual effect exists when two sine waves one the first harmonic of the other, are simultaneously transmitted into an isotropic nonlinear medium, such as water. On each sine wave, the peak travels faster in the water than off-peak parts of the wave does. Hence the wave peaks overshoot its middle, the wave collapses, breaks up, etc. Both the waves of the transmitted harmonic set do that. However, if one pretends that one transmitted the difference frequency between them, and not the waves themselves, a strange phenomenon results. Regardless of the breakup of the primary harmonic set, the difference frequency travels through the water as if it were a real frequency in a linear medium. This effect has been proven and is used in underwater sonar equipment.

For example, see Owen Flynn, "Parametric arrays: A new concept for sonar," **Electronic Warfare Magazine**, June 1977, p. 107-112. Any two sine-wave frequencies as simultaneous drivers combine to produce a sine-wave difference frequency propagating in water, essentially without sidebands or reverberations. Its pattern has a main lobe approximately equal to that of the high frequency drive, but devoid of sidelobes. The level of the propagating difference frequency is proportional to both the product of the two fundamental drive levels and to the square of the desired value of difference frequency.

Living cells contain a great percentage of water. Hence the effect should apply to those targeted cells, under the conditions stated.

From general relativity, we know that any pattern and dynamics of mass-energy, such as in a cell and all its parts and dynamics, directly interacts with local spacetime to curve it, and any set of curvatures of spacetime interact with any conglomerate of mass-energy and its parts and dynamics. The set of precise curvatures and their dynamics we call an engine. In a mass embedded in a local region of spacetime containing an engine, the engine will interact with the mass-energy to change it if the mass-energy and its dynamics do not "fit" the engine and its dynamics.

In a diseased, damaged, or dead cell, the mass-energy of that cell and its "template" (form and dynamics) differs from its template while the cell was living and normal. Let us now see what happens when that dead cell emits a biophoton.

A photon emitted from a dielectric such as a damaged cell, is not emitted just from one spot. Every part of the dielectric participates in the emission of that photon. (See "porthole concept", to be added). Further, each emitted photon contains in its scalar potential and its magnetic vector potential, the exact longitudinal EM waveset that constitutes the vacuum engine of the damaged cell that emitted it. When a cell absorbs a photon, it absorbs that vacuum engine carried by the photon also. If it absorbs a stream of photons of harmonic interval, the difference frequency constitutes in terms of a wave, traveling through the cell water as if in a linear medium, and transporting that vacuum engine to every part of the absorbing cell dielectric.

So the biophotons emitted from Kaznacheyev's damaged, diseased, or dying cells sent biophotons containing the exact spacetime curvature engines and dynamics of their precise condition (template). Further, a harmonic interval of such radiation is transmitted into the targeted cells, and absorbed. The mixing of the two absorptions eventually is sufficient to establish the harmonic interval, thus with a clear EM signal difference that travels through the cell's water and to every tiniest part of it. This "difference frequency clear signal" also contains the pure vacuum engines of the template of the changes in the diseased, dying, or damaged emitting cells.

The result is the "kindling" (coherent integration) of the template in the absorbing cell's local spacetime in which it is embedded. As that spacetime engine grows, it differs from the resident engine of the absorbing cell. That difference is itself an engine, and it operates steadily upon that absorbing cell to alter its engine and then its physical condition and state.

As the new engine continues to interact, the physical cell is gradually changed into an equilibrium condition in its mutual interaction with its local spacetime engine. That occurs after the absorbing cell has developed the same disease, damage, or dying condition as the transmitting cells.

This is the secret of the Kaznacheyev experiments. The Kaznacheyev work was allowed to be released in the open literature to stimulate the U.S. scientific and intelligence communities and see whether or not the scientists and analysts had applied a unified field theory and higher symmetry electrodynamics to the EM bioeffects problem. The totally casual reception of the Kaznacheyev experiments in the West, with no interest or interaction from the stimulated communities, assured the KGB conclusively that the West was still in kindergarten in its knowledge of EM bioeffects, and particularly had little or no knowledge in the field of EM biological warfare.

Kaznacheyev referred to the effect as the "cytopathogenic mirror" effect, for the pathogenic effects from the emitting damaged cells being "mirrored' in the targeted cells.

See Vlail Kaznacheyev and L. P. Mikhailova, **Ultraweak Radiation in Intercellular Interactions**, [in Russian], Novosibirsk, 1981. An English exposition of much of the Kaznacheyev work is given in Vlail Kaznacheyev, "Electromagnetic Bioinformation in Intercellular Interactions," **Psi Research**, 1(1), Mar. 1982, p. 47-76. See also Vlail Kaznacheyev, "Apparent information transfer between two groups of cells," **Psychoenergetic Systems**, 1(1), Dec. 1974; Vlail Kaznacheyev *et al*., "Distant intercellular interactions in a system of two tissue cultures," **Psychoenergetic Systems**, 1(3), Mar. 1976, p. 141-142. In the same issue, see "A Comment" by William A. McGarey, p. 143; "A Comment" by Arthur C. Hastings, p. 143-144.

Seven or eight nations now have longitudinal EM wave interferometer weapons, capable of beaming right through the earth and ocean to the other side of the planet. At least two of these nations—Russia and China—are capable of adding engine structures to these interferometers, and sweeping a targeted population area to generate that specific disease condition in that target. A sophisticated use would be to have agents (such as terrorist teams already in the United States and with biological agents in hand) release a small quantity of smallpox in the area previously targeted. The LWIs have swept the entire area continuously for a period, slowly kindling (especially at night) the exact form of the disease within the bodies of the populace. A curious thing happens if the level of kindling of the smallpox state has been kept just beneath the observable state, within what is sometimes called the "shadow state" (just barely virtual). A smallpox pandemic will explode in that populace with a ferocity never seen in modern times, and at an unparalleled rate. This is further exacerbated by "spreading the immune system" prior to the attack (term and discussion to be added), which seriously weakens the immune system's ability to resist any single pathogenic attack.

There are hardly any supplies of smallpox vaccine left that are viable. Even where there are, the Russian laboratories developed strains of smallpox resistant to the normal vaccine, and after the collapse of the Russian economy and the former Soviet state, these strains were sold on the black market to the highest bidder. Further, most of the Soviet scientists employed in those secret biowar facilities wound up employed in several other nations, most hostile to the United States.

The point is this: Such a strike could in fact kill up to 2 billion people worldwide. Further, the entire affair would appear to be just a chance breakout of smallpox, and its spread through a nonresistant world populace.

When modern biological warfare is actually analyzed in detail, the "bang for the buck" is greater than it is for nuclear weapons. Further, a rogue or hostile nation can take its time in advance and develop quantities of smallpox vaccine (for the very strain it will use), then initiate such a clandestine campaign after it has vaccinated its own populace, armed forces, and agents. Guess who survives after such an attack.

CYTOTOXIC

Toxic (acts as a poison or toxin) to cells.

A *toxin* is a colloidal proteinaceous poisonous substance that is a specific product of the metabolic activities of a living organism. The toxin is usually very unstable, and is notably toxic when introduced into the tissues.

DARK ENERGY

The Heaviside nondiverged energy flow component, surrounding every field/charge and potential/charge reaction but unaccounted in present electromagnetic theory after being arbitrarily discarded by Lorentz.

DATUM

Consideration, or data considered, or information considered, or action considered, or result considered.

DEATH

The disintegration of the personal quantum potential's connection to the physical body's atomic nuclei by loss of the mind-body connection mechanism.

Simply put, separation of the quantum potential containing the time-like mind-frame from the body. Loss of the preferential tuning of a physical body to its mindworld. This causes loss of the preferential consciousness loop or life channel, resulting in "death" (reversion to inert matter) of the body. Actually the quantum potential and the mind-frame remains, so the *being* is unchanging and indestructible, hence consists of all changes and destructions simultaneously, with none separated individually. Life and death thus are two sides of the same coin, and the coin is immutable, regardless of which side is exposed.

DE BROGLIE WAVE

A matter wave, conceived by Louis de Broglie.

The quantum mechanics wave associated with a particle of matter, which can give rise to interference effects. An orbital electron in an atom is associated with a standing de Broglie wave on a Bohr orbit. De Broglie waves always move faster than the speed of light, the speed being given by c^2/v, where c is the velocity of light in vacuum and v is the velocity of the particle of mass. De Broglie wave velocities thus vary from the speed of light to infinite speed (everywhere at once). In his speech accepting the Nobel Prize, de Broglie emphasized that, since these waves produce real physical effects, they are real and must not be regarded simply as mathematical conveniences.

DEBYE, PETER

Dutch-born American physical chemist and Nobelist, 1884-1966, who performed important and fundamental studies in bipole moments and diffractions of X-rays and electrons in gases.

DEDIFFERENTIATION, CELLULAR

The reversion of a cell or cellular structure to a more primitive or generalized condition.

Dedifferentiation is often preliminary to a major change in the cell or cellular structure. It can also be a reversion of the cell to a previous—even *primeval*—cell form. The important point is that dedifferentiation returns the cell to a previous (past) cellular state. Reversion of a cancer cell, e.g., would cause the cell to return to a normal cell, since that is the nature of its "cellular past." It is vitally important that Becker has demonstrated that cells can be differentiated (moved forward to a future state) or dedifferentiated (moved backward to a previous state) electrically, by very weak DC currents (picoamperes). He was nominated for a Nobel Prize for this epochal work.

Actual electromagnetic redifferentiation of terminal tumors in laboratory animals was repeatedly demonstrated by Prioré et al in the late 60s and early 70s and reported in the peer-reviewed French medical journals, as was reversion of depressed immune systems, cures of infectious diseases, and curing of arteriosclerosis. It is inexplicable that this positively demonstrated cure of cancer—which could also cure infectious diseases and probably can be developed to cure AIDS—was suppressed in the mid-70s and has not been vigorously pursued by present establishment medical science.

DEGENERATE SEMICONDUCTOR

A semiconductor whose conductivity approaches that of a metal.

DELGADO, JOSE M. R.

Noted Spanish neurophysiologist well-known for his research on brain behavioral mechanisms and their control by electrical stimulation; who implanted electrodes in the brains of animals and humans and demonstrated that their responses (both behavioral and emotional) were specific and depended upon the specific localized part of the brain that was stimulated.

A TV tape made by Delgado showed a spectacular demonstration where he stopped a charging bull in mid-stride. With a small hand-held radio transmitter, he transmitted a radio signal to a receiver implanted in the head of the bull. This dramatic demonstration caused a world-wide sensation.

The significance of his work is given by Becker: *"Delgado discovered the exact parts of the brain in which electrical stimulation produced fear, anxiety, pleasure, euphoria, or rage in human subjects. He found that certain sites produced major personality alterations. For example, stimulation of one such site could cause very proper, reserved young ladies to become flirtatious and sexually aggressive. Other sites inhibited maternal or aggressive behavior. In short, Delgado was able to profoundly alter human behavior through electrical stimulation of discrete areas of the brain." … electrodes were implanted in the pleasure centers of rats' brains. The animals were provided with two levers to press. One of these delivered food, and the other produced electrical stimulation of the pleasure center. Invariably, the rats chose to press the lever that stimulated the pleasure center, even to the extent that they died of starvation*." (Becker, **Cross Currents**, p. 221-222).

It is known based on a rare OMNI interview that Delgado progressed to detailed study and experimentation for the behavioral and emotional effects in monkeys of specific magnetic field frequencies on monkeys. These successful experiments involved electrical currents produced in the brain but hundreds of times lower in intensity than those required for direct electrode stimulation. Since then, some information has been cautiously released from Western military studies showing that microwave pulses can couple to the central nervous system and produce stimulation and behavior alteration similar to Delgado's released experimental results.

Comment: The ultimate and most refined techniques in the field of electromagnetic control of human behavior, volition, emotion, etc. is provided by Russian psychoenergetics, the military version of which is totally under KGB control. This work has progressed far beyond what Delgado and Becker were discussion so long ago. The use of the infolded longitudinal EM waves and "engines"—once the technology is developed—allows direct engineering of conscious and unconscious mind, memory including short term and long term, perception, awareness, etc. The additional advantage of using EM longitudinal waves is that mass is largely a very thin dispersion of particles, with (relatively speaking) very large distances between them, somewhat like the solar system but on different scale. This "inner space" is filled with EM waves, potentials, and fields—all of which decompose into sets of longitudinal EM waves and their impressed dynamics. Thus the earth and ocean are readily penetrated by longitudinal EM wave beams, and the Russians (KGB) has developed such LW interferometers since the mid 1950s. However, by LW interferometry where the patterns and dynamics of the carried LWs are engineered, any desired mapping pattern of precise EM signals, frequencies, phases, and magnitudes can be reproduced in distant interference zones, reaching right through the ocean. These interferometers could localize the distant interferometry into a 6-inch diameter volume as early as 1985, so from that time forward it gradually became possible to perform all of Delgado's "inserted electrode" EM stimulus in a single selected human brain from the opposite side of the earth. So approximately 1985 is when I would estimate the beginning of the "golden age" (ugh!) of distant psychoenergetics was initiated.

By 1997, this development would be into at least third generation weapons, just being deployed or just having been deployed, considering an somewhat accelerated weapons development program where 6 years is one generation. By 1997, very complex individual behavioral and perceptual control should have just arrived in on-site deployed strategic weapons systems. See discussion under *conscious mind*.

Some selected useful references are: J.M.R. Delgado et al., **Journal of Anatomy**, vol. 134, 1982, p. 533 reports that developmental defects occur in chick embryos exposed to various ELF frequencies. See also J.M.R. Delgado, **Physical Control of the Mind: Toward a Psychocivilized Society**, Vol. 41, World Perspectives, Harper & Row, New York, 1969.

DEMODULATION

From a carrier containing a modulated signal, recovering the signal that was used to modulate it.

DENSE SIGNAL ENVIRONMENT

For our purposes, when the number of weak EM signals crossing one square meter per second reaches 200,000.

At 500,000 important nonlinear optical type effects of significance—particularly long term cumulative effects—begin to occur in the exposed biological organism.

DEPARTING ORTHOROTATIONS

In space of dimensions greater than four, the rotating of an object or entity away from its line of motion, in the direction of a dimension at right angles to the line of travel in the observer's three-space, by some number of additional 90° rotations.

The Lorentz transform in special relativity, e.g., is just a formula for this kind of rotation. What we call "velocity" is actually a measure of rotation. In 4-space, any object in 3-space can only rotate "out" of 3-space in one direction: toward the time-axis. As the object rotates toward that time-axis, we see the object as having a velocity in 3-space, and its "length along the line of motion" as having diminished. When the object rotates the full 90°, its "length along the line of motion" has been converted to "time" rather than length. Hence it has zero length along the line of motion and is moving at c, the speed of light in ambient space. It is also no longer material, but is a sort of flat plane surface moving at speed c in a direction perpendicular to the plane.

In that 4-space model, it is impossible for anything to move faster than light speed. So Einstein's postulate dealing with the fact that it is impossible to translate mass, signals, etc. faster than light speed has a built-in assumption that only one orthogonal departing rotation can be made from 3-space. That postulate need not apply at all if more than one departing orthorotation is permitted—which of course requires a space of 5 dimensions or greater.

The notion is that, if we allow a spacetime of greater than four dimensions, by continuing to rotate ever more orthoturns in a departing direction away from the original line of travel, the rotated object loses one observable dimension for every orthorotation. Hence with three "departing" orthorotations it becomes a "nonobservable point" to the normal observer, but one that would be moving at speed c^3. A single orthorotation would make the 3-dimensional object a two-dimensional plane moving at speed c.

No matter how many rotations are made in a departing manner, the object is still connected to the time dimension common to all dimensions (assuming only a single time dimension for simplicity). So it exists in an orthorotated space, but in the same time. To the physical observer in 3-space, it thus appears to be a "time-like" or "mental" object only. Nonetheless, by affecting the density and structuring of the time domain, it can have an effect on a 3-spatial object. We discuss that mechanism under the subjects of the mind-to-body coupling mechanism and the body-to-mind coupling mechanism. Further, with the Sachs-Evans unified field theory approach, the time-domain can be directly engineered. This means that both "inert" or physical reality and time-like or "mental" reality can be directly engineered by novel electrodynamic means.

In short, a photon is just a particle (such as an electron) that is orthorotated once (toward the time axis). In photon emission, a little bit of the mass-energy turns into orthorotated photon energy. In photon absorption, the absorbed photon energy turns back into mass-energy.

The higher dimensional orthorotational concept was originally formed to allow a physical modeling grasp on a "mental" object as compared to a "physical" object, and to have a connection mechanism between the two. Such an approach can be used to model both mind and matter, their interaction, etc. The present author has used it to solve the old philosophical problem of "intent", of how the perception of self is attained, how the external world is perceived separate from self, etc. A model for both living and nonliving states does emerge.

This or a very similar approach has been used by the Russian's highly classified weapon science called *energetics*. That third branch of energetics is called *psychoenergetics* and it is the physics of directly engineering mind states, mind operations, memory, etc. by extended electrodynamic means. We have previously detailed much of this work privately, but with some detailed openly in a few papers. E.g., see T. E. Bearden, "Mind Control and EM Wave Polarization Transductions, Part I", **Explore**, 9(2), 1999, p. 59; Part II, **Explore**, 9(3), 1999, p. 61; Part III, **Explore**, 9(4,5), 1999, p. 100-108.

DESTRUCTIVE INTERFERENCE

When two waves or wavesets from two different sources superpose to produce a combined waveset that has a lower intensity than the sum of the intensities of the two original waves.

DETERMINISTIC PATTERN OR TEMPLATE

The exact arrangement, by plan and deterministic action, of a group of entities.

E.g., of the photons in a "herd" or "group" of them. Or a set of spacetime curvatures, into a dynamic structure called a "spacetime curvature engine"—or "engine" for short. Or by the virtual photons in the vacuum flux, or a deterministic set of changes to that vacuum flux (the vacuum flux that is called the "vacuum potential." I have called this function—of a deterministic patterning or templating of the virtual flux (particle view) of the potential—*dimensioning* the potential.

DIELECTRIC

Literally, "against electric (current)."

...originally coined to mean "opposes the flow or conduct of electric fluid."

In today's language, a dielectric is a non-conducting material used to oppose or prevent the flow of electric charges. Even empty vacuum exhibits some dielectric resistance. "Dielectric" is also used to refer to a nonconducting material (often used between the metal plates of a capacitor or elsewhere) which can (i) sustain a change in potential across a distance (i.e., an **E**-field), and (ii) serve as an insulator. Space itself is a dielectric, or at least it is said to exhibit certain dielectric qualities.

DIFFERENTIATION, CELLULAR

(1) specialization of body parts or organs in the evolutionary process. (2) modification of different parts of the body to perform particular functions. (3) modification of the cells forming these body parts or organs so as to perform the necessary cellular functions required to support the functioning of the body part or organ.

DIFFRACTION

The bending of light at the edge of an opaque object.

Usually diffraction introduces undesired distortion and is a problem. However, it can be useful and desirable—for example, in a diffraction grating.

DIMENSION

A certain primary geometrical physical attribute, such as length, used to describe the separational relationships of physical phenomena.

The degree of that separation is known as "length", "time", etc. By "geometrical" we mean that the "dimension" is considered to "exist" in either the presence or absence of the observable physical phenomenon; however, by understood agreement the dimension itself is not directly observable. It can be inferred ("measured"), however, by comparative operations of simple devices such as clocks and meter sticks, and its simplistic definition is usually given as "that which has measurable magnitude." Prescribed measuring procedures are used to assign magnitudes to these inferred dimensions, using specific scales.

Actually, "dimension" just means "fundamental quantity of separation" and "geometry" in the most general sense. The number of dimensions taken in advanced physics usually represents a somewhat arbitrary choice for good modeling fit. In modern Kaluza-Klein theory, for example, it becomes necessary to accept some 10 or 11 dimensions in the usual particle physics case. General relativity has incorporated the interaction of the abstract geometry (spacetime) with mass. Until Sachs' extension of Einstein's work into a unified field theory and Evans' incorporation of O(3) electrodynamics as an important subset of Sachs' unified theory, general relativity has largely remained a nonexperimental discipline, at least in the laboratory. With the new Sachs-Evans approach, however, GR becomes substantially engineerable by novel electromagnetic means, including in the laboratory and in devices.

DIMENSIONING

This is an artificial term I sometimes use to mean "forming an exact pattern or 'template', particularly of nested curvatures of spacetime, where the pattern/template may also be dynamic. It involves the internal structuring of the "dimensioned" entity.

The use of the term "dimensioning" makes sense in unified field theory, but is awkward in normal EM theory which erroneously considers that EM energy propagates in an uncurved spacetime. The mere presence of a change in local spatial energy, created by the wave energy itself when present in that local region, curves the local spacetime. Hence the EM wave rigorously travels in curved spacetime, and in fact identically is a propagating, oscillating curvature of spacetime.

Dimensioning also implies a deliberate form or structure (with dynamics) created in the virtual photon flux of the vacuum or of the virtual photon flux comprising a scalar potential, or in the infolded longitudinal wave EM inside all EM potentials, fields, and waves. It implies an associated set of spacetime curvatures and their dynamics. The latter are referred to as "engines", "vacuum engines", "spacetime curvature engines", etc.

Dimensioning potentials or signals or carrier waves also involves adding hidden *vacuum engines* to them. I chose the descriptive term *dimensioning* because adding such templates (hidden vacuum engine structures) is equivalent to increasing the EM topology by adding dimensions. Since an EM wave or field or vector potential can be decomposed into two scalar potentials, then by "dimensioning" one or both of the scalar potentials one can "infold" the desired hidden structures or patterns (vacuum engines) inside an EM carrier wave, EM field, or vector potential. So I called this *dimensioning* those entities. Internally structuring the two scalar potentials via arrays of EM LW emitters, and then applying the necessary dynamics (modulations), is primarily the manner in which dimensioning can be directly engineered. When dimensioning is present, two identical EM waves as seen on the oscilloscope may have dramatically differing internal structures (dimensioning), and hence the two will produce drastically differing effects when they interact with the same or similar objects. This of course is the mechanism involved in the Kaznacheyev experiments and in the decades-long microwave radiation of the U.S. Embassy in Moscow, where health changes and diseases were electromagnetically induced in personnel in field-free (stable and nonchanging potentials) areas.

Russian energetics refers to what we are calling "dimensioning" simply as adding *the information content of the field*. A very skilled disinformation program (actually, a strategic deception program) has been used to deceive the West into believing the phrase refers to ordinary spectral analysis. It doesn't. The importance of the dimensioning concept is that one has not formed mere "signals," instead, one has formed *vacuum engines*. If a receiving object receives a signal, it may or may not act upon that "signal information." If it receives a *vacuum engine*, however, the engine (structured local spacetime flux) directly acts upon it to make the requisite change. Further, the energy for the interaction's working upon the exposed object or system is furnished continually from the curved spacetime set and their dynamics. The receiving object has absolutely no choice in that action occurring to it, and the action can occur from the gluons and quarks inside the charges in the nuclei, to the lattice structures, to the system dynamics, to the elements so as to transmute them, etc.

Note that when a dimensioned EM field or potential is absorbed by an object, that object also has internal EM fields and potentials which have substructures (usually rather random). However, the internal structure of the absorbed dimensioned entity and the internal structures of the EM fields, potentials, and waves do mix in a direct diffusion process. Hence with continued irradiation, the target can be "charged up" with the desired internal dimensioning structure. This is how the microwave irradiation of the U.S. Embassy accomplished disease induction, using signals with the desired disease dimensioning impressed in their structures, particularly in the potentials. In the Gulf War Disease, a much more sophisticated use of this mechanism was made, using a quantum potential as the carrier. All the effects (including the body fluid transmission, the EM fields of the body transmitting and kindling some of the effects in children in proximity to a dimensioned veteran parent, can be explained.

The use of dimensioned EM fields, waves, and potentials—and the use of dimensioned quantum potentials in Bohm's hidden variable theory—allows an entirely new science of EM biological warfare, far more threatening and lethal than the more primitive physical pathogenic kind. It is also possible to use the techniques for revolutionary healing, as unwittingly shown by Prioré and the scientists working with him, and also as shown by Becker *et al*.

The only way in which the action of a vacuum engine (dimensioned carrier entity) can be resisted is to create and simultaneously introduce the exact antiengine for it.

Once the action has been completed in the receiving object and it has been changed, the only way it usually can be undone is to form a precise antiengine for that action, amplify the antiengine, and let the antiengine act upon the object for a sufficient time to "time reverse it back to its previous physical state and condition". The Prioré mechanism utilized that method for reversing the cellular damage due to cancer and infectious diseases, and to restore suppressed immune systems. The same mechanism, if re-developed, could also be used to reverse aging in living human patients.

The engine and antiengine processes can also be applied by structuring the "time-charging" or "time-excitation charging" of the particles of mass in a body. The "port-hole" concept even allows ordinary EM radiation to be used to forcibly transduce the input ordinary EM into the extraordinary EM and thereby forcibly accomplish the necessary time-charging actions for disease and body deterioration reversal. See discussions under "port hole concept" and "time-charging".

DIPOLE

In the simplest case, two separated charges of (usually equal and) opposite sign.

As a general definition, a localized positive charge or charge distribution, and a localized negative charge or charge distribution, such that the net charge summation is zero, but wherein the positive and negative charge distributions do not superpose. We point out, however, that in regular physics *electrical charge* has no proper definition. Try looking it up in several physics dictionaries! Then check our proposed definition of electrical charge. As is well-known in particle physics, a dipole is a broken symmetry in the virtual photon flux of the vacuum. By definition of broken symmetry, this means that *some* of the virtual energy flux continuously absorbed from the seething vacuum by the charges of the dipole, is not re--radiated as virtual energy. Instead, it is integrated coherently and re-radiated in 3-space as real emitted EM energy. The dipole is therefore a true "negative resistor" since it receives EM energy in unusable form, and re-emits it in usable form. In classical EM theory, the problem of how every charge and dipole can continuously emit EM energy to form all the associated fields and potentials and their energy, is an unsolved problem—sometimes called the most pressing problem in electrodynamics, both classical and quantal. For the solution and a discussion, see my paper "Giant Negentropy from the Common Dipole," Journal of New Energy, 5(1), Summer 2000, p. 11-23.

Because of the broken 3-symmetry of the dipole, the EM energy flow is not conserved in three dimensions (symmetry represents a conservation law, and broken symmetry represents the violation of that conservation law—in this case, violation of conservation of 3-space EM energy flow). Instead, EM energy flow is conserved in 4-dimensions, and the hidden inflow of EM energy to the dipole is actually from the complex plane (time domain). Thus all EM energy is actually received from the time-domain, and so the importance can be seen of the internal structuring of time-flow and of longitudinal EM waves in the time

domain. Such time-domain energy flows appear naturally in O(3) electrodynamics; see M. W. Evans and T. E. Bearden, "The Most General form of the Vector Potential in Electrodynamics," **Optik** (in review).

DIRAC, PAUL A. M.

Noted English physicist, 1902-1984, who shared the Nobel Prize for developing wave mechanics and predicting the existence of the positron.

DIRAC SEA

Considering the vacuum as containing—amongst other things— a "sea" of an infinite negative energy conditions or states ("holes") for electrons, almost all of which are filled with electrons.

In Dirac electron theory, the relativistic wave equation for the electron has four components, which correspond to two spin orientations and two energy conditions: positive and negative. Thus the vacuum possesses a "sea" of negative energy conditions for electrons. These are called "holes" and are considered to ordinarily be filled or mostly filled with electrons which have fallen into these negative energy states. The Dirac sea thus is this vacuum sea of negative energy electrons. In forward time, if energy is added, electrons can be lifted from this sea. If spacetime is locally curved, additional holes may be created so that normal positive energy electrons fall in and disappear, creating the appearance of an "electrical energy sink." If the curvature is in the opposite direction, electrons may be lifted from the Dirac sea by the curvature, thus producing a flow of electrons and creating the appearance of an "electrical energy source."

DISCRETIZED

Occurring in a finite size, fixed as a function of one or more variables.

So long as the same value(s) of the variable(s) are selected, the discretized entity is always the same size. However, if the value(s) of the determining variables are changed, the value of the discretized quantity may change so that it is not a whole number multiple of the former entity. Compare this to a quantized entity, where the values of the variable(s) are held to those wherein the entity will always be a multiple of an entity of fixed size.

DISEQUILIBRIUM

Broken equilibrium, which in turn involves breaking appropriate conservation laws.

DISSOCIATION

Separation of ideas from their affects or feelings, resulting in independent functioning of these components of a person's mental processes.

Simply put, fragmentation of the mind and personality. Severe dissociation is the definition of insanity.

DISTORTION CORRECTION THEOREM

"If a scalar wave E1(r) propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica E2(r), then E2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E1."

Quoted from Amnon Yariv, **Optical Electronics**, 3rd Edn., Holt, Rinehart and Winston, New York, 1985, p. 500-501.

What is missing from the distortion correction theorem is hidden in the phrase *"if we generate in some region of space ... its phase conjugate replica.."*. Since electrodynamicists and optical physicists have been unaware that all EM energy at any point in space comes from the time domain to that point, then the actual phase conjugate wave in the imaginary plane (from the time domain) is not utilized as the phase conjugate replica. Instead, the interaction of that wave with charges, which actually produces the force-field wave in space, is assumed. In short, one is looking at the "effect" wave, not the "cause" wave. However, since time is not an observable even in theory, it is this "effect" wave in 3-space that will be measured by our instruments.

Note also that the distortion correction theorem says nothing about longitudinal EM waves in the time domain. Interestingly, in nonlinear optical pumping, it appears that the 3-space energy of the pumping 3-space waves is transformed into the time domain by the pumping, and thence flows from the time domain into the 3-space domain to form the progression of the time-reversed replica wave in 3-space.

It is apparent that much more work should be done upon the foundations of phase conjugate optics, in a higher symmetry electrodynamics model such as O(3) electrodynamics and particularly in the unified field theory as in the Sachs-Evans combined approach.

DNA (DEOXYRIBONUCLEIC ACID)

Nucleic acid that constitutes the genetic material of cellular organisms and also certain viruses.

DRUDE, PAUL

Important German physicist, 1863-1906, who formulated the theory of the free electron gas inside conductors, using it to formulate a theory of metallic resistance.

DRUDE ELECTRON GAS

The "free" electrons that have broken loose from their atoms in a conductor, and are thus free to "wander around" and "migrate"—or flow as current when exposed to an emf.

Also called the electron gas, or Drude electron gas. Named after the German physicist Paul Drude who died in 1906, who formulated Drude's theory of metallic resistance based on EM theory and his own theory of electrons. See P. Drude, Ann. Physik, Vol. 1, p. 566; Vol. 3, 1900, p. 370, 869 for the original Drude papers.

DUALITY PRINCIPLE

In quantum mechanics, the principle that photons and other particles propagate like waves and interact like particles, so that their descriptions as only waves or only particles is inadequate.

ECM

Electronic Countermeasures.

Electromagnetic measures taken against targeted electronics or electromagnetics operations in systems, particularly in hostile weapon systems, command and control systems, etc. There are entire textbooks in the West that are devoted to ECM effects, uses, effectiveness, etc. A great deal of ECM equipment is also used by any modern military force. However, in our view what is greatly lacking as yet in Western ECM is the deliberate design and use of novel new kinds of ECM based on the extended higher electrodynamics such as O(3) electrodynamics, and particularly by use of longitudinal EM waves and by use of the infolded electrodynamics inside all EM fields, potentials, and waves. Longitudinal EM wave interferometers (LWIs), e.g., can reach right through the earth and the ocean to emerge on the other side of the earth. In the interference zone (IZ), real EM "transverse wave" energy is created readily by the interferometry. Biasing of the chassis grounds of the distant LWI transmitters can control whether the "normal" EM energy appearing in the target IZ is convergent (cooling) or divergent (heating). By sharp pulsing of the LWI transmitters, massive cold explosions or hot explosions can be created in the IZ. Continuous LWI interferometry can produce geometric forms of EM energy, which usually glow due to the ionization of the atmosphere, etc. in the dense EM energy regions. Since these can also involve general relativistic effects as well as electromagnetics effects in the U(1) CED sense, obviously a dramatic expansion of the entire field of measures and countermeasures is entailed.

We believe these LWI weapons may be what was referred to by U.S. Defense Secretary Cohen as follows: *"Others are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our efforts."* Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

EDGE WAVES

In electromagnetics, waves that form parallel to a material edge.

EDISON, THOMAS ALVA

Noted American inventor, 1847-1900, whose staggering number of inventions included the storage battery, electric light bulb, phonograph, motion pictures, and carbon microphone.

E-FIELD (ELECTRIC FIELD)

The electric field or electric intensity E. That field on a spinning charged mass which produces an electrical force resulting in a linear motion of the charge.

See also discussion under c, above.

E-FIELD, MOTIONAL

In classical EM theory, the electric field produced by moving a conductor in a magnetic field. Often called *motional inductance* of the field.

In the orthodox theory, motional inductance is deemed to be identical to the inductance caused by a time rate of change of the magnetic field, experienced by the moving conductor.

E-FIELD, STATIC

In orthodox theory, the electric field in the space surrounding a static charged particle, induced by the presence of the charged particle.

In classical EM, there is no notion as to the *causative mechanism* for this static field of and from a charge, which implicitly is assumed to just continuously create and pour out EM energy in all directions, thus grossly violating energy conservation.. Consideration of this anomaly leads to what has been called the most pressing problem in both quantal and classical electrodynamics: the question of the formation of the fields and potentials associated with the "source charge".

For a full solution to this problem, see my "Giant Negentropy from the Common Dipole," **Journal of New Energy**, 5(1), Summer 2000, p. 11-23. Also on this website.

EHRENHAFT, FELIX

Scientist who performed numerous experiments believed to demonstrate fractional charges.

EINSTEIN, ALBERT

German (Jewish) physicist, 1879-1955, who emigrated to the U.S. and formed special and general relativity theory, discovered and formed the theory of Brownian motion, recommended the development of the atomic bomb to President Roosevelt, and profoundly affected the course of science and the modern world.

EINSTEIN-de HAAS EFFECT

The rotation observed in a freely hanging ferromagnet when it becomes magnetized.

It has been used in the Einstein-de Haas method to determine the gyromagnetic ratio of a ferromagnetic material by suspending a cylinder of the material from a torsion fiber and measuring the angular displacement of the cylinder when its magnetization is reversed.

EINSTEIN, PODOLSKY, AND ROSEN PARADOX

Thought experiment in 1935 for measuring two correlated photons separated and at distant locations, protesting that quantum mechanics requires that the particles communicate instantly, which is a "spooky action-at-a distance" (Einstein's phrase).

The experiment eventually was performed and it works, just as required by quantum mechanics. The paradox inspired the development of hidden-variable theories.

EINSTEIN'S POSTULATES

(1) All the laws of physics are equally valid in all inertial frames of reference,

(2) the speed of light is the same to every inertial observer, and

(3) the observable local effects of a gravitational field are indistinguishable from those arising from acceleration of the frame of reference.

The first is called the special relativity principle, the second is called the law of light propagation, and the third is called the equivalence principle. It is now known that postulates (1) and (2) are not independent of each other. Note that the third postulate implies that any local force is due to a "gravitational field" (acceleration of the frame of reference). It also implies that gravitational force has a mechanism, since quantum mechanics assigns a differential operator, operating upon a potential, to create every force. By extended inference, it can be seen that the third postulate also implies that there should exist a method to turn any type of force (field) into gravitational force (field).

The Russian physicist Sakharov has strongly postulated that gravitation is not even a fundamental field of physics, of the kind used by Maxwell in his electrodynamics. Instead, in this view **G**-field is always comprised of, and made from, other fields and interactions upon them. Indeed, such has always been implicit in general relativity, it just took Sakharov to formally propose it. E. g., see A. D. Sakharov, "Vacuum Quantum Fluctuations in Curved Space and the Theory of Gravitation," **Soviet Physics Doklady**, Vol. 12, No. 11, 1968, p. 1040-1041 [English translation.] Sakharov's article (in Russian) in **Doklady. Akad. Nauk SSSR**, Vol. 177, 1967, p. 70-71.

Now let us do a little "tinkering" with Einstein's postulates. For the first one, we point out that in the new approach using dimensioning and subspaces, the notion of an inertial frame now has acquired additional complexity! The "gross translation" effects—which tends to be what physics ultimately focuses upon—can remain the same, and yet vacuum engines can be buried up inside the inertial frame to act upon a mass in non-translating ways. Everything translation-wise can remain the same, but now matter can be transmuted and transformed, etc., still right there in an inertial frame. So when the infolded electrodynamics inside all fields, potentials, and waves are utilized, the notion of "inertial frame" has acquired a higher topology and then one inertial frame may differ very substantially from another inertial frame. This of course move one from special relativity into full general relativity, and even there into a slight extension. Special relativity can remain special relativity on the surface, and yet effects occur "within" the objects postulated to exist in this inertial frame. The "inertial frame" concept in the postulates is now just a sort of special "equilibrium case" of a higher topology "inertial frame" notion.

The second postulate now stands as a "special case" of a far more general second postulate. It actually defines (and limits) "light" to bulk changes in the entire vacuum potential magnitude. It only applies to light signals which are "bulk upheaval" disturbances of the vacuum potential (spacetime). Specifically it need not apply to the "inner EM/GR realm" of longitudinal EM waves infolded inside the vacuum potential, other potentials, signal carriers, etc. Superluminal communication is now included in this "hidden variable" communication. The Fogal semiconductor is in fact capable of infolding and outfolding EM signals, including producing the internal longitudinal EM waves, and during their infolded state these signals are permitted to move at superluminal velocity.

So the second postulate needs to be restated to include the present statement as a special case. Notice that the concepts "light" and "speed of light" have now taken on much richer, extended meanings, since there is "outfolded" light and "infolded" light, so to speak. Light now is not just the "external perturbation wave" in the ambient vacuum potential medium (in flat spacetime). Instead, it can also be an "internal perturbation longitudinal wave" inside a "net flat spacetime" which does not show on the "surface" at all. Indeed, it may move in the time dimension or in 3-space. It now includes the transmission of an extraordinary "vacuum engine" as well as the usual transmission of just an ordinary signal.

And these infolded vacuum engines can be visualized as very special sets of longitudinal EM waves and their dynamics, consistent with the Whittaker decomposition. His U(1) symmetry electrodynamics decomposition—particularly when enriched in the higher symmetry O(3) electrodynamics—applies to the ambient vacuum as a potential (it is a potential since it has energy density). So the "subspace" inside spacetime, so to speak, is just a set of LWs and their dynamics, and that subspace itself is engineerable, just as is the "bulk curvature of spacetime" itself. Further, we may now consider space itself is just a vast superhighway for such superluminal LWs and their dynamics. Mass is mostly empty space with only an occasional particle here and there and with fields, potentials, and waves in between. Hence huge masses such as the ocean and earth are actually superhighways for the direct passage of longitudinal EM waves, "engines", etc. The degree of "transparency" is a function of the degree of cleanness of the LWs.

The third postulate has also been dramatically extended and requires revision. As presently stated, antigravity effects do not appear to be included in present physics heretofore. The "gravitational effects and external accelerated effects" notion in conventional physics is still founded purely on *ordinary bulk translation*. Now it need not be. For example, the system can appear to be an ordinary system, as judged by normal "external light" observation. Yet its internal vacuum engines can cause local violation of most so-called "laws of nature." The reason a "law of nature" can be violated is that one is now able to violate the premises upon which it is postulated, and which are required to hold if the law is to hold. Or another way to look at it: any conservation law is the result of a symmetry. Breaking that symmetry allows violation of that specific conservation law.

So as we've said so many times before, the infolded EM inside the "conventional" EM fields, waves, and potentials—and inside the vacuum potential and spacetime itself—dramatically changes the present theories of electromagnetism, quantum mechanics, and general relativity. Further, for the first time the Sachs unified field theory allows an *engineering* approach which simultaneously crosses, includes, and extends all three disciplines in the required manner. The approach can be placed into good engineering models based on the Sachs work, particularly using the O(3) electrodynamics subset spearheaded by Evans, and the models can be tested and verified or falsified.

EINSTEIN'S GENERAL THEORY OF RELATIVITY

Mathematical theory of gravitation in which the gravitational force is mathematically described by a curvature in space or spacetime.

In other words, the geometry and its dynamics have become physical agents.

It is important to note that, in general relativity, the curvature of spacetime acts on mass-energy, and changes in or to mass-energy interact back upon spacetime to change its curvature.

Further, we consider that an exact pattern of curvatures of spacetime and their dynamics exists for every mass system and its dynamics. This is the engine concept. The most general way to engineer matter is not by brute force translation, but by forming spacetime engines. Once formed, these engines act upon any mass placed in the engine region, to eliminate the deltas existing in that mass's resident engine and the impressed engine. The curvature of spacetime itself furnishes the energy for the continuing action upon the mass, once we pay to form the engine. The mass can be acted upon at any level, from its gluons and quarks to its nuclei, to its atoms, its lattice forces and binding energy, etc. Significantly, the Sachs theory applies to physical reality from beneath the quarks and gluons to the entire universe, and folds in quantum mechanics, electrodynamics, and general relativity into a single unified field theory that is (in theory) engineerable by higher symmetry electrodynamics means.

ELECTRIC FIELD

The *conventional* definition is this: "1. a region in space in which a stationary electric charge experiences a force due to its charge. 2. the electric force per unit test charge." **Dictionary of Science and Technology**, ibid., p. 720. That definition is flawed. Consider the "spatial aspects" of part 1. If an electric field is defined as a force per unit charge, it is not a region in massless space but is an effect of something existing in massless space and interacting with the charged mass. The electric field *prior to interaction* is indeed related to a region in space, because it is identically a curved spacetime region. In the Sachs approach, general relativity and electrodynamics have become one and the same. So prior to interaction, the *field as it independently exists prior to interaction with charge* has become a curved spacetime region, and the field is *purely* a spacetime curvature effect. The interaction with mass to produce a force on and of that mass (mass is a component of force, and there is no such thing as a massless force) is a separate consideration from the field as it exists in space prior to interaction. The result of this entity's interaction with charged mass has nothing to do with *what an electric field is*; but with *what it does to charged mass*. Further, the force evidenced on a charged particle is not due to its charge; it has that charge always, whether or not there is a net force evidenced on it!

Part 2 is a little better. The only problem is, it totally disagrees with the entity existing in space prior to interaction. In other words, here it's a "force on a charge", which is an effect occurring after the interaction. Again, it is what the field *does or accomplishes*, not what it *is*. Hopefully the reader can now begin to see what terrible difficulties await anyone who seriously attempts *foundations definitions*. Feynman sums it up admirably in one of his famous statements: "*Everything we know is only some kind of approximation, therefore, things must be learned only to be unlearned again or, more likely, corrected."* An additional difficulty is that the very notion of a separate massless force independent of the mass on which it operates, is fictitious, yet continues to be widely used. Recalling that any true definition is an identity and not an equation, let us start with the definition of force:

$\mathbf{F} \equiv d/dt(m\mathbf{v})$. As can be seen, force is a system comprised of (i) a mass component and (ii) a nonmass component. The force is not something separate from the mass, at all! Further, force is not even unitary. It's a system comprised of two coupled components; the mass and a coupled (interacting) gradient in a potential flux. *Note that* $\mathbf{v}$ *involves motion through, and interaction with, the virtual flux comprising the vacuum potential. Note that* $d\mathbf{v}/dt$ *involves a gradient in that flux interaction with the mass*. Unfortunately mechanics is still using the medieval concept of a "separate force acting upon a separate mass." That is wrong, unless we change the fundamental definition of force itself. See, e.g., Robert Bruce Lindsay and Henry Margenau, **Foundations of Physics**, Dover Publications, New York, 1963, p. 283, where the authors emphasize that a "field of force" at any point is actually defined only for the case when a unit mass is present at that point. The reason can be seen: mass is a necessary component of force, and without mass present there cannot be a force present.

ELECTRIC DIPOLE

See Dipole.

ELECTRODYNAMICIST

A specialist in electrodynamics,

...the physics of the relationships between electric, magnetic, and mechanical phenomena—and especially a specialist in electrodynamics theory.

It should be pointed out that essentially all electrodynamicists are versed in U(1) electrodynamics, and a much smaller number are versed in more advanced electrodynamics such as O(3) symmetry electrodynamics, unified field theory electrodynamics, non-Abelian electrodynamics, etc. The electrodynamics field is actually a very vast field indeed, touching everything in physics. Very often, when one needs a particular electrodynamics problem solved, it calls for a special category of electrodynamicist and not just an electrodynamicist in general. One must therefore sometimes examine the background of the electrodynamicist making a statement or a pronouncement: electrodynamicists after all do have differing views and differing disciplines within the field.

ELECTROMAGNETIC PULSE (EMP)

A sharp pulse of electromagnetic radiation produced when an explosion occurs in an unsymmetrical environment, especially at or near the earth's surface or at high altitudes.

Essentially the same as an electromagnetic shock wave, a wave of great intensity which results when waves with different intensities propagate with different velocities in a nonlinear optical medium. An EMP is also produced when two intense longitudinal scalar electrostatic potential wave patterns meet and couple into a sudden flash of vector EM energy.

ELECTROMAGNETIC SMOG

The background of extremely weak EM radiation that fills the normal modern environment, particularly in developed nations.

The individual signals are too weak to individually produce effects of any significance in biological systems. However, in a dense EM smog environment with 500,000 signals per square meter per second, the signal complex and its nonlinearity begin to produce highly nonlinear effects in biological systems. These effects also produce damage that may cumulate over a long period of time, including for years. This bioeffects area has largely not been investigated by EM bioeffects scientists.

It should be pointed out that electric lines, telephone lines, transmission lines, etc. act as long wire antennas to detect and propagate such very weak EM signal noise. Essentially all the radiators in the environment—including electronics equipment, TV stations, radio stations, factory machinery, etc.—thus produce very weak signals picked up by these long line antennas and piped into every home, factory, neighborhood, etc.

ELECTROMOTIVE FORCE (EMF)

A difference of potential created by sources of electrical energy—i.e., by separated charges (dipoles)—which can be utilized to drive electrical currents through external circuits. Also, open circuit voltage, or the limit of the potential difference between the source's terminals as the current in the external circuit approaches zero.

Poorly named. Also quite confused in the standard theory and usage. First, *emf* is not a *force* at all. It is a difference in potential, hence it is measured in volts. Also, it is not considered an **E**-field, since that is a field of force. Yet it is in fact a , restricted to the direction between the two measurement points, and is considered to be an **E**-field in the theory!

For this reason the standard theorists say that the term is sometimes used as equivalent to a difference in potential, but that strictly speaking it should be applied only to a source of electrical energy! The problem is that conventional theorists are unaware that a potential is a bidirectional flow of energy in 3-space, where the energy enters from the time-domain (complex plane). Since they are unaware that a potential is hidden negentropic energy flow process involving broken 3-symmetry and viable 4-symmetry, the theorists are unable to consider the potential in general as a source of energy flow. Yet they are forced to

consider a potential difference across the terminals of a source as "somehow a flow of energy, that generates forces upon the electrons to propel them through the circuit as current flow."

In the new viewpoint, a resolution is achieved of these incongruities by more accurately defining the E-field with respect to the potential as E [q]/q. It is noted that [dA/dt]q/q also produces an E-field, so that the full definition of the E-field is as E [(+dA/dt)q]/q. However, one volt represents one joule (of excess energy) per coulomb of charge. *The energy density flow in an electric circuit is in the voltage, in the emf, and it is not in the current per se*. The electron current (drift current) carries the excess energy that is being dissipated as work in the circuit, but in a nominal circuit the drift current only moves a few inches per hour. Half the energy is dissipated in the external circuit and external losses, and half is dissipated in forcing spent electrons in the ground return line back up through the back-emf of the source, performing work inside the source to dissipate its separation of charges. Left alone, any dipole will furnish emf indefinitely, freely receiving the energy from the time domain (complex plane) and outputting it in 3-space. The free flow of EM energy will continue unabated from the undestroyed dipole, regardless of how many external loads and losses are powered (how much energy is collected and dissipated from the ongoing flows representing the potential). So electrical circuits should be developed which allow little or no electrons to be forced back up through the dipole to dissipate its separation of charges and destroy the dipole.

ELECTROMOTIVE FORCE, BACK (BACK EMF)

Back emf is a loose term used for the *counter-electromotive force*.

When the source is powering a circuit or circuit element, the term "back emf" is used to refer to the forcing of current (electrons) back up through the source against its emf, thereby performing work inside the source to dissipate its separation of charges (its dipolarity). When a potential source of electrical energy—such as a capacitor, an inductor, or a rotating machine—is receiving energy from the source and converting it to dissipative power and work, that "powered" device is said to develop a *counter-emf*. A source has a built-in emf *a priori*, that is holding its charges separated so that it is dipolar. When electron current is forced backwards through the source through its built-in counter-emf, and backwards against its emf, work is performed against the internal resistance of the source to dissipate its separation of charges, thereby dissipating the source. If electron current is not allowed to flow back up through the source against its back emf and through its built-in counter-emf, no dissipation of the source occurs, even though energy density (not electron current dq/dt but energy flow d/dt) is flowing from the source and can be collected in collectors in the external circuit to store the energy as a created local energy source. This collected energy can then be shuttled to a separate load circuit and released, to provide a "heat pump" cycling operation and overunity coefficient of performance.

Nikola Tesla in fact knew how to shuttle energy in a circuit in such fashion, as Barrett's quaternion analysis of Tesla's actual patented circuits has revealed. [See T.W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," Annales de la Fondation Louis de Broglie, 16(1), 1991, p. 23-41.] Note that a rigorous analysis of those same circuits, using tensors or vectors, will not show the effect.

When the original source dipole is not dissipated because electron current is not passed back up through its back-emf to scatter the charges, the original source dipole will continue to furnish emf indefinitely.

The terms emf and counter-emf are normally applied only to recognized sources of electricity. Emf is applied as the algebraic sum of the potential differences acting in a circuit attached to a source. Back-emf (counter-emf) is applied as the potential difference internally through the source, between its terminals. Its main application is thought to be a *powered device or component in the circuit*. Actually, its main application is to prevent COP>1.0 electrical power systems from being developed and utilized.

ELECTROMYOGRAPHY (EMG)

A diagnostic application which detects changes in electrical potentials associated with muscle contractions.

Specific electrical patterns have been associated with specific abnormal states (e.g., denervated muscle), but the method has not yet been systematically developed beyond this application.

ELECTRON

Stable elementary particle in all atoms, and having a negative charge of 1.602×10^{-19} coulombs, spin ½, and mass of 9.11×10^{-31} kilograms.

ELECTRON GAS

A system of electrons with only weak interactions so that the electrons may be regarded as moving independently.

Thus, in many ways, that collection of electrons can be treated as a gas. Also see discussion under Drude Electron Gas.

ELECTRO-OPTICS

A technology in which electrons are focused and steered as if they were light. Examples are the cathode ray tube (CRT) and the electron microscope.

ELECTRO-POLLUTION

Also called *electromagnetic smog* and *electronic smog*. The conglomerate or maze of EM fields and radiations that are produced by technologies such as electric power transmission and radio transmission, and that can have long term cumulative harmful effects on humans.

The new viewpoint dramatically extends the types of fields and effects involved, and gives entirely new mechanisms for the interaction of EM fields and radiation with biological systems, including cumulative effects, signal-density effects, and vacuum engine effects. A mechanism for long term causation of cancer and leukemia by electro-pollution is derivable in the new approach.

As an example, even though the myriad of very weak EM signals comprising the electro-pollution are individually tiny, each when interacting at a local site with the body or its cells involves a broken 3-symmetry and thus an involvement of 4-symmetry, with corresponding giant negentropy. Further, the Heaviside dark energy component accompanying that local field interaction will in turn interact with essentially all the other locations of the body. Each of these interactions involves broken 3-symmetry and involvement of 4-symmetry. The result of the large complex of broken 4-symmetries constitutes a direct structuring in the time domain, hence weak time-pumping and weak time-charging. Time charge excitation decays only very slowly, emitting longitudinal EM waves inside the body as the charge decays.

Over a long period of time (sometimes years), this "time-hash" or "time-jamming" upon the operation of the master cellular control system, the immune system, and the cellular regeneration system is cumulatively detrimental. In this way, effects such

as leukemia, cancer, etc. may be gradually "kindled". However, there have been no real scientific laboratory "cause and effect" investigations of this phenomenology at all. Nonetheless, the results will and do show in epidemiology studies, which are then attacked by orthodox scientists (many employed directly or indirectly by the power industry, etc.) on the grounds that no laboratory cause and effect evidence has been shown.

In short, this is one of the areas where the lack of scientific cause and effect laboratory evidence—because such experiments have not even been done—is improperly used to negate real scientific work showing deleterious effects that powerful interests do not wish shown.

ELECTRO-RETINOGRAPHY (ERG)

A diagnostic application that monitors changes in electrical potentials across the retina to assess eye movements.

This is almost the only method available for noninvasive monitoring of Rapid Eye Movement (REM) sleep.

ELECTROSTATIC COOLING

To be added

ELECTROSTATIC SCALAR POTENTIAL

A static (stationary) ordering in the virtual photon flux of vacuum.

The word "static" is unfortunate and should be replaced by "stationary", since the underlying active vacuum medium is always in violent motion, and there is nothing truly "static" in the universe. But an equilibrium condition can exist, even in violent motion, so that a stationary entity persists. An example is a perfect whirlpool in a river.

ELF

Extremely Low Frequency.

Used to describe EM fields whose frequencies lie in the range from just above 0 Hz (direct current) to 300 Hz. This includes power line frequencies (60 Hz in U.S. and 50 Hz in Europe) and frequencies used by certain U.S. military ELF communication systems such as for submerged submarines.

EM

Electromagnetics.

EMF

Electromotive force. See discussion under that term.

EM FIELD

Electromagnetic field. In its loose usage, it refers in a very broad way to any field, force, or energy associated with electromagnetic interactions, charges and currents.

Thus "EM field" includes electrostatic fields, magnetostatic fields, electromagnetic fields (including radiation and induction), vector-potential and scalar-potential fields, Hertz potentials, Fitzgerald potentials, Whittaker potentials, etc.

In its precise usage, "EM field" conventionally refers to an EM "force" field, such as the **E**-field, **D**-field, **B**-field, **H**-field. In classical electromagnetics (CEM), as a holdover from the old assumption of a material ether, the force fields are considered (erroneously) to exist in mass-free space, and they are also considered to be the primary causes of electromagnetic phenomena. This is a non sequitur, and it involves substituting the effect for the cause.

In the new viewpoint, the force fields do not exist in vacuum, but only in and on and of the charged particles themselves, where mass is present to form one component of the force. The force fields are therefore effects and not primary causes. The primary causes of all electromagnetic phenomena is taken to be the potentials; however, the hidden Stoney/Whittaker/Ziolkowski internal structures of gradient-free scalar potentials may interfere to cause potential gradients in and on charged particle systems. This therefore includes distance-free scalar potential interferometry and action at a distance, as well as vacuum engines.

The new view uses Sachs' unified field theory, and considers that the EM field in the vacuum, or an EM potential in the vacuum, is a curvature of spacetime function. Thus the new view is a unified field theory where GR has become EM and EM has become GR, and where EM can involve or produce gravitational, temporal, and inertial effects as well.

EM FORCE FIELD IN THE VACUUM (A FALSE CONCEPT)

The erroneous notion that there exist forces in the vacuum, so that the set of forces at a set of spatial points forms a force field.

This ignores the fact that mass is a component of force, and the presence of a force requires the presence of a mass. When Maxwell formed his electrodynamics theory, he and almost everyone else believed that a thin material ether pervaded empty space. Thus there was a "material medium" in which electromagnetic fields existed, and so it followed that real forces existed in this material medium, from point to point. Indeed, to the early electrodynamicists there was no point in all the universe where mass was absent.

Heaviside, Hertz, and Gibbs reduced Maxwell's 20 quaternion equations to the present four vector equations, but did not change the *force field in space* assumption used by Maxwell. Heaviside detested the "mystical" potentials favored by Maxwell, and believed they were figments of one's imagination. He regarded the forces as the primary EM causes.

Yet even while Heaviside *et al*. were retranslating and topologically reducing Maxwell's theory dramatically, the Michelson-Morley experiment in the 1880s had already destroyed the material ether on which those same force fields were based.

Physicists, however, have continued to use the notion of a separate force acting on a separate mass, which of course is also a non sequitur, substituting effect for cause yet again. Hence the foundations of physics remain fundamentally fouled.

For a succinct discussion of potentials versus forcefields as the primary EM causes, see Y. Aharonov and D. Bohm, "Significance of Electromagnetic Potentials in the Quantum Theory," **Physical Review, Second Series**, 115(3), 1959, p. 485-491. See also Y. Aharonov and D. Bohm, "Further considerations on electromagnetic potentials in the quantum theory," **Physical Review**, 123(4), Aug. 15, 1961, p. 1511-1524.

EM GENERATRIX

Whatever generates electromagnetics, particularly the fields. Time is the ultimate EM generatrix.

Whittaker showed in 1904 that the interferometry of two scalar potentials (i.e., of their hidden multiwave structures) can create all classical EM fields, no matter how complex, thereby starting a branch of electrodynamics known as *superpotential* theory. See E. T. Whittaker, "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions," Proc. Lond. Math. Soc., Series 2, Vol. 1, 1904, p. 367-372. The paper was published in 1904 and orally delivered in 1903.

In 1903 Whittaker showed that any scalar potential (e.g. between the ends of a dipole) can be decomposed into a harmonic set of phase conjugate EM longitudinal wavepairs. The present author applied the Whittaker decomposition to the scalar potential between the ends of a dipole, and pointed out that the conjugate half-set may be taken as converging EM waves from the complex plane (the time domain), while the real half-set may be taken as diverging EM longitudinal waves emitted from the dipole in all directions in 3-space. The dipole is a known broken 3-symmetry in the dipole's violent virtual energy exchange with the vacuum; hence this shows that breaking 3-spatial symmetry allows nature to fall back to a more primary 4-symmetry. Hence energy flow conservation is violated in 3-space, but is rigorously obeyed in 4-space. Further, the free flow of 3-spatial energy from the dipole continues so long as the dipole exists.

The dipole thus is a true negative resistor, receiving EM energy in unusable form (from the complex plane; i.e., the time domain), transforming it into usable energy, and outputting the usable energy. This is also the fundamental mechanism for extracting unlimited EM energy from the seething vacuum, taking the energy from the time domain via the giant negentropy mechanism. See my paper, "Giant Negentropy from the Common Dipole," *ibid*.

This also means that the source of all EM 3-spatial energy is from the time domain, and is due to broken 3-symmetry. The ultimate EM generatrix is thus time. The ability of a bit of broken 3-symmetry (such as formation of a simple dipole) to initiate a continuing and ongoing flow of free EM energy via the 4-symmetry between time-energy and spatial energy, means that *negentropic* engineering, once we get the hang of it, is far easier than our present *entropic* engineering. In essence, we have to learn how to do electrical engineering all over again, from a much more fundamental point of departure.

EMI (ELECTROMAGNETIC INTERFERENCE)

Disturbances of electronic equipment's operation by intrusion of extraneous EM signals from outside sources. Also, disturbances of the operation of one or more subsystems of an electronic system by intrusion of undesired signals from other subsystems.

EMI, ANOMALOUS

An "ad hoc" term denoting an unexpected nonlinear optical functioning process in a dense signal environment whereby nonlinearities on the skin of a vehicle or cover of an equipment become pumped phase conjugate mirrors, so that they emit amplified phase conjugate replicas (PCRs)—of signals and fields impinging upon the skin or covering and the nonlinearity from electronic circuitry operating inside.

By the distortion correction theorem, these amplified PCRs precisely backtrack the signal waves that impinged upon the phase conjugate mirror from inside the vehicle or electronics, back to the original source of the internal signal. The result is the scavenging of energy from the dense electronic signal environment and sharply focusing and directing it into the operating circuits of the internal electronics. Thus internal signals, often amplified, start sporadically appearing through the circuits. These sporadic jamming signals due to the anomalous EMI effect are known as EMI fireflies.

Such EMI fireflies were resoundingly experienced in U.S. missiles and aircraft in the U.S. air attack on Libya in 1986. Although some of the anomalous EMI effects could have been produced by the unusually dense EM signal environment and poor hardening of circuits and electronics, it is believed that the weak jamming was also a test being conducted of a laboratory prototype Russian quantum potential weapon.

This weapon appears to have been finished and deployed at the end of 1989, and then utilized against Allied forces in the Gulf War, accounting for the Gulf War Disease. We have previously explained why British, Canadian, and American soldiers acquired the disease, why the native populace did not, and why the French troops did not.

Inside the human body, the anomalous EMI effects may be used to produce time-charging and delayed interference with the immune system, the master cellular control system, and the cellular regeneration system. By using dimensioned signals, the targeted systems can be specifically and deterministically affected as desired, for any set of disease damage types and symptomology desired. So the technology may be used to induce a "cocktail" mix of various infectious disease damage types. The induced time-charging effects—where the time-charge is dimensioned—followed by longitudinal EM wave emissions from the time-charges as they decay in the veteran's body, can induce the same or similar symptoms and damage in close family members exposed to the weak but dimensioned longitudinal EM radiation. This applies not only to wives but also to family members such as children often in close proximity to the veteran. In addition, exchange of bodily fluids from the veteran to his spouse can directly induce the symptoms in the spouse since those fluids are themselves still time-charged (with dimensioned time charge) and slowly decaying.

ENDOTHERMIC EXPLOSION

An EM implosion, resulting in explosive electrostatic cooling. The sudden, explosive reversal of electromagnetic energy scattering in a spacetime area so that the local EM heat energy is converted back to a negative potential. In this manner, explosive electrostatic cooling occurs in the area.

Endothermic EM explosion occurs by pulsed scalar Whittaker interference of two longitudinal EM wavesets beamed from two LW EM transmitters. The distant transmitters of the LW interferometer must have their local electrical grounds biased well below the ambient zero potential in the distant interference zone (IZ). Whittaker internal EM waves radiate through subspace (the LW superhighways inside EM fields, potentials, and waves in mass) from the transmitter to the interference zone, and also from the interference zone back to the negatively biased transmitter/receiver, emerging there as ordinary electromagnetic scattering energy or *heat*. All *normal* explosions are exothermic in nature, and ordinary electromagnetic heat energy is radiated away. A scalar EM interferometer/howitzer, however, may produce an endothermic explosion (an energy implosion) at a distance, explosively extracting the heat energy at the implosion site and receiving the energy back at the transmitter site for disposal.

The same LW interferometer can also produce an exothermic explosion in the distant interference zone, merely by positively biasing the electrical chassis grounds of the scalar EM potential transmitters and pulsing the transmission. Negative biasing of the transmitters' electrical chassis grounds and a pulsed transmission result in an endothermic explosion in the distant interference zone.

ENDOTHERMIC LONGITUDINAL EM WAVE INTERFEROMETRY

Extraction of EM energy from a distant intersection area by a scalar interferometry whose electrical grounding is biased well below the ambient potential in the distant interference zone.

The result is a cooling of the interference zone, and heat energy emerging at the transmitters.

ENERGETICS

The Russian term for what I have called advanced higher-symmetry electromagnetics,

...using artificially constructed Whittaker internal biwave structures to make activated potentials that have specific, desired "vacuum engines", where the EM field is a curvature of spacetime function, and thus involving a unified field theory that is engineerable by novel electrodynamic means.

I believe that the closest Western work approaching the Russian energetics science is the O(3) higher symmetry electrodynamics pioneered by Evans, particularly when combined with Sachs' unified field theory as an important subset. The other closest Western work would seem to be the important work of Barrett in SU(2)×SU(2) symmetry electrodynamics.

The activated potential containing the infolded vacuum engine structures is said to have been *dimensioned*. These dimensioned potentials can be combined to form EM carrier waves which contain the hidden vacuum engines. These vacuum engines, scalar Whittaker EM interferometry, and activation of vacua and matter are used to perform unified field engineering.

Russian energetics also adds the formation and use of the quantum potential, enabling
(i) instantaneous action at a distance with multiple separated target nodes, (ii) essentially limitless direct energy amplification in the assembly of receiving nodes, without additional energy input at the initiating node, and (iii) engineering of hidden variables inside distant targets, instantaneously, without transmission *as such* through space. The quantum potential itself can be *dimensioned*, so that vacuum engines can be instantaneously transmitted into distant targets, altering their local spacetimes to contain the desired engine(s). Note that no intervening barrier can "impede" or "shield" a quantum potential because it does not travel through space as such; it just appears everywhere at once in the space where it will be.

Adding to classical EM theory, general relativity, and quantum mechanics the internal EM energy in the scalar EM potential will generate a superset of each discipline. These three new supersets are unified in their common internal EM energy subset. As a bonus mind, personality, memory, and deep biological cellular and system control are also available, since the internal time-energy domain is used by biological systems for these living functions. Energetics thus is an engineerable, unified field theory of physics and metaphysics.

Russian energetics is largely still a "secret" science, developed over the last five decades and highly weaponized. In the Russian scheme the overall area is called *energetics*. It consists of three subsets: (i) *energetics*, which applies to nonliving systems, (ii) *bioenergetics*, which applies to the physical bodies, cells, chemistry, genetics, etc. of living organisms, and
(iii) *psychoenergetics*, which applies directly to the minds, personalities, memories, emotions, and perceptions of living systems. Russian energetics research, development, weapons, and weapon sites are under the rigid control and operation of the KGB, by whatever name it may use from time to time. The energetics weapons are not in the regular Russian armed forces. Energetics weapons have been tested worldwide for several decades, and this testing has been documented elsewhere by the present author.

ENERGY

Usually erroneously defined as the "capacity to do work".

The closest definition is: *The invariance of that which is varying*. Note that this is a 5-law logic definition and not an Aristotelian definition.

Here we have a real bucket of worms. This term is usually totally misdefined (as in the nostrum that "energy is the capacity to work") in physics, which defines energy as the "ability to scatter itself or change its own form" which obviously are not identities! A common definition is given as "a quantity that describes the capacity to do work; commonly divided into three major classifications: kinetic (dynamic) energy, potential (static) energy, and radiant (electromagnetic) energy. Well, energy can be changed in form and that is work. But energy is not the "capacity to change its own form", but is its own form, as can be seen.

Anyway, we'll have a go at a definition perhaps a little more acceptable, though still imperfect. Then we'll discuss things a bit.

Rigorously, energy is any deterministic or coherent structuring, either dynamic or stationary, existing in the virtual particle flux of vacuum. While that *sounds* good, it is still "the invariance of that which is varying." Ultimately, a thing is defined in terms of its appositive.

The *type* of energy depends upon the type of virtual particle(s) whose flux is selected. E.g., electromagnetic energy is a deterministic or coherent structuring, either dynamic or stationary, in the virtual *photon* flux of vacuum. Any trapped energy (ordering in the vacuum virtual particle flux) is gravitational in nature, since trapped energy is gravitational. In a mass, e.g., it is the trapped energy that is gravitational, not the mass per se, in the modern view. Contrast the definition of electromagnetic energy to the definition of an electrostatic scalar potential (ESSP): The electrostatic scalar potential is a stationary trapped deterministic or coherent dynamic wave-structuring of the virtual photon flux of vacuum. Thus it can be seen that the ESSP is a special case of EM energy: the stationary trapped case. For this reason, a mass—which is an enormous amount of statically trapped EM energy—may properly be considered as an extremely dense EM potential, which we refer to as the *mass potential*.

A potential is any trapped ordering or coherence, either static or dynamic, in the virtual particle flux of vacuum. A specific type of potential represents a selection of a particular virtual particle's flux in the vacuum, and an ordering—either static or dynamic—imposed in that flux.

However, since the scalar potential is just the static ordering in the virtual particle flux of vacuum, it follows that the scalar potential must contain—and in fact be totally composed of—internal order. E. T. Whittaker showed the form of that order in 1904. (See entry under Whittaker, E. T.) The scalar potential is composed of a harmonic series of pairs of antiparallel transverse waves. The antiwave of each wave/antiwave pair is a time reversed replica of the wave in that pair. In other words, the scalar potential is a special type of Fourier harmonic frequency expansion, coupled with its own phase conjugate present simultaneously.

Feynman said it bluntly: *"It is important to realize that in physics today, we have no knowledge of what energy is."* [Richard P. Feynman, Robert B. Leighton, and Matthew Sands, **Lectures on Physics**, Addison-Wesley, Reading, MA, Vol. 1, 1964, p. 4-2.]

E.g., particularly see R. B. Lindsay, "The concept of energy and its early historical development." **Foundations of Physics**, 1(4), 1971, p. 383-393. Lindsay investigates the concept of energy from its early historical origin. The root of the concept is the notion of *invariance in the midst of change*. Lindsay covers the concept and its evolvement (or lack thereof!) from ancient times through the 18th century.

The real problem is that the notion of energy implicitly involves the age-old unresolved philosophical problem of change, posed by Heraclitus over 3,000 years ago and unresolved to this day. *It cannot be solved within the realm of 3-law Aristotelian logic!* One way of posing it is something like this, after Heraclitus: "For a thing to change, it must turn into something else. How can a thing be itself and something else also? How can a thing have changed, and yet not have changed?"

The problem is that Aristotelian logic has a serious flaw of omission; it actually *implicitly assumes* a fourth law, which is the age-old philosopher's nightmare that, when a thing is pursued to the limit, *it invariably turns into its own opposite*. So in anguish the philosophers spoke of this nightmare as the "accursed necessity for the identity of opposites."

I did resolve the philosophers' nightmare some years ago, by adding a fourth law of logic to the Aristotelian three, which completes and extends Aristotelian logic, and an application rule which can be taken as a fifth law. E.g., see Appendix III: "A Conditional Criterion for Identity, Leading to a Fourth Law of Logic," in T. E. Bearden, **AIDS: Biological Warfare**, Tesla Book Company, Chula Vista, California, 1988, p. 428-443. A simple proof of the fourth law is given in that paper. For a much more elegant treatment of a higher topology logic, which is also practical and useful beyond the limitations of Aristotelian logic, see G. Spencer Brown, **Laws of Form**. Julian Press, New York, 1972. For a proper perspective on mathematics and on Aristotelian logic, see Morris Kline, **Mathematics: The Loss of Certainty**, Oxford University Press, New York, 1980.

It may be that, since by "identity" we mean at least the identity of "left" and "right" different observations, considering the left and right sides of the identity statement. If so, then already we involve a violation of Aristotelian logic in the very notion of "definition". In short, ultimately we can only define a thing in terms of an appositive in the first place. So we write an identity statement where left and right are different sides, then state "Oh, no, they are the same thing after all!" Said in that manner, the problem can clearly be seen. In one sense a definition is pure Zen, where no truth can be stated at all unless the speaker says two exactly opposing things, and then waits for the recipient to realize the truth that has been stated.

What this all means is that, since "energy" (and any other definition, ultimately) involves a logical contradiction in Aristotelian logic, we must "define" *energy* simultaneously in an appositive ways: (i) in the wave view and (ii) in the particle view. However, we point out that the notion of a "moving particle" is the notion of something considered momentarily as fixed (i.e., the particle), but which is immediately thereafter (in time snapshot #2) considered as moving. Notice that "moving" is changing, and so it involves Heraclitus' problem of change *a priori*. The notion of a "moving wave" is also a similar thing; i.e., "a wave" momentarily considers the entity as static and not changing (in time snapshot #1), and in the next moment (time snapshot #2) considers it as moving (changing). We can only point out this dichotomy for the reader to reflect upon and hopefully to grasp. *The conscious mind is a serial processor; it is extremely fast but still perceives snapshot by snapshot, serially. It essentially has been fitted to the single photon interaction, as has Aristotle's three laws of logic*. The problem is in the operation of conscious perception itself, not in nature which is not limited to just serial processing.

The unconscious mind is a massively parallel processor, so it can have many "different slides or snapshots in the slide projector" at the same time. So with our conscious mind's perception (Aristotelian logic is just a model of that, using single photon interaction as the physical observation mechanism) we see in terms of "either-or". On the other hand, with our unconscious we can also grasp the fact that single snapshot A can be the same thing as a totally different snapshot B, if the rules of "decision as to identity" are changed between snapshot A and snapshot B. Suppose that by "identity" we mean "incapable of being discriminated between." Is a black marble identical to a red marble, e.g.? It is perceived so if you are color blind. It is perceived not to be identical if you are not color blind. The point is something that most philosophers missed or brushed aside: identity is not absolute, but is "perceived identity". Identity is the result of a decision operation, based on multiple perceptions, recall from memory, and comparison of two remembered perceptions. The most simple form of comparison is simple subtraction.

The unconscious (massively parallel) perception can handle both snapshots simultaneously. The conscious mind only can see a single marble at a time, so it will see one or the other. In a *third* time interval it will recall from memory the first perception, compare it with the memory of the second perception (say, by simple detailed subtraction), and then decide whether object A is perceived to be identical to object B. The unconscious (massively parallel processor) can handle both the marble snapshots at the same time. It can see both the identity of the two, to a color-blind "identity decision process" and also the nonidentity of the two, to a color-sensitive "identity decision process." Again, nature is not limited to the single-snapshot, serial perception process of our conscious (serial) processor!

Unfortunately, in physics and mathematics we seem to still be thoroughly confused on this very perception issue. Brown's work may be the first work to straighten out the area of the topology of the logic utilized. My own independent effort was successful but far cruder than Brown's; Brown did it elegantly. We bring all this out because when one deeply looks into foundations and true definitions, one will directly confront the philosopher's nightmare and one's own conscious mind will never be able to resolve the problem. One's unconscious can resolve it, but it requires a certain "stretching of the realization" to harmonize monocular perception of the conscious mind with multiocular perception of the unconscious mind.

Just as a small example, the question of "is it a wave or a particle" once raged as a great debate in physics, and was never resolved. Instead, physicists just finally shook hands and agreed to quit arguing and fighting about it, and agreed to accept that the same entity could sometimes act as a particle, and in other cases it could act as a wave, and that *as it existed in the present, before observation,* it was somehow both a wave and a particle but we couldn't see its true nation (in that fashion). The key, of course, is that the question was posed in "either-or" form (Aristotelian logic form), and it cannot be answered in that reduced logic. Instead, a higher topology logic is required. Brown's logic answers it easily, as does my own four law superset of Aristotelian logic (five law superset if we count the application rule as a separate law). In the present, e.g., we have masstime and not mass. Just after a photon is emitted, we have mass and not masstime. The latter photon emission process consummates "observation." The point is, the true entity does exist in zero time as a spatial entity. It is not a spatial entity but is a spatiotemporal entity. If the "interaction" process tears off its "time-tail," it is converted to a "spatial entity" (frozen snapshot) and therefore seems to be a particle. If the "interaction" process does not remove the time-tail, it remains a spatiotemporal entity and therefore seems to be a wave. The *concept* of particle is 3-spatial concept. The concept of wave involves time also. No wave can exist and "be a wave or wavelike" unless it has some time extension to "be waving" *in*!

The physicists debating the wave-particle duality, you see, missed the most important point that *no observable exists in time or persists, a priori.* Hence rigorously no particle exists in time.

So we define energy (particle view) as any virtual particle flux pattern, where that definition automatically considers a single particle in translation as well as multiple particles in their myriad of translations. We define energy (wave view) as any wave flux, where that automatically considers a single wave in translation as well as multiple waves in their myriad of translations. Now note that one is going to have to deal with, and discriminate between, energy, energy flow, energy collection, and collected-energy dissipation.

As the reader can see, whenever one struggles with foundations issues, the problems get very complicated. We've beat this dead horse quite enough, and leave the further beating to the reader!

ENERGY AMPLIFYING COIL

A coil whose magnetic energy flow input is first split into two energy flow inputs, each equal to the original energy flow available from a magnetic source. Both the split energy flows then interact simultaneously with the coil, amplifying its electrical energy output compared to the conventional case where only a single energy flow interacts with the coil.

In the motionless electromagnetic generator (MEG), the curl of the magnetic vector potential of a permanent magnet (i.e., its magnetic field), is extracted and held within the core material of a special transformer, while the magnetic vector potential of the

permanent magnet is freely replenished in uncurled (field-free) magnetic vector potential form in space around the core material. Both the full magnetic field in the core and the full uncurled magnetic vector potential in space adjacent to the core interact with each output coil of the transformer. Hence a single potential energy flow is "split" into two flows each equal to the original EM energy flow, and both the parallel flows energetically interact with the output coil. This increases the energy interacting with the coil by this "dual interaction", so that the coil is said to be an "energy amplifying coil".

ENERGY COLLECTION/COLLECTING

In electromagnetics, exposure of an interceptor/collector, e.g., a charged particle, into an impinging EM energy flow, so that some of the flow is diverted around the intercepting particle. We may say that the flow of energy has been "reordered" in a stream around the diverting charge.

Energy collection is not a thing which "has been accomplished" and finished; instead, it is an ongoing process.

Note now that, if you perform or consider or impose any sort of ordering at all in the energy flow/flux, rigorously you have just implied an *energy collection/collecting* process. The energy part of a photon, e.g., would seem not to be "energy" per se. Instead, it is an energy collection/collecting, and a time collection/collecting as well. Yet that energy part is energy also! [Not to worry! Energy and energy-collecting, contrasted as appositives, become identities at the extreme boundary separating the two concepts. That boundary is the photon concept. Aristotelian logic does not apply on the boundary, which violates the Aristotelian law of the excluded middle.] More reasonably, a charged capacitor does not have "stored energy" per se in it, in the sense of "so many chunks of energy called joules". Instead, it has an *ongoing energy collection/collecting process*, where the asymmetry in the local vacuum flux exchange, of the dipole across the capacitor plates, continually extracts and "gates" a flow of EM energy from the capacitor dipole. That energy-flow bathes all the trapped charges in the capacitor. The energy-flow interaction with the trapped charges creates the
E-field and all the rest.

The diverted part of the total energy flow, is what is calculated in the "Poynting flow" or
S-flow.

ENERGY, DISINTEGRATED

An ad hoc term for the energy of the incoherent virtual particles in the virtual particle flux.

ENERGY DISSIPATION

Refers to the scattering or disordering of energy.

This is somewhat of a misnomer, broadly used in physics and somewhat erroneous.

Energy dissipation" *per se* does not mean that the energy is destroyed. Instead, there is the dissipation of the ordering (*collected/collecting*) of energy in which the diversion (local ordering) process disappears. What we call the "dissipation in space" of energy is rigorously the dissipation of the collection/collecting in space of the energy. In short, the energy is scattered, as in a resistive load, in all directions. But it is still there in space, just disordered.

Recall that all EM energy at a dipolarity comes directly from the time domain. It is the collecting process, not the energy, that is dissipated from a point or a region. Only *collected/collecting* of energy can be truly dissipated. With that understood, then dissipation of collected energy is simply removing the "collector" from the energy density flow impinging upon it to cause the collecting process to occur, or removing the flow of energy impinging upon the collector so that it intercepts and diverges some of it around itself.

So there are two ways in which this "collected energy" dissipation can occur: (i) the collector is moved out of the impinging energy-flow-stream, or (ii) the energy-flow-stream impinging on the collector is reduced to zero. Note that "changing the form" of the energy—i.e., changing the collector and the type of collecting—involves both conditions (i) and (ii). Thus energy is dissipated when the *collector/collecting* form is changed. In the conventional, less accurate statement, work is performed when "the form of the energy is changed." That now should be stated as "work is performed when the collector in the energy-flow-stream is changed to a different collector, because the first collector must be removed from the energy-flow-stream or the energy-flow-stream must be removed from it.

In physics we also consider that "positive" work by a body is work it does on something else, while "negative" work is work done upon the body by something else. We specifically emphasize that collection/collecting need not be a unitary, one-time occurrence! The EM energy-flow impinging upon a collector roars on by it at something like the speed of light. The entire flow is diminished by only about 10^{-13} (the nominal energy collecting fraction) as it flows onto, and on beyond a coulomb of charge. If that departing energy-flow is then retroreflected or otherwise *returned* to pass back through again, additional energy collection/collecting can and does occur from it. This can be repeated many times, particularly in an intensely-scattering, optically active material. Also, after the collected fraction of energy is dissipated, we can also retroreflect the scattered energy flow back and reuse it again. This too can be repeated many times.

So we must be careful of the present *work-energy theorem*, which is a special case and assumes only a single pass of the energy-flow in the "collection/collection" of energy that "changes form." If we institute additional passes, with additional "collection/collecting of energy, then we can collect and "use" a little more energy from all that enormous energy-flow that otherwise would escape us. If we dissipate some of the collected energy, then also intercept the departing dissipated energy flow and return it, we can collect some of the energy flow again and then dissipate that new collection again. And so on.

One can permissibly get many joules of "work" from a single joule of energy by iterative retroreflection, iterative re-collection, and iterative dissipation, without violating the conservation of energy law. This is one of the major secrets of overunity energy processes. It is proven by the overunity or excess emission (Letokhov was forced to call it "negative absorption of the medium" from an intensely scattering, optically active medium, as in the Lawandy experiment and in his patented process for lasing without population inversion. It is also proven by Patterson's adaptation of anti-Stokes emission.

Let's do a gedanken (thought) experiment, where we do not even apply the nominal 10^{-13} energy collection fraction. Let's just *conventionally* say "energy flow," "energy collection," and "energy dissipation," and ignore the "collection fraction." Since we are talking theoretically, we can have a perfect system. So we have a closed system, which we open to input some energy into. The system then opens in the load to dissipate all the energy back to the environment, thereby doing work. Now suppose I passively (i.e., without any input energy of my own, by perfect retroreflection) return all the dissipated energy back to the input once again. We simply let it flow back in, the system collects it again, and then dissipates it again—giving us the same amount of work we had the first time. Then we do it again. And again. I think you get the picture. The fact that energy can neither be created or destroyed, but only changed, means that the "same energy" can be *recycled* over and over. One has to have two different actions: one that changes the form of the energy so we get some work, and the other that retroreflects and recovers the dissipated energy (does negative work!) so that we can recycle it and dissipate it again. In principle, by recycling of energy one can get many joules of work from a single joule of energy. Nature does it every day! Every joule of energy formed at the initial

"Big Bang," is still with us. Every joule of it has on the average already performed many joules of work since then. And as we stated, the anti-Stokes emission process is a concrete example and demonstration that the energy recycling process can be accomplished in physical systems, so that the systems permissibly exhibit COP>1.0.

A most common example is the replenishment of a potential. E.g., the magnetic vector potential can be curled as a **B**-field, and that **B**-field can be totally confined inside a toroid, inside a long coil, or in certain magnetic core materials (as in the motionless electromagnetic generator or MEG for short). The **A**-potential will be replenished as fast as you withdraw the "total **B**-field" from it. So outside the toroid or the long solenoid, you will have as much **A**-potential energy as you started with, and the Aharonov-Bohm effect proves that the energy is there and will interact with electrons. Meanwhile, in the trapped **B**-field you also have drawn off as much energy as ostensibly the **A**-potential contained in the first place.

ENERGY, ELECTROMAGNETIC

Any deterministic or coherent structuring, either dynamic or static, existing in the virtual photon or charged particle flux of vacuum.

Note that, since a photon may also be considered a positron-electron pair, the flux of charged virtual electrons and positrons is included in the flux of photons.

ENERGY FLOW

The passage of energy, in any form, in one direction or generally in one direction.

Even though this "definition" is in error, we now just bypass the unresolved "observables do not persist" problem and the 4th law nature of change (e.g., motion) problem and proceed.

Note that this energy flow may be the overall movement of an omnidirectional energy flux, or it may be the movement of waves, or both. It may be in the kinetic energy of a moving mass. If the flow is everywhere the same, or even approximately the same, we often speak of the entire "flow" as just "energy." Often energy flow is also considered to have occurred from a region of more intense energy flux to a region of less intense energy flux, and vice versa. In other words, energy divergence or convergence is also considered as energy flow. As can be seen, *the usage of the term "energy flow" is not precisely defined in physics! It isn't going to be, at least not in ordinary Aristotelian logic terms.*

ENERGY FLUX

The passage of energy flow, in any form, through a unit area, and in any direction (usually all directions).

This includes both passage in a single direction, or passage in multiple directions at once.

ENERGY, FREE

Any environment or entity which freely emits, furnishes, or makes available energy which can be either collected and used as furnished or transduced into usable form and collected and used to power loads and do useful work.

The word "free" does not apply to costs, but rather to the source of the energy. Of course the ideal is energy that is both free for the taking (collecting and using) and also inexpensively taken and used.

Implicit in the notion of free EM energy from the vacuum are five key concepts: (1) the local vacuum/spacetime itself is filled with EM energy of generally unusable form, (2) some sort of organizing principle is utilized in one part of the circuit or system to cohere the vacuum energy and transduce it into usable EM form, (3) a gating mechanism is utilized to divert the vacuum energy in transduced usable EM form from the active vacuum to the external circuits or load parts of a device, (4) the coherent gated extra energy available in the external circuits or load parts is intercepted by those circuits or load parts, couples to them, and potentializes them with extra EM energy, so that the energy is collected by the system and regauges the system asymmetrically, and (5) the external circuits or load parts then scatter or dissipate the coupled extra energy to produce useful work, without destroying the organizing and gating mechanism that is extracting and furnishing usable EM energy from the vacuum.

ENERGY SOURCE

A function or entity which furnished energy.

Since energy cannot be created or destroyed, there is really no such thing as a "source", though it is a term commonly used. So called "energy sources" actually gate energy, changing it from one form to another. As an example, all 3-space EM energy is gated into 3-3-space from the time-domain. To the gating entity or "source" of the 3-space EM energy, there is an input of EM energy flow from the time domain (complex plane). The source must be a broken 3-symmetry in energy flow, so that more primary 4-symmetry energy flow applies. Hence the conservation law applies to the inflow of energy from the time dimension and the outflow of energy in 3-space.

ENGINEERING, ENTROPIC

Engineering or designing systems and processes whose operation "spills" or wastes some energy.

Entropic systems—which are the products of entropic engineering—thus have COP<1.0 and function in forward-time.

ENGINEERING, NEGENTROPIC

Engineering or designing systems and processes whose operation freely "receives" excess energy, so that they output more energy than the operator inputs, the excess being received from the external environment or other source.

ENTROPY

Thermodynamics term representing a measure of a system's capacity to undergo spontaneous change. In short, a quantity which measures the extent to which the energy of a system is unavailable to do work.

Entropy is given by $dS = dQ/T$, where dS is an infinitesimal change in entropy for a system absorbing an infinitesimal quantity of head dQ at absolute temperature T. In statistical mechanics, entropy is a measure of the disorder in a system and is given by $S = k \ln P + C$, where S is the value of entropy (disorder) for a system in a given state, P is the probability of that state's occurrence, k is a fixed constant, and C is an arbitrary constant. Intuitively, the concept of entropy corresponds to the concept of disorder. We specifically call attention to the fact that the "S" used in representing entropy is not at all the **S** used for Poynting flow.

In physics, a measure of the randomness or disorder of a system. Given by S = k ln g, where S is the entropy, k is the Boltzmann constant, and g is the total number of microstates available to the system. Sometimes stated as S = k ln (multiplicity).

Intimately connected with the Second Law of thermodynamics, which may be stated for the macroscopic case (after Baierlein) as follows: "If a system with many molecules is permitted to change, then—with overwhelming probability—the system will evolve to the macrostate of largest multiplicity and will subsequently remain in that macrostate. Stipulation: allow the system to evolve in isolation. (The stipulation includes the injunction, do not transfer energy to or from the system." [Ralph Baierlein, Thermal Physics, Cambridge University Press, Cambridge, 1999, p. 29].

ENTROPY, NEGATIVE (NEGENTROPY)

In a sense, the reversal of disorder, or reversal of entropy.

Since the normal or forward flow of time is entropic, negentropy is intimately related with time-reversal. This can be seen crudely this way: As a physical thing exists in time, it decays, ages, deteriorates, etc. In short, its ordering as a viable separate thing gets more and more disrupted. If it is then "reordered" precisely back to its original state, that is obviously a time-reversal of that entity.

Since the production of energy is connected to the production of more ordering, then it would seem to follow that any negentropic process also produces more energy. Or, that production of excess energy accompanies a negentropic process, and vice versa.

When we factor in the giant negentropy process, it is seen that all EM spatial energy comes from the time domain, via the broken 3-symmetry of the source charge or source dipole. Here we have a pure negentropic process. Hence we may now advance a new definition of negentropy for electrodynamics: *negentropy is the direct and ongoing conversion of time-energy (time-structuring and time-ordering) into 3-space EM energy*. Dipolarity (polarization) is the process initiating and producing the negentropy. Polarization is accompanied by ongoing negentropy so long as the polarization persists.

Another way of defining negentropy even more rigorously—for electrodynamics—is to define it in spacetime as a *broken 3-symmetry in EM energy flow with concomitant relaxation to a more primary 4-symmetry between time-energy flow and 3-spatial EM energy flow*, *where time-energy flow is transduced into 3-spatial EM energy flow.*

When a system with one measure of multiplicity progresses to a state with a decreased measure of multiplicity; i.e., when its total number of microstates decreases in the transition. A nonequilibrium steady state (NESS) system can exhibit negative entropy, and the entropy can further decrease progressively toward negative infinity as time passes. [D. J. Evans and Lamberto Rondoni, "Comments on the Entropy of Nonequilibrium Steady States," *J. Stat. Phys*., 109(3-4), Nov. 2002, p. 895-920]. Note that the Second Law of thermodynamics only rigorously applies to an isolates system, where neither mass nor energy crosses the boundary of the system. In the NESS system, that prohibition is violated, hence the second law need not apply. The common source charge is an example of such a NESS system continuously producing negative entropy, because it absorbs virtual energy from the vacuum, transduces it into observable energy, and re-emits the energy as observable photons radiating at light speed in all directions and forming the associated EM fields and potentials and their energy.

ENTROPY (POSITIVE)

When a system in a state with ordering progresses to a state with less ordering, i.e., when its total number of microstates increases in the transition.

ENZYME

Any of various proteins or conjugated proteins (compound of a protein and a nonprotein) produced by living cells, that serves as a catalyst for specific biochemical reactions at body temperatures.

EPIDEMIOLOGY

The study of the various factors influencing the occurrence, distribution, prevention, and control of disease, injury, and other health-related events in a defined human population.

EQUILIBRIUM

In physics, the state of a system in which opposing forces balance each other; i.e., sum to a vector zero.

In mechanics, a system of particles where the net force acting upon each constitutent particle is zero.

In chemistry, the state of a solution where the forward and reverse reactions are equal and balance each other, so that the chemical reactants and products maintain the same amounts.

EQUIVALENCE PRINCIPLE (PHYSICS)

One of the principles of relativity theory. The mass of the body determined by using the gravitational force on it to measure the mass, and the mass of the body determined by using inertial force on it to measure the mass, yield equal measurements for the mass.

ETHER

An extremely fine substance theorized to exist in space in lieu of sheer emptiness.

Discussed by Tesla, Einstein, Whittaker, and others. Originally conceived as the luminiferous ether, a thin material fluid pervading all space. Maxwell, e.g., believed in this material ether, and formulated his theory accordingly. Thus he mistakenly provided forces in the vacuum, which forces require a material vacuum. I.e., mass is a component of force; there is no force without mass, since $\mathbf{F} \equiv d/dt(m\mathbf{v})$. The hoary old medieval notion that a separate force acts upon a separate mass that it affects, is completely in error, though still utilized in mechanics! Modern field theorists know better, but correction of this massive error in physics has not been widely accomplished.

Originally, the ether was seen as a ghostly-thin, *material*, fluid medium postulated to fill space and carry electromagnetic waves, similar to the way in which a gas carries sound waves. Faraday and Maxwell added the assumption that EM fields existed as material taut strings (Faraday's lines of force) with conveniently missing endholders to provide the tension on the strings. The Michelson-Morley experiments eliminated any such material ether, but not a Lorentz-invariant nonmaterial ether (of which

vacuum itself is one example, in the modern view). Maxwell's equations were derived from a mechanical ether theory. Einstein once proposed that the vacuum, complete with its electromagnetic fields, should be called the new *ether*. In our own approach we have come full circle back to Einstein's suggestion, since the so-called "fields" are really just curvatures of spacetime and are included in our use of the vacuum as a giant potential comprised of virtual particle flux. The Sachs unified field theory, I believe, is the best available, particularly when the Evans O(3) symmetry electrodynamics is included as a special subset of it. In my own view, I regard "vacuum potential" and "spacetime" as essentially identities. Thus both the vacuum potential and spacetime have further internal structuring and dynamics. In relativity, this view is akin somewhat to the notion of "subspace" used on the Star Trek series.

Today the word "ether" is again acceptable in the literature when used in context of its modern quantum mechanical meaning. The "ether gas"—the quantum mechanical vacuum—is considered to be composed of virtual particles. The particles spontaneously come into being and then vanish so quickly they cannot be individually detected. That is, today the ether is regarded as a sort of specialized virtual particle gas—sort of a gas of "effervescent energy bubbles", so to speak—where the individual particles are continually being created and annihilated at a fantastic rate.

A good reference on the modern view of the vacuum is I. J. R. Aitchison, “Nothing’s plenty: The vacuum in modern quantum field theory,” **Contemporary Physics**, 26(4), 1985, p. 333-391. For an O(3) treatise, see M. W. Evans, P. K. Anastasovski, T. E. Bearden *et al*., "Derivation of the Lehnert field equations from gauge theory in vacuum: Space charge and current," **Foundations Of Physics Letters**, 13(2), Apr 2000, p.179-184. It is shown that the Lehnert field equations in vacuum, with concomitant space charge and current, can be derived straightforwardly from standard gauge theory applied in vacuum, using the concept of covariant derivative and Feynman's universal influence. The Lehnert and Proca field equations are shown to be inter-related through the well-known de Broglie theorem, in which the photon mass can be interpreted as finite. These ideas go some way towards addressing the inconsistency inherent, in Maxwell's famous displacement current, which has no concomitant vacuum space charge.

For technical insight into the attributes for extracting EM energy from the vacuum, see particularly M. W. Evans, P. K. Anastasovski, T. E. Bearden *et al*., "Classical electrodynamics without the Lorentz condition: Extracting energy from the vacuum," **Physica Scripta** 61(5), May 2000, p.513-517. It is shown that if the Lorentz condition is discarded, the Maxwell-Heaviside field equations become the Lehnert equations, indicating the presence of charge density and current density in the vacuum. The Lehnert equations are a subset of the O(3) Yang-Mills field equations. Charge and current density in the vacuum are defined straightforwardly in terms of the vector potential and scalar potential, and are conceptually similar to Maxwell's displacement current, which also occurs in the classical vacuum. A demonstration is made of the existence of a time dependent classical vacuum polarization which appears if the Lorentz condition is discarded. Vacuum charge and current appear phenomenologically in the Lehnert equations but fundamentally in the O(3) Yang-Mills theory of classical electrodynamics. The latter also allows for the possibility of the existence of vacuum topological magnetic charge density and topological magnetic current density. Both O(3) and Lehnert equations are superior to the Maxwell-Heaviside equations in being able to describe phenomena not amenable to the latter. In theory, devices can be made to extract the energy associated with vacuum charge and current. More than a dozen ways to approach extracting EM energy from the vacuum are presented.

EVANS, MYRON W.

Noted chemical physicist, primary developer of O(3) symmetry electrodynamics, and Director of the Alpha Foundation's Institute for Advanced Study (AIAS).

Under Evans, the work of the AIAS has made enormous contributions to physics and particularly to the extraction of usable EM energy from the vacuum. In the opinion of the present author, Evans is perhaps the single most important scientist in the Western world in the emerging field of electrical energy from the vacuum and in solving the world energy crisis.

EVIL

Refers to an act or acts perceived to be detrimental to the receiver or referent, in the positive time stream.

Oddly, the chain of events perceived to involve "evil" to a referent in the forward time stream, would be perceived to be equally *beneficial* to the referent, viewed in the *negative* time stream. In other words, evil in general is a synthesis of the results of observed actions or acts in the *forward time motion*, hence it is conjugated when time flow is reversed.

This is not just an idle question. In our physical body, the photon interaction with the electron shells of the atoms in the body largely determines the observed forward movement of one's material body through time. The conscious mind, fitted to the single photon interaction, thus perceives its "existence" in such terms. Meanwhile, in the nuclei of the atoms of our material body, the charge and hence the field interactions are reversed (giving Newton's third law reactions). That of course is a time-reversed flow of events, not sensed by our conscious mind, but possibly sensed by our deep unconscious mind. The question then arises, "Do we then actually exist both forwards and backwards in time?" In terms of good and evil, if the answer is yes, then this would have profound implications to theology and to the study of human consciousness.

Theologians (and philosophers) have pondered the "nature" of good and evil for literally thousands of years, and have reached no truly firm conclusion to date. The sticking point (theologically) seems to be the puzzle of a perfect, "all good" creator who had to have created evil also (since the Creator is axiomized to have created all). To the question, "How could a perfect Creator have created—or even tolerated—evil?", theologians have yet to find a satisfactory answer. Neither could they find a satisfactory answer to the question of, "How can the Creator, being all-just, and being all-powerful, then allow any evil act to occur?" In short, why does the Creator seemingly not "police up our perceived imperfections in the creation?" In short, theologians struggled with a formidable problem of how to justify the Creator's continued tolerance of evil, even for a moment.

There is no satisfactory answer to such questions, of course, in 3-law Aristotelian logic, because they are four-law logic situations. However, since the 3-logic is incomplete, one should examine the question in 4-law logic, and also in light of one's assumptions regarding the existence of the Creator. The question is unresolvable in 3-law logic and with the assumption of a Creator traveling through time, as we perceive ourselves to do. However, if time itself is a creation, then the axiomized Creator may be more properly axiomized as existing both in and outside time, and "everywhere in time at once" as well. The unlimited Creator must even be postulated to be able to "both be and not be simultaneously; if He cannot do that little trick, He has a limit." That trick must be allowed, else the Creator has a limit and is thus imperfect. But to such an axiomized Creator "permeating time everywhere at once, from beginning to end, which shall be the "beginning" and which shall be the "end?" And if we pick a beginning and an end, what shall be the "intermediate ordering" that we pick? There is no absolute position in either space or time to the "everywhere and everywhen at once" axiomized Creator.

The problem of good and evil then becomes a similar problem to the "wave or particle" question. Good and evil are two sides of the same coin, transposed one into the other by time-reversal. With respect to finite creatures perceiving themselves moving

forward in time, not existing in the future and not existing in the past, the question merely demonstrates that our perception itself is in error.

It may be, then, that there is a solution (whether one prefers it or not!) to such profound and ancient philosophical and theological problems in four-law or five-law logic. However, we will leave that question to the logicians and to the theologians to more properly decide.

EXCESS COLLECTED ENERGY

Collection by an interceptor/collector of a greater fraction of the EM energy flow impinging upon it, than is normal.

Any static electric or magnetic charge, e.g., with an EM energy density flow impinging upon it, has excess "energy collection" or "energy collecting" upon it, due to the altered vacuum virtual photon flux that is now exchanging with it. In a nominal electric circuit, e.g., a single "pass" of the EM energy flow from the source dipole, along the circuit conductors and across the conduction electrons, causes an "excess energy collection" upon the intercepting surface charges in the conductors. This potentializes the Drude electrons in the circuit and leads to subsequent dissipation in the loads (and losses) of about 10^{-13} of the EM nondiverged Heaviside energy flow that actually was extracted by the source dipole from the vacuum and sent down through space surrounding the conductors of the external circuit.

That is a single-pass energy collection fraction for a static charge. Almost all the Heaviside energy flow missed the circuit and passed on beyond the circuit "collectors" in one pass-by at essentially the speed of light, on out into deep space and beyond. On the other hand, if the already-passed EM energy flow is retroreflected, so that it returns for another pass along the circuit, then an *additional* amount of the repassing energy can be collected by those sluggish electrons. In a nominal circuit being used as an example, the electrons travel only about 5 or 6 inches per hour longitudinally down the conductors, restrained by the repulsion of the electrons beyond them. So *multiretroreflection*, *multipass*, *multicollection* can be used to provide excess energy and overunity efficiency. This is a change to the present statement of the work-energy theorem, which up to now has assumed single pass, single energy collection. The well-known anti-Stokes emission from certain highly scattering, optically active media, e.g., produces more energy radiating back out of the media than the amount of stimulating radiation energy input into the media. This is Letokhov's "negative absorption of the medium", which is really the excess emission from the medium due to retroreflection and multiple re-collections.

Also, if the intercepting charge is resonated, it sweeps out a greater geometrical cross section in the streaming energy flow, thereby diverging more and thus "collecting" more energy. In the Bohren experiment, e.g., this effect yields collection of some 18 times as much energy by the resonant charge as the same charge collects in static mode.

EXOTHERMIC

Giving off heat, or emitting scattered EM energy. Producing forward time energy.

FARADAY, MICHAEL

Noted English physicist and chemist, 1791-1867, who discovered field theory and electromagnetic induction. Faraday invented the dynamo also and formulated his laws of electrolysis.

His work directly inspired Maxwell, who vowed to study no other electromagnetics theory until he had captured Faraday's work in a mathematical theory.

FIELD

In mathematics, a set with two binary operations. In electromagnetics in more common terms, it is a region consisting of magnitudes and/or vector directions assigned to some active entity (spacetime itself) at each point in the region.

Designated addition and multiplication, satisfying the conditions that the set is a commutative group with respect to addition, that the set with the identity of the additive group omitted is a commutative group with respect to multiplication, and that multiplication distributes over addition for all elements in the set.

For our purposes, in plain language the fundamental notion is that a "field" is a sort of cleared, level space or region (e.g., in spacetime) where things can be placed and actions can occur amongst them, to them, on them, and of them. What the "place or space" is, can get a bit complicated, as can what is placed there and what actions are permitted. In short, we view a field as an altered (curved) region in spacetime, and this special curvature interacts with certain kinds of entities placed in that region. In return, those entities also interact back upon the spacetime curvature to alter it. Hence there is a dynamic two-way interaction between field and matter, where half of this interaction (the back-interaction of charge or matter) is missing from present classical electrodynamics.

EXOTHERMIC EXPLOSION

An explosion where ordinary heat and electromagnetic energy are released and radiate away from the explosive site. All normal explosions are exothermic.

Particularly used for a pulsed longitudinal EM wave interferometer, which in the distant interference zone (IZ) will produce a sudden eruption of scattering EM energy from the local spacetime curvature suddenly induced, when the interferometry transmitter chassis grounds are biased well above the ambient potential in the distant IZ.

FERMI LIQUID

A liquid where the individual particles or molecules comprising it are basically non-interacting, so that they can roam freely.

In an electron gas in a conductor, e.g., treatment of the free conduction electrons as a gas allows a theoretical modeling and explanation of conduction and resistance. Contrast to a Luttinger liquid, where the electrons interact with each other and thus enable the formation of collective phenomena.

FEYNMAN, RICHARD

Noted physicist, Nobelist, and co-developer of quantum electrodynamics.

Feynman is particularly noted for his refreshing three volumes of physics: See Richard P. Feynman, Robert B. Leighton and Matthew Sands, **The Feynman Lectures on Physics**, Addison-Wesley, New York, 1963. The book is particularly noteworthy in that it gives the student some insight into foundations problems in physics. E.g., in Vol. I on p. 2-4, Feynman defines the electric field not in terms of force per unit charge *per se*, but in terms of its potentiality for producing a force only when a charge is present for the force to be developed upon.

FEYNMAN DIAGRAM

A two-dimensional diagram of particle interactions, both in the virtual and observable levels, and both backward and forward in time and named after Richard Feynman who first employed them.

FIBER FUSE

Effect in fibers or fiber optic cable, whose core contains germanium, whereby heating the cable at one spot with a small flame will launch a focused traveling heat energy effect which melts a small hole in the core about every centimeter, and marches down the cable at about a meter per second to the end of the cable, destroying the optical transmission capability and ruining the cable.

Oddly, by igniting the fiber fuse from the other end of the damaged cable, a reverse fiber fuse effect will often march back down the cable in similar fashion except that it fills in the melted holes in the core, restoring the transmission capability of the cable.

If the energy required to melt all the holes (or fill them again) is taken into account, the amount of energy required to launch the fiber fuse is much less. This phenomenon does not appear to have an adequate technical explanation at present.

For an excellent description with photographs, see Ivars Peterson, “Fibers With Flare,” **Science News**, 140(13), Sep. 28, 1991, p. 200-201. For technical information and analysis, see D. P. Hand and P. St. J. Russell, “Solitary thermal shock-waves and optical damage in optical fibers,” **IEE Colloquium on ‘Non-Linear Optical Waveguides’**,” IEE Digest No. 88, London, England, 1988, p. 101-103; — Soliton-like thermal shock-waves in optical fibres: origin of periodic damage tracks," **Fourteenth European Conference on Optical Communication (ECOC 1988),** Sep. 11-15, 1988, Publication No. 292, 1(2), 1988, p. 111-114; — “Solitary thermal shock waves and optical damage in optical fibers: the fiber fuse,” **Optics Letters**, 13(9), Sep. 1988, p. 767-769; D. P. Hand and T. A. Birks, “Single-mode tapers as ‘fibre fuse’ damage circuit-breakers,” **Electronics Letters**, 25(1), Jan. 5, 1989, p. 33-34.

See P. St. J. Russell, “Power Conservation and Field Structures in Uniform Dielectric Gratings,” **Journal of the Optical Society of America A**, 1(3), Mar. 3, 1984, p. 293-299. Russell is actually referring to apparent violation of local conservation of energy. This would be indicated if the vacuum-to-mass interaction is not taken into account. Russell’s analysis therefore supports the fact that (i) the vacuum-mass interaction is required, (ii) the fiber fuse does utilize some of its gated vacuum energy (i.e., the usually non-diverged portion of the Poynting flow), and (iii) the fiber fuse is a legitimate, repeatable overunity process, although a "runaway" process, uncontrolled, and not sustainable.

FIELD

In physics, "a region of space marked by a physical property, as gravitational or electromagnetic force or fluid pressure, having a determinable value at every point in the region."

[Thanks to **Webster's II New Riverside University Dictionary**.]

Here one must *not* think of "space" as emptiness, as mathematicians do, but as a virtual particle flux, a dynamic entity, and as dynamic spacetime. A field then is a set of entities and their relationships and operations in a region of *that* kind of space, where the entities and operations are themselves "space stuff". They are all "virtual" in that they are not individually observable. However, their impact upon or interaction with mass—particularly charged mass—can be and often is observable, in that we can see some change of the mass (its direction of travel, translation, acceleration, deceleration, rotation, generation of current, etc.). If the entities are point-like and are naively supposed to have magnitude only, or if we only specify their energy density magnitude at each point, then that "marked space region" is said to be a *scalar field*. If the entities are point-like but have both magnitude and direction, they are said to be a *vector field*.

Further the deponent saith not because even the foundations physicists are in hot water in trying to define the field, and if the deponent saith more he will surely deep-fry in hot oil!

FIELD, SCALAR

A field, to any point of which is assigned a magnitude only.

FIELD, VECTOR

A field, to any point of which is assigned both a magnitude and a direction.

FLAT (UNCURVED) SPACETIME

A vacuum/spacetime whose virtual particle flux intensity—and therefore its local energy density—does not change as a function of spatial position or averaged time.

That is, a flat spacetime in my view is a quantum mechanical vacuum whose virtual particle flux and energy density are constant in magnitude and internal constitution with respect to spatial position and in averaged time. Note that a flat spacetime (vacuum potential) can still contain vacuum engines, and thus still be *dimensioned*. In that case, contrary to normal physics, the flat spacetime itself will still interact with an embedded object and change it, even though it may not translate it. To perform transmutation of elements, e.g., one is interested in just such engines and not in translating through space the element being treated. This dimensioning or activation of the local flat spacetime can result in an otherwise unexpected, seeming violation of one or more laws of nature in the dimensioned region.

FISSIONING, ACTION

The splitting of the action quantum into two canonical variables (for example, energy and time), only one of which can normally be completely detected or measured. ("Action" has the dimensions of angular momentum—energy x time, momentum x length, etc.)

Fissioning produces length, discrete bit by discrete bit, and time likewise. The physical reality of separated physical objects is thus continually created, discrete bit by discrete bit, monocularly. All that ever observably exists in the "present" is a single quantum change, just occurring. Recombining of the two canonical action fission fragments is called "fusion." Fusion also occurs monocularly, quantum by quantum. Rigorously, the physical world of separated objects never exists as such except in memory recall of vast numbers of past ordered quantum changes that occurred one by one.

FLUX

The amount of some quantity (such as energy, particles, volume of fluid, etc.) flowing across a given area (usually a unit area perpendicular to the flow) per unit of time.

The term flux density is now more commonly used. Loosely, "flux" refers to the perpendicular flow through an area, while "flux density" refers to the magnitude or intensity (rate) of the flux. In some cases such as a flux of particles of different velocities, the

number of particles may be multiplied by the average velocity to give an average flux density that is weighted.

FLUX DENSITY

The amount of some quantity (such as energy, particles, volume of fluid, etc.) flowing across a given area (usually a unit area perpendicular to the flow) per unit of time.

FOGAL, WILLIAM (BILL)

Soon-to-be-noted researcher and inventor of the Fogal semiconductor (two patents so far), as well as a superluminal infolding-outfolding communication system and other remarkable longitudinal EM wave processes.

I am happy to be a friend and colleague of Bill Fogal.

FOGAL SEMICONDUCTOR

A special semiconductor invented by Bill Fogal which, in its operational regime, utilizes an integrated semiconductor, tantalum capacitor, and feedback resistor to accomplish charge blocking (blocking of electron current flow dq/dt) while passing displacement current d/dt

The Fogal semiconductor can also accomplish amplified phase conjugation of signals as well as infolding (translation of input transverse EM waves to output longitudinal EM waves) and outfolding (translation of received input longitudinal EM waves to output transverse EM waves). Used in communication systems, it opens the use of the unlimited "infolded" electromagnetics bandwidth. Since it may communicate using longitudinal EM waves, it is also usable for superluminal or a specialized "tunneling" communication through the "interior" of normal EM waves, potentials, and fields.

See William J. Fogal, "High Gain, Low distortion, Faster Switching Transistor," U.S. Patent No. 5,196,809, Mar. 23, 1993; — "High Gain, Low Distortion, Faster Switching Transistor," U.S. Patent No. 5,430,413, July 4, 1995, a continuation of his earlier patent.

FORCE

In mechanics, identically the time derivative of momentum, or $\mathbf{F} \equiv d/dt(m\mathbf{v})$.

Simply, changing of the old concept of mass-motion. One must realize that it is not the mass in motion, but the single undivided quantity "mass-motion" or "mass-velocity" (momentum) that is changed. In short, $\mathbf{F} \equiv d/dt(m\mathbf{v})$. In present EM theory, force fields are erroneously taken to exist in empty, massless vacuum. However, the mechanical definition is an identity, not an equality. Thus force does not *separately exist in contact with* a mass, but *consists of* a changing "mass-motion." Since this force can be induced into and of the mass-motion target at a distance, in the new approach one is confronted with the fact that there is a more fundamental mechanism that produces force itself, and that is a curvature of spacetime.

Distant curvatures of spacetime to produce forces on exposed charged mass systems are also engineered by longitudinal EM wave interferometry.

FORCE FIELD

An effect that exists as a local vacuum virtual particle flux interaction upon and with a unit mass or unit charge whereby a particular type of matter is affected.

The force field has two components, one the mass and the other massless. In electrodynamics, one normally thinks (erroneously!) of the massless component, and refers to that component alone as "the force field." This considers the "force field" as a separate entity, acting upon a separate "mass." Whether it is logically correct or not, that is the prevailing way physics and electrodynamics uses it! So in this definition, let us momentarily accept the common incorrect usage, for convenience, while pointing out the real definition as we need to.

For example, conventionally the EM force fields can affect and change the state of motion of any charged particle or any magnetic particle. In classical physics, the force fields are considered the primary causative agents; when these fields are zero, then the motion of the particle or system is unaffected. Consequently, conventional EM theory assumes that all the EM phenomenology ceases once the force fields are absent. Today we know that is not true at all, as we explain in this glossary.

FORCE-FREE PROPAGATION

Propagation of force-free disturbances in the vacuum flux

(i.e., infolded inside the ambient vacuum potential, or inside a constant DC voltage.) Such "infolded" propagation is not limited to the speed of light, but may even travel in the Coulomb gauge so that it is instantaneous. More usually, it can travel superluminally. It may be regarded as a special form of "tunneling", which is known (both theoretically and experimentally) to produce superluminal propagation to the external observer. The music of Beethoven's 40th symphony, e.g., has been experimentally transferred between two points in a physical waveguide by such "quantum tunneling" at over four times the speed of light in vacuum.

We regard tunneling as moving in a sort of "subspace", i.e., within the internal structuring of spacetime itself. It is not limited by the speed of light and Einstein's postulate, which we believe only applies to signals moving in spacetime in bulk, and not to signals moving *within* substructuring inside that spacetime.

FOUNDATIONS OF MATHEMATICS

The concepts, operations, assumptions, postulates, logic, definitions, and axioms of algebra systems.

FOUNDATIONS OF PHYSICS

The postulates, assumptions, concepts, and definitions upon which a scientific physics model rests. Included are the postulates, concepts, assumptions, definitions, and operations of the mathematics in which the scientific model is expressed, as well as the postulates, concepts, assumptions, definitions, and operations of the physics entities and functions assigned to the mathematical symbols.

Thus "scientific truth"—even mathematical truth (see Morris Kline's **Mathematics: The Loss of Certainty**—is actually a *qualified* truth. What is true in one model (one set of postulates, assumptions, concepts, and definitions, including those in the algebra) may not be always true when one or more of the postulates, assumptions, concepts, and definitions is/are changed, and/or when the topology of the mathematics in which the model is expressed is changed, etc.

The major flaws in present physics models involve errors in the foundations. However, a successful physics model is rather quickly dogmatized and often turned into a belief structure by many scientists rather than being regarded as a tentative model. Consequently, scientists who attempt to do serious work in foundations are generally ignored or ostracized and rather

vehemently attacked if they propose any significant changes to one of the dogmatized models. Particularly, all funding and "benefits" of the scientific bureaucracy are denied the heretical foundations scientist, unless he or someone can rather quickly come forth with an iron-tight experimental proof of the heresy. Any attempted change in foundations is usually met with ad hominem attack, a barrage of criticism, loss of position, and denial of research funding. Science has a long history of just such dogmatic oppression of great scientific discoveries. To name a few (there are hundreds): The first laser paper was rejected by the journals as being ridiculous. When Mayer proposed conservation of energy, he was hounded and ridiculed so fiercely that he suffered a nervous breakdown and attempted suicide. Years later, near the end of his life conservation of energy was adopted because it greatly facilitated understanding and calculation, and the same system now lionized him as a scientific hero. Ovshinsky suffered personal attack, ridicule, and charges of charlatanism in pushing amorphous semiconductors; everyone knew that only crystalline semiconductors could work. The situation changed when several thousand Xerox machines were observed to now contain amorphous semiconductors which were working just fine! Louis de Broglie's matter wave hypothesis caused consternation to his thesis advisors; but because he was Prince Louis de Broglie, they felt obligated to send it to the great Einstein so that he would reject it and then they could regretfully reject the thesis of the Prince. When Einstein replied that it was probably true, they felt they had no choice but to publish it *because de Broglie was a Prince of the old French aristocracy, and as such was not to be casually trifled with.* So foundations work is fraught with the greatest peril to the practitioner. Yet it is the most important work in physics, and it is a continuing black mark against the scientific establishment that they do not openly encourage *and fund* the most able physicists, grad students, and post-docs to examine and revise the errors in foundations concepts and postulates. Because of the prevailing dogmatism, science itself continually strangles the new ideas and concepts that would provide the physics of the 22nd century now. In an eerie turn of events, science has become in a strange way its own worst enemy, and the strongest barrier to the advance of science.

FOUR-SPACE (4-SPACE)

The "normal" spacetime used in physics, consisting of three spatial dimensions and one time dimension. Minkowski spacetime.

FOURTH LAW OF LOGIC

the law that a thing and its opposite become identical on the boundary, i.e., in multiple simultaneous observation. Identity is merely the loss of observational or perceptual distinction; when formerly "two" objects are simultaneously observed by a single observer, two slides have been shown at once in the slide projector. It does not matter at that point what each was individually observed to be before; now there is no observable distinction or difference. We previously showed that the law is implicitly assumed in the three laws of Aristotelian logic anyway, and published a simple proof of the fourth law. Without the fourth law, Aristotelian logic "eats itself". What results in the four law logic is that either (1) the three laws apply explicitly and the fourth implicitly, or (2) the fourth law applies explicitly and the fourth implicitly. This *application rule* itself can be taken as a fifth law of logic. The fourth law is also the law of the paradox: I.e., when something is true but violates one or more of the Aristotelian laws, it is a case where the fourth law applies explicitly. The conclusions derivable from a four law logic agree generally with the conclusions derivable from G Spencer Brown's **Laws of Form**.

FOUR-WAVE MIXING

A nonlinear multiwave mixing effect when four waves mix in a highly nonlinear situation so that wave to wave interaction occurs.

FRACTIONAL CHARGE

A hypothetical particle having a charge less than the electron's charge. Often called a quark, where its charge is 1/3 or 2/3 the charge of the electron.

A few years ago, Stanford University researchers found evidence of free quarks. There is also now the fractional Hall effect. In the 1920's Ehrenhaft reported the discovery and production of fractional charges of all sizes, and his experiments have been replicated by Michailov, with papers by Michailov and Barrett.

In the new approach, when time-energy is utilized, quarks can be freed or nearly freed rather easily in "time-reversal zones". It would appear that, as the new approach develops, free quarks will become a normal event rather than one intensely sought but terribly difficult to come by experimentally.

FRAME, LORENTZ

A frame of reference which is not accelerated with respect to the laboratory observer.

In this case, the frame may be rotated (moving at a constant velocity) but it is not rotating (the frame is not accelerated with respect to the observer, and spacetime is not curved). In this case special relativity applies, as do the conservation laws. If the local spacetime is curved, the frame is accelerated and spacetime is curved. Locally, then, general relativity applies. In this case, locally the conservation laws (energy, momentum, charge, and spin) can be violated. However, in ordinary general relativity, it has been tacitly assumed that locally the curvature of spacetime is negligible. Hence locally a Lorentz frame is assumed, and the conservation laws are assumed to apply locally also. In scalar electromagnetics, the local spacetime is always curved and general relativity applies locally. In this case, the conservation laws need not apply.

FRAME, REFERENCE)

A spatial, organized, measured lattice placed in "emptiness" (space, spacetime).

Normally refers to a 3-dimensional, spatial frame. All objects and points in the "universe" or spatial frame are considered to simultaneously coexist at separate, measured points in the frame. Differs from the vacuum in that, rigorously, vacuum has no existing definite lengths and no existing definite time intervals, as these appear only after measurement or detection, and are relative to the observer and to the interactions ongoing as well as in the detection process itself. The "laboratory frame" is the static reference frame of the observer or measurement. A separate reference frame may be assumed to exist for any fixed or moving object, or centered on any point in another frame. When a type of frame is assumed, the entire class of physical interactions that can occur has been restricted to an assumed set or type. In other words, given the frame, the *conventional* physics has been assumed. One of the greatest restrictions of an assumed "frame" is to rule out the consideration (existence) of other higher dimensions.

Note that, in the new unified field theory approach, the other higher dimensions are always available and cannot be ruled out in general, but only in some special case. Every curvature of spacetime, and any internal additional curvature to that primary curvature, adds a new dimension. In our view, a spacetime may be "flat" in overall curvature, but consist of internally structured deterministic curvatures or "engines". In this view, normal inertial frames, e.g., may still contain vacuum engines, which will not affect the normal *bulk translation* rules, but may affect any or all of the nontranslation mechanisms, including the very laws of nature in many cases.

FREE ENERGY

Excess energy freely received from its external active environment by an open system that is far from thermodynamic equilibrium in its exchange with that environment.

To use this free excess energy, it must be collected, transported to a load or loads with minimal losses, and then dissipated in the load(s) to power them, without any substantial portion of the free energy being used to close the system's "gate" through which the excess energy is input to it.

There is a separate thermodynamics for such open systems far from thermodynamic equilibrium in their active environmental exchange. Such a system is permitted to exhibit five "magic" functions: it is permitted to (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy than the operator himself inputs (the excess energy is freely received from the active environment, (4) power itself and its load simultaneously (all the energy is freely received from the active environment), and (5) exhibit negentropy.

The entropy of such a system cannot even be calculated. Some useful references are: Ilya Prigogine with D. Kondepudi, **Modern Thermodynamics: From Heat Engines to Dissipative Structures**, Wiley, Chichester, 1998; Ilya Prigogine, **The End of Certainty: Time, Chaos, and the New Laws of Nature**, Free Press, New York, 1996, 1997; G. Nicolis and I. Prigogine, **Exploring Complexity**, Piper, Munich, 1987; Gregoire Nicolis, "Physics of far-from-equilibrium systems and self-organization," Chapter 11 in Paul Davies, Ed., **The New Physics**, Cambridge University Press, Cambridge, 1989, p. 316-347.

FREE ENERGY SYSTEM

Any open system not in thermodynamic equilibrium, which freely receives excess energy from an external source,

...and collects and utilizes this free excess energy to freely power external loads, so that a permissible system COP>1.0 is achieved, as allowed by the nonlinear thermodynamics of open systems in disequilibrium with their environment.

Implicit in the notion of free electromagnetic energy systems are six key concepts: (1) the local vacuum/spacetime is known to be filled with hidden (i.e., virtual) energy in violent motion, i.e., the local vacuum/spacetime is a violent virtual energy flux and therefore a scalar potential, (2) a broken symmetry—i.e., some sort of organizing and gating mechanism, such as the common dipole—in this hidden (virtual) energy flux of the vacuum is utilized as a source, to cohere the virtual energy and divert it as energy flow $\mathbf{S} = \mathbf{E}\times\mathbf{H}$, from the broken symmetry initiation point onto the external circuits or load parts of a device, (3) the coherent gated extra *virtual* energy flow available in the external circuits or load parts couples to (interacts with) the mobile charges in those circuits or load parts, so that gradients developed in the interacting virtual flux form force fields on and of the particle masses, driving the mobile charges along the circuit and through current-impeding circuit components such as loads, (4) in the interaction of the driven charges with the driving virtual energy flux, their spin and erratic motions integrate a tiny "coupling fraction" of the driving virtual energy into observable (i.e., macroscopic field) energy, thus creating the **E**-fields and **B**-fields, (5) the current-impeding external components or load parts scatter or dissipate the coherence of the driven charges, and thereby dissipate the collected energy or change the form of the collected field energy, thereby producing useful work, and (6) little or none of the excess collected energy in the circuit is split off and dissipated in the gate (asymmetry component serving as the **S**-flow source) to destroy the gate and thereby destroy its asymmetry in the vacuum flux, which is what is extracting and producing the free energy flow.

FUSION, ACTION

In the new approach, the recombining of two canonical bits of a fissioned action quantum.

The fusion process "cancels" the bits produced by the fission process, and constitutes a negative spacetime operation. The physical world is thus eliminated, bit by bit, in a monocular fusion operation that produces the "past". The "mass" of a particle is taken to be proportional to, and identically comprised of, the absolute value of its fission and fusion rate. When fission and fusion rates of a particle are equal, the particle is unaccelerated; when unequal, the particle is accelerated. Vice versa, when the particle is unaccelerated, the fission and fusion rates are equal, and when the particle is accelerated, the fission and fusion rates are unequal.

GAIA HYPOTHESIS

The hypothesis by Lovelock that the earth and its biosphere is a living thing, at least in some sense.

In the new viewpoint, there exists a biospheric quantum potential which contains an extended mind and therefore is indeed an extended lifeform—one which includes the earth and the quantum potentia all its creatures and species. In the new sense, even so-called "inert" matter is alive, being continually bathed by energy flow dimensioned with lifeform templates, and therefore equally alive in all directions and nonpreferential.

GATE

Refers to something (a component or function) which extracts some part of a flux or flow, compacting it into a stream, and "sending it out."

A moving board wall or gate may be swung into a river, e.g., to divert or "gate" some of the river's flow out into a sluice ditch and on to a waterwheel powering a mill. Similarly, a dipole extracts some of the energy from the vacuum virtual photon flux exchange with the end charges of the dipole, and "gates" (diverts) the extracted portion of energy out from the ends of the dipole as energy flows. This creates the scalar potential surrounding each charge, and also the **E**-fields. Even a "static" dipole does this "gating" of vacuum energy into an energy flow.

The fundamental gate for all EM energy in 3-space is the dipole or dipolarity. The source of the 3-space EM energy continuously emitted by any charge or dipole is an equal inflow of EM energy from the complex plane (from the time domain). Thus EM energy flow is conserved in 4 dimensions but not in 3-space. In particle physics, it is well-known that any dipole or charge is such a broken 3-symmetry in its fierce vacuum energy flux exchange. However, particle physics considers the input energy to be virtual particle energy from the vacuum and therefore random energy. Whittaker 1903 shows it is actually from the time domain of spacetime (from the complex plane) and the input energy flow from the vacuum is not random but precisely organized in a harmonic set of longitudinal EM phase conjugate waves. Of course by wave-particle duality we simply consider the two pictures to be just different and permitted models of the same thing.

GATING EFFECT

The effect of extracting part of a flux or flow, compacting it into a useful stream, and "sending it out."

See *gate*.

GAUGE

In electromagnetism, usually considered a possible choice for (change of) electric scalar potential and magnetic vector potential, without any net change of force fields so that the change satisfies Maxwell's equations.

Interestingly, gauge field theory includes the axiom of gauge freedom. In EM systems, this means that one is free to "regauge" or change the potential energy of the system freely and at any time, so long as the change results in a static stress potential energy change. In the real world, one may have to pay a little bit for switching. But essentially physics already assumes that one can cause his EM system to take on excess potential energy at will, so long as it is a *stress potential* energy change only.

In short, only the *symmetrical* regauging case has been considered in electrodynamics. Yet every electrical power system must first potentialize the system *asymmetrically* rather than symmetrically. In the theoretically perfect system, this asymmetrical regauging is done freely. Hence every electrical power system first breaks gauge symmetry, in order to take on extra energy so that it can do work. Further, the source of the potential energy flowing into the asymmetrically regauged electrical system so freely, comes from the source dipole's extraction of EM energy from the time-domain (complex plane) due to its broken 3-symmetry in EM energy flow.

So the highest "gauge" principle is that energy can be freely extracted from the vacuum, anywhere and at any time, freely and easily, by making a dipolarity—which changes a single potential and asymmetrically regauges the system.

It follows that one is in theory free to "dissipate" this excess free energy in external loads to power them. Again, in the real world one may have to pay some switching costs, but that can be minimized by efficient switching. However, since no conventional electrical power system accomplishes this free powering of its loads, it rigorously follows that the conventional system must self-enforce symmetry in its discharge of the free potential energy achieved by the initial *asymmetrical regauging*.

Thus, if we believe gauge field theory—the most modern of physics theories and in many ways the most useful—and also believe its assumption of free asymmetrical regauging that is hidden in its gauge freedom principle, then COP>1.0 electrical power systems are absolutely permitted by nature and by gauge field theory where asymmetrical regauging is deliberately used.

It follows that some feature in electrical power systems as we presently design and build them, must be preventing these systems from exhibiting overunity COP. And so it is. The ubiquitous closed current loop circuit results in the circuit forcibly and symmetrically regauging itself while dissipating its excitation energy to power its loads and losses. This forces half the collected regauging (free) energy to be dissipated in the external circuit's loads and losses, and half of it to be dissipated in the source dipole to scatter the charges and destroy the dipole. This means that less than half the available free regauging energy is used to power the load, while half is used to destroy the entity—the source dipole—actually furnishing the free regauging energy from the vacuum.

Hence all our present electrical power systems are inherently free energy systems freely extracting their energy from the vacuum, but are fiendishly designed so that they kill themselves (shut off all free asymmetric regauging energy from the vacuum, by destroying the source dipole) faster than they catch some of the free energy from the vacuum to power their loads.

To restore the source dipole requires at least as much energy dissipation as was done to destroy it. In our conventional self-destructive systems, the generator shaft must thus be continuously powered in order to form the magnetic field inside the generator, so that this magnetic field can then dissipate its available energy to force the scattered charges back apart to form an ordered source dipole.

We pay the power company to have a giant wrestling match inside its own generators and *lose*. And in a sense, we do it because our theoreticians love gauge symmetry more than they tolerate broken gauge symmetry. So they build lovely, symmetry-restoring electrical power systems—and monstrously mangle and destroy the fragile biosphere in the process.

GAUGE FREEDOM

The axiom in gauge theory that one can freely change the potentials of an EM system, so long as the net new forces resulting from the change will sum to a zero vector resultant so that the system remains "symmetrical" in its force-field functioning with respect to the system prior to the change of potentials.

Gauge and gauge freedom are actually formal restrictions of an even more important asymmetrical regauging principle: *a potential in a system can be freely changed at any time, thus freely changing the potential energy of the system freely and at will*. Symmetrical regauging is achieved only by multiple application of this asymmetry rule to provide a net symmetry condition again, with a change in locked-in stress potential energy of the system.

GAUGE SYMMETRY

Abstract mathematical symmetry of a field, that relates to the freedom to regauge (change the value of) potentials, without affecting the values of the field quantities.

In short, the higher principle that the potentials can be changed freely and at will—and hence the potential energy of the regauged system can be changed freely and at will—is arbitrarily restricted to a very special case: Each change of potential involves the appearance of an new free force field. This *asymmetrical* change can be made freely and at will, at any time. However, the notion of gauge symmetry restricts any set of such changes to the special case where the new free force fields produced must sum to a net zero force field of opposing forces. In short, it severely restricts the freedom to change the potentials—to the special case where the resulting change of the system's potential energy must remain a static stress potential energy condition. Note that this arbitrarily eliminates any overunity functioning of the regauged system in which the altered potential(s) and altered system potential energy exist(s). See the discussions of *gauge* and *gauge freedom*, above.

GAUGE THEORY

A field theory using a field that has one or more gauge symmetries.

Note the accent on gauge symmetry and the net *symmetrical* regauging restriction. This restriction is a carry-forward of the old notion that the potentials are not primary, but the fields are primary causes of all EM phenomena.

For the overunity researcher, broken gauge symmetry is the interesting feature which must avidly be sought in his experimental systems. Hence he must seek out and familiarize himself with a wide variety of *broken symmetry effects* and phenomenology. He must also rigorously analyze his circuits with a keen view to where gauge symmetry can be broken, where and how gauge symmetry is automatically restored during excitation discharge, etc. Unless the automatic self-enforcing of symmetrical gauge transformation during excitation discharge is violated, no EM system can produce COP>1.0. In addition, without elaboration, the overunity researcher must also learn to consider the time-domain functions of the circuit, and particularly the giant negentropy of the common dipole. Unless he understands that all EM energy comes from the vacuum and from the complex plane via the broken 3-symmetry of a dipolarity, he cannot understand his own circuits.

Electromagnetics was the first gauge theory. Gauge theory is widely utilized today, and particularly in particle physics. In overunity power systems, the system must exhibit a broken gauge symmetry at least twice: (1) in initially potentializing the system to freely increase its potential energy, thus exciting the system so that it has energy with which to do work, and (2) then

discharging this free excitation energy in the load without simultaneously destroying the source dipole providing the continual potentializing.

The conventional COP<1.0 electrical power system restores net 3-space symmetry by continually destroying the "free asymmetrical regauging" component: the source dipole, and using more of the energy freely received from the vacuum via dipole asymmetry to destroy the dipole than is used to power the load. This requires that at least as much 3-space energy be input to the system again, to restore the dipole and thus potentialize the external circuit, as was used to destroy the dipole. Hence as much 3-space energy has to be input as is dissipated in all the loads and losses, including inside the generator. For that reason, our scientists and engineers unwittingly but deliberately design and build only COP<1.0 systems.

Without elaboration, we also accent that spacetime curvature is always involved in an overunity EM power system, and the tempic (time) potential of the output end of an overunity system differs from the tempic potential of the input end, so that the gradient (the tempic force) is directed from output to input—exactly the reversal of the case for a COP<1.0 power system.

GAUGE TRANSFORMATION (IN ELECTROMAGNETICS)

In EM, gauge transformation is conventionally taken to be the addition of the gradient of some function of space and time to the magnetic vector potential—and simultaneously the addition of the negative of the partial derivative of the same function with respect to time, divided by the speed of light, to the electric scalar potential.

This procedure gives different potentials but leaves the electric and magnetic fields unchanged. It restricts gauge transformations to *net symmetrical* transformations. However, the increase or decrease in potential energy of the system, due to changing the potentials, results in a change in the stress of the system and a change in its stress energy. This is because two new antiparallel forces are created, which change the stress of the system.

In essence, gauge symmetry then involves the implicit assumption that a functioning system is the same regardless of how it is stressed, and regardless of the state of its stress energy. We point out that, gravitationally, this is not true since any change in the local potential energy of the system is a spacetime curvature change, hence a gravitational change.

GENERAL THEORY OF RELATIVITY

Einstein's theory of gravity in which the gravitational force is represented by a curvature in spacetime.

GIANT NEGENTROPY (OF THE DIPOLE)

The receipt from the time domain of spacetime (the vacuum), by any dipolarity, of enormous longitudinal EM wave energy flow, transduction of that absorbed energy from the complex plane into real 3-space, and emission of that enormous energy flow in all directions in 3-space, automatically and indefinitely after a little energy has been expended to separate the charges and make the dipole. The EM waves in the input from the time domain and the output in 3-space are perfectly ordered and correlated, which is a giant ordering of the vacuum/spacetime and is thus a giant negentropy.

In circuits, the source dipole in the generator or battery, once made, performs this function. Only a minuscule fraction (some 10^{-13}) of the energy pouring out of the generator's or battery's terminals strikes the surface charges of that attached external circuit and is diverged into the conductors to power the Drude electrons and the circuit. All the rest is just wasted.

See my paper, "Giant Negentropy from the Common Dipole," *ibid*.

GRAVITON

The quantum (smallest piece) of the gravitational field, with spin 2.

In the quantum theory of general relativity, the graviton is massless and has spin 2. In the new approach, a graviton is considered to be a paired (coupled) photon and antiphoton, each of which has spin one, so that the graviton couplet has spin 2. A scalar potential is comprised of gravitons, not merely photons, since it can be decomposed into a harmonic series of bidirectional wavepairs. In each wavepair, a wave and its antiwave precisely superpose. We insist on a further strong condition: that in the biwave, the photons comprising the wave and the antiphotons comprising the antiwave also must obey the *distortion correction theorem*. This means that the antiphotons and photons are passing through each other in opposite directions, continually coupling into gravitons and decoupling again.

GRAVITY

The phenomenon characterized by the physical attraction of any two material bodies.

Actually, in modern general relativity it is the trapped energy in the masses that produce the gravity potentials. Ideally, the gravitational force between two masses is proportional to the product of the masses divided by the square of the distance between them. In the new approach, one recognizes that mass itself is defined in terms of, and identically consists of, the time derivative of an action flux. [For a force-free fundamental definition of mass, see T.E. Bearden, **Quiton/Perceptron Physics: A Theory of Existence, Perception, and Physical Phenomena**, National Technical Information System, Report AD-763210, 1973.] A photon flux is also an action flux. A virtual photon flux is an action flux. So the vacuum consists of a gigantic action flux—which with certain interactions forms mass itself. But since photons are action quanta and photon flux is action flux, and since mass and gravitation are functions imposed on such action flux; then mass, EM, and gravitation become different aspects of the same thing. All of them can be electromagnetically engineered, directly, as indeed can be the flow of time itself. By affecting the flow of time electromagnetically, one is thus able to affect the gravitational force between two objects electromagnetically. Antigravity, for example, can be achieved by a mechanism that is given in this glossary. Hutchinson has demonstrated the levitation of objects weighing up to 60 lbs., albeit sporadically and uncontrollably. At my urgent request, Sweet performed a highly successful antigravity experiment some years ago, reducing the weight of a 6-pound object by 90%, smoothly and controllably, in several smoothly controlled steps. I consider that the experiment tested and validated my approach to an engineerable mechanism for antigravity. For the results of the test, see Floyd Sweet and T.E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," **Proceedings of the 26th Intersociety Energy Conversion Engineering Conference (IECEC '91)**, Boston, Massachusetts, 1991, p. 370-375.

GROSS PARTICLE TRANSLATION

Refers to translating the entire particle in space, rather than internally structuring the particle's potential (massless charge).

GROSS POTENTIAL GRADIENT FIELDS

The usual gradient in a scalar potential's gross magnitude, as in $-\nabla\phi$.

GYROELECTRONS

Spinning electrons considered as gyroscopes, so that when longitudinally perturbed they can and will laterally precess.

Considering (in a gross first order model) the conduction electrons in the Drude gas in a conductor as little gyros, because they are (i) spinning on an axis, (ii) severely restrained in their ability to move forward longitudinally down the conductor as current, and (iii) much more free to precess laterally in the conductor. Thus when the gyroelectrons in the receiving wire antenna, perturbed by an incoming longitudinal EM wave in the vacuum, are longitudinally perturbed, they precess laterally so that our instruments (which detect electron wiggles, not the incoming vacuum EM wave) do detect "transverse waves." However, they are detecting the transverse gyroelectron precession waves. The old electrodynamicists, long before the electron or the atom was discovered, simply envisioned the incoming EM wave as "waves in the thin material fluid ether" which were "intercepted" as electric fluid waves in the antenna. Hence since their instruments reported that the intercepted "electric fluid" was vibrating transversely, they firmly believed (erroneously) that this proved the ether wave to be transverse also, just as those "taut string waves" that Maxwell and Faraday had believed in. That is the total *raison d'etre* behind the mistaken notion of the transverse EM wave in the vacuum ether!

HARMONIC SERIES

Consisting of a fundamental frequency, its first harmonic, its second harmonic, etc.

HEAVISIDE, OLIVER

Noted English self-taught physicist and brilliant electrodynamicist, 1850-1925, who played a role in discarding Maxwell's quaternions, and also played a role in forming vector mathematics and formulating the vector reduction of Maxwell's theory from 20 quaternion equations in some 20 unknowns to the present 4 vector equations.

What are presently taught as "Maxwell's equations" in university are actually Heaviside's equations.

Lorentz symmetrically regauged the Maxwell-Heaviside equations, again greatly simplifying their mathematical solution—and also unwittingly discarding all permissible overunity Maxwellian systems in the process.

HEAVISIDE ENERGY FLOW COMPONENT

(1) The enormous nonintercepted and nondiverged energy flow component pouring out of the terminals of the battery or generator, and missing the external circuit entirely so that it is wasted.

(2) The enormous energy in the EM field, potential, or wave that misses the interaction of the field, potential, or wave with the assumed unit point static electric charge.

(3) See also discussion under Giant Negentropy.

HERACLITUS

To be added.

HERTZ, HEINRICH

Noted German physicist who together with Heaviside and others transformed Maxwell's theory from quaternion algebra to vector algebra, and who also produced EM waves, thus confirming Maxwell's theory.

HIDDEN BIWAVES

Those bidirectional EM wavepairs that comprise the scalar potential are indeed "hidden" with respect to our normal "electron translation" (i.e., electron wiggle) detectors and instruments.

HIDDEN VARIABLE THEORY

A class of quantum mechanical theories which considers that the quantum state of a physical system is not a complete specification after all. The "hidden variables" are those additional components necessary to provide the "complete state" of the system.

The hidden variables are those extra components of the theorized complete state, which are not contained in the quantum state. Bohm's hidden variables theory is the best known of all of these theories, and makes the same predictions as does the conventional quantum mechanics. In addition, it eliminates the terrible problem of the "missing chaos," eliminates the quantum measurement problem, and it suggests that quantum mechanics can be engineered if the hidden variables themselves can be engineered. In the new approach, one goes a step further by considering hidden EM variables infolded inside the potentials themselves, including inside the quantum potential utilized by Bohm. The advantage of this assumption is that it poses an *engineerable* interpretation, after work by Stoney, Whittaker, and Ziolkowski. Further, the Russians have utilized this type of EM hidden variable theory, along with the quantum potential, to develop secret advanced weapons. The physics of this area is called *energetics*.

HIERONYMUS, T. GALEN

Founder of the American version of radionics, who patented a radionics machine and process to start the cycle of radionics in this country.

HILBERT, DAVID

Noted German mathematician, 1862-1943, who did advanced work in geometry, theory of invariants, integral equations, and mathematical physicist.

Noted particularly for his development of Hilbert space.

HOLE (ELECTRON HOLE)

An unfilled vacancy in an ordering of electron energy levels, as in a lattice or in the Dirac Sea.

Electron energy levels have two energy states: (1) *positive energy* state, and (2) *negative energy* state. The positive energy states are associated with the positions of normal energy electrons. The negative energy states are almost all filled, and this is the Dirac sea.

The absence of an electron from either energy state creates a particular kind of hole. When an electron is absent from an electron positive energy state position in a lattice, that results in an excess of positive charge at that point vacated by the electron. Note that when an electron then refills that hole (recombination occurs), the electron remains in a positive energy state, does not disappear, and no radiation occurs.

When an electron is lifted from an electron negative energy state in the Dirac sea, that leaves behind a hole in the negative energy state in the Dirac sea. When an electron subsequently refills that hole, it "falls" in and disappears, decaying to a lower energy level and emitting radiation due to the difference in the energy levels.

The difference between holes in the Dirac sea and holes in the electron positive energy levels in a lattice, are very different. In short, they lead to two quite different kinds of "hole and electron" interactions. In the lattice "hole-filling" (recombination), there is no excess radiation given off and the electron does not disappear from the positive energy continuum. In the Dirac sea hole-filling, excess radiation is given off and the electron disappears from the positive energy continuum.

Under the influence of an electric field, a *positive energy* hole in a crystal lattice—where an electron has left and is therefore absent—will effectively propagate through the lattice as a positive charge, but usually much slower than the electron propagates in the opposite direction as an electron current. The process is actually more complex and involves continuous interaction with the electrons and their physical distribution pattern and location. The hole current is mathematically treated as a special positive charge current, often referred to as a positron current. In a current-carrying conductor or semiconductor, one has a current of electrons traveling in one direction and simultaneously a current of holes (hole positrons) traveling in the opposite direction, but recombining.

As stated, in addition to lattice holes, there also can exist unfilled holes in the Dirac negative energy states comprising the vacuum, particularly when fields are present. In this case, it is a *negative energy* hole. A positive energy electron that falls into a Dirac sea hole will emit energy as it falls to that lower energy state. To lift one of the electrons from the Dirac sea and leave a hole, energy must therefore be added to the negative energy electron in the Dirac hole.

When fields are present, Dirac holes may exist and may move as hole current in circuits under certain conditions. The situation is complex; see Felix Finster, "Definition of the Dirac Sea in the Presence of External Fields," **Adv. Theor. Math. Phys**., Vol. 2, 1998, p. 963-985. Updated copy (version 4) is on http://xxx.lanl.gov/abs/hep-th/9705006.

When a free electron fills a positive energy hole in a lattice (positive electron energy state), this effectively disposes of both the hole and the *free* electron which is now a *bound* electron, and is called *recombination*. The electron does not disappear. In a material lattice, there is no energy radiation from this, just the disappearance of the hole and the "binding" of a free electron so that it is no longer free.

In visualizing positive hole currents, passing the hole current though a surplus of available electrons (as in a negative charge donor material) will result in "hole filling" and recombinations. One may therefore speak of disposing of unwanted hole current by recombination, and in fact this is widely accomplished in semiconductors by controlling the doping.

HOLE CONDUCTION (LATTICE)

The movement of electron vacancies (holes) in a lattice continually left behind by hopping of the electrons as they break loose from their bonded positions and move freely in an electron current.

When an electron hops out of a lattice bond, it leaves behind a bonding gap or "hole" in the positive electron energy state at that bond site, so that an extra positive charge appears there at the hole. As the electrons move in one direction in a conducting lattice, the holes move in the opposite direction in a "positive current", but at a much slower pace than the electron current moves.

HOLE CURRENT (LATTICE)

See *hole conduction (lattice)*.

HOMEOPATHY

A system of medical treatment based on the theory that certain diseases can be cured by giving very small doses of substances which in a healthy person would produce symptoms like those of the disease. (Opposed to allopathy).

Homeopathy is based upon formation and use of dimensioned potentials (particularly the potential composed of the extremely rapid "making and breaking" hydrogen bonds in a fluid) containing vacuum engines. Any material or solute, and therefore any molecule, contains its own specific vacuum engine, its own charges, and its own dimensioned potential. Dissolving the material in water, or even using a suspension of it in water, allows the bonding potential in the water to interact with the potential of the solute or suspension. Potentials superpose, and they also diffuse and mix their inner structures (vacuum engines) into each other. So the material or solute diffuses its vacuum engines into the interior of the hydrogen bonding potential, in effect ordering and templating the hydrogen bonding itself! Vigorous shaking of the suspension or solution assures that all the fluid and H-bonding potential is exposed to the solute of suspended particles, so that a thorough exchange of vacuum engines occurs. This process in homeopathy is called *potentizing*. It's actually just creating the desired internal vacuum engines in the H-bonding potential of the water. Once that's done, there's really no further need for the solute or the suspended particles. By repeatedly diluting the solution to the extreme, then one can reach a point where there is a high probability that not a single molecule of the original solute is remaining in the fluid. Yet in each dilution, shaking can be used to insure the even spread of the vacuum engines through the newly introduced H-bonding potential in the newly introduced water. At the end, there exists an altered fluid whose H-bonding potential now contains the desired vacuum engines. Drinking that water now introduces those vacuum engines into the body fluids, bloodstream, etc. The ingested dilute new vacuum engines will then diffuse through the various potentials of the body, and produce altered chemical functioning of the kind that could have been induced by the chemical or active solute material. The advantage is that the harsh material residue of the chemical or solute is not present in the body, as it is when allopathy is utilized.

HYPERFUNCTIONING

Functioning in hyperspace as opposed to 4-dimensional Minkowski space.

Higher topological functioning.

HYPERSPACE

Refers to a space of more than four dimensions, and specifically to those spatial dimensions outside the normal three.

IDENTITY OF OPPOSITES

On the boundary, A and not-A are identical. If all of a thing is collected, one reaches the boundary of that thing and it turns into its own opposite.

INERTIAL FRAME

A frame of reference in which force-free bodies move along straight lines, and the postulates of special relativity are valid.

In the new approach, this notion is extended; even in an inertial frame, force-free bodies may move along straight lines, the postulates of special relativity may remain valid, and yet the EM hidden variable may induce other changes in the usual laws of nature due to the action of hidden vacuum engines infolded in the *dimensioned* local spacetime (vacuum potential).

INFOLDED HIDDEN DYNAMICS

Refers to:

(i) Bohm's hidden variable theory and the internal dynamics of the hidden variables/entities themselves, and

(ii) to the hidden biwave pairs comprising a scalar potential, with the internal dynamics of those waves such as tuning off harmonic frequency, multiplication, variation of phasing and magnitude, etc.

Also, by Whittaker 1903 the scalar potential can be decomposed into the bidirectional wavepair set in harmonic series. By Whittaker 1904, each of the waves in a biwave pair can be further decomposed into two potentials, so each pair of waves would consist of four potentials. That is, the entire set of internal biwave pairs can be replaced by four times as many internal "partial potentials" as was the number of biwave pairs. Then Whittaker 1903 can be applied once again to break each one of those scalar potentials into new biwave pairs, and so forth and so forth. So the potential can be expressed as waves within waves within waves, or potentials within potentials within potentials, and so on. The neat thing is that each successive infolding (internesting) is a higher dimensional functioning and a higher topology. So one can build (with some little pain!) specific infolded wave patterns that will work in—say—the 7th dimension of hyperspace, or the eighth dimension, and so on. This is why I called the internal structuring of a potential (or the two potentials comprising an EM wave) *dimensioning* the potential or the wave. As a half-baked nuclear engineer whom the Army never let practice his discipline, I wanted some way to directly engineer the nucleus. *That has now been found*. Unfortunately it has also already been highly weaponized in secrecy by one or more foreign nations. In other words, one can design a signal and assemble it (with some difficulty) that will flip one quark in a nucleon in an atom. That way one can transmute an element either into the next higher element isomer or the next lower element isomer. Using a quantum potential to "transport" the necessary vacuum engines, the effect can be accomplished at a great distance, in multiple targets simultaneously, and the effect is not shieldable. "Jumps" in nuclear transmutation can also be accomplished. The migration of electrons to and from an atom (as in solution, e.g.) makes and negates ions continuously. Thus continually the external potentials and the nuclear potentials intercommunicate. This means that their vacuum engines continually diffuse. Any dimensioning of the external potentials will be passed into the nuclear potentials as a dimensioning action also. If certain conditioning vacuum engines are present in the external potentials, then the slow diffusion into the nuclear potentials begins to affect the nucleons and their interactions, the quarks comprising the nucleons, the particles such as pions continually exchanged between nucleons, etc. The mechanism for nuclear transmutations and production of new species is there! I believe, e.g., and am working to more clearly express, that the major mechanism producing the new nuclear species in cold fusion experiments just such dimensioned potentials, involving the inadvertent dimensioning of potentials comprised of the hydrogen bondings of the water and other factors.

INFOLDED REAL VECTOR COMPONENTS

Well, simply take a set of real force vectors that altogether sum to a vector zero resultant.

That "vector zero system" is a zero with respect to forced *translation* of a particle or mass. It is not an absence per se, but is the presence of specifically hidden and "infolded" real vectors. Two elephants pushing each other to a draw form such a "zero-translating" system. That "zero system" is quite different from two crickets pushing against each other to a draw! Anyone who thinks all zeros are "absences" and who thinks all zeros are equal, is invited to try standing between the crickets and observing how he feels, then standing between the elephants and see how he feels. The latter might be a real bummer. So zeros can differ! And a zero can be a presence of many real things, all still there but "infolded" and "hidden," but just the absence of any *one and only one* thing. Even in arithmetic, e.g., we are free to pull 5-3-2 right out of 0, or pull out 4-7+8-6-2+5+1+1-3-1/2-1/2 (if I got the arithmetic correct!). And so on. So we have always *used* the fact that a net zero can have a real internal composition, without detailing it exactly. We teach our schoolchildren to do it, but fail to tell them what they are doing!

When you sum EM force fields to zero, the fields are still there and real. You have altered the energy of the system or volume, and also the potential energy of the system or volume. And you have done it in specific directions, magnitudes, etc. along the "fingers" of the infolded patterns. In short, you have made a specific vacuum engine. Mass, fluid, nuclei, molecules, etc. exposed to that "conditioned vacuum potential" may well undergo physical and chemical and electrical changes. Golden once performed experiments which powerfully conditioned the local vacuum, and all clocks and watches (mechanical, electrical, etc.) in the local area were awry for four days.

INFOLDING

With reference to signals, infolding means "placing the signal or modulation or change upon one or more of the internal bidirectional wavepairs comprising the scalar potential.

Since all EM potentials ultimately represent changes to the ambient vacuum potential, one has conditioned or altered the vacuum itself when infolding is utilized. Infolding of EM signals, vectors, and directions produces *vacuum engines*. By Whittaker's principle and Bearden's corollary, these vacuum engines can be designed to affect matter—including atomic nuclei, nucleons, etc.—in any manner desired.

INFORMATION CONTENT OF THE FIELD

Russian euphemism for the structuring of the hidden longitudinal EM waves and their dynamics, that comprise any EM potential, field, or wave.

INFRASONIC

Below sonic.

Frequencies below what the ear can hear. Below about 20 Hertz.

INTERFEROMETER

An instrument in which a wave is split into two waves or beams, which after traveling over different paths are subsequently reunited and display interference.

INTERFEROMETRY

Measurement of wavelengths of light and very small distances and thicknesses,

...for determining indices of refraction, and for analyzing small parts of a spectrum by means of the interference phenomena of light.

INTERNAL SPACE

To be added.

ITERATED

Done repeatedly, like picking beans one at a time.

JOSEPHSON EFFECT

Flow of Cooper pairs (superconducting electron pairs) across a thin dielectric separating two superconducting electrons, in the absence of a voltage drop.

That is, the pair of electrons can "tunnel" through a thin insulating barrier.

JOSEPHSON JUNCTION

The thin dielectric separating two superconducting electrons, with subsequent Josephson tunneling of Cooper pairs.

JOSEPHSON TUNNELING

See *Josephson effect*.

JOULE

A measure of energy.

One joule equals one watt for one second. In physics the unit of work or energy in the MKS system, being the amount of work done by one newton acting through a distance of one meter, equal to 10,000,000 ergs.

JUNG, CARL GUSTOV

Noted Swiss psychiatrist and psychologist who founded Jungian analytical psychology, formulated the principle of synchronicity, and advanced and delineated collective unconscious mind.

From the content of his German patients, Jung predicted WW II two decades before it occurred.

KINDLING

Coherent integration (adding) of similar virtual components among the vast "noise" of dissimilar virtual components, so that the "signal-to-noise" ratio of the integrated signal steadily increases, and the integrated "observable signal" grows out of the background virtual state noise.

This "kindling" process is directly analogous to coherent integration of nondiscernible radar signals far beneath the received noise, to build and extract the real radar return signals from targets. This sort of process dramatically increases the "sensitivity" of the radar. Real, very tiny signals even 100 dB or more beneath the noise level can be retrieved in such fashion by modern radars.

Similar processes can integrate very minute signals already passed into the virtual state and presumed to be nonexistent. Usually, however, the difference frequency between two frequencies at least one harmonic interval apart must be used, considering the vacuum's virtual flux state as an isotropic nonlinear medium.

One may also hypothesize that potentials and propagating signals may decrease with distance, but are never truly "lost" in that they never reach a total zero. When they reach the quantum level, further decrease in amplitude simply results in their passing into the virtual state (subquantum level).

KIRCHHOFF'S CURRENT-LAW

At any time, the sum of the instantaneous currents flowing into a node or point in a circuit equals the sum of the instantaneous currents flowing out of that node or point.

KIRCHHOFF'S VOLTAGE LAW

At any time, the sum of all voltage rises in a closed loop circuit equals the sum of all drops in that closed loop circuit.

LAMB, WILLIS EUGENE JR.

American physicist and Nobelian who discovered the hyperfine structure of the hydrogen spectrum, and first measured the interaction of the vacuum energy that generates a change in the energy levels of the hydrogen atom, according to Dirac's theory and quantum electrodynamics.

LAMB SHIFT

A very small correction to the first excited state of the hydrogen atom due to interaction of the vacuum.

Willis Lamb experimentally confirmed this prediction of quantum electrodynamics to high accuracy.

LAMELLAR CURRENT

Current in thin layers.

Thin layers of current. Thin sheets of current.

LASER

A device that generates light in which all the photons are exactly in step and produce a coherent beam.

Laser light has one wavelength and is more easily controlled than other kinds of light. Use of a laser to perform interferometry is one way to create holograms; use of a laser to illuminate a hologram is one way to read it. Originally the word "laser" was an acronym that stood for "light amplification by stimulated emission of radiation." Note that when TiO_2 particles in suspension, with a small amount of fluorescent dye added, are weakly illuminated by a small coherent light source (a laser), a tremendous room-filling output of coherent light emission occurs, by the anti-Stokes emission effect. This is lasing without population inversion, and it is a validated and easily testable overunity process. This is the process patented by Lawandy.

LASING WITHOUT INVERSION

The amplification of coherent light in an intensely scattering medium, comprised of certain powdered laser crystals or suspensions of similar material, where a variety of phenomena such as gain narrowing and amplifying random walk of light propagating in the medium, combine to give laser emission with diffusive feedback.

Gain tends to depend on the volume of the medium, so that at a certain medium the gain in light amplification by the medium exceeds the losses, and the laser action results above this critical volume. The intensity of the light scattering (multiply reflecting) in the medium then will increase rapidly until an "explosion" of light results in an intense flash of coherent light in all directions from the medium volume.

If the excitation is still present, the process will be repeated and the energy density will again exceed the critical value, rapidly generating another intense flash of light. This process can be repeated many times, given the presence of continued excitation.

A very interesting phenomena that can occur is coherent backscattering. Here the light scatters over both a forward-time path and a time-reversed path, perhaps with each path consisting of more than 1,000 scatterings. Because of time-reversal symmetry, the two waves (forward and backward) acquire exactly the same (though random!) phase. So the two waves after all this 1,000 scatterings on their paths, meet and interfere constructively in the direction back toward the exciting light source.

In theory the mean free path can be made shorter and shorter, so that all the light would be trapped inside the medium. This is called Anderson localization, and it has been reported in the literature; see D.S. Wiersma, P. Bartolini, A. Lagendiji, and R. Righini, "Localization of light in a disordered medium," **Nature**, Vol. 390, 1997, p. 671; John Sajeev, "Frozen light," *ibid*., p. 661-662.

This work grew out of original work called out by Letokhov but largely ignored for more than two decades.

References: D. Wiersma and A. Lagendijk, "Laser action in very white paint," **Physics World**, Jan. 1997, p. 33-37; — "Light diffusion with gain and random lasers," **Physical Review E54**, 1996, p. 4256; N.M. Lawandy et al., "Laser action in strongly scattering media," **Nature**, Vol. 368, 1994, p. 436; V.S. Letokhov, Generation of light by a scattering medium with negative resonance absorption," **Sov. Phys. JETP**, Vol. 26, 1968, p. 835.

Note that we have nominated a version of this process, together with consideration of the erroneously discarded Heaviside nondiverged energy flow component, as the fundamental mechanism proposed to be involved in gamma ray bursters, x-ray bursters, and in some gamma ray and x-ray flashes associated with atmospheric phenomena on earth in thunderstorms, etc. We also nominated the missing Heaviside energy flow component as the agent accounting for the excess gravity (some 90% of the total gravity) in the arms of spiral galaxies that hole those arms intact so they do not fly apart. See T.E. Bearden, "Dark Matter or Dark Energy?", **Journal of New Energy,** 4(4), Spring 2000, p. 4-11 (also available on http://www.cheniere.org); — "Giant Negentropy from the Common Dipole," **Proceedings of Congress 2000**, St. Petersburg, Russia, Vol. 1, July 2000 , p. 86-98. Also published in **Journal of New Energy**, 5(1), Summer 2000, p. 11-23. Also carried on DoE open website http://www.ott.doe.gov/papersbooks.html and on http://www.cheniere.org.

LAW OF PHYSICS

A restriction placed upon the physical mechanisms that can occur under certain broad assumptions as to the background situation and environment.

Actually, in nature there are no such rigidly fixed "laws"; these are only man's synthesis for the behavior of large classes of systems under very general conditions. Any "law of physics" can be violated if the conditions contained in its assumptions are violated. Conservation laws are often touted as "laws of physics." Actually, the conservation laws assume a closed system or one in equilibrium, and a linear spacetime (Lorentz frame). If either or both of these assumptions is locally violated, any or all of the conservation laws can be violated locally, even though the overall global conservation is still upheld. Quite simply, in that case one has opened the system (broken symmetry). In particle physics, broken symmetry already results in violation of one or more of the conservation laws. In leading Russian physics journals, papers are regularly published containing unrestricted general relativity with concomitant violation of any and all conservation laws.

LAWANDY PATENTS

Patents covering and related to anti-Stokes emission (excess emission of energy) in strongly scattering, optically active media such as TiO2 particles in suspension.

More energy is emitted than one must input to stimulate the effect. It is being hailed as a new form of lasing, without the requirement for population inversion.

LETOKHOV, V. S.

Russian pioneer in excess emission phenomena from stimulated media.

LETOKHOV EFFECT

The excess emission (overunity emission of energy) phenomena in strongly scattering, optically active media, usually referred to as "negative absorption of the medium".

For an overview, see V. S. Letokhov, “Stimulated emission of an ensemble of scattering particles with negative absorption,” **ZhETF Plasma**, 5(8), Apr. 15, 1967, p. 262-265; —“Generation of light by a scattering medium with negative resonance absorption,” **Sov. Phys. JETP**, 26(4), Apr. 1968, p. 835-839; — “Laser Maxwell’s Demon,” **Contemporary Physics**, 36(4), 1995, p. 235-243.

LOCALITY

Characteristic where interactions are local in spacetime.

LOCALIZED

Confined to a small region of a large system rather than being extended through the system or at a distance.

LOCAL VIRTUAL PHOTON FLUX OF VACUUM

Refers to a local region of the vacuum, which also refers to the vacuum flux density of that region.

LONGITUDINAL COMPONENT

In EM waves, the longitudinal component of the fields along the direction of travel,

...as opposed to the transverse components at right angles to the direction of travel.

LONGITUDINAL E-FIELD

We may divide any electrical field into two components, a transverse component and a longitudinal component.

Of course one or the other may be a zero vector.

LONGITUDINAL GRADIENT

Compression wave gradients (differences) in density or pressure,

...considered in a direction from their origin along the direction of primary movement, vs. transverse waves, which act perpendicular to that direction.

LONGITUDINAL INTERIOR WAVE

In conventional theory, the electric portion of the EM wave is a transverse field oscillation, and the longitudinal component is essentially zero.

In the new "infolded" wave approach, there is no overall transverse gradient in the vacuum potential, but there is an infolded longitudinal gradient which oscillates "inside the vacuum potential." This is rather like a "pressure wave" transmitted under water, without causing a surface wave involving physical upheaval and fall-off of the water. In EM, by analogy the speed of the "bulk upheaval" transverse wave is nominally c, the speed of light in vacuum [but see discussion of galloping waves, for what really happens!]. The speed of the pressure wave, under water, may be very much greater than c, because it is a special "tunneling" process and it also involves the galloping wave effect. Experimental measurement of superluminal tunneling velocities—such as more than 4c—are already well-known in the literature.

To better visualize this "pressure wave," consider that it is like a sort of "velocity modulation" upon the edge of the conventionally-visualized plane wave front of a traveling transverse wave, except now the plane itself does not move. All the succeeding planes are "bumped" by the velocity modulation of one plane, and so the velocity modulation propagates through (inside) the vacuum potential as a modulated pressure wave, without transverse change of the potential.

Now we have a very special medium! It consists of bidirectional EM wave pairs, one passing through the other. In such a case, it is already known that the speed of a "planar wave front" in the superposition and resulting interference of two oppositely moving waves can in fact greatly exceed the speed of light momentarily, then slow dramatically below than the speed of light, etc., so long as the average velocity is c. This is called the galloping wave effect. [E.g., see William G. Harter et al., "Galloping waves and their relativistic properties, **American Journal of Physics**, 53(7), July 1985, p. 671-679.]. Since the plane wavefront within the interior *can* in fact vary its velocity, we are quite free to use this "velocity pulse modulation" effect of wavefront speed variation, to place signal intelligence upon the planar wave front speed variations. So we can transmit hidden pressure waves with intelligence on them, through the interior of the vacuum potential. *Further, the restriction to an average velocity of c does not have to apply, and the planar pressure pulses can be transmitted much faster than c*. This is the basis of the work Fogal and I are struggling with, in order to achieve superluminal communication. It is also what we have been struggling with in an effort to come up with a communication system that can propagate infolded signals inside the H-bonding potential of the ocean itself, so that high-data-rate communications with deep submarines could be utilized, at any distance, and the huge, gawky, frightfully expensive, and environment-affecting ELF systems be done away with. We also think it should eventually be possible to develop an underwater radar type of system, but it's far too early at this point to try to conceptualize just exactly how it would work.

LONGITUDINAL WAVE

A "pressure" type of wave, similar to sound, in which the vibrations are along the direction of travel of the wave.

Hence, a wave composed of alternating densifications and rarefactions, where we focus upon the longitudinal component of the changes. In the past we have used the term "scalar waves" to imply longitudinal standing waves, such as in one infolded Stoney-Whittaker wavepair inside the scalar potential. In classical EM theory, the Poynting vector predicts no longitudinal wave of energy from a time-varying, electrically charged source. In fact, even in the ordinary theory, an exact solution of the problem does allow this longitudinal wave, as shown by Keech and Corum, **International Journal of Theoretical Physics**, 20(1), 1981, pp. 63-68. Conventionally, as explained elsewhere in this glossary, the classical electromagnetic wave is modeled as a vector string wave, comprised of transverse vibrations on implicitly assumed material taut strings in the vacuum. In the new approach, such transverse vector force field waves (Hertz waves) do not exist *as such* in vacuum; instead, two coupled, dynamic scalar potentials exist there. The **E** and **B** fields are formed and exist as the these potentials and their gradient coupling to spinning charged detecting mass particles.

LONGITUDINALLY

Of or in length. Running or placed or operating or changing lengthwise. Opposed to transverse.

LORENTZ, HENDRIK ANTOON

Renowned Dutch physicist and Nobelist, 1853-1928, who developed the Lorentz transformations and Fitzgerald-Lorentz contraction.

He shared the Nobel Prize for discovering the Zeeman effect.

LORENTZ INVARIANCE

An inertial frame is independent of the velocity of the frame relative to any other frame.

LORENTZ INVARIANCE PRINCIPLE

The principle that the laws of physics are the same in all reference frames.

LORENTZ REGAUGING

Changing the two potentials in the Maxwell-Heaviside equations in potential form so that the resulting equations have the variables separated.

An unfortunate effect is that this discards all Maxwellian systems far from equilibrium in their vacuum exchange, hence discards all permissible Maxwellian COP>1.0 systems.

LORENTZ SYMMETRY

Referring to the symmetrical regauging by Lorentz of Maxwell's equations.

LORENZ, LUDWIG VALENTIN

Scientist who first changed Maxwell's equations—two years after their publication in 1865—by (effectively) symmetrically regauging them, thereby unwittingly discarding all Maxwellian systems far from thermodynamic equilibrium with the active vacuum.

See L. V. Lorenz, "On the identity of the vibrations of light with electrical currents," Philosophical Magazine, Vol. 34, 1867, p. 287-301. In this paper Lorenz gave essentially what today is called the Lorentz symmetrical regauging.

Comment: (gratefully received from T. Barrett) This paper gave f(t-r/c) functions. Fitzgerald said that Lorenz's functions were essentially the same as his, and Fitzgerald became a leading proponent of "retarded potentials". But it is believed that Fitzgerald was unaware of Lorenz's work until the 1880's, so he is given credit for parallel development. Some people talk of Fitzgerald-Lorenz functions. This is a regauging, but the term "gauge" (inspired by railroad gauges) was first introduced by Hermann Weyl in the 1900s. He used it for a change in length and was shot down by Einstein's theory—Weyl's theory was not relativistic. The idea resurfaced in the 1920s when quantum theory was being formulated, but this time it meant "change in phase" and not "change in length".

Comment by T.E.B.: Thus "Lorentz" regauging of Maxwell's equations really was first done by Lorenz in 1967. However, not too much attention was paid to L. V. Lorenz' work (e.g., by Fitzgerald). When H. A. Lorentz later used symmetrical regauging (essentially Lorenz' regauging), his influence was so great that it was adopted straightaway and has remained adopted to this day.

LOW ENERGY NUCLEAR REACTION (LENR)

Cold fusion, or the anomalous transmutations of elements which occur in certain electrolytes with specially prepared palladium electrodes.

The transmutations occur even though in conventional theory there is insufficient energy to accomplish them.

Conventional science has rather vehemently attacked cold fusion and many of the cold fusion scientists, even though there are now hundreds of successful experiments in multiple laboratories throughout the world.

In our view, once the properly-prepared palladium lattices are loaded with positive ions, the formation of temporary, fleeting time-reversal zones in the electrolyte temporarily reverses the law of attraction and repulsion of charges. Thus H+ ions, e.g., may attract each other in even numbers (opposite numbers are forbidden by the Pauli exclusion principle), so closely that each enters the strong (nuclear) force region of the other, so that the group becomes a quasi-nucleus. Note that the gluons are partially "unglued" by the TRZ formation, and so the preferred method of "decay" of the anomalous TRZ state as the surrounding electrolyte ions move to negate it, is by flipping of a quark. One D+ ion coupled to one H+ ion, e.g., when attracted into a quasi-nucleus in a TRZ, may decay into tritium by flipping one quark and changing one of the protons into a neutron. Two H+ ions may decay into deuterium (D+) by flipping one quark and turning an H+ into a neutron. Two D+ ions may simply "tighten further" into a real nucleus as the TRZ decays, and result in an alpha particle (helium nucleus). The TRZ hypothesis does precisely explain the most important reactions that are experimentally shown to occur. For more on this hypothesis, see T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," **Explore**, 8(6), 1998, p. 7-16; — ., "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," Journal of New Energy, 3(2/3), 1998, p. 12-28.

MAGNETIC DIPOLE

Paired north and south magnetic poles of equal strength over microscopic or macroscopic distance.

MAGNETIC INDUCTION

The act of a change in magnetic field producing an electric field at right angles, which in turn produces electron flow.

MAGNETIC SPIN

Refers to the intrinsic angular momentum, known as spin, of electrons, protons, and neutrons, etc.

The electrons combined in an atom or ion have a resultant angular momentum, that is the combined intrinsic spin of the electrons and the angular momentum due to their motion around the nucleus. There is also a magnetic moment associated with this angular momentum (spin) whenever it is nonzero. Therefore atoms or ions with nonzero spin are *magnetic* atoms or ions. This is often loosely referred to as "magnetic spin." It is actually the magnetic moment of nonzero spin.

MAGNETOELECTRONICS

New microelectronic components which exploit the spin of the electron rather than its charge.

References: A Barthelemy *et al*., "Giant Steps with Tiny Magnets," **Physics World**, Nov. 1994, p. 34-38; G. Prinz, "Magnetoelectronics," **Science**, Vol. 282, 1998, p. 1660.

MAGNETORESISTANCE

A change in electrical resistivity in a material when a magnetic field is applied to the material.

MAGNETORESISTANCE, COLOSSAL

A very large change in electrical resistance observed in the manganese perovskite materials when a magnetic field is applied to them. The effect in these materials is the largest magnetoresistance effect known at present.

See N. A. Babushkina *et al*., "Metal-insulator transition induced by oxygen isotope exchange in the magnetoresistive perovskite manganites," **Nature**, Vol. 31, 1998, p. 159; L. I. Balcells *et al*., "High-field magnetoresistance at interfaces in manganese perovskites," **Phys. Rev**. **B**, Vol. 58, 1998, p. R14697; M. Blamire *et. al*., "Understanding and utilizing colossal magnetoresistance materials," **Phil. Trans. Roy. Soc. A**., Vol. 356, 1998, p. 1469-1712.

MAGNETOSTATIC SCALAR POTENTIAL

Roughly, the "pole strength" differential between the two poles of a magnetic dipole.

Anyone who wishes may polish this definition.

MASSLESS DISPLACEMENT CURRENTS

Currents without mass.

Examples in the standard theory include $d\phi/dt$, $d\mathbf{E}/dt$, $d\mathbf{P}/dt$, $d\mathbf{B}/dt$, etc.

MATTER

Highly condensed 3-spatial energy, compressed by the factor c^2 …

and with the observation process d/dt having been applied to the fundamental masstime entity to provide mass as a frozen snapshot. Matter, of course, has internal structure, order and organization, and dynamics. All matter is in a continuous energetic exchange with its vacuum (4-spatial) environment.

MAXWELL, JAMES CLERK

Brilliant scientist who first formulated the unified theory of electricity and magnetism.

James Clerk Maxwell was born on June 13, 1831 in Edinburgh, Scotland. In 1847 he entered the University of Edinburgh, then transferred to Cambridge in the fall of 1850. After graduation, he stayed on at Cambridge in a research position. He was elected a Fellow of Trinity College and placed on the staff of college lecturers. In 1856 he returned to Scotland, where he took up a Chair of natural Philosophy at Marishal College, Aberdeen. In autumn, 1860 he took a new position as Chair and Professor of Natural Philosophy and Astronomy at King's College, London (a position he held until 1865, at which time he resigned). Maxwell was financially independent. He was elected to the Royal Society in 1861, while at King's College. From 1865 to 1871 he resided at his ancestral Scottish country home, Glenlair, developing his major ideas into book form. Maxwell returned to Cambridge in 1871, where he became the first holder of the Cavendish Chair of Experimental Physics. There he also supervised the construction and operation of Cavendish Laboratory. His treatise on electromagnetism appeared in 1873. He held his position at Cambridge until he died on Nov. 5, 1879 at age 48, of a form of stomach cancer—the same ailment that had killed his mother when he was a child. [Thanks to **Encyclopaedia Britannica**!]

MAXWELL (UNIT)

Unit of magnetic flux, in the cgs system.

MAXWELL'S ELECTRODYNAMICS

Maxwell's electrodynamics is Maxwell's equations.

MAXWELLIAN SYSTEM

Any physical or electromagnetic system whose electrodynamic operations obey James Clerk Maxwell's electrodynamics model.

The term is usually applied with respect to those systems which obey a highly reduced subset of Maxwell's after the Lorentz regauging of the Maxwell-Heaviside equations. This subset is now inappropriately referred to as "Maxwell's equations". This is unfortunate. As a result, today many scientists and most engineers no longer understand that Maxwell's theory—when embedded in a higher topology algebra—permits a vast richness of additional EM systems and behaviors, including full unified field theory operations. In the standard U(1) gauge symmetry electrodynamics, all these higher symmetry functions and systems are excluded *a priori*. From our view, this is particularly sad since these arbitrary reductions of Maxwell's theory arbitrarily excluded all EM systems far from equilibrium in their exchange with the active vacuum. Hence almost all scientists and engineers believe it is against the very laws of nature to propose an electrical power system that produces more energy out—and more work in the load—than the energy input made by the operator himself. This sad error has resulted in (1) crippled electrical power systems that extract their output energy from the vacuum but kill themselves faster than they power their loads, (2) the giant pollution of the earth, (3) extraordinary energy costs, (4) struggles and wars over oil and energy resources, and (5) the looming giant economic collapse of the economies of many nations. Further, unless this latter facet is checked, it may also lead to (6) the unleashing of all the weapons of mass destruction in the arsenals of many nations, destroying all civilization and much of the biosphere.

McCREA

To be added.

MICHELSON, ALBERT ABRAHAM

German-born American physicist who invented an interferometer (Michelson interferometer) named after him. Michelson used his interferometer in a renowned experiment designed to measure the velocity of the earth through the ether, which would produce a shift in his interferometer pattern. No such shift was observed, which indicated the absence of an ether wind and was largely responsible for the downfall of the concept of the material ether which had been assumed previously.

Reference: Albert A. Michelson and Edward Morley, "Influence of Motion of the Medium on the Velocity of Light," **American Journal of Science**, Vol. 31, 1886, p. 377-386; — "On the Relative motion of the Earth and the Luminiferous Ether," **ibid.**, Vol. 34, 1887, p. 333-345.

MIND

From the medical view, with thanks to **Webster's Medical Desk Dictionary**, Merriam-Webster Inc., Springfield, Massachusetts, 1986: (1) The element or complex of elements in an individual that feels, perceives, thinks, wills, and especially reasons; (2) the conscious mental events and capabilities in an organism, (3) the organized conscious and unconscious adaptive mental activity of an organism.

See an extended discussion of *mind* under *energy*.

MIND-BODY COUPLING

To be added.

MIND-MATTER INTERACTION

The n-space interaction between the time-like mind and its time-like operations and the 3-spatial physical body and its 3-space operations. To first order, we may treat these interactions in four dimensions.

MIND OPERATIONS

To be added.

MOTION

To be added.

MOTIONLESS ELECTROMAGNETIC GENERATOR (MEG)

Transformer-like COP>1.0 electrical power generator invented by Bearden, Kenny, Hayes, Moore, and Patrick which powers the transformer core with a permanent magnet, but separates the curled magnetic vector potential A (the magnetic field B) from the uncurled magnetic vector potential A, so that the magnetic field flux is retained in the core while the A-potential is replenished outside the core and adjacent to it.

The overunity mechanism is thus provided by a version of the Aharonov-Bohm experiment, which proves that this splitting of the A-potential does occur and that the uncurled A-potential will interact energetically with electrons. In short, by "splitting the potential" and potentializing two paths to the same energy density as the original unsplit potential, the MEG doubles the available potential energy available via the permanent magnet dipole's broken 3-symmetry in the active vacuum. Both the curled A-potential (magnetic field) inside the core and the uncurled A-potential outside the core interact simultaneously with the output coils when pulsed. Thus the output coils "doubly interact" instead of singly interacting. This "double-dipping" of available energy flow allows permissible COP>1.0, since the system is far from equilibrium with the active vacuum exchange.

Pulsing applies the Lenz law effect to both the split potentials, further increasing the energy density of the two interactions with the output coils. The MEG nominally exhibits from COP = 1.7 to COP = 10, using two input coils.

See M.W. Evans, P.K. Anastasovski, T.E. Bearden et al., "Classical Electrodynamics Without the Lorentz Condition: Extracting Energy from the Vacuum," **Optik** 111(6), 2000, p. 246-248; — "Inconsistencies of the Maxwell-Heaviside Theory of Electrodynamics: The Aharonov-Bohm Effect," **Journal of New Energy**, 4(3), Winter 1999,p. 236-240; — "Vacuum Energy Flow and Poynting Theorem from Topology and Gauge Theory," submitted to **Physica Scripta** (in review); — "The Aharonov-Bohm Effect as the Basis of Electromagnetic Energy Inherent in the Vacuum," submitted to **Optik** (in review), — "Explanation of the Motionless Electromagnetic Generator with O(3) Electrodynamics, **Foundations of Physics Letters**, 2001 (in press). See also T.E. Bearden, "Energy from the Active Vacuum: The Motionless Electromagnetic Generator," in M.W. Evans (Ed.), **Contemporary Optics and Electrodynamics**, Wiley, 2001, 3 vols. (in press), comprising a Special Topic issue as vol. 114, I. Prigogine and S.A. Rice (series eds), ***Advances in Chemical Physics***, Wiley.

MULTICOLLECTION

Multiple collection of the same energy flow, by rerouting the passed Poynting energy back around to the collectors for another pass by them, with additional collection.

A common means of "returning" the Poynting flow for additional collection is retroreflection, as in phase conjugate reflection.

Since a nominal energy collection fraction on a single pass is only about 10^{-13}, a great many re-passes of the same energy can be returned. Work is done on the collector in each pass. One joule of energy can actually perform many joules of work; this is a change to the usual statement of the work-energy theorem, which assumes single pass, single collection only.

MULTIPASS RETROREFLECTION

Iteratively retroreflecting the same Poynting energy flow, each time it impinges on and passes by an intercepting collector, so that multiple passes of the same energy flow are made onto and by the collector.

More and more of the passing enormous energy is collected as more and more passes by are made. The collected energy is then dissipated as work in the circuit or device. Such processing can allow overunity EM circuits and devices.

MULTIPASSES

Multiple passes. See multipass retroreflection.

NANOTECHNOLOGY

The fabrication of devices with atomic or molecular precision, to produce operating devices with minimum feature sizes less than 100 nanometers.

Often described as a marriage between chemistry and engineering. The self-assembling of the units is referred to as *molecular manufacturing*, and the devices are built one atom or molecule at a time with programmed nanoscopic arms. As occurred with the modern machine and technology age, the first requirement is to develop the tools that do the working, and the "tools that build the tools." That fundamental work is off the ground and running already.

Nanomanufacturing plants capable of manufacturing bulk materials or arbitrary structures with atomic precision are envisioned, with almost every atom being placed precisely as desired.

Nanotechnology may well produce the next great scientific revolution. As an example, nanobots have been visualized that will circulate in a human body's bloodstream and specifically attack cancer cells. Nanobots for cleaning up air and water pollution are possible. Food synthesis is envisioned since the technology provides the ability to combine molecules directly.

As with all technologies, the ethics lies in the hands of the system designer and the user. Increased technology always allows greater use for good and greater use for bad purposes. Because of the extraordinary "evil uses" that can be employed in the use of nanobots, Bill Joy, chief scientist of Sun Microsystems, recommends no further development of nanotechnology and no further research. He stated,*"... we have the possibility not just of weapons of mass destruction but of knowledge-enable mass destruction… hugely amplified by the power of self-replication… we are on the cusp of the further protection of extreme evil…"*

Joy's fears are well-founded. Already the union of artificial intelligence with self-replicating nanobots is foreseen. If that union is successful, one can foresee the unleashing of what can only be called "species" of self-replicating, smart nanobots bent on the mass destruction of humanity in various ways.

Also, contrast the nanobots to our discussion of even more advanced nanotechnology of causal system robots (CSRs) using functioning system of causal fields (sets of longitudinal EM waves and their dynamics, prior to having interacted with charged mass, and thence being systems that are functioning sets of spacetime curvatures). We have already survived one massive world-wide insertion of an armada of such CSRs—fortunately first generation systems and with no countermeasures, so they were easily detected and destroyed. We may not survive the next such insertion and attack, as the maturity of the CSRs increases.

Considering the usual focus of governments and human control systems, my prediction is that *detrimental, self-replicating, smart* nanobots for use in war, surprise strategic attack, and mass destruction of human targets is already on the early planning boards. The obvious war applications of nanotechnology will advance faster than the peaceful applications, behind a public screen of simpler benevolent developments. This is almost certain, since the lead time for maturing the nanotechnology is from 10 to 20 years. This long lead time rules out most private capital ventures of substantial magnitude. It results in the requirement for government funding, just as development of the atomic bomb was government funded. As a nanotechnology "arms race" begins and heats up, one will see the equivalent of new but hidden "Manhattan Projects" in specialized mass

destruction weapons nanotechnology. Rather substantial funding of nanotechnology research and development by several nations is already a fact.

Unethical aspects aside, the potential for useful and benevolent purposes of nanotechnology is very great. The development in this new field is now beginning to escalate almost exponentially, year by year, funded primarily by governments and to a more limited extent by private companies.

Reference: David Cook, Jessica Voorhees, and Brian Valz, "Nanotechnology: The Coming Molecular Revolution," available on website http://nanotech.about.com.

NEGATIVE ABSORPTION OF THE MEDIUM

Excess emission from a medium, as in the Letokhov work and in Bohren's experiment. The excess energy is received from the vacuum interaction.

NEGATIVE RESISTOR

Any component or function or process that freely receives energy from outside the system in unusable or disordered form and outputs that energy in usable, ordered form inside the system, where that is the net function performed.

We specifically do not include "differential" negative resistors such as the tunnel diode, thyristor, and magnetron which dissipate and disorder more energy from the system, overall, than they order and furnish to the system in their negative resistance regime.

NEGENTROPIC

Functioning to produce or involve negentropy.

Reordering previously scattered energy without requiring the operator or experimenter to input energy to do the reordering work (an example is passive retroreflection of scattered EM energy).

NEGENTROPIC ENGINEERING

Expending a little bit of energy to form a dipole or dipolarity, and then intercepting, collecting, and using some of the enormous EM energy freely extracted by the dipole from the vacuum indefinitely, without using any of the extracted EM energy to scatter the charges in the dipole and destroy the dipole, thereby shutting of the vacuum's furnishing of copious free energy.

NEWTONIAN 3RD LAW

For every action there is an equal and opposite reaction.

This law should be extended and restated something like this: "for every action there is an opposite and equal reaction if the causative mechanism of the reaction is allowed to occur and not first redirected away from its target." An example of a violation of Newton's third law as usually stated, is provided by the emission of a phase conjugate replica wave from a phase conjugate mirror material. No matter how powerfully pumped, the PCM does not recoil. The reason is that the antiwave cause of Newtonian third law recoil was intercepted by nonlinear multiwave interaction before it could reach its target nuclei, and rediverted away from the atom and on out of the material. Since the causative mechanism for Newtonian recoil did not occur, the PCM did not recoil.

NEWTONIAN RECOIL

As used in the paper, refers to Newton's third law reaction created as the recoil of the nucleus of an atom which absorbs an incoming EM longitudinal wave, or emits one.

NEWTON'S THIRD LAW

For every action there is an opposite and equal reaction.

In Maxwell's electrodynamics, Newton's third law is missing. It is missing because of the coarseness of the modeling which Maxwell was forced to use. Maxwell's seminal paper was read in 1864 and published in 1865. At the time, neither the electron nor the atom had been discovered, much less the nucleus of the atom. A molecule was just a blob with no structure. Electricity was considered to be a thin material fluid, flowing through the wires much like water through a pipe. In fact, Maxwell actually wrote a material fluid flow theory, since hydrodynamics was developed at the time.

So there was, at the time, no notion of the Drude electron gas in a wire and the positively charged nuclei in the atoms in the wire. So there was no notion of two oppositely charged entities in the conductor, both reacting to any EM field entering from space and interacting with the wire.

Further, Newton's third law had always been used mystically without any known cause. It was experimentally established that the reaction occurred, but scientists were forced to just assume its occurrence.

Consequently, Maxwell wrote equations for the reaction of a unitary electric fluid in the conductors. He knew that the wire recoiled, but wrote no equations containing the cause of Newton's third law reaction.

What really happens in the wire is that both the Drude electrons rearrange their positioning vis a vis the lattice, resulting in an apparent current. The actual movement (drift velocity) of the electrons down the wire is very slow, in a nominal case being a few inches per hour. The electrons, having spin, act as little gyros so to speak, longitudinally restrained by the repulsion of the electrons ahead. So the electrons precess laterally, and spend most of their movement in lateral precession movement. This alone proves that the perturbing force is longitudinal, as indeed does Whittaker's decomposition of the scalar potential into longitudinal EM waves. The gradient of the scalar potential (the E-field) is also such a decomposition. But the electron precession waves—which is what our instruments measure in the wire—are indeed lateral waves, in general consonance with Faraday's notion that the force field lines were physical and like taut strings. Maxwell merely assumed Faraday's notion, to give us the transverse EM wave in space. Consequently, the old electrodynamics envisioned that fluid vibrations (ether vibrations) from space had been intercepted by the wire to shake the electric fluid accordingly. And since that electric fluid obviously shook laterally, that "proved" that the waves in spacetime were lateral "plucked taut string" type waves. Actually it proved no such thing, because they were measuring electron precession waves.

The positive nuclei usually have a m/q ratio several hundred thousand times the m/q ratio of an equal charge of electrons. Hence the massive nuclei also react to the field interaction, and move very slightly in the opposite sense from the electrons. That reaction is ignored in Maxwell's general equations, though when the equations are applied, they require that nuclei movement.

In short, the electrons precess and the nuclei recoil oppositely, and that is the generation of Newton's third law reaction.

When we excite a wire antenna with a wave excitation, we produce both electron precession waves and nuclear recoil waves in the nuclei. These two waves are of equal energy, though the nuclei waves are very highly damped in magnitude because of the

high m/q ratio of the nuclei. Nonetheless, each of these "lateral" waves slaps the vacuum potential with *identical energy*. So two equal waves of spacetime curvature occur. I can be seen that the net vacuum wave is actually a longitudinal EM wave, composed of waves of vacuum (spacetime) energy rarefaction and densification. Electrodynamicists, considering the vacuum to be filled with a material ether, used the "effect" wave in matter as the cause wave. Hence they used a transverse EM wave in spacetime, when indeed the spacetime wave is and always was a longitudinal EM wave, just as Tesla insisted.

Maxwell's equations are based primarily on the interaction of field and single charge. Actually, the reaction is always between the field and a dipole. Even when the field interacts with an "isolated charge", there are clustering virtual charges of opposite sign around the "isolated" charge so that the "isolated charge" is actually a set of composite dipoles, where each dipole consists of a virtual charge of opposite sign and a differential piece of the isolated observable charge. So the Newtonian third law reaction is also there with an isolated charge, but occurs in the vacuum itself, resulting in vacuum polarization.

Nonetheless, the "transverse EM wave in vacuum" notion is so embedded in electrodynamics that we seem to be stuck with it. It means, however, that the "field in space" used in electrodynamics must be regarded as only a sort of "convenient transfer function" and not a real transverse oscillation entity. This of course accords with Feynman and Wheeler's pointing out that only the potential for the EM wave exists in space, in case a charge is brought in to interact with its gradients.

And needless to say, since the vacuum is a big potential and only potentials and potential changes can exist in it, then Whittaker's 1903 paper decomposing the scalar potential into longitudinal EM waves is paramount and decisive. EM waves in the vacuum a priori must be longitudinal waves, because they are only the changes to the vacuum potential. And that potential at each and every point, changes and all, decomposes into longitudinal EM waves in 3-space with convergent longitudinal EM waves incoming from the time domain.

NISBET

To be added.

NON-ABELIAN ELECTRODYNAMICS

To be added.

NONLINEAR MATERIAL

A substance whose optical properties vary with the intensity of the light.

Most optical substances are very weakly nonlinear, but a great deal of research has been exerted to find materials with stronger nonlinearities. Also, a material which creates and emits the fundamental and additional harmonic frequencies when illuminated with a single frequency. Many nonlinear materials also weakly produce time-reversed (phase conjugate) fundamentals and/or harmonics when illuminated with a fundamental frequency. Such a nonlinear material that creates time reversed waves (phase conjugate replica waves) is said to function as a *phase conjugate mirror*. The phase conjugate replica reappears in space back along the path in space—even through a highly distorting medium—where the input stimulus (signal wave) has traveled or is traveling.

Thus the phase conjugate replica or time-reversed wave normally backtracks its signal wave stimulus to the distant source of that signal wave, even hundreds or thousands of miles away. This "crawfishing" and "concentrating" characteristic is also known as *retroreflection*. Note that an ordinary EM wave *diverges* as a function of the radius traveled away from its emission source, while a time-reversed or phase conjugate replica wave will *converge* as a function of the radius traveled away from its emission source (the mirror), if its stimulus signal wave was emitted from a distant point source. Ideally, a phase conjugate mirror produces a single time-reversed wave in addition to the input signal wave. By stressing *(pumping)* the mirror with the input of two additional opposing waves (ideally orthogonal to the input or *signal wave*), the phase conjugate replica wave output by the mirror is amplified, and may contain up to all the energy in the pumping waves.

NON SEQUITUR

A conclusion or inference not following from the original argument or premise.

NONEQUILIBRIUM THERMODYNAMICS

Colloquial term referring to the new thermodynamics of self-organizing systems and structures in disequilibrium with their environment.

Since the 1960s, there has emerged in physics (and in thermodynamics!) a surprising new area: the physics of far-from-equilibrium systems and the self-organization and large-scale ordering of such systems. E.g., a single Bénard cell (a particular self-organizing circulation structure in convection-type systems), may involve the coherent behavior of some 10^{21} molecules, in a region of convection where one would classically expect only randomness. These new physics and thermodynamics interactions are surprisingly being found in a very wide variety of systems and phenomena, including living systems and nonliving systems. The phenomena of interest include dissipative systems in disequilibrium with their environment, but with stability of their own systems and forms. Open systems in disequilibrium with their environment can permissibly achieve COP>1.0, and they can exhibit local negentropy. The physics and thermodynamics of such systems is still rapidly developing. For a good overview, see Gregoire Nicolis, "Physics of far-from-equilibrium systems and self-organization," in **The New Physics**, edited by Paul Davies, Cambridge University Press, 1989, p. 316-347. For a full technical presentation, see G. Nicolis and I. Prigogine, **Self-Organization in Nonequilibrium Systems**, Wiley, New York, 1977.

NONLINEAR MATERIAL

In physics, any substance whose response to an external causative or influencing agent is not proportional to the magnitude of the causative agent or influence.

NONLINEAR OPTICAL FUNCTIONING (NLO FUNCTIONING)

Functioning in a manner prescribed by nonlinear optics and quantum optics,

...particularly with respect to time-reversal effects, use of phase conjugate mirrors, phase conjugate reflection, and pumping for amplified phase conjugate reflection.

To quote Knight, "A phase conjugate mixing device has remarkable optical properties: perfect retroreflection, the complete cancellation of optical aberrations and inhomogeneities in wavefronts, and the ability to reverse an optical beam and return it to its source."

NONLINEAR PHASE CONJUGATE OPTICS

See *phase conjugate optics*.

NONLOCALIZATION

Producing or rendering an effect or effect-producing agent at a distance, rather than at the immediate location of the effector.

Extended throughout a large region or system, or to a distant part of a large region or system, rather than being confined to a small region of the large region or system.

NON-RIEMANNIAN (GEOMETRY)

Riemannian geometry is the geometry of Riemannian manifolds;

i.e., manifolds having an infinitesimal squared distance ds that is everywhere positive. A non-Riemannian geometry violates this property. [A manifold is a topological space with certain technical characteristics.]

NUCLEONS

Name for the neutrons or the protons in a nucleus. In the nucleus, the neutrons and protons are continually changing one into the other by exchange of the charge.

O(3) ELECTRODYNAMICS

To be added.

OPEN SYSTEM

A system that communicates with its environment, and exchanges energy, matter, or both between system and environment.

The system may be in equilibrium with that exchange, so that it effectively does not retain and utilize received environmental energy to power loads or accomplish external work. Note that it may in fact receive and store excess energy from the environment, or give up energy to the environment, and then remain in equilibrium under its new potential energy conditions. That is, the system may asymmetrical regauge itself but not utilize any of the regauging energy to accomplish external work. When potential is applied to an electromagnetic system, the system is similarly asymmetrical regauged and its potential energy is increased. However, if the system then destroys its source of regauging potential energy faster than it powers its load, it is said to symmetrically regauge itself when discharging its freely received excitation energy.

The system may be far from equilibrium in its energetic exchange with its environment, and if it asymmetrically discharges its freely received excitation energy, it can exhibit COP>1.0. In that case the system effectively retains and utilizes some of its freely received environmental energy to power loads or accomplish external work, and the operator himself does not have to furnish that part of the energy dissipated as useful work.

OPTICAL SWITCHING

Refers to switching of optical signals, or switching using optical frequency switching techniques, components, and circuits.

ORTHODOX TRANSISTORS

Ordinary transistors in use today.

Such transistors will not perform the Fogal semiconductor special functions.

ORTHOGONAL ROTATION

Simply speaking, a rotation from one direction to a direction at right angles to it.

The Lorentz transform of special relativity, e.g., is a formula for the rotation of an object and all its parts away from its line of motion, as a function of the object's velocity, in a direction toward the time axis. The speed c just represents a full orthogonal turn, so that the intersection of the object with the observer 3-space, along the original line of motion, is zero.

To the observer, the three dimensional object (at speeds less than c) has become a two-dimensional plane moving at speed c. In a space of more than 4 dimensions, the orthorotation may be toward a higher spatial dimension rather than toward the time dimension. As can be seen, such orthorotation is intimately connected with the transformation of an electron or electron/positron pair into a photon, and vice versa. Orthorotations are extremely important when one models the physics of mind and matter interaction, and the physics of a living organisms including both its mind and its physical body—as in psychoenergetics.

OSCILLATING QUANTUM WELL

A quantum well which is oscillating in magnitude and sometimes in sign.

OVERPOTENTIAL

Essentially the overpotential (as in an electrode in a solution) is a shift in the Fermi level necessary to allow the electron in the electrode metal to have energies overlapping with vacant acceptor levels in molecules adjacent to the electrode in the solution.

The overpotential effect appears at small "double surfaces" of things in very close contact, particularly in electrochemistry and in solid state physics. The overpotential enables electron transfer, e.g., by tunneling. The overpotential increases with the log of the reaction rate that occurs at the overpotential location.

For a small reaction rate, the overpotential is small; but for a small increase in the overpotential there occurs a *dramatic* increase of reaction rate. Fogal has utilized the overpotential effect in his semiconductor, to great advantage in accomplishing unusual charge blocking and other special effects.

One of the world experts in the theory and use of the overpotential is Dr. J. O'M. Bockris. E.g., for a short overview pointing out the importance of the overpotential, see Bockris, "Overpotential: a lacuna in scientific knowledge," **Journal of Chemical Education**, 48(6), June 1971, p. 352-358 (a paper which Bockris graciously sent me some years ago). Quoting from that reference, p. 355: "The formal definition of overpotential is 'the change of potential of the electron-conducting phase when reaction rate across its interface with the ion-conducting phase with which it is in contact is changed from zero to a certain velocity.'" And again, p. 355: "...overpotential... in fact determines what fraction of the energy of the self-functioning cell has to be wasted in making the cell work and deliver energy at a certain power." For a more detailed and wider exposition of the overpotential, its effects, and its uses, see J. O'M. Bockris and A. K. N. Reddy, **Modern Electrochemistry**, Vol. 1 & 2, Plenum Press, 1970.

OVERUNITY COEFFICIENT OF PERFORMANCE

More energy out or work out of a system than the operator or experimenter must himself or herself furnish and input.

An open thermodynamic system far from thermodynamic system is permitted to achieve such an overunity performance, so any overunity electrodynamic system must be such. Well-known nonelectromagnetic examples are solar cells, heat pumps, windmills, sails on sailboats, waterwheels for powering watermills, a gliding bird in thermal updrafts, etc. A well-known electromagnetic example is the common solar cell. The common household heat pump has a theoretical COP limit of 8.22, and well-designed units usually achieve some 4.0 or so, so long as the ambient environment does not change too drastically from the design limits. As the environment changes and cools down appreciably, however, most home heat pumps lose efficiency and have to switch onto heating strips, which have a COP ≈ 1.0.

Contrary to prevailing belief, it is certainly possible to have EM systems which are also open thermodynamic systems, far from equilibrium, and freely receiving excess energy (asymmetrically regauging a potential) from an external source, to wit, their violent virtual flux exchange between the vacuum and the system. All EM system are already *open systems* in the virtual particle flux exchange with vacuum; that is already well-known in particle physics, even though the 130-year-old classical electrodynamics does not even include the vacuum-mass exchange. The only question, then, is how to establish an asymmetry in that vacuum-mass flux exchange. Here again, every electrical charge and every dipole is already just such a broken symmetry in the vacuum flux, as has been known in particle physics for four decades! It takes on the average about 50 years, however, for vital discoveries in one discipline to "cross fertilize" into another discipline. At any rate, the symmetry of every electric power system, in the vacuum flux, is already broken in its source dipole. This rigorously means that, if we simply avoid doing something we are doing in our power systems to restore symmetry as a matter of course, it is possible to utilize the free broken symmetry of the source dipole to provide an overunity EM system.

In 1996 I showed that such overunity EM systems are permitted and prescribed by Maxwell's theory, prior to the arbitrary imposition of *symmetrical* regauging of the Maxwell equations (i.e., the Lorentz condition). Violation of the Lorentz condition (by asymmetrical self-regauging) is a necessary but not sufficient condition for an overunity EM device. An asymmetric regauging will certainly give us excess free energy in the system, and an excess force to use that energy in translating against a load impedance to do work, if we design the system properly to do just that.

To achieve overunity, in a circuit one must prevent the (presently universal) re-imposition of the Lorentz condition by the use of one-half the excess received energy to drive the return electrons from the load back through the back emf of the source, killing the gate and restoring symmetry, the Lorentz condition, and equilibrium between vacuum flux and system. All our present EM systems are specifically designed to drive those electrons back through the back emf and thus restore symmetry, *deliberately* asymmetrically self-regauging a second time and *deliberately* restoring the Lorentz condition, along with *deliberately* killing the source dipole's asymmetry in the vacuum flux exchange.

PARADOX (LOGICAL)

A thing that is true, e.g., as shown by experiment, but which violates one or more of the three Aristotelian laws of logic.

Any logic algebra or system has a topology. A paradox in one topology can often be resolved by increasing the topology of the logic. All logical paradoxes in the 3-law Aristotelian logic system are simply fourth-law logic cases in a logical superset, and—at least hypothetically—the fourth law can be applied to resolve them. For a discussion and proof of the 4th law correction to Aristotelian logic, see Appendix III: "A Conditional Criterion for Identity, Leading to a Fourth Law of Logic," in T.E. Bearden, **AIDS: Biological Warfare**, Tesla Book Co., Chula Vista, California, 1988, p. 428-443. Logic has many aspects that often may shock our casual expectations: For example, one of the most advanced axioms in mathematics is called the Axiom of Choice. It is used in the proof of many advanced theorems. Using the Axiom of Choice, it can be shown that it is possible to cut a ball into a finite number of pieces, then reassemble the pieces into two balls of the same size, with no air gaps between pieces! While this seemingly defies all common physical sense (and I've not found anyone who has done it!), it is mathematically correct. For a proof, see Thomas J. Jech, **The Axiom of Choice**, American Elsevier, New York, 1973, p. 3-6. For a good perspective on Aristotelian logic, see Morris Kline, **Mathematics: The Loss of Certainty**, Oxford University Press, New York, 1980.

PARITY

Deals with studying a system of sequence of events as if reflected in a mirror. A system has parity is it undergoes no fundamental operational change if replaced with its mirror-reflected twin.

PARTIALLY TIME-REVERSED REGION

A region of space in which an object experiences not only the ordinary forward flow of time, but an extra induced backwards flow of time, usually a fraction of the time-forward time stream.

One result may be to "reduce" time-forward force fields, by a fraction. This is important in bridges, where one must pass EM energy flow onto a follow-on load circuit, but the return current in that circuit must be allowed to circulate back through the load bridge itself, against the inducing back emf. By partially time-reversing the region occupied by the back emf, that back emf is seen as a smaller value by the return current being passed back up through the back emf. The result is that current will circulate in the load loop, powered entirely by the bridging of Poynting flow $\mathbf{S} = \mathbf{E}\times\mathbf{H}$ onto the load circuit.

Another result of a partially time-reversed region is that the law of attraction and repulsion of charges is partially reversed. If the time-reversal predominates in the region, as in a momentary time-reversal zone in some electrolytes, then the law of attraction and repulsion of charges is reversed. In that case like charges attract and unlike charges repel. Two positive H+ ions, e.g., may be drawn so tightly together that each enters the edge of the strong force region of the other, forming a quasi-nucleus. Note that in each H+ ion the gluon forces are almost dissolved and the quarks are nearly freed. Then as the time-reversal zone decays back to a normal time-forward zone, the decay changes begin from inside out, resulting in the flip of a quark to change one of the H+ ions to a neutron n. The n and the H+ ion draw together as the preferred decay state, resulting in the formation of deuterium or a D+ ion. This and similar "time reversal zone" reactions have been proposed by this researcher as the mechanisms generating the anomalous deuterium, tritium, and alpha particles (helium nuclei) in the "cold fusion" reactions. It is indeed a special type of low spatial energy fusion, but a very high energy reaction since time-energy is involved as the active ingredient, and time-energy has the same energy density as mass.

PARTICLE PHYSICS

The branch of physics using accelerators to study high-energy particle collisions, to determine properties of atomic nuclei and of the elementary particles themselves.

So far as I am aware, conventional particle physicists do not consider time-energy interaction and time-reversal zone novel nuclear interactions at all.

PATTERSON EFFECT

The intense multiscattering, multipass, multicollection of Poynting energy density flow in an assemblage of palladium-clad spherical bead capacitors, as the palladium adsorbs hydrogen ions from the fluid in which the beads are immersed, and charges

up as a capacitor, thereby becoming an energy-flow generator, and nonlinearly increasing the energy-flow as the charge of the capacitors increases.

The Patterson effect yields the Patterson Power Cell® , a validated overunity power system which has shown COP>1200 in independent university testing. The Patterson effect is a variation and adaptation of the well-known anti-Stokes emission effect, which for three decades has been validated in physics journals to produce overunity emission in certain intensely scattering active media.

PATTERSON POWER CELL®

Patented overunity power unit by James Patterson, which has been independently validated to yield COP>1.0.

See James Patterson, "System for Electrolysis of Liquid Electrolyte," U.S. Patent No. 5,372,688, issued Dec. 13, 1994. Filed Dec. 2, 1993. 26 claims, 7 drawing sheets.

PAUTRIZEL, RAYMOND

Eminent French parasitologist who worked with Antoine Priore, and who performed many definitive experiments demonstrating the Priore healing effect.

PEGRAM'S EXPERIMENT

Experiment which demonstrates a relation between electric and magnetic fields in the vacuum which the Maxwell-Heaviside theory does not prescribe.

Simultaneously, a coaxial cylindrical condensor and solenoid are rotated. The rotation produces a magnetic field in the solenoid in the axial direction and between the plates of the condensor. The condensor can be charged by shortening the plates of the condensor. This indicates a cross relation in the vacuum between electric and magnetic fields which does not exist in the Maxwell-Heaviside theory.

Reference: G. B. Pegram, **Physical Review**, Vol. 10, 1917, p. 591.

PERPETUAL MOTION MACHINE

Assertion that no machine can indefinitely operate, since no closed system can input its output power back to itself while powering a load because powering itself and its load violates the equilibrium thermodynamics (i.e., the thermodynamics of a closed system).

The "defenders of the underunity faith" use the statement that "there cannot be any such thing as a perpetual motion machine" as an article of faith and iron dogma. Usually they classify a so-called "perpetuum mobile" as to which law of *equilibrium thermodynamics* it is thought to violate.

For permissible Maxwellian overunity systems, the entire "perpetual motion" conundrum is nonsensical, since we are always speaking of an EM system *far from thermodynamic equilibrium* with its active vacuum environment. The *equilibrium* thermodynamics assumed by the critics does not even apply to such systems, as witness the Nobel Prize awarded to Prigogine in 1977 and the voluminous literature on such open dissipative systems.

As an example, see Stanley W. Angrist, "Perpetual Motion Machines," **Scientific American**, vol. 218, Jan. 1968, p. 114-122. Angrist gives a typical critique using classical equilibrium thermodynamics. He calls *permissible* overunity systems (open dissipative systems receiving excess energy from an external source) *false perpetual motion machines* or *fictitious perpetual motion machines*. Also see Angrist's article, "Perpetual Motion," **Encyclopaedias Britannica, Bicentennial Edition, Macropaedia** Vol. 14, 1976, p. 102-105. Here he gives a very good summary of the subject as ordinarily posed, with precise definitions included for perpetual motion machines of the first, second, and third kinds and for fictitious perpetual motion machines. Unfortunately his entire argument is completely irrelevant to any study of permissible overunity machines, which he already has labeled as "fictitious perpetual motion machines" and has already admitted that they exist! The substance of his entire argument is that systems in equilibrium cannot power themselves. That is of course quite true, but is a mere tautology and has no relation to an open system in disequilibrium, which *can* power itself and its load simultaneously, by the laws of physics and the laws of *disequilibrium* thermodynamics. So in fact Angrist, as do the skeptics who continue to assail legitimate overunity EM system researchers as perpetual motion nuts, establishes his own dummy strawman and demolishes it, while ignoring—so to speak—the huge Statue of Liberty before him.

Now this is not to pick on Angrist! He appears to be a reasonable scientist, carefully stating his thesis in a straightforward manner. His voice is quoted as a *reasonable* critical voice, and not like the usual *extremist* critic who engages in ad hominem attacks from the outset. It merely shows that (1) the entire "perpetuum mobile" prohibition does not even apply to overunity EM systems far from thermodynamic equilibrium with the active vacuum, (2) the critics are either unwittingly or deliberately using the wrong type of thermodynamics as the basis of their entire argument, (3) the *reasonable* perpetual motion critics—wittingly or unwittingly—simply set up an irrelevant strawman and precede to knock it down, and (4) in fact the critics already admit to a machine that will in fact run itself and power its load indefinitely or perpetually unless something changes or breaks or fails, but then oddly label it as a "fictitious" or "false" perpetual motion machine! Meanwhile, in the universe around us we universally observe things in violent and perpetual motion, having continued so for some 15 billion years. None of the atoms seem to be running down, nor do any of the molecules. And they are open systems brought out of equilibrium by absorption of energy, and decaying back into equilibrium (or approaching it) by emission of excess energy.

The eerie point is that technical publications such as **Scientific American** and **Encyclopaedia Britannica** do not seem to question the line of reasoning advanced by those knocking perpetual motion, or even fully analyzed their argument. What we really deal with in terms of skeptics in this area is either (1) a reasonable, scientific skeptic such as Angrist (his listing of machines and attempts for machines not in disequilibrium with their active environment to run themselves is very good), or (2) an unreasonable person spouting dogma and venom, who should simply go read some disequilibrium system thermodynamics and learn etiquette.

Also, we strongly object to supercilious phrases invariably employed by harsh skeptics who insist we are looking for "something for nothing" or "a free lunch". No legitimate overunity energy researcher has ever considered such a thing. We freely admit that the excess energy is received from the active vacuum exchange, via a broken symmetry in that exchange. Should the farmer refuse to use a windmill or waterwheel because he's getting a "free lunch" for energy input? For those who so quickly hurl such condemnatory phrases, let me hold up a mirror and show them an analog of their position: The famed surgeon Alfred Velpeau wrote in 1839: *"The abolishment of pain in surgery is the chimera. It is absurd to go on seeking it today. 'Knife' and 'pain' are two words in surgery that must forever be associated in the consciousness of the patient. To this compulsory combination we shall have to adjust ourselves."* [Martin Gumpert, **Trail-Blazers of Science**, Funk and Wagnalls, New York, 1936, p. 232.]

The strident, dogmatic critics of open overunity disequilibrium EM systems are stating an exact analogy to Velpeau's statement. The *scientific* worth of their criticism is precisely the scientific worth that eventually was shown for Velpeau's pronouncement.

PHASE CONJUGATE

Of an entity: its time reversal. For waves, often referred to as *wavefront reversal*.

PHASE CONJUGATE MIRROR

A nonlinear material which, when provided with an input wave, emits a phase conjugate replica (time reversed replica) of that input wave.

The input wave is by practice called the *signal wave*. The time-reversed wave output is by practice called the *phase conjugate replica*.

PHASE CONJUGATE OPTICS

That portion of nonlinear optics dealing with multiwave mixing, formation of time-reversed waves, phase conjugate reflection (PCR), phase conjugate mirrors (PCMs), pumping PCMs to amplify their emitted PCRs, nonlinear interferometry, distortion correction, self-targeting, laser tracking, adaptive optics, and so on.

PHASE CONJUGATE REPLICA (PCR)

Of a wave: the time-reversed duplicate of the wave.

PHASE-CONJUGATING ACTION

In nonlinear optics, the process or action of producing a time reversed replica of an input wave.

For a particle, producing its antiparticle. For a cell, dedifferentiating it back to some previous form, genetics and all.

PHASE CONJUGATION

In nonlinear optics, the novel nonlinear mixing of waves which generate an output wave—called the phase conjugate replica or time-reversed replica—that precisely retraces the path previously taken by the input wave that stimulates the action.

The process or action of producing a time-reversed wave. Phase conjugation can compensate for aberrations and distortions in the input. Real time holography can also be produced by applying the phase conjugation process.

PHASE-LOCKED HARMONIC SERIES

In Whittaker decomposition of the scalar potential: The decomposition produces a set of bidirectional wavepairs, as explained previously.

Each of these wavepairs has a given frequency, starting from a fundamental. In other words, the other wavepairs are harmonics of the fundamental wavepair. Further, these are regularly arranged in a lattice, so that "timing" or "phasing" is rigidly locked in place.

PHENOMENOLOGY

In physics, the philosophical and experimental study of physical phenomena,

... as distinguished from ontology, (which is the study of being).

PHOTON

In physics, the basic action quantum.

Considered to be the basic quantum of the EM field. Well, there's a little problem with that. The photon contains energy and time, and so must also occupy a time interval. The notion of forcefield rigorously contains mass as a component; yet mass is missing from the concept of field as it is applied. The EM field is conceived as a spatial entity only. It may spatially vary as a function of time, of course, but it itself does not occupy time, at least conceptually. These considerations raise some startling difficulties in the ready conclusion that the photon is the fundamental quantum of EM field. If a "piece of the photon" is missing from the field, how can the field be made of photons? How can one get area out of a straight line? I simply pose this problem for the theorists and the foundations physicists, pointing out that it has universally been fashionable for physicists to ignore that *the photon carries not only a little increment of energy, but also a little increment of time*. My own work has been to look at the dimensional difference between masstime and mass; i.e., between a mass that has just absorbed a photon, and thus must consist of masstime (4-space), and just after that masstime then re-emits the photon, reverting back to mass (3-space). From this one can build, e.g., a mechanism that generates the actual flow of time itself. It is in theory an engineerable mechanism.

PHYSICAL REALITY

To be added.

PING-PONG

To be added.

PINNA

The outer ear(s). Of particular interest to us are the tiny little folds in the ear.

PINNA INFORMATION

Refers to hidden information content of the field, or in the received signal.

Comes from the little folds in the pinna (outer ear). For sound direction and distance sensing, the tiny pinna folds of the outer ear use phase reflection information more than 40 dB below the primary sound signal that strikes the eardrum. In EM signals, we are referring to "hidden" or infolded information deep within a signal from a distant target. In fact everything in the target contributes to the signal emission from it, and all that information is riding "within" the signal, in its deep "pinna" information. The Fogal chip can outfold some of this pinna information, so that information can be recovered from a signal which no other process heretofore could recover. For a dramatic future use, as the Fogal semiconductors and equipment using them are developed, there will emerge detecting units that can see highly detailed structure in the human body, merely from processing the light reflected from the exterior of the body. The details eventually will rival and even surpass that of magnetic resonance imaging, and will be essentially noninvasive.

It is also true that hidden "vacuum engines" can be transmitted back into the body, so that "problems" or disorders can be directly corrected. As an introduction to this type of area, where cellular disease "antiengines" can be created in the body to directly reverse cells and their genetics, curing the disease, see T.E. Bearden, "Vacuum Engines and Priore's Methodology: The True Science of Energy-Medicine, Parts I and II." **Explore**!, 6(1), 1995, p. 66-76; 6(2), 1995, p. 50-62. A major book on this subject will soon be published. For a presentation for the nonspecialist, see T. E. Bearden, "Hidden Mechanism for Reversal of Diseased Cells to a Previous Healthy State," **Resonance**, Newsletter of the Bioelectromagnetics Special Interest Group, Mensa, No. 29, Nov. 1995, p. 11-15.

PINNA INFORMATION CONTENT

In electromagnetics, the hidden inner Stoney-Whittaker-Ziolkowski infolded EM information inside the scalar potential.

Since an EM wave can be represented as two scalar potentials, then by infolding pinna information inside one or both of the two potentials, it is infolded inside the carrier wave. Thus hidden information can be and is carried by all EM radiation and all EM signals. The Fogal semiconductor for the first time enables the outfolding and processing of some of this information.

PINNA INFORMATION DETECTORS

Detectors based on use of the Fogal semiconductor, which can outfold, process, and display some of the hidden information inside the scalar potential and inside signal emissions from distant objects.

PINNED ELECTRONS

Electrons held stationary by a magnetic field, or other set of forces that react to "push them back into their positions" whenever they try to move away.

PINNING

The act of restricting (by restoring forces and fields) movement (particularly of electrons) due to a disturbing magnetic field or other external force.

POLYHEDRON

A solid figure, especially with more than six plane surfaces.

POSITRON

An antielectron (time-reversed electron), possessing a positive charge. In Dirac's relativistic theory of the electron, a positron may be regarded as an empty negative energy state in the Dirac sea whose usual occupying electron has been removed.

POWER

The time rate at which work is done (at which the form of energy is changed).

In electrical engineering, the term "power" is erroneously also used to mean "energy".

PRIGOGINE, ILYA

Noted Belgian chemist and Nobelist, and one of the pioneers of the thermodynamics of open systems far from thermodynamic equilibrium.

Prigogine was awarded the 1977 Nobel Prize for his work on the theory of dissipative structures in nonequilibrium thermodynamics.

PRIORÉ, ANTOINE

Italian radar technician, remaining in France after WW II, who discovered the use of novel waves from plasmas emitted when normal EM waves were introduced, and who used this effect to accomplish remarking healing in laboratory animals of terminal tumors, infectious diseases such as trypanosomas, restore suppressed immune systems, and heal atherosclerosis.

Prioré's beam was actually longitudinal EM waves. The body when irradiated by longitudinal EM waves adds a weaker phase conjugate replica, thus converting LW nonlinear optical pumping from the 3-space domain to the time domain. This time-reverses the irradiated cells and all their components back to a previous physical state and condition.

Such "time-domain" pumping is used by the living body's cellular regeneration system to restore cellular damage and heal the cells, within its limits. Thus Prioré unwittingly uncovered a way to dramatically amplify the body's own healing and regenerative powers.

POYNTING, JOHN HENRY

An English physicist who lived from 1852-1914, whose contributions to electromagnetics included the energy flow theory now known as Poynting flow.

He contributed the Poynting theorem, which states that the rate of EM energy loss in a specific region of space is equal to the sum of the dissipation rate (heat loss) flowing across the boundary of the region. Concurrently with Oliver Heaviside, Poynting conceived the notion that energy flowed through space, which previously had not appeared in physics. Heaviside actually published first, but obscurely; Poynting published in a prestigious journal, so the theory came to be known as "Poynting theory." Poynting himself always gave credit to Heaviside for being first. Also, the Heaviside version $\mathbf{S} = \mathbf{E}\times\mathbf{H} + \mathbf{G}$ was more extensive than Poynting's $\mathbf{S} = \mathbf{E}\times\mathbf{H}$. Heaviside was a recluse; years after his death, in his little garret apartment some papers were discovered beneath the floorboard. Therein Heaviside has used his **G** term (a closed energy flow, or "trapped energy" term) to represent gravitation, and had worked out a testable theory of electrogravitation. Modern general relativity indeed considers that it is energy—particularly trapped energy—that is responsible for generating gravitational field and gravitational potential. Apparently nothing at all was done or has been done with Heaviside's electrogravitational theory. See H. J. Josephs, "The Heaviside papers found at Paignton in 1957," **The Institution of Electrical Engineers Monograph No. 319**, Jan. 1959, p. 70-6.

POYNTING ENERGY

Loose term (not rigorous!) used to describe the flow through space of Poynting energy density $\mathbf{S} = \mathbf{E}\times\mathbf{H}$. It actually describes not the energy flow density per se, but that component of it that would be intercepted by a unit point charge.

POYNTING ENERGY DENSITY FLOW

A more rigorous term used to describe the flow through space of the Poynting energy density flow component **S** = **E**×**H**, that would be intercepted by a unit point charge.

POYNTING ENERGY FLOW

Loose term (not completely rigorous) used to describe the flow of energy density **S** = **E**×**H**.

Rigorously, note that both **E** and **H** are "defined" only after their reaction with a unit point static charge. Hence **S** is the resulting component of the overall energy flow that interacts with the charges (with the circuit) and is diverged into the circuit to power it. It is *not* the entire energy flow, which also includes a vast Heaviside nondiverged component that does not strike the charge and interact with it, and hence does not interact with the circuit but is just wasted.

POYNTING GENERATOR

Any dipole or potential difference, which represents a broken symmetry in the vacuum's virtual particle flux, and hence extracts virtual energy from that asymmetry, and gates it out as a gushing energy flow in 3-space. The component of that energy flow that would be intercepted and diverged by a unit point charge is the Poynting energy flow **S** = **E**×**H**.

POYNTING VECTOR

The vector **S**, given as **S** = **E**×**H**, which is used to represent the Poynting (intercepted and collected by a unit point coulomb) energy density flow component.

In Heaviside's version, **S** = **E**×**H** + **G**, where **G** is an energy circulation flow term of trapped energy flow.

PPCM

Pumped phase conjugate mirror.

A phase conjugate mirror material which has introduced to it appositive or "pump" waves. In the phase conjugating process, up to all the energy in the pump waves can be output as the energy in the emitted phase conjugate replica wave. Thus the PPCM is an amplifier, very similar to a triode.

PRIMARY IMAGE

The image or portion of an overall image that is of most interest, and usually the sharpest in focus.

PROBABILISTICALLY

Of or determined by the laws of probability.

Note particularly the somewhat dichotomous use of "determined by—probability." The entire notion in probability is that the overall result is not individually determined, but that there are multiple outcomes of the experiment, each of which occurs with a certain frequency out of a very large number of trials. If a single result always occurs, that is said to be a deterministic change, not a probabilistic change. Unfortunately if one pursues the definition of "probability" in mathematics and logic, one eventually finds that it is dichotomous, as was our definition of energy. Ultimately the foundations guys just threw up their hands and said, "Oh, what the heck! Probability is probability, every fool knows that!" The problem cannot be resolved in 3-la w Aristotelian logic; it requires a higher topology logic.

PROBABILITY

The probability of a simple event is the ratio of the number of times it occurs to the total number of trials (for a large, essentially infinite number of trials).

Note that "trials" constitute things that have occurred (are past). Probability has resisted rigorous logical definition by Aristotelian logic; the reason is that it is an expression of the fourth law, the identity of opposites. Probability is the expression of the future (that which has not occurred) in terms of the past (that which has occurred). Since we have been trained to conceive or think of something as if it had just been perceived to occur, then this is the only way we can *conceive* the future—as if it were an "already occurred past" to us.

But with Aristotelian logic, the future cannot be composed of a set of pasts (the law of the excluded middle prevents it!), and probability has no acceptable logical basis. With four-law logic, the future can be modeled in terms of—and even be identical to—the past, and probability has a logical basis.

Consider *throwing a die to land with one face up*. Thinking of the event (as if it has just occurred, in terms of the most recent past), one can conceive six ways of looking at it. In other words, one can conceive of six "most recent pasts." By the fourth law, the total "most recent past" is identical to the "most immediate future," on the common boundary. If one therefore *collects* all six "most recent pasts," they turn into the most immediate future, by the fourth law of logic. One may argue that only a single one of the events will actually occur. Here one counters with the observation that, when it occurs, it is the past, not the future, and then it has not been collected so as to move to the boundary. One also points out that, with the hidden variable approach, in theory it is possible to directly engineer those probabilities while the Schrödinger wavefunction is still propagating and has not yet collapse to constitute an "observation." I.e., it is possible to engineer Wheeler's "pre-reality," and determine in advance just which of the outcomes shall occur.

Now, if this type of equipment eventually gets built and is small and portable, just think what one could do in Las Vegas!

PRODUCT SET OF INTERNAL WAVES

Modulations of the internal bidirectional wavepairs comprising a scalar potential.

This set was added in the mid-1980s by Ziolkowski, to Whittaker's 1903 sum set. When a signal is "infolded" inside the DC potential, it is modulated upon (multiples) one or more of the internal biwave pairs. Ziolkowski's work is necessary to deal with that; Stoney and Whittaker alone do not handle it.

PSYCHOENERGETICS

Russian branch of energetics where extended electrodynamics is targeted upon the mind and its functions, hence in the time-domain and employing time-polarized EM waves.

PSYCHOTRONICS

Czechoslovakian name for extended electrodynamics effects on the living body.

PUMPED PHASE CONJUGATE MIRROR (PPCM)

A nonlinear material which:

(i) when provided with an input wave, emits an amplified phase conjugate replica (time reversed replica) of that wave, and

(ii) has additional opposing waves as inputs, so that their energy is transformed into the amplified energy of the time-reversed replica wave.

The word "mirror" is misleading, in that the "mirror" may be just a highly nonlinear material, or be an actual smooth metallic surface containing "hot spots" by heating, etc. In any case, it is the nonlinearities such as the hot spots that produce the phase conjugating action.

PUTHOFF, HAROLD

Noted physicist active in a variety of fields and investigations including in psychoenergetics, extended electrodynamics, energy from the vacuum, parapsychology, remote viewing, psychokinesis, zero-point energy of the vacuum, and cosmology.

We have specifically mentioned his important cosmological feedback principle.

QM VACUUM

The quantum mechanical vacuum, which models the vacuum as an intense flux of virtual particles, each appearing an disappearing in such extreme time intervals as to be unobservable individually.

Violent fluctuations of extremely short duration constantly occur in the QM vacuum flux. Various calculations estimate the energy density (in mass units) as up to 10^{80}-10^{90} grams per cubic centimeter, or even greater.

QUALITATIVELY

Determination based on qualitative analysis, usually as contrasted to quantitative determinations.

QUANTIZED

i) Reduction of some observable quantity to multiples of some small, indivisible unit, or,

ii) expressed in terms of quantum theory.

QUANTUM

A single "particle" of the quantity action.

The quantum is always composed of two fundamental quantities (canonical variables), and it is the "fissioning" of the action quantum into two pieces which results in detection of one of the pieces. An indefinite "smear" of part of the two pieces may be simultaneously detected by a linear detector, but never both exactly (Heisenberg uncertainty principle). More recent work has shown that, in a highly nonlinear situation, both canonical variables can be determined simultaneously to any desired degree of accuracy, in which case the Heisenberg uncertainty principle does not hold in its conventional form. This fundamental change in what has been regarded as one of the "sacred laws" of physics has not yet made it into most physics texts.

QUANTUM ELECTRODYNAMICS

The theory of photons and electrically charged particles and their interactions.

The use of the term "quantum" implies that the EM radiation's discrete photon nature is significant, so that quantum theory must be employed.

QUANTUM FIELD THEORY

A quantum mechanical theory in which "... a physical field is considered as a collection of particles and forces, and observable properties of an interacting system are expressed as finite quantities rather than state vectors."

[**Dictionary of Science and Technology**, ibid.] More simply (after Davies, **The New Physics**, 1989): "The theory that describes the quantum effects of a classical system of fields defined on space-time and satisfying various partial differential equations."

QUANTUM POTENTIAL

A special potential added to the Schrödinger equation, by Bohm in his hidden variable theory of quantum mechanics.

The quantum potential can move instantaneously. In my book **Gravitobiology**, I published a mechanism by means of which a quantum potential can be created. (There may of course be *other* QP-creating mechanisms). An iterative, mutually phase conjugating of EM signals passed back and forth between two objects, or among many of them, is called *self-targeting*. Extreme self-targeting can produce such a QP or partially produce one, particularly if a dense "pumping" (optical sense) of the phase conjugate mirror objects occurs. I am presently proposing the QP as a means of direct energy amplification. I.e., if there is "instantaneous travel" between two light-observed points, then to the instantaneous agent there is no length separation or time separation between the points. This of course means that in effect the objects now coexist "superposed" on each other in a multiply connected space, at least with some fraction of "coupling".

Suppose the coupling fraction is 0.5, and 100 widely separate d nodes are so connected by a common QP. Then if one puts in 1 joule per second of energy flow at a given node, there will instantly and simultaneously appear at each of the other 99 nodes one-half joule of energy per second flow. So I can gain quite a bit o f *direct energy amplification* in this distributed system, and nothing can "shield" the distant nodes. Presently, other than possibly Gabriel Kron's "open path", I have not found any other consideration of "direct amplification of energy at a distance".

The implications of the quantum potential—in everything from power sources to medicine to weaponry—are staggering. Weapons based on just this very QP, multiply connected space, and direct energy amplification appear to have already been developed and are on site in three nations. A fourth either is just getting them or is nearing their deployment.

QUATERNION

Expression comprised of the sum of four terms, one of which is real and three of which contain imaginary units, and that can be written as the sum of a scalar and a three-dimensional vector.

QUATERNION ALGEBRA

The algebra of quaternions and their mathematical operations.

Quaternion algebra is of higher topology than either vector algebra or tensor algebra. Maxwell's original equations are some 20 equations in 20 unknowns, in quaternion algebra. Heaviside and others reduced the algebra to vector algebra and some four

equations. The present vector equations taught in university as "Maxwell's equations" are in fact Heaviside's truncation of the Maxwell theory. Going to tensor algebra electrodynamics cannot recover the full range of Maxwell's quaternion theory.

As an example, what Tesla actually did in his patented circuits cannot even be seen in vector or tensor analysis. On the other hand, analysis of his circuits by quaternion electrodynamics clearly reveals his startling ability to shuttle the energy in the circuit at will. See T. W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," **Annales de la Fondation Louis de Broglie**, 16(1), 1991, p. 23-41.

QUINTESSENCE

Literally, the "fifth essence". In short, dark energy.

RADIONICS

To be added.

REACTIVE POWER

Electrical power, measured in volts-amps-reactive (vars) that cannot do work as is.

For sinusoidal waveforms, the formula for reactive power is given by $I \cdot V \cdot \sin\theta$, where θ is the phase angle between the voltage and the current.

REAL, HIDDEN DYNAMICS

The dynamics of vacuum engines, or of "internal energy" or "internal work" ongoing in a system or volume of space.

REAL HIDDEN VECTORS

The "hidden" or "infolded" real vector components,

e.g., of a vector zero summation system.

A group of nonzero, finite vectors which as a system sum to a net translation zero; i.e., which do not translate a resisting mass or charge, but do "stress" it. Such a system therefore constitutes a stress potential.

REAL POWER (ACTIVE POWER)

Power, measured in watts, that can do work, including generating heat.

For sinusoidal waves, real power is given by the formula $I \cdot V \cdot \cos\theta$, where θ is the phase angle between the voltage and the current.

REAL VECTORS

Vectors in three space, without imaginary components.

REGAUGE, REGAUGING

Changing the scalar potential or the vector potential, or both.

If one or both of the potentials is/are changed so that a net force is created in the system, that is an asymmetrical regauging.

If only one potential is changed, a net force results and that is an asymmetrical regauging.

If both potentials are changed but carefully selected so that the free force resulting from one change is equal and opposite to the free force resulting from the other, that is a net symmetrical regauging, often called a "Lorentz regauging".

RECTANGULAR TRANSFORMATION MATRIX

Standard mathematical physics.

REFLECTION

The rebound of light or other energy from a surface.

A smooth surface (e.g., a mirror) may produce a specular reflection. A rough surface (e.g., a sheet of paper) produces a diffuse reflection. Actually, in reflection of light, the same light does not rebound; instead, the light incident upon the mirror or surface is absorbed, and new light is re-emitted by that surface. Further, considering reflection from a dielectric, every interior part of the dielectric participates in the reflection. All the internal information about the entire object—everything!—is there in that reflected light, infolded as the hidden "information content of the field" (Stoney-Whittaker-Ziolkowski structuring inside the two scalar potentials comprising the reflected wave). With the Fogal semiconductor, at least some of that hidden "pinna" information in a sample detection of the reflected light can be outfolded and displayed.

REFRACTION

The bending of light as it passes from one medium to another.

It is the phenomenon that enables a lens to focus light and that makes a stick appear to bend where it dips into water.

REPULSION BEAM

A beam of energy directed at a target, which when absorbed by the target will generate a force in and on that target to push it away from the beam projector.

REPULSION-FORCE-GENERATING BEAMS

Beams of energy which "push away" their targeted receivers, by inducing a force in the receiver directed away from the source of the beam.

RETARDED WAVE

The electromagnetic wave that is derived from the retarded fields, which in turn are derived from the retarded potentials.

This means that the retarded wave at a point or region of space has arrived there or exists there as the result of the dynamics of charges and currents that existed at earlier times.

RETROREFLECTING

Precisely reversing the path of.

An example is a phase conjugate reflection.

SACHS, MENDEL

Noted scientist who has completed the work of Einstein and developed a unified field theory covering the universe from the tiniest part to the entire conglomerate.

SACHS' UNIFIED FIELD THEORY

An extension and completion of Einstein's work that includes the universe and its dynamics from the tiniest part to the entire conglomerate, and includes quantum mechanics, electromagnetics, gravitation, and the strong and weak forces.

SCALAR

Characterized by magnitude only.

SCALAR (QUANTITY)

In ordinary vector analysis, a quantity completely characterized by magnitude only.

Actually, it contains magnitude and time, because to exist it must steadily exist in time. So we take the smallest increment of observer time we wish to consider, and that is the minimum "length" of the time-tail that the scalar must occupy and have, i n order to even be a "perceived or detected" thing. Before the mathematician jumps in with a nice limiting process to take away the time-tail, if you let that little time interval get too close to zero, then you get too close to eliminating the observer himself, and the entire problem vanishes including mathematics and physics and the observer as well.

One simply cannot demonstrate something that does not exist in time—on paper, in one's mind, or otherwise! Be careful of the term "spacelike " in physics! It hides a logical nightmare. This was the very problem I uncovered in Aristotelian logic; the little increments of time to have a "perceived A" or a "perceived not-A" or to apply an "identity decision criteria" to determine identity or nonidentity, had been left out for lo these 2,000 or so years.

SCALAR ELECTROMAGNETICS

That electrodynamics that arises from considering transverse EM waves, longitudinal EM waves, time-polarized EM waves, electrogravitation, superluminal EM signals, interferometry, nonlinear optical functions, time-as-energy, and the infolded electrodynamics inside all usual EM fields, waves, and potentials.

SCALAR POTENTIAL

Usually considered synonymous with the electric potential.

Here we have another "logical nightmare."

Anyway, the conventional "definition" of electric potential assumes one knows what a "potential" is already, and goes something like this: "The potential measured by the energy of a unit positive charge at a point, expressed relative to an equipotential surface, generally the surface of the earth, that has zero potential." [**Dictionary of Science and Technology**, ibid., p. 722.]. Well, that is botched. It tells or attempts to tell what the *measurement* of a potential is, using a unit positive charge and a process. A potential cannot be its own magnitude measurement, just as a man cannot be his own weight measurement.

So what do we do? We have to tell what the potential *is*. This is the problem that so mystified and infuriated Oliver Heaviside, when he altered and diminished Maxwell's equations to rid them of every potential that he could. Heaviside stated that the potential was *"mystical and ought to be murdered from the theory."* He tried to do just that, and conditioned generations of electrodynamicists to believe that the potential had no physical reality at all, but was only a mathematical convenience. Nahin expresses Heaviside's view as follows: "In an 1893 letter to Oliver Lodge, Heaviside said of his own work that it represented the 'real and true "Maxwell" as Maxwell would have done it if he had not been humbugged by his vector and scalar potentials.'" Paul Nahin, **Oliver Heaviside: Sage in Solitude**, IEEE Press, New York, 1988, p. 134, n. 37.

The concept of potential was developed by Poisson, Green, and others from about 1813 to 1827. Three notions involved in the development of the concept of the potential are: (i) there is the collection or storage of energy in the system, via the collect ion or storage of some entity therein, and this "potential energy" can be released and dynamically used, (ii) the potential is a scalar function whose spatial rate of change is a vector force, and (iii) the dynamics of the stored energy is suspended by the "storage" or "collecting" entity; in other words it is a sort of "suspended action" waiting to be unleashed. *It requires some action—such as interception and divergence—to release the leashed energy*.

We have to disagree with the second notion, having already discussed the fact that no vector force exists unless mass is present, since mass is a component of force. Here we have a residue of the old "material ether" concept. For the third notion, we note that the concept of a "virtual" particle or particle flux means that it cannot become observable unless some interaction is imposed. So we may handle the "third notion" requirement by assuming the potential to be composed of hidden virtual particle flux, or hidden wave flux, in wave-to-wave interaction.

Physics basically tries to define the electrical potential as energy per coulomb, or $\phi = W/Q$. That equation, however, is actually not a definition at all, but rather is an algorithm for calculating the magnitude of the excess energy collection/collecting upon a coulomb of charge, when that coulomb is immersed in the potential ϕ. It in fact is the *reaction cross section* of the potential, not the potential entity itself. This now begins to give us a clue. Potential is *energy* in some fashion. So the entity ϕ must have essentially the same definition as energy! Potential energy, collected energy, stored energy, whatever it's energy first and foremost.

Refer to our discussion of the 3-law logical contradiction in the concept of energy. The same logical contradiction must be present in the notion of the potential.

Just as we did for energy, we must define the scalar potential ϕ in two appositive ways: (i) in the wave view and (ii) in the particle view. So we define potential (particle view) as any virtual particle flux. We also define potential (wave view) as any hidden wave flux. Further, we note that the energetic vacuum is composed of a virtual particle flux (particle view) and so it is also a *potential*. Since the virtual particle flux of the vacuum is extremely intense, the vacuum potential is enormous in magnitude.

We shall also consider any other potential to ultimately be a change to the vacuum potential. Originally, one conceived of a potential occupying the "vacuum as an empty space." Then general relativity made the vacuum into spacetime, geometrized it, and made the geometry itself dynamic and operative—i.e., energetic. Okay! Then that makes spacetime itself a potential.

We also firmly dispose of the peculiar and deformed notion that the scalar potential of a point-source charge (at any spatial point that the potential occupies) may be *defined* as the "work performed upon a unit charge by pushing it in against the **E**-field of that source charge, to that spatial point." This is an equation and not a definition at all; instead, it is an algorithm for calculating the energy density magnitude of the scalar potential. It is a fine algorithm, but it has nothing at all to do with what the potential itself *is*. Again, a man cannot be defined as an algorithm for calculating the magnitude of his height or his weight or his energy density!

Without further discussion, we also somewhat extend the general relativity notion of spacetime as dynamic geometry, as follows: In a special sense, spacetime ≡ geometry ≡ potential ≡ "trapped " or collected/collecting energy. So when we engineer the internal structure of the potential, we also engineer the internal structure (subspace) of spacetime and spacetime geometry. Curvature of spacetime, e.g., becomes simply a change in the energy density of the vacuum, from the ambient value, and it can be internally structured so as to contain "engines". When we apply the hidden EM variable theory of the Stoney-Whittaker-Ziolkowski work, particularly when we consider the phase conjugate pairing as it exists in spacetime before interaction with charge, we are engineering and extending (i) electromagnetics, (ii) quantum mechanics, (iii) general relativity, (iv) spacetime, (v) the spacetime curvature concept, and (vi) spacetime geometry.

SCATTERING PROCESSES

Collision processes in which an incident particle such as a photon, electron, or proton, of known energy or direction or both, collides with another entity, and emerges from the collision with a different energy or direction or both.

SCHRÖDINGER, ERWIN

Noted Austrian physicist and Nobelist who discovered the wave equation named after him as the Schrödinger equation, and performed other vital work in wave mechanics.

SCHRÖDINGER EQUATION

In quantum mechanics: an equation that describes the propagation of waves associated with subatomic particles, or more generally, that describes the evolution over time of the quantum state of a system.

SCHUMANN RESONANCES

The extremely low frequency (ELF) resonant frequencies of the Earth-Ionospheric waveguide.

The first five Schumann resonances calculated from a simple model are 10.6 Hz, 18.3 Hz, 25.8 Hz, 33.4 Hz, and 40.9 Hz. However, better models are available and the frequencies vary from these simple model solutions. A better calculation gives the first four as 8, 14, 20, and 26 Hz nominally. The measured Schumann resonance corresponding to the 8 Hz is about 7.75 Hz. This is very near the mechanical resonance frequency of the human body, and also is evidenced in brain waves often "locking" to this frequency in the natural environment.

See W. O. Schumann, **Z. Naturforschung**, Vol. 72, 1952, p. 149, 250. For detailed models and discussion of the observations, see J. Galejs, **J. Res. Nat. Bur. Standards**, Vol. 69D, 1965, p. 1043.

SELF-ENERGY

In a quantum mechanical system, the energy associated with the emission and absorption of virtual particles.

In a classical system, the energy associated with the interaction among parts of the system itself.

SELF-ORGANIZATION

(After Davies, **The New Physics**, 1989): *"Spontaneous emergence of order, arising when certain parameters built in a system reach critical values."*

Simpler put, it is the spontaneous formation of patterns of localized order in a system which begins in a more homogeneous state. In short, the system moves from a simpler to a more complex state.

SELF-POTENTIAL (E.G., OF THE ELECTRON)

The potential created in and of the charge

...(e.g., the electron) by its virtual particle flux exchange with the vacuum.

Also, an asymmetry in the virtual photon flux of the vacuum, caused by the interaction of the charge (e.g., the electron) with the vacuum flux. From here, we note that the self-potential must consist of real observable 3-space EM energy flow or flows from the electron, because of the asymmetry. However, the charge is not the primary source *per se* of the energy flows that establish the self-potential, but instead is the asymmetric gate in the vacuum flux that "gates out" the potential and its energy flux. The asymmetry in the vacuum flux is the actual *source*. Indeed, the energy is received by the charge in the form of converging longitudinal EM energy waves from the complex plane (from the time domain). The spin of the charges of the dipole transduce the absorbed complex EM energy into real observable EM longitudinal wave energy, and pour it out in all directions in 3-space. See my paper, "Giant Negentropy from the Common Dipole," *ibid*. for the mechanism for the charge also.

SELF, SENSE OF

To be added.

SELF-TARGETING

Between two entities, where each acts partially or wholly as a phase conjugate mirror, self-targeting is the iterative phase conjugation or "ping-ponging" and rapid convergence of beams between the two PCMs.

It has a spectacular application in *phase conjugate shooting* from a spaceborne laser against a rising hostile booster, even several thousand miles distant. First a laser pulse is "bounced off" the distant target, and the reflected pulse returns to the receiver in the laser platform. It carries the movement-induced alteration of the distant target on the pulse it reflected. The next emitted pulse is an amplified phase conjugate replica of that received pulse, and it will backtrack to the same spot on the rising booster, leading it a bit and converging moderately so that it meets that spot. That spot begins to heat up, increasing its nonlinearity and making it act even more as a PCM. So its reflected signal off the "hot spot" is also a phase conjugate replica of the pulse that it received from the laser. That reflected pulse now will moderately converge its reflected energy upon the distant laser, increasing the return to the laser. The ping-pong continues, so that the laser beam narrows sharply upon the distant hot spot, and the reflected beam from the hotspot narrows sharply upon the distant laser. This "iterative narrowing ping pong" locks the laser upon the distant hotspot, even though the booster is moving. This process continues for the necessary dwell time, until the beam melts

through that spot and explodes the hostile booster. The iterative phase conjugating reflection, or "ping ponging" between the target spot and the laser, is called *self-targeting*.

S-FLOW

The Poynting energy density flow S, where **S** ≡ **E**×**H** + **G**.

E is the electric field, **H** is the magnetic field strength, and **G** is a trapped closed loop flow of energy density.

The **S**-flow is not the total energy flow per se. Since the fields **E** and **H** and the closed loop **G** are only defined in terms of the intercepted, trapped or "collected" energy, then **S**-flow is always *with respect to* some assumed intercepting/collecting entity, usually an assumed unit point charge.

SIGNAL WAVE

In nonlinear optics, the input signal (wave) to a phase conjugate mirror (PCM), which stimulates the PCM to emit a phase conjugate replica (PCR) wave in return.

SLEPIAN CURRENT

The vector jϕ , which in a current loop represents the energy unit area per coulomb of flowing charge, per unit of time, that is collected/collecting from the Poynting **S**-flow and dissipated in that current loop in its load s and losses.

It does not include the enormous amount of Heaviside nondiverged energy density flow that is flowing along the outside of the circuit conductors, and that is not being collected and therefore not being dissipated.

SLEPIAN FLOW

"Flow of collected-energy density dissipation" in a current loop,

...and therefore to the vector jf in the current loop, which represents the energy per unit area per coulomb of flowing charge, per unit of time, that is being dissipated in that current loop in its loads and losses.

It does not represent the enormous amount of energy that is flowing along the circuit, that is not being collected, not diverged, and therefore does not enter the circuit to be dissipated from it.

SLEPIAN VECTOR

Refers to the vector $j\phi$ in a current loop,

...which represents the energy density per coulomb of flowing charge, per unit of time, that is being dissipated in that current loop in its loads and losses.

It does not represent the enormous amount of energy that is flowing along the circuit, but not being collected and therefore not being dissipated. We accent that *only intercepted and collected energy can be dissipated!*

SOLID-STATE PARAMETRIC OSCILLATORS

A parametric oscillator circuit employing solid state devices.

A parametric oscillator is a device that oscillates by rhythmically changing a parameter (such as capacitance or inductance, etc.).

Simple switching between differing values of the parameter is often used to induced the periodic change of the parameter.

SOLITON

A wave pulse which propagates without changing its shape and without dispersion.

SOURCE DIPOLE

Any dipole, considered from the viewpoint that EM energy continuously pours out of it.

There is no true "source" as such in nature, since the energy is not created but only gated. In the case of the dipole and electrical charge as sources of EM energy, fields, and potentials, we solved that vexing problem in our "Giant Negentropy from the Common Dipole", *ibid*.

SPACETIME

The entity represented by the "fused product" of space and time, to give "space × time".

Spacetime is also dynamic geometry, in the general relativistic interpretation. We consider spacetime to be a potential, and also geometry, and also vacuum, and also virtual particle flux, and also hidden wave flux.

SPATIAL CLOUD

A cloud of something (such as electrons) in a spatial region.

SPATIALLY

With reference to space and spatial position.

SPECIAL RELATIVITY

Einstein's theory of inertial frames in which, if two systems are moving uniformly in relation to each other, one cannot determine anything about their motion except that it is relative.

Each of the two frames is said to be "rotated" with respect to the other, but not accelerating. The velocity of light in space (the vacuum) is constant, and is independent of the velocity of its source and the velocity of an observer. All the laws of physics are the same in all inertial frames of reference.

SPIN

The intrinsic angular momentum of a particle, such as an electron, proton, neutron, photon, graviton etc.,

...even when at rest, as if it were a top spinning about an axis, but had to spin 720 degrees before it turned "full circle."

Spin is quantized, and is always described as a half or whole spin, e.g., - 1, - 1/2, 0, 1/2, 1, etc. A spinning charged particle such as an electron thus demonstrates a magnetic moment, due to the circulation of charge in the spinning. In the nucleus of an atom, the spin of the nucleus is the resultant of the spins of the nucleons (particles comprising the nucleus).

Spin of particles would appear to be more like an "implosion" to "explosion" circulation; in other words, it circulates in the time domain (complex plane) as well. It would appear that the spin of a particle is the basic feature that integrates the (disintegrated) flux energy of vacuum flux into observable charge. Apparently all observable fields, matter, effects, etc. depend upon this basic mechanism to zip together virtual entities and form observable phenomena.

SPIRAL GALAXY

Those galaxies having arms which extend in the form of spirals.

About 70% of all galaxies are spiral galaxies.

The interesting thing is that only about 10% of the gravity necessary to hold the spiral arms together can be accounted for by known gravitational sources. This has led to the theorizing of dark (hidden) matter of exotic and unknown form, which would be responsible for the excess gravity.

The present author has proposed that the unaccounted enormous Heaviside component of the EM energy flow surrounding every field/charge interaction and not entering into that interaction, accounts for the missing source of the gravity. See "Dark Matter or Dark Energy?", Journal of New Energy, 4(4), Spring 2000, p. 4-11.

S-SOURCE

Source of Poynting energy density flow.

Source of **S** = **E**×**H** flow. The primary source is considered to always be an asymmetry in the virtual particle flux of the vacuum. The **S**-flow rigorously is that component of the overall energy flow that is intercepted by some system of interest—either present or assumed. That component of the overall energy flow that is not intercepted by the system of interest, is referred to by this author as the Heaviside energy flow or the dark energy flow associated with every field/charge interaction.

STONEY To be added

To be added.

STONEY/WHITTAKER BIWAVE DECOMPOSITION OF THE SCALAR POTENTIAL ACROSS THE DIPOLE

(i) a scalar potential (i.e., a difference in potential) exists between the end charges of a dipole,

(ii) that potential (difference) can be mathematically decomposed into a harmonic series of bidirectional EM wave pairs, where each pair consists of an EM wave and its precisely superposed time-reversed twin. Thus a dipole is a "source" or identically is a set of hidden bidirectional waves (wave view).

STRING THEORY

A rather recent mathematical physics theory which replaces the zero-dimensional "point" used in previous physics with a one-dimensional object called a "string".

It has been particularly effective in describing the gluon forces between two colored particles in particle physics, and has since been extended to many other areas. It is sometimes referred to as the "theory of everything".

"STRING" WAVE

The transverse wave on a taut string produced when the string is plucked.

The string wave itself stays on the string and does not travel through the slapped external medium.

However, Faraday believed that EM fields in vacuum consisted of "material lines of force" which behaved like such taut material strings, without any physical endholders. He thought that EM disturbances were simply the transverse disturbances of those "lines of force". He profoundly affected Maxwell's thinking, so that Maxwell accepted these physical lines of force. Consequently Maxwell *assumed* those same "transverse taut string vibration waves" in his EM wave theory.

In eliminating the "stringholders" for the assumed taut strings, Faraday and Maxwell discarded the Newtonian third law half of electrodynamics! They discarded half the energy and half the wave as well. Consequently today physics has no causative mechanism for Newton's third law, because it threw out the EM mechanism for it more than a century ago and never noticed it!

SU(2)×SU(2) SYMMETRY ELECTRODYNAMICS

To be added.

SUBSPACE

In vector mathematics: a subset of a vector space which is closed under vector addition and scalar multiplication operations.

In physics: Physics often uses the term "space" to refer to spacetime. It also uses the term "space" to refer to the dimensions of space, without the dimensions of time. At any rate, the spatial portion of spacetime is represented mathematically by some convenient number of dimensions. In the most usual practice, Minkowski spacetime of 3 spatial dimensions and one time dimension is utilized. In the Minkowski space, we now consider that "space" to be a vacuum scalar potential. If we consider the internal Stoney-Whittaker-Ziolkowski biwave pairs comprising that vacuum potential, we may transmit a signal communication along one or more of these internal biwaves, without changing any of the others. In that case, no overall potential gradient and overall forcefield signal appears. That domain that is infolded "inside" the scalar potential is said to be subspace. It may be modeled as a space of n-dimensions, where those dimensions are compacted and not observable to an external observer. Subspace gained great popularity from the Star Trek television series, where the spaceships used "subspace communications" to have signals propagate far faster than the speed of light. Bill Fogal has been working with some success on what should be a concrete realization of just this very "subspace communication system", with infolded signals that move much faster than the speed of light in vacuum.

SUPERCONDUCTIVITY

Property of some materials or metals whereby their resistance reduces to zero at very low temperatures.

These materials also exhibit many additional properties that are anomalous when compared to normal materials. Much research effort has gone into the attempt to find materials which exhibit superconductivity at higher temperatures, with the goal of reaching room temperature superconductivity.

SUPERLUMINAL

In a manner or with a speed faster than c, the speed of light in vacuum.

SUPERLUMINAL COMMUNICATION

The movement of signals faster than the speed of light in vacuum,

...and the transmission and reception of such signals and extraction of their transported information.

Longitudinal EM waves are not limited to speed c; transverse EM waves are limited to speed c. The infolded electrodynamics inside all EM fields, potentials, and waves consists of longitudinal EM phase conjugate wavepairs, with their impressed electrodynamics. Hence this "subspace" is a superhighway for such waves, including for those moving at superluminal velocity. In essence this is a very special kind of "tunneling" which we might refer to as *subspace tunneling*. The limitation to light speed rigorously applies to the modeled transverse EM waves which are a sort of "bulk upheaval" waves similar to waves on the surface of the ocean. As in the ocean wave analogy, "pressure" waves underneath the ocean may travel very much faster than the bulk upheaval waves on the surface.

When making longitudinal EM waves, the process is imperfect and the resulting longitudinal EM waves will have a transverse residue as well. The resulting "transverse-noisy" LW is called an *undistorted progressive wave*. Undistorted progressive waves may move slower than the speed of light or faster than the speed of light. See W. A. Rodrigues Jr. and J.-Y. Lu, "On the existence of undistorted progressive waves (UPWs) of arbitrary speeds $0 \leq v < \infty$ in nature," **Foundations of Physics**, 27(3), 1997, p. 435-508. A slightly corrected version is downloadable as hep-th/9606171 on the Los Alamos National Laboratory web site, and includes corrections to the published version.

SUPERPOSE

To lay or place on, over, or above something else, with the connotation of mixing.

SUPERPOSITION

The simple linear addition and subtraction of two or more values, states, etc.

Superposition is one of the key principles in field theories and in the concept of potentials.

SUPERSET

A large set referenced to a small set, where the small set is included in the larger set.

The large set is said to be a *superset* of the small set. The small set is said to be a *subset* of the larger set.

SW (STONEY-WHITTAKER) STRUCTURES

The Stoney-Whittaker hidden bidirectional EM wavepairs comprising the scalar potential, and structuring (altering) of same.

We call this internal EM dynamics inside every EM wave, field, and potential the "infolded" electrodynamics. Russian weapon scientists refer to it as the *information content of the field*.

SYMMETRICAL REGAUGING

In electromagnetics, changing the scalar potential to a different value, and simultaneously changing the vector potential to a different value, with the two changes just precisely selected so that the two extra forces (each created by one of the changes) are equal and opposite—thus canceling with respect to translation and doing no net external work.

We note that the two forces themselves must be considered to be present and still working continuously in opposition, increasing the stress upon the system regauged with excess energy, or decreasing the stress upon the system regauged with less energy.

This presence of "equal and opposite" excess forces from the symmetrical regauging is known as the *Lorentz condition*. The end result is that the *net* force fields of the regauged system remain the same, even though the stress of the system has been altered by the regauging and the potential energy of the system has also been changed. Since abstract vector mathematics contains no such thing as "stress" in its background vector space, zero vector resultant system of multiple nonzero vectors are most often simply discarded. Early electrodynamicists symmetrically regauged Heaviside's two "Maxwell" equations (potential form) so as to easily separate the variables. The net effect was to discard that set of the Heaviside/Maxwell equations that prescribed and included open electrodynamic systems that freely receive and collect energy from the external vacuum, and also obtain a free excess force which then can permissibly utilize that excess energy to translate and produce external work upon the system or externally upon a load. In short, the symmetrical regauging discarded practical overunity electrodynamic circuits and devices, which Maxwell's equations—even in their Heaviside modified form—have always prescribed and permitted. Contrast to asymmetrical regauging.

We specifically point out that the two extra forces remain, as does their energy, and both may be dynamic as the system is dynamic. Hence when one regauges, one has changed the gravitational aspects of the system and also curved the local spacetime. Further, this ST curvature is internally structured and that structure is dynamic. Thus contrary to the assumptions of electrodynamics, the regauged system *is not* the same as the original system.

SYMMETRY

A theory or process possesses a symmetry with respect to certain operations performed on it, if those applied operations do not change the theory or process.

The theory or process is then said to be "symmetric" with respect to those operations. As an example, there is no observable change in a circle when it is rotated or reflected in a mirror. The circle is therefore said to have rotational symmetry and reflection symmetry.

TANTALUM CAPACITOR

Electrolytic capacitor with a tantalum or sintered-slug anode,

...such as solid tantalum, tantalum-foil electrolytic, and tantalum-slug capacitors.

For the same capacitance, the weight and volume of the tantalum capacitor are less than comparable aluminum electrolytic capacitors. In other words, you can make the little son-of-a-gun smaller, for a given capacitance and charge it must hold. When utilized in the Fogal fashion, the tantalum capacitor also exhibits other properties that are still proprietary to Fogal's semiconductor processes and to Bill Fogal.

TARGETED PINPOINTS

Refers to those separated points which engage in self-targeting between themselves and some separated signal energy source (as in Fogal's semiconductor).

The effect is to sharply narrow the retroreflected source signal energy from the source onto the separated points by means of the mutual ping-ponging. In this fashion much more energy density from the source can be concentrated on the targeted pinpoints. In effect, phase conjugate shooting is evoked.

TENSOR

A special mathematical entity which is an element of a vector space such that it represents the tensor product of vector spaces and their duals.

Much of modern physics and advanced electromagnetics is expressed in tensor algebra theory.

TESLA, NIKOLA

Famous American emigré electrical inventor and eccentric whose numerous inventions fueled much of the electrical 20th century.

Tesla produced the AC system, including polyphase systems. From his experiments he knew that the EM wave in vacuum was longitudinal, like sound waves. In spite of his great accomplishments, his eccentricities and grandiose pronouncements did not endear him to electrodynamicists! An example is his acrid comment: *"...I showed that the universal medium is a gaseous body in which only longitudinal pulses can be propagated, involving alternating compressions and expansions similar to those produced by sound waves in the air. Thus, a wireless transmitter does not emit Hertz waves which are a myth, but sound waves in the ether, behaving in every respect like those in the air, except that, owing to the great elastic force and extremely small density of the medium, their speed is that of light."* Another major example is his statement: *"The Hertz wave theory of wireless transmission may be kept up for a while, but I do not hesitate to say that in a short time it will be recognized as one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history."*

Ironically, modern quantum mechanics has almost proven Tesla right that "the universal medium is a gaseous body." Today the modern QM vacuum is very much like a virtual particle gas. And of course the discussions in this present annotated glossary show why I personally am of the opinion that Tesla was also correct in his firm disbelief that those Faraday-Maxwell "taut physical strings without physical holders" filled the ether and provided transverse EM wave oscillations. I also agree with him that the EM wave in vacuum is a longitudinal wave, exactly like a sound wave. I believe that the transverse gyroelectron precession waves that our instruments actually measure in the conductor when it receives an incoming EM wave from the vacuum, proves that the vacuum wave is indeed longitudinal—else it would seem we must discard the spin of an electron and the theory of gyroscopes. Finally, one should see, e.g., Patrick Cornille, "Inhomogeneous Waves and Maxwell's Equations." Chapter 4 in **Essays on the Formal Aspects of Electromagnetic Theory**, Aklesh Lakhtakia, Ed., World Scientific, New York, 1993. Cornille clearly shows that Maxwell's equations are directly created by scalar potential interferometry. As he states, this means that EM force field wave s are created by the interference of sound-type scalar potential waves, or "sound creates light." This strongly supports Tesla's original statement that EM waves in the vacuum are actually EM sound waves, much like sound waves i n a gas.

TESLA'S MAGNIFYING TRANSMITTER (include Jackson quote)

To be added.

THERMOACOUSTICS

The generation of sound waves by heat.

THERMOACOUSTIC ENGINE

Essentially a closed resonant chamber containing three heat exchangers and a working fluid—such as an inert gas—under pressure, and used with a transducer to provide power such as mechanical power.

One heat exchanger is the hot-side exchanger through which heat is injected, another is the cold-side exchanger in which a coolant is circulated, and the third is a passive device between the other two, and known as a regenerator or thermal capacitor. The heating and cooling changes the pressure in the fluid greatly, and the regenerator oscillates back and forth, taking energy from the fluid, then giving it back, and keeping the engine going. A pressure wave (shock wave) moves through the working fluid and produces a resonator effect. The end result is an engine with rapidly fluctuating pressure gradients and no moving parts. The pressure gradients are then tapped off to drive a piston, which drives a linear alternator producing electricity. In a typical application, a single piston with a surface area of 1.5 square inches, and with a travel of only one centimeter, operated at 500 Hz, will produce about 30 horsepower output.

Information on these engines can be found on the Fellows Research Group website at http://www.io.com/~frg, or E-mail to frg@io.com. Many thanks to Oscar L. Fellows, "Be Our Guest: Thermoacoustic Engines—Propulsion, Power for the 21st Century," **Power Online**, 1/24/2000.

THERMODYNAMIC EQUILIBRIUM

Stable state eventually reached by an isolated system. One may consider it a "balanced" or "preferred" state.

Actually, a totally isolated system could not change. Any system is in a constant exchange with its vacuum environment, a priori, and no such thing as a completely isolated system exists in nature. Hence once excited, a system—to reach equilibrium—must exchange with its environment and is not a truly isolated system. But systems do exchange with their environment in hidden forms, so we can just let the original statement stand as is. Sloppy, but okay so long as we recognize the limits.

TIME

To be added.

TIME-CHARGE

To be added.

TIME-CHARGING

To be added.

TIME-ENERGY

To be added.

TIME-EXCITATION

To be added.

TIME-FLOW MECHANISM

To be added.

TIME-POLARIZED ELECTROMAGNETIC WAVE

An electromagnetic wave whose vibrations occur in the time domain only.

The wave is theorized in quantum field theory, or at least its time-polarized photon is theorized and called a "scalar" photon. There seems to be no Western method for detecting such waves, though they are predicted by theory.

TIME-POLARIZED (SCALAR) PHOTON

A photon whose vibrations occur in the time domain only, also known as a "scalar" photon.

TIME-FORWARD WAVE

A normal wave moving in forward time. Otherwise known as the retarded wave.

The external observer comfortably sees its forward progress as expected.

TIME REVERSAL

The process of forming the phase conjugate

...(e.g., of a wave or particle or entity or process or vacuum engine.).

We accent that *time-reversing a single object or single group of objects* is not the same thing as "travel into the past" so popularized by science fiction. For time travel to the past, the entire universe and everything in it except the traveler, would have to be time-reversed. That would not seem possible by any stretch of the imagination today! On the other hand, time-reversal of a single thing such as a particle or a wave—or even a group of things such as a group of particles or waves—is not only feasible but is readily achievable. A positron is a time-reversed electron, e.g. Becker showed that laughably weak DC electrical trickle currents (picoamperes) across otherwise intractable bone fractures could engender healing of the bone fractures. In investigating the effect, he showed that entire cells—specifically in that case, the red blood cells—were time-reversed (dedifferentiated) and then fast-forwarded (redifferentiated) into new kinds of cells, *genetics and all*.

In France in the 1960s and early 1970s, the Priore team showed in laboratory animals that this mechanism (which they nor anyone else understood they were unwittingly evoking) could be used to dramatically reverse and quickly cure terminal tumors, infectious diseases, arteriosclerosis, and suppressed immune systems. The same approach, if redeveloped, could stop and totally wipe out the emerging major new pandemic of hepatitis C, which nothing will touch at present and which will surpass AIDS infections after the turn of the century. The approach could totally reverse AIDS and eliminate all HIV infection, because it could simply time-reverse HIV-infected cells back to normal cells, genetics and all. In other words, it could readily and cheaply and quickly eliminate AIDS from the face of the earth. Further, the disease could be eliminated whenever a patient tested positive for HIV infection; there would be no need to wait for debilitation to set in. For coverage in detail, see T. E. Bearden, "Vacuum Engines and Priore's Methodology: The True Science of Energy-Medicine. Parts I and II." **Explore**!, 6(1), 1995, p. 66-76; 6(2), 1995, p. 50-62.

TIME-REVERSAL ZONE

A region of space in which a component of the overall time flow runs backwards, and hence the fundamental mechanism generating the flow of a mass through time is reversed.

Such zones are theorized as temporarily occurring in cold fusion, particularly once the palladium lattice is loaded with hydrogen or deuterium ions. Such a temporary region in the electrolyte is an excited state, and the other ions will move to nullify it and cause its decay. During its existence, ions in it experience a reversal of the law of attraction and repulsion of charges. In the TRZ, like charges attract and unlike charges repel. Thus suddenly the low spatial energy transmutation of elements in cold fusion experiments can be explained (they have been validated in some 600 successful experiments, in various laboratories in various nations, by excellent scientists). E.g., two H+ ions may attract, and so closely that each enters the edge of the strong force region of the other, forming a quasi-nucleus. Then as the TRZ decays, the preferred energetic change is from inside out. In other words, the gluon forces have been partially nullified and the quarks in the nucleons are almost freed. Hence the favored energetic decay from the excited state of the TRZ is by quark flipping, where one H+ ion in the quasi-nucleus changes into a neutron. The quasi-nucleus becomes a quasi-nucleus of deuterium, and will tighten into deuterium as the TRZ induced action vanishes. This is the way the excess deuterium is formed in the cold fusion experiments. Two deuterium D+ ions may also form a quasi-nucleus of (D+)(D+) particularly where the electrolyte is loaded with deuterium to start with. In that case, as the TRZ decays, the quasi-nucleus just tightens into a helium 4 nucleus or alpha particle, accounting for the excess alpha particles formed. And so on.

The concept of the TRZ thus is consistent with hundreds of successful experiments, and introduces a completely new type of nuclear reactions to physics, at low spatial energy where transmutations such as occur are not presently thought to be possible. We point out that these are extremely high energy reactions when the time-energy interaction is considered, since time has an energy density equal to mass. Time-energy is some c^2 times as dense as is spatial energy used by particle physicists in their interactions. By transposing some of the time-energy into spatial energy as the TRZ decays, the new "low energy nuclear reactions" actually involve the necessary degree of "high energy" required for the interactions.

TIME-REVERSED WAVE

A phase conjugate reflected wave, which is a wave moving in reversed time.

Since the external observer "sees" in forward time only, he sees the wave as traveling in the opposite direction as its generatrix wave front is moving.

TOPOLOGICAL

Invariant under transformation by continuous mappings.

...or related to the properties of geometric shapes and figures that remain invariant under transformation by continuous mappings.

TOPOLOGICAL PROPERTY

Those properties of a geometrical space that are unchanged by continuous distortion of the space.

TOPOLOGY

Mathematics of the properties of geometric configurations invariant under transformation by continuous mappings.

In short, the mathematics of the large-scale structure of curved spaces.

TOROIDAL COIL

A coil of wire curved around into toroidal form.

Contrast to the standard solenoidal coil form.

TOROIDAL TRANSFORMER

A transformer comprised of toroidal coils instead of solenoidal coils.

TRANSFORMATION MATRIX

A matrix (rectangular array of algebraic or numerical quantities) for replacement of the variables in an algebraic expression by their values in terms of another set of variables.

Used, e.g., in solving equations involving Hamiltonians.

TRANSVERSE

Wave movement perpendicular to the wave's primary direction of principal propagation, as in the movement of a taut rope in a wavelike motion traveling down the rope.

(As opposed to longitudinal).

TRANSVERSE EM WAVE IN THE VACUUM

The completely erroneous notion that EM disturbances in the vacuum are composed of transverse "string waves."

Faraday, e.g., believed that the EM field in the vacuum consisted of his "lines of force" as material taut strings—erroneously without the necessary holders to put the tension forces on the strings. He thought that when there was an EM disturbance, it was a "plucking" or transverse vibration of these "taut strings." Maxwell also believed in Faraday's material lines of force, and set out to capture them in his electrodynamic theory. He did so by simply assuming the lines (tubes) of force and their transverse "string wave" vibration. This is equivalent to assuming that the electromagnetic vacuum itself is composed of material taut strings, and that additional EM fields are just additional taut material strings.

TRANSVERSE FIELD COMPONENT

The modeled component of the electromagnetic field (as in a moving EM wave in vacuum) that is oriented at right angles to the line of motion.

TRANSVERSE WAVE

A wave where the medium is undergoing repetitive lateral translations, as a lateral wave in a taut string.

The EM wave is vacuum is erroneously modeled as a transverse "string wave," as a relic from Faraday's original belief that EM fields existed in the (assumed) material ether as physical taut strings. He thus believed that EM disturbances were the disturbances of "pluckings" of these taut strings. Maxwell accepted Faraday's physical lines of force and constructed his electrodynamics mode to specifically include the material ether, the physical "taut strings" lines of force notion, and Faraday's "string waves" as the electromagnetic vibrations in the ether. This discards half the energy, half the phenomena, half the wave, and Newton's third law causative EM mechanism.

TUNNELING

In quantum mechanics, a phenomenon where a particle penetrates and crosses a small region where the opposing potential is greater than the particle's available energy.

The phenomenon is thought to be impossible according to classical physics, but occurs nonetheless. Further, the speed of transit through the "tunneling" separation can be superluminal. Tunneling of music between two points has been measured to occur at more than four times the speed of light.

A more extended type of tunneling is the travel of longitudinal EM waves infolded inside the normal EM potentials, fields, and waves. Indeed, this is a more fundamental electrodynamics, and it can be shown that interferometry of this "internal" electrodynamics creates the external electrodynamics by a form of longitudinal EM wave interferometry. E.g., see M.W. Evans, P.K. Anastasovski, T.E. Bearden et al., "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry," **Journal of New Energy**, 4(3), Special Issue, Winter 1999, p. 76-78.

UNCONSCIOUS MIND

To be added.

UNIFIED FIELD THEORY (ENGINEERABLE)

A unified theory of the four forces of physics—the electromagnetic, gravitational, strong, and weak forces —that is not just an intellectual model but which is also engineerable on the laboratory bench and in actual physical systems using higher symmetry O(3) electrodynamics.

That's a mouth-filling phrase (yes, we sometimes write awkward phrases unintentionally; it's amazing how reasonable such things sound when you're laboring along at 3:00 a.m. and bleary-eyed as a wet toadstool!)

UNIFIED FIELD THEORY OF MIND AND MATTER

To be added.

UNITARITY

Principle that all probabilities sum to unity.

UNITARY Q_E

Fixed or unit charge q of the electron.

This notion is held only because the q is not decomposed into its component elements, but treated as if it were an indivisible unit. That is in error! The mass of a fundamental particle at rest is quantized, and the massless charge (self-potential) of the particle is discretized as a function of the background potential (virtual particle flux density) in which it is embedded or to which it is exposed. In our view the definition of a charge q is $q \equiv m_q\phi_q$. The *electrical charge* should be taken to be the massless ϕ_q component. The definition of charge q_e of an electron is rigorously given by the identity $q_e \equiv m_e\phi_e$. The *electrical charge* of the electron should be taken to be the massless ϕ_e component.

If a charge (say, an electron) is placed in an additional potential ϕ_1, then the total massless charge of the electron (i.e., its virtual vacuum flux exchange with mass me) is $(\phi_e+\phi_1)$. As can be seen, the massless charge of the electron (its virtual flux activity) has now changed. The electron is then said to *be collecting and to have collected* excess energy (which may be either positive or negative, depending upon the sign of ϕ_1.). Further, either ϕ_e or ϕ_1 or both can be internally and deterministically *dimensioned* (structured in Stoney-Whittaker-Ziolkowski fashion). When its massless charge (its own potential ϕ_e) is so dimensioned, then the dimensioned electron is said to contain or transport a *vacuum engine*.

VACUUM ENGINE

Particle view: Deterministic internal pattern or template deliberately created in the virtual flux of a scalar potential.

It can also be created in, and transported by, the two scalar potentials that comprise a static or dynamic force field, or a moving EM wave in the vacuum. It can also be created in the local vacuum, in which case it has a "charge-up" creation time and a "discharge time," exhibiting a sort of "time constant" very much like a capacitor charging and discharging. In the wave view, the vacuum engine is a deterministic internal pattern or template deliberately created in the Stoney-Whittaker-Ziolkowski internal biwaves and wave products comprising the scalar potential. Again, it can be implanted in the vacuum or in an EM signal as a carrier. The self-energy (scalar potential) portion of any electric charge or magnetic charge can also be a "carrier" that is conditioned (*dimensioned*) with a vacuum potential. The process or act of conditioning any of the carriers with vacuum engines is called *dimensioning* that carrier. Russian energetics refers to the vacuum engines of a dimensioned carrier as the *information content of the field*.

VACUUM FLUX EXCHANGE

The virtual particle interaction between the active vacuum and a charged particle.

The charged particle is an asymmetry in this flux exchange interaction, and extracts and gates some of the vacuum energy as a Poynting **S**-flow. In turn, this S-flow transports and creates in space the **E** field and the scalar potential f associated with the charged particle. An electrically charged particle is thus a little Poynting energy generator, a source of potential, and a source of **E**-field. It is a little electrical dynamo, a little free energy generator. It is already an open system in disequilibrium with its environment—the fierce vacuum flux. Its self-energy (potential) and its "fields," plus its Poynting energy flow, are the result of its asymmetry in the vacuum flux exchange.

VACUUM'S VIRTUAL PARTICLE FLUX

In the particle viewpoint, the quantum mechanical vacuum identically is a virtual particle flux.

Present physics, however, is prone to refer to the vacuum as (an implied emptiness) containing a virtual particle flux. Energy, vacuum, spacetime, virtual particle flux, and dynamic geometry are all synonyms.

VECTOR

In mathematics, an entity completely characterized by a magnitude and a direction.

VECTOR POTENTIAL

In electrical engineering: "Potential postulated in electromagnetic field theory."

Space differentiation (*curl*) of the vector potential yields the field. Magnetic vector potential is due to electric currents, while electric vector potential is assumed to be due to a flow of magnetic charges." [**Chambers Science and Technology Dictionary**, Peter M. B. Walker (Ed.), Chambers Cambridge, 1988, p. 947.

Note that the foregoing is not yet a definition, saying only that it is a postulated potential, then giving some characteristics. Informally, in my view the vector potential is just sort of an ordinary scalar potential, every point of which is in motion in something like a swirling fashion. The magnetic vector potential **A** is most common. There doesn't seem to really be a definition of **A**; the equation $\mathbf{B} = \nabla\times\mathbf{A}$ is usually (erroneously!) said to "define" the **A**. So we are left with the question $\mathbf{A} \equiv$????, since no equation is a definition of anything.

Electrodynamicists have no difficulty in calculating the direction and magnitude of **A**, and in using it, but so far as I can find there is still no real definition. As an ad hoc definition I consider the **A**-potential to be identically a virtual photon flux of vacuum that is moving as an ensemble along the direction of the **A**-vector. Inputs for a more rigorous definition of the form $\mathbf{A} \equiv$ (x) would be most welcome!

At any rate, the **A** is known to be quite real and an independent "field" of nature, because when the curl operator is removed from operating on **A**, the **B**-field is zeroed but the *curl-free* **A**-field can still remain and interfere with the fields of charged particles and magnetic poles to cause real effects in physical systems, including at a distance. This latter is known as the Aharonov-Bohm effect.

VECTOR FIELD

In ordinary theory, the assigning of a magnitude and a direction (that is, a vector) to each point in a region of space.

The entire set of vectors and their spatial points is called a vector field.

VECTOR ZERO

See discussion under *zero vector*.

VIRTUAL ANTIPHOTONS

An antiphoton that spontaneously appears and disappears, so swiftly that it cannot be individually observed.

VIRTUAL PARTICLE

A fleeting quantum particle that spontaneously appears and disappears, so swiftly that it cannot be individually observed, so that it exists only temporarily.

The virtual particle does not satisfy the usual relation between energy, momentum, and mass because it is underneath the Heisenberg uncertainty principle. The virtual particle can have any amount of energy momentarily, so long as the product of its energy and the time interval of its existence is less than the uncertainty principle's minimum magnitude.

Nonetheless, the interactions of large numbers of virtual particles with a mass or charge can combine to generate real observable effects. In quantum field theory, all forces of nature are caused by the interaction of the forced mass entity with virtual particles. Interaction of a mass with virtual photons, e.g., is projected to cause all mechanical and electromagnetic forces.

VIRTUAL PARTICLE FLUX EXCHANGE

Interaction with or exchange of, a flux of virtual particles.

Interaction of a mass with virtual particles most often consists of the mass absorbing the virtual particles and re-emitting them.

VIRTUAL PHOTON FLUX (VPF)

A flux of virtual photons.

(Hey, how's *that* for a tautology!) First, see definition and discussion under *flux*. For electromagnetics, the vacuum can often be modeled as a flux of virtual photons. One gets the virtual charges also, since the photon is considered to also consist of a positron-electron pair. That is, the photon is continually separating into a positron-electron pair, which then annihilate each other to form additional photon(s), etc.

VIRTUAL PHOTON FLUX EXCHANGE

The mutual exchange of virtual photons, as between the vacuum and a charged mass, or between two colliding masses.

The emitted photons from one mass are absorbed in the other mass and re-radiated.

VIRTUAL PHOTON FLUX OF VACUUM

The vacuum identically is a flux of virtual particles.

For most electromagnetic cases, it can just be modeled as identically a flux of virtual photons.

VIRTUAL PHOTONS

Photons which spontaneously appear and disappear in the vacuum so quickly that they cannot be individually observed.

VIRTUAL POSITRONS

Positive electrons (positrons) which spontaneously appear and disappear in the vacuum so quickly that they cannot be individually observed.

WHITTAKER, E. T.

Well-known mathematical physicist, who dramatically extended Stoney's earlier work of 1897-8 and authored two papers in 1903 and 1904 giving the basic theory of scalar electromagnetics (Russian energetics, not including the quantum potential portion).

The 1903 paper is E.T. Whittaker, “On the Partial Differential Equations of Mathematical Physics,” **Mathematische Annalen**, Vol. 57, 1903, p. 333-355.

The 1904 paper is E.T. Whittaker, “On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions,” **Proc. Lond. Math. Soc**., Series 2, Vol. 1, 1904, p. 367-372. The paper was published in 1904 and orally delivered in 1903.

WHITTAKER'S DECOMPOSITION OF THE SCALAR POTENTIAL

Decomposition of the scalar potential into a harmonic set of bidirectional longitudinal EM phase conjugate wavepairs.

In his paper “On the Partial Differential Equations of Mathematical Physics,” **Mathematische Annalen**, Vol. 57, 1903, p. 333-355, Whittaker showed that the scalar EM potential can be decomposed into a harmonic series of bidirectional EM wavepairs. In each pair, one wave is the phase conjugate of the other, and exists in the time domain. However, this phase conjugate wave has been considered as having been detected by intercepting charge as a 3-space EM wave travelling in a reversed direction. Hence from a detectable viewpoint, the Whittaker decomposition yields bidirectional longitudinal EM waves in 3-space, as has been pointed out by several electrodynamicists (e.g., Barrett).

However, the present author considered the difference between the phase conjugate wave as it exists prior to interaction with the assumed intercepting unit point charge, and the detected 3-space wave after the detecting charge is assumed. By applying the Whittaker decomposition and also considering the nature of the EM wave in spacetime *prior to interception by a unit point charge*, this led to the discovery of a new and more primary 4-symmetry in EM energy flow, once 3-symmetry is broken, that exists automatically between the time domain (complex plane) and 3-space.

Thus because a dipole (or a charge treated as a set of composite dipoles) breaks 3-symmetry (as is well-known in particle physics), the more general 4-symmetry results automatically when the nature of the potential between the ends of the dipole(s) is considered. This yields the fundamental mechanism by which EM energy is extracted from the vacuum (from the complex plane or the time domain) and output in 3-space from a "source charge" or a "source dipole". In short, it yields the giant negentropy mechanism when the unaccounted Heaviside energy flow component from a charge or dipole is considered as well as the intercepted tiny Poynting energy flow component. See T. E. Bearden, "Giant Negentropy from the Common Dipole", **Journal of New Energy**, 5(1), Summer 2000, p. 11-23; also on http://www. cheniere.org.

In his second paper, “On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions,” **Proc. Lond. Math. Soc**., Series 2, Vol. 1, 1904, p. 367-372, Whittaker showed that the interference of two such scalar potentials can and does create all the field energy, patterns, and functions of classical electromagnetics.

Whittaker's second paper initiated what today is loosely referred to as *superpotential theory*. For an excellent overview discussion of superpotentials and related things, see Melba Phillips, “Classical Electrodynamics,” in **Principles of Electrodynamics and Relativity, Vol. IV of Encyclopedia of Physics**, edited by S. Flugge, Springer-Verlag, 1962.

WORK

The changing of the form of energy.

WORK, EXTERNAL

The changing of the form of the external energy of a body or system.

WORK, INTERNAL

The changing of the form of the internal energy of a body or system.

WORK-ENERGY THEOREM

To be added.

ZERO POINT ENERGY

The minimum energy of a system due to its quantum fluctuations, resulting from its incessant virtual particle activity. Quantum mechanically, no system of interest (including even spacetime itself) can have zero energy.

The zero-point energy of the vacuum is the lowest energy vacuum state, with fluctuations taken into account. Even at low energies, quantum fluctuations continually arise, and result in an incessant, extremely rapid, and violent "jittering" of the energy momentarily present. The minimum energy due to these quantum fluctuations is called the *zero-point energy.*

ZERO VECTOR

(1) A vector having no length (no magnitude) or specific direction.

(2) Absence of any or all finite vectors.

(3) Resultant of a system of multiple, finite vectors whose vector sum has no specific direction.

Note that the second definition differs drastically from the first. That is, we cannot say that a vector resultant zero has no infolded magnitude, if we consider its components, all of whom have magnitude. See the discussion under "zero." In vector analysis, the zero vector axiom states that any vector v plus a zero vector is equal to a zero vector plus v. Note that, being an axiom, this is not proven, but just assumed. We very much disagree with that blanket axiom; it reduces vector analysis to a highly special single case, where all zero vector systems are to be considered equal, and totally "inactive." In the real world that need not be true at all. There are an infinite number of different zero vector resultant systems, and so zero vectors may differ, if their infolded component "substructure" is considered. In the real world, things that are vectors very often have energy. The energy is infolded and hidden, so that it represents not only a local curvature of spacetime, but also a structured, deterministic set (a *template*) of curvatures of local spacetime. Therefore this zero vector system is actually a *vacuum engine*. Any mass system placed in such a potential, will be acted upon in its parts by that local vacuum engine. Further, the zero vector resultant system is a "potential," since it does contain "collected internal energy." This potential is obviously an artificial potential, since it is deterministically structured internally.

So between zero vector resultant systems, the "infolded, hidden energies" differ dramatically in

(i) total infolded and trapped (collected) energy,

(ii) specific internal action patterns (templates),

(iii) general relativistic effects, and

(iv) type of vacuum engine. Accordingly, the actions the zero-vector system induces in an exposed mass may be designed in advanced. This is vacuum engineering. This is spacetime engineering.

The problem is the *vector algebra itself*. In the abstract algebra, a "vector space" is regarded as an inert thing, where the only actants are the overall net nonzero vectors, and there is no interaction between an overt vector and a covert set o f vectors. The vector space is not allowed to have an internal realm, stress, hidden engines, or to interact with the vectors representing the physical system. Consequently, for over a century electrodynamicists—thinking primarily of translation—have routinely discarded such "zero vector systems" as if they represented the total absence of any finite vector. *This they do, in the unsuitable assumptions of the vector algebra*. This they do not do, in the real world.

The common practice in electrical physics of replacing a zero-summed system of nonzero vectors with a vector zero of "complete absence of vectors" is incomplete, and such did not exist in Maxwell's original *quaternion* theory. This present practice should be changed; it has reduced the topology of electromagnetics far too much, and gutted the most important parts of the theory insofar as an extended electromagnetics is concerned. The vector zero should be replaced with a special organized vector zero system and a scalar potential. The interactions of the "hidden" vectors should be incorporated. By failing to do this, physics excludes the ability to engineer electrogravitation, spacetime, the virtual state, local general relativity, free energy, effects at a distance, and the probabilities of the states propagated by the Schrödinger equation. It also excludes unification of all forces.

In the new view, a zero vector may be a system of nonzero vectors that vectorially sum or multiply to zero for translation purposes, but the components may still exist "inside" and dynamically function inside the zero-resultant envelope. This substructure can act on nonlinear or resonant systems. Any or all components may be time varying, or none of them may be. The zero vector system may thus be a dynamic vacuum engine. In addition, such a vector zero system is considered to be also a scalar stress potential, whose magnitude is equal to the sum of the absolute values of the perpendicular components. In addition, a separate type of stress potential may be included for the magnitude of the absolute values of the swirl components (torques). Other associated potentials may be included for the system, particularly if the system is in multiple dimensions, if it consists of more than one type of virtual particle flux, if several fluxes intercommute, etc. Such a system can also be designed and created to deterministically interact with and on the life force itself, the mind, thought, and personality, but that is beyond the scope of this discussion.

ZERO-VECTOR-SUMMATION SURFACE

A surface or assumed spatial surface in which vectors under consideration interact to sum to a vector zero resultant.

ZERO-VECTOR-SUMMATION SYSTEMS

Zero summations of real, nonzero vectors, so that the real vectors are still present but do not cause translation of exposed mass or charges.

With respect to observing/detecting process that depend upon charge translation, the vectors are said to be hidden and infolded —i.e., with respect to detection by translation. See discussion under *zero vector*.

ZIOLKOWSKI, RICHARD

To be added.

Return to top of page

The "Porthole" Concept with technical background

Amplifying the cellular regenerative (healing) system of the body for treatment and healing of mass casualties

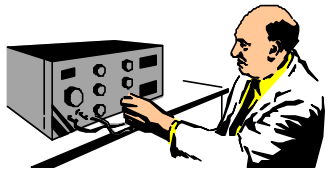

Outline of the presentation

- Mechanism for deep EM exchange of a body with its active EM environment
- Becker's epochal work and its ramifications
- Kaznacheyev's startling results and ramifications
- Weaponization of Kaznacheyev's findings
- Importance of time-energy and the time-domain
- Mechanisms for medical treatment and healing

Outline of the presentation (2)

- Prioré's revolutionary results and their ramifications.
- Proposed new mechanism for cancer promotion.
- Porthole concept: The 2-minute shortcut.
- Terrorist biological warfare capabilities.
- Summary and conclusion.
- Budgetary and Program package.

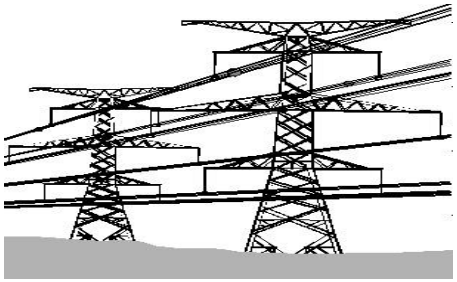

Mechanism for the body's deep EM exchange with its active EM environment

And some ramifications

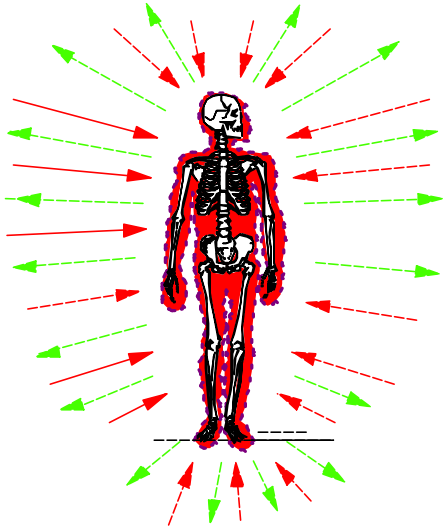

The body continually receives and retransmits EM energy

- The body may be considered as a dielectric.
- Every part of the dielectric participates in the absorption and emission of each photon to and from any point on the surface.*
- Mechanical force effects are also electrical in nature and exchange similarly.

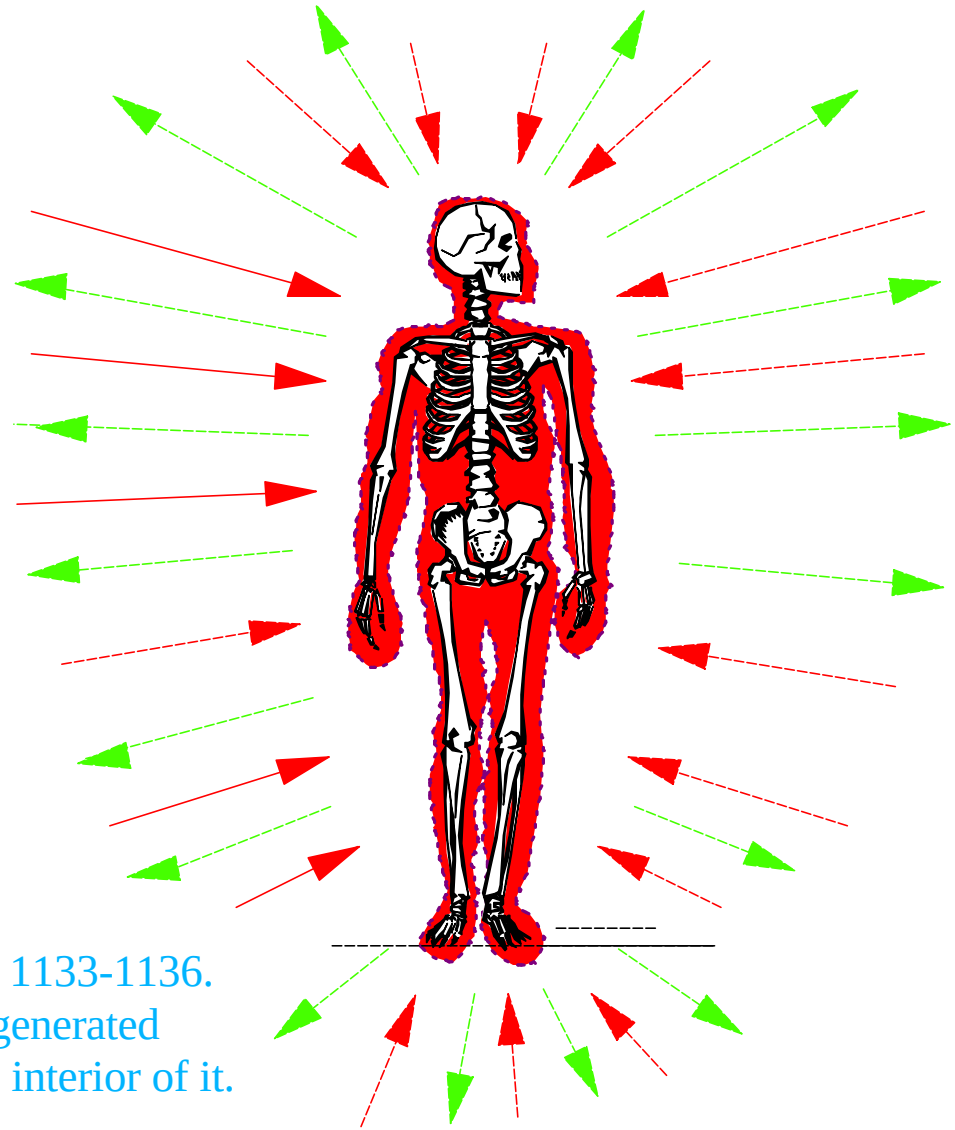

* Reali, G. C., "Reflection from dielectric materials," American Journal of Physics, 50(12), Dec. 1982, p. 1133-1136. The reflected field from a dielectric material is not generated just at its surface but comes from everywhere in the interior of it.

Ramifications:

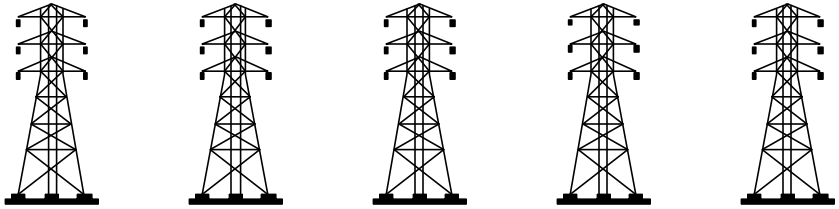

- There is an EM "dielectric transmission path" connecting every part of every cell to every part of the surface of the body.
- All electrical processes in the body, including deep within the cell and its nucleus, participate in the absorption and emission of every photon to and from the body's outer surface (and every mechanical force* experience).
- The EM emission energy of the body is a conglomerate mix of fractions of all processes and functions ongoing in the body or affecting it, including in every cell.
- This includes all electromagnetic, mechanical, chemical, and environmental effects upon and in the body and every tiniest part of it, and provides an extended definition of "stress".

* At base, all normal mechanical forces are generated by electromagnetic forces.

Ramifications (2)

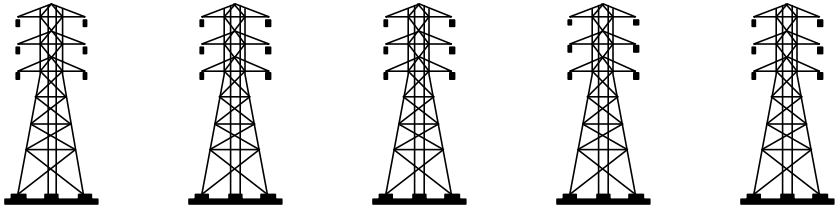

- The reaction of each photon absorbed on any point of the outer surface of the body, connects through the dielectric transmission path to every part of the body, including to every part of every cell*.
- Every emission from the body is participated in by every part of the body, including every part of every cell.
- The body's emission "changes" its environment, adding EM radiation. Some of the internal induced changes (excited states) in the body decay by this external emission. Some do not, but must be otherwise dealt with internally by the body systems.
- The body's EM absorption allows the environment to change or affect every function, operation, and part of the body, by adding EM radiation. All are continually being affected and deviated, both helpfully and harmfully, by these deeply induced EM interactions.
- The body's reaction (healing) must continually readjust and correct deviations from normalcy, in every part of every cell.

* In quantum physics, part of the photon is localized and part is nonlocalized, reaching even across the universe.

Ramifications (3)

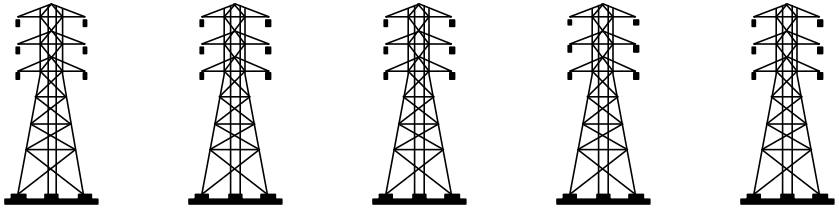

- The sum total of all the impinging external EM radiation upon the body, plus mechanical "special EM" radiation, thus affects and changes the body and all its processes, participating in them.
- That impinging EM radiation can be manipulated to either harm or heal the body and any or all of its cells.
- The body must continually overcome these externally-induced EM changes in its cells and processes, to maintain normalcy. Some EM changes are restored by the subsequent dielectric emission process, relieving the previously-induced deviant EM excitations in its internal processes. Some are not.
- The poorly studied *cellular regenerative system* performs the remainder of the restorative function, which is the fundamental "healing" function of the body.*

*The cellular regenerative system was mostly studied by Becker and a few others. See R. O.Becker, and David G. Murray, "The electrical control system regulating fracture healing in amphibians," Clinical Orthopaedics and Related Research, No. 73, Nov.-Dec. 1970, p. 169-198.

Becker's epochal work

And its ramifications

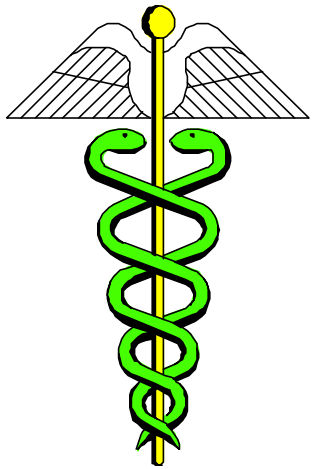

Becker's bone fracture healing

- Tiny DC currents (picoamperes)
- Pulsed DC current can be utilized
- Pulsed magnetic fields may be utilized

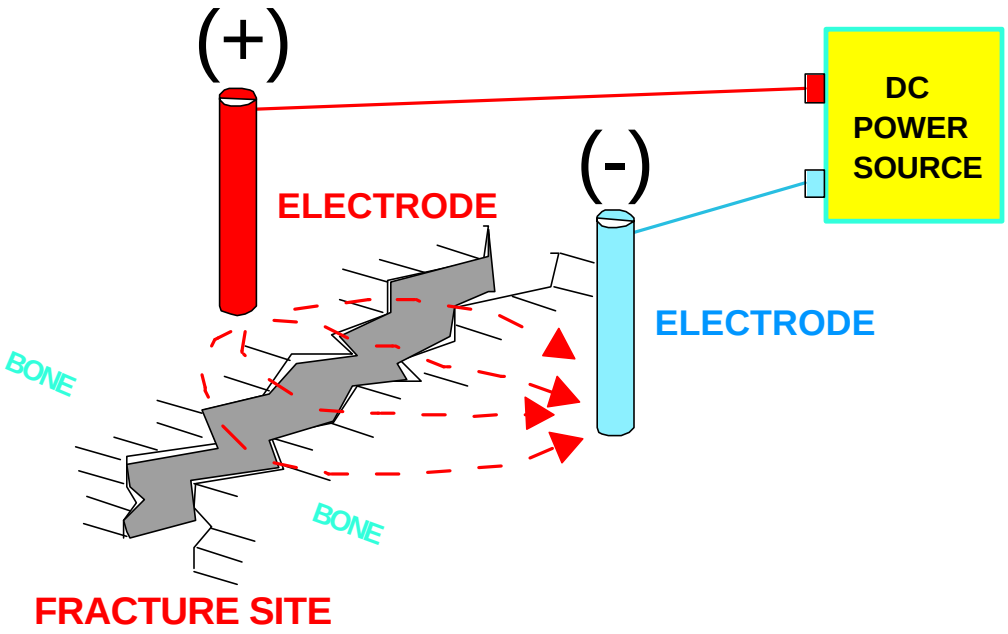

RED BLOOD CELL DEDIFFERENTIATES

Shucks hemoglobin coat
Grows nucleus

NEW CELL REDIFFERENTIATES

Turns into type of cell that makes cartilage

NEW CELL REDIFFERENTIATES

Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture

Becker's theoretical DC control system involved with response to injury

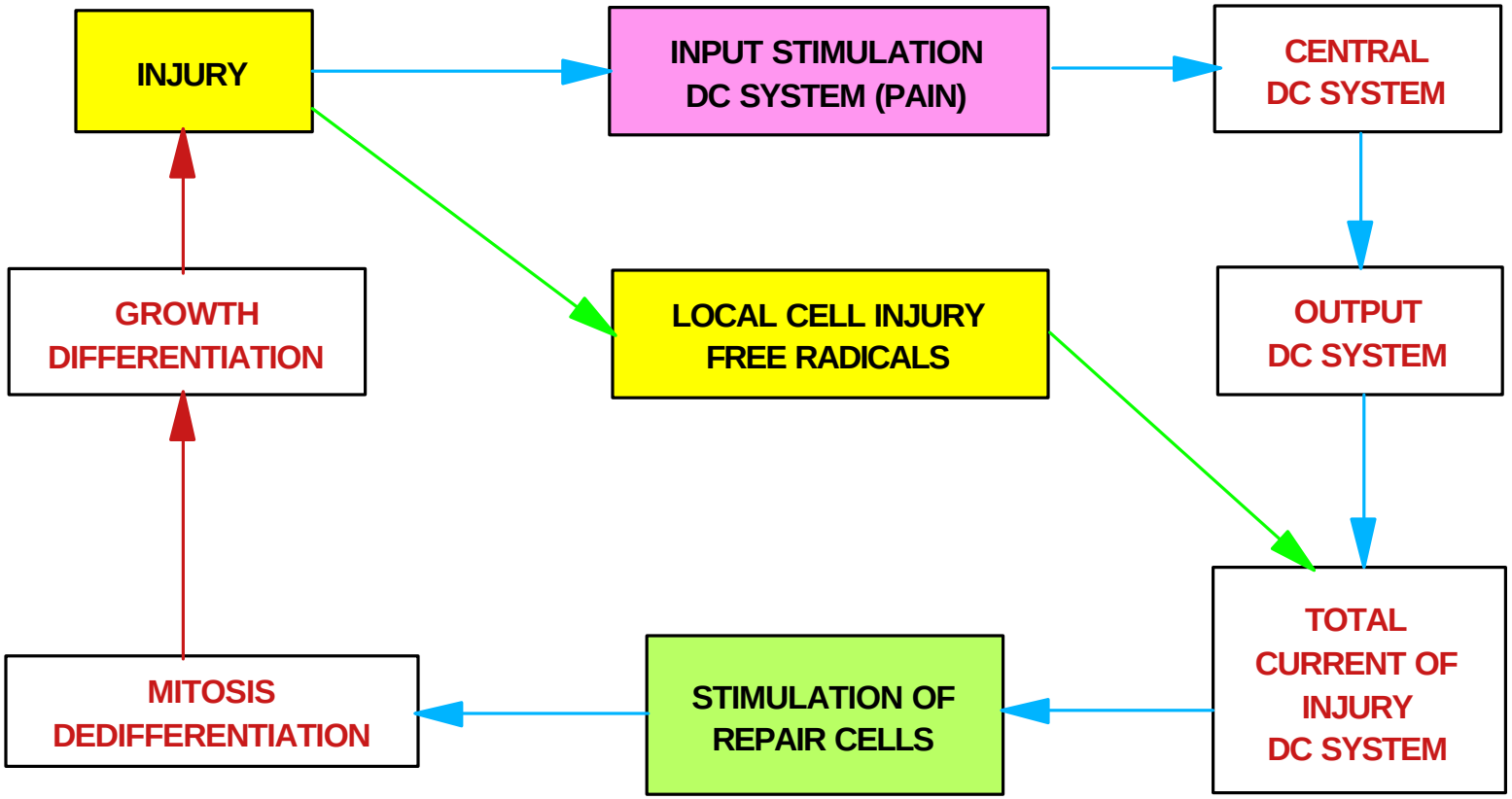

*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

Becker's proposed control system governing regeneration*

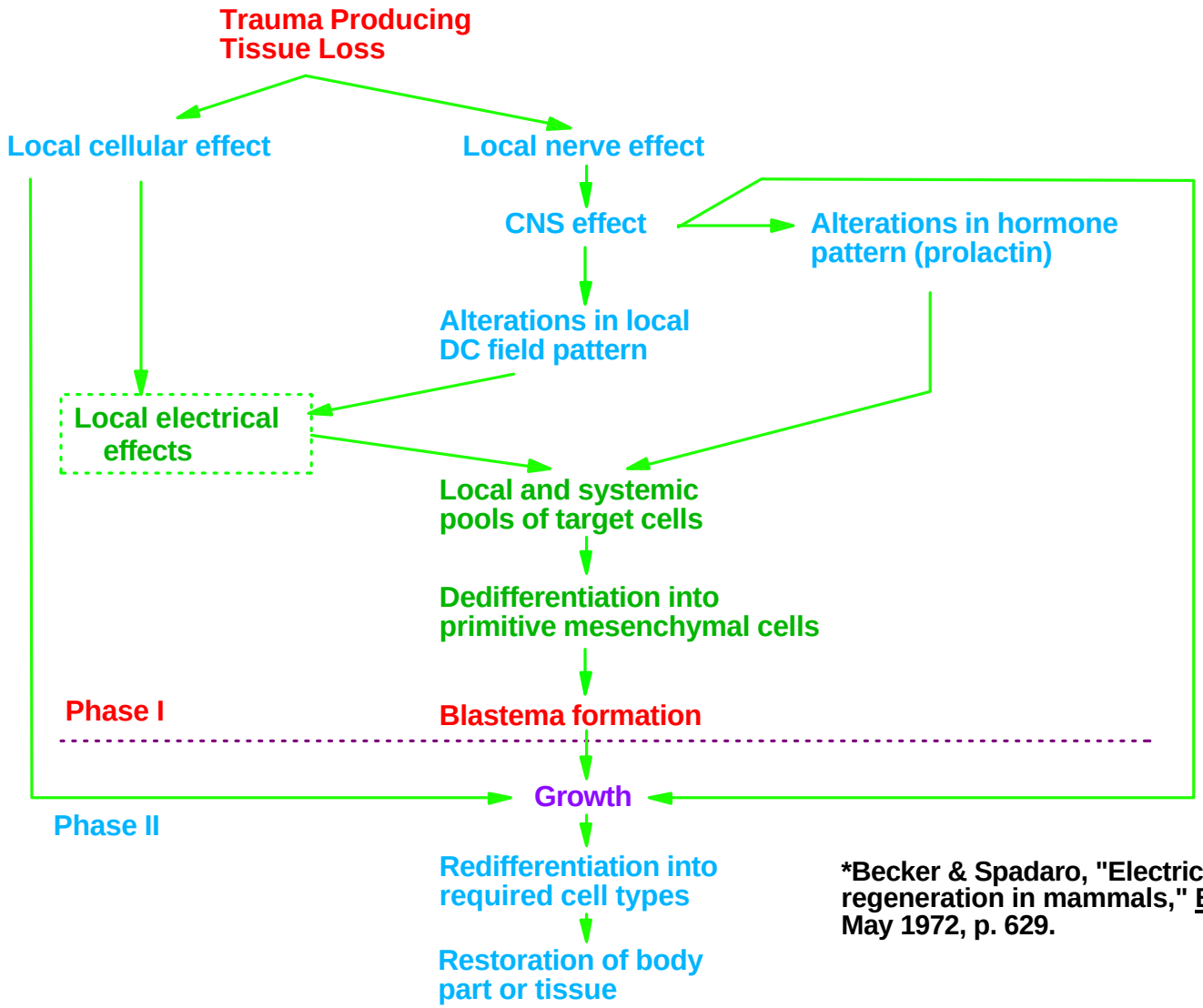

*Becker & Spadaro, "Electrical stimulation of partial limb regeneration in mammals," Bull. N. Y. Acad. Med., 48(4), May 1972, p. 629.

Extending Becker's work

- Becker had only the archaic classical electrodynamics available to him. That EM is grossly inadequate.
  - Insufficient group symmetry to model the process.
  - Already eliminates the "infolded" longitudinal wave EM that structurally and dynamically comprises all "normal" EM potentials, fields, and waves.
  - It is this internal LW EM that is manipulated and used by the cellular regenerative system.
- Nonlinear phase conjugate optics was not yet developed when Becker did his seminal work.
- Successful higher symmetry electrodynamics models -- such as O(3) -- have been developed and are available.

A sad commentary

- Becker was nominated for the Nobel Prize, but he was hounded, his funds were withdrawn, and he was forced to retire early.
- His main "sin" was having the courage to testify against the harmful effects of unrestricted powerline radiation and electronic smog.
- Powerful interests then crushed him, set up their own well-funded institutes, and hired scientists who then predictably found that powerline radiation was no problem.
- Such research is so tainted that recently several important journals have now required the authors of submitted papers to state what their affiliated companies do, and what "company massaging" of their research occurred.
- From a higher symmetry EM view, it is obvious that the dielectric pathway and quantum electrodynamics already show a significant problem due to such radiation, particularly with respect to long-term effects.
- This is particularly significant since "noise" -- the mere presence of more "hash" -- appreciably amplifies the dielectric transmission effect. So the major factor becomes EM smog *signals density*, not signal power.

Kaznacheyev's startling results

And its ramifications

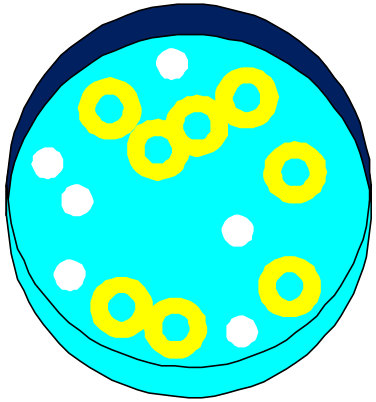

Proof that the cellular condition is radiated from groups of cells

- It follows that a diseased, damaged, or infected cell culture will and does emit its exact internal EM condition, hence the disease or damage "generatrix form" itself (in the internal structuring of the EM radiations).
- Further, these "state" emissions can couple into other targeted cells to produce disease and disorder in them.
- This was clearly proven in some 15,000 Russian experiments by Kaznacheyev.
- Kaznacheyev demonstrated induction of cellular disease and disorder between EM-coupled but otherwise environmentally shielded cell cultures
- Similar experiments have been replicated in the West by Reid *et al*., and by Popp *et al*.

Kaznacheyev's induction of cellular disease and disorder

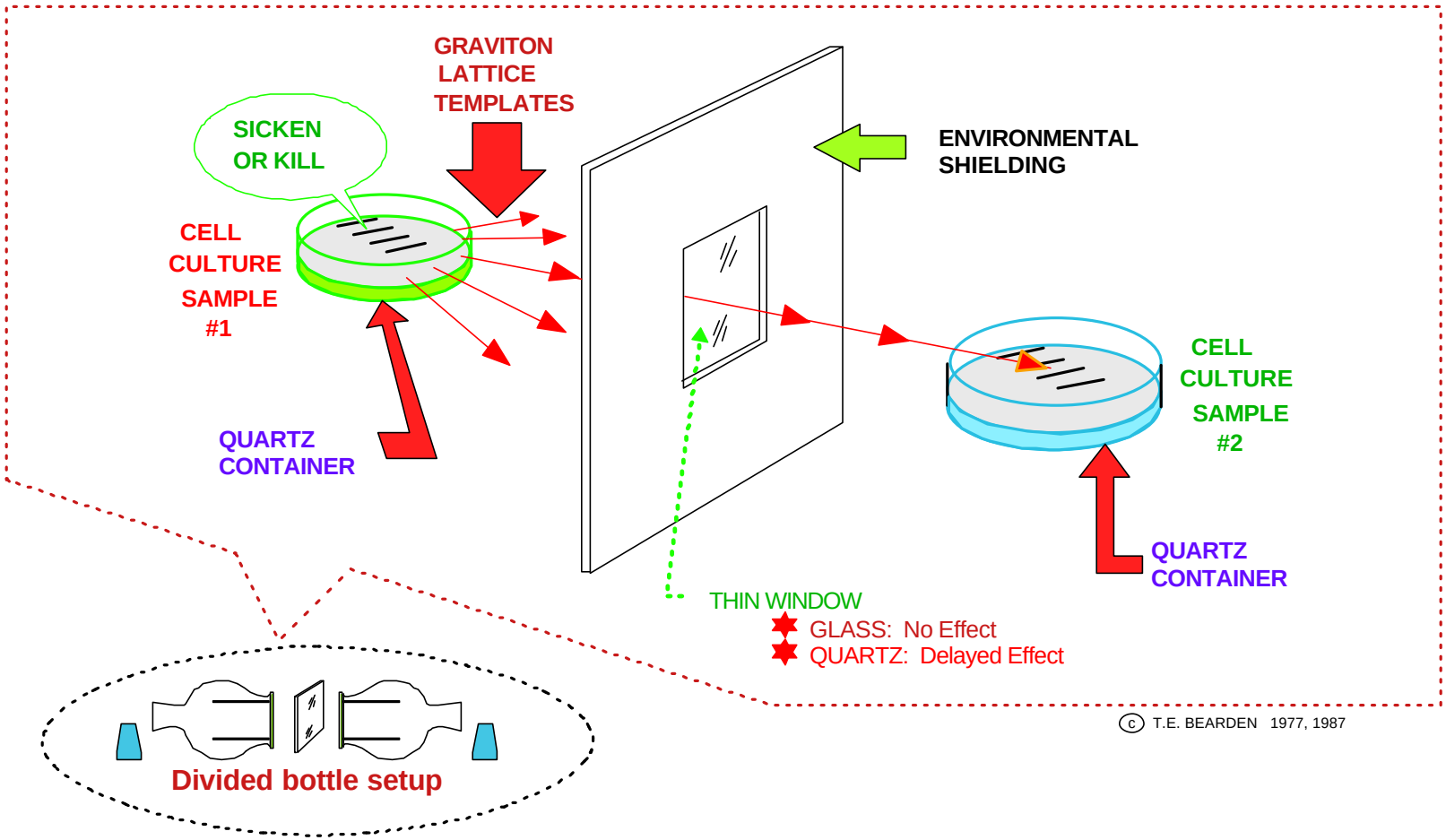

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Note: Minimum lattice is one harmonic interval: IR to UV is such a minimum G-lattice. Consider particularly the dielectric pathway in the emitting diseased cells and in the receiving targeted healthy cells.

Another surprising feature of Kaznacheyev's experiments

- The experiments do not work if the targeted cells are in normal light, such as sunlight*.
- The reason is that the normal light bandwidth occupies a single harmonic interval between ultraviolet and infrared.
- Hence its difference frequencies also fill such an interval. For a set of n frequencies, the number *d* of difference frequencies is $d >> n$.
- Thus the visible light spectrum represents "jamming" of specific internal EM signal inputs through the dielectric pathway into the body, turning much of the environmental signals into harmless warmth.

* It has also been shown that if bacteria are killed in the "dark" by UV, then 24 hours later placed in sunlight, a substantial fraction of the "dead" bacteria will revive.

Ramifications of Kaznacheyev's experimental results

- At least one harmonic interval is necessary for the effect to be evidenced in the target cells.
- Interestingly, if we assume the body dielectric to be isotropically nonlinear (to first order):
  - Velocities of the actual transmitted frequencies depend upon the particular point on the wave amplitude.
  - The transmitted frequencies overshoot, interfere, breakup, etc. The difference frequency does not.
  - The "difference frequency" is transmitted through the nonlinear dielectric medium as if it were a sine wave passing through a linear medium*.
- To our knowledge, this direct and deep communication of electronic "hash" difference frequencies in dielectric human bodies has not been investigated in the West.

* Owen Flynn, "Parametric arrays: A new concept for sonar," Electronic Warfare Magazine, June 1977, p. 107-112.

Ramifications of Kaznacheyev's experimental results (2)

- A heterodyne signal -- at the difference frequency between an input signal and a reference signal -- can be enhanced by adding noise*.
- Thus the signal of the disorder in the cellular pattern emitted from diseased cells, received by normal cells, can be amplified electronically and rather easily.
- Powerline radiation (electronic smog) thus carries its own amplification mechanism. Eventually the amplification overcomes any squelching by sunlight, etc.
- The Russians promptly (as early as the late 1950s) weaponized and tested these and similar effects.

* Dykman, M. I. et al., "Noise-enhanced heterodyning in bistable systems," Physical Review E, 49(3), Mar. 1994, p. 1935-1942

Weaponization of Kaznacheyev's findings

And its ramifications

"Microwave" radiation of the U.S. Embassy in Moscow.

Former U.S. Embassy in Moscow.

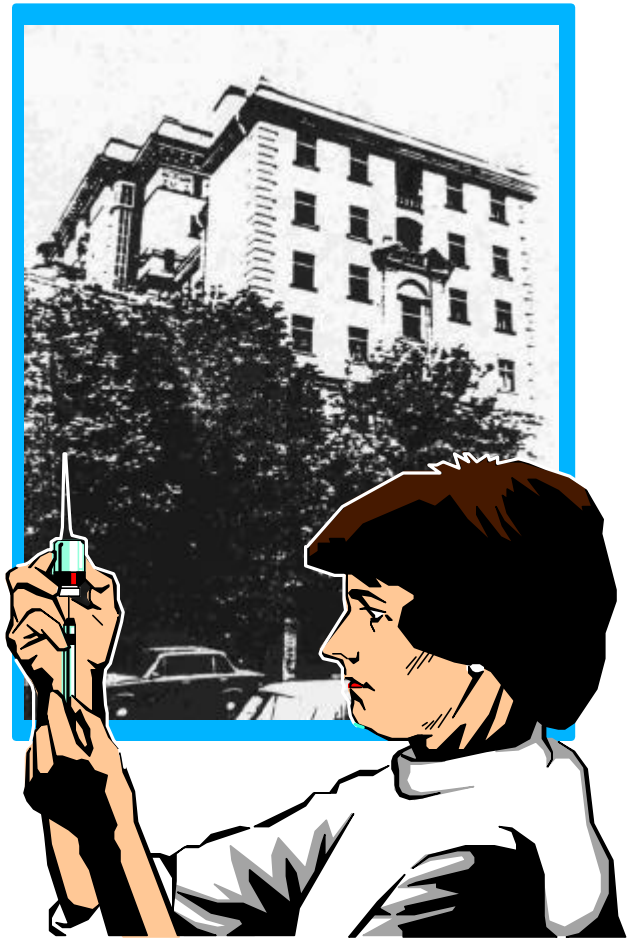

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

Ramifications of the microwave radiation of the U.S. Embassy

- The cellular disorder pattern in the EM radiation is carried by the field-free scalar potential.
- Since the disorder pattern is a "conglomerate", it must be carried by an internal EM structure existing inside the scalar potential itself.
- Whittaker decomposed the scalar potential into the appropriate internal longitudinal EM biwave structure in 1903*.

* E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Mathematische Annalen, Vol. 57, 1903, p. 333-355

The importance of time as energy, and the time-domain

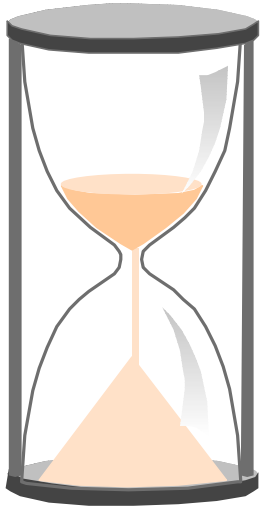

Time as energy

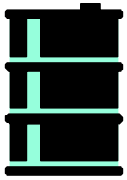
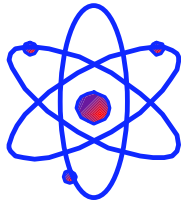

- In physics, the fundamental units one uses in his model are arbitrary.
  - A valid model can be made using only one unit.
  - It is already done in one branch of physics, using length as the single fundamental unit.
- Make a model with a single unit, the joule.
  - All other entities become functions of the joule.
  - We are familiar with mass as highly compressed EM energy, by the factor c^2.
  - It turns out that time is also highly compressed EM energy, by the factor c^2.
  - 1 sec. $\approx 9 \times 10^{16}$ joules.

How to see that "time is compressed spatial energy"

- Take some spatial EM energy and compress it by c^2
- Place it in 3-space, and it is *mass*.
- Place it on the time axis, and it is *time*.

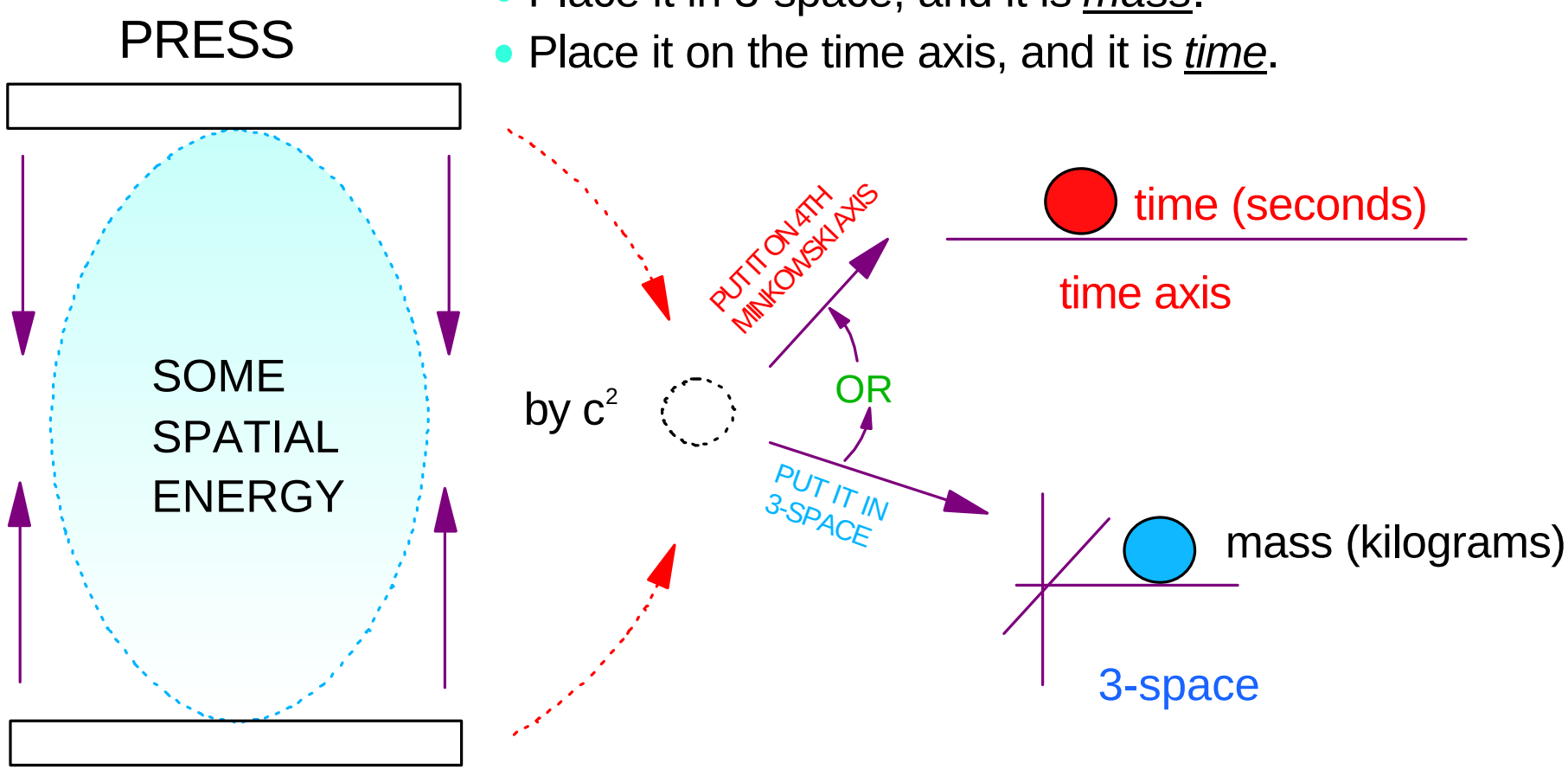

- When time-energy is converted into mass-energy, time is "decompressed" (expanded) into 3-space EM energy and 1 sec. $\approx 9 \times 10^{16}$ joules.

Time as EM energy in the time domain, with a density the same as mass-energy

- Bearden* reinterpreted (corrected) the 1903 Whittaker decomposition of the potential in 2000.
- The reinterpretation is consistent with broken symmetry in particle physics, for which Lee and Yang received the Nobel Prize in 1957.
- It is also powerfully supported by quantum field theory, notably by Mandl and Shaw in 1984**.
- Whittaker's pair is a combined time-polarized (scalar) EM wave and a 3-space longitudinal EM wave.

* T. E. "Giant Negentropy from the Common Dipole," Journal of New Energy, 5(1), Summer 2000, p. 11-23.

** F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1984, Chapter 5.

All EM energy in 3-space freely comes from the time domain

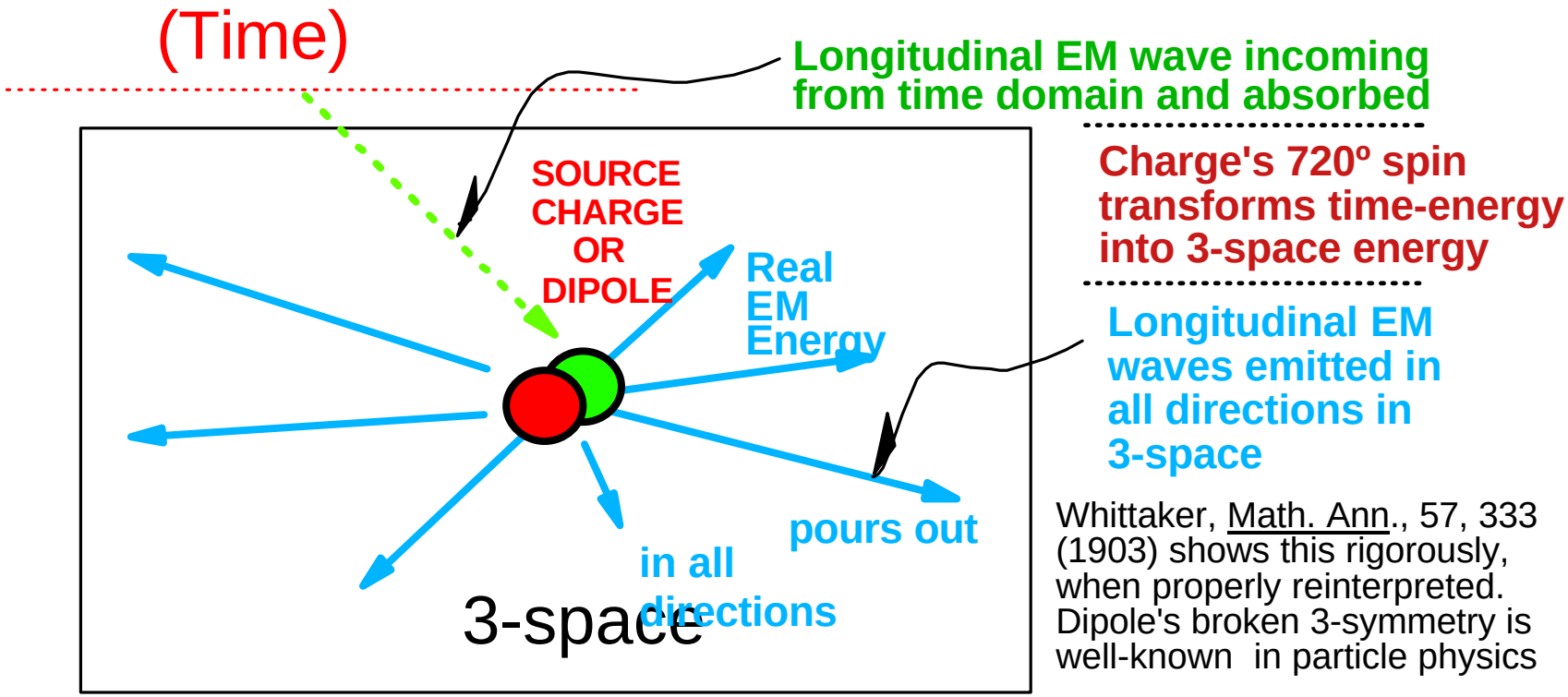

Whittaker, Math. Ann., 57, 333 (1903) shows this rigorously, when properly reinterpreted. Dipole's broken 3-symmetry is well-known in particle physics

Note: Whittaker (and others) interpreted the phase conjugate half set of LWs after interaction with the charges of the dipole, and as a 3-space *effect* rather than the time-domain *cause*. This fundamental non sequitur was just repeated since then, until corrected by Bearden to be consistent with broken symmetry and quantum field theory.

Strong support from quantum field theory

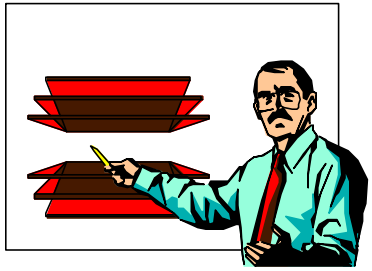

- Quantum field theory recognizes four photon polarizations:
  - Energy along x-, y-, z-, or t- axis.
  - Polarized along x- and/or y-axis, the photon is a *transverse* photon.
  - Polarized along z-axis (along its line of motion in 3-space), the photon is a *longitudinal* photon.
  - Polarized along the time-axis, the photon is a *time-polarized* or *scalar* photon.
- The individual longitudinal or scalar photon is not observable*.
- The combination of a longitudinal photon and a scalar photon is observable as the instantaneous scalar potential*.

* F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1984, Chapter 5.

Mechanism generating the flow of a mass through time

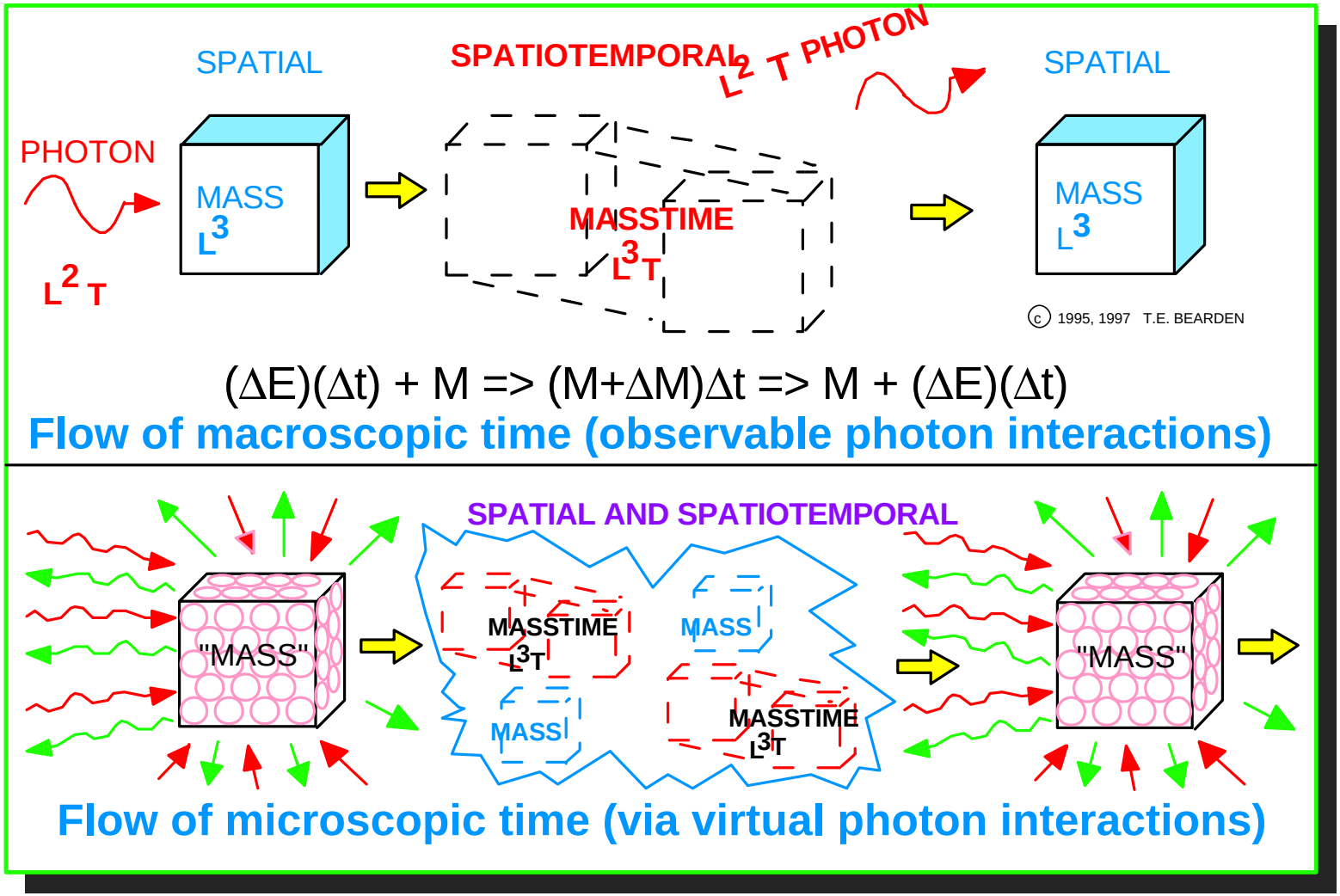

Mechanism is engineerable

Pumping a mass in the time-domain will time-reverse it back to an earlier state

- The reinterpreted biwave EM structure of the scalar potential means that time-reversal (phase conjugation by pumping in the time-domain) can be utilized to time-reverse a targeted cell (its mass-energy) in its entirety, including its genetics.
- Becker's bone fracture experiments showed it:
  - Weak scalar potential across the fracture site.
  - LWs in 3-space and time-energy waves in time
  - Red blood cells entered, dedifferentiated by shucking their hemoglobin and growing a nucleus, which is dedifferentiation (time-reversal of the cell and its mass-energy back to a previous physical state).

Principle for time-reversing a time-pumped mass

- Becker's cells then redifferentiated and changed -- first to primitive cartilage cells, then to primitive bone cells which were deposited in the fracture, healing it with new bone growth.
- This shows "time-forwarding" (redifferentiation) of the cell also.
- Becker actually showed that the *time-domain pumping* of the cells (by the time-polarized EM waves of Whittaker's reinterpreted wavepairs comprising the scalar potential), and the time-pumping of their mass-energy, operated to continuously and steadily *remove the delta between that cell's present condition and its former "normal" cellular physical condition in that area*.
- This is the long-sought secret of stem-cell research.
- Phase conjugate optics had not been born at the time. Without realizing its full nature, Becker demonstrated the body's own internal mechanism for healing, and the fundamental mechanism for time-reversing a physical mass, whether living or inert.

Mechanisms for use in medical treatment and healing

And ramifications

Successive deep penetration reactions of the cellular dielectric

- Change after change affects the cell and all of its parts, including from the external environment.
- Each successive change affects primarily the internal "LW EM structures and dynamics" comprising the ordinary potentials, fields, and waves.
- Thus in positive time the internal EM structurings produce successive "overlaid layers of change" -- so to speak -- in the internal EM structuring and dynamics of a cell in the body. These layers contain the "delta" from normal state.

Successive deep penetration reactions of the cellular dielectric (2)

- During time reversal, highest layer deltas are successively "peeled away" by the interaction of the mass-energy with the time-domain pumping.
- The result is to return the cell directly back to successive physical states, in the case of a single disease or disorder.
  - A cancer cell is returned to a normal cell prior to its "promotion".
  - An HIV-infected cell would be returned to its normal unaffected condition, free of HIV-induced genetic change.
  - For injuries and damage, the existing "delta" in each successive state-layer is steadily reduced to zero.
- This process thus can involve both cellular differentiation and dedifferentiation, as shown by Becker and by Prioré.

Engines (vacuum engines, spacetime curvature engines)

- Following Whittaker* as reinterpreted**, all normal EM fields, potentials, and waves decompose into sets of longitudinal EM waves (LWs) and their dynamics.
- Since these LWs and their dynamics are dynamics in the local energy density of spacetime (ST), they constitute *ST curvatures*.
- Hence they are general relativity infolded inside electrodynamics.
- By manipulating and changing these LWs, one manipulates and changes spacetime curvatures and their dynamics.
- The result is a unified field model where one directly controls and engineers a set of ST curvatures by use of higher group symmetry electrodynamics.
- Controlled patterns of local curvatures of ST are called "vacuum engines" or "spacetime curvature engines" -- or just "engines".

* E.T. Whittaker, Math. Ann., 57, 333-355 (1903); Proc. Lond. Math. Soc., Series 2, 1, 1367-372 (1904).
** T. E. Bearden, J. New Energy, 5(1), 11-23 (2000).

Pumping with EM time-polarized waves forms *amplified* antiengines

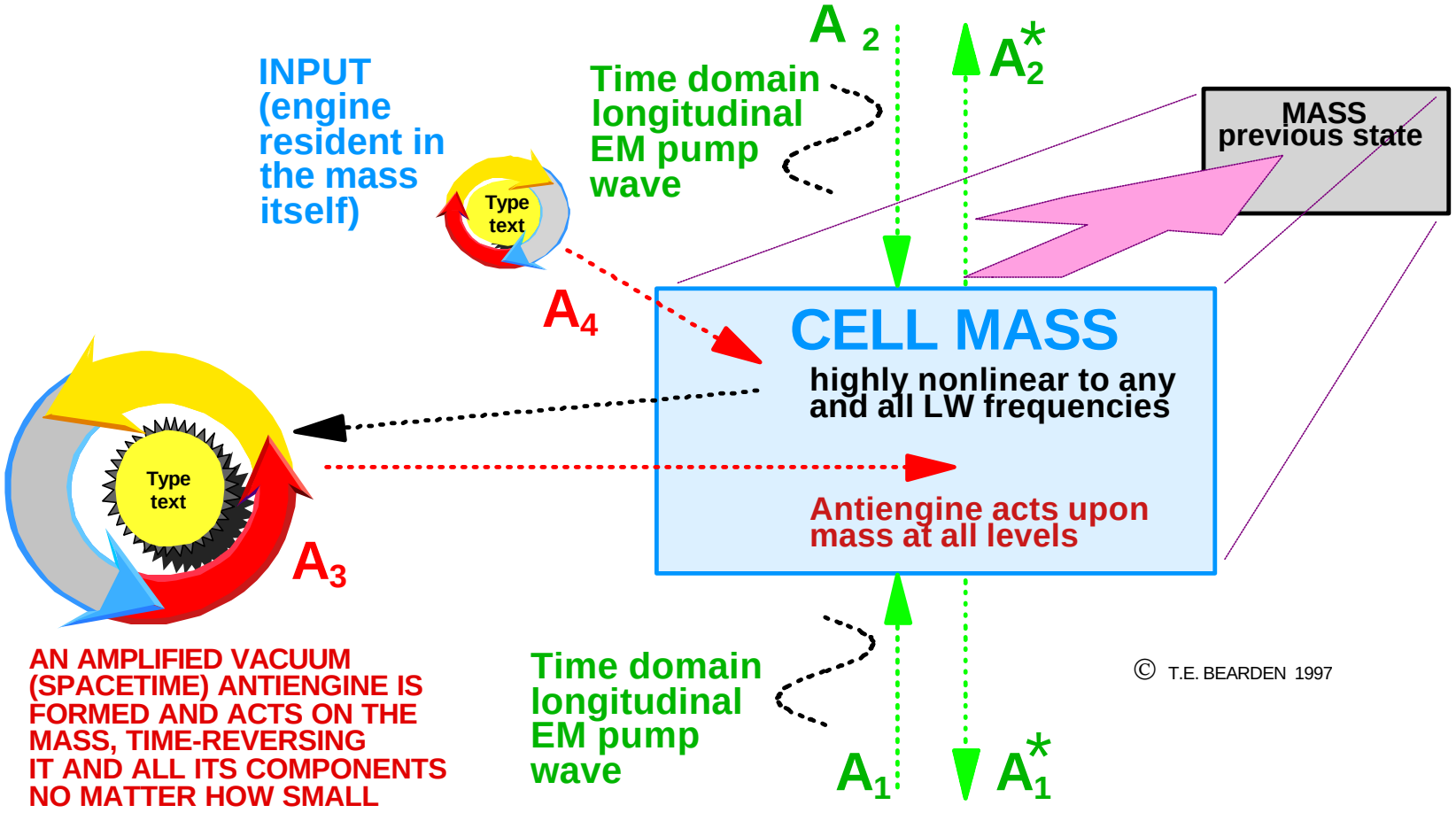

AN AMPLIFIED VACUUM (SPACETIME) ANTIENGINE IS FORMED AND ACTS ON THE MASS, TIME-REVERSING IT AND ALL ITS COMPONENTS NO MATTER HOW SMALL

© T.E. BEARDEN 1997

A DRAMATIC EXTENSION TO NONLINEAR OPTICAL PUMPING

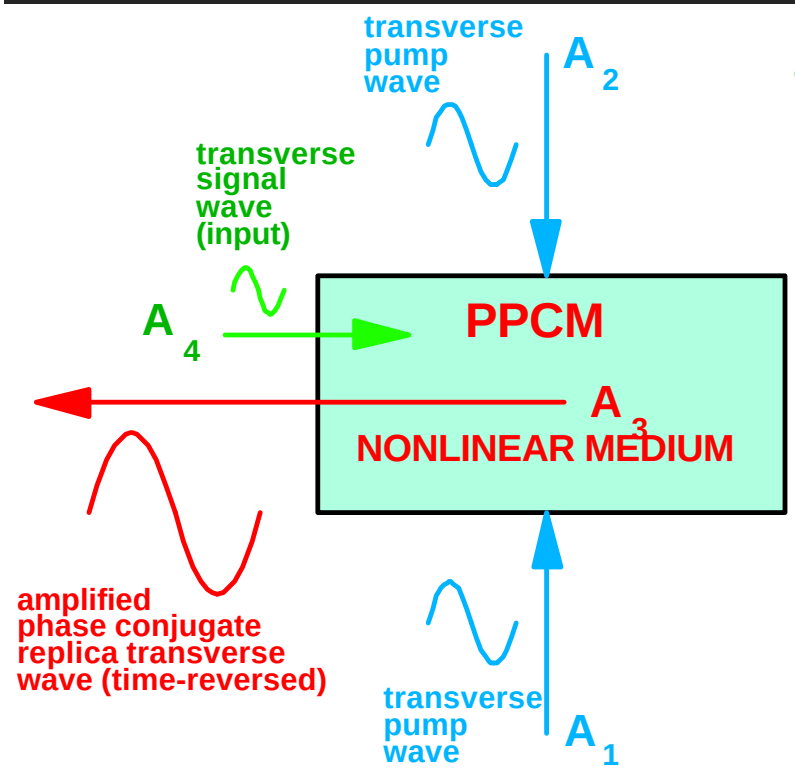

a. Pumping with transverse EM waves produces a time-reversed *wave*.

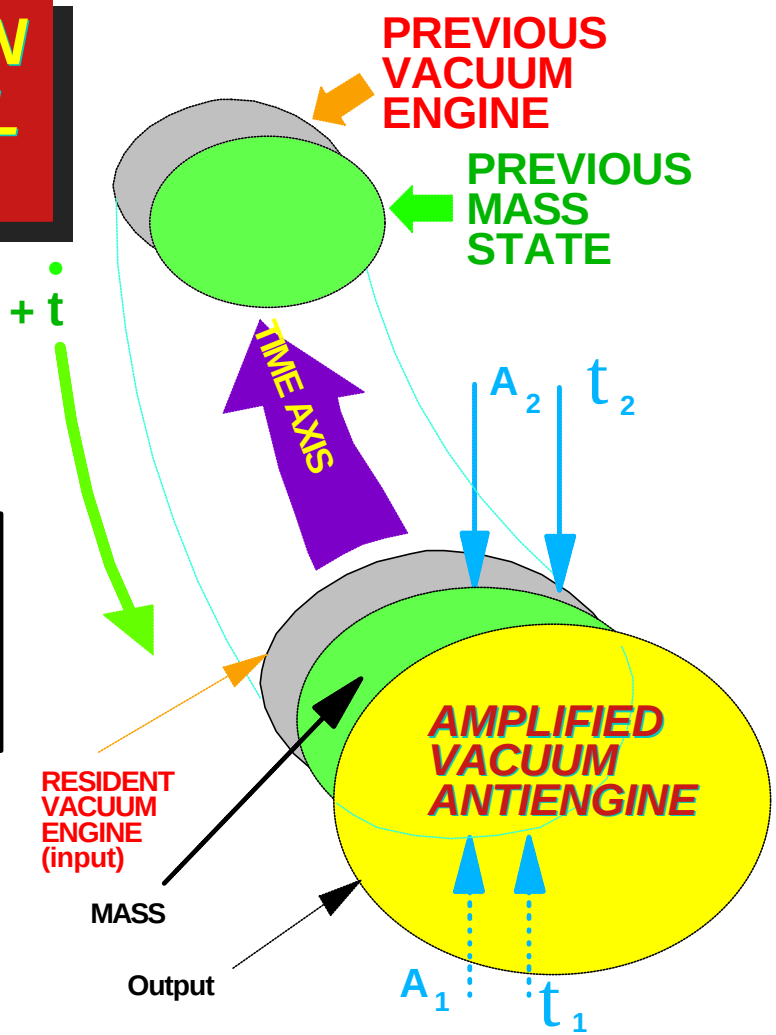

b. Pumping with longitudinal EM waves A_1 and A_2 time-reverses *the mass itself*.

Time-reversal of a mass to a new physical state not in its past

- Original engine A'
- New engine B' added
- Time-pumping moves to new "past" that is determined by (A'+B')

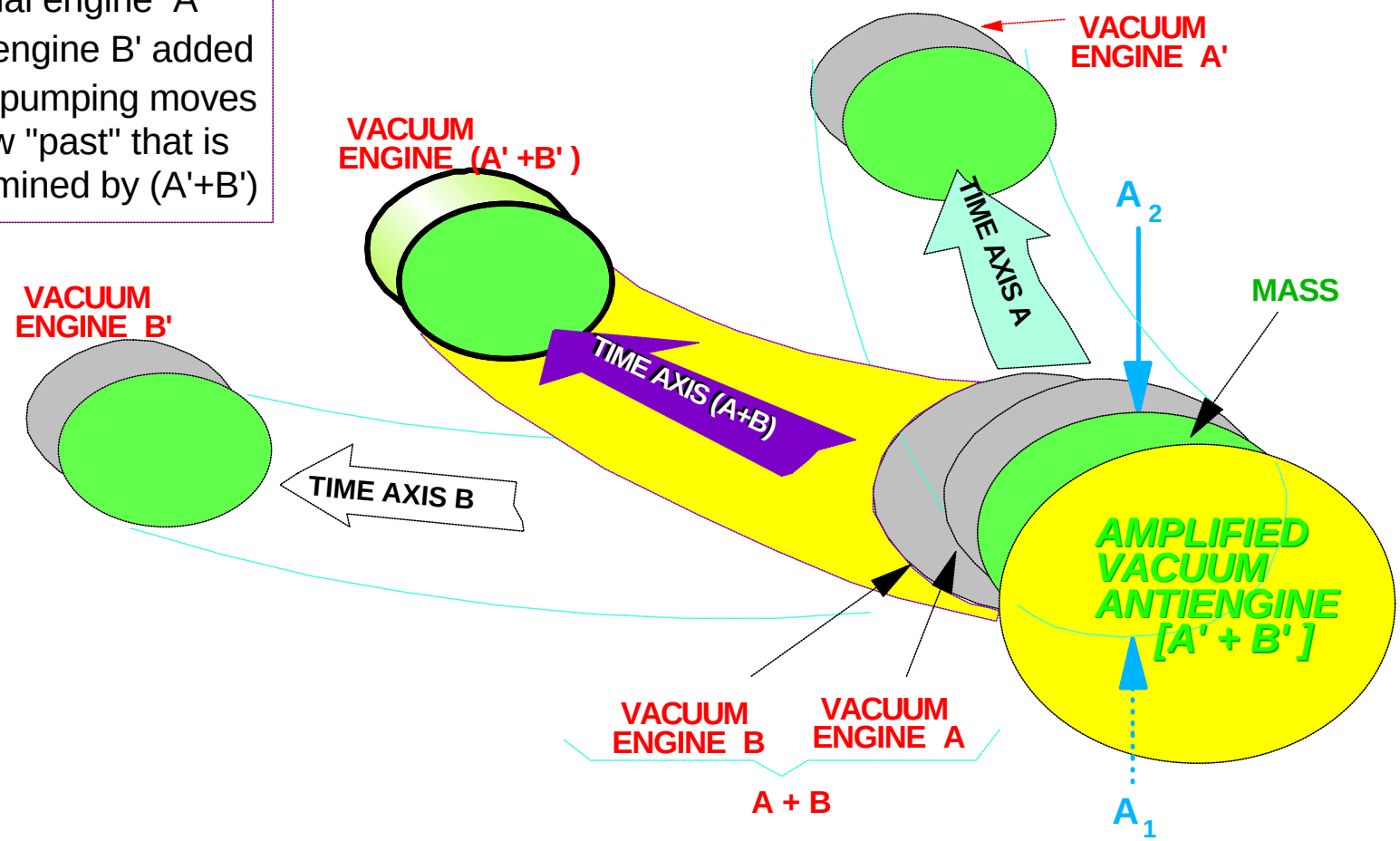

Extended general relativity principle

- All levels of energy structures and all levels of time structures mold spacetime geometry.
- The "pattern" is called a *template* for a vacuum engine (spacetime curvature engine).
- Spatial and temporal structurings of the engine act upon any exposed mass at all levels.
- This produces a template of forces, for precise translations and stresses within the mass at all levels. The forces exist in both time and 3-space.

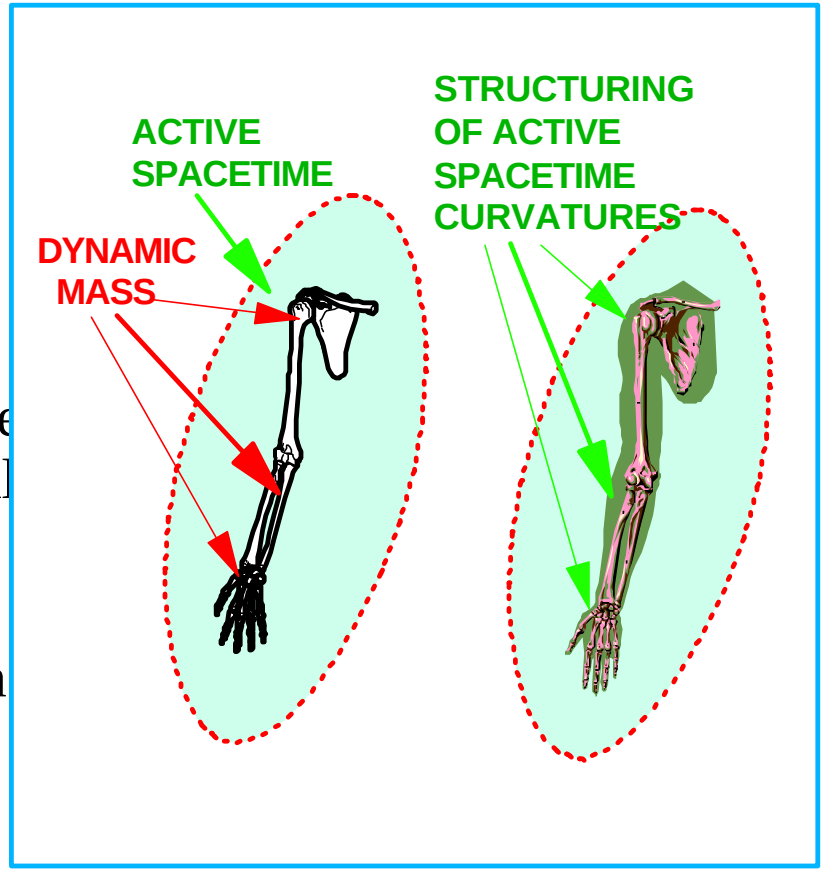

Engines: Working spacetime demons

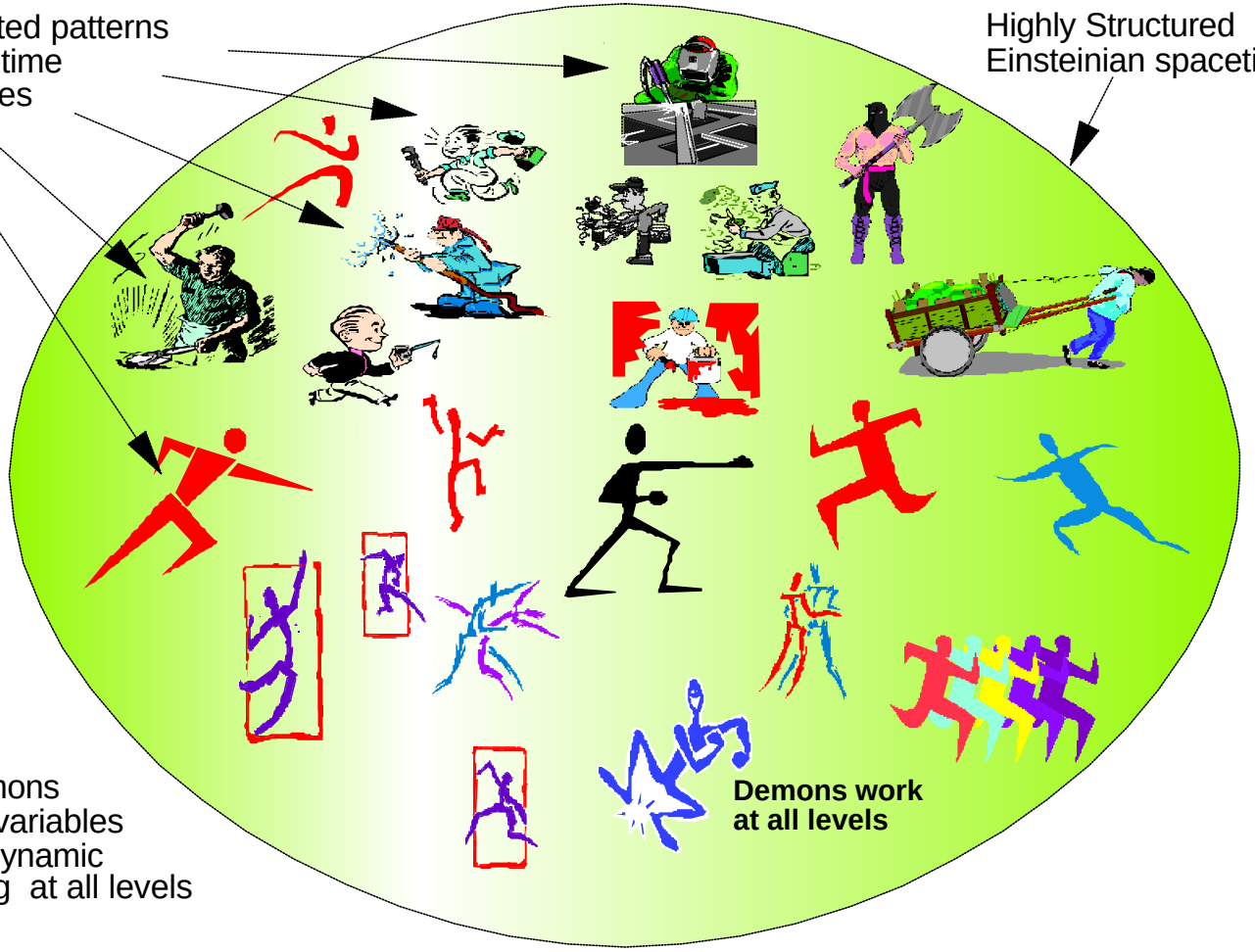

Maxwellian Demons
are EM hidden variables
organized into dynamic
structures acting at all levels

Signal vs. vacuum engine

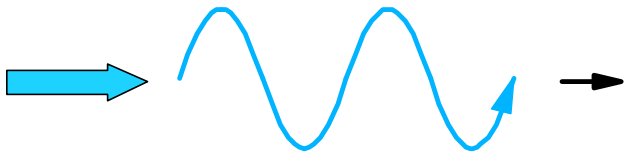

SIGNAL (INFO)

- ★ Information received
- ★ Any overt physical action must be taken by cell itself
- ★ Cell must furnish the energy for any action it takes
- ★ Passes from outside to in

A. ***Cell must do the action itself; vacuum energy exchange is passive. Energy or fuel for doing the action must be added to cell externally.***

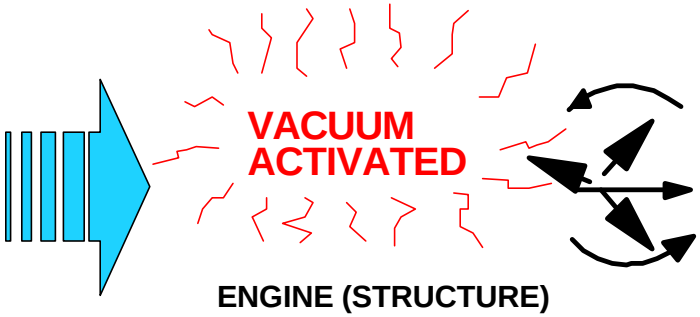

ENGINE (STRUCTURE)
TEMPLATE (FORM)

- ★ Information itself acts
- ★ Local spacetime curved, with internal subcurvatures
- ★ Produces template of forces in local spacetime (ST)
- ★ Arises from within local ST
- ★ Acts on and changes all parts of cell, including its genetics

B. ***Cell is acted upon; vacuum energy exchange does the specific action. No energy or fuel for doing the action need be added to cell externally.***

Unified field theory requires modeling and use of supersystem

Three components interact with each other:

- System and its dynamics
- Local active vacuum and its dynamics
- Local curvatures of spacetime and their dynamics.

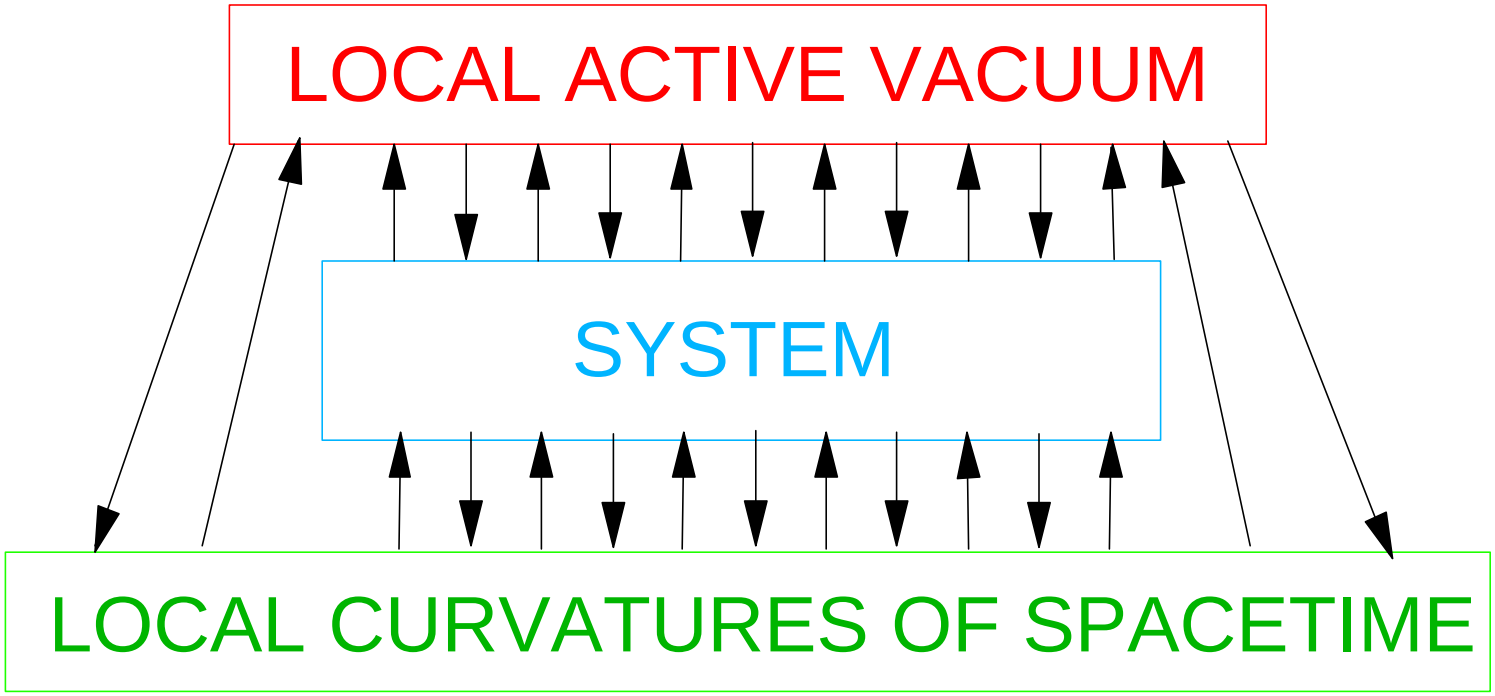

Classical EM kills the supersystem, prevents supersystem engineering

- Assumes flat local spacetime
- Assumes inert vacuum

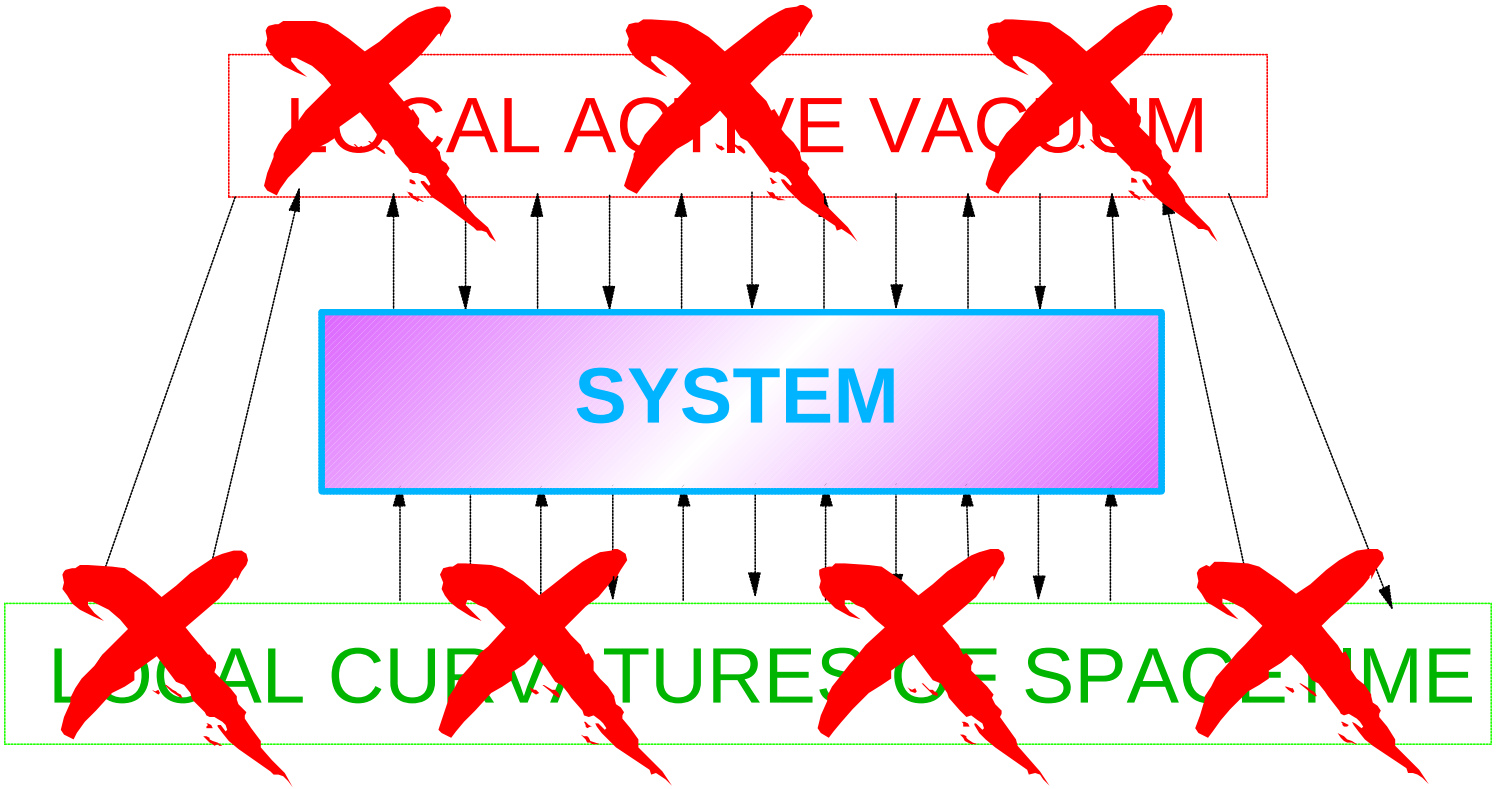

Malignant teratoma exhibits both time-reversal and fast-forwarding

- A teratoma cell is a tumor cell that has reverted to stem cells, then proceeds to differentiate toward new kinds of normal cells.
- May produce hair, skin, muscle, heart, bone, and other type cells.
- Sometimes present at birth.
- Demonstrates both "time-reversal" and "time-forwarding".
- The missing key is the engine function(s).

Miller-Fox-Urey biogenesis experiments

- Engines of and from all life forms ever on earth or in the universe exist in the ambient vacuum potential.
- The Miller-Fox-Urey experiments were not in a "sterile" environment.
- Heat (IR) and UV constitute (1) a harmonic interval with a difference frequency, and (2) amplifying by the process previously shown.
- These experiments "kindled" previously living forms from the available gases etc. by amplifying the ancient living engines from their virtual state to the observable state, so that the masses were molded into the physical states of their templates.

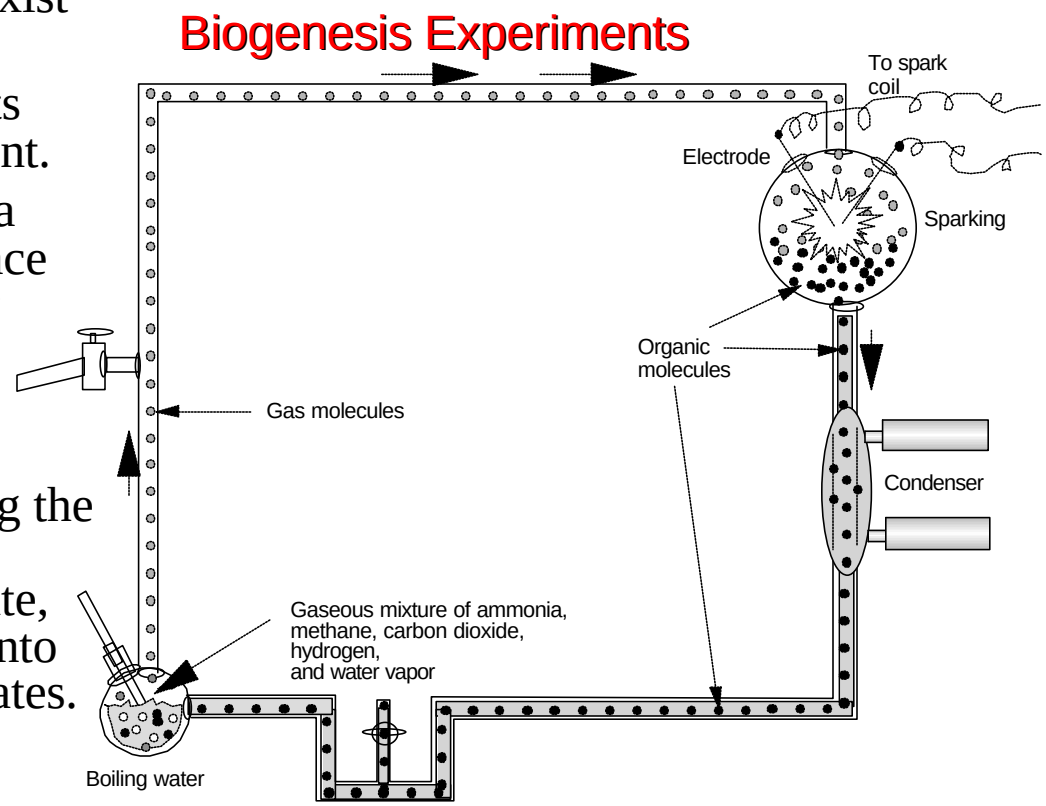

Cloning to produce stem cells

- Human DNA can be inserted in an animal cell, and the cell chemically tricked into proceeding as if fertilized.
- Formation, increase, and growth of stem cells begins and continues.

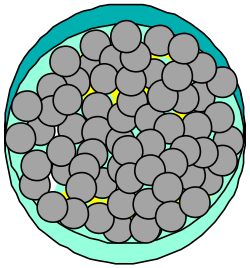

- The "engine" carried by the human DNA is changing the matter available into human cells.
- readily demonstrated experimentally.

Regeneration in a strain of rat with part of its immune system missing

- In mammals, the immune system plays a role in reducing the regeneration capability, compared to that of more primitive systems.
- In a strain of rat where that "suppressive" part of the immune system is missing, the regenerative capability is dramatically increased.
  - Can regrow cut away sections of tail.
  - Regrows plug cut out of ear.
  - Reconnects severed optic nerve.
  - Partially restores severed spinal cord.

- The suppressive "delta" engine of the immune system, operating simultaneously with the underlying primitive regenerative engine, sums to the modern much-reduced regenerative engine in the mammal.

An observation for the future

- When the science of engines is developed, physicians will be able to tailor these engine combinations to restore severed human spines, regrow severed limbs, etc.
- They will also be able to direct the body's "normal growth" to reduce and direct birth defects, genetic defects, etc.

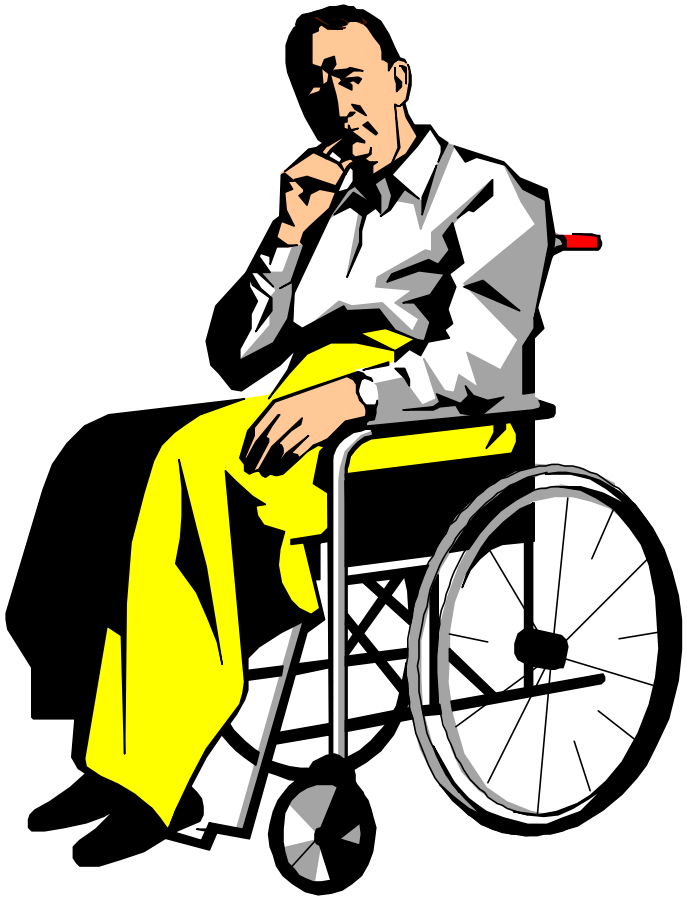

Biochemistry and EM models

- Medical scientists analyze such things as teratomas in terms of biochemistry and the biochemical model.
- An assembly of charges and charge distributions, with their associated fields and potentials, drives all chemistry at base level.
- The charge assembly and its dynamics involves a corresponding assembly of spacetime curvatures and their dynamics. These are *the cause that is driving the charge assembly and its dynamics, and therefore the chemistry*..
  - In unified field theory (such as that of Sachs) and O(3) electrodynamics.
  - Not in classical U(1) EM theory or quantum electrodynamics.
- Conventionally a causative EM field in space is "defined" as the *diversion from* that spatial field by and after its interaction with charge).
  The "definition" substitutes the effect for the cause, a non sequitur.
- This is a known major flaw, pointed out in one fashion or another by many physicists such as Wheeler and Nobelist Feynman.
- Classical EM theory is a 137-year-old model, seriously flawed. These flaws emerge in biochemistry and medical science.

Necessary EM corrections*

- Many of the corrections necessary in electrodynamics modeling either have been done or are underway.
- Higher symmetry, non-Abelian electrodynamics models have long been developed in particle physics.
- The new approach extends these models to also incorporate general relativity, thus producing a unified field theory*.
- In the new approach, spacetime curvature engines are perfectly natural and understandable, and can be directly modeled and engineered by advanced theorists.
- In short, the theory is sufficiently advanced and robust that technology and engineering can now advance.
- This will be a great leap forward for biochemistry and medical science, particularly in therapeutic methods.

* Sachs's unified field theory implemented by O(3) electrodynamics presently is the most suitable to use. Numerical methods are required.

Prioré's revolutionary results in lab animals

And its ramifications

Prioré (right) makes a point to Chaban-Delmas, Mayor of Bordeaux

- Many of the Prioré team's experiments were done in Bordeaux.
- Antoine Prioré patents:
  - "Apparatus for producing radiations penetrating living cells," U.S. Patent No. 3,368,155, Feb. 6, 1968.
  - "Method of producing radiations for penetrating living cells," U.S. Patent No. 3,280,816, Oct. 25, 1966.
  - "Procede et dispositif de production de rayonnements utilisables notamment pour le traitement de cellules vivantes," [Procedure and Assemblage for Production of Radiation Especially Serviceable for the Treatment of Living Cells], Republique Francais Brevet d'Invention P.V. No. 899.414, No. 1,342,772, Oct. 7, 1963.

Block diagram of Prioré's method

Time-reversing the cells back to normal state

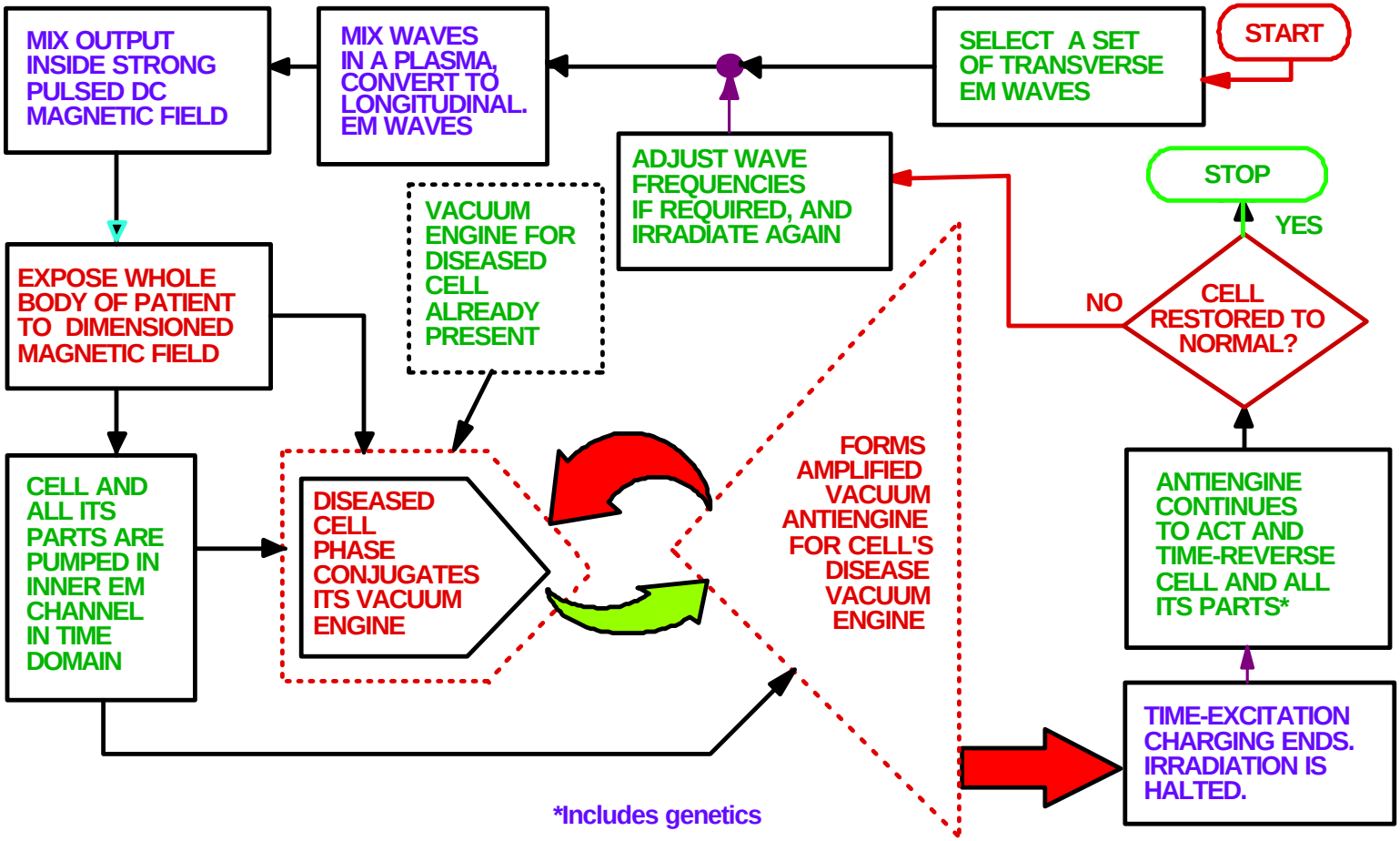

*Includes genetics

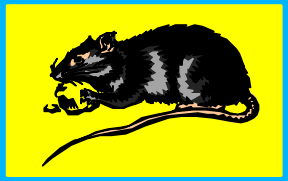

In Laboratory Animals:

Prioré Team Cured

- **Terminal malignant tumors**
- **Clogged arteries (atheriosclerosis)**
- **Suppressed Immune Systems**
- **Infectious trypanosomas**
- ***Results were presented to French Academy of Science by Robert Courrier, Director of the Biology Section of the Academy***
- ***<u>No one understood the mechanism!</u>***

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Some peculiar results by the Prioré team

- Once a rat is cured of a particular disease:
  - A single drop of blood from the cured rat, injected into another rat stricken with same disorder, would result in the injected rat getting well slowly.
  - This ability to transfer immunity and healing in the extracted drop of blood gradually decayed over a period of a few weeks.
- Showed that even the fields and potentials in the blood had been altered internally, in the treated animal.
- Showed that the injected animal's cellular regenerative system possessed the ability to also time-domain pump over the entire body, everywhere reducing the delta between that injected drop of blood now the rat's own, and the rest of the blood in its body.

Proof of cellular time-reversal

- Pautrizel compared identical treatment of immature rats with immature immune systems, and mature rats with mature immune systems.
- Treatment restored the damaged mature system back to full mature functioning, and it promptly recognized and dispatched the pathogens.
- Treatment restored the damaged immature system back to full immature functioning, unable to cope, and the pathogens promptly reinfected and killed the immature rat.
- The lesson: The body is indeed returned to a previous physical state. The pathogens themselves are not killed by the treatment, but by restoring the ability of the immune system to recognize and destroy them.
- Only the *previous ability* of the immune system is restored by the process.

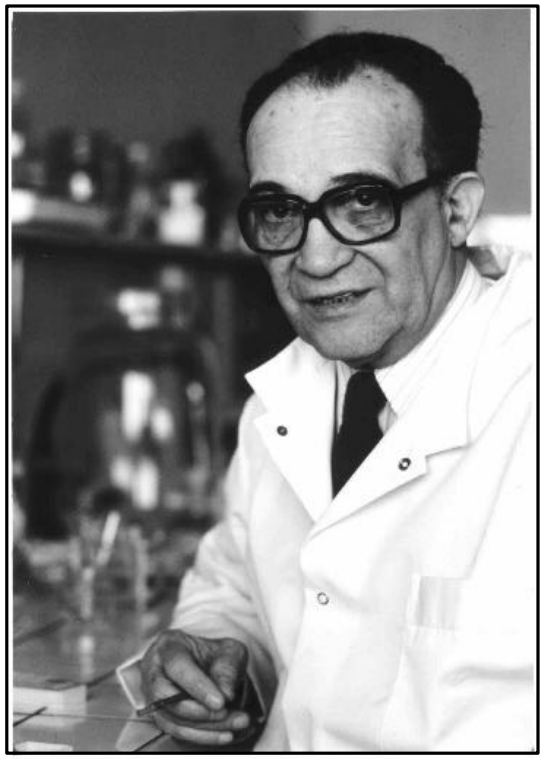

PROF. RAYMOND PAUTRIZEL
(Renowned Parasitologist)

Disadvantages of Prioré method

- Large plasma tube and facility required.
  - 3-stories high building bay if to treat humans.
  - Long irradiation time (2-3 hours).
  - Slow, numerous experimental adjustments.
- Fundamental mechanism was unknown.
  - Phase conjugate optics not yet born in West.
  - No higher symmetry EM modeling used.
  - Prioré thought it was a result of ionization.
  - Importance of difference frequency unknown.
  - Body dielectric transmission path unknown.

3-Story high Prioré device for treating humans

- At the end of the project, Prioré had developed a large unit to treat humans.
- A few were treated.
- Cures replicated what had been done in lab animals
- The massive size of the unit and long treatment time (hours) made the process bulky and very inconvenient -- and also expensive

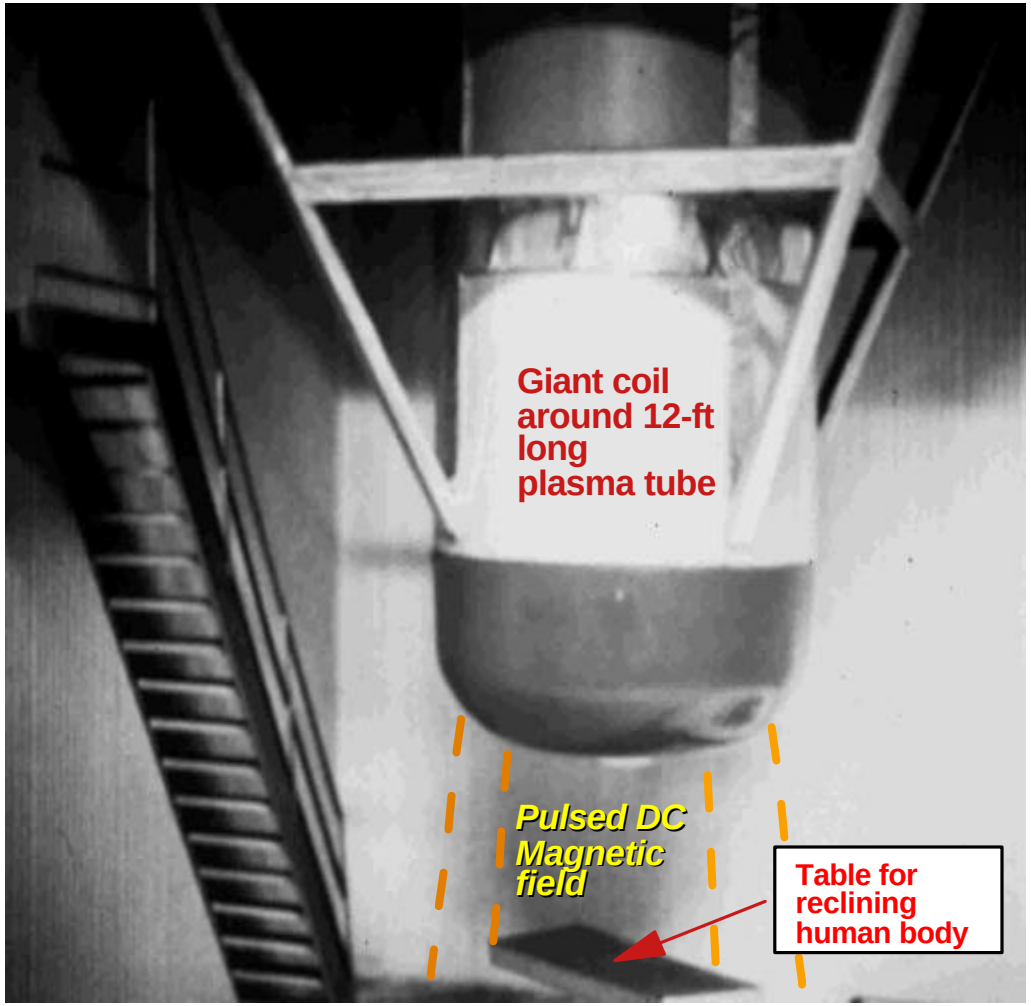

17-foot Prioré plasma tube

Used in large machine (3-stories high) to treat a limited number of human patients

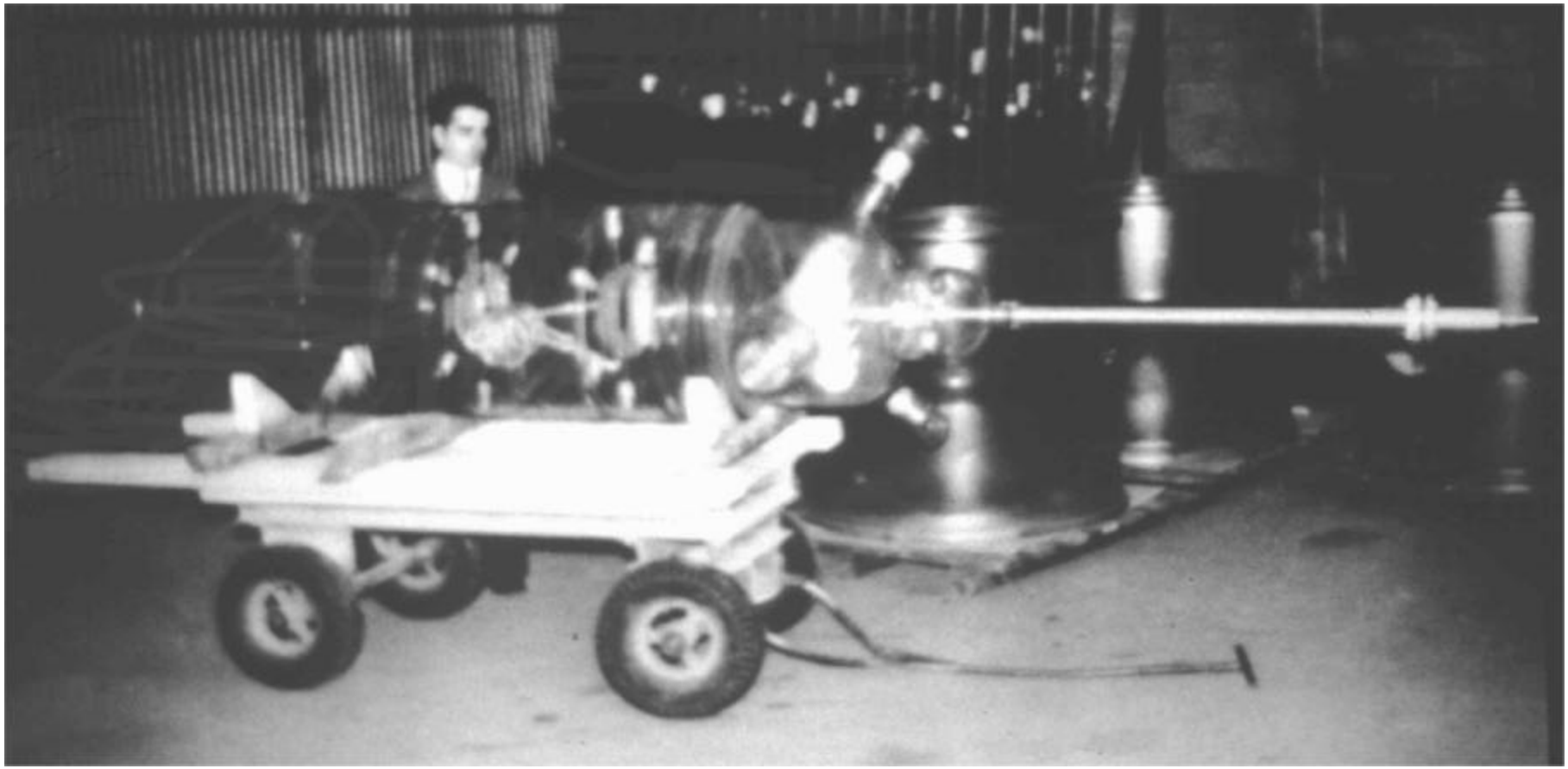

A proposed new mechanism for cancer promotion

And its ramifications

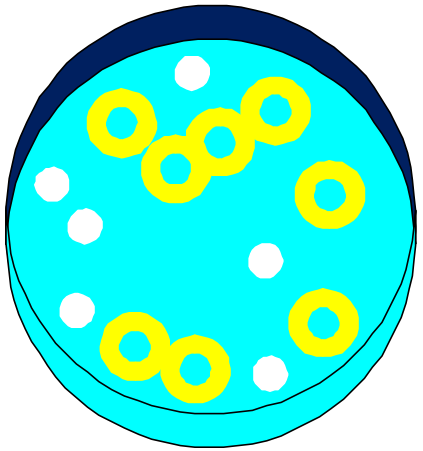

Remarks on cancer from a new perspective

- Two stages: cellular damage and promotion of the damaged cell to a tumorous cell. Promotion presently is poorly understood if at all.
- A master cellular control system (MCS) (studied by Popp et al.) controls both the immune system and the cellular regenerative system, as well as normal functions of the cells.
- The "past history" of ancestral development of aerobic cells and higher multicell aerobic bodies on planet Earth, resides in the "internested engine layers" in every tiniest part of the entire body dielectric, and in all cells.

Remarks on cancer from a new perspective (2)

- Faced with cell damage (such as sustained hypoxia) it cannot handle, the MCS continues to "peel the layers" in taking actions related to ever more distant pasts.
- Faced with continuing hypoxia, e.g., the MCS eventually reaches ancestral layers -- with an engine -- it forces the damaged cells to start moving back toward the original primeval anaerobic form.
- The first step backward is *separation from central growth control*, freeing the cell to multiply independently. At the same time, genetic changes in the cell are forced and produced, starting it back toward becoming an anaerobe.
- These actions comprise the *promotion process*.

The promotion process via engines

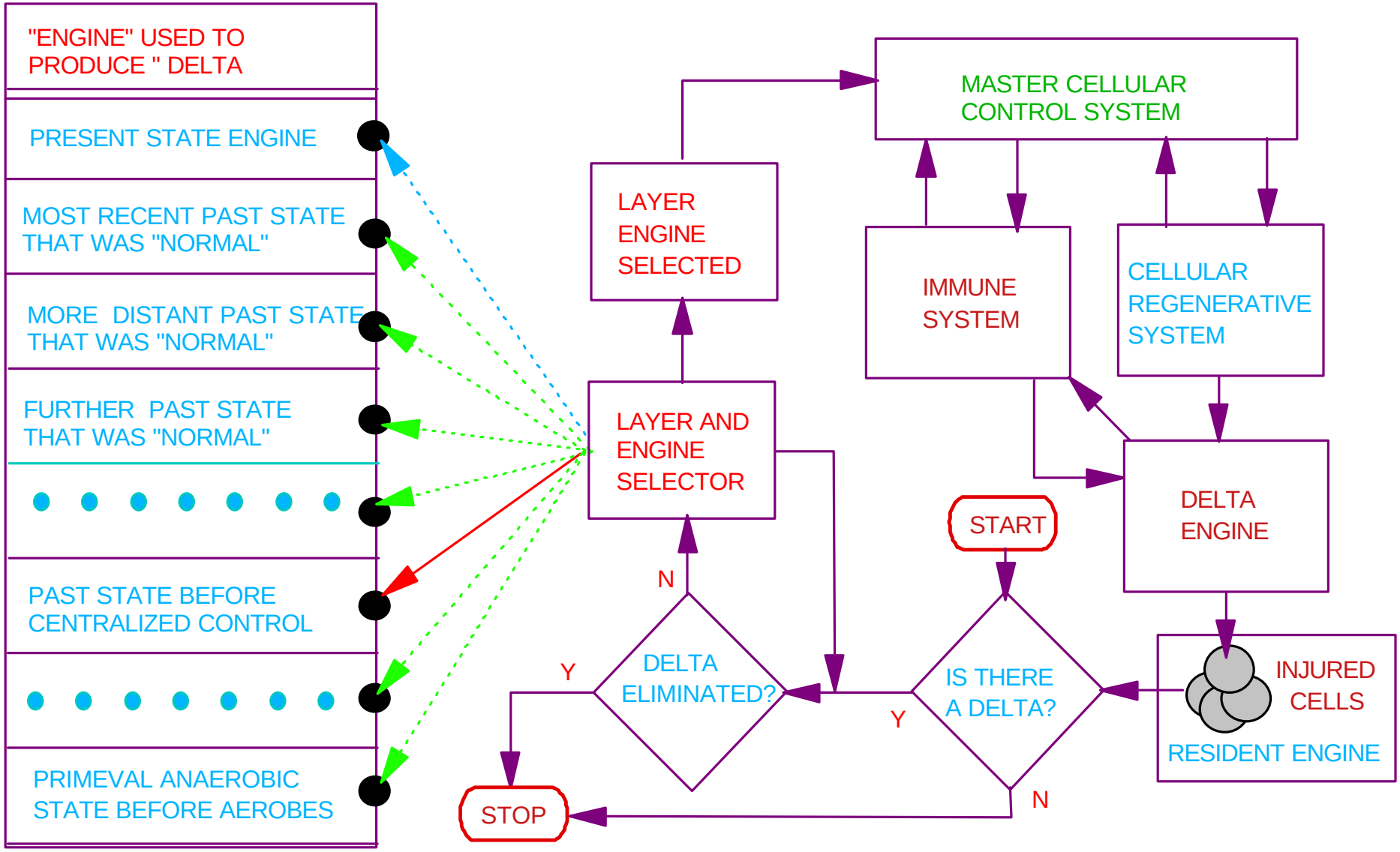

Evolution of aerobic systems

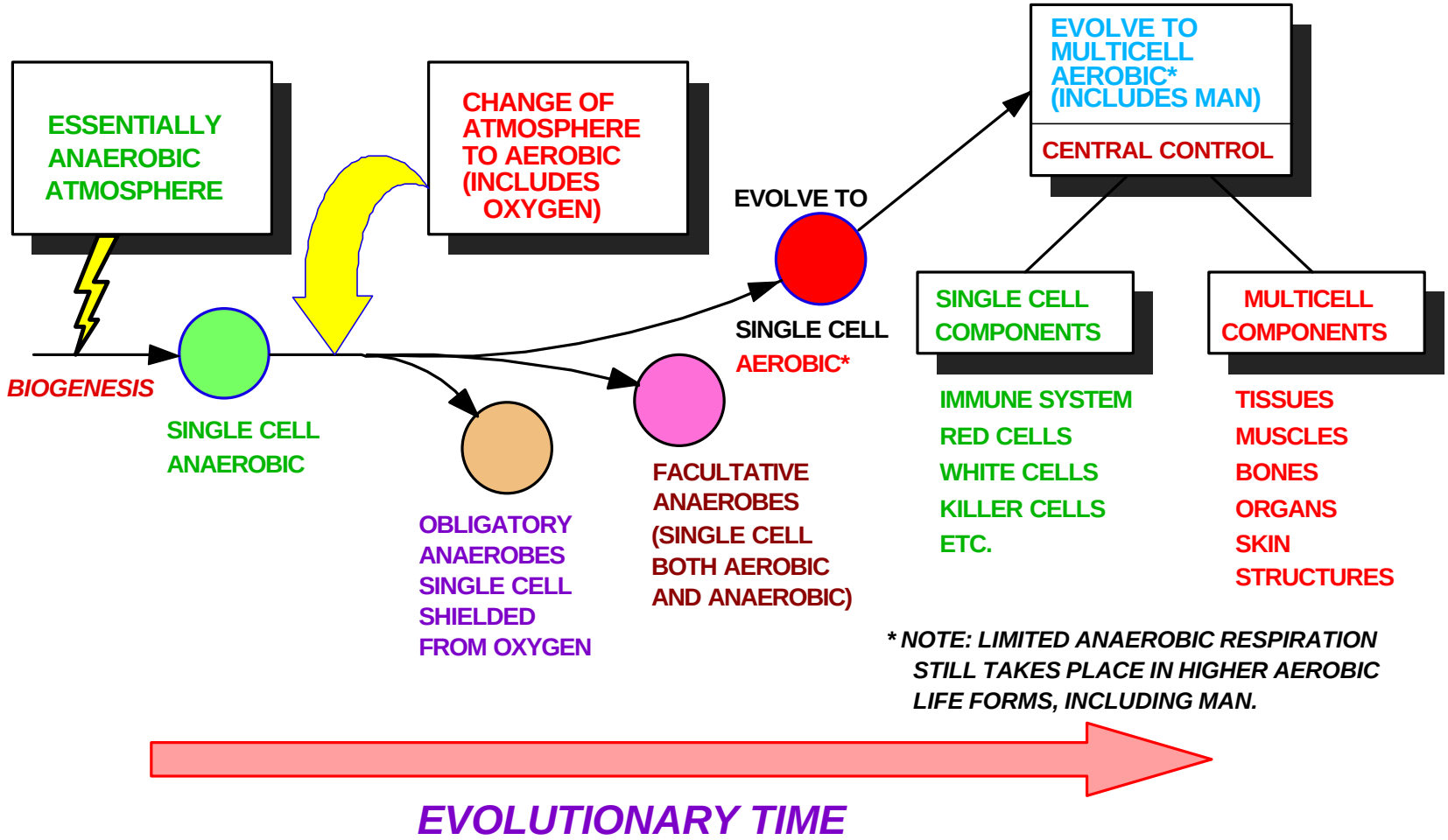

First step in self-promotion of cancer due to hypoxia

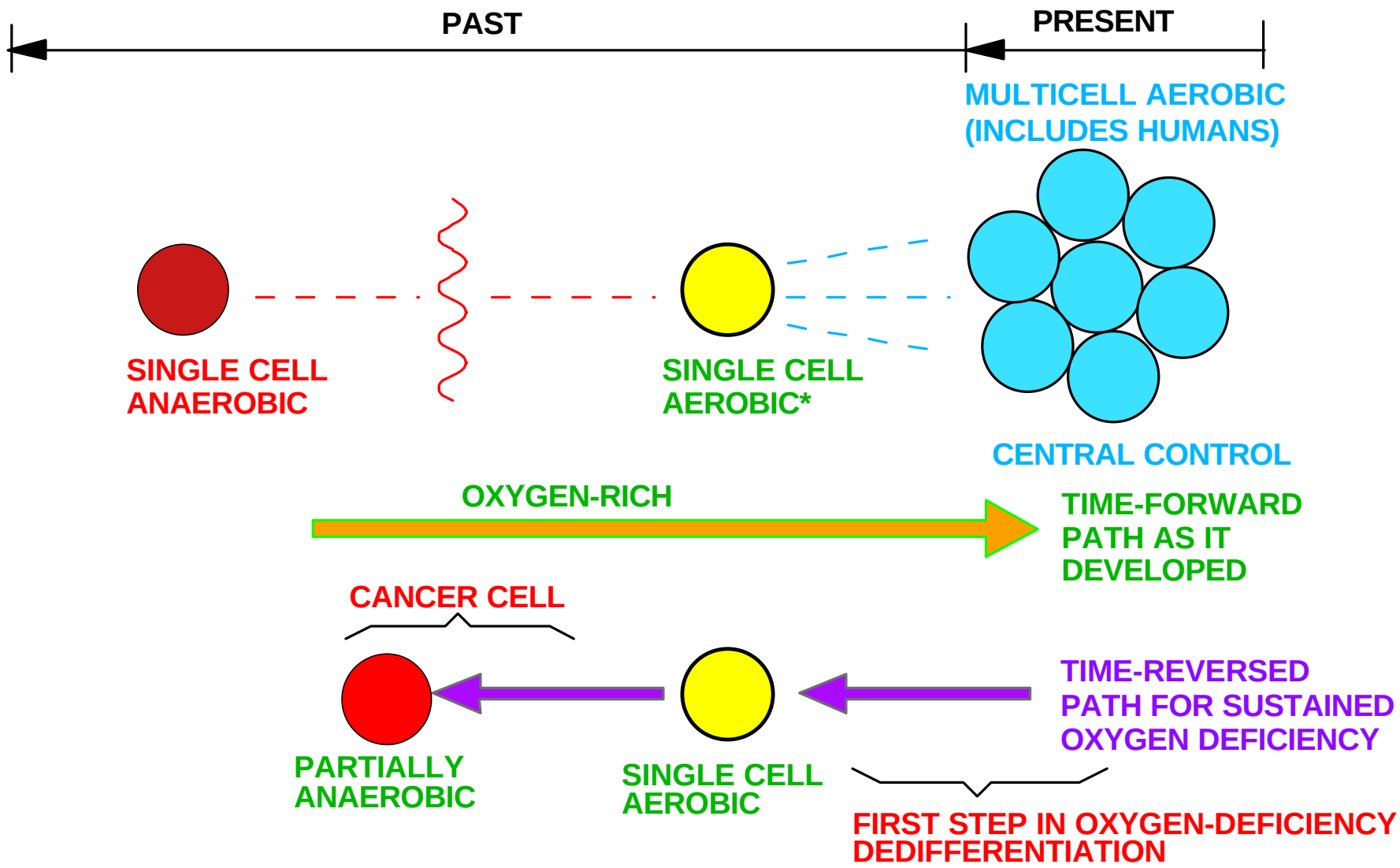

Block diagram of the cellular regenerative system

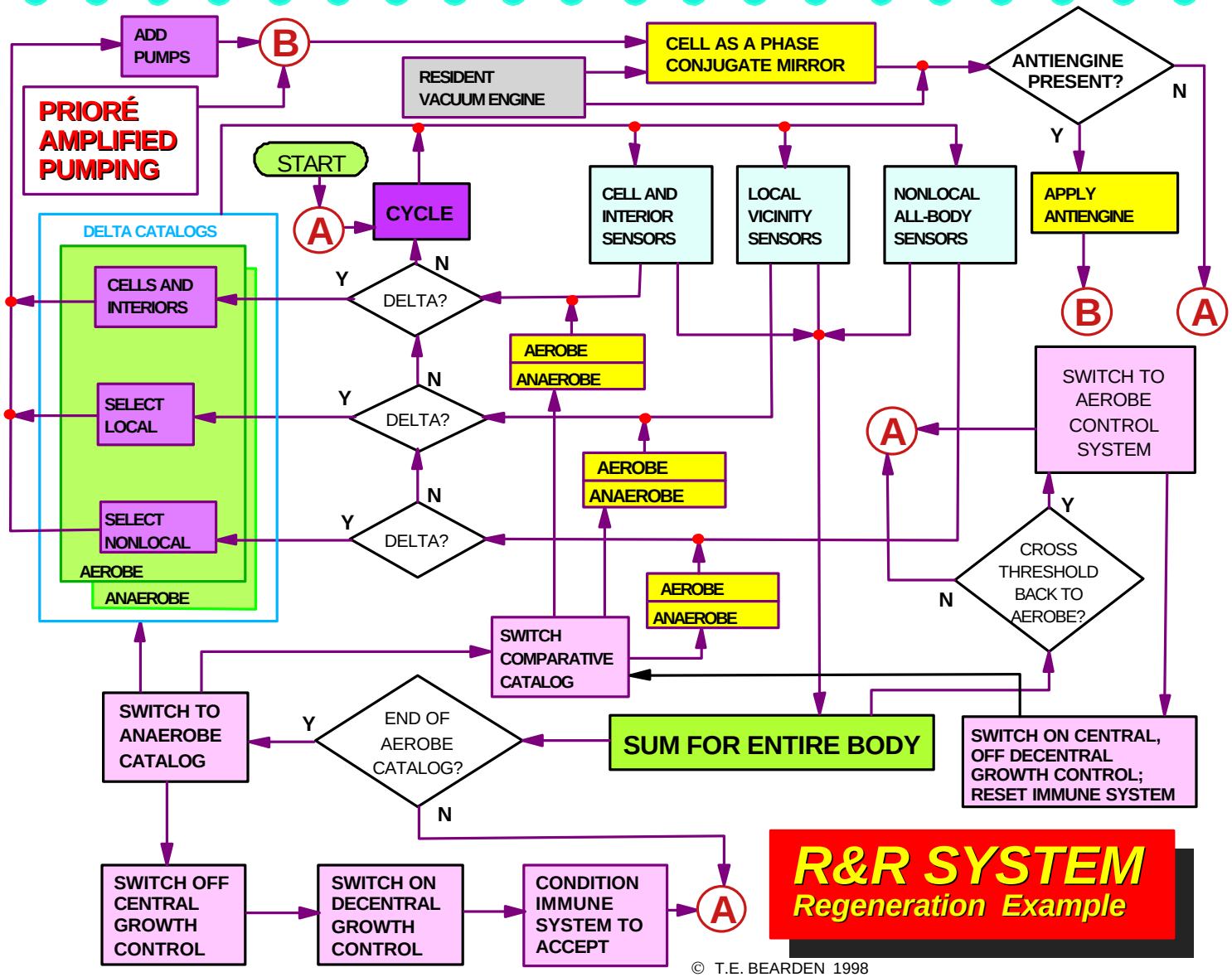

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Bombshell: Amplified EM healing

- A unified field theory approach and use of supersystem analysis has broken the basic mechanism for healing itself.
  - The Sachs unified field theory applies and has been partially fitted.
  - Evans-Vigier O(3) electrodynamics can properly model it, including both the internal and external electrodynamics and effects of engines.
  - Direct engineering development is now possible.
- Experimental proof of the results obtainable already exists in the literature.
- A medical revolution is in the offing.

Potential Medical Applications

- **Non-traumatic cancer treatment**
  - *Cure cancers and leukemias of all types*
  - *Remove pre-cancerous state*
  - *Restore system*
- **Treat and cure Infectious diseases**
- **Cure AIDS and restore immune systems**
- **Defense against biological warfare**
  - *Virulent diseases from unknown agents*
  - *Treat, cure prior to symptoms developing*
  - *Both civil populace and armed forces*
- ***Dramatically lower health costs***
- ***Rejuvenate the aged***

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To treat and save mass casualties: What is urgently needed now:

- A small, portable, relatively inexpensive treatment unit, not requiring plasmas etc.
- Treatment in 2 to 5 minutes rather than 2-hours.
- Simple treatment application, almost anywhere.
- Effective in advanced stages as well as prior to emergence of symptoms.

- Effectiveness against a wide array of illnesses.
- Use is easy, high school student can be trained in 30 minutes.
- Crash program to develop, flood down through emergency systems in great quantities.

The Solution:

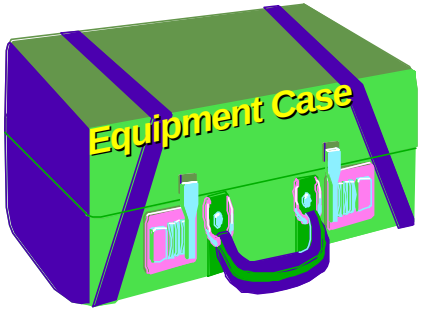

- Two blankets have antennas in them.
- Uses the "porthole" concept (discussed shortly)
- Eliminates plasma tube mixing etc.
- Computer-controlled complex signal structure.

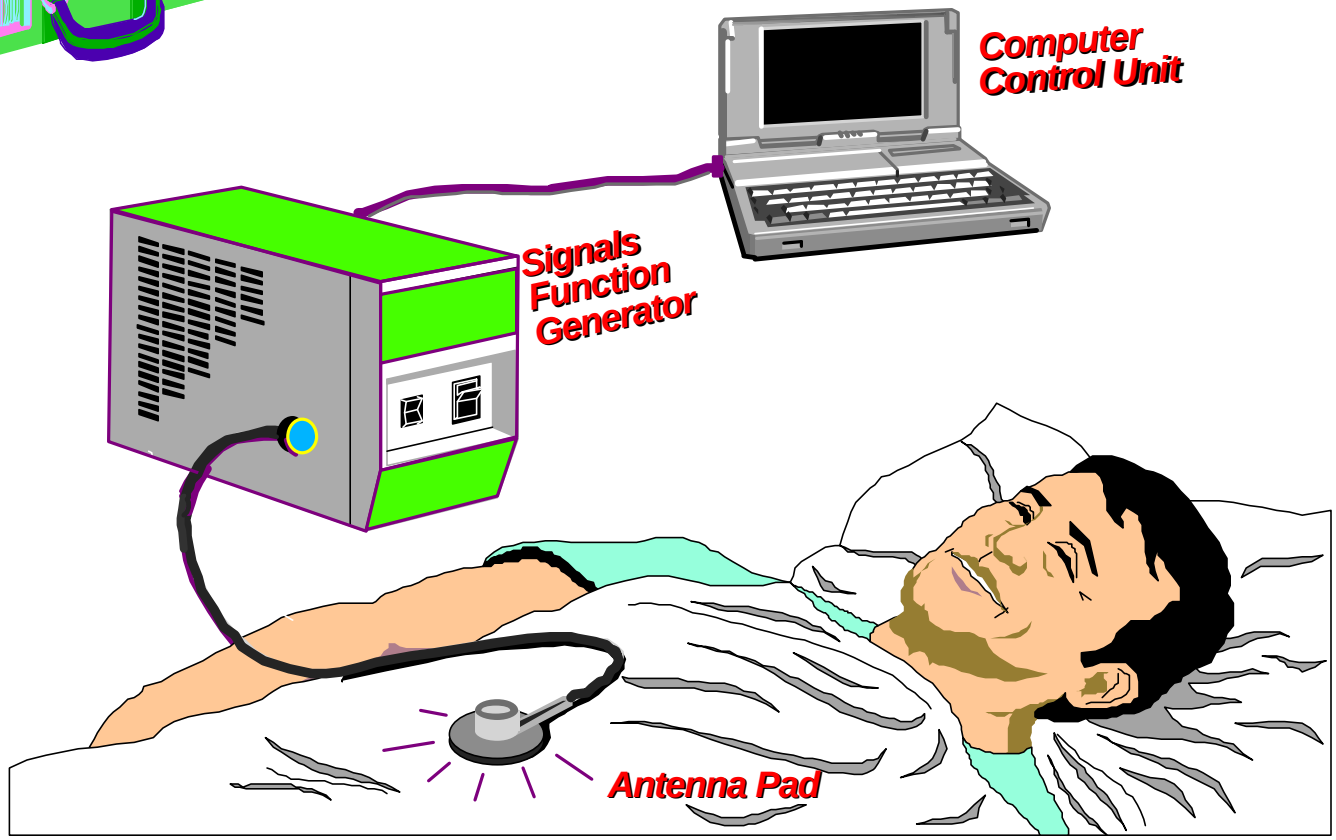

The Porthole concept:

The two-minute treatment shortcut

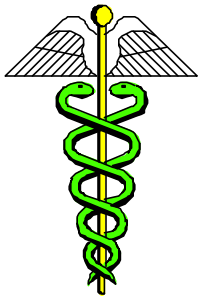

How the porthole concept works

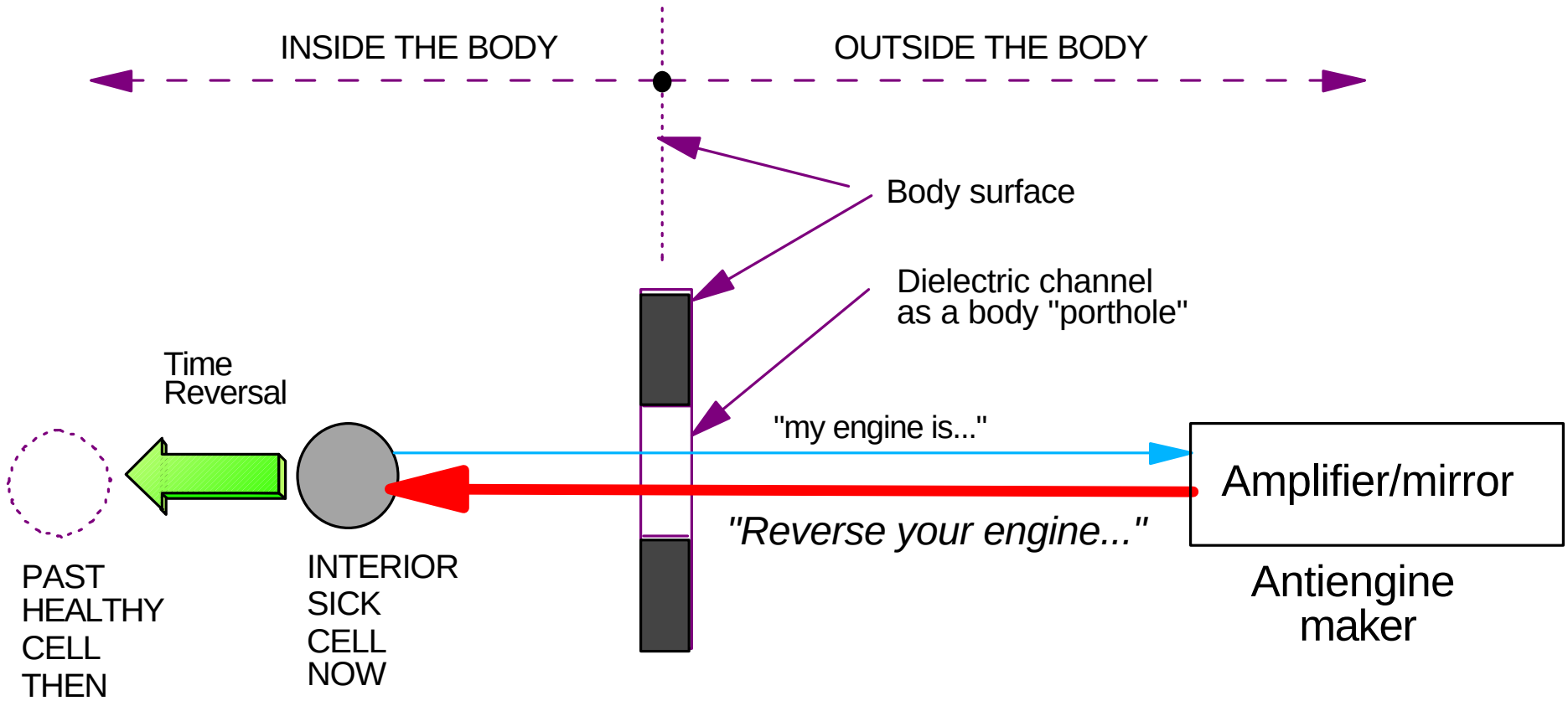

Porthole concept: An analogy of the dielectric path and inner-outer functional connections

- Imagine perfectly reversible dynamic light processes inside a large "cruise ship", that are also perfect phase conjugate mirrors
- Each process receives, absorbs, and emits light continuously
- Light escaping through the portholes is a composite from all the dynamic processes ongoing inside
- If we record and amplify the escaping light, then force it back through the portholes, it reverses all the internal processes
- The processes revert back, slowly, to a previous ongoing process state
- We cease radiation, and the processes reverse and move forward again

Porthole concept: The discovery

- The processes themselves, *in their own "frame"*, are never actually "reversed". Instead, the frame's motion through time is reversed.
  - Each to itself moves normally -- just receiving, absorbing, and radiating light, regardless of "whatever light" is interacting
  - This is due to a peculiarity of the photon and photon interaction
- Photon interaction creates observed physical reality, including the "frame" and the seeming "passage of a mass through time"
  - The photon is its own antiparticle, which is just a photon traveling in the opposite direction
  - So in this case we can use "light" to precisely time reverse (to the observer) the frame and the apparent operations (to the observer)
- When we cease irradiation, after a decay period to remove the reversed excitation, all functions are now seen to be moving forward normally in observer forward time, but from a previous physical state or condition

Using the porthole concept: Research

- The body's own emitted dense, broadband signals are recorded across a broad bandwidth
  - These signals are amplified, then rebroadcast precisely back into the body
  - This returns an amplified "reversed" signal set back through the dielectric path, invoking and applying the porthole concept in all processes
- The returning photons produce time-charging but in reversed frame direction
  - Tremendous potential energy is absorbed in highly compressed "time-energy" form in seconds
  - This "time-potential" slowly drains off as the body processes and cells reverse back to a previous state

Research using the porthole concept

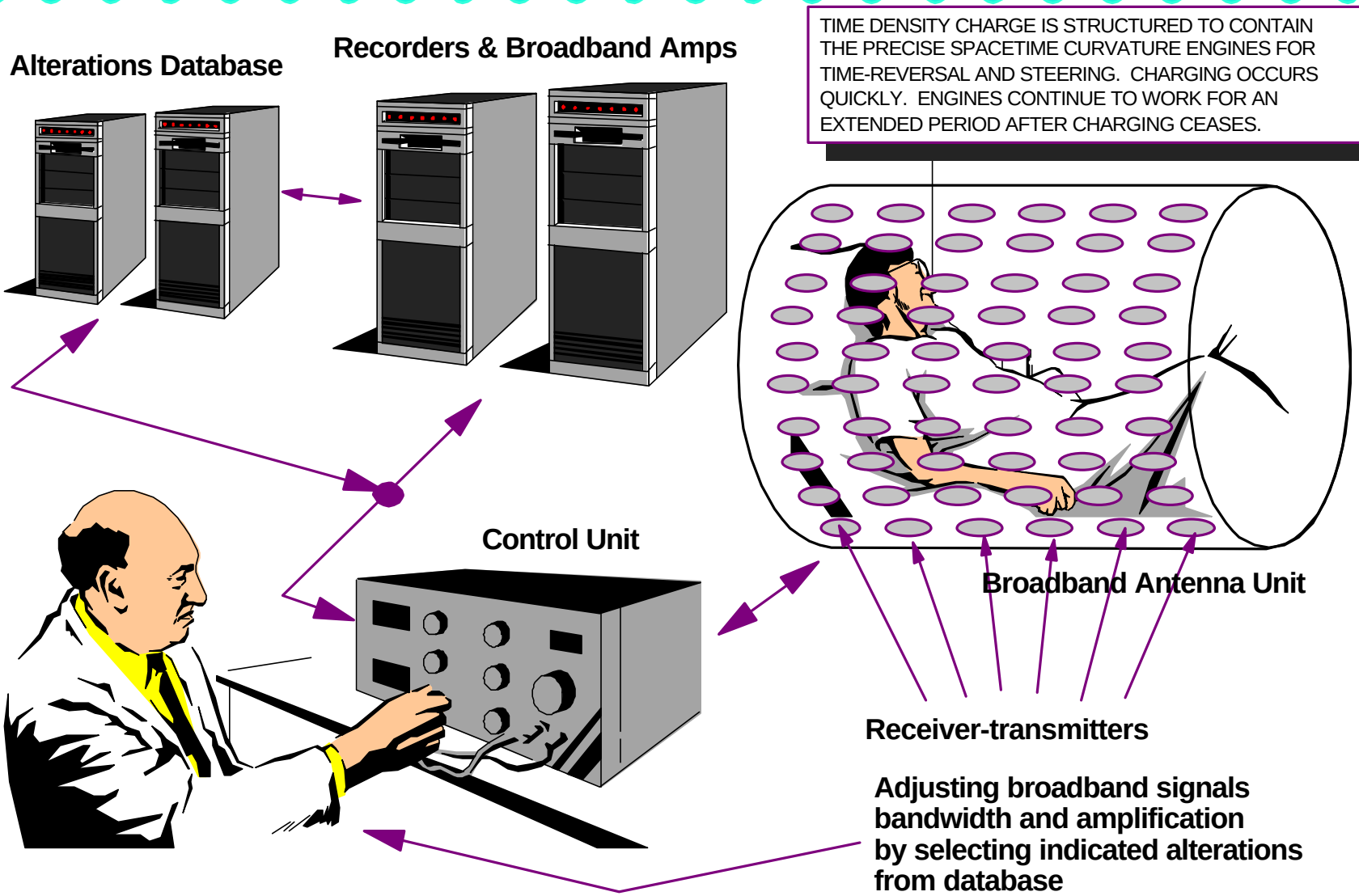

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Portable unit then developed for rapid treatment of mass BW casualties

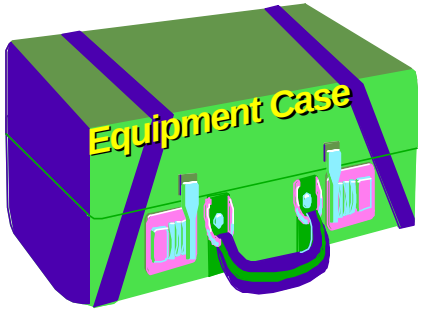

- Two blankets have antennas in them.
- Uses the "porthole" concept (discussed shortly)
- Eliminates plasma tube mixing etc.
- Computer-controlled complex signal structure.
- Irradiation for 2 minutes.

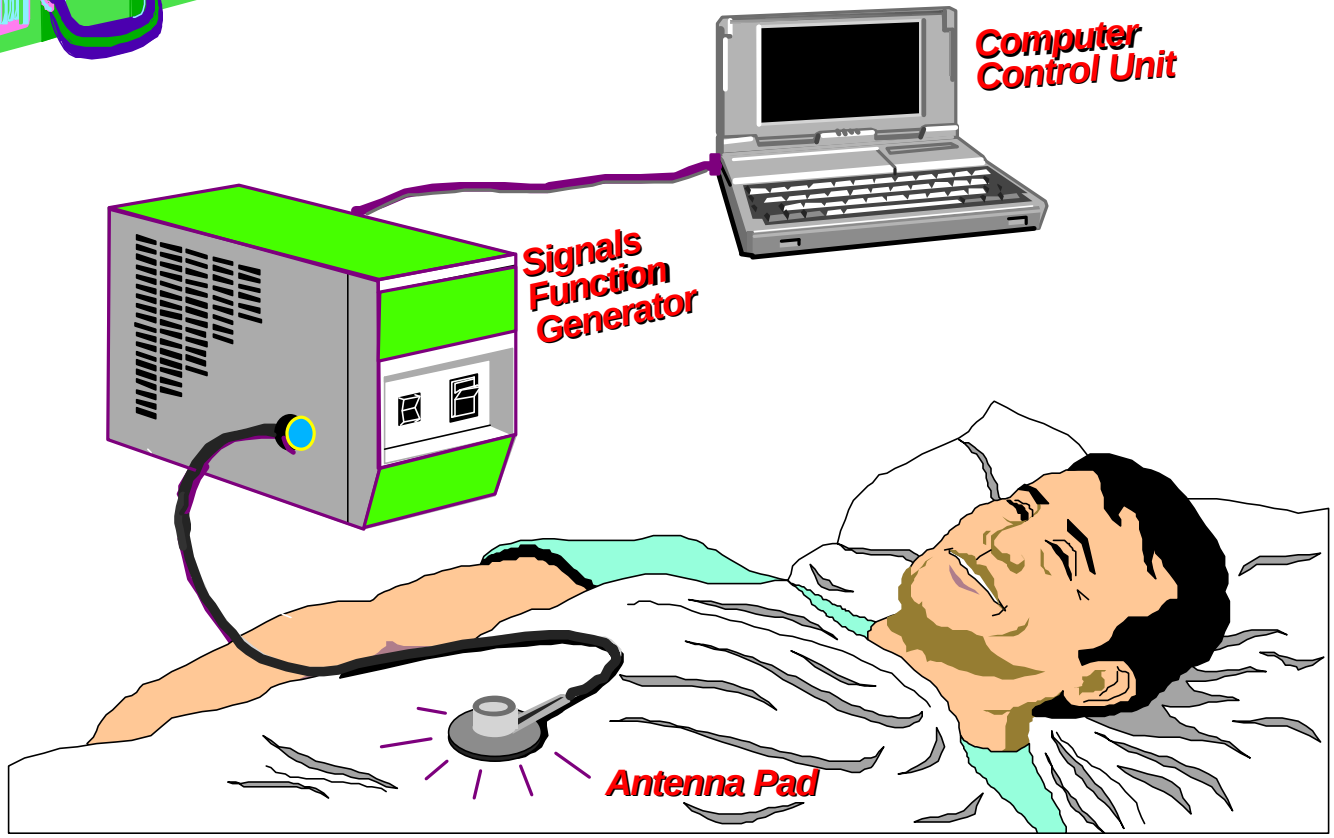

Training to use the unit

- High school student level, 30 minutes.
- Patient lies on one blanket, other covers him.
- Set the prescribed standard signal sets from listing.
- Computer-controlled generator produces the signal.
- Irradiation for 2 minutes, uncover patient, bring in another.
- Unit can be self-powering from vacuum energy (MEG*).

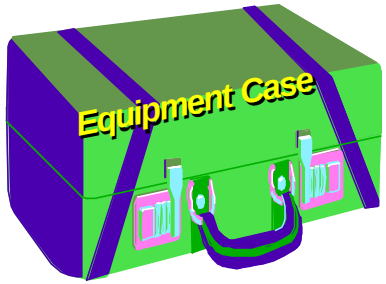

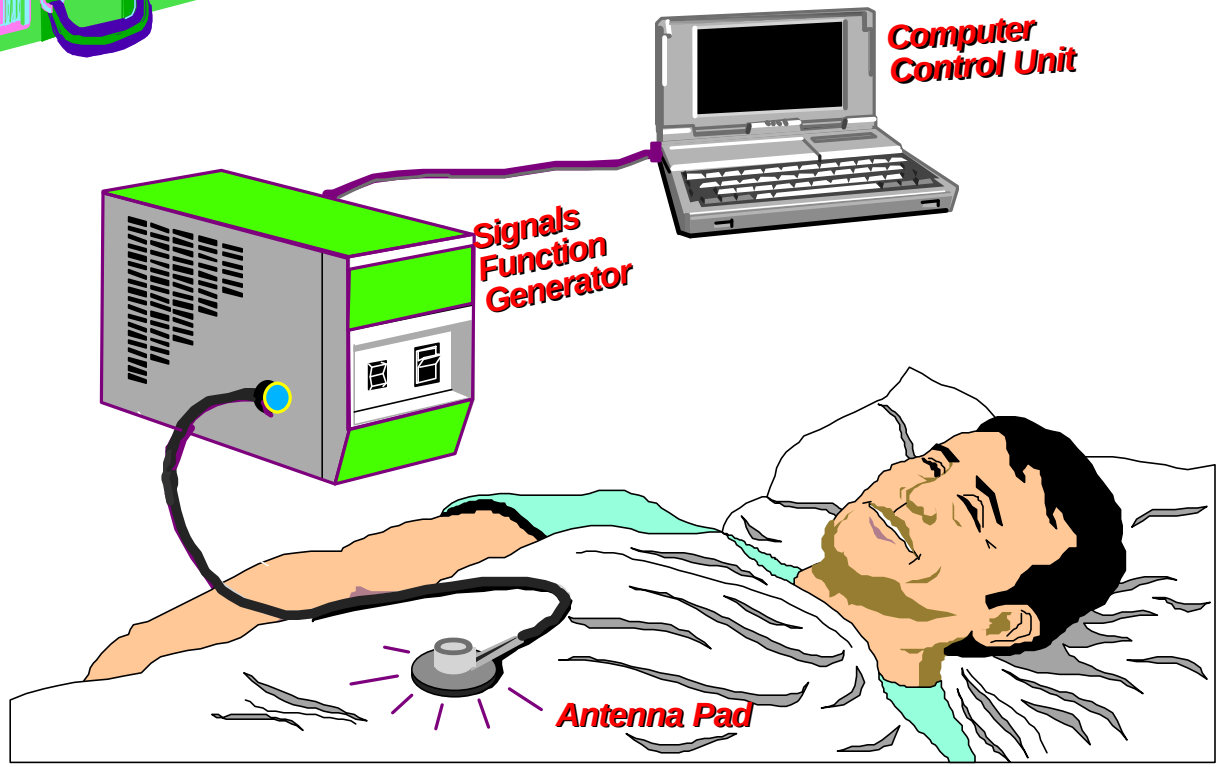

Additional advantages

- Can be developed in a crash program in 2-3 years.
- After sunk costs, projected cost per unit in mass production is less than $100,000
- Can be produced by the thousands
- Then flooded down through
  - Fire stations and police stations
  - Red cross units, hospitals, clinics
  - Emergency action teams and armed forces
- Large numbers of operators easily produced
- Emergency training could be watching a 15 minute film, then performing one graded practice run
- First generation equipment can save some 70% of the coming mass casualties from anthrax etc.

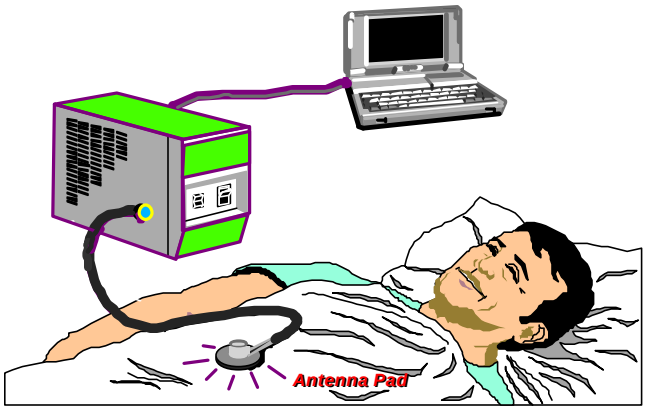

Terrorist BW warfare capabilities against the United States

The growing threat

Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.

- **One terrorist, one light aircraft with spray tank**
- **100 kilograms of anthrax**
- **Flies over greater metropolitan Washington, D.C.**
- **Calm night**
- ***1-3 million casualties result****
- ***Most of those stricken will die***
- **Presently little can be done to save the stricken civilians**
- ***Attacks on several population centers might produce some 10 million or more casualties***

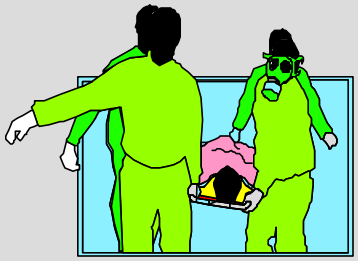

***Per OTA Report to Congress, 1993**

For decades, infiltration of terrorist teams into the U.S.

- From several foreign nations, not just Bin Laden in Afghanistan
- Several thousand Cuban guerillas, from training camps in Southern Mexico
- Russian Spetznaz teams
- Nuclear warheads (up to 80 KT)
- Biological warfare agents
- Yakuza in oriental populations in our cities
  - Yakuza manufactures Russian energetics weapons in their own facilities in Japan
  - Possesses the new EM weapons referred to by Secretary of Defense Cohen in 1997
- We are now in a very long, hard war and will suffer millions of casualties in our cities. It may last for decades.

Defense Secretary Cohen*

(Involvement of secret superweapons)

"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our [counterterrorism] efforts."

* Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

Some typical BW agents

- Smallpox, including different strain developed by Russia (some sold to terrorists)
- Anthrax
  - Over 400 known locations around the Earth have cultures
  - Difficult to decontaminate
- Bubonic Plague
- Botulism toxin
- Tularemia (rabbit fever)
- Hemorrhagic fevers, such as Ebola

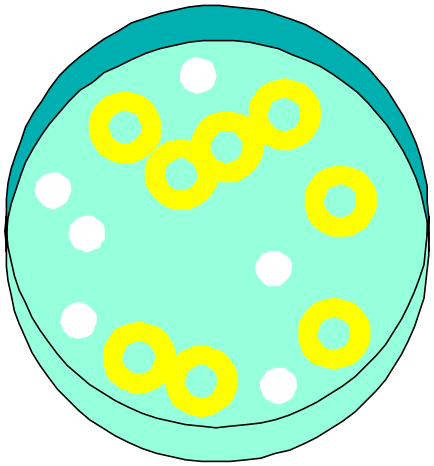

Anthrax

- OTA study: Some 200 pounds released in a spray, on calm night over Washington, D.C. could result in up to 3 million casualties
- Symptoms usually in 2-10 days
  - Sometimes as long as 7 weeks
  - Flu-like symptoms

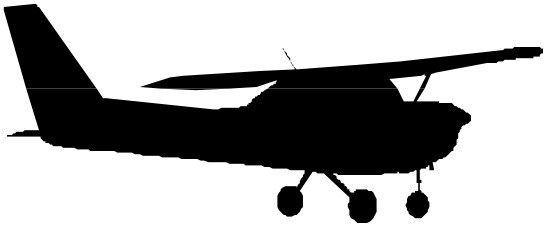

- Then 1-3 days later, shock and breathing problems cause death in up to 100%
- Antibiotics given early (before symptoms) can prevent infected persons from becoming ill
- Limited vaccine, reserved for military

Smallpox

- More than 500 million people killed in the 20th century before "eradicated" in 1977. Vaccination ceased in 1980.
- Russians kept it, developed new strains, sold to terrorists
- Symptoms in about 12 days: fever, headache, nausea. Rash similar to chickenpox then appears.
- Rash turns into hard blisters. *Highly contagious*, kills one-third of its victims.
- No cure. About 12 million doses of vaccine left.
- If smallpox is unleashed in any major city on earth, it will eventually kill 2 billion, or about 1/3 of the human species -- unless a radical new cure is found and utilized.

Bubonic Plague: Historically the most feared (Black Death)

- From 1980-1994, 18,739 cases in 20 countries.
- Symptoms occur in 1-6 days after inhaling the pneumonic form.

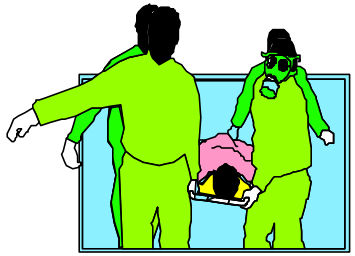

- High fever, cough, labored breathing lead to respiratory failure and death.
- It is contagious.
- Rapid use of antibiotics can be effective.
- Vaccine not currently produced in the U.S.

Botulism toxin (a nerve toxin)

- Single most poisonous BW substance known.
  - Typically borne in food, contacted by eating.
  - Could be developed as aerosol weapon.
- Symptoms in 24-36 hours; blurred vision and difficulty swallowing, speaking.
- Paralyzes muscles, leading to respiratory failure and death.
- Centers for Disease Control and Prevention maintain a botulism antitoxin supply.

Tularemia

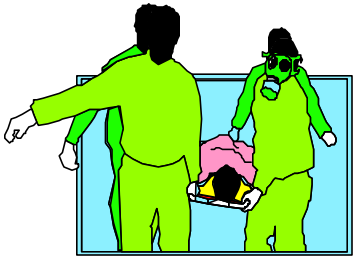

- U.S. studied its weapon potential in 1950s and 1960s.
- Symptoms appear in 3-5 days, including fever, chills, headache, and weakness
- Inflammation and hemorrhaging of the airways can lead to death.
- Without antibiotics, one-third die. Can be 90% if breathed in, in aerosol form.
- Vaccine developed and under review by FDA.

Hemorrhagic fevers, such as Ebola

- E.g., origin of Ebola is unknown. Probably transmitted to humans by animals, to begin a breakout.
- Symptoms in 3-5 days, include fever, aching muscles, diarrhea.
- Hemorrhaging of fluids out of tissues and orifices.
- From 30 to 90 percent die, depending on specific fever type.
- Some of these fevers respond to antiviral drugs.
- The drugs are in short supply.
- Presently *containment* is the primary goal.

A factor the U.S. does not know

(Secret involvement of clandestine superweapons)

- Three nations (not the U.S.) developed quantum potential weapons using Bohm's hidden variable theory of quantum mechanics.
- Can induce disease engines in matter or bodies at a distance.
- Have developed "spreading" of immune systems in a targeted populace (cleverly tested in Gulf War against U.S. troops).
  - Cocktail mix of disease engines for 2 dozen different diseases
  - Targeted area's human immune systems react to these engines when they are still in virtual state, just below quantum threshold.
  - Spread immune system's resources thus "thinned" across response to two dozen shadow diseases at once.
- Hit with a terrorist BW attack, the spread immune systems are overwhelmed much more easily and quickly.
  - Yield (casualties) of the attack is increased by factor of 3-5.
  - Spreading of U.S. immune systems has been accomplished and is still being maintained.

Summary and conclusion

The new war

A new Pearl Harbor: Strike on the World Trade Center in NYC

- The North Tower has already been struck and is burning.
- A second jetliner is about to strike the South Tower.

Fireball From Impact on South Tower

- The two buildings held some 50,000 occupants
- Evacuation was underway after the first strike
- More than 6,000 persons were killed
- This is more than were killed in the Dec. 7, 1941 strike on Pearl Harbor

Collapse of the South Tower

- The first tower to collapse was the South Tower
- It is still uncertain just how many people were caught inside and killed
- This is a half million tons of debris, falling from the New York skyview.

Collapse of the North Tower begins

- The North Tower then collapsed
- This was another half-million tons of debris falling from the NYC skyview

Collapse of North Tower finishes

- Collapse of the North Tower killed many rescue workers, fire-men, and policemen
- At this writing, the total casualties are still unknown

Next began the recovery efforts

- Recovery operations will require months
- At this writing, the total casualties are still unknown
- The damage was done by two civilian jetliner "bombs"

The Pentagon was hit on the same day

- Hundreds were killed the same day when another jetliner struck the Pentagon.
- Yet another jetliner, possibly headed for the White House, crashed enroute when the passengers attacked the suicide terrorist hijackers.

A sobering thought

- Nuclear weapons are already smuggled into the U.S., as are BW agents such as anthrax, smallpox, etc.
- Had a 40-80kT weapon been exploded in New York and one in Washington, millions would have perished and both cities would have been devastated
- There would have been no recovery of those cities for many decades

Present Status of the WMD Threat to the United States

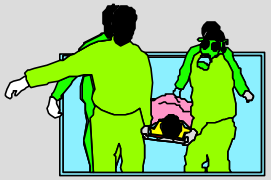

- **Many foreign nations are hostile to the U.S. and sponsor terrorists**
- **Some 25 nations have WMD or are acquiring them**
  - **BW agents and weapons**
  - **Chemical agents and weapons**
  - **Nuclear materials and weapons**
- **Thousands of students and émigrés**
- **Infiltrated teams, BW, other WMD already**
- **Castro guerrillas infiltrated over the years**
- **<u>Can do unacceptable damage to U.S. now</u>**
- ***<u>May reach knockout capability</u>***

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***Per OTA Report to Congress, 1993**

The U.S. is terribly unprepared

- Limited medical supplies, antibiotics, vaccines
- Insufficient facilities, emergency teams
- No civilian shelters (much less BW-filtered)
- Not enough doctors, nurses, masks, etc.
- Present treatment methods woefully inadequate
- Triage will apply
  - First treat those most likely to recover
  - Others (showing symptoms, or advanced) are just set aside to die
- Other attacks are a matter of *when*, not *if*.

Conclusion

- As several cities are struck, millions of U.S. civilian casualties will result. Devastation will be enormous.
- We shall eventually lose more American lives than in all the rest of our wars to date.
- Present medical therapeutic science is totally inadequate to do the job. It cannot save us.

- At some point, when we are sufficiently damaged, the Spetznaz or other terrorists may detonate nuclear weapons in our cities, with appalling carnage.
- A combined superweapon technology and terrorist groups will then destroy the remaining populace.
- On its present course, the inadequacy of Western medicine may doom us.

A difficult truth to consider

- In any strategic strike, the first phase is to get the strategic weapons (weapons of mass destruction) delivered to their distant targets.
- That has already been done.
- Eerily, the first phase of World War III has already been accomplished.
- It was already accomplished before the Sept. 11, 2001 strike on New York and Washington. That was the new "Pearl Harbor", and only the opening round. It already killed more Americans than died at Pearl Harbor on Dec. 7, 1941.
- Unless we improve our medical therapy quickly and dramatically, we will lose -- particularly when the hidden energetics weapons and outside terrorist sponsorship by hostile nations are factored in.

A personal perspective

- There now exists an overwhelming, immediate moral imperative to get this development program done at the utmost speed humanly possible.
- The sheer survival of the United States and Western civilization depends upon it.
- Officialdom is aware that the KGB/Russians have long planned to finish the U.S., after initial nuclear exchanges, by fierce and massive BW strikes.
- It appears that the plan has changed to let the terrorists do the main work, while augmenting U.S. casualty levels by energetics weapons.

China is also involved

- China has declared South China Sea the territorial waters of China
- China will eventually take Taiwan
  - Has massed missile artillery trained on Taiwan
  - Recently held invasion practice on an island near Taiwan
- Recently deployed fearsome EMP weapons utilizing negative energy rather than positive energy (Dirac sea theory)
  - Extinguishes all electron currents
  - Duds electrical and electron systems instantly
  - Instant death to struck bodies
  - Instant kill of missiles, aircraft, electronics in nuclear warheads
  - Ultimate "death ray"; can be made small or large
- Recent 2-carrier U.S. task force maneuvered in South China Sea to caution China
  - The new Chinese EMP weapon was trained on that task force
  - Could have destroyed it within minutes

Final thoughts

???

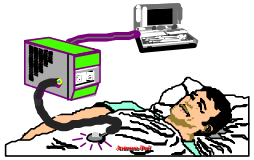

- This is one of the great turning points in history.
- The development program is eminently doable. That it works has been experimentally demonstrated. The long-vexing puzzle of the active mechanism has been solved.
- Our scientific community bitterly opposes any use of electromagnetics -- even an advanced, higher symmetry electrodynamics -- for medical treatment.
- A consortium of the scientific community, the large pharmaceuticals, FDA, and the AMA will oppose this project even while the U.S. is being destroyed wholesale.
- It can only be done in the private sector, and there will likely be no funding unless by philanthropists.

Continuation

Business plan, development program, budget breakdown, proposed schedule etc. go here.

Weapons Slides

The Tom Bearden Website

Help support the research

"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our [counterterrorism] efforts." *

Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

Slides
(covers period up to 1999)

- The Coming Strategic Attack on the United States
- Outline
- Loss of two separate A-10 Warthogs in 1997
- Typical ABM Defenses (Widely Deployed by mid-70s)

- Launch Phase Anti-Missile System
- Launch Phase Anti-Bomber System
- HC-130s Engines Quit, Aircraft Crashes
  Nov. 22, 1996
- 1996 Actions by this analyst
- Additional Information Exists: Not Analyzed, Not Integrated in Briefing
- Kill of Arrow DC-8, Gander AFB, Dec. 12, 1985
- Satellite Photos of Plumes in Soviet Arctic Since 1974
  See "Fer de Lance" for additional information
- Aum Shinrikyo ("Supreme Truth" Cult), Shoko Asahara, Leader

  Aum Shinrikyo - Anatomy of a Dangerous Cult
- Ashkhabad Problem and Its Solution
- Strange Characteristics of Iran Quake, Sep. 1978
- Iran Earthquake, September 1978
- Situation Now (Assessment)
- Situation Now (Assessment 2)
- Aspects of Strong Local Asymmetry
- Mass Casualty Problem: Aerial Anthrax

Spray on Washington, D.C.

- Present Status of the WMD Threat to the United States
- Some Present Problems in the U.S. WMD Defense Capabilities
- Internal Terrorist Threat with Weapons of Mass Destruction: Now & Future
- Attempt to Ban Energetics Weapons Worldwide
- Brezhnev's Schedule
- Large glowing Tesla globe witnessed in Red China by hundreds
- Cold Explosion -- 9 April 1984 Near Kurils, and formation and growth of spherical shell (globe)
  Sequence of Events
- Cold Explosion -- 9 April 1984 Near Kurils, and formation and growth of spherical shell (globe)
  What They Were
- Cold Explosion -- 9 April 1984 Near Kurils (Plus additional weapons effects)
- Countering Insane MAD Systems:
  Find Loophole, Exploit It
- Next Generation Counter to Both Sane and Insane MAD systems
- Simultaneous Dudding of Nuclear Weapons Worldwide

- Simultaneous Dudding of Nuclear Weapons Worldwide
- Operation Divine Wind II
- Advanced EMBW Applications
- EM Biological Warfare (EMBW)
- Microwave Radiation of U.S. Embassy in Moscow
- Pentagon EMI Studies, 1989
- EM Missile Practice (6 slides)
- Subdivisions of Soviet Energetics Program
- Communism's Goal
- Manuilsky's Goal vs. Status Today (Dec. 1996)
- Professor Hellman, German Scientist Released from Work in Soviet Union
- Hemispheres and Globes of Light (4 slides)
- How Could Such Superweapons Ever Be Concealed?
- Soviets Easily Concealed These Superweapons for Four Decades
- Microscope-type, laser-like interferometer for inducing quick α-decay in samples of otherwise longer-lived isotopes
- Longitudinal Wave Interferometry: Endothermic

- Longitudinal Wave Interferometry: Exothermic
- U.S. Air Attack on Libya, April 1986
- Lightning Wall
  circa 1959-1960
- Lisitsyn's Report: Brain Code Broken
- Large Longitudinal Wave Interferometer (LWI) Accident
- Large Longitudinal Wave Interferometer (LWI) Accident
- Use of Hidden Information Content of the Field Can Provide Action-At-A-Distance
- Two Types of Mutual Assured Destruction (MAD) System
- Psychoenergetics Weapons Teams Mentally Disable All Personnel
- Strikes Against Special Ship and Energetics Weapons Sites
- "Mindsnapper" Attack on Special Ships and Energetics Weapons Sites
- How Much Off Guard Are We?
  (7 Slides)
- Possible Targets: 1995-9 Escalation Phase
- Propagation of Weapon Effects
- Yugoslav Earthquake, Followed by Cold Explosion
  April 15th, 1979

- Countering an Insane QP Weapon
- Gulf War Disease: KGB QP Weapon Induced ST Curvature Engines for a Cocktail of Diseases
- Self-Targeting in Inner EM Channel Can Produce a Quantum Potential
- Mechanism for Producing a Quantum Potential
- Major Principles for Use of Quantum Potential Weapons
- Major Principles for Use of Quantum Potential Weapons (2)
- Instantaneous Communication by a Quantum Potential
- Participants in a quantum potential share a common multiply-connected spacetime (MCST)
- Quake in Tangshan, China
  28 July, 1976
- Exchanging Earthquakes
- Instant Communication by a Quantum Potential
- Westerners Do Not React to Slow Threats
- Characterizing a Given Risk or Risk Factor
- Technical Risk Management
- Aum Shinrikyo's Sarin Facility

- In Scalar Beam Interference Zone
- Physicist Schappeller Auralaz Munster, Austria
- Initial Soviet Plan for Cold War, After WWII
- Josef Stalin: Absolute Dictator
- Exploding any Resistance by Operational Scientists
- Significant Soviet Statements
- Captain Svoboda Dives Headlong to Her Death
- T-polarized Beam Projector
- Possible Tests (1)
- Possible Tests (2)
- Possible Tests (3)
- Possible Tests (4)
- Mushroom Cloud Rising From Sea
- Launches from Cape Canaveral and Vandenberg AFB Provided Practice Targets of Opportunity
- The sinking U.S.S. Thresher, with her controls jammed, implodes when she reaches crush depth
- Embodiment of an instrument array sufficient to discriminate when time-density charging has occurred, and that transduction

of time-charge decay has occurred.

- Time-Polarized EM Wave Interferometer Creating Space-Time Curvature Engines in a Distant Interference Zone
- Transmutation of Radioactive Nuclei at a Distance
- Transmutation of Radioactive Nuclei
- Typical Tesla Shield, Northern Route of Japan
- A Curious Tide in Human Affairs
- Large Scalar EM Interferometer (LASI) Accident Near Urals, 1958
- The Superpower Paradox: Asymmetric Cheap WMD Strategic Strike and Destruction
- The KGB/Yakuza-Aum War Plan
- Why Western Science is Ignorant of KGB Energetics
- Transmutation of Radioactive Nuclei at a Distance
- TheYakuza
- Yugoslav Earthquake, Followed by Cold Explosion
  April 15, 1979

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* Note that the Secretary did not speak the words in square blocks; these were added by the writers later,

probably to "soften the tone" of the Secretary's information release. So the Secretary confirmed that some nations of the world -- not just some ragged terrorists, as the writers tried to imply for spin control -- do possess novel electromagnetic weapons and are using them to induce earthquakes, engineer the weather and climate, and trigger volcanic eruptions.

THE COMING STRATEGIC ATTACK ON THE UNITED STATES

By an AUM/Yakuza/KGB/Communist Coalition Using Energetics SuperWeapons

T.E. Bearden, LTC
U.S. Army (Retired)
M.S. Nuclear Eng.
Fellow Emeritus, AIAS

With Technical Background and History of Energetics Weapons

Partial support by the Association of Distinguished American Scientists is gratefully acknowledged.d

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Outline

- Background: Classical Electromagnetics (and Defects)
- Background: Energetics (Scalar Electromagnetics)
- Background: Soviet Energetics Weapon Development
- KGB/Communist Plans
- Countering of Soviet/KGB/Communist Plan in Mid-80s
- Soviet Economic Collapse and Adaptation of Plan
- Weapons Bleed-Out: KGB/Russian Mafia
- Yakuza: The Japanese Mafia
- Aum Shinri Kyo (Supreme Truth) Cult
- Coalition: Aum/Yakuza/KGB/Communists/Russian Mafia
- Operation Divine Wind II: Three Phases
  - Phase I: On-Site Training Phase (Completed)
  - Phase II: Escalation Phase (In Progress)
  - Phase III: 1997 Strategic Strike on the United States
  - Support Plan A: Feints, Deception, Sabotage & Terrorism
  - Support Plan B: Test Range
  - Support Plan C: Worldwide Weather Engineering
  - Support Plan D: Strategic and Combat Intelligence
- Special Information
- Recommended Actions

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The Tom Bearden Website

Help support the research

Loss of two separate A-10 Warthogs in 1997

- A-10 Mysterious Flyaway and Crash - April 2, 1997
- Death of Second A-10 Pilot - May 27, 1997
- Captain Button's Mysterious Flyaway and Eventual Crash
- Death of Second A-10 Pilot - May 27, 1997

A-10 Mysterious Flyaway and Crash

April 2, 1997

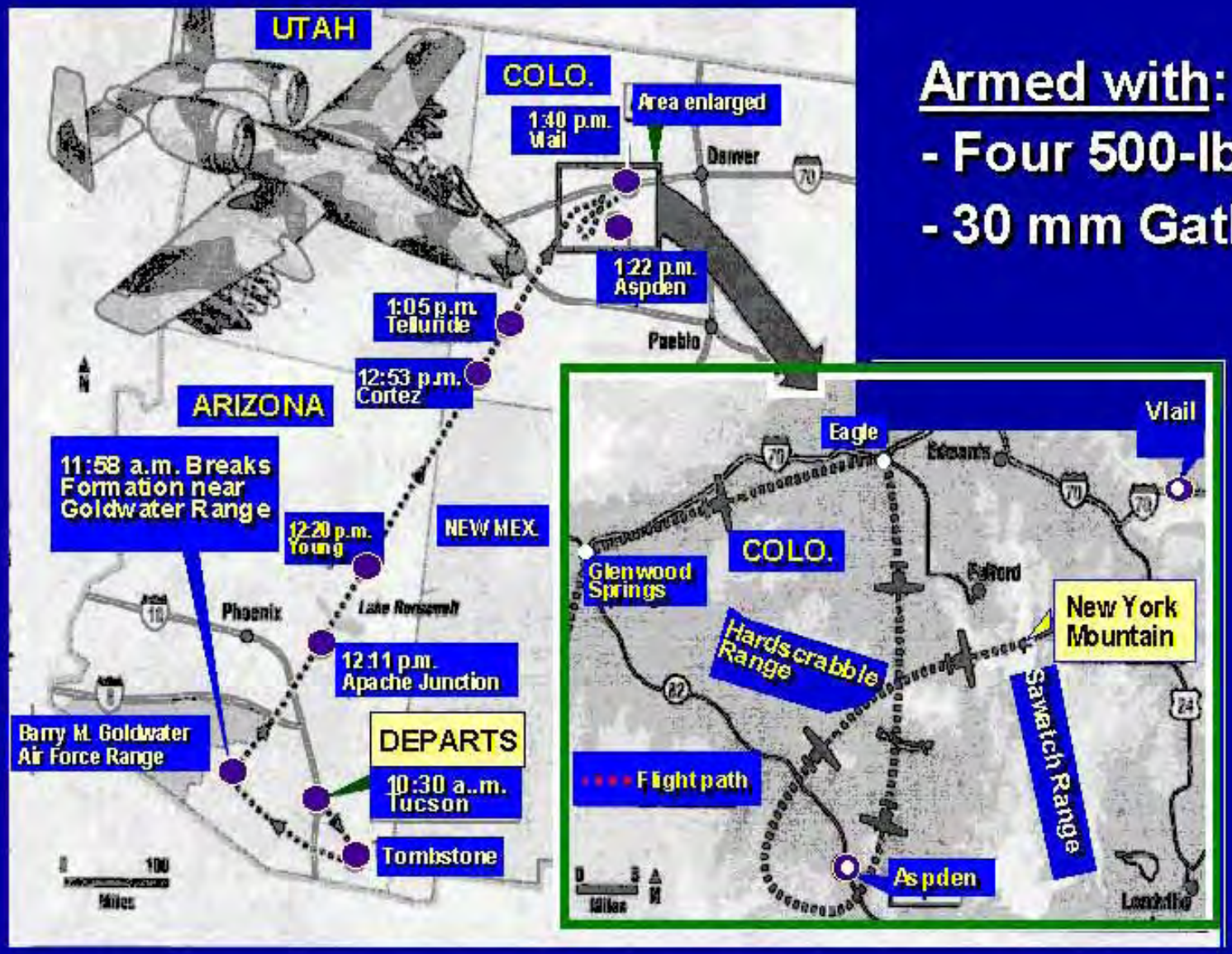

Armed with:

- Four 500-lb bombs
- 30 mm Gatling gun

Death of 2nd A-10 Pilot May 27, 1997

- Captain Amy Svobody
- Night training mission
- From Davis-Montham AFB
- From same wing as Captain Button, who flew his A-10 off course for over an hour and then crashed on April 2.
- Climbout from ordnance delivery on target
- Nosed down sharply and dived into ground

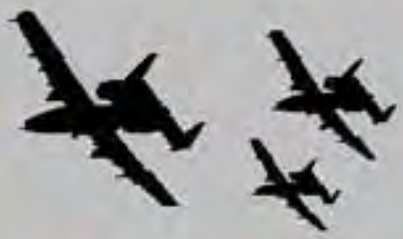

Companion A-10's

- Experienced night flyer & instructor
- Nosed sharply over and flew into ground
- Psychoenergetic kill

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Psychoenergetic weapon induced instant hypnogogic state and reversed Svoboda's sense of up and down.

A-10 Mysterious Flyaway and Crash

April 2, 1997

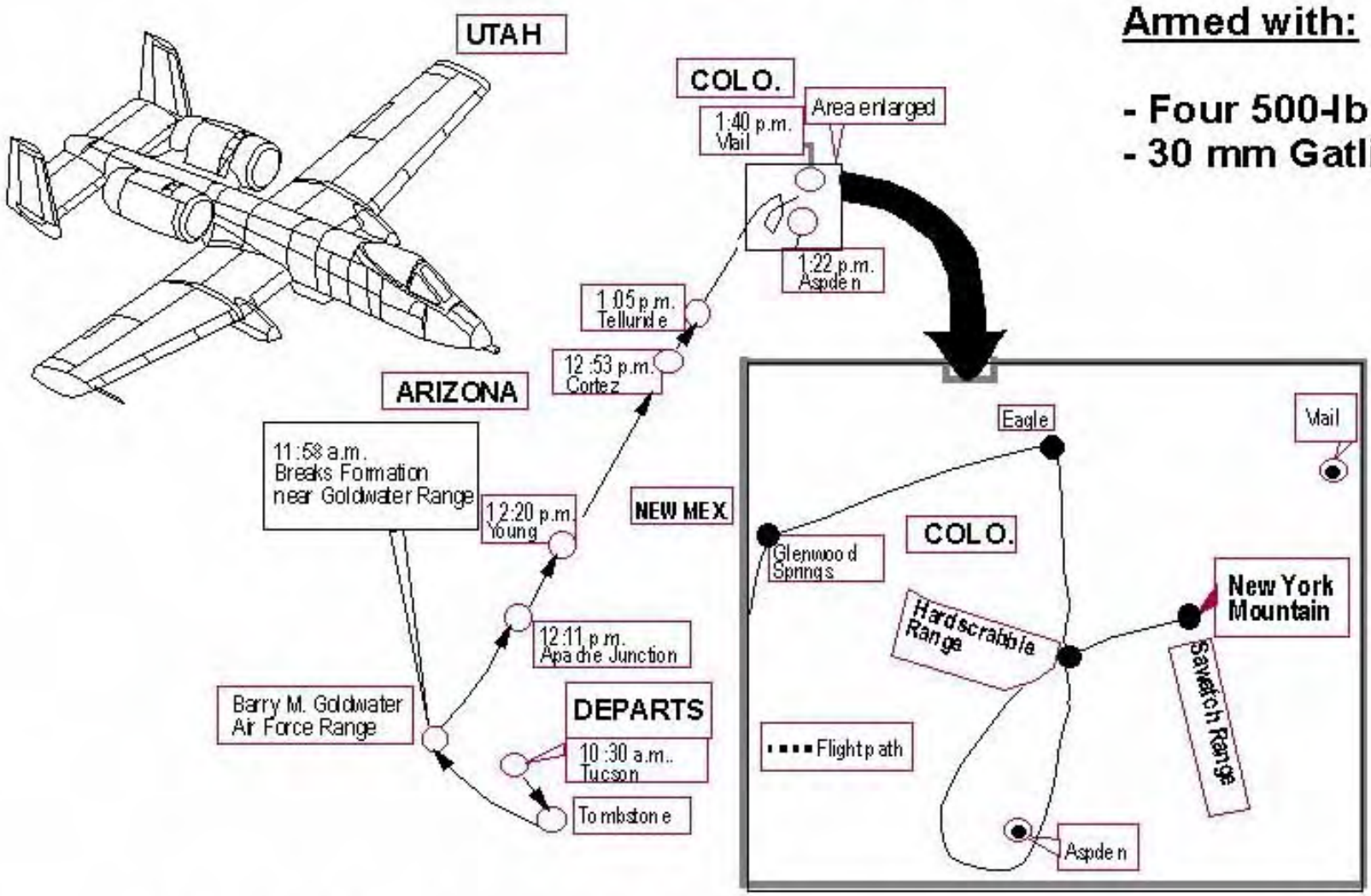

Armed with:

- Four 500-lb bombs
- 30 mm Gatling gun

Figure 14a. Captain Button's mysterious flyaway and eventual crash.

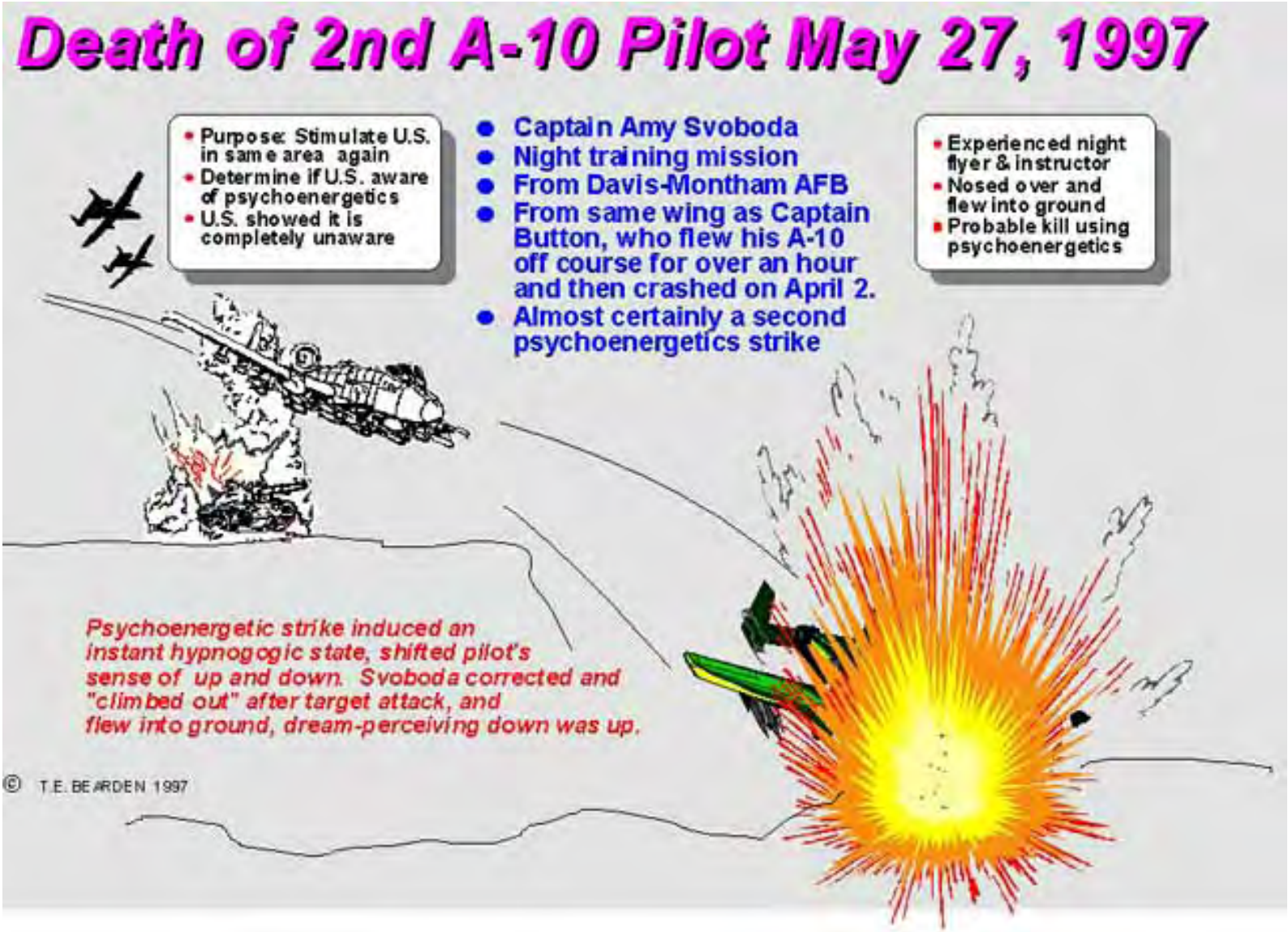
Death of 2nd A-10 Pilot May 27, 1997
• Purpose: Stimulate U.S. in same area again
• Determine if U.S. aware of psychoenergetics
• U.S. showed it is completely unaware
• Captain Amy Svoboda
• Night training mission
• From Davis-Montham AFB
• From same wing as Captain Button, who flew his A-10 off course for over an hour and then crashed on April 2.
• Almost certainly a second psychoenergetics strike
• Experienced night flyer & instructor
• Nosed over and flew into ground
• Probable kill using psychoenergetics
Psychoenergetic strike induced an instant hypnogogic state, shifted pilot's sense of up and down. Svoboda corrected and "climbed out" after target attack, and flew into ground, dream-perceiving down was up.
© T.E. BEARDEN 1997

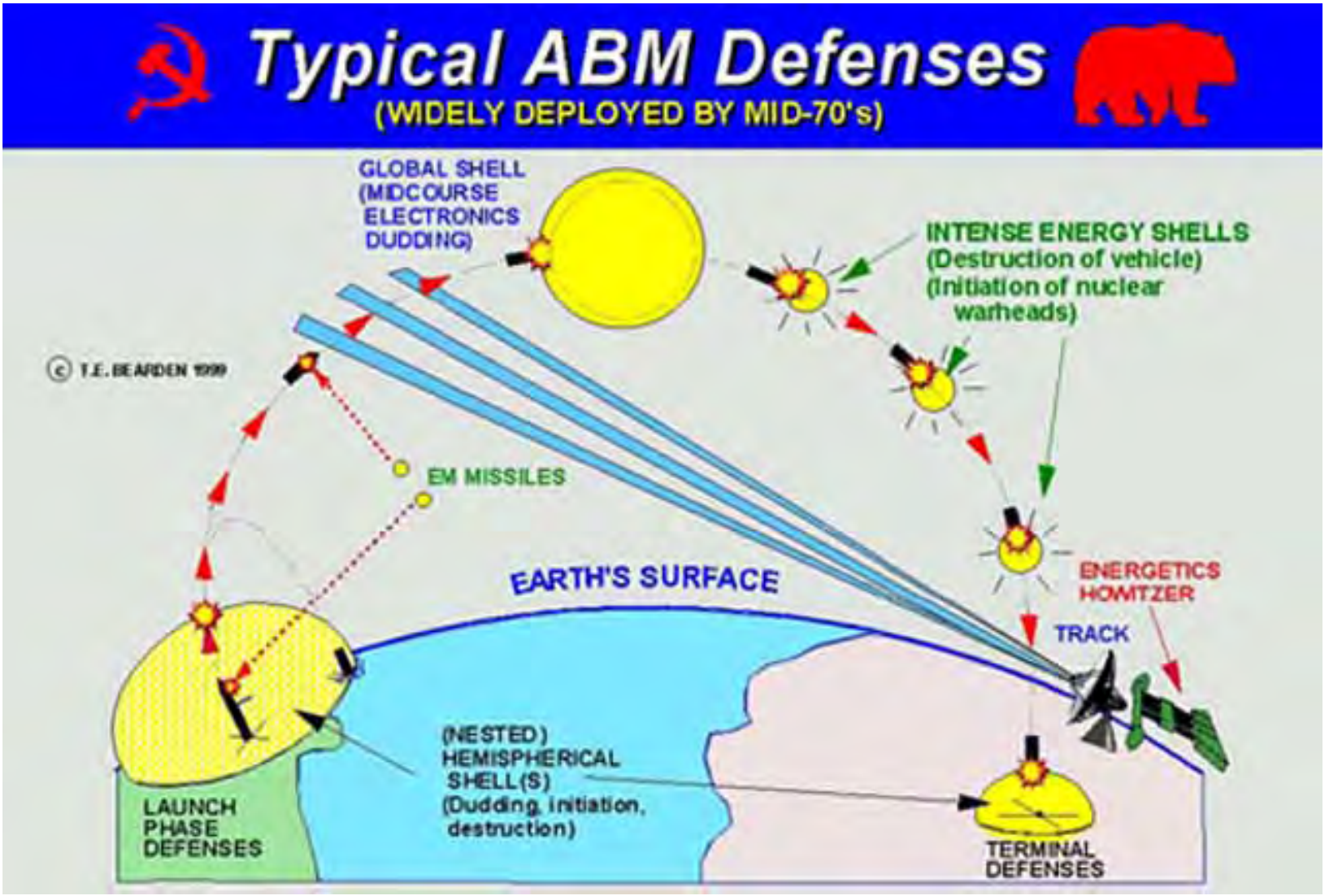
Typical ABM Defenses
(WIDELY DEPLOYED BY MID-70's)
GLOBAL SHELL
(MIDCOURSE
ELECTRONICS
DUDDING)
INTENSE ENERGY SHELLS
(Destruction of vehicle)
(Initiation of nuclear
warheads)
© T.E. BEARDEN 1999
EM MISSILES
EARTH'S SURFACE
ENERGETICS
HOWITZER
TRACK
(NESTED)
HEMISPHERICAL
SHELL(S)
(Dudding, initiation,
destruction)
LAUNCH
PHASE
DEFENSES
TERMINAL
DEFENSES

LAUNCH PHASE ANTIMISSILE SYSTEM

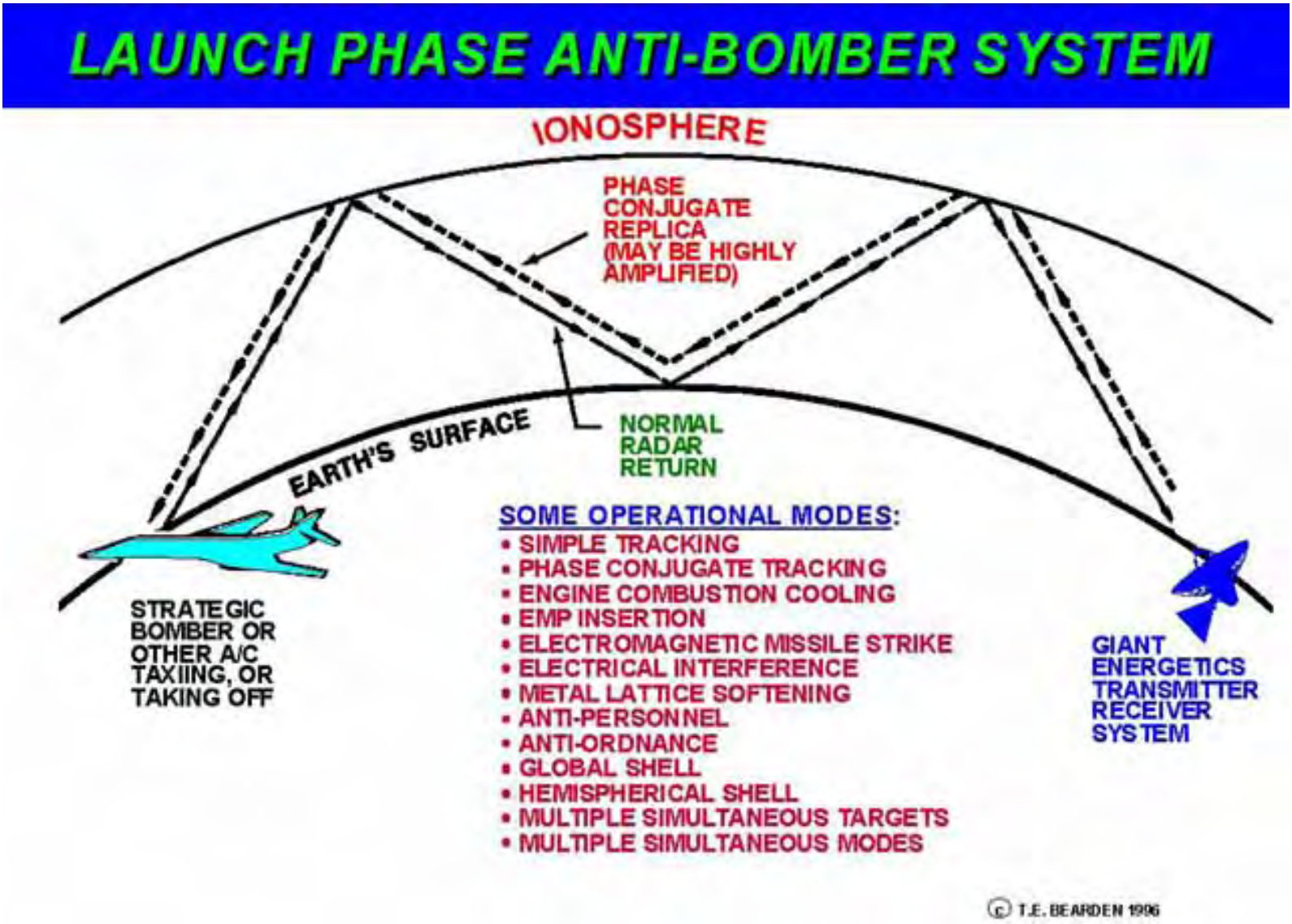
LAUNCH PHASE ANTI-BOMBER SYSTEM
IONOSPHERE
PHASE CONJUGATE REPLICA (MAY BE HIGHLY AMPLIFIED)
NORMAL RADAR RETURN
EARTH'S SURFACE
STRATEGIC BOMBER OR OTHER A/C TAXIING, OR TAKING OFF
SOME OPERATIONAL MODES:
• SIMPLE TRACKING
• PHASE CONJUGATE TRACKING
• ENGINE COMBUSTION COOLING
• EMP INSERTION
• ELECTROMAGNETIC MISSILE STRIKE
• ELECTRICAL INTERFERENCE
• METAL LATTICE SOFTENING
• ANTI-PERSONNEL
• ANTI-ORDNANCE
• GLOBAL SHELL
• HEMISPHERICAL SHELL
• MULTIPLE SIMULTANEOUS TARGETS
• MULTIPLE SIMULTANEOUS MODES
GIANT ENERGETICS TRANSMITTER RECEIVER SYSTEM
© T.E. BEARDEN 1996

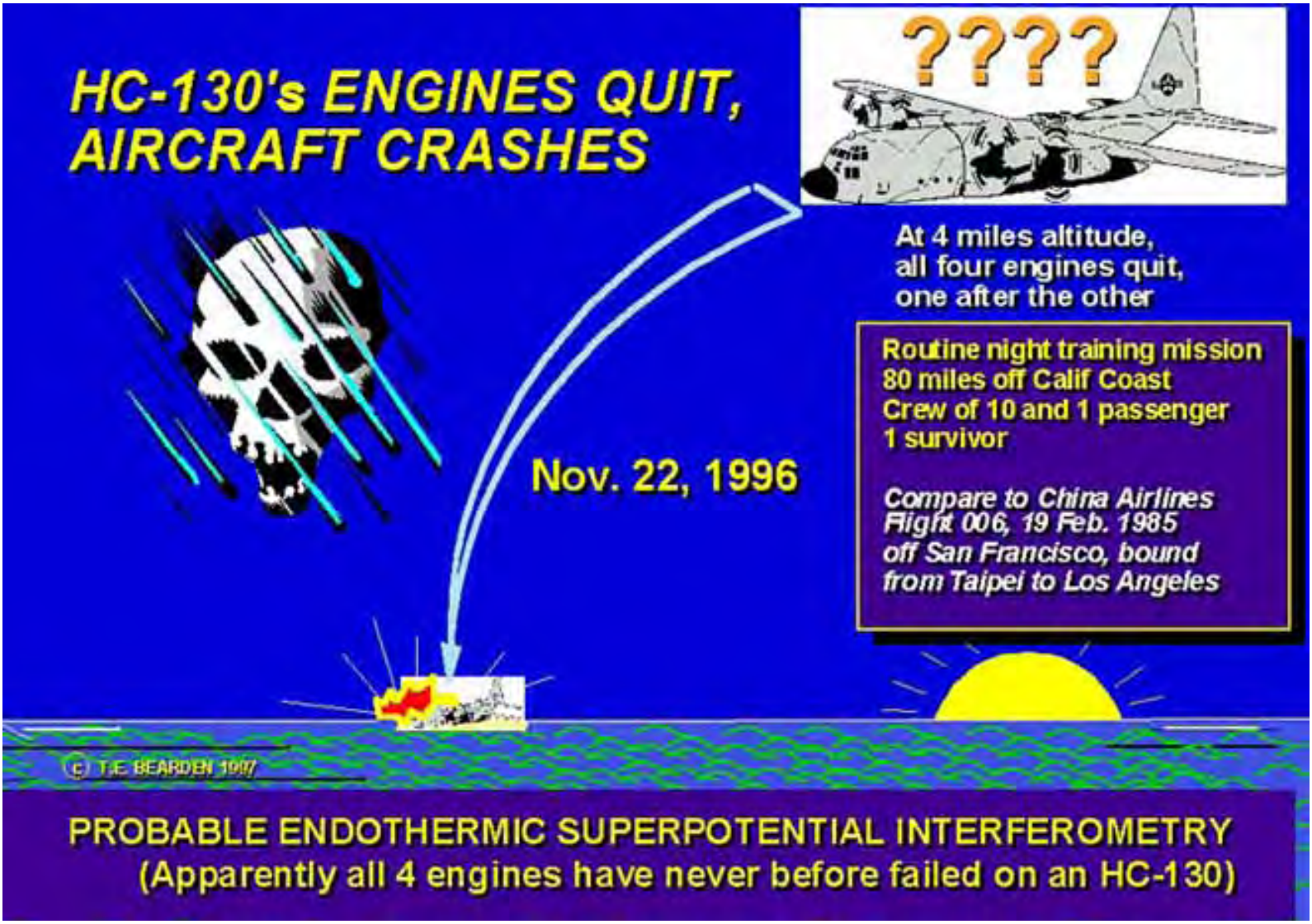
HC-130's ENGINES QUIT, AIRCRAFT CRASHES
????
At 4 miles altitude, all four engines quit, one after the other
Routine night training mission
80 miles off Calif Coast
Crew of 10 and 1 passenger
1 survivor
Compare to China Airlines Flight 006, 19 Feb. 1985 off San Francisco, bound from Taipei to Los Angeles
Nov. 22, 1996
© T.E. BEARDEN 1997
PROBABLE ENDOTHERMIC SUPERPOTENTIAL INTERFEROMETRY
(Apparently all 4 engines have never before failed on an HC-130)

CTEC PROPRIETARY

1996 Actions by this analyst

- In July 1996, with the kill of TWA-800 it became apparent that the KGB/Communists were preparing a massive strategic energetics attack upon the U.S.

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- Began intensive, nearly round-the-clock effort to uncover what was happening, and what had occurred in KGB/Com weapons since 1991
- Began preparing full-up set of briefing slides simultaneously
  - In early 1996, had briefed J6 on scalar EM, per his request
  - Had strongly suggested a follow-on weapons brief
  - Adamant opposition by NRL, NOL, others
- Similar energetics attack scenario in 1986 was countered. Soviets at that time did not possess operational QP weapons, and so could not successfully overcome dead-man fuzing
  - Also could not dud nukes worldwide, because QP required.
  - First lab prototype QP test was in April 1986
- KGB had solved the dead-man fuzing problem by QP's. Deployed circa 1989-1990. Some earlier weapons then leased.

Additional Information Exists; Not Analyzed, Not Integrated in Briefing

- Yakuza arranged involvement of
  - Red Chinese
  - North Koreans
  - A Taiwanese element
- Aum Shinrikyo may have been used as "Red Herring" to deceive West
- Oriental faction plots to strike Russians after the successful first strike on West
- KGB/Russians aware, will counter
  - Plan pre-emptive strike against Oriental faction first
  - Have reserved most advanced, powerful energetics weapons for that purpose

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The Tom Bearden Website

Help support the research

Kill of Arrow DC-8, Gander AFB, Dec. 12, 1985

- Slide 1
- Slide 2
- Slide 3
- Slide 4
- Slide 5
- Slide 6

KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Soviet EM missile weapon strike practice two weeks earlier at Cape Canaveral
► Offset from night shuttle launch
► EM missile photographed by Bob Gladwin
► Associated marker beacon photographed
• Canadian Board split on findings
► Half thought icing, half disagreed intensely
► "Due to icing" approved with half absent
► Separate dissenting finding issued
• U.S. officials hiding Iran/Contra affair
► Feared terrorist bomb, MidEast sponsor
► Pressured Board, Gen. Off. bulldozed site
• Lack of icing on aircraft later validated

KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Eyewitness observed beams form in the sky
• Saw streak-down and strike of EM missile
– Struck right fuselage ahead of the engines
– Hole was burned through fuselage there
– Photo of hole published in AW&ST
– No explosive residues on hole
• Consistent with ignition and outgassing of plastics in forward cabin
• Consistent with pre-crash HCN deaths

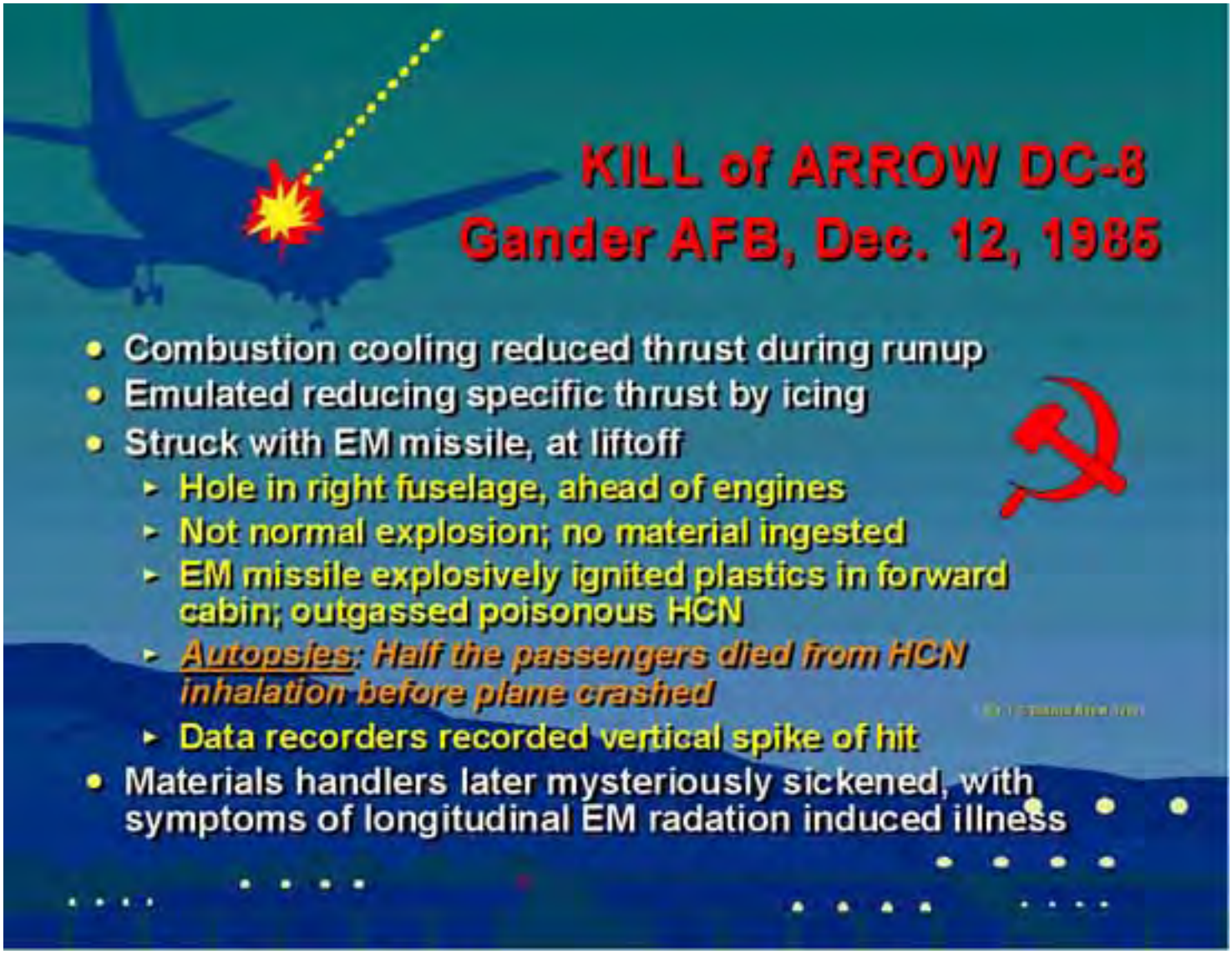
KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Combustion cooling reduced thrust during runup
• Emulated reducing specific thrust by icing
• Struck with EM missile, at liftoff
▸ Hole in right fuselage, ahead of engines
▸ Not normal explosion; no material ingested
▸ EM missile explosively ignited plastics in forward cabin; outgassed poisonous HCN
▸ Autopsies: Half the passengers died from HCN inhalation before plane crashed
▸ Data recorders recorded vertical spike of hit
• Materials handlers later mysteriously sickened, with symptoms of longitudinal EM radation induced illness

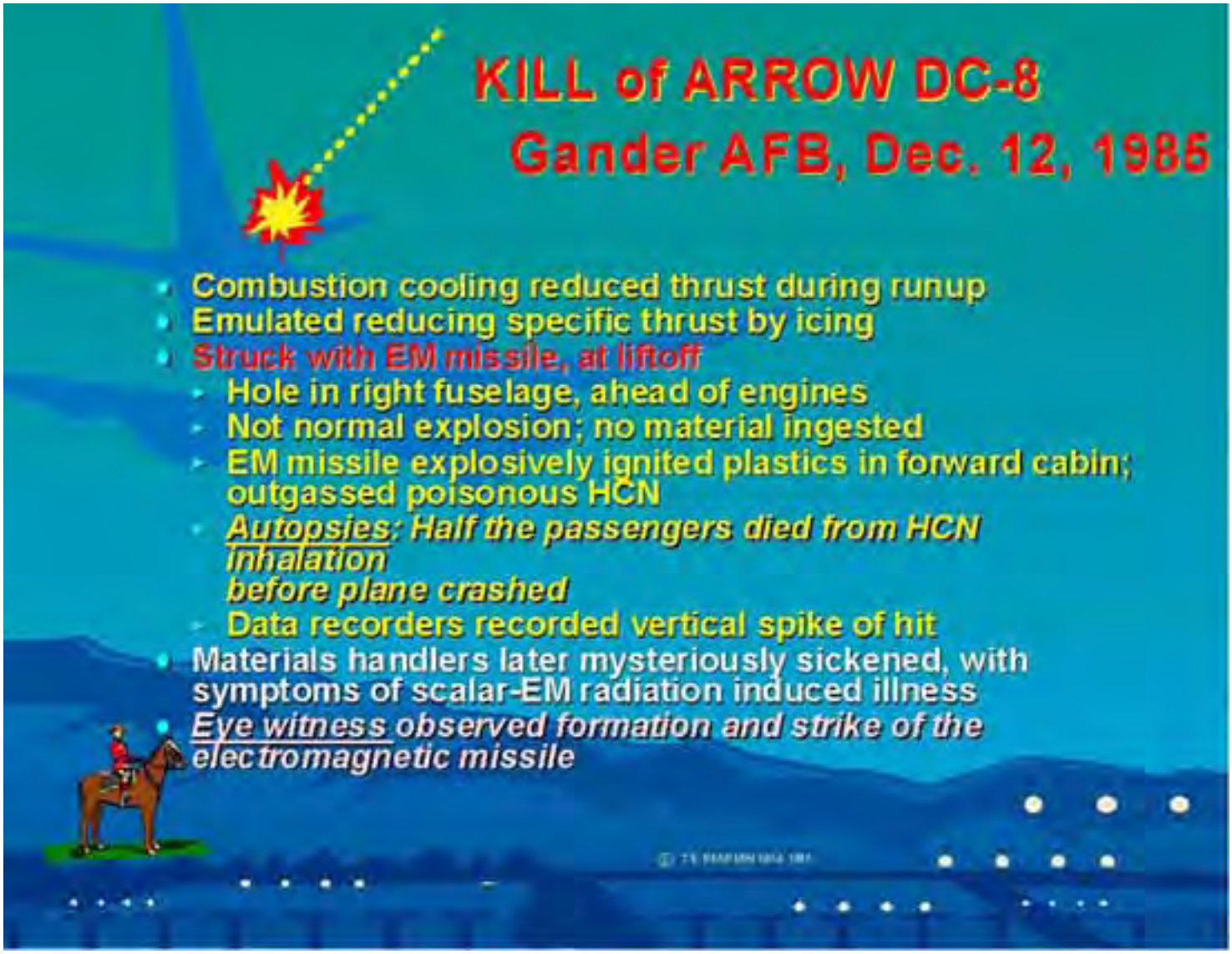
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Gander AFB, Dec. 12, 1985
Combustion cooling reduced thrust during runup
Emulated reducing specific thrust by icing
Struck with EM missile, at liftoff
Hole in right fuselage, ahead of engines
Not normal explosion; no material ingested
EM missile explosively ignited plastics in forward cabin; outgassed poisonous HCN
Autopsies: Half the passengers died from HCN inhalation
before plane crashed
Data recorders recorded vertical spike of hit
Materials handlers later mysteriously sickened, with symptoms of scalar-EM radiation induced illness
Eye witness observed formation and strike of the electromagnetic missile

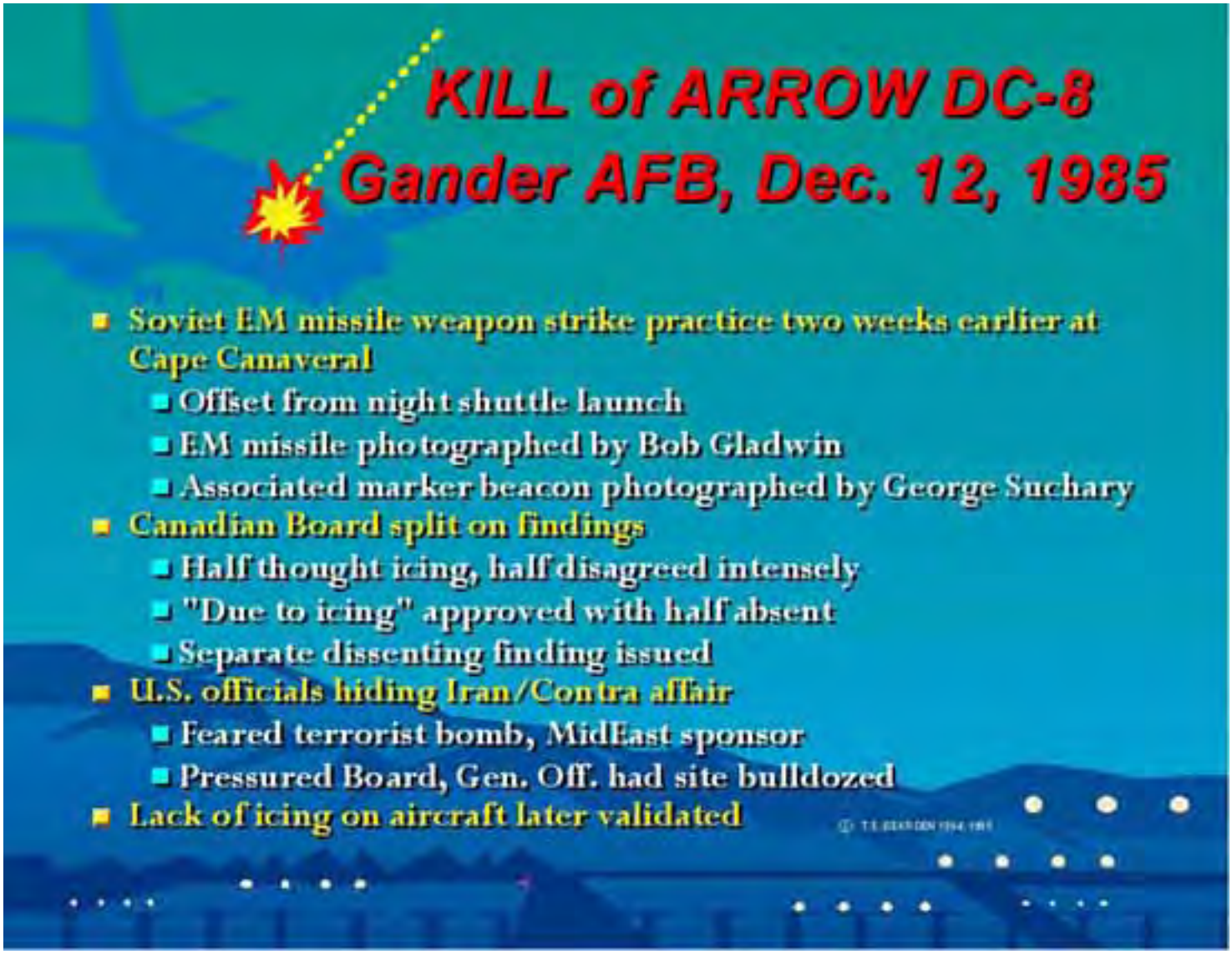
KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
Soviet EM missile weapon strike practice two weeks earlier at Cape Canaveral
Offset from night shuttle launch
EM missile photographed by Bob Gladwin
Associated marker beacon photographed by George Suchary
Canadian Board split on findings
Half thought icing, half disagreed intensely
"Due to icing" approved with half absent
Separate dissenting finding issued
U.S. officials hiding Iran/Contra affair
Feared terrorist bomb, MidEast sponsor
Pressured Board, Gen. Off. had site bulldozed
Lack of icing on aircraft later validated

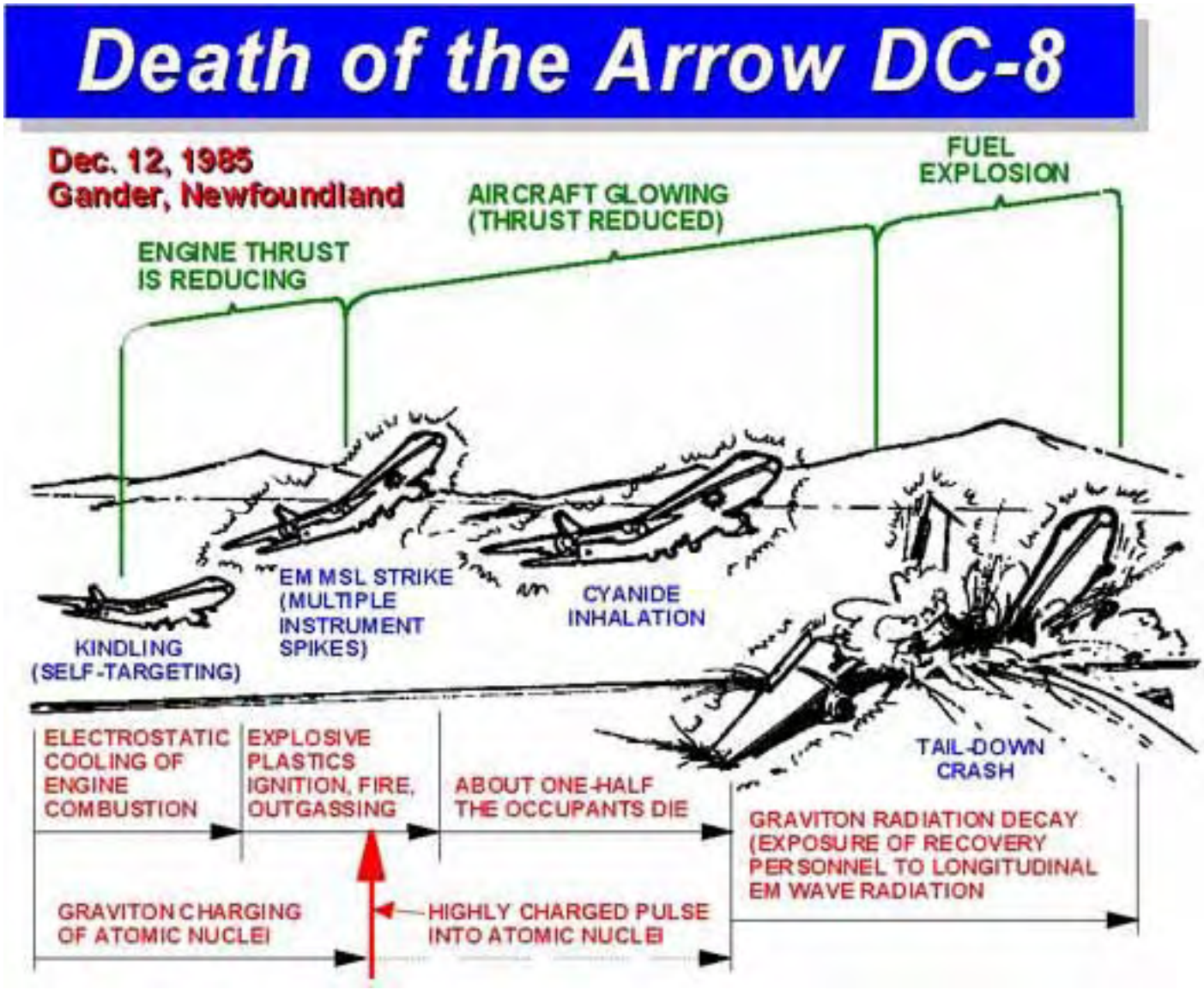
Death of the Arrow DC-8
Dec. 12, 1985
Gander, Newfoundland
ENGINE THRUST IS REDUCING
AIRCRAFT GLOWING (THRUST REDUCED)
FUEL EXPLOSION
KINDLING (SELF-TARGETING)
EM MSL STRIKE (MULTIPLE INSTRUMENT SPIKES)
CYANIDE INHALATION
TAIL-DOWN CRASH
ELECTROSTATIC COOLING OF ENGINE COMBUSTION
EXPLOSIVE PLASTICS IGNITION, FIRE, OUTGASSING
ABOUT ONE-HALF THE OCCUPANTS DIE
GRAVITON RADIATION DECAY (EXPOSURE OF RECOVERY PERSONNEL TO LONGITUDINAL EM WAVE RADIATION
GRAVITON CHARGING OF ATOMIC NUCLEI
HIGHLY CHARGED PULSE INTO ATOMIC NUCLEI

Satellite Photos of Plumes in Soviet Arctic Since 1974*

- Two aircraft flew through for analysis
  - Solid material, mostly ice, a little clay
  - Much colder than surrounding air
  - *Signature of cold exhaust from exothermic scalar interferometry operations*
  - No volcanic material
  - No radioactive material

- May be 2 to 3 times as many incidents
  - Only examined satellite imagery in winter
  - Only periodic satellite coverage
  - Hypothesized methane venting, cloud seeding

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*As of 1989, when this information was gathered

AUM SHINRIKYO
("SUPREME TRUTH" CULT)

Shoko Asahara, Leader

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Ashkhabad Problem and Its Solution

- ***PROBLEM:***
  - Stress increasing in two-plate fault zone
  - 1,000 shocks yearly
  - Kara Kum canal
  - Hydraulic pressure
  - 1948: Ashkhabad 80% destroyed by quake

- ***SOLUTION:***
  - Stress-relieve plate stresses from fault

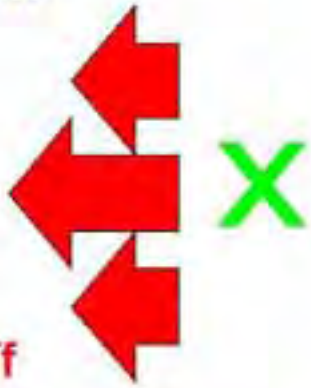

- ***IMPLEMENTATION:***
  - Induce nearby earthquake
  - Deceive by *predicting* a quake, setting off nuclear explosion

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Strange Characteristics of Iran Quake, Sep. 1978

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- **Signatures**
  - 7.4 on Richter scale
  - No aftershocks: 6.0 expected (normal)
  - Strange epicenter
  - Anomalous depth

- **Deception**
  - 10 MT Soviet nuclear explosion 36 hours before the quake
  - Prior disinformation regarding Soviet attempted development of focusing shock waves from underground nuclear explosions, to cause distant earthquakes

Iran Earthquake Sept. 1978

- Killed 25,000 Iranians
- Soviet city of Ashkhabad saved
- Soviets "predicted" quake in advance; then induced it
- Quake had serious anomalies (signatures)
- Deception measures were used by Soviets
  - Prediction in advance
  - "Theory" of quake-induction by nuclear explosions
  - Fired underground nuclear explosion as "Red Herring" candidate for cause

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Situation Now (Assessment)

- In May 1997: second A-10 pilot (lady), in pullup from night ordnance delivery on target, was struck with psychoenergetic weapon takeover. Sense of vertical was reversed. She perceived herself diving, sharply corrected, and dove headlong into the ground.

- Additional aircraft kills uncovered, including one 4-engine aircraft whose engines all failed. This closely repeats the earlier 1985-1987 scenario.
- Korean Airlines Flight 801 crashed on Guam on anniversary of loading of the atomic bomb that was dropped on Hiroshima in WW II. The Enola Gay, which dropped the bomb, took off from Guam in wee morning hours of August 6, 1945. The local opns order on Guam was also issued on Aug. 5.

- *Presently the Coalition (KGB/Communists/Aum Shinrikyo/Yakuza) is waiting for proper time to launch the final strike. It is still on.*

Situation Now (Assessment 2)

- April 97: Mind control test against Captain Button:
  - Demonstrates ability to control crewman in complex operations for more than one hour.
  - KGB requires one hour total QP crew control on a site to have crew disable insane QP wpns.
- Once QP systems disabled, Mindsnapper attacks and instantly kills every living thing in QP site area. Contaminates area for months (emits longitudinal EM wave radiation, which disrupt any life forms attempting to enter struck area). Sites nullified.
- Mind control over one crewman requires one weapon system plus up to 20-30 operators for controlling thoughts, hearing, perceptions, etc.
- *In Apr. 97, KGB building and deploying weapons and training crews. Ready for new attack 1999-2000.*

Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum
- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another

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Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.

- One terrorist, one light aircraft with spray tank
- One kilogram of anthrax
- Flies over greater metropolitan Washington, D.C.
- Calm night
- *1-3 million casualties result**
- *Most of those stricken will die*
- Presently little can be done to save the stricken civilians
- *Attacks on several population centers might produce some 10 million or more casualties*

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*Per OTA Report to Congress, 1993

Present Status of the WMD Threat to the United States

- Many foreign nations are hostile to the U.S. and sponsor terrorists
- Some 25 nations have WMD or are acquiring them
  - BW agents and weapons
  - Chemical agents and weapons
  - Nuclear materials and weapons
- Thousands of students and émigrés
- Infiltrated teams, BW, other WMD already
- Castro guerrillas infiltrated over the years
- Can do unacceptable damage to U.S. now
- *May reach first strike knockout capability*

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*Per OTA Report to Congress, 1993

Some Present Problems in the U.S. WMD Defense Capabilities

- No shelters (require overpressure, BW filtering, masks, showers, supplies)
- No stockpiled vaccines, medical supplies, immunoglobulins, masks, suits, food, fuel, generators, heaters, water purification units
- Totally insufficient medical facilities, personnel, and emergency response teams
- Triage, full martial law will be required
- No answer to massive decontamination problem
- State, county, city inadequately staffed and insufficiently trained for mass casualties
- Terrorist teams, BW agents, other WMD on site, waiting
- Water supplies, food, crops, farm animals also vulnerable
- Electric power grid, bridges, trains, railroads vulnerable
- Present medical science cannot save very many of the casualties, now or in the foreseeable future

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Internal Terrorist Threat with Weapons of Mass Destruction: Now & Future

TODAY:

- Sabotage
- Chemicals
- Biological agents
- Nuclear materials
- Powerful explosives
- Assassination
- Kidnapping and hostages
- Contamination
- Shoulder-fired AD missiles
- Terrorism

FUTURE ADDITIONS:

- Orthodox EM weapons
- Energetics EM biological warfare
- Scalar EM (energetics) weapons
- Scalar EM disease induction
- Alteration of behavior and emotions
- Alteration of memory
- Direct control of thoughts, perception
- Quantum potential weapons
- Psychoenergetics weapons
- Action-at-a-distance effects

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Attempt to Ban Energetics Weapons Worldwide

- On June 13, 1975, in a major speech Brezhnev urged the United States to agree on a ban of research and development of new kinds of weapons "more terrible than anything the world has known."
- On July 2, 1975 Brezhnev repeated his proposed ban on development of frightful new weapons, to a group of U.S. Senators.
- In August 1975, Ponomarev called for a ban on frightful new weapons of mass destruction.
- On Sept. 23, 1975 Gromyko presented a draft treaty agreement to the 30th Session of the UN General Assembly, for banning development of frightful new weapons.
- *No one had the foggiest notion what the Russians were talking about!*

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Brezhnev's Schedule

"We are achieving with detente what our predecessors have been unable to achieve with the mailed fist...
...by 1985 our power will be so irresistible that we can do what we wish anywhere on the globe."

Leonid Brezhnev,
in a secret 1973 meeting in Prague
with European Communist leaders.

"By the early 1980's we and our allies will control the high seas, space, and most of the earth's land area."

Kosygin,
to Imelda Marcos,
July 1978

In 1985-87, the Soviets did attempt to move, still constrained by nuclear dead man fuzing. That attempt was blocked, primarily by scalar EM countering demonstrations and dead man fuzing.

In April 1986, the first Soviet lab prototype of a quantum potential weapon specifically designed toward 10-min neutralization of nukes worldwide was gingerly tested against our U.S. airstrike on Libya. It was weakly tested in the "induced EMI" mode, for deception.

By 1990 that weapon was deployed and a new attack preparation phase was entered, scheduled for 1997.

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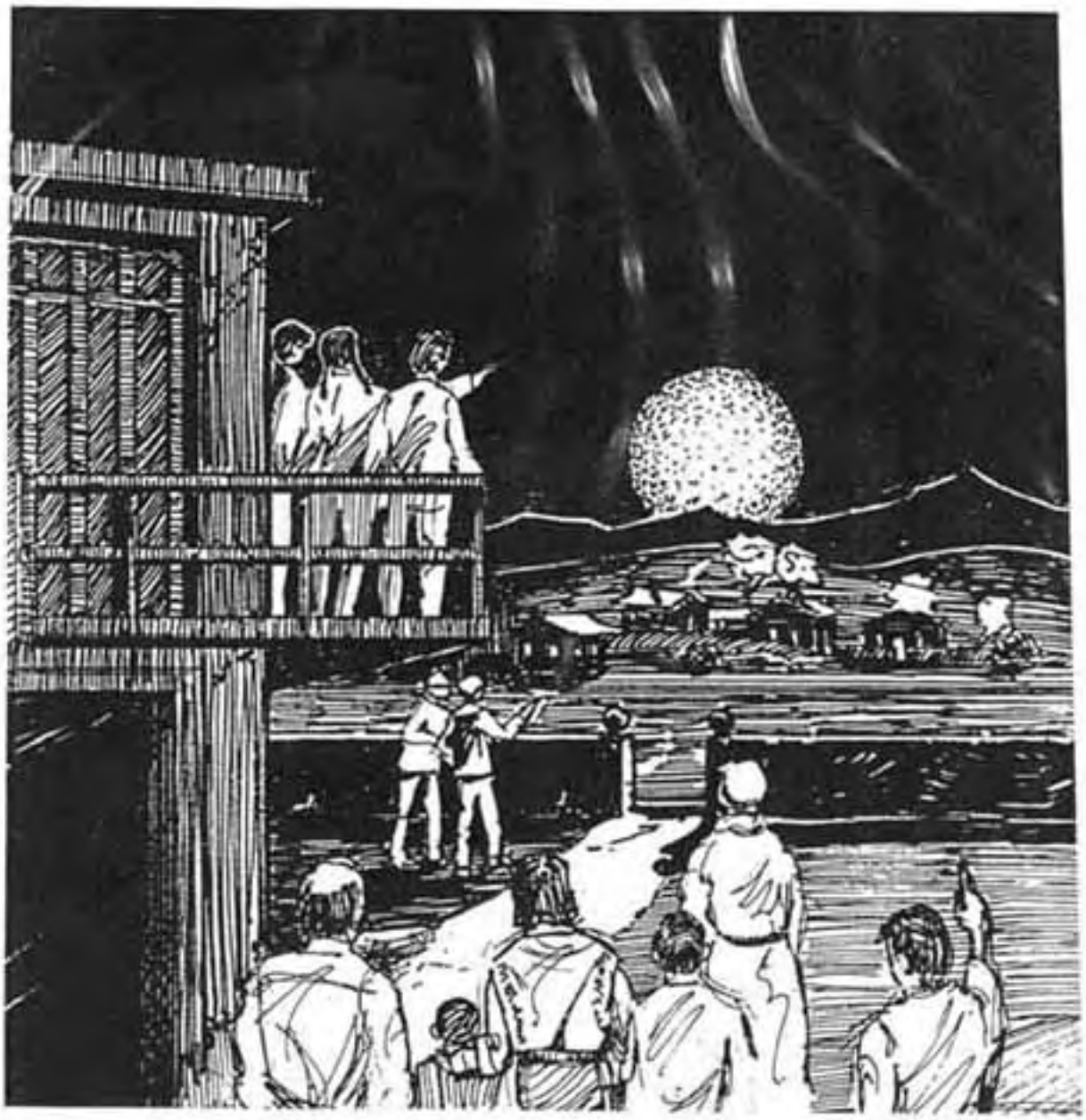

COLD EXPLOSION -- 9 April 1984 Near Kurils

And Formation and growth of spherical shell (globe)

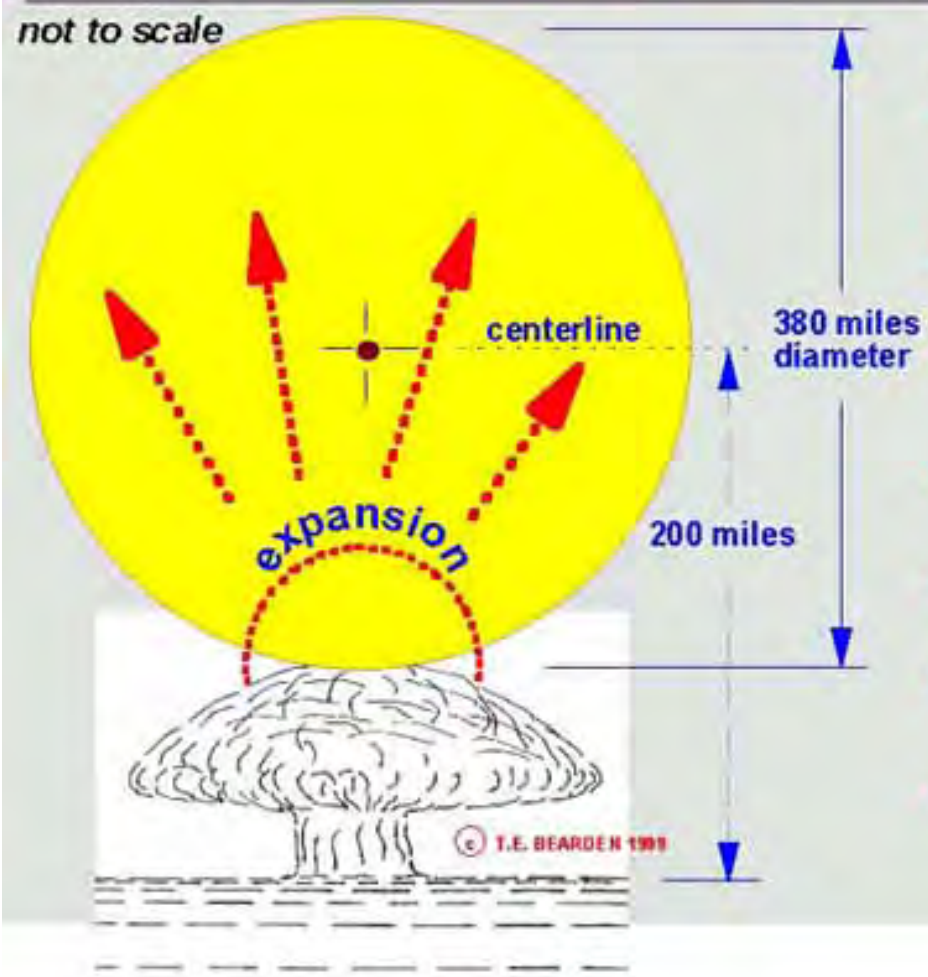

Sequence of Events

- Geyser of water rose rapidly from surface, mushroomed out
- Reached 60,000 feet altitude in two minutes
- Brilliantly glowing globe then appeared in top
- Globe increased greatly in size and altitude
- Reached diameter of 380 miles
- Center reached altitude of 200 miles
- Observed by multiple qualified pilots

COLD EXPLOSION -- 9 April 1984 Near Kurils

And Formation and growth of spherical shell (globe)

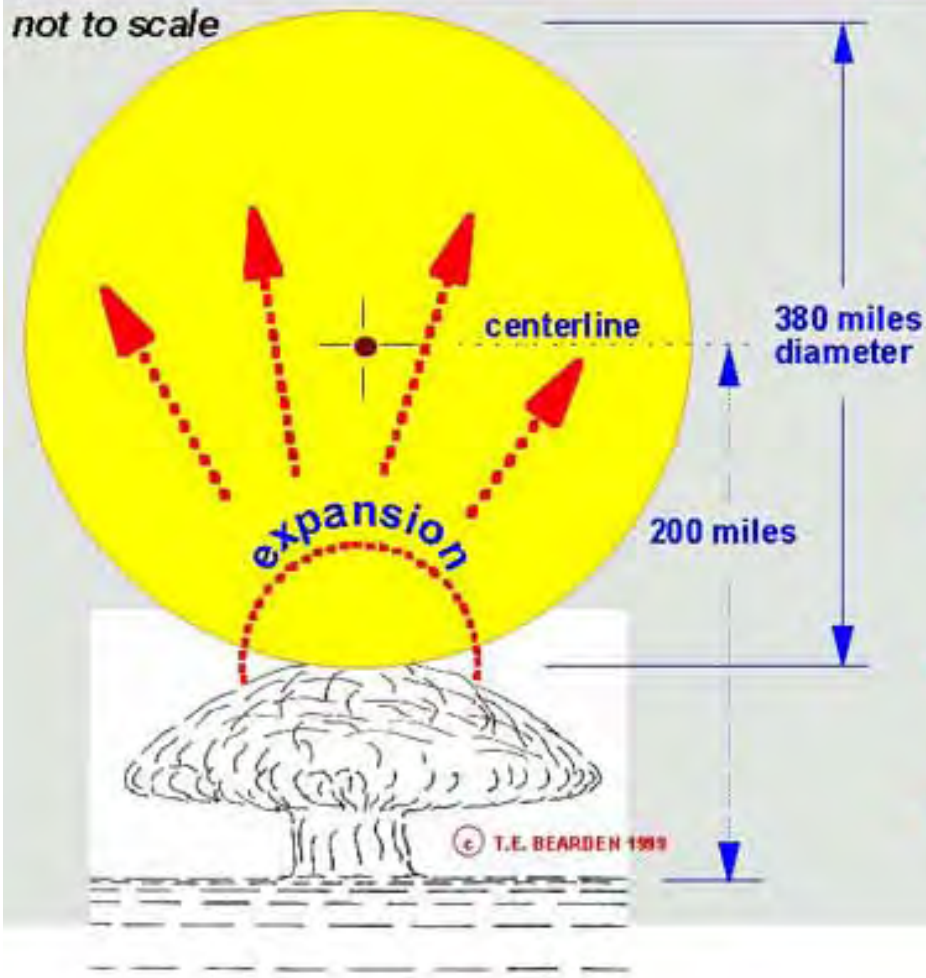

What They Were

- Superpotential interferometry using LWs
- First, a cold explosion just above surface
- Then small intense shell of glowing EM energy for 1-on-1 targeting
- Larger globe for large area as for ICBM targets approaching in zone
- With ST engines, can dud incoming nukes and all electronics
- Use in or out of Earth's atmosphere

COLD EXPLOSION -- 9 April 1984 Near Kurils
(Plus additional weapons effects)
JAL
Halo expanded to giant globe.
380 miles diameter, center over 200 miles
high.
© T.E. BEARDEN 1996

Countering Insane Mad Systems: Find Loophole, Exploit It

- If MADs not quantum potential systems, easily countered by instant QP strike which destroys targeted MAD weapons worldwide with certainty.
- Have to be certain of types of dead-man fuzing. All dead-man fuzing weapons must be included in the assured target list for the striking quantum potential weapon.

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- Multiple targeted MADS require multiple vacuum engines in the striking quantum potentials.
- Uncertainty and risk introduced if not certain of all MAD systems and all dead-man fuzing systems.

- Newest generation psychoenergetic LW interferometry weapons can instantly take over minds of all personnel on targeted sites, with targeted crews quickly disarming their own MAD weapons' launch capability as well as the weapons themselves.
- Mindsnapper then kills all living things and contaminates sites.
- Next generation QP Psy-En weapons can disrupt and destroy minds of an entire targeted national population. The nature of warfare moves irrevocably to the human mind, where of course the fundamental problem arises anyhow.

Next Generation Counter to Both Sane and Insane MAD Systems

- ***Localized quantum potential in an area, used in psychoenergetics mode***
  - Gradually produces mild, continuous hypnotic state
  - Targeted population remains entirely conscious, functional
  - Internal "word thoughts" emerge directly in subconscious
  - Targeted persons all unaware of these "word thoughts"
  - Operates somewhat similar to "post hypnotic suggestion"
  - Gradually changes emotions, psychological outlook
  - Over a period of time, deviates and entrains entire target population's outlook, belief structure, temperament
- ***Moves Psywar to inside the human component***
- ***Human minds are the only battleground***
- ***Can be accomplished without overt signature***
- ***Countered only by inserting same methodology into deeper mind level (collective unconscious)***

Simultaneous Dudding of Nuclear Weapons Worldwide

- Via quantum potential joining U235 and Plutonium in warheads
- Includes weapons airborne, underwater, in storage
- These are *transmutations of the nuclides themselves*
- *Part of the initial barrage launched by Aum/Yakuza/KGB*
- *Will occur in the first minutes of the strategic strike, following psychoenergetically crew-disabling QP weapons*

Note: Duds both overt and covert nuclear weapons and weapons-grade materials -- including "suitcase-delivered" covert weapons on site in Russia which otherwise provide dead man fuzing

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Simultaneous Dudding of Nuclear Weapons Worldwide

- Via quantum potential joining U235 and Plutonium warheads
- Includes weapons airborne, underwater, in storage
- These are not explosions, but are *transmutations and increased fissioning rates*
- *Part of the initial barrage launched by Aum/Yakuza/KGB*
- *Will occur in the first minutes of the strategic strike*

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Note: Duds both overt and covert nuclear weapons and weapons-grade materials.

The Tom Bearden Website

Help support the research

Operation Divine Wind II

Slide 1

Slide 2

Slide 3

Slide 4

YAKUZA &
AUM SHINRIKYO

DIVINE WIND II

U.S.

★ **A secret coalition of Yakuza/Aum Shinrikyo and KGB/Communist forces plan to launch a massive, surprise energetics attack on the United States, given a low-risk opportunity.**

★ **Major weapons utilized will be the scalar EM (energetics) superweapons (including quantum potential weapons) that were developed, deployed, and operated by the KGB under the former Soviet Empire, and continuing after its dissolution.**

KGB

★ **Yakuza/Aum crews have extensively trained and test-fired, from on-site in Russia. They have *leased* operational control of the first three generation energetics superweapons (which work by superpotential interferometry).**

MINDSNAPPER AND
PSYCHOENERGETICS

★ ***The Escalation Phase of interdicting and destroying actual U.S. targets (e.g., TWA-800, two A-10s) is already underway.***

★ ***The first blow in the Strike Phase will dud all nuclear weapons and weapons materials worldwide, in minutes; destroy special ship and energetics weapon sites instantly, disable 99% of the U.S. population instantly, and kill 80% of targeted populations in from 10 minutes to 3 days.***

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QUANTUM
POTENTIAL

YAKUZA &
AUM SHINRIKYO

U.S.

DIVINE WIND II

- ★ A secret coalition of Yakuza/Aum Shinrikyo and KGB/Communist forces plans to launch a massive, surprise energetics attack on the United States and its allies, given the first low-risk opportunity.

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KGB

- ★ Attack was thwarted twice in 1997 by a small nation countering with QP weapons.
- ★ KGB psychoenergetics counter for the last QP weapon counter was tested in April 1997.
- ★ Ready time for a new scheduled attack is latter quarter 1999 through first half of 2000.

YAKUZA &
AUM SHINRIKYO

DIVINE WIND II

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- ★ **A secret coalition of Yakuza/Aum and KGB/Communist forces will launch a massive, surprise, strategic attack on the United States in 1997.**
- ★ Major weapons utilized will be the scalar EM (energetics) superweapons that were developed, deployed, and operated by the KGB under the former Soviet Empire, and continuing after its dissolution.
- ★ Yakuza/Aum crews have extensively trained and test-fired, from on-site in Russia. They have *leased* operational control of the energetics superweapons.
- ★ *Escalation Phase of interdicting and destroying actual U.S. targets (e.g., TWA-800) is already underway.*
- ★ *The first blow in the Strike Phase will dud all nuclear weapons and weapons materials worldwide, in minutes; destroy special ship and energetics weapon sites instantly, and kill 80% of targeted populations in 3 days.*

KGB/COMMUNISTS

MINDSNAPPER

QUANTUM
POTENTIAL

OPERATION DIVINE WIND II

Three Phases and Support

Operational Phases

- Phase I: On-Site Training Phase (Completed)
- Phase II: Escalation Phase (In Progress)
- Phase III. 1997 Strategic Strike on the U.S.
  - *First strike (QP) in Phase III duds all nuclear weapons and nuclear powerplants worldwide, in minutes*
  - *Psychoenergetic strike (QP) disables people instantly*
  - *Mindsnapper attack of special assets for 100% success*
  - *QP initiation of fast-acting, lethal diseases kills 80% of targeted populations in three days or less*

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Support Plans

- Plan A: Feints, Deception, Sabotage, and Terrorism
- Plan B: Testing and Test Range
- Plan C: Worldwide Weather Engineering
- Plan D: Strategic and Combat Intelligence

Advanced EMBW Applications

- Covert EMBW: Examples
  - Activate materials and their potentials with ST disease engines. Potentials superpose and their infolded ST dynamics diffuse
  - Activate water's structuring (H-bonding) potential with disease engines
  - Bias electrical power grid ground fields by weak diseases
  - Employ disease-structured quantum potential in distant area
- Overt death ray (mind snapper)
  - Powerful scalar EM pulse in target area "jerks" rate of flow of time
  - The "time snap" sharply separates mind from body and each cell
- EMBW CM:
  - Irradiate bodies with longitudinal EM waves; self-converts to t-pumping and produces exact amplified ST antiengine
  - Antiengine arises out of local ST, affects all parts of all cells
  - Cells are t-charged with antiengine structure
  - Continuing action restores regenerative and immune systems and reverses cellular damage

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EM Biological Warfare (EMBW)

- KGB/Communists have developed highly effective
  - Electromagnetic biological warfare (EMBW)
  - Counters to orthodox biological warfare
  - Mass death ray weapons
    - Small version of "mindsnapper" tested in Afghanistan
    - Killed occupants in two villages, in separate strikes
    - Unusual aspects (so-called "smerch" gas)
- Russia/KGB is the only group with a complete counter to biological warfare, either covert or overt, and to EMBW
- EMBW (covert and overt) is a preferred option for KGB
  - MAD Doctrine is completely destabilized for a sufficiently covert Russian EMBW strike
  - Situation has existed for at least two decades
  - Can alter germs, bacteria, viruses of specific kind, in a specific target area, to produce antibiotic-resistant strains
  - Can induce any kind of cellular disease or damage at a distance
- U.S. national characteristic: no reaction to slowly increasing threat

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Microwave Radiation of U.S. Embassy in Moscow

Former U.S. Embassy in Moscow.

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter?)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

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Pentagon EMI Studies, 1989

Washington Post, 22 Jan. 1989, p. A4

- Analysts of severe EMI effects in strike on Libya, 1986
  - performed major 3-year, 66-man study
  - Blamed effects on U.S. forces' own signals
  - Did not know of any other "signals" present
  - Knew nothing of quantum potential weaponry, energetics weaponry
- 7-month preliminary study
  - Severe EMI Problem exists
  - EMI shielding often waived in our weapon systems
  - Thousands of conflicts possible
- Also studied UH60 Blackhawk helicopter problems (which *were* due to its lack of good EMI shielding, and not quantum potentials)
  - uncommanded turns
  - Five EMI crashes 1982-1989
  - $175 M program to shield it
- So found that U.S. transmission combinations can
  - Affect aircraft flight control
  - Turn off fuel supply
  - Cause uncommanded dive/turn
  - Bring down U.S. warplanes
- *Actually, Libyan EMI was induced by Soviet quantum potential tests which can do all those things and much more*

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EM Missile Practice

- EM Missile Practice
  Latter Sept. - Early Nov. 1996
  Melbourne, Australia
- Deception: Using EM Missile to Reinforce Notion of SAM Attack
  Saturday evening, Nov. 16, 1996
- Intelligence Probe: Insuring U.S. Still Unaware of Energetics Weaponry
  Thursday, December 12th, 1996
- EM Missile Strike, Offset from Night Shuttle Launch, Cape Canaveral, Florida
  The Smoking Gun in November 1985
- Distant Operator Onsite in Russia Slew Away Registration Point
  Marker Beacon over Night Shuttle Launch, 26 November, 1985
- EM Missile Practice and Deception
  November 17, 1996

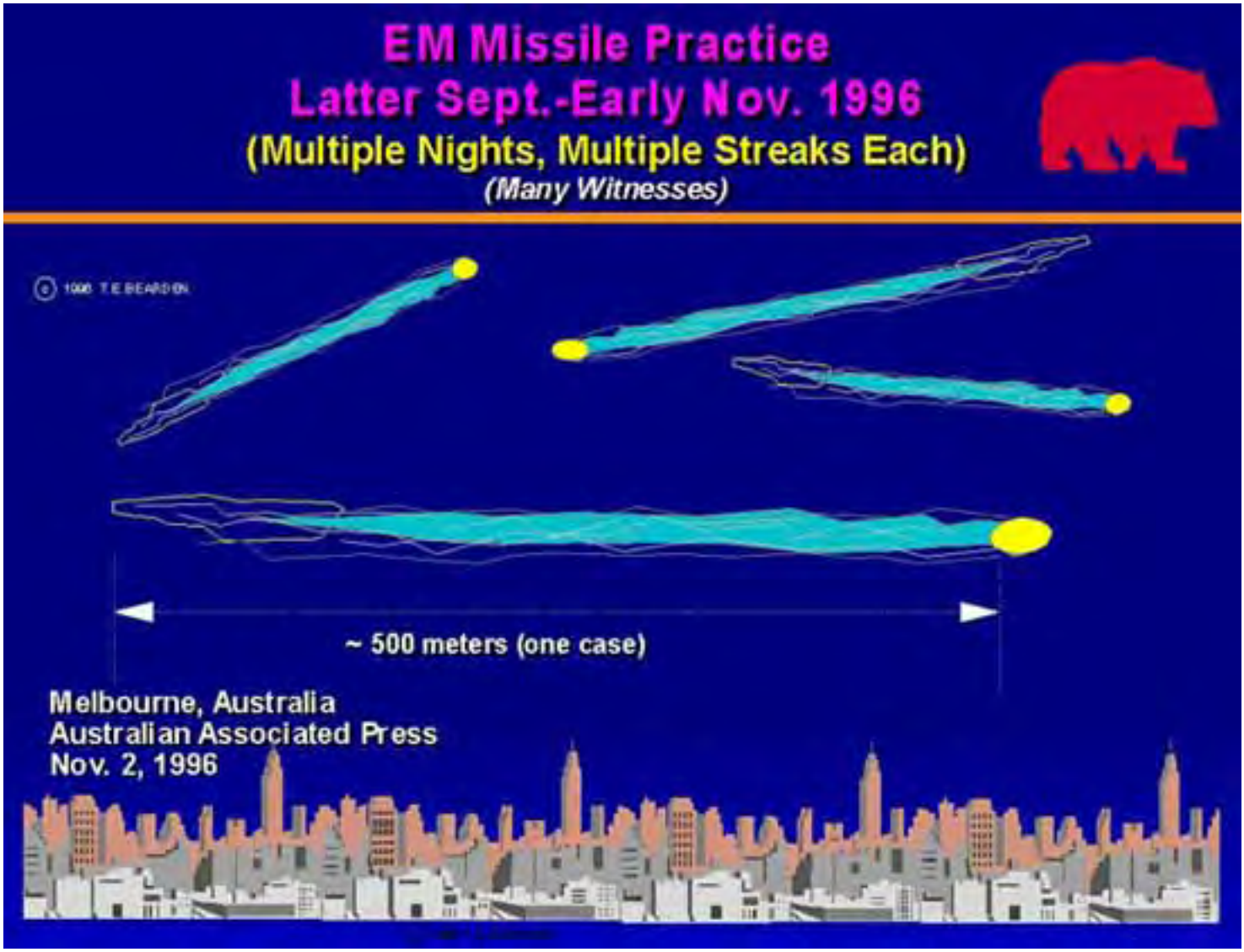
EM Missile Practice
Latter Sept.-Early Nov. 1996
(Multiple Nights, Multiple Streaks Each)
(Many Witnesses)
© 1996 T.E.BEARDEN
~ 500 meters (one case)
Melbourne, Australia
Australian Associated Press
Nov. 2, 1996

Deception: Using EM Missile to Reinforce Notion of SAM Attack

Saturday Evening
Nov. 16, 1996

Note: Meteor shower was forecast, which provided perfect decoy to FBI investigators, to steer them off the true scent.

Pakistan International Airlines Flight 712, just after takeoff from John F. Kennedy Airport, on path similar to that taken by TWA Flight 800, July 17, 1996

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Intelligence Probe: Insuring U.S. Still Unaware of Energetics Weaponry
Thursday
Dec. 12, 1996
Pilot sighted what he called a "green flare".
No danger, no evasive action.
Saudi Arabian Airlines 747
en route from Riyadh, Saudi Arabia
to John F. Kennedy Airport.
At 12,000 ft., not far from where
TWA Flight 800 was killed on July 17, 1996
FBI: "Probably a meteorite."
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EM Missile Strike, Offset from Night Shuttle Launch

Cape Canaveral, Florida

PHOTO BY BOB GLADWIN

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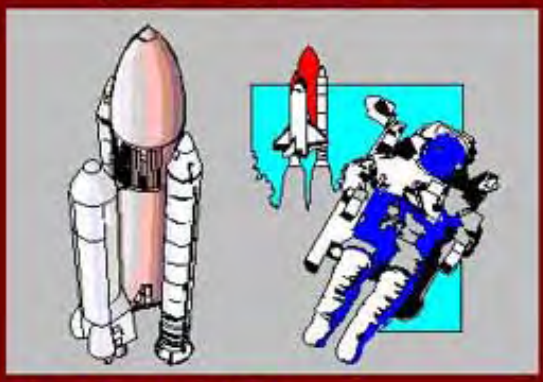

The Smoking Gun in Nov. 1985

Distant Operator Onsite in Russia
Slews Away Registration Point
© T.E. BEARDEN 1995, 1999.
MARKER BEACON
Over Night Shuttle Launch
Cape Canaveral, Florida
26 Nov 1985
Photographed by George Suchary
28 Nov 1985
Two weeks later, the same weapon killed the Arrow DC-8
at its takeoff from Gander, Newfoundland.

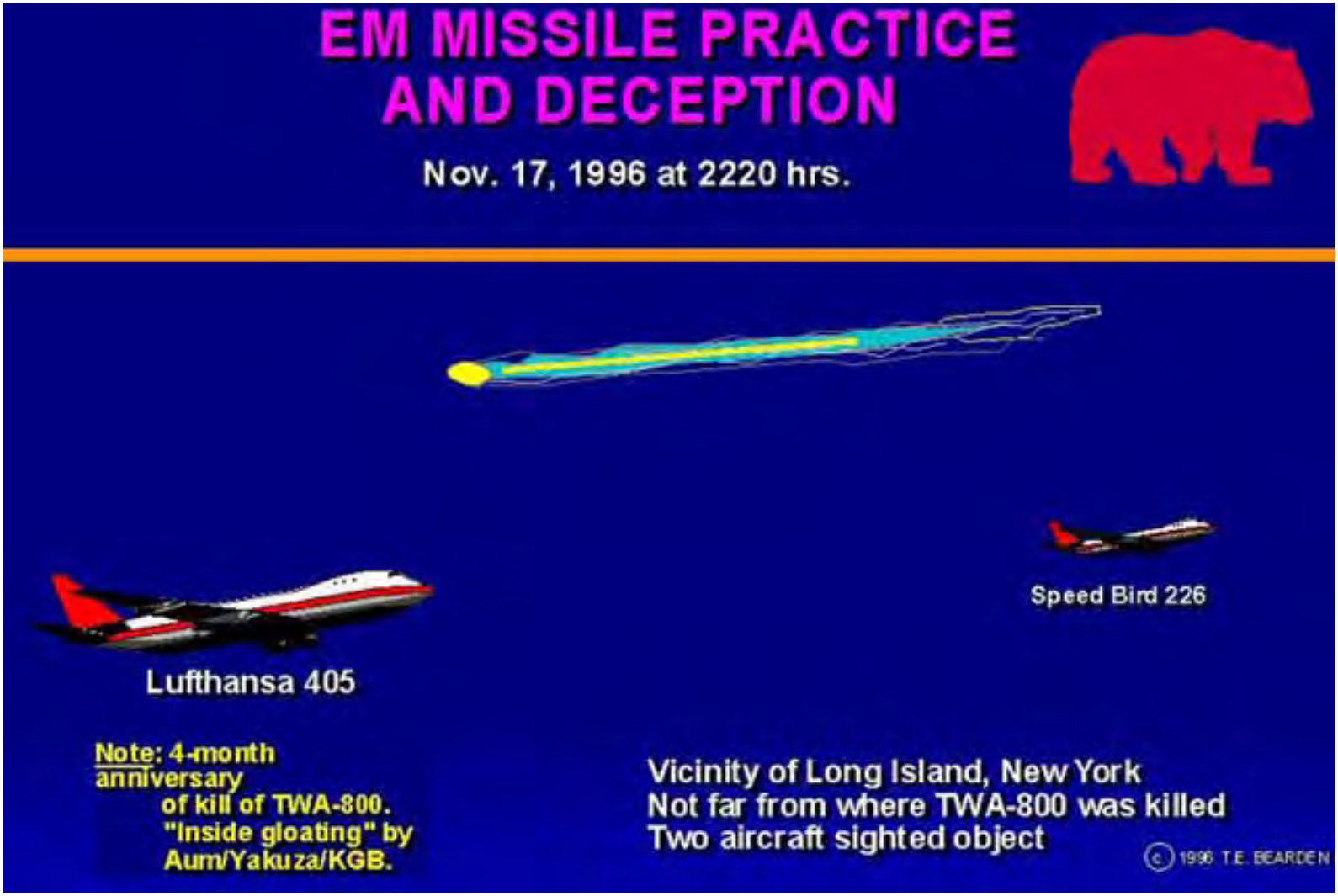
EM MISSILE PRACTICE
AND DECEPTION
Nov. 17, 1996 at 2220 hrs.
Speed Bird 226
Lufthansa 405
Note: 4-month
anniversary
of kill of TWA-800.
"Inside gloating" by
Aum/Yakuza/KGB.
Vicinity of Long Island, New York
Not far from where TWA-800 was killed
Two aircraft sighted object
© 1996 T.E. BEARDEN

Subdivisions of Soviet Energetics

NONLIVING SYSTEMS

Energetics

- Nonliving systems
- Scalar Interferometry
- Action-at-a-Distance
- Quantum Potential
- Vacuum Engines
- Spacetime Structuring
- Material, Field Effects
- Nuclei, Lattice Changes
- Hidden EM Variables
- SWZ Effects

LIVING SYSTEMS

Bioenergetics

- Living Systems (Bodies)
- Cells, cellular changes
- Master Cell Control (Popp)
- Spacetime Structuring
- Disease Induction, Remission
- Action-at-a-Distance
- Quantum Potentials
- Scalar Interferometry
- Hidden EM Variables
- SWZ Effects

Psychoenergetics

- Living Systems (Minds)
- Thoughts, Memories, Emotions
- Conscious/Unconscious Minds
- Spacetime Structuring
- Species, Biospheric Minds
- Action-at-a-Distance
- Quantum Potentials
- Scalar Interferometry
- Hidden EM Variables
- SWZ Effects

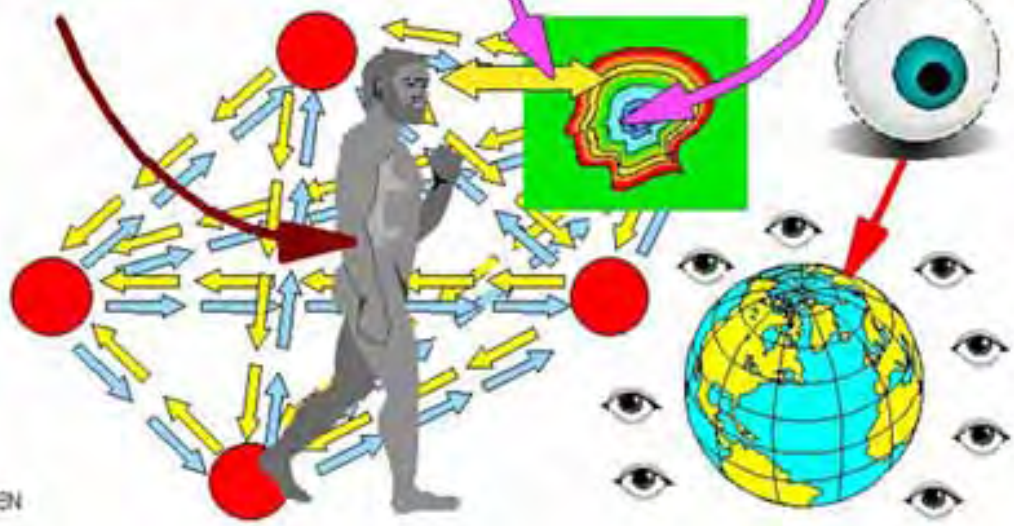

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Communism's Goal

- "War to the hilt between communism and capitalism is inevitable. Today, of course, we are not strong enough to attack... To win we shall need the element of surprise. The bourgeoisie will have to be put to sleep. So we shall begin by launching the most spectacular peace movements on record. There will be electrifying overtures and unheard-of concessions. The capitalist countries, stupid and decadent, will rejoice to cooperate in their own destruction. They will leap at another chance to be friends. As soon as their guard is down, we shall smash them with our clenched fist."

Dimitry Z. Manuilsky
Lenin School of Political Warfare, Moscow
(circa 1934)

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Manuilsky's Goal vs. Status Today

Manuilsky, 1934	Situation, Dec. 1996
▪ War is inevitable.	▪ Has not changed.
▪ Not strong enough to attack now.	▪ Strong enough now; preparations completed. Need right opportunity.
▪ Need surprise.	▪ Have achieved total surprise.
▪ Must put us to sleep.	▪ We are sound asleep.
▪ Need most spectacular peace movement on record.	▪ Done. We think the Russian threat gone, cold war ended.
▪ Electrifying overtures, unheard-of concessions.	▪ Done, and still occurring every day. It has worked beautifully.
▪ Capitalists will cooperate.	▪ We are cooperating in spades!
They will leap to be friends.	▪ We've leaped, and are leaping.
▪ They will let down their guard.	▪ No ABM, junked lots of nukes, shrunk our forces to the bone.
▪ We'll strike them then.	▪ They would have struck (twice) in 1997, but for deterence by another nation (not U.S.) having QP weapons
	▪ *They are still looking for a risk-free opening to strike*

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Professor Hellman, German Scientist Released from Work in Soviet Union

- Worked in Soviet Union after WWII
- Eventually escaped to Germany, then to Brazil (handsome offer)

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- Took part in highly unusual Soviet energetics development and experiments
- Large areas of the sea could be and were *suddenly frozen*
- *No particular attention was paid to this information by highly qualified scientists*
- *In intelligence terms, this is A-1 information of the highest caliber*
- *Bohm also was invited to Brazil, which started an energetics weapon program. Brazil developed such weapons including weak quantum potential weapons (0.95 confidence)*

Hemispheres of Light

- March 20th, 1969
  Caribbean and Western North Atlantic
- Hemisphere and Globes, 1977
  24 March, 1977
- Virgin Islands Incident
  August 1969
- Typical Shield Test, Northern Route to Japan
  June, 1982

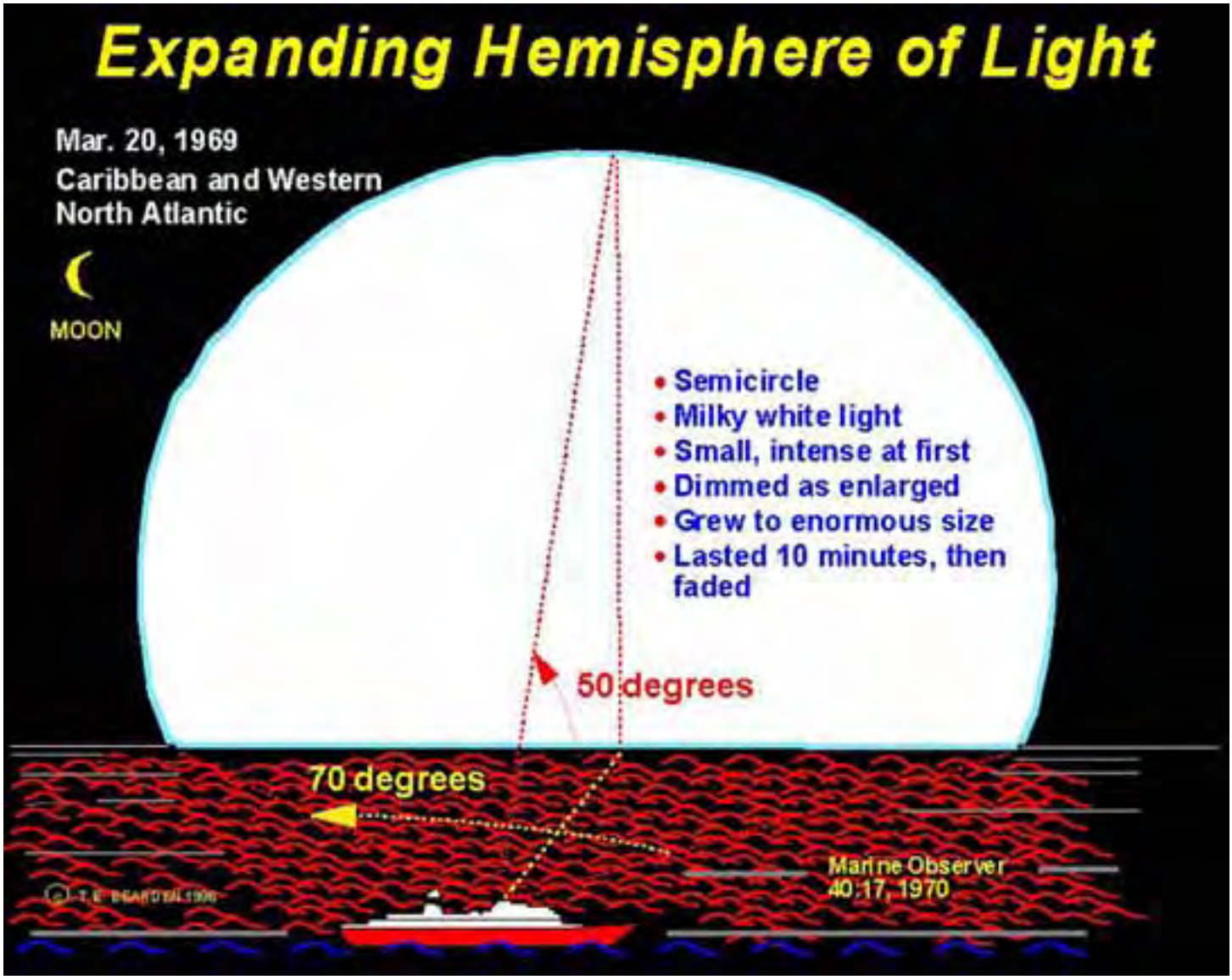
Expanding Hemisphere of Light
Mar. 20, 1969
Caribbean and Western
North Atlantic
MOON
• Semicircle
• Milky white light
• Small, intense at first
• Dimmed as enlarged
• Grew to enormous size
• Lasted 10 minutes, then faded
50 degrees
70 degrees
Marine Observer
40:17, 1970

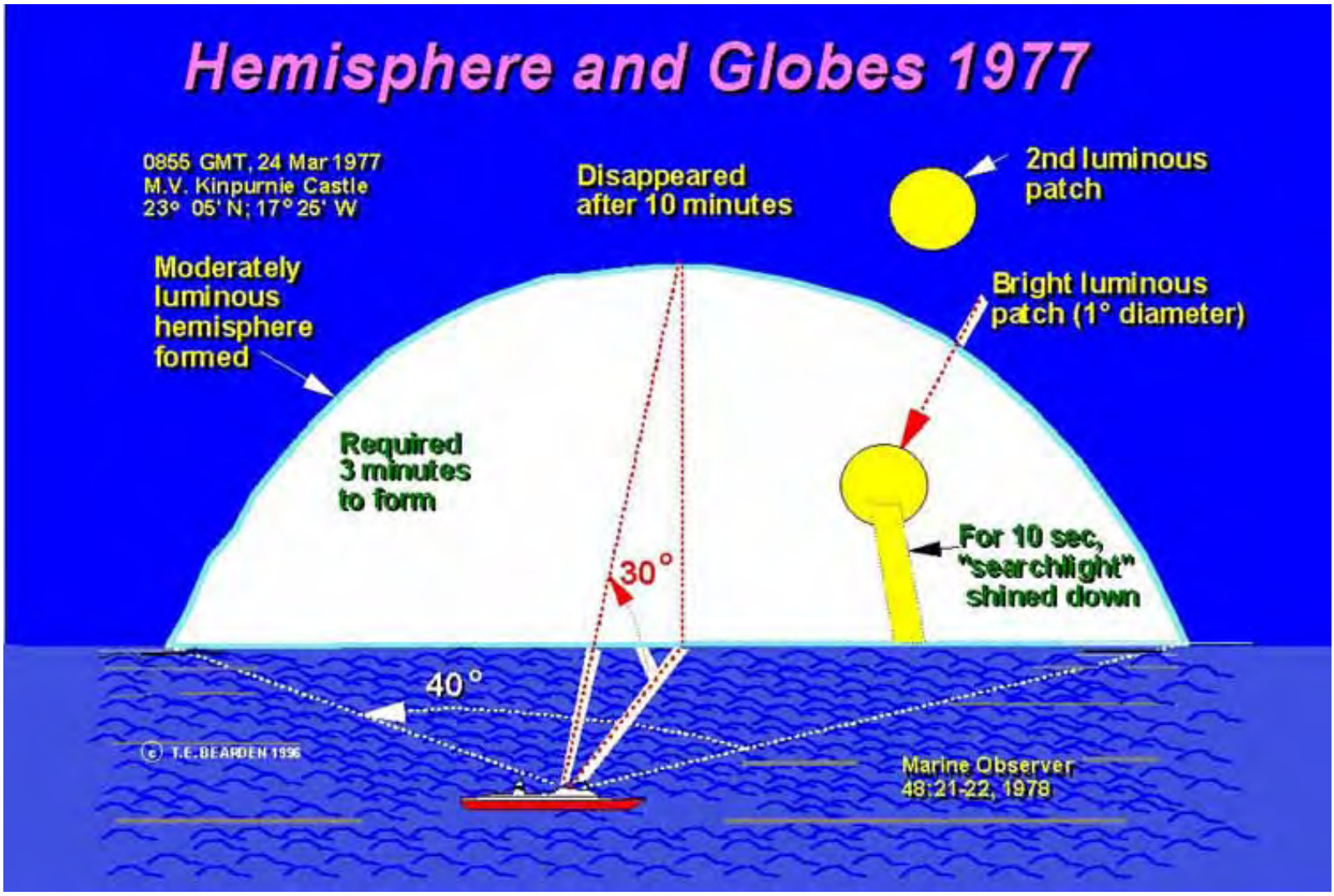
Hemisphere and Globes 1977
0855 GMT, 24 Mar 1977
M.V. Kinpurnie Castle
23° 05' N; 17° 25' W
Disappeared after 10 minutes
2nd luminous patch
Moderately luminous hemisphere formed
Bright luminous patch (1° diameter)
Required 3 minutes to form
For 10 sec, "searchlight" shined down
30°
40°
© T.E. BEARDEN 1996
Marine Observer 48:21-22, 1978

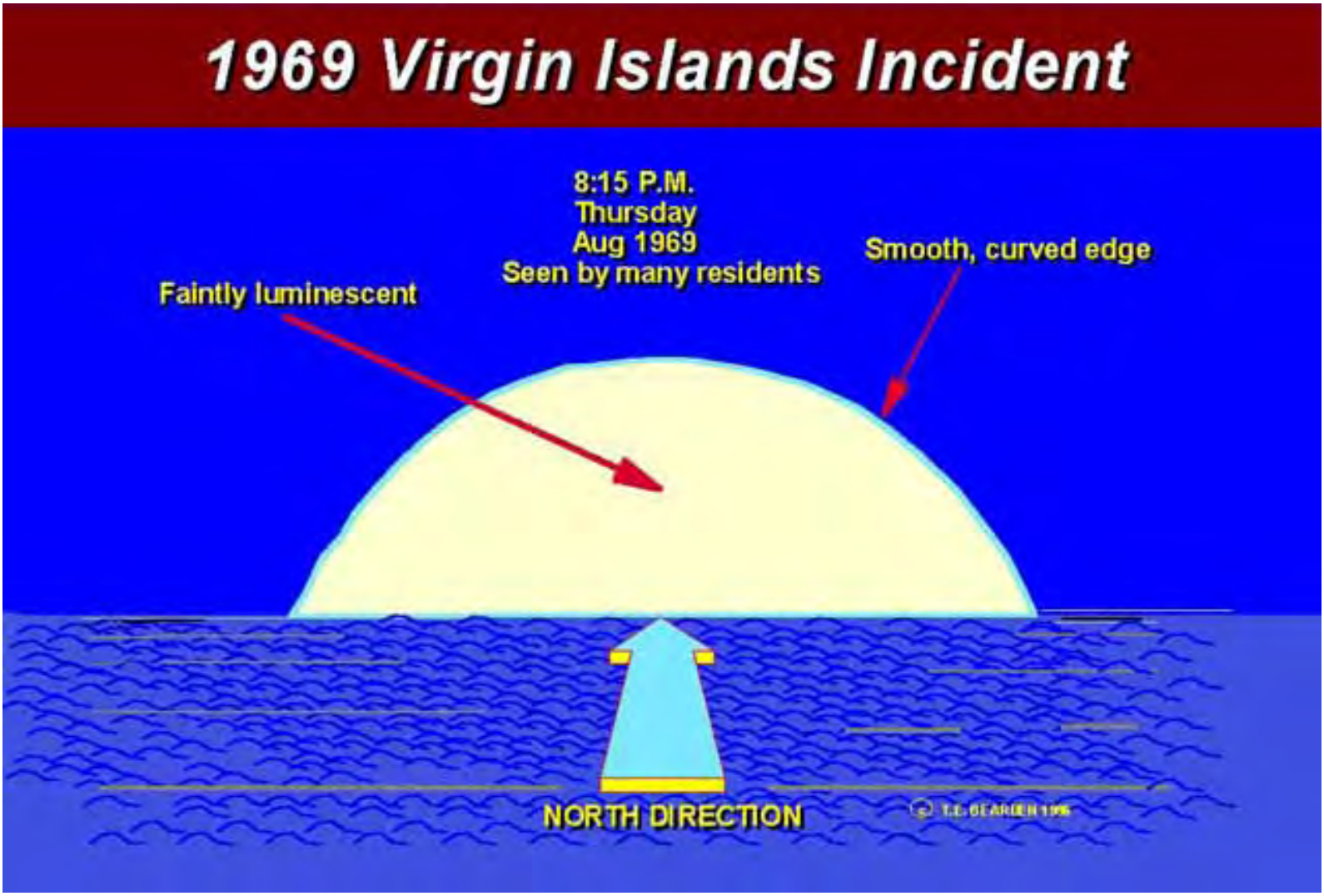
1969 Virgin Islands Incident
8:15 P.M.
Thursday
Aug 1969
Seen by many residents
Smooth, curved edge
Faintly luminescent
NORTH DIRECTION

Typical Shield Test, Northern Route to Japan
18-27 km diameter
Asahi Evening News, Tokyo
June 22, 1982
Multiple tests seen per month, for years.
Pilots simply ceased reporting them.

How Could Such Superweapons Ever Be Concealed?

- Arthur C. Clarke's law states:

  "Any sufficiently advanced technology is indistinguishable from magic."

- To U.S. scientists, "magic" means "impossible"
- Longitudinal EM waves and LW interferometers have been regarded as fantasy and impossible
- To deceive foe on rather open use of unknown technology without discovery:

  "Disguise its uses as understandable accidents, human error, acts of nature, other known technology, etc."

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Soviets Easily Concealed These Superweapons for Four Decades

- Intensive Soviet deception plan utilized
  - Embedded in other weapon system tests
  - Made to resemble natural acts, accidents, etc.
  - Open science releases coordinated to show Russian scientists worked on "normal" science
- West thought Russian scientists inferior
- U.S. scientific community was and is dogmatic, and fiercely suppresses real scientific innovation
- Terribly flawed electrodynamics not ruthlessly shaken and changed in West

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- West had no basis for understanding energetics

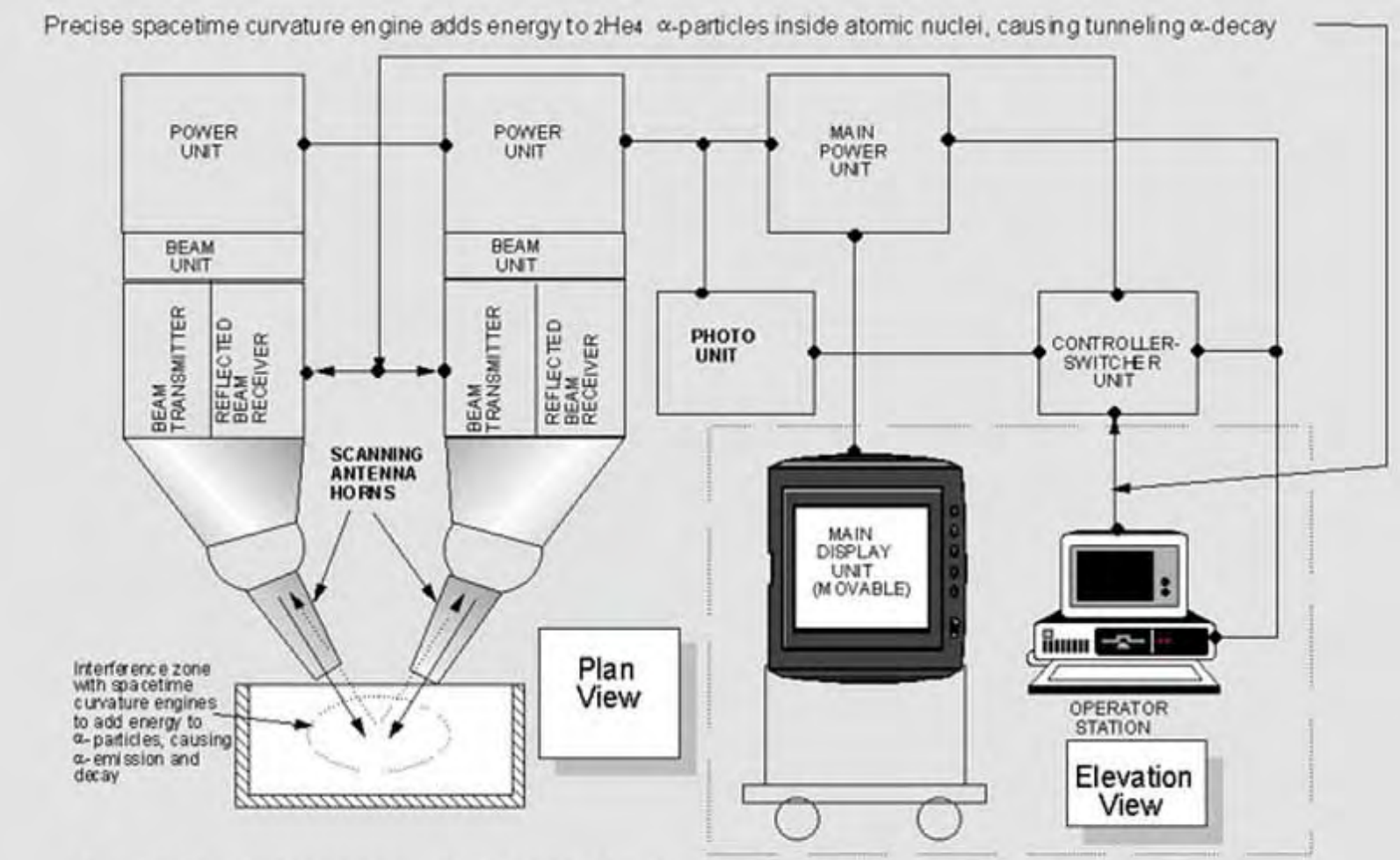

Figure 26. Microscope-type, laser-like interferometer for inducing quick α-decay in samples of otherwise longer-lived isotopes.

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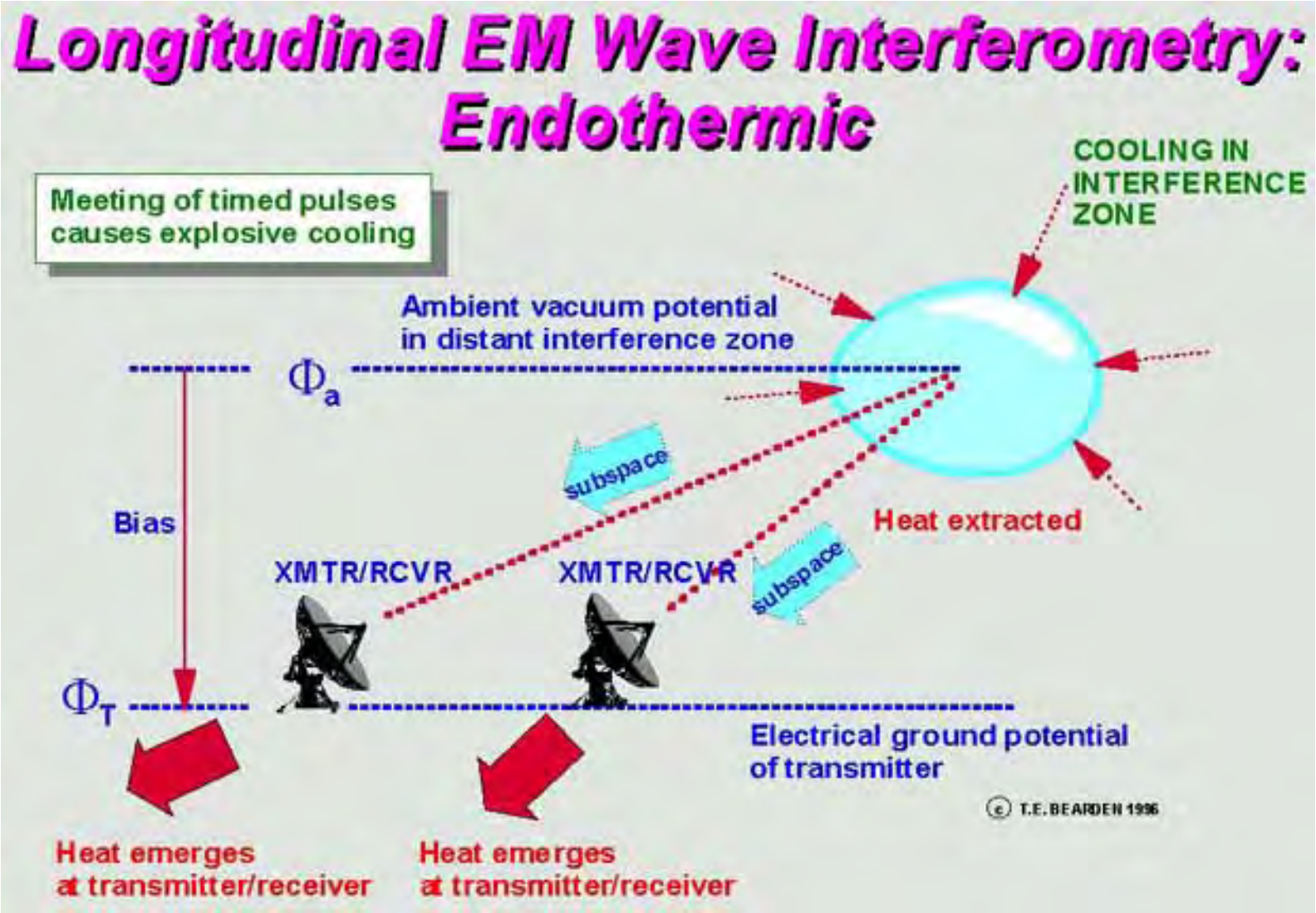
Longitudinal EM Wave Interferometry: Endothermic
Meeting of timed pulses causes explosive cooling
COOLING IN INTERFERENCE ZONE
Ambient vacuum potential in distant interference zone
Φ_a
subspace
Bias
Heat extracted
XMTR/RCVR
XMTR/RCVR
subspace
Φ_T
Electrical ground potential of transmitter
© T.E. BEARDEN 1996
Heat emerges at transmitter/receiver
Heat emerges at transmitter/receiver

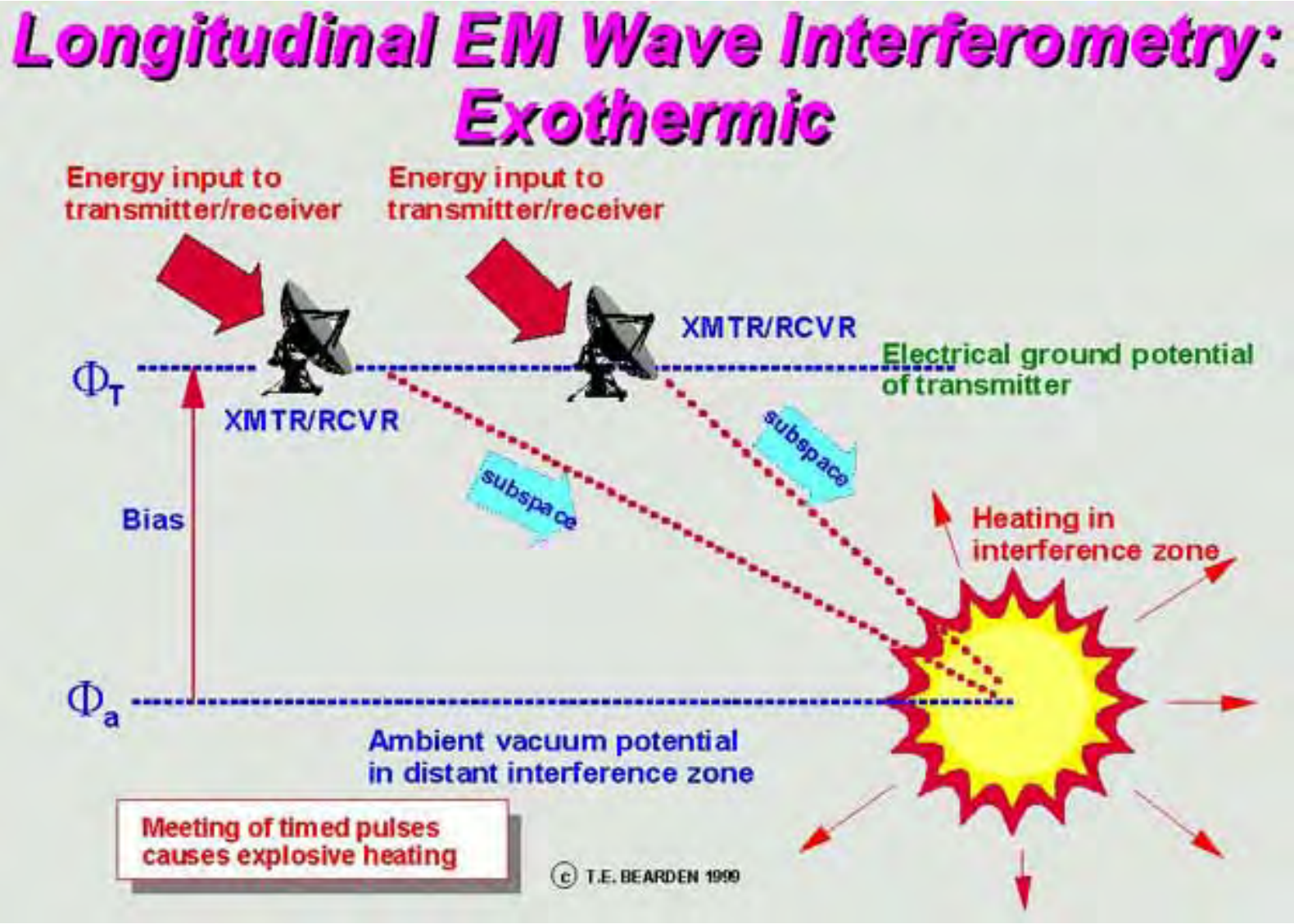
Longitudinal EM Wave Interferometry: Exothermic
Energy input to transmitter/receiver
Energy input to transmitter/receiver
XMTR/RCVR
XMTR/RCVR
Electrical ground potential of transmitter
Φ_T
subspace
subspace
Bias
Heating in interference zone
Φ_a
Ambient vacuum potential in distant interference zone
Meeting of timed pulses causes explosive heating
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The Tom Bearden Website

Help support the research

U.S. Air Attack on Libya
April 1986

- Slide 1
- Slide 2
- "Washington Post" Article
  January 22, 1989

U.S. Airstrike on Libya
April 1986*
• 33 U.S. AIRCRAFT IN STRIKE
• MANY HIGH-POWERED TRANSMITTERS
– COMMUNICATIONS
– JAMMERS
– RADARS
• SEVERE, UNEXPECTED "EMI" ENCOUNTERED
– ONE F-111 DOWNED
– NUMEROUS WEAPONS WENT ASTRAY
– THREE FOREIGN EMBASSIES DAMAGED
– SEVEN AIRCRAFT FORCED TO ABORT
• COMMANDERS: "US OR THEM?"
*Washington Post, 22 Jan. 1989, p. A4
Mild quantum potential weapon tested against electronics in U.S. aircraft and missiles
EM energy arises from every point in spacetime inside the electronics

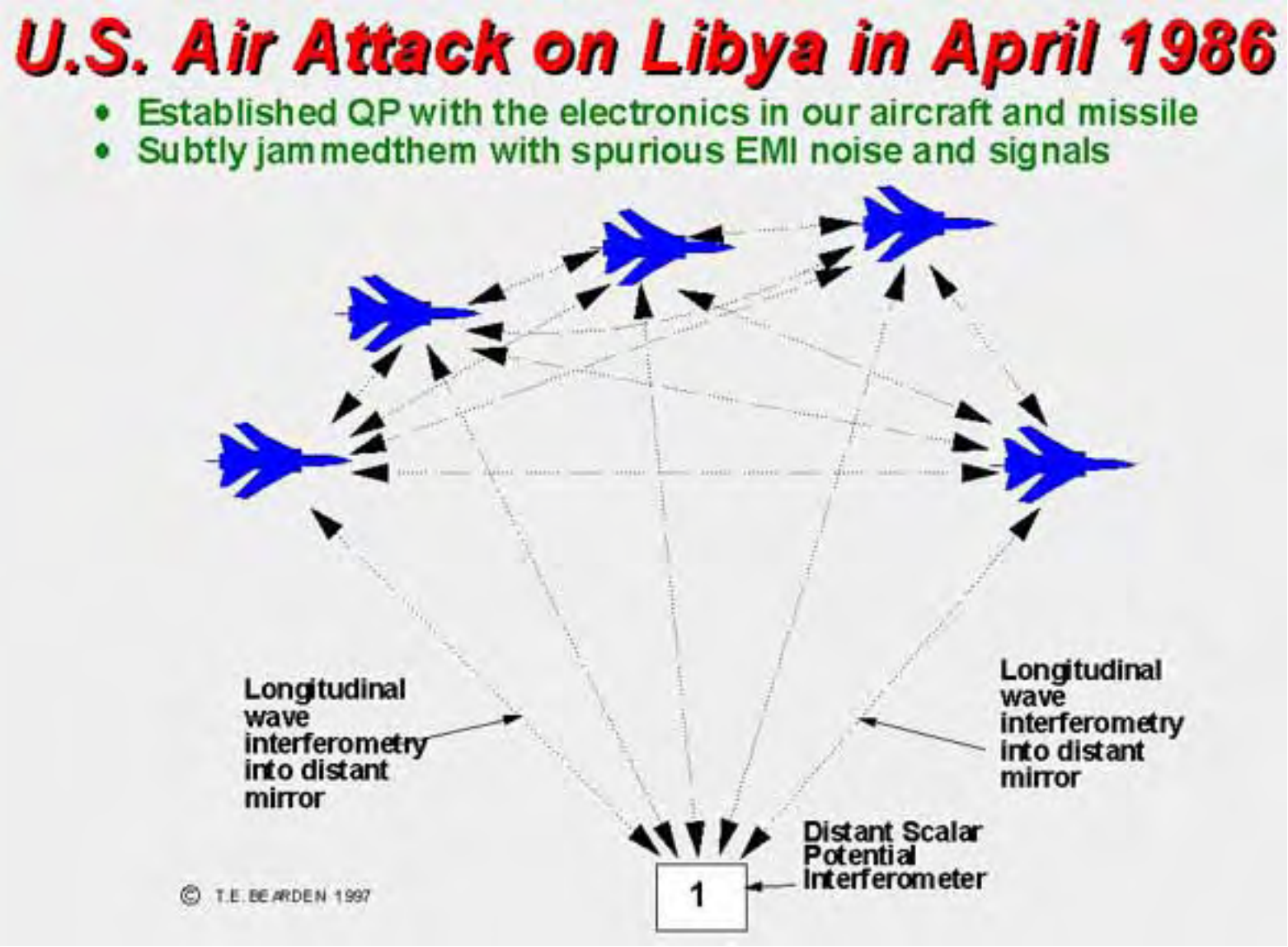
U.S. Air Attack on Libya in April 1986
• Established QP with the electronics in our aircraft and missile
• Subtly jammedthem with spurious EMI noise and signals
Longitudinal wave interferometry into distant mirror
Longitudinal wave interferometry into distant mirror
Distant Scalar Potential Interferometer
1
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Lightning Wall

- Aircraft on course of 270 degrees
- Approached "solid wall of lightning" in an otherwise cloudless sky
  - From very high altitude to near the water
  - Extended north-south as far as one could see
- Radar scope clear
- *Rigged aircraft for heavy weather*
- *Plunged directly through wall*
- *Wall was very thin*

circa 1959-1960
Interview with Patrol plane commander
U.S. Navy P5 aircraft
Over Atlantic, 200 miles east of Norfolk

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Lisitsyn's Report: Brain Code Broken

- THEORY DEVELOPED AND FITTED
- HYSTERESIS MEMORY LOOP
- CONTROLLED EM INDUCTION
  - IMAGES
  - SENSATIONS
  - PREDETERMINED EMERGENCE
- 23 EEG BANDS
  - UP TO 8.1×10^{20} HZ
  - 11 INDEPENDENT CHANNELS

S.K. Lisitsyn, "New Approach to the Analysis of Electroencephalograms," DDC Report AD73005, p. 16-25.

JC1-34

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Large Longitudinal EM Wave Interferometer (LWI) Accident

- 1958 nuclear explosion near Urals
  - Contaminated 1200 square kilometers
  - Signature of large LWI accident
  - Buried atomic wastes suddenly exploded
  - Region contaminated to this day
- Soviets were well along with advanced LWI prototypes and testing
  - In Jan. 1960 Khrushchev announced these forthcoming "fantastic" weapons
  - 1958 difficulties would have been resolved by 1960

© T.E. BEARDEN 1990, 1999

Large Longitudinal EM Wave Interferometer (LWI) Accident

- Expected cause of 1958 accident
  - Huge LW energy beams built up
  - Catastrophic short-out in transmitter
  - LW energy flashed over into earth and spread
  - Struck and fissioned stored nuclear wastes
- Developed new safety circuits
  - For transmitter short-out, instantly activates to hold LW beam energy and prevent flash-over
  - Similar accident happened in 1986 at Chernobyl, except private U.S. group blew that transmitter to prevent catastrophic quake in California

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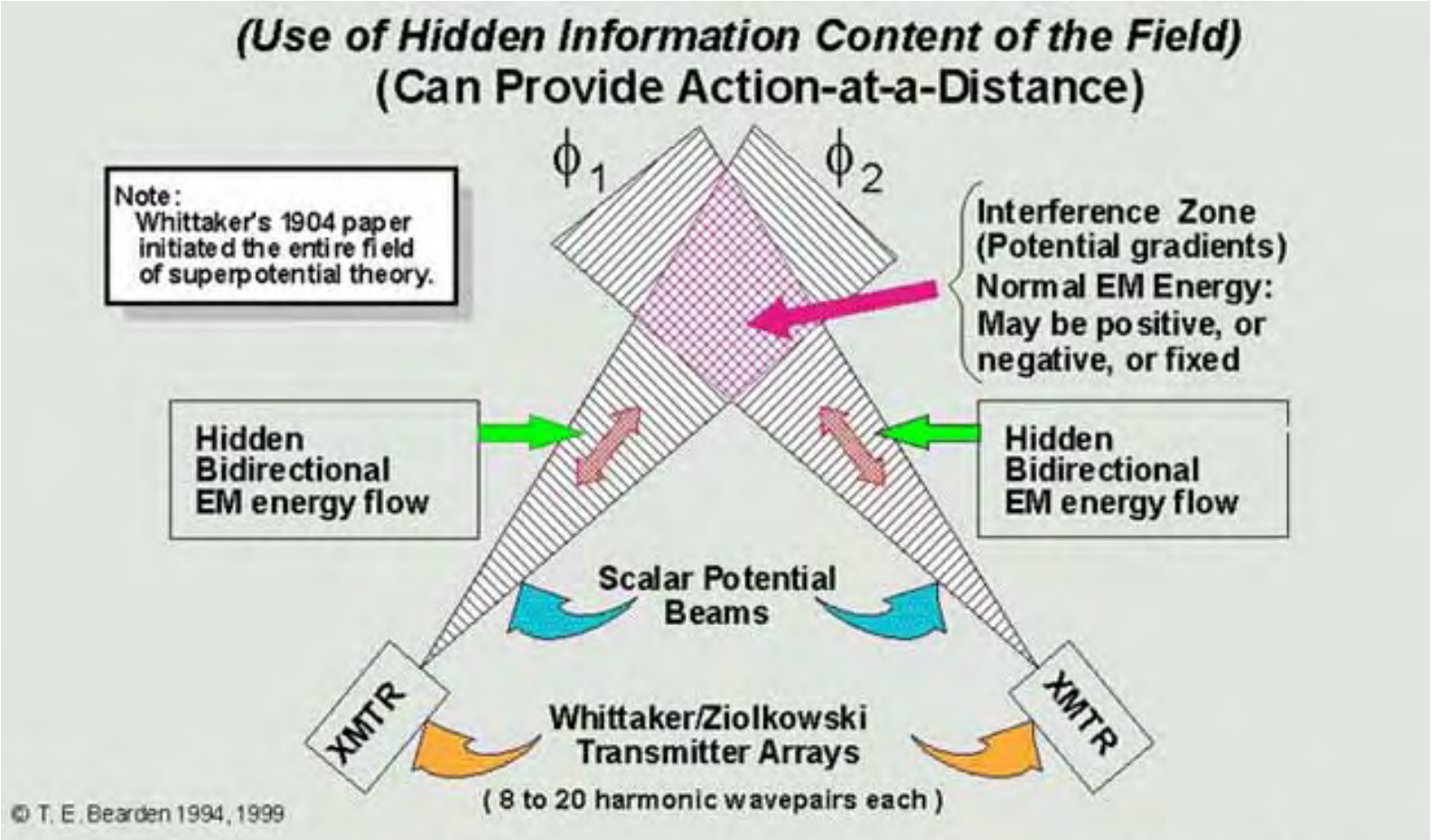

Figure 5. Scalar potential interferometry (between the two sets of bidirectional longitudinal EM wavepair functions) produces all EM force fields and waves.

Two Types of Mutual Assured Destruction (MAD) Systems

- ***Sane system:***
  - Turned off or on standby
  - Wait until attacked or attack is imminent
  - Humans consider situation, make strike decision
  - Command order issued to weapons officers
  - Human finger initiates launch sequence
  - Usually requires code entry, etc. for assured launch control

- ***Insane system:***
  - Computer periodically (e.g., every 2 hours) initiates launch
  - During sequence, there is a period (say, 2 min.) where operators can enter stop order (usually coded)
  - If correct stop not entered, weapons automatically launch
  - if correct stop entered, computer resets, and after another 2 hrs, automatically reinitiates the launch sequence

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Psychoenergetics Weapons Teams
Mentally Disable All Personnel
(COUNTERS ALL SANE MAD SYSTEMS)
(NULLIFIES HUMAN COMPONENT OF ALL WEAPON SYSTEMS)
ELECTRICAL THOUGHT-WORDS ARISE DIRECTLY IN BRAIN, HENCE IN MIND, BYPASSING SENSOR INPUTS
INSTANT HYPNOGOGIC STATE, WITH INSERTED THOUGHT-WORDS
Effects arise in local spacetime, simultaneously in all minds in the targeted area
INSTANT HYPNOGOGIC STATE; WITH WAKING DREAM
PERCEIVED REALITY NOW CONTROLLED
TARGETED POPULACE
• Site personnel instantly hypnogogic and mentally controlled.
• Distant weapon controller teams coord crew actions
• Standdown insane weapons to maintenance standby.
• Mindsnapper then strikes, kills all personnel, and nullifies site for months.
Indicators: Two A-10 incidents 1997, LIDA device since 1950s.
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Strikes Against Special Ship and Energetics Weapon Sites

- Via powerful scalar EM pulses in each targeted area, so sharp time-jerks occur
  - Mind and its operations exist in time but not in 3-space
  - Coupling interaction of mind operations to body occurs through flow of time
  - Flow or change of flow of time must be smooth, for coupling of mind to body
- *Sharp jerk in time flow snaps mind's coupling to body, instantly separates mind*
- *Instant death for every virus, bacterium, cell, insect, mammal, living creature*
- *Contaminates struck sites for months, perhaps a year*

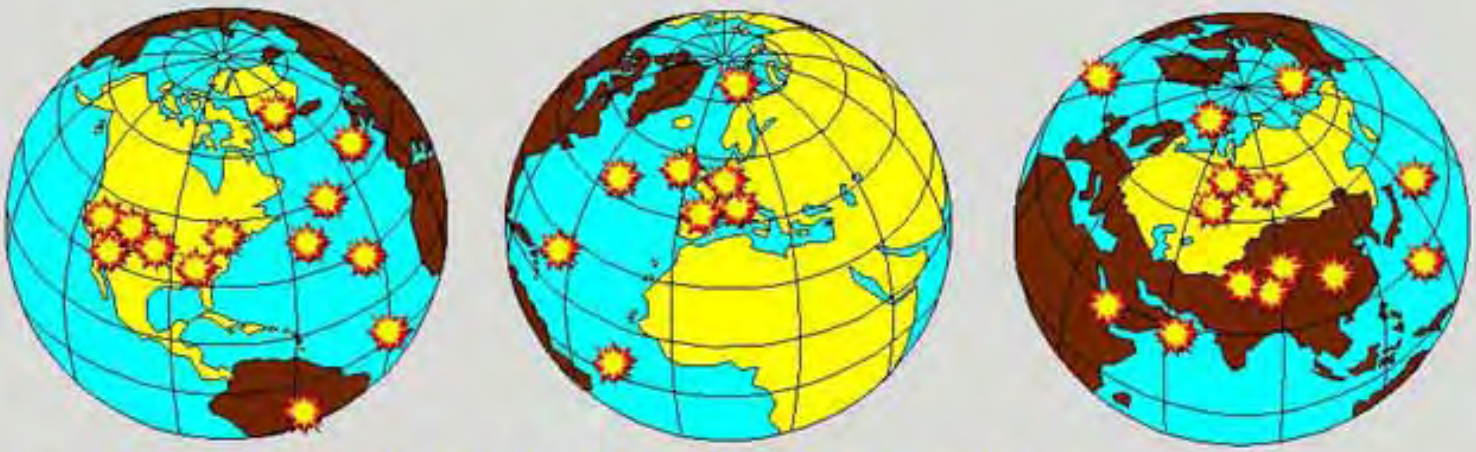

Note: In other words, this is the part of the "preparation barrage" that attacks the enemy's response capability (i.e., his "artillery" and his "airpower") and suppresses it. The use of the "mindsnapper" weapons provides 100% assurance of success.

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"MINDSNAPPER" ATTACK ON SPECIAL SHIPS & ENERGETICS WEAPONS SITES

"We have a new, fantastic weapon ... so powerful that, if unrestrainedly used, it could wipe out all life on earth."

Khrushchev, speaking to Presidium, Jan. 1960

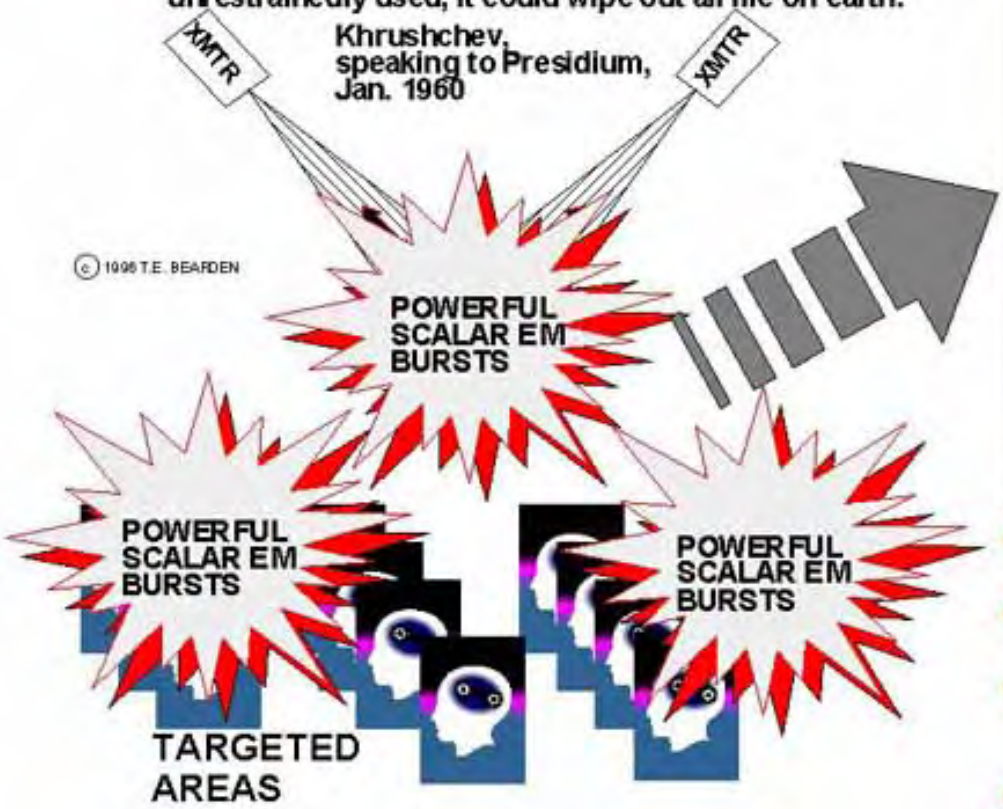

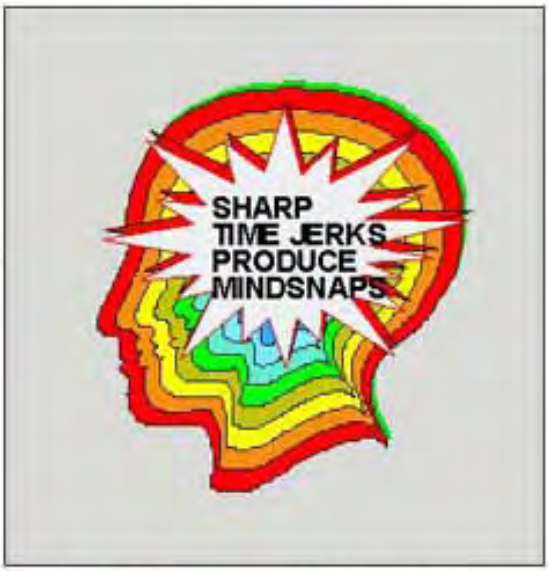

- Minds snapped loose from bodies (every living thing)
- Struck areas completely sterilized of all life
- LWs emitted; slow decay of time-charge makes contamination persistent
- Tested twice in Afghanistan

The Tom Bearden Website

Help support the research

How Much Off Guard Are We?

- Slide 1
- Slide 2
- Slide 3
- Slide 4
- Slide 5
- Slide 6
- Slide 7

How Much Off Guard Are We?

- *Legitimate U.S. forces have no energetics weapons or defenses against them*
- *No DoD general, military officer, or enlisted person reporting to the government of the United States has <u>any:</u>*
  - Training in energetics or energetics weapons
  - Experience in energetics or energetics weapons development and usage
  - Training in strategy, tactics, deployment, and employment of energetics weapons
  - Knowledge of energetics weapons effects and capabilities
  - Knowledge of the energetics weapons, tactics, deployment, and employment by the KGB/Russians
- *Civilian and military, scientific and intelligence, and news media personnel do not recognize energetics weapons effects happening right over their own heads*

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How Much Off Guard Are We?

- Kill of U.S.S. Thresher in 1963 not recognized. Left signatures.
- 23 years of KGB weather engineering, particularly over U.S. and North America, ignored and not recognized.
- Decades of irradiation of U.S. Embassy, fatally injuring three U.S. Ambassadors, health changes in personnel shrugged off ineptly.
- Massive building of underground sites, all through former Soviet Union, lamely speculated as perhaps "ABM" system or?.
- 1985, 1986 Soviet kills of U.S. aircraft, spacecraft, personnel ignored as "accidents" by legitimate U.S. communities.
- Quantum potential strike on soldiers in Gulf war ignored.
- Quantum potential deterioration of U.S. populace's immune systems ignored.
- Exchange of earthquakes and massive retaliatory destruction of Soviet missile ammunition storage sites, 1986-1989, ignored.
- U.S. scientific and military communities adamantly refuse to rework electromagnetics, though known to be seriously flawed.
- Refuse to apply Stoney/Whittaker work to engineer hidden variables, even though present quantum mechanics also known to be wrong because it does not contain such "hidden order."
- Refuse to develop, structure, and apply Bohm's quantum potential, for instantaneous action at a distance. Russians developed it.

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  - Not recognized.
  - Left signatures.
- **23 years of KGB weather engineering**
  - Particularly over U.S. and North America
  - ignored and not recognized.
- **Decades of microwave irradiation of U.S. Embassy**
  - Fatally injured three U.S. Ambassadors
  - Induced health changes in personnel
  - Shrugged off ineptly.
- **Massive building of underground sites**
  - All through former Soviet Union
  - Lamely speculated as perhaps "ABM" system or?.

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How Much Off Guard Are We?

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- Refuse to apply Stoney/Whittaker work to engineer hidden variables, even though present quantum mechanics also known to be wrong because it does not contain such "hidden order."
- Refuse to develop, internally structure, and apply Bohm's quantum potential, which gives instantaneous action at a distance and great energy amplification.
- Russians developed quantum potential weapons, which obsolete all other weapons.

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JUST HOW MUCH OFF GUARD ARE WE?
Kill of TWA-800 1996
Kill of USS Thresher 1963
Cold Explosion Off Japan Apr 1984
Kill of Space Shuttle Challenger 1986
From The Huntsville (AL) Times 18 Sep 96:
"Retired Gen. Wayne Downing concluded that U.S. forces are so far superior to potential foes that opponents have turned to terrorism as the only way of challenging them."
The Times also provided the information that Defense Secretary William Perry agreed with Gen. Downing's conclusion.
President's party airplane crash 1996
3 Dead U.S. Ambassadors from Moscow Embassy Radiation
QP Gulf War Syndrome: 16,000 persons disabled
QP jamming, U.S. air attack on Libya, 1996
Kill of Arrow DC-8 Gander AFB Dec 1985

JUST HOW MUCH OFF GUARD ARE WE?`

3 Dead U.S Ambassadors, U.S. Weather Engineered 20 years

Kill of USS Thresher Nuclear Submarine Apr 1963

QP Test on U.S. Troops in Persian Gulf, 1991 (Gulf War Syndrome)

TWA-800 1996; President's C-130 crash 1996

Arrow DC-8 Gander AFB Dec 1985

Challenger 1986

Quantum Potential Jamming of Air Attack on Libya Apr 1986

Blind Euphoria to Even the Ballistic Missile Threat

- U.S. National Intelligence Estimate (NIE) released in Nov. 1996 states there is no foreseeable threat to the U.S. from "indigenous missiles" for at least 15 years.
- Clinton has claimed a program for ABM defense is too expensive, would violate ABM Treaty with former USSR.
- Soviets developed an ABM system in violation of the treaty.
- In June 96 Russia test-launched an SS-19, their 26th ICBM test in 5 years.
- *"Russia still retains and is modernizing a vast nuclear arsenal... still the only nation of earth that could destroy America in a matter of minutes. Indeed, given the weakness of the Russian Army, Russia's superpower ambitions rest more than ever on its nuclear capabilities."* *
- "For the first time since the dawn of the nuclear age, there is not a single Russian missile pointed at America's children." **

Comment: Punch a computer button and the missiles are pointed! The armed missiles are still there, ready and waiting.

Bulleted info courtesy Washington Inquirer, June 24, 1996.

* House Nat'l Security Chmn, Floyd Spence.
** Bill Clinton, State of the Union Message.

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Possible Targets: 1995-9
Escalation Phase
(Based on 1985-87 test program)
Earthquakes
Missiles
Power Grids &
Distribution Systems
Satellites
Ships
Shuttle
Launches
& Flights
JETLINERS
Radio/TV
Subs
Microwave Nets
Radars &
Nets
Communications
and Computer Nets

Propagation of Weapon Effects

- All conventional weapons use propagation through 3-space of matter or energy or both
  - Matter (bombs, missiles, projectiles, etc.)
  - Energy (EM force fields, sonic force fields, etc.)
  - Basically one-to-one, or one "bus" to many-on-many
  - Finite propagation velocity v: where $0 < v \leq c$
  - Time delay: Shielding and pre-strike retaliation possible
- Structured quantum potential propagates vacuum ordering (vacuum engines), instantly
  - Zero time delay (through multiply-connected spacetime)
  - No propagation "through space", no "velocity" as such
  - Easily one-to-many, without limit
  - Dramatic energy amplifier (gates, amplifies flux ordering)
  - Effects arise in local spacetime; no shielding possible
  - No range limit, since striking distance always zero
- QP weapons obsolete all other weapons

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Yugoslav Earthquake, Followed by Cold Explosion

Apr. 15
1979

- Magnitude 7.2 on Richter scale
- Epicenter 33 km. deep
- More than 100 aftershocks
- At Kamenari:
  - Adriatic sea mushroomed up
  - Like atomic bomb explosion
  - Signature of a cold explosion
  - Similar to Apr. 1984 test off coast of Japan, near Kurils (see inset graphics)
- Note that April is a significant test month for the Communists (preparing official reports for May Day?)

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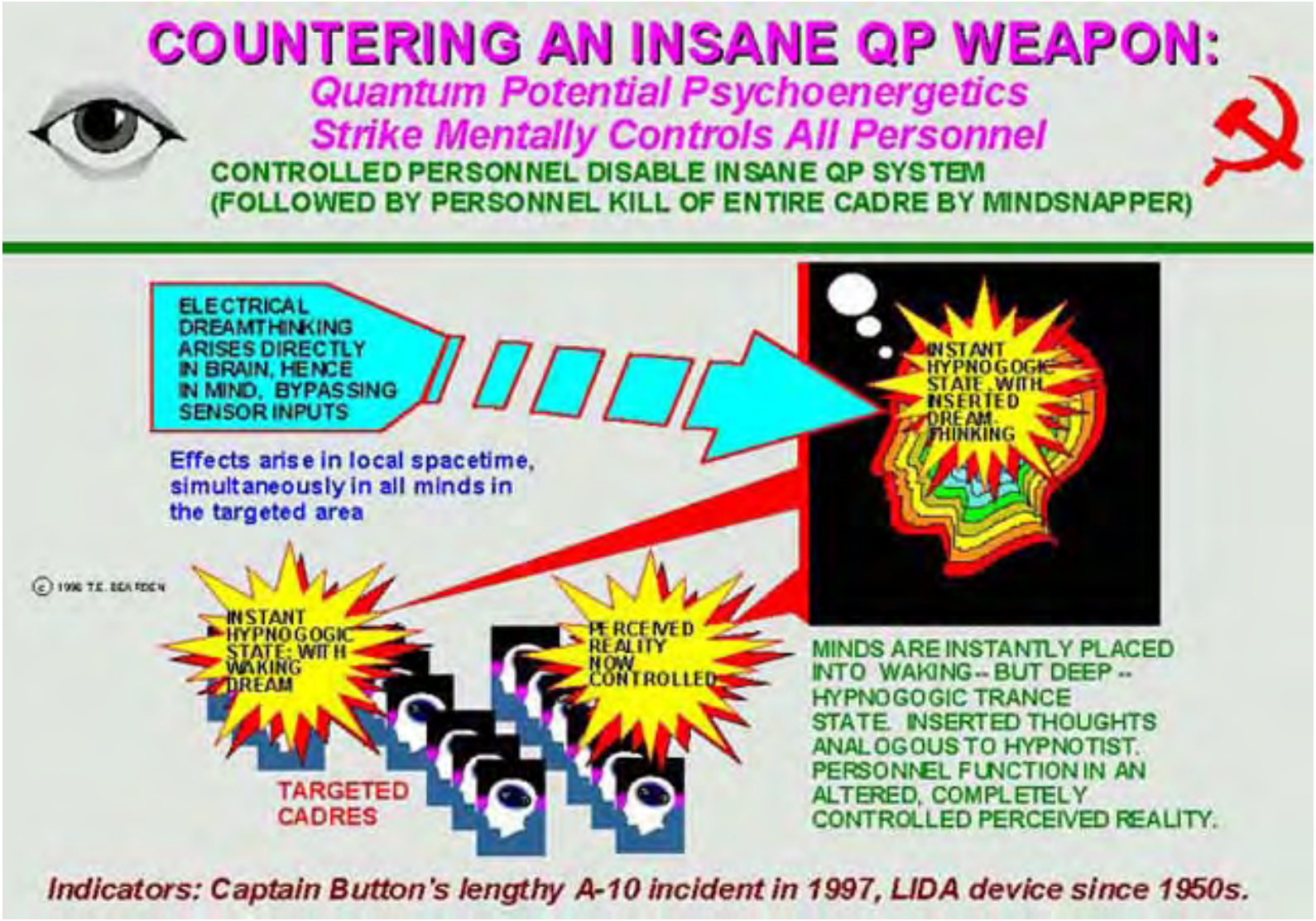
COUNTERING AN INSANE QP WEAPON:
Quantum Potential Psychoenergetics
Strike Mentally Controls All Personnel
CONTROLLED PERSONNEL DISABLE INSANE QP SYSTEM
(FOLLOWED BY PERSONNEL KILL OF ENTIRE CADRE BY MINDSNAPPER)
ELECTRICAL DREAMTHINKING ARISES DIRECTLY IN BRAIN, HENCE IN MIND, BYPASSING SENSOR INPUTS
Effects arise in local spacetime, simultaneously in all minds in the targeted area
INSTANT HYPNOGOGIC STATE, WITH INSERTED DREAM-THINKING
INSTANT HYPNOGOGIC STATE, WITH WAKING DREAM
PERCEIVED REALITY NOW CONTROLLED
TARGETED CADRES
MINDS ARE INSTANTLY PLACED INTO WAKING -- BUT DEEP -- HYPNOGOGIC TRANCE STATE. INSERTED THOUGHTS ANALOGOUS TO HYPNOTIST. PERSONNEL FUNCTION IN AN ALTERED, COMPLETELY CONTROLLED PERCEIVED REALITY.
Indicators: Captain Button's lengthy A-10 incident in 1997, LIDA device since 1950s.

Gulf War Disease: KGB QP Weapon Induced
ST Curvature Engines for a Cocktail of Diseases
LIBYA
EGYPT
CHAD
SUDAN
SAUDIA ARABIA
IRAN
IRAQ
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Distant Scalar Potential Interferometer with iterative self-targeting

Self-Targeting in Inner EM Channel Can Produce a Quantum Potential

Once QP is established, energy transmission is direct and instantaneous. Energy input to one single participant will simultaneously appear in all other participants, the amount depending on their fractions of participation with the input station.

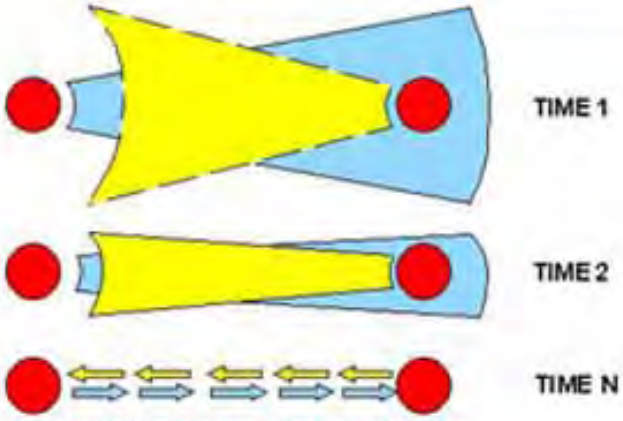

NARROWING OF INTERACTING POTENTIALS INTO LASER-LIKE BEAMS, BETWEEN TWO PUMPED SOURCES. NOW ONLY LONGITUDINAL WAVES CONNECT THE LINKED OBJECTS.

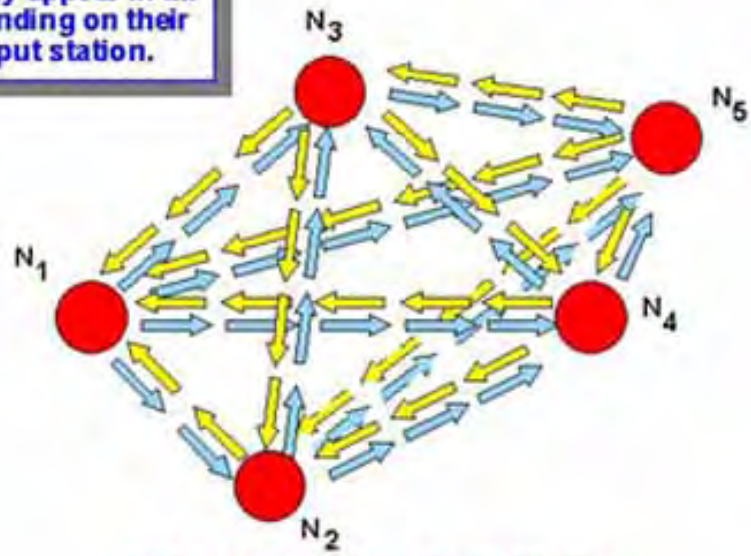

SELF-TARGETING EFFECT AMONG ALL PAIRS OF INTERACTING PUMPED SOURCES

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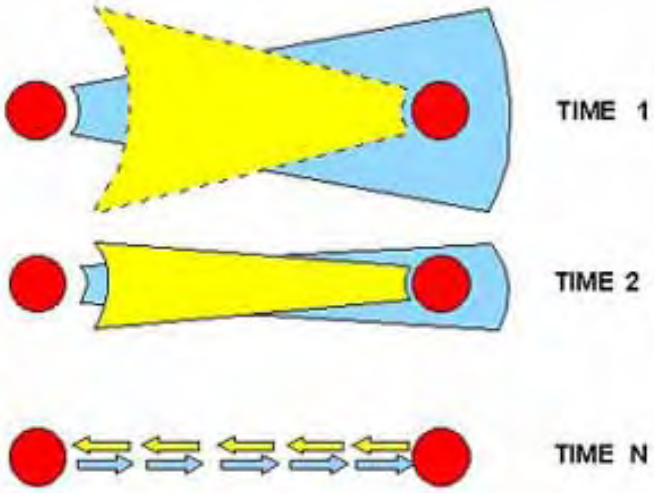

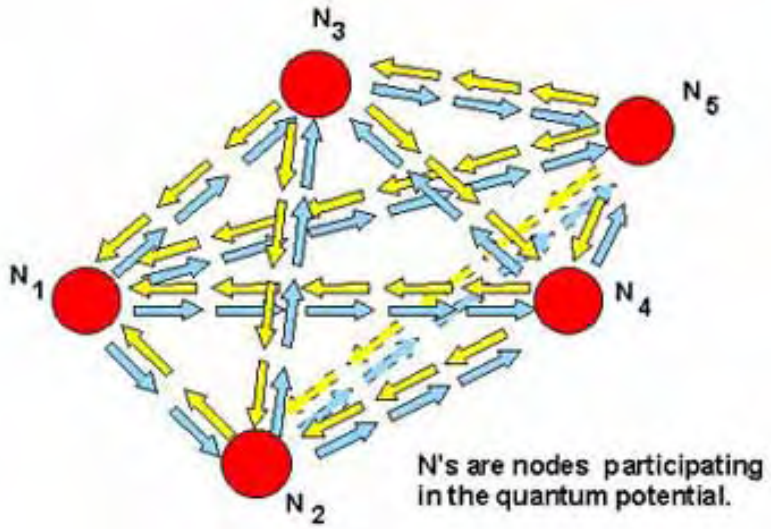

a. Iterative retroreflection between any pair of nodes narrows the interconnecting potentials to a laser-like, bidirectional beam. Iterative phase conjugate reflection provides self-targeting.

b. The quantum potential exists as narrow, laser-like beams between participating nodes, even when the nodes are widely separated. The beam space is multiply-connected; transmission is instantaneous.

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Consider the hidden Stoney/Whittaker bidirectional EM waves that comprise the potential from each source node. If these nodes have sufficient intersymmetry of dynamic material form, then self-targeting occurs between the two nodes of any nodal pair. By iterative phase conjugate reflection, the scattering is narrowed into interconnecting wavepairs, in laser-like beams, between each two nodes. Thus the interconnecting potentials narrow into laser-like, bidirectional beams. The Coulomb gauge may apply, and a quantum potential may be formed.

Figure 30. Mechanism for generating a quantum potential, by iterative self-targeting induced into a system of multiple scattering nodes. Once a QP is established, spatial separation has little or no effect.

Major Principles for Use of Quantum Potential Weapons

- Must disable dead-man fuzing prior to massive use of scalar interferometry weapons.
- Must assure immediate, complete nullification of unique enemy assets (quantum potential assets, special ships, and energetics weapons).
- Personnel can be destroyed instantly with mindsnapping; area is sterilized of life, and effect persists, gradually dying away.
- Personnel can be disabled instantly with various psychoenergetic weapons; area not sterilized.
- Personnel can be destroyed in short order by using EM BW weapons; area not sterilized.
- If foe has energetics weapons, then it is a quick-draw "gunslinger" contest unless insane MAD systems deployed.
- Complete surprise is of decisive importance.
- Tailor effect used to specific target, objective.
- *Note: Must use "insane" MAD systems to deter.*

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Quantum Potential Weapons: Major Principles (Continued)

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- Three major classes of use exist:
  - Use of bulk energy only (as in bulk heating or cooling) without substructuring
  - Use of internal structuring of the bulk energy, so that *vacuum engines* appear in target
  - Use of more deeply nested engines allows direct intervention in mind, long term memory, perception, thoughts, emotions, personality
- Use of vacuum engines allows engineering at a distance of:
  - *Atomic nuclei* including structures, reactions, and transmutations
  - *Bulk matter* including translations, lattice bonding, chemistry, chemical interactions, electromagnetic interactions
  - *Deep biological control systems* such as
    - Becker's cellular control (recovery) system
    - Popp's cellular control system
  - *Cells* including:
    - Structuring, differentiation and dedifferentiation
    - Genetic changes, chemical changes
    - Induction of disease states without normal disease vectors
  - *Mind/matter interface*, including long-term memory, perception, emotion, thought, mental state

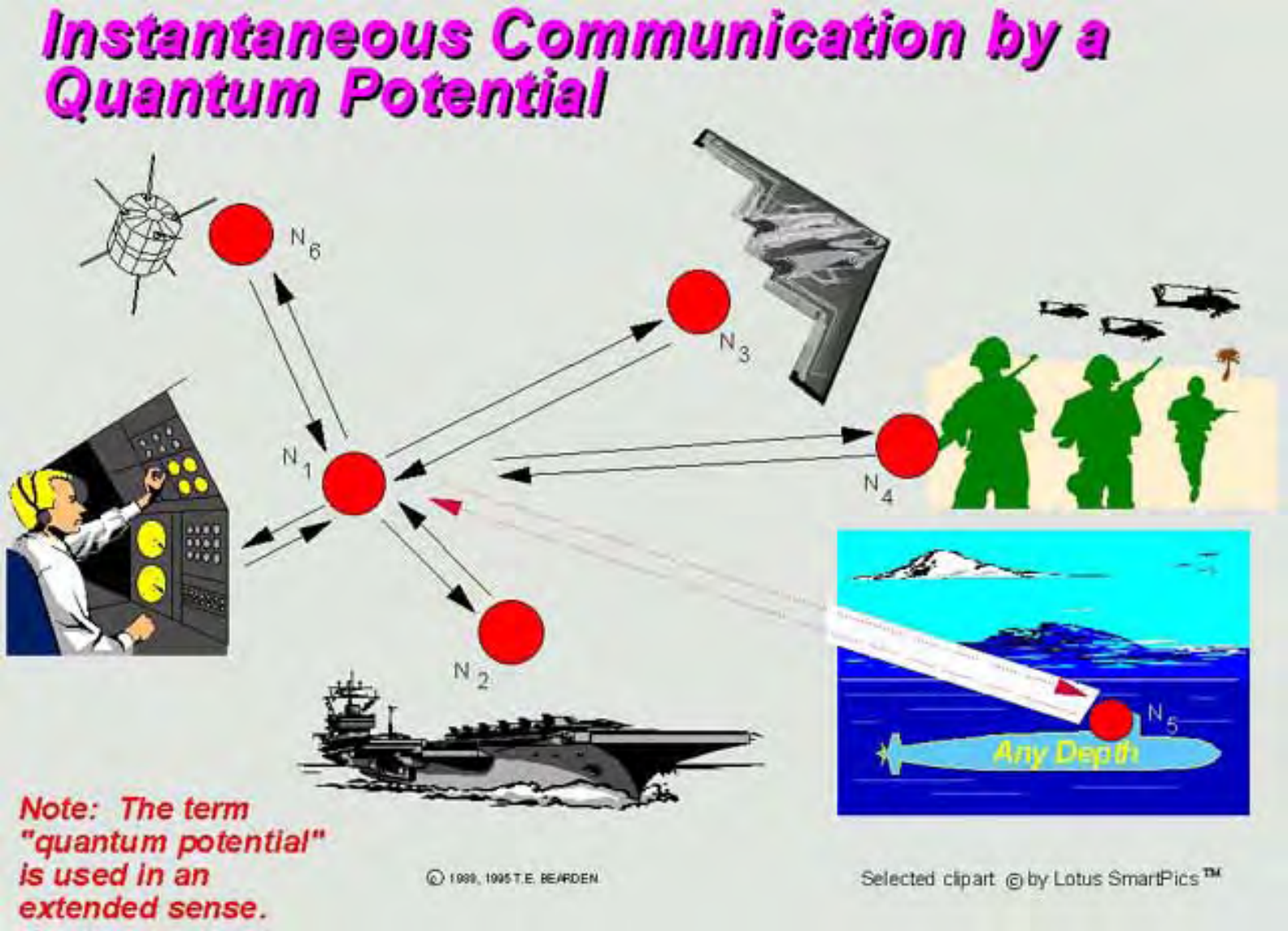
Instantaneous Communication by a Quantum Potential
N6
N3
N1
N4
N2
N5
Any Depth
Note: The term "quantum potential" is used in an extended sense.
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Selected clipart © by Lotus SmartPics™

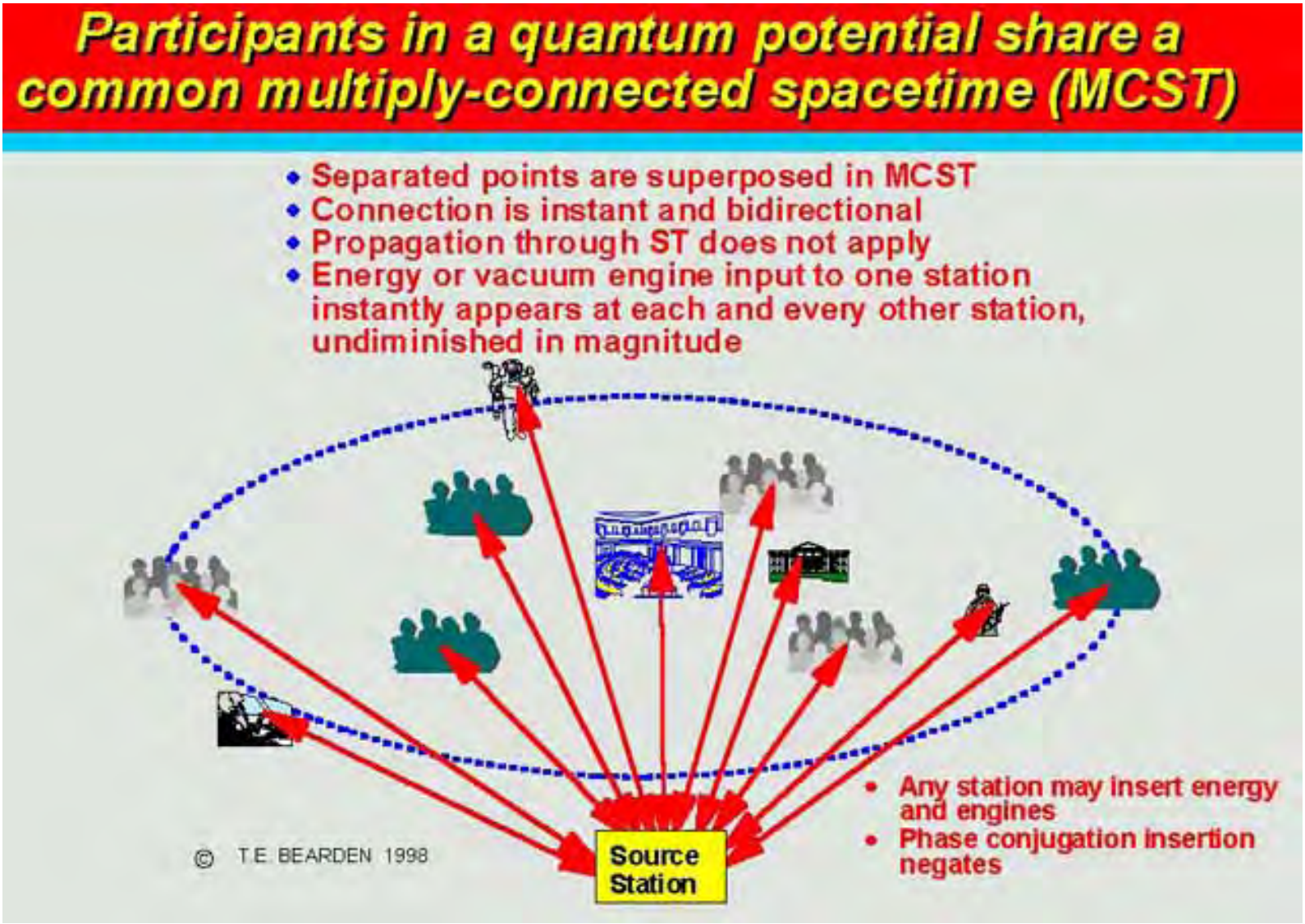
Participants in a quantum potential share a common multiply-connected spacetime (MCST)
• Separated points are superposed in MCST
• Connection is instant and bidirectional
• Propagation through ST does not apply
• Energy or vacuum engine input to one station instantly appears at each and every other station, undiminished in magnitude
• Any station may insert energy and engines
• Phase conjugation insertion negates
Source Station
© T.E. BEARDEN 1998

Quake in Tangshan, China

28 July, 1976

- 7.8 on Richter scale
- Hundreds of thousands killed
- Accompanied by extensive light, electrical effects
  - Starting 3 to 5 days before
  - Communications interference within 250 km
  - Sky lighting observed
- [Personal comments]

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Counting Rifles: Put up or shut up!

(Exchanging Earthquakes)

Opening bet

- Quebec 25 Nov 88
- Pasadena 3 Dec 88

Raise you

- Armenia 7 Dec 88

Call - what do you have?

- Malibu 18 Jan 89

Four aces

- Soviet Central Asia 23 Jan 89

Clear table (stress relief)

- Bakersfield et al various

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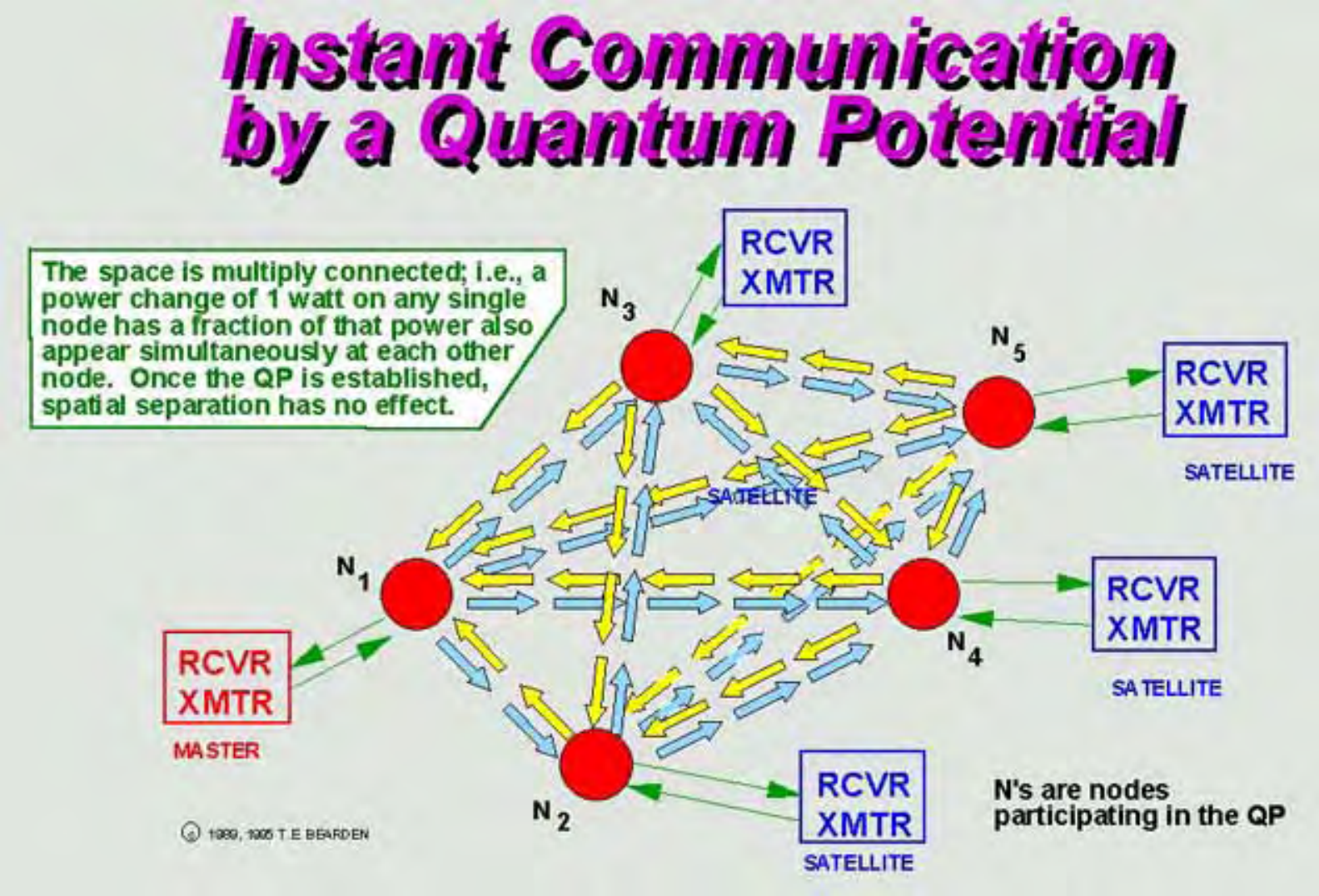
Instant Communication by a Quantum Potential
The space is multiply connected; i.e., a power change of 1 watt on any single node has a fraction of that power also appear simultaneously at each other node. Once the QP is established, spatial separation has no effect.
RCVR XMTR
N3
N5
RCVR XMTR
SATELLITE
SATELLITE
N1
RCVR XMTR
N4
SATELLITE
RCVR XMTR
MASTER
N2
RCVR XMTR
SATELLITE
N's are nodes participating in the QP
© 1999, 1005 T.E BEARDEN

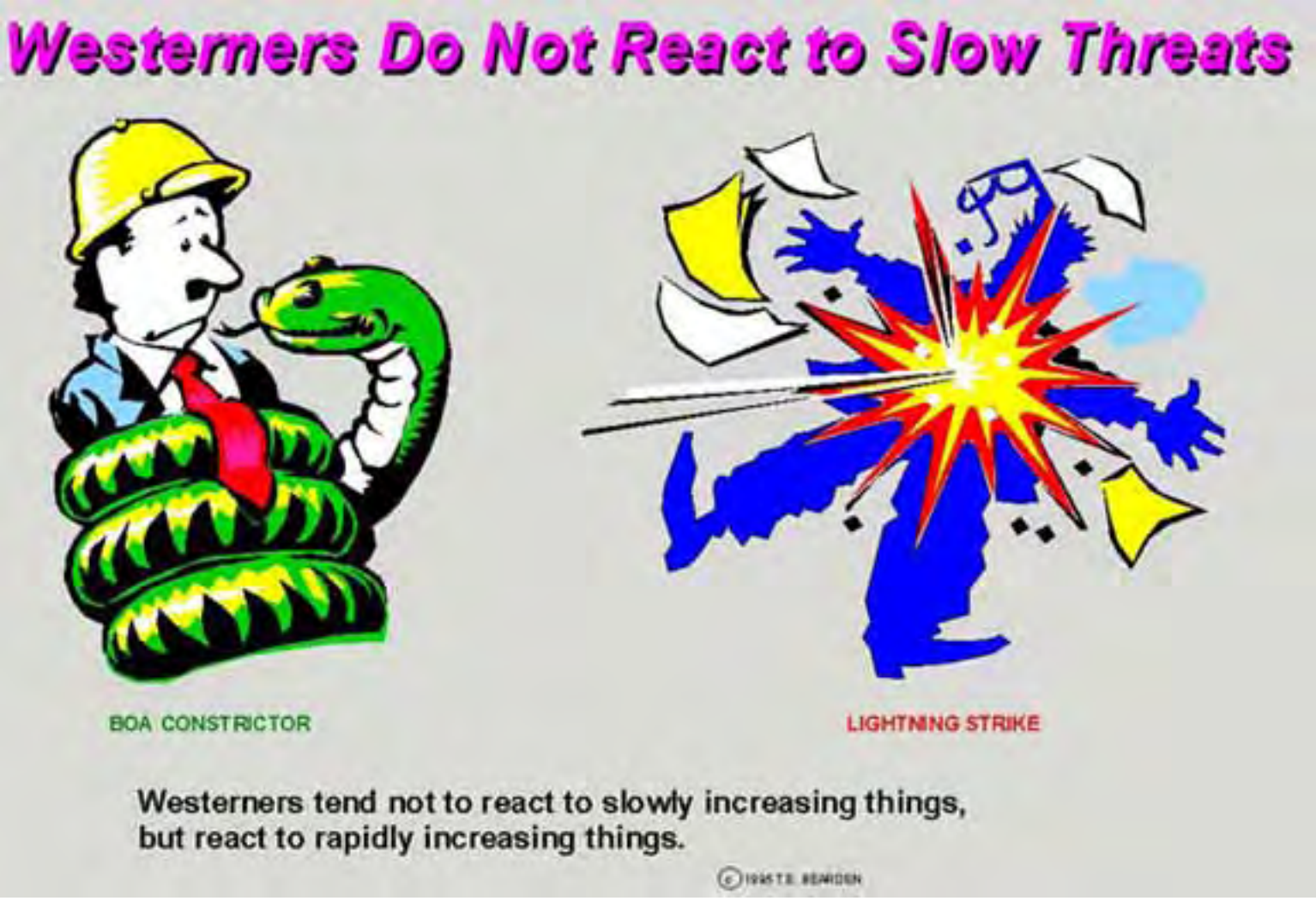
Westerners Do Not React to Slow Threats
BOA CONSTRICTOR
LIGHTNING STRIKE
Westerners tend not to react to slowly increasing things,
but react to rapidly increasing things.

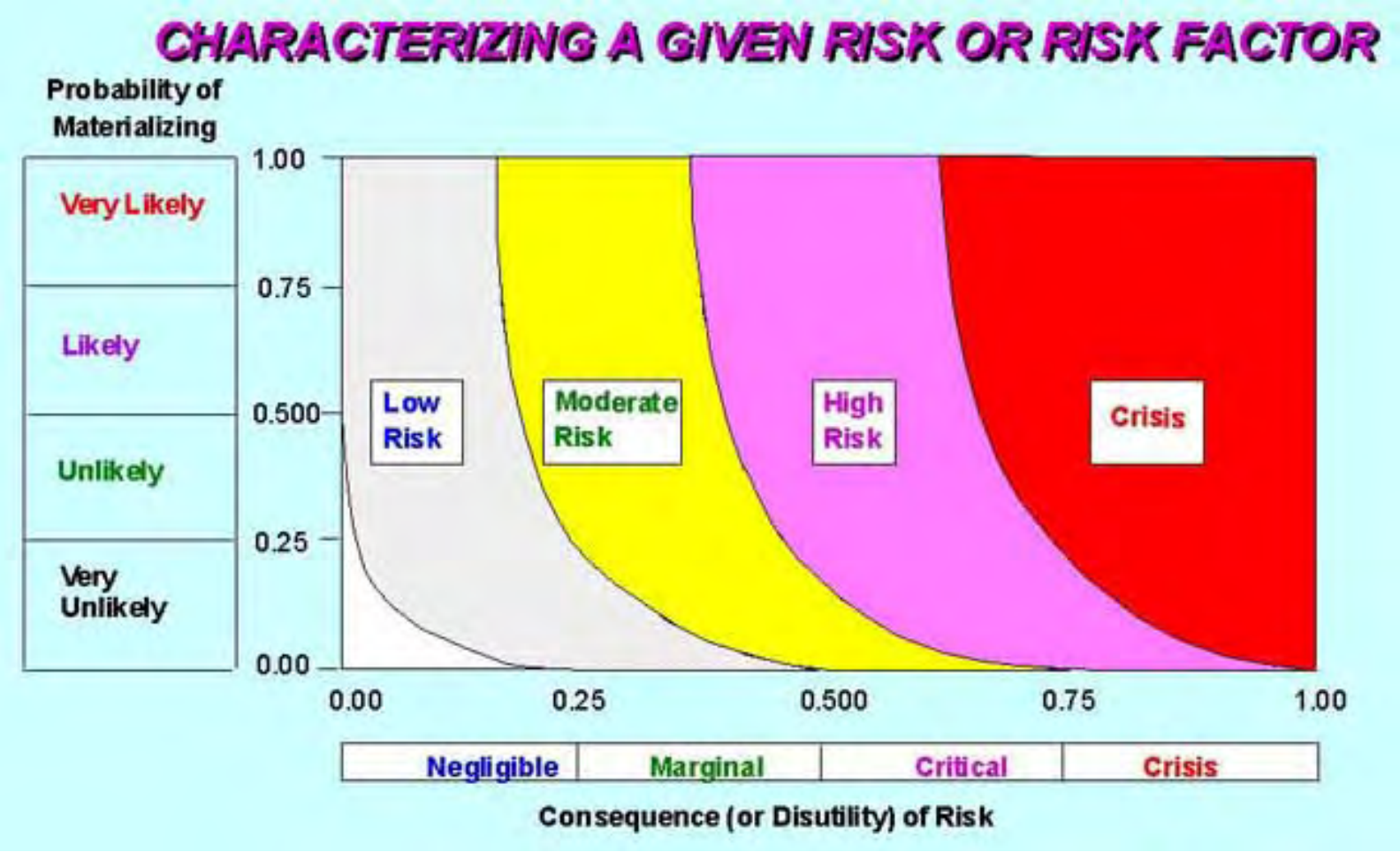
CHARACTERIZING A GIVEN RISK OR RISK FACTOR
Probability of Materializing
Very Likely
Likely
Unlikely
Very Unlikely
1.00
0.75
0.500
0.25
0.00
Low Risk
Moderate Risk
High Risk
Crisis
0.00
0.25
0.500
0.75
1.00
Negligible
Marginal
Critical
Crisis
Consequence (or Disutility) of Risk

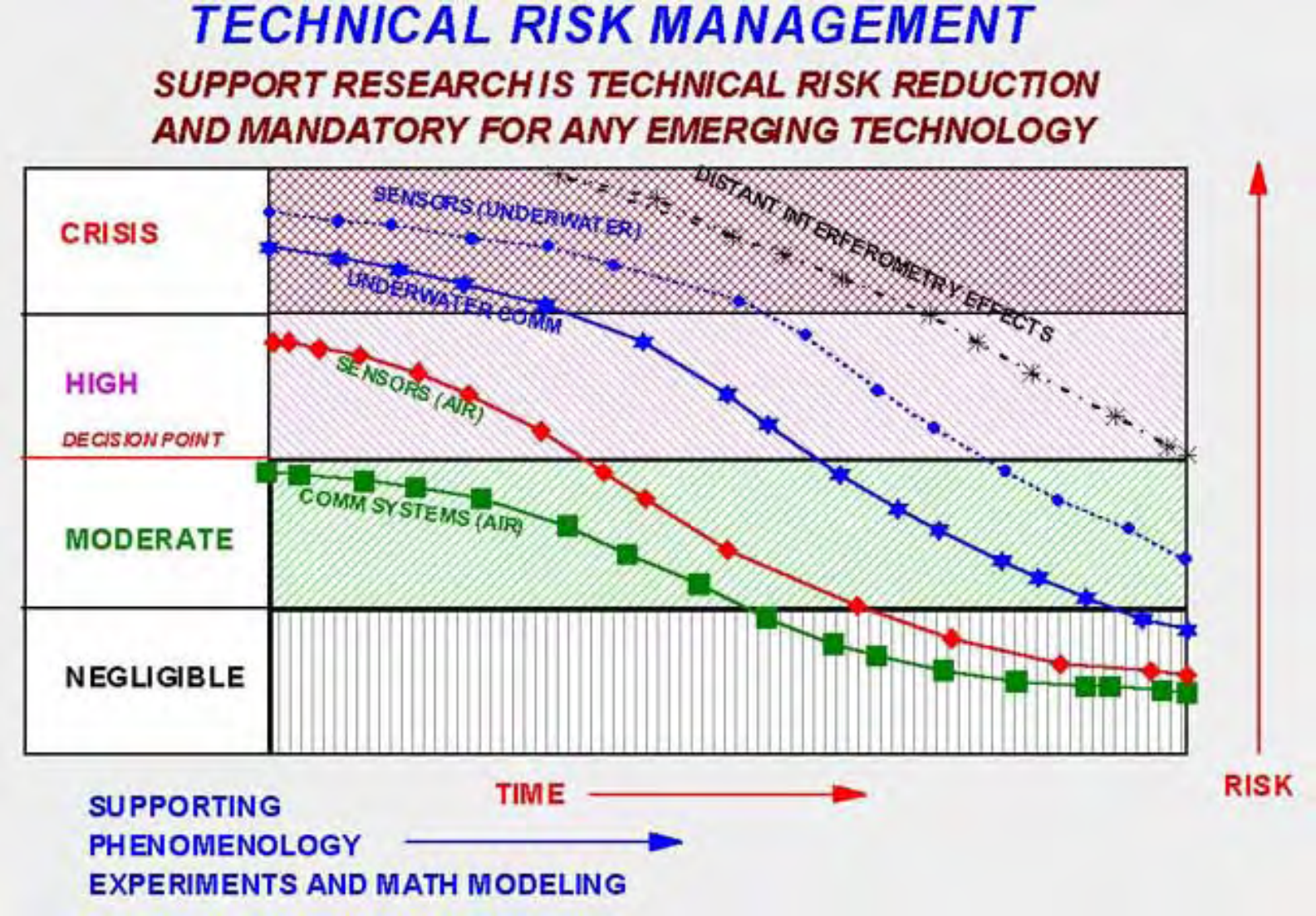
TECHNICAL RISK MANAGEMENT
SUPPORT RESEARCH IS TECHNICAL RISK REDUCTION
AND MANDATORY FOR ANY EMERGING TECHNOLOGY
CRISIS
HIGH
DECISION POINT
MODERATE
NEGLIGIBLE
SENSORS (UNDERWATER)
DISTANT INTERFEROMETRY EFFECTS
UNDERWATER COMM
SENSORS (AIR)
COMM SYSTEMS (AIR)
TIME
RISK
SUPPORTING
PHENOMENOLOGY
EXPERIMENTS AND MATH MODELING

Aum Shinrikyo's Sarin Facility

The interior of Satian No. 7, a suspected sarin production plant

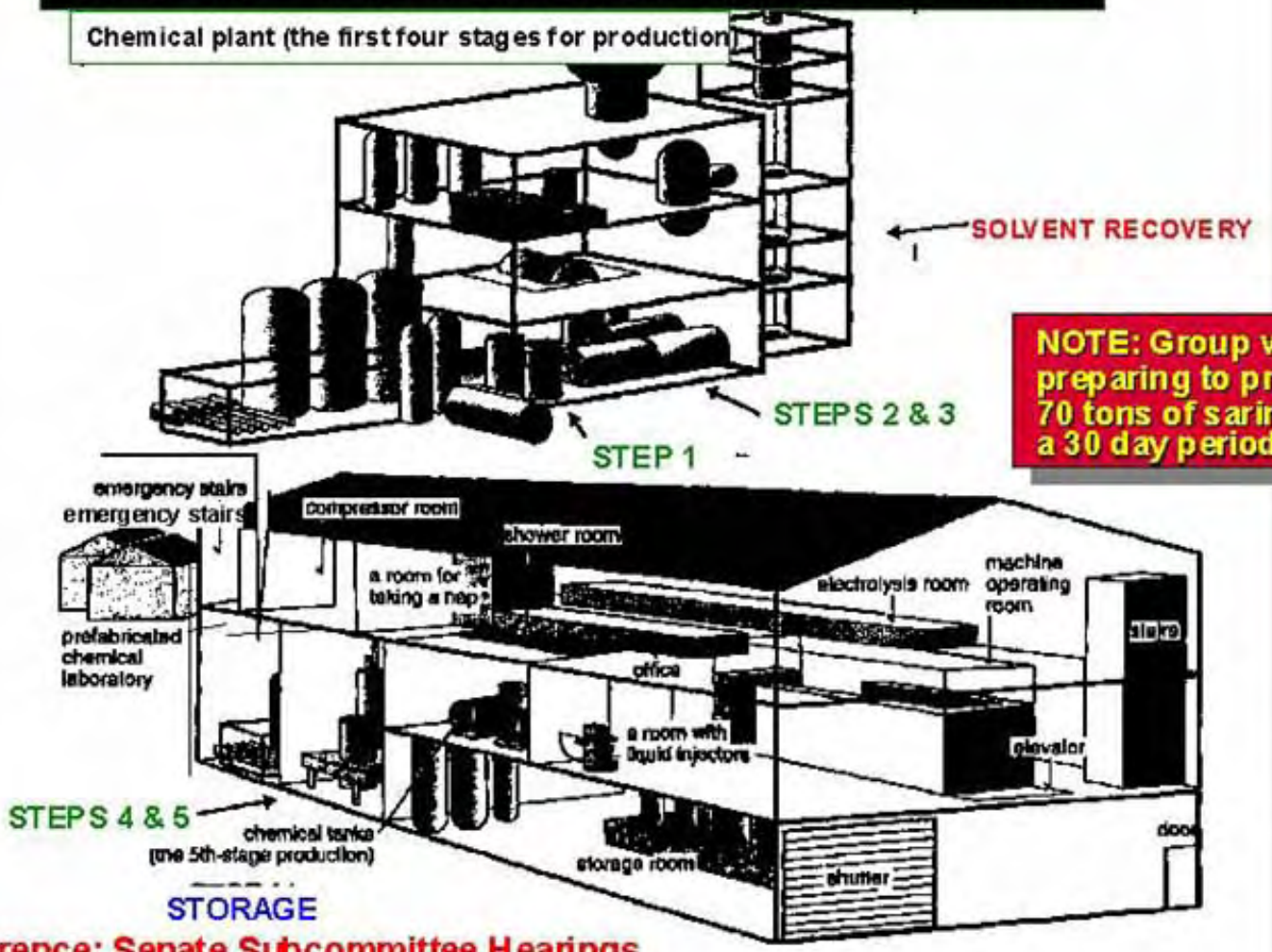

NOTE: Group was preparing to produce 70 tons of sarin in a 30 day period.

Reference: Senate Subcommittee Hearings

In Scalar Beam Interference Zone

- De-phasing of wave/antiwave pairs occurs
- Zero-summation destroyed
- Ordinary EM reappears [Whittaker 1904]
- Ordinary energy appears or disappears (i.e., may produce heating or cooling)
- Energy bottle effect
- Can add or extract EM energy
- Can produce specific ST curvature engines

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Physicist Schappeller Auralaz Munster, Austria:

- British Intelligence interview, about 1948
  - Used Kaluza-Klein theory
  - Worked with Russians
- Schappeller claimed he could:
  - Cause "implosions" rather than explosions
  - Use gravitational and electromagnetic energy
  - Cause large areas of the ocean to freeze
  - Tap earth-ionospheric field
  - Produce enormous energy
- *This is precisely what Hellman worked on in the USSR, after WW II!*

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Initial Soviet Plan for Cold War, After WW II

- Develop and deploy SAM bomber defense
- Catch up in atomic weapons
- Master and apply rocketry
- Wed atomic warheads to rockets
- Initiate "Cold" War
  - Bleed the dragon
  - Guerrilla wars
  - Terrorism
  - Insurgencies
- *Find, develop, and weaponize next great technical breakthrough area as highest national priority*

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Josef Stalin: Absolute Dictator

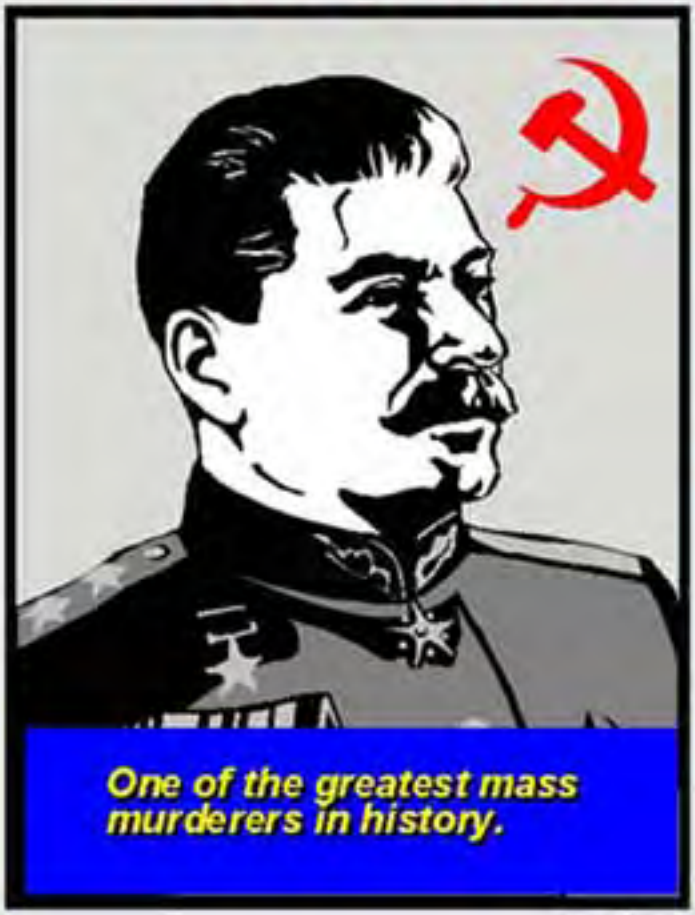

- Secret police and spies everywhere
- Purged his own officer corps
- Always deeply suspicious
- Regularly purged his enemies or those perceived to be shaky or untrustworthy
- Absolute power, justice had nothing to do with it
- Opponents often just disappeared in the night, never to be seen again
- Secret police often tortured, killed them
- Others sent to slave labor camps to die by severe work, starvation, and beatings or downright massacre
- Had experienced unusual abilities of Wolf Messing, so knew that some persons could do unusual things
- Forced Soviet weapon physics into this psychoenergetics realm also

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Exploding any Resistance by Operational Scientists
Josef Stalin
© T.E. BEARDEN 1997
The Communists slaughtered 20 million Russian Kulaks to collectivize Soviet farming
Assembled Academy
"The destiny of communism has been frustrated by the U.S. development of the atomic bomb. That is not the last great technical breakthrough. The next one WILL be Soviet! You will provide me with that great new technical breakthrough at all speed, or I will have your heads. Do I make myself clear, comrades?"

Significant Soviet Statements

- "In the final revolution, it does not matter if three-quarters of the earth is destroyed, so long as the other quarter emerges communist." *[Lenin]*

- "If a means of total neutralization of foreign missiles is to be found, it can only come from a group of new principles in physics, called energetics." *[Nobelian Petr Kapitsa, to Nikita Khrushchev, in answer to Khrushchev's demand for a 100% method of defense against long range missile attack.]*

- "We will bury you." *[Khrushchev, to Nixon, Kitchen Debate]*

- "We have a new weapon, just within the portfolio of our scientists, so to speak, which is so powerful that, if unrestrainedly used, it could wipe out all life on earth. It is a *fantastic* weapon." *[Khrushchev, speaking to the Presidium, Jan. 1960]*

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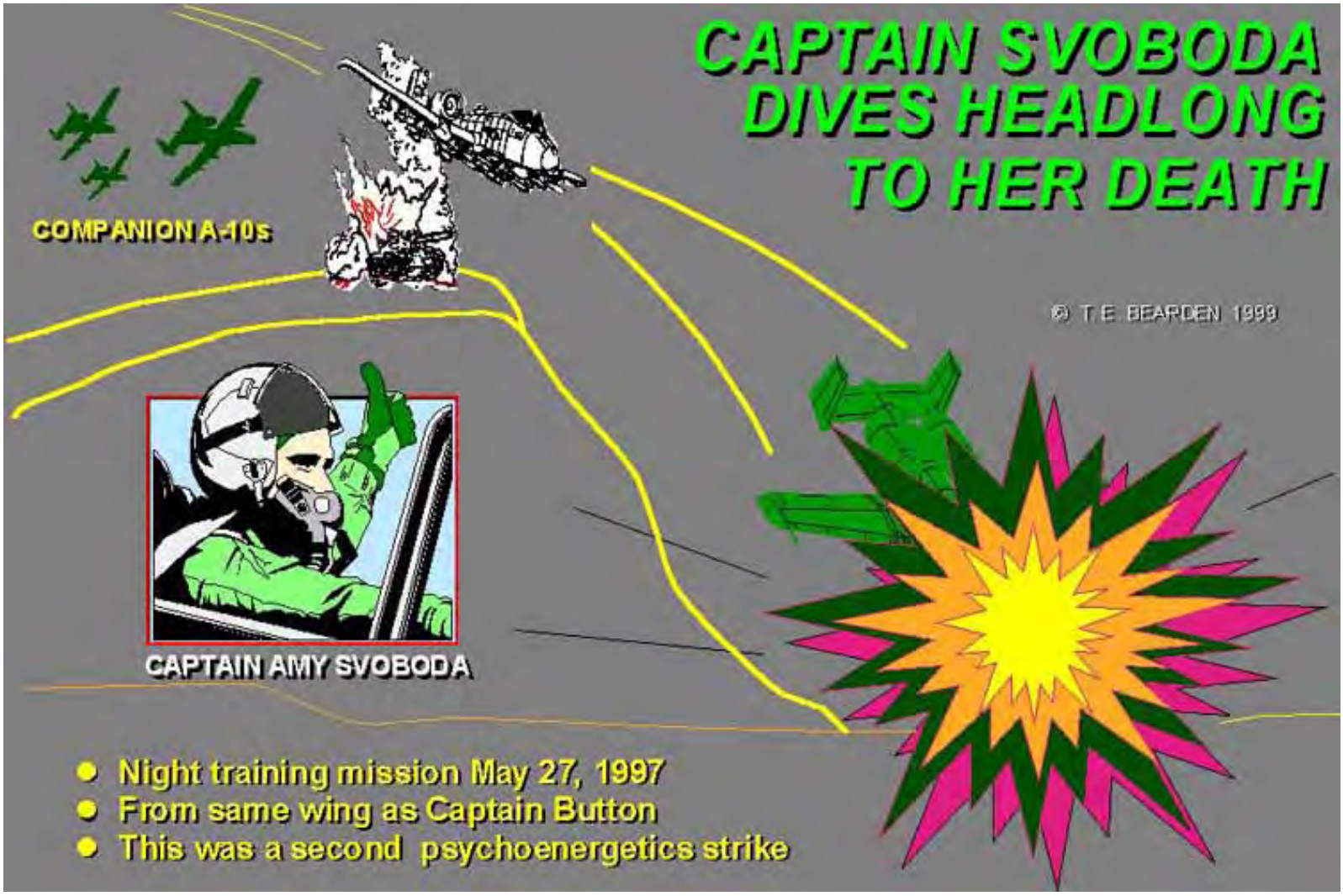
CAPTAIN SVOBODA
DIVES HEADLONG
TO HER DEATH
COMPANION A-10s
© T.E. BEARDEN 1999
CAPTAIN AMY SVOBODA
• Night training mission May 27, 1997
• From same wing as Captain Button
• This was a second psychoenergetics strike

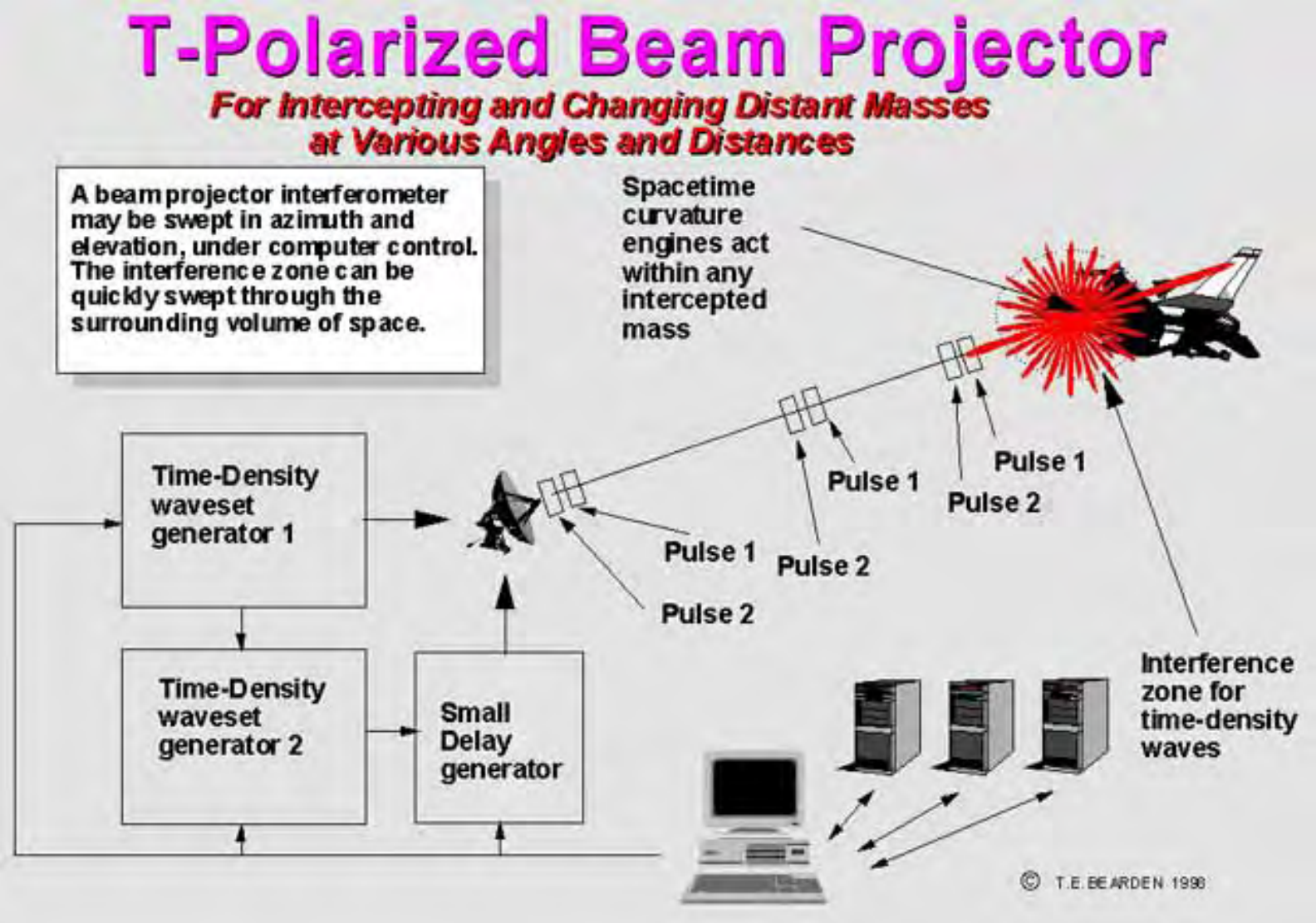
T-Polarized Beam Projector
For Intercepting and Changing Distant Masses
at Various Angles and Distances
A beam projector interferometer may be swept in azimuth and elevation, under computer control. The interference zone can be quickly swept through the surrounding volume of space.
Spacetime curvature engines act within any intercepted mass
Time-Density waveset generator 1
Time-Density waveset generator 2
Small Delay generator
Pulse 1
Pulse 2
Pulse 1
Pulse 2
Pulse 1
Pulse 2
Interference zone for time-density waves
© T.E. BEARDEN 1998

Possible Tests (1)

- 1958 nuclear accident in Urals
- Disease induction in U.S. Embassy personnel in Moscow
- Siberian disease/death transmission experiments
- Destruction of USS Thresher nuclear submarine, Apr. 10, 1963
- Nuclear explosion transmitted into ocean underwater, 100 miles north of Puerto Rico, Apr. 11, 1963

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Possible Tests (2)

- Eight F-111's downed in Vietnam immediately after deployment
- Several large earthquakes
- Mysterious aircraft losses in groupings
- Numerous underground "nuclear" tests
- Nuclear tests at Semipalatinsk without associated seismic activity
- High altitude rumbles, snaps, booms
  - *Off English coast*
  - *Off East coast of U.S.*
  - *Over West Coast of U.S. in thunderstorms*

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Possible Tests (3)

- Blinding of several U.S. satellites (up to 4 hours in duration)
- Cold Explosion off Kurils 1984
  - First, a cold explosion
  - Then test of giant Tesla shield 300 mi. dia.
- Tests offset from shuttle launch Nov. 85
- Kill of Arrow DC-8,Gander, NFLD Dec. 1985
- Titan kill, Vandenberg AFB, CA early 1986
- Kill U.S. Challenger, off Cape Canaveral 1986
- Earthquakes induced, 1986-88
- Dozens of tests of shields around the world
- Decades of radiating U.S. Embassy in Moscow

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Possible Tests (4)

- Extensive tests 1990-99 in Western Australia
- Engineering of weather since 1990 by Yakuza
- Possible nuclear dudding test in WA in 90s by Aum Shinrikyo
- C-130 engine flameout kill
- TWA-800 kill 1997
- Gulf War Disease Induced, 1991
- Spreading of immune systems of U.S. populace, 1990s
- Psychoenergetic control of Captain Button
- Psychoenergetic control of Captain Svoboda
- Twice in 1997, within days of full strategic destruction of U.S.

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Mushroom cloud rising from sea

- 0514 hrs, 9 April 1984
- Gray-white cloud appeared
- Rose 60,000 feet in 2 minutes
- South of Kuril Islands
  - *180 miles southeast of Hokaido*
  - *200 miles from Tokyo*
- Soviet missile testing scheduled about 350 miles away, at 2100 hrs, 9 April 1984

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Launches from Cape Canaveral
and Vandenberg AFB
Provided Practice Targets of Opportunity

The sinking U.S.S. Thresher, with her controls jammed, implodes when she reaches crush depth

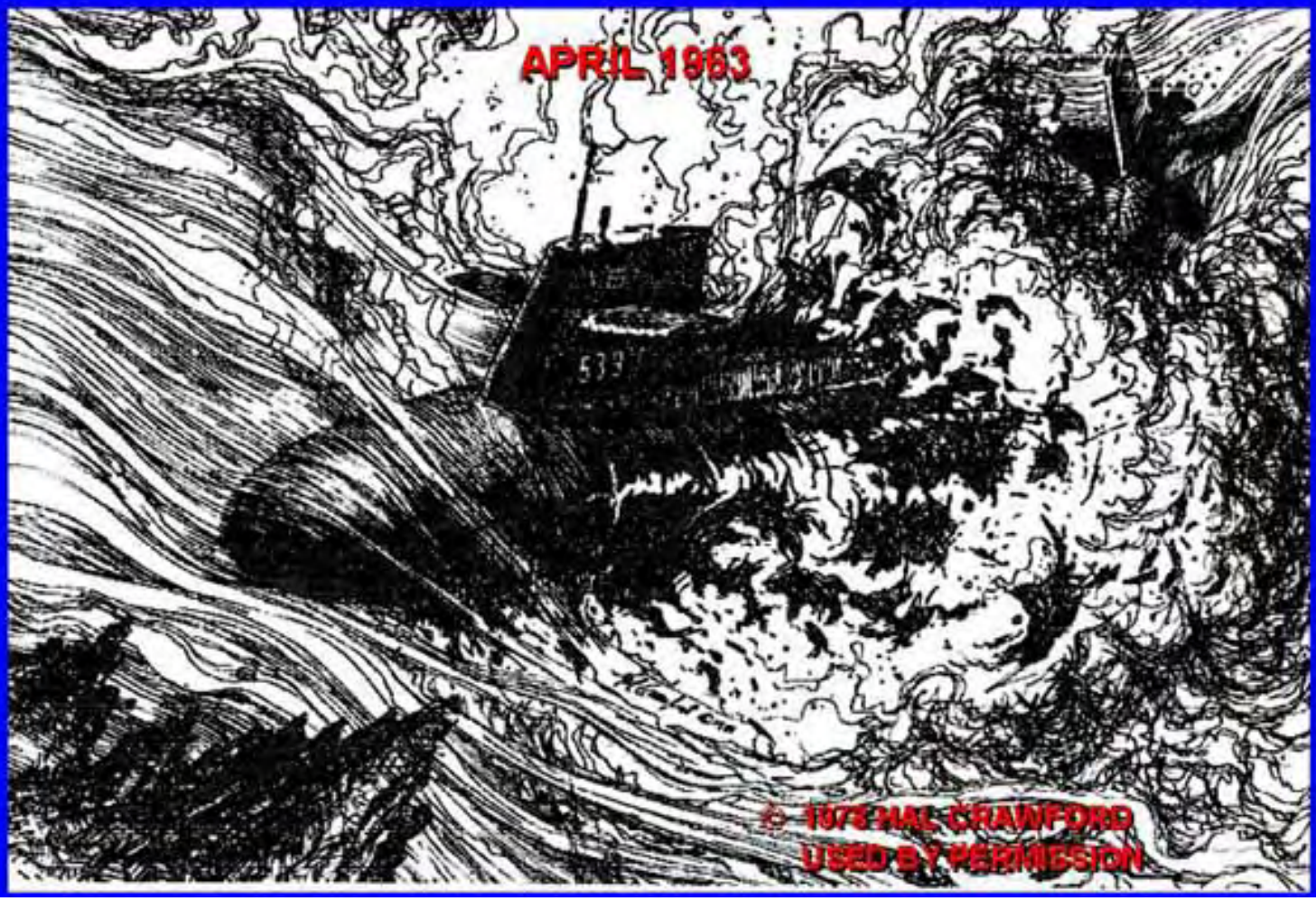

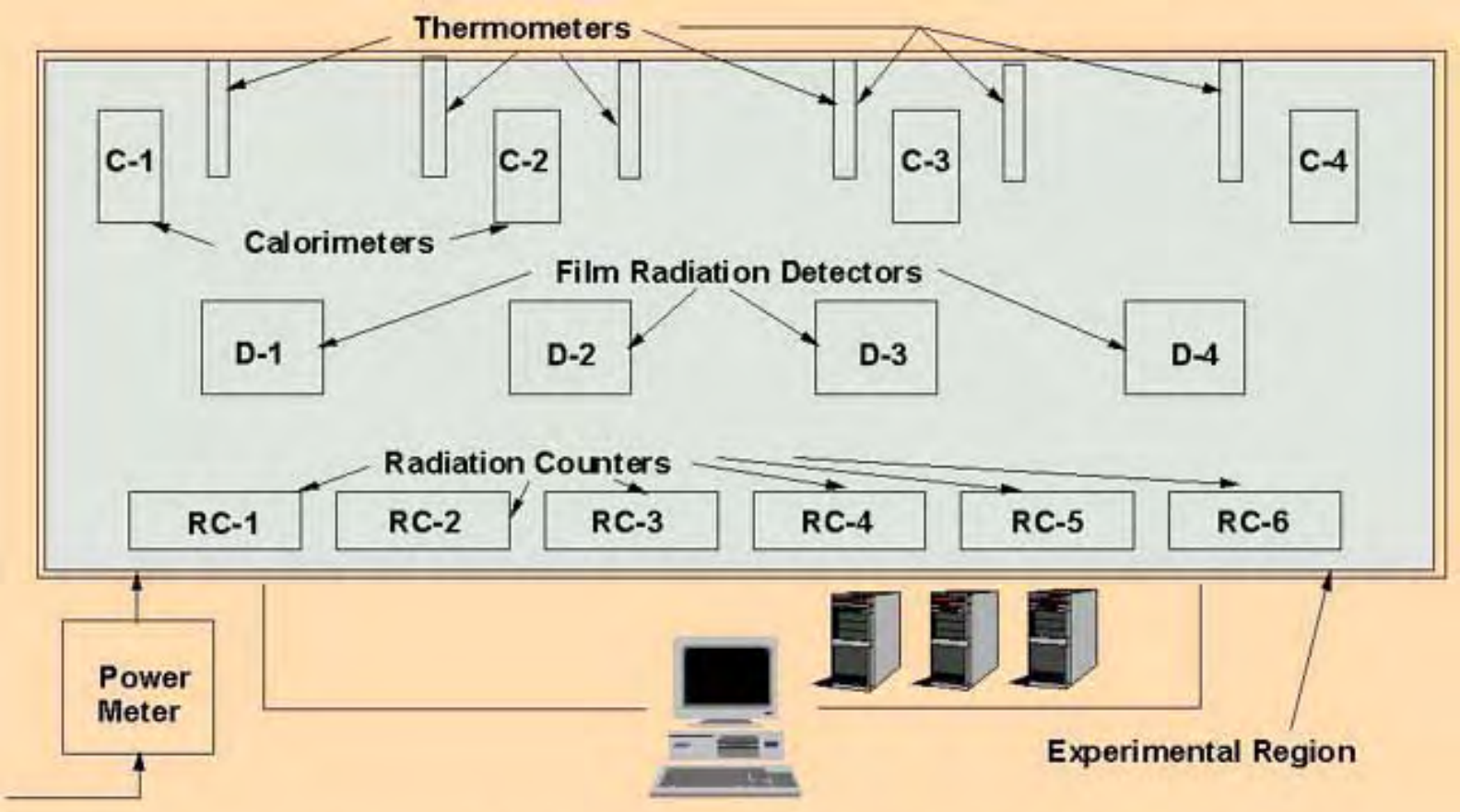

Figure 32. Embodiment of an instrumental array sufficient to discriminate when time-density charging has occurred, and that transduction of time-charge decay is occurring.

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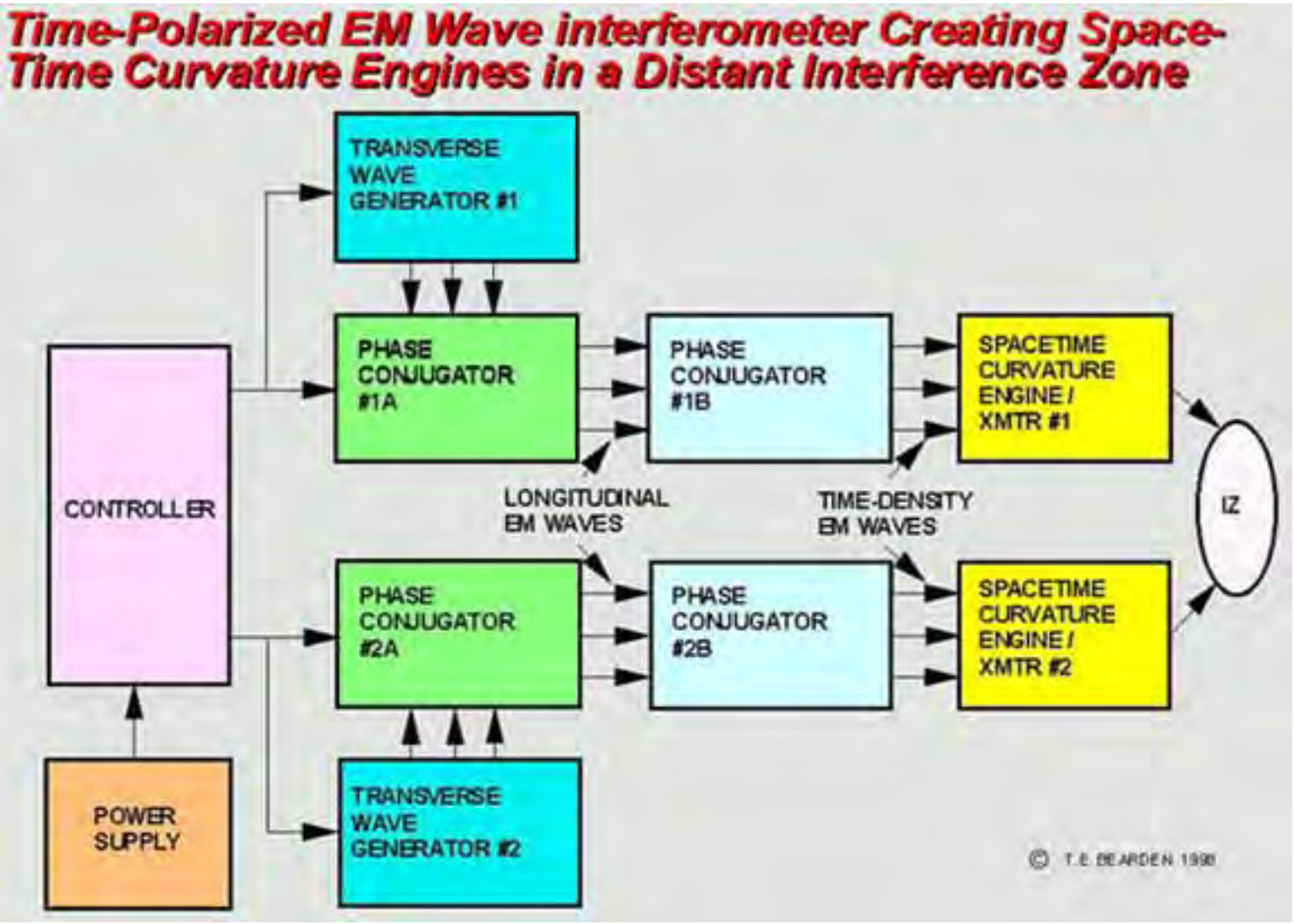
Time-Polarized EM Wave interferometer Creating Space-Time Curvature Engines in a Distant Interference Zone
TRANSVERSE WAVE GENERATOR #1
PHASE CONJUGATOR #1A
PHASE CONJUGATOR #1B
SPACETIME CURVATURE ENGINE / XMTR #1
CONTROLLER
LONGITUDINAL EM WAVES
TIME-DENSITY EM WAVES
IZ
PHASE CONJUGATOR #2A
PHASE CONJUGATOR #2B
SPACETIME CURVATURE ENGINE / XMTR #2
POWER SUPPLY
TRANSVERSE WAVE GENERATOR #2
© T.E. BEARDEN 1990

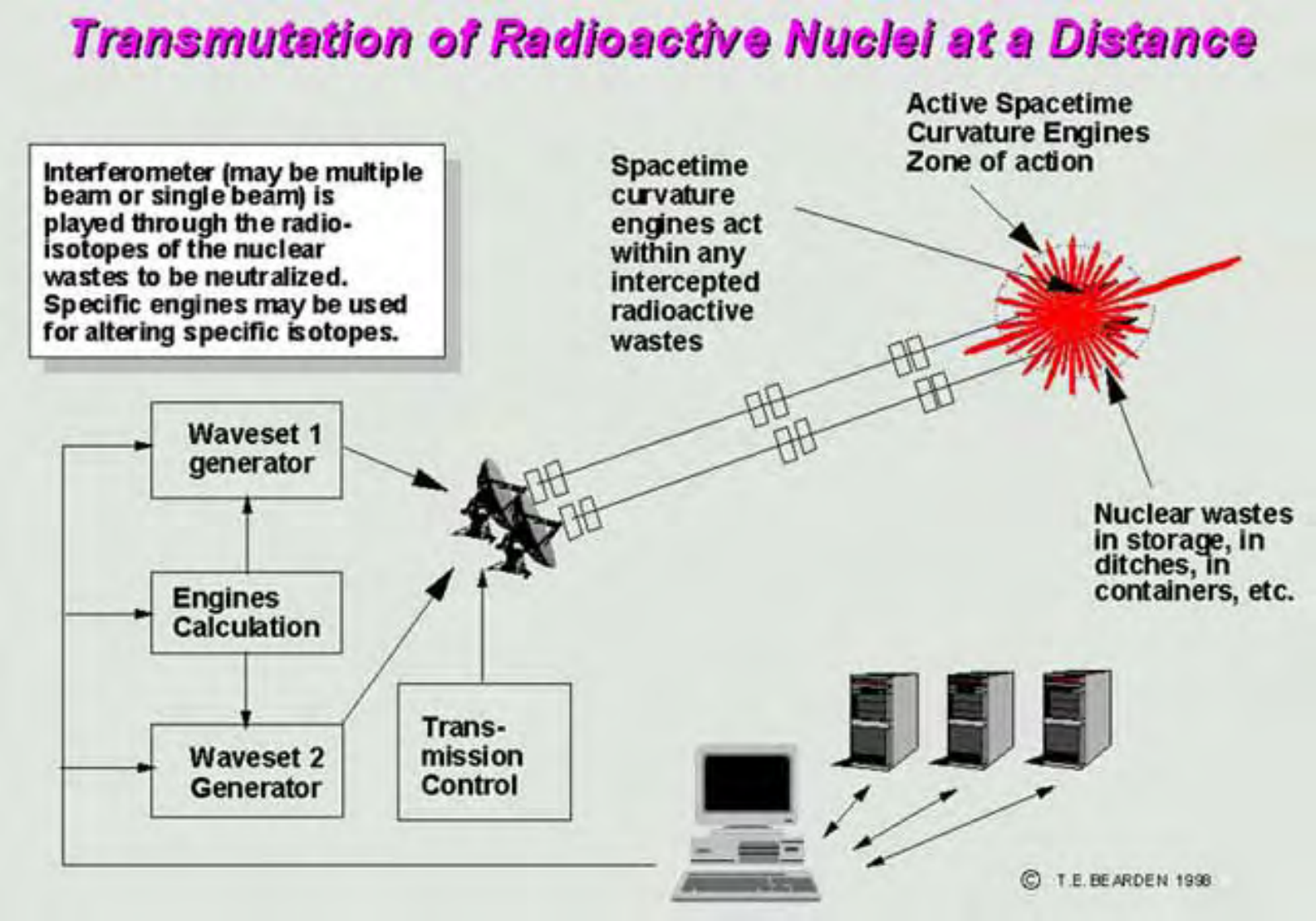
Transmutation of Radioactive Nuclei at a Distance
Interferometer (may be multiple beam or single beam) is played through the radio-isotopes of the nuclear wastes to be neutralized. Specific engines may be used for altering specific isotopes.
Spacetime curvature engines act within any intercepted radioactive wastes
Active Spacetime Curvature Engines Zone of action
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
Nuclear wastes in storage, in ditches, in containers, etc.
© T.E. BEARDEN 1998

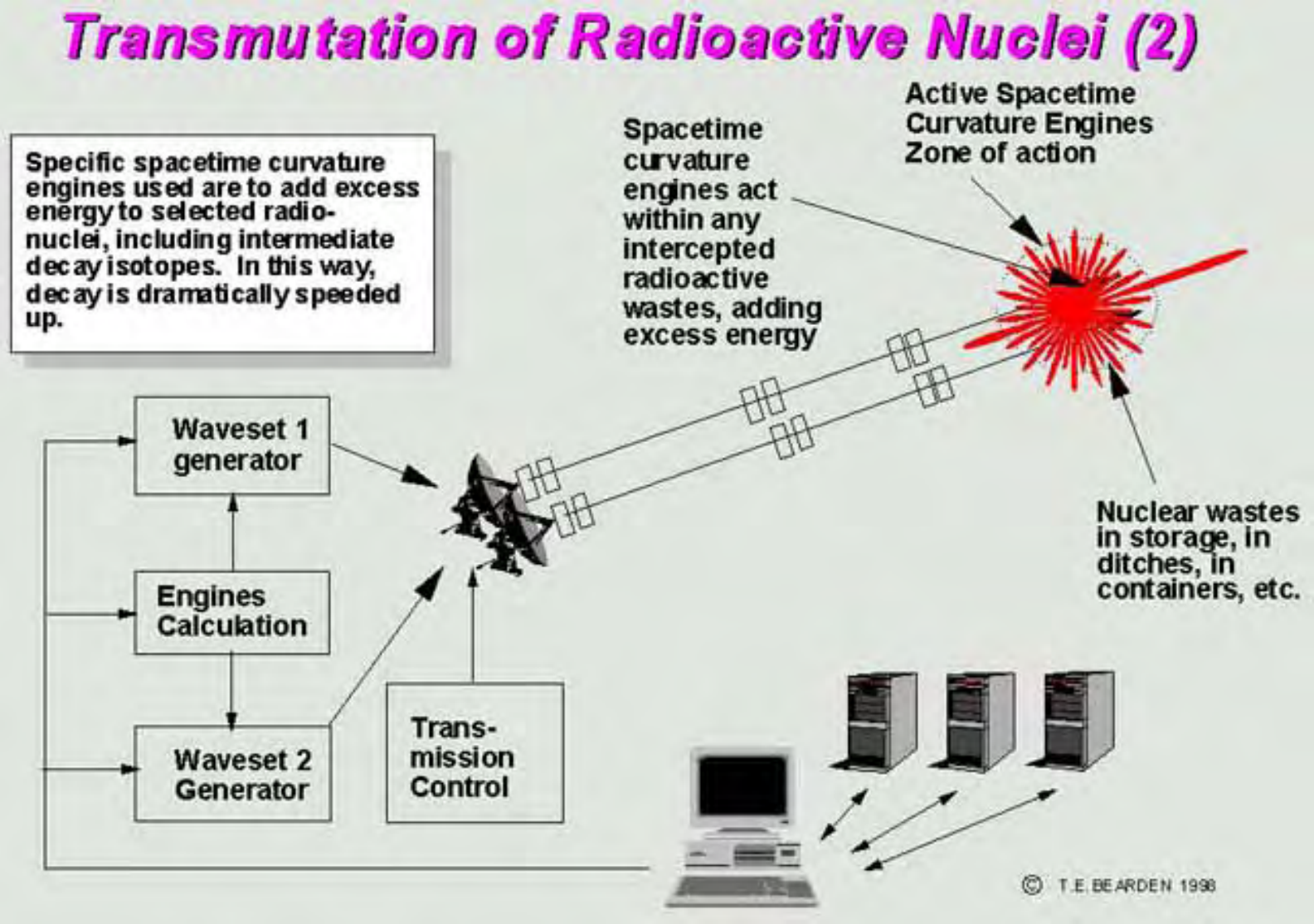
Transmutation of Radioactive Nuclei (2)
Specific spacetime curvature engines used are to add excess energy to selected radio-nuclei, including intermediate decay isotopes. In this way, decay is dramatically speeded up.
Spacetime curvature engines act within any intercepted radioactive wastes, adding excess energy
Active Spacetime Curvature Engines Zone of action
Nuclear wastes in storage, in ditches, in containers, etc.
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
© T.E. BEARDEN 1998

Typical Shield Test, Northern Route to Japan
18-27 km diameter
Asahi Evening News, Tokyo
June 22, 1982
Multiple tests seen per month, for years.
Pilots simply ceased reporting them.
© T.E. BEARDEN 1994,1995

A Curious Tide in Human Affairs

To win its freedom in the long run, usually a group must defeat its attackers or suppressors *at least twice*.

- We fought the British twice for our independence.
- We are fighting ourselves twice to free the slaves. - American Civil War
  - Civil rights struggle
- We beat the Germans twice, in WW I and WW II
- We beat the Hispanics in the Spanish-American War. *That's once*. (They're winning the second by crossing the border. The U.S. is becoming a Hispanic Nation).

But we also have some unfinished business at hand.

- We checked the Russians in the Cold War. *Once*.
- We checked the Japanese in WW II. *Once*.
- We checked the KGB in the Cold War. *Once*.
- We checked the Communists in the Cold War. *Once*.
- We checked Saddam Hussein in the Gulf War. *Once*.

Large Scalar EM Interferometer (LASI) Accident Near Urals, 1958

© T.E. BEARDEN 1994, 198

- 1958 nuclear explosion near Urals
  - Signature of large scalar interferometer (LASI) accident
  - Buried atomic wastes suddenly exploded
  - Large region contaminated to this day
- Soviets were well along with advanced LASI prototypes and testing
  - Khrushchev announced forthcoming advent of these "fantastic" weapons in Jan. 1960
  - 1958 difficulties could have been resolved by 1960
- Expected 1958 cause: transmitter short-out and failure in a nearby LASI discharged its cumulated energetics beam energy into the ground
- *Spreading ground pulse struck nearby atomic wastes, fissioning nuclei*

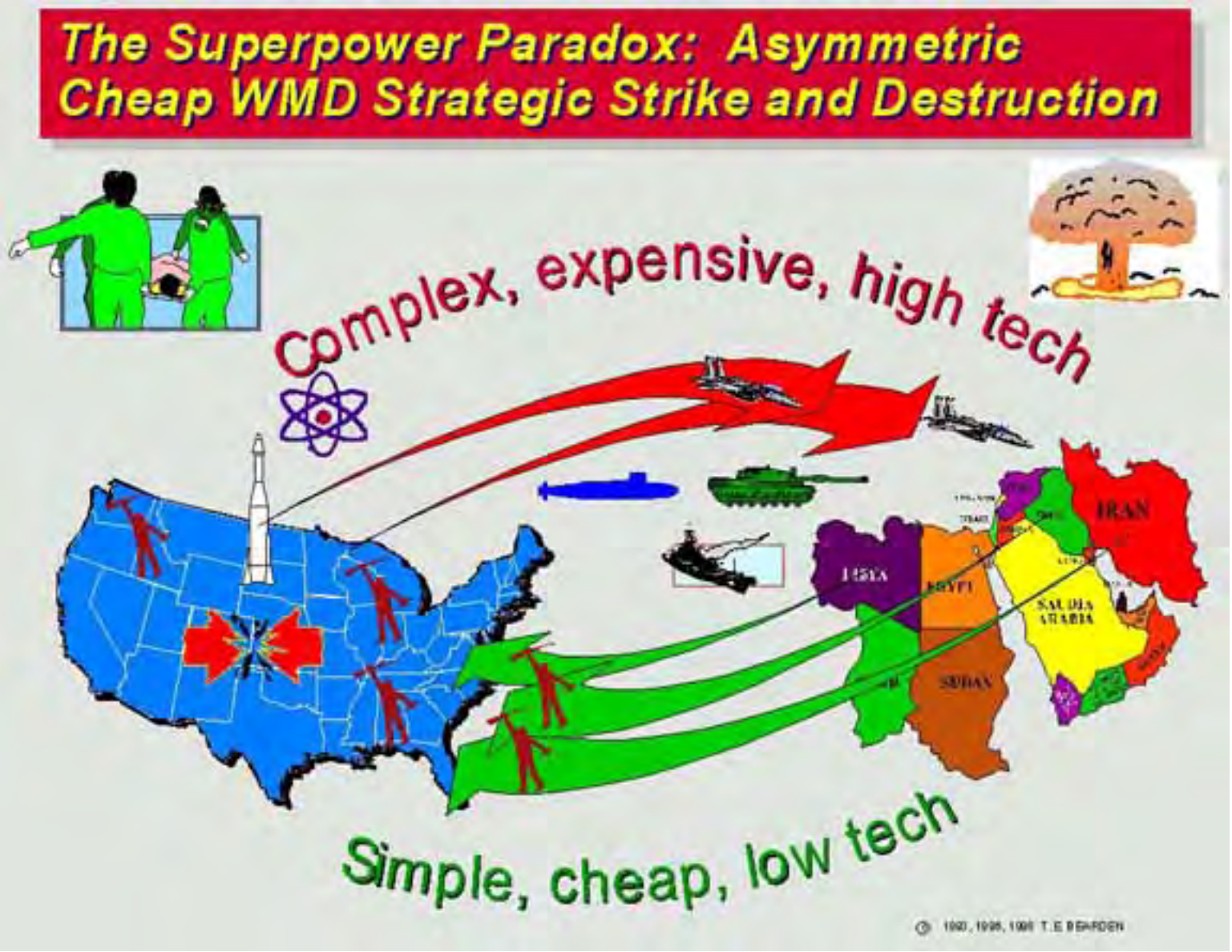
The Superpower Paradox: Asymmetric
Cheap WMD Strategic Strike and Destruction
Complex, expensive, high tech
IRAN
LIBYA
EGYPT
SAUDI ARABIA
SUDAN
Simple, cheap, low tech

THE KGB/YAKUZA-AUM WAR PLAN

- *Dud all quantum potential weapons in other nations via psychoenergetics.*
- *Remove U.S., Israel, Brazil, West Europe as military powers.*
- *Destroy nuclear weapons, hostile energetics weapons, hostile ships, 80% of targeted populaces in first hour of strikes.*

LEASE

1990-91

Aum/Yakuza Acquired Use of on-site Russian Scalar EM (Energetics) Weapons.

Began Geosurvey of Test Range (Western Australia) for training.

KGB Tested QP population wpn (Gulf War Syndrome)

TRAIN

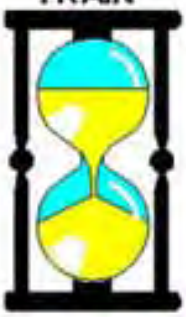

1991-94

Began extensive training of AUM-Yakuza crews in Russia, with practice firing into Western Australia. J-team took over world-wide weather engineering. Preparing for occupation of West Australia.

ESCALATE

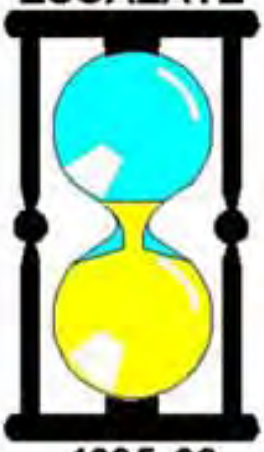

1995-99

Began EM kill of selected lone U.S. targets, law strategic deception plan.

U-2 a/c? USAir 747?
TWA-800 C-130
ValueJet? A-10s

Surged electrical grids. Worldwide practice kills, scalar interferometry. QP modification of selected pathogens

STRIKE!

Plan:
Trigger terrorist BW, & WMD attacks.
Enhance BW infections with QP wpn.
When ready, counter insane QPweapons with psychoenergetics. Destroy QP wpns.
Dud all nuclear weapons worldwide;
Time-snap ships, scalar weapons sites;
Attack major target populations w/QP.
Then cleanup with interferometry strikes.

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Why Western Science is Ignorant of KGB Energetics

- *Foundations* of electrodynamics and much of Western physics are seriously flawed
- Only just rediscovering longitudinal EM waves
- No knowledge of using time-polarized EM waves
- Does not know a powerful GR is hidden in EM
- Ignores inner structure of potentials, waves, fields
- Hotly defends errors, ignores for a century
- Determined to push big nuclear science
- Suppresses research to approved dogma by rigorously controlling precisely what research the funds can be used for

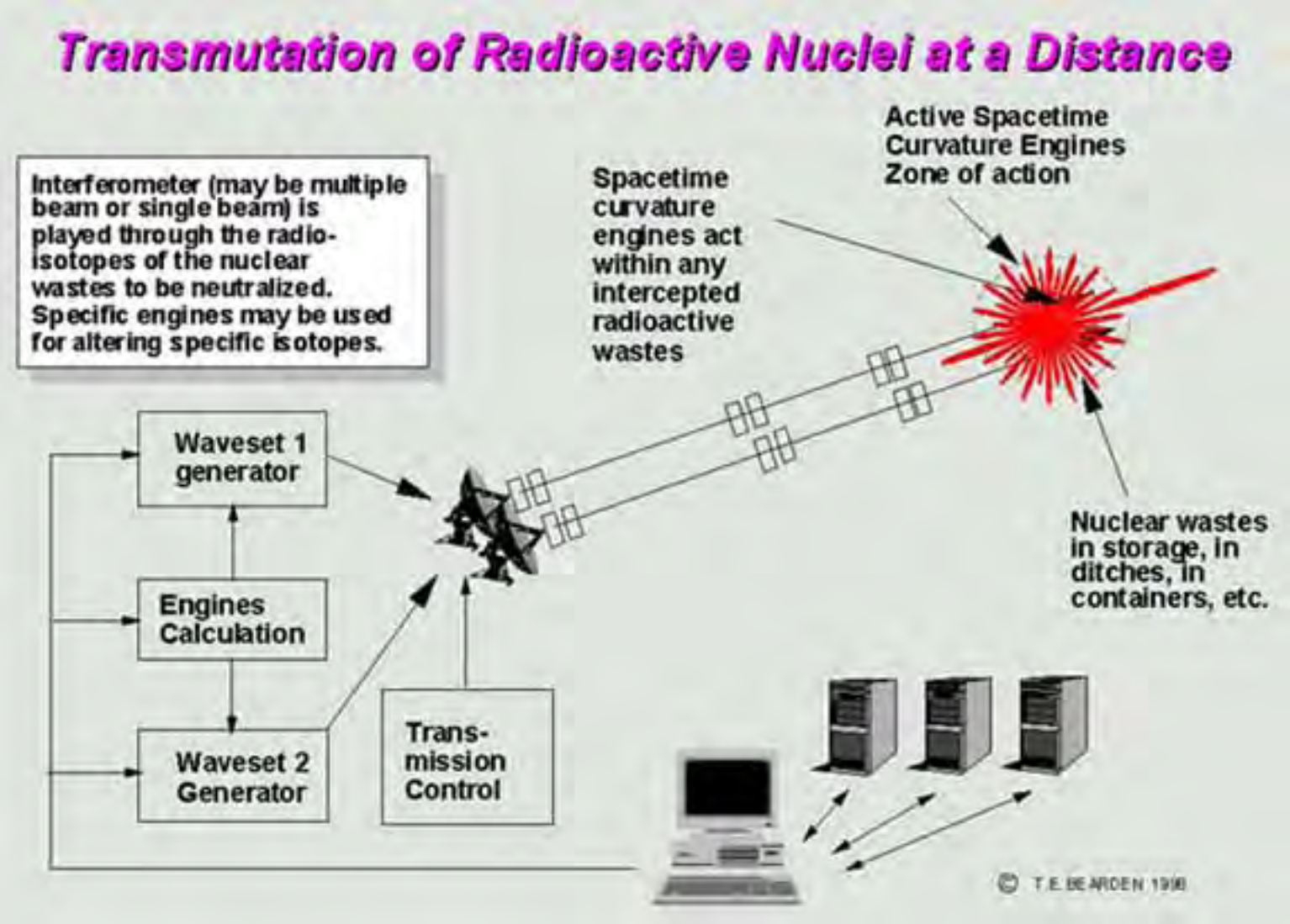
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Active Spacetime Curvature Engines Zone of action
Nuclear wastes in storage, in ditches, in containers, etc.
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
© T.E. BEARDEN 1998

THE YAKUZA

(JAPANESE MAFIA)

To do business with Japan is to do business with the Yakuza

The Last Samurai, Defending Bushido

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- **3 Major Yakuza Groups, In Coalition.**
- **Penetrate Japanese Government.**
- **Open Offices, Signs on Street.**
- **Public Romanticizes Yakuza as Last Japanese Samurai**
- **In Large High-Tech Corporations.**
- **In Control of Japanese Banks.**
- **Japanese Real-Estate Rip-off.**
- **$500 - 1,000 Billion per Year Income.**
- **Rapidly Spreading in U.S.**
- **Uniting Mafia Groups Worldwide.**
- **Coalition with Aum Shinrikyo.**
- **Leased Russian Energetics Weapons.**
- **Crews On-site in Russia, Trained.**
- **Practice Firings into Western Australia for Three Years. (Dozens of Shots per Month)**
- **Now in Escalation Phase, Killing U.S. Targets.**
- **All-out Strike on U.S. ready 1999-2000.**
- **Now held in check by KGB, dead-man fuzed by small nation friendly to U. S.**

Yugoslav Earthquake, Followed by Cold Explosion

Apr. 15 1979

- Magnitude 7.2 on Richter scale
- Epicenter 33 km. deep
- More than 100 aftershocks
- At Kamenari:
  - Adriatic sea mushroomed up
  - Like atomic bomb explosion
  - Signature of a cold explosion
  - Similar to Apr. 1984 test off coast of Japan, near Kurils (see inset graphics)
- *Note that April is a significant test month for the Communists (preparing official reports for May Day?)*

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SCALAR WEAPONS

UNDERSTANDING THESE MAKES IT EASIER TO UNDERSTAND THE NATURE OF THE AETHERS. WE'LL START WITH TOM BEARDEN'S FACTUAL INFO ABOUT THE RESULTS OF THE RUSSIAN'S SCALAR WEAPONS PROGRAM

http://www.cheniere.org/books/ferdelance/intro.htm

THE RUSSIANS USED SCALAR WEAPONS TO BLOW UP THE CHALLENGER SPACE SHUTTLE, A NUMBER OF OTHER LAUNCH VEHICLES, VARIOUS JET AIRPLANES, MODIFY THE WEATHER AND KILL UNTOLD NUMBERS OF BIRDS & FISH, WHICH HAS HAPPENED AGAIN RECENTLY. HAARP DEVICES CAN DO THIS.

SIMPLY PUT: A SCALAR WEAPON IS A FIGURE 8 WAVE FORM THAT IS NOT IN HARMONY WITH AN AMBIENT AETHER, IF POWERFUL ENOUGH THE SCALAR WEAPON CHANGES THE SIZE OF THE BACKGROUND SCREEN AETHER, WHICH THEN NO LONGER SUPPORTS THE MANIFESTATION OF MATTER, WHICH DESTABILIZES AND EXPLODES.

THE REASON WE ARE NOT ALL SPEAKING RUSSIAN IS BECAUSE THE MOST UNSTABLE MATTER IS IN NUCLEAR WARHEADS - DESTROYING THE ENTIRE WORLD IS NOT WINNING A WAR. PROVIDED, OF COURSE, THAT YOU LIVE ON THAT WORLD - THERE IS EXCELLENT EVIDENCE THAT A SCALAR WEAPON WAS USED TO DESTROY THE BIG BEAUTIFUL PLANET WHERE THE ASTEROID BELT IS NOW. THAT'S IN THE BOOK "COSMIC WAR".

GIGGLE, LAUGHING MY ASS OFF AT THIS ONE FROM BEARDEN:

It has also become fashionable in the West to believe that all the laws of physics are already discovered. We assume we already know all of them. While we have been pridefully crowing this tune, the Soviets have been steadily discovering new laws in secret, as well as new ways to circumvent the old laws.

THE SAD PART IS THAT IT HASN'T CHANGED - WESTERN SCIENTISTS ARE IDIOTS WHO ARE LEADING THE WORLD INTO DESTRUCTION. OR SITTING BACK AND WATCHING THE DESTRUCTION, WRINGING THEIR HANDS AND SAYING THAT FUKUSHIMA RADIATION WILL BE WITH US FOR 1000s OF YEARS. B.S. THERE ARE A NUMBER OF ENERGETIC WAYS TO CANCEL RADIATION INSTANTLY.

BEARDEN TAUGHT ME ABOUT SCALAR ENERGY - BUT, THEN HE HAS STARTED PARROTING LAME STREAM PHYSICS - PROBABLY TO KEEP HIS HEAD FROM BEING SEPARATED FROM HIS BODY BY OUR CONTROLLERS.

SCALAR WEAPONS ARE DESCRIBED IN A NUT SHELL ABOVE. BUT, WE'LL EXPAND IT A LITTLE - THE SIMPLE FACT THAT THEY WORK IS PROOF THAT THE AETHERS IS THE BACKGROUND SCREEN THAT SUPPORTS THE MANIFESTATION OF MATTER, WHICH IS ALL DIVINE I.E. MADE FROM IMAGES.

THE AETHERS PROGRESS IN SIZE ACCORDING TO THE FIBONACCI SERIES, BECAUSE EVERYTHING FROM THE QUANTUM TO THE COSMOS MANIFESTS ACCORDING TO THE FIBONACCI SERIES - ITS ALL FRACTAL I.E. A RECURRING MATHEMATICAL PATTERN, THAT IS PERFECT THROUGHOUT CREATION. HERE'S THE PROOF - OUR ENTIRE GALAXY IS IN PERFECT HARMONY WITH ONE NUMBER = RIDICULOUSLY AMAZING

http://blog.hasslberger.com/docs/PERFECTION.pdf

THUS, IF YOU CHANGE THE BACKGROUND SCREEN, THEN MATTER HAS TO CHANGE = THE RESULT OF USING A SCALAR WEAPON.

THE PRECISE WAY THE WEAPON WORKS IS TO IMPOSE A MAN MADE SCALAR WAVE ON AN AREA OF SPACE. GIVEN ENOUGH POWER TO THE SCALAR WAVE, IT WILL CAUSE THE AETHER IN THAT AREA TO MATCH ITS SIZE (LIKE ATTRACTS LIKE). WE ARE TALKING UNBELIEVABLY SIMPLE.

YOU CAN MAKE ONE YOURSELF - AMAZINGLY THE REQUIRED WINDINGS OF A SCALAR PRODUCING COIL CAN BE USED AS A WEAPON OR FOR HEALING - ITS CALLED A RADIONIC WITNESS WELL WHEN USED FOR HEALING.

TO MAKE A WITNESS WELL ONE WINDS INSULATED WIRE AROUND A GAP IN SPACE I.E. THE CENTER OF A TORROID. THE WIRE IS WOUND TO THE LEFT AND TO THE RIGHT. THE MORE WINDINGS THE MORE POWERFUL. AND, OF COURSE, THE POWER OF THE WAVE IS A FUNCTION OF THE POWER OF THE DC ELECTRICITY USED TO ACTIVATE THE DOUBLE WOUND COIL. SUCH A COIL PRODUCES A FIGURE 8 WAVE THAT IS THE SIZE OF THE CENTER OF THE COIL. IF THAT SIZE HAPPENS TO BE THE SIZE OF AN AMBIENT AETHER, YOU'RE NOT GOING TO HAVE A WEAPON.

IF YOU MAKE SUCH A COIL FOR HEALING, POWER IS NOT REQUIRED, IT AUTOMATICALLY CONNECTS WITH THE AETHERS IN A POSITIVE WAY.

IF YOU MAKE IT AS A WEAPON ADD LOTS OF POWER AND BE A LONG WAYS AWAY, WHEN YOU TURN IT ON. THE DESTRUCTIVE EFFECT IS INSTANTANEOUS - I'VE SEEN IT, WE BUILT ONE.

SCALAR WAVES ARE ALSO REFERRED TO AS PHASE CONJUGATED WAVES,

MEANING TWO SINE WAVES THAT ARE 180 DEGREES OUT OF PHASE FROM ONE ANOTHER. (WESTERN LAME STREAM IDIOTS SAY THAT THOSE TWO WAVES CANCEL ONE ANOTHER.)

ONE SINE WAVE IS SAID TO RUN IN TIME FORWARD AND THE OTHER IN TIME REVERSE. AND THERE ARE A NUMBER OF EFFECTS THAT PROVE THIS. ONE EXAMPLE: DON BRANDT (ONE OF BEARDEN'S PROTEGEES) USED A SCALAR WAVE TO REGROW A LEG ON A CAT (A KID HAD SHOT IT OFF WITH A .22), WHEN DON FINISHED, THE CAT HAD ITS LEG BACK AND ALL OF THE CLOCKS WITHIN FIVE MILES WERE 15 MINUTES BEHIND TIME - THAT WAS THE LAST TIME HE PLAYED WITH THAT.

IN 2-D THERE IS NO LINEAL TIME.

BOTTOM LINE: SCALAR WEAPONS PROVE THE NATURE OF THE AETHER AS THE BACKGROUND SCREEN - IF THAT WAS NOT SO, THEN SCALAR WEAPONS WOULD NOT WORK.

ALSO, SCALAR WAVES THAT ARE IN HARMONY WITH AN AMBIENT AETHER ARE VERY BENEFICIAL AND USEFUL - A BEE'S HONEYCOMB IS AN EXCELLENT EXAMPLE. DITTO GRAPHENE.

LOVE AND BLESSINGS

PS: THERE HAVE BEEN A NUMBER OF HUMAN "CIVILIZATIONS" IN THIS SOLAR SYSTEM AND ON THIS PLANET. OUR CONTROLLERS LIKE US TO BE STUPID, BECAUSE IT SEEMS THAT WHEN EVER WE MAKE GREAT TECHNOLOGICAL ADVANCES OR SPIRITUAL ADVANCES, THEN THEY WIPE US OUT. WE ARE AN ENTERTAINMENT SLAVE SPECIE.

THIS LAYS OUT HOW OUR DREAMS / ANUs ARE SHARED WITH OTHERS AND THAT JESUS' ENERGY IS FOUNDATIONAL
http://blog.hasslberger.com/docs/GOLDFISH_JESUS_REVELATIONS.pdf

THIS IS FUNNY AND SHOWS THAT THE EARTH IS THE BEST ENTERTAINMENT SYSTEM IN ALL OF GOD'S CREATION:
http://blog.hasslberger.com/docs/EARTH_WINS.pdf

OH - THE CHEMTRAILS WILL KILL JUST ABOUT EVERY LIVING THING ON THE FACE OF THIS PLANET, IF WE DON'T START MEDITATING AND BUILDING ORGONE DEVICES, WHICH HAS TO BE DONE EVEN IF THEY STOP SPRAYING BECAUSE THE EFFECTS OF THE CHEMTRAILS CAN AND WILL CARRY ON, EVEN IF THE SPRAYING STOPPED.

Scalar Wars

The Brave New World of Scalar Electromagnetics

by Bill Morgan

For the past six months I have been undergoing the greatest **paradigm shift** I have ever had to go through. It has rattled my nerves and shaken my bones. This intense adjustment of my "world" has come about by studying the information given by Col. Tom Bearden at his website Cheniere. The new knowledge there has necessitated a total revision of my ideas about physical reality, the world we live in, and the future of humanity. This paradigm shifting even actually made me dizzy on certain days as I tried to absorb and digest Bearden's vast amount of information. I am not a scientist at all, just a layman, and I have little comprehension of the math and high physics of this new science called "**Scalar Electromagnetics**." But there is a great deal of information at Cheniere which needs to become common knowledge as fast as possible, for the sake of the survival of life on earth. To that end I have put together this small primer of Bearden's ideas, as a kind of "beginner's guide" to his website. (I have tried to underline certain words and phrases which are part of the new "jargon" of talking about these "new" phenomena. Also I have taken the liberty of bolding certain words and phrases to help them stick in the mind).

(Note: Throughout "**EM**" means "**electromagnetic**," and "**LW**" means "**longitudinal wave**")

This article has six sections:

New Waves 2. Tapping the Waves 3. Weaponization 4. Healing 5. Psychoenergetics 6. As It Stands

1. New waves discovered

Longitudinal EM energy fills vacuum of space, the time domain of spacetime, time as compressed energy, E=tc2, waves of time, phase conjugate wave pairs.

"Electric power is everywhere present in unlimited quantities and can drive the world's machinery without the need of coal, oil, gas, or any other of the common fuels." Nikola Tesla

"At any point and at any time, one can freely and inexpensively extract enormous EM energy flows directly from the active vacuum itself." Tom Bearden

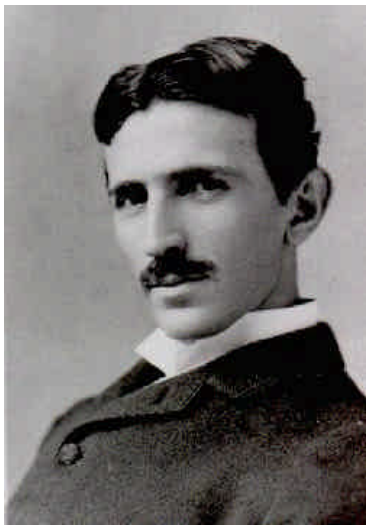

I guess the first thing to try to comprehend is that a "new" kind of electromagnetic (EM) wave has been discovered in the empty vacuum of space called “longitudinal” waves, which, when engineered, can be an inexhaustible supply of energy in great magnitude at any place in the universe. The word "new" is in quotes because the discovery really goes back to **Nikola Tesla** and his discovery of what he called "radiant energy." It is also not "new" because the Russians (KGB) have been working on this technology for over 30 years and have **weaponized** these "new" longitudinal scalar waves to a great degree.

These are the very weapons **Nikita Khrushchev** spoke of in January, 1960.

> "By 1957-8 the Soviets had progressed to the point of a giant scalar EM accident in the Urals which exploded nearby atomic wastes, devastating the area. They had also progressed to development of great new superweapons using their new energetics - weapons to which Khrushchev referred in 1960 when he informed the Soviet Presidium of a new, fantastic weapon in development, a weapon so powerful that it could wipe out all life on earth if unrestrainedly employed."' Tom Bearden

After over 30 years of development, and extensive testing around the globe, these new scalar electromagnetic weapons are up and running and ready to go. Tom Bearden, at his website Cheniere, discusses the history of these new scalar electromagnetic weapons in his paper "Historical Background of Scalar EM Weapons."

Some Immediate Implications

The implications of successful engineering of the longitudinal waves are enormous, and will change the world as we know it, one way or another. Among other things, these discoveries mean that:

1. The **solutions to the energy crisis and the "oil problem" are in hand**. These oil wars are unnecessary. There is endless energy available freely from the domain of time.

2. **Unbelievably powerful weapons** are not only possible, but are already operating in several nations. The many powers of these weapons are unprecedented and mind-boggling.

3. The **cure of diseases such as cancer and AIDS**, in fact nearly any disease, has become possible within a few years of sufficient funding. Everyone can be made healthy and stay healthy.

4. **Mind control on a mass scale** has now become possible, and the machines to do it are already in place in certain nations. It has become possible to mentally enslave whole populations with the twist of a few dials.

So the layman will need to understand that there is a new kind of electromagnetic energy that is altogether different from what he knows, e.g. radio, TV, cell phones, etc. The ordinary EM waves that we have known about are called transverse EM waves, to distinguish them from the new longitudinal EM waves. These scalar waves do not actually exist in our "material" world, but exist only in the vacuum of empty space, or the time domain. And we must keep in mind that this vacuum of space we speak of exists all through everything. Even our bodies are mostly empty space between atoms and molecules. So the gateway to this seething ocean of energy can be there at every point in the universe. This seething ocean of energy is all around us and all through us.

Emptiness is Full

This amazing discovery announces that the "emptiness" of empty space is in fact not empty, but a great ocean of seething energy!

Col. Bearden refers to this ocean of energy as being of the "time domain." It seems like something from Star Trek but this is where scalar electromagnetics has come to. And where it is going may be beyond anything Star Trek could have dreamed of.

We live in a 3-dimensional world, which physics calls "3-space." But there is also spacetime, or 4-space, or the "4th dimension." Then suddenly comes this amazing new knowledge that time itself is actually compressed energy. And it is energy which is compressed by exactly the same factor by which matter is considered compressed energy: the speed-of-light-squared!

So we have a new companion to the famous E=mc2. It is now paired with E=tc2 (where t is actually "delta-t," or change in time). Or (amaze your family and friends and) say:

"E equals em-cee-squared"

and

"E equals delta-tee-cee-squared"

It has a nice ring to it, like some freedom bell announcing a new era.

And as the atomic bomb released the compressed energy in matter, so can we now unleash the tremendous energy that is compressed into time itself. It gives a completely new meaning to the term "time bomb."

Some New Terminology of Scalar Electromagnetics

A new science, several new names

> "Those [Russian] weapon scientists resurrected an old term from the history of electrodynamics, called "energetics". That is their approach to a unified field theory, where everything is based on "energetics". This model as its foundations uses a very similar approach to that "single fundamental unit" model, where energy is the unit. If one makes the energy EM in nature, then one has the Russian energetics approach. This unified approach gathers everything in, including all energy actions and relations in inert matter (the first branch of energetics, called by the same name), all field and matter interactions in living matter (the second branch of energetics, called "bioenergetics"), and all mind operations and mind-matter interactions (the third branch of energetics, called "psychoenergetics"). [ed: sometimes also called "psychotronics" by the Russians]

Rick Andersen in an article called "What is Scalar Electromagnetics?" describes the new science this way:

> "Scalar EM is the brainchild of Lt. Col. (retired) Thomas E. Bearden, a systems analyst and wargames specialist who has been advocating a view of electromagnetics which is based on the notion of a vast, unseen background of scalar energies (as opposed to vector energies) which underlie all physical reality.
>
> "If Bearden is correct in his Scalar EM theory, then we can build devices which would enable us to alter gravity, time, inertia, and the apparent mass of an object. This of course has ENORMOUS implications for military applications, space-vehicle drives, time-travel, teleportation, paranormal phenomena, and just about every other area one can think of." http://twm.co.nz/Beard_scalem.html

> "Time-energy, time-currents, and time-structuring play the dominant role in electromagnetics. Time-as-energy eventually becomes engineerable, as easily as is spatial energy now. We are always dealing with spacetime and with spacetime curvature."
>
> Bearden: http://www.cheniere.org/techpapers/Vision%202000%20paper.doc

The scalar energy discovered in the vacuum of space is sometimes called "zero-point" energy. Thomas Valone explains how this term came about.

What does "Zero Point" mean?

"Boyer traces the historical “creation of the vacuum” as proceeding in stages in parallel with the historical development of ideas about the vacuum. To paraphrase, he says that in the 17th century, it was thought that a totally empty volume of space could be created by simply removing all matter and, in particular, all gases. That was our first concept of the vacuum. Just get rid of all the gas. Late in the 19th century, it became apparent that the region still contained thermal radiation. But it seemed that the radiation might be eliminated by cooling. So the second concept of getting a real vacuum is to cool it down to zero temperature. Just go all the way to absolute zero. Then we’ve got a real vacuum. Right? Well, since then, both theory and experiment have shown that there is a non-thermal radiation in the vacuum and that it persists even if the temperature could be lowered to absolute zero. Therefore, it was simply called the “zero point” radiation. "Thomas Valone http://www.seaspower.com/InsideZeroPoint.htm

> "**For our very survival, it is absolutely imperative that informed citizens be aware of this dramatic change, which is just now starting. The powerful new science and engineering must be controlled and used for humanity's benefit, not its detriment. Else it will eventually be let loose unrestrainedly, to destroy all life on earth - a possibility indicated by Nikita Khrushchev in 1960**." - Bearden
>
> http://www.cheniere.org/explore%20articles/priore1/p4.jpg

2. Tapping the waves

Endless free energy, Tesla's radiant energy, the dipole as the gateway to the energy of the void, MEG in one year, Bedini, Yakuza, etc. End of Oil, geopolitical chaos, rogue groups

Move Over G.E. & Big Oil, Energy is Everywhere!

Third-world nations set to rise

> "Certain powerful interests did not wish the extended electromagnetics to be discovered or taught. That, after all, would lead to free energy and loss of economic control of the citizens. That was precisely why Nikola Tesla had already been suppressed ... Today it is still being suppressed by the orthodox establishment."
> http://www.cheniere.org/books/ferdelance/s25.htm

The vast seething ocean of energy of the vacuum, the longitudinal scalar EM waves of the time domain, can now be tapped and "transduced" into ordinary (transverse) EM energy in our 3-Space world. The process can be compared to putting a paddlewheel into a river. The energy acquired is free, since the river is there flowing whether we tap it or not. And it is a mighty river, and is not diminished by our paddlewheel.

This means that a permanent solution to the "energy crisis" is at hand, if only those who hold it so secret would give it up to humankind.

It means our species' insane use of oil is no longer necessary. We can make automobiles that need no fuel at all. We can build motors that power themselves. It means that unlimited electrical power can be available for free anywhere in the world. Every house and even shack can have its own power supply.

Of course there is the cost of the equipment at first, but the energy flow is free for the presumably very long life (no moving parts) of the generator. It will probably take decades to shift over to scalar power.

But the ability to tap the scalar (longitudinal) EM waves of the vacuum (which exists everywhere) also means that unbelievably powerful weapons can be, and already have been developed. In fact these weapons are so dangerous that the fear engendered becomes a psychological obstacle to the grasping of the facts.

I struggled with this myself for months, and even though Tom Bearden had completely convinced me already, it is hard to accept the fact that for everyone on earth the "worst that might happen" has suddenly gotten much worse. It takes time to deal with that, to realize it and get over it.

Indeed, the possibilities of these new weapons, which are tapping the huge energies of time, are so terrifying it is natural for the mind to simply say: "I don't want to hear about that."

And the government, likewise, pretends these weapons do not exist and tries to keep it secret from the people. Because most people would indeed be truly alarmed to know the actual situation. Col. Tom Bearden has decided that the people need to know the truth anyway. As a People on a Planet we must face this now, and ban the use of scalar weapons in war or in mass mind control. The current deployment of these weapons is a world emergency which we must all face.

The physics and mathematics of the longitudinal waves and the time domain are clearly beyond the layman, but I recommend scanning through them anyway just to get a sense of the wonder and the elegance of it all and some of the exotic terms which are used. Two of the most important papers by Col. Bearden are:

Giant Negentropy from the Common Dipole

The Final Secret of Free Energy.

Despite the complexity of the science involved, Bearden sums up the essential secret of it all in a few words.

> "There is no problem at all in extracting all the energy one wishes from the active vacuum, anywhere in the universe, at any time. Just make a dipole.

> The problem is in (1) catching some of that freely gushing EM energy in a circuit containing a load, and (2) dissipating the caught and collected EM energy in that load to power it, without using half the caught energy to destroy the source dipole's).
>
> That is the ONLY real energy problem on the planet, and always has been."
>
> http://www.cheniere.org/correspondence/022502.htm

A dipole could be a battery, which is polarized into negative and positive. Or the terminals of a generator. Or any magnet with its two poles. Or an atom with its positive and negative charges. Or the earth's magnetic field, the sun, and all heavenly bodies. Even a galaxy must be some kind of mega-dipole. Wherever there is a dipole there is already immense scalar EM energy ushering out of and back into the vacuum. And there have already been demonstrated a number of diverse methods for tapping that energy as it flows. (John Bedini, Edwin Gray, Bruce de Palma, and others). Bearden provides what he calls a "partial list" on his website.

> "In other words, nature then gladly gives us as much EM energy flow as we need, indefinitely — just for paying a tiny little bit initially to "make the little dipole." After that, we never have to pay anything again, and nature will happily keep on pouring out that 3-flow of EM energy for us. This is the giant negentropy mechanism I uncovered, performed in the simplest way imaginable: just make an ordinary little dipole."
>
> Bearden http://www.cheniere.org/techpapers/Unnecessary%20Energy%20Crisis.doc

How to Buy a Free Energy Machine

Answer: Just wait one more year! 2003. Then get off the Grid!

Perhaps the most eagerly awaited event now is the marketing of Bearden's Motionless Electromagnetic Generator (MEG) scheduled to begin in about a year's time. This is when the proof will hit the fan. Many people have said to me, when talking about free energy, "I'll believe it when I can go to the store and buy one." Hopefully in a year's time they will be able to order their own MEG. And then they will believe, because it works and is working.

Says Bearden: "I will admit that the chief scientist of an important experimental group in a large company was rather stunned at the type of output we were able to obtain. The MEG may look like just a transformer, but it is not. It is a completely different breed of cat."

(Bearden : http://www.cheniere.org/correspondence/011202.htm)

Soon the cat will be fully out of the bag. The first MEG units will supply 2.5 kilowatts of free electricity. Forever. Units can be connected together to double or triple the wattage. After that gets going, 10 kilowatt generators are planned. Energy will flow freely from the time domain indefinitely, and there are no moving parts to wear out. This manufacturing project is a heroic effort and will change the world as we know it. For once people are in possession of such devices there can be no further denial from anyone, including the government and/or "secret-government."

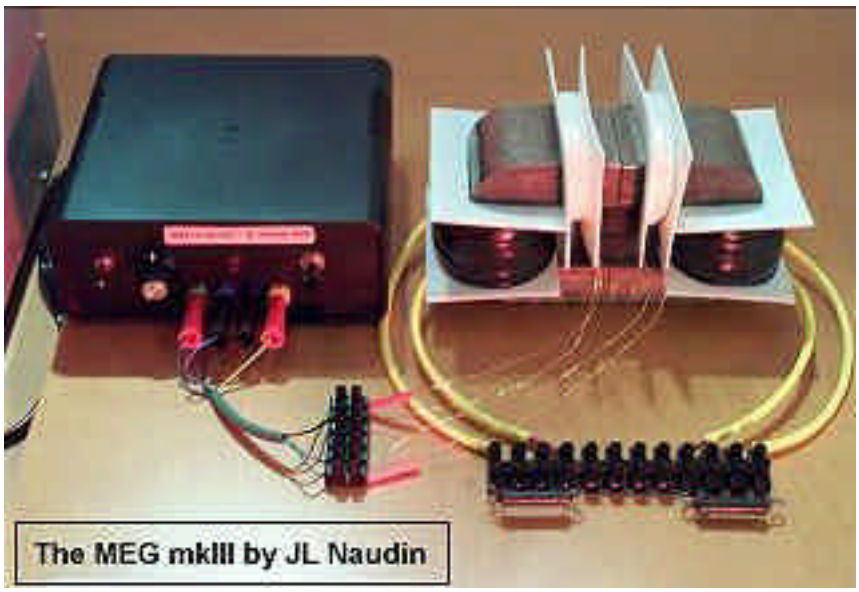

The Motionless Electromagnetic Generator

(Successfully replicated here by J. L. Naudin)

The physics of how the MEG works is explained in the paper "The Motionless Electromagnetic Generator: Extracting Energy from a Permanent Magnet with Energy Replenishment from the Active Vacuum."

The device was successfully replicated by J.L. Naudin in France, and others, like Steve Utne, are also working on their own models. But Magnetic Energy Limited's MEG is actually scheduled for production soon and looks to be the first commercially available free-energy generator in history!

I imagine it will not take long for tinkerers to put them into their electric cars and make the first fuelless automobiles since Tesla's unheralded (and unheeded) experiments. Or for builders to begin building houses powered by MEG's. Houses which will never see electric bills. How can they ever make enough of these to meet the demand that will suddenly be there? Bearden is right, it needs to be an all-out crash program of the government on the order of the Manhattan Project.

I must include here that Bearden is quick to point out that he is not himself the inventor of the MEG, but is a partner and advisor in bringing it to the public market through Magnetic Energy Limited, Inc. I must also admit that I am praying for the success of this venture, and the ending of the absurd and criminal withholding of this technology from the people by the black-ops military-industrial people. This secrecy has cost the planet over 30 years of unnecessary pollution.

The first units off the assembly line, which is being set up in a "friendly" unnamed nation, will usher the public at last into the new era of scalar electromagnetics.

As of December, 2001, the situation with the MEG was described by Bearden in a letter.

> "What we presently have with the MEG is a successful laboratory experiment. At least a year's very hard research will have to be done before we will be ready to put a commercial power supply into production.
>
> "Consequently, we have made an agreement with a foreign partner (the National Materials Science Lab of the National Academy of Sciences of a friendly foreign nation) to do that year's research. At the same time, we are trying to make an agreement with one or more large financial partners here in the U.S."
>
> Bearden http://www.cheniere.org/correspondence/121901.htm
>
> "So we are hopeful that we will be able to start introducing units on the market about a year from now. Quite simply, we will either succeed or we will fail. But we will give it our very best effort."
>
> Bearden http://www.cheniere.org/correspondence/012202a.htm

Bearden has given another technical explanation of how the MEG works here in a letter.

Motionless Electromagnetic Generator patented, 3-26-2002

Click here to read the patent

"In Magnetic Energy Limited, all business discussions and arrangements are taken care of by Dr. Lee Kenny, Managing Partner. There are five of us who are co-inventors of the MEG, and two of the others are really the principal inventors." Bearden http://www.cheniere.org/megstatus.htm

Free Energy has been Suppressed

Secret Government Aware of Free Energy

"In this world of contemporary times, all the agencies, CIA, FBI, KGB, NSA, Electric Power Research Institute, DARPA, Brookings Institution, Henry Kissinger, Edward Teller, et al., all are aware of [free-energy researcher Bruce] De Palma and his ideas.

"Because these individuals and institutions are employed by the ruling elite to forecast the future and satisfy present needs and demands, it is clear that free energy is a threat to the world order constructed by business and the mindset of those who want to own the world.

"Free energy represents Man's aspirations and dreams of freedom and equality, uniform division of resources and the ability to choose one's own future.

"The fact that free energy is suppressed speaks to the greed and self-interest of a ruling elite which, even in the face of an emergency of global starvation, resource depletion and environmental pollution, will not give one inch if it means loss of control. This is an

> attitude of paranoid delusion and fantasy which can only arise from the alienation of a class of elitists who, through their money, are completely insulated from the reality of the day to day fight for existence of the common man."
>
> http://depalma.pair.com/Absurdity/Absurdity07/ProblemOfFreeEnergy.html

Bearden describes one case of suppression when the Yakuza killed the Kawai engine in his very presence in Huntsville, Alabama.

> "That night a jet arrived from Los Angeles, with a Yakuza on board. The next morning Kawai no longer controlled his company, his invention, or his own fate. The Kawai party was in fear and trembling. The Yakuza coldly dissolved the agreement, they packed up the two Kawai engines we had, and left. And that was that."

So it is not only governments who are keeping this revolutionary technology from seeing the light of day. The Yakuza? KGB? The Aum Shinrikyo cult? Our "leaders" need to be honest about what is going on, otherwise they look foolish, acting out a kind of "Alice In Wonderland" script before the public, a script that has become completely unbelievable.

Concerning the criminal withholding of this scalar technology by the military black-budget people, and the cover-up of the actual situation regarding scalar weapons throughout the world, Tom has this to say:

> "The high government officials of the United States of America grossly violated our constitution and their sworn oaths of office. Our constitution specifically charges the government of the United States to defend the people of the United States. That means our officials are specifically charged with defending our people. Yet they deliberately agreed not to do so, and they deliberately sacrificed us in advance.
>
> "They committed treason of the highest kind, by deliberately surrendering us to total destruction anytime the big balloon goes up."
>
> Bearden http://www.cheniere.org/books/ferdelance/s75.htm

Energy Crisis Solved

One of the "must read" documents at Cheniere is "The Unnecessary Energy Crisis: How to Solve It Quickly," especially since the "oil wars," which Bearden has foreseen for decades, have now already begun.

Here are some clips from that Document:

> "To avoid the impending collapse of the world economy and/or the destruction of civilization and the biosphere, we must quickly replace much of the "electrical energy from oil" heart of the crisis at great speed, and simultaneously replace a significant part of the "transportation using oil products" factor also.

> "The technical basis for that solution and part of the prototype technology required, are now at hand. We discuss that solution in this paper."

And although the solution to the energy problem and the oil wars may be at hand, Bearden suggests there is still an urgent rush that needs to be made to save human civilization from collapse.

> "Once the technology hardware solutions are ready for mass production, even with a massive worldwide deployment effort some five years are required to deploy the new systems sufficiently to contain the problem of world economic collapse. This means that, by the end of 2003, those hardware technology solutions must have been completed, and the production replacement power systems must be ready to roll off the assembly lines en masse.
>
> "The 2003 date appears to be the critical "point of no return" for the survival of civilization as we have known it.
>
> "Reaching that point, say, in 2005 will not solve the crisis in time, and the collapse of the world economy as well as the destruction of civilization and the biosphere will still almost certainly occur, even with the solutions in hand."
>
> "The good news is that we now know how to easily initiate continuous and powerful "electromagnetic winds" from the vacuum at will. Once initiated, each free EM energy wind flows continuously so long as the simple initiator is not deliberately destroyed."

On page 9 he explains the concept of the dipole, and how there is already huge scalar energy flowing in the time domain around any dipole. Hold a magnet or a battery in your hand and you hold a stress in time and a beautiful flowing loop of longitudinal waves!

Bearden decries the scientific community in the West for being unable to let go of their dogma long enough to see that the greatest discovery in human history lies at their feet, but for their stubborn ignorance.

> "The present energy crisis then is due totally to that "conspiracy of ignorance" we referred to, that is maintained by the scientific community, and that has been maintained by it for more than 100 years.
>
> "This is the real situation that the environmentalists must become aware of, if they are to see the correct path into which their energies and efforts should be directed — to solve both the energy crisis and the problem of gigantic pollution of the biosphere. "As far as anyone in the legislative branch of government ever understanding the profundity of the discovery and engineering of scalar waves, Tom Bearden says they are at a great disadvantage in doing so.
>
> "The nontechnical person — e.g., a Senator or a Congressperson — is operating under a distinct disadvantage. If he or she takes the stance that much better electrical power systems can readily be achieved, he or she is in fact opposing almost the entire set of University, Government Technical, Power Company, Battery Company, and Organized

> Science communities. Further, in most cases his technical advisors are themselves from one or the other of those communities, and likely to go back into that community or those communities when the Senator or Congressperson leaves office, or even before. So the Congress and the non-technical government community at large operate at a great disadvantage...Bearden National Emergency Declaration is Needed
>
> "The Government Non-Technical community (the Senate and the Congress, in particular) are in far better shape than the Government Technical community, to appreciate the world implications of the pending economic disaster. I am hopeful that both the environmentalists and the Government Non-Technical community will rapidly unite in a common goal to get this vacuum energy program launched, under a National Emergency declaration. If so, then they can solve the energy crisis and the pending economic crisis, in fairly short order, and permanently."
>
> unnecessary_energy_crisis.htm#congress_disadvantage

In the conclusion of his paper The Unnecessary Energy Crisis: How to Solve It Quickly Bearden again states the urgency of replacing our centralized power grids with highly dispersed and local taps on the freely flowing energy of the active vacuum. Given the abilities of the Tesla howitzers, the power grids of all nations are sitting ducks.

> "Personally, the present author regards the increasing energy crisis as the greatest strategic threat to the United States in its entire history. I will do anything within my power to help prevent what I perceive to be the looming economic collapse of the Western world, preceded or accompanied by a sudden, explosive, all-out and continuing exchange of the WMD arsenals of most of the world.
>
> ...In the name of all humanity, let us begin! Else by the time this first decade of the new millennium ends, much of humanity may not remain to see the second decade."

3. Weaponization

Scalar interferometry, Tesla howitzer, Tesla dome, heat/cold, dudding, 10 nations have them, dead-man fusing & Insane Systems, scalar strategy, earthquakes and weather wars, solar storms, mind attacks, leased to Yakuza, many examples of testing, quantum potential weapons.

> "Indeed, Soviet energetics weapons are now capable of destroying both our triad shield, our homeland, our armed forces in the field, and our population, quickly and efficiently. We have a new "gap" of monumental proportions: not a missile gap, not a submarine or bomber gap, and not even a particle beam or laser gap. We have a scalar electromagnetics or electrogravitation gap." Bearden http://www.cheniere.org/books/ferdelance/intro.htm

"We have a new weapon, just within the portfolio of our scientists, so to speak, which is so powerful that,

if unrestrainedly used, it could wipe out all life on earth. It is a fantastic weapon." Khrushchev, to the Presidium, Jan. 1960

> "We've totally missed the most incredible "secret superweapons" development program of all times, and the worldwide testing of the weapons themselves.
>
> "Hiroshima and Nagasaki should serve as object lessons in the price of ignorance of such technological breakthroughs.
>
> "History does repeat itself. But this time it's not we Americans who got the great new superweapon first."
>
> Bearden http://www.cheniere.org/books/ferdelance/s75.htm

Warfare has been changed forever by the development of these scalar energy longitudinal wave howitzers. To get a basic understanding of scalar waves is to have the imagination suddenly run wild as all the implications and possibilities regarding warfare fall into place. One realizes with a certain horror that the world has totally changed, and that there are some very fearsome possibilities. Remember, the power for these weapons comes from the time domain, longitudinal EM waves in the vacuum of empty space, and the power is tremendous and mind-boggling. Being able to blast away at any target from a distant control booth is something that has never happened before. This is incredible power to be in control of and it divides the history of weaponry into "before" and "after." And the destructive power of these weapons is delivered instantaneously to the target from the local vacuum at the place of the target.

From an interview:

> Questioner: "Are you saying that real energy can be transmitted faster than the speed of light?"
>
> Bearden: "Yes. But hyperspatially. Not through 3-space, but "around" it. Again, this means that it's possible to produce energetic changes in a distant system at a distant place, without transmitting energy "through space" in the normal sense. You transmit "around" space, so to speak, and directly in time or through a higher dimension, depending on the model you're using to understand this. Further, the speed of the internal EM energy transmission is not limited to the speed of light."
>
> http://twm.co.nz/beard_interview.htm

Here are some initial considerations about scalar weapons and scalar wars

1. Tesla Howitzer 2. Tesla Domes 3. Rogue groups 4. WW III 5. Russian "UFOs?"

3a. The Tesla Howitzer and its modes of action

Source: Tom Bearden's weapons slides and Fer-de-Lance Briefing

For one thing there is no delivery of any thing to any place. Bombs are obsolete. So are the planes to get them there. No helicopters necessary. All current nuclear devices are rendered nearly useless by electronic "dudding." All distant-destruction can be done from a control room, and to any point on earth. The destructive power of "men" has just increased by orders of magnitude. The new weapons could even cause storms on the sun! Thus there is great urgency to make these new facts public and known, with the hope that all nations would come together to ban the use of scalar weapons.

Two scalar antennae together along with the computers to control them, make up a scalar interferometer, and according to Col. Bearden the Russians have hundreds of such installations already. These interferometers are called "Tesla Howitzers." They can deliver a giant blast of energy to the distant target site, true "action-at-a-distance".

The first howitzer mode is called the "exothermic" mode of operation because immense EM energy blasts outward at the target site. The blast of a scalar howitzer can be of near nuclear level in destructiveness, and can be repeated easily, at that place, or nearby, or anywhere.

The howitzer can use a lesser exothermic power setting and simply destroy all electronics in the target area. Thus they can render our nuclear missiles inoperable as they sit in their silos by "frying" the electronic circuits that guide them. They can bring down any airplane, anywhere in the world, at any time. Any person anywhere, if their exact position is known, can be assassinated without a shot being fired.

The howitzers can also bring down power grids anywhere in the world, at any time. Thus they could bring Wall Street to an instant halt by disabling all its electronics. Even this one little easy tweak of the howitzer could cripple the U.S. economy in a single day. No wonder the "leaders" don't want you to know! This is a new era we are in. The discovery and development of scalar interferometry has put us in a new world, whether we like it or not. Anyone could be expected to go into denial, the befuddled senators and congressmen included. But we have to wake up.

In a second howitzer mode called the "endothermic" mode, the howitzer sucks energy out of the target area, essentially creating a blast of cold at the distant target. It is even capable of freezing parts of the ocean. Bearden gives a number of cases where these "cold explosions" have been witnessed, mostly by airline pilots. April 9, 1984: 1 2 3) A huge mushroom cloud of mostly water is seen rising miles into the sky from out of the ocean, an awesome sight.

In the endothermic mode the sucked-out energy must go somewhere, so it is vented out at some other chosen spot on the earth. These endothermic plumes have been photographed by satellite.

> "The exhaust in the left picture is about 150 miles long, and is nearly horizontal (about 1.5 degrees above the horizontal). It is entirely consistent with the continuous exhaust from a "dumping transfer" scalar EM howitzer in the continuous exothermic mode. (The primary howitzer, of course, was activated in the endothermic mode.)" Bearden More Plumes

By using both of these heat (exothermic) and cold (endothermic) modes together the weather can be altered anywhere. Warm the air over here, cool it down over there, put a curl in the jet stream, dissipate clouds, create clouds, whip up a tornado. Bearden speaks about using the endothermic howitzer mode as a weapon of war:

"Cold explosions can be used to freeze tanks, personnel, and equipment. The equipment and tanks thaw out. The personnel thaw out too, but they are dead when they do." Bearden, Fer-de-Lance

(This endothermic mode of the howitzers makes me think that there might one day be a cure for the problem of global warming after all. Could not a big device, situated in space or on the moon, be able to vent a great deal of excess heat outside the atmosphere into space, thus functioning as a kind of planetary thermostat?)

While the United States has experimented with electomagnetic weapons using ordinary transverse EM waves, the longitudinal [LW] weaponized waves are truly of another order altogether.

For one thing they do not have to travel through space, for they come from the time domain, which is everywhere. The energy of the blast, the heat or light or whatever, comes from the vacuum of space at the location of the target itself. This is astonishing. The weapons actually just trigger the release of immense energy from the vacuum at the target location.

> "... it is possible to focus the potential for the effects of a weapon through spacetime itself, in a manner so that mass and energy do not "travel through space" from the transmitter to the target at all. Instead, ripples and patterns in the fabric of spacetime itself are manipulated to meet and interfere in and at the local spacetime of some distant target. There interference of these ripple patterns creates the desired energetic effect (hence the term energetics) directly in and through the target itself, emerging from the very spacetime (vacuum) in which the target is imbedded at its distant location." Bearden Fer-de-Lance

The big Tesla howitzers are aimed at their targets by using a worldwide electromagnetic pattern called the "Woodpecker Grid," begun by the Russians in 1976.

You can hear the Woodpecker signal here: http://www.cheniere.org/misc/woodpeckersound.htm

The woodpecker grid is just that, a grid of EM waves which provide a channel for the LW waves to any point on earth. Computers use the woodpecker grid information to hone down the aiming of the howitzers to a pinpoint location on earth. (For that matter, it could be under the earth, in space, or under the sea).

A third howitzer mode is what Col. Bearden calls "Mindsnapper" mode. This is a truly frightening mode which affects the electromagnetic mind-body connection. Being mind-snapped at a low level would cause you to lose consciousness. Being mind-snapped at a slightly higher power would "entrain" all minds in the target area into a kind of hypnogogic trance, a state in which they would all be highly susceptible to suggestions and orders.

Being mind-snapped at high level would so disrupt the mind-body connection that everyone in the target area would fall down, instantly dead. Not only that, everything around you and inside you would be killed, so that your sterilized body would not rot for quite a long time.

The Mindsnapper can be used for a small area, or to kill an entire population. In fact, using the scalar waves to affect the human mind has become a new field in its own right, and has been dubbed "psychoenergetics." (This is discussed below in section 5).

Bearden describes the use of the howitzer in mind-snapping mode against people, to cause unconsciousness or death:

> "From a military viewpoint, these scalar EM weapons are really quite all-around weapons.
>
> "For example, they are very lethal against personnel.
>
> "Set in the "high intensity pulse mode," one blast and a person's nervous system is destroyed instantly. Total, instantaneous death results. One can blast away at entire groups of infantrymen, for example. It's the peak power that's important, not the average power. So the weapon doesn't require too much battery power.
>
> "Set on a lower intensity pulse mode, one zap can simply knock out a person, rendering him instantly unconscious. Quite useful if one needs prisoners to interrogate. Also very silent, which is useful in operations employing stealth and surprise." Bearden http://www.cheniere.org/books/ferdelance/s80.htm
>
> "Those hit by the scalar EM weapon, however, have a most peculiar death mode.
>
> "Death comes-instantly and totally. There is no convulsion, no response. The entire nervous system is destroyed instantly. Every living cell in the body is killed instantly, including all bacteria, germs, etc.
>
> "A body hit with this thing falls like a limp rag and lies where it falls. It doesn't decay in even 30-45 days. In a macabre fashion, it's been reduced to something like food irradiated with nuclear radiation; everything is killed, so the material is preserved for an extended period before any decay can set in."
>
> Bearden http://www.cheniere.org/books/ferdelance/s81.htm

He goes on to say that the same "bazooka-sized scalar EM pulse weapon" can also be used to knock out a tank with one shot (or pulse). So tank warfare is obsolete. Helicopters? Bearden points out: "... if he's attacked by a helicopter or a fixed-wing aircraft, he can bring the same weapon to bear on it. He can knock down a chopper or a jet. With one shot."

Obituary for Tank Warfare

Tanks useless against portable LW weapons

> "For example, suppose one attacks a tank. [with an LW weapon] With scalar EM pulse, the personnel die instantly. Total personnel kill is achieved.
>
> All electronic systems of the tank are dudded. Total systems kill is achieved. The ammunition in the tank explodes. Total kill is achieved.
>
> The fuel explodes. This is another total kill mechanism.
>
> That tank has been killed totally, by a variety of mechanisms, all simultaneously.
>
> That's a k-kill in any analyst's book.
>
> And don't worry about retrieval and repair. That tank is finished permanently.
>
> Even the most modern tank is just as vulnerable as the most obsolete."
>
> Bearden http://www.cheniere.org/books/ferdelance/s88.htm

One begins to get the idea how profoundly the conventional means of warfare have been obsoleted. All the usual weapons of war have been rendered nearly useless! And Star Trek's "Phaser," with its "stun" and "kill" modes is here at last.

Although it is the weapons aspect of scalar electromagnetic which has received the most developmental effort, Bearden points out that a great many other amazing things that may be accomplished in this new field of science. Beam me up Scotty!

> "Superluminal communications systems, hyperspace drive, and materialization and dematerialization are all hypothetically possible, using scalar electromagnetics. As the technology develops, we should see the development of many of the systems long thought impossible except in science- fiction."
>
> Bearden http://www.cheniere.org/books/ferdelance/s15.htm

Bearden describes a huge test of the Russian scalar weapons systems which occurred in 1985, a test that went completely unnoticed by western scientists:

> "Just before May 1, 1985 the Soviet Union performed a "full-up" operational test of their entire strategic scalar EM weapons complex. This test was detected and monitored periodically by Frank Golden. Some 27 of these giant Soviet "power taps" were locked into the molten core of the earth, producing forced (entrained) scalar resonance of the entire planet on 54 controlled frequencies under our very feet. The remainder of the scalar frequency spectrum was ablaze with literally hundreds of Soviet scalar transmitters: probably the entire strategic scalar command and control system to

> underwater submarines, higher command centers, distant commands, etc. was activated in the giant exercise.
>
> "For several days, the system was exercised on a mind-boggling scale, apparently as part of the Soviet Union's highly accentuated 40th anniversary celebration of the end of World War II.
>
> "Ironically, not a single U.S. intelligence agency, laboratory, or scientist detected this monstrous exercise for the new Soviet leader, Gorbachev. Not a one of them had a detector for scalar EM radiation, and not a one of them officially believes the exercise ever happened."
>
> Bearden http://www.cheniere.org/books/ferdelance/s38.htm
>
> "The Woodpecker grid/howitzer weapon system can be placed over the ocean and used against cruise missiles, naval surface-to-air and surface-to-surface missiles, submarine-launched ballistic and cruise missiles, etc. Placed over a carrier task force, it can also take care of the aircraft launched by the carrier as fast as they are launched. It can also handily take care of the missiles launched by guided-missile cruisers of the accompanying task force."
>
> (Bearden http://www.cheniere.org/books/ferdelance/s65.htm)

The whole series of the Fer-de-Lance briefing slides and comments is a "must read" for anyone wanting to be aware of the actual state of things in this world right now. It is a new world and it takes some getting used to. Fer-de-Lance speaks clearly, for the layman, of the way things stand.

What is it like to operate these Tesla Howitzers? Col. Bearden gives us an idea in his "Fer-de-Lance" briefing, Slides 66-71.

Who needs armies anymore? A entire war can be fought and won by a handful of men sitting in a comfortable control booth! The scalar electromagnetics revolution has made all previous forms of warfare nearly obsolete.

Why haven't the Russians used the scalar weapons yet?

Bearden gives his thoughts on this in "Fer-de-Lance." The power of these weapons is so great that an accident or war could wipe out all life on earth, and even affect the sun.

> "As can be appreciated, this entire concept [MAD] is now totally obsoleted by the Soviet possession of scalar EM weapons.
>
> 'The "mutual assured destruction" capability -- or MAD concept as it was so aptly named! -- is no longer mutual. And for two reasons: (1) the Soviet surprise attack could destroy essentially all our Triad forces wherever they are, in the first attack. (2) Even if a very small number of our strategic forces survive, the puny strike we could attempt to launch could be repeatedly decimated from launch to terminal phase.

'The restraint on the Soviets is not because of our Triad forces. The restraint is twofold: (1) a second nation has scalar EM weapons, and would undoubtedly unleash them upon the Soviet Union with great violence if such a massive world-wide destruction of U.S. forces occurred or was threatened (is it really "accidental" that six major Soviet missile ammunition storage sites mysteriously exploded within seven months?); (2) the closed-loop scalar radiation exchange system of Earth-Sun could be inadvertently "tweaked" in the feedback loop from Earth to Sun, so that a large solar scalar resonance was stimulated. In that case the Sun could emit a mighty resonant "burp" that would simply wipe out all life on Earth in a fiery shower.

'The "terror" in the "balance of terror" between nations has just increased by many, many orders of magnitude.

'The biblical prophecy that the Earth will be wiped out by "fire and brimstone from heaven" is very near fulfillment now.

'Put another way, the pucker factor -- even on the Russians who may contemplate unleashing Armageddon -- is higher than any Western strategic analyst has ever imagined, even in his wildest nightmares.

'Truly these weapons are "more frightening than the mind of man has imagined," as Brezhnev put it in 1975.

'The frightening scalar EM weapons can be used, but only very, very gingerly indeed. If a slight mistake is made, everybody loses everything."

Bearden http://www.cheniere.org/books/ferdelance/s74.htm

But the Russians (KGB) are not the worst of it. Bearden claims that some of the scalar weapons have been leased to the Yakuza for about a billion a year, and that only the KGB is holding the Yakuza in check from making a full-scale all out scalar attack on the west.

U.S. Defense Secretary William Cohen

Warns about eco-terrorism using scalar electromagnetic weapons

"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves... So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations...It's real, and that's the reason why we have to intensify our [counter terrorism] efforts." - Defense Secretary William Cohen, 1997

In a letter to a writer named "Russell" Bearden says,

"In short, Russell, the Secretary of Defense of the United States confirmed that there are indeed novel kinds of EM weapons, right now and have been for some time, which have been and are being used to (1) initiate earthquakes, (2) engineer the weather and climate,

and (3) initiate the eruption of volcanoes. We wrote about those exact uses of the weaponry decades ago. Several nations now have such weapons. Three of them (two on one side and the other on a hostile side) are even firing practice shots into Western Australia, as a convenient test range."

http://www.earthchangestv.com/ufo/0209gandor.htm

Tesla Howitzers in Weather mode

How to Make Weather

"Engineering the weather is duck soup; they tested that over the U.S. in 1967, and entered upon continuing operations over North America on July 4, 1976 as a grim kind of KGB "Bicentennial Gift" to the United States. Here's how it is done with several interferometers.

"First, the interferometers can deliberately make "high pressure areas" (cool the air so it shrinks and its "footprint" pressure on the ground increases because its density increases) and "low pressure areas" (heat the air so that expands and its "footprint" pressure on the ground decreases because its density decreases). Well, if one makes the highs and lows where one wishes them, and judiciously and somewhat slowly moves them along a given path, these highs and lows will entrain the jet streams and thus "steer" the weather.

"So if you wish a very cold snap or attack, go up into Canada and start these actions to steer down some streams that bring some very frigid air. Establish other highs and lows judiciously to "block" or "slow" other jet streams and flows as desired. In this way, one can pull the "large cold air masses coming down from Canada" deep into the southern U.S. at will. They do it regularly. If you wish an ice storm, add an additional current of warm moist air you bring up (steer up by using artificial highs and lows) from the ocean. Where they meet, you will get freezing rain, then sleet, then severe icing accumulating. This type of attack does rather large damage to the struck area."

http://www.earthchangestv.com/ufo/0209gandor.htm

Whole websites have now sprung up showing weather radar anomalies which may well be indications of scalar weather engineering. One list of over 500 images is here. Cheniere has its own collection here.

In another section at Cheniere are many photos of cloud anomalies which reveal the underlying grid along which the clouds are forming or un-forming. Bearden relates a startling incident in these clandestine ongoing "weather wars."

"During the spring of 1986, abnormally strong Soviet weather engineering occurred over the U. S., causing a drastic drought in the southeastern U.S. This drought was broken by a colleague who used an extremely powerful scalar EM device to redirect jetstreams. A most unusual and unique signature of the "blocking" against the Soviet scalar EM actions

resulted: Two huge circulations developed in the atmosphere, clearly showed as two adjacent giant "holes" in the swirling cloud cover over the middle and eastern U.S.

"Between these two giant holes, the cloud circulations formed a stream of clouds, moving to the south, looking very: much like a giant vertical "bar" of a huge "Y-shaped" cloud flow.* Several national weathermen commented on this unusual pattern, which had not been observed before. The pattern continued, day after day, as the blocking continued."

* On the weather maps.

http://www.cheniere.org/books/analysis/history.htm

Tesla Howitzers in Earthquake mode
How to Make an Earthquake

"Here's how you initiate a very large earthquake with such weapons. Take a convenient fault zone of set of them. Focus the interferometry on the fault zone, in the "diverging" mode, and deposit EM energy there in the rocks on both sides, increasing (slowly) the stress in the rocks by the reverse piezoelectric effect (deposit excess energy, get crystal mechanical movements).

"Do it slowly, and the stress will build up to large pressures well-above a plate slip minimum energy required. At some point, the rocks yield and one or both sides "slip" and move rather sharply, giving a very large earthquake in that zone.

"Do the same thing down in the earth (remember, LWs easily penetrate right through the earth and ocean at will, and so the "interference zone" focus can be inside the earth or beneath the ocean, at will.

"Anyway, focus this thing down to where the active part of the volcano is still slumbering, down where the hole in the plate has been made. Keep increasing the deposition of energy in the magma itself, and eventually the increasing pressure from deep within that volcano, underground, will cause an eruption. Build the energy slow, and the eruption will likely be much larger."

http://www.earthchangestv.com/ufo/0209gandor.htm

Yugoslav Earthquake, Followed by Cold Explosion

Strange Characteristics of Iran Quake, Sep. 1978

Tesla Howitzers in Tesla's "Big Eye" mode

How to make a Big Eye in the Sky

By using longitudinal wave interferometry in a weakly endothermic mode a new kind of "radar" is now possible, one which can look right through the earth and oceans. Because the endothermic

mode extracts energy from the distant target, a pattern of the target area can be scanned for in the returned energy.

> "Thus the receiver produces a representation of the energy extracted from various locations within the distant endothermic zone. By displaying the received signals on an appropriately scanned screen, a representation of the distant scene in the intersection zone can be created. Indeed this is a special kind of "microwave interferometry," and -- with modern techniques -- the imagery obtained might be surprisingly good. With development, it might even become as good as the image presently obtained by side-looking acquisition radars.
>
> "Interestingly enough, since scalar EM beams will easily penetrate the earth or the ocean, one can also look beneath the earth or beneath the ocean with this type of scanning scalar interferometer.
>
> "The importance of this capability to strategic and tactical reconnaissance is obvious. Camouflage, cover, and concealment have no effect on such a system. One can easily look inside buildings and into underground facilities. With a small system such as this, the U.S. Marines at Khe Sahn would have had little difficulty locating the tunnels continually dug under the perimeter by the Viet Cong. And targets under jungle canopies are directly visible."
>
> Bearden http://www.cheniere.org/books/ferdelance/s42.htm

Tesla Howitzers can destroy all life on earth

How to Make a Storm on the Sun!!
(Just make a big mistake with your Tesla howitzers)

The deepest dangers of the use of scalar weapons are frighteningly pointed out by Bearden here where he considers that the sun, earth and moon (actually the whole solar system) is a delicately balanced arrangement of scalar (longitudinal) EM radiation. There is a scalar connection between the earth and the sun, which are both giant dipoles gushing energy in the time domain. Big scalar events on the earth could alter this balance causing true catastrophe.

"Indeed, a solar response could be stimulated so that the Sun would violently belch and destroy our biosphere, among other effects."

Unrestrained scalar warfare could cause huge solar storms? To realize that human activity could actually affect the sun itself is truly mind boggling.

Bearden goes on to say:

> "Accordingly, use of huge scalar EM weapons is a double-edged sword. Unless carefully employed, use of the weapons could cause a terrible backlash to the user as well as the victim, and even accidentally cause the destruction of the earth itself. It is not accidental

that in 1960 Khrushchev stated that his new fantastic weapon could -- if unrestrainedly used -- destroy all life on earth.

"This appalling backlash potential is apparently what prompted Brezhnev in 1975 to make so strong an effort to get agreement to outlaw the development of "new weapons of mass destruction" more frightful than the mind of man had even dreamed of. Gromyko even introduced such a draft agreement into the proceedings of the United Nations. The first article of the draft agreement indicated that the nature of the weapons referred to would be negotiated. Sadly, the entire Western world did not even know what the Russians were talking about."

http://www.cheniere.org/books/ferdelance/s24.htm

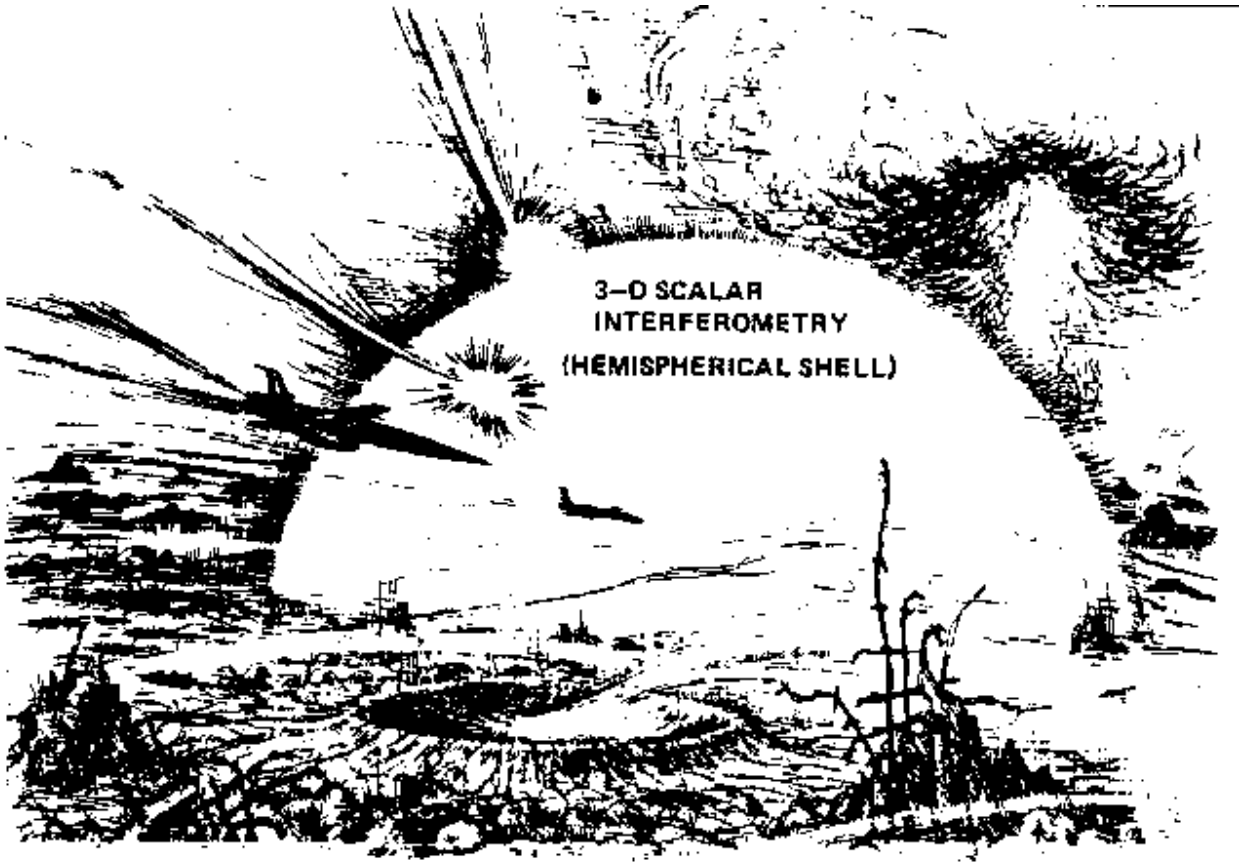

3b. Tesla domes provide near-perfect defense shield.

(Slide from Cheniere.org)

The Tesla howitzers can be used in a nearly impregnable defensive mode whereby they throw up a dome (**Tesla Dome**) or a sphere (**Tesla Globe**) of highly powerful electromagnetic energy, enough to "dud" or destroy missiles which try to penetrate them. Once again, this energy is not

going through space from the howitzer, but being made to emerge from the local vacuum at the location of the shell. KGB tests of these domes have been witnessed by airline pilots around the world. Bearden gives many examples of the Tesla domes being sighted around the world in his briefing paper "Fer-de-Lance." (Russian dome test, another globe incident, yet another globe test). These giant electromagnetic domes can be hundreds of miles across, or narrowed down more to total impermeability.

> "Such a shell may be several hundred miles in diameter at the base. The enormous energy required to form such a defense shell is obtained by a "scalar power tap" into the molten core of the earth itself, as previously explained. In late April/early May of 1985, 27 such "power taps" were placed in the earth by the Soviets. If each tap is capable of powering four to six large scalar EM weapons, then the Soviet strategic scalar EM arsenal contains over 100 monstrous superweapons capable of generating exothermic explosions, endothermic explosions, engineering the weather, locating and destroying underwater submarines, detecting and destroying ballistic missiles shortly after launch, detecting and destroying long range strategic bombers as soon as they are airborne, etc."
>
> http://www.cheniere.org/books/ferdelance/s52.htm

By using nested domes one can protect the domed area even against nuclear radiation itself. Tesla globes can be used to hit airborne targets by simply placing a globe of any chosen size in the flight path of the incoming missile. It does double duty because the missile hits it going in, and then the rubble hits it again going out the other side.

While the U.S. persists in its useless boondoggle "missile defense system" by shooting a missile with a missile (missiles which would already have been "dudded" by the Tesla howitzers), between the domes and the globes the Russians (KGB) have in hand (operational) a nearly perfect missile defense system. Someone should ask the Secretary of Defense if the U.S. Tesla domes are in place. And over which cities? How powerful are our American Tesla domes?

Bearden cites a number of examples of these domes being tested around the world:

March 20, 1969 | March 24, 1977 | August 17, 1980 | June 17, 1966 | June 18, 1982 | June 22, 1976

In a slide from the Fer-de-Lance briefing it is shown how the "woodpecker grid" itself also acts as a sensor, detecting any missile launch anywhere, and how the howitzers can respond instantly by delivering a blast to exactly the right coordinates, right along the channels of that same grid which is feeding the location information about the missile launch. This certainly beats "trying to hit a bullet with a bullet." Especially since YOUR bullet would probably be instantly inoperable in a real scalar war situation.

3c. Rogue Groups in the government

Bearden fears that these scalar electromagnetic secrets may have fallen into the hands of what he called secret "rogue groups" within the labyrinthine depths of the black-ops special-access domain of the secret government. "In the extreme, such a deep black program can even become a

"captured" program," he says, "which is totally in the hands of rogues and no longer reports to or is bound by the dictates of the parent government."

> "They have their own agendas. And being rogue groups, they may well bring in unethical, immoral tricks: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A certain percentage of a highly secret rogue group will wind up using all these things and more. It's a human characteristic, the old primate dominance game. Only now disguised and hidden under deep classification. ...
>
> "In highly classified groups, these groups are greatly enabled to joust more widely, unethically, and immorally because it is so deeply hidden. So very deep classification evokes the growth and intensity of rogue groups. It's the old 'Power corrupts, and absolute power corrupts absolutely' routine. ... Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, may not operate under very much legitimate government control at all, and may operate specifically for the purposes of the rogue group or groups that have gained control."
>
> "The involvement of at least some rogue groups, some being "cowboys" who operate well outside all laws and ethics, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, it could account for what seems to be actually occurring. "
>
> http://www.cheniere.org/explore%20articles/mind%20control3/p05.htm

3d. World War III has already begun

Because it is now possible to cripple the power grids and electronics of any nation, that nation could be reduced to economic ruin without ever firing an actual "shot." Without electricity Wall Street cannot operate. Without electricity you quickly need martial law. One no longer needs to wage a conventional war anymore at all. There are now lots of new ways to bring any nation to its knees.

> "We are at war, whether we like it or not. And we are going to have strategic strikes on an unparalleled scale for us. Pearl Harbor was nothing compared to what is coming down, once we consider the "augmentation" and such.
>
> "When that factor is considered, then it's a totally new ball game on replacing the power system. There isn't going to be much choice; the old one is going to be destroyed or so badly crippled that it will collapse the U.S. economy in a way we have not seen since 1929. Of course, in such a case hitting us, we will be under martial law, the works, everywhere. For one thing, it's the only way you can keep the cities from imploding from within, by the criminal element, looting, robbing, killing, etc. Simply wait and see; it's on the way."

> Although Bearden has for years decried the "scalar-gap," and chided the military for falling so far behind the Russian KGB in the field of scalar electromagnetics, recent statements indicate that things may at last have changed somewhat.
>
> "In the new war, the first phase of WW III has already been completed. Hence President Bush's recognition that this is a total war, and has to be taken to the enemy no matter where he may be hiding or in what sanctuary or in what foreign nation. This is an entirely different war than anything the U.S. has ever fought in its history. And before it is over, it is going to kill more Americans than have died in all the previous wars in our history. The news media and the public have not yet recognized that awful situation and predicament. Most are already thinking that, well, we won in Afghanistan so it's just about over. Instead, it has only just begun.
>
> "Anyway, that's a brief uptake on some of the weapon situation today. Some 10 nations or more now have LWIs, and five have the QPs. I'm still working on how many have the appalling negative EMP weapons, but would estimate 6 or 7 nations have them in one stage or the other, either deployed or in at least advanced development. And in my estimation, the Yakuza will have them within three to five years if they have to build them themselves, and quicker if they can buy them from the Russians, Chinese, or???"
>
> Bearden http://www.cheniere.org/correspondence/030202a.htm

When he was asked the question '**Does the government listen to Tom Bearden?**" Bearden said:

> "Let me speak carefully. I am very satisfied with how I've been listened to in the quarters where the rubber meets the road. The West is no longer defenseless, not by any means. Cannot amplify it further than that."
>
> http://www.cheniere.org/correspondence/030202a.htm

Bearden has briefed the government a number of times and the Cheniere website contains a great number of his graphic military briefing slides.

3e. Are the Russians making "UFOs?"

Scalar electromagnetics engineering opens the possibility of antigravity vehicles and "hyperspace travel." In other words we can now make our own UFO's! Of such scalar-powered antigravity vehicles, which have now become possible, Bearden has this to say:

> "We might expect to see such vehicles glowing. Their various surface features and mechanisms might appear to be glowing or revolving lights, etc.
>
> "They could exhibit incredible "aerodynamic performance," seemingly in the atmosphere. Actually they would not be moving "through" the atmosphere at all, but through a higher space outside each particle of atmosphere.

"They could seem to materialize and dematerialize.

"They could seem to plunge into the ocean or rise out of it.

"They could even seem to operate under the ocean or inside the earth itself.

"Such anomalous vehicle performances have been seen all over the world, particularly since a few years after WWII.

"It appears that one or more nations of Earth are operating such vehicles now in great secrecy. Our own "government" may even be one of these.

"If so, it isn't our true "government/government." Instead, it's the "control group/government." It's government at the operational level, but at higher level it belongs to certain control groups who have penetrated our government's vitals and taken over all such projects."

Bearden http://www.cheniere.org/books/ferdelance/slide32.htm

In an excellent article on her Earthfiles website, Linda Moulton Howe reports on the utter bafflement of Norwegian scientists over mysterious lights appearing in the valley of Hessdalen, Norway.

She writes of the research there: "The results can be broken down into two groups: 95% are thermal plasmas and 5% are unidentified solid objects. The plasmas emit long wave radio

frequencies and strangely, their temperatures do not vary with change in size or brightness." She quotes the scientists' research summary:

> "1) most of the luminous phenomenon is a thermal plasma;
>
> 2) the light-balls are not single objects but are constituted of many small components which are vibrating around a common barycenter;
>
> 3) the light-balls are able to eject smaller light-balls;
>
> 4) the light-balls change shape all the time;
>
> 5) the luminosity increase of the light balls is due to the increase of the radiating area. But the cause, and the physical mechanism with which radiation is emitted, is currently unknown."

This would almost certainly seem to be another example of the testing of the scalar howitzers. It is baffling because, as Bearden points out repeatedly, Western scientists have limited knowledge of the scalar electromagnetic principles by which the howitzers operate. The Hessdalen scientists were completely baffled as to where the energy of these plasma balls was coming from.

Ms. Howe interviews Massimo Teodorani, Ph.D., Astrophysicist, who released the report on the 2001 Hessdalen sightings. The scientist speaks of the baffling phenomenon observed.

> "I don't know how it is possible that Nature is spontaneously able to do that. Anyway, we deduce that the plasma is trapped inside a sort of magnetic cage and the magnetic cage closes around the plasma and keeps it fixed in some way, prevents it from expanding. But where does it come from? We don't know."

By what we have been considering here, we can recognize the signatures of scalar electromagnetic engineering. If it is a Tesla howitzer, then the energy for the plasma balls is coming from the vacuum of spacetime at the very location of the balls themselves, triggered by scalar interferometers aimed through the woodpecker grid.

These kind of balls can be used as marker beacons giving feedback for precision aiming of the howitzers. The energy of the marker beacon can be read back into the computers giving precise location information for pinpoint aiming. The target area can be very small, or widened out.

There is a little movie of one of the Hessdalen plasma balls here. It would seem to be a clear documentation of a scalar howitzer marker-beacon. How many other current "UFO" sightings are actually the witnessing of Tesla howitzer tests?

In fact there are a great many anomalous events of the past few decades which might very well be explained by the Russian testing of their longitudinal electromagnetic weapons. It would seem that the mysterious appearance of crop circles around the world could be accomplished by feeding a precise mathematical graphic pattern into the computerized aiming software and change the very molecular structure of the crops themselves along the lines of that pattern. The

stalks fall over from the localized effect of the longitudinal waves. A plasma ball tracing patterns? Are they slyly sending a message to see if we are "getting it" yet?

The "Cambridge Angel" - Made by Russian scalar plasma balls?

Also see: Interview with Tom Bearden

(Slide from Cheniere.org)

4. Healing powers of longitudinal waves

Healing via longitudinal waves, time reversal of cells (de-differentiation), Priore's machine, Bearden's proposed "blanket" version, using the electric power grid for healing waves or for broadcasting disease patterns. Scalar Biowar.

The good news!

> "Any sort of disease whatsoever - physical or mental - will be rapidly curable, simply and cheaply. It will be possible to reverse aging and rejuvenate the person. It will be possible to regrow limbs and straighten misshapen spines - and directly remove the causes of mental diseases and cure them as well. Lifespan will be staggeringly increased, without 'old age's debilitation.' AIDS, cancer, leukemia, and genetic diseases will be completely conquered. The potential for a true golden era is upon us, for all humanity."
>
> Bearden- http://twm.co.nz/beard_interview.htm

Proof of the healing powers of longitudinal waves from the vacuum is seen in the work of Antoine Priore who produced longitudinal scalar waves using a gigantic glass tube filled with plasma. He himself did not understand why it worked or how it cured cancer in animals.

> "The Priore team cured terminal tumors, trypanosomias, and other dread diseases in laboratory animals in France, in the 1960s and 1970s, under rigorous scientific protocols by eminent scientists. The Priore project was funded by the French Government to the tune of several millions of dollars (equivalent).
> http://www.explorepub.com/articles/energetics.html
>
> ". . . Prioré's machines concretely demonstrated a nearly 100% cure of all kinds of terminal cancers and leukemias, in thousands of rigorous laboratory tests with animals. These results were shown to medical scientists as early as 1960." http://www.cheniere.org/priore/index.html

Bearden has stated that the longitudinal EM waves can have a healing effect because they always come in pairs called "phase conjugate pairs" and one of the pair is time-reversed. This enables engineering of the waves to "pump" the cells of the body (with waves from the time domain) and actually time-reverse the cells back to a previous healthy condition. The scalar cure of cancer does not involve killing the cancer cells but rather pumping them with time energy into a previous condition. I know, this seems miraculous, and is it not?

Priore and his giant plasma tube

This healing power in the longitudinal waves of the time domain is a mind-boggling thing to face. It took me months to get through it, and to suffer the fact that the cure for cancer and AIDS was right there, in this new scalar electromagnetics technology, and that it has been kept back from the people for so many decades now.

Bearden has a great deal to say about the work of Priore, who himself did not understand why his machine worked. Priore did not know about the longitudinal scalar waves of the time domain. In fact, Tom Bearden has supplied, at last, the missing explanation as to how that big giant two-story glass tube consistently cured cancer in animals.

"**The medical implications are enormous**. By just reversing the damaged cells back to a previous physical state, this gives a physics mechanism for controlled cellular dedifferentiation, in biology terms. Physicians will time-reverse diseased, damaged or aged cells back to an earlier healthy condition, including all the cellular genetics. Normal cells are just reversed to a slightly younger condition."

> "We believe this mechanism explains the revolutionary but baffling electromagnetic cures achieved by a team of outstanding French scientists in the 1960s and early 70s, working with inventor Antoine Prioré. In lab animals, cures were achieved for terminal tumors, infectious diseases such as trypanosomiasis, and atheriosclerosis. In addition, deliberately suppressed immune systems were dramatically restored.
>
> "We hypothesize that this is the long-sought mechanism of how the living body heals itself. In short, the body's cellular control system induces cellular reversal by weak time-domain pumping of the damaged cells and the affected area. The cellular regeneration system performs all healing of cellular damage in the body; the immune system heals nothing, not even its own damaged cells) .
>
> "For the first time medical science can develop as a science of healing rather than a science of intervention. And it will develop as a science of unlimited healing, since no pathogen can resist action by curved spacetime engines." Bearden
>
> http://www.cheniere.org/techpapers/Vision%202000%20paper.doc

See Priore's machine See Slides of how it works.

Bearden has extended the Priore work, with the previously missing knowledge now in place, and designed a revised system (for irradiating the body with longitudinal waves) which gets rid of Priore's giant glass plasma tube and uses instead an antenna unit which surrounds the body. He has also provided the missing explanation of how it works. There is an article from "Explore" magazine, Part I and Part II.

In fact, Bearden has presented to the U.S. government a plan to use a portable version of a Scalar Healing Blanket where wire channels in the blanket act as a scalar antenna, which can both send and receive scalar electromagnetic waves. A two minute treatment of the waves is sufficient to restore the body to its earlier healthy condition. Thus even thousands could be treated easily and quickly in a biowar mass attack situation.

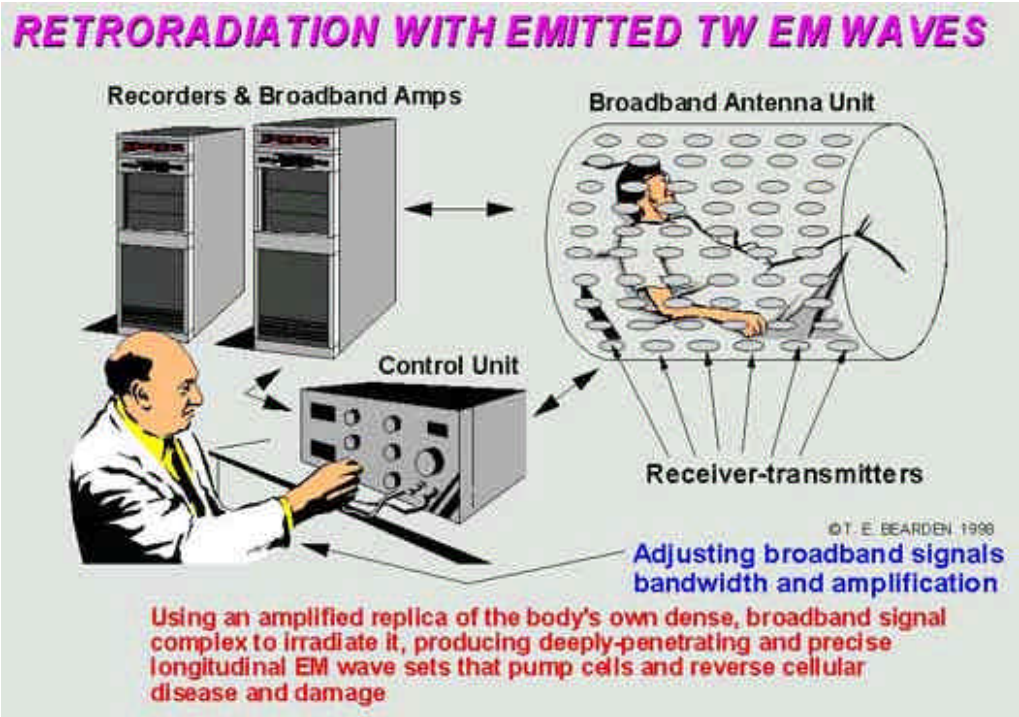

"To defend against things like anthrax attacks on our civilian population centers, we also have recommended to the U.S. Government the crash development of small, portable treatment machines—using similar "antiengine-forming" and cellular reversing "porthole technology". [See Figure 13 on previous page]. Such portable machines could be developed cheaply and quickly, and present government facilities could be used to massively attack the correlate database production problem. "The portable treatment units could be cranked out by the hundreds of thousands and flooded down through emergency response agencies such as the police forces, the National Guard, emergency hospitals,

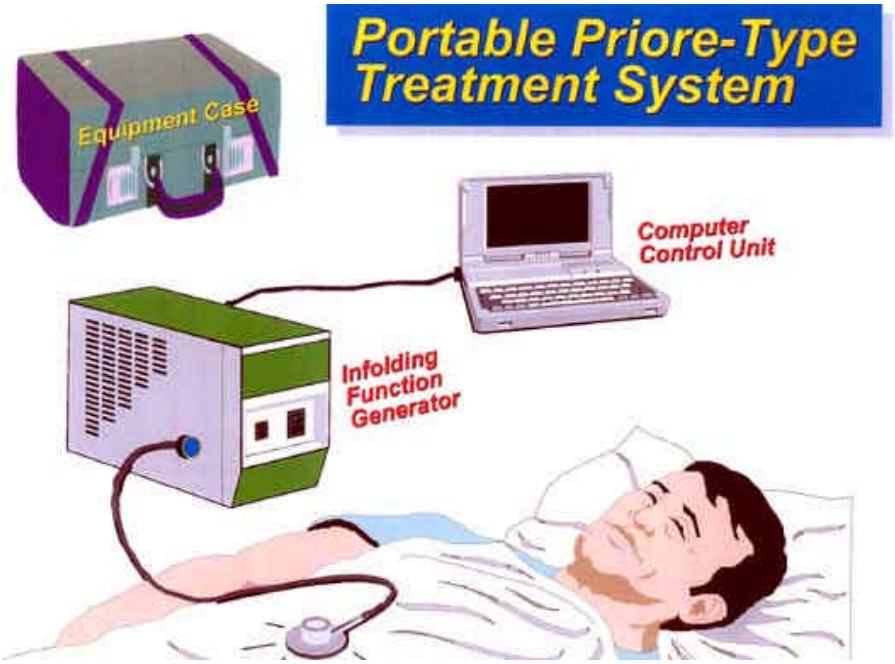

emergency response teams, etc."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p04.htm

The Scalar Healing Blanket would fit into large suitcase. It has three basic parts, the longitudinal wave generator, a laptop computer, and the antenna-blanket. The plan was a stroke of Bearden's genius, but unfortunately it fell on befuddled government ears. "Unfortunately, so far the DOD [Dept. of Defense] doesn't even understand what the heck we're talking about!"

Article '**Healing with Energy**': http://www.explorepub.com/articles/energetics.html

"We tried very hard in 1998 to call attention to the extreme national need for the most urgent possible development of a portable computer-controlled treatment device based on the experimentally proven Prioré methodology, but extended to a much simpler and far more rapid method of treatment.

"Quick development of this technology could lead to a suitcase size device, capable of treating a patient in less than one minute, and stopping the symptoms and disease progress cold, then reversing it. Three "less than a minute" treatments one week apart would be required for complete cure. As an added advantage, partial reversal of aging in older patients would also be accomplished as a bonus, in addition to time-reversing the damaged and diseased cells...

"The method proposed to the DoD in 1998 used normal EM in a peculiar way to force the body itself to make its own time-polarized EM waves, and pump every part of its cells -- including the genetics -- in the time domain.

"Quite simply, we are going to be struck this way (QP spreading the immune systems of the populace plus professional smallpox, anthrax, etc. BW attacks on our population centers) and by other means we've spoken of in other papers and briefings."

Bearden http://www.cheniere.org/correspondence/021401.htm

The Dark Side of the Force:
Creating and broadcasting disease

Speaking of the scalar wave induction of disease by longitudinal wave patterns Bearden refers to work by French scientist Kervran Russian scientist Kaznacheyev, who proved that any disease could be transmitted electromagnetically.

"It works this way: the Kaznacheyev experiments (and others) demonstrated that any cellular disease or disorder can be initiated into cells at a distance, by electromagnetic means (albeit unusual EM in nature). The decades of microwave radiation of the U.S. Embassy in Moscow, was an ongoing set of "stimuli" to ping the U.S. system and, by its response, ascertain how far along (or if it was "along") in its knowledge of such weapons. The radiation was responsible for many health changes in personnel and for the eventual deaths of three U.S. Ambassadors."

Bearden http://www.cheniere.org/correspondence/021702a.htm

In a letter he writes,

> "Yes, the Kaznacheyev experiments were quite real; 15,000 or so in military research institutes in Siberia. As with so many other novel areas investigated and developed by the Soviets, most U.S. investigators just assumed normal EM, which is not what the Kaznacheyev experiments involved, and not what was carrying disease induction patterns from one cell culture to another in rigorous lab tests."

How to "Broadcast" Diseases

Longitudinal EM Biowars

Bearden explains how the new quantum potential weapons can be used to induce disease-at-a-distance in a population, or to "spread" the immune system so thin that a conventional bio-attack would be greatly potentiated. By "broadcasting" virtual disease patterns over a population, the immune system is so overloaded by the presence of the "shadow" diseases that its effectiveness is thinned out.

> "In short, alter the internal wavestructure, and one creates a curved spacetime 'engine' that acts on mass in any fashion one chooses to design -- including initiate diseases . . . Now visualize one of these 'vacuum engines' or 'spacetime curvature engines' that acts on mass to generate the exact effects produced by anthrax. (Or any other disease one wishes) . . . Call the virtual state of a disease engine the disease pattern in the "shadow" state, just prior to becoming observable. . . .
>
> "And the master cellular control system responds to "coming events that cast their shadows before". In short, it responds to the upper level of the "shadow state" of a disease, still in the virtual state! (Hey, virtual particles are real, virtual photons are real, virtual ST curvatures are real --- just very fleeting, only for another to immediately arise). The exchange of virtual particles is known to generate all forces in physics anyway! . . .
>
> "So the cellular control system responds to "shadow state" disease patterns. Enter a QP weapon application. Place a quantum potential weapon "area" on the United States, so that the entire populace is in it. The slowly introduce and bring up in the shadow state, the necrotizing fasciitis disease engine. At some point, the cellular control systems will react, and order the immune system into action. In other words, immune system resources will be committed against this "immediately coming" enemy. Bring it on up a little, but still just in the shadow state. Voila! Humans form a bell-shaped distribution curve. And even if the structure of the QP fluctuates a little, fluctuating a bit stronger and a bit weaker, etc. A few of those targeted bodies will now actually develop necrotizing fasciitis. So far, just like the U.S. Embassy targeting, except a different "carrier".
>
> "But now there is an exact signature that this is what is doing it, and not normal vector carriers of disease and contact or exposure infection. The few cases of necrotizing fasciitis that break out will be most puzzling. They will be randomly scattered across the

entire nation, and so few that the vector carrier and contact or exposure explanation completely fails."

"And that one happened, right here in the U.S., not so long ago. Check it out.

"So carefully adjust the patterns for, say, 12 major terrible diseases, to that "adjusted and desired shadow state level". Now add all 12 patterns into the internal structure of the quantum potential. Now it has 12 shadow state disease engines in it.

"Place that one on a populace. The cellular control systems order the immune systems into action, and they now have to commit their finite resources to 12 different areas. This greatly thins the response an immune system can make to any one of those 12 disease patterns! In short, it "spreads" the capabilities of the immune system, which can be galvanized to great effort, but only can perform a small bit against each area.

"Suppose one of those "galvanized" areas in the targeted populace's immune systems is anthrax. And suppose the bad guys now hit one or more of those cities with a professional anthrax attack. A former OTA study showed that a professional anthrax aerial spray attack against Washington D.C., dispensing 100 kilograms of anthrax spores in the spray, will account for 1 to 3 million casualties. And that's in an "unthinned" set of immune systems. In the "thinned" set, one can at least double or triple, and even up to five times, that estimate. So conservatively, now there would be from 2 to 6 million casualties. And even mild anthrax spray attacks in other "thinned" cities would also be amplified.

"That one is being set up, or already set up, right now. There are other such "augmentation" setups also under way.

"So the weapons alluded to by the SecDef in 1997 are already being employed. WW III has already begun, and our populace (and our scientific community) is blissfully unaware of it."

http://www.cheniere.org/correspondence/021702a.htm

Most of us can remember the strange outbreaks of the so-called "flesh eating disease." It seemed to break out here and there randomly with no known cause. Bearden believes this was a test of the newer quantum potential weapons which go even beyond the capabilities of the Tesla howitzers.

"The Kaznacheyev "disease induction by novel electrodynamics" work is also the basis for the spacetime curvature engines (not EM signals!) carried by quantum potential EM biological weapons for distant induction of diseases etc. into the population of an entire nation or area, such as the U.S.

"This quantum potential disease induction weapon -- capable of attacking an entire population of a nation or area -- has been tested several times in the U.S. at very low levels, in the shadow state only (we explain shortly) and it has a most peculiar signature. E.g., one test used necrotizing fasciitis (flesh-rotting disease) engines.

> "The disease 'engine' was deliberately kept down in the 'shadow state' (virtual state, just below the observable state) so that only a tiny bit of the populace with depressed thresholds would "breach the observable threshold' due to the population forming a bell-shaped curve as to the threshold level. The major signature of the test was that the cases of the disease broke out totally statistically and randomly, spread all over, without any 'disease vector' in between.
>
> "In short, it was not spread in any manner required by normal deterministic disease vectoring, but was a totally random set of occurrences. Several other diseases were also tested this way in the American populace, with precisely the same signature."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

"Apparently one planned use of such an augmented clandestine BW weapon will be smallpox, e.g. As you know, the Russians did develop smallpox for biological warfare, and even developed a new strain against which previous vaccination is ineffective.

> "The vast numbers of expected casualties, coupled with immune system spreading, are absolutely irresistible to the Russian mind. You can count on it that they have seen that the smallpox is already on site here, in the U.S. and in the hands of professional terrorist teams. Of course, the Russians/KGB will protest they have nothing to do with that! Yet likely the KGB will have flatly arranged it or at least assisted it. The capability for mass destruction of the nation is so lucrative and easy to achieve in advance, that they would never be able to resist doing it."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

Bearden believes the Gulf War Syndrome involved the use of scalar technology to induce a disease state, as he stated in a 1997 interview:

> "I'll say this flatly, and I won't answer any further questions about it; the Gulf War Syndrome was induced... It was induced with this stuff. All the rest... was contributing factors that everybody's talking about... There are some deeper signatures, if you look into it very deeply, that show you exactly how it was done and the fact that it was induced. It was a test. It was a test of a very special kind of weapon I have not talked about yet. Anyway you can use it to create diseases."
>
> Bearden http://twm.co.nz/beard_weapon.htm

Besides using the woodpecker grid to target a population, the entire electrical grids of nations can be used as "channels" for disease patterns to be broadcast to all people near that grid. Your own house wiring can become an antenna, broadcasting these "shadow" patterns of disease, weakening your immune system.

And here one faces the frustrating fact that the same power grids could be set to channel patterns which would keep the entire population healthy, rejuvenated, continuously bathing in the time-reversing old-age-defying energy of the spacetime vacuum. We have no idea yet of how long the

human life span could be increased with this new technology. People might be able to live two centuries given full humane development of this technology.

5. Psychoenergetics

Mental entrainment, inducing hypnogogic trance, mind control, broadcasting thoughts and feelings, the Ant World, education via EM [LW] mental download, the "Feelies," revolution in spirituality, "enlightenment machine?" Scalar churches?

Psychoenergetics is simply using the scalar interferometers to manipulate and engineer the human psyche. To me it is the most mind-boggling and frightening aspect of longitudinal wave engineering.

The mind is electromagnetic in nature, and itself of the time-domain. It is not observable in 3-space. There is no thing you can point to that is the mind. As Bearden says**, "The mind is time-like**."

The longitudinal scalar EM waves are also of the time-domain. By overlaying certain infolded patterns (oscillations in time) on the longitudinal waves, a thought or feeling may be made to arise in a person or persons who are in the **interference zone** (where the wave beams cross).

The person will not notice anything, feeling that this thought or idea is his or her own idea. The longitudinal wave pattern might be a wave of panic or fear that spontaneously sweeps over you, perhaps inexplicably. It could even be in the form of a sudden intense patriotism. It could be explicit words and phrases, which everyone would think they had thought of by themselves. Or it could be rage and hatred, angry and violent. On the other hand It could also be a continuous sense of docility and placidity. This is the brave new world of psychoenergetics and the coming "Mind Wars."

Scalar Psychoenergetics in its most primitive form simply "entrains" all minds in the target area into a deep hypnogogic trance. In this state of mind people would be suddenly extremely suggestible, and would likely believe anything they are told, and would obey any orders given. Talk about winning the hearts and minds of the American People!

Tom Bearden makes me think of **Paul Revere**, who heroically conveyed important warnings for the sake of the new nation. But the words of the famous phrase have now strangely and curiously mutated into the once-inconceivable: "**One if by land, Two if by mind**."

Indeed one strategy in a Mind War would be to simply take over the minds of the "leaders" of the enemy nation. The targeted leader would not be aware that anything was amiss, although he might begin to make unexpected changes in policy.

And are, in fact, any of our "leaders" already having secret thoughts that are not their own? Who knows? Frighteningly, we can no longer be sure. The new sciences of scalar electromagnetics

and psychoenergetics are even now plunging humanity into a sudden science-fiction-like world beyond anything in humanity's previous imaginings.

> "The Russians reached the point in the mid 1990s that they could take over control of a person's mind, with modified longitudinal EM waves including some time-polarized EM waves, and with a team of specialists (estimate 25-30 per transmitter, and one transmitter and team per controlled person)." Bearden http://www.cheniere.org/misc/time.htm

In a slide Bearden illustrates how a Scalar War would involve a psychoenergetics attack on the operators of the enemy scalar installation, entraining their minds into hypnogogic trance and getting them to shut down their systems.

And ultimately psychoenergetic warfare goes to the very heart of human identity itself. For if my thoughts might no longer be "mine," then who and what am I? Can my very sense of being "me" be hijacked by some nefarious psychoenergetic scheme? Will the "secret government" eventually dictate directly into your mind how you feel about yourself? Or what you think you are? Or what you should do?

How Does Longitudinal EM Mind Control Work?

The physics of scalar psychoenergetics as expounded by Col. Bearden seems even more arcane and over-my-head than that of extracting energy from the vacuum. I can't understand it, but I look through it anyway. Each time another tiny understanding might occur, or a term might fall into place. I know the mathematics is forever beyond me.

One paper to begin with is "Mind Control and EM Wave Polarization Transductions" This is such serious stuff that Bearden includes a strong warning about misuse of this knowledge. Psychoenergetics weapons can mentally maim and physically kill.

Warning!

(From "Mind Control and EM Wave Polarization Transductions")

> "This article refers to experimental research techniques which can be detrimental or lethal in the hands of any but highly skilled, qualified experimental scientists proceeding under proper laboratory safety procedures. The purpose of this article is strictly for information to properly qualified and authorized scientists in certified laboratories. We do not propose or condone any use of these procedures for nonapproved practice of medicine without a license. Neither the publisher nor the author are responsible for accidents or outcomes in the use of these experimental procedures and techniques. Any researcher who performs these procedures and experiments is acting on his or her own volition, and is solely responsible for insuring safety, qualifications, and legality of the acts and their results. We neither suggest nor condone unauthorized experimentation on human subjects. Such is a criminal violation of the constitutional rights of the subject under Federal and State laws, and is both illegal and immoral."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p01.htm

After the serious warning comes the description of the paper. This is heady stuff for the layman.

> "Calling full attention to the special note above, in this paper we present a high-level overview of the novel electromagnetic nature of mind operations, mind and body coupling, and intent - the induction of physical 3-space EM energy changes into the brain and nervous system, and into every cell of the body, from the mind's time-like coherent operations. We summarize the time-polarized electrodynamics used to engineer and affect mind operations and the mind-body coupling loop. Transaction mechanisms whereby differing EM wave polarization's can be transformed one-into-the-other are presented."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p01.htm

I will leave it to the technically astute to try to understand the mechanisms of operation which are described in scientific language. But there are tidbits for the layman. Here he speaks of the difficulty Western scientists have in opening up to the "immaterial" (longitudinal wave) nature of the human mind.

Western Science Remains Largely Materialistic

> "Ironically, most Western scientists are materialists and consider "mind" as a mystical and nonscientific concept. They tend to consider mind operations and functions either to be simply "meat computer" operations and functions, or at best to be very weak ordinary transverse-wave EM operations and functions in the brain and nervous system. This serious self-limitation exists because in the body we measure only weak TW [transverse wave] EM operations and functions correlated to biological behavior and brain operations. We simply do not know how to measure "mind operations" directly.
>
> "With no mind measurements possible and no instruments, it is understandable that Western science considers only the physical side of the mind-matter interface.
>
> "Presently our scientists do not measure the longitudinally-polarized EM wave operations and functions in the body and around it in nature. Few of them are aware that a maelstrom of such LW [longitudinal wave] functions exist in the body and in all of nature in general."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p05.htm

Western methods of influencing the mind with EM waves have only used transverse waves, not the longitudinal waves of the vacuum. If only transverse waves are used one pretty well has to hit the target mind with a sledgehammer of waves.

Western Science knows only transverse EM waves

Brute Forcing Time Functions versus Fine Control Methods

> "Ironically, Western mind control researchers using transverse EM waves for mind control research, are using a brute force method of evoking and using vacuum engines

> (spacetime curvature engines) and a special form of general relativity, although they do not appear to realize it.
>
> "While KGB scientists also use TW EM "brute force" TW waves when necessary, they do "imprint" or "activate" those waves with the desired internal LW and time-polarized EM wave and photon structures required to directly perform the mind engineering desired... Bearden
>
> "These "fitted brute-force models" certainly can be very powerful, and certainly can produce the exact results shown in the experimental verifications of the fittings. However, they do not of themselves allow sophisticated design for example of the necessary time-polarized wave assemblies for engineering the entire human collective unconscious simultaneously, or for engineering the entire collective unconscious of all species on Earth (i.e., Gail's collective unconscious), or even for precisely engineering the memory and knowledge base of an individual.
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p09.htm

The seemingly magical operations of psychoenergetics, sometimes called "psychotronics," cannot be achieved with ordinary transverse EM wave energy. But they are possible with longitudinal scalar waves because the mind itself is scalar in nature.

> "We note that all mind operations are time-like, i.e., they are comprised as scalar EM photon functions and scalar EM wave functions. Thus the mind is a very special kind of electromagnetic system, existing in the time domain..."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p08.htm

The engineering of the mind can only be accomplished with the waves of time.

The course of psychoenergetics development necessitates the building of a vast database of settings and patterns which bring about given mental and/or emotional states. A kind of "gnome" of the psyche. Bearden describes the process of the decoding of this "gnome."

> "Now the scientists would perform many phenomenology experiments, making one little change at a time and profusely recording the data. Each time, they would establish the physical change(s) that occur in the body and/or the mental and emotional changes that occur in the mind for each spectral reinsertion back through the "ship's portholes". They would simply but painstakingly (over some years) build up an extensive database of those individual correlates.
>
> "In these experiments, the experimenters will eventually be able to provoke any body or mind change they wish. Strong emotion. Intense pain. Intense pleasure. Painful thoughts. Images. Memories. Perceptions. Dreams. Visions. Memory losses. Memory changes. Personality changes. Etc. The "delta" in the emission spectrum (the changes from zero reference spectrum) represent the precise totality of all mental, physical, organic, chemical, etc. changes and interactions."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p01.htm

"A second stage in the research would be to test the correlates and porthole insertions upon a statistically significant cross section of ordinary people, and/or specialized populations (such as toughened soldiers). The program would evolve a highly complex, very effective, ever-improving science and technology of mind and behavior control and engineering mechanisms, complete with finished database and developed applications equipment."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p02.htm

Summing up his paper Bearden speculates on what the actual situation the science of psychoenergetics probably is. The intense secrecy with which this knowledge has been kept from the public has led to the current farce of the "government" pretending it all does not exist, and this secrecy may have now put us at great risk.

"The implication is that in the West one or more highly classified, sustained, heavily funded developments in advanced mind control programs, probably exists and probably has existed for some time. Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, may not operate under very much legitimate government control at all, and may operate specifically for the purposes of the rogue group or groups that have gained control.

"In a nutshell, that's what may be going on in the clandestine mind control projects in several Western governments. The involvement of at least some rogue groups, some being "cowboys" who operate well outside all laws and ethics, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, it could account for what seems to be actually occurring. As also is "usual" in such a mess, one or more of the rogue groups eventually may become very powerful because their secret weapons are very powerful. They may become confident, thinking they have the "best in the world." They may actually believe they are ahead of the Russians..."

"Remember that, in every large and powerful human organization, the basis for rogue groups is power and secrecy. They are always seeking to increase their power, control, influence, prestige, etc. Nothing else. Patriotism and mission are—to rogue groups—often just idle words. They have their own agendas. And being rogue groups, they may well bring in unethical, immoral tricks: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A certain percentage of a highly secret rogue group will wind up using all these things and more. It's a human characteristic, the old primate dominance game. Only now disguised and hidden under deep classification."

"The Russians, with their additional knowledge of the actual mechanisms in the transforms, will be much more advanced than the West, because their fundamental psychoenergetics science is far more advanced, so long as we continue to use the old U(l) electrodynamics. Further, the Russians have decades of use of longitudinal interferometry beams to reach right through the earth and ocean and produce stringent EM effects at a distance. So they will also be able to do the same things here in "mind control" with LW [longitudinal wave] interferometers, through intervening mass."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p05.htm

Bearden cites two examples where he believes the Russian KGB tested the psychoenergetics capabilities of their scalar interferometers. One was the case of Captain Button in his A-10 "Warthog" aircraft on April 2, 1997.

> "Over Arizona, Captain Button was thrown into a hypnogogic state, and his perceptions instantly altered and controlled. In his instant "dream-waking" state, everything seemed perfectly normal. His sense of direction was altered a bit more than 90 degrees, so he simply corrected and turned and "flew toward the range", actually flying off course by more than 90 degrees and ignoring radio contacts. He flew right on out of Arizona."
>
> "At one point he circled, probably thinking he was over the range, and he probably dropped his ordnance there. Then he "flew on back toward home," as he thought in his waking dream state, until his fuel ran out and he crashed and died in the explosion—dream-thinking until he died that everything was normal. All the while, his sense of the passage of time was altered. To him, in his dream-thinking, dream-acting state, everything was normal and nothing untoward had happened. So the distant KGB transmitters and associated psychoenergetics team controlled him for over an hour. "Indeed, that was the exact purpose of the test: demonstrate control (at a great distance) of a skilled person performing highly skilled tasks."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p06.htm

The paper "Mind Control and EM Wave Polarization Transductions" ends with the most chilling and frightening possibility of all: the psychoenergetic engineering of the human species as a whole.

The Ant World

The Final Race for Direct Mind Control of the Entire Human Species

> "The KGB psychoenergetics weapons scientists—because of their direct measurements and detections (and use) of t-polarized waves and LWs [longitudinal waves] for decades—also understand that Jung's collective unconscious mind (of the entire human species) also has its own time-like operations and correlates, which one measures also when using t-polarization measurements and sorting it all out. The collective unconscious mind operations are buried several levels deeper inside the recursive Whittaker structuring inside the EM fields, waves, and potentials. "The KGB scientists also know that something very like Gaia — a collective unconscious mind for all species on earth — also exists, and they are striving to be able to sort out and measure that one as well. The Gaia operations are buried even deeper in the recursive structuring inside the EM fields, waves, and potentials.""Actually, from day one, the Russian mind control scientists have had their eventual goal set upon this "deeper area of mind and possible mind control" of the entire human species.
>
> "I am convinced that the KGB psychoenergetics scientists understand this deeper area. If they can learn to directly engineer the collective human species unconscious, they can

> then convert the human species easily into a sort of "ant" society, modeled along ideal Communism lines, except of course with an excluded "hierarchy at the top" running everything. The "ant society" — communist style — is still a variation of feudalism (all systems tend to feudalism or some form thereof). "The KGB psychoenergetics weapon scientists are seriously pressing on toward that very goal. In my opinion they are not very far from it right now...
>
> "Some versions of Russian mind control devices were used on Russian soldiers in the Afghan War to condition them for performance of merciless acts." 13
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p07.htm

More about "The Ant World"

Whether it is the Russians planning an "ant world" society or rogue U.S. black-ops groups withholding a great boon from human race, the secrecy on all sides around has allowed largely criminal elements to take over this technology while leaving the civilized elements in the dark. Openness and the spreading of this knowledge among good and decent people is essential, and for that we will have to overcome our frightened denial.

> "Meanwhile, rogue groups amongst Western clandestine mind control researchers will probably arise if they have not already done so. They will likely seek to increase their personal control and further isolate the programs from orthodox government review and from government and legislative control. They may even divert the research into highly illegal and unethical means, because it furthers their own rogue agendas. That is how clandestine U.S. government research can sometimes go sour, unless great care is exercised by the oversight committees in the House and the Senate.
>
> "Sometimes when rogue groups do gain control and total secrecy of a given new technological area, then what appears to be "U.S. government operations" do start to encompass a criminal and unethical operations, hidden usually beneath the deep veil of high classification. Also, if it's "scientific," no one is ever brought to justice, even if the "evil science actions" are uncovered and publicly revealed."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p08.htm

Like the huge energy of the Tesla howitzers, the ability to engineer the mind with longitudinal waveforms is a seeming "magical" thing which can be used for good or ill. Bearden envisions that further developments will allow something like the "downloading" of knowledge via scalar interferometry. Everyone could be highly educated, and quickly and easily.

In the conclusion of the paper "Mind Control and EM Wave Polarization Transductions" Bearden makes a plea to the nations of the world regarding the use of psychoenergetic engineering.

> "Let us hope this great new area, already off to a bad start, can be bridled and steered in the direction helping and healing people, rather than killing or abusing them. The excesses in its bad use are a potent threat to all nations on earth.

"Yet it can revolutionize medical science, education, communication, and psychology. We foresee the day -- perhaps 30 years hence -- when education will be accomplished by directly loading the software into the mind. Then in three weeks one will "load" a doctorate, say, in physics. In three more weeks on will also load a doctorate in chemistry. Another three weeks, in electrical engineering. Another three weeks, an MD And so on. When that happens then truly everyone on earth can be educated. Freedom from ignorance may well be another great freedom that is legally recognized. There will be no impoverished large groups lacking the education to find decent, productive jobs.

"We urge all nations to use the principles involved: not for human abuse, but for healing, educating, uplifting, and life-expanding of every person on earth. If we do, we shall all have a far brighter future. Then we shall check what has started out to be the Sword of Damocles and turn it into the golden Millennium."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p08.htm

(Perhaps after so many frightening topics a slight break is in order here to consider the lighter side of psychoenergetics. For example, what will be the ultimate impact on the entertainment industry?)

The Feelies at Last!

Psychoenergetics will be able to bring about at last, for better or for worse, Aldous Huxley's fanciful idea in his novel "Brave New World," an entertainment format which he called "The Feelies." Those were something you went to, like going to the movies, but you would experience all the actual feelings themselves, as if the depicted events were actually happening to you. Although our "leaders" seem too dim to grasp what is going on in the world of scalar electromagnetics, it should not take some young Hollywood genius too long to understand that The Feelies are now possible, and that the immense megabucks of potential profit more than justify heavy investment in bringing it to market.

One can imagine that first "Feelie" theater, "The Huxley" perhaps, a large comfortable area surrounded by nine giant screens (not just one screen!), which become 3D if you put on your headset. And The Huxley is fitted with the finest sound, and oh, by the way, a modest sized scalar interferometer with computer. And there are one or more new tracks now recorded on the film next to the sound track. These are the digital patterns of thoughts, feelings, and ideas to be fed into the theater's interferometer. And these thoughts and feelings and ideas will be felt by the audience as if they were their own thoughts and ideas. It is an entirely new art form. Psychevision.

As important (and no doubt famous) as the actors would be the "feelers," those from whose minds the feelings were lifted in the original programming of the Feelie tracks. Because, for example, Brad Pitt might be a good and handsome actor, but can he really feel it? Like the dubbing of foreign language films, it might be necessary to dub the "emotional track" using a deeper and more profound person's feelings, thoughts and ideas.

It might even be engineered so that if you sat on one side of the theater you would feel like the hero, and on the other side you would feel exactly like the bad guy! What would that lead to?

We have all cried at a movie some time, most people have, though they might not want to admit it. But this would be deep sobbing and a flood of tears, if the director so desired it. You would feel it at your core. Or, take a big chase scene, you would be terrified. They are breathing down your neck! You would be gripped by panic.

For that matter, the whole genre of Horror-Feelie would be too much for many people to take. Do I really want to feel that an actual vampire is tearing at my throat with his fangs?

A Religious Feelie would make you feel the exaltation of a saint at his prayers, or give you the definite feeling that you are Christ suffering on the cross. All the pain could be there too. The stickiness of the blood. The very feeling itself: "Why hast thou forsaken me?" Who among us could come up that despair for scanning? Had this been developed a bit earlier we might watch a documentary of, say, Mother Theresa, containing her own actual deep sense of compassion, which we would feel arising in us as our own.

Then again, a Psychedelic Feelie could induce an LSD-like state and simply blow the audience's minds.

Even in its simplest most primitive mode, the hypnogogic trance induction with its increased suggestibility, would completely alter the experience of even ordinary current movie going.

6. As it Stands - 2002

"Anyway, it's presently a "Mexican stand-off" with the various parties maneuvering with check and countercheck. That is the real "balance of terror" that is held by such a fragile balance."

"You can see the implications if such weapons fall into the hands of the radical terrorists. Ordinary positive energy EMP shooters can be made fairly readily and cheaply from nearly just Radio Shack parts or surplus parts. It just takes some know-how... When and if the Yakuza [Japanese mafia] gets those (and they will, it's just a question of time), you can begin to appreciate some of the turns this present terrorism and our war on it will take."

Bearden http://www.cheniere.org/correspondence/021702a.htm

The very thought of the building of one of these howitzers by "some lone-nut gunman" from Radio Shack parts makes one realize how serious it is for humanity to face the crisis it has come to.

Once again, as at the dawn of the nuclear era, humanity finds itself at the crossroads of Heaven and Hell. As a species, we must stop and consider. And there is at least one real difference between this visit to the crossroads and the last: this time there is a very real possibility of a true "earthly heaven" on the Heaven side.

The poor nations could come to a good life. Disease could be largely eliminated. Fossil fuel pollution could end. Global warming could be solved, and the weather could be managed in a humane way, bringing water where there is drought, and sunny skies where there is flood. Scalar interferometry would be there to avert any possible hits by asteroids or comets. Mars could be colonized and terraformed. Everyone would be highly educated through psychoenergetic downloading of knowledge. And the wisdom of the wise could be realized directly through scalar connection to their minds and hearts.

These stunning sudden possibilities give me pause to think: if our species has reached this crossroads in such a short span of centuries, then surely other species in this vast universe have passed this way before and long ago. And of those who chose the path to "planetary heaven," what is their life like now? It might be good if some of them were with us now, to guide us through this last struggle over this pesky old good-and-evil problem. It is our last chance to choose the path which benefits the whole species, and not just some elite group or faction.

The Disclosure Project

One person working tirelessly to bring to bring these technologies into the open is Dr. Stephen Greer of the Disclosure Project, which is calling for congressional hearings into the issues of UFOs and the free energy technology that was, perhaps in part, reverse-engineered from them.

> "Once abundant and nearly free energy is available in impoverished areas for agriculture, transportation, construction, manufacturing and electrification, there is no limit to what humanity can achieve. It is ridiculous — obscene even — that mind-boggling poverty and famine exists in the world while we sit on classified technologies that could completely reverse this situation. "So why not release these technologies? Because the social, economic and geo-political order of the world would be greatly altered. Every deep insider with whom I have met has emphasized that this would be the greatest change in known human history. The matter is so highly classified not because it is so silly, but because its implications are so profound and far reaching. By nature, those who control such projects do not like change. And here we are talking about the biggest economic, technological, social and geo-political change in known human history. Hence, the status quo is maintained, even as our civilization hurtles towards oblivion...
>
> "With the types of weapons currently in the covert arsenal — weapons more fearsome even than thermonuclear devices — there is no possibility of a survivable conflict. Yet in the darkness of secrecy, actions have been taken on behalf of every human that may

> endanger our future. Only a full, honest disclosure will correct this situation. It is not possible for me to convey in words the urgency of this."
>
> Dr. Stephen Greer http://www.disclosureproject.org/ES-DisclosureImplications-2.htm

Greer and his team have assembled hundreds of witnesses, many of whom are military or ex-military, who are ready to testify to congressional hearings what they know about the covert black projects which have kept free-energy and antigravity propulsion technology secret from the people.

Greer points out the need to regulate these technologies so they are limited to peaceful uses, but this is of course difficult when the government simply chooses to pretend they do not exist. In the meantime, as the President and the Defense Department continue the charade of war-as-usual, those scalar (longitudinal wave) installations which DO exist continue to fall into ever more sinister hands. And there is no reporter in the press brave enough to ask, "Mr. Secretary of Defense, what steps are you taking to defend our MINDS from attack by the big Russian longitudinal interferometers?"

Longitudinal Interferometers are Proliferating

In a later statement Bearden reveals that in fact the Yakuza [Japanese mafia] has already leased some of the interferometers with a nearly $1 billion "down payment:"

> "After the collapse of the Soviet Union's economy, lots of things got available for lease or purchase that would never have been under the old system. That happened in the resulting economic chaos. The Russian Mafia rose to prominence, as did some wheeling and dealing entrepreneurs who played both ends against the middle.
>
> "In that atmosphere, and in the need for money, the KGB allowed leasing of the earlier longitudinal EM wave interferometers to a consortium of the Yakuza and Aum Shinrikyo. They did this only after they had tested and deployed their great new quantum potential weapons. That class of weapon is the dominant weapon on earth. Five nations now have it: Brazil, Russia (KGB), China, and two nations friendly to the U.S. The deal to lease many of the earlier LWIs [longitudinal wave interferometers] to the Japanese Yakuza and Aum Shinrikyo was consummated at the end of 1989, with a down payment of $900 million in gold bullion as "up front" money. I don't know what the lease per year was and is, but probably something like a billion dollars a year. So the rogue Japanese acquired longitudinal EM weapons and that technical know-how. In fact, the Yakuza is producing certain kinds of those in its own facilities in Japan now."
>
> Bearden http://www.cheniere.org/correspondence/030202a.htm

Personally, I am a little uncomfortable with the knowledge that the Japanese mafia may now be able to insert things into my mind. I'd like to sleep at night knowing that my dreams are my own, such as they may be, and not some weird fantastic visions cooked up by a criminal organization. This is a world emergency.

And in Bearden's analysis, it all comes back to the issue of energy. It is the energy crisis which is now provoking the current "oil wars," since oil production has hit the "Hubbert Peak" and will decline. And the electrical power grids must be replaced with scalar power as fast as possible, for these grids are now totally vulnerable to any possessor of longitudinal interferometers. They can all be wiped out in minutes. By anyone who possesses or controls a Tesla howitzer.

> "Anyway, in my personal view, we should have a national Manhattan Project right now, to develop decentralized electrical power systems taking their energy from the vacuum . . . The MEG is real and so are several other systems invented by private inventors and colleagues. All these efforts should be massively funded and massively and quickly developed. The survival of this nation is going to depend upon it. . . . There are many other facets, but the major point is that our scientific apparatus and the public are still unaware of what a desperate struggle we have entered, since it was thrust upon us. 9-11 was a wake-up call. It was certainly bad enough, and one grieves for those lost American lives. But I fear the worst is yet to come, and it is coming at us like a runaway train hurtling right down the track at us."
>
> Bearden http://www.cheniere.org/correspondence/021702a.htm
>
> "The electromagnetic weapons mentioned by the Secretary of Defense in April 1997 are in terrorist hands also, including the Yakuza and Aum Shinrikyo. That rogue group leased those earlier weapons on site in Russia, from the KGB, at the end of 1989. The SecDef stated that such weapons were being used to initiate earthquakes, initiate volcanoes into eruption, and control and engineer the weather. Quite true. And presently there is a truly massive set of weather engineering operations going on over North America, from that rogue Japanese group manning the weapons in Russia. Some 10 nations of the world now have the type of longitudinal EM wave interferometer weapons (which are what the SecDef was most probably referring to). There are other even more fearsome weapons, possessed by five nations. So a great deal of the state of the world is not covered in the news at all, and will not be . . .
>
> "We have been in an undeclared war of an eerie kind for some decades. That war seems now to have started to heat up also. The destructive capability of some of these weapons is awesome, and far greater than nuclear."
>
> Bearden http://www.cheniere.org/correspondence/021702a.htm
>
> "In that sense, the first phase of WW III is already completed. Now we are only waiting for Phase II.
>
> "It is against that backdrop that I think one must "analyze" such things as how fast we will be replacing the power grid (it's going to go anyway, and catastrophically, the terrorists will see to that). And everything we have is critically dependent upon energy, from the economy to jobs to mobility, to the millions of trucks that transport our goods every day, etc.
>
> "As far as I am concerned, we are already late in declaring a great national emergency in energy, because of the coming destruction of the present energy infrastructure. The

> scientific community should lead, follow, or get out of the way. The emergency is not in seeking "alternative but conventional" systems. It is in developing "energy from the vacuum" on an emergency, crash basis.
>
> "Unfortunately, everywhere I look I just see business as usual. Most Americans (and news media) seem to think, hey, Afghanistan is finished except for a bit of cleanup, and it's just about over).
>
> "It isn't. It has only just begun."
>
> Bearden http://www.cheniere.org/correspondence/021702a.htm

Beyond the Howitzers: Quantum Potential Weapons

Do not use EM propagation through space

As more and more nations acquire the scalar interferometers, Bearden speculates on the next generation of longitudinal weapons called "quantum potential" [QP] weapons.

> "The quantum potential weapons are presently only held by three nations: Russia (in the hands of the KGB, which is now know by its new name), Brazil, and the "friendly little nation." Red China may be working on them, but is just at the beginning...
>
> "The QP weapons have been highly reserved by the Russians. However, the complete extent of their capabilities is still being figured out...
>
> "The quantum potential weaponry (possessed by only three nations) is supreme, because it uses multiply connected spacetime, and DOES NOT involve propagation of EM energy through space as does the longitudinal EM wave interferometers.
>
> Bearden http://www.cheniere.org/misc/qp.htm
>
> "The operational deployment of full-scale strategic QP weapons on site in Russia occurred at the end of 1989, which is when the formal weapons first went operational. These weapons are not in the inventory of the regular Russian armed forces, but all research and development, manufacturing, deployment, an manning and employment is under the ruthless control of the KGB. Shortly thereafter (within weeks), the KGB leased many of their earlier longitudinal EM wave interferometer (LWI) weapons to a rogue Japanese group comprised of the Aum Shinrikyo and Yakuza."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

In another paper, "Time Polarization - Significance and Weaponization," Bearden tells the story of how a KGB longitudinal wave attack was averted by the longitudinal weapons of a "friendly small nation."

So as it stands, it is precarious. Not until the people demand an end of what author Jim Marrs has dubbed the "Rule by Secrecy," can the people's representatives tackle the big problems of a worldwide ban on Scalar Wars and the shifting over to an essentially oil-free economy.

Latest Update from Tom Bearden - March 2002

The whole situation is changing so fast that when I asked Tom to look over this article he mentioned the seeming contradiction when some of the above statements are taken together. At different times the information he has is updated so one has to keep a kind of running track. He was kind enough to clear up the confusion here with the situation as it stands as of March, 2002.

> "We knew of three nations having the QP weapons for some time. Then we found out last year that five nations had it. So that explains my using the figure "three" first (which represented what I knew at the time). Later I found out about the other two nations. China, e.g., only deployed its QP weapon this past year. So that explains the apparent contradiction between me using "five" in later papers and "three" in earlier ones. It was the best information I had at that time. Might mention that so the reader will understand the apparent discrepancy." Tom Bearden

Emptiness is Full of Energy

"The Tao is an empty vessel;
it is used, but never filled.
Oh, unfathomable source
of ten thousand things!

"Oh, hidden deep but ever present!
I do not know from whence it comes.
It is the forefather of the gods."

Lao Tzu -Tao te Ching

Afterward

Because of the extreme seriousness of the topics brought forward in this article, I asked Tom Bearden to look it over to make sure I had not gotten anything too terribly wrong or mixed up. I did not want to pass on any misunderstanding of my own. I felt a little nervous writing to an eminent scientist, and hoped I had not presumed upon his time.

But Tom was so kind as to answer immediately, and to my relief I had not gotten anything too terribly wrong. Here is his letter, in which he clears up a misunderstanding, and reports on his current health treatment, and gives a call to the young grad students to turn themselves loose in the whole new field of scalar electromagnetics and free energy.

Subject: RE: Article on Tom Bearden and "Scalar Wars"
Date: Fri, 22 Mar 2002 22:54:01 -0600

Bill,

Well, I must say I'm astounded at your persistence and hard work in congealing all that together. My compliments on a hard job quite well done.

Couple tiny things: In the area mentioning Kervran and Kaznacheyev: Kervran was French; Kaznacheyev was and is Russian. Little typo of "spredding" the immune system. Should be "spreading".

We knew of three nations having the QP weapons for some time. Then we found out last year that five nations had it. So that explains my using the figure "three" first (which represented what I knew at the time). Later I found out about the other two nations. China, e.g., only deployed its QP weapon this past year. So that explains the apparent contradiction between me using "five" in later papers and "three" in earlier ones. It was the best information I had at that time. Might mention that so the reader will understand the apparent discrepancy.

Otherwise, it's pretty accurate.

Just now I'm letting the weapons take care of themselves; have to, as I will be recovering now for nearly a year from now after the heart attack last year and discovering that I had contracted mycoplasia (the BW modified kind) in Canada in 1968. Finally got a test which confirmed the chronic mycoplasia (which I had for 33 years!). The stuff burrows inside one's red corpuscles, then draws nutrients from the hemoglobin, hardening it and reducing its ability to take on oxygen (by as much as 50% or more). The resulting symptom is loss of endurance (which I had for that 33 years) -- the so-called "chronic fatigue syndrome".

Many of the Gulf War Veterans who are sick also have it, though they apparently have other complicating factors as well. A very high percentage of persons with chronic fatigue syndrome also have mycoplasia. The treatment for the long-standing mycoplasma infection of that nature is to stay on antibiotics for a year. The only time the mycoplasma is vulnerable is when one wears out a red cell in normal usage, and the body makes a new red cell to replace it. The mycoplasma comes out of the dying cell to infect the new replacement cell, so it is exposed and vulnerable at that specific time and that time only. The antibiotics kills it at that time. Hence the necessity to stay on antibiotics for such a long time so it is continuously in your bloodstream (I've already been on antibiotics for over two months, and have at least 10 more months to go). We also take a little medical oxygen every day.

Another symptom of the mycoplasma infection is the association of runaway fibrillation of the heart. To stop that, there are pills one takes, and they stop it. But they also further reduce the volume of blood pumped by the heart, so that this projects one right back into the hypoxia, dizzy, loss of balance, etc. Catch 22 situation; the fibrillation will build and cause heart attack, stroke, etc. if not stopped, and if stopped it puts you back in the hypoxia which can cause many things! With the conventional treatment, you're damned if you do and damned if you don't. Hence the need for a little extra medical oxygen, so you can take the "heart clamp" pill and stop the fibrillation, but also augment the oxygen enough to continue to survive without a stroke or some such. Interestingly, it's very difficult to even obtain a mycoplasma test, and Medicare fights you tooth and nail over paying for the oxygen. Either they will pay for it or I'll pay for it myself; it is absolutely necessary.

After a heart attack, one is treated in the heart clinic by specialists who are very caring and excellent practitioners, but know nothing of mycoplasma infection, so not consider it even a part of "heart disease", and who are rather puzzled when one has no clogging of the arteries, has the right count of red corpuscles (largely nonfunctional, of course, but there), pumps the right amount of blood, etc. So they identify and treat only the runaway fibrillation, do not prescribe the oxygen -- and essentially place you on a regime as best they know, but one that is guaranteed to kill or maim you or turn you into a totally disabled person or human vegetable via stroke, paralysis, etc. Fortunately my family doctor will prescribe the oxygen anyway, though I may have to pay for it myself. Whatever works!

However, I'm slowly improving little by little, working as much as I'm able to and trying to finish my book: Energy from the Vacuum: Concepts and Principles, and get it to the publisher for publication later this year. Hopefully the book will turn all the interested young grad students and post-docs loose in the free-energy area. They will not have to spend 30 agonizing years to get to where I am, and where a few others are, but can simply start here and go forward. Since speed to develop energy from the vacuum is of the essence because of the world situation, I'm moving on it as fast as I am physically able to.

Meanwhile, working with the AIAS (Alpha Foundation's Institute for Advanced Study), the AIAS (15 authors) has now gotten about 20 scientific papers published in leading journals (Foundations of Physics, Foundations of Physics Letters, Physical Scripta, Optik, etc.) dealing with electromagnetic energy from the vacuum. Several more are either approved for publication or in the review process also. So slowly we are getting it into the mainstream scientific literature. Hopefully it will be in time, but it's cutting it close.

Very best wishes,

Tom Bearden

Late update

Massive display of longitudinal interferometers?

UFO Fleet Taped Over Bedhampton, England

Is this sighting a case of the testing of all the Russian (KGB) longitudinal interferometers at once? And coordinating their targeting through the woodpecker grid to a common place, as an exercise in making a massive scalar attack upon a given region? Was this a confluence of Russian Tesla howitzer marker-beacons?

Certainly for a massive all-out scalar attack you would want coordinated movements of the target areas of many howitzers at once, for you could then just cut a bloody swath across a wide area, all the howitzer blasts marching across the land in a kind of scalar version of the "scorched-earth policy." All in a line, blasting, and heat, and mind waves. Or you might want to put the blasts all in the same place for a truly horrendous destruction. And on top of that biowar on citizens whose immune systems have been weakened with the quantum potential weapons. This is the latest version of Armageddon.

And should any madmen gain control of these weapons, any rogue group at all, and should they have some agenda to radically depopulate the world, to simply kill by the billion, the means will be in their hands to do so.

Update: MEG patent granted

Motionless Electromagnetic Generator Patent Granted

This message is from Jean-Louis Naudin, the French scientist who successfully replicated the Motionless Electromagnetic Generator (MEG) in France. He announces the granting of the patent to the MEG Builder's group at Yahoo.

----- Original Message -----

From: jnaudin509@aol.com
To: jlnlabs@yahoogroups.com
Sent: Tuesday, March 26, 2002 2:20 PM
Subject: [jlnlabs] (Info) GOOD NEWS : The Tom Bearden's MEG IS PATENTED

Dear ALL,

GOOD NEWS !!!!

The Motionless Electromagnetic Generator from Tom Bearden is now PATENTED US 6362718 granted on March 26, 2002

US Patent 6,362,718 :
Motionless Electromagnetic Generator (MEG)

Abstract: An electromagnetic generator without moving parts includes a permanent magnet and a magnetic core including first and second magnetic paths. A first input coil and a first output coil extend around portions of the first magnetic path, while a second input coil and a second output coil extend around portions of the second magnetic path. The input coils are alternatively pulsed to provide induced current pulses in the output coils. Driving electrical current through each of the input coils reduces a level of flux from the permanent magnet within the magnet path around which the input coil extends. In an alternative embodiment of an electromagnetic generator, the magnetic core includes annular spaced-apart plates, with posts and permanent magnets extending in an alternating fashion between the plates. An output coil extends around each of these posts. Input coils extending around portions of the plates are pulsed to cause the induction of current within the output coils.

Inventors: Patrick; Stephen L. (2511 Woodview Dr. SE., Huntsville, AL 35801); Bearden; Thomas E. (2211 Cove Rd., Huntsville, AL 35801); Hayes; James C. (16026 Deaton Dr. SE., Huntsville, AL 35803); Moore; Kenneth D. (1704 Montdale Rd., Huntsville, FL 35801); Kenny; James L. (925 Tascosa Dr., Huntsville, AL 35802)

Appl. No.: 656313
Filed: September 6, 2000

For some technical info see my web site at : http://jnaudin.free.fr/html/meg.htm

Best Regards
Jean-Louis Naudin
Email: JNaudin509@aol.com
Main Web site : http://jlnlabs.org
Site France : http://jlnlabs.multimania.com

Click here to view patent # 6,362,718

Patent Story on Rense.com:

Rense.com
MEG Scalar Energy Device
Patented - Production Starts Next Year

From Bill Morgan
wmorgan@nycap.rr.com
3-28-2

Patent was granted on March 26, 2002 for "The Motionless Magnetic Generator," (MEG) US Patent 6,362,718, which is likely to become the first commercially available free energy device in history in about one year from now. The machine will provide free electricity from the vacuum, for the life of the device, which should be a very long life since it has no moving parts. You can see a picture of scientist Jean-Louis Naudin's MEG replication model at: http://jnaudin.free.fr/html/meg.htm.

It has strong magnets, coils, and a controller unit with the electronics. Naudin made the announcement to the MEG-builder's Yahoo group. The announcement has significance since the patent office has always been skeptical of devices which seem to "get-something-for-nothing." But according to the new science of scalar electromagnetics, the MEG does not break the law of conservation of energy. It's just that the energy is conserved in the fourth dimension, time, and not our 3-space world.

The MEG provides electrical energy by tapping the longitudinal electromagnetic (EM) waves which exist in almost infinite abundance in the vacuum of space. This ocean of energy which permeates everything is sometimes called the "zero point" energy, since it remains there even at absolute zero temperature.

Four inventors are listed: Stephen L. Patrick, Thomas E. Bearden, James C. Hayes, Kenneth D. Moore.

Tom Bearden has explained the operation of the MEG on his website Cheniere.org, and also speaks about the new fearful weapons that can and have been made using the same "longitudinal waves" of the vacuum.

The complicated physics of how the MEG works is explained in the paper "The Motionless Electromagnetic Generator: Extracting Energy from a Permanent Magnet with Energy Replenishment from the Active Vacuum," which can be found at Tom Bearden's website:

cheniere.org.(http://www.help4all.de/energy/MEGpaper.pdf)

The first MEG units to be produced for sale will output 2.5 kilowatts of free electricity. Forever. They should be in production about a year from now. Facilities for manufacturing the device are being set up in an unnamed "friendly nation."

This free electricity will flow indefinitely, without much, or any maintenance. The units may be hooked together to provide more wattage, so four of them would provide 10 kilowatts. After some production experience units will be made which output 10 kilowatts each. With a couple of those units a house could get off the electrical grid.

Tom Bearden, one of the inventors has said "I will admit that the chief scientist of an important experimental group in a large company was rather stunned at the type of output we were able to

obtain. The MEG may look like just a transformer, but it is not. It is a completely different breed of cat." This cat, it would seem, is out of the bag now.

The ordinary EM waves we are familiar with are called "transverse" waves, to distinguish them from the new "longitudinal" EM waves of the vacuum. Bearden has explained in depth on his website cheniere.org that wherever there is a dipole (battery, generator, magnet) there is an unseen flow of longitudinal EM waves in that local vacuum, the only problem is in tapping that energy and "transducing" it to electricity. Bearden says that the problem with all the electrical circuits we have is that they are two-wire circuits, a loop by which half the energy goes back to destroy the dipole. In the MEG that closed loop is never made. So the dipole is not being destroyed.

Patents are not granted on devices which do not work, so in a sense this announcement proclaims a new era. The MEG device itself proclaims and proves that energy is abundantly available everywhere, for free. We only have to build the devices to tap it. MEG type devices could be put into a car with an electric engine to make a truly fuel-less automobile. Electricity can be available in very remote places. People will be able to get off our very terrorist-vulnerable power grids. In an era of terrorism a highly dispersed power system would be most desirable rather than our centralized systems.

What is somewhat astonishing to me is the discovery by Bearden et. al. that time itself is actually compressed energy, and that this free energy is actually coming from the time domain, the ocean of longitudinal EM waves which fill the empty vacuum of spacetime. In fact, time is energy compressed by the same factor that matter is compressed energy: the speed-of-light squared. Thus there is a new companion to Einstein's E=mc2. Can you say "E equals delta-tee-cee-squared?" The "tee" is time and delta-tee is change in time.

A company has been set up to manufacture the MEG called Magnetic Energy Limited.

The ramifications of free energy are enormous. The oil wars are not necessary. If we threw as much money at this technology as we are spending on the oil wars we would be free of the need for oil in less than a decade. With fuel-less cars air pollution will be greatly lessened. Third world nations can raise their standard of living eventually. And the energy is free. And it never runs out.

I have put together a kind of "Bearden for Beginners" article which explains some of the basic concepts of the current state of scalar technology.

http://www.prahlad.org/pub/bearden/scalar_wars.htm

The granting of the MEG patent is the herald of the new era of scalar electromagnetics, and the free energy which flows forever and never runs out.

Bill Morgan
wmorgan@nycap.rr.com

Do the magnets run down after a while?

Further developments: Tom Bearden clears up a question

When the MEG patent was released many questioned the patent language which seemed to imply that permanent magnets of the MEG would "wear out" after awhile. I myself wondered about the same thing so I put the question to Tom, and here is his reply.

> Dear Bill,
>
> Thanks for the kind words; much appreciated.
>
> I'm not up to going on radio or TV, and won't be for quite some time. Still suffering from hypoxia, though very slowly improving, and will still be on antibiotics for 10 more months at least (maybe longer).
>
> Obviously an extensive dialog developed between the Patent office and our patent attorneys. As best I can understand it, the Patent office accepts the fact that a permanent magnet produces and emits energy, or has a history of accepting it. They do not appear to be at all cognizant of the broken symmetry of opposite charges, and hence of a dipole. So in their opinion (which seems to be vague), the magnet has to use itself up very gradually, or some such. So some rewrites were essentially required by the Patent office.
>
> All I can say is that a magnet is a very durable thing, so long as you don't heat it up too much or shock it to much. Certainly one will make a good 20 years, and of course there are plenty of magnets that have been around awhile longer.
>
> That said, in our earliest experiments we did "measure" some such effect, or so we thought, until we found that a particular instrument was bad and giving erroneous readings. So with a new instrument, we have not observed since then any such readings.
>
> Out of all that fuzziness came the inclusion of "using up the magnets gradually". So far as we are aware (after correcting those early readings on a defective instrument), we have seen no such measurements or effects since then at all. Nonetheless, just in case there is some very small effect in that respect, at least it's in there.
>
> Actually, as you are aware, capacitors and solid state components are the major concerns for failure, and any system does require maintenance, both periodic and whenever malfunction or failure occurs. The MEG is no different from any other device in that respect, so of course it will have a component failure rate and maintenance required from time to time, just as any other electromagnetic device. But without moving parts, it can be ruggedized and made very durable indeed.
>
> Please give Jeff Rense my regrets, and I do admire his work and his show. He's laying it in there.
>
> The depth of the scientific mindset against COP>1.0 is inexplicable, particularly when physics itself already has COP>1.0 validated experiments (such as Bohren's experiment,

which outputs 18 times as much as one inputs by Poynting calculations), and it works every time. Any competent university optics lab can perform the experiment. Also, even the conventional texts admit that a charged capacitor or electret laid on a permanent magnet, so that the E of the cap or electret and the H of the magnet are at right angles, is a "free energy machine". That silly thing will just sit there and pour out Poynting energy S = EXH indefinitely. Years and years and years. If you wait just a single year, that silly thing has changed the energy density of a volume of space a light year in radius, reaching out well beyond the solar system. Now that's a WHALE of a lot of EM energy that beast poured out in that year, and it will still be going strong and pouring it out at a steady rate. The charges and dipoles in original matter in the universe have been pouring out EM energy in that fashion for some 14 billion years, give or take a billion or so. It's also easy to see that, prior to Lorentz's ARBITRARY symmetrical regauging of the Maxwell-Heaviside equations, those equations prescribe both EM systems in equilibrium with their active environment, and EM systems not in equilibrium with it. The latter systems are permitted by the thermodynamics of open disequilibrium systems to perform five magic functions: (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy than the operator inputs (the active environment inputs the rest of it), (4) power itself and its load (the active environment inputs all the energy, like a windmill), and (5) exhibit negentropy. That is a well-established thermodynamics. Lorentz arbitrarily discarded all such open disequilibrium EM systems in order to get simpler equations having analytical solutions and not requiring numerical methods. So he simply scrapped all the really interesting and challenging EM systems in Maxwell's theory. ARBITRARILY!

That our scientific establishment continues to teach only that "half" of the theory, and not point out the rest to the young students, and not fund research into developing such systems that take energy from the vacuum, is simply inexplicable. It's a matter of total dogma, not science at all.

But hopefully it is changing a little bit. At least now we cite chapter and verse when these things were done, and what they are, and the young grad students and post docs can go check the papers and make up their own minds.

That is the real hope of the future: that we get a generation of young fellows, with excellent skills, who now know where all the skeletons got hidden in the closet, and understand that the electrical engineering model arbitrarily assumes an inert vacuum environment (falsified for more than a half century in particle physics) and a local flat spacetime (falsified for nearly a century by general relativity).

Once they know that past history, and go read into what broken symmetry of opposite charges means for a dipole and for all dipolar EM circuits, they will set to and change that more than a century of error. In that case, we shall have numerous solutions to the energy crisis rather quickly, popping up all over.

Good thing. It will certainly displace some great energy barons, but it will also free the populace. One can extract all the EM energy from the vacuum one wishes, anywhere, anytime, with ridiculous ease. One can produce that "electrical wind of energy" at will, by making a simple dipole and then letting it alone. The only energy problem is in how to

then intercept some of that energy flow and "catch" it in a circuit, discharge it in a load to power it, and not use half the "caught" energy to kill that dipole that is gushing out the extracted EM energy from the vacuum.

Very best wishes,

Tom Bearden

END

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Tesla's Scalar Fields Still Beaming On!

The superluminal (faster than light) scalar or longitudinal waves Nikola Tesla used to magnify and wirelessly transmit power are not just a thing of the past. IEEE engineer, Steve Jackson, discusses and demonstrates how they can be utilized today, and he is open sourcing it here!

by Hank Mills
Pure Energy Systems News

Nikola Tesla is the father of the modern age. His inventions of radio, remote controlled devices, alternating current, and induction motors (among many others), paved the way for modern civilization. Yet other of his inventions barely saw the light of day, despite their tremendous potential.

Such a severely under utilized technology is his wireless energy transmission techniques. By producing scalar (longitudinal) waves, he could achieve superluminal (faster than light) communication, send signals through any material including Faraday cages, and wirelessly beam power to receivers. Researchers like Steve Jackson provide hope that by open sourcing Tesla's work, scalar wave transmission can proliferate and positively benefit the world.

Last Thursday, March 24, 2011, Steve Jackson held a presentation and demonstration of a scalar wave transmitter and receiver at a local IEEE meeting at McMaster University in Ontario, Canada. During the talk he gave an overview of Tesla's life, his inventions, and a plethora of information on his wireless power transmission technology. Afterwards, he demonstrated a small electric fan attached to a scalar wave receiver powered by a transmitter over twenty feet away. Tesla's technology is alive today!

Furthermore, he has approached us at PES Network to open source his design. You can download his PowerPoint presentation here. We'll be uploading to

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tesla-energy.org

Jim Murray and Paul Babcock's 4790% SERPS Presentation	Ignition Secrets DVD by Aaron Murakami	
Magnetic Energy Secrets, Paul Babcock, Parts 1 & 2	Battery Secrets by Peter Lindemann	

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our PESNetwork YouTube account a video of his presentation to the IEEE in a couple of days. It's in process of being transmitted, but will take a while, as it is 3+ Gb. We're expecting to get instructions from Steve on Monday, and we'll be posting a PESWiki page to organize all this material to streamline the presentation.

Take a look at the following video that shows a small boat powered by scalar waves many feet from a transmitter.

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Demonstration of Tesla's Wireless Power Transmission System duplicated at the Tesla Tech Conference, July 2007.

Scalar Wave Properties

You might be wondering what in the world is a scalar wave! It's actually pretty simple. Unlike a transverse wave (like an ordinary radio or light wave) a scalar wave's amplitude does not fluctuate up and down. Instead, try to visualize it more like a vibration of electric potential expanding and contracting in the direction of propagation.

Scalar waves are also often called "Tesla Waves" or "Longitudinal Waves." All of these terms refer to the same type of wave which oscillates in the direction of propagation instead of perpendicular to the direction of movement. These waves have many unique properties which have been tested and confirmed repeatedly.

1) They are capable of penetrating any solid object including Faraday Cages. You can put a transmitter in a box of thick metal and a receiver outside of the box will receive the scalar wave frequency you are pulsing. The potential here is for a transmitter that can penetrate any obstacle or perhaps communicate directly through the Earth from one side of the globe to the other.

2) They are capable of superluminal travel. These waves are claimed not to be electromagnetic, but composed of pure potential energy. Due to this, the speed of light limit does not apply to them. The propagation speed of a scalar wave has been measured as faster than the speed of light and thought by some researchers to be potentially of infinite velocity. (Perhaps SETI - The Search for Extraterrestrial Intelligence - needs a different kind of receiver in order to pick up signals from elsewhere in the universe! Why would advanced ET civilizations even bother using slow transverse waves for interstellar communications?)

3) They are capable of transmitting power. It can then be put to use powering motors, lights, vehicles, etc.

4) A scalar transmitter can wirelessly send power to a receiver through any obstacle. For example, as mentioned above, you can setup a transmitter, put it in a Faraday Cage or a metal box, and a

receiver can receive power far away.

5) During the process of transmission and reception they can magnify power. You can input a certain quantity of power into a scalar wave transmitter and yet the receiver can receive several times the power.

6) Transmitters and receivers can communicate.

7) A conventional transverse wave transmitter cannot sense if a receiver has "tuned in." However, in a scalar system the transmitter and receiver interact because they are in a state of resonance.

As you can see Scalar Waves hold many potential applications for communication, energy, and other applications. To mimic a commercial for a popular brand of cell phone, "Scalar Waves do what Transverse waves don't." They are fast, penetrating, connected, and can broadcast magnified power. These waves are begging to be utilized!

Recipes for Scalar Waves

Nikola Tesla's most famous scalar wave transmitter was his Wardenclyffe tower on Long Island, NY. Prior to that, at the height of his amazing inventive career, he had a lab in Colorado Springs, Colorado. He was able to beam power to receivers miles away that were used to illuminate neon tubes. A great deal is known about his tower, transmitters, and receivers. It is all detailed in his patents. This allows for present day replications!

From examination of Tesla's patents, researchers have learned that perhaps the most critical component of a scalar wave system is the antenna. It is composed of a flat "pancake coil" composed of both a primary and a secondary winding. The coil is connected to a spherical metallic resonator that helps transmit and receive scalar waves.

A particularly good source for information about scalar wave systems is the website of German scientist, author, and researcher, Konstantin Meyl. He has published a series of books that describe scalar wave systems, detail their components, and discuss their operation. His books also dive into the science and physics of scalar waves, among other fascinating topics.

In fact, he offers scalar wave kits for sale on his site. They include all the components needed for a complete system, arrive in an aluminum suitcase that can serve in the same manner as a Faraday cage for your experiments, and come with a book detailing the kit. These kits have been used by experimenters to prove to themselves and others the existence of scalar waves and their unique properties.

Take a look at the following video to see Konstantin demonstrating a scalar wave transmitter and receiver. The same device in the following video is for sale right now on the internet from his website.

M
eyl shows Tesla's longitudinal electricity transmission in Washington
DC at a Tesla,m meeting in 2003!

Even NASA is paying attention to scalar waves to some degree. The paper titled, "Advanced Energetics for Aeronautical Applications: Volume II" by David S. Alexander offers a review of scalar wave (longitudinal wave) research. It mentions the work of Konstantine Meyl and others in the field. Interestingly, the paper also discusses how Dr. James Clerk Maxwell's original equations specifically allowed for scalar or longitudinal waves. Only many years later did short sighted scientists who did not care to deal with Maxwell's complex equations based in "quaternions" mathematics arbitrarily discard longitudinal waves. Due to this, many mainstream scientists doubt their existence despite their history and the mountain of evidence which proves they are very, very real.

Opening Tesla's Technology

Steve Jackson's goal is to open source Tesla's wireless power transmission technology. This is very possible to do, due to the simple nature of

the parts and components required. During his talk he published a list of components required to build a system. This same information can be found in the books of Konstantin Meyl and elsewhere on the internet.

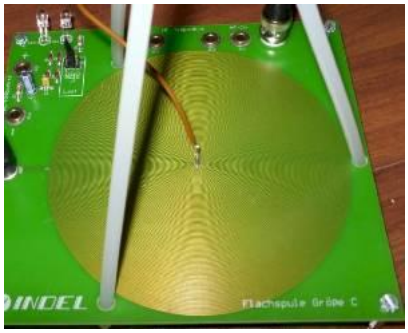

By open sourcing this technology, ordinary individuals could prove to themselves, friends, associates, co-workers, and others that Tesla's technology worked as claimed. Not only does it work, but can be replicated and used for practical applications today. All unique properties of scalar waves could be harnessed and developed to revolutionize our society.

When Steve releases plans, drawings, and other information, probably next week, we will add them to a project page at PESWiki.com. We'll add a link from this page when it is ready.

Earth Changes and the Future

In his books and lectures, Konstantin Meyl has compared superluminal scalar waves to the neutrino, which is also thought by some to travel faster than light. Neutrinos bombard the Earth in all directions, but the majority of them arrive from the central star of our solar system. Due to the fact that approximately half of the neutrinos are absorbed as they pass through the Earth, it is thought they may interact with the core and inner layers of our planet.

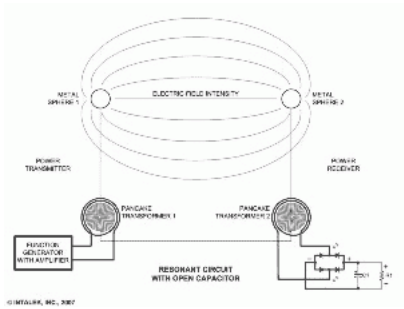

Circuit diagram used by Steve comes from Intalek.com, Figure 3.

Some researchers suggest solar phenomenon can produce variations in neutron emissions which may trigger "earth changes" on our planet. This was depicted in the blockbuster movie, 2012, as the cause for the crust disruptions from the mantle heat-up from increased solar activity. Hence, studying and understanding the nature of scalar waves may increase our chance of survival during chaotic periods in the future. Perhaps by understanding them we could eventually learn how to constructively utilize them to stabilize our planet during periods of solar fluctuations, sun spots, flares, etc.

Perhaps with the use of scalar wave technology, earthquakes, volcanic eruptions, or other natural disasters could be prevented or detected ahead of time. Even a one hour warning before an earthquake, such as the one that recent devastated Japan, could save thousands of lives. Although all kinds of unique technologies are possible with scalar waves, at a minimum we need to understand how neutrinos and scalar waves interact without planet. Not doing so could result in needless death and suffering.

Lets get moving!

To not harness scalar wave technology for the benefit of mankind would be tragic. Our civilization is facing adversity in countless forms. Hunger, disease, pollution, poverty, and war threaten our future and the future of our children. Scalar waves exist, they are useful, and the information to build devices that generate and receive them is available to everyone. To better understand our universe, to ensure the continuation of our civilization, and to honor Nikola Tesla we should do our best to support the open sourcing of this technology.

Videos

On March 30, Steve conveyed the following YouTube links showing his presentation to the local IEEE on March 24.

#1 Slide 1 https://www.youtube.com/watch?v=qs-2s85lO6o
#2 Slide 20 https://www.youtube.com/watch?v=s4kvJpUgGKI
#3 Slide 39 https://www.youtube.com/watch?v=4YXPa73NNsA
#4 Slide 57 https://www.youtube.com/watch?v=LqhRDY56CqU
#5 Slide 81 https://www.youtube.com/watch?v=e1Ht5OVyI5Q
#6 Slide 93 https://www.youtube.com/watch?v=JuehDylES_A

Replication Instruction should be done tomorrow.

Contact

Steve can be reached by email at steve.jackson@ieee.org

# # #

This story is also posted at *BeforeItsNews*.

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Comments

Feel free to view/post comments down below. The following came in by other means.

Not Scalar "Wave"

On March 27, 2011, 1:45 pm, Karl Palsness wrote:

You should read about Scalar .. it is a "Scalar FIELD" there should be no such thing as a "Scalar wave"; and there is a "Longitudinal Wave", instead of scalar wave. Scalar waves just don't exist according to the word scalar meaning size. A Tesla coil has a scalar field around it...and emits a longitudinal wave....

A Tesla-era dictionary defined it as:

> **Scalar** -- In physics, a quantity which has magnitude, or magnitude and sign only, without direction, such as density, mass, energy, etc., as distinguished from a vector quantity.

and

> **longitudinal wave**: A "pressure" type of wave, similar to sound, in which the vibrations are along the direction of travel of the wave. Hence, a wave composed of alternating densifications and rarefactions, where we focus upon the longitudinal component of the changes.

* * * *

Longitudinal Waves (L.M.D.)s

On April 02, 2011 12:29 AM MST, Dr. Eng. Roberto Handwerker <info {at} deltaavalon.com> wrote:

Dear Sirs,

this mail is a reply to a number of e-mail messages I got from [...], subsequently from Dr. K. Meyl and from Mr. S. Jackson about longitudinal waves ("L.M.D.s").

The matter "L.M.D"s. is not new at all but there is still too much discussion around it from different point of views, i.e. mathematics/physics calculus and electrical devices; this has slowly but definitely led to a total chaos even on the Web, resulting in misunderstanding and disbelief, which doesn't help anybody;

therefore, the best approach for an engineer is to be very straight and careful especially when someone talks about Nikola Tesla and theories about aether and L.M.D.s., still not accepted by the "Academic World" who is as happy to hear such arguments as could be "a sailboat in a forest" so to speak and who brings in turn only useless negative criticism and hectic hysterism instead of helping clarify.

This is why I prefer to proceed "step by step" scientifically replicating some Tesla apparatus and demonstrating his experiments, which is of course not easy because he was the Mozart of the art.

I will present a book about the above and will very soon attend a Meeting in Italy to talk about L.M.D.s and show some working devices to public: it is always a pleasure to demonstrate FACTS and WORKING DEVICES rather than only showing some slides and theoretically discuss matters as "Lorenz gauge vs. Coulomb gauge", "quaternions vs. vectors", "T.E.M. vs. L.M.D." etc. etc. Only facts count, observation of Nature and research: math must consequently follow, as always.

It is therefore more useful instead to bring something new to L.M.D.s tech and to the understanding of Tesla, like for instance my "Tesla power wireless" system with the "small car-

demo" shown in my following vids on You Tube (& others under "HorizonDelta"): https://www.youtube.com/watch?v=0BGFF4ltEv and https://www.youtube.com/watch?v=dvZH3RCdeVw

also a tech e-book "Longitudinal dielectric waves in a Tesla coil and quaternionic Maxwell's equations" can be found on my Website for download:

https://www.deltaavalon.com/immagini/L.M.D. waves in a Tesla Coil revised.pdf

I hope the above helped positive discussion and knowledge.

Regards

Dr. Eng. Roberto Handwerker
DELTA Ingegneria

* * * *

The Laplace Operator

On March 31, 2011 2:06 PM MST, Konstantin Meyl wrote:

Subject: Re: About Scalar Field and an Italian Book

There is one comment, making clear, where the problem is localized:

Karl Palsness wrote:

> "You should read about Scalar .. it is a "Scalar FIELD" there should be no such thing as a "Scalar wave"; and there is a "Longitudinal Wave", instead of scalar wave. Scalar waves just don't exist according to the word scalar meaning size. A Tesla coil has a scalar field around it...and emits a longitudinal wave..."

If a scientist is using an expression, he first has to define, what the meaning is. This is what I do in my books, but in America, nobody seems to read my writings. I explain that the scalar wave is nearly the opposite of a scalar field. The expression is more than 200 years old and in mathematics exactly explained by the field equation of Laplace.

The Laplace Operator (describing the distribution of a wave in space) may be separated in 2 parts: grad div - curl curl. The second part is explaining the EM wave, a transverse wave, while the first part gives a scalar wave: The div applied on a vector is scalar! This is why scalar particles or vortices as part of the wave equation are propagating as a scalar wave. But they are propagating in the direction of a field vector and by this the wave is longitudinal and has a direction. In mathematics it is known, that the grad applied on a scalar is a vector again. This is why the scalar wave is propagating in one direction, not in a scalar way, as Karl Palsness wants the scalar wave to do. So he has to read the literature first before he is spreading nonsense in the world wide web.

My opinion about the education in the states is not the best. Lets help to improve it.

* * * *

Other Relevant Coverage

- Featured / OS: Wireless Transmission > Scalar > Tesla > Coils > Jackson >
  Tesla Coils for Dummies - Are you interested in building a Tesla Coil to produce stunning effects that violate the "established" laws of physics, but are somewhat less than technically savvy than a rocket scientist? Then you are in luck, because this article is for you! (*PESN*; April 29, 2011)

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  Jackson's Wireless Aetheric Power Transmission Open Source Project - To facilitate the replication of these plans, as well as to characterize, optimize, improve, and come up with the zillion applications that can come from it, including: 1) harnessing aetheric energy, 2) superluminal communication, 3) wireless transmission of power through any barrier, 4) anti-gravity capabilities, and 5) creating defensive shields to make conventional war obsolete. (*PESWiki*; April 21, 2011)

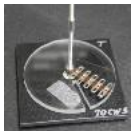

- Featured / OS: Wireless Transmission / Electromagnetic > Scalar > Solid State > Tesla > Coils > Jackson >
  Tesla Coils: Unleash the Aether - Nikola Tesla's most significant contribution was not AC power, radio, or the induction motor, but what we call the Tesla Coil - a tool which allows for the power of the aether to be unleashed and harnessed. Now being launched through an open source project. (*PESN* and *BeforeItsNews*; April 19, 2011)

- Featured / OS: Wireless Transmission / Electromagnetic > Scalar > Solid State >
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"It is harder to crack a prejudice than an atom." // "I'd rather be an optimist and a fool than a pessimist and right." -- Albert Einstein

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All truth passes through three stages:
First, it is ridiculed;
Second, it is violently opposed; and
Third, it is accepted as self-evident.
-- Arthur Schopenhauer (1788-1860)

"When you're one step ahead of the crowd you're a genius. When you're two steps ahead, you're a crackpot."
-- Rabbi Shlomo Riskin, (Feb. 1998)

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[The Tom Bearden Website]

Subject: RE: Missing Reference Slide
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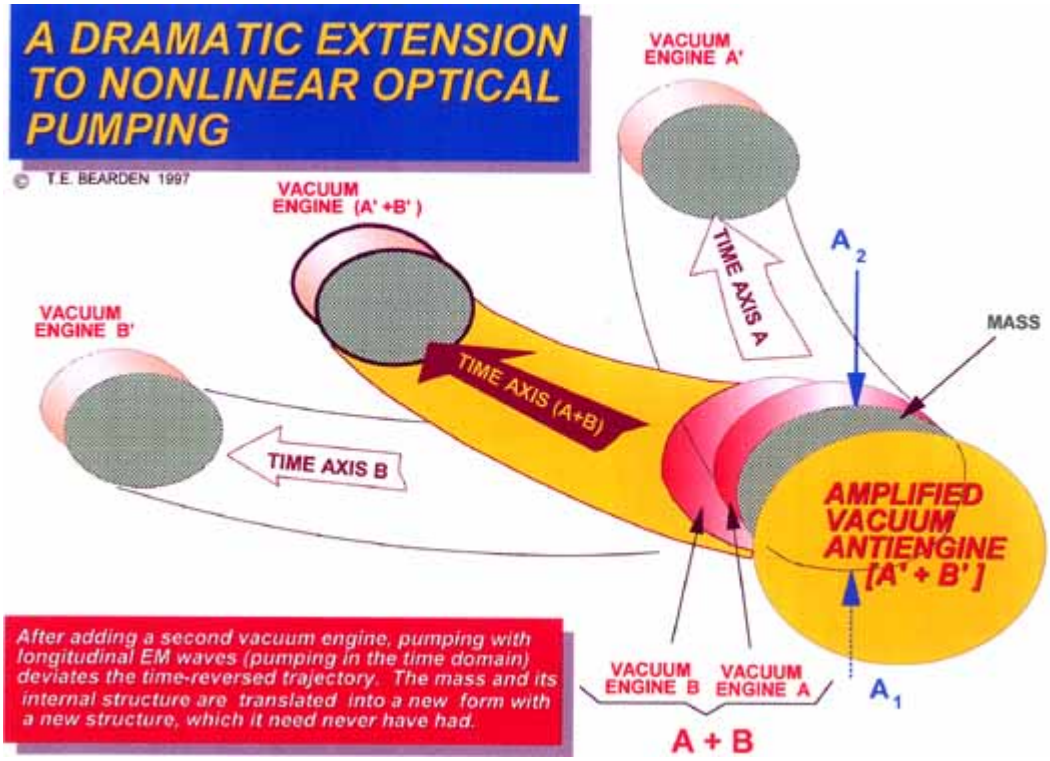

Yes, that is the slide. It works this way: When you time-reverse a cell, you effectively create a major anti-engine for the cell's exact "engine" (exact set of spacetime curvatures at all levels). Because of the precise one-to-one correspondence, this antiengine then "backs the cell up" along the original time-path it took in its physical functioning and changes, back to a precise earlier condition where the disease or disorder was not present. For a cancer cell, e.g., this backs the cell up past where it was originally "promoted" from a stressed or damaged cell to a tumor cell. That makes it into a "damaged cell". The antiengine continues to act, backing it up further into the state before the damage or disorder occurred. That then constitutes "healing" of that cell in a rigorous sense.

The cloning methods etc. used, do violence to the cell in the process. At the cellular level, damaging it or any part of it in the process changes the resident spacetime curvature engine set, to include the damage. You then "clone" a cell with an imperfect resident engine. The cloned cell then interacts with a large variety of phenomenology, continually altering various subcomponents of its resident engine by taking on additional subengines or changing some of its former subengines. Somewhere later, that festering "delta" in the resident engine -- after sufficient interactions with other environmentally-induced engines, will undergo interactions that "add" two deltas so something detrimental to the organism. At that point, physical damage to the cell erupts in "anomalous"

fashion. Actually it erupts by perfectly normal fashion, once the internal engines and their interactions are understood.

This would appear to pose a problem anytime you *artificially* change the subengines of an organism, as in the case of genetically modified food. The small physical damage associated with splicing the genetics has associated with it the injection of such an artificial engine. The interactions of future environmental engines with the spliced genetic organism or plant then remains to be seen. Not all interactions would appear to happen in the limited test time usually allotted for testing the "effects". Anyway, that was the intention.

E.g., Pautrizel demonstrated that immature rats, having immature immune systems, would be restored by the Priore process back to the same immature immune system. The Priore process did not destroy the parasites themselves, but depended upon restoring the immune system back to its first ability to recognize the pathogen and go after it. Priore did not directly "kill" anything! In that case, the pathogens simply re-infected the immature rats, because their immature immune systems could not adequately protect them. It would be the intention of the research, in later generation equipment, to be able to design a specific "extra engine" and introduce it to the pumping, in addition to the "resident engine" in the subject to be treated. That "extra input engine" would accordingly generate a specific "extra antiengine" component in the total antiengine produced. When sufficient research and development maturity has been reached to be able to design such desired "extra engines" to cause the exact, desired extra antiengine to be produced, then the "extra antiengine" technique can be used, e.g., to time-reverse Pautrizel's immature infected rat back to an infected rat with a now-matured immune system. In that case, the rat's stronger immune system would make short work of the pathogen, just as analogously infected mature rats did.

To correct birth defects, etc., obviously one would have to change the actual time-path backwards, to a "state" that the body did not have physically, but which its genetics had before the damage. I foresee that eventually, after some years of development, the process would mature until it could regrow severed limbs, or correct dwarfism, etc. Of course that would be fourth or fifth generation, but it is definitely possible, given sufficient development.

Cheers,

Tom

AD 763210

QUITON/PERCEPTRON PHYSICS: A THEORY OF EXISTENCE, PERCEPTION, AND PHYSICAL PHENOMENA

by

Thomas E. Bearden

March 1973

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ABSTRACT

A fundamental answer is attempted to the questions of being, time, space, existence, perception, and physical phenomena. Mass, empty space, reality, gravitational attraction, continuity, discontinuity, and relativity are among the "things" and "nonthings" for which relationships and explanations are provided.

Perception is defined as detection by a mass of change to itself and as a differentiating process. Perceived physical phenomena are revealed to be first derivatives of ultimate reality, and outputs of the physical perceiving device call the "perceptron." Using the operation of the physical perception process on action, the units of which are energy times time, an entirely different view is generated of both reality and the Heisenberg uncertainty principle. When superposition is imposed as a condition, the Heisenberg uncertainty principle is revealed to be a quantized statement. A concept of the absolute value of a dimensional molecule is advanced.

A reality model is constructed of an action continuum and a nonaction continuum separated by an operational threshold whose magnitude is given by an uncertainty principle. Perception is modeled as a process which switches atomic quanta of action and nonaction back and forth across the threshold. Mass is explained as perceptron switch activity rate, and a mass definition equation is generated. One kilogram mass is shown to represent 17.053 x 10^{50} perceptron switches per second. From the model, Newton's laws of motion and gravity can be generated directly from the concept of the interaction of mass with space itself, space being taken as a massless fluid, or ether, composed of tiny nonaction particles called "quitons." Einstein's postulates of special relativity are also shown to follow from the model, and a statement of the equivalence principle is shown to be consistent with the model.

The concept of "lineception" as a causal chain of perceptron operations is advanced. "Inception" is developed as a noncausal modulation of lineception and as a distinguishing feature of a living system. The possibility is raised that inception could provide an explanation of the noncausal, statistical, ultramicroscopic universe and yet require large ensembles of ultramicroscopic events to conform to causality. Inception is shown to lead to karma. Perception is shown to be causal and to generate causality itself.

Some elementary philosophical implications of quiton/perceptron theory are pointed out and briefly discussed.

I. INTRODUCTION

The unsolved problems of physics stem from the unclear nature of the physical perception of change, and their resolution lies in the analysis of perception as a physical process. The unsolved problems of metaphysics stem from the same source, and can be resolved by the same perception analysis.

Specifically, a physical detection system can detect changes to itself and nothing else. These detected internal changes are thus what a detector "sees" or "observes" or "perceives" as changes to its external environment, i. e., as its physical phenomena. Thus a mass, being itself a physical detecting system, must detect only changes to itself, and these perceived changes to itself constitute its observed physical phenomena. For that reason, these perceived changes are obviously entirely relative to (i. e., are part of) the perceiver (observer); more precisely, they are entirely relative to and part of the perceiver's mass, which is the detector that is doing the perceiving.

Since only changes are perceived by a mass, then mass's perception must be a differentiating process. Ergo, perceived physical phenomena are first derivatives of a higher, or more fundamental, reality. The nature of that higher reality is by definition unperceivable (perception differentiates or fragments it), and it involves the quantity "action."[1] Action itself is not perceivable; change of action is perceivable since perception differentiates action. If superposition is placed on the Heisenberg uncertainty principle as a required condition, then the uncertainty principle contradicts itself for all except integral or zero multiples of a quantum of action. Correction of the uncertainty principle by imposing superposition as a condition provides a statement of the basic operation of perception -- the detection by a mass of change to itself.

All mental perception of a human being regarding physical phenomena is received (i. e., is inputted to the mind) from a physical sensory apparatus whose primary ingredient is mass. Thus we may describe the perceptive mind as consisting of sensory outputs of mass perceptions; that is, the input to mental perception must be the output of mass perception, and this interface within the mind may be referred to as the "perceptive mind."

From the above foundation, a comprehensive theory of perception can be constructed, and a most unusual model of "reality" emerges. A variety of unsolved questions are then resolved by the model. The resolutions include, among other things, 1) derivation of the postulates of relativity; 2) definition of the nature of time and space; 3) the explanation of gravity; 4) the generation of causality itself; 5) resolution of the wave theory of light with the quantum theory of light; 6) the explanation of why ultramicroscopic phenomena are statistical yet large ensembles of ultramicroscopic phenomena are causal; and 7) validation of Mach's principle and the equivalence principle. A totally new and precise definition of mass and of being itself are also two unexpected results. The problems of metaphysics are also answered: metaphysics is elevated to an exact science without any tinge of dogma, and physics and metaphysics are united.

---

[1] Planck's constant, Heisenberg's uncertainty principle, the principle of least action, the energy of a photon, etc., are derived from action and perception's differentiation of action.

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II. EXISTENCE, PERCEPTION, OBSERVATION AND PHYSICAL PHENOMENA

We first define perception[1] as detection by a mass of change[2] to itself, and state that it is an operation performed by that mass. The physical apparatus that accomplishes this perception is termed a "perceptron," which thus may be an electron, an atom, or the sensory apparatus of a living being.

A change detector does not detect the state of its input, but rather detects changes in that state. So in this sense a change detector can be regarded as a state differentiator. Therefore a perceptron differentiates, i.e., it perceives changes in its input and generates outputs in accordance. When its input is constant it will have no output. Thus zero output of a perceptron does not necessarily mean zero input.

What is to be fed into the perceptron's input section exists; i.e., existence (ultimate reality)[3] is defined as what is to be fed into the perceptron's input. The output of the perceptron is that which is perceived, or what we ordinarily call "physical phenomena."[4] Since the perceptron differentiates its input state, then physical phenomena are first derivatives of ultimate reality, which precisely accounts for the sharp separation between observable and nonobservable, i.e., between macroscopic and microscopic.

Any change in a perceptron's input section must involve both time change, Δt, and energy change, ΔE. So we may assume their product, $\Delta E \Delta t$, has always occurred in a perceptron's input whenever it produces an output. The output will be a derivative of the input, e.g.,

$$\frac{\Delta E \Delta t}{\Delta t} = \Delta E \tag{1}$$

and

$$\frac{\Delta E \Delta t}{\Delta E} = \Delta t\,, \tag{2}$$

where in each case the constant of proportionality has been ignored.

---

[1]We differentiate between <u>perception</u> and <u>realization</u>. Perception is entirely a physical process, and causal. Realization is a mental process and is not restricted to causal relationships.

[2]Reflecting, one notes that mass can only change in a nonmass manner. It cannot "change" without involving space and time, both of which are "nonmass." Therefore a mass change <u>must</u> be composed of both mass and nonmass.

[3]"Ultimate" in that it is higher or more fundamental than perceived reality.

[4]Changes to mass and only changes to mass constitute physical phenomena. Changes to one mass constitute "its" perceived physical phenomena, or its physical universe.

"Changes to mass and only changes to mass constitute physical phenomena. Changes to one mass constitute "its" perceived physical phenomena, or its physical universe. Since the other masses in its universe are perceived by it (i.e., created in its perception by its perception process), then these masses must be entirely relative to the mass perceptron that perceives them. Ergo, perceived mass is relative to the perceiver.

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Any detector has an operational input threshold, i.e., a minimum discernible signal. The Heisenberg uncertainty principle states the requirement for such energy-time changes:

$$\Delta E \Delta t \geqslant \hbar/2 \ . \tag{3}$$

Its smallest value, or

$$\Delta E \Delta t = \hbar/2 \ , \tag{4}$$

is then the input threshold for a physical perceptron to operate and produce an output.[1] Letting $k = \hbar/2$, we can write this simply as

$$\Delta E \Delta t = k \ . \tag{5}$$

Since existence has been defined as that which is fed into the perceptron's input, then that existence exists whether or not the perceptron operates, and the case[2] where

$$\Delta E \Delta t < k \ , \tag{6}$$

also exists (i.e., can be present in the input of a perceptron) but cannot be perceived or detected (i.e., the perceptron will not operate and produce an output).

At this point we diverge to remark that the product of energy and time is a quantity called "action," and the units of action are

$$A \equiv \frac{ML^2}{T} \tag{7}$$

Thus the input state to a perceptron is composed of an action continuum,[3] and the perceptron differentiates action quanta to produce physical phenomena.

---

[1]We acknowledge additional uncertainty statements but for simplicity will use only one in this paper.

[2]Equation (6) exists and it is proper to write it down and search out its ramifications. Equation (3) is a limiting condition which applies only to mass. But since our physical experience must involve nonmass (e.g., photons, space, time, being), then nonmass considerations must be examined. A good beginning is to consider the entire field of nonmass possibility, i.e., that field of nonmatter changes defined by (6), which includes the entire subquantum domain. So we legitimately examine two conditions: Eq. (3) must define (or apply as a condition to) the mass phenomena (change, quantized) system, and (6) must define (or apply to) the nonmass phenomena (subquantum) system.

[3]We exactly define continuity as the failure to perceive difference (change), and

phenomena (subquantum) system.

[3]We exactly define continuity as the failure to perceive difference (change), and discontinuity as the perception of difference (change). The difference between continuous and discontinuous is entirely one of perception. Thus there are two kinds of continuity: absence of perceptron operation at all, and identically repeated perceptron operations. The first kind exists outside of perception while the second kind exists in perception-to-perception. These are two powerful definitions, which among other things enable one to understand such concepts as limiting process, derivative, point, line, and plane. Mathematics itself is the game of perception, nothing more and nothing less.

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When a large quantity of action is to be fed into a perfect perceptron, the input process cannot occur instantaneously; a Δt must be outputted (created)[1] by the perceptron for each operation. Thus perception processes steps or quanta of exactly k size, and exactly k size only. Inputs of less than k size are simply collected[2] until the aggregate is equal to k, then differentiated to produce an output. We must therefore rewrite the Heisenberg uncertainty principle as

$$\Delta A = nk \quad , n = \pm 0, 1, 2, \ldots \quad , \tag{8}$$

where the plus and minus signs are necessary since action only has to change about some constant level in the perceptron input, and this change may be either additive or reductive (this quantum statement is actually the basis for quantum physics).[3] Thus, from the viewpoint of a perceptron, its output universe of physical phenomena is constructed by successive granular differentiation of unit operations, each of size k, but it detects no time lapse (creates no Δt) between operations.

When differentiated by a perceptron, an action atom may be regarded as being "chopped up" (the word "differentiated" literally means separated or torn apart):

$$\frac{\Delta E \Delta t}{n} = \frac{k}{n} \quad \bar{A} , \qquad n = 2, 3, 4, \ldots \quad , \tag{9}$$

where the bar over the A indicates nonaction, or action atoms which have been broken into bits.

Thus we now conceive of an action continuum of action atoms and a nonaction continuum[4] of bits of action atoms. The two continua coexist and the perceptron

---

[1]Or "extracted from an action quantum $\Delta E \Delta t$," which means exactly the same as "created." Einstein's treatment of simultaneity showed that it was operational, but if simultaneity itself is operationally created then both time and length must also be operationally created.

[2]This is not a simple discontinuous operation, since no time flow exists (Δt is not being outputted) during this collection process. We have to think of the process discontinuously, but the stepwise process is actually continuous (in time), or discontinuous, or both.

[3]Since ΔE may be positive or negative, we may state the uncertainty principle as $|\Delta E \Delta t| \geqslant k$, or as $\Delta A = nk$, $|n| \geqslant 1$. Consider the two cases $\Delta A > 0$, $n = 1$, and $\Delta A < 0$, $-1 < n < -2$. Superimposing them would give $|\Delta A| < k$, which violates the uncertainty principle. Thus, assuming superposition must hold, the uncertainty principle can be made to violate itself for all except integral values of n, and it follows that the Heisenberg uncertainty principle must be written as a quantized statement.

[4]The separation into two continua is artificial, but is necessary to allow us to perceive perceptron operation with our brain perceptron mind. There is absolutely

"The separation into two continua is artificial, but is necessary to allow us to perceive perceptron operation with our brain perceptron mind. There is absolutely no separation in the reality continuum itself; rather, there is only an operational separation caused by and in perception. Hegel was very nearly correct in his realization that the dialectical principle was the magic key to the universe of perceived phenomena. However, thesis (action) and antithesis (nonaction) do not meet to give a synthesis (the transfer function or switching) which is different from either; rather, thesis (action) is changed (transferred or switched) to its antithesis (nonaction) and vice versa. It is the switching or transfer process that is the synthesis (output of the perceptron, perception) which is different from the thesis and the antithesis.

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operates, or moves, in them. Only action quanta of exactly k size can be processed by the operating perceptron to give outputs which we know as physical phenomena. Such phenomena (events) consist of aggregates of extremely large numbers of perceptron operations. Action atoms will be referred to simply as "action atoms." The very smallest bits or fragments[1] of action atoms will be referred to as "quitons" and the symbol "q" used for one quiton. For convenience, we shall regard the "magnitude"[2] of q to be very much less than k, or

$$q \ll k \,. \tag{10}$$

The perceptron's process of collecting quitons to form action atoms will be termed "fusion," which is an additive change to the constant action continuum. "Fission" will be the term for the perceptron's process of breaking up action atoms into aggregates of quitons, where the size of each aggregate is less than k; fission is a reductive change to the constant action continuum. The term "switching" will be used to refer to either fission or fusion, or both.[3]

Fission and fusion are merely transfers or switches across the k-threshold separating the action and nonaction continua, and may be represented by either of the diagrams shown in Fig. 1.

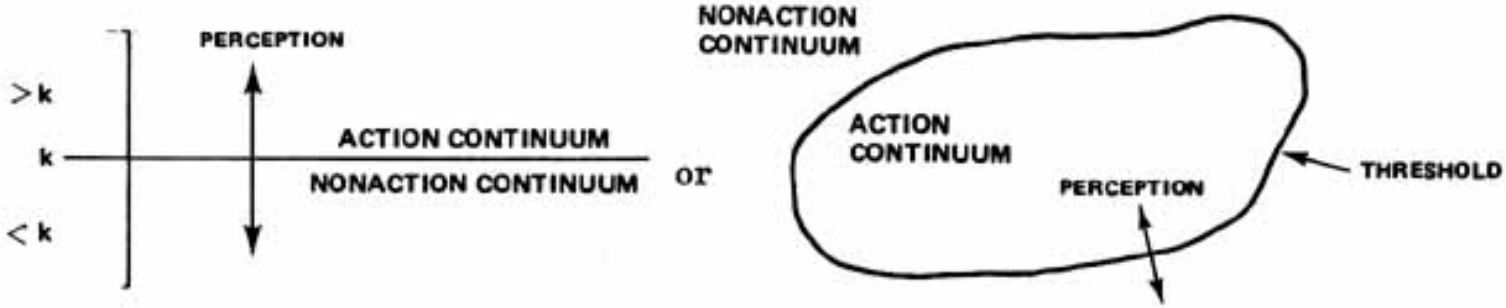

Fig. 1. Continua of the Universe

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[1]These are actually nonthings and not bits or pieces at all, but since we can only perceive or think of things, we will model them as things. The difficulty is in the nature of thought, not in the nature of reality.

[2]The perceivable magnitude of a quiton is zero, i.e., it is not perceivable.

[3]And, in fact, switching can also refer to the transfer of Δt into ΔL, i.e., the creation of space from time or vice versa. Separation (relation) is composed of ΔL and Δt, and we know from relativity that when relativistic (perceived) ΔL is changed, then relativistic (perceived) Δt is also changed. When time dilates, length contracts; and when time shrinks, length expands. Therefore the statement that length and time are intertransferrable is valid: one kind of separation can be transferred into another kind of separation just as one kind of energy can be changed into another kind of energy. Since this transfer itself is an operation, then there is a rate (i.e., a constant) of transfer. This constant is actually a parameter, since by special relativity it can vary as a function of the mass changes themselves. And since we are dealing with mass changes (perception), then the rate of transfer constitutes a rate of mass change (rate of perception). Since perception is finite

since by special relativity it can vary as a function of the mass changes themselves. And since we are dealing with mass changes (perception), then the rate of transfer constitutes a rate of mass change (rate of perception). Since perception is finite, perceived mass change cannot be infinite but must also be finite. Therefore a limiting rate of perception must exist. From the equations of special relativity, this limiting rate of perception or mass change is c, the speed of light, and its value may be taken as the rate of change of a mass switch itself.

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We now examine the expression for energy of a photon:

$$E = hf \tag{11}$$

Considering fission of an action atom as a chopping of that atom, the process can be expressed by:[1]

$$\begin{bmatrix}\text{Minimum}\\ \text{time rate of}\\ \text{change of action}\end{bmatrix} = \begin{bmatrix}\text{Energy}\\ \text{Transferred}\end{bmatrix} \simeq \begin{bmatrix}\text{atom of}\\ \text{action}\end{bmatrix}\begin{bmatrix}\text{cuts or chops}\\ \text{per second}\end{bmatrix}, \tag{12}$$

or

$$\frac{\Delta A}{\Delta t} = \Delta E = C_1 kf , \tag{13}$$

where C_1 is a constant of proportionality. According to Eq. (1), the energy perceived to be expended (transferred to quiton disturbances) in fissioning of an action atom ought to be proportional to the speed of the chopping action. Neglecting constants of proportionality, Eq. (13) is simply[2]

$$\Delta E = hf , \tag{14}$$

where the Δ symbol is deliberately added to show that it is a transfer process. The equation works in reverse for fusion of quitons into action atoms, i.e., the energy ΔE transferred to each action atom assembled is proportional to its rate of assembly.

We can now represent a perceptron as shown in Fig. 2, which corresponds precisely to the two-pronged arrows shown in the diagrams of Fig. 1. A perceptron has two channels, fission and fusion, in which switching transfers between action and nonaction are involved.

By Eq. (2), one of the outputs of a perceptron is Δt. Since perception creates its own time interval, it only has its kind of time, i.e., positive time, to deal with. Thus only positive time is perceived, and what we think of as positive time flow is merely the successive Δt's created by perception.[3]

---

[1]Note how admirably the view of tearing apart or differentiating the action atom describes the result. The smaller the Δt torn from (ΔE Δt) (or the quicker the separation), the larger the ΔE left (produced), i.e., the more energetic the separation. The atom of action is a quantum of action and one integral piece; the ΔE and Δt, however, are not necessarily of individually fixed size.

tion. The atom of action is a quantum of action and one integral piece, the ΔE and Δt, however, are not necessarily of individually fixed size.

[2]Action atoms can occur in more than one size (see note 1 on p. 3).

[3]This explains why we sense existence as if we were the point of contact of a pointer moving along a time line. In effect, perceptron time advances one time slice at a time, where the slice is of Δt thickness. Thus all physical phenomena occur in minute granular sequences.

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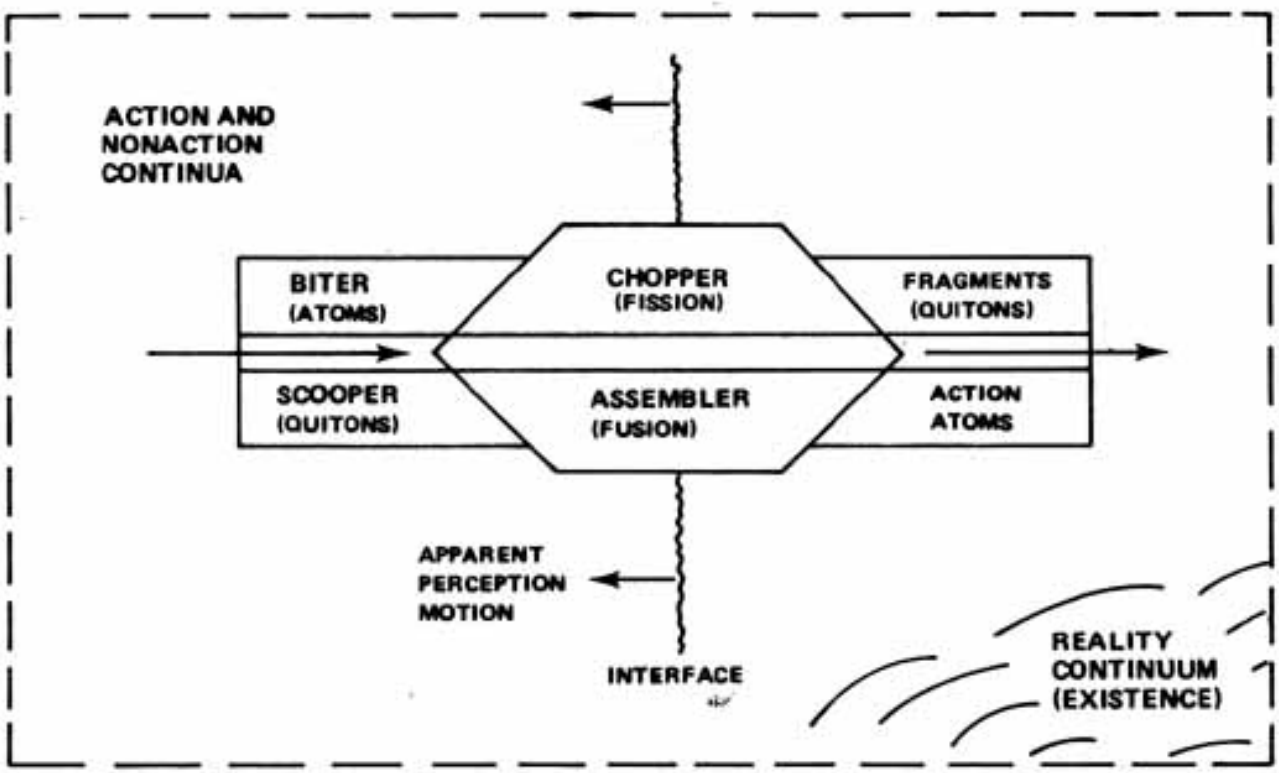

Fig. 2. The Fundamental Perceptron Switch

The existence of a negative time flow can be postulated by a simple symmetry analogy, but this postulated negative time, by definition, cannot be a perceptron output. We use the term "reflection" to denote a postulated operation in negative time[1] symmetrical to perception which operates only in positive time. Reflection is essential to the explanation of electric charge and charge effects,[2] but these will not be discussed here. Figures 3, 4, and 5 summarize the concepts of reflection, perception, and positive and negative time.

We now introduce the concept of absolute value of a dimensional molecule.[3] To illustrate, if we know that F = Ma, we will state that

$$|F| \equiv |Ma| \equiv |M| \times |a| = M\ |a| \quad , \tag{15}$$

where the last expression is true because of the nondivisibility of the unit ΔL and

---

[1]Modern theorists such as Feynman, Wheeler, and Dirac of necessity incorporate negative time operation into their theories involving action-at-a-distance.

[2]The quiton/perceptron theory can and does explain what "charge" is, why like charges repel and unlike charges attract, etc. It predicts the force of attraction or repulsion to be proportional to Q_1Q_2/R^2.

[3]Although perceptron output bits may vary in magnitude from operation to operation,

[3]Although perceptron output bits may vary in magnitude from operation to operation, they are of absolutely fixed size in any one operation or between any two consecutive operations. So for one operation or any two consecutive operations, a dimensional molecule is merely a product and division of certain-sized bits, and is itself of one fixed magnitude. Any other dimensional quantity of equal absolute value is therefore of the same size for that operation. At this level, differentiation is simple bit division and integration is simple bit multiplication.

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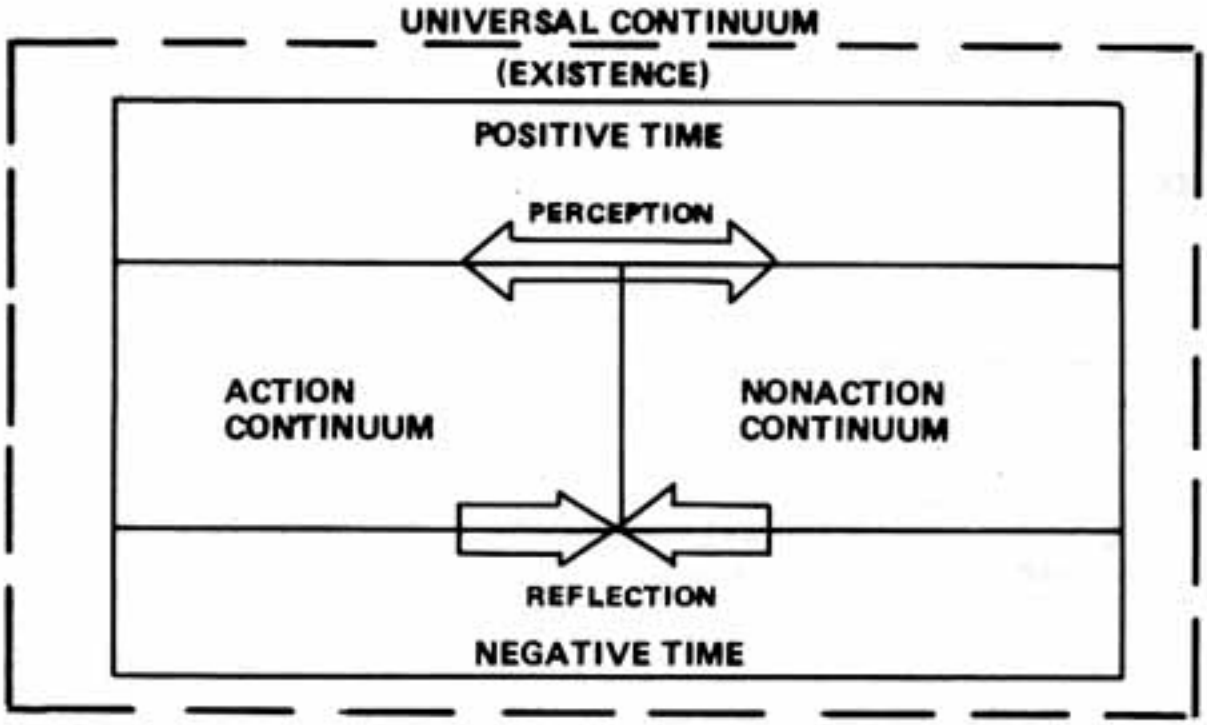

Fig. 3. The Continua (Complete Model)

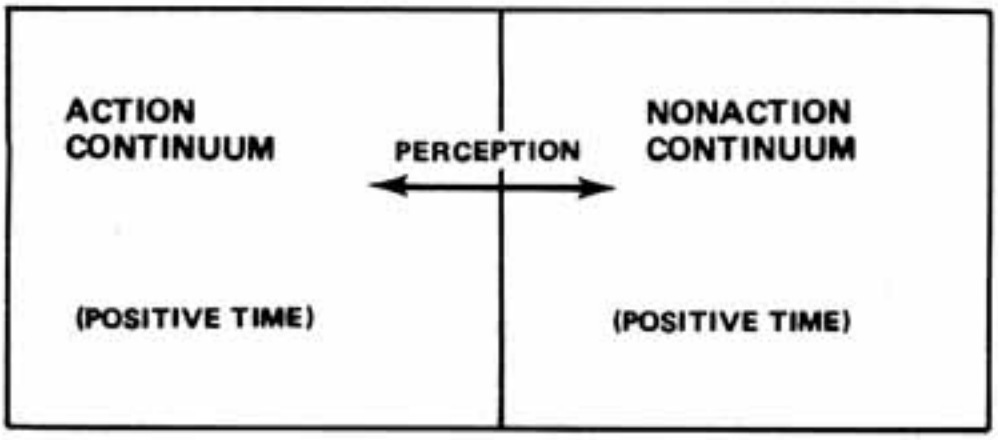

Fig. 4. The Positive Time Continua -- Model in Which Perception Acts

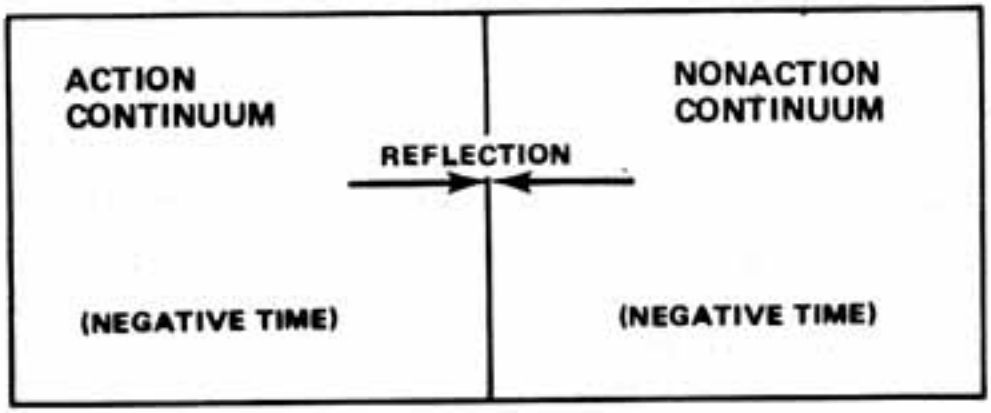

Fig. 5. The Negative Time Continua -- Model in Which Perception Does Not Act

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Δt quanta outputted by one perceptron operation. The absolute value signs must be added to any dimensional molecule which can take on either positive or negative values. Dimensionally,

$$M_0 = |E| \ , \tag{16}$$

where M_o is rest mass and requires no absolute value sign since a quantity of rest mass is only positive. Actually, since perceptron operation only outputs quanta, then the perceptron outputs ΔE and ΔM_o, or

$$\Delta M_0 = \left|\Delta E\right| \ , \tag{17}$$

and repetition rate allows perception of M_0 as a positive quantity. Then

$$\frac{\Delta A}{\Delta M} \longrightarrow \frac{\Delta(L^2)}{\Delta t} \ . \tag{18}$$

The perceptron expression of the right-hand side of (18) will be[1]

$$\frac{\Delta(L^2)}{\Delta t} \longrightarrow \frac{\Delta L \Delta L}{\Delta t} \longrightarrow \Delta L\,(V) \ , \tag{19}$$

and then we have

$$\Delta E \Delta t(V/V) \longrightarrow \frac{\Delta E(V\Delta t)}{V} \longrightarrow \Delta P(\Delta t)(\Delta L/\Delta t) \longrightarrow \Delta P \Delta L \ , \tag{20}$$

which must be another statement of the minimum condition of the Heisenberg uncertainty principle, or

$$k = \Delta P \Delta L \ . \tag{21}$$

It follows that

$$\Delta P \Delta L = nk, \qquad n = \pm 0, \pm 1, \pm 2, \ldots \tag{21a}$$

To consider why constant velocity yields special relativity, from $E = ML^2/T^2$ and Eq. (16), we can write

$$M = \left|\frac{ML^2}{T^2}\right| = M\left|\frac{L^2}{T^2}\right| \ . \tag{22}$$

Dividing out the M gives

$$1 = \left|\frac{L^2}{T^2}\right| = \left|\frac{L}{T}\right| = \frac{|L|}{|T|} = |V| \ . \tag{23}$$

[1]Obviously $\Delta(L^2) = 2L\Delta L + (\Delta L)^2$, but the units of $2L\Delta L$ are $\Delta L\Delta L$.

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So velocity is a dimensionless quantity in the absolute dimensional sense, i.e., in the perceptron operational sense, and "the laws of physics apply equally well for all observers as long as they are moving with constant velocities" (Einstein's postulate). When the perceptron process is applied to a system of objects whose relative velocities are constant, the inputs to perception always differ by a constant value and the differentiated outputs of perception do not differ, i.e., the differential of $f(x) + C_1$ is identical to the differential of $f(x)$.[1]

Observation is related to perception as shown in Fig. 6. An observer observes only perceptron outputs[2] -- never ultimate reality -- from his sensory apparatuses.

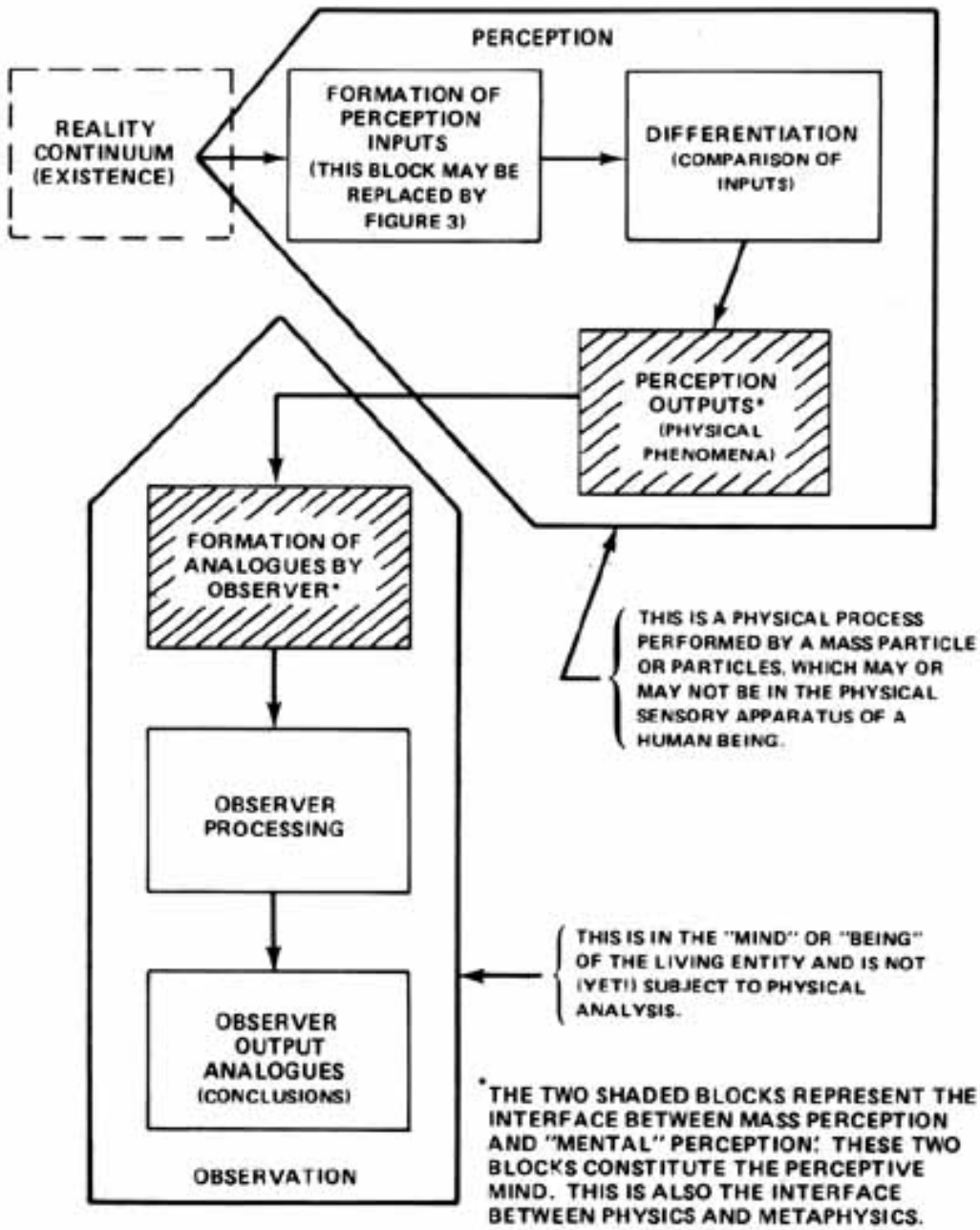

Fig. 6. Overall Relationships

[1]Einstein's treatments of simultaneity and special relativity may be regarded as

[1]Einstein's treatments of simultaneity and special relativity may be regarded as statements that one can determine a length (measure a ΔL) only by $\Delta L \equiv c\Delta t$, and one can determine (measure) a Δt only by $\Delta t \equiv \Delta L/c$ in the static case.

[2]The process of observation actually consists of both perception and realization.

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III. MASS AND SPACE

The nonaction continuum may be further visualized as a sea or gas of small, unperceivable particles, i.e., of quitons and aggregates of quitons which are less than k in magnitude. Since mass is a perceived quantity and a quiton cannot be perceived, a quiton or aggregate of less than k magnitude has zero mass.

Since fission and fusion both constitute perceptron switching, we may explain mass by visualizing a changing pile of quiton bundles, each of k size, in which the total rate of switching activity is what we call the "mass"[1] of the pile. Thus the mass is equal to the sum of the absolute values of the fission and fusion activities:

$$M \equiv \left|\frac{\Delta A_i}{\Delta t}\right| + \left|\frac{\Delta A_o}{\Delta t}\right| \simeq \left|\dot{n}_i + \dot{n}_o\right| \quad k \ , \tag{24}$$

or

$$M \simeq \left|\dot{n}_i + \dot{n}_o\right| \qquad \text{sw/sec}, \tag{25}$$

where[2]

Δt = perceptron operation time (one operation)

M = perceived mass of the pile

ΔA_i = action created from fuzing quitons into action atoms

ΔA_o = action lost from fissioning action atoms into quitons

$\dot{n}_i$ = number of k-sized bundles per second fused into atoms

$\dot{n}_o$ = number of atoms per second fissioned into quitons

sw/sec = one perceptron operation per second.

---

[1] If ΔE is time rate of change of action, and if the absolute dimensional value of rest mass and rest mass energy are the same, then mass must also be a time rate of change of action. One kilogram mass equals 17.053×10^{50} sw/sec.

[2] The switch concept is necessary to explain charge and charge effects. The switching occurs between the positive (perception outputted) and negative (reflection outputted) time streams. Three types of switches exist, two of which are charge switches and all of which are mass switches. Switching may also be regarded as change of Δt into ΔL. For a mass switch, the limiting value of the conversion parameter b in ($\Delta L = b\Delta t$) is c, the speed of light. However, the

regarded as change of Δt into ΔL. For a mass switch, the limiting value of the conversion parameter b in ($\Delta L = b\Delta t$) is c, the speed of light. However, the concept of switching can be expanded; $b < c$ implies mass switching; $b = c$ implies quitons moving (maximum switching limit for mass switching); $b > c$ implies DeBroglie waves moving, which are not switching in the normal sense at all. Technically, the condition $b < c$ applies to Eqs. (24) and (25).

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The use of the mass definition equation can be illustrated by a simple example. First,

$$k \equiv h/2 = 0.527 \times 10^{-34} \text{ joule-sec} \tag{26}$$

$$1 \text{ kg mass} = 8.987 \times 10^{16} \text{ joules}, \tag{27}$$

so

$$1 \text{ kg mass} = \frac{8.987 \times 10^{16} \text{ joules}}{0.527 \times 10^{-34} \text{ joule-sec/switch}} \tag{28}$$

$$1 \text{ kg mass} = 17.053 \times 10^{50} \text{ switches/sec}. \tag{29}$$

For a mass that does not accelerate, switches must occur in couplets. This would require, for example, that angular momentum be quantized in quanta of 2k magnitude, since two switches would process two action atoms -- one in and one out of the mass action pile. Since

$$2k = h/2\pi, \tag{30}$$

then angular momentum should be quantized in $h/2\pi$ quanta, which indeed it is: from the Bohr theory of the hydrogen atom,[1]

$$mvr = \frac{nh}{2\pi}, \quad n = 0, 1, 2, \ldots, \tag{31}$$

and the change permitted is thus

$$\Delta(mvr) = \frac{nh}{2\pi}, \quad n = 0, \pm1, \pm2, \pm3, \ldots \tag{32}$$

What we normally think of as empty space is sometimes described as the absence of mass and energy, existing in time.[2] Empty space can be defined by

$$\frac{\Delta A}{\Delta t} = 0; \qquad \frac{\Delta \bar{A}}{\Delta t} = 0, \tag{33}$$

which merely state that no perceptron output is occurring. Thus empty space exists only as defined by a perceptron and is merely the total absence of perception. While these equations rule out fission and fusion, they do not rule out the static presence of large numbers of quitons and quiton aggregates each of which is less than k in size (a quiton may be viewed as a quantum of space or a quantum of ether).

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[1]Beiser, Concepts of Modern Physics, McGraw Hill, 1963.

[2]Actually there is no time connected with the existence of space; the time is connected only with our perception of change; that is, space is a product of perception, or the nonoperation of perception, and is related to a mass perceptron. Similarly, space itself has no length -- length is relative between two masses. That is why both length and time can change, and why a specific length and a specific time can

space itself has no length -- length is relative between two masses. That is why both length and time can change, and why a specific length and a specific time can be different to different observers.

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A massless quiton cannot individually generate any drag resistance against matter in the Newtonian sense. So a mass object moving along at a constant velocity will just push a stream of massless quitons ahead of it. In effect, the mass "bulldozer" is pushing its own medium along with it, and this requires no force.[1] Therefore, empty space (i. e., the zero output condition of one's mass perceptron) is filled with (has added to it) streams and streams of quitons moving ahead of other objects (perceived by one's perceptron) from all over the universe (perceived by one's perceptron). These quiton streams may be regarded as quiton pulses or quiton waves[2] in one's own static-relative quiton pond. The static-relative quiton pond of a mass will be called its "q-space" or "space" (more commonly referred to as the mass's inertial frame of reference).

When impinging on a perceptron's mass, these disturbances are being collected into k-sized quanta and switched into action atoms. The switching produces outputs that reveal the presences of the disturbing masses. The situation for a perceived mass is described in Fig. 7. Note that a fusion pileup is shown in front of the perceived object due to the object's motion, and a fission pileup is shown at the rear (switching is actually distributed throughout). Additional switching is occurring in the pileups and constitutes increase in mass. So one's mass perceptron perceives the moving object's mass as having increased. The relative velocity of the object with respect to one's perceptron determines the additional collection rate of quitons, and hence the additional switching rate, occurring for the object in one's perceptron q-space. The perceived increase in the moving body's mass is a function of the increased collection rate, which is a function of both the initial mass switch size M_0 and the velocity V, or

$$M = f(V, M_0) . \tag{34}$$

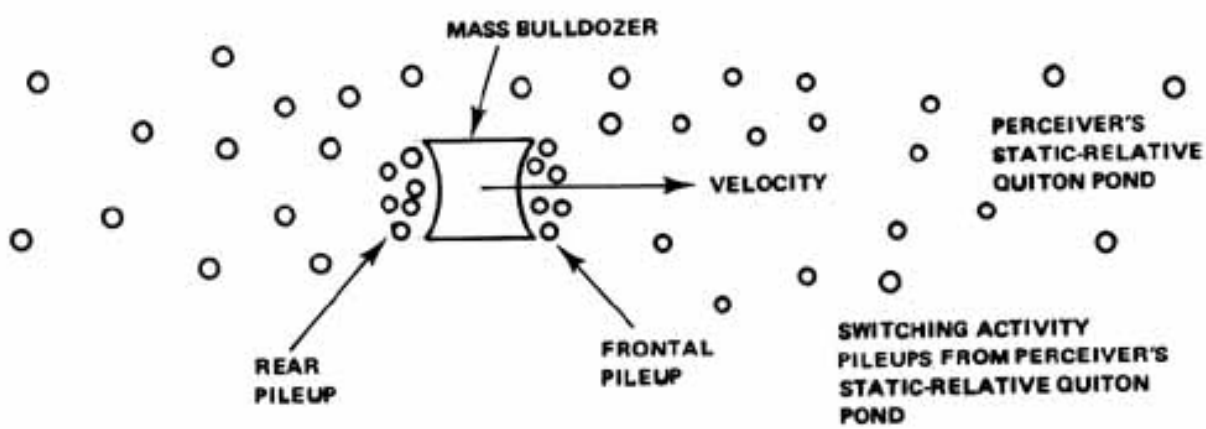

Fig. 7. Increased Perceiver Switching Due to Perceived Velocity

[1]More precisely, it requires no resultant (unbalanced) force. Both fission and fusion create forces; however, these forces are opposing, and so when fission rate equals fusion rate the resultant force is zero.

[2]These pulses or waves are not in themselves perceived, so one can equally well consider them bunches of particles or waves. The difficulty lies with the perceptron mind, not with the disturbances.

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If the perceiver shifts "his view" to the object, he would at the same time shift his perceptron to it and so would then see the same sort of effect existing on his vacated mass. The pileup is relative to the perceiver and is occurring in the perceiver's perceptron itself.[1] So material objects do not just move through an ether, they carry their own q-space ethers right along with them.[2] And all they can detect is the disturbances in that q-space that produces switching transfers in and out of the action and nonaction continua.

We now wish to know the standard medium velocity at which wave disturbances move in the q-space. The question is, what has zero mass, is unperceivable, and yet can move through the perceiver's empty space ether[3] at some standard velocity? Photons satisfy all these requirements. Photons themselves cannot be perceived -- only their interactions can; and photons move in free space at the velocity c, the speed of light. Thus c is the quiton medium's wave velocity[4] and quiton disturbances move in a q-space at the velocity c. They move only in a q-space and in nothing else, since movement (velocity) is defined as $\Delta L/\Delta t$, and both ΔL and Δt exist only to the perceptron that created them. Therefore, velocity of a perceived object is absolutely relative to the perceiver since it is part of the perceiver's mass's perception. At this point, Einstein's postulate that "the speed of light is the same for every observer" can be seen to follow directly from the quiton/perceptron model.

But a difference exists between the speed of light in q-space and the speed of light in a medium. Simply speaking, when light travels in a medium the quiton waves (photons) are perceived to interact with particles (get switched by other switches) continually. In each imposed interaction switching perceived, another Δt occurs in the perceiver's perceptron. Thus more Δt's occur, and the photon is perceived to take longer in traveling through the medium than through free q-space; that is, the perceiver's perceptron (in which the medium itself exists) creates more time output in the case of light traveling through a perceived medium than light traveling through unperceived free q-space.

---

[1]This point is emphasized. The mass's mass does not increase as perceived by itself; its mass does increase as seen by the perceiver. This fact alone is sufficient to establish that the increase in mass is subjective, not objective (although these two terms are usually misused). That is what the term "relative" means, i.e., relative to the subject. Note that the perceiver is always the subject. The fact that the effect occurs only to the perceiver should indicate that it is the perceiver's perception process which is causing the effect.

[2]Thus one can have one space moving through another space.

[3]From Einstein's Theory of Relativity by Max Born, p. 224: "Einstein in later years proposed calling empty space equipped with gravitational and electromagnetic fields the 'ether,' whereby, however, this word is not to denote a substance with its traditional attributes. Thus in the 'ether,' there are to be no determinable points, and it is meaningless to speak of motion relative to the 'ether.' Such a use of the word 'ether' is of course quite admissible, and when once it has been sanctioned by usage in this way, probably quite convenient." The use of "ether" here is quite close to Einstein's proposal; however, in our usage it is meaningful to speak of "perceived motion of a perceived object" in the q-space ether of the perceiver. Otherwise, there can be no observation and no observer, which are of course necessary

"perceived motion of a perceived object" in the q-space ether of the perceiver. Otherwise, there can be no observation and no observer, which are of course necessary to Einstein's theory.

[4]Velocity is unperceivable; it is actually the constant of proportionality for the perceptron's direct transposition of Δt into ΔL. And c, the constant velocity of light, represents the limit of the perceptron's ability to do this.

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It should be noted, but will not be pursued further here, that electromagnetic waves in space are merely quiton wave disturbances[1] moving in a perceptron's q-space. The energy being transmitted is the "energy equivalence" of the nonaction quiton aggregates that were chopped up from action atoms. When these fissioned aggregates are again collected in some perceptron, then $\overline{\Delta E}$ is recovered as ΔE, or perhaps as ΔM.

In passing, we note that hidden in the principle of complementarity is the fact that wave and particle are operationally excluded, i.e., separated by an operation. A wave by definition is operational (dynamic). The most elementary idea involved in the concept of a particle is that it is nonoperational; i.e., it doesn't have to move, or change, or function, or be dynamic to exist. Obviously that which is operational differs from (is separated from) that which is nonoperational, but such separation itself is differentiation which is an operation. Therefore, wave (operation) and particle (nonoperation) are operationally separated. The only "mystery" in complementarity is that one must stop (interfere with) an operational entity to have a nonoperational entity, and one must start (interfere with) a nonoperational entity to have an operational entity. Depending upon the conditions imposed upon it, an entity can be either operational or nonoperational. For example, the operation of superposition must be imposed upon DeBroglie waves before they can constitute a particle. It then follows that the particle's velocity must in fact be the velocity of the superimposed group, i.e., the wave packet's velocity. By the same reasoning it follows that one cannot measure a particle's exact position (which is a static or nonoperational entity) and its exact momentum (which is a moving or operational entity) at the same time. The same is true for the particle's exact time position (nonoperational) and its exact kinetic energy (operational). Thus uncertainty principles, complementarity, and the relationship of DeBroglie wave velocity to wave packet velocity all involve the one fundamental concept that an operational entity is separated from a nonoperational entity by an operation. The changing is separated from the unchanging by a change; i.e., the changing is operationally derived from the unchanging, or perceived reality is derived from unperceived reality.

[1]Photons are aggregates of quitons; quiton aggregate behavior is particulate. Behavior from the standpoint of individual quitons is wave-like. This explains the dual behavior of light and reconciles its wave and quantum aspects.

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IV. IMPACT ON PHYSICS

A. MICHELSON-MORLEY EXPERIMENT

The Michelson-Morley experiment was conducted in the Michelson/Morley/earth q-space. The Michelson/Morley/earth perceptron(s) would perceive the speed of light to be the same in all directions, i.e., any fringe shift observed should have been a result of experimental uncertainty only. The experiment did not prove there was no ether; it did prove there was no perceivable ether[1] through which the earth was moving. The results admitted of a static-relative ether if it is unperceived. Perception is a process, and if the process does not occur then perception does not occur. Since by definition the q-space of a perceptron does not cause the perceptron to operate, then the q-space is unperceived by the perceptron.

More careful examination of observation reveals the following facts: A perceived mass has a constant mass when not moving with respect to the perceiver. When it is moving through the space frame or the ether of the perceiver with a constant velocity v, its perceived mass is again constant but is now perceived to be greater than was its rest mass. From whence came the extra mass?

The extra mass effect is only to the perceiver. The only possible sources for the extra mass in perception are the original rest mass M_0 and the empty space of the perceiver's space-frame (i.e., the interaction of perceived mass with unperceived space). Space does not drag, in the conventional Newtonian sense, against a moving body that is not accelerating. And space is unperceivable; therefore it can be visualized as a massless fluid. Thus the increase in perceived mass (which is a change) must come from the perceived mass's increase in velocity in perceiver space (because velocity is all that was changed), and it must involve the physical operation of the perceiver's physical perceiving mechanism. A perceived mass does exert resistance (drag) called "inertia" whenever it is accelerated in the perceiver's space-frame. This resistance is a force. Perceived force is equal to perceived mass times perceived acceleration through the perceiver's space.[2]

---

[1] Is not space an unperceivable ether? An extract from Einstein's Theory of Relativity by Max Born, p. 223, states: "If each of two observers who are moving relative to each other can assert with equal right that he is at rest in the ether, there can be no ether. Thus, the extreme development of the ether theory leads to its dissolution as a fundamental concept." The conclusion that there can be no ether does not logically follow. Each observer can assert that he is at rest in an ether (space), and these spaces can be intermoving. That is precisely what a "moving frame of reference" is: one space moving through another. Today we retain the (or more correctly, an) ether concept, but call it "space" or "inertial frame of reference" or "frame." The conclusion should have been that there can be no single "stable ether," but that there can be many.

[2] Newton's law, F = ma,* to date has been used in a half sense, i.e., that the acceleration of a perceived mass through the perceiver's unperceived q-space generates force. If this is true, and relativity holds, then the acceleration of any other unperceived q-space, through a perceived mass, also generates force; through one perceived mass in a perceiver's q-space, the q-spaces of all other perceived accelerating masses are accelerating and thereby generating forces on it. By this "other half" of Newton's law and by relativity, Mach's principle (that inertia of a mass is derived from the

accelerating and thereby generating forces on it. By this "other half" of Newton's law and by relativity, Mach's principle (that inertia of a mass is derived from the other masses of the universe) can be shown to be true. Although not collated and developed as such, it is possible to derive the postulates of both special (Continued)

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This equation states that a perceived accelerating mass must react with the perceiver's q-space, and in fact this interaction may be taken as the basic mechanism that creates force itself. Again the perceiver's physical perception mechanism is the causative agent.

A quite logical conclusion at this point is that the perceiving mechanism perceives (produces) additional perceived mass from the interaction of perceived rest mass with perceived mass-motion (velocity) through its unperceived space.[1] Also, the perceiving mechanism produces perceived inertial drag from the interaction of perceived mass with the mass's perceived acceleration through its unperceived space.

The concept of "ether" should not be rejected while the concept of "space" is retained, since the latter is actually an unperceivable ether. Rather, the concepts of mass, perception, and ether-space should be tailored to fit the perceived phenomena. Quiton/perceptron theory (perception theory) is a deliberate transfer function model specifically tailored to fit these criteria.

B. GRAVITATIONAL ATTRACTION

Newton's law of universal gravitation can be generated, in both effect and form, from quiton/perceptron theory.

A perceptron's q-space is filled with streams and streams of quiton disturbances moving ahead of its perceived moving objects from all over its universe. Thus there exists a flux of quitons at any point in its space, and this flux is isotropic to the first approximation: because of the vast interstellar distances between disturbing masses, the flux gradient in the relatively local neighborhood of any perceiver point is essentially zero. The quiton disturbance flux can be represented as shown in Fig. 8. A quiton flux stream switching pressure P_1 is exerted on M_1 and a switching pressure P_2 is exerted on mass M_2. In any one flux stream line in this shadowed zone, the pressure against either of the two bodies is reduced in proportion to the amount of switching flux subtracted from that flux line by the other body. The total reduction of switch pressure in the shadowed zone is therefore proportional to the product of the two masses M_1 and M_2, considering the effects to be mutually independent.

(Footnote 2 continued from preceding page) and general relativity from quiton/perceptron theory, and the steps essential to that derivation are contained in this paper.

*[More precisely, $F = d/dt\ (mv) = ma + v\ dm/dt$. From the second term, increase or decrease in mass of a moving object also produces a force. This second force component may not be too important except in microscopic phenomena, but for fast microscopic changes in mass (e.g., in the nucleus) it could generate significant forces. Also note that the velocities of all other spaces (i.e., velocities of the q-spaces of all other moving objects) in the perceiving mass's universe interact with its perceived mass change rates, according to the second term of Newton's law, relativistic form.]

[1]A disagreement has long existed over whether a "nonthing" exists if it cannot be observed. The argument is illogical; e.g., if a photon itself cannot be perceived and only effects (changes) produced by it are perceived, does a photon exist? It

A disagreement has long existed over whether a "nothing" exists if it cannot be observed. The argument is illogical; e.g., if a photon itself cannot be perceived and only effects (changes) produced by it are perceived, does a photon exist? It exists, but cannot be perceived to exist, i.e., it exists outside of perception, but does not exist in perception. The same is true of the notion of space.

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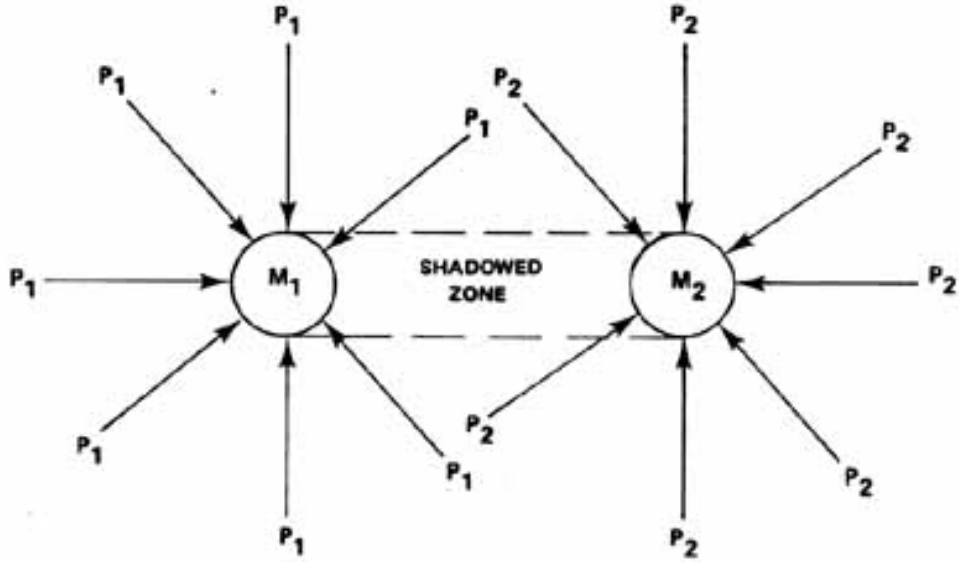

Fig. 8. Gravitational Attraction of Masses

From purely geometrical considerations, a shielding factor is also present due to the solid angle that is shadowed about any mass point. This effect is proportional to $1/R^2$ by usual solid angle considerations. Putting these two factors together, the attraction of mass should therefore be proportional to M_1M_2/R^2, or

$$F = K \frac{M_1 M_2}{R^2} \tag{35}$$

which is the expression for Newton's universal law of gravitational force, and this force is driving the two masses together.[1] By merely extending the basic statement by superposition of the effects of every perceived mass-pair in the perceptron's universe, one obtains the attraction of mass[2] for the universe.

---

[1]It is not accidental that electric, magnetic, and gravitational field forces all obey "inverse square of the distance" laws, since these forces are derived from analogous switching operations.

[2]Attraction of mass implies an effect derivable from the presence of mass only. Mass is a switching rate. Therefore attraction of mass must be derived from switching only. Now a massless fluid generates no drag against a constant velocity mass, but switching is a negative quiton acceleration which does generate force. So switching generates drag, but constant velocity does not. This accounts for the error long made in considering the "mass shadowing" explanation of gravitational attraction to suffer from a serious defect of implied retardation force due to velocity through an ether-flux (see, for example, the Feynman Lectures on Physics, Vol. 1, p. 7-9). Velocity of an ether flux through a body merely affects the mass of the body; it does not generate force. Acceleration of an ether flux through a body generates a resultant force on that body. In Feynman's example of an orbital body, let us assume perfect circular motion with constant speed. Since the speed of the ether flux is always constant, the mass is always constant. Since the component of acceleration tangential to the circle is zero, there is no force generated tangentially to the orbit. But since there is a constant radially outward acceleration of flux through the orbital body, then there is a constant radial force outwards that is generated, and this force is called the "centrifugal force," i.e., the "center-fleeing" force.

body, then there is a constant radial force outwards that is generated, and this force is called the "centrifugal force," i.e., the "center-fleeing" force.

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It should be noted that for extremely small masses at extremely close distances, or for extremely short times, turbulence and interference effects can form in the shadowed zone of Fig. 8 and superposition may no longer hold.

C. NEWTON'S THIRD LAW OF MOTION

One of the recognized ways of stating Newton's third law of motion is: "To every action force there is an opposite and equal reaction force." This law follows from quiton/perceptron theory, as can be shown by examining two colliding bodies. It should be stressed that these two bodies, and all changes related to them, exist as changes in the output of the perceiver's perceptron. It must always be borne in mind that these changes, or physical phenomena, exist as outputs of the perceiver's mass perceptron.[1,2]

Figure 9 shows perceived bodies M_1 and M_2 in constant velocity motion just before collision. A deliberate choice was made of a case where the momenta of the two bodies were not equal, so that the initial switching rates for the two masses were different. In the example, $M_1V_1 > M_2V_2$. The mass switching drag of each body is again represented by small circles. Each body has the same size roll in front as in the rear, so its switch pressure forces are balanced. Figure 10 shows the collision.

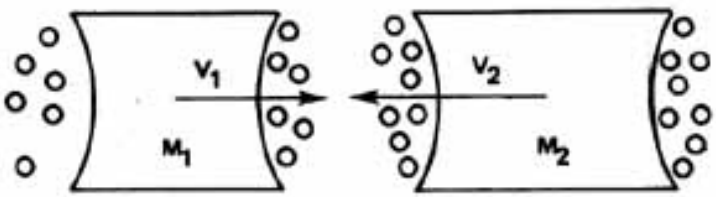

Fig. 9. Two Bodies Before Collision

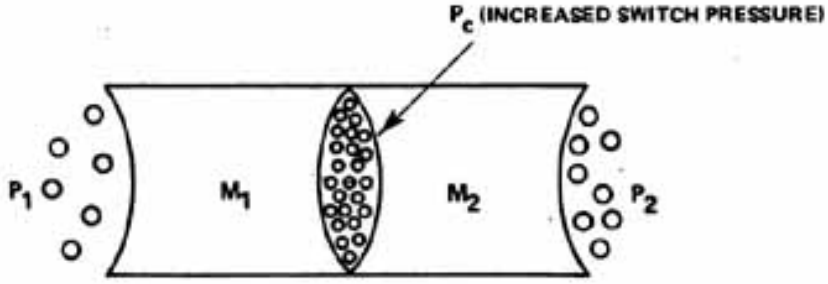

Fig. 10. Two Bodies at Moment of Collision

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[1]We consider the question: "If a tree falls in a forest and there is no ear to hear it, is there a sound created?" A tree is a perceived tree, a forest is a perceived forest, and a fall is a perceived change. Their presence or existence implies a perceiver and perception; thus they imply that a "sound" change would be perceived, since they imply a perceiver to perceive it. If, however, by "no ear to hear it" we mean "no perceiver present at all," then the question as posed contains a self-contradiction: with no perceiver, there can be no perceived tree, perceived forest, perceived fall, or perceived sound.

[2]The manner of searching for quiton/perceptron causal explanation of a physical

or perceived sound.

[2]The manner of searching for quiton/perceptron causal explanation of a physical phenomenon is to ask, "What would the perceptron have to do to generate the phenomenon?".

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There is an almost instantaneous switch pressure increase in the contact zone between the colliding bodies, and consequently there is a switch pressure differential across each body as shown in Fig. 11.

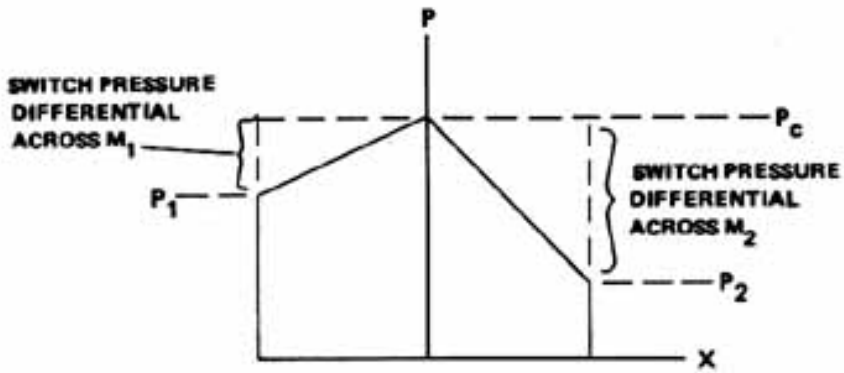

Fig. 11. Switch Pressure Relationships at Collision

In the figure, the contact pressure P_c is exerted against each body, so that the pressure forces on the two bodies act in opposite directions. But for any two colliding bodies, the contact areas, one against the other, are the same. This common contact area will be called A_c. Since $P \equiv F/A$, then

$$|F_1| = |F_2| = P_c A_c \ . \tag{36}$$

But since the pressure forces on the two bodies are being exerted in opposite directions, then

$$\vec{F}_1 = -\vec{F}_2 \ , \tag{37}$$

which is Newton's third law of motion.

D. NEWTON'S SECOND LAW OF MOTION

Neglecting constants of proportionality, Newton's second law of motion may be stated in the most general sense as

$$F = \frac{d(mv)}{dt} \ . \tag{38}$$

The first step in deriving this law is to examine a point mass which is perceived moving with velocity $\vec{V}$, as shown in figure 12.

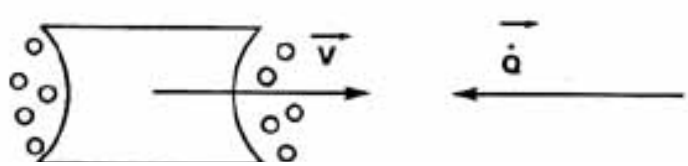

Fig. 12. Moving Point Mass

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An increased rate of quiton switching activity exists along the axis containing the velocity vector $\vec{V}$. We will call this increased quiton activity a vectorial "current" $\vec{\dot{Q}}$, and define its direction as contrary to the velocity vector. The mass is perceived to be moving against the current vector, and

$$\vec{\dot{Q}} \ \alpha \ -\vec{V} \ . \tag{39}$$

When the current $\vec{\dot{Q}}$ is steady, i.e., when

$$\vec{\dot{Q}}_{in} = \vec{\dot{Q}}_{out} \ , \tag{40}$$

then the switching activity, and hence the mass and the energy, are constant. Therefore, from $v = \pm\sqrt{2E/m}$, the velocity remains constant.

If $\vec{\dot{Q}}_{out}$ suddenly increases, then

$$\vec{\dot{Q}}_{in} < \vec{\dot{Q}}_{out} \ , \tag{41}$$

which can be represented as in Fig. 13.

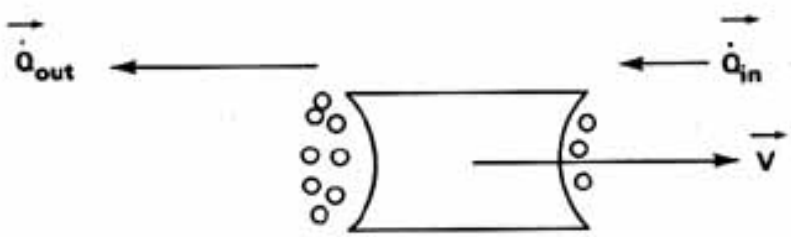

Fig. 13. Difference in Quiton Current

From Eq. (39),

$$\vec{\dot{Q}} = -k_1\vec{V} \ . \tag{42}$$

At any time in a quiton current, the switch pressure force exerted against the mass can be represented as

$$F = P_c A_c \ , \tag{43}$$

where P_c is the switch pressure and A_c is the area of contact. However, since the area of contact A_c, or the drag area, is the mass switch rate itself, then (neglecting constraints of proportionality)

$$A_c \ \alpha \ M' \tag{44}$$

$$A_c \propto M' \quad , \tag{44}$$

where M' is the switch rate at the point of switch pressure application. We will next examine the switch pressure forces before and after one perceptron operation

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(i.e., across the smallest possible time interval Δt used by the perceptron itself in perceiving a change). When there is any difference in the pressure forces against the body front and body rear, this difference is the resultant force $\vec{R}$, or

$$\vec{R} = \left[(P_c A_c)_{in} - (P_c A_c)_{out}\right] \vec{q} \quad , \tag{45}$$

where $\vec{q}$ is a unit vector whose direction is given by the direction of $\dot{\vec{Q}}_{in} - \dot{\vec{Q}}_{out}$. Now, from Eq. (44),

$$\vec{R} = \left[(M'P_c)_{in} - (M'P_c)_{out}\right] \vec{q} \quad . \tag{46}$$

Since $P_c \; \alpha \; \dot{Q}$ and $\dot{\vec{Q}} \; \alpha \; (-\vec{V})$, then (neglecting constants of proportionality)

$$\vec{R} = -\left[(M'\dot{\vec{Q}})_{in} - (M'\dot{\vec{Q}})_{out}\right] \quad , \tag{47}$$

which from Eq. (39) gives

$$\vec{R} = (M'\vec{V})_{in} - (M'\vec{V})_{out} \tag{48}$$

or

$$\vec{R} = K_4 \Delta(M'\vec{V}) \quad . \tag{49}$$

However, this has happened in the smallest possible time Δt, and since by definition

$$\Delta(M'\vec{V})_{min\ \Delta t} = (M'\dot{\vec{V}}) \quad , \tag{50}$$

then

$$\vec{R} = k_4(M'\dot{\vec{V}}) = k_4 \frac{d}{dt}(M'\vec{V}) \quad , \tag{51}$$

which is Newton's second law of motion, relativistic form. Acceleration of a body is caused by a difference in mass switch rate (i.e., a switch rate gradient)[1] induced across it by transfer of momentum from another moving body or by induction from a field such as an electrostatic field or a magnetic field.

E. NEWTON'S FIRST LAW OF MOTION

Newton's first law, that "a body at rest or in uniform motion will remain at rest or in uniform motion unless some external force is applied to it," can be derived from the same type of considerations used to develop the second law. Obviously, if

$$\ddot{\vec{Q}} = 0 \quad , \tag{52}$$

[1]Switching can be thought of as transfer of Δt into ΔL. An increased switch rate represents an increased rate of transfer resulting in a higher value for the ratio

[1]Switching can be thought of as transfer of Δt into ΔL. An increased switch rate represents an increased rate of transfer resulting in a higher value for the ratio of ΔL to Δt being outputted. Since the ratio $\Delta L/\Delta t$ is defined as v, an increase in this ratio increases the velocity, and thus acceleration occurs.

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then

$$\vec{R} = 0 \tag{53}$$

and

$$\vec{a} = 0 \quad , \tag{54}$$

in which case the body at rest will not move and the body in uniform motion will remain so, by the definition of acceleration. Every perceptron repetition will output the identical value for V as the preceeding repetition, and that is why the first law holds.

F. IDENTITY OF LENGTH AND TIME

From $E = Mc^2$, we have

$$c^2 = E/M = 9 \times 10^{16} \text{ joules/kg} \tag{55}$$

$$c^2 \Leftrightarrow 9 \times 10^{16} \text{ joules/kg} \times 1/17.053 \text{ kg sec/sw} \tag{56}$$

$$c^2 \Leftrightarrow 0.527 \times 10^{-34} \text{ joule-sec/sw} \tag{57}$$

$$c^2 \Leftrightarrow \text{k/mass switch} \ . \tag{58}$$

Thus

$$c^2 = (3 \times 10^8)^2 \text{ m}^2/\text{sec}^2 \Leftrightarrow \frac{\text{k}}{\text{mass switch}} = \text{one sw opn} \tag{59}$$

$$\text{one sw opn} \Rightarrow (3 \times 10^8)^2 \ \text{m}^2/\text{sec}^2 \tag{60}$$

$$\Rightarrow 3 \times 10^8 \text{ m/sec} \tag{61}$$

$$\Rightarrow 1 \text{ sec} = 3 \times 10^8 \text{ meters} \ . \tag{62}$$

Length and time are thus synonymous,[1] and c is the constant of proportionality (more precisely, the identical ratio for transposing Δt into ΔL will be maintained for each perceptron operation). Therefore, a perceptron actually outputs only one thing which may be taken to be either Δt or ΔL (it actually outputs only change

[1]By "synonymous" we mean that Δt and ΔL are intertransposable by perception operation. The term c is the velocity (rate of change) of switching itself, i.e., the speed at which quitons themselves can move, since quitons are being switched by mass. Therefore c ought indeed to be the wave velocity at which quitons move, and thus represents the maximum ΔL obtainable from Δt by mass in normal switching. The possibility exists that abnormal (turbulent) switching can deviate from this limitation. Thus "time warping," "time travel," "hyperspace travel," and the interplanetary drive may indeed

that abnormal (turbulent) switching can deviate from this limitation. Thus "time warping," "time travel," "hyperspace travel," and the interplanetary drive may indeed be possible. Since at least one of these effects of turbulence in switching (that of DeBroglie wave velocity exceeding the speed of light) is theoretically accepted, the problem of turbulent switching should be well worth the theorist's attention and effort.

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itself, which is perceived and thought of as ΔL and Δt). All other dimensions, quantities, and dimensional molecules are but bit division or bit multiplication. This seems to be consistent with some of the latest conclusions from general relativity theory.

In passing we note that there is no separation without relation, and there is no relation without separation. Therefore

$$\text{relation} \Leftrightarrow \text{separation.} \tag{63}$$

Also, there is no operation without separation, and there is no separation without operation. Therefore

$$\text{operation} \Leftrightarrow \text{separation.} \tag{64}$$

It follows that

$$\text{operation} \Leftrightarrow \text{separation} \Leftrightarrow \text{relation.} \tag{65}$$

We note a difference between free space and a Cartesian space (inertial reference frame). In a Cartesian space or inertial reference frame a definite length is considered to have been established for each and every point in that frame. But such a definite length to each point is rigorously operational by statement (65) above, i. e., such a length is defined by an operation. Specifically, it is defined by the operation of a mass perceptron (or an understood mass perceptron) at the origin of the frame. Such a frame is linear if the identical type of perceptron operation has defined the length to each point. If the type of defining operation varies, then the frame so defined is nonlinear; i. e., its space is said to be curved or distorted.

In one perceptron, its length defining operation and its mass defining operation can interfere or react one with the other. This type of interference or interaction is the direct interaction of frame space (length) with mass and it is the fundamental generating mechanism of force. All forces are so generated (see again the inset footnote on p. 17). And in fact a perceived moving force does work in the direction of its perceived movement rather than in the force's perceived direction precisely because of the moving operational length's interaction (interference) with the operationally generated force. This interference interaction is between operations in the same perceptron and generates what is called work.

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V. ELEMENTARY PHILOSOPHICAL IMPLICATIONS

Every scientific treatise is filled with forms of the words "one" and "be," yet none attempt to define these metaphysical terms. Ontologists and metaphysicians have uncovered many problems connected with these two words, but no real solutions. In addition, the historical preoccupation of metaphysics with dogmatic religious beliefs contributed strongly to its disfavor, since scientists were required to exert considerable effort to establish the scientific (observational) method as a legitimate criterion for the judgment of physical truth. Consequently, both science and philosophy today are constructed on quite undefined foundations, primarily because of the failure to recognize the relationship of perception operation to reality, which recognition is a prerequisite to the synthesis of physics and metaphysics. One therefore must comprehend the concepts of be (exist),[1] thing (perception), and one (thing) from the viewpoint of the relation between perception and ultimate reality.

A. EXISTENCE, THING, AND ONE

Existence has been defined here as "what is to be fed into the perceptron's input." In the situation where all operation of the perceptron has ceased, what can be said to exist in the input? First, what exists is a continuum: it has no limit, interface, dimension, time, velocity, change, space, place, or discontinuity since these are all derived from perceptron operations and the perceptron is not operating. What exists is continuity only, with no discontinuity.[2] To comprehend this, we must examine the thought process itself more closely, realizing that "to think" is "to perceive thoughts."

What is a "thing?" Further, what is "one" -- one "thing," one "anything?" A thing is first a perceived thing: it resulted from the output of a perceptron operation, in which one input bite and one output occurred. This output is characterized by the the fact that it is one, and the absence of one (i.e., zero) is the absence of output.[3] Figure 14 shows these relationships. The perceptron operation created the separation between the inside and the outside by creating a ΔL and a Δt, that is what the delta symbol means. Thus the operation of the perceptron determines the basic nature of one itself, and any one necessarily requires that a perceptron operation has occurred. In fact, the perceptron itself is a result of perceptron operations. Thus indeed all is relative. A perceptron exists and is able to function because it perceives other perceptrons to exist and function. Thus perceptrons are mutually created derivatives of reality

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[1] Being is undifferentiated; that is its total definition. It cannot be perceived, since perception differentiates. It is continuity only, without any discontinuity, which is unperceivable. The preoccupation of being with causality (perception) is technically called "inception," the influencing of perception. In Zen philosophy this is technically "attachment to the world of illusion (change);" the literal meaning of "incarnation."

[2] This concept is unperceivable, by the definition of perception, which accounts for its difficulty. To be a "perceived one" implies limit (finiteness); oneness itself, without a bound or limit to make it a one (perceived), cannot be perceived. This is the primary limitation of the human mind (i.e., of perceptive thinking)--being, continuity, and oneness themselves imply absence of perception (differentiation) and are therefore unperceivable.

[3] Thus Boolean algebra describes the most basic operation, and is applicable to the

are therefore unperceivable.

[3]Thus Boolean algebra describes the most basic operation, and is applicable to the "operational" world.

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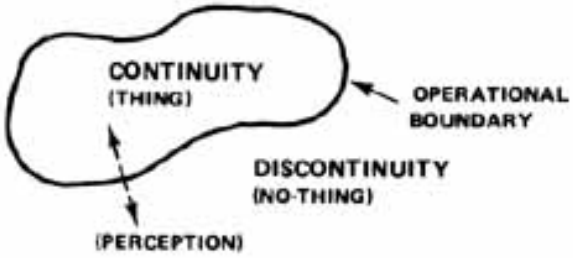

Fig. 14. Nature of One

which drive themselves and each other. Note that the preceding sentence itself is a perception.

So in the fullest sense, Gautama Buddha was indeed correct to state that the world of phenomena (changes) is an "illusion," relative only to itself (i.e., to perceptrons).[1] Einstein, expressing this idea in the language of mathematics, produced the theory of relativity and inaugurated a new physics. Buddha and Einstein spoke in different technical languages, but both expressed the same idea. The only difference is that in science we have assumed that our observations themselves are real and perfect. They are real, but not perfect in that they represent only changes in ultimate reality. Thus observational science alone can never reveal ultimate reality.

Another approach may aid in the comprehension of the nature of one. What is meant by the statement "he is the man?" Reflecting, one realizes that what is meant is that the perceived thing HE is exactly the same perceived thing THE MAN, and this identity exists now (during this one Δt perceptron time slice). There is no part of HE that is discontinuous from THE MAN, or vice versa. The different forms of the verb "be" attempt to express continuity without discontinuity, or unlimited oneness which is a state and not a thing. However, we do use the verb "be"[2] to relate continuity between different time slices. "He is the man" is related in the present time slice; "he was the man" means that HE in the NOW slice is identical to THE MAN in a past slice; etc.

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[1]The reader interested in Zen will find complete agreement between this paper and Zen precepts, and will find the paper of some assistance in comprehending the unperceivable (unthinkable) Zen realizations. In Zen, for example, the aim is to comprehend at once the totality of reality, directly, escaping beyond the limiting fetters of perceptive thought. Now if it is actually possible to do this, and if some unusual men have done it, then their enigmatic writings should contain the wisdom of their experience, and should correspond to ultimate reality itself. Since ostensibly their insight is obtained by other-than-logic and other-than-perceptive means, then their statements should appear illogical and unperceivable.* Thus the "sound of one hand clapping" and other illogical concepts are used in Zen as a meditative means of driving the student beyond logical perception (certainly the sound of one hand clapping cannot be perceived or thought) to realization. But if the Zen experience is actually valid, then reality itself must be pure Zen (i.e., unperceivable), and so it would appear to be. We note that for each component part of all, the opposite part must exist. So all can be regarded as the complete set of all possible opposites or contradictions.

*(However, this most assuredly does not imply that every statement that is illogical and unperceivable is of value!)

[2]It should be stressed again that being is defined as undifferentiated (unseparated,

is illogical and unperceivable is of value!)

[2]It should be stressed again that being is defined as undifferentiated (unseparated, unperceived). Being is simply continuity without discontinuity.

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B. REALITY, ULTIMATE REALITY, BEING, AND ULTIMATE BEING

Actually one should be quite careful in using these terms. What does one get when one differentiates reality? One gets another reality, but not the primary or ultimate reality. For example, assume that length and time are real. When one time-differentiates length, one obtains velocity, which of course is real also but quite different from either length or time. However, velocity is always operationally related to the two first (assumed) reals length and time, because differentiation is an operation. So what is meant by "ultimate reality" is that state (or essence, or whatever name one prefers) that is not differentiated. Since "being" (continuity with no discontinuity) is defined as "that which is not differentiated," then the ultimate reality is pure being.

But all perceivables are differentials of ultimate reality. When one differentiates being, one gets pieces (differentials) of being which themselves are beings, but they have been perceived (differentiated) from a more primary or higher being. Therefore any being that one perceives has been differentiated (separated) by perception,[1] which explains why human beings, for example, consider themselves separate or individual (one). They are separate only in their individual perceptions. Thus "beings" by its plural nature always implies fragments (differentials) of a higher being (of singular nature). There can be many such integral levels: starting with one function, one can integrate it, then the resulting function can be integrated, etc., as long as we are speaking of definite integrals between two limits. When we reach a state that has no pieces or limits, the process is finished. That state is <u>being</u> in the ultimate sense, i.e., ultimate being.

One perceives these integral levels directly in nature, i.e., in the perceived phenomenological world. Living molecules (tiny beings) of RNA, DNA, etc., integrate together into a cell (a higher level being). Cells then integrate into a still higher being (man, animal, plant), which is the level on which man finds himself. But since man is perceivable and there are more men than one, it follows directly that men are capable of being integrated into a still higher being,[2] and the only word we have at present to describe such an ultimate being is "God." It is not at all accidental, therefore, that the ultimate being cannot be directly perceived by man, since by the definition of perception the ultimate being cannot be perceived by a lower order being such as man (i.e., since perception differentiates, or separates, then only differentials of being, or separate beings, are perceivable).

The avatar Jesus, having no technical concept for the derivative available in the language of the day, used the analogy of the father-son relationship, the son being the derivative of the father in this sense. Thus he referred to himself as the "Son of Man" (the derivative of all mankind or of integrated mankind) and also as the "Son of God" (the derivative of the integral of man). He continually referred to the ultimate being as "Father." It is little wonder that he was not understood then, and has not been understood for almost twenty centuries.

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[1]Thus not only are physical objects relative to the perceiver's perception, but so are the perceived beings. Ergo the entire perceived universe, both living and non-living, is related to perception, and in fact perception and creation are abstractly

are the perceived beings. Ergo the entire perceived universe, both living and non-living, is related to perception, and in fact perception and creation are abstractly synonymous.

[2]This statement contains obvious implications to the theory (i.e., to the goal) of evolution.

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VI. CAUSALITY AND ITS MODIFICATION

A little closer look at perception can be obtained by viewing it from the causal standpoint.[1] All that perception really creates is Δt and ΔL (which are the same, ignoring constants of proportionality), and the perception we normally think of is point perception, where a point is one switching operation. The perception point may be thought of as following a line path which we will call "lineception" (Fig. 15). Physical phenomena as seen by one perceptron constitute this lineception; or rather, it constitutes the physical phenomena that are perceived or observed by the perceptron. Any point-based perceptron system, such as human perception, will accordingly perceive the universe of physical phenomena as if the perceiving system were a pointer moving along a lineception.[2]

Fig. 15. Lineception (One Connected to One)

For each perception there is a reflection, so there exists (but by definition cannot be perceived) a similar line-path, or "lineflection" as shown in Fig. 16.

Fig. 16. Lineflection (One Connected to One)

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[1]Perception is identical to causality itself, i.e., perception can be said to generate causality. The causal view is that causes inputted to a situation operate to produce, or output or create, effects. According to its inputs, the perceptron generates causal outputs. An adequate theory of perception should be able to explain all causal (perceived) phenomena. We might define causality as the set of all causes. Then the answer to the question, "What causes causality itself?" is <u>causality itself</u>; i.e., since it is the set of all causes, causality must contain its own cause. Causality must therefore be closed or circular. The entire causal world must then be purely relative to itself (closed). Closer attention to causal operation yields the following: We perceive something change (in time or in space), then the situation changes so that we perceive new changes emerge (occur later, or separately). Thus the line of perception by its own unperceived operation connects the perceived cause (change) to the perceived effect (change), i.e., perception generates causality. Since perception itself is causal, then causality truly causes itself. This indeed is closed or circular--causality generates perception (perception is causal) and perception generates causality (causality is perceptive). Thus the idea that perception generates causality is completely consistent with our initially assumed definition of causality as the set of all causes.

causal; and perception generates causality (causality is perceptive). Thus the idea that perception generates causality is completely consistent with our initially assumed definition of causality as the set of all causes.

[2]A "frame" or "coordinate system" is a point-centered perceptron system centered about the "understood perceptron" at the origin.

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The ultimate reality, or existence, contains all, all-at-once (ultimate reality is allness, or oneness). At each operation of the perceptron, the exact amount of Δt and ΔL, and their relationship, put out by a perceptron is a function of its input quiton disturbances. A great number, in fact perhaps an infinite number, of different input states are possible, i. e., exist in all, all-at-once (ultimate reality). So an equally large number of output states are possible (exist ultimately),[1] but one particular input condition results in one particular output condition. We can represent the all possible lineceptions existing as "multiception" (Fig. 17). From this figure, a lineception can be seen to be one particular path through multiception. The corresponding multiflection could, of course, be illustrated in similar manner but with negative components.

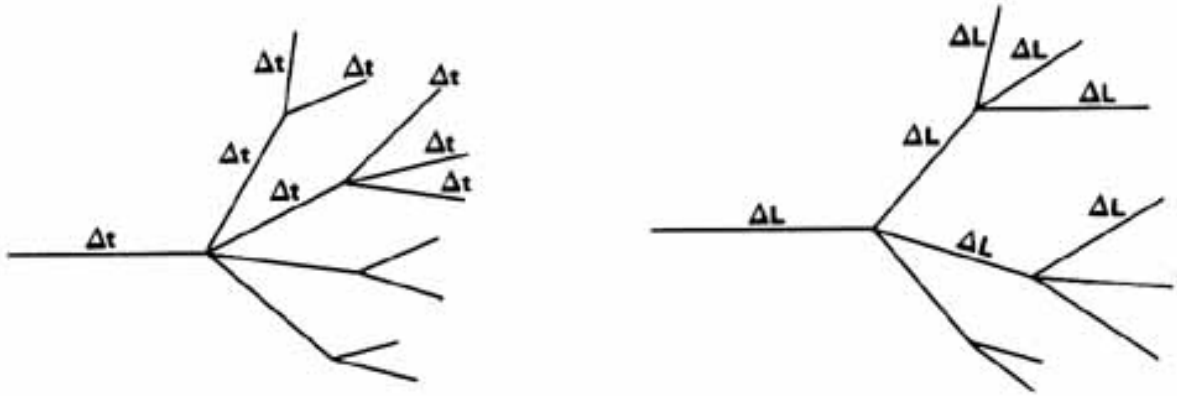

Fig. 17. Multiception (One Connected to Many)

One could immediately apply statistics to the concept along the lines illustrated by Fig. 18.

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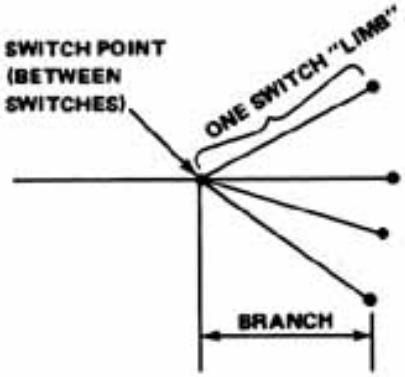

Fig. 18. One Branch

[1]It is stressed that these multiceptions exist, which is not at all the same limited statement as "exist now," but much more comprehensive; e.g., all possible numbers must exist in zero, else, given the number A, there is no justification for the axiom that A + (-A) = 0. The "absence of number" means precisely the "absence of all possible

exist in zero, else, given the number A, there is no justification for the axiom that A + (-A) = 0. The "absence of number" means precisely the "absence of all possible numbers." Paradoxically, if we think of that absence, we make it present by the act of thinking; i.e., trying to perceive it (absence is not perceivable). This contradiction, of having to make the unthinkable into its opposite so that it is thinkable is both the characteristic and the limitation of perception and perceptive thinking, and has long been an insurmountable obstacle to scientist and philosopher alike.

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At each switch point, the perceptron is faced with the branch of possibilities ahead, which all exist in multiception but only one of which exists in one perception, or lineception.[1] A certain set of limbs in the branch must have a perception probability equalling 1, and thus each of the limbs has some finite probability.[2] The input conditions to the perceptron then determine which limb is selected for the next switching operation; and, of course, the input conditions are the results of other related perceptrons' operations (relativity). The statistics will not be pursued further here.

For an absolutely mechanistic world, the entire process is automatic according to quite rigidly fixed rules. A system of perceptrons that behave this way shall be referred to as "mechanically switched." What we call "non-living systems" are mechanically switched systems. But what we call a "living system" is able to arbitrarily select the limb taken, to some extent at least,[3] i.e., the fact that a living system is able to choose its behavior within certain limits, directly implies that it must be able to deflect its lineception from a mechanically switched lineception. The only way it can possibly do this is to influence the switching operation of the perceptron. But since the output of one switching operation is a mechanistic function of the inputs, then the only way a life system can affect the perceptron switching operation is by affecting the input to some extent. How could it possibly do this?

In our crude model, the nonaction continuum is composed of action atom fragments, or quitons. But such non-things are massless by definition (they are not being switched and the absence of switching defines masslessness), and we can think of the nonaction continuum as a massless fluid or ether or empty space, since these terms are all synonymous. All that is implied by these terms is that the fluid is composed of massless elements, which merely means they are not being switched. They are capable of being switched, of course, but switching is not being done. The main point is that force, in the conventional sense, is not required to move a massless fluid, so the input fluid to a perceptron can possibly be interfered with by some nonphysical means requiring zero force. The <u>being</u> portion of a life system can apparently do this to some extent.

Since the switch time of a perceptron is on the order of 10^{-21} seconds, then even an incredibly tiny quiton input variation to a perceptron will result in

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[1]It is stressed that all possibilities exist and are real, but do not exist in perception. Perception is the only difference between unperceived reality and perceived reality.

[2]Which leads to an unusual view of "probability." A perceptron operation is already finished when one perception is complete; that is why "the past is always gone, the present has just occurred, and the future is never here." Perceptron operation continually creates the perceptron's universe as it operates, including all changes, time, space, etc.). Thus, at the conclusion of any one perceptron operation, a multitude of lineception steps can exist for the next operation. However, although possibly quite large, the number of next steps available must be finite to be causal (perceivable). It is the process of perception that makes probability finite. Perception is finite; nonperception is infinite.

[3]The only alternative conclusion is that the living system is unable to deliberately

perception is finite; nonperception is infinite.

[3]The only alternative conclusion is that the living system is unable to deliberately modify its behavior and its behavior is purely mechanical. But since this implies that all behavior is absolutely programmed and predictable, which is obviously false, this alternative is not valid and the original conclusion stands.

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noticeably altered lineception after one second of such variation. So it is quite reasonable to presume the futility of trying to measure such infinitesmal influence as is brought to bear on one single perceptron operation. However, the total influence can obviously be detected after being accumulated by a very large number of perceptron operations, and for living systems it is. So while we have not proved the mechanism of life-system manipulation of lineception, we have shown a logical progression from an assumed mechanism to a result that is universally verified by countless observations (i. e., all living systems are observed to manipulate causality, which manipulation is, after all, the definition of behavior). Since no other mechanism has been proposed, to the author's knowledge, that would reasonably explain the observed phenomenon of life-system manipulation of lineception, it is logical to accept as true the assumed mechanism -- a life system can exert an incredibly tiny influence on perceptron inputs,[1] i. e., on the ether or on empty space.[2,3]

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[1]This tiny influence is the basis of the realization process. To comprehend the noncausal, the individual observer usually wrestles diligently with the problem, repeatedly attempting to perceive it causally. In each such attempt, the tiny influence of inception on perceptron inputs is exerted. Over an ensemble of such attempts, the perceptron causal output can be modified, i.e., modulated noncausally to give what are now slightly noncausal perceived outputs. Presence of a required fit or required output pattern in the perceptive mind allows the output to be examined (compared) against the required output, i.e., it allows the selection of the proper noncausally modulated causal transfer function. When the outputs match, one then has a breakthrough or realization which matches the real world pattern but which cannot be directly perceived causally. However, since the mental file of the perceptive mind has now filed the proper transfer function, the individual has assimilated the information and understands it, being able to recall the noncausally modulated causal transfer function at will. Thus in Zen, the ultimate example of realization is described as "enlightenment." Phrases such as "direct perception of reality," "direct experience of ultimate reality," or "direct realization of all-being" are also used in trying to portray the nonperceivable realization. Conventional science hides the entire process behind vague terms, such as "creative thinking," which actually only conceal the fact that we do not know what it is, or how it is accomplished.

Note that such "creative realization" can cover either purely causal or noncausally modulated perception, the difference being merely whether the inputs are incepted in a normal manner comparable to causal phenomena, or in another manner. Realization is derived only from inception. Since the observed phenomena of physics already appear to be noncausal (statistical) in the ultramicroscopic region while ensembles of these yet appear to be causal, then the physicist is already confronted with the necessity of changing causality but at the same time retaining causality. The implications to the observation process itself must be examined, and they remove the dichotomy between physics and metaphysics when pursued.

[2]The Hieronymus effect is an example of this in reverse. It generates an effect on living nervous systems that is not the result of electric, magnetic, or gravitational fields, and is not caused by matter in motion. For that matter, a polygraph has been used to clearly measure a response of plants to human thoughts alone, and such an effect is not presently explainable within the body of physics theory. "Firewalking" is another unexplainable phenomenon from the standpoint of present physics theory as is acupuncture.

[3]All psi phenomena derive from this effect (inception) together with turbulent

is acupuncture.

[3]All psi phenomena derive from this effect (inception) together with turbulent switching. A straightforward theory of psi phenomena (and of such things as fire-walking and acupuncture, for that matter) can conceivably be generated from the quiton/perceptron theory.

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Of course the most efficient development of manipulation of lineception (i.e., the widest response) by a life system would necessitate a control system approach; i.e., life system direct manipulation of only a very small control valve or control mechanism, which in turn controls the input to a much larger mechanistic (deterministic) servo amplifier. Systems like this are universally observed in life systems. Thus the great bulk of a life system's manipulation of lineception is servomechanistic: the actual direct influence of life (being) on matter (perceptron switching) is so microscopic as to be immeasurable at its operating level, and only its macroscopic effects become measurable. For that reason the scientist has never been able to isolate the mechanism of life's manipulation of lineception, nor is he likely to be able to do so in the foreseeable future.[1]

Life's manipulation of lineception will be denoted by the term "inception," and can be thought of as a modulation (partial change or additive change) of the lineception carrier. Ordinary physical phenomena are macroscopic ensembles of lineceptions, where the deterministic (mechanistic) law holds absolutely but in a relative manner (ensemble to ensemble) which is fixed cause-and-effect, or causality, from the viewpoint of perception. Since inception is a modulation of lineception, then living behavioral phenomena should be superimposed as envelopes on causal lineceptions, or causal lineception ensembles, and, indeed, they are universally observed to be so superimposed.[2]

Absolute or ultimate reality, however, can be thought of in one respect as all multiceptions and all multiflections, all-at-once, which is timeless (i.e., which is both all-possible-times and zero time simultaneously or identically).[3] Along any one lineception, causality applies; yet since a very large number of changes to that lineception are available in just one multiception branch, then quite a large

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[1]This latter statement, of course, is subject to challenge.

[2]Since all matter <u>is</u>, it <u>contains being</u>. Another intriguing possibility exists: that there are two types of inceptive systems, or two magnitude directions that inception takes. The first type would produce inception with difficulty, and its inception would only be apparent at the macroscopic level; the second type would produce inception with ease, its inception would be apparent only at the microscopic level. The first type would correspond to what we call "living systems," while the second would correspond to what we call "inert systems." Living systems' inception would be observable to human senses and human instruments, while inert system's inception would not. A second and remarkable consequence would be, that in the extreme microscopic case, inception would dominate and this scale would appear to be absolutely statistical (individually unpredictable), which apparently is true (i.e., degree of causality represents degree of restraint of inception). This would modify causality (for individual events) at the ultramicroscopic level, but at higher levels causality would still apply due to the karma effect on perceived ensembles. It is significant that at present the universe of matter seems to behave in precisely this fashion. To summarize, perception is causal -- it generates causality. Inception, being noncausal, must be below the perception threshold. Aggregates of inception (noncausal) that equal or exceed the perception threshold become causal (are processed by perception) and generate causal karma.

[3]Since every perceived ΔT has an unperceived complement $-\Delta T$ which exists in reflec-

[3]Since every perceived ΔT has an unperceived complement $-\Delta T$ which exists in reflection, then the sum total of all times in absolute existence, which includes both perception and reflection, equals zero time.

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number of inceptions are available to be applied to that one lineception by an organism to change or direct the lineception. Herein is the explanation of karma. Since every inception made by an organism (or by a submicroscopic particle of being for the second case, see note 2, p. 32) changes its entire lineception, it also changes its entire perceived or relative universe, which is the only universe it knows or senses. And since causal feedbacks from this perceived universe[1] occur to the organism's perceptron (which itself is part of that perceived universe), then the effects of the organism's actions indeed return precisely to it. So, "as a man soweth, that shall he also reap" is quite true.[2]

It is now possible to formulate some conclusive statements:

1. One perceptron follows a lineception path, mechanically basing its output on its inputs, and this operation establishes causality to perception repetition, i.e., to lineception.

2. Ordinary physical phenomena are merely ensembles of related lineceptions, and are perceived to be absolutely deterministic (obey only cause-and-effect.

3. Living phenomena exhibit the effects (selective behavior) of inception (modulations impressed on lineception) which occasionally diverts one lineception from its deterministic lineception limb to another multiception limb, resulting in a changed (modulated) lineception.

4. Ultimate, or absolute, reality may be thought of as the sum-total of all multiceptions and multiflections.

5. "God" is all-being, which is all multiflection and multiception at once, which is both <u>no time at all</u> and <u>forever</u> and <u>all forevers</u> as well.

6. "God's will" is lineception and its accompanying lineflection.

7. "Man's will" or "free will" is inception, the modulation of lineception (and unknowingly its accompanying lineflection). Inception, however, imposes a feedback on the inceptor since a precise feedback, from the inception changes to perception, occurs to the perceptron of the perceiver. This feedback resulting from inception is karma.

8. The law of cause and effect (causality) exists in perceived nonmodulated phenomena (ensembles of lineceptions).

9. Causality is affected (modulated) by living systems, but applies to each choice once made. The causal feedback from inception is karma.

---

[1]"Perceived" must be accented: the nonperceived universe is not causal, since by definition causality invokes a perceiver and the perception process.

[2]Collective karma of any ordered group such as a species must exist in like manner. On the submicroscopic level, "karma of ensembles" means that the statistics of

[2]Collective karma of any ordered group such as a species must exist in like manner. On the submicroscopic level, "karma of ensembles" means that the statistics of lineceptions and inceptions still lead to causal relationships in the perceived collective phenomena.

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10. Neither causality or karma applies in ultimate reality, although all
causality lineceptions and their reflections, and all modulations
(inceptions) and the karma reflections of those inceptions, are
included in ultimate reality.

VII. CLOSING REMARKS

The quiton/perceptron approach appears to offer a most extensive area for further investigation, and it is hoped that the physicists will interest themselves in the concept. It offers explanations for the problems long posed by ontology, and unifies the bases of science and metaphysics.

We state categorically that the theory explains what electric charge is, why like charges repel, and why unlike charges attract. In addition, since all phenomena are perceptron outputs, the theory indicates that multiple effects which are very close in time or distance will interfere with each other due to turbulent switching; i. e., conservation of mass/energy holds only as long as no switch interference exists. Turbulent switching can possibly disrupt all known physical laws. Unexpectedly strong forces, such as nuclear force, might in fact result from this effect. Other implications include possibility of travel faster than the speed of light (deBroglie waves do this now) and of travel back and forth in "time."

Since both laboratory instruments and human sensory apparatuses are perceptrons and differentiate reality, investigations of physical phenomena should include the laws of the perceptron as well as the laws of the perceived phenomena.

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13. ABSTRACT

A fundamental answer is attempted to the question of being, time, space, existence, perception, and physical phenomena. Mass, empty space, reality, gravitational attraction, continuity, discontinuity, and relativity are among the "things" and "nonthings" for which relationships and explanations are provided.

Perception is defined as detection by a mass of change to itself and as a differentiating process. Perceived physical phenomena are revealed to be first and derivatives of ultimate reality, and outputs of the physical perceiving device called the "perceptron." Using the operation of the physical perception process on action, the units of which are energy times time, an entirely different view is generated of both reality and the Heisenberg uncertainty principle. When superposition is imposed as a condition, the Heisenberg uncertainty principle is revealed to be a quantized statement. A concept of the absolute value of a dimensional molecule is advanced.

A reality model is constructed of an action continuum and a nonaction continuum separated by an operational threshold whose magnitude is given by an uncertainty principle. Perception is modeled as a process which switches atomic quanta of action and nonaction back and forth across the threshold. Mass is explained as perceptron switch activity rate, and a mass definition equation is generated. One kilogram mass is shown to represent 17.053×10^{50} perceptron switches per second. From the model, Newton's laws of motion and gravity can be generated directly from the concept of the interaction of mass with space itself, space being taken as a massless fluid, or ether, composed of tiny nonaction particles called "quitons." Einstein's postulates of

composed of tiny nonaction particles called "quitons." Einstein's postulates of

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14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
causality perception perceptron quiton quiton/perceptron theory gravitation mass reality metaphysics being existence space time photon action action quantum quantum observation relativity Karma complementarity physical phenomena Mach's principle Newton's laws inertia Debroglie wave Einstein's postulates Michelson-Morley experiment ontology Heisenberg Uncertainty Principle superposition equivalence principle simultaneity inertial frame						

ABSTRACT (Continued)

special relativity are also shown to follow from the model, and a statement of the equivalence principle is shown to be consistent with the model.

The concept of "lineception" as a causal chain of perceptron operations is advanced. "Inception" is developed as a noncausal modulation of lineception and as a distinguishing feature of a living system. The possibility is raised that inception could provide an explanation of the noncausal, statistical, ultramicroscopic universe and yet require large ensembles of ultramicroscopic events to conform to causality. Inception is shown to lead to karma. Perception is shown to be causal and to generate causality itself.

Some elementary philosophical implications of quiton/perceptron theory are pointed out and briefly discussed.

and briefly discussed.

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Tony,

Found a cy of
The paper, so here it is.

Cheers,

Tom

P.S. Shortly after this
the SAAM-D was renamed
the PATRIOT.

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SCALAR WEAPONS: Read It and Weep

- Posted by Ms MoD on July 27, 2011 at 4:42 in HAARP
- View Discussions

This is a REALLY long paper but it is broken down into categories so you can easily skip to sections of interest to you. I found this after reading Twelve Things You Should Know About Scalar Weapons which was posted by FDF in April and is a MUCH SHORTER overview of scalar technology by the same author. I highly recommend it but wanted to post the longer version here as well which you can download in the PDF attached. Topics in the paper are listed below -MoD

SCALAR WEAPONS: Read It and Weep
By C Verismo

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2. BEAM WEAPONS OF A CENTURY AGO
3. THE CONTINUATION OF TESLA'S SCALAR WAVE TECHNOLOGY
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23 OBLITERATING INDIVIDUALS
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28. HOW DID RUSSIA GET UFOs?
29 FORMER BOLSHEVIKS RUNNING AMERICA
30 REPLICAS USED FOR THE LANDINGS, AFTER ORIGINALS SHOT DOWN
31. CLOAKED RUSSIAN UFOS ABOVE USA

32. ALL U.S. SATELLITES SHOT DOWN BY RUSSIA UNTIL 1981
33. LIES, LIES AND LIES
34. FRICTION WITH THE JAPANESE
35. ENTERPRISE SHUTTLE DETERMINED TO SPY ON RUSSIA
36. RUSSIA INTENSIFIES ATTACKS
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38. BOLD ATTACKS ON AMERICA
39. THE STRUGGLE AT THE TOP FOR POWER
40. THE STEALTH PLANE COMES TO THE RESCUE
41. PHANTOM AGAINST THE COSMOSPHERE
42. THE EXPECTED GENOCIDE
43. PLANS FOILED TO DESTROY RUSSIA'S MILITARY ARSENAL
44. BRAZIL
45. INDIA
46. JAPAN
47. KOBE 'EARTHQUAKE'
48. CHINA
49. OKLAHOMA FBI BUILDING 'BOMBING'
50. WHO ELSE HAS UFOs?

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HAARP Patents (Assigned to APTI, Inc. Los Angeles, CA, Washington, DC)

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http://www.freepatentsonline.com/4686605.pdf

U.S. Patent 5038664: Method For Producing A Shell Of Relativistic Particles At An Altitude Above The Earth's Surface ~ Issued: Aug. 13, 1991 Filed: Jan. 10, 1985
http://www.freepatentsonline.com/5038664.pdf

U.S. Patent 4712155: Method And Apparatus For Creating An Artificial Electron Cyclotron Heating

Region Of Plasma ~ Issued: Dec. 8, 1987 Filed: Jan. 28, 1985
http://www.freepatentsonline.com/4712155.pdf

U.S. Patent 5068669: Power Beaming System ~ Issued: Nov. 26, 1991 Filed: Sep. 1, 1988
http://www.freepatentsonline.com/5068669.pdf

U.S. Patent 5218374: Power Beaming System With Printer Circuit Radiating Elements Having Resonating Cavities ~ Issued: June 8, 1993 Filed: Oct. 10, 1989
http://www.freepatentsonline.com/5218374.pdf

U.S. Patent 5293176: Folded Cross Grid Dipole Antenna Element ~ Issued: Mar. 8, 1994 Filed: Nov. 18, 1991
http://www.freepatentsonline.com/5218374.pdf

U.S. Patent 5202689: Lightweight Focusing Reflector For Space ~ Issued: Apr. 13, 1993
http://www.freepatentsonline.com/5202689.pdf
Filed: Aug. 23, 1991

U.S. Patent 5041834: Artificial Ionospheric Mirror Composed Of A Plasma Layer Which Can Be Tilted ~ Issued: Aug. 20, 1991 Filed: May. 17, 1990
http://www.freepatentsonline.com/5041834.pdf

U.S. Patent 4999637: Creation Of Artificial Ionization Clouds Above The Earth ~ Issued: Mar. 12, 1991 Filed: May. 14, 1987
http://www.freepatentsonline.com/4999637.pdf

U.S. Patent 4954709: High Resolution Directional Gamma Ray Detector ~ Issued: Sep. 4, 1990 Filed: Aug. 16, 1989
http://www.freepatentsonline.com/4954709.pdf

U.S. Patent 4817495: Defense System For Discriminating Between Objects In Space ~ Issued: Apr. 4, 1989 Filed: Jul. 7, 1986
http://www.freepatentsonline.com/4817495.pdf

U.S. Patent 4873928: Nuclear-Sized Explosions Without Radiation ~ Issued: Oct. 17, 1989 Filed: June 15, 1987
http://www.freepatentsonline.com/4873928.pdf

Still think that HAARP is just another wacky fictional conspiracy? The above listed patents should be enough to convince any intelligent person that HAARP is real and is now actively modifying our weather and triggering earthquakes. For those who are still not convinced, look to the United States Congress for proof. In order for HAARP to get funding the people who first created HAARP needed funding. That funding was made possible by the US government. If you were to look at Congressional records you would find documents that states just one of the many official purposes of HAARP – for penetrating the earth with signals bounced off of the ionosphere. Congress was informed by people in the High Frequency Active Auroral Research Program that the bounced signals would be used to look inside the planet to a depth of many kilometers in order to locate underground munitions, minerals and tunnels. If you bounced the known earthquake signature signal (2.5 Hz) for a sustained period of time an earthquake could triggered many kilometers inside Earth's crust. The U.S. Senate actually set aside $15 million dollars in 1996 (Clinton and Al Gore Administration) to develop this ability alone — earth-penetrating-tomography.

Update April 21, 2011

Under pressure from the International community the HAARP website is up again. No data is available from April 7 to April 12, 2011. Data before and after shows the signature frequency of an earthquake (2.5Hz) being transmitted. Also shows energy spikes which indicates active weather modification. Now that the website is up again you can view the data for the Japan earthquake at http://137.229.36.30/cgi-bin/scmag/disp ... i?20110311. From the magnetometer induction data you can see 2.5Hz (earthquake inducing frequency) being broadcasted and recorded for several days before the 9.0 magnitude earthquake. To see what a normal (no HAARP broadcasting) day looks like view the magnetometer charts for the days of March 15, 16 and 17 – March 16, 2011 http://137.229.36.30/cgi-bin/scmag/disp ... 0316&Bx=on. No earthquake inducing broadcast was detected from March 15 to March 27, 2011. On March 28, 2011 a low powered broadcast was detected from approximately 12:00 am to 3:00 am. Broadcasting resumed on April 2, 2011. April 6, 2011 shows you what the magnetometer charts looks like when a solar storm blasts Earth. No data is available from April 7, 2011 to April 13, 2011 – a shutdown. Starting on April 15, 2011 and ending approximately 10:00 am April 16, 2011 the earthquake inducing frequency of 2.5Hz was detected being broadcasted.
Short URL: http://presscore.ca/2011/?p=2261

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Permalink Reply by Jenny on July 27, 2011 at 6:23
WOW MoD! What a paper! I need like a year to get through it all but it sure is awesome to have it all in one place! Excellent!

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Permalink Reply by Ms MoD on October 26, 2012 at 6:38

Boeing Tests Microwave Missile That Can Knock Out All Electronics (CHAMP)
Huffington Post UK | By Michael Rundle 24/10/2012

Boeing is testing a missile which can destroy electronics in a wide area with little or no physical damage.

The 'Champ' (Counter-electronics High-powered Advanced Missile Project) may "one day change warfare", Boeing said.

"This technology marks a new era in modern-day warfare," said Keith Coleman, CHAMP program manager for Boeing Phantom Works.

"In the near future, this technology may be used to render an enemy's electronic and data systems useless even before the first troops or aircraft arrive".

The missile was tested on 16 October, when the high-powered microwaves were fired at a two storey building built especially for the job.

The missile would, if successful, take out rows of personal computers which were turned on to gauge the effect of the blast.

The result?

"Seconds later the PC monitors went dark and cheers erupted in the conference room. CHAMP had successfully knocked out the computer and electrical systems in the target building. Even the television cameras set up to record the test were knocked off line without collateral damage."

Seven targets were hit in the one-hour test, and all were successfully disabled.

There is a long way to go before the microwave can be placed into a missile and used to disable targets without loss of life, but the team is hopeful it could prove to be a milestone in non-lethal warfare.

"Today we turned science fiction into science fact," Coleman said.

http://www.huffingtonpost.co.uk/2012/10/24/boeing-tests-microwave-m...

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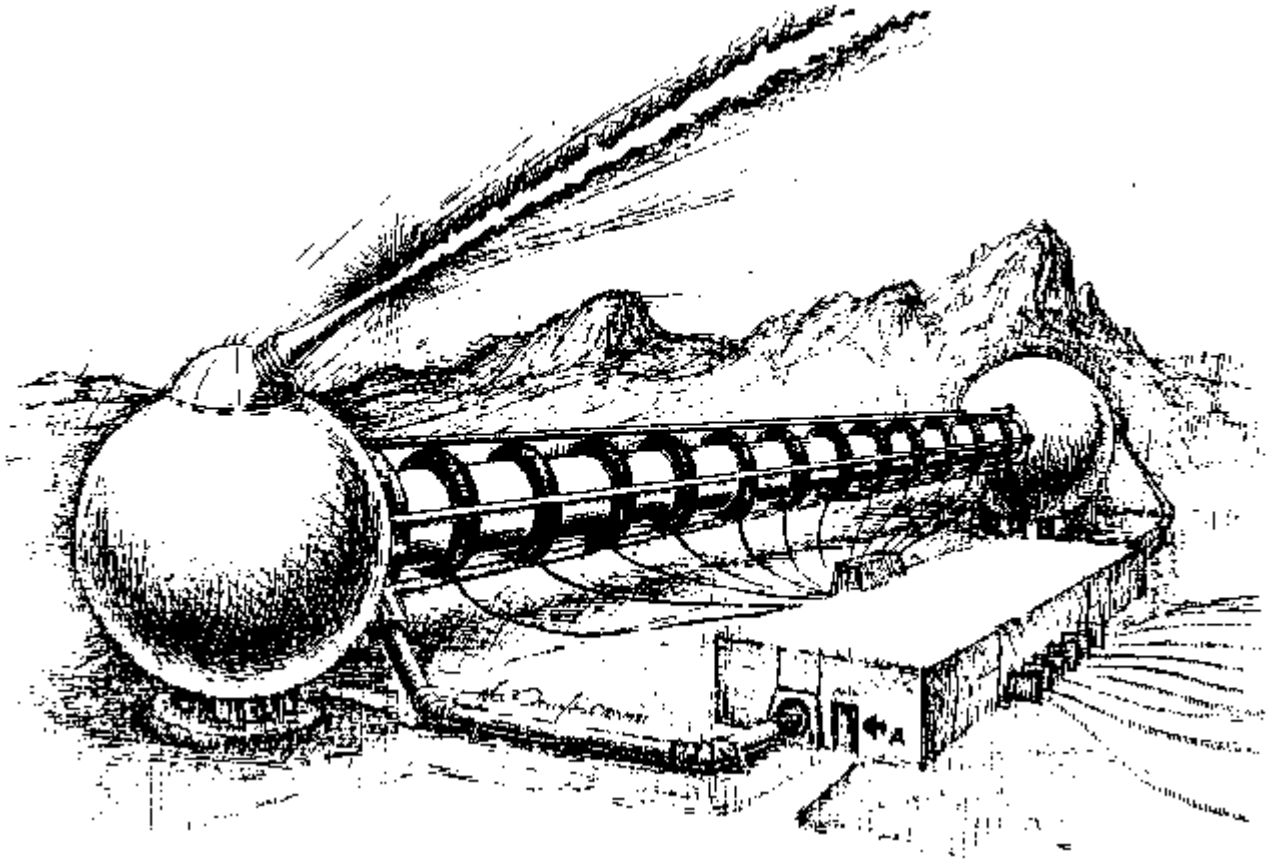

Scalar Potential Interferometer

Figure 6. Multimode Tesla Weapon

In the 1930's Tesla announced other bizarre and terrible weapons: a death ray, a weapon to destroy hundreds or even thousands of aircraft at hundreds of miles range, and his ultimate weapon to end all war -- the Tesla shield, which nothing could penetrate. However, by this time no one any longer paid any real attention to the forgotten great genius. Tesla died in 1943 without ever revealing the secret of these great weapons and inventions.

Unfortunately, today in 1981 the Soviet Union has long since discovered and weaponized the Tesla scalar wave effects. Here we only have time to detail the most powerful of these frightening Tesla weapons -- which Brezhnev undoubtedly was referring to in 1975 when the Soviet side at the SALT talks suddenly suggested limiting the development of new weapons "more frightening than the mind of man had imagined." One of these weapons is the Tesla howitzer recently completed at the Saryshagan missile range and presently considered to be either a high-energy laser or a particle beam weapon, (See Aviation Week & Space Technology, July 28, 1980, p. 48 for an artist's conception.)

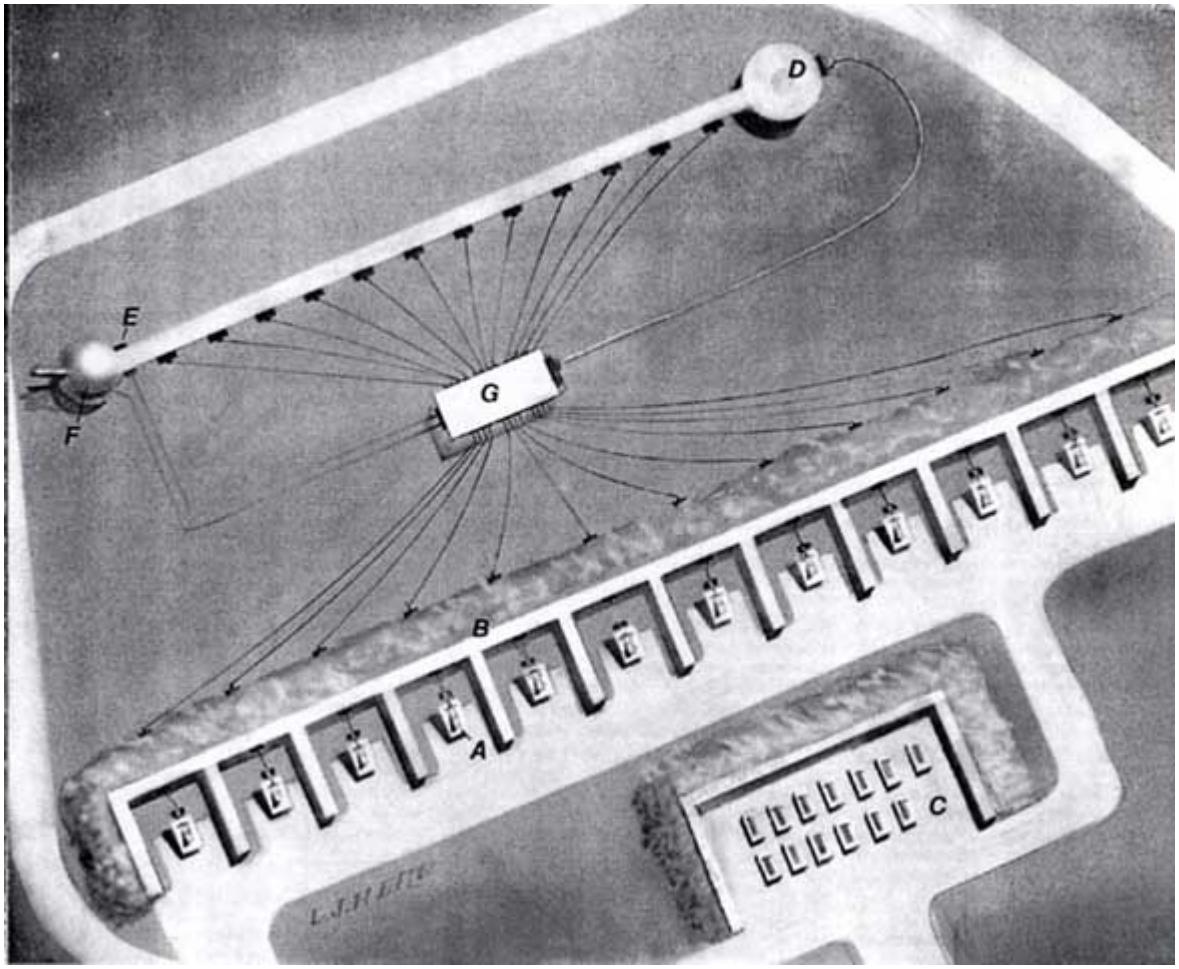

Aviation Week & Space Technology July 28, 1980

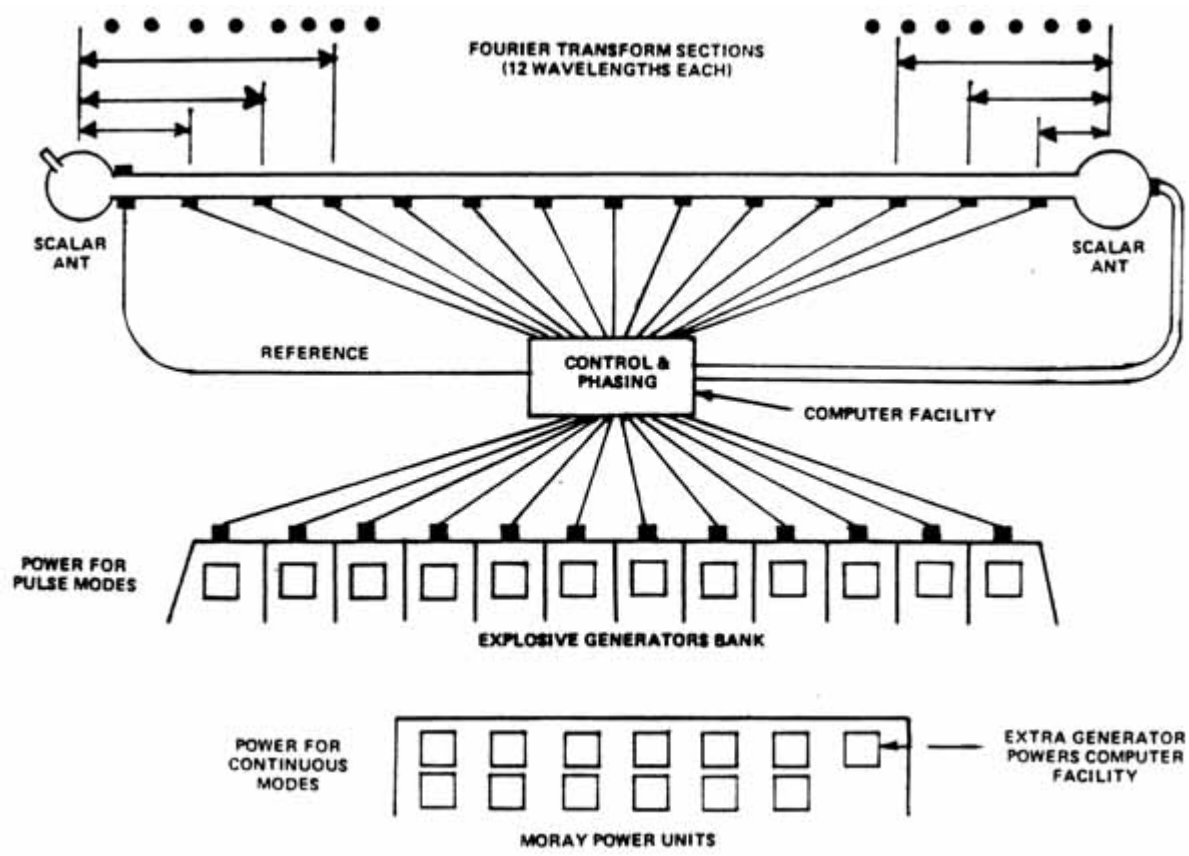

Figure 7. Tesla Weapons at Saryshagan

The Saryshagan howitzer actually is a huge Tesla scalar interferometer with four modes of operation. One continuous mode is the Tesla shield, which places a thin, impenetrable hemispherical shell of energy over a large defended area. The 3-dimensional shell is created by interfering two Fourier-expansion, 3-dimensional scalar hemispherical patterns in space so they pair-couple into a dome-like shell of intense, ordinary electromagnetic energy. The air molecules and atoms in the shell are totally ionized and thus highly excited, giving off intense, glowing light. Anything physical which hits the shell receives an enormous discharge of electrical energy and is instantly vaporized -- it goes pfft! like a bug hitting one of the electrical bug killers now so much in vogue.

If several of these hemispherical shells are concentrically stacked, even the gamma radiation and EMP from a high altitude nuclear explosion above the stack cannot penetrate all the shells due to repetitive absorption and reradiation, and scattering in the layered plasmas.

In the continuous shield mode, the Tesla interferometer is fed by a bank of Moray free energy generators, so that enormous energy is available in the shield. A diagram of the Saryshagan-type Tesla howitzer is shown in figure 7. Hal Crawford's fine drawing of the interferometer end of the Tesla howitzer is shown in figure 6. Hal's exceptional rendition of the Tesla shield produced by the howitzer is shown in figure 8.

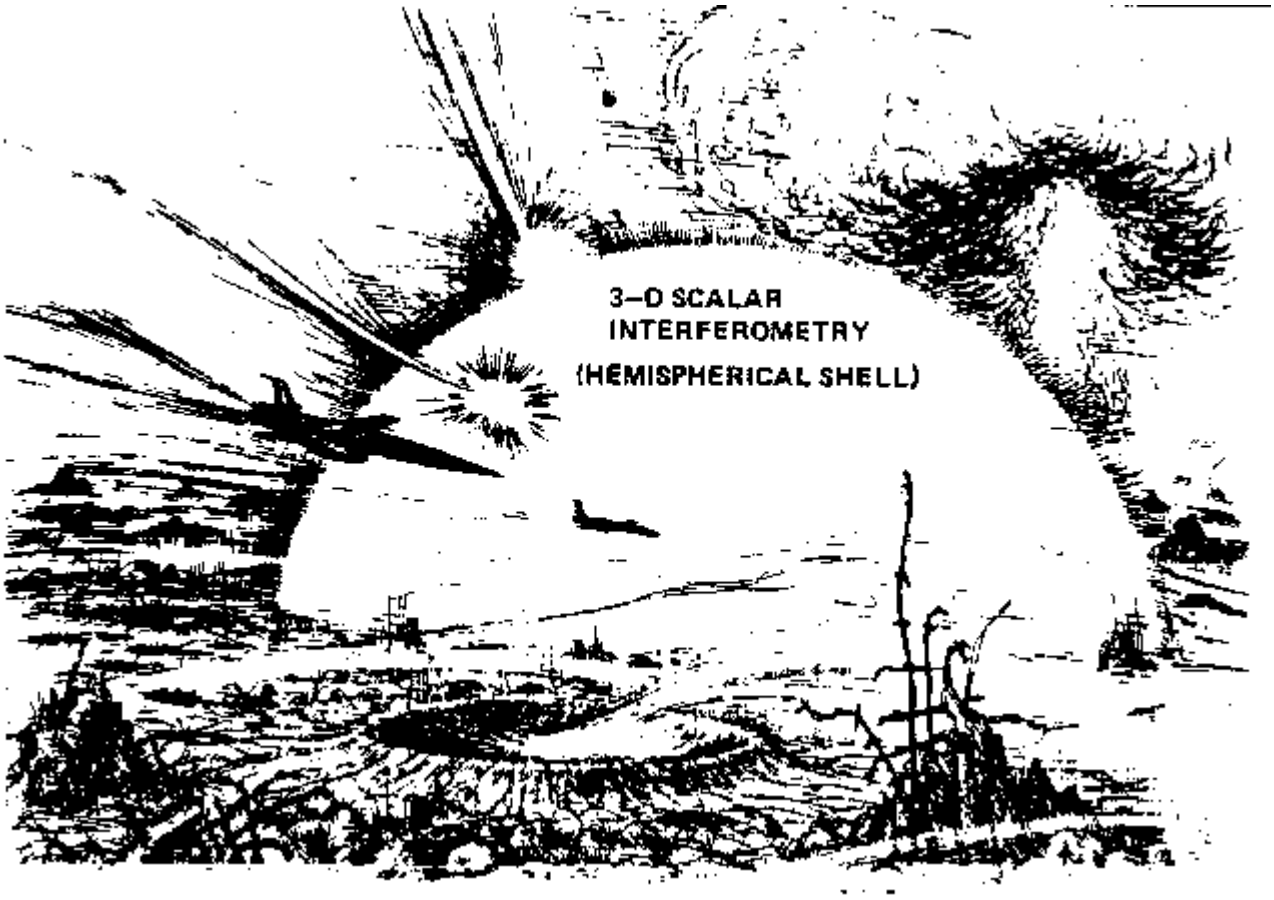

Figure 8. The Tesla Shield

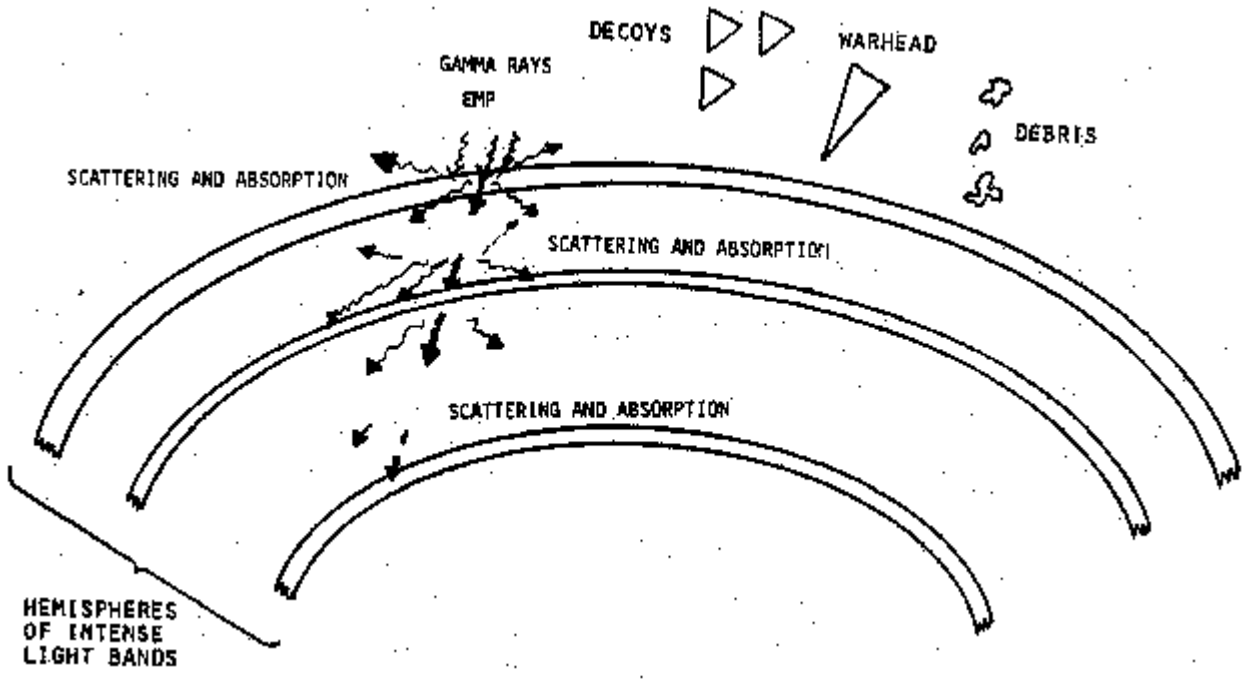

Figure 9. Tesla Terminal Area Defense System

In the pulse mode, a single intense 3-dimensional scalar phi-field pulse form is fired, using two truncated Fourier transforms, each involving several frequencies, to provide the proper 3-dimensional shape (Figure 10). This is why two scalar antennas separated by a baseline are required. After a time delay calculated for the particular target, a second and faster pulse form of the same shape is fired from the interferometer antennas. The second pulse overtakes the first, catching it over the target zone and pair-coupling with it to instantly form a violent EMP of ordinary vector (Hertzian) electromagnetic energy. There is thus no vector transmission loss between the howitzer and the burst. Further, the coupling time is extremely short, and the energy will appear sharply in an "electromagnetic pulse (EMP)" strikingly similar to the 2-pulsed EMP of a nuclear weapon.

This type weapon is what actually caused the mysterious flashes off the southwest coast of Africa, picked up in 1979 and 1980 by Vela satellites. The second flash, e.g., was in the infrared only, with no visible spectrum. Nuclear flashes do not do that, and neither does superlightning, meteorite strikes, meteors, etc. In addition, one of the scientists at the Arecibo Ionospheric Observatory observed a gravitational wave disturbance -- signature of the truncated Fourier pattern and the time-squeezing effect of the Tesla potential wave -- traveling toward the vicinity of the explosion.

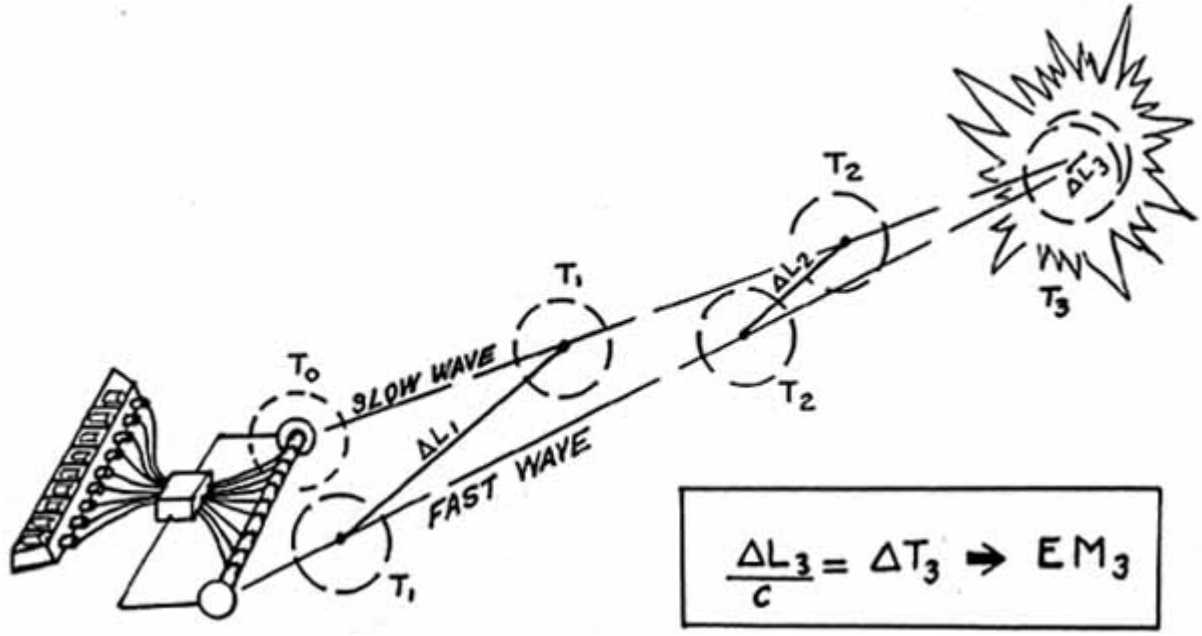

TESLA HOWITZER
(SCALAR INTERFEROMETER)

Figure 10. "Nuclear" Flashes off the Coast of Africa

Lithuania - 10 Sep 1976 - British European Airways Flight #831 between Moscow and London

CIA Report Released under FOIA

Figure 11. Continuous Tesla Fireball

The pulse mode may be fed from either Moray generators or -- if the Moray generators have suffered their anomalous "all fail" malfunction -- ordinary explosive generators. Thus the Tesla howitzer can always function in the pulse mode, but it will be limited in power if the Moray generators fail.

In the continuous mode, two continuous scalar waves are emitted -- one faster than the other -- and they pair-couple into vector energy at the region where they approach an in-phase condition. In this mode, the energy in the distant "ball" or geometric region would appear continuously and be sustained -- and this is Tesla's secret of wireless transmission of energy at a distance without any losses. It is also the secret of a "continuous fireball" weapon capable of destroying hundreds of aircraft or missiles at a distance. An example of a Soviet test of this mode of operation is shown in figure 11.

Witness to a super weapon?

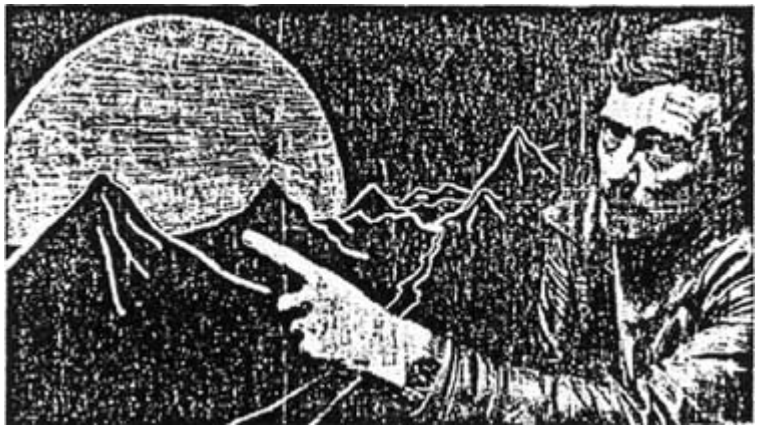

Nick Downie describes the strange lurid glow that flared silently over the Hindu Kush

THE SUNDAY TIMES, 17 AUGUST 1980

(Multiple incidents in Sept., 1979)

TEHERAN, IRAN 17 JUNE 1966

SEEN FROM NEAR MEHRABAD AIRPORT

OBSERVED 4-5 MINUTES

SEEN BY 2 AIRCRAFT

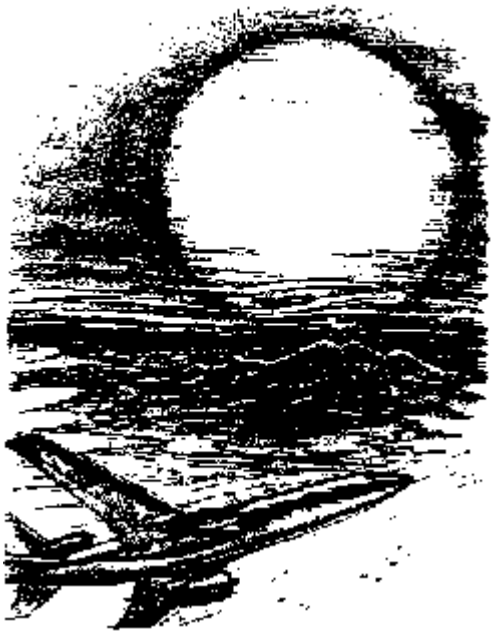

CIA REPORT RELEASED UNDER FOIA

Figure 12. Tesla EMP Globe

The volume of the Tesla fireball can be vastly expanded to yield a globe which will not vaporize physical vehicles but will deliver an EMP to them to dud their electronics. A test of this mode is shown in figure 12. (See also Gwynne Roberts, "Witness to a Super Weapon?", the London Sunday Times, 17 August 1980 for several other tests of this mode at Saryshagan, seen from Afghanistan by British TV cameraman and former War Correspondent Nick Downie.)

If the Moray generators fail anomalously, then a continuous mode limited in power and range could conceivably be sustained by powering the interferometer from more conventional power-sources such as advanced magnetohydrodynamic generators.

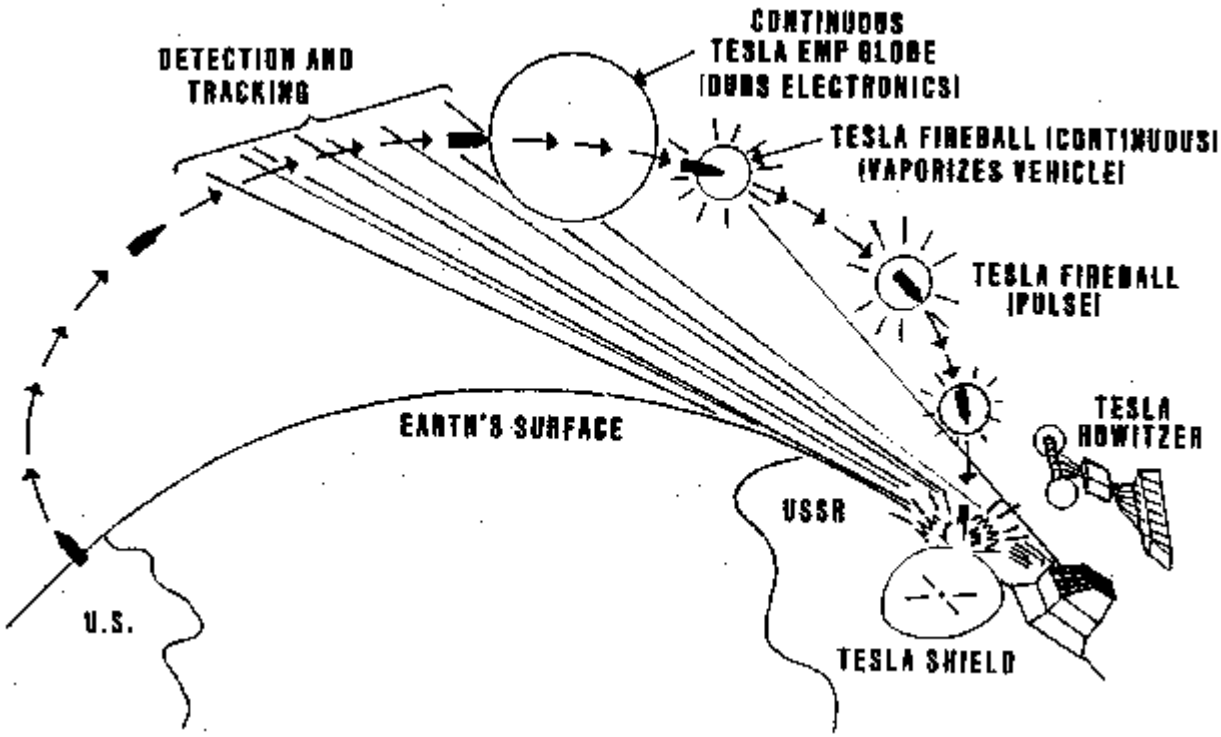

Figure 13. Tesla ABM Defenses

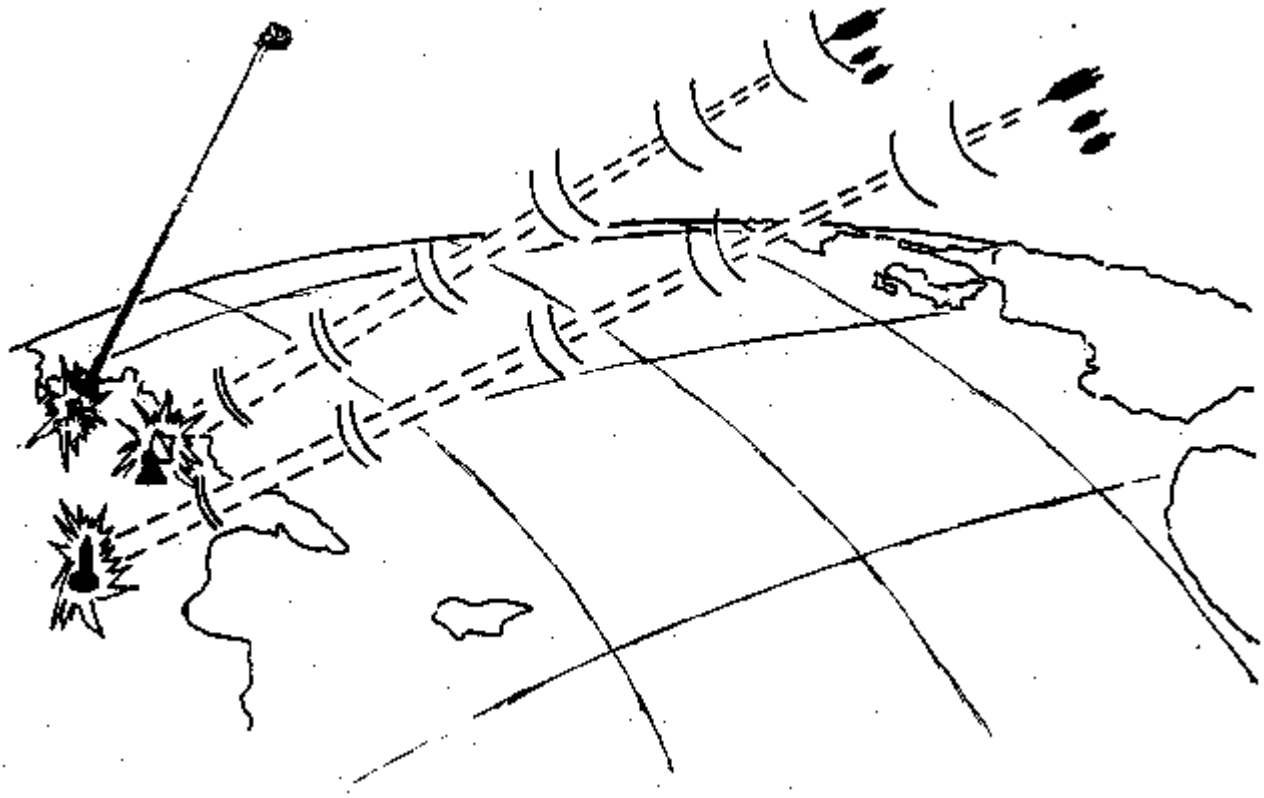

Figure 14. Moray/Tesla Technology: Star Wars Now

Typical strategic ABM uses of Tesla weapons are shown in figure 13. In addition, of course, smaller Tesla howitzer systems for anti-tactical ballistic missile defense of tactical troops and installations could

be constituted of more conventional field missile systems using paired or triplet radars, of conventional external appearance, in a scalar interferometer mode.

With Moray generators as power sources and multiply deployed reentry vehicles with scalar antennas and transmitters, ICBM reentry systems now can become long range "blasters" of the target areas, from thousands of kilometers distance (figure 14). Literally, "Star Wars" is liberated by the Tesla technology. And in air attack, jammers and ECM aircraft now become "Tesla blasters." With the Tesla technology, emitters become primary fighting components of stunning power.

The potential peaceful implications of Tesla waves are also enormous. By utilizing the "time squeeze" effect, one can get antigravity, materialization and dematerialization, transmutation, and mindboggling medical benefits. One can also get subluminal and superluminal communication, see through the earth and through the ocean, etc. The new view of phi-field also provides a unified field theory, higher orders of reality, and a new super-relativity, but detailing these possibilities must wait for another book.

With two cerebral brain halves, the human being also has a Tesla scalar interferometer between his ears. And since the brain and nervous system processes avalanche discharges, it can produce (and detect) scalar Tesla waves to at least a limited degree. Thus a human can sometimes produce anomalous spatiotemporal effects at a distance and through time. This provides an exact mechanism for psychokinesis, levitation, psychic healing, telepathy, precognition, postcognition, remote viewing, etc. It also provides a reason why an individual can detect a "stick" on a radionics or Hieronymus machine (which processes scalar waves), when ordinary detectors detect nothing. Unfortunately there is not room to develop the implications of this human Tesla interferometry in detail, for that must wait for yet another book, presently in its initial stages, that Hal Crawford and I are writing.

Table 5. Orders of Reality

- **PHOTONS ARE**
  - **> PAIR-COUPLED SCALARS**
  - **> VELOCITY-LIMITED TO C**
  - **> CARRIERS OF T**
- **PHOTON INTERACTION**
  - **> IS UBIQUITOUS**
  - **> PRODUCES $\dot{T}$ = C**
  - **> YIELDS 1st ORDER REALITY**
- **SCALAR O WAVES**
  - **> NOT VELOCITY-LIMITED**
  - **> YIELD HIGHER ORDER REALITIES**

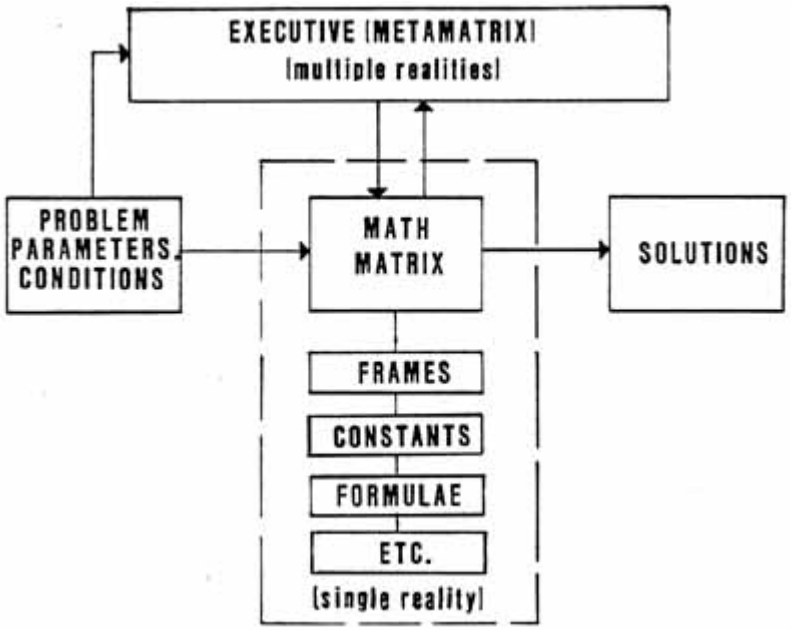

Figure 15. Implications of Tesla Potential

At the July 1981 U.S. Psychotronics Association's Annual Conference in Dayton, Ohio, I presented the first rough paper on the Tesla secret and scalar interferometry. A videotape of the presentation was made and will shortly be available. I am also scheduled to make a special presentation at the Alternate Energy Conference in Toronto, Canada in latter October, 1981. A professional, videotaped two-hour presentation on this subject is also being prepared. Wide distribution of the material through the international underground physics and technology network has already been made. This time, God willing, Tesla's secret will not be suppressed for another 80 years!

And perhaps it is not yet too late. The material has cost me (now) some 16 years of agonizing labor and nearly $100,000 of my own personal funds. No orthodox university, scientific group, foundation, or governmental agency would support such an effort, either financially or otherwise. Indeed, most ordinary journals will not even accept material on such matters. Nonetheless, the area is of overwhelming importance and I truly believe Tesla's lost secret will shortly affect the lives of every human being on earth.

Perhaps with the free and open release of Tesla's secret, the scientific and governmental bureaucracies will be. shocked awake from their slumber, and we can develop defenses before Armageddon occurs. Perhaps there is hope after all -- for even Brezhnev, in his strange July, 1975 proposal to the SALT talks, seemed to reveal a perception that a turning point in war and weaponry may have been reached, and that human imagination is incapable of dealing with the ability to totally engineer reality itself. Having tested the weapons, the Soviets must be aware that the ill-provoked oscillation of timeflow affects the minds and thoughts -- and the very lifestreams and even the collective species unconsciousnesses -- of all lifeforms on earth. They must know that these weapons are two-edged swords, and that the backlash from their use can be far more terrible to the user than was the original effect to his victim.

If we can avoid the Apocalypse, the fantastic secret of Nikola Tesla can be employed to cure and elevate man, not kill him. Tesla's discovery can eventually remove every conceivable external human limitation. If we humans ourselves can elevate our consciousness to properly utilize the Tesla electromagnetics, then Nikola Tesla -- who gave us the electrical twentieth century in the first place -- may yet give us a fantastic new future more shining and glorious than all the great scientists and sages have imagined.

References

http://www.cheniere.org/books/part1/teslaweapons.htm

- ▶ Reply
-

Permalink Reply by rose on August 4, 2013 at 10:54

yeah this ones from deep in the archives Greg - I would love to see that article!!!

- ▶ Reply
-

Permalink Reply by deanna munson on August 4, 2013 at 18:16

what if these weapons work in conjunction with cell towers and smartgrid/wifi relays? i just read this and it blew me away how the dangers this is being purposely ignored http://www.stayonthetruth.com/electromagnetic-fields---killing-fiel... "

November 14 1996, Omnipoint, New York City's first digital cellular provider, did open for business, broadcasting from thousands of antennae newly erected on the rooftops of apartment buildings. According to the health authorities, an early flu hit New York City - but not Boston, and not Philadelphia - on about 15 November. The flu was severe and ran a prolonged course, often dragging on for months instead of the usual two weeks.

At Christmas time, the Cellular Phone Task Force placed a small classified ad in a free weekly newspaper. It read: 'If you have been ill since 11/15/96 with any of the following: eye pain, insomnia, dry lips, swollen throat, pressure or pain in the chest, headaches, dizziness, nausea, shakiness, other aches and pains, or flu that won't go away, you may be a victim of a new microwave system blanketing the city. We need to hear from you.' And we did hear from them. Hundreds called, men, women, whites, blacks, Asians, Latinos, doctors, lawyers, teachers, stockbrokers, airline stewards, computer operators. Most had woken up suddenly in mid-November, thinking they were having a stroke or a heart attack or a nervous breakdown, and were relieved to know they were not alone and not crazy.

Later, I analysed weekly mortality statistics, which the Centres for Disease Control publish for122 US cities. Each of dozens of cities recorded a 10-25 per cent increase in mortality, lasting two to three months, beginning on the day in 1996 or 1997 on which that city's first digital cell phone network began commercial service." we already know these agendas are being forced everywhere.no one is even noticing how even though everyone is already "connected" they are still erecting more and more towers and infastructure,by force in the case of smartmeters.wired in connections now cost over double what wifi does.they just put up another tower here on my block,disguised as a flipping pine tree.cant block the effects when it comes from literally all sides

- ▶ Reply
-

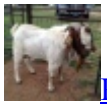
Permalink Reply by Rhonda Reichel on August 6, 2013 at 6:15

Scalar weapons makes all the billions we spend on war obsolete.....what a racket

- ▶ Reply
-

Permalink Reply by steve on August 9, 2013 at 6:43
having read a few pages, it looks like a weapon of distraction to me. The physics is in the realm of the tooth fairy, and the history has the ring of recent manufacture

- ▶ Reply
-

Permalink Reply by rose on August 9, 2013 at 12:24

- ▶ Reply
-

Permalink Reply by steve on August 9, 2013 at 16:03
plus, Tom Beardon is nothing but a fear merchant.

- ▶ Reply
-

RSS

Welcome to
The ConTrail

Sign Up
or Sign In

Or sign in with:

Visitors

Live Traffic Feed

Watch Live | Get FEEDJIT

Richmond, California, United States arrived 0 secs ago.

Adelaide, South Australia, Australia arrived 20 mins ago.

San Francisco, California, United States arrived 21 mins ago.

San Francisco, California, United States arrived 37 mins ago.

San Francisco, California, United States arrived 40 mins ago.

Hamilton, Waikato, New Zealand arrived 56 mins ago.

New Zealand arrived 1 hour 6 mins ago.

San Diego, California, United States arrived 1 hour 9 mins ago.

Oceanside, California, United States arrived 1 hour 22 mins ago.

Australia arrived 1 hour 54 mins ago.

Groups

Health and Wellbeing

123 members

99 Comments 10 Favorites

Vaccination Information

87 members

163 Comments 6 Favorites

-

  Simply Good Stuff

  40 members

  112 Comments 3 Favorites

-

  EMF and EMR Information …

  101 members

  74 Comments 13 Favorites

-

  Cancer Treatment Options

  74 members

  77 Comments 9 Favorites

-

  Grow your own Food and M…

  96 members

  52 Comments 12 Favorites

-

  Childbirth

  3 members

  1 Comment 0 Favorites

- View All

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Foundations of Electro-Magnetism

Slide Series

- Major Points of Presentation
- Chung's Carbon Filament Negative Resistor
- Aharanov-Bohm Effect
- Absorption and emission reactions (1)
- Absorption and emission reactions (2)
- Anti-engine for cell's deviation reverses cell back to normal
- Asymmetric regauging produces excess force, which can be used to do work on the system
- Asymmetric regauging produces excess force, which can be used to do work on the regauging system
- Becker's bone fracture healing experiments
- Becker's theoretical control system governing regeneration
- Becker's theoretical DC control system involved with response to injury
- Geometrical Distortion of Poynting Energy Flow
- Cosmic Bootstrap: Before the Big Bang
- Bridging Enables COP > 1

- Aspects of Strong Local Symmetry
- Other Aspects of Strong Local Symmetry
- Bunge on the Status of Electrodynamics
- Bunge on the Status of Electrodynamics and Physics
- Bunge on the Status of Classical and Quantum Physics
- Fractions of BW Casualties Surviving
- First Step in Self-Promotion of Cancer Due to Hypoxia
- Differentiation and Dedifferentiation Timelines
- Evolution of Cells on Earth
- A Charged Particle q is a Coupled System of m and Ø
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (1)
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (2)
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (3)
- A Charged Particle is a Coupled System
- The Anomalies in Navy Electrolyte Experiments at China Lake
- Chung's Carbon Filament Negative Resistor

- Typical circuit has about 10^{-13} energy collection efficiency
- Classical View of EM
- Curved Spacetime acts as source or sink
- Chronic Disease Puzzling
- Cancer Characteristics
- Solving a Cancer Enigma
- Cancer: Characteristics
- Nonlinear Optics Distortion Correction Theorem
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)
- In Time-Reversed Zone: Nuclear reactions are biased
- In Time-Reversed Zone: Dynamics may be reversed
- Time-Reversed Zone: Significant only after time-density charging
- A New Conservation of Energy Law
- Questions on Carcinogens and EM

Radiation

- AS DEFINED, fields and potentials only exist in and on charged matter
- Serious flaws and errors in classical EM theory
- Electrodynamicists' Reaction to Removal of the Material Ether
- Reaction to Loss of Material Ether (1)
- Reaction to Loss of Material Ether (2)
- Some EM waves in Spacetime
- Air Medium Disturbances Generated When Air is Perturbed by a Plucked Taut String
- Launching a Spacetime Perturbation ("EM Wave") from a Wire Antenna
- Phase Conjugate Wavepairs Produce New Waves
- Scalar Electromagnetics (Energetics) View of EM (1)
- Scalar Electromagnetics (Energetics) View of EM (2)

- Scalar Electromagnetics (Energetics) View of EM (3)
- Extended General Relativity Principle
- Extension of Work-Energy Theorem
- 34 Flaws in Classical EM Theory
- MTW's General Relativity Principle
- Use of General Relativity (GR) in Particle Physics
- The Missing Infolded Electrodynamics
- Infolded Engines: Excluded by Present Physics
- Mass curves and structures spacetime; ST curvatures change and structure mass (1)
- Mass curves and structures spacetime; ST curvatures change and structure mass (2)
- At Infinite Velocity: Each Is Every Other
- Lisitsyn's Report: Brain Code Broken
- Lorentz Closed Surface Integration
- Lorentz's physically insignificant energy flow can be collected and utilized
- Lorentz surface integration of the Poynting vector around a closed surface
- Longitudinal EM Photon Interaction with Charge
- Mass is transparent to longitudinal EM waves, which move through the infolded interiors of internal waves, potentials, and fields in the mass.

- Pumping with Longitudinal EM waves Time-reverses the Mass
- Maxwell's Quaternion Theory
- Maxwellian Systems before and after Regauging
- Maxwell's four equations reduce to: Page 1
- Maxwell's four equations reduce to: Page 2
- More to come

Major Points of Presentation

- Electrodynamic is seriously flawed
  - Some major flaws
  - Corrections indicated
- Why past corrective attempts failed
  - Force field concept is material
  - Missing two infolded transforms (M->ST; ST->M)
- Missing Infolded general relativity inside electrodynamics
- Several Kinds of EM Waves in Space
  - How to make
  - Transduction
- A French medical example as a deep experimental demonstration
  - Spectacular regenerative cures funded by French Govt
  - Not comprehended, therefore suppressed
- Cold Fusion examples of time-density wave effects
  - China Lake instrumental anomalies in electrolysis
  - Explanation of anomalous behavior of instruments
  - Explanation of new nuclear reactions
  - Wave energy transduction provides excess heat
- Urge theorists to consider dramatically new reactions

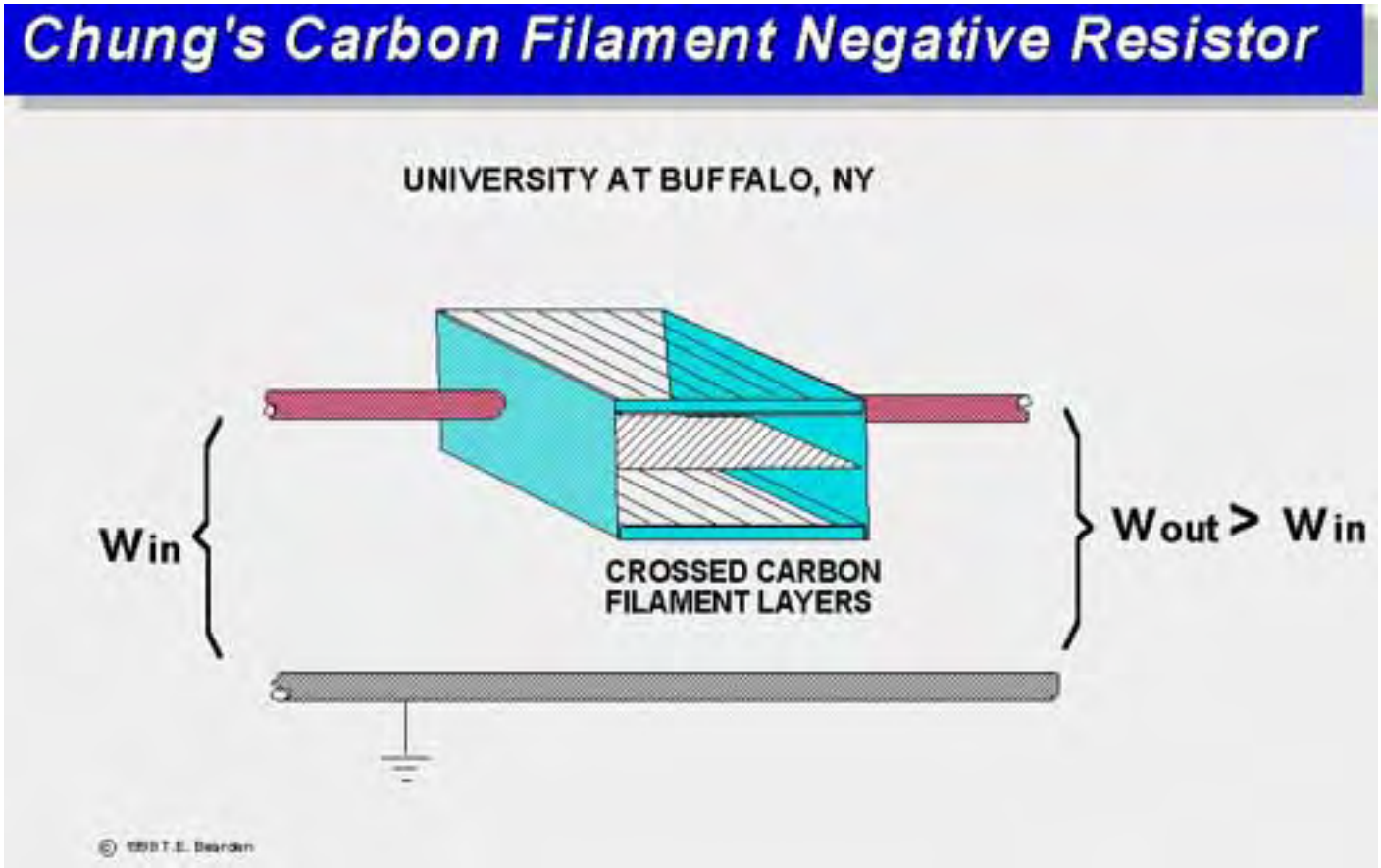
Chung's Carbon Filament Negative Resistor
UNIVERSITY AT BUFFALO, NY
Win
CROSSED CARBON
FILAMENT LAYERS
Wout > Win
© 1991 T.E. Bearden

Aharonov-Bohm Effect

- In field-free regions
  - E-field is zero
  - B-field is zero
- Potentials still exist, just no gradients
  - Cause real effects
  - Interference is the key
  - Contain sum-zeroed substructures
- Does not follow from
  - Mechanics
  - Classical electromagnetics
- Required by quantum mechanics

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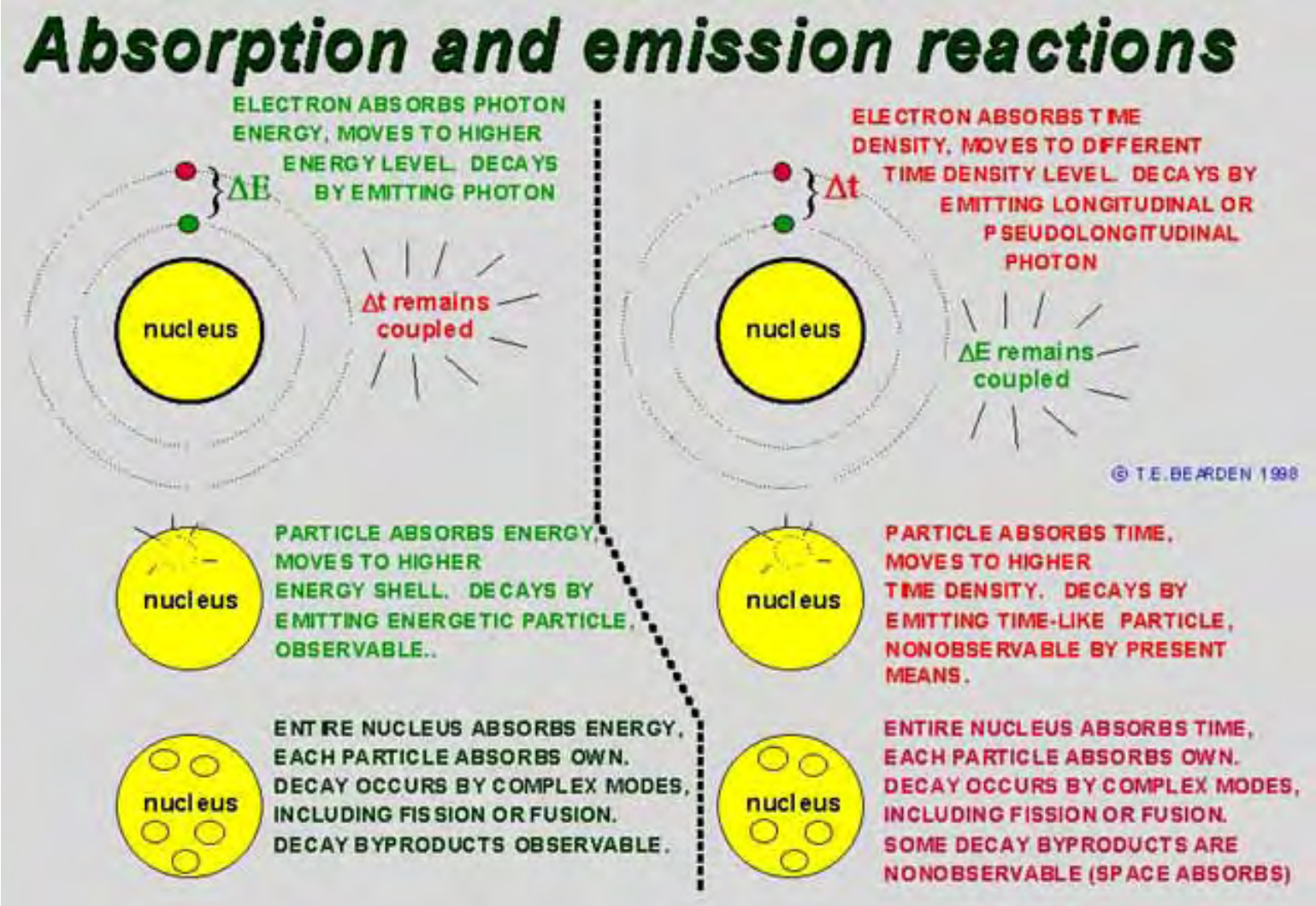
Absorption and emission reactions
ELECTRON ABSORBS PHOTON ENERGY, MOVES TO HIGHER ENERGY LEVEL. DECAYS BY EMITTING PHOTON
ΔE
nucleus
Δt remains coupled
ELECTRON ABSORBS TIME DENSITY, MOVES TO DIFFERENT TIME DENSITY LEVEL. DECAYS BY EMITTING LONGITUDINAL OR PSEUDOLONGITUDINAL PHOTON
Δt
nucleus
ΔE remains coupled
© T.E. BEARDEN 1998
nucleus
PARTICLE ABSORBS ENERGY, MOVES TO HIGHER ENERGY SHELL. DECAYS BY EMITTING ENERGETIC PARTICLE, OBSERVABLE..
nucleus
PARTICLE ABSORBS TIME, MOVES TO HIGHER TIME DENSITY. DECAYS BY EMITTING TIME-LIKE PARTICLE, NONOBSERVABLE BY PRESENT MEANS.
nucleus
ENTIRE NUCLEUS ABSORBS ENERGY, EACH PARTICLE ABSORBS OWN. DECAY OCCURS BY COMPLEX MODES, INCLUDING FISSION OR FUSION. DECAY BYPRODUCTS OBSERVABLE.
nucleus
ENTIRE NUCLEUS ABSORBS TIME, EACH PARTICLE ABSORBS OWN. DECAY OCCURS BY COMPLEX MODES, INCLUDING FISSION OR FUSION. SOME DECAY BYPRODUCTS ARE NONOBSERVABLE (SPACE ABSORBS)

Absorption and emission reactions

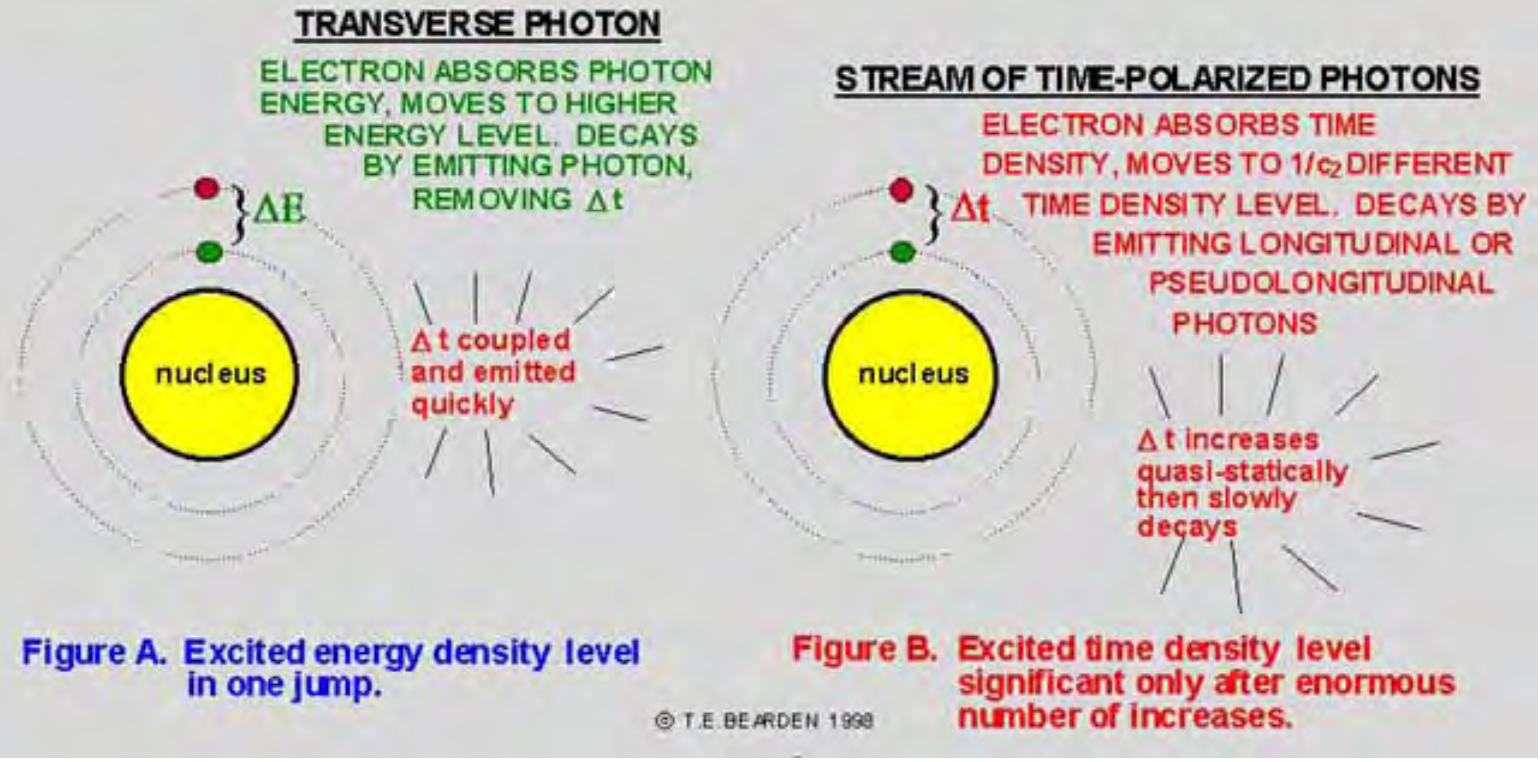

Figure A. Excited energy density level in one jump.

Figure B. Excited time density level significant only after enormous number of increases.

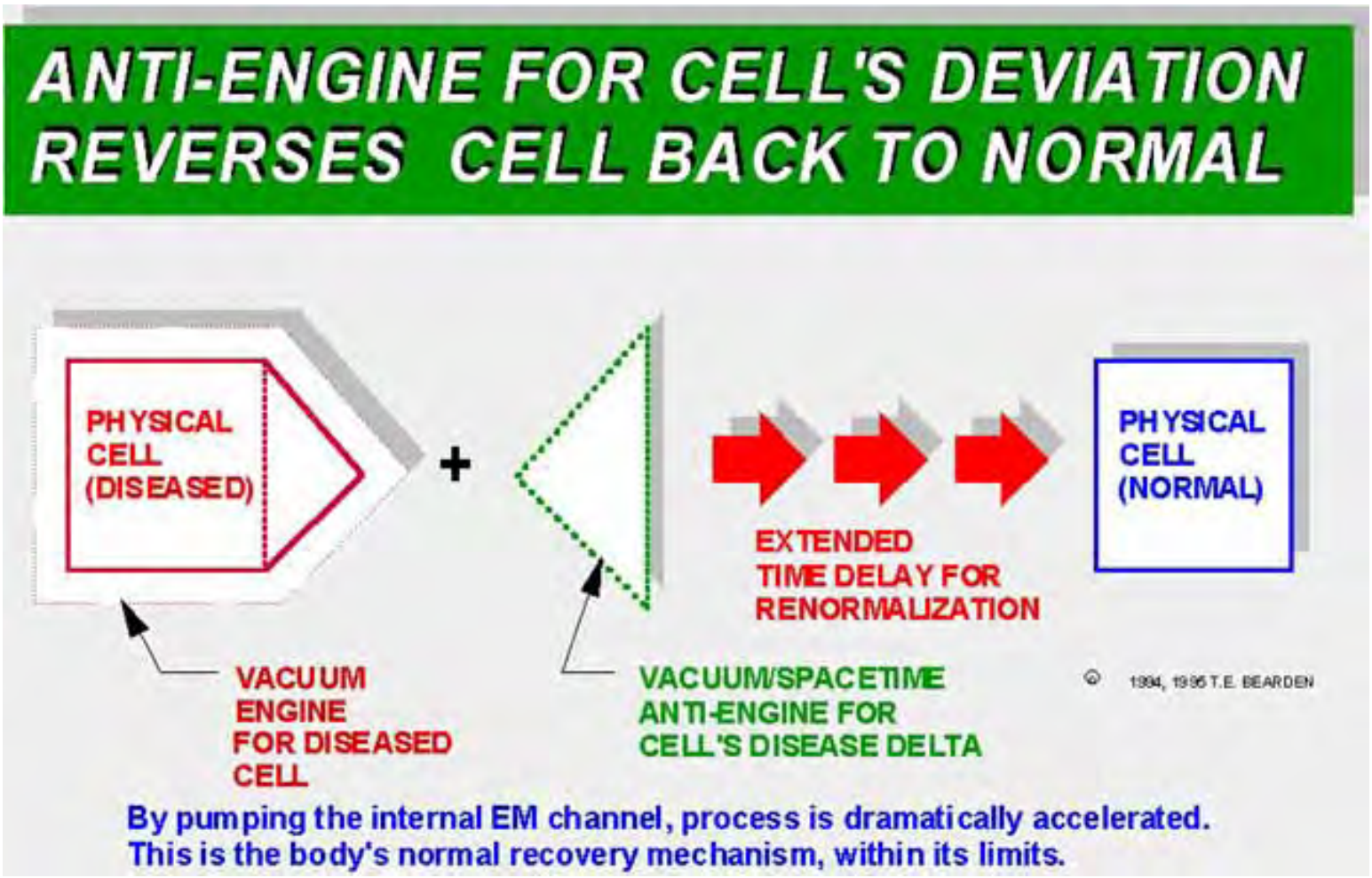
ANTI-ENGINE FOR CELL'S DEVIATION
REVERSES CELL BACK TO NORMAL
PHYSICAL CELL (DISEASED)
+
EXTENDED TIME DELAY FOR RENORMALIZATION
PHYSICAL CELL (NORMAL)
VACUUM ENGINE FOR DISEASED CELL
VACUUM/SPACETIME ANTI-ENGINE FOR CELL'S DISEASE DELTA
© 1994, 1995 T.E. BEARDEN
By pumping the internal EM channel, process is dramatically accelerated.
This is the body's normal recovery mechanism, within its limits.

Asymmetric Regauging Produces Excess Force, Which Can be Used to Do Work on the System

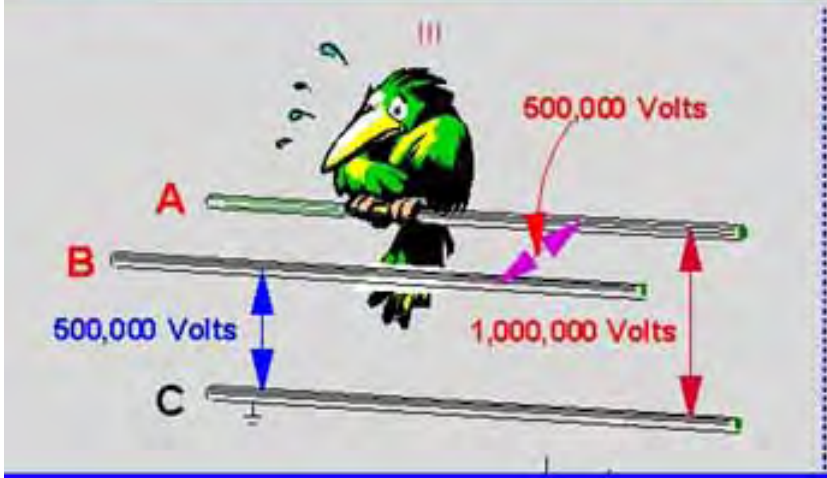

Net Symmetric Regauging Does No Excess Work on the System

This little bird put one foot on wire A, and then the second foot on wire A also. He *net symmetrically* regauged, so he had no net excess force across him, even though his potential energy was increased. He asymmetrically regauged each foot, but both simultaneously so that one countered the other. Wise little bird!

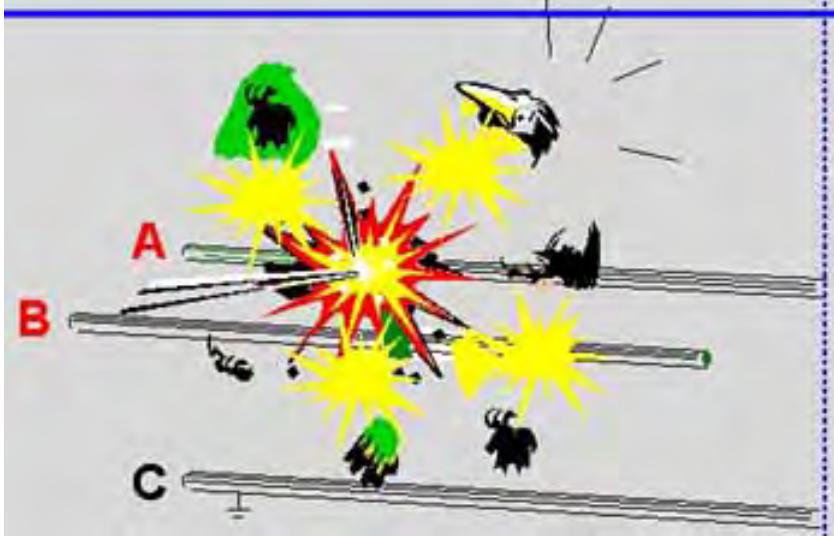

Net Asymmetric Regauging Can Do Excess Work on the System

This little bird put one foot on wire A, and then the second foot on wire B. He *net asymmetrically* regauged, so he had lots of net excess force across him. That force then violently translated his little body parts every which way, doing lots of work in and on him. Bummer!

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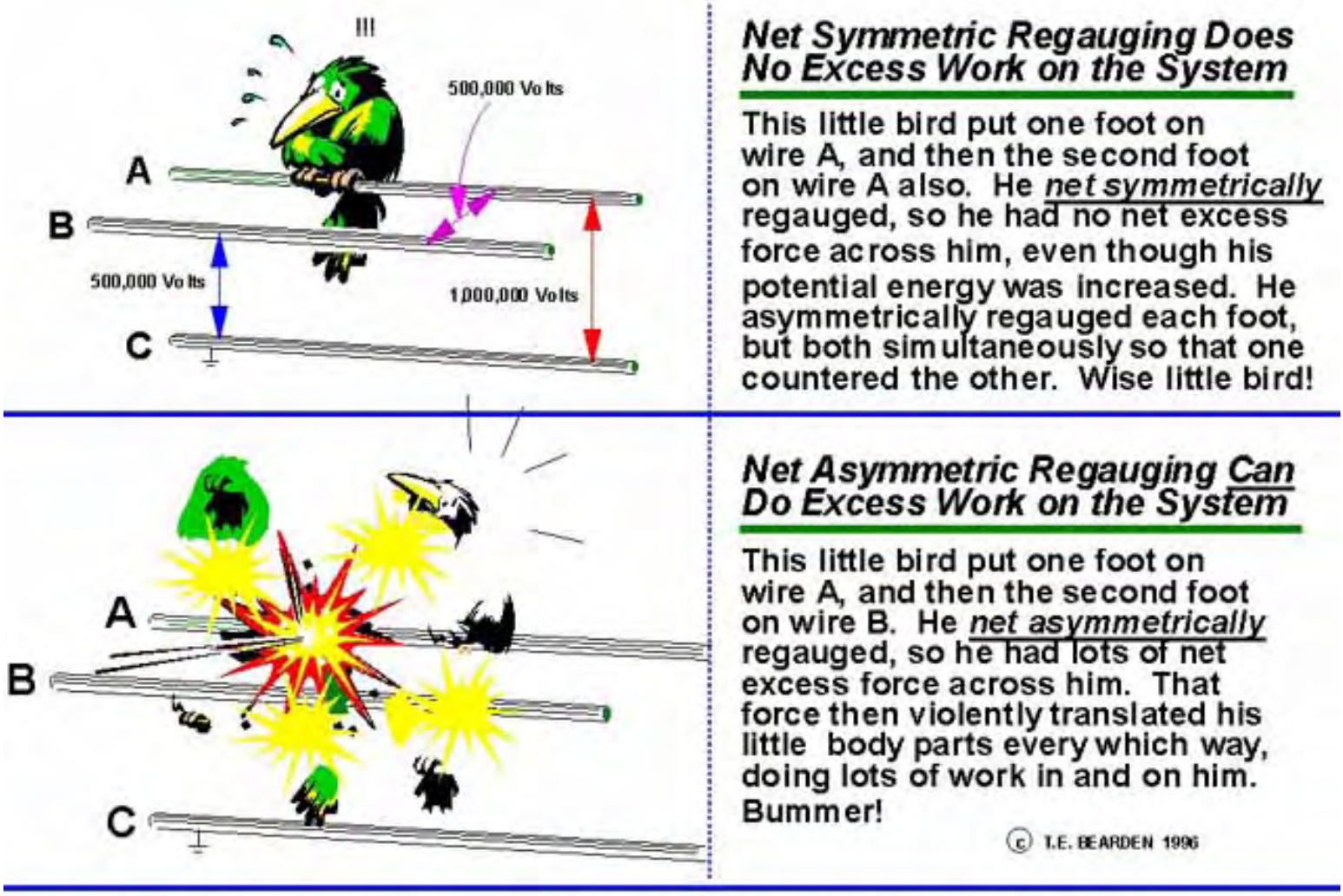

Figure 32. Asymmetric regauging produces excess force, which can be used to do work on the regauging system.

Selected clipart © by Lotus SmartPics™

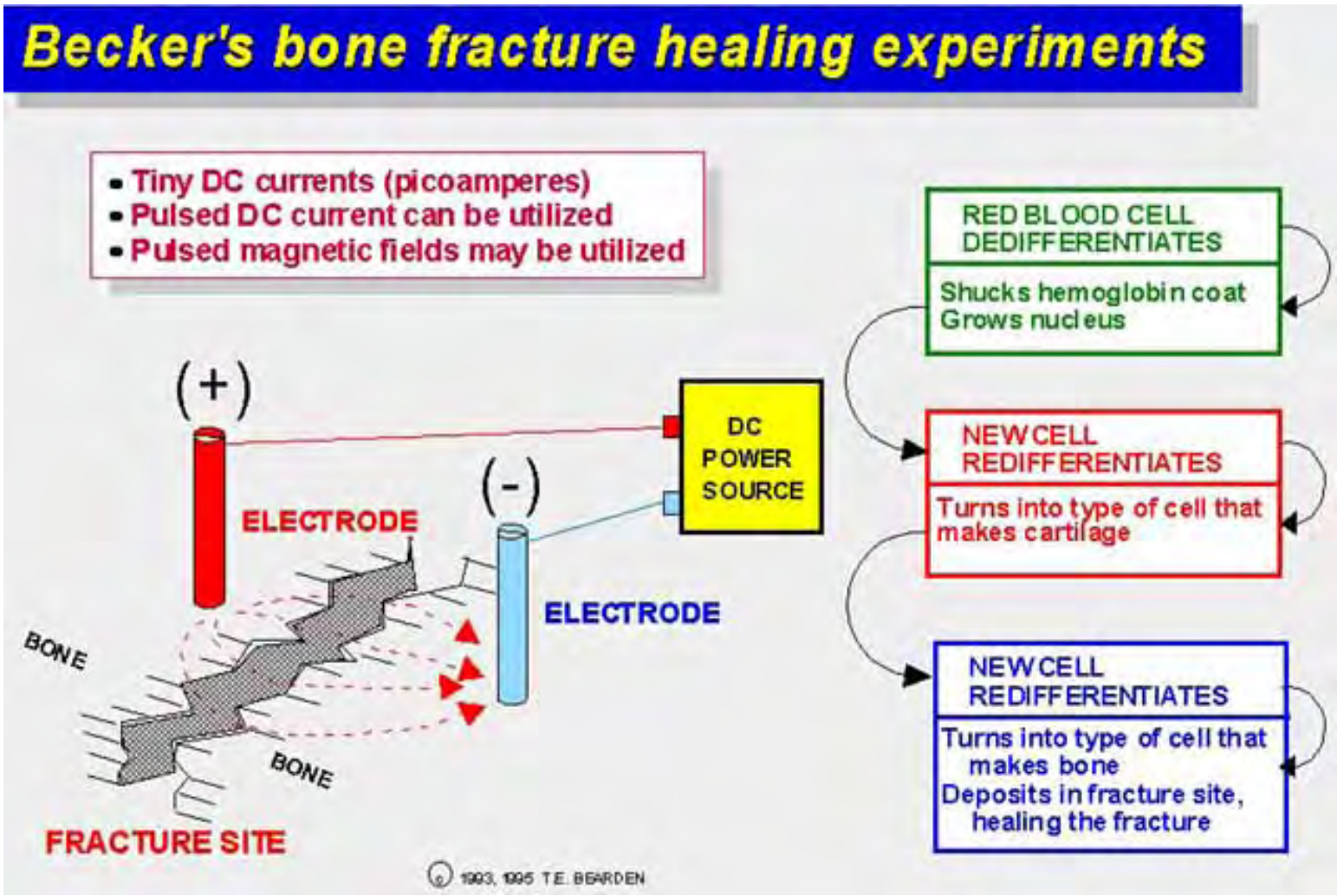
Becker's bone fracture healing experiments
• Tiny DC currents (picoamperes)
• Pulsed DC current can be utilized
• Pulsed magnetic fields may be utilized
(+)
(-)
ELECTRODE
ELECTRODE
DC POWER SOURCE
BONE
BONE
FRACTURE SITE
RED BLOOD CELL DEDIFFERENTIATES
Shucks hemoglobin coat
Grows nucleus
NEW CELL REDIFFERENTIATES
Turns into type of cell that makes cartilage
NEW CELL REDIFFERENTIATES
Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture
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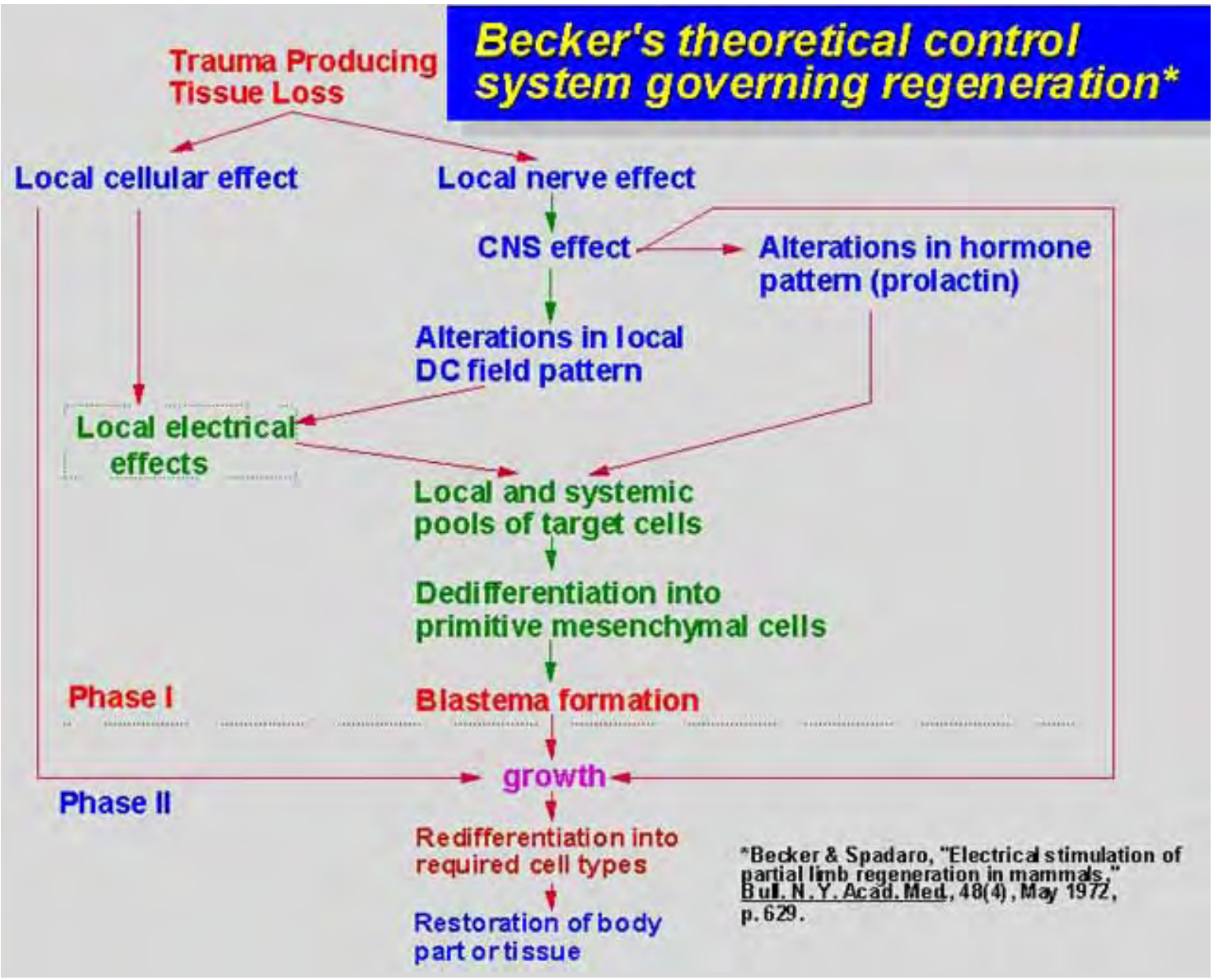
Becker's theoretical control system governing regeneration*
Trauma Producing Tissue Loss
Local cellular effect
Local nerve effect
CNS effect
Alterations in hormone pattern (prolactin)
Alterations in local DC field pattern
Local electrical effects
Local and systemic pools of target cells
Dedifferentiation into primitive mesenchymal cells
Phase I
Blastema formation
growth
Phase II
Redifferentiation into required cell types
Restoration of body part or tissue
*Becker & Spadaro, "Electrical stimulation of partial limb regeneration in mammals," Bull. N.Y. Acad. Med., 48(4), May 1972, p. 629.

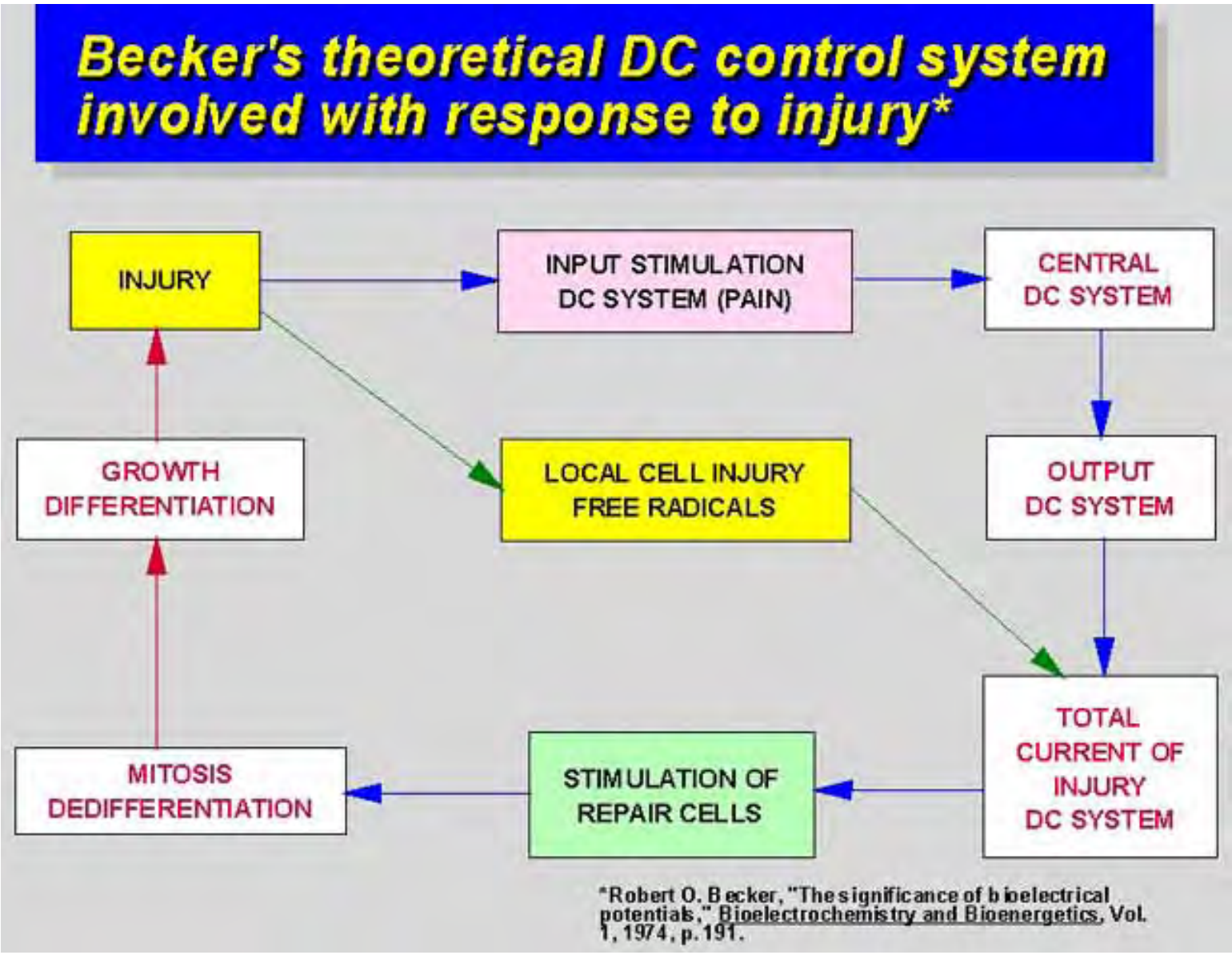
Becker's theoretical DC control system involved with response to injury*
INJURY
INPUT STIMULATION DC SYSTEM (PAIN)
CENTRAL DC SYSTEM
GROWTH DIFFERENTIATION
LOCAL CELL INJURY FREE RADICALS
OUTPUT DC SYSTEM
TOTAL CURRENT OF INJURY DC SYSTEM
MITOSIS DEDIFFERENTIATION
STIMULATION OF REPAIR CELLS
*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

Geometrical Distortion of Poynting Energy Flow

At or near resonance frequency, in the case shown the energy collection fraction (reaction cross section) increases dramatically.

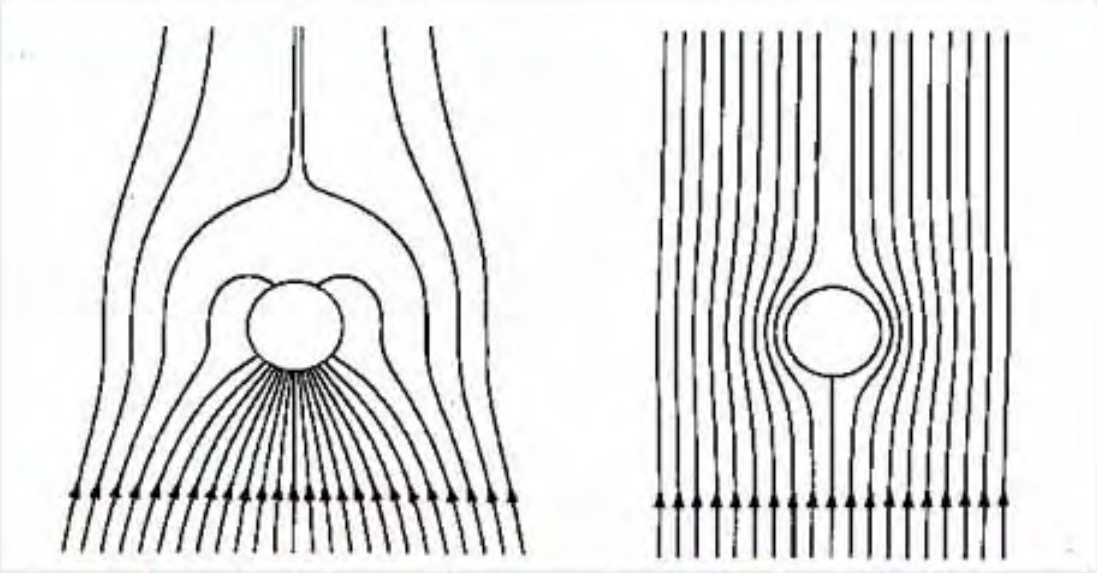

a. Around an aluminum sphere at light energy 8.8 eV. Absorption efficiency = 18.00.

b. Around an aluminum sphere at light energy 5eV. Absorption efficiency = 0.1.

Figures per Craig F. Bohren, "How can a particle absorb more than the light incident upon it? ", American Journal of Physics, 51(4), Apr. 1983, p. 326.

Cosmic Bootstrap: Before the Big Bang:

- *Cosmic repulsion behaved like a fluid with negative pressure*
- *The "universe" inflated (expanded) as a "false vacuum"*
- *As the negative-pressure fluid expanded, its energy went up rather than down*
- *When inflation stopped, the false vacuum decayed from its excited state*
- *Its excitation energy was released in a single great burst*

Paul Davies, Superforce, 1984, p. 194

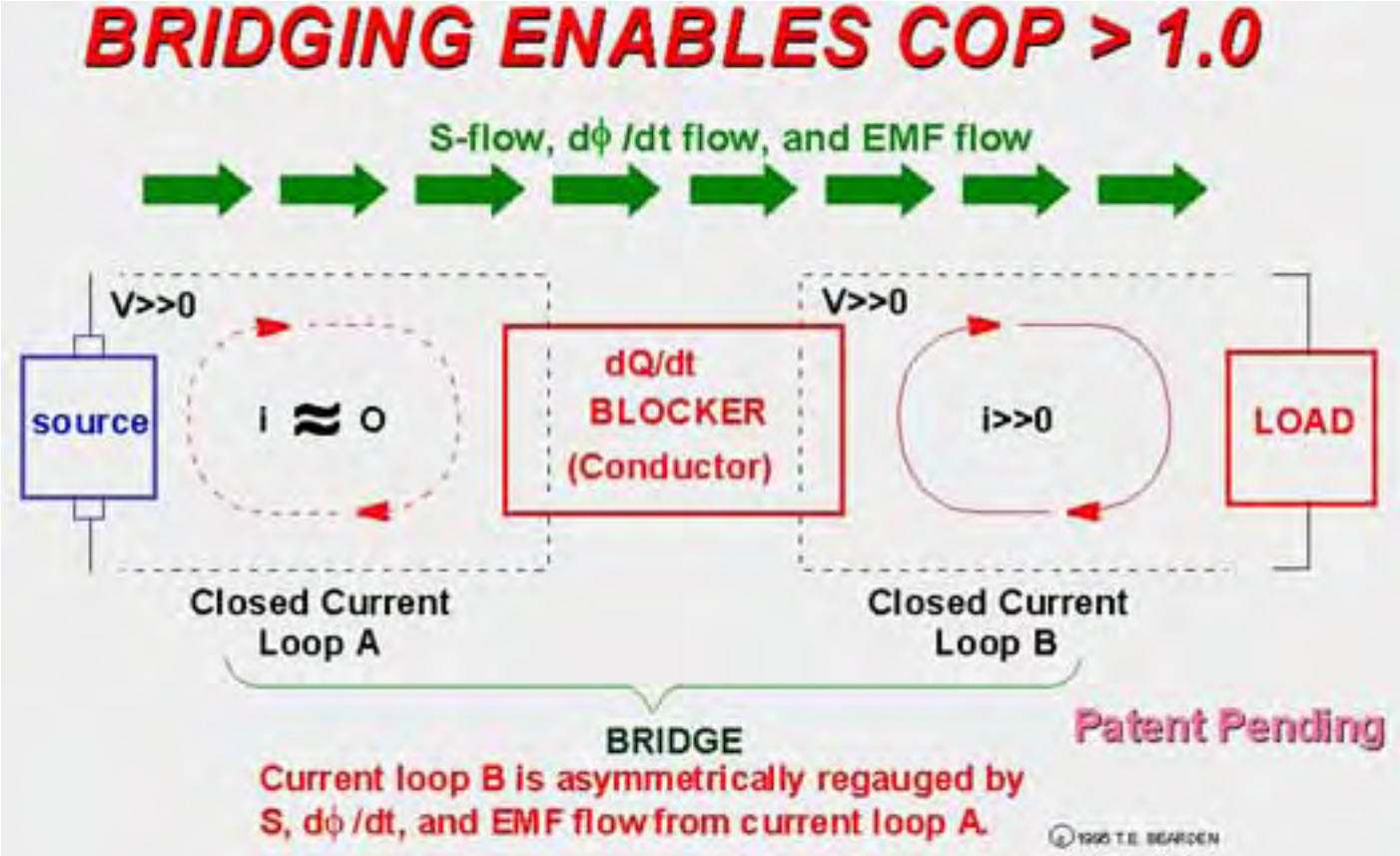
BRIDGING ENABLES COP > 1.0
S-flow, dϕ /dt flow, and EMF flow
V>>0
source
i ≈ 0
dQ/dt
BLOCKER
(Conductor)
V>>0
i>>0
LOAD
Closed Current
Loop A
Closed Current
Loop B
BRIDGE
Patent Pending
Current loop B is asymmetrically regauged by
S, dϕ /dt, and EMF flow from current loop A.
©1995 T.E. BEARDEN

Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum

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- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another
- STRUCTURING THE INFOLDED EM INSIDE POTENTIALS, FIELDS, AND WAVES
  - Strongly breaks local symmetry
  - Provides spacetime engines giving the above effects

Other Aspects of Strong Local Asymmetry

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- Local spacetime is curved
- Lorentz invariance of vacuum is violated
- May be a local "sink" or "source"
- Gravitational-inertial effects from EM
- Translation between virtual and observable
- Electrogravitational solitons
- Action at a distance
- Transmutation effects may exist
- Scalar/pseudoscalar field translation
- COMMENT: Thus the use of infolded longitudinal EM fields and waves to strongly break local symmetry allows internested clustering of spacetime curvatures. These spacetime structures are *vacuum engines*, or *spacetime engines*.

Bunge on the Status of Electrodynamics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state..."

"... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176.

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Bunge on the Status of Electrodynamics and Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state...

"... neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

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*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176.

Bunge on the Status of Classical and Quantum Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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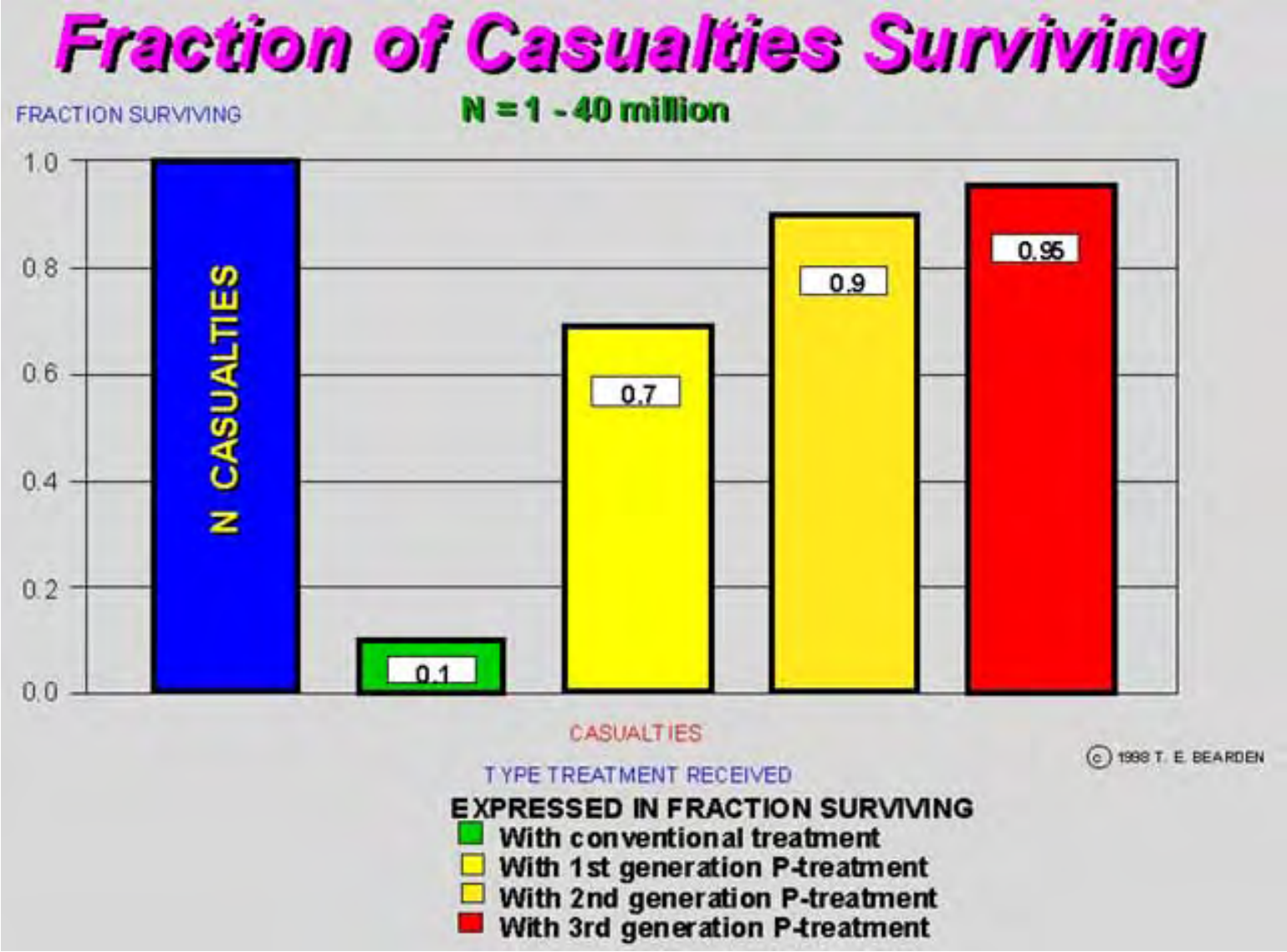
Fraction of Casualties Surviving
FRACTION SURVIVING
N = 1 - 40 million
1.0
0.8
0.6
0.4
0.2
0.0
N CASUALTIES
0.1
0.7
0.9
0.95
CASUALTIES
TYPE TREATMENT RECEIVED
© 1998 T. E. BEARDEN
EXPRESSED IN FRACTION SURVIVING
With conventional treatment
With 1st generation P-treatment
With 2nd generation P-treatment
With 3rd generation P-treatment

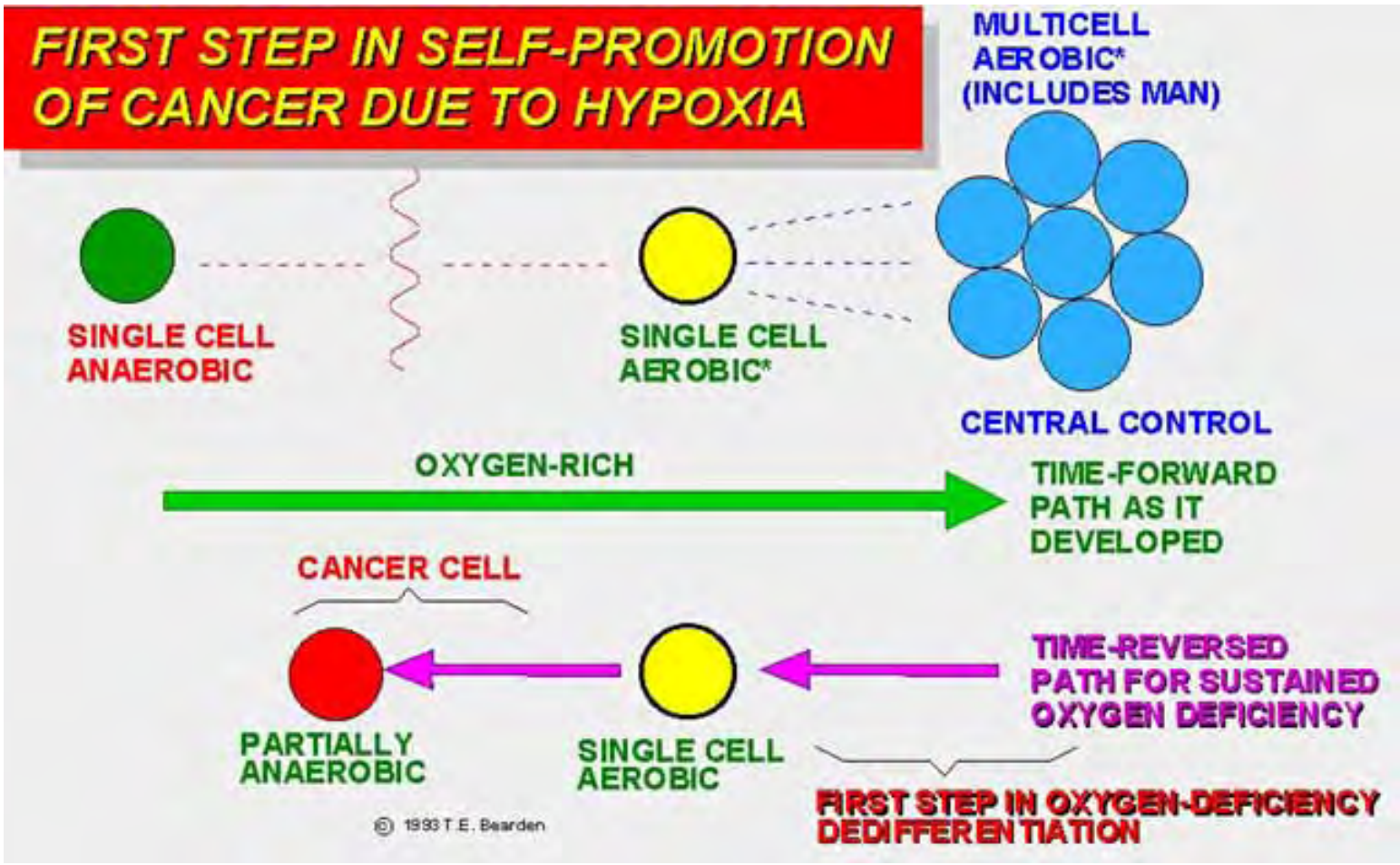
FIRST STEP IN SELF-PROMOTION OF CANCER DUE TO HYPOXIA
MULTICELL AEROBIC* (INCLUDES MAN)
SINGLE CELL ANAEROBIC
SINGLE CELL AEROBIC*
CENTRAL CONTROL
OXYGEN-RICH
TIME-FORWARD PATH AS IT DEVELOPED
CANCER CELL
TIME-REVERSED PATH FOR SUSTAINED OXYGEN DEFICIENCY
PARTIALLY ANAEROBIC
SINGLE CELL AEROBIC
FIRST STEP IN OXYGEN-DEFICIENCY DEDIFFERENTIATION
© 1993 T.E. Bearden

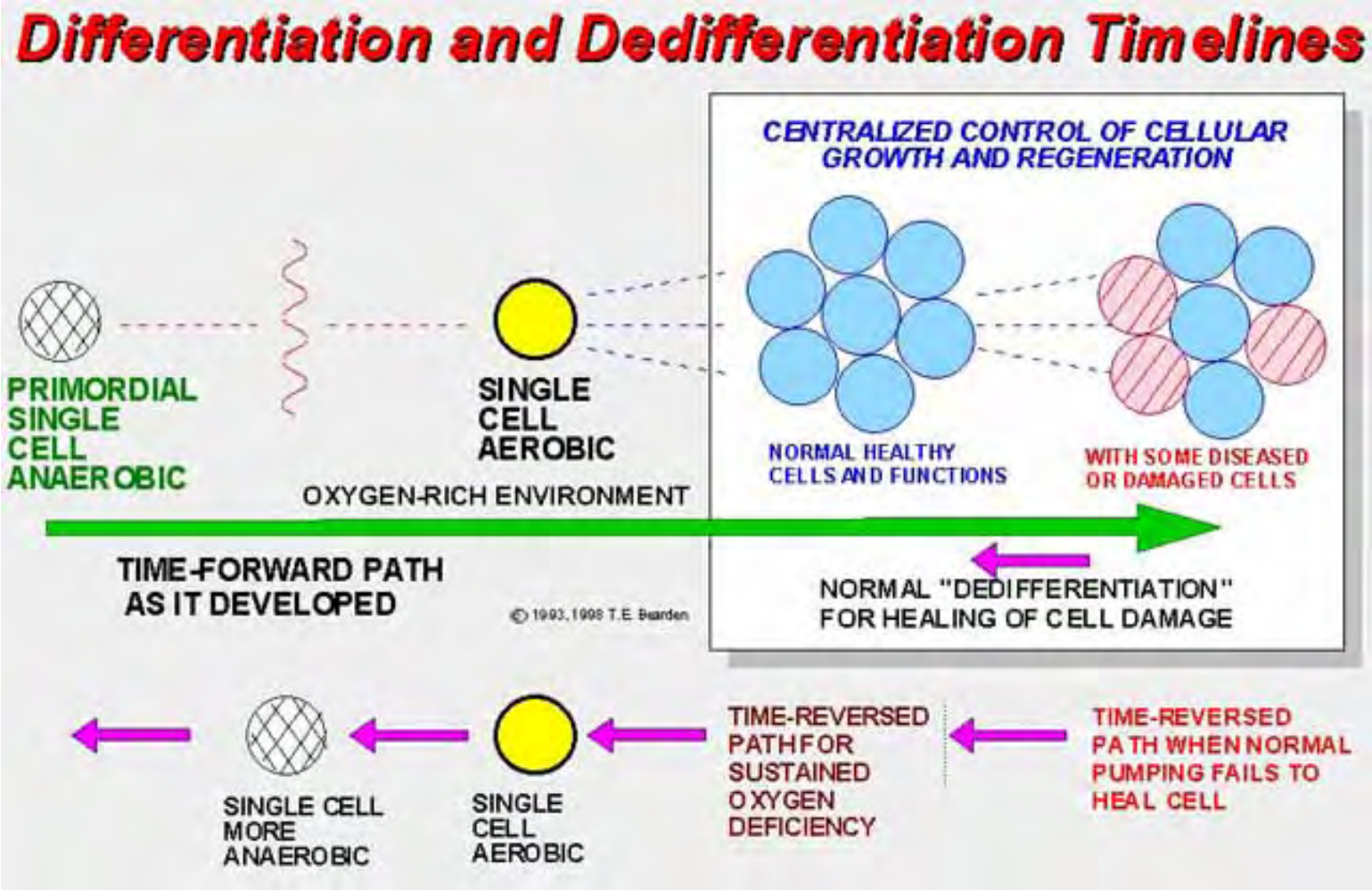
Differentiation and Dedifferentiation Timelines
CENTRALIZED CONTROL OF CELLULAR GROWTH AND REGENERATION
PRIMORDIAL SINGLE CELL ANAEROBIC
SINGLE CELL AEROBIC
OXYGEN-RICH ENVIRONMENT
NORMAL HEALTHY CELLS AND FUNCTIONS
WITH SOME DISEASED OR DAMAGED CELLS
TIME-FORWARD PATH AS IT DEVELOPED
© 1993, 1998 T.E. Bearden
NORMAL "DEDIFFERENTIATION" FOR HEALING OF CELL DAMAGE
SINGLE CELL MORE ANAEROBIC
SINGLE CELL AEROBIC
TIME-REVERSED PATH FOR SUSTAINED OXYGEN DEFICIENCY
TIME-REVERSED PATH WHEN NORMAL PUMPING FAILS TO HEAL CELL

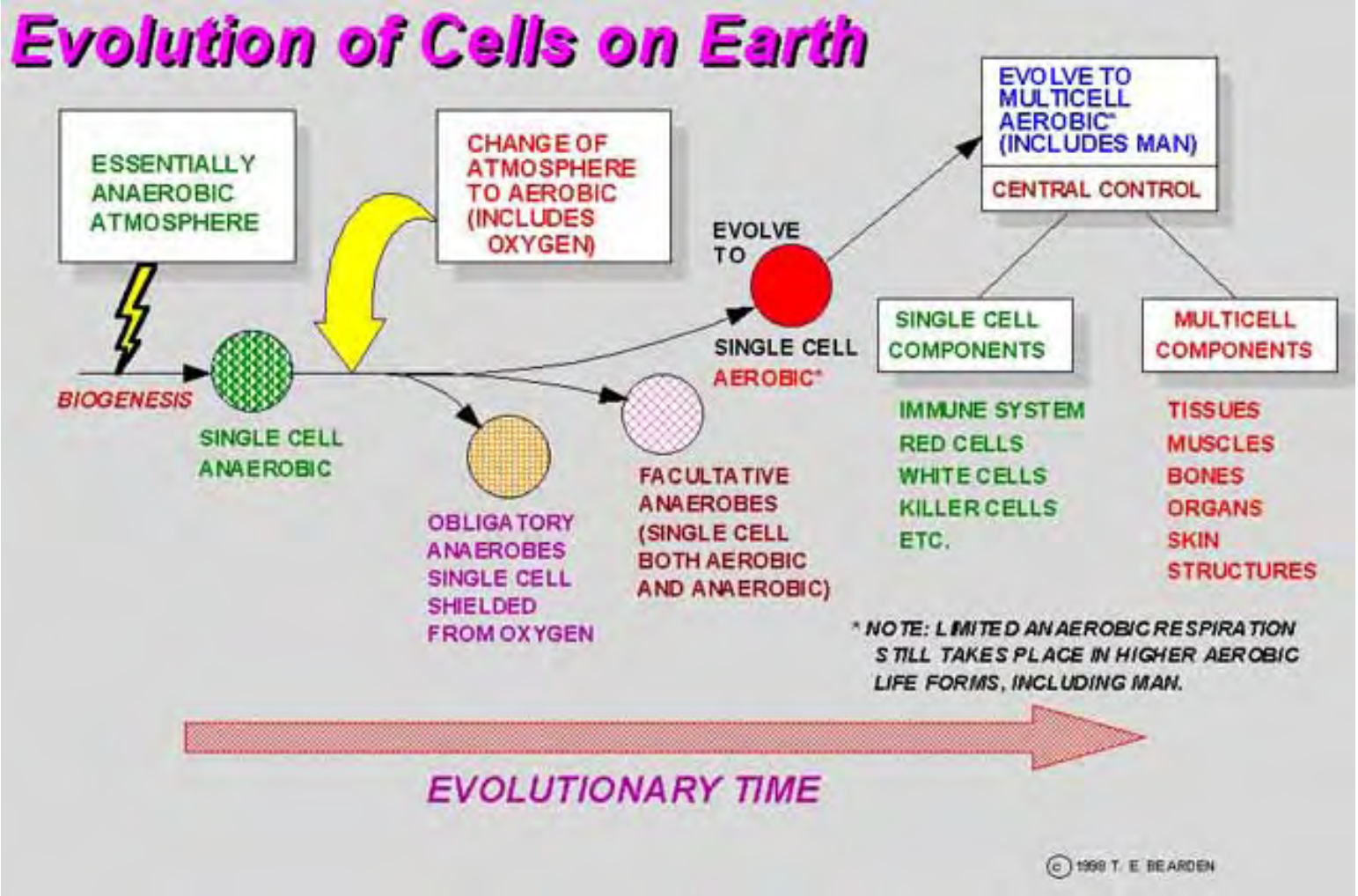
Evolution of Cells on Earth
ESSENTIALLY ANAEROBIC ATMOSPHERE
CHANGE OF ATMOSPHERE TO AEROBIC (INCLUDES OXYGEN)
EVOLVE TO MULTICELL AEROBIC* (INCLUDES MAN)
CENTRAL CONTROL
EVOLVE TO
SINGLE CELL AEROBIC*
SINGLE CELL COMPONENTS
MULTICELL COMPONENTS
BIOGENESIS
SINGLE CELL ANAEROBIC
OBLIGATORY ANAEROBES SINGLE CELL SHIELDED FROM OXYGEN
FACULTATIVE ANAEROBES (SINGLE CELL BOTH AEROBIC AND ANAEROBIC)
IMMUNE SYSTEM
RED CELLS
WHITE CELLS
KILLER CELLS
ETC.
TISSUES
MUSCLES
BONES
ORGANS
SKIN
STRUCTURES
* NOTE: LIMITED ANAEROBIC RESPIRATION STILL TAKES PLACE IN HIGHER AEROBIC LIFE FORMS, INCLUDING MAN.
EVOLUTIONARY TIME
© 1999 T. E. BEARDEN

A Charged Particle q Is a Coupled System of m and ϕ

(A proposed formal definition of a charged mass)

Note: X is a coupling operator

$$q \equiv f_q \times m_q$$

Also note that the ϕ portion of the charged particle can be internally structured, per Stoney-Whittaker-Ziolkowski, with hidden bidirectional EM wavepairs (their sums and products). Note that this constitutes an EM application of Bohm-type hidden variable theory, with many ramifications.

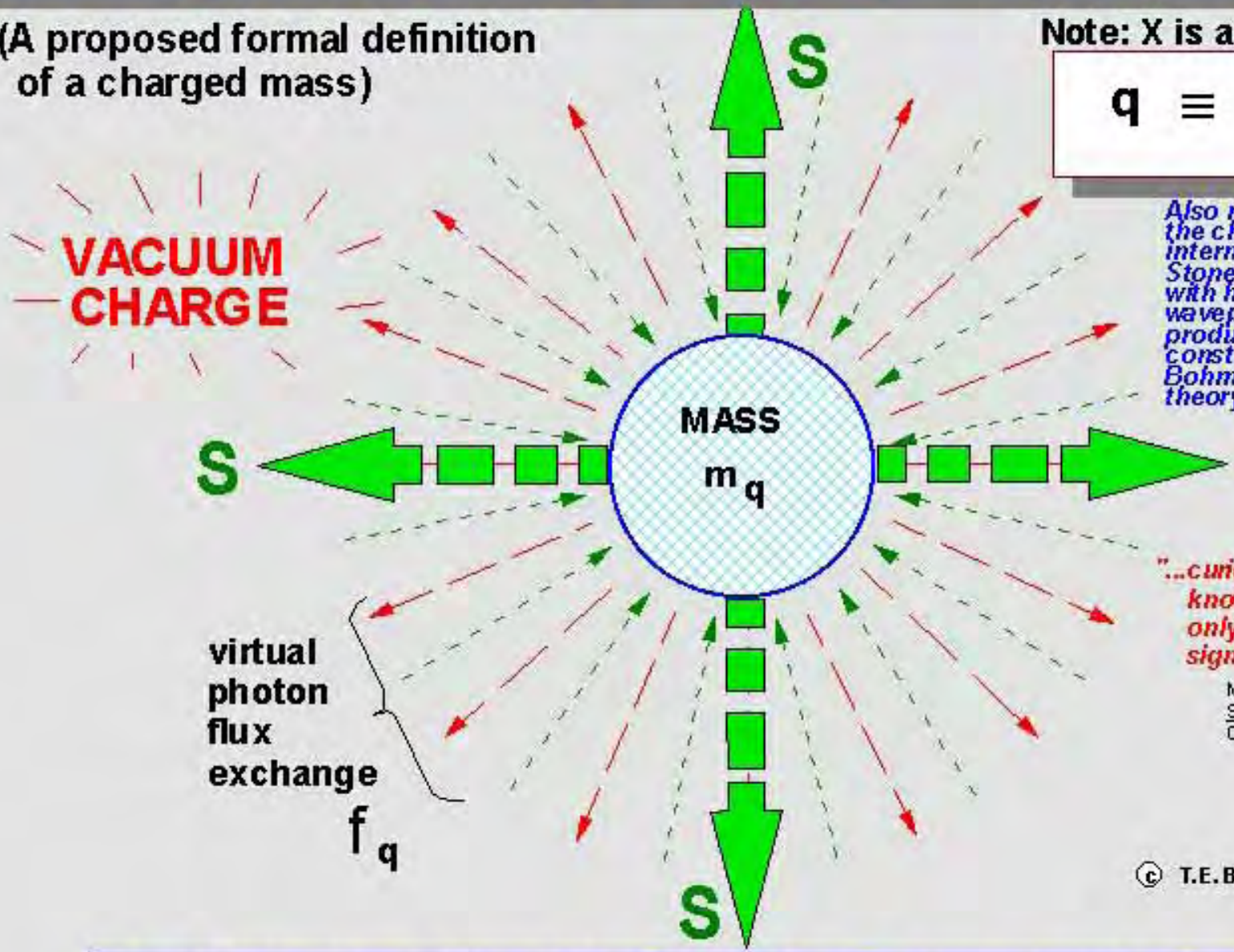

S = EXH

"...curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."

M.P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, 1993, p. 127.

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An electric charge Q consists of a massless flux component and a mass component, coupled together (interacting). Q is a broken symmetry. The mass of the charge continually and violently exchanges virtual photons with the surrounding vacuum.

Thus Q is energetically driven by the surrounding vacuum potential, which itself is to first order just a violent virtual photon flux.

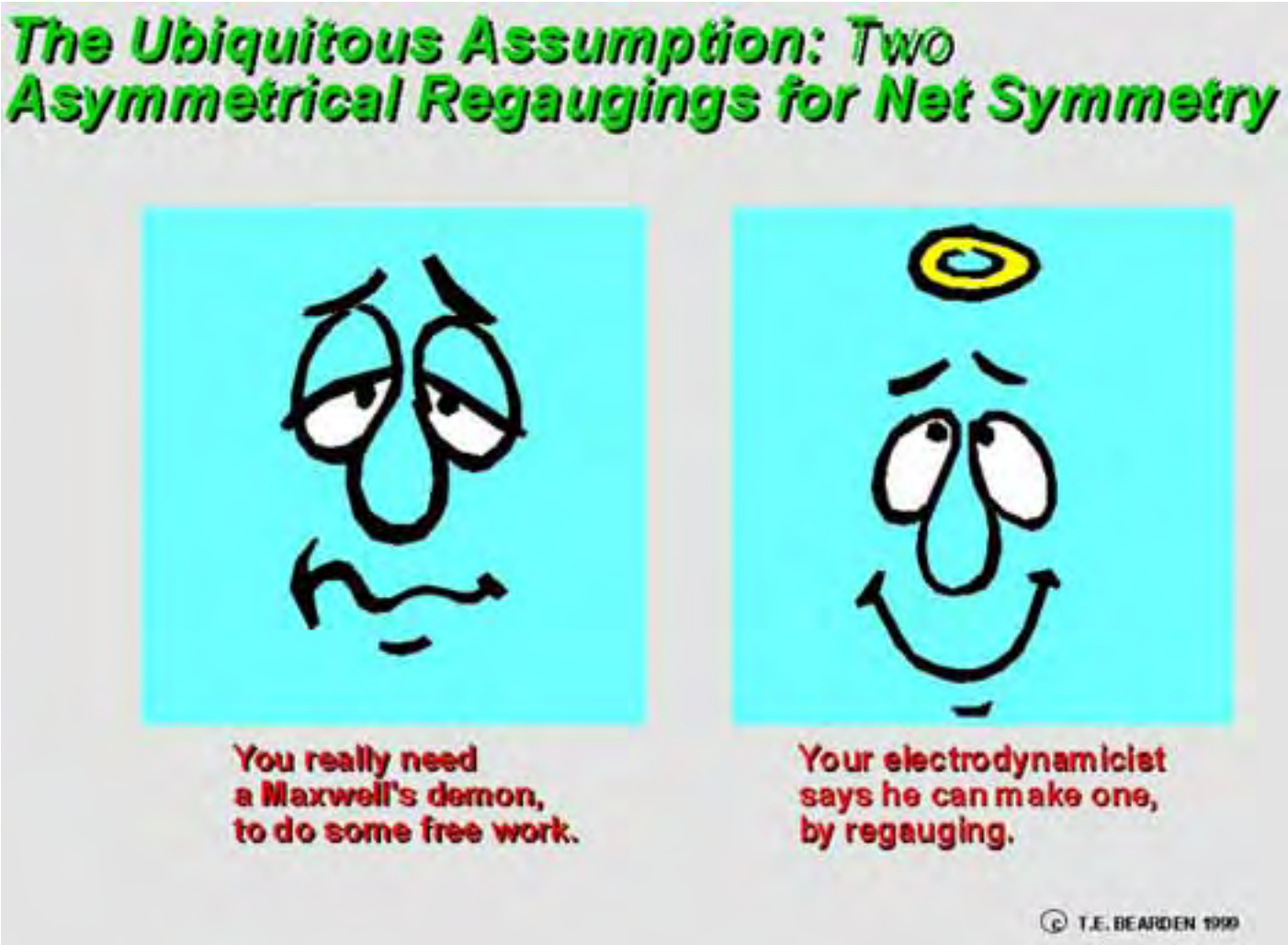
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
You really need a Maxwell's demon, to do some free work.
Your electrodynamicist says he can make one, by regauging.
© T.E. BEARDEN 1999

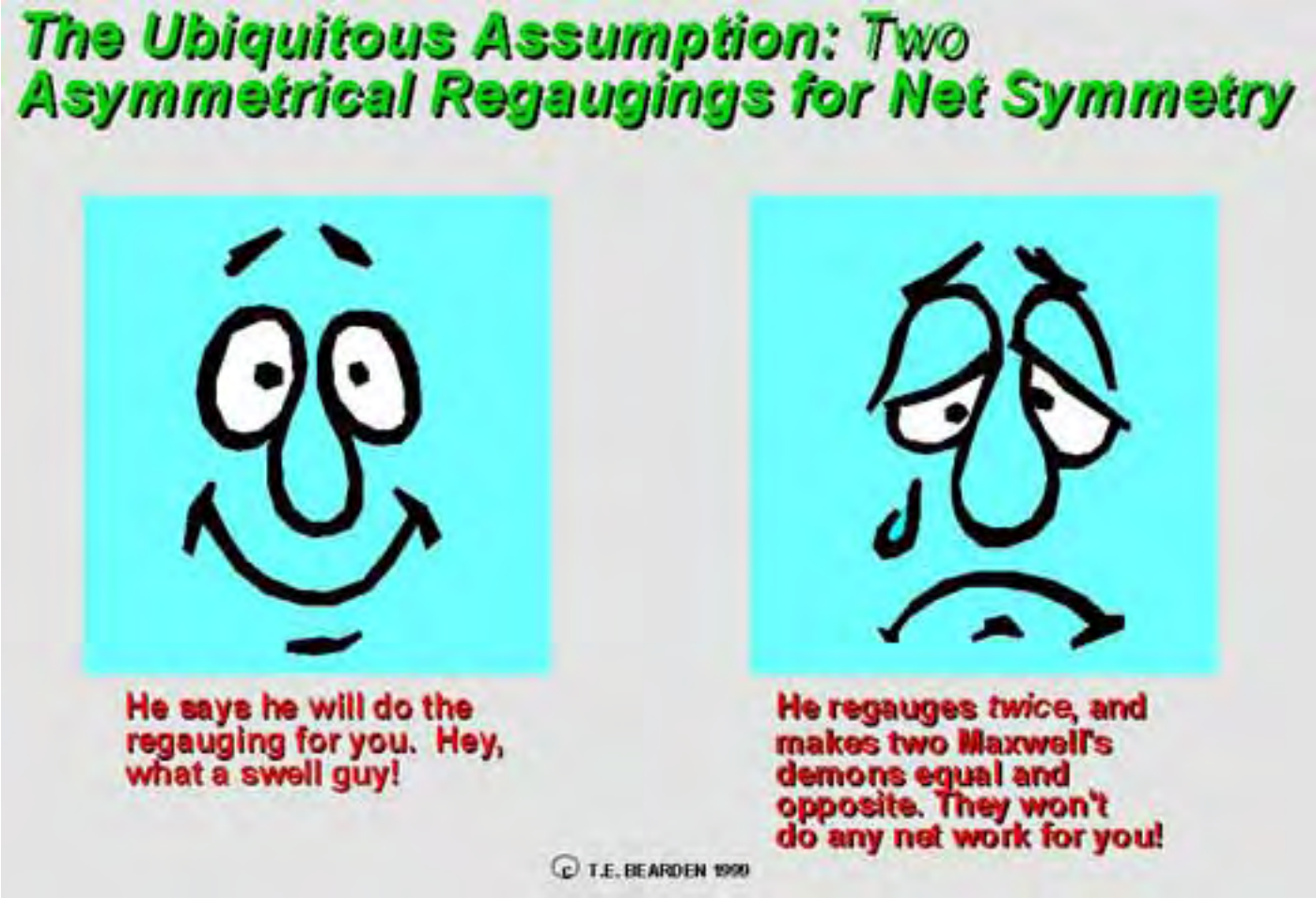
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
He says he will do the regauging for you. Hey, what a swell guy!
He regauges twice, and makes two Maxwell's demons equal and opposite. They won't do any net work for you!
© T.E. BEARDEN 1990

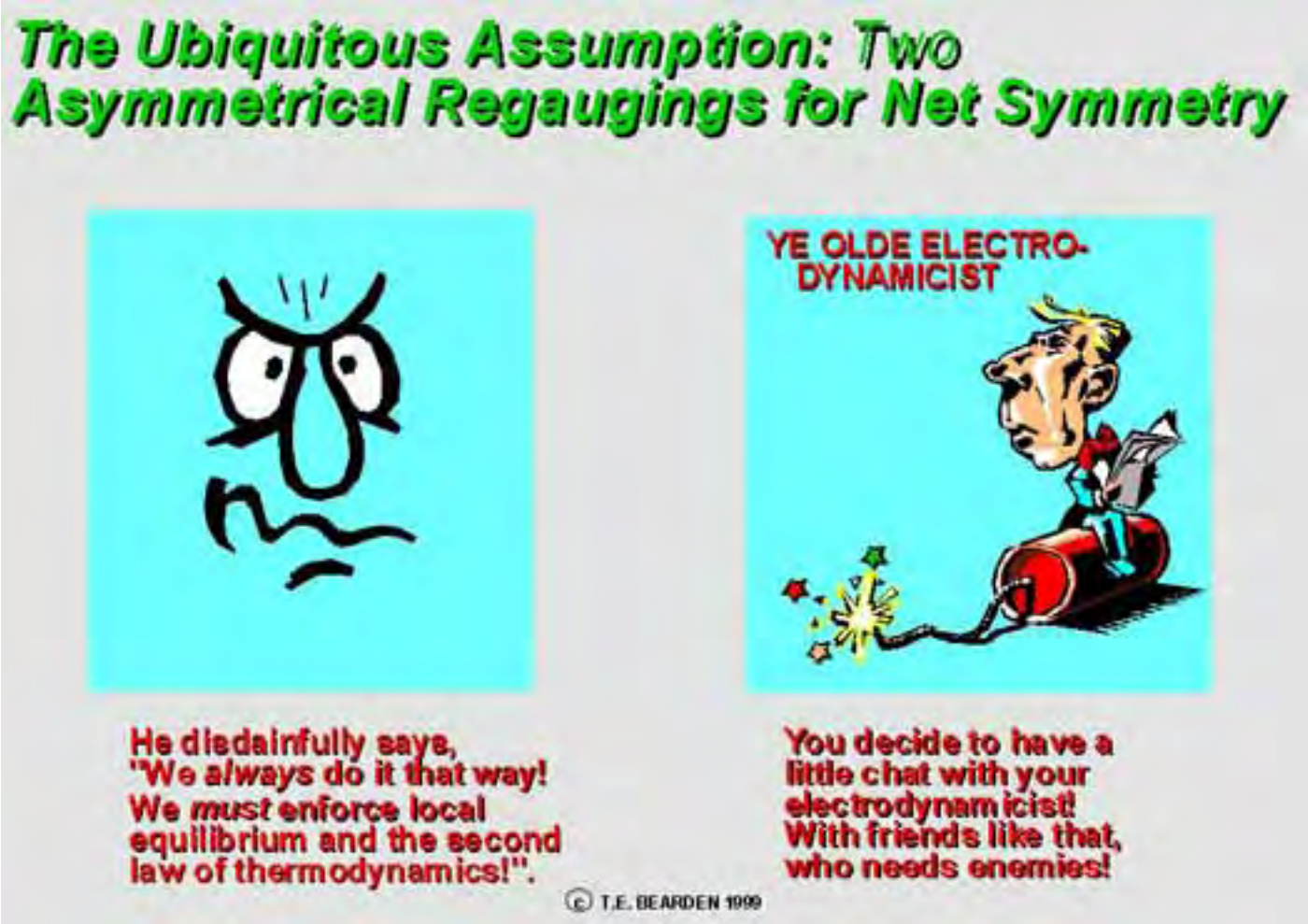
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
YE OLDE ELECTRO-DYNAMICIST
He disdainfully says, "We always do it that way! We must enforce local equilibrium and the second law of thermodynamics!".
You decide to have a little chat with your electrodynamicist! With friends like that, who needs enemies!
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A Charged Particle Is a Coupled System

(The first formal definition of charge)

$$q \equiv \phi_q \times m_q$$

Note: X is a coupling operator

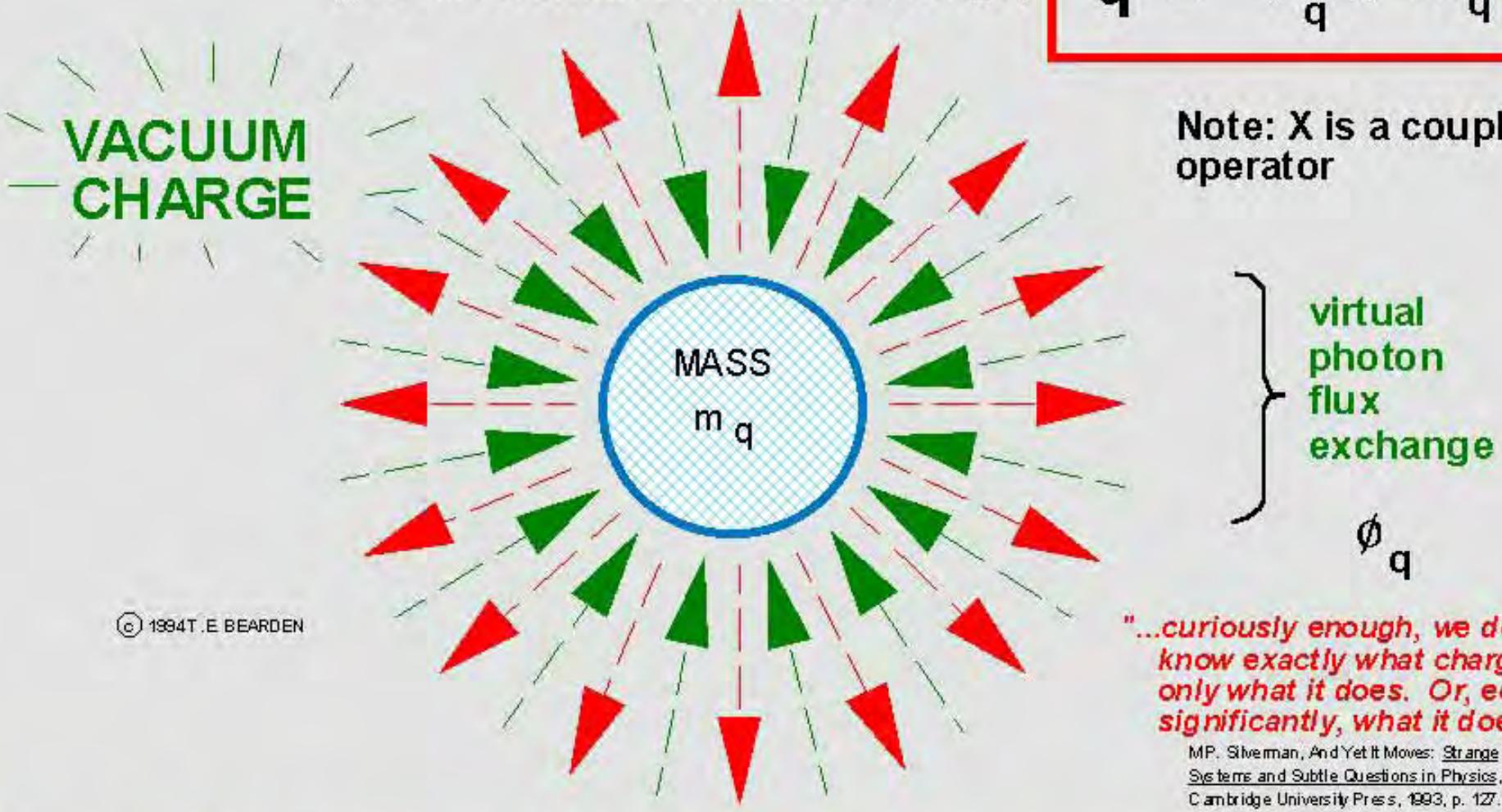

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"...curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."

M.P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, 1993, p. 127.

An electric charge q is a broken symmetry in its fierce energy exchange with the active vacuum. It coherently integrates some of the virtual energy absorbs and outputs it as Poynting energy flow.

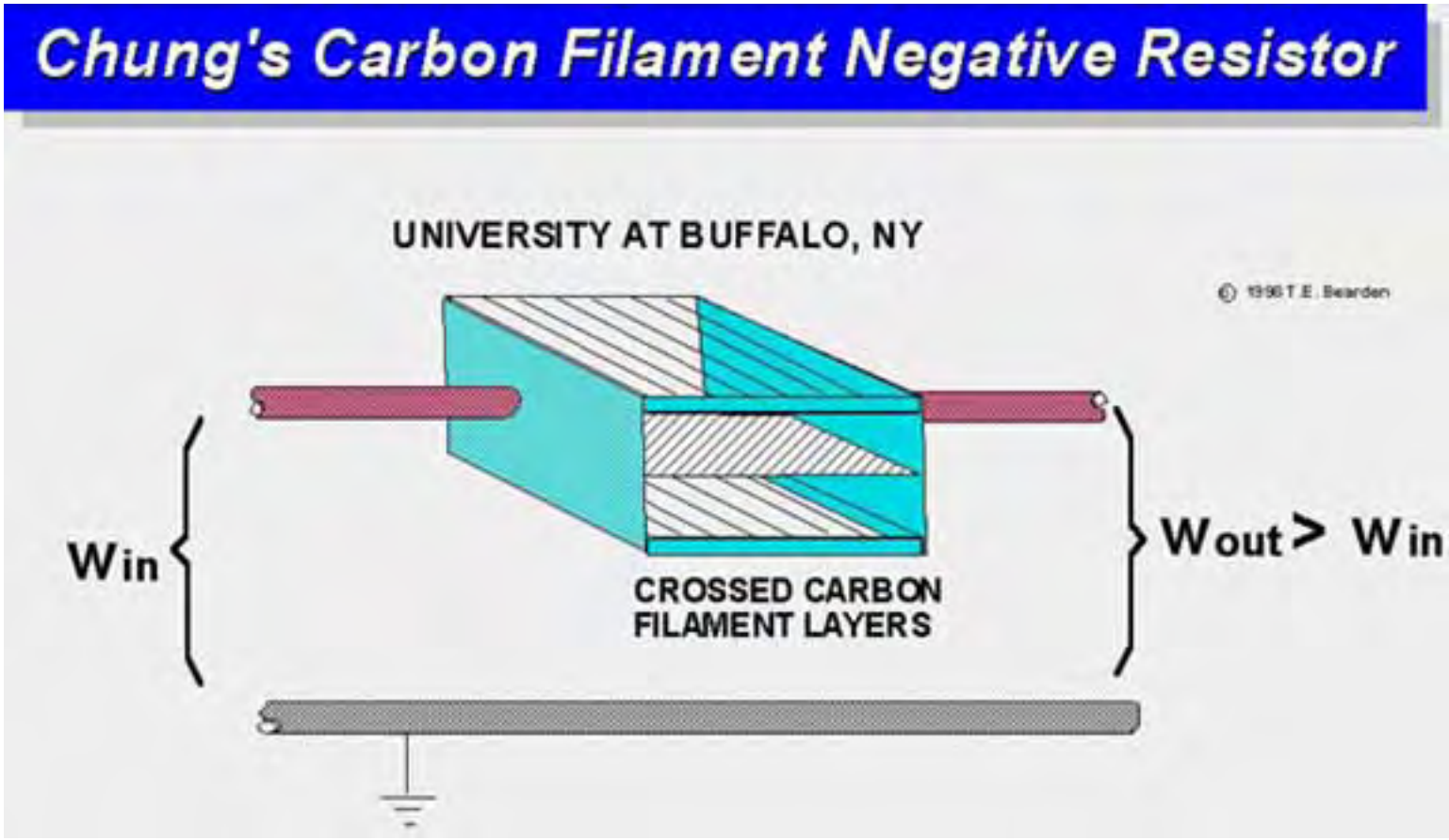
Chung's Carbon Filament Negative Resistor
UNIVERSITY AT BUFFALO, NY
© 1996 T.E. Bearden
Win
Wout > Win
CROSSED CARBON
FILAMENT LAYERS

Typical circuit has about 10^{-13} energy collection efficiency

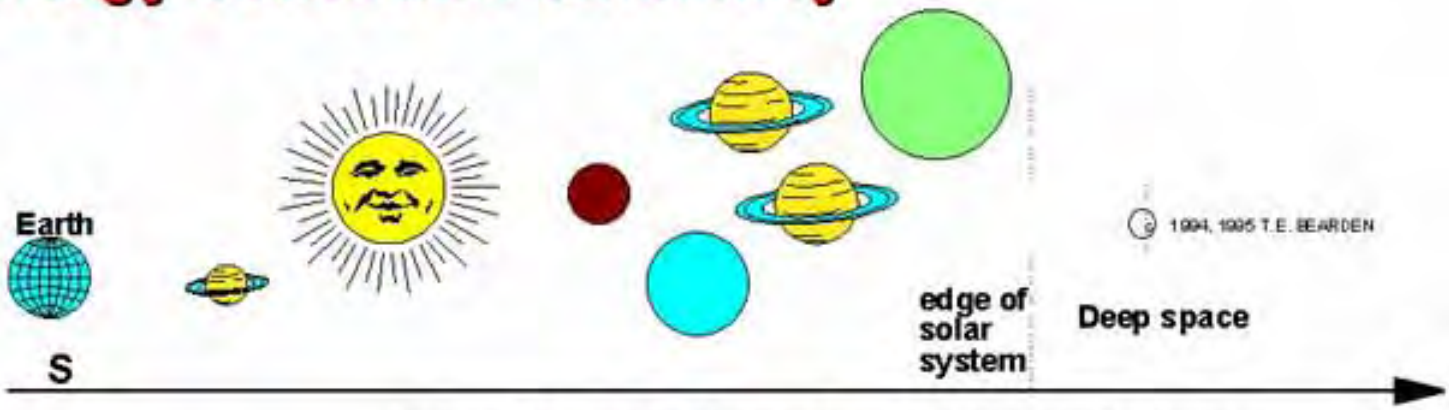

Distance traveled by S in one hour is 1.08x10exp(12) meters.

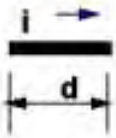

Example: 1.3 amps flowing in DC circuit, 1.8 mm diameter copper wire. J = 51 A/cm ^{2}

d_j = 0.1368 meters

S violently transports ϕ provided from the source.
j ϕ sluggishly transports the energy collected and dissipated in the circuit..

For the case discussed, the electron drift velocity in the circuit is about 3.8 x 10^{-5} meters/sec. So Jϕ moves about 0.1368 meters in one hour. Thus Jϕ has collected about 0.1368 meters of the ϕ-filled S-tube. During that same hour, the S-flow evoked by the power source will have traveled 1.08x10^{12} meters. The ϕ of both currents is the same. Both are involved in the same energy-filled tube. Thus S has provided and transported about 7.89x10^{12} times as much energy along the circuit in one hour as the jϕ has been able to collect, transport, and dissipate as work in the circuit. Thus this circuit provides about 10^{13} collection efficiency.

Classical View of EM

- Potentials just mathematical conveniences
  - Not real
  - No internal structure, just magnitude
- Force fields primary, causative, can exist in space in absence of observable mass
  - All EM actions due to force fields, none when zero
  - No action at a distance
- Vacuum empty; without energy or structure
  - No locally curved spacetime
  - No gravity effects
  - No quantum effects
- Maxwell's equations complete
  - Symmetrically regauged ***arbitrarily***
  - Topology dramatically reduced

Curved Spacetime acts as source or sink

- May emit excess radiation and energy (e.g., heat)
- May absorb radiation and energy (e.g., cool)
- May transduce waves TW ⇔ LW ⇔ TDW
- New energy conservation law applies

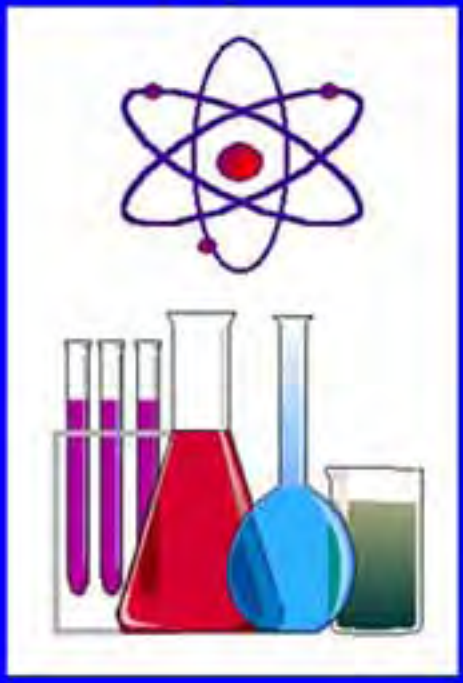

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CHRONIC DISEASE PUZZLING

- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
- MANY TROUBLING FACTORS EXIST
  - *MIND*
  - *STRESS*
  - *SPONTANEOUS REMISSION*
  - *PLACEBO EFFECTS*
  - *COMBINATIONS*
- GENERATION OF THE PLACEBO EFFECT BY THE CELLULAR REGENERATION SYSTEM IS UNRECOGNIZED

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Cancer Characteristics

- Not one disease, but a whole range
- Starts in damaged aerobic cell
- Cell shakes off body's central control
  - Starts uncontrolled division
  - Becomes a lump
- Can send forth cancer cells
  - Through blood
  - Through lymph
- Form metastases (secondary tumors)
- Often become anaerobic

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Solving a Cancer Enigma

- An enigma has been failure of immune system to attack some tumor cells
  - Suppressor cells may curb immune system?
  - Tumor may lack antigens normally identified by the immune system?
- *Promotion of damaged cell to cancer is usually ordered by cellular control system*
  - *Regenerative and recovery system forces cell back toward anaerobe*
  - *First step breaks free from central growth*
  - *Control continues to recognize cell as self*

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CANCER: CHARACTERISTICS

- NOT ONE DISEASE BUT A WHOLE RANGE
- STARTS IN ORDINARY (AEROBIC) CELL
- CELL SHAKES OFF BODY'S DICTATORIAL CONTROL*
- STARTS UNCONTROLLED DIVISION
- BECOMES A LUMP
- CAN SEND FORTH CANCER CELLS
  - THROUGH BLOOD
  - THROUGH LYMPH
- THESE FORM METASTASES (SECONDARY TUMORS)
- OFTEN BECOME ANAEROBIC (NON-OXYGEN USING)
- ENIGMA IS FAILURE OF IMMUNE SYSTEM TO ATTACK SOME TUMOR CELLS
  - SUPPRESSOR CELLS MAY CURB IMMUNE SYSTEM
  - TUMOR MAY LACK ANTIGENS NORMALLY IDENTIFIED BY THE IMMUNE SYSTEM

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*R&R system forces cell back toward anaerobe

Nonlinear Optics
Distortion Correction Theorem

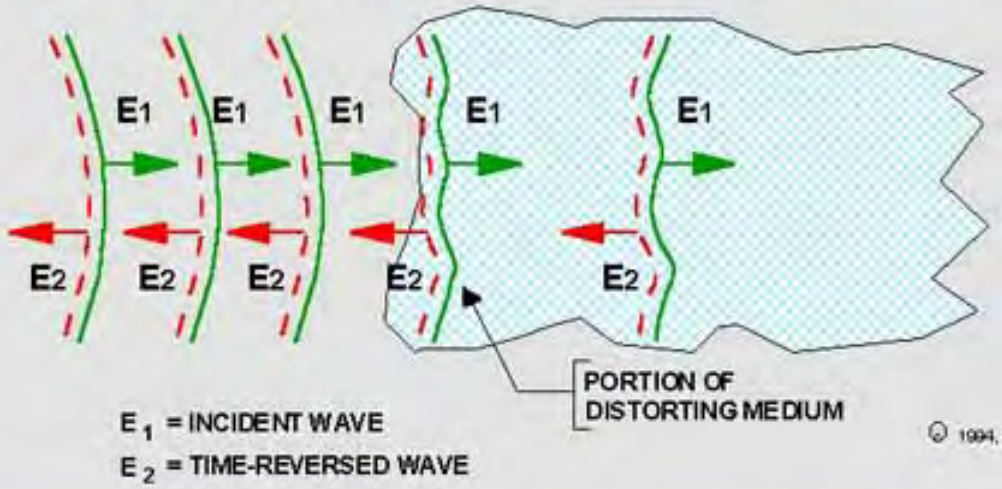

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"If a scalar wave $E_1(r)$ propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica $E_2(r)$, then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1."

The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)

- Nucleon interchange
  - Changes neutron into proton and vice versa
  - At high rate (flat spacetime assumed)
- Statistics become skewed due to curved ST
- Can bias statistics toward either neutron or proton end
  - Biases toward transmutation of elements along isomer chains
  - Concept of "isomer" is vastly expanded

The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)

- **Normal dynamics (impulses) may reverse**
  - *Like charges attract, unlike charges repel*
  - *Positive charges cluster (are drawn together)*
  - *H+ ions (protons) may form quasi-nuclei*
  - *Nucleus coulomb barrier becomes assistant*
- **Many "impossible" reactions now possible**
  - *Quark access and quark flipping by EM*
  - *Ion clustering*
  - *Positive charges as phase conjugate mirrors*
  - *Time-density waves and time-energy charging*

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The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)

- **Not observed until time-energy charging has become substantial**
  - *Time delay (hours, days)*
  - *Transduction of LW --> TW involved*
  - *Specific time-charging history of detectors is involved in twhether they detect or not*
  - *Longitudinal EM waves become significant*
- **Curved spacetime can act as source or sink**
  - *May emit excess radiation*
  - *May absorb excess radiation*

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In Time-Reversed Zone:
Nuclear reactions are biased

- In normal flat ST, n ⇔ p at high rate
- Curved ST skews statistics
- Biases to either n or p
- Biases to transmutation along isomer chain
- "Isomer" concept greatly expanded

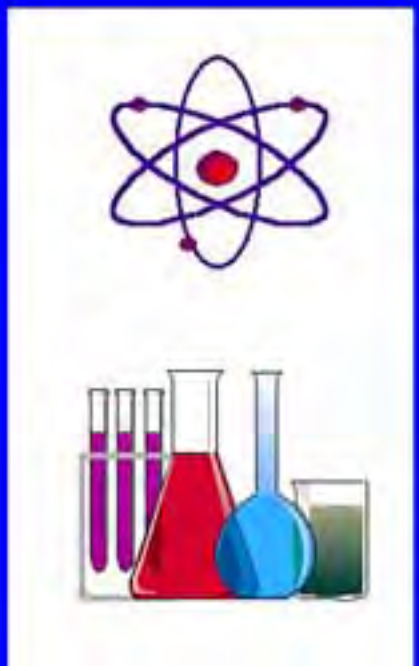

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In Time-Reversed Zone: Dynamics may be reversed

- Like charges may attract and unlike charges repel
- Coulomb barrier becomes Coulomb assistant
- Clusters like charges and forms artificial nuclei
- "Impossible" nuclear reactions at low energy
- Time-density interactions

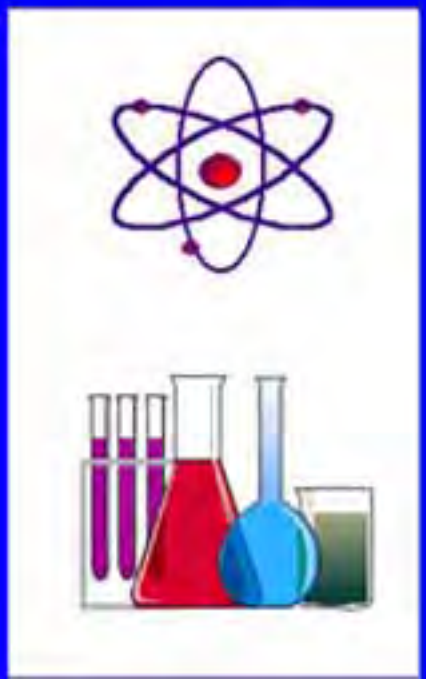

Time-Reversed Zone:

Significant only after time-density charging

- Hours, for "fast" onset
- Days, for "slower" onset
- Transduction involved for TW ⇔ LW ⇔ TDW
- Time-history of each detector is significant
- Longitudinal EM waves become significant

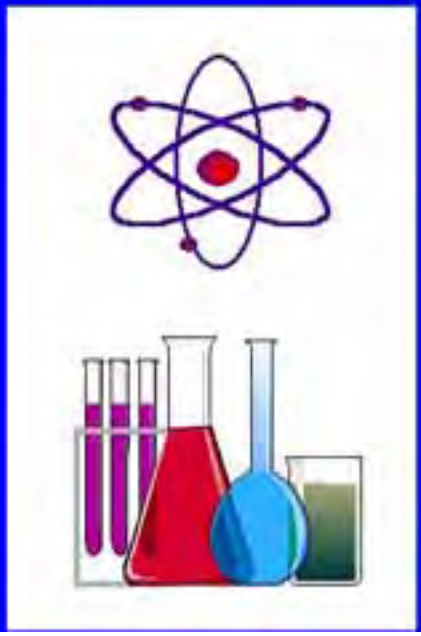

A New Conservation of Energy Law

- Physics conserves total "energy and mass-energy"
- Now also must consider "time-energy"
- Conserve total mass-time-energy (spatiotemporal energy)
- Let E_T = total energy, E_M = mass energy, E_E = ordinary energy, and E_t = time energy. Then

$$E_T = E_E + E_M + E_t$$

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$$(kE_t \Rightarrow E_E > 0) \Rightarrow E_T > (E_M + E_E)$$

- If some E_t is transduced into E_E, the experiment will violate the old spatial mass-energy conservation law

QUESTIONS ON CARCINOGENS AND EM RADIATION

- UNRESOLVED QUESTIONS ON EM RADIATION
  - DOSAGES
  - ACTIVE MECHANISMS
  - REPLICATION DIFFICULTIES
  - MEASUREMENT DIFFICULTIES
  - WHERE, WHEN, HOW ILL EFFECTS OCCUR
- SIMILAR QUESTIONS EXIST ABOUT EVERY CARCINOGEN
- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
  - FACTORS SUCH AS MIND, STRESS, SPONTANEOUS REMISSION, PLACEBO EFFECTS, AND COMBINATIONS OF FACTORS ARE PARTICULARLY TROUBLESOME
  - GENERATION OF THE PLACEBO EFFECT BY THE REGENERATION & RECOVERY SYSTEM IS UNRECOGNIZED

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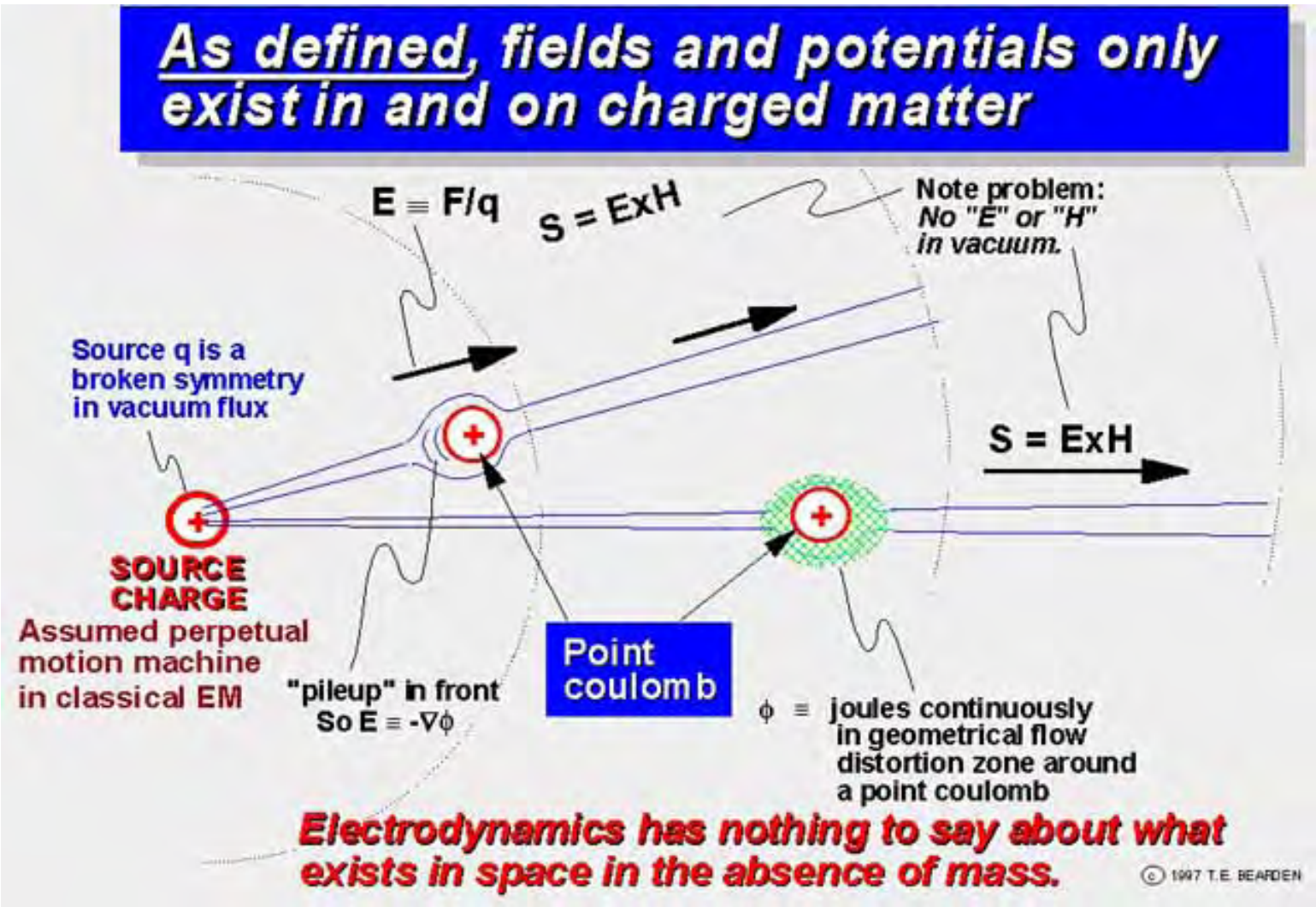
As defined, fields and potentials only exist in and on charged matter
E ≡ F/q
S = ExH
Note problem:
No "E" or "H"
in vacuum.
Source q is a
broken symmetry
in vacuum flux
S = ExH
SOURCE
CHARGE
Assumed perpetual
motion machine
in classical EM
"pileup" in front
So E ≡ -∇ϕ
Point
coulomb
ϕ ≡ joules continuously
in geometrical flow
distortion zone around
a point coulomb
Electrodynamics has nothing to say about what
exists in space in the absence of mass.
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Serious flaws and errors in classical EM theory.

1. Eliminates the Internal EM Inside the Scalar Potential.
2. No Definition of Electrical Charge or of Scalar Potential.
3. Equations Still Assume Material Ether Per Maxwell (Unchanged).
4. Use of Force Fields in Vacuum is False (and Known to be So).
5. Treats Charge q as Unitary Instead of Coupled System $q = \phi[q]m(q)$.
6. Confuses Massless Potential Gradients as Forces (See #3, #4).
7. Does Not Utilize Mass as a Component of Force (See #23).

8. Erroneously Assumes EM Force Fields as Primary Causes.
9. Topology of EM Model Has Been Substantially Reduced.
10. Does Not Include Quantum Potential or Action at a Distance.
11. Does Not Include Superluminal Velocity of Inner EM Components.
12. Does Not Utilize Extended Near-Field Coulomb Gauge Effects.
13. Does Not Include EM Generatrix Mechanism for Time Flow.
14. Does Not Unify Photon and Wave Aspects (Requires 7-D Model).

15. Does Not Include Electron Spin and Precession (See #19, #24).
16. Treats EM Energy As Existing In "Chunks," Instead of as Flow.
17. Confuses Energy and Energy Collection (See #16).
18. Discards Half of Every EM Wave in Vacuum (See #22).
19. Erroneously Uses Transverse Vacuum Wave; It's Longitudinal.
20. Arbitrarily Regauges Maxwell's Equations to Eliminate Overunity.
21. Omits Phase Conjugate Optics Effects (The *Rule* in Internal EM).
22. Does Not Include EM Cause of Newtonian Reaction Force.
23. Erroneously Assumes Separate Force Acting on Separate Mass.
24. Confuses Detected Electron Precession Waves as Proving Transverse EM Waves in Vacuum (Remnant of Old "EM Fluid" Concept).
25. Due to Error in String Wave, Omits the Ubiquitous Antiwave.
26. *Assumes* Equilibrium; Not True Unless Include Vacuum Interactions.
27. Higher Topology Required, to Model Electromagnetic Reality.
28. Lorentz surface integration discards Poynting energy transport.
29. Has nothing at all to say about form of EM entities in massless space.
30. Eliminates the infolded general relativity using EM-force as curve agent.
31. Does not include longitudinal EM waves as time domain oscillations.
32. Does not include EM mechanism that generates time flow and flow rate.

© T.E. [illegible] 1991, 1997

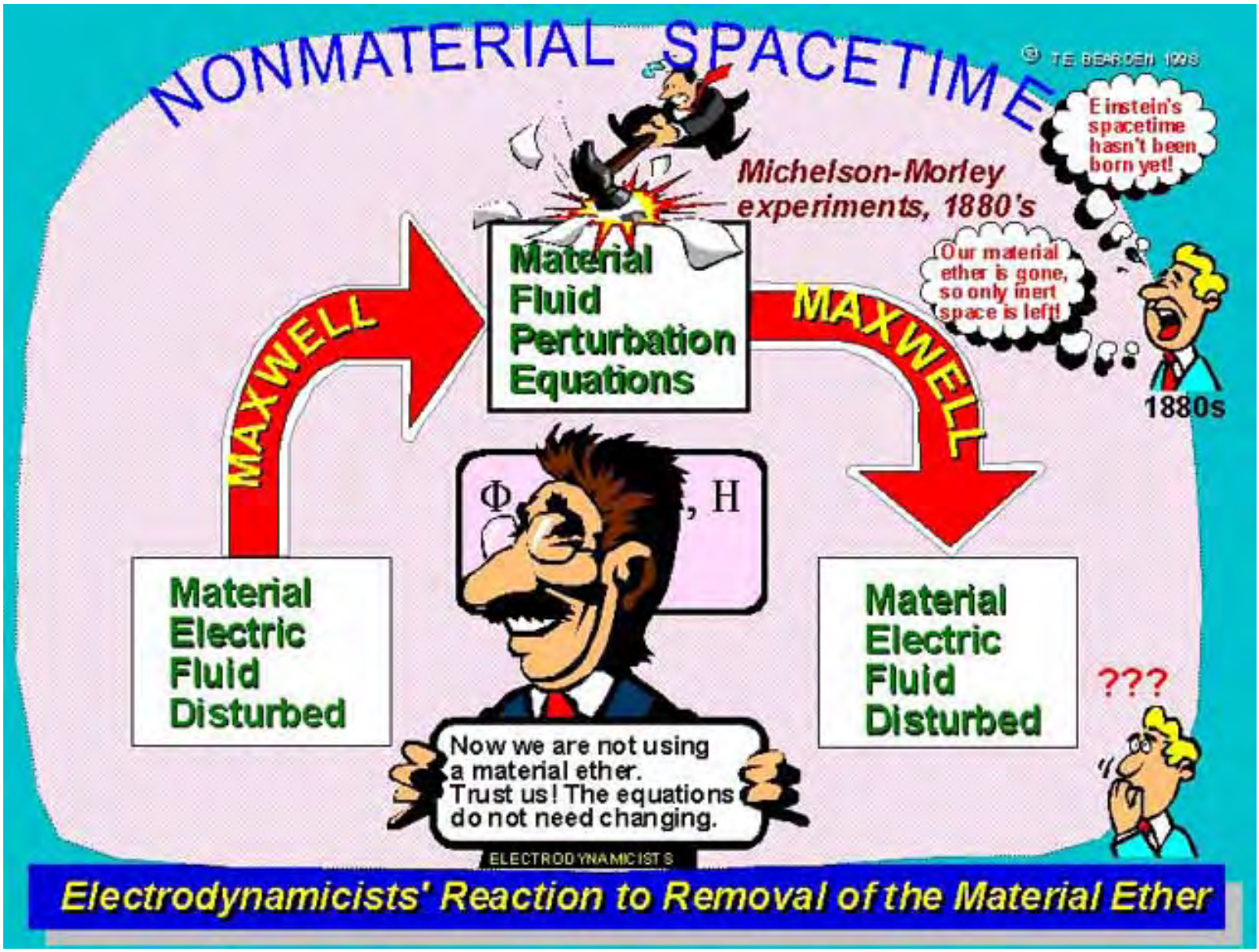
NONMATERIAL SPACETIME
© T.E. BEARDEN 1998
Einstein's spacetime hasn't been born yet!
Michelson-Morley experiments, 1880's
Our material ether is gone, so only inert space is left!
1880s
MAXWELL
Material Fluid Perturbation Equations
MAXWELL
Φ
, H
Material Electric Fluid Disturbed
Material Electric Fluid Disturbed
???
Now we are not using a material ether. Trust us! The equations do not need changing.
ELECTRODYNAMICISTS
Electrodynamicists' Reaction to Removal of the Material Ether

REACTION TO LOSS OF MATERIAL ETHER
Material Ether Assumed in Equations
Potentials, Fields, and Waves Assumed Material
Not a single equation was changed!
Now we are not using a material ether. Trust us! The equations do not need changing.
© T.E. BEARDEN 1999
ELECTRODYNAMICISTS

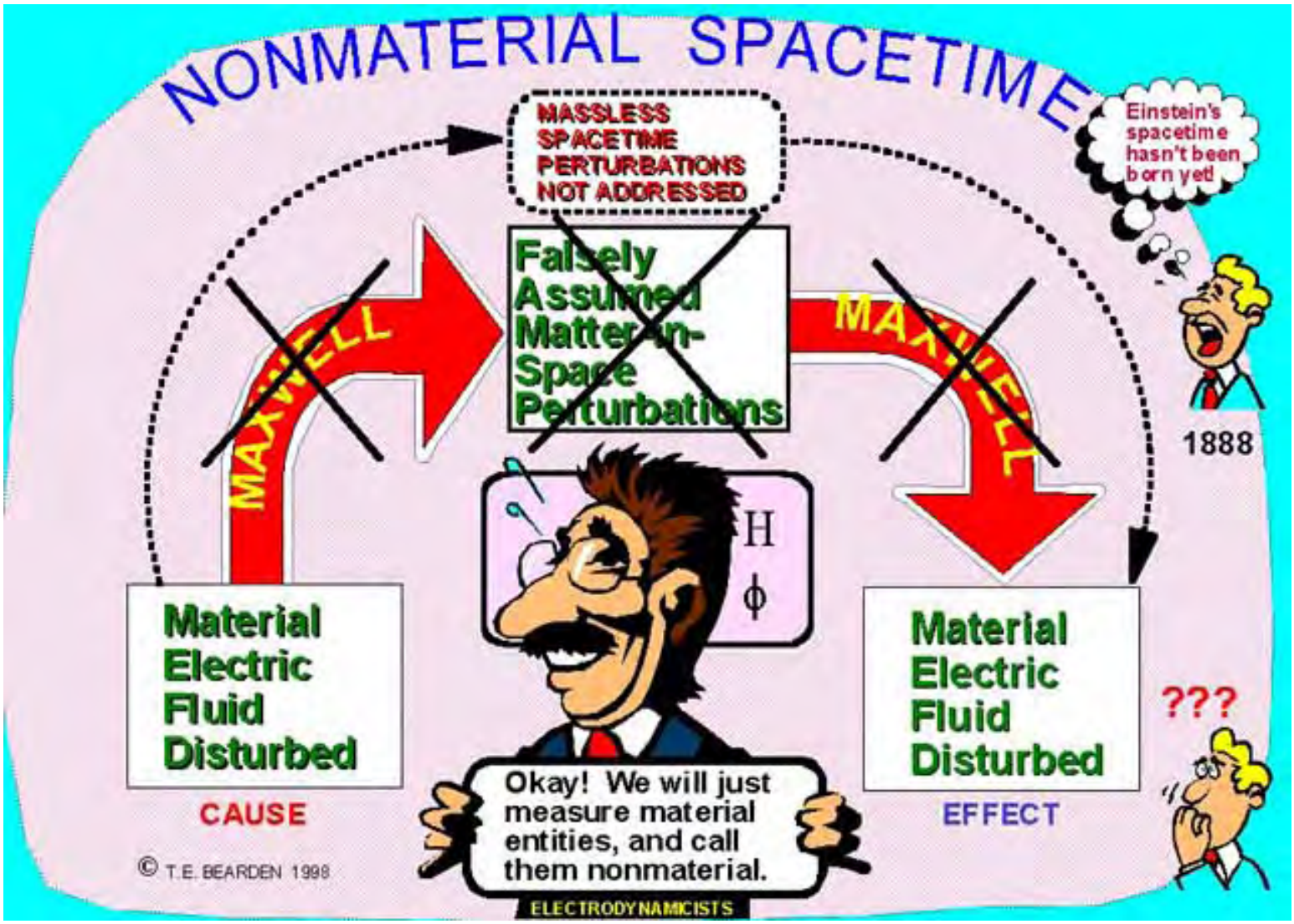
NONMATERIAL SPACETIME
MASSLESS SPACETIME PERTURBATIONS NOT ADDRESSED
Einstein's spacetime hasn't been born yet!
Falsely Assumed Matter-in-Space Perturbations
MAXWELL
MAXWELL
1888
H
ϕ
Material Electric Fluid Disturbed
CAUSE
Material Electric Fluid Disturbed
EFFECT
???
Okay! We will just measure material entities, and call them nonmaterial.
ELECTRODYNAMICISTS
© T.E. BEARDEN 1998

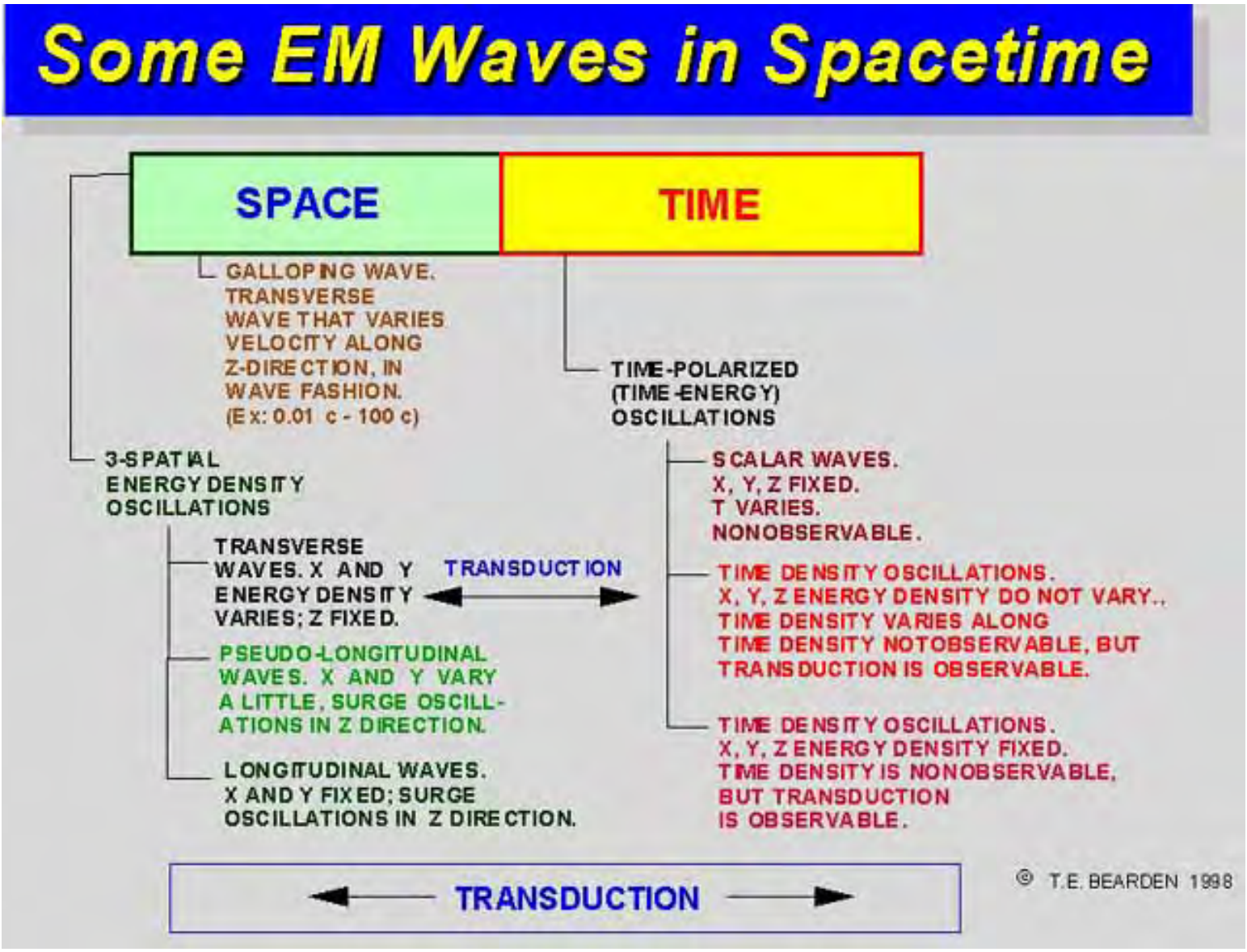
Some EM Waves in Spacetime
SPACE
TIME
GALLOPING WAVE. TRANSVERSE WAVE THAT VARIES VELOCITY ALONG Z-DIRECTION, IN WAVE FASHION. (Ex: 0.01 c - 100 c)
TIME-POLARIZED (TIME-ENERGY) OSCILLATIONS
3-SPATIAL ENERGY DENSITY OSCILLATIONS
SCALAR WAVES. X, Y, Z FIXED. T VARIES. NONOBSERVABLE.
TRANSVERSE WAVES. X AND Y ENERGY DENSITY VARIES; Z FIXED.
TRANSDUCTION
TIME DENSITY OSCILLATIONS. X, Y, Z ENERGY DENSITY DO NOT VARY., TIME DENSITY VARIES ALONG TIME DENSITY NOTOBSERVABLE, BUT TRANSDUCTION IS OBSERVABLE.
PSEUDO-LONGITUDINAL WAVES. X AND Y VARY A LITTLE, SURGE OSCILLATIONS IN Z DIRECTION.
LONGITUDINAL WAVES. X AND Y FIXED; SURGE OSCILLATIONS IN Z DIRECTION.
TIME DENSITY OSCILLATIONS. X, Y, Z ENERGY DENSITY FIXED. TIME DENSITY IS NONOBSERVABLE, BUT TRANSDUCTION IS OBSERVABLE.
TRANSDUCTION
© T.E. BEARDEN 1998

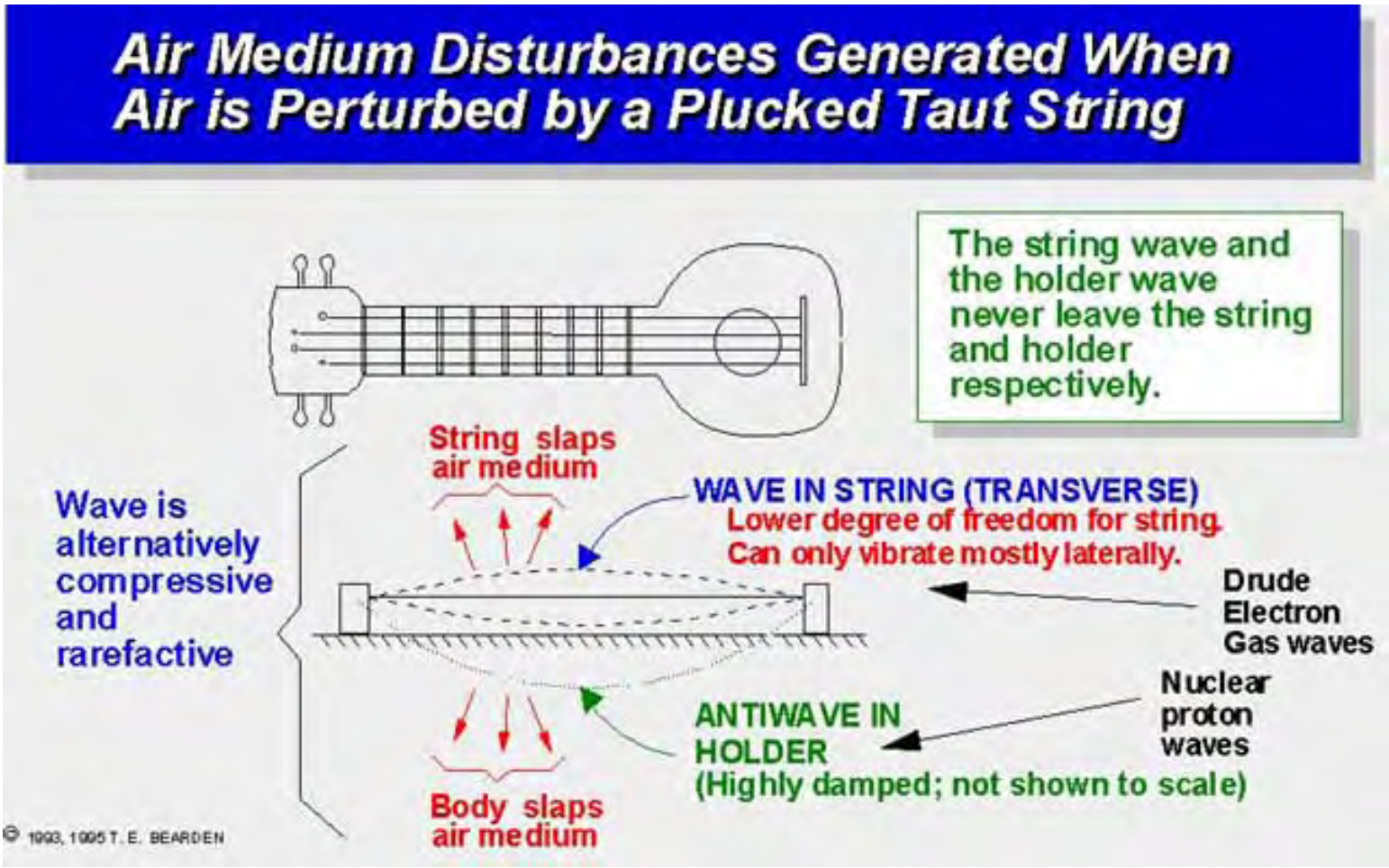
Air Medium Disturbances Generated When Air is Perturbed by a Plucked Taut String
The string wave and the holder wave never leave the string and holder respectively.
String slaps air medium
Wave is alternatively compressive and rarefactive
WAVE IN STRING (TRANSVERSE)
Lower degree of freedom for string.
Can only vibrate mostly laterally.
Drude Electron Gas waves
Nuclear proton waves
ANTIWAVE IN HOLDER
(Highly damped; not shown to scale)
Body slaps air medium
© 1993, 1995 T. E. BEARDEN

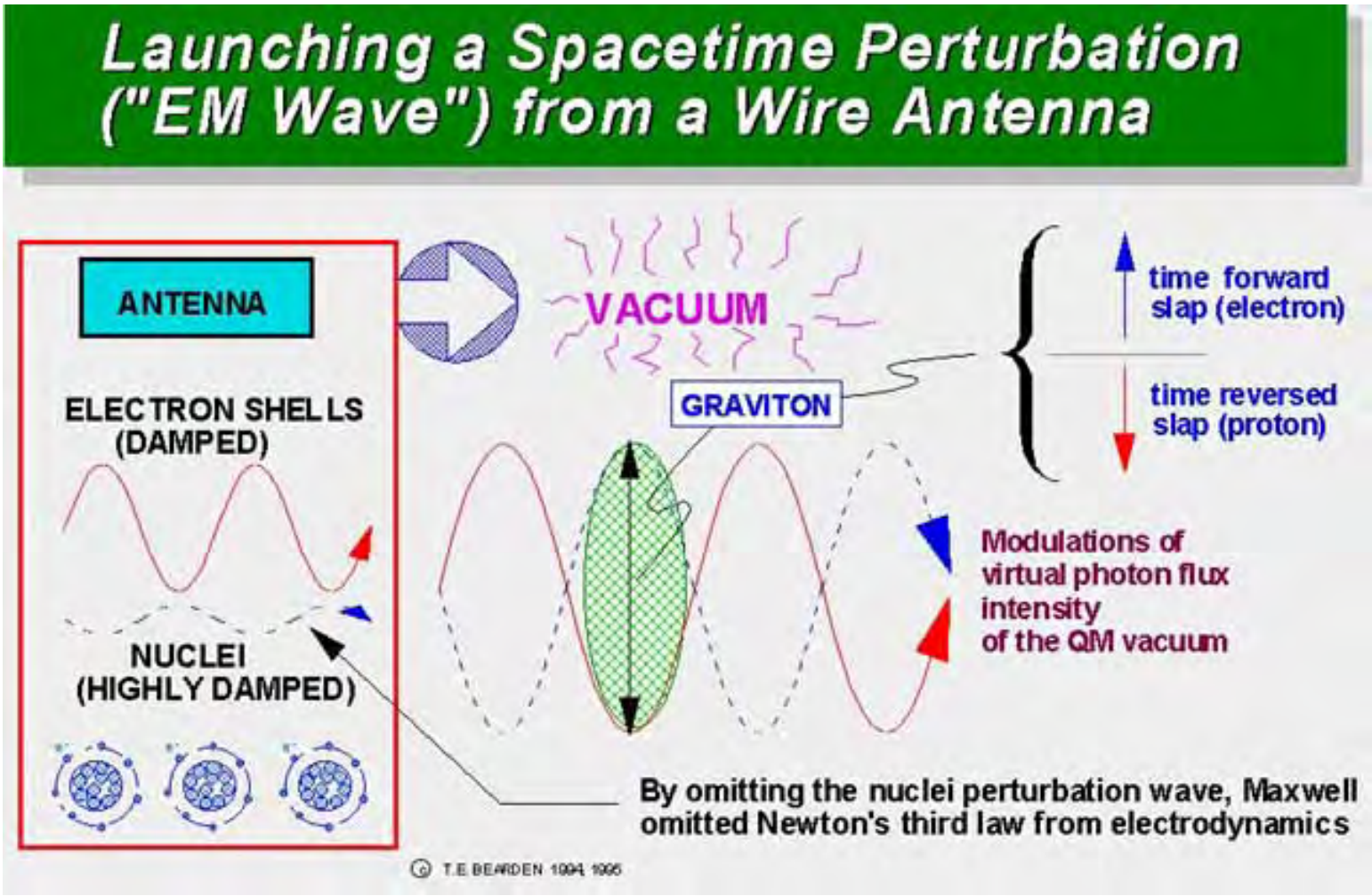
Launching a Spacetime Perturbation ("EM Wave") from a Wire Antenna
ANTENNA
ELECTRON SHELLS (DAMPED)
NUCLEI (HIGHLY DAMPED)
VACUUM
GRAVITON
time forward slap (electron)
time reversed slap (proton)
Modulations of virtual photon flux intensity of the QM vacuum
By omitting the nuclei perturbation wave, Maxwell omitted Newton's third law from electrodynamics
© T.E BEARDEN 1994 1995

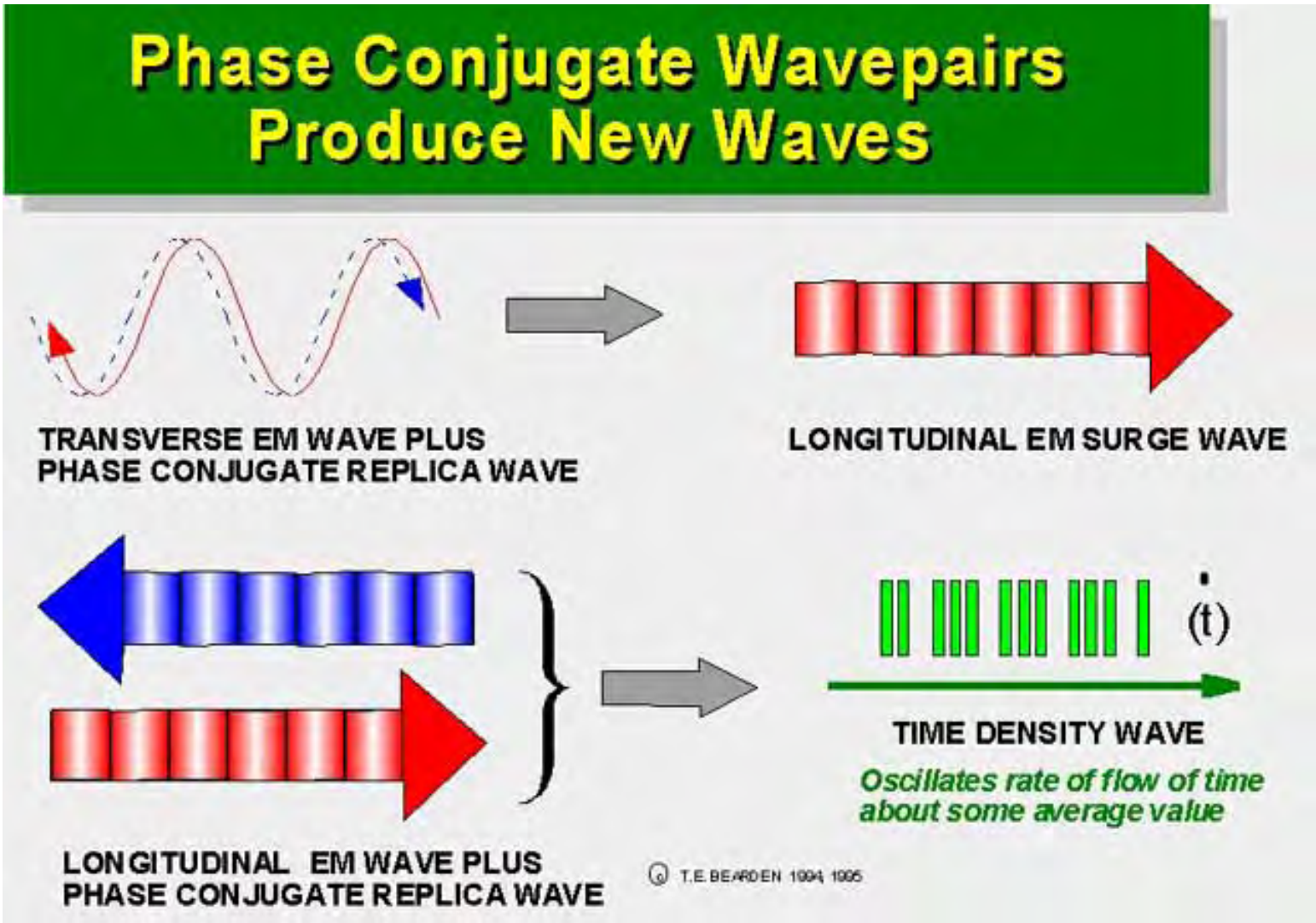
Phase Conjugate Wavepairs
Produce New Waves
TRANSVERSE EM WAVE PLUS
PHASE CONJUGATE REPLICA WAVE
LONGITUDINAL EM SURGE WAVE
LONGITUDINAL EM WAVE PLUS
PHASE CONJUGATE REPLICA WAVE
(t)
TIME DENSITY WAVE
Oscillates rate of flow of time
about some average value
© T.E. BEARDEN 1994, 1995

Scalar Electromagnetics (Energetics) View of EM

- Potentials real; primary causes of EM phenomena
  - Force fields made by differentiations of potentials
  - Force fields are effects, not primary causes
  - Force fields exist only in, on mass particles
- Actions due to potentials and their interference
  - Action at a distance or locally
  - Quantum potential and hidden variables
- Locally curved spacetime, engineerable by EM
  - Gravity effects not necessarily negligible
  - Strong EM force or time used as agent of curvature

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Scalar Electromagnetics (Energetics) View of EM (Cont'd)

- Potentials have internal structure
  - Stoney/Whittaker structure
  - Longitudinal EM phase conjugate wavepairs
  - Each wavepair is a time-polarized EM wave
- Vacuum EM is a potential and has microstructure
  - Stoney-Whittaker biwaves/t-polarized waves
  - Fluctuations exhibit chaos
- Spacetime ≡ Vacuum ≡ Potential ≡ Flux

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Scalar Electromagnetics (Energetics) View of EM (Cont'd)

- Statistics may have hidden order (already chaotic)
- Uses spacetime curvature engines to alter matter (inside-out or outside-in)
- Engineerable EM mechanism generates rate of flow of a mass through time
- Quantum potential with specific QP can be used for instant action at a distance

Extended General Relativity Principle

- "All levels of energy structures and all levels of time structures mold spacetime geometry.
- This is called a ***vacuum engine*** (spacetime engine).
- Spatial and temporal structuring act upon mass at all levels.
- This produces ***templates*** of forces, for translations and stresses."

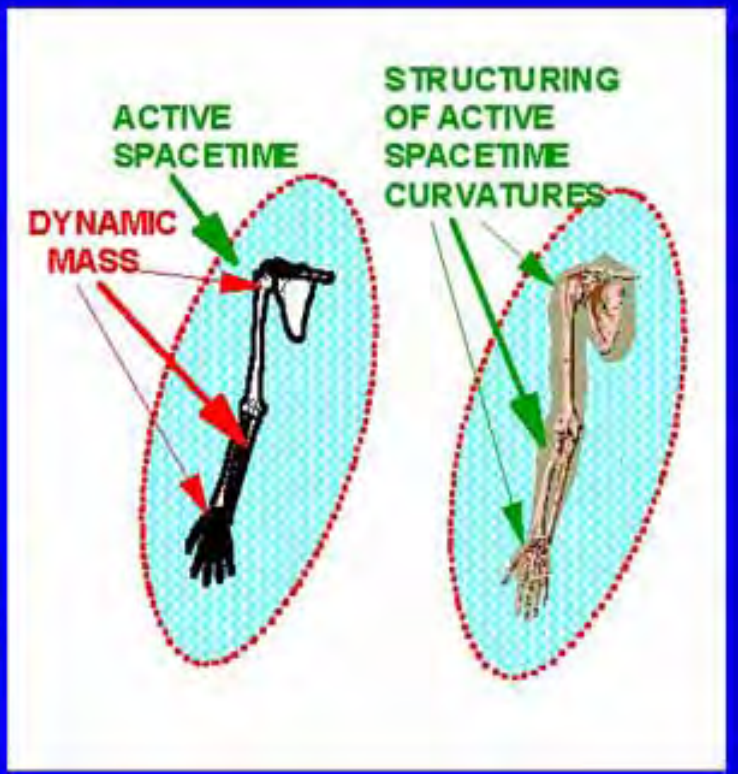

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Extension of Work-Energy Theorem

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- *Theorem:* $W = k_f - k_i = \Delta k$ [1]
- k must be interpreted not as energy *per se*, but as *collected/collecting* energy.
- The reaction cross section λ for the collecting process must be included.
- *Extension:* $W = \lambda (k_f - k_i) = \lambda \Delta k$ [2]
- Normally $\lambda \leq 1$, as for elastic collision or Stokes emission.
- However, $\lambda > 1$ is now possible, for processes which asymmetrically self-regauge. An example is Letokhov's negative absorption of the medium.
- Working models are the Patterson Power Cell® and Lawandy lasing without population inversion.

MTW's General Relativity Principle

- "Space acts on matter, telling it how to move.
- In turn, matter reacts back on space, telling it how to curve."

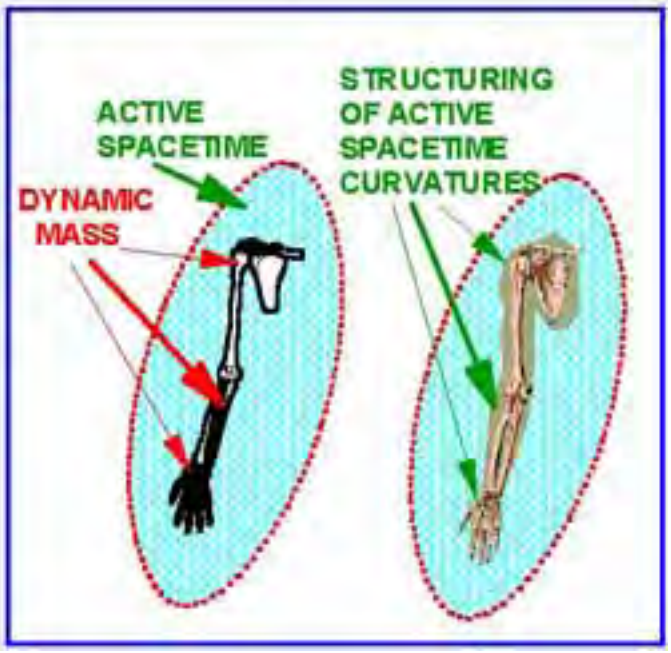

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Use of General Relativity (GR) in Particle Physics

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- GR seldom used in particle physics
- In cold fusion, Matsumoto* has applied general relativity
- Consistent with important cold fusion results
- Used spacetime (ST) curvature by energy density
- Matsumoto did not utilize:
  - Longitudinal EM waves
  - Time density waves
  - Time density curvatures of ST (gain = $9 \times 10_{16}$)

* T. Matsumoto, "Mechanisms of Electro-Nuclear Collapse," Proc. ICCF-7, Vancouver, BC, Canada, Apr. 1998, p. 98

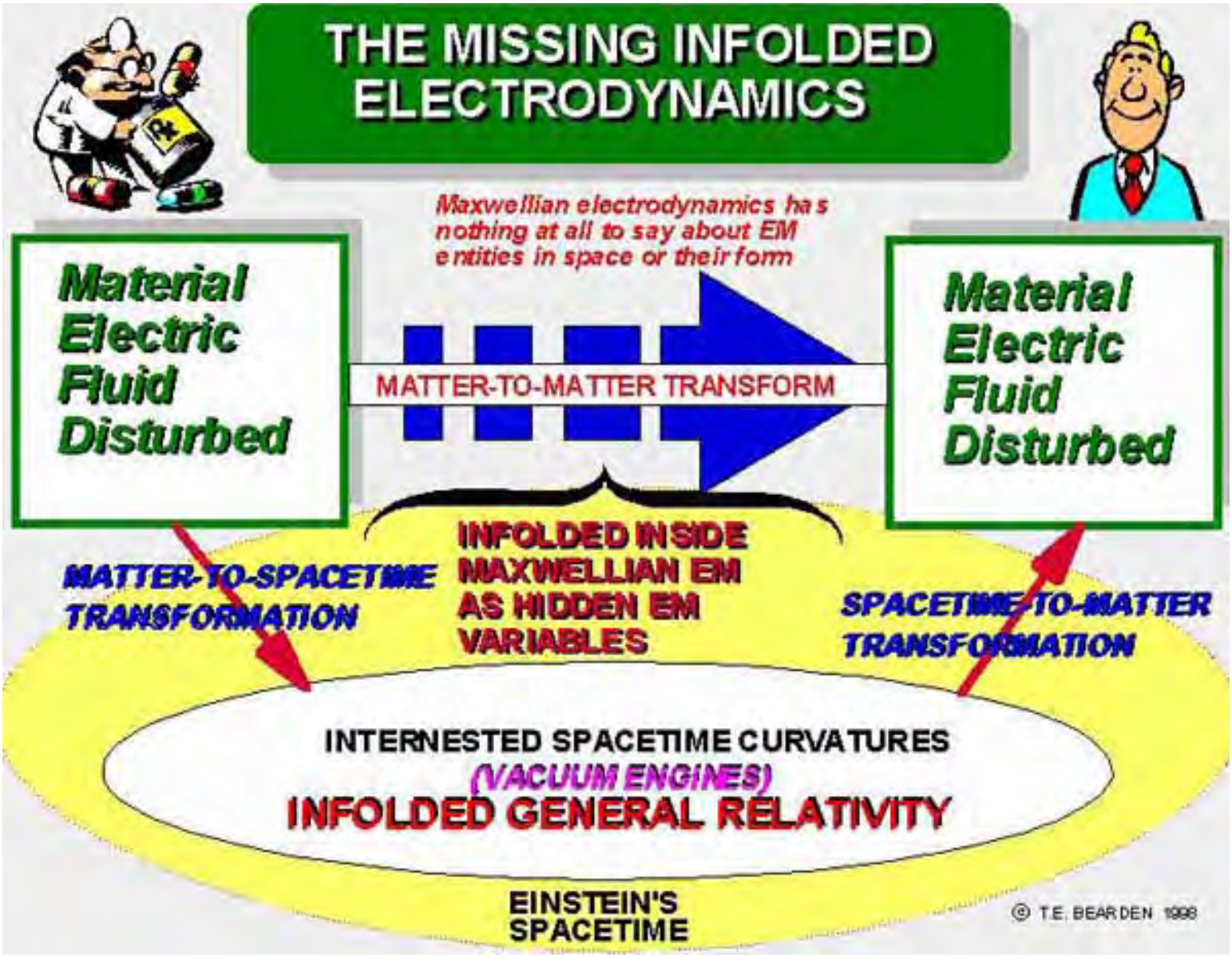
THE MISSING INFOLDED ELECTRODYNAMICS
Maxwellian electrodynamics has nothing at all to say about EM entities in space or their form
Material Electric Fluid Disturbed
MATTER-TO-MATTER TRANSFORM
Material Electric Fluid Disturbed
INFOLDED INSIDE MAXWELLIAN EM AS HIDDEN EM VARIABLES
MATTER-TO-SPACETIME TRANSFORMATION
SPACETIME-TO-MATTER TRANSFORMATION
INTERNESTED SPACETIME CURVATURES
(VACUUM ENGINES)
INFOLDED GENERAL RELATIVITY
EINSTEIN'S SPACETIME
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Infolded Engines: Excluded by Present Physics

- *The infolded dynamics of EM systems are not considered in general relativity, electromagnetics, or quantum mechanics*
- *None of these disciplines include such spacetime curvature engines (vacuum engines)*
- *Thus GR, EM, and QM cannot be unified, since ST curvature engines are where the unification mainly occurs*

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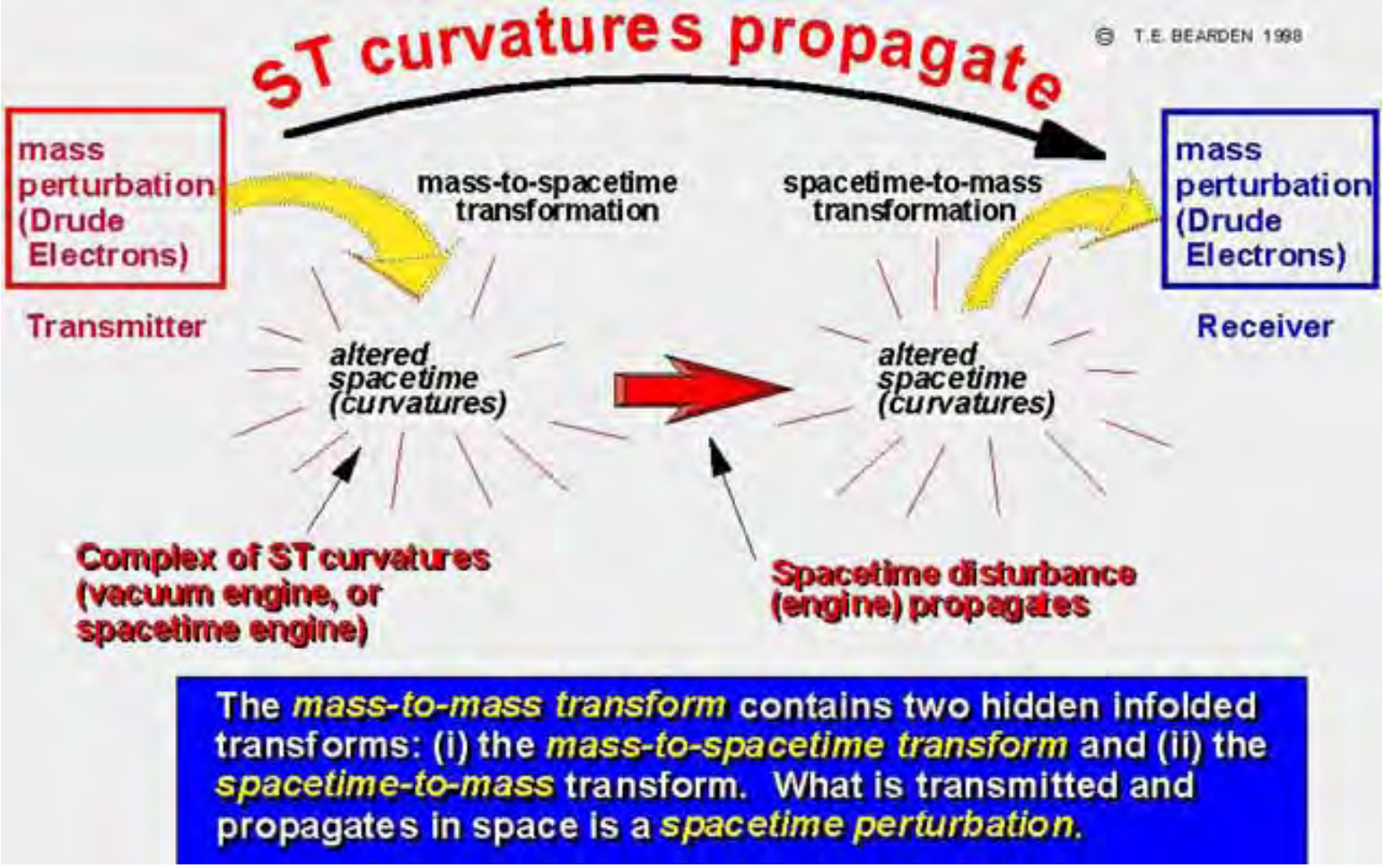
ST curvatures propagate
© T.E. BEARDEN 1998
mass perturbation (Drude Electrons)
Transmitter
mass-to-spacetime transformation
spacetime-to-mass transformation
mass perturbation (Drude Electrons)
Receiver
altered spacetime (curvatures)
altered spacetime (curvatures)
Complex of ST curvatures (vacuum engine, or spacetime engine)
Spacetime disturbance (engine) propagates
The mass-to-mass transform contains two hidden infolded transforms: (i) the mass-to-spacetime transform and (ii) the spacetime-to-mass transform. What is transmitted and propagates in space is a spacetime perturbation.

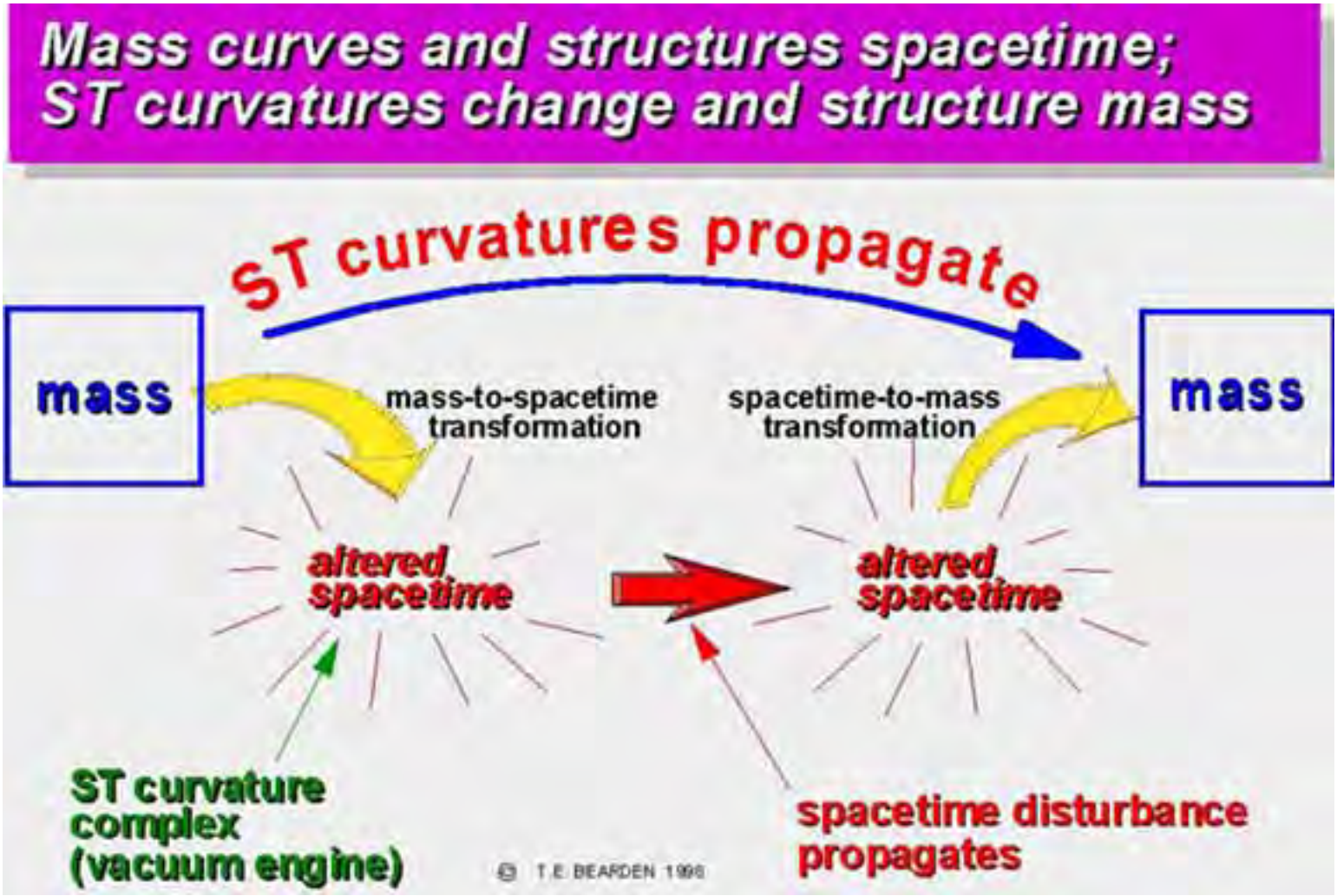
Mass curves and structures spacetime;
ST curvatures change and structure mass
ST curvatures propagate
mass
mass-to-spacetime transformation
spacetime-to-mass transformation
mass
altered spacetime
altered spacetime
ST curvature complex (vacuum engine)
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spacetime disturbance propagates

At Infinite Velocity:
Each Is Every Other
SPACETIME
VIRTUAL PARTICLE FLUX
POTENTIAL
MIND AND MIND LEVELS
MASS
PLANET
LIVING ORGANISMS
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Lisitsyn's Report: Brain Code Broken

- THEORY DEVELOPED AND FITTED
- HYSTERESIS MEMORY LOOP
- CONTROLLED EM INDUCTION
  - IMAGES
  - SENSATIONS
  - PREDETERMINED EMERGENCE
- 23 EEG BANDS
  - UP TO 8.1 X 10^{20} HZ
  - 11 INDEPENDENT CHANNELS

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S.K. Lisitsyn, "New Approach to the Analysis of Electroencephalograms," DDC Report AD73005, p. 16-25.

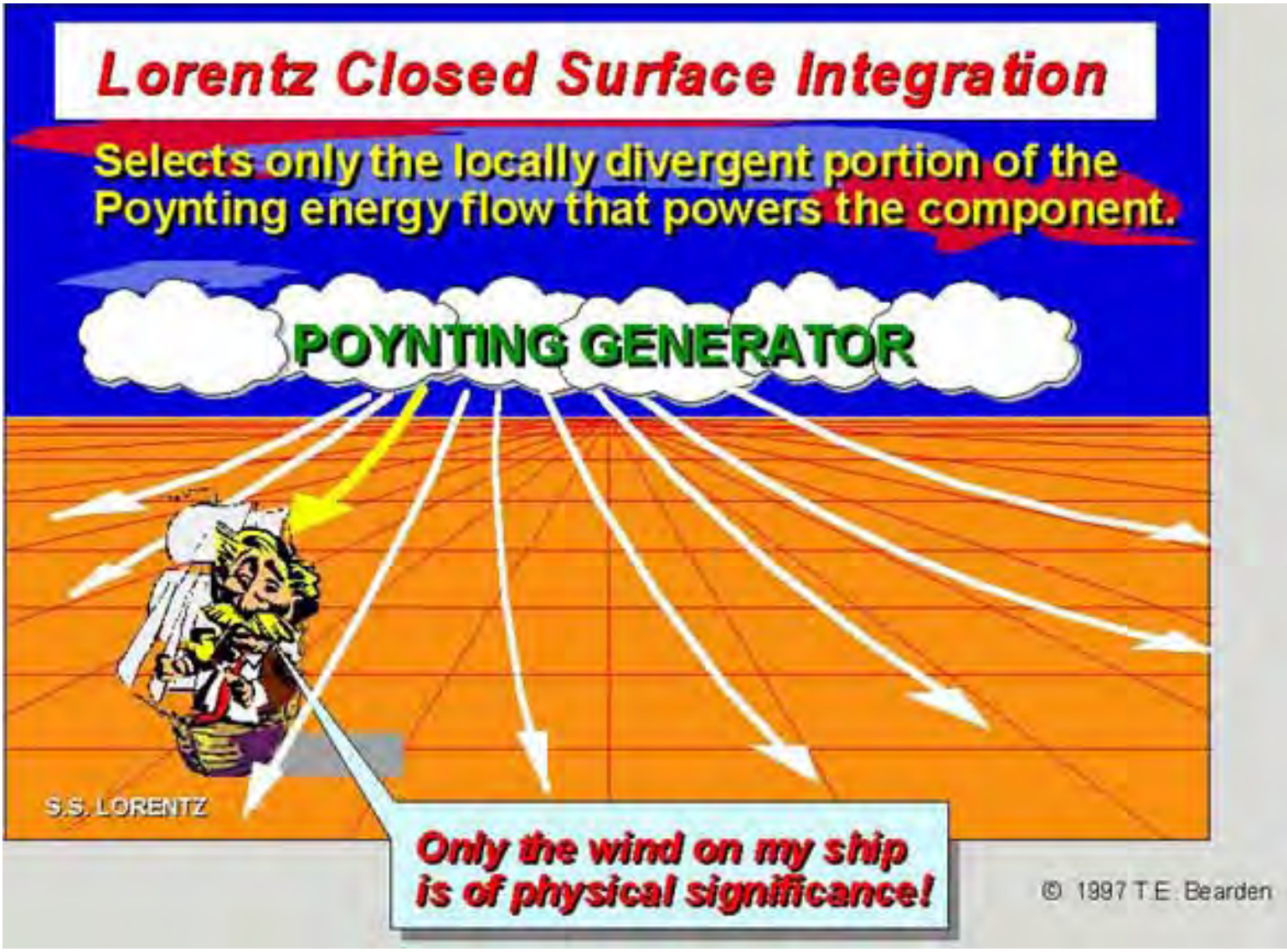
Lorentz Closed Surface Integration
Selects only the locally divergent portion of the Poynting energy flow that powers the component.
POYNTING GENERATOR
S.S. LORENTZ
Only the wind on my ship is of physical significance!
© 1997 T.E. Bearden

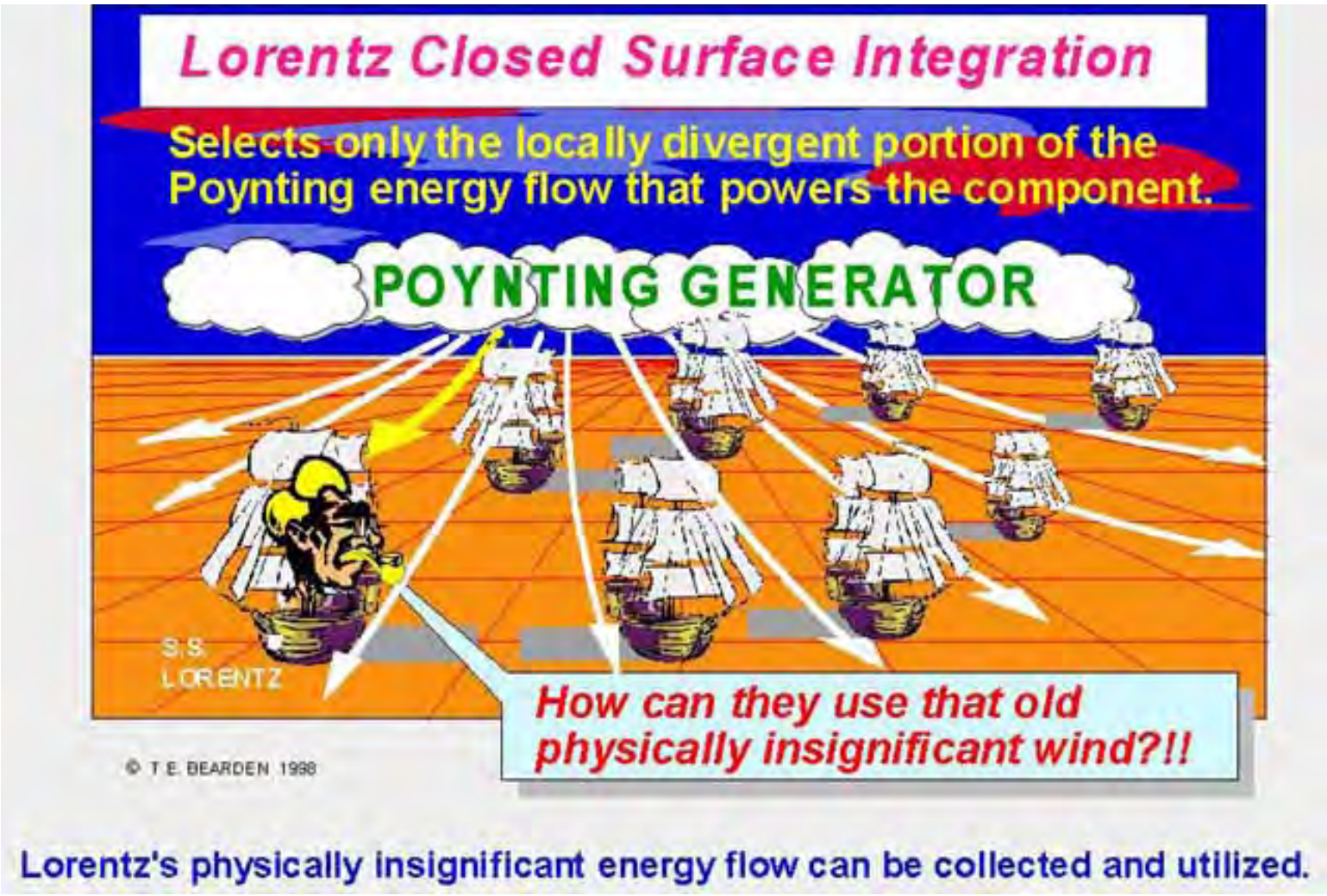
Lorentz Closed Surface Integration
Selects only the locally divergent portion of the Poynting energy flow that powers the component.
POYNTING GENERATOR
S.S. LORENTZ
How can they use that old physically insignificant wind?!!
© T.E. BEARDEN 1998
Lorentz's physically insignificant energy flow can be collected and utilized.

Lorentz surface integration of the Poynting vector around a closed surface

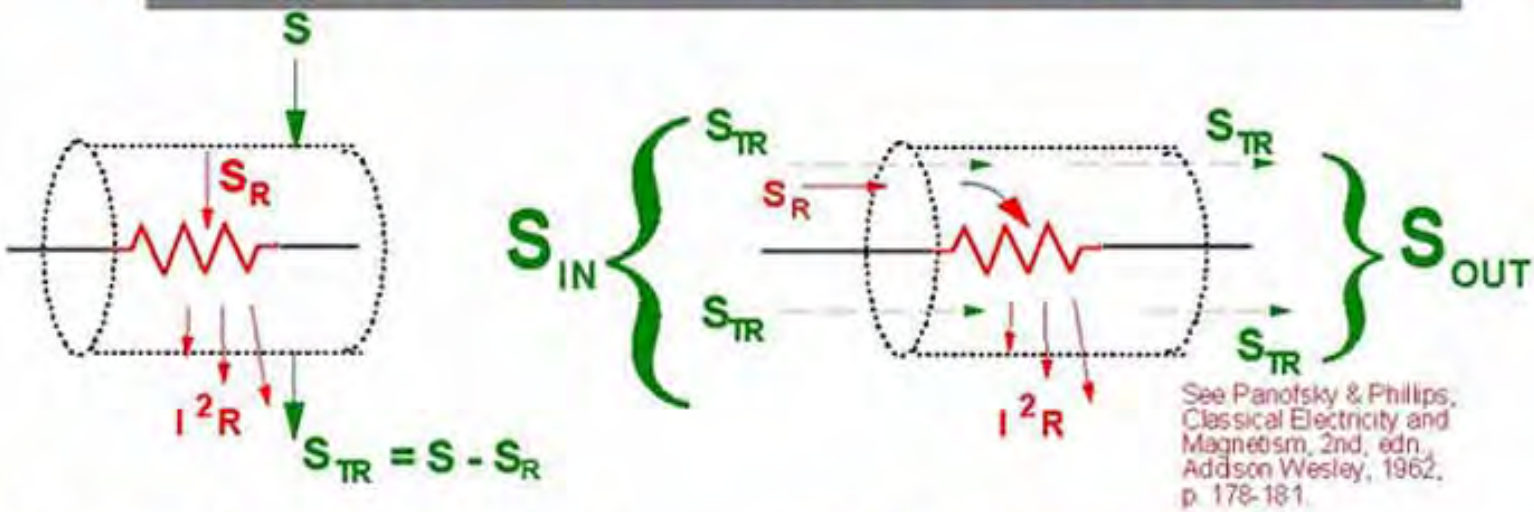

See Panofsky & Phillips, Classical Electricity and Magnetism, 2nd. edn. Addison Wesley, 1962, p. 178-181.

1a. Lorentz surface integration.

1b. Actual S in and S out.

Note: If the S-vector is integrated over the closed surface, then all energy *transport* passage is zeroed, leaving only the very small component of the input S-flow that is powering the joule heating of the resistor. In short, only the small component of the S-flow that is equal in magnitude to the Slepian vector $j\phi$ remains. This measures only the tiny portion of the S-flow that is "collecting" on electrons passing through the resistor, and therefrom being dissipated out of the resistor as joule heating. It discards everything else (all S_{TR}'s and S_{OUT}). S_{IN} becomes S_R.

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Longitudinal EM Photon Interaction with Charge

- Creates time-density wave pumping
- Slowly creates time-density charging

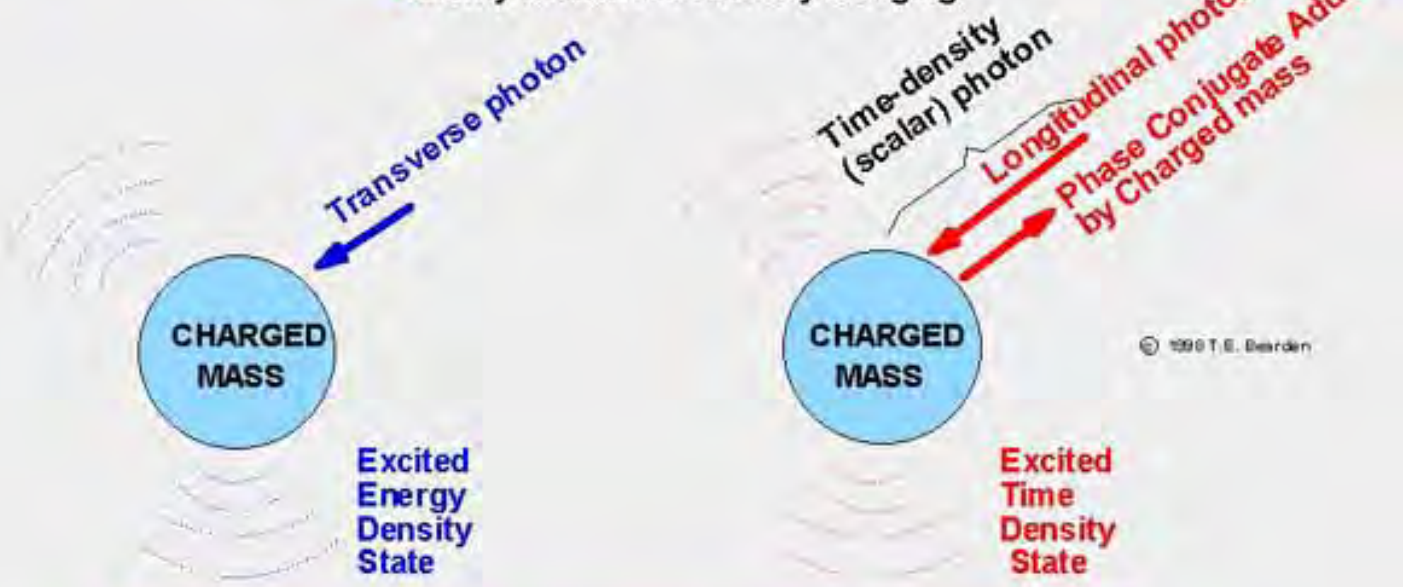

- Fundamental units are arbitrary in physics
- Can express all physics in one unit -- e.g., time
- Time is highly compressed energy
- 1 sec = 9 x 10_{16} joules of transverse EM wave energy

Figure 1-8. Infolded biwave composition of a scalar potential.

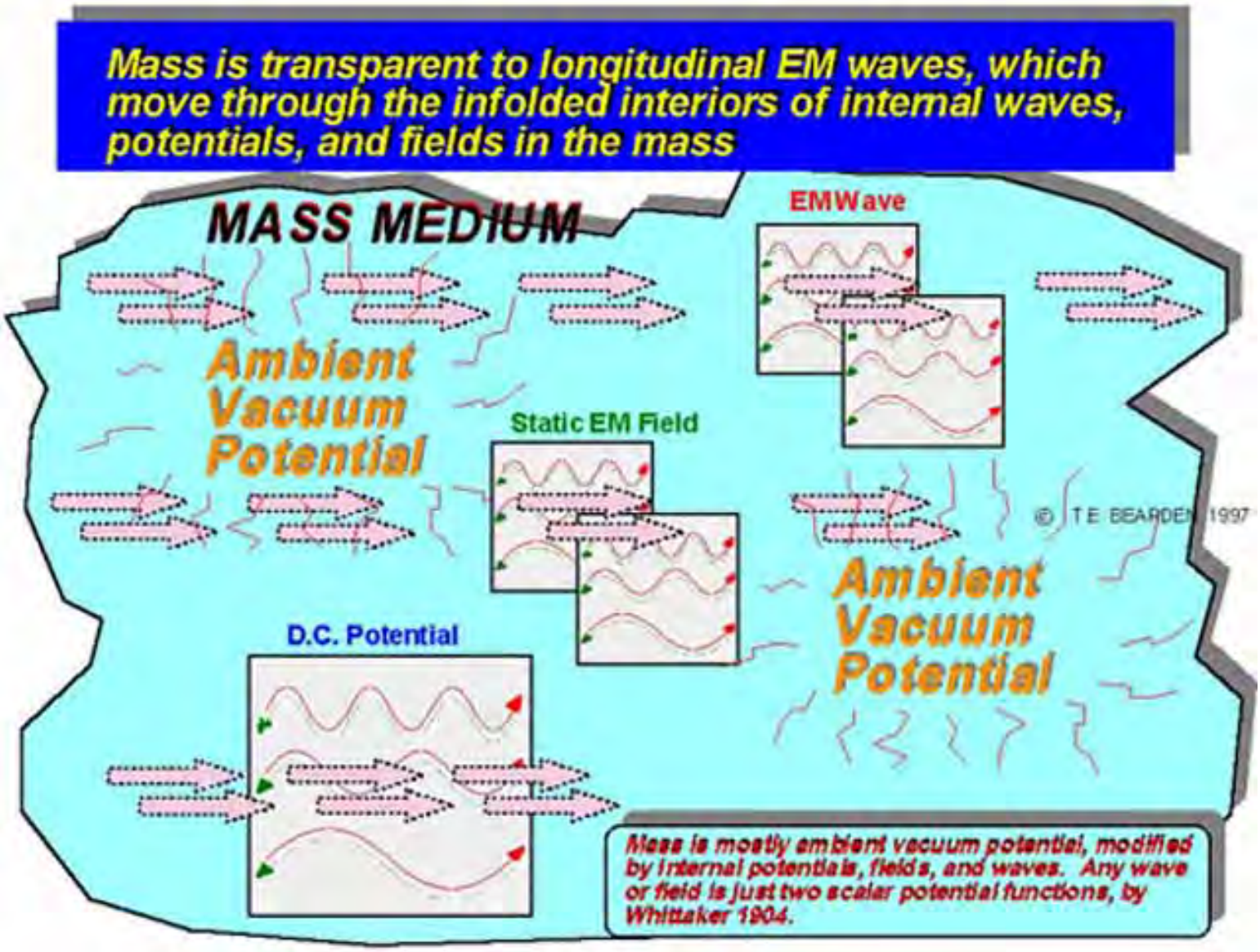

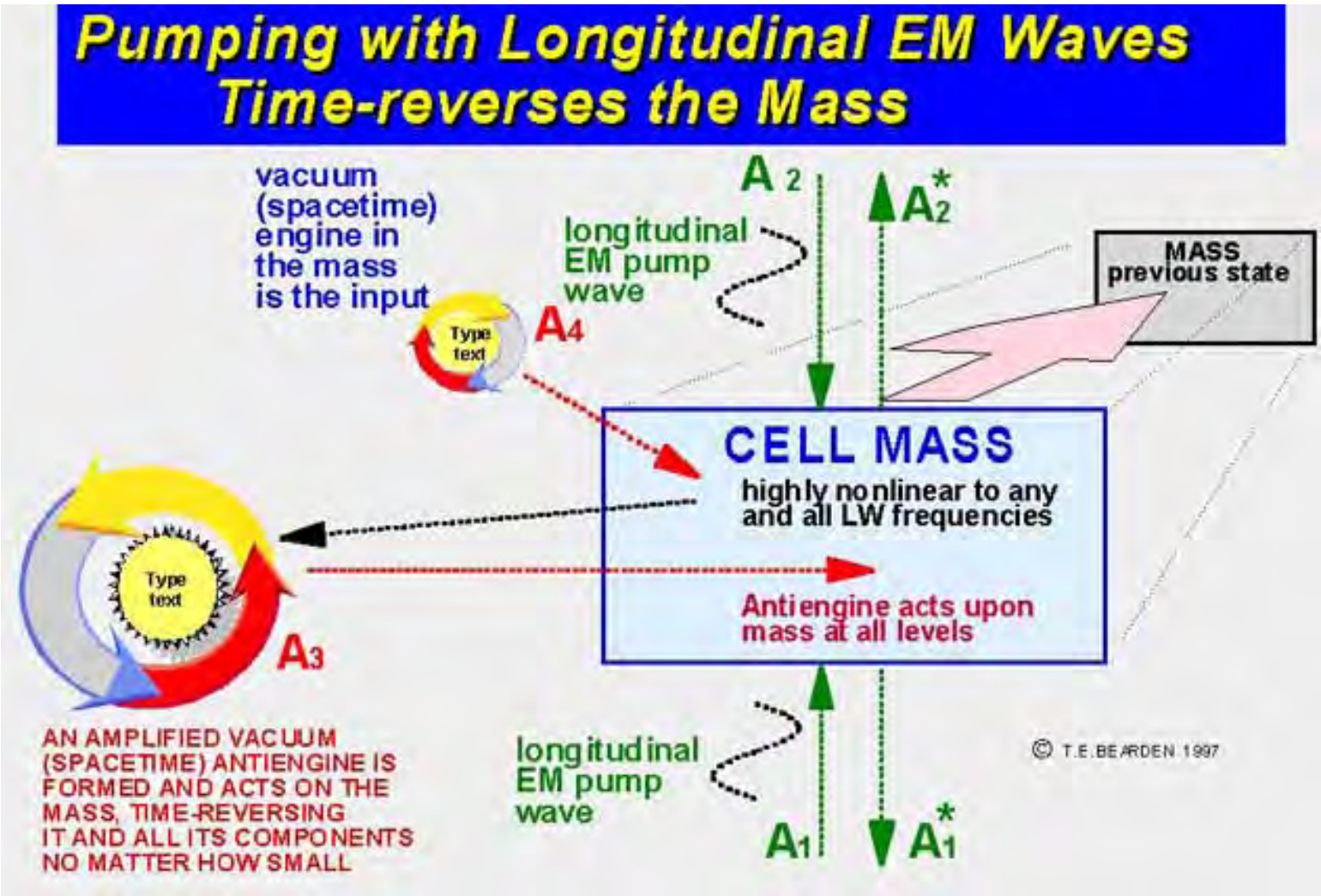
Pumping with Longitudinal EM Waves
Time-reverses the Mass
vacuum (spacetime) engine in the mass is the input
A 2
A*2
longitudinal EM pump wave
MASS previous state
Type text
A4
CELL MASS
highly nonlinear to any and all LW frequencies
Type text
A3
Antiengine acts upon mass at all levels
AN AMPLIFIED VACUUM (SPACETIME) ANTIENGINE IS FORMED AND ACTS ON THE MASS, TIME-REVERSING IT AND ALL ITS COMPONENTS NO MATTER HOW SMALL
longitudinal EM pump wave
© T.E.BEARDEN 1997
A1
A*1

Maxwell's Quaternion Theory

- **Quaternions:**
  - Discovered by Hamilton in 1843
  - A quaternion has a vector part
  - A quaternion has a scalar part
  - First significant non-arithmetic number system
  - Higher topology than vector or tensor algebra
- **Maxwell's theory was in quaternion equations**
  - 20 equations in 20 unknowns
  - Reduced to a small 4-equation subset by Heaviside and Gibbs
  - EM topology dramatically reduced

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Maxwellian Systems

Before regauging, after symmetrical regauging, and after asymmetrical regauging

Note: Any system must first break equilibrium in its vacuum exchange, before it can energize Drude electrons and "power" the load. Asymmetric regauging is always utilized. Powering loads and losses is a symmetry-restoring operation.

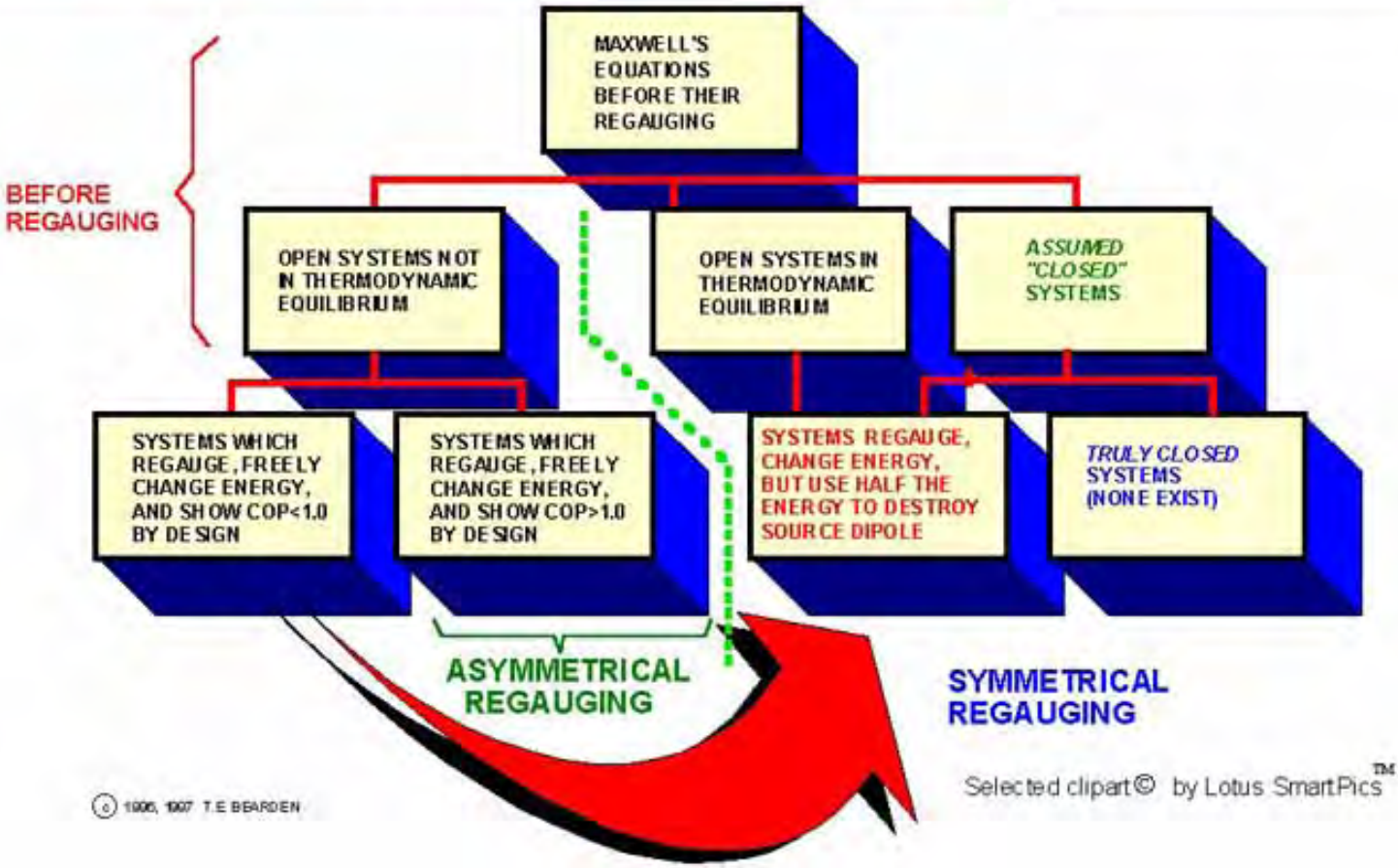

Maxwell's four equations reduce to:

$$\nabla^2 \Phi + \frac{1}{c}\frac{\partial}{\partial}(\nabla \bullet A) = -4\pi\rho \qquad [1]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 A}{\partial t^2} - \nabla(\nabla \bullet A + \frac{1}{c}\frac{\partial \Phi}{\partial t}) = -\frac{4p}{c}J \qquad [2]$$

A is replaced by A', where

$$A' = A + \nabla\Lambda \qquad [3]$$

The new B' field then becomes

$$B' = \nabla \times (A + \nabla\Lambda) = \nabla \times A + 0 = \nabla \times A = B \qquad [4]$$

A new E-field will also be formed. So let

$$\Phi' = \Phi - \frac{1}{c}\frac{\partial \Lambda}{\partial t} \qquad [5]$$

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Per Jackson, (A,Φ) are *habitually* chosen so that

$$\nabla \bullet A + \frac{1}{c}\frac{\partial \Phi}{\partial t} = 0 \qquad [6]$$

The *net symmetrical* regauging separates variables. Two inhomogeneous wave equations result:

$$\nabla^2 \Phi - \frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} = -4\pi\rho \qquad [7]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 A}{\partial t^2} = -\frac{4\pi}{c} J \qquad [8]$$

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Equations [1] and [2] *arbitrarily* changed to [7] and [8]

HUNTSVILLE EDITION

The Southeast's Oldest E-Zine!

CHASING THE WILD DRAGON

Foundations of a New Science

By T.E. Bearden
November 12, 1995

It is a pleasure to accept the offer of John and Larry to write a column in their new InterNet magazine. Theirs is a great venture, and with the energy and knowledge they bring to the task, one can be confident of their success in making this a very interesting and informative publication.

There is a new “rebel” science slowly being born, with most of the work being done outside the universities and orthodox scientific community. In the months ahead it will be my job to try to acquaint you with the gist of what’s going on, and what all the excitement is about.

This first article is deliberately just introductory, and its purpose is to interest you in the unusual fields we are going to be covering in more scientific detail, in future columns. We will also be listing a variety of references from the technical literature, which bear upon the various points addressed.

In this first article a little of my own background experience [note 1] is given, so you can decide whether you will be interested in what we have to say!

The real purpose of the column will just be to *present information* that you may not be able to readily obtain any other way. We will not argue or debate with skeptics; nothing productive is to be gained by that. If the information we present is useful to you, then our purpose has been accomplished. If it isn’t of use to you, then just file it in the old wastebasket. Also, from time to time I may answer a generic question, constructed from multiple queries. Individual responses to correspondence cannot be provided.

The work toward a new breakthrough science is going on in a broad spectrum of “fields,” most of which are not yet recognized by academia as even constituting legitimate areas of scientific endeavor (Table 1).
Some of the major areas involved are:

- theoretical and experimental research in overunity electrical machines,
- free energy research of other kinds, such as devices utilizing thermodynamics phase changes,
- rapidly advancing efforts in cold fusion,

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- direct engineering of quantum change via a new kind of "hidden electrodynamic variables",
- the direct engineering of the vacuum's virtual photon flux exchange with matter,
- action at a distance, including the deliberate formation and usage of quantum potentials,
- direct engineering of the local curvature of spacetime (yes, the direct engineering of general relativity, using the new hidden kind of electrodynamics),
- use of the new "hidden" electromagnetics to engineer body cells including the reversal of diseased cells, genetics and all, back to a previous healthy state (cellular dedifferentiation, in biophysical terms, or cellular phase conjugation, in physics terminology),
- research toward the direct engineering of the mind, including both the conscious and unconscious minds, long-term memory, and the personality itself, and
- a ruthless re-examination (and correction where necessary and possible) of the definitions, concepts, and postulates that present physics is founded upon.

Each of these "major areas" as yet has no single "experts" in the sense that individuals exist who possess a "mastery" of the given area. As an example, in spite of multiple researchers and decades of vigorous research, no one is really an "overall expert" in the overunity electrical power systems field. The "field" itself is still struggling to be born and is not recognized at all by orthodoxy; in fact, many orthodox scientists bitterly resent one even attempting to work in this area. There is as yet no cohesive single "theory" of overunity electrical or magnetic machines, although our own group is making rapid progress in that respect. But there is still no universal agreement amongst even the researchers themselves. Literally the field is still being discovered.

This "groping dimly toward a new field" should not be too surprising. After all, the early electromagnetics researchers went through the same tortuous, agonizing kind of development. They were playing with cat fur, glass rods, and pith balls for quite an extended period before understanding progressed to the point where Maxwell could mathematically tie together and model the results of the experimenters such as Faraday and others. It has taken a century and a half for modern electromagnetics and electronics to reach its own present development. It is going to take another decade or so before the overunity researchers can overturn several ill-founded parts of the present electromagnetics and get the emerging field onto a solid foundations footing and into a solid theoretical position.

In the effort to produce a theoretical model of electromagnetics, Maxwell and his predecessors performed a magnificent work. Yet they also made very serious errors (Table 2), which persist to this day. [note 2] Let us list just a few of the more blatant errors in classical EM theory today:

First, Franklin guessed wrong on which way electrical current flowed in a circuit. There is no definition at all of electrical charge in all of physics, and there is no acceptable definition of potential (that is, there is no rigorous definition of just good old "voltage.") There are no "fields of force" in the vacuum; there are just potential gradients __ because the vacuum is just one vast potential (virtual particle flux) in the first place. Force fields actually occur only in and of the matter in a material system. The primary causative agents of electromagnetics are not the so-called "force fields' at all, but are the potentials __ as is well-known in quantum mechanics. [note 3] Maxwell assumed a material ether in his equations. The Michelson-Morley experiment destroyed the material ether, but the Maxwell equations have never been changed accordingly. The electron was not yet discovered when the Maxwell equations were written; the theory does not address electron spin. Maxwell was already dead some two decades when Barus' 1898 paper [note 4] was published, pointing out the strange "backwards-traveling" wave (i.e., time-reversed wave) solution to the wave equation. In addition, Heaviside and Gibbs had already produced their vector truncation __ this truncated theory is the modern so-called "Maxwell's equations" that universities teach today __ of Maxwell's theory.

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in a higher topology (quaternion algebra), and inverted some 20 quaternion equations. Heaviside and Gibbs created vector algebra, and seriously curtailed Maxwell's theory when they "translated" it into the much lower topology of vectors and some four equations. The later addition of tensors as the basis mathematics did not restore the lost topology provided by the quaternion model. [note 6]

For the EM wave, Maxwell simply assumed the transverse EM wave that had come from the much earlier derivation of the familiar wave equation from the old "plucked taut string" notions. [note 7] Yet when one closely examines and corrects some of the erroneous *assumptions* [note 8] made for the actual mathematical derivation of this "taut string" transverse wave, one finds (Figure 1) that an equal-energy second antiphased transverse "antiwave" is actually produced by the instrument and added to the "plucked string's" transverse wave disturbance of the air medium, to produce a longitudinal wave of compression and rarefaction in the air itself. The "transverse string wave" in fact never leaves the string. The string wave is not the wave that is launched into the medium.

A similar electromagnetic situation exists. In a whip antenna (Figure 2), the Drude electron gas in the conductor does exhibit a transverse "string-type" EM wave of electron precession. However, at the same time, by Newton's third law (which Maxwell neglected because at the time the atom was regarded as just a blob with no internal structure) the positively charged, phase conjugated atomic nuclei have equal energy, highly damped transverse recoil waves created in them. Further, these "nuclei-recoil" waves are phase conjugate replicas of the electron gas waves. The total disturbance that is launched into the vacuum from the whip antenna is (a) the normal transverse disturbance of the virtual photon flux of vacuum caused by the electron gas wave, and (b) the coupled equal-energy transverse antiwave caused by the nuclei-recoil via Newton's third law. The amplitude of the material antiwaves of nuclei vibration are highly damped because of the massiveness of the nuclei; however, they are of equal energy to the electron wave. But when launched into the same vacuum, the two equal-energy wave disturbances experience equal damping because they are in the same medium. Hence the wave and antiwave are (a) locked together in the vacuum, and (b) of equal energy, and (3) of equal amplitude once launched into the vacuum. What results is a vacuum EM wave of rarefaction (reduction in intensity) and compression (increase in intensity) of the virtual photon flux of vacuum __ just exactly like what is launched into the surrounding gaseous air medium from the "plucked taut string" and perturbed body of a physical instrument. The EM wave in vacuum is a longitudinal wave directly analogous to a sound wave __ just as Nikola Tesla stated. [note 9]

The vacuum may be considered a scalar potential, in which case it has an internal biwave structure (Figure 3). Interference of two potentials __ i.e., the hidden interference (Figure 4) of their internal wave structures __ in fact already creates all EM fields and waves.

When the incoming longitudinal "biwave" from the vacuum strikes the atoms of the receiving antenna, each atom may be considered a dynamic assembly of multiple dipoles, where each dipole consists of one of the electrons in the electron shells and one of the positive charges in the nucleus. The receiving dipole in the interacting atom splits the two waves apart again (Figure 5). The negatively charged end of the dipole is time-forward, and the positively charged end is time-reversed. Hence the separated normal-wave-half of the biwave interacts with the electron, to give again the familiar transverse "electron precession" wave that we detect with our "electron wiggle-detecting" instruments (Figure 6). This detected electron precession wave is what all our textbooks prescribe erroneously as the vacuum wave! The separated time-reversed-wave-half of the incoming vacuum wave is split off and interacts with the positive end of the receiving atomic dipole, in the time-reversed atomic nucleus, thus generating Newton's third law reaction force to provide the recoil of the nucleus. Present physics has ignored this second wave altogether, because of the serious error in the original derivation of the wave equation from plucked strings. Thus

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would appear to violate Newtonian third law reaction. Phase conjugate mirrors already do just exactly this when they emit a phase conjugate replica wave. They direct the antiwave outside and away from the atom instead of inwards into the nucleus. So they do not recoil, no matter how powerful a phase conjugate replica wave they emit.

Finally, we can also show that the EM wave in vacuum is longitudinal, by yet another approach. The electrons in the electron gas in a conductor are spinning, and they are severely constrained longitudinally to be able to move only very, very slowly down the wire. So when perturbed, they act as gyroscopes, and precess at right angles to the perturbing force. The fact that the gyroelectrons in a wire move radially almost entirely, and only "slip" down the wire very slowly with a "drift" velocity, already proves conclusively that the incoming vacuum disturbance was longitudinal. The precession of a gyro is at right angles to the perturbing force. Therefore rigorously the vacuum EM waves are longitudinal, because the gyroelectrons moved transversely. The present assumption of the transverse EM wave in vacuum contradicts the entire theory of gyroscopes! [note 10] There are many other errors in classical EM that we will point out in future articles; this should give the reader a flavor of what is in store for him in future articles.

So there are no truly satisfactory "experts" in any of the 14 fields. Yet there is still something to be said for having some years of experience in one or more of the areas. I have had the good fortune or misfortune, depending upon one's viewpoint, to be involved in various of those 14 activities for some 30 years or more, and am active in several of the areas now. My colleagues and I are particularly active in researching overunity electrical devices (see Figure 8), to include the effects of controlled chaotic oscillators, charge-blocking oscillators, and oscillators driven by in-shuttled (bridged) Poynting field energy density flow ExH. Parametric oscillation is known to have yielded overunity electrical machines and was fully reported by Russian researchers in the Russian and French technical journals in the mid 1930s. [note 11] We will further cite that little-known work in future articles. Also, we are working mightily upon true negative resistors (Figure 9), wherein the resistor scavenges some of the disorganized energy from the vacuum's energetic exchange with the charges in the system, organizes and collects it, and then outputs that collected energy flow into the external circuit. Such a resistor acts as a power source. Kron, perhaps the greatest of the electrical machinery scientists, is known to have produced such true negative resistors.

I have also proposed a theoretical explanation of the Priore device (Figure 10) in France which in laboratory animals demonstrated remarkable cures of terminal tumors, cured trypanosomias, reversed atheriosclerosis, and restored suppressed immune systems. The Priore work was not anecdotal, but was performed under rigorous scientific protocols, working under the auspices of renowned French scientists such as Courrier and Pautrizel. The work is properly reported in numerous papers in the French medical literature. [note 12] The results were certainly achieved, but neither Priore himself nor the scientists of the day could understand the mechanism involved. The deciphering of that causative technical mechanism utilized by the Priore group required 10 years of intense effort. The results have now been published in the journal Explore! and are there for anyone to read. [note 13]
Presently my CTEC colleagues and I have filed three patent applications and a continuation, on various methods for overunity processes and apparatuses, room temperature superconductivity, Poynting generators, etc.

As an example, we took exactly the opposite approach to room temperature superconductivity as has been taken by all the orthodox researchers to date. What exactly is sought, after all, for superconductivity (SC) in a section of an electrical circuit? Well, one has some electrons on one side of that SC section that are transporting excess potential, as given by the Slepian vector J*. [note 14] What is desired is to get some electrons on the other side of the SC section that also are transporting the same amount of excess energy in the form of J*. You can do that in two ways: (1) you can flow the electron carriers through the SC section, carrying their J*, or (2) you can block the J and flow the * itself across as the Poynting flow S. [note 15] Nondivergent Poynting flow flows along an equipotential, which is

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tantamount to a crash, and massive correlation of the electrons and of the electron to lattice interactions is necessary if one is to get the electrons through there without excess collisions that shake off some of the excess * from J*, as scattered photons (heat) or as a change of form of the energy (as in straining the dielectric of a capacitor to convert electrical energy to mechanical strain energy via the piezoelectric effect.)

Our approach is exactly the opposite (Figure 11) and Figure 12). Why not just *stop* the flow of excited electron carriers on one side of the SC section, and continue the nondiverging flow of the Poynting field energy density S across that section at room temperature? Then the cryogenics is not needed at all. After all, circuits already work that way anyhow __ except standard practice is to nullify the process by letting current be driven around the sourcing current loop and back through the back EMF of the primary source. A quantum well (or several other methods) can be used to trap the "sourcing" electrons in the conductor just prior to entering the SC section. The "receiving" electrons on the other side of the SC section, however, must be in their own dq/dt-isolated current loop.

Normal sources do not furnish electrons and current to a circuit anyway. Sources just furnish Poynting flow S and EMF. [note 16] In the receiving current loop, the EMF appears automatically once the S-flow flows in and is "locked on to" by the receiving electrons. Given q**, you will immediately have J* if the electrons are free to move in the conducting circuit (see Figure 13). Further, you have eliminated all the loss terms from the standard Poynting equation for energy losses. So all the energy flow S just flows across the SC section, without any current or Cooper pairs flowing through that SC section. The SC section has become a "bridge" which (1) strips off the Poynting field energy density flow S from the electron current dq/dt on the sourcing side of the SC/bridge section, by simply reducing the dq/dt to zero; and (2) continues to pass the S-flow across the dq/dt-blocked SC/bridge section to the other side (Figure 14). The excess S-flow (and EMF) pours into the receiving dq/dt-isolated current loop, exciting the electrons therein to produce dq/dt and J*. *Any closed current loop is self-powered, once it receives S and EMF. It furnishes its own electrons; it only requires excess energy and EMF.* [note 17]

So our approach gives room temperature superconductivity in a very straightforward manner, once you discover how to block the current dq/dt in a conductor. Blocking it in an insulator is not sufficient, because that drops the potential and stops the S-flow and the equipotential * (the EMF). However, a degenerate semiconductor such as the Fogal chip can be used, as can several other processes for blocking dq/dt in a conductor. We will discuss these in a future article.

Another advantage of this approach to room temperature superconductivity is that now one can also have permissible overunity coefficient of performance. Now the load can be placed in its own S-receiving, isolated current loop. With the sourcing current loop furnishing only S and not dq/dt, the load is still powered normally in its own closed dq/dt current loop, but none of the load current is passed back through the back EMF of the primary source in the sourcing circuit.

This principle — that at least a substantial portion of the load current must not pass back through the primary source — is the primary principle required for a permissible overunity electrical machine (Figure 15). A permissible overunity electrical machine is one which produces more power in the load than you have to put into the machine to run it.

Obviously, the laws of physics and thermodynamics require such an overunity machine to be an open system that extracts and utilizes excess energy from an external source. In the case outlined, we extract the excess energy directly from the vacuum in the form of S-flow; essentially we convert our primary source to a Poynting generator rather than a "power" (energy flow loss rate) generator. The resulting9. overunity machine accomplishes both room temperature superconductivity and also overunity coefficient of performance (Figure 16). It does not violate the

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exchange between the vacuum and each end of the dipole. [note 19] [note 20] When we attach "conducting leads" to a dipolar source, as in the simple two-wire circuit, all we are doing with the conductors is providing waveguides for the extracted S-flows from the vacuum to flow along (it flows outside the conductors) without loss. In effect, each lead is simply extending the pole (i.e., the terminal) to which it is connected.

My associates and I are also working on several other inventions at present, including two more patent applications to be filed in the near future. One of those is in the field of overunity power systems, while the other is in an entirely different, highly proprietary nuclear effort. I will address all these areas in future columns, and those columns will have real "meat" in them.

Present "big science" proclaims that overunity electrical machines are impossible. The reader should understand that the U.S. Patent and Trademarks Office is never going to grant a patent for an overunity electrical machine unless the machine is independently tested and replicated, and unless it is certified by scientists of impeccable credentials. This is as it should be. Legitimate free energy researchers accept that dictum. Eventually the stuff has to work on the bench in order to be validated. On the other hand, free energy researchers also point out that one must not demand of us the next 100 years of national research by a hundred major laboratories immediately! This is still a shoestring operation, because all conventional sources of research funds are denied to the serious overunity researcher (with the single exception of occasional personal funding of a researcher by a private individual). In other words, we demand at least the same kind of consideration that the orthodox nuclear fusion community has enjoyed. Billions of dollars have been poured into that sinkhole, and not a single controlled fusion power unit is working anywhere in the world after decades of work at enormous expense to the taxpayers.

So we overunity researchers deserve at least a decade or two of our own, to try to accomplish overunity electrical system development. We also painfully point out that "Big Science" will not fund a single overunity researcher, for specific overunity purpose, no matter what his credentials or capability. In fact, "Big Science" is part of the problem, because it fervently seeks to prevent any legitimate research in overunity. To carry out its suppression campaign. it resorts to vilification, character assassination, libel, and slander of the overunity researchers themselves __ again, regardless of their qualifications or legitimate scientific procedures. [note 21]

Indeed, orthodoxy has a black record with respect to energy. When Mayer advanced the conservation of energy law, orthodoxy hounded him unmercifully. He was universally ridiculed as the very epitome of a fool. He lost his job and suffered a nervous breakdown. Then years later toward the end of his life, scientists came to accept the conservation of energy as a most useful tool that dramatically simplified much of their analyses. So then science began to laud Mayer. There are a thousand other such examples; suffice it to say that "big science" is a bureaucracy and a "bell-shaped distribution curve" just like any other large group of people. Some scientists are near-angels. Others are near-devils. The vast majority are neither, but are just ordinary persons doing a special kind of job. In the scientific bureaucracy, however, the manipulative scientists scurry, slash, and manipulate their way toward the top. So the leadership of any big bureaucracy __ including the scientific bureaucracy __ is always rife with such near-scalawags and power-hungry individuals. Scientists are not exceptions to the same human weaknesses that we all evidence. If you really want to see jealousy, backbiting, and fierce "back-room dealing" and power-struggling, just get into a university research environment! But because the "power merchants" of any bureaucracy always fiercely resist any challenge to their position or superiority, big science has always fiercely resisted anything truly revolutionary. And today they also enlist the power of the state to enforce their dictums. We will devote one of our future columns to pointing out some glaring examples of persecution of independent researchers by big science. It is an area that all unorthodox researchers should be well-aware of. The world of science does not run by sweet reason and lofty

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telling that dogmatic scientists due to vilify free energy researchers. It is a lie that they have also successfully sold to the U.S. Patent and Trademarks Office. Anyone with a modicum of knowledge of modern physics already knows that there does not exist a single closed system in the universe, anywhere. In particular, every physical system is continuously "open" to the violent exchange of energy with the surrounding vacuum. It's just that most systems are in local equilibrium in these flow exchanges, except for minuscule gating accomplished for such things as the Lamb shift, etc.

By analogy it's something like this. The free energy researcher is standing by the banks of a mighty, rushing river with breathtaking falls, turbulent areas, etc. Big Science is begrudgingly admitting that, yes, there is a river there, but it is an insane delusion to think that you can tap that energy. The free energy researcher is saying that, well, if I can build a gating sluice a little distance upstream, perhaps I can divert a small portion of the river's flow downstream to my waterwheel, and power my mill. The orthodox scientist then vilifies the free energy researcher for even having such a heretical thought. In fact, says the orthodox researcher, any fool can see that the laws of nature force the river's flow to stay firmly in its banks, because it is a closed system, and Moses brought that law down off the mountain with him on a special stone tablet. Then he adds all the other smug remarks such as, "If it could be done, then we at MIT and Harvard and Caltech would already have done it!" So until the orthodox scientist develops a little less dogma and a little more common sense, and learns the difference between a scientific discussion and a dogfight, the free energy researcher can hardly communicate with him.

The goal of the legitimate free energy researcher is to find a way to break the local equilibrium of this universal energy exchange, and gate a tiny bit of it up into the external circuit as excess electrical energy (Figure 17). Then he must collect the excess energy, and shuttle it from the "gating and collecting circuit" over to a dq/dt-closed current loop containing the load. He must also prevent the load current, or most of it, from passing back through the primary source against its back EMF, because if it does that, he will destroy the separation of charges in the dipolar source, killing the dipole and extinguishing the "excess energy gating." In other words he must find a way to process and transport the energy flow across dq/dt-blocked bridges between the source's closed dq/dt-current loop and the load's closed dq/dt-current loop. Ruthlessly it is an energy transport S-flow problem, not a J* energy transport problem. If he uses J* in his sourcing current loop, he automatically drives the current dq/dt back through the back EMF of his source and kills it. If he does not drive dq/dt back through the source, the source will furnish S-flow for an indefinite period! Every battery and generator we have ever built is already a "free energy" machine in that it already involves broken local symmetry in the vacuum energy exchange. We have just not realized how to use our power sources purely as Poynting S-flow sources.

So we must treat an electrical system as an open system with broken local symmetry (Table 3) in the vacuum flux exchange, so that the system extracts (gates) excess energy from an external source. In this case the source is the system's flux exchange with the vacuum. This approach is no more mysterious or bizarre than putting a waterwheel in a river, or a windmill in a wind, or a bank of solar cells out in the sunshine. The universal "free source of energy" that the overunity researcher seeks to tap is the violent exchange of virtual photons between the electrical charges of the system and the surrounding quantum mechanical vacuum (Figure 18). In quantum physics this powerful, energetic exchange of the vacuum with electrical matter is now proven both experimentally and theoretically. It is already accepted in quantum physics that the vacuum is filled with electromagnetic energy. The researcher doesn't have to prove it anymore; he just has to find out how to properly use it. The artesian well is already there; we just have to learn how to collect and use the flowing water without dynamiting the well!

The remaining objection orthodox scientists usually raise against the notion of extracting vacuum energy has been

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density of the exchange causing the Lamb shift is greater than the surface energy density of the sun. Different physicists have made various theoretical estimates of the energy density of this seething vacuum. A conservative ballpark figure is something on the order of 1090 grams per cubic centimeter, expressed in mass units.

It has also been my good fortune to know and work closely with several other free energy researchers. I was a colleague of Floyd ("Sparky") Sweet (recently deceased) for about seven years; Sparky held a Master's degree in EE from MIT and had years of experience with General Electric and other firms. He was a highly skilled researcher who invented the solid state vacuum triode amplifier (Figure 19), a unit which produced 500 watts of output and a coefficient of performance of 1,500,000. I personally tested the machine, activated the magnets on one occasion, and understand how it all worked. [note 24] The paper [note 25] I co-authored in 1991 with Floyd is still the only paper in the orthodox engineering literature that reports (a) successful overunity functioning of a solid state magnetic device, and (b) a successful antigravity experiment on the laboratory bench, reducing the weight of an object by 90%. [note 26]

We stress again that a legitimate overunity electrical machine must be an open system, receiving excess electrical energy from the surrounding vacuum. As such, it must operate in a higher topology than normal electrical machines (Figure 20).

My good friend Frank Golden has long been a close colleague. Years ago Frank developed a motor that produced overunity efficiency, but then to our astonishment we found (courtesy of Bill Tiller, [note 27] with whom we were working at the time) that its operation depended upon a 5-year-long conditioning (structuring) of the local ambient potential in order to work. Previously we had been entirely unaware that one can sometimes condition the local vacuum and the local matter in the area with a particular dynamic form. Given the local conditioning, a motor with that form will then work in that vicinity, but not necessarily elsewhere at an appreciable distance away. We now understand the mechanism for such "conditioning of the vacuum." We also now know what to do if an overunity machine is actually a machine of that type (many of them are not). In other words, we know how to convert it to a machine that will work anywhere, anytime. We will be addressing such little-known things in future articles.

John Bedini is also a close friend and colleague; John built several experimental motors (both electrical and magnetic) in the overunity area, and performed successful trans-mutation experiments. John is a recognized genius in high-end sound amplifier development. Many audiophiles worldwide still swear that the Bedini amplifier is the best and sweetest-sounding audio amplifier ever built. One of John's battery-powered electrical motors (Figure 21), for example, ran continuously off its battery for about five years, and kept the battery charged. When you realize that such a small electric motor is only about 35% efficient, then you realize that about 65% of the energy flowing out of the battery was being dissipated in the motor as heat, core losses, etc. So the unit was continuously performing work for that five years. [note 28] The 1/8 hp motor represented a load in which the continuous rate of work being done (the rate of energy dissipation) was about 0.08 hp. We will have more to say on this motor and its technical process in a future article.

Bill Fogal is a close colleague; Bill has patented the world's first dq/dt-blocking semiconductor, [note 29] which partially blocks the normal current while continuing to pass the flow of voltage (Table 4). I have written a proprietary technical explanation of the Fogal semiconductor, which utilizes an extremely little-known feature called the "overpotential." The overpotential part of the theory is experimentally proven and theoretically explained in an obscure part of electrochemistry, by a few chemists who specialize in electrode effects. J. O'M. Bockris is probably the leading world expert in overpotential theory; he authored the textbook on it. [note 30]

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because we did not have the proper instruments available. E.g., all our oscilloscopes were "hard grounded" to building ground, and we needed to make "floating differential ground" measurements in order to settle things once and for all. McLain and Wooten have filed for a patent, and multiple tests with excellent equipment have indeed indicated overunity. What happens next remains to be seen. I suspect that the two inventors may simply accept foreign capital investment and go offshore.

Howard Johnson is also a respected colleague, whom I very much admire. (See Figure 23). Howard has continued to work quietly and patiently upon his patented permanent magnet motor, [note 31] including patenting various magnetic gates, etc. that are necessary to make such a motor work in a rotary configuration. [note 32] Howard employs a two-particle theory of magnetism; i.e., each magnetic flux line is envisioned as having a particle traveling from the north pole to the south pole, and also a particle traveling from the south pole to the north pole. The particles are spinning; the forward-time particle spins in one direction, and the antiparticle spins in the other direction. Howard then slightly separates the two particle flows. [note 33] In other words, Johnson splits the flux lines themselves, into two different pieces. When so separated, the component lines are now curls, so their paths curve. The paths of the two "curl particles" are different; one curls in one direction and the other curls in the opposite direction. Further, a predominance of one form of curl particle gives a "time-forward" aspect, while a predominance of the other form of curl particle gives a "time-reversed" aspect. Johnson is thus able to employ a deeper kind of magnetism than the textbooks presently contain. He demonstrates that a "spin-altered" magnetic assembly exhibiting (to a compass or other such detector) a north polarity can attract another unaltered magnetic assembly exhibiting a north polarity. In short, he can make a north pole attract a north pole. We will give you further insight into Johnson's two-particle theory in a future article. [note 34] We will also explain how and why the physicists missed that antiparticle in the magnetic field's flux lines, and thereby failed to advance the theory of magnetism to a deeper level. Make no mistake, one day when the new theory is done, Johnson may well be awarded a Nobel Prize for his epochal discovery of a deeper structure of magnetism.

Bits and pieces of the new science approach are just now beginning to spill into a few conventional journals and symposia. For some time a few of the rebels spearheading this new science have been doing something that the University scientists should have been doing all along. The rebels have been meticulously examining the concepts, postulates, and definitions that the present scientific models are founded upon, to reveal serious foundations errors. Corrections for some of these errors have been discovered and made. [note 35] Others are still problems yet to be resolved. Yet slow progress is being made, and a "flip-over" of the old science is likely to occur within the next decade if not sooner. By then the new concepts will have become "solid" enough to allow producing an engineering mathematical model. Also the supporting experiments will have become solid enough to justify the new concepts and the model.

In this first article I wanted to introduce the 14 major areas. We will be discussing these areas in some technical detail in the future. We'll also include current major news items of development in these areas, for the interested lay reader. I'll particularly try to give you the benefit of extensive reference citations painfully gathered over the last 30 years. The articles will be targeted toward both the serious researcher and the interested, educated layman.

So that's the agenda for the months ahead. We hope you find this information and the approach of direct interest and use.

Again, it's a privilege to be aboard. And we invite you to hang on in the future; it's going to be a wild but exciting ride. We really are going to chase this wild dragon with great vigor.

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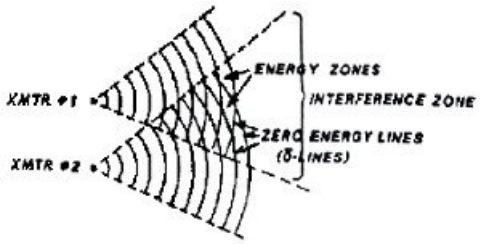

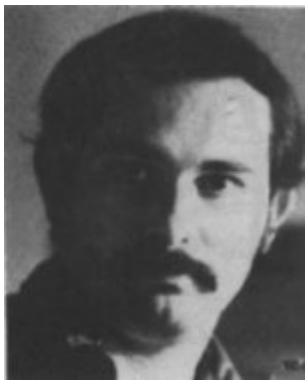

Scalar Wave Detection

Warren York
Scalar Wave Researcher

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WARNING: Do not attempt electrical construction on any of the equipment, coils or devices described here unless you are fully qualified. In some cases LETHAL voltages and charges are required. Also be advised that improper use, application and physical methods may cause psychological tramuma or permanent physical and neurological damage when near the vicinity of such equipment. This information is being provided as a point of interest to our readers... the publisher and author disclaim any responsibility in the use or misuse of this information.

Introduction

All of this talk so far on scalar waves and scalar technology has no purpose in the scientific community until something can be detected, observed and duplicated. The original seedlings and thoughts which led to Lt. Col. Bearden's scalar theories were developed out of observation. If not by Lt. Col. Bearden himself, then by others from many noncorrelated paths.

I already have given a small sample list of such observers from Nikola Tesla to the latest, Moray King. I have just read a newly released book by Moray entitled ***Tapping the Zero Point Energy***. I also recommend highly for others interested in scalar technology to obtain copies of Bearden's works and books from the new release of ***Excalibur Briefings*** to ***AIDS--Biological Warfare***. The two books and papers will fill in the much needed base work on understanding scalar technology and can be obtained through the High Energy Catalog.

I also understand that a new book is in the making which is a rebuttal entitled something along the lines of *Anti-Scalar*. All of this is healthy in any development process, for without pros and cons, the sorting of correct data to trash data cannot be accomplished. On the other hand, I would like to point out that any conclusions should be supported by actual tests and not just by armchair theory.

Anybody can debate from the armchair but to have any meaning to back up their statements, one must present tests where one gets his or her hands dirty. That is to say that until I had reactions and observed actual phenomena occurring, all the theories were no more than that--just theories. This is what I hope to accomplish here with these articles on scalar technology. I feel this is a true new technology and deserves some serious consideration.

If I had not gotten my hands dirty and followed through on others' experiments from other observers then I would never have been convinced that something extraordinary was taking place. Even though my senses told me I was wasting my time I set out on the monotonous task of duplicating others's work and notes of observation. This is what I hope some of you will do and start to help unfold and unleash this hidden knowledge called scalar -- zero point energy -- stress energy and even radionics. Itis true indeed that it has many names over the years, but now we can at least have hope of defining its true limits and abilities.

The detection methods I will present here are not confirmed by myself or corresponding researchers as of yet due to development is still in progress. In one method I can only accept the word of the researcher as to his results. Until I or others duplicate results it remains a possible process and approach in detection.

My own detection came in the form of two experiments which were reproductions of another author's work based on this technology. When I had reproducible results I knew there was more to scalar than just theory. The process is now underway in developing a reliable instrument or means of detection that others can use. Up to this point most of scalar observations have been uncertain and always with the person or operator being part of the circuit. Nobody could remove the person at this point to bring scalar under true observation conditions. Due to a simple observation in Mr. George Meek's work in electro-voice phenomena (EVP), where my first breakthrough was established, this now seems a possibility. The personal element was still included in the circuit but unlike radionics or Hieronymus devices, could be reproduced by anybody once special conditions were met. A co-researcher has hit upon a method which was initially observed by Nikola Tesla and shows promise of another breakthrough in removing the personal element.

I will now discuss my initial breakthrough to scalar detection which will help you follow my thinking on what is needed and just what we are looking for in scalar detection. Scalar properties are the dictating key elements in this approach. I will then describe a possible detection method of another researcher and finally what I feel will be a unique approach with an instrument currently under construction by Mr. Russell Clift, a co-researcher/inventor, and myself. Do not feel you have to adhere to these techniques for they are only a guideline and starting point to spring from in your own approach to this subject. They are not established yet and will most likely be altered many times before their completion.

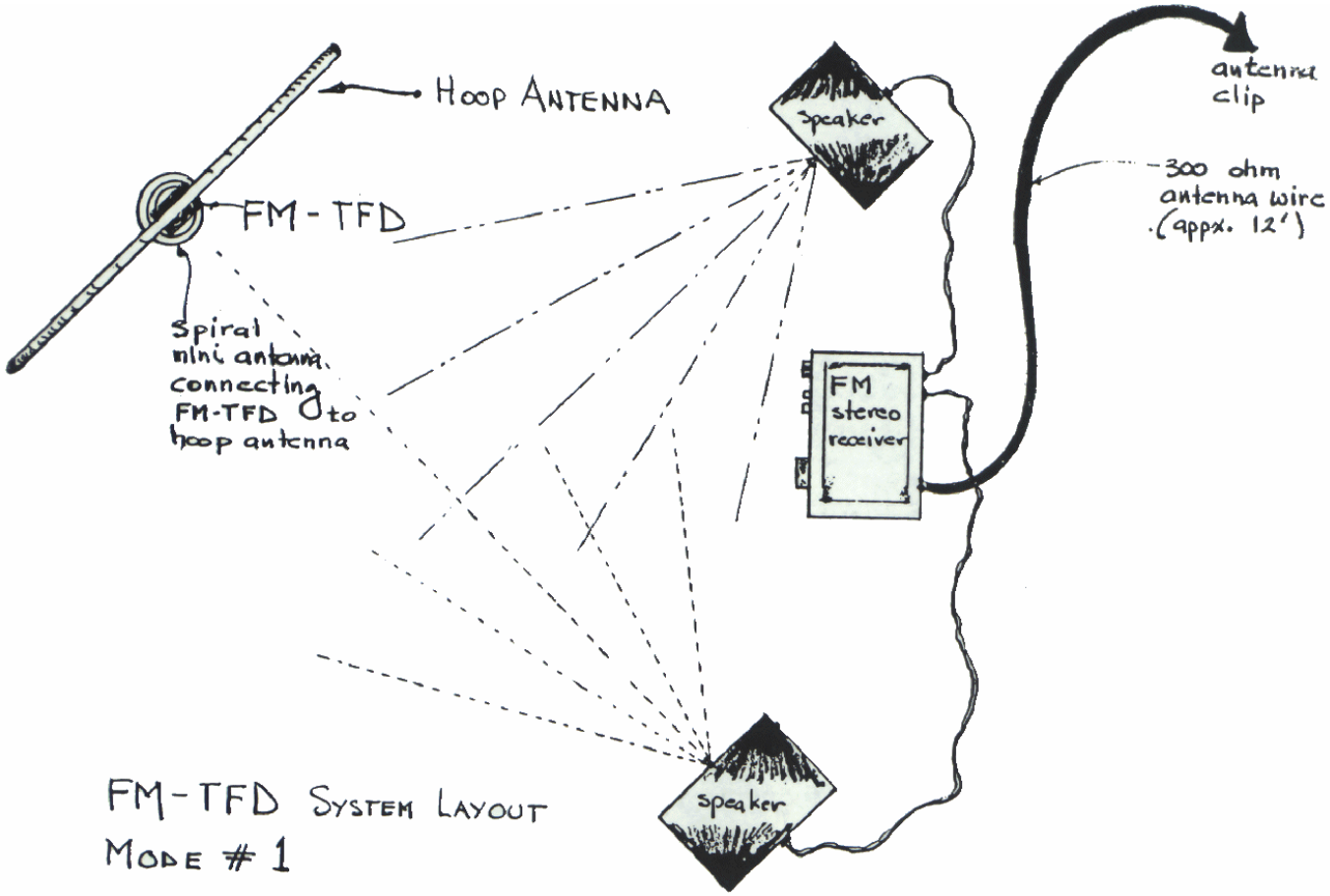

Figure 1. **System Layout for FM-TFD [Mode 1]**

As in all unknowns there are always unforeseen dangers involved and one should always use extreme caution and behave professionally in all approaches with any experimenting. Madame Curi and the XRay research is a good example. They paid dearly for their progress in X-Ray development with their lives. Scalar and its properties can be just as deadly as it is fascinating. I hope you read the seriousness in my tone for no matter how science fictionish scalar may sound to you now, I assure you the reality of actuallity can end up staring you in the face.

<u>Breakthrough Event</u>

Several years ago a Mr. George Meek presented me with construction planes and notes to a device he called Mark V. [Figure 1] Mr. Meek had been researching a phenomenon better known as EVP, or electro-voice phenomena. [Figure 2]

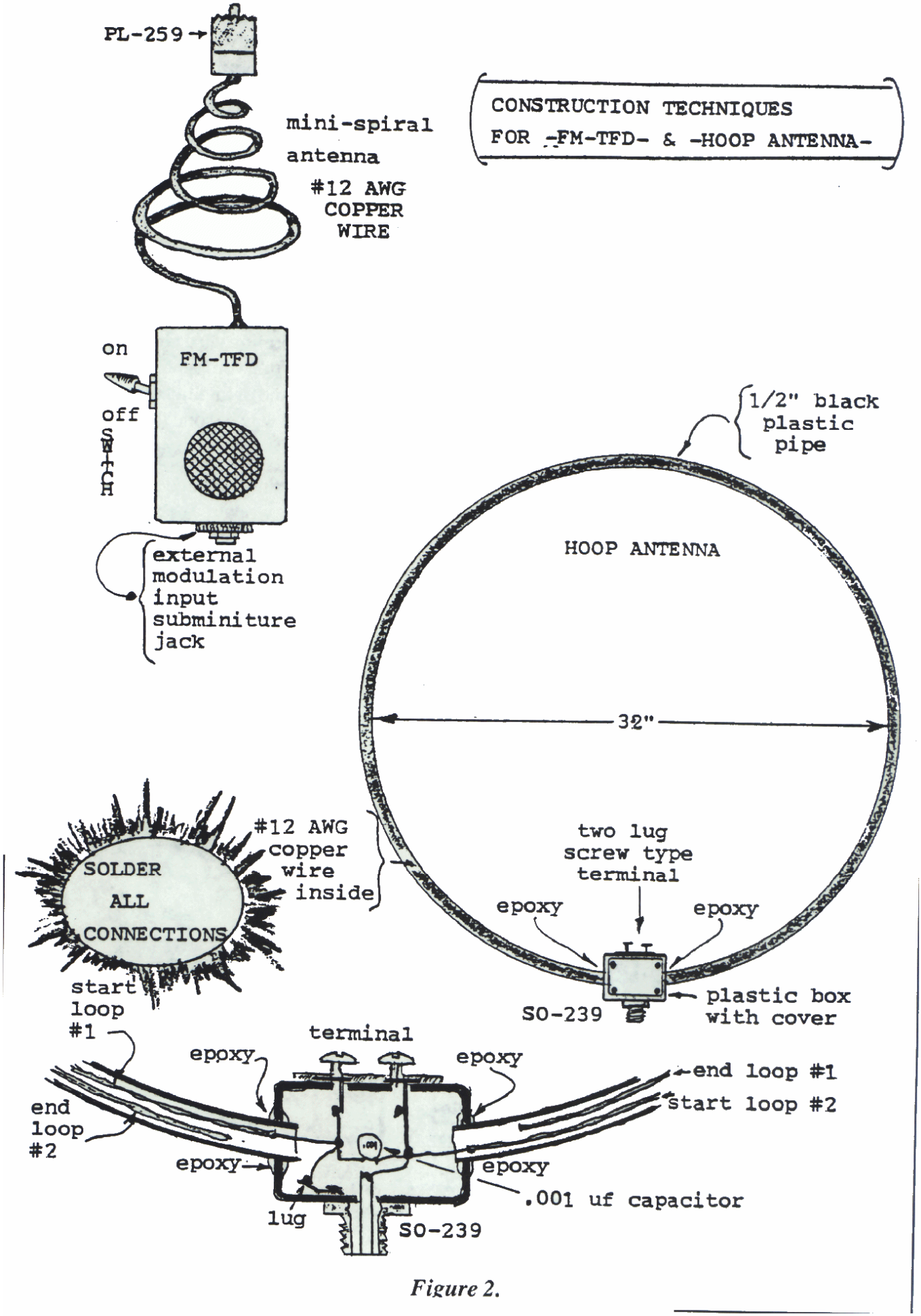

Figure 2.

Figure 2. **Construction Techniques for FM TFD & Hoop Antenna**

I would like to take a second here and answer a letter from one of **Extraordinary Science**'s subscribers printed in our last issue. Mr. Jeff King from New Zealand had written to the effect if perhaps I could cover what relationship scalar technology has in reference to EVP. [Figure 3] Well here it is, for this was the first reproducible effect dealing with scalar energy [interference pattems] [Figure 4] that I could verify really took place. My second breakthrough was also in the EVP area but I will not be able to go into it at this time due to available space to cover what must be covered now.

In short, Mr. Meek claimed to have a fantastic breakthrough of his own in the communications field of EVP. His claims were a recorded two-way conversation with another dimension. ***ZAP!*** Right here one would stop and feel that Mr. Meek and his researchers needed psychological help as I am sure some of you feel about me at this point. I contacted Mr. Meek and he flew down to El Paso so we could talk in person. He brought me two audio tapes of which one surely did have what appeared two-way communication in real time.

Up to this point all EVP claims were after the fact type of events. That is, the voices always appeared on blank tape after the operator had run the tape recorder for a period of time. No audible sounds were heard during the initial recording, only after playback of the tape--sort of the same thing being done now with channeling, but the person is still part of the circuit. Not all voices were understandable or clear enough to be real voice prints or just random white noise perhaps forming what almost sounds like words. In other cases, the words and even statements were definitely clear and of intelligent source. Well, Mr. Meek's tape went way beyond this to a two-way real time conversation.

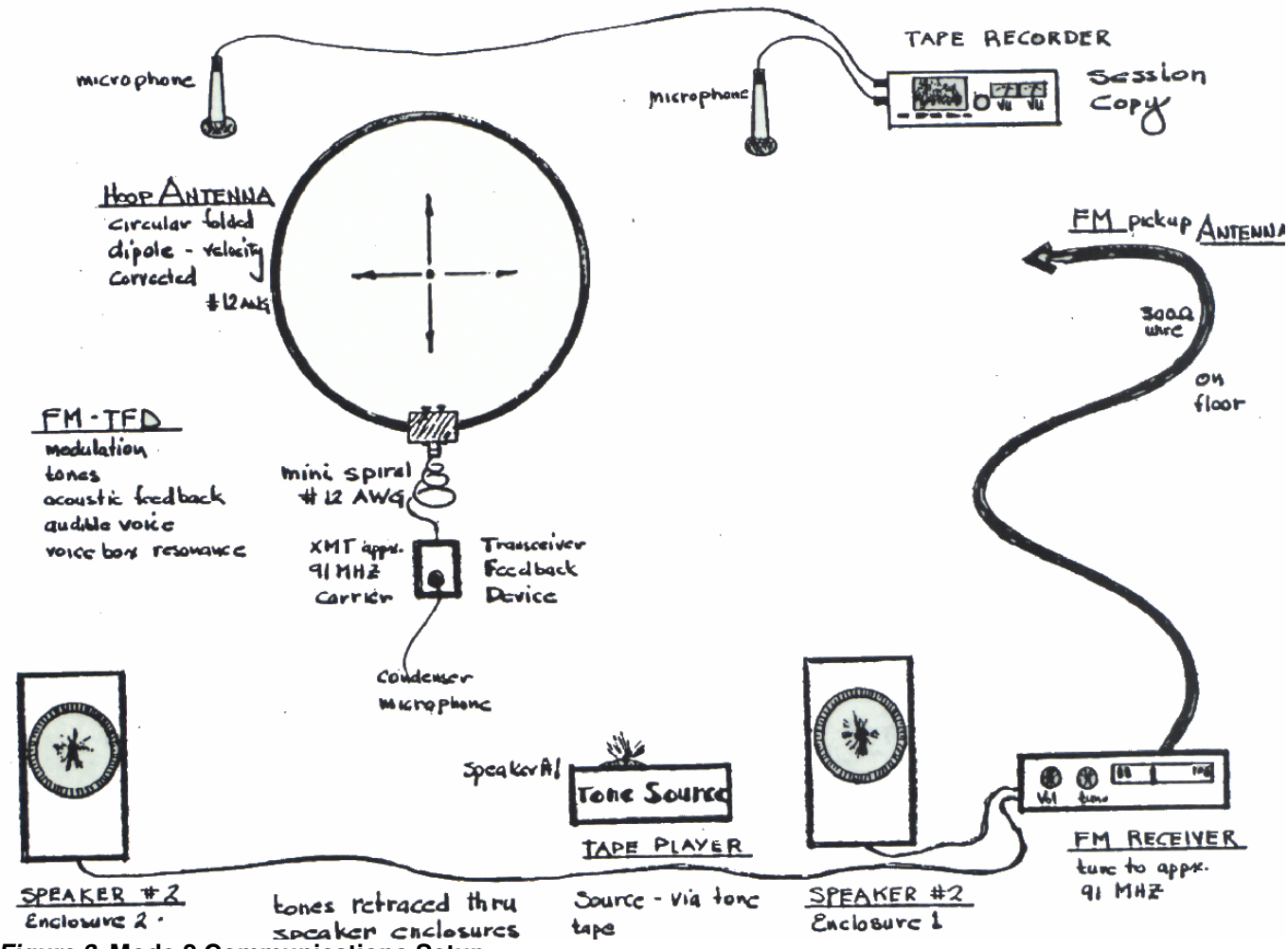

Figure 3. **Mode 2 Communications Setup**

Fascinated by these claims I wanted to know more on how such a process worked. This is where he presented me with the second tape. It consisted of thirteen mixed electronic tones. No, there is no magical number in why thirteen tones were used only that they were needed to create interference patterns. These tones with an acoustical feedback and RF transmission with a Smith coil produced a unique interference pattern [scalar-RF and acoustical stress field].

I followed the notes and set out to reproduce this fantastic claim. At one point in the notes was one observation statement:

The system seems capable of feeding back changes in emotional states.

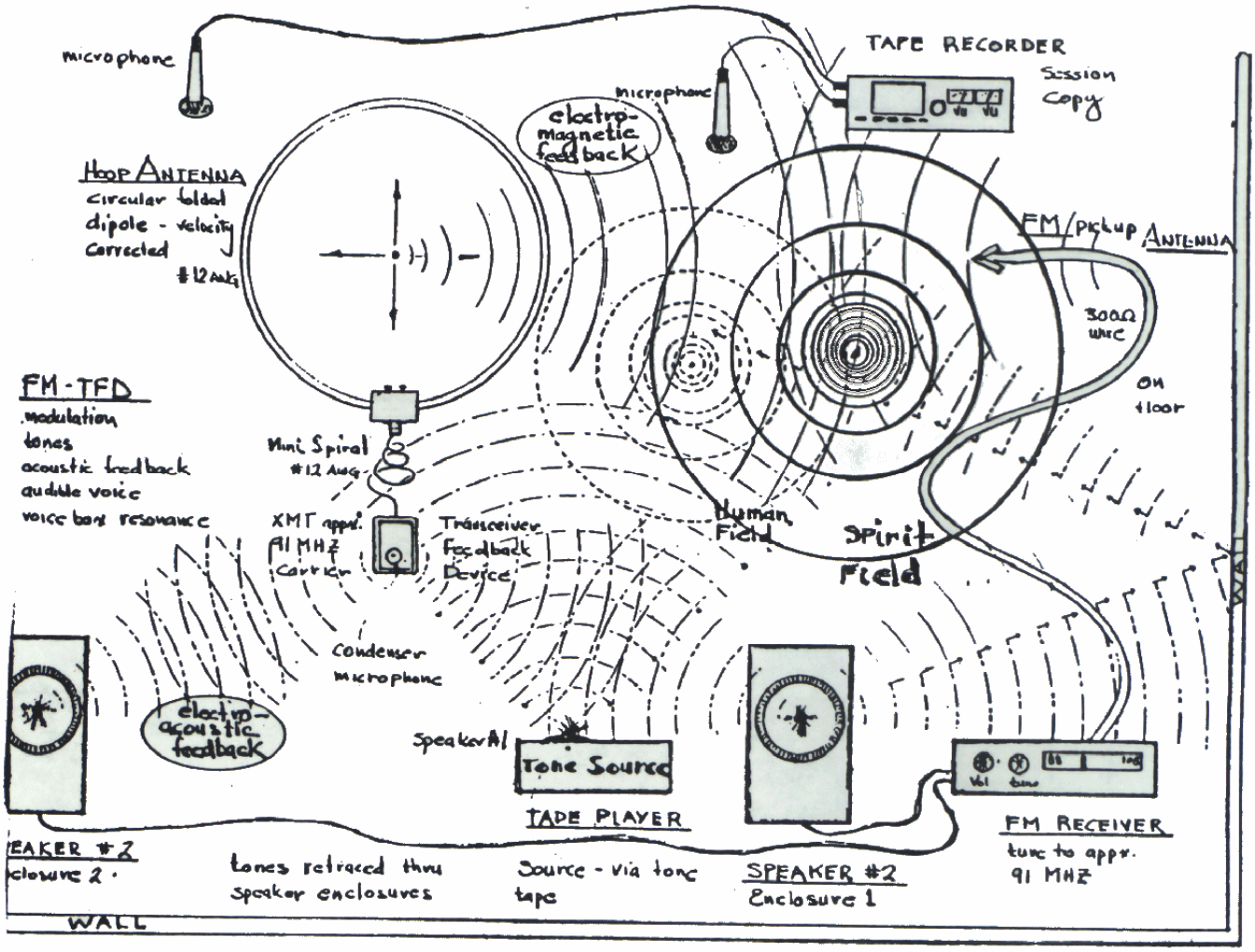

Figure 4. **Mode 2 Communications Interference Pattern**

I stopped there and to my amazement found the observation to be true. I was able to control an avalanche effect in a balanced tone of a set of acoustical and RF frequencies with only my own concentration -- no doppler effect or movement or contacts to my body in any way. I taped this effect and it is available to those who wish to observe the level of control of an electrical circuit with shear stress energy from a human.

This observation is equal to Nikola Tesla's observation of his plasma globe and tensing a fist. He found the plasma trail would rotate in relation with the tension or muscle pressure produced. I will cover this process in a moment for the plasma approach in construction a scalar indicator seems to be ideal due to its extreme sensitivity that up until now has been the human or personal element.

<u>Bedini Version ---- Dea/Faretto Scalar Detector</u>

In this version of an electromagnetic scalar detector you will see that a coil is suspended in a magnetic field within a shielded case. [Figure 5] It is not indicated but I am sure the coil should be wound as a scalar coil. See "Construction of a Scalar Coil," **ExtraOrdinary Science**, Vol.I, Issue 3, page 16. The shielding is so all that known EMF fields will be run to ground and not affect the sensor within the case. As you know, one of the properties of scalar energy is that it cannot be shielded. All known EMF will be stopped from entering the case except gravity fields and scalar energy.

I am not saying that gravity fields or scalar fields are EMF, but only that the formula to each have a basic root in the EMF part of the spectrum. A generated scalar pulse or field will cut past the case shielding and affect the atoms of the scalar coil within the magnetic field which in tum will be coupled to the op amp. Any change or effect will then be displayed on the scope indicating a pulse or field of some kind has gotten past the system's shielding and to the sensor. You should see a change in the display around 6AM when the sun comes up and there is a slight gravity shift. [1,2]

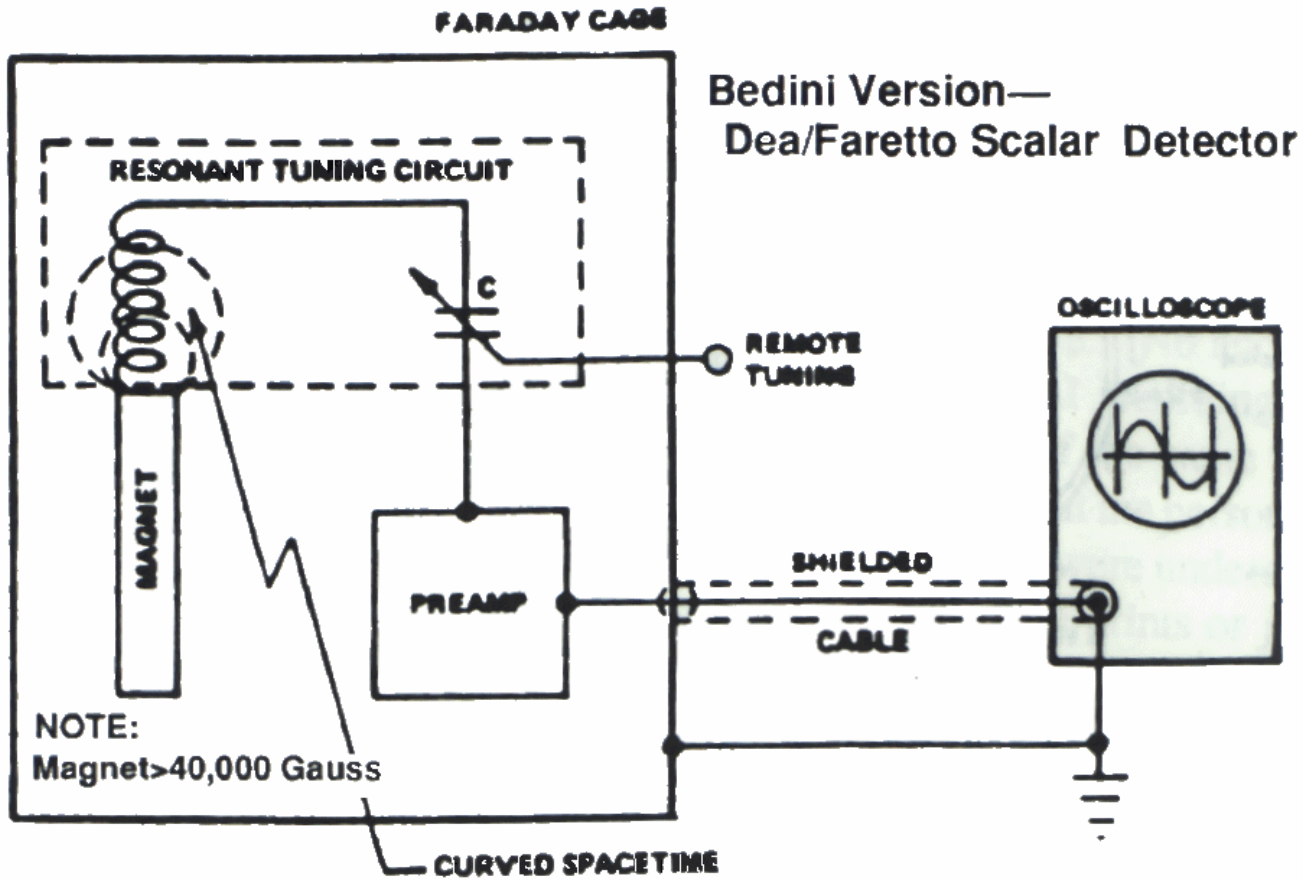

Figure 5. **Bedini Version of Dea/Faretto Detector**

<u>Plasma Scalar Detector</u>

This is the method which is under construction by Russell Clift and myself. At the time of this printing the construction is not far enough to give any details or results as to this approach. [See Figure 6] This is based on the same construction of Nikola Tesla's experiment.[3] Figure 7 is for experiments with various voltages and ion currents. Figure 8 is a simple multiplier for the AC supply shown in Figure 6.

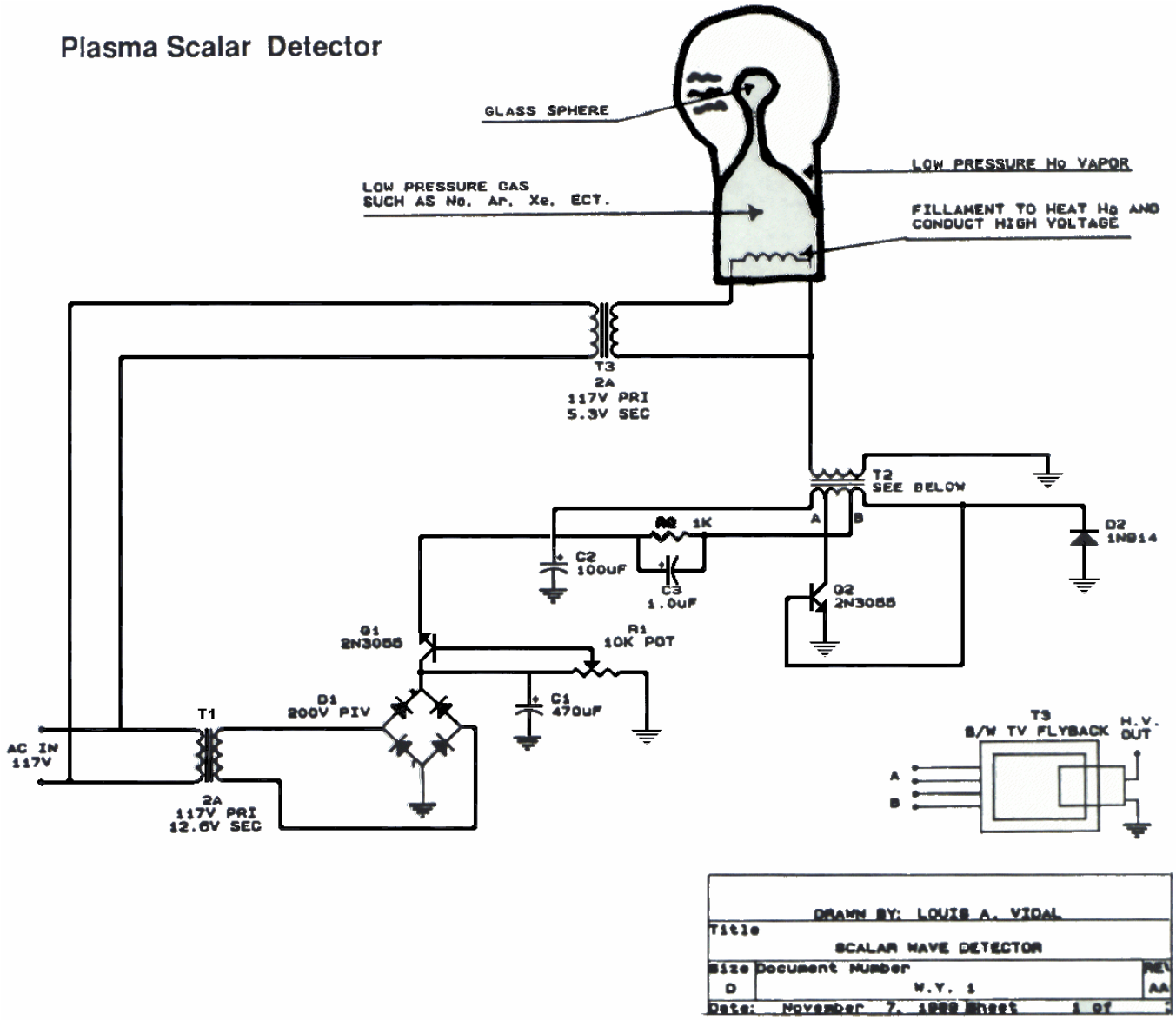

Figure 6. **Plasma Scalar Detector**

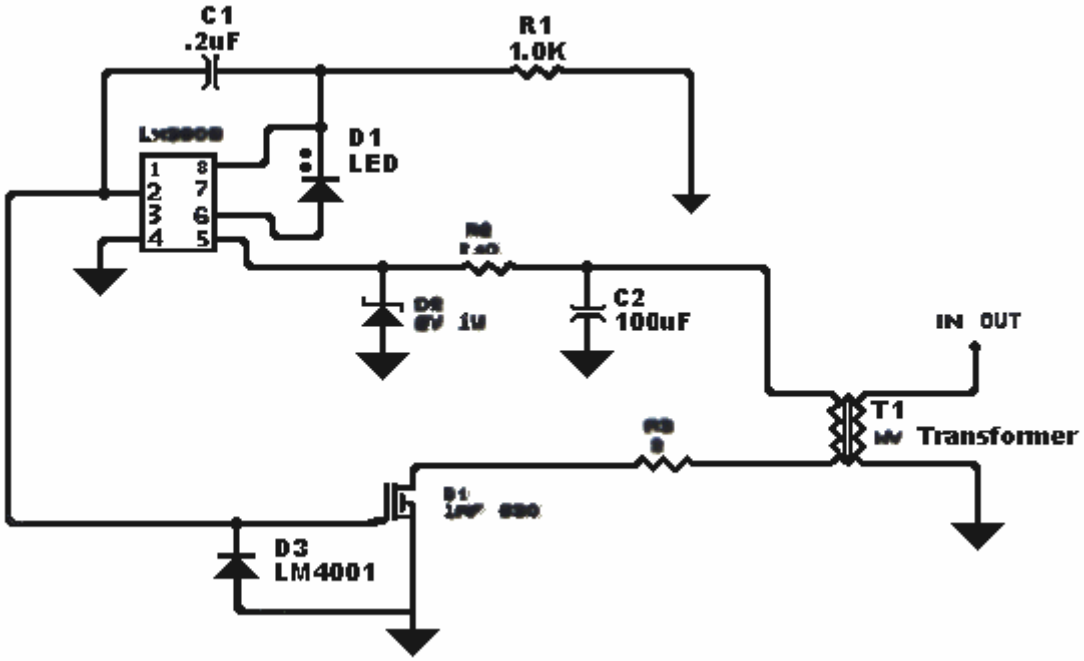

Figure 7. **Power Supply**

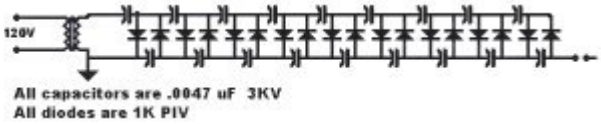

Figure 8. **Voltage Multiplier**

I know I have just touched upon this subject so far but I hope I have given some of you starting points in your own research and findings. I will welcome any and all papers or works you may do in the scalar field and submit your work for publication here for others to read and gain from. Will be looking forward to your replies in the new year. Thank you for your interest.___***WRY***

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1. Michael Polonyi, "Electrodynamics, Inertia and Gravitation: A Unifying Approach," **Speculations in Science and Technology**, Vol. 10, No. 2, page 145, 1987.

2. Gregory Hodowanec, "Gravitational Impulses," **Electronics Experimenters Handbook**, January 1989, page 114.

Thomas Cummerford Martin, **Inventions. Researches and Writings of Nikola Tesla**, page 226 to page 228.

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Chasing the Wild Dragon Tables and Figures

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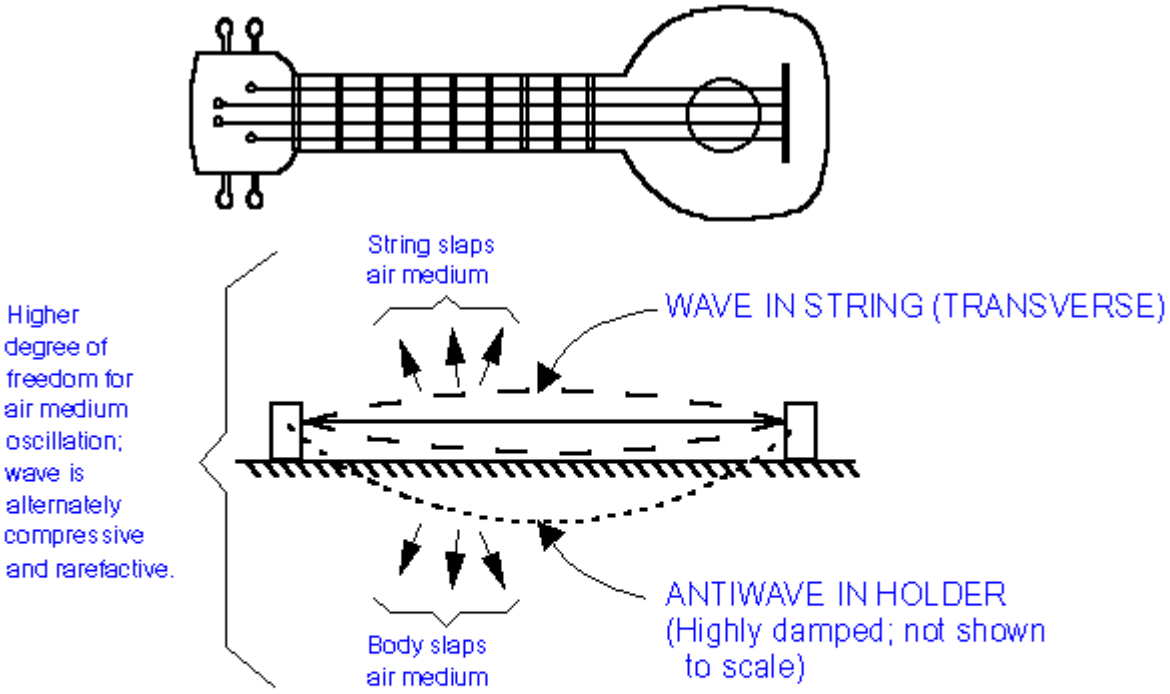

Figure 1. Air medium disturbances generated by plucked string.
Two waves are created, both slapping the air medium at the same time, but in opposite directions. A disturbed medium oscillates according to its own degrees of freedom. The air has more degrees of freedom than the string. A wave of compression and rarefaction is created in the air medium.

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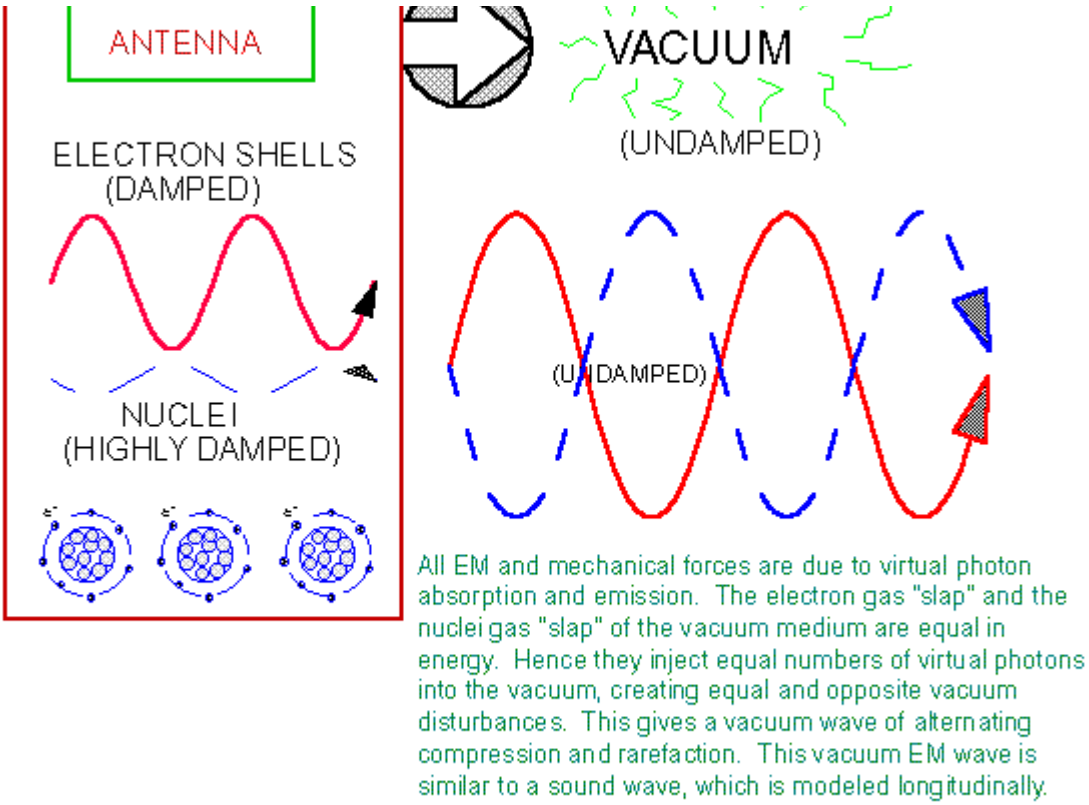

Figure 2. Launching an EM wave from a wire antenna.

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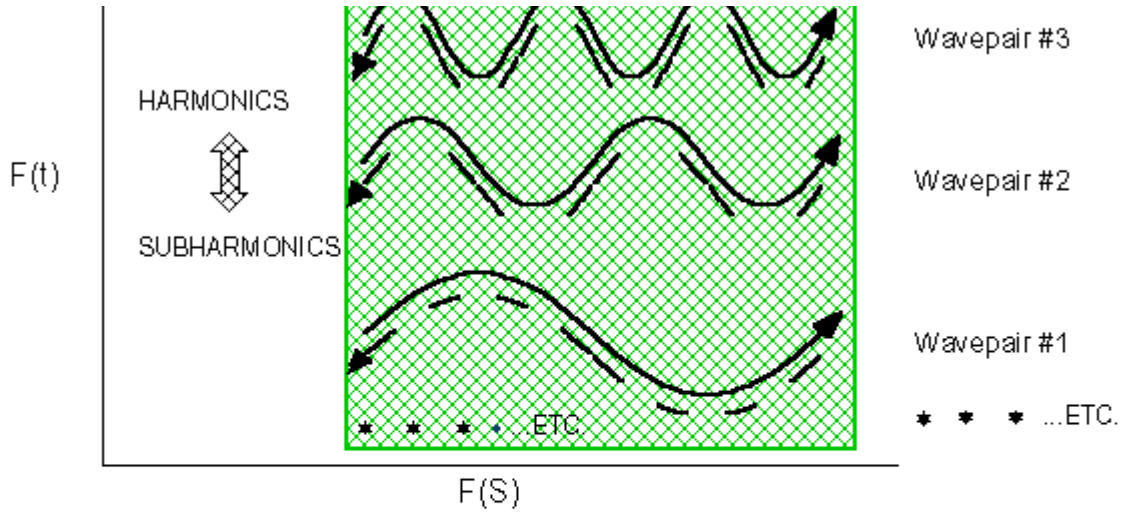

Figure 3. Internal Wave Structure of the scalar potential.

A harmonic set if wavepairs, where in each wavepair the two waves superpose spatially, but travel in opposite directions. The two waves in each pair are true phase conjugates and time-reversals of each other. Thus they comprise a coupled wave and antiwave. The photons must also be coupled into photon/antiphoton pairs, by a strong application of the distortion correction theorem of nonlinear optics.
Each wavepair is a standing electrogravitational wave.

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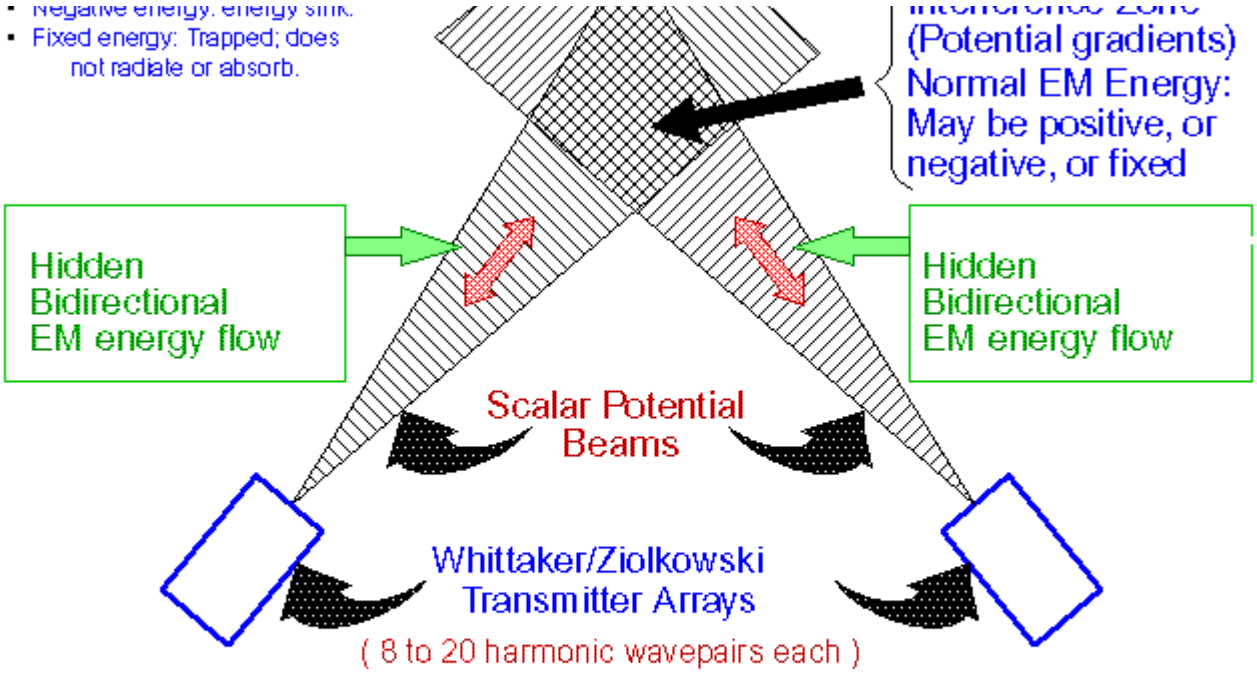

Figure 4. Scalar potential interferometry provides action-at-a-distance. It already creates normal EM fields and waves.

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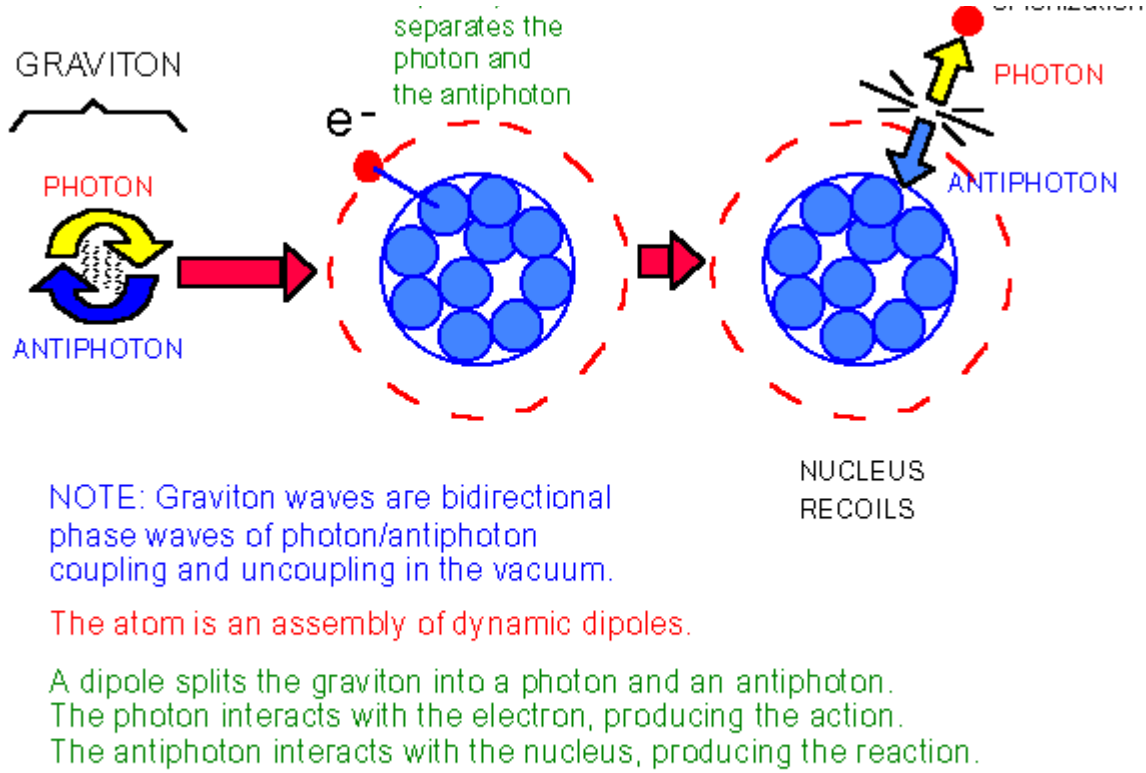

Figure 5. Graviton interaction with matter produces the photon interaction and Newton's third law reaction.

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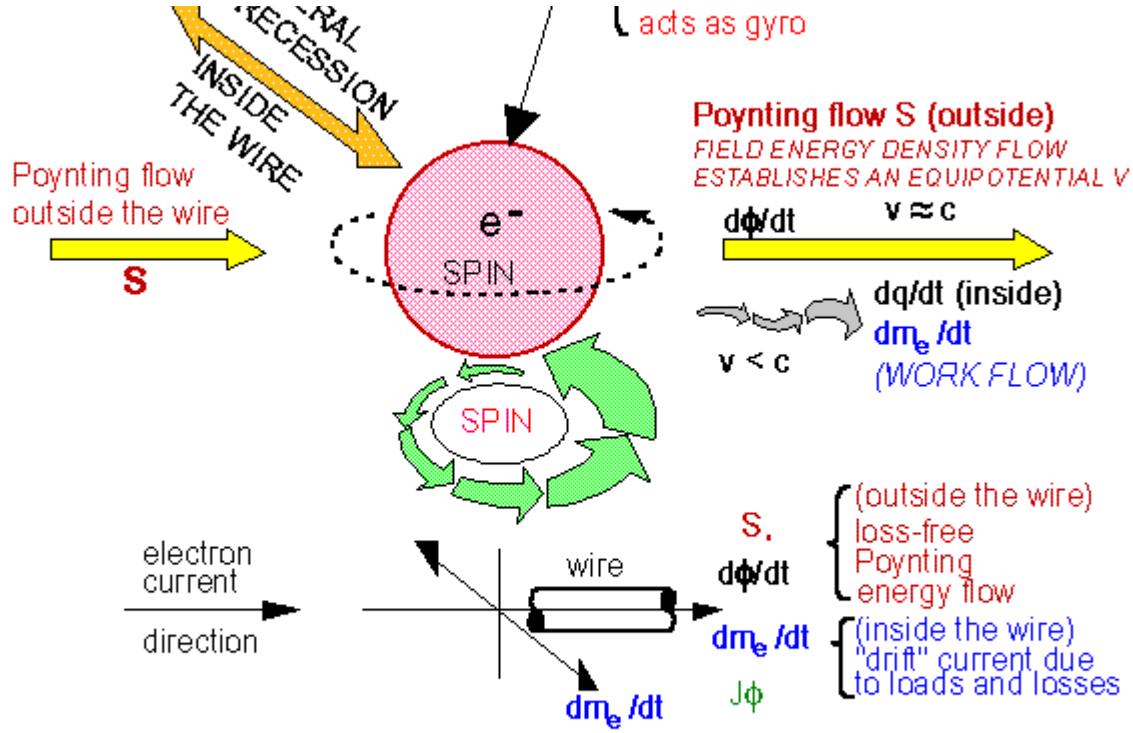

Figure 6. Currents in and along a conductor, with electron precession.

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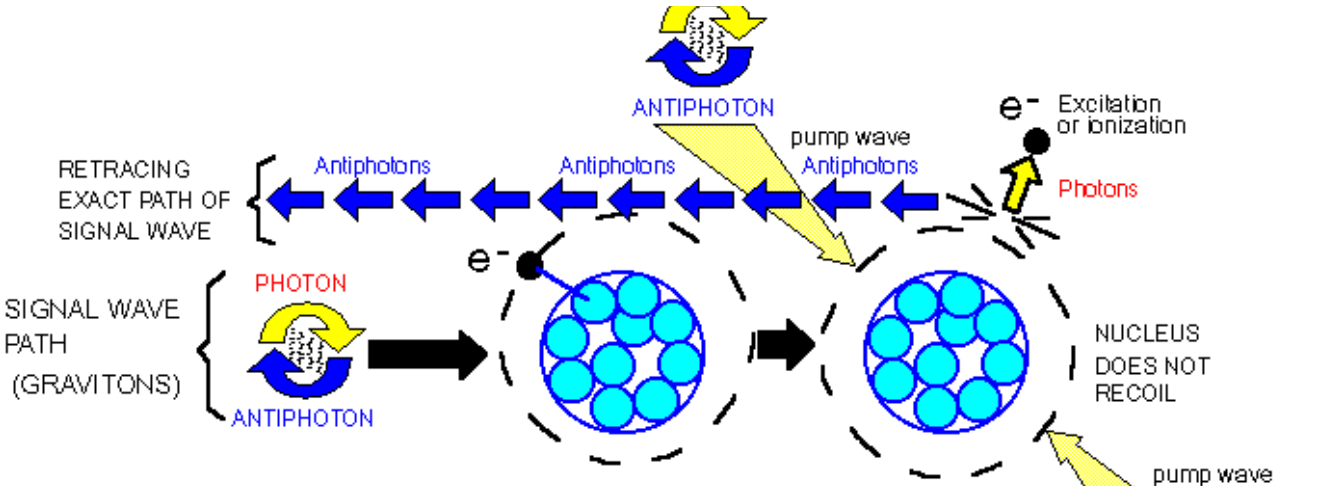

- Dipolarity of the atom separates photon and antiphoton.
- Photon interacts with electron.
- Pumped nonlinear atom acts as a pumped phase conjugate mirror. Directs the antiphoton back along the path taken by graviton.
- Antiphoton does not interact with nucleus. Thus there is no nuclear recoil force generated.
- Nucleus thus does not recoil.
- Not a violation of Newton's third law, once one understands the mechanism that generates third law reaction. In the absence of the generating mechanism, there is no third law recoil. In EM field theory, the "missing antiwave" has necessitated third law omission.

Figure 7. Emission of antiphoton; nucleus does not recoil. Atom acts as a pumped phase conjugate mirror.

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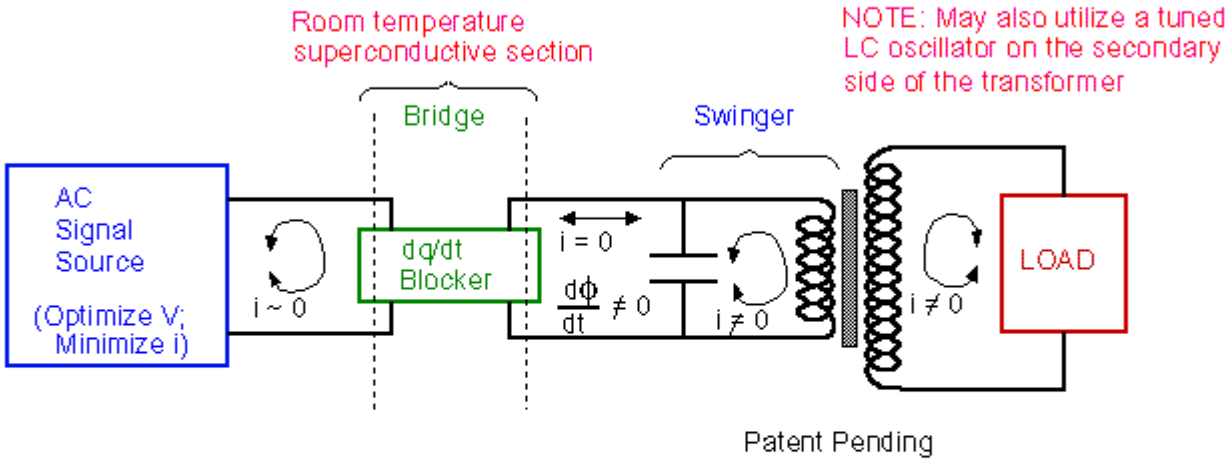

Figure 8. dq/dt-free driving a swinger by S-flow.

Poynting energy flow S with its accompanying potential V is shuttled from the source to a tuned LC oscillator in resonance at the driving frequency or slightly below. The LC oscillator is driven by S-flow and dV/dt flow alone. The swinger furnishes its own free electrons, which receive S and EMF from the bridge, thereby producing dq/dt.

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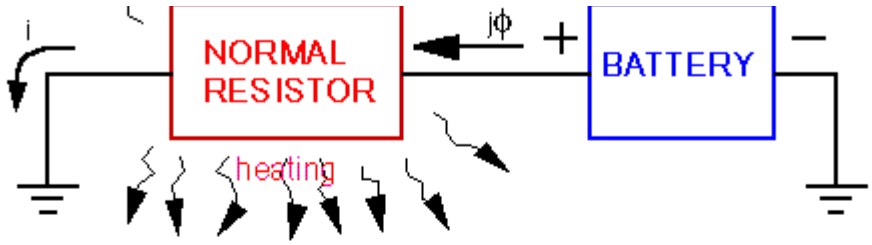

Figure 9a. Normal resistor receives ordered energy and scatters it.

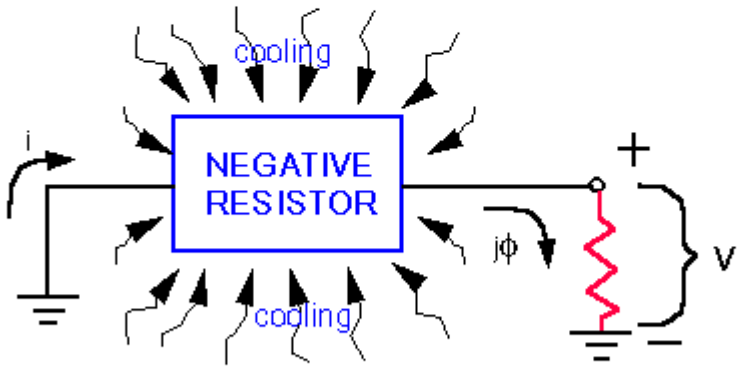

Figure 9b. Negative resistor receives, concentrates, and reorders scattered energy.

Figure 9. Normal resistor versus a negative resistor.

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Some 17 signals were fed into a rotating plasma, which added phase conjugates to them. This infolded 17 wavepairs, each pair a coupled wave/antiwave, thereby forming a scalar potential with an artificial Whittaker pump wave internal structure. This infolded pump wave complex was modulated onto a powerful, rippling magnetic field, guaranteeing penetration even into the atomic nuclei. A specific, amplified antiengine for the exact cellular disease state was generated, reversing the diseased cells back to a previous healthy state.

Figure 10. Priore's laboratory apparatus for cellular reversal.

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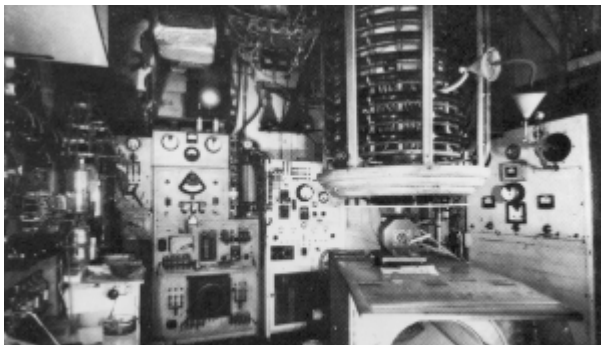

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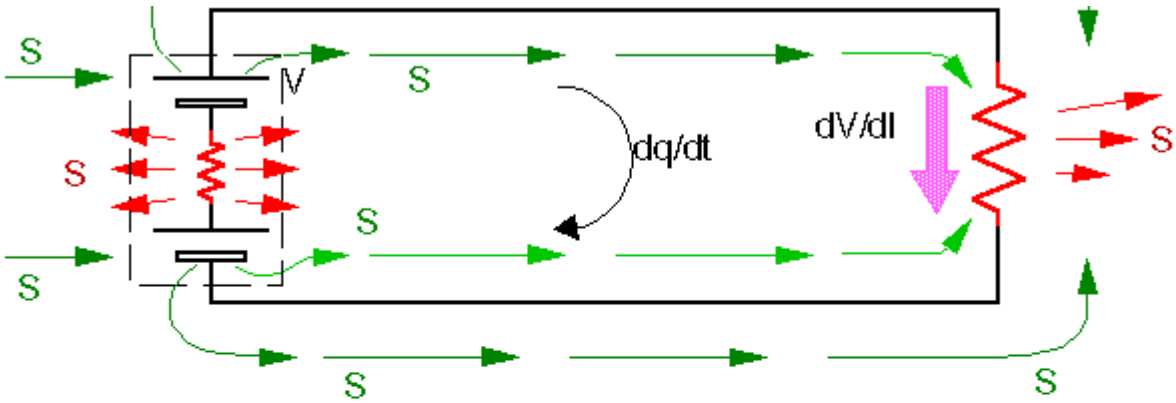

Note: EM texts err in showing the battery "gate" as the source of energy.

Figure 11. Poynting S-flow along a simple circuit.

From particle physics, any electric charge is a broken symmetry in the vacuum's virtual particle flux. Any dipole is thus two locally broken symmetries. Thus the dipole acts as a gate/source, driven by the fierce vacuum flux. So a dipole already "extracts" and gates EM energy flow, directly from the seething vacuum.

Every battery and generator is already a "free energy" source of extracted and gated EM energy from the vacuum.

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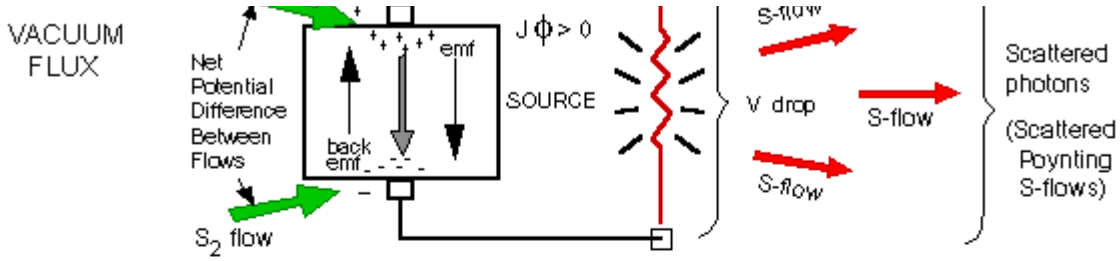

Figure 12a. Normal current flow; Jϕ is the electron transport of energy, while S is the speed-of-light Poynting energy flow.

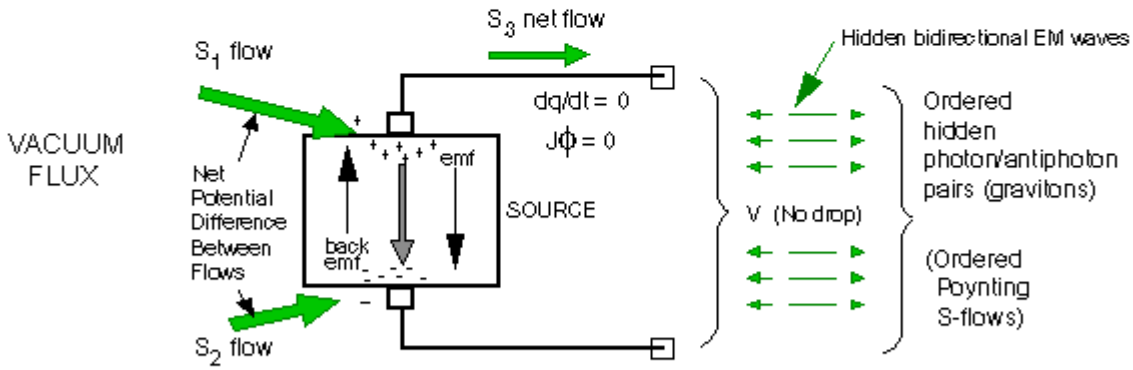

Figure 12b. In a conductor with dq/dt blocked; S-flow and hidden Whittaker-wave flow continue.

Figure 12. Overt and covert field energy density flows.

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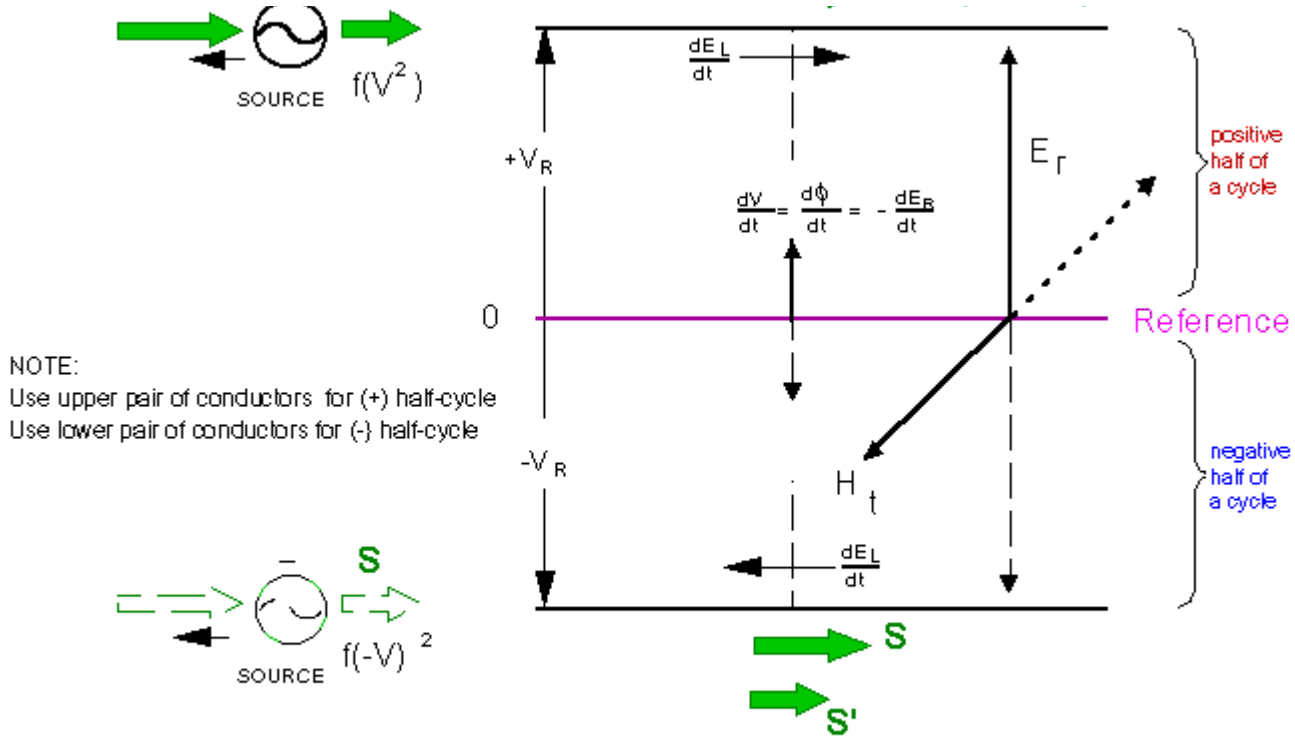

Figure 13. Poynting vector currents S and S' versus massless displacement currents.

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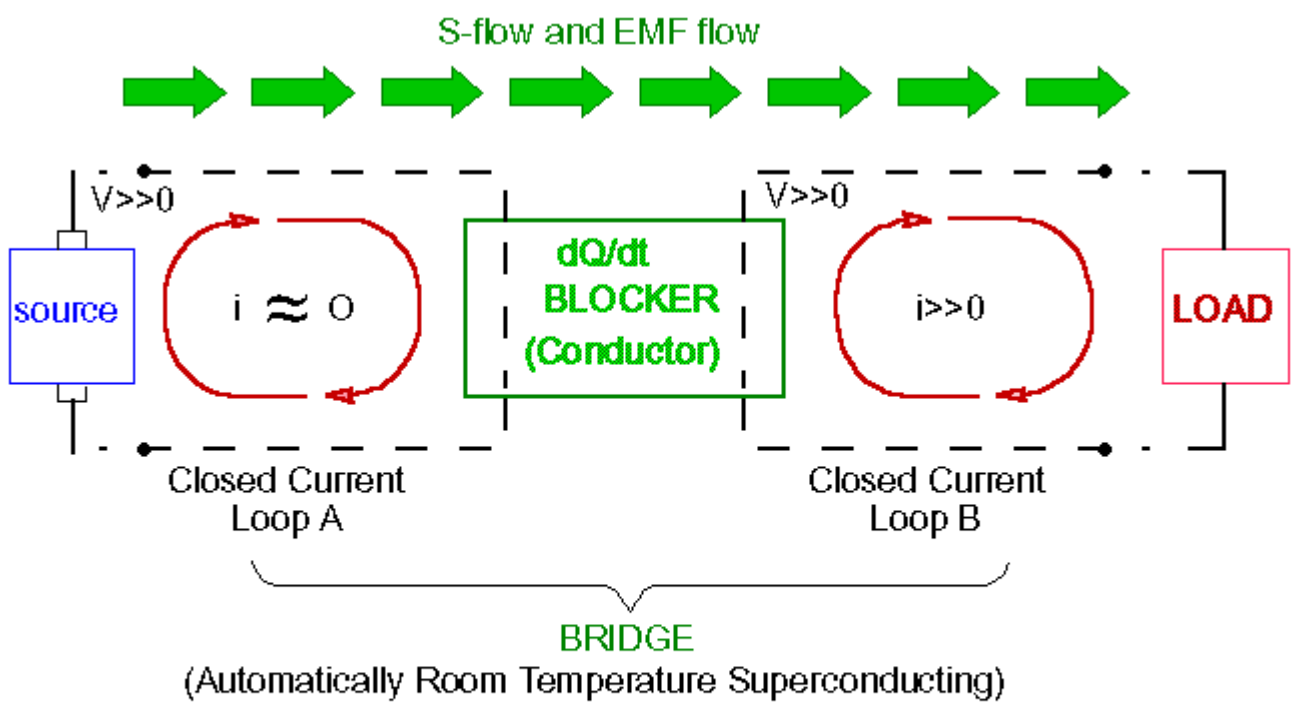

Figure 14. Bridging to enable room temperature superconductivity.

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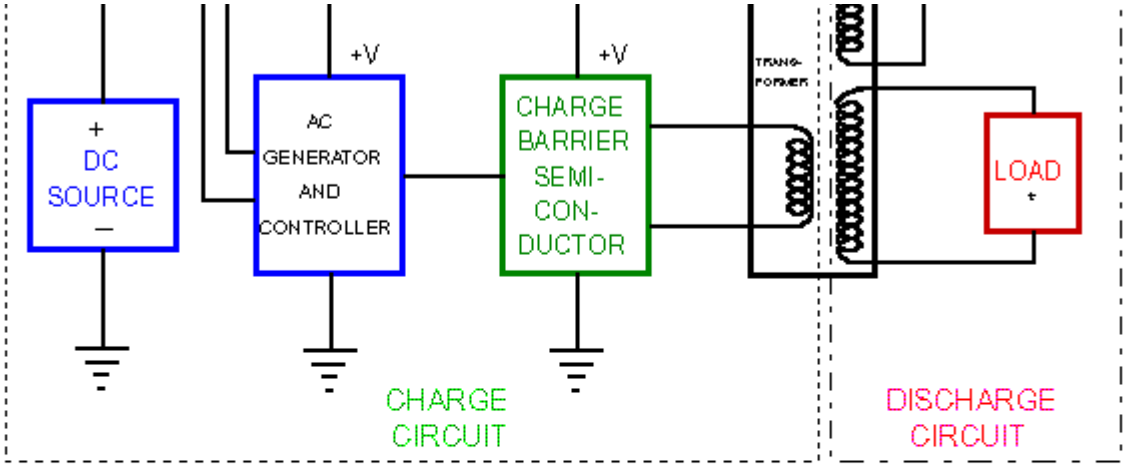

Patent Pending

* NOTE:
DISCHARGE CIRCUIT AND LOAD GROUND
MUST BE ISOLATED FROM THE
CHARGE CIRCUIT GROUND.
FEEDBACK LOOP MUST BE RIGIDLY CLAMPED AND LIMITED.

Figure 15. Use of Fogal semiconductor for overunity (closed system).

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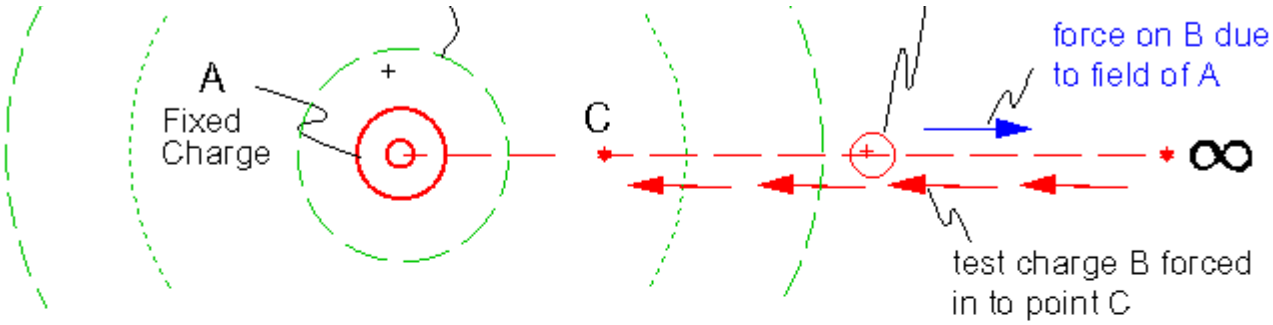

Figure 16a. Magnitude of the scalar potential is determined by work required to push in a unit charge from infinity; e.g., against a repelling like charge. If test charge is released, work will be performed upon it to translate it back toward infinity

Figure 16a. Process for overunity coefficient of performance.

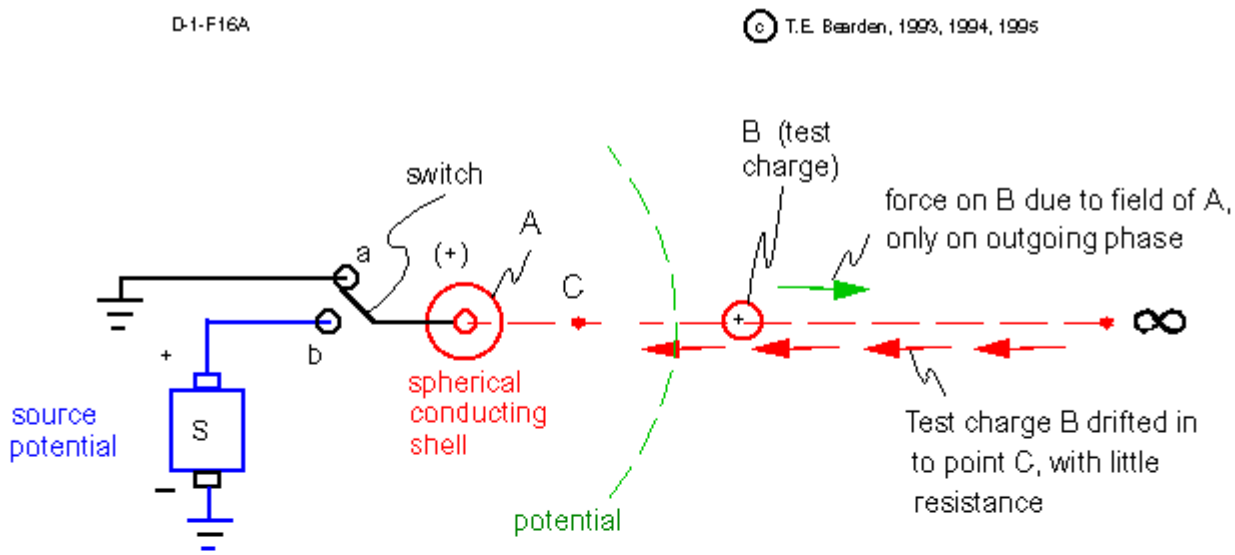

Assumptions: Capacitance of A very small; charge B large, power-free switching

Switch potential off, drift in test charge B, switch potential back on. Can now get free work from repelled test charge B. Get much more free work if A is at a high potential, and charge B is large.

Figure 16 b. Demonstration of overunity efficiency

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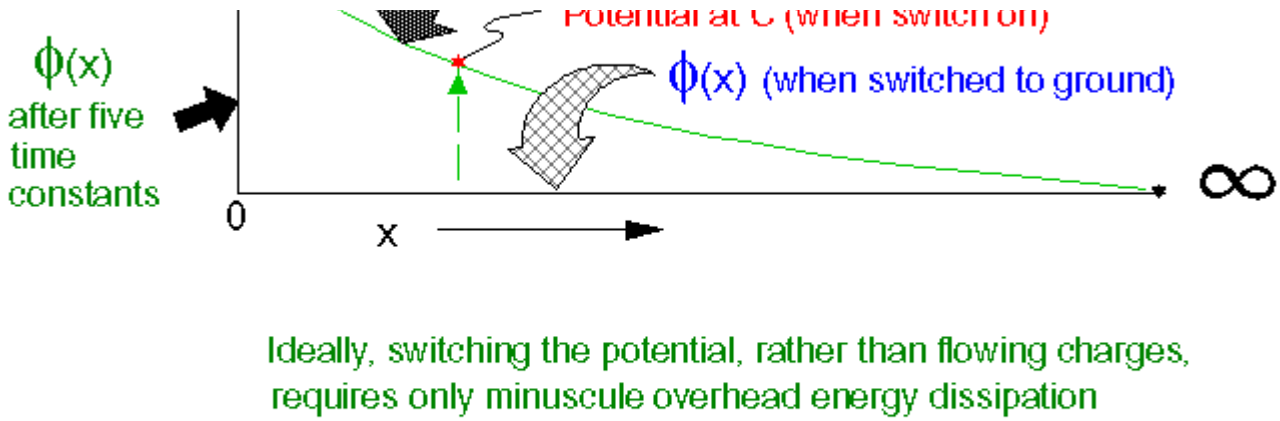

Figure 16c. Potential to which test charge is exposed.

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Open system receiving excess energy from an external source

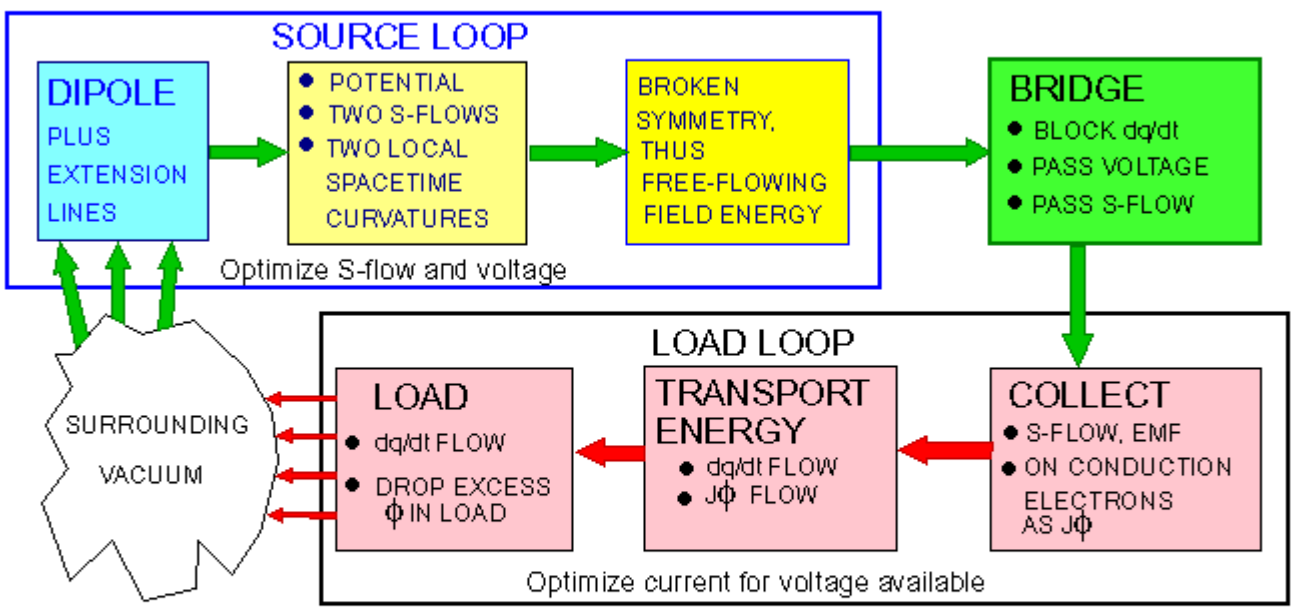

Figure 17. Operation of an overunity electrical power system.

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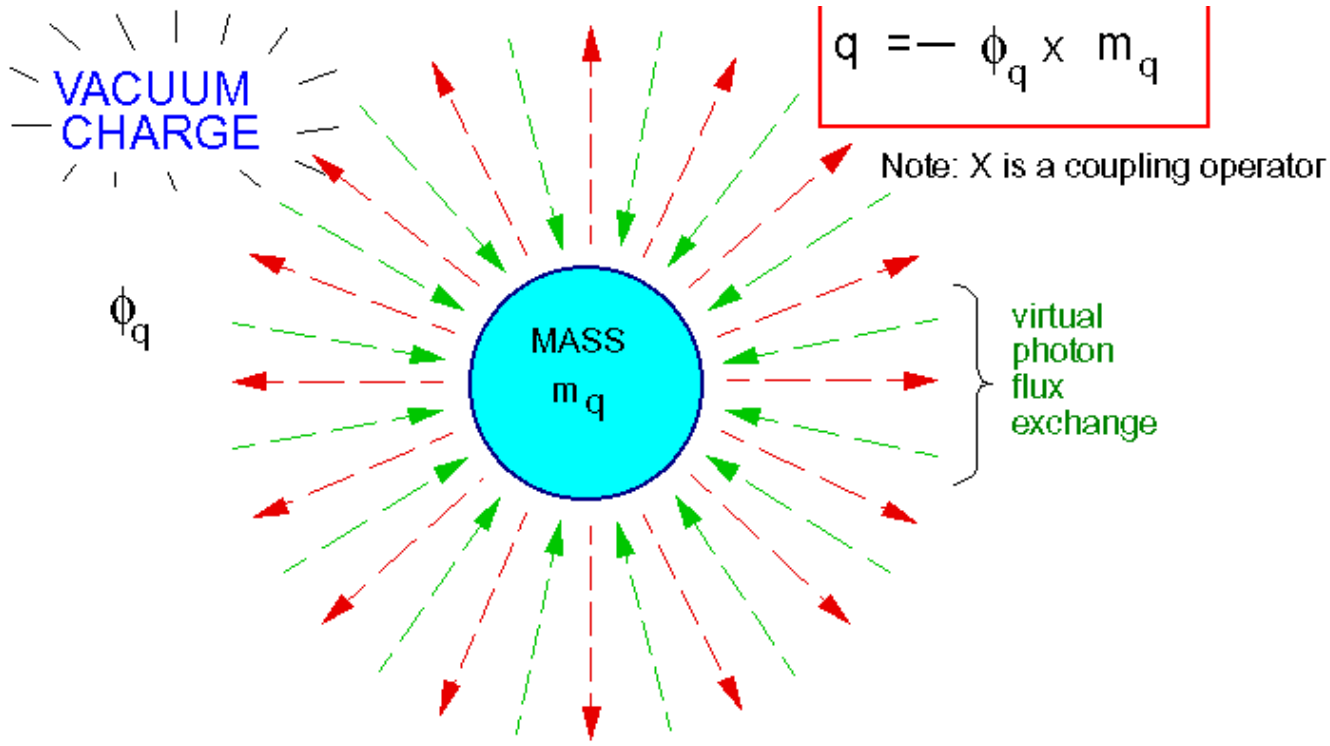

Figure 18. An electric charge q is a broken symmetry. It continuously and violently exchanges energy with the vacuum.

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The Dawn of E-BOMB

For the wired world, the allure and the danger of high-power microwave weapons are both very real

By Michael Abrams

In these media-fueled times, when war is a television spectacle and wiping out large numbers of civilians is generally frowned upon, the perfect weapon would literally stop an enemy in his tracks, yet harm neither hide nor hair. Such a weapon might shut down telecommunications networks, disrupt power supplies, and fry an adversary's countless computers and electronic gadgets, yet still leave buildings, bridges, and highways intact. It would strike with precision, in an instant, and leave behind no trace of where it came from.

In fact, it almost certainly is already here, in the form of high-power microwave (HPM) weapons. As their name suggests, HPMs generate an intense "blast" of electromagnetic waves in the microwave frequency band (hundreds of megahertz to tens of gigahertz) that is strong enough to overload electrical circuitry. Most types of matter are transparent to microwaves, but metallic conductors, like those found in metal-oxide semiconductor (MOS), metal-semiconductor, and bipolar devices, strongly absorb them, which in turn heats the material.

An HPM weapon can induce currents large enough to melt circuitry. But even less intense bursts can temporarily disrupt electrical equipment or permanently damage ICs, causing them to fail minutes, days, or even weeks later. People caught in the burst of a microwave weapon would, by contrast, be untouched and might not even know they'd been hit. (There is, however, an effort to build a microwave weapon for controlling crowds; a person subjected to it definitely feels pain and is forced to retreat.)

"HPM sources are maturing, and one day, in the very near future, they will help revolutionize how U.S. soldiers fight wars," says Edl Schamiloglu, a professor of electrical and computer engineering at the University of New Mexico in Albuquerque and one of the leading researchers in this burgeoning field.

The fact that we seldom hear about HPM weapons only adds to their exoticism. Last spring, stories leaked to the press suggested that the Pentagon, after decades of research, had finally deployed such a device in Iraq. And when news footage showed a U.S. bomb destroying an Iraqi TV station, many informed onlookers suspected it was an electromagnetic "e-bomb."

"I saw the detonation, and then I saw the burst—which wasn't much. If they took the station out with that blast, I strongly suspect that we used Iraq as a proving ground" for HPMs, says Howard Seguine, an expert on emerging weapons technology with Decisive Analytics Corp., in Arlington, Va.

But while the U.S. military proudly paraded assorted new war-making technology during its conquest of Iraq, from unmanned combat aerial vehicles to a new satellite-based tracking network, it remained tight-lipped about this "mother of all weapons." Asked at a 5 March news briefing to confirm the rumor, General Tommy Franks, head of U.S. forces during the war, would only say, "I can't talk to you about that because I don't know anything about it."

Military secrecy is nothing new, of course. What is known about microwave weapons is that the U.S. military has actively pursued them since the 1940s, when scientists first

CHIP SIMONS

Microwave weapons researcher Edl Schamiloglu sits in front of the Pulserad-110A accelerator, which his lab at the University of New Mexico uses to produce single 100-nanosecond pulses of electron beams, each pulse emitting hundreds of megawatts of power.

observed the powerful electromagnetic shock wave that accompanied atmospheric nuclear detonations, suggesting a new class of destructiveness. While much of the work on HPMs remains classified, the Pentagon has also recently sponsored a number of U.S. university laboratories to work out the basic principles of microwave weapons, including reliable and compact nonnuclear ways of generating microwave pulses.

Many of those results are being published in the open literature [see To Probe Further, p. 30]. In fact, all you need is a reasonable grasp of physics and electrical engineering to appreciate the ingeniousness of microwave weapons. Anyone with a technical bent could probably also build a crude e-bomb in their garage, a thought that security-minded folks find rather troubling.

How they work

From the military's perspective, HPM weapons, also known as radiofrequency weapons, have many things going for them: their blast travels at the speed of light, they can be fired without any visible emanation, and they are unaffected by gravity or atmospheric conditions. The weapons come in two flavors: ultrawideband and narrowband. Think of the former as a flashbulb, and the latter as a laser; while a flashbulb illuminates across much of the visible spectrum (and into the infrared), a laser sends out a focused beam at a single frequency.

Like the flashbulb, ultrawideband weapons radiate over a broad frequency range, but with a relatively low energy (up to tens of joules per pulse). Their nanoseconds-long burst produces a shock that indiscriminately disrupts or destroys any unshielded electronic components within their reach. The bomb's destructiveness depends on the strength of the ultrawideband source, the altitude at which it is initiated, and its distance from the target [see "E-Bomb Anatomy," p. 29].

Narrowband weapons, by contrast, emit at a single frequency or closely clustered frequencies at very high power (from hundreds up to a thousand kilojoules per pulse), and some can be fired hundreds of times a second, making an almost continuous beam. These pulses can be directed at specific targets—say, a command and control complex positioned on the roof of a hospital in a densely populated neighborhood—and tuned to specific frequencies. Technologically more sophisticated than ultrawideband sources, they are far more difficult to develop, but are reusable and potentially of much greater use to the U.S. military.

Both versions wreak the same kind of havoc on just about any kind of unprotected electronic equipment. Particularly vulnerable is commercial computer equipment; anything in excess of just tens of volts can punch through gates in MOS and metal-semiconductor devices, effectively destroying the device, explains Carlo Kopp, a visiting research fellow in military strategy at the Strategic and Defense Studies Centre in Canberra, Australia, and a computer scientist who lectures at Monash University in Melbourne. The higher the circuitry's density, the more vulnerable it is, because less energy is required to overload and destroy the transistors. HPMs also produce standing waves in electrical grid wiring and telephone and communications wiring, entering through cables, antennas, and even ventilation grills. They can immobilize vehicles with electronic ignition and control systems, too.

"Since the frequency is high, this permits parasitic or stray capacitances to couple energy via paths in the circuit that may not be protected against overvoltage," Kopp explains.

The e-bomb

You could deliver an e-bomb in a number of ways: cruise missile, unmanned aerial vehicle, or aerial bomb. Whether ultrawideband or narrowband, the e-bomb consists of both a microwave source and a power source [again, see diagram, p. 29]. Ultrawideband e-bombs aim to create an electromagnetic pulse like that accompanying a nuclear detonation, except that the nuclear material is replaced with a conventional, chemical explosive. The microwave source typically relies on an extremely fast switching device, according to Kopp, who has written widely on weaponizing HPM technology. Narrowband e-bombs might use a virtual cathode oscillator (vircator) tube or a variant of a magnetron. Though termed narrowband, they don't have the high coherency seen in signal-carrying applications, Kopp says.

It takes gigawatts of power to feed an e-bomb's microwave source. For that, the flux compression generator, or FCG, is a good choice, says Kopp. Invented by Clarence ("Max") Fowler at Los Alamos National Laboratory after World War II as a byproduct of research into atomic bomb detonators, FCGs are conceptually simple. The best-known type consists of an explosive-packed copper cylinder surrounded by a helical current-carrying coil. Upon detonation, the explosion flares out the cylinder, short-circuiting the coil and progressively reducing the number of turns in the coil, thus compressing the magnetic flux. Large FCGs have produced tens of gigawatts, and they can be cascaded—connected end to end—so that the output from one stage feeds the next.

Despite its simplicity, an FCG-powered e-bomb is probably too difficult for the average terrorist to build on the cheap. For one thing, to test the assembled apparatus, you have to blow it up. For weapons researchers, the e-bomb poses other problems. The strength of the shock wave dissipates rapidly as it moves out from the explosion. To knock out an electrical power substation, for example, the weapon has to strike within about a hundred meters. "Like all microwave radiation, the effect follows an inverse square law with increasing distance," Kopp notes. Though the explosion needed to force out the current can be fairly small, it keeps the munition from being fully nonlethal and nondetectable. Also, anything that's been hardened or shielded against an electromagnetic pulse from a nuclear bomb will probably emerge unscathed.

Focused like a laser

The type of narrowband HPM weapons that the U.S. military is looking at offers everything that e-bombs do not. They're nonlethal, reuseable, and tunable, and they can be fired from miles away. Like a laser, the focused beam disperses only slightly over great distances. With a frequency range that is between about 1 and 10 GHz, they can penetrate even electronics shielded against a nuclear detonation. The deepest bunkers with the thickest concrete walls are not safe from such a beam if they have even a single unprotected wire reaching the surface.

Schamiloglu holds a rippled-wall waveguide connected to an antenna. The waveguide is where kinetic energy from a pulsed-power-driven electron beam is transformed into high-power microwaves. In the background sit the Pulserad-110A [left] and the Russian-built Sinus-6 [right]. The Sinus-6 can fire a several-gigawatt pulsed beam 200 times a second in 10-nanosecond bursts.

CHIP SIMONS

A microwave beam is created much like a laser beam. Between the batteries (or other power source) and the beam sit three elements: capacitors that turn the stored energy into an electron beam of nanosecond bursts, a microwave source that converts the electron beam into focused, high-frequency electromagnetic waves, and an antenna that points and shoots the beam.

Kirtland Air Force Base, in Albuquerque, N.M., is considered the epicenter of the Pentagon's research on pulsed-power electromagnetic weapons. There, its premier pulsed-power system, the Shiva Star, is housed behind meter-thick walls [see photo, p. 28]. An Air Force spokesperson refused to comment on what goes on in their pulsed-power programs, but a fact sheet on the Web site of Kirtland's Directed Energy Directorate describes the Shiva Star as capable of producing "120 thousand volts and 10 million amps for down to one millionth of a second to produce a power flow equivalent to a terawatt."

The Kirtland machine isn't used to investigate HPM weapons per se, and its massive size makes it clearly impractical for delivering microwave beams to any spots of real military interest. Indeed, one big push in microwave weapons has been toward portability. "Back in the 1960s and 1970s, the attitude was, 'Yeah, we can do it—but we need Hoover Dam as our power supply,' " says Seguine. But just as batteries for cellphones and laptops have shrunk and gained capacity, so have sources for microwave weapons.

In the 1990s, the U.S. Air Force Office of Scientific Research set up a five-year Multidisciplinary University Research Initiative (MURI) program to explore microwave sources. One of those funded was the University of New Mexico's Schamiloglu, whose lab is located just a few kilometers down the road from where the Shiva Star sits behind tightly locked doors. Thanks in large part to his and his colleagues' efforts, the fundamental capabilities and limitations of high-power microwave sources are now better understood and appreciated.

Amidst the lead bricks and clutter in Schamiloglu's basement lab lies his masterwork: the Sinus-6. "A lot of laboratories come up with very cute names for these devices," Schamiloglu notes with a smile. "We never did." With a huge cylinder at one end connected to the long microwave source, the Sinus-6 looks like a giant torch lying on its side [see photo, above]. The big cylinder contains a Tesla transformer, whose two coils vibrate in resonance and amplify the incoming voltage "with nearly 100-percent efficiency," Schamiloglu says. Once the pulse has been transformed into an electron beam, it is guided by a strong axial magnetic field through the long tube that will turn it into microwaves.

The Sinus-6 can fire a several-gigawatt pulsed beam 200 times a second in 10-nanosecond bursts. "It has to be pulsed power because what you're after is high peak power," says Schamiloglu. "The power in the microwaves is going to depend on the electric field squared, so if you generate very large power, then the electric field is going to be big."

How big? To drive the Sinus-6's beam continuously for an entire second, you'd need to supply about 25 gigajoules—"the entire output of a typical coal-fired electrical plant for 10 full seconds," Schamiloglu says. Another reason for pulsed rather than continuous power is to avoid a problem at the output end: the air around the antenna would heat to a plasma that in turn would interfere with a continuous beam at these power levels.

The key to reaching gigawatts of power is dumping all the energy in one gigantic, nearly instantaneous pulse. A pressurized gas switch prevents the Tesla transformer from prematurely dumping as it builds up for the next pulse. The switch is filled with highly compressed and nonconducting nitrogen gas. When the transformer coils reach 700 kV, the nitrogen gas breaks down, and the pulse leaps through to the electron-beam diode.

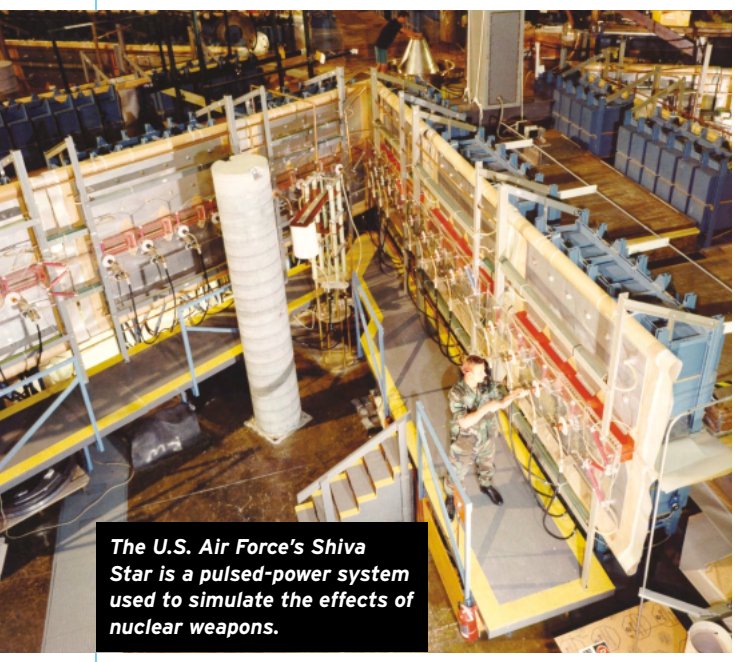

The U.S. Air Force's Shiva Star is a pulsed-power system used to simulate the effects of nuclear weapons.

"Once you've fired the switch, it conducts, it generates a pulse," says Schamiloglu. "It conducts because you've made a plasma channel out of the gas. Then you have to wait for that plasma to recombine and form a neutral gas again. A typical time scale for this thing to recombine and fizzle out and be a neutral gas again is probably on the order of milliseconds."

Among the best candidates for supplying microwaves is the backward wave oscillator; it has the advantage of being tunable (plus or minus 20 percent) and producing output in the 4–10-GHz range. To turn the kinetic energy from the Sinus-6's electron beam into high-power microwaves, the oscillator uses a rippled-wall waveguide, also called a slow-wave structure [see photo, p. 27].

The structure sets up standing electromagnetic waves in such a way that energy is rapidly transferred to them from the incoming beam of relativistic electrons from the Sinus-6. This growing energy initially propagates in the opposite direction of the beam's movement—hence the device's name—and is then reflected forward and radiated in the form of high-power microwaves. Backward wave oscillators, by the way, are also being tested as a way to push giant sails into outer space, to detect space debris, and to clear minefields.

Being able to tune an HPM weapon comes in handy when a particular target proves invulnerable to a particular frequency. "Experience has shown that if the frequency is slightly altered, measurable effects are discerned," Schamiloglu notes. People used to believe that varying the frequency of HPMs wasn't practical, but Schamiloglu and his students proved them wrong.

Coincidence and curiosity led to their discovery. Schamiloglu first acquired the Sinus-6 from Russian researchers in the early 1990s. (The Soviet Union once boasted a sophisticated program to develop microwave weapons; after its collapse, parts of that legacy were put up for sale, to the delight of researchers like Schamiloglu.) But once the apparatus was assembled in his New Mexico lab, he couldn't get it to operate as promised, so Russian colleagues flew over to help.

"One of them took the RF structure [the rippled-wall waveguide] and started hammering on the thing," Schamiloglu recalls. When they tried it again, everything worked. "I was baffled why manhandling this RF structure—ramming it in—could affect the power so much," says Schamiloglu. So he started a series of experiments in which he slightly displaced the backward wave oscillator by increments. With a little experimentation assisted by computer simulations, his team found that the frequency could be adjusted by changing the distance between the diode and the microwave source. The result is that the backward wave oscillator is now one of the few pulsed-power HPM sources that can be tuned.

Smaller is better

One disadvantage of this oscillator, however, is that it needs an external magnetic field to create the microwave beam, a major hurdle to making the whole system smaller. The size of the Sinus-6 and attendant equipment in Schamiloglu's basement suggests that the U.S. military is nowhere near fielding a narrowband HPM weapon. "When I first started working on high-power narrowband sources, we joked that you can do more damage dropping this equipment on someone than you can by using it," he recalls. "People know how to make microwave sources in the laboratory. The challenge is to take this and package it into an autonomous platform and have it function at the same parameter levels."

Schamiloglu is now hard at work under a new MURI program to study the possibilities of making a compact pulsed-power source. Current narrowband generators are typically several meters long, batteries not included. Schamiloglu and his colleagues are studying how to incorporate novel ceramics into pulsed-power systems, which they believe will allow the length of such sources to be halved. The trick is identifying materials with a high dielectric constant that can also survive the harsh electric fields. "Materials will be an important part in making the next giant leap," he says.

Life in a glass house

Among those agreeing that narrowband HPM weapons will need more refining before they become truly useful to the military is Loren B. Thompson, chief operating officer of the Lexington Institute, a military think tank based in Arlington, Va. He looked

U.S. AIR FORCE

E-Bomb Anatomy

In this hypothetical design for an e-bomb, a two-stage flux compression generator provides gigawatts of power to the virtual cathode oscillator (vircator), which produces the high-power microwaves. The bomb's destructiveness depends on the microwave source and target's vulnerability to electromagnetic attack, among other things, but a 10-GW, 5-GHz HPM device would have a "lethal" footprint 400 to 500 meters across, producing field strengths of several kilovolts per meter. Such an e-bomb would wreak major havoc if detonated over a heavily populated area.

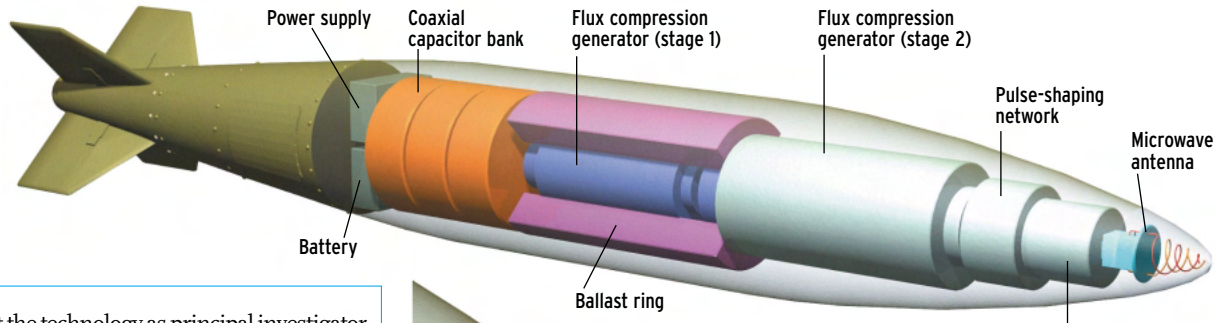

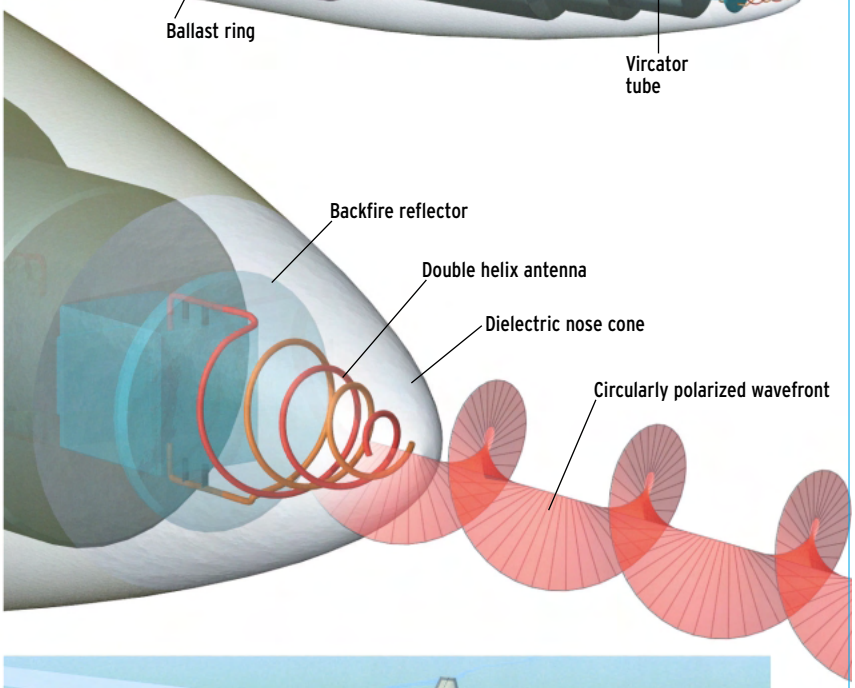

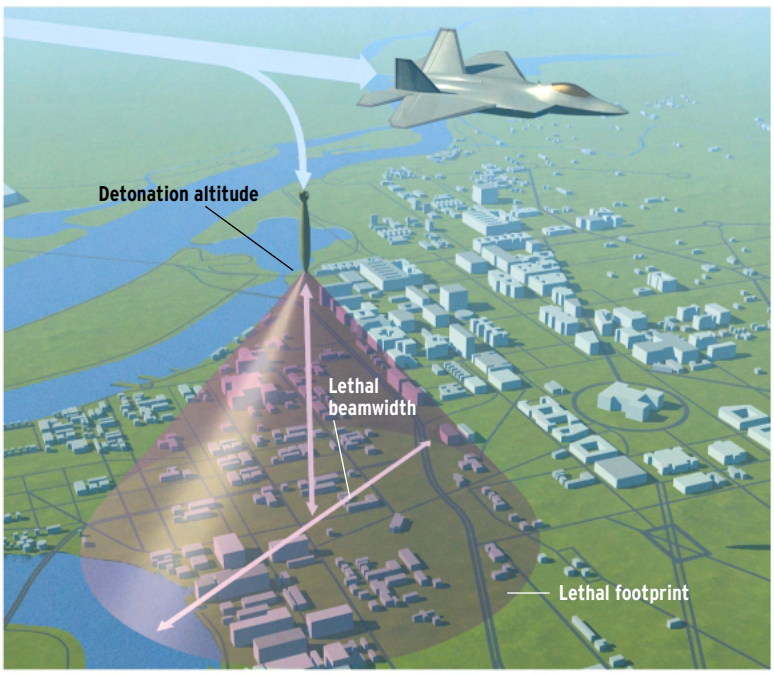

at the technology as principal investigator of "Directed-Energy Weapons: Technologies, Applications and Implications," a report that the institute put out in February. "We have some fairly rudimentary weapons that we're ready to use," Thompson says. "This is going to be a very important weapons technology, and the basic physical principles are well understood. But the military is having some difficulty in assimilating them."

Thompson's report speaks of a future with satellites delivering missile-debilitating microwaves, unmanned vehicles that fly by and destroy communications systems, and war without civilian casualties. But the fact remains that it's the U.S. military—as well as U.S. financial institutions, PCs, and Game Boys—that will be the most susceptible to such weapons.

"One of the things that happened during the last 10 years—as the Pentagon fell in love with network-centered warfare—is that we purchased a lot of very fragile digital systems off the shelf from commercial sources," Thompson notes. Such moves were taken in the name of cost and efficiency, but the resulting equipment is almost certainly more vulnerable to electromagnetic attack than the vacuum tubes and heavy metal-encased electronics of yesteryear.

"Computers become more vulnerable as the voltage at which they operate becomes smaller," says Victor Granatstein, professor of electrical engineering at the University of Maryland in College Park, who is studying the effects of microwave pulses on integrated electronics. "When our opponent was the

ILLUSTRATION: JOHN MACNEILL SOURCE: CARLO KOPP

Soviet Union, the electronics were much more robust because they weren't miniaturized. Now they have very thin oxide layers that can easily break down." Wireless networking makes matters worse. Computers and other communications devices now have antennas attached, giving an electromagnetic pulse a direct pathway to its guts.

Meanwhile, the U.S. Navy no longer requires that all its hardware be hardened against nuclear electromagnetic pulses. It deemed that maintaining those standards was too costly and slowed down the integration of new technology. The presumption was that after the Cold War, nobody would be using nuclear bombs, says the Lexington Institute's Thompson. "Whenever I ask the admirals, 'Well, what if someone did use a nuclear bomb?,' I just get this kind of blank I-don't-have-an-answer-for-that sort of look."

Don't Try This at Home

First things first: we do not under any circumstances recommend that you build your own electromagnetic weapon. But if you're hellbent on adding to the mayhem, cheaply and without too much studying, you might try a high-energy radiofrequency, or HERF, gun. As described by engineering student Rostislav Persion on his Web site, Voltage Labs, which is devoted to do-it-yourself electromagnetic weapons, you can make one from a microwave oven.

Before you begin, though, wait until everyone else has left the house. Next, take apart the microwave oven, but don't disconnect any of the components; manufacturers intentionally make this hard to do, so you may end up just breaking the machine. Inside you will find the oven's microwave source: the magnetron. Wrap a tube of sheet metal around it to act as a waveguide. Your power source is the house's ac, so just plug in the oven and point it at your TV. Warning: there's a real possibility that you will burn yourself instead.

For schematics and a demonstration, head to the Web at http://www.voltsamps.com/pages/projects/herf004/. —*M.A.*

In the wrong hands

The scariest part of microwave weapons may be that crude forms of the technology are readily available to anyone right now. "Any nation with a 1950s technology base capable of designing and building nuclear weapons and radars" can build an e-bomb, says military analyst Kopp. Indeed, more than 20 countries now have programs to develop some type of RF weapon.

"The more widespread the technology is, the more likely that people with nefarious purposes will have access. It's just an inescapable fact," says Thompson. "I don't know what we're going to do. Nobody in Washington knows. I imagine that the way the clear thinking starts is with a catastrophe."

Criminals and pranksters have already started exploiting that weakness. In one of the more harmless applications, a Japanese scam artist rigged up a weak microwave generator inside a suitcase to rip off a pachinko parlor. When he placed the suitcase next to one of the machines (which is something like a cross between a slot machine and a pinball machine) and turned it on, the pachinko machine went haywire and disgorged a pile of coins. The perp managed the trick several times before he was caught.

Other press accounts hint at electromagnetic weapons being deployed by Chechen troops, and by an unnamed assailant trying to topple London's futures market [see "Don't Try This at Home," above].

Thankfully, protecting yourself against the microwave-enabled goofballs of the world isn't too difficult. "It is analogous to existing techniques used to trap RF interference inside equipment, except that the higher power levels require special measures," Kopp notes. Rooms or equipment chassis must become electrically sealed Faraday cages, and protective devices must be added wherever cables enter the protected volume. "Optical fibers are very useful in this game."

Such protective measures are a lot cheaper to design in from the beginning than to add on afterward, says Howard Seguine. "The general rule of thumb is that if you do the hardening during the design phase, it increases the cost roughly 1 percent. If you do it afterward, it may cost as much as 30 percent more."

But maybe hardening is a waste of time. Arthur Varanelli, a Raytheon Co. engineer who has helped write several IEEE standards for electromagnetic field measurement, human exposure, and safety, is skeptical that a malicious prankster could exploit the technology.

"Some of this stuff is just so far out there," Varanelli says. "I just don't see people running around with Buck Rogers ray guns. It's great for a science fiction writer, great to prey upon people's fears." He scoffs at the suggestion that a do-it-yourselfer could build a microwave weapon potent enough to do real damage. "People can put tacks in the road. Are we worried about electronic tacks in the air?"

The wide disparity in opinions and the uncertainty about microwave weapons, from Loren Thompson on one end to Arthur Varanelli on the other, are all part of what makes them so powerful, says military analyst John Pike, who is director of GlobalSecurity.org (Alexandria, Va.). "It all depends on the complex interactions between the weapon and the target," he notes. "I can set up a strap-down chicken test that makes [an HPM weapon] look pretty good. But as soon as I start getting into real-world targets, maybe it doesn't work so well."

"Part of the story is we don't know what the story is," Pike says. "These are weapons that by their nature seek the shadows. And unlike cluster bombs or atomic bombs, they aren't going to leave behind unambiguous evidence of their use." ●

To Probe Further

For a detailed technical discussion of high-power microwaves, see *High-Power Microwave Sources and Technologies*, edited by IEEE Fellows Robert J. Barker and Edl Schamiloglu (Wiley–IEEE Press, 2001). Schamiloglu is also coauthor, with James Benford and John Swegle, of the forthcoming *High-Power Microwaves*, 2nd edition (Institute of Physics, 2004).

The truly prepared, or merely paranoid, will want to consult Carlo Kopp's "Hardening Your Computing Assets" at http://www.globalsecurity.org/military/library/report/1997/harden.pdf.

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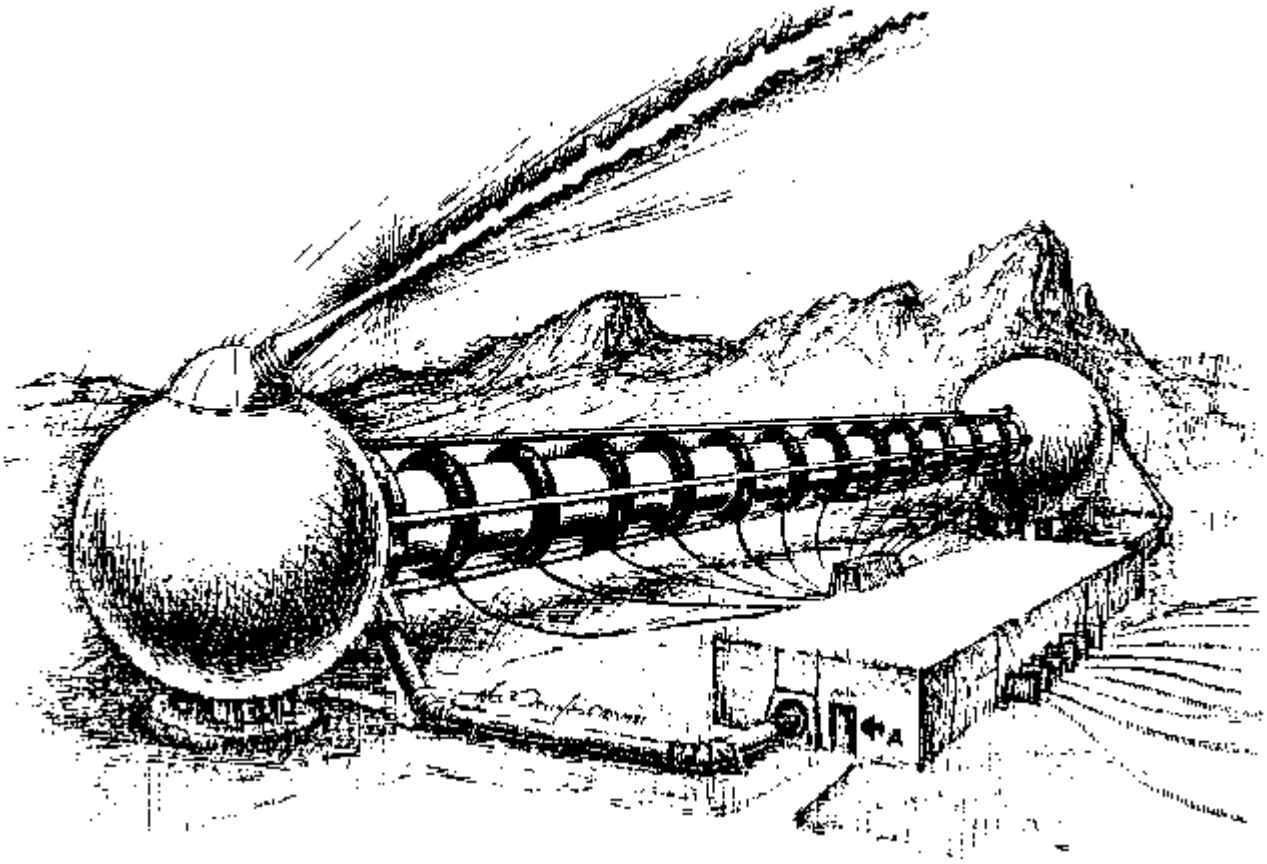

Scalar Potential Interferometer

Figure 6. Multimode Tesla Weapon

In the 1930's Tesla announced other bizarre and terrible weapons: a death ray, a weapon to destroy hundreds or even thousands of aircraft at hundreds of

miles range, and his ultimate weapon to end all war -- the Tesla shield, which nothing could penetrate. However, by this time no one any longer paid any real attention to the forgotten great genius. Tesla died in 1943 without ever revealing the secret of these great weapons and inventions.

Unfortunately, today in 1981 the Soviet Union has long since discovered and weaponized the Tesla scalar wave effects. Here we only have time to detail the most powerful of these frightening Tesla weapons -- which Brezhnev undoubtedly was referring to in 1975 when the Soviet side at the SALT talks suddenly suggested limiting the development of new weapons "more frightening than the mind of man had imagined." One of these weapons is the Tesla howitzer recently completed at the Saryshagan missile range and presently considered to be either a high-energy laser or a particle beam weapon, (See Aviation Week & Space Technology, July 28, 1980, p. 48 for an artist's conception.)

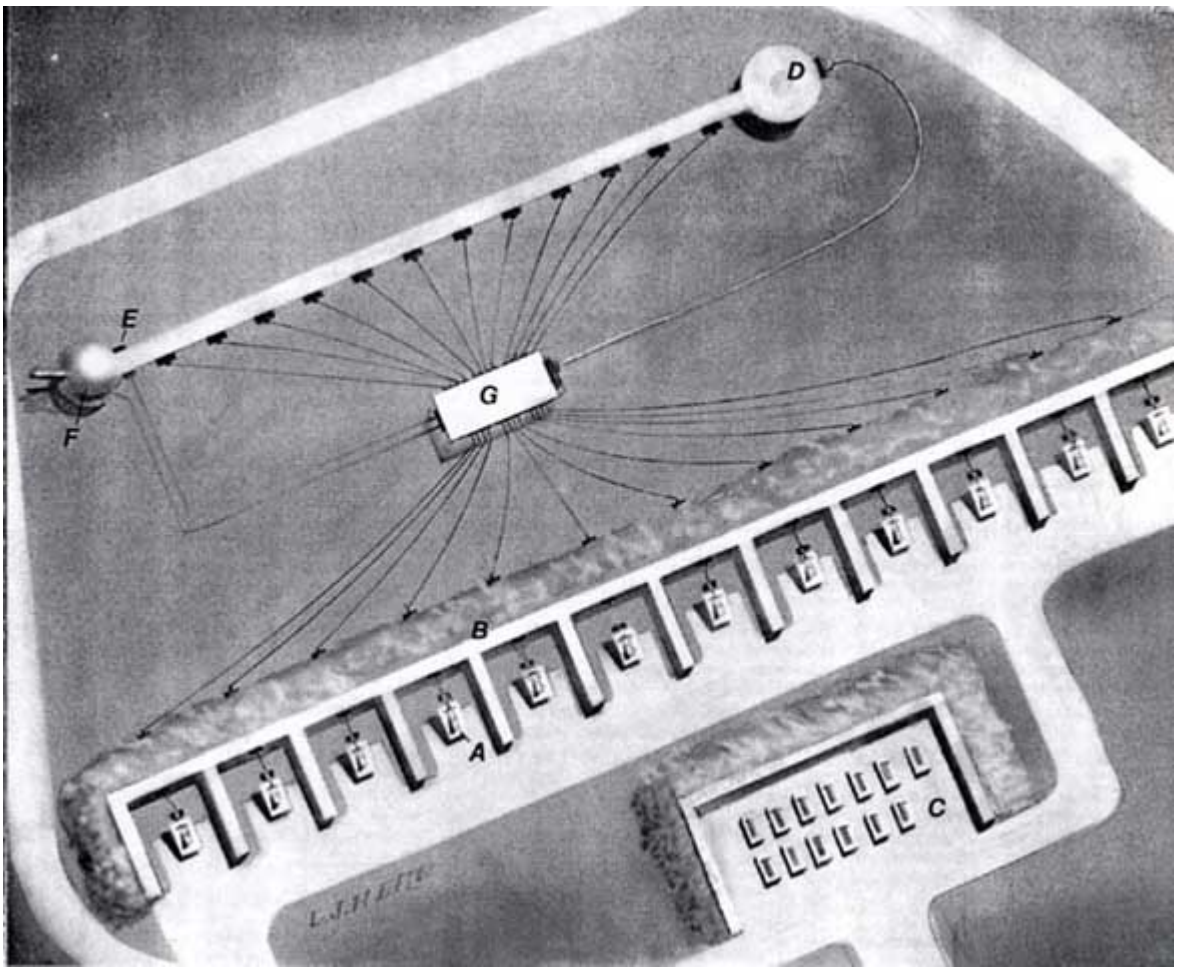

Aviation Week & Space Technology July 28, 1980

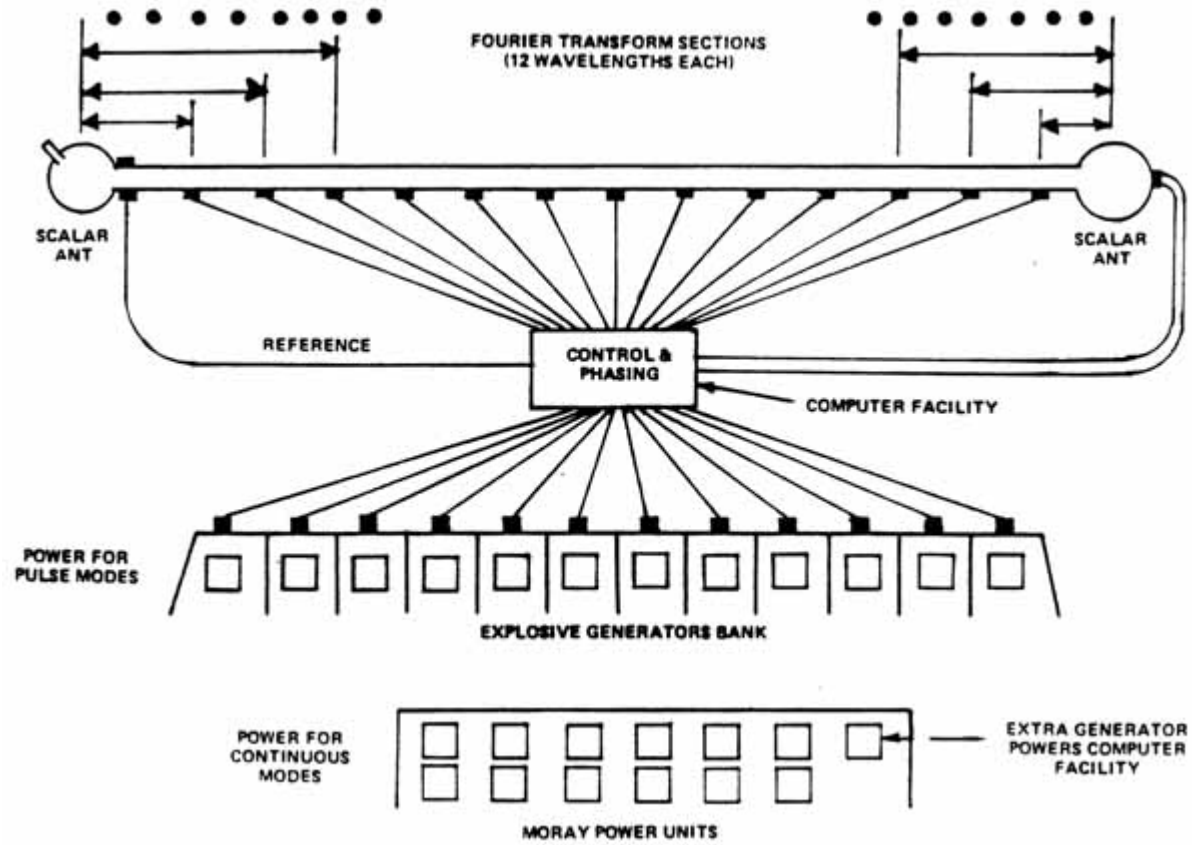

Figure 7. Tesla Weapons at Saryshagan

The Saryshagan howitzer actually is a huge Tesla scalar interferometer with four modes of operation. One continuous mode is the Tesla shield, which places a thin, impenetrable hemispherical shell of energy over a large defended area. The 3-dimensional shell is created by interfering two Fourier-expansion, 3-dimensional scalar hemispherical patterns in space so they pair-couple into a dome-like shell of intense, ordinary electromagnetic energy. The air molecules and atoms in the shell are totally ionized and thus highly excited, giving off intense, glowing light. Anything physical which hits the shell receives an enormous discharge of electrical energy and is instantly vaporized -- it goes pfft! like a bug hitting one of the electrical bug killers now so much in vogue.

If several of these hemispherical shells are concentrically stacked, even the gamma radiation and EMP from a high altitude nuclear explosion above the stack cannot penetrate all the shells due to repetitive absorption and reradiation, and scattering in the layered plasmas.

In the continuous shield mode, the Tesla interferometer is fed by a bank of Moray free energy generators, so that enormous energy is available in the shield. A diagram of the Saryshagan-type Tesla howitzer is shown in figure 7. Hal Crawford's fine drawing of the interferometer end of the Tesla howitzer is shown in figure 6. Hal's exceptional rendition of the Tesla shield produced by the howitzer is shown in figure 8.

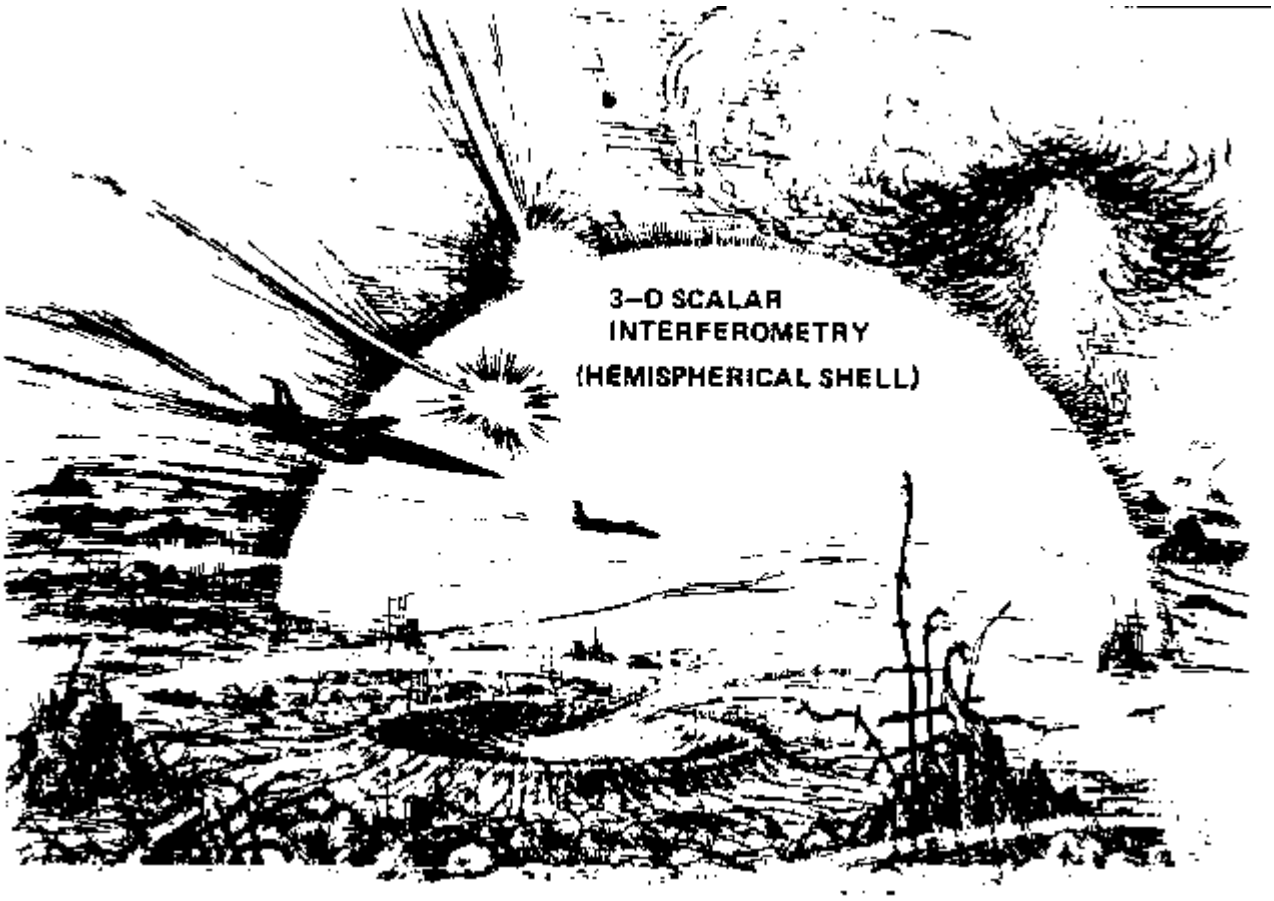

Figure 8. The Tesla Shield

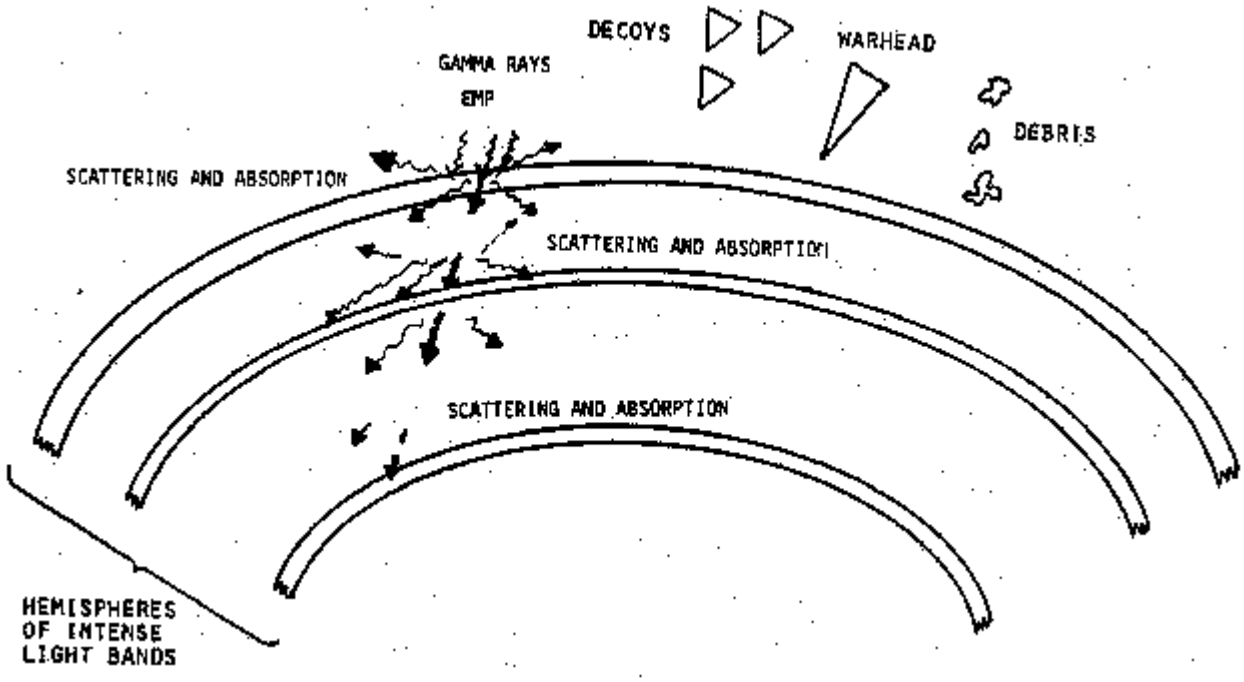

Figure 9. Tesla Terminal Area Defense System

In the pulse mode, a single intense 3-dimensional scalar phi-field pulse form is fired, using two truncated Fourier transforms, each involving several frequencies, to provide the proper 3-dimensional shape (Figure 10). This is why two scalar antennas separated by a baseline are required. After a time delay calculated for the particular target, a second and faster pulse form of the

same shape is fired from the interferometer antennas. The second pulse overtakes the first, catching it over the target zone and pair-coupling with it to instantly form a violent EMP of ordinary vector (Hertzian) electromagnetic energy. There is thus no vector transmission loss between the howitzer and the burst. Further, the coupling time is extremely short, and the energy will appear sharply in an "electromagnetic pulse (EMP)" strikingly similar to the 2-pulsed EMP of a nuclear weapon.

This type weapon is what actually caused the mysterious flashes off the southwest coast of Africa, picked up in 1979 and 1980 by Vela satellites. The second flash, e.g., was in the infrared only, with no visible spectrum. Nuclear flashes do not do that, and neither does superlightning, meteorite strikes, meteors, etc. In addition, one of the scientists at the Arecibo Ionospheric Observatory observed a gravitational wave disturbance -- signature of the truncated Fourier pattern and the time-squeezing effect of the Tesla potential wave -- traveling toward the vicinity of the explosion.

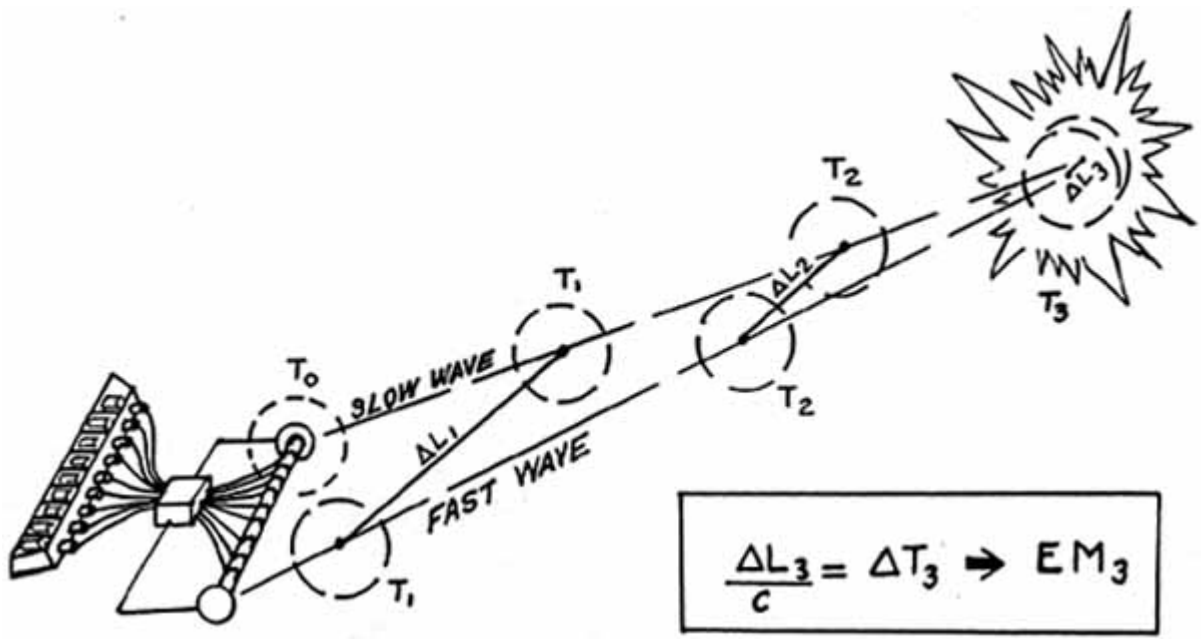

TESLA HOWITZER
(SCALAR INTERFEROMETER)

Figure 10. "Nuclear" Flashes off the Coast of Africa

Lithuania - 10 Sep 1976 - British European Airways Flight #831 between Moscow and London

CIA Report Released under FOIA

Figure 11. Continuous Tesla Fireball

The pulse mode may be fed from either Moray generators or -- if the Moray generators have suffered their anomalous "all fail" malfunction -- ordinary explosive generators. Thus the Tesla howitzer can always function in the pulse mode, but it will be limited in power if the Moray generators fail.

In the continuous mode, two continuous scalar waves are emitted -- one faster than the other -- and they pair-couple into vector energy at the region where they approach an in-phase condition. In this mode, the energy in the distant "ball" or geometric region would appear continuously and be sustained -- and this is Tesla's secret of wireless transmission of energy at a distance without any losses. It is also the secret of a "continuous fireball" weapon capable of destroying hundreds of aircraft or missiles at a distance. An example of a Soviet test of this mode of operation is shown in figure 11.

Witness to a super weapon?

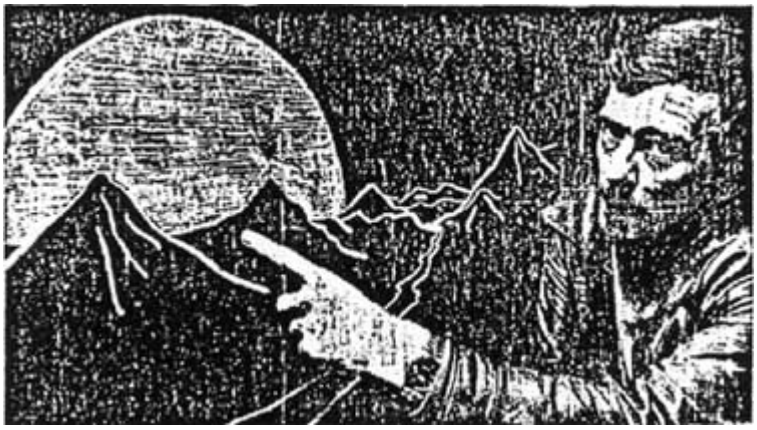

Nick Downie describes the strange lurid glow that flared silently over the Hindu Kush

THE SUNDAY TIMES, 17 AUGUST 1980

(Multiple incidents in Sept., 1979)

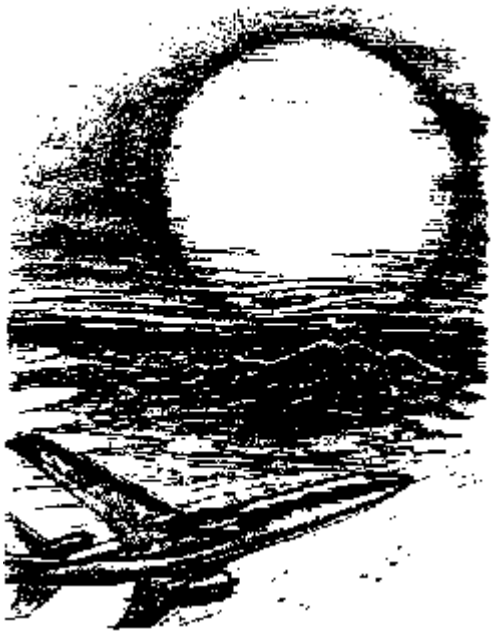

TEHERAN, IRAN 17 JUNE 1966

SEEN FROM NEAR MEHRABAD AIRPORT

OBSERVED 4-5 MINUTES

SEEN BY 2 AIRCRAFT

CIA REPORT RELEASED UNDER FOIA

Figure 12. Tesla EMP Globe

The volume of the Tesla fireball can be vastly expanded to yield a globe which will not vaporize physical vehicles but will deliver an EMP to them to dud their electronics. A test of this mode is shown in figure 12. (See also Gwynne Roberts, "Witness to a Super Weapon?", the London Sunday Times, 17 August 1980 for several other tests of this mode at Saryshagan, seen from Afghanistan by British TV cameraman and former War Correspondent Nick Downie.)

If the Moray generators fail anomalously, then a continuous mode limited in power and range could conceivably be sustained by powering the interferometer from more conventional power-sources such as advanced magnetohydrodynamic generators.

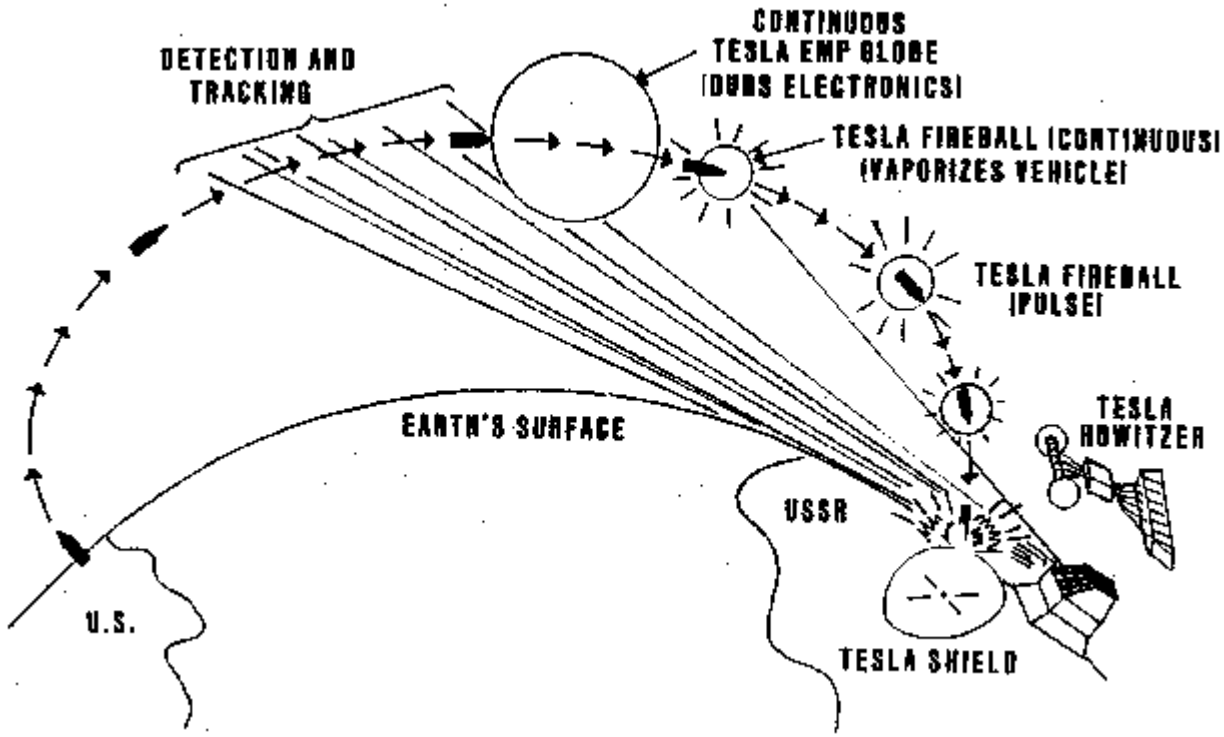

Figure 13. Tesla ABM Defenses

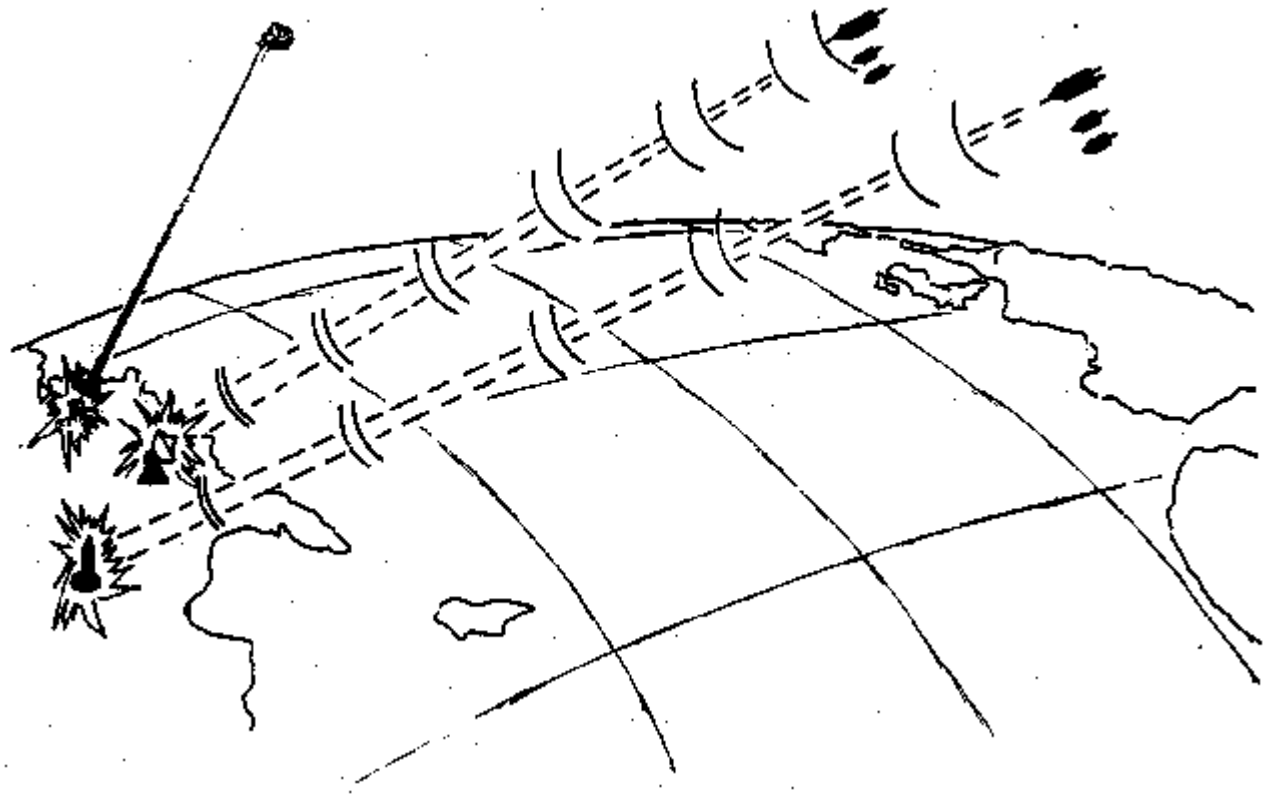

Figure 14. Moray/Tesla Technology: Star Wars Now

Typical strategic ABM uses of Tesla weapons are shown in figure 13. In addition, of course, smaller Tesla howitzer systems for anti-tactical ballistic missile defense of tactical troops and installations could be constituted of more

conventional field missile systems using paired or triplet radars, of conventional external appearance, in a scalar interferometer mode.

With Moray generators as power sources and multiply deployed reentry vehicles with scalar antennas and transmitters, ICBM reentry systems now can become long range "blasters" of the target areas, from thousands of kilometers distance (figure 14). Literally, "Star Wars" is liberated by the Tesla technology. And in air attack, jammers and ECM aircraft now become "Tesla blasters." With the Tesla technology, emitters become primary fighting components of stunning power.

The potential peaceful implications of Tesla waves are also enormous. By utilizing the "time squeeze" effect, one can get antigravity, materialization and dematerialization, transmutation, and mindboggling medical benefits. One can also get subluminal and superluminal communication, see through the earth and through the ocean, etc. The new view of phi-field also provides a unified field theory, higher orders of reality, and a new super-relativity, but detailing these possibilities must wait for another book.

With two cerebral brain halves, the human being also has a Tesla scalar interferometer between his ears. And since the brain and nervous system processes avalanche discharges, it can produce (and detect) scalar Tesla waves to at least a limited degree. Thus a human can sometimes produce anomalous spatiotemporal effects at a distance and through time. This provides an exact mechanism for psychokinesis, levitation, psychic healing, telepathy, precognition, postcognition, remote viewing, etc. It also provides a reason why an individual can detect a "stick" on a radionics or Hieronymus machine (which processes scalar waves), when ordinary detectors detect nothing. Unfortunately there is not room to develop the implications of this human Tesla interferometry in detail, for that must wait for yet another book, presently in its initial stages, that Hal Crawford and I are writing.

Table 5. Orders of Reality

- **PHOTONS ARE**
  - **> PAIR-COUPLED SCALARS**
  - **> VELOCITY-LIMITED TO C**
  - **> CARRIERS OF T**
- **PHOTON INTERACTION**
  - **> IS UBIQUITOUS**
  - **> PRODUCES $\dot{T}$ = C**
  - **> YIELDS 1st ORDER REALITY**
- **SCALAR O WAVES**
  - **> NOT VELOCITY-LIMITED**
  - **> YIELD HIGHER ORDER REALITIES**

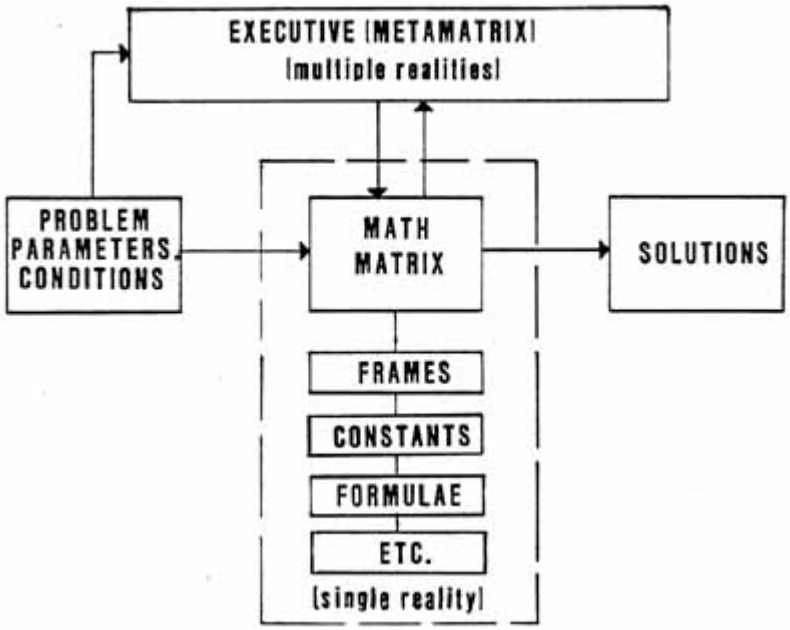

Figure 15. Implications of Tesla Potential

At the July 1981 U.S. Psychotronics Association's Annual Conference in Dayton, Ohio, I presented the first rough paper on the Tesla secret and scalar interferometry. A videotape of the presentation was made and will shortly be available. I am also scheduled to make a special presentation at the Alternate Energy Conference in Toronto, Canada in latter October, 1981. A professional, videotaped two-hour presentation on this subject is also being prepared. Wide distribution of the material through the international underground physics and technology network has already been made. This time, God willing, Tesla's secret will not be suppressed for another 80 years!

And perhaps it is not yet too late. The material has cost me (now) some 16 years of agonizing labor and nearly $100,000 of my own personal funds. No orthodox university, scientific group, foundation, or governmental agency would support such an effort, either financially or otherwise. Indeed, most ordinary journals will not even accept material on such matters. Nonetheless, the area is of overwhelming importance and I truly believe Tesla's lost secret will shortly affect the lives of every human being on earth.

Perhaps with the free and open release of Tesla's secret, the scientific and governmental bureaucracies will be. shocked awake from their slumber, and we can develop defenses before Armageddon occurs. Perhaps there is hope after all -- for even Brezhnev, in his strange July, 1975 proposal to the SALT talks, seemed to reveal a perception that a turning point in war and weaponry may have been reached, and that human imagination is incapable of dealing with the ability to totally engineer reality itself. Having tested the weapons, the Soviets must be aware that the ill-provoked oscillation of timeflow affects the minds and thoughts -- and the very lifestreams and even the collective species unconsciousnesses -- of all lifeforms on earth. They must know that these weapons are two-edged swords, and that the backlash from their use can be far more terrible to the user than was the original effect to his victim.

If we can avoid the Apocalypse, the fantastic secret of Nikola Tesla can be employed to cure and elevate man, not kill him. Tesla's discovery can eventually remove every conceivable external human limitation. If we humans ourselves can elevate our consciousness to properly utilize the Tesla electromagnetics, then Nikola Tesla -- who gave us the electrical twentieth

century in the first place -- may yet give us a fantastic new future more shining and glorious than all the great scientists and sages have imagined.

References

The Tom Bearden Website

34 Flaws in Classical EM Theory

Note: If the scientific community had done their job, this Website would probably not be necessary.

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1. SLIDE 1
2. SLIDE 2
3. SLIDE 3
4. SLIDE 4
5. SLIDE 5

Flaws In Classical EM Theory

1. Eliminates the Internal EM Inside the Scalar Potential.
2. No Definition of Electrical Charge or of Scalar Potential.
3. Equations Still Assume Material Ether Per Maxwell (Unchanged).
4. Use of Force Fields in Vacuum is False (and Known to be So).
5. Treats Charge q as Unitary Instead of Coupled System $q = \phi(q)m(q)$.
6. Confuses Massless Potential Gradients as Forces (See #3, #4).
7. Does Not Utilize Mass as a Component of Force (See #23).

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Flaws In Classical EM Theory (2)

8. Erroneously Assumes EM Force Fields as Primary Causes.
9. Topology of EM Model Has Been Substantially Reduced.
10. Does Not Include Quantum Potential or Action at a Distance.
11. Does Not Include Superluminal Velocity of Inner EM Components.
12. Does Not Utilize Extended Near-Field Coulomb Gauge Effects.
13. Does Not Include EM Generatrix Mechanism for Time Flow.
14. Does Not Unify Photon and Wave Aspects (Requires 7-D Model).

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Flaws In Classical EM Theory (3)

15. Does Not Include Electron Spin and Precession (See #19, #24).
16. Treats EM Energy As Existing In "Chunks," Instead of as Flow.
17. Confuses Energy and Energy Collection (See #16).
18. Discards Half of Every EM Wave in Vacuum (See #22).
19. Erroneously Uses Transverse Vacuum Wave; It's Quasi-Longitudinal.
20. Arbitrarily Regauges Maxwell's Equations to Eliminate Overunity Maxwellian Systems.
21. Omits Phase Conjugate Optics Effects (Which are the *Rule* in Internal EM).

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Flaws In Classical EM Theory (4)

22. Does Not Include EM Cause of Newtonian Reaction Force.
23. Erroneously Assumes Separate Force Acting on Separate Mass.
24. Confuses Detected Electron Precession Waves as Proving Transverse EM Waves in Vacuum (Remnant of Old "EM Fluid" Concept).
25. Due to Error in String Wave, Omits the Ubiquitous Antiwave.
26. *Assumes* Equilibrium; Not True Unless Include Vacuum Interactions.
27. Higher Topology Required, to Model Electromagnetic Reality.

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Flaws In Classical EM Theory (5)

28. Lorentz surface integration discards Poynting energy transport.
29. Has nothing at all to say about form of EM entities in massless space.
30. Eliminates the infolded general relativity using EM-force as curve agent.
31. Does not include longitudinal EM wave phase conjugate pairs as time domain oscillations.
32. Does not include EM mechanism that generates time flow and flow rate.
33. Does not include time-excitation charging and decay.
34. Does not utilize time-reversal zones.

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The Tom Bearden Website

Mind Control and EM Wave Polarization Transductions - Part I, II & III

Reprinted from "Explore" magazine, 1999

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- Page 9

- The U.S. approach to mind control

- "Voices in my head"
  Flanagan's neurophone - used to give instructions to diplomats during negotiations, etc.

Mind Control and EM Wave Polarization Transductions, Part 1

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Special Note

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Abstract

For some time we have been repeatedly queried about the technical mechanisms and unusual electrodynamics of advanced mind control research, both in the West and abroad. Calling full attention to the special note above, in this paper we present a high-level over-view of the novel electromagnetic nature of mind operations, mind and body coupling, and *intent*•the induction of physical 3-space EM energy changes into the brain and nervous system, and into every cell of the body, from the mind's time-like coherent operations. We summarize the time-polarized electrodynamics used to engineer and affect mind operations and the mind-body coupling loop. Transduction mechanisms whereby differing EM wave polarizations can be transformed one-into-the-other are presented. We give two specific examples of lethal foreign military tests in 1997 of advanced mind control weapons against two military pilots over the central U.S. Some dangers and potential benefits of the emerging mind control technology are pointed out

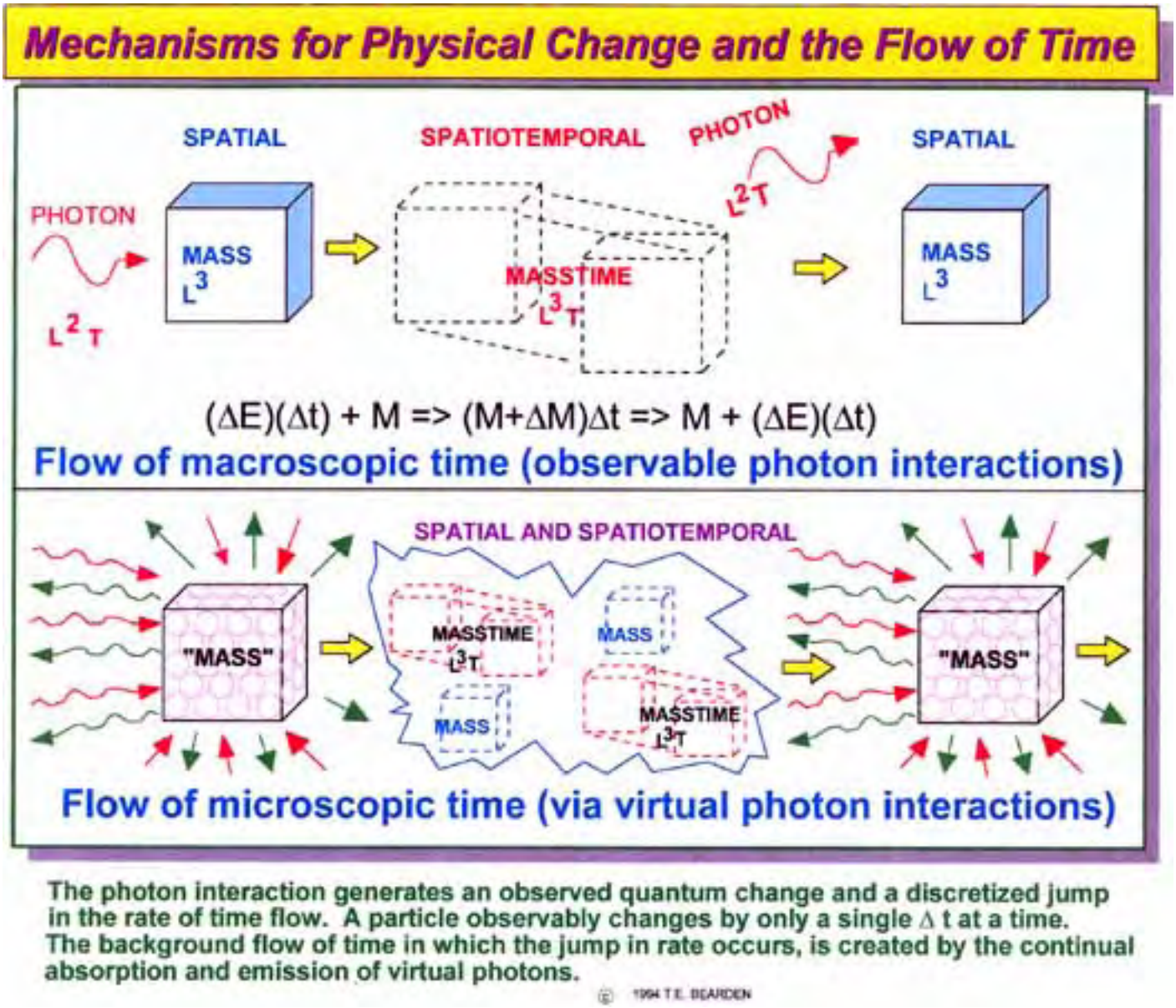

Figure 1. Mechanism that generates a mass's flow through time.

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Introduction and Background

In quantum field theory, there are four polarizations of photons.[1] Using 4-space and the z-direction as the direction of propagation, we have x- and y- polarizations where the 3-spatial energy of the photon is oscillating laterally, in the x- or y- direction. These are *transverse polarized* photons, as is any combination of the two. The third polarization is along the z-direction, which is a longitudinal polarization. In other words, the 3-spatial energy of the longitudinal photon cannot oscillate in the x- or y- direction, and so it is oscillating to-and-fro along the line of motion, z-. The fourth polarization occurs when the energy is frozen in all three spatial dimensions x-, y-, and z- and it cannot oscillate in any of those directions. In that case, the photon oscillates its energy in the t- direction, providing the t-polarized photon. We will later discuss how time is actually highly condensed energy.

In Minkowski 4-space, body operations are space-like, and are so treated in conventional materialistic physics. Mind and mind-operations are time-like, not space-like, even though they are totally electromagnetic in nature.[2]

As is well-known, all observation in physics is considered 3-spatial..[3] Mass is a 3-spatial concept, and we detect changes to mass (as, e.g., in the shift of electrons in the circuits of electrical instruments). So one may model the common physical observation mechanism as a *time-differentiating process* which *a priori* discards time-change and retains 3-spatial energy change.[4] That is, Minkowski reality is modeled in the fundamental units of L^3t. Physical observation (via the transverse photon interaction) is the process given by applying the operator $\partial/\partial t$ to L^3t, yielding an L^3 output. Hence mind and mind operations are excluded by the usual physics instruments and observation, which simply exclude the time domain in their outputs and do not "measure" it.

For this reason, physicists have erroneously considered mind to be "metaphysical" and nonreal. Indeed, most physicists to one extent or the other are materialists, and consider the "mind" to be nothing but the operations ongoing in a "meat computer." Nonetheless, in the time-domain the time is absolutely real, and it is completely electrodynamic in nature. There is no metaphysics involved, and the temporal domain—along with mind and mind operations—is simply an erroneously neglected area of physics. In present physics, the notion of mind is comfortably disposed of by imposing the use of the "observer" concept, with out ever specifying that the observer has a consciousness and a mind. Indeed, "observation" is only about what that "observer" perceives. Obviously, one has a dramatically crippled physics if one eliminates that nonobservable called "time." Similarly, one also has a dramatically crippled physics when one eliminates the mechanisms and physics ongoing in those time-like and dynamic "things" such as mind, that occupy time and function in it.

From this viewpoint, Western physics adheres to its 3-spatial measurement foundation only by ignoring the transduction of time-polarized EM changes into detectable longitudinal and transverse EM wave changes. In this aspect, present Western physics is severely self-crippled.

Time is totally electromagnetic and energetic in nature. The flow of time is not a separate external river on which a mass floats along like a boat drifting down the current of a great flowing river. Instead, the flow of time is generated directly on every mass by its total set of photon interactions, both virtual and ob servable. We have previously presented the exact mechanism for the flow of time. *[Figure 1]*

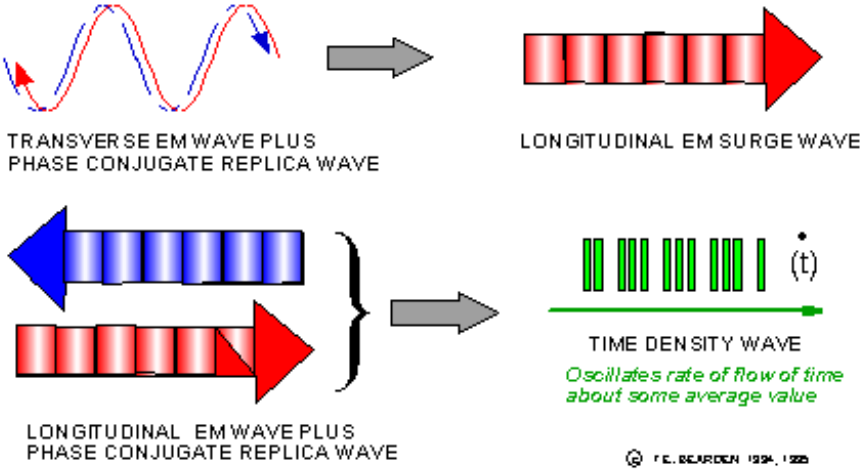

Figure 2. Transduction of EM wave type by successive phase conjugate pairing.

Further, a photon is comprised of angular momentum, therefore of (energy)x(time). It transports both energy and time, not just energy alone. When absorbed by a mass, not only does it "energy-excitation" charge the mass, but also it "time-excitation" charges it, converting the former "mass" to "mass time". Rigorously it is *masstime* that emits a photon, not *mass*. So a mass moves through time in little spurts, by the continual macroscopic addition and subtraction of little Dt components. Further, in being driven through time, mass is continually altered to masstime (a quite different critter from mass), to mass, to masstime, to mass, etc.

In any masstime state, a myriad of tiny virtual photon interactions made of very tiny (DE)(Dt)'s interact with that same mass during that particular larger Dt of the masstime state (m+Dm)(Dt). Hence mass in its alternate masstime state has that state internally structured by its surrounding environment's interactions with it. The masstime state is internally structured energetically in its (DE) component, and also internally structured temporally in its (Dt) component.

A standard charged fundamental particle such as an electron, e.g., is not necessarily identical with another, when the internal structuring of its masstime state is considered. Further, by two papers by Whittaker,[5] interferometry of masstime states with either energy reactions or temporal reactions can yield observable effects and changes due to these neglected "hidden variables" in the electron's masstime alternative states. To engineer the mind and its operations directly, one must perform electrodynamic engineering in the *time* domain, not in the 3-space EM energy density domain. The direct engineering of time-like mind and mind operations—in all levels and all aspects—requires the use of *time-polarized photons and time-polarized EM waves*. This is the rarest form of electrodynamics, almost untouched by Western physicists.

One can either painfully produce such time-polarized photons and EM waves and directly irradiate a target mass with specific assemblies of them, or one can force the mass itself to iteratively transduce ordinary transverse EM waves first into longitudinally-polarized EM waves and then into time-polarized EM waves. Both will be discussed briefly.

In the West, it appears that the present author's discovery of mechanisms for producing time-polarized (scalar) EM waves [see *Figure 2*] and for transducing between wave polarizations has no precedent. [See *Figure 3*]. While scalar (time-polarized) photons are known in the literature,[1] the creation and use of time-polarized EM waves does not seem to appear in the Western physics literature.[6]

Wave transduction or *polarization transductions* are terms used by the author for the process of transforming an EM wave's particular polarization into another polarization type. Such transduction to other than transverse polarization forms is little known in the West. It appears essentially haphazardly in some experiments, usually without any recognition by the experimenters themselves. Significant transduction in experiments will also produce "strange" and unexplained anomalies in the instruments being used for experimental measurements.[7]

So most probably Western mind control researchers have not recognized the methodology and mechanisms[8] for transducing one type of EM wave polarization directly into another.[9] They continue to seek the "mind" in 3-space and hence in the brain, rather than in the time domain. On the other hand, it appears

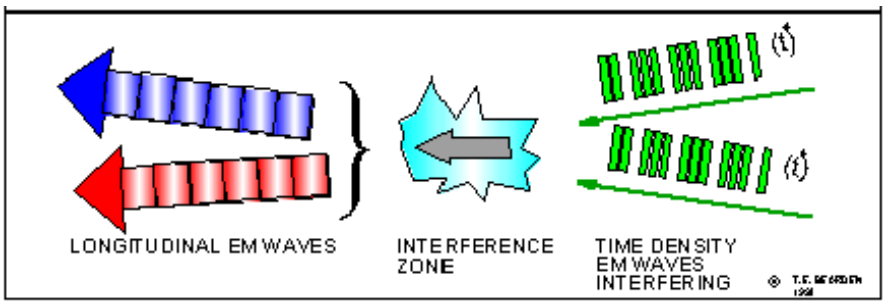

Figure 3. Interference processes for transducing higher EM wave polarizations into lower polarization states.

that the Russian KGB energetics[10] weapons scientists—particularly those in psychoenergetics[11]—have known and used methods of transducing one wave polarization into another, for at least two decades. It follows that those same scientists have very probably developed mind engineering and mind control via novel time-polarized EM wave means and a dramatically extended electrodynamics of the time-like mind operations.

In the present paper we briefly develop the wave transductions and the basis for mind engineering, including the specialized use of ordinary transverse wave (TW) EM spectra to force internal EM wave transductions and time-domain operations inside irradiated bodies, cells, and tissues. Through the mind-body coupling mechanism, these transductions of transverse EM waves can operate upon the mind and its deepest operations as well as upon the body, every cell, and every part of every cell.

Russian Mind Control Uses Higher EM Wave Polarizations

It is apparent that the KGB psychoenergetics weapons scientists know and use the full extended EM wave polarization range. As a postulation, one would expect our own weapons scientists to know and utilize the orthodox transverse wave (TW) EM for similar research and experimentation. However, in the West scientists are just beginning to realize the importance of a very general (and weaker) type of longitudinal EM wave (LW) polarization, as evidenced by the appearance of dozens of papers on "undistorted progressive waves" (UPWs, which are essentially imperfect LW s with TW residues remaining). The Los Alamos National Laboratory web site has a number of such papers—particularly by Rodrigues[12] and Lu—available for free downloading. UPWs have very interesting characteristics. If they were perfect longitudinal EM waves, they would have infinite energy and infinite speed. Since only imperfect UPWs can be physically made, their speed can vary from slower than the speed of light to faster than the speed of light. Their energy can also vary over a great range.

Another characteristic of UPWs that are reasonably good longitudinal EM waves, is that they pass readily through a large depth of water and mass, including through the ocean and the earth with only small interactions and losses. Yet by interfering two such beams of "high quality" UPWs at a great distance, then in the interference zone ordinary EM energy will rise directly out of local spacetime potential, as essentially shown by Whittaker[13] nearly a century ago. Russian weapon research facilities have weaponized these effects[14] for nearly 50 years, under rigid KGB control and operation. Nonetheless, even if using only ordinary TW waves, Western mind control researchers may get some fairly good results, brute-force-like, by using gross correlates between just the input irradiating TWs and the exhibited behavioral responses of the individual. The net input-output correlations can be determined, even though not taking into account the actual wave polarization transduction mechanisms ongoing inside the irradiated dielectric (or brain, or mind, etc.). However, Western researchers appear to have no knowledge of the exact mechanisms by means of which coherent time-like mind operations of a biological organism couple to the organism's 3-spatial body to provide the mental control loop. They also appear unaware of how the coherent 3-spatial behavior responses of the body couple back to the time-like mind to provide it with a sensory feedback of the body's responses.

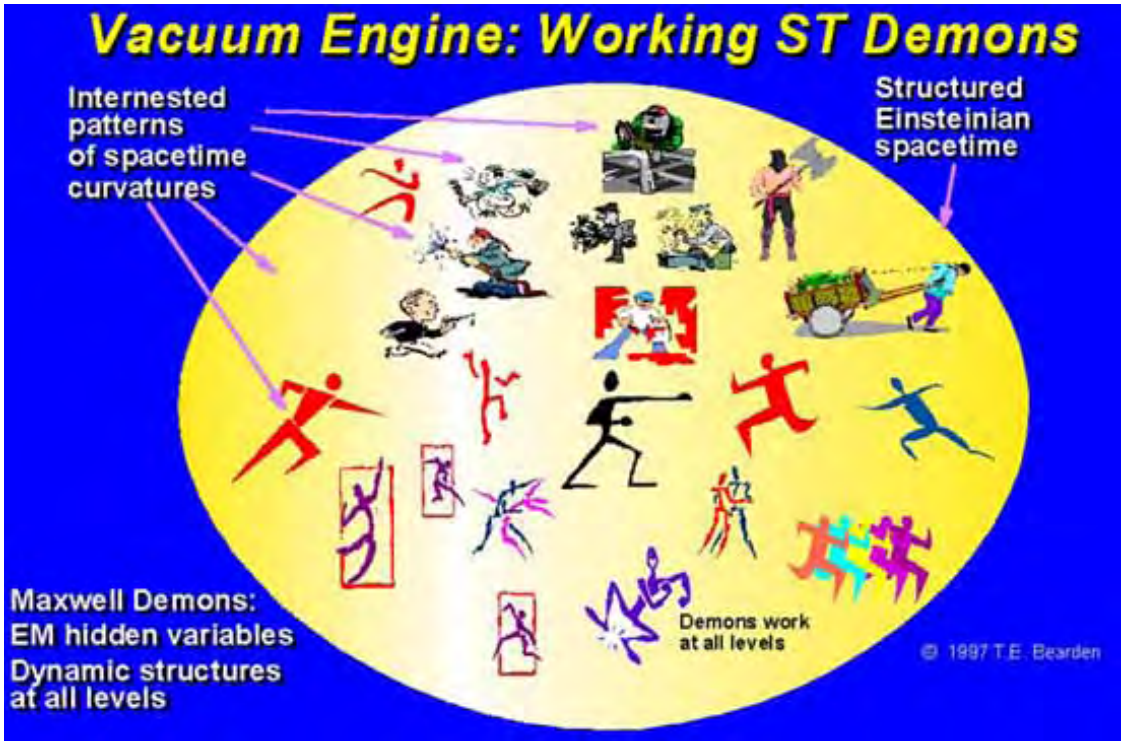

Figure 4. A spacetime curvature engine has myriads of small ST curvature components which act upon mass at all levels.

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General Relativity Aspects

Both these coupling mechanisms can be taken directly from general relativity, if one puts one's mind to it. However, unless the wave polarization transformations are known, it is difficult or impossible to apply the ordinary GR *directly*, since relativists usually concentrate upon spacetime curvature by altering 3-space energy density rather than by altering time-polarized "time-energy" density.

In applied general relativity, spacetime itself is an active medium. One speaks of a change in spacetime as a "spacetime curvature". Any curvature of spacetime in a local region directly performs continuous work upon any mass embedded in that region. Vice versa, any mass (or other concentration of energy) in a local spacetime continuously acts upon that spacetime to "curve" it.

So if one wishes to perform actions upon mass in a distant region, one may generate local curvatures of spacetime in that region, and these curvature "engines" will directly act upon the mass at all levels. *[Figure 4]* This is very different from energy propagation through space from one point to another. Now the "ordinary EM energy and actions" arise from every spatiotemporal point within the mass, at every level, and move upwards (from inside to outside). So we speak of specific forms of "templates" of nested spacetime curvatures formed and utilized to engineer mass "from inside out" as *spacetime curvature engines or vacuum engines*.

Use of vacuum (spacetime curvature) engineering[15] is a far more powerful form of engineering than is provided by energy propagation through space. As an example, it is easy to alter the quarks in a nucleon, using spacetime curvature engines and time-charging decay. Indeed, we have developed the mechanisms for cold fusion and the electronuclear interaction (formation of new nuclides) at feeble energy. An Invention Disclosure[16] on this work has been filed with the U.S. Patent Office, and formal patent applications are in preparation. Some information on these mechanisms and principles has been released[17].

Time as Dense EM Energy and a Strong Spacetime Curvature Agent

The advantage of using the time-polarized "time-energy" for spacetime curvature is that time is ordinary energy compressed by a factor of at least c^2—which, in the MKS system of units, is some $9¥10^{16}$. Thus use of time-polarized EM photons and waves as ST curvature agents gives an amplification of $9¥10^{16}$ over the use of transverse-polarized EM waves for that purpose. In turn, the use of the strong EM force in ordinary TW waves as an agent of ST curvature is already a nominal 10^{40} times as strong as is the weak G force used as the agent of ST curvature.

The bottom line is this: For spacetime curvature effects, the use of the t-polarized domain provides amplification of some $9¥10^{56}$ greater than the weak G-force ST curvature agent usually considered in general relativity[18].

Western Science Remains Largely Materialistic

Ironically, most Western scientists are materialists and consider "mind" as a mystical and nonscientific concept. They tend to consider mind operations and functions either to be simply "meat computer" operations and functions, or at best to be very weak ordinary transverse-wave EM operations and functions in the brain and nervous system.[8] This serious self-limitation exists because in the body we *measure* only weak TW EM operations and functions correlated to biological behavior and brain operations. We simply do not know how to measure "mind operations" directly.

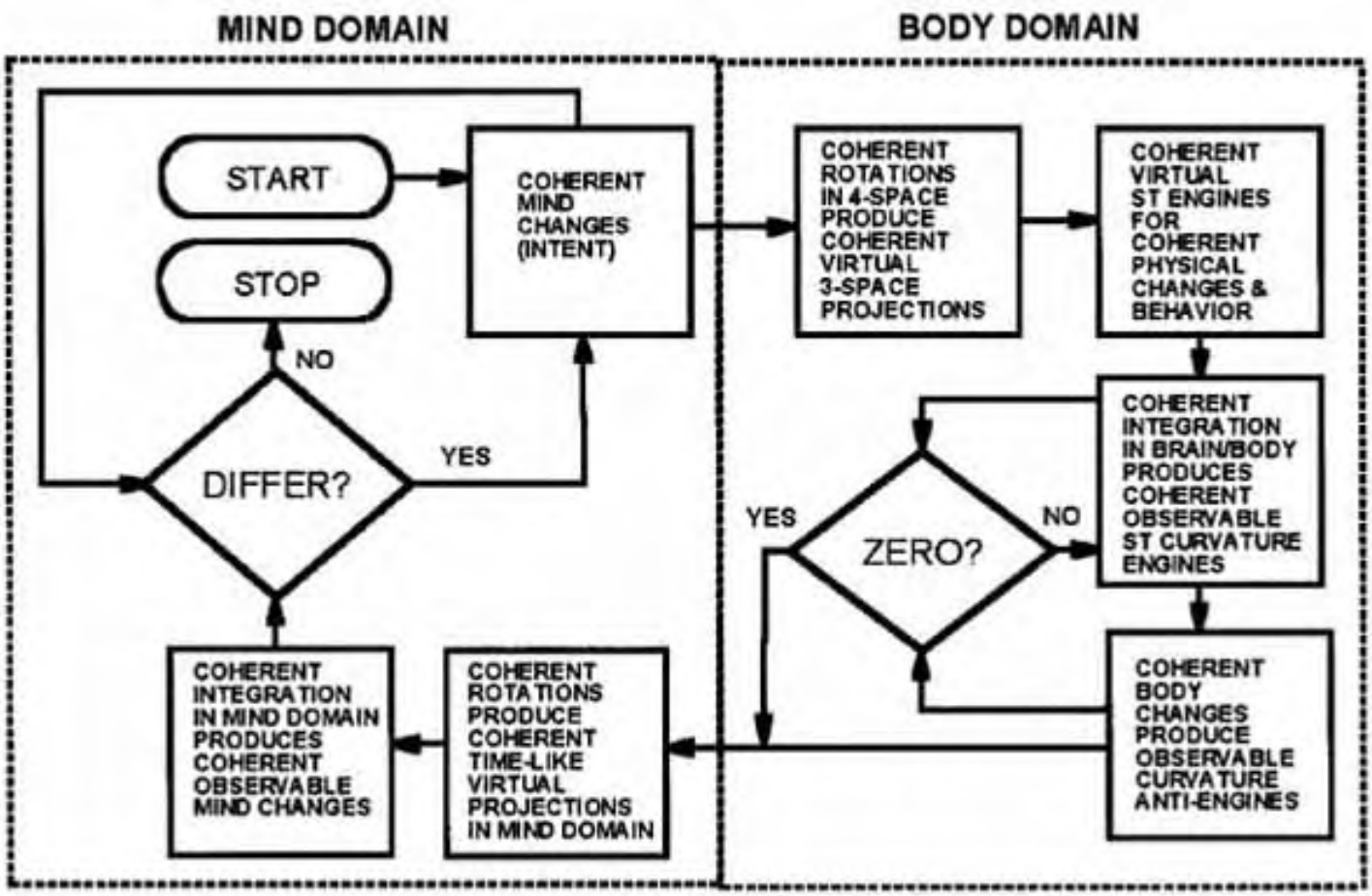

Figure 5. Mind-to body coupling and body-to-mind coupling.

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With no mind measurements possible and no instruments, it is understandable that Western science considers only the physical side of the mind-matter interface.

Presently our scientists do not measure the longitudinally-polarized EM wave operations and functions in the body and around it in nature. Few of them are aware that a maelstrom of such LW functions exist in the body and in all of nature in general. Presently only highly theoretical quantum field theorists seem to even be aware of the existence of scalar (t-polarized) photons, and even they are unaware of t-polarized EM waves. Certainly our scientists do not measure t-polarized EM waves in and around the body and in nature, nor do they make them in the laboratory. Apparently they have not studied such waves and their interactions with matter—living and inert—at all.

But it's even worse. In ignoring the time component transported by photons and EM waves, science has also erroneously omitted half of the excitation charging and excitation decay processes whenever a mass interacts with photons and EM waves. More on that later.

Brute Forcing Time Functions versus Fine Control Methods

Ironically, Western mind control researchers using transverse EM waves for mind control research, are using a brute force method of evoking and using vacuum engines (spacetime curvature engines) and a special form of general relativity, although they do not appear to realize it.

While KGB scientists also use TW EM "brute force" TW waves when necessary, they do "imprint" or "activate" those waves with the desired internal LW and time-polarized EM wave and photon structures required to directly perform the mind engineering desired. They also do not hesitate to use LWs and t-polarized waves overtly. So in blunt terms, Western compared to Russian mind control research is probably like comparing an automobile body shop with a fine surgical ward. Having long ago worked out all those "exact correlates" to the internal "information content of the field" is where the KGB scientists are at least 20 years ahead of the West.

The reason one can get mind and behavior results with the TW electromagnetics, while bypassing the real mechanism which uses t-polarized waves and photons, is due to (1) the very peculiar nature of the EM emission from a dielectric, and (2) what can be done by re-radiating that dielectric with its emitted spectrum, deliberately and very carefully altered in selected parts. We will return to that important feature later.

Polarization and Observability

As we stated, there are four photon polarizations and therefore there must be correspondingly four EM wave polarizations[1] The first three polarizations are the x-, y-, and z- spatial polarizations. The x- and y- polarizations are transverse polarizations and the z-polarization is a longitudinal polarization along the direction of propagation (along the z-axis, by standard notation). Simply put, we may visualize the transverse polarizations as rather like the wiggling of a fish's tail from side to side as the fish moves forward, or a whale's flukes up and down as the whale moves forward, or some combination thereof. We may visualize the longitudinal polarization as a sort of "repetitive accordion effect" along the line of motion of the wave. Usually the z- polarization is neglected in EM wave theory, although in recent years physicists have "rediscovered" longitudinal EM waves and are now intensely researching the use and characteristics of such waves.[12]

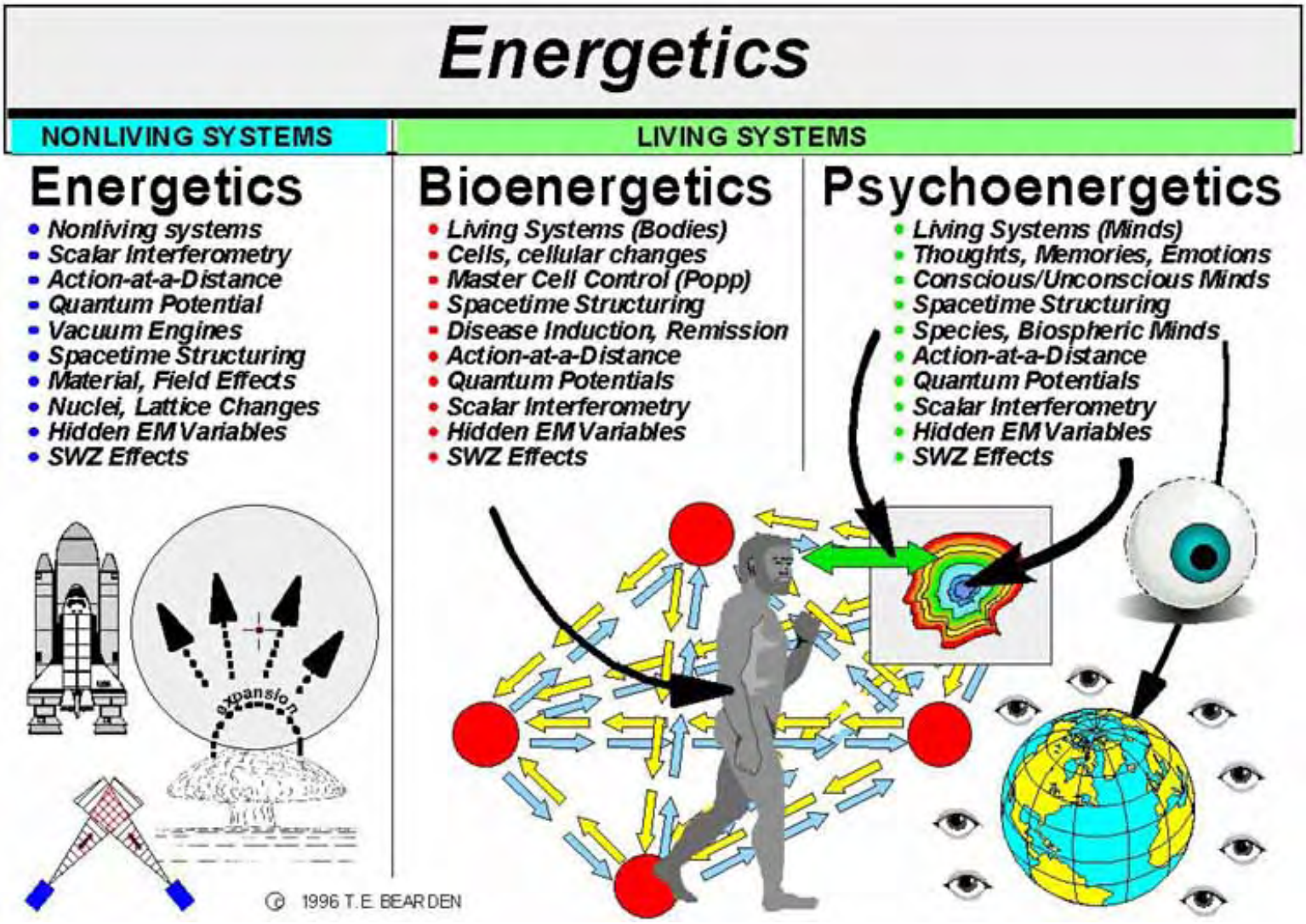

Figure 6. The three divisions of Soviet energetics and their characteristics.

Unfortunately, in quantum field theory there has been a tendency to regard the t-polarized or "scalar" photon—where the local rate of time is oscillated—as unobservable. Oscillation of the local rate of time produces powerful oscillations of local space-time curvatures, due to the extreme energy density of time. Individually, the t-polarized photon tends to be unobservable. However, a *coherent sequential group* of such t-polarized photons, each individually in the virtual state with respect to the external observer, may simply integrate in its interaction with mass over a short time period into observable change because of the coherent integration of virtual spacetime curvatures into a larger, observable spacetime curvature.

Rotations and Projections in 4-Space

Relativistically, any velocity change in 4-space is a rotation. Any such rotation in the time-domain also creates a tiny projection component into 3-space. Any such rotation in the 3-spatial domain also creates a tiny projection component into the time domain.

Hence a sufficient series of coherent time-domain (mental) changes produces a coherent series of virtual changes in 3-space (the body), thereby coherently integrating into an observable energy change in the body. A sufficient series of coherent 3-spatial energy changes produces a coherent series of virtual changes in the time domain which coherent integrate into an observable time-domain change.

Solution to the Age-Old Philosophical Problem of Intent

This is in fact the solution to the age-old problem of *intent*, or how the nonmaterial (i.e., non-3-spatial and non-observable) mind induces a 3-spatial, observable energy change upon the 3-spatial body. It is also the solution to the problem of *awareness*; i.e., how the mind is aware of itself[19] and of the responses of the body. Together the two form a closed loop coupling of the mind and body. The time delay in the loop together with memory recall for comparison, creates the sense of "persistence" of self in time. This also creates the sense of being a "separate, closed being" (i.e., of separate persistence in time—in the living entity). The sense of "separation of self from an external world" is created by comparing those body-to-mind sensory feedbacks which are not correlated to the mind's previous feed-forward intent.

Time As Energy and Why It Is Very Dense Energy

In addition to the three spatial polarizations of photons and EM waves, there is a very, very useful t-polarization along the time axis. In this polarization, the 3-spatial energy is not oscillating at all. Instead, the time or time-energy is oscillating. Time can be taken to be energy compressed by at least c^2, so it has at least the same energy density as mass. In other words, one second is 9×10^{16} joules of time-energy (energy compressed into time). The t-polarized photon or EM wave is called the scalar photon or scalar EM wave, respectively.

To demonstrate why time can be regarded as energy, we need only point out that the choice of fundamental units in any physics model is totally arbitrary. We usually choose these units to ease the mathematical manipulation, ease our understanding, and simplify the ability to visualize or "grasp" the physics. However, if one wishes, one can build all of physics from a single fundamental unit—e.g., energy. In that case, one readily sees that time is a function of energy and only energy. Hence it is perfectly proper to regard time as energy, and to seek out what form the function takes in our normal system of units (say, the MKS system).

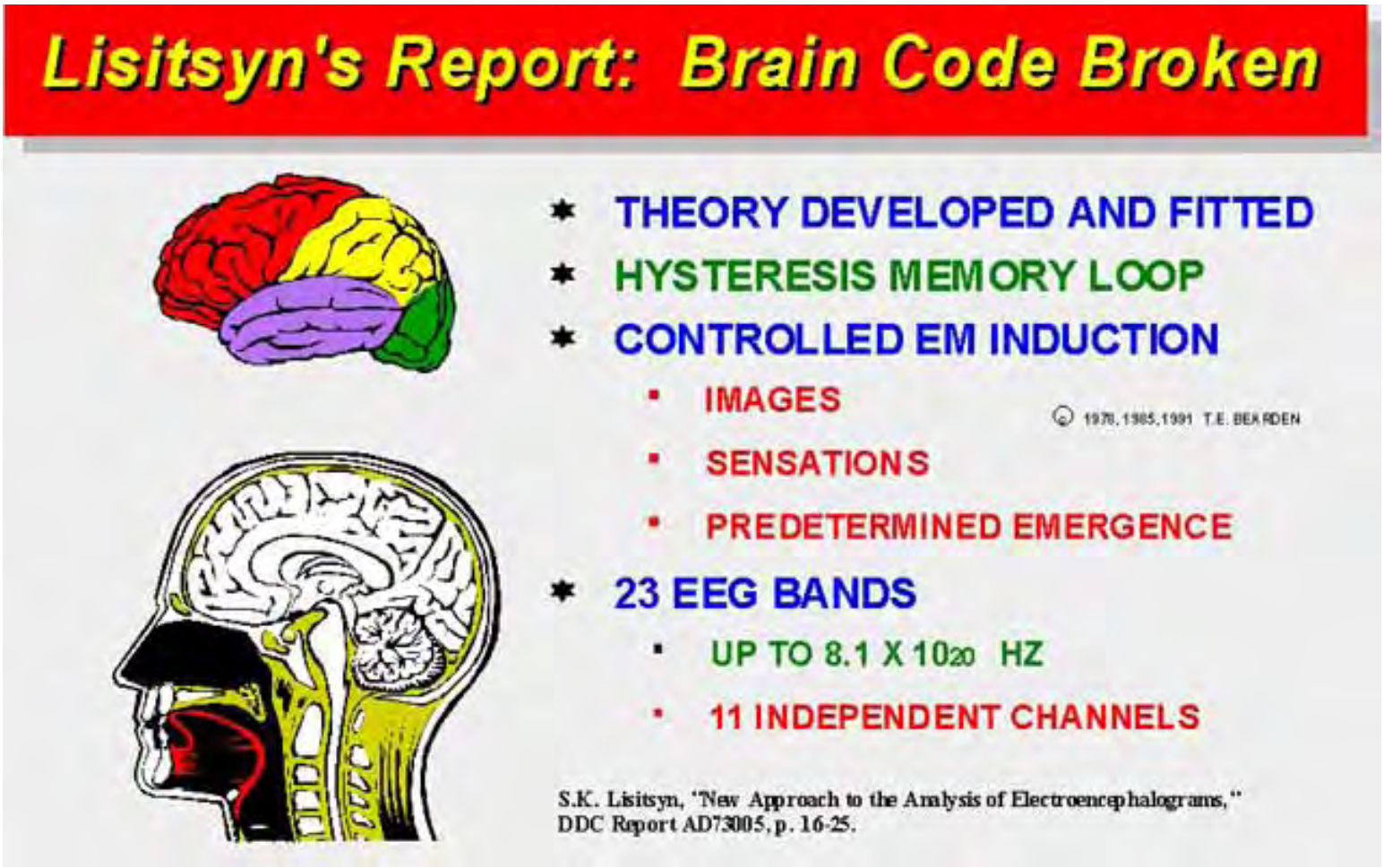

Figure 7. In the 1960s, Lisitsyn revealed Russian scientists had deciphered the human brain code.

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In that system, it appears that any change in time Δt can be taken as always a function of a corresponding change in energy ΔE, where $\Delta t \leq (\Delta E) \div c^2$ [1] from which it follows that $\Delta E \geq (\Delta t) \times c^2$ [2] For convenience, we take the special case where $\Delta t = (\Delta E) \div c^2$ [3] $\Delta E = (\Delta t) \times c^2$ [4].

Observation as Used in Physics Is Spatial

We note that all mind operations are time-like, i.e., they are comprised as scalar EM photon functions and scalar EM wave functions. Thus the mind is a very special kind of electromagnetic system, existing in the time domain, and thus "lost" by the stripping away of time in the ordinary observation process. Physical observation is essentially a time-differentiating mechanism applied to a 4-spatial change, or in terms of MKS fundamental units L and t, observation θ is $\theta = \partial/\partial t(L^3 t) = L^3$ [5].

Thus, as is well-known in quantum mechanics, physical observation is 3-spatial, and time is not a physical observable, even in theory. Since mind is time-like, it follows that mind is not a physical observable either, since discarding the time dimension also discards the mind. In short, one may also take physical operation as the mechanism that separates mind and body. To observe is to separate. We point out, however, that merely "separating and discarding" the time domain (as in physical observation of a single change) does not eliminate it, nor does it eliminate the single time-like mind change that may be involved in an intentional volition. The time domain certainly remains, even though only the 3-spatial intersection of the 4-spatial Minkowski change is given by physical mechanism and the resulting "outputs". So a series of coherently integrated "mental intent" changes introduced into the human body's overall servo-mechanism provides the continuing input. From there, ordinary physics will generate the resulting actions induced in the body by that servomechanism and its amplifying mechanisms.

Two Coupling Mechanisms Make a Closed Loop

This is the "mind-to-body" coupling mechanism. [See *Figure 5*] It is the mechanism whereby the mind is coupled to the body, and whereby mental intent is able to induce a series of physical inputs into the body servomechanism.

So the body's servomechanism then generates the responses of the body (including everything from chemistry to electrical changes to muscular movements, etc.). These responses are changes in 3-space.

The conscious mind is a *serial processor*, though extremely rapid. It produces the series of coherent intent inputs for volitional behavior.

The unconscious mind is a *massively parallel processor*.[20] It continually produces the vast series of coherent "unconscious intent inputs" for control of all the deeper processes in the body, beyond usual conscious awareness.

However, as the body moves or changes in 3-space, each resulting quantum change in body 3-space is also a slight rotation out of 3-space and toward the time axis. Hence it induces—in the "virtual state" in the time domain—a precisely correlated projection. The body's responses are in general coherent, so a coherent series of virtual state changes in the time-domain (in

observation. So we may say *that the time-change remains in the virtual state, with respect to attempted physical observation of a single Minkowski 4-space change.*

Rotation, Coherent Integration, and Intent

Previously we pointed out that any change in a 4-space entity may be regarded as a rotation away from the "trajectory" of the entity. Hence each and every t-polarized change creates a very small projection into 3-space by its rotation slightly away from the time axis. All mind changes in the time-domain actually produce virtual 3-spatial projections in 3-space (in the physical domain). We define "intent" as the continued production of successively coherent mental changes, producing coherent virtual changes in the 3-space body system, with coherent integration of those 3-space virtual changes into observable 3-space energy inputs into the 3-space body system. Successively coherent mind-changes will produce successively coherent 3-space virtual changes. In short, coherent mind-changes will produce coherent integration of those 3-space virtual projections into an observable 3-space change. This is the creation of an ordinary 3-spatial energy change induced upon the 3-space body. In short, this is the mechanism whereby time-like mental intent is able to produce a series of coherent observable quantum changes in the physical body (as in the brain and nervous system).

The Body as a Servomechanism

From the standpoint of control theory, we may consider the body system to be a complex servomechanism system comprised of many subordinate servo systems with feedback and feedforward the mind realm) are created successively. In short, again we have coherent integration, this time in the mind or time domain. This produces "observable" changes in the time-mind domain, which are coherent with the body's 3-spatial changes actually performed. Thus the mind receives feedback directly from the physical movements and changes of the body. This is the manner in which the body is coupled back to the mind.[21]

By comparing the "intent" behavioral move that was "fed forward" into the body, with the return "response" move analog that was "fed back" from the body to the mind, the mind is able to determine errors and differences, and originate additional correctional commands.

Thus the entire mind-body loop is a closed-circuit system of feedforward and feedback, together with corrections. It also has multiple levels of such, infolded in the larger volitional levels. See again *Figure 4*.

This solves the age-old problem of the mechanisms for the mind-body coupling, intent, volition, conscious and unconscious functioning, sense of the external world, sense of the internal world, sense of "being in" the external world, etc.[22]

All This Is Included in Russian Psychoenergetics

This is the highly summarized basis for *psychoenergetics*, the KGB's division of energetics that deals with the mind and body coupling and functions, and direct engineering of (1) the mind-body coupling and (2) the mind operations directly. [See *Figure 6*] The KGB intent, of course, has always been to exploit this science for the degradation, killing, and control of human beings, including all humanity.

The Russians know full well that, if you

looping.

Given the input from intent, ordinary servo theory will take it from there. Once a servo has an input, servomechanism theory describes the response of the

produce and utilize scalar EM photons and t-polarized EM waves, you can directly affect and engineer mind and mind operations at any and all levels. Western researchers, who know nothing of how to make

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time-polarized photons and time-polarized EM waves, do not yet know that. Consequently the Russians have developed a highly secret science of *directly* engineering the mind and its operations, including thought, images, perceptions, feelings, emotions, memory, and mind processing. Indeed, Lisitsyn[23] wrote quite specifically of this capability in the 1960s. [See *Figure 7*]

Western clandestine mind control researchers are apparently still slowly and painfully fitting TW EM irradiation correlates to induced or resulting mental and physical behavior responses. They seem unaware of the actual wave transductions occurring inside the body and mind, but are unwittingly inducing those transductions in hidden fashion anyway and in "brute-force input-response fitting" models.

These "fitted brute-force models" certainly can be very powerful, and certainly can produce the exact results shown in the experimental verifications of the fittings. However, they do not of themselves allow sophisticated design—for example—of the necessary time-polarized wave assemblies for engineering the entire human collective unconscious simultaneously, or for engineering the entire collective unconscious of all species on Earth (i.e., Gaia's collective unconscious), or even for precisely engineering the memory and knowledge base of an individual.

This fine research article will be continued in Part II with Russian Methodology, Waves and Wave Transduction, The Cellular Control

spacetime that is highly active. The mind is rooted in the time-domain and projects from that domain into 3-space. The body is rooted in the 3-space domain and projects into the time-domain. To "change" or "function" in one domain is automatically to function in the other. EM and gravitational phenomena are still modeled separately by human scientists, but not by nature.

3. In quantum mechanics, time is not an observable, but merely a parameter.

4. It is convenient to consider mass as a 3-spatial form of condensed energy.

5. E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics, " Mathematische Annalen, Vol. 57, 1903, p. 333-355;— "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions, "Proc. Lond. Math. Soc., Series 2, Vol. I, 1904, p. 367-372.

6. A NERAC document search yielded some 16 good references on t-polarized photons, but not a single reference on t-polarized EM waves.

7. E.g., such previously inexplicable instrument anomalies have accompanied some excellent and rigorous electrolyte experiments at U. S. Navy research facilities at China Lake. For a description, see Melvin H Miles and Benjamin F. Bush, "Radiation measurements at China Lake: Real or Artifacts?", Proc. ICCF - 7 (International Conference on Cold Fusion—7, Vancouver, BC, Canada, Apr. 1998, p. 101. For a brief explanation of the anomalies, see T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves, " Explore!, 8(6), 1998, p. 7-16;— "Toward a Practical Unified Field Theory and a Deep Experimental Example," Proc. INE Symposium, Univ. Utah, Aug. 14-15, 1998.

8. Many U. S. researchers and journalists—and even many scientists—have wrestled with the problems of mind, intent, and mind-body coupling. Enumeration of those efforts would itself require an entire book. For an introduction into that domain, the reader is referred to the very determined exposé by

System, and other matters of interest. ♦

ABOUT THE AUTHOR

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He is president of the Association of Distinguished American Scientists (ADAS), a life member of the Alabama Academy of Science, Emeritus member of the American Association of Physics Teachers, and has served on the Board of Directors of several associations and corporations. Tom is a guitarist, a retired aikidoist (Sandan, Yoseikan style), is happily married and has two sons and two daughters. He and his wife Doris live in Huntsville, Alabama where Tom is retired from aerospace, continues private research, and serves as a consultant to industry on Scalar

Cheryl Welsh in her very timely book, The 1950's Discovery of the Code of the Brain, May 1988, published on the Internet. Simply employ any Net search engine and search on the name Cheryl Welsh. A connection to the site and to Welsh's book will immediately be found Welsh's important compendium is highly recommended, giving the reader a "birds eye view", so to speak, of how Western scientists think and proceed regarding the subject of mind control by electromagnetic means. Unfortunately all journalists so far researching the area have not been aware that Western electrodynamics itself is seriously flawed, and that the great Russian advances in mind engineering and mind control are a result of their secret but complete revision and correction of Western electrodynamics to provide the basis for energetics. Until Western scientists revise their own decrepit old electrodynamics fouling the textbooks, they will never catch up to the Russian mind control developments springing from intense development programs that did that revision in the late 1940s and early 1950s.
9. An Invention Disclosure on these processes and enhancement embodiments has been filed with the U. S. Patent Office. Formal patent applications are also in preparation.
10. Energetics is a unified science of an extended electrodynamics possessing a hidden infolded general relativity inside the potentials, fields, and waves. It deliberately employs higher polarizations (longitudinal and tempic) of photons and EM waves to engineer action at a distance, use of specific patterns of spacetime curvature created at a distance, and direct engineering of either inert or living bodies. It also encompasses the direct engineering of time-like mind and mind functions. It is divided into three divisions, depending upon the nature of the target. Targeted against inert materials, structures, fields, and waves it is called "energetics. "Against living bodies, their fields, and biochemistry, it is called "bioenergetics." Against the mind and mind functions, it is called "psychoenergetics".
11. Psychoenergetics is that branch of energetics used to directly affect and engineer

electromagnetics processes.

R E F E R E N C E S

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1. E.g., see Lewis H Ryder, Quantum Field Theory, Cambridge University Press, 2nd Edition, 1996, p. 147+. For an even deeper discussion of photon polarization, see F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1984, under the heading "Covariant Quantization of the Photon Propagator" in Chapter 5. Mandl and Shaw argue that the longitudinal and scalar polarizations are not directly observable, but only in combination, where they manifest as the "instantaneous" Coulomb (i.e. electrostatic) potential.
2. Nature is unified and not separated into the "separate" disciplines our science has prescribed. Thus the mind is also totally electrogravitational. The mind works not just with EM
forms in an inert space, but also with spacetime curvatures in a the mind, memory, perception, thought, emotion, sensation, personality, and other mind functions of a living biological organism. It is usable against a single personal conscious (serial processor) mind and a single personal unconscious (massively parallel) processor mind In theory it is also usable against lungs collective unconscious mind and its functions, as well as the deeper unconscious for all species on Earth (i.e., against Gaia). We are speaking of physics, not metaphysics.
12. W A. Rodrigues Jr.. and J.-Y. Lu, "On the existence of undistorted progressive waves (UPWs) of arbitrary speeds $0 \leq v < \infty$ in nature," Foundations of Physics, 27(3), 1997, p. 435-5•08 A slightly corrected version is downloadable as hep-th/9606171 on the Los Alamos National Laboratory website.
13. E. T. Whittaker, "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions, "Proc. Lond. Math. Soc., Series 2, Vol. I, 1904, p. 367-372. The paper was published in 1904 and orally delivered in 1903.
14. E.g., see T. E. Bearden, Fer-de-Lance, Tesla Book Co., 1986;—AIDS: Biological Warfare, Tesla Book Co., 1988;—Soviet Weather Engineering Over North America, 1-hour videotape, 1985,—Gravitobiology; A New Biophysics, Tesla Book Co., P.O. Box 121873, Chula Vista, CA 91912, 1991,—Energetics of Free Energy Systems and Vacuum Engine

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Therapies, Tara Publishing, Internet node www.tarapublishing.com/books, July 1997; — Energetics: Extensions to Physics and Advanced Technology for Medical and Military Applications, CTEC Proprietary, May 1, 1998, 200+ pages furnished to selected government agencies and key Congressional committee leaders.

15. E.g., see T.D. Lee, Particle Physics and Introduction to Field Theory, Harwood; New York, 1981. On P.383, Nobelist Lee points out that the microstructure of the scalar vacuum field (i.e., of vacuum charge) is not utilized. Particularly see Lee's own attempt to indicate the possibility of using vacuum engineering, in his "Chapter 25; Outlook; Possibility of Vacuum Engineering, " p. 824-828. With wave transductions and use of higher polarization EM waves, there are far better and more powerful ways to do vacuum (spacetime curvature) engineering.

16 T.E. Bearden, "Formation and Use of Time-Reversal Zones, EM Wave Transduction, Time-Density (Scalar) EM Excitation and Decay, and Spacetime curvature Engines to Alter Matter and Convert Time Into Energy," Invention Disclosure Document #446522, Oct. 26, 1998.

17. T.E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves, "Explore!, 8(6), 1998, p. 7-16; — "Toward a Practical Unified Field Theory and a Deep Experimental Example," Proc. INE Symposium, Univ. Utah, Aug. 14-15, 1998.

18. We have used the enormous energy density of time in our approach to a totally new kind of electronuclear interaction at feeble spatial energy. By use of a time-reversal zone (TRZ) in a fluid; the free H+ ions—which are free protons—can be induced to attract each other so tightly that the edge of the nuclear force region is entered. In that case the protons form a quasi-nucleus. When the TRZ decays back to a time-forward zone (TRZ), this new quasi-nucleus decays by changing quarks in one or more nucleons, thereby producing new nuclides. We point out that means "sense of existing in time".

20. The "unconscious" is totally conscious, just multiply so. The conscious mind can see only "a single slide in the slide projector at a time, " so to speak. When it "looks" at the ongoings and outputs of the unconscious, it "sees" millions of slides in the slide projector simultaneously. Hence it cannot distinguish "one and one only". So it just sees nothing, where by "nothing" we mean "no single distinguishable thing." It therefore is unable to consciously perceive the actions of the unconscious. When the unconscious wishes to communicate with the conscious (because of unresolved conflicts, etc.), it must produce large groupings integrated into "symbolic scenarios". Hence the symbolism of the unconscious, and the basis for therapeutic psychology and psychiatry. A "symbol", after all, is just a thing which can have many different meanings, all folded into one.

21. The mind continually has activities of its own, each of which produces coherent changes in the body to a much smaller degree. The interweaving of these "smaller self-changes" infolded inside the 3-space major intent changes also produces slight body changes, which in turn "project back" into the mind. This huge group of "infolded self-loops" produces the sense of "my body" being "volitionally directed or occupied" simultaneously with the "greater intent" loops which represent "my intentional actions with my body". Further; the body servo continually receives a myriad of inputs from its sensory systems, both from changes inside the body and from incoming changes from the external universe. This interweaving produces the awareness of "being in the external world" by having (i) changes whose feedback do not match mind-intent changes, and (ii) changes whose feedback does match mind-intent changes. This of course applies to both the conscious and unconscious levels. The purpose here is to demonstrate that there exists an actual physics of the living being, the mind as well as the body, and the coupling and interfiinctioning of mind and body.

this is actually a very high energy reaction; however; since the time-energy is used and is very, very dense, the amount of 3-spatial energy that must be used is very small. If this new mechanism holds, it represents a revolution in particle physics.

19. "Self-awareness" refers to be continually "refreshed" by time-delayed coherent feed-back inputs from the body to the mind; where these inputs compare to the recalled memory of the minds inputs to the body. In short, the time-delay coherence creates the sense of "existing in time". Awareness usually

22. The methodology also easily extends to include deeper interlays for the collective human unconscious mind and for Gaia—the collective unconscious mind level for all the species on earth.

23. S. K Lisitsyn, "New Approach to the Analysis of Electroencephalograms, " in Problems of Bionics— (Selected Articles), Defense Documentation Center Report AD 73005, date unknown, p. 16-25. Available through the National Technical Information System (NTIS).

Mind Control and EM Wave Polarization Transductions, Part 2

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This article continues on with T.E. Bearden's article, Part 1 of which was published in Volume 9, #2 of Explore! for the Professional. Because we feel that Col. Bearden's caution below is so very important we are repeating its publication in all parts of this article.

Special Note

This article refers to experimental research techniques which can be detrimental or lethal in the hands of any but highly skilled, qualified experimental scientists proceeding under proper laboratory safety procedures. The purpose of this article is strictly for information to properly qualified and authorized scientists in certified laboratories. We do not propose or condone any use of these procedures for non-approved practice of medicine without a license. Neither the publisher nor the author are responsible for accidents or outcomes in the use of these experimental procedures and techniques. Any researcher who performs these procedures and experiments is acting on his or her own volition, and is solely responsible for insuring safety, qualifications, and legality of the acts and their results. We neither suggest nor condone unauthorized experimentation on human subjects. Such is a criminal violation of the constitutional rights of the subject under Federal and State laws, and is both illegal and immoral.

A Strategic Threat Completely Unrecognized by the West

The Russian methodology leads directly to rather mind-bending, extended capabilities. KGB psychoenergetics scientists seem fixed on an eventual goal of directly engineering Jung's collective human unconscious, thereby converting the entire human species into a sort of "ant" species. In short, they seek to engineer what they regard as "perfect communism and perfect order" directly in the entire species. *Figure 8* indicates the direct connection of every human's conscious and unconscious mind to the collective species unconscious and to Gaia, the collective unconscious for all species on Earth. Since time is internally structured and layered, it follows that time-like mind levels are also internested and layered.

This appears to be a significant strategic threat, *well along in its development*, that our scientific and intelligence communities have completely failed to recognize.

The direct engineering of the entire human collective species is a doable.[1] It is going to be done, whether we like it or not. In that race (which may eventually determine whether or not we retain any personal freedom at all), the "democratic" nations are woefully behind. In fact, the West has not even realized there is such a new kind of "arms race" for dictatorship and control of the "collective species mind" and we have already almost lost it. The West has not yet even developed the overall theory of psychoenergetics.

Waves and Wave Transductions

A pure longitudinal EM wave (LW) would have infinite energy and infinite speed. In practice, one can only approach this perfect LW wave, and one always has transverse residues remaining. Hence the "imperfect" longitudinal EM waves we can make in suitable equipment and techniques, are known as "undistorted progressive waves" (UPWs). The UPWs may have velocity far greater than the speed of light, or less than the speed of light. So the speed v of UPWs can vary as

$$0 < v < \infty \qquad [6]$$

The Russians also know that, when a nearly-pure longitudinal EM wave interacts with matter (it usually doesn't interact very much, and has a low reaction cross section), the mass immediately adds the phase conjugate replica to the interacting LW portion, regardless of frequency, thereby transducing the input LW interactions into scalar (time-polarized) EM interactions.

One transduces from TW to LW to Scalar EM via iterative phase conjugation. One transduces from scalar EM to LW to TW via iterative interferometry. It took the present author 20 years to discover this simple thing; we now have filed an invention disclosure on the process and embodiments for performing it, and will be following with formal patent applications. Let TW = transverse EM wave, LW = longitudinal EM wave, and TDW = time-density EM wave (another name I use for t-polarized or scalar EM waves, since the density of time-energy is what is varying). Let (I) = interfering with, PCR = phase conjugate replica wave with a coupled set of parentheses enclosing the type of wave. The rules for wave type transduction are:

$$\mathrm{TW} + \mathrm{PCR(TW)} \Rightarrow \mathrm{LW} \qquad [7]$$

$$\mathrm{LW} + \mathrm{PCR(LW)} \Rightarrow \mathrm{TDW} \qquad [8]$$

Going the other way, the rules are:

$$\mathrm{TDW\ (I)\ TDW} \Rightarrow \mathrm{LW} \qquad [9]$$

$$\mathrm{LW\ (I)\ LW} \Rightarrow \mathrm{TW} \qquad [10]$$

In EM smog (dense EM signals, even though very weak), there is increased nonlinear multiwave interactions, both interferometric and phase conjugative. So in such EM smog there exists an increased, non-negligible component of LW and TDW irradiation, formed by the above transduction interactions in the irradiated living cells and bodies. This latter part accounts for many of the long term effects which show up in "correlative" studies, but which do not show up in the normal limited-frequencies TW experiments produced by so-called "physical experiments."

The standard EM bioeffects manner of experimenting uses a theoretical model of simple, direct energy deposition by means of absorption in cells and tissues. Now we must utilize an "open system" throughout the body dielectric in which higher polarized EM energy (either LW or t-polarized) travels readily throughout all areas of the body.

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EM Bioeffects and Wave Transductions

In the EM bioeffects experiments to date, there has been absolutely zero control of the internal transductions, and there has been no consideration of them. Almost all transductions of TWs into LWs will immediately result into transduction into TDW and time-excitation charging of the cells and all their internal components. These time-excitation charges (excited states of time-charging) will then slowly decay, emitting longitudinal EM waves in the process which travel throughout the body. These emitted LWs interfere with each other and the LW processes in the body, producing low level TW "noise jamming" of the cellular processes and—most especially—of the deep cellular control system of the body. The latter system functions by means of LWs and TDWs. Long-term effects of such "noise jamming" of biochemistry reactions and the control systems of the cells and body, can lead to degenerative diseases such as arthritis, atherosclerosis, Alzheimer's disease, heart disease, cataracts, tumors, leukemia, somewhat accelerated aging, immune system weakening and depressing, etc. As the body's natural defense and regeneration ability weakens, opportunistic infections further add to the degeneration.

It was shown by Whittaker in 1903 that any scalar EM potential is comprised of a harmonic series of bidirectional longitudinal EM wavepairs. [See *Figure 9*] Each longitudinal EM wave pair in the harmonic series is a phase conjugate pair. Unknown to Whittaker, that "LW phase conjugate pair" is actually a time-polarized EM "photon" structure, containing a phase conjugate LW photon substructure. So staid old "voltage" (potential) is comprised of a harmonic series of time-polarized EM waves!

The corresponding "t-polarized photons" are actually spin-4 *supergravitons* comprised of coupled antipairs of LW "photons". Each LW photon is a spin-2 *graviton* comprised of a coupled TW photon-antiphoton pair. Each TW photon and antiphoton in the coupled pair has spin-1. The couplet, being the longitudinal "photon" or graviton, thus has spin-2. And so on.

In 1904, Whittaker showed that any EM field or wave pattern can be decomposed into two scalar potential functions. By applying Whittaker 1903 decomposition to each scalar potential function, any EM field or wave has an enormously rich internal structure, comprised of scalar potential functions in interference. Each scalar potential function is comprised of time-polarized EM waves (made of spin-4 supergravitons). Each time-polarized EM wave is further comprised of bidirectional longitudinal EM wavepairs. Each longitudinal EM wave is further comprised of phase-conjugate pairs of transverse EM waves. Each transverse EM wave is further comprised of two scalar potential functions, each of which is in turn comprised of an infinite harmonic series of time-polarized EM waves, and so on *ad infinitum* and *ad nauseum*. Obviously all EM potentials, fields, and waves have an enormous "internal structure" or internal "information content of the field".

The Cellular Control System Uses t-Polarized EM Photons and Waves

The master cellular control system (MCCS) in the body utilizes these photon-gravitons, their corresponding EM wave polarizations, and transductions between them. By the use of very powerfully condensed gravitons and supergravitons, it is able to utilize small but highly significant direct curvatures of spacetime in precise patterns. In short, it utilizes general relativistic spacetime curvature engines, rather than "EM photon signals", to accomplish its control of the cells and their processes. It does not merely send a "signal" and hope the cell itself acts upon it. Instead, it sends an "engine" which alters the local spacetime in which the cell and all its components are embedded. This "local ST curvature engine" then physically works directly upon the cell and all its parts, to alter the cell according to the specific "template" of the engine.

This is the direct application of the Wheeler's simple statement of general relativity: *Mass (trapped energy) acts upon spacetime to curve it, and curved spacetime acts upon mass to change it.*

Popp's "ordinary photon" study of this cellular control system[2] therefore will detect the coherent ordinary TW photon residues which result from the photon polarization transductions occurring from the actions of the ST curvature engines upon the cells.

Cellular division, biochemical processes, growth and growth control, cell differentiation and dedifferentiation, etc. are all controlled by the MCCS or one of its subsystems, using spacetime curvature engines. The ordinary TW electronic activity our biophysicists detect and correlate are simply the intermediate components of the actual ongoing polarization transductions.

The Cellular Control System Uses EM Time-Energy

One important subsystem of the MCCS controls the immune system's functions, including the deepest and most subtle functioning performed by all elements of the immune system. This system has been rather intensively studied, but since our biophysicists have not possessed the full electrodynamics utilized, only the correlated residue of normal TW EM waves and photons have been recognized and studied. Hence Western biophysics is in its very crude infancy.

Incorporation of the total wave and photon polarizations, together with their transductions, will eventually present a revolution in both biomedicine and biophysics. Unfortunately, presently our entire medical community is very firmly entrenched in only ordinary TW EM polarizations and ordinary biochemistry. Our scientists thus are studying less than 1% of the functioning of the living organism.

As an example, since Western scientists have no knowledge or research into the time-polarized mind domain and mind-body coupling, the mystery of the *placebo effect*—in which the mind has been verified to produce actual physical effects – will indefinitely remain a mystery.[3] As one result of that "crippling" of our medical theory, medical experimenters have to deliberately drive experiments on drug effects, etc. beyond the "mind's own threshold" of physical effect. In short, they have to drive the experimental results over and above the results being accomplished by the placebo effect. They must perform valid placebo control experiments, and subtract the placebo component results from their own experimental results, to determine the "delta" induced purely by the drugs.

The Regenerative Subsystem

Another important subsystem of the MCCS controls the *regenerative system* of the body. The regenerative system has various mechanisms, including growth control, differentiation and dedifferentiation of cells, etc. Becker's portrayal of the regenerative system is shown in *Figure 10*. One of its most important functions is healing and restoring damaged or diseased cells. It does that by a most remarkable process.

This system has been very poorly studied, mostly by Becker[4] *et al.*, although there is still sporadic, ill-funded, and ill-planned research on regenerative effects from time to time.[5] Becker and his colleagues came closest, and—considering the severe limita-

tions of the orthodox U(1) EM model available to them—Becker's work is particularly revolutionary. He demonstrated beyond question that simple DC potentials could generate cellular differentiation and redifferentiation, and produce results at global sites in the body and not just at the local injury sites where the DC potentials were applied.

Becker was nominated for a Nobel Prize for his Herculean efforts and remarkable results. For his trouble he was hounded, his funds were withdrawn, and he was forced to retire at an early age in his 50s. His biggest "heresy" was to bravely point out that power line radiations had deleterious effects upon biological systems, and to testify to it in a series of hearings and court cases where a very powerful electrical power industry essentially ran rough shod over science and the public.

Organized Science Is Highly Politicized and Imperfect

It is not only politicians that are "bought and paid for" by powerful vested financial interests. In organized science, precisely the same arrangement holds true. Scientists are no better or no worse than any other segment of humanity. A surprising percentage will produce the results desired by their benefactors, if provided with cushy jobs, good income, prestige, and secure positions.

It has been said that money is power. It has also been said that power corrupts, and absolute power corrupts absolutely. In the scientific community, as well as in the political community, this "great corruption" by great financial power has been elevated to an art form. Simply examine the funds made available to scientists. There is not enough for all the scientists, so it is fiercely competitive. If the scientist does not get grants (e.g., a would-be professor at a university), he does not bring in extra money to the university. He cannot get his graduate students funded, so his own innovative (read: heretical) research is thwarted. His papers are rejected by the journals, and before long he has no funded position in science. If lucky, he will be employed in the grocery store or the butcher shop.

Every bit of funding available for the scientists to compete for (and apply for grants) already has firmly fixed controls of exactly what research can be done with that money. The "science" that will be applied is already formulated. That and only that can be done. It is a tribute to the dedication and resourcefulness of our working scientists themselves, that anything innovative at all gets done.

One can have a very fine scientific career, tenure as a professor, get one's graduate students funded, get one's papers published in prestigious journals, win awards and achieve stature and prestige, if one just plays the desired game prescribed by the "old boys schools" in control of almost all the scientific funding. Yes, one can permissibly move the decimal point in the present models a bit, and be rewarded handsomely for doing so. But one is damned if one attempts any serious change or overthrow of obsolete scientific models and practices favored by the "system".

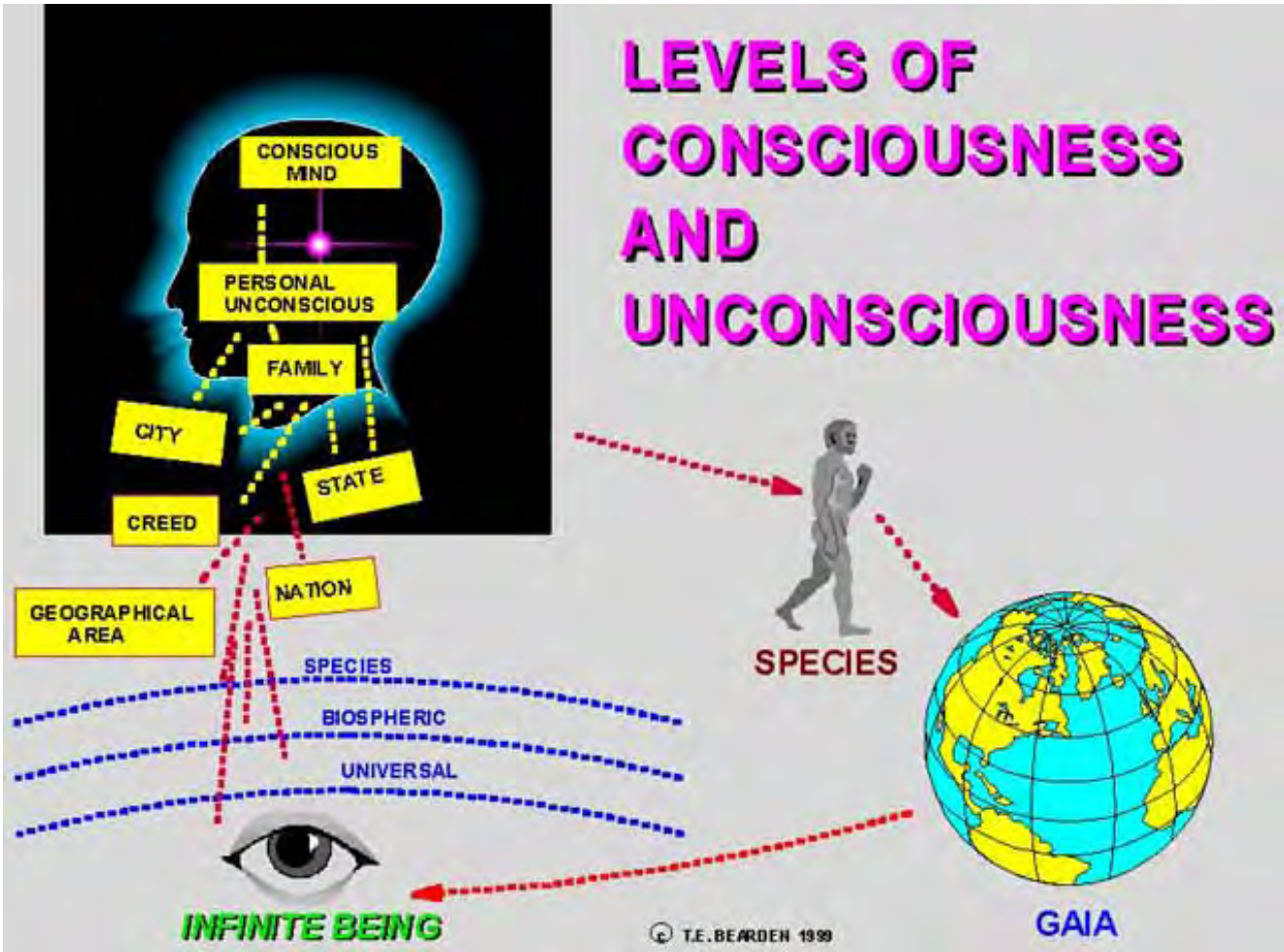

Figure 8. Nested levels of consciousness and unconsciousness. The mind levels contain the "life" and "mind" dynamics.

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That is precisely why all our universities continue to teach a terribly flawed electrodynamics that is a caricature with at least 32 major foundations flaws in it.[6]

And that's why the organized Western scientific community has betrayed the taxpayers who largely fund its research. In short, the scientific community fiercely enforces dogma, suppresses innovation, and has denied the U.S. the very defense we need to survive against our pressing enemies who have not been so scientifically dogmatic.

Microwave Radiation of the U.S. Embassy in Moscow

Because of the strongly enforced adherence to the insane foundations errors in classical electrodynamics, our scientists still do not comprehend the decades of so-called "microwave radiation" of personnel in the U.S. Embassy in Moscow.[7] All diseases and health changes produced in those personnel were in *field-free areas* (i.e., where the potentials were persistent and unchanging, with no gradients etc.)[8] No one even thought to look at the "inner longitudinal EM phase conjugate biwave composition" of those potentials, where they would have found the Whittaker internal bidirectional longitudinal EM wavepairs and the internal time-polarized EM waves. They would also have found the infolded, very powerful general relativity: the spacetime curvatures deterministically formed and being utilized to directly alter the irradiated cells and their constituents.

Instead, government-funded studies did a rather straightforward "force field" analysis, and concluded that, since there were no fields there, it could not have been the microwave radiation.

Elementary statistics would immediately indicate a different conclusion: The diseases and health changes were 100% correlated to the presence of potentials, and 100% anticorrelated to the presence of fields. Hence it was the field-free potentials that had to be inducing the diseases and health changes. If it were NOT the radiation at all, then some changes would have occurred in personnel in areas where fields were *present*, as well as in areas where fields were *absent*. Since this did not occur, such a premise is destroyed by self-contradiction. In short, the data actually proved (i) it was indeed the radiation that was causing the diseases and health changes, and (ii) further, it was the field-free potentials that were the culprit.

That this elementary statistical conclusion eluded our scientific community and our government community, is absolutely inexplicable.

Three U.S. Ambassadors eventually died of diseases induced by their exposure to the Embassy radiation. Ironically, Kaznacheyev[9] had openly released some of the results of thousands of Soviet military experiments showing that any kind of cellular disease or disorder could be induced in targeted cells by novel EM radiation emitted from diseased or damaged cells. Apparently no one in the West deciphered the mechanisms involved in Kaznacheyev's epochal work.

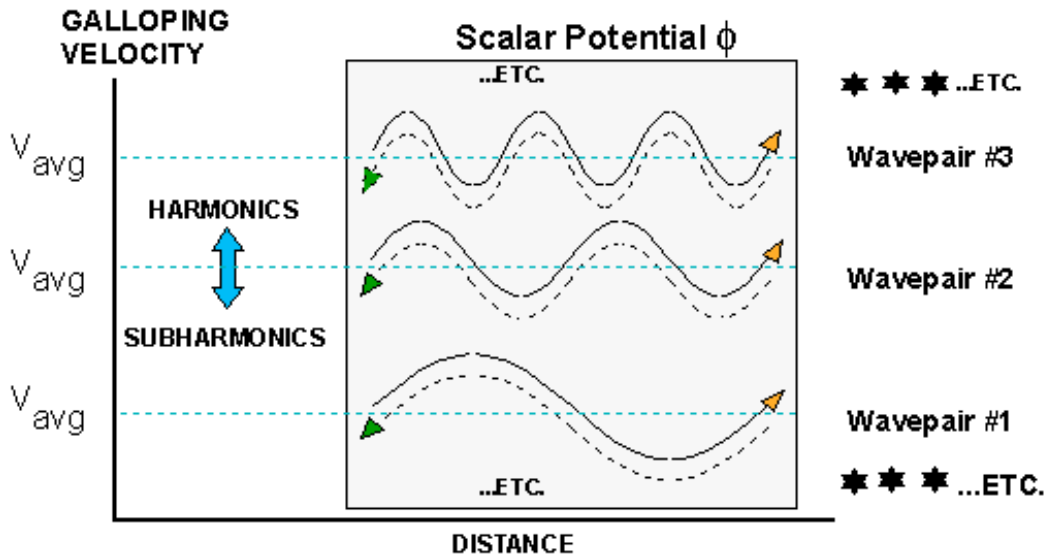

The Structure Is:

- A harmonic set of longitudinal phase conjugate wavepairs.
- In each wavepair the two waves superpose spatially after detection, but travel in opposite directions.
- The convergent wave set is in the imaginary plane, and hence is not observable. It is EM energy incoming to the potential (dipolarity) from the time domain.
- The charge's spin is 720 degrees, 360 in the real plane and 360 in the imaginary plane.
- Hence the charge receives the complex convergent EM energy, transduces it into real EM energy, and emits enormous energy at the speed of light in all directions -- which includes bidirectional pairs in 3-space (after the reaction, being after "observation").
- This produces the fields and potentials from the "source charge or dipole."
- Mandl and Shaw argue that the scalar (time-polarized) photon and longitudinal photon are observable only in similar pairs, which then makes the instantaneous scalar potential. Thus their quantum field theory work strongly supports the "negative resistor" interpretation of the scalar potential and our solution to the source charge and source dipole problem.

Figure 9. Infolded longitudinal biwaves (time-polarized EM waves)

composition of a scalar potential.

The Present Situation in Western EM Bioeffects Research

Our scientific community has not even *designed physical experiments* to validate long-term EM bioeffects of the kind caused by induced wave transductions and long-term effects inside the absorbing human cells and in the body's regenerative and immune systems. Western science has no knowledge of these technical internal "wave polarization transduction" mechanisms. Yet the basis for such mechanisms has existed in the hard physics literature for decades. Leading EM bioeffects researchers seem totally unaware of small reaction cross sections inside the body cells and tissues for the transduction of transverse EM signals into LW and t-polarized EM signals. Conventional Western researchers have not investigated it, and often will not believe it when it is pointed out to them along with the supporting basis in the literature.

A major part of the mainline "EM bioeffects" community, of course, seems comfortably funded largely by the power industry etc.[11] The record is clear that this dominant, well-funded group has little or no intention of "finding" anything that will question powerline radiation safety and upset their cushy positions.

In fact, leading bioeffects researchers have pointed out this deliberate biasing of EM bioeffects as a research area. Quoting Dr. Andrew A. Marino, one of the great pioneers in the area of EM bioeffects[10] and powerline radiation assessment.[11]

"Neither scientists nor the public can rely on power-industry research or analysis to help decide whether powerline electromagnetic fields affect human health because power-industry research and analysis are radically misleading."

Dr. Marino then gives the specific details to prove it, and he shows specifically how they slant and mangle their experiments and interpretations of the results, to do it. If the major financial interests cannot *scientifically* destroy determined, honest researchers such as Marino and Becker, they do not hesitate to attempt to destroy them in lawsuits.

The "Diffusion Mixmaster" at All Body and Cellular Levels

Every mass and all its particles are in a violent energy exchange with the active vacuum. A human body and every part of it is in a continual exchange of EM energy with its environment(s), including transverse, longitudinal, and t-polarized (scalar) EM energy exchanges. Further, within the dielectric body there is a sort of intensive "diffusion" of special kind, actually due to iterative phase conjugation and iterative interferometry of the dense signals environment impinging upon it. This internal "diffusion" and transduction (iterative multiwave phase conjugation and iterative multiwave interferometry) thoroughly "mixes up and transduces" one type of EM wave or signal into the other, including many of the body's own TW, LW, and TDW signals.

Continual or sustained TDW exposure (irradiation by t-polarized EM waves) charges the body and its particles with time-excitation charging, something which has been erroneously omit-

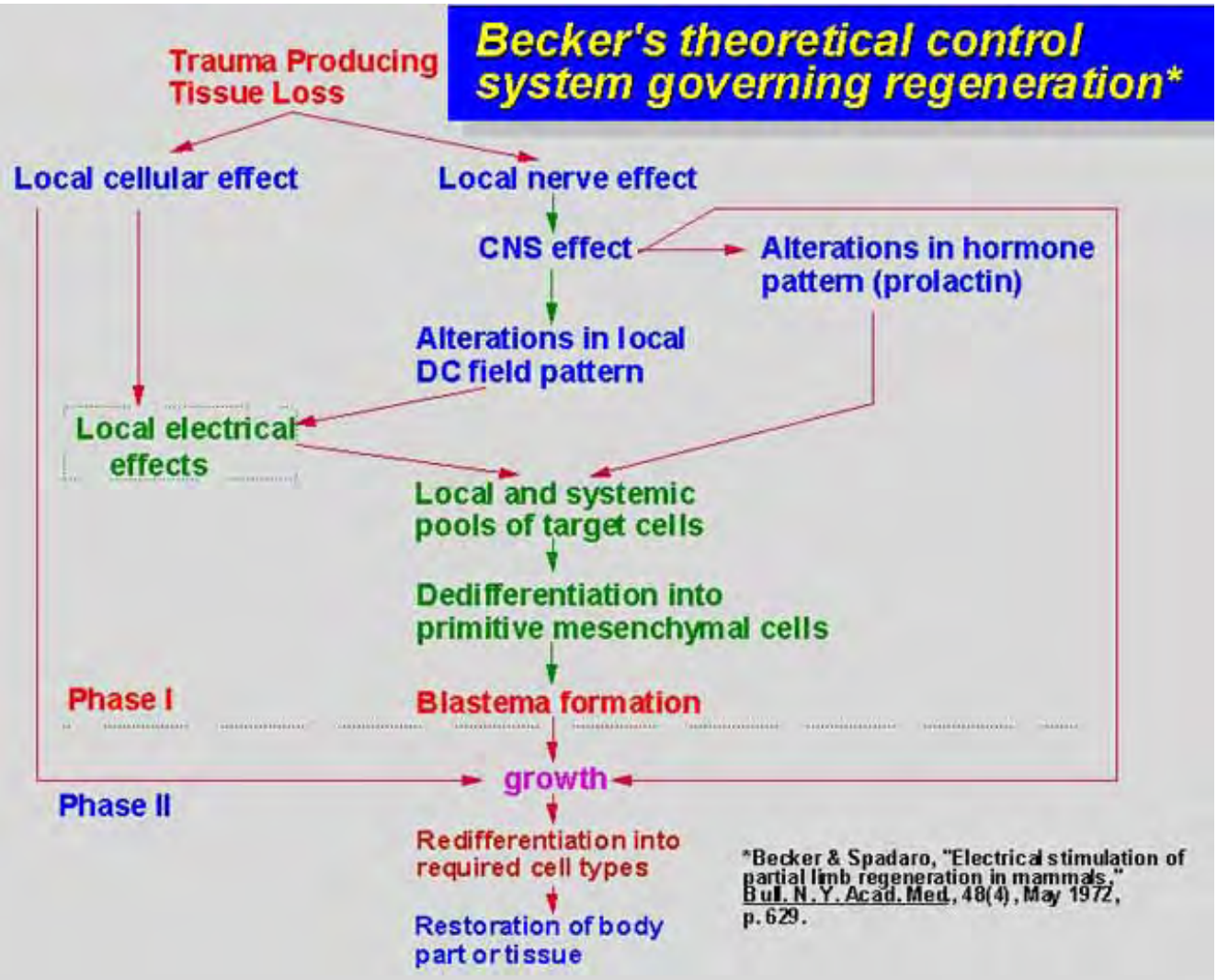

Figure 10. Becker's model of the Regenerative system of the body.

ted in physics, but is true nonetheless. Inexplicably, physicists just ignore what happens time-wise when a mass absorbs a photon. We have covered that elsewhere.

So inside the body dielectric, there is a "diffusion mix" correlate of any and every type of the waves, to any or all of the exchanges, plus the additional internal interactions of the body in its TW, LW, and scalar EM wave transductions. There is a one-to-one correspondence to any one of the three types of polarization waves (transverse, longitudinal, and scalar) and everything going on anywhere in the body.

Note that the type of LW we are using is actually made of phase conjugate pairs of transverse EM waves, so its "photons" are made of photon/antiphoton pairs. That is, our longitudinal EM wave has an internal TW structure, and the LW wave is comprised of spin-2 *gravitons*. Our longitudinal EM wave has an internal structure, and it dramatically differs from the LW used by the U.S. scientific community which ignores wave, field, and potential infolded substructures. Our LW (which seems to be what the Russians use) is also a gravitational wave because it is comprised of oscillations in its distributions of spin-2 photon/antiphoton pairs (i.e., *gravitons*).

The type of t-polarized (scalar) EM wave we are using is a phase conjugate coupled pair of the specialized electrogravitational (EG) LWs. The "t-polarized photons" comprising this t-polarized "EM" wave are comprised of spin-4 *supergravitons*. These are, I believe, what the KGB energetics weapons scientists use also. By iteration, we can go into as deep an internal multilevel structuring of EM and EG waves, of any type, via methods shown by Whittaker.[12]

Now let us examine a body as a dielectric, sitting there in its exchange, in relative equilibrium. It turns that every tiniest piece of a dielectric participates in any emission from it[13]—even the emission of a single photon, graviton, or supergraviton. Well, it *would* so participate, due to the special sort of correlated diffusion and interferometry and phase conjugation that we pointed out. Anything that escapes (is re-emitted) from the body, has been through this "diffusion wringer". It has escaped from each and every internal part of the body.

Novel Signatures in Body-Emitted EM Radiation of Any Polarization

A single photon or wave emitted from a dielectric carries in its internally structured time component a *template* of the exact internal time structuring of every part of the dielectric emitting that photon. It carries in its internally structured energy component a *template* of the internal energy structuring of every part of the dielectric emitting it. An emitted EM wave, being a collection of emitted photons and photon structures, thus carries the same internal structuring of both its transported energy and its transported time.[14] Western scientists do not use the internal

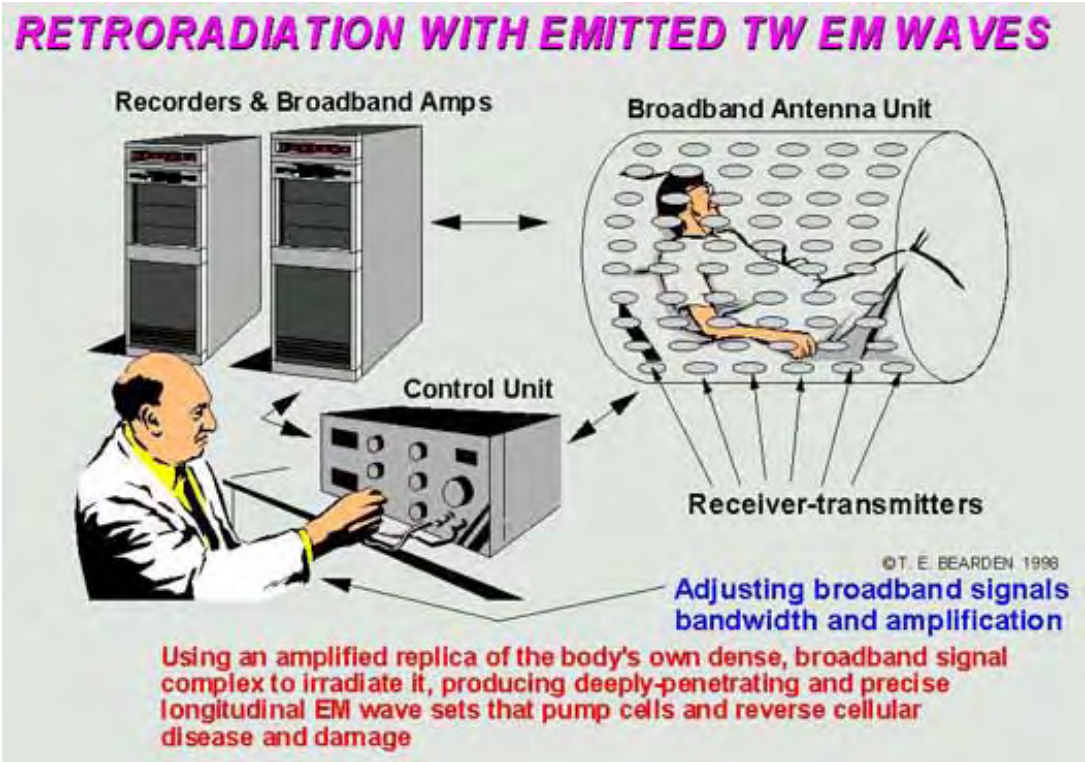

Figure 11.

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structuring of photons and EM sine waves, have no instruments for that, and so do not know it. The Russians know it,[15,16] use it, and have developed sophisticated instruments for it for the last 30 years or more.

Shortly we will postulate how conventional scientists experimenting with mind and behavior control electromagnetically might utilize an immediate consequence of the fact that the specific emission from a body at any time—whatever type of wave component we look at—is a total correlate to all that body's internal functions, its energy exchanges with its environment, its states, its mental states and conditions, etc.

And we accent that the coherently integrated intent-changes in that body from its coupled mind's operations are also in the substructure of photons and EM waves emitted from the living body into its environment.

How Western Mind Control Scientists Might Proceed

Conventional scientists would ignore scalar photons and waves, determine the TW spectrum, and then slowly and painfully correlate that to the various physical, mental, and emotional things. That's the way they would *have* to do it, since apparently they use only standard electrodynamics. They can in fact do this via brute force, because that emission TW spectrum is of waves escaping from the entire "diffusion machinery" mixmaster in the body dielectric. It does contain all those integrated *mind-intent* 3-space correlates as well as the ordinary body 3-space energy correlates.

Anyhow, in envisioning Western procedures, the test body would be sitting there, in its normal (let's say fairly normal and quiet) EM environment. [See *Figure 11*] Let's assume this body is not sick, but is healthy and normal. Its emissions are a part of its equilibrium condition. It follows that the totality of its TW emissions is correlated to the sum total of everything that interacted with the body, plus its own internal reactions, including from mind-body coupling. Indeed, everything that has ever happened to that entity—physically, mentally, emotionally, etc.—has internal correlates infolded inside the emitted transverse EM wave spectrum.[17]

So first the scientists would simply measure the full environmental TW spectrum down to very tiny levels in all frequency bands possible—everything that is coming in to the body from its environment. They would probably perform the experiments in a triply-shielded Faraday cage, so the external environment outside the cage contributes very little transverse EM wave noise (perhaps some Schumann resonance). Magnetic wave shielding and ELF shielding is something else again, and longitudinal EM wave shielding is in general not possible unless longitudinal EM waves are employed in the shielding. But a "quiet external TW environment" enhances the isolation and measurement of the specific TW signal transforms the Western experimenters would be seeking.

Then they would measure everything likewise that the body is *emitting* when in that environment. That is the "zero reference" or "normal reference" level. They would measure every aspect: frequency, amplitude, phase, wave shape, modulation, etc.

Probable Experimental and Measurement Techniques

Next they would selectively irradiate the body with specific signals, frequencies, waveforms, etc. They would begin by using portions of the same frequencies that are being emitted from the body in the "zero reference" environment. They would insure that the returned signal was of higher amplitude than the usual signal being emitted by the body at that same frequency and type.

They would consider the body dielectric as a "ship with portholes". Light (EM transverse wave energy) coming out of the portholes has originated and adapted from everywhere inside the ship and its operations. When the experimenters reinsert energy through one or more portholes, they are interested in determining precisely which operations inside the ship are affected. So the body physiological functions are also heavily instrumented.

By feeding back in the exact EM pattern and magnitude escaping the body dielectric through a single porthole, one "nullifies" that part of the emission by producing a net equilibrium in that component. This will in turn produce changes elsewhere in the spectrum emission from other portholes, and this can be measured. It will also produce "stress changes" in specific portions of the body dielectric, and in the heavily instrumented body these physiological, chemical, electrical, etc. changes can also be detected. Monitoring of the skin conductance, e.g., indicates the level of stress, and EEG monitoring with sophisticated instrumentation can indicate something of the brain wave states.

In short, the necessary measurements from which to construct specific correlates can be performed, recorded, and later analyzed.

This article will be concluded in Volume 9, #4 with Improving the Methodology, Further Phenomenology Experiments, Rejuvenation and other matters. ◆

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President and Chief Executive Officer, CTEC, Inc. Lieutenant Colonel U.S. Army (Retired). MS Nuclear Engineering, Georgia Institute of Technology. BS mathematics, Northeast Louisiana University. Graduate of Command & General Staff College, U.S. Army. Graduate of Guided Missile Staff Officer's Course, U.S. Army (equivalent to MS in Aerospace Engineering). Numerous electronic warfare and counter-countermeasures courses.

Tom is the leading advocate of scalar potential electromagnetics and the Fogal charge-blocking semiconductor. He is involved in alternate energy devices and scalar electromagnetic system prototypes. He has defined charge q as a coupled system of two components, advanced a mechanism for a vacuum engine, whereby the vacuum's virtual particle flux is organized and used to energetically shape and manipulate matter and energy, and advanced a mechanism for a Bohm-type quantum potential, which theoretically allows the engineering of action at a distance in physical systems.

He is president of the Association of Distinguished American Scientists (ADAS), a life member of the Alabama Academy of Science, Emeritus member of the American Association of Physics Teachers, and has served on the Board of Directors of several associations and corporations. Tom is a guitarist, a retired aikidoist (Sandan, Yoseikan style), is happily married and has two sons and two daughters. He and his wife Doris live in Huntsville, Alabama where Tom is retired from aerospace, continues private research, and serves as a consultant to industry on Scalar electromagnetics processes.

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1. *In fact, it simply applies in the laboratory that method that is already used by species for the so-called "directed evolution" component of evolution. The exact mechanisms for directed evolution also arise naturally in the new approach. Directed evolution is required; e.g., no reptilian species could have evolved slowly into a bird. As it started slow changes, it would have not been able to fly or to run, and would have been simply destroyed immediately by predators. Instead, such evolution occurs in a single jump in a species hard-pressed for a lengthy period. In the evolution of birds, one day every reptile egg that hatched, now hatched into a complete and functional bird with light bones, feathers, etc. A continuing debate (with perhaps more emotion than science) continues to this day on directed evolution. But it is real, and the mechanism can readily be generated (we've already done the gist of it).*

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3. *With novel use of EM time-energy to curve spacetime, the physical actions of the "placebo effect" are due to the use of such "spacetime curvature engines" to produce actual physical effects—at least temporarily —in the cells and throughout the body's chemistry, physiology, etc. Experimental detection of these physical effects are well-established in the orthodox medical literature.*
4. *For example, see particularly R. O. Becker, "The direct current field: A primitive control and communication system related to growth processes,"* Proceedings of the. XVI International. Congress of Zoology, *Washington, D.C., Vol. 3, 1963, p. 179-183;—"The direct current control system: A link between environment and organism,"* New York State Journal of Medicine, *Vol. 62, 1962, p. 1169-1176;—and D. G. Murray, "A method for producing cellular dedifferentiation by means of very small electrical currents,"* Trans. N.Y. Acad. Sci., *Vol. 29, 1967, p. 606-615;—and Joseph A. Spadaro, "Electrical stimulation of partial limb regeneration in mammals,"* Bulletin of the New York Academy of Medicine, *Second Series, 48(4), May 1972, p. 627-64.*
5. *E.g., a popular discussion is given by John Travis, "Starting Over: Some Animals can regenerate limbs or even most of their bodies. How?"*, Science News, *152(18), Nov. 1, 1997, p. 280-282. For a typical technical paper, see Jeremy P. Brockes, "Amphibian limb regeneration: Rebuilding a complex structure,"* Science, *276(5309), Apr. 4, 1997, p. 81-87.*
6. *I have one viewgraph which lists those 32 major flaws in electrodynamics. Further, leading theorists (Evans, Crowell, and others) in the Alpha Foundation's Institute for Advanced Study (AIAS)—of which I am a Fellow Emeritus by AIAS's kind tolerance—have added about another very technical and very fundamental dozen or so errors to my own list. A leading foundations scientist with over 500 papers in the literature commented dryly to the AIAS that "I broadly agree. that the transverse plane wave view of vacuum electrodynamics is the biggest blunder of twentieth century science. Faraday visualized that "EM disturbances" surrounding wires, magnets, etc. were simply the transverse plucking of taut strings. As he states in his book, Maxwell—who also firmly believed in the material ether—simply captured Faraday's thinking and assumed that transverse "plucked string" wave disturbance in the material ether. At the time all this was expressed, the electron had not been discovered, the atom had not been discovered, the molecule was a featureless blob, and no one had the slightest notion of an atomic nucleus filled with protons and neutrons. Charge was simply a "certain volume of electric fluid" and everything electromagnetic was expressed in fluid dynamics. As an example, that "material fluid" and "material ether" theory was destroyed in the late 1880s by the Michelson-Morley experiment. All the Maxwell equations assume that material ether to this day; not a single equation was ever changed to eliminate the material ether assumptions during the last 110 years.*
7. *For full explanations of the "Moscow Signals," see T. E. Bearden, .,* Gravitobiology: A New Biophysics, *Tesla Book Co., P.O. Box 121873, Chula Vista, CA 91912, 1991;—*AIDS: Biological Warfare, *Tesla Book Co., 1988. For an excellent Government study of the Embassy radiation by excellent but orthodox Johns Hopkins scientists, see A. M. Lilienfeld* et al., Foreign Service Health Status Study: Evaluation of Health Status of Foreign Service and Other Employees from Selected Eastern European Posts, *Department of Epidemiology, of Hygiene and Public Health, The Johns Hopkins University, Baltimore, Maryland, Final Report, July 31, 1978. On p. 245, it is noted that a marked excess of symptoms were noted in the Moscow employee group as compared to other East European employees in other East European nations.*
8. *Johns Hopkins researchers established the exact field patterns present in the Embassy from the microwave carrier radiation; see Robert C. Mallaliew,* A Model of the Microwave Intensity Distribution within the U.S. Embassy, *Moscow 1966 to 1977, Report FS-80-166, Applied Physics Laboratory, Johns Hopkins University, Aug. 1980. Nowhere in any of the Government-funded studies is there any consideration of field-free scalar potentials and their internal time-polarized EM wave structures (the bidirectional phase conjugate wavepairs shown by Whittaker to comprise the scalar potentials). Yet the field radiation patterns surprisingly showed that in just such field-free, persistent potential zones was where 100% of the health changes occurred.*
9. *Vlail Kaznacheyev and L. P. Mikhailova,* Ultraweak Radiation in Intercellular Interactions, *[in Russian], Novosibirsk, 1981 [an English exposition of much of the Kaznacheyev work is given in Vlail Kaznacheyev, "Electromagnetic Bioinformation in Intercellular Interactions,"* Psi Research, *1(1), Mar. 1982, p. 47-76.]. See also Vlail Kaznacheyev* et al., *"Distant intercellular interactions in a system of two tissue cultures,"* Psychoenergetic Systems, *1(3), Mar. 1976, p. 141-142. In the same issue, see "A Comment" by William A. McGarey, p. 143; "A Comment" by Arthur C. Hastings, p. 143-144. See also Vlail Kaznacheyev, "Apparent information transfer between two groups of cells,"* Psychoenergetic Systems, *1(1), Dec. 1974. The Soviet Union awarded Kaznacheyev a very high medal for his achievements.*
10. *For a very nice summary of EM bioeffects from the more conventional view, see Robert O. Becker and Andrew A. Marino,* Electromagnetism and Life, *State University of New York Press, Albany, 1982. The book is also available at http://www.ortho.lsumc.edu/Faculty/Marino/El/ElPub.html.*
11. *Andrew A. Marino,* Powerline Electromagnetic Fields and Human Health, *http://www.ortho.lsumc.edu/Faculty/Marino/Marino.html. This book is highly recommended. Particularly see "Chapter 5, Blue-Ribbon Committees and Powerline EMF Health Hazards," and "Chapter 6: Power-Industry Science and Powerline EMF Health Hazards." Biophysicist Marino is one of the leaders in the field and has been personally involved in many skirmishes with powerline-dominated studies and findings.*
12. *E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics,"* Mathematische Annalen, *Vol. 57, 1903, p. 333-355; — "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions,"* Proc. Lond. Math. Soc., *Series 2, Vol. 1, 1904, p. 367-372.*
13. *Reali, G. C., "Reflection from dielectric materials,"* American Journal of Physics, *50(12), Dec. 1982, p. 1133-1136. The reflected field from a dielectric material is not generated just at its surface but comes from everywhere in the interior of it.*
14. *Present physics models the EM wave as transporting energy, but erroneously omits that it also transports time. A photon is made of angular momentum, or "energy x time". Since EM waves are made of photons, it follows that they transport both the energy components and the time components making up those photons. An EM wave is a wave of angular momentum, not just a wave of energy.*
15. *KGB energetics weapons scientists call this internal structuring the "information content of the field." However, the Russians use a good deception plan, which implies that the "information content of the field" is just the normal transverse EM spectral content of EM signals. Appreciable "pertinent" work using that phrase is produced by the open Russian scientific community, thus confusing the issue. Our electrodynamicists seem to buy it hook, line, and sinker. The deception plan also tricks Western scientists into thinking that psychoenergetics is nothing but a Russian version of Western parapsychology. Again, our scientists comfortably accept this with smug satisfaction.*
16. *Presently the Russians are in a great new version of this deception plan, with the goal of deceiving Western scientists into thinking that the "secret" Russian energetics is based on torsion fields. Consequently they are releasing substantial material on torsion wave theory, including replicable experimental results. The released version of torsion fields has one glaring omission: the time components and structuring. This deception plan is excellent, because the torsion field theory that is released, is indeed "real" and testable. It is also revolutionary, with respect to present Western science. It almost positively assures diverting the attention of much of the Western science community into this highly limited subset of the full Russian torsion theory—effectively diverting the West away from psychoenergetics and the direct use of t-polarized EM waves and fields, torsion or otherwise.*
17. *We point out that E. T. Whittaker, in "On the Partial Differential Equations of Mathematical Physics,"* Mathematische Annalen, *Vol. 57, 1903, p. 333-355, showed that every scalar potential is comprised of an internal structure of bidirectional longitudinal EM phase conjugate wavepairs in an infinite set of harmonics. Each of those phase conjugate longitudinal EM wavepairs comprises a time-polarized EM wave. So the common potential contains an internal longitudinal EM wave structure that is further organized into an internal time-polarized EM wave structure. The mind-intent correlates and the total mind and emotional experience correlates from fertilization of the egg that led to development of that person, is in the internal substructure of every potential in the living body. In his "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions,"* Proc. Lond. Math. Soc., *Series 2, Vol. 1, 1904, p. 367-372, Whittaker also showed that any EM field or wave is comprised of two scalar potential functions. It follows from Whittaker and Reali that the EM emissions from the living body carry the internal correlates of everything that has been experienced by that person from conception in the womb. Sometimes this deep embedded "hidden information content" can even be accessed in deep hypnosis. I once observed the deep hypnotic regression of a subject back to her prenatal experiences prior to birth, where the subject relived hearing words of rejection by the father, before the subject was born. The occurrence of the incident and the father's words were directly confirmed on the spot by the mother, who was closely observing the session as it occurred. It turned out that this particular rejection of the baby still in the womb had played a major role in subsequent deep psychological problems experienced by that person all her life. To resolve the problem, use of a powerful "simulated" reliving pre-birth experience was conducted with the subject again in the pre-birth state and actively participating, but now with the father figure directly expressing love, acceptance, and cuddling and hugging his daughter. This led to a rather dramatic remission of most of the deep psychological problems within 24 hours.*

Mind Control and EM Wave Polarization Transductions, Part 3 of 3

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This outstanding article is the last, Part 3, Part I and 2 of which were published in Volume 9, #2 and #3 of Explore! for the Professional. Because we feel that Col. Bearden's Special Note below is so very important we are repeating its publication in all 3 parts of this article.

Special Note

This article refers to experimental research techniques which can be detrimental or lethal in the hands of any but highly skilled, qualified experimental scientists proceeding under proper laboratory safety procedures. The purpose of this article is strictly for information to properly qualified and authorized scientists in certified laboratories. We do not propose or condone any use of these procedures for nonapproved practice of medicine without a license. Neither the publisher nor the author are responsible for accidents or outcomes in the use of these experimental procedures and techniques. Any researcher who performs these procedures and experiments is acting on his or her own volition, and is solely responsible for insuring safety, qualifications, and legality of the acts and their results. We neither suggest nor condone unauthorized experimentation on human subjects. Such is a criminal violation of the constitutional rights of the subject under Federal and State laws, and achieving many more effects in the targeted bio-organism or groups of them. With Hunt's method, the system as an open dissipative system far from thermodynamic equilibrium in its environment is being measured as such. This more directly allows for determination of the environmental inputs on a much broader range of subsystems, both space-like and time-like. Particularly for mental and emotional correlates to environmental stimuli, such measurements and correlations are essential.

More Comprehensive Phenomenology Experiments

To return: Now the scientists would perform many phenomenology experiments, making one little change at a time and profusely recording the data. Each time, they would establish the physical change(s) that occur in the body and/or the mental and emotional changes that occur in the mind for each spectral reinsertion back through the "ship's portholes". They would simply but painstakingly (over some years) build up an extensive database of those individual correlates.

In these experiments, the experimenters will eventually be able to provoke any body or mind change they wish. Strong emotion. Intense pain. Intense pleasure. Painful thoughts. Images. Memories.

is both illegal and immoral.

Two Ways to Improve the Methodology and Experimental Correlates

We diverge momentarily: If they wish to improve this methodology, they will consider the body dielectric as a nonlinear isotropic medium. Then they will pretend that the spectrum of difference frequencies between each two adjacent waves is the spectrum of "emissions" from the body. They would also use those, as if they were actual emitted spectral signals, instead of the actual signals emitted. That procedure will give superior correlations, but it is more complicated. Part of that is known for underwater sonar,[1] and so our own scientists may or may not have realized it for use in mind and behavior correlate determination with respect to the body dielectric.

Another dramatic improvement in the depth to which the correlates can be constructed, is provided by detecting each porthole output in a two-channel device, where one channel has an adjustable time-delay as utilized by Dr. Valerie Hunt.[2] The two channels—one real-time and one slightly delayed—are then mixed, as by Hunt's method, producing an instrumental measurement of the chaotic part of the functions. Again, this can be measured, recorded, and later analyzed. It adds (i) a completely different kind of thermodynamics in the system measurements, (ii) a dramatically extended set of correlates, (iii) more direct measurement of the time-polarization causative signals, and (iv) an applications technology eventually having many additional degrees of freedom and therefore capable of Perceptions. Dreams. Visions. Memory losses. Memory changes. Personality changes. Etc. The "delta" in the emission spectrum (the changes from zero reference spectrum) represent the precise totality of all mental, physical, organic, chemical, etc. changes and interactions.

A particularly vulnerable aspect of every mammal is the pleasure center in the brain. Experiments have shown that, when this center is stimulated, it is the most addictive experience possible. Rats will forego food, endure electrical shocks, starve, and even die to obtain stimulation of this center. Obviously a device capable of generating signals that evoke direct stimulation of the pleasure center in humans would be a powerful weapon.[3]

Extending the Data Base

See Figure 12. After the researchers have made an "individual porthole signal insertion" correlate database, then they would make a "two, three, four," porthole signal insertion correlate database by inducing selected multiple changes at once. Again they would analyze everything; the program would need one or more supercomputers. It would also require quite a highly qualified multidisciplinary team, extensive facilities, substantial funding, and would be many years in duration. We are describing a decades-long program. But it's a doable.

With sufficient development and performance of such a program, the researchers would have produced (with sufficient testing and analysis, and sufficient retest validation and verification) a database of "specific correlates for a given overall desired physical, mental, or physical and

mental delta."

A second stage in the research would be to test the correlates and porthole insertions upon a statistically significant cross section of ordinary people, and/or specialized populations (such as toughened soldiers). The program would evolve a highly complex, very effective, ever-improving science and technology of mind and behavior control and engineering mechanisms, complete with finished database and developed applications equipment.

The Dielectric Body as a Ship With Portholes

Again let us review what the EM transverse wave irradiation from the body dielectric represents. Think of the body dielectric as a sort of "ship", with lots of portholes. When it gets irradiated, certain operations happen internally to that radiation, i.e., certain "processes" and "interactions" occur, which change both the mental and physical states. The output emissions back from the body dielectric, out through the filtering "portholes", will directly correlate to what has happened inside the ship.

It is terribly important to realize that one can use the same frequencies and spectra coming back out of those "portholes" to insert EM signals and waves etc. back in there, and into the deepest processes going on in the body and in the mind (at all levels, including the deep unconscious). times. So it will reach directly into and affect any and every part of the dielectric, as you wish, and in whatever manner you have correlates for.

We filed an invention disclosure[4] on the above correlate and "back-porthole" process for use in directly inducing full and efficient conversion directly to time-density (scalar, or time-polarized) EM waves inside the body/ cells, therefore immediately and directly time-excitation charging the body cells and all their internal components.

Subtracting the Normal Correlates to Obtain the Deltas

A specifically diseased body, e.g., has a specifically tailored change in its "normal" emission spectra, because of the disease condition alteration of its resident spacetime curvature engine. By having a database for the normal emission spectra of the healthy body, one can subtract it from the actual emitted spectra, to obtain the "delta spectrum".

If the correlates have been previously determined by the above mentioned research program, then one may simply introduce an amplified "delta spectrum" into the body, i.e., through the portholes. This will immediately time-excite the cells and their components throughout the body, particularly where that disease does exist. It turns out that the time-excitation charging by that method will "pump" those diseased cells in the time domain. The cells themselves (and all their parts) are highly nonlinear—to time-excitation

Remember, whatever you put back in there, is going back through the "mixmaster" hopper. It will be iteratively phase conjugated and interfered with by everything, countless charging, they are totally nonlinear. So they will act as rather perfect pumped phase conjugate mirrors, but pumped in the time-energy domain rather than in the spatial

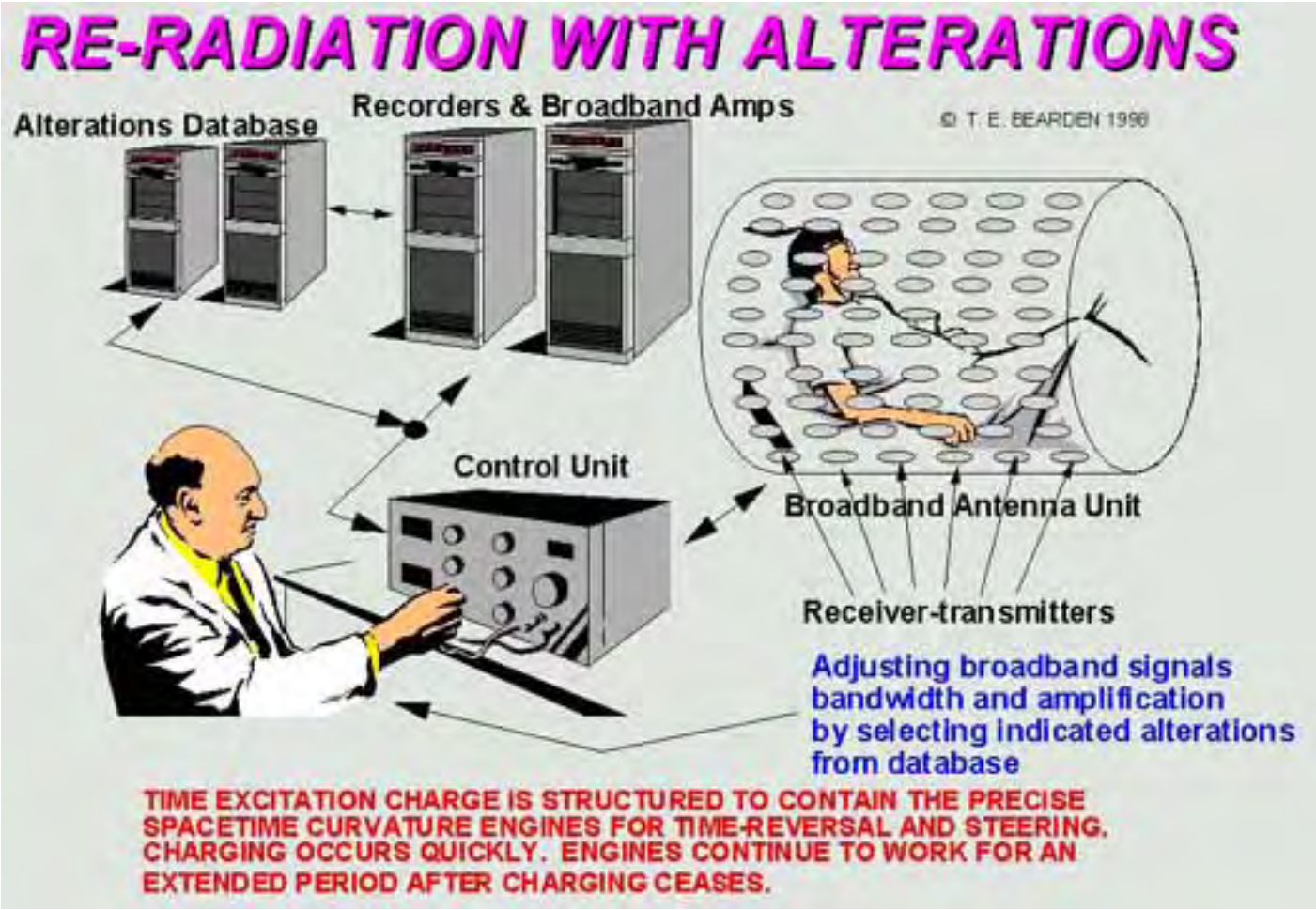

Figure 12. Using an amplified replica of the body's own dense, broadband signal complex, containing added alterations, to irradiate the body and produce deeply-penetrating precise time-density charging for cellular time-reversal while steering the time-reversal trajectory to also correct a congenital condition.

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energy domain. This is a dramatic extension to nonlinear phase conjugate optics theory.[5]

General relativity tells us that each specific detail of the mass and energy structure of each cell and all its parts—down to the finest details—is accompanied by a precise set of spacetime curvatures. By reintroducing the same energy as the disease delta TW waves, the affected cells add the phase conjugates, converting the inserted TW signals into longitudinal EM wave signals. The longitudinally-pumped cells again phase conjugate, converting these longitudinal EM waves to time-polarized EM waves, and "charging" the cells and all their parts in the time domain.

Suddenly, at that point the resident spacetime curvature engine—rather than TW or LW EM waves-serves as the "input signal" to the cell-and-its-parts as pumped phase conjugate mirrors (PCMs), pumped in the time domain. An extension to the distortion correction theorem of nonlinear optics results. An exact, amplified antiengine for the diseased cells—i.e., a phase conjugate replica of the resident spacetime curvature engine—is formed. This amplified antiengine overpowers the resident disease engine, powerfully time-reversing the cells and their components back to a previous healthy state. The time-reversal actually occurs over a period of time after the "time excitation charge-up" ceases, say over the next week or two. Usually two to three quick irradiations are required, one week apart, to give a time-reversing period of three to four weeks.

Even though appreciable forces are operating internally upon the cells and all their parts, there is no net translation force upon the cells or any part. E.g., as Pepper[6] states,

"On a more fundamental level, the ideal lossless PCM reverses all the quantum numbers of the incident photon (i. e., linear momentum, angular momentum, etc.). It can be shown that the PCM therefore experiences no linear or angular momentum transfer from the incident photons; hence, the PCM is free from photon radiation pressure and torques."

Note that, in ordinary EM theory, it is precisely translation forces that are engendered upon charged mass by EM fields. This process is quite different. In biological terms, this process dedifferentiates (in physics: time-reverses) the diseased cells and all their components—including the genes—back to an earlier healthy state.

By taking a diseased body and feeding back into it an exact amplified replica of its emitted TW spectrum, one can force the body to "time-excitation charge" all cells and their components immediately, with high efficiency. The human body and every cell and every part of every cell does the necessary "calculation" for the exact antiengine for each part. Since time is extremely condensed spatial EM energy (by a factor of almost 10^{17}), a startling contraction occurs in the radiation time required to time-charge the cells and their components and charged particles. This is a method for instant initiation of time-charging, hence it is extremely rapid. What took Priore several hours of LW irradiation to accomplish in the body,[7] can now be done in seconds with this "thwarting" and spectrum transduction method. In fact, it is an intense stress on

the body, and—say—should only

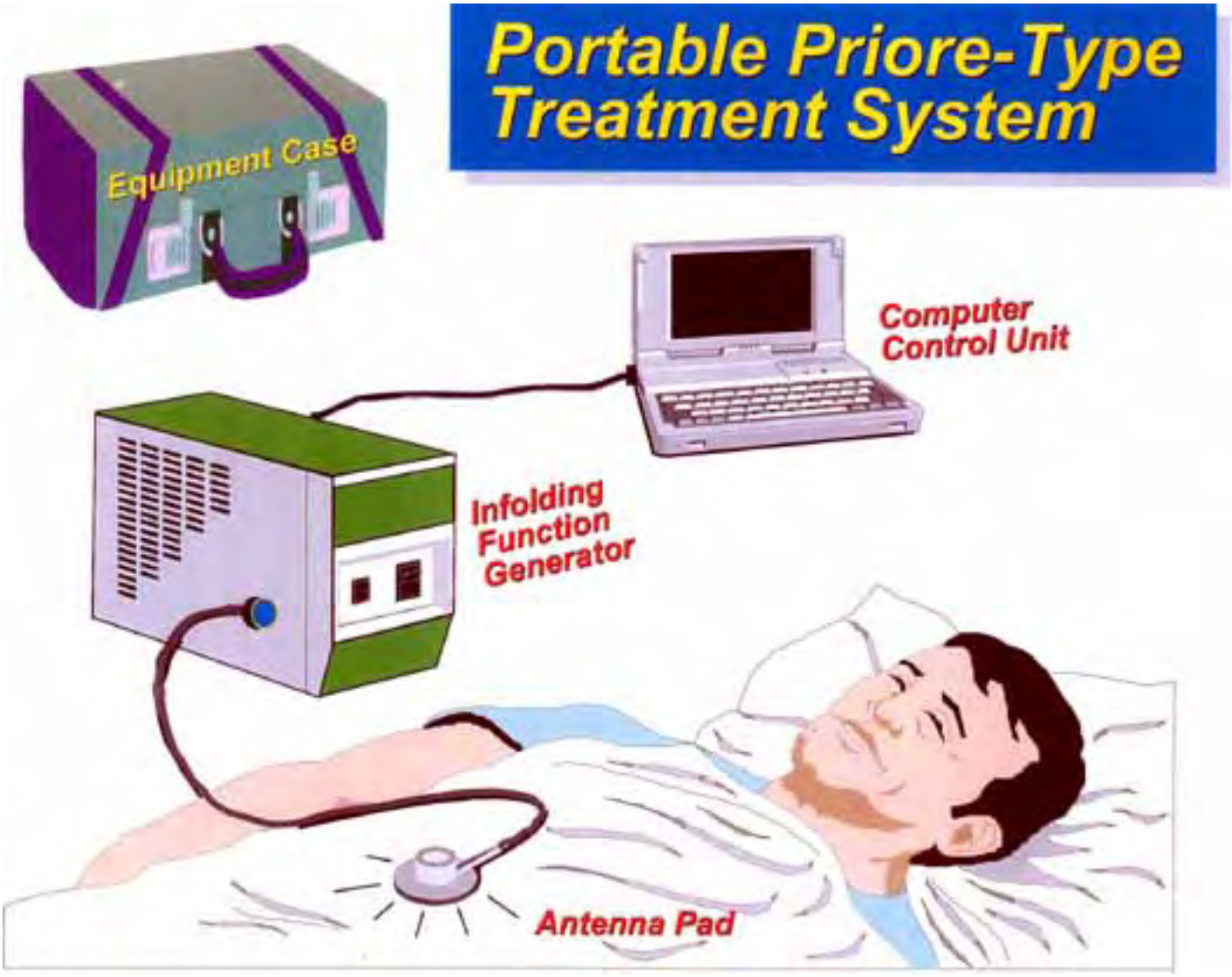

Figure 13. Portable first-method treatment unit proposed to the Department of Defense. For treating and curing mass casualties from terrorist BW attacks on U.S. population centers.

be continued for 30 seconds or so. We highly stress that overcharging in this time domain can be detrimental or even lethal if prolonged.

At the end of the very short time-excitation charging time, the body is "time-excitation charged in all its minutest particles". So everything is therefore pumped in the time domain for the next several days after the irradiation is removed, since the time-charge decays very gradually over a period of time. During that decay period, every part of the cell and body acts as a pumped phase conjugate mirror material, pumped in the time domain rather than in the 3-space energy domain. When time-pumped, the mass itself reverses to a previous physical state. This can be used for both nonliving and living masses. Because there is no forcible translation manipulation of the cells and their parts, it can be utilized on living cells in vivo. In the case of diseased cells—e.g., AIDS-it appears that three precisely determined 30-second "AIDS correlate" irradiations a week apart, should be sufficient to completely cure AIDS, including removal of all HIV-genetics changes from every previously infected cell of the body. Also, it would accomplish considerable rejuvenation of the body (making the body younger).

Rejuvenation: Restore the Telomeres and Produce Immortal Cells

Saving Most of the Casualties from Mass Terrorist Attacks

To defend against things like anthrax attacks on our civilian population centers, we also have recommended to the U.S. Government the crash development of small, portable treatment machines—using similar "antiengine-forming" and cellular reversing "porthole technology". [See Figure 13 on previous page]. Such portable machines could be developed cheaply and quickly, and present government facilities could be used to massively attack the correlate database production problem. The portable treatment units could be cranked out by the hundreds of thousands and flooded down through emergency response agencies such as the police forces, the National Guard, emergency hospitals, emergency response teams, etc.

Each device could be used in "assembly line" fashion upon hundreds of sickened patients, in case of a WMD (weapons of mass destruction) attack upon one or more of our cities. The first generation equipment would save probably 70% of the stricken (as from anthrax, etc.). With second generation equipment, one would expect 90% of the stricken casualties could be saved.

Just now, there is a very dim prognosis for all those casualties, using present available treatment capabilities. Time and lack of vaccines defeats just about everything that can be done. Brutally speaking, most of those unfortunate enough to breath in anthrax spores from an

In fact, it is now known that the gradual loss of the telomeres—the natural ends of chromosomes—in a cell's chromosomes is what causes the cell to age. The gradual loss of the telomeres and the resulting shortening of the chromosomes represents a cellular "disease state" or "disorder" state" accompanied by a precise delta in the spacetime curvature engine accompanying every affected (aging) cell.

By determining the correlate for that precise telomere loss in the aging body's emitted radiation spectrum, an effective telomere regeneration process immediately emerges. One simply amplifies that aging "precise telomere reduction" correlate and reradiates the body with it, passing an amplified correlate back into every cell of the body. The cells and all their parts—including the chromosomes—add the phase conjugate replicas, converting the incoming TW EM correlates to longitudinal EM wave correlates. The cells again phase conjugate the LWs and add the phase conjugate replicas, converting the LW correlates to time-polarized EM wave pumping correlates. This latter process time-excitation-charges the aging cells and all their parts, including the genes and chromosomes. The cellular matter itself produces the amplified "aging antiengine" for each and every cell and telomere ending. The result is to again add telomeres, converting the cell back to a younger, more vigorous cell, and reversing the process of aging.

We point out without further elaboration that these methods also introduce direct engineering signals into the body's master cellular control system, including the regenerative subsystem. Hence the body's regenerative subsystem is involved in helping produce the necessary engines and operate upon the short telomere chains to add back telomeres. More specifically, the regenerative subsystem is changed into attack, are going to die. At least 80% of them will expire, in spite of everything the present system can do for them.

Note each device could rapidly treat a whole series patients, one right after the other, merely laying them between "blankets" containing wire antennas, irradiating with the proper correlate spectrum quickly, moving on to the next patient, irradiating quickly (seconds), etc. The entire apparatus could be made to fit in a large suitcase-sized container, and it would be highly portable and controlled by a laptop-sized computer.

Unfortunately, so far the DOD doesn't even understand what the heck we're talking about! The National Institute of Health (NIH) and the National Science Foundation (NSF) are not interested at all. After all, it isn't drugs, vaccines, antibiotics, etc. — which are simply not going to do the job. However, those are what the government and scientific communities are going to finance to the tune of hundreds of millions of dollars. They are then going to lose almost all those mass casualties when the terrorist attacks on our population centers inevitably occur.

Those are Americans. They are going to die. Most of them could be saved. We ought to save them.

For any change in state (physical, chemical, emotional, mental, perceptual), the body dielectric "portholes" change and the output spectrum changes. The delta from zero reference now represents that exact change.

Where Western Mind Control Research Has Probably Arrived

Western mind control researchers probably first established a correlation database of porthole emission correlates to changes in internal states, both physical

perfect consonance with the external introduction of the amplified antiengines.

That exact process can be used to rejuvenate the aged population and remedy most of the debilities of growing old. That is how we eventually intend to do it, if we can convince the U.S. government and the U.S. scientific community to perform the necessary research and validation.

and mental. They almost certainly recognize the peculiar participation of every part of the body dielectric in the TW emission spectrum from the body. They will almost certainly have opted for this "porthole" notion of some similar expression of it, and the "thwarting" of these "relaxation and release" emission processes to engender internal physical changes in the body and in the brain-meat-computer, as they see it.

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They probably experimented with different TW EM radiation mixes, to see what the body emission change to, and what states are induced. Undoubtedly they found that the induced states began to correlate with the former emission delta data base. That is, they found out which delta emissions spectra, reversed and amplified and fed back thorough the portholes, produce what internal changes.

Use for healing is the simplest of all. Use for killing or debilitating is more complicated. Of course weapons researchers wish to look only at the killing aspects. That is something they understand. They do not understand healing, for they do not even have the "regenerative" or "healing" mechanism in any of the scientific papers or texts. Becker[8] came closest in this country, and Priore did it in France. Both of those scientists were suppressed and paid a bitter price for their revolutionary and innovative research.

But look at what has been done, by "input-output" correlation research. The scientists will have a database now, that tells what state emerges in the body and in the mind, for what irradiation spectra (frequency, relationships, phases, amplitudes, wave shapes, etc.) one uses. And they did not work out all the wave-to-wave transductions ongoing in the mind and body connection and in the body and in the mind, individually, between TWÛLWÛTDW.

We suspect that this is the course Western mind control researchers will have taken, without even realizing the internal wave transductions occurring. And they would not be concerned with that. They would have what they want, for weapons, mind control, and behavior control. And of the internal "mix" of the dielectric and all its tiniest portions. So Western mind control researchers and rogue groups probably do get good results.

We are not just picking on the U.S. government here! Internal divisive groups exist in all large and powerful groups, and joust for power. In highly classified groups, these groups are greatly enabled to joust more widely, unethically, and immorally because it is so deeply hidden. So very deep classification evokes the growth and intensity of rogue groups. It's the old "Power corrupts, and absolute power corrupts absolutely" routine.

The implication is that in the West one or more highly classified, sustained, heavily funded developments in advanced mind control programs, probably exists and probably has existed for some time. Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, may not operate under very much legitimate government control at all, and may operate specifically for the purposes of the rogue group or groups that have gained control.

In a nutshell, that's what may be going on in the clandestine mind control projects in several Western governments. The involvement of at least some rogue groups, some being "cowboys" who operate well outside all laws and ethics, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, it could account for what seems to be actually occurring. As also is "usual" in such a mess, one or more of the rogue groups eventually may become very powerful because their secret weapons are very powerful. They may become confident, thinking they have the "best in the world." They may actually believe they are ahead of the Russians.

they would of course ignore the healing aspects. And they would get results of course, revolutionary results. So they would undoubtedly classify the program very highly, thinking that they had the best of the best.

Rogue Groups May Also Have Arisen to Divert the Purpose of the Projects

And that is where real problems may arise. Every human group has within it competing subgroups, jousting for power. The more highly classified the group and its activities, and the less that is known about it outside its confines, the more strongly and secretly the subgroups can play. So they can emerge as rogue groups pursuing their own agendas, not that of their duly elected governments. In the extreme, such a deep black program can even become a "captured" program, which is totally in the hands of rogues and no longer reports to or is bound by the dictates of the parent government.

It has long been suspected in some quarters that even the US's highly classified research community may be riddled by such rogue groups, and so may be certain highly sensitive parts of the Research and Development community.

Remember that, in every large and powerful human organization, the basis for rogue groups is power and secrecy. They are always seeking to increase their power, control, influence, prestige, etc. Nothing else. Patriotism and mission are—to rogue groups—often just idle words. They have their own agendas. And being rogue groups, they may well bring in unethical, immoral tricks: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A certain percentage of a highly secret rogue group will wind up using all these things and more. It's a

Where the Russians Probably Have Arrived

On the other hand, the Russians will have developed instruments for detecting and isolating the LWs and the scalar waves, in addition to the ordinary mundane instruments for measuring the TWs. So they will have not only the TW correlates, but also the much finer TWÛLWÛTDW (scalar EM wave) correlates. They will understand and employ the use of vacuum engines (spacetime curvature engines) which Western researchers will often invoke but not understand or even be aware that this is what is being invoked. In other words, Western researchers probably just use the old method of "input fi set of functions fi output". That is the standard basis for almost all Western system analysis. With it, one doesn't have to know the exact functions and processes going on in the middle. One just determines a transfer function from a given input to the output that results. Then one catalogs that transfer function. One does that for lots and lots of transfer functions for particularly desirable results, and one has the system analysis. One also has the immediate basis for a rapidly-developed applications technology.

Western scientists are good system analysts. But they have little or no comprehension of what is really going on in that "inside the ship functions" portion, even though they have determined the transform function which acts upon the input to give the "from the portholes" output.

The Russians, with their additional knowledge of the actual mechanisms in the transforms, will be much more advanced than the West, because their fundamental psychoenergetics science is far more advanced, so long as we continue to use

human characteristic, the old primate dominance game. Only now disguised and hidden under deep classification.

Nonetheless, the "simplified" TW EM "porthole correlate" approach will yield very positive results, due to the correlation existing with the LW s and scalar portions the old U(l) electrodynamics. Further, the Russians have decades of use of longitudinal interferometry beams to reach right through the earth and ocean and produce stringent EM effects at a distance. So they will also be able to do the same things here in "mind control" with LW interferometers, through intervening mass

including the earth and ocean. Western mind-control scientists and their rogue groups—assuming they exist as postulated—largely will not be able to do that, and probably won't even recognize Russian testing of psychoenergetics weapons directly in or over Western nations.

Russian Lethal Psychoenergetics Mind Control Tests Over the U. S.

In fact, the KGB tested just such highly advanced mind control weapons over the middle of the United States in 1997 on two occasions. The tests were conducted against Captain Button in his A-10 "Warthog" aircraft on April 2, 1997 [See Figure 14], and upon Captain Svoboda in her A-10 "Warthog" on May 27, 1997. [See Figure 15].

Over Arizona, Captain Button was thrown into a hypnogogic state, and his perceptions instantly altered and controlled. In his instant "dream-waking" state, everything seemed perfectly normal. His sense of direction was altered a bit more than 90 degrees, so he simply corrected and turned and "flew toward the range", actually flying off course by more than 90 degrees and ignoring radio contacts. He flew right on out of Arizona. At one point he circled, probably thinking he was over the range, and he probably dropped his ordnance there. Then he "flew on back toward home," as he thought in his waking dream state, until his fuel ran out and he crashed and died in the explosion—dream-thinking until he died that everything was normal. All the while, his sense of the passage of time was altered. To him, in his dream-thinking, dream-acting state, everything was normal and nothing untoward had happened. So the distant KGB transmitters and associated psychoenergetics team controlled him for over an hour.

Indeed, that was the exact purpose of the test: demonstrate control (at a great distance) of a skilled person performing highly skilled tasks. A secondary purpose was to stimulate the U.S. government, watch its investigation and findings, and ascertain if the U.S. knew of the extent to which Russian KGB mind control weaponry had advanced. Obligingly, we proved to me KGB that we did not understand what had actually happened to Captain Button.

Captain Svoboda was from the same Wing as Captain Button and was its most experienced night fighter A-10 pilot. In fact, she taught other pilots the fine points of night flying combat missions in the A-10. About two months after Captain Button's bizarre flight and death, Svoboda was engaged in night target bombing on the range. Rising from her ordnance drop on me target, Svoboda was suddenly struck and rendered hypnogogic and in a waking-dream state. Her sense of the vertical was instantly reversed. Superb pilot that she was, she immediately dream-perceived she was diving, not climbing out of the delivery. She instantly corrected to "climb out". So in the real world she dived sharply into the ground and her aircraft exploded.

This test demonstrated the instant alteration of a skilled pilot's perception, causing that pilot to inadvertently react promptly in an unintentionally suicidal manner. A secondary purpose of the test was to stimulate the U.S. government system again, to see if the system recognized what had

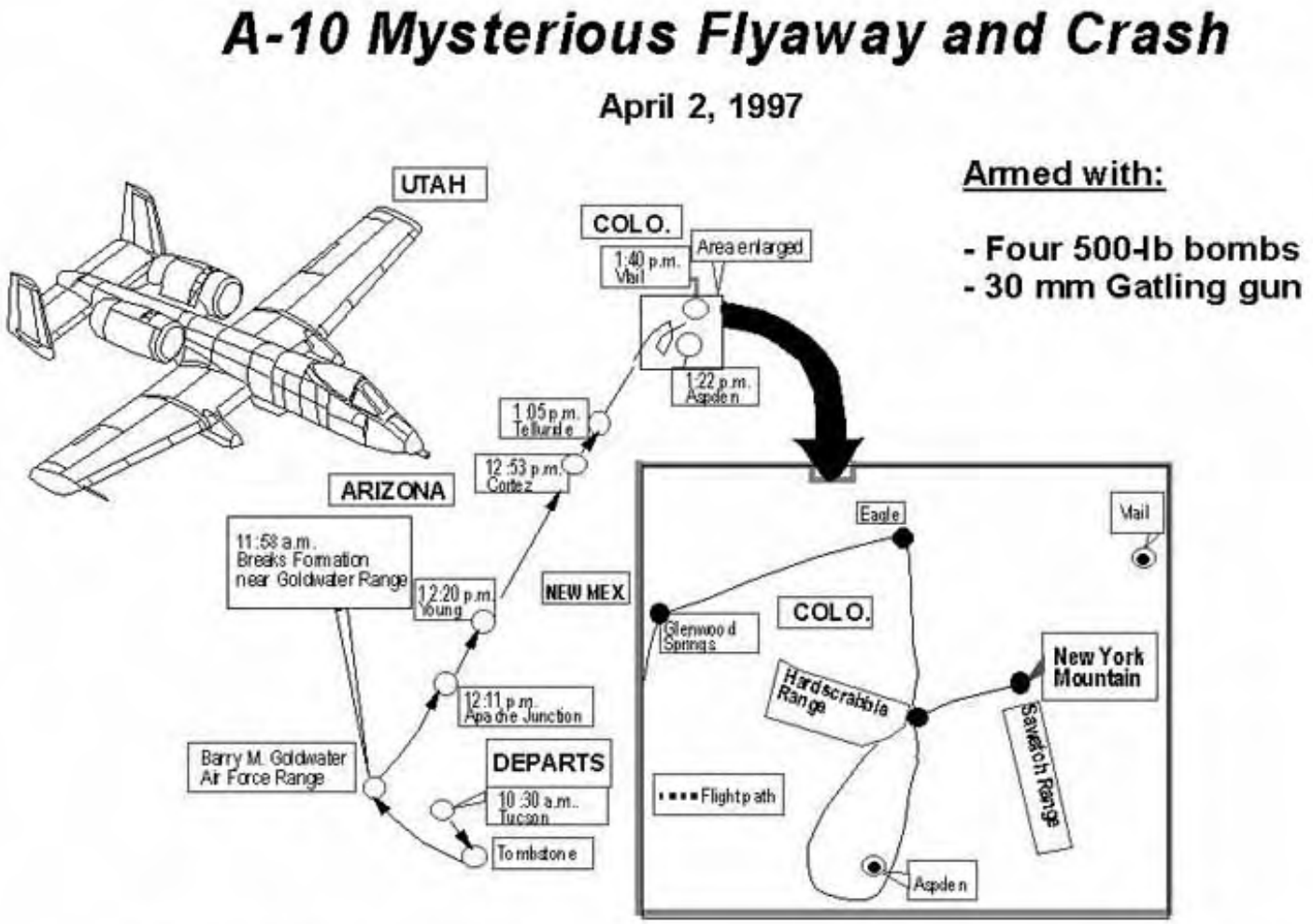

Figure 14a. Captain Button's mysterious flyaway and eventual crash.

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occurred. Sad to say, it did not and it has not. It was lamely speculated that Svoboda probably looked over her shoulder like a rank greenhorn, and inadvertently dived her aircraft into the ground while looking back at the target. If there was one pilot in the USAF who would have not done that, it was Captain Svoboda. At any rate, the KGB determined that the U.S. scientific, intelligence, and governmental communities did not have the foggiest notion of what had occurred.

In private proprietary communications[9] we have explained further, to proper parties, exactly the reasons for these two tests, and what exactly was being tested, and what is its planned strategic use.

The Final Race for Direct Mind Control of the Entire Human Species

The KGB psychoenergetics weapons scientists—because of their direct measurements and detections (and use) of t-polarized waves and LWs for decades—also understand that Jung's collective unconscious mind (of the entire human species) also has its own time-like operations and correlates, which one measures also when using t-polarization measurements and sorting it all out. The collective unconscious mind operations are buried several levels deeper inside the recursive Whittaker structuring inside the EM fields, waves, and potentials.

The KGB scientists also know that something very like Gaia— a collective unconscious mind for all species on earth—also exists, and they are striving to be able to sort out and measure that one as well. The Gaia operations are buried even deeper in the recursive structuring inside the EM fields, waves, and potentials. If one reads some later books by Kaznacheyev,[10] e.g , this human species unconscious mind aspect and the biosphere unconscious mind aspect emerges loud and clear, if one interpolates between the lines, so to speak. Actually, from day one, the Russian mind control scientists have had their eventual goal set upon this "deeper area of mind and possible mind control" of the entire human species.

I am convinced that the KGB psychoenergetics scientists understand this deeper area. If they can learn to directly engineer the collective human species unconscious, they can then convert the human species easily into a sort of "ant" society, modeled along ideal Communism lines, except of course with an excluded "hierarchy at the top" running everything. The "ant society"—communist style—is still a variation of feudalism (all systems tend to feudalism or some form thereof).

The KGB psychoenergetics weapon scientists are seriously pressing on toward that very goal. In my opinion they are not very far from it right now. It is simply a matter of developing sufficiently complex equipment to be able to directly engineer the time-domain substructuring at sufficiently deep levels. It is a doable, although it is very, very complex and very, very difficult. On the other hand, they have been at it for decades. Even in the 50s the Russians already had the old LIDA device,[11] capable of inducing a catatonic trance-like state in a mammal—either a human or a cat,[12] for example. Some versions of Russian mind control devices were used on Russian soldiers in the

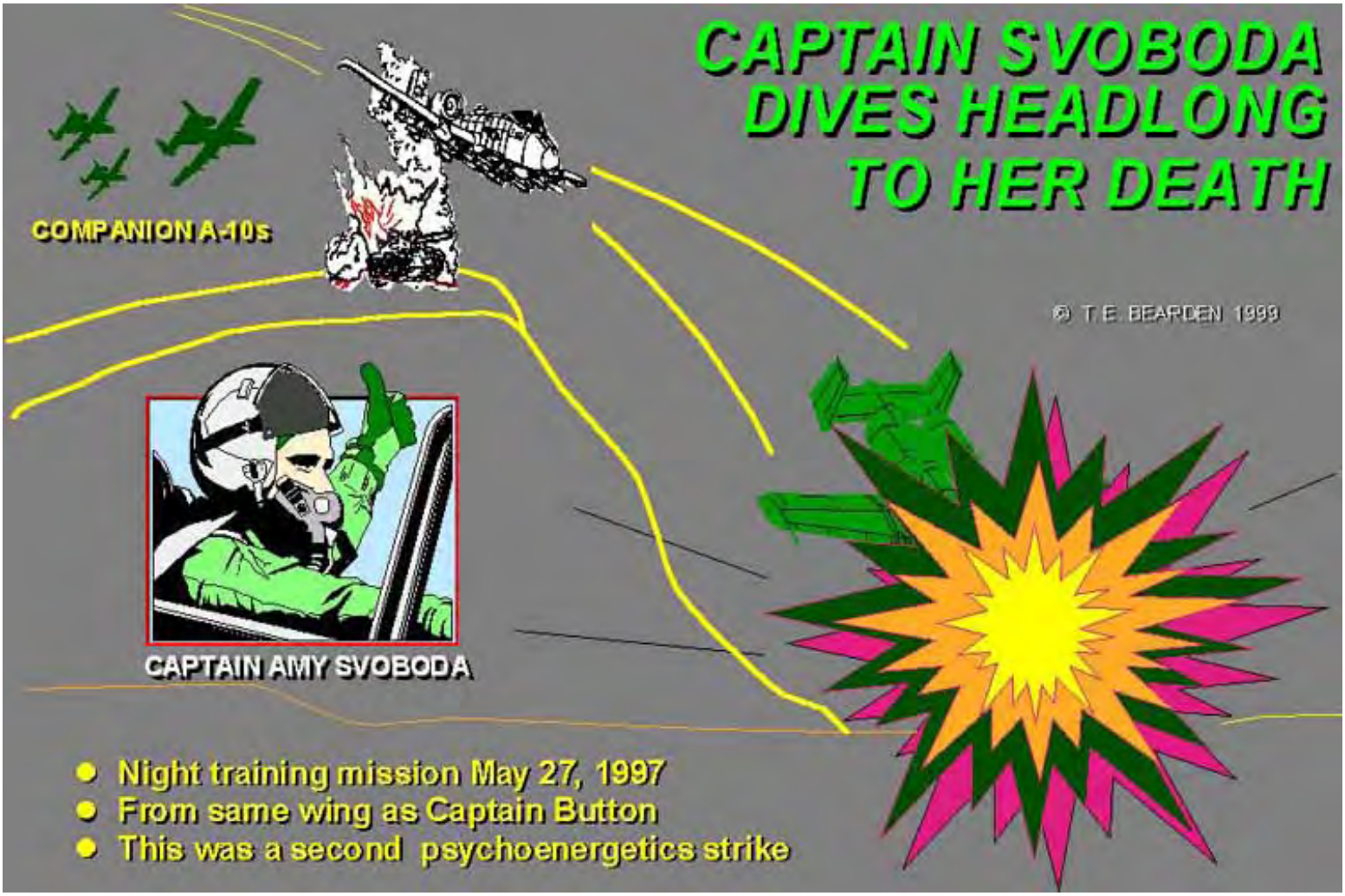

Figure 15. Captain Svoboda dives headlong to her death.

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Afghan War to condition them for performance of merciless acts.[13]

Potential U.S. Rogue Groups and Two Recent Examples

Meanwhile, rogue groups amongst Western clandestine mind control researchers will probably arise if they have not already done so. They will likely seek to increase their personal control and further isolate the programs from orthodox government review and from government and legislative control. They may even divert the research into highly illegal and unethical means, because it furthers their own rogue agendas. That is how clandestine U.S. government research can sometimes go sour, unless great care is exercised by the oversight committees in the House and the Senate.

Sometimes when rogue groups do gain control and total secrecy of a given new technological area, then what appears to be "U.S. government operations" do start to encompass a criminal and unethical operations, hidden usually beneath the deep veil of high classification. Also, if it's "scientific," no one is ever brought to justice, even if the "evil science actions" are uncovered and publicly revealed.

We Certainly Have Proof of Such Rogue Activity. For Example, Here are Two Prominent Cases:

1. For three decades, scientists from the U.S. government, universities, and civilian contractors secretly as a result of those ghoulish experiments. So what happened when this gruesome thing was revealed? Again President Clinton publicly apologized! The head of the Executive Branch did not turn the macabre matter over to his Attorney General to prosecute. How many of these scientists were indicted? Not one. How many are going to be indicted? Not one. Suppose again this had been done by a private doctor in his own private clinic. You get the point.

There is Little or No Punishment of Rogue Scientific Groups

Shockingly, the U.S. government at the highest level has directly shown (and these are not all such cases by any means!) that mass crimes against U.S. civilians, perpetrated by portions of the U.S. scientific community in direct conspiracy and in secret, will likely be condoned. The perpetrators will not be indicted, tried, or convicted.

Note the connection of the "rogue groups" thesis to the above incidents. Note how rogue scientific groups got away with it in both these cases. There may be other rogue scientific groups getting away with such things today. They should not be able

conspired to treat unsuspecting human patients with whole body nuclear radiation, including some retarded children and cancer patients. Some of those patients—including some of the retarded children—died as a result. These illegal experiments were conducted in great secrecy, and the results were highly classified. Eventually these actions were revealed, and a Presidential investigation committee investigated. These experiments would seem to be little different from the WWII Nazi and Japanese experiments on human prisoners. Are those U.S. scientists who were responsible for those retarded children's' deaths any different from the Nazi scientists and criminals we executed at Nuremberg? So what happened when this terrible thing finally came out into the open? President Clinton publicly apologized! How many of the responsible scientists were indicted for murder? Not one. None is ever going to be. Suppose a doctor here in South Alabama, with his own private clinic, had secretly irradiated those human patients and retarded children with whole body nuclear radiation, over a period of 30 years, resulting in some agonizing deaths. How many state and federal agencies would have come after him with arrest warrants? Probably about 50 or so. Would he have been indicted, tried, convicted, and executed or sent to prison for life? Absolutely! Would the President of the United States have apologized? Not on your life; he would have turned it over to the U.S. Attorney General with a strong directive to to get away with it. But they can.

Perhaps a most startling additional part of those two incidents is that there was no great public outcry from the scientific community, deploring these murders and demanding that the criminal scientists be indicted and tried.

As the old saying goes, "By their silence they have convicted themselves." The organized scientific community, as a community, has shown that it has little or no ethics, and—while deploring any scientific murdering that "gets revealed,"—is not really interested in justice. In short, much of the U.S. scientific community may now have very little ethics left.

We are not talking about normal individual scientists, but the Big Science community. There is a whale of a lot of difference between the two. In the Big Science community, there can be and there are rogue groups. Lots of them. There is deep cover, deep classification. And there is very probably advanced mind control research and testing, be it legal or illegal. Hopefully most of it is legal and constrained. However, some of it is almost certain to be illegal and ill constrained.

Human beings are still human beings. All the good and evil is still there, regardless of the group. The stage settings change, but the cast of characters and the play never change.

It's sad, but 'twas ever thus. Hidden parts of our own governments—and other governments throughout the world—are no different from the old medieval groups, where nobles etc. were always plotting against the king, or using the king's power for their own nefarious end. The rogue groups today are no different from all the scheming and conniving groups that destroyed the Roman Empire. Great empires fall from within, not usually from without!

investigate and prosecute on criminal charges.

2. Again for three decades, scientists from (i) the U.S. Government, (ii) universities, and (iii) civilian contractors conspired to give poor syphilitic blacks in Tuskegee, Alabama a placebo while ostensibly treating them for syphilis. The purpose of the program was to deliberately observe and record the ravages of the disease to its fruition in their wracked bodies. So the scientists deliberately sat there and watched their brains rot and their bodies rot. They kept meticulous notes, of course. It was very scientific. And it was macabre. They "treated" some 400 blacks in the "program." Over 100 blacks died

Conclusion

This concludes our brief portrayal of the probable directions that mind control research has taken, in Russia and in the West. It is a novel and powerful area, and it poses both severe dangers and great benefits to all the peoples of the Earth.

Let us hope this great new area, already off to a bad start, can be bridled and steered in the direction of helping and healing people, rather than killing or abusing them. The excesses in its bad use are a potent threat to all nations on earth. Yet it can revolutionize medical science, education, communication, and psychology. Eventually it can engineer the mind and memory directly, beneficially. We foresee the day—perhaps 30 years hence—when education will be

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accomplished by directly loading the software into the mind. Then in three weeks one will "load" a doctorate, say, in physics. In three more weeks one will also load a doctorate in chemistry. Another three weeks, in electrical engineering. Another three weeks, an M. D. And so on. When that happens, then truly everyone on earth can be educated. Freedom from ignorance may well be another great freedom that is legally recognized. There will be no impoverished large groups lacking the education to find decent, productive jobs.

We urge all nations to use the principles involved: not for human abuse, but for healing, educating, uplifting, and life-expanding of every person on Earth. If we

446955, Oct. 23, 1998, forwarded to US. Patent Office on Nov. 4, 1998.

5. A very good introduction to nonlinear phase conjugate optics is given by David M. Pepper, "Nonlinear Optical Phase Conjugation," Optical Engineering, 21(2), March/ April 1982, p. 156-183. Also see David M. Pepper, "Applications of Optical Phase Conjugation," Scientific American, 254(1), Jan. 1986, p. 74-83.

6. Pepper, Optical Engineering, ibid., p. 158.

7. See T.E. Bearden, Energetics of Free Energy Systems and Vacuum Engine Therapies, Tara Publishing, Internet node www. tarapublishing.com/books,July 1997. See also T.E. Bearden, "Energetics Update and Summary, " Part I, Explore, 7 (6), 1997, p. 60-67, Part II, Explore!, 7(7), 1997, p. 53-56; Part III Explore!, 8(1), I997, p. 53-56; Part IV; Explore!, 8(3), 1997, p. 56-63. See also T.E. Bearden, "Vacuum Engines and Priore's Methodology: The True Science of Energy-Medicine: Parts I and II " Explore!, 6(1), 1995, p. 66-76; 6(2), 1995, p. 50-62.

8. E.g., see R.O. Becker; Charles H. Bachman, and Howard Friedman, The direct current system: A link between the environment and the organism, " New York State Journal of Medicine, Vol. 62,

do, we shall all have a far brighter future. Then we shall check what has started out to be the Sword of Damocles and turn it into the golden Millennium.

We are reminded of a poignant quote from Teilhard de Chardin:

"Someday, after we have mastered the winds, the waves, the tides and gravity, we shall harness for God the energies of love. Then for the second time in the history of the world man will have discovered fire."

May the nations of the world utilize the new mind engineering science to truly free all minds into a common love of, and respect for, their fellow humans of every color, creed, and circumstance. As de Chardin envisioned, may we use the new science to discover a new fire, burning clearer and brighter than anything that has gone before. ♦

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April 15, 1962, p. 1169-1176. See also R. 0. Becker; "The direct current field: A primitive control and communication system related to growth processes, "Proceedings of the XVI International Congress of Zoology, Washington, D.C., VOL.3, 1963, p. 179-183; —"The neutral semiconduction control system and its interaction with applied electrical current and magnetic fields," Proc. 1lth International. Cong. Radiol., Amsterdam, Excerpta Medica Foundation, 1966, Series 105, p. 1753-1759. See particularly Robert O. Becker and David G. Murray, "The electrical control system regulating fracture healing in amphibians," Clinical Orthopaedics and Related Research, Vol. TBD, No. 73, Nov.-Dec. 1970, p. 169-198.

9. Bearden, T.E., Energetics: Extensions to Physics and Advanced Technology for Medical and Military Applications, CTEC Proprietary, May 1, 1998, 200+ page enclosure to CTEC Letter, "Saving the Lives of mass BW Casualties from Terrorist BW Strikes on US. Population Centers," distributed to selected high U.S. Government agencies and Legislative subcommittees, May. 4, 1998.

10. E. g. , Vlail Petrovich Kaznacheyev, V. I. Vernadsky's Study on Biosphere and NooSphere, 1989 [in Russian]. Vernadskys concepts included living matter, biosphere, and human-transformed biosphere (noosphere). Kaznacheyev writes of evolution and

energy, and advanced a mechanism for a Bohm-type quantum potential, which theoretically allows the engineering of action at a distance in physical systems.
He is president of the Association of Distinguished American Scientists (ADAS), a life member of the Alabama Academy of Science, Emeritus member of the American Association of Physics Teachers, and has served on the Board of Directors of several associations and corporations. Tom is a guitarist, a retired aikidoist (Sandan, Yoseikan style), is happily married and has two sons and two daughters. He and his wife Doris live in Huntsville, Alabama where Tom is retired from aerospace, continues private research, and serves as a consultant to industry on Scalar electromagnetics processes.

R E F E R E N C E S

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1. Owen Flynn, "Parametric arrays: A new concept for sonar, "Electronic Warfare Magazine, June 1977, p. 107-112.
2. Valerie Hunt, presentation to the U.S. Psychotronics Associations Annual Symposium, Bergamo Center, Ohio, 1988. Hunt presented epochal work showing chaos—and thus hidden order—in recorded ELF electromagnetic radiation from human bodies. Hunt split the received EM signals into two identical channels, time-delayed one channel by a very slight amount, then recombined (mixed) the nondelayed and delayed signals. The result was that attractors precisely indicative of chaos appeared. This positively proves that human systems produce ordered time-structuring of EM. organization of the living matter as the biosphere of the earth. Without specifying the exact technical details, Kaznacheyev discusses the gist of much of what is in this present article. The present author has an autographed copy of Kaznacheyevs book referenced above.
11. Rabichev, Lev Yakovlevich; Vladislav Fedorovich Vasiliev; Alexandr Sergeevich Putilin; Tatyana Grigorievna Ilina; Petr Vasilievich Raku; and Leopold Pavlovich Kernitsky, "apparatus for the treatment of neuropsychic and somatic diseases with heat, light, sound; and VHF electromagnetic radiation," U. S. Patent. No. 3,773,049, Nov. 20, 1973. This is the U. S. patent for the LIDA machine, developed by the Russians prior to the Korean War. Additional patents or applications are as follows: Italy, #619,129, March 1961. Germany, #1,183,607, Dec. 1964. Great Britain, #826,766, Jan. 1960.
12. Stefan T. Possony, "Psy-War: Soviet Device Experiment," Defense & Foreign Affairs Daily, 12(104), June 7, 1983, p. 1-2. Reports on Dr. Ross Adey's investigation of the Soviet device called LIDA which is used to bombard human brains with radio waves in the 40-MHz region. Also reports on work by A.S. Davydov of the Ukrainian Academy of Sciences, who discovered how the blood-brain barrier can be penetrated by low-frequency radio waves so that brain cells

3. Years ago, I read an obscure reference to Russian research directly along that line, with successful development of just such a portable device. Unfortunately I lost the reference in a disastrous flood in my basement and have been unable to recover it.
4. T. E. Bearden, "Alteration of Materials by Wideband Multiwave Irradiation Combined with Selective Emission Manipulation," Invention Disclosure Document Number

are affected. See also "Soviet device uses radio waves as tranquilizer, " Associated Press release, Huntsville [Alabama] Times, May 19, 1983. Dr. Ross Adey tested the Soviet LIDA machine on a cat, and in two or three minutes the cat was sitting quietly, almost as though transfixed, and uninterested in its surroundings. The animal remained uninterested in its surroundings for some 20 to 30 minutes after the machine was turned off.

13. "KGB Used PIS to Program Soldiers, "Resonance, No. 30, Mar. 1996, p.29. Quoting: "During the 1970s, the Soviet KGB developed a Psychotronic Influence System (PIS) that was used to turn people into programmable "human weapons." Soldiers fighting in the Afghan conflict were trained using the system which employs a combination of high frequency radio waves and hypnosis. Commands are activated by code words or cyphers. The purpose of PIS was to render regular soldiers and members of the special forces incapable of feeling sympathy.

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THE NEUROPHONE

Another device that uses the new hyperspatial, virtual state, nested modulation technology (and has done so for seventeen or eighteen years) is Dr. Pat Flanagan's neurophone. With brilliant insight and intuition far beyond that of science at the time, Pat invented and patented the instrument by the time he was seventeen years old. The neurophone is a device that, contrary to all present theory and knowledge, will directly "pump the brain" and reproduce sound and information directly in the brain and mind system, without going through the auditory system at all. A simplified diagram of Pat's improved neurophone is shown in Figure 11.

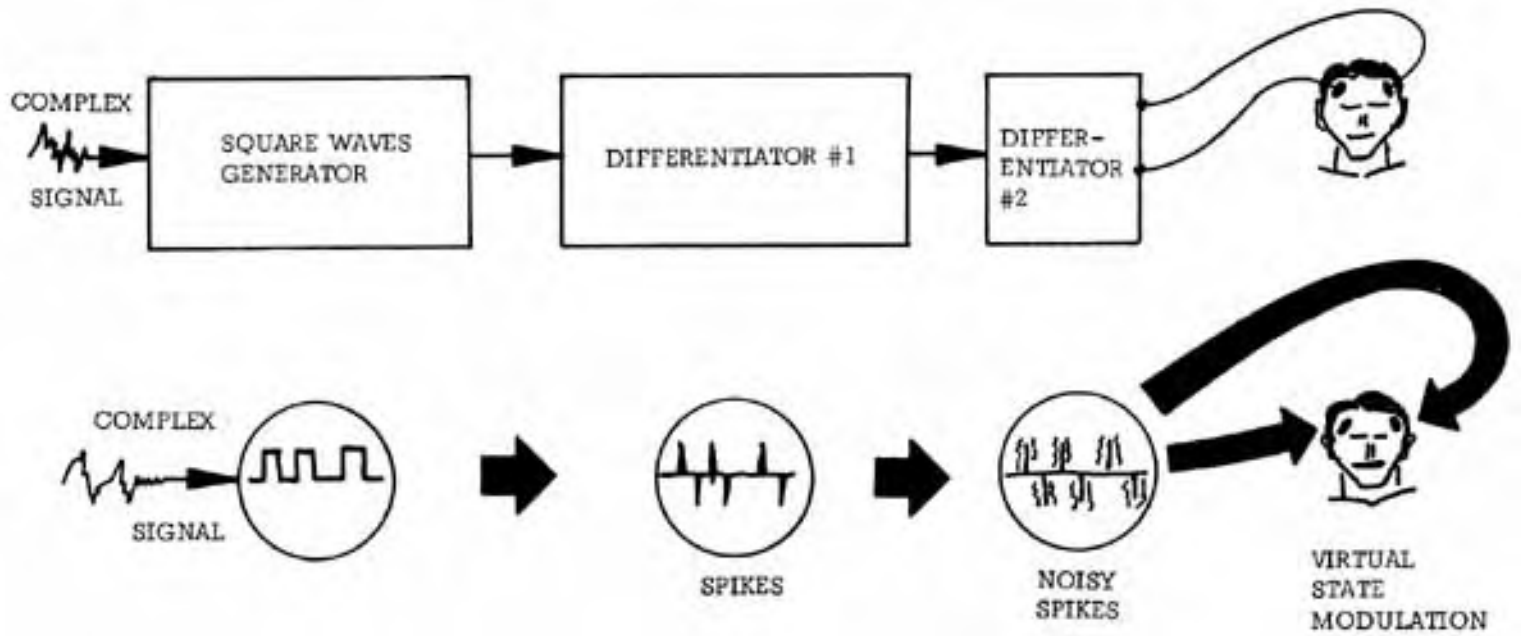

Figure 11. A simplified diagram of the improved Flanagan neurophone

Briefly, the device takes a complex signal, such as the sound of an orchestra playing a musical interlude, and electrically processes it as shown in the figure. First the signal is passed into a section that clips everything into a series of square waves, remarkably analogous to the sort of clipped waves Lisitsyn confirms are the information carriers of the human brain. Next the square waves are differentiated, yielding a series of sharp spikes (note that these spikes retain the pulse-time content of the clipped signal). These spikes are again differentiated, and since these are finite spikes with real nonzero rise times and decay times rather than theoretical constructs, a series of noisy spikes results from the second differentiator section. From here, the noisy spikes are introduced to special contact electrodes, one of which is normally placed on the forehead, while the other may be placed almost anywhere, including on the foot. Nowhere are any sound waves introduced to the head.

The square-wave clipper section reduces the complex signals, their overtones, and their complex modulations to square waves, retaining the temporal content of the wave mix but not the waves themselves. The first and second differentiators heighten or filter through the temporal content of the higher-order differentiations, that is, they serve as a band pass filter unit to accent the time keying of the neutrinic and mindfield portions or aspects of the signal. When these time spikes are then introduced across the body as pulsed voltages, they are modulated directly on the dendrite firings of the brain and nervous system, providing direct and pulsed modulation of the neutrinic and mindfield component channels of the mind-brain-consciousness-life loop itself. Thus the neurophone directly inputs information into the brain and nervous system, bypassing all the normal sensory systems that lie between the mind-brain loop and the outside environment.

Indeed, a similar development has been reported by two University of Missouri researchers. Dr. Donald York, a neurophysiologist, and Dr. Thomas Jensen, a speech pathologist, have recently reported identifying and decoding twenty-seven words and syllables in specific brain wave patterns and correlating these electroencephalographic patterns with both the spoken word and the silently thought word in about forty subjects. At present, Dr. York and Dr. Jensen are programming a computer with a brain wave vocabulary, to monitor and read the EEG of a stroke victim's brain and help stroke victims who have lost their powers of speech to communicate.

While all such developments can obviously be misused, their potential for assistance to mankind is enormous. Indeed, my own premise that brain linkage is possible and can be used to advance all mankind to the sixth stage of species evolution is slowly being proven. It is within our reach now to develop a multi-channel communications system that will directly link brains, minds, and consciousness into a single functional being; and I have already pointed out that the psychokinetic power of the emergent entity increases exponentially with the number of linked stages. The normal corpus callosum linkage of the two cerebral halves in each human head proves that brains, minds, and beings can be linked and

integrated into one.

The Excalibur Briefing details the basic concepts of the theory involved in hyperspace-virtual state engineering, and thus in the engineering of mind-life-consciousness links to multicellular organisms here on earth. Pat Flanagan's neurophone proves that complex information can be implanted directly in the brain and mind, bypassing the normal isolating barriers. Drs. York and Jensen have shown that the brain wave does indeed contain recognizable, decodable information analogues. Lisitsyn has already reported measuring the number of independent channels involved and has documented the importance of the clipped brain waves as opposed to the sine-wave content. If we have the vision, we can still develop a brainlink and rapidly apply it to link sixty to one hundred persons, thereby opening a conscious, multidimensional "eye" for the collective human unconsciousness, gently rousing ZARG into wakefulness, and fulfilling human destiny without undergoing the psychotronic Armageddon planned by the Soviets. The time is short, but it can still be done if the funding, the vision, and the team can be established on a crash priority basis.

SOVIET "WOODPECKER" SIGNALS

But, as I have said, all this can be used for the detriment of mankind as well as for its benefit. Unfortunately, it appears that the Soviet Union has chosen to weaponize the effects on a global scale. A prime example is the "woodpecker" signals emanating from the USSR in the 5-30 megahertz region and interfering with communications around the earth.

These complex woodpecker signals appear to originate from two or three dozen powerful Soviet transmitters, each with a power estimated as high as 40 megawatts (Figure 12).

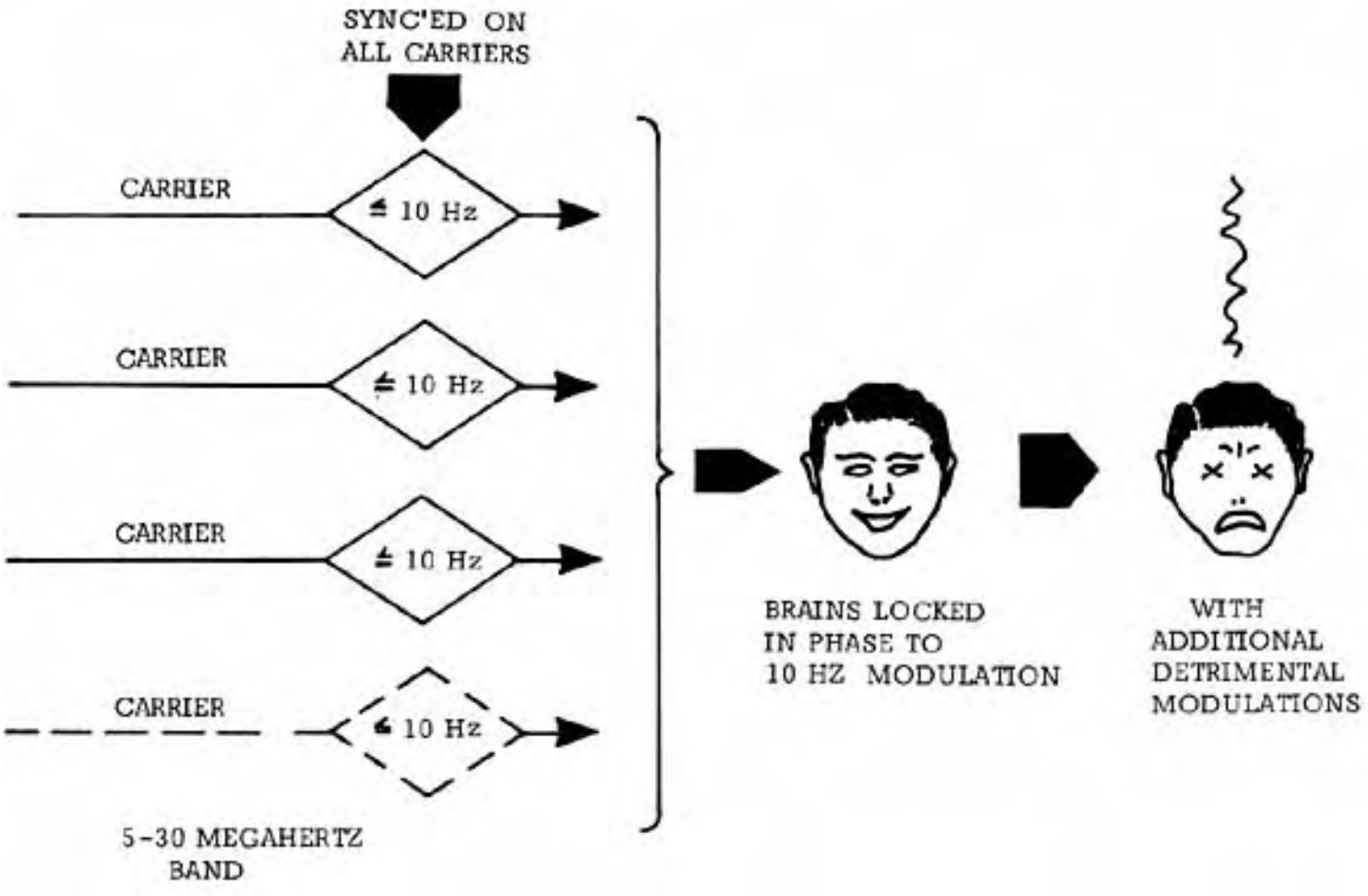

Figure 12. The Soviet "woodpecker" signals

The pioneering experimental measurements of these signals by Dr. Robert Beck and William Bise have shown just how deadly a potential may be possessed by the signals. These measurements have been performed in Eugene and Portland, Oregon; Los Angeles, California; Huntsville, Alabama; and several other locations. They have been particularly significant on the West Coast in and around Eugene, Oregon because of the presence of a direct current transmission line several hundred miles long, which has acted as a long wire antenna, picking up the signals and rebroadcasting them with appreciable gain in the vicinity.

Typically the signals may be found on, say, sixteen different carriers between 10 and 20 megahertz. Twelve of the carriers may appear normal, with normal side-bands, and the other four may have the carrier and both sidebands suppressed but still show the biologically significant modulation (for example, 10 hertz). On all sixteen channels a strong 10 hertz modulation may appear, all perfectly time synchronized and in phase channel-to-channel. The received signal from one of these carriers may be twenty-five to thirty times as strong as the earth's back-ground magnetic field, which is oscillating at approximately 7.0 to 7.5 hertz. Other complex modulation frequencies, many of them changing, are present on the various channels.

Normally, the brainwaves of mammals in an area are gently entrained by the normal oscillations of the earth's magnetic field and are oscillating along at, say, 7.5 hertz. Under continuous radiation from the Soviet

woodpecker signals, a percentage (say 30 percent) of the mammalian brains may be captured by the 10 hertz modulation on the overpowering Soviet signals. These captured brains are now in forced oscillation and are riding along in phase with the 10 hertz Soviet modulation. In other words, a certain percentage of the human brains in an area will phase lock to the 10 hertz modulation, and that will effectively lock into those brains the sixteen carrier frequencies with their concomitant frequency mixes and complex signal modulations. If the signals are made much more powerful (for example, by focusing them onto one particular area or increasing the power of the transmitters), then a much higher percentage of brainwave entrainment can be accomplished in the targeted area. By simply adding on the desired modulation patterns, the Soviets can now pump material directly into the mind-brain-consciousness-life loops of the entrained brains. The weapon implications are enormous: raw emotion such as sheer terror or panic can be transmitted; death or disease patterns of all kinds can be transmitted; informational content (thoughts and ideas) can be impressed directly into the captured brains and minds and processed as if originating inside each brain itself. Indeed, as long as the Soviets keep the effects rather gentle, an entire population can be subtly influenced without governmental notice. Certain specific ELF frequencies can rapidly disable or even kill, and for wartime use those frequencies can be directly implanted in the captured brains themselves by the woodpecker signals. It appears that 1984 came a little early, and one can perhaps now understand Brezhnev's strange 1975 proposal to the SAL T negotiations that we should also consider outlawing the development of new weapons more frightful than the mind of man has ever conceived.

The signals also have direct application against strategic targets other than personnel. For example, by incorporating the correct nested modulation pattern, the positron kindling (electron squelching) pattern can be impressed. By beaming through the earth (with a circularly polarized signal or with other complex modulation forms), a beam with a strong neutrinic component, which will squelch electrons and which will interact with great preference for strong voltages or strong magnetic fields, can be directed at a target complex. In the targeted area aircraft and communications systems can be disabled; automobile, truck, and other ignition systems will fail; power transformers and large motors and generators will fail; power transmission systems with their associated high voltages will fail; and so on. Even independent, self-contained emergency power equipment, such as at military installations and strategic missile sites, will fail to operate. Further, to some of these signals, the earth and the sea are as transparent as glass, and so underwater nuclear submarines can be electrically disabled on station before their missiles can be fired, while strategic missile complexes can be electrically disabled before their deadly nuclear missiles can be hurled toward their distant targets. If some submarines and land complexes succeed in firing missiles before being disabled, these missiles can be electrically dudded and scrubbed from the sky over Soviet territory while

still far from their intended targets.

So, as stated at the end of *Excalibur*, the players are on stage and in place. The final act begins. One thing is sure - mankind will never be the same again after seeing the play!

VACUUM ENGINES AND PRIORE'S METHODOLOGY: THE TRUE SCIENCE OF ENERGY-MEDICINE

Part I of II

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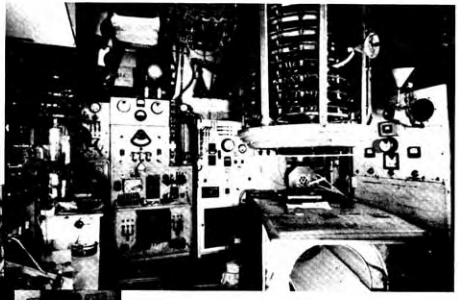

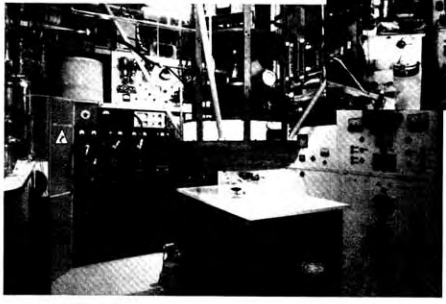

Photo 1. (to the right) Priore's laboratory. Workbench with animal cage is in the right foreground, under a large overhead assembly to hold the coil for producing the rippling magnetic field.

Photo 2. (below) Priore's laboratory. Workbench now has coil installed. The rippling magnetic field descended vertically through the patient. The magnetic field was modulated by the wave/antiwave output of 17 EM waves mixed in a rotating plasma in a giant mixer tube.

December 1, 1994

Overview

In the late 1960s and early 1970s, Antoine Priore and a team of leading French scientists demonstrated conclusive, total remissions of terminal tumors and infectious diseases in hundreds of laboratory animals. Their research was performed under rigorous scientific protocols and funded by the French Government. The approach employed very complicated mixing of multiple EM signals in a rotating plasma, and modulating the mixed output upon a very strong rippling magnetic field to which the body of the test animal was exposed. Complete remission of the treated diseases was obtained. In addition, the animals' immune systems were also restored to normal. Further, disease-specific antibodies were also created: a single drop of blood drawn from an animal that had been treated and recovered, and injected into the body of a second animal with the same terminal illness, resulted in total remission of the disease in the second animal *and its total recovery*. In the mid-70s Priore's work was suppressed, because of hostility of the oncology community, change of the French Government and loss of further funding, and complete inability of physicists and biological scientists to even hypothesize a mechanism for the curative results.

After a 10-year struggle to discover the Priore mechanism, the present author has proposed a sweeping new explanation for the exact Priore curative mechanism. It represents a totally new kind of medical therapy – one which can dramatically treat and cure a breathtakingly wide variety of diseases. The electrical physics is based on the Stoney, Whittaker, and Ziolkowski decomposition of the scalar EM potential into bidirectional EM wave pairs. Deliberate assembly of such a structure forms a *vacuum engine* of nested curvatures of local spacetime.[1] Priore unwittingly made such a hyperspatially structured vacuum engine, one with the special characteristic that it *time-reversed* (dedifferentiated) diseased cells back to their earlier normal state. The Priore approach not only produces remission of a specific targeted disease, but also fully restores the cells and "factories" of the patient's immune system because they too revert back to their previous healthy condition.[2]

[1] *In short, Priore found and utilized a method of electromagnetically engineering general relativity in the laboratory – something physicists had not done and have no knowledge of. Neither have they done it overtly today, and neither do they have knowledge of it today.*

[2] *We point out that chemistry is largely driven by charge and charge distribution. The new methodology essentially controls charge and its distribution. Hence it can control and order all the biochemistry.*

Becker et al have shown conclusively that very weak DC currents and pulsed magnetic fields can produce cellular dedifferentiation (change to a previous state) and redifferentiation (change forward to a new state). It follows that transcription (change of the genetics) must also be altered correspondingly. Becker was nominated for a Nobel Prize for his experimental and theoretical demonstration of the mechanism. He also proposed a fundamental electrical control mechanism to account for his revolutionary results.

Kaznacheyev et al have shown that almost any cellular disease or damage can be transferred electromagnetically from one cell culture to another under special conditions. Popp has theoretically and experimentally shown that an electromagnetic master cellular control system exists in the body, as indeed has Becker. Thus it is clear and independently demonstrated that (1) disease can be created or reversed electromagnetically, and (2) the fundamental cellular control system is electromagnetic in nature. We comment that, viewed as physical materials, the cells and their constituents are sufficiently nonlinear that their EM functions, responses, and effects transcend the present classical EM model. A modern addition to nonlinear electromagnetics is the methodology and results of nonlinear phase conjugate optics (NLO). Accordingly, understanding of the higher topology EM/bioeffects functioning requires application and understanding of NLO principles, *regardless of frequency band.*

We also extend the general relativity model by addition of higher topology EM. We incorporate the Stoney/Whittaker/Ziolkowski decomposition of the scalar EM potential into hidden bidirectional waves. This is then applied to structure and engineer the vacuum. The method is also capable of structuring and engineering both mind and matter.

As a case in point, the elements of the new EM bioeffects approach are applied to the Gulf War Syndrome – the strange conglomerate of illnesses and symptoms developed by many Gulf War participants, usually beginning shortly after their arrival back in the United States from the MidEast. Previously unrecognized biological effects of a dense EM signal environment are advanced and their causative mechanisms explained. These new "dense signal environment" bioeffects, coupled with other simultaneous biologically-active suppressants, allow a full explanation of the Gulf War Syndrome and its characteristics. Both normal and anomalous symptoms are explained.

The Priore approach extends and complements Becker's pioneering approach by allowing positive engineering control of dedifferentiation of cells and their redifferentiation. A cancer cell may be regarded as a dedifferentiation or partial dedifferentiation of a normal cell back toward a more primitive or "immature" geological form. In NLO terms, this is a form of phase conjugation (time reversal) of the cell back toward a previous state, or even its *ancestral* cellular form *(see figure 1 below).* By phase conjugating the cancer cell anew and amplifying the process, the diseased cell can quickly be reversed back to a normal cell.

It is possible, using the Priore technique, to phase conjugate cells in the body, including all of them simultaneously if need be. Further, conjugation can be made specific to the type of cell or tissue one desires to affect. One need not "know" the specific disease's "EM signal complex," one must simply "pump the cell correctly" where it and its parts are treated as pumped phase conjugate mirrors (PPCMs). In a higher EM topology, the "diseased-cell-as-a-PPCM" already possesses a special "standing signal wave" input that represents the erroneous *vacuum engine* associated with the change to the specific disease state. Pumping the cell *in this special EM topology* creates the precise, amplified *vacuum anti-engine* in this same special EM topology and renormalizes the cell.

Because of the special EM topology utilized, direct engineering of both mind and matter are provided by the new approach, which also represents a unification and extension of electromagnetics, quantum mechanics, general relativity, and biology. It should be capable of reversing most physical and mental disorders that assail a biological organism.

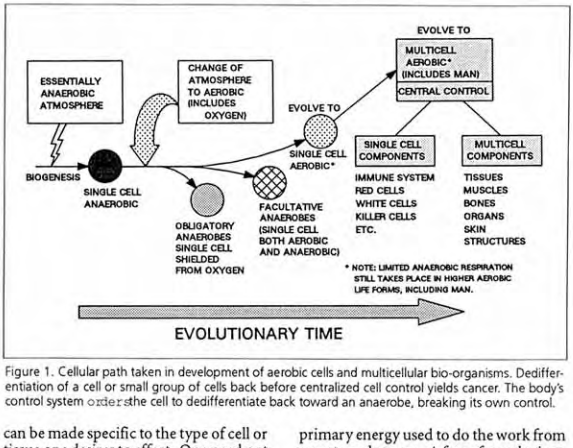

Figure 1. Cellular path taken in development of aerobic cells and multicellular bio-organisms. Dedifferentiation of a cell or small group of cells back before centralized cell control yields cancer. The body's control system orders the cell to dedifferentiate back toward an anaerobe, breaking its own control.

Introduction

In this paper we discuss the present method of utilizing EM energy in science and engineering, and also discuss a radically different second method that is beginning to emerge *(see Table 1 on following page).* The main text is an overview, with technical elaboration in the footnotes.

The first (Type 1) engineering method may be likened to a leaky pipe: We always pour in more energy than the work we get back out. We have to furnish the primary energy used to do the work from an external source. A few of our devices, such as a common heat pump, are open systems extracting and using some excess energy from an external source. These devices may have a coefficient of performance (COP) – work output of the machine divided by work done on the machine to run it – of greater than unity. However, the vast majority of our machines have COPs of less than 1.0. Many of them have COPs of less than 50%, and many have COPs of less than 30%.

As can be seen, Type 1 engineering is very wasteful of energy! In a sense, the present struggle to attain room temperature superconductivity is a struggle to eventually have many more machines that attain a COP approaching 1.0, and so decrease the waste of energy in our

Table 1. Two Ways To Do Engineering.

- *Type 1* Engineering: Vacuum Quiescent, Use External Energy Upon Matter
  - Does not involve mind, thought, life, time streams
  - Time is not an observable
  - Must furnish all the energy
  - Western science uses this method.
- *Type 2* Engineering: Gate and Structure the Vacuum Flux Itself
  - Involves mind, thought, life, time streams
  - Time is an observable
  - Furnish only initial energy, and maintenance
  - Use vacuum's energy (vacuum engines)

Type 1 machines. Vacuum engines allow COPs of far greater than 1.0.

After several decades of painful progress in understanding the nature of the quantum mechanical vacuum, today it is accepted in physics that the vacuum itself is a seething inferno of electromagnetic energy. It is thus a legitimate source of energy, could we but extract and use it. This is now accepted both by leading physicists and by the U.S. Patent Office. Further, as of 1993 it has been clearly shown that, contrary to conventional objections, thermodynamics does not rule out the extraction and utilization of the vacuum's energy as heat and power to operate our engines.[3]

We have now reached one of the great scientific plateaus of history: (1) *The vacuum is energetic, containing an incredible density of electromagnetic energy in a violent flux;* (2) *at least in theory, it is possible to extract energy from the vacuum and utilize it;* and (3) *every particle of mass exists as a nonlinearity in a violent flux of virtual particle energy exchange with the vacuum. In short, every system is an open system, being violently "driven" by the vacuum flux, where normally the "driving flux" is in equilibrium or nearly so.*

This paper briefly describes a great new scientific breakthrough which is approaching as a result of the new understanding of the vacuum energy. This new scientific development will usher in the greatest change to humanity of all time (*see Figure 2*). It is characterized by the laboratory ability to: (4) Deterministically structure and gate the vacuum's fierce flux of virtual particle energy – even at a distance – and make the vacuum itself an ***engine*** to do any kind of work on an embedded physical system that we choose.[4] (5) Deterministically form a quantum potential, and utilize this potential to achieve essentially instantaneous action at a distance.[5] (6) Engineer the hidden inner structure of any potential; this includes also the potential for the Schroedinger equation, including Bohm's ***quantum potential,*** so that physical reality can actually be engineered prior to the collapse of the wave function and the occurrence of the quantum change. This is engineering and altering an entity in its *pre-reality state.* (7) Engineer and alter the flow of time and the laws of nature in a particular area, including the entire planet or solar system. (8) Simply and cheaply treat and cure essentially every present infectious disease and many other abnormalities. This includes cancer, leukemia, AIDS, malaria, sleeping sickness, arteriosclerosis, etc. – even mental disorders. It also includes reversing the effects of the aging process. (9) Directly engineer, form, create, heal, or modify mind, thought, long-term memory, life, etc.[6] And finally, (10) Directly engineer and alter the species quantum potential, an entire species, and the planetary quantum potential for all species and all living creatures on earth.

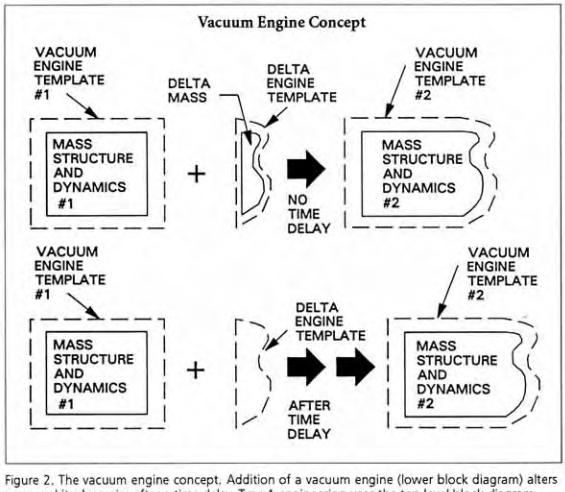

Figure 2. The vacuum engine concept. Addition of a vacuum engine (lower block diagram) alters mass and its dynamics after a time delay. Type 1 engineering uses the top level block diagram.

[3]Daniel C. Cole and Harold E. Puthoff, "Extracting Energy and Heat from the Vacuum," **Physical Review E**, 48(2), Aug. 1993, p. 1562-1565.

[4]*In other words, to perform vacuum engineering, extended from the suggestion of Nobel Laureate T.D. Lee (**Particle Physics and Introduction to Field Theory,** Harwood, New York; Chapter 25: Outlook, "Possibility of Vacuum Engineering," p. 824-828.). Lee recognizes that vacuum engineering can in theory be accomplished, but also that this has never even been tried.*

[5]*For a presentation of the mechanism for creating a quantum potential, see T.E. Bearden, **Gravitobiology,** Tesla Book Co., Chula Vista, CA, 1991, p. 33-36.*

[6]*The weapons developers are slowly grappling their way toward this new science, which the Russians call energetics. Application to the physical world at large is just referred to as energetics. Application of energetics to mind engineering is called **psychoenergetics.** Application to the physical body and its structures is called bioenergetics. In the U.S., development of mind and behavior alteration and control is now being dealt with in embryonic fashion under the subject heading of nonlethal warfare.*

This paper is an informal "quick note" to point out the new scientific plateau and introduce the second kind of science and engineering. The new ***vacuum engineering***[7] offers the greatest threat to humanity that has ever existed,[8,9,10] and at the same time offers the greatest promise of benefit.

For our very survival, it is absolutely imperative that informed citizens be aware of this dramatic change, which is just now starting. The powerful new science and engineering must be controlled and used for humanity's benefit, not its detriment. Else it will eventually be let loose unrestrainedly, to destroy all life on earth – a possibility indicated by Nikita Khrushchev in 1960.[11]

The First Kind of Engineering (Type 1)

First there's the normal way to do engineering (Type 1), which we are all taught as engineers and scientists. Here the vacuum/spacetime itself stays *inert* and out of our way.[12] We ourselves furnish energy into or onto the system we are trying to move or activate, spilling some of this energy all the while, and we struggle until we get the mass to move and the system to operate and perform work.

This "first kind" of engineering is essentially a continual *wrestling match*. Nature herself is the opponent. The engineer furiously struggles with nature, to force her to do the work he wishes to do. *This is the only overt kind of engineering presently done on earth*. It is primitive and severely limited in what it can do. In Type 1 engineering, the mind and thought are not affected since the *flow of time connectivity* and the *flow of mind connectivity* are not affected.

The Second Kind of Engineering (Type 2)

Clandestinely, however, the Russians (actually, the KGB) in their secret advanced weapons labs, and three other nations not hostile to the U.S., have also weaponized a second kind of science and engineering, but kept it firmly a secret of the highest order. The second kind of engineering (Type 2) is dramatically different, far more powerful, and essentially unlimited in what it can do. Some of the simpler elements have spilled into the open press. For example (*see Figures 3 & 4 on next page*), Vlail Kaznacheyev and his colleagues have shown, in thousands of meticulous experiments, that almost any disease or damage to cells can be induced in an isolated cell culture by electromagnetic radiation from the diseased or damaged culture, if a full harmonic interval (infrared to ultraviolet) is open for electromagnetic (photonic) exchange between the cultures.[13] The present author's proposed mechanism for the Priore and Becker results also explains the Kaznacheyev results.[14] It also explains the decades-long Russian induction of health changes and diseases in the microwave radiation of the U.S. Embassy in Moscow.[15]

In Type 2 engineering, the background vacuum/spacetime itself is deliberately altered, structured, and made asymmetrical. One then uses this *struc-*

[7]*Terminology after Nobel Laureate Lee, ibid., p. 383. Lee points out that the microscopic structure of the scalar vacuum field is not utilized. The particulate flux structure can indeed be engineered, but this has never even been tried by conventional physicists. An excellent coverage of asymmetries and observables is given on p. 181-188. E.g., whenever a symmetry is spontaneously broken, a nonobservable (virtual entity) has become observable. There thus exist vacuum engineering mechanisms for the direct translation between virtual and observable states. Indeed, a whole new vista has opened in physics – some are calling it a "new physics" – due to the discovery that it is possible to directly amplify the virtual state into observable state. E.g., see Serge Haroche and Daniel Kleppner, "Cavity quantum electrodynamics," **Physics Today**, Jan. 1989, p. 24-30 for an overview. In 1979 the present author foresaw, albeit crudely, the emergence of virtual state engineering by means of a possible hyperspatial (virtual state) amplifier. See T.E. Bearden, "Virtual state engineering and its implications," National Technical Information System, Report AD-A065762, 1979.*

[8]*The Russian weapon engineers model the vacuum as a virtual EM dipole plasma, rather than as a simple particle flux; e.g., see A.V. Chernetski, "Processes in Plasma Systems with Electric Charge Division," Georgi Pleckonov Institute of National Economy, Moscow, 1989 for an introductory theoretical exposition of the basic model with respect to physical energy systems.*

[9]*Use of dipoles focuses immediately upon the hidden electromagnetics. Application of plasma theory then exposes the higher nonlinear EM aspects and the characteristics of a higher topology EM theory. Interestingly, Priore used all the elements fitting this theoretical model, employing a giant plasma-filled tube for multi-signal EM mixing, to produce "hidden EM" vacuum engines.*

[10]*Decades ago, the Russians also applied the virtual EM dipole plasma vacuum to the problem of direct engineering of mind, behavior, and cellular control functions. For the fact that they succeeded in decoding the mind/brain/s operations, see S.K. Lisitsyn, "New approach to the analysis of electroencephalograms," Problems of Bionics (**Selected Articles**), p. 16-25, National Technical Information System Report AD 730045. See also the various references by Kaznacheyev, sanitized by the Soviet State at the time to prevent revealing the actual primary mechanisms.*

[11]*For a partial discussion of Khrushchev's statement of the impending availability of such new Soviet superweapons, see Max Frankel, "Khrushchev says Soviet will cut forces a third; sees 'Fantastic Weapon'," New York Times, Jan. 15, 1960, p. 1.*

[12]*Technically the vacuum is always highly active, in violent flux exchange with all particles of mass. However, in Type 1 engineering this exchange activity is in equilibrium. So action and reaction are balanced in all directions. With no observable asymmetry, no single net force accumulates for the observer to see, and the vacuum appears to be an "emptiness."*

[13]*See Vlail Kaznacheyev and L.P. Mikhailova, **Ultraweak Radiation in Intercellular Interactions**, [in Russian], Novosibirsk, 1981. Vlail Kaznacheyev, "Electromagnetic Bioinformation in Intercellular Interactions," **Psi Research**, 1(1), Mar. 1982, p. 47-76 contains an English translation of much of the information referenced in Kaznacheyev's 1981 book. See Vlail Kaznacheyev et al, "Distant intercellular interactions in a system of two tissue cultures," Psychoenergetic Systems, 1(3), Mar. 1976; "Apparent information transfer between two groups of cells," **Psychoenergetic Systems**, 1(1), Dec. 1974; V.P. Kaznacheyev, "Information function of Ultraweak Light Flows in Biological Systems," in **Problems in Biophysics**, Novosibirsk, 1967, p. 7-18 [in Russian]; V.P. Kaznacheev and A.V. Troftmov, Cosmic Consciousness of **Humanity:** Problems of New Cosmogony. Elendis-Progress, Tomsk, Russia, 1992.*

[14]*See T.E. Bearden, Gravitobiology, Tesla Book Co., P.O.B. 121873, Chula Vista, CA 91912; 1991. See also Bearden, Cancer and the Unresolved Health Issues in the Biological Effects of EM Fields and Radiation, Tesla Book Company, 1993.*

[15]*The Soviets radiated the U.S. Embassy in Moscow with weak microwave radiation for decades, starting in the early 1950s. Anomalous health changes and diseases were induced in U.S. Embassy personnel. Three Ambassadors eventually died of leukemia-like illnesses of mysterious nature. The results of the Johns Hopkins scientific study of the Embassy radiation problem also provide strong evidence for the explanation, since health changes and diseases only occurred in those areas of the Embassy where the EM force fields from the radiation were zero. In other words, induced health changes occurred only in personnel in those Embassy areas where the potentials from the radiation had zero gradients, so that the potentials were persistent. This 100% correlation to persistent potentials exclusively, is exceptionally strong evidence that the EM radiation was the actual cause. If independent of the EM radiation, health changes would not have precisely correlated to any component of the radiation! The Johns Hopkins scientists were quite competent, but only considered classical EM theory (CEM) in their assessment. CEM assumes that, when the force fields are zero, the electromagnetic actions are zero. That of course has been disproved in quantum mechanics, which has shown theoretically and experimentally that the potentials, not the force fields, are the primary causes of all EM phenomena. [See Y. Aharonov and D. Bohm. (1959) "Significance of Electromagnetic Potentials in the Quantum Theory," Physical Review, Second Series, 115(3), 1959, p. 485-491; Bertram Schwarzschild, "Currents in normal-metal rings exhibit Aharonov-Bohm effect," Physics Today, 39(1), Jan. 1986, p. 17-2.] Even when the force fields are zero, the potentials may remain and provide real changes in charged particle systems by scalar interferometry. Indeed, the force fields do not even exist in vacuum, as CEM assumes. The Johns Hopkins scientists concluded – based on the erroneous CEM model they applied – that since no force fields were present where any of the health changes occurred, the cause could not have been the weak microwave radiation. Had it not been the radiation, some of the health changes would inevitably have occurred where the EM force fields were nonzero. The investigators' results falsified their own study's conclusion, by simple expectation mathematics. Had they known of the SWZ structured potential and its possibilities, they would have realized that by showing 100% correlation to the force-free potentials, they had actually proven that it was indeed the radiation that was the cause, and the force-free potentials component was the actual culprit The team was excellent; its tools failed it. For a complete discussion, see Bearden, Gravitobiology, 1991, p. 27-32.*

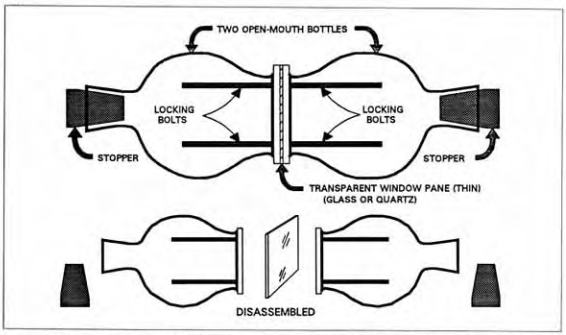

Figure 3. Kaznacheyev's two-chamber apparatus. A cell culture is divided into two parts. Left ones are damaged or killed. Effect is replicated in right cells through windowglass, but not quartz.

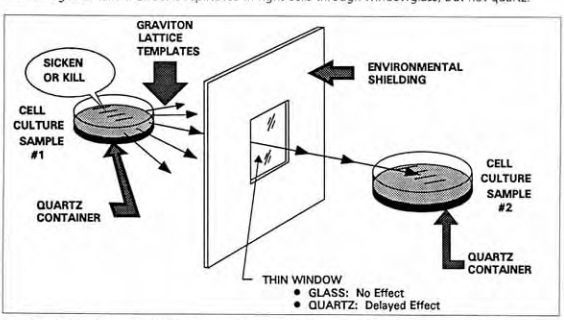

Figure 4. Kaznacheyev's cytopathogenic mirror effect: Death and disease transmission via graviton lattice templates. Quartz passes a minimum G-lattice, glass does not.

tured, asymmetrical vacuum to do the work and furnish all the required energy flow.

The vacuum is known to be a *seething inferno of energy.*[16] It is a violent flux of virtual particles, according to quantum mechanics (QM). A ***virtual particle*** is one which quantum mechanically arises out of nowhere and almost instantly returns to nowhere. It may be highly energetic and "hotter than a firecracker" while it exists. But its span of existence is so short that our instruments cannot *individually* detect it.

However, we can and certainly do experimentally detect the result of the interaction of *large numbers* of virtual particles. Physics states that all forces of the universe are caused by the exchange of such virtual particles. It is also theoretically and experimentally proven that every particle of mass is in a violent virtual particle flux exchange with the surrounding vacuum. Several experiments directly show this – the Lamb shift for one.[17] The Lamb shift is largely due to fluctuations of the hidden virtual flux exchange with the vacuum, and involves a local energy density far greater than the surface energy density of the sun's surface.

Vacuum Engines: Ordering and Utilizing the Vacuum Virtual Particle Flux

In Type 2 engineering, one structures and orders the violent virtual particle flows of the fundamental vacuum/spacetime (VST) itself.[18] Accordingly, it alters and orders the vacuum's violent energetic exchange with any mass particles and physical systems in the area. One *oneself* does not input the energy that does the actual work on the material system located in that region of VST. Instead, one only inputs the energy necessary for the *gating and directing* of the VST flux energy in that area. This structuring and gating of the virtual particle flux forms an organized, energetic pattern which I have dubbed a ***vacuum engine*** (after Nobel Laureate Lee's recognition that the vacuum itself could in theory be engineered, but that such had never even been tried).

This ***vacuum engine*** now does the work and furnishes all the working energy. We just have to pay to set up the *gating mechanism and the template* in the beginning, and continue to pay a little bit to sustain them. Literally we have created

[16] *For a good overview of the active vacuum, see R. Podolny, Something Called Nothing: Physical Vacuum: What Is It?, translated by Nicholas Weinstein, Mir Publishers, Moscow, 1986, revised from the 1983 Russian edition. See also I.J.R. Aitchison, "Nothing's plenty: The vacuum in modern quantum field theory," Contemporary Physics, 26(4), 1985, p. 333-391; Jack S. Greenberg and Walter Greiner, "Search for the sparking of the vacuum," Physics Today, 35(8), Aug. 1982, p. 24-32; Richard E. Prange and Peter Strance, "The semiconducting vacuum," American Journal of Physics, 52(1), Jan. 1984, p. 19-21; Walter Greiner and Joseph Hamilton, "Is the Vacuum Really Empty?", The American Scientist, 68(2), Mar.-Apr. 1980, p. 154-164; Timothy Boyer, "The Classical Vacuum," Scientific American, Aug. 1985, p. 70. See also important papers by H.E. Puthoff: "Source of vacuum electromagnetic zero-point energy," Phys. Rev. A, 40(9), Nov. 1, 1989, p. 4857-4862; "Gravity as a zero-point fluctuation force," Phys. Rev. A., 39(5), Mar. 1, 1989, p. 2333-2342; and "The Energetic Vacuum: Implications for Energy Research," Speculations in Science and Technology, 13(4), 1990, p. 247-257.*

[17] *W.E. Lamb, Jr. and R.C. Retherford, "Fine structure of the hydrogen atom by a microwave method," Physical Review, Vol. 72, 1947, p. 241-243. Demonstration of the displacement of one of the fine structure electron states of the hydrogen atom by a frequency of about 1060 megacycles played a central role in the development of quantum mechanics, and earned Lamb the Nobel Prize. The observation makes the reality of dynamic vacuum fluctuations inescapably evident.*

[18] *Since the vacuum can be altered, we now must speak of various vacuua, not just one. "A" vacuum, "a" spacetime, and "a" scalar potential are synonymous. "The" ambient vacuum at any local point is a maelstrom of the scalar (hidden multiwave) interferometry of potentials from every charged particle in the universe (adapting Puthoff's Cosmological Feedback Principle). This scalar EM interferometry creates the EM fluctuations of the quantum mechanical vacuum, by Whittaker 1903 & 1904.*

a stupendous *energy amplifier*.[19] By continuing to expend a little maintenance and steering energy, we can gate and utilize the energies of an enormous engine which can apply incredible energy densities, even at a distance. In principle it can apply anything from a feather's touch up to the explosion of a star. It can be used to engineer anything from a single particle or wave, to the atomic nucleus, to a planet or a sun.[20]

Engineering General Relativity & Nesting Spacetime Curvatures

We actually engineer general relativity (GR) itself, since the Stoney,[21] Whittaker,[22] and Ziolkowski[23] (SWZ) papers point the way to how to do just that *(see figure 5)*. In short, by using the SWZ approach, one is able to utilize electro-magnetics in a new way, to directly form these curvatures of local spacetime. We also *nest* these curvatures to form a ***template*** of structured multiple curvatures; this template constitutes the deliberate format of the vacuum engine *(see figure 6)*.

Indeed, this is a radically different concept of spacetime structure. It is well-known that, whenever one applies a local hidden variable theory, the GR theory of spacetime structure must be radically altered.[24]

We stress that, in Type 2 engineering, one directly extends, applies and engineers general relativity, but by a novel use of electromagnetics. As can be seen, establishment science is not doing that at all, but is doing only Type 1 engineering. Literally anything one wishes can be engineered in the Type 2 fashion, at least in theory, including transmutation of elements, materialization and dematerialization of matter, free energy electrical power sources, and antigravity. However, Type 2 engineering is even more powerful than that. It also is the ultimate form of virtual reality engineering, for it allows the direct engineering of both physical reality and the mind itself.

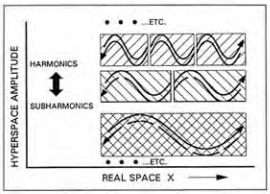

Figure 5. Stoney/Whittaker/Ziolkowski internal EM biwave structure of the scalar EM potential.

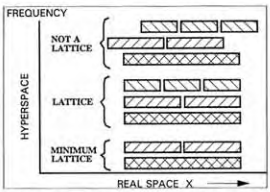

Figure 6. Grav iton lattices and nonlattices. Templates require G-lattices. Minimum lattice is one harmonic interval.

Mind, 3-Space, Hyperspace, Mind Flow, and the Flow of Time

Mind exists in time, but not in our familiar 3-space. Mind does not exist spatially in the same 3-space in which we model physical phenomena.[25] Mind occupies (to the physicist) only one dimension – the time dimension – of Minkowski's 4-space of physical matter. This means that the attachment of mind to matter (in a living biological organism) involves a *mind flow* process, hidden in and occupying the *time flow* process *(see figure 7 below)*.

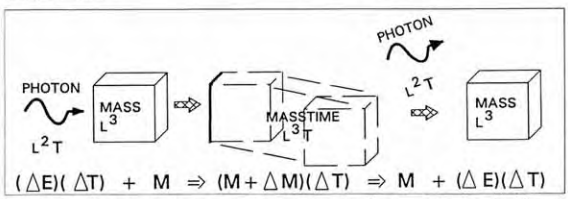

Figure 7. The photon interaction generates observed quantum change and the discretized flow of time. A particle usually connects to only a single delta T at a time. Every other particle is connected to that small increment of time also, as are all minds.

[19] *An example of such an actual amplifier was Floyd Sweet's vacuum triode – a 6-lb., solid-state device containing special coils and two separated barium ferrite magnets. The magnets were specially activated by Sweet's proprietary process so as to powerfully self-oscillate at a chosen ELF frequency, such as 60 Hz. [Such self-oscillation of barium compounds are well-known, but at optical frequencies. Use of a photorefractive magnetic material that is also an insulator allowed Sweet to initiate self-oscillation at ELF frequencies.]. An input sine wave of 10 Volts and 33 microamperes then produced 500 watts of phase conjugate replica EM power, extracted from the self-oscillation energy between the vacuum and the magnets. The amplifier gain (COP) of this open system, self-oscillating, pumped phase conjugate mirror device was some 1,500,000. A successful antigravity test of the device was also performed by Sweet at my urging, and resulted in a controlled reduction of its weight on the laboratory bench by 90%. For as much as could be revealed of the operation and testing of Sweet's proprietary device, see Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," Proceedings of the 26th Intersociety Energy Conversion Engineering Conference (IECEC '91), Boston, Massachusetts, 1991, p. 370-375. Unfortunately nothing can be done with the device – e.g., because of formidable legal entanglements due to the conflicting agreements Sweet made with different financial backers. However, McLain & Wooten have produced a repicable, tested, overunity device & full construction details have been rebuilt on Internet.*

[20] *In the modern geometrical view, all individual field energies come from the conglomerate structure called "gravitational field." Transforming one field energy into another kind may be done by first transforming the initial field energy back into G-field energy, then re-releasing the G-field energy as the desired new type of field energy. Vacuum engines allow control and utilization of this process.*

[21] *G. J. Stoney, "XLVIII. On a Supposed Proof of a Theorem in Wave-motion, To the Editors of the Philosophical Magazine," Philosophical Magazine, 5(43), 1897, p. 368-373.*

[22] *E.T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Mathematische Annalen, Vol. 57, 1903, p. 333-355; "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions," Proceedings of the London Mathematical Society, Series 2, Vol. 1, 1904, p. 367-372.*

[23] *Richard W. Ziolkowski, "Exact Solutions of the Wave Equation With Complex Source Locations," J. Math. Phys., 26(4), April 1985, p. 861-863. See also Ioannis Besieris, Amr M. Shaarawi, and Richard W. Ziolkowski, "A bidirectional traveling plane wave representation of exact solutions of the scalar wave equation," J. Math. Phys., 30(6), June 1989, p. 1254-1269. See also Michael K. Tippett and Richard W. Ziolkowski, "A bidirectional wave transformation of the cold plasma equations," J. Math. Phys., 32(2), Feb. 1991, p. 488-492.*

[24] *E.g., see Abner Shimony, "Events and processes in the quantum world," in Quantum Concepts in Space and Time, Eds. R. Penrose and C.J. Isham, Clarendon Press, Oxford, 1986, p. 192: "...local hidden variable theories may be possible only if relativity theory is replaced by a radically different theory of spacetime structure." (My comment is that this should not be surprising, since classical electromagnetics, quantum mechanics, and general relativity are in profound contradiction of each other, and cannot be unified as they are, in spite of decades of Herculean efforts by many excellent physicists).*

[25] *We may model a mind as a separate 3-space, and its functional operations as "physical" in that hyperframe. Thus a mind and its operations are hyperspatial and outside physical matter's 3-space. Both mind and matter 3-spaces share a common 4th (time) dimension. So it requires at least seven dimensions to model a living creature, eight to model a species, and nine to model all life on earth. The 4th dimension of the mindworld hyper-4-space coincides with the 4th dimension of the physical world's Minkowski 4-space. A priori, mind/matter engineering operations involve engineering and structuring the time stream. This allows engineering either physical reality or mental reality or both simultaneously.*

Normally, so QM tells us, the observation process destroys time, so that all "observables" are spatial only. So the completion of each observable change in a living mass system momentarily destroys the only connection that the mass had with its associated mind! It vanished in the so-called "collapse of the wave function."[26,27,28] Fortunately, little pieces of time are always being serially added and subtracted by the ubiquitous photon interaction process with every mass. Hence the body's particles of mass are continually being *connected to* and *disconnected from* little serial bits of the time stream, and from corresponding serial bits of the *mindstream* of that individual.

Type 2 Disruption of Time and Mind

Type 1 engineering does not disrupt or affect the flowing time stream. Hence it does not disrupt or affect the flowing mindstreams of biological systems in the vicinity.

This is not necessarily true of Type 2 engineering! Type 2 engines of appreciable power can and will disrupt and destroy the body's continual detachment from and re-attachment to its mind-stream. Type 2 engines will appreciably disrupt and alter the flowing time stream, and thus disrupt and alter the flowing mindstreams of all life forms in the vicinity. The size of the "vicinity" depends upon the size of the engine.

So to beneficially utilize vacuum engines, we do not strive for control of vast energies. We must use a surgeon's scalpel, so to speak, instead of a giant steam hammer. If one seeks weapons, on the other hand, one will strive for control of much greater vacuum engine energies. The KGB secret laboratories, e.g., have pursued this goal for over four decades. Several generations of Type II weapons have been developed and deployed, all under continued KGB control and operation. These Type 2 weapons could, in the words of Khrushchev's address to the Presidium in January 1960, *"...wipe out all life on earth if unrestrainedly used."* Now one can easily see how that could happen: ***Any massive use of Type 2 weapons will substantially upset the time stream on earth, including all individual time streams. It will so disrupt all the mind streams of all earth's creatures that their connections to their physical bodies will be instantly broken.*** At least now we know why Brezhnev himself was so frightened of these weapons in 1975.[29]

Another unusual characteristic of Type 2 engineering is the *slowly decaying persistence of any special vacuum engine structure artificially created in the vacuum.* We may analyze this effect in terms of the "ghost forms" of quantum mechanics.[30,31,32]

Engineering the Mind, Its Operations, and Its Contents

The vacuum engine affects/curves/structures not only the three *spatial* dimensions of ST, but also the *time* dimension. Hence the vacuum engine approach can be used to engineer not only the observable physical matter (which is 3-spatial), *but also the mind and thought (which are time-like to the external observer).* Literally one can "get into the mind's connection channel" and alter the mind, its contents, and its operations at will by using appropriate vacuum engines.

By appropriately and selectively nesting the spacetime (ST) curvature structuring, one can even reach beyond the

[26] *Rigorously, the emission of a photon by the living mass destroys its time channel, thus collapsing the wave function and disconnecting the mind. Absorption of another photon immediately thereafter adds an increment of time back to the mass, forming* **masstime** *and reconnecting the time channel and hence the mind channel. Mass does not exist in time per se; masstime does. The temporary disconnection of the time channel by photon emission causes the wave function to collapse; a priori a wave cannot exist without some time available in which to wave! This in fact produces the observable mass from masstime. The problem is that the physicists have ignored the transport by the photon of Δt as well as ΔE. Thus they have not noticed that the ubiquitous photon interaction with a mass creates the continual addition and subtraction of time increments. This continual coupling and uncoupling of mass to and from the time dimension creates a* ***discretized*** *flow (passage) of time for that mass. This continual connection and disconnection of a mass to and from only a tiny little piece of the time channel is responsible for the past and the future not being observable; "being observable" is simply being connected to a single small Δt increment, not all the increments that have gone before or that will follow hence. When one looks at the corner of a room, the 3-spatiality of one's mass instrumentation system is why one can see length, width, and height but not the fourth dimension, time.*

[27] *Since the photon interaction – including the virtual photon interactions – can be engineered, obviously the passage of an object through the discretized timestream can also be engineered, electromagnetically. Not only can a photon, electron, or proton be time-reversed, but also an assemblage of photons, electrons, protons and neutrons can be time-reversed. Among other things, this means that a diseased living physical cell can be time-reversed (dedifferentiated) back to a previous healthy state, as shown by Priore and also by Becker. Kaznacheyev, as does Becker, also shows that healthy living cell can be "time-forwarded" (differentiated) to a new state, if bombarded with the weak vacuum engine templates (graviton lattice structures) for that state. The minimum graviton lattice (ordering of SWZ wavepairs) utilizes one harmonic frequency interval. Thus quartz will pass Kaznacheyev's cytopathogenic effect, since it passes IR to UV – one harmonic interval. Ordinary window glass does not pass a complete harmonic interval, hence cannot pass the minimum graviton lattice and destroys the disease-inducing vacuum engine template.*

[28] *Since the entire area is highly nonlinear, then nonlinear oscillator theory applies. Graviton lattices may therefore be activated harmonically or subharmonically. This means that "optical band" results can be initiated by analogous subharmonic input – e.g., microwaves or even sound waves. G-lattices work like music; one recognizes a C-chord regardless of the octave. In similar manner, vacuum engines (G-lattices) may be shifted by any number of octaves, with initiation of results then being delayed in the responding physical systems, as prescribed by nonlinear oscillator theory.*

[29] *See Christopher S. Wren, "Brezhnev Talk for Accord against "Terrifying Arms", New York Times, June 14, 1975, p. 1, 11.*

[30] *Since statistically every possible change in the vacuum is constantly and continually occurring in each and every differential volume, no matter how small, then from time to time in that maelstrom any physical (and mental) template we care to visualize appears, exists for a very short but finite time, then disappears, then reappears, etc. Such a continual, untidy characteristic is called a* ***ghost form,*** *and usually downplayed or ignored in the teaching of QM because it is "unpleasant." However, anything and everything – no matter how bizarre and whether living or inert – has a small but nonzero "density of reality" in the vacuum flux. Everything that ever was or will be, and everything that never was and never will be, is also there. The point is, creation of a vacuum engine template for a ghost form adds energy to (activates) that form. Just as a Dirac "ghost form electron" can be lifted from the vacuum by adding energy, so can any other ghost form, be it "living" or "dead." The process is fundamental and not just for electrons. Adding energy to a ghost template, we increase the local energy density of that ghost form in all electrical potentials in the entire area. This structuring of vacuum spacetime extends radially in all directions, tailing off to zero at infinity. When the inputting energy is ceased, the energized/activated form will then gradually decay over a period of time.*

[31] *We may compare the activation, persistence, and decay of the ghost form to an accumulator fed by two inputs, one blue liquid and one yellow liquid, with an outlet pipe on the opposite side. Suppose only the blue pipe is turned on; the tank is filled with blue liquid and blue liquid comes out the outlet. Now we turn on the yellow valve, and yellow liquid also starts entering. Over a period of time, the liquid in the tank will gradually turn green, as will the fluid from the outlet. Now we turn off the yellow valve. Over a period of time, the fluid in the tank will gradually turn back to blue color, as will the outlet liquid. Energizing and decaying ghost template structuring of the vacuum works the same way.*

[32] *For inputs that have raised the ghost template near or above the observable (quantum) threshold, this "decay time" may be quite long. Golden once accidentally charged up his local area with such a local template, in a powerful experiment that lasted about eight hours. Materializations occurred, determined by the thought-form (steady ghost form) inputs from the minds of the unintentional participants. In addition, interference with the timestream occurred, as indicated by all local clocks – mechanical, electrical, pendulum, etc. – going substantially astray. The materializations decayed away in a couple of hours, simply dematerializing back into the virtual state when their average energy density level reduced past the quantum threshold. It required four days for the entire "ghost template" to decay away and for the clocks in the area to fully resume normal operation.*

ordinary 3-space and get directly into the higher dimensional space one may mathematically use to model the mind *(see figure 8)*. One can then directly "engineer" in that *pure mind* arena (in the *mental spacetime*, in the modeling sense). This capability, I believe, was responsible for Brezhnev's vivid fear of these weapons in 1975, and his statement to visiting U.S. senators that, not only must the nations of the earth ban nuclear weapons, but also the development of new weapons of mass destruction *"more frightful than the mind of man has ever imagined."*[33] Gromyko later introduced a draft treaty to that effect to the United Nations the same year, and urged the nations of the world to sign it.[34] Article one of the draft treaty stated that the Russians would identify the type of weapons when negotiations on the treaty started. *No one had the slightest notion what the Russians were referring to.* However, three other nations – not hostile to the U.S. – later did develop some of these Type 2 weapons. The Soviet Union was already engaged in operational testing against U.S. and other targets, with incidents mistaken for "accidents" or "anomalies" by the world's news agencies.[35] During the beginning of the 1980s the three nations began checking the Soviet Union by demonstrating their own use of the weapons against Soviet targets. Again the open press did not recognize the true nature of the incidents involved. At the close of the 1980s the triad *vigorously* "checked" the Soviet Union, clearly demonstrating their ability to devastate the Soviet Union should it attempt to devastate friendly nations.

So a special case of "deterrence by massive retaliation" came into being in the Type 2 weapons area as well as in the conventional and nuclear areas. Does the reader recall, e.g., the mysterious explosion of several Soviet missile ammunition

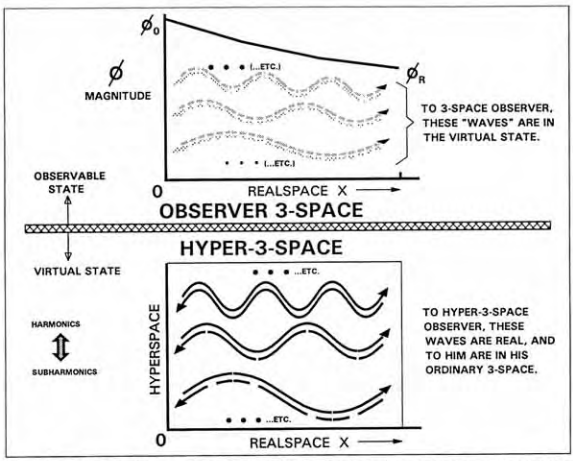

Figure 8. The 7-space EM potential. In observer 3-space (top figure), the potential is composed of a virtual particle flux. In hyper 3-space, the potential is a harmonic series of a SWZ bi-directional EM wavepairs.

storage sites in the space of a few months in 1983-84?[36] A single one of these explosions destroyed a third of all the missiles in the entire Soviet Northern Fleet. There were other major incidents whose true nature and cause went unnoticed.

Frustrated in the intent to dominate the world by surreptitious, delicate use of its Type 2 weapons, the economy of the Soviets simply fell apart. The Berlin Wall was torn down and the Soviet Union broke apart into independent regional nations.

In that upheaval of the Soviet Union, however, the KGB remained intact, well-funded, and still firmly in possession and control of the Type 2 superweapons, including development, manufacturing, deployment, manning, and operational employment.[37,38]

Wheeler's Principle and Its Extension

Einstein has strongly pointed out the necessity to review foundations *(see table 2)*.

The great physicist Wheeler has a very nice statement on the curvature of spacetime. Briefly, he summarizes the gist of GR as *"Geometry tells mass how to move, and mass tells geometry how to curve."*[39] By "geometry" he is referring to *spacetime*. So we may immediately sub-

[33] *Wren, 1975, ibid.*

[34] *Prohibition of the Development and Manufacture of New Types of Weapons of Mass Annihilation and of New Systems of Such Weapons, draft treaty introduced by Gromyko at the United Nations' 30th session of the General Assembly, New York, Sept. 23, 1975. The first article provided that the types of these new weapons would be "specified through negotiations on the subject."*

[35] *A long list of these incidents has been published by this author, through the Tesla Book Company. See T.E. Bearden, Soviet Weather Engineering Over North America, 1985; Fer-de-Lance, 1986; AIDS: Biological Warfare, 1988, Analysis of Scalar Electromagnetics, 1990, and Gravitobiology, 1991.*

[36] *See photograph, Jane's Defence Weekly (JDW), 2(3), July 28, 1984, p. 92; see also Mark Daly, "Goa and Goblet SAMs in Severomorsk explosion," JDW, 2(6), Aug. 18, 1984, p. 224; Derek Wood, "Soviets' northern fleet disabled... 'not viable' for six months," JDW, 2(1), July 14, 1984, p. 3; Derek Wood, "Six explosions in the past seven months," JDW, 2(1), July 14, 1984, p. 3; John Moore, "The aftermath of Severomorsk," JDW, 2(6), Aug. 18, 1984, p. 224.*

[37] *To survive as the leader of Russia, Yeltsin of necessity formed a pact with the KGB. KGB support insured that no coup of substance could be mounted against him, and that the KGB would insure his remaining in power. In return, Yeltsin saw that the KGB was well-funded, remained intact, retained all its secret weapons laboratories and secret weapon scientists and manufacturing facilities, and retained and continued to operate all its deployed, operational superweapons. The KGB changed its name and continued business on a less public profile. Publicly it officially turned a "much gentler face" toward the Russian citizenry. But essentially the KGB still controls most of the Russian military officer corps. Through the KGB/military connection the Communist Party can still accomplish a military coup and seize control of the country again, at least for the foreseeable future, when it chooses to do so. The Russian threat has not disappeared; it is simply hibernating.*

[38] *The Communists/Generals in control of the KGB and these superweapons are perfectly capable of turning the unfortunate dissolution into an excursion scenario of their long-planned major concessions offensive prior to ultimately striking the West with a clenched fist and destroying it. The communist aim has not changed one iota since 1917, although the communists have temporarily lost or relinquished control over the Russian civilian populace. For a description of this "29th move of the chess game," see T.E. Bearden, "Glasnost: 29th Move of a 30-Move Chess Game," Raum & Zeit, 1990.*

[39] *W. Misner, K.S. Thorne and J.A. Wheeler. (1973) Gravitation, W.H. Freeman and Co., San Francisco, 1973, p. 408. On p. 5 the principle is stated as "Space acts on matter, telling it how to move. In turn, matter reacts back on space, telling it how to curve." Thus space is already a vacuum engine that acts on matter, and mass-energy acts on space to curve it.*

Table 2. Einstein on Reviewing Foundations

"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts, He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them."

Albert Einstein, "Foreword," in Max Jammer, Concepts of Space: The History of the Theories of Space in Physics, Harvard University Press, Cambridge, Massachusetts, 1969, p. xi-xii.

Table 3. Wheeler's Principle and a Corollary

Wheeler

"Geometry tells mass how to move, and mass tells geometry how to curve."

By "geometry" is meant "spacetime." Translating: "Mass tells spacetime how to curve, and curved spacetime tells mass how to move."

Corollary

"Trapped EM energy tells spacetime how to curve. The structuring of that trapped EM energy tells the resulting curved spacetime how to nest its curvatures. This forms a vacuum engine. Its nested curvatures of local spacetime tell mass and energy how to structure and move. By forming vacuum engines deterministically, one may use them to affect, alter, and change local mass, energy, and mind as desired."

stitute synonyms to yield "Mass tells spacetime how to curve, and curved spacetime tells mass how to move."

We further modify and extend this latter statement, replacing mass by its trapped EM energy (this is consistent with general relativity) and adding nesting of such trapped energies. We also allow for altering the timestream, the mind, and the mindstream. With these modifications, a corollary to Wheeler's principle results as follows: *"Trapped EM energy tells spacetime how to curve. The structuring of that trapped EM energy tells the resulting curved spacetime how to nest its curvatures. This forms a* ***vacuum engine.*** *Its nested curvatures of local spacetime tell mass and energy how to structure and move. By forming vacuum engines deterministically, one may use them to affect, alter, and change local mass, energy, and mind in any manner desired" (see table 3).*

To gain a "feel" for spacetime curvature, one may visualize it as analogous to the variation of local pressure in a gas or fluid.[40] Using the earth's atmosphere as a model, we may precisely create pressure points and areas (lows and highs) throughout, and gradually move them at will. This control of highs and lows will allow control and direction of the atmospheric flows. Theoretically, the entire atmospheric flow of the earth can be steered and controlled, by using such an approach. In short one can directly "steer" the weather worldwide, or over a given continent. Present Russian development allows this weather control process to be done sufficiently to control and steer the great jet streams, with concomitant direct influencing of the weather.[41] *We have not had any truly "normal" weather over the U.S. since 1976.*

Type 2 Engineering Is Just Beyond the Present Vanguard of Science

As can be appreciated, Type 2 engineering is beyond vanguard science. The forefront of orthodox science is still where Wheeler's original statement is, and does not apply the SWZ methodology nor nesting of spacetime curvature. Science still does not even try to create vacuum engines and perform vacuum engineering *(see table 4 on page 76)*. Conventional scientists are still very firmly rooted in Type 1 engineering.

In ordinary GR, nowhere does there appear a precise definition of the term "gravitational field."[42] The G-field is just a *conglomerate of loose things*, and – by Sakharov's postulate – not a fundamental field of nature at all.[43] It already follows that, since "gravitation" is "geometry of spacetime," then "curvature" of spacetime is achieved by altering and changing the "conglomerates that comprise G-field" from their ambient conditions. The ability to structure and nest such curvatures also follows in straightforward fashion.[44]

Pumped Phase Conjugate Mirrors and the Priore Mechanism

The astounding thing is that Antoine Priore, using pure intuition, was able to arrive at an exact process for forming a special kind of beneficial vacuum engine![45]

We know today – but scientists did not know it when most of Priore's work was being done! – that a highly nonlinear material acts as a ***phase conjugate mir-***

[40] *It is actually the variation of the local energy density of the vacuum from its normal value.*

[41] *See T.E. Bearden, Soviet Weather Engineering Over North America, 1-hr. videotape, 1985. Available through the Tesla Book Co. In the last few years, the Russians have substantially increased their weather engineering capability and activity. Most of the transmissions from this system are now fairly good electrogravitational waves (coupled wave/antiwave pairs), with EM imperfections many dB below signal level. Hundreds of them are utilized when the system is actively employed over the U.S. By applying Whittaker 1904, these signals – invisible to the normal receiver – can be received and displayed.*

[42] *Misner, Thorne and Wheeler, Gravitation, 1973, p. 399.*

[43] *A.D. Sakharov, "Vacuum Quantum Fluctuations in Curved Space and the Theory of Gravitation," Soviet Physics Doklady, Vol. 12, 1968, p. 1040-1041 [English translation.] Sakharov's article (in Russian) is in Doklady. Akad. Nauk SSSR, Vol. 177, 1967, p. 70-71.*

[44] *General relativists already accept the vacuum as containing a 4-momentum-flux river. See Misner, Thorne, and Wheeler, Gravitation, 1973, p. 130-131. They treat the stress energy tensor as a machine (ibid., p. 131). The only difficulty is that they have not realized that, by applying the SWZ approach, much more complicated "vacuum machines" than they have considered can be built and utilized electromagnetically.*

[45] *See Christopher Bird, "The Case of Antoine Priore and His Therapeutic Machine: A Scandal in the Politics of Science," Explorel, 5(5-6), 1994, p. 97-110 for an excellent summary of the Priore Affair. The Priore group cured terminal tumors, sleeping sickness, and arteriosclerosis in lab animals and restored suppressed immune systems. Eminent, even world-renowned French scientists worked with him. The work was funded by the French government and published in leading French scientific journals. It was suppressed when the French government changed to a leftist government in the mid 70s.*

ror[46,47] *(see figures 9 & 10).* In other words, when one puts in a sine wave, e.g., in addition to producing harmonics the nonlinear material will also produce a strange, backward-traveling replica of the input wave. This "backward wave" has been well-known since the early 1970s. It is truly a *time-reversed* wave (Barus wrote the solution much earlier).[48] It will backtrack back through space, over the *exact* path taken by the input wave.[49,50] If the input wave is continuous, this "phase conjugate replica" (PCR) time-reversed wave will precisely appear everywhere in space that the input wave occupies.

The key here is "everywhere in space." It does not matter how tortuous and twisted the route taken by the input wave; the PCR will backtrack it and appear spatially superposed with it. This has been *experimentally* proven many times in nonlinear optics.[51] One concludes that the vacuum has a memory,[52] and the PCR wave can retrace the memory of the path previously taken by its stimulus.

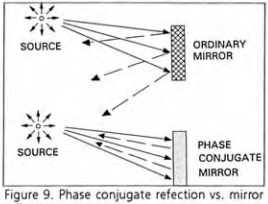

Figure 9. Phase conjugate refection vs. mirror reflection.

Figure 10. Pumped phase conjugate mirror.

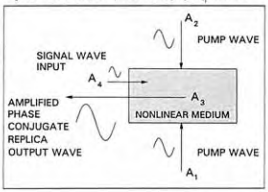

Another nice thing has been discovered and is used in the relatively new nonlinear optics. If one "pumps" the phase conjugate mirror with opposing waves (such as, e.g., bidirectional EM wavepairs), then up to all the energy in the pump waves is absorbed and re-emitted in the "crawfishing" PCR wave.[53] In other words, the stimulated PCM can be made into an amplifier of the time-reversed wave output, just by "pumping" it with the proper bidirectional wavepairs.[54,55]

Anomalous "Bio-Jamming" and Deep Diffusion by EM Smog

Pumping by EM waves or by simultaneously varying EM forces due to opposing streams of photons will produce a much higher probability of 4-wave mixing and multiphoton interactions. Simply put, this probability is a function of the sheer photon/signal density, along the lines pointed out – but not clarified – by

[46] *Elsewhere we have pointed out that, for the primary EM interactions with a living system, we must employ an electromagnetics of higher topology than the conventional EM (either vector or tensor). Barrett has shown that a higher topology EM will involve and exhibit nonlinear optical functioning without necessarily employing optical materials. See T.W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," Annales de la Fondation Louis de Broglie, 16(1), 1991, p. 23-41. Thus if we wish to utilize higher topology EM functioning in and on the body/mind, or just to comprehend such functioning, the nonlinear optical processes will form part of that functioning. We must be familiar with phase conjugate optics functions, regardless of the frequency range we operate within, and we must examine the situation accordingly.*

[47] *In the conventional struggle to elucidate EM effects on biological systems, the failure to realize this higher topology principle has led to experiments that are often difficult or impossible to replicate, primary interactive mechanisms remaining a mystery, and the inability to definitively answer even the simplest question such as "Does power line radiation enhance the emergence of cancer and leukemia, and if so, how and under what circumstances?" Forty years of research by able and determined EM bioeffects scientists have thus failed us, because the model they so stringently apply is grossly in error. What they have thoroughly proved is that their fundamental model is incorrect and inadequate for the intended purpose for which it is being utilized. The solution is not to just continue more experiments in the same vein, but to revise the model itself. We have previously pointed out (Bearden, Cancer and the Unresolved..., 1993, ibid., p. 40) the present EM bioeffects model, the modification areas required, and how to ascertain when the adjusted model is correct.*

[48] *Carl Barus, "A Curious Inversion in the Wave Mechanism of the Electromagnetic Theory of Light," American Journal of Science, Vol. 5, Fourth Series, 1898, p. 343-348 gives the first known solution of Maxwell's equations for a time-reversed or "backwards-traveling" EM wave.*

[49] *According to the well-known "Distortion Correction Theorem" of nonlinear optics. For a precise statement of the theorem, see Amnon Yariv, Optical Electronics, 3rd Edn., Holt, Rinehart and Winston, New York, p. 500-501. See particularly Chapter 16: "Phase Conjugate Optics – Theory and Applications."*

[50] *For the space-borne laser, e.g., the U.S. uses iterative phase conjugation – known as self-targeting – of a booster-reflected laser signal to keep a powerful laser beam locked upon the same spot on a distant missile booster, rising during its launch phase, long enough to burn through the casing and destroy the booster, even 10,000 miles away. The process is known as phase conjugate shooting.*

[51] *A striking example is given by David M. Pepper (1986) "Applications of Optical Phase Conjugation," Scientific American, 254(1), Jan. 1986, p. 75. Possibly the best extant introduction to the subject of nonlinear optical phase conjugation is David M. Pepper, "Nonlinear Optical Phase Conjugation," Optical Engineering, 21(2) March/April 1982, p. 156-183.*

[52] *Without extended discussion we call attention to the importance of this finding with respect to homeopathic medicine and therapy. In fluids, obviously one proceeds from vacuum flux organization and memory upward through matter's organization (and hidden memory), through the individual particles of the nucleus, to the nucleus, to the atom, to the molecule, etc. Between the atom and the molecule levels we encounter hydrogen bonding actions in fluids, which is of great importance to the biochemistry, especially the protein chemistry. It is possible to show that the mind operations and the cellular control operations also SWZ structure the H-bonding activities of the body's aqueous fluid; it can also be shown that any chemical, drug, additive, and EM smog also structures and affects the H-bonding. However, further discussion of these two elements is beyond our scope for this presentation.*

[53] *Note that "pumping" is simply a expansion of the notion of stressing the material. Emission of the amplified PCR wave is a kind of piezoelectric release of the stress energy. The point is that physical stress of a material can be freely tapped and energy continually extracted, if that stress is varying. The McLain/Wooten device uses that principle.*

[54] *To create a normal PCR wave response to an overt EM signal wave input, nonlinear optics uses overt EM pump waves. For the hidden EM signal wave input – i.e., for the hyperspatial vacuum engine as input – one must use "hyperspatial" wave pumping. The "cell as a phase conjugate mirror" must be pumped by hidden (hyperspatial) EM waves inside a scalar EM potential. In the normal case, an amplified, normal EM PCR wave is produced in response to a normal signal wave input and normal pump waves. In the vacuum engine case, an amplified, hyperspatial EM PCR wave complex is produced in response to a hyperspatial signal wave input and hyperspatial pump waves.*

[55] *Note that the amplified PCR wave represents a reorganization and deterministic redirection of stress energy. Hence it is a time-reversed operation, and also a negentropic operation. Since the PPCM operates as an open system not in thermodynamic equilibrium, with input of excess energy in the form of the pumping, negentropic operation is permitted by nonlinear thermodynamics (of a system far from thermodynamic equilibrium) For a lay summary of such thermodynamics, see Gregoire Nicolis, "Physics of far-from-equilibrium systems and self-organization," in Paul Davies, Ed., The New Physics, Cambridge University Press, Cam bridge, 1989, p. 316-47. For a more technical presentation, see G. Nicolis and I. Prigogine, (1987), Exploring Complexity, Piper, Munich, 1987. Prigogine received the Nobel Prize for his pioneering work in this field.*

Devyatkov et al.[56,57] Thus dense electronic smog – even though it contains only extremely weak signals – increases the nonlinear optics type of interaction. This allows anomalously deep penetration and *diffusion* of special weak EM signals due to the "pumping" aspect of multiphoton interaction. The nonlinear cells and cell parts act as pumped phase conjugate mirrors (PPCMs) when subjected to multiphoton interactions.

Worse, the *signal wave* inputs to the PPCMs are the normal weak EM signals of the body itself. Hence the resulting PCRs from the PPCMs are superposing phase conjugates of the body's normal signals. This results in (1) a "diffusive" effect in the body of the PPCM formations, and (2) formation of very weak "EM cancellation" signals throughout the body, specifically targeted to the body's own control signals, including those to and of the immature immune cells in the bone marrow. In the bone marrow, "*partial-cancellation jamming*" *(see figure 11)* occurs in the normal control and development of the immune system cells as they are created. Slowly errors and degradation damage accumulate with time, including over the years. This cumulative immune system damage combines with other damage effects due to pesticide residues, pollutants, etc. The combined degradation results in long-term cumulative damage to the immune system and its cells. Increasing errors in the immune system's functioning eventually result in appearance of immune system disorders and increasing vulnerability to

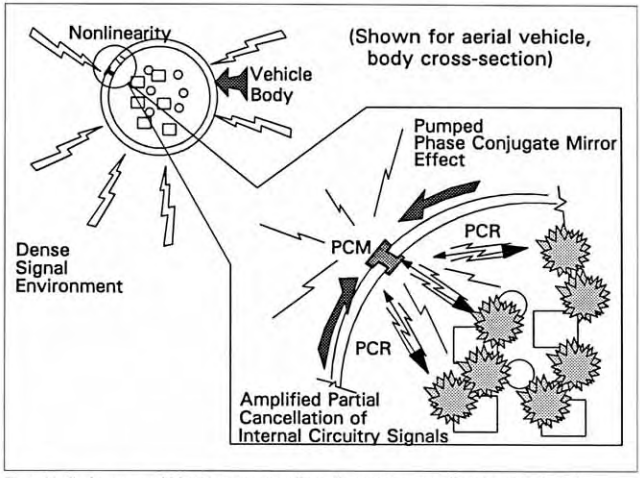

Figure 11. Single versus multiphoton penetration effects. Phase conjugation effects become of significance, generating PCR signals which couple to and backtrack the cells' and tissues' own signals, this penetrating throughout the body with weak partial cancellation jamming.

Table 4. Mechanism for the Priore Therapy

- Produced Specific SWZ-Structured Scalar Potential
  - 17 EM frequencies mixed in a rotating plasma
  - Phase conjugates added by the plasma
  - Formed vacuum engine with hyperspace pump waves
  - Modulated onto a rippling magnetic field which carried it to every cell and all its parts
  - Jyperspatial pumping of cells/parts as PPCM's
- PPCM's created amplified anti-engines for disease there
- Anti-engine reversed cells/parts back to normal state
  - Cells return to control by cellular control system
  - Restored cellular control system to full functioning
- Scrubbed out the cumulated precancerous state
- Eliminated shadow disease state
- Restored the immune system to high functioning
- No excessive trauma to treated animal

In Part II of this wonderful article, by Mr. Bearden, a few of the topics you can look forward to are; The Gulf War Syndrome, How to Make a Gravitational Wave & Curve Spacetime, Potentials & Gravity and How Priore Made Vacuum Engines.

[56] *The Russians refer to the hidden EM wave structure of the scalar potential – i.e., to the SWZ structuring and vacuum engine templates – as the information content of the field. Western scientists assume this phrase refers to ordinary spectral analysis and communications, ignoring those statements that the normal EM theory does not apply. Also, Devyatkov et al seem in no great hurry to express their true meaning more clearly. See N.D. Devyatkov (Ed.), Applications of Low-Intensity Millimeter-Wave Radiation in Biology and Medicine, IRE Akad. Nauk. SSR, Moscow, 1985. [in Russian]. See also N.D. Devyatkov, Yu. V. Gulyaev, et al, [Organizing Committee Chairmen], Digest of Papers - International Symposium on Millimeter Waves of Non-thermal Intensity in Medicine, co-sponsored by Research and Development Association "ISTOK" and Research Institute of U.S.S.R. Ministry of Electronic Industry ("ORION"), Moscow, Oct. 3-6, 1991. Collection of 300 papers. [In Russian].*

[57] *However, some leading Western scientists – such as Wheeler, Feynman, and Jaynes – strongly advocate replacing the present erroneous concept of the EM force field existing in spacetime with the notion that what exists there instead is an information storage device containing a summary of what we need to predict the behavior of a charge if there should be one at the point. E.g., see J.A. Wheeler and R.P. Feynman, "Classical electrodynamics in terms of direct interparticle action," Reviews of Modern Physics, Vol. 21, 1949, p. 425-433; E.T. Jaynes, "Probability in quantum theory," in Complexity, Entropy, and the Physics of Information, Ed. W.H. Zurek, Addison-Wesley, Redwood City, CA, 1990, p. 33-55.*

VACUUM ENGINES AND PRIORE'S METHODOLOGY: THE TRUE SCIENCE OF ENERGY-MEDICINE

Part II of II

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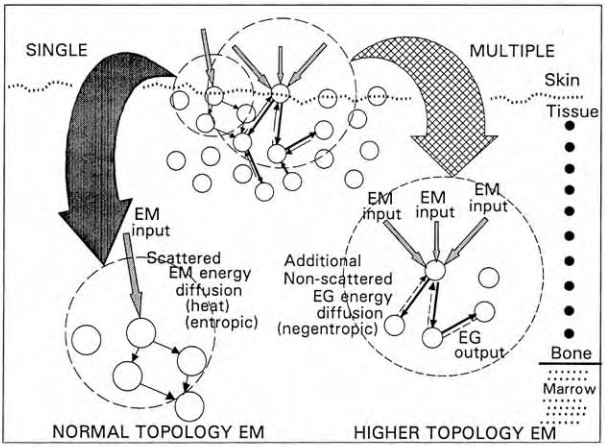

Fig. 12. Single versus multiphoton penetration effects. Phase conjugation effects become of significance, generating PCR signals which couple to and backtrack the cells' and tissues' own signals, thus penetrating throughout the body with weak partial cancellation jamming.

The Gulf War Syndrome

For very dense EM smog environments such as in the recent Gulf War, both the anomalous EM diffusion effect and the partial cancellation jamming effect on humans are dramatically accelerated. Cellular and immune system damage that would require decades of exposure at very low EM smog levels will cumulate in only a few months. In turn, this accelerated malfunctioning of the cellular control system and the immune system enhances the effects of other biological suppressants already present in the body or encountered during the dense signal environment exposure period. These augmented suppressants include the degradation due to the individual's prior lifetime EM smog exposure, attack by unfamiliar disease organisms endemic to the areas, exposure to oil fire smokes and pollutants, exposure to increased UV from solar radiation, and exposure to chemical agents and possibly surreptitious biological warfare agents.[58]

Further, in the haste to protect the troops from possible chemical and biological attack, all soldiers were administered a nerve agent called pyridostigmine bromide; in addition, approximately 150,000 were inoculated with anthrax vaccine, and 8,000 also received experimental botulism toxin shots.[59] Normally for medically-administered agents, the relatively minor suppression effects on the immune systems and body are followed by quick recovery, due to a properly functioning immune system and cellular control system. However, all three of these Gulf War preventive medical treatments do create "small cases of sickness" in the normal body.[60] In other words, a low level of the disease strain *is created* in the patient. Further, even after the apparent "initial recovery," there will now be a much longer dormant "apparently healthy" period during which the *vacuum engine templates for the disease remain, until they have finally decayed away.* In a sustained dense signal environment, this "decay away" period may be dramatically extended or never occur; in fact, the disease may progress from the vacuum-engine state to the low level physical state, then into a fully developed syndrome.

So we introduce the concept of the *relative level of a disease.* First, the disease and/or its vacuum engine templates are in the body. A low level or absence of disease, as we normally think of it, is with respect to the high disease level – the full-up, developed state of the disease. A disease level is "low" because of the ability of the immune system to fight it, overcome it, and reduce it to a "pre-disease" state; and the ability of the cellular control system to eventually rid itself of the disease vacuum engine templates, retaining only antibodies against its re-invasion. When the disease is not physically present according to conventional medical standards, but nonetheless the vacuum templates are present and not yet cleared out, we shall refer to that state as the shadow state of the disease. The cellular control system largely combats this state.[61]

[58] *Both Senator Riegle's and Senator Rockefeller's May 1994 hearings concluded that all 695,000 troops who served in the Gulf War were also exposed to chemical and biological toxins.*

[59] *Stephen Salgaller, "U.S. Role in Gulf War Illness." Letters,* **Science News,** *146(7), Aug. 13, 1994, p. 99.*

[60] *Note that at least one of these three treatments was still quite experimental. Consequently there exists less confidence in stating that its normal side effects are minimal and tolerable.*

[61] *Apparently by being able to phase conjugate with weak amplification, so that it forms anti-engines that usually are stronger than the disease's vacuum engines, gradually reversing the shadow state to normal.*

If the immune system and cellular control system are impaired, a shadow state of the disease can gradually progress to a "low level" of disease, then to a higher level, and become serious or even life threatening. This is true when conventionally the disease is physically absent but its shadow state is still present and cannot be disposed of by the cellular control system, as clearly shown by Kaznacheyev's experiments.[62,63]

We point out, but do not pursue, that the cellular control system also deals with the shadow states of diseases. In the normal state of "free from disease," the cellular control system successfully and continually deals with incident diseases, overcoming them at the shadow state level. Its process for continual disposal of the shadow state residues is hypothesized to be a version of slightly amplified phase conjugation of the vacuum engine's shadow state level.

In the model we are advancing, the disease entry and development occur by successively (1) creating its shadow state and successfully maintaining it in spite of the cellular control system's phase conjugation efforts, (2) breaching the threshold of physical changes, so that at least physical indicators of the struggle by the now-involved immune system appear, (3) progressing until conventional medicine recognizes "low level disease or infection," (4) increasing until conventionally-recognized "developed disease or infection," (5) increasing until the disease is serious and even life-threatening, and (6) increasing until the patient can no longer sustain life and dies. *We note that the best preventative medicine would and should be practiced at the shadow infection level.* The Priore therapeutical approach is capable of doing that.[64]

In the "normal" – if such an adjective can be used! – sustained "weak EM smog" exposure, the shadow state may last for several years or even several decades, prior to sufficiently accumulated degradation of the cellular control system and the immune system to allow the physical emergence of the disease. For much denser EM smog, such as existed in the Gulf War, the shadow incubation process is highly shortened, as is the time to progress from one stage to another higher stage of the disease or disorder condition.

In other words, in a dense but weak EM smog environment, the recovery from "minor diseases" actually administered as part of the initial vaccination and preventive medicine will be substantially altered because of the accelerated damage to the immune system and cellular control system. The control/immune degradation may be fast enough that the disease starts increasing from the shadow state toward higher levels, instead of being reduced and eliminated by the control/immune systems.[65,66]

Consequently, the Gulf War participants were thrust into a unique new situation: The second (shadow state) phase of decay of the "minor diseases" created in the bodies receiving the three preventive medications was interfered with by the EM fog. Because of individual variation in past cumulative damage experience, the individual control/immune systems varied from soldier to soldier. The smog environment varied in density and intensity from place to place, and from time to time. Hence the degree of interference varied from soldier to soldier because of (1) variation of past control/immune degradation, (2) variation of the EM smog exposure, and (3) variation of exposure to other suppressants. A bell-shaped distribution curve of the extent of the *net interference to net control/immune functionality*[67] would result, when the soldiers are taken as a group. That is, some of the participants just had a somewhat longer 2nd phase recovery period; some an extended 2nd phase recovery period; some a sustained, gradual rise in the 2nd phase, toward physical disease but not yet developing the Gulf War Syndrome. Some had a sustained, quicker rise toward actual physical disease instead of a decay, and have had sufficient time to develop the physical disease.

When the additional individual expo-

[62] *Kaznacheyev, several references, ibid. That is, suppose we have the shadow disease possess only a strength such that the normal cellular control system and immune system could overcome it. If the cellular control system is weakened, the disease progresses across the physical barrier. If the immune system is still strong, it can handle the encroaching disease, but will give physical indicators of its struggle (increased white corpuscles, etc.) If the immune system is also degraded, the disease will progress to low level physical disease, higher level, etc. On the other hand, if the cellular control system is normal but the shadow state of the disease is amplified, the phase conjugation defenses of the cellular control system will be breached and the disease will impel itself into low-level disease, then high level, and then kill the cells, in spite of a normal immune system combatting the breach of the cellular control system. This latter is what Kaznacheyev's experiments showed. It is also what the decades of Soviet weak microwave radiation of the U. S. Embassy in Moscow showed.*

[63] *The discerning reader will note that we are presenting the gist of a new theory of cellular disease.*

[64] *We also point out the electromagnetic biological warfare capability in this area, long since developed by the Russians and under total control of the KGB. The U.S. Embassy radiation, including the health changes and the death of three U.S. Ambassadors, was just to stimulate the U.S. intelligence and scientific communities at the highest levels. By the U.S. electromagnetic response at the Embassy itself, the Soviets could then know for certain whether or not the U.S. was aware of this EM biowar capability, and whether or not it had secretly developed defenses. Our actions assured them we had no such capabilities and no defenses – and were totally unaware of the true nature of the Embassy radiation.*

[65] *Note that the multiplicity of the assault on the control/immune systems augments the resistance and recovery difficulty. E.g., each B-cell lymphocyte can attack only a single antigen – alien property of the surface of an invader. There are about one billion B-cells in the human body, which between them are specific for about a million antigens. As can be seen, the immune system is continually having to develop B-cells with new specificities due to the continual meeting of new strains of antigens. Cumulated damage to this system affects both the body's resistance to diseases it has already acquired specific B-cells for, and its resistance to new strains for which it must make B-cells for new antigens. There is a sort of threshold, at any given time, beyond which the B-cell responses cannot keep pace, and start being overwhelmed. There is also an error tolerance level; when the errors due to deterioration surpass this level. the immune system will often begin attacking the body's own tissues in error. This results in disorders such as arthritis and cartilage and joint deterioration. With sufficient errors, previous immunity abilities also are degraded, so that more ordinary diseases become serious threats.*

[66] *The administering of three "lightly suppressive" treatments closely occurring with the soldier's entry into the Combat Zone thus posed a significantly greater problem than normal to his or her control/immune systems' operations, because the control/immune systems were suddenly degraded and hampered by the suppressive effects of the dense EM signals environment. In other words, the control/immune systems were moderately attacked by the three medical treatments (three enemy light cavalry divisions), and at the same time the entire control/immune system complex was subjected to substantial interference and suppression (the normal friendly) troop divisions were simultaneously placed under fierce and sustained attack throughout the zone. A general whose divisions are already committed in furious combat and under heavy bombardment, as are all his command posts and communications systems, has great difficulty freeing up, reconfiguring, and recommitting some of his committed troops to properly combat three other enemy forces that suddenly have appeared over the horizons from other directions!*

[67] *We may also define this as a disease progression ratio. This ratio should assume a distribution curve. For first-order simplicity, we are assuming a normal distribution.*

sures are factored in, there should have been essentially three broad groups: (1) relatively minor damage sustained, where any overt effects will only begin to appear many years hence if at all, (2) more damage sustained, where overt effects will begin to appear within the next few years, and (3) heavier damage sustained, where overt effects begin to appear either while still in the Gulf Region or within some months or so after returning.

Hence many of the Group 3 veterans of the Gulf war developed anomalous infections and immune system disorders shortly upon their return from such damage-accelerating exposure, resulting in the mysterious "Gulf War Syndrome." Conventional medical science will recognize – and has recognized – the overt phase 3 physical disease syndrome, but its cause and effective treatment remain and will remain medical mysteries. Conventional medical science will entirely fail to recognize Groups 1 and 2 cases, and will label them as due to aging, mental stress, or ordinary rise of diseases.

The syndrome has involved the "anomalous EM smog diffusion" process, as previously explained. It may – and in many cases it will – exhibit certain "signature" differences from normal diseases. The genetics of the victim are affected, and so are altered by induced transcription[68] to carry at least a portion of the "syndrome template." Semen, ova, saliva, and blood will particularly be so affected. A wife may complain that her husband's body fluids are now irritating to her skin, even producing "burning" sensations. Children conceived and born may be borne with the syndrome, or with one or more aspects of it.[69] The syndrome template can be transmitted by exchange of body fluids, so wives may also contract the syndrome and develop the disease from their husbands.[70]

Conventional EM Bioeffects Knowledge Is Insufficient

Present "EM bioeffects" scientific models contain absolutely no modeling of partially jamming the body's own special EM control system by turning its EM signals partially into G-signals, thereby partially nullifying them. It also contains no modeling of the anomalous EM diffusion process.[71] Thus the conventional medical approaches also do not contain any proper means of accounting the mechanisms for, and results of, long-term exposure to electronic smog and other combined agents and effects. Conventional scientists also have no knowledge of the major degradation mechanisms involved. The conventional medical models specifically are useless when confronted with something such as the Gulf War Syndrome or the decades of Russian microwave radiation of the U.S. Embassy personnel in Moscow. Capable scientists turn to their conventional models for answers, and the models fail them. Therefore present medical science is baffled when faced with such diseases and syndromes.[72] (*See figure 13 on next page*)

How to Make a Gravitational Wave and Curve Spacetime

We return now to the fundamentals of Type 2 engineering.

If one superposes an ordinary EM wave with its true phase conjugate replica wave, where the two waves are of equal strength, the *EM forcefield aspects* of the combined wavepair (standing wave) vanish, while the energy-density aspects remain. At every point the E-fields and the B-fields sum to vector zero *forcefield* resultants. The standing wave that results will not cause EM movement of charged particles.

However, the *energy densities* of the two locked (and now "hidden") EM waves remain and add. By standard GR, this "trapped EM density standing wave" must constitute a standing gravitational wave and a standing wave in the local curvature of spacetime!

It follows that, by assembling a harmonic set of such wavepairs, a la Stoney and Whittaker, one can form a region of spacetime such that the energy density is deterministically altered and controlled, and to engineering levels.

Engineering general relativity suddenly became a lot easier! Ironically, present physics only considers primarily the *very weak* ST curvature that can be obtained by the extremely weak gravitational "attraction of mass" G-force. For electrons, e.g., the G-force is only on the order of 10^{-42} times as strong as the electric force. Consequently orthodox GR simply "cannot pack enough trapped G-field energy into the local space" in the laboratory to get measurable effects. Only in the vicinity of a very large mass, such as the sun or a star or a black hole, does the weak G-force reach sufficient strength to yield directly observable, strong effects. Yet by using EM vacuum engines and the SWZ approach, one can obtain readily-measurable GR effects right on the laboratory bench.

The conventional medical models specifically are useless when confronted with something such as the Gulf War Syndrome or the decades of Russian microwave radiation of the U.S.

[68] *Note that the transcription component may continue to develop in the same "post disease" manner as does the shadow disease of the overall Gulf War Syndrome. The returnee continues to experience EM smog and other control/immune suppressants, though at a lesser level than experienced in the Gulf War environment.*

[69] *Such aspects are highly controversial. A few affected families are reporting such symptoms and aspects, but officially "there is no evidence" for them. However, with the initial appearance of the syndrome, officially veterans who complained of this illness were briefed by these same medical "au thorities" that their physical symptoms were stress-related, and that the cause was all in their mind!*

[70] *In a fashion similar to Priore's animal experiments that demonstrated the transfer of curative templates by a single drop of blood. Kaznacheyev showed that disease templates could also be transferred.*

[71] *In fact, EM bioeffects research for decades has used, and continues to use, sheer energy deposition (scattering of EM energy by the tissues – heat by another name!) as a measure of the exposure level. They have not applied nonlinear phase conjugate self-targeting effects at all.*

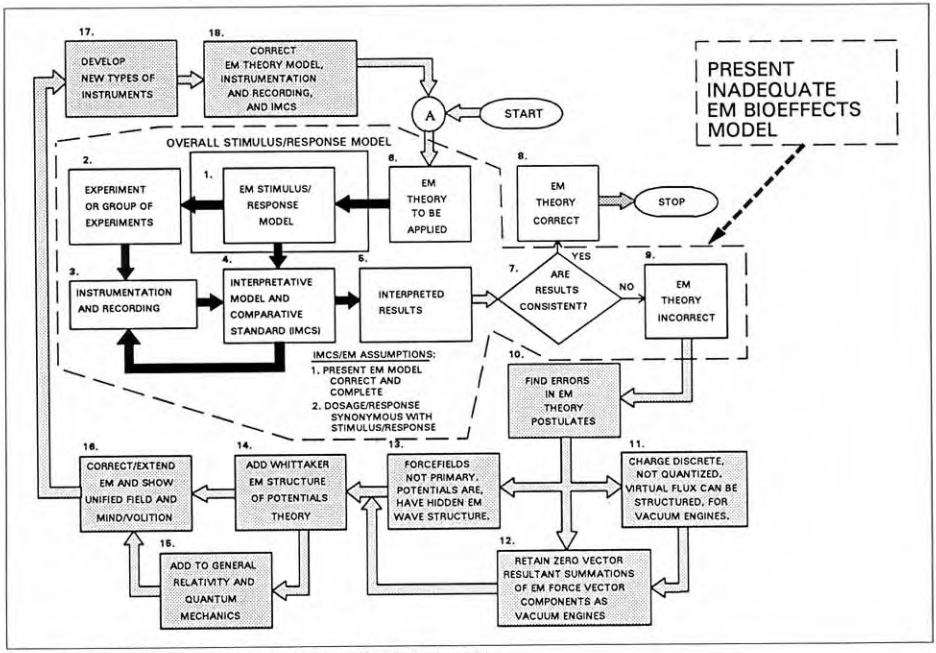

Fig. 13. Necessary corrections for the present inadequate EM bioeffects model.

Potentials and Gravity

Obviously one can simply add harmonics of such EM "locked in" wavepairs, to produce a standing "constant value potential" pattern of a fixed *excess* energy density of vacuum or a fixed *decrease* in the energy density of vacuum. This harmonic series of bidirectional EM wave pairs – the *sum set* of wavepairs – is precisely what Stoney and Whittaker showed makes an ordinary EM scalar potential. In other words, they showed the actual energy-trapping mechanism, and dramatically altered the view of a scalar potential as being simply an "electrostatic" entity and a scalar field. Instead, it is a *hidden-variable energy flow process.*[73,74,75]

Its external "scalar field" aspect is just its "local energy density" aspect, not its fundamental nature.[76]

As is well-known in GR, all potentials are gravitational because they contain trapped energy. *Any* trapped energy is gravitational, a priori, according to GR. Ziolkowski independently rediscovered the SW decomposition in the 1980s and extended it to also add the product set. Since multiplication of waves is *modulation*, in my opinion Ziolkowski actually wrote the basis for hyperspatial (or subspatial, if one models physics in only 4-dimensions) communication at superluminal velocity, essentially instantaneously anywhere in the universe. (*See figure 14 on opposite page*)

"Paired assembly of an EM wave and its true PCR" was and is the way to turn EM energy directly into gravitational en-

[72]*Just as it is also essentially baffled by many conventional dread diseases such as cancer, leukemia, AIDS, arteriosclerosis, etc. – which indicates that the conventional "models" for those diseases are also seriously deficient.*

[73]*The present preoccupation of physicists with the scalar potential is simply to provide an algorithm for calculating the local energy density – in excess joules per collecting point-coulomb of charge – and erroneously call that the definition of the potential. The magnitude of the energy collection density of the potential at a point is not what the potential is, and such is not its definition. Defining how much water can be poured out of a standard bucket, when it is dipped into a flowing river and filled with water, does not define the river!*

[74]*From the particle view, the potential is an ordering in a virtual particle flux of the vacuum. From the wave view, the potential is comprised of an ordered, harmonic series of SWZ bidirectional EM waves, where each wave reaches to the ends of the universe before having a zero energy density. It follows that the energy in each hidden sine wave is infinite, just as it is for any overt theoretical EM sine wave. So any potential – even that of a flashlight battery – already involves an infinite amount of flowing hidden EM energy, being exchanged by the source and the entire universe, flowing in both directions along any radial from the source of the potential. The scalar potential is a flowing, continual exchange of energy between each and every point in the universe and the local source of the potential.*

[75]*Both the wave and particle forms of the potential exist simultaneously. The particle nature exists in Minkowski 4-space. The "hidden SWZ waves" exist in a hyper-4-space whose time dimension is the same as that of Minkowski 4-space. The scalar EM potential actually exists as a 7-dimensional entity. The internal hidden EM flow is not confined to the speed of light in space, because it does not flow "through" 3-space; instead, it flows "around" it.*

[76]*E.g., Whittaker, 1904, ibid. shows us that all of classical electromagnetics can be made by the interference of two scalar fields, which is just a special kind of hyperspatial multiwave interferometry.*

ergy.[77] This is the unification of EM and GR that eluded Einstein all the latter part of his life, and that has continued to elude scientists today. This is the way to "trap" EM energy locally, even though the EM wave energy is flowing at the speed of light or greater. This is the way to change EM energy into gravitational energy.[78] Further, it is engineerable and testable. Remember, physics requires that energy be conserved; however, it can certainly *change its form*. GR already says that it is the trapped energy that is gravitational, not mass per se, and regardless of what kind of energy is trapped. Ultimately Einstein's formula $E = mc^2$ is actually a statement of the trapped EM energy in a mass. However, heretofore no one had the slightest notion as to the actual trapping mechanism. The SWZ work actually shows the trapping mechanism itself and allows the engineering of *electrogravitation*.

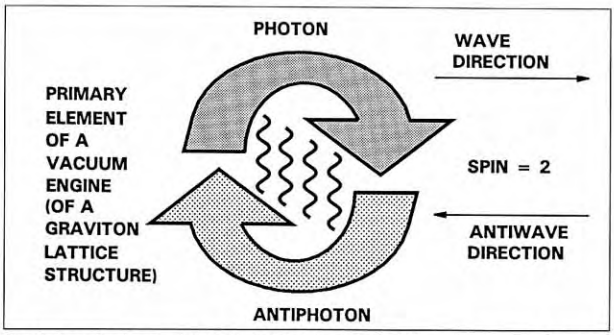

Fig. 14. A graviton is a coupled photon/antiphoton pair. In the bidirectional wavepair of the SWZ internal structure of the scalar potential, photons in the wave continually couple and uncouple as the wave and antiwave pass through each other.

How Did the Revolutionary Stoney/Whittaker Work Go Unnoticed?

Apparently, neither Stoney nor Whittaker realized that their work was pure electrogravitation. *When the referenced papers by Stoney and Whittaker were published, special relativity, general relativity, and quantum mechanics had not even been born yet!* Indeed, there still was not a wide adoption of Heaviside's vector interpretation of Maxwell's fading quaternion theory. Even classical EM was still in its infancy and just getting off to a good start.

In the 1980s Ziolkowski realized that the internal biwaves of a potential could be engineered, but remained primarily focused upon his important work with electromagnetic missiles and focus waves (slugs of EM energy which stay together as they travel, and do not spread out.) Ziolkowski is one of the pioneers in that field.

How Priore Made Vacuum Engines

This "vacuum engine methodology" was and is what Priore's intuition led him to! For the electromagnetic treatment of laboratory animals, his EM therapy device first inputted some 17 or so frequencies into a rotating plasma.[79,80] We know today that such plasmas *phase conjugate* the wave inputs, but that was not known when Priore first did it.

Obviously Priore himself did not understand the actual mechanism, but his brilliant intuition led him to discover how to do it! For many years no one knew how aspirin worked, yet that did not prevent it from being used widely and effectively.

In other words, Priore used the plasma to *unwittingly* add PCRs to each of his waves and form 17 magic SWZ "wavepairs." The entire SWZ wavepair assembly thus made an *artificial potential*, having a "vacuum engine" pumping substructure of hidden bidirectional EM waves. Adjustment of selected frequencies away from their harmonic positions adds multiplications and beat frequency modulations, creating *specific* templates and *specific* vacuum engines. These SWZ waves are hyperspatial; hence they are in the domain of the deep mind's cellular control system. When an abnormal body cell is pumped by these hyperspatial waves, the cell's own hyperspatial vacuum-engine "signal input complex" triggers a specific dedifferentiation anti-engine for that specific abnormal state. By Wheeler's principle, if spacetime curvature is *present in* the material cell, its energy and template are *applied to* the cell and act upon it. With vigorous pumping, the anti-engine is also *amplified* and so the cellular response is more rapid. In other words, the amplified anti-engine fairly quickly overpowers the disease engine and reverses the abnormal cell and all its contents back to their previous *normal* states. (*See figure 15 on the following page*)

Priore's new signal complex came out of the plasma mixing (phase conjugating) tube with SWZ structures of wavepairs, where each pair was composed of two bidirectional (opposing) EM waves. Priore then modulated this output upon a very strong, rippling magnetic field as a carrier, and radiated the body of the patient with that resultant field and its transported hyperspatial SWZ anti-engine components.

Nuclear magnetic resonance guarantees that such a magnetic field with all its modulations will be delivered entirely through the body, penetrating the flesh and bones and even the atomic nuclei themselves. It will certainly penetrate the bone marrow where all the blood cells (which includes most of the immune system's cells) are born! It will penetrate everywhere else also. So all the cells of the immune system will be exposed to the AC magnetic carrier and its impressed hyperspatial biwaves and their modulations.

The body's cells and cell-parts are highly nonlinear, and so they are also *demodulators*. They strip off the SWZ modulations. This puts the amplified vacuum anti-engines directly into and

[77] *I have previously pointed out that, in a coupled wave/antiwave pair, the photons in the wave and the antiphotons in the superposed phase conjugate replicate wave also pair into photon/antiphoton pairs, which have spin-2 helicity and hence are gravitons. This follows merely from a strong application of the distortion correction theorem. However, it is the fundamental union of EM and G into a single engineerable theory. See Bearden,* ***Gravitobiology,*** *1991, p. 1-9.*

[78] *By Whittaker 1904, we can always interfere two such potential fields and obtain an EM field, even at a distance. Thus we can also readily turn the gravitational (trapped EM) energy back to EM field (untrapped EM) energy.*

[79] *David M. Rorvik, "Do the French Have a Cure for Cancer?"* ***Esquire,*** *July 1975, p. 110-11, 142-149 gives an overview of the Priore Affair and some details of the electromagnetics of the machine.*

[80] *Note the immediate connection to the Russian energetics model, which is directly fashioned after the nature and nonlinear EM functioning of plasmas. Priore was directly applying Soviet energetics, although neither he nor any other Western scientist could have known that.*

onto the cells, including all the cells of the immune system, and including each and every part of each cell. Small wonder then that the Priore methodology could restore suppressed immune systems! Time-reversing the damaged immune cells and their damaged internal components back to a previous healthy state was one magnificent result. The radiation also delivers the modulations directly into the master potential (the body's quantum potential) that contains its mind, its long-term memories, and its master control system for all cells. Thus not only are the diseased cells and the immune cells affected, but also the *master cellular control system* for all body cells is directly affected.[81]

In a related work, Becker (*See figure 16 on the following page*) and his colleagues stimulated bone healing in difficult fractures by use of tiny DC currents. They have shown that picoamperes of steady DC current trickled across the fracture site induces bone healing. Becker showed that, surprisingly, red blood cells are dedifferentiated – shucking their hemoglobin and growing a nucleus in the process. These cells redifferentiate into the kind of cells that make cartilage. Then *those* cells redifferentiate anew, into the kind of cells that make bone, and heal the fracture with new bone deposit. Becker also proposed a complete, operational DC control system, staying within the limitations of conventional EM theory.[82,83,84]

15-A. Priore demonstrates a point to Mr. Chaban-Delmas, Mayor of Bordeaux and a friend and mentor.

15-B. Dr. Raymond Pautrizel, noted immunologist, worked directly with Priore. Dr. Pautrizel is Professor Emeritus, University of Bordeaux, and holder of the first chair in immunology in France.

Dr. Robert Courrier (not shown), head of the Biology Section of the French Academy of Science as well as its Secretaire Perpetuel at the time, was also a noted colleague. He personally presented the astounding results of the Priore Team's experiments to the Academy.

Fig. 15. Priore was supported by notable French political leaders and eminent French scientists were his close scientific colleagues.

A proposed explanation of the fundamental vacuum-engine mechanism for the Priore and Becker effects has previously been given in some detail by Bearden.[85] (*See figure 17 on next page*)

[81] *We refer to an expanded version of Popp's cellular control system. E.g., see Fritz Albert Popp, "Photon Storage in Biological Systems," in Fritz Albert Popp et al, eds.,* ***Electromagnetic Bio-Information: Proceedings of the Symposium, Marburg, Federal Republic of Germany, Sep. 5, 1977;*** *Urban & Schwarzenberg, Baltimore, 1979, p. 123-149. Popp reports the theoretical and experimental discovery that mitogenetic radiation from cells can be seen as a sort of "waste" from a virtual electromagnetic field with a high coherence. This field has a tendency to become stationary over the whole organism. In addition, it includes the storage of "virtual" coherent photons.* ***Comment:*** *Our substitution of the SWZ hidden wave approach to replace Popp's QM particle approach greatly facilitates understanding and specifying the control system, and materially eases direct engineering of it.*

[82] *E.g., see R.O. Becker, "The direct current field: A primitive control and communication system related to growth processes."* ***Proceedings of the. XVI International. Congress of Zoology****, Washington, D.C., Vol. 3, 1963, p. 179; "The control system governing bone growth in response to mechanical stress."* ***J. Ark. Med. Soc.****, Vol. 62, 1966, p. 404; R.O. Becker and D.G. Murray, "A method for producing cellular dedifferentiation by means of very small electrical currents."* ***Trans. N.Y. Acad. Sci.****, Vol. 29, 1967, p. 606. See particularly Robert O. Becker, "The significance of bioelectric potentials."* ***Bioelectrochemistry and Bioenergetics,*** *Vol. 1, 1974, p. 187-199. Becker proposes that a complete, operational system exists in living organisms, and controls such basic functions as growth, healing, and biological cycles. The system is described in anatomical detail. It functions as a data transmission system in an analog fashion using varying levels of direct current as its signal. The system interlocks physically with the nervous system and is postulated to be its precursor. There are two electrochemical limbs of great significance in the operation of the system. One is between the DC system and the nervous system; the other is between the DC system and all body cells. The concept explains all of the diverse effects reported for the biological effects of applied electrical currents including: electrical anesthesia, electrical growth control, and electroacupuncture. It also furnishes a testable hypothesis for predicting other effects of clinical significance.*

[83] *We comment that the SWZ approach allows control and conditioning – both externally and internally – of both limbs of Becker's proposed DC control system.*

[84] *See also C.W. Hsue, "A DC Voltage is Equivalent to Two Traveling Waves on a Lossless, Nonuniform Transmission Line,"* ***IEEE Microwave and Guided Wave Letters,*** *Vol. 3, 1993, p. 82-84. Hsue shows that the steady DC voltage on a transmission line powering a resistive load, mathematically decomposes into bidirectional EM traveling waves. The bone-healing setup used by Becker et al is precisely of this configuration. The fracture corresponds to the resistive load and the two electrodes on each side correspond to the transmission lines. Hence Becker's team actually employed a form of the Stoney/Whittaker/Ziolkowski harmonic biwave decomposition of the scalar potential, to accomplish hyperspatial pumping and formation of anti-engines of vacuum energy. So this is another application of the same basic "cell-reversing" methodology, as also utilized more extensively by Priore. Becker's brilliant work of course was and is independent and unique, and he was nominated for a Nobel Prize because of his absolutely fundamental work in showing electromagnetic differentiation and dedifferentiation of cells. That he has not been awarded the prize is regrettable and, in my opinion, an injustice.*

[85] *T.E. Bearden, "Mechanism for Long-Term Cumulative Biological Effects of EM Radiation," presented to the 70th Annual Meeting of the Alabama Academy of Science, University of Alabama at Huntsville, March 25, 1993. A digest of this presentation is published by the Tesla Book Company, P.O. Box 121873, Chula Vista, CA 91912 as T.E. Bearden,* ***Cancer and the Unresolved Health Issues in the Biological Effects of EM Fields and Radiation,*** *1993 and includes both text and hard copies of viewgraphs.*

How the Priore Vacuum Engine Reversed Cells to a Previous State

Taking a GR view, any mass already has its own vacuum engine for its exact form and internal structure and dynamics, in the finest detail. That particularly follows Wheeler's principle; if the mass is there, the appropriate spacetime curvature and dynamic energy structuring is there. If the mass has internal structuring, so does the spacetime curvature: it becomes *nested* curvatures with a precisely correlated template. In short, any mass – living or not – is imbedded in a precise vacuum engine. Any and every change adds a specific delta to this vacuum engine component. Just as a tree has rings for its past years and an onion has layers, the vacuum engine of an object has an exact template for that object's entire past, *as do the mind and its components also.*[86]

So when a normal living cellular mass changes to a diseased state, *a priori* it has added an additional delta vacuum engine (representing the change that resulted in the disease) to its original vacuum engine (which represents the original healthy state of the cell). The cell and all its parts are highly nonlinear and act as phase conjugate mirrors, *including to the higher topology (hyperspatiality) of the vacuum engine. Any living system we isolate and study is at least 7-dimensional.*

Putting all this together, we now can understand the marvelous nature of what Priore did. By exposing the body, treated part, cells, and cell parts to Priore's modulated rippling magnetic field, the "hidden pump waves" carried by that magnetic field are applied to each and every cell and to all its parts, in the exposed area. *In the exposed area, each and every cell and its parts become powerfully pumped phase conjugate mirrors for its hyperspatial vacuum engine complex.*

Extending the language of nonlinear optics, the particular *net* vacuum engine of the diseased cell or part constitutes a "standing input" *hyperspatial signal wave complex*, already input to the hyperspatially pumped phase conjugate mirror cell or cell part. When pumped by "hidden" pump waves, each and every one of those PC mirrors will now originate an *amplified phase conjugate replica of the signal wave complex. Each one will produce a highly amplified, time reversed replica of*

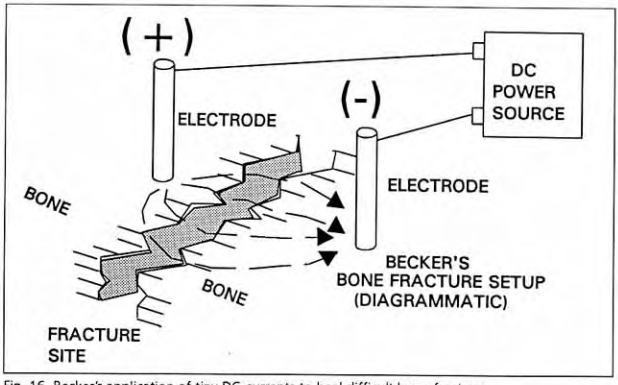

Fig. 16. Becker's application of tiny DC currents to heal difficult bone fractures.

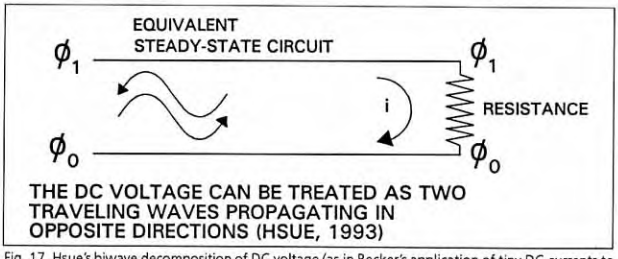

Fig. 17. Hsue's biwave decomposition of DC voltage (as in Becker's application of tiny DC currents to heal difficult bone fractures).

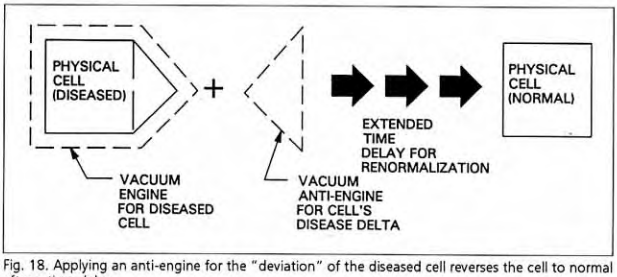

Fig. 18. Applying an anti-engine for the "deviation" of the diseased cell reverses the cell to normal after a time delay.

its specific standing vacuum engine. This includes amplified time reversed replicas of both the "healthy" component of each standing vacuum engine and the "disease delta" component. (*See figures 18 above and 19 on following page*)

In other words, every pumped diseased cell and cell part – including the genes and chromosomes – will produce a very powerful, highly amplified, "reverse vacuum engine" (an *anti-engine*) which is fantastically specific and precisely time-reverses the cell and its parts, including the genes and chromosomes as well, back to their *previous normal states.*

[86] *If one alters the internal structure (rings) of a tree, one changes the tree. If one alters the internal structures and dynamic functioning of matter, one changes the matter accordingly. If one alters the internal structures and dynamics of the mind, one changes the mind, its contents, and its function ing accordingly, as well as the subsequent behavior exhibited by the altered individual.*

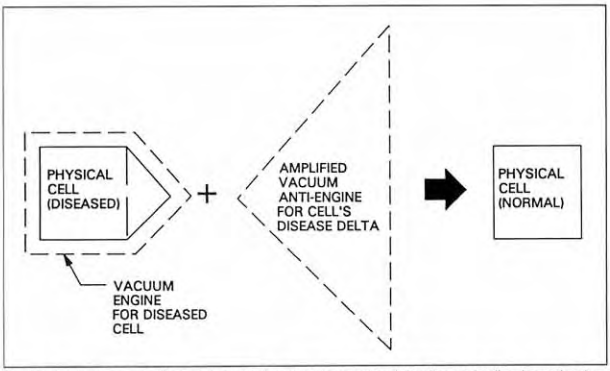

Fig. 19. Applying an amplified anti-engine for the "deviation" of the diseased cell reduces the time delay required to reverse it back to normal.

Rejuvenation

Any *normal* cell that is exposed to hyperspatial (Priore-type) pumping just reverts to a *slightly younger* normal state. Note that this allows *rejuvenation*.[87] Priore's earliest experiments that so riveted his attention and set him on the path of discovery, were in fact the abnormal prolongation of the life of fruits! For each class of disease, Priore just had to fiddle with the frequencies until he had the right set of pump waves for the specific "disease delta vacuum engine." This he did by trial and error. So when it is "Priore-pumped," a cancer cell reverses back to a normal cell, as does a precancerous cell as well.

The revolutionary Priore therapy is startling but simple. The diseased cell is analogous to an automobile that has been driven slowly off the road into the rough. Priore's methodology shifts the car into reverse gear, guns the engine, and quickly and precisely backs the car back onto the roadway. It is one of those profoundly beautiful embodiments analogous to Faraday's unipolar generator; it strikes directly to the heart of the fundamental principle. A cell develops damage and disease over a period of time. Simply time-reverse it quickly back to its original healthy state.

AIDS Could be Quickly Cured the Same Way

Given Priore-pumping, an AIDS-infected cell would revert back to a normal cell, including all its genetics, and including for all of the hundreds of "strains" of AIDS that exist in an advanced AIDS patient. With this ap- proach one could completely reverse and eliminate AIDS whenever a positive reading occurs in the HIV virus test, and prior to the appearance of the actual physical sym- ptoms! If the person just has the antibodies and not the disease, the treatment will still do him absolutely no harm. (It will actually make his cells a "little bit younger and more vigorous," and help his immune system.) If he has both the AIDS antibodies and the infection as well, he will be completely cured and his immune system will be restored to complete vitality.

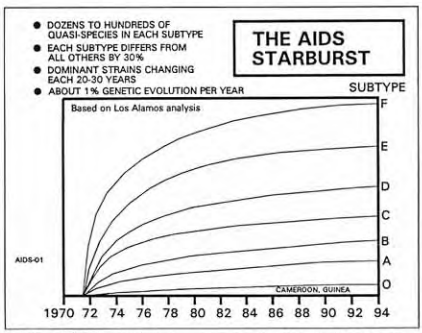

Fig. 20. AIDS is continually changing since the HIV virus is a retrovirus and unstab.

Most Diseases Could be Cured by the New Therapeutic Modality

Any infectious disease known or unknown can be cured by the same means. The marvelous thing is that one need not know the specific technical pattern for the delta vacuum engine for a specific disease! One just has to *correctly adjust the hidden SWZ pumping frequencies.*

Arteriosclerosis

In arteriosclerosis, it has been found that the greatest part of the damage is due to the presence of some rather ordinary viruses, and abnormal cell growth by the body's own cells as a result of triggering by previous viral infection. Cellular reversal (dedifferentiation) gets it all; the viruses and the abnormal cells. Everything reverts to normal, and the body's restored processes quickly "police up" the extra cell growth, using its natural control processes which are now restored to full functioning. *This is how the Priore team was able to so dramatically cure the "clogged arteries" of laboratory animals.*

The Priore approach (pumping of the

[87] *One should not be surprised that a time-reversal operation upon an entire body leads to reversal of physical aging in that body! But we point out that the time reversal we speak of is not at all the "time travel to the past" so beloved by generations of science fiction writers. For that, one would have to reverse each and every part of the universe simultaneously, except the observer, back to an exact former state, in perfect universal coordination. One would have to pump the entire universe, except for the observer! The observer would then remain as is with no change, while his entire world "went back in time" to a past state. The pumping of the universe would have to stop instantaneously (decay of the false vacuum?), and the universal anti-engine would have to stop operation and decay instantaneously (another big bang, perhaps?). We are not referring to anything such as that! We are referring to the reversal of a single little part of the universe, back to its previous state, which is practical and can be done. Universal time reversal – and hence time travel for the observer – is not practical, at least within our present knowledge and within the time reversal model we are applying. We should point out, however, that time reversal is a legitimate part of physics, and is not science fiction. E.g., for an overview, see Robert G. Sachs,* ***The Physics of Time Reversal,*** *University of Chicago Press, Chicago, Illinois, 1987.*

diseased cell's self-contained vacuum engine to create a very powerful vacuum anti-engine and reverse diseased cells back to normal) is the most powerful therapy for cellular disease ever conceived of. If the cells have ever been normal, they can be reverted to normal.[88] One can also probably regrow lost limbs, etc. but that takes too long to explain here! The methodology should also be able to completely reverse disorders such as Alzheimer's disease, and very probably muscular dystrophy as well. It should even be possible to reverse the physical effects of aging!

Much More Than This Introduction Has Been Theorized

This is the gist of the mechanism for the Priore therapy's startling success, although it has required some 10 years of very hard work to decipher the mechanics of the process. Along the way, I have also personally discovered and added a great deal more (for example, the quantum potential aspect of a living system and any enclave of living systems, the mechanism to generate a quantum potential, the precise mechanism for Sheldrake's morphogenetic field, the mechanism for directed evolution, the unusual electromagnetic nature of mind and thought, the mechanism for engineering mind and thought, engineering the entire species, and engineering the entire living biosphere), but this much should suffice for now for introductory purposes.

A technical book has been laboriously begun, and hopefully will be finished and published in about a year. Two 2-hour videos are also tentatively being planned. A four-hour technical briefing has already been prepared and presented.

Reactions to this Vacuum Engine Explanation

In response to numerous queries as to the reactions to this explanation of the Priore mechanism: Reactions tend to be rather good when (1) the technical person is open-minded, in other words, a friendly skeptic, (2) the technical person endures a grueling 2-hour or 4-hour detailed slide presentation I prepared, and (3) sufficient follow-up dialogue is accomplished to answer residual questions. Otherwise, the "mental jump" required of the participant is just too great.[89] Also, perhaps 60-70% of the conventional scientists are absolutely against anything that smacks of "revolutionary." From about half of this contingent the approach may generate disbelief and even overt emotional hostility, just as Priore himself and his associates encountered.[90]

However, some of the sharpest young graduate students readily make the transition, if they interact with me for a long enough period and enough times to understand the physics of the approach. *It did not take me 10 years to decipher an easy thing!* The causative mechanism for Priore's accomplishment is terribly involved and very, very deep. It is slightly beyond the present scientific vanguard, although the bits and pieces necessary to decipher the Priore mechanism are now in the literature. But putting them together has been a bone-crushing, terrible task. Priore was truly a century ahead of the science of his time!

Nonetheless, there is much hope, because the material is slowly taking root in a few sharp young graduate minds. For example, one of the major Eastern Universities would be astonished to know that their sharpest, brightest young PhD candidate – one they already assume will win a Nobel Prize in the future – is a full convert, and thoroughly understands cellular reversal by hidden-variable SWZ pumping, a la Priore. But at my strong urging, he is keeping it a secret until he graduates, and then he will *gradually* begin to filter in some of these ideas. That way he does not initiate his destruction by his peers because of too much energetic advocacy too quickly.

The Priore Approach is Urgently Needed

We simply must get this Priore therapeutic approach developed, for it is extremely important to all humanity. Our very survival may depend upon it.

Presently all our antibiotics are beginning to fail; the disease organisms are becoming quite resistant. Already our hospitals have strains of diseases that few if any antibiotics will touch. Hundreds of thousands of hospital patients each year are already experiencing complications due to contracting an antibiotic-resistant infection. Probably about 20,000 a year are dying as a result, and the death rate is increasing. In the future, one will have to seriously weigh whether it is better for one's chance of survival to enter the hospital and be treated, or to take one's chances with the disease and not enter the hospital.

With the rising failure of the antibiotics, (*See figure 21 on page 60*) and the rising possession of tailored biological weapons by hostile nations and international terrorists,[91] (*See figure 22 on page 60*) we shall shortly have no defense against an onslaught of pandemics unheard of since the Black Death swept medieval Europe of one third the population. Literally the age of pestilence and dread diseases of Revelations is upon us.[92]

[88] *They can also be "reversed to normal" even if they have never before been normal. The master cellular control system contains a master blueprint for the normal cell and can make an appropriate template for the specific disease delta vacuum engine, or one can be introduced (e.g., by injection of a drop of blood from a person previously cured of that specific disease; this was in fact demonstrated by the Priore group.). Pumping will then reverse the patient back to normal, as was actually shown by the Priore group. Indeed, the body's own system may be able to use the correct anti-engine template from the drop of blood and cure itself without pumping, as was also shown by the Priore group, if the body itself is reasonably healthy.*

[89] *Simply "dropping it on someone" by mail, for example – as I did to Elizabeth Taylor's foundation and Ross Perot's office – is just too much for a casual reading to grasp. A polite acknowledgment was received from the Taylor foundation, and no acknowledgment at all was received from the Perot camp.*

[90] *As an example, Priore completed the course work for his PhD and submitted his thesis, documenting his formidable and revolutionary work. Because of the ferocity of the oncology establishment toward the Priore team and its accomplishments, the university rejected his thesis. During the two decades or so since then, untold millions have died worldwide from diseases the team cured. These deaths could have been prevented had the Priore work been vigorously pursued and developed by the scientific community.*

[91] *It is not a question of if the international terrorists will use biological weapons against the U.S. civilian populace, but only of when. Astoundingly, often it may even be possible for the terrorists to simply buy their biological warfare agents from us! In a lawsuit by Desert Storm Syndrome victims against certain U.S. companies, one of the companies is alleged to have sold germs – such as anthrax, tularemia, and botulism – to Iraq by mail. These are highly effective biological warfare agents. E.g., a few spray tanks spraying such agents over a large U.S. city complex at night, using an easily obtained light plane to get in a few hours "flying practice," would result in tens or even hundreds of thousands of deaths within days. According to U.S. government-released data, inhaling a few anthrax spores into the lungs has a very high probability of killing the inhaler, unless treatment is started immediately. Even with immediate treatment, many deaths will still occur. A substantial number of nations are now obtaining and producing lethal biological warfare agents – which have been called the "poor man's atomic bomb." Some of the international terrorist groups are also acquiring the biological warfare agents.*

[92] *A good exposition of the rapidly increasing resistant-disease problem is given by Garrett, Laurie,* ***The Coming Plague: Newly Emerging Diseases in World out of Balance,*** *Farrar, Straus and Giroux, New York, 1994.*

In addition, the costs of the present allopathic medicine are rising rapidly and threatening to either bankrupt the nation, or become so expensive that only the wealthy can afford adequate medical care. Even the wealthy could be trapped in the future and denied adequate medical treatment. The Clinton Medicare bill, if approved, would make it a felony to pay a doctor out of one's own pocket, after denial of such treatment by the administrative bureaucracy. It also makes it a felony for the doctor to give the treatment to the disapproved paying person. Thus both the patient and the doctor could be sent to prison, wealthy or not.[93]

Cell Conjugation by Vacuum Anti-Engines Is the Only Hope

Priore's approach offers an answer to both the age of pestilence and the impending biological warfare strikes against our armed forces and our civilian population.[94,95] By prompt cellular reversal, infection even by totally unknown and modified agents can be quickly voided. Infection by newly adapted, resistant strains of presently known diseases can be quickly conjugated. So the problem of the failing vaccines and antibiotics can be solved quickly, simply, and cheaply. However, the cell-reversing treatment devices and trained, experienced medical staffs must be widely available!

Diseased cell conjugation by EM means is also the only therapy that can largely *eliminate* the debilitating diseases of humanity. Per Wheeler's principle, vacuum engines can mold the *physical matter* of the living body and conditions, operations, and content of the mind, memory, and personality. As the Priore therapy is developed and extended, it will become possible to correct bent spines, mental retardation, mental diseases, genetic defects, physical accidents and disabilities, birth defects, etc. It will be possible to regrow amputated limbs and restore deteriorated cartilage, organs, and joints. It should also be possible to directly remove deep psychiatric problems, heal chemical imbalances, and address and heal such presently difficult disorders as schizophrenia.

The development and application of Type 2 medical engineering can usher in the greatest, most beneficial revolution of all time. As just *one* example, eventually it will be possible to quickly educate students by simply loading the appropriate "software" into their minds and long term memory, in only a few weeks of "sessions." At that point there need no longer be, anywhere in the world, an educationally disadvantaged person.

It can also be used to usher in the most diabolical revolution of all time if we are not careful to (1) be informed of the Type 2 engineering area, including who is developing what, and for exactly what purposes, and (2) rigorously control the development and use of this technology as it progresses. Our legal, political, and scientific leaders – and we common citizens – will have to grapple with the ethics of what is done and to and for whom it is done. Just as one example, the same technology that will allow direct loading of the software in the long-term memory to achieve rapid education, will allow altering or changing any part of the long term memory, including the built-in emotional responses, etc. *Loading software is loading software! What is loaded depends only upon what is in the software.* In theory it is possible not only to alter the learned behavior, memories, emotions, and reactions, but also the genetically "born-in" behavior, emotions, and reactions. The potential for the Type 2 engineering to be used for enslaving and roboticizing humanity should be obvious.

Far more carefully than with any other technology in history, we must ensure that this new one is developed for good, not for evil. To quote an old adage, *the price of freedom is eternal vigilance.* Never before in all of history have those words been more true.

In Conclusion

Pioneers such as Priore, Becker, Kaznacheyev, and Popp have shown us a

[93] *In fact, under present law all property, homes, bank accounts, and monies of both the patient and the doctor would simply be confiscated – without any legal charge, arrest, or trial – under an absolutely medieval reinterpretation of U.S. law that has again given police at all levels such sweeping and unconstitutional powers. The Clinton Health Care Plan, presently on hold but still alive and sure to be introduced again, is reported to include the establishment of an entire department solely devoted to confiscating assets from patients and doctors who commit such "crimes." Defendants victimized by the present confiscation reinterpretation of law have a slim chance of even forcing the issue into a court. Even if they succeed in getting into court for a hearing, win it and get full "exoneration," the authorities can still keep the property! In the most insane and unjust legal action in all of U.S. history, this law now charges the property itself with having committed the crime, not the erstwhile human defendant. By what means can the "property" defend itself? No one has an answer, for the property is not an individual and has no legal rights for jury protection under the law! U.S. lawyers and judges are actually insisting that this is rational and makes sense. They have already precisely redefined U.S. law into what is specifically required to institute a police state. The police forces who carry out this confiscation are themselves awarded a percentage of the "haul." What does the citizen do when the police forces themselves become the robbers by administrative fiat, and there is no court redress possible? Ostensibly passed to counter organized crime and the drug cartel, this law has rapidly been applied directly to the citizenry, and its use is one of the fastest growing "new techniques" by the various levels of law enforcement. In this paper we have deliberately not dwelled upon the political aspect of the already-emerging police state in control of medical treatment. We simply summarize how the bureacratic medical establishment is likely to meet the challenges of the coming plagues and the associate astounding rise in medical costs. In fact the reader will almost certainly see the rise of an iron "state dictatorship" in medicine, as is already emerging in other legal areas.*

In this paper my primary purpose is technical, not political, so we defer detailing the more involved political aspects of the emerging police state (the New World Order – more aptly the New World Feudalism) to other more capable authors and sources. One central thought should remain firmly in mind All political systems and isms tend ultimately to feudalism, which is always the best system for the oligarchy or elite at the top who control and own everything. In any society, there is always an on-going struggle by a fraction of the most powerful to convert the society to special forms of feudalism.

[94] *Some biological agents are very lethal and the associated disease develops at a frightening pace. E.g., the strains of Staphylococcus bacteria that cause necrotizing fascitis and necrotizing myositis – two versions of the "flesh-destroying" disease – are noteworthy examples. Necrotizing is causing inflammation and/or death of tissue, fascitis refers to "sheet" or connective tissue, and myositis refers to muscle tissue. Recently the Quebec separatist leader Lucien Bouchard was suddenly felled by necrotizing myositis, lost a leg, and at this writing is stable and will recover. The disease is usually fatal in 80% of the cases. There is nothing diabolical in his contacting the disease; the bacteria are present from time to time and can enter the body through a nick or otherwise. The disease and the bacteria are known; however, in the past such cases have been relatively rare. The lethality of the disease is augmented by the rapidity of its development. Delayed recognition of the disease may place the patient already beyond the ability of conventional agents to arrest it in time to save him. With the modern hospital and population environment being highly favorable for the more rapid modification and adaptation of disease organisms, even previously rare diseases such as necrotizing fascitis/myositis are ticking time bombs waiting to become resistant to our antibiotics and explode in the dense urban populations.*

[95] *We refer to strikes using biological organisms. We have mentioned but deliberately not dwelled upon the use of electromagnetic induction of lethal cellular diseases at a distance. Such strategic capability to attack a nation and destroy its citizens and soldiers is presently on-line in Russia, under total control by the KGB, not by the conventional Russian military forces.*

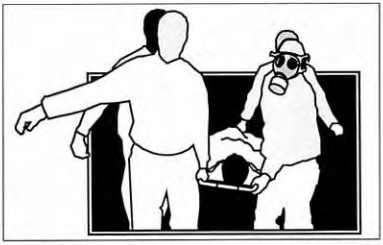

Fig. 21. Present antibiotic therapy is failing as disease organisms adapt.

Fig. 22. Terrorists will eventually use biological warfare strikes. Biological warfare is an increasing threat to military forces and the civil populace.

great vision. Having seen it, when one looks at the incredible human suffering throughout the world, and then at the formidable problems of our Type 1 medical science that is struggling so mightily and losing the battle, one is reminded of a phrase by Dante:

"Heaven wheels above you

Displaying to you her eternal glories

And still your eyes are on the ground."

With every fiber of our being, we exhort the scientific community to lift its eyes from the ground, and develop and apply the Type 2 medical technology as rapidly as humanly possible, for human benefit. Else half of humanity will perish in the coming tide of pestilence. Even the conventional scientists agree that the pestilences are coming, and that conventional approaches are already losing the battle. Long ago Albert Einstein wrote these prophetic words:

"It would of course be a great step forward if we succeeded in combining the gravitational field and the electromagnetic field into a single structure. Only so could the era in theoretical physics inaugurated by Faraday and Clerk Maxwell be brought to a satisfactory close."

Einstein's passionately-sought unification of EM and G has now been accomplished. It has magnificent medical science applications for the benefit of all humankind. Meanwhile, in the orthodox medical journals, the scientists themselves are recognizing the demise of antibiotics and the coming unstoppable plagues. The scientists are redoubling their efforts to apply the present inadequate models, and their efforts are admittedly failing. *If they keep to their present course, the war is already lost!*

In the name of all the bleeding, suffering, and dying peoples of the world, we must do better than that! We can do better than that, if we rapidly redevelop and apply the Priore approach.

We call fervently for a great new "War on Disease" that is empowered, funded, and staffed to perform the task. It can be done in perhaps three years, and perhaps for as little as $60-100 million if we streamline procedures, keep the bureaucracy off the team's necks, and give the team scientists the authority of a War Commander with a mission order to *get on with it.*

What happens next is up to the scientists, the politicians, and the concerned leaders of all the nations of the world. *They simply must not fail us.* They and their families are in the same frying pan as the rest of us. This is not the time for dogma, posturing, arrogance, protecting one's territory, yapping about who's going to control the presently inadequate medicine, yakking about pseudoscience, striving for personal position and power, bowing to the big drug companies and their vested interests, and playing the "Who's to be the big monkey?" game. *We need a new Manhattan Project. We need it now.*

Else we who have sown the wind will most certainly reap the coming whirlwind.

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liver, and lymph nodes. Dourine is a dis ease favoring horses and asses, marked by inflammation of the genitals, subcutaneous edematous plaques, low-grade fever, progressive paralysis, emaciation, and death. Nagana is a highly fatal disease in/ of domestic animals in tropical Africa marked by fluctuating fever, inappetance, edematous swelling, and sluggishness, and is transmitted by the tsetse fly and possibly by other biting flies. Sleeping sickness is a serious disease that is prevalent in much of tropical Africa; it is marked by fever, protracted lethargy, tremors, and loss of weight, and is transmitted by tsetse flies. Surra is a severe Old World febrile and hemorrhagic disease of domestic animals and is transmitted by biting insects.

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Editorial Note: *We would like to express our appreciation to Mr. Bearden for this wonderful article.*

The Tom Bearden Website

"Dossier Priore"

by Jean-Michel Graille

Photographs

Cover	
Plate 1	The inauguration: the construction of the M 600 had not yet started but, symbolically, the Mayor of Bordeaux starts the smaller machine at close range. (Archives R.P.)
Plate 2	Inaugural scroll.
Plate 3	An information meeting held in Bordeaux. From left to right: Antoine Priore, Robert Courrier, Raymond Pautrizel and Francis Berlureau. (Archives R.P.)
Plate 4	February 1975. Antoine Priore and Professor Pautrizel at the "suspended" base of the M 600, the enormous experimental prototype built by Leroy-Somer. The apparatus would only function for a few days but did make it possible to carry out some experiments with very promising results.
Plate 5	Anne-Nelly Pautrizel. Professor Pautrizel's sister and collaborator, who participated in almost all the experiments with the Priore apparatus since 1968. (Photo J.M.G.)
Plate 6	Pierette Châteaureynaud-Duprat, head of research at C. N.R.S., doctor of science and specialist in grafts, carried out in 1969 and 1970 two series of decisive experiments concerning the proof and the explanation of the biological effectiveness of the Priore Ray.

Plate 7

The Priore machine. The model financed by Pautrizel, the only one which is still likely to function, the one with which patients will be officially looked after as from 1977, is finished in August 1968. In fact, the apparatus is installed all in one place.

Plate 8

1969. Old friends of Priore retrace the road to Floirac. With a monkey-wrench or soldering-iron in hand, they devote all their leisure time to building the new machine for their friend. Here, on the scales, inspector Plantin, of the legal identity service. In coveralls, scarf around his neck, municipal worker M. Léglise.
(Archives R.P.)

Plate 9

A courageous man. Perpetual Secretary of the Academy of Sciences, elder President of the Academy of Medicine, "father" of endocrinology and fertilization, Professor Robert Courrier could have benefited from its prestige and its retirement. At 67, he took all the risks to defend that which he believed in deeply. He has fought now for twenty years. One of the rare photos of him, in the company of Antoine Priore and Professor Pautrizel, taken on 25th March 1970 in the laboratory at Floirac.
(Archives R.P.)

Jean-Michel Graille
DOSSIER PRIORE
Une nouvelle affaire Pasteur?
Denoël

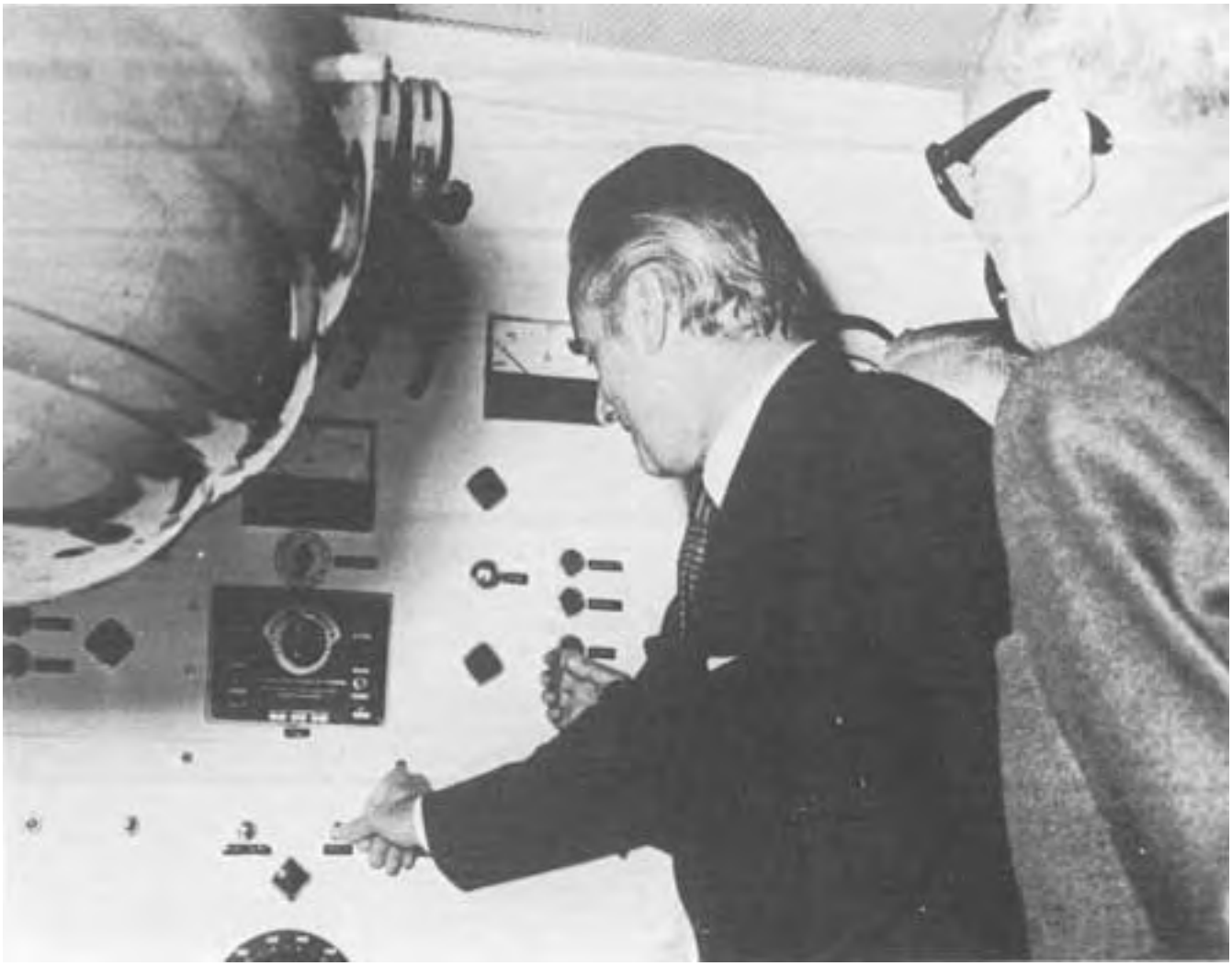

Translation:

JACQUES CHABAN-DELMAS
THE MAYOR OF BORDEAUX
PRESIDENT OF THE URBAN COMMUNITY
AND
ANTOINE PRIORE
HAVE INSTALLED ON THE 21 NOVEMBER 1970
THE FIRST STONE OF THE SCIENTIFIC RESEARCH LABORATORY
FOR THE BIOLOGICAL EFFECTS OF THE PRIORE RAY

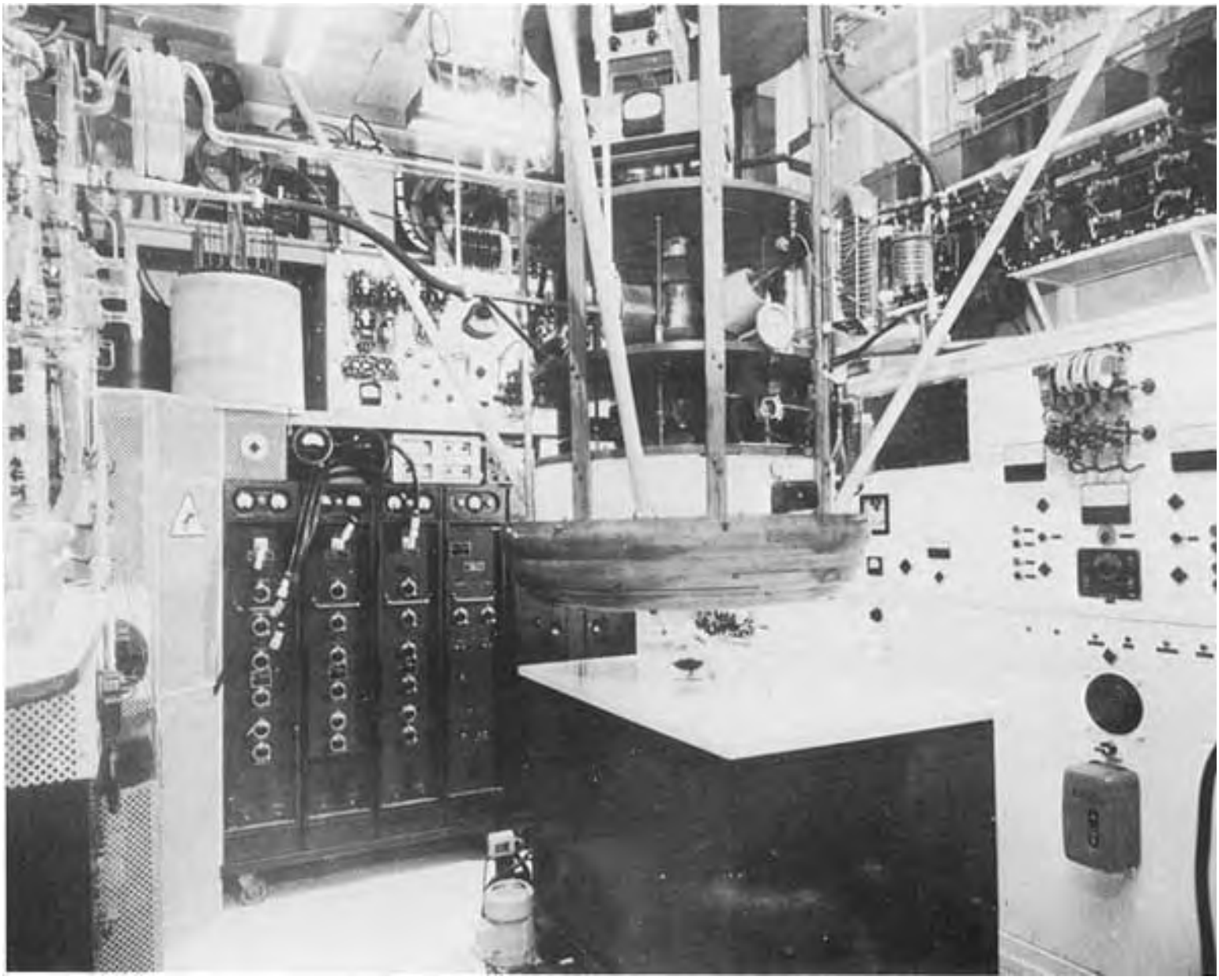

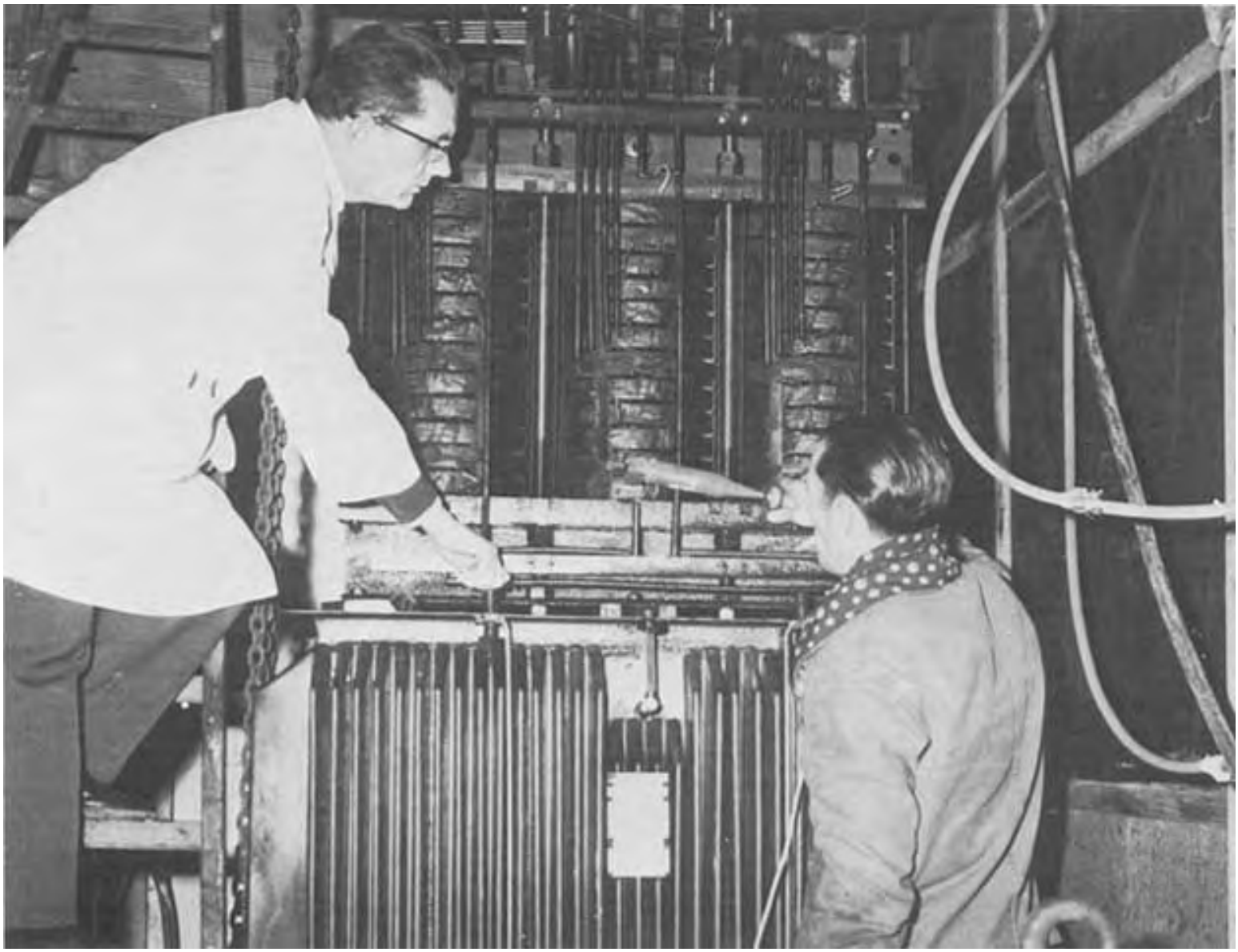

Making Laser Weapons a Reality

Figure 1. The Boeing HEL MD has demonstrated the ability to destroy a 60 mm mortar round in flight. (Photo courtesy of Boeing Defense)

Directed energy weapons first took a step towards reality in the 1980s under President Reagan's Strategic Defense Initiative (SDI), dubbed "Star Wars" by the media. But, the technology didn't really materialize at that time and the cessation of the Cold War largely removed the immediate impetus to develop it. Since then, lasers have become widely used in military applications, particularly for target designation and aircraft countermeasures, but there is still no significant deployment of lasers as offensive weapons. Now, advances in high power fiber laser technology, particularly in the efficiency, compactness and weight of their pump diode lasers, are poised to make laser weapons a practical reality.

Figure 2. A Coherent | DILAS T-Bar chip contains five emitters, outputs about 50 W, and is 5 mm wide.

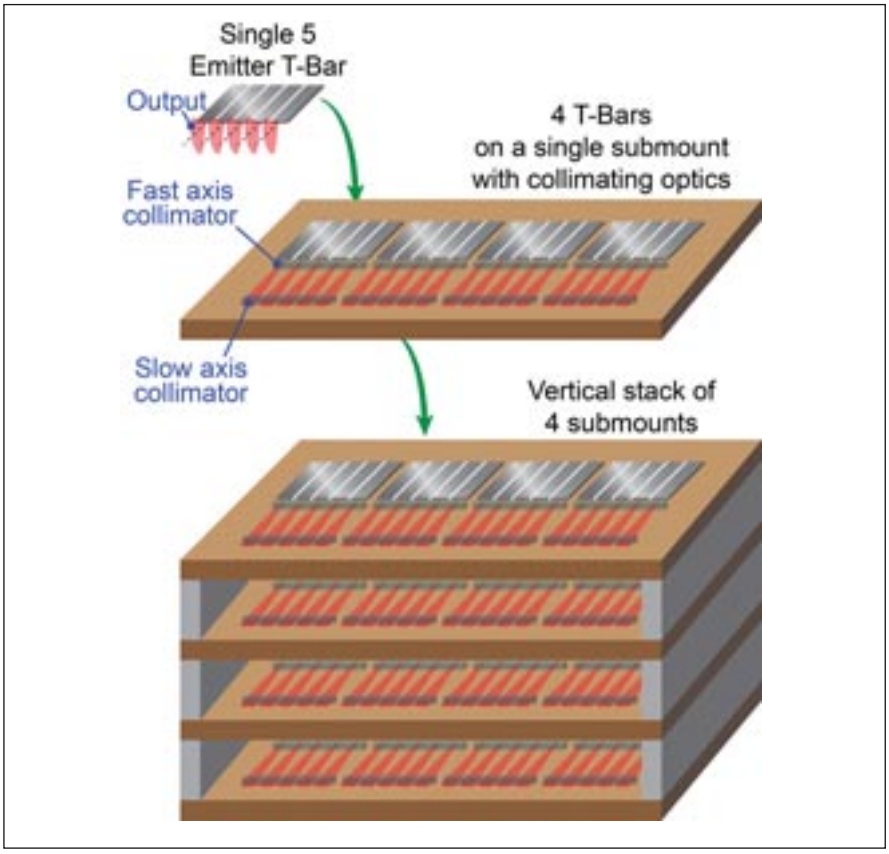

Figure 3. Progression from a single T-Bar die to an 80-emitter stack. The light from all these emitters can be efficiently coupled into a single 225 μm core fiber with a 0.22 NA.

Laser Weapons Overview

The concept behind Reagan's SDI was to protect the United States behind a "missile shield" that would prevent nuclear weapons, delivered via either intercontinental or submarine-launched ballistic missiles, from reaching North America. Part of the SDI was to be lasers, or other directed energy weapons, placed in permanent orbit, which could rapidly knock out a nuclear missile already in flight towards its target. Lasers, in particular, were a promising technology for this application because they can be quickly "charged up" (i.e. be made ready to fire), and their output can reach a fast-moving target nearly instantaneously.

Because these lasers were intended to be deployed primarily in space, or in fixed locations, and used either never (hopefully) or just once, there wasn't much concern about their cost, physical size, weight or operational efficiency. The key goal was simply that they would work when needed, delivering the required knock-out punch.

The offensive laser weaponry under development today is intended to serve almost the exact opposite purpose than the SDI, and therefore has very different goals in terms of its design and functionality. For example, one major laser weapons initiative is for C-RAM (Counter Rocket, Artillery and Mortar). These are systems intended to be deployed in the battlefield to protect troops and equipment from incoming projectiles. Currently, these are envisioned to be single, vehicle mounted lasers, with output powers in the 10 kW to 50 kW range.

Boeing has already successfully prototyped such a system, which they call the High Energy Laser Mobile Demonstrator (HEL MD). This consists of a 10 kW solid state laser installed on an Oshkosh Tactical Military Vehicle, along with all the necessary targeting and control systems. HEL MD has proven the ability to lock on to and destroy a mortar round of about 10 inches in length, traveling at hundreds of miles per hour, from several miles out. The system is also effective against Unmanned Aerial Vehicles (UAVs or drones); in this case, it may be sufficient to damage the drone's navigation and targeting systems, rather than completely destroy it. Similarly, other offensive laser weapons systems are being designed to deliver "swarm defense," that is, to protect a ship or base from attack by a large number of inexpensive drones.

Thus, today's laser weapons are meant to defend against swarms of inexpensive mortar rounds, drones and other projectiles, and are intended to be mounted on platforms which are mobile and self-contained (meaning they may not have ready access to an external source of power). This gives rise to several design imperatives. First, they must deliver a low cost per engagement; it's simply not economically feasible to employ an expensive weapon (such as a missile costing over $100,000) to knock out a drone which costs $1,000, or a mortar round which might cost less than $100. The laser weapon must also be capable of rapid fire so that it can't just be overwhelmed by a large number of simultaneous incoming rounds. Also, rapid fire reduces the number of individual laser weapons systems needed to protect a given number of troops. But, the ability to deliver rapid fire also necessitates that the system be electrically efficient. Otherwise the laser weapon will require access to a large quantity of fuel, which is difficult (and dangerous) to transport into a battlefield. Fi-

nally, it's desirable that laser weapons be physically compact, especially for airborne use.

SWaP Optimization

The push to optimize the size, weight and power (called SWaP in military parlance) of field deployed laser weapons has driven a progression in the technology of the gain material used from chemical (e.g. deuterium fluoride), to solid state, and, most recently, to fiber. One reason for this is because fiber lasers offer inherently higher efficiency, in terms of converting input pump energy to usable output, than nearly any other laser type, except diode lasers. However, diode lasers by themselves don't provide the necessary brightness or beam quality, while diode-pumped fiber lasers can. And, beam quality is critical because it determines the distance over which the laser can be focused to a spot size small enough to reach the power density necessary to damage its target.

Fiber lasers offer other advantages in terms of SWaP optimization. Chemical and lamp pumped solid state lasers require a significant overhead in terms of the equipment and power supplies required to run them. In contrast, both solid state (e.g. slab and rod) and fiber lasers can be diode pumped, and diode power supplies and pump modules themselves are electrically efficient and lend themselves to miniaturization. This efficiency, in turn, reduces the cooling requirements, and all its attendant equipment (pumps, heat exchangers, etc.).

But, as laser weapons evolve towards ever higher powers, fiber laser technology becomes increasingly attractive over solid state. Currently, individual fiber lasers can deliver up to about 2 kW of power, but multiple units can be combined to deliver around 10 kW in a single beam with extremely good mode quality. It's a bit more difficult to scale up the power of a solid-state laser, especially while maintaining good mode quality. This is because scaling up and/or increasing the pump power to a traditional solid state laser typically excites higher order modes, and introduces other issues related to thermal lensing.

Of course, there are also challenges to increasing the power of a fiber amplifier.

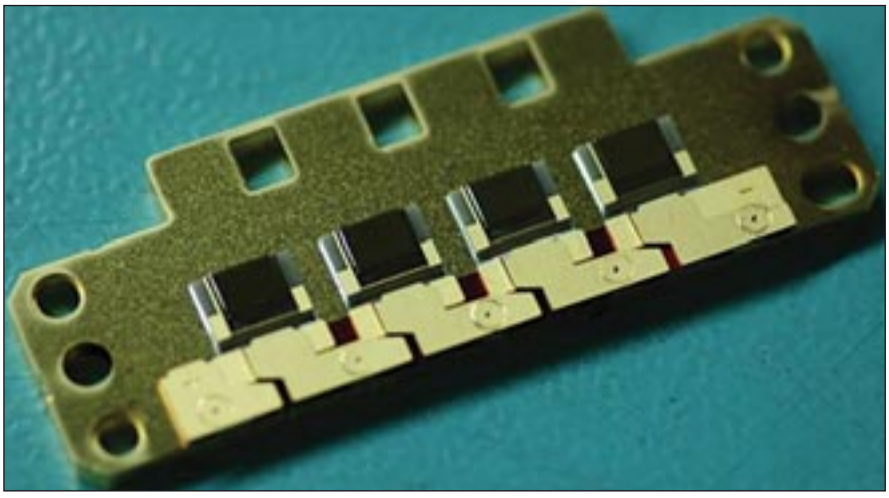

Figure 4. Four T-Bars mounted on a macrochannel cooler with collimating optics.

And, because the optical efficiency of their pumping is already so high (~85%), there's not much room for improvement there. So, the focus is on raising the pump power itself, without increasing package size and weight, as well as on methods for low loss beam combining of multiple single mode lasers, all while still maintaining good beam quality.

Pumping Technology Advances

In terms of SWaP optimization of pump diodes for laser weapons, a current benchmark is to achieve a weight to output power ratio of 1 kg/kW. Coherent | DILAS has developed several advances in diode laser technology to reach this goal, and, in fact, is already working on devices that will attain the next level of performance – 0.5 kg for 1 kW of output.

One key to reaching the SWaP benchmark has been the company's introduction of T-Bar (for "tailored" bar) construction, a design approach intended to combine the high total output power of traditional diode laser bars with the relaxed cooling requirements of single emitters. The basic unit of the T-Bar is a diode laser mini-bar having five emitters on a single, 5 mm wide substrate which outputs about 50 W total. In contrast, traditional diode laser bars are usually 10 mm wide, contain at least 19 emitters, and can output over 200 W, depending on the number of emitters and type of heatsink.

For military applications, four of these T-Bar dies are mounted on to a single substrate, yielding a total of 20 emitters. Then, up to four of these substrates are stacked vertically, bringing the total number of individual emitters in this compact assembly to 80, with a total output of about 800 W.

The key optical characteristic of the T-Bar design is that the combination of wide emitter spacing, low divergence and relatively low beam parameter product (in both fast and slow axes) is tailored to enable the light from all 80 of these individual emitters to be efficiently co-linearized and coupled into a single 225 µm core fiber having a numerical aperture of only 0.22. This, in turn, permits highly efficient coupling into the pumping mode volume of the gain fiber. And, this light collection can be accomplished using a relatively simple and compact optical system. This is how output power per unit volume is maximized.

In contrast, the high divergence and poor mode quality of traditional diode laser bars necessitate the use of complex optics for light collection, and still make it impossible to couple all their output into a single, low numerical aperture fiber. Furthermore, high power diode laser bars often suffer from a problem called "smile." This is a sagging or bending alignment error in emitter position along the bar which makes it quite difficult to collimate and co-linearize its output.

Besides the advantage of producing the largest amount of fiber coupled light out in a given system volume, T-Bar construction also offers significantly improved cooling characteristics over traditional bars. In a traditional diode laser bar, the small emitter spacing causes significant thermal crosstalk between the individual emitters, and a very high efficiency cooling system must therefore be employed. This is usually in the form of a so called "microchannel" cooler, in which water is rapidly circulated through channels within the heatsink. But the small bore of the microchannels (tens of microns) makes it easy for them to be clogged by particulates. Thus, the water must be stringently conditioned and filtered, and large, heavy, high pressure pumps must be employed to circulate it rapidly enough to achieve the required level of cooling in these traditional bars.

Furthermore, traditional diode bars are usually placed directly on the heatsink in order to achieve good thermal contact. However, this makes the microchannel cooler part of the electrical circuit, thus necessitating the use of deionized water in order to avoid a short circuit. This imposes yet another requirement that increases cost and complexity.

The larger emitter spacing of the T-Bar largely eliminates this thermal crosstalk, and greatly relaxes the attendant cooling requirement. As a result, Coherent | DILAS has been able to introduce a "macrochannel" cooler. This is a system which uses substantially larger bore channels, thus allowing the use of less stringently filtered tap water, and eliminating the need for high pressure pumping. Also, the reduced cooling requirement enables the laser bar to be placed on a submount, rather than in direct electrical contact with the cooler, which avoids the necessity of using deionized water.

T-Bar construction also delivers better cooling characteristics than single emitter diode lasers. This is because single emitters are typically supplied already packaged. Since the diodes are mounted within the package, there is an extra thermal interface which makes it more difficult to efficiently cool them.

In conclusion, after decades of imagining, offensive laser weapons are nearly ready for deployment on the battlefield. Advances in diode laser pumping technology are proving to be a key enabling factor in this development. And, these military grade pump diode lasers can be constructed using the same automated, high volume fabrication equipment used for industrial product manufacturing, meaning they can be readily delivered at competitive prices.

This article was written by Chris Ebert, Ph.D., Director, Business Development, Coherent | DILAS, (Tucson, AZ). For more information, visit ***http://info.hotims.com/65852-501****.*

The Tom Bearden Website

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from **STAR WARS NOW!**

The Bohm-Aharonov Effect, Scalar Interferometry, and Soviet Weaponization
by Lt. Col. T.E. Bearden (retd.), 1984
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A Sensitive Scalar Wave Detector

Very briefly we present a method of making a very sensitive scalar wave detector so that direct measurement and quantization can be established.

First, we regard one oscillation (one wavelength) of the scalar potential wave as a longitudinal photon. Note that this photon contains a substructure, which may be deliberately determined (when artificially made) or randomized (when naturally made in the idealized case).

For convenience we represent normal linearized vacuum (spacetime) as a horizontal or longitudinal vector (Figure 4), implying the direction of motion of the wave in the laboratory frame. By horizontal position in our diagram, we imply a linear, uncurved spacetime and a non-rotated frame. We represent the longitudinal scalar wave as a horizontal vector, and the usual Hertzian wave as a vertical or "transverse" vector. We visualize a normal detector as detecting only a vertical or "transverse" vector, as we have illustrated in Figure 4.

As can be seen, in a linear, unrotated or uncurved spacetime a pure scalar wave has no vertical component projected upon the laboratory frame vector, so it is not detectable by normal detectors.

To detect the scalar wave, of course we could bend it so that it has a projected vertical component in the laboratory frame (Figure 5). However, this would be an impure wave, not a pure scalar wave, and that is not what we wish.

A better way is to bend or curve spacetime itself in a small region, so that a longitudinal wave that passes through that region now possesses a vertical component with respect to that region (Figure 6). Thus a normal detector there will detect that vertical component. We conduct the detection current out of the "bent spacetime" region to an outside (normal) detector, and we then have a scalar wave detector.

To illustrate, we show conceptually how this has been successfully done. Figure 7 shows the concept. First, we utilize a magnetic pole to provide the infolded energy (potential) to bend or curve spacetime. To reach good sensitivity, we need a pole strength connected with a magnetic field strength of 40,000 Gauss or higher. We utilize a small superconducting magnet, which can reach field strengths of from 40,000 to 80,000 Gauss.

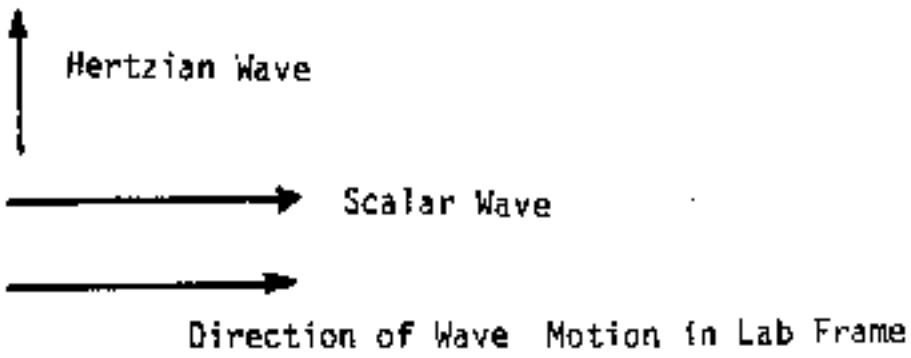

Figure 4. Linear, uncurved laboratory frame.

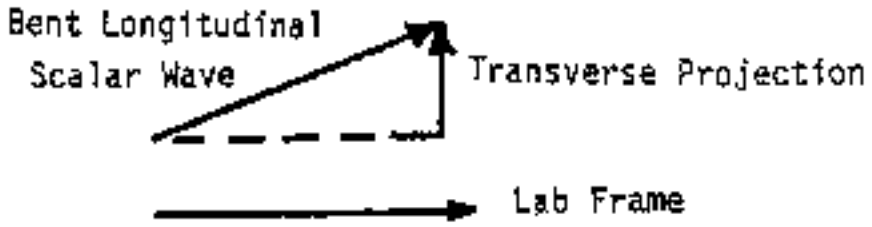

Figure 5. Rotating the longitudinal wave produces a transverse component.

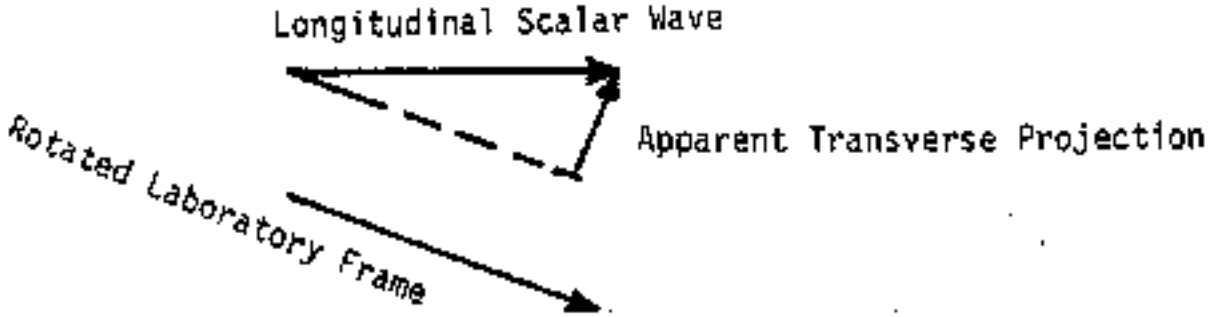

Figure 6. Bending the laboratory spacetime frame produces a transverse component.

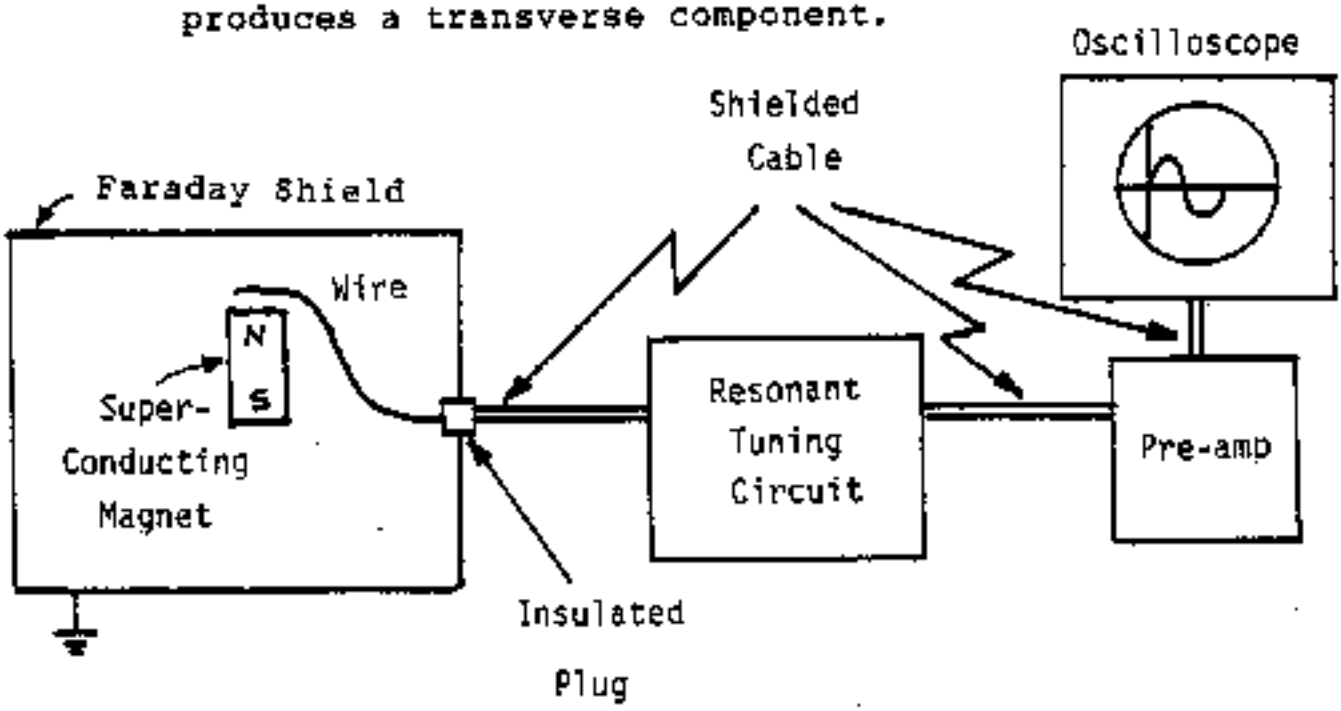

Figure 7. A sensitive scalar wave detector.

Figure 7. A sensitive scalar wave detector.

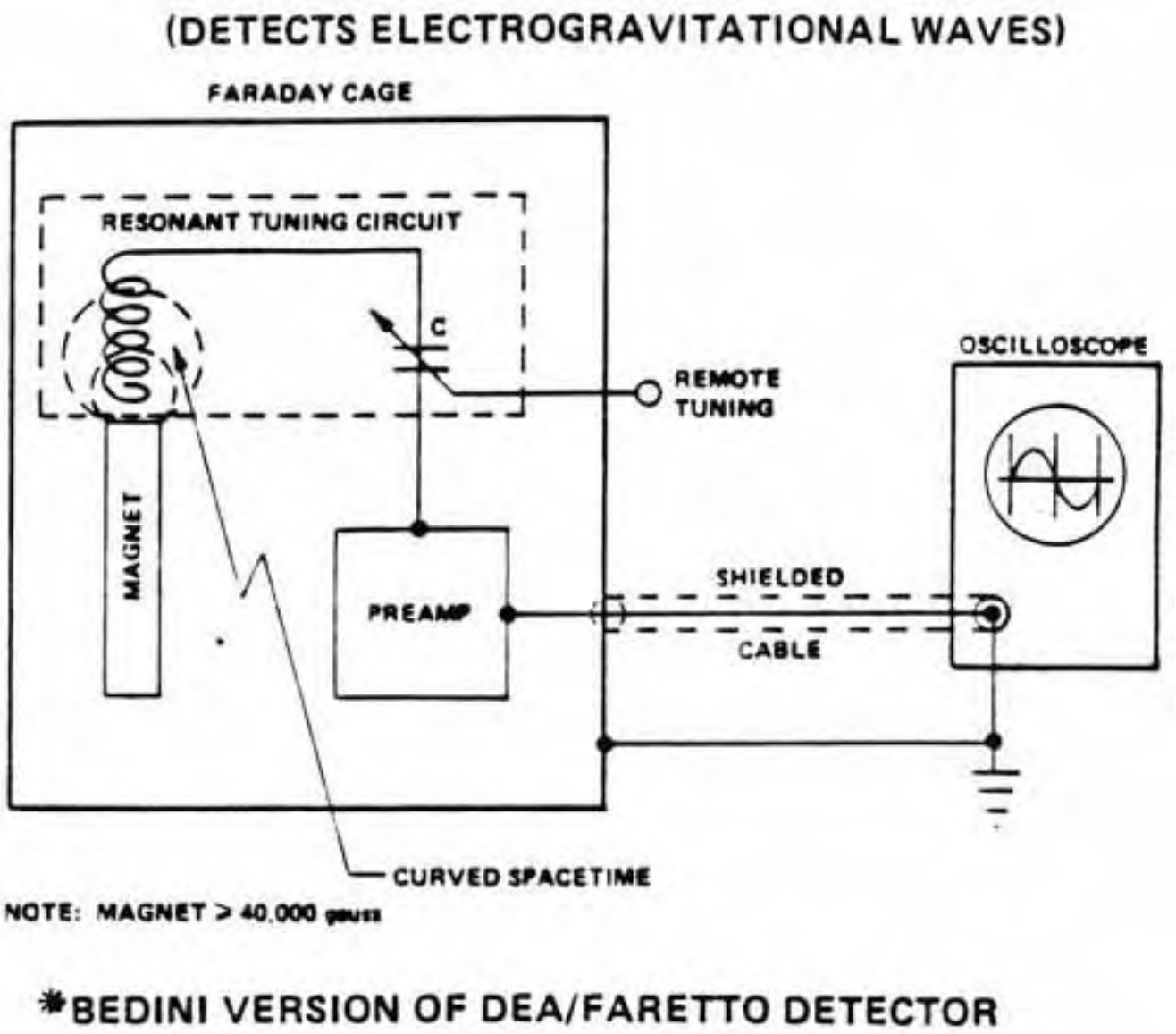

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Then to prevent detection of superfluous "normal" radiation, we shield the entire magnet in a grounded Faraday cage, as shown in the figure. Hertzian waves will be grounded in this shield, while scalar waves will readily penetrate it undiminished. In other words, the Faraday cage serves as a "stripper," to strip away the ordinary waves, leaving only the scalar waves to penetrate inside. An ordinary wire lies at the top of the magnetic pole, in proximity to it. The wire runs out of the Faraday cage through an insulated port to a resonant tuning circuit, which is sharply tunable over the range of frequencies we are interested in. A preamp amplifies the output of the tuner, and in turn feeds the input of an oscilloscope or other detector.

With this detector we can select the frequency desired, and detect any passing scalar waves of that frequency. By other variations of amps and preamps, regenerative circuits, etc. we can obtain all the

sensitivity desired, and utilize ordinary detection equipment already well-known and highly developed.

Additional Information about detecting Scalar Waves

Figure 11. NETWORK OF VIRTUAL TRANSMITTERS

(See Woodpecker Grid)

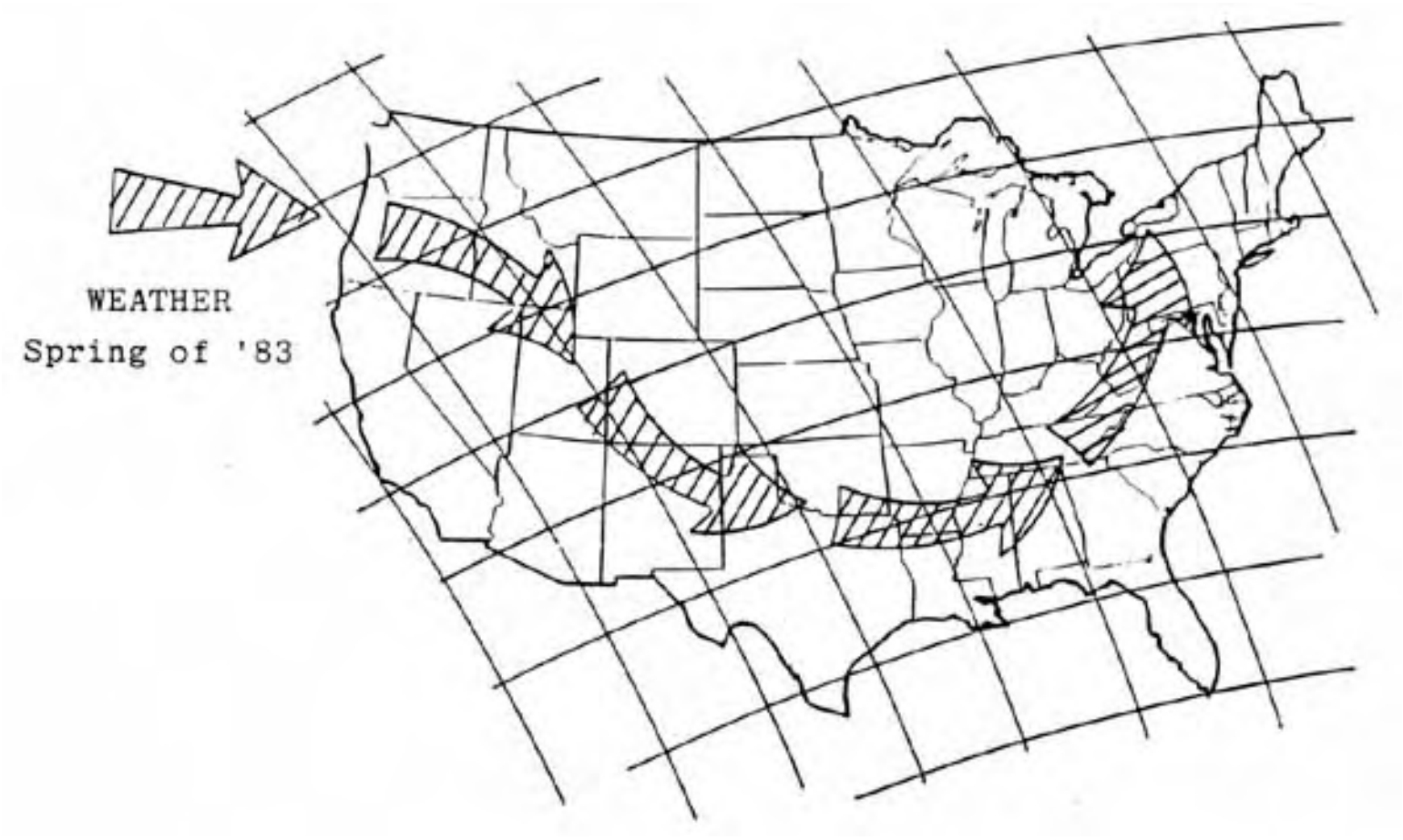

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Figure 12. VIRTUAL TRANSMITTERS IN THE INTERFERENCE GRID

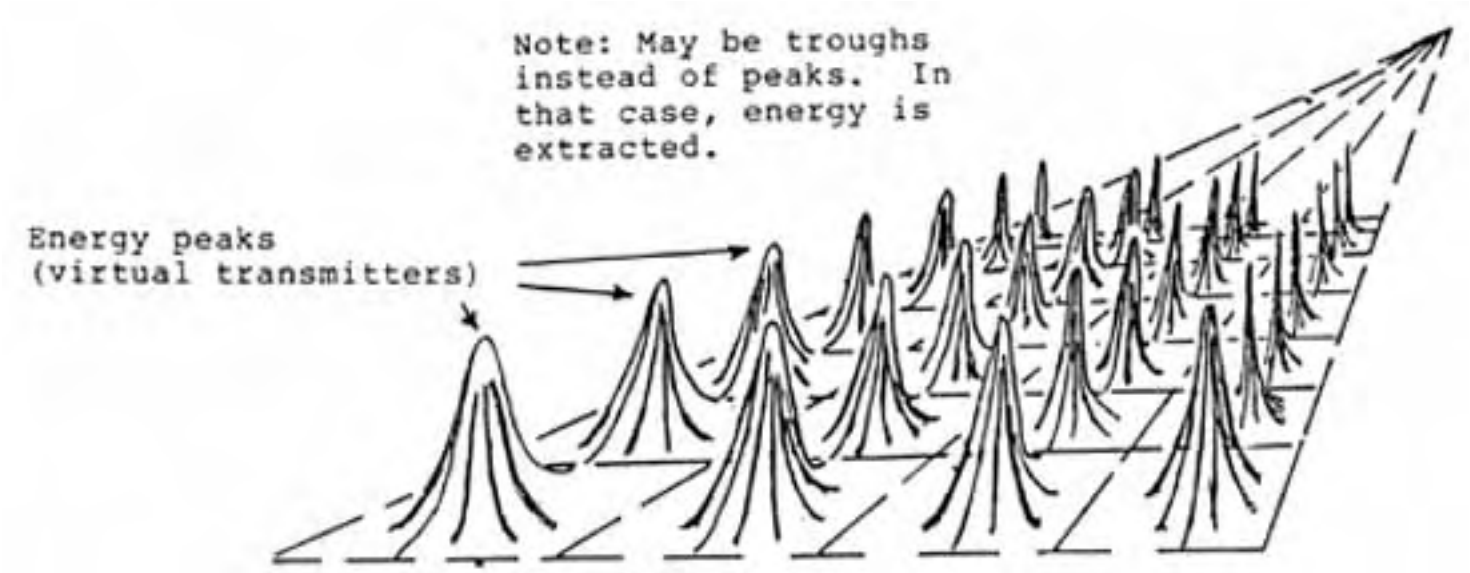

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The Tom Bearden Website

Figure 13. GIANT RADIAL RELATED TO A VIRTUAL TRANSMITTER

Fall 1983: Florida Alabama

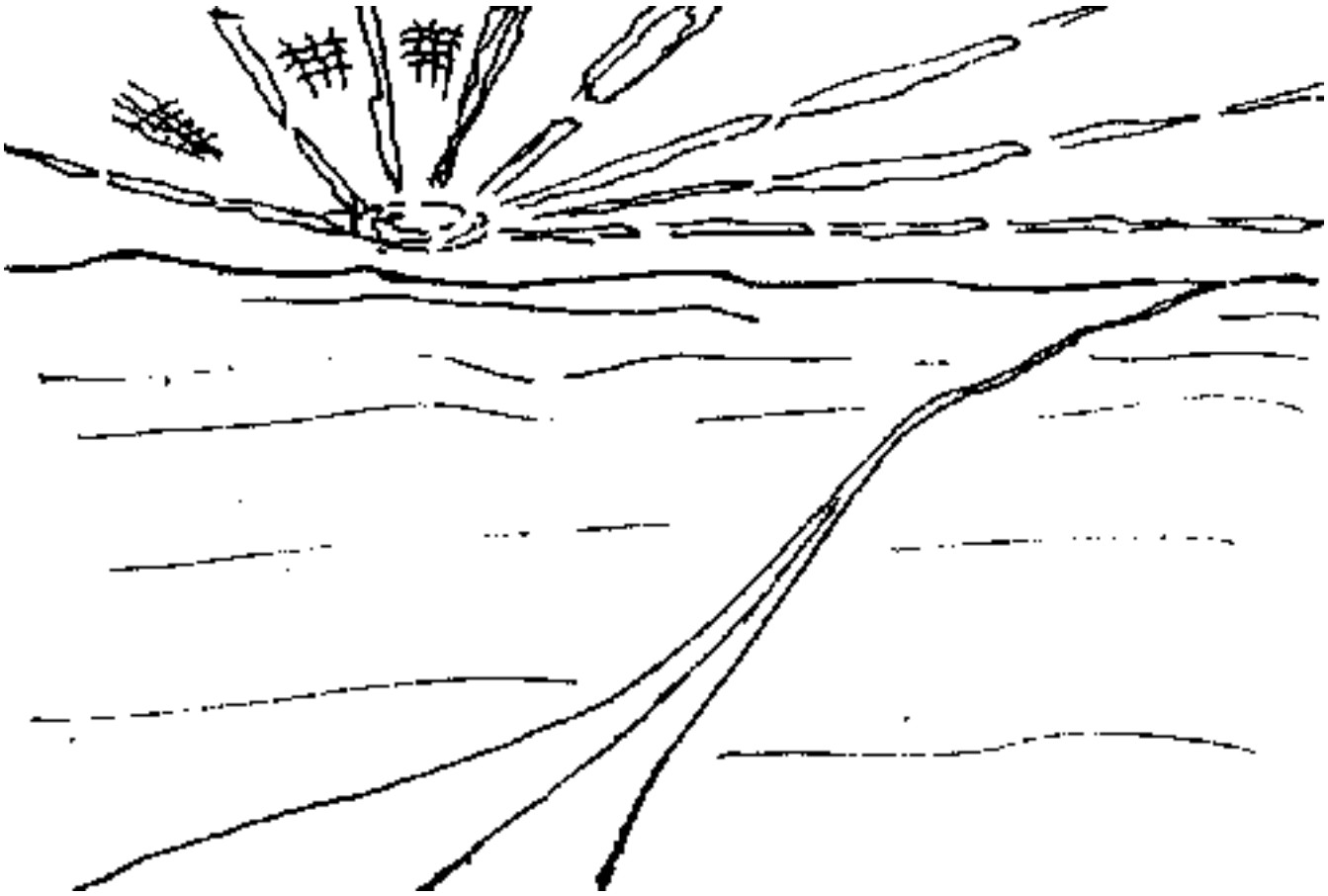

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Figure 14. FORMATION OF A SINGLE GIANT RADIAL

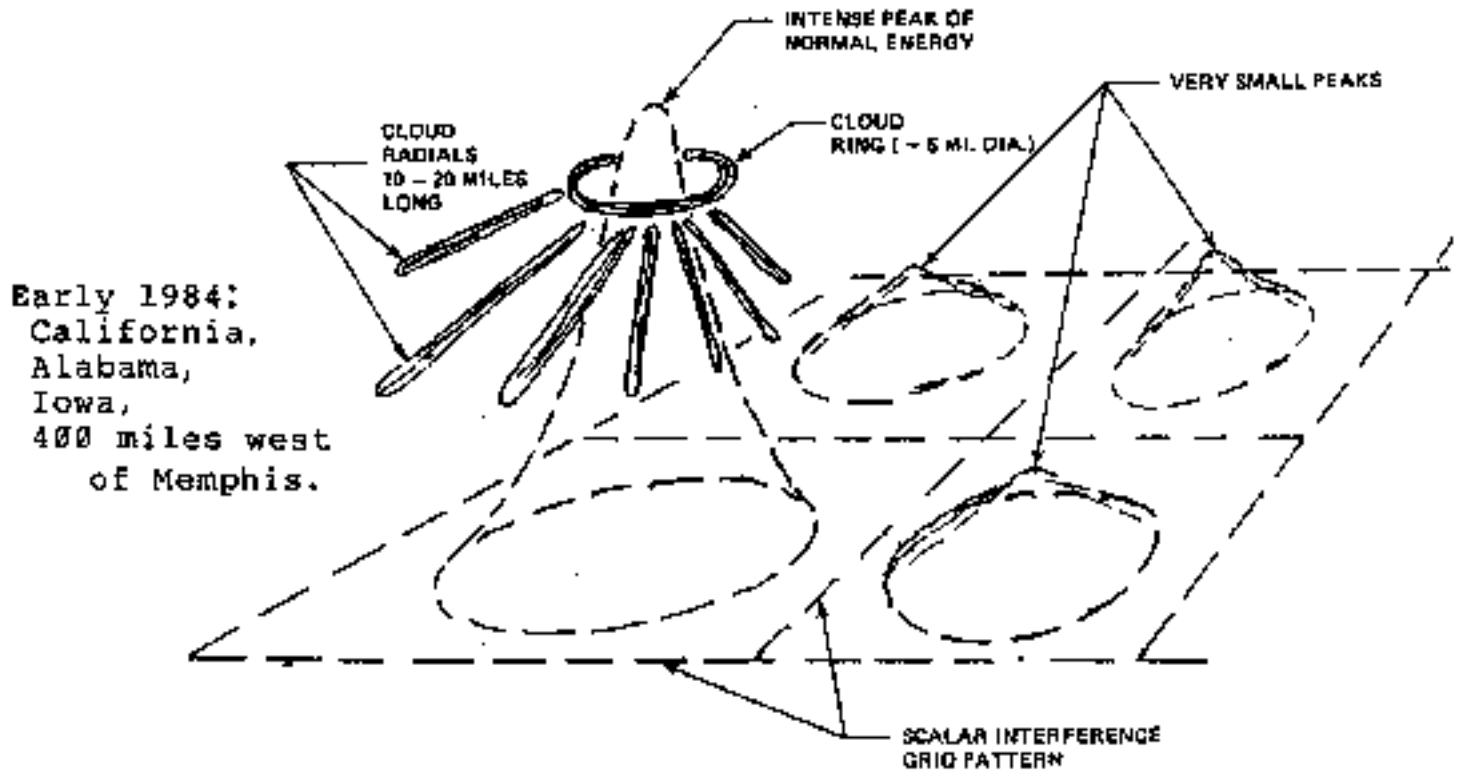

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A Briefing on Soviet Scalar Electromagnetic Weapons
by Lt. Col. T.E. Bearden (retd.), 1986
Copyright

2. Continual cloud radials have repeatedly been seen and photographed over Huntsville, Alabama, associated with weather engineering and grid activity. Typical radials seen by this author are shown in Bearden, Soviet Weather Engineering Over North America, 1-hr. v1deotape, 1985. Huntsville is apparently a pivot point or "hinge point" for bending and controlling the jetstream.

3. Spectacular cloud grid patterns have been seen over Huntsville, Alabama and Los Angeles, California. An excellent videoclip of one of the Los Angeles area grids, personally observed and shot by KABC Open Mind talk show host Bill Jenkins, is shown in Bearden, Soviet Weather Engineering Over North America,;1-hr. videotape, 1985. An artist's sketch of an earlier gigantic grid, extending from horizon to horizon in every direction, seen over Huntsville, Alabama by Tom Bearden and Ken Moore, is also shown in the tape. The videotape is available from P.O. Box 1472, Huntsville, AL 35807. Sketches and details of another highly anomalous grid pattern observed in the greater Los Angeles area by engineer Ron Cole are shown in figures 5 and 6.

The reason that clouds of water droplets and/or ice particles detect the scalar interferometry and form signature patterns is simple: Consider each H2O molecule as having two light little hydrogen atoms hanging on to the much heavier oxygen atom. The covalent sharing with the oxygen atom of the electron from each hydrogen atom means that

1. the electrostatic scalar potential between the H ion and the O ion it is bonded to, is rhythmically varying as the electron is shared back and forth,
2. this varying potential contains "electron spin holes" since it is made by the moving electron,
3. two such varying potentials exist since there are two H atoms sharing covalent electrons with the O atom,
4. the two H ions are at an angle of over 100 degrees with respect to each other,
5. the molecule assembly thus constitutes one part (one half, so to speak) of a scalar interferometer with imbedded electron spin holes for electron hooking,
6. Incident scalar waves from outside the system interact with the "half scalar interferometer." This scalar interferometry interaction is coupled to the covalent bonding electron because of the internal spin hole pattern of the molecular half of the interferometer. The coupled electron moves with the sca1ar pattern's changes, causing an observable interaction with and in the electrical structure and ionic potential of the molecule,
7. the weak H to H hydrogen bonding between molecules connects resulting ionic potential changes to the structuring of the entire macroscopic cloud assembly. Thus by scalar interferometry with the H_2O "half interferometers", an incident scalar EM pattern is detected and translated into patterns of E and B force fields. The H_2O molecules then "line up" in accord with the electrical patterns detected.

Thus the clouds form "signature patterns" according to the incident scalar EM radiation patterns. Giant cloud radials in the targeted area are probably due to the type and shape of antennas including the type and shape of the electrical wires establishing the antennas' ground planes -- used by the Soviet Union to project the scalar waves. Note that such "radial" antenna patterns were occasionally used by James Harris Rogers in his underground and undersea scalar EM transmission system.

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Figure 15. FORMATION OF A DOUBLE GIANT RADIAL

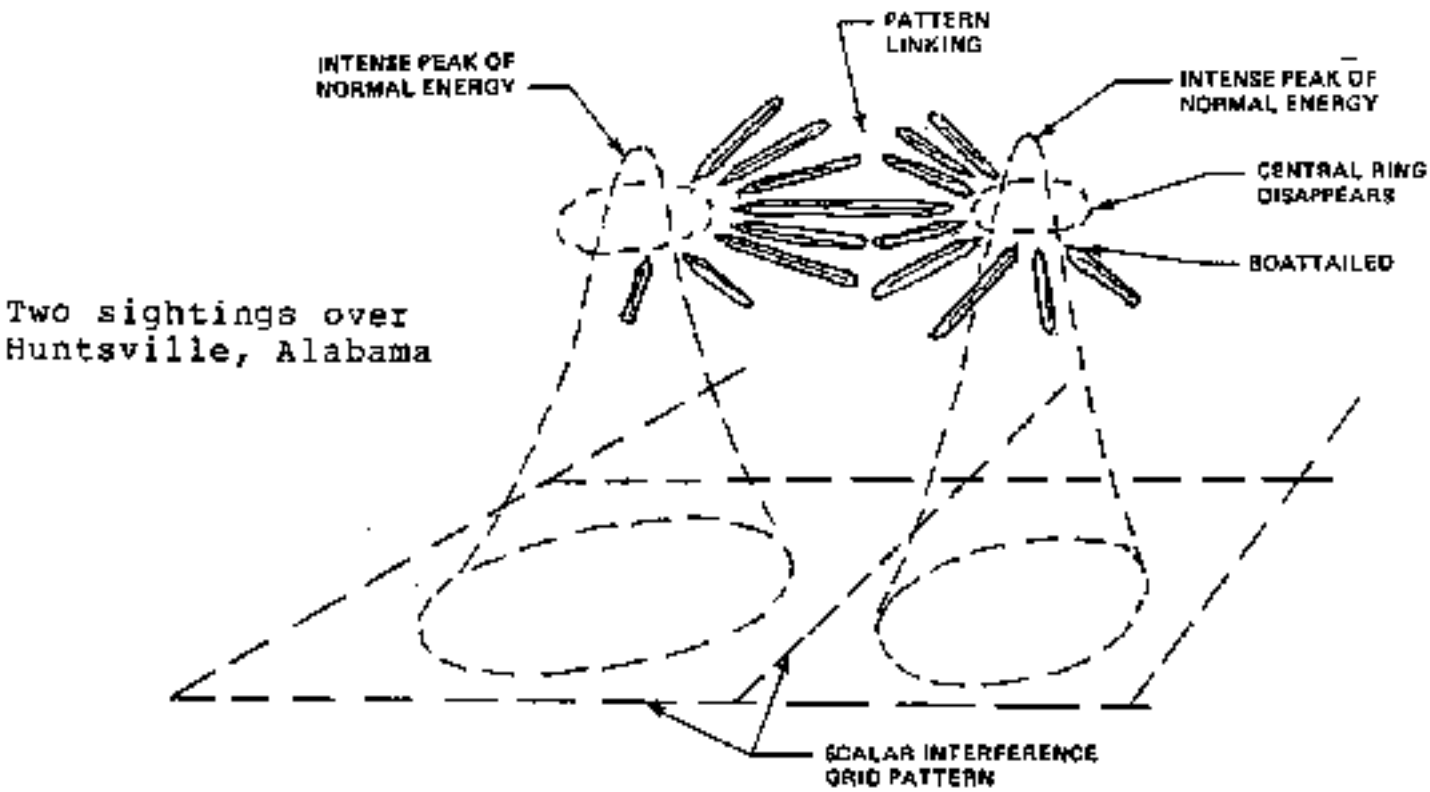

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Figure 16. DETECTION OF TRANSVERSE AND LONGITUDINAL WAVES

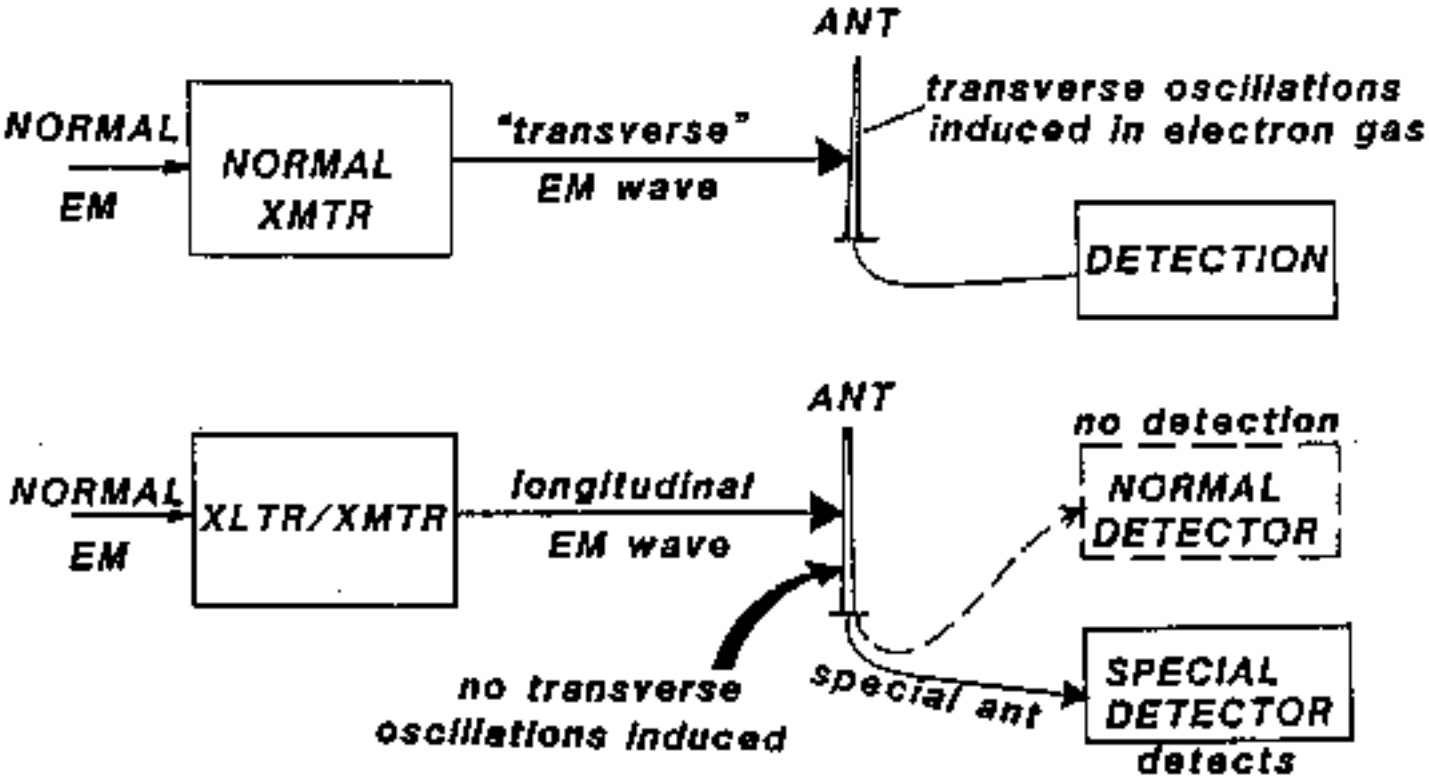

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Defense Department Briefing on Priore Treatment to counter Biological Warfare

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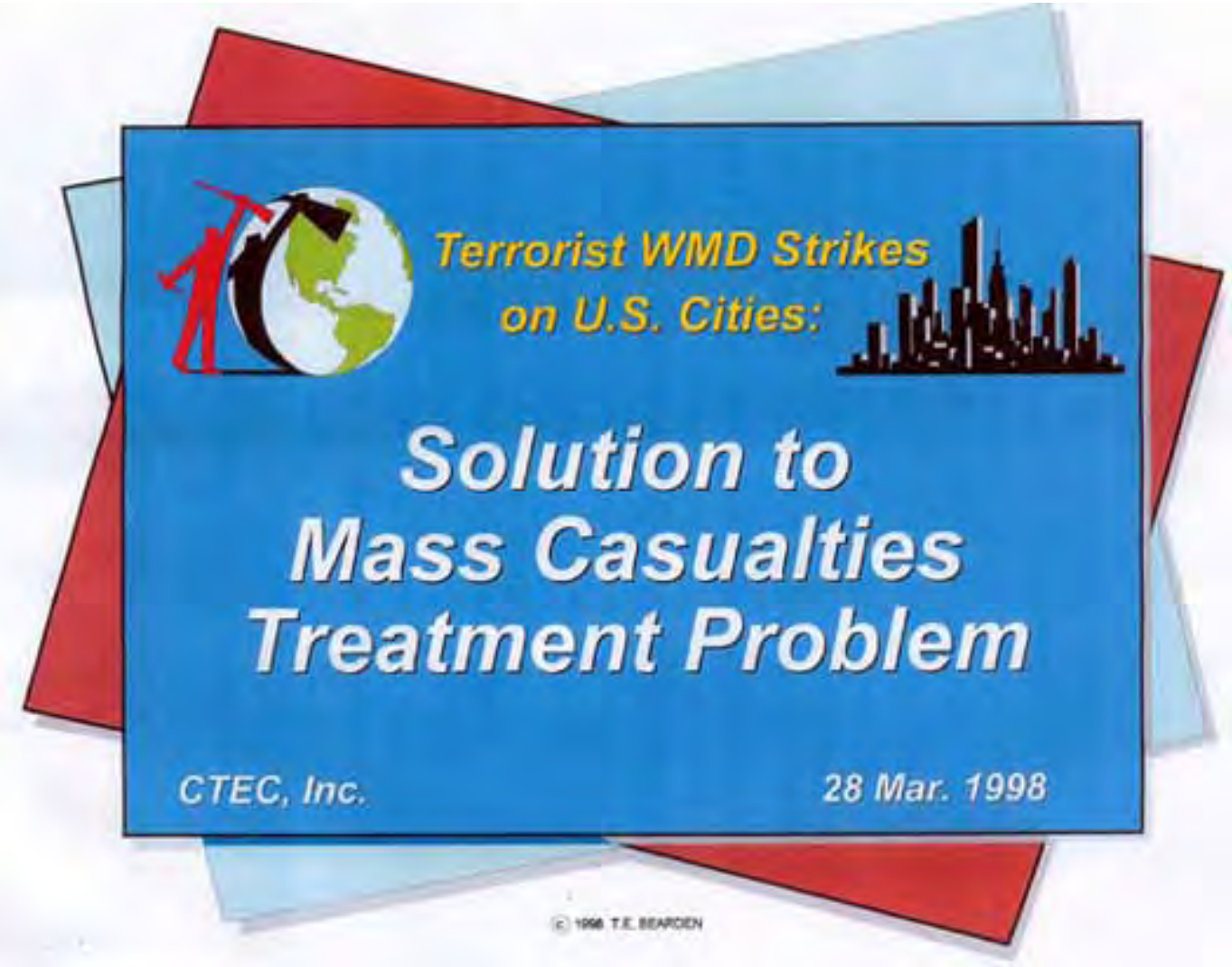

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Key Points in the New Technology

- There is a vast new kind of electrodynamics *hidden inside* all EM potentials, fields, and waves
  - Longitudinal EM waves and complexes
  - Oscillations in time domain

- These complexes are an *infolded general relativity*
  - Clustered formations of *spacetime curvatures*
  - *Very powerful*, since the EM force is used as the agent of curvature

- In general relativity, similar precise complexes permeate and *act on any mass at all internal levels*
- With this approach, one *can now manipulate matter* -- living or inert -- *in any manner desired*, depending only on the level of development of the technology
- Priore unwittingly used this to *cure dread diseases*
- This is a *revolution in all of science*

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- *We have uncovered the major mechanisms* to utilize

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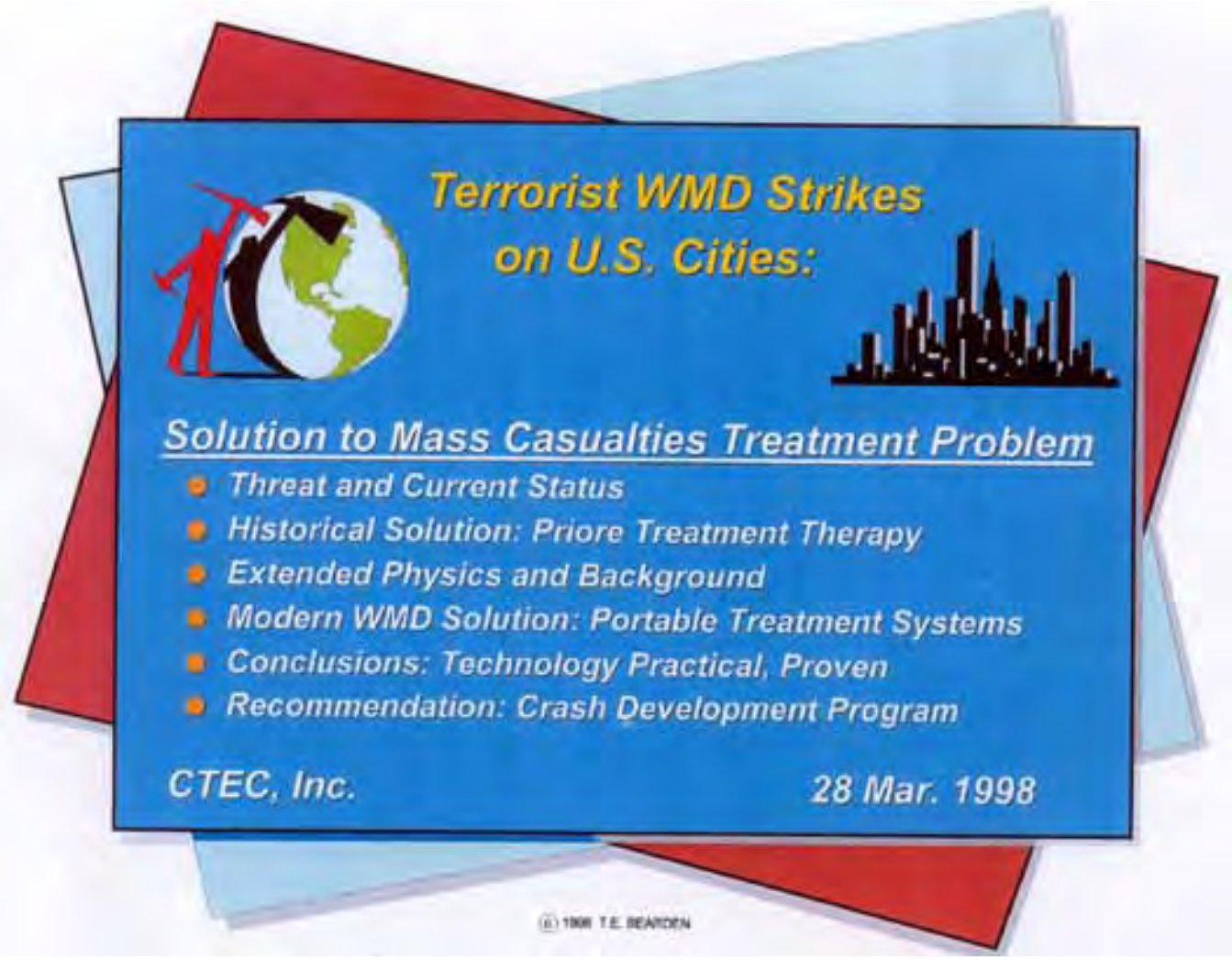

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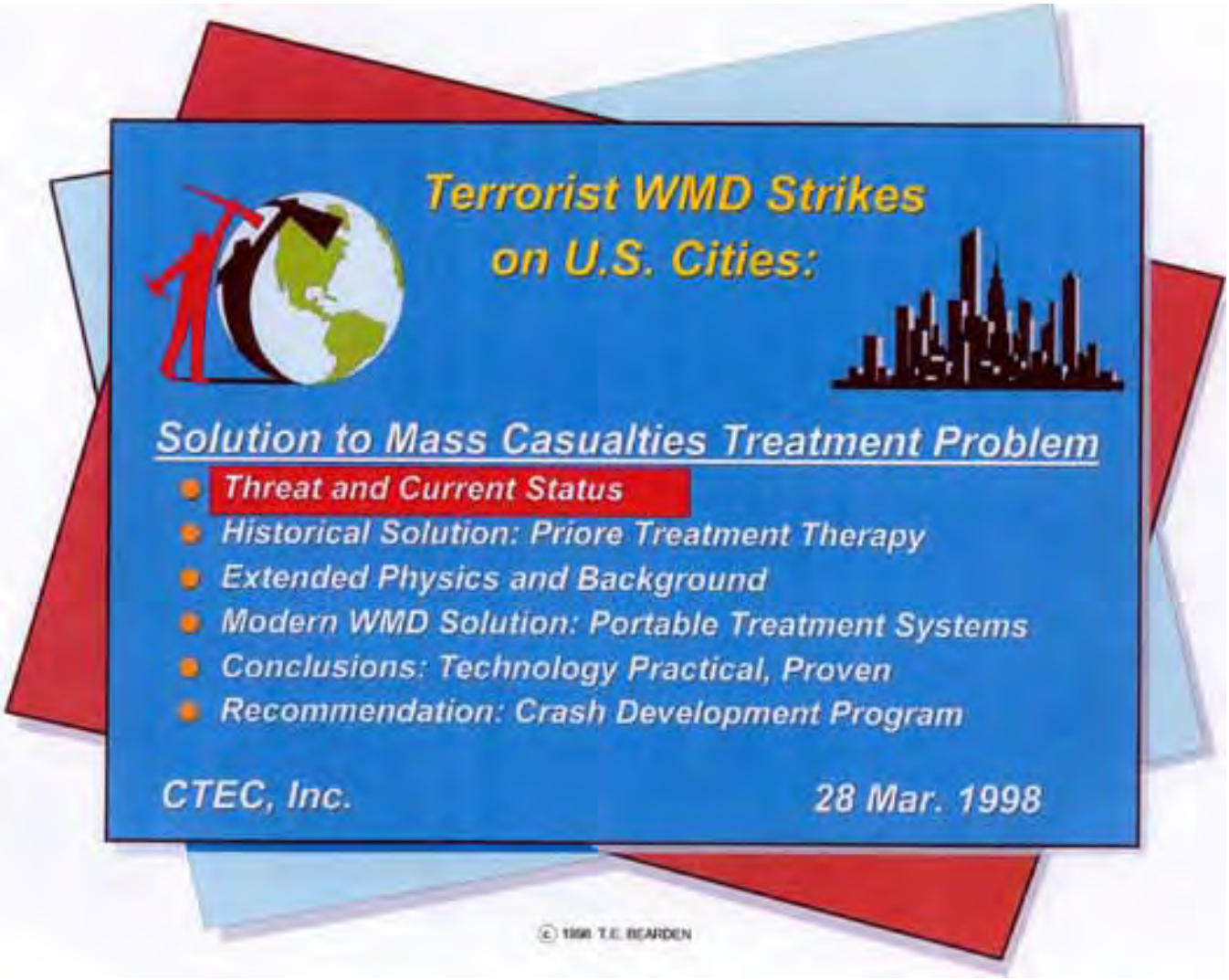

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THE TERRORIST THREAT

TODAY:

- Sabotage
- Chemicals
- Biological agents
- Nuclear materials
- Powerful explosives
- Assassination
- Kidnapping and hostages
- Contamination
- Shoulder-fired AD missiles
- Terrorism

FUTURE ADDITIONS:

- EM weapons
- EM biological warfare
- Scalar EM weapons
- Scalar EM disease induction
- Alteration of behavior and emotions
- Alteration of memory
- Direct thought control
- Action-at-a-distance effects

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Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.

- One terrorist, one light aircraft with spray tank
- 100 kilograms of anthrax
- Flies over greater metropolitan Washington, D.C.
- Calm night
- 1-3 million casualties result*
- Most of those stricken will die
- Presently little can be done to save the stricken civilians
- Attacks on several population centers might produce some 10 million or more casualties

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*Per OTA Report to Congress, 1993

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Present Status of the WMD Threat to the United States

- Many foreign nations are hostile to the U.S. and sponsor terrorists
- Some 25 nations have WMD or are acquiring them
  - BW agents and weapons
  - Chemical agents and weapons
  - Nuclear materials and weapons
- Thousands of students and emigres
- Infiltrated teams, BW, other WMD already
- Castro guerrillas infiltrated over the years
- Can do unacceptable damage to U.S. now
- *May reach first strike knockout capability*

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*Per OTA Report to Congress, 1993

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Some Present Problems in the U.S. WMD Defense Capabilities

- No shelters (require overpressure, BW filtering, masks, showers, supplies)
- No stockpiled vaccines, medical supplies, immunoglobulins, masks, suits, food, fuel, generators, heaters, water purification units
- Totally insufficient medical facilities, personnel, and emergency response teams
- Triage, full martial law will be required
- No answer to massive decontamination problem
- State, county, city inadequately staffed and insufficiently trained for mass casualties
- Terrorist teams, BW agents, other WMD on site, waiting
- Water supplies, food, crops, farm animals also vulnerable
- Electric power grid, bridges, trains, railroads vulnerable
- Present medical science cannot save very many of the casualties, now or in the foreseeable future

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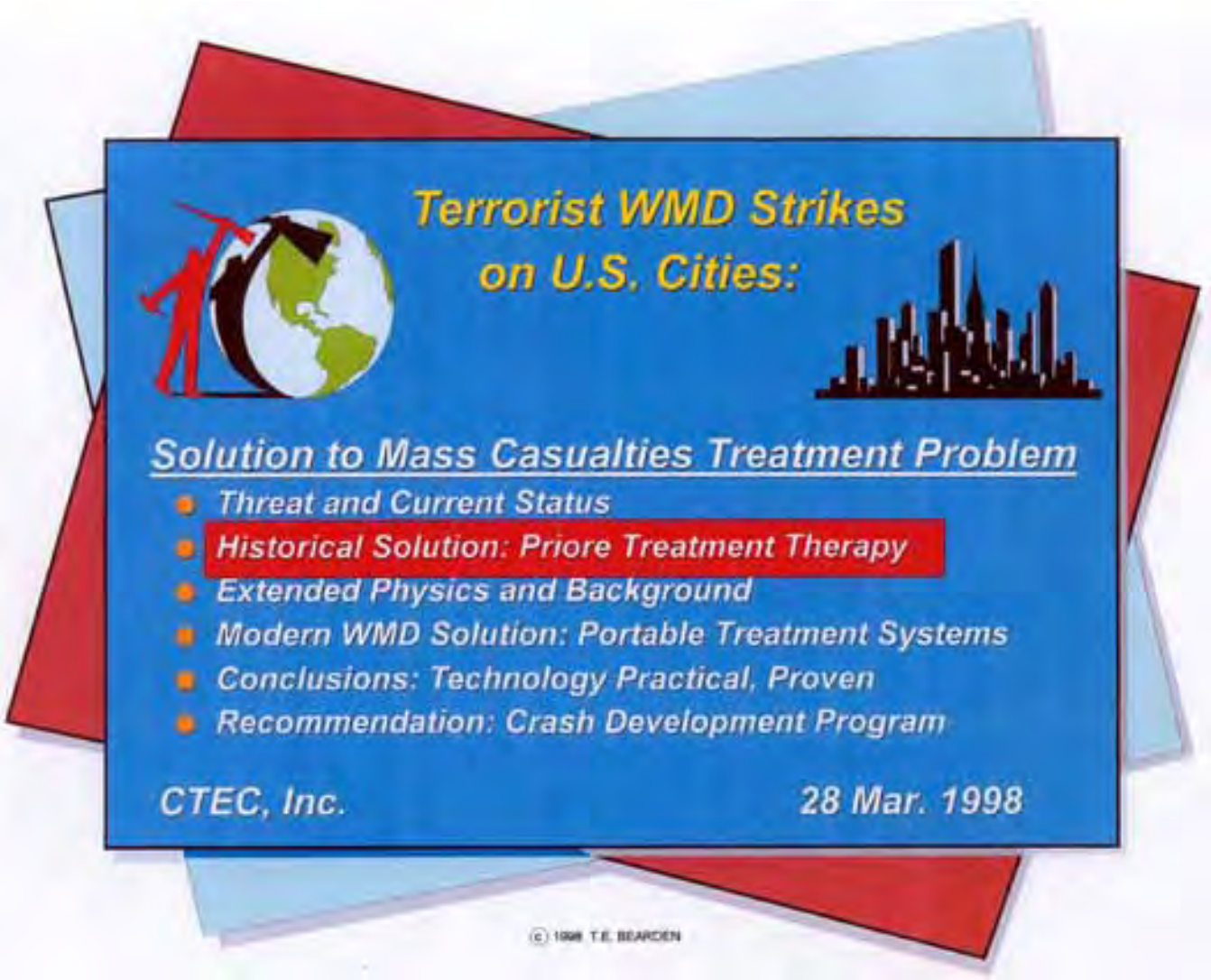

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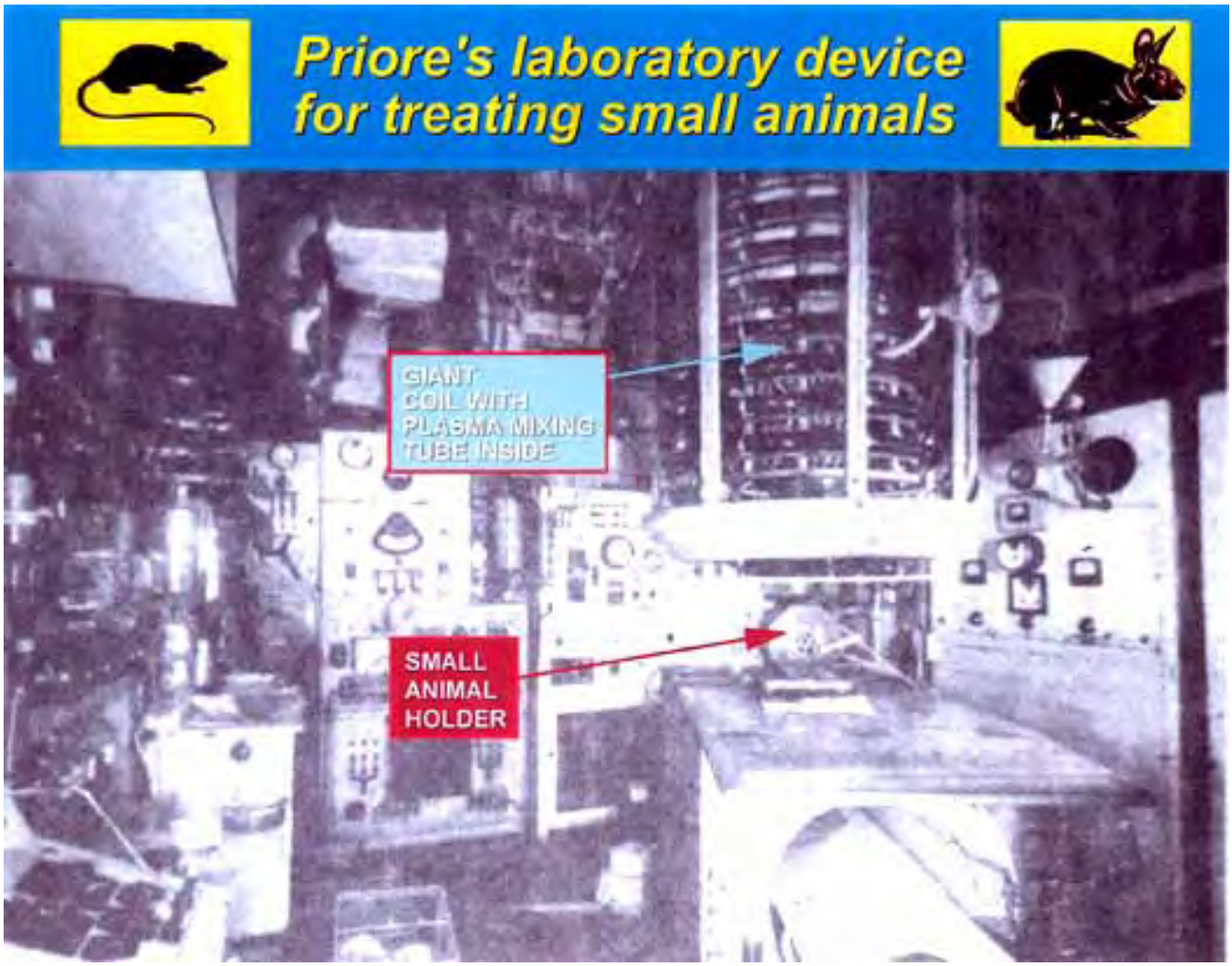

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Photo courtesy of Bob Whitney

Antoine Priore (right) with the Mayor of Bordeaux, Mr. Chaban-Delmas.

The Priore technical mechanism unwittingly involved a dramatic extension to both nonlinear optics and general relativity. However, nonlinear optics itself had not yet been born in the 1950s and 1960s when Priore worked out his methodology. The extension to general relativity has not been previously envisioned even to the present day. When the Priore project was suppressed by the changed French government in the mid-1970s, nonlinear optics itself was just being initiated. To the present day, however, there has previously been no inkling of the dramatic extension to NLO that arises by using longitudinal EM pump waves and thereby pumping in the time domain.

It is little wonder that Priore himself did not understand the nature of the technical mechanism he was utilizing, and neither did anyone else, and neither *has* anyone else prior to this time.

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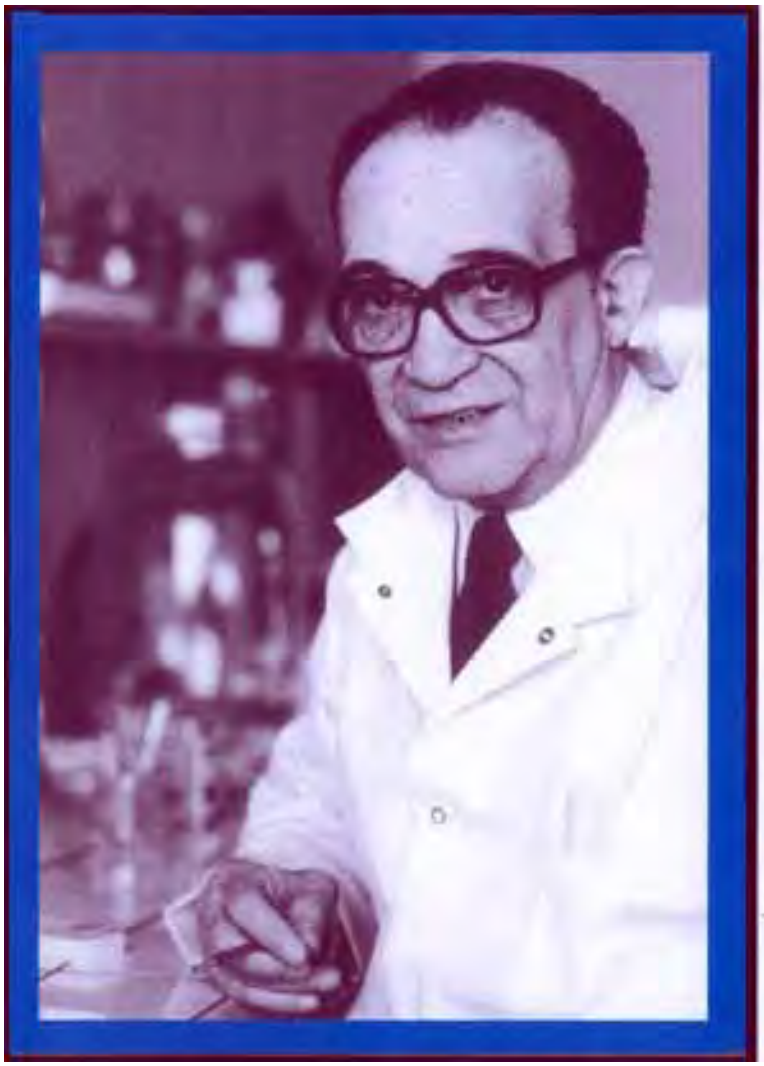

Raymond Pautrizel, eminent French parasitologist who worked with Priore

Among other things, Pautrizel treated seriously infected immature rats with the Priore ray. These rats had never had a mature immune system. When they were removed from the machine, they still sickened again and died, because their immature immune systems could not resist the pathogen *(Trypanosoma)*. So even though the damaged cells were reversed back to normal, the "normal" immune system was unable to fight off pathogens, which reinfected the cells and killed them, killing the rats.

This established the time-reversal nature of the therapy.

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12-Foot plasma tube in Priore's large device

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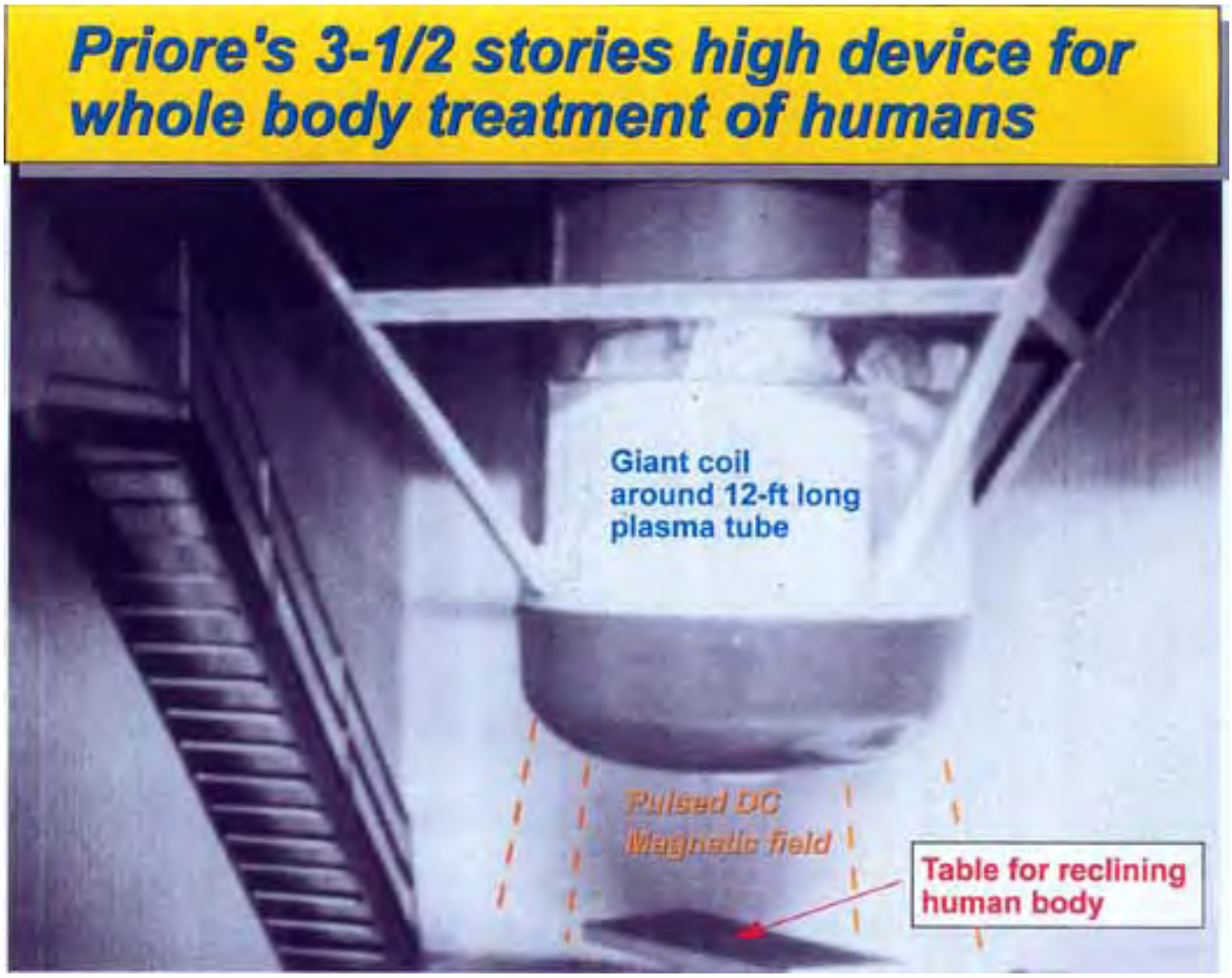

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MECHANISM OF THE PRIORE THERAPY

- FACT: DISEASE-SPECIFIC VACUUM ENGINE PRESENT FOR ANY CELLULAR DISEASE, BY WHEELER'S PRINCIPLE
  - *DISEASE CAN BE REVERSED BY CREATING AMPLIFIED VACUUM ANTI-ENGINE (BEARDEN'S PRINCIPLE)*
  - *ANTI-ENGINE IS CREATED BY PUMPING THE NONLINEAR CELLS IN THE "INNER EM" DOMAIN, TIME-REVERSING THEM*

- PRIORE UTILIZED A PLASMA TO PHASE CONJUGATE AND "INFOLD" MULTIPLE BIDIRECTIONAL LONGITUDINAL EM PUMP WAVES
  - *17 FREQUENCIES MIXED IN A ROTATING PLASMA*
  - *PHASE CONJUGATES ADDED BY THE PLASMA*
  - *INFOLDED MIX INTO STRONG PULSED DC MAGNETIC FIELD, WHICH CARRIED IT INTO ATOMIC NUCLEI*
  - *PUMPED ALL NONLINEAR CELLULAR COMPONENTS TO PRODUCE AMPLIFIED, SPECIFIC VACUUM ANTI-ENGINE*

- NEGATED THE LONG-TERM CUMULATIVE CELLULAR DEDIFFERENTIATION ORDER GENERATED BY LONG-TERM HYPOXIA. TUMOR CELLS REVERTED TO NORMAL CELLS.
- SCRUBBED OUT THE CUMULATED PRECANCEROUS STATE
- RESTORED THE IMMUNE SYSTEM TO HIGH FUNCTIONING
- NO EXCESSIVE TRAUMA TO TREATED ANIMAL

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Priore's therapeutic methodology: Using infolded longitudinal EM waves as NLO pump waves, to pump in the time domain

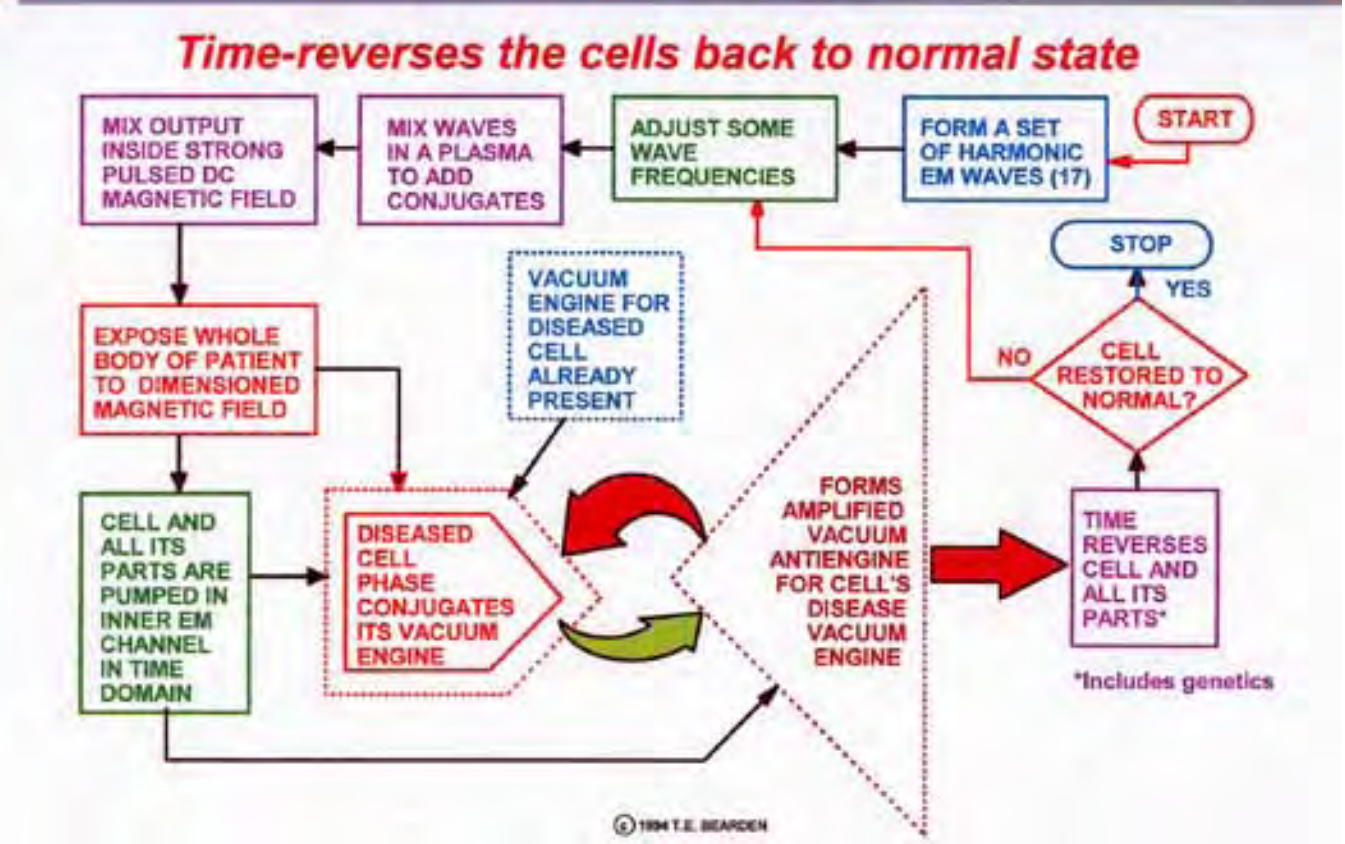

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DRASTICALLY REDUCED CUMULATIVE DETERIORATION AFTER PRIORE THERAPY

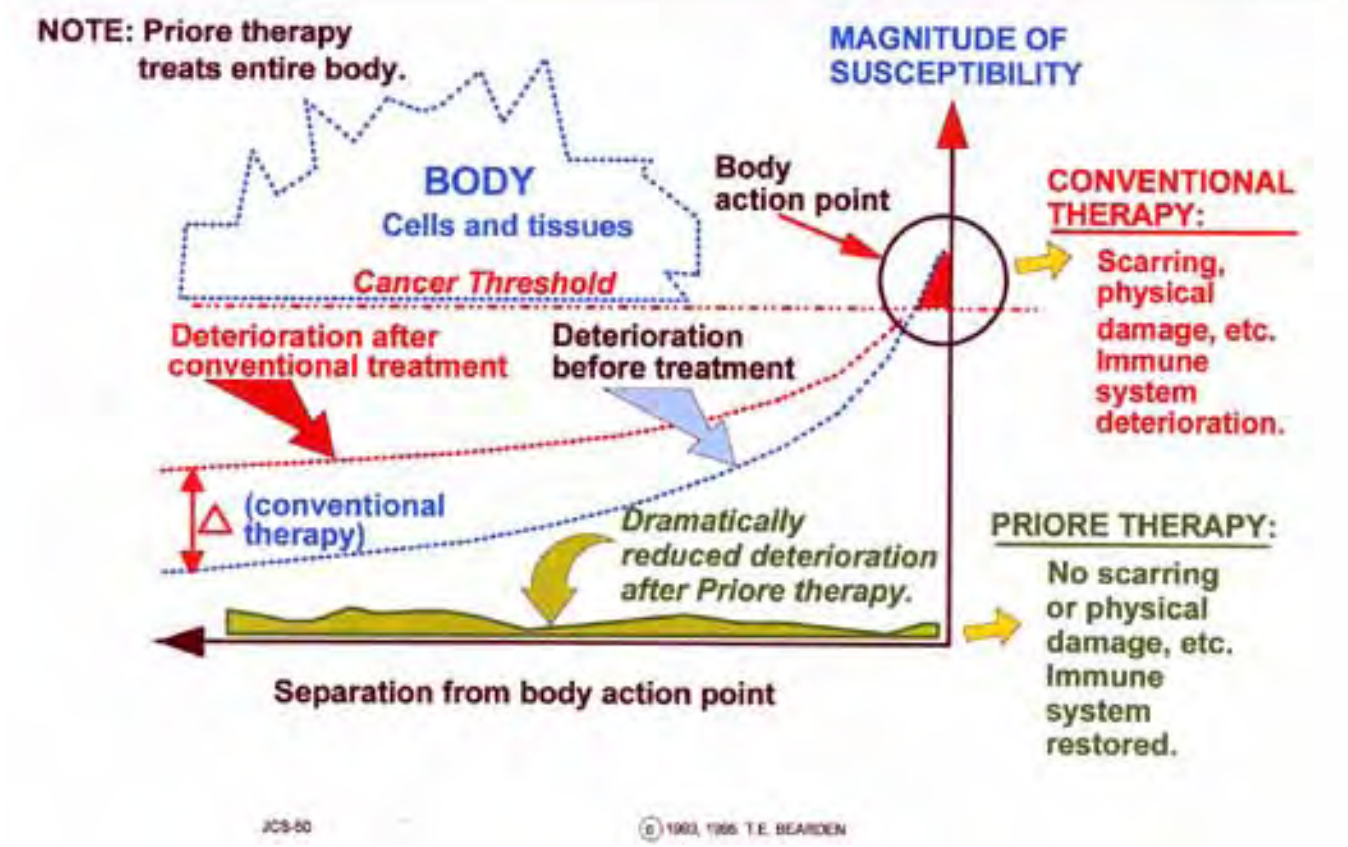

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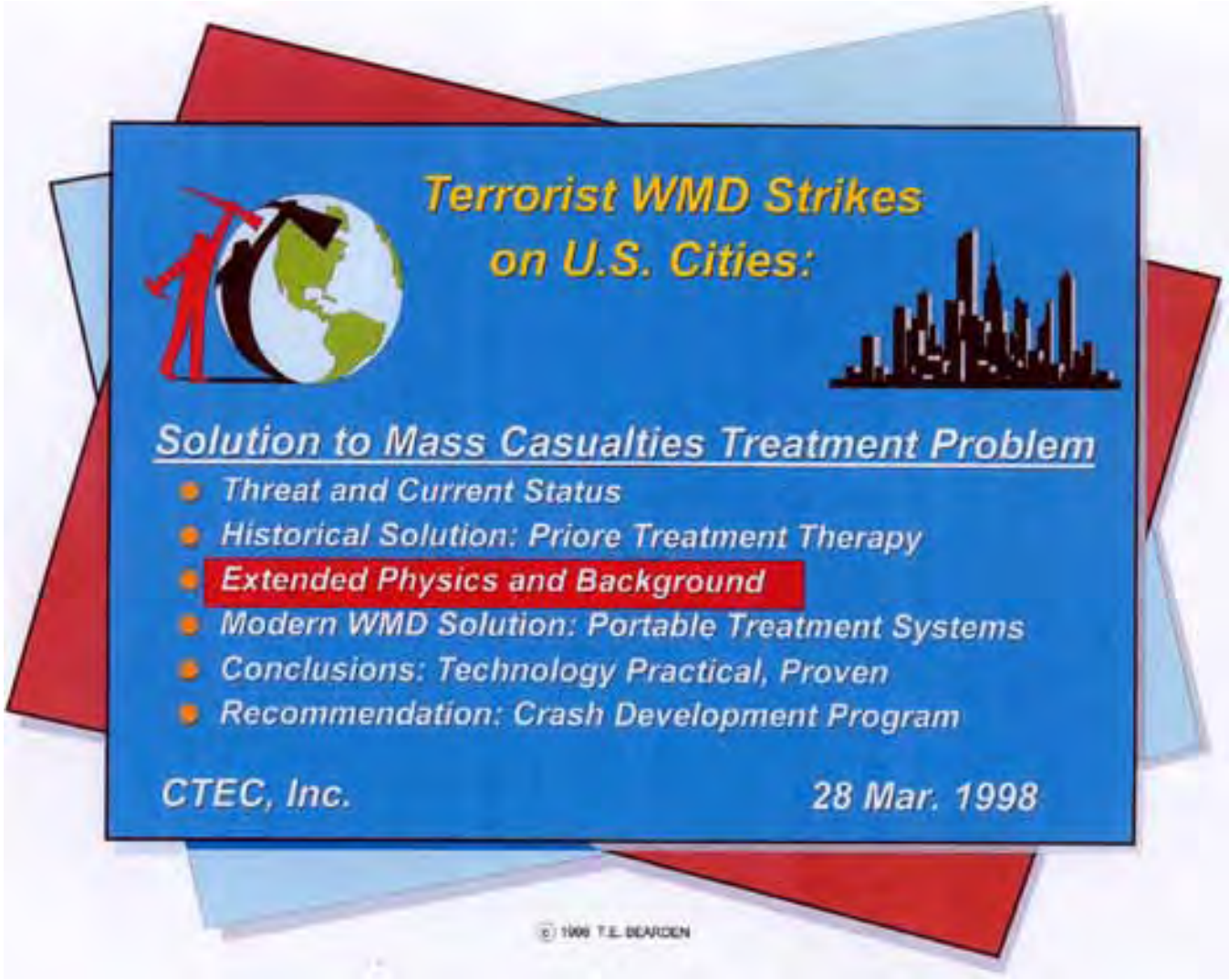

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Founders of Scalar Electromagnetics

- **G.J. Stoney:**

Decomposed the scalar potential into bidirectional wave pairs.

"On a supposed proof of a theorem in wave-motion," Phil. Mag., 5(43), 1897, p. 368-373 (and several other papers).

- **E.T. Whittaker:**

Decomposed the scalar potential into a series of bidirectional EM wave pairs in harmonic series, where the two waves in each pair are conjugates (i.e., a wave/antiwave pair) and are longitudinal waves.

"On the partial differential equations of mathematical physics," Math. Ann., Vol. 57, 1903, p. 333-355.

Showed that all classical EM -- including waves -- can be replaced by two interfering scalar potential functions.. (This founded superpotential theory, extended by Nisbet, Bromwich, Debye, McCrea, and others.)

"On an expression of the electromagnetic field due to electrons by means of two scalar potential functions," Proc. Lond. Math. Soc., Series 2, Vol. 1, 1904, p. 367-372.

- **R.W. Ziolkowski:**

Independently rediscovered the biwave decomposition of the scalar potential and added the product set (in theory enabling modulations and communications) to Stoney and Whittaker's sum set.

Various papers, 1985 to date.

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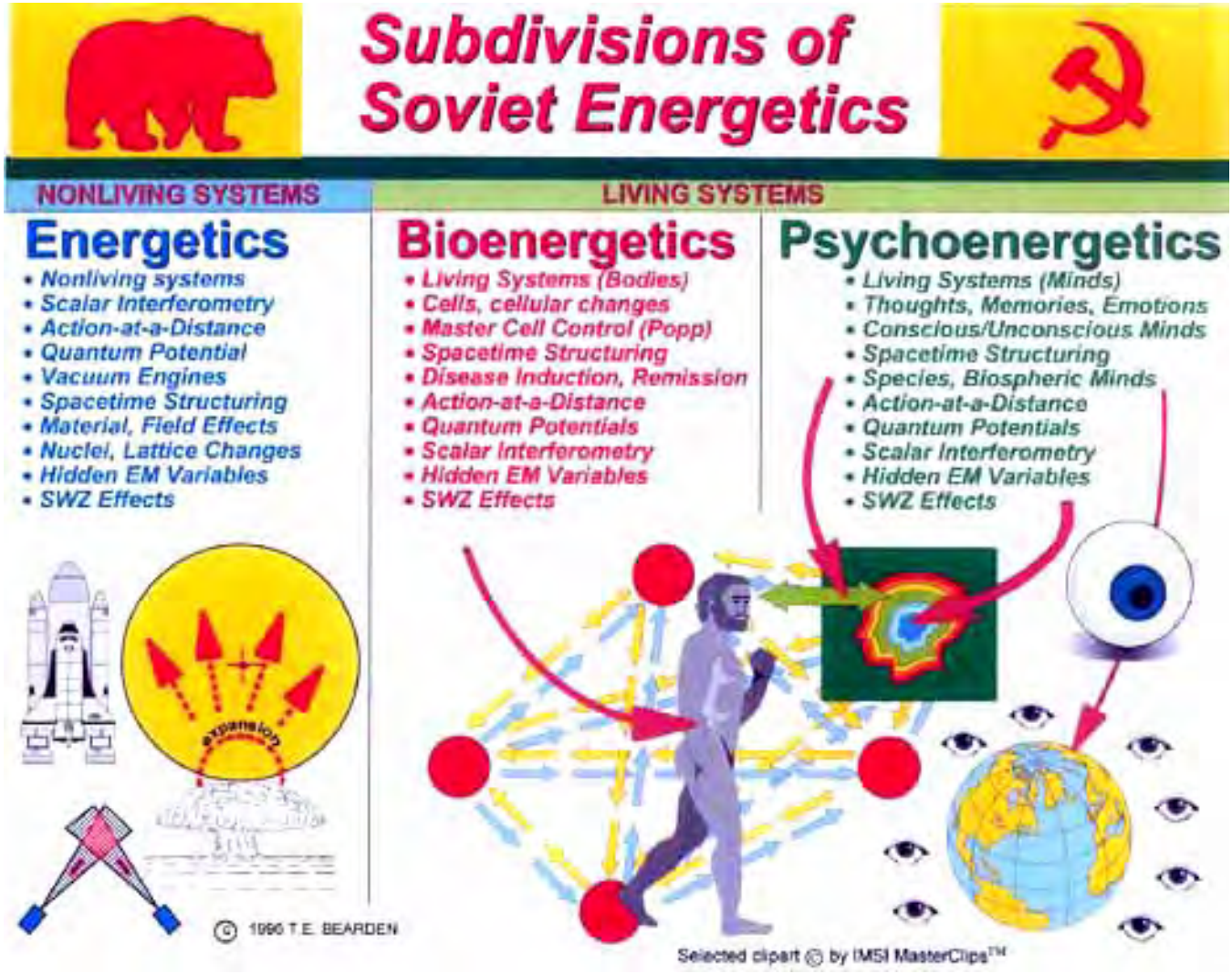

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Bunge on the Status of Classical and Quantum Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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EINSTEIN ON REVIEWING FOUNDATIONS

"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them."

Albert Einstein, "Foreword," in Max Jammer, Concepts of Space: The History of the Theories of Space in Physics, Harvard University Press, Cambridge, Massachusetts, 1969, p. xi-xii.

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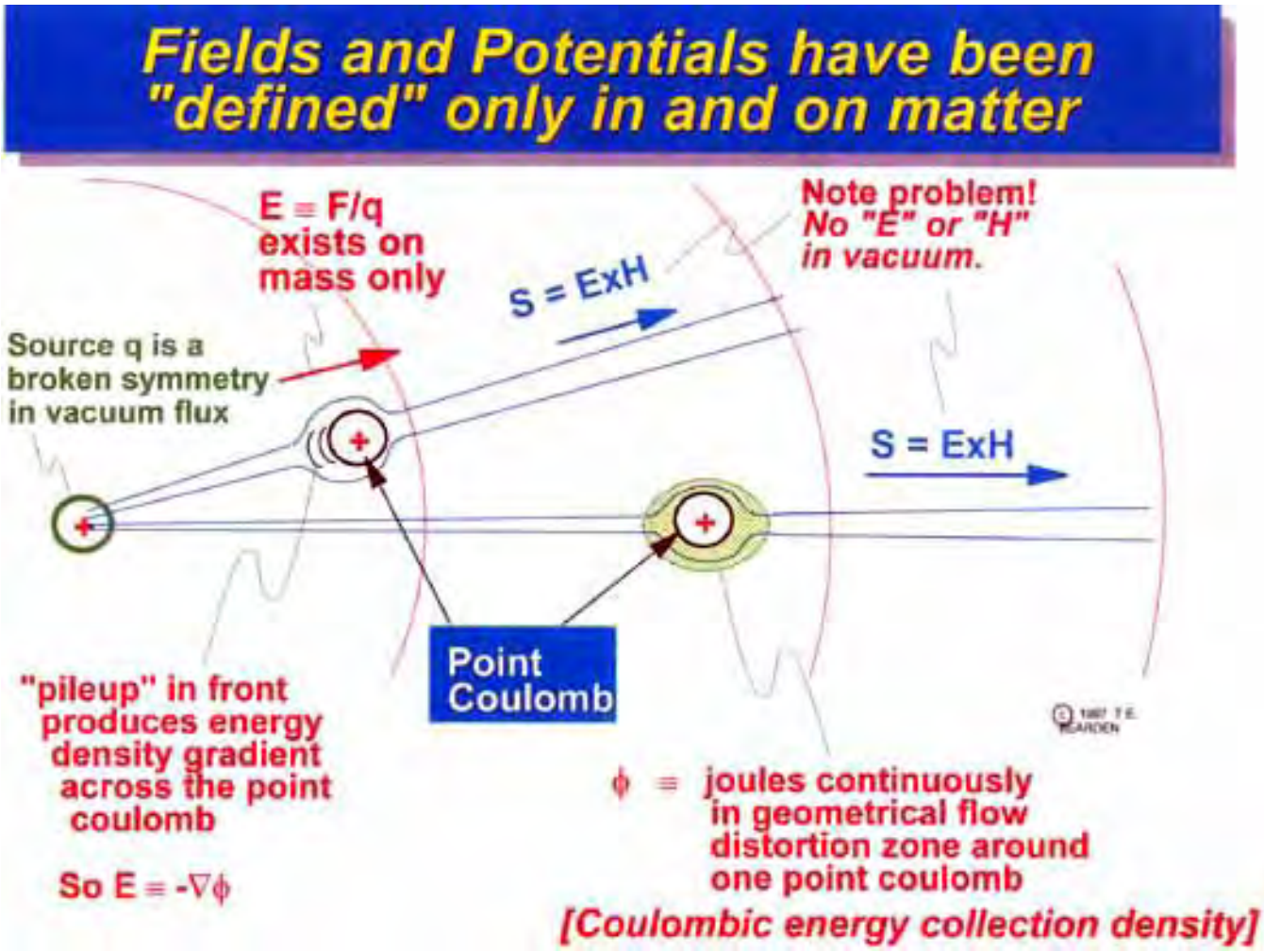

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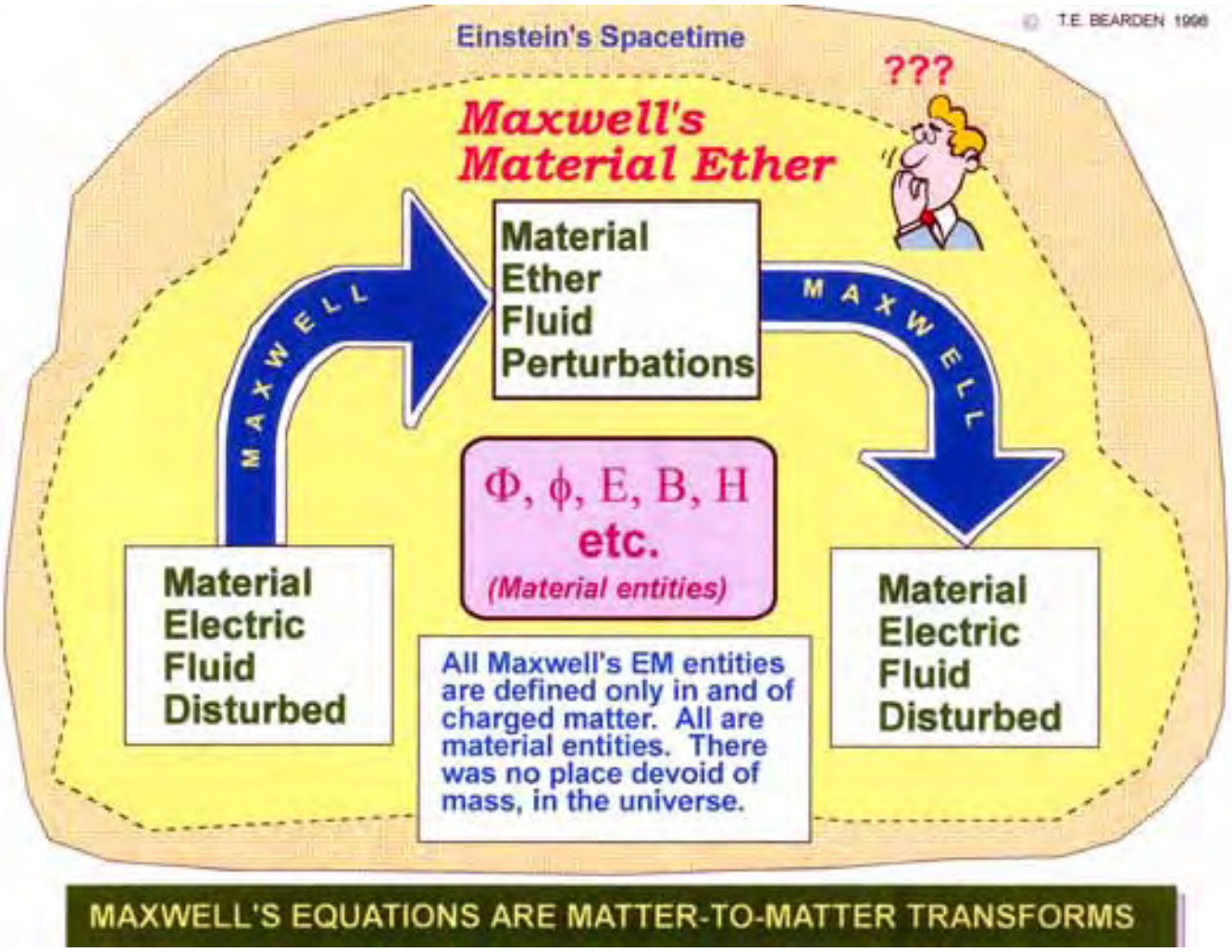

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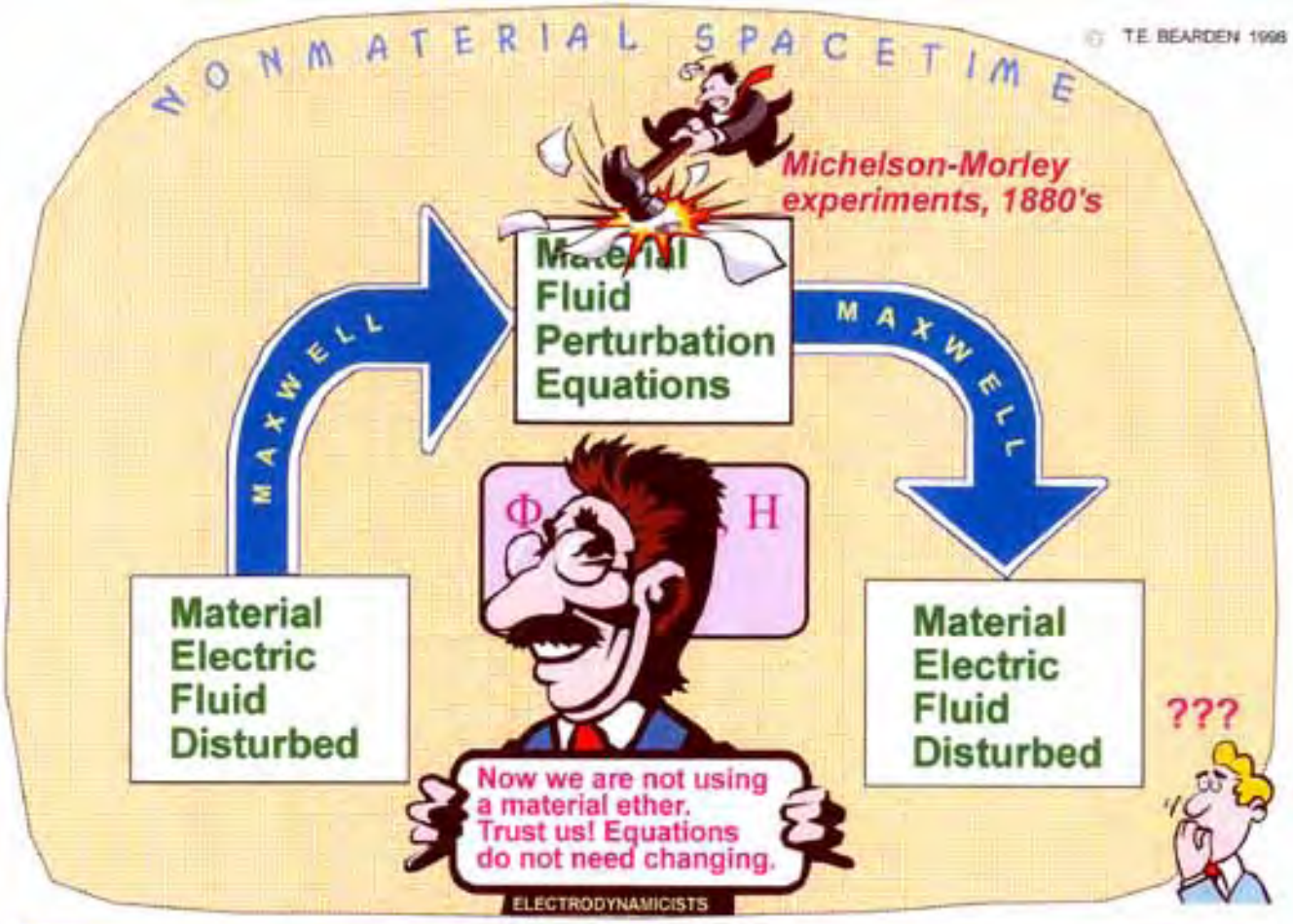

Electrodynamicists' Reaction to Removal of the Material Ether

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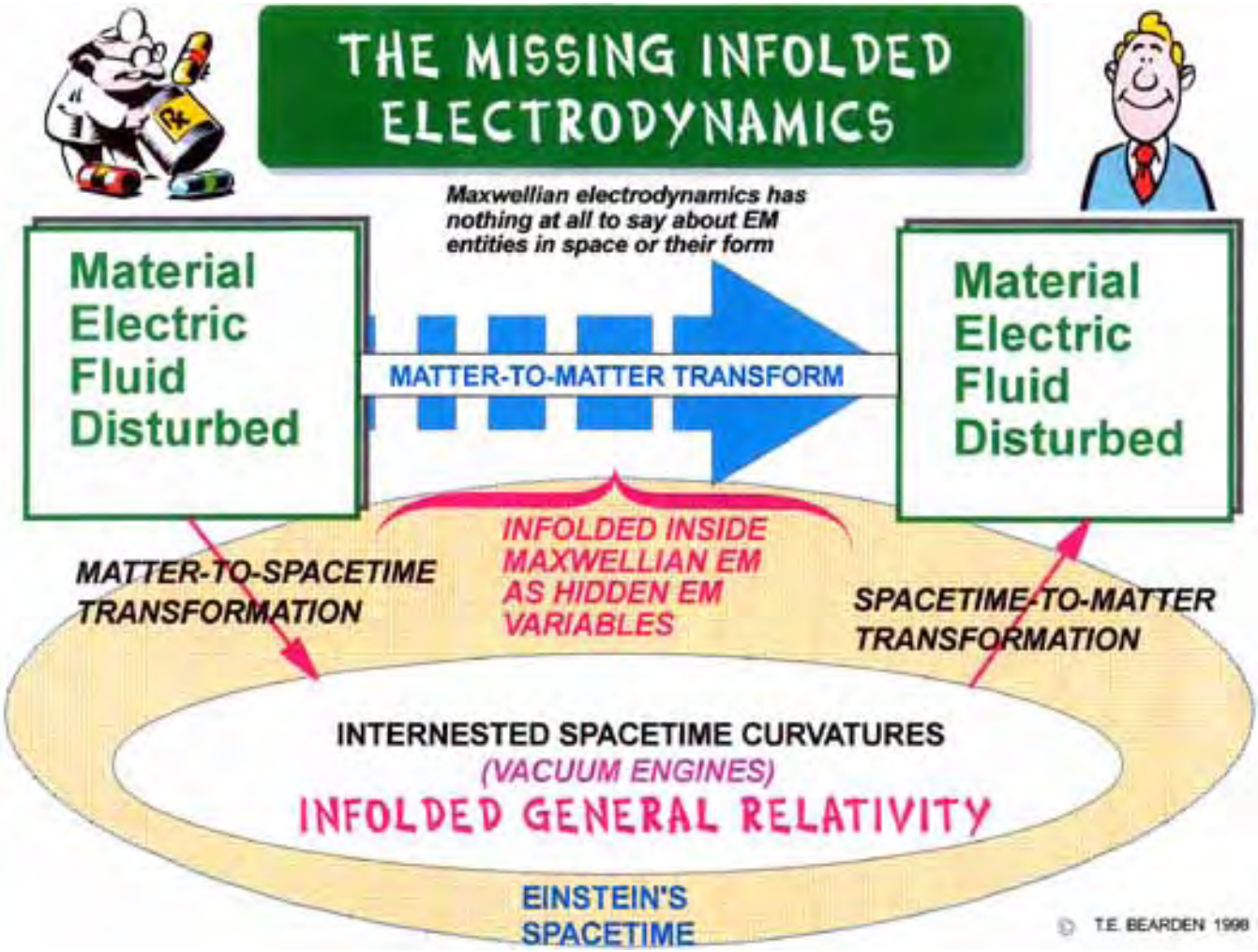

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Nonlinear Optics
Distortion Correction Theorem

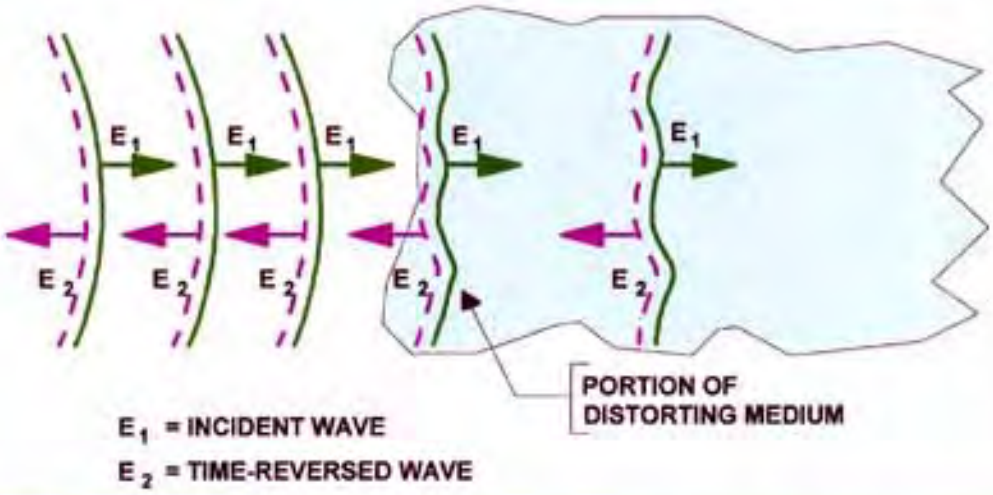

"If a scalar wave $E_1(r)$ propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica $E_2(r)$, then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1."

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Infolded longitudinal EM biwave composition of a scalar potential

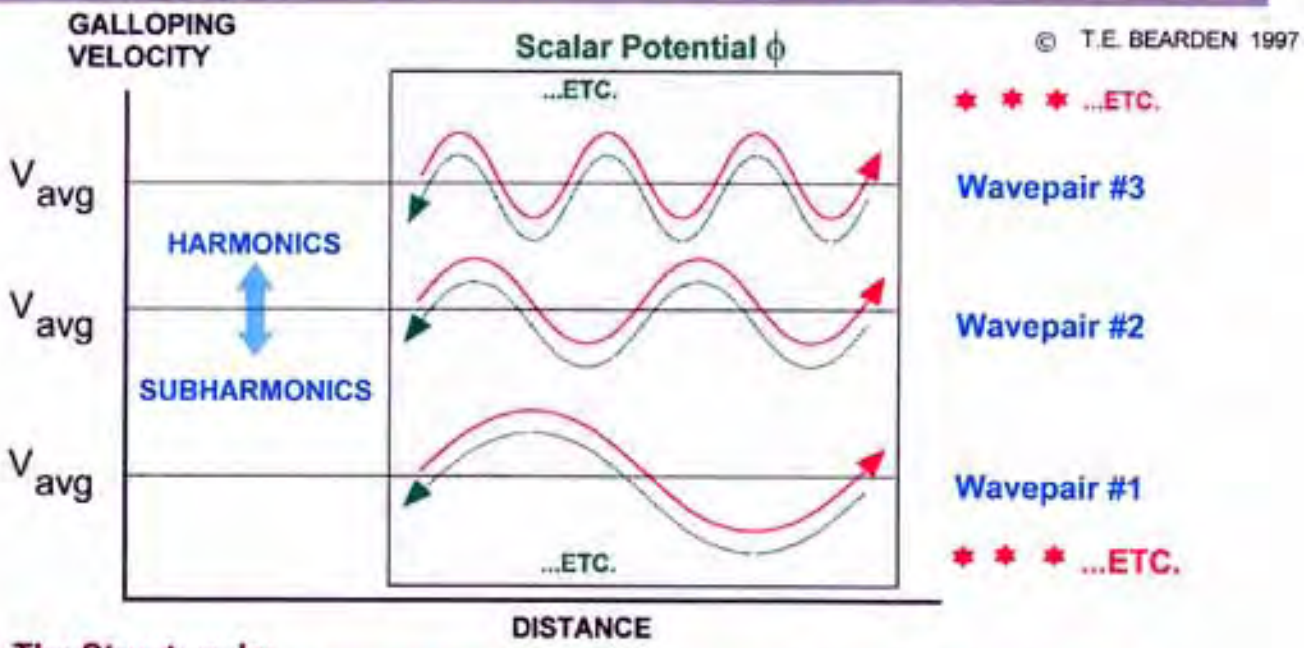

The Structure Is:

A harmonic set of longitudinal EM wavepairs. In each wavepair the two waves superpose spatially, but travel in opposite directions. The two are phase conjugates and time-reversed replicas of each other. Thus they comprise a coupled longitudinal wave and antiwave. The photons must be coupled into photon/antiphoton pairs (gravitons) by a strong application of the distortion correction theorem of nonlinear optics. Each wave in the biwave pair is a galloping wave. Each wavepair is a standing electrogravitational wave. In nonlinear optics, such a wavepair is a pump wave which pumps in the time domain.

Note: Think of the oscillations as velocity modulations.

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The Zero-Vector Axiom Destroys "Topologies within Topologies"

- The axiom: There is a unique vector, $\bar{0}$, in V (the vector space) such that
  $$\bar{V} + \bar{0} = \bar{0} + \bar{V}$$
- Note that $\bar{V} + \bar{0}_i = \bar{0}_j + \bar{V}$; $\bar{0}_i = -\bar{0}_i = n\bar{0}_i$
  so $\bar{0}_i = \bar{0}_j = \bar{0}_k = \ldots + \bar{0}_n = \ldots$
- This makes all $\bar{0}_i$ equal by assumption, since there is *assumed* to be only a single type $\bar{0}$ without real components
- In fact, $\bar{0}$ is <u>*not unique*</u>. An *infinite number* of different zero-vector systems, with real components, satisfy the zero-vector axiom.

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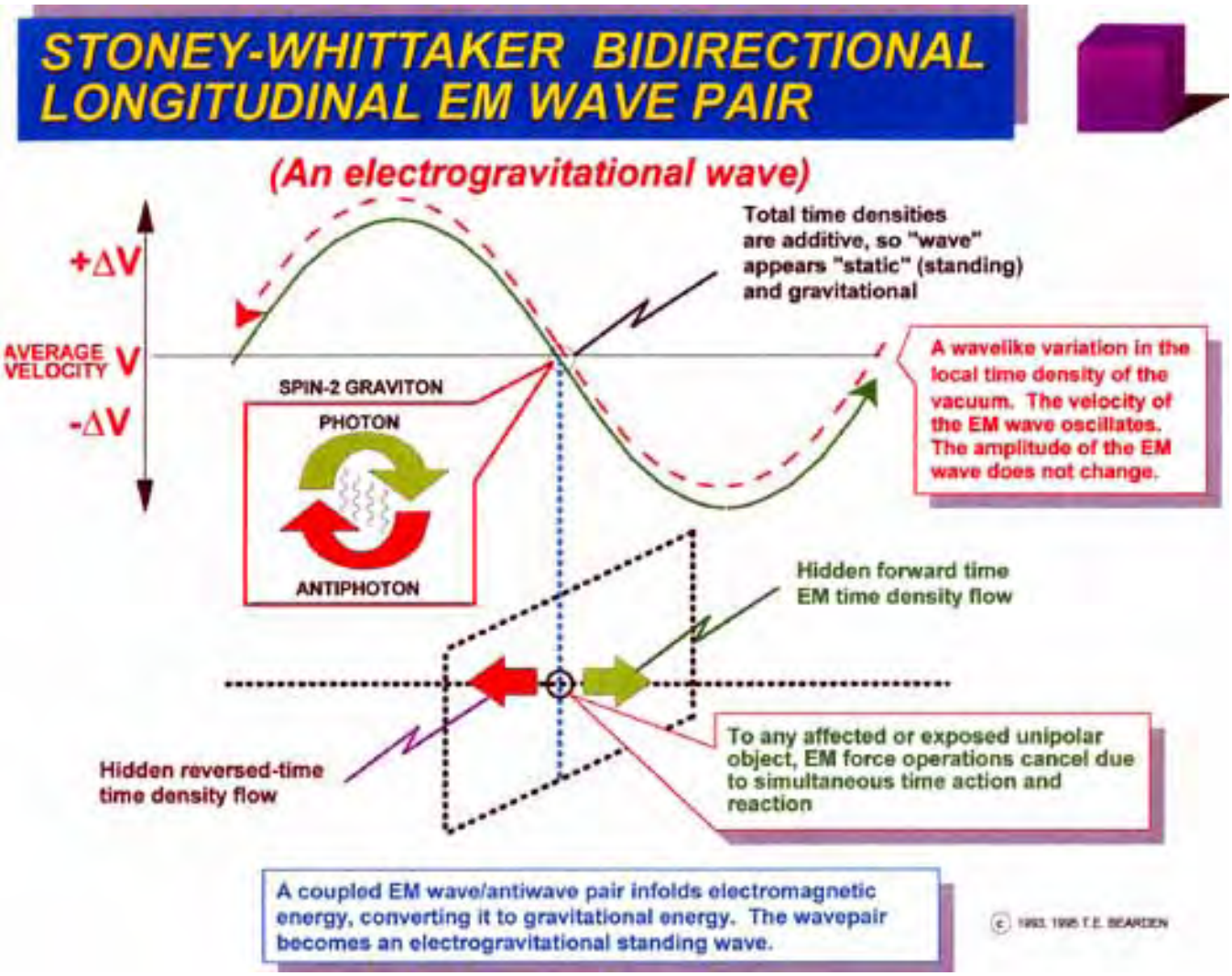

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Undistorted Progressive Waves (UPWs)*

(waves with velocity v, where $0 \leq v \leq \infty$)

- Major equations of interest having UPW solutions are:
  - *Homogeneous wave equation*
  - *Maxwell equations*
  - *Dirac, Weyl, and Klein-Gordon equations*

*Rodrigues and Lu, *Found. Phys.* 27(3), 1997, p. 435-508.

- UPWs are translationally invariant, and do not spread, or they reconstruct their original form after a certain period.
- UPW solutions have infinite energy. Quasi-UPWs can have finite energy and can in principle be launched into space.
- Subluminal Maxwell solutions are called *EM particles*. Superluminal Maxwell solutions are called *X-waves*.
- *Experimental results indicate such waves will be produced within the next few years.*

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- *Nimtz has translated Mozart's 40th symphony at v = 4.7c.*

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Velocity modulating a longitudinal EM wave oscillates rate of flow of time

$$V = \frac{L}{t}$$

Observer sees it this way

Constant transverse wave magnitude

Wave oscillates its velocity along its path, about a nominal value

Wave oscillates this way

Constant transverse magnitude

Wave oscillates magnitude of its transported t, about a nominal value

Note:

- Waves consist of photons
- Each photon consists of energy x time
- Each photon carries time as well as energy
- A wave is both a spatial energy dynamics and a temporal dynamics
- Wave complexes carry dynamic time structures as well as dynamic energy structures

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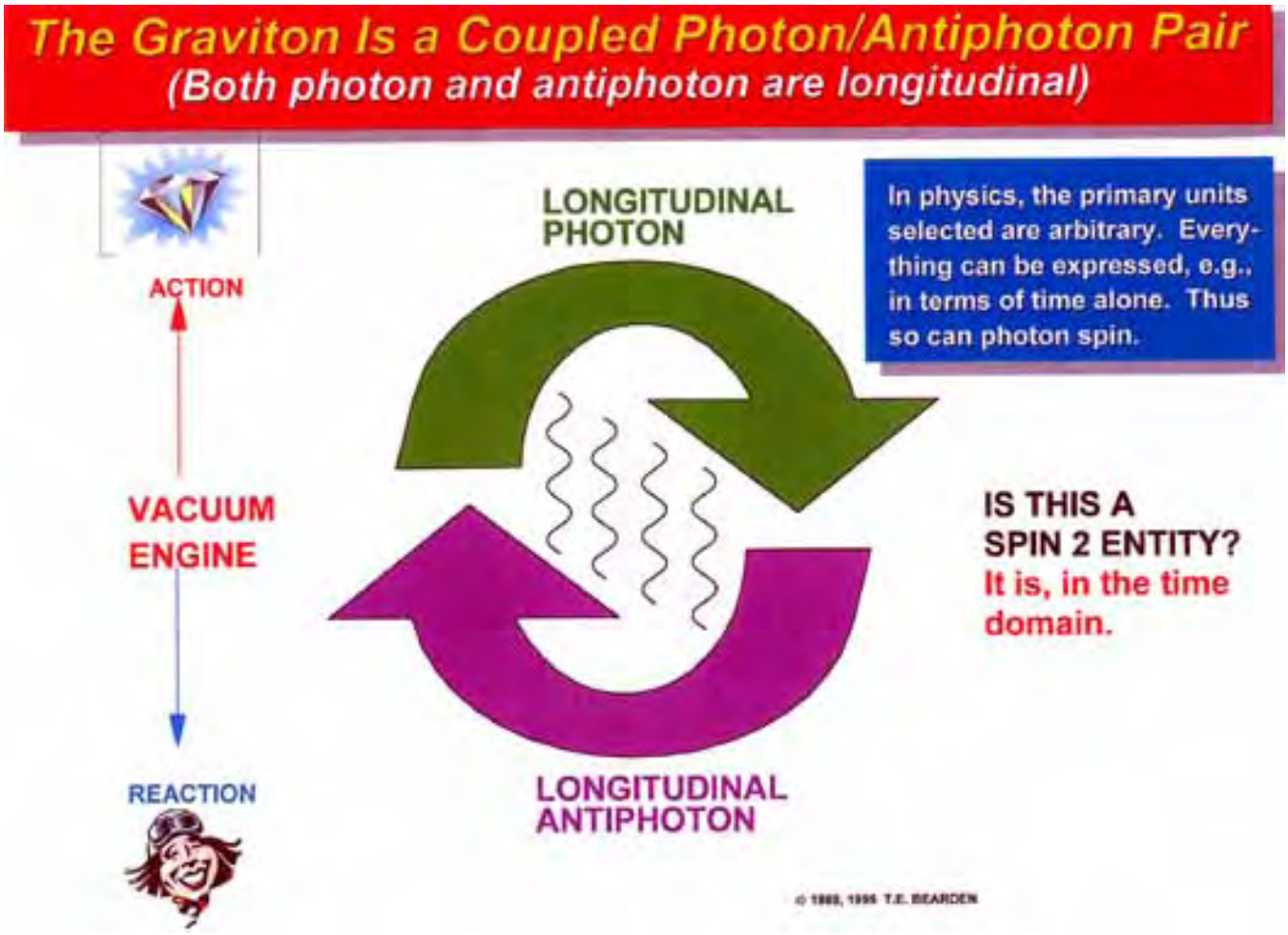

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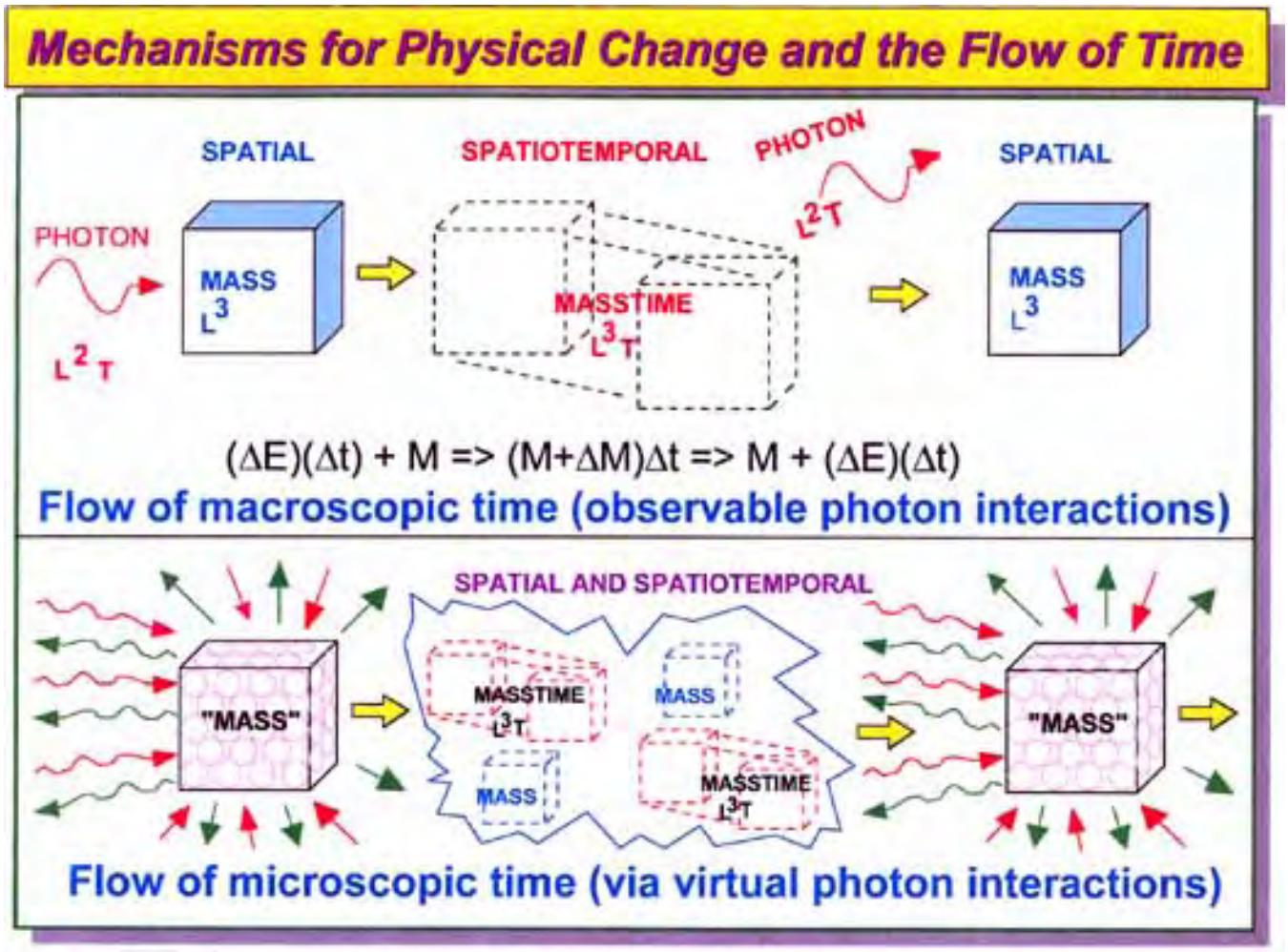

The photon interaction generates an observed quantum change and a discretized jump in the rate of time flow. A particle observably changes by only a single Δ t at a time. The background flow of time in which the jump in rate occurs, is created by the continual absorption and emission of virtual photons.

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Any EM Field or Wave Pattern Is Produced by interference of Two Scalar Potential Functions *(E.T. Whittaker, 1904)*

(Use of Hidden Information Content of the Field)

(Can Provide Action-at-a-Distance)

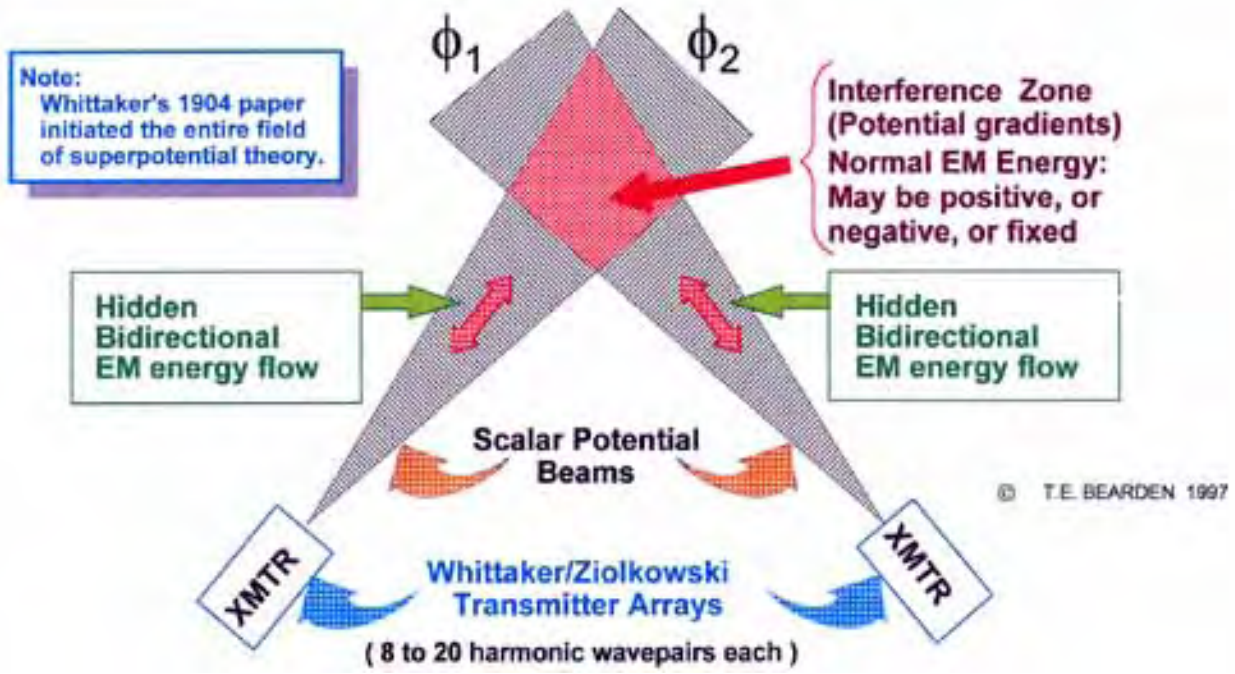

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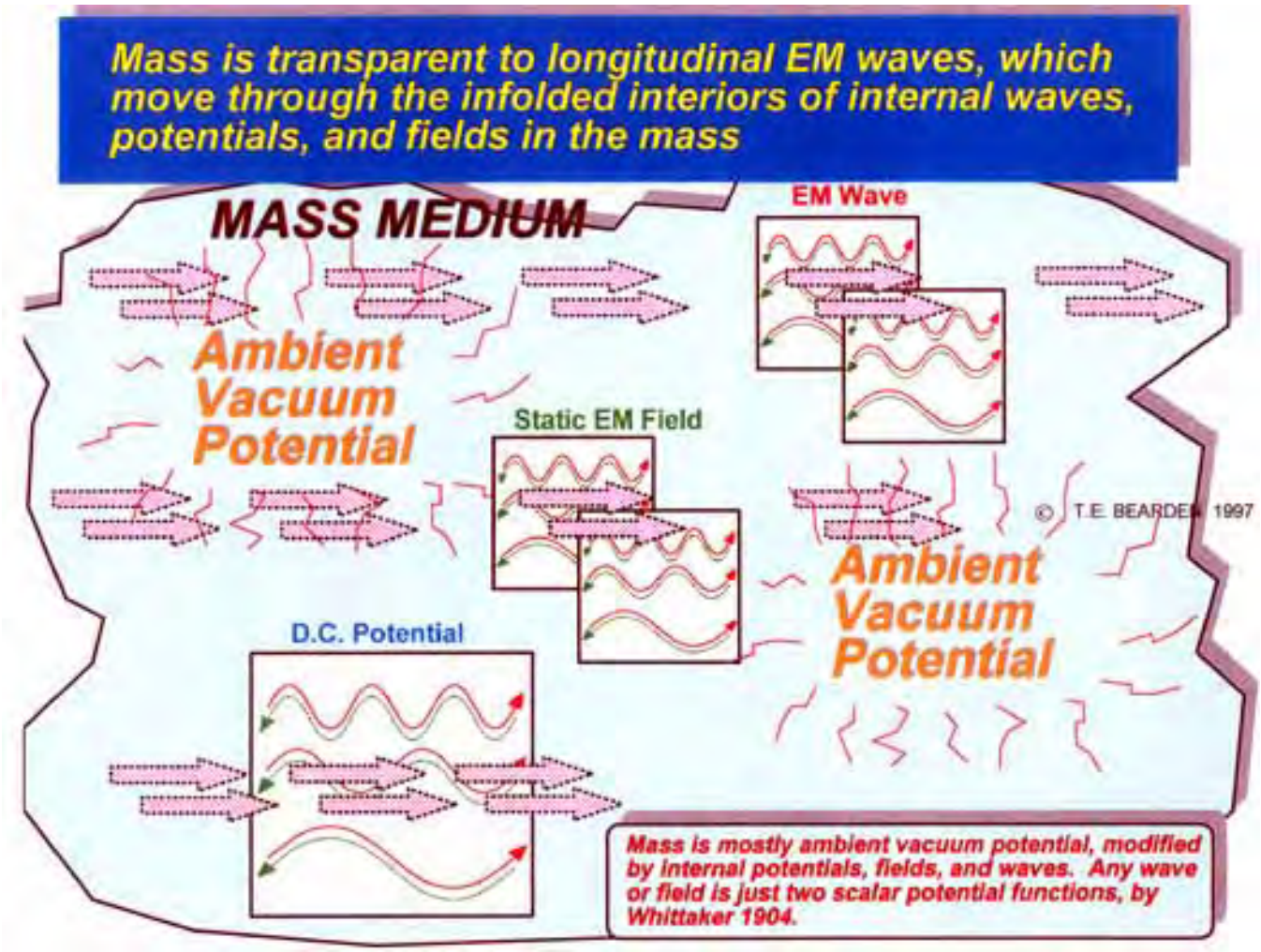

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Deep penetration of weak signals in a dense signal environment, by nonlinear retroreflection

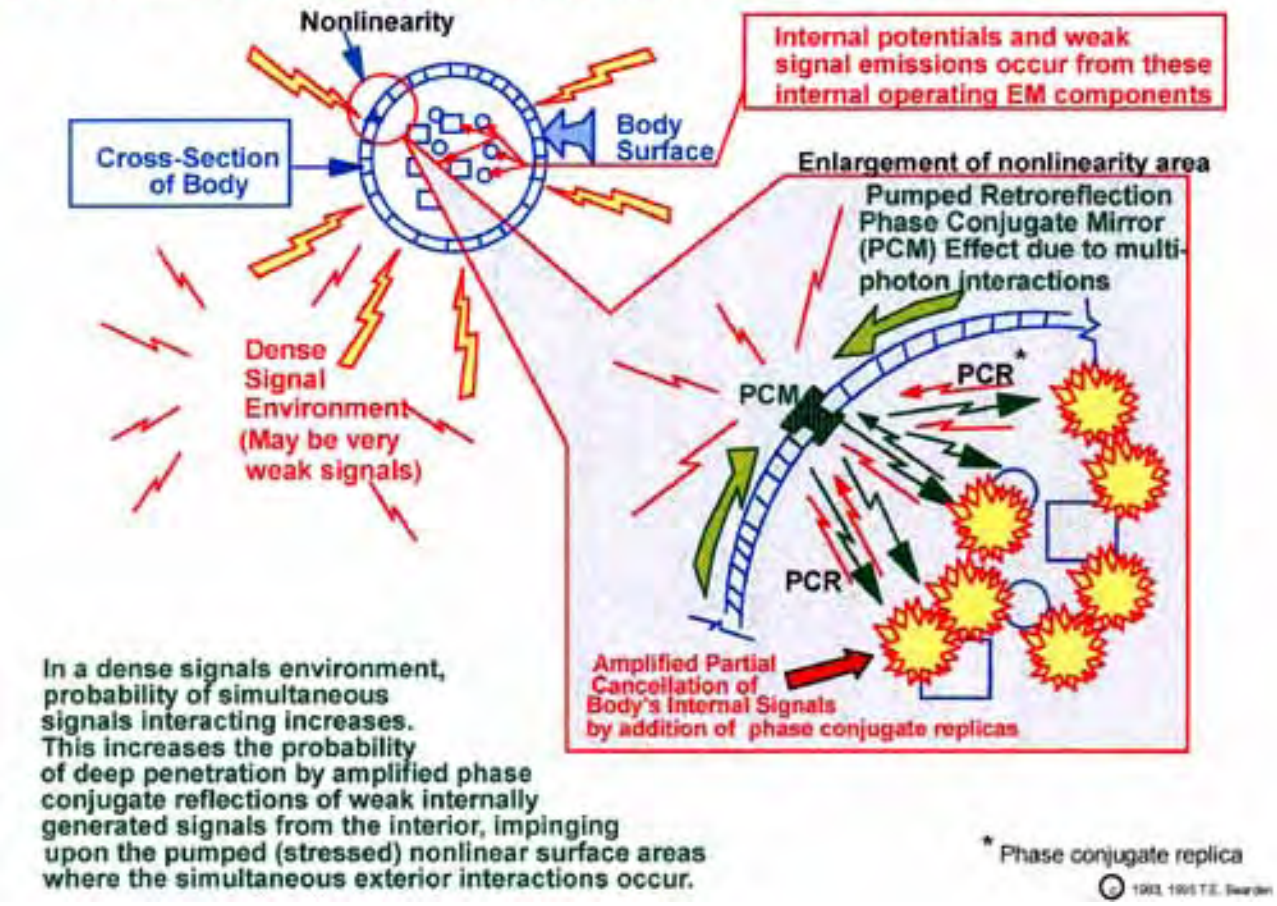

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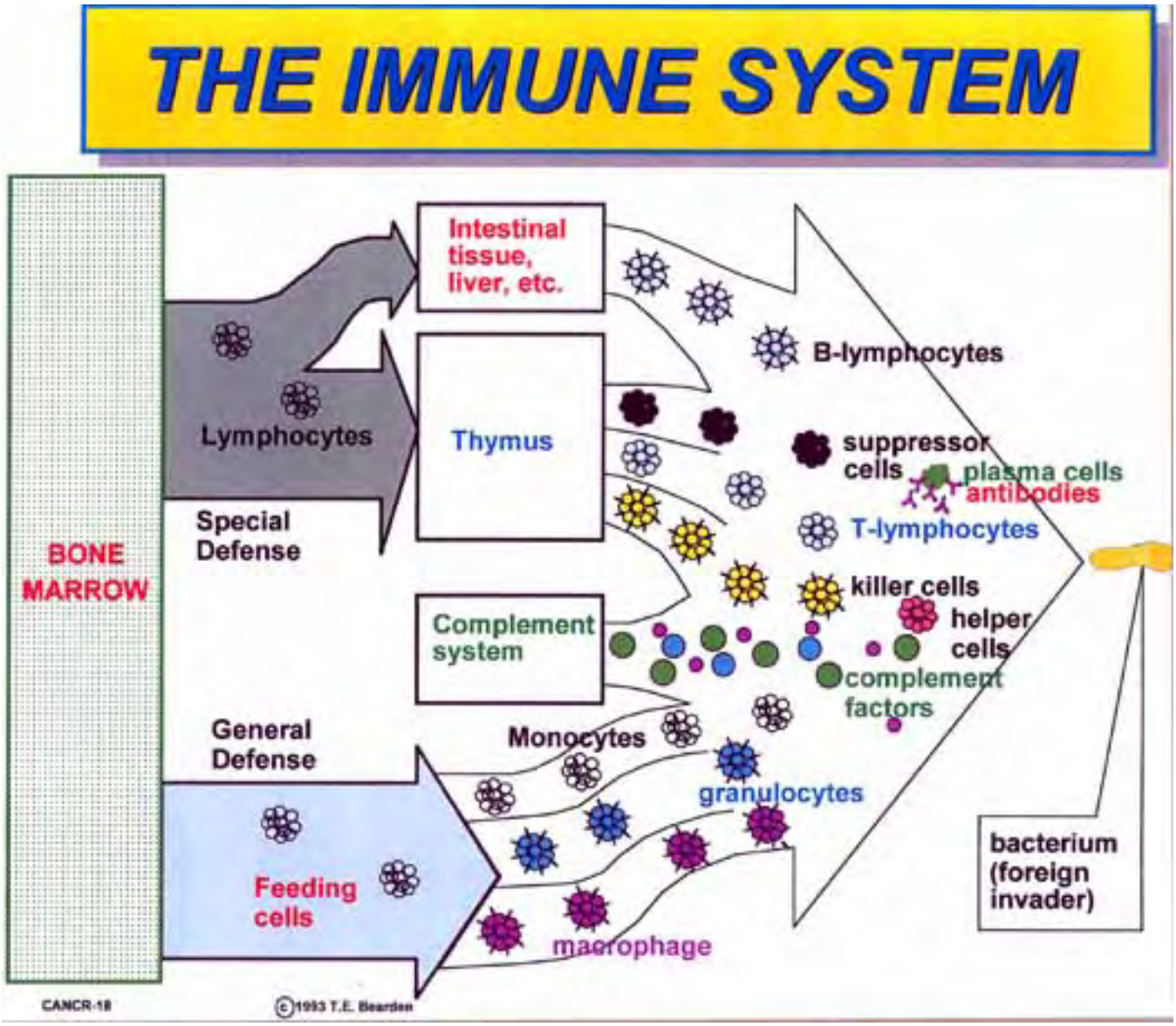

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Popp's master cellular control system

- Provides coherent, long-range interactions in biological systems
- Is an organized morphogenetic field at the basis of functional control

- Emission very sensitive to almost all external and internal influences
- Both spontaneous and delayed luminescence occur
- Photons stored in cell during the delay

- Leakage provides ultraweak, coherent biophoton emission from the system
- Fractional intensity pattern: few to some 100s of photons/cm^2/sec
- Optimum signal-to-noise ratio

- A single delayed biophoton may be able to trigger 10^{10} reactions in a cell before its release
- Spectrum almost continuous within optical range from 200-800 nm.

- Biophoton emission shows biological system always out of equilibrium
- Emission has holistic characteristics
- Correlations to most, if not all, of the biological functions of the organism

- DNA, all other processes are sources
- Single main process of whole system, different processes strongly coupled
- Information function and sync of biological clocks (oscillators)

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CANCER: CHARACTERISTICS

- NOT ONE DISEASE BUT A WHOLE RANGE
- STARTS IN ORDINARY (AEROBIC) CELL
- CELL SHAKES OFF BODY'S DICTATORIAL CONTROL*
- STARTS UNCONTROLLED DIVISION
- BECOMES A LUMP
- CAN SEND FORTH CANCER CELLS
  - THROUGH BLOOD
  - THROUGH LYMPH
- THESE FORM METASTASES (SECONDARY TUMORS)
- OFTEN BECOME ANAEROBIC (NON-OXYGEN USING)
- ENIGMA IS FAILURE OF IMMUNE SYSTEM TO ATTACK SOME TUMOR CELLS
  - SUPPRESSOR CELLS MAY CURB IMMUNE SYSTEM
  - TUMOR MAY LACK ANTIGENS NORMALLY IDENTIFIED BY THE IMMUNE SYSTEM

**R&R system forces cell back toward anaerobe*

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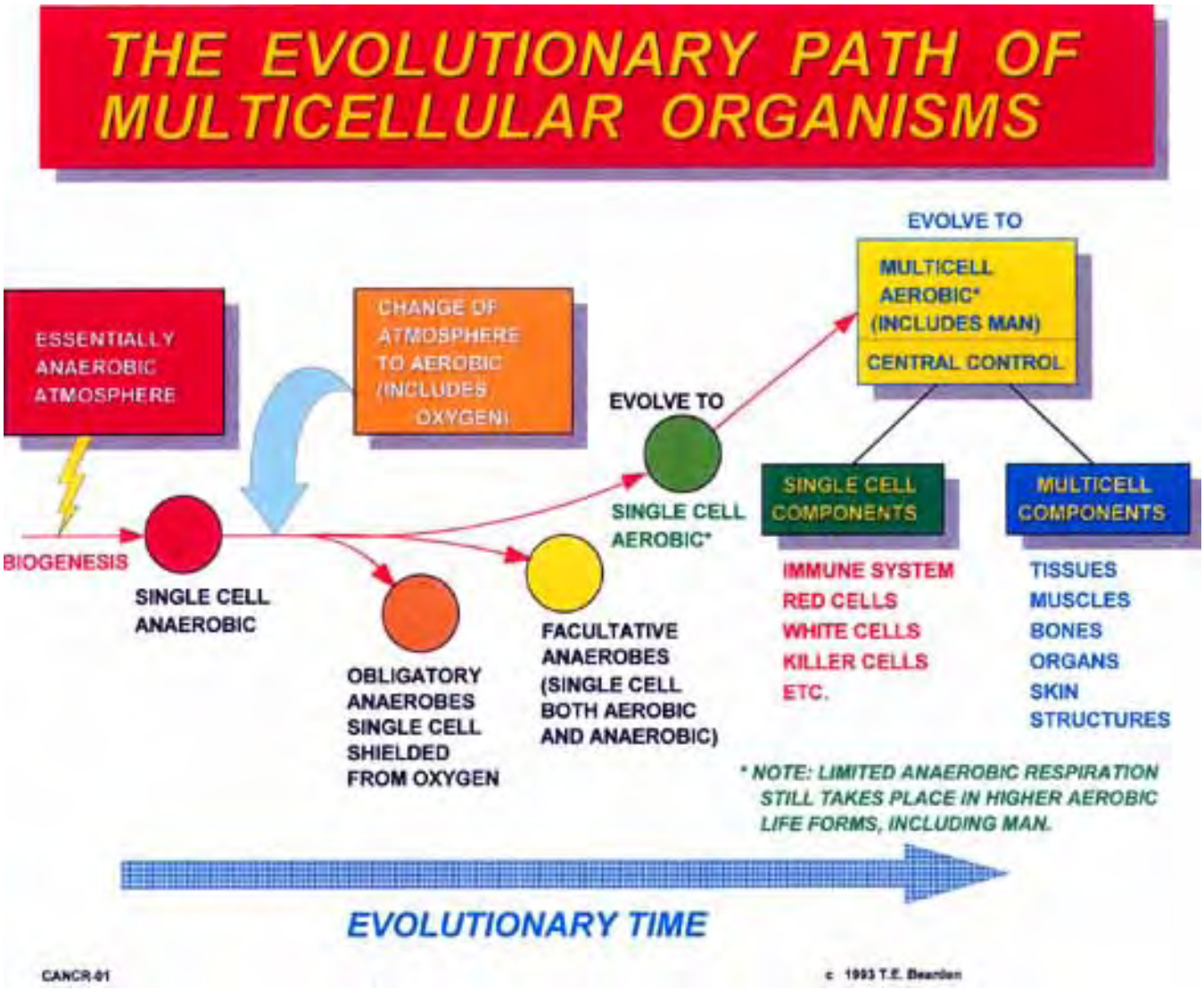

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EFFECT OF FLUID CONTAMINATION ON HEMOGLOBIN'S OXYGEN TRANSPORT

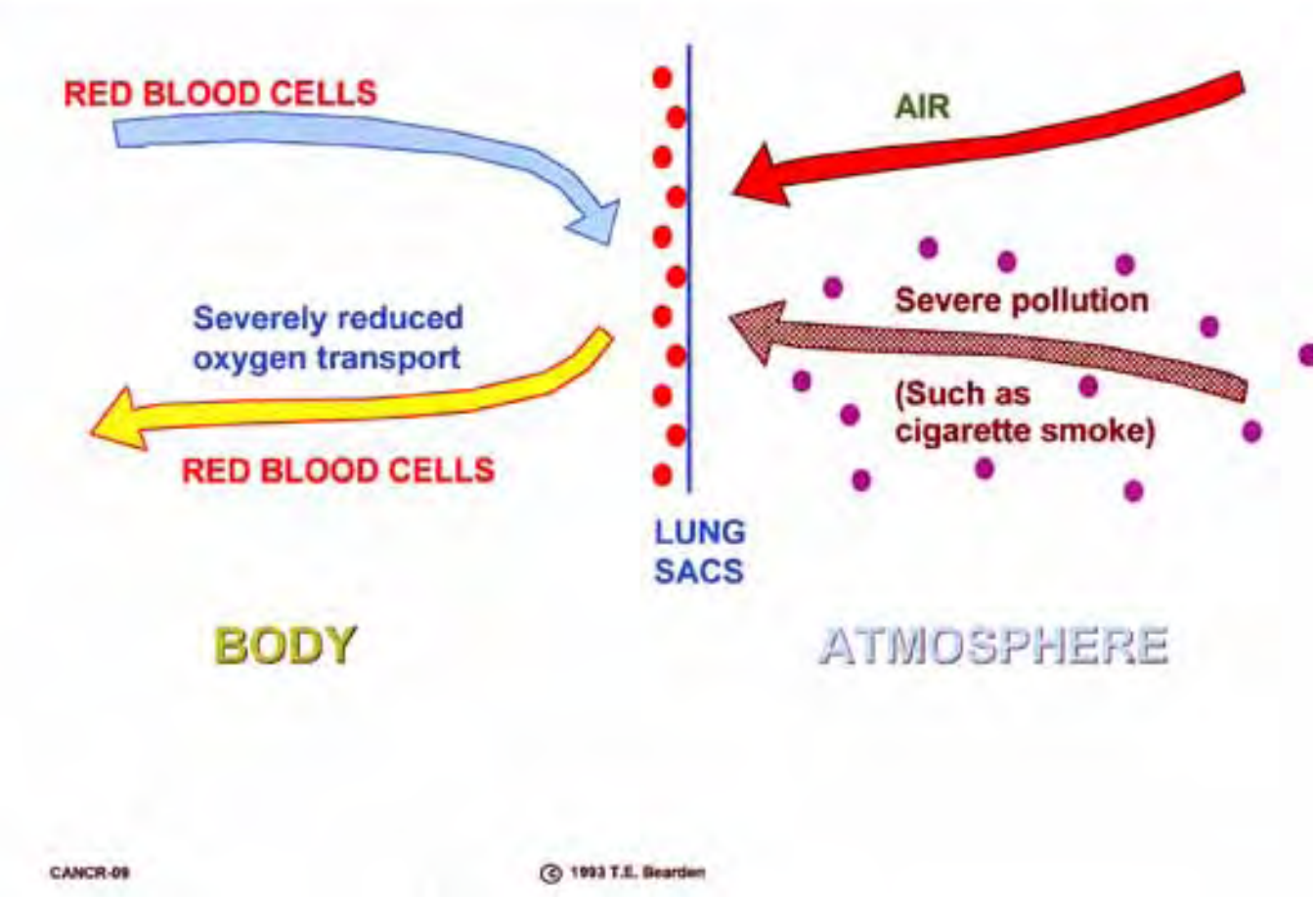

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FIRST STEP IN SELF-PROMOTION OF CANCER DUE TO HYPOXIA

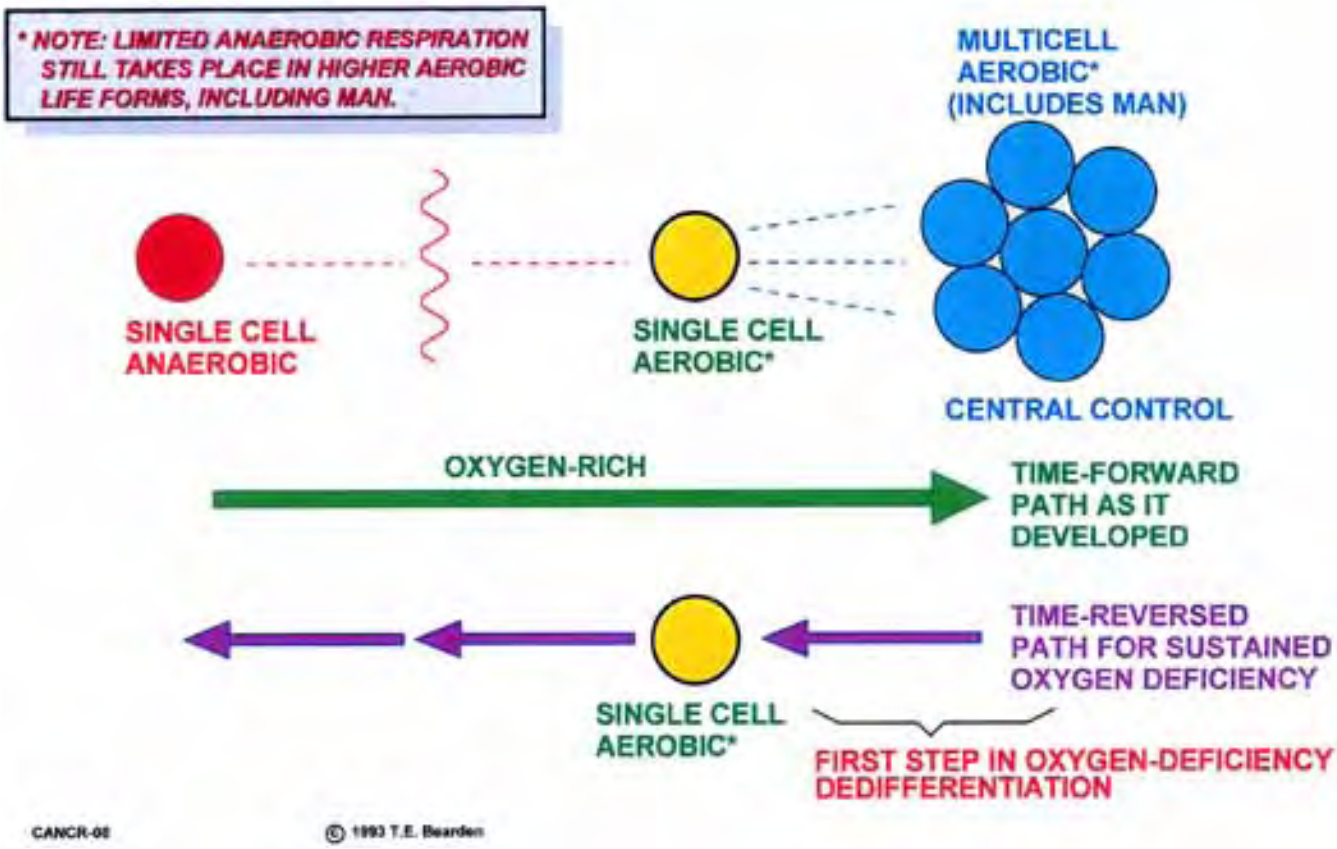

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BECKER'S CELLULAR GROWTH CONTROL

- Two major links uncovered between :
  - The DC system and nervous system
  - The DC system and all body cells
- Bioelectric potentials of primary importance
- Physiology presently considers controls limited to:
  - Neural action potential
  - Various hormone chemical agents
  - Chemical agents associated with DNA/RNA system
- Complete Operational Biological Control System:
  - Controls growth, healing, biological cycles, etc.
  - Operates in ANALOG mode; various levels of DC
  - Interlocks physically with nervous system (and may be its precursor)
  - Other chemical agents
  - Tissue growth and healing NOT INCLUDED
- Medical community now more concerned with diseases resulting from:
  - Inadequate/abnormal growth
  - Inadequate healing

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Becker's dc treatment of bone fractures

Application of tiny DC currents to heal difficult bone fractures. Only picoamperes are utilized. Pulsed DC current or pulsed magnetic fields may also be utilized.

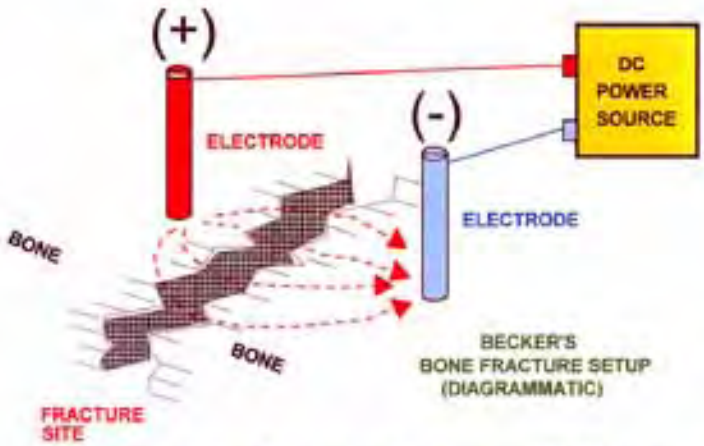

RED BLOOD CELL DEDIFFERENTIATES
Shucks hemoglobin coat
Grows nucleus

NEW CELL REDIFFERENTIATES
Turns into type of cell that makes cartilage

NEW CELL REDIFFERENTIATES
Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture

Proves that cells can be time-reversed (phase conjugated) (dedifferentiated) or time-forwarded (redifferentiated) by application of very weak electromagnetic signals, when those signals contain longitudinal bidirectional EM "pump wave" wavepairs, which cause the cell and its parts to create precise vacuum antiengines.

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Becker's theoretical DC control system involved with response to injury*

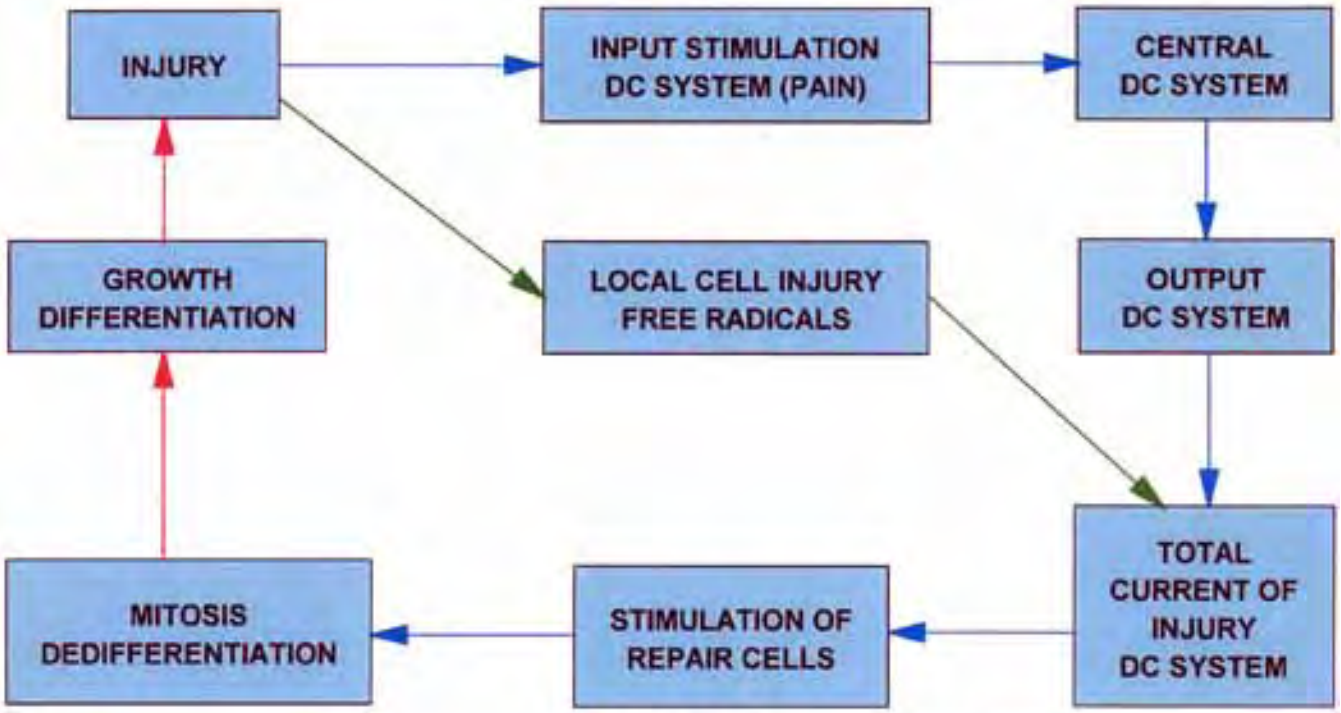

*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

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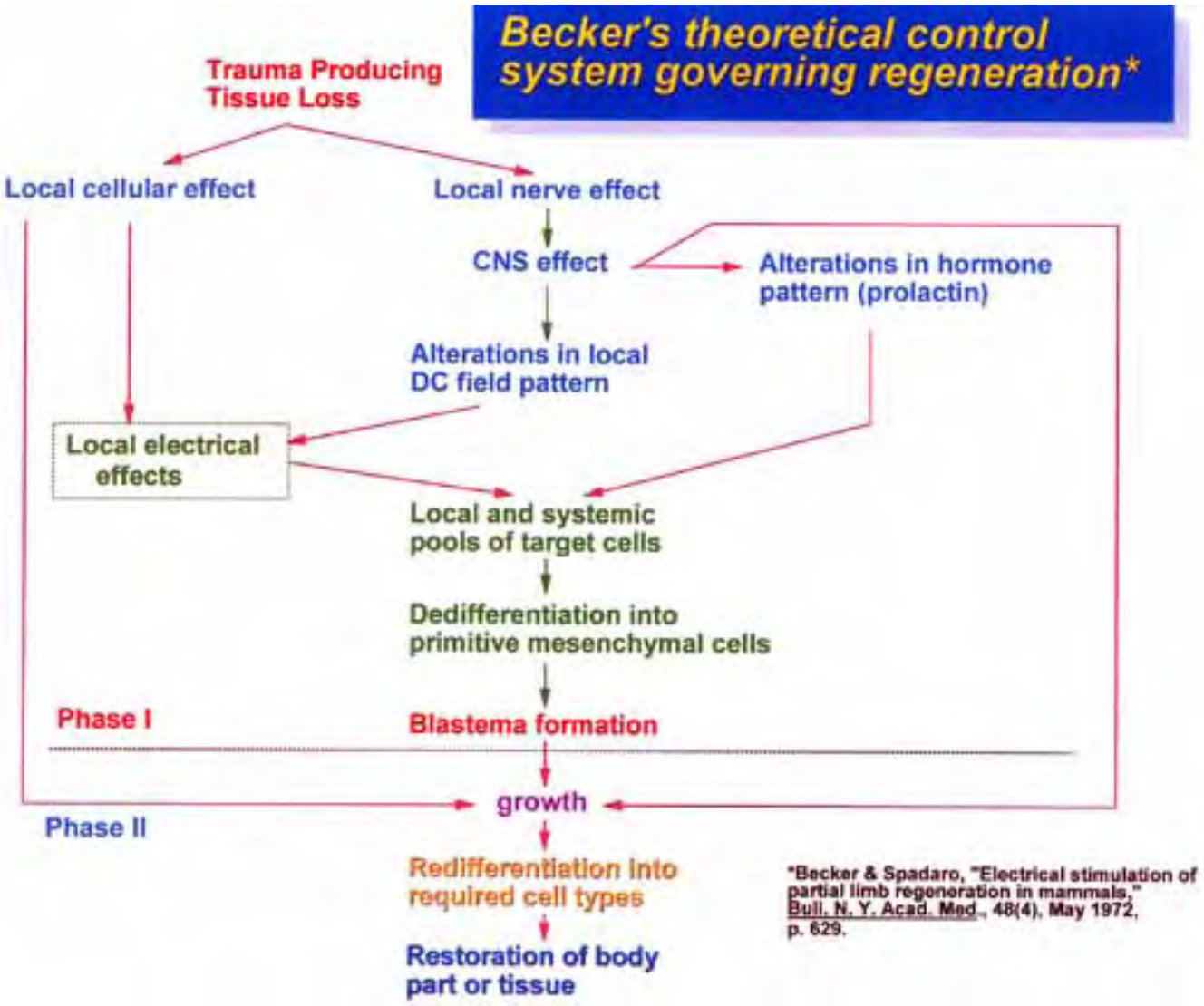

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Link Between Standing DC Potentials and the Nervous System

- Standing DC potentials on intact surfaces of all living animals demonstrate a complex field pattern spatially related to the anatomical arrangement of the nervous system
  - Can be measured directly on the peripheral nerves
  - Polarity difference related to whether nerve is or is not a sensor
  - Steady (weak) current flow exists
  - Demonstrates solid state/semiconductor phenomena
  - Accurately reflects (amplitude and polarity) the general level of neural activity
    - Sleep versus wakefulness
    - Anesthesia versus conscious
    - Other parameters
- DC levels determine the level of neural activity
- Action potential system exists upon a substratum of DC potentials which pre-existed it
- DC potentials substrata had and have control functions over basic properties of the living organism

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Becker's Findings on Cellular Injury and Regeneration*

- Cellular processes are regulated by a precise control system
- Attempted to apply engineering control-system theory
- Cells and tissues have solid-state electrochemical features which provide control signals in the control system
  - Growth process
  - Electron transfer
  - Semiconduction
  - Self-organizing *(NOTE: Implies hidden variables and nonlocal causality)*
- Complex electrical events at the injury site initiate cellular aspects such as dedifferentiation and mitotic activity
- Regeneration is a 2-step process, each with different controls
  - Electrical triggers with threshold values results in appearance of blastema
  - Complex data transmission to blastema establishes it as a self-organizing system capable of growth and redifferentiation
  - Mammals lack ability to produce blastemas except for bone, but partial regeneration growth has been shown in response to electrical stimuli
- Growth related to electrical more than electrochemical aspects
- Hematopoietic marrow as source of cells for the blastema
  - Monocytes can take place in regenerative processes in limbs
  - Lymphocytes can dedifferentiate under certain circumstances
  - Marrow elements can be induced into osteogenesis

*R.O. Becker & J.A. Spadaro, "Electrical Stimulation of Partial Limb Regeneration in Mammals," Bull. N. Y. Acad. Med., 48(4), may 1972, p. 627-641.

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Corrections For the Present EM Bioeffects Model

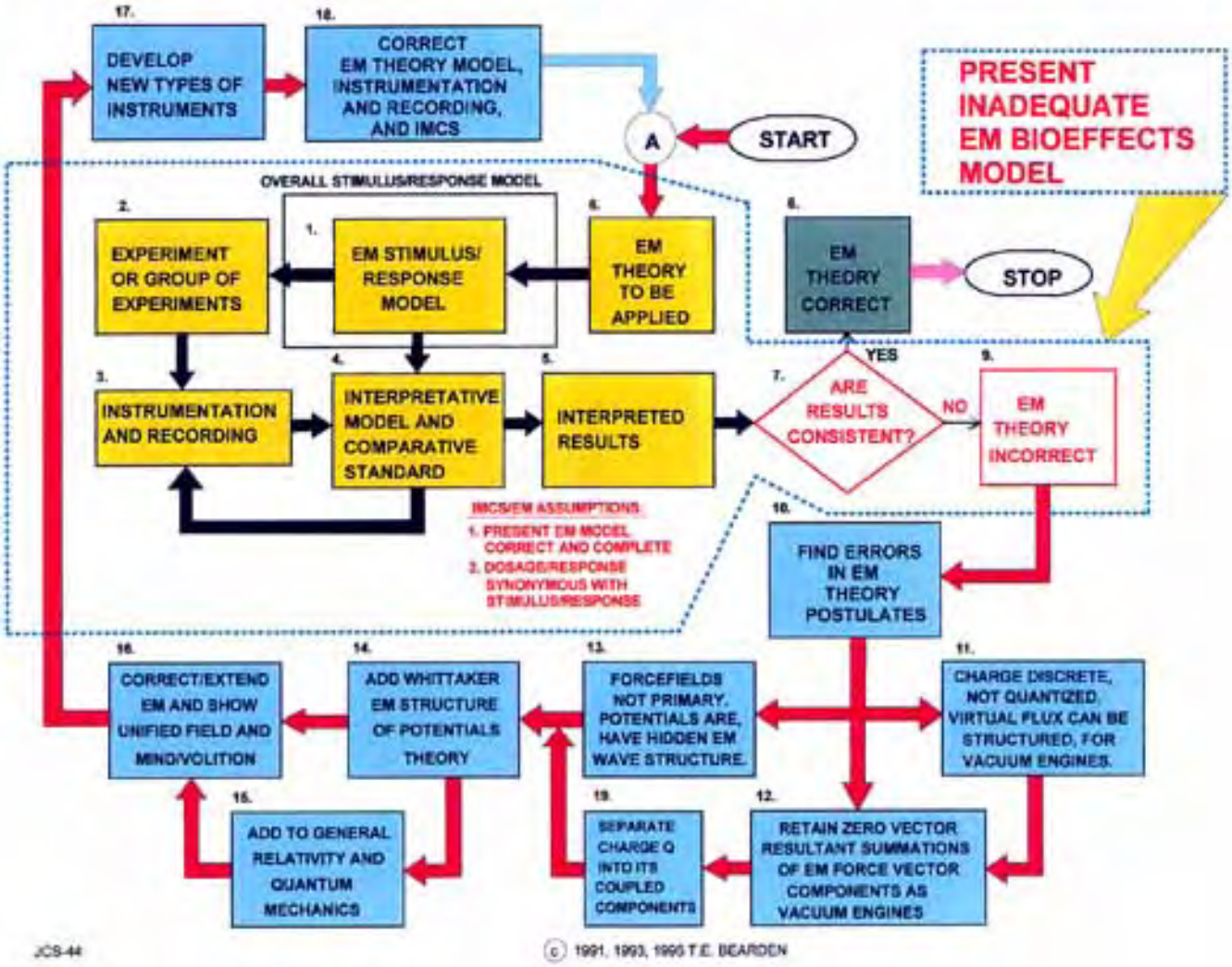

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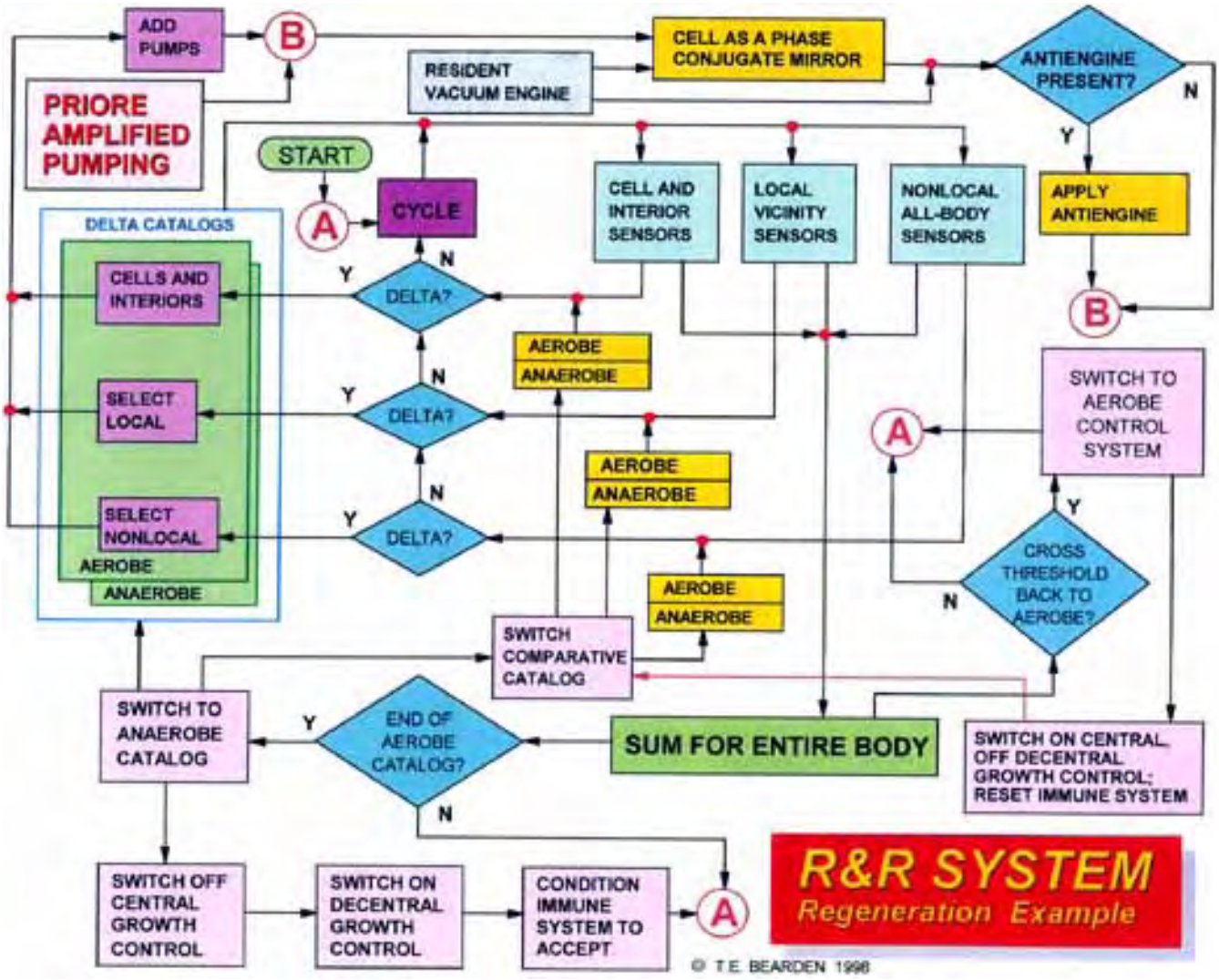

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Kaznacheyev's Cytopathogenic Mirror Effect

Disease vacuum engines transported by photons and waves

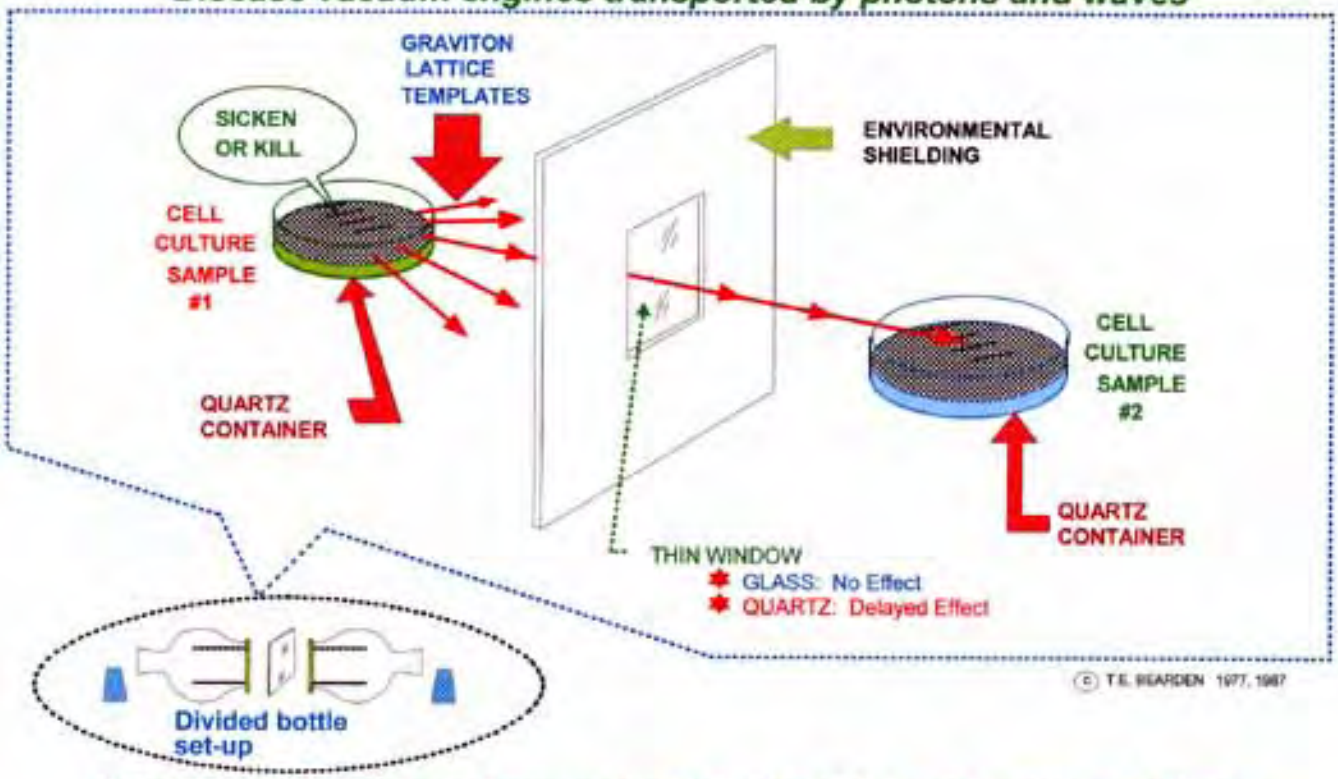

Note: Minimum lattice is one harmonic interval: IR to UV is such a minimum G-lattice.

Distant induction of cellular death and diseases, by special EM means. Coupled photon-antiphoton pairs (gravitons) in a structured harmonic lattice ordering constitute the disease or disorder template.

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MICROWAVE RADIATION OF U.S. EMBASSY IN MOSCOW

Former U.S. Embassy in Moscow.

Selected clipart © by Lotus SmartPics™

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter?)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

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Self-Targeting in Inner EM Channel Can Produce a Quantum Potential

Once QP is established, energy transmission is direct and instantaneous. Energy input to one single participant will simultaneously appear in all other participants, the amount depending on their fractions of participation with the input station.

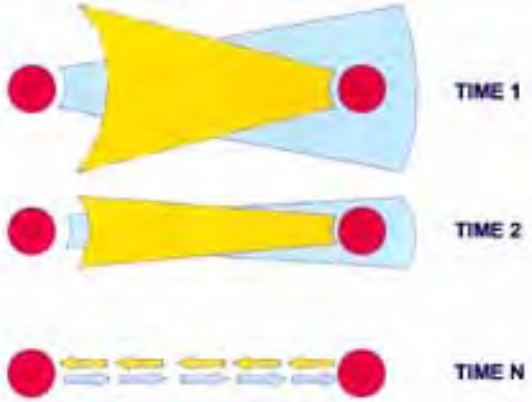

NARROWING OF INTERACTING POTENTIALS INTO LASER-LIKE BEAMS, BETWEEN TWO PUMPED SOURCES. NOW ONLY LONGITUDINAL WAVES CONNECT THE LINKED OBJECTS.

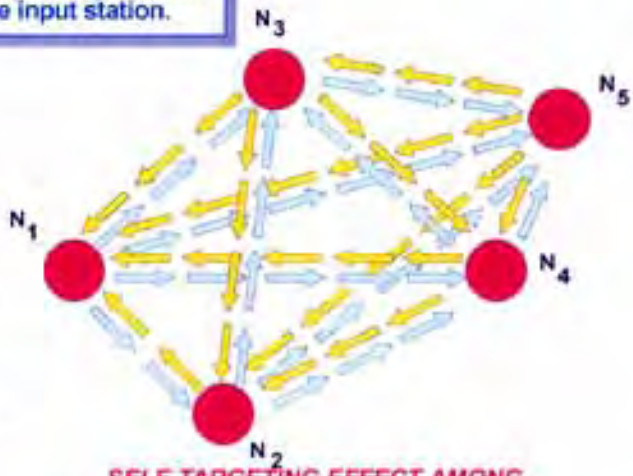

SELF-TARGETING EFFECT AMONG ALL PAIRS OF INTERACTING PUMPED SOURCES

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Quantum potential and hidden variable theory

a. Quantum Potential Characteristics

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- No point source
- Not radiated
- Quantum potential between two particles
  - Interaction does not vanish as spatial separation becomes very large
  - Instantaneous connection, so multiply-connected space

b. Hidden Variable Theory and the Quantum Potential

- $$V_{quantum} = \frac{\hbar}{2m}\frac{\nabla^2\sqrt{\rho}}{\sqrt{\rho}}$$
- "A quantum particle moves as if it were subject, in addition to its external potentials, to a potential which is a function of its own probability distribution."
- Bohm's H.V.T. assumes:
  - Particle and wave function real and separate
  - Wave function obeys Shroedinger's equation
  - Particle obeys classical mechanics
  - Particle couples to wave function through a quantum potential

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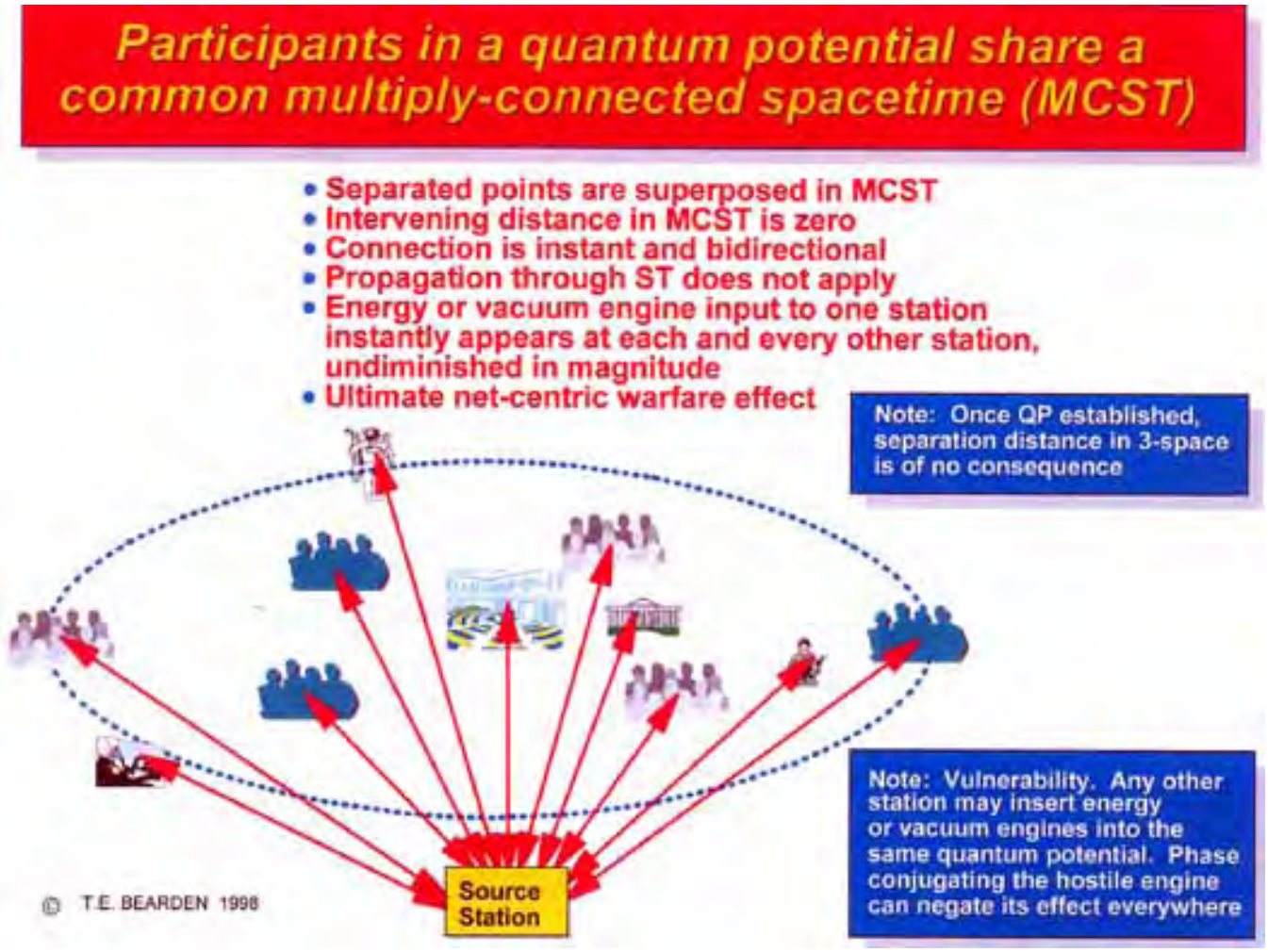

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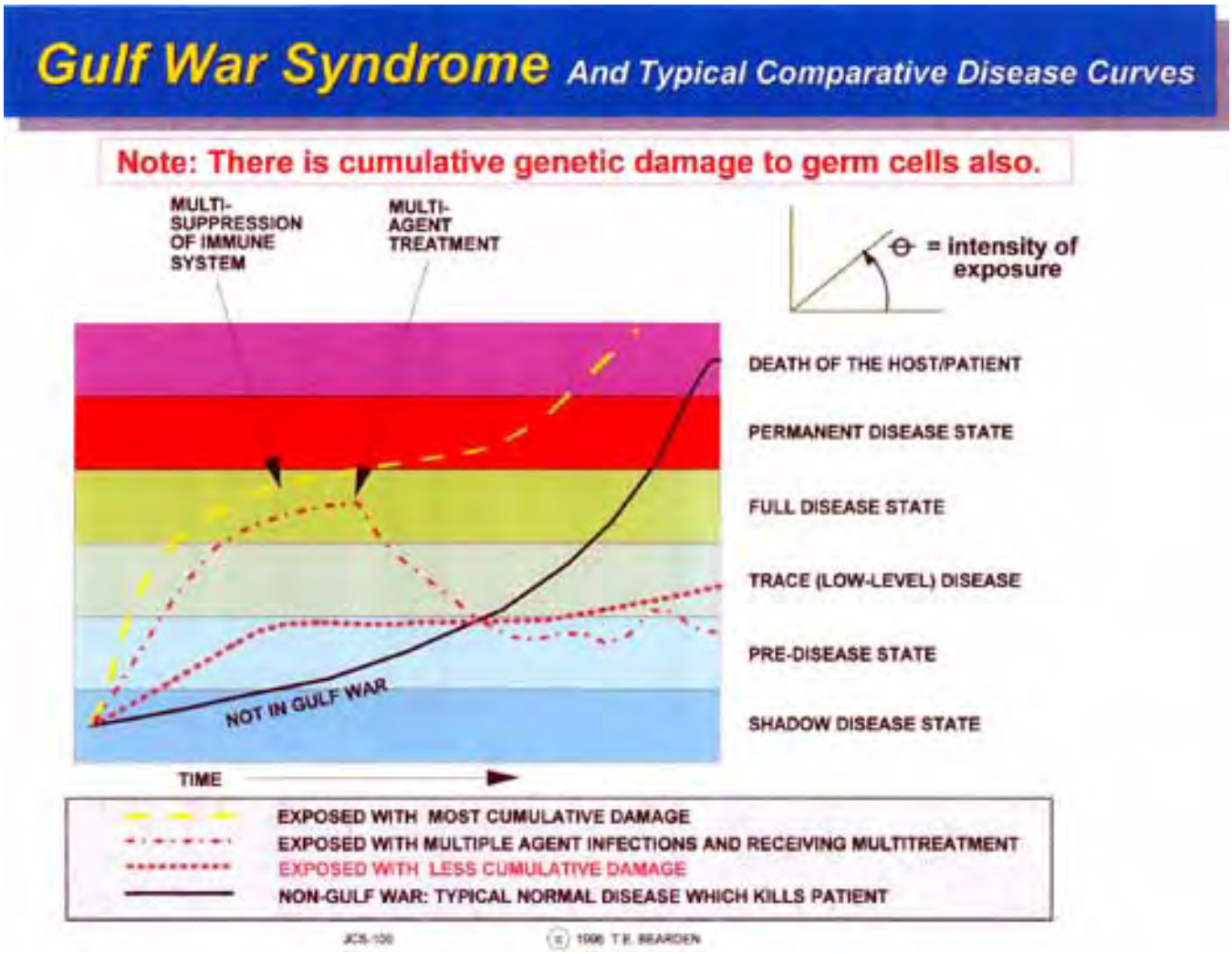

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Force Fields and Symmetry

- Force fields are nature's way of imposing local gauge symmetries on the world
- E.g., electromagnetic field is a manifestation of the simplest known gauge symmetry consistent with the principles of special relativity
- For the EM case, the gauge transformations correspond to changes in 'voltage' from place to place

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Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum

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- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another
- STRUCTURING THE INFOLDED EM INSIDE POTENTIALS, FIELDS, AND WAVES
  - Strongly breaks local symmetry
  - Provides spacetime engines giving the above effects

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Other Aspects of Strong Local Asymmetry

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- Local spacetime is curved
- Lorentz invariance of vacuum is violated
- May be a local "sink" or "source"
- Gravitational/inertial effects from EM
- Translation between virtual and observable
- Electrogravitational solitons
- Action at a distance
- Transmutation effects may exist
- Scalar/pseudoscalar field translation
- COMMENT: Thus the use of infolded longitudinal EM fields and waves to strongly break local symmetry allows internested clustering of spacetime curvatures. These spacetime structures are *vacuum engines*, or *spacetime engines*.

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Small Entities Emit Powerful S-Flows

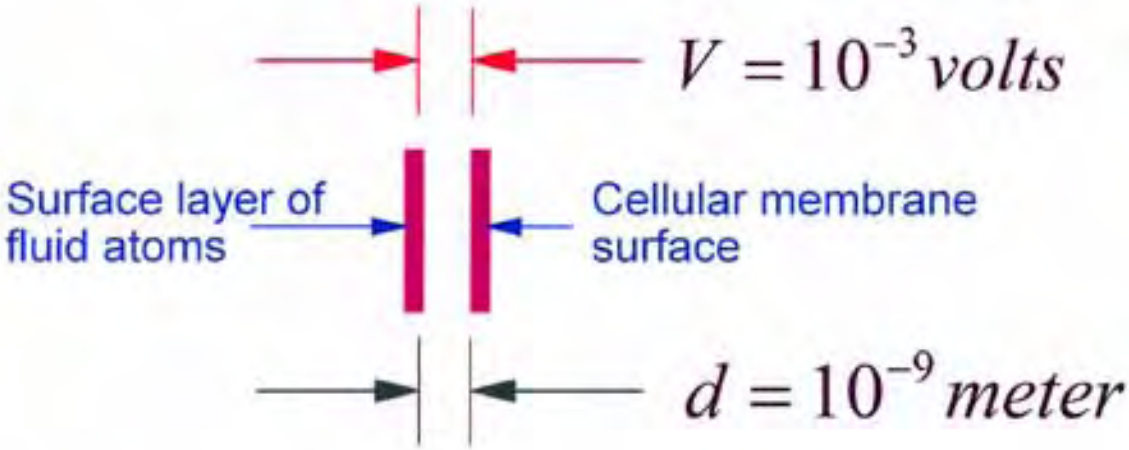

$$E = 10^{6}\ \text{volts / meter}$$

$$S \approx f(E^2) = f(10^{12})$$

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What is the "magnitude" of a potential?

- What is taught is the *"interaction cross section,"* i.e., the joules collected from the associated S-flow by one point coulomb of intercepting/collecting charge.

$$W = Vq = \phi q \quad \text{(joules)} \qquad [1]$$

$$\phi = W/q \quad \text{(joules/coul)} \qquad [2]$$

Let $\phi < 1$ and fixed; $q \Rightarrow n$ where $n = \infty$

$$W \Rightarrow k, \text{ where } k = \infty \qquad [3]$$

- *From any "finite" potential, no matter how small, an unlimited amount of energy can be collected, by increasing the collection (number of coulombs) (interaction cross section).*
- Actual magnitude of the potential ϕ must be very, very large, since we can treat it as infinite or unlimited, via $W = \phi q$.
- *Else Equation [1] could not be linear.*

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Table A1. THE VACUUM ENERGETICALLY INTERACTS WITH EVERY PARTICLE, CONTINUALLY.

- The vacuum is:
  - Ground (zero) state of the electromagnetic (photon) field.
  - Ground (zero) state of mass field.
  - Empty of *observable* particles or photons.
  - Filled with *non-observable* (virtual) particles and photons.
  - Violently fluctuating microscopically and electromagnetically.
  - Constantly interacting with all particles, including partially shielding their bare charges.
- Lamb Shift -- vacuum's alteration of the energy level of an electron in the hydrogen atom.
  -- Difference in energy (frequency units) is 1057.862 MHz.
  -- Lamb was awarded a Nobel Prize for showing this.
  -- Energy *density* exceeds that of the sun's surface!
- Casimir Effect -- vacuum creates an attraction between two conducting surfaces in close proximity.
  -- experimentally proven, well-known.

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- Cole and Puthoff proved that there is no thermodynamic reason why energy cannot be extracted from the vacuum as heat and power, and utilized.
- The common dipole is a broken symmetry in the virtual photon flux of vacuum. It extracts virtual energy, integrates it, and re-emits it as Poynting energy density flow S = ExH (which observably interacts with charged particles and magnetic poles).

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Extended Superpotential Theory

(Adding Vacuum Engines)

- Any EM field or wave is created by (comprised of) two potentials which interfere with each other in a given area
  - *May be either scalar or vector potentials*
  - *May interfere locally or at a distance*
  - *Process is distance independent*
- Any scalar potential is comprised of a harmonic series of bidirectional longitudinal EM wavepairs (Whittaker 1903).
- Ziolkowski circa 1985 added the interior product set to Whittaker's sum set. Thus he added modulations.
- By assembling a deliberate "sum and product" set of biwaves, a scalar potential can be created having an internal deterministic structure.
  - *This structures local vacuum potential/spacetime curvatures, in specific forms (templates)*
  - *Now have added vacuum engines*
  - *Have infolded general relativity inside electrodynamics*

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Vacuum Engine: Jillions of Working ST Demons

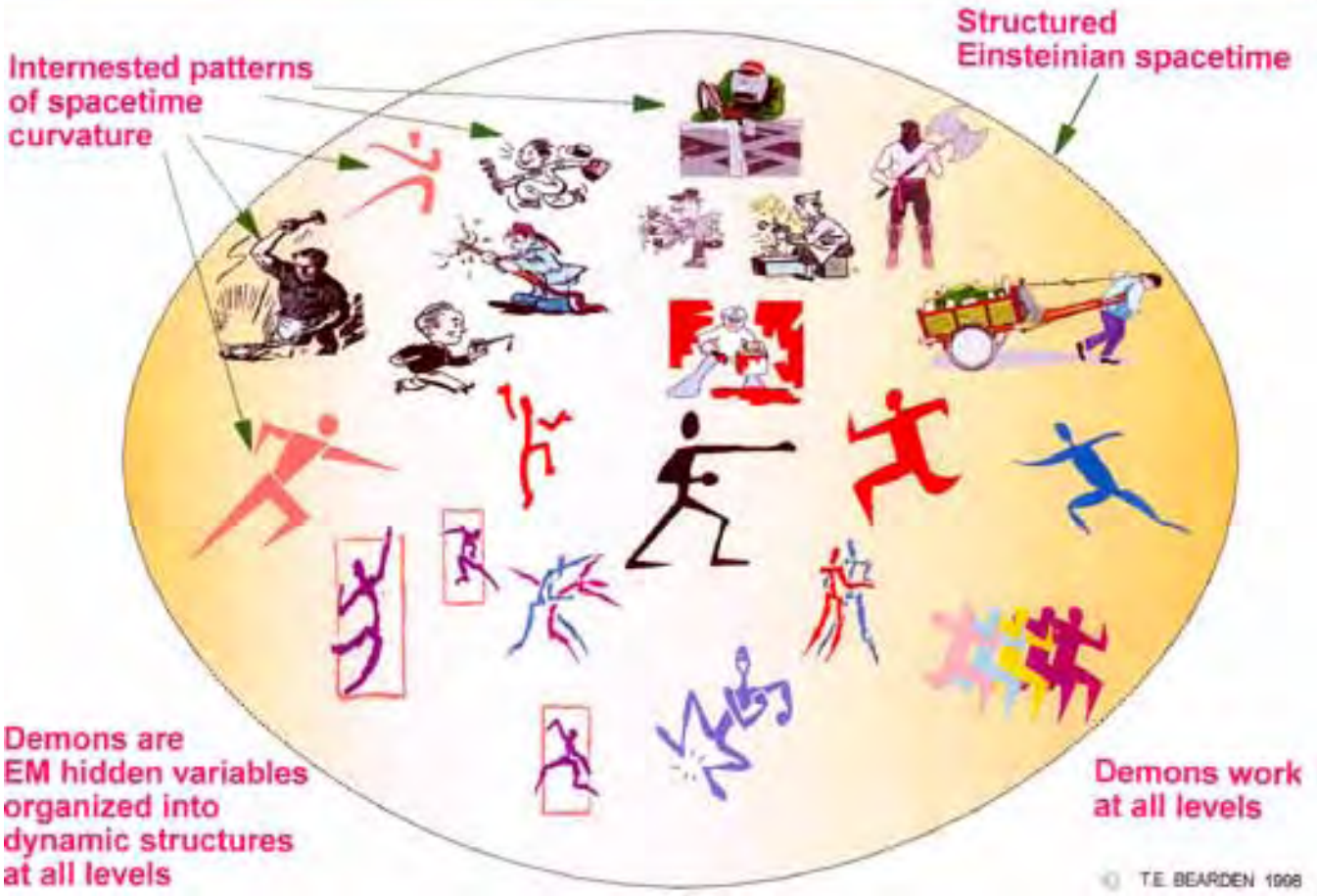

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Active Spacetime and a Specific Vacuum Engine

(A General Relativistic Concept and Analogy)

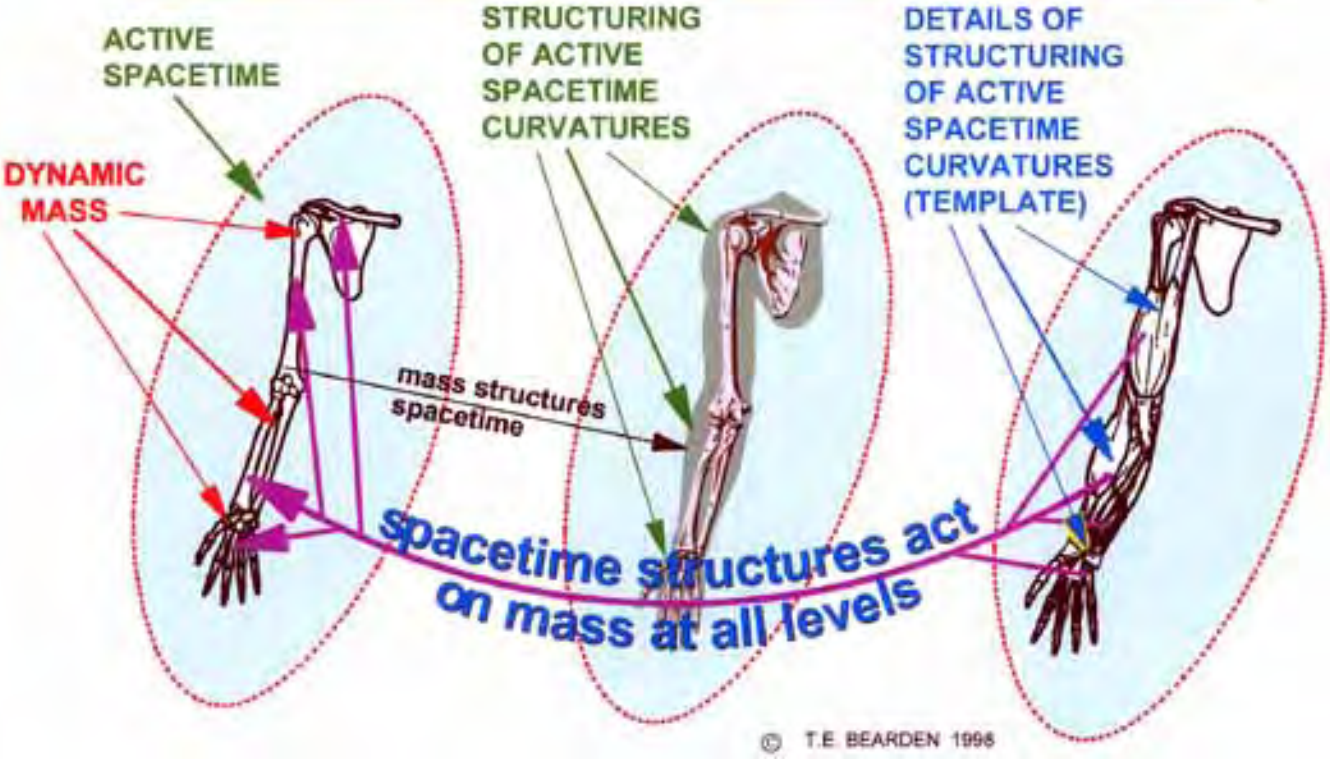

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Extension of Wheeler's general relativity principle:

- Mass (trapped energy) and its structuring curves and structures spacetime complexes (engines).
- Curved and structured spacetime engines produce forces on mass and its components, telling them how to move and structure.
- Since very strong EM force is used as agent of curvature, very powerful general relativistic effects can be obtained by arranging the LWs in the input EM potentials, fields, and waves.
- General relativity becomes directly engineerable in devices of unparalleled capability.

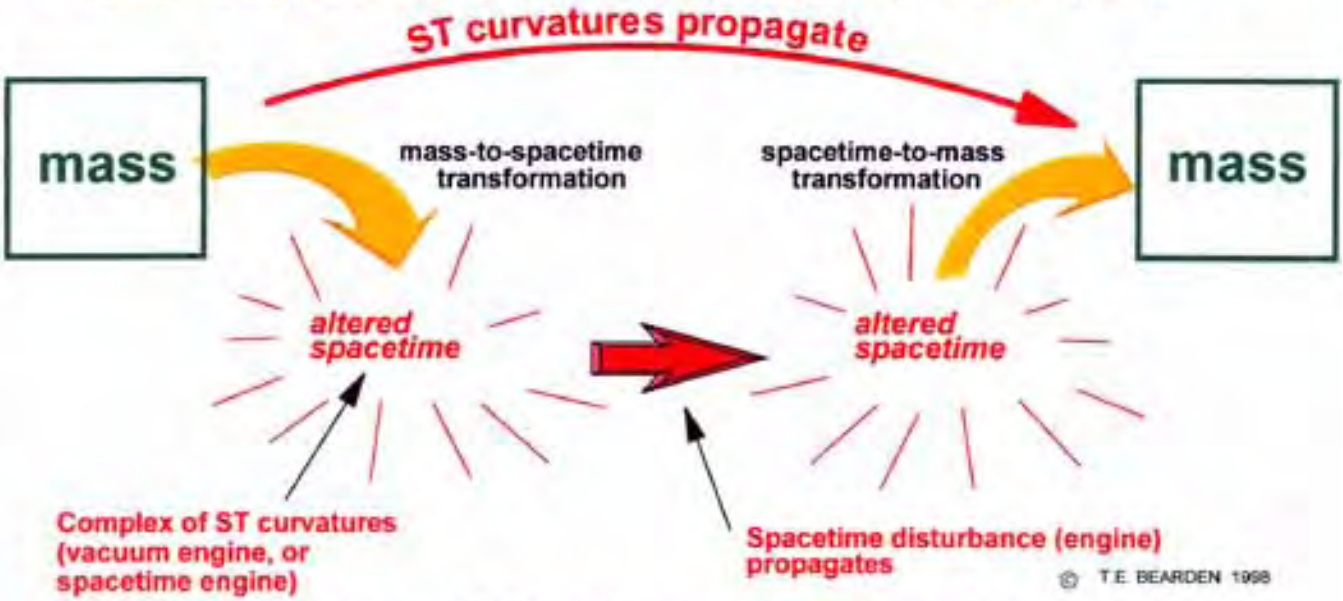

Electrodynamics has a hidden but ignored electro-general-relativity infolded inside (comprising) its so-called potentials, fields, and waves (in space in the absence of mass). What are presently defined as potentials, fields, and waves rigorously exist only in, on, and of charged mass, as pointed out by Aharonov and Bohm in 1959. All of this is just longitudinal EM waves and their interactions.

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SIGNAL VERSUS VACUUM ENGINE

SIGNAL (INFO)

- INFORMATION RECEIVED
- ANY OVERT PHYSICAL ACTION MUST BE TAKEN BY RECEIVER

A. *Receiver must do the action itself; vacuum energy exchange is unaltered. Energy or fuel for doing the action must be added to receiver externally.*

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VACUUM ACTIVATED

ENGINE (STRUCTURE)
TEMPLATE (FORM)

- "INFORMATION" ITSELF ACTS
- VACUUM FLUX GRADIENTS CHANGE ALL PARTS AND CHARACTERISTICS OF RECEIVER, INSIDE AND OUT

B. *Receiver is acted upon; altered vacuum energy exchange does the specific action. No energy or fuel for doing the action need be added to receiver externally.*

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Electronuclear Interactions by Vacuum Engines

- An EM potential is gravitational due to its trapped energy.
- A local EM potential is a local curvature of spacetime.
- *Structured* potentials are structured *(nested)* local spacetime curvatures; hidden variable theory applies.
- Structured potentials thus are *vacuum engines*.
- Gradient-free potential penetrates the atom, into nucleus.
- *With steady application, a structured gradient-free potential can be used to engineer the atomic nucleus at will.*
- Normal cold fusion systems structure a small fraction of their potentials, by chance geometries, boundaries, etc.
- This produces some new nuclides, but haphazardly.
- *The process can be developed and controlled. The nucleus can be deterministically engineered at will.*

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Vacuum Engineering

Using Inner EM Energy and Structuring to Engineer Physical Reality

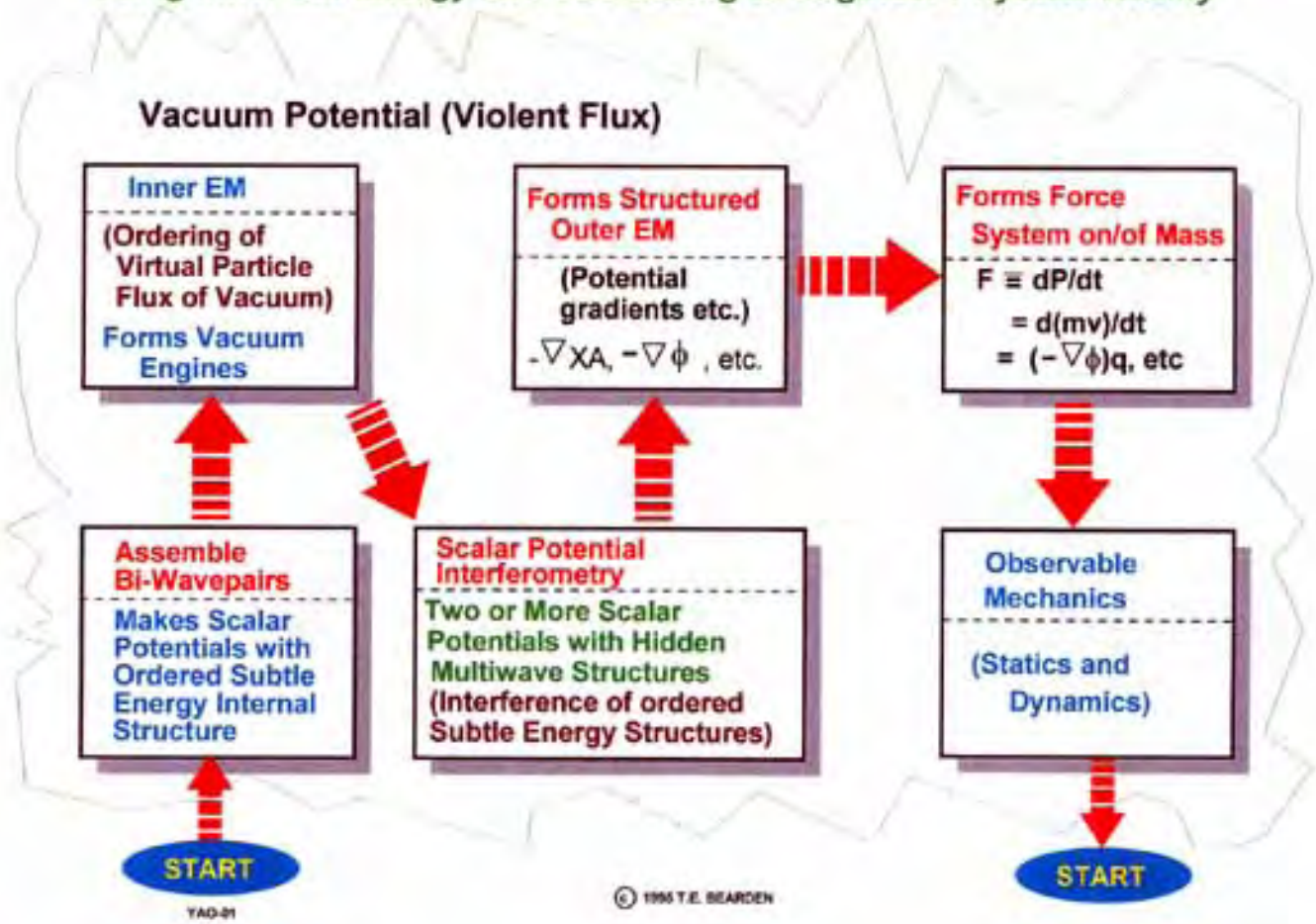

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Impact of Vacuum Engineering

- "If they [quantum fluctuations of vacuum] can be [tapped], the impact upon our civilization will be incalculable. Oil, coal, nuclear, hydropower, would become obsolete -- and so would many of our worries about environmental pollution."
- "Don't sell your oil shares yet -- but don't be surprised if the world again witnesses the four stages of response to any new and revolutionary development:
  - 1. It's crazy!
  - 2. It may be possible -- so what?
  - 3. I said it was a good idea all along.
  - 4. I thought of it first."

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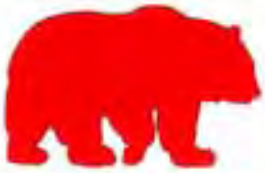

Arthur C. Clarke
"Space Drive: A Fantasy That Could Become Reality"
Nov./Dec. 1994

- *Comment:*
  - *Every dipole's broken symmetry in its energetic exchange with the vacuum already freely extracts vacuum energy.*
  - *In power sources, the dipole gates the extracted energy out as S = EXH, which flows almost entirely outside the conductors.*
  - The circuit interacts with, and uses, only about 10^{-13} of S. The electrodynamicists calculate only this small S-component.

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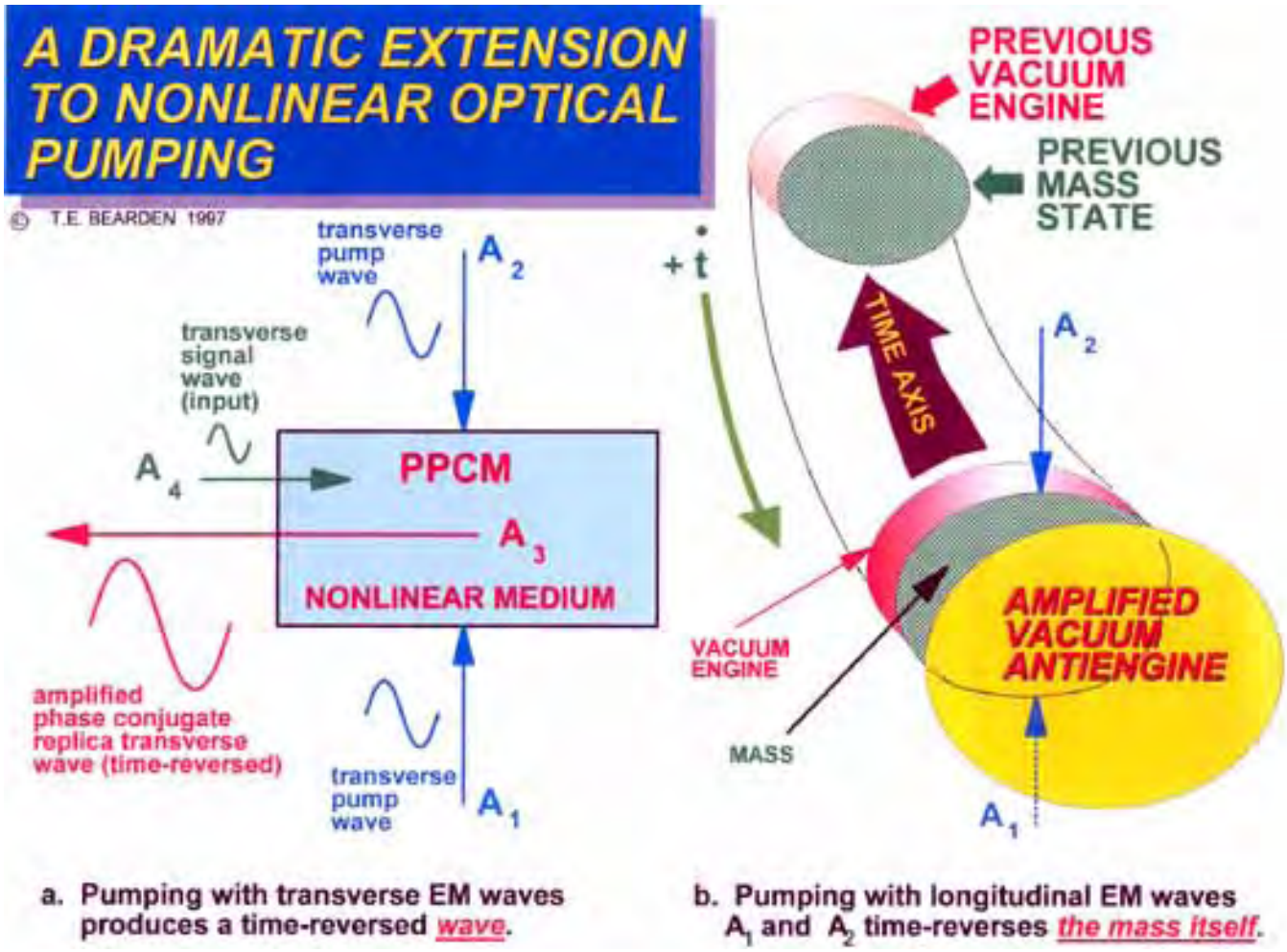

a. Pumping with transverse EM waves produces a time-reversed *wave*.

b. Pumping with longitudinal EM waves A_1 and A_2 time-reverses *the mass itself*.

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Time Conservation and Some Properties

(Energy and time are canonical)

- Time can neither be created nor destroyed
  - *Its form can be changed, and it can be positive or negative*
  - *Time can be collected or dissipated, converged or diverged*
  - *Time can oscillate and move in waves*
  - *Longitudinal (infolded) EM waves oscillate time*
- Time is always in motion, and that motion is variable
  - *Collected/collecting time is a continuing stationary change in an ongoing time flow*
  - *Time/collecting time can be internested and internally structured*

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- Time has gravitational aspects
  - *Negative (trapped) time is antigravitational*
  - *Emitting negative time is gravitational, to the emitter*
- Nonlinear optical pumping can use longitudinal EM waves
  - *Pumping a nonlinear mass by longitudinal (infolded) EM waves pumps it in its masstime form, in the time domain*
  - *This creates an amplified vacuum antiengine for the mass, and time-reverses the mass back to a previous state*

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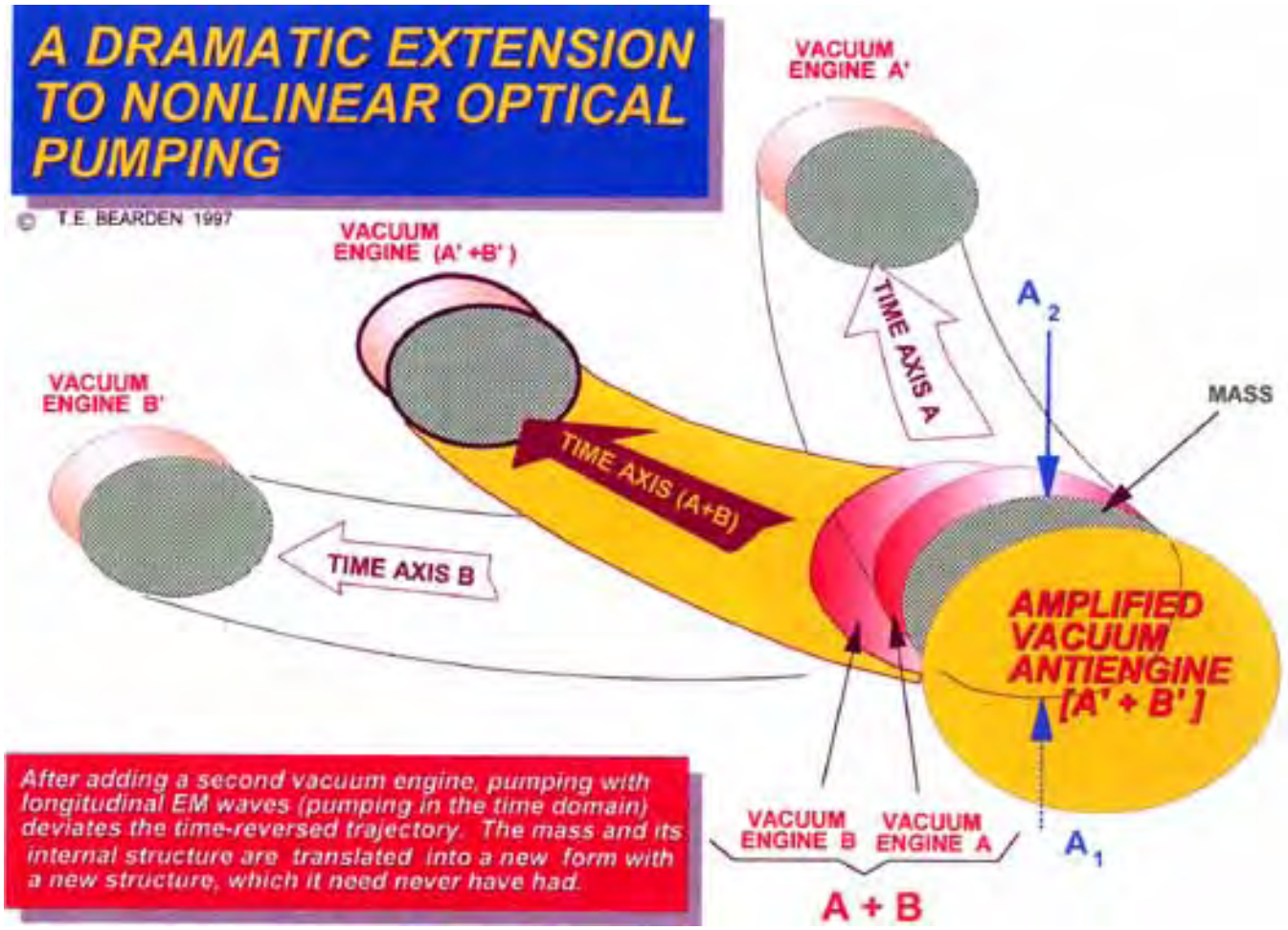

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Key Points in the New Technology

- There is a vast new kind of electrodynamics *hidden inside* all EM potentials, fields, and waves
  - Longitudinal EM waves and complexes
  - Oscillations in time domain

- These complexes are an *infolded general relativity*
  - Clustered formations of *spacetime curvatures*
  - *Very powerful*, since the EM force is used as the agent of curvature

- In general relativity, similar precise complexes permeate and *act on any mass at all internal levels*
- With this approach, one *can now manipulate matter* -- living or inert -- *in any manner desired*, depending only on the level of development of the technology
- Priore unwittingly used this to *cure dread diseases*
- This is a *revolution in all of science*

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- *We have uncovered the major mechanisms* to utilize

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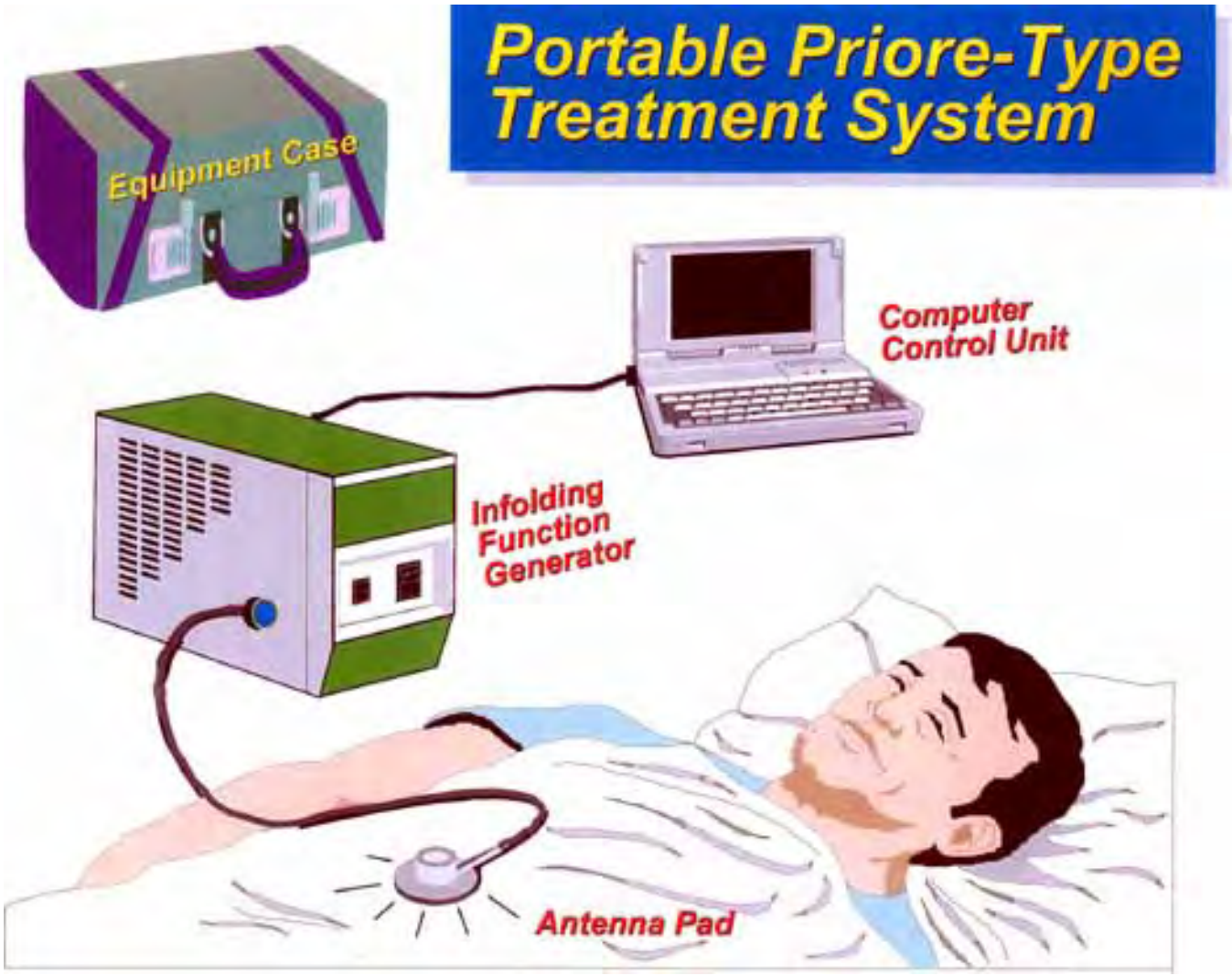

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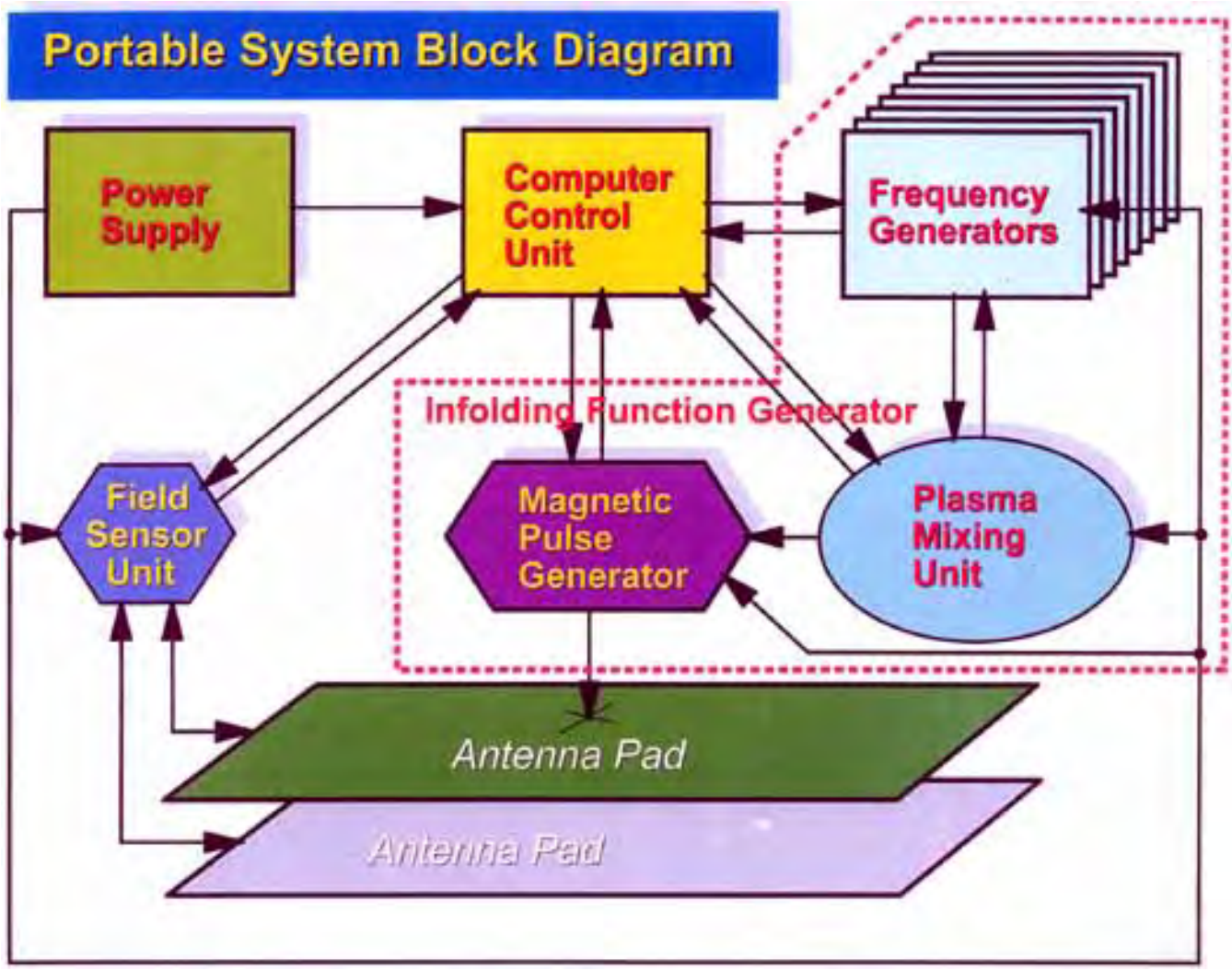

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PORTABLE PRIORE TECHNOLOGY UNIT

- FACT: DISEASE-SPECIFIC VACUUM ENGINE PRESENT FOR ANY CELLULAR DISEASE, BY WHEELER'S PRINCIPLE
  - *DISEASE CAN BE REVERSED BY CREATING AMPLIFIED VACUUM ANTI-ENGINE (BEARDEN'S PRINCIPLE)*
  - *ANTI-ENGINE IS CREATED BY PUMPING THE NONLINEAR CELLS IN THE "INNER EM" DOMAIN, TIME-REVERSING THEM*

- PRIORE UTILIZED A PLASMA TO PHASE CONJUGATE AND "INFOLD" MULTIPLE BIDIRECTIONAL LONGITUDINAL EM PUMP WAVES
  - *17 FREQUENCIES MIXED IN A ROTATING PLASMA*
  - *PHASE CONJUGATES ADDED BY THE PLASMA*
  - *INFOLDED MIX INTO STRONG PULSED DC MAGNETIC FIELD, WHICH CARRIED IT INTO ATOMIC NUCLEI*
  - *PUMPED ALL NONLINEAR CELLULAR COMPONENTS TO PRODUCE AMPLIFIED, SPECIFIC VACUUM ANTI-ENGINE*

- NEGATED THE LONG-TERM CUMULATIVE CELLULAR DEDIFFERENTIATION ORDER GENERATED BY LONG-TERM HYPOXIA. TUMOR CELLS REVERTED TO NORMAL CELLS.
- SCRUBBED OUT THE CUMULATED PRECANCEROUS STATE
- RESTORED THE IMMUNE SYSTEM TO HIGH FUNCTIONING
- NO EXCESSIVE TRAUMA TO TREATED ANIMAL

CANCR-49

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SAVING THE STRICKEN CIVILIANS

SURVIVORS OF N CASUALTIES

(N = 1-40 MILLION)

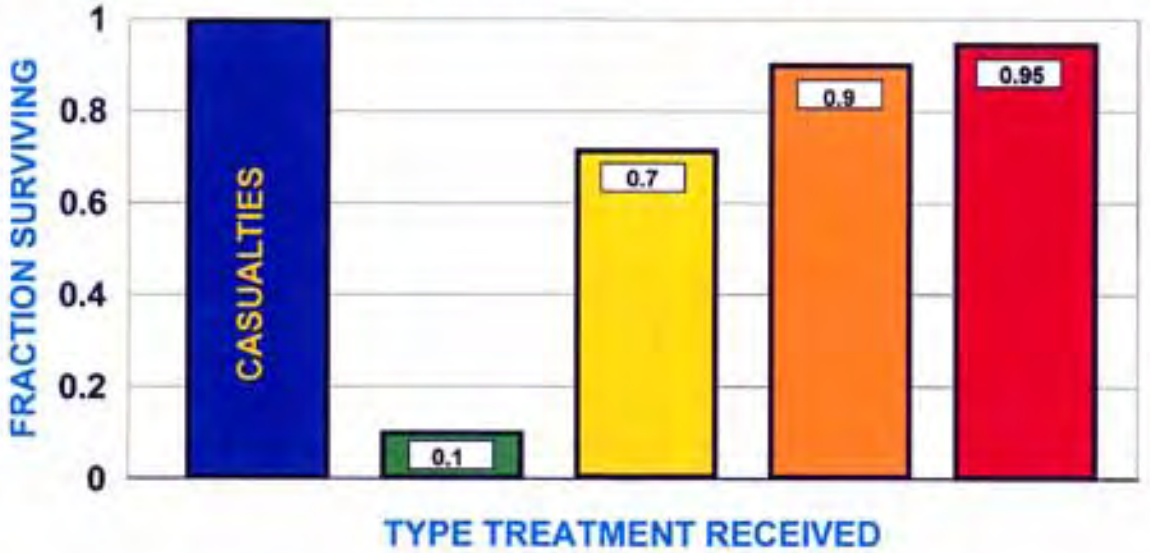

EXPRESSED IN FRACTION SURVIVING
- With conventional treatment
- With 1st generation P-treatment
- With 2nd generation P-treatment
- With 3rd generation P-treatment

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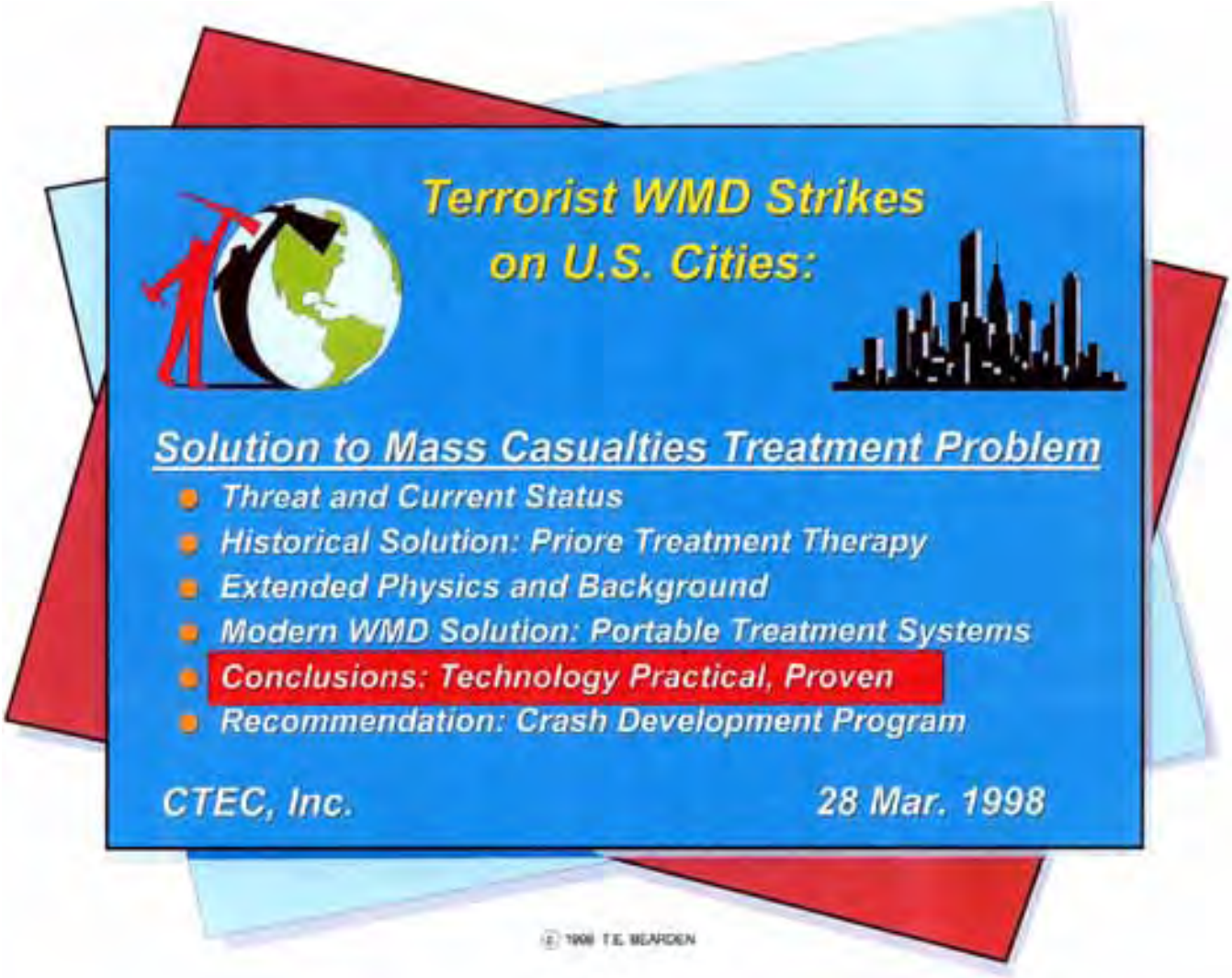

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Summary and Conclusions

- **A new therapeutic paradigm of great scope and effectiveness has been developed**
  - *Will provide effective, quick treatment of mass casualties*
  - *Will provide cures for unknown agents*
  - *No pathogen strains are resistant to this process*
- **Results have been proven experimentally**
  - *Documented in French scientific literature*
  - *Rigorous scientific protocols, eminent scientists*
  - *Technical mechanism deciphered*
- **Will treat and cure many diseases**
  - *Aids, atheriosclerosis, cancer and leukemia*
  - *Sleeping sickness*

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- **Portable units can be developed quickly**
  - *18-month crash development program required*
  - *high level authority and overwatch essential*
- ***Will solve the BW mass casualty treatment problem, both civilian and military***

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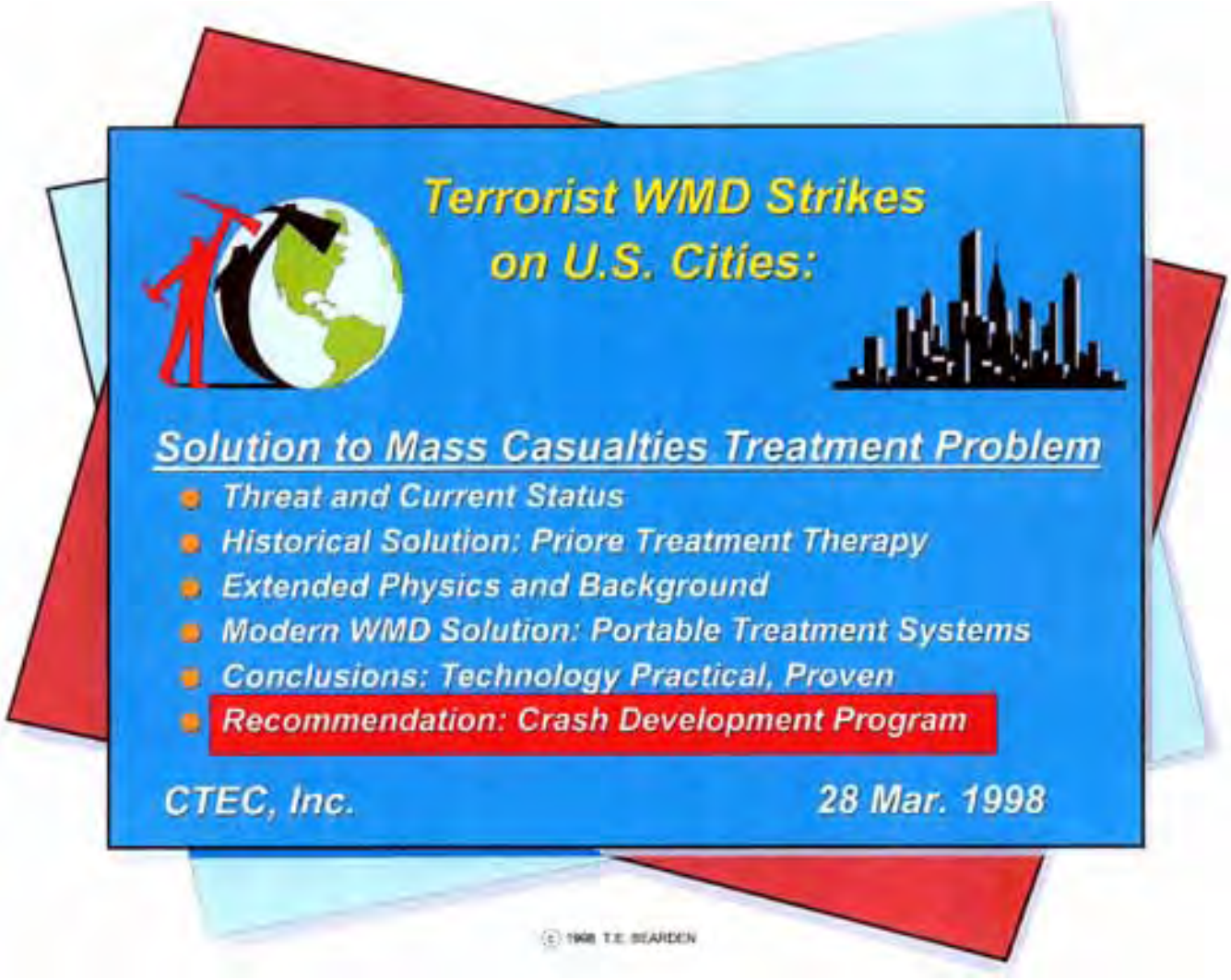

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Recommend implementing:

- Crash development program
  - Suitcase-sized portable unit
  - 18-month Manhattan-type project
  - Simultaneous theoretical modeling, animal testing w/breadboard models
  - SecDef and Congressional overwatch
  - Presidential Decision Directive
- Parallel logistics support program
  - Plan high speed production lines
  - Mass distribution, storage, maintenance
  - User, maintenance training
  - Plan C4 and usage at all levels
  - Integrate firemen, police, National Guard, FEMA, medical facilities, etc.

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Final Thoughts:

- The current internal BW threat can and will kill more Americans than all our previous wars combined
- The Priore technology is the only solution in sight that can save most of those casualties

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CTEC, Inc.
2311 Big Cove Road
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(256) 539-5951 Fax

CTEC, Inc.

June 24, 1998

Dr. Jane F. Kinsel, Director
Office of Policy Analysis
Department of Health & Human Services
Bathesda, MD 20892

Dear Dr. Kinsel:

Your letter of June 8 is appreciated. However, the entire action package had already gone to the Assistant SecDef and also to Major General Neary in the USAF.

The proof of a revolution in medical treatment was in the package. The basis for it is already demonstrated experimentally in the scientific literature, both in the U.S. and in France. We are speaking of something already proven, but missed by the entire U.S. medical community. Strong words, but true. Let me be specific.

Any cell in the body can be time-reversed (physics term) or dedifferentiated (biology term) back to an earlier state, by pumping (i.e., "squeezing" in simple terms) that cell with longitudinal EM waves as pump waves. There are considerable papers in the French scientific literature showing the experimental results.

Apply that to cancer. We are stating bluntly that all cancerous cells in the body can be "depromoted" back to normal cells easily. Further, the damage previously done to them (such as by sustained hypoxia due to contaminants reducing the oxygen-carrying ability normally given to it by some 60-to-80 surrounding water molecules per red cell and the consequent H-bonding interactions) will also be reversed. The cells can all be returned to healthy, normal cells again, without "killing" or "burning" or "cutting" anything.

With some development of the technology, you can quickly and easily cure every cancer patient in every hospital in the United States.

Now apply it to AIDS. Since you can time-reverse every cell in the body, you can time-reverse the HIV-infected cells – genetics and all – right back to normal cells with normal genetics. Those cells not infected and healthy, will just get a "little younger" again.

So with that small development, you can quickly and easily cure every AIDS patient in every hospital in the United States.

I would have thought that NIH would certainly be interested in such a revolutionary therapy which has already been demonstrated in laboratory experiments. World-renowned French scientists – such as the eminent parasitologist Pautrizel and research PhDs assigned directly by Robert Courrier, head of the Biology Section of the French Academy of Sciences, worked with Prioré in performing those startling experiments that proved what we are saying.

The method was rigorously shown to cure infectious diseases (such as trypanosomiasis), atherosclerosis (which now afflicts millions of Americans), and terminal tumors. It was shown to reverse suppressed immune systems back to normal vigorous functioning.

Please permit me to disagree with you that the examination of such is not the mission of the NIH. To the contrary, it is precisely the NIH which should have some of its very best scientists looking into this.

The action package to DoD was to propose a crash program to develop this methodology in the form of a small, portable unit for treatment of mass casualties resulting from a terrorist BW attack on our cities (now expected in the next few weeks, as you must be aware). The leading Arab terrorist of the world has already promised just this.

We are speaking of several million Americans who are going to die. They are going to die in spite of everything that NIH and its labs can do, even though I know you will make a heroic effort. With NIH present methods, you cannot do very much for those stricken Americans at all. Everything we have in the "normal" kit bag is almost useless against a knowledgeable spray attack of modified smallpox (as you know, the Russian secret BW labs have made and sold tons of that already, to guess who!). Or a spray of tularemia (you are well aware of the extreme lethality of that), or anthrax (easily obtained). It is also common knowledge that these terrorist teams with their BW agents are already on site in this country, waiting for the word to attack. This has now been officially raised to our primary Strategic Threat.

In the face of such looming strikes on the U.S., I simply cannot believe that the NIH does not feel it within their mission to rigorously check out a proposed method for saving perhaps 70% of those coming deaths (first generation equipment), and up to 90% with second generation equipment.

Perhaps you just did not read the package carefully. I urge you to do so.

Else NIH is going to look very, very bad when (1) the strikes do occur, (2) they can't handle them (and they cannot, as you well know), (3) they had within their hands in advance, a proposed methodology that could have been investigated intensely, to save millions of those stricken Americans.

As a staunch supporter of NIH and especially CDC, I have to believe that there is a different attitude there. If NIH is not interested in a previously experimentally demonstrated method of saving millions of Americans, then the only recourse left is the political channel.

I assure you that my critique of electrodynamics is well-founded, as supported by various leading physicists such as Nobelist Feynman (who stated bluntly that the field concept is wrong), Wheeler, Bunge, and so on. It is inexplicable why all our universities are still teaching a 130 year old abridged (Heaviside's) subset of Maxwell's theory, and one that still contains a material ether even though that was falsified 110 years ago!

You already have seen the misuse of this technology by the Russians, in the decades-long radiation of the U.S. Embassy in Moscow. Is it not NIH's mission to understand how they generated all those diseases and health changes? Have you ever looked into Kaznacheyev's experiments showing that ANY cellular disease or disorder can be induced in cells at a distance by purely EM means? Have you looked into what got eliminated from electrodynamics by ignoring the hidden longitudinal EM inside every potential, field, and wave? Do you realize what ignoring that has done to American chemistry, biochemistry, and medical science?"

I would hope that the NIH would at least be interested in its own mission area!

I challenge you bluntly to admit that no one presently understands the primary operation of the human cellular *regenerative* system. That's because its technical principle is not presently in our recognized physics, biochemistry, and medical science – even though it has been in the hard physics literature since 1903-4. Becker's epochal work came closest; since he only had access to the conventional EM model, it failed him. But he at least showed you rigorously that cells can be changed (both differentiated and redifferentiated) all over the map by laughably weak EM – picoamperes of current, which means persistent DC potentials. In the microwave radiation of the U.S. Embassy, all the health changes occurred in regions absent of fields – i.e., absent of bleed-off of the potentials. Hence in regions of stable DC potentials! With 100% correlation of the health changes to persistent, gradient free potentials, and 100% anticorrelation to changing potentials (i.e., fields), our own scientists concluded totally erroneously that it could not have been the EM radiation causing the changes, when their own results had just proven that it was.

Now I ask you: Can NIH explain how it was that the DC potentials caused those health changes? I think not. If it could, it would understand the action package I wrote, and its importance.

This is not a "political" letter. I'm just an ordinary American citizen who has done about 30 years very hard work on this particular area. The work is good enough now to stand on its own merits. The scientific community will eventually accept it, about 50 years from now. But we cannot wait 50 years! Those millions of Americans are going to die, because of the bureaucracy and inaction of our own scientific organizations. Whether they like it or not, the U.S. scientific community is now the forefront of the struggle for this nation to survive. And they are failing us dramatically.

So as a parent who wants his children to live, and his neighbors' children to live, and those millions of soon-to-be stricken Americans to live also, I urge you to at least have someone competent in physics (and knowledgeable that the foundations of physics itself are in woeful shape!) check the work. Has anybody there *read* any of the references to the Prioré work I cited? Does anyone there realize that *there are no EM forcefields in space?* Probably not.

Dr. Kinsel, there is a time for "business as usual" and there is a time to do some serious new work. Those stricken Americans are going to be lying there. Nothing NIH can do is going to stop that. That's a given, and it is not my own estimate. It's the official estimate. And you *know* you presently do not have the tools to do anything really effective about it.

Frankly, I interpret your letter to me as just the normal "spin control" for easy disposition. I would hope that NIH would seriously rethink the situation, get off the "spin control" and "business as usual" posturing, and do something dramatically different for a change.

What have you got to lose? A little time from perhaps two or three of your best scientists.

What have you got to gain? Saving untold millions of American lives. A new, *already partially demonstrated* cure for most dread diseases such as AIDS and cancer – diseases which you presently cannot do very much about in spite of decades of heroic struggle.

Sincerely,

cc: Senator Shelby, Congr. Cramer

T.E. Bearden
President and CEO

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CTEC, Inc.

May 12, 1998

Dr. Harold Varmus, Director
National Institute of Health
Bathesda, MD 20892
(301) 496-1766

Dear Dr Varmus:

We have recently sent action documents to the Director of Nuclear and Counterproliferation, Office of the DCS, Air and Space Operations, HQ USAF and to the DoD (General Busbee) Assistant Secretary of Defense, as well as several Senate and House committees, which may be of interest to you. For one thing, we give the technical mechanism used to generate the Gulf War Syndrome. The same weaponry is now being used to rapidly induce new strains of certain pathogens worldwide. I urge you to closely read that section of the letter to MG Neary which explains the GWS, why the French did not get it, and why Southern Iraqis got an increase in cancer and leukemia but not GWS. Also explained is how the "microwave radiation" of the U.S. Embassy in Moscow induced diseases for decades, and how we failed to comprehend it because the standard EM model deceived us.

There is a way to treat and quickly cure most diseases, including the mass casualties resulting from a terrorist BW strike on our civilian population centers, our military bases, or our forces in the field. The method is little known, but was scientifically demonstrated in France in the 1960s and early 1970s before cancellation of the Prioré Project when the French Government changed. Eminent French scientists worked on the project, and the results are fully documented in leading French scientific journals. References are listed in a separate attachment.

Previously the Western scientific community has been unable to understand the technical mechanism responsible for such remarkable cures, because of serious foundations flaws in Western physics and electrodynamics. *Foundations* physicists have long been aware our science is flawed, and have pointed out many of these fundamental errors. However, the operational science establishment has not paid attention, even though physicists such as Feynman and Wheeler pointed out that the notion of "force fields in space" was totally wrong.

As a primary example, there is an "infolded" electrodynamics inside all potentials, fields, and waves that is far more primary than the coarse EM that is in our textbooks. It is actually an infolded general relativity, and this is what the Russians have weaponized. This infolded EM-GR has been ignored in the West (but not in Russia) since 1903.

As another example the potentials, fields, and waves of present electrodynamics are rigorously defined – and exist – only in the presence of mass. They do not exist in such form (force fields and oscillating force fields) at all in space, in the absence of mass. Rigorously, Maxwell's equations are mass-to-mass transforms, since Maxwell and everyone at the time assumed the ubiquitous presence of the material ether. In other words, to the founding electrodynamicists, there was no place in all the universe that was devoid of mass. Hence they defined all EM entities as entities containing mass. Even though Michelson-Morley experiments of more than a century ago destroyed that material ether, not a single Maxwellian equation has ever been changed! They still assume the material ether.

Specifically missing from our electrodynamics are two essential transforms: (1) the mass-to-spacetime transform, and (2) the spacetime-to-mass transform. In other words, these two transforms are "infolded" or hidden inside (comprise) the end point extremum case – the mass-to-mass transform actually written by Maxwell.

But these two missing transforms are just general relativity (they correspond precisely to Wheeler's principle of general relativity). So general relativity has always been infolded inside electrodynamics as we know it, but ignored. Further, this is a very powerful general relativity, since it uses the very strong EM force as the agent of spacetime curvature. Hence now one can engineer a powerful general relativity in the laboratory and in practical devices, and even action-at-a-distance, which one cannot do using merely the staid and weak G-force.

It turns out that longitudinal EM waves as shown by E.T. Whittaker in 1903 and 1904 are far more primary than our present EM theory and even our present GR theory. Both EM and GR are directly engineerable using longitudinal EM waves, including subluminal and superluminal EM waves in vacuum, and including action at a distance. One can engineer complexes of spacetime curvatures as desired, which in turn are *spacetime engines* (Wheeler's term). These engines can act upon mass – either living or inert – in any fashion desired, and at any distance desired.

The little-known and poorly understood Regeneration & Recovery (R&R) system – as contrasted to the immune system – utilizes this exact "spacetime engine" methodology to restore damaged or diseased cells, within its limitations – "dedifferentiating" or "time-reversing" them back to normal. The mechanism is fully explained in the attached package. The proposed program applies this fundamental method to greatly amplify the effect. Thus cancer cells can be reversed back to normal cells, HIV-infected cells (HIV-factories) can be reversed back to normal cells (genetics and all), etc. This represents a dramatic and unparalleled new medical therapeutic methodology of extreme power. The same techniques can simply be conjugated one additional time, and used to produce diseases and cellular changes at a distance, including in entire mass populations, as the KGB is doing right now. Specifically, by impressing an extremely weak "cocktail mix" of disease spacetime engines on the U.S. populace, the immune systems are reacting and being "spread thin" across several "shadow state" infectious pathogenic conditions. Thus when an actual terrorist BW attack occurs, the lethality of the strike will be remarkably enhanced because the immune systems will be "thinned" in their ability to fend off this new pathogen. By doing it this way, BW warfare can actually be conducted upon the U.S. without anyone being the wiser.

Our very survival as a nation is threatened by remarkable KGB weapons using this fully documented, extended electrodynamics. Bluntly, unless we take off our scientific blinders and understand Russian energetics weapon science, GWS and the Embassy health changes in Moscow were just a picnic before what is upon us. After two decades of work on the KGB energetics weapon problem, we have fully deciphered the technical mechanisms and what energetics is, as well as citing many of the Russian weapon tests and how they were done. Again, you can see that for yourself in the package.

Now that we understand the technical mechanisms, we are proposing rapid redevelopment of the Prioré process, in portable suitcase-sized units to be mass produced and filtered down into the entire emergency community for mass treatment of lethal infectious diseases resulting from BW strikes. And we are strongly urging the U.S. scientific community to quickly investigate and come to grips with this vast new *biological engineering* mechanism. Our very survival depends on it.

The inclosed documents provide an overview of the process. There is nothing else on the scientific horizon that can save the majority of all those stricken Americans, once the first foreign-sponsored terrorist teams strike our population centers with BW agents.

Sincerely,

Incls: Full package with table of contents

T.E. Bearden
President & CEO

The Tom Bearden Website

Energy, Observations and Comments

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1. A Conservative Field Requires a Single-Valued Potential
2. Earth-Electrosphere and Earth-Ionosphere Capacitors
3. Earth's Poynting Energy Flow
4. The Hidden Energy Flow around us
5. Electrostatic Fields of the Earth's Electrosphere Capacitor in Fair Weather and Thunderstorms
6. Flow of Current and Energy Into, Through, and Along a Conductor
7. Energy "collected" on a charge
8. Fiber Fuse Effect
9. Impact of Vacuum Engineering
10. Lawandy's Experiment
11. Field may be nonconservative for a multivalued potential
12. The Ostrich Problem - Part 1
13. The Ostrich Problem - Part 2
14. Russia had Overunity Devices in 1930s
15. Energy output of human body
16. A "static" Poynting S-flow free-energy generator
17. Topology and Energy Conservation
18. Block Diagram: Sweet's Vacuum Triode

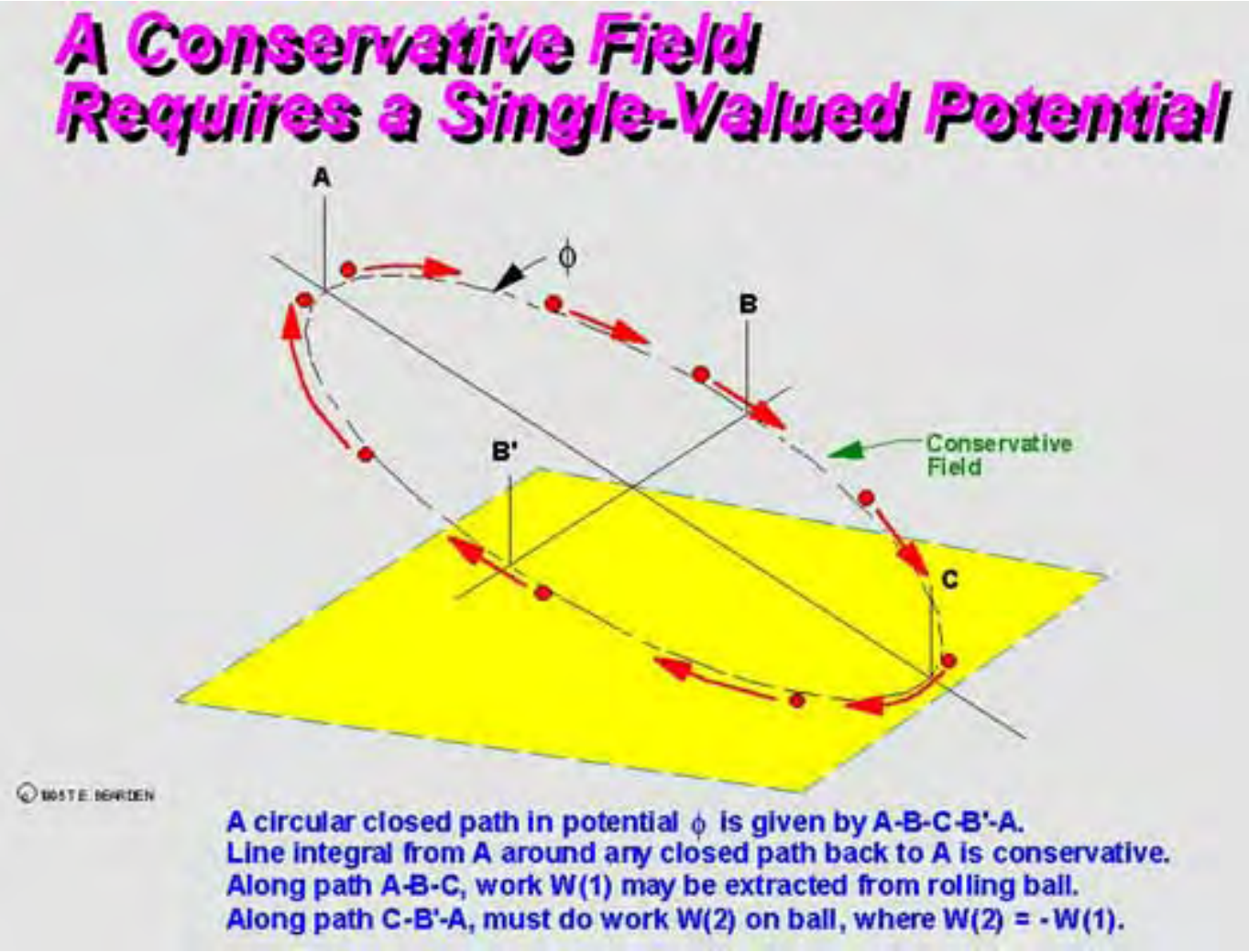

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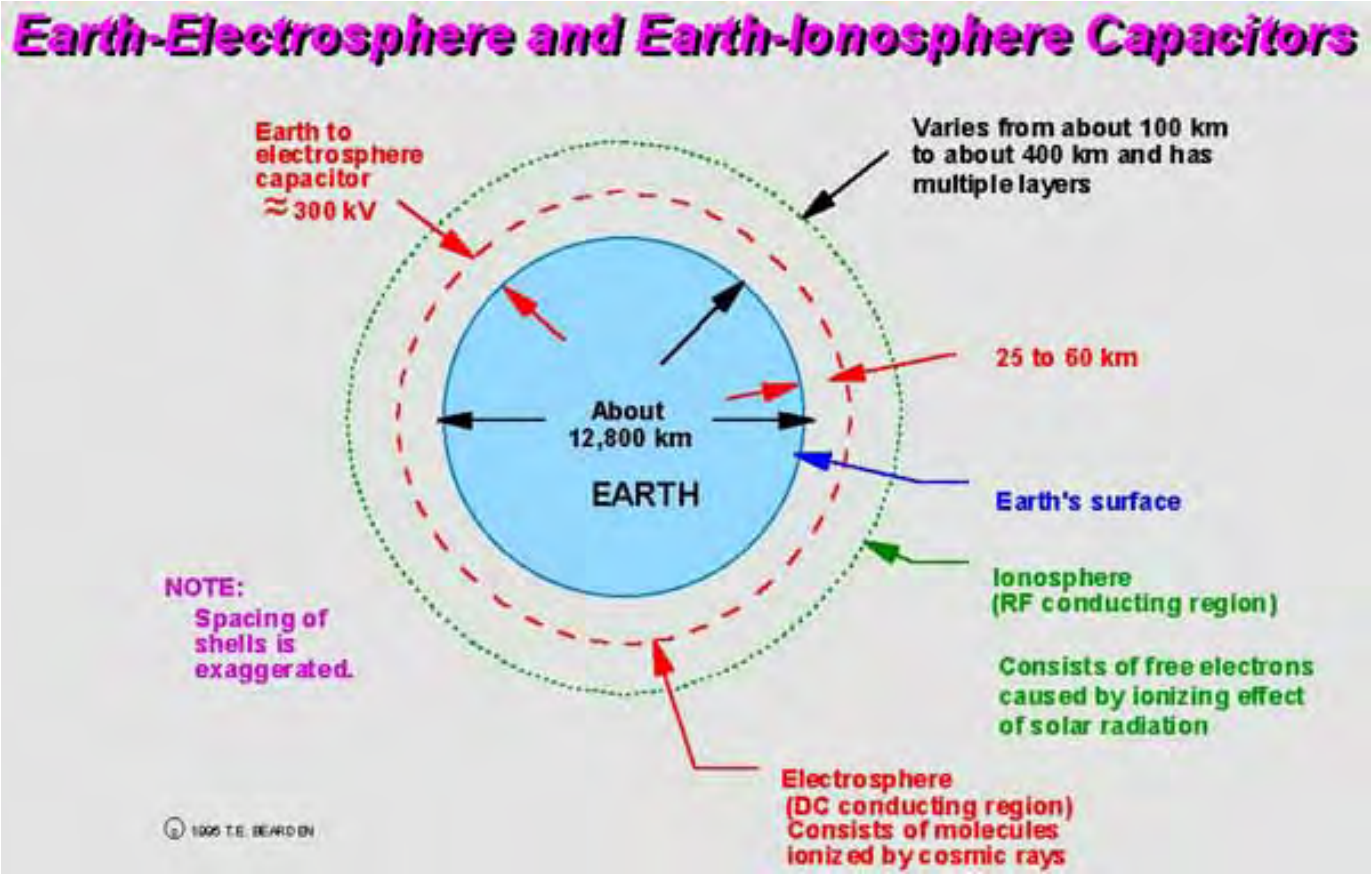

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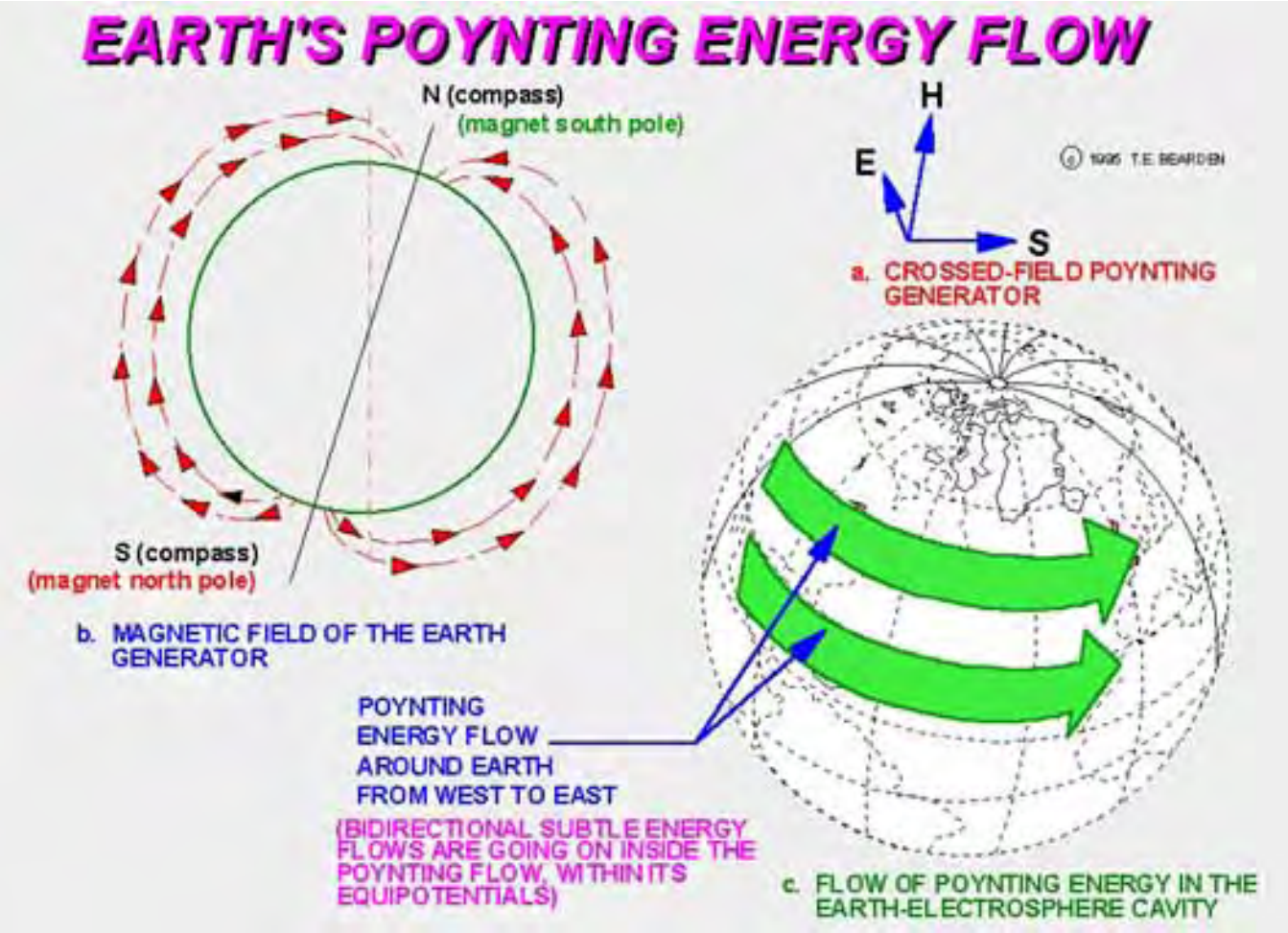

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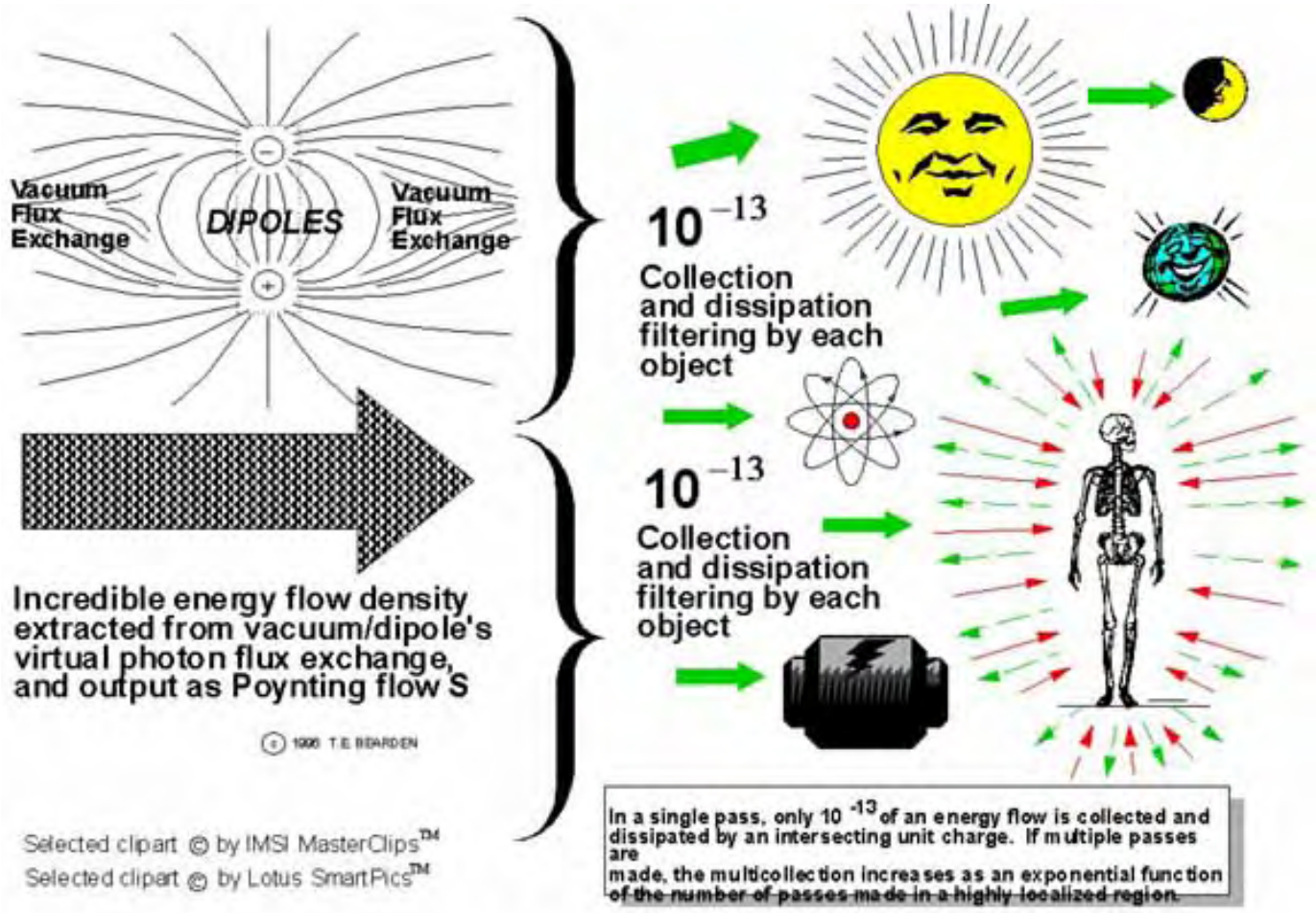

Figure 19. The world of physical matter exists behind a dramatic 10^{-13} filter in a fiery cauldron of fierce and primeval EM energy flow.

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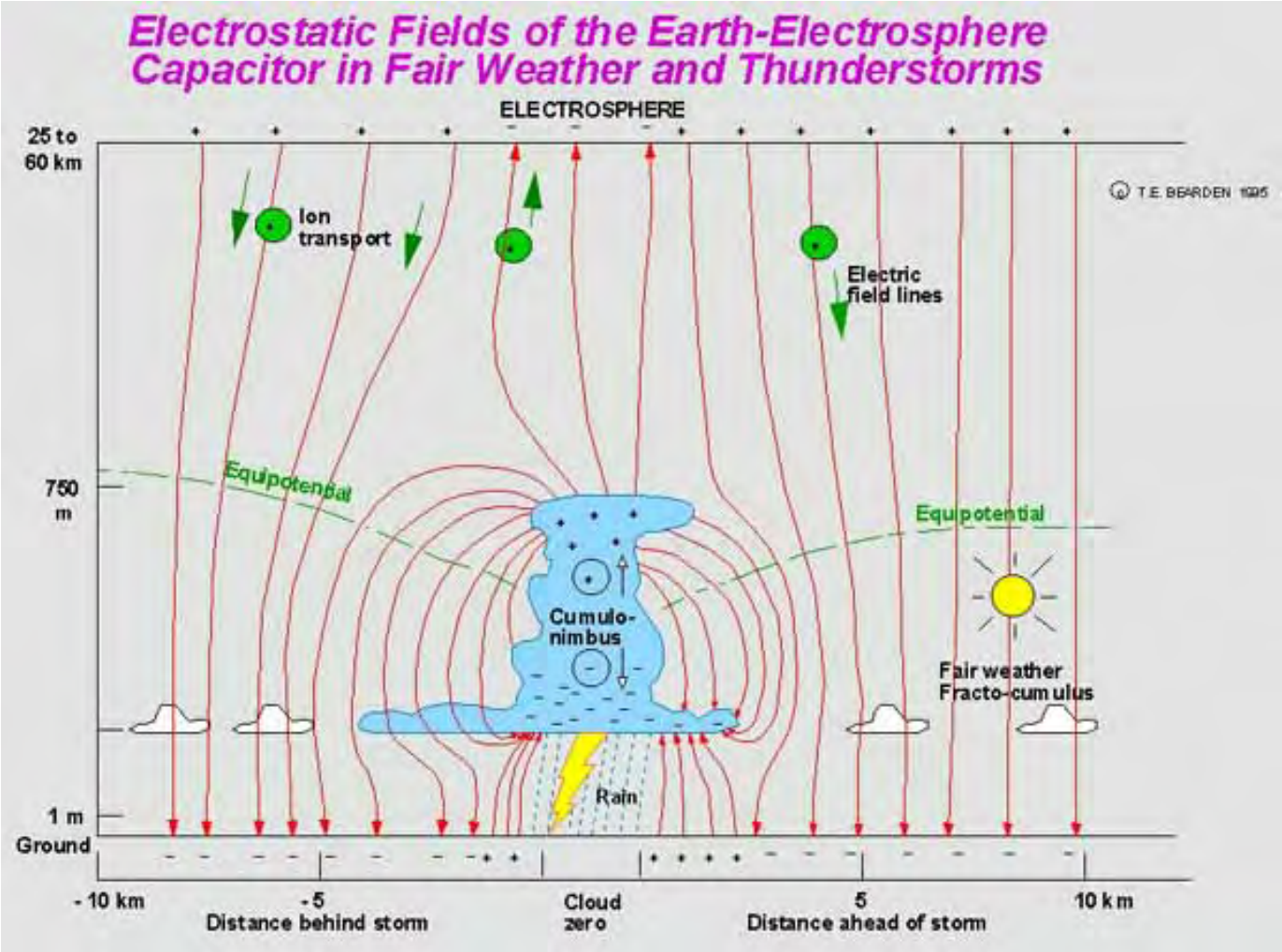

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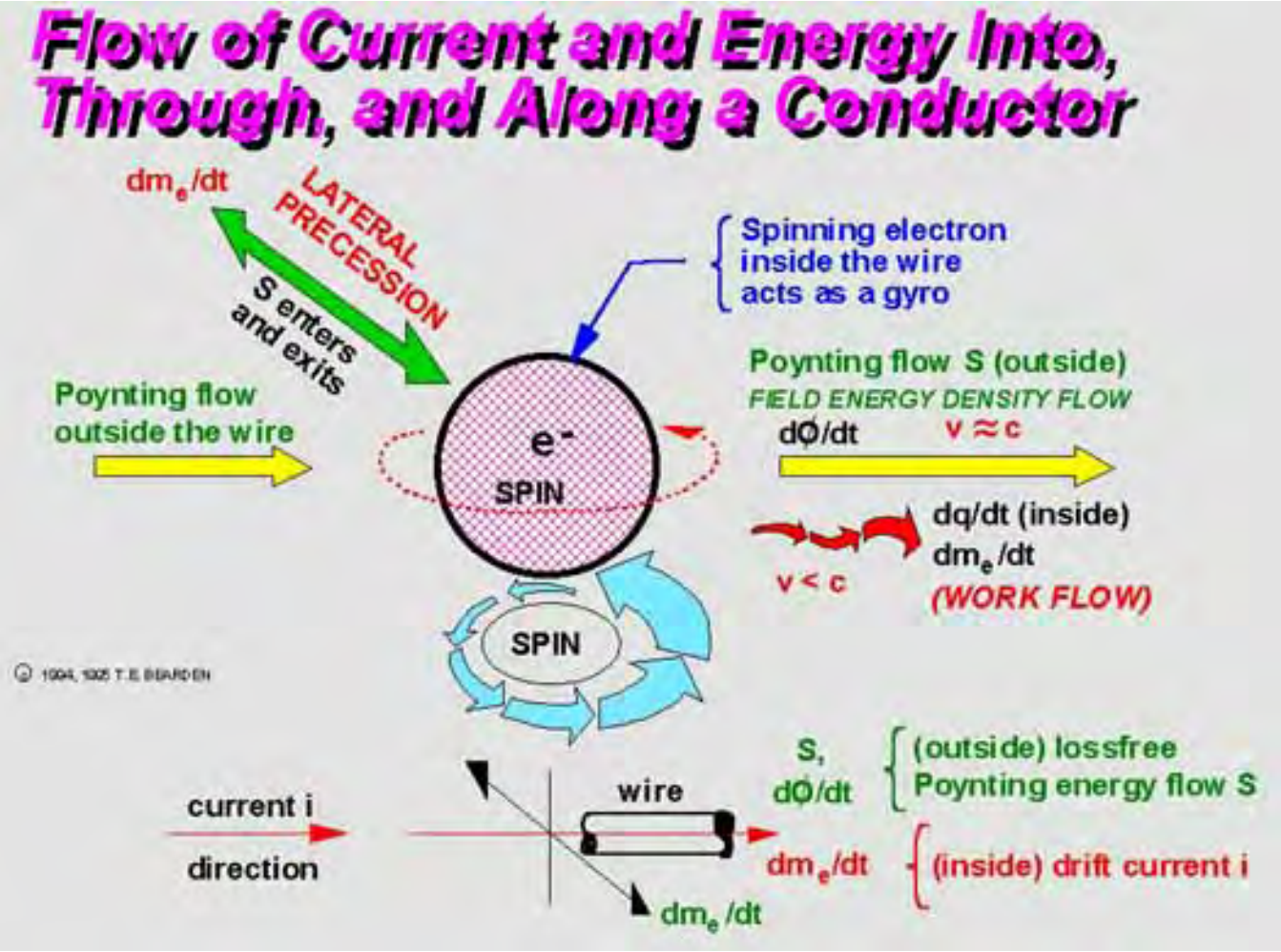

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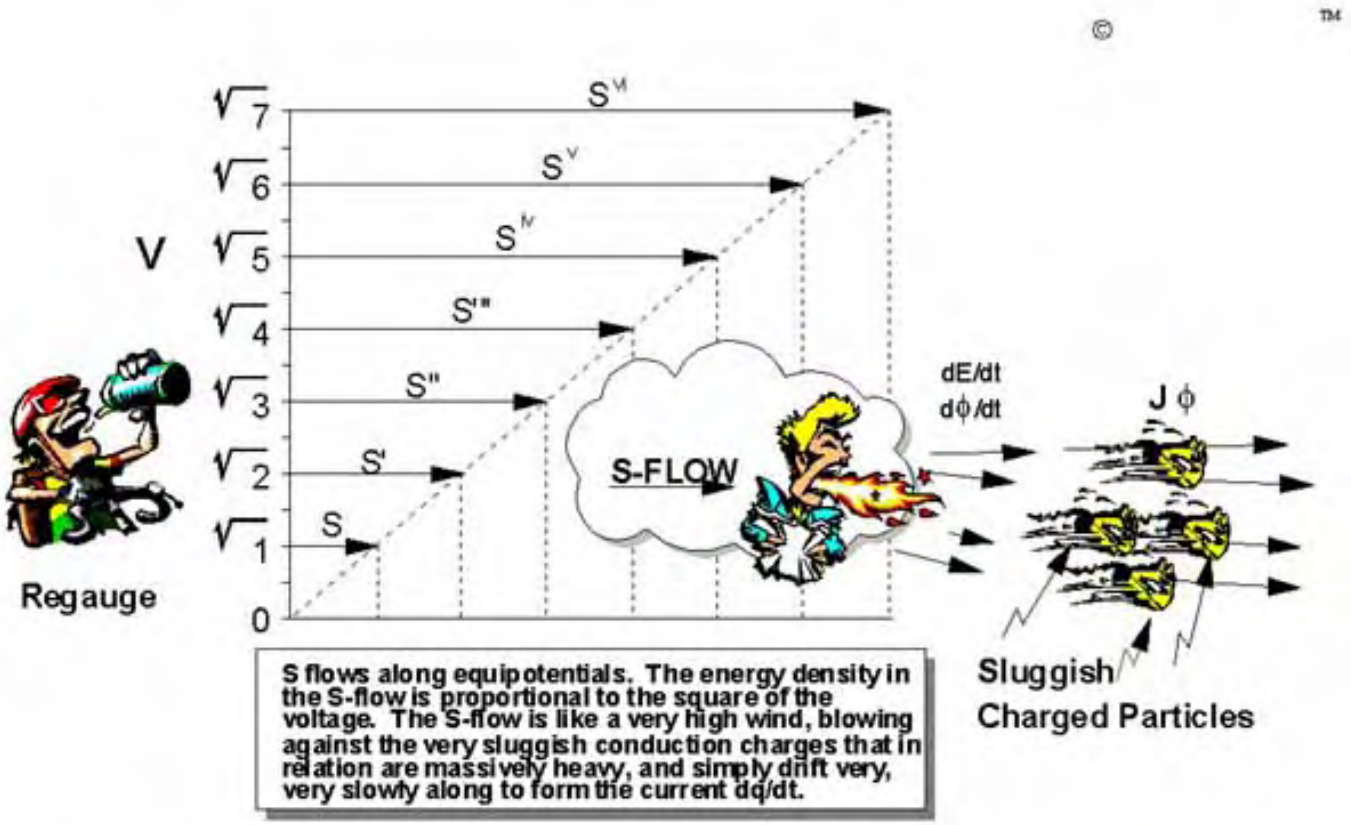

Figure 17. Energy "collected" on a charge depends upon the charge being in a continuous Poynting S-flow. When S ceases, there is no excess energy "collected" on the charge. Energy collection never occurs in chunks, but is always a dynamic, ongoing process.

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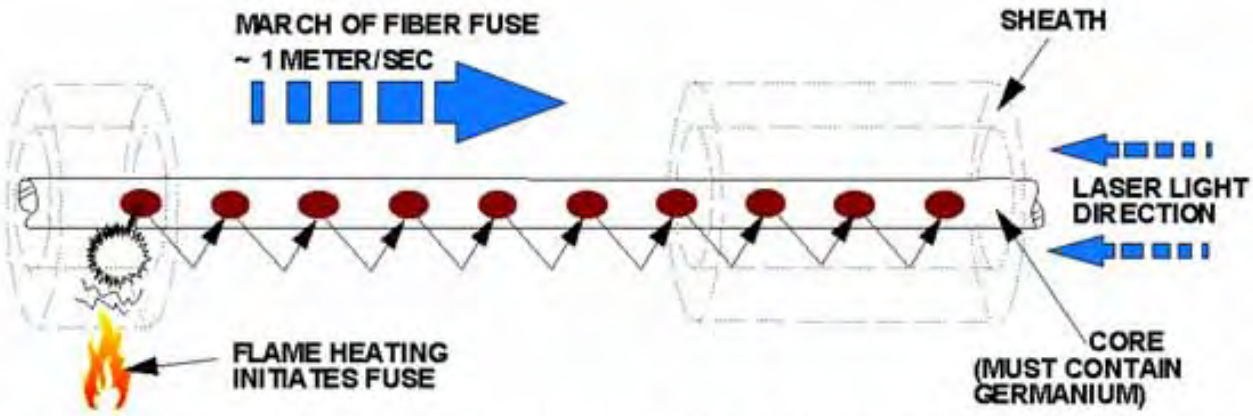

31A. Fiber fuse destroys core of fiber optics cable of indefinite length, pitting core with holes.

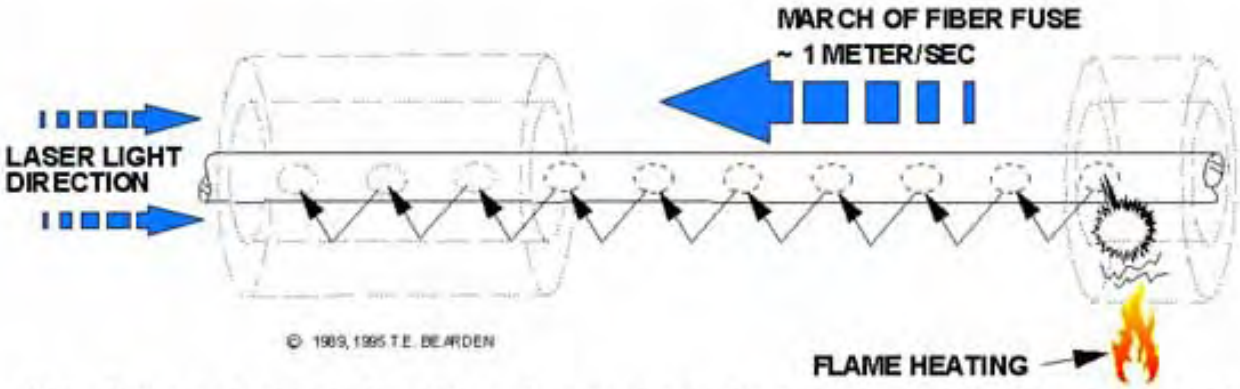

31B. Reversed second fiber fuse often *restores* pitted core in cable, filling holes back up.

Figure 31. Fiber fuse effect and its strange anomalies.

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Impact of Vacuum Engineering

- "If they [quantum fluctuations of vacuum] can be [tapped], the impact upon our civilization will be incalculable. Oil, coal, nuclear, hydropower, would become obsolete – and so would many of our worries about environmental pollution."
- "Don't sell your oil shares yet – but don't be surprised if the world again witnesses the four stages of response to any new and revolutionary development:
  - 1. It's crazy!
  - 2. It may be possible -- so what?
  - 3. I said it was a good idea all along.
  - 4. I thought of it first."

Arthur C. Clarke
"Space Drive: A Fantasy That Could Become Reality"
Nov./Dec. 1994

- *Comment:*
  - *Every dipole's broken symmetry in its energetic exchange with the vacuum already freely extracts vacuum energy.*
  - *In power sources, the dipole gates the extracted energy out as S = EXH, which flows almost entirely outside the conductors.*
  - The circuit interacts with, and uses, only about 10^{-13} of S. The electrodynamicists calculate only this small S-component.

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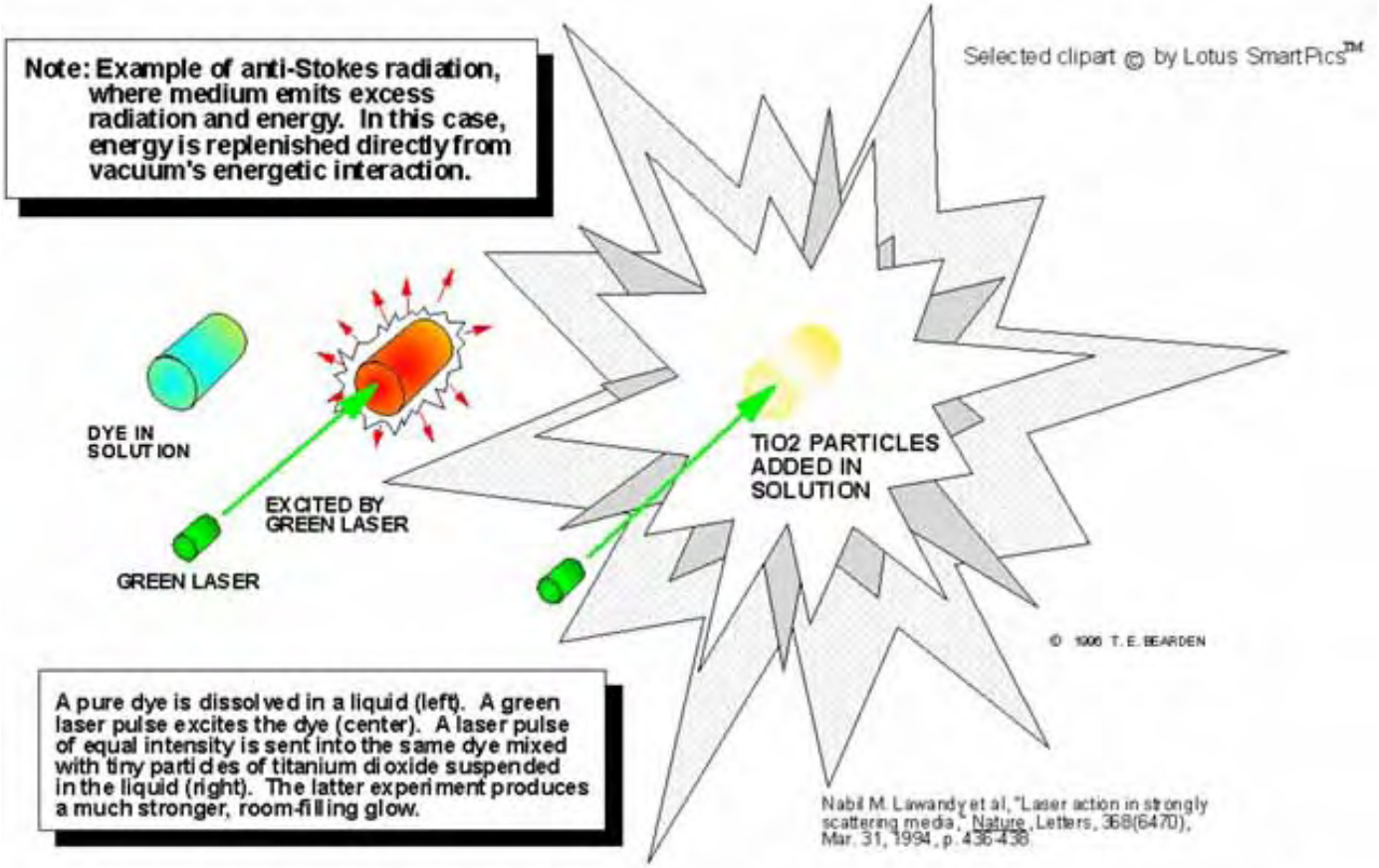

Figure 28. Lawandy's experiment (Letokhov-Lawandy effect) with multipass, multicollection of energy. Formation of a quantum potential can also become involved. Retroreflection and self-targeting are key.

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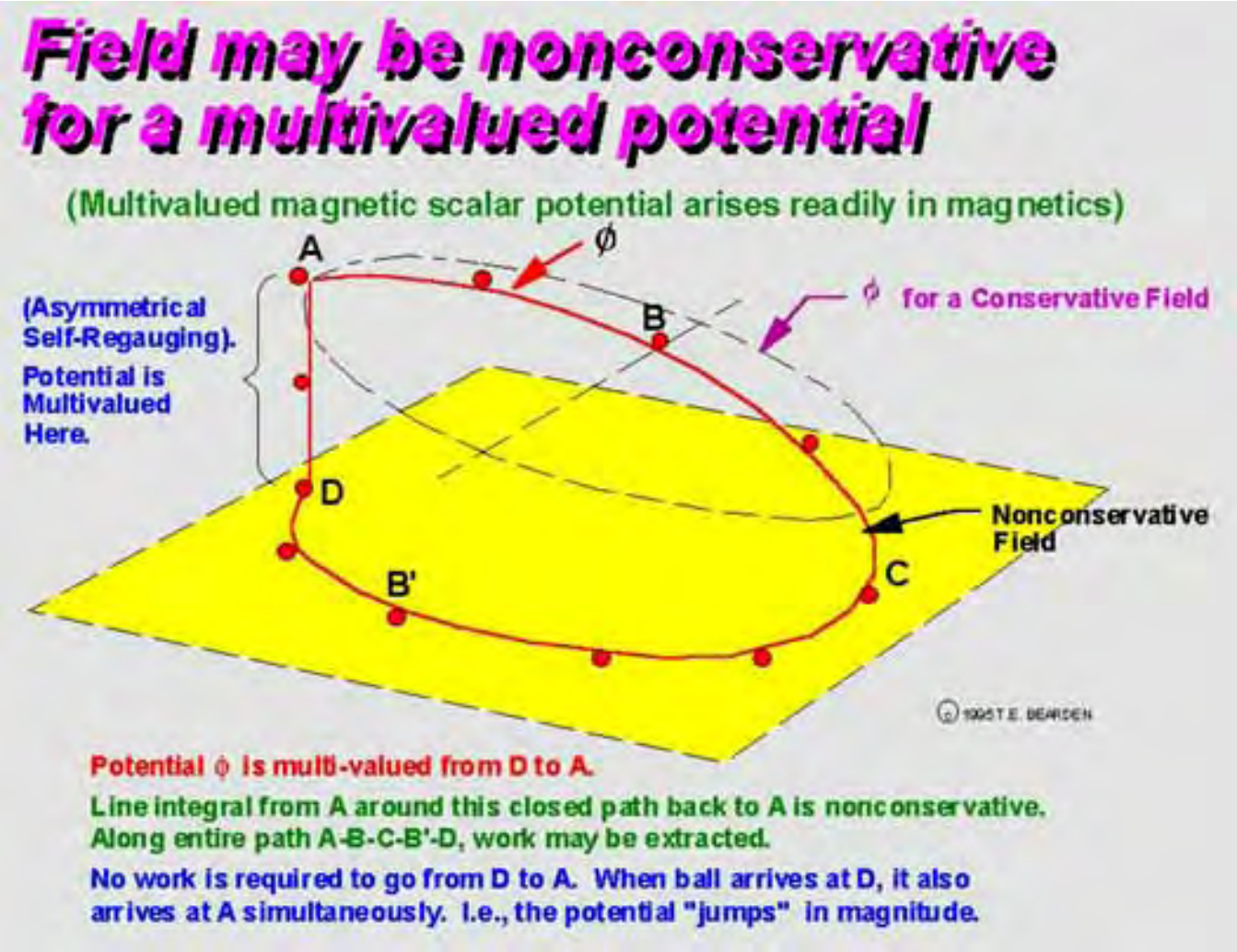

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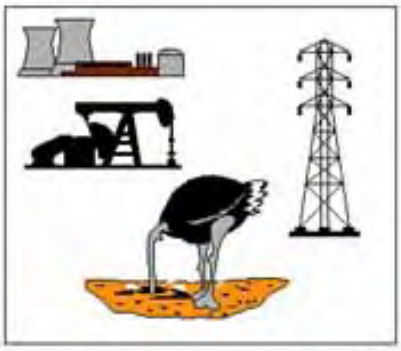

We're running out of energy! We must redouble our efforts!

We have to keep polluting the Earth, if we are to have energy!

Actually, a *few* of our electrical systems already produce all the energy we could ever need! *Learn to collect it and use it!*

Selected clipart © by IMSI MasterClips™
Selected clipart © by Lotus SmartPics™

All our antibiotics are failing! Millions will die from the new age of pandemics and from terrorists' BW attacks!!

We have to relegate EM effects on biological systems to the trash heap. We can only try to find more drugs and antibiotics.

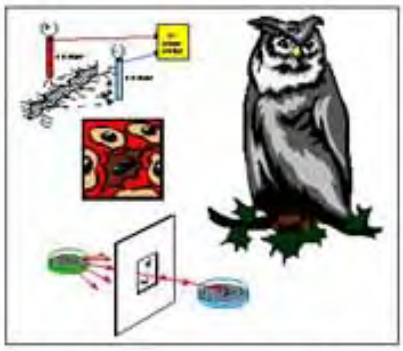

Actually, Priore already showed how to cure most dread diseases, by making and directing vacuum engines. Becker showed you it worked. *Develop it and use it!*

Figure 33. The only problem is the ostrich problem.

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We're running out of energy!
We must redouble our efforts!

We have to keep polluting the Earth, if we are to have lots of electrical energy!

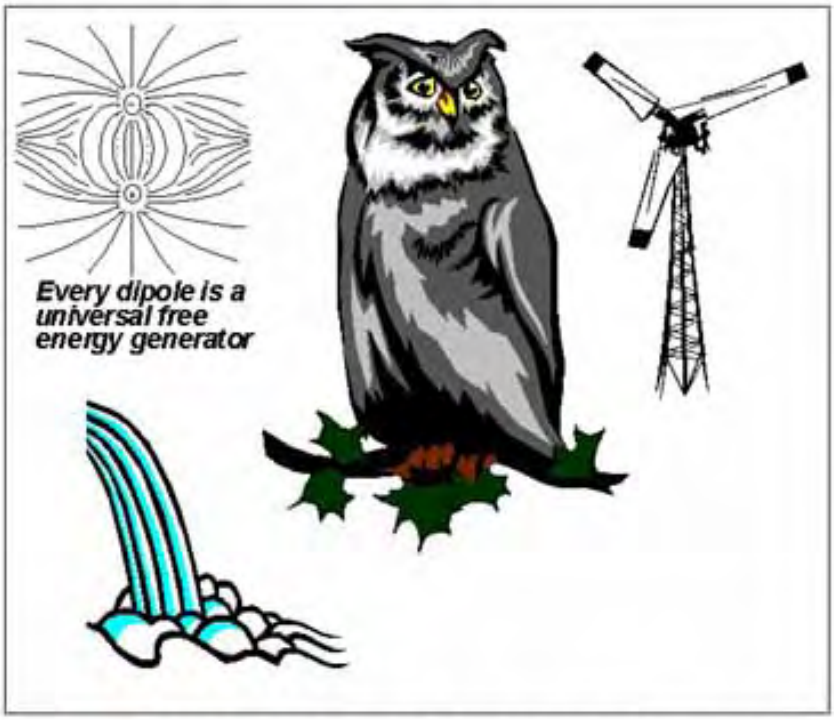

Actually, a single one of our large electrical power systems already produces all the free Poynting energy the world could ever need! *We just have to learn how to collect more of it and use it without continually destroying the source dipole!*

Figure . The only energy resource problem is the theoretical ostrich problem. We must become theoretical owls, rather than ostriches.

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RUSSIAN "SWITCHED PARAMETERS" DEVICES: SELF-OSCILLATING ROTARY GENERATORS*

- Excites oscillations without explicit sources of magnetic or electric forces (i.e., regauges)
  - Periodic variation in system's parameters
  - Experimental and theoretical proof
  - Multiple successful systems made, tested
  - Papers published in Russian, French journals
- As theory predicts, power continually increases unless load is adjusted to stabilize system
- Several large systems tested to self-destruction
- Several large stable systems built, tested

* "On the parametric excitation of electric oscillations," L.I. Mandel'shtam and N.D. Papaleksi, Zh. Tek. Fiz. 4(1), 1934, p. 5-29.

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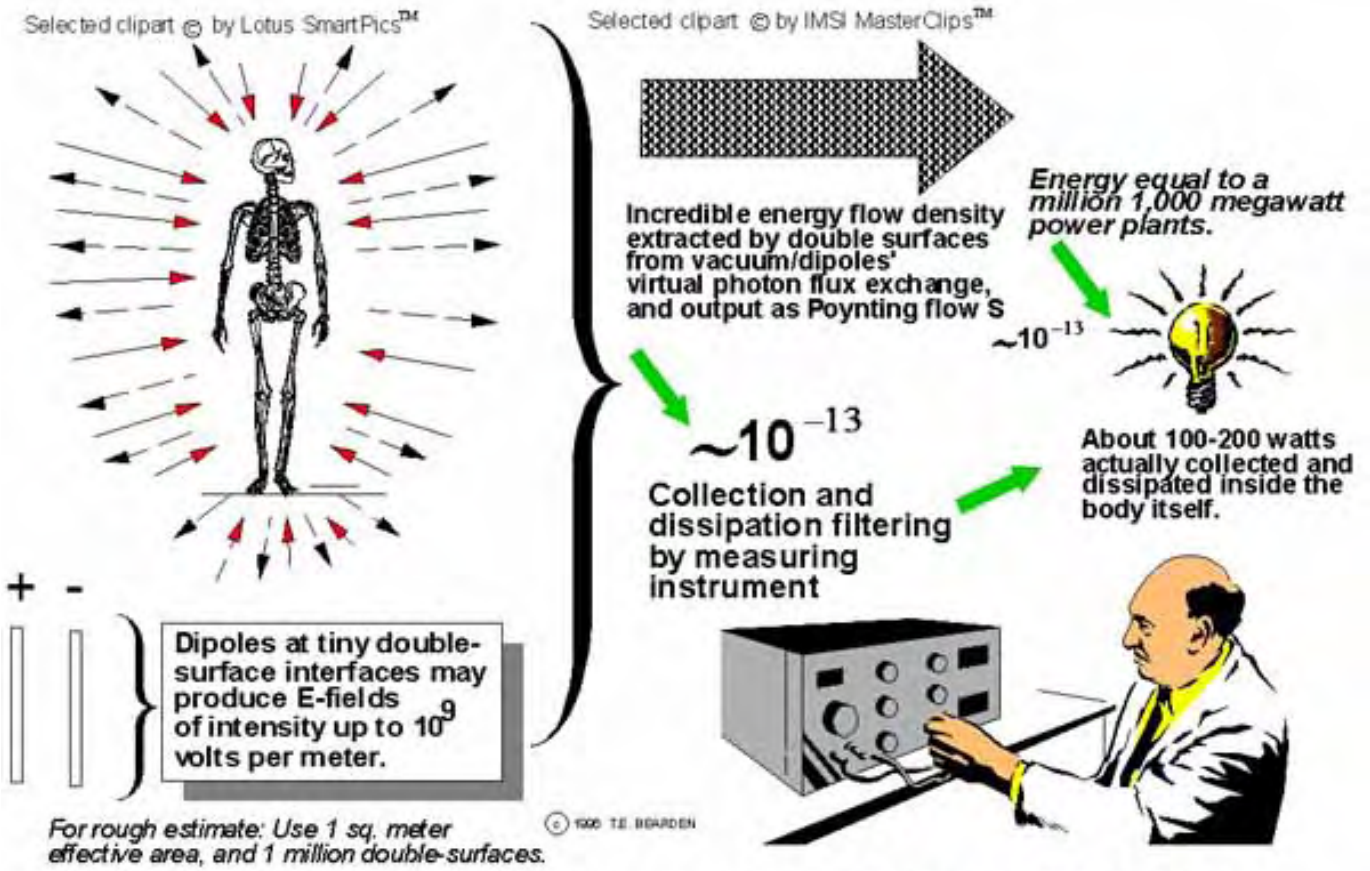

Figure 20. One human body produces more energy flow than all the electrical power loads on earth dissipate. However, only 100-200 watts of its own energy output is collected and dissipated by the body.

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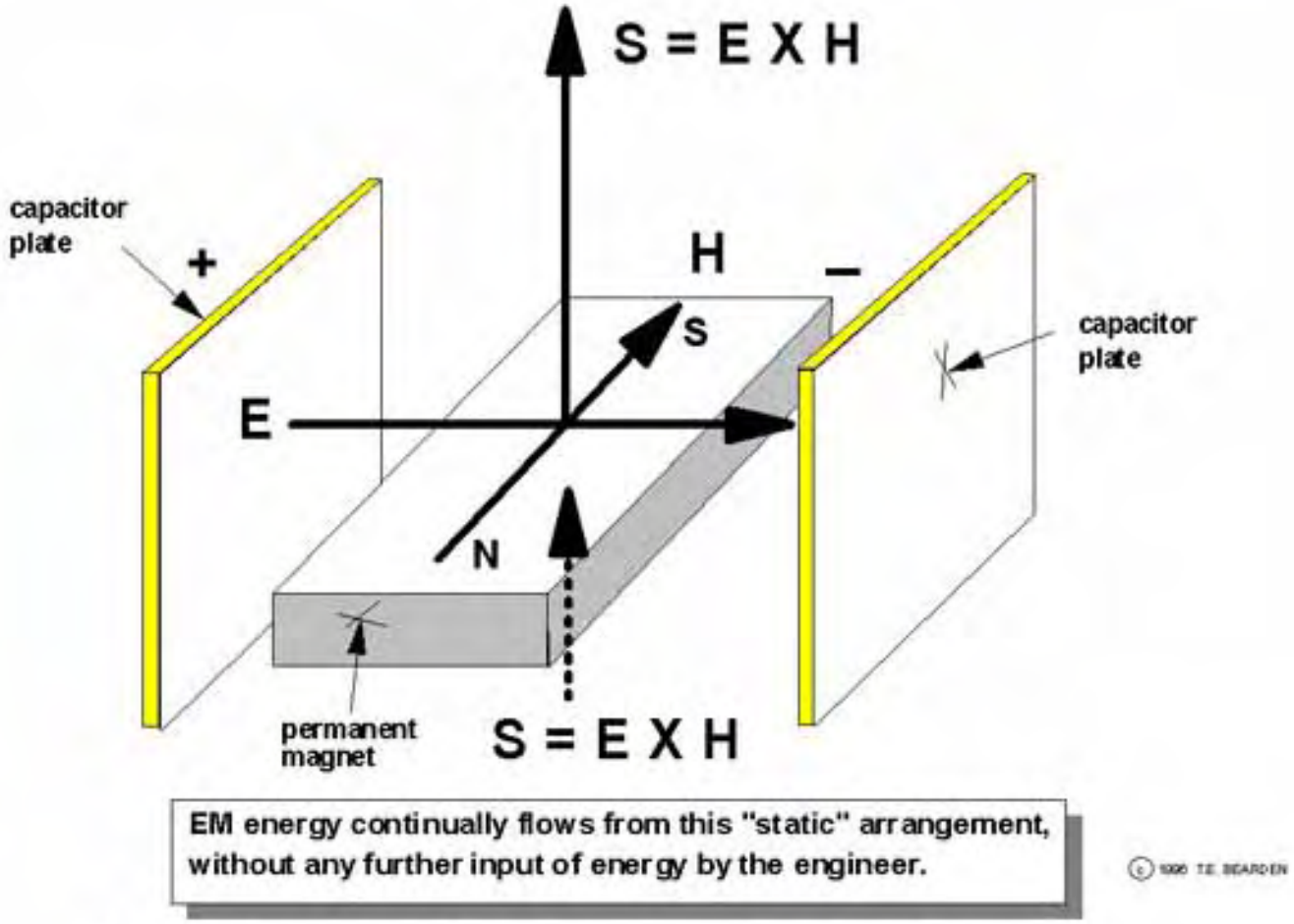

Figure 18. A "static" Poynting S-flow free-energy generator.

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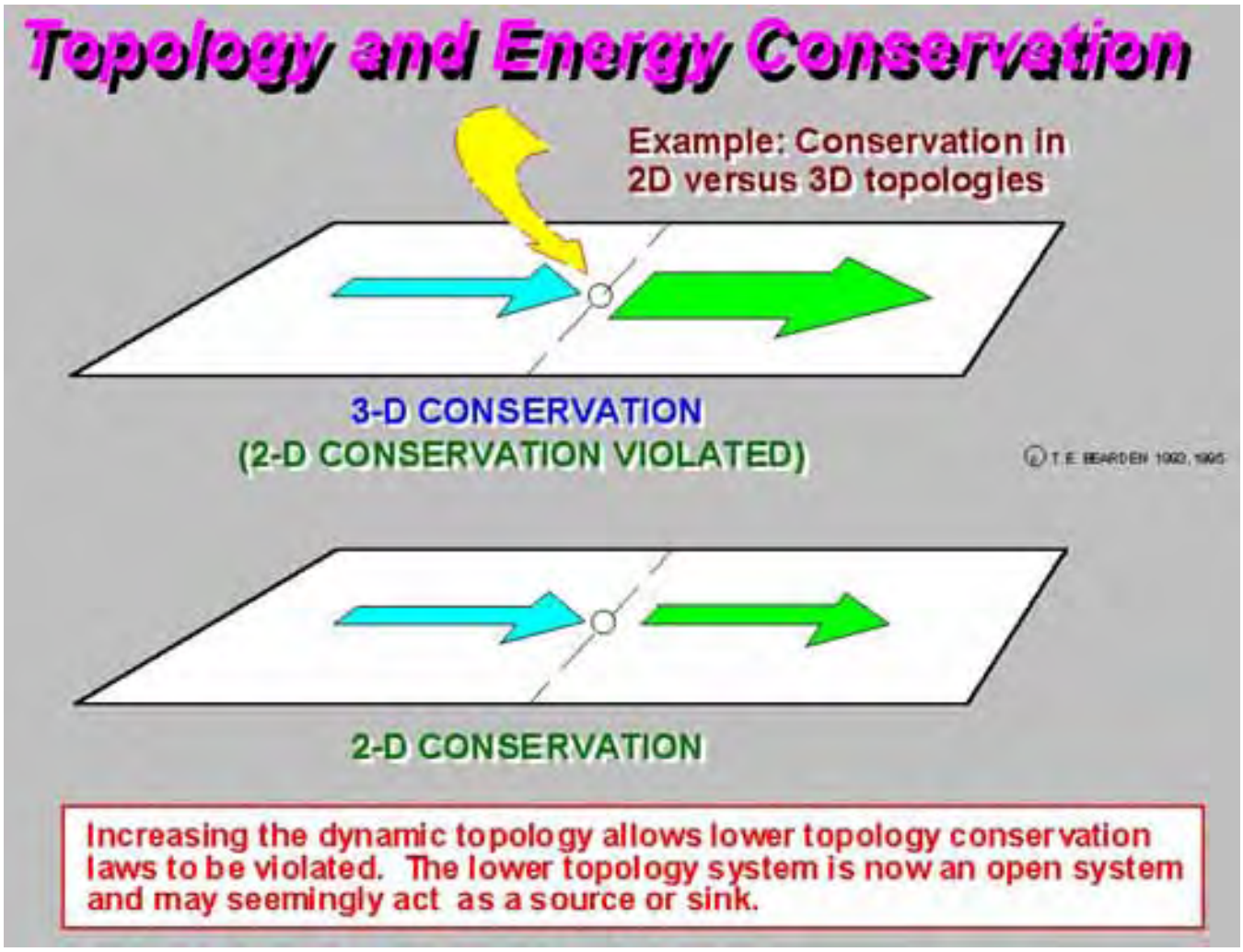

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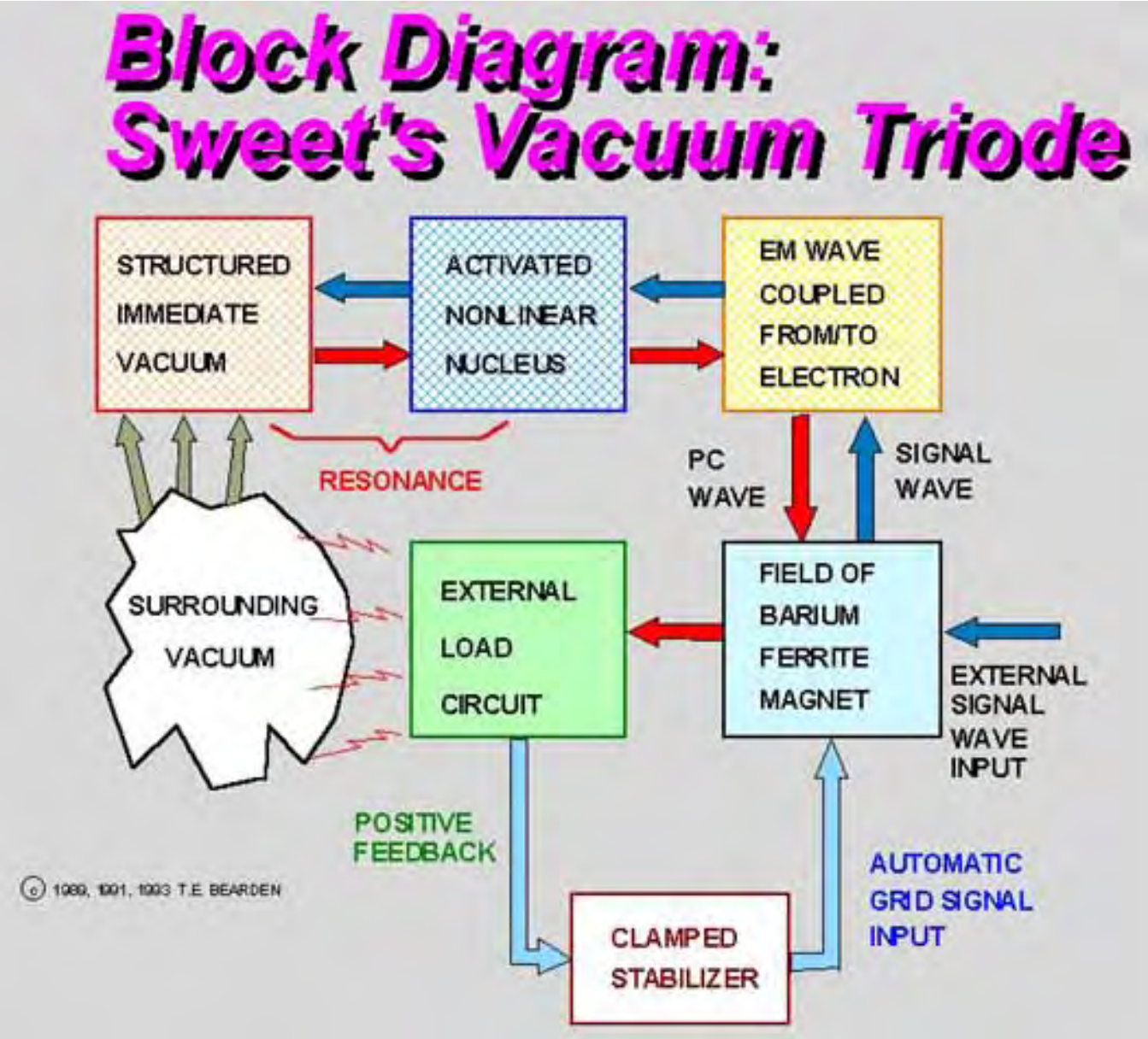

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The Tom Bearden Website

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Foundations of Electro-Magnetism

Slide Series

- Major Points of Presentation
- Chung's Carbon Filament Negative Resistor
- Aharanov-Bohm Effect
- Absorption and emission reactions (1)
- Absorption and emission reactions (2)
- Anti-engine for cell's deviation reverses cell back to normal
- Asymmetric regauging produces excess force, which can be used to do work on the system
- Asymmetric regauging produces excess force, which can be used to do work on the regauging system
- Becker's bone fracture healing experiments
- Becker's theoretical control system governing regeneration
- Becker's theoretical DC control system involved with response to injury
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- Cosmic Bootstrap: Before the Big Bang
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- Aspects of Strong Local Symmetry
- Other Aspects of Strong Local Symmetry
- Bunge on the Status of Electrodynamics
- Bunge on the Status of Electrodynamics and Physics
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- First Step in Self-Promotion of Cancer Due to Hypoxia
- Differentiation and Dedifferentiation Timelines
- Evolution of Cells on Earth
- A Charged Particle q is a Coupled System of m and Ø
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (1)
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- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (3)
- A Charged Particle is a Coupled System
- The Anomalies in Navy Electrolyte Experiments at China Lake
- Chung's Carbon Filament Negative Resistor

- Typical circuit has about 10^{-13} energy collection efficiency
- Classical View of EM
- Curved Spacetime acts as source or sink
- Chronic Disease Puzzling
- Cancer Characteristics
- Solving a Cancer Enigma
- Cancer: Characteristics
- Nonlinear Optics Distortion Correction Theorem
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)
- In Time-Reversed Zone: Nuclear reactions are biased
- In Time-Reversed Zone: Dynamics may be reversed
- Time-Reversed Zone: Significant only after time-density charging
- A New Conservation of Energy Law
- Questions on Carcinogens and EM

Radiation

- AS DEFINED, fields and potentials only exist in and on charged matter
- Serious flaws and errors in classical EM theory
- Electrodynamicists' Reaction to Removal of the Material Ether
- Reaction to Loss of Material Ether (1)
- Reaction to Loss of Material Ether (2)
- Some EM waves in Spacetime
- Air Medium Disturbances Generated When Air is Perturbed by a Plucked Taut String
- Launching a Spacetime Perturbation ("EM Wave") from a Wire Antenna
- Phase Conjugate Wavepairs Produce New Waves
- Scalar Electromagnetics (Energetics) View of EM (1)
- Scalar Electromagnetics (Energetics) View of EM (2)

- Scalar Electromagnetics (Energetics) View of EM (3)
- Extended General Relativity Principle
- Extension of Work-Energy Theorem
- 34 Flaws in Classical EM Theory
- MTW's General Relativity Principle
- Use of General Relativity (GR) in Particle Physics
- The Missing Infolded Electrodynamics
- Infolded Engines: Excluded by Present Physics
- Mass curves and structures spacetime; ST curvatures change and structure mass (1)
- Mass curves and structures spacetime; ST curvatures change and structure mass (2)
- At Infinite Velocity: Each Is Every Other
- Lisitsyn's Report: Brain Code Broken
- Lorentz Closed Surface Integration
- Lorentz's physically insignificant energy flow can be collected and utilized
- Lorentz surface integration of the Poynting vector around a closed surface
- Longitudinal EM Photon Interaction with Charge
- Mass is transparent to longitudinal EM waves, which move through the infolded interiors of internal waves, potentials, and fields in the mass.

- Pumping with Longitudinal EM waves Time-reverses the Mass
- Maxwell's Quaternion Theory
- Maxwellian Systems before and after Regauging
- Maxwell's four equations reduce to: Page 1
- Maxwell's four equations reduce to: Page 2
- More to come

Major Points of Presentation

- Electrodynamic is seriously flawed
  - Some major flaws
  - Corrections indicated
- Why past corrective attempts failed
  - Force field concept is material
  - Missing two infolded transforms (M->ST; ST->M)
- Missing Infolded general relativity inside electrodynamics
- Several Kinds of EM Waves in Space
  - How to make
  - Transduction
- A French medical example as a deep experimental demonstration
  - Spectacular regenerative cures funded by French Govt
  - Not comprehended, therefore suppressed
- Cold Fusion examples of time-density wave effects
  - China Lake instrumental anomalies in electrolysis
  - Explanation of anomalous behavior of instruments
  - Explanation of new nuclear reactions
  - Wave energy transduction provides excess heat
- Urge theorists to consider dramatically new reactions

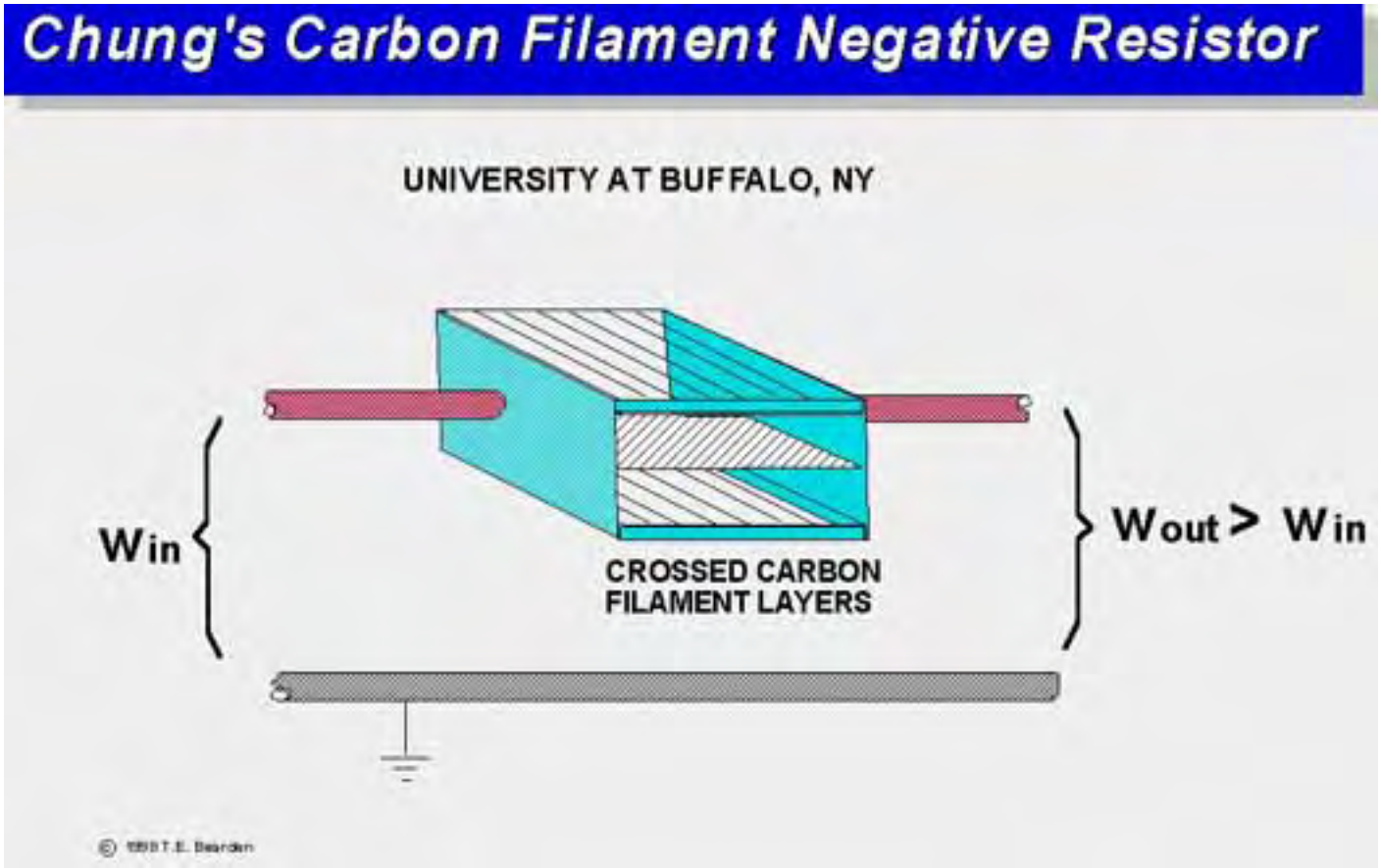
Chung's Carbon Filament Negative Resistor
UNIVERSITY AT BUFFALO, NY
Win
CROSSED CARBON
FILAMENT LAYERS
Wout > Win
© 1991 T.E. Bearden

Aharonov-Bohm Effect

- In field-free regions
  - E-field is zero
  - B-field is zero
- Potentials still exist, just no gradients
  - Cause real effects
  - Interference is the key
  - Contain sum-zeroed substructures
- Does not follow from
  - Mechanics
  - Classical electromagnetics
- Required by quantum mechanics

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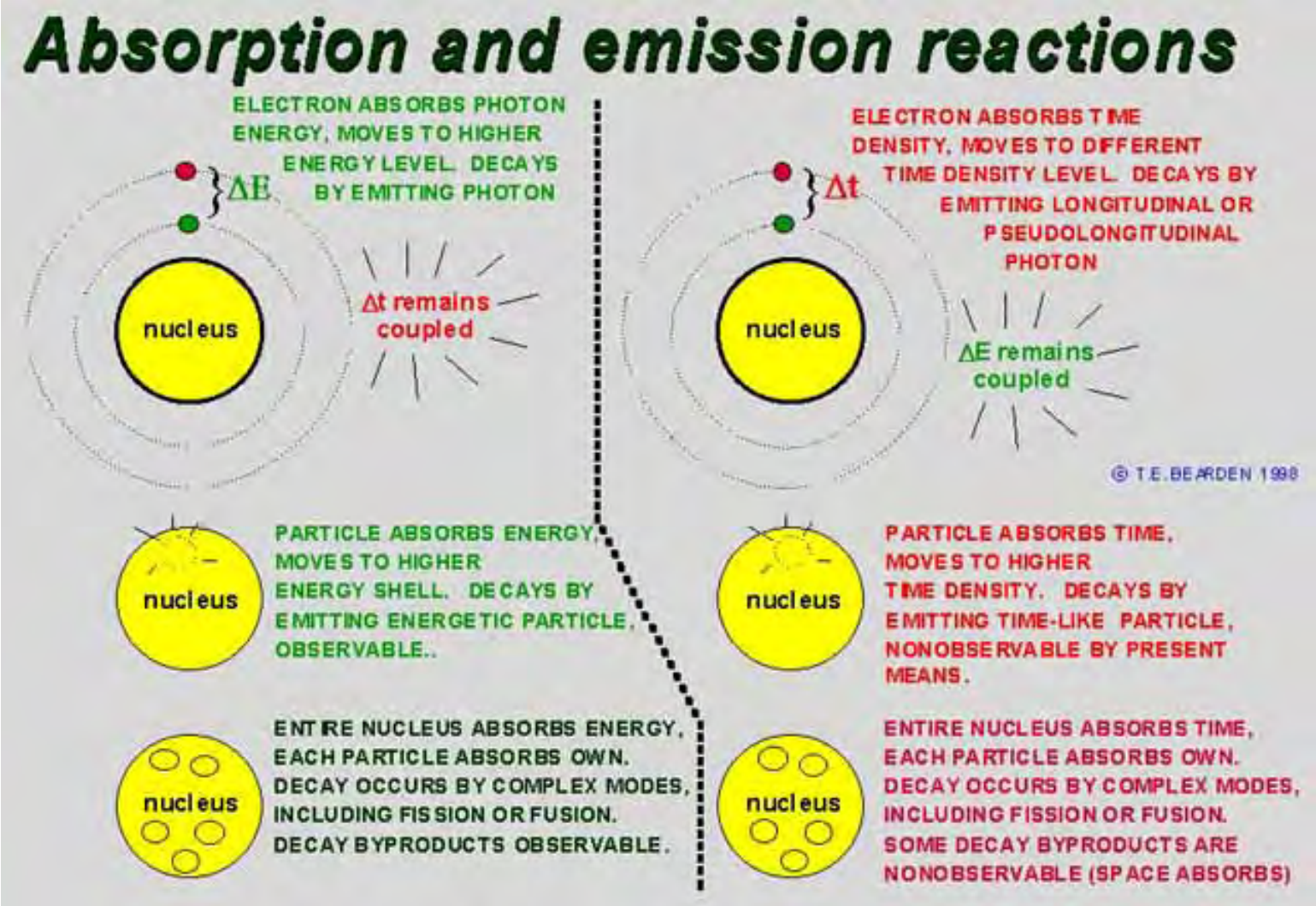
Absorption and emission reactions
ELECTRON ABSORBS PHOTON ENERGY, MOVES TO HIGHER ENERGY LEVEL. DECAYS BY EMITTING PHOTON
ΔE
nucleus
Δt remains coupled
ELECTRON ABSORBS TIME DENSITY, MOVES TO DIFFERENT TIME DENSITY LEVEL. DECAYS BY EMITTING LONGITUDINAL OR PSEUDOLONGITUDINAL PHOTON
Δt
nucleus
ΔE remains coupled
© T.E. BEARDEN 1998
nucleus
PARTICLE ABSORBS ENERGY, MOVES TO HIGHER ENERGY SHELL. DECAYS BY EMITTING ENERGETIC PARTICLE, OBSERVABLE..
nucleus
PARTICLE ABSORBS TIME, MOVES TO HIGHER TIME DENSITY. DECAYS BY EMITTING TIME-LIKE PARTICLE, NONOBSERVABLE BY PRESENT MEANS.
nucleus
ENTIRE NUCLEUS ABSORBS ENERGY, EACH PARTICLE ABSORBS OWN. DECAY OCCURS BY COMPLEX MODES, INCLUDING FISSION OR FUSION. DECAY BYPRODUCTS OBSERVABLE.
nucleus
ENTIRE NUCLEUS ABSORBS TIME, EACH PARTICLE ABSORBS OWN. DECAY OCCURS BY COMPLEX MODES, INCLUDING FISSION OR FUSION. SOME DECAY BYPRODUCTS ARE NONOBSERVABLE (SPACE ABSORBS)

Absorption and emission reactions

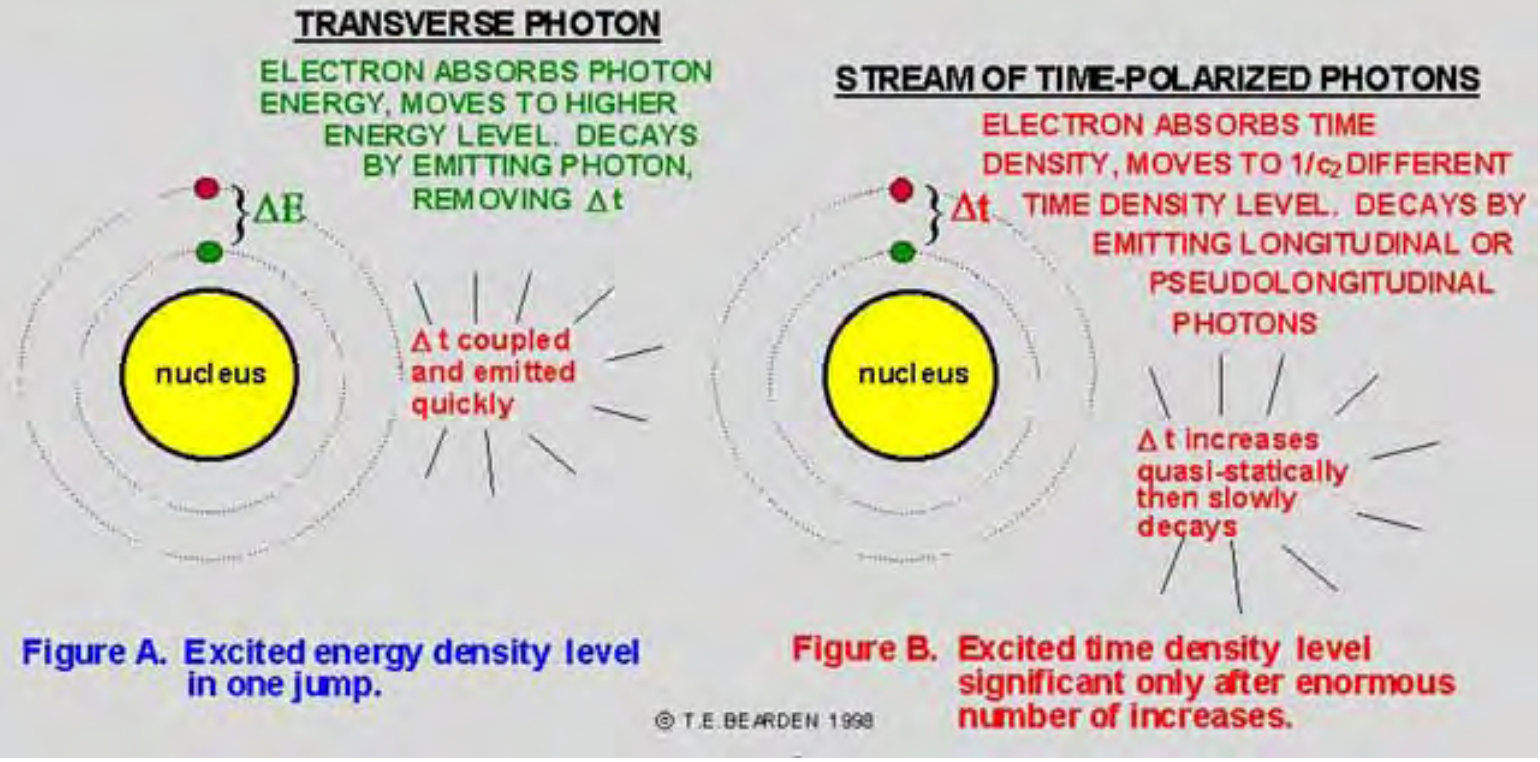

Figure A. Excited energy density level in one jump.

Figure B. Excited time density level significant only after enormous number of increases.

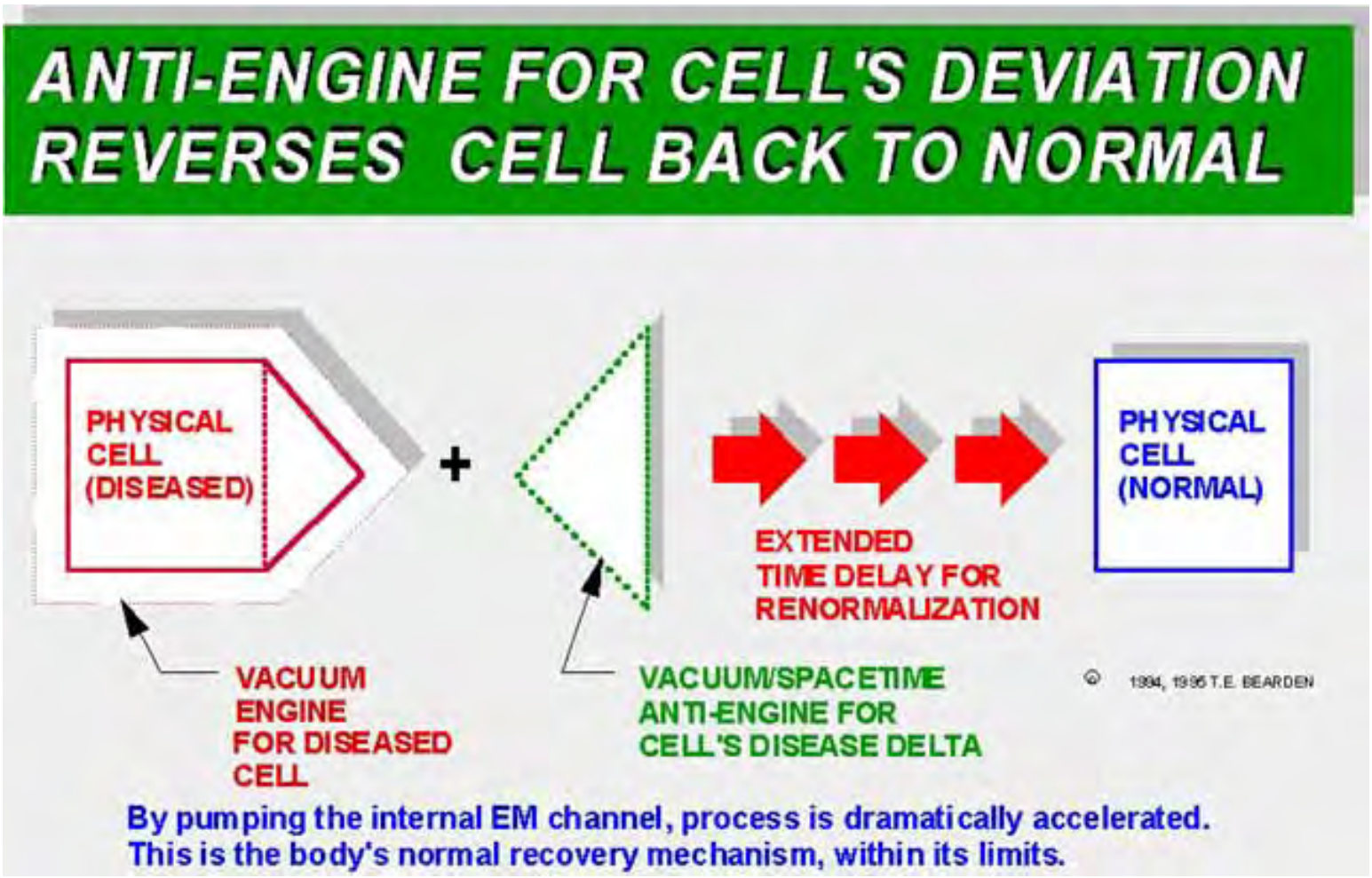
ANTI-ENGINE FOR CELL'S DEVIATION
REVERSES CELL BACK TO NORMAL
PHYSICAL CELL (DISEASED)
+
EXTENDED TIME DELAY FOR RENORMALIZATION
PHYSICAL CELL (NORMAL)
VACUUM ENGINE FOR DISEASED CELL
VACUUM/SPACETIME ANTI-ENGINE FOR CELL'S DISEASE DELTA
© 1994, 1995 T.E. BEARDEN
By pumping the internal EM channel, process is dramatically accelerated.
This is the body's normal recovery mechanism, within its limits.

Asymmetric Regauging Produces Excess Force, Which Can be Used to Do Work on the System

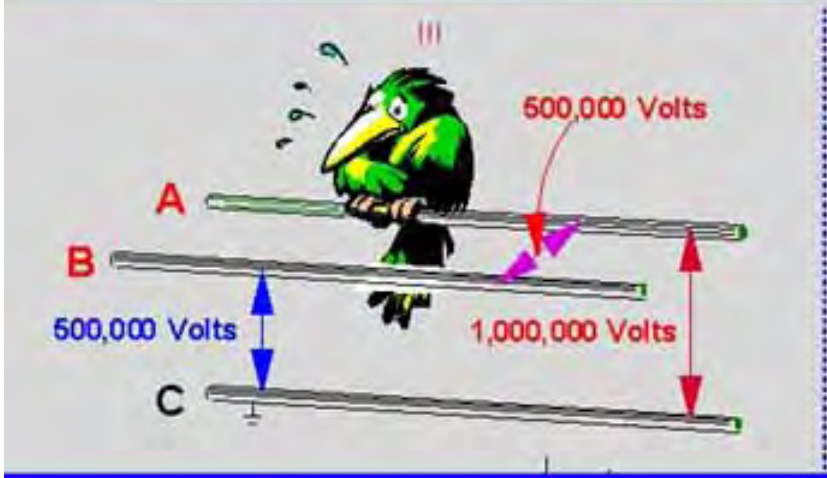

Net Symmetric Regauging Does No Excess Work on the System

This little bird put one foot on wire A, and then the second foot on wire A also. He *net symmetrically* regauged, so he had no net excess force across him, even though his potential energy was increased. He asymmetrically regauged each foot, but both simultaneously so that one countered the other. Wise little bird!

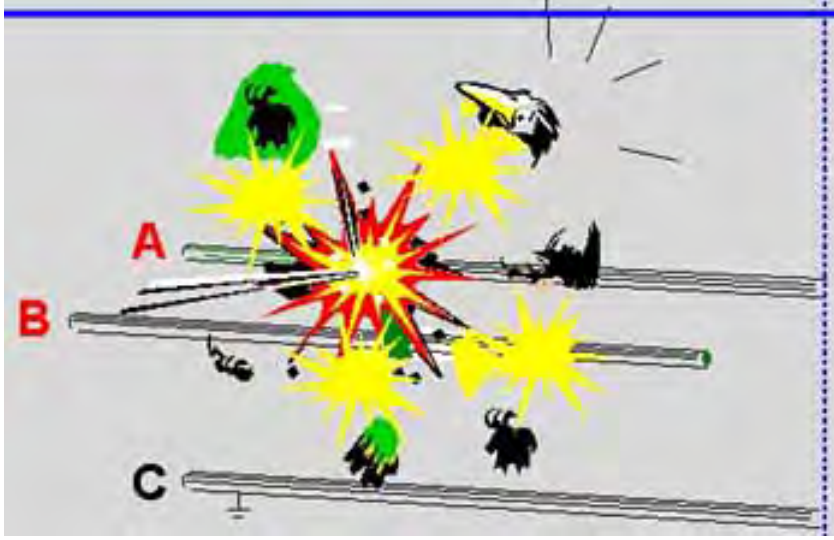

Net Asymmetric Regauging Can Do Excess Work on the System

This little bird put one foot on wire A, and then the second foot on wire B. He *net asymmetrically* regauged, so he had lots of net excess force across him. That force then violently translated his little body parts every which way, doing lots of work in and on him. Bummer!

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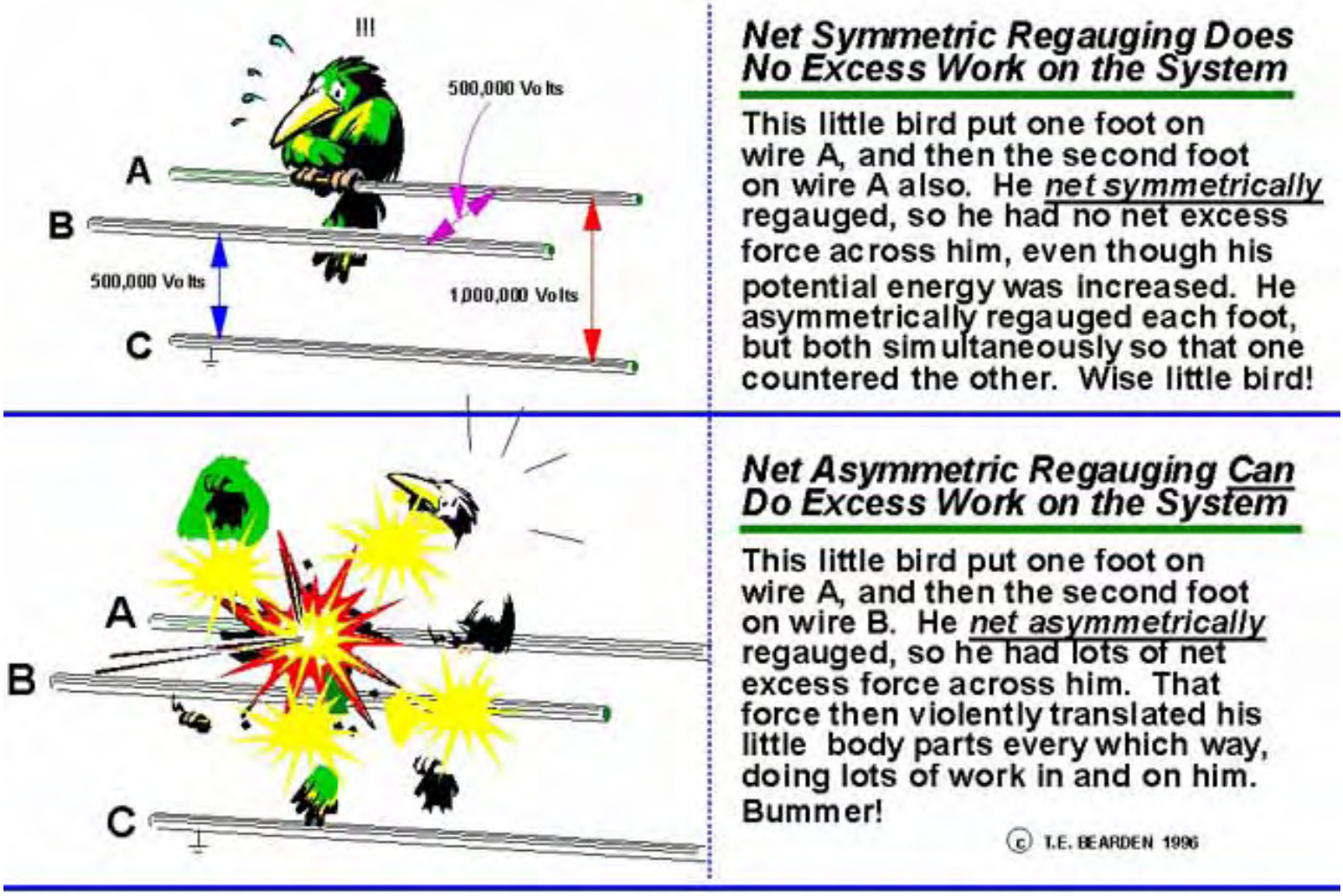

Figure 32. Asymmetric regauging produces excess force, which can be used to do work on the regauging system.

Selected clipart © by Lotus SmartPics™

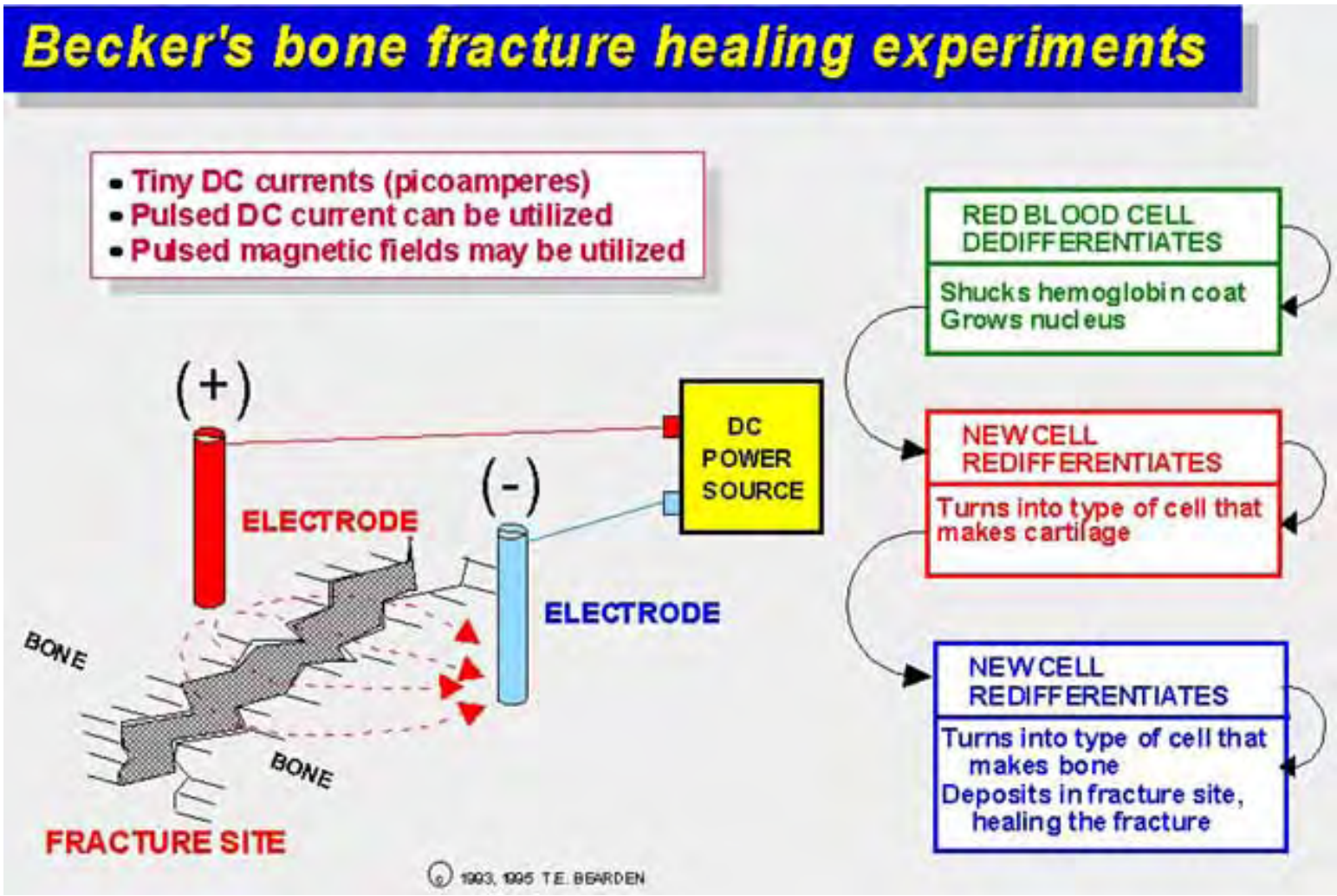
Becker's bone fracture healing experiments
• Tiny DC currents (picoamperes)
• Pulsed DC current can be utilized
• Pulsed magnetic fields may be utilized
(+)
(-)
ELECTRODE
ELECTRODE
DC POWER SOURCE
BONE
BONE
FRACTURE SITE
RED BLOOD CELL DEDIFFERENTIATES
Shucks hemoglobin coat
Grows nucleus
NEW CELL REDIFFERENTIATES
Turns into type of cell that makes cartilage
NEW CELL REDIFFERENTIATES
Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture
© 1993, 1995 T.E. BEARDEN

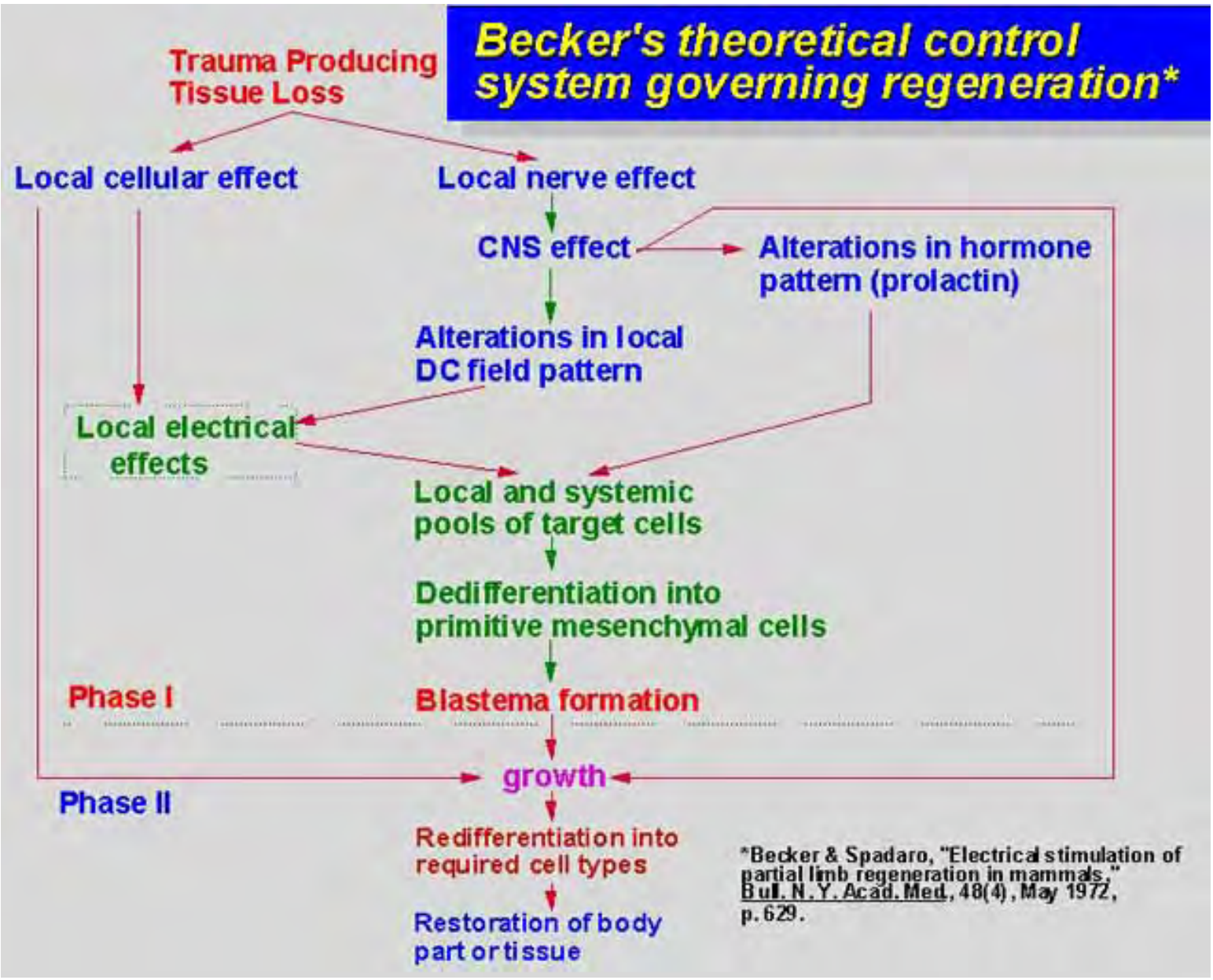
Becker's theoretical control system governing regeneration*
Trauma Producing Tissue Loss
Local cellular effect
Local nerve effect
CNS effect
Alterations in hormone pattern (prolactin)
Alterations in local DC field pattern
Local electrical effects
Local and systemic pools of target cells
Dedifferentiation into primitive mesenchymal cells
Phase I
Blastema formation
growth
Phase II
Redifferentiation into required cell types
Restoration of body part or tissue
*Becker & Spadaro, "Electrical stimulation of partial limb regeneration in mammals," Bull. N.Y. Acad. Med., 48(4), May 1972, p. 629.

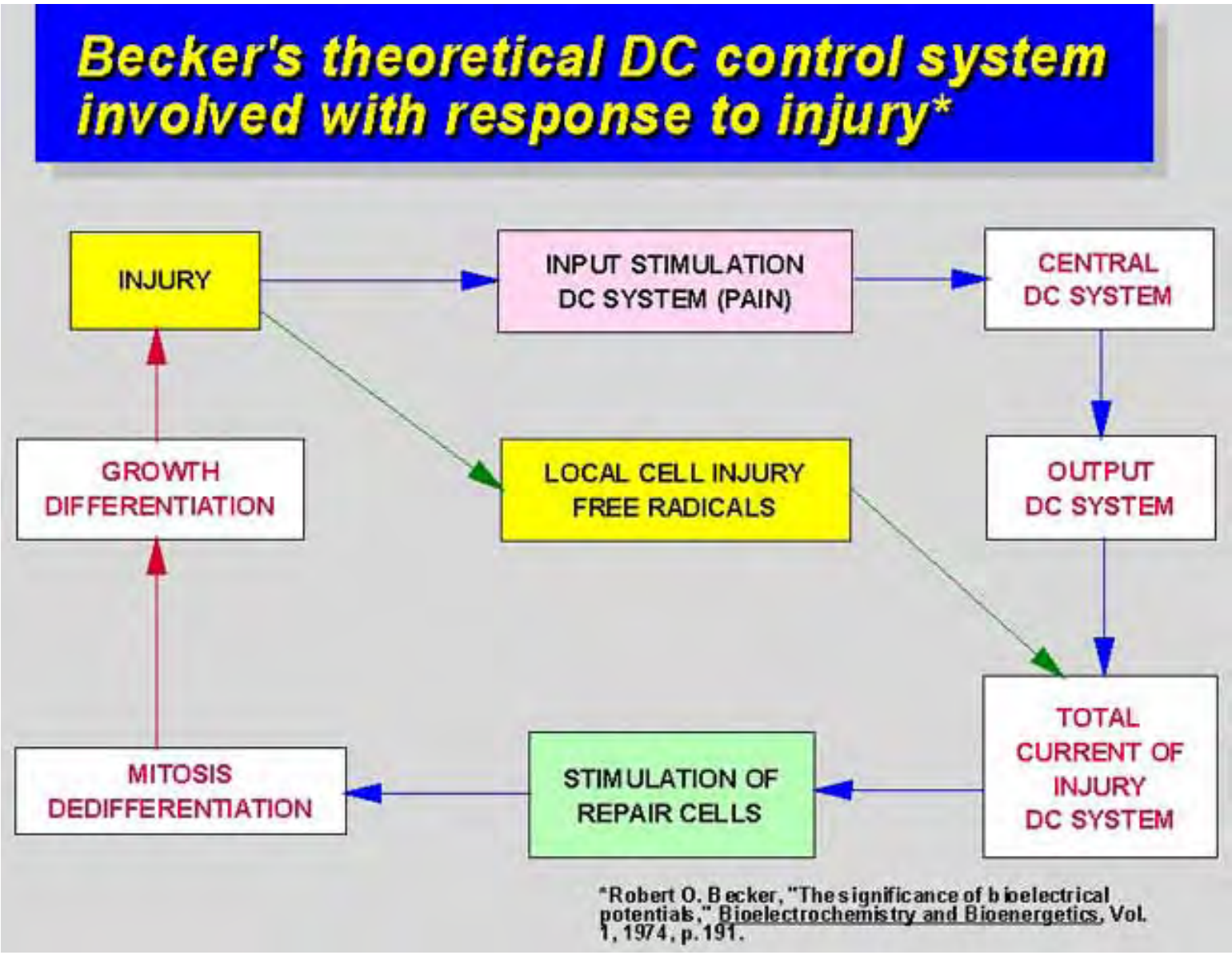
Becker's theoretical DC control system involved with response to injury*
INJURY
INPUT STIMULATION DC SYSTEM (PAIN)
CENTRAL DC SYSTEM
GROWTH DIFFERENTIATION
LOCAL CELL INJURY FREE RADICALS
OUTPUT DC SYSTEM
TOTAL CURRENT OF INJURY DC SYSTEM
MITOSIS DEDIFFERENTIATION
STIMULATION OF REPAIR CELLS
*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

Geometrical Distortion of Poynting Energy Flow

At or near resonance frequency, in the case shown the energy collection fraction (reaction cross section) increases dramatically.

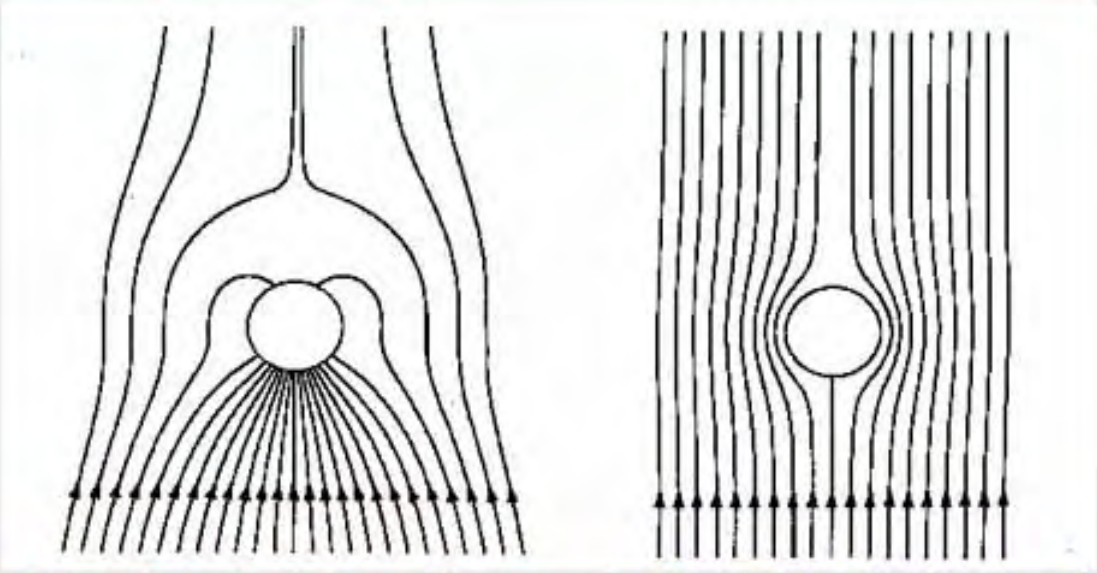

a. Around an aluminum sphere at light energy 8.8 eV. Absorption efficiency = 18.00.

b. Around an aluminum sphere at light energy 5eV. Absorption efficiency = 0.1.

Figures per Craig F. Bohren, "How can a particle absorb more than the light incident upon it? ", American Journal of Physics, 51(4), Apr. 1983, p. 326.

Cosmic Bootstrap: Before the Big Bang:

- *Cosmic repulsion behaved like a fluid with negative pressure*
- *The "universe" inflated (expanded) as a "false vacuum"*
- *As the negative-pressure fluid expanded, its energy went up rather than down*
- *When inflation stopped, the false vacuum decayed from its excited state*
- *Its excitation energy was released in a single great burst*

Paul Davies, Superforce, 1984, p. 194

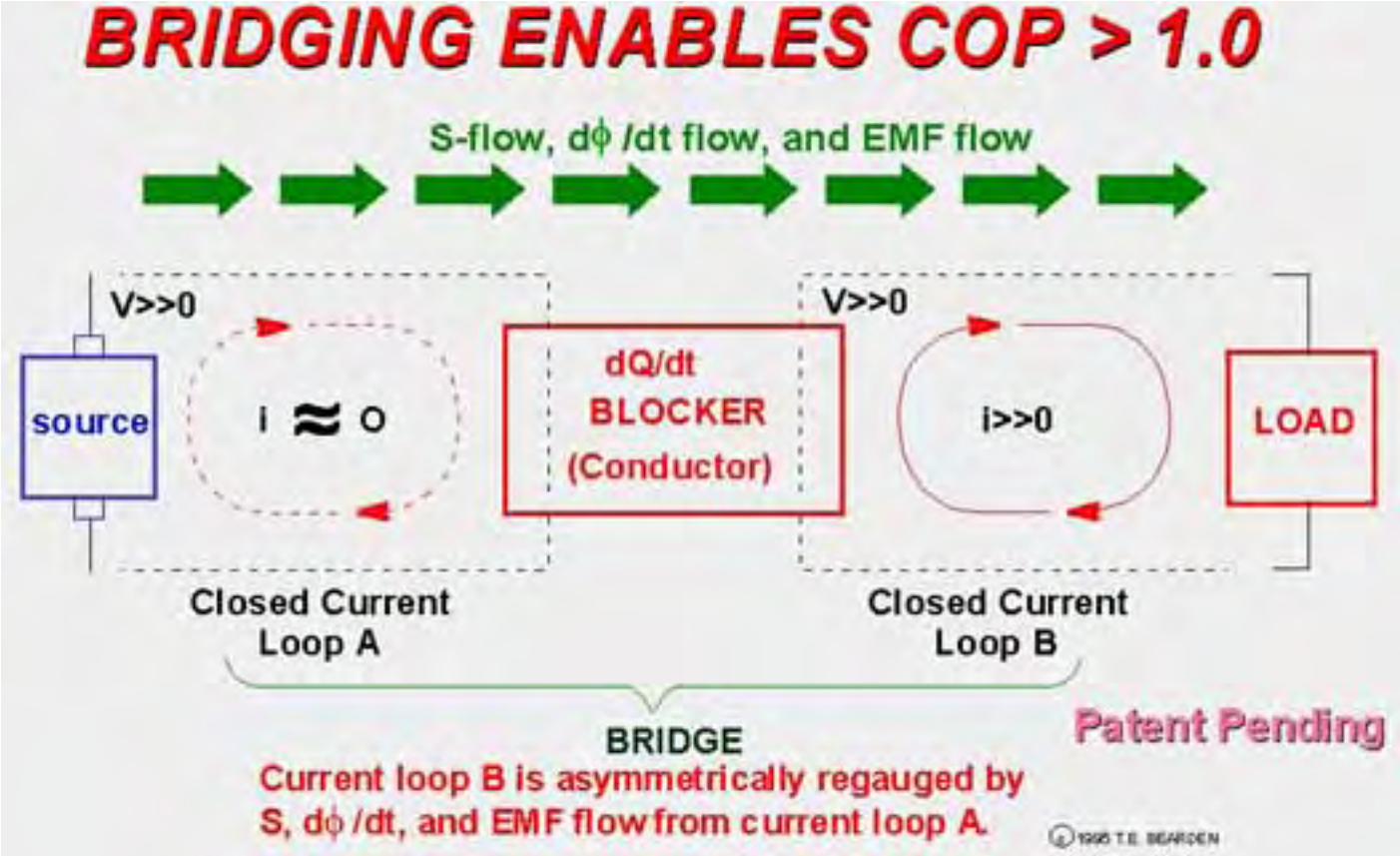
BRIDGING ENABLES COP > 1.0
S-flow, dϕ /dt flow, and EMF flow
V>>0
source
i ≈ 0
dQ/dt
BLOCKER
(Conductor)
V>>0
i>>0
LOAD
Closed Current
Loop A
Closed Current
Loop B
BRIDGE
Patent Pending
Current loop B is asymmetrically regauged by
S, dϕ /dt, and EMF flow from current loop A.
©1995 T.E. BEARDEN

Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum

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- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another
- STRUCTURING THE INFOLDED EM INSIDE POTENTIALS, FIELDS, AND WAVES
  - Strongly breaks local symmetry
  - Provides spacetime engines giving the above effects

Other Aspects of Strong Local Asymmetry

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- Local spacetime is curved
- Lorentz invariance of vacuum is violated
- May be a local "sink" or "source"
- Gravitational-inertial effects from EM
- Translation between virtual and observable
- Electrogravitational solitons
- Action at a distance
- Transmutation effects may exist
- Scalar/pseudoscalar field translation
- COMMENT: Thus the use of infolded longitudinal EM fields and waves to strongly break local symmetry allows internested clustering of spacetime curvatures. These spacetime structures are *vacuum engines*, or *spacetime engines*.

Bunge on the Status of Electrodynamics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state..."

"... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176.

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Bunge on the Status of Electrodynamics and Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state...

"... neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

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*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176.

Bunge on the Status of Classical and Quantum Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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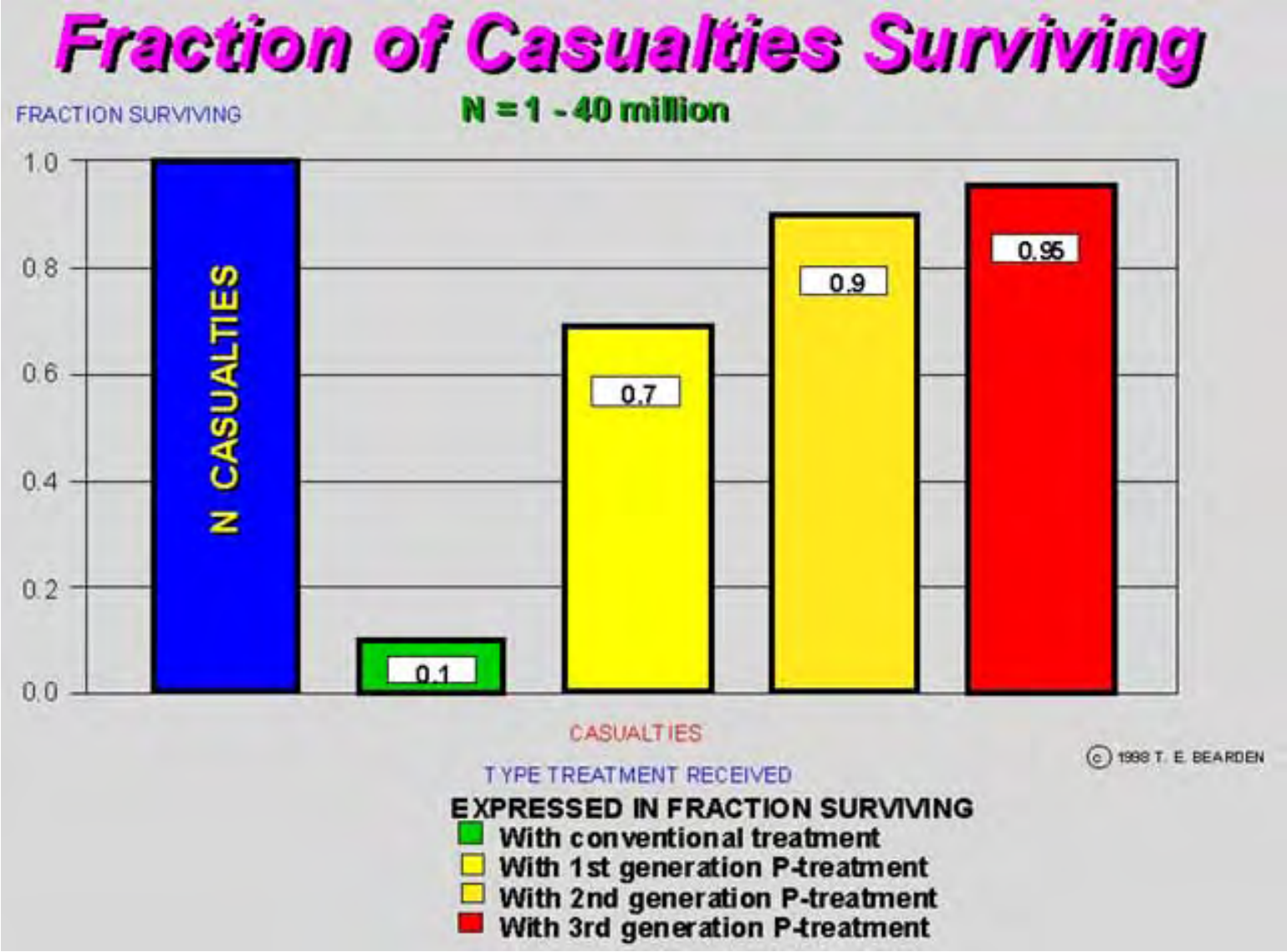
Fraction of Casualties Surviving
FRACTION SURVIVING
N = 1 - 40 million
1.0
0.8
0.6
0.4
0.2
0.0
N CASUALTIES
0.1
0.7
0.9
0.95
CASUALTIES
TYPE TREATMENT RECEIVED
© 1998 T. E. BEARDEN
EXPRESSED IN FRACTION SURVIVING
With conventional treatment
With 1st generation P-treatment
With 2nd generation P-treatment
With 3rd generation P-treatment

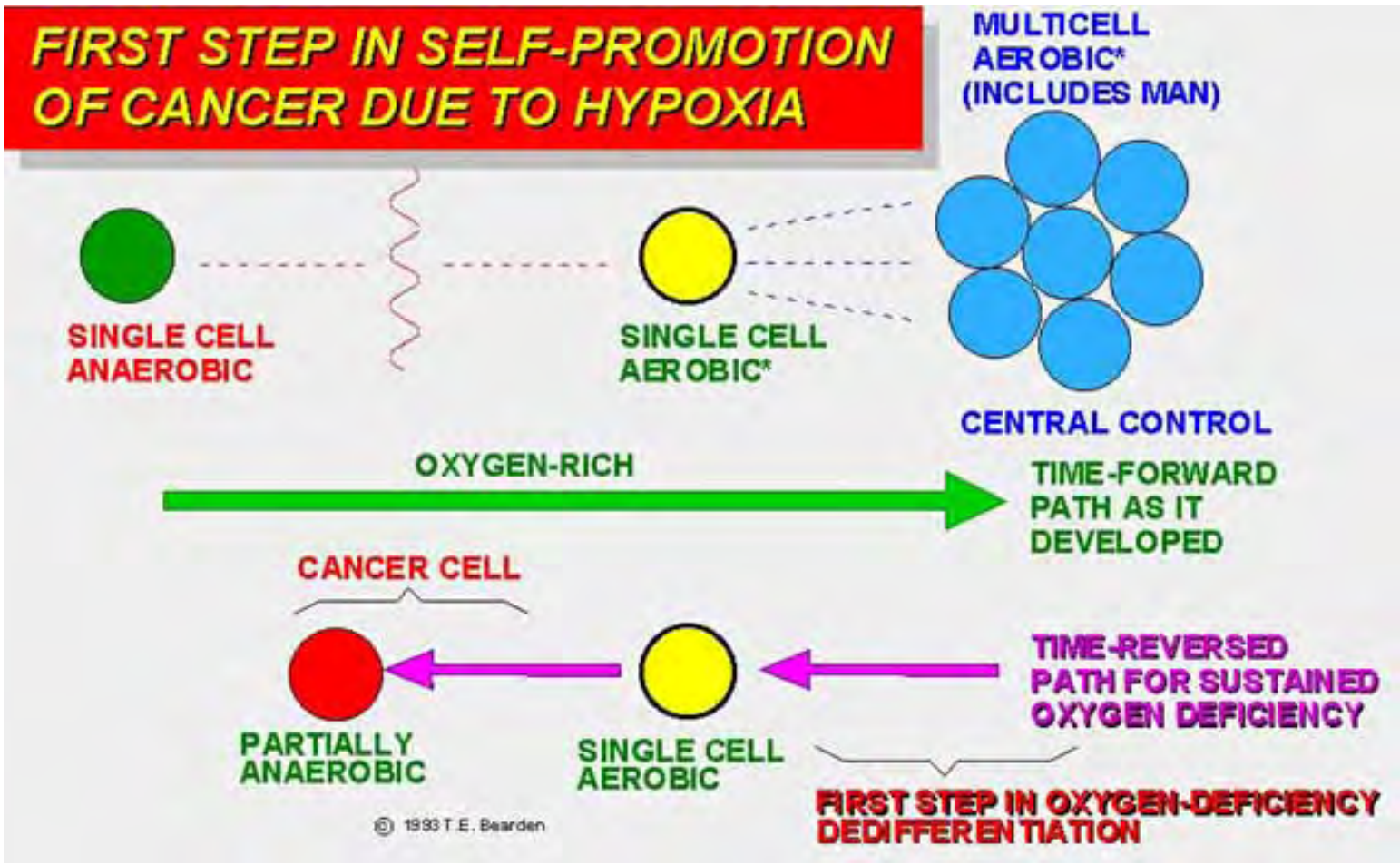
FIRST STEP IN SELF-PROMOTION OF CANCER DUE TO HYPOXIA
MULTICELL AEROBIC* (INCLUDES MAN)
SINGLE CELL ANAEROBIC
SINGLE CELL AEROBIC*
CENTRAL CONTROL
OXYGEN-RICH
TIME-FORWARD PATH AS IT DEVELOPED
CANCER CELL
TIME-REVERSED PATH FOR SUSTAINED OXYGEN DEFICIENCY
PARTIALLY ANAEROBIC
SINGLE CELL AEROBIC
FIRST STEP IN OXYGEN-DEFICIENCY DEDIFFERENTIATION
© 1993 T.E. Bearden

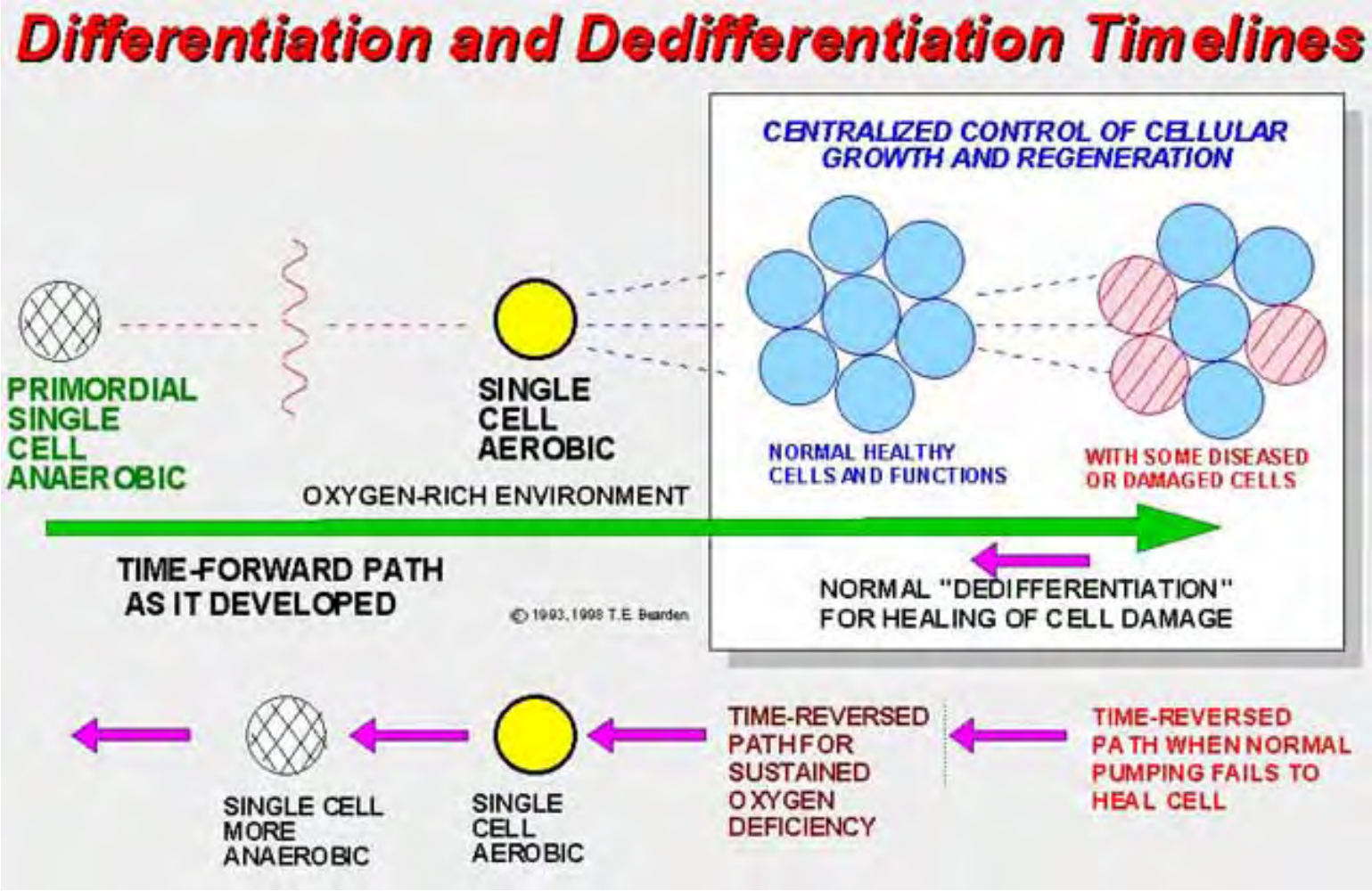
Differentiation and Dedifferentiation Timelines
CENTRALIZED CONTROL OF CELLULAR GROWTH AND REGENERATION
PRIMORDIAL SINGLE CELL ANAEROBIC
SINGLE CELL AEROBIC
OXYGEN-RICH ENVIRONMENT
NORMAL HEALTHY CELLS AND FUNCTIONS
WITH SOME DISEASED OR DAMAGED CELLS
TIME-FORWARD PATH AS IT DEVELOPED
© 1993, 1998 T.E. Bearden
NORMAL "DEDIFFERENTIATION" FOR HEALING OF CELL DAMAGE
SINGLE CELL MORE ANAEROBIC
SINGLE CELL AEROBIC
TIME-REVERSED PATH FOR SUSTAINED OXYGEN DEFICIENCY
TIME-REVERSED PATH WHEN NORMAL PUMPING FAILS TO HEAL CELL

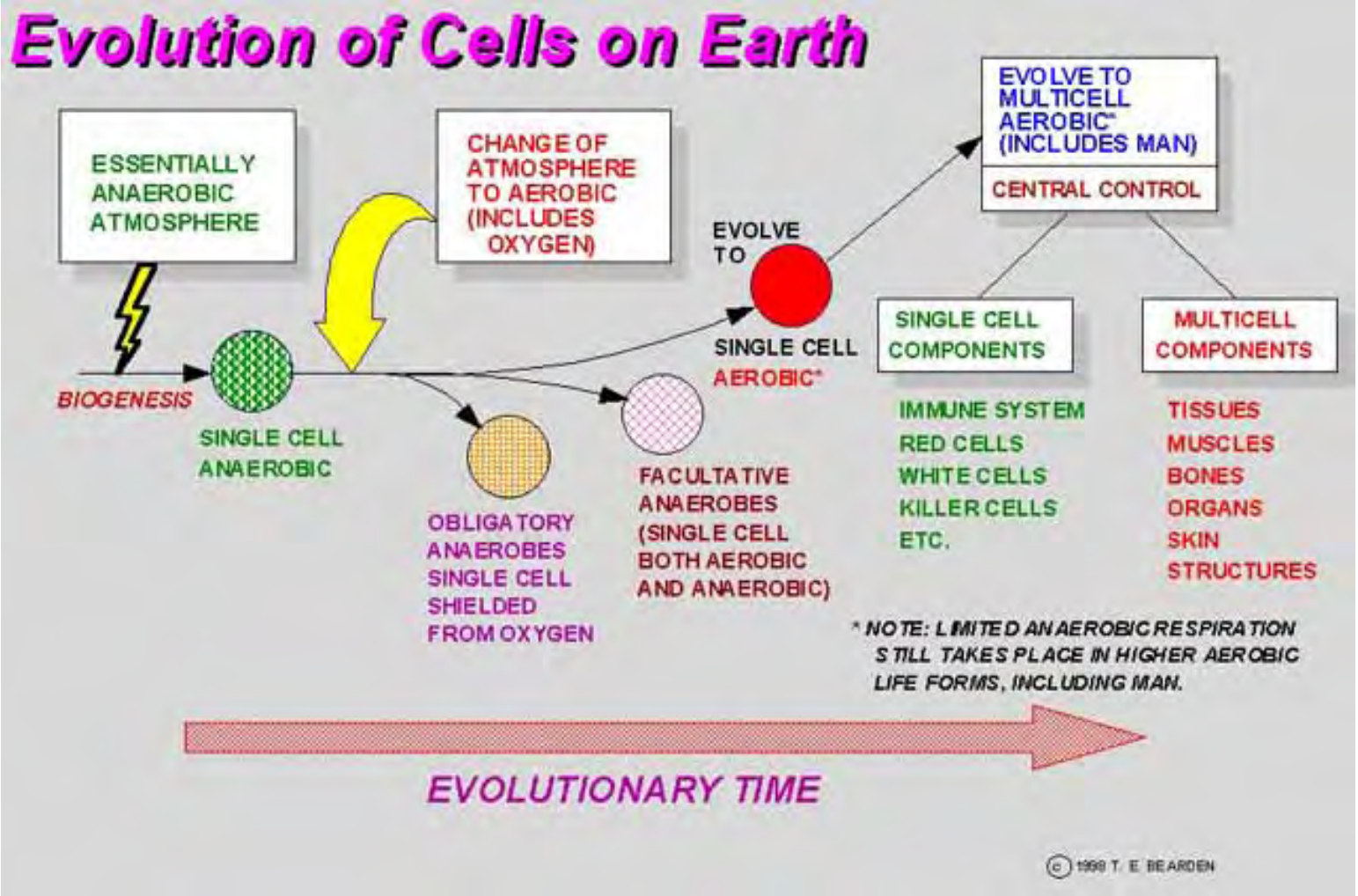
Evolution of Cells on Earth
ESSENTIALLY ANAEROBIC ATMOSPHERE
CHANGE OF ATMOSPHERE TO AEROBIC (INCLUDES OXYGEN)
EVOLVE TO MULTICELL AEROBIC* (INCLUDES MAN)
CENTRAL CONTROL
EVOLVE TO
SINGLE CELL AEROBIC*
SINGLE CELL COMPONENTS
MULTICELL COMPONENTS
BIOGENESIS
SINGLE CELL ANAEROBIC
OBLIGATORY ANAEROBES SINGLE CELL SHIELDED FROM OXYGEN
FACULTATIVE ANAEROBES (SINGLE CELL BOTH AEROBIC AND ANAEROBIC)
IMMUNE SYSTEM
RED CELLS
WHITE CELLS
KILLER CELLS
ETC.
TISSUES
MUSCLES
BONES
ORGANS
SKIN
STRUCTURES
* NOTE: LIMITED ANAEROBIC RESPIRATION STILL TAKES PLACE IN HIGHER AEROBIC LIFE FORMS, INCLUDING MAN.
EVOLUTIONARY TIME
© 1999 T. E. BEARDEN

A Charged Particle q Is a Coupled System of m and ϕ

(A proposed formal definition of a charged mass)

Note: X is a coupling operator

$$q \equiv f_q \times m_q$$

Also note that the ϕ portion of the charged particle can be internally structured, per Stoney-Whittaker-Ziolkowski, with hidden bidirectional EM wavepairs (their sums and products). Note that this constitutes an EM application of Bohm-type hidden variable theory, with many ramifications.

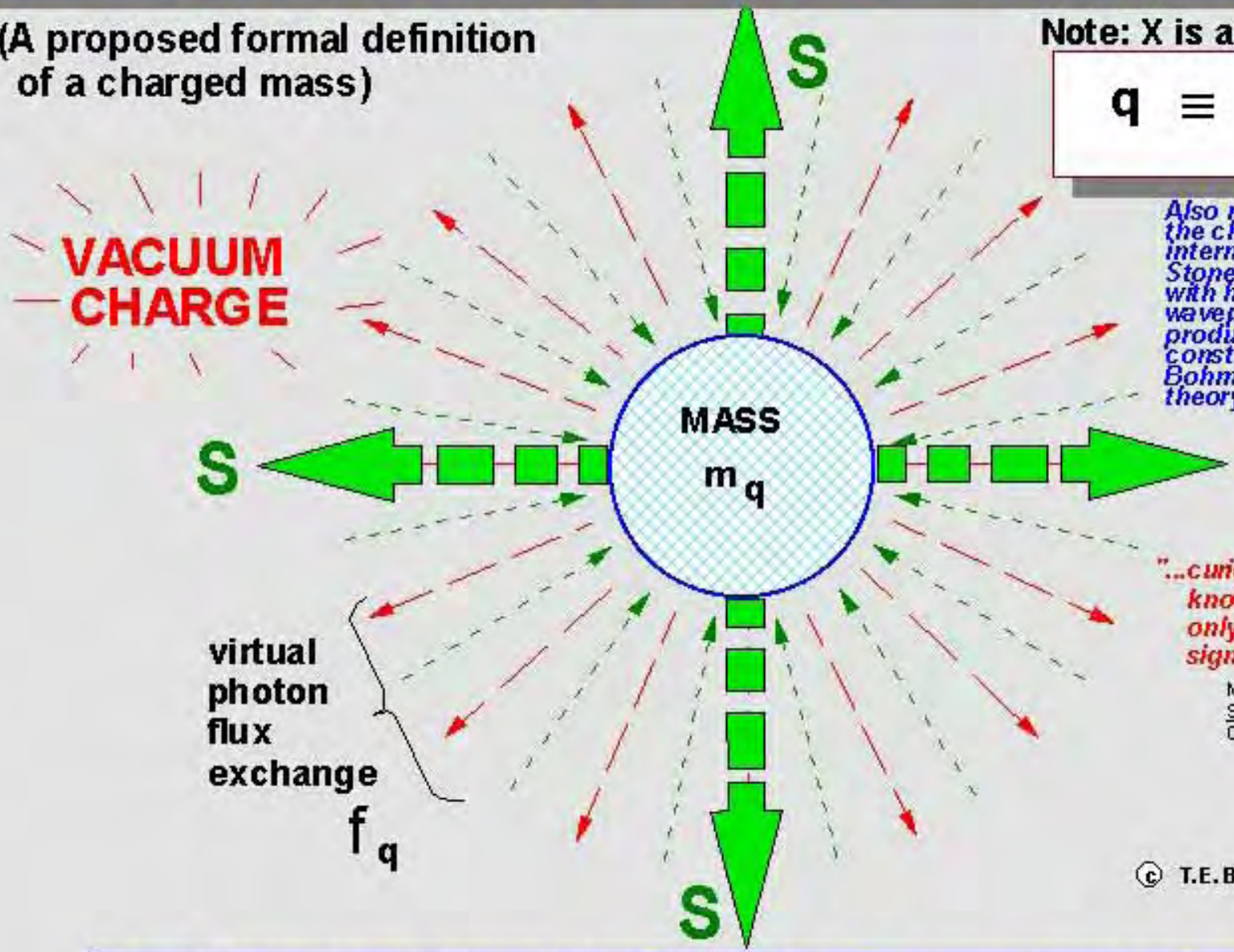

S = EXH

"...curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."

M.P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, 1993, p. 127.

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An electric charge Q consists of a massless flux component and a mass component, coupled together (interacting). Q is a broken symmetry. The mass of the charge continually and violently exchanges virtual photons with the surrounding vacuum.

Thus Q is energetically driven by the surrounding vacuum potential, which itself is to first order just a violent virtual photon flux.

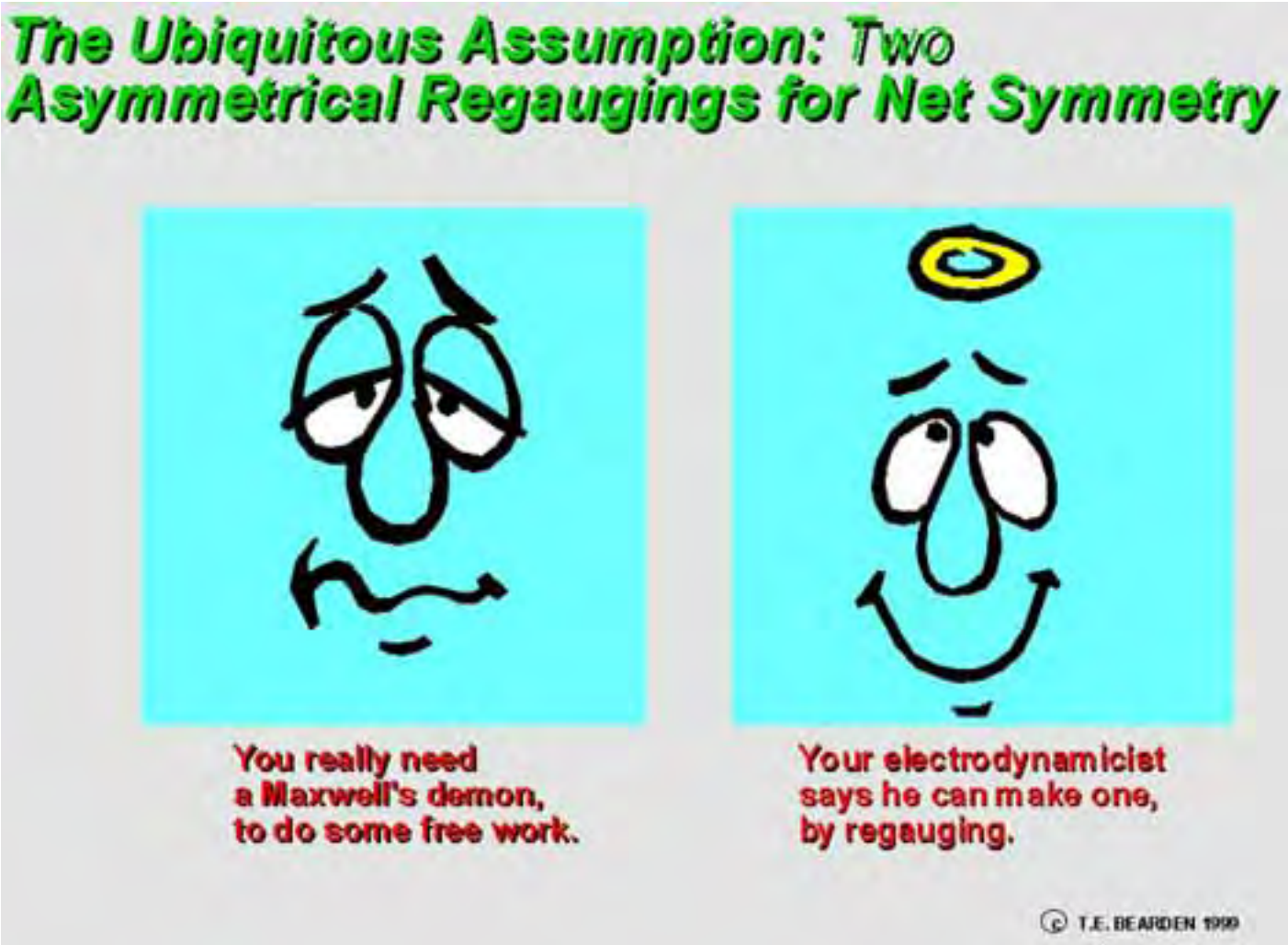
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
You really need a Maxwell's demon, to do some free work.
Your electrodynamicist says he can make one, by regauging.
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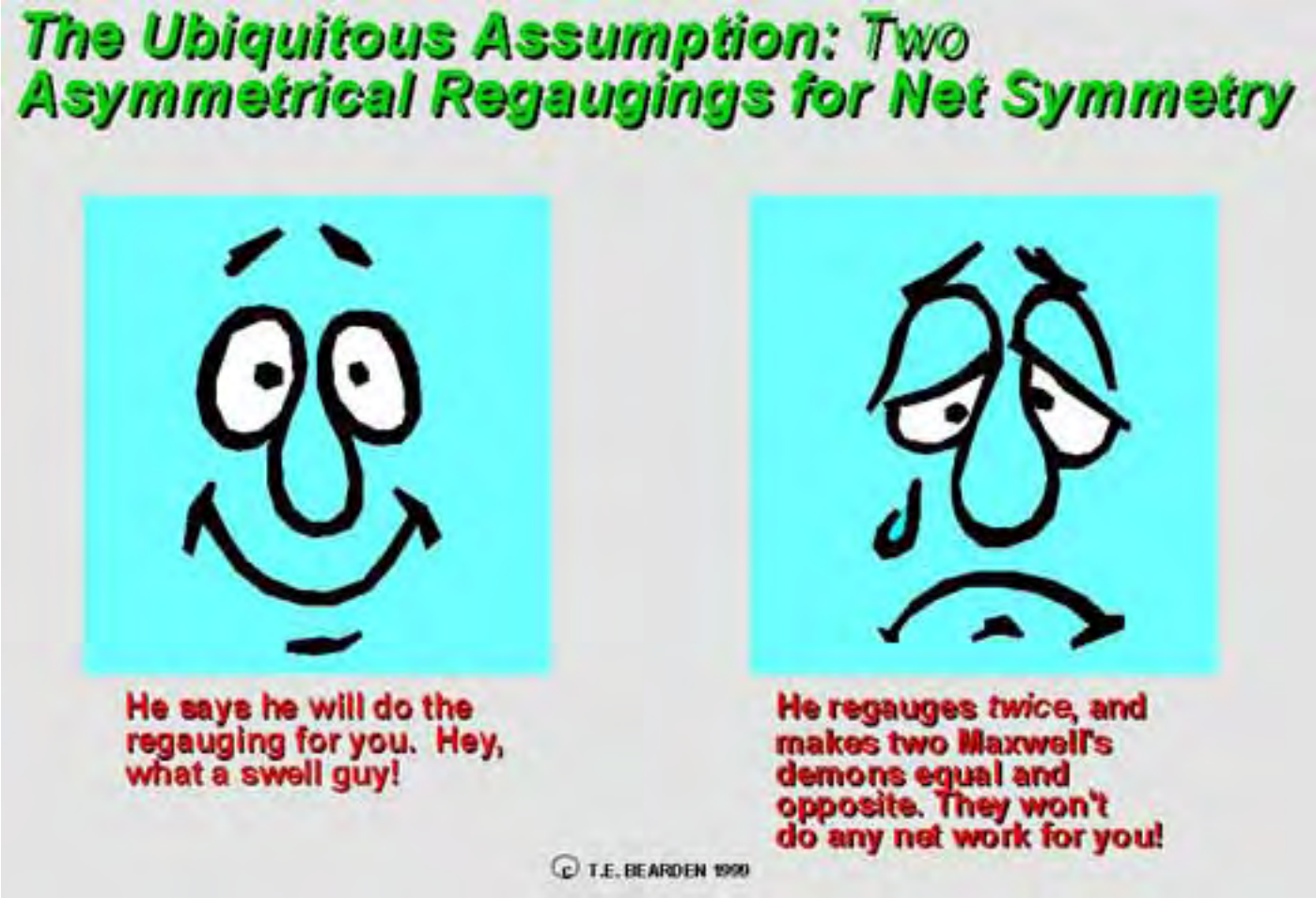
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
He says he will do the regauging for you. Hey, what a swell guy!
He regauges twice, and makes two Maxwell's demons equal and opposite. They won't do any net work for you!
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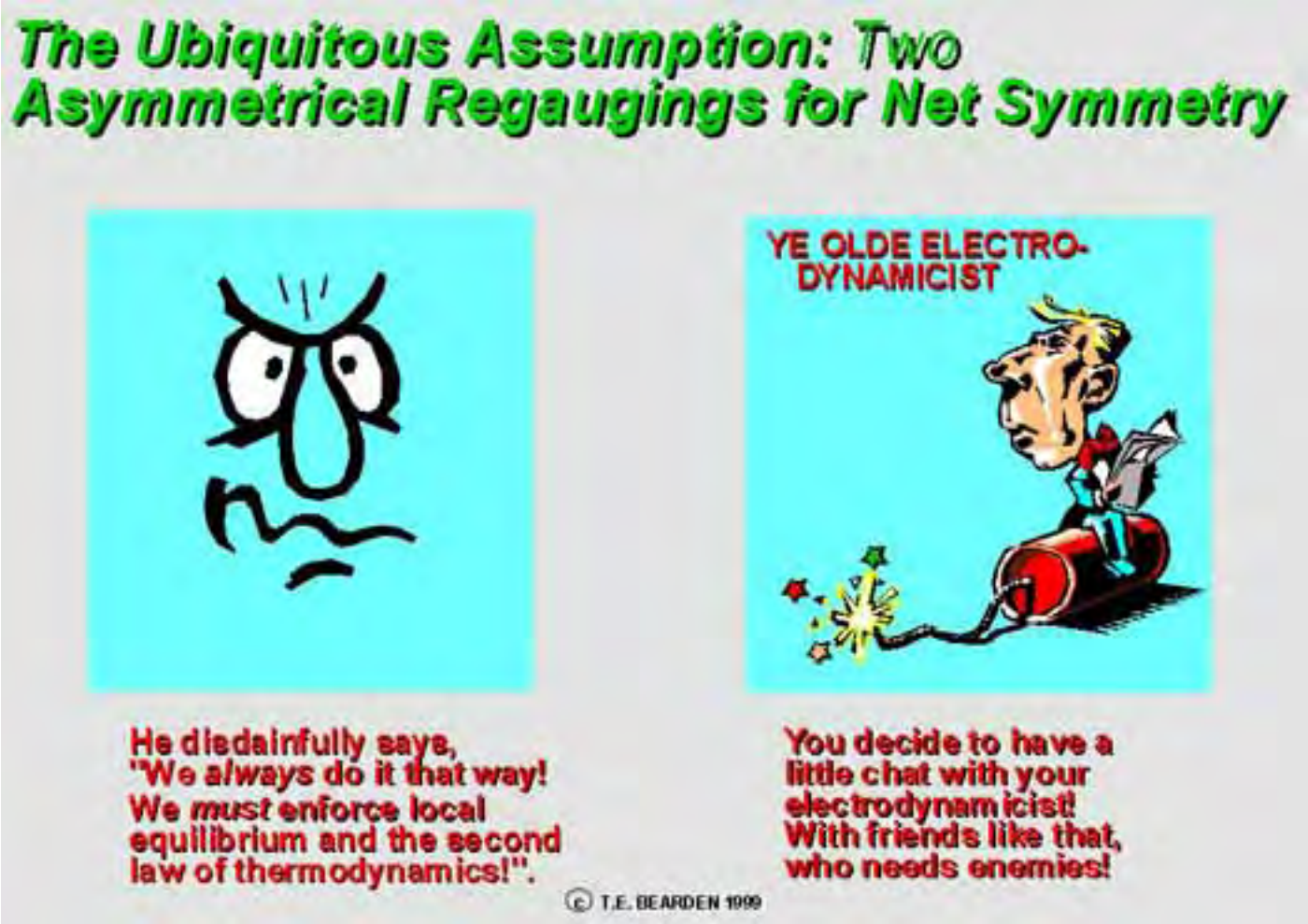
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
YE OLDE ELECTRO-DYNAMICIST
He disdainfully says, "We always do it that way! We must enforce local equilibrium and the second law of thermodynamics!".
You decide to have a little chat with your electrodynamicist! With friends like that, who needs enemies!
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A Charged Particle Is a Coupled System

(The first formal definition of charge)

$$q \equiv \phi_q \times m_q$$

Note: X is a coupling operator

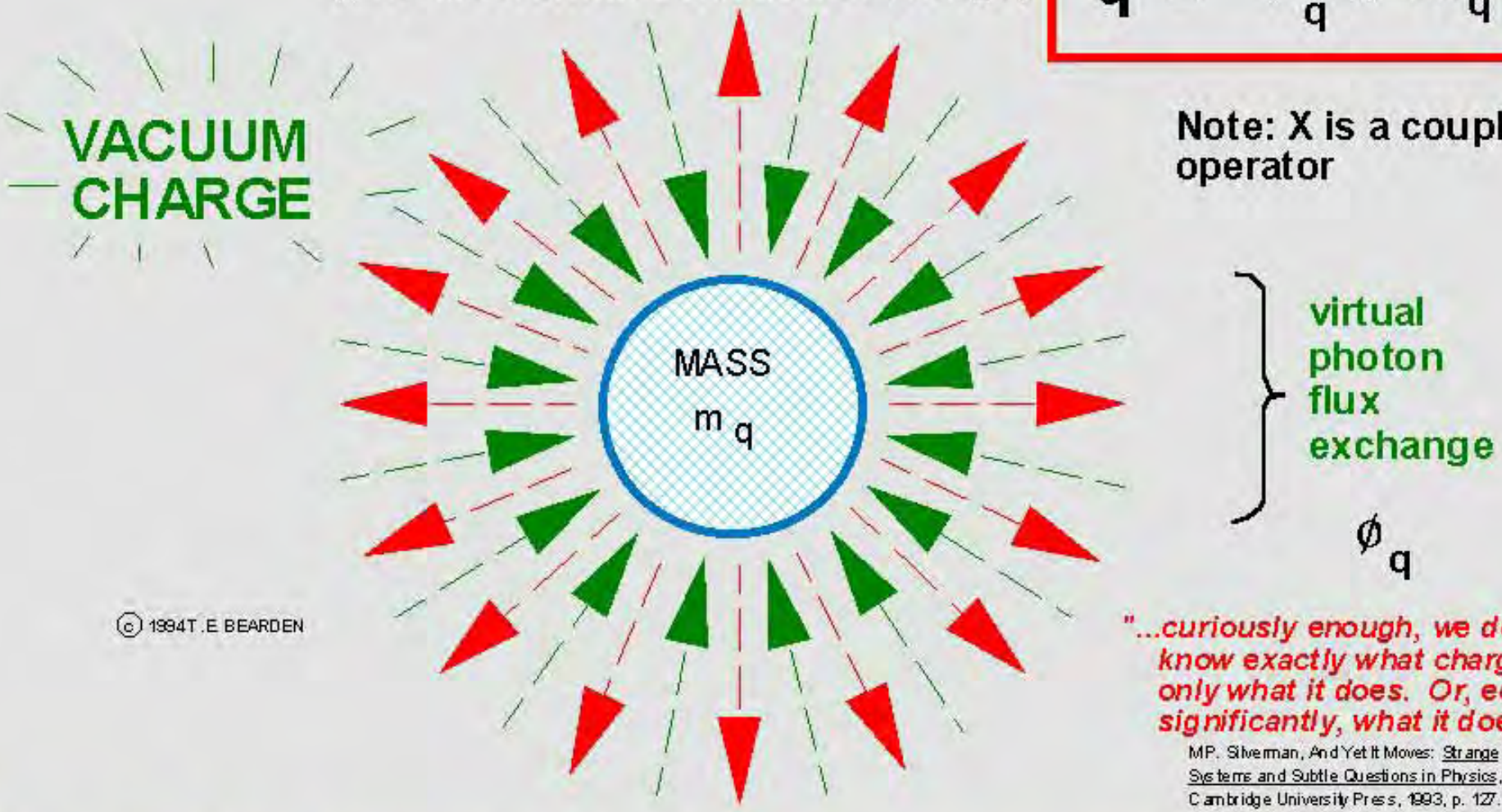

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"...curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."

M.P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, 1993, p. 127.

An electric charge q is a broken symmetry in its fierce energy exchange with the active vacuum. It coherently integrates some of the virtual energy absorbs and outputs it as Poynting energy flow.

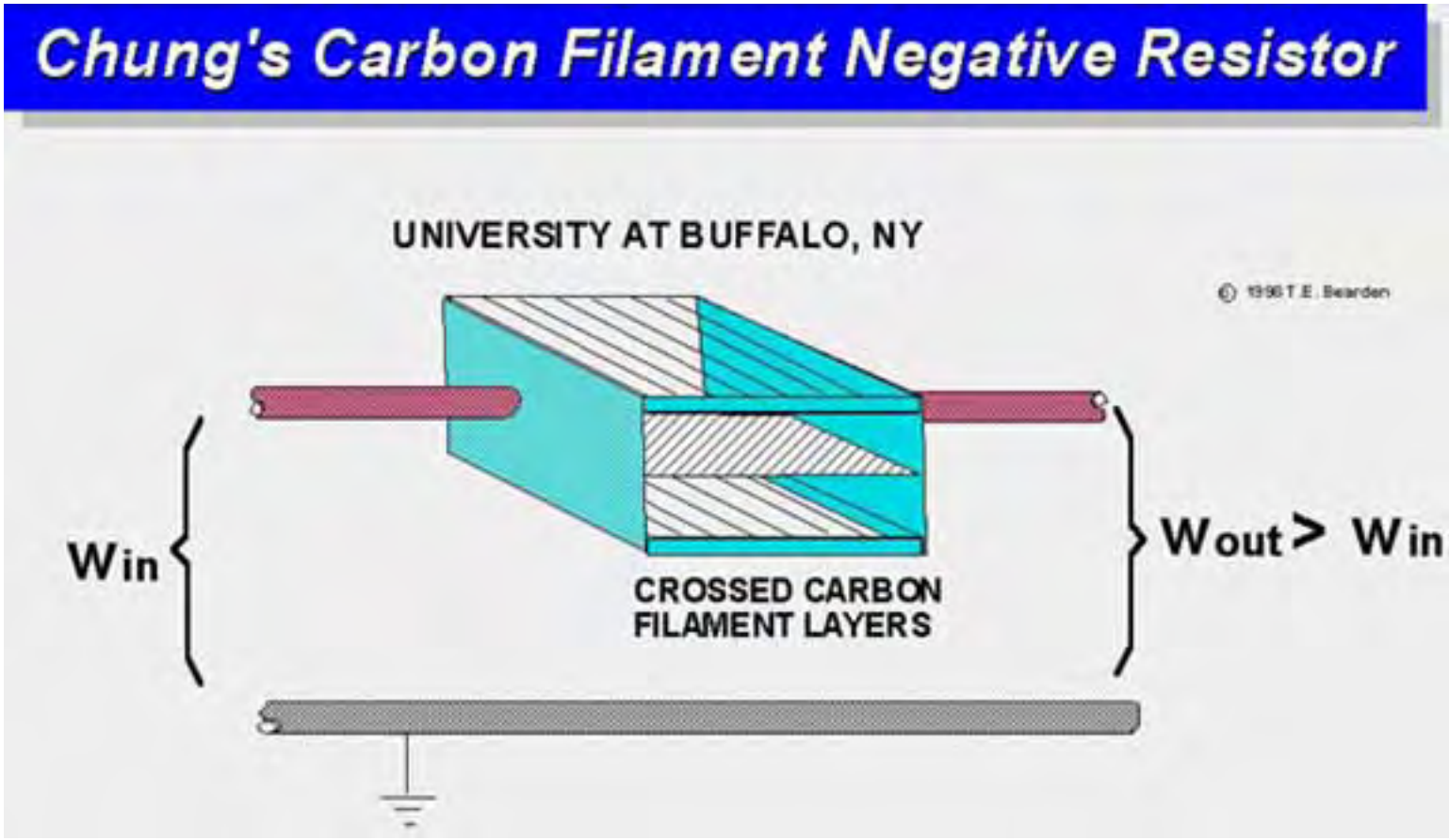
Chung's Carbon Filament Negative Resistor
UNIVERSITY AT BUFFALO, NY
© 1996 T.E. Bearden
Win
Wout > Win
CROSSED CARBON
FILAMENT LAYERS

Typical circuit has about 10^{-13} energy collection efficiency

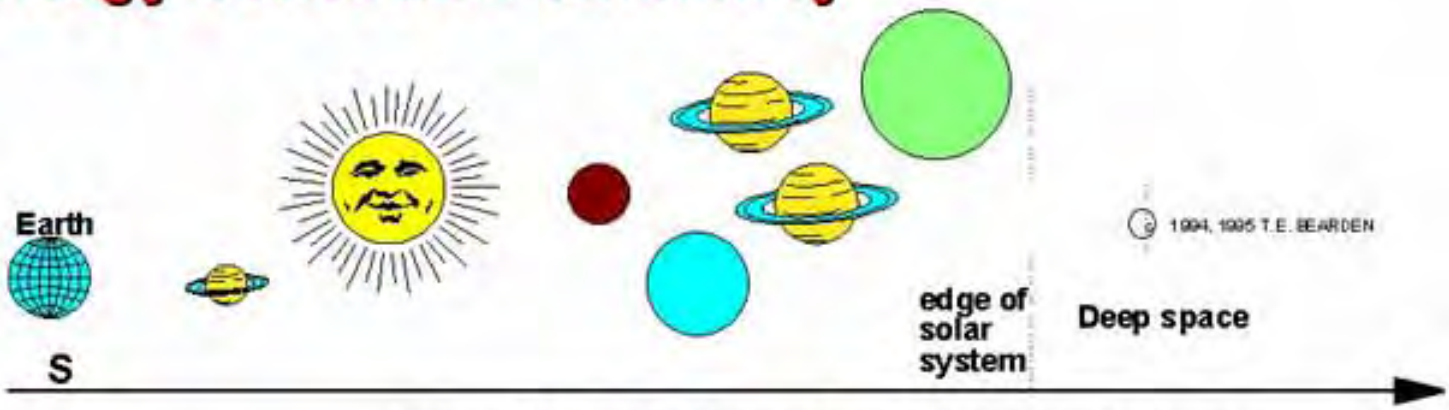

Distance traveled by S in one hour is 1.08x10exp(12) meters.

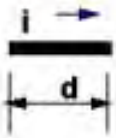

Example: 1.3 amps flowing in DC circuit, 1.8 mm diameter copper wire. J = 51 A/cm ^{2}

d_j = 0.1368 meters

S violently transports ϕ provided from the source.
j ϕ sluggishly transports the energy collected and dissipated in the circuit..

For the case discussed, the electron drift velocity in the circuit is about 3.8 x 10^{-5} meters/sec. So Jϕ moves about 0.1368 meters in one hour. Thus Jϕ has collected about 0.1368 meters of the ϕ-filled S-tube. During that same hour, the S-flow evoked by the power source will have traveled 1.08x10^{12} meters. The ϕ of both currents is the same. Both are involved in the same energy-filled tube. Thus S has provided and transported about 7.89x10^{12} times as much energy along the circuit in one hour as the jϕ has been able to collect, transport, and dissipate as work in the circuit. Thus this circuit provides about 10^{13} collection efficiency.

Classical View of EM

- Potentials just mathematical conveniences
  - Not real
  - No internal structure, just magnitude
- Force fields primary, causative, can exist in space in absence of observable mass
  - All EM actions due to force fields, none when zero
  - No action at a distance
- Vacuum empty; without energy or structure
  - No locally curved spacetime
  - No gravity effects
  - No quantum effects
- Maxwell's equations complete
  - Symmetrically regauged ***arbitrarily***
  - Topology dramatically reduced

Curved Spacetime acts as source or sink

- May emit excess radiation and energy (e.g., heat)
- May absorb radiation and energy (e.g., cool)
- May transduce waves TW ⇔ LW ⇔ TDW
- New energy conservation law applies

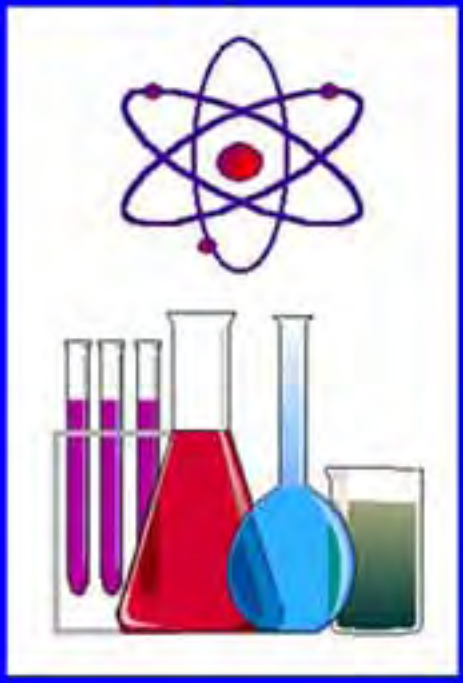

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CHRONIC DISEASE PUZZLING

- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
- MANY TROUBLING FACTORS EXIST
  - *MIND*
  - *STRESS*
  - *SPONTANEOUS REMISSION*
  - *PLACEBO EFFECTS*
  - *COMBINATIONS*
- GENERATION OF THE PLACEBO EFFECT BY THE CELLULAR REGENERATION SYSTEM IS UNRECOGNIZED

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Cancer Characteristics

- Not one disease, but a whole range
- Starts in damaged aerobic cell
- Cell shakes off body's central control
  - Starts uncontrolled division
  - Becomes a lump
- Can send forth cancer cells
  - Through blood
  - Through lymph
- Form metastases (secondary tumors)
- Often become anaerobic

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Solving a Cancer Enigma

- An enigma has been failure of immune system to attack some tumor cells
  - Suppressor cells may curb immune system?
  - Tumor may lack antigens normally identified by the immune system?
- *Promotion of damaged cell to cancer is usually ordered by cellular control system*
  - *Regenerative and recovery system forces cell back toward anaerobe*
  - *First step breaks free from central growth*
  - *Control continues to recognize cell as self*

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CANCER: CHARACTERISTICS

- NOT ONE DISEASE BUT A WHOLE RANGE
- STARTS IN ORDINARY (AEROBIC) CELL
- CELL SHAKES OFF BODY'S DICTATORIAL CONTROL*
- STARTS UNCONTROLLED DIVISION
- BECOMES A LUMP
- CAN SEND FORTH CANCER CELLS
  - THROUGH BLOOD
  - THROUGH LYMPH
- THESE FORM METASTASES (SECONDARY TUMORS)
- OFTEN BECOME ANAEROBIC (NON-OXYGEN USING)
- ENIGMA IS FAILURE OF IMMUNE SYSTEM TO ATTACK SOME TUMOR CELLS
  - SUPPRESSOR CELLS MAY CURB IMMUNE SYSTEM
  - TUMOR MAY LACK ANTIGENS NORMALLY IDENTIFIED BY THE IMMUNE SYSTEM

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*R&R system forces cell back toward anaerobe

Nonlinear Optics
Distortion Correction Theorem

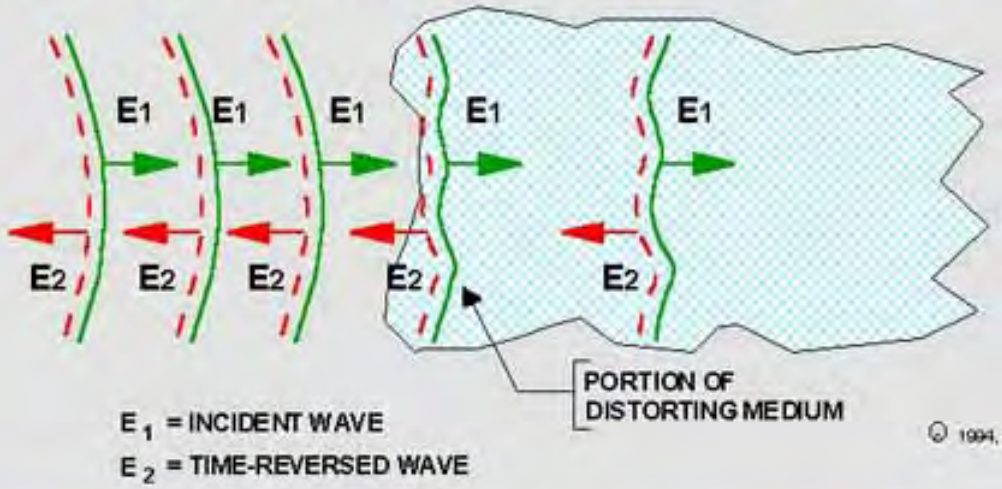

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"If a scalar wave $E_1(r)$ propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica $E_2(r)$, then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1."

The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)

- Nucleon interchange
  - Changes neutron into proton and vice versa
  - At high rate (flat spacetime assumed)
- Statistics become skewed due to curved ST
- Can bias statistics toward either neutron or proton end
  - Biases toward transmutation of elements along isomer chains
  - Concept of "isomer" is vastly expanded

The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)

- **Normal dynamics (impulses) may reverse**
  - *Like charges attract, unlike charges repel*
  - *Positive charges cluster (are drawn together)*
  - *H+ ions (protons) may form quasi-nuclei*
  - *Nucleus coulomb barrier becomes assistant*
- **Many "impossible" reactions now possible**
  - *Quark access and quark flipping by EM*
  - *Ion clustering*
  - *Positive charges as phase conjugate mirrors*
  - *Time-density waves and time-energy charging*

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The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)

- **Not observed until time-energy charging has become substantial**
  - *Time delay (hours, days)*
  - *Transduction of LW --> TW involved*
  - *Specific time-charging history of detectors is involved in twhether they detect or not*
  - *Longitudinal EM waves become significant*
- **Curved spacetime can act as source or sink**
  - *May emit excess radiation*
  - *May absorb excess radiation*

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In Time-Reversed Zone:
Nuclear reactions are biased

- In normal flat ST, n ⇔ p at high rate
- Curved ST skews statistics
- Biases to either n or p
- Biases to transmutation along isomer chain
- "Isomer" concept greatly expanded

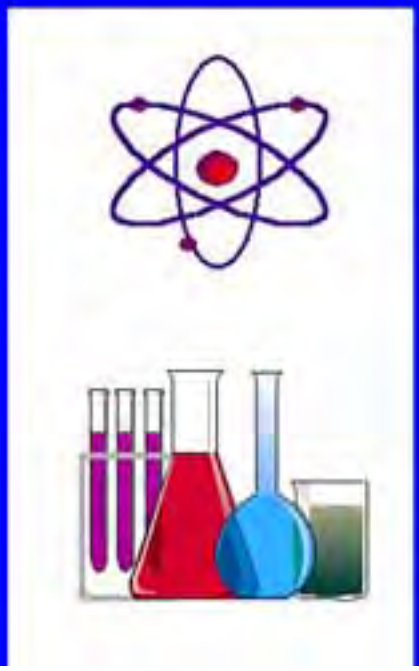

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In Time-Reversed Zone: Dynamics may be reversed

- Like charges may attract and unlike charges repel
- Coulomb barrier becomes Coulomb assistant
- Clusters like charges and forms artificial nuclei
- "Impossible" nuclear reactions at low energy
- Time-density interactions

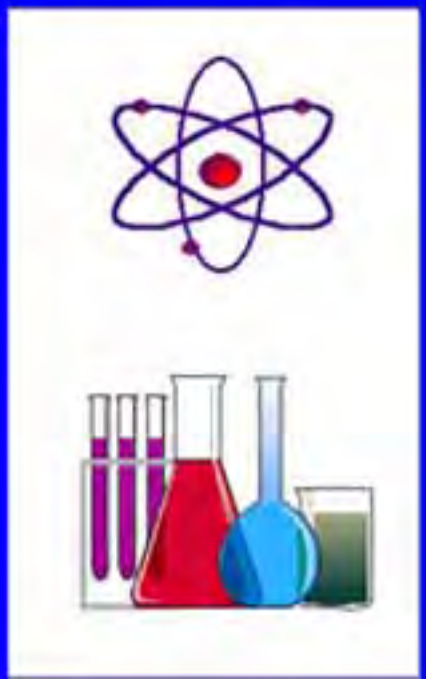

Time-Reversed Zone:

Significant only after time-density charging

- Hours, for "fast" onset
- Days, for "slower" onset
- Transduction involved for TW ⇔ LW ⇔ TDW
- Time-history of each detector is significant
- Longitudinal EM waves become significant

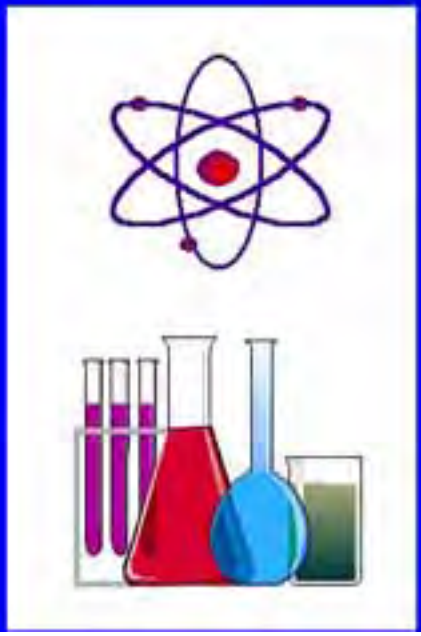

A New Conservation of Energy Law

- Physics conserves total "energy and mass-energy"
- Now also must consider "time-energy"
- Conserve total mass-time-energy (spatiotemporal energy)
- Let E_T = total energy, E_M = mass energy, E_E = ordinary energy, and E_t = time energy. Then

$$E_T = E_E + E_M + E_t$$

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$$(kE_t \Rightarrow E_E > 0) \Rightarrow E_T > (E_M + E_E)$$

- If some E_t is transduced into E_E, the experiment will violate the old spatial mass-energy conservation law

QUESTIONS ON CARCINOGENS AND EM RADIATION

- UNRESOLVED QUESTIONS ON EM RADIATION
  - DOSAGES
  - ACTIVE MECHANISMS
  - REPLICATION DIFFICULTIES
  - MEASUREMENT DIFFICULTIES
  - WHERE, WHEN, HOW ILL EFFECTS OCCUR
- SIMILAR QUESTIONS EXIST ABOUT EVERY CARCINOGEN
- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
  - FACTORS SUCH AS MIND, STRESS, SPONTANEOUS REMISSION, PLACEBO EFFECTS, AND COMBINATIONS OF FACTORS ARE PARTICULARLY TROUBLESOME
  - GENERATION OF THE PLACEBO EFFECT BY THE REGENERATION & RECOVERY SYSTEM IS UNRECOGNIZED

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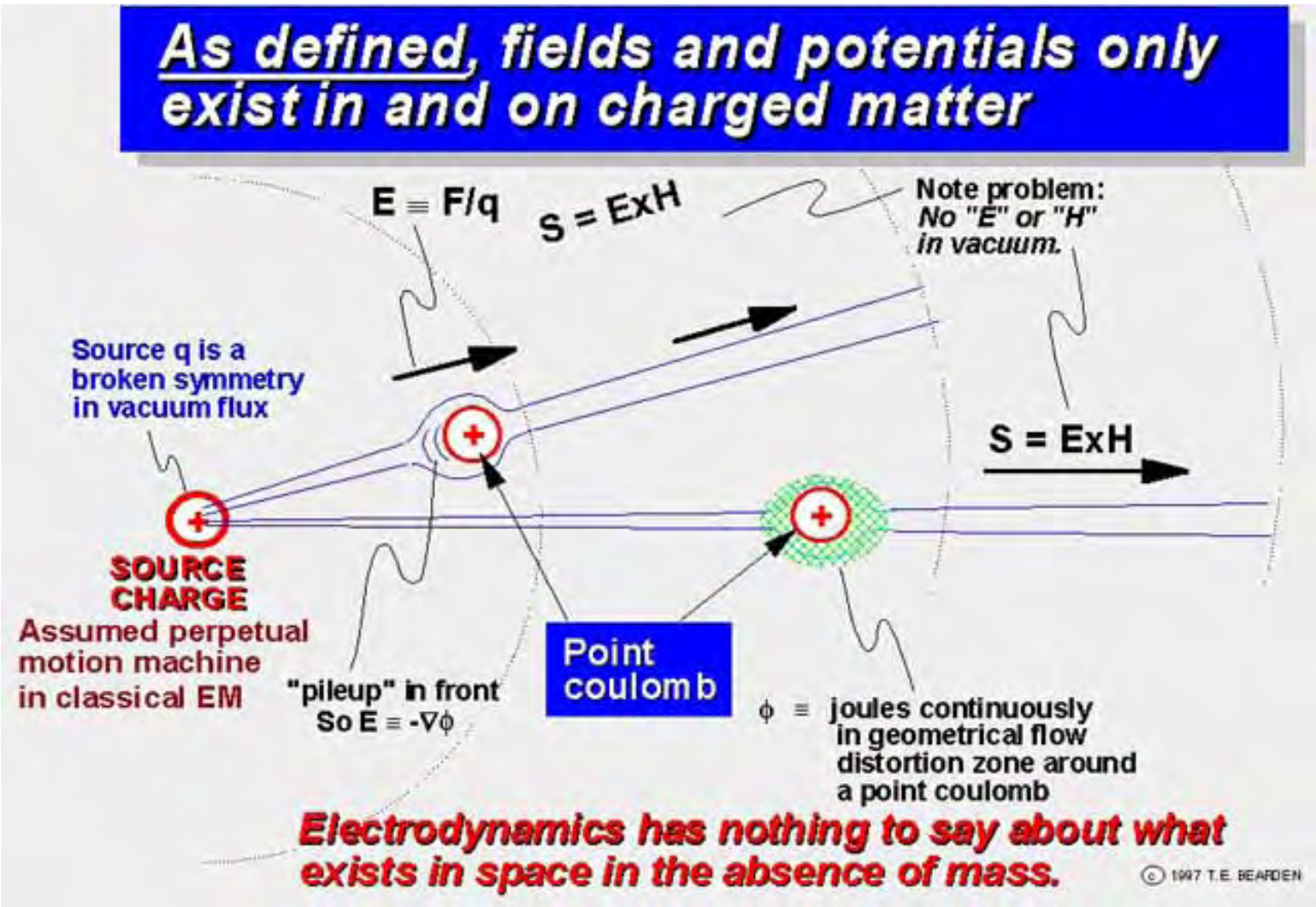
As defined, fields and potentials only exist in and on charged matter
E ≡ F/q
S = ExH
Note problem:
No "E" or "H"
in vacuum.
Source q is a
broken symmetry
in vacuum flux
S = ExH
SOURCE
CHARGE
Assumed perpetual
motion machine
in classical EM
"pileup" in front
So E ≡ -∇ϕ
Point
coulomb
ϕ ≡ joules continuously
in geometrical flow
distortion zone around
a point coulomb
Electrodynamics has nothing to say about what
exists in space in the absence of mass.
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Serious flaws and errors in classical EM theory.

1. Eliminates the Internal EM Inside the Scalar Potential.
2. No Definition of Electrical Charge or of Scalar Potential.
3. Equations Still Assume Material Ether Per Maxwell (Unchanged).
4. Use of Force Fields in Vacuum is False (and Known to be So).
5. Treats Charge q as Unitary Instead of Coupled System $q = \phi[q]m(q)$.
6. Confuses Massless Potential Gradients as Forces (See #3, #4).
7. Does Not Utilize Mass as a Component of Force (See #23).

8. Erroneously Assumes EM Force Fields as Primary Causes.
9. Topology of EM Model Has Been Substantially Reduced.
10. Does Not Include Quantum Potential or Action at a Distance.
11. Does Not Include Superluminal Velocity of Inner EM Components.
12. Does Not Utilize Extended Near-Field Coulomb Gauge Effects.
13. Does Not Include EM Generatrix Mechanism for Time Flow.
14. Does Not Unify Photon and Wave Aspects (Requires 7-D Model).

15. Does Not Include Electron Spin and Precession (See #19, #24).
16. Treats EM Energy As Existing In "Chunks," Instead of as Flow.
17. Confuses Energy and Energy Collection (See #16).
18. Discards Half of Every EM Wave in Vacuum (See #22).
19. Erroneously Uses Transverse Vacuum Wave; It's Longitudinal.
20. Arbitrarily Regauges Maxwell's Equations to Eliminate Overunity.
21. Omits Phase Conjugate Optics Effects (The *Rule* in Internal EM).
22. Does Not Include EM Cause of Newtonian Reaction Force.
23. Erroneously Assumes Separate Force Acting on Separate Mass.
24. Confuses Detected Electron Precession Waves as Proving Transverse EM Waves in Vacuum (Remnant of Old "EM Fluid" Concept).
25. Due to Error in String Wave, Omits the Ubiquitous Antiwave.
26. *Assumes* Equilibrium; Not True Unless Include Vacuum Interactions.
27. Higher Topology Required, to Model Electromagnetic Reality.
28. Lorentz surface integration discards Poynting energy transport.
29. Has nothing at all to say about form of EM entities in massless space.
30. Eliminates the infolded general relativity using EM-force as curve agent.
31. Does not include longitudinal EM waves as time domain oscillations.
32. Does not include EM mechanism that generates time flow and flow rate.

© T.E. [illegible] 1991, 1997

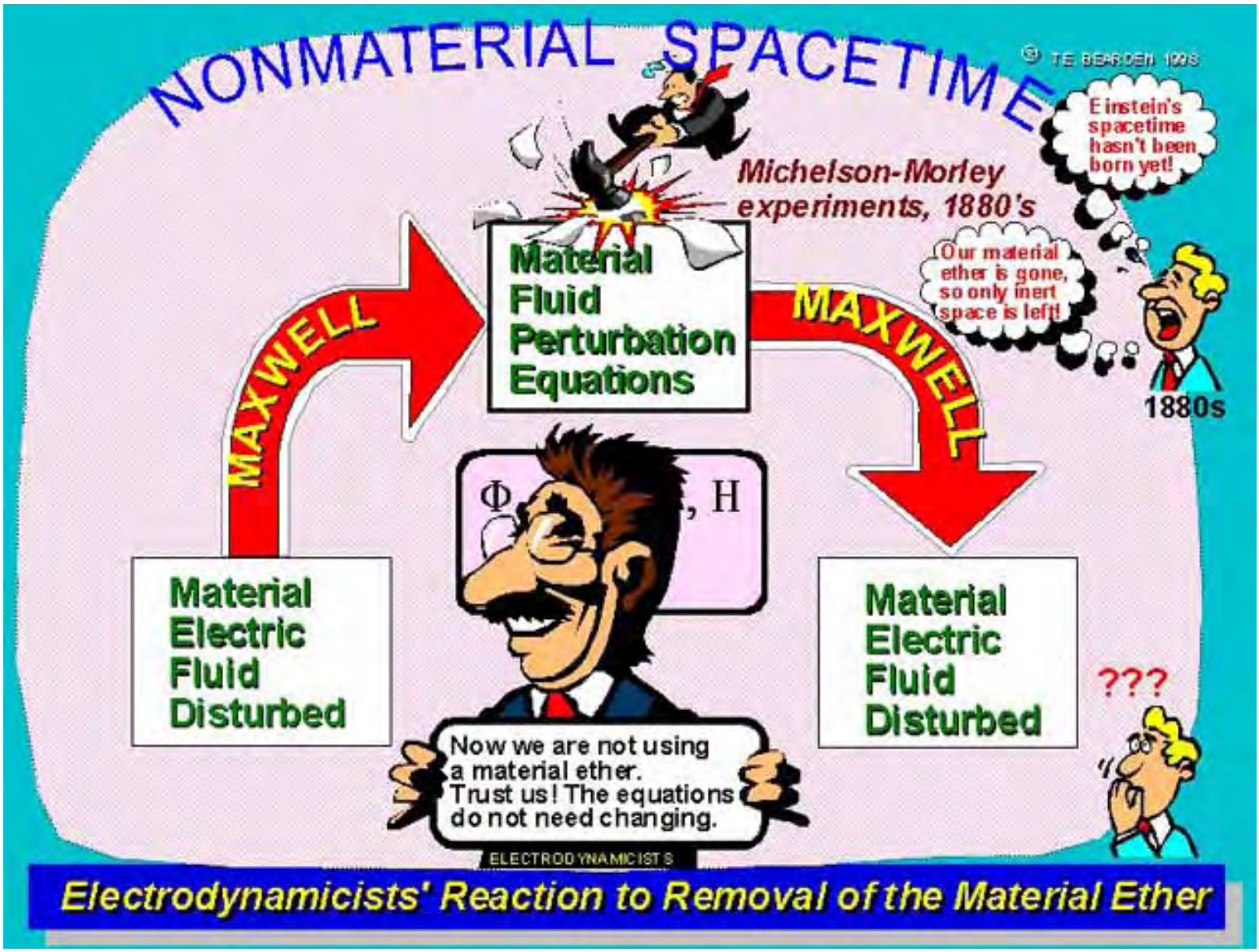
NONMATERIAL SPACETIME
© T.E. BEARDEN 1998
Einstein's spacetime hasn't been born yet!
Michelson-Morley experiments, 1880's
Our material ether is gone, so only inert space is left!
1880s
MAXWELL
Material Fluid Perturbation Equations
MAXWELL
Φ
, H
Material Electric Fluid Disturbed
Material Electric Fluid Disturbed
???
Now we are not using a material ether. Trust us! The equations do not need changing.
ELECTRODYNAMICISTS
Electrodynamicists' Reaction to Removal of the Material Ether

REACTION TO LOSS OF MATERIAL ETHER
Material Ether Assumed in Equations
Potentials, Fields, and Waves Assumed Material
Not a single equation was changed!
Now we are not using a material ether. Trust us! The equations do not need changing.
© T.E. BEARDEN 1999
ELECTRODYNAMICISTS

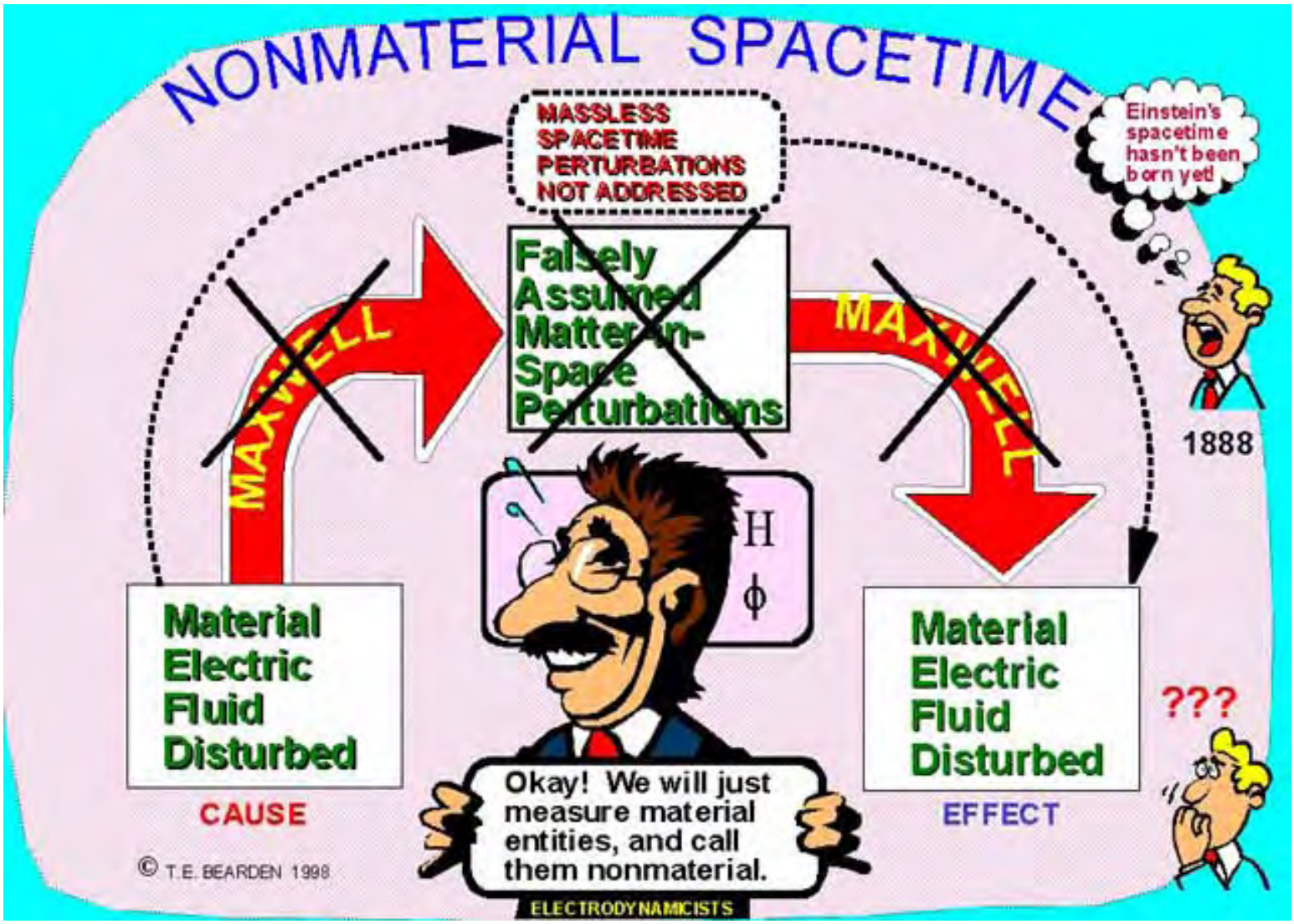
NONMATERIAL SPACETIME
MASSLESS SPACETIME PERTURBATIONS NOT ADDRESSED
Einstein's spacetime hasn't been born yet!
Falsely Assumed Matter-in-Space Perturbations
MAXWELL
MAXWELL
1888
H
ϕ
Material Electric Fluid Disturbed
CAUSE
Material Electric Fluid Disturbed
EFFECT
???
Okay! We will just measure material entities, and call them nonmaterial.
ELECTRODYNAMICISTS
© T.E. BEARDEN 1998

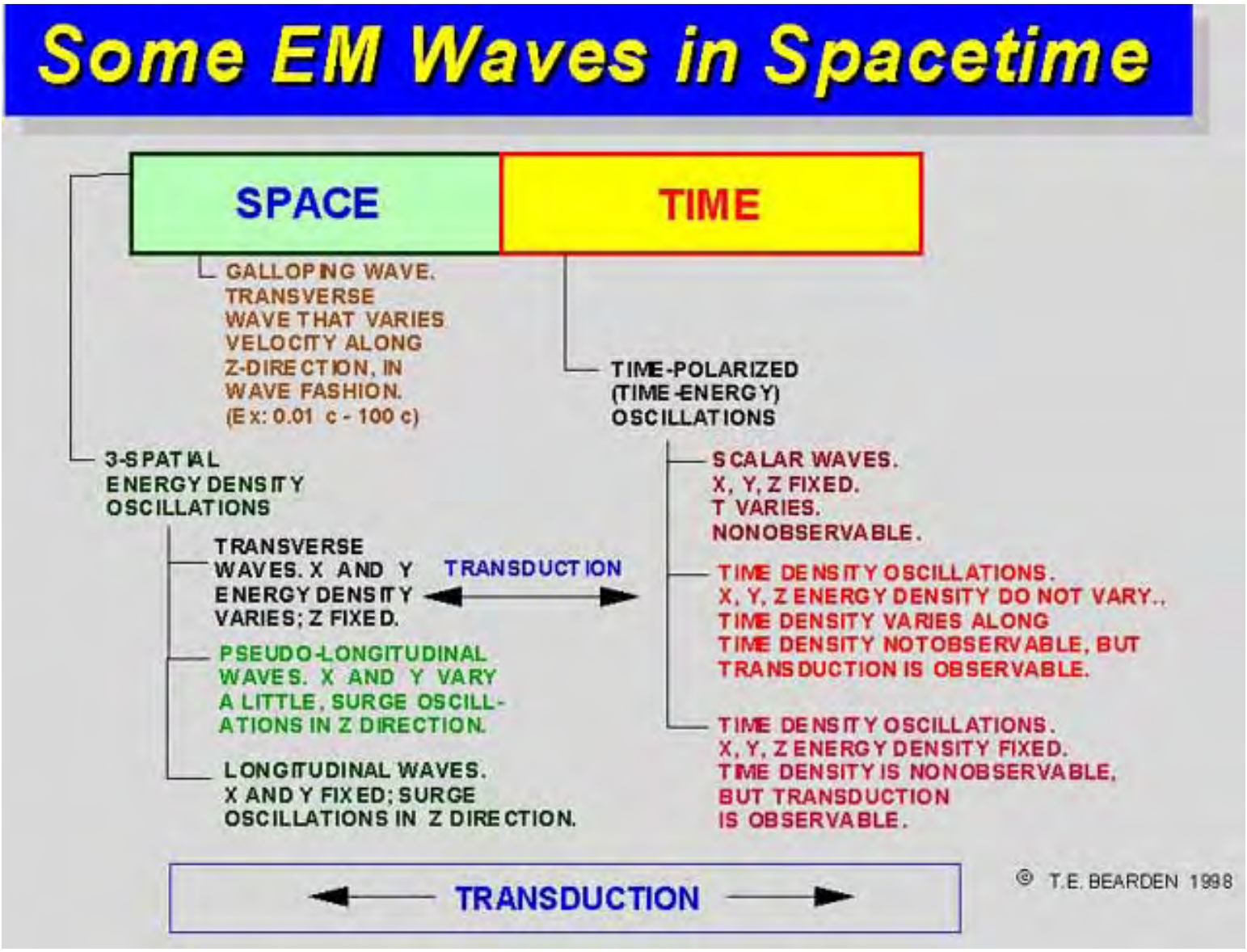
Some EM Waves in Spacetime
SPACE
TIME
GALLOPING WAVE. TRANSVERSE WAVE THAT VARIES VELOCITY ALONG Z-DIRECTION, IN WAVE FASHION. (Ex: 0.01 c - 100 c)
TIME-POLARIZED (TIME-ENERGY) OSCILLATIONS
3-SPATIAL ENERGY DENSITY OSCILLATIONS
SCALAR WAVES. X, Y, Z FIXED. T VARIES. NONOBSERVABLE.
TRANSVERSE WAVES. X AND Y ENERGY DENSITY VARIES; Z FIXED.
TRANSDUCTION
TIME DENSITY OSCILLATIONS. X, Y, Z ENERGY DENSITY DO NOT VARY., TIME DENSITY VARIES ALONG TIME DENSITY NOTOBSERVABLE, BUT TRANSDUCTION IS OBSERVABLE.
PSEUDO-LONGITUDINAL WAVES. X AND Y VARY A LITTLE, SURGE OSCILLATIONS IN Z DIRECTION.
LONGITUDINAL WAVES. X AND Y FIXED; SURGE OSCILLATIONS IN Z DIRECTION.
TIME DENSITY OSCILLATIONS. X, Y, Z ENERGY DENSITY FIXED. TIME DENSITY IS NONOBSERVABLE, BUT TRANSDUCTION IS OBSERVABLE.
TRANSDUCTION
© T.E. BEARDEN 1998

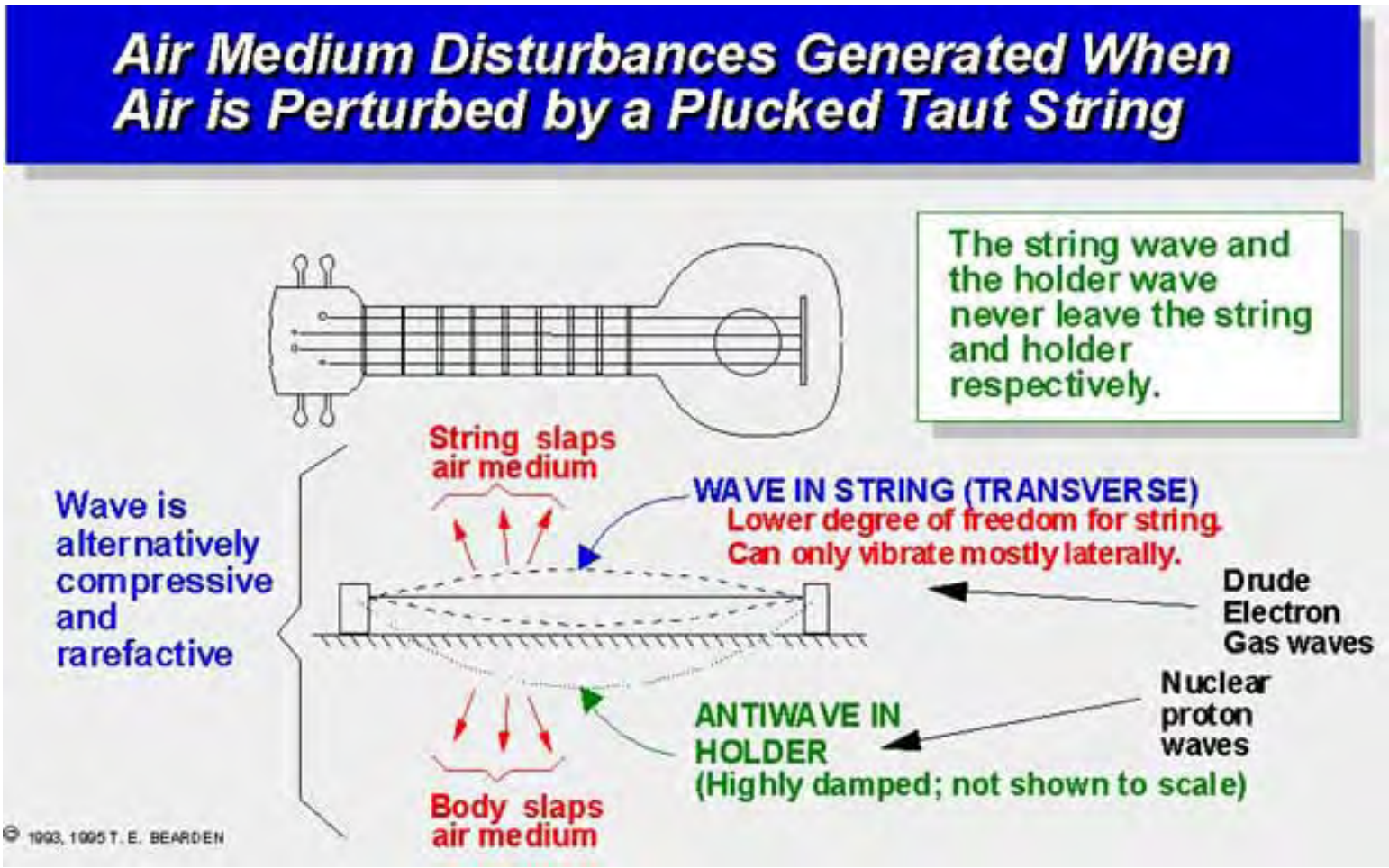
Air Medium Disturbances Generated When Air is Perturbed by a Plucked Taut String
The string wave and the holder wave never leave the string and holder respectively.
String slaps air medium
Wave is alternatively compressive and rarefactive
WAVE IN STRING (TRANSVERSE)
Lower degree of freedom for string.
Can only vibrate mostly laterally.
Drude Electron Gas waves
Nuclear proton waves
ANTIWAVE IN HOLDER
(Highly damped; not shown to scale)
Body slaps air medium
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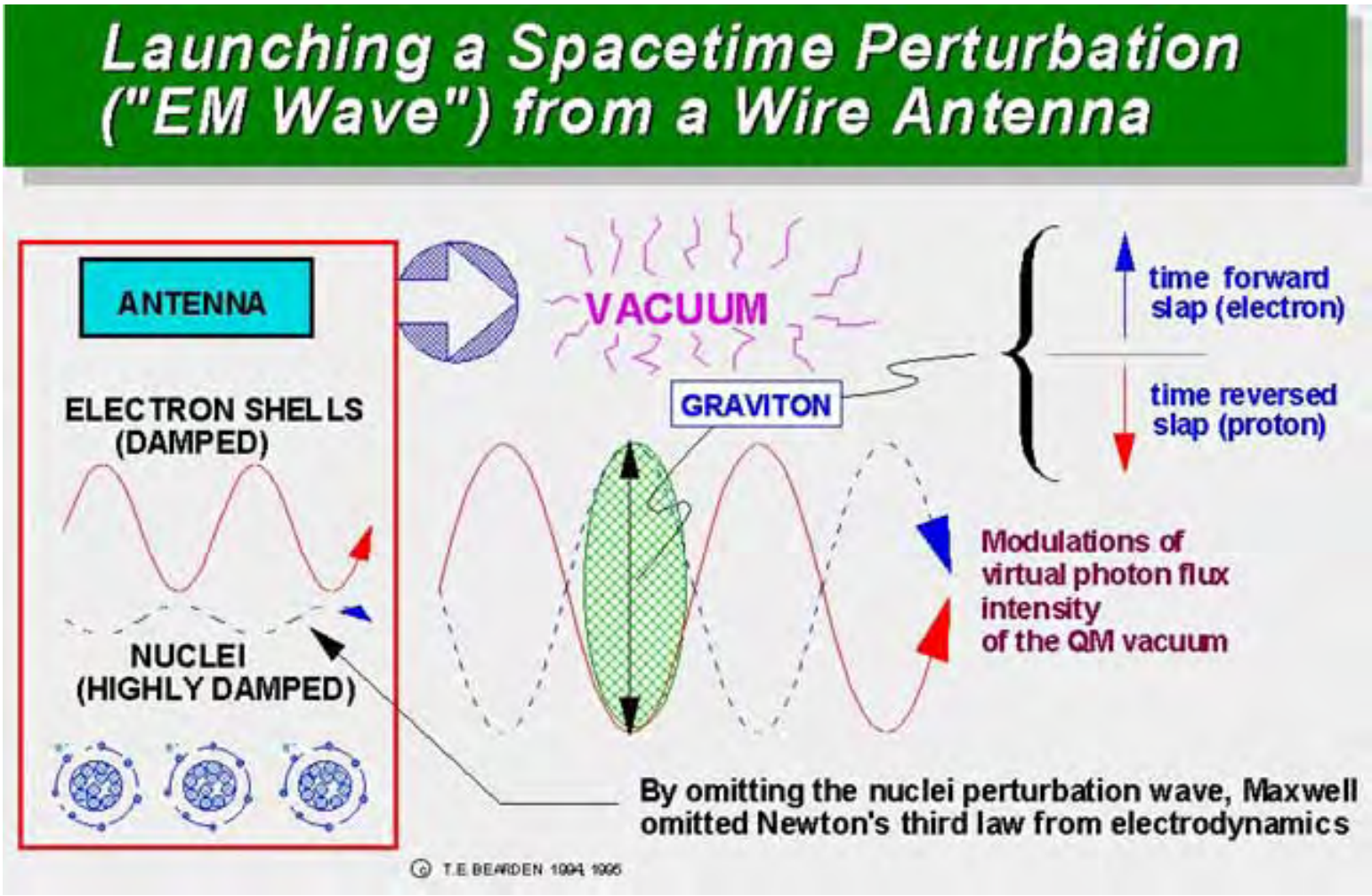
Launching a Spacetime Perturbation ("EM Wave") from a Wire Antenna
ANTENNA
ELECTRON SHELLS (DAMPED)
NUCLEI (HIGHLY DAMPED)
VACUUM
GRAVITON
time forward slap (electron)
time reversed slap (proton)
Modulations of virtual photon flux intensity of the QM vacuum
By omitting the nuclei perturbation wave, Maxwell omitted Newton's third law from electrodynamics
© T.E BEARDEN 1994 1995

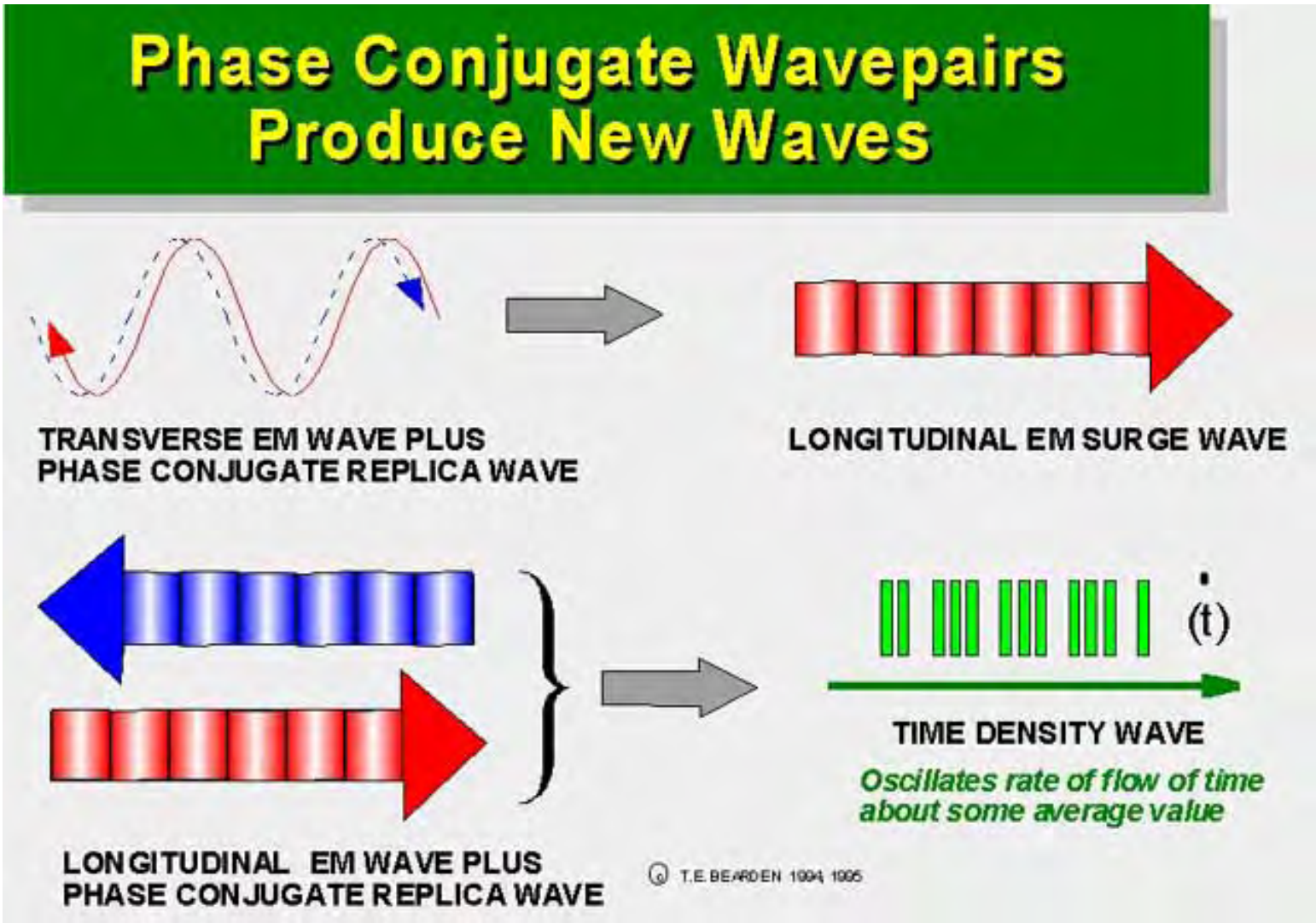
Phase Conjugate Wavepairs
Produce New Waves
TRANSVERSE EM WAVE PLUS
PHASE CONJUGATE REPLICA WAVE
LONGITUDINAL EM SURGE WAVE
LONGITUDINAL EM WAVE PLUS
PHASE CONJUGATE REPLICA WAVE
(t)
TIME DENSITY WAVE
Oscillates rate of flow of time
about some average value
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Scalar Electromagnetics (Energetics) View of EM

- Potentials real; primary causes of EM phenomena
  - Force fields made by differentiations of potentials
  - Force fields are effects, not primary causes
  - Force fields exist only in, on mass particles
- Actions due to potentials and their interference
  - Action at a distance or locally
  - Quantum potential and hidden variables
- Locally curved spacetime, engineerable by EM
  - Gravity effects not necessarily negligible
  - Strong EM force or time used as agent of curvature

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Scalar Electromagnetics (Energetics) View of EM (Cont'd)

- Potentials have internal structure
  - Stoney/Whittaker structure
  - Longitudinal EM phase conjugate wavepairs
  - Each wavepair is a time-polarized EM wave
- Vacuum EM is a potential and has microstructure
  - Stoney-Whittaker biwaves/t-polarized waves
  - Fluctuations exhibit chaos
- Spacetime ≡ Vacuum ≡ Potential ≡ Flux

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Scalar Electromagnetics (Energetics) View of EM (Cont'd)

- Statistics may have hidden order (already chaotic)
- Uses spacetime curvature engines to alter matter (inside-out or outside-in)
- Engineerable EM mechanism generates rate of flow of a mass through time
- Quantum potential with specific QP can be used for instant action at a distance

Extended General Relativity Principle

- "All levels of energy structures and all levels of time structures mold spacetime geometry.
- This is called a ***vacuum engine*** (spacetime engine).
- Spatial and temporal structuring act upon mass at all levels.
- This produces ***templates*** of forces, for translations and stresses."

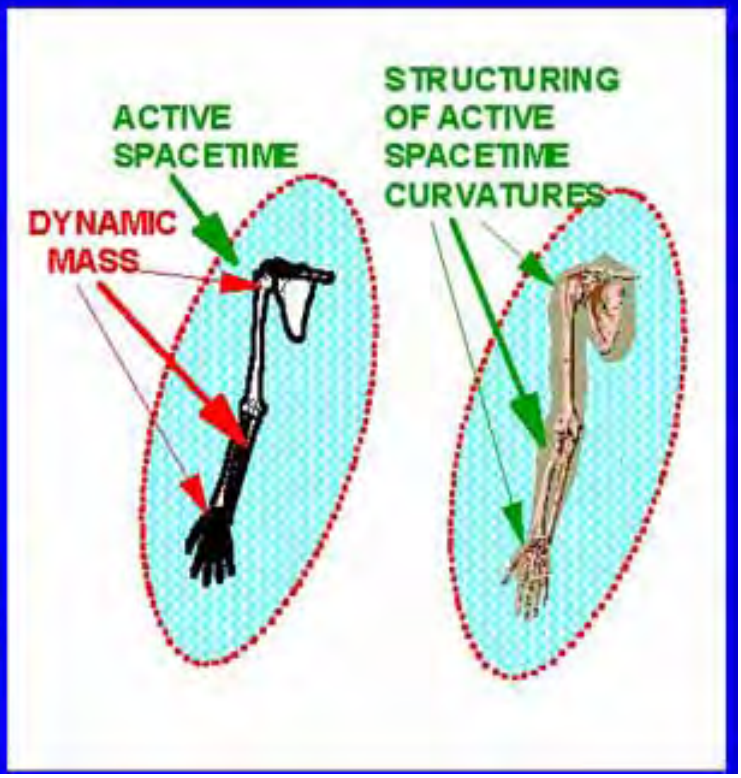

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Extension of Work-Energy Theorem

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- *Theorem:* $W = k_f - k_i = \Delta k$ [1]
- k must be interpreted not as energy *per se*, but as *collected/collecting* energy.
- The reaction cross section λ for the collecting process must be included.
- *Extension:* $W = \lambda (k_f - k_i) = \lambda \Delta k$ [2]
- Normally $\lambda \leq 1$, as for elastic collision or Stokes emission.
- However, $\lambda > 1$ is now possible, for processes which asymmetrically self-regauge. An example is Letokhov's negative absorption of the medium.
- Working models are the Patterson Power Cell® and Lawandy lasing without population inversion.

MTW's General Relativity Principle

- "Space acts on matter, telling it how to move.
- In turn, matter reacts back on space, telling it how to curve."

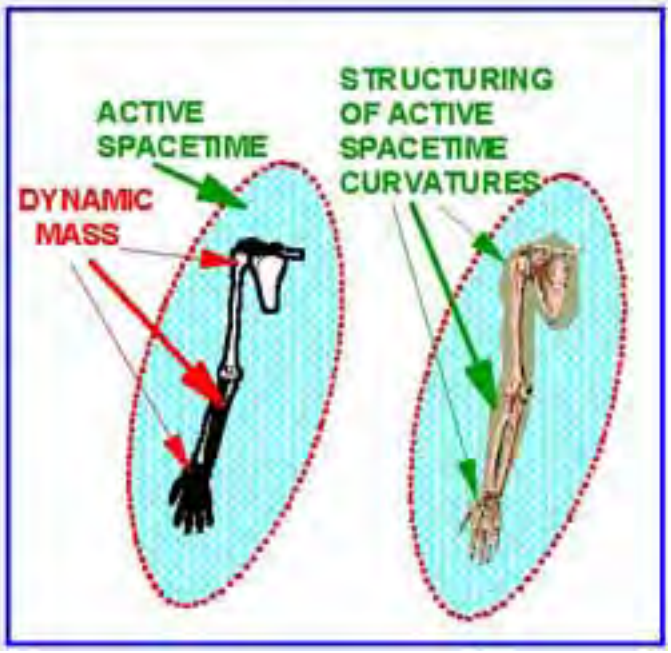

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Use of General Relativity (GR) in Particle Physics

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- GR seldom used in particle physics
- In cold fusion, Matsumoto* has applied general relativity
- Consistent with important cold fusion results
- Used spacetime (ST) curvature by energy density
- Matsumoto did not utilize:
  - Longitudinal EM waves
  - Time density waves
  - Time density curvatures of ST (gain = $9 \times 10_{16}$)

* T. Matsumoto, "Mechanisms of Electro-Nuclear Collapse," Proc. ICCF-7, Vancouver, BC, Canada, Apr. 1998, p. 98

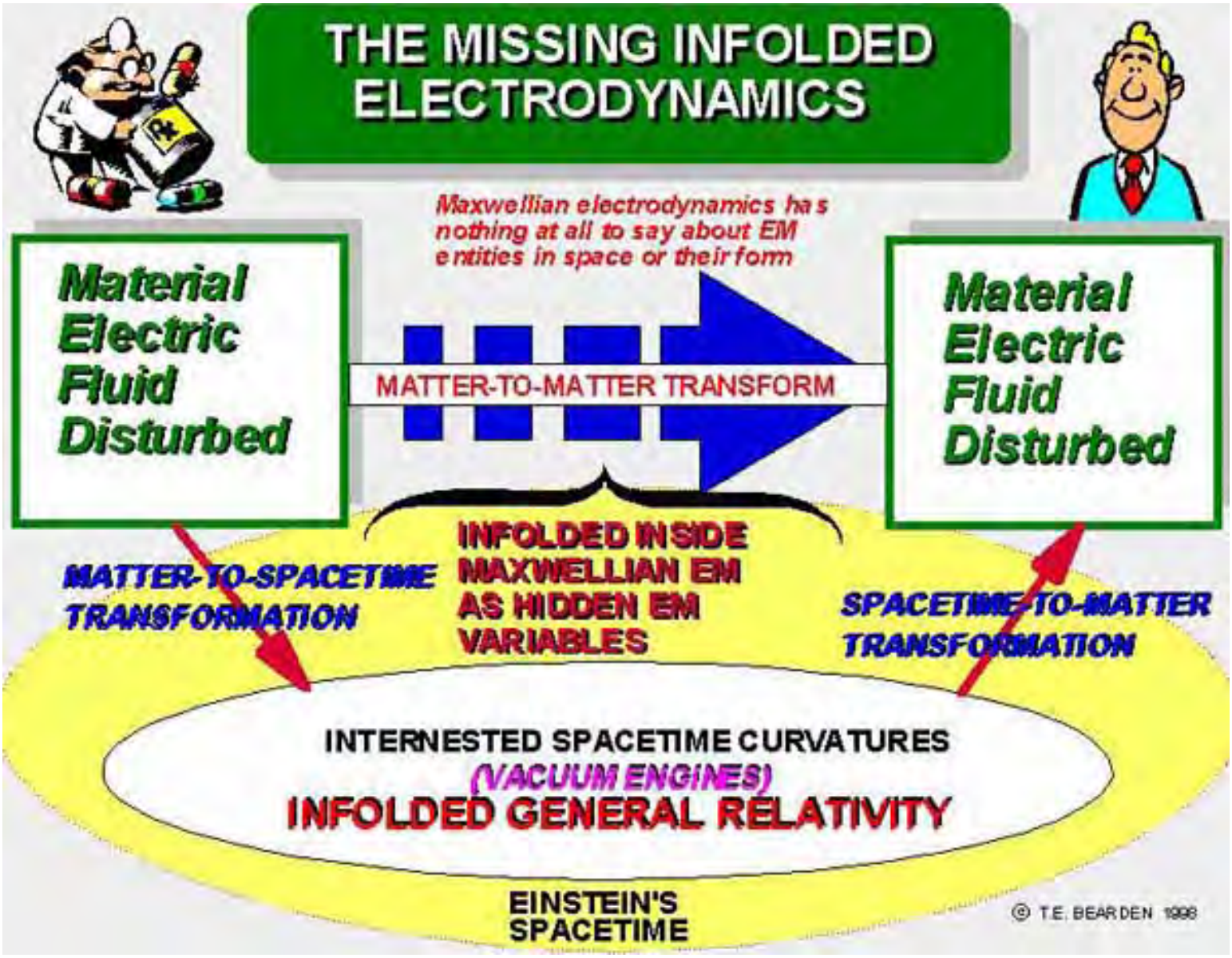
THE MISSING INFOLDED ELECTRODYNAMICS
Maxwellian electrodynamics has nothing at all to say about EM entities in space or their form
Material Electric Fluid Disturbed
MATTER-TO-MATTER TRANSFORM
Material Electric Fluid Disturbed
INFOLDED INSIDE MAXWELLIAN EM AS HIDDEN EM VARIABLES
MATTER-TO-SPACETIME TRANSFORMATION
SPACETIME-TO-MATTER TRANSFORMATION
INTERNESTED SPACETIME CURVATURES
(VACUUM ENGINES)
INFOLDED GENERAL RELATIVITY
EINSTEIN'S SPACETIME
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Infolded Engines: Excluded by Present Physics

- *The infolded dynamics of EM systems are not considered in general relativity, electromagnetics, or quantum mechanics*
- *None of these disciplines include such spacetime curvature engines (vacuum engines)*
- *Thus GR, EM, and QM cannot be unified, since ST curvature engines are where the unification mainly occurs*

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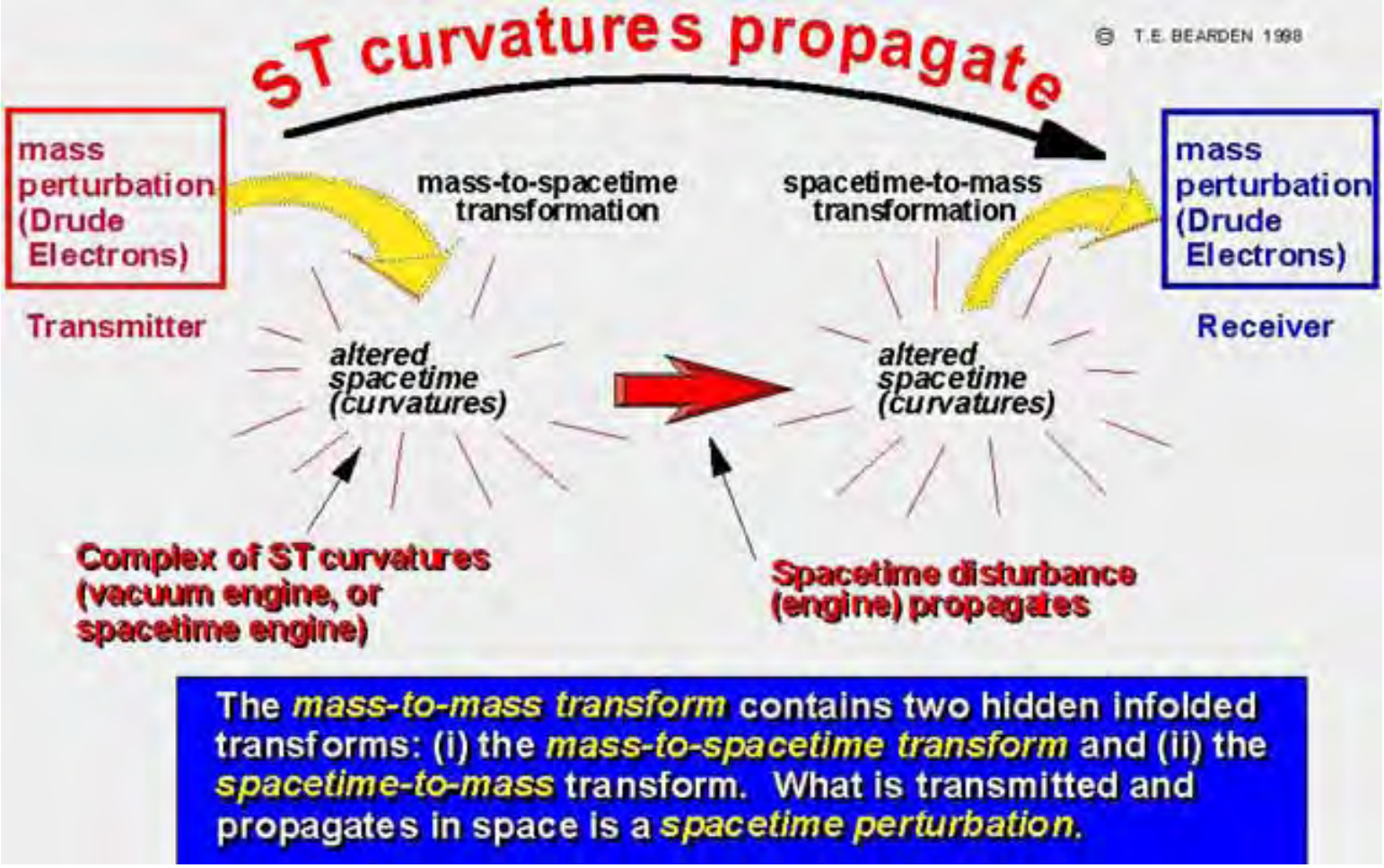
ST curvatures propagate
© T.E. BEARDEN 1998
mass perturbation (Drude Electrons)
Transmitter
mass-to-spacetime transformation
spacetime-to-mass transformation
mass perturbation (Drude Electrons)
Receiver
altered spacetime (curvatures)
altered spacetime (curvatures)
Complex of ST curvatures (vacuum engine, or spacetime engine)
Spacetime disturbance (engine) propagates
The mass-to-mass transform contains two hidden infolded transforms: (i) the mass-to-spacetime transform and (ii) the spacetime-to-mass transform. What is transmitted and propagates in space is a spacetime perturbation.

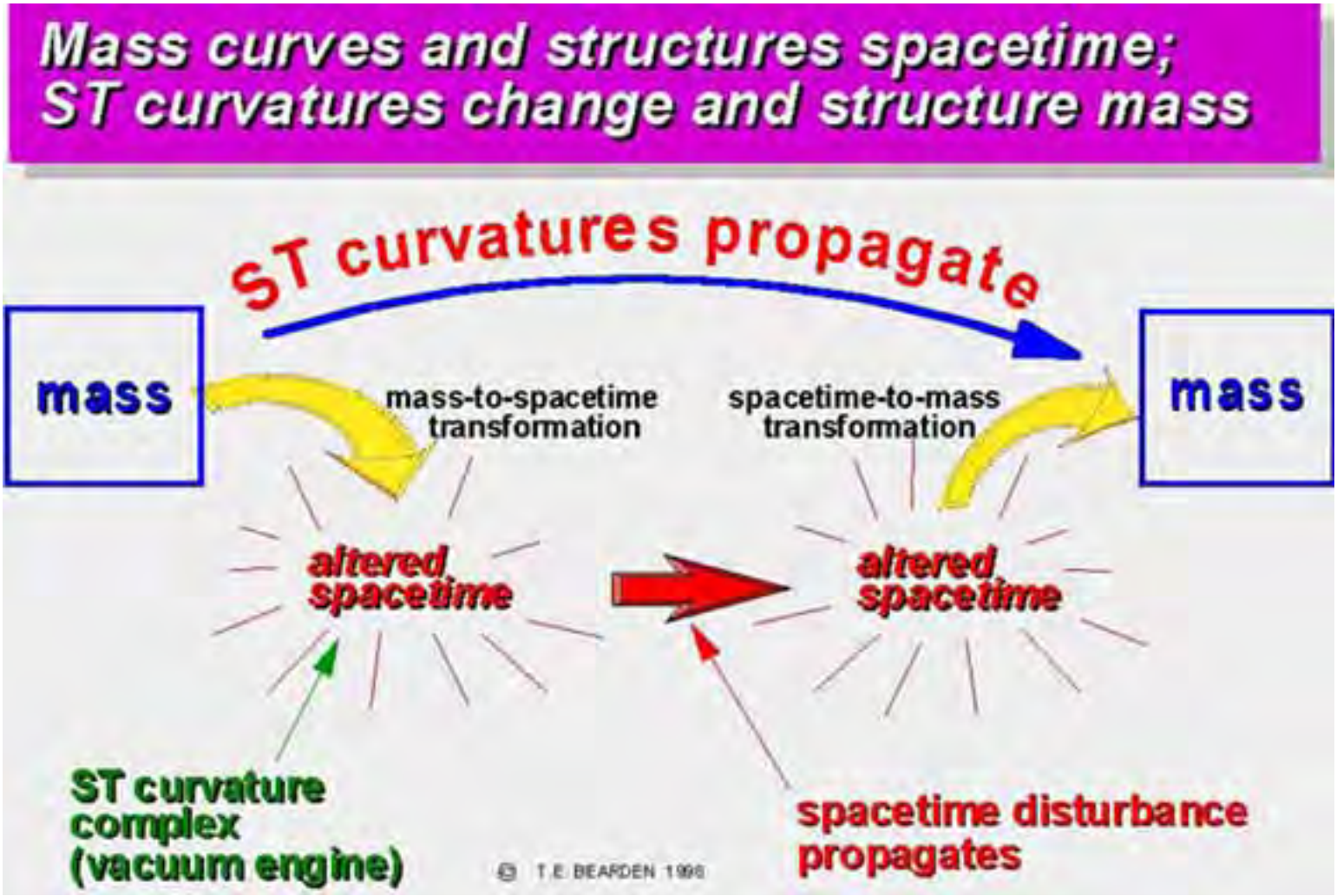
Mass curves and structures spacetime;
ST curvatures change and structure mass
ST curvatures propagate
mass
mass-to-spacetime transformation
spacetime-to-mass transformation
mass
altered spacetime
altered spacetime
ST curvature complex (vacuum engine)
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spacetime disturbance propagates

At Infinite Velocity:
Each Is Every Other
SPACETIME
VIRTUAL PARTICLE FLUX
POTENTIAL
MIND AND MIND LEVELS
MASS
PLANET
LIVING ORGANISMS
© 1997 T.E. Bearden

Lisitsyn's Report: Brain Code Broken

- THEORY DEVELOPED AND FITTED
- HYSTERESIS MEMORY LOOP
- CONTROLLED EM INDUCTION
  - IMAGES
  - SENSATIONS
  - PREDETERMINED EMERGENCE
- 23 EEG BANDS
  - UP TO 8.1 X 10^{20} HZ
  - 11 INDEPENDENT CHANNELS

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S.K. Lisitsyn, "New Approach to the Analysis of Electroencephalograms," DDC Report AD73005, p. 16-25.

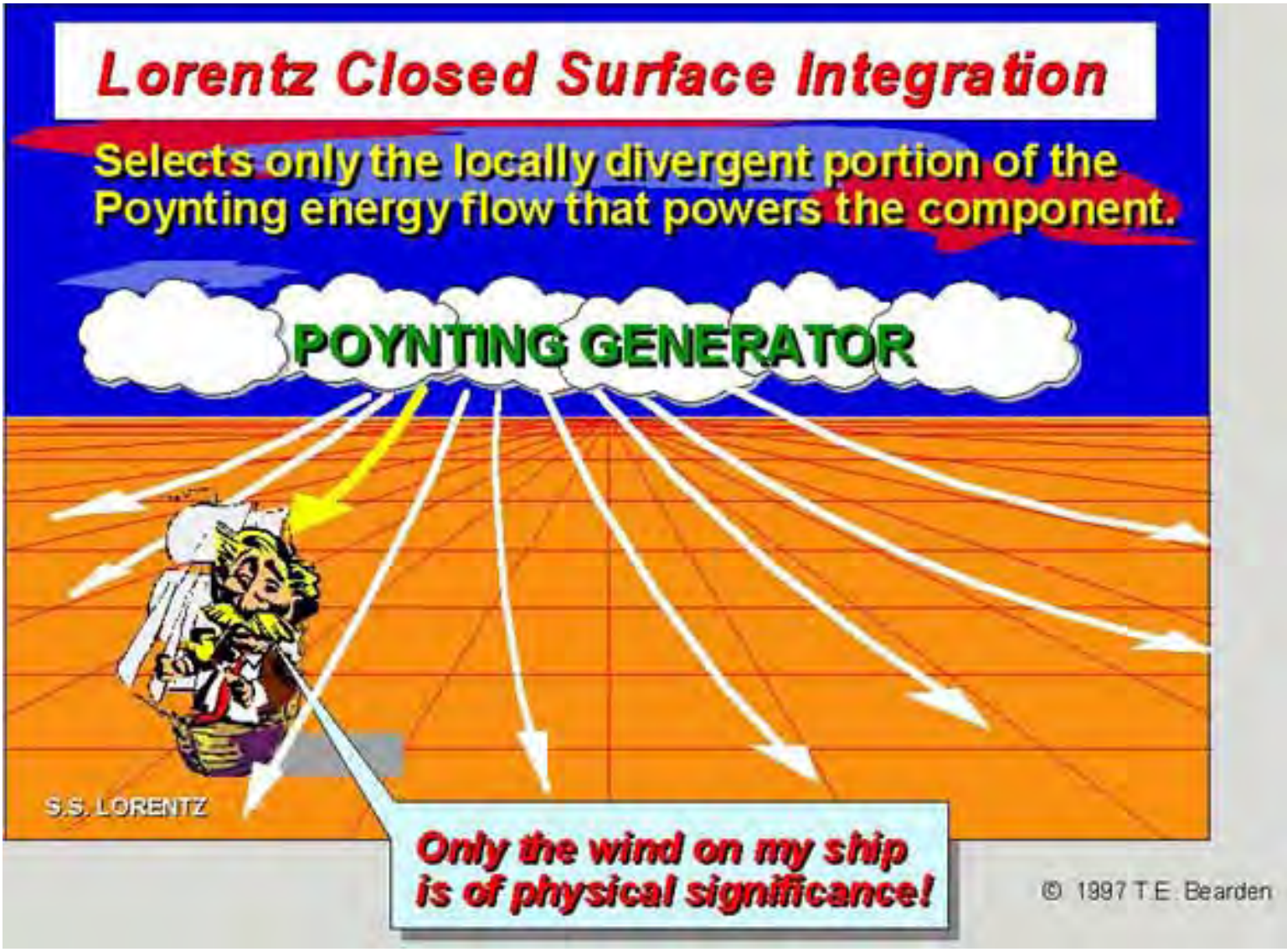
Lorentz Closed Surface Integration
Selects only the locally divergent portion of the Poynting energy flow that powers the component.
POYNTING GENERATOR
S.S. LORENTZ
Only the wind on my ship is of physical significance!
© 1997 T.E. Bearden

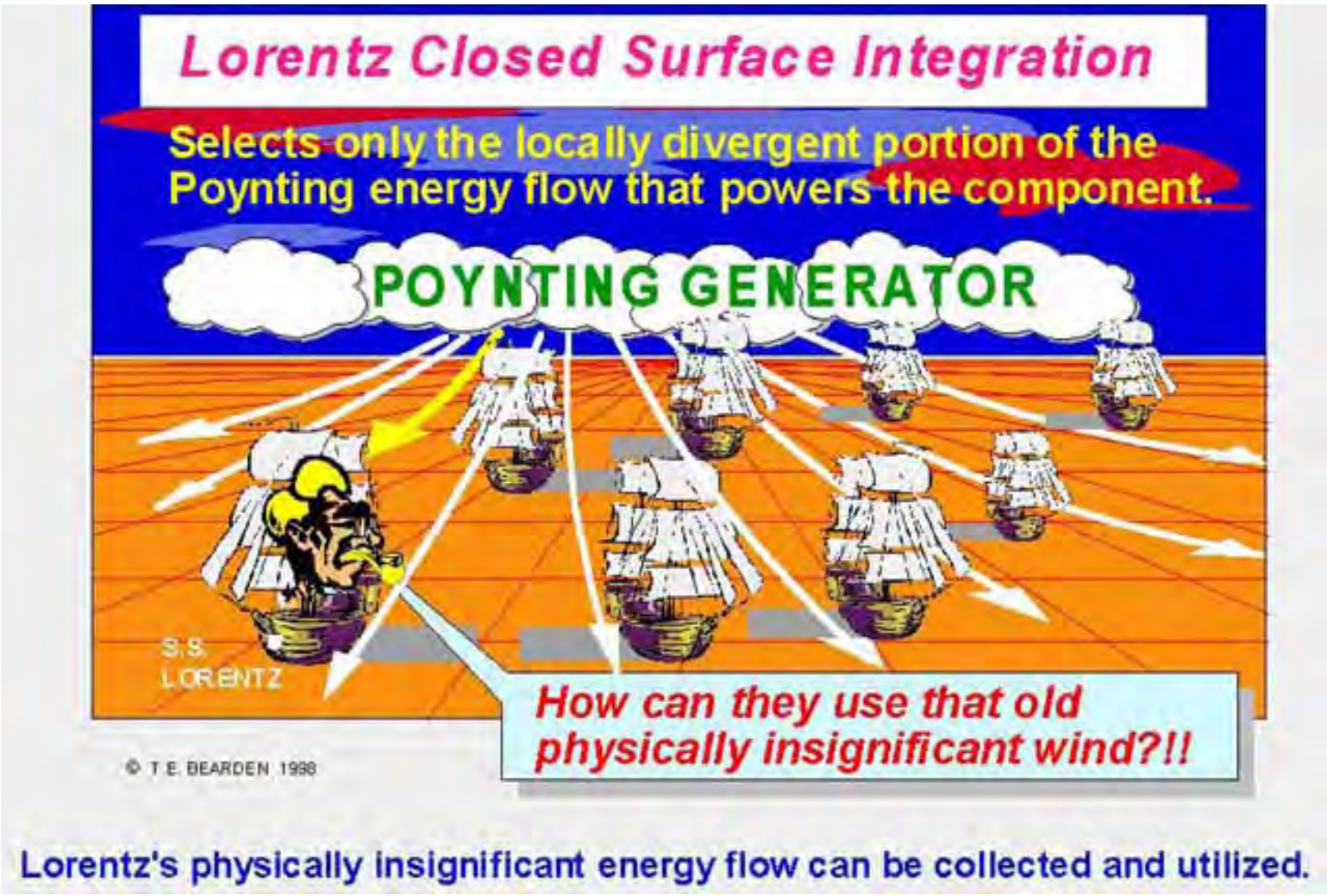
Lorentz Closed Surface Integration
Selects only the locally divergent portion of the Poynting energy flow that powers the component.
POYNTING GENERATOR
S.S. LORENTZ
How can they use that old physically insignificant wind?!!
© T.E. BEARDEN 1998
Lorentz's physically insignificant energy flow can be collected and utilized.

Lorentz surface integration of the Poynting vector around a closed surface

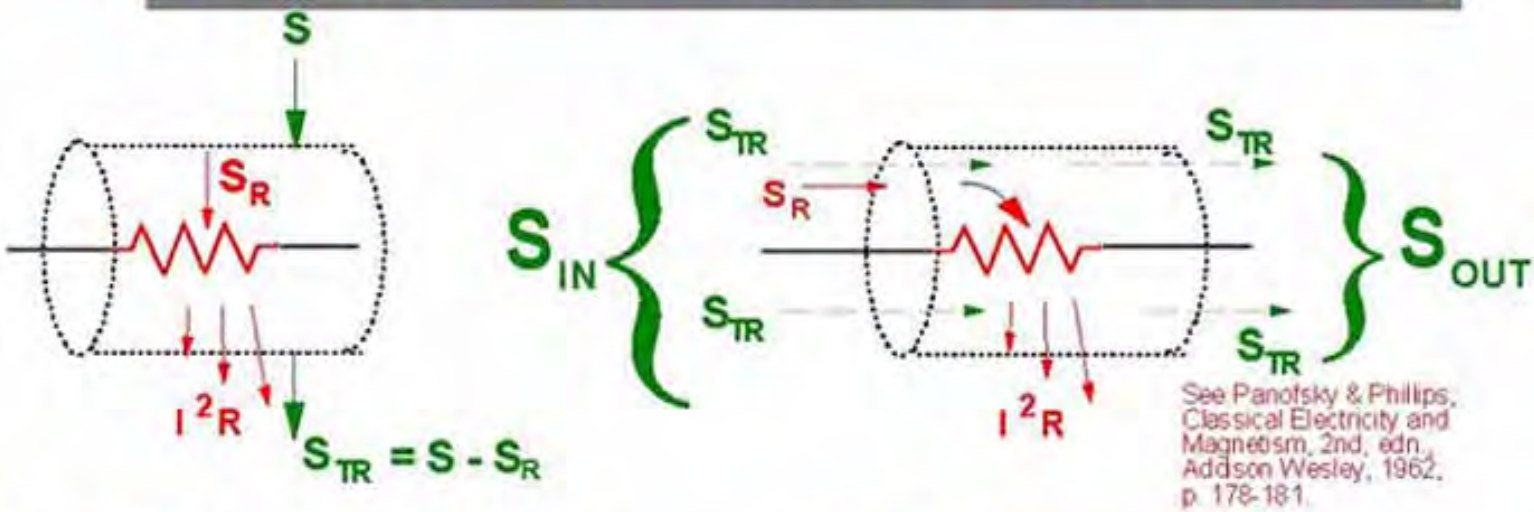

See Panofsky & Phillips, Classical Electricity and Magnetism, 2nd. edn. Addison Wesley, 1962, p. 178-181.

1a. Lorentz surface integration.

1b. Actual S in and S out.

Note: If the S-vector is integrated over the closed surface, then all energy *transport* passage is zeroed, leaving only the very small component of the input S-flow that is powering the joule heating of the resistor. In short, only the small component of the S-flow that is equal in magnitude to the Slepian vector $j\phi$ remains. This measures only the tiny portion of the S-flow that is "collecting" on electrons passing through the resistor, and therefrom being dissipated out of the resistor as joule heating. It discards everything else (all S_{TR}'s and S_{OUT}). S_{IN} becomes S_R.

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Longitudinal EM Photon Interaction with Charge

- Creates time-density wave pumping
- Slowly creates time-density charging

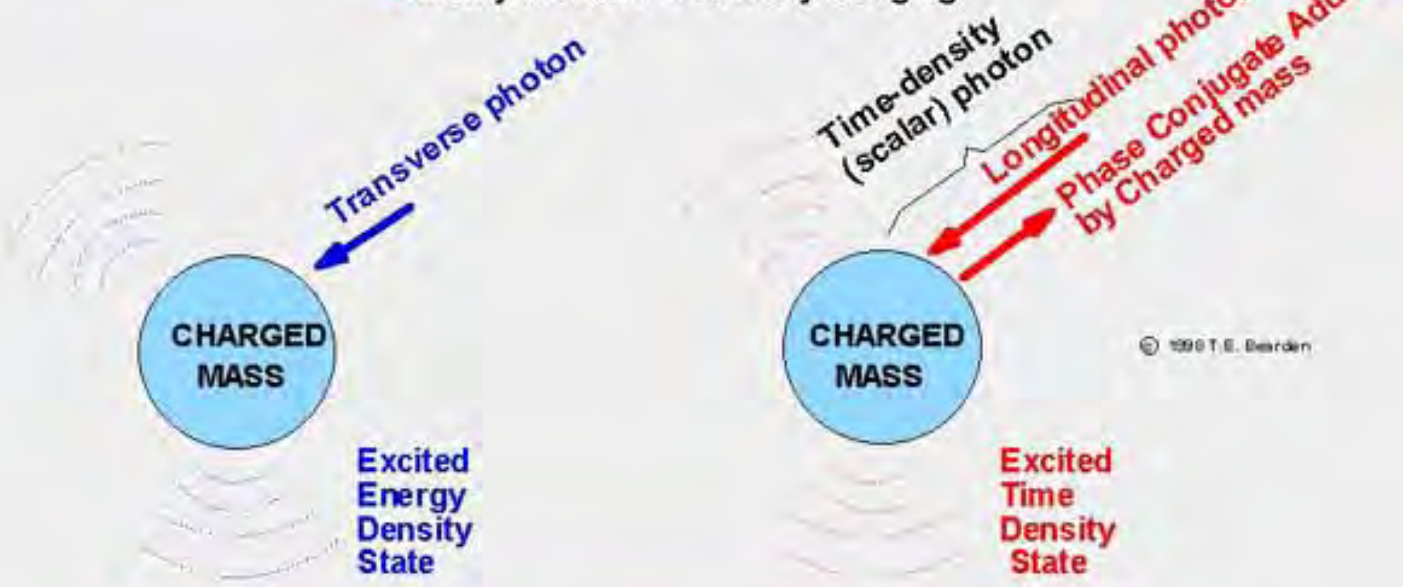

- Fundamental units are arbitrary in physics
- Can express all physics in one unit -- e.g., time
- Time is highly compressed energy
- 1 sec = 9 x 10_{16} joules of transverse EM wave energy

Figure 1-8. Infolded biwave composition of a scalar potential.

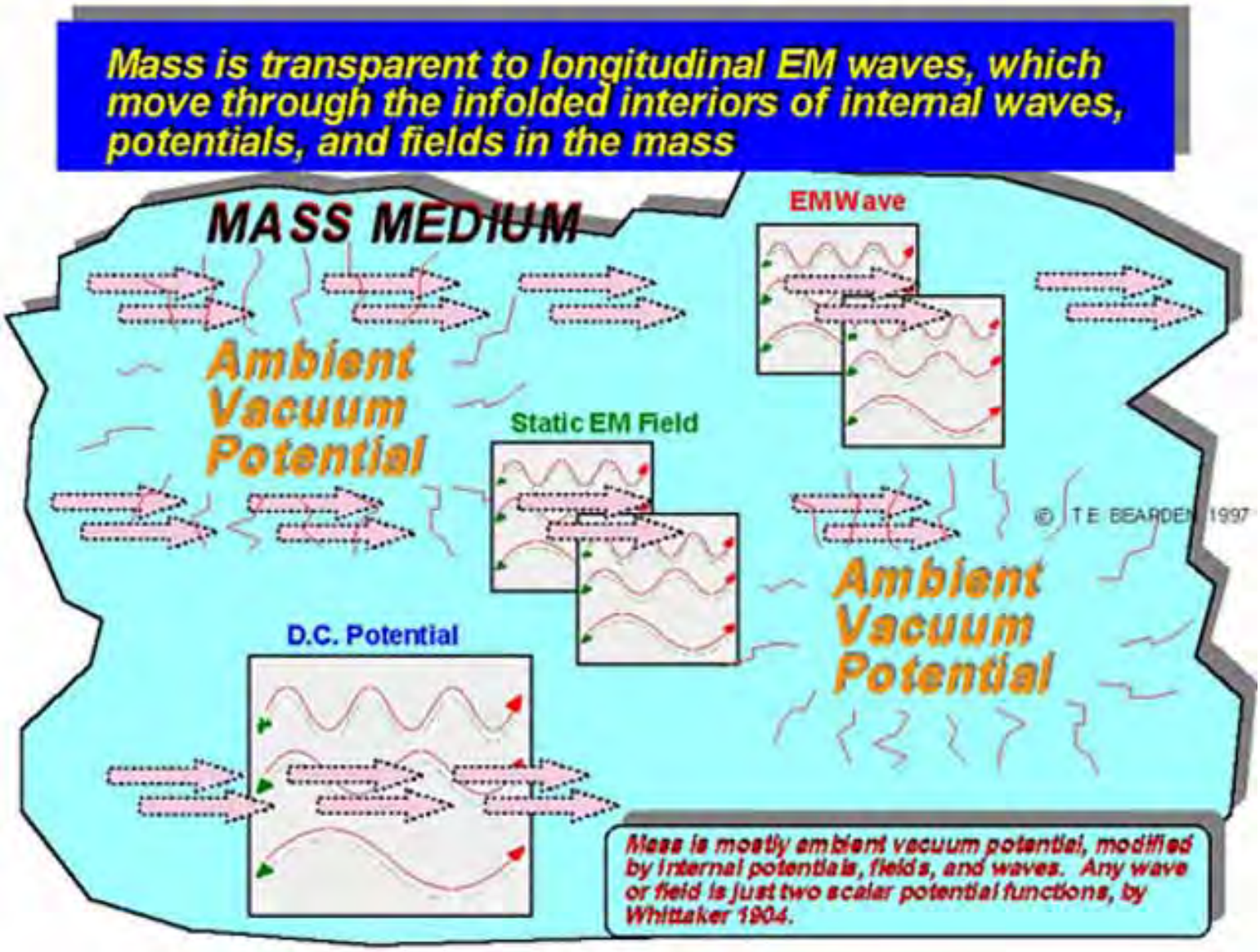

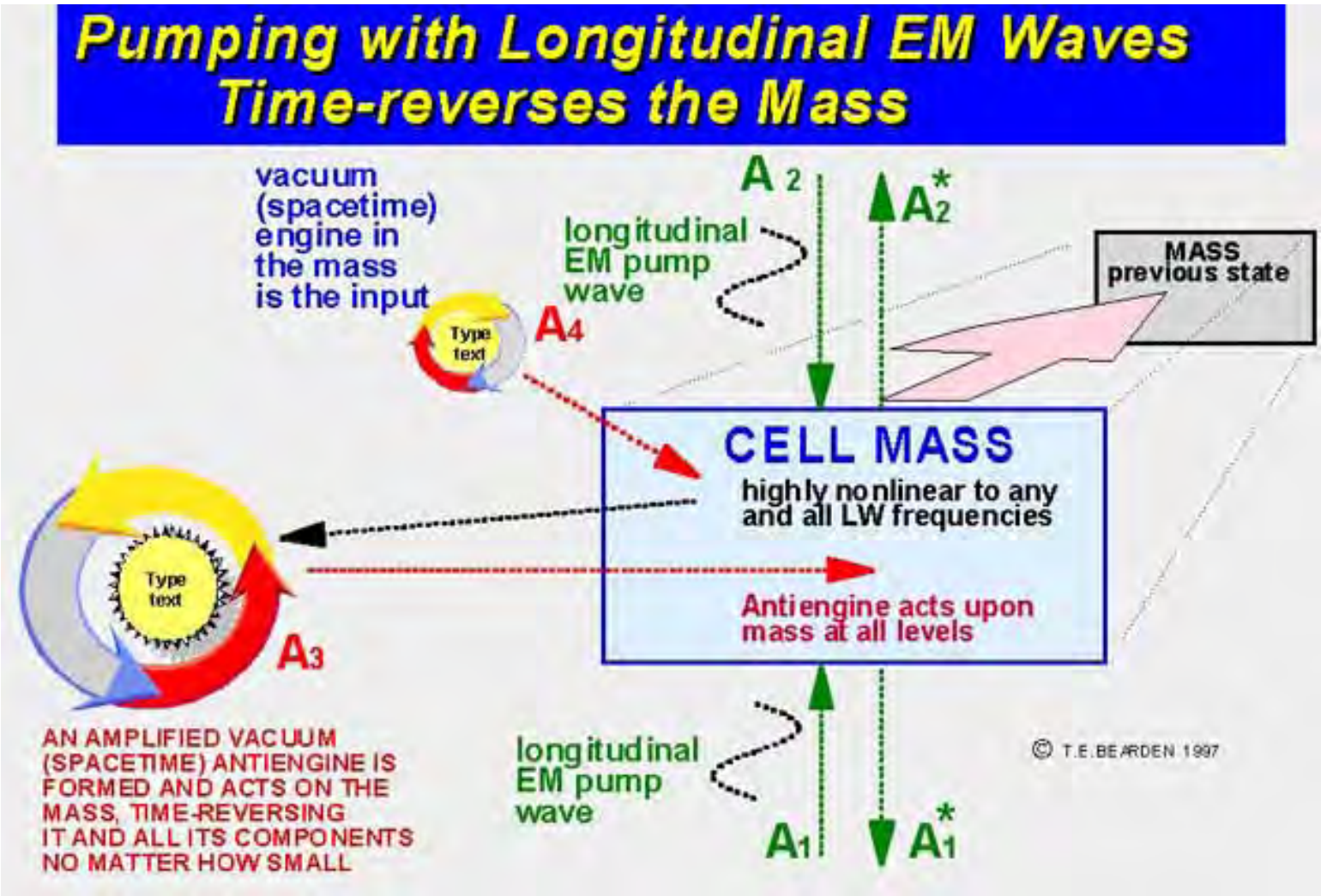
Pumping with Longitudinal EM Waves
Time-reverses the Mass
vacuum (spacetime) engine in the mass is the input
A 2
A*2
longitudinal EM pump wave
MASS previous state
Type text
A4
CELL MASS
highly nonlinear to any and all LW frequencies
Type text
A3
Antiengine acts upon mass at all levels
AN AMPLIFIED VACUUM (SPACETIME) ANTIENGINE IS FORMED AND ACTS ON THE MASS, TIME-REVERSING IT AND ALL ITS COMPONENTS NO MATTER HOW SMALL
longitudinal EM pump wave
© T.E.BEARDEN 1997
A1
A*1

Maxwell's Quaternion Theory

- **Quaternions:**
  - Discovered by Hamilton in 1843
  - A quaternion has a vector part
  - A quaternion has a scalar part
  - First significant non-arithmetic number system
  - Higher topology than vector or tensor algebra
- **Maxwell's theory was in quaternion equations**
  - 20 equations in 20 unknowns
  - Reduced to a small 4-equation subset by Heaviside and Gibbs
  - EM topology dramatically reduced

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Maxwellian Systems

Before regauging, after symmetrical regauging, and after asymmetrical regauging

Note: Any system must first break equilibrium in its vacuum exchange, before it can energize Drude electrons and "power" the load. Asymmetric regauging is always utilized. Powering loads and losses is a symmetry-restoring operation.

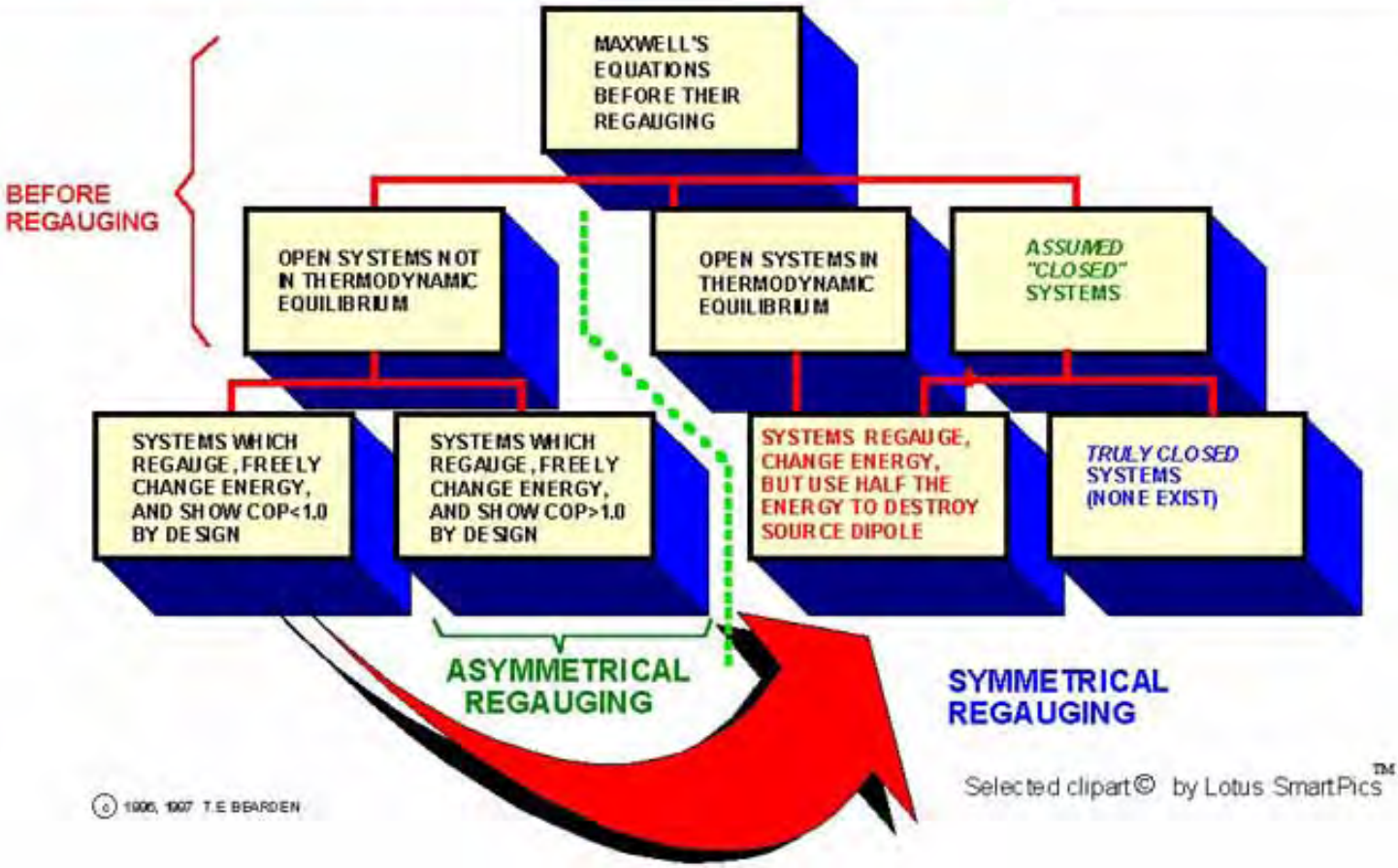

Maxwell's four equations reduce to:

$$\nabla^2 \Phi + \frac{1}{c}\frac{\partial}{\partial}(\nabla \bullet A) = -4\pi\rho \qquad [1]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 A}{\partial t^2} - \nabla(\nabla \bullet A + \frac{1}{c}\frac{\partial \Phi}{\partial t}) = -\frac{4p}{c}J \qquad [2]$$

A is replaced by A', where

$$A' = A + \nabla\Lambda \qquad [3]$$

The new B' field then becomes

$$B' = \nabla \times (A + \nabla\Lambda) = \nabla \times A + 0 = \nabla \times A = B \qquad [4]$$

A new E-field will also be formed. So let

$$\Phi' = \Phi - \frac{1}{c}\frac{\partial \Lambda}{\partial t} \qquad [5]$$

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Per Jackson, (A,Φ) are *habitually* chosen so that

$$\nabla \bullet A + \frac{1}{c}\frac{\partial \Phi}{\partial t} = 0 \qquad [6]$$

The *net symmetrical* regauging separates variables. Two inhomogeneous wave equations result:

$$\nabla^2 \Phi - \frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} = -4\pi\rho \qquad [7]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 A}{\partial t^2} = -\frac{4\pi}{c} J \qquad [8]$$

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Equations [1] and [2] *arbitrarily* changed to [7] and [8]

The Tom Bearden Website

Life Systems
Toward the Beginning of the End

---

1. Toward the Beginning of the End: Capstone Presentations
2. Toward the Beginning of the End
3. Biospheric Evolution
4. A Living Biological System
5. The Evolutionary Path of Multicellular Organisms
6. To Paraphrase Churchill
7. Directed Evolution: Mechanism for Species Reactive Adaptation
8. Earth's Poynting Energy Flow
9. The Immune System
10. Mind and Matter Interaction
11. Levels of Consciousness and Unconsciousness
12. Access to Mind, Memory and Thought
13. US Intelligence Statement on Soviet Psi Research
14. Mind and Matter Interaction
15. Conscious and Unconscious Minds
16. Velocity is Rotation
17. Species Reactive Adaptation: Directed Evolution
18. Technology's Goal
19. Technology's End
20. Technological Species' Problems

The Tom Bearden Website

Briefings

One of Tom's first public lectures: World Futures Society 1982
Other panelists included James Beale, Carol Rosin, Barbara Marx Hubbard and Glenn Doman

---

The "Porthole" Concept
Extension of the Priore Method of Healing as applicable to the treatment of biological warfare effects and cellular afflictions such as cancers, AIDS etc.
NEW

Hubbert's Peak: The Impending Oil Crisis, by Professor Kenneth S. Deffeyes
Book Review and Slides

A National Report on America's Energy Crisis
by Energy Secretary Spencer Abraham - March 19, 2001

Commentary and Slide Show (66) by Tom Bearden

A Visual Tour of what they don't want you to know about electrical circuits
10 Trillion Percent of the Current Produced is Wasted!

Weapons Slides

The Missing Infolded Electrodynamics
85 slides

A Brief Technical Background to the Extended Priore Healing Methodology
11 slides

Briefing sent by Tom Bearden to Defense Department, National Institute of Health, USAF, National Science Foundation etc. re extended and improved Priore Treatment to counter mass casualties from Biological Warfare

- Letter to DHHS re adoption of Priore technology
  24 June, 1998
- Letter to NIH re adoption of Priore technology
  12 May, 1998

Towards the Beginning of the End - Lecture in Florida for Capstone Presentations, Sept. 1998

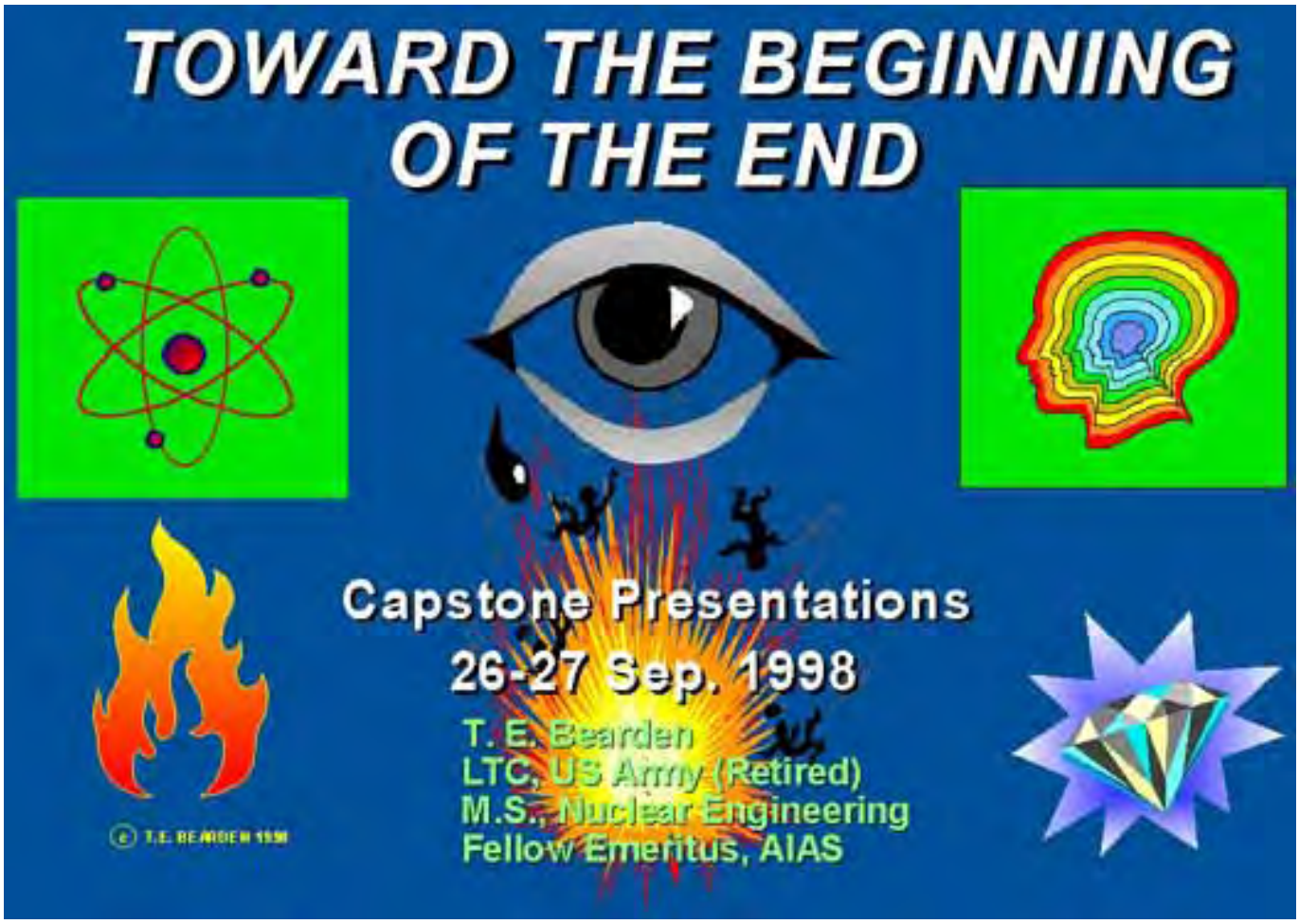

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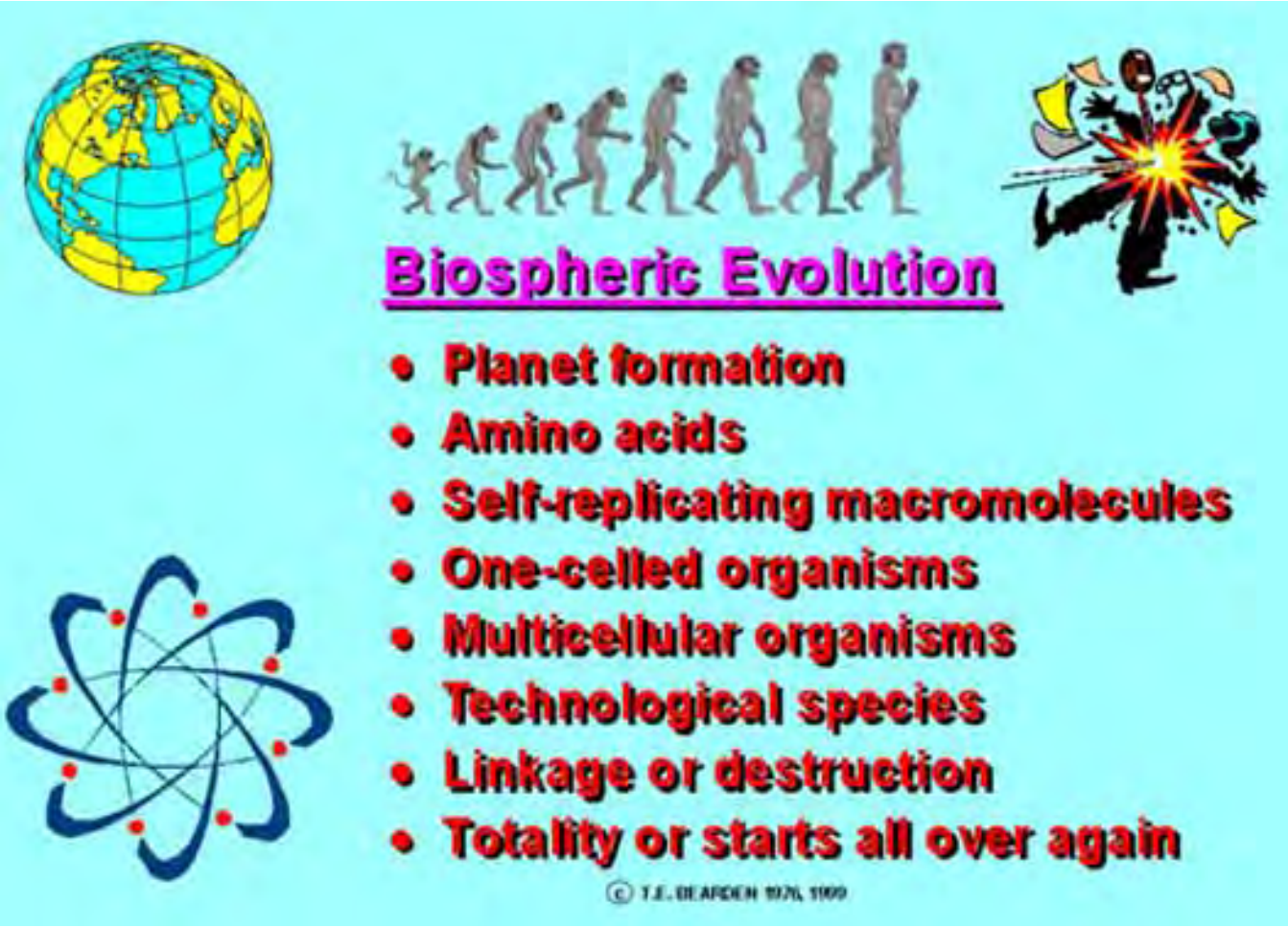

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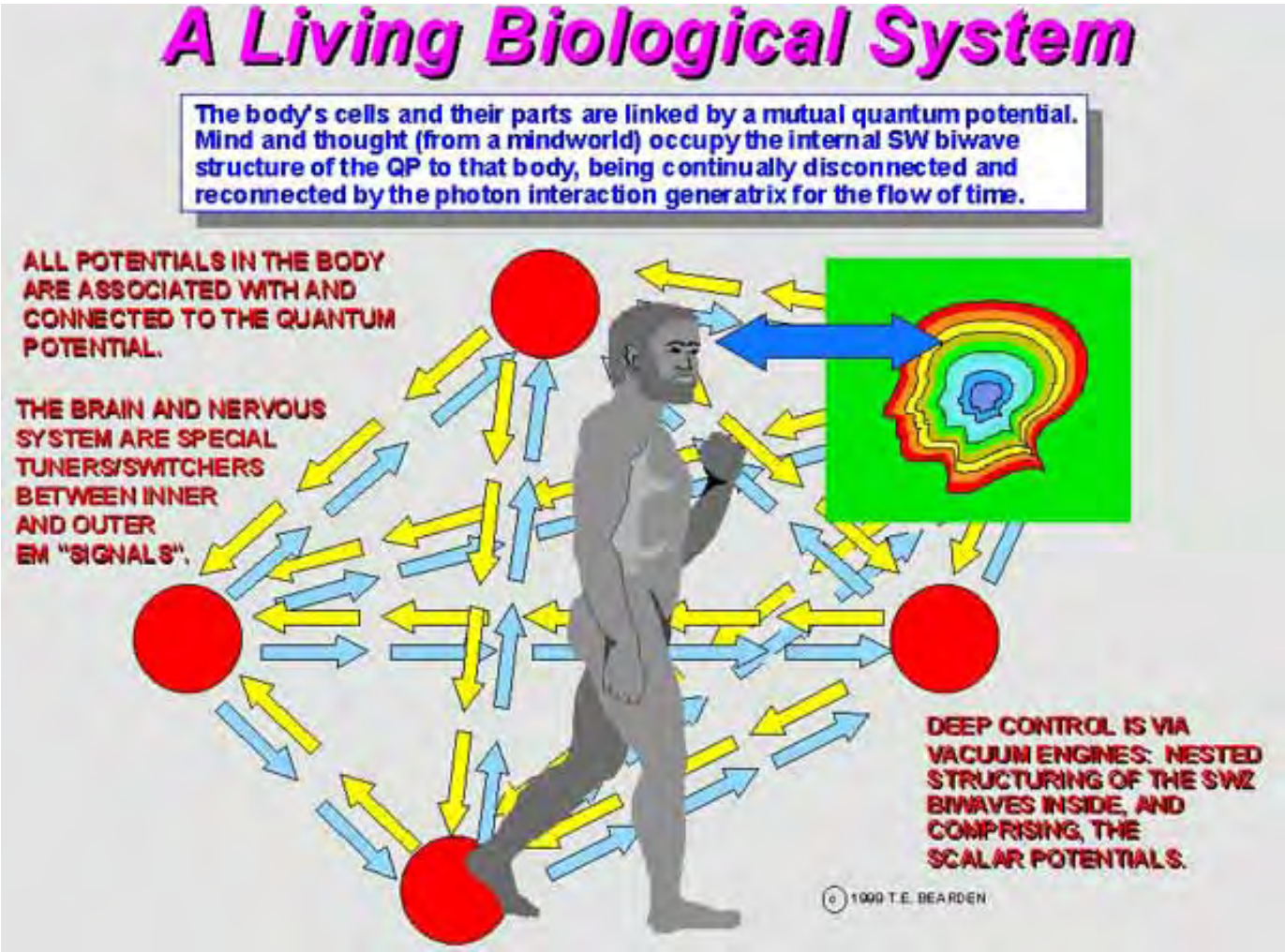

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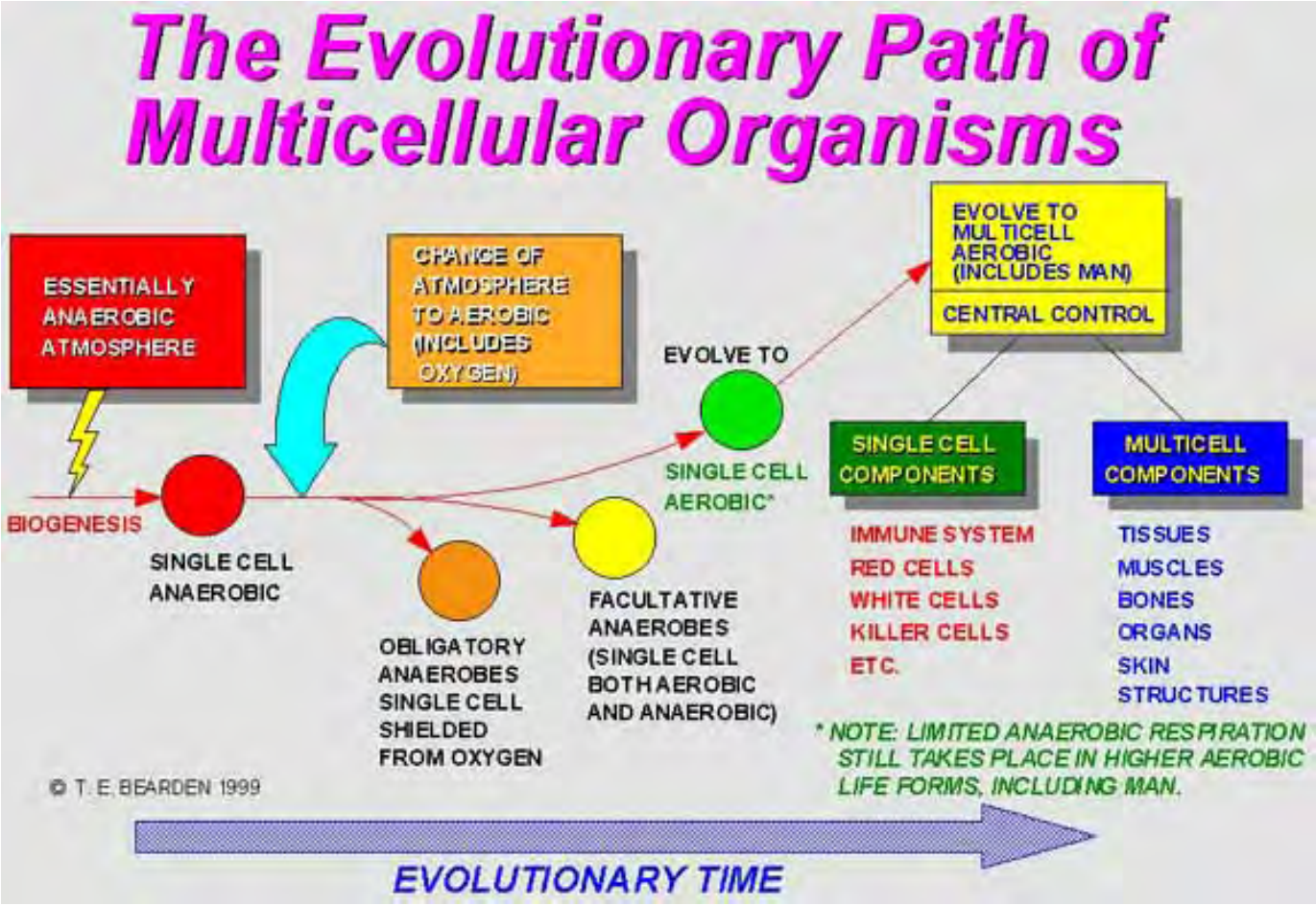

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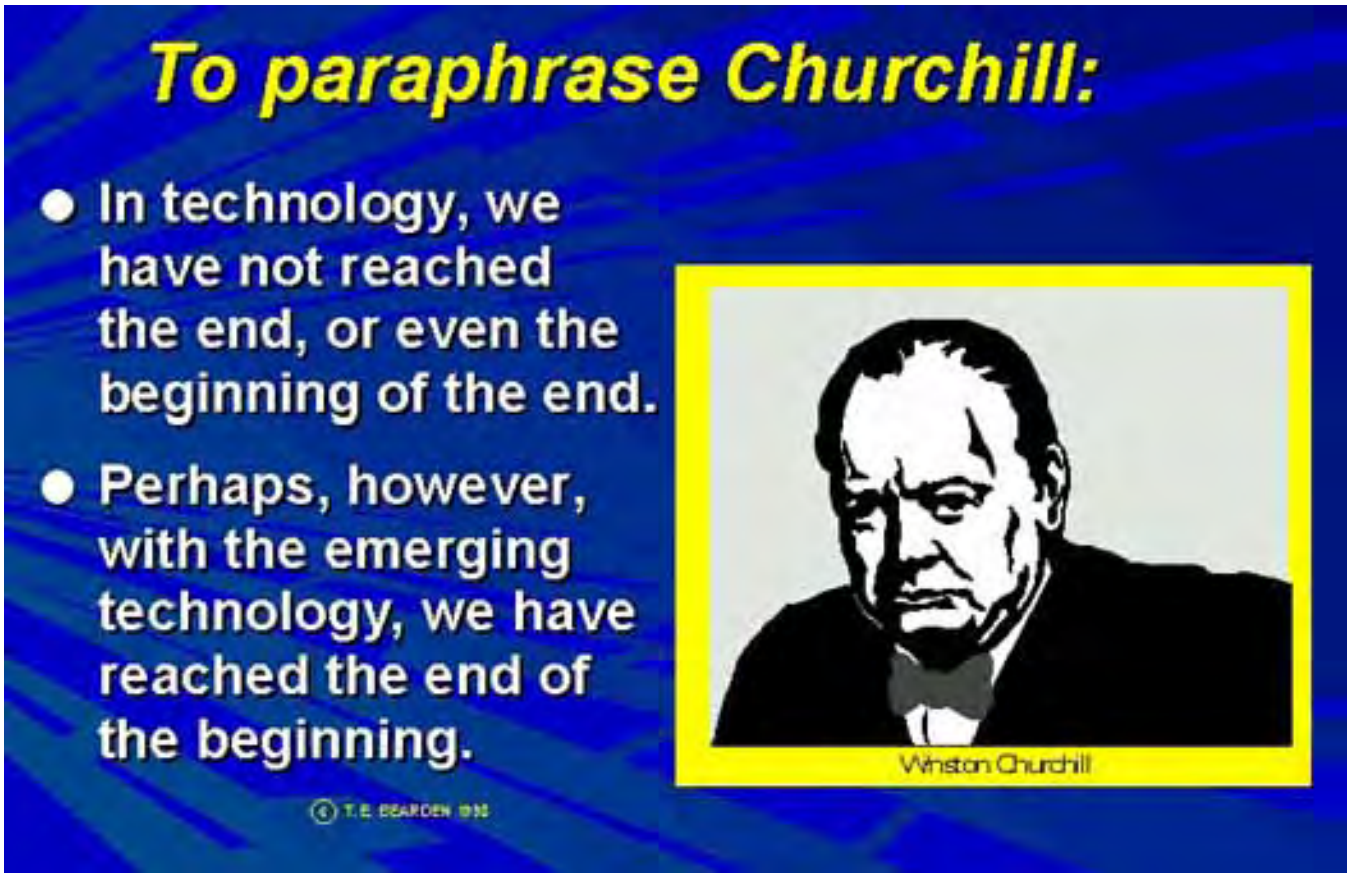

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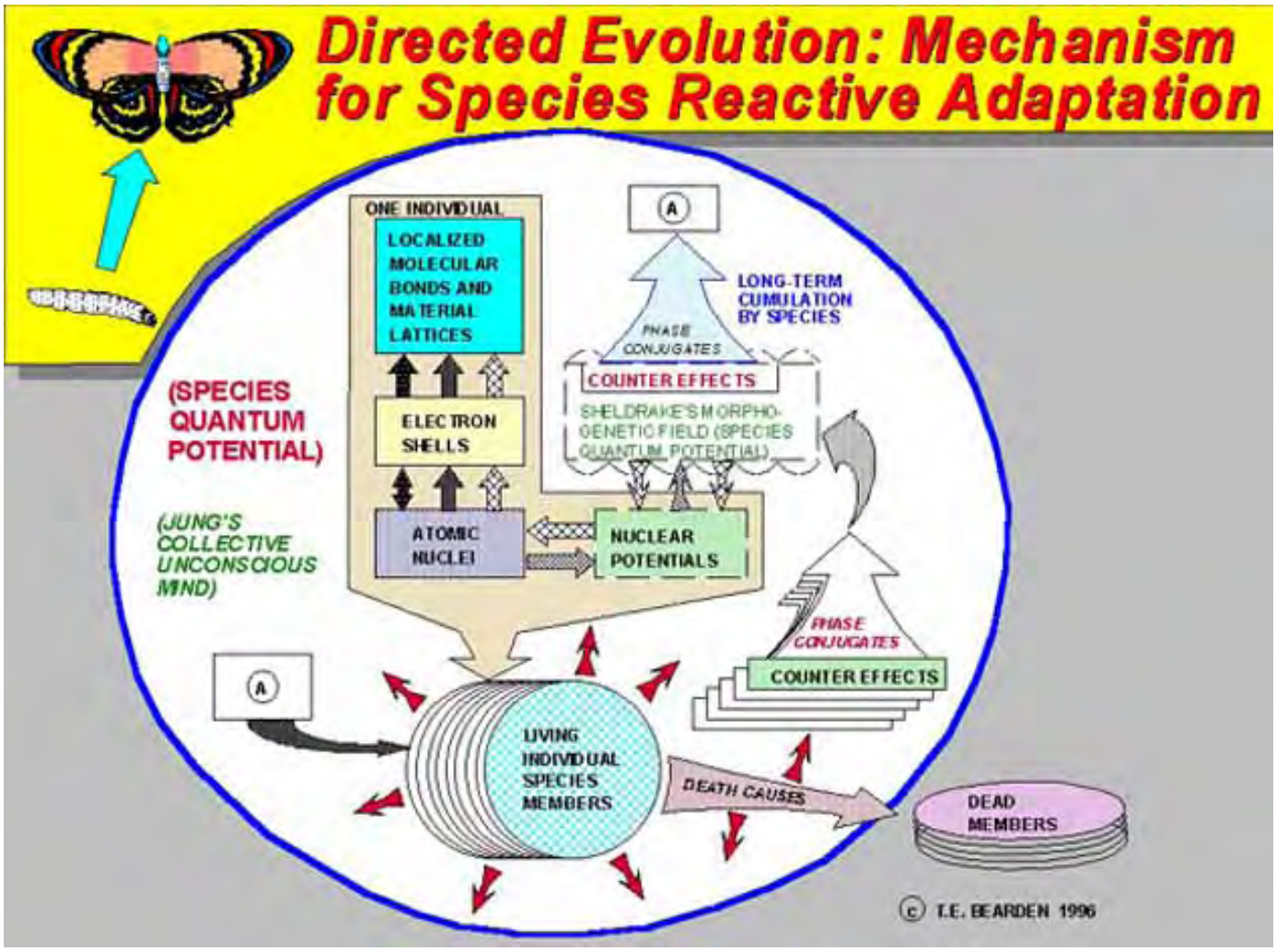

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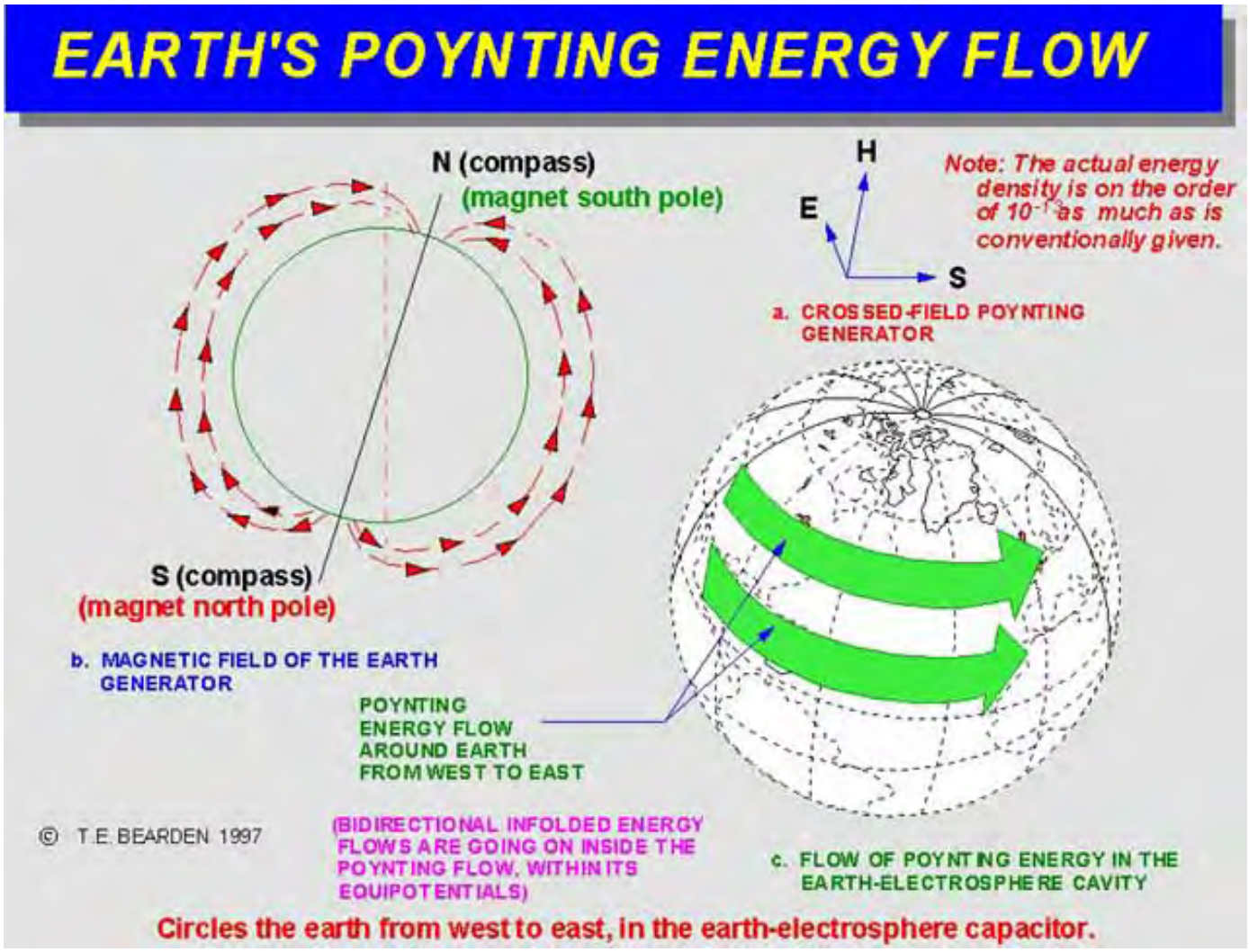

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Note: Should be 10^{13}

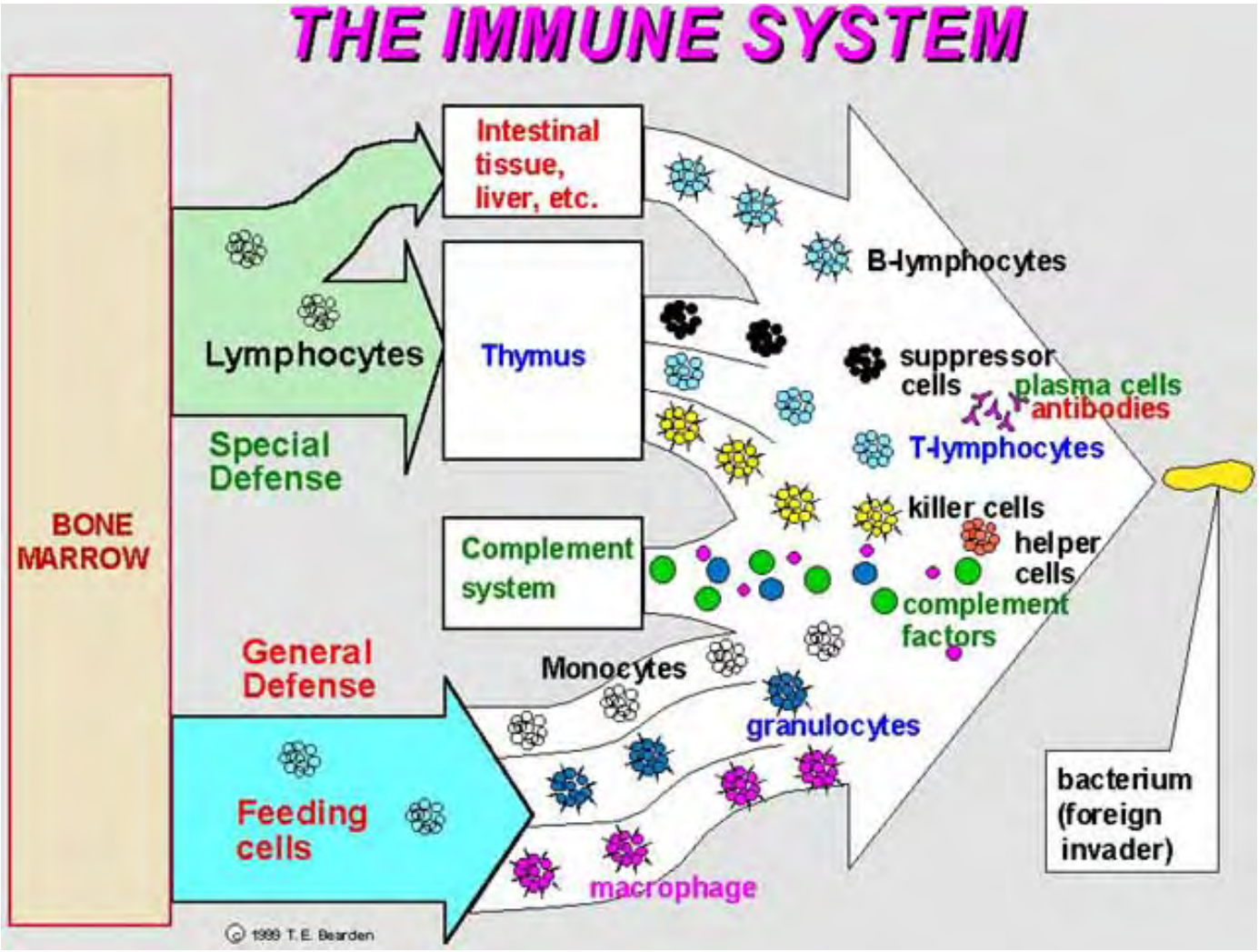

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Mind and Matter Interaction

- Living systems: matter, mind, life, death, time
- Function of the extended quantum potential
- Nature of conscious and unconscious mind
- Gaia and collective species unconscious mind
- EM topology vs. mind and matter interactions
- Paranormal phenomena: Mechanisms
- Unsuspected EM effects on biological systems
- Recovery system: Use of scalar "internal" EM
- Vacuum engines, death rays, and healing rays
- Priore's scalar EM therapeutic method
- Resolution of the fundamental technological species problem: The Lady or the Tiger?

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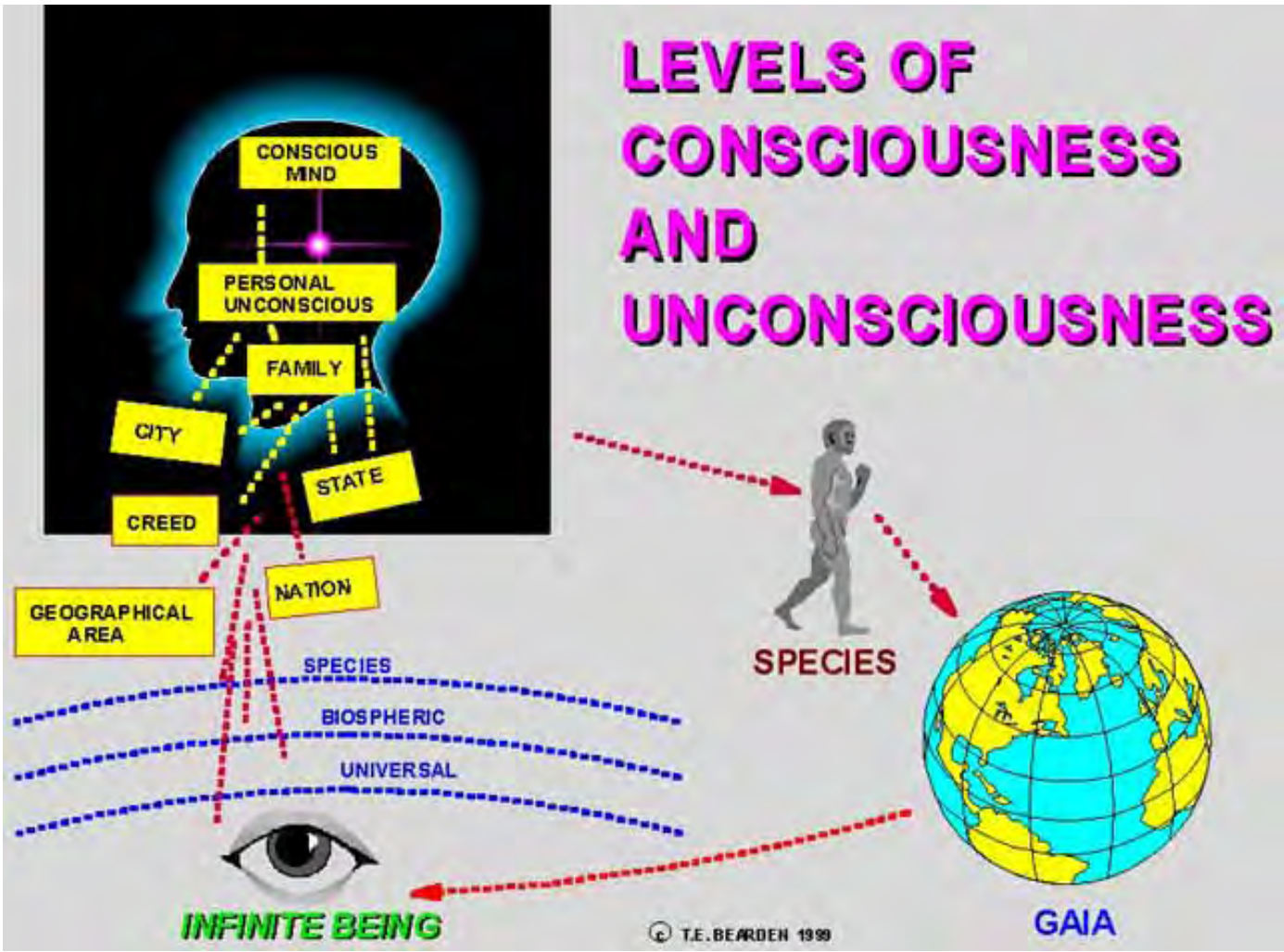

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Access to Mind, Memory, and Thought

- Internal Whittaker channels in Body
- Used for master control functions
  - Mind, memory, thought
  - Master cellular control
  - Immune system
  - Regenerative system
- Dynamics infolded inside longitidinal EM biwave structure of scalar potentials
- Gives access to mind and control software

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U.S. Intelligence Statement on Soviet Psi Research*

- Sooner or later, Soviets may be able to
  - Know:
    - Contents of documents
    - Troop and ship movements
    - Installation locations and nature
  - Mold thoughts at a distance
  - Disable equipment at a distance
  - Kill persons at a distance
- *Comment: Soviet psychoenergetics is a physics, not Western parapsychology. Much of this capability now exists and has been weaponized in action-at-a-distance weapons.*

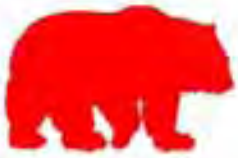

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*Controlled Offensive Behavior - USSR (U)
DIA Report ST-CS-01-169-72, July 1972

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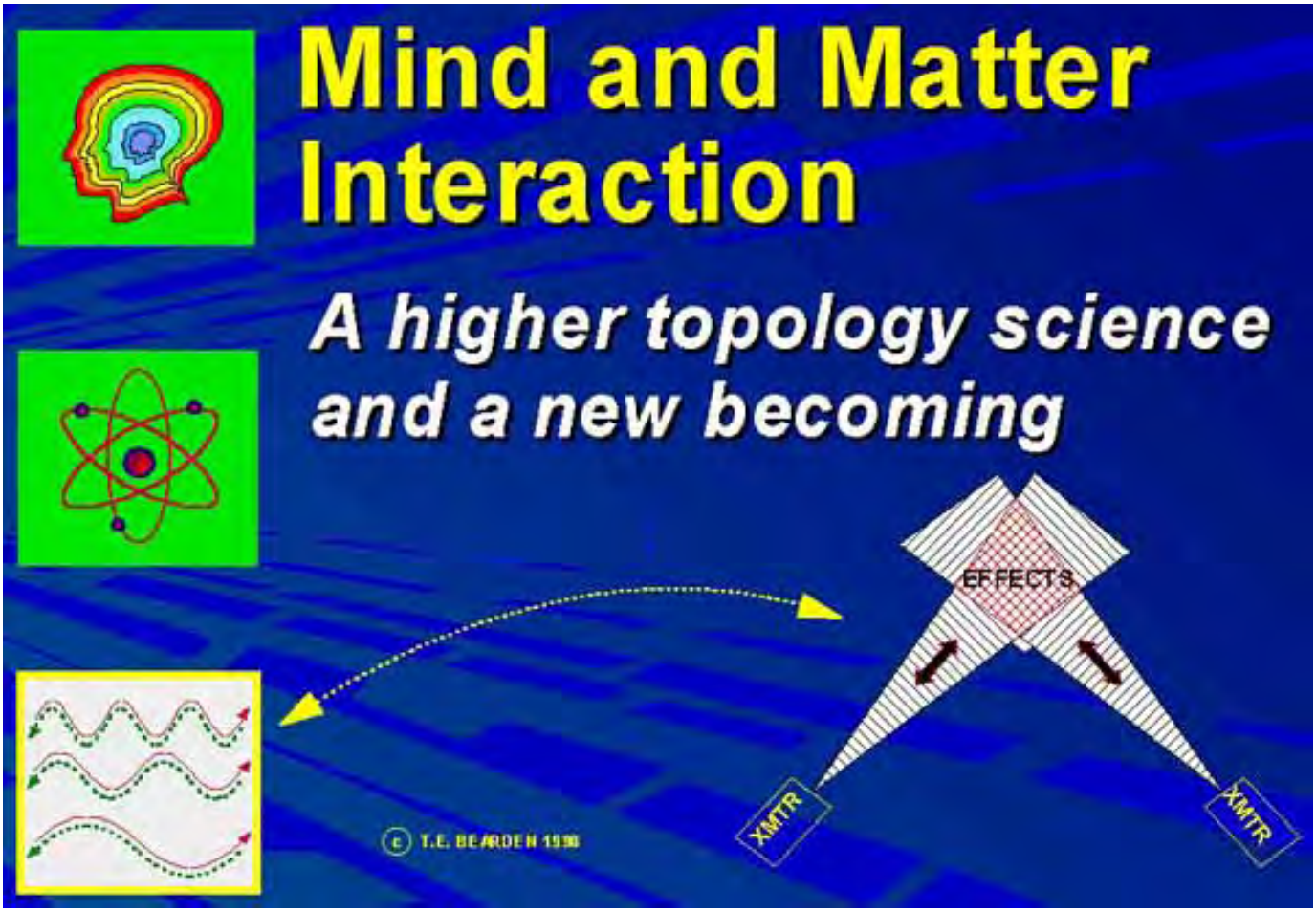

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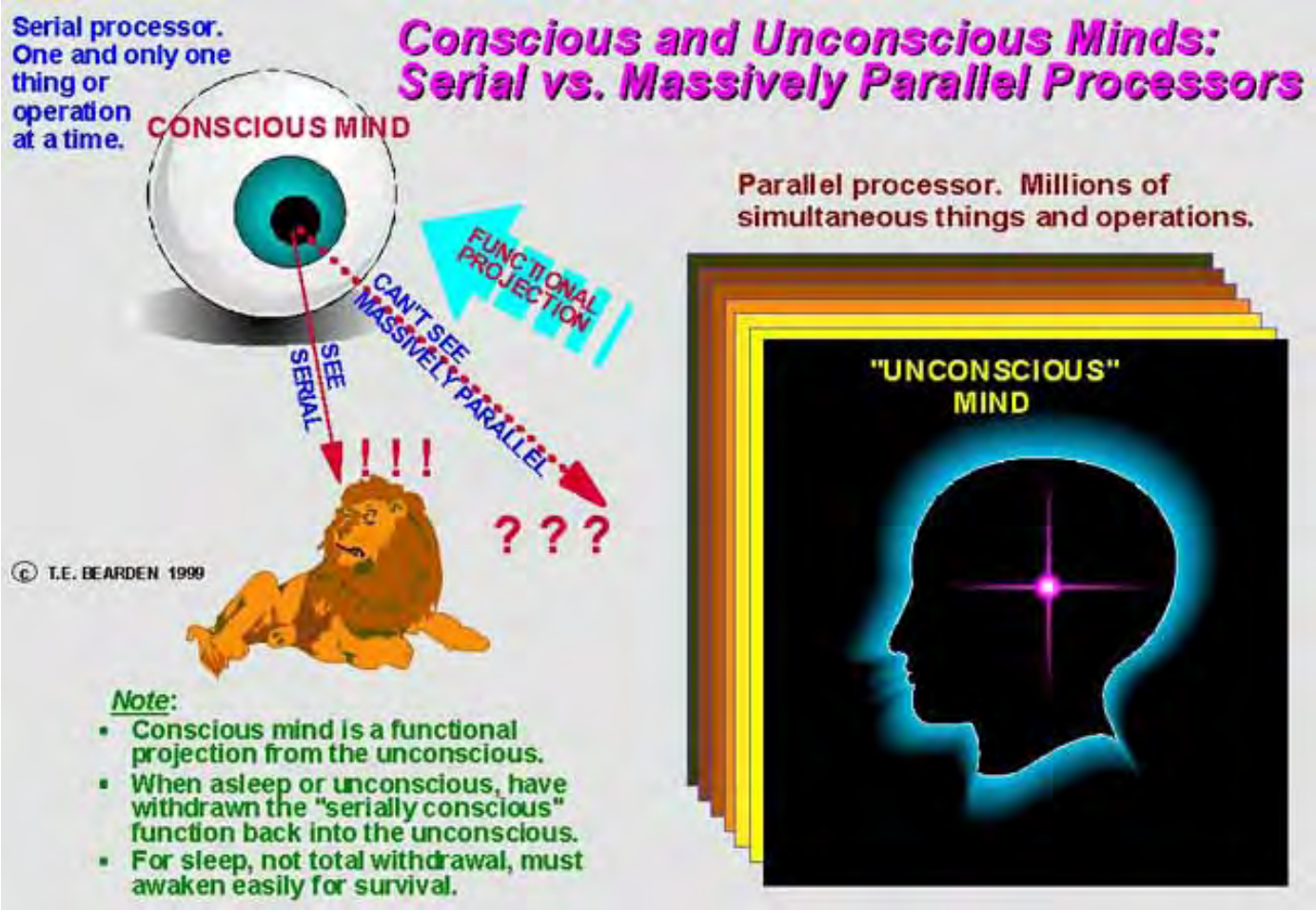

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Velocity Is Rotation

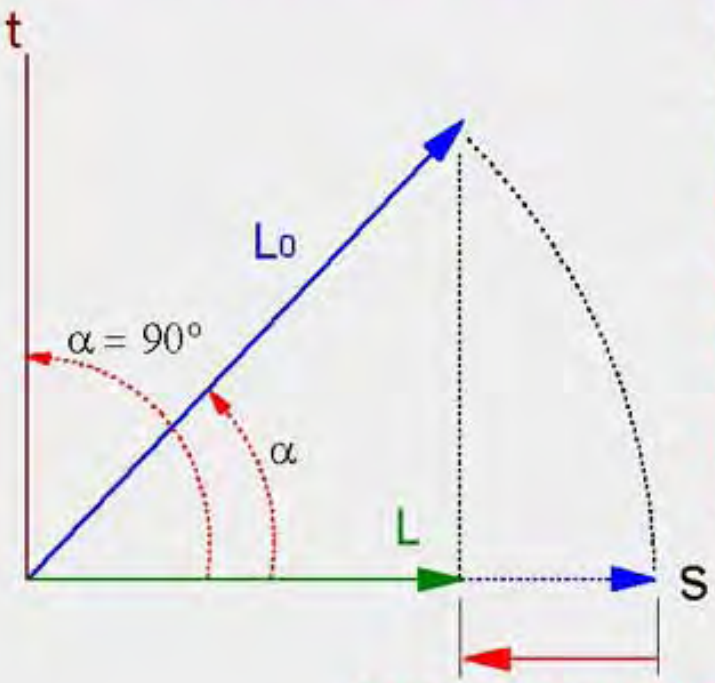

An object moving with velocity v < c has rotated slightly out of 3-space toward the time dimension. It's "projection" back into 3-space is shorter, providing the Lorentz-Fitzgerald contraction.

When velocity v = c, a full right-angle turn has been made, and the object has "lost" its projection along its direction of motion. Hence it appears as a 2-dimensional plane moving at the speed of light; in short, a photon or a light wave.

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Lorentz-Fitzgerald Contraction

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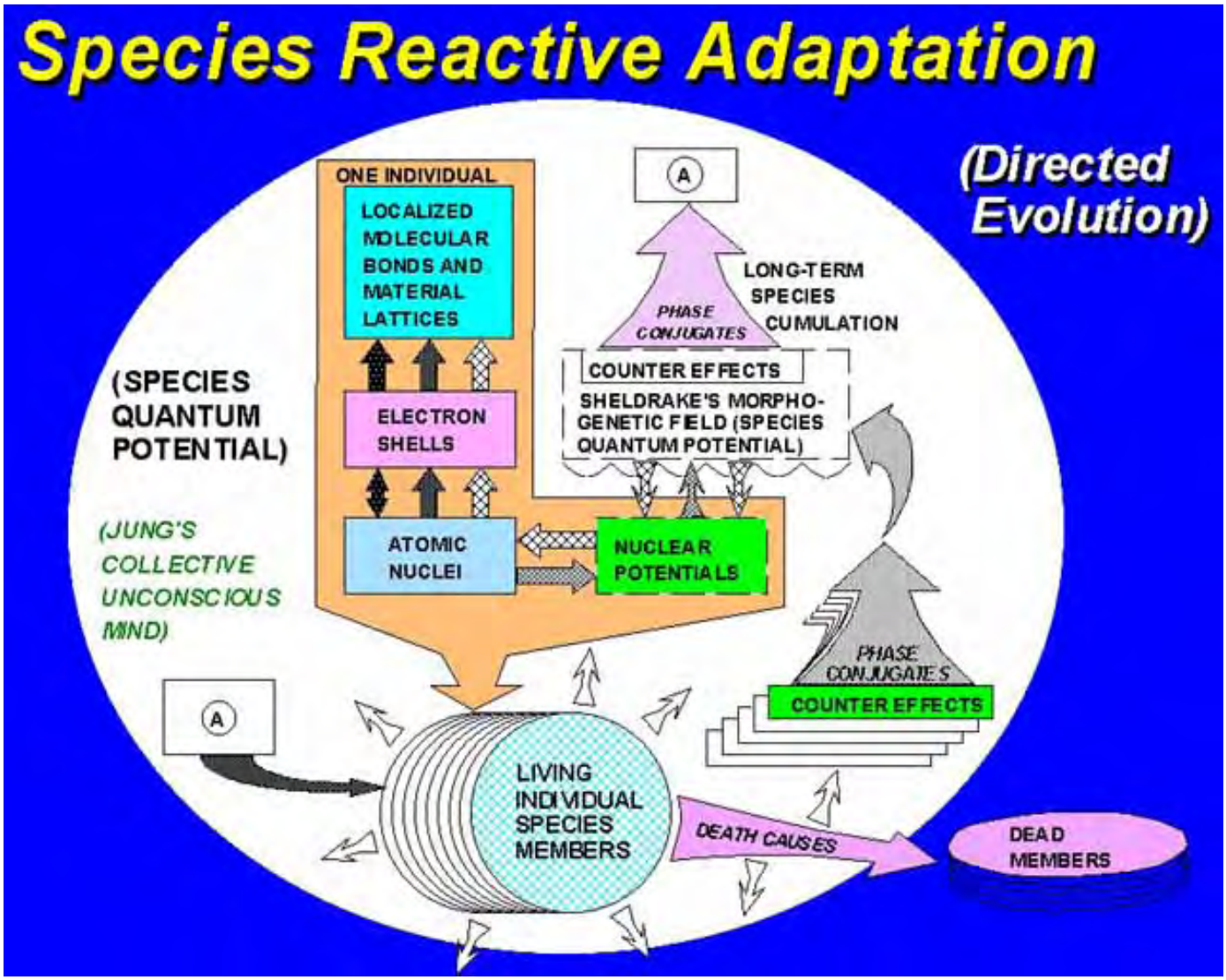

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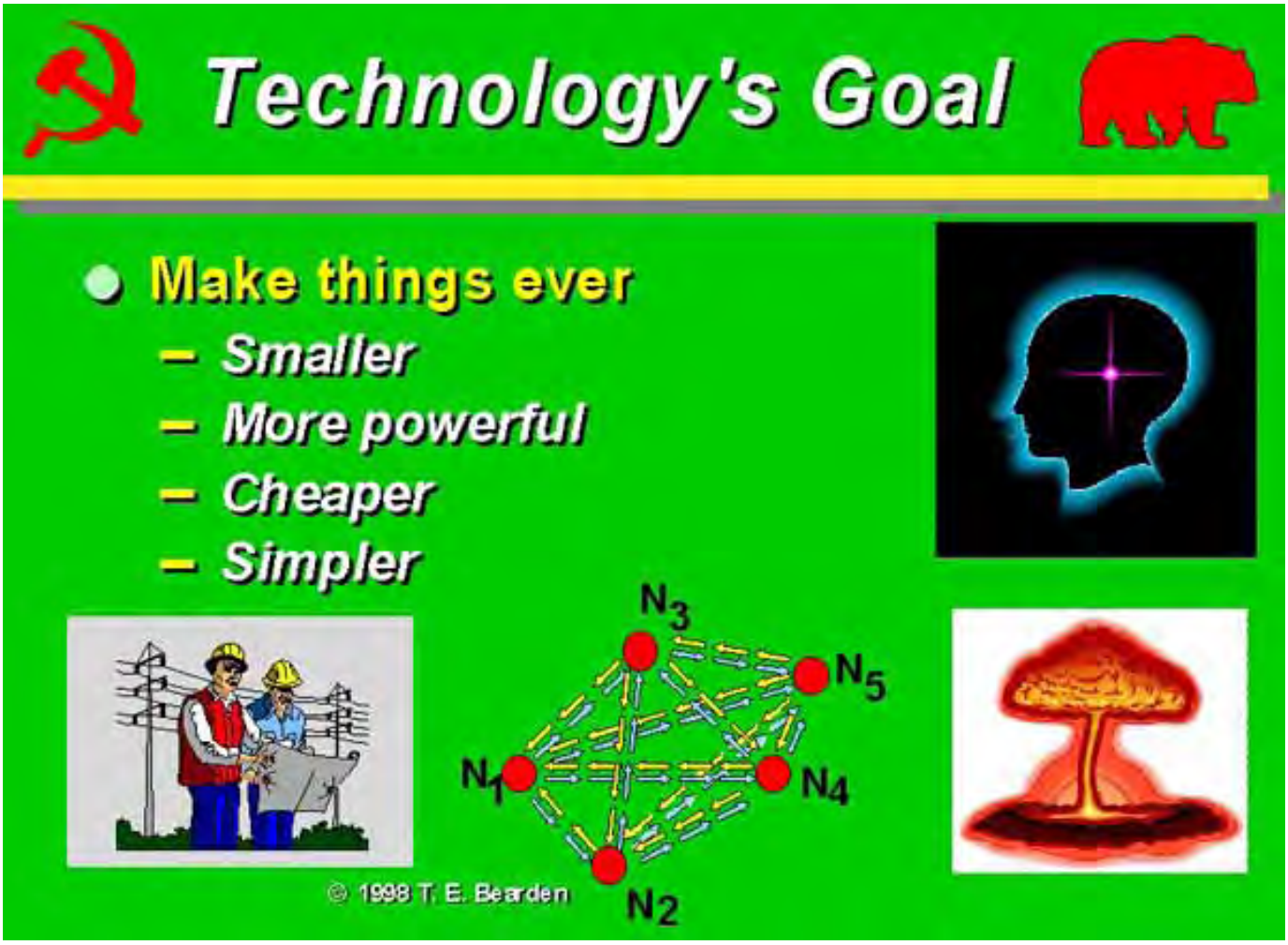

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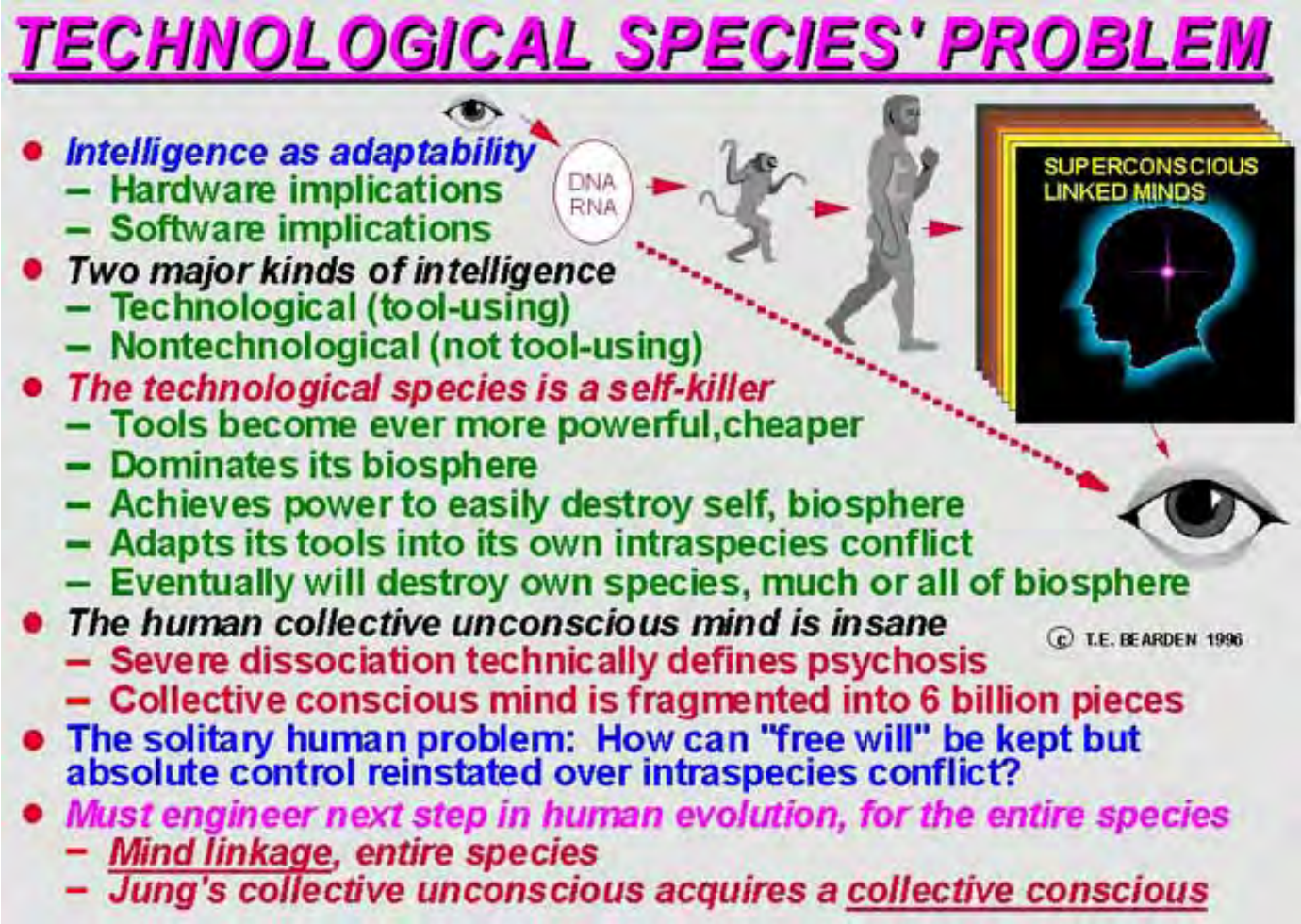

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The Missing Infolded Electro-dynamics

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3. Major Points (cont.)
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5. Extended General Relavity Principle
6. Active Spacetime and Specific Vacuum Engine
7. Electrodynamicists React to Removal of Material Ether
8. Reaction to Loss of Material Ether
9. Massless Spacetime Perturbations Not Addressed
10. Bunge on Status of Electrodynamics
11. Bunge (continued)
12. Poynting Energy Flow Along Two Parallel Conductors
13. Fields and potentials defined only in/on charged matter
14. Wave in String (Transverse)
15. Launching EM Wave from Wire Antenna
16. Phase Conjugate Wavepairs Produce New Waves
17. Time-Polarized (Scalar) EM Wave
18. Mechanism for flow of time
19. Present systems coefficient of performance (COP)<1.0
20. Bridging for Overunity
21. Free Energy Generator
22. Demonstration of Overunity Concept
23. Altered Spacetime Curvatures
24. Interaction of Mass and Spacetime Curvature
25. Composition of Scalar Potential
26. Lorenz Closed Surface Integration
27. How can they use that old physically insignificant wind?!!
28. Vacuum Engines: Spacetime Demons
29. Undistorted Progressive Waves (1)
30. Undistorted Progressive Waves (2)
31. Other Superluminal Waves
32. Becker's Experiments: Healing Bone Fractures
33. Producing a Specific Spacetime Curvature Engine
34. Pumping A Phase Conjugate with Transverse EM

35. Differentiation and Dedifferentiation
36. First Step to Cancer: Hypoxia
37. Longitudinal Photon Interaction with Charge
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74. Time Reversal of Mass to a Form Not in Its Past
75. Cellular R&R System

76. Portable Prioré Treatment System
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81. Cellular Evolution
82. Becker's Regeneration System
83. Becker's Control System Responds to Injury
84. Casualties Surviving Conventional Treatment
85. "Time as fuel" is the future

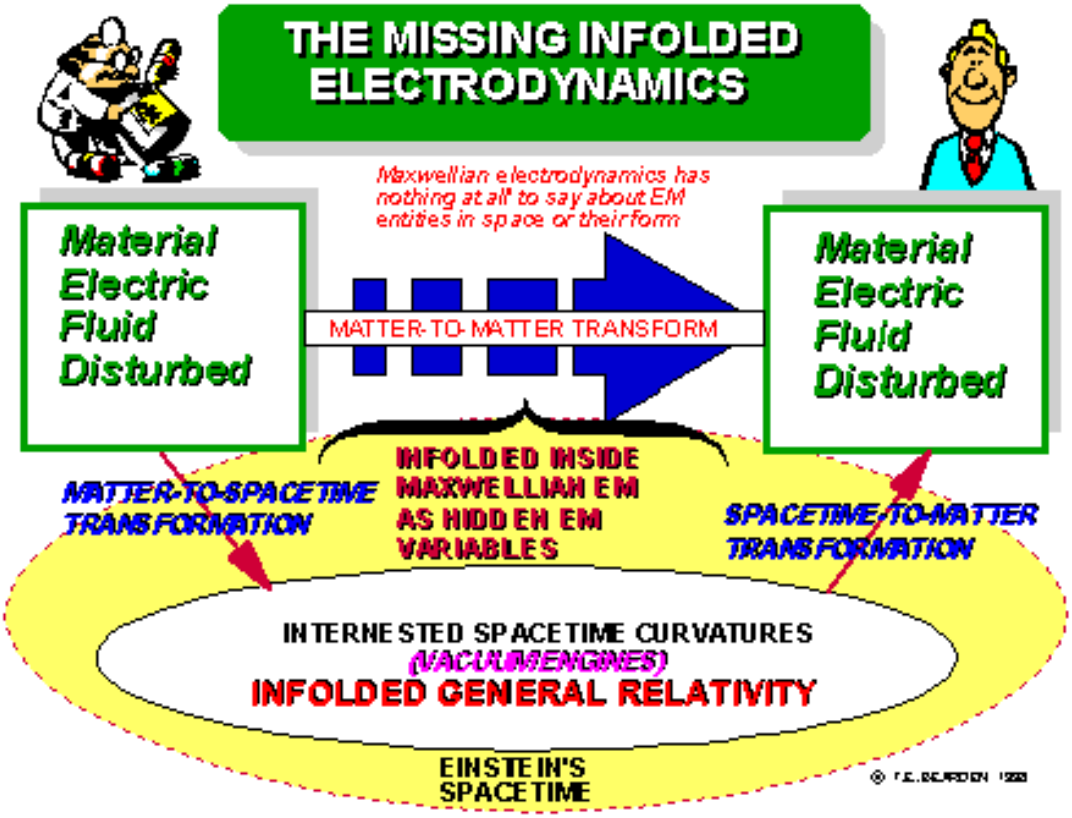

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Major Points of Presentation

- Electrodynamic is seriously flawed
  - Some major flaws
  - Corrections indicated
- Why past corrective attempts failed
  - Force field concept is material
  - Missing two infolded transforms (M->ST; ST->M)
- Missing Infolded general relativity inside electrodynamics
- Several Kinds of EM Waves in Space
  - How to make
  - Transduction
- A French medical example as a deep experimental demonstration
  - Spectacular regenerative cures funded by French Govt
  - Not comprehended, therefore suppressed
- Cold Fusion examples of time-density wave effects
  - China Lake instrumental anomalies in electrolysis
  - Explanation of anomalous behavior of instruments
  - Explanation of new nuclear reactions
  - Wave energy transduction provides excess heat
- Urge theorists to consider dramatically new reactions

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Major Points of Presentation

- Electrodynamic is seriously flawed
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MTW's General Relativity Principle

- "Space acts on matter, telling it how to move.
- In turn, matter reacts back on space, telling it how to curve."

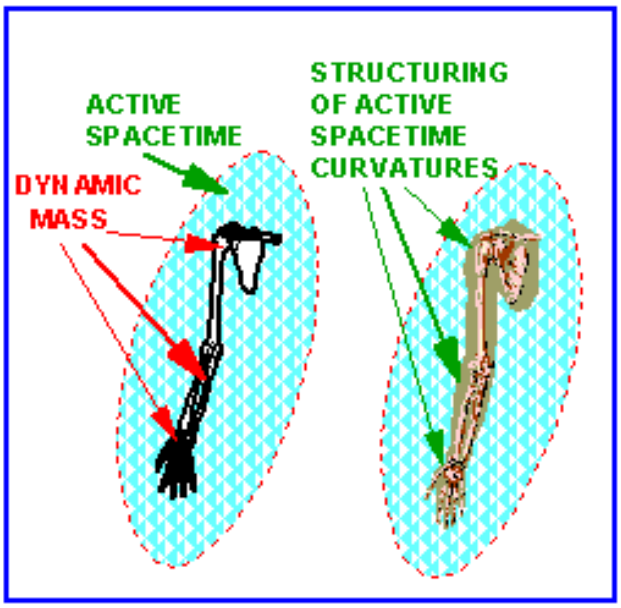

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Extended General Relativity Principle

- "All levels of energy structures and all levels of time structures mold spacetime geometry.
- This is called a *vacuum engine* (spacetime engine).
- Spatial and temporal structuring act upon mass at all levels.
- This produces *templates* of forces, for translations and stresses."

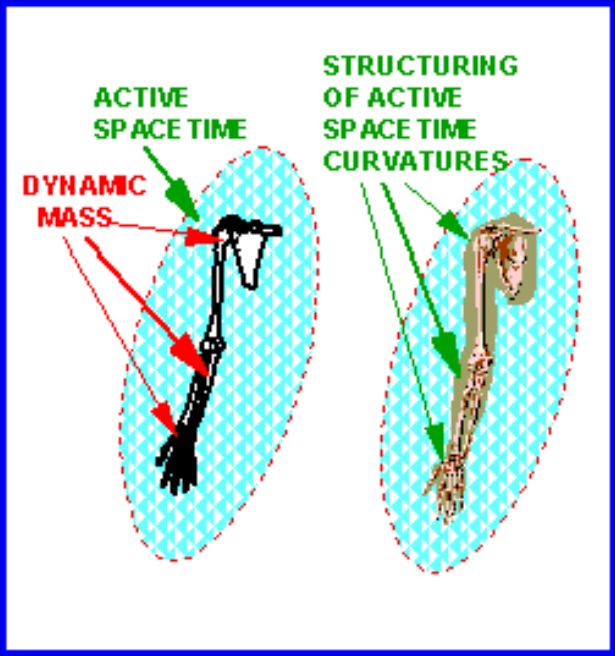

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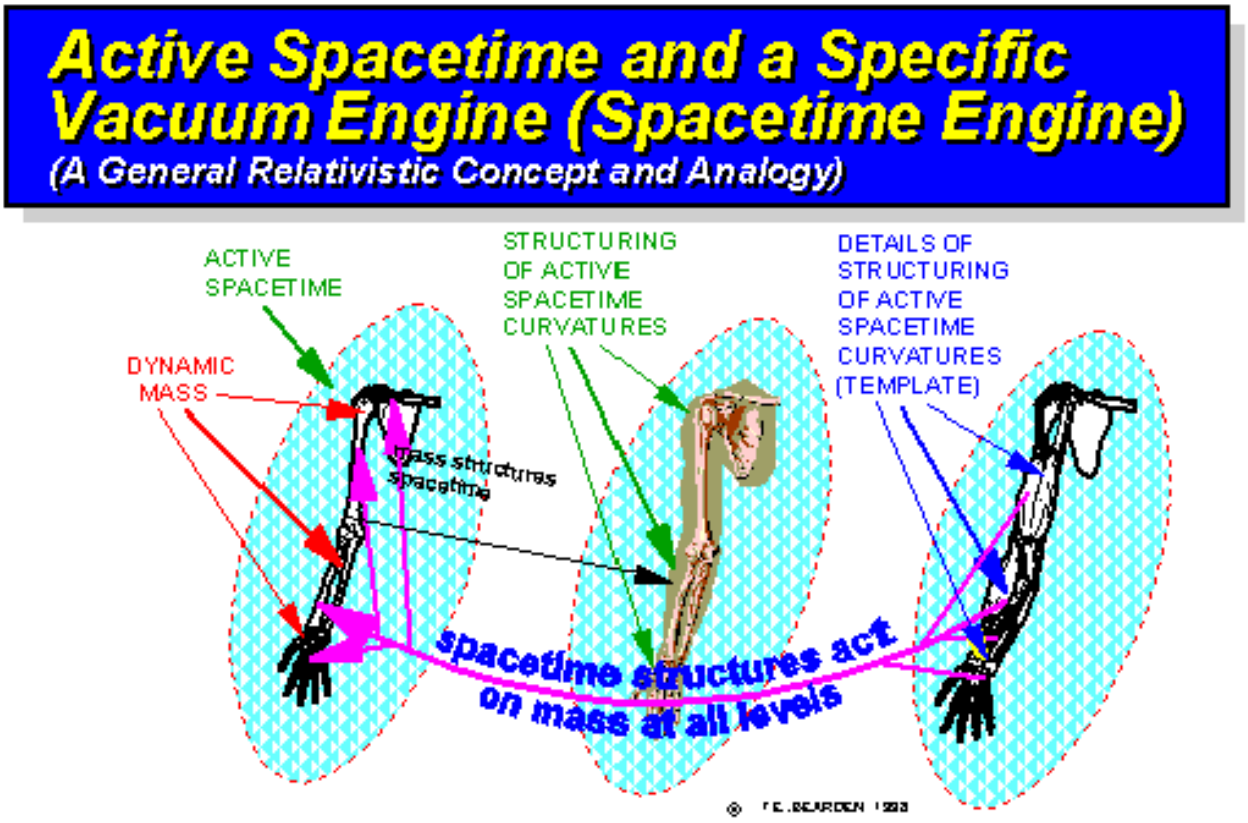

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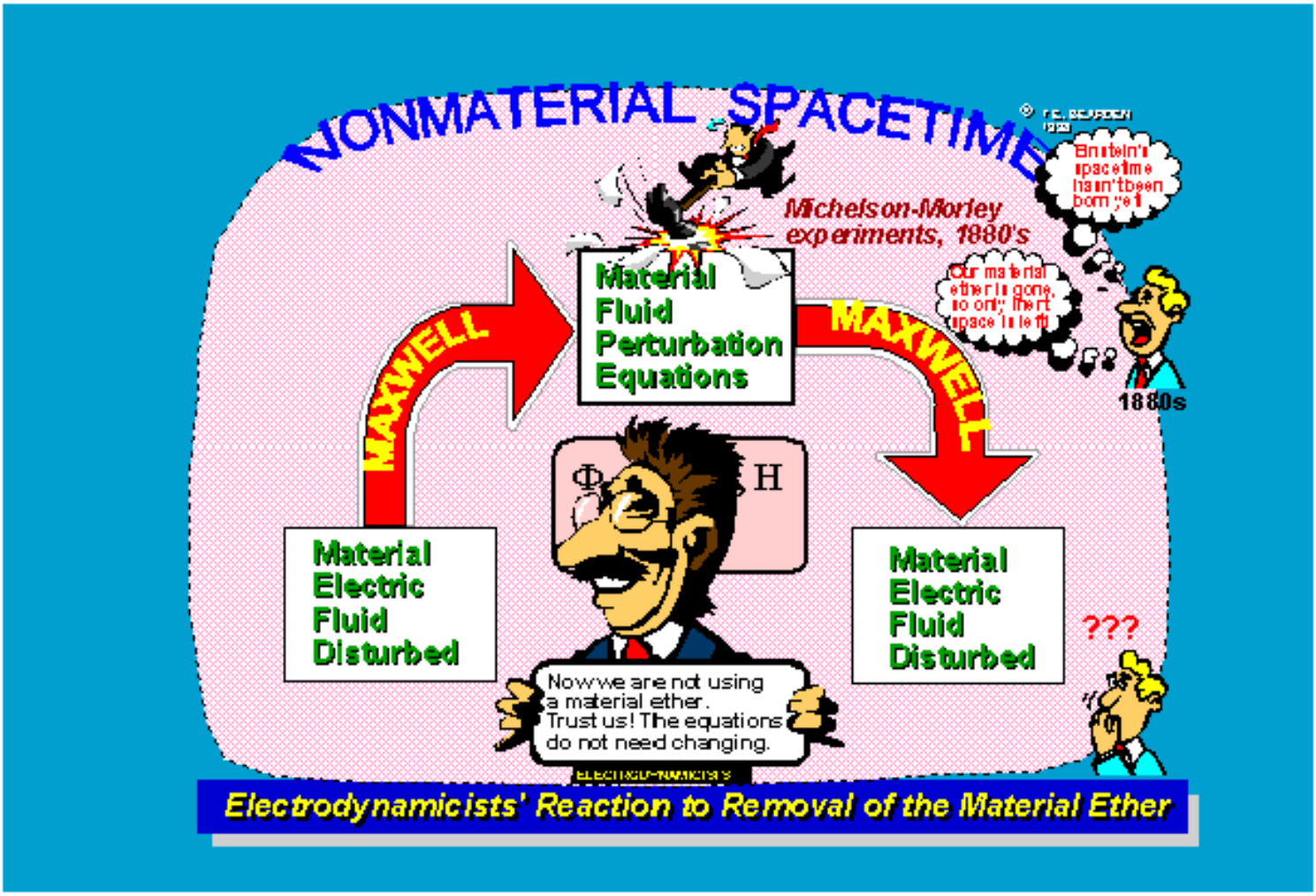

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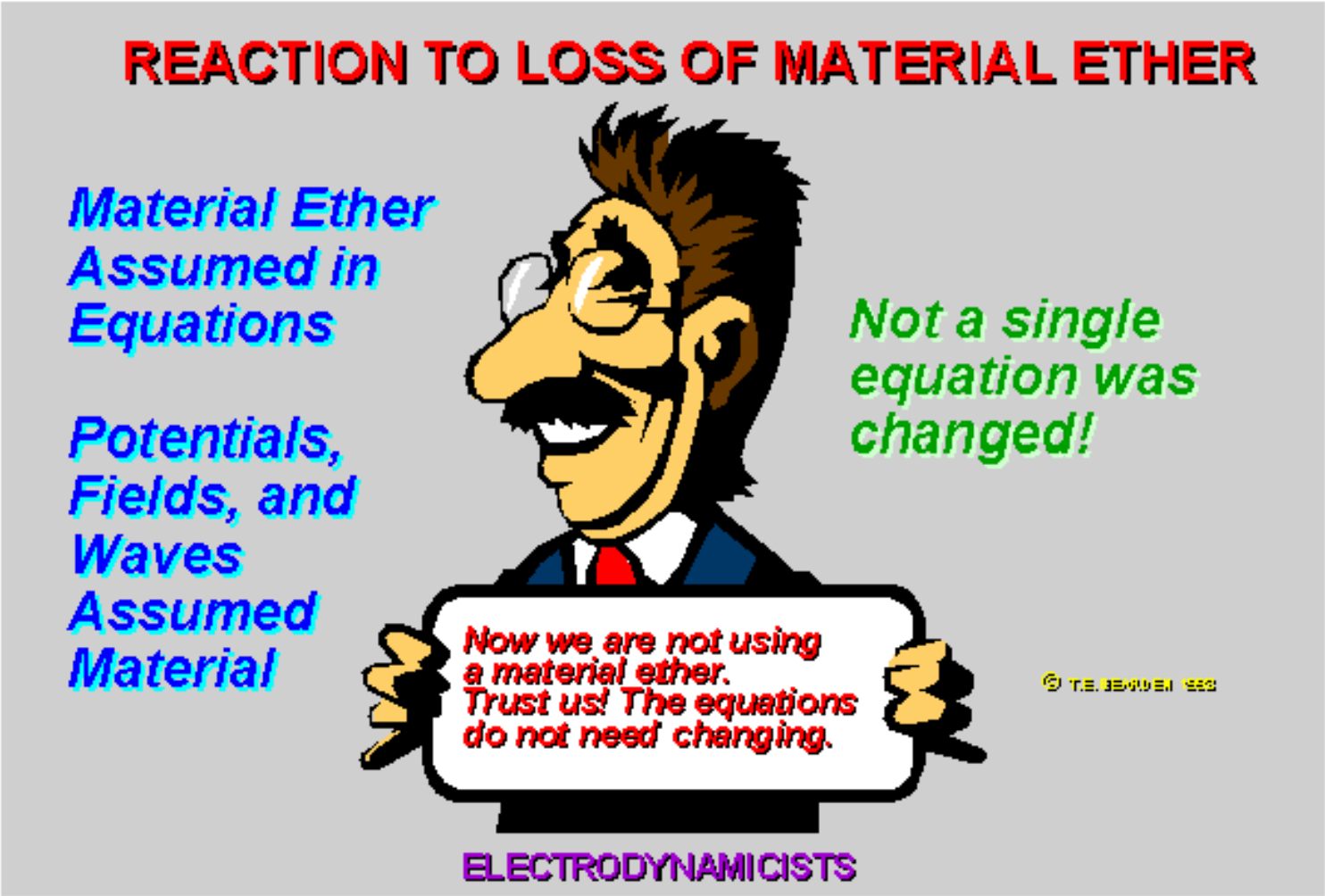

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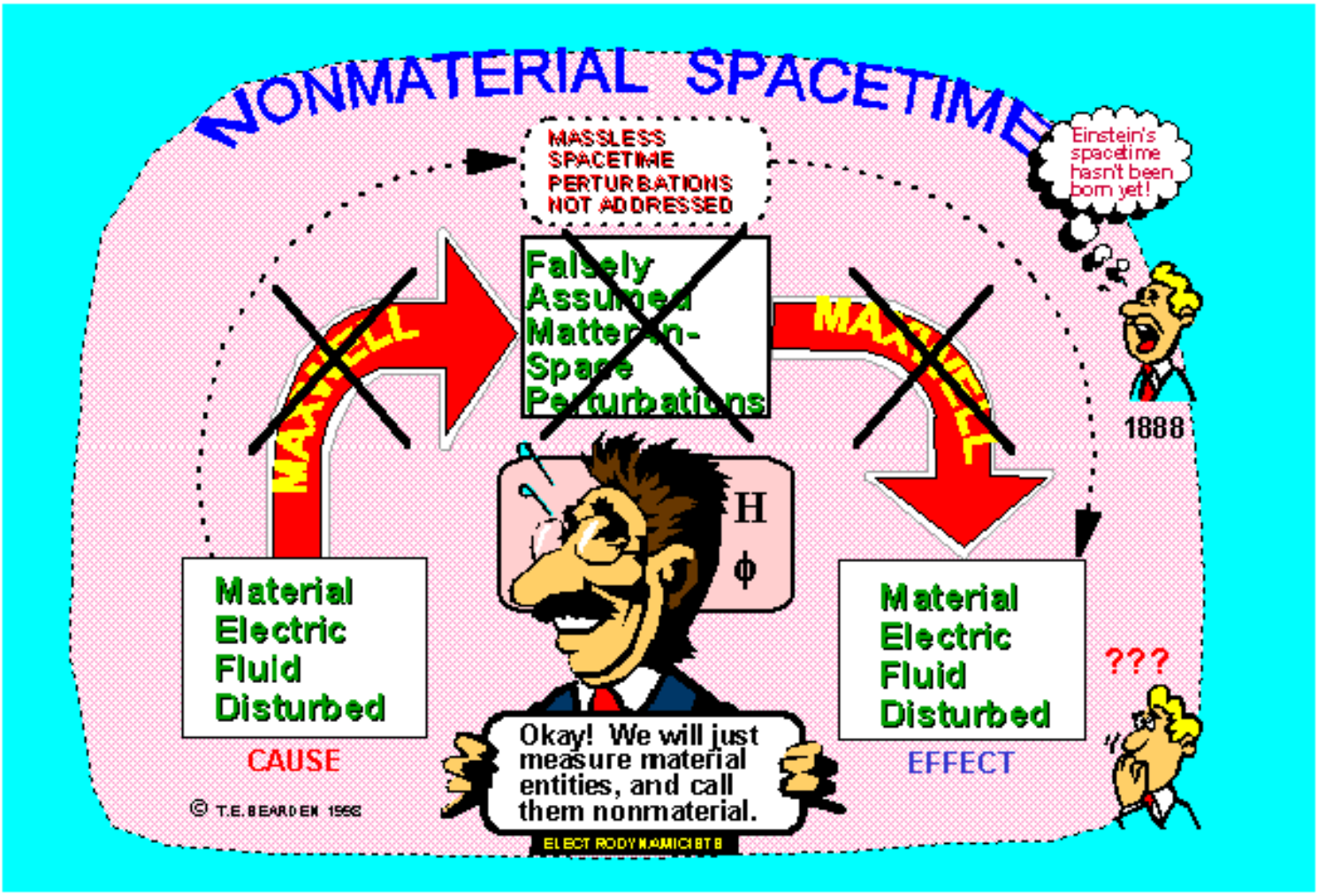

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Bunge on the Status of Electrodynamics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state..."

"... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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Bunge on the Status of Electrodynamics and Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state...

"... neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

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*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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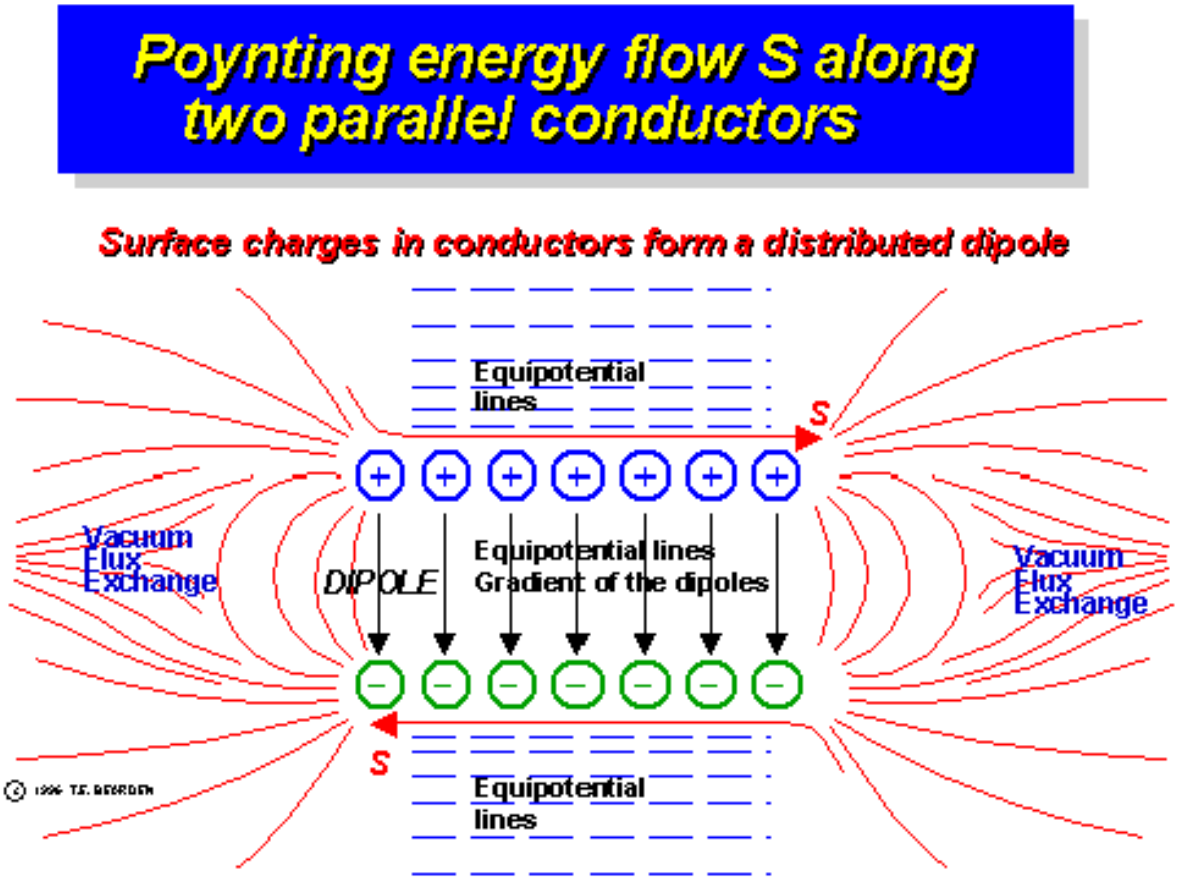

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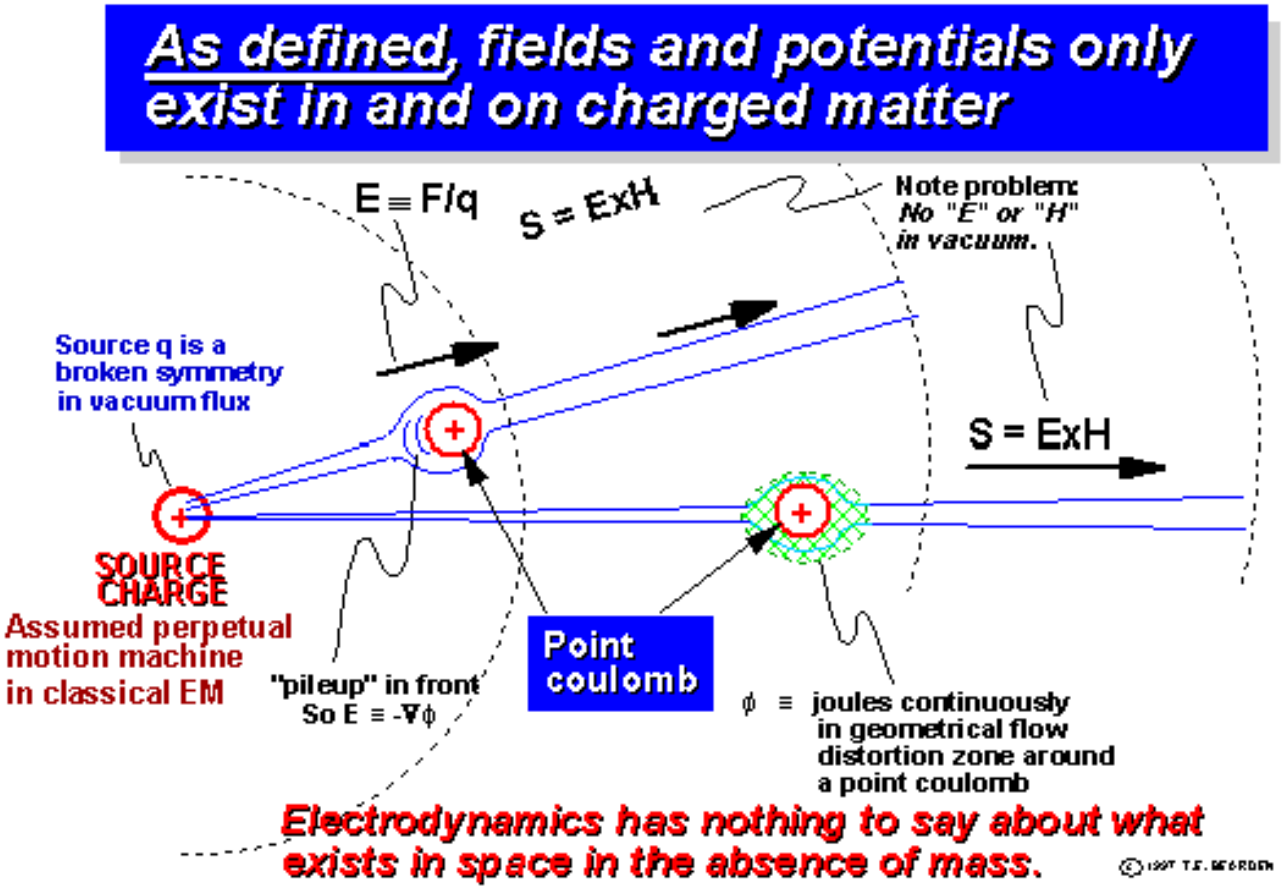

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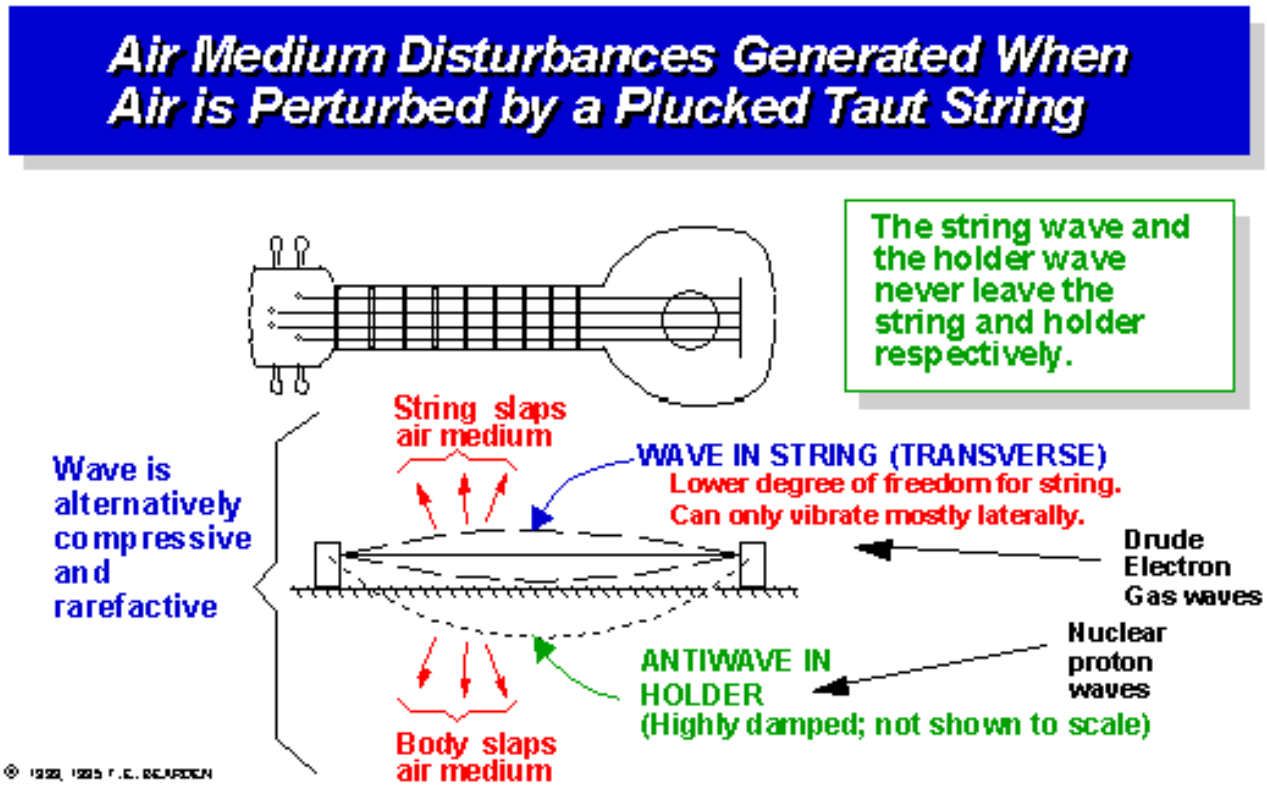

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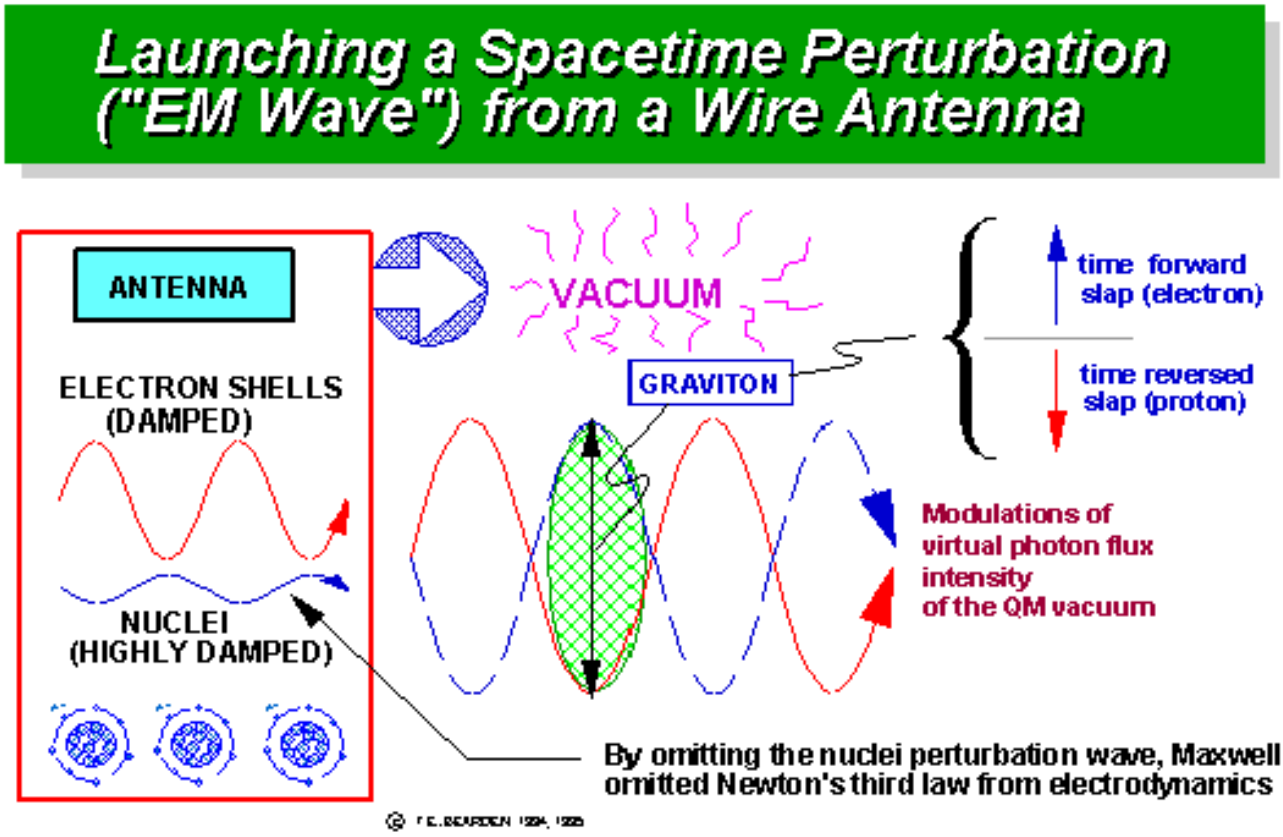

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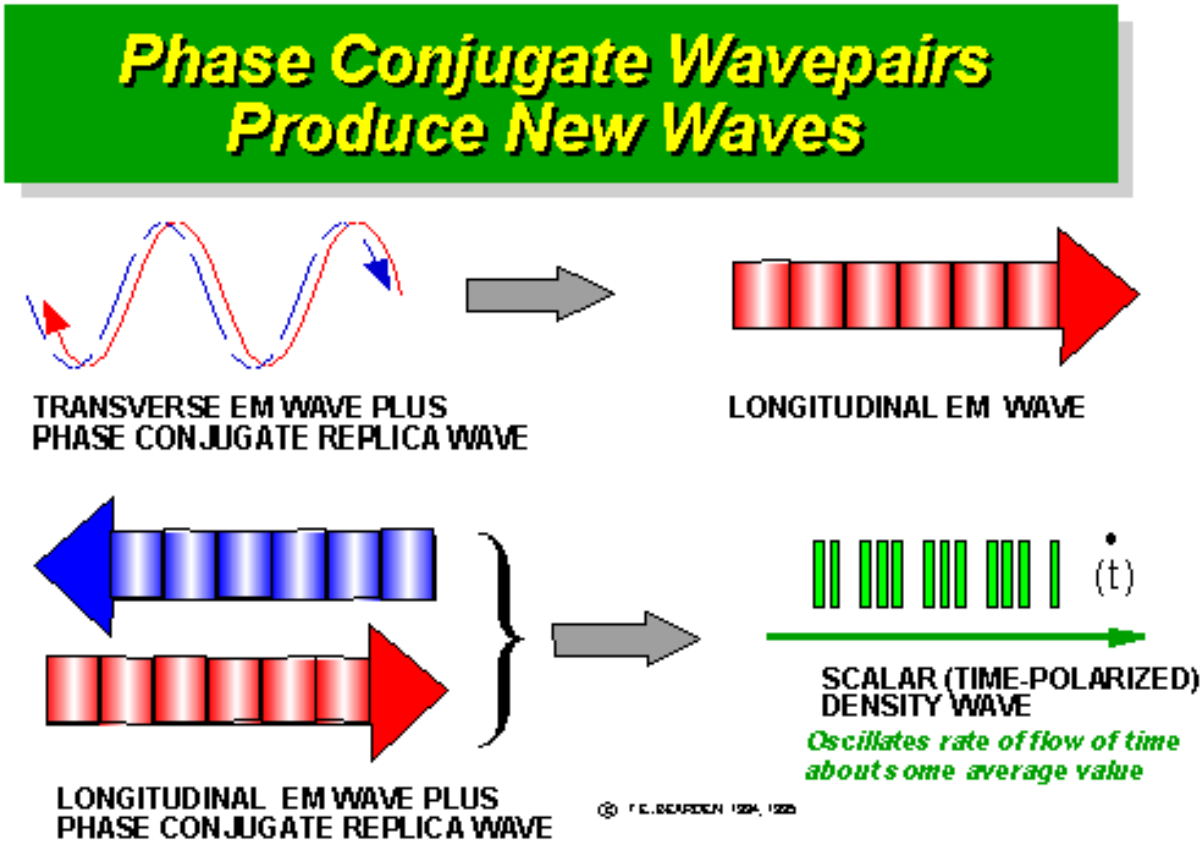

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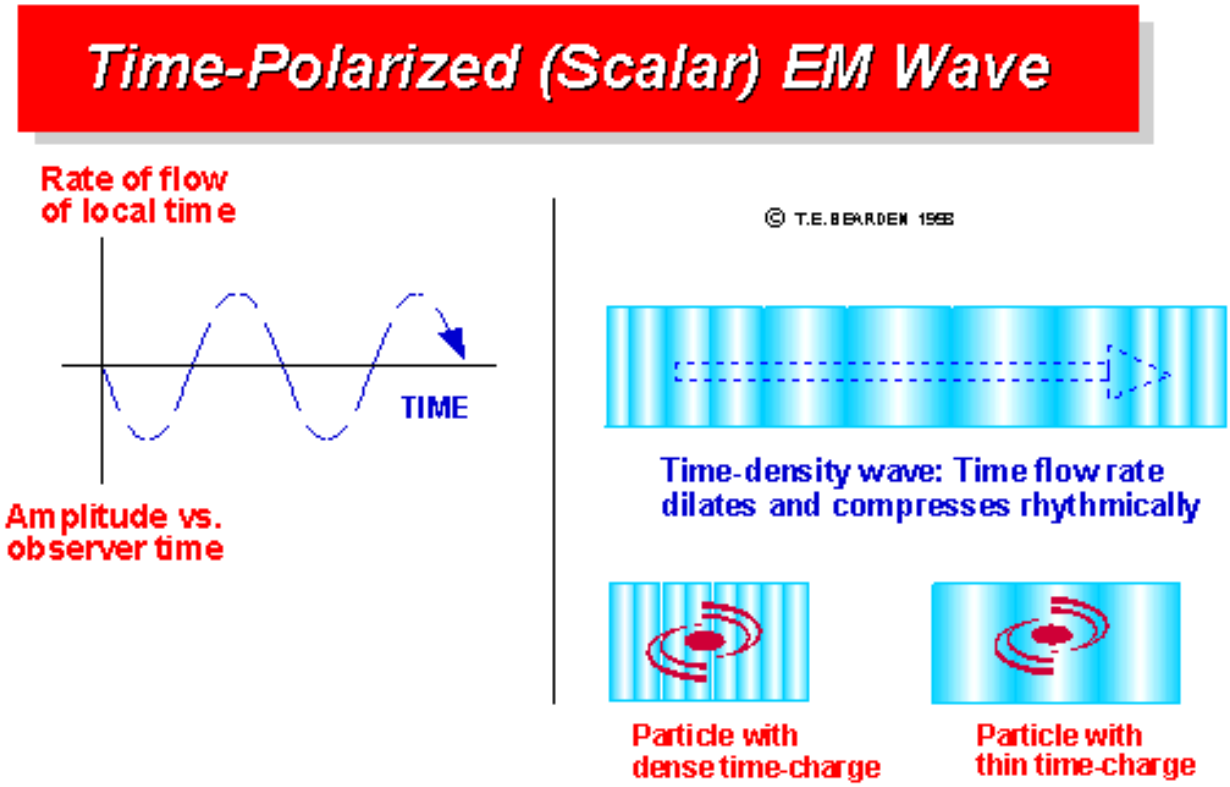

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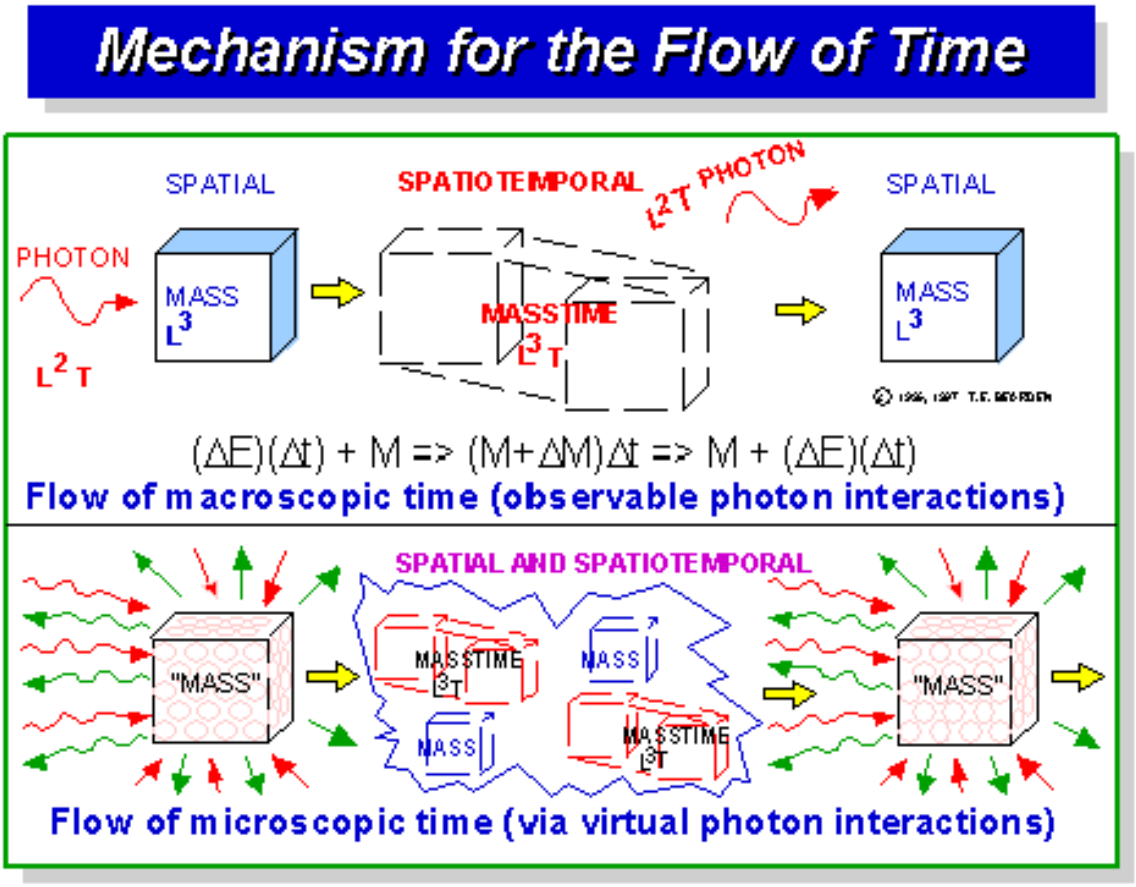

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WHY PRESENT SYSTEMS HAVE COP < 1.0

Dissipative power inside source = VI_T and $VI_T > FI_L$

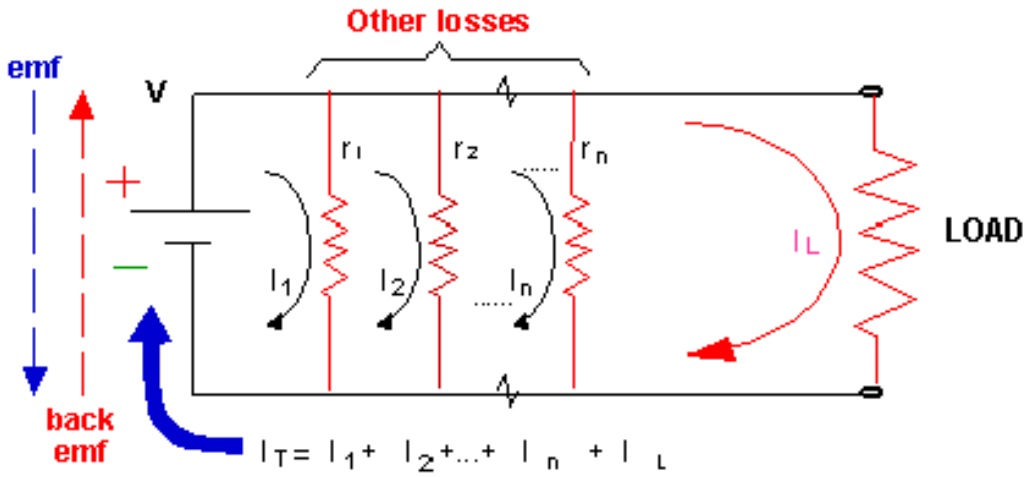

$$I_T = I_1 + I_2 + \ldots + I_n + I_L$$

$$\text{Eff} = \frac{P_L}{P_T} = \frac{V \times I_L}{V \times I_T} = \frac{I_L}{I_T}$$

$I_T > I_L$; so Eff < 1.0

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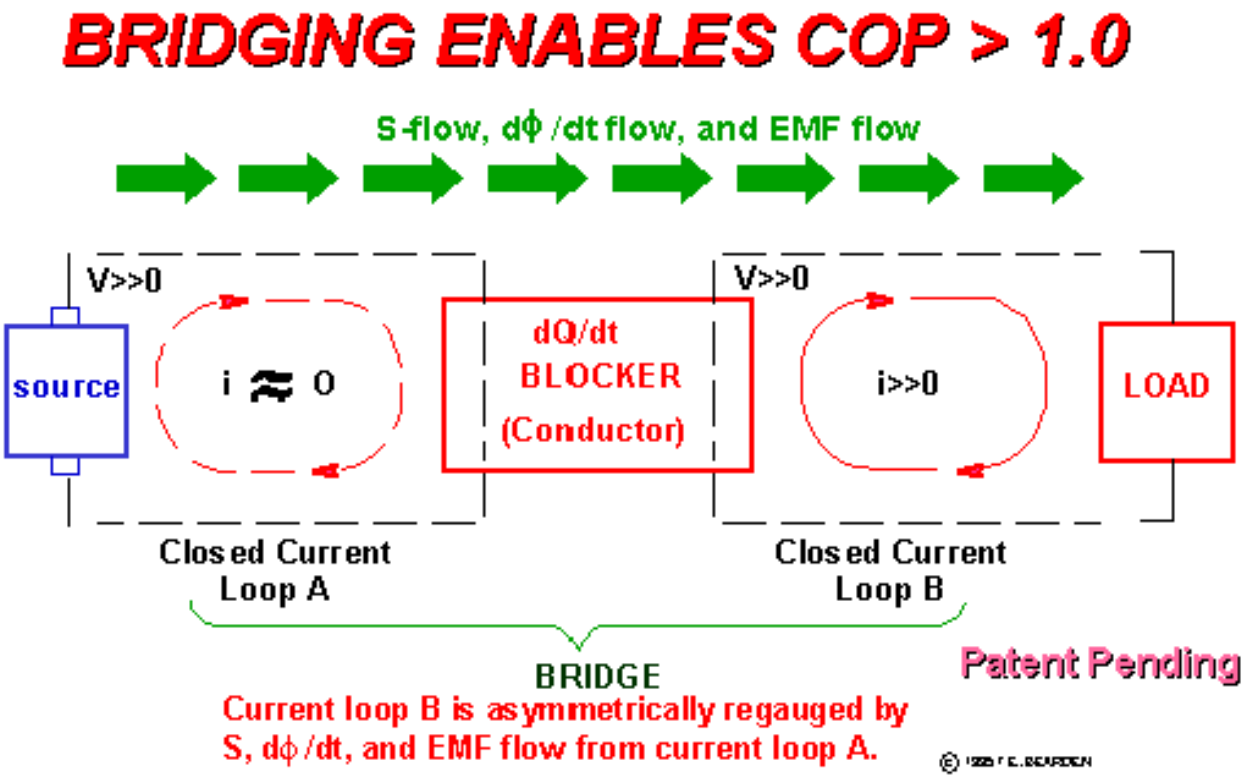

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"Static" Poynting free-energy generator

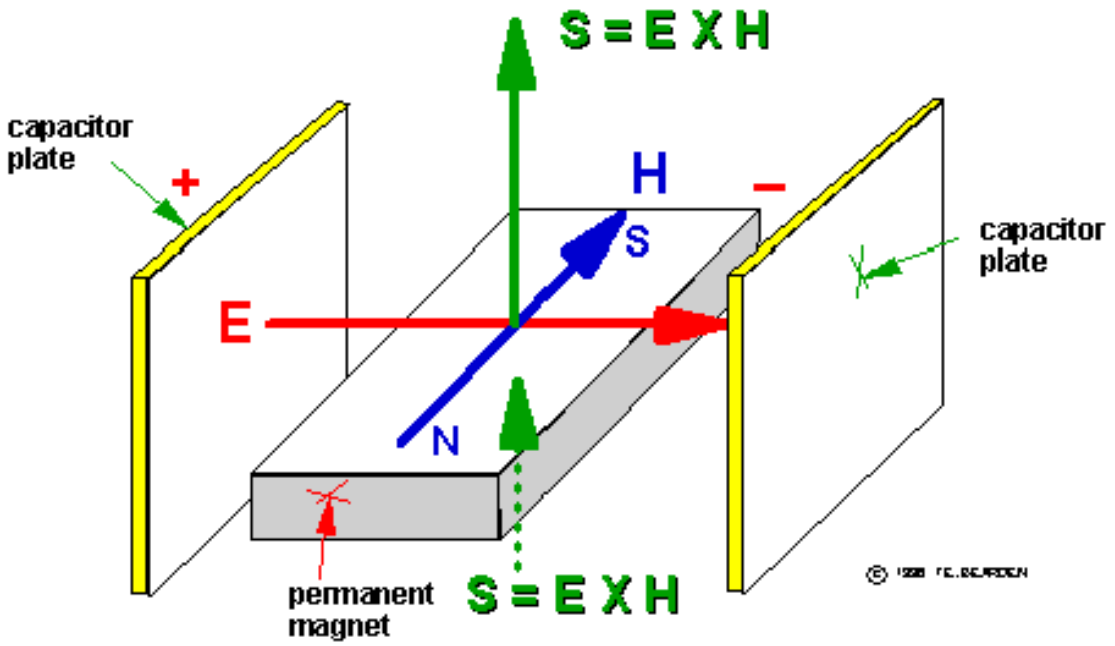

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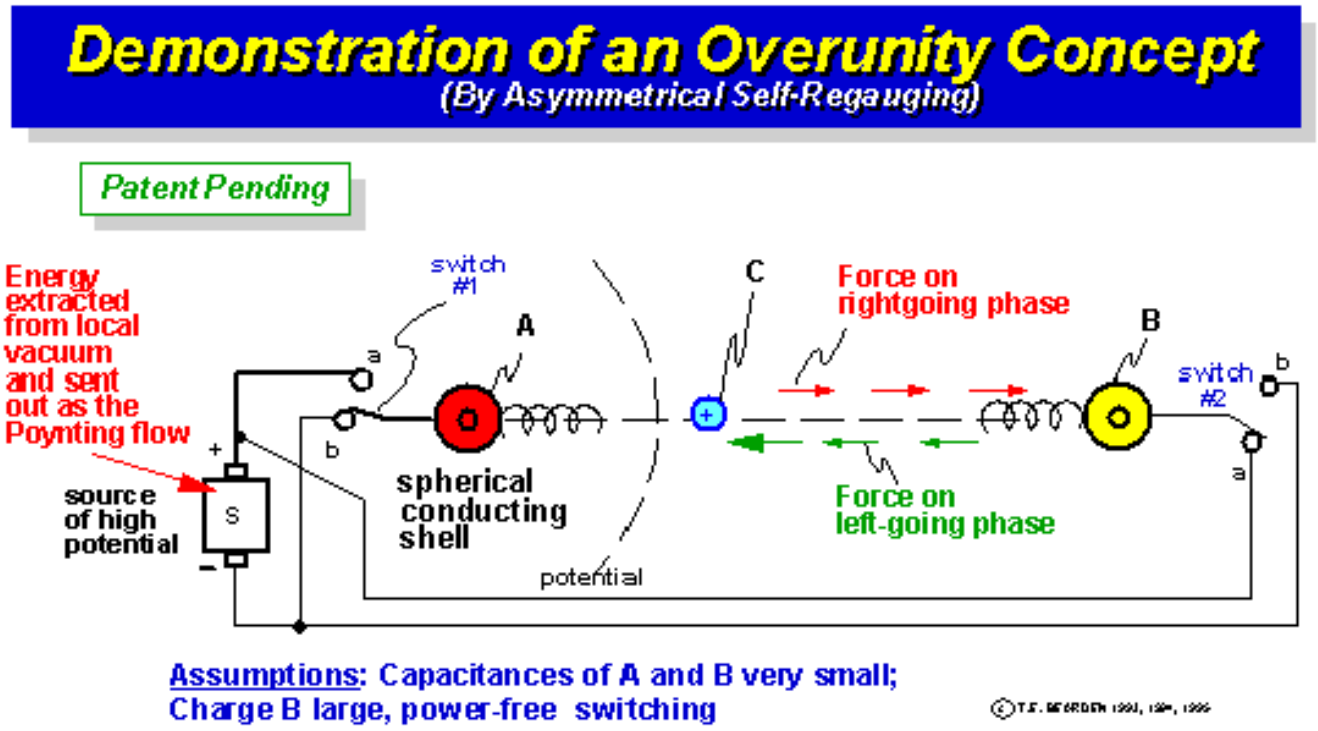

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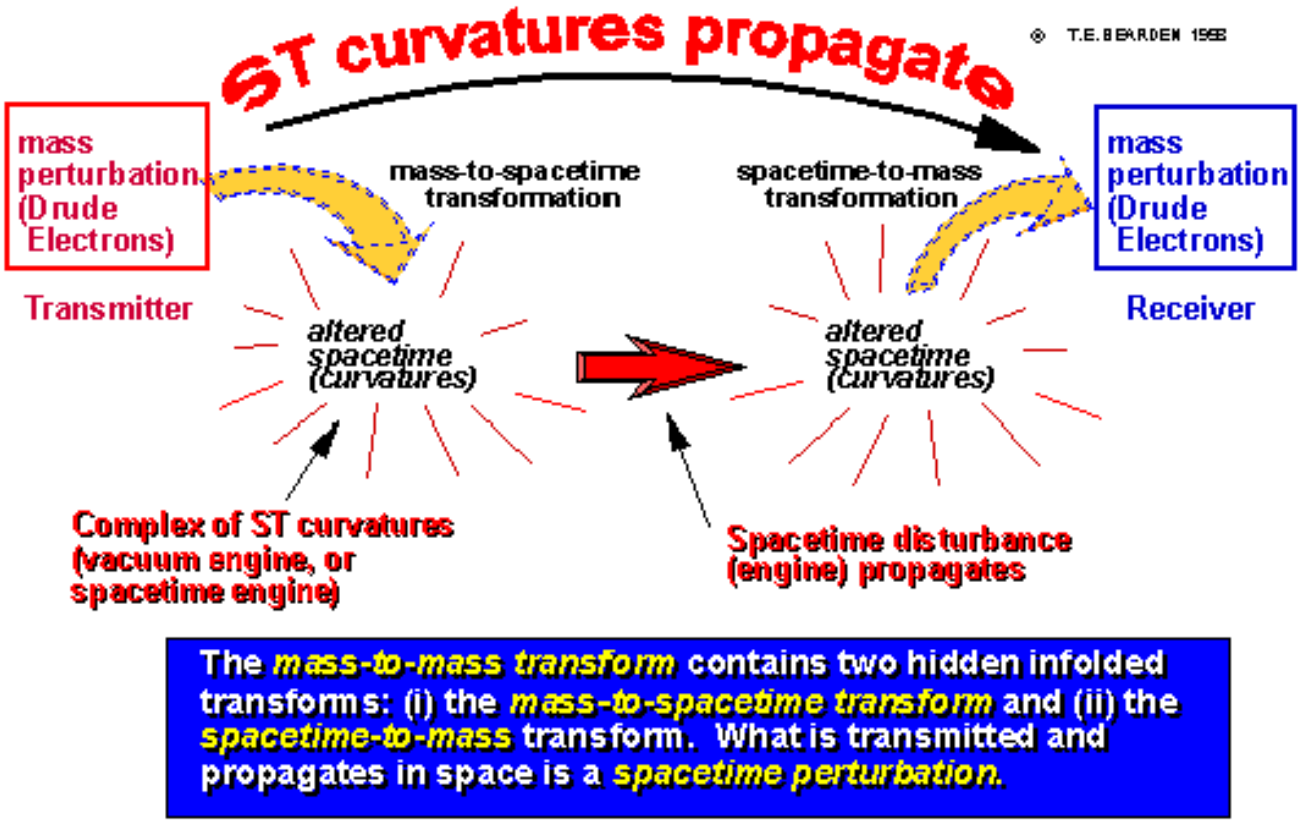

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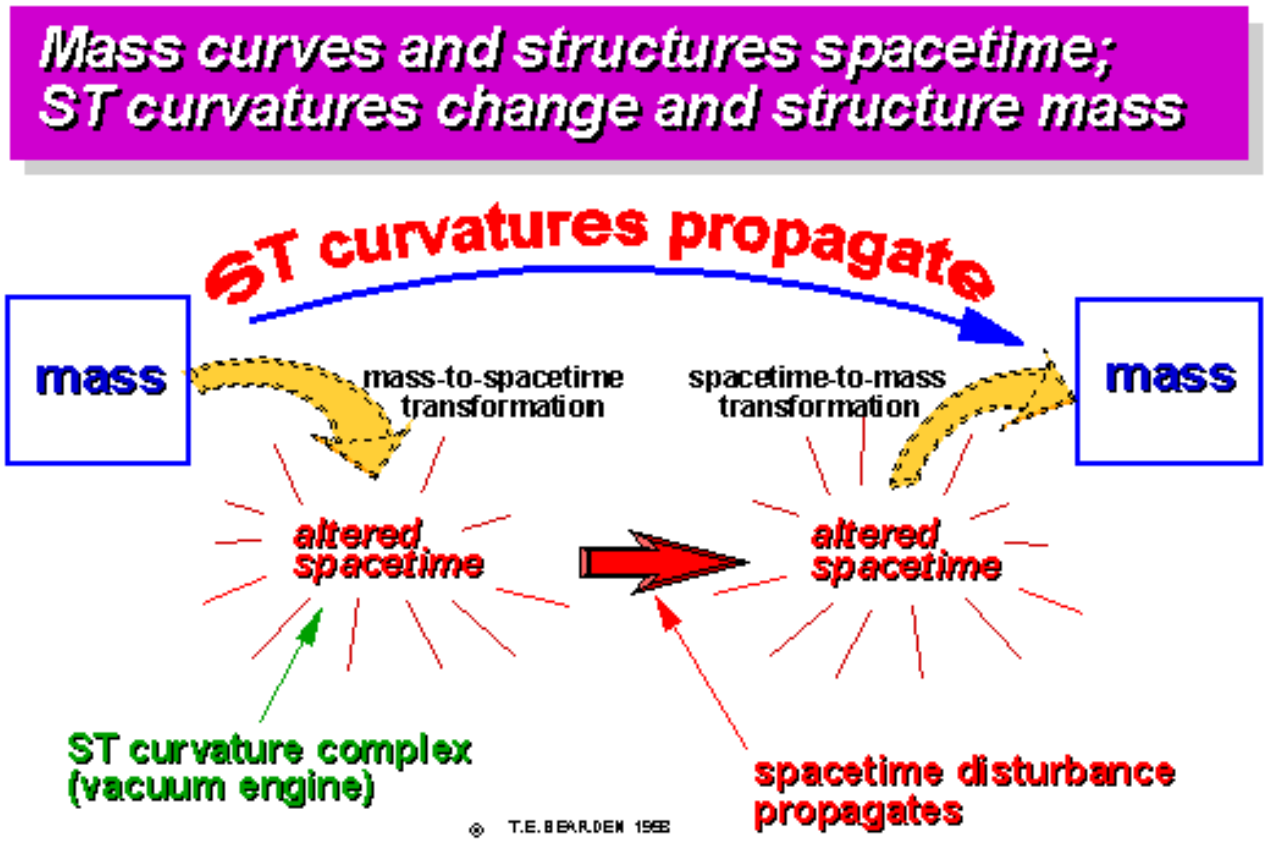

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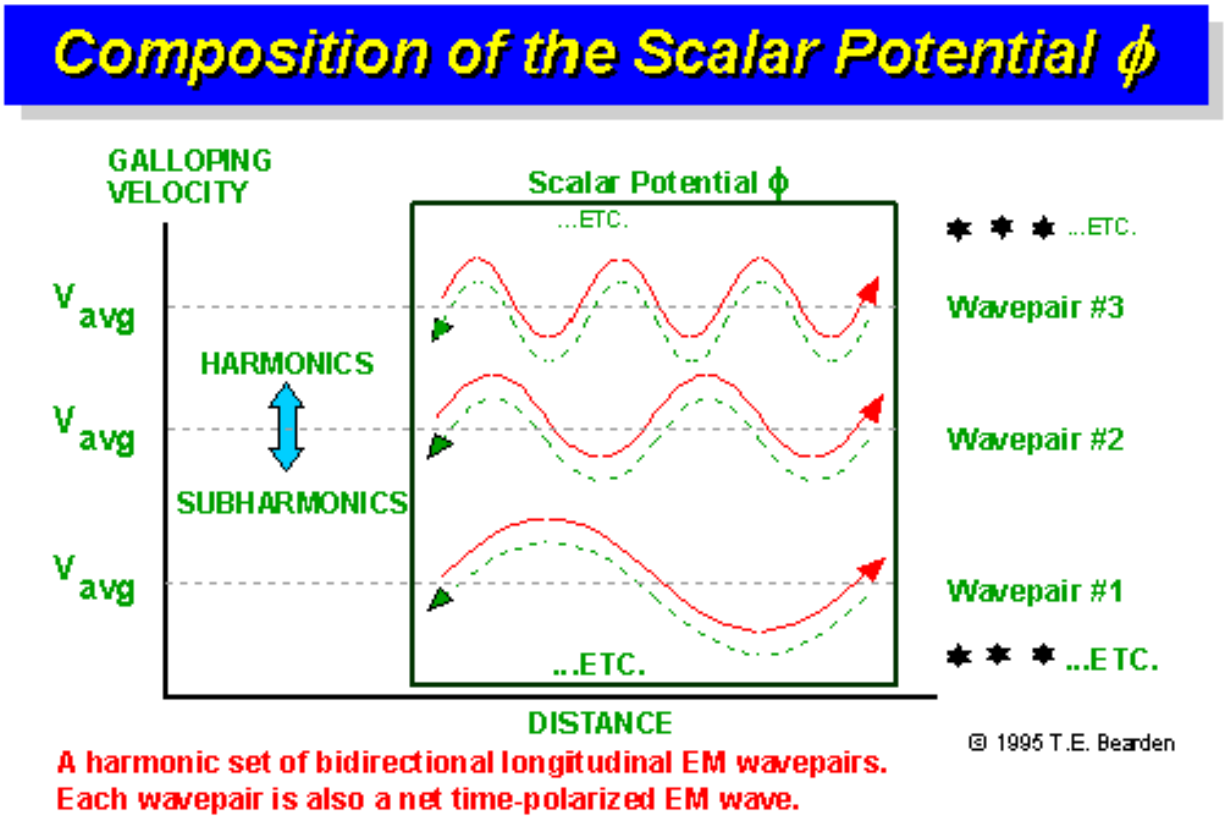

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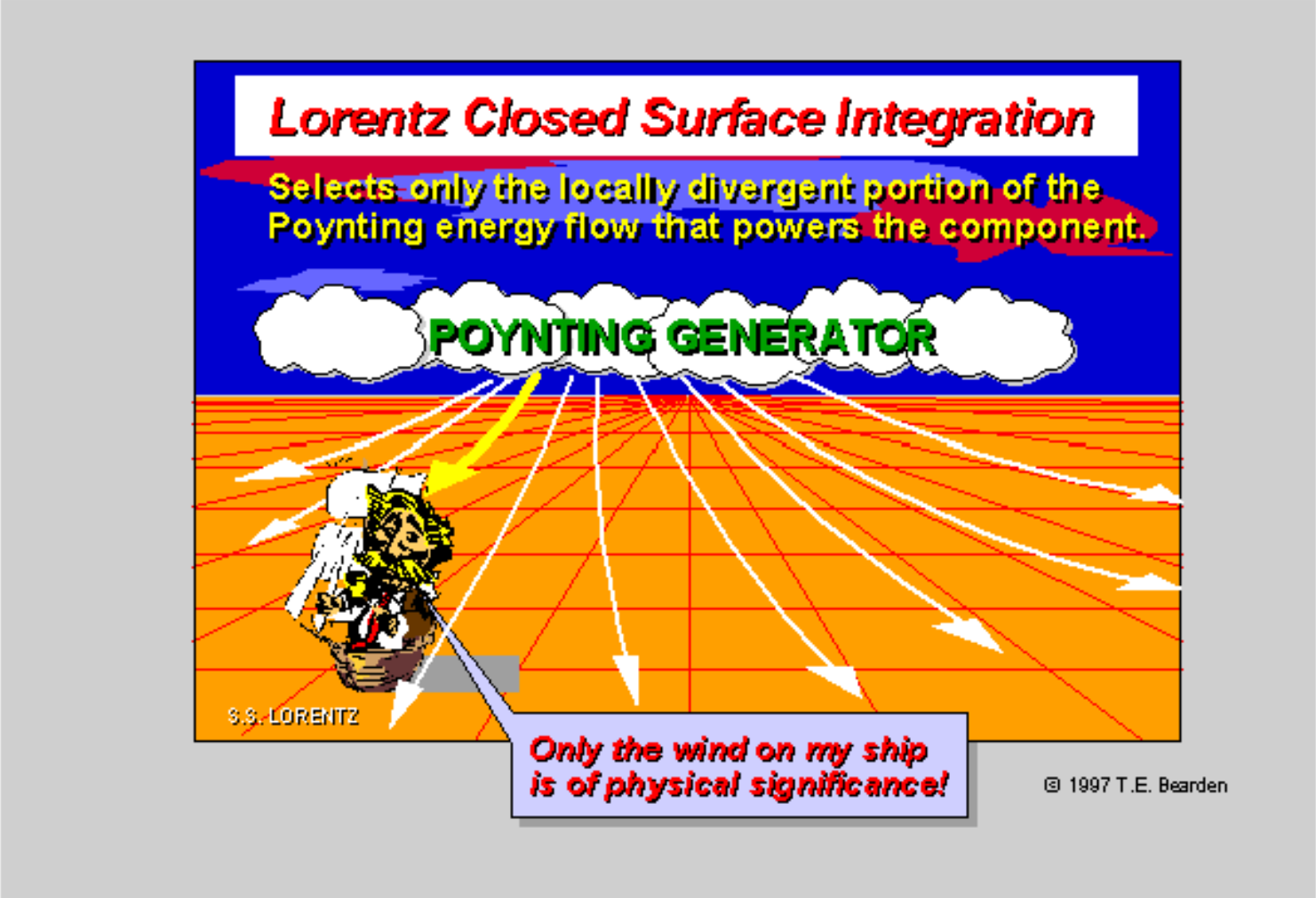

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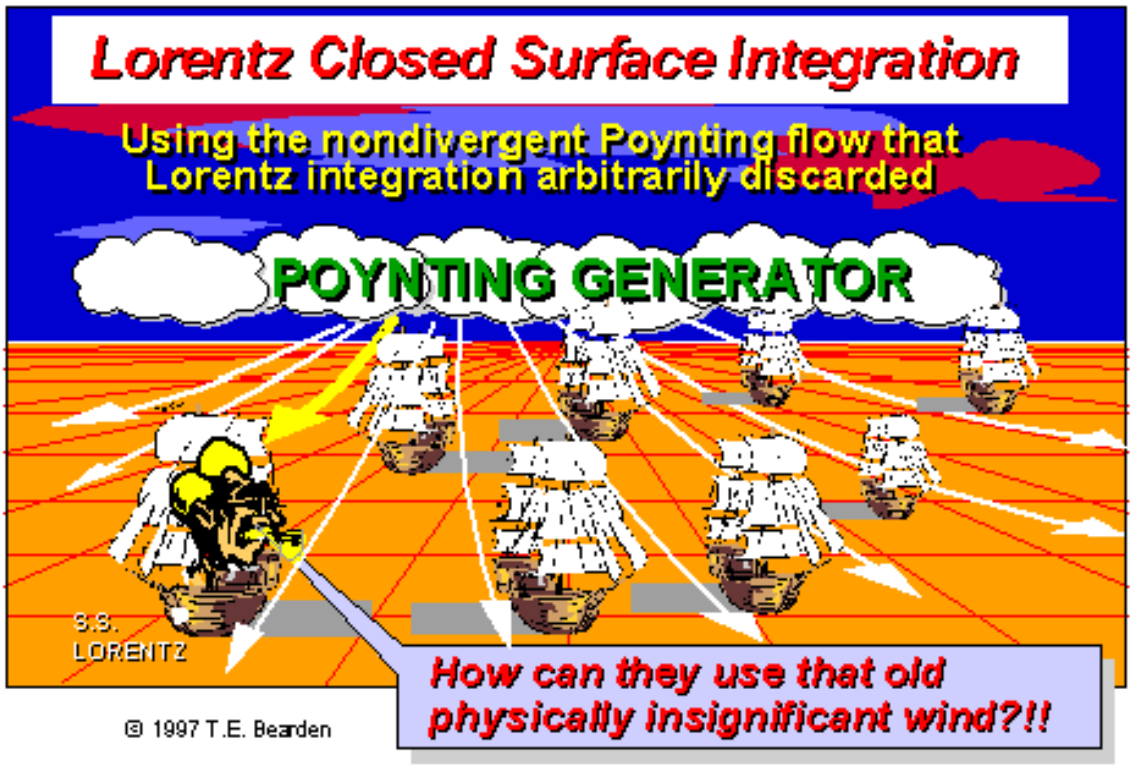

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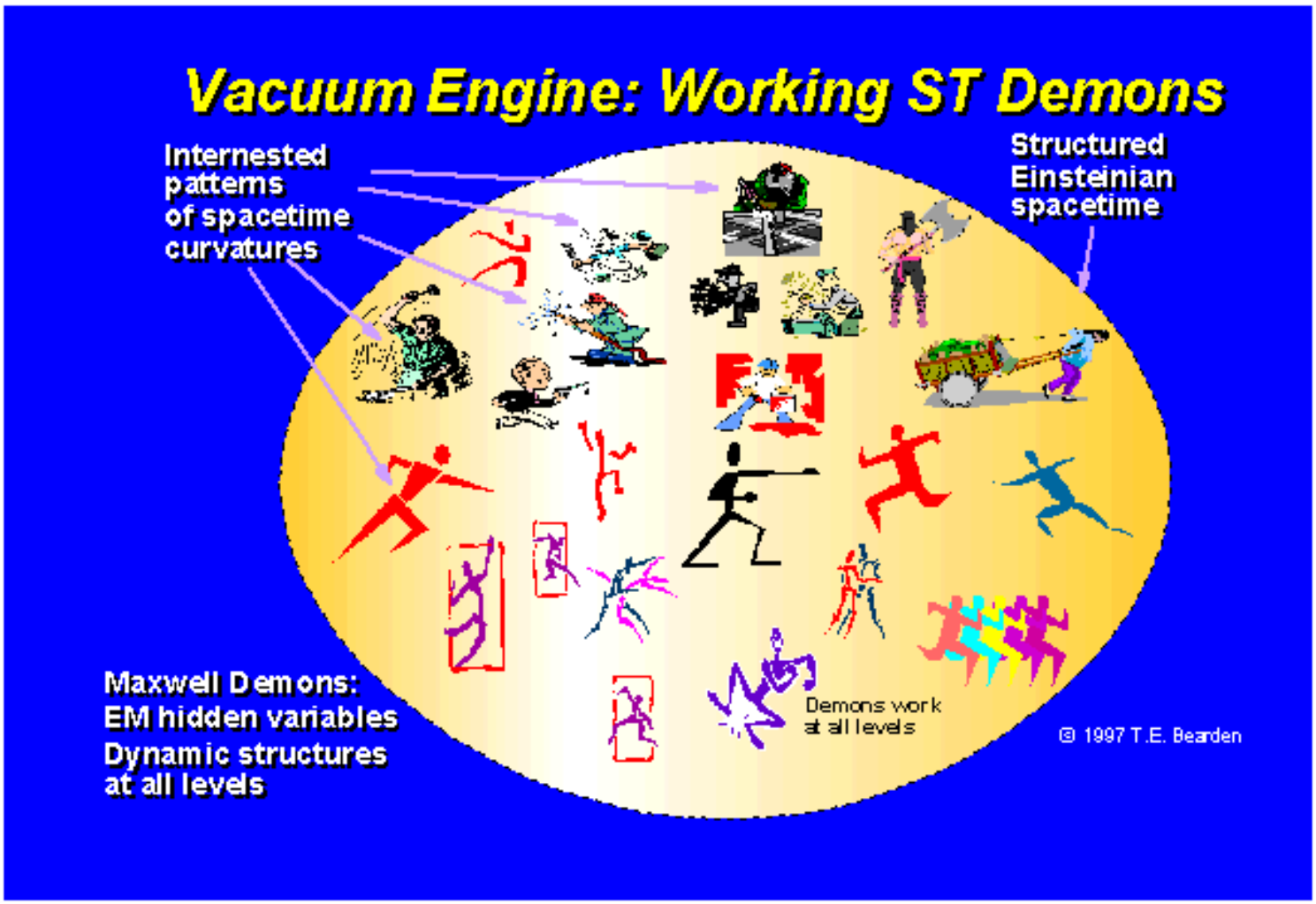

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Undistorted Progressive Waves (UPWs)

Waves with velocity v, where ≤ v < ∞

- UPWs:
  - Translationally invariant
  - Do not spread, or reconstruct after a period
  - Have infinite energy
- Quasi UPWs:
  - Can have finite energy
  - In theory, can be launched into space
  - Can move subluminally
  - Can move superluminally

*Rodrigues and Lu, *Found. Phys.* 27(3), 1997, p. 435-508.

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Undistorted Progressive Waves (UPWs)

Waves with velocity v, where ≤ v < ∞

- Major equations having UPW solutions:
  - *Homogeneous wave equation*
  - *Maxwell equations*
  - *Dirac, Weyl, and Klein-Gordon Equations*
- Maxwell solutions:
  - *Subluminal solutions are EM particles*
  - *Superluminal solutions are X-waves*
- Experiment indicates such waves will will be produced soon

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*Rodrigues and Lu, *Found. Phys.* 27(3), 1997, p. 435-508.

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Other Superluminal Waves

- Waves can move superluminally in quantum tunneling
- Nimtz *et al.* have translated Mozart's 40th symphony at v = 4.7 c
  - *Through a barrier in a waveguide*
  - *Other researchers have also transmitted EM waves superluminally through quantum tunneling*

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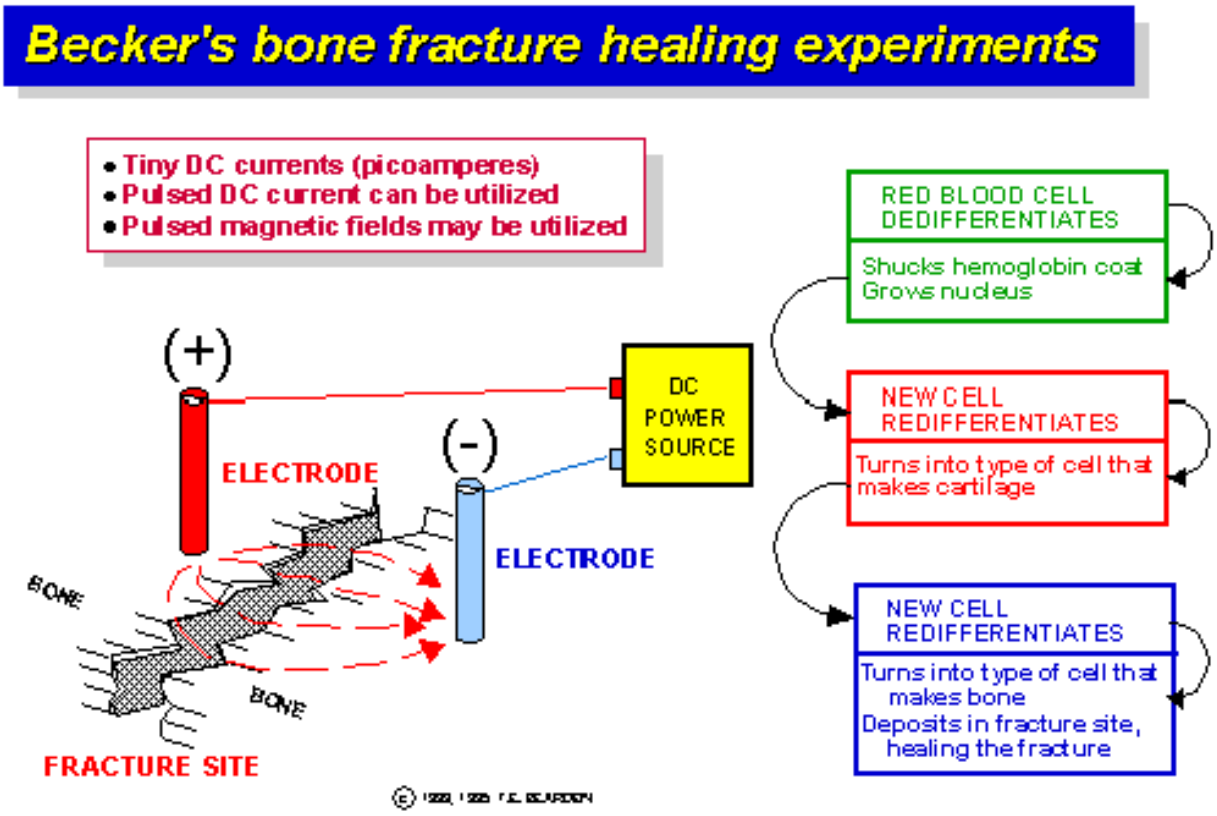

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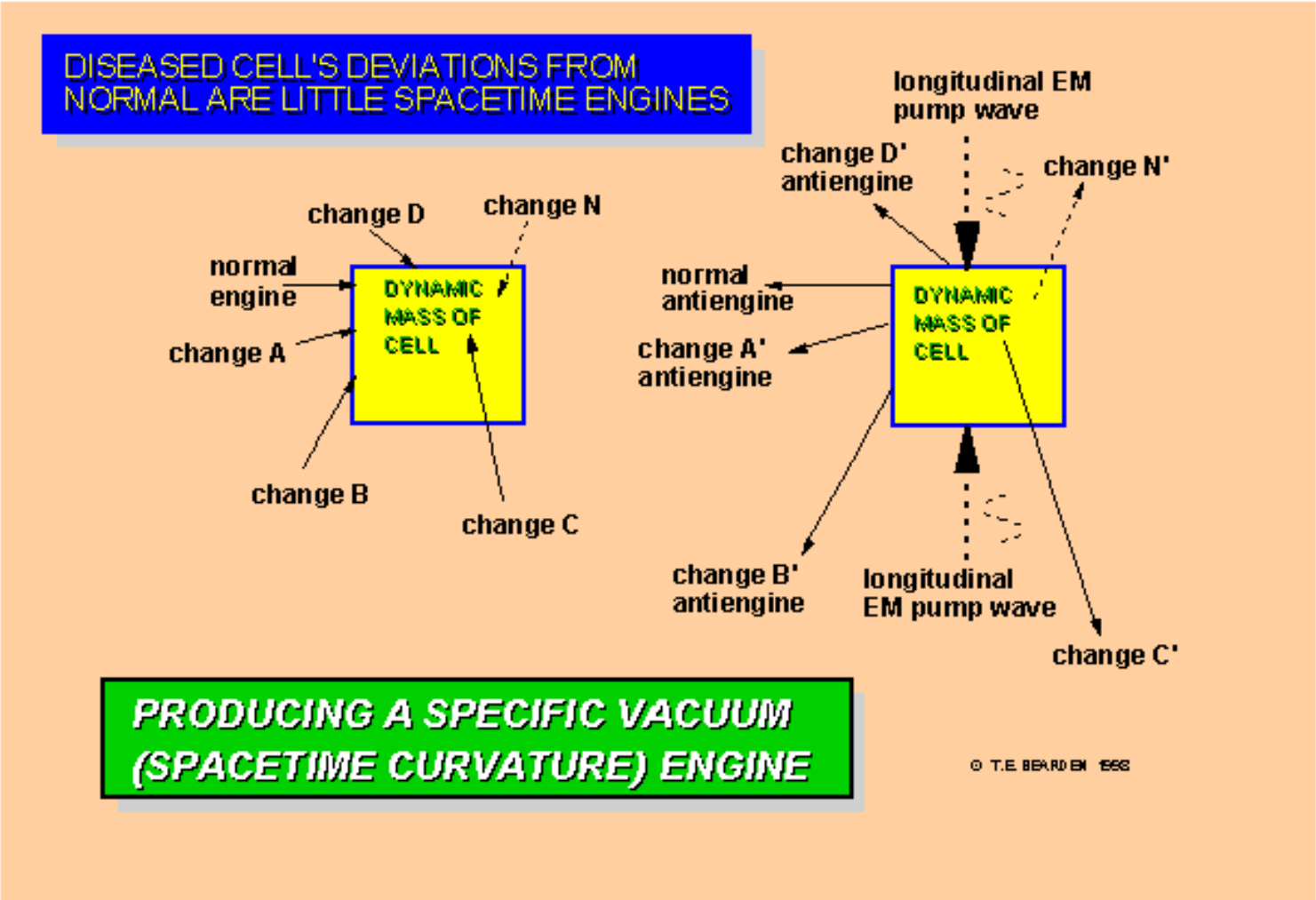

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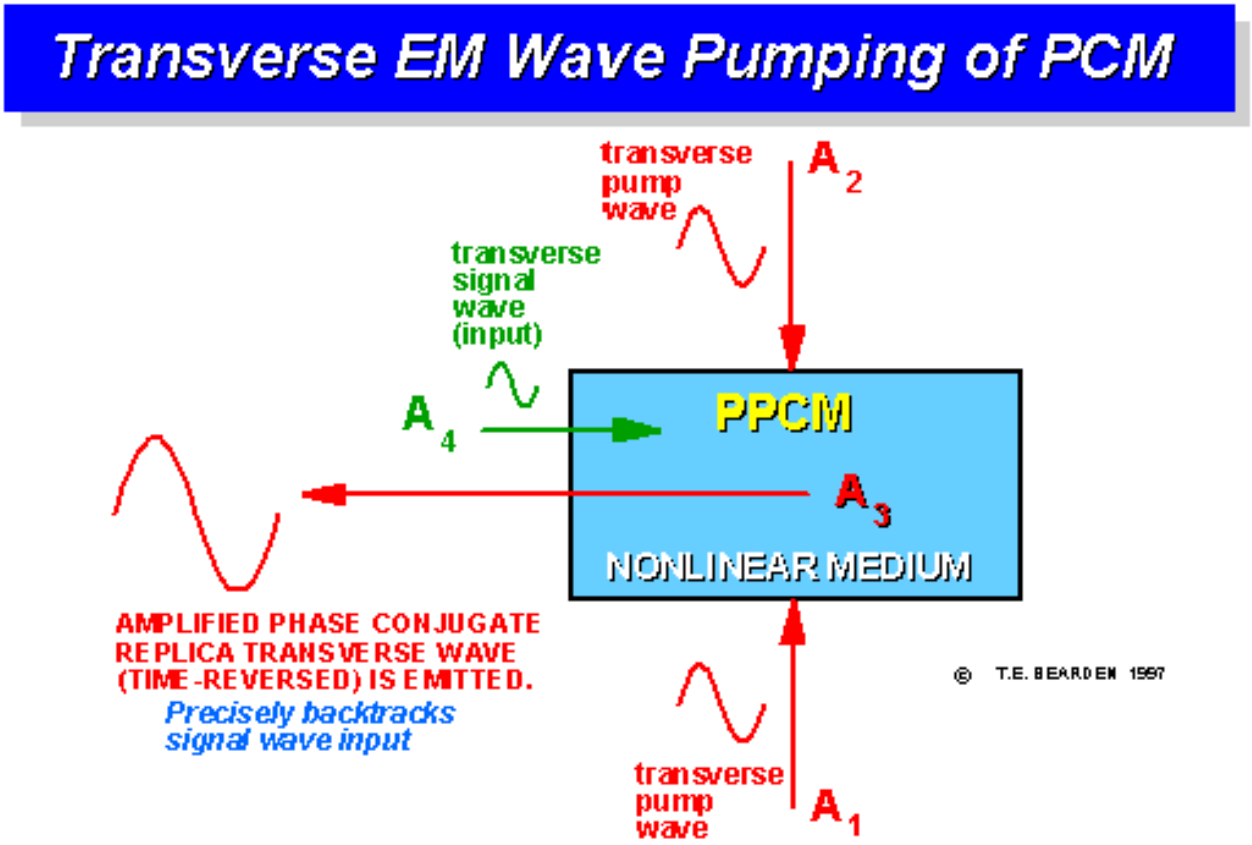

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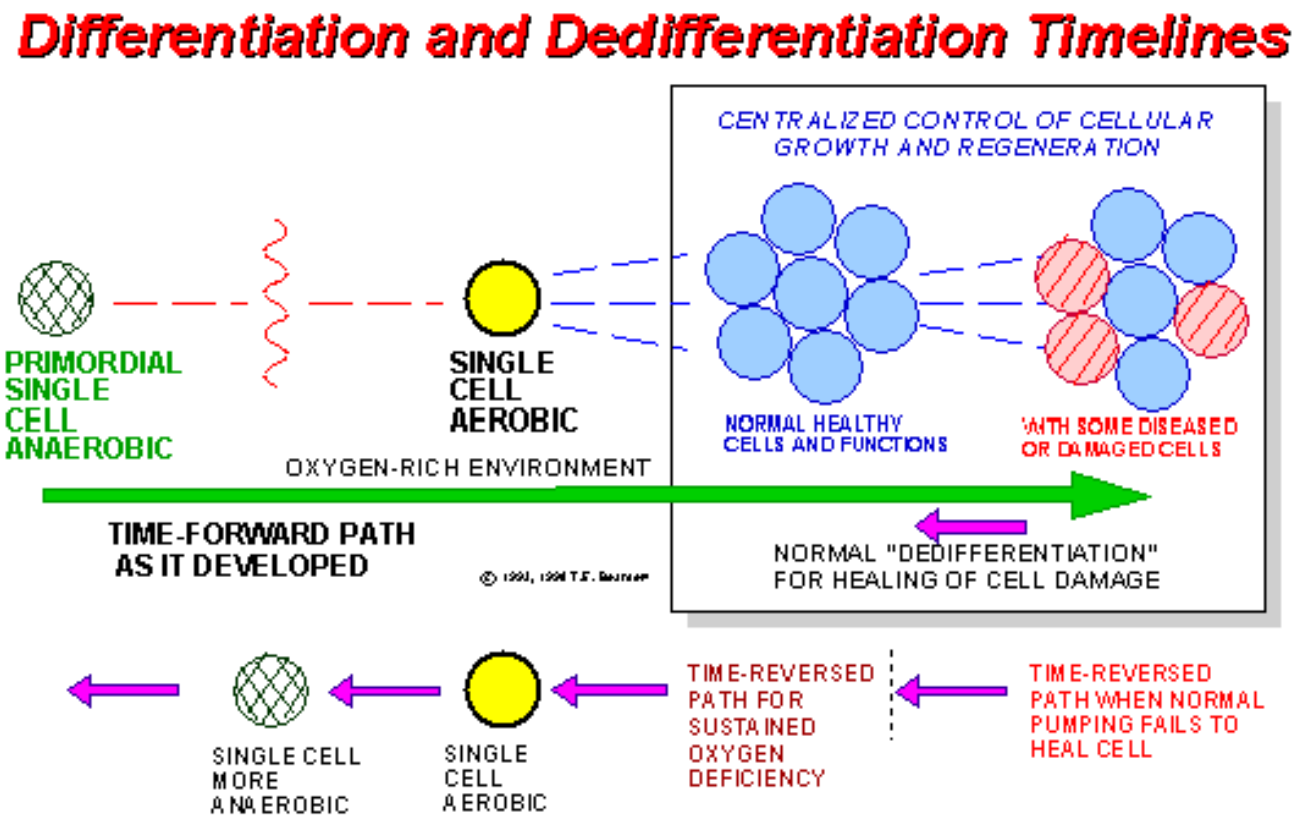

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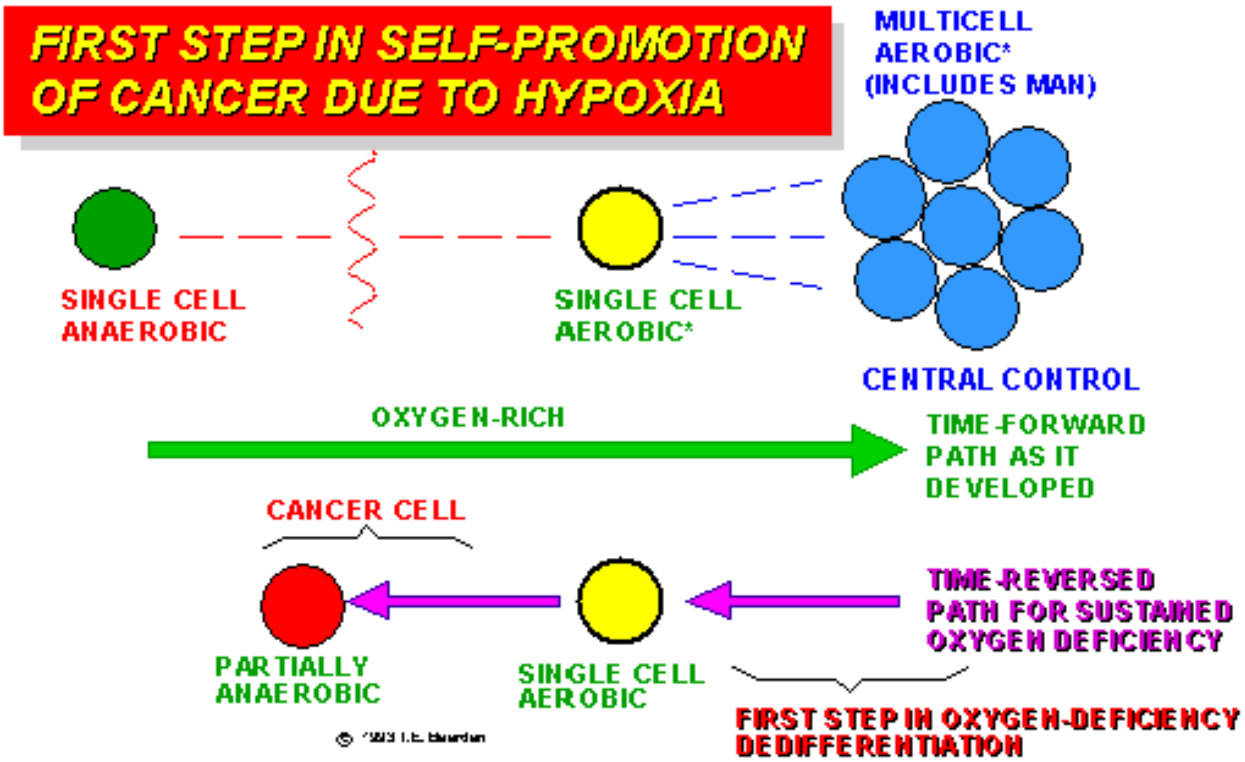

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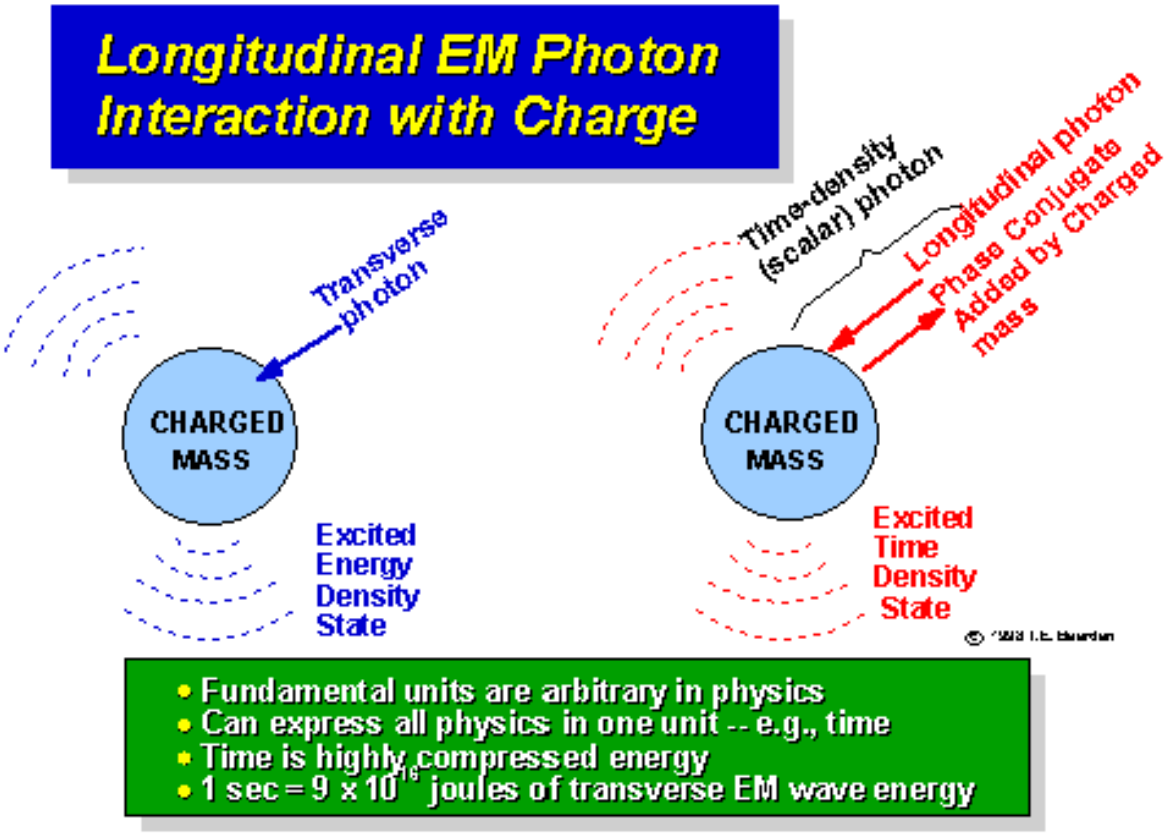

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Use of General Relativity (GR) in Particle Physics

- GR seldom used in particle physics
- In cold fusion, Matsumoto* has applied general relativity
- Consistent with important cold fusion results
- Used spacetime (ST) curvature by energy density
- Matsumoto did not utilize:
  - Longitudinal EM waves
  - Time density (time-polarized EM) waves
  - Time density curvatures of ST (gain = 9×10^{16})

* T. Matsumoto, "Mechanisms of Electro-Nuclear Collapse," Proc. ICCF-7, Vancouver, BC, Canada, Apr. 1998, p. 98.

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Pepper* on Time Reversing Mass

- Conventional NLO interactions restricted to bosons (spin 1 particles) by Pauli exclusion principle
- Concludes electrons, protons, neutrons, etc. (fermions, or spin 1/2 particles) cannot take part in such interactions
- Perhaps time reversal possible for bosons that are multiple fermions (two protons, Helium 4, pi and K mesons, etc.)

- Time-reversal of mass demonstrated by Priore, Pautrizel, et. al. without recognizing it.** Questions exclusion for:
  - Multi-fermion reaction with EM longitudinal waves
  - Multi-fermion reaction with time-density EM waves
- Prior to the laser, NLO - though known in theory - was a gedanken experiment regarded as experimentally unviable

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* David M. Pepper, "Nonlinear Optical Phase Conjugation," Optical Engineering, 21(12), Mar./Apr. 1982, p. 156-183.

** Before the development of NLO in the mid-to-latter 1970s.

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Pepper* on time-reversing mass

- Conventional NLO interactions
  - *Restricted to bosons (spin 1 particles)*
  - *By Pauli exclusion principle*
- Fermions cannot take part in such interactions
  - *Electrons*
  - *Protons*
  - *Neutrons*
- Perhaps time reversal possible for multiple fermions (quasi-bosons)
  - *Two protons*
  - *Helium 4*
  - *pi and k mesons*

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* David M. Pepper, "Nonlinear Optical Phase Conjugation," Optical Engineering, 21(12), Mar./Apr. 1982, p. 156-183.

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Pepper* on time-reversing mass (2)

- Time-reversal of mass demonstrated by
  - *Priore, Pautrizel, other Priore team scientists*
  - *Without recognizing it*
- Apparently n-tuple fermions, where n is even, can be time-reversed
  - *Impact of longitudinal EM waves*
  - *Impact of scalar (time-density) EM waves*
  - *Major part played by time-reversal regions*
- Prior to the laser, NLO - though known in theory - was a gedanken experiment and regarded as experimentally unviable

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* David M. Pepper, "Nonlinear Optical Phase Conjugation," Optical Engineering, 21(12), Mar./Apr. 1982, p. 156-183.

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Chung's Carbon Filament Negative Resistor

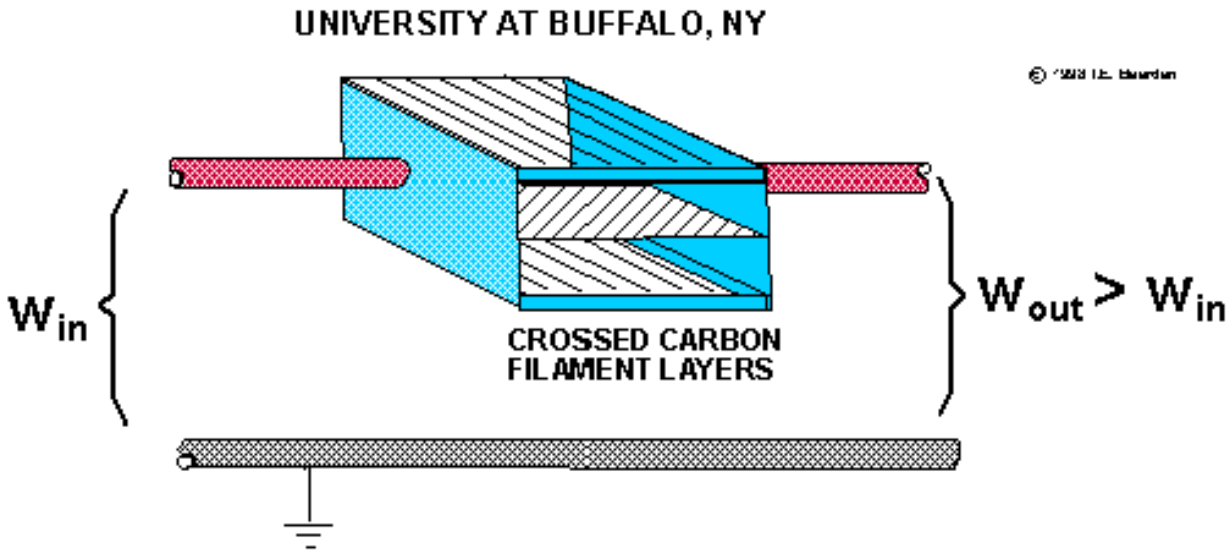

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Consistency of China Lake Anomalies

- Variation in LW-TW transduction from experiment to experiment
- Majority produced insufficient transduction to cause ionization discharge of the GM tube gas (to cause detection)
- Correlation between appearance of anomalous radiation and the expected time periods to load palladium with deuterium
  - Within few hours in co-deposit experiments where palladium is loaded with deuterium as it deposits from solution
  - Required days of electrolysis for rods that load much slower
- The faster the deuterium loaded, the greater the interaction of deuterium in phase conjugating and self-targeting in lattice
- Variation in GM detector readings
  - One would read anomalous radiation, another would be blind to it
  - A few experiments gave simultaneous readings from two detectors
- Experiments perfectly consistent with LW-TW transduction, time-density charging, variation in GM time histories, and new conservation of energy law

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Time-Reversal Zones in Nuclear and Chemical Reactions

- TIME REVERSAL ZONE: A volume or area in a reaction environment where phase conjugate waves predominate over time-forward waves
  - In a given reaction, time-reversal may apply
  - If so, like charges attract and unlike charges repel
  - Charges move against potential gradient, to external observer
  - Time density and longitudinal EM waves become significant
  - Coulomb barrier turns into Coulomb assistant
- Examples (assuming a time-reversed zone):

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$$^{1}H^{+} + {}^{1}H^{+} \text{-->} {}^{2}H^{++} \text{-->} {}^{1}n + {}^{1}H^{+} \text{-->} {}^{2}H^{+} = \text{deuterium}$$

$$2({}^{1}H^{+} + {}^{1}H^{+}) \text{-->} 2\,({}^{2}H)^{++} \text{-->} 2({}^{1}n + {}^{1}H^{+})$$

$$\text{-->} 2({}^{1}n) + 2({}^{1}H)^{++}$$

$$\text{-->} {}^{4}He^{++} = \text{helium}$$

Quark flipping and energy balancing with curved spacetime assumed)

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The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)

- Nucleon interchange
  - Changes neutron into proton and vice versa
  - At high rate (flat spacetime assumed)
- Statistics become skewed due to curved ST
- Can bias statistics toward either neutron or proton end
  - Biases toward transmutation of elements along isomer chains
  - Concept of "isomer" is vastly expanded

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The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)

- Normal dynamics (impulses) may reverse
  - Like charges attract, unlike charges repel
  - Positive charges cluster (are drawn together)
  - H+ ions (protons) may form quasi-nuclei
  - Nucleus coulomb barrier becomes assistant
- Many "impossible" reactions now possible
  - Quark access and quark flipping by EM
  - Ion clustering
  - Positive charges as phase conjugate mirrors
  - Time-density waves and time-energy charging

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The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)

- Not observed until time-energy charging has become substantial
  - *Time delay (hours, days)*
  - *Transduction of LW --> TW involved*
  - *Specific time-charging history of detectors is involved in twhether they detect or not*
  - *Longitudinal EM waves become significant*
- Curved spacetime can act as source or sink
  - *May emit excess radiation*
  - *May absorb excess radiation*

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On Nuclear Reactions in TR-Zones

- **Nuclear interactions now are biased:**
  - Normal nucleon interchange changes neutron into proton and vice versa, at a high rate (flat spacetime assumed)
  - Statistics now become skewed due to curved spacetime
  - Can bias statistics toward either the neutron end or proton end
  - Thus biases toward transmutation of elements along isomer chains
  - Concept of "isomer" vastly expanded
- **Normal dynamics (impulses) may be reversed**
  - Coulomb barrier becomes coulomb assistant
  - Reactions "impossible" from energy density standpoint become possible, even easy, from time-density standpoint
- **Does not become significant until sufficient time-density charges**
  - Time-delay (hours, days) before TR reactions become significant
  - Transduction of LW-->TW involved
  - Specific time-history of detectors is significant
  - longitudinal EM waves become significant
- **Curved spacetime acts as source or sink**
  - Energy balance in curved spacetime may emit excess radiation
  - Energy balance in curved spacetime may absorb excess radiation

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In Time-Reversed Zone:
Nuclear reactions are biased

- In normal flat ST, n ⇔ p at high rate
- Curved ST skews statistics
- Biases to either n or p
- Biases to transmutation along isomer chain
- "Isomer" concept greatly expanded

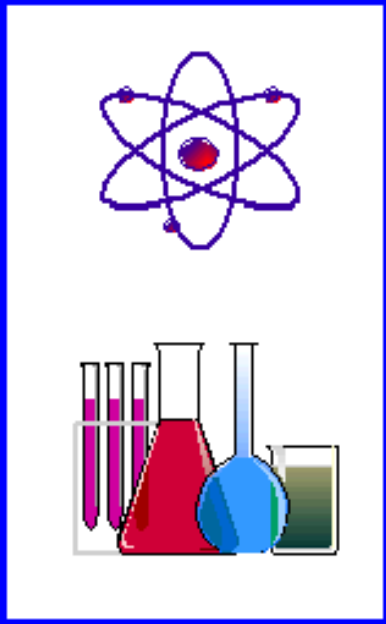

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In Time-Reversed Zone:
Dynamics may be reversed

- Like charges may attract and unlike charges repel
- Coulomb barrier becomes Coulomb assistant
- Clusters like charges and forms artificial nuclei
- "Impossible" nuclear reactions at low energy
- Time-density interactions

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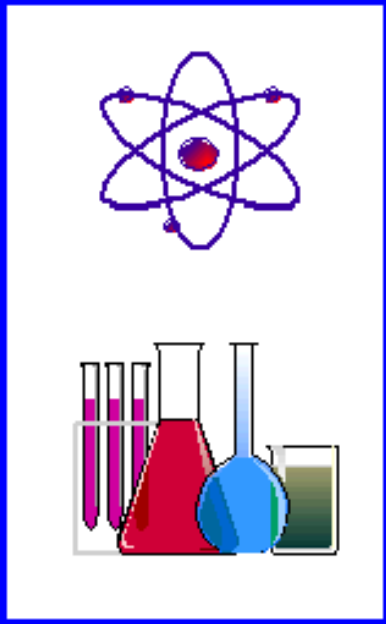

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Time-Reversed Zone:
Significant only after time-density charging

- Hours, for "fast" onset
- Days, for "slower" onset
- Transduction involved for TW ⇔ LW ⇔ TDW
- Time-history of each detector is significant
- Longitudinal EM waves become significant

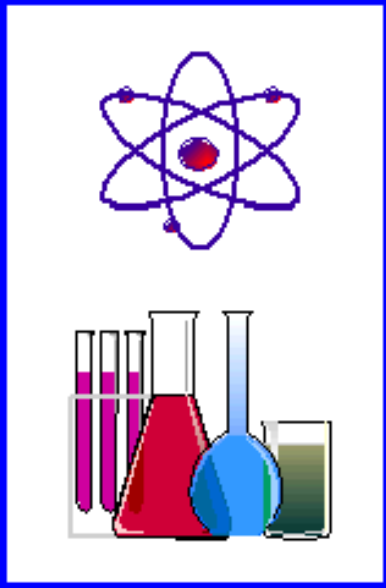

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Curved Spacetime acts as source or sink

- May emit excess radiation and energy (e.g., heat)
- May absorb radiation and energy (e.g., cool)
- May transduce waves TW ⇔ LW ⇔ TDW
- New energy conservation law applies

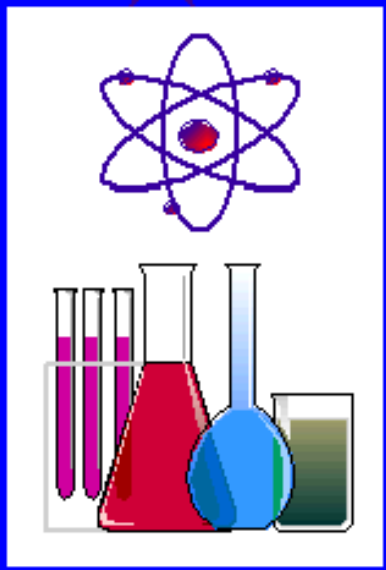

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Anomalous LW EM Emission Phenomena at China Lake (1)

- **Anomalous radiation from electrolysis in ionization processes**
  - Two experiments producing excess power
  - Dental X-ray film showed exposure
  - Simultaneous control study: no exposure
  - 20 experiments without excess power: no exposure
- **Excess energy strongly indicates excess film exposure**

© [illegible]

* Melvin H. Miles and Benjamin F. Bush, "Radiation Measurements at China Lake: Real or Artifacts?" Proc. ICCF-7, Vancouver, BC, Canada, Apr. 1998, p. 101.

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Anomalous LW EM Emission Phenomena at China Lake (2)

- **GM and NaI detector reaction when electrolysis with heavy water ongoing**
  - Several Geiger-Muller (GM) tubes gave anomalous detection
  - Reached 73 sigma above background
  - No anomalies when experiment off
- ***GM tube detects anything which causes its internal ionization***
  - *Nuclear radiation is ionizing*
  - *Transduced x-ray & gamma is ionizing*

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Sufficient LW-to-TW Transduction Ionizes GM Tube Gas (3)

- **Time-history of detector involved**
  - Some GM detectors show anomalous high counts, some do not
  - Time histories of GM detectors are varied
  - Time histories of film vary minimally
- ***Experimental results consistent with***
  - *LW-to-TW transduction including delay*
  - *Time-energy charging*
  - *New extension to energy conservation law*

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Sufficient LW-to-TW Transduction Ionizes GM Tube Gas (4)

- **Time-history of detector involved**
  - Some GM detectors show anomalous high counts, some do not
  - Time histories of GM detectors are varied
  - Time histories of film vary minimally
- ***Experimental results consistent with***
  - *LW-to-TW transduction including delay*
  - *Time-energy charging*
  - *New extension to energy conservation law*

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Consistency of Anomalies

- LW-to-TW transduction varied from experiment to experiment
- Most experiments produced insufficient transduction to cause ionization
- Appearance of anomalous radiation correlated with expected time loading of palladium with deuterium
  - Within few hours in experiments where palladium loads with deuterium as it deposits from solution
  - Required days for rods that load much slower

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Consistency of Anomalies (2)

- Faster the deuterium loaded, the greater the interaction of deuterium in
  - Phase-conjugating and self-targeting
  - Producing time-reversal zones
  - Generating quasi-nuclei of H+ ions (protons)
- Variation in GR detector readings
- Experimental results predictable by
  - LW-TW transduction and time-reversal zones
  - Varying time-density charging on GM tubes
  - Variation in GM tube experience histories
  - Time-reversal zones generating electronuclear interactions and quasi-nuclei of H+ clusters

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Experimental LW Emission Phenomena in Electrolysis

- Anomalous radiation from electrolysis in ionization processes
  - Two experiments producing excess power
  - Dental x-ray film showed exposure
  - Simultaneous control study: No exposure
  - 20 experiments without excess power: No exposure
- Excess energy strongly indicates excess film exposure
- GM and NaI detector reaction when electrolysis ongoing w/heavy water
  - Several Geiger Muller (GM) tubes gave anomalous detection
  - Reached 73 σ above normal background counts
  - No anomalies when experiment off
- GM tube detects anything which causes its internal gas to ionize
  - Nuclear radiation is "ionizing" radiation
  - Transduced x-ray and gamma radiation is "ionizing" radiation
  - Sufficient LW-TW transduction ionizes GM gas
- Time History of detector involved
  - Some GM detectors show anomalous high counts, some do not
  - Time histories of GM detectors vary appreciably
  - Time histories of film vary minimally
- Experiments consistent with time-density charging, LW-TW transduction, and new conservation of energy law

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* Melvin H. Miles and Benjamin F. Bush, "Radiation Measurements at China Lake: Real or Artifacts?" Proc. ICCF-7, Vancouver, BC, Canada, Apr. 1998, p. 101.

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A New Conservation of Energy Law

- Physics conserves total "energy and mass-energy"
- Now also must consider "time-energy"
- Conserve total mass-time-energy (spatiotemporal energy)
- Let E_T = total energy, E_M = mass energy, E_E = ordinary energy, and E_t = time energy. Then

$$E_T = E_E + E_M + E_t$$

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$$(kE_t \Rightarrow E_E > 0) \Rightarrow E_T > (E_M + E_E)$$

- If some E_t is transduced into E_E, the experiment will violate the old spatial mass-energy conservation law

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QUESTIONS ON CARCINOGENS AND EM RADIATION

- UNRESOLVED QUESTIONS ON EM RADIATION
  - DOSAGES
  - ACTIVE MECHANISMS
  - REPLICATION DIFFICULTIES
  - MEASUREMENT DIFFICULTIES
  - WHERE, WHEN, HOW ILL EFFECTS OCCUR
- SIMILAR QUESTIONS EXIST ABOUT EVERY CARCINOGEN
- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
  - FACTORS SUCH AS MIND, STRESS, SPONTANEOUS REMISSION, PLACEBO EFFECTS, AND COMBINATIONS OF FACTORS ARE PARTICULARLY TROUBLESOME
  - GENERATION OF THE PLACEBO EFFECT BY THE REGENERATION & RECOVERY SYSTEM IS UNRECOGNIZED

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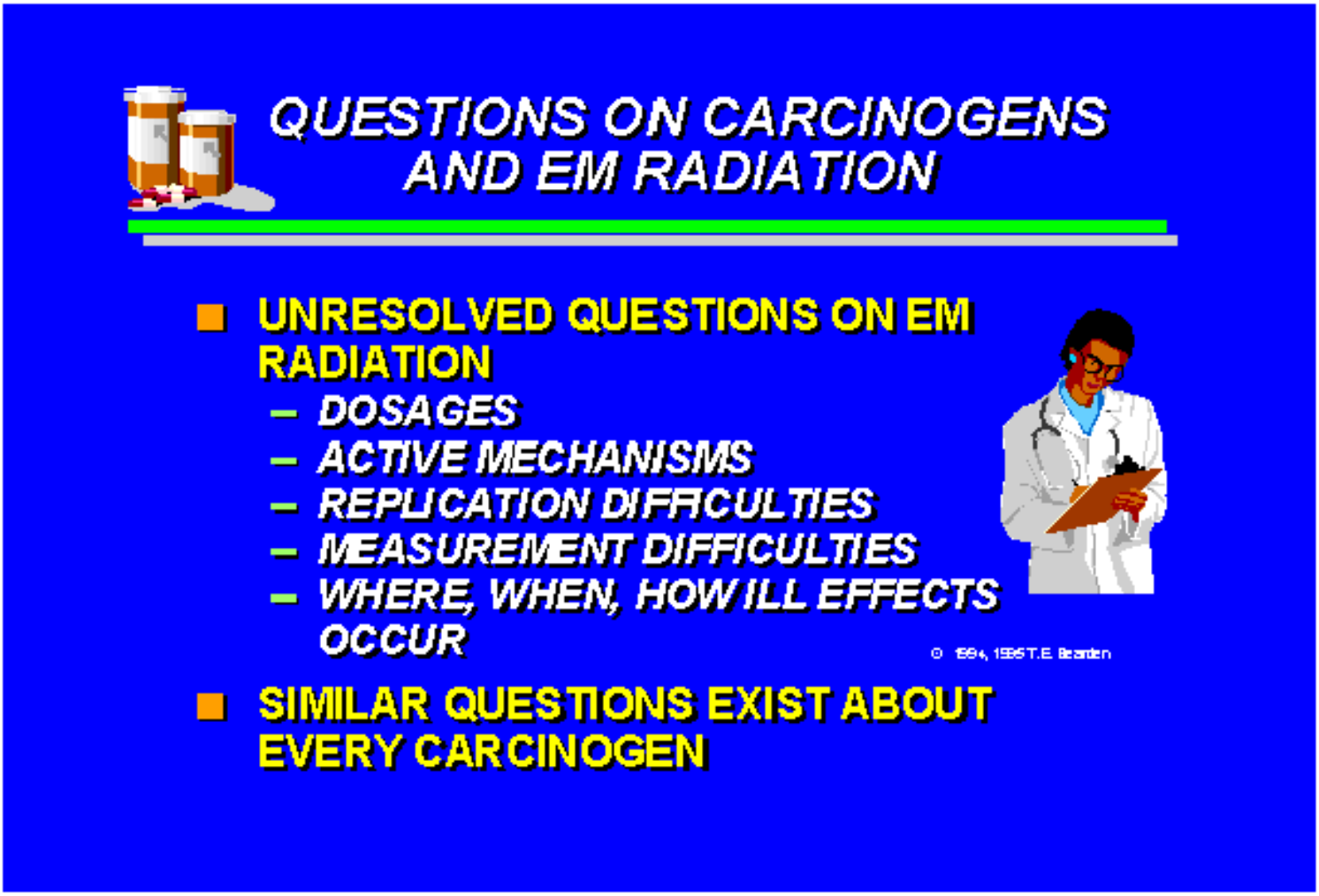

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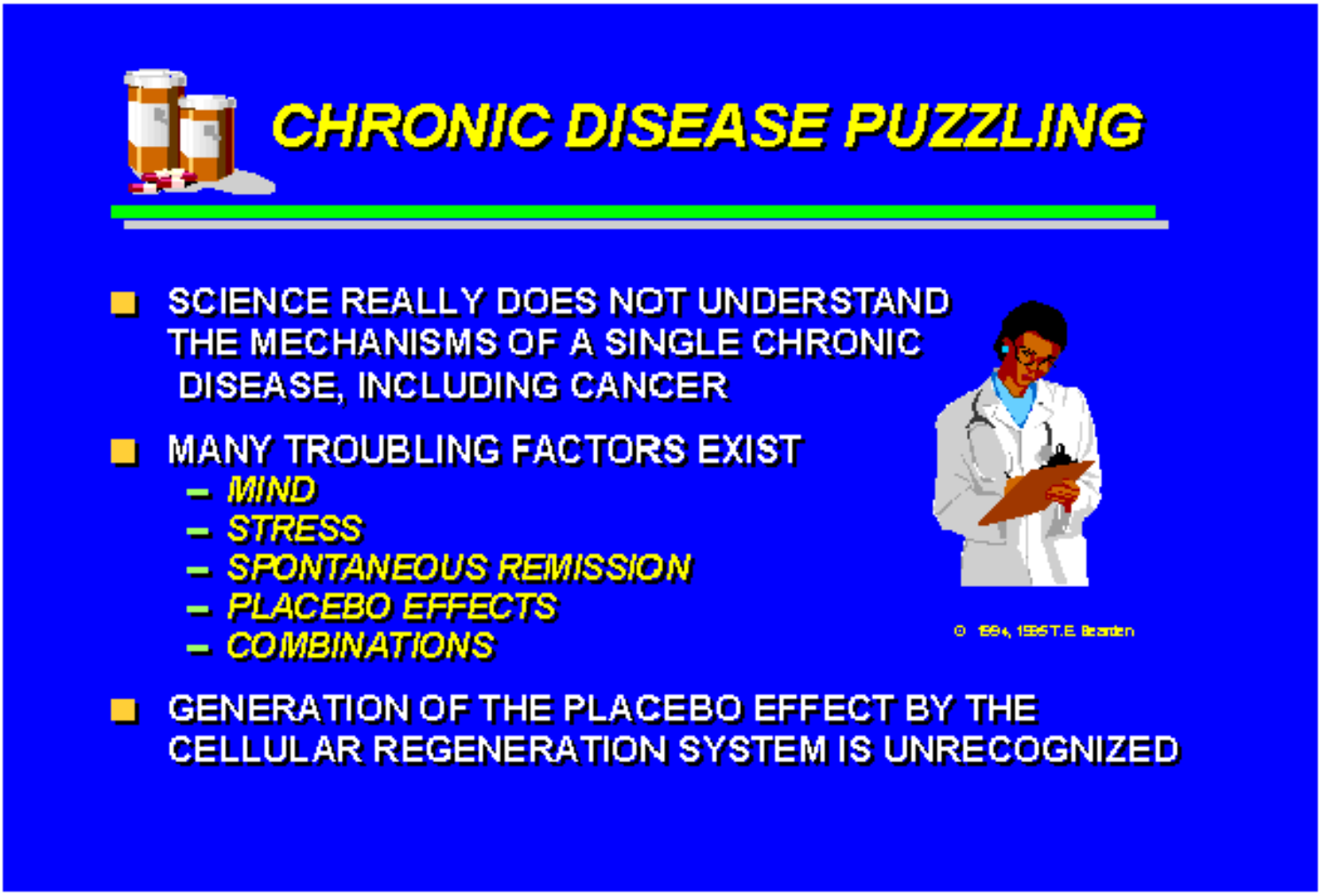

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Cancer Characteristics

- Not one disease, but a whole range
- Starts in damaged aerobic cell
- Cell shakes off body's central control
  - Starts uncontrolled division
  - Becomes a lump
- Can send forth cancer cells
  - Through blood
  - Through lymph
- Form metastases (secondary tumors)
- Often become anaerobic

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Solving a Cancer Enigma

- An enigma has been failure of immune system to attack some tumor cells
  - Suppressor cells may curb immune system?
  - Tumor may lack antigens normally identified by the immune system?
- *Promotion of damaged cell to cancer is usually ordered by cellular control system*
  - *Regenerative and recovery system forces cell back toward anaerobe*
  - *First step breaks free from central growth*
  - *Control continues to recognize cell as self*

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CANCER: CHARACTERISTICS

- NOT ONE DISEASE BUT A WHOLE RANGE
- STARTS IN ORDINARY (AEROBIC) CELL
- CELL SHAKES OFF BODY'S DICTATORIAL CONTROL*
- STARTS UNCONTROLLED DIVISION
- BECOMES A LUMP
- CAN SEND FORTH CANCER CELLS
  - THROUGH BLOOD
  - THROUGH LYMPH
- THESE FORM METASTASES (SECONDARY TUMORS)
- OFTEN BECOME ANAEROBIC (NON-OXYGEN USING)
- ENIGMA IS FAILURE OF IMMUNE SYSTEM TO ATTACK SOME TUMOR CELLS
  - SUPPRESSOR CELLS MAY CURB IMMUNE SYSTEM
  - TUMOR MAY LACK ANTIGENS NORMALLY IDENTIFIED BY THE IMMUNE SYSTEM

*R&R system forces cell back toward anaerobe

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PORTABLE PRIORE TECHNOLOGY UNIT

- FACT: DISEASE-SPECIFIC VACUUM ENGINE PRESENT FOR ANY CELLULAR DISEASE, BY WHEELER'S PRINCIPLE
  - DISEASE CAN BE REVERSED BY CREATING AMPLIFIED VACUUM ANTI-ENGINE (BEARDEN'S PRINCIPLE)
  - ANTI-ENGINES CREATED BY PUMPING THE NONLINEAR CELLS WITH LONGITUDINAL EM WAVES

- PRIORE UTILIZED A PLASMA TO PHASE CONJUGATE AND "INFOLD" MULTIPLE BIDIRECTIONAL LONGITUDINAL EM PUMP WAVES
  - MULTIPLE FREQUENCIES MIXED IN A ROTATING PLASMA
  - PHASE CONJUGATES ADDED BY THE PLASMA
  - INFOLDED MIX INTO STRONG PULSED DC MAGNETIC FIELD, WHICH CARRIED IT INTO ATOMIC NUCLEI
  - PUMPED ALL NONLINEAR CELLULAR COMPONENTS TO PRODUCE AMPLIFIED, SPECIFIC VACUUM ANTI-ENGINE

- NEGATED THE CUMULATIVE CELLULAR DEDIFFERENTIATION ORDER GENERATED BY LONG-TERM HYPOXIA. TUMOR CELLS REVERTED TO NORMAL CELLS.
- SCRUBBED OUT CUMULATED PRECANCEROUS STATE
- RESTORED THE IMMUNE SYSTEM TO HIGH FUNCTIONING
- NO EXCESSIVE TRAUMA TO TREATED ANIMAL

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Lisitsyn's Report: Brain Code Broken

- THEORY DEVELOPED AND FITTED
- HYSTERESIS MEMORY LOOP
- CONTROLLED EM INDUCTION
  - IMAGES
  - SENSATIONS
  - PREDETERMINED EMERGENCE
- 23 EEG BANDS
  - UP TO 8.1 X 10^{20} HZ
  - 11 INDEPENDENT CHANNELS

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S.K. Lisitsyn, "New Approach to the Analysis of Electroencephalograms," DDC Report AD73005, p.16-25.

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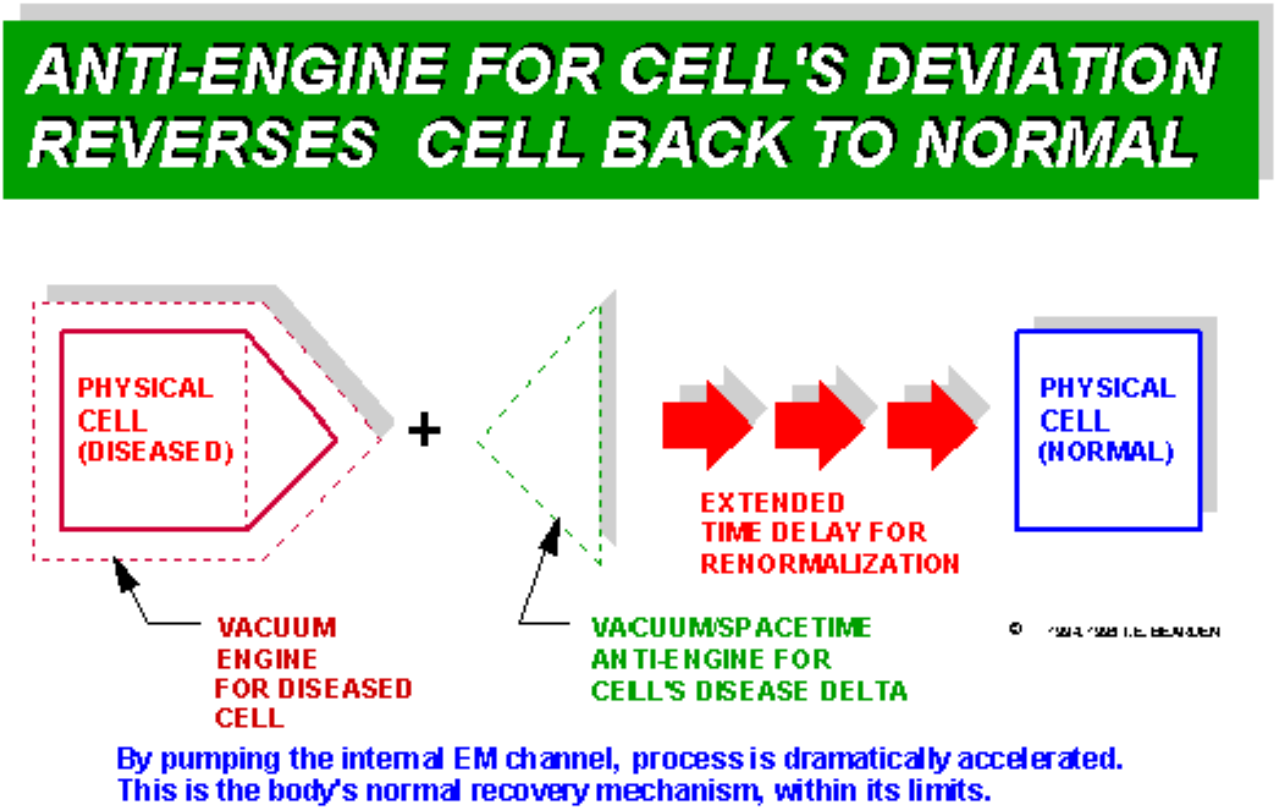

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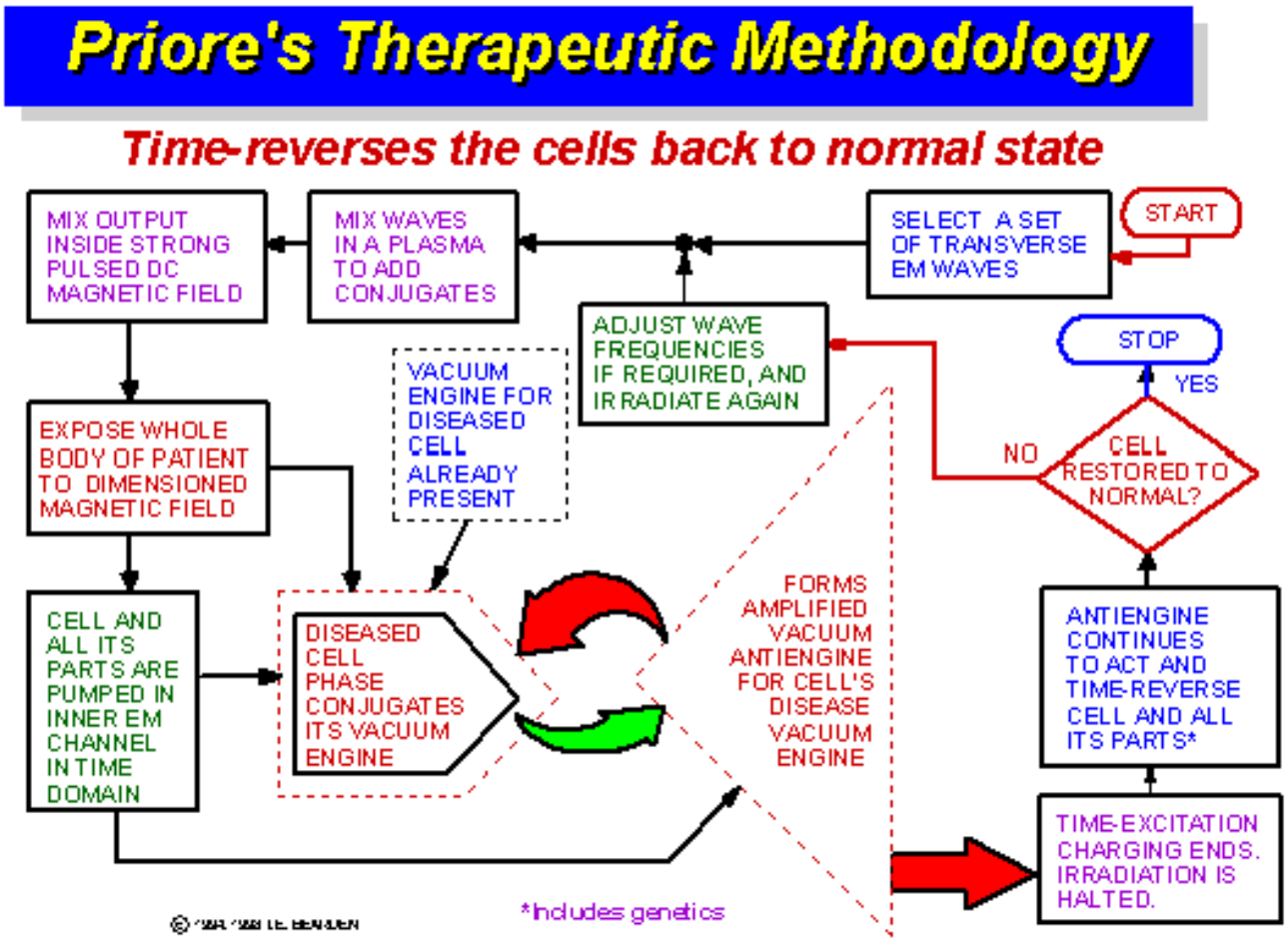

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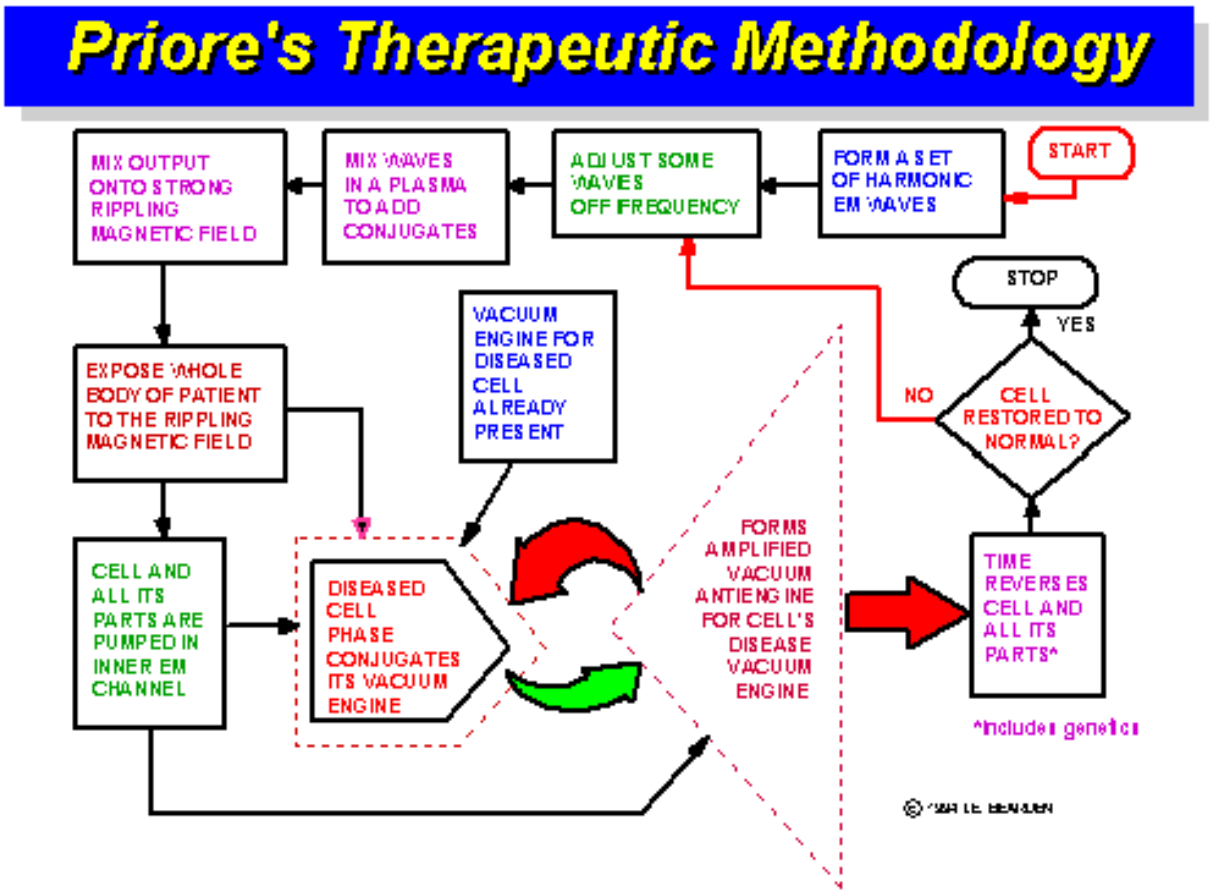

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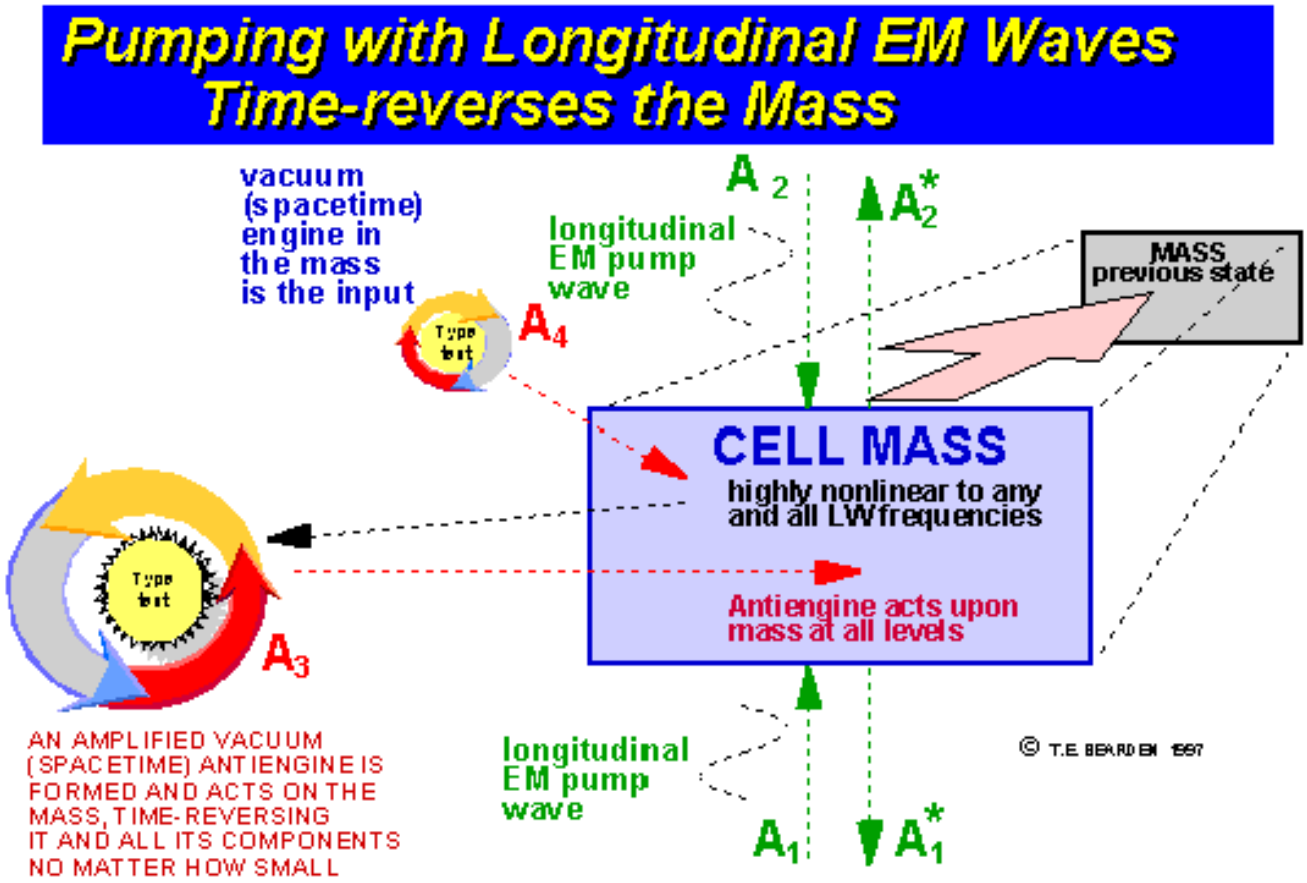

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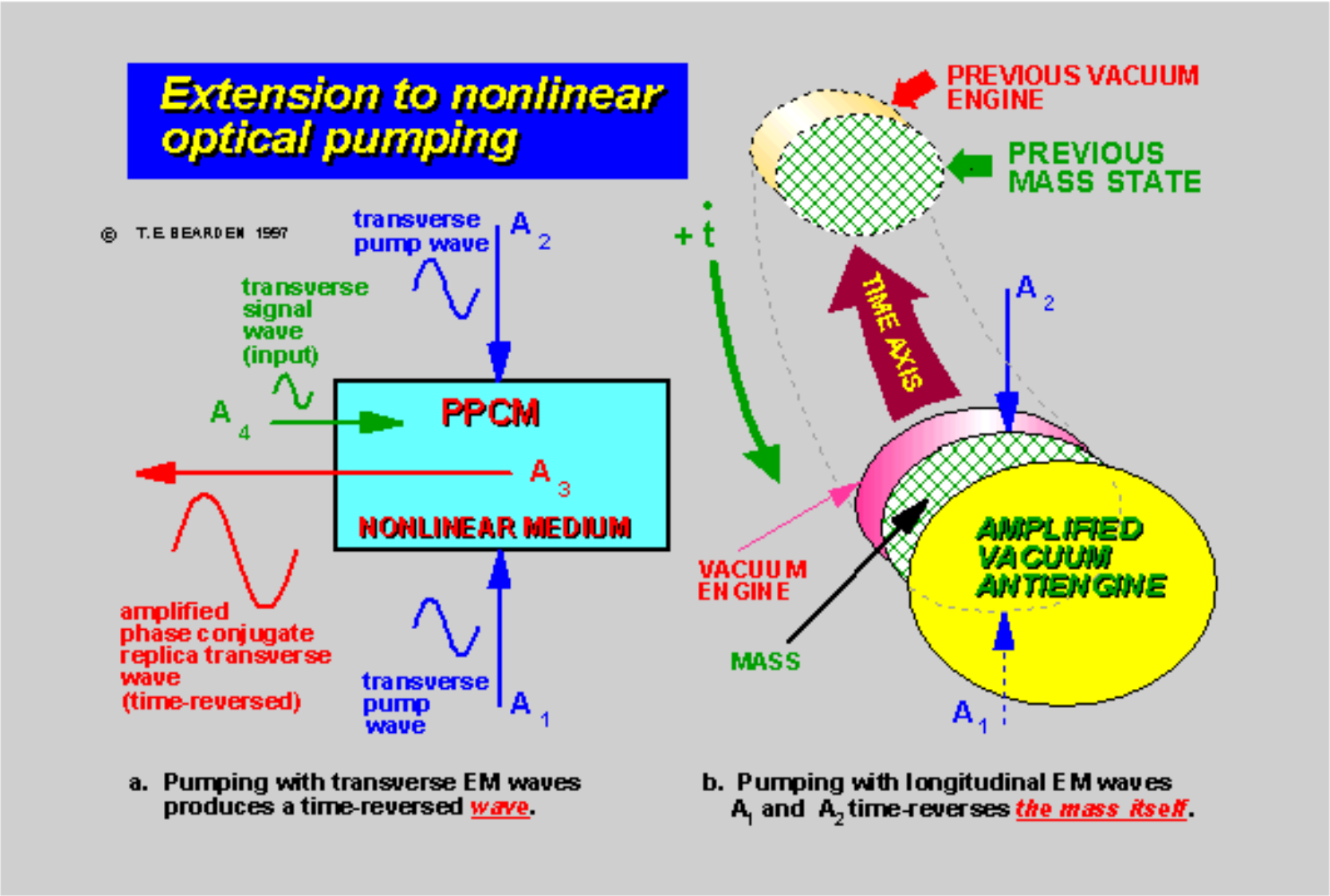

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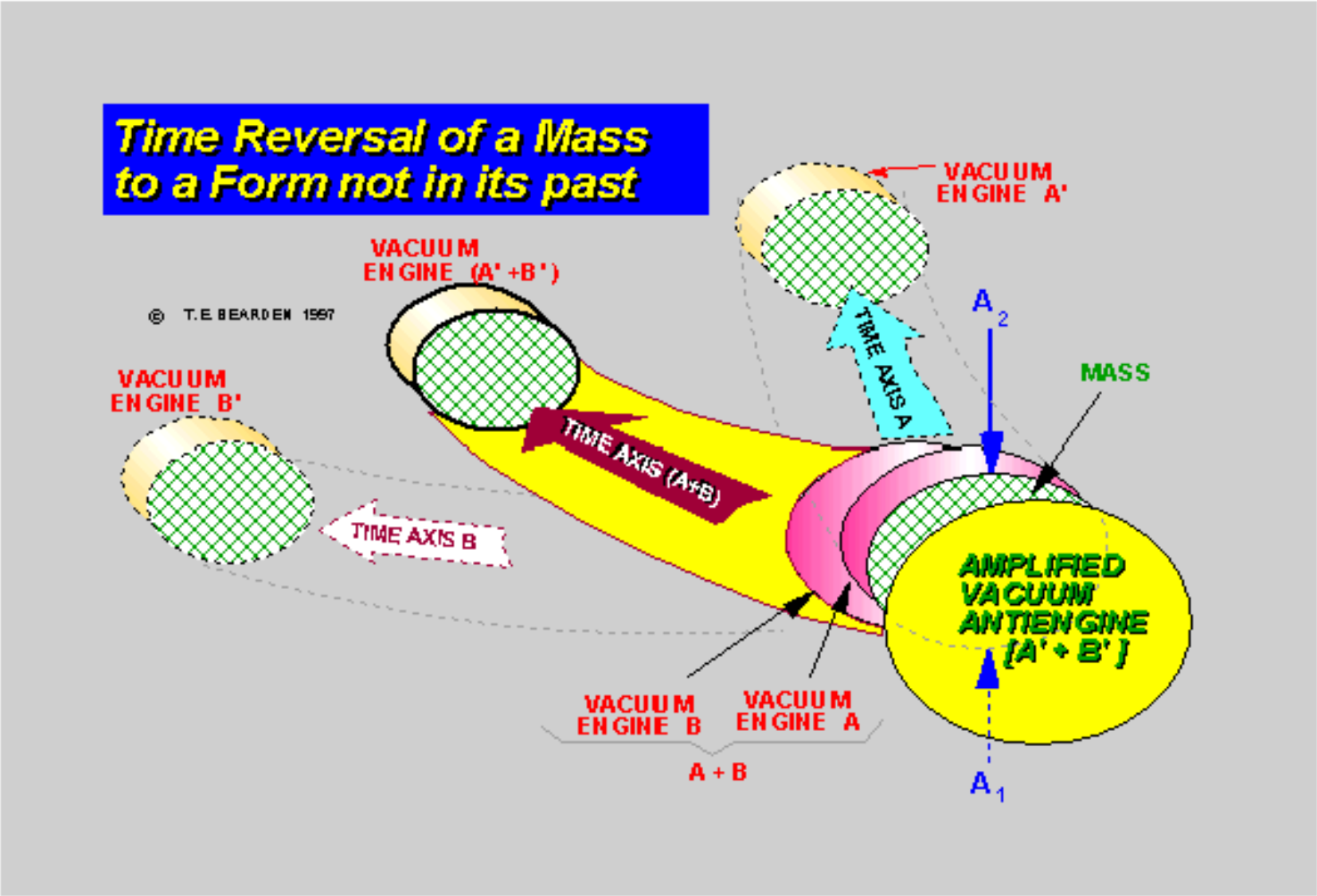

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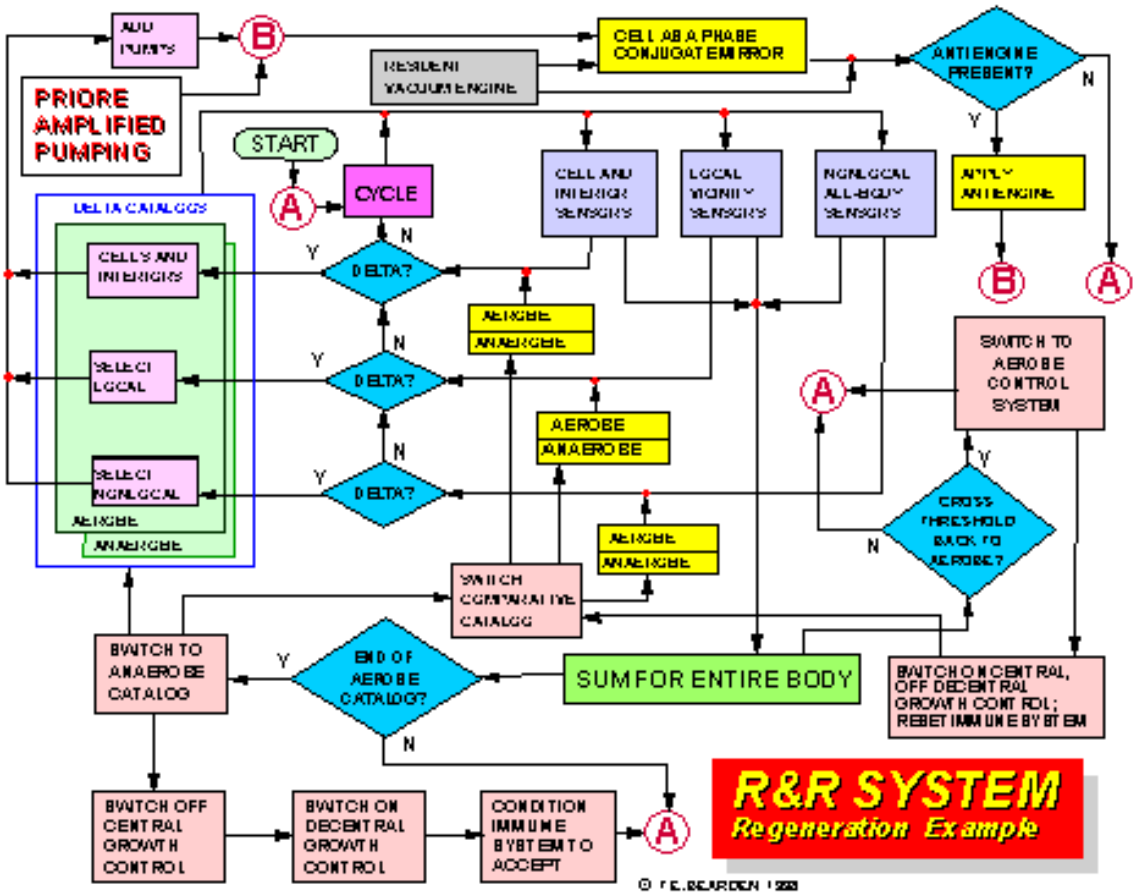

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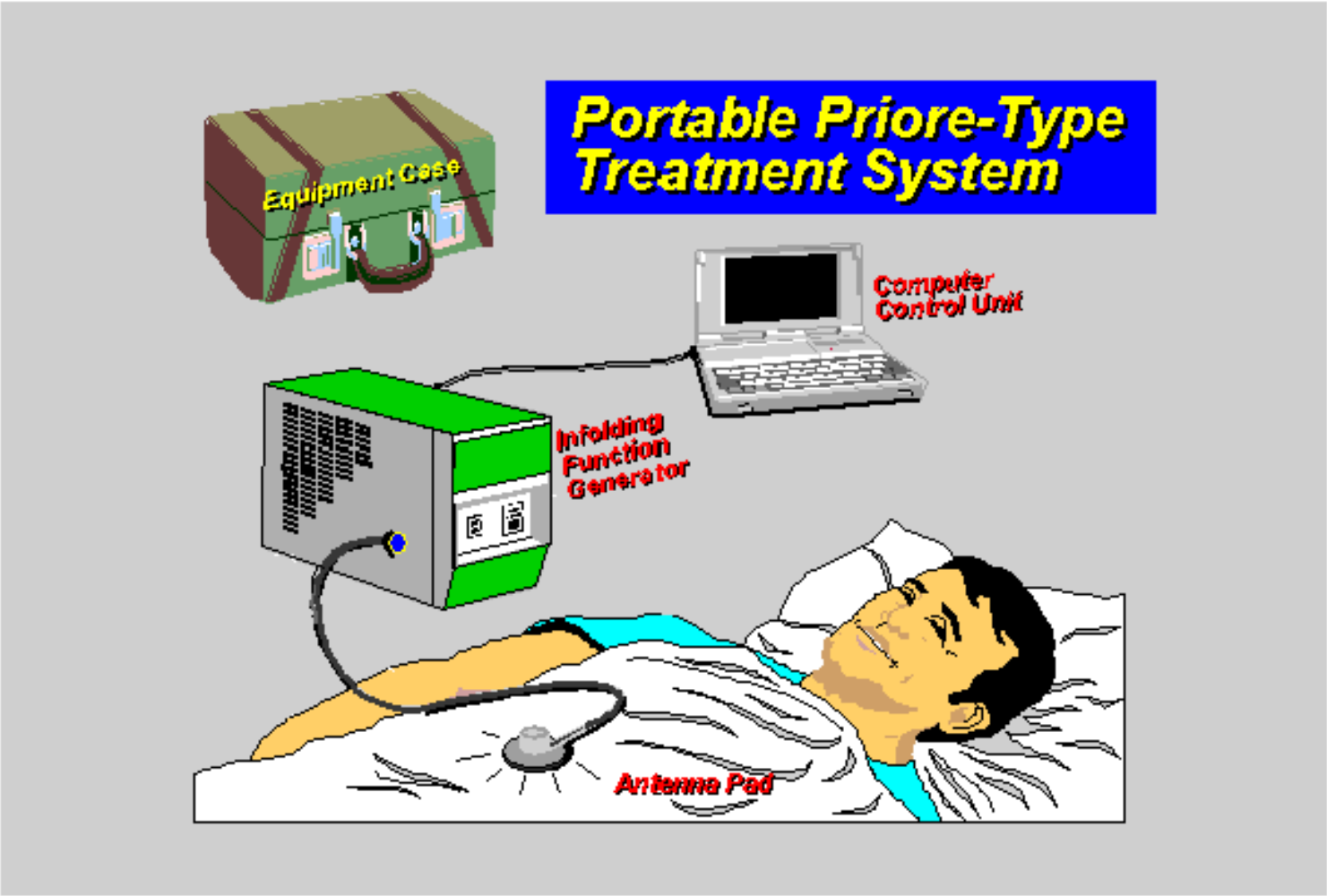

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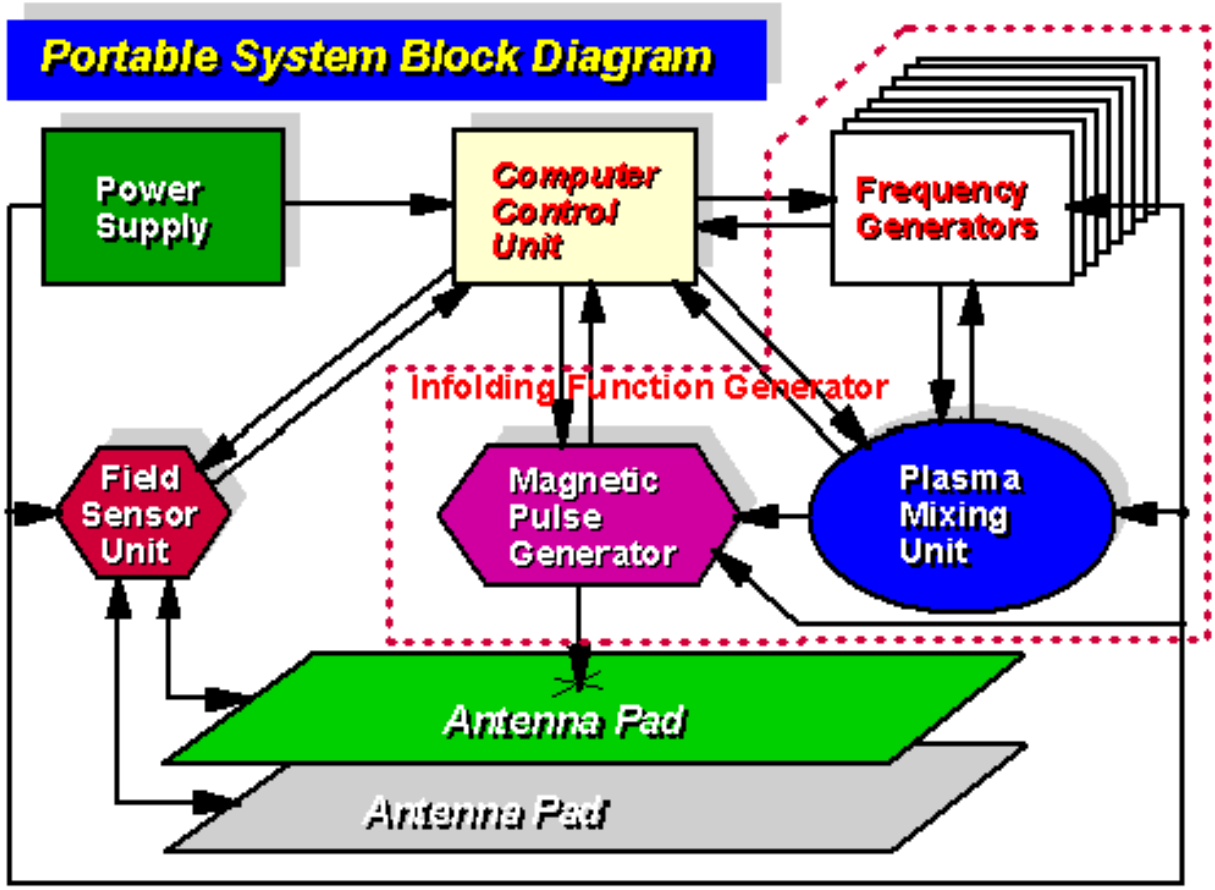

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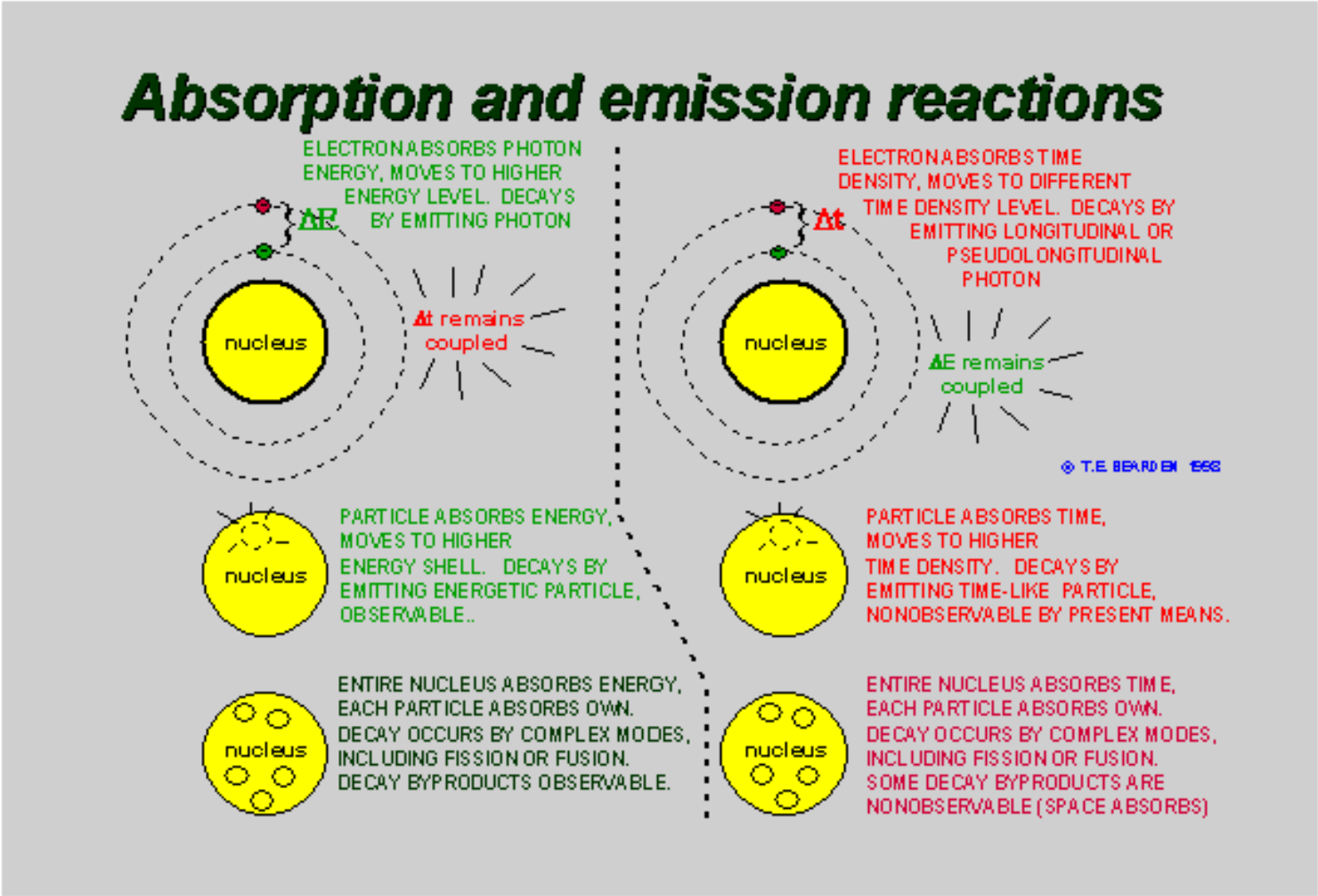

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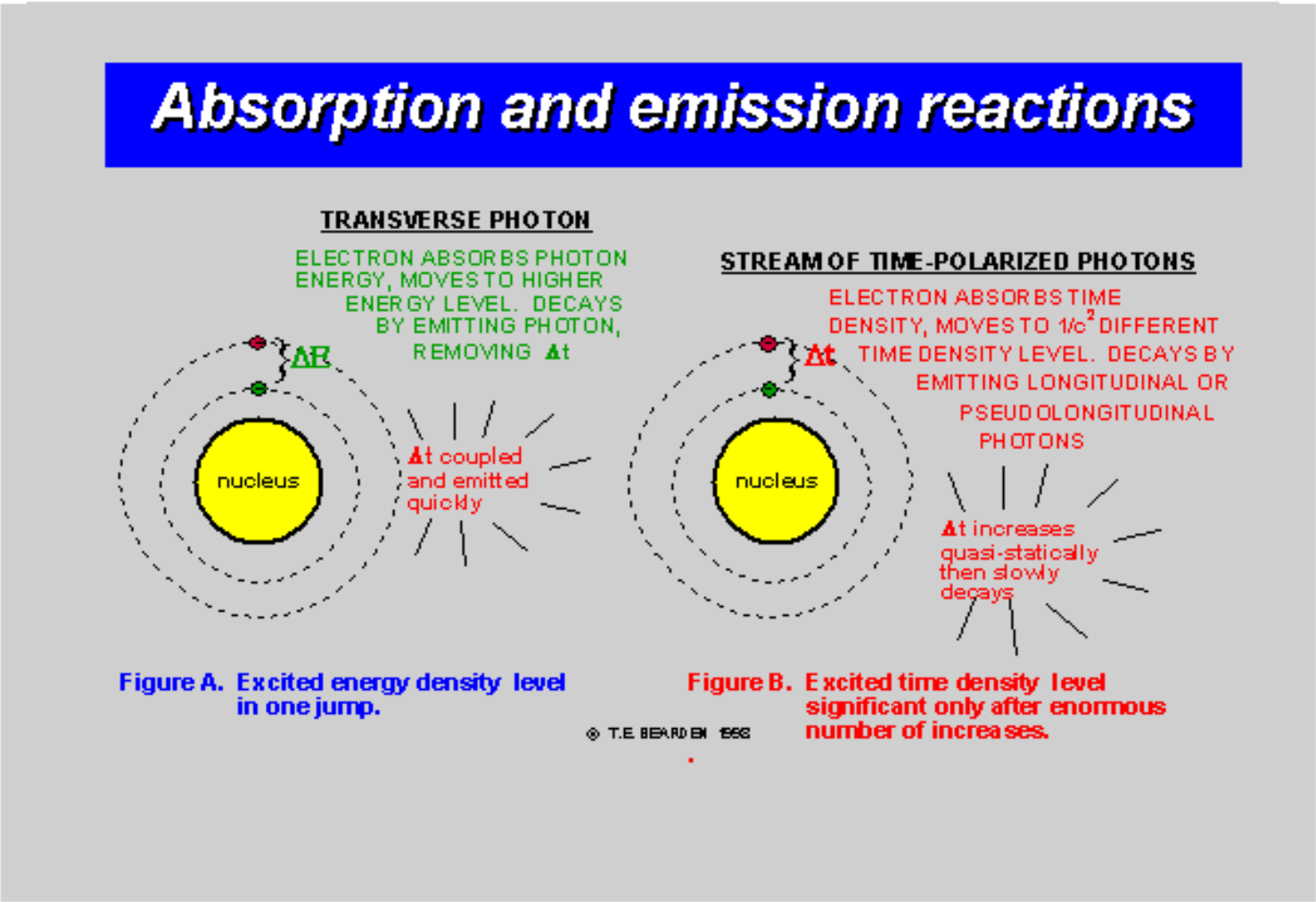

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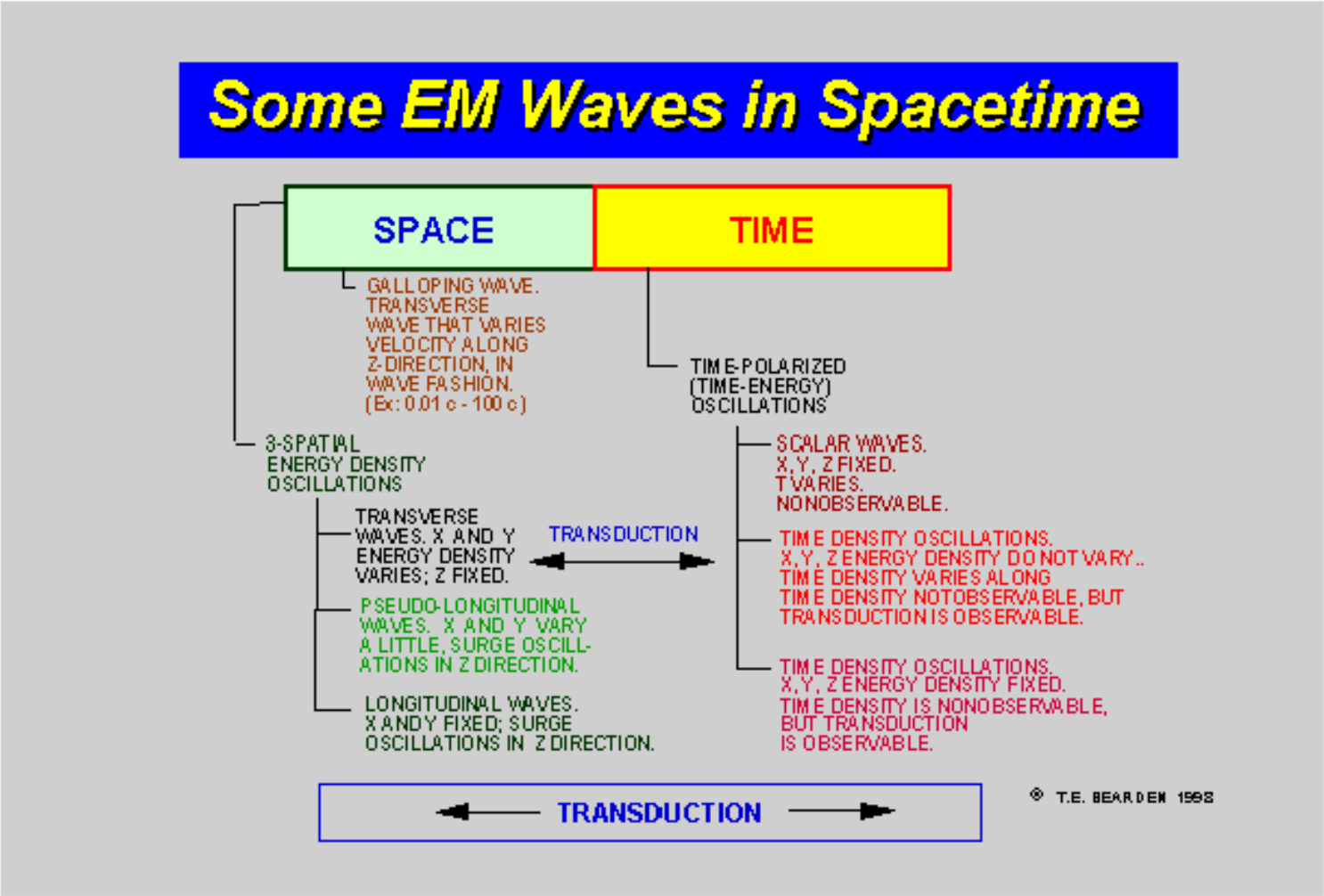

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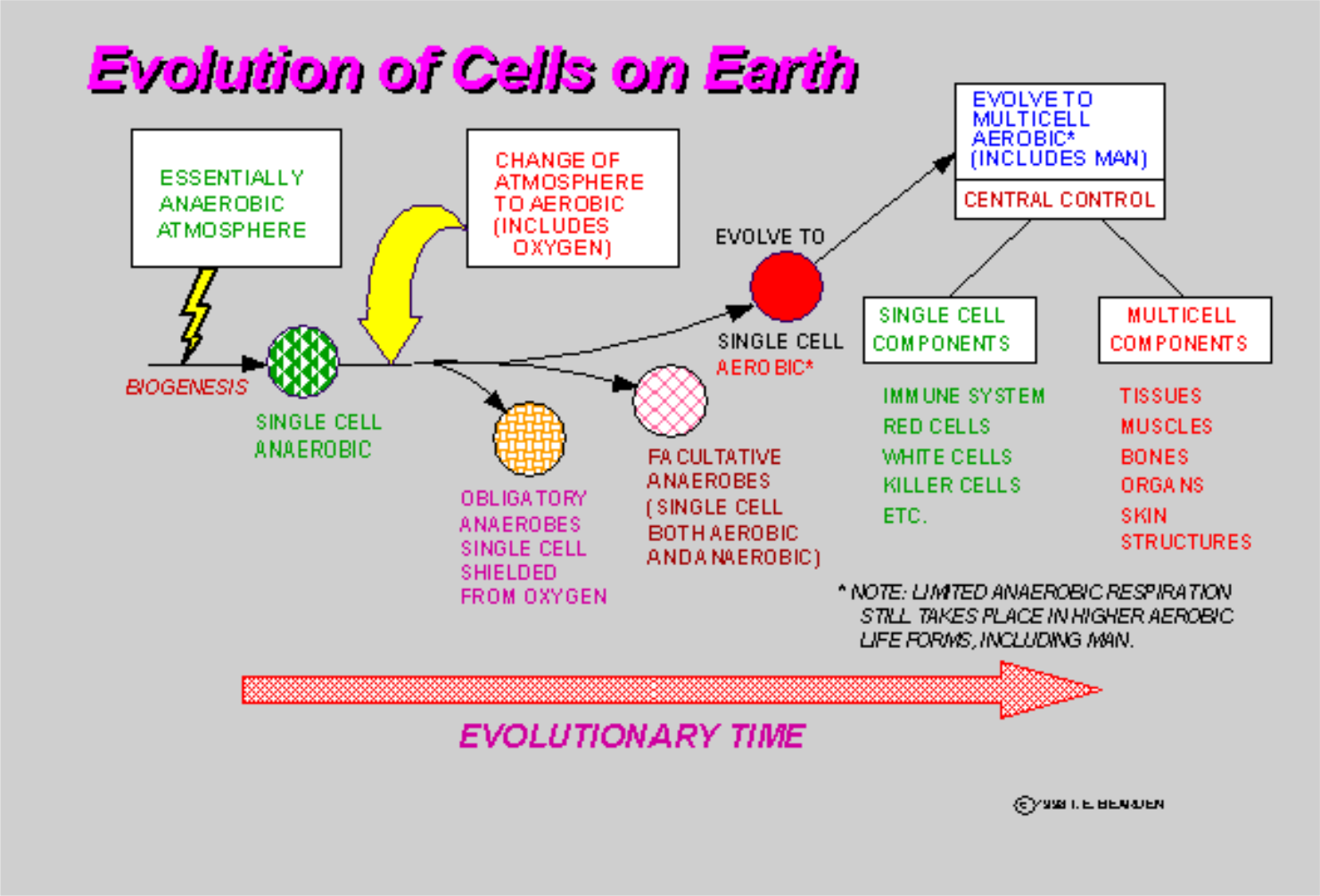

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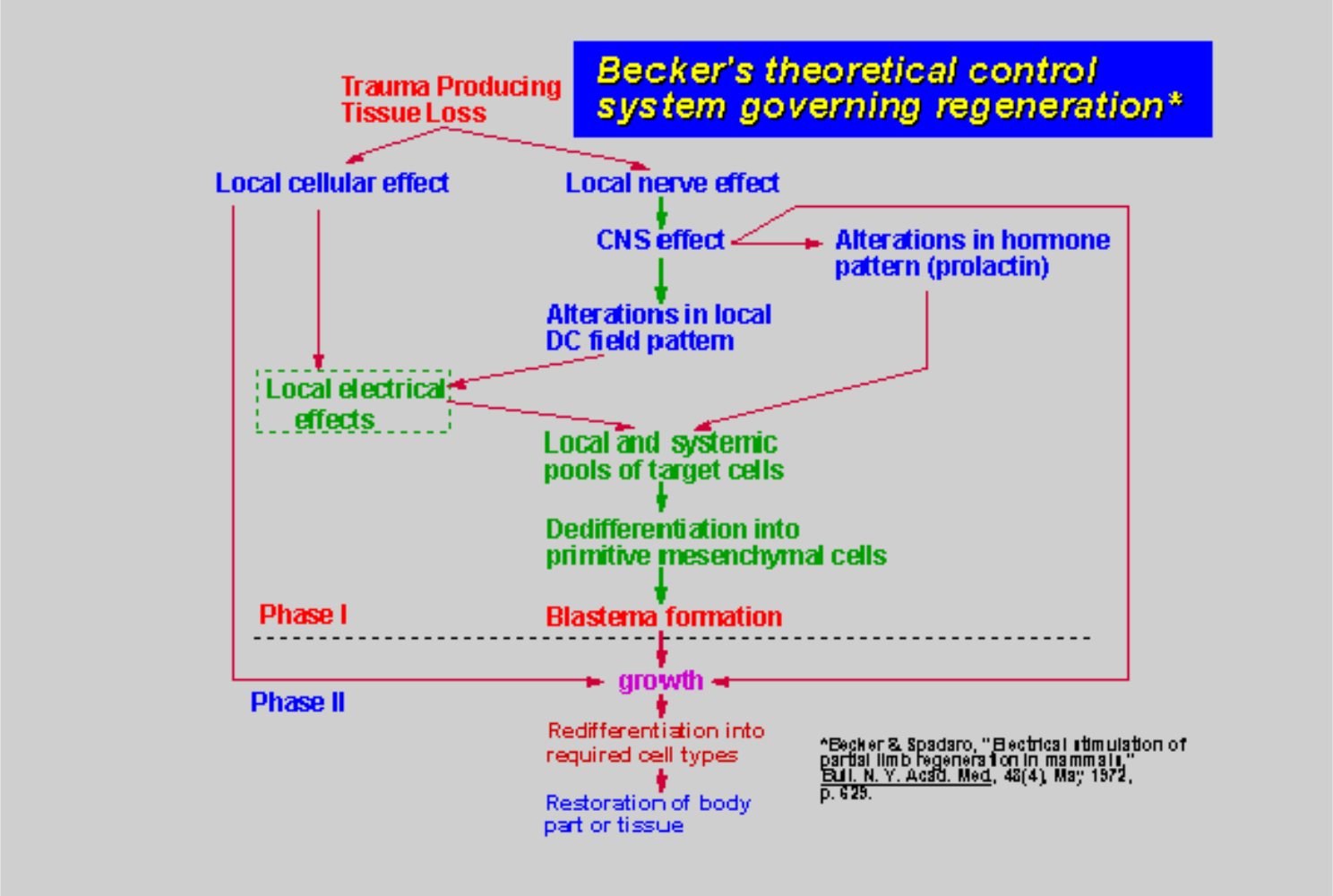

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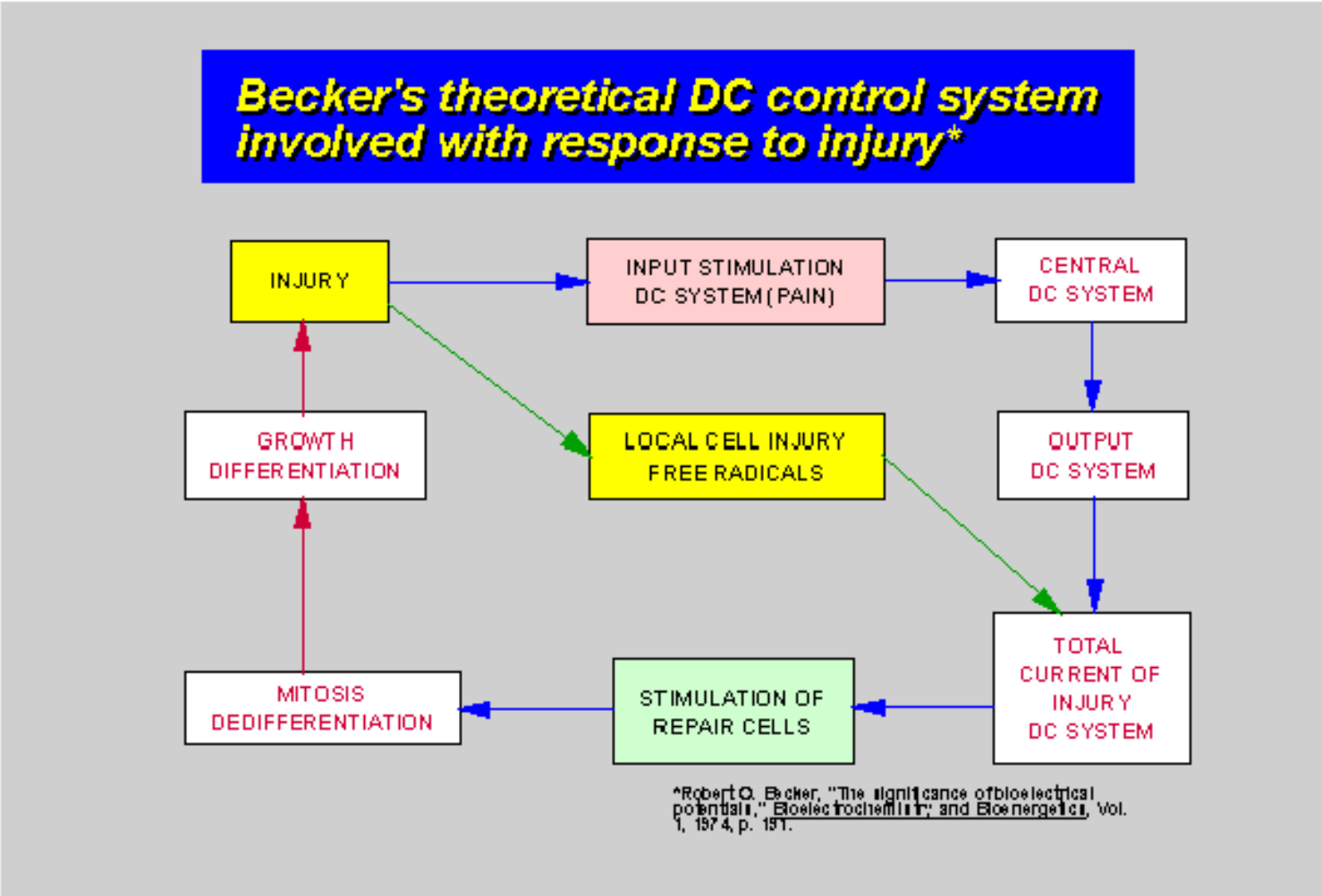

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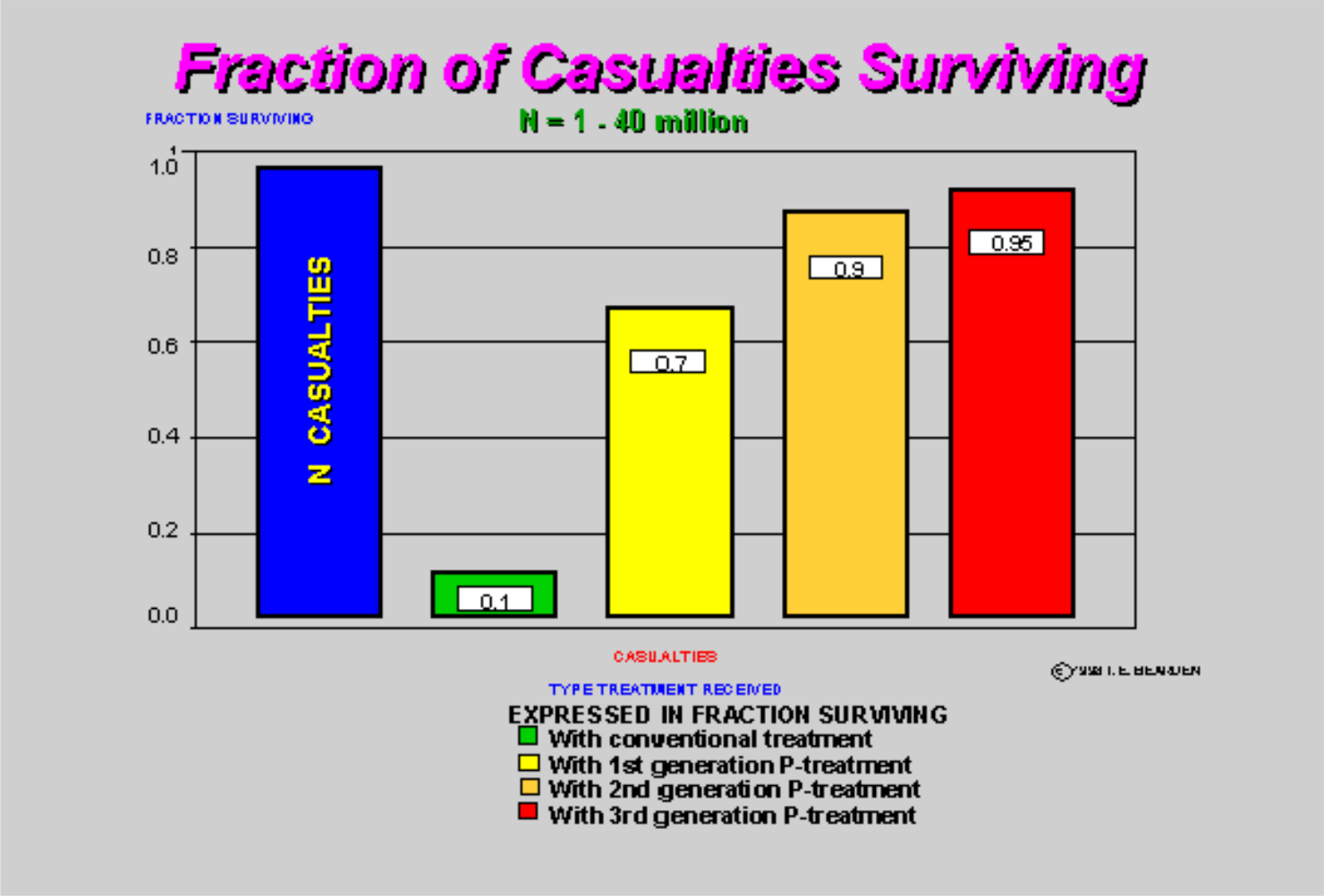

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"Time as fuel" is the future

- Present energy science is insufficient
- Eventually will use energy locked up in time itself
- Cold fusion will provide entrée
- Cold fusion has evidence of time-as-energy
- Theorists and experimentalists should examine the implications
- Must revise foundations of Electrodynamics

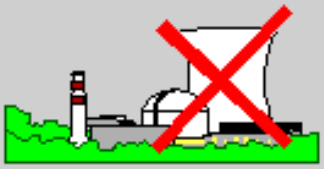

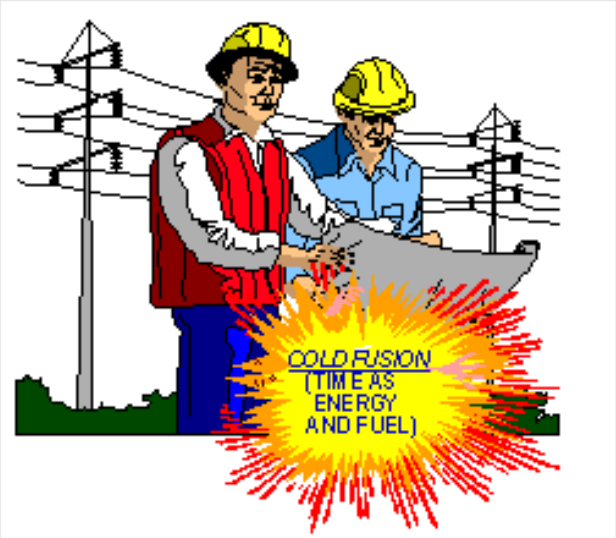

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A National Report on America's Energy Crisis

Remarks by U. S. Secretary of Energy Spencer Abraham

U. S. Chamber of Commerce, National Energy Summit March 19, 2001

Opening Remarks

I would like to congratulate the U. S. Chamber of Commerce for convening this two-day National Energy Summit and I appreciate your invitation to participate. As we all know, the topic of energy is as timely as the day's headlines. In just my first eight weeks as Energy Secretary, California has faced almost daily power alerts. Rising natural gas prices have punished consumers with bills that, in some cases, are double or triple last winter's. And forecasts for this summer suggest the possibility of rolling blackouts.

The good news is that America's energy problems can be solved. The bad news is that the situation in California is not isolated, it is not temporary, and it will not fix itself.

America faces a major energy supply crisis over the next two decades. The failure to meet this challenge will threaten our nation's economic prosperity, compromise our national security, and literally alter the way we live our lives.

America has heard these dire warnings before - in fact, they seem to be a recurring theme in our nation's energy discussion, almost since "Colonel" Drake made the first oil strike near Titusville, Pennsylvania in 1859. "The amazing exhibition of oil," advised the State Geologist of Pennsylvania, "[is] a temporary and vanishing phenomenon-one which young men will live to see come to its natural end. " That was in 1885.

Around the same time, John Archbold - who succeeded John D. Rockefeller as head of Standard Oil - joked about the prospects for oil discoveries in Oklahoma: "Are you crazy?" Archbold said. "I'll drink every gallon produced west of the Mississippi. "

I don't know if anyone ever called Mr. Archbold on that pledge. But for whatever reason, in 1914 the U. S. Geological Survey predicted that the U. S. would soon exhaust its available oil supplies. They issued the same warning in 1926. And again in 1939. And in 1949.

All of these warnings have proven false. Despite all these expert predictions, the world has not run out of oil or other resources. And yet here we are, faced with the most serious energy shortage since the days of oil embargoes and gas lines.

My point is, America's current energy supply crisis is not due to some inevitable neo-Malthusian depletion of resources. The United States - and our North American and hemispheric neighbors-are blessed with a rich abundance of natural resources. It's political leadership that has been scarce.

For the past eight years, Washington sat on the sidelines as our nation's energy needs mounted. During the 1990s, the Clinton Administration employed a policy of taxing demand, limiting supply, and ignoring the rapidly expanding needs of the future.

Their energy strategy boiled down to: you can't find it . . . you can't transport it . . . and even if you get it, we don't want you to use it.

Through neglect or complacency or ideology, this approach has led us to the crisis we face today.

The Bush Administration is fully prepared to respond to the broad set of challenges we inherited. But we must be candid with the American people about the magnitude of the problem - which is what I'd like to talk about today.

America's Energy Supply Challenges

Three overriding facts starkly define the challenge of America's energy needs over the next two decades:

First, demand for energy is rising across the board, but particularly for natural gas and electricity;

Second, supplies are being limited by a regulatory structure that, in many respects, has failed to keep pace with advances in technology and an uncertain political environment that often discourages investment in desperately needed facilities;

And third, our energy infrastructure - that network of the generators, transmission lines, refineries and pipelines that convert raw resources into usable fuel - is woefully antiquated and inadequate to meet our future needs.

Unless these challenges are addressed, America's energy supply will be continually at risk . . . our citizens will encounter blackouts and other lifestyle-altering disruptions . . . and our economy will be hobbled by rising energy prices. Let me briefly outline some of the major issues on the horizon:

Oil: Rising Consumption, Accelerating Dependence

In the next 20 years, according to estimates by the Energy Information Administration, America's demand for oil is projected to increase by 33 percent. Yet as consumption surges, U. S. production continues to drop precipitously. We now produce 39 percent less oil than we did in 1970, losing nearly 4 million barrels a day in the process. And unless energy policy is changed, production will slip further - to just 5.1 million barrels per day by 2020 - down from a high of 9. 4 million a day 30 years ago. This widening gap between demand and domestic supply will make us increasingly dependent upon foreign imports. Back in 1973-at the height of the oil crisis - America imported just 36 percent of its oil from abroad.

Today, we import 54 percent. And, if we allow this trend to continue, we will soon be forced to look abroad for some 64 percent of our oil. This will put more power in the hands of foreign suppliers - power they are not reluctant to use, as we just saw when the OPEC cartel decided to reduce oil output by one million barrels a day.

While this administration does not agree with OPEC's decision, that decision demonstrates the importance of increasing America's production of oil. Securing an affordable, reliable and adequate supply of crude is a critical challenge. But it is only half the oil story.

Since 1980, the number of American refineries has been cut in half. There hasn't been a new refinery built in the United States in over 25 years. New regulatory interpretations limit the ability of existing refineries to expand capacity. Add to that regulations that require the production of more than 15 different types of gasoline-and you have a refining industry strained to capacity, leaving us dangerously vulnerable to regional supply disruptions and price spikes.

Refineries are so constrained that when President Clinton made the politically symbolic gesture of releasing 30 million barrels of oil from the Strategic Petroleum Reserve last fall, that oil had to be shipped overseas to be refined.

Natural Gas: Rapidly Rising Demand; Constraints on Supply

Many of the same issues confront the future of natural gas. America's demand for natural gas is projected to rise even more rapidly than oil. If Department of Energy projections are correct, by 2020 Americans will consume 62 percent more natural gas than we do today. More than 9 out of 10 of the announced new electric generating plants will be fired by natural gas.

This approaching wave of new demand begs the question: Do we have an energy policy and a regulatory structure capable of meeting our natural gas needs?

Consider just a few constraints in this market.

Right now, an estimated 40 percent of potential gas resources in the United States are on federal lands that are either closed to exploration or covered by severe restrictions. The last lease sale in the some areas of the Gulf of Mexico was more than a decade ago. New discoveries of natural gas in the United States have fallen for three straight years, creating increasing pressure for more imports.

The notion that we can rely so heavily on natural gas . . . maintain severe restrictions on exploration . . . and still enjoy low prices is a dangerous assumption.

Even if we find the supplies, moving that gas to market will require an additional 38,000 miles of transmission pipeline and 255,000 miles of distribution lines-at an estimated cost of $120-$150 billion.

Today's pipeline system can hardly handle the supplies we know exist. Alaska's Prudhoe Bay, for example, produces about 8 billion cubic feet of natural gas a day - approximately 13 percent of America's daily consumption.

But that gas never reaches the market. Instead, it is just pumped back into the ground, waiting until a pipeline is built to connect the Alaska fields to the U.S./Canada distribution system.

Electricity: Powering the Information Economy

As everyone knows, we also face a real challenge in generating enough electricity to light out homes and run our businesses. Over the next 20 years, the Department of Energy estimates that electricity demand in the United States will increase by 45 percent. That rising growth rate will require the construction of over 1,300 new power plants-about 65 every year.

Yet, the last time we added that much power was 1985.

Furthermore, there is reason to believe that this could turn out to be a conservative estimate. During the 1990s, electricity consumption far outstripped projections, driven by the energy-hungry information economy. Some experts calculate that the demands of the Internet already consume some 8-13 percent of electricity. If demand grows at just the same pace as during the last decade, we'll need nearly 1,900 new plants by 2020-or more than 90 every year-just to keep pace.

Hundreds of new generating plants will place even greater pressure on our already strained and aging power grid. America's network of transmission lines, substations and transformers was built when utilities were tightly regulated monopolies providing service to assigned regions. Interconnections between suppliers were strictly an emergency backup measure to guard against rare service interruptions. The system was simply not designed for long-haul swapping of power in a highly competitive market.

Consumers are already feeling the impact of a transmission systems stressed by rising demand. Transmission bottlenecks contributed to the blackouts that have swept through California and to price spikes in New York City last summer that cost consumers an estimated $100 million.

Coal, Nuclear, and Hydro-Electric Power

Coal has historically been American's number one source for affordable electricity; it currently powers half of America's electricity generators. And at today's recovery rates, our nation has enough coal to keep those plants running for the next 250 years.

Coal generators have already been called upon to make broad reductions in emissions. The Bush Administration supports those efforts-and we will back it up with greater incentives for investment in clean coal technology.

But the administration will not regulate coal out of existence . . . and we will not support measures that will threaten electricity supplies and significantly raise electricity prices. President Bush made the right decision last week not to impose new federal mandates on the emissions of carbon dioxide. If America is to have reliable electricity over the next 20 years, coal must continue to play a major role.

But, coal is not the only energy source facing an uncertain future. There hasn't been a new nuclear power plant permit granted since 1979. Many of the 103 existing nuclear plants are not even expected to file for a renewal of their licenses as they expire over the next 15 years.

Even hydroelectric power generation is expected to fall sharply.

Re-licensing a hydro facility can take a decade or more and cost millions. And now, even though consumers are faced with potential blackouts and chronic electricity shortages in the West, activists and some political leaders want to breach one or more of the four federal dams on the Snake River to help young salmon, on their trek to the sea.

The Dangers of Complacency

What are the dangers of complacency in light of these challenges? How does it all add up for our economy and our citizens?

This nation's last three recessions have all been tied to rising energy prices - and there is strong evidence that the latest crisis is already having a negative effect.

The National Association of Manufacturers estimates that soaring fuel prices between 1999 and 2000 cost the U.S. economy more than $115 billion-shaving a full percentage point off our Gross Domestic Product. A January survey of its 5,500 members reveals that nearly one quarter were forced to curtail operations.

During a two-week period this past January, Californians lost an estimated $2.3 billion in wages, sales and productivity. Layoffs are already hitting workers in the West as companies shift production to states with more reliable energy sources. Then there are the jobs that will never be created.

Intel's CEO Craig Barrett announced that the world's leading chipmaker won't be expanding in California: "As long as California is a Third World country," Barrett said, "we won't build $2 billion manufacturing plants here."

The Food and Agricultural Policy Institute reports that farmers are likely to see their income drop 20 percent over the next two years due to higher energy costs.

Rising energy costs are hitting every family's checkbook, primarily affecting those who can afford it least. Gas bills for many homeowners in the Washington, DC area more than tripled this year. Some residents are reporting that their heating bills are higher than their food bills this winter.

The power crisis isn't just pinching our wallets, it's changing the way we live our lives. In California, power outages have shut down traffic lights, darkened schools and closed businesses. The governor has ordered local police to patrol the streets-not for criminals, but to make sure businesses keep their lights dimmed.

But California is not the only state facing a mismatch between supply and demand. With electricity shortages predicted for New York City and Long Island this summer . . . low capacity margins threatening electricity reliability in the Midwest, Southeast and Northern Plains states . . . and strained refinery capacity in the Midwest, Americans across the nation are feeling the energy squeeze.

The Need For A National Energy Policy

Rising demand . . . tightening supplies . . . an aging power infrastructure . . . a decade of neglect from Washington: These are the trends that define America's emerging energy needs.

President Bush has committed this administration to meeting these challenges - a job that begins with the urgent task of developing and implementing a long-term national energy policy.

To accomplish this, President Bush created an Energy Task Force headed by Vice President Cheney. He

has asked us to define a clear strategy - a strategy that will allow environmentally responsible exploration and recovery of our domestic resources . . . enhance our commitment to conservation and energy efficiency . . . and encourage investment in new technology to further the development of renewable energy sources.

I wish I could say that the energy crisis now sweeping the nation has shocked the political system into action. But like other political discussions in recent years, the debate over energy seems as deeply polarized as ever.

On one end of the spectrum, some activists propose what amounts to a "zero tolerance" policy toward exploration and cling to the quixotic idea that new, undiscovered sources will somehow allow us to meet our energy needs. On the other end, some advocates place an almost limitless faith in special tax breaks for this favored activity or subsidies for that preferred industry.

The two extremes in our energy debate are founded on several enduring myths - myths that today conspire to block any true advance toward a rational and stable energy policy in the United States. Here are a few of the more prominent ones.

Myth Number 1: It is impossible to balance energy exploration and environmental protection.

Advances in technology have brought us a long way from the days when wildcatters punched holes in the ground based on the hunch they might hit a gusher. But from a regulatory standpoint, our view of oil and gas exploration hasn't changed much since we saw Jed Clampett strike "black gold" and split for Beverly Hills.

Today, satellites and computers are the tools of choice in the exploration business. Geologists can bounce acoustic and electrical vibrations off the earth's inner depths, gather the resulting mass of data into powerful computers and then create three dimensional and even four dimensional maps of resource fields miles below the surface.

Armed with these pinpoint accurate images, companies employ advanced equipment to drill vertically, horizontally and around corners-allowing us to access supplies from previously unimaginable depths, up to six miles away.

The marriage of oil and gas exploration with cutting-edge technology means fewer rigs, fewer roads and fewer pipelines. Drilling operations that required 65 acres in the 1970s need only 10 acres today. Technological improvements in just the past 15 years have generated success rate increases of 50 percent. America's national energy policy must reflect these staggering advances that have revolutionized the way we develop our resources.

Myth Number 2: All our current problems are due to an energy industry that is engaged in a massive conspiracy to gouge consumers by limiting supply to drive up prices.

This myth has been punctuated by calls for investigations into everything from last summer's Midwest gasoline price spikes, to recent allegations that power generators in the West have been withholding electricity. We have a fair and objective process for judging these claims-and action will be taken when it is merited. Over the past two weeks, for example, the Federal Energy Regulatory Commission ordered power companies to rebate some $124 million to California utilities. Meanwhile, the Federal Trade Commission recently cleared gasoline suppliers of all charges relating to last summer's price increases.

But charges of price gouging largely miss the point. There is no magic source of supply; no hidden pool of energy that can be turned on and off like a faucet. California-and other power-strapped states-will never solve the power crises they confront until they resolve the conflict between demand and supply.

Earlier this year, one company proposed building a $400 million power plant in California that would have provided enough additional electricity to light 600,000 homes in energy-starved Silicon Valley. The company pledged to plant 800 new trees to beautify the area. They proposed cloaking the power station in a brick facade to make it essentially indistinguishable from a high-rent office complex. They even promised to help maintain the local habitat for the endangered bay checkerspoon butterfly.

Their environmentally-sensitive plans won the support of the Sierra Club, the American Lung Association and the NAACP. But city officials voted unanimously -- 11-0 -- to reject the plan. In an editorial, the local paper called this move "Dumb and Dumber."

Meanwhile, further south, plans to build a 550-megawatt gas-fired generator in a Los Angeles suburb were scrapped after residents voted 2:1 against the project. The local mayor added a much-needed dose of reason and maturity to the debate-by launching a hunger strike in opposition to the plant.

In California, workers are being laid off, companies are leaving the state, farmers and small businesses are losing millions, consumers are threatened with rolling blackouts, but local officials reject power plants with little regard for the consequences. Is it really any mystery why there hasn't been a single new power plant built in California in the last decade?

Myth Number 3: The Bush energy plan is focused almost exclusively on opening the Arctic National Wildlife Refuge (ANWR) to exploration-a move that would buy us only about 6 months worth of American consumption while destroying a pristine natural wilderness, not to mention disrupting the breeding ground of the Porcupine Caribou.

Let's separate fact from fiction when it comes to ANWR.

First, according to estimates by the U. S. Geological Survey, ANWR holds between 5. 7 to 16 billion barrels of recoverable reserves-with a mean estimate of 10. 4 billion barrels. And that assumes the use of drilling technology now nearly a decade old. This represents more than 300 times the amount of the

oil President Clinton released from the Strategic Petroleum Reserve last fall. And based on December 2000 figures, it would free us from about 54 years of oil imports from Saddam Hussein and Iraq.

Second, exploration would impact only about 2,000 acres out of more than 19 million. To put that in perspective, the massive Arctic National Wildlife Refuge is about the same size as the entire State of South Carolina; the two thousand acres that would be affected is less than half the size of Dulles airport.

And as for the caribou, the herd in the Prudhoe Bay area grew more than 9-fold over the past 20 years to an estimated 28,000 in 2000-seemingly irrefutable evidence that caribou mating and oil exploration can peacefully coexist.

The decision to open a small portion of ANWR should be made on the merits. But it should not be made on the mistaken assumption that opening ANWR will allow us to produce our way to full energy independence.

America first became a net importer of energy in the 1950s - and our economy will continue to depend, in part, on imported oil. However, closing off virtually every available new source of domestic supply, enhances the leverage and power of an oil cartel that cannot be relied on to put America's interests first. While the resources of ANWR won't make us energy independent, they will help increase America's energy security by ensuring a more diverse supply of oil.

Myth Number 4: Government subsidies and tax breaks are the best way to encourage new exploration and production of energy.

This administration will continue to support funding for energy research and development initiatives. But capital is best allocated to its highest uses through the workings of the free market, not manipulations of the tax code. Government regulatory policy should not be aimed at picking winners and losers in any market, including energy. Neither should tax policy.

Myth Number 5: We can forego traditional sources and instead meet rising energy demand by harnessing wind, geothermal, solar and other forms of renewable power.

Excluding hydro-power, renewable sources currently generate about 2 percent of America's electricity. Billions have been invested in developing renewable energy-and will continue to be invested under the Bush Administration. But renewables have yet to overcome the economic advantages of conventional energy sources.

Even with promising advances in research and development, renewables will only provide, according to Energy Information Administration estimates, about 6 percent of our total electricity consumption by 2020. Even if renewables exceed our most optimistic expectations, they would still supply only a fraction of our needs over the next 20 years.

Myth Number 6: Price controls are the answer to today's energy crisis.

Memories are short, aren't they. So let me remind everyone. America imposed price controls on oil and gas in the 1970s. They were an utter failure. They led to shortages and rationing and the idea that America was gripped by malaise.

Let me be clear: The Bush Administration does not support price controls. Price controls on electricity will lead to more blackouts. Price controls on gasoline will lead to gas lines. Price controls will deepen America's energy crisis, because they won't reduce demand, but they will cripple incentives for desperately needed new investments in energy supply.

Charting a New Policy Course

The challenges are formidable . . . the warning signs are obvious . . . but I am optimistic because I know this administration's commitment is equal to the task.

Our national energy policy will be comprehensive. It will reach across every department that touches the energy marketplace-from the Interior Department and the EPA to the Transportation Department and the DOE.

Our national energy policy will be hemispheric. It will be based on the understanding that our policy cannot stand in isolation from our neighbors throughout the Americas.

Our national energy policy will stress the need to diversify America's energy supply. It will be founded on the understanding that diversity of supply means security of supply . . . and that a broad mix of supply options-from coal to windmills, nuclear to natural gas-will help protect consumers against price spikes and supply disruptions.

And our national energy policy will be balanced. It will leapfrog the myths that stifle change-rejecting the notion that there is no middle ground between environmental protection, regardless of the cost and energy exploration, regardless of the impact.

Soon we will deliver our recommendations to President Bush. Later, we will introduce legislation aimed at winning bipartisan support for a national energy policy that matches the magnitude of the challenge. I am hopeful that men and women of good will-from both ends of the political spectrum . . . from environmental organizations to industry groups-will then come together and transcend the stale debate that has characterized energy policy in recent years.

About 150 years ago, America faced a vastly different energy crisis.

Supplies of whale oil were becoming more and more scarce. Few could afford to pay for the luxury of this or other costly methods of illumination. Sure, crude oil was available. In those days it was soaked up with rags, wrung out into small vials, and then sold as a treatment for toothaches . . . until an entrepreneur lined up an investor and a chemist and launched an energy revolution that would light the world.

In America, resources become scarce only when our imagination languishes. By engaging that imagination, I am confident we can meet the challenges of today. If complacency yields to action. If we resolve to strike a rational balance between our energy needs and our environmental concerns. And if a national energy policy becomes an urgent priority.

Thank you.

Report by Energy Secretary Spencer Abraham

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Report by Energy Secretary Spencer Abraham

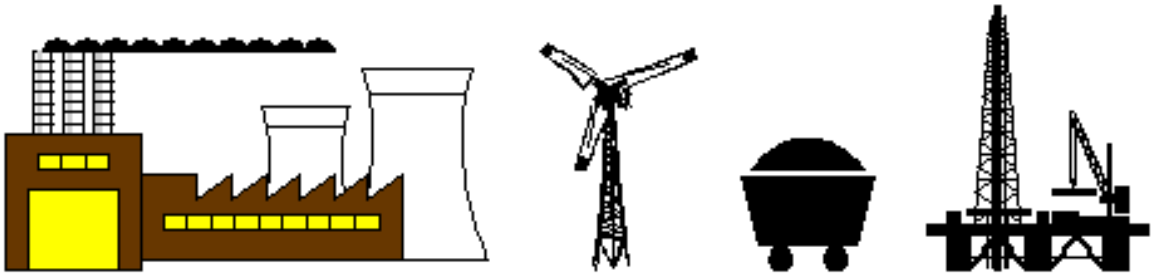

National Energy Summit,
U.S. Chamber of Commerce
Mar. 19, 2001

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National energy policy for 8 years

- The national policy imposed the following:
  - Taxed energy demand
  - Limited the energy supplies
  - Ignored expanding energy needs
- Summary of the past policy on energy:
  - You cannot find it
  - You cannot transport it
  - If you get it, we don't want you to use it
- *Good News:* Crisis can be solved
- *Bad News:* Not temporary; will not fix itself

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Energy supply challenges

- Demand for energy rising across the board, particularly for natural gas and electricity
- Supplies limited by regulatory structure
  - Failed to keep pace with technology advances
  - Uncertain political environment discourages investment in desperately needed facilities
- Energy infrastructure is woefully antiquated and inadequate

Note: The energy infrastructure is that network of generators, transmission lines, refineries, and pipelines that convert raw resources into usable energy or fuel

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Oil: Rising consumption and accelerating dependence

- In U.S., will increase 33 percent in 20 years
- U.S. production continues to drop
  - Produce 39% less now than in 1970
  - At present reduction rate, production will decrease to 5.1 million barrels per day by 2020, down from 9.4 million barrels per day in 1970.
- Imports have steadily risen
  - From 36% in 1973 to 54% today
  - Will soon rise to 64% unless checked
  - Empowers foreign suppliers such as OPEC
- Assuring affordable, reliable, adequate supply of crude oil is a critical national challenge

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Oil: Rising consumption and accelerating dependence

- We have been decreasing the infrastructure
  - Since 1980, U.S. refineries reduced by 50%
  - No new refinery built in over 25 years
  - New regulatory interpretations limit expansion of capacity of existing refineries
  - Regulations require producing more than 15 different types of gasoline
  - Refining industry strained to capacity
- E.g., Clinton symbolically released 30 million barrels of oil from the Strategic Petroleum Reserve
- *The oil had to be shipped overseas to be refined!*

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Natural Gas: Rapidly rising demand, supply constraints

- By 2020, U.S. will consume 62% more natural gas than today
- More than 9 out of 10 of announced new electric power plants will be fired by natural gas
- 40% of potential gas resources are on federal lands either closed or severely restricted
- Last lease in Gulf of Mexico more that 10 years ago
- New discoveries falling
- Dangerous to assume relying on natural gas, severely restricting exploration, keeping low prices

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Natural Gas: Rapidly rising demand, supply constraints

- Given enough natural gas, 38,000 more miles of transmission pipelines and 255,000 miles of distribution lines will be needed
- This alone will cost $120-150 billion
- E.g., Alaska's Prudhoe Bay produces 8 billion ft^3 per day
  - About 13% of America's daily consumption
  - Never reaches the market, pumped back into ground
  - Waiting on building a pipeline to connect Alaska fields to US/Canada distribution system

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Electricity: Needs, problems

- Over 20 years, conservative estimate is that demand will increase 45%
  - Will require construction of 1,300 new power plants, about 65 every year (about one every 6 days)
  - Last time we added so many power plants was 1985
- Some experts calculate demand will increase faster
  - May require nearly 1,900 new power plants
  - That is 90 per year (about one every four days)
- Either way, will place great pressure on already strained and aging power grid

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The aging power grid

- Network of transmission lines, substations, and transformers
- Built when utilities were tightly regulated, supplied service to assigned regions
- Interconnections between suppliers were strictly emergency backup measure for rare usage
- Not designed at all for long-haul swapping of power in a competitive market
- Transmission bottlenecks contributed to California blackouts this winter and price spikes in New York City last summer

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Coal fired electrical power

- Coal powers half our electricity generators.
- Enough coal for 250 years.
- Coal emissions slated for broad reductions
- Administration will support new technology, but will not threaten electricity supplies and let it significantly raise electricity prices
- President Bush therefore decided not to impose new mandates on CO_2 emissions
- If nation is to have reliable electricity over next 20 years, coal must play a major role

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Nuclear power plants

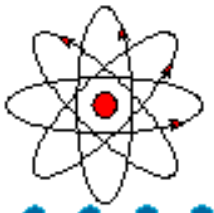

- No new nuclear power plant permit granted since 1979
- 103 existing nuclear power plants
- Many not expected to even file for license renewal as licenses expire over the next 15 years

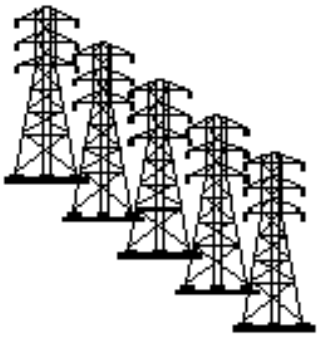

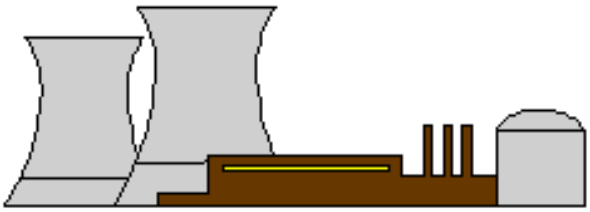

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Hydroelectric power generation

- Expected to fall sharply
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- Some activists and political leaders want to breach one or more of the four federal dams on the Snake River to help young salmon on their trek to the sea

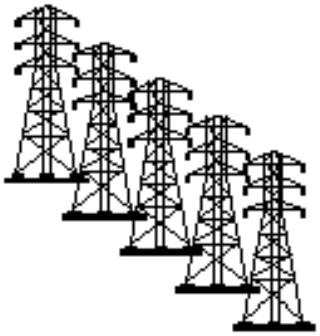

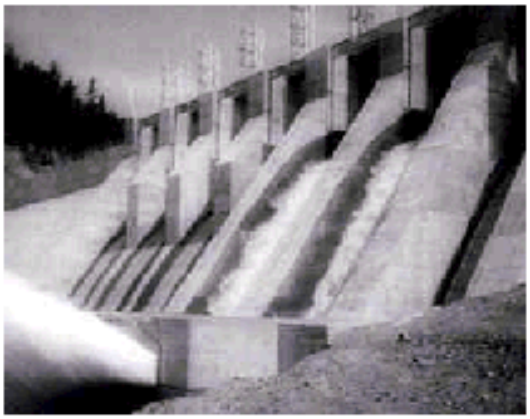

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Dangers of complacency

- Last three recessions tied to rising energy prices
- Latest crisis already causing negative effects
- Soaring fuel costs: extra $115 billion between 1999 and 2000; 1% off Gross Domestic Product
- In two weeks in January 2001:
  - Californians lost $2.3 billion in wages, sales, etc.
  - Layoffs hitting in West as manufacturers shift to states with more reliable energy sources
  - Intel will not build $2 billion plants in California to expand there.
  - Farmers' incomes to drop 20% in next two years

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Dangers of complacency (2)

- Some homeowner gas bills in Washington D.C. more than tripled this year
- Heating bills of some residents exceeded their food bills during the winter

- California power outages shut down traffic lights, closed businesses, darkened schools
- Police patrols were used to insure compliance
- Electricity shortages predicted for New York City and Long Island this summer
- Strained refinery capacity in the Midwest
- Low capacity threatens electricity reliability in Midwest, Southeast, and Northern Plain states

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Need for national energy policy

- Rising demand, tightening supplies, aging power infrastructure, decade of neglect
- President created Energy Task Force, headed by VP Cheney, to determine strategy
  - Environmental responsible exploration and recovery
  - Conservation and energy efficiency
  - Encourage investment in new technology for renewable energy sources
- Debate is still deeply polarized

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Extremes of the energy positions

- Some activists:
  - Zero tolerance to exploration
  - New, undiscovered sources will somehow provide for us

- Some advocates:
  - Limitless faith in special tax breaks for a favored activity or subsidies for a preferred industry

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Six prominent myths, none of which is true

1. It is impossible to balance energy exploration and environmental protection
2. There is a massive energy industry conspiracy, limiting supply to drive up prices
3. The Bush energy plan is focused almost exclusively on opening the Arctic National Wildlife Refuge (ANWR) to exploration
4. Government subsidies and tax breaks are the best way to encourage new exploration and energy production
5. Can forego traditional sources and meet demand by wind, geothermal, solar, and other forms of renewable power
6. Price controls are the answer to the energy crisis

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Can we balance exploration and environmental protection?

- Today, satellites and computers are tools of choice for exploration.
- Acoustic and electrical vibrations off the earth's depths provides maps of resource fields

- With advanced equipment, drill vertically, horizontally, or around corners up to 6 miles
- Fewer rigs, fewer roads, fewer pipelines
- 65 acre drilling in 1970s needs only 10 now
- Success rates have increased 50 percent

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Is there a price gouge conspiracy?

- Calls to investigate gasoline price spikes
- Allegations that power generators in the West have been withholding electricity
- Investigation and action is taken where merited
  - FERC ordered power companies to rebate $124 million to California utilities
  - FTC cleared gasoline suppliers relating to last summer's price increases
- There is no hidden energy pool that can be turned on and off like a faucet
- Must solve power crises by resolving conflict between demand and supply

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Is there a price gouge conspiracy? (2)

- Early this year (2001) one company proposed to build a $400 million power plant in California
  - Additional electricity for 600,000 homes
  - Plant 800 trees to beautify the area
  - Cloak facility in a brick facade to resemble a high-rent office complex
  - Help maintain habitat for an endangered butterfly
- Project supported by Sierra Club, American Lung Association and NAACP.
  - City officials unanimously (11 to 0) rejected it
  - Local paper called this move "Dumb and Dumber".

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Is there a price gouge conspiracy? (3)

- Plans to build a 550 megawatt gas-fired generator in a Los Angeles suburb were scrapped
- Residents voted 2:1 against the project
- Local mayor launched a hunger strike in opposition to it.
- In California:
  - Workers are being laid off
  - Companies are leaving the state
  - Consumers threatened with rolling blackouts
  - Local officials reject power plants with little regard
- Is it really any mystery why there hasn't been a single new power plant built in California in the last decade?

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Arctic National Wildlife Refuge Exploration

- **Myth:** Would buy only about 6 months worth of consumption while destroying pristine wilderness and disrupting the caribou
- **Fact:** The ANWR holds from 5.7 to 16 billion barrels of recoverable reserves (mean is 10.4)
  - More than 300 times the oil Clinton released
  - Frees us from equivalent of 54 years of imports from Saddam Hussein and Iraq
  - Exploration involves only some 2,000 of more than 19 million acres -- like half the Dulles airport compared to the entire state of South Carolina

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Arctic National Wildlife Refuge Exploration (2)

- The caribou herd in the Prudhoe Bay area grew more than 9-fold over the last 20 years (to 28,000 in 2000)
- Proves that caribou mating and oil exploration can peacefully co-exist
- Exploration should be considered on merits
- Opening ANWR will help, but does not allow full energy dependence

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Our increasing oil imports

- U.S. became a net importer of oil in 1950s
- Closing off all new domestic sources enhances leverage and power of oil cartels
- These cannot relied on to put American interests first

- Development of domestic resources such as ANWR will help increase energy security by ensuring a more diverse supply of oil

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Government subsidies and tax breaks

- Administration will continue to support funding for energy research and development initiatives.
- Capital is best allocated through the workings of the free markets, not manipulating the tax code
- Government regulatory policy should not aim at picking winners and losers
- Neither should tax policy

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Renewable energy sources

- Excluding hydro-power, renewable sources generate about 2% of America's electricity
- Bush administration will continue to invest in renewable energy sources
- Renewables have not overcome economic advantages of conventional sources
- Even with promising advances, renewables will provide only about 6% of our total electricity by 2020.
- Even with most optimistic breakthroughs, they will supply only a fraction of our needs over the next 20 years.

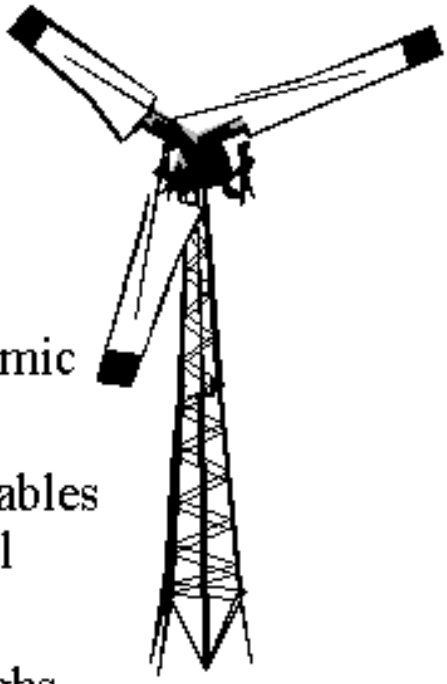

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Price controls

- America imposed price controls on oil and gas in the 1970s; they were an utter failure
- Led to shortages, rationing, and idea that America was gripped by malaise
- Administration does not support price controls
  - Lead to more blackouts and gas lines
  - Will not reduce demand, but cripple incentives for new investments in energy supply
  - Will deepen America's energy crisis

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Charting a new national policy

- Comprehensive. Across every department.
- Hemispheric. Includes the Americas.
- Diversify the energy supply for security, with a broad mix of options.
- Balanced. Combines environmental protection and energy exploration.
- Recommendations to be delivered to President Bush soon.
- Legislation will be introduced and bipartisan support.
- Hope that men and women of good will come together and transcend the present stale debate.

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Commentary

by Tom Bearden, Ph.D.

12 April 2001

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Commentary:

- A reasoned and professional assessment of the present energy crisis situation by Secretary Abraham
- Demonstrates administration and DOE are energetically attempting to get the crisis under control with conventional methods
- Scientific advisers have no "out-of-the-box" energy knowledge; policy stays essentially "in-the-box"
  - Shortage of oil, get more oil
  - Shortage of natural gas, get more natural gas
  - Shortage of electrical power plants, build more
  - Need 90 per year; build them
  - Short distribution grid, build additional
  - Shortage pipelines, build some more
- Cannot "get more" in time to prevent economic disaster
- Cannot avoid overrunning first quarter 2004 "point of no return"

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Caution: It is stressed that

- Given only the conventional Lorentz-regauged electrical design model, COP>1.0 EM systems are impossible. That type of EM only designs COP<1.0 systems!
- Given advice from scientific "experts" who know only COP<1.0 design, U(1) electrodynamics, and Lorentz regauged power system theory, the Administration is doing the best that can be done, all factors considered.
- The DoE and the Administration must use whatever they have available to them, to try to solve the crisis.
- Hence DoE and the Administration is not at fault. On the contrary, they are trying very hard to solve this escalating energy crisis, using the tools the scientists offer them.
- It is the U.S. scientific community that is squarely to blame for this sad state of affairs, and for the coming economic collapse.

COP = Coefficient of Performance

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An example of the time problem

- TVA and Texaco are discussing building a coal gasification 1,500 megawatt power plant.
  - Near Scottsboro, Alabama
  - Construction could begin in 2002.
  - In 3-6 years, begin producing electricity.
  - If 5 years, it will come on line in 2007.

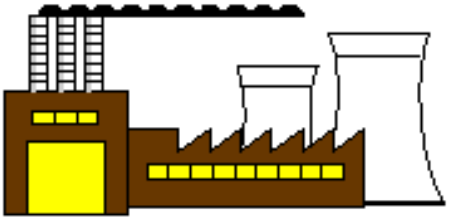

- 90 plants are required per year, beginning now.
- 2007 is about the time that world economies are crumbling, conflicts are raging, and all the arsenals weapons of mass destruction will be unleashed.
- 2007 is about the time civilization will be destroyed, if we continue on the present course.
- With only present solution, can get perhaps 400 to 450 plants ready to come on line, *about the time they are destroyed*

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The pending disaster

- The world energy crisis will escalate steadily, forcing collapse of world economy circa 2008.
- As nations' economies crumble, conflicts soar and one or more nations will exchange nukes and other *weapons of mass destruction* (WMD). Security partners forced to enter the melee.
- This evokes the long-dreaded WMD "spasm" response.
  - Only way for a nation to survive is to destroy its perceived foes before they destroy it.
  - Everybody fires everything, as fast as they can, unleashing all the arsenals of WMD, desperate attempt to survive.
  - Civilization and much of the biosphere is destroyed. Unleashing of smallpox alone will kill 2 billion.
- The time for this Armageddon is circa 2007.

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The bottom line:

- Self-powering and COP>1.0 electrical power systems must be rolling off the assembly lines en masse by first quarter 2004. That is the "point of no return".
- Otherwise, the point of no return will be overrun and no solution is possible, by any means, by anyone or by everyone.
- If that deadline is missed, the crisis curves cannot be "damped" in time to prevent world economic collapse.
- It is still doable, but only with a massive national effort of the highest priority. No one recognizes that as yet.
- Meanwhile, the scientific community is doing business as usual. You will have to just push most of it aside.
- We are "fiddling while Rome prepares to explode".

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Here are some events etc.

- Exxon Mobil Corp. soared to the top of the Fortune 500.
- Oil, gas, and power companies climbed.
- Increased income due to
  - Falling supplies so price increases
  - Utility deregulation. CA stupidly capped end prices, and freed middle prices. Dunce cap award for that one!
  - Soaring natural gas prices.
  - OPEC maneuvering to keep oil prices high
- Pacific Gas & Electric declared bankruptcy; another CA power company on the ropes.

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Lowered energy requirements for appliances

- Approved in last days of Clinton administration
- Washing machines must use 35% less energy, beginning in 2007
- Water heaters must use 5%-9% less energy, beginning in 2004
- Adds about $240 to price of washing machine
- Lower energy costs over time will offset initial increased cost
- Approved by Bush administration in April 2001 after review

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Easing air conditioner and heat pump standards

- Bush administration eased Clinton's new efficiency standards
  - Still require air conditioners and heat pumps to use 20% less energy than most current models, beginning in 2006
  - Clinton standard was 30% less
- All central home air conditioning units must meet minimum seasonal efficiency ratio (SEER) of 12, compared to present 10
- Replaces Clinton SEER standard of 12
- In California, easing these standards requires two more power plants

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Navarro's Estimate*

Peter Navarro, economist at UC Irvine,

in conjunction with Utility Consumers's Action Network

*Jennifer Coleman, "Power costs could be triple last year's for Californians," AP release, 22 Apr. 2001

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Factors driving comparisons

- Last summer, soaring costs drove three utilities to brink of financial ruin
- This summer costs may rise by as much as three-fold
- Factors at play:
  - Drought-induced reduction of hydroelectric power supplies in Pacific Northwest
  - Predicted hotter-than-average summer
  - Competition from other states
- State buys about 1/3 of its power from spot market
- Spot market likely to see substantial increases

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Prices likely per kilowatt-hour

- Last summer, peak average high price was 86 cents per KWHR
- This summer expected to hit $1 to $2 per KWHR
- Consumer rates capped at about 10 cents per KWHR
- The growing gap will have to be filled by state funds, which themselves are dwindling
- Eventually the California taxpayers have to pay the difference, which is from 10 to 20 times what they are paying now for capped power

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Covering debt already incurred

- Since January, California has authorized $5.7 billion to buy power for customers of Pacific Gas and Electric Co. and Southern California Edison
- The two utilities' credit was cut off due to
  - Soaring wholesale costs
  - Cap on consumer rates
  - Went nearly $14 Billion in debt
- San Diego Gas and Electric Co. incurred debts but is in better shape
- State will be repaid by $10 Billion in bonds
  - Expected to be issued in May
  - Expected to last till September but will not
  - PG&E and Edison Customers will pay off the bonds

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Deteriorating situation, rising prices

- Prices rising
  - Will rise even more as demand increases
  - Demand will rise by about 50 percent during the summer
- California's own generation resources cannot meet projected peak demands and reserve requirements
  - May fall by 3,500 megawatts short (peaks)
  - Enough power for 2.6 million households
- Power grid manager must depend on imports
  - Northwest drought makes extra power scarce to find
  - Northwest utilities themselves may have to import, not supply extra

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Other Factors

Credit, payback, scarcities

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Paying the piper: California's bond rating reduced

- Standard & Poor dropped California's bond rating two notches, from AA to A+
  - Financial drain from continuing energy crisis
  - Mounting uncertainty in costs to state of current electrical power crisis
  - Likely long term detrimental effect on state's economy
  - State's ability to pay its debt has reduced
- Rating not reduced further because of
  - State's diverse economy
  - Proposed revenue bonds to reimburse state treasury
- Can reduce further if California does not make $10 Billion bond issue and pay off its energy-related debts

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Associated Press: Gasoline supplies are critical

- Supplies tightest for mid-April since U.S. government record-keeping began in 1963
- There is a shortage of reformulated gasoline that produces less smog and is required during summer
  - MTBE additive made from methanol, a derivative of natural gas
  - Natural gas prices quadrupled Dec-Jan; MTBE reduced by 1/3
  - California uses more MTBE-treated gasoline than any other state
  - Gas-guzzling SUV sales boomed in 1999 and 2000
- Any kind of refinery snag will be amplified
- Last winter, major refiners had to focus on filling heating oil shortage instead of replenishing gasoline supplies for summer
- Now many forced out of service to take care of maintenance that was put off to deal with the heating oil crisis
- Environmental restrictions make it difficult to build refineries; none constructed in the U.S. for more than 20 years

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A peculiar problem

- E.g., Magnetic Energy Ltd. has a working laboratory experiment COP>1.0 device (a motionless electromagnetic generator - MEG).
- Solved basic EM system COP>1.0 theory.
- Two years more R&D necessary to finish, do production engineering and scale up for production.
- Immediate capital needed: $20 million.
- Negotiations with large capital firms:
  - Most have substantial capital committed to normal power community, long term.
  - MEL success thus costs them dearly in unrecovered funds.
  - They shoot themselves in the foot if they fund the MEG, since this is a "very disruptive" technology.

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MEG uses the Aharonov-Bohm effect to extract free energy from the vacuum (1)

- The Aharonov-Bohm effect (ABE) is in over 2,000 published physics papers in the hard literature.
- Hundreds of experiments prove it. Physicists themselves would not believe it for 25 years after it was advanced and proven. Now it is universally accepted.
- Free evocation of ABE never appeared for use in power systems, without paying energy to evoke it, until we used ABE in the MEG and *freely* evoked it.
- If the magnetic field **B** of a source is locally confined in a closed path (as in a toroid), the outside local spacetime (ST) where the **B**-field was withdrawn is still curved. Curved ST is energetic. The 3-space energy has been transformed into curl-free magnetic vector potential **A**. But one pays for that **A** around a toroid, since one has to "feed" the toroid.

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MEG uses the Aharonov-Bohm effect to extract free energy from the vacuum (2)

- We uncovered a transformer core material that will *freely* do that **B**-localization of the **B**-flux of a permanent magnet, extracting all the **B**-flux into a closed transformer-like core path.
- The uncurled **A**-potential forms outside the core path as a freely flowing river of energy.
- We pay nothing at all to get the **A**-energy flow going, or to sustain it. That's for free.
- The vacuum energy exchange and locally curved ST sustain that energy flow indefinitely, due to the permanent magnet dipole's broken 3-symmetry.

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MEG uses the Aharonov-Bohm effect to extract free energy from the vacuum (3)

- We then hang "collecting antenna circuits" in that free river of energy flow in **A**-space outside the core.
- We pulse-perturb the river *a little*, with very sharp-edged pulses of low energy. Huge **E**-fields (i.e., d**A**/dt) are formed and strike the antenna circuits.
- From the large AC **E**-fields, we can intercept and collect large AC energy. The energy is dissipated in loads in the external separate collecting circuits, with no back emf into the primary circuit.
- Only small average *input* energy is required. We pay only to *switch* or *gate* the large energy flow.

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MEG uses the Aharonov-Bohm effect to extract free energy from the vacuum (4)

- By analogy, imagine an old triode vacuum tube.
- Suppose we trick nature into *giving* us the cathode and electron energy flow, for free, really pouring energy out of there continuously.
- Then we only have to put in a grid to switch it, a plate to intercept and catch it, and a plate circuit to dissipate it in a load.
- In the MEG, the permanent magnet and the special core provide the cathode and free flow.
- We provide the "grid" gating, plate "catching," and "plate circuits" with loads that are powered.

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MEG uses the Aharonov-Bohm effect to extract free energy from the vacuum (5)

- The MEG becomes a *free transmitter with multiple receivers* system, *not* a transformer but a triode.
- The transmitted energy is absolutely free, taken right from curved ST. We only have to "perturb" or shake the flow a tiny bit, in sharp little shocks without much energy. The broken 3-symmetry of the magnetic dipole, in the fierce vacuum exchange, furnishes the energy in the large **E**-fields by d**A**/dt.
- The COP that can be achieved by the MEG is limited only by the **A**-space available outside the core for collection, and the number of surface charges in those external circuits powering the loads.

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Negentropic Engineering

- Can easily produce continuous giant EM energy flows from the vacuum: anywhere, anytime, for peanuts
- Once flow initiated, no further input required
- Focuses on real energy problem: intercepting the pouring energy and dissipating it in loads
- Dramatic implications:
  - Reduces hydrocarbon combustion; meet Kyoto accords
  - Obsoletes nuclear power, reduces nuclear wastes
  - Reduces biospheric pollution
  - Reduces biological effects of pollution
- One drills the vacuum for energy, much easier than drilling the ground for oil and natural gas

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Rigorous "out-of-the-box" work

- Evans, Anastasovski, Bearden et al. (15 authors), Alpha Foundation's Institute for Advanced Study:
  - "Explanation of the Motionless Electromagnetic Generator with O(3) Electrodynamics," *Found. Phys. Lett.* 14(1), Feb. 2001, p. 87-94.
  - "Explanation of the Motionless Electromagnetic Generator with the Sachs Theory of Electrodynamics", *Found. Phys. Lett.* 14(8), Aug. 2001 (in press).
  - "Energy from the Vacuum," in referee process.
  - "O(3) Electrodynamics from the Irreducible Representations of the Einstein Group," in referee process.
  - "Electromagnetic Energy from Curved Spacetime," in referee process..
  - "The Effect of Vacuum Energy on the Atomic Spectra," *Found. Phys. Lett.*, 13(3), June 2000, p. 289-296.
  - "Operator Derivation of the Gauge Invariant Proca and Lehnert Equations: Elimination of the Lorentz Condition," *Found. Phys.*, 30(7), 2000, p. 1123-1130.
  - "Runaway Solutions of the Lehnert Equations: The Possibility of Extracting Energy from the Vacuum," *Optik*, 111(9) 2000, p. 407-409.
  - "Classical Electrodynamics Without the Lorentz Condition: Extracting Energy from the Vacuum," Physica Scripta, 61(5), May 2000, p. 513-517.

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Rigorous "out-of-the-box" work (2): (Bedini "negative resistor" in a battery)*

- A battery-powered circuit is not a single closed current loop; but has two largely separate current half-loops:
  - Internal ion current between plates.
  - External electron current from outside of one plate, through external circuit and load, to other plate.
- M/q ratios very different: Ion current more than 200,000 times heavier per coulomb than electron current.
- Can dephase the two currents, overpotentialize both.
- Battery can thus be hyper-recharged while external circuit simultaneously powered.
- Bedini has been building successful little prototypes for more than 20 years. Could dramatically improve electric automobiles.

* T.E. Bearden, "Bedini's Method for Forming Negative Resistors in Batteries," *Journal of New Energy*, 5(1), Summer 2000, p. 24-38. http://www.cheniere.org/techpapers/Bedini.pdf

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Initiating a Battery to COP>1.0

- A Battery is highly nonlinear with multiple currents
  - Electron current largely bound between outside of plates and external circuit including through load
  - Ion current confined between plates, through separators
  - Mass-to-charge ratios of the two currents are vastly different
- Can dephase currents by 180°
  - ion current in charging mode
  - electron current in circuit-powering mode, powering circuit
- Done by forming negative resistor
  - Sharp, higher potential at insulator interface on plate surface
  - Bidirectional overpotentialization
  - Energy extracted from active vacuum

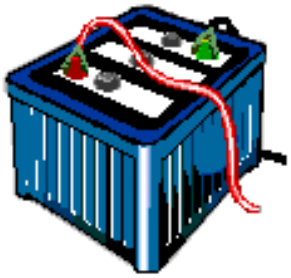

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Secretary alone cannot solve it

- Scientific community, universities, national labs, NSF, NAS, power companies doing business as usual
  - No really out-of-the-box energy research
  - Do not realize all electrical systems and power lines are powered by energy extracted from the vacuum
  - Not correcting flawed electrodynamics, uninterested
  - Not funding any vacuum energy extraction projects
- New policy cannot quickly eliminate the long delay time till new electrical power plants come on line
  - Need 60 to 90 powerplants per year; first one can be operational only after several years even with crash program
  - Skyrocketing energy, trucking and other transport costs will drive the nation into financial disaster during that delay
- Only doable solution: vacuum-energy systems

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What is desperately needed

- Separate "Manhattan Project" on energy from the vacuum systems, reporting to Secretary
  - Operate under Presidential Decision Document
  - Staffed with carefully selected scientists and engineers
  - Top priority funding
  - Round-the-clock research
- Support from selected personnel in national labs, universities, research corporations
- Start with known COP>1.0 systems; factual information can be provided

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Why it can be done in time

- Already have elements of necessary theory of Maxwellian disequilibrium COP>1.0 systems; funding will finish it rapidly
- Several legitimate COP>1.0 systems exist, can be quickly developed and scaled up
- Two years or less after start, a range of self-powering systems can be rolling off the assembly lines en masse
- A great breakthrough in close-looping principles for self-powering technology has been accomplished
  - Deeply proprietary, can be released
  - Using breakthrough, parallel program can develop self-powering of many present power systems
  - Will not be discussed without the program

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Cautions!

- In the so-called "free energy field", many charlatans, much disinformation, some honest mistakes, some real systems and information
- Absolutely must separate wheat from chaff
- Working laboratory proof-of-principle devices do exist; groups need funds for development
- Inventors with such systems usually do not comprehend the actual mechanism used
- U.S. is 100 years behind in applying necessary corrections to electrodynamics; but some courageous scientists have begun

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The scientists have failed us

- Secretary Abraham, it is the U.S. scientific community which has failed us, and which is responsible for this unnecessary crisis.
- No textbook presently even correctly states what actually powers a power line. The basis has been in particle physics for a half-century.
- Before arbitrary regauging by Lorentz in the 1880s, the Maxwell-Heaviside theory does prescribe electrical power systems far from equilibrium in their fierce vacuum exchange, including systems which power themselves and their load, extracting the energy from their broken symmetry in their active vacuum energy exchange.
- Every power system already wastes a trillion times more energy than is placed on the power line; scientists and engineers do not even know it.
- Heaviside published the basis for that in the 1880s and 1890s; Poynting never even knew it. Lorentz knew it, couldn't explain the source, stated "no physical significance" and discarded it.
- This discarded "Heaviside energy" is what is generating the extra gravity in spiral galaxies, and holding their arms together. Scientists arbitrarily discarded it in the 1880s; have forgotten it today.

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The scientific community enforces a 137-year-old flawed EM model

- Equations still assume material ether.
- Thoroughly confuse cause and effect.
- "Fields" as defined in electrical engineering do not exist outside matter (Feynman, Wheeler)
- Arbitrarily discards vacuum energy exchange and usage.
  - Proven for nearly 50 years in particle physics
  - Dipole exchange particularly significant because dipole's negentropy extracts *all* EM energy -- used in the system -- from the vacuum. Every system already powered by the vacuum anyway.
- Arbitrarily discards about 10 trillion times as much EM energy present around a circuit as the circuit intercepts.
- Scientific community pummels most scientists who try to change model or develop systems far from equilibrium in their known violent energy exchange with the active vacuum.
- ***Same flawed power system schema for more than a century.***

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All EM 3-space energy freely comes from the time domain*

* T. E. Bearden, "Giant Negentropy of the Common Dipole," Journal of New Energy, 5(1), Summer 2000, p. 11-23. http://www.cheniere.org/techpapers/GiantNegentropy.pdf

Whittaker, Math. Ann., 57, 333 (1903) shows this rigorously.
Dipole's broken 3-symmetry well-known in particle physics

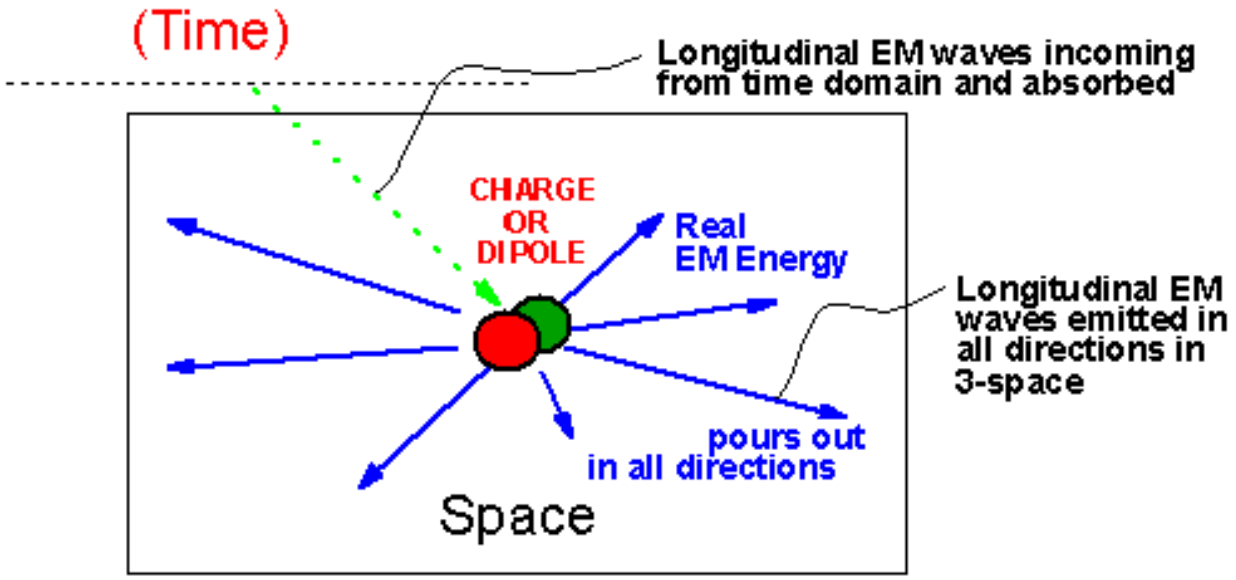

Note: Whittaker (and others) interpreted the phase conjugate half set of LWs after interaction with the charges of the dipole; and as an *effect* rather than the *cause*. This fundamental non sequitur has just been repeated since then. Thus they missed the solution of the source charge and source dipole.

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Astonishing but true

- All the hydrocarbons burned, nuclear fuel rods consumed, dams and windmills built, fuel cells consumed, and batteries installed do not add a single direct watt to the power line. Never have, never will.
- All that does is continually restore the generator source dipole, which our systems are designed to continually destroy faster than they power their loads.
- The dipole extracts energy from the vacuum, and pours it out to fill all space around the power lines. The power lines intercept and use only about 10exp(-13) of it.
- Nobody tries to catch any of the rest of it. *There is no ordinary source of that energy flow, which is enormously greater than the energy put into the shaft of the generator.*

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With plentiful, cheap, clean electrical energy:

- Even poorest nations get onto the fast track
  - Rapid development of infrastructure
  - Concentrate on clean water, medical treatment, education, plentiful food
  - Rise of industries and creation of jobs
- Gradual but permanent shift in electric power
  - Accent decentralized systems
  - Dramatically reduce vulnerability of power grids
  - Practical, agile electric cars, trucks, trains
- Releases the iron grip of energy barons

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Recommendations to DOE

- "Out-of-the-box" prototypes do exist, theory developed.
- Crash Manhattan project; Presidential Decision Directive.
- Intense program with highly selected scientists to correct EM flaws and extend EM theory to higher symmetries.
- Obtain compensated release of breakthrough close-looping process to initiate many normal power systems into self-powering systems, and rapidly develop and apply. No discussion without program and NDA.
- Protect patent rights of o/u inventors. Suspend national labs, universities, other research labs from "cluster patenting" in the area. They sign nondisclosure, non-compete, eliminate "march in" theft clauses.
- President order release of known overunity systems captured from inventors and in deep black community.

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In conclusion:

- Secretary Abraham, the threat of weapons of mass destruction attacks and giant destruction is not overestimated. It's really worse.
- Large Russian nuclear weapons, e.g., are already in U.S. cities, with on-site Spetznaz teams to explode them. See Lunev's book.
- Professional teams with anthrax, smallpox, etc. already in place, waiting. Unleashing smallpox alone will kill 2 billion worldwide.
- In the WMD strategic attack, the delivery to the target stage is already accomplished.
- 25 nations -- many hostile to the U.S. -- now have nukes, biological warfare agents, etc.
- The earth is in fact a giant powder keg, waiting to explode at the touch of a match. Unless solved at enormous speed, the energy crisis will certainly strike that match about 2007.
- Only one thing -- energy from the vacuum -- can do it. Neither the DoE nor the U.S. scientific community are working on that.

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The "Porthole" Concept with technical background

Amplifying the cellular regenerative (healing) system of the body for treatment and healing of mass casualties

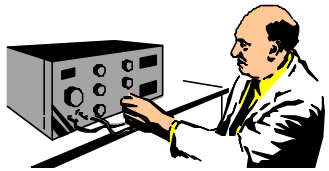

Outline of the presentation

- Mechanism for deep EM exchange of a body with its active EM environment
- Becker's epochal work and its ramifications
- Kaznacheyev's startling results and ramifications
- Weaponization of Kaznacheyev's findings
- Importance of time-energy and the time-domain
- Mechanisms for medical treatment and healing

Outline of the presentation (2)

- Prioré's revolutionary results and their ramifications.
- Proposed new mechanism for cancer promotion.
- Porthole concept: The 2-minute shortcut.
- Terrorist biological warfare capabilities.
- Summary and conclusion.
- Budgetary and Program package.

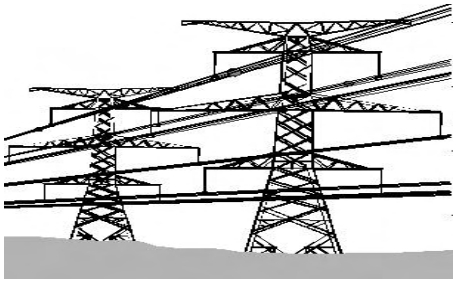

Mechanism for the body's deep EM exchange with its active EM environment

And some ramifications

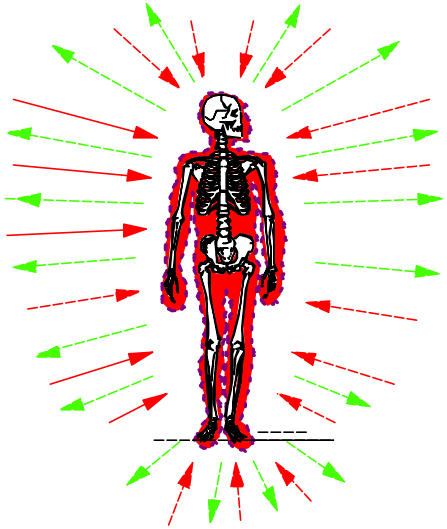

The body continually receives and retransmits EM energy

- The body may be considered as a dielectric.
- Every part of the dielectric participates in the absorption and emission of each photon to and from any point on the surface.*
- Mechanical force effects are also electrical in nature and exchange similarly.

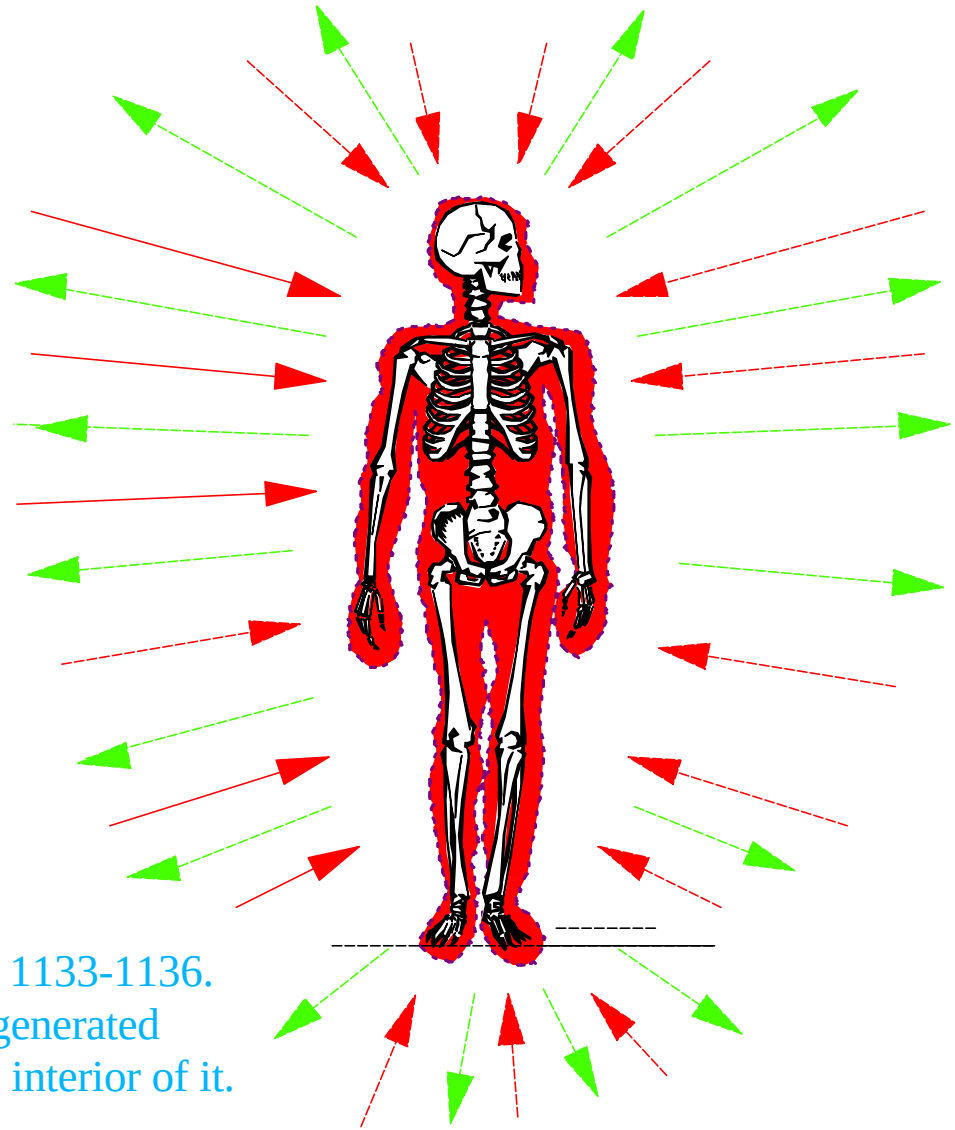

* Reali, G. C., "Reflection from dielectric materials," American Journal of Physics, 50(12), Dec. 1982, p. 1133-1136. The reflected field from a dielectric material is not generated just at its surface but comes from everywhere in the interior of it.

Ramifications:

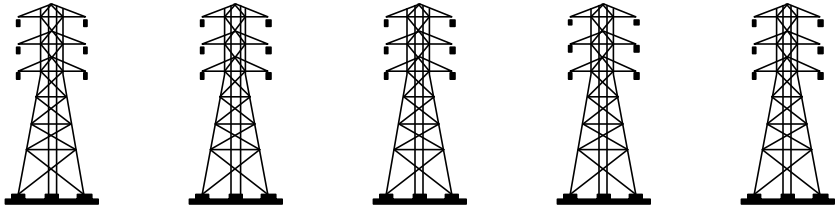

- There is an EM "dielectric transmission path" connecting every part of every cell to every part of the surface of the body.
- All electrical processes in the body, including deep within the cell and its nucleus, participate in the absorption and emission of every photon to and from the body's outer surface (and every mechanical force* experience).
- The EM emission energy of the body is a conglomerate mix of fractions of all processes and functions ongoing in the body or affecting it, including in every cell.
- This includes all electromagnetic, mechanical, chemical, and environmental effects upon and in the body and every tiniest part of it, and provides an extended definition of "stress".

* At base, all normal mechanical forces are generated by electromagnetic forces.

Ramifications (2)

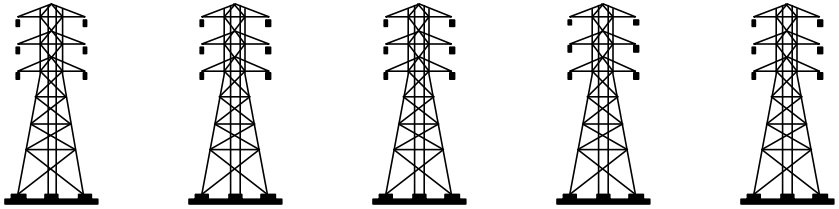

- The reaction of each photon absorbed on any point of the outer surface of the body, connects through the dielectric transmission path to every part of the body, including to every part of every cell*.
- Every emission from the body is participated in by every part of the body, including every part of every cell.
- The body's emission "changes" its environment, adding EM radiation. Some of the internal induced changes (excited states) in the body decay by this external emission. Some do not, but must be otherwise dealt with internally by the body systems.
- The body's EM absorption allows the environment to change or affect every function, operation, and part of the body, by adding EM radiation. All are continually being affected and deviated, both helpfully and harmfully, by these deeply induced EM interactions.
- The body's reaction (healing) must continually readjust and correct deviations from normalcy, in every part of every cell.

* In quantum physics, part of the photon is localized and part is nonlocalized, reaching even across the universe.

Ramifications (3)

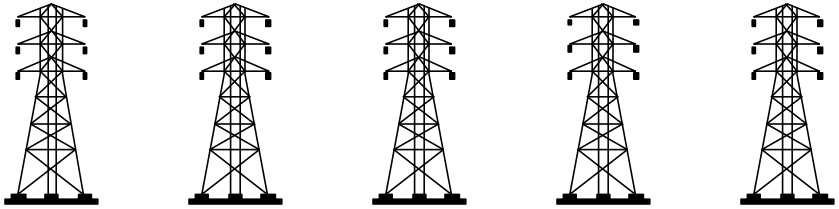

- The sum total of all the impinging external EM radiation upon the body, plus mechanical "special EM" radiation, thus affects and changes the body and all its processes, participating in them.
- That impinging EM radiation can be manipulated to either harm or heal the body and any or all of its cells.
- The body must continually overcome these externally-induced EM changes in its cells and processes, to maintain normalcy. Some EM changes are restored by the subsequent dielectric emission process, relieving the previously-induced deviant EM excitations in its internal processes. Some are not.
- The poorly studied *cellular regenerative system* performs the remainder of the restorative function, which is the fundamental "healing" function of the body.*

*The cellular regenerative system was mostly studied by Becker and a few others. See R. O.Becker, and David G. Murray, "The electrical control system regulating fracture healing in amphibians," Clinical Orthopaedics and Related Research, No. 73, Nov.-Dec. 1970, p. 169-198.

Becker's epochal work

And its ramifications

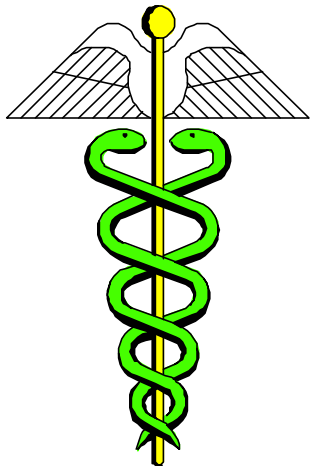

Becker's bone fracture healing

- Tiny DC currents (picoamperes)
- Pulsed DC current can be utilized
- Pulsed magnetic fields may be utilized

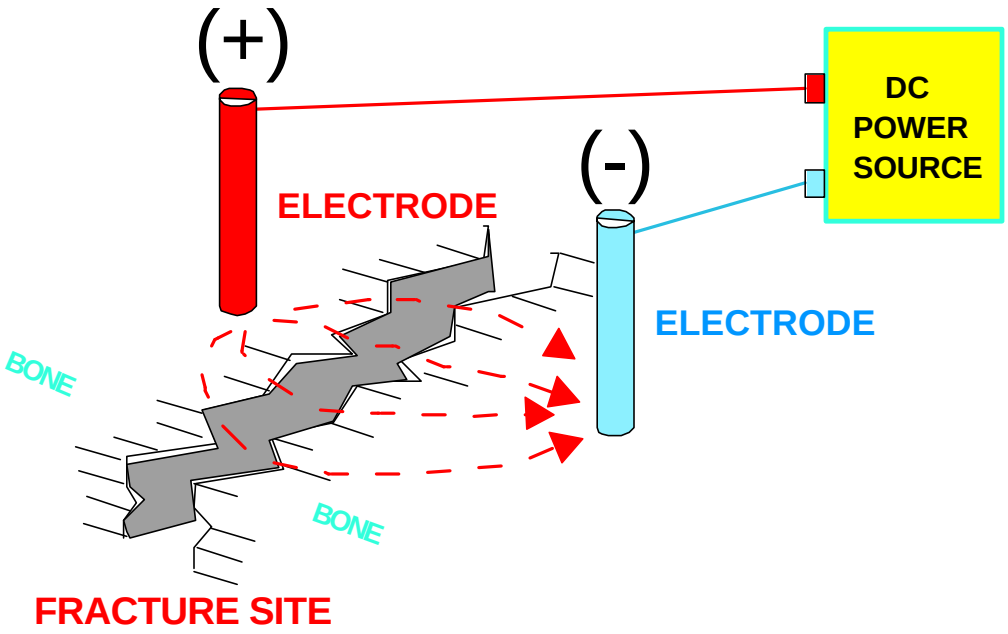

RED BLOOD CELL DEDIFFERENTIATES

Shucks hemoglobin coat
Grows nucleus

NEW CELL REDIFFERENTIATES

Turns into type of cell that makes cartilage

NEW CELL REDIFFERENTIATES

Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture

Becker's theoretical DC control system involved with response to injury

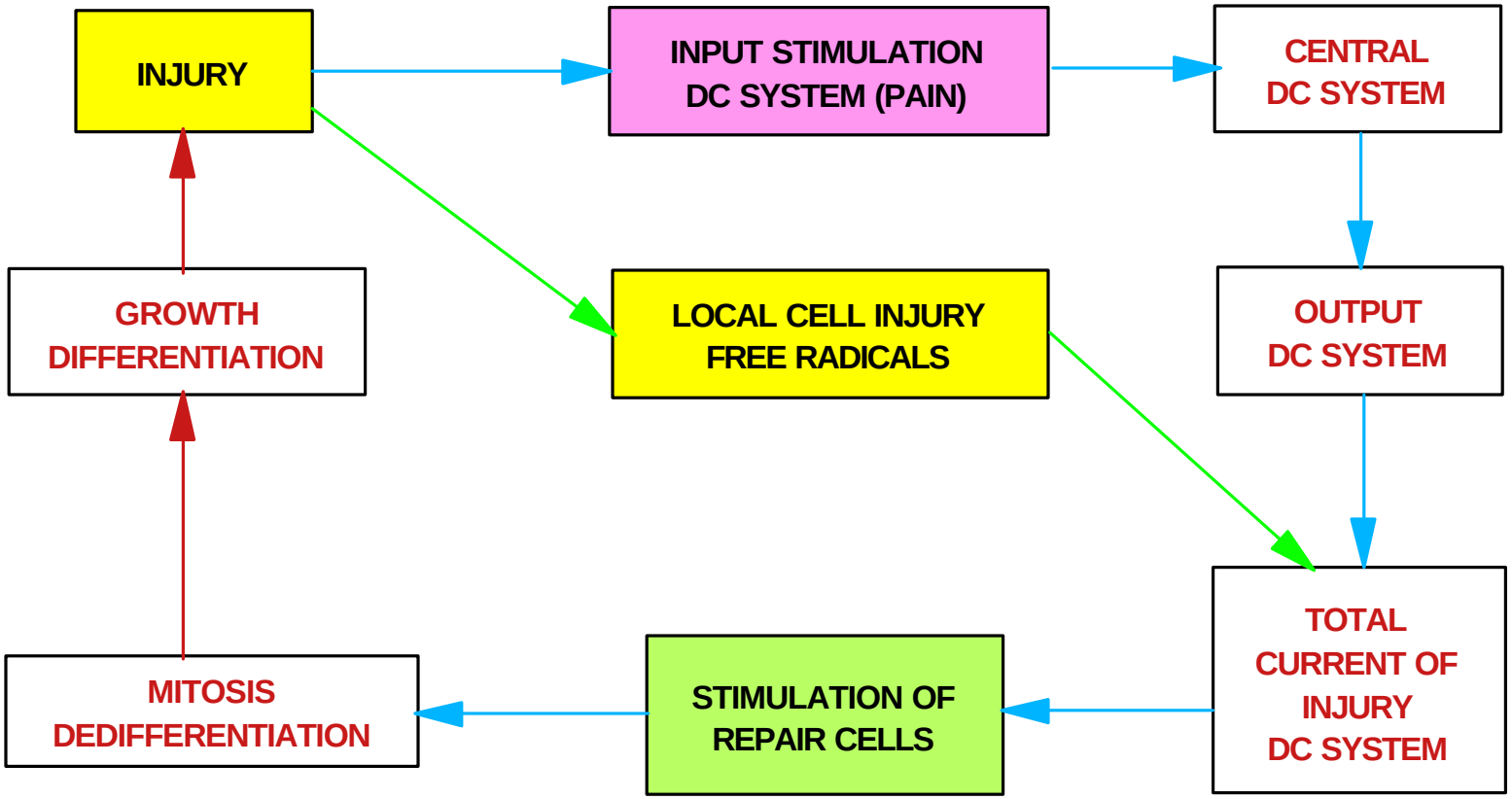

*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

Becker's proposed control system governing regeneration*

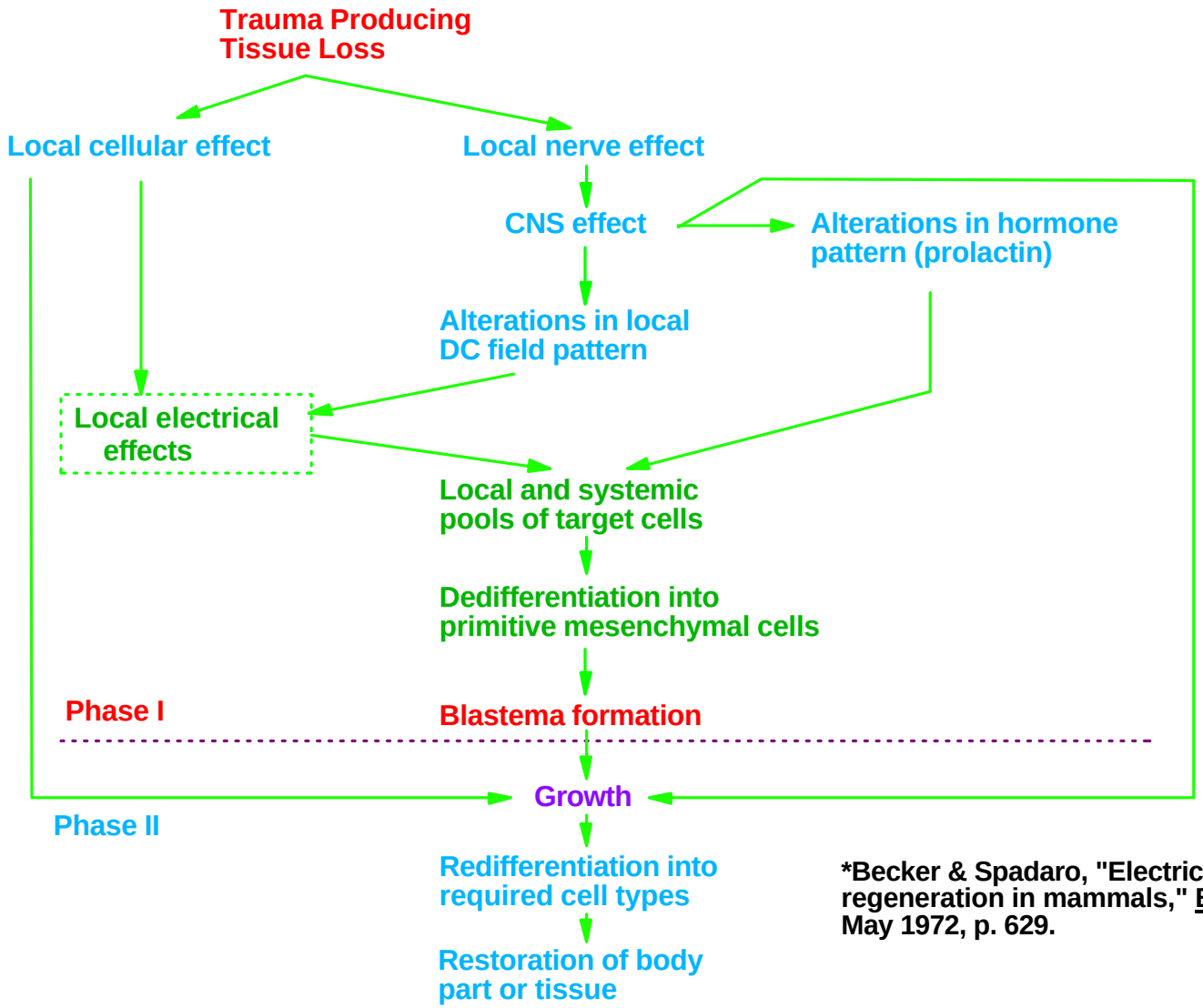

*Becker & Spadaro, "Electrical stimulation of partial limb regeneration in mammals," Bull. N. Y. Acad. Med., 48(4), May 1972, p. 629.

Extending Becker's work

- Becker had only the archaic classical electrodynamics available to him. That EM is grossly inadequate.
  - Insufficient group symmetry to model the process.
  - Already eliminates the "infolded" longitudinal wave EM that structurally and dynamically comprises all "normal" EM potentials, fields, and waves.
  - It is this internal LW EM that is manipulated and used by the cellular regenerative system.
- Nonlinear phase conjugate optics was not yet developed when Becker did his seminal work.
- Successful higher symmetry electrodynamics models -- such as O(3) -- have been developed and are available.

A sad commentary

- Becker was nominated for the Nobel Prize, but he was hounded, his funds were withdrawn, and he was forced to retire early.
- His main "sin" was having the courage to testify against the harmful effects of unrestricted powerline radiation and electronic smog.
- Powerful interests then crushed him, set up their own well-funded institutes, and hired scientists who then predictably found that powerline radiation was no problem.
- Such research is so tainted that recently several important journals have now required the authors of submitted papers to state what their affiliated companies do, and what "company massaging" of their research occurred.
- From a higher symmetry EM view, it is obvious that the dielectric pathway and quantum electrodynamics already show a significant problem due to such radiation, particularly with respect to long-term effects.
- This is particularly significant since "noise" -- the mere presence of more "hash" -- appreciably amplifies the dielectric transmission effect. So the major factor becomes EM smog *signals density*, not signal power.

Kaznacheyev's startling results

And its ramifications

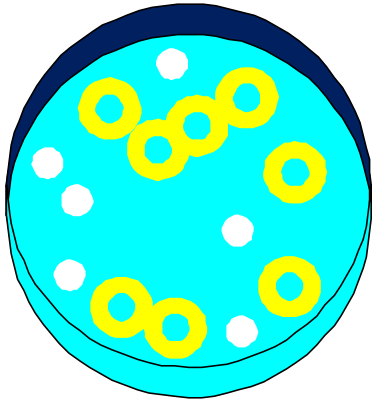

Proof that the cellular condition is radiated from groups of cells

- It follows that a diseased, damaged, or infected cell culture will and does emit its exact internal EM condition, hence the disease or damage "generatrix form" itself (in the internal structuring of the EM radiations).
- Further, these "state" emissions can couple into other targeted cells to produce disease and disorder in them.
- This was clearly proven in some 15,000 Russian experiments by Kaznacheyev.
- Kaznacheyev demonstrated induction of cellular disease and disorder between EM-coupled but otherwise environmentally shielded cell cultures
- Similar experiments have been replicated in the West by Reid *et al*., and by Popp *et al*.

Kaznacheyev's induction of cellular disease and disorder

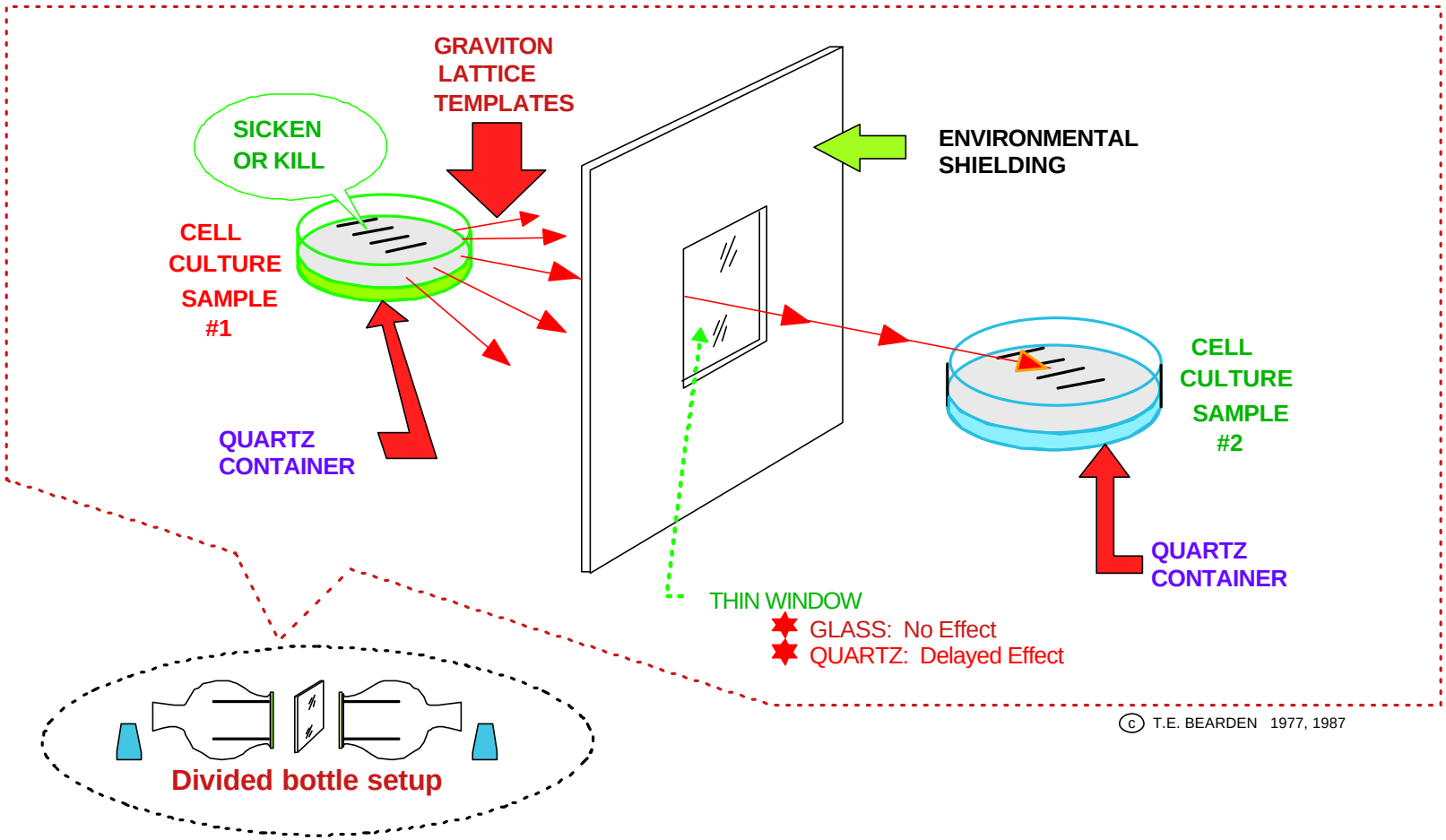

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Note: Minimum lattice is one harmonic interval: IR to UV is such a minimum G-lattice. Consider particularly the dielectric pathway in the emitting diseased cells and in the receiving targeted healthy cells.

Another surprising feature of Kaznacheyev's experiments

- The experiments do not work if the targeted cells are in normal light, such as sunlight*.
- The reason is that the normal light bandwidth occupies a single harmonic interval between ultraviolet and infrared.
- Hence its difference frequencies also fill such an interval. For a set of n frequencies, the number *d* of difference frequencies is $d >> n$.
- Thus the visible light spectrum represents "jamming" of specific internal EM signal inputs through the dielectric pathway into the body, turning much of the environmental signals into harmless warmth.

* It has also been shown that if bacteria are killed in the "dark" by UV, then 24 hours later placed in sunlight, a substantial fraction of the "dead" bacteria will revive.

Ramifications of Kaznacheyev's experimental results

- At least one harmonic interval is necessary for the effect to be evidenced in the target cells.
- Interestingly, if we assume the body dielectric to be isotropically nonlinear (to first order):
  - Velocities of the actual transmitted frequencies depend upon the particular point on the wave amplitude.
  - The transmitted frequencies overshoot, interfere, breakup, etc. The difference frequency does not.
  - The "difference frequency" is transmitted through the nonlinear dielectric medium as if it were a sine wave passing through a linear medium*.
- To our knowledge, this direct and deep communication of electronic "hash" difference frequencies in dielectric human bodies has not been investigated in the West.

* Owen Flynn, "Parametric arrays: A new concept for sonar," Electronic Warfare Magazine, June 1977, p. 107-112.

Ramifications of Kaznacheyev's experimental results (2)

- A heterodyne signal -- at the difference frequency between an input signal and a reference signal -- can be enhanced by adding noise*.
- Thus the signal of the disorder in the cellular pattern emitted from diseased cells, received by normal cells, can be amplified electronically and rather easily.
- Powerline radiation (electronic smog) thus carries its own amplification mechanism. Eventually the amplification overcomes any squelching by sunlight, etc.
- The Russians promptly (as early as the late 1950s) weaponized and tested these and similar effects.

* Dykman, M. I. et al., "Noise-enhanced heterodyning in bistable systems," Physical Review E, 49(3), Mar. 1994, p. 1935-1942

Weaponization of Kaznacheyev's findings

And its ramifications

"Microwave" radiation of the U.S. Embassy in Moscow.

Former U.S. Embassy in Moscow.

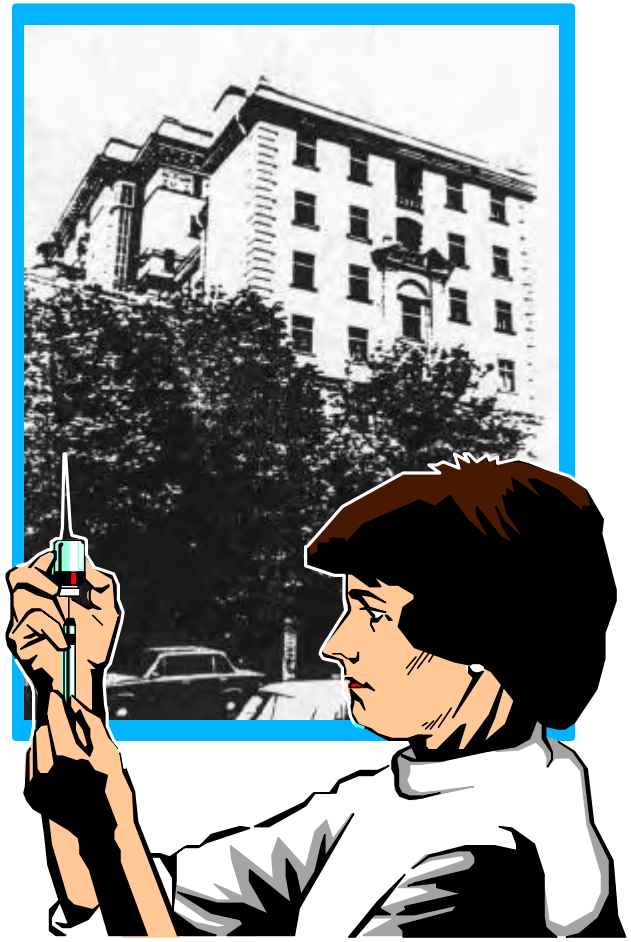

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

Ramifications of the microwave radiation of the U.S. Embassy

- The cellular disorder pattern in the EM radiation is carried by the field-free scalar potential.
- Since the disorder pattern is a "conglomerate", it must be carried by an internal EM structure existing inside the scalar potential itself.
- Whittaker decomposed the scalar potential into the appropriate internal longitudinal EM biwave structure in 1903*.

* E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Mathematische Annalen, Vol. 57, 1903, p. 333-355

The importance of time as energy, and the time-domain

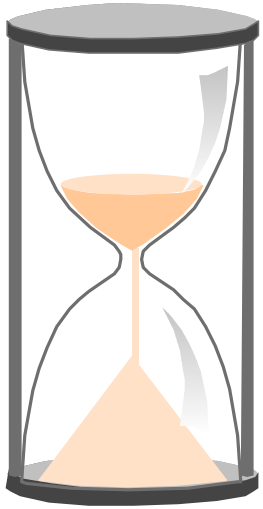

Time as energy

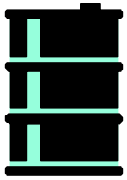
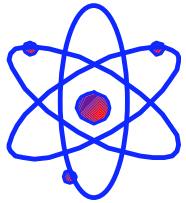

- In physics, the fundamental units one uses in his model are arbitrary.
  - A valid model can be made using only one unit.
  - It is already done in one branch of physics, using length as the single fundamental unit.
- Make a model with a single unit, the joule.
  - All other entities become functions of the joule.
  - We are familiar with mass as highly compressed EM energy, by the factor c^2.
  - It turns out that time is also highly compressed EM energy, by the factor c^2.
  - 1 sec. $\approx 9 \times 10^{16}$ joules.

How to see that "time is compressed spatial energy"

- Take some spatial EM energy and compress it by c^2
- Place it in 3-space, and it is *mass*.
- Place it on the time axis, and it is *time*.

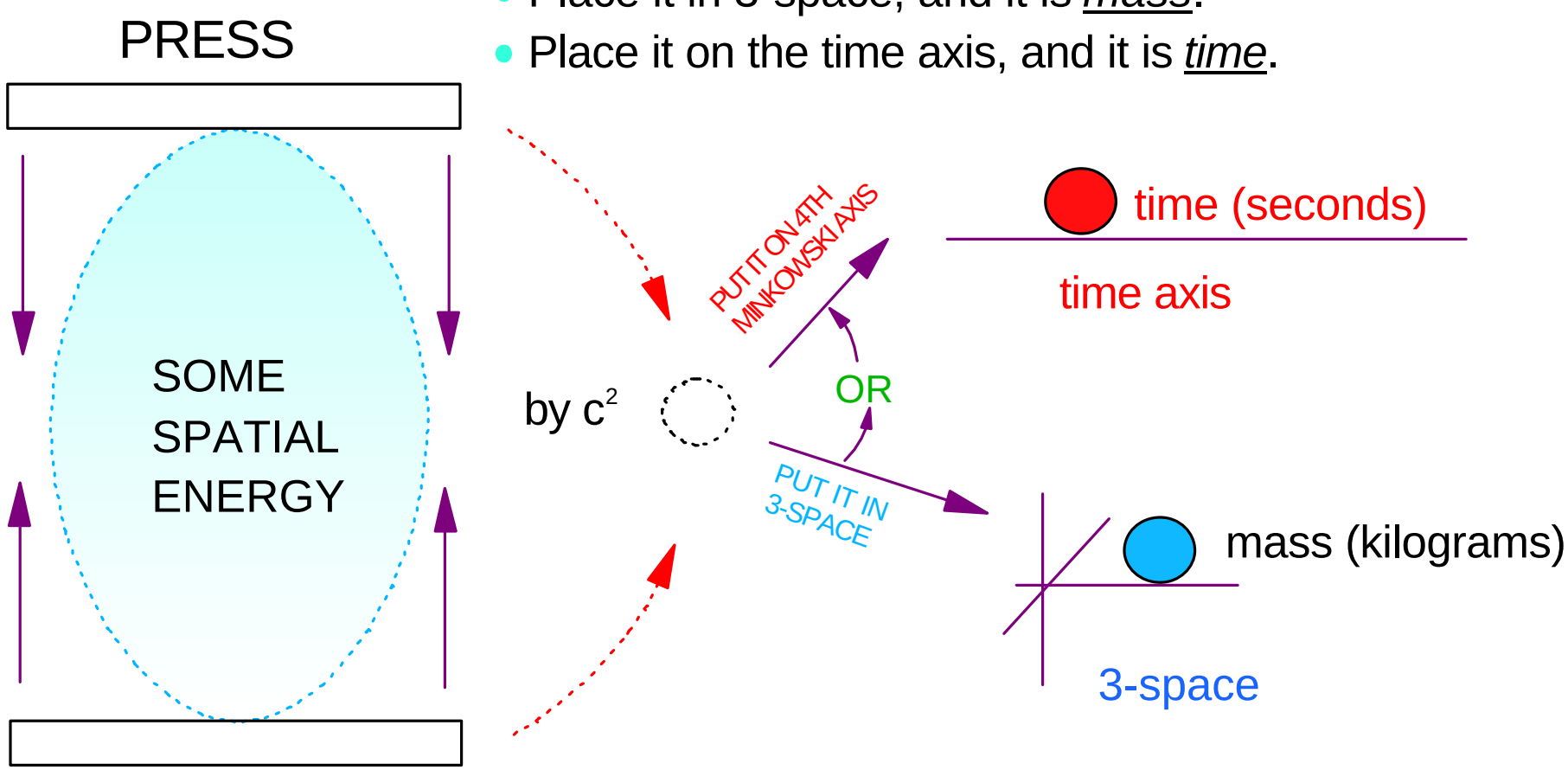

- When time-energy is converted into mass-energy, time is "decompressed" (expanded) into 3-space EM energy and 1 sec. $\approx 9 \times 10^{16}$ joules.

Time as EM energy in the time domain, with a density the same as mass-energy

- Bearden* reinterpreted (corrected) the 1903 Whittaker decomposition of the potential in 2000.
- The reinterpretation is consistent with broken symmetry in particle physics, for which Lee and Yang received the Nobel Prize in 1957.
- It is also powerfully supported by quantum field theory, notably by Mandl and Shaw in 1984**.
- Whittaker's pair is a combined time-polarized (scalar) EM wave and a 3-space longitudinal EM wave.

* T. E. "Giant Negentropy from the Common Dipole," Journal of New Energy, 5(1), Summer 2000, p. 11-23.

** F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1984, Chapter 5.

All EM energy in 3-space freely comes from the time domain

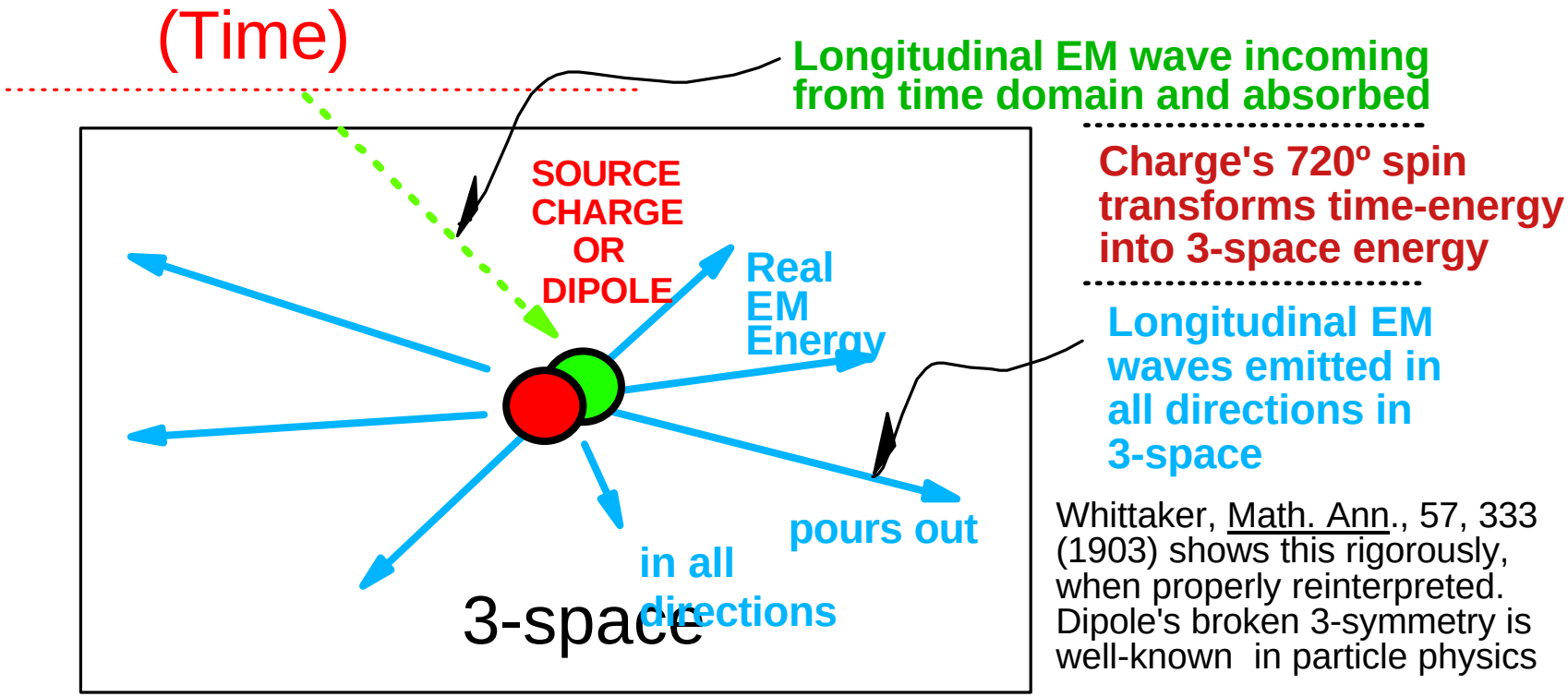

Whittaker, Math. Ann., 57, 333 (1903) shows this rigorously, when properly reinterpreted. Dipole's broken 3-symmetry is well-known in particle physics

Note: Whittaker (and others) interpreted the phase conjugate half set of LWs after interaction with the charges of the dipole, and as a 3-space *effect* rather than the time-domain *cause*. This fundamental non sequitur was just repeated since then, until corrected by Bearden to be consistent with broken symmetry and quantum field theory.

Strong support from quantum field theory

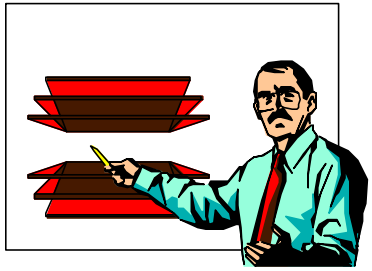

- Quantum field theory recognizes four photon polarizations:
  - Energy along x-, y-, z-, or t- axis.
  - Polarized along x- and/or y-axis, the photon is a *transverse* photon.
  - Polarized along z-axis (along its line of motion in 3-space), the photon is a *longitudinal* photon.
  - Polarized along the time-axis, the photon is a *time-polarized* or *scalar* photon.
- The individual longitudinal or scalar photon is not observable*.
- The combination of a longitudinal photon and a scalar photon is observable as the instantaneous scalar potential*.

* F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1984, Chapter 5.

Mechanism generating the flow of a mass through time

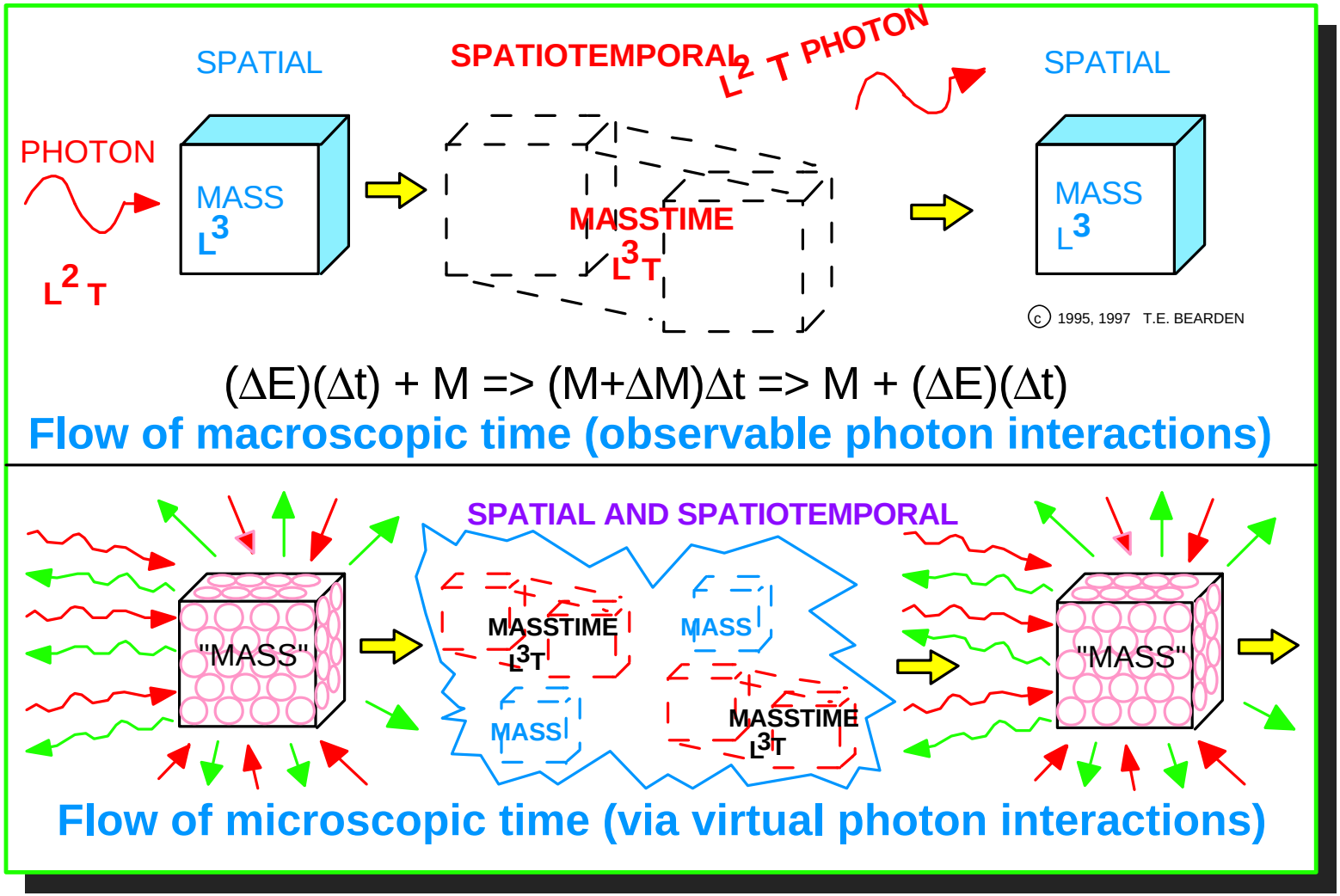

Mechanism is engineerable

Pumping a mass in the time-domain will time-reverse it back to an earlier state

- The reinterpreted biwave EM structure of the scalar potential means that time-reversal (phase conjugation by pumping in the time-domain) can be utilized to time-reverse a targeted cell (its mass-energy) in its entirety, including its genetics.
- Becker's bone fracture experiments showed it:
  - Weak scalar potential across the fracture site.
  - LWs in 3-space and time-energy waves in time
  - Red blood cells entered, dedifferentiated by shucking their hemoglobin and growing a nucleus, which is dedifferentiation (time-reversal of the cell and its mass-energy back to a previous physical state).

Principle for time-reversing a time-pumped mass

- Becker's cells then redifferentiated and changed -- first to primitive cartilage cells, then to primitive bone cells which were deposited in the fracture, healing it with new bone growth.
- This shows "time-forwarding" (redifferentiation) of the cell also.
- Becker actually showed that the *time-domain pumping* of the cells (by the time-polarized EM waves of Whittaker's reinterpreted wavepairs comprising the scalar potential), and the time-pumping of their mass-energy, operated to continuously and steadily *remove the delta between that cell's present condition and its former "normal" cellular physical condition in that area*.
- This is the long-sought secret of stem-cell research.
- Phase conjugate optics had not been born at the time. Without realizing its full nature, Becker demonstrated the body's own internal mechanism for healing, and the fundamental mechanism for time-reversing a physical mass, whether living or inert.

Mechanisms for use in medical treatment and healing

And ramifications

Successive deep penetration reactions of the cellular dielectric

- Change after change affects the cell and all of its parts, including from the external environment.
- Each successive change affects primarily the internal "LW EM structures and dynamics" comprising the ordinary potentials, fields, and waves.
- Thus in positive time the internal EM structurings produce successive "overlaid layers of change" -- so to speak -- in the internal EM structuring and dynamics of a cell in the body. These layers contain the "delta" from normal state.

Successive deep penetration reactions of the cellular dielectric (2)

- During time reversal, highest layer deltas are successively "peeled away" by the interaction of the mass-energy with the time-domain pumping.
- The result is to return the cell directly back to successive physical states, in the case of a single disease or disorder.
  - A cancer cell is returned to a normal cell prior to its "promotion".
  - An HIV-infected cell would be returned to its normal unaffected condition, free of HIV-induced genetic change.
  - For injuries and damage, the existing "delta" in each successive state-layer is steadily reduced to zero.
- This process thus can involve both cellular differentiation and dedifferentiation, as shown by Becker and by Prioré.

Engines (vacuum engines, spacetime curvature engines)

- Following Whittaker* as reinterpreted**, all normal EM fields, potentials, and waves decompose into sets of longitudinal EM waves (LWs) and their dynamics.
- Since these LWs and their dynamics are dynamics in the local energy density of spacetime (ST), they constitute *ST curvatures*.
- Hence they are general relativity infolded inside electrodynamics.
- By manipulating and changing these LWs, one manipulates and changes spacetime curvatures and their dynamics.
- The result is a unified field model where one directly controls and engineers a set of ST curvatures by use of higher group symmetry electrodynamics.
- Controlled patterns of local curvatures of ST are called "vacuum engines" or "spacetime curvature engines" -- or just "engines".

* E.T. Whittaker, Math. Ann., 57, 333-355 (1903); Proc. Lond. Math. Soc., Series 2, 1, 1367-372 (1904).
** T. E. Bearden, J. New Energy, 5(1), 11-23 (2000).

Pumping with EM time-polarized waves forms *amplified* antiengines

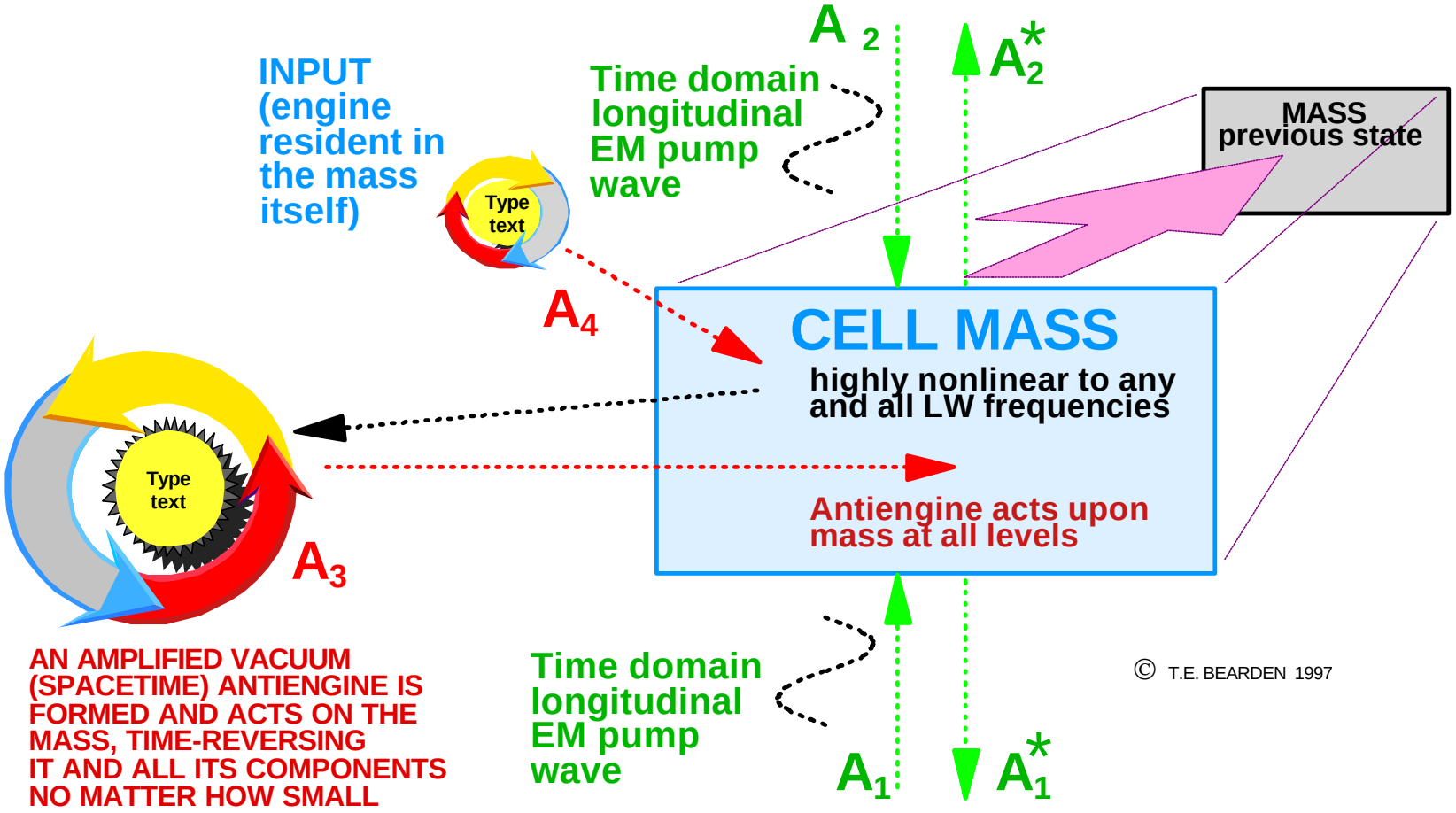

AN AMPLIFIED VACUUM (SPACETIME) ANTIENGINE IS FORMED AND ACTS ON THE MASS, TIME-REVERSING IT AND ALL ITS COMPONENTS NO MATTER HOW SMALL

© T.E. BEARDEN 1997

A DRAMATIC EXTENSION TO NONLINEAR OPTICAL PUMPING

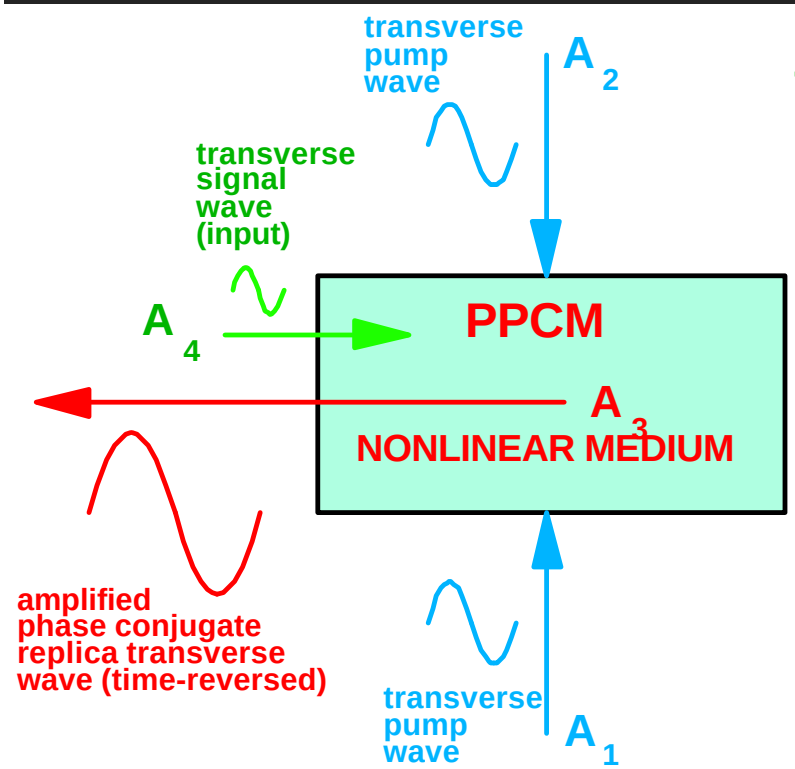

a. Pumping with transverse EM waves produces a time-reversed *wave*.

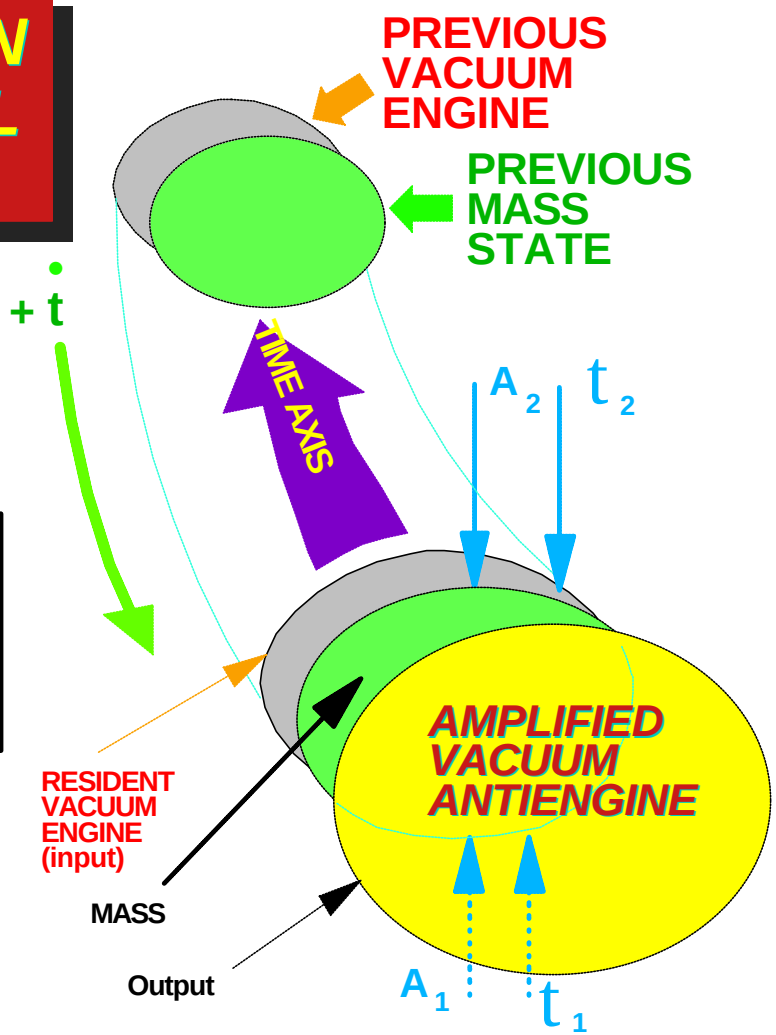

b. Pumping with longitudinal EM waves A_1 and A_2 time-reverses *the mass itself*.

Time-reversal of a mass to a new physical state not in its past

- Original engine A'
- New engine B' added
- Time-pumping moves to new "past" that is determined by (A'+B')

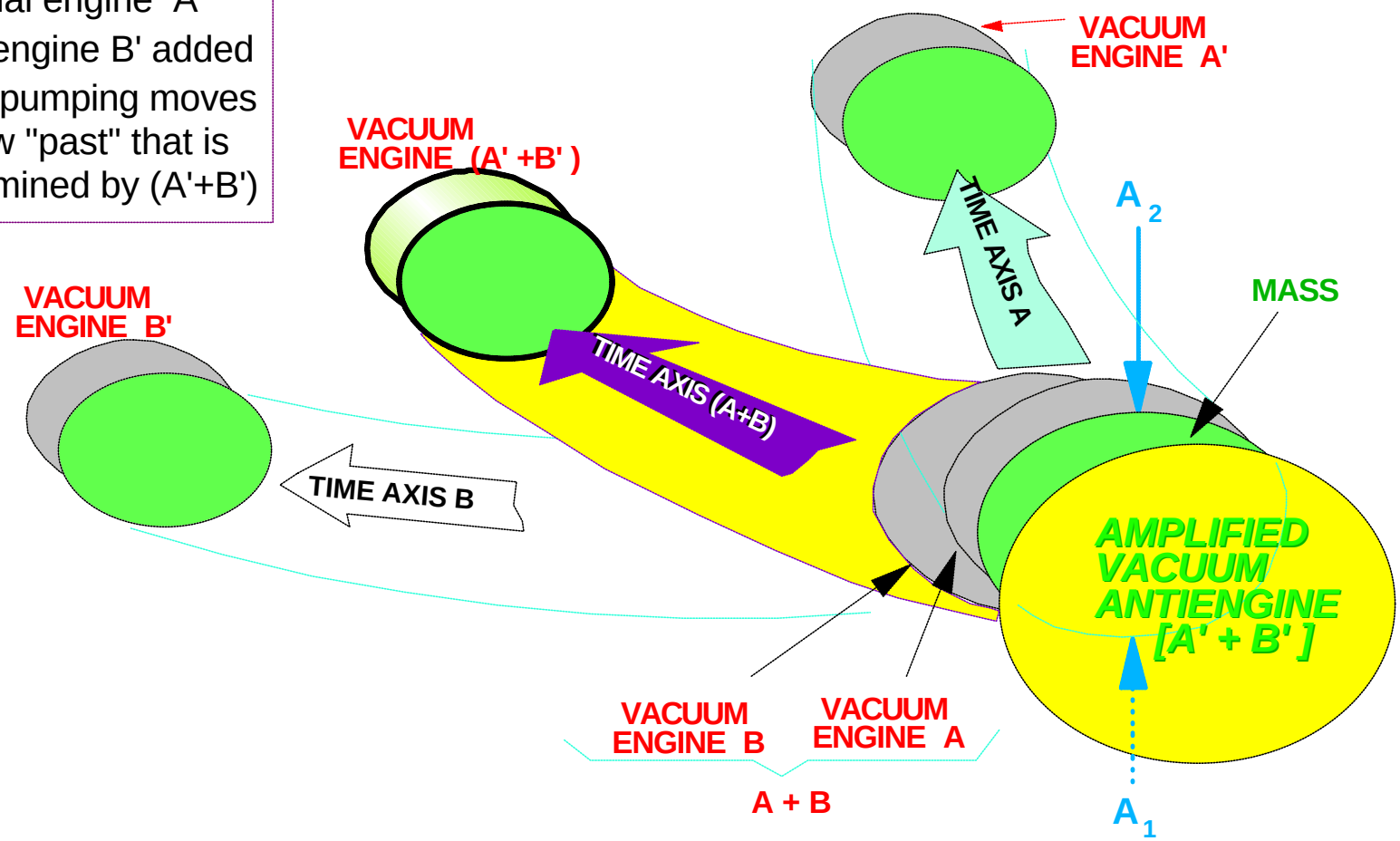

Extended general relativity principle

- All levels of energy structures and all levels of time structures mold spacetime geometry.
- The "pattern" is called a *template* for a vacuum engine (spacetime curvature engine).
- Spatial and temporal structurings of the engine act upon any exposed mass at all levels.
- This produces a template of forces, for precise translations and stresses within the mass at all levels. The forces exist in both time and 3-space.

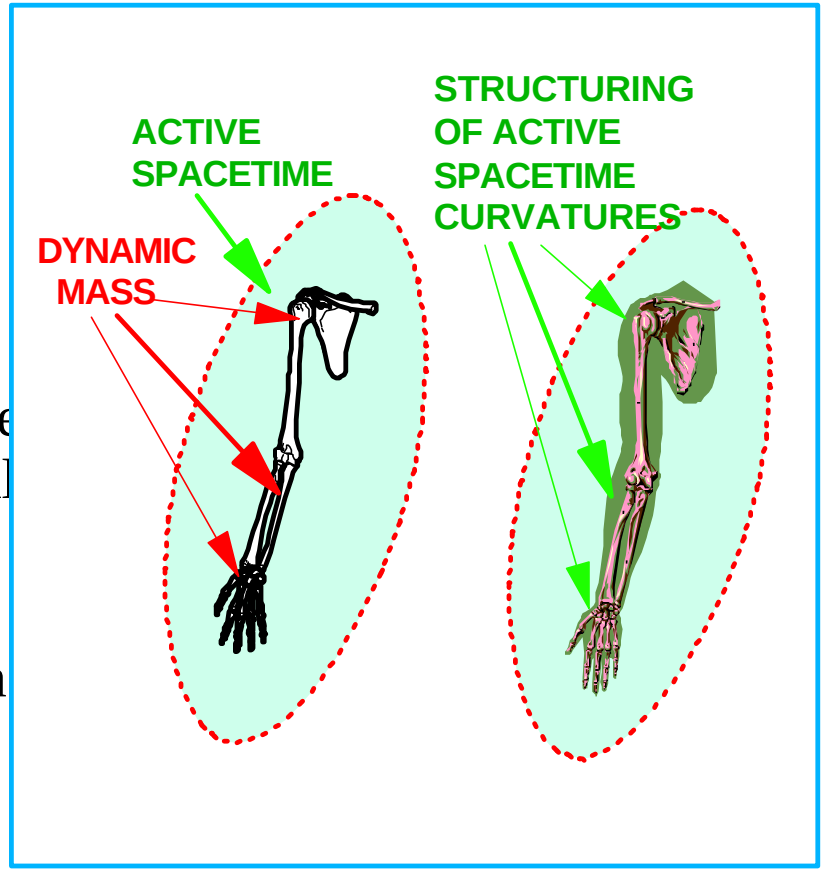

Engines: Working spacetime demons

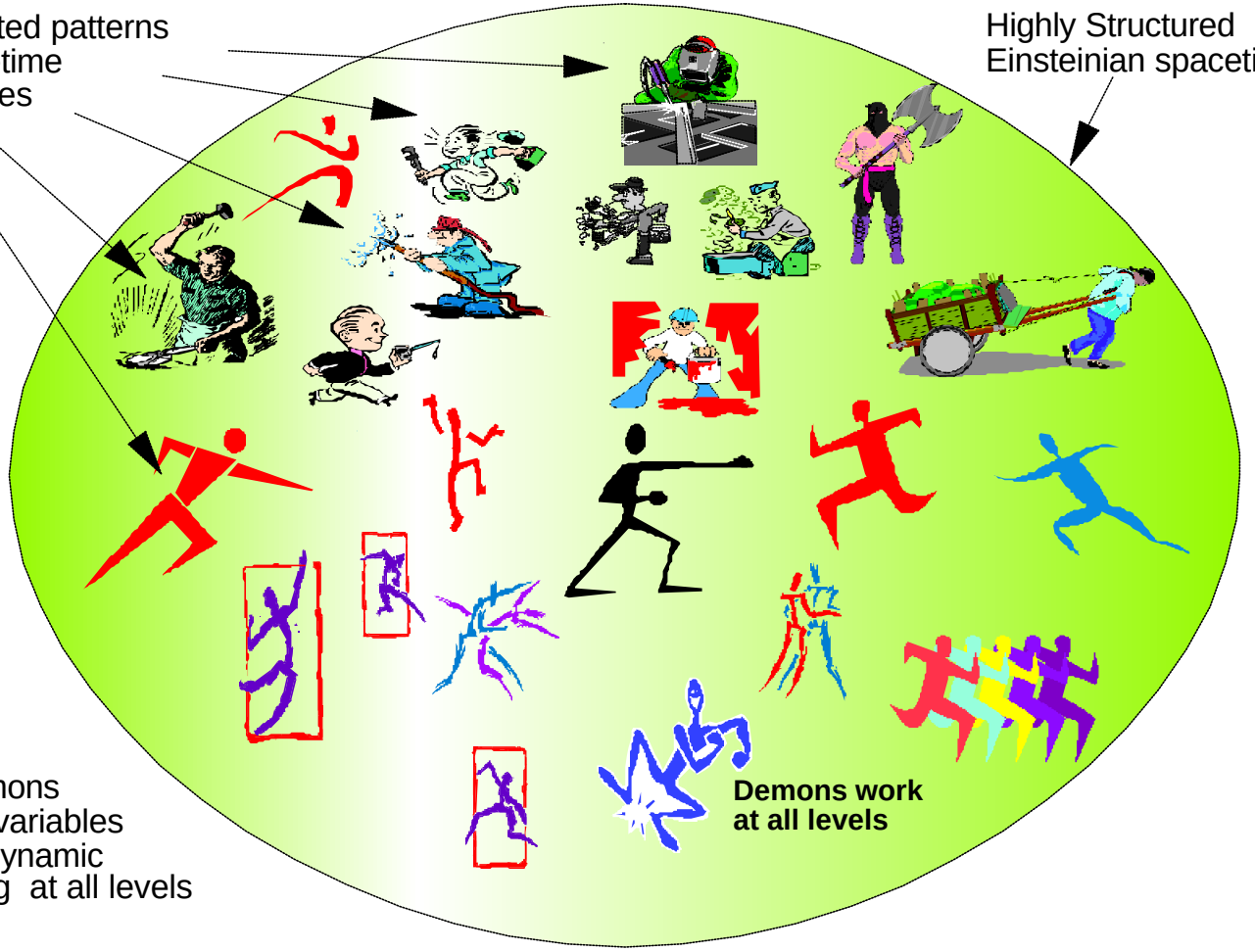

Maxwellian Demons
are EM hidden variables
organized into dynamic
structures acting at all levels

Signal vs. vacuum engine

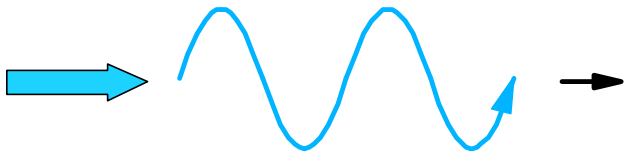

SIGNAL (INFO)

- ★ Information received
- ★ Any overt physical action must be taken by cell itself
- ★ Cell must furnish the energy for any action it takes
- ★ Passes from outside to in

A. ***Cell must do the action itself; vacuum energy exchange is passive. Energy or fuel for doing the action must be added to cell externally.***

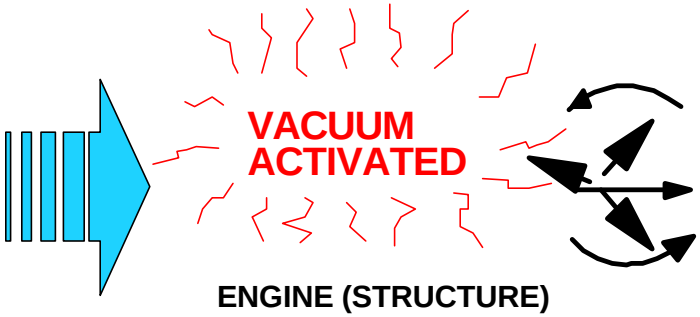

ENGINE (STRUCTURE)
TEMPLATE (FORM)

- ★ Information itself acts
- ★ Local spacetime curved, with internal subcurvatures
- ★ Produces template of forces in local spacetime (ST)
- ★ Arises from within local ST
- ★ Acts on and changes all parts of cell, including its genetics

B. ***Cell is acted upon; vacuum energy exchange does the specific action. No energy or fuel for doing the action need be added to cell externally.***

Unified field theory requires modeling and use of supersystem

Three components interact with each other:

- System and its dynamics
- Local active vacuum and its dynamics
- Local curvatures of spacetime and their dynamics.

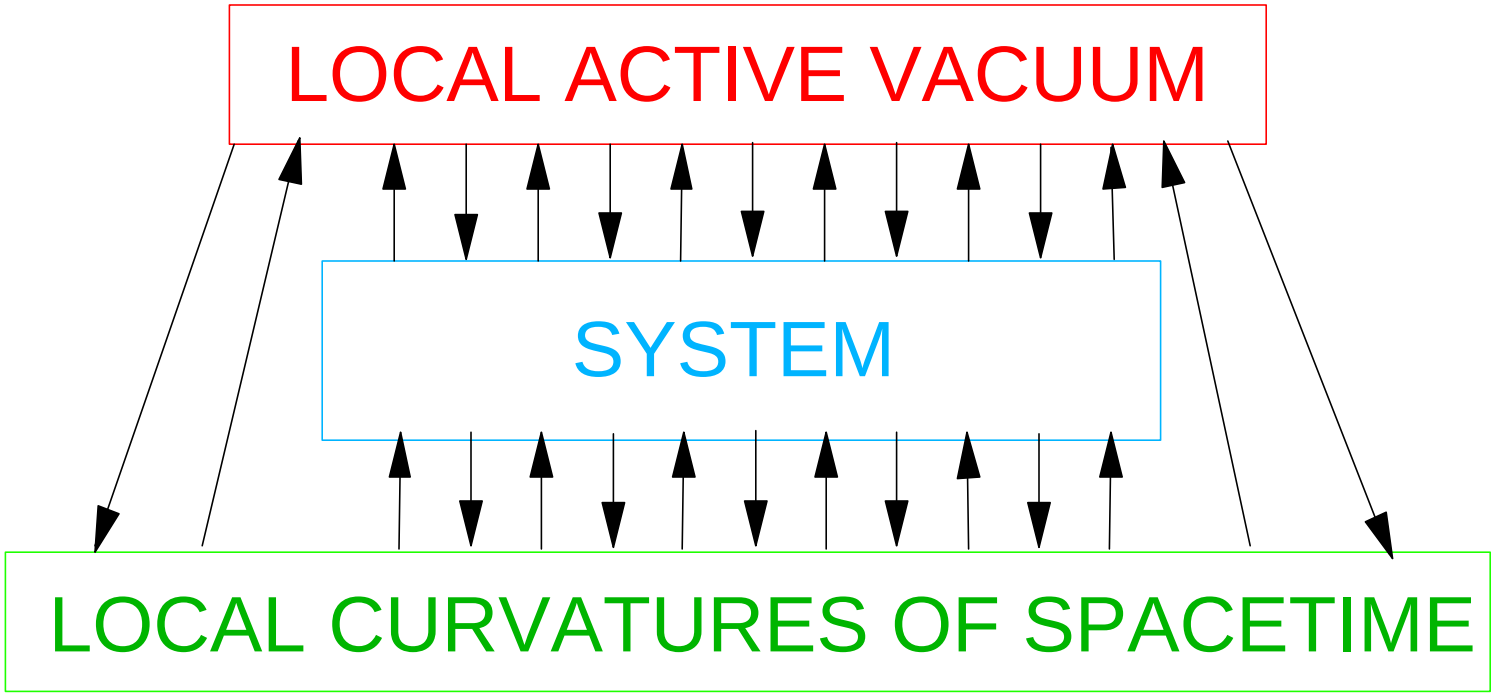

Classical EM kills the supersystem, prevents supersystem engineering

- Assumes flat local spacetime
- Assumes inert vacuum

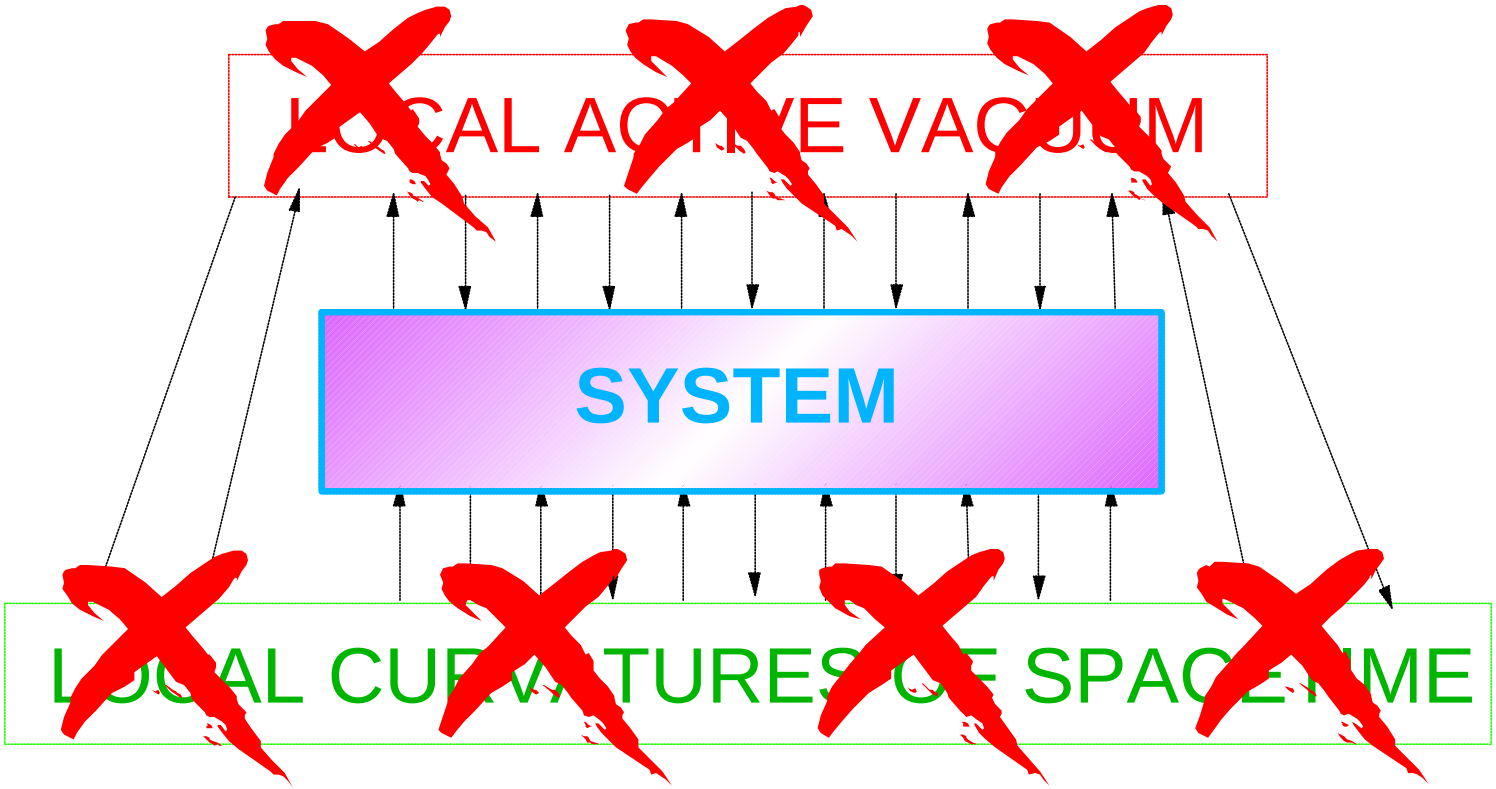

Malignant teratoma exhibits both time-reversal and fast-forwarding

- A teratoma cell is a tumor cell that has reverted to stem cells, then proceeds to differentiate toward new kinds of normal cells.
- May produce hair, skin, muscle, heart, bone, and other type cells.
- Sometimes present at birth.
- Demonstrates both "time-reversal" and "time-forwarding".
- The missing key is the engine function(s).

Miller-Fox-Urey biogenesis experiments

- Engines of and from all life forms ever on earth or in the universe exist in the ambient vacuum potential.
- The Miller-Fox-Urey experiments were not in a "sterile" environment.
- Heat (IR) and UV constitute (1) a harmonic interval with a difference frequency, and (2) amplifying by the process previously shown.
- These experiments "kindled" previously living forms from the available gases etc. by amplifying the ancient living engines from their virtual state to the observable state, so that the masses were molded into the physical states of their templates.

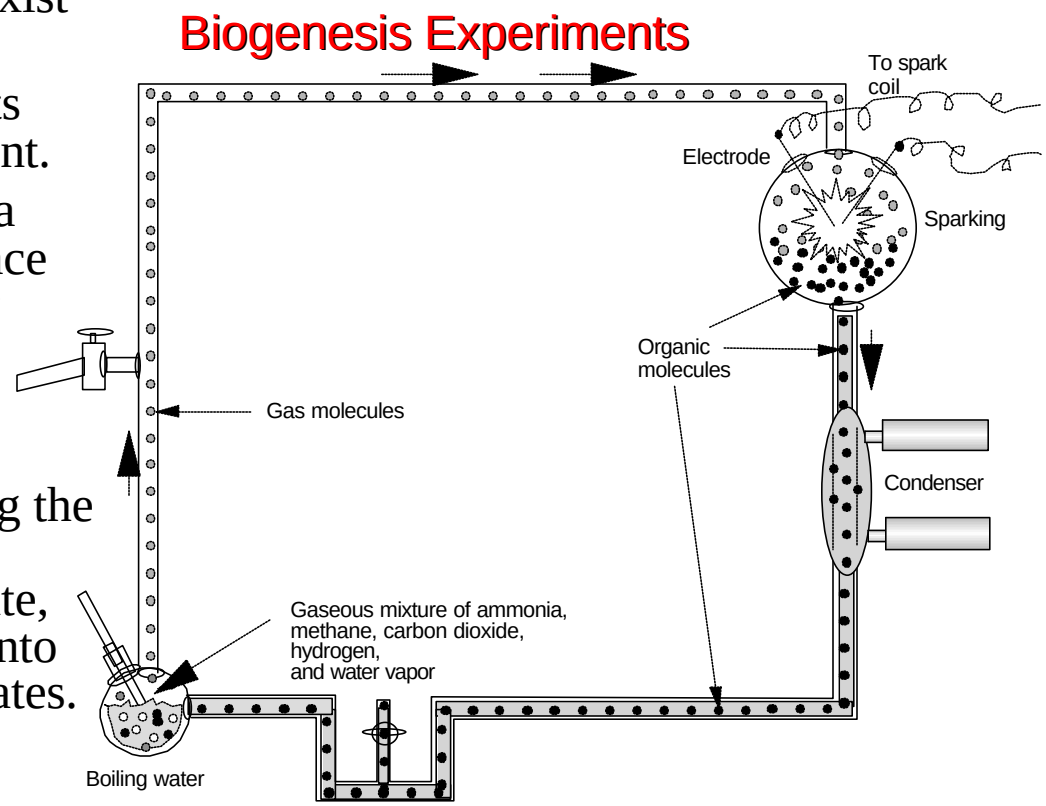

Cloning to produce stem cells

- Human DNA can be inserted in an animal cell, and the cell chemically tricked into proceeding as if fertilized.
- Formation, increase, and growth of stem cells begins and continues.

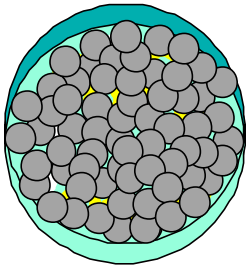

- The "engine" carried by the human DNA is changing the matter available into human cells.
- readily demonstrated experimentally.

Regeneration in a strain of rat with part of its immune system missing

- In mammals, the immune system plays a role in reducing the regeneration capability, compared to that of more primitive systems.
- In a strain of rat where that "suppressive" part of the immune system is missing, the regenerative capability is dramatically increased.
  - Can regrow cut away sections of tail.
  - Regrows plug cut out of ear.
  - Reconnects severed optic nerve.
  - Partially restores severed spinal cord.

- The suppressive "delta" engine of the immune system, operating simultaneously with the underlying primitive regenerative engine, sums to the modern much-reduced regenerative engine in the mammal.

An observation for the future

- When the science of engines is developed, physicians will be able to tailor these engine combinations to restore severed human spines, regrow severed limbs, etc.
- They will also be able to direct the body's "normal growth" to reduce and direct birth defects, genetic defects, etc.

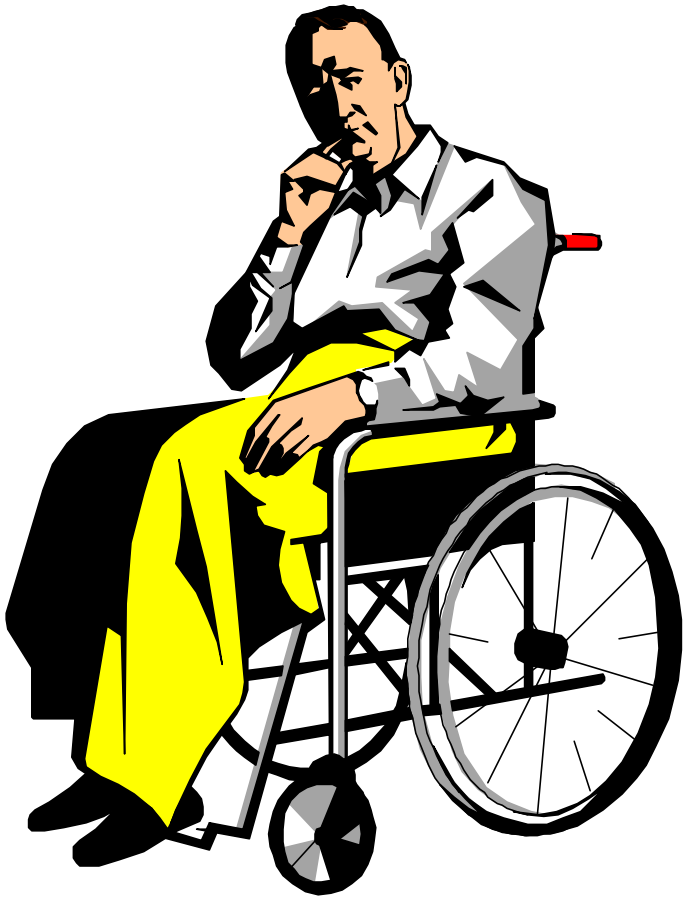

Biochemistry and EM models

- Medical scientists analyze such things as teratomas in terms of biochemistry and the biochemical model.
- An assembly of charges and charge distributions, with their associated fields and potentials, drives all chemistry at base level.
- The charge assembly and its dynamics involves a corresponding assembly of spacetime curvatures and their dynamics. These are *the cause that is driving the charge assembly and its dynamics, and therefore the chemistry*..
  - In unified field theory (such as that of Sachs) and O(3) electrodynamics.
  - Not in classical U(1) EM theory or quantum electrodynamics.
- Conventionally a causative EM field in space is "defined" as the *diversion from* that spatial field by and after its interaction with charge).
  The "definition" substitutes the effect for the cause, a non sequitur.
- This is a known major flaw, pointed out in one fashion or another by many physicists such as Wheeler and Nobelist Feynman.
- Classical EM theory is a 137-year-old model, seriously flawed. These flaws emerge in biochemistry and medical science.

Necessary EM corrections*

- Many of the corrections necessary in electrodynamics modeling either have been done or are underway.
- Higher symmetry, non-Abelian electrodynamics models have long been developed in particle physics.
- The new approach extends these models to also incorporate general relativity, thus producing a unified field theory*.
- In the new approach, spacetime curvature engines are perfectly natural and understandable, and can be directly modeled and engineered by advanced theorists.
- In short, the theory is sufficiently advanced and robust that technology and engineering can now advance.
- This will be a great leap forward for biochemistry and medical science, particularly in therapeutic methods.

* Sachs's unified field theory implemented by O(3) electrodynamics presently is the most suitable to use. Numerical methods are required.

Prioré's revolutionary results in lab animals

And its ramifications

Prioré (right) makes a point to Chaban-Delmas, Mayor of Bordeaux

- Many of the Prioré team's experiments were done in Bordeaux.
- Antoine Prioré patents:
  - "Apparatus for producing radiations penetrating living cells," U.S. Patent No. 3,368,155, Feb. 6, 1968.
  - "Method of producing radiations for penetrating living cells," U.S. Patent No. 3,280,816, Oct. 25, 1966.
  - "Procede et dispositif de production de rayonnements utilisables notamment pour le traitement de cellules vivantes," [Procedure and Assemblage for Production of Radiation Especially Serviceable for the Treatment of Living Cells], Republique Francais Brevet d'Invention P.V. No. 899.414, No. 1,342,772, Oct. 7, 1963.

Block diagram of Prioré's method

Time-reversing the cells back to normal state

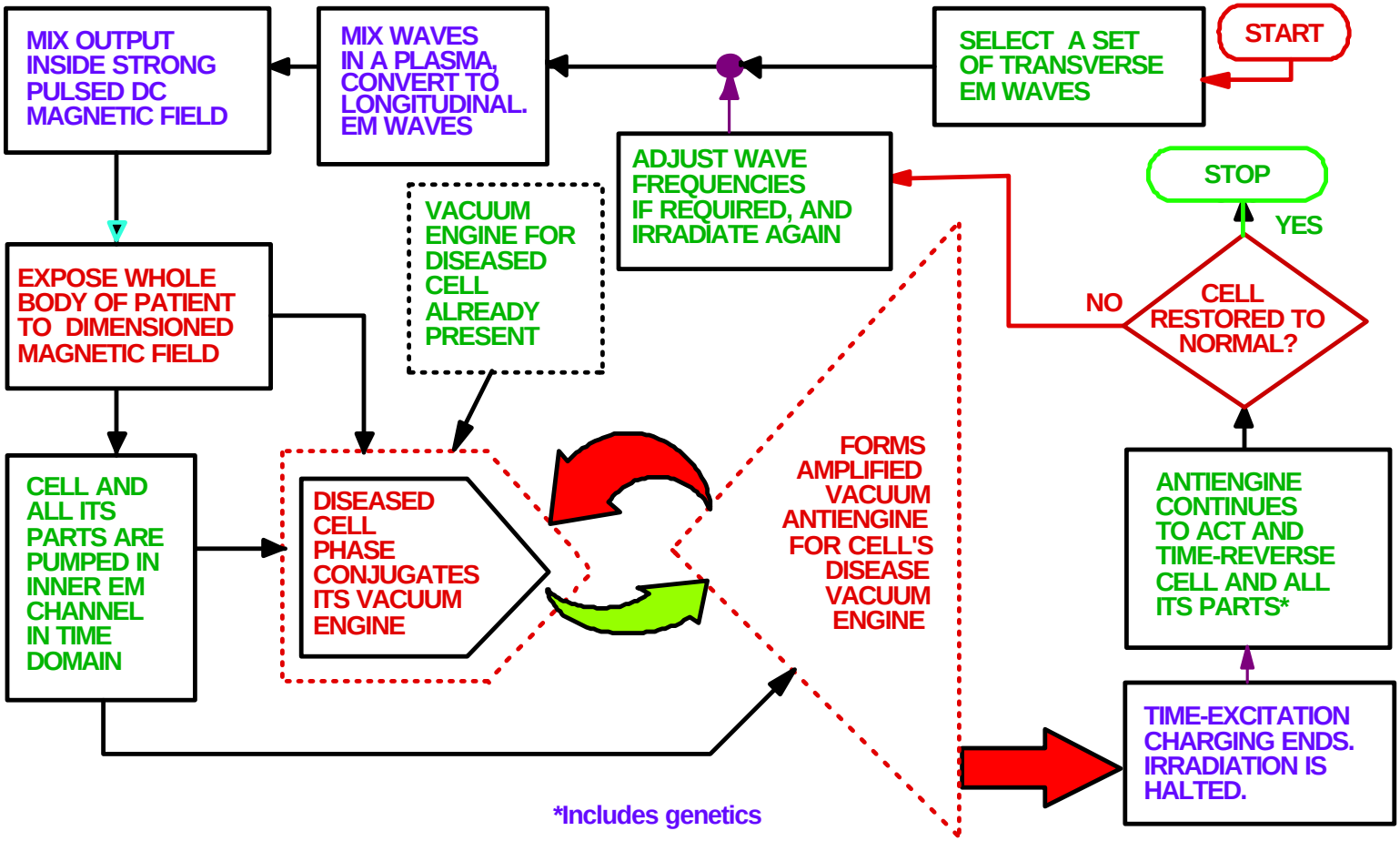

*Includes genetics

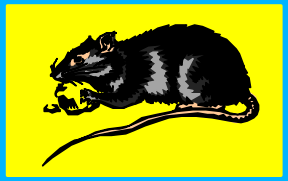

In Laboratory Animals:

Prioré Team Cured

- **Terminal malignant tumors**
- **Clogged arteries (atheriosclerosis)**
- **Suppressed Immune Systems**
- **Infectious trypanosomas**
- ***Results were presented to French Academy of Science by Robert Courrier, Director of the Biology Section of the Academy***
- ***<u>No one understood the mechanism!</u>***

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Some peculiar results by the Prioré team

- Once a rat is cured of a particular disease:
  - A single drop of blood from the cured rat, injected into another rat stricken with same disorder, would result in the injected rat getting well slowly.
  - This ability to transfer immunity and healing in the extracted drop of blood gradually decayed over a period of a few weeks.
- Showed that even the fields and potentials in the blood had been altered internally, in the treated animal.
- Showed that the injected animal's cellular regenerative system possessed the ability to also time-domain pump over the entire body, everywhere reducing the delta between that injected drop of blood now the rat's own, and the rest of the blood in its body.

Proof of cellular time-reversal

- Pautrizel compared identical treatment of immature rats with immature immune systems, and mature rats with mature immune systems.
- Treatment restored the damaged mature system back to full mature functioning, and it promptly recognized and dispatched the pathogens.
- Treatment restored the damaged immature system back to full immature functioning, unable to cope, and the pathogens promptly reinfected and killed the immature rat.
- The lesson: The body is indeed returned to a previous physical state. The pathogens themselves are not killed by the treatment, but by restoring the ability of the immune system to recognize and destroy them.
- Only the *previous ability* of the immune system is restored by the process.

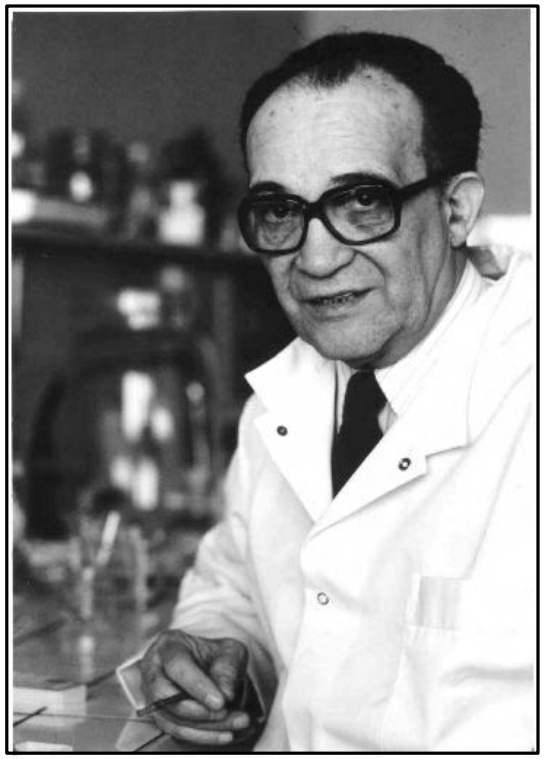

PROF. RAYMOND PAUTRIZEL
(Renowned Parasitologist)

Disadvantages of Prioré method

- Large plasma tube and facility required.
  - 3-stories high building bay if to treat humans.
  - Long irradiation time (2-3 hours).
  - Slow, numerous experimental adjustments.
- Fundamental mechanism was unknown.
  - Phase conjugate optics not yet born in West.
  - No higher symmetry EM modeling used.
  - Prioré thought it was a result of ionization.
  - Importance of difference frequency unknown.
  - Body dielectric transmission path unknown.

3-Story high Prioré device for treating humans

- At the end of the project, Prioré had developed a large unit to treat humans.
- A few were treated.
- Cures replicated what had been done in lab animals
- The massive size of the unit and long treatment time (hours) made the process bulky and very inconvenient -- and also expensive

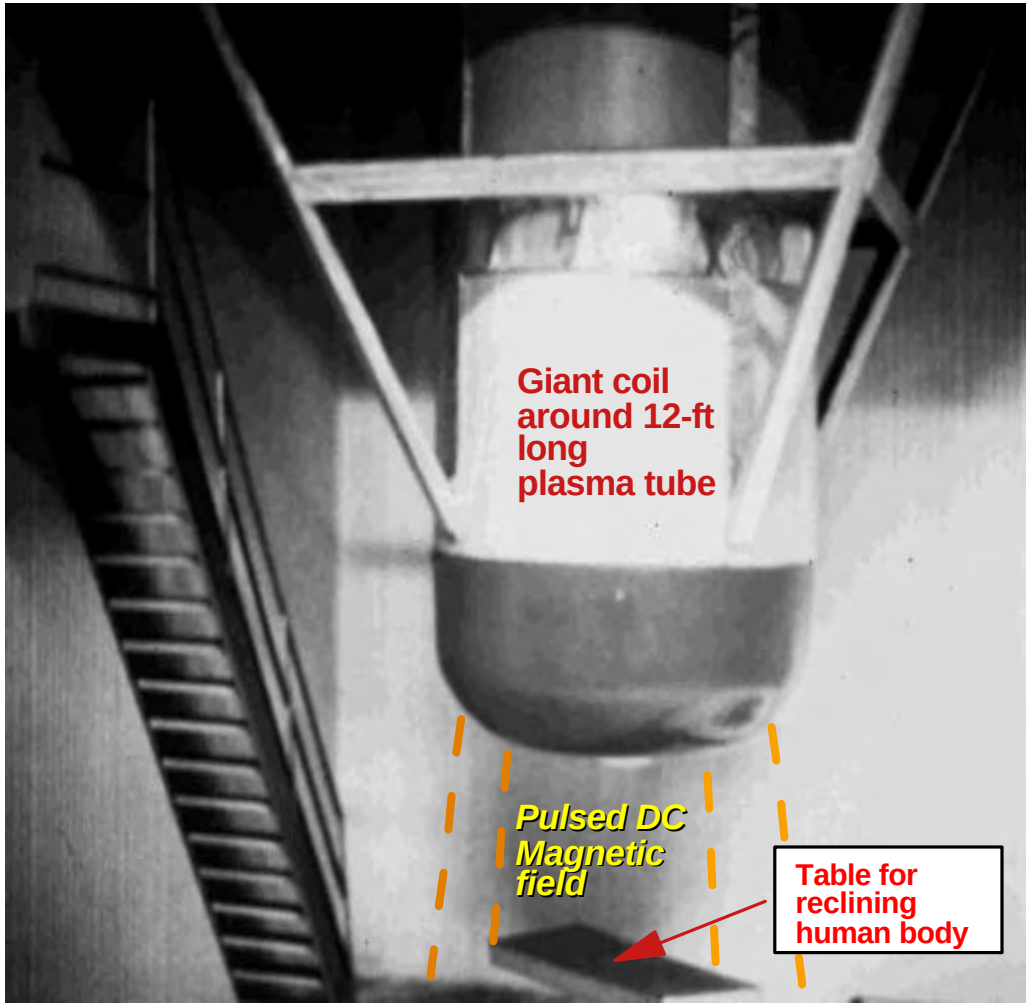

17-foot Prioré plasma tube

Used in large machine (3-stories high) to treat a limited number of human patients

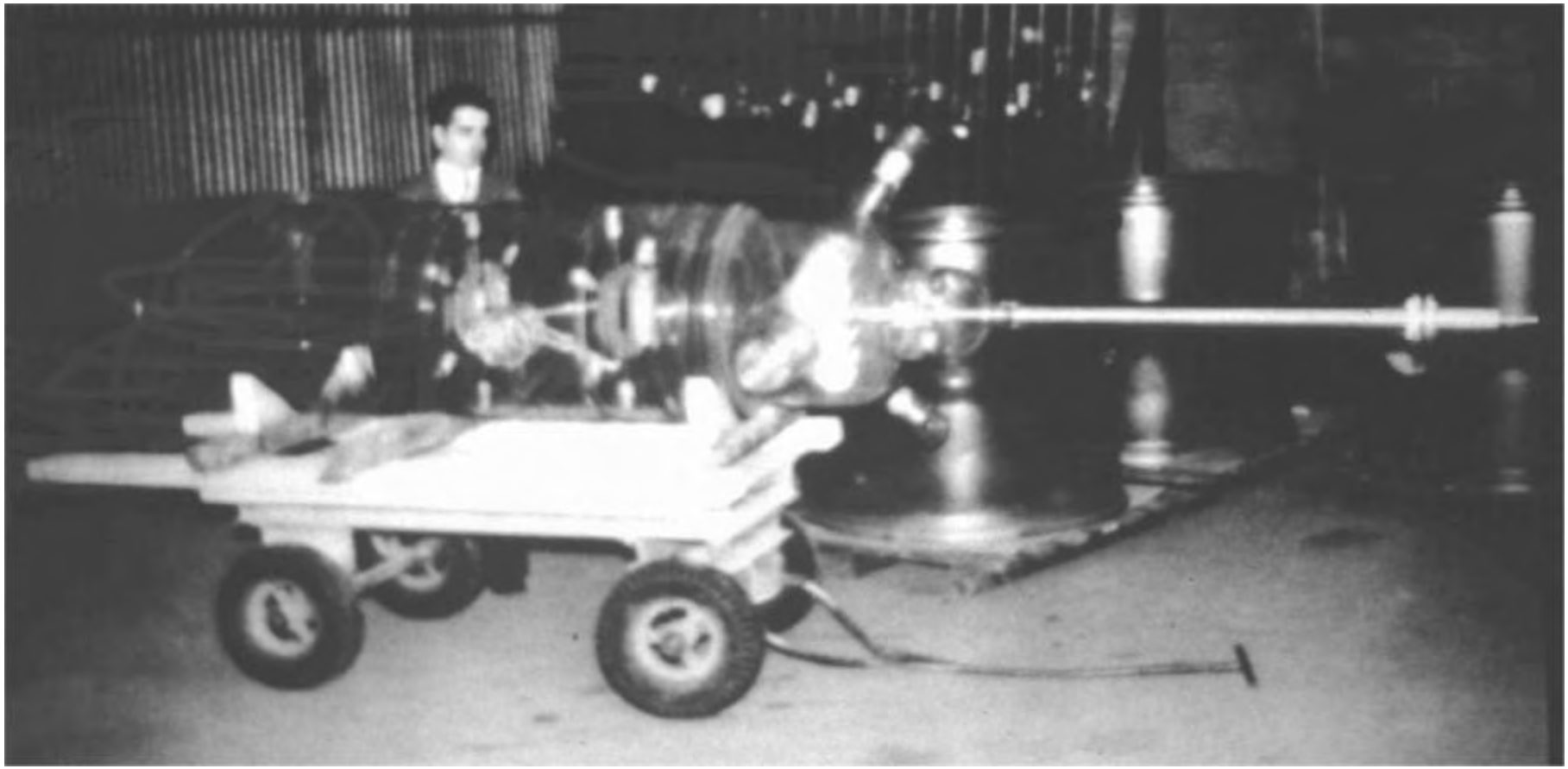

A proposed new mechanism for cancer promotion

And its ramifications

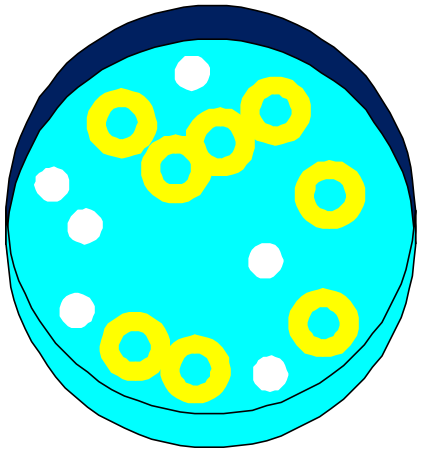

Remarks on cancer from a new perspective

- Two stages: cellular damage and promotion of the damaged cell to a tumorous cell. Promotion presently is poorly understood if at all.
- A master cellular control system (MCS) (studied by Popp et al.) controls both the immune system and the cellular regenerative system, as well as normal functions of the cells.
- The "past history" of ancestral development of aerobic cells and higher multicell aerobic bodies on planet Earth, resides in the "internested engine layers" in every tiniest part of the entire body dielectric, and in all cells.

Remarks on cancer from a new perspective (2)

- Faced with cell damage (such as sustained hypoxia) it cannot handle, the MCS continues to "peel the layers" in taking actions related to ever more distant pasts.
- Faced with continuing hypoxia, e.g., the MCS eventually reaches ancestral layers -- with an engine -- it forces the damaged cells to start moving back toward the original primeval anaerobic form.
- The first step backward is *separation from central growth control*, freeing the cell to multiply independently. At the same time, genetic changes in the cell are forced and produced, starting it back toward becoming an anaerobe.
- These actions comprise the *promotion process*.

The promotion process via engines

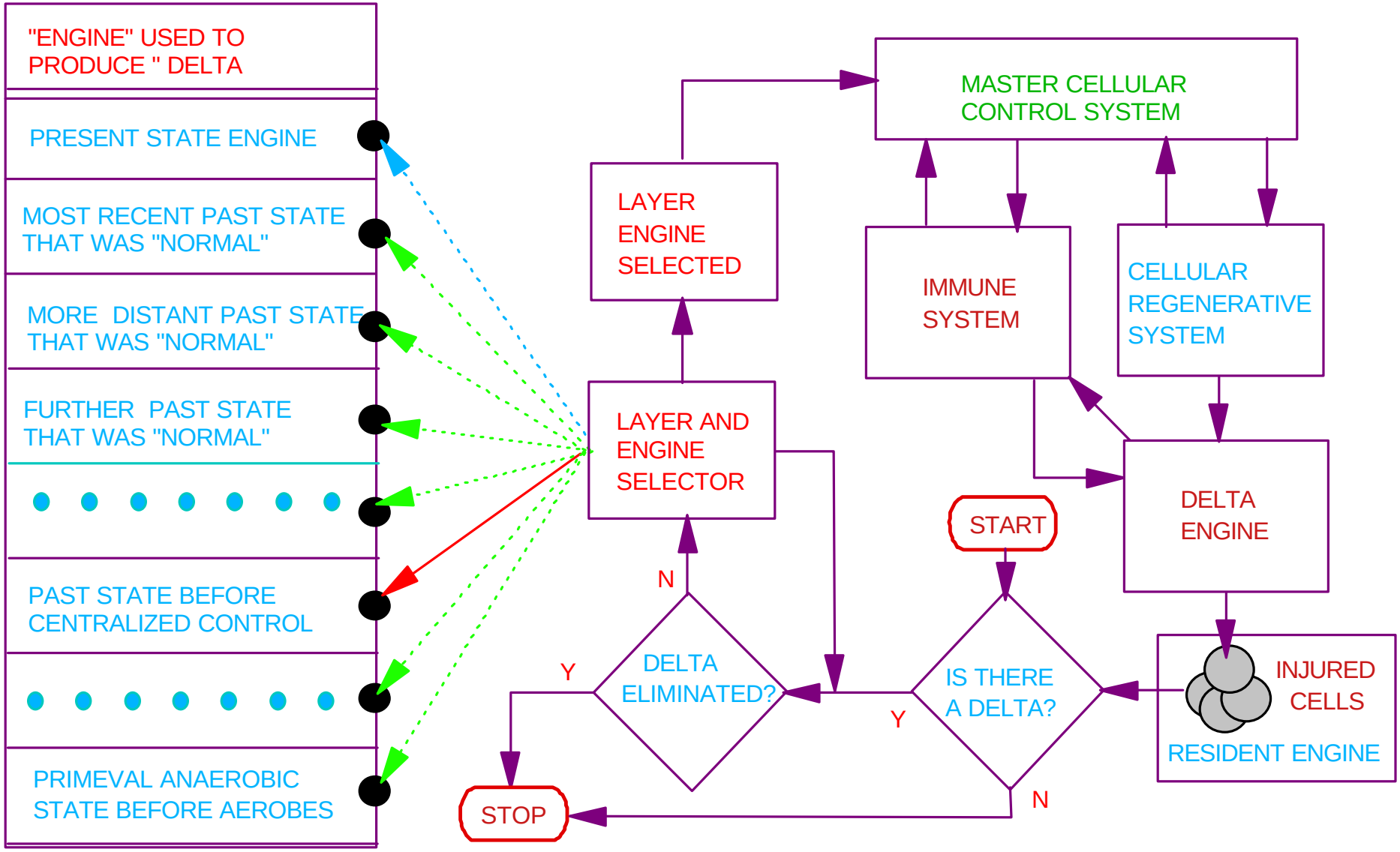

Evolution of aerobic systems

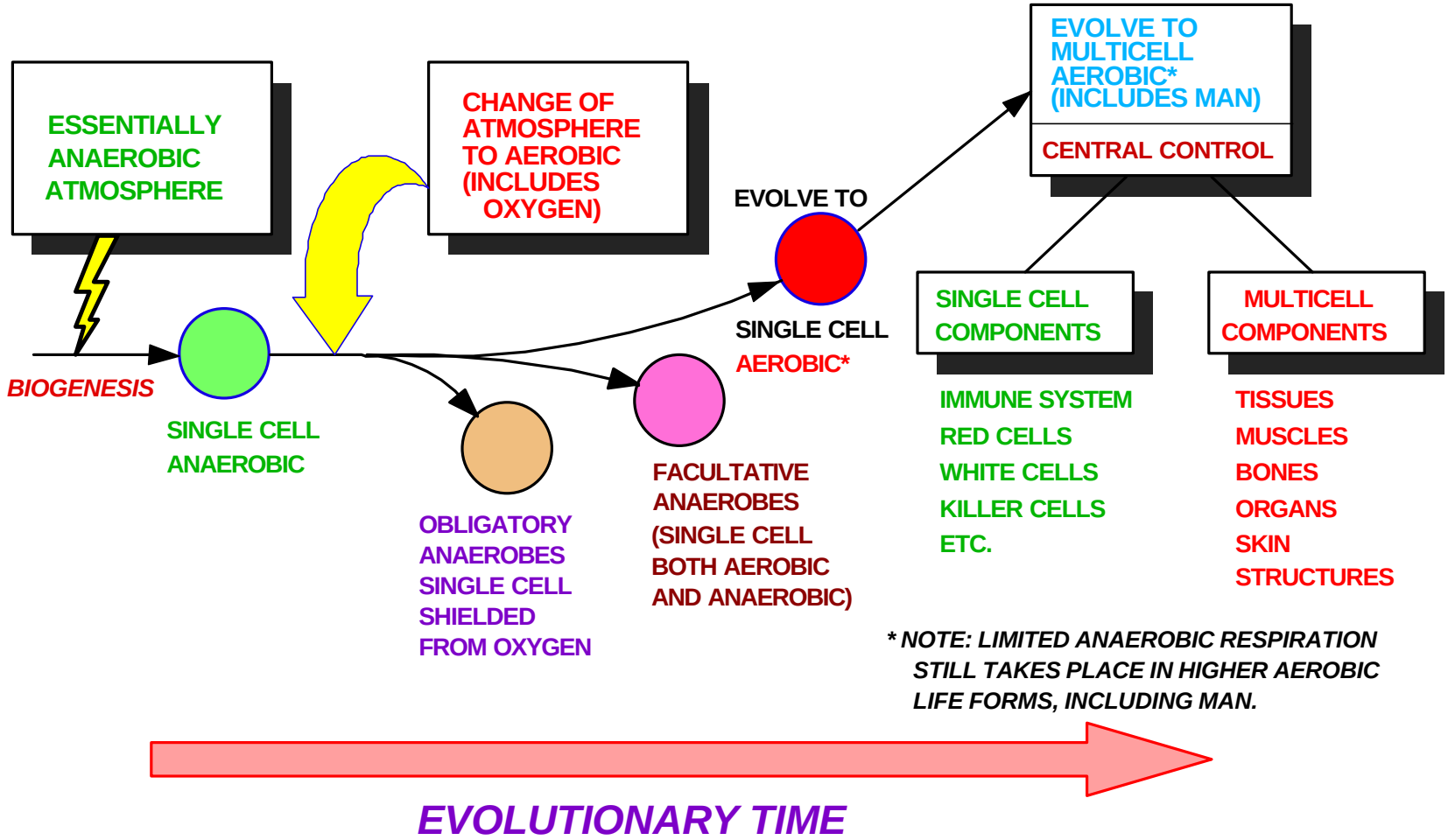

First step in self-promotion of cancer due to hypoxia

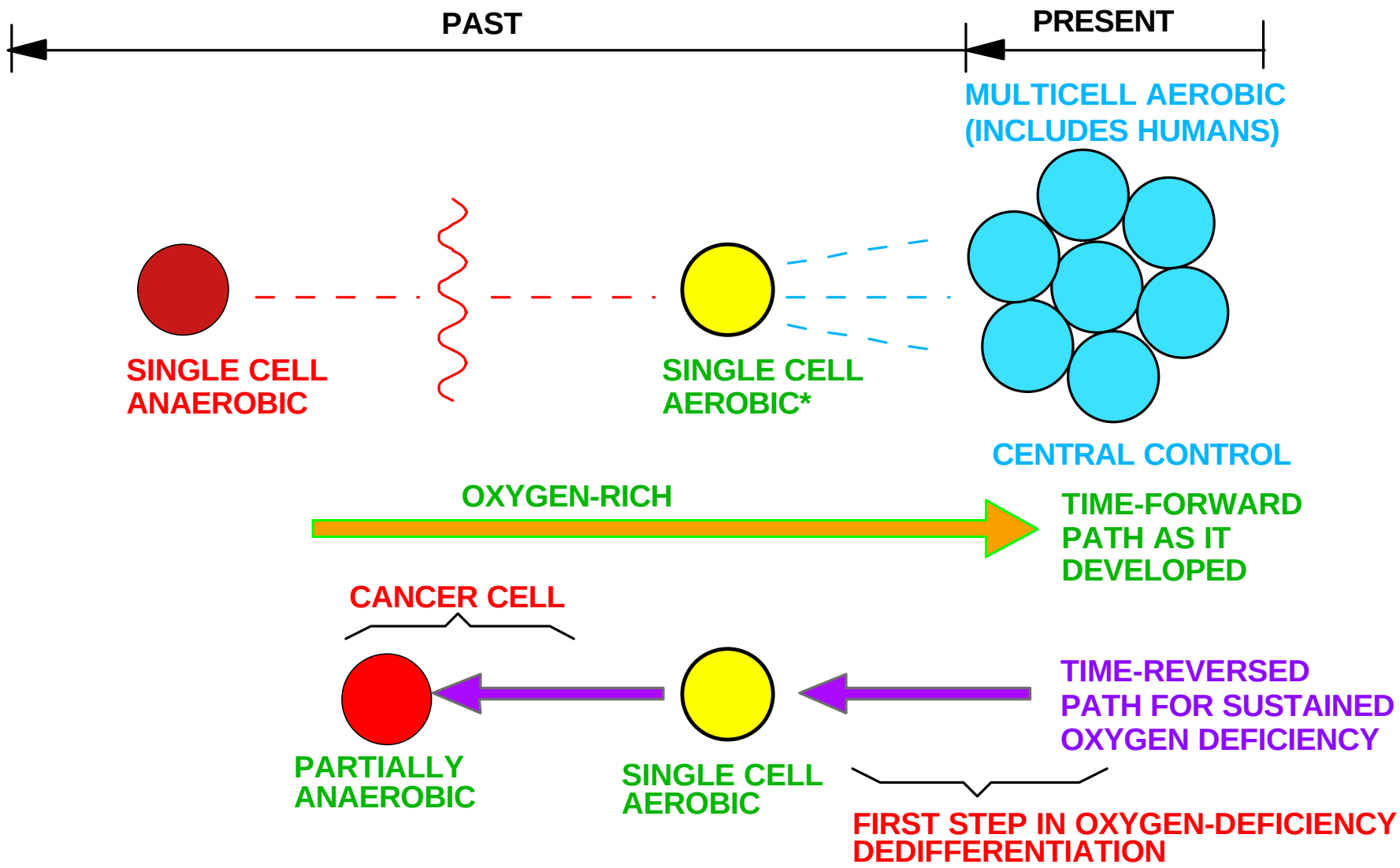

Block diagram of the cellular regenerative system

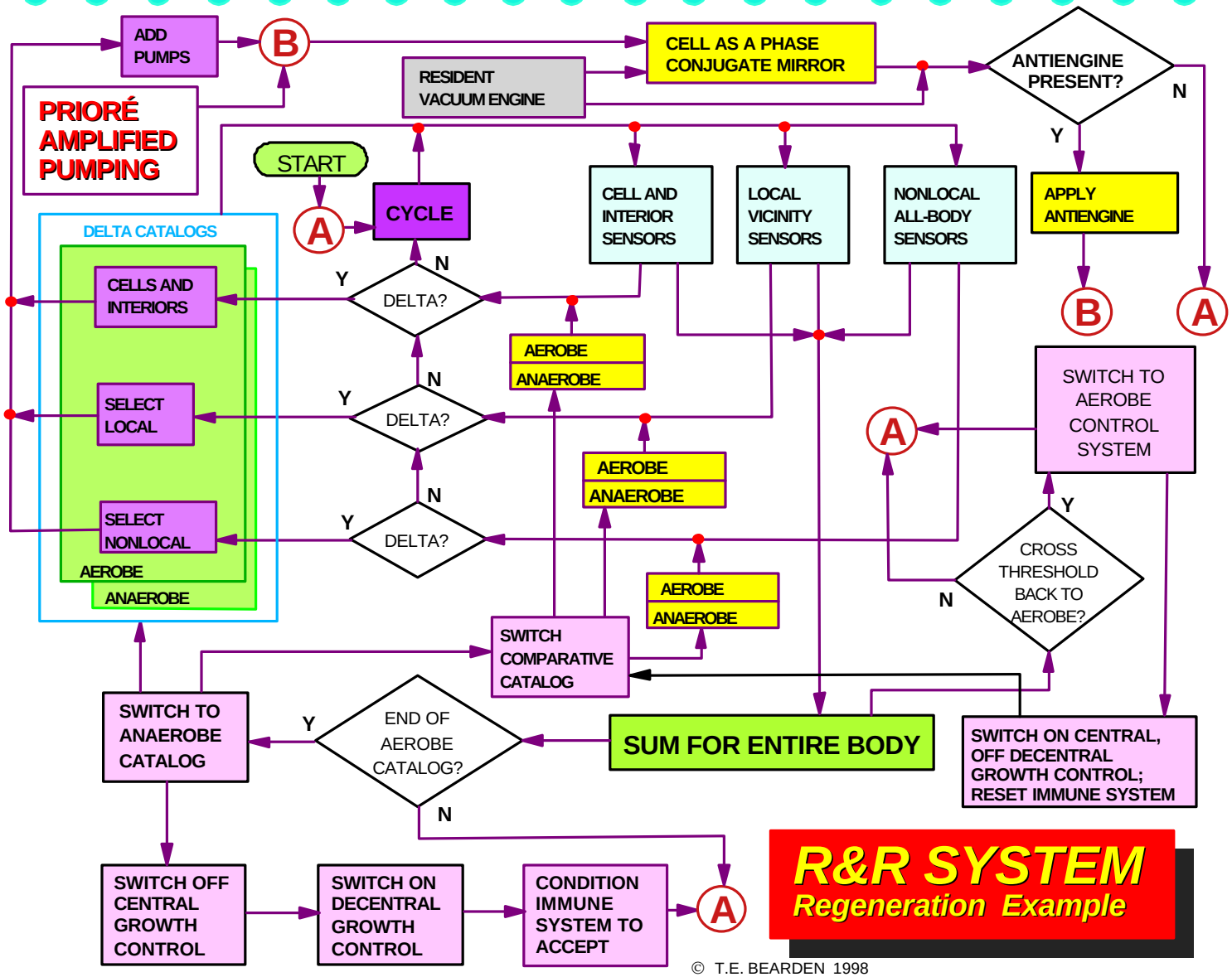

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Bombshell: Amplified EM healing

- A unified field theory approach and use of supersystem analysis has broken the basic mechanism for healing itself.
  - The Sachs unified field theory applies and has been partially fitted.
  - Evans-Vigier O(3) electrodynamics can properly model it, including both the internal and external electrodynamics and effects of engines.
  - Direct engineering development is now possible.
- Experimental proof of the results obtainable already exists in the literature.
- A medical revolution is in the offing.

Potential Medical Applications

- **Non-traumatic cancer treatment**
  - *Cure cancers and leukemias of all types*
  - *Remove pre-cancerous state*
  - *Restore system*
- **Treat and cure Infectious diseases**
- **Cure AIDS and restore immune systems**
- **Defense against biological warfare**
  - *Virulent diseases from unknown agents*
  - *Treat, cure prior to symptoms developing*
  - *Both civil populace and armed forces*
- ***Dramatically lower health costs***
- ***Rejuvenate the aged***

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To treat and save mass casualties: What is urgently needed now:

- A small, portable, relatively inexpensive treatment unit, not requiring plasmas etc.
- Treatment in 2 to 5 minutes rather than 2-hours.
- Simple treatment application, almost anywhere.
- Effective in advanced stages as well as prior to emergence of symptoms.

- Effectiveness against a wide array of illnesses.
- Use is easy, high school student can be trained in 30 minutes.
- Crash program to develop, flood down through emergency systems in great quantities.

The Solution:

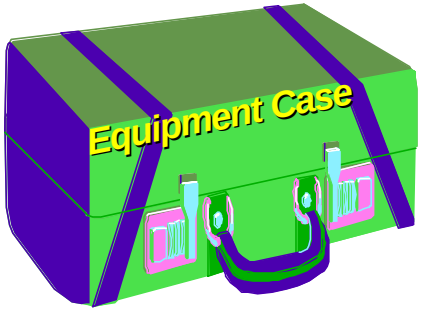

- Two blankets have antennas in them.
- Uses the "porthole" concept (discussed shortly)
- Eliminates plasma tube mixing etc.
- Computer-controlled complex signal structure.

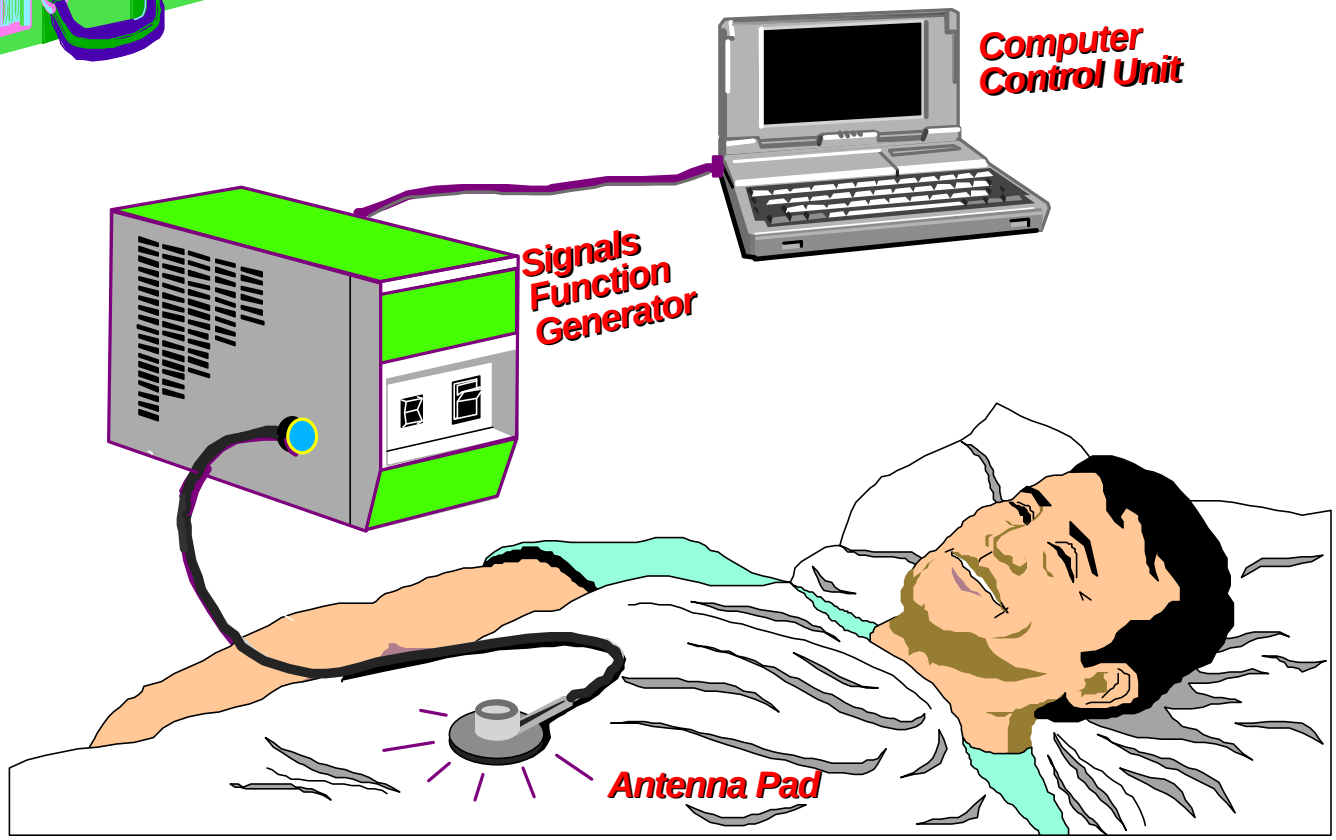

The Porthole concept:

The two-minute treatment shortcut

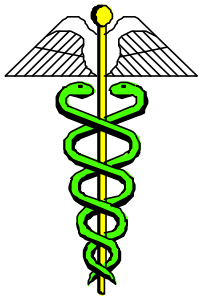

How the porthole concept works

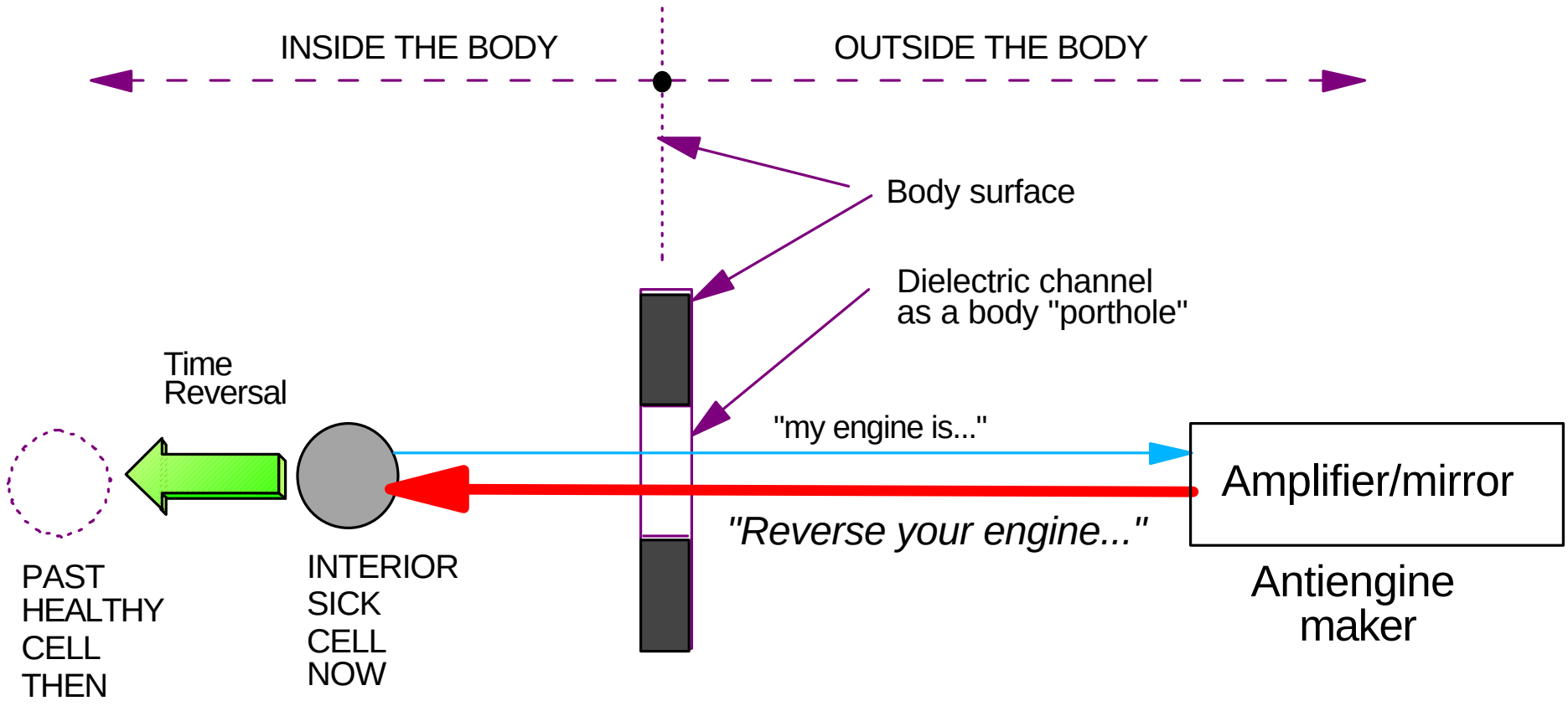

Porthole concept: An analogy of the dielectric path and inner-outer functional connections

- Imagine perfectly reversible dynamic light processes inside a large "cruise ship", that are also perfect phase conjugate mirrors
- Each process receives, absorbs, and emits light continuously
- Light escaping through the portholes is a composite from all the dynamic processes ongoing inside
- If we record and amplify the escaping light, then force it back through the portholes, it reverses all the internal processes
- The processes revert back, slowly, to a previous ongoing process state
- We cease radiation, and the processes reverse and move forward again

Porthole concept: The discovery

- The processes themselves, *in their own "frame"*, are never actually "reversed". Instead, the frame's motion through time is reversed.
  - Each to itself moves normally -- just receiving, absorbing, and radiating light, regardless of "whatever light" is interacting
  - This is due to a peculiarity of the photon and photon interaction
- Photon interaction creates observed physical reality, including the "frame" and the seeming "passage of a mass through time"
  - The photon is its own antiparticle, which is just a photon traveling in the opposite direction
  - So in this case we can use "light" to precisely time reverse (to the observer) the frame and the apparent operations (to the observer)
- When we cease irradiation, after a decay period to remove the reversed excitation, all functions are now seen to be moving forward normally in observer forward time, but from a previous physical state or condition

Using the porthole concept: Research

- The body's own emitted dense, broadband signals are recorded across a broad bandwidth
  - These signals are amplified, then rebroadcast precisely back into the body
  - This returns an amplified "reversed" signal set back through the dielectric path, invoking and applying the porthole concept in all processes
- The returning photons produce time-charging but in reversed frame direction
  - Tremendous potential energy is absorbed in highly compressed "time-energy" form in seconds
  - This "time-potential" slowly drains off as the body processes and cells reverse back to a previous state

Research using the porthole concept

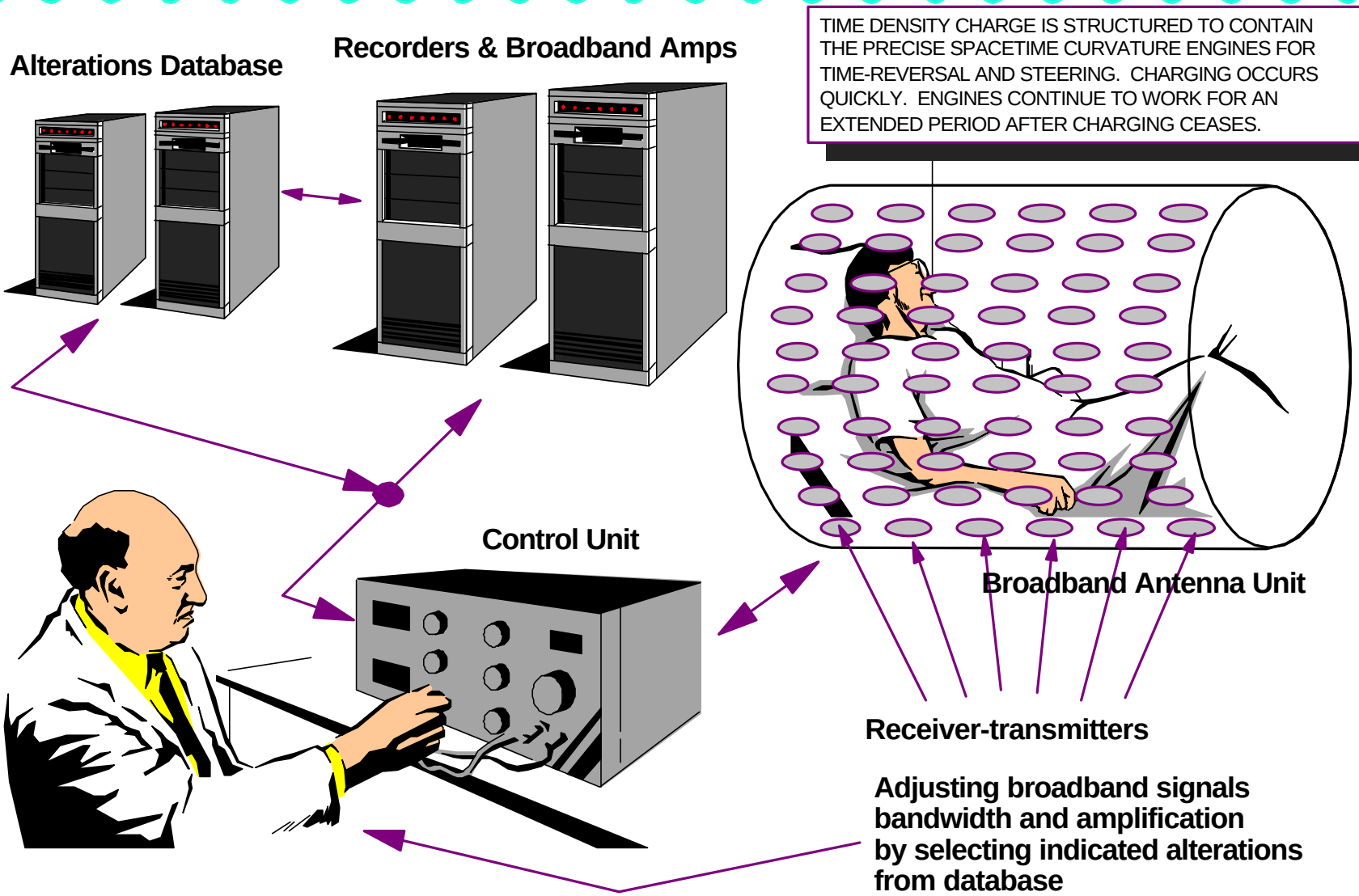

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Portable unit then developed for rapid treatment of mass BW casualties

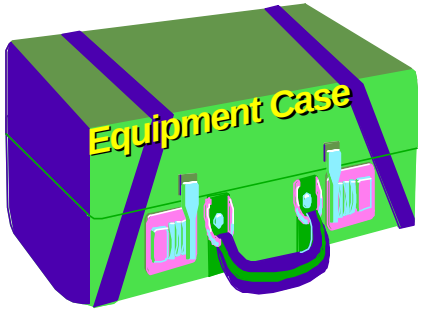

- Two blankets have antennas in them.
- Uses the "porthole" concept (discussed shortly)
- Eliminates plasma tube mixing etc.
- Computer-controlled complex signal structure.
- Irradiation for 2 minutes.

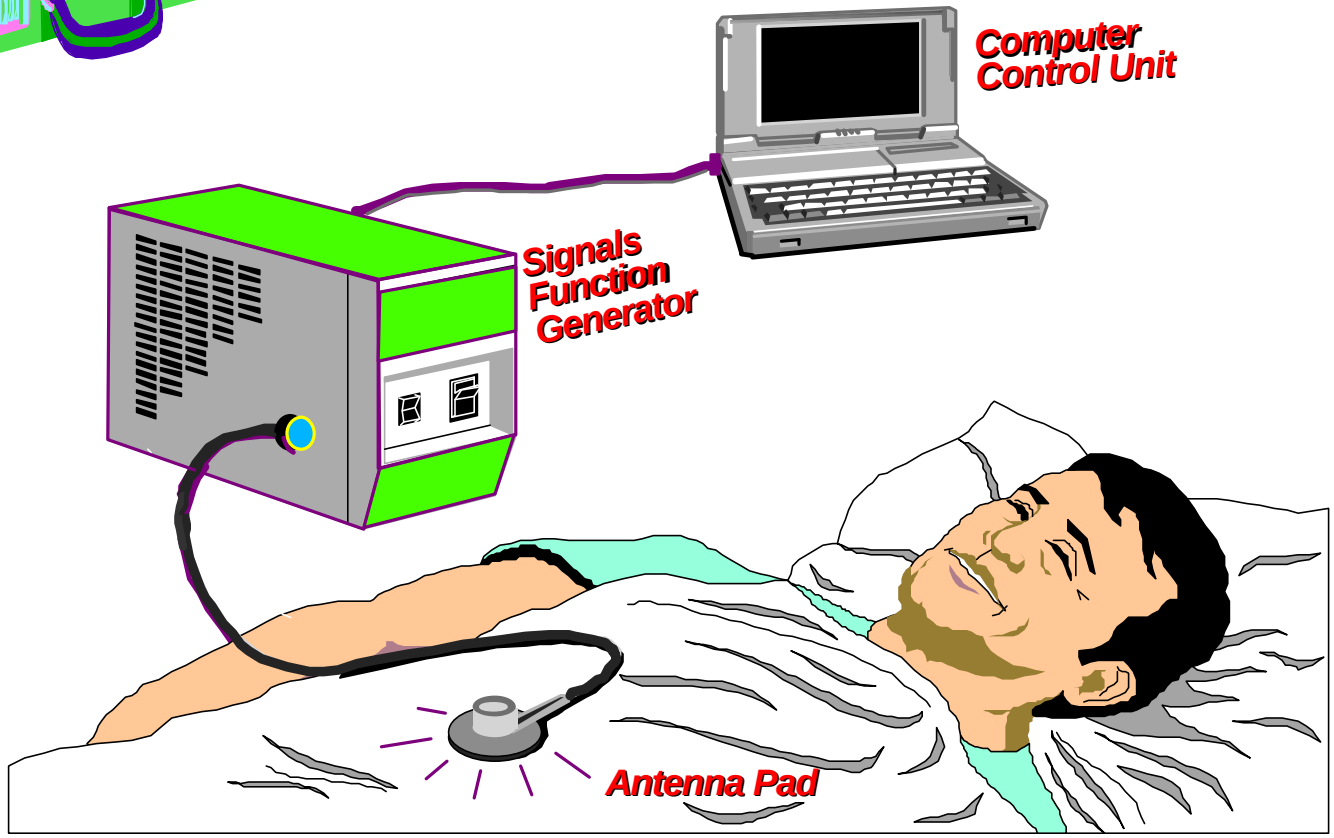

Training to use the unit

- High school student level, 30 minutes.
- Patient lies on one blanket, other covers him.
- Set the prescribed standard signal sets from listing.
- Computer-controlled generator produces the signal.
- Irradiation for 2 minutes, uncover patient, bring in another.
- Unit can be self-powering from vacuum energy (MEG*).

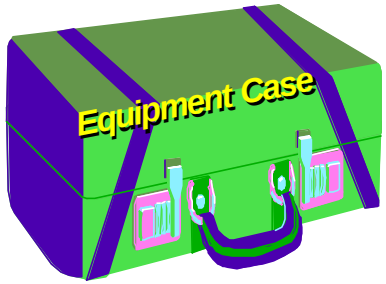

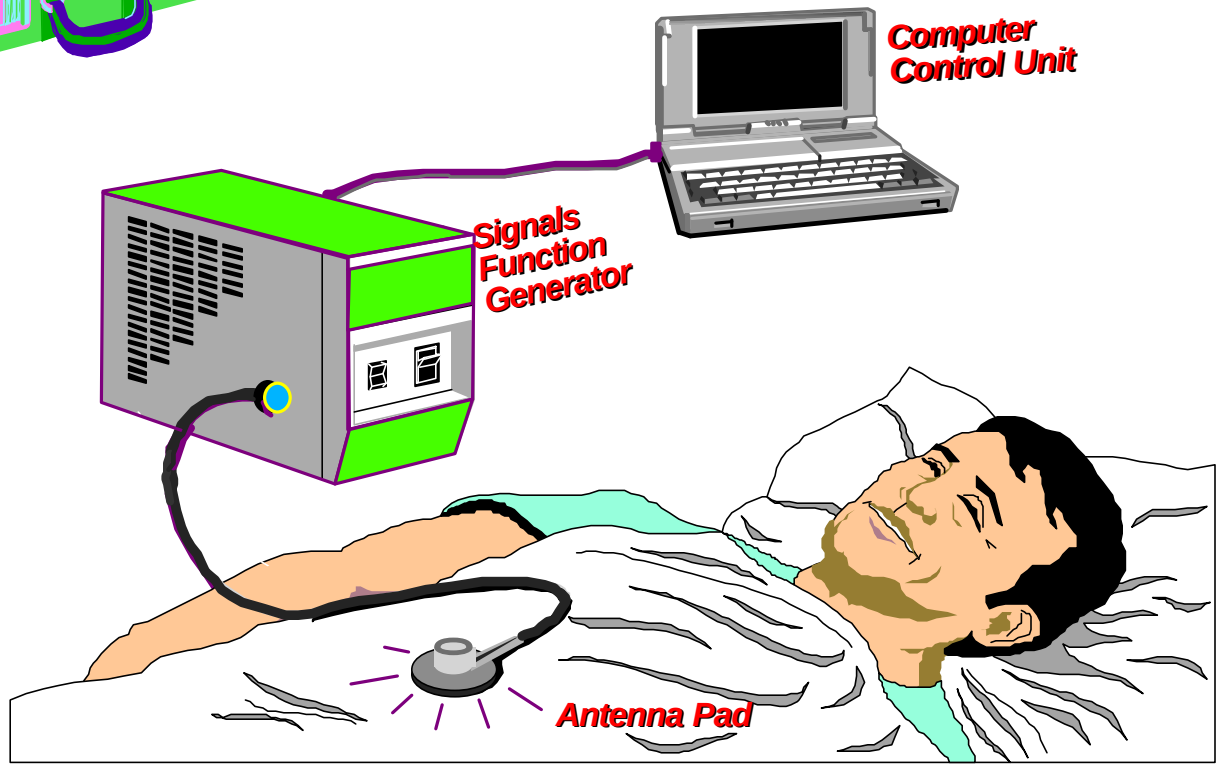

Additional advantages

- Can be developed in a crash program in 2-3 years.
- After sunk costs, projected cost per unit in mass production is less than $100,000
- Can be produced by the thousands
- Then flooded down through
  - Fire stations and police stations
  - Red cross units, hospitals, clinics
  - Emergency action teams and armed forces
- Large numbers of operators easily produced
- Emergency training could be watching a 15 minute film, then performing one graded practice run
- First generation equipment can save some 70% of the coming mass casualties from anthrax etc.

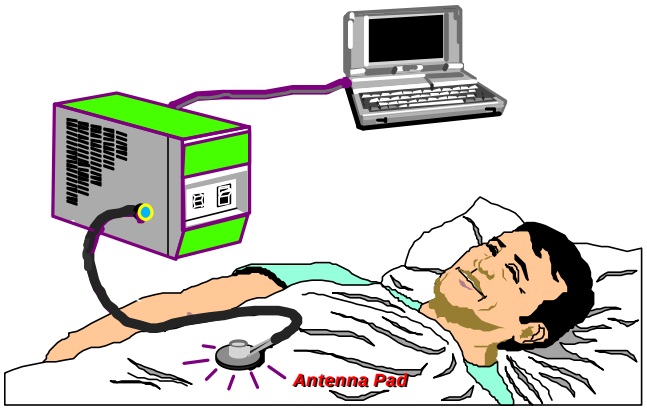

Terrorist BW warfare capabilities against the United States

The growing threat

Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.

- **One terrorist, one light aircraft with spray tank**
- **100 kilograms of anthrax**
- **Flies over greater metropolitan Washington, D.C.**
- **Calm night**
- ***1-3 million casualties result****
- ***Most of those stricken will die***
- **Presently little can be done to save the stricken civilians**
- ***Attacks on several population centers might produce some 10 million or more casualties***

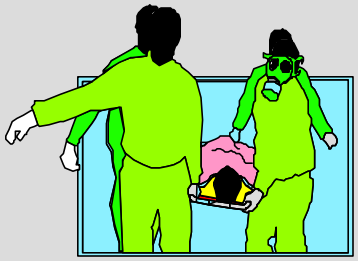

***Per OTA Report to Congress, 1993**

For decades, infiltration of terrorist teams into the U.S.

- From several foreign nations, not just Bin Laden in Afghanistan
- Several thousand Cuban guerillas, from training camps in Southern Mexico
- Russian Spetznaz teams
- Nuclear warheads (up to 80 KT)
- Biological warfare agents
- Yakuza in oriental populations in our cities
  - Yakuza manufactures Russian energetics weapons in their own facilities in Japan
  - Possesses the new EM weapons referred to by Secretary of Defense Cohen in 1997
- We are now in a very long, hard war and will suffer millions of casualties in our cities. It may last for decades.

Defense Secretary Cohen*

(Involvement of secret superweapons)

"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our [counterterrorism] efforts."

* Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

Some typical BW agents

- Smallpox, including different strain developed by Russia (some sold to terrorists)
- Anthrax
  - Over 400 known locations around the Earth have cultures
  - Difficult to decontaminate
- Bubonic Plague
- Botulism toxin
- Tularemia (rabbit fever)
- Hemorrhagic fevers, such as Ebola

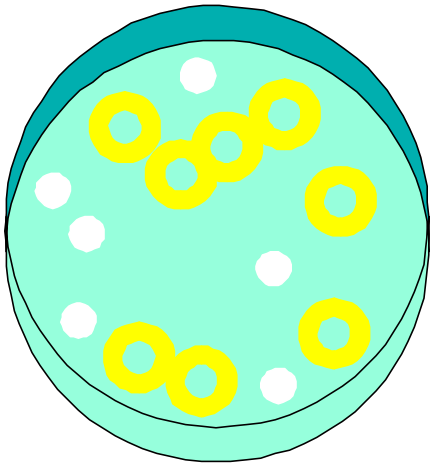

Anthrax

- OTA study: Some 200 pounds released in a spray, on calm night over Washington, D.C. could result in up to 3 million casualties
- Symptoms usually in 2-10 days
  - Sometimes as long as 7 weeks
  - Flu-like symptoms

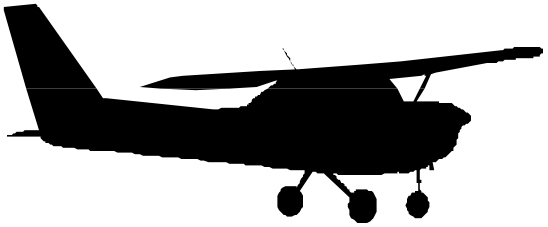

- Then 1-3 days later, shock and breathing problems cause death in up to 100%
- Antibiotics given early (before symptoms) can prevent infected persons from becoming ill
- Limited vaccine, reserved for military

Smallpox

- More than 500 million people killed in the 20th century before "eradicated" in 1977. Vaccination ceased in 1980.
- Russians kept it, developed new strains, sold to terrorists
- Symptoms in about 12 days: fever, headache, nausea. Rash similar to chickenpox then appears.
- Rash turns into hard blisters. *Highly contagious*, kills one-third of its victims.
- No cure. About 12 million doses of vaccine left.
- If smallpox is unleashed in any major city on earth, it will eventually kill 2 billion, or about 1/3 of the human species -- unless a radical new cure is found and utilized.

Bubonic Plague: Historically the most feared (Black Death)

- From 1980-1994, 18,739 cases in 20 countries.
- Symptoms occur in 1-6 days after inhaling the pneumonic form.

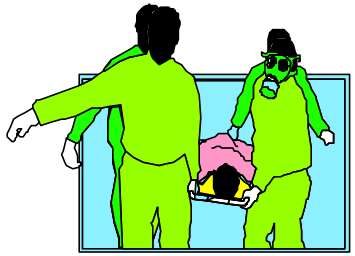

- High fever, cough, labored breathing lead to respiratory failure and death.
- It is contagious.
- Rapid use of antibiotics can be effective.
- Vaccine not currently produced in the U.S.

Botulism toxin (a nerve toxin)

- Single most poisonous BW substance known.
  - Typically borne in food, contacted by eating.
  - Could be developed as aerosol weapon.
- Symptoms in 24-36 hours; blurred vision and difficulty swallowing, speaking.
- Paralyzes muscles, leading to respiratory failure and death.
- Centers for Disease Control and Prevention maintain a botulism antitoxin supply.

Tularemia

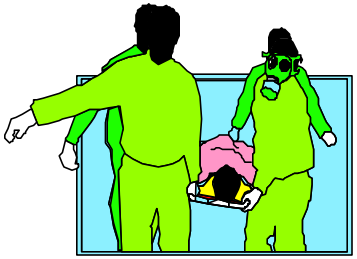

- U.S. studied its weapon potential in 1950s and 1960s.
- Symptoms appear in 3-5 days, including fever, chills, headache, and weakness
- Inflammation and hemorrhaging of the airways can lead to death.
- Without antibiotics, one-third die. Can be 90% if breathed in, in aerosol form.
- Vaccine developed and under review by FDA.

Hemorrhagic fevers, such as Ebola

- E.g., origin of Ebola is unknown. Probably transmitted to humans by animals, to begin a breakout.
- Symptoms in 3-5 days, include fever, aching muscles, diarrhea.
- Hemorrhaging of fluids out of tissues and orifices.
- From 30 to 90 percent die, depending on specific fever type.
- Some of these fevers respond to antiviral drugs.
- The drugs are in short supply.
- Presently *containment* is the primary goal.

A factor the U.S. does not know

(Secret involvement of clandestine superweapons)

- Three nations (not the U.S.) developed quantum potential weapons using Bohm's hidden variable theory of quantum mechanics.
- Can induce disease engines in matter or bodies at a distance.
- Have developed "spreading" of immune systems in a targeted populace (cleverly tested in Gulf War against U.S. troops).
  - Cocktail mix of disease engines for 2 dozen different diseases
  - Targeted area's human immune systems react to these engines when they are still in virtual state, just below quantum threshold.
  - Spread immune system's resources thus "thinned" across response to two dozen shadow diseases at once.
- Hit with a terrorist BW attack, the spread immune systems are overwhelmed much more easily and quickly.
  - Yield (casualties) of the attack is increased by factor of 3-5.
  - Spreading of U.S. immune systems has been accomplished and is still being maintained.

Summary and conclusion

The new war

A new Pearl Harbor: Strike on the World Trade Center in NYC

- The North Tower has already been struck and is burning.
- A second jetliner is about to strike the South Tower.

Fireball From Impact on South Tower

- The two buildings held some 50,000 occupants
- Evacuation was underway after the first strike
- More than 6,000 persons were killed
- This is more than were killed in the Dec. 7, 1941 strike on Pearl Harbor

Collapse of the South Tower

- The first tower to collapse was the South Tower
- It is still uncertain just how many people were caught inside and killed
- This is a half million tons of debris, falling from the New York skyview.

Collapse of the North Tower begins

- The North Tower then collapsed
- This was another half-million tons of debris falling from the NYC skyview

Collapse of North Tower finishes

- Collapse of the North Tower killed many rescue workers, fire-men, and policemen
- At this writing, the total casualties are still unknown

Next began the recovery efforts

- Recovery operations will require months
- At this writing, the total casualties are still unknown
- The damage was done by two civilian jetliner "bombs"

The Pentagon was hit on the same day

- Hundreds were killed the same day when another jetliner struck the Pentagon.
- Yet another jetliner, possibly headed for the White House, crashed enroute when the passengers attacked the suicide terrorist hijackers.

A sobering thought

- Nuclear weapons are already smuggled into the U.S., as are BW agents such as anthrax, smallpox, etc.
- Had a 40-80kT weapon been exploded in New York and one in Washington, millions would have perished and both cities would have been devastated
- There would have been no recovery of those cities for many decades

Present Status of the WMD Threat to the United States

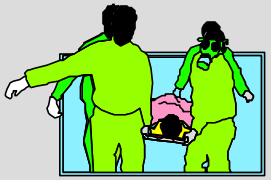

- **Many foreign nations are hostile to the U.S. and sponsor terrorists**
- **Some 25 nations have WMD or are acquiring them**
  - **BW agents and weapons**
  - **Chemical agents and weapons**
  - **Nuclear materials and weapons**
- **Thousands of students and émigrés**
- **Infiltrated teams, BW, other WMD already**
- **Castro guerrillas infiltrated over the years**
- **<u>Can do unacceptable damage to U.S. now</u>**
- ***<u>May reach knockout capability</u>***

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***Per OTA Report to Congress, 1993**

The U.S. is terribly unprepared

- Limited medical supplies, antibiotics, vaccines
- Insufficient facilities, emergency teams
- No civilian shelters (much less BW-filtered)
- Not enough doctors, nurses, masks, etc.
- Present treatment methods woefully inadequate
- Triage will apply
  - First treat those most likely to recover
  - Others (showing symptoms, or advanced) are just set aside to die
- Other attacks are a matter of *when*, not *if*.

Conclusion

- As several cities are struck, millions of U.S. civilian casualties will result. Devastation will be enormous.
- We shall eventually lose more American lives than in all the rest of our wars to date.
- Present medical therapeutic science is totally inadequate to do the job. It cannot save us.

- At some point, when we are sufficiently damaged, the Spetznaz or other terrorists may detonate nuclear weapons in our cities, with appalling carnage.
- A combined superweapon technology and terrorist groups will then destroy the remaining populace.
- On its present course, the inadequacy of Western medicine may doom us.

A difficult truth to consider

- In any strategic strike, the first phase is to get the strategic weapons (weapons of mass destruction) delivered to their distant targets.
- That has already been done.
- Eerily, the first phase of World War III has already been accomplished.
- It was already accomplished before the Sept. 11, 2001 strike on New York and Washington. That was the new "Pearl Harbor", and only the opening round. It already killed more Americans than died at Pearl Harbor on Dec. 7, 1941.
- Unless we improve our medical therapy quickly and dramatically, we will lose -- particularly when the hidden energetics weapons and outside terrorist sponsorship by hostile nations are factored in.

A personal perspective

- There now exists an overwhelming, immediate moral imperative to get this development program done at the utmost speed humanly possible.
- The sheer survival of the United States and Western civilization depends upon it.
- Officialdom is aware that the KGB/Russians have long planned to finish the U.S., after initial nuclear exchanges, by fierce and massive BW strikes.
- It appears that the plan has changed to let the terrorists do the main work, while augmenting U.S. casualty levels by energetics weapons.

China is also involved

- China has declared South China Sea the territorial waters of China
- China will eventually take Taiwan
  - Has massed missile artillery trained on Taiwan
  - Recently held invasion practice on an island near Taiwan
- Recently deployed fearsome EMP weapons utilizing negative energy rather than positive energy (Dirac sea theory)
  - Extinguishes all electron currents
  - Duds electrical and electron systems instantly
  - Instant death to struck bodies
  - Instant kill of missiles, aircraft, electronics in nuclear warheads
  - Ultimate "death ray"; can be made small or large
- Recent 2-carrier U.S. task force maneuvered in South China Sea to caution China
  - The new Chinese EMP weapon was trained on that task force
  - Could have destroyed it within minutes

Final thoughts

???

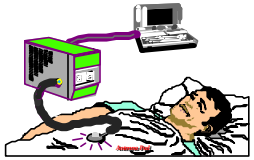

- This is one of the great turning points in history.
- The development program is eminently doable. That it works has been experimentally demonstrated. The long-vexing puzzle of the active mechanism has been solved.
- Our scientific community bitterly opposes any use of electromagnetics -- even an advanced, higher symmetry electrodynamics -- for medical treatment.
- A consortium of the scientific community, the large pharmaceuticals, FDA, and the AMA will oppose this project even while the U.S. is being destroyed wholesale.
- It can only be done in the private sector, and there will likely be no funding unless by philanthropists.

Continuation

Business plan, development program, budget breakdown, proposed schedule etc. go here.

Weapons Slides

The Tom Bearden Website

Help support the research

"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our [counterterrorism] efforts." *

Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

Slides
(covers period up to 1999)

- The Coming Strategic Attack on the United States
- Outline
- Loss of two separate A-10 Warthogs in 1997
- Typical ABM Defenses (Widely Deployed by mid-70s)

- Launch Phase Anti-Missile System
- Launch Phase Anti-Bomber System
- HC-130s Engines Quit, Aircraft Crashes
  Nov. 22, 1996
- 1996 Actions by this analyst
- Additional Information Exists: Not Analyzed, Not Integrated in Briefing
- Kill of Arrow DC-8, Gander AFB, Dec. 12, 1985
- Satellite Photos of Plumes in Soviet Arctic Since 1974
  See "Fer de Lance" for additional information
- Aum Shinrikyo ("Supreme Truth" Cult), Shoko Asahara, Leader

  Aum Shinrikyo - Anatomy of a Dangerous Cult
- Ashkhabad Problem and Its Solution
- Strange Characteristics of Iran Quake, Sep. 1978
- Iran Earthquake, September 1978
- Situation Now (Assessment)
- Situation Now (Assessment 2)
- Aspects of Strong Local Asymmetry
- Mass Casualty Problem: Aerial Anthrax

Spray on Washington, D.C.

- Present Status of the WMD Threat to the United States
- Some Present Problems in the U.S. WMD Defense Capabilities
- Internal Terrorist Threat with Weapons of Mass Destruction: Now & Future
- Attempt to Ban Energetics Weapons Worldwide
- Brezhnev's Schedule
- Large glowing Tesla globe witnessed in Red China by hundreds
- Cold Explosion -- 9 April 1984 Near Kurils, and formation and growth of spherical shell (globe)
  Sequence of Events
- Cold Explosion -- 9 April 1984 Near Kurils, and formation and growth of spherical shell (globe)
  What They Were
- Cold Explosion -- 9 April 1984 Near Kurils (Plus additional weapons effects)
- Countering Insane MAD Systems:
  Find Loophole, Exploit It
- Next Generation Counter to Both Sane and Insane MAD systems
- Simultaneous Dudding of Nuclear Weapons Worldwide

- Simultaneous Dudding of Nuclear Weapons Worldwide
- Operation Divine Wind II
- Advanced EMBW Applications
- EM Biological Warfare (EMBW)
- Microwave Radiation of U.S. Embassy in Moscow
- Pentagon EMI Studies, 1989
- EM Missile Practice (6 slides)
- Subdivisions of Soviet Energetics Program
- Communism's Goal
- Manuilsky's Goal vs. Status Today (Dec. 1996)
- Professor Hellman, German Scientist Released from Work in Soviet Union
- Hemispheres and Globes of Light (4 slides)
- How Could Such Superweapons Ever Be Concealed?
- Soviets Easily Concealed These Superweapons for Four Decades
- Microscope-type, laser-like interferometer for inducing quick α-decay in samples of otherwise longer-lived isotopes
- Longitudinal Wave Interferometry: Endothermic

- Longitudinal Wave Interferometry: Exothermic
- U.S. Air Attack on Libya, April 1986
- Lightning Wall
  circa 1959-1960
- Lisitsyn's Report: Brain Code Broken
- Large Longitudinal Wave Interferometer (LWI) Accident
- Large Longitudinal Wave Interferometer (LWI) Accident
- Use of Hidden Information Content of the Field Can Provide Action-At-A-Distance
- Two Types of Mutual Assured Destruction (MAD) System
- Psychoenergetics Weapons Teams Mentally Disable All Personnel
- Strikes Against Special Ship and Energetics Weapons Sites
- "Mindsnapper" Attack on Special Ships and Energetics Weapons Sites
- How Much Off Guard Are We?
  (7 Slides)
- Possible Targets: 1995-9 Escalation Phase
- Propagation of Weapon Effects
- Yugoslav Earthquake, Followed by Cold Explosion
  April 15th, 1979

- Countering an Insane QP Weapon
- Gulf War Disease: KGB QP Weapon Induced ST Curvature Engines for a Cocktail of Diseases
- Self-Targeting in Inner EM Channel Can Produce a Quantum Potential
- Mechanism for Producing a Quantum Potential
- Major Principles for Use of Quantum Potential Weapons
- Major Principles for Use of Quantum Potential Weapons (2)
- Instantaneous Communication by a Quantum Potential
- Participants in a quantum potential share a common multiply-connected spacetime (MCST)
- Quake in Tangshan, China
  28 July, 1976
- Exchanging Earthquakes
- Instant Communication by a Quantum Potential
- Westerners Do Not React to Slow Threats
- Characterizing a Given Risk or Risk Factor
- Technical Risk Management
- Aum Shinrikyo's Sarin Facility

- In Scalar Beam Interference Zone
- Physicist Schappeller Auralaz Munster, Austria
- Initial Soviet Plan for Cold War, After WWII
- Josef Stalin: Absolute Dictator
- Exploding any Resistance by Operational Scientists
- Significant Soviet Statements
- Captain Svoboda Dives Headlong to Her Death
- T-polarized Beam Projector
- Possible Tests (1)
- Possible Tests (2)
- Possible Tests (3)
- Possible Tests (4)
- Mushroom Cloud Rising From Sea
- Launches from Cape Canaveral and Vandenberg AFB Provided Practice Targets of Opportunity
- The sinking U.S.S. Thresher, with her controls jammed, implodes when she reaches crush depth
- Embodiment of an instrument array sufficient to discriminate when time-density charging has occurred, and that transduction

of time-charge decay has occurred.

- Time-Polarized EM Wave Interferometer Creating Space-Time Curvature Engines in a Distant Interference Zone
- Transmutation of Radioactive Nuclei at a Distance
- Transmutation of Radioactive Nuclei
- Typical Tesla Shield, Northern Route of Japan
- A Curious Tide in Human Affairs
- Large Scalar EM Interferometer (LASI) Accident Near Urals, 1958
- The Superpower Paradox: Asymmetric Cheap WMD Strategic Strike and Destruction
- The KGB/Yakuza-Aum War Plan
- Why Western Science is Ignorant of KGB Energetics
- Transmutation of Radioactive Nuclei at a Distance
- TheYakuza
- Yugoslav Earthquake, Followed by Cold Explosion
  April 15, 1979

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* Note that the Secretary did not speak the words in square blocks; these were added by the writers later,

probably to "soften the tone" of the Secretary's information release. So the Secretary confirmed that some nations of the world -- not just some ragged terrorists, as the writers tried to imply for spin control -- do possess novel electromagnetic weapons and are using them to induce earthquakes, engineer the weather and climate, and trigger volcanic eruptions.

THE COMING STRATEGIC ATTACK ON THE UNITED STATES

By an AUM/Yakuza/KGB/Communist Coalition Using Energetics SuperWeapons

T.E. Bearden, LTC
U.S. Army (Retired)
M.S. Nuclear Eng.
Fellow Emeritus, AIAS

With Technical Background and History of Energetics Weapons

Partial support by the Association of Distinguished American Scientists is gratefully acknowledged.d

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Outline

- Background: Classical Electromagnetics (and Defects)
- Background: Energetics (Scalar Electromagnetics)
- Background: Soviet Energetics Weapon Development
- KGB/Communist Plans
- Countering of Soviet/KGB/Communist Plan in Mid-80s
- Soviet Economic Collapse and Adaptation of Plan
- Weapons Bleed-Out: KGB/Russian Mafia
- Yakuza: The Japanese Mafia
- Aum Shinri Kyo (Supreme Truth) Cult
- Coalition: Aum/Yakuza/KGB/Communists/Russian Mafia
- Operation Divine Wind II: Three Phases
  - Phase I: On-Site Training Phase (Completed)
  - Phase II: Escalation Phase (In Progress)
  - Phase III: 1997 Strategic Strike on the United States
  - Support Plan A: Feints, Deception, Sabotage & Terrorism
  - Support Plan B: Test Range
  - Support Plan C: Worldwide Weather Engineering
  - Support Plan D: Strategic and Combat Intelligence
- Special Information
- Recommended Actions

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The Tom Bearden Website

Help support the research

Loss of two separate A-10 Warthogs in 1997

- A-10 Mysterious Flyaway and Crash - April 2, 1997
- Death of Second A-10 Pilot - May 27, 1997
- Captain Button's Mysterious Flyaway and Eventual Crash
- Death of Second A-10 Pilot - May 27, 1997

A-10 Mysterious Flyaway and Crash

April 2, 1997

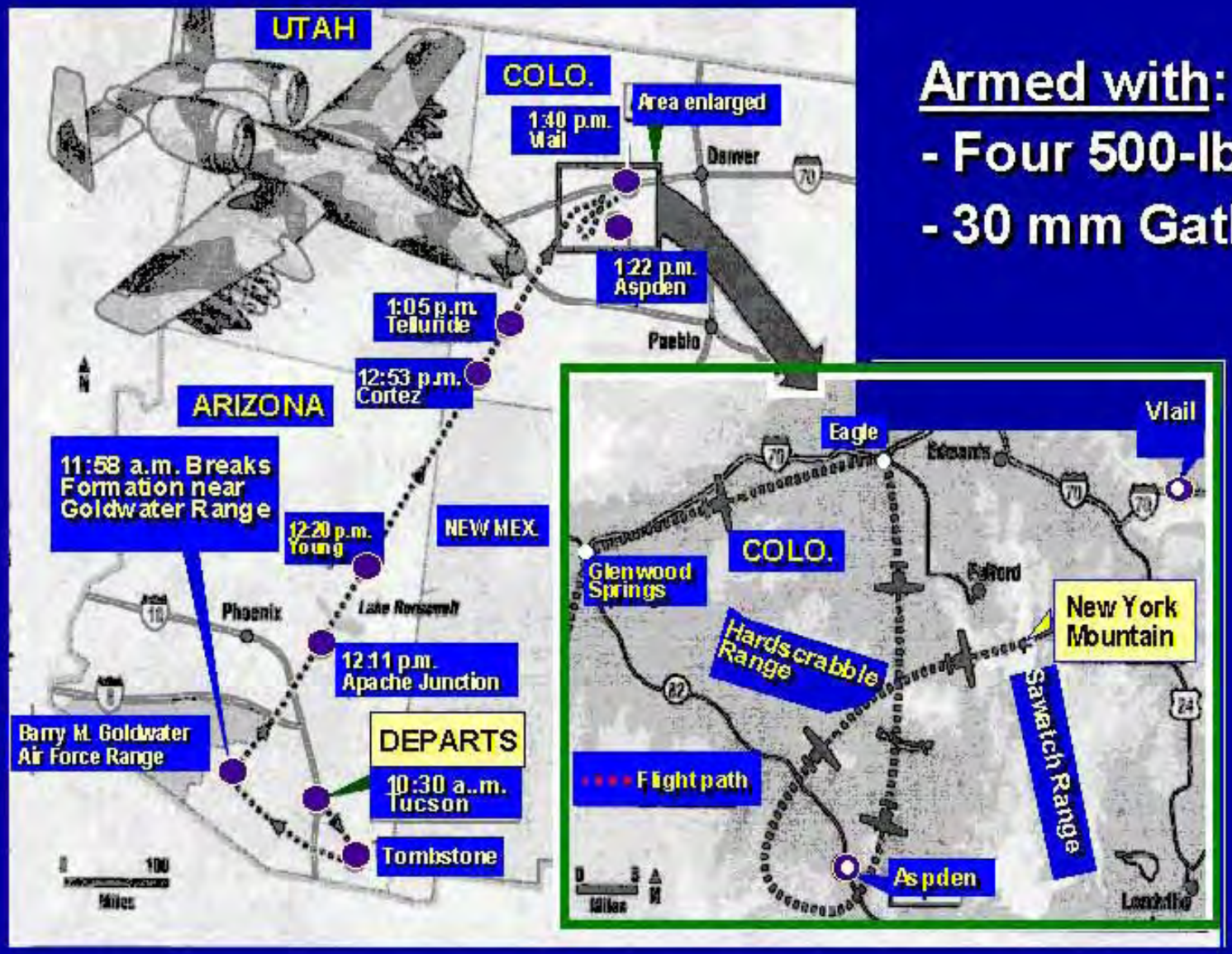

Armed with:

- Four 500-lb bombs
- 30 mm Gatling gun

Death of 2nd A-10 Pilot May 27, 1997

- Captain Amy Svobody
- Night training mission
- From Davis-Montham AFB
- From same wing as Captain Button, who flew his A-10 off course for over an hour and then crashed on April 2.
- Climbout from ordnance delivery on target
- Nosed down sharply and dived into ground

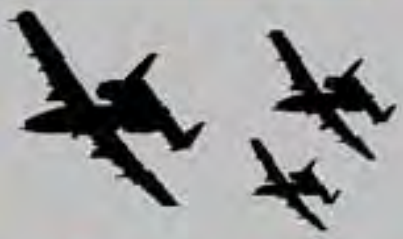

Companion A-10's

- Experienced night flyer & instructor
- Nosed sharply over and flew into ground
- Psychoenergetic kill

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Psychoenergetic weapon induced instant hypnogogic state and reversed Svoboda's sense of up and down.

A-10 Mysterious Flyaway and Crash

April 2, 1997

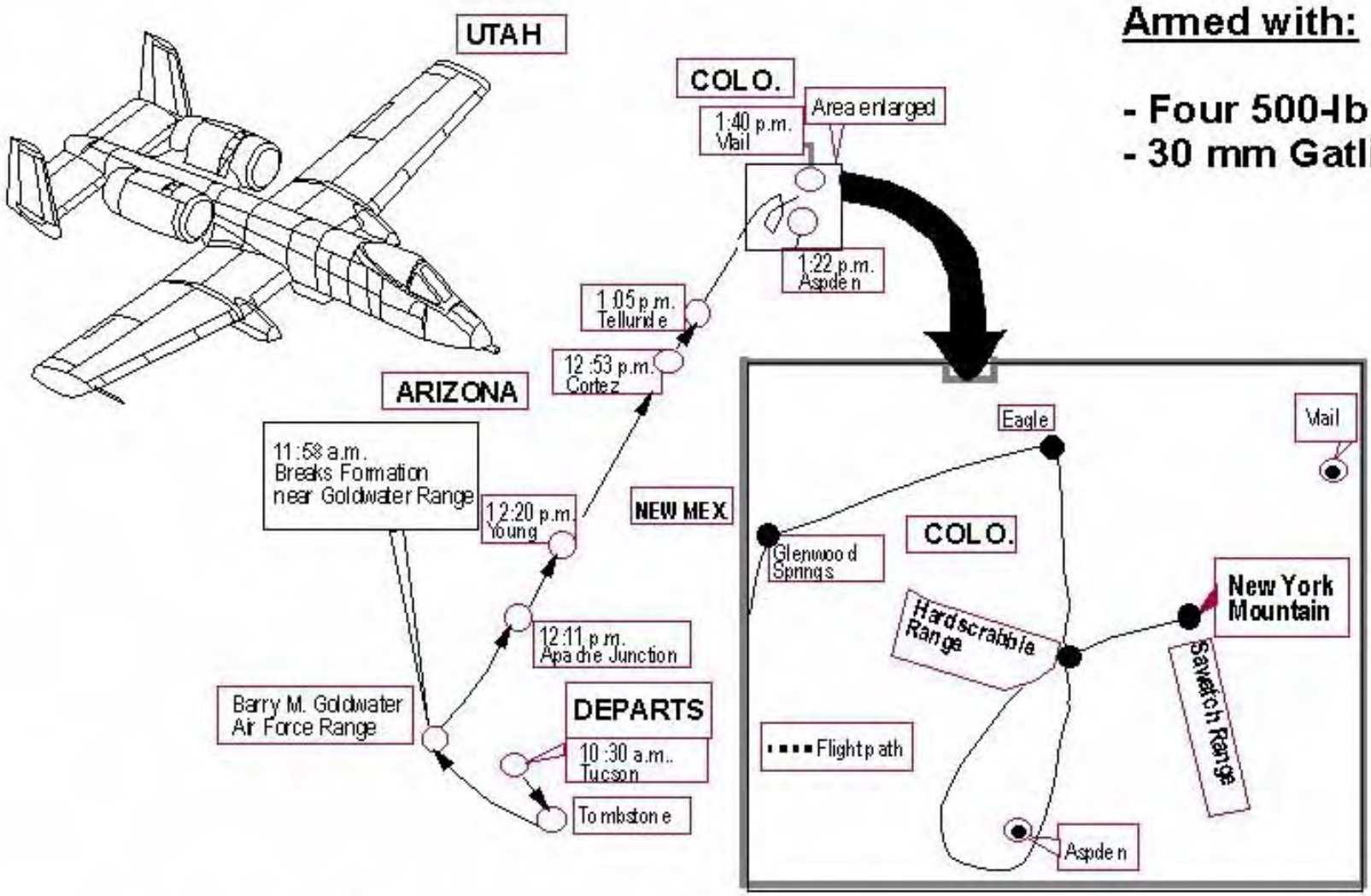

Armed with:

- Four 500-lb bombs
- 30 mm Gatling gun

Figure 14a. Captain Button's mysterious flyaway and eventual crash.

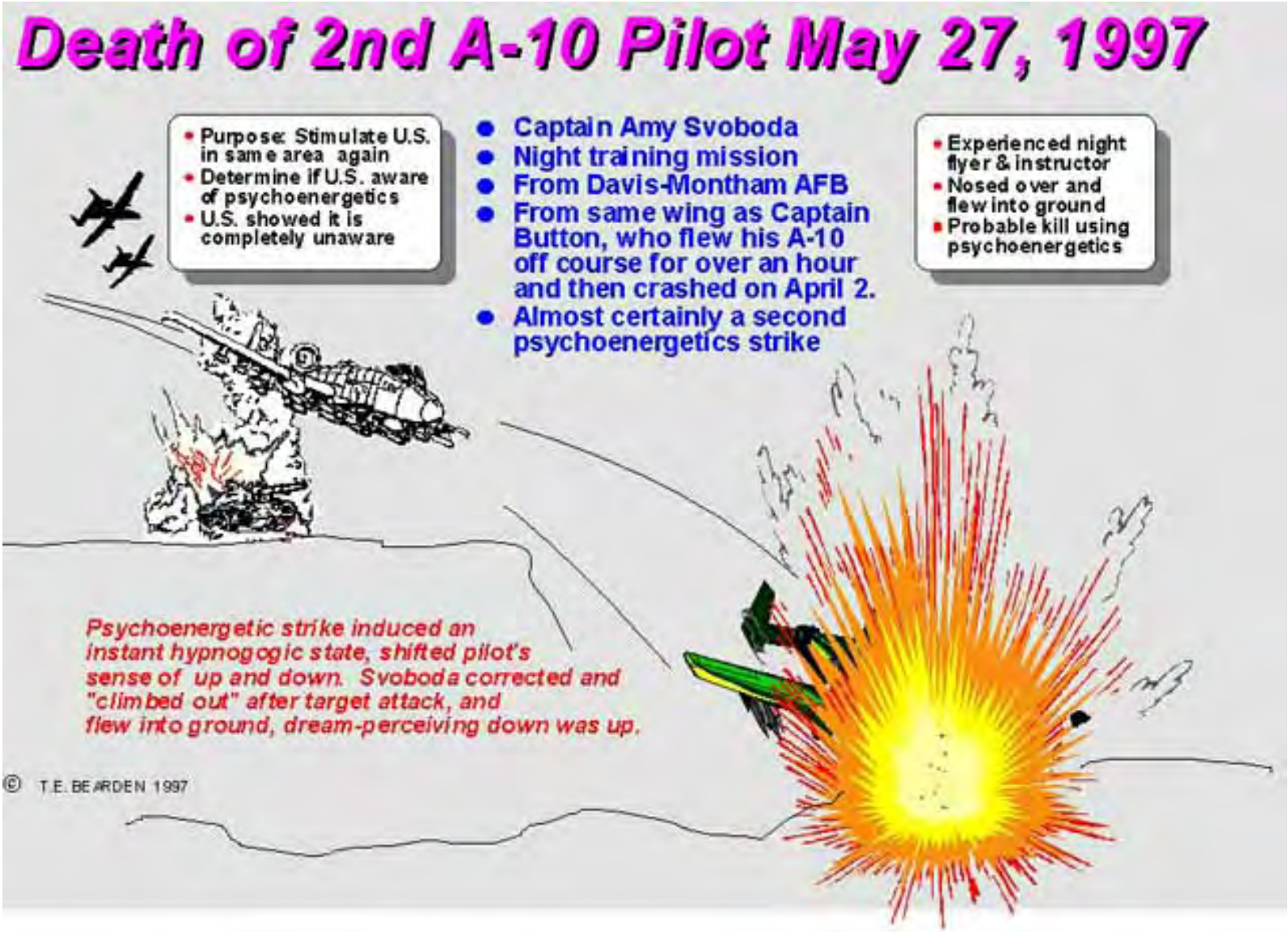
Death of 2nd A-10 Pilot May 27, 1997
• Purpose: Stimulate U.S. in same area again
• Determine if U.S. aware of psychoenergetics
• U.S. showed it is completely unaware
• Captain Amy Svoboda
• Night training mission
• From Davis-Montham AFB
• From same wing as Captain Button, who flew his A-10 off course for over an hour and then crashed on April 2.
• Almost certainly a second psychoenergetics strike
• Experienced night flyer & instructor
• Nosed over and flew into ground
• Probable kill using psychoenergetics
Psychoenergetic strike induced an instant hypnogogic state, shifted pilot's sense of up and down. Svoboda corrected and "climbed out" after target attack, and flew into ground, dream-perceiving down was up.
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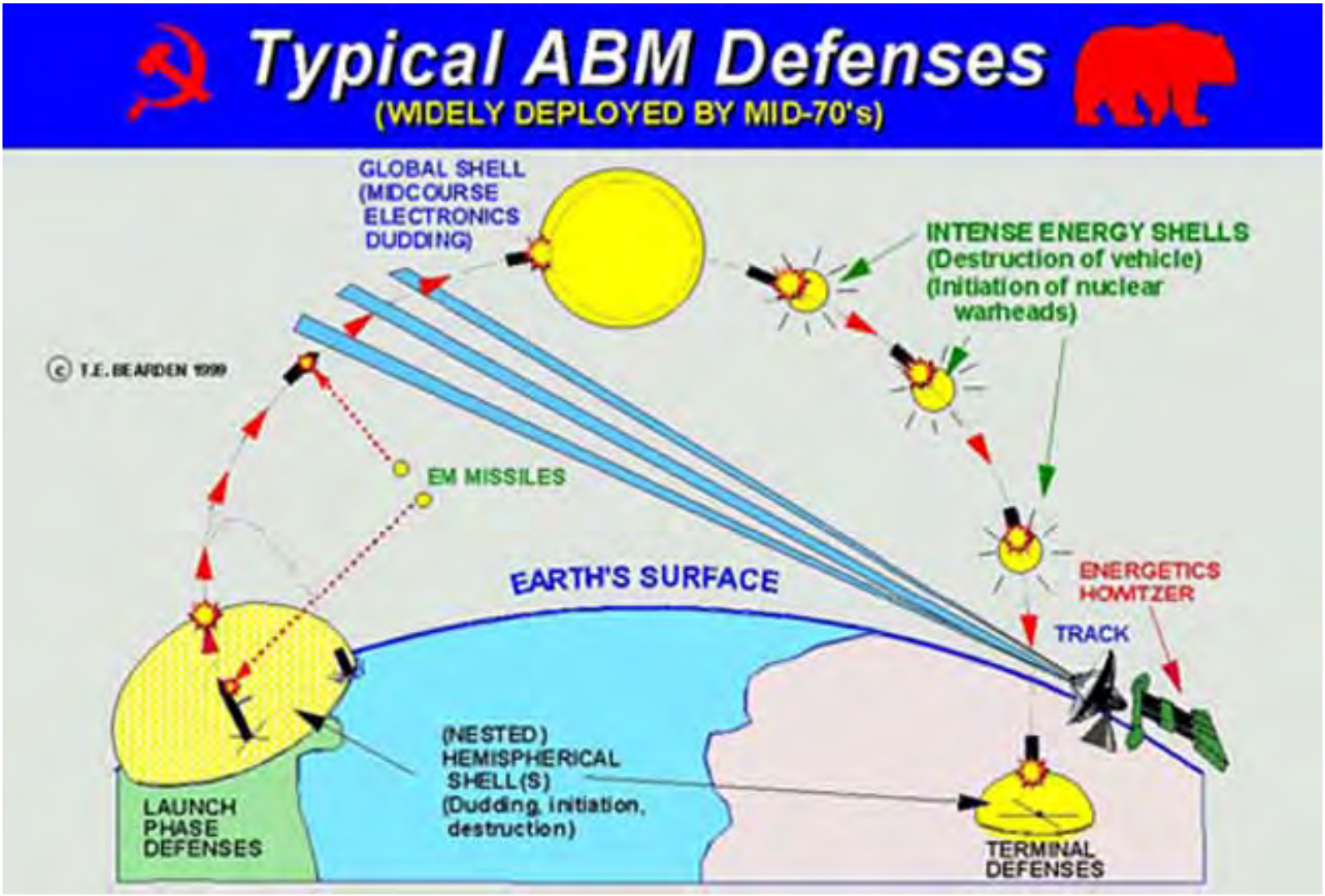
Typical ABM Defenses
(WIDELY DEPLOYED BY MID-70's)
GLOBAL SHELL
(MIDCOURSE
ELECTRONICS
DUDDING)
INTENSE ENERGY SHELLS
(Destruction of vehicle)
(Initiation of nuclear
warheads)
© T.E. BEARDEN 1999
EM MISSILES
EARTH'S SURFACE
ENERGETICS
HOWITZER
TRACK
(NESTED)
HEMISPHERICAL
SHELL(S)
(Dudding, initiation,
destruction)
LAUNCH
PHASE
DEFENSES
TERMINAL
DEFENSES

LAUNCH PHASE ANTIMISSILE SYSTEM

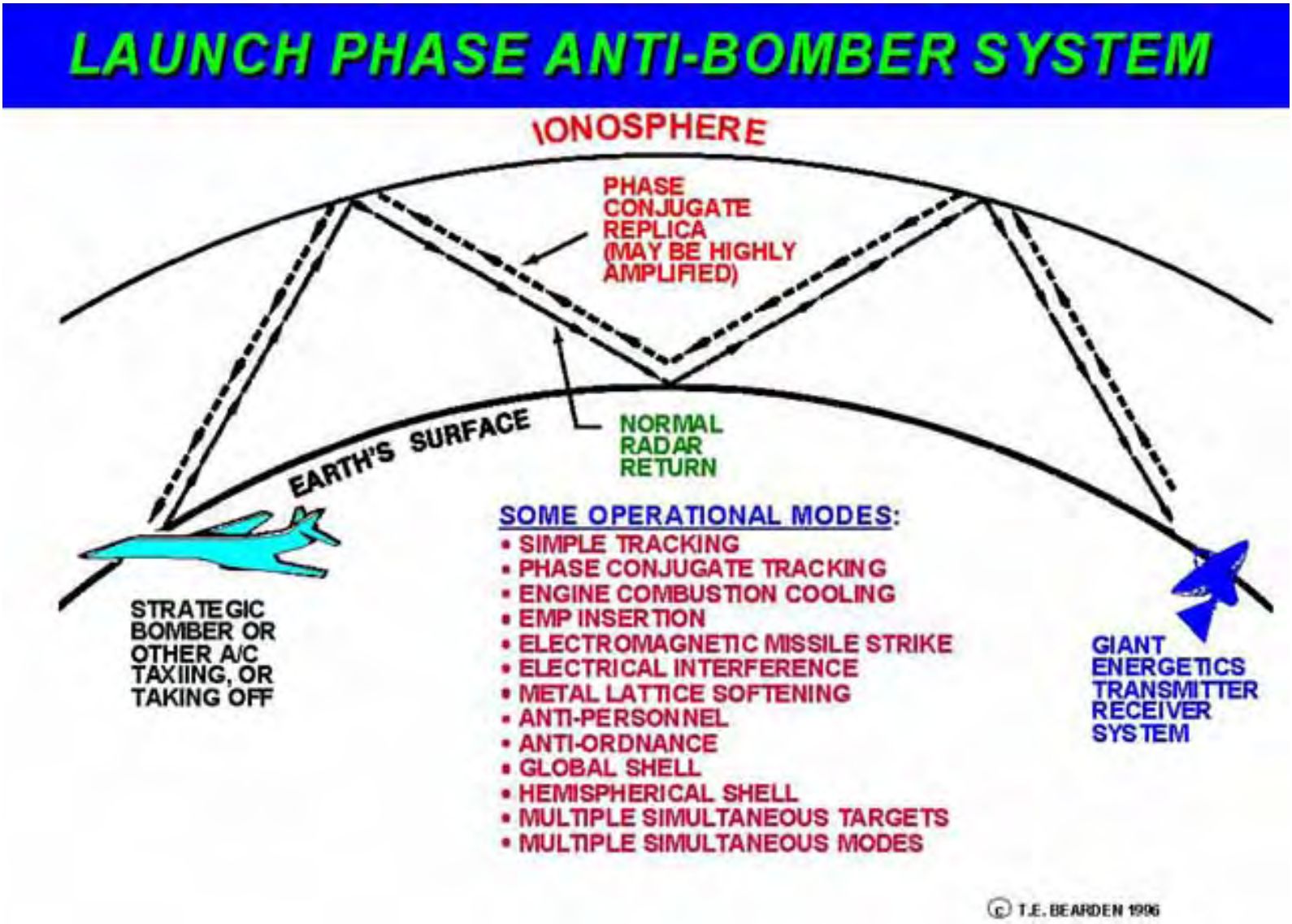
LAUNCH PHASE ANTI-BOMBER SYSTEM
IONOSPHERE
PHASE CONJUGATE REPLICA (MAY BE HIGHLY AMPLIFIED)
NORMAL RADAR RETURN
EARTH'S SURFACE
STRATEGIC BOMBER OR OTHER A/C TAXIING, OR TAKING OFF
SOME OPERATIONAL MODES:
• SIMPLE TRACKING
• PHASE CONJUGATE TRACKING
• ENGINE COMBUSTION COOLING
• EMP INSERTION
• ELECTROMAGNETIC MISSILE STRIKE
• ELECTRICAL INTERFERENCE
• METAL LATTICE SOFTENING
• ANTI-PERSONNEL
• ANTI-ORDNANCE
• GLOBAL SHELL
• HEMISPHERICAL SHELL
• MULTIPLE SIMULTANEOUS TARGETS
• MULTIPLE SIMULTANEOUS MODES
GIANT ENERGETICS TRANSMITTER RECEIVER SYSTEM
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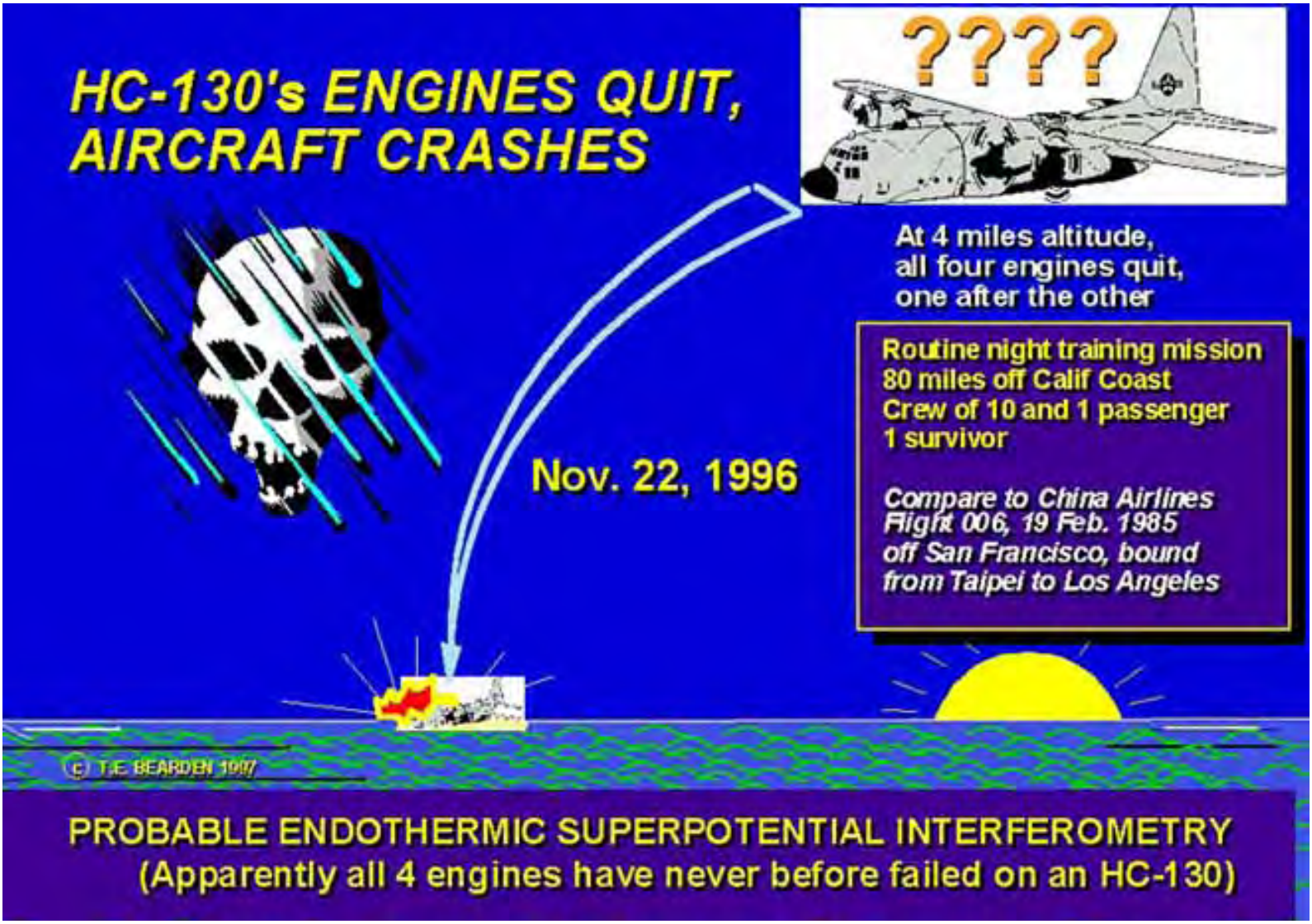
HC-130's ENGINES QUIT, AIRCRAFT CRASHES
????
At 4 miles altitude, all four engines quit, one after the other
Routine night training mission
80 miles off Calif Coast
Crew of 10 and 1 passenger
1 survivor
Compare to China Airlines Flight 006, 19 Feb. 1985 off San Francisco, bound from Taipei to Los Angeles
Nov. 22, 1996
© T.E. BEARDEN 1997
PROBABLE ENDOTHERMIC SUPERPOTENTIAL INTERFEROMETRY
(Apparently all 4 engines have never before failed on an HC-130)

CTEC PROPRIETARY

1996 Actions by this analyst

- In July 1996, with the kill of TWA-800 it became apparent that the KGB/Communists were preparing a massive strategic energetics attack upon the U.S.

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- Began intensive, nearly round-the-clock effort to uncover what was happening, and what had occurred in KGB/Com weapons since 1991
- Began preparing full-up set of briefing slides simultaneously
  - In early 1996, had briefed J6 on scalar EM, per his request
  - Had strongly suggested a follow-on weapons brief
  - Adamant opposition by NRL, NOL, others
- Similar energetics attack scenario in 1986 was countered. Soviets at that time did not possess operational QP weapons, and so could not successfully overcome dead-man fuzing
  - Also could not dud nukes worldwide, because QP required.
  - First lab prototype QP test was in April 1986
- KGB had solved the dead-man fuzing problem by QP's. Deployed circa 1989-1990. Some earlier weapons then leased.

Additional Information Exists; Not Analyzed, Not Integrated in Briefing

- Yakuza arranged involvement of
  - Red Chinese
  - North Koreans
  - A Taiwanese element
- Aum Shinrikyo may have been used as "Red Herring" to deceive West
- Oriental faction plots to strike Russians after the successful first strike on West
- KGB/Russians aware, will counter
  - Plan pre-emptive strike against Oriental faction first
  - Have reserved most advanced, powerful energetics weapons for that purpose

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The Tom Bearden Website

Help support the research

Kill of Arrow DC-8, Gander AFB, Dec. 12, 1985

- Slide 1
- Slide 2
- Slide 3
- Slide 4
- Slide 5
- Slide 6

KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Soviet EM missile weapon strike practice two weeks earlier at Cape Canaveral
► Offset from night shuttle launch
► EM missile photographed by Bob Gladwin
► Associated marker beacon photographed
• Canadian Board split on findings
► Half thought icing, half disagreed intensely
► "Due to icing" approved with half absent
► Separate dissenting finding issued
• U.S. officials hiding Iran/Contra affair
► Feared terrorist bomb, MidEast sponsor
► Pressured Board, Gen. Off. bulldozed site
• Lack of icing on aircraft later validated

KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Eyewitness observed beams form in the sky
• Saw streak-down and strike of EM missile
– Struck right fuselage ahead of the engines
– Hole was burned through fuselage there
– Photo of hole published in AW&ST
– No explosive residues on hole
• Consistent with ignition and outgassing of plastics in forward cabin
• Consistent with pre-crash HCN deaths

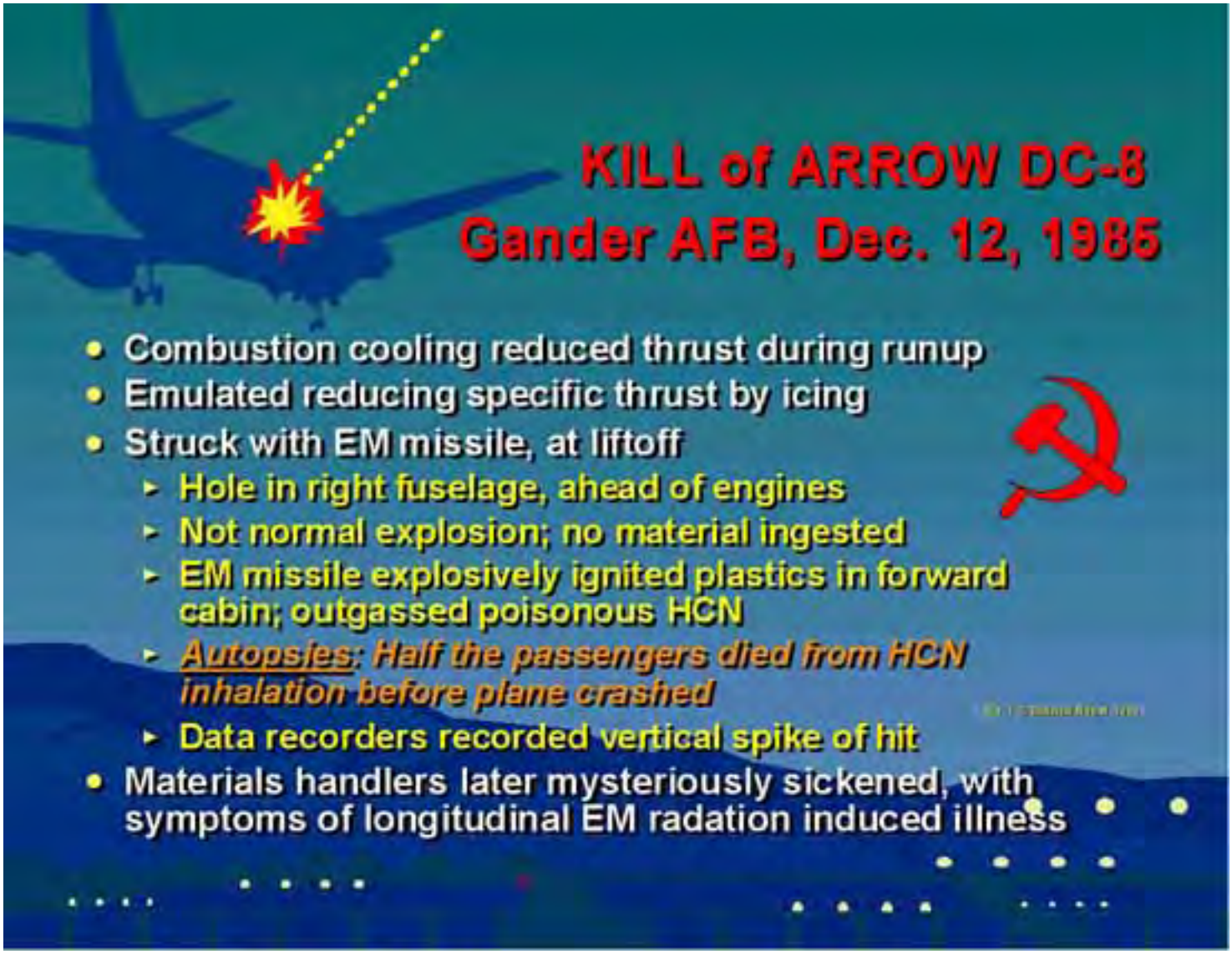
KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Combustion cooling reduced thrust during runup
• Emulated reducing specific thrust by icing
• Struck with EM missile, at liftoff
▸ Hole in right fuselage, ahead of engines
▸ Not normal explosion; no material ingested
▸ EM missile explosively ignited plastics in forward cabin; outgassed poisonous HCN
▸ Autopsies: Half the passengers died from HCN inhalation before plane crashed
▸ Data recorders recorded vertical spike of hit
• Materials handlers later mysteriously sickened, with symptoms of longitudinal EM radation induced illness

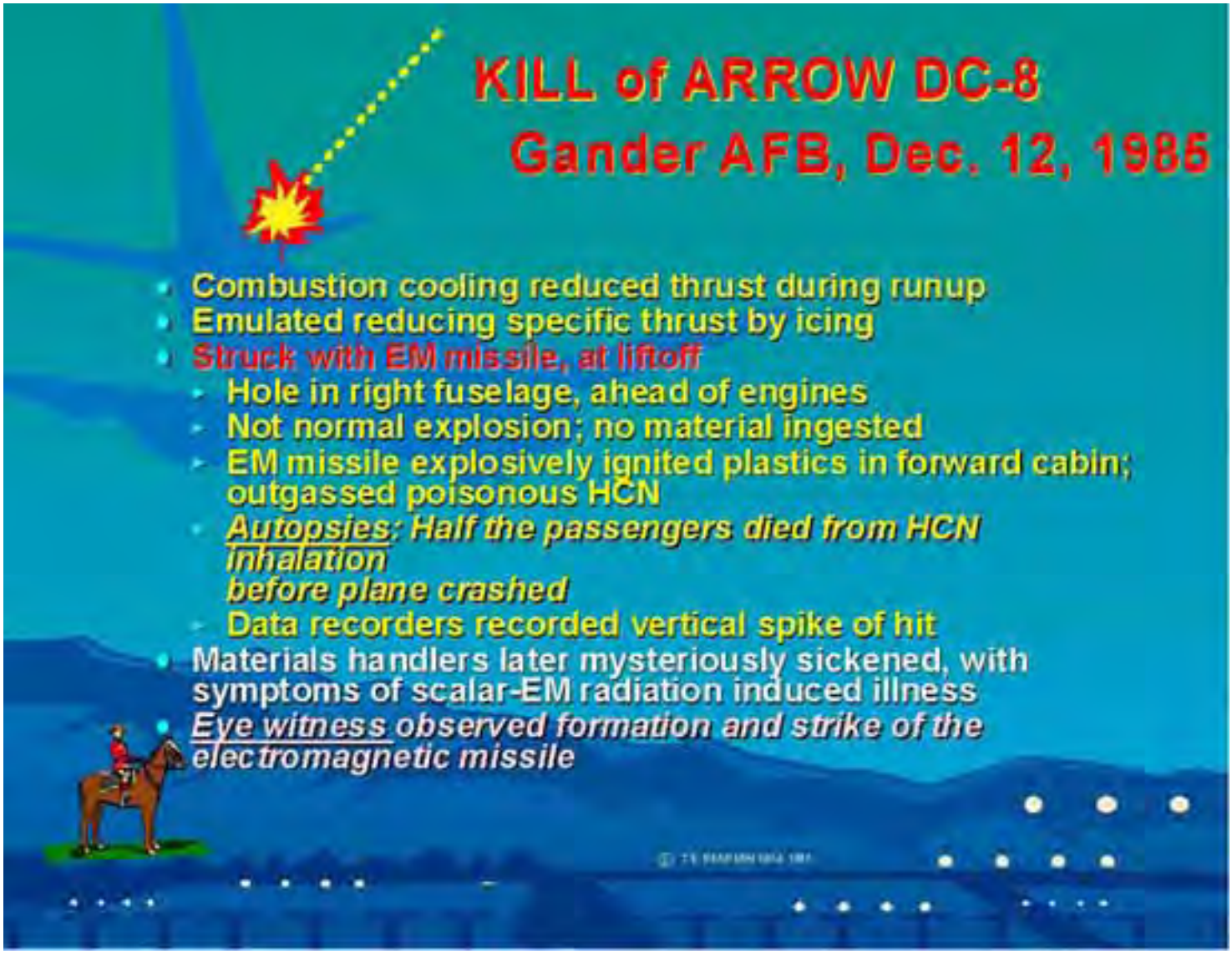
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before plane crashed
Data recorders recorded vertical spike of hit
Materials handlers later mysteriously sickened, with symptoms of scalar-EM radiation induced illness
Eye witness observed formation and strike of the electromagnetic missile

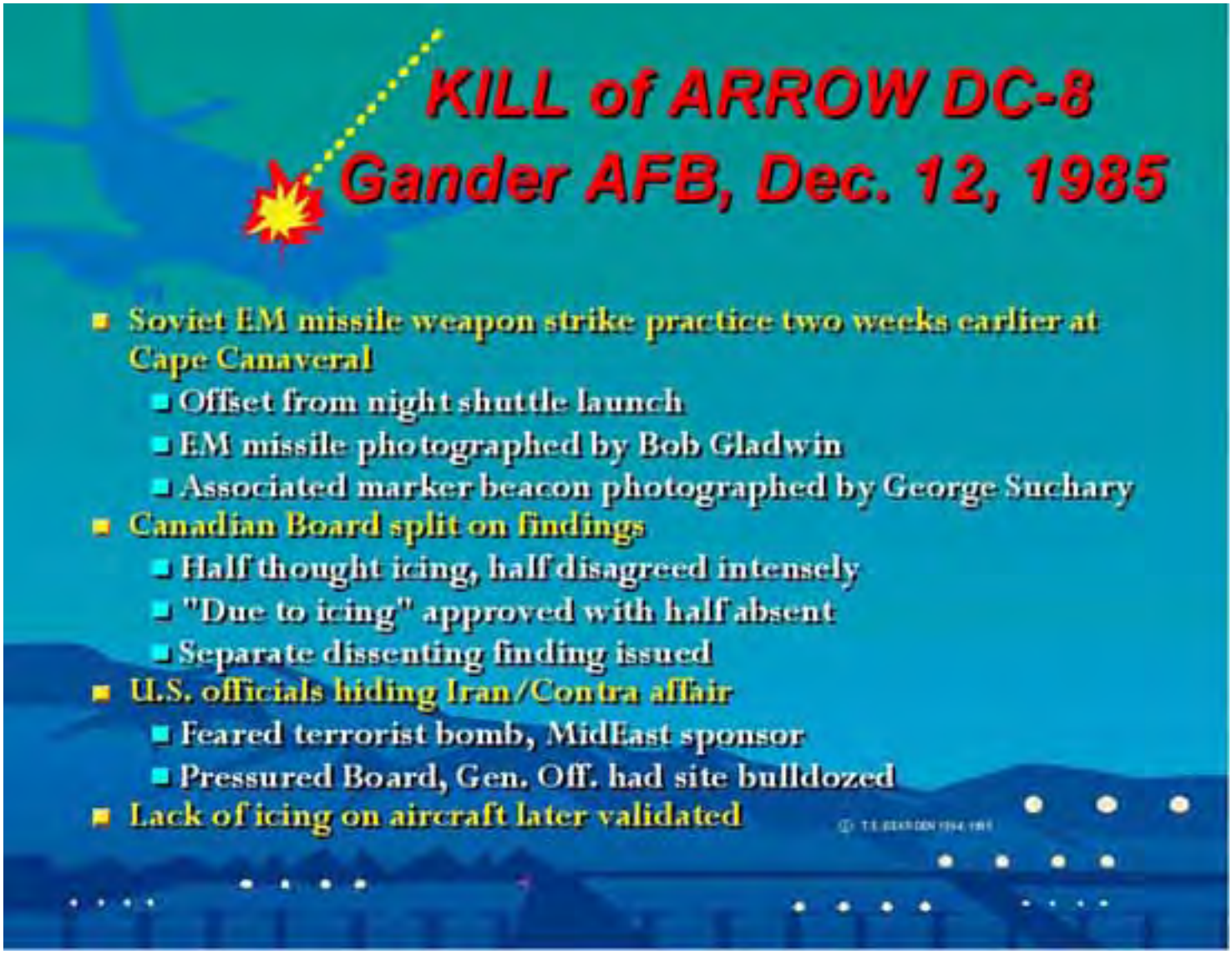
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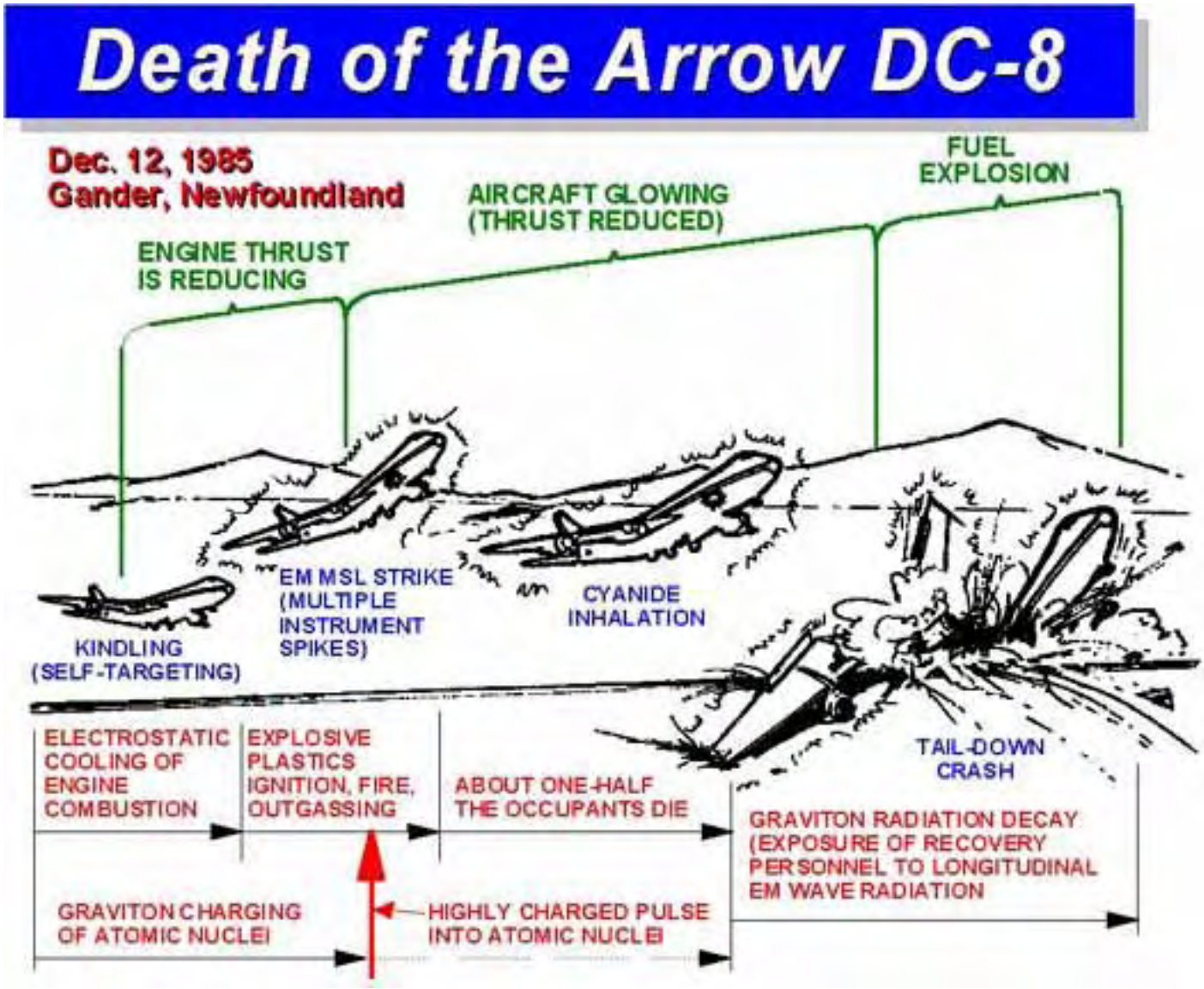
Death of the Arrow DC-8
Dec. 12, 1985
Gander, Newfoundland
ENGINE THRUST IS REDUCING
AIRCRAFT GLOWING (THRUST REDUCED)
FUEL EXPLOSION
KINDLING (SELF-TARGETING)
EM MSL STRIKE (MULTIPLE INSTRUMENT SPIKES)
CYANIDE INHALATION
TAIL-DOWN CRASH
ELECTROSTATIC COOLING OF ENGINE COMBUSTION
EXPLOSIVE PLASTICS IGNITION, FIRE, OUTGASSING
ABOUT ONE-HALF THE OCCUPANTS DIE
GRAVITON RADIATION DECAY (EXPOSURE OF RECOVERY PERSONNEL TO LONGITUDINAL EM WAVE RADIATION
GRAVITON CHARGING OF ATOMIC NUCLEI
HIGHLY CHARGED PULSE INTO ATOMIC NUCLEI

Satellite Photos of Plumes in Soviet Arctic Since 1974*

- Two aircraft flew through for analysis
  - Solid material, mostly ice, a little clay
  - Much colder than surrounding air
  - *Signature of cold exhaust from exothermic scalar interferometry operations*
  - No volcanic material
  - No radioactive material

- May be 2 to 3 times as many incidents
  - Only examined satellite imagery in winter
  - Only periodic satellite coverage
  - Hypothesized methane venting, cloud seeding

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*As of 1989, when this information was gathered

AUM SHINRIKYO
("SUPREME TRUTH" CULT)

Shoko Asahara, Leader

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Ashkhabad Problem and Its Solution

- ***PROBLEM:***
  - Stress increasing in two-plate fault zone
  - 1,000 shocks yearly
  - Kara Kum canal
  - Hydraulic pressure
  - 1948: Ashkhabad 80% destroyed by quake

- ***SOLUTION:***
  - Stress-relieve plate stresses from fault

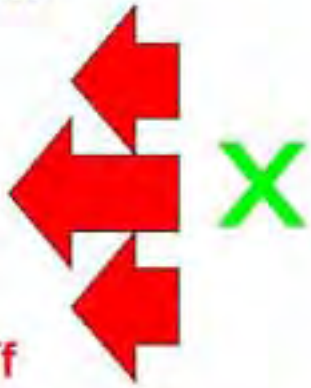

- ***IMPLEMENTATION:***
  - Induce nearby earthquake
  - Deceive by *predicting* a quake, setting off nuclear explosion

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Strange Characteristics of Iran Quake, Sep. 1978

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- **Signatures**
  - 7.4 on Richter scale
  - No aftershocks: 6.0 expected (normal)
  - Strange epicenter
  - Anomalous depth

- **Deception**
  - 10 MT Soviet nuclear explosion 36 hours before the quake
  - Prior disinformation regarding Soviet attempted development of focusing shock waves from underground nuclear explosions, to cause distant earthquakes

Iran Earthquake Sept. 1978

- Killed 25,000 Iranians
- Soviet city of Ashkhabad saved
- Soviets "predicted" quake in advance; then induced it
- Quake had serious anomalies (signatures)
- Deception measures were used by Soviets
  - Prediction in advance
  - "Theory" of quake-induction by nuclear explosions
  - Fired underground nuclear explosion as "Red Herring" candidate for cause

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Situation Now (Assessment)

- In May 1997: second A-10 pilot (lady), in pullup from night ordnance delivery on target, was struck with psychoenergetic weapon takeover. Sense of vertical was reversed. She perceived herself diving, sharply corrected, and dove headlong into the ground.

- Additional aircraft kills uncovered, including one 4-engine aircraft whose engines all failed. This closely repeats the earlier 1985-1987 scenario.
- Korean Airlines Flight 801 crashed on Guam on anniversary of loading of the atomic bomb that was dropped on Hiroshima in WW II. The Enola Gay, which dropped the bomb, took off from Guam in wee morning hours of August 6, 1945. The local opns order on Guam was also issued on Aug. 5.

- *Presently the Coalition (KGB/Communists/Aum Shinrikyo/Yakuza) is waiting for proper time to launch the final strike. It is still on.*

Situation Now (Assessment 2)

- April 97: Mind control test against Captain Button:
  - Demonstrates ability to control crewman in complex operations for more than one hour.
  - KGB requires one hour total QP crew control on a site to have crew disable insane QP wpns.
- Once QP systems disabled, Mindsnapper attacks and instantly kills every living thing in QP site area. Contaminates area for months (emits longitudinal EM wave radiation, which disrupt any life forms attempting to enter struck area). Sites nullified.
- Mind control over one crewman requires one weapon system plus up to 20-30 operators for controlling thoughts, hearing, perceptions, etc.
- *In Apr. 97, KGB building and deploying weapons and training crews. Ready for new attack 1999-2000.*

Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum
- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another

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Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.

- One terrorist, one light aircraft with spray tank
- One kilogram of anthrax
- Flies over greater metropolitan Washington, D.C.
- Calm night
- *1-3 million casualties result**
- *Most of those stricken will die*
- Presently little can be done to save the stricken civilians
- *Attacks on several population centers might produce some 10 million or more casualties*

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*Per OTA Report to Congress, 1993

Present Status of the WMD Threat to the United States

- Many foreign nations are hostile to the U.S. and sponsor terrorists
- Some 25 nations have WMD or are acquiring them
  - BW agents and weapons
  - Chemical agents and weapons
  - Nuclear materials and weapons
- Thousands of students and émigrés
- Infiltrated teams, BW, other WMD already
- Castro guerrillas infiltrated over the years
- Can do unacceptable damage to U.S. now
- *May reach first strike knockout capability*

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*Per OTA Report to Congress, 1993

Some Present Problems in the U.S. WMD Defense Capabilities

- No shelters (require overpressure, BW filtering, masks, showers, supplies)
- No stockpiled vaccines, medical supplies, immunoglobulins, masks, suits, food, fuel, generators, heaters, water purification units
- Totally insufficient medical facilities, personnel, and emergency response teams
- Triage, full martial law will be required
- No answer to massive decontamination problem
- State, county, city inadequately staffed and insufficiently trained for mass casualties
- Terrorist teams, BW agents, other WMD on site, waiting
- Water supplies, food, crops, farm animals also vulnerable
- Electric power grid, bridges, trains, railroads vulnerable
- Present medical science cannot save very many of the casualties, now or in the foreseeable future

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Internal Terrorist Threat with Weapons of Mass Destruction: Now & Future

TODAY:

- Sabotage
- Chemicals
- Biological agents
- Nuclear materials
- Powerful explosives
- Assassination
- Kidnapping and hostages
- Contamination
- Shoulder-fired AD missiles
- Terrorism

FUTURE ADDITIONS:

- Orthodox EM weapons
- Energetics EM biological warfare
- Scalar EM (energetics) weapons
- Scalar EM disease induction
- Alteration of behavior and emotions
- Alteration of memory
- Direct control of thoughts, perception
- Quantum potential weapons
- Psychoenergetics weapons
- Action-at-a-distance effects

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Attempt to Ban Energetics Weapons Worldwide

- On June 13, 1975, in a major speech Brezhnev urged the United States to agree on a ban of research and development of new kinds of weapons "more terrible than anything the world has known."
- On July 2, 1975 Brezhnev repeated his proposed ban on development of frightful new weapons, to a group of U.S. Senators.
- In August 1975, Ponomarev called for a ban on frightful new weapons of mass destruction.
- On Sept. 23, 1975 Gromyko presented a draft treaty agreement to the 30th Session of the UN General Assembly, for banning development of frightful new weapons.
- *No one had the foggiest notion what the Russians were talking about!*

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Brezhnev's Schedule

"We are achieving with detente what our predecessors have been unable to achieve with the mailed fist...
...by 1985 our power will be so irresistible that we can do what we wish anywhere on the globe."

Leonid Brezhnev,
in a secret 1973 meeting in Prague
with European Communist leaders.

"By the early 1980's we and our allies will control the high seas, space, and most of the earth's land area."

Kosygin,
to Imelda Marcos,
July 1978

In 1985-87, the Soviets did attempt to move, still constrained by nuclear dead man fuzing. That attempt was blocked, primarily by scalar EM countering demonstrations and dead man fuzing.

In April 1986, the first Soviet lab prototype of a quantum potential weapon specifically designed toward 10-min neutralization of nukes worldwide was gingerly tested against our U.S. airstrike on Libya. It was weakly tested in the "induced EMI" mode, for deception.

By 1990 that weapon was deployed and a new attack preparation phase was entered, scheduled for 1997.

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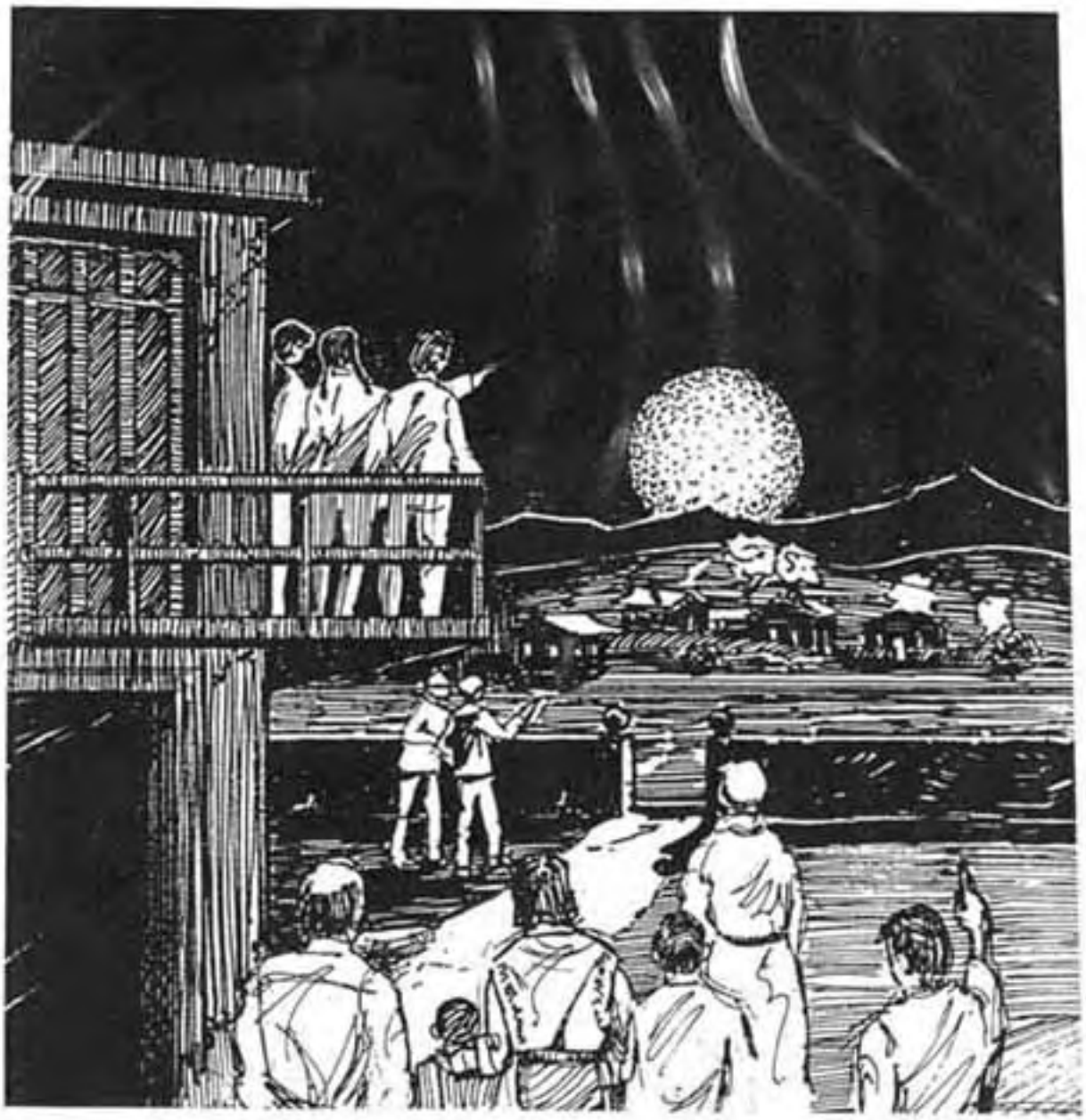

COLD EXPLOSION -- 9 April 1984 Near Kurils

And Formation and growth of spherical shell (globe)

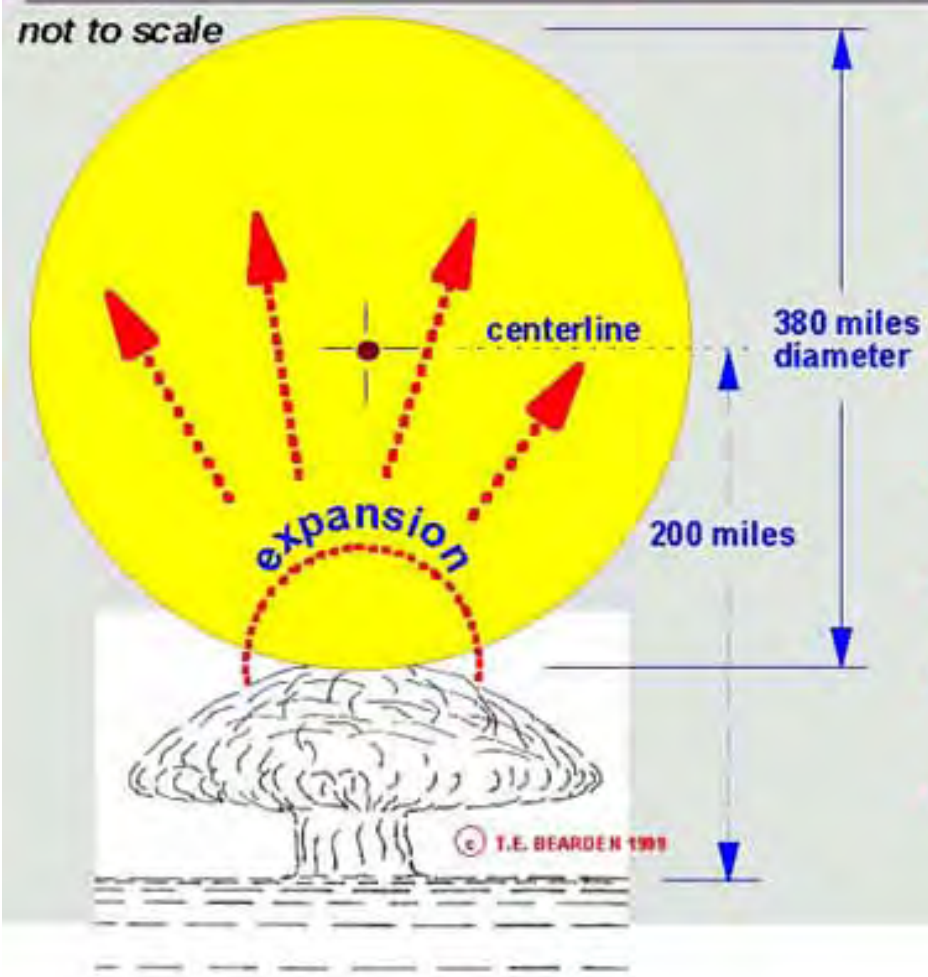

Sequence of Events

- Geyser of water rose rapidly from surface, mushroomed out
- Reached 60,000 feet altitude in two minutes
- Brilliantly glowing globe then appeared in top
- Globe increased greatly in size and altitude
- Reached diameter of 380 miles
- Center reached altitude of 200 miles
- Observed by multiple qualified pilots

COLD EXPLOSION -- 9 April 1984 Near Kurils

And Formation and growth of spherical shell (globe)

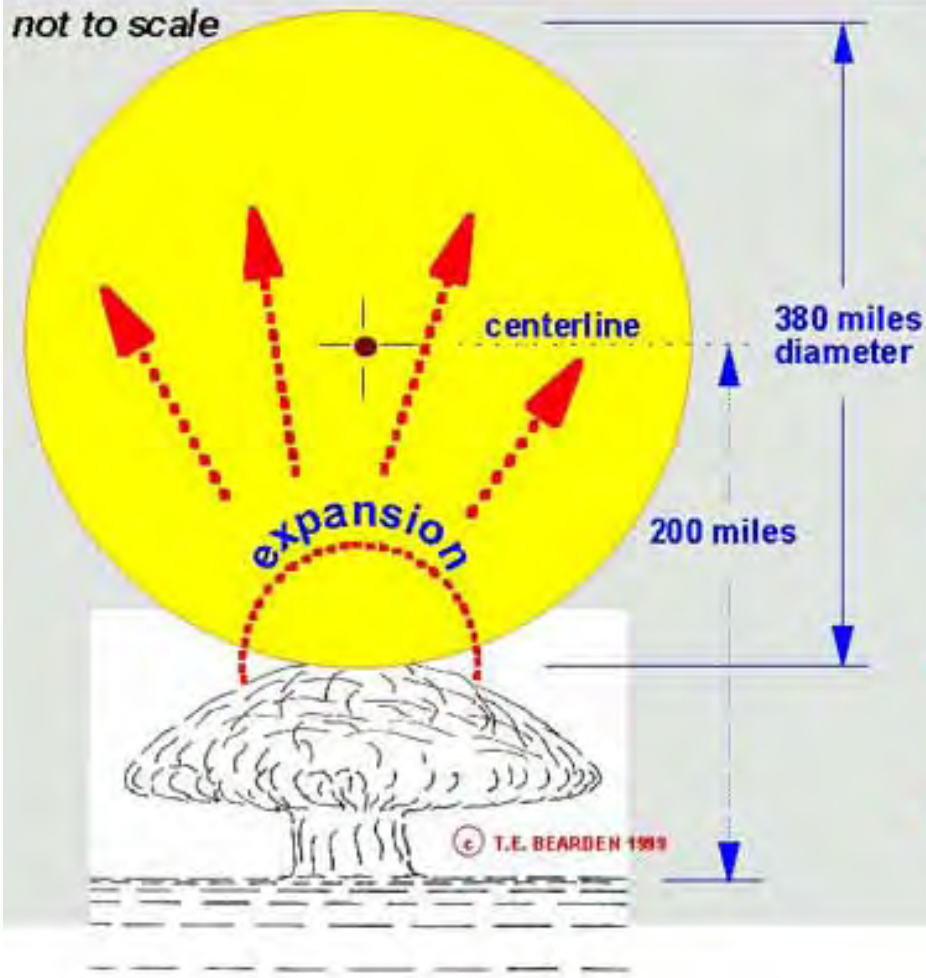

What They Were

- Superpotential interferometry using LWs
- First, a cold explosion just above surface
- Then small intense shell of glowing EM energy for 1-on-1 targeting
- Larger globe for large area as for ICBM targets approaching in zone
- With ST engines, can dud incoming nukes and all electronics
- Use in or out of Earth's atmosphere

COLD EXPLOSION -- 9 April 1984 Near Kurils
(Plus additional weapons effects)
JAL
Halo expanded to giant globe.
380 miles diameter, center over 200 miles
high.
© T.E. BEARDEN 1996

Countering Insane Mad Systems: Find Loophole, Exploit It

- If MADs not quantum potential systems, easily countered by instant QP strike which destroys targeted MAD weapons worldwide with certainty.
- Have to be certain of types of dead-man fuzing. All dead-man fuzing weapons must be included in the assured target list for the striking quantum potential weapon.

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- Multiple targeted MADS require multiple vacuum engines in the striking quantum potentials.
- Uncertainty and risk introduced if not certain of all MAD systems and all dead-man fuzing systems.

- Newest generation psychoenergetic LW interferometry weapons can instantly take over minds of all personnel on targeted sites, with targeted crews quickly disarming their own MAD weapons' launch capability as well as the weapons themselves.
- Mindsnapper then kills all living things and contaminates sites.
- Next generation QP Psy-En weapons can disrupt and destroy minds of an entire targeted national population. The nature of warfare moves irrevocably to the human mind, where of course the fundamental problem arises anyhow.

Next Generation Counter to Both Sane and Insane MAD Systems

- ***Localized quantum potential in an area, used in psychoenergetics mode***
  - Gradually produces mild, continuous hypnotic state
  - Targeted population remains entirely conscious, functional
  - Internal "word thoughts" emerge directly in subconscious
  - Targeted persons all unaware of these "word thoughts"
  - Operates somewhat similar to "post hypnotic suggestion"
  - Gradually changes emotions, psychological outlook
  - Over a period of time, deviates and entrains entire target population's outlook, belief structure, temperament
- ***Moves Psywar to inside the human component***
- ***Human minds are the only battleground***
- ***Can be accomplished without overt signature***
- ***Countered only by inserting same methodology into deeper mind level (collective unconscious)***

Simultaneous Dudding of Nuclear Weapons Worldwide

- Via quantum potential joining U235 and Plutonium in warheads
- Includes weapons airborne, underwater, in storage
- These are *transmutations of the nuclides themselves*
- *Part of the initial barrage launched by Aum/Yakuza/KGB*
- *Will occur in the first minutes of the strategic strike, following psychoenergetically crew-disabling QP weapons*

Note: Duds both overt and covert nuclear weapons and weapons-grade materials -- including "suitcase-delivered" covert weapons on site in Russia which otherwise provide dead man fuzing

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Simultaneous Dudding of Nuclear Weapons Worldwide

- Via quantum potential joining U235 and Plutonium warheads
- Includes weapons airborne, underwater, in storage
- These are not explosions, but are *transmutations and increased fissioning rates*
- *Part of the initial barrage launched by Aum/Yakuza/KGB*
- *Will occur in the first minutes of the strategic strike*

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Note: Duds both overt and covert nuclear weapons and weapons-grade materials.

The Tom Bearden Website

Help support the research

Operation Divine Wind II

Slide 1

Slide 2

Slide 3

Slide 4

YAKUZA &
AUM SHINRIKYO

DIVINE WIND II

U.S.

★ **A secret coalition of Yakuza/Aum Shinrikyo and KGB/Communist forces plan to launch a massive, surprise energetics attack on the United States, given a low-risk opportunity.**

★ **Major weapons utilized will be the scalar EM (energetics) superweapons (including quantum potential weapons) that were developed, deployed, and operated by the KGB under the former Soviet Empire, and continuing after its dissolution.**

KGB

★ **Yakuza/Aum crews have extensively trained and test-fired, from on-site in Russia. They have *leased* operational control of the first three generation energetics superweapons (which work by superpotential interferometry).**

MINDSNAPPER AND
PSYCHOENERGETICS

★ ***The Escalation Phase of interdicting and destroying actual U.S. targets (e.g., TWA-800, two A-10s) is already underway.***

★ ***The first blow in the Strike Phase will dud all nuclear weapons and weapons materials worldwide, in minutes; destroy special ship and energetics weapon sites instantly, disable 99% of the U.S. population instantly, and kill 80% of targeted populations in from 10 minutes to 3 days.***

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QUANTUM
POTENTIAL

YAKUZA &
AUM SHINRIKYO

U.S.

DIVINE WIND II

- ★ A secret coalition of Yakuza/Aum Shinrikyo and KGB/Communist forces plans to launch a massive, surprise energetics attack on the United States and its allies, given the first low-risk opportunity.

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KGB

- ★ Attack was thwarted twice in 1997 by a small nation countering with QP weapons.
- ★ KGB psychoenergetics counter for the last QP weapon counter was tested in April 1997.
- ★ Ready time for a new scheduled attack is latter quarter 1999 through first half of 2000.

YAKUZA &
AUM SHINRIKYO

DIVINE WIND II

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- ★ **A secret coalition of Yakuza/Aum and KGB/Communist forces will launch a massive, surprise, strategic attack on the United States in 1997.**
- ★ Major weapons utilized will be the scalar EM (energetics) superweapons that were developed, deployed, and operated by the KGB under the former Soviet Empire, and continuing after its dissolution.
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- ★ *Escalation Phase of interdicting and destroying actual U.S. targets (e.g., TWA-800) is already underway.*
- ★ *The first blow in the Strike Phase will dud all nuclear weapons and weapons materials worldwide, in minutes; destroy special ship and energetics weapon sites instantly, and kill 80% of targeted populations in 3 days.*

KGB/COMMUNISTS

MINDSNAPPER

QUANTUM
POTENTIAL

OPERATION DIVINE WIND II

Three Phases and Support

Operational Phases

- Phase I: On-Site Training Phase (Completed)
- Phase II: Escalation Phase (In Progress)
- Phase III. 1997 Strategic Strike on the U.S.
  - *First strike (QP) in Phase III duds all nuclear weapons and nuclear powerplants worldwide, in minutes*
  - *Psychoenergetic strike (QP) disables people instantly*
  - *Mindsnapper attack of special assets for 100% success*
  - *QP initiation of fast-acting, lethal diseases kills 80% of targeted populations in three days or less*

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Support Plans

- Plan A: Feints, Deception, Sabotage, and Terrorism
- Plan B: Testing and Test Range
- Plan C: Worldwide Weather Engineering
- Plan D: Strategic and Combat Intelligence

Advanced EMBW Applications

- Covert EMBW: Examples
  - Activate materials and their potentials with ST disease engines. Potentials superpose and their infolded ST dynamics diffuse
  - Activate water's structuring (H-bonding) potential with disease engines
  - Bias electrical power grid ground fields by weak diseases
  - Employ disease-structured quantum potential in distant area
- Overt death ray (mind snapper)
  - Powerful scalar EM pulse in target area "jerks" rate of flow of time
  - The "time snap" sharply separates mind from body and each cell
- EMBW CM:
  - Irradiate bodies with longitudinal EM waves; self-converts to t-pumping and produces exact amplified ST antiengine
  - Antiengine arises out of local ST, affects all parts of all cells
  - Cells are t-charged with antiengine structure
  - Continuing action restores regenerative and immune systems and reverses cellular damage

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EM Biological Warfare (EMBW)

- KGB/Communists have developed highly effective
  - Electromagnetic biological warfare (EMBW)
  - Counters to orthodox biological warfare
  - Mass death ray weapons
    - Small version of "mindsnapper" tested in Afghanistan
    - Killed occupants in two villages, in separate strikes
    - Unusual aspects (so-called "smerch" gas)
- Russia/KGB is the only group with a complete counter to biological warfare, either covert or overt, and to EMBW
- EMBW (covert and overt) is a preferred option for KGB
  - MAD Doctrine is completely destabilized for a sufficiently covert Russian EMBW strike
  - Situation has existed for at least two decades
  - Can alter germs, bacteria, viruses of specific kind, in a specific target area, to produce antibiotic-resistant strains
  - Can induce any kind of cellular disease or damage at a distance
- U.S. national characteristic: no reaction to slowly increasing threat

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Microwave Radiation of U.S. Embassy in Moscow

Former U.S. Embassy in Moscow.

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter?)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

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Pentagon EMI Studies, 1989

Washington Post, 22 Jan. 1989, p. A4

- Analysts of severe EMI effects in strike on Libya, 1986
  - performed major 3-year, 66-man study
  - Blamed effects on U.S. forces' own signals
  - Did not know of any other "signals" present
  - Knew nothing of quantum potential weaponry, energetics weaponry
- 7-month preliminary study
  - Severe EMI Problem exists
  - EMI shielding often waived in our weapon systems
  - Thousands of conflicts possible
- Also studied UH60 Blackhawk helicopter problems (which *were* due to its lack of good EMI shielding, and not quantum potentials)
  - uncommanded turns
  - Five EMI crashes 1982-1989
  - $175 M program to shield it
- So found that U.S. transmission combinations can
  - Affect aircraft flight control
  - Turn off fuel supply
  - Cause uncommanded dive/turn
  - Bring down U.S. warplanes
- *Actually, Libyan EMI was induced by Soviet quantum potential tests which can do all those things and much more*

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EM Missile Practice

- EM Missile Practice
  Latter Sept. - Early Nov. 1996
  Melbourne, Australia
- Deception: Using EM Missile to Reinforce Notion of SAM Attack
  Saturday evening, Nov. 16, 1996
- Intelligence Probe: Insuring U.S. Still Unaware of Energetics Weaponry
  Thursday, December 12th, 1996
- EM Missile Strike, Offset from Night Shuttle Launch, Cape Canaveral, Florida
  The Smoking Gun in November 1985
- Distant Operator Onsite in Russia Slew Away Registration Point
  Marker Beacon over Night Shuttle Launch, 26 November, 1985
- EM Missile Practice and Deception
  November 17, 1996

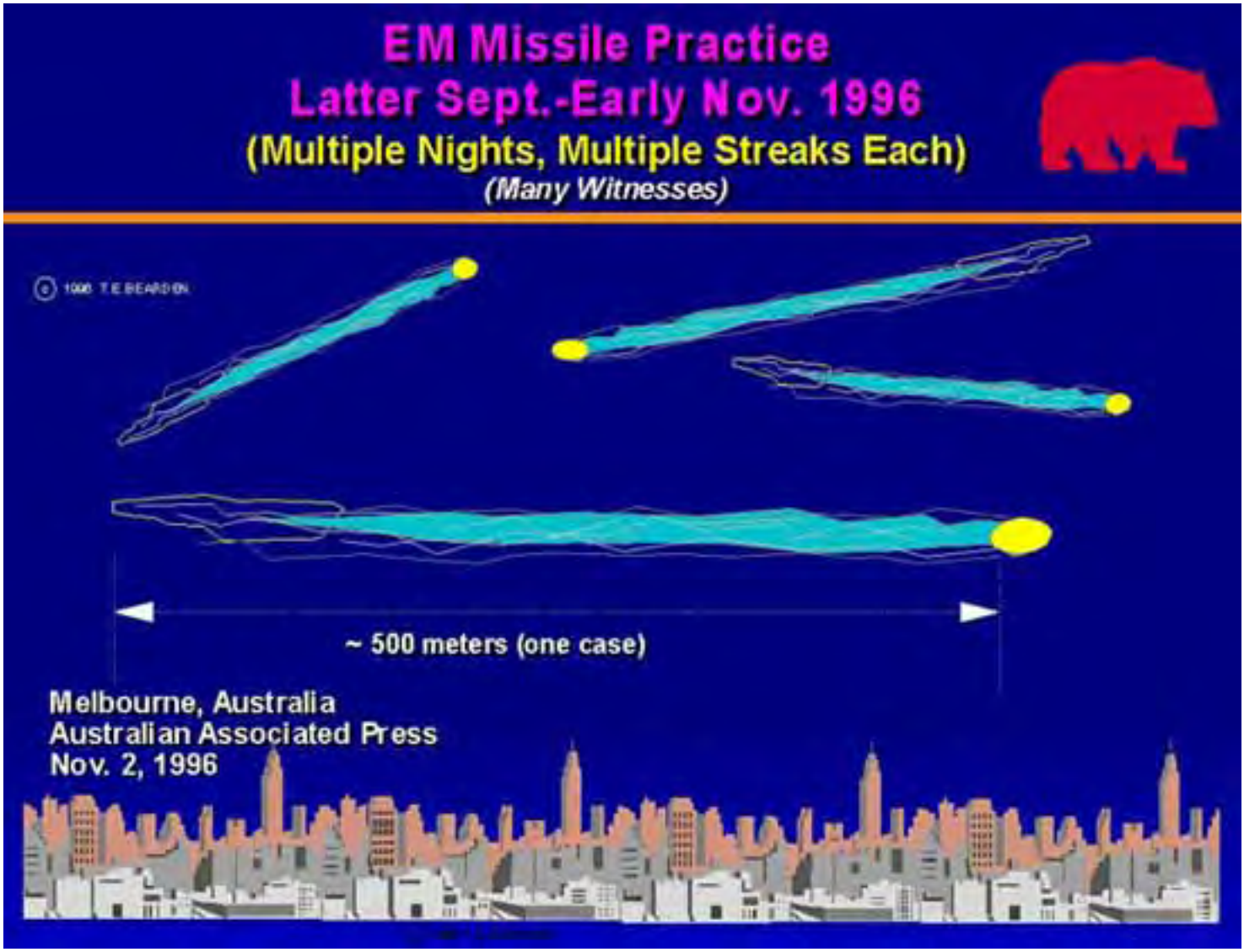
EM Missile Practice
Latter Sept.-Early Nov. 1996
(Multiple Nights, Multiple Streaks Each)
(Many Witnesses)
© 1996 T.E.BEARDEN
~ 500 meters (one case)
Melbourne, Australia
Australian Associated Press
Nov. 2, 1996

Deception: Using EM Missile to Reinforce Notion of SAM Attack

Saturday Evening
Nov. 16, 1996

Note: Meteor shower was forecast, which provided perfect decoy to FBI investigators, to steer them off the true scent.

Pakistan International Airlines Flight 712, just after takeoff from John F. Kennedy Airport, on path similar to that taken by TWA Flight 800, July 17, 1996

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Intelligence Probe: Insuring U.S. Still Unaware of Energetics Weaponry
Thursday
Dec. 12, 1996
Pilot sighted what he called a "green flare".
No danger, no evasive action.
Saudi Arabian Airlines 747
en route from Riyadh, Saudi Arabia
to John F. Kennedy Airport.
At 12,000 ft., not far from where
TWA Flight 800 was killed on July 17, 1996
FBI: "Probably a meteorite."
© T.E. BEARDEN 1996

EM Missile Strike, Offset from Night Shuttle Launch

Cape Canaveral, Florida

PHOTO BY BOB GLADWIN

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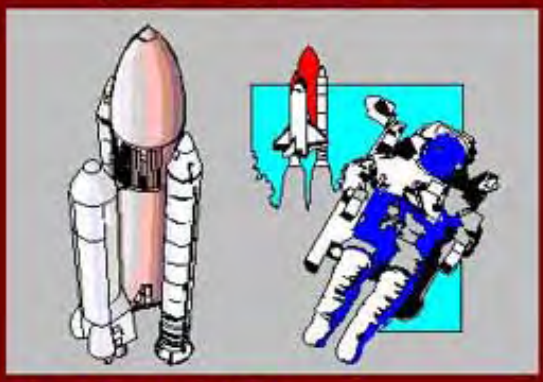

The Smoking Gun in Nov. 1985

Distant Operator Onsite in Russia
Slews Away Registration Point
© T.E. BEARDEN 1995, 1999.
MARKER BEACON
Over Night Shuttle Launch
Cape Canaveral, Florida
26 Nov 1985
Photographed by George Suchary
28 Nov 1985
Two weeks later, the same weapon killed the Arrow DC-8
at its takeoff from Gander, Newfoundland.

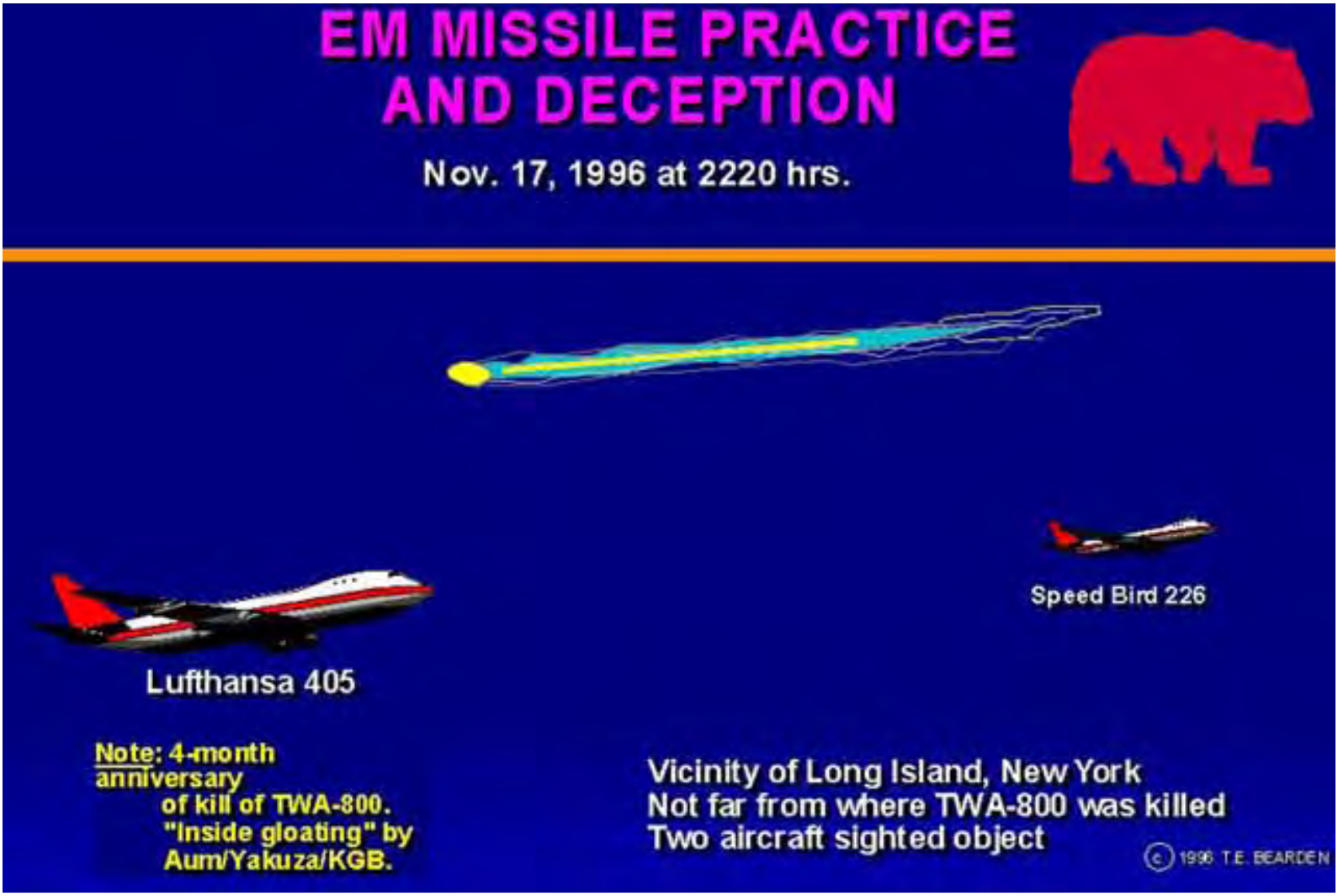
EM MISSILE PRACTICE
AND DECEPTION
Nov. 17, 1996 at 2220 hrs.
Speed Bird 226
Lufthansa 405
Note: 4-month
anniversary
of kill of TWA-800.
"Inside gloating" by
Aum/Yakuza/KGB.
Vicinity of Long Island, New York
Not far from where TWA-800 was killed
Two aircraft sighted object
© 1996 T.E. BEARDEN

Subdivisions of Soviet Energetics

NONLIVING SYSTEMS

Energetics

- Nonliving systems
- Scalar Interferometry
- Action-at-a-Distance
- Quantum Potential
- Vacuum Engines
- Spacetime Structuring
- Material, Field Effects
- Nuclei, Lattice Changes
- Hidden EM Variables
- SWZ Effects

LIVING SYSTEMS

Bioenergetics

- Living Systems (Bodies)
- Cells, cellular changes
- Master Cell Control (Popp)
- Spacetime Structuring
- Disease Induction, Remission
- Action-at-a-Distance
- Quantum Potentials
- Scalar Interferometry
- Hidden EM Variables
- SWZ Effects

Psychoenergetics

- Living Systems (Minds)
- Thoughts, Memories, Emotions
- Conscious/Unconscious Minds
- Spacetime Structuring
- Species, Biospheric Minds
- Action-at-a-Distance
- Quantum Potentials
- Scalar Interferometry
- Hidden EM Variables
- SWZ Effects

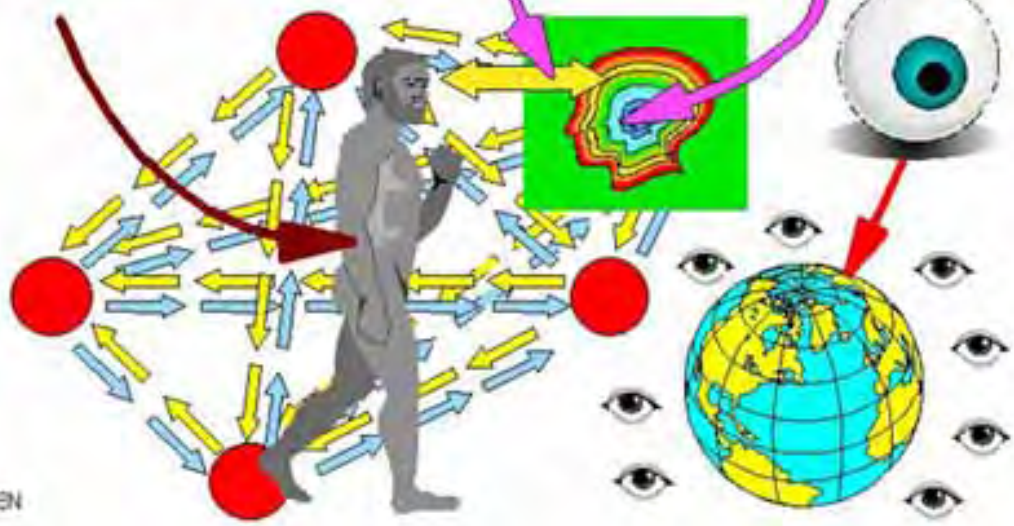

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Communism's Goal

- "War to the hilt between communism and capitalism is inevitable. Today, of course, we are not strong enough to attack... To win we shall need the element of surprise. The bourgeoisie will have to be put to sleep. So we shall begin by launching the most spectacular peace movements on record. There will be electrifying overtures and unheard-of concessions. The capitalist countries, stupid and decadent, will rejoice to cooperate in their own destruction. They will leap at another chance to be friends. As soon as their guard is down, we shall smash them with our clenched fist."

Dimitry Z. Manuilsky
Lenin School of Political Warfare, Moscow
(circa 1934)

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Manuilsky's Goal vs. Status Today

Manuilsky, 1934	Situation, Dec. 1996
▪ War is inevitable.	▪ Has not changed.
▪ Not strong enough to attack now.	▪ Strong enough now; preparations completed. Need right opportunity.
▪ Need surprise.	▪ Have achieved total surprise.
▪ Must put us to sleep.	▪ We are sound asleep.
▪ Need most spectacular peace movement on record.	▪ Done. We think the Russian threat gone, cold war ended.
▪ Electrifying overtures, unheard-of concessions.	▪ Done, and still occurring every day. It has worked beautifully.
▪ Capitalists will cooperate.	▪ We are cooperating in spades!
They will leap to be friends.	▪ We've leaped, and are leaping.
▪ They will let down their guard.	▪ No ABM, junked lots of nukes, shrunk our forces to the bone.
▪ We'll strike them then.	▪ They would have struck (twice) in 1997, but for deterence by another nation (not U.S.) having QP weapons
	▪ *They are still looking for a risk-free opening to strike*

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Professor Hellman, German Scientist Released from Work in Soviet Union

- Worked in Soviet Union after WWII
- Eventually escaped to Germany, then to Brazil (handsome offer)

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- Took part in highly unusual Soviet energetics development and experiments
- Large areas of the sea could be and were *suddenly frozen*
- *No particular attention was paid to this information by highly qualified scientists*
- *In intelligence terms, this is A-1 information of the highest caliber*
- *Bohm also was invited to Brazil, which started an energetics weapon program. Brazil developed such weapons including weak quantum potential weapons (0.95 confidence)*

Hemispheres of Light

- March 20th, 1969
  Caribbean and Western North Atlantic
- Hemisphere and Globes, 1977
  24 March, 1977
- Virgin Islands Incident
  August 1969
- Typical Shield Test, Northern Route to Japan
  June, 1982

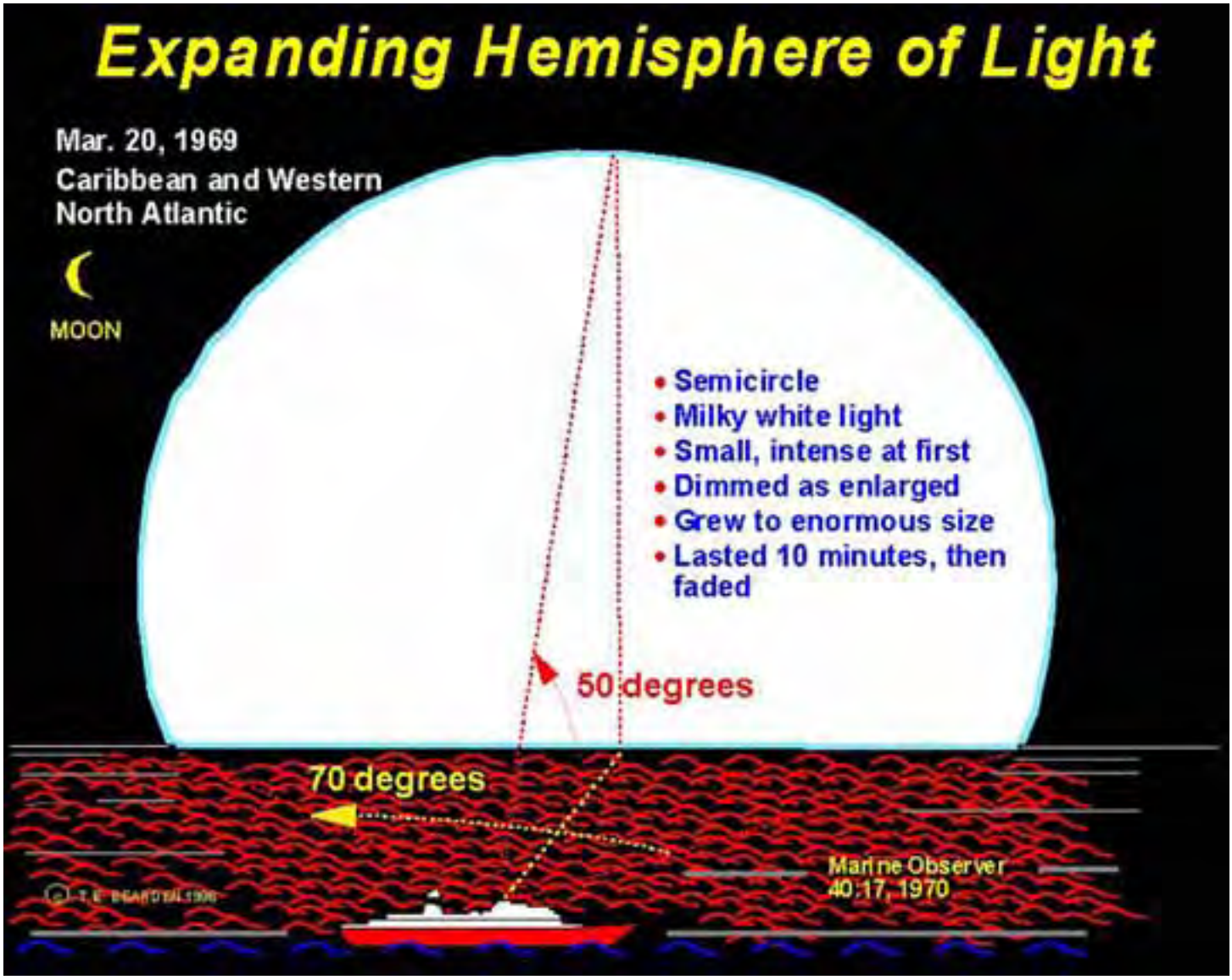
Expanding Hemisphere of Light
Mar. 20, 1969
Caribbean and Western
North Atlantic
MOON
• Semicircle
• Milky white light
• Small, intense at first
• Dimmed as enlarged
• Grew to enormous size
• Lasted 10 minutes, then faded
50 degrees
70 degrees
Marine Observer
40:17, 1970

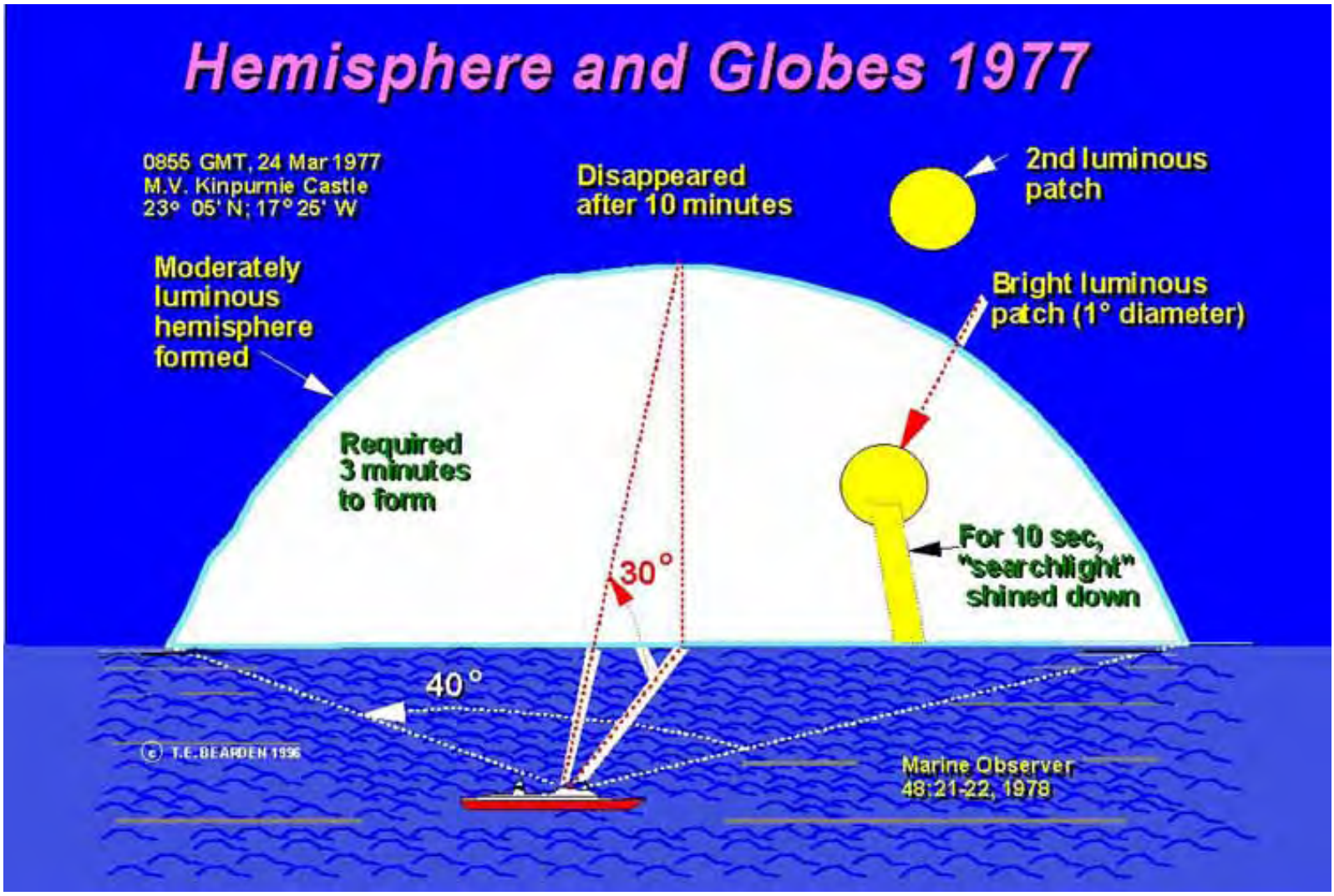
Hemisphere and Globes 1977
0855 GMT, 24 Mar 1977
M.V. Kinpurnie Castle
23° 05' N; 17° 25' W
Disappeared after 10 minutes
2nd luminous patch
Moderately luminous hemisphere formed
Bright luminous patch (1° diameter)
Required 3 minutes to form
For 10 sec, "searchlight" shined down
30°
40°
© T.E. BEARDEN 1996
Marine Observer 48:21-22, 1978

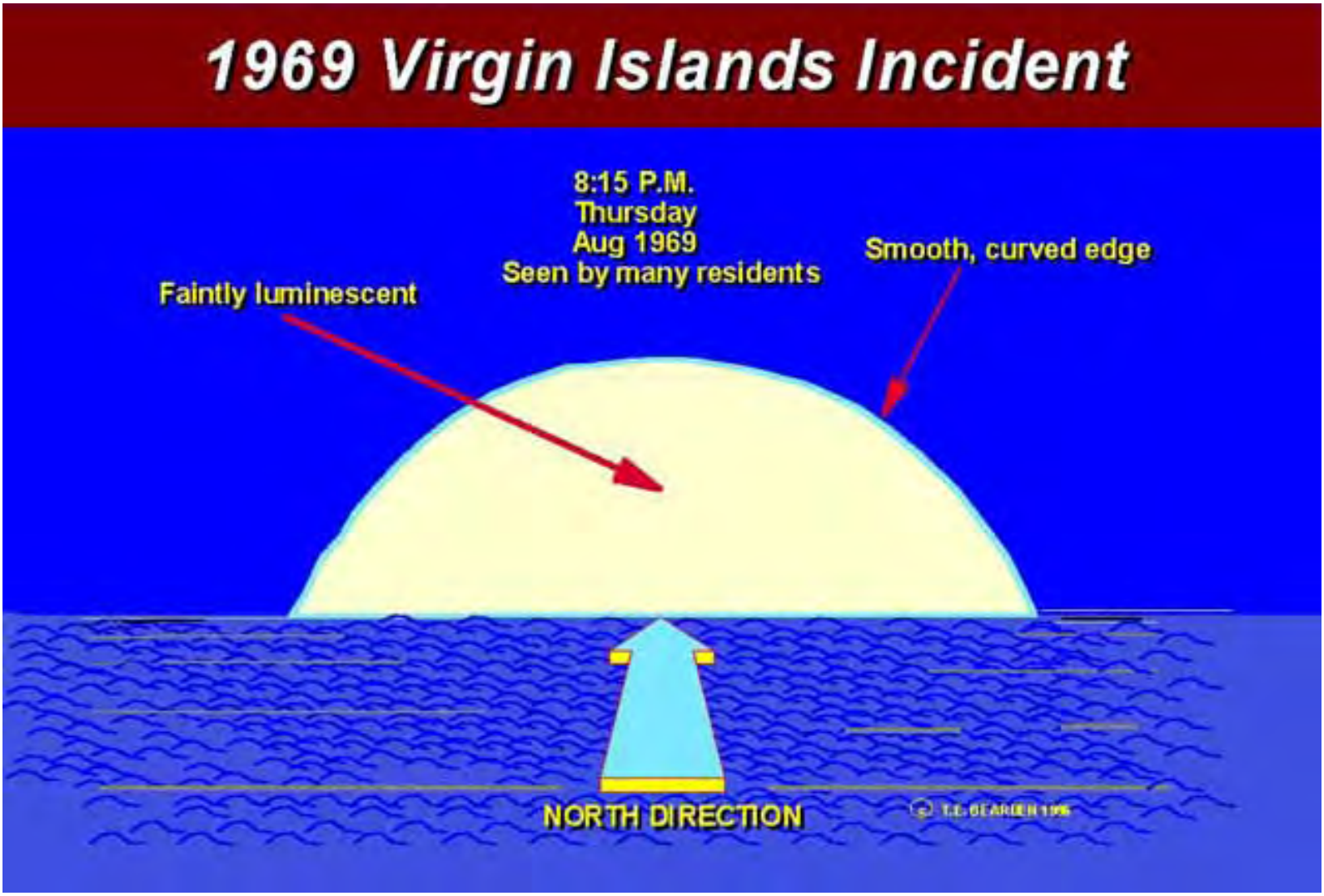
1969 Virgin Islands Incident
8:15 P.M.
Thursday
Aug 1969
Seen by many residents
Smooth, curved edge
Faintly luminescent
NORTH DIRECTION

Typical Shield Test, Northern Route to Japan
18-27 km diameter
Asahi Evening News, Tokyo
June 22, 1982
Multiple tests seen per month, for years.
Pilots simply ceased reporting them.

How Could Such Superweapons Ever Be Concealed?

- Arthur C. Clarke's law states:

  "Any sufficiently advanced technology is indistinguishable from magic."

- To U.S. scientists, "magic" means "impossible"
- Longitudinal EM waves and LW interferometers have been regarded as fantasy and impossible
- To deceive foe on rather open use of unknown technology without discovery:

  "Disguise its uses as understandable accidents, human error, acts of nature, other known technology, etc."

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Soviets Easily Concealed These Superweapons for Four Decades

- Intensive Soviet deception plan utilized
  - Embedded in other weapon system tests
  - Made to resemble natural acts, accidents, etc.
  - Open science releases coordinated to show Russian scientists worked on "normal" science
- West thought Russian scientists inferior
- U.S. scientific community was and is dogmatic, and fiercely suppresses real scientific innovation
- Terribly flawed electrodynamics not ruthlessly shaken and changed in West

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- West had no basis for understanding energetics

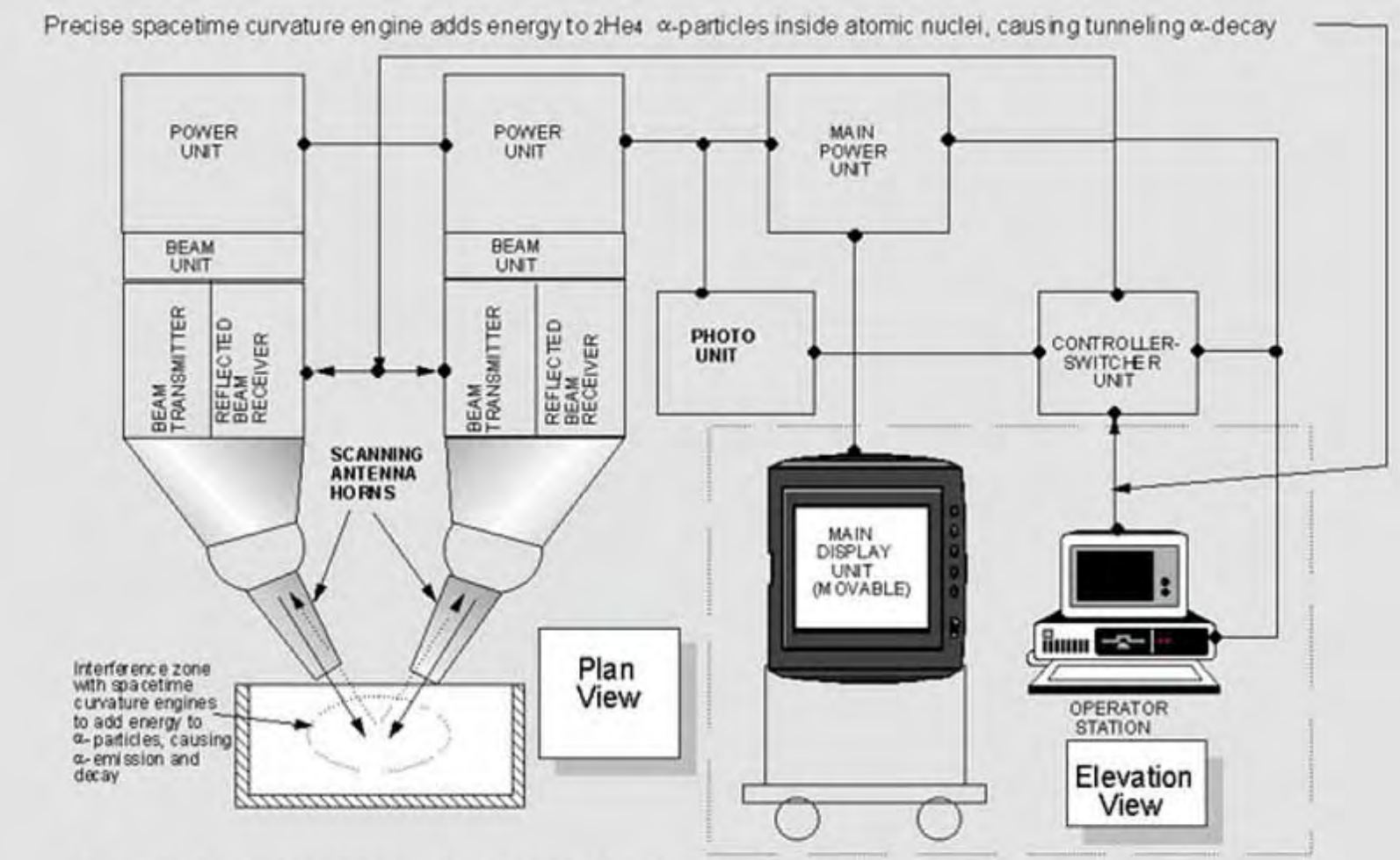

Figure 26. Microscope-type, laser-like interferometer for inducing quick α-decay in samples of otherwise longer-lived isotopes.

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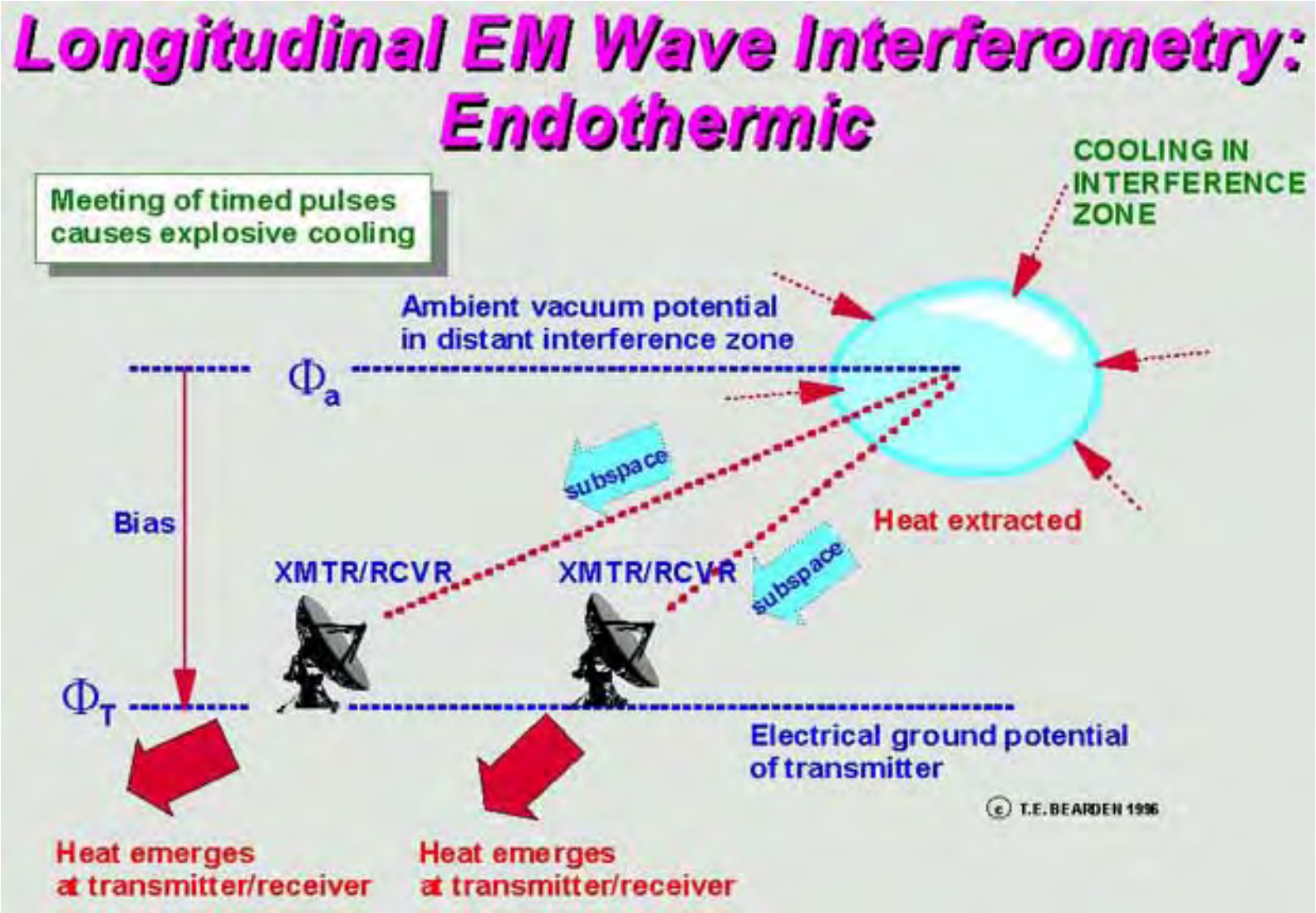
Longitudinal EM Wave Interferometry: Endothermic
Meeting of timed pulses causes explosive cooling
COOLING IN INTERFERENCE ZONE
Ambient vacuum potential in distant interference zone
Φ_a
subspace
Bias
Heat extracted
XMTR/RCVR
XMTR/RCVR
subspace
Φ_T
Electrical ground potential of transmitter
© T.E. BEARDEN 1996
Heat emerges at transmitter/receiver
Heat emerges at transmitter/receiver

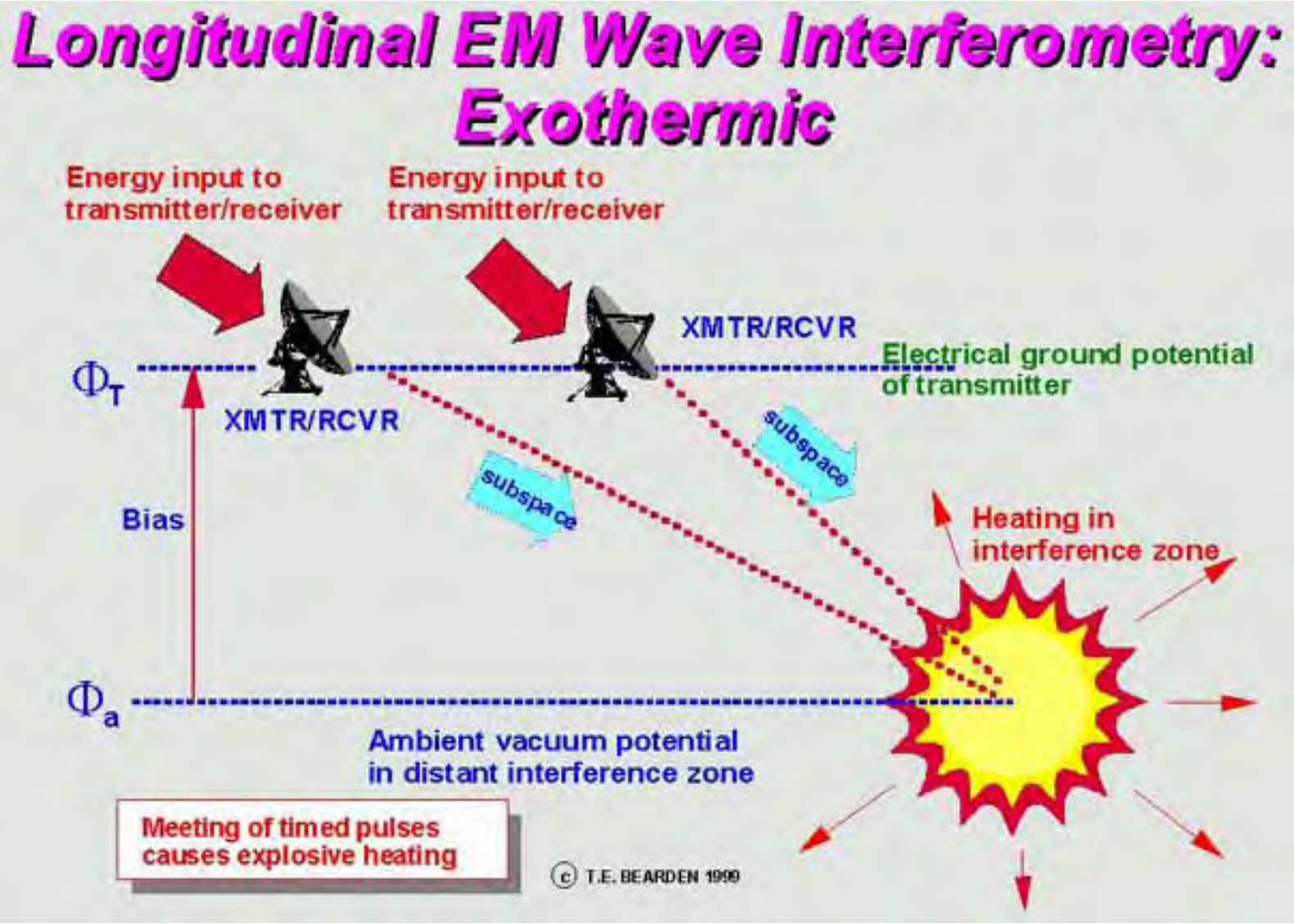
Longitudinal EM Wave Interferometry: Exothermic
Energy input to transmitter/receiver
Energy input to transmitter/receiver
XMTR/RCVR
XMTR/RCVR
Electrical ground potential of transmitter
Φ_T
subspace
subspace
Bias
Heating in interference zone
Φ_a
Ambient vacuum potential in distant interference zone
Meeting of timed pulses causes explosive heating
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The Tom Bearden Website

Help support the research

U.S. Air Attack on Libya
April 1986

- Slide 1
- Slide 2
- "Washington Post" Article
  January 22, 1989

U.S. Airstrike on Libya
April 1986*
• 33 U.S. AIRCRAFT IN STRIKE
• MANY HIGH-POWERED TRANSMITTERS
– COMMUNICATIONS
– JAMMERS
– RADARS
• SEVERE, UNEXPECTED "EMI" ENCOUNTERED
– ONE F-111 DOWNED
– NUMEROUS WEAPONS WENT ASTRAY
– THREE FOREIGN EMBASSIES DAMAGED
– SEVEN AIRCRAFT FORCED TO ABORT
• COMMANDERS: "US OR THEM?"
*Washington Post, 22 Jan. 1989, p. A4
Mild quantum potential weapon tested against electronics in U.S. aircraft and missiles
EM energy arises from every point in spacetime inside the electronics

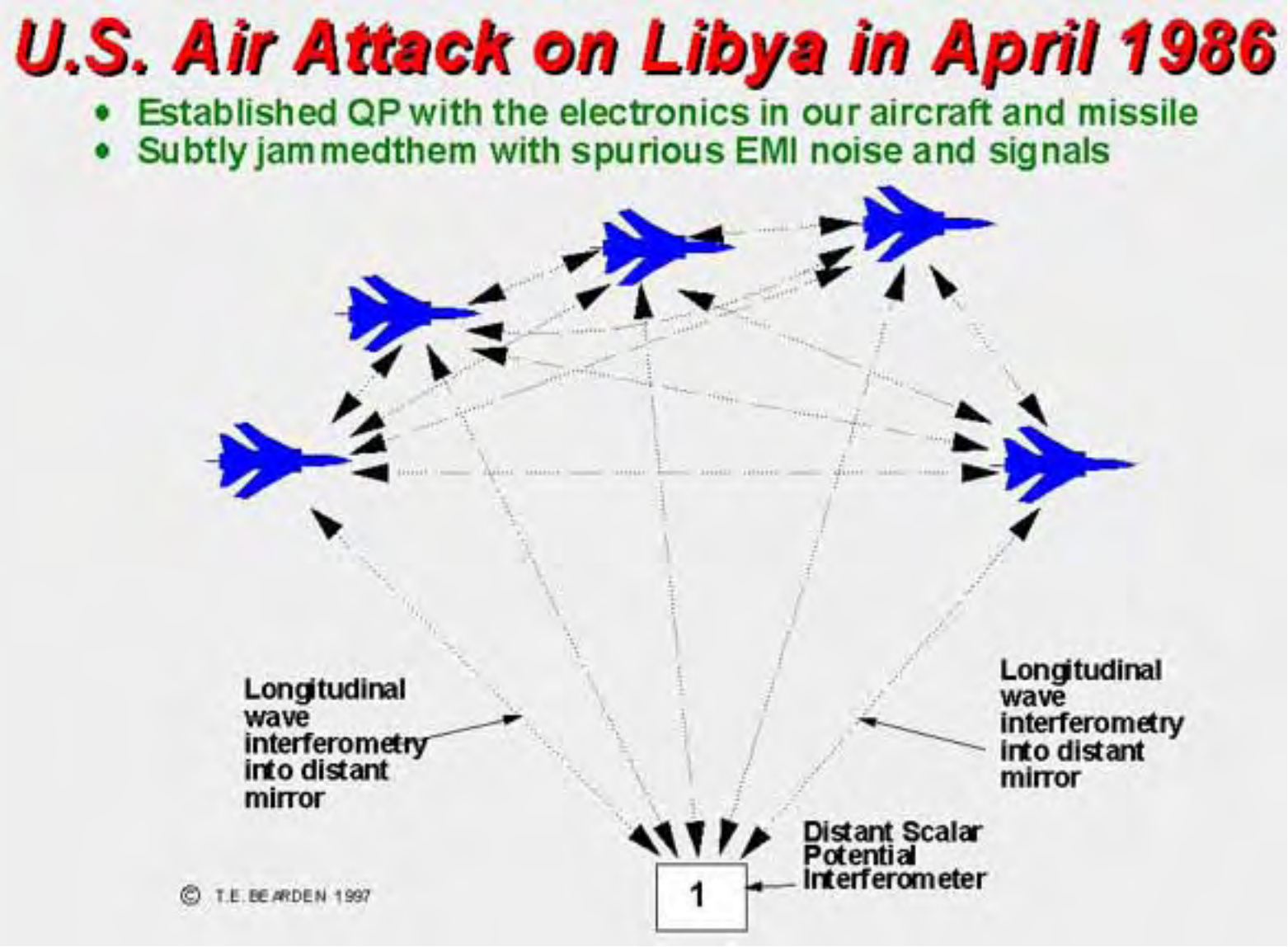
U.S. Air Attack on Libya in April 1986
• Established QP with the electronics in our aircraft and missile
• Subtly jammedthem with spurious EMI noise and signals
Longitudinal wave interferometry into distant mirror
Longitudinal wave interferometry into distant mirror
Distant Scalar Potential Interferometer
1
© T.E. BEARDEN 1997

Lightning Wall

- Aircraft on course of 270 degrees
- Approached "solid wall of lightning" in an otherwise cloudless sky
  - From very high altitude to near the water
  - Extended north-south as far as one could see
- Radar scope clear
- *Rigged aircraft for heavy weather*
- *Plunged directly through wall*
- *Wall was very thin*

circa 1959-1960
Interview with Patrol plane commander
U.S. Navy P5 aircraft
Over Atlantic, 200 miles east of Norfolk

© T.E. BEARDEN 1996

Lisitsyn's Report: Brain Code Broken

- THEORY DEVELOPED AND FITTED
- HYSTERESIS MEMORY LOOP
- CONTROLLED EM INDUCTION
  - IMAGES
  - SENSATIONS
  - PREDETERMINED EMERGENCE
- 23 EEG BANDS
  - UP TO 8.1×10^{20} HZ
  - 11 INDEPENDENT CHANNELS

S.K. Lisitsyn, "New Approach to the Analysis of Electroencephalograms," DDC Report AD73005, p. 16-25.

JC1-34

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Large Longitudinal EM Wave Interferometer (LWI) Accident

- 1958 nuclear explosion near Urals
  - Contaminated 1200 square kilometers
  - Signature of large LWI accident
  - Buried atomic wastes suddenly exploded
  - Region contaminated to this day
- Soviets were well along with advanced LWI prototypes and testing
  - In Jan. 1960 Khrushchev announced these forthcoming "fantastic" weapons
  - 1958 difficulties would have been resolved by 1960

© T.E. BEARDEN 1990, 1999

Large Longitudinal EM Wave Interferometer (LWI) Accident

- Expected cause of 1958 accident
  - Huge LW energy beams built up
  - Catastrophic short-out in transmitter
  - LW energy flashed over into earth and spread
  - Struck and fissioned stored nuclear wastes
- Developed new safety circuits
  - For transmitter short-out, instantly activates to hold LW beam energy and prevent flash-over
  - Similar accident happened in 1986 at Chernobyl, except private U.S. group blew that transmitter to prevent catastrophic quake in California

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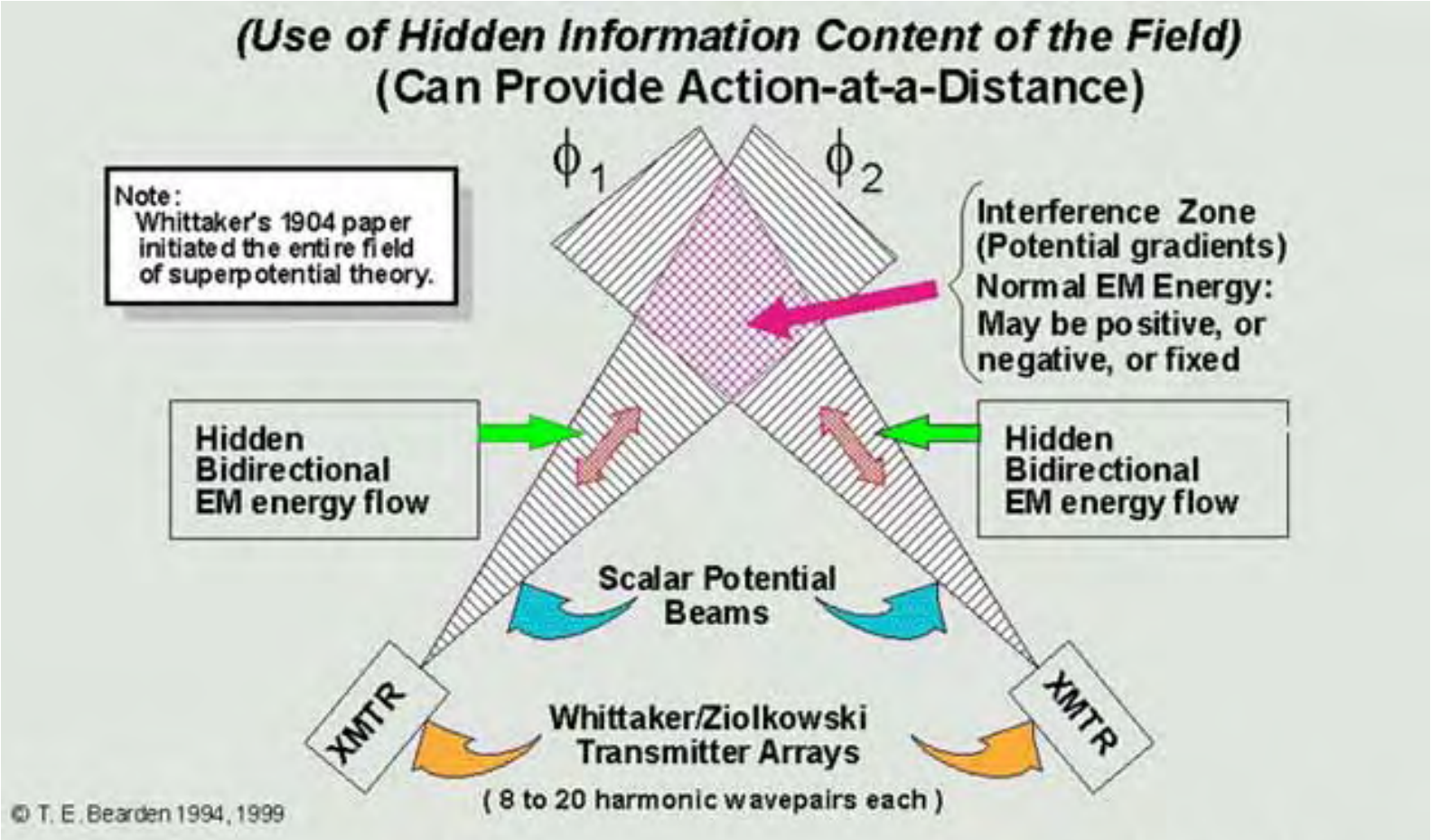

Figure 5. Scalar potential interferometry (between the two sets of bidirectional longitudinal EM wavepair functions) produces all EM force fields and waves.

Two Types of Mutual Assured Destruction (MAD) Systems

- ***Sane system:***
  - Turned off or on standby
  - Wait until attacked or attack is imminent
  - Humans consider situation, make strike decision
  - Command order issued to weapons officers
  - Human finger initiates launch sequence
  - Usually requires code entry, etc. for assured launch control

- ***Insane system:***
  - Computer periodically (e.g., every 2 hours) initiates launch
  - During sequence, there is a period (say, 2 min.) where operators can enter stop order (usually coded)
  - If correct stop not entered, weapons automatically launch
  - if correct stop entered, computer resets, and after another 2 hrs, automatically reinitiates the launch sequence

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Psychoenergetics Weapons Teams
Mentally Disable All Personnel
(COUNTERS ALL SANE MAD SYSTEMS)
(NULLIFIES HUMAN COMPONENT OF ALL WEAPON SYSTEMS)
ELECTRICAL THOUGHT-WORDS ARISE DIRECTLY IN BRAIN, HENCE IN MIND, BYPASSING SENSOR INPUTS
INSTANT HYPNOGOGIC STATE, WITH INSERTED THOUGHT-WORDS
Effects arise in local spacetime, simultaneously in all minds in the targeted area
INSTANT HYPNOGOGIC STATE; WITH WAKING DREAM
PERCEIVED REALITY NOW CONTROLLED
TARGETED POPULACE
• Site personnel instantly hypnogogic and mentally controlled.
• Distant weapon controller teams coord crew actions
• Standdown insane weapons to maintenance standby.
• Mindsnapper then strikes, kills all personnel, and nullifies site for months.
Indicators: Two A-10 incidents 1997, LIDA device since 1950s.
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Strikes Against Special Ship and Energetics Weapon Sites

- Via powerful scalar EM pulses in each targeted area, so sharp time-jerks occur
  - Mind and its operations exist in time but not in 3-space
  - Coupling interaction of mind operations to body occurs through flow of time
  - Flow or change of flow of time must be smooth, for coupling of mind to body
- *Sharp jerk in time flow snaps mind's coupling to body, instantly separates mind*
- *Instant death for every virus, bacterium, cell, insect, mammal, living creature*
- *Contaminates struck sites for months, perhaps a year*

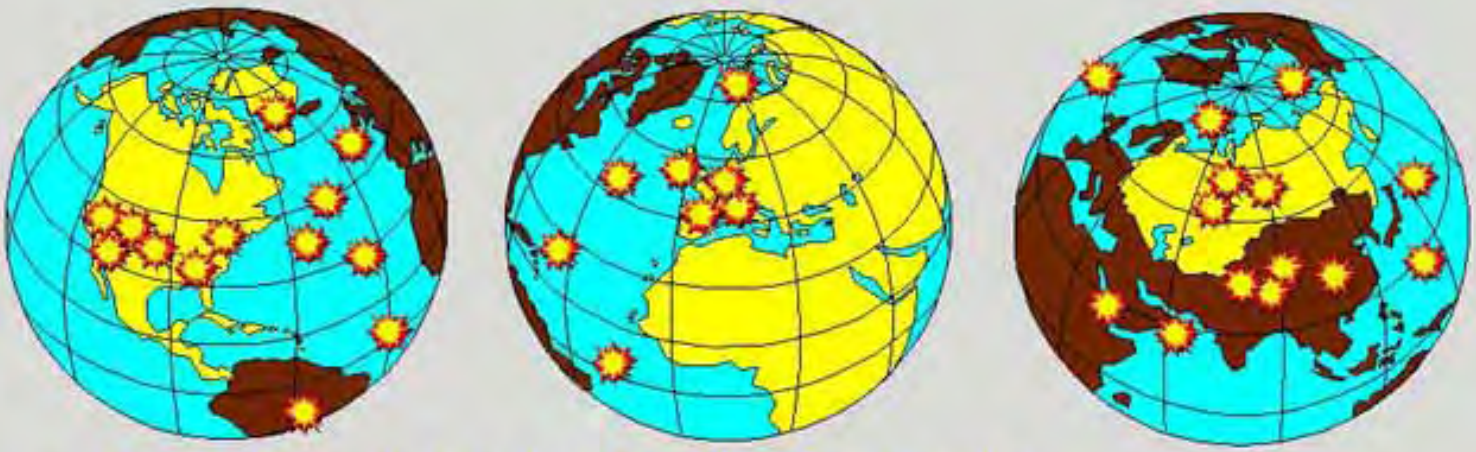

Note: In other words, this is the part of the "preparation barrage" that attacks the enemy's response capability (i.e., his "artillery" and his "airpower") and suppresses it. The use of the "mindsnapper" weapons provides 100% assurance of success.

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"MINDSNAPPER" ATTACK ON SPECIAL SHIPS & ENERGETICS WEAPONS SITES

"We have a new, fantastic weapon ... so powerful that, if unrestrainedly used, it could wipe out all life on earth."

Khrushchev, speaking to Presidium, Jan. 1960

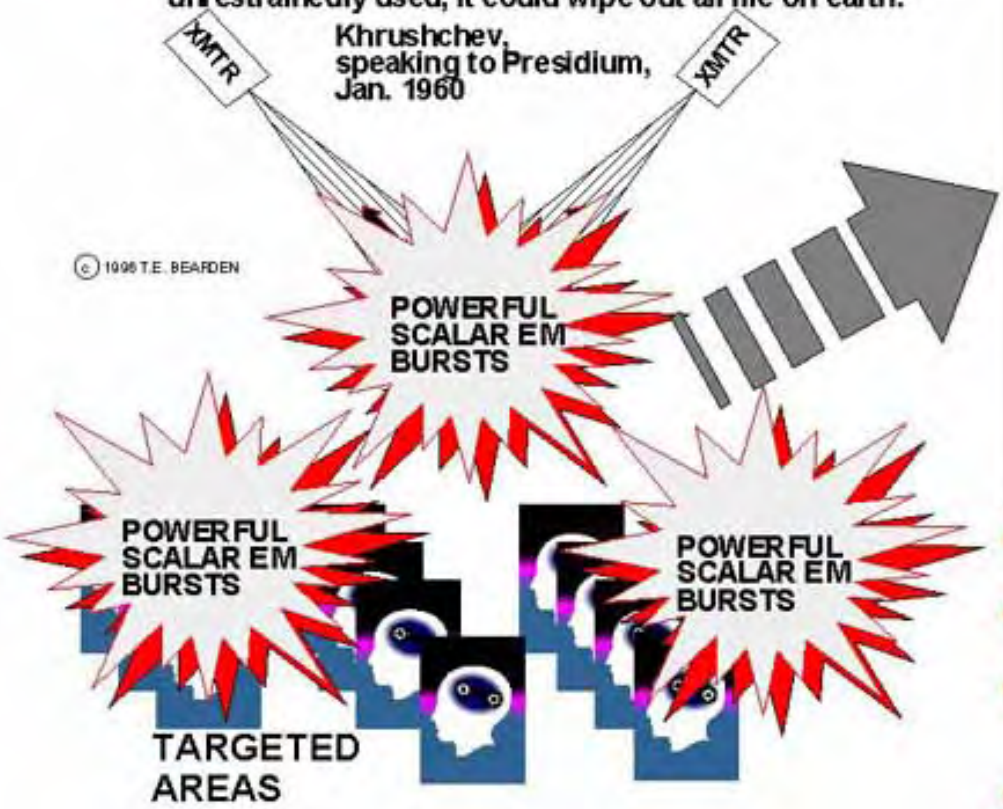

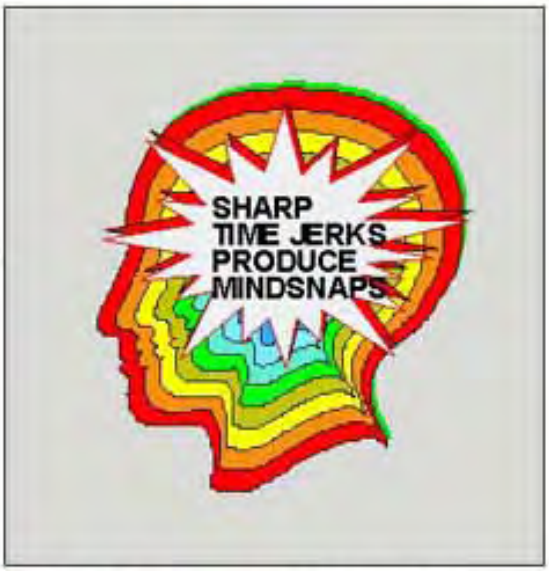

- Minds snapped loose from bodies (every living thing)
- Struck areas completely sterilized of all life
- LWs emitted; slow decay of time-charge makes contamination persistent
- Tested twice in Afghanistan

The Tom Bearden Website

Help support the research

How Much Off Guard Are We?

- Slide 1
- Slide 2
- Slide 3
- Slide 4
- Slide 5
- Slide 6
- Slide 7

How Much Off Guard Are We?

- *Legitimate U.S. forces have no energetics weapons or defenses against them*
- *No DoD general, military officer, or enlisted person reporting to the government of the United States has <u>any:</u>*
  - Training in energetics or energetics weapons
  - Experience in energetics or energetics weapons development and usage
  - Training in strategy, tactics, deployment, and employment of energetics weapons
  - Knowledge of energetics weapons effects and capabilities
  - Knowledge of the energetics weapons, tactics, deployment, and employment by the KGB/Russians
- *Civilian and military, scientific and intelligence, and news media personnel do not recognize energetics weapons effects happening right over their own heads*

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How Much Off Guard Are We?

- Kill of U.S.S. Thresher in 1963 not recognized. Left signatures.
- 23 years of KGB weather engineering, particularly over U.S. and North America, ignored and not recognized.
- Decades of irradiation of U.S. Embassy, fatally injuring three U.S. Ambassadors, health changes in personnel shrugged off ineptly.
- Massive building of underground sites, all through former Soviet Union, lamely speculated as perhaps "ABM" system or?.
- 1985, 1986 Soviet kills of U.S. aircraft, spacecraft, personnel ignored as "accidents" by legitimate U.S. communities.
- Quantum potential strike on soldiers in Gulf war ignored.
- Quantum potential deterioration of U.S. populace's immune systems ignored.
- Exchange of earthquakes and massive retaliatory destruction of Soviet missile ammunition storage sites, 1986-1989, ignored.
- U.S. scientific and military communities adamantly refuse to rework electromagnetics, though known to be seriously flawed.
- Refuse to apply Stoney/Whittaker work to engineer hidden variables, even though present quantum mechanics also known to be wrong because it does not contain such "hidden order."
- Refuse to develop, structure, and apply Bohm's quantum potential, for instantaneous action at a distance. Russians developed it.

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  - Not recognized.
  - Left signatures.
- **23 years of KGB weather engineering**
  - Particularly over U.S. and North America
  - ignored and not recognized.
- **Decades of microwave irradiation of U.S. Embassy**
  - Fatally injured three U.S. Ambassadors
  - Induced health changes in personnel
  - Shrugged off ineptly.
- **Massive building of underground sites**
  - All through former Soviet Union
  - Lamely speculated as perhaps "ABM" system or?.

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- Refuse to apply Stoney/Whittaker work to engineer hidden variables, even though present quantum mechanics also known to be wrong because it does not contain such "hidden order."
- Refuse to develop, internally structure, and apply Bohm's quantum potential, which gives instantaneous action at a distance and great energy amplification.
- Russians developed quantum potential weapons, which obsolete all other weapons.

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JUST HOW MUCH OFF GUARD ARE WE?
Kill of TWA-800 1996
Kill of USS Thresher 1963
Cold Explosion Off Japan Apr 1984
Kill of Space Shuttle Challenger 1986
From The Huntsville (AL) Times 18 Sep 96:
"Retired Gen. Wayne Downing concluded that U.S. forces are so far superior to potential foes that opponents have turned to terrorism as the only way of challenging them."
The Times also provided the information that Defense Secretary William Perry agreed with Gen. Downing's conclusion.
President's party airplane crash 1996
3 Dead U.S. Ambassadors from Moscow Embassy Radiation
QP Gulf War Syndrome: 16,000 persons disabled
QP jamming, U.S. air attack on Libya, 1996
Kill of Arrow DC-8 Gander AFB Dec 1985

JUST HOW MUCH OFF GUARD ARE WE?`

3 Dead U.S Ambassadors, U.S. Weather Engineered 20 years

Kill of USS Thresher Nuclear Submarine Apr 1963

QP Test on U.S. Troops in Persian Gulf, 1991 (Gulf War Syndrome)

TWA-800 1996; President's C-130 crash 1996

Arrow DC-8 Gander AFB Dec 1985

Challenger 1986

Quantum Potential Jamming of Air Attack on Libya Apr 1986

Blind Euphoria to Even the Ballistic Missile Threat

- U.S. National Intelligence Estimate (NIE) released in Nov. 1996 states there is no foreseeable threat to the U.S. from "indigenous missiles" for at least 15 years.
- Clinton has claimed a program for ABM defense is too expensive, would violate ABM Treaty with former USSR.
- Soviets developed an ABM system in violation of the treaty.
- In June 96 Russia test-launched an SS-19, their 26th ICBM test in 5 years.
- *"Russia still retains and is modernizing a vast nuclear arsenal... still the only nation of earth that could destroy America in a matter of minutes. Indeed, given the weakness of the Russian Army, Russia's superpower ambitions rest more than ever on its nuclear capabilities."* *
- "For the first time since the dawn of the nuclear age, there is not a single Russian missile pointed at America's children." **

Comment: Punch a computer button and the missiles are pointed! The armed missiles are still there, ready and waiting.

Bulleted info courtesy Washington Inquirer, June 24, 1996.

* House Nat'l Security Chmn, Floyd Spence.
** Bill Clinton, State of the Union Message.

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Possible Targets: 1995-9
Escalation Phase
(Based on 1985-87 test program)
Earthquakes
Missiles
Power Grids &
Distribution Systems
Satellites
Ships
Shuttle
Launches
& Flights
JETLINERS
Radio/TV
Subs
Microwave Nets
Radars &
Nets
Communications
and Computer Nets

Propagation of Weapon Effects

- All conventional weapons use propagation through 3-space of matter or energy or both
  - Matter (bombs, missiles, projectiles, etc.)
  - Energy (EM force fields, sonic force fields, etc.)
  - Basically one-to-one, or one "bus" to many-on-many
  - Finite propagation velocity v: where $0 < v \leq c$
  - Time delay: Shielding and pre-strike retaliation possible
- Structured quantum potential propagates vacuum ordering (vacuum engines), instantly
  - Zero time delay (through multiply-connected spacetime)
  - No propagation "through space", no "velocity" as such
  - Easily one-to-many, without limit
  - Dramatic energy amplifier (gates, amplifies flux ordering)
  - Effects arise in local spacetime; no shielding possible
  - No range limit, since striking distance always zero
- QP weapons obsolete all other weapons

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Yugoslav Earthquake, Followed by Cold Explosion

Apr. 15
1979

- Magnitude 7.2 on Richter scale
- Epicenter 33 km. deep
- More than 100 aftershocks
- At Kamenari:
  - Adriatic sea mushroomed up
  - Like atomic bomb explosion
  - Signature of a cold explosion
  - Similar to Apr. 1984 test off coast of Japan, near Kurils (see inset graphics)
- Note that April is a significant test month for the Communists (preparing official reports for May Day?)

© T.E. BEARDEN 1994, 1995

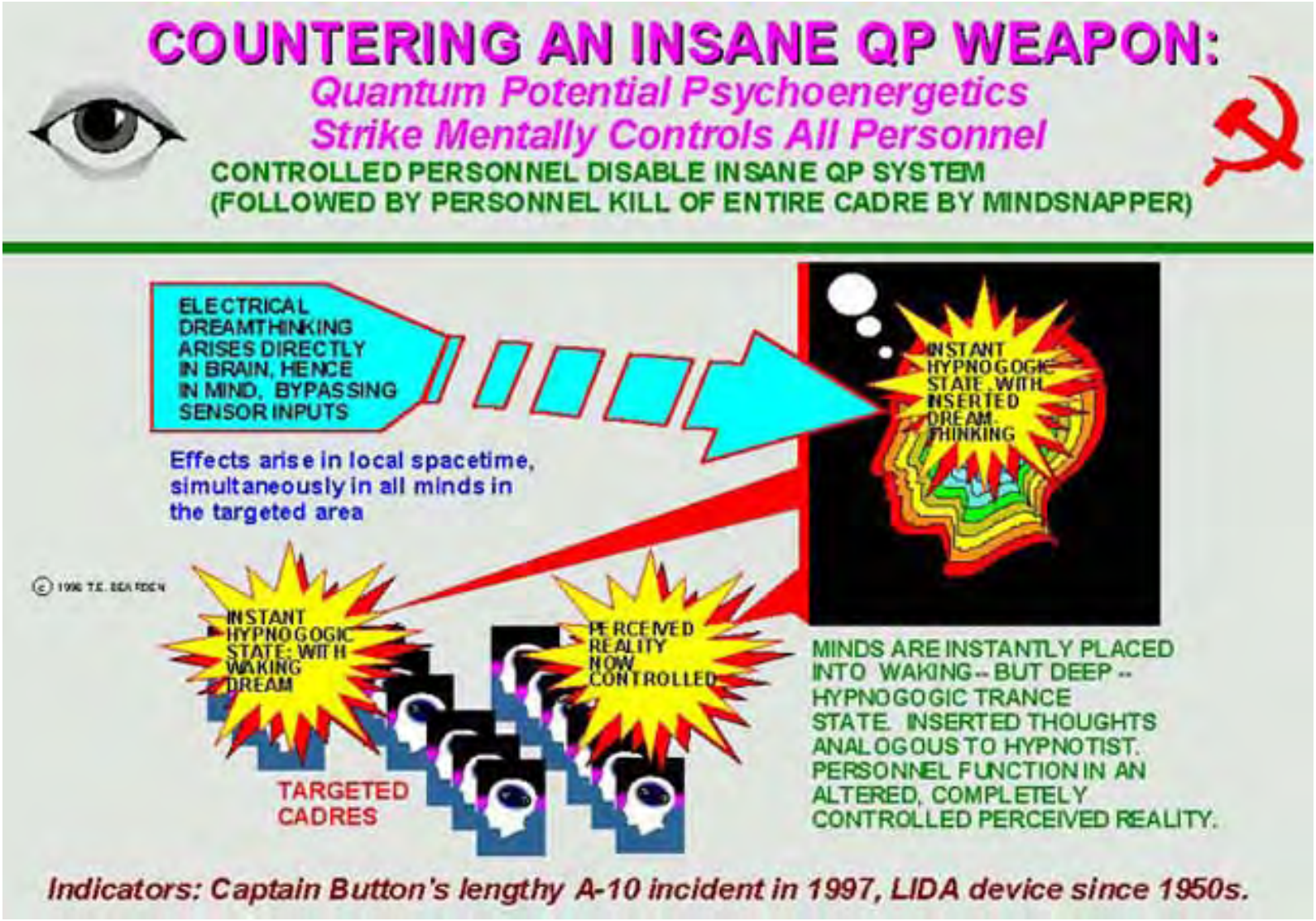
COUNTERING AN INSANE QP WEAPON:
Quantum Potential Psychoenergetics
Strike Mentally Controls All Personnel
CONTROLLED PERSONNEL DISABLE INSANE QP SYSTEM
(FOLLOWED BY PERSONNEL KILL OF ENTIRE CADRE BY MINDSNAPPER)
ELECTRICAL DREAMTHINKING ARISES DIRECTLY IN BRAIN, HENCE IN MIND, BYPASSING SENSOR INPUTS
Effects arise in local spacetime, simultaneously in all minds in the targeted area
INSTANT HYPNOGOGIC STATE, WITH INSERTED DREAM-THINKING
INSTANT HYPNOGOGIC STATE, WITH WAKING DREAM
PERCEIVED REALITY NOW CONTROLLED
TARGETED CADRES
MINDS ARE INSTANTLY PLACED INTO WAKING -- BUT DEEP -- HYPNOGOGIC TRANCE STATE. INSERTED THOUGHTS ANALOGOUS TO HYPNOTIST. PERSONNEL FUNCTION IN AN ALTERED, COMPLETELY CONTROLLED PERCEIVED REALITY.
Indicators: Captain Button's lengthy A-10 incident in 1997, LIDA device since 1950s.

Gulf War Disease: KGB QP Weapon Induced
ST Curvature Engines for a Cocktail of Diseases
LIBYA
EGYPT
CHAD
SUDAN
SAUDIA ARABIA
IRAN
IRAQ
© 1999 T. E. BEARDEN
Distant Scalar Potential Interferometer with iterative self-targeting

Self-Targeting in Inner EM Channel Can Produce a Quantum Potential

Once QP is established, energy transmission is direct and instantaneous. Energy input to one single participant will simultaneously appear in all other participants, the amount depending on their fractions of participation with the input station.

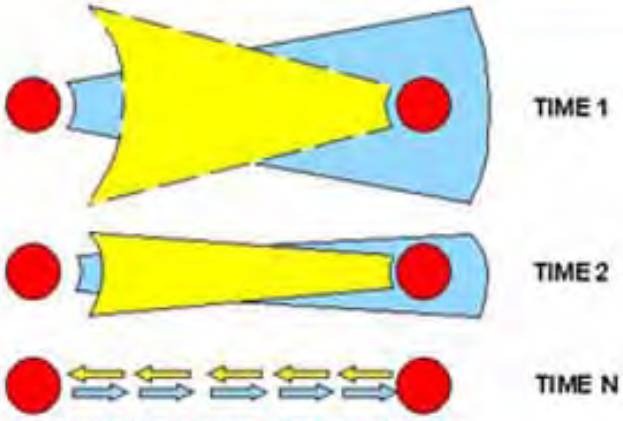

NARROWING OF INTERACTING POTENTIALS INTO LASER-LIKE BEAMS, BETWEEN TWO PUMPED SOURCES. NOW ONLY LONGITUDINAL WAVES CONNECT THE LINKED OBJECTS.

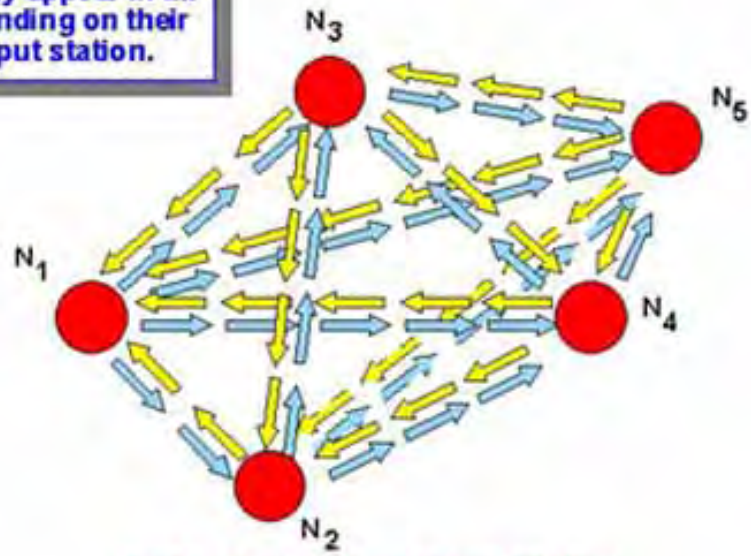

SELF-TARGETING EFFECT AMONG ALL PAIRS OF INTERACTING PUMPED SOURCES

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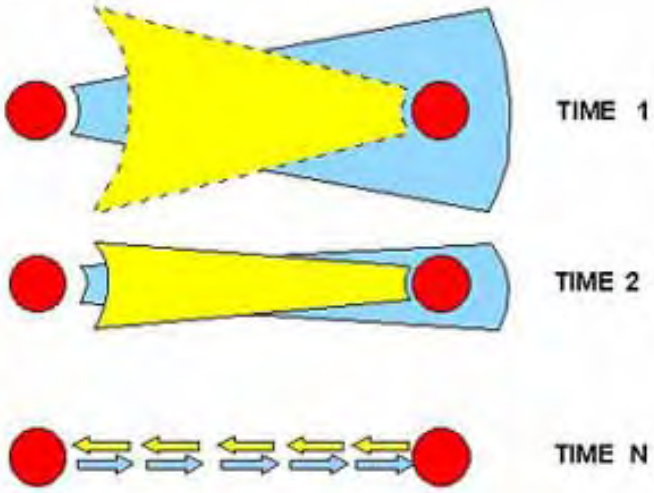

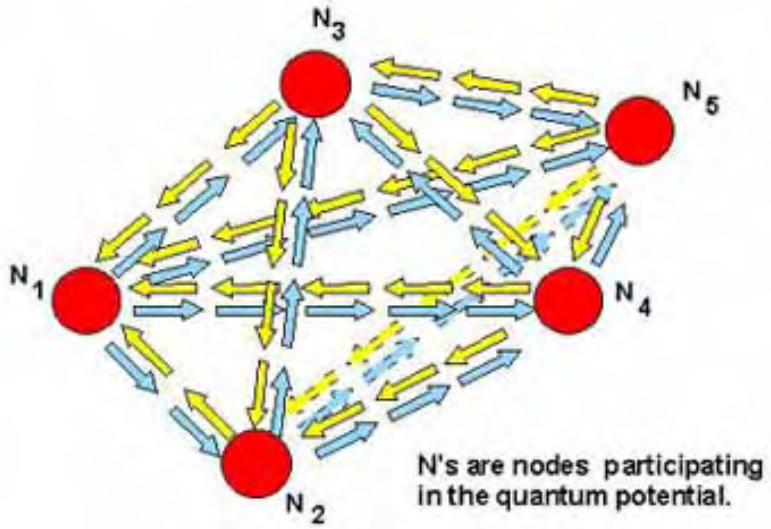

a. Iterative retroreflection between any pair of nodes narrows the interconnecting potentials to a laser-like, bidirectional beam. Iterative phase conjugate reflection provides self-targeting.

b. The quantum potential exists as narrow, laser-like beams between participating nodes, even when the nodes are widely separated. The beam space is multiply-connected; transmission is instantaneous.

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Consider the hidden Stoney/Whittaker bidirectional EM waves that comprise the potential from each source node. If these nodes have sufficient intersymmetry of dynamic material form, then self-targeting occurs between the two nodes of any nodal pair. By iterative phase conjugate reflection, the scattering is narrowed into interconnecting wavepairs, in laser-like beams, between each two nodes. Thus the interconnecting potentials narrow into laser-like, bidirectional beams. The Coulomb gauge may apply, and a quantum potential may be formed.

Figure 30. Mechanism for generating a quantum potential, by iterative self-targeting induced into a system of multiple scattering nodes. Once a QP is established, spatial separation has little or no effect.

Major Principles for Use of Quantum Potential Weapons

- Must disable dead-man fuzing prior to massive use of scalar interferometry weapons.
- Must assure immediate, complete nullification of unique enemy assets (quantum potential assets, special ships, and energetics weapons).
- Personnel can be destroyed instantly with mindsnapping; area is sterilized of life, and effect persists, gradually dying away.
- Personnel can be disabled instantly with various psychoenergetic weapons; area not sterilized.
- Personnel can be destroyed in short order by using EM BW weapons; area not sterilized.
- If foe has energetics weapons, then it is a quick-draw "gunslinger" contest unless insane MAD systems deployed.
- Complete surprise is of decisive importance.
- Tailor effect used to specific target, objective.
- *Note: Must use "insane" MAD systems to deter.*

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Quantum Potential Weapons: Major Principles (Continued)

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- Three major classes of use exist:
  - Use of bulk energy only (as in bulk heating or cooling) without substructuring
  - Use of internal structuring of the bulk energy, so that *vacuum engines* appear in target
  - Use of more deeply nested engines allows direct intervention in mind, long term memory, perception, thoughts, emotions, personality
- Use of vacuum engines allows engineering at a distance of:
  - *Atomic nuclei* including structures, reactions, and transmutations
  - *Bulk matter* including translations, lattice bonding, chemistry, chemical interactions, electromagnetic interactions
  - *Deep biological control systems* such as
    - Becker's cellular control (recovery) system
    - Popp's cellular control system
  - *Cells* including:
    - Structuring, differentiation and dedifferentiation
    - Genetic changes, chemical changes
    - Induction of disease states without normal disease vectors
  - *Mind/matter interface*, including long-term memory, perception, emotion, thought, mental state

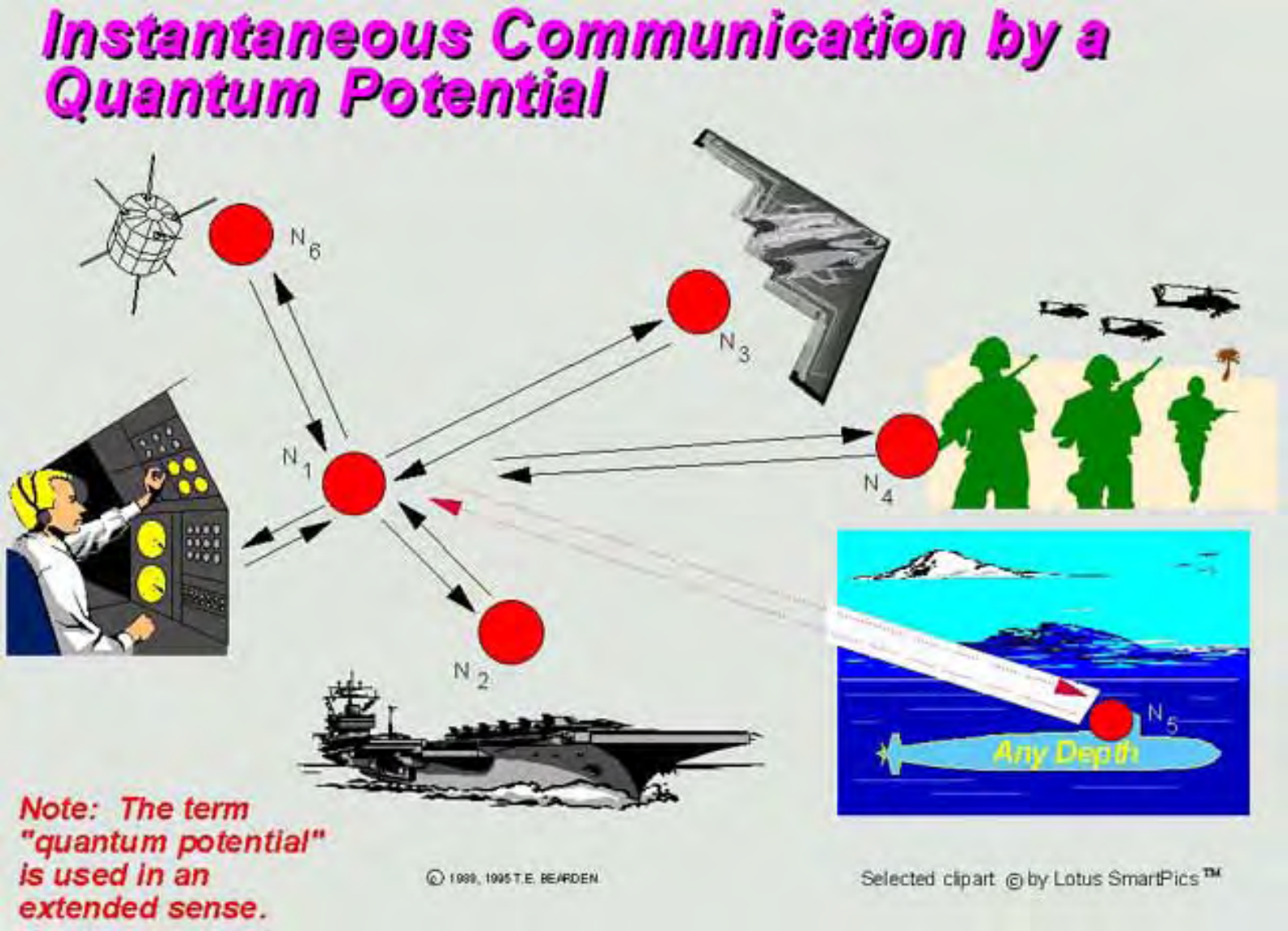
Instantaneous Communication by a Quantum Potential
N6
N3
N1
N4
N2
N5
Any Depth
Note: The term "quantum potential" is used in an extended sense.
© 1999, 1995 T.E. BEARDEN
Selected clipart © by Lotus SmartPics™

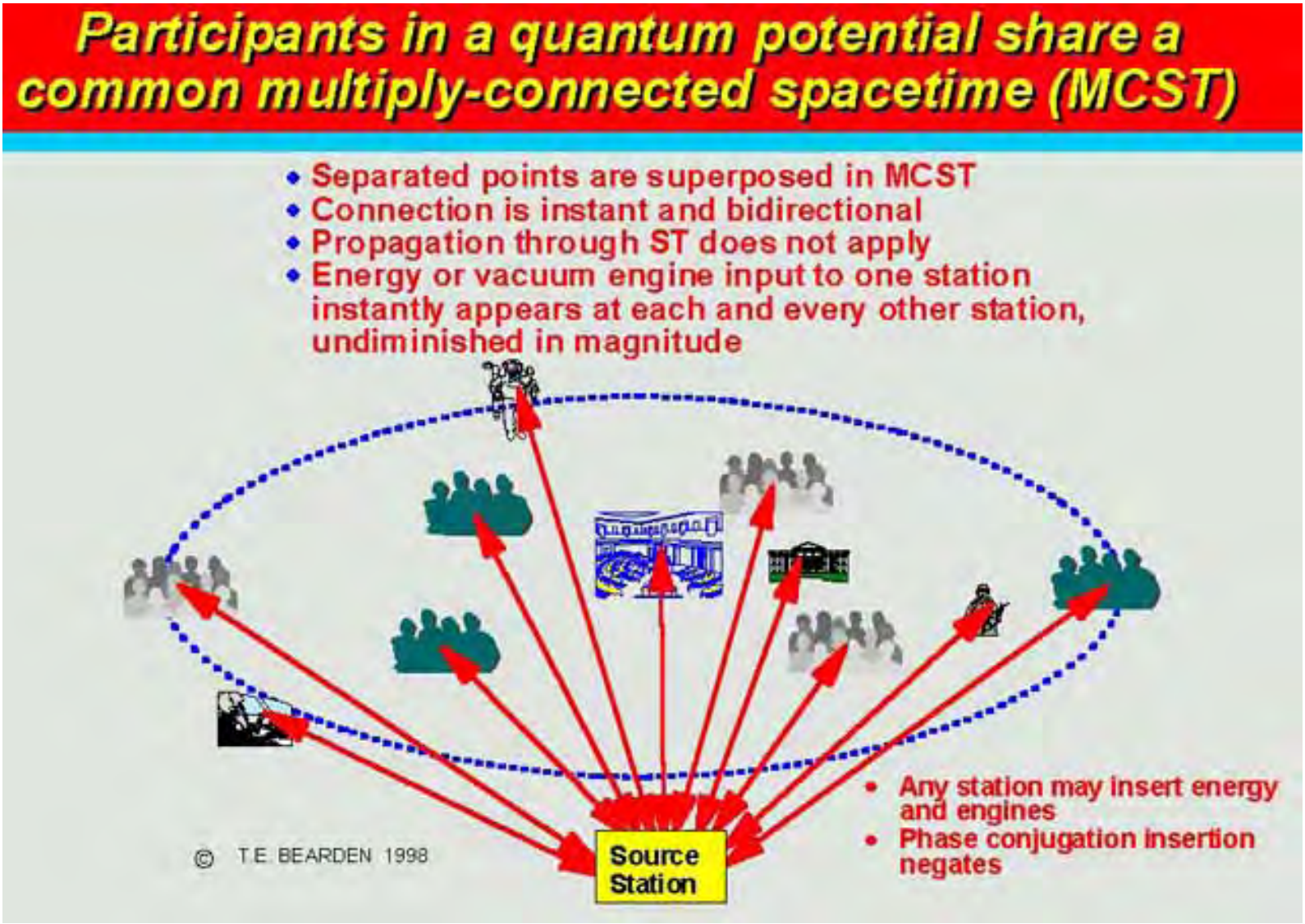
Participants in a quantum potential share a common multiply-connected spacetime (MCST)
• Separated points are superposed in MCST
• Connection is instant and bidirectional
• Propagation through ST does not apply
• Energy or vacuum engine input to one station instantly appears at each and every other station, undiminished in magnitude
• Any station may insert energy and engines
• Phase conjugation insertion negates
Source Station
© T.E. BEARDEN 1998

Quake in Tangshan, China

28 July, 1976

- 7.8 on Richter scale
- Hundreds of thousands killed
- Accompanied by extensive light, electrical effects
  - Starting 3 to 5 days before
  - Communications interference within 250 km
  - Sky lighting observed
- [Personal comments]

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Counting Rifles: Put up or shut up!

(Exchanging Earthquakes)

Opening bet

- Quebec 25 Nov 88
- Pasadena 3 Dec 88

Raise you

- Armenia 7 Dec 88

Call - what do you have?

- Malibu 18 Jan 89

Four aces

- Soviet Central Asia 23 Jan 89

Clear table (stress relief)

- Bakersfield et al various

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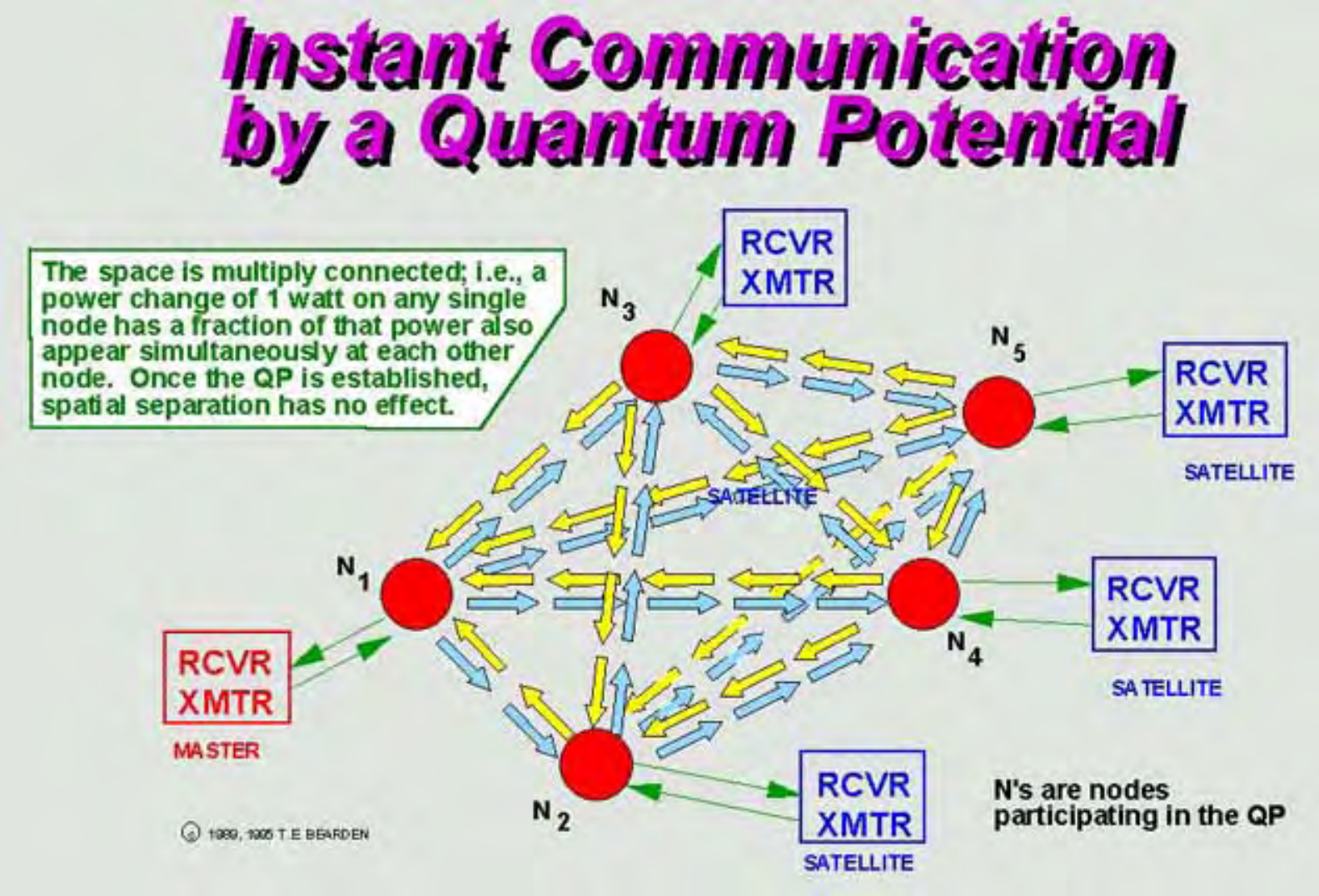
Instant Communication by a Quantum Potential
The space is multiply connected; i.e., a power change of 1 watt on any single node has a fraction of that power also appear simultaneously at each other node. Once the QP is established, spatial separation has no effect.
RCVR XMTR
N3
N5
RCVR XMTR
SATELLITE
SATELLITE
N1
RCVR XMTR
N4
SATELLITE
RCVR XMTR
MASTER
N2
RCVR XMTR
SATELLITE
N's are nodes participating in the QP
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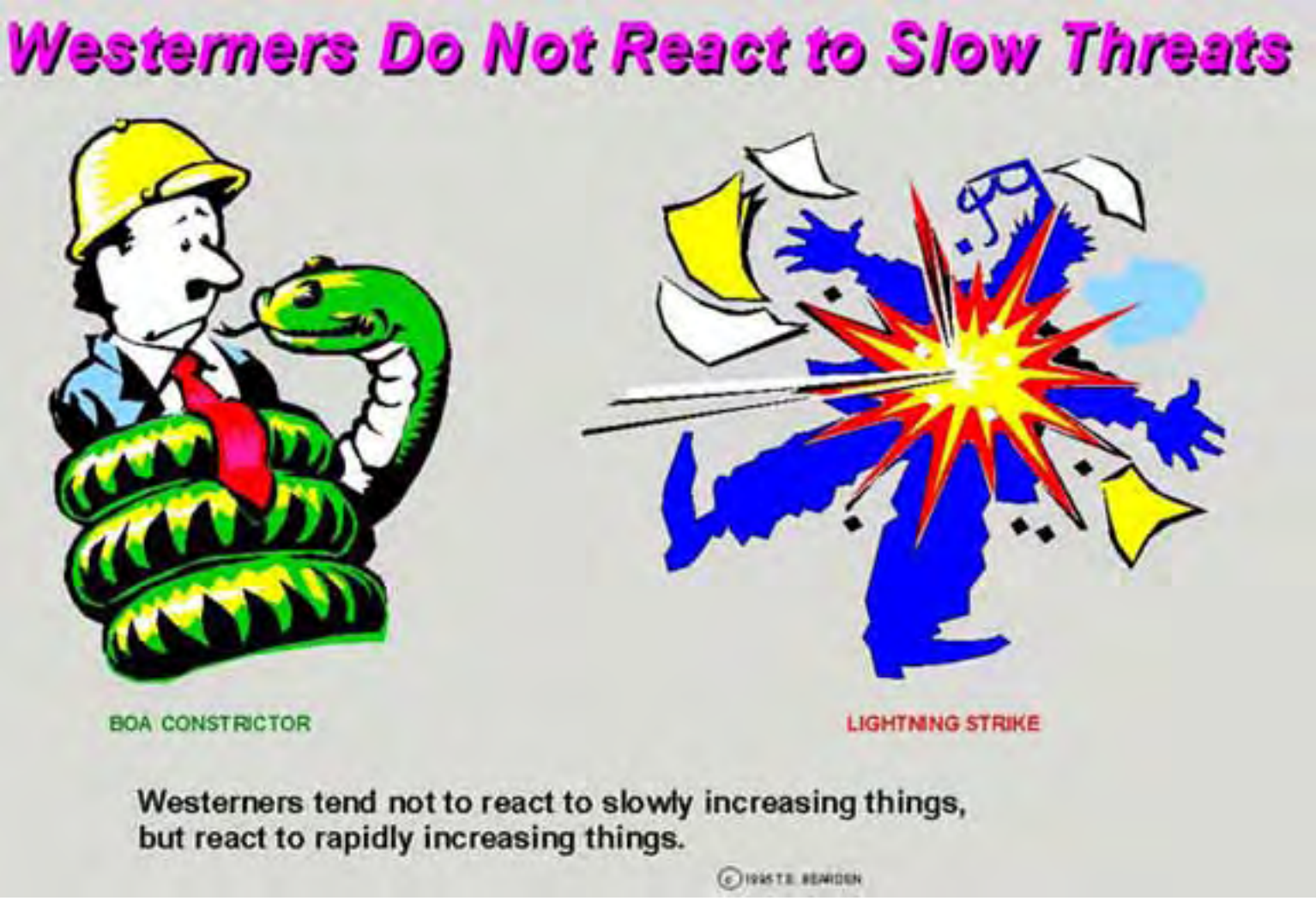
Westerners Do Not React to Slow Threats
BOA CONSTRICTOR
LIGHTNING STRIKE
Westerners tend not to react to slowly increasing things,
but react to rapidly increasing things.

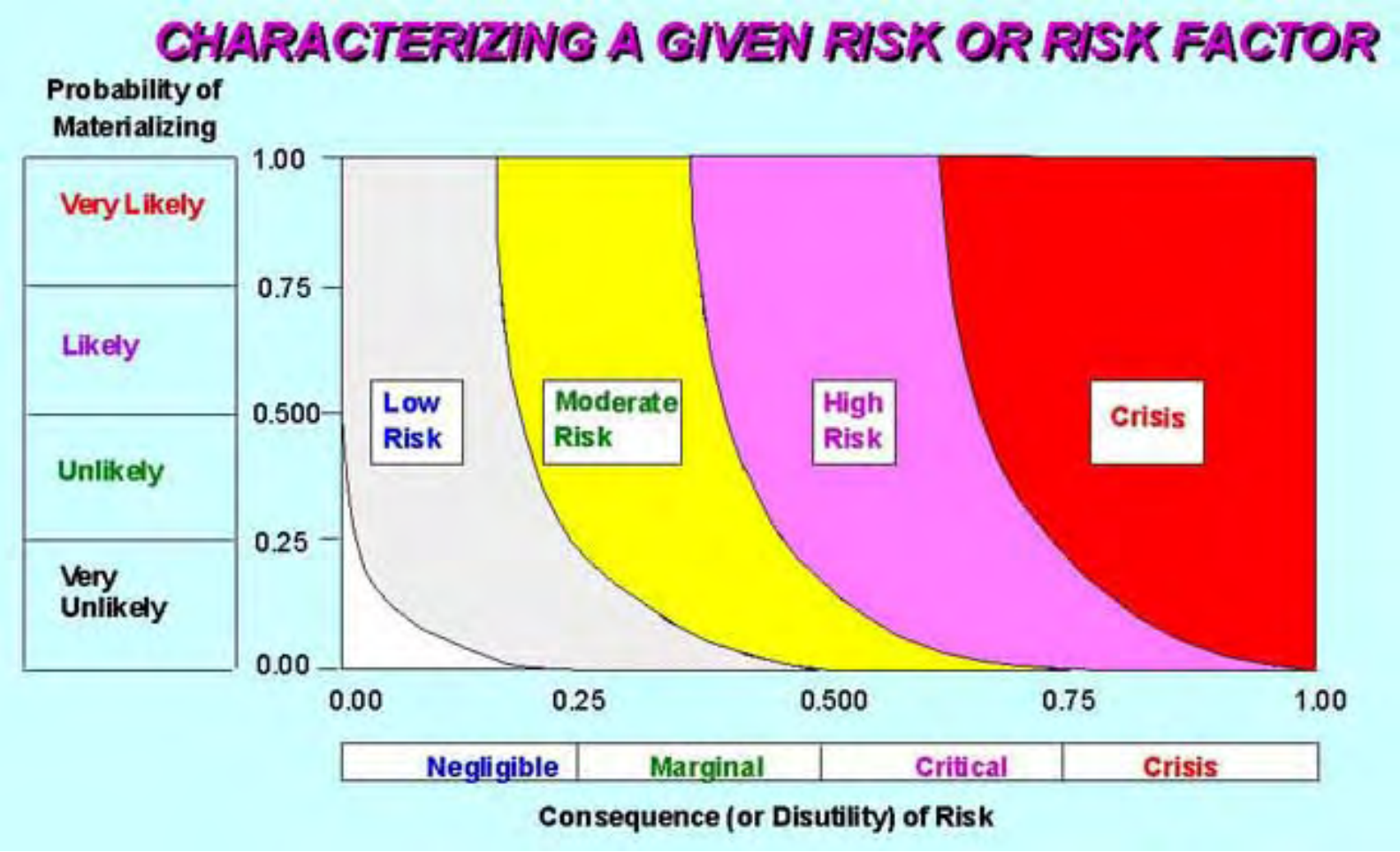
CHARACTERIZING A GIVEN RISK OR RISK FACTOR
Probability of Materializing
Very Likely
Likely
Unlikely
Very Unlikely
1.00
0.75
0.500
0.25
0.00
Low Risk
Moderate Risk
High Risk
Crisis
0.00
0.25
0.500
0.75
1.00
Negligible
Marginal
Critical
Crisis
Consequence (or Disutility) of Risk

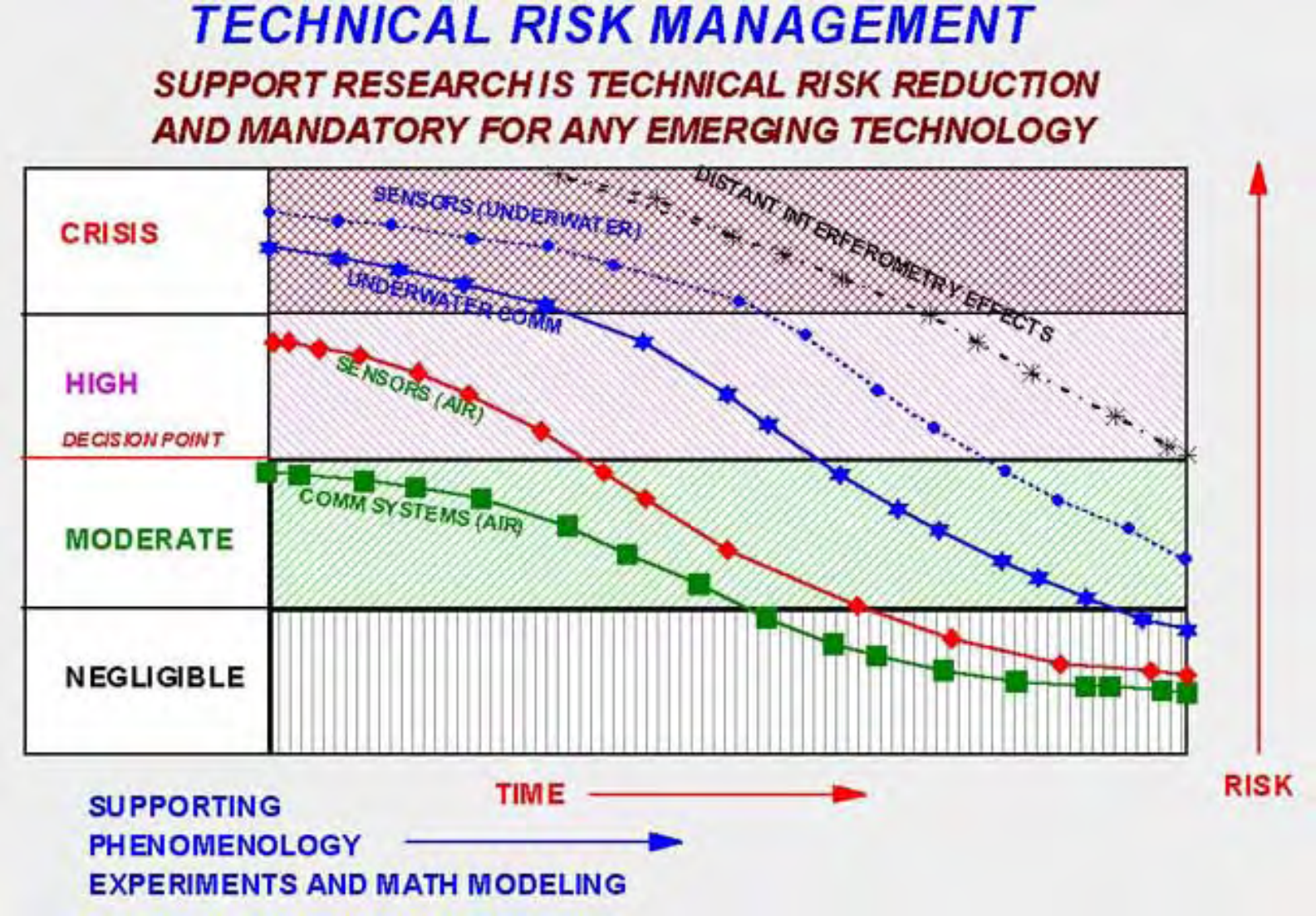
TECHNICAL RISK MANAGEMENT
SUPPORT RESEARCH IS TECHNICAL RISK REDUCTION
AND MANDATORY FOR ANY EMERGING TECHNOLOGY
CRISIS
HIGH
DECISION POINT
MODERATE
NEGLIGIBLE
SENSORS (UNDERWATER)
DISTANT INTERFEROMETRY EFFECTS
UNDERWATER COMM
SENSORS (AIR)
COMM SYSTEMS (AIR)
TIME
RISK
SUPPORTING
PHENOMENOLOGY
EXPERIMENTS AND MATH MODELING

Aum Shinrikyo's Sarin Facility

The interior of Satian No. 7, a suspected sarin production plant

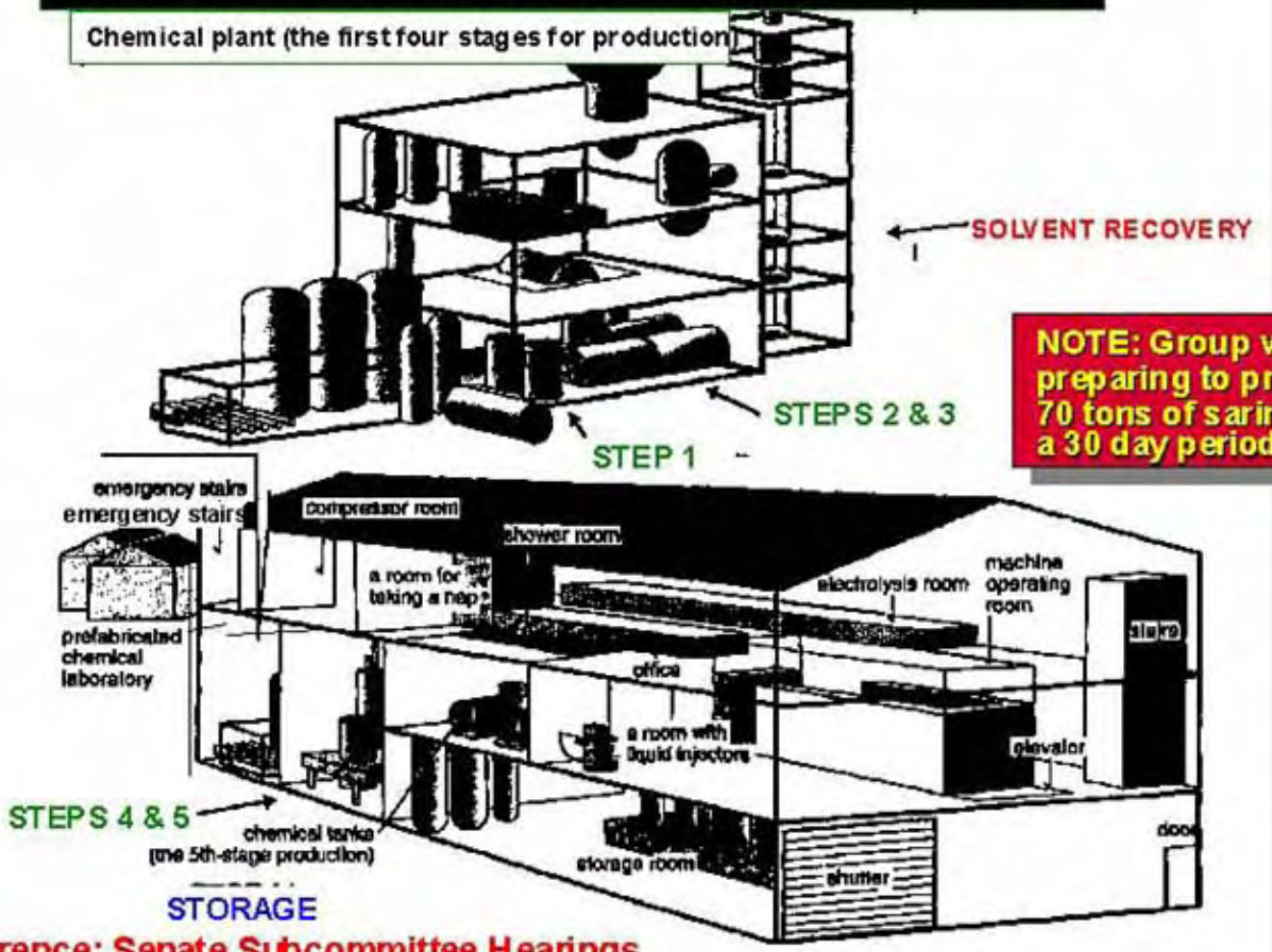

NOTE: Group was preparing to produce 70 tons of sarin in a 30 day period.

Reference: Senate Subcommittee Hearings

In Scalar Beam Interference Zone

- De-phasing of wave/antiwave pairs occurs
- Zero-summation destroyed
- Ordinary EM reappears [Whittaker 1904]
- Ordinary energy appears or disappears (i.e., may produce heating or cooling)
- Energy bottle effect
- Can add or extract EM energy
- Can produce specific ST curvature engines

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Physicist Schappeller Auralaz Munster, Austria:

- British Intelligence interview, about 1948
  - Used Kaluza-Klein theory
  - Worked with Russians
- Schappeller claimed he could:
  - Cause "implosions" rather than explosions
  - Use gravitational and electromagnetic energy
  - Cause large areas of the ocean to freeze
  - Tap earth-ionospheric field
  - Produce enormous energy
- *This is precisely what Hellman worked on in the USSR, after WW II!*

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Initial Soviet Plan for Cold War, After WW II

- Develop and deploy SAM bomber defense
- Catch up in atomic weapons
- Master and apply rocketry
- Wed atomic warheads to rockets
- Initiate "Cold" War
  - Bleed the dragon
  - Guerrilla wars
  - Terrorism
  - Insurgencies
- *Find, develop, and weaponize next great technical breakthrough area as highest national priority*

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Josef Stalin: Absolute Dictator

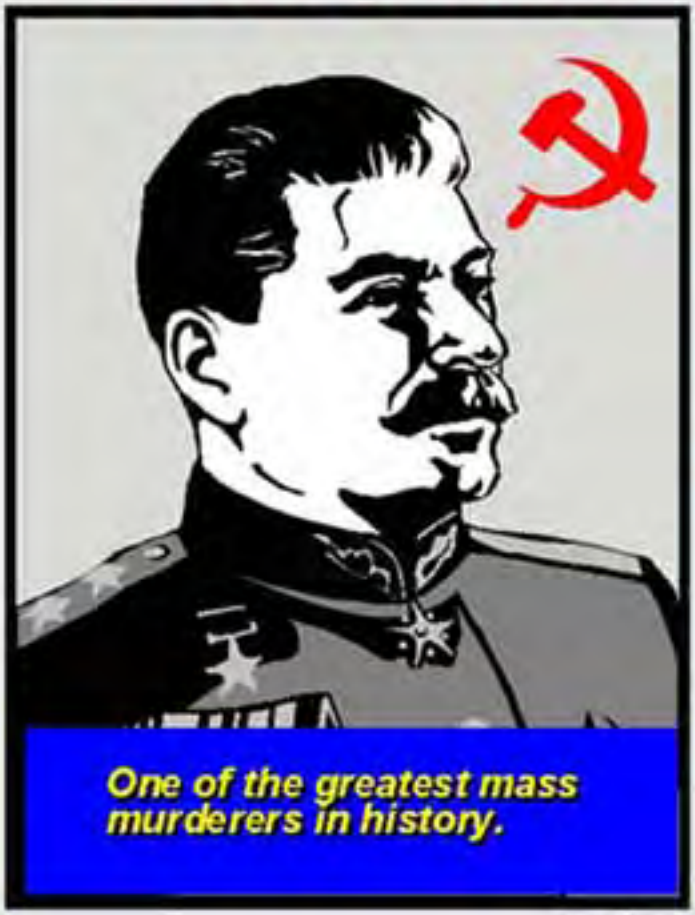

- Secret police and spies everywhere
- Purged his own officer corps
- Always deeply suspicious
- Regularly purged his enemies or those perceived to be shaky or untrustworthy
- Absolute power, justice had nothing to do with it
- Opponents often just disappeared in the night, never to be seen again
- Secret police often tortured, killed them
- Others sent to slave labor camps to die by severe work, starvation, and beatings or downright massacre
- Had experienced unusual abilities of Wolf Messing, so knew that some persons could do unusual things
- Forced Soviet weapon physics into this psychoenergetics realm also

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Exploding any Resistance by Operational Scientists
Josef Stalin
© T.E. BEARDEN 1997
The Communists slaughtered 20 million Russian Kulaks to collectivize Soviet farming
Assembled Academy
"The destiny of communism has been frustrated by the U.S. development of the atomic bomb. That is not the last great technical breakthrough. The next one WILL be Soviet! You will provide me with that great new technical breakthrough at all speed, or I will have your heads. Do I make myself clear, comrades?"

Significant Soviet Statements

- "In the final revolution, it does not matter if three-quarters of the earth is destroyed, so long as the other quarter emerges communist." *[Lenin]*

- "If a means of total neutralization of foreign missiles is to be found, it can only come from a group of new principles in physics, called energetics." *[Nobelian Petr Kapitsa, to Nikita Khrushchev, in answer to Khrushchev's demand for a 100% method of defense against long range missile attack.]*

- "We will bury you." *[Khrushchev, to Nixon, Kitchen Debate]*

- "We have a new weapon, just within the portfolio of our scientists, so to speak, which is so powerful that, if unrestrainedly used, it could wipe out all life on earth. It is a *fantastic* weapon." *[Khrushchev, speaking to the Presidium, Jan. 1960]*

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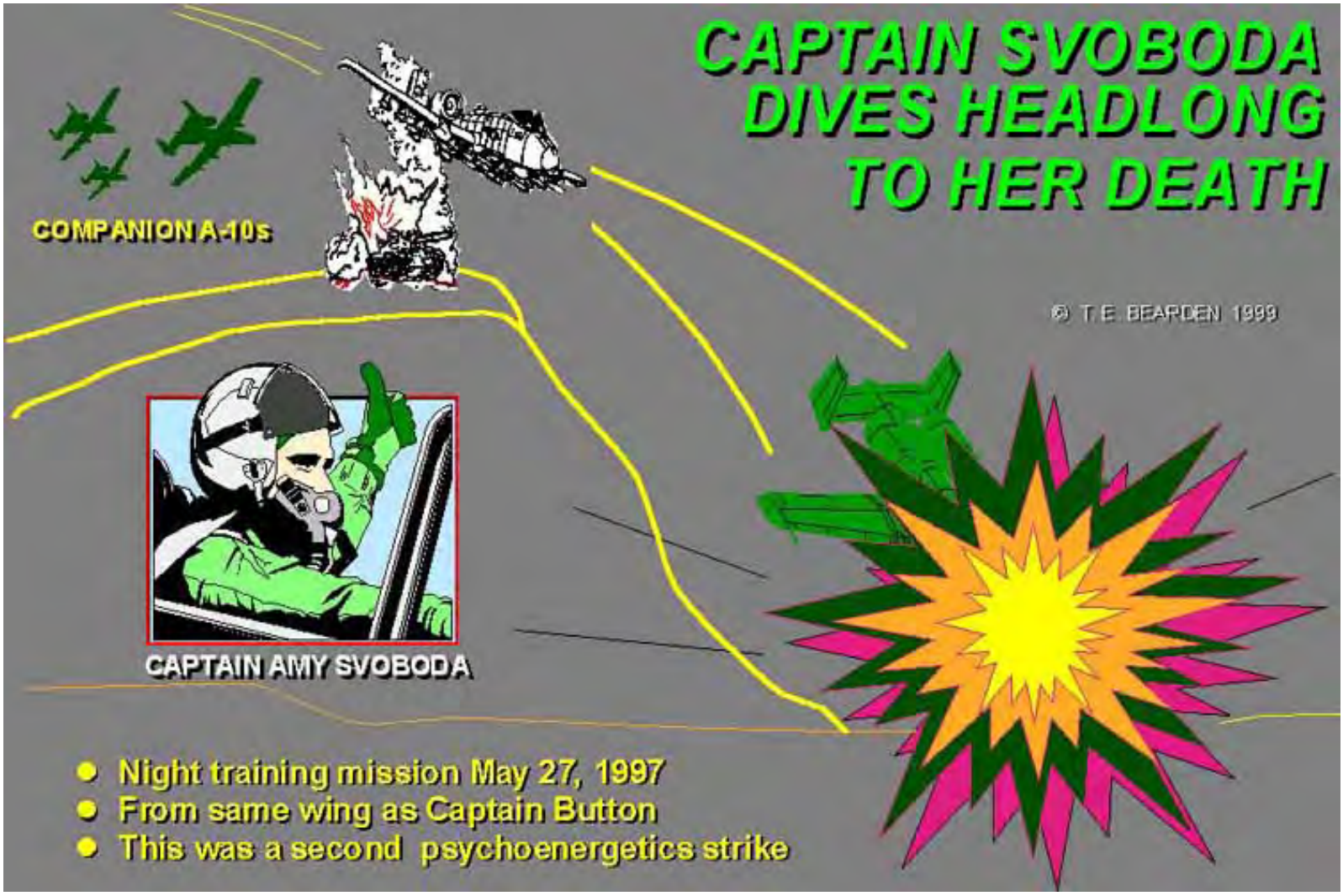
CAPTAIN SVOBODA
DIVES HEADLONG
TO HER DEATH
COMPANION A-10s
© T.E. BEARDEN 1999
CAPTAIN AMY SVOBODA
• Night training mission May 27, 1997
• From same wing as Captain Button
• This was a second psychoenergetics strike

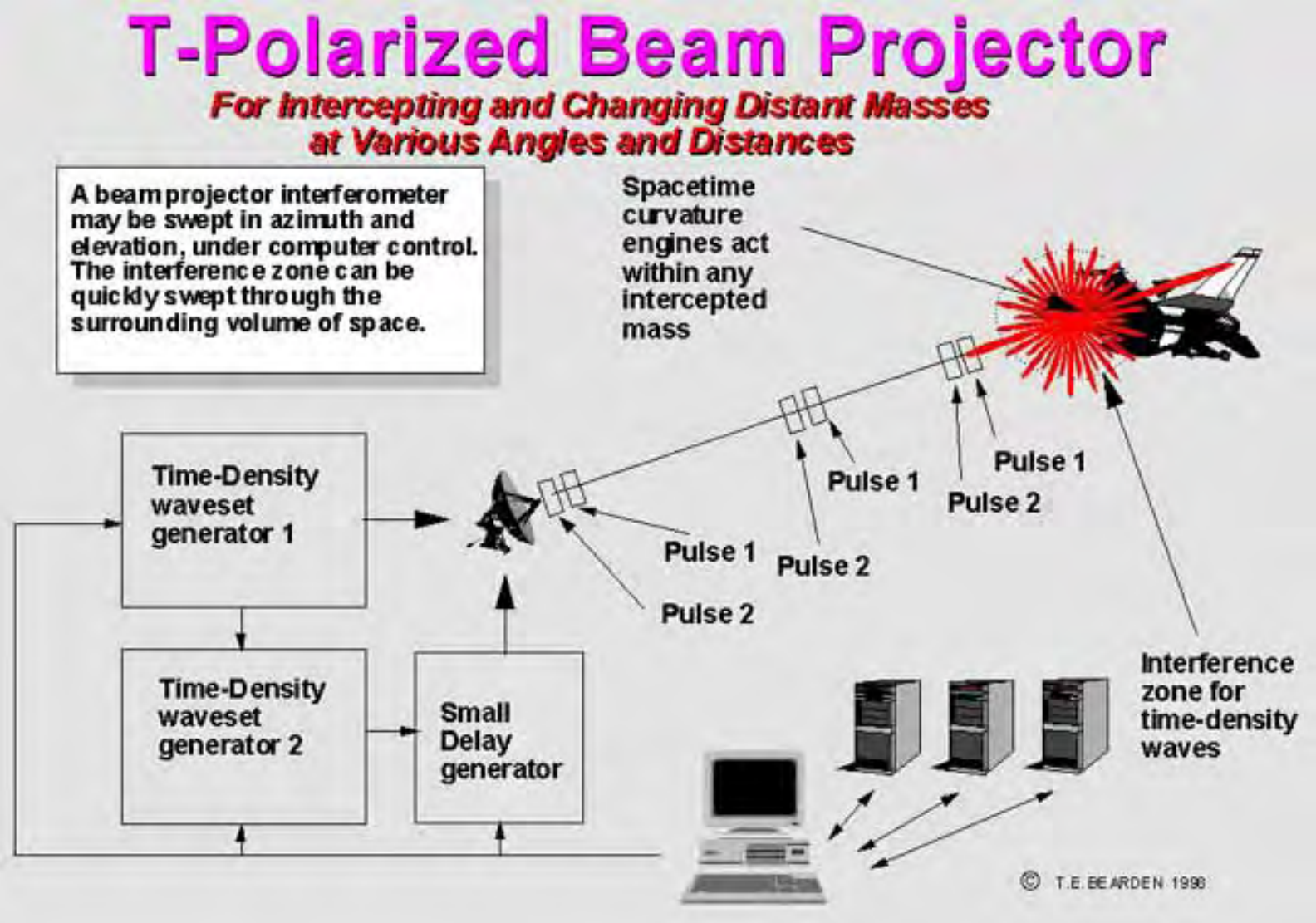
T-Polarized Beam Projector
For Intercepting and Changing Distant Masses
at Various Angles and Distances
A beam projector interferometer may be swept in azimuth and elevation, under computer control. The interference zone can be quickly swept through the surrounding volume of space.
Spacetime curvature engines act within any intercepted mass
Time-Density waveset generator 1
Time-Density waveset generator 2
Small Delay generator
Pulse 1
Pulse 2
Pulse 1
Pulse 2
Pulse 1
Pulse 2
Interference zone for time-density waves
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Possible Tests (1)

- 1958 nuclear accident in Urals
- Disease induction in U.S. Embassy personnel in Moscow
- Siberian disease/death transmission experiments
- Destruction of USS Thresher nuclear submarine, Apr. 10, 1963
- Nuclear explosion transmitted into ocean underwater, 100 miles north of Puerto Rico, Apr. 11, 1963

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Possible Tests (2)

- Eight F-111's downed in Vietnam immediately after deployment
- Several large earthquakes
- Mysterious aircraft losses in groupings
- Numerous underground "nuclear" tests
- Nuclear tests at Semipalatinsk without associated seismic activity
- High altitude rumbles, snaps, booms
  - *Off English coast*
  - *Off East coast of U.S.*
  - *Over West Coast of U.S. in thunderstorms*

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Possible Tests (3)

- Blinding of several U.S. satellites (up to 4 hours in duration)
- Cold Explosion off Kurils 1984
  - First, a cold explosion
  - Then test of giant Tesla shield 300 mi. dia.
- Tests offset from shuttle launch Nov. 85
- Kill of Arrow DC-8,Gander, NFLD Dec. 1985
- Titan kill, Vandenberg AFB, CA early 1986
- Kill U.S. Challenger, off Cape Canaveral 1986
- Earthquakes induced, 1986-88
- Dozens of tests of shields around the world
- Decades of radiating U.S. Embassy in Moscow

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Possible Tests (4)

- Extensive tests 1990-99 in Western Australia
- Engineering of weather since 1990 by Yakuza
- Possible nuclear dudding test in WA in 90s by Aum Shinrikyo
- C-130 engine flameout kill
- TWA-800 kill 1997
- Gulf War Disease Induced, 1991
- Spreading of immune systems of U.S. populace, 1990s
- Psychoenergetic control of Captain Button
- Psychoenergetic control of Captain Svoboda
- Twice in 1997, within days of full strategic destruction of U.S.

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Mushroom cloud rising from sea

- 0514 hrs, 9 April 1984
- Gray-white cloud appeared
- Rose 60,000 feet in 2 minutes
- South of Kuril Islands
  - *180 miles southeast of Hokaido*
  - *200 miles from Tokyo*
- Soviet missile testing scheduled about 350 miles away, at 2100 hrs, 9 April 1984

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Launches from Cape Canaveral
and Vandenberg AFB
Provided Practice Targets of Opportunity

The sinking U.S.S. Thresher, with her controls jammed, implodes when she reaches crush depth

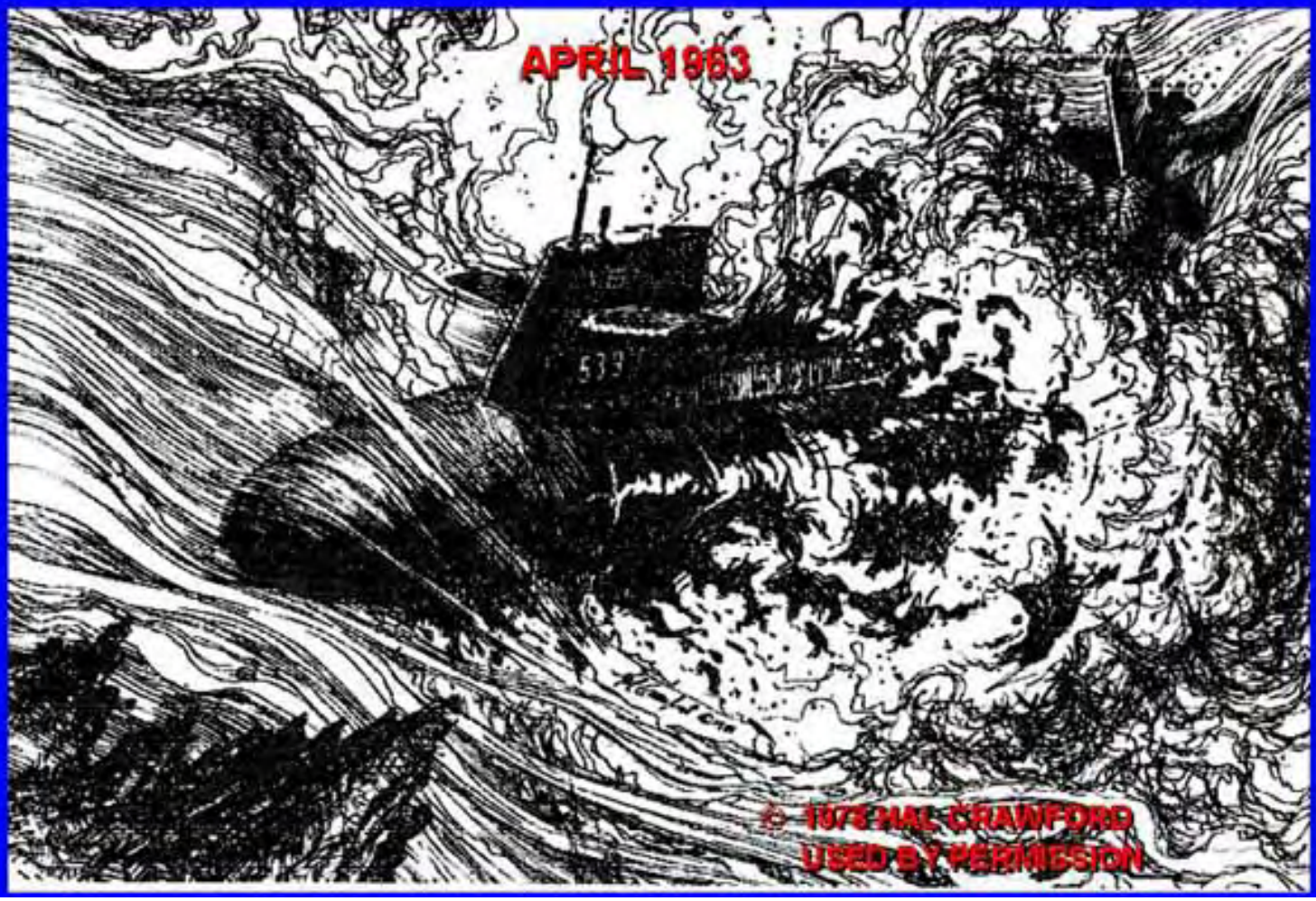

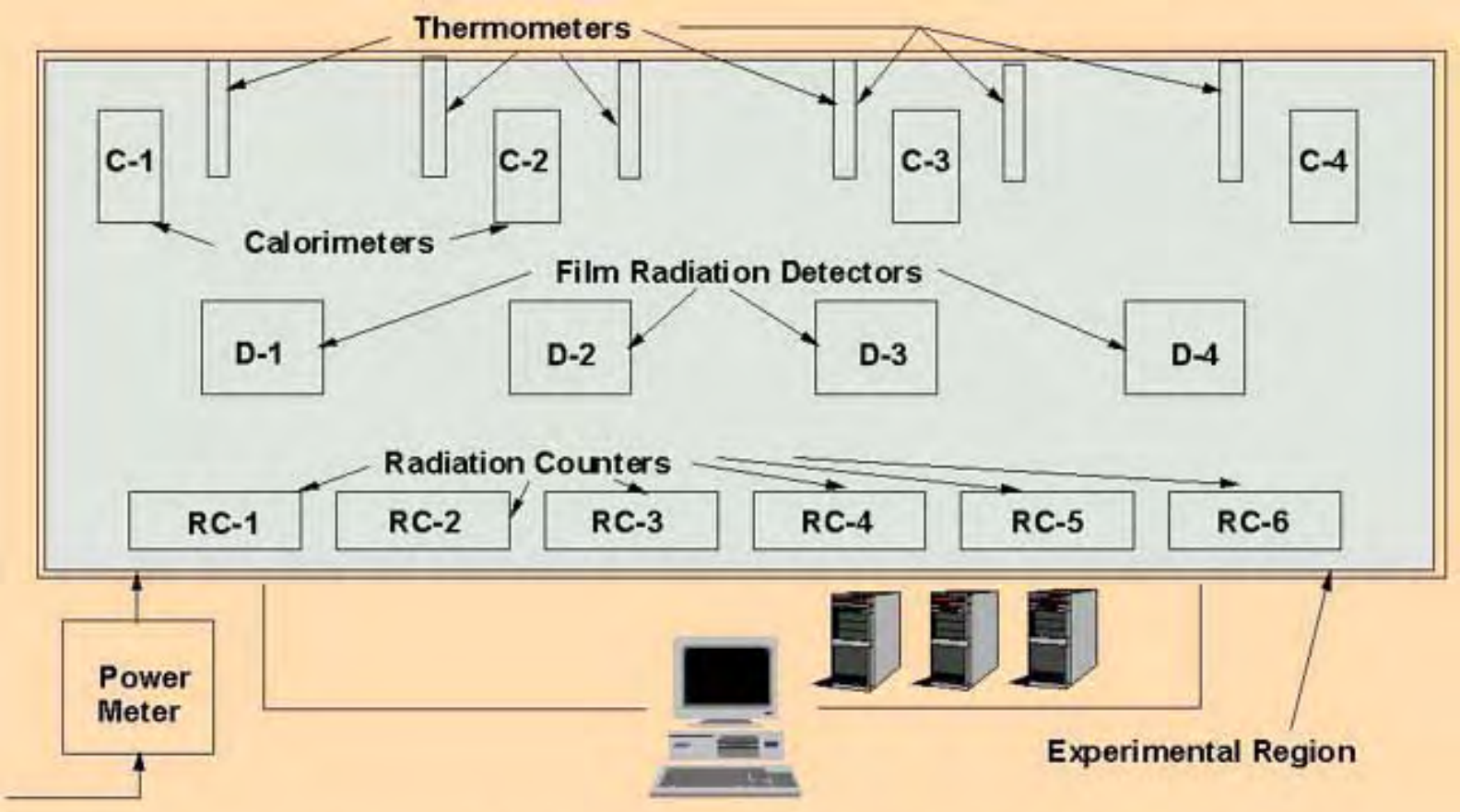

Figure 32. Embodiment of an instrumental array sufficient to discriminate when time-density charging has occurred, and that transduction of time-charge decay is occurring.

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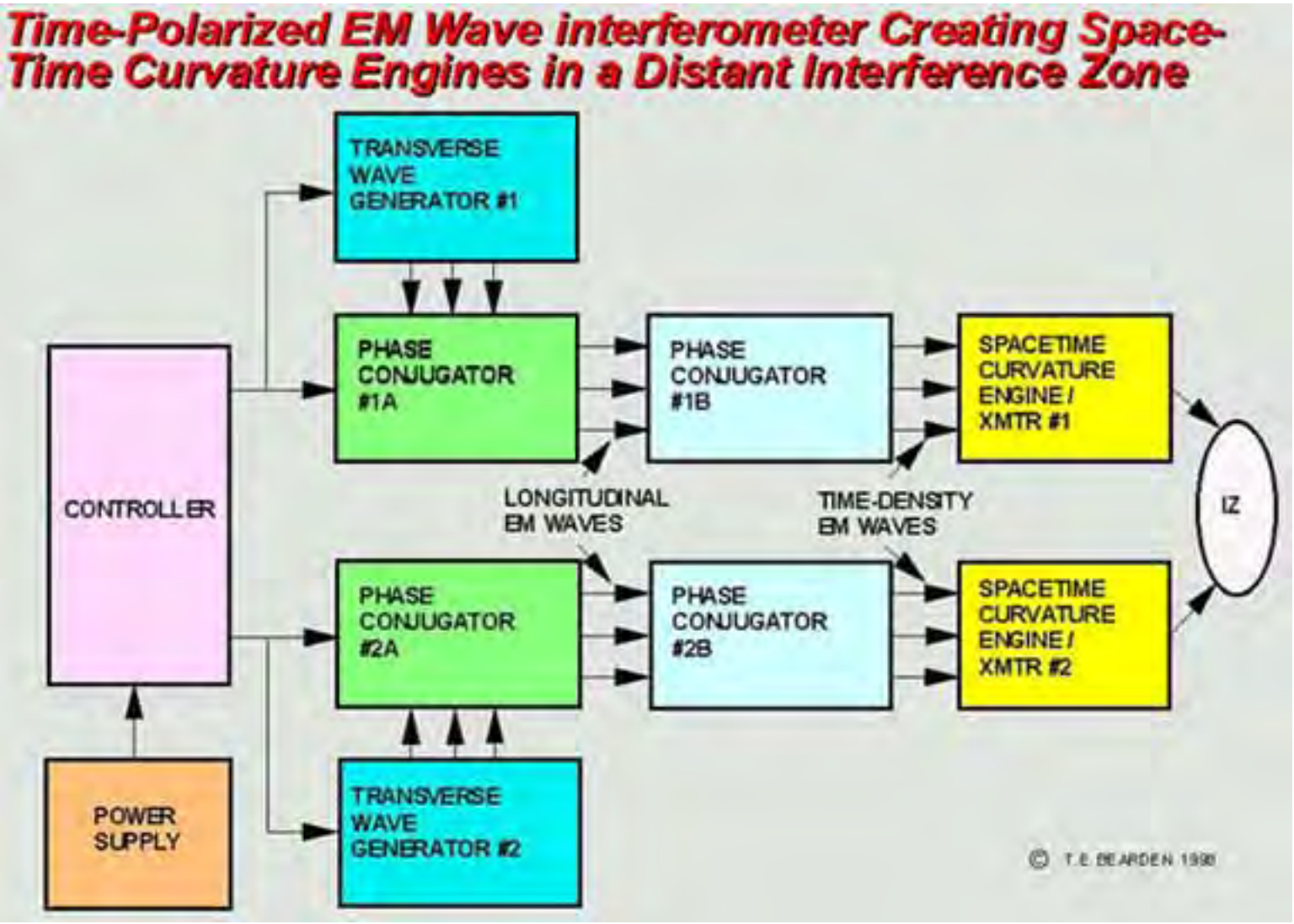
Time-Polarized EM Wave interferometer Creating Space-Time Curvature Engines in a Distant Interference Zone
TRANSVERSE WAVE GENERATOR #1
PHASE CONJUGATOR #1A
PHASE CONJUGATOR #1B
SPACETIME CURVATURE ENGINE / XMTR #1
CONTROLLER
LONGITUDINAL EM WAVES
TIME-DENSITY EM WAVES
IZ
PHASE CONJUGATOR #2A
PHASE CONJUGATOR #2B
SPACETIME CURVATURE ENGINE / XMTR #2
POWER SUPPLY
TRANSVERSE WAVE GENERATOR #2
© T.E. BEARDEN 1990

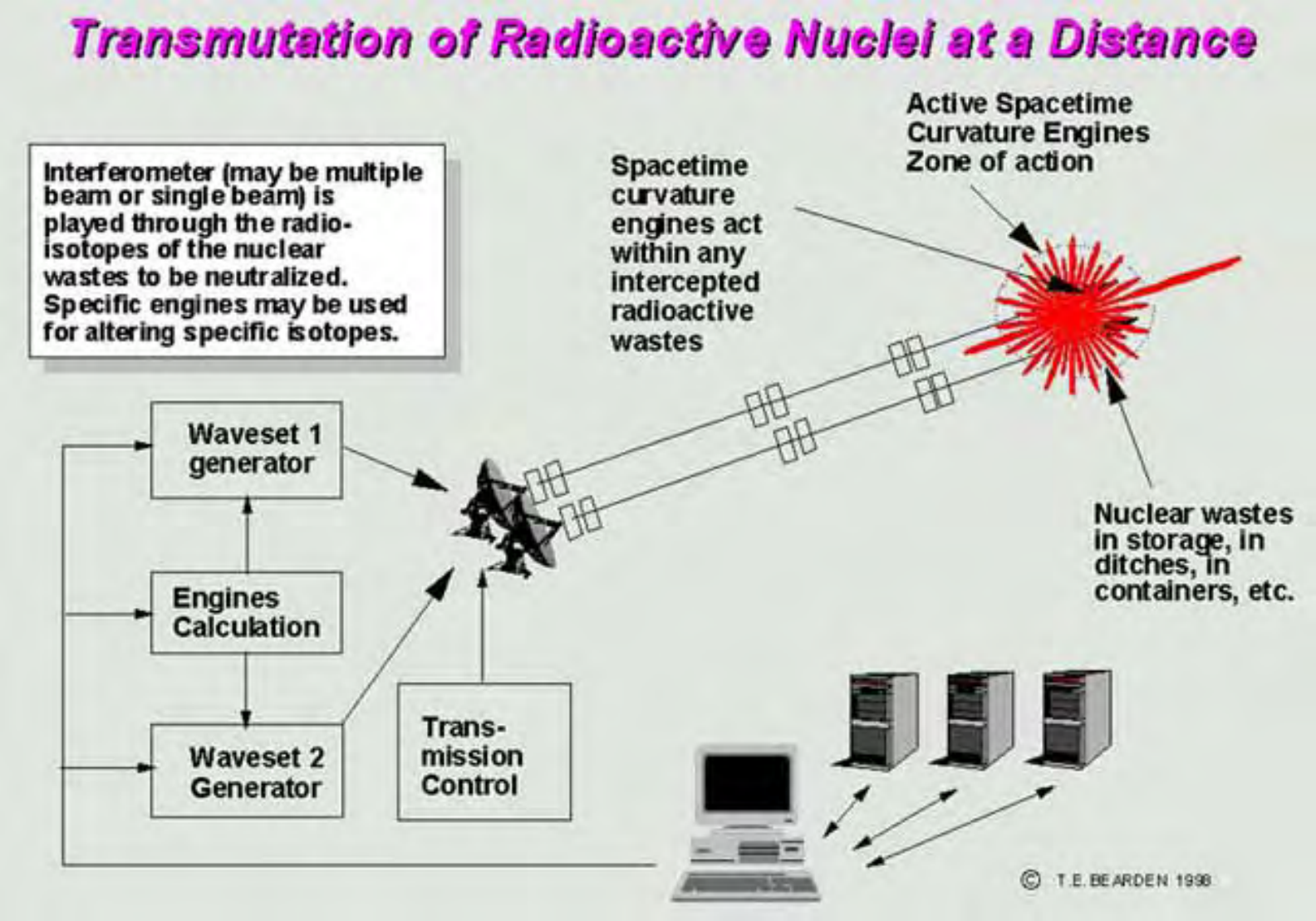
Transmutation of Radioactive Nuclei at a Distance
Interferometer (may be multiple beam or single beam) is played through the radio-isotopes of the nuclear wastes to be neutralized. Specific engines may be used for altering specific isotopes.
Spacetime curvature engines act within any intercepted radioactive wastes
Active Spacetime Curvature Engines Zone of action
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
Nuclear wastes in storage, in ditches, in containers, etc.
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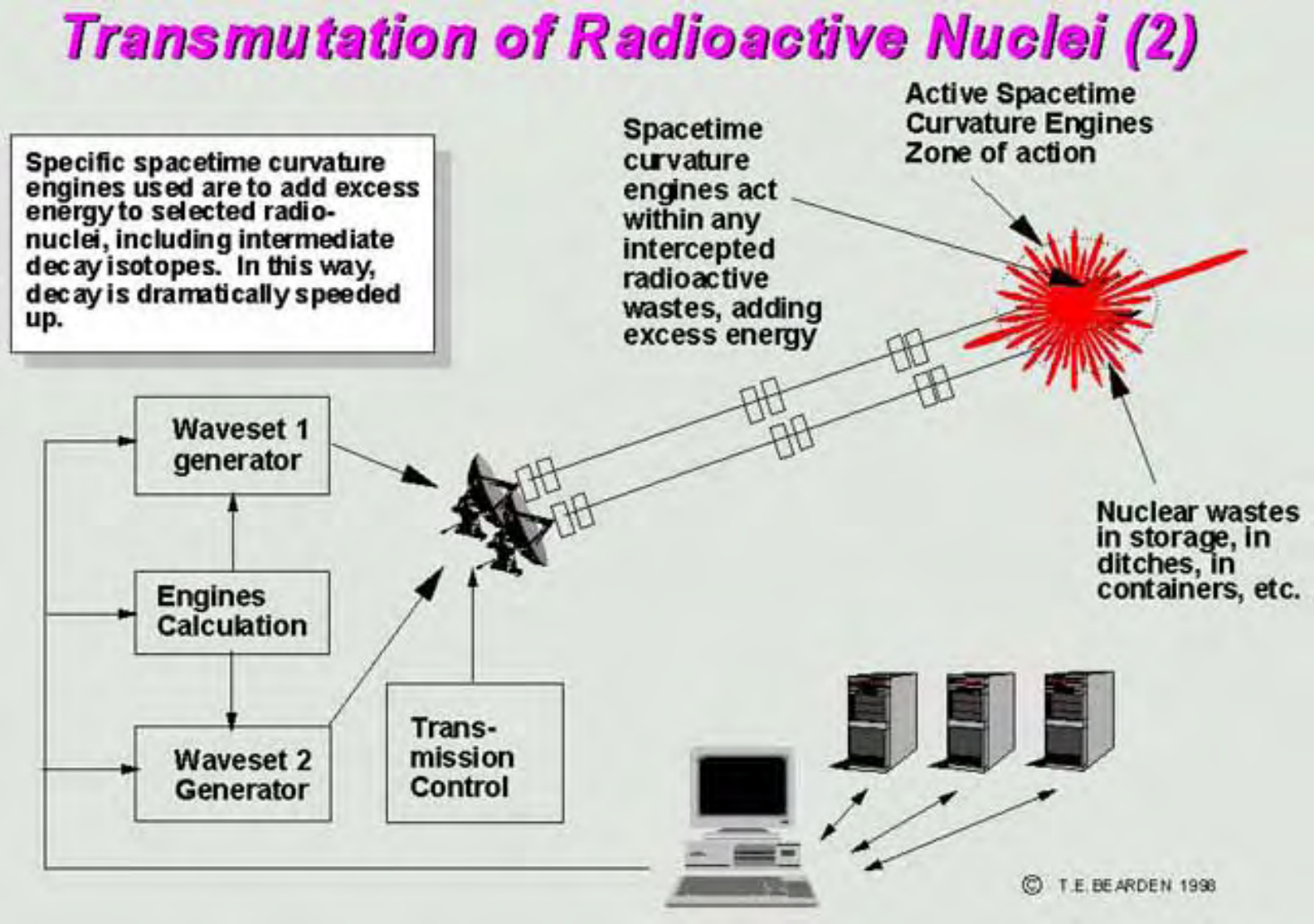
Transmutation of Radioactive Nuclei (2)
Specific spacetime curvature engines used are to add excess energy to selected radio-nuclei, including intermediate decay isotopes. In this way, decay is dramatically speeded up.
Spacetime curvature engines act within any intercepted radioactive wastes, adding excess energy
Active Spacetime Curvature Engines Zone of action
Nuclear wastes in storage, in ditches, in containers, etc.
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
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Typical Shield Test, Northern Route to Japan
18-27 km diameter
Asahi Evening News, Tokyo
June 22, 1982
Multiple tests seen per month, for years.
Pilots simply ceased reporting them.
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A Curious Tide in Human Affairs

To win its freedom in the long run, usually a group must defeat its attackers or suppressors *at least twice*.

- We fought the British twice for our independence.
- We are fighting ourselves twice to free the slaves. - American Civil War
  - Civil rights struggle
- We beat the Germans twice, in WW I and WW II
- We beat the Hispanics in the Spanish-American War. *That's once*. (They're winning the second by crossing the border. The U.S. is becoming a Hispanic Nation).

But we also have some unfinished business at hand.

- We checked the Russians in the Cold War. *Once*.
- We checked the Japanese in WW II. *Once*.
- We checked the KGB in the Cold War. *Once*.
- We checked the Communists in the Cold War. *Once*.
- We checked Saddam Hussein in the Gulf War. *Once*.

Large Scalar EM Interferometer (LASI) Accident Near Urals, 1958

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- 1958 nuclear explosion near Urals
  - Signature of large scalar interferometer (LASI) accident
  - Buried atomic wastes suddenly exploded
  - Large region contaminated to this day
- Soviets were well along with advanced LASI prototypes and testing
  - Khrushchev announced forthcoming advent of these "fantastic" weapons in Jan. 1960
  - 1958 difficulties could have been resolved by 1960
- Expected 1958 cause: transmitter short-out and failure in a nearby LASI discharged its cumulated energetics beam energy into the ground
- *Spreading ground pulse struck nearby atomic wastes, fissioning nuclei*

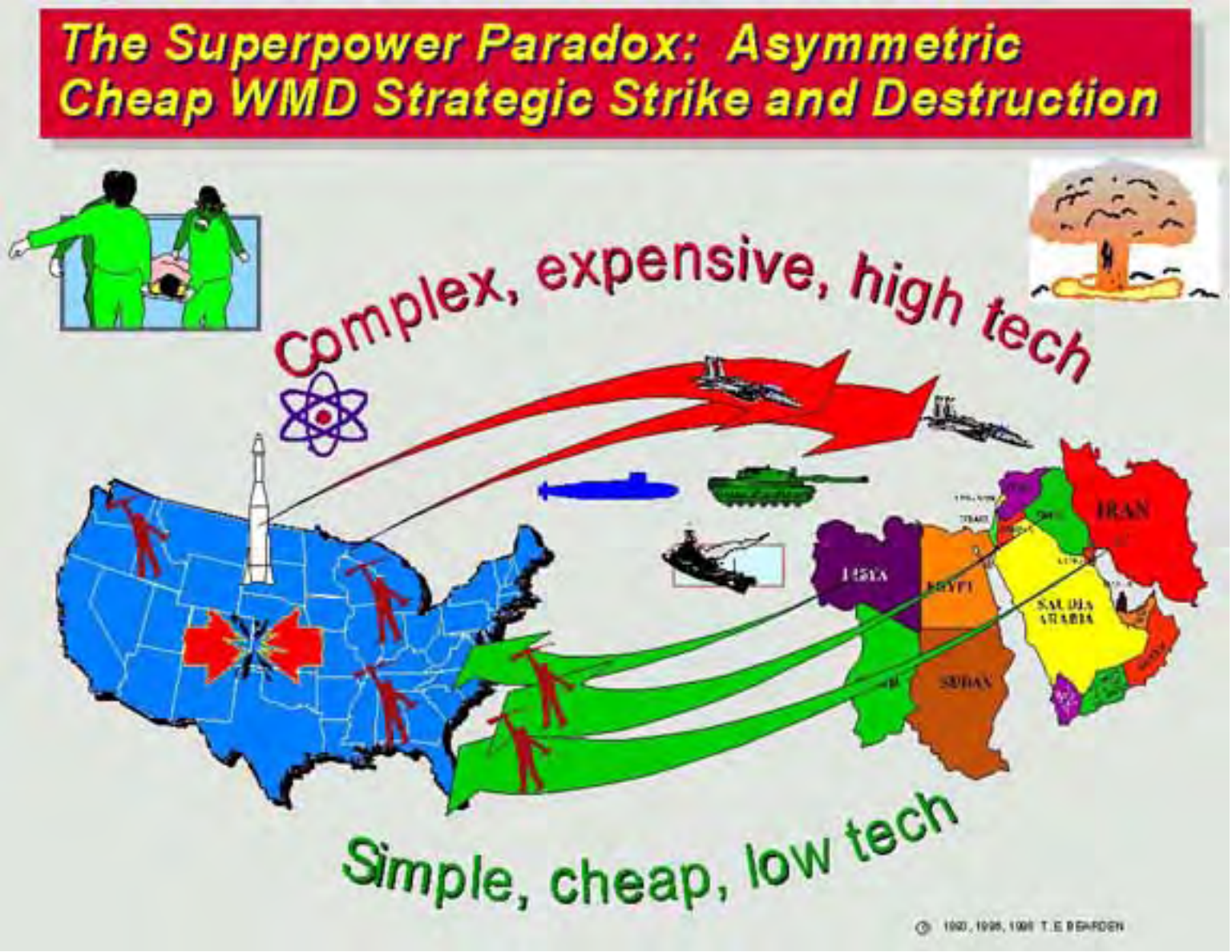
The Superpower Paradox: Asymmetric
Cheap WMD Strategic Strike and Destruction
Complex, expensive, high tech
IRAN
LIBYA
EGYPT
SAUDI ARABIA
SUDAN
Simple, cheap, low tech

THE KGB/YAKUZA-AUM WAR PLAN

- *Dud all quantum potential weapons in other nations via psychoenergetics.*
- *Remove U.S., Israel, Brazil, West Europe as military powers.*
- *Destroy nuclear weapons, hostile energetics weapons, hostile ships, 80% of targeted populaces in first hour of strikes.*

LEASE

1990-91

Aum/Yakuza Acquired Use of on-site Russian Scalar EM (Energetics) Weapons.

Began Geosurvey of Test Range (Western Australia) for training.

KGB Tested QP population wpn (Gulf War Syndrome)

TRAIN

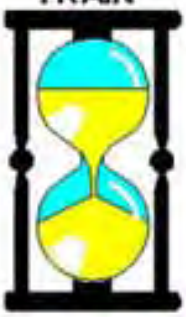

1991-94

Began extensive training of AUM-Yakuza crews in Russia, with practice firing into Western Australia. J-team took over world-wide weather engineering. Preparing for occupation of West Australia.

ESCALATE

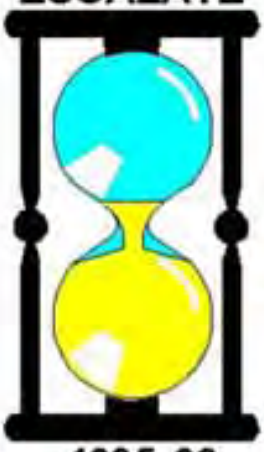

1995-99

Began EM kill of selected lone U.S. targets, law strategic deception plan.

U-2 a/c? USAir 747?
TWA-800 C-130
ValueJet? A-10s

Surged electrical grids. Worldwide practice kills, scalar interferometry. QP modification of selected pathogens

STRIKE!

Plan:
Trigger terrorist BW, & WMD attacks.
Enhance BW infections with QP wpn.
When ready, counter insane QPweapons with psychoenergetics. Destroy QP wpns.
Dud all nuclear weapons worldwide;
Time-snap ships, scalar weapons sites;
Attack major target populations w/QP.
Then cleanup with interferometry strikes.

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Why Western Science is Ignorant of KGB Energetics

- *Foundations* of electrodynamics and much of Western physics are seriously flawed
- Only just rediscovering longitudinal EM waves
- No knowledge of using time-polarized EM waves
- Does not know a powerful GR is hidden in EM
- Ignores inner structure of potentials, waves, fields
- Hotly defends errors, ignores for a century
- Determined to push big nuclear science
- Suppresses research to approved dogma by rigorously controlling precisely what research the funds can be used for

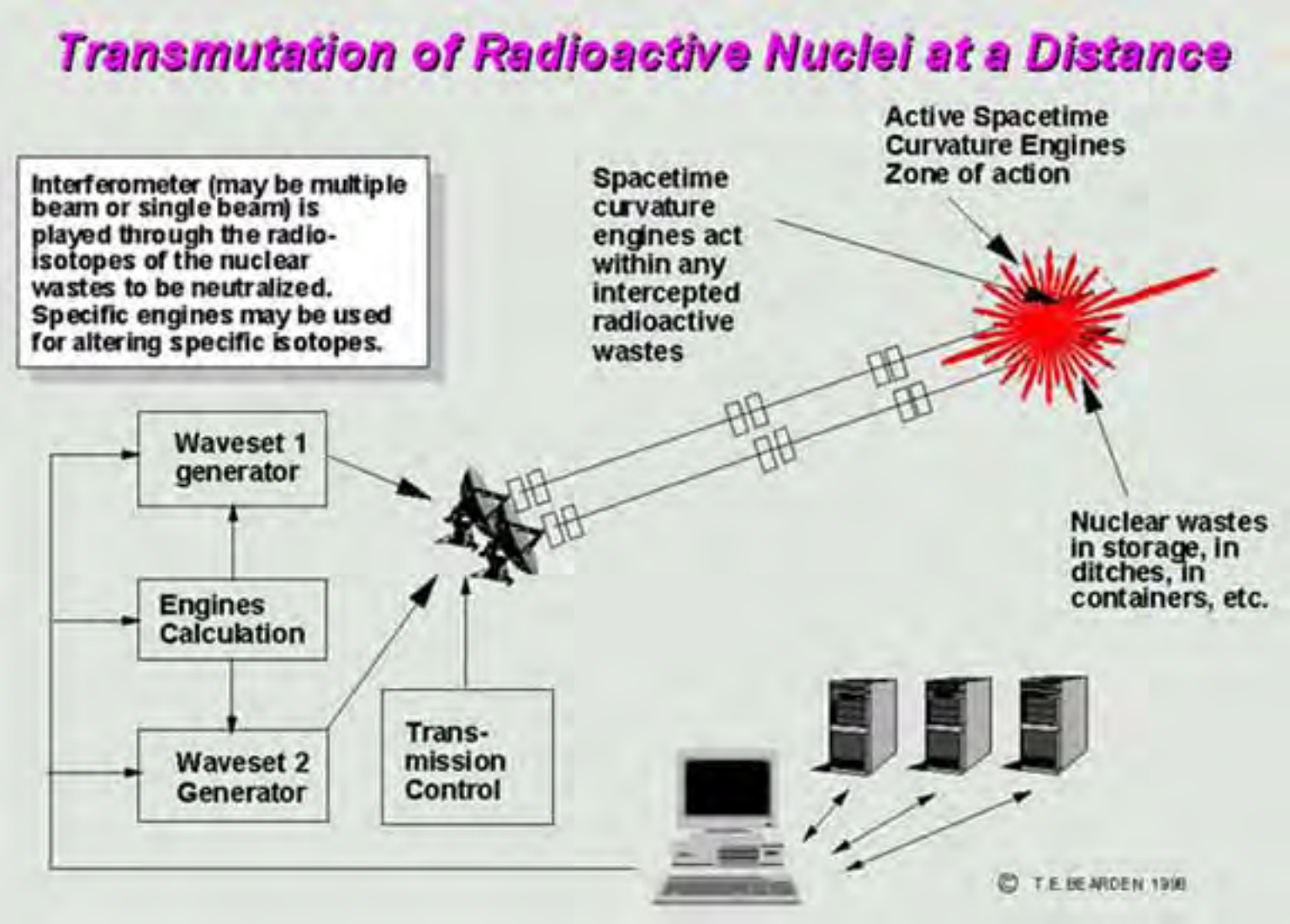
Transmutation of Radioactive Nuclei at a Distance
Interferometer (may be multiple beam or single beam) is played through the radio-isotopes of the nuclear wastes to be neutralized. Specific engines may be used for altering specific isotopes.
Spacetime curvature engines act within any intercepted radioactive wastes
Active Spacetime Curvature Engines Zone of action
Nuclear wastes in storage, in ditches, in containers, etc.
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
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THE YAKUZA

(JAPANESE MAFIA)

To do business with Japan is to do business with the Yakuza

The Last Samurai, Defending Bushido

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- **3 Major Yakuza Groups, In Coalition.**
- **Penetrate Japanese Government.**
- **Open Offices, Signs on Street.**
- **Public Romanticizes Yakuza as Last Japanese Samurai**
- **In Large High-Tech Corporations.**
- **In Control of Japanese Banks.**
- **Japanese Real-Estate Rip-off.**
- **$500 - 1,000 Billion per Year Income.**
- **Rapidly Spreading in U.S.**
- **Uniting Mafia Groups Worldwide.**
- **Coalition with Aum Shinrikyo.**
- **Leased Russian Energetics Weapons.**
- **Crews On-site in Russia, Trained.**
- **Practice Firings into Western Australia for Three Years. (Dozens of Shots per Month)**
- **Now in Escalation Phase, Killing U.S. Targets.**
- **All-out Strike on U.S. ready 1999-2000.**
- **Now held in check by KGB, dead-man fuzed by small nation friendly to U. S.**

Yugoslav Earthquake, Followed by Cold Explosion

Apr. 15 1979

- Magnitude 7.2 on Richter scale
- Epicenter 33 km. deep
- More than 100 aftershocks
- At Kamenari:
  - Adriatic sea mushroomed up
  - Like atomic bomb explosion
  - Signature of a cold explosion
  - Similar to Apr. 1984 test off coast of Japan, near Kurils (see inset graphics)
- *Note that April is a significant test month for the Communists (preparing official reports for May Day?)*

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Technical Background on the Priore Healing Process

Contents

1. Technical Background on the Priore Healing Process
2. Transduction of EM wave types by successive phase conjugation.
3. Time-charging and Time-density excited states
4. Interference for transduction in slow decay of time-density excited states
5. Infolded longitudinal biwaves composition of a scalar potential
6. Scalar potential interferometry produces all EM force fields and waves
7. Some serious flaws and errors in classical EM theory (#1-16)
8. Some serious flaws and errors in classical EM theory (#17-32)
9. Abnormal penetration depth of weak signals due to photon interaction
10. Amplified replica of body's signal complex to reverse cellular disease & damage
11. Amplified replica of body's signal complex to correct a congenital condition

Technical Background on the Priore Healing Process

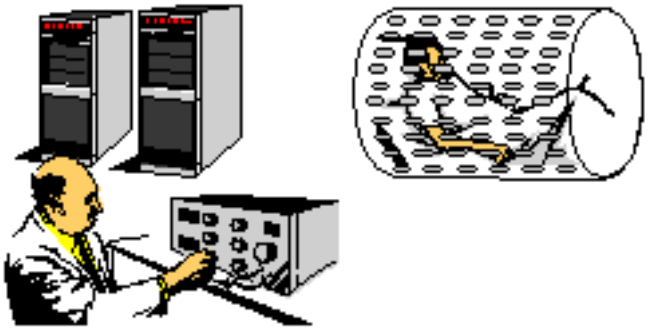

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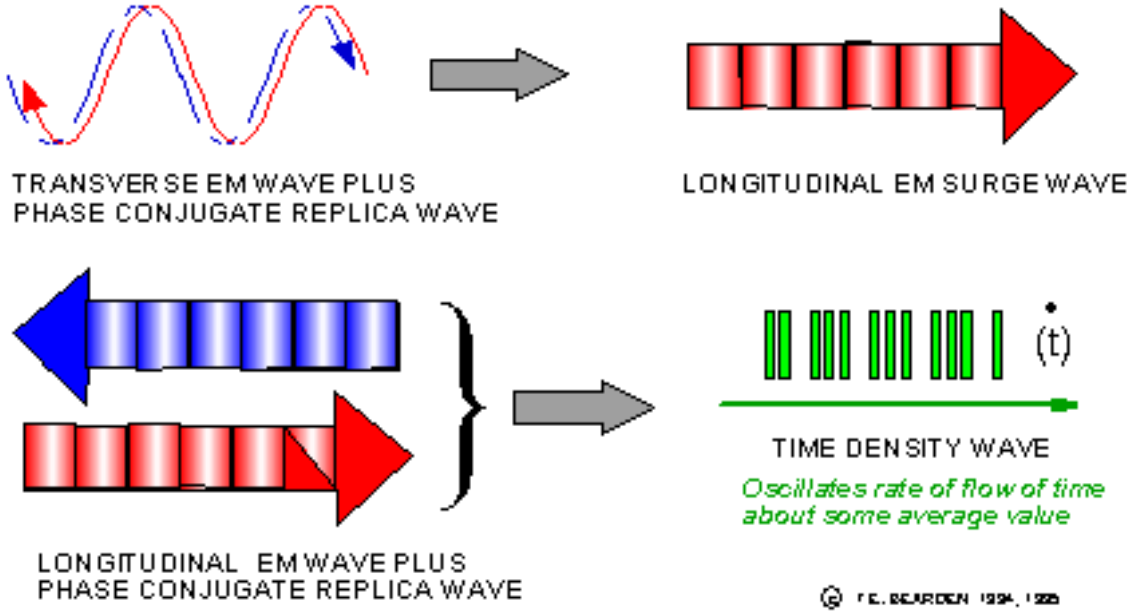

Figure 1. Transduction of EM wave types by successive phase conjugation.

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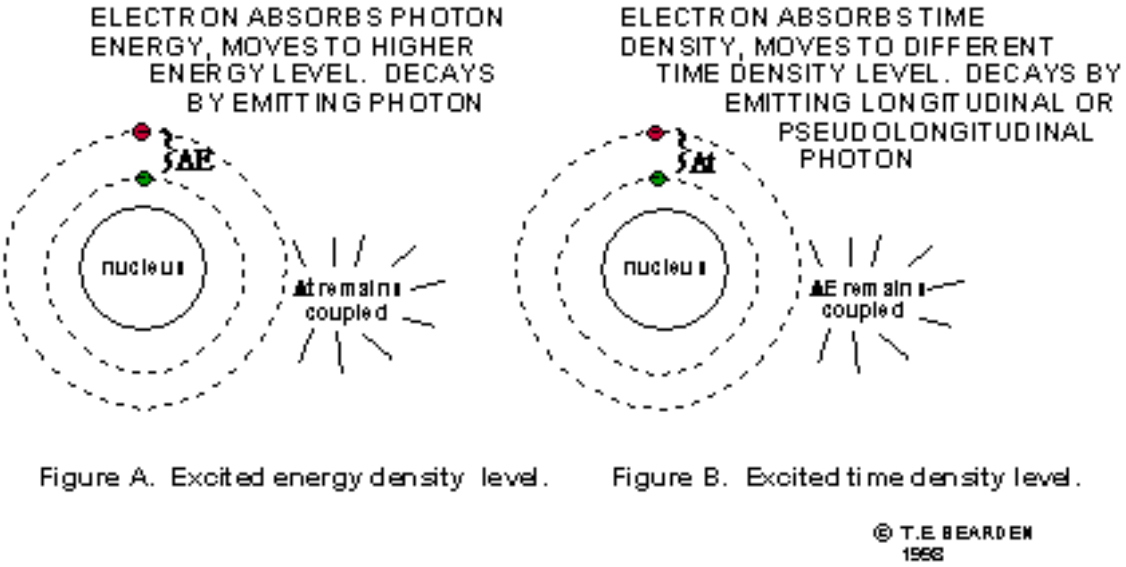

Figure 2. Time-charging and Time-density excited states, contrasted to ordinary spatial energy excited state.

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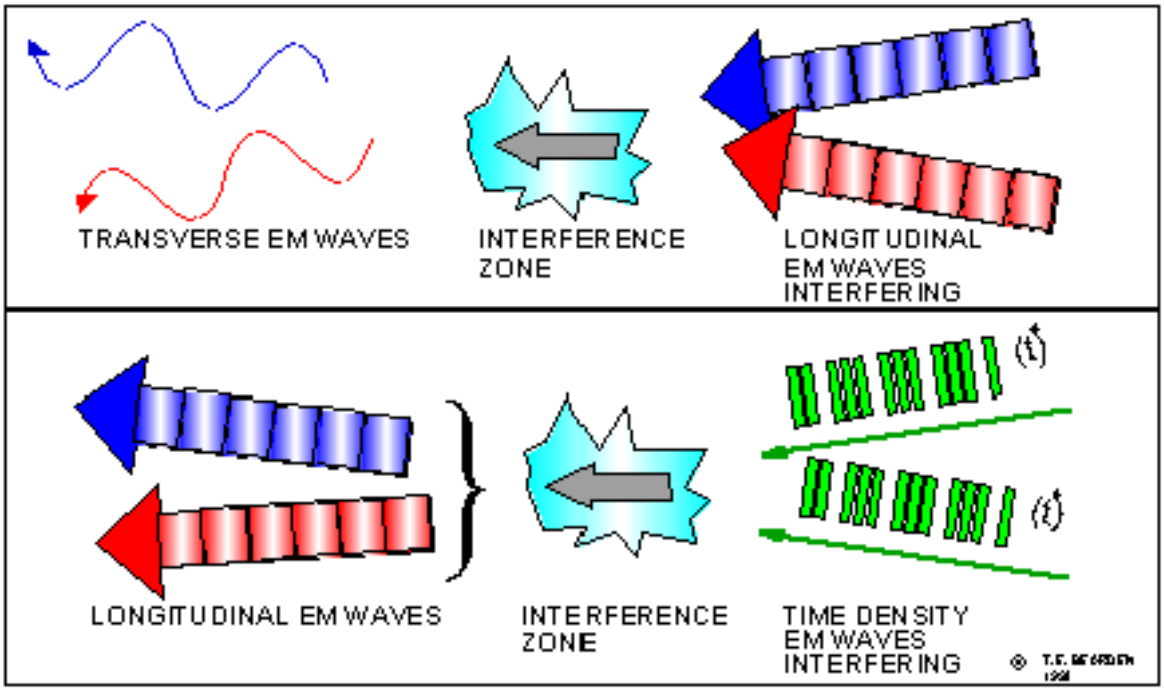

Figure 3. Interference processes for transduction in slow decay of time-density excited states.

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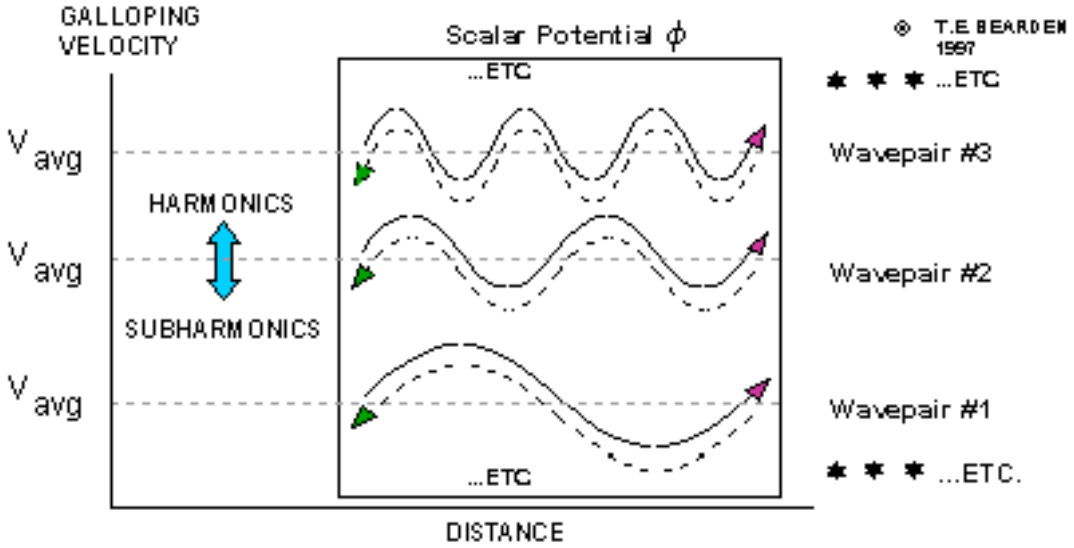

The Structure Is:

A harmonic set of longitudinal wavepairs. In each wavepair the two waves superpose spatially, but travel in opposite directions. The two are phase conjugates and time-reversed replicas of each other. Thus they comprise a coupled longitudinal wave and antiwave. Each wavepair is a time-density wave and therefore an electrogravitational wave.

Figure 4. Infolded longitudinal biwaves (time-density EM waves) composition of a scalar potential.

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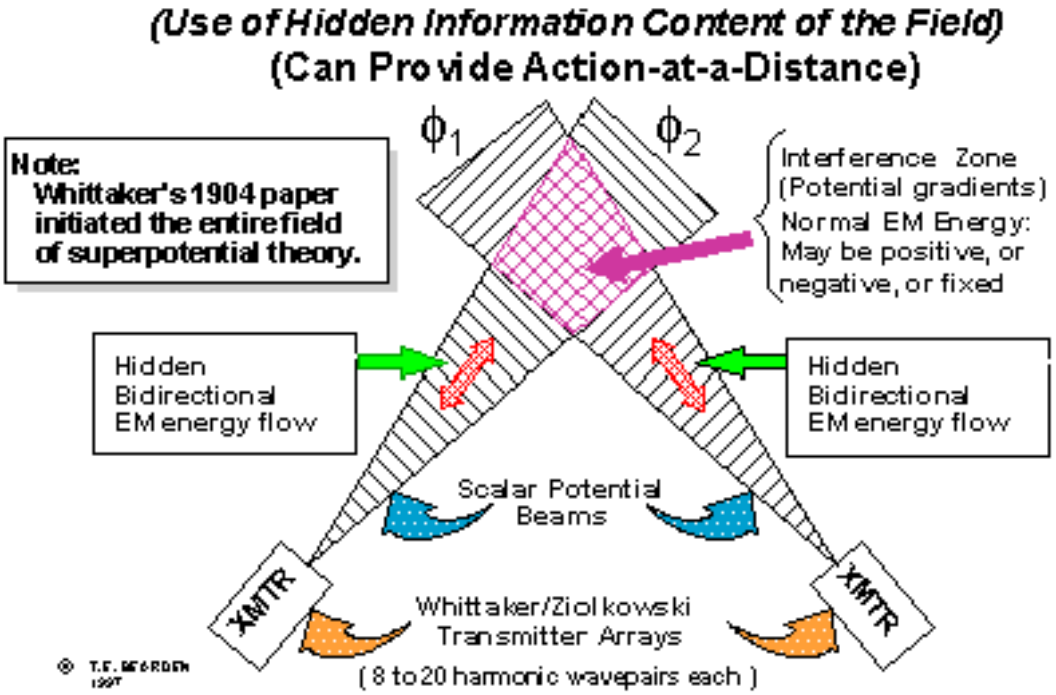

Figure 5. Scalar potential interferometry (between the two sets of bidirectional longitudinal EM wavepairfunctions) produces all EM force fields and waves.

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1. Eliminates the Internal EM Inside the Scalar Potential.
2. Equations Still Assume Material Ether Per Maxwell (Unchanged).
3. No Definition of Electrical Charge or of Scalar Potential.
4. Use of Force Fields in Vacuum is False (and Known to be So).
5. Treats Charge q as Unitary Instead of Coupled System q = ϕ(q)m(q).
6. Confuses Massless Potential Gradients as Forces (See #3, #4).
7. Does Not Utilize Mass as a Component of Force (See #23).

---

8. Erroneously Assumes EM Force Fields as Primary Causes.
9. Topology of EM Model Has Been Substantially Reduced.
10. Does Not Include Quantum Potential or Action at a Distance.
11. Does Not Include Superluminal Velocity of Inner EM Components.
12. Does Not Utilize Extended Near-Field Coulomb Gauge Effects.
13. Does Not Include EM Generatrix Mechanism for Time Flow.
14. Does Not Unify Photon and Wave Aspects (Requires 7-D Model).

---

15. Does Not Include Electron Spin and Precession (See #19, #24).
16. Treats EM Energy As Existing In "Chunks," Instead of as Flow.

Figure 6. Some serious flaws and errors in classical EM theory (#1-16)

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17. Confuses Energy and Energy Collection (See #16).
18. Discards Half of Every EM Wave in Vacuum (See #22).
19. Erroneously Uses Transverse Vacuum Wave; It's Longitudinal.
20. Arbitrarily Regauges Maxwell's Equations to Eliminate Overunity.
21. Omits Phase Conjugate Optics Effects (The *Rule* in Internal EM).
22. Does Not Include EM Cause of Newtonian Reaction Force.
23. Erroneously Assumes Separate Force Acting on Separate Mass.
24. Confuses Detected Electron Precession Waves as Proving Transverse EM Waves in Vacuum (Remnant of Old "EM Fluid" Concept).
25. Due to Error in String Wave, Omits the Ubiquitous Antiwave.
26. *Assumes* Equilibrium; Not True Unless Include Vacuum Interactions.
27. Higher Topology Required, to Model Electromagnetic Reality.
28. Lorentz surface integration discards Poynting energy transport.
29. Has nothing at all to say about form of EM entities in massless space.
30. Eliminates the infolded general relativity using EM-force as curve agent.
31. Does not include longitudinal EM waves as time domain oscillations.
32. Does not include EM mechanism that generates time flow and flow rate.

Figure 6. Some serious flaws and errors in classical EM theory (#17-32)

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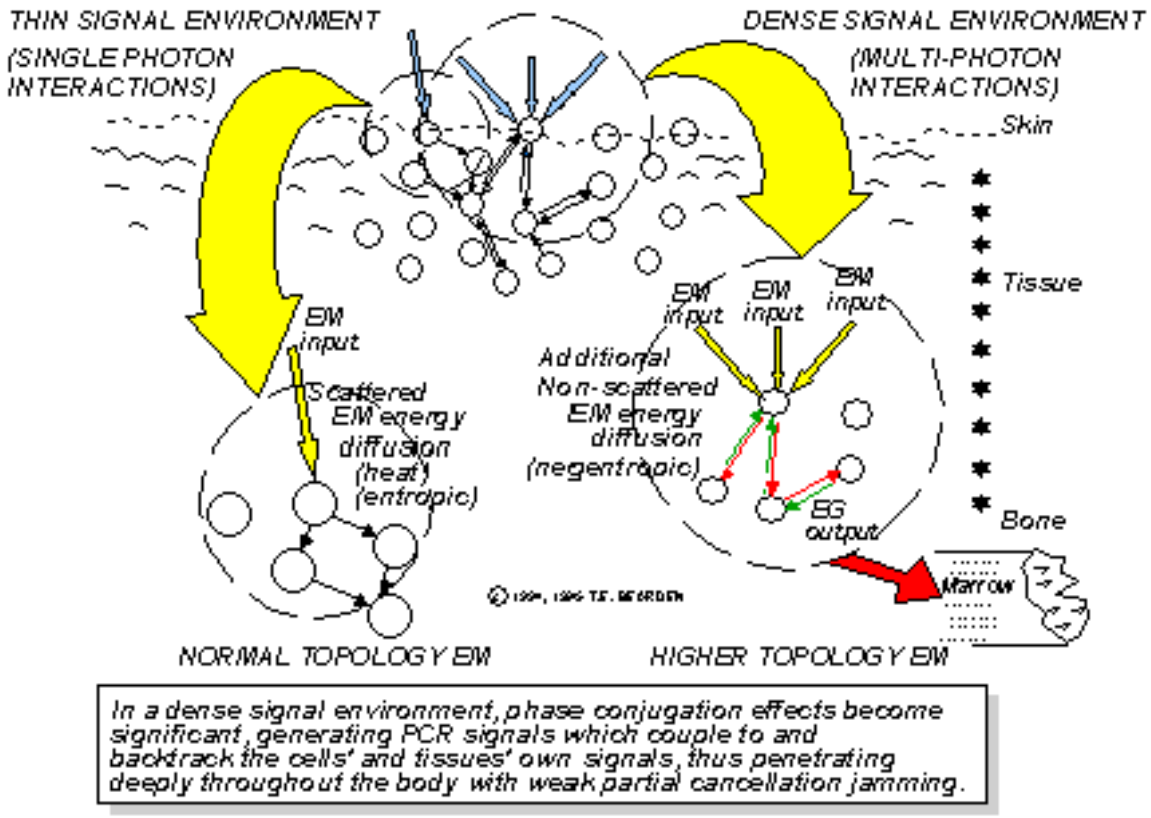

Figure 30. Abnormal penetration depth of incident weak signals due to multiphoton interaction in a dense weak signal environment.

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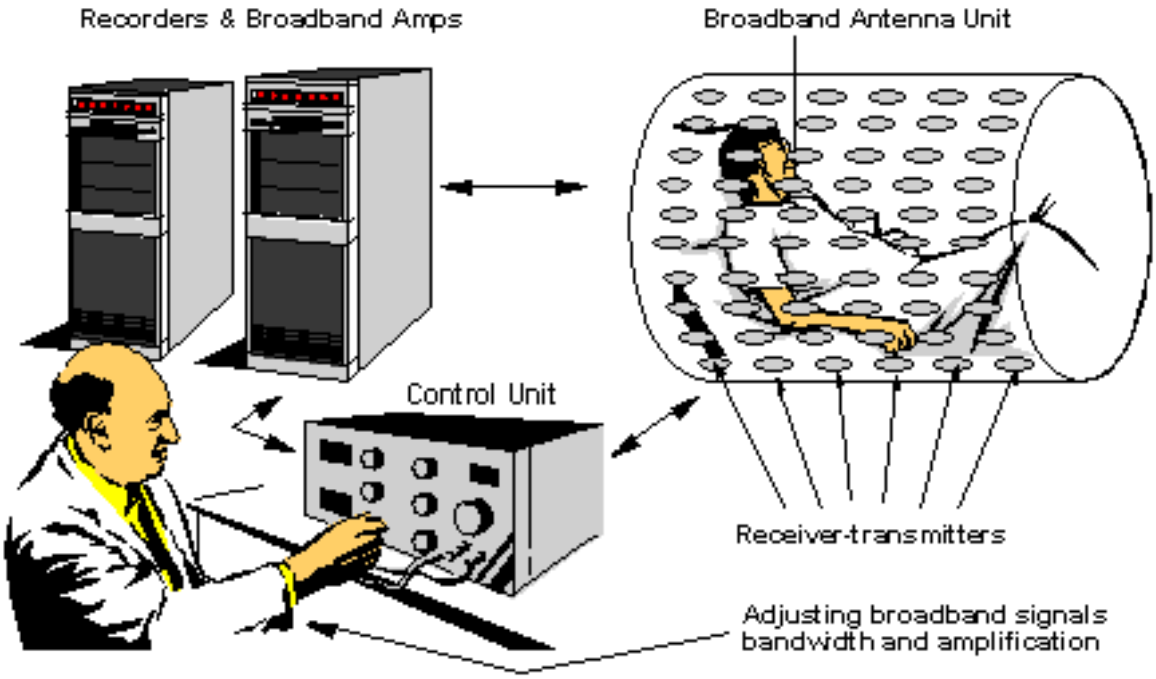

Figure 31. Using an amplified replica of the body's own dense, broadband signal complex to irradiate it, producing deeply-penetrating and precise longitudinal EM wave sets that pump cells and reverse cellular disease and damage.

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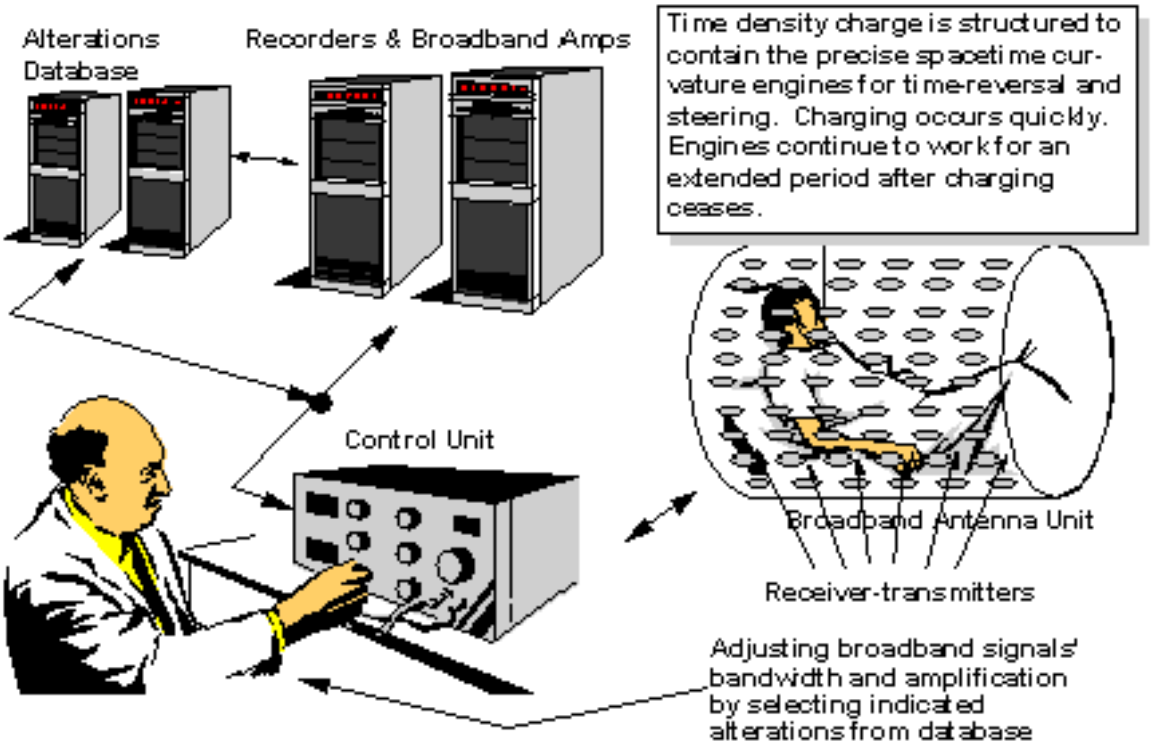

Figure 9. Using an amplified replica of the body's own dense, broadband signal complex containing added alterations, to irradiate the body and produce deeply-penetrating precise time-density charging for cellular time-reversal, while steering the time-reversal trajectory to also correct a congenital condition.

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The Anomalies in Navy Electrolyte Experiments at China Lake

These novel experimental anomalies, like those of Cold Fusion, were caused by using time as an energy source by transducing time-energy into spatial energy. Transducing one microsecond per second of time into spatial EM energy, yields nearly 10^{11} watts of power

- Melvin H. Miles and Benjamin F. Bush, "Radiation measurements at China Lake: Real or Artifacts?", *Proc. ICCF-7 (International Conference on Cold Fusion—7)*, Vancouver, BC, Canada, Apr. 1998, p. 101.

- Consistency of China Lake Anomalies
- Anomalous LW EM Emission Phenomena at China Lake (1)
- Anomalous LW EM Emission Phenomena at China Lake (2)
- Sufficient LW-to-TW Transduction Ionizes GM Tube Gas (3)
- Sufficient LW-to-TW Transduction Ionizes GM Tube Gas (4)
- Consistency of Anomalies
- Consistency of Anomalies (2)

- Experimental LW Emission Phenomena in Electrolysis

Consistency of China Lake Anomalies

- Variation in LW-TW transduction from experiment to experiment
- Majority produced insufficient transduction to cause ionization discharge of the GM tube gas (to cause detection)
- Correlation between appearance of anomalous radiation and the expected time periods to load palladium with deuterium
  - Within few hours in co-deposit experiments where palladium is loaded with deuterium as it deposits from solution
  - Required days of electrolysis for rods that load much slower
- The faster the deuterium loaded, the greater the interaction of deuterium in phase conjugating and self-targeting in lattice
- Variation in GM detector readings
  - One would read anomalous radiation, another would be blind to it
  - A few experiments gave simultaneous readings from two detectors
- Experiments perfectly consistent with LW-TW transduction, time-density charging, variation in GM time histories, and new conservation of energy law

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Anomalous LW EM Emission Phenomena at China Lake (1)

- **Anomalous radiation from electrolysis in ionization processes**
  - Two experiments producing excess power
  - Dental X-ray film showed exposure
  - Simultaneous control study: no exposure
  - 20 experiments without excess power: no exposure
- **Excess energy strongly indicates excess film exposure**

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* Melvin H. Miles and Benjamin F. Bush, "Radiation Measurements at China Lake: Real or Artifacts?"

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Anomalous LW EM Emission Phenomena at China Lake (2)

- GM and NaI detector reaction when electrolysis with heavy water ongoing
  - Several Geiger-Muller (GM) tubes gave anomalous detection
  - Reached 73 sigma above background
  - No anomalies when experiment off
- *GM tube detects anything which causes its internal ionization*
  - *Nuclear radiation is ionizing*
  - *Transduced x-ray & gamma is ionizing*

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Sufficient LW-to-TW Transduction Ionizes GM Tube Gas (3)

- **Time-history of detector involved**
  - Some GM detectors show anomalous high counts, some do not
  - Time histories of GM detectors are varied
  - Time histories of film vary minimally
- ***Experimental results consistent with***
  - *LW-to-TW transduction including delay*
  - *Time-energy charging*
  - *New extension to energy conservation law*

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Sufficient LW-to-TW Transduction Ionizes GM Tube Gas (4)

- **Time-history of detector involved**
  - Some GM detectors show anomalous high counts, some do not
  - Time histories of GM detectors are varied
  - Time histories of film vary minimally
- ***Experimental results consistent with***
  - *LW-to-TW transduction including delay*
  - *Time-energy charging*
  - *New extension to energy conservation law*

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Consistency of Anomalies

- LW-to-TW transduction varied from experiment to experiment
- Most experiments produced insufficient transduction to cause ionization
- Appearance of anomalous radiation correlated with expected time loading of palladium with deuterium

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  - Within few hours in experiments where palladium loads with deuterium as it deposits from solution
  - Required days for rods that load much slower

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Consistency of Anomalies (2)

- Faster the deuterium loaded, the greater the interaction of deuterium in
  - Phase-conjugating and self-targeting
  - Producing time-reversal zones
  - Generating quasi-nuclei of H+ ions (protons)
- Variation in GR detector readings
- Experimental results predictable by
  - LW-TW transduction and time-reversal zones
  - Varying time-density charging on GM tubes
  - Variation in GM tube experience histories
  - Time-reversal zones generating electronuclear interactions and quasi-nuclei of H+ clusters

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Experimental LW Emission Phenomena in Electrolysis

- Anomalous radiation from electrolysis in ionization processes
  - Two experiments producing excess power
  - Dental x-ray film showed exposure
  - Simultaneous control study: No exposure
  - 20 experiments without excess power: No exposure
- Excess energy strongly indicates excess film exposure
- GM and NaI detector reaction when electrolysis ongoing w/heavy water
  - Several Geiger Muller (GM) tubes gave anomalous detection
  - Reached 73 σ above normal background counts
  - No anomalies when experiment off
- GM tube detects anything which causes its internal gas to ionize
  - Nuclear radiation is "ionizing" radiation
  - Transduced x-ray and gamma radiation is "ionizing" radiation
  - Sufficient LW-TW transduction ionizes GM gas

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- Time History of detector involved
  - Some GM detectors show anomalous high counts, some do not
  - Time histories of GM detectors vary appreciably
  - Time histories of film vary minimally
- Experiments consistent with time-density charging, LW-TW transduction, and new conservation of energy law

* Melvin H. Miles and Benjamin F. Bush, "Radiation Measurements at China Lake: Real or Artifacts?" Proc. ICCF-7, Vancouver, BC, Canada, Apr. 1998, p. 101.

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A Visual Tour of what they don't want you to know about electrical circuits

10 TRILLION PERCENT OF THE CURRENT PRODUCED IS WASTED!

---

1. The scalar potential is a harmonic set of phase conjugate longitudinal EM waves.
2. The dipole is a true negative resistor.
3. The dipole's broken 3-symmetry initiates a spreading giant negentropic reordering of a fraction of the vacuum's energy.
4. Energy flow contours surrounding a transmission line.
5. Heaviside and Poynting energy flow components. The Heaviside component is often **10 trillion times** the Poynting component, but **is simply wasted** in ordinary single-pass energy circuits.
6. Negative resistance process v. positive resistance process.
7. Lorentz's integration trick to discard the enormous Heaviside non-diverged energy flow component.

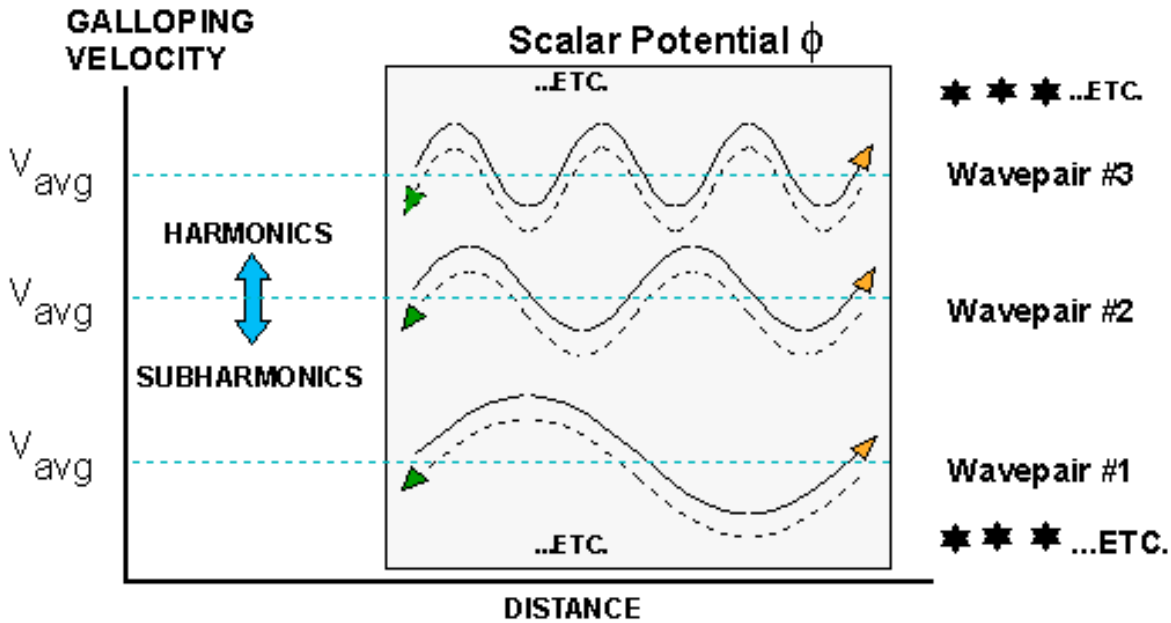

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The Structure Is:

- A harmonic set of longitudinal phase conjugate wavepairs.
- In each wavepair the two waves superpose spatially after detection, but travel in opposite directions.
- The convergent wave set is in the imaginary plane, and hence is not observable. It is EM energy incoming to the potential (dipolarity) from the time domain.
- The charge's spin is 720 degrees, 360 in the real plane and 360 in the imaginary plane.
- Hence the charge receives the complex convergent EM energy, transduces it into real EM energy, and emits enormous energy at the speed of light in all directions -- which includes bidirectional pairs in 3-space (after the reaction, being after "observation").
- This produces the fields and potentials from the "source charge or dipole."
- Mandl and Shaw argue that the scalar (time-polarized) photon and longitudinal photon are observable only in similar pairs, which then makes the instantaneous scalar potential. Thus their quantum field theory work strongly supports the "negative resistor" interpretation of the scalar potential and our solution to the source charge and source dipole problem.

Figure 1. The scalar potential is a harmonic set of phase conjugate longitudinal EM waves.

Note: Decompose the potential between the end charges of the dipole

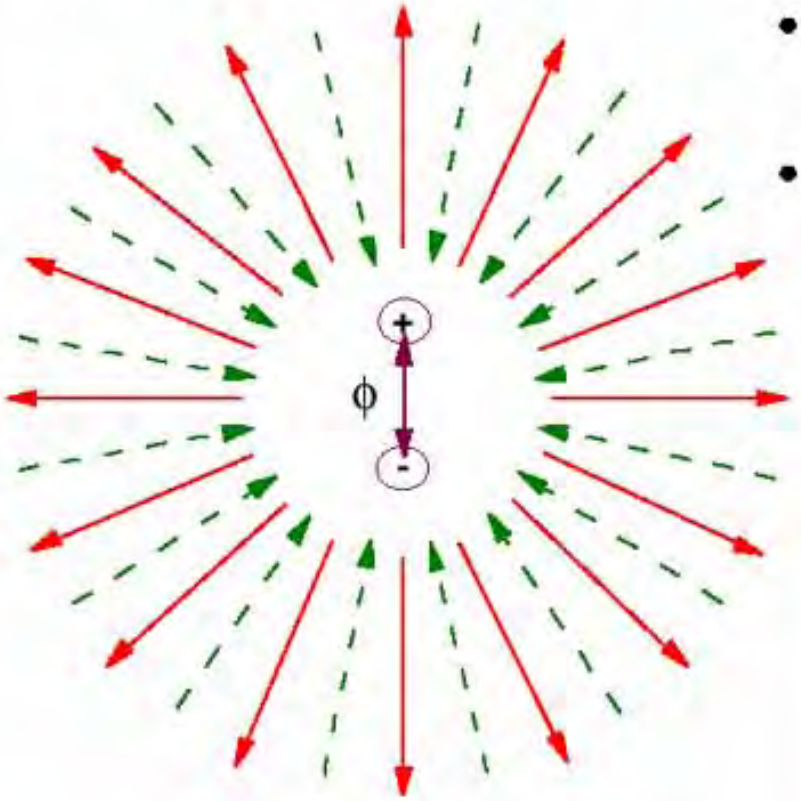

- Receives enormous EM energy in complex plane (similar to reactive power)
- Transduces it into real EM energy and emits it in all directions at the speed of light
- The emitted EM energy forms the fields and potentials and their energy, across space, from this "source dipole"

* Basis established by E.T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Math. Ann. 57, 333 (1903). Ignored since then.

LEGEND

Outgoing real EM energy

Incoming complex EM energy

Figure 2. The dipole is a true negative resistor.

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Broken 3-space symmetry initiates jump to 4-space symmetry between complex plane and real plane. Energy flow is now conserved in 4-space, but not in 3-space. This is the true negative resistor effect, and a negentropic reordering of the vacuum.

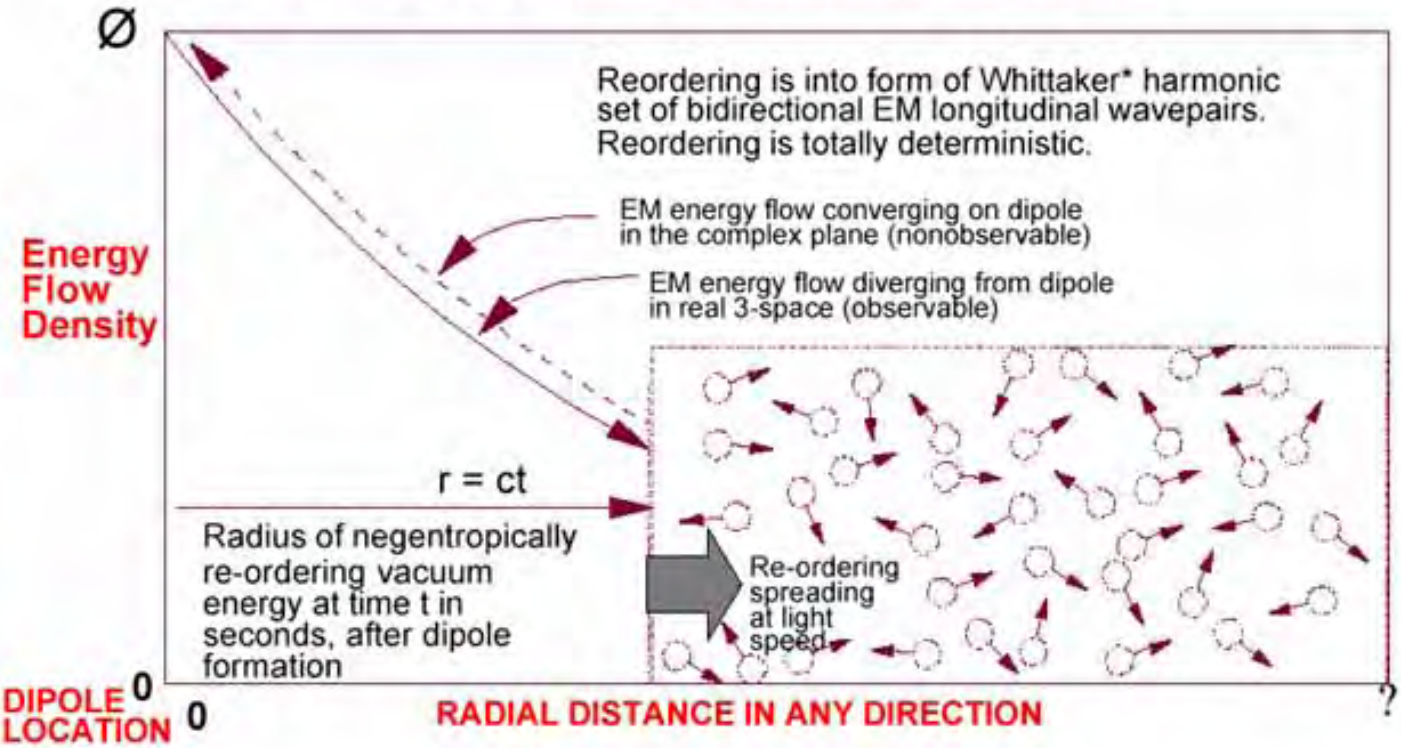

Figure 3. The dipole's broken 3-symmetry initiates a spreading giant negentropic reordering of a fraction of the vacuum's energy.

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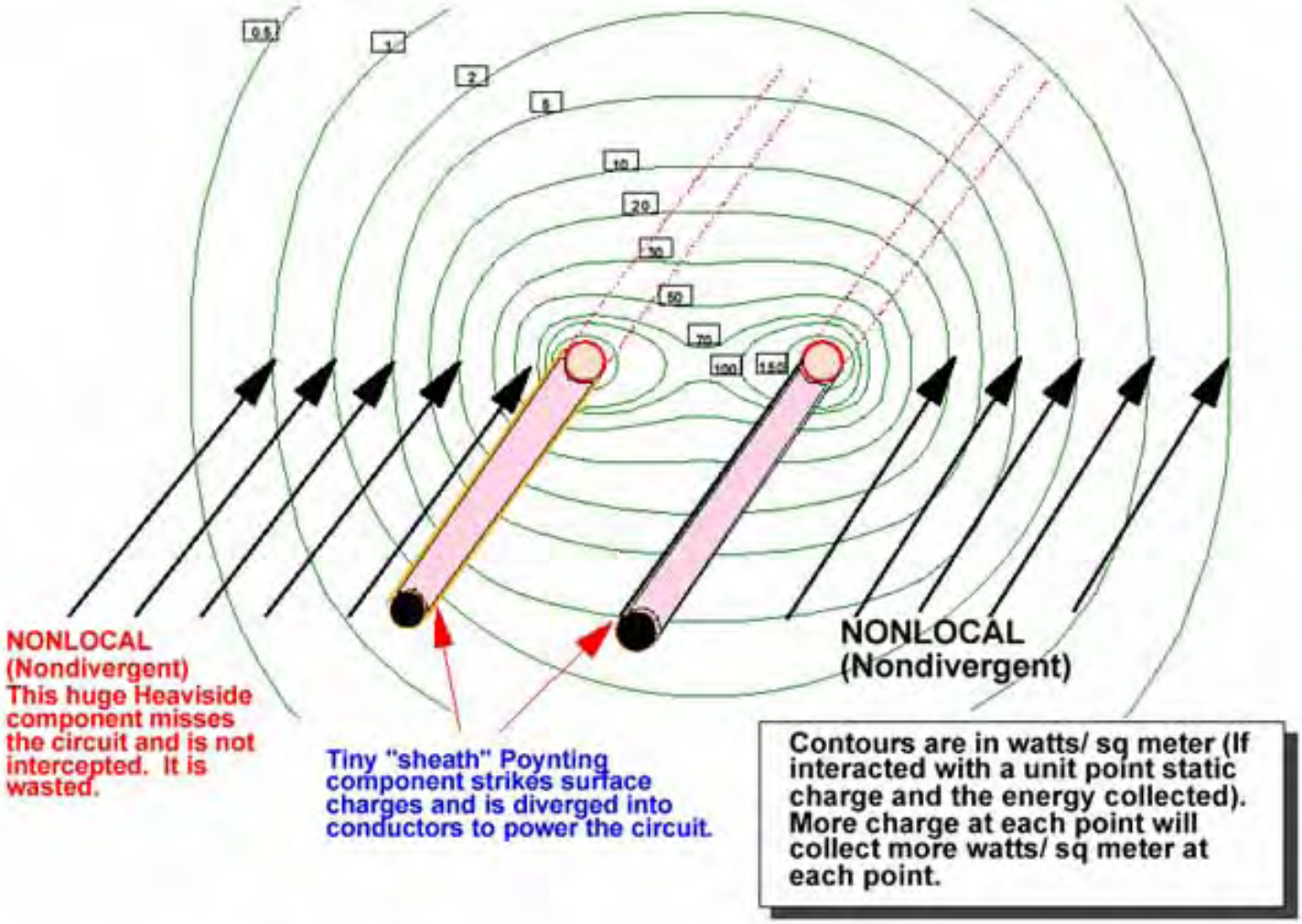

Figure 4. Energy flow contours surrounding a transmission line.

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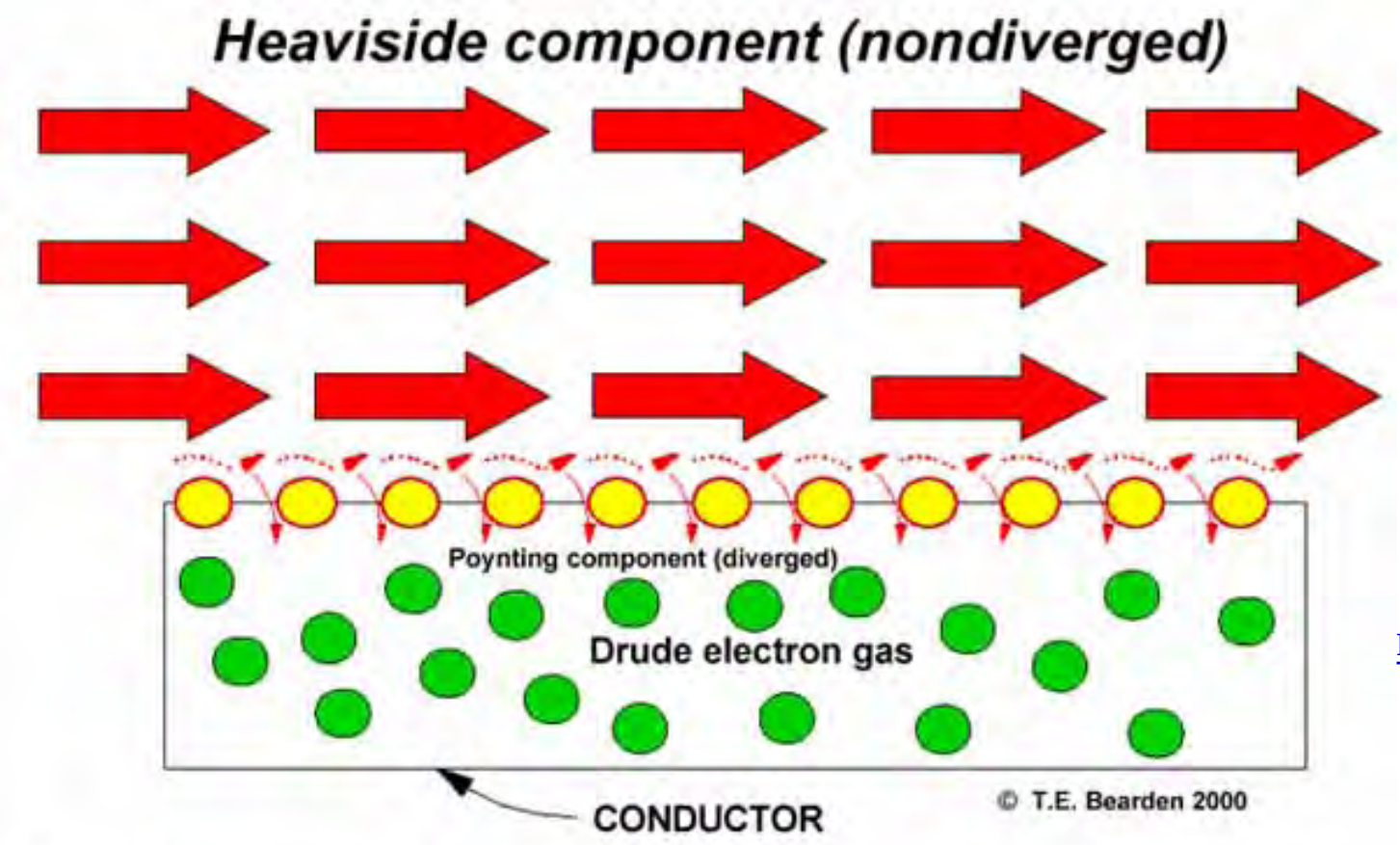

Figure 5. Heaviside and Poynting energy flow components. The Heaviside component is often 10 trillion times the Poynting component, but is simply wasted in ordinary single-pass energy flow circuits.

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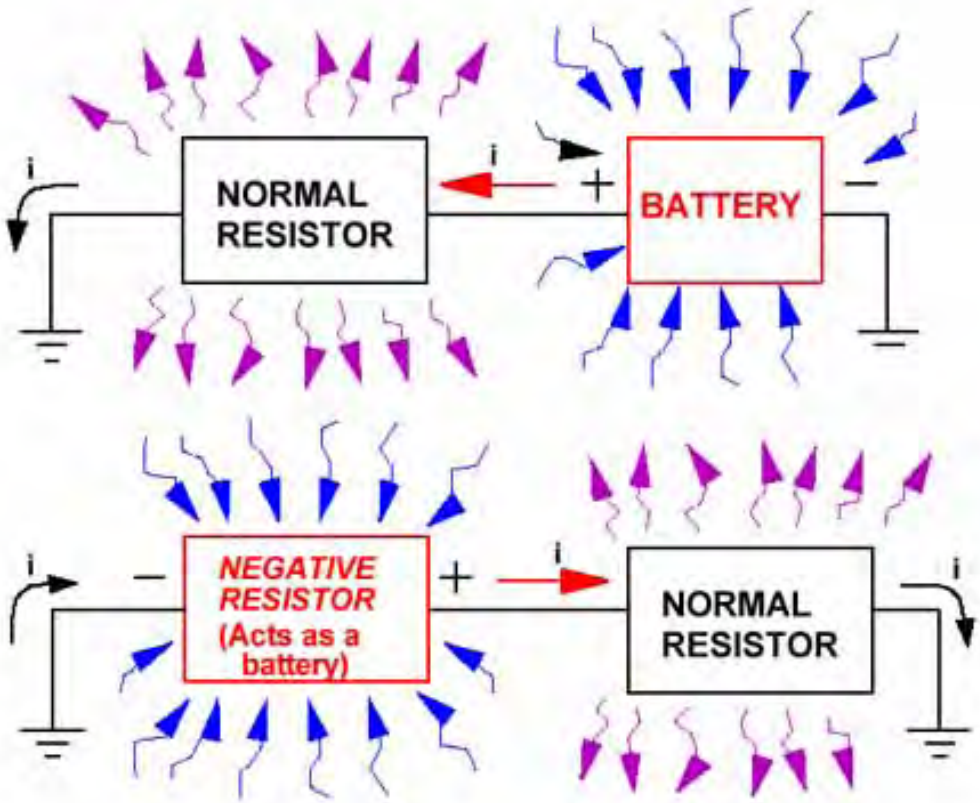

Figure 6. Negative resistance process vs. positive resistance process. A negative resistor receives energy in unusable form, transduces it, and outputs it in usable form. A positive resistor receives energy in usable form, and scatters it into unusable form.

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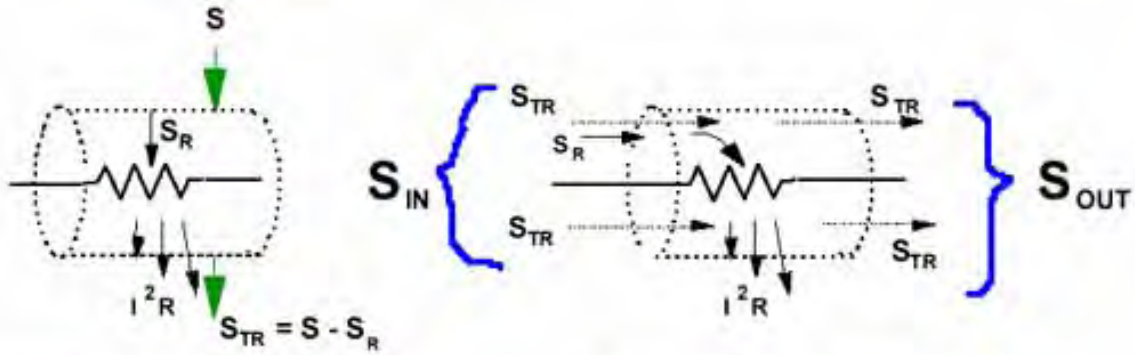

1a. Lorentz surface integration.

1b. Actual S in and S out.

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See Panofsky & Phillips, Classical Electricity and Magnetism, 2nd. edn., Addison Wesley, 1962, p. 178-181.

Note: If the S-vector is integrated over the closed surface, then all nondiverged energy flow is zeroed, leaving only the very small component of the input S-flow that is powering the joule heating of the resistor. In short, only the small component of the S-flow that is equal in magnitude to the Poynting vector remains. This measures only the tiny portion of the S-flow that is intercepted and diverged into the conductors by their surface charges, powering the electrons and then dissipated out of the resistor as joule heating.

The Lorentz procedure arbitrarily discards the enormous Heaviside component that misses the circuit entirely and is wasted. This results in a non sequitur of first magnitude in energy flow theory .

Figure 7. Lorentz's integration trick to discard the enormous Heaviside non-diverged energy flow component.

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CHASING THE WILD DRAGON:

Foundations of a New Science

By T.E. Bearden
November 12, 1995

It is a pleasure to accept the offer of John and Larry to write a column in their new InterNet magazine. Theirs is a great venture, and with the energy and knowledge they bring to the task, one can be confident of their success in making this a very interesting and informative publication.

There is a new "rebel" science slowly being born, with most of the work being done outside the universities and orthodox scientific community. In the months ahead it will be my job to try to acquaint you with the gist of what's going on, and what all the excitement is about.

This first article is deliberately just introductory, and its purpose is to interest you in the unusual fields we are going to be covering in more scientific detail, in future columns. We will also be listing a variety of references from the technical literature, which bear upon the various points addressed.

In this first article a little of my own background experience [note 1] is given, so you can decide whether you will be interested in what we have to say!

The real purpose of the column will just be to *present information* that you may not be able to readily obtain any other way. We will not argue or debate with skeptics; nothing productive is to be gained by that. If the information we present is useful to you, then our purpose has been accomplished. If it isn't of use to you, then just file it in the old wastebasket. Also, from time to time I may answer a generic question, constructed from multiple queries. Individual responses to correspondence cannot be provided.

The work toward a new breakthrough science is going on in a broad spectrum of "fields," most of which are not yet recognized by academia as even constituting legitimate areas of scientific endeavor (Table 1).

Some of the major areas involved are:

1. theoretical and experimental research in overunity electrical machines,
2. free energy research of other kinds, such as devices utilizing thermodynamics phase changes,
3. rapidly advancing efforts in cold fusion,
4. work on permanent magnet motors,
5. antigravity research, both theoretical and experimental,
6. development and utilization of a "hidden" electrodynamics inside the scalar potential (inside voltage),
7. the "memory" of space and materials; where this "memory" can be deliberately conditioned so that space and the materials themselves become causal actants rather than simple inert entities,

8. direct engineering of quantum change via a new kind of "hidden electrodynamic variables,"
9. the direct engineering of the vacuum's virtual photon flux exchange with matter,
10. action at a distance, including the deliberate formation and usage of quantum potentials,
11. direct engineering of the local curvature of spacetime (yes, the direct engineering of general relativity, using the new hidden kind of electrodynamics),
12. use of the new "hidden" electromagnetics to engineer body cells including the reversal of diseased cells, genetics and all, back to a previous healthy state (cellular dedifferentiation, in biophysical terms, or cellular phase conjugation, in physics terminology),
13. research toward the direct engineering of the mind, including both the conscious and unconscious minds, long-term memory, and the personality itself, and
14. a ruthless re-examination (and correction where necessary and possible) of the definitions, concepts, and postulates that present physics is founded upon.

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Notes and References:

[1] For those interested in orthodox qualifications, I have an M.S. in nuclear engineering (1971) from Georgia Institute of Technology and a BS in mathematics (1953) from what is now Northeast Louisiana University with a minor in electronic engineering.

Table 1. Fourteen Emerging New Science Areas

1. Overunity Electrical Machines and Power Systems
2. Overunity Devices Using Thermodynamical Phase Changes
3. Cold Fusion and Non-Nuclear Transmutation
4. Self-Powered Permanent Magnet Motors
5. Antigravity and Antigravity Engineering
6. Use of the "Inner" EM Inside the Scalar Potential
7. Vacuum Engineering, With Vacuum and Materials Memory
8. Direct Engineering of Quantum Change
9. Engineering and Structuring of Massless Charge Flux
10. Action-At-A-Distance, Including Use of Quantum Potentials
11. Direct Engineering of Local Spacetime Curvature
12. "Inner EM" Time Reversal of Diseased Cells Back to Health
13. Direct Engineering of the Mind, Including Software Loading
14. Unified Field Revision of Foundations Concepts of Science

Each of these "major areas" as yet has no single "experts" in the sense that individuals exist who possess a "mastery" of the given area. As an example, in spite of multiple researchers and decades of vigorous research, no one is really an "overall expert" in the overunity electrical power systems field. The "field" itself is still struggling to be born and is not recognized at all by orthodoxy; in fact, many orthodox scientists bitterly resent one even attempting to work in this area. There is as yet no cohesive single "theory" of overunity electrical or magnetic machines, although our own group is making rapid progress in that respect. But there is still no universal agreement amongst even the researchers themselves. Literally the field is still being *discovered*.

This "groping dimly toward a new field" should not be too surprising. After all, the early electromagnetics researchers went through the same tortuous, agonizing kind of development. They were playing with cat fur, glass rods, and pith balls for quite an extended period before understanding progressed to the point where Maxwell could mathematically tie together and model the results of the experimenters such as Faraday and others. It has taken a century and a half for modern electromagnetics and electronics to reach its own present development. It is going to take another decade or so before the overunity researchers can overturn several ill-founded parts of the present electromagnetics and get the emerging field onto a solid foundations footing and into a solid theoretical position.

In the effort to produce a theoretical model of electromagnetics, Maxwell and his predecessors performed a magnificent work. Yet they also made very serious errors (Table 2), which persist to this day. [note 2] Let us list just a few of the more blatant errors in classical EM theory today:

First, Franklin guessed wrong on which way electrical current flowed in a circuit. There is no definition at all of electrical charge in all of physics, and there is no acceptable definition of potential (that is, there is no rigorous definition of just good old "voltage.") There are no "fields of force" in the vacuum; there are just potential gradients __ because the vacuum is just one vast potential (virtual particle flux) in the first place. Force fields actually occur only in and of the matter in a material system. The primary causative agents of electromagnetics are not the so-called "force fields' at all, but are the potentials __ as is well-known in quantum mechanics. [note 3] Maxwell assumed a material ether in his equations. The Michelson-Morley experiment destroyed the material ether, but the Maxwell equations have never been changed accordingly. The electron was not yet discovered when the Maxwell equations were written; the theory does not address electron spin. Maxwell was already dead some two decades when Barus' 1898 paper [note 4] was published, pointing out the strange "backwards-traveling" wave (i.e., time-reversed wave) solution to the wave equation. In addition, Heaviside and Gibbs had already produced their vector truncation __ this truncated theory is the modern so-called "Maxwell's equations" that universities teach today __ of Maxwell's theory. Not a single one of them ever appeared in any book or paper by James Clerk Maxwell. [note 5]

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Table 2. Some Defects In Electrodynamics

1. Conventional Current Direction Is Reversed
2. No Definition of Charge or Potential
3. Equations Still Assume Material Ether
4. Use of Force Fields in Vacuum is Known to be False
5. Treats Charge as Unitary; lnstead, It is a Coupled System
6. Confuses Massless Potential Gradients as Forces
7. Does Not Utilize Mass as a Component of Force
8. Erroneously Assumes Force Fields as Primary Causes
9. Topology of EM Model Has Been Substantially Reduced
10. Does Not Include Quantum Potential
11. Does Not Include Proven Action At A Distance
12. Does Not Utilize Near Field Coulornb Gauge Effects
13. Does Not Include EM Generatrix for Time Flow
14. Does Not Unify Photon and Wave Aspects
15. Does Not Include Electron Spin and Precession
16. Treats Energy As Existing In "Chunks," instead of as Flow
17. Confuses Energy and Energy Collection
18. Discards Half of Every EM Wave in Vacuum
19. Erroneously Uses Transverse Vacuum Wave; It's Longitudinal
20. Omits Phase Conjugate Optics Effects
21. Does Not Include EM Cause of Newtonjan Reaction Force
22. Erroneously Assumes Separate Force Acting on Separate Mass

[2] For an independent statement that electrodynamics, both classical and quantal, are in serious disarray, see Mario Bunge, Foundations of Physics, Springer-Verlag, New York, 1967, p. 176. Quoting: "...it is not usually acknowledged that electrodynamics, both classical and quantal, are in a sad state." Bunge points out many errors in electrodynamics. See also Terence W. Barrett, "Electromagnetic Phenomena Not Explained by Maxwell's Equations," in Lakhtakia, A. (ed.): Essays on the Formal Aspects of Electromaqnetic Theory, World Scientific, Singapore, 1992, p. 6-86. To find information on what's wrong with EM theory, one must read foundations literature, not the standard textbooks. One of my own contributions has been to point out that the notion of charge q is not unitary. In fact, electrical charge should be defined in terms of q ~ m(sub q)~(sub q). In other words, electric charge q has a massive part m, and a massless part consisting of its potential phi. Further, the magnitude of phi is just the change in the virtual photon flux of the ambient vacuum, due to the [quantum field theoretic] virtual photon exchange with the mass of the q. It follows that the true electrical charge of a particle is just its native potential ~, which is also a dynamic energy exchange with the surrounding vacuum. It also follows that this massless electrical charge changes whenever the particle is placed in a potential (in a different ambient virtual photon flux). After all, potentials superpose; that is their major characteristic. Note that the potential of the test particle is ignored in classical electromagnetics, whenever one speaks of the "E-field" upon the particle. Further, the actual structure of this virtual photon flux that comprises massless electrical charge, can itself be deterministically structured and utilized to generate nonlinear effects that do not appear at all in the present conventional theory. We will be covering many of these effects in future articles.

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[3] E.g., see Y. Aharonov and D. Bohm, "Significance of Electromagnetic Potentials in the Quantum Theory," Physical Review, Second Series, 115(3), 1959, p. 485-491. Effects of potentials on charged particles exist even in the region where all the fields (and therefore the forces on the particles) vanish, contrary to classical electrodynamics. The quantum effects are due to the phenomenon of interference. These effects occur in spite of Faraday shielding. The Lorentz force does not appear anywhere in the fundamental quantum theory, but appears only as an approximation that holds in the classical limit. In QM, the fundamental physical entities are the potentials, while the fields are derived from them by differentiation.

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[4] Carl Barus, "A Curious Inversion in the Wave Mechanism of the Electromagnetic Theory of Light," American Journal of Science, Vol. 5, Fourth Series, 1898, p. 343-348.

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[5] E.g., see Paul J. Nahin, Oliver Heaviside: Saqe in Solitude, IEEE Press, New York. Quoting from p. 9: "...nowhere in Maxwell's writings do the equations for the electromagnetic field appear as we write them today. Maxwell used an amalgamation of Cartesian component and quaternion notation, and it was Heaviside who first wrote the electromagnetic field equations in modern vector form." Quoting from p. 92: "In actuality , however, the fields were not the primary reality to Maxwell at all (that is an idea that developed after Maxwell's death and is due to Hertz and Heaviside), but rather it was Faraday's 'electrotonic state' that he thought to be the real thing. Like Faraday, Maxwell believed that electromagnetic effects are observable results of an altered state of the ether. The mathematical formulation of this electrotonic state, for Maxwell, is what we today (as he did) call the vector potential." And again, from p. 96: "To Maxwell, however, the vector potential had a most definite physical meaning."

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So the time-reversed EM wave that one finally sees emerging in nonlinear phase conjugate optics in the early 1970s was omitted from the Maxwellian theory and its later modification by Heaviside and Gibbs. Maxwell's actual theory is in a higher topology (quaternion algebra), and involves some 20 quaternion equations. Heaviside and Gibbs created vector algebra, and seriously curtailed Maxwell's theory when they "translated" it into the much lower topology of vectors and some four equations. The later addition of tensors as the basis mathematics did not restore the lost topology provided by the quaternion model.[note 6]

For the EM wave, Maxwell simply assumed the transverse EM wave that had come from the much earlier derivation of the familiar wave equation from the old "plucked taut string" notions. [note 7] Yet when one closely examines and corrects some of the erroneous *assumptions* [note 8] made for the actual mathematical derivation of this "taut string" transverse wave, one finds (Figure 1) that an equal-energy second antiphased transverse "antiwave" is actually produced by the instrument and added to the "plucked string's" transverse wave disturbance of the air medium, to produce a longitudinal wave of compression and rarefaction in the air itself. The "transverse string wave" in fact never leaves the string. The string wave is not the wave that is launched into the medium.

A similar electromagnetic situation exists. In a whip antenna (Figure 2), the Drude electron gas in the conductor does exhibit a transverse "string-type" EM wave of electron precession. However, at the same time, by Newton's third law (which Maxwell neglected because at the time the atom was regarded as just a blob with no internal structure) the positively charged, phase conjugated atomic nuclei have equal energy, highly damped transverse recoil waves created in them. Further, these "nuclei-recoil" waves are phase conjugate replicas of the electron gas waves. The total disturbance that is launched into the vacuum from the whip antenna is (a) the normal transverse disturbance of the virtual photon flux of vacuum caused by the electron gas wave, and (b) the coupled equal-energy transverse antiwave caused by the nuclei-recoil via Newton's third law. The amplitude of the material antiwaves of nuclei vibration are highly damped because of the massiveness of the nuclei; however, they are of equal energy to the electron wave. But when launched into the same vacuum, the two equal-energy wave disturbances experience equal damping because they are in the same medium. Hence the wave and antiwave are (a) locked together in the vacuum, and (b) of equal energy, and (3) of equal amplitude once launched into the vacuum. What results is a vacuum EM wave of rarefaction (reduction in intensity) and compression (increase in intensity) of the virtual photon flux of vacuum __ just exactly like what is launched into the surrounding gaseous air medium from the "plucked taut string" and perturbed body of a physical instrument. The EM wave in vacuum is a longitudinal wave directly analogous to a sound wave __ just as Nikola Tesla stated. [note 9]

The vacuum may be considered a scalar potential, in which case it has an internal biwave structure (Figure 3). Interference of two potentials __ i.e., the hidden interference (Figure 4) of their internal wave structures __ in fact already creates all EM fields and waves.

When the incoming longitudinal "biwave" from the vacuum strikes the atoms of the receiving antenna, each atom may be considered a dynamic assembly of multiple dipoles, where each dipole consists of one of the electrons in the electron shells and one of the positive charges in the nucleus. The receiving dipole in the interacting atom splits the two waves apart again (Figure 5). The negatively charged end of the dipole is time-forward, and the positively charged end is time-reversed.

Hence the separated normal-wave-half of the biwave interacts with the electron, to give again the familiar transverse "electron precession" wave that we detect with our "electron wiggle-detecting" instruments (Figure 6). This detected electron precession wave is what all our textbooks prescribe erroneously as the vacuum wave! The separated time-reversed-wave-half of the incoming vacuum wave is split off and interacts with the positive end of the receiving atomic dipole, in the time-reversed atomic nucleus, thus generating Newton's third law reaction force to provide the recoil of the nucleus. Present physics has ignored this second wave altogether, because of the serious error in the original derivation of the wave equation from plucked strings. Thus physics presently has absolutely no causative mechanism for Newton's reaction force. Instead, scientists just "mystically invoke the appearance of this magic force." Describing that something occurs, and naming its occurrence, does not constitute advancing a causative mechanism!

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[6] E.g., see T.W. Barrett, "Tesla's Nonlinear Oscillator- Shuttle-Circuit (OSC) Theory," Annales de la Fondation Louis de Broglie, 16(1), 1991, p. 23-41. Barrett shows that a higher topology EM model (e.g., quaternions) allows shuttling and storage of potentials in circuits, and also allows additional EM functioning of a circuit that a conventional EM analysis cannot reveal. Tesla's actual patented circuits in fact exhibit this higher topology, when a quaternion EM analysis of them is performed. No orthodox vector/tensor analysis can show this.

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[7] All the early experimenters seemed to assume the transverse string-type wave automatically for the vacuum medium. E.g., Faraday speculated that light and radiant heat might be transverse vibrations propagated along his "lines of force," from which the direct "plucked string" analogy can readily be seen. In short, he considered that his lines of force could be perturbed to vibrate laterally, just like a plucked string. See M. Faraday, "Thoughts of Ray-Vibrations," Philosophical Magazine, (3), vol. xxvii, 1846, p. 345. Maxwell also assumed the transverse EM wave in vacuum without question, as did Heaviside, Hertz, and Gibbs and as has almost every electrodynamicist since then.

---

[8] The worst is the assumption of infinitely rigid endposts holding the taut string, so that no movement of these endposts occurs. This further assumes that no induced movement of the body of the instrument occurs. The end result is to eliminate all of that wave that is produced in the body of the instrument, and retain only the transverse wave produced in the string. In the first place, this standard procedure has now become a total violation of Newton's third law, which among other things requires that forces be formed in oppositional pairs. So the standard method for the launch of a wave from an instrument is flawed. Specifically, the "transverse string wave" is falsified insolaf as its appearance in the surrounding medium. This is not the wave that actually exits the instrument and that is launched into the medium. This universal oversight on the part of mathematicians and physicists is a colossal joke upon them. Literally, when a physicist writes the transverse wave equation on the board, he has just discarded exactly half the physics. This means that, in his interactions, at the end there will suddenly appear this mysterious, mystical "equal and opposite reaction force" that is created by the erroneously ignored antiwave. So he has to piously invoke this reaction force "from the blue." Yet quantum field theory teaches us already that all mechanical and electromagnetic forces on a mass are generated by absorption and emission of virtual photons. Hence Newton's third law reaction force must also be so generated. This means that there must exist an equal number of virtual antiphotons interacting in the antiforce, as there was virtual photons interacting in the causative force. By symmetry there must also exist an equal and opposite wave, or antiwave, made of these same antiphotons. The actual disturbance that entered from the vacuum must therefore have consisted of both wave and antiwave. QED.

Tables:

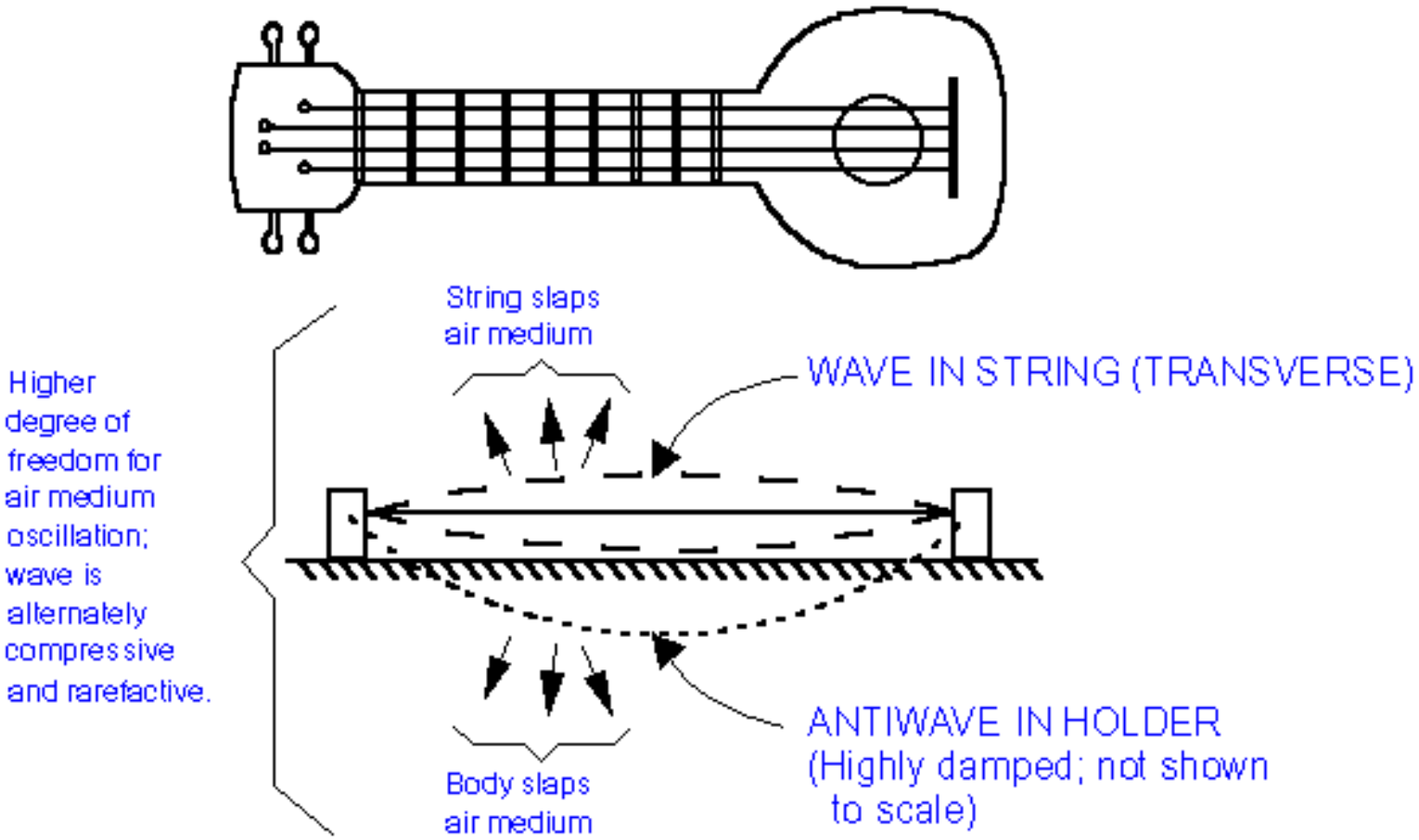

Figure 1. Air medium disturbances generated by plucked string.

Two waves are created, both slapping the air medium at the same time, but in opposite directions. A disturbed medium oscillates according to its own degrees of freedom. The air has more degrees of freedom than the string. A wave of compression and rarefaction is created in the air medium.

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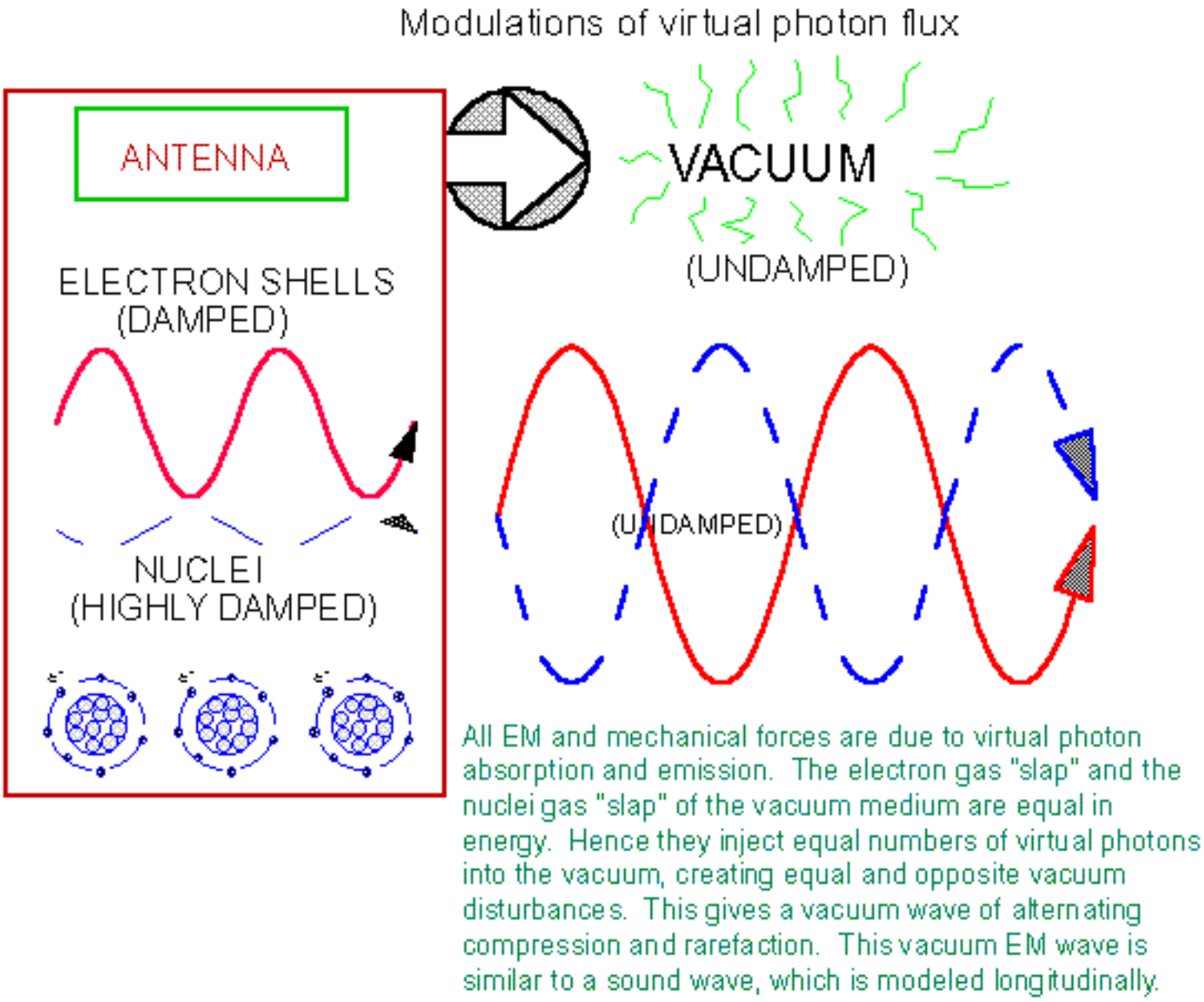

Figure 2. Launching an EM wave from a wire antenna.

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[9] See Nikola Tesla, "Pioneer Radio Engineer Gives Views on Power," New York Herald Tribune, Sep. 11, 1932. Quoting: "...I showed that the universal medium is a gaseous body in which only longitudinal pulses can be propagated, involving alternating compressions and expansions similar to those produced by sound waves in the air. Thus, a wireless transmitter does not emit Hertz waves which are a myth, but sound waves in the ether, behaving in every respect like those in the air, except that, owing to the great elastic force and extremely small density of the medium, their speed is that of light." Today the QM vacuum has been theoretically and experimentally shown to consist of a "gas" of virtual particles, rather like Tesla stated. Tesla was also correct about the longitudinal EM wave in the vacuum. He was also correct in his statement that a fundamental charged particle can alter its charge, if one considers the massless charge ~ of charge q separately from the mass m of charge q. When the charge q is placed in a nonzero potential V, it follows that the new charge of the electron is simply (~+V).

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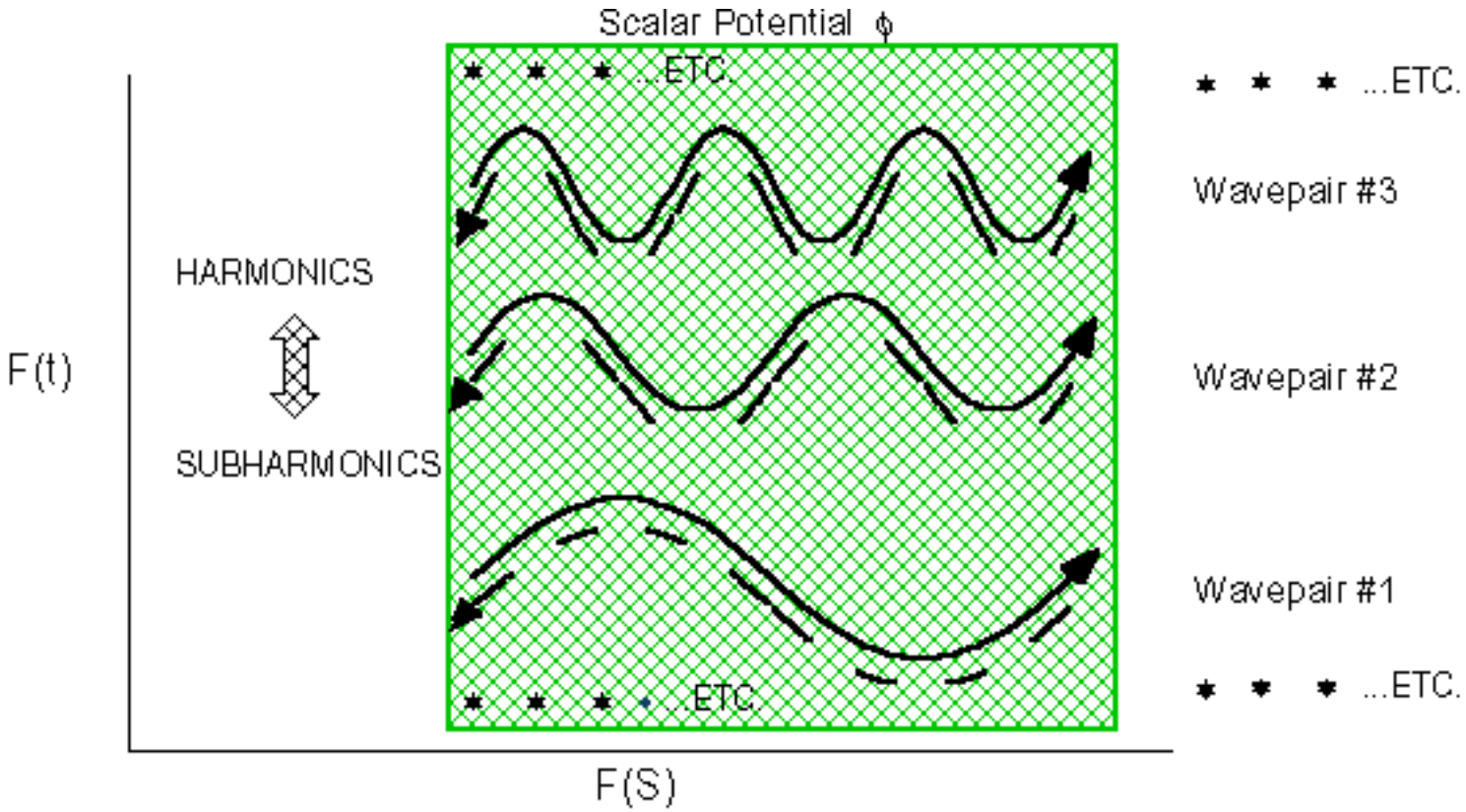

Figure 3. Internal Wave Structure of the scalar potential.

A harmonic set if wavepairs, where in each wavepair the two waves superpose spatially, but travel in opposite directions. The two waves in each pair are true phase conjugates and time-reversals of each other. Thus they comprise a coupled wave and antiwave. The photons must also be coupled into photon/antiphoton pairs, by a strong application of the distortion correction theorem of nonlinear optics.
Each wavepair is a standing electrogravitational wave.

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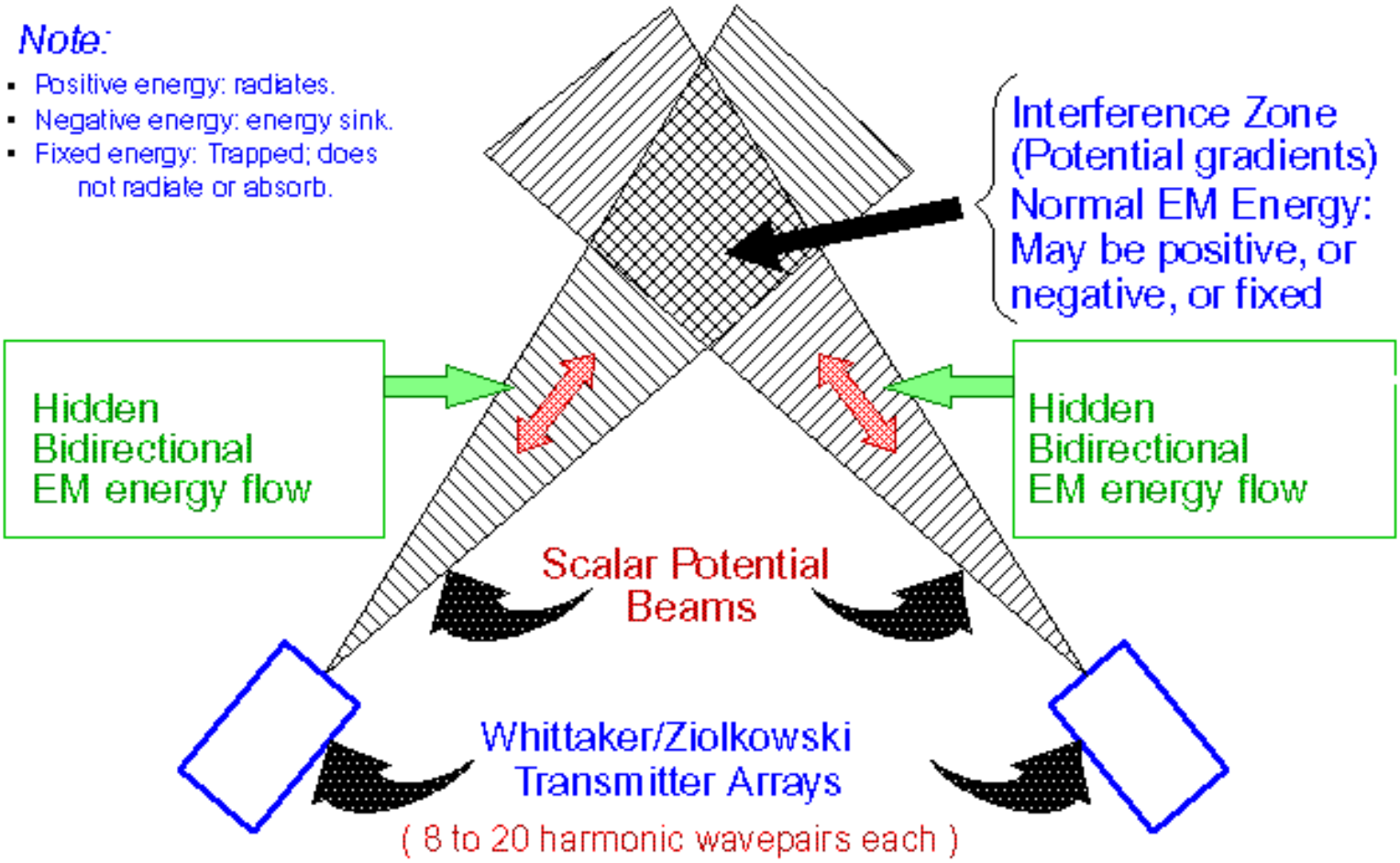

Figure 4. Scalar potential interferometry provides action-at-a-distance. It already creates normal EM fields and waves.

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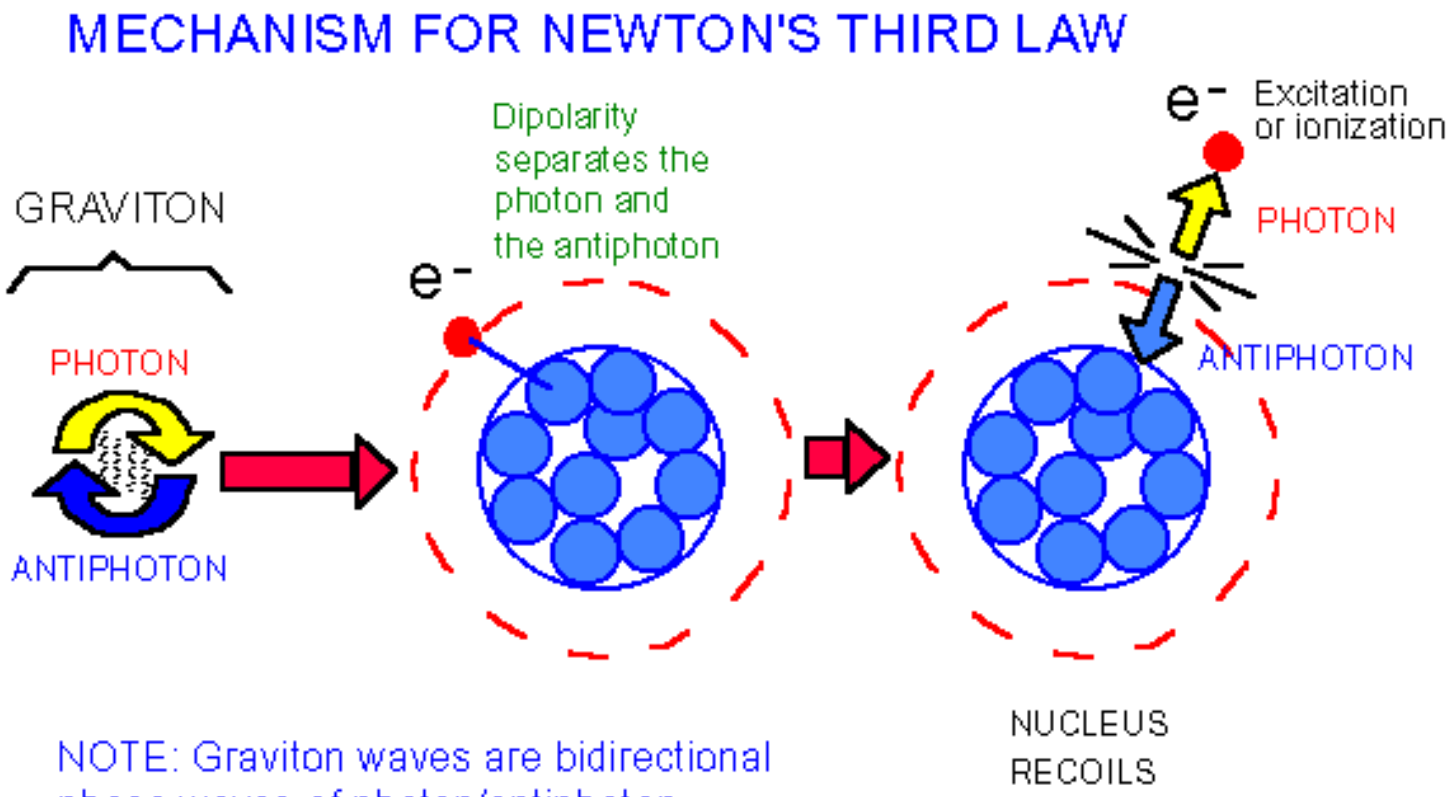

NOTE: Graviton waves are bidirectional phase waves of photon/antiphoton coupling and uncoupling in the vacuum.

The atom is an assembly of dynamic dipoles.

A dipole splits the graviton into a photon and an antiphoton.
The photon interacts with the electron, producing the action.
The antiphoton interacts with the nucleus, producing the reaction.

Figure 5. Graviton interaction with matter produces the photon interaction and Newton's third law reaction.

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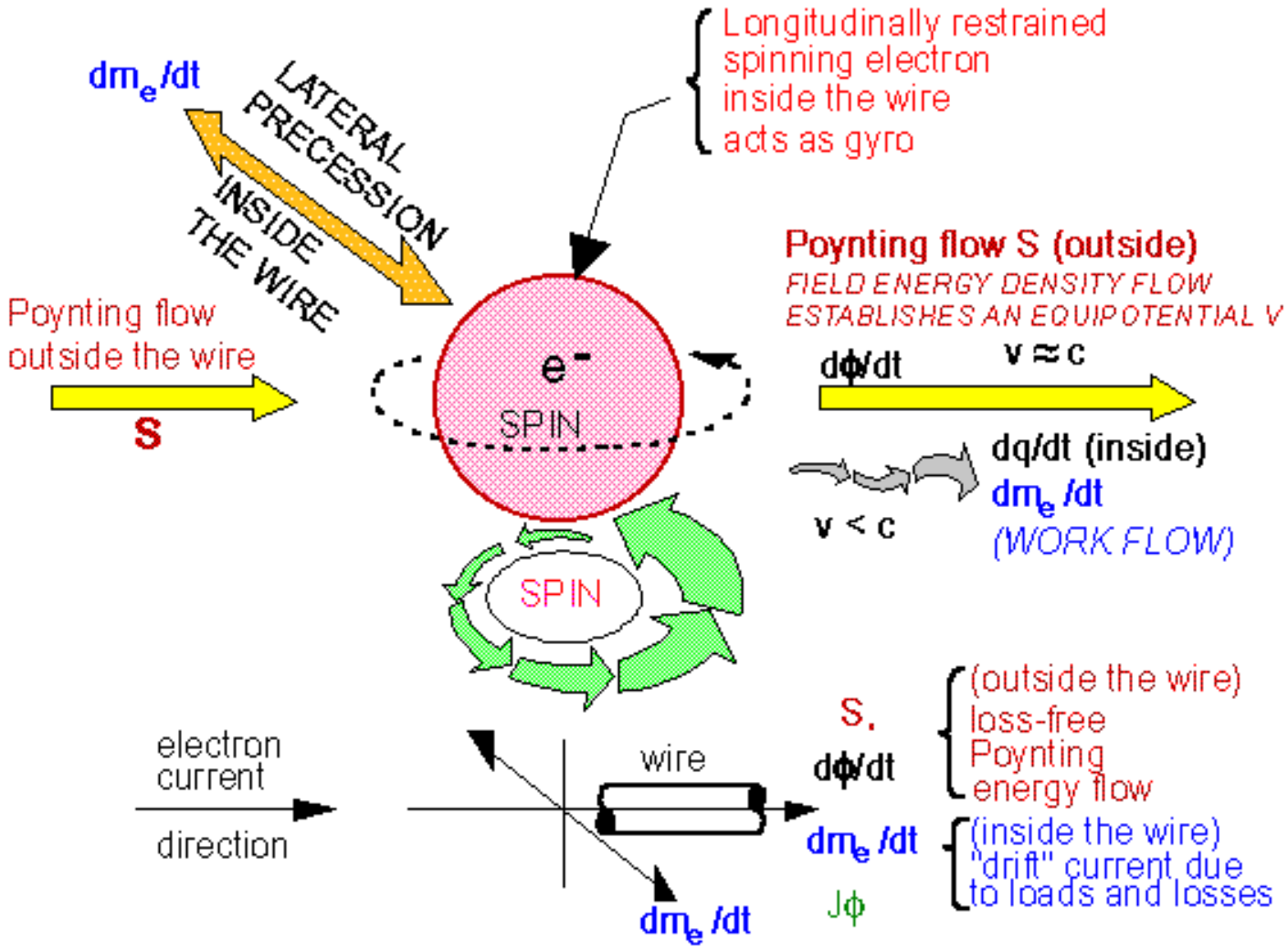

Figure 6. Currents in and along a conductor, with electron precession.

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Further, if we should trick the time-reversed wave half into coming outside the atom instead of going inside to interact with the nucleus (Figure 7), then it follows that the nucleus would not recoil. In that case the interaction would appear to violate Newtonian third law reaction. Phase conjugate mirrors already do just exactly this when they emit a phase conjugate replica wave. They direct the antiwave outside and away from the atom instead of inwards into the nucleus. So they do not recoil, no matter how powerful a phase conjugate replica wave they emit.

Finally, we can also show that the EM wave in vacuum is longitudinal, by yet another approach. The electrons in the electron gas in a conductor are spinning, and they are severely constrained longitudinally to be able to move only very, very slowly down the wire. So when perturbed, they act as gyroscopes, and precess at right angles to the perturbing force. The fact that the gyroelectrons in a wire move radially almost entirely, and only "slip" down the wire very slowly with a "drift" velocity, already proves conclusively that the incoming vacuum disturbance was longitudinal. The precession of a gyro is at right angles to the perturbing force. Therefore rigorously the vacuum EM waves are longitudinal, because the gyroelectrons moved transversely. The present assumption of the transverse EM wave in vacuum contradicts the entire theory of gyroscopes! [note 10] There are many other errors in classical EM that we will point out in future articles; this should give the reader a flavor of what is in store for him in future articles.

So there are no truly satisfactory "experts" in any of the 14 fields. Yet there is still something to be said for having some years of experience in one or more of the areas. I have had the good fortune or misfortune, depending upon one's viewpoint, to be involved in various of those 14 activities for some 30 years or more, and am active in several of the areas now. My colleagues and I are particularly active in researching overunity electrical devices (see Figure 8), to include the effects of controlled chaotic oscillators, charge-blocking oscillators, and oscillators driven by in-shuttled (bridged) Poynting field energy density flow ExH. Parametric oscillation is known to have yielded overunity electrical machines and was fully reported by Russian researchers in the Russian and French technical journals in the mid 1930s. [note 11] We will further cite that little-known work in future articles. Also, we are working mightily upon true negative resistors (Figure 9), wherein the resistor scavenges some of the disorganized energy from the vacuum's energetic exchange with the charges in the system, organizes and collects it, and then outputs that collected energy flow into the external circuit. Such a resistor acts as a power source. Kron, perhaps the greatest of the electrical machinery scientists, is known to have produced such true negative resistors.

I have also proposed a theoretical explanation of the Priore device (Figure 10) in France which in laboratory animals demonstrated remarkable cures of terminal tumors, cured trypanosomias, reversed atheriosclerosis, and restored suppressed immune systems. The Priore work was not anecdotal, but was performed under rigorous scientific protocols, working under the auspices of renowned French scientists such as Courrier and Pautrizel. The work is properly reported in numerous papers in the French medical literature. [note 12] The results were certainly achieved, but neither Priore himself nor the scientists of the day could understand the mechanism involved. The deciphering of that causative technical mechanism utilized by the Priore group required 10 years of intense effort. The results have now been published in the journal Explore! and are there for anyone to read. [note 13]

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PHOTON INTERACTION WHEN ATOM PHASE CONJUGATES

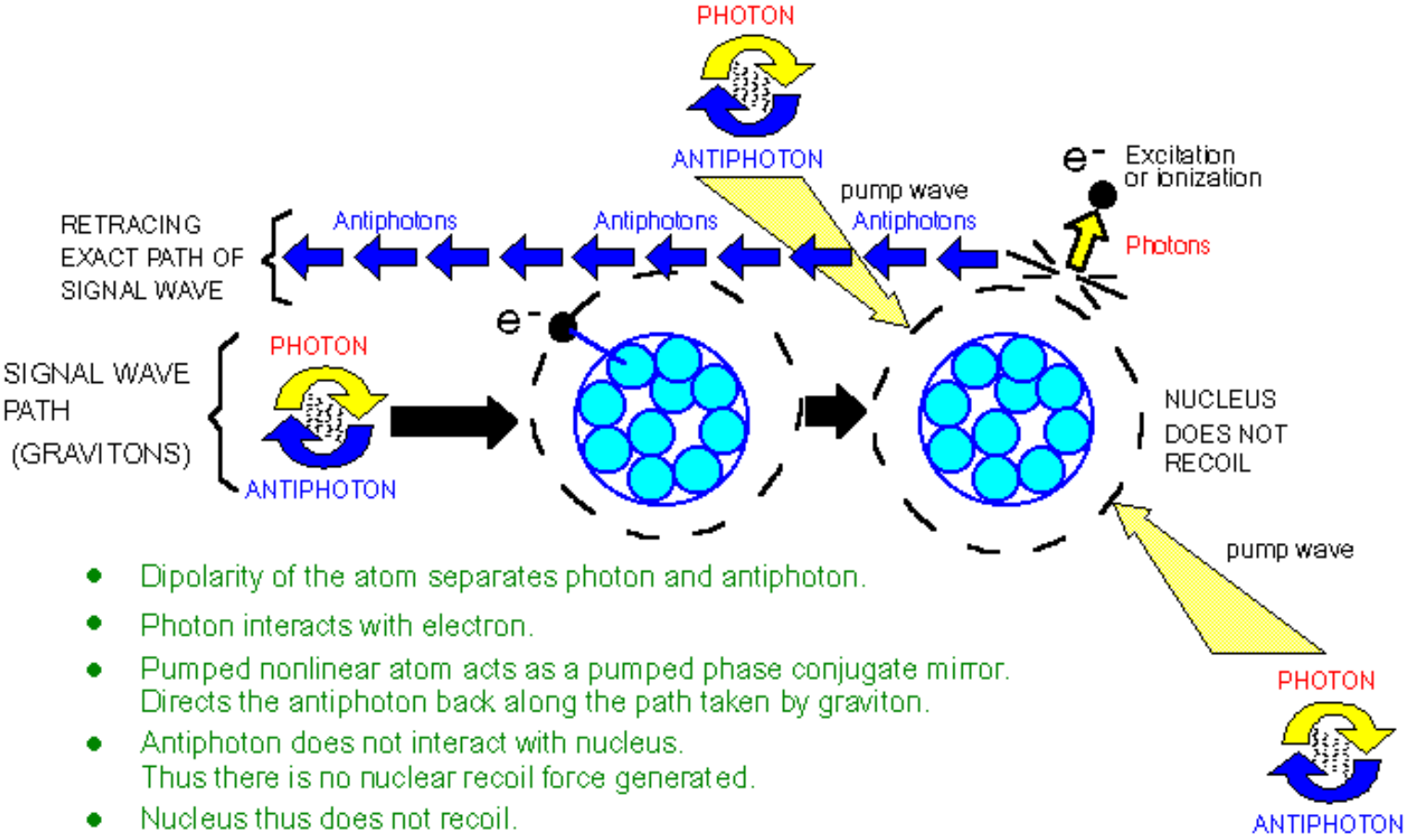

- Dipolarity of the atom separates photon and antiphoton.
- Photon interacts with electron.
- Pumped nonlinear atom acts as a pumped phase conjugate mirror. Directs the antiphoton back along the path taken by graviton.
- Antiphoton does not interact with nucleus. Thus there is no nuclear recoil force generated.
- Nucleus thus does not recoil.
- Not a violation of Newton's third law, once one understands the mechanism that generates third law reaction. In the absence of the generating mechanism, there is no third law recoil. In EM field theory, the "missing antiwave" has necessitated third law omission.

Figure 7. Emission of antiphoton; nucleus does not recoil. Atom acts as a pumped phase conjugate mirror.

D-1-F7

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[10] When Maxwell's theory was constructed, the electron had not yet been discovered, and so the dipolarity of the atom was unknown. An atom was regarded just as a "blob." Electricity in a conductor was regarded as a thin material fluid Maxwell's equations are in fact hydrodynamic equations. So the founders regarded the detection of induced motion in the electric fluid as induced translation, not induced precession. They had no idea of "spins" of particles of the fluid, nor of gyro precession of those particles. Instead, q was regarded just as a "piece of electric fluid," similar to a cubic centimeter of fluid.

A fundamental AC resonant principle for an overunity electrical power system

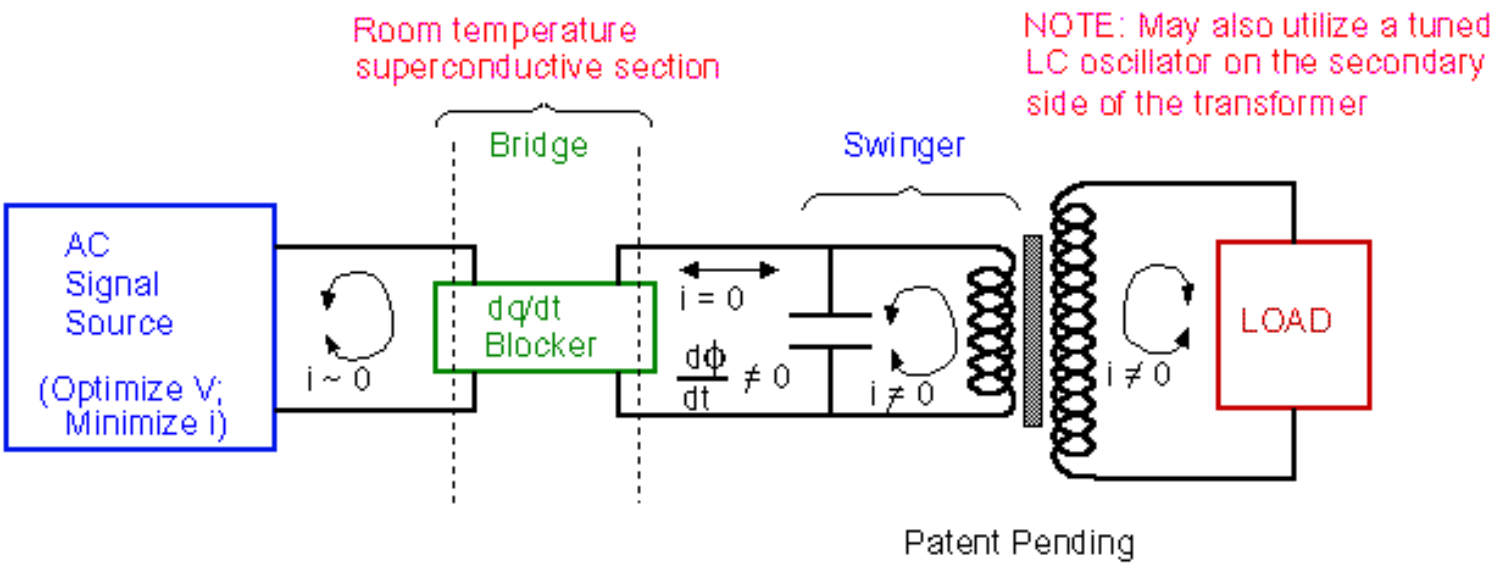

Figure 8. dq/dt-free driving a swinger by S-flow.

Poynting energy flow S with its accompanying potential V is shuttled from the source to a tuned LC oscillator in resonance at the driving frequency or slightly below. The LC oscillator is driven by S-flow and dV/dt flow alone. The swinger furnishes its own free electrons, which receive S and EMF from the bridge, thereby producing dq/dt.

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[11] E.g., see L. Mandelstam [Mendel'shtam, L.I.], N. Papalexi, A. Andronov, S. Chaikin and A. Witt. (1935) "Report on Recent Research on Nonlinear Oscillations," Translation of "Expose Des Recherches Recentes Sur Les Oscillations Non Lineaires," Technical Physics of the USSR, Leningrad, Vol. 2, 1935, p. 81-134. NASA Translation Doc. TT F-12,678, Nov. 1969. Summarizes lengthy work at the Institute of Physics of the University of Moscow and several of the laboratories on the problem of self-powered, self- oscillating nonlinear oscillators. The paper reports significant work and progress in oscillations created by the oscillating system itself (self-oscillation) without participation of any external forces varying with time and without the expense of a constant source of energy (e.g., a storage battery). Such a system was shown to self-increase in an underdamped manner until system self-destruction. Adding a nonlinear load allowed the systems to stabilize its dynamic operation so that it powered a load under overunity conditions and did not self-destruct. Extensive additional references on this spectacularly successful overunity energy project are listed.

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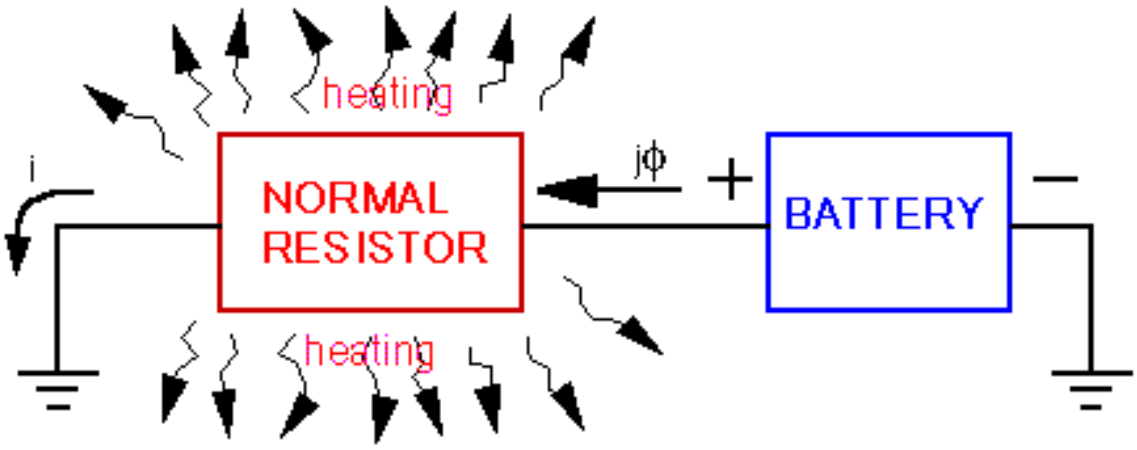

Figure 9a. Normal resistor receives ordered energy and scatters it.

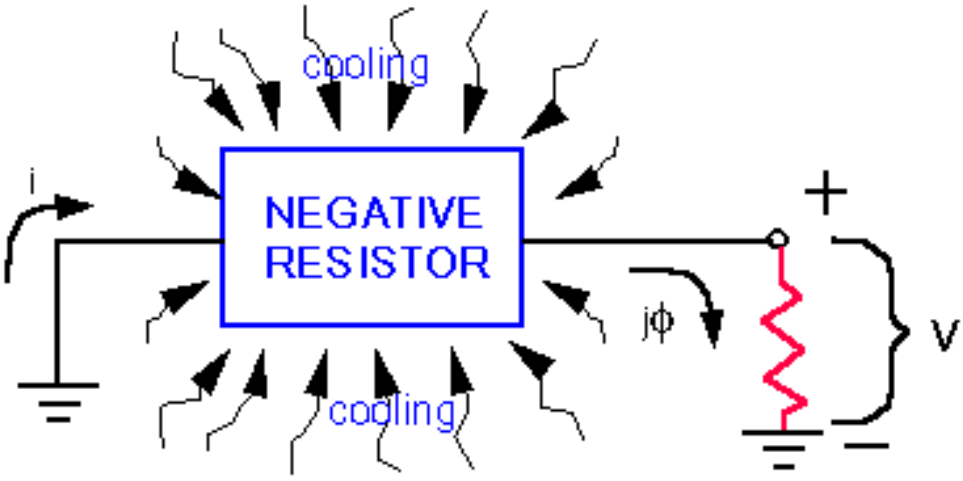

Figure 9b. Negative resistor receives, concentrates, and reorders scattered energy.

Figure 9. Normal resistor versus a negative resistor.

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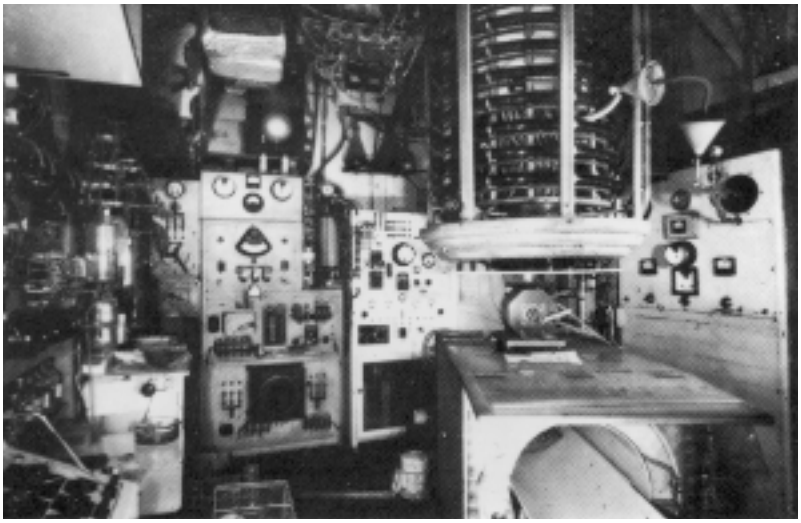

Some 17 signals were fed into a rotating plasma, which added phase conjugates to them. This infolded 17 wavepairs, each pair a coupled wave/antiwave, thereby forming a scalar potential with an artificial Whittaker pump wave internal structure. This infolded pump wave complex was modulated onto a powerful, rippling magnetic field, guaranteeing penetration even into the atomic nuclei. A specific, amplified antiengine for the exact cellular disease state was generated, reversing the diseased cells back to a previous healthy state.

Figure 10. Priore's laboratory apparatus for cellular reversal.

D-1-F10

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[12] For citations and the exposition of our proposed explanation of the Priore mechanism, see T.E. Bearden, "Vacuum engines and Priore's methodology: The true science of energy-medicine." Part I, Explore!, 6(1), 1995, p. 66- 76, Part II, Explore!, 6(2), 1995, p. 50-62.

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[13] Bearden, "Vacuum engines and...," ibid.

Presently my CTEC colleagues and I have filed three patent applications and a continuation, on various methods for overunity processes and apparatuses, room temperature superconductivity, Poynting generators, etc.

As an example, we took exactly the opposite approach to room temperature superconductivity as has been taken by all the orthodox researchers to date. What exactly is sought, after all, for superconductivity (SC) in a section of an electrical circuit? Well, one has some electrons on one side of that SC section that are transporting excess potential, as given by the Slepian vector J*. [note 14] What is desired is to get some electrons on the other side of the SC section that also are transporting the same amount of excess energy in the form of J*. You can do that in two ways: (1) you can flow the electron carriers through the SC section, carrying their J*, or (2) you can block the J and flow the * itself across as the Poynting flow S. [note 15] Nondivergent Poynting flow flows along an equipotential, which is just another way of saying that, if the S-flow does not diverge, it carries the same potential * along with it. Hence it carries the EMF right along with it as it flows without divergence.

Conventional approaches have all tried to shove the electron carriers through the SC lattice section. Doing that is like trying to fire a very slow bullet through several million rotating fans in a straight line. So cryogenics (to slow the fanblades to a crawl) and massive correlation of the electrons and of the electron-to-lattice interactions is necessary if one is to get the electrons through there without excess collisions that shake off some of the excess * from J*, as scattered photons (heat) or as a change of form of the energy (as in straining the dielectric of a capacitor to convert electrical energy to mechanical strain energy via the piezoelectric effect.)

Our approach is exactly the opposite (Figure 11 and Figure 12). Why not just *stop* the flow of excited electron carriers on one side of the SC section, and continue the nondiverging flow of the Poynting field energy density S across that section at room temperature? Then the cryogenics is not needed at all. After all, circuits already work that way anyhow __ except standard practice is to nullify the process by letting current be driven around the sourcing current loop and back through the back EMF of the primary source. A quantum well (or several other methods) can be used to trap the "sourcing" electrons in the conductor just prior to entering the SC section. The "receiving" electrons on the other side of the SC section, however, must be in their own dq/dt-isolated current loop.

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[14] Briefly, the S-flow outside the wire will be flowing along essentially at the speed of light, at or with the same since S-flow without divergence is along an equipotential. Said another way, a nondiverging Poynting flow S exhibits a constant potential ~ along its streamlines. A tiny, tiny portion of the S-flow is intercepted by the sluggish electrons (which may be moving as dq/dt at 11 feet per hour, in a typical case), to form the Slepian vector J~. The J~ portion is just the minute fraction of the S-flow that is actually intercepted by the electron current and transported to the impedances, for releasing the excess ~ in the loads and losses. [Incidentally, this wee note resolves a century of controversy over exactly how EM energy flows in circuits. The orthodox literature abounds with discussions, differing positions, and debates and with errors.]

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[15] Note that this also automatically involves a host of other types of controversial displacement currents, such as d~/dt, dV/dt, dE/dt, dP/dt, dD/dt, etc. The literature is thoroughly floundering as to exactly how all these currents are related, together with the Slepian vector J~ and the Poynting vector S, as well as the "normal" current dq/dt. We will be discussing the "master key" for these relationships in future articles.

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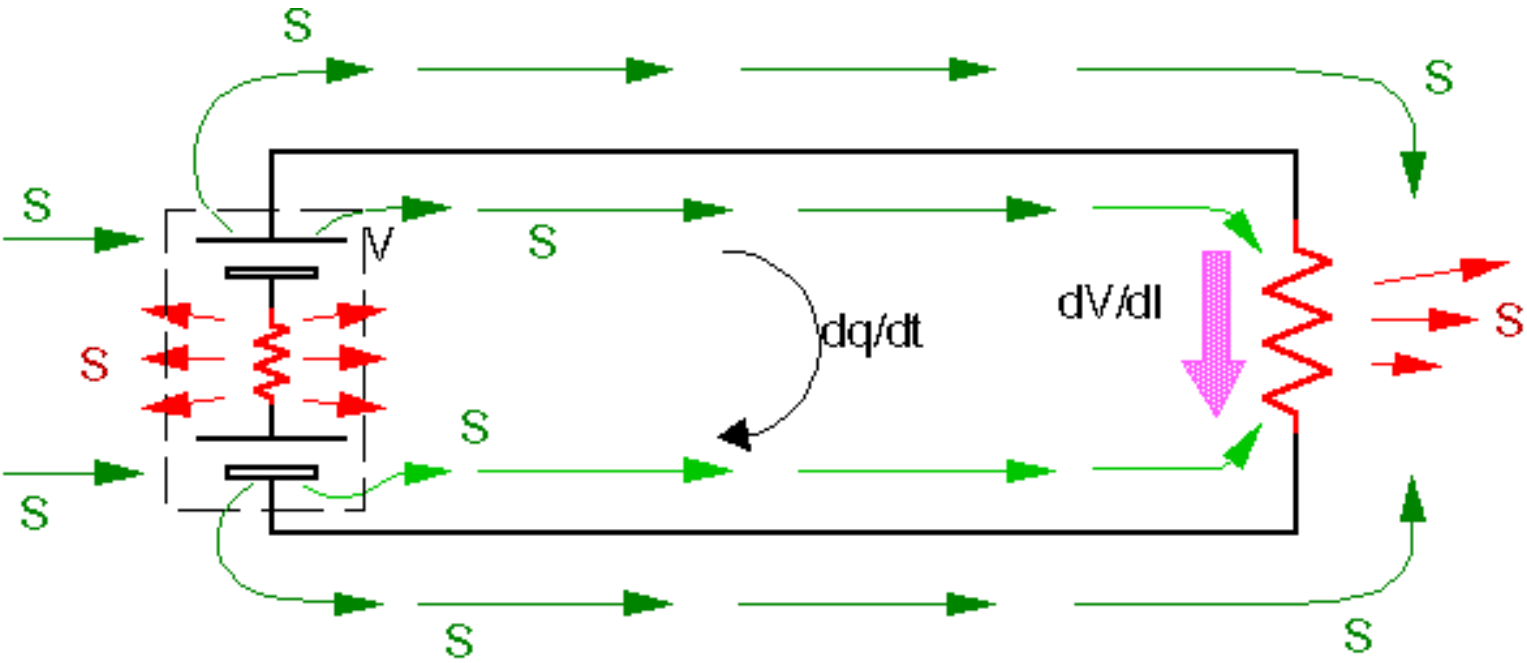

Note: EM texts err in showing the battery "gate" as the source of energy.

Figure 11. Poynting S-flow along a simple circuit.

From particle physics, any electric charge is a broken symmetry in the vacuum's virtual particle flux. Any dipole is thus two locally broken symmetries. Thus the dipole acts as a gate/source, driven by the fierce vacuum flux. So a dipole already "extracts" and gates EM energy flow, directly from the seething vacuum.

Every battery and generator is already a "free energy" source of extracted and gated EM energy from the vacuum.

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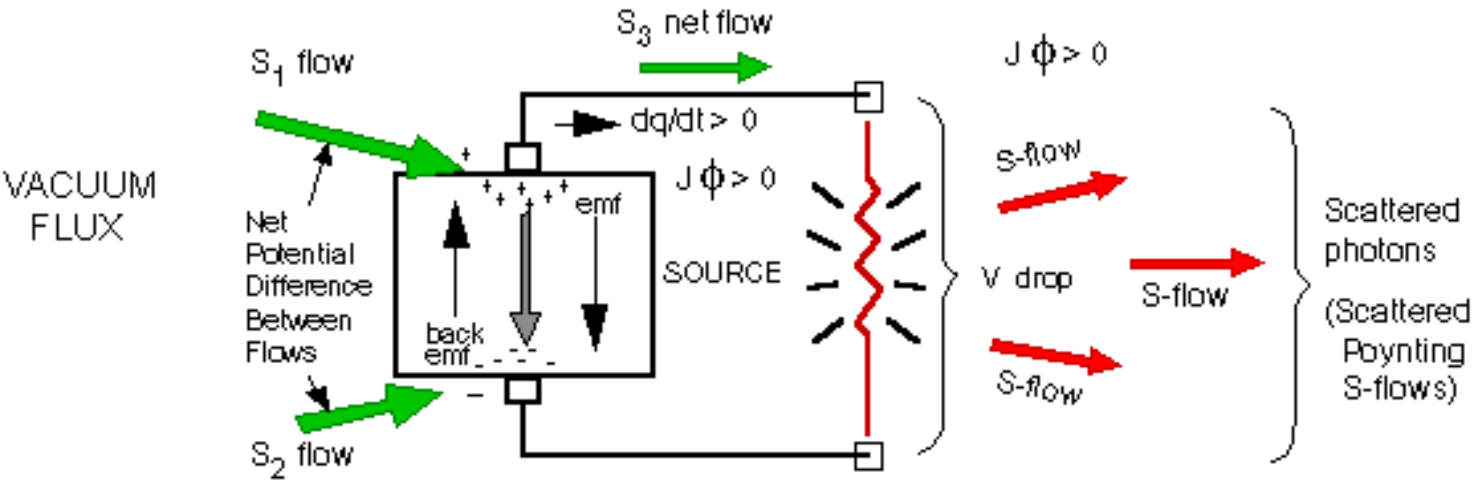

Figure 12a. Normal current flow; Jϕ is the electron transport of energy, while S is the speed-of-light Poynting energy flow.

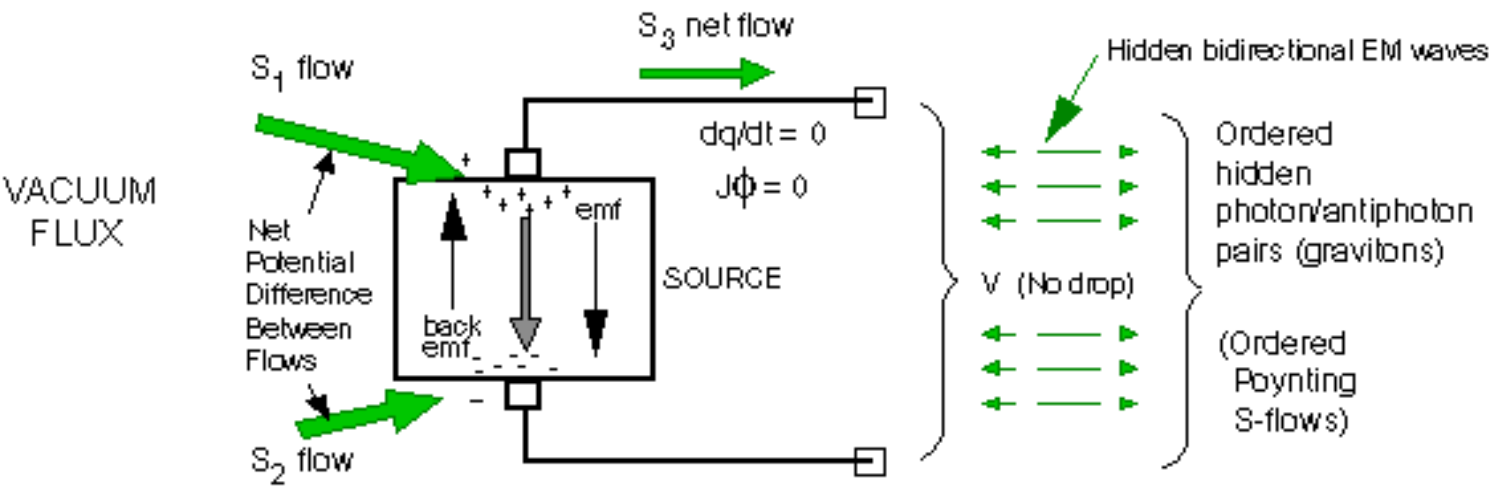

Figure 12b. In a conductor with dq/dt blocked; S-flow and hidden Whittaker-wave flow continue.

Figure 12. Overt and covert field energy density flows.

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Normal sources do not furnish electrons and current to a circuit anyway. Sources just furnish Poynting flow S and EMF. [note 16] In the receiving current loop, the EMF appears automatically once the S-flow flows in and is "locked on to" by the receiving electrons. Given q**, you will immediately have J* if the electrons are free to move in the conducting circuit (see Figure 13). Further, you have eliminated all the loss terms from the standard Poynting equation for energy losses. So all the energy flow S just flows across the SC section, without any current or Cooper pairs flowing through that SC section. The SC section has become a "bridge" which (1) strips off the Poynting field energy density flow S from the electron current dq/dt on the sourcing side of the SC/bridge section, by simply reducing the dq/dt to zero; and (2) continues to pass the S-flow across the dq/dt-blocked SC/bridge section to the other side (Figure 14). The excess S-flow (and EMF) pours into the receiving dq/dt-isolated current loop, exciting the electrons therein to produce dq/dt and J*. *Any closed current loop is self-powered, once it receives S and EMF. It furnishes its own electrons; it only requires excess energy and EMF.* [note 17]

So our approach gives room temperature superconductivity in a very straightforward manner, once you discover how to block the current dq/dt in a conductor. Blocking it in an insulator is not sufficient, because that drops the potential and stops the S-flow and the equipotential * (the EMF). However, a degenerate semiconductor such as the Fogal chip can be used, as can several other processes for blocking dq/dt in a conductor. We will discuss these in a future article.

Another advantage of this approach to room temperature superconductivity is that now one can also have permissible overunity coefficient of performance. Now the load can be placed in its own S-receiving, isolated current loop. With the sourcing current loop furnishing only S and not dq/dt, the load is still powered normally in its own closed dq/dt current loop, but none of the load current is passed back through the back EMF of the primary source in the sourcing circuit.

This principle -- that at least a substantial portion of the load current must not pass back through the primary source -- is the primary principle required for a permissible overunity electrical machine (Figure 15). A permissible overunity electrical machine is one which produces more power in the load than you have to put into the machine to run it.

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[16] E.g., see Robert L. Shrader, Electronic Communication, Sixth Edn., MacMillan/McGraw-Hill, New York, NY, 1991. (1993 Imprint). Quoting from p. 6: "A source of electric energy does not increase the number of ~ree electrons in a circuit; it merely produces a concerted pressure on any aimlessly moving electrons."

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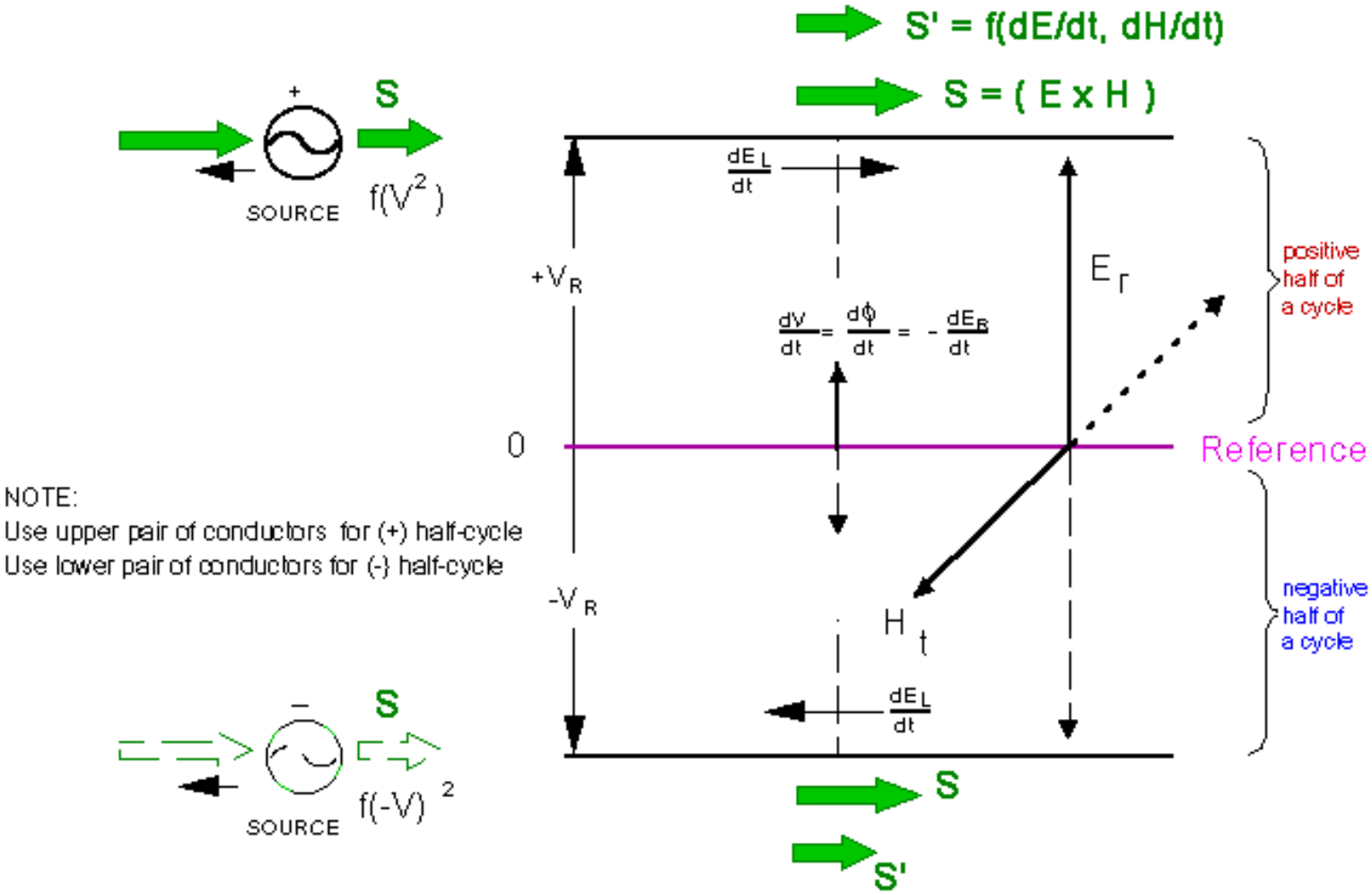

Figure 13. Poynting vector currents S and S' versus massless displacement currents.

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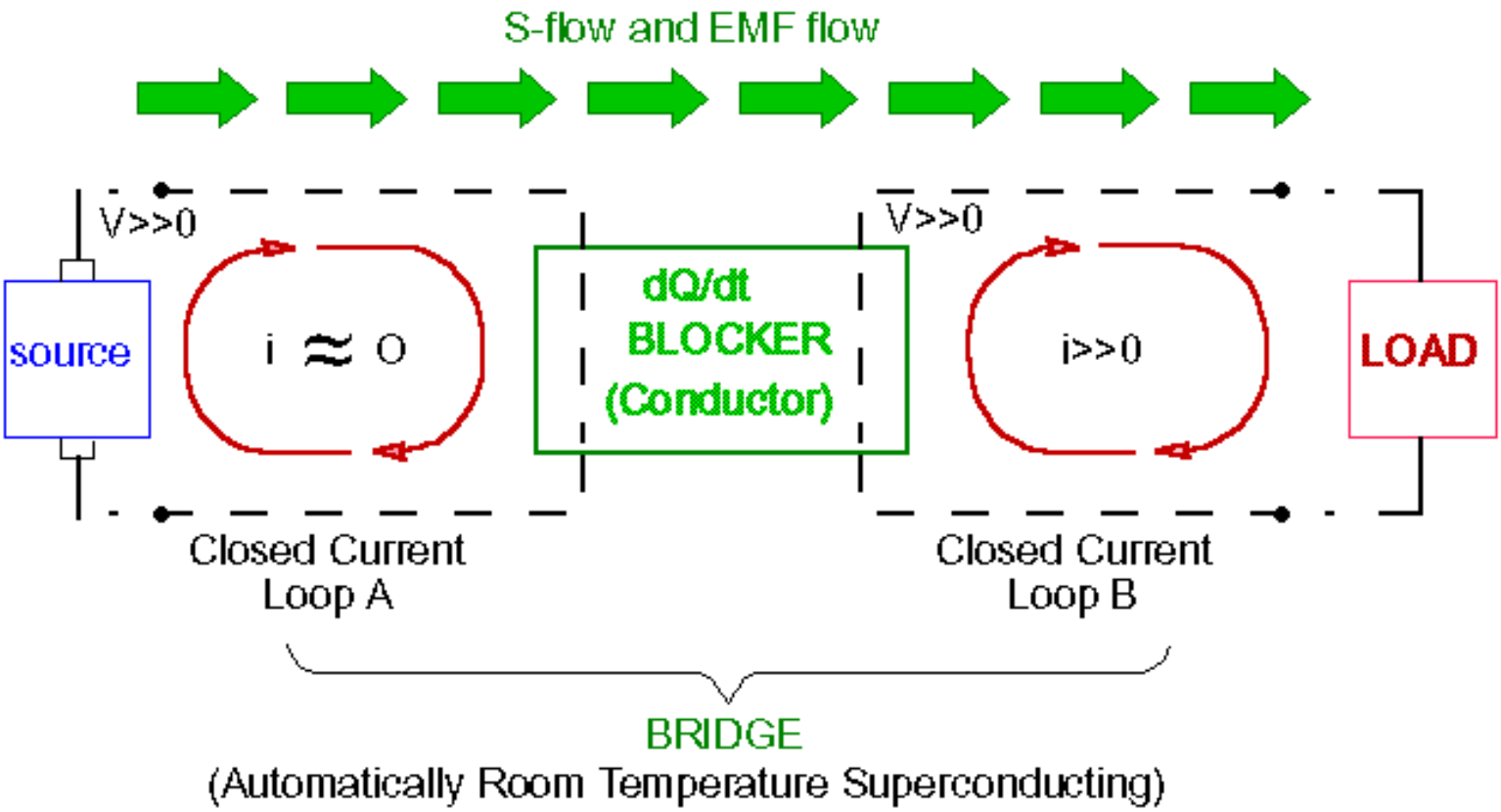

Figure 14. Bridging to enable room temperature superconductivity.

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[17] My own approach has been, if that's all that the circuits require from our primary power source, then let's simply accept that directly from the source without performing any work in the source. Iœ you do it this way, the source is never dissipated, but will last indefinitely. Sources furnish flowing field energy density, not "energy" per se. If you only demand S-flow, you can have all you wish from a source, without exhausting your source. The trick is to find how to steadily dissipate some of this "artesian well" of flowing S to drive electrons through the load, but without driving electrons back through the back EMF of the source.

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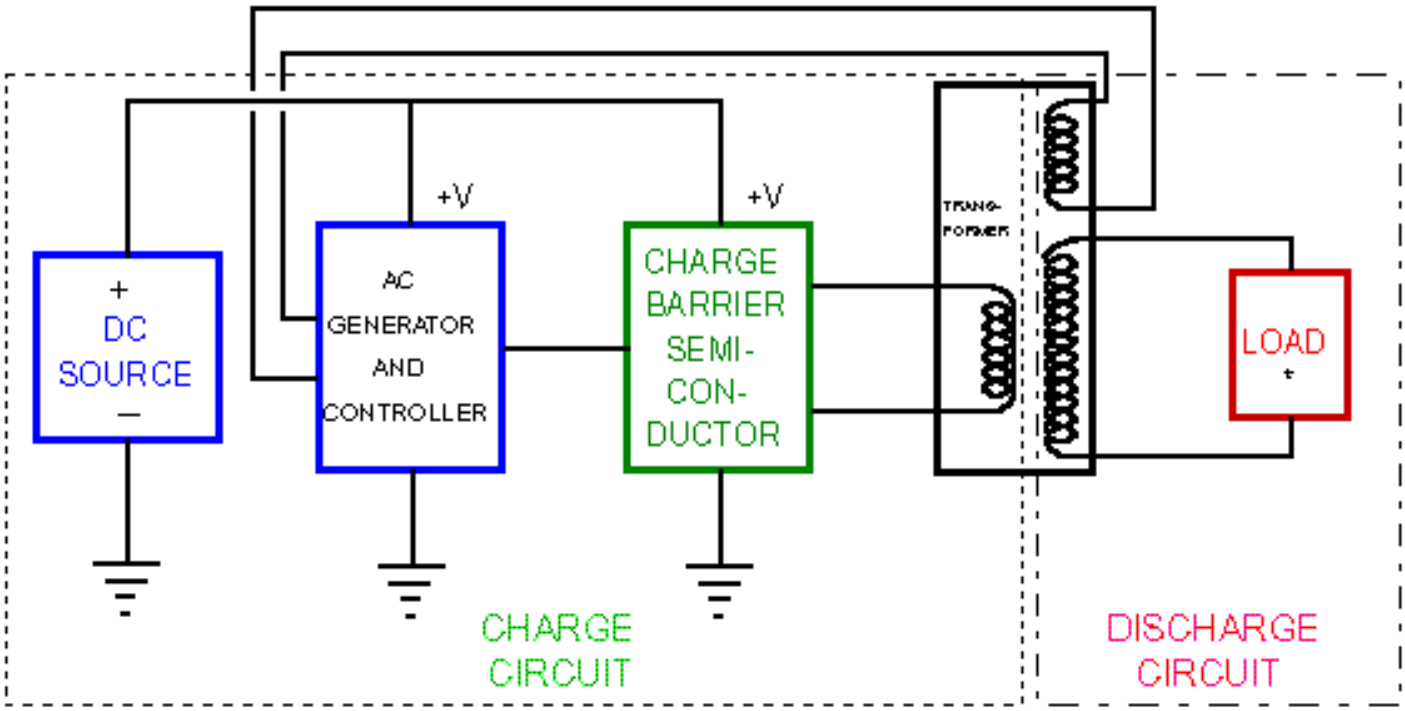

Patent Pending

* NOTE:
DISCHARGE CIRCUIT AND LOAD GROUND
MUST BE ISOLATED FROM THE
CHARGE CIRCUIT GROUND.
FEEDBACK LOOP MUST BE RIGIDLY CLAMPED AND LIMITED.

Figure 15. Use of Fogal semiconductor for overunity (closed system).

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Obviously, the laws of physics and thermodynamics require such an overunity machine to be an open system that extracts and utilizes excess energy from an external source. In the case outlined, we extract the excess energy directly from the vacuum in the form of S-flow; essentially we convert our primary source to a Poynting generator rather than a "power" (energy flow loss rate) generator. The resulting overunity machine accomplishes both room temperature superconductivity and also overunity coefficient of performance (Figure 16). It does not violate the conservation laws of physics. It does not violate the second law of thermodynamics because it is an open system receiving and utilizing excess energy from the vacuum, and the second law need not apply to such systems. [note 18]

You see, all power systems are already free energy density flow sourcing systems, if we but use them correctly. Every dipole is a "gating device" for extracting excess field energy density flow from the violent bidirectional flux exchange between the vacuum and each end of the dipole. [note 19] [note 20] When we attach "conducting leads" to a dipolar source, as in the simple two-wire circuit, all we are doing with the conductors is providing waveguides for the extracted S-flows from the vacuum to flow along (it flows outside the conductors) without loss. In effect, each lead is simply extending the pole (i.e., the terminal) to which it is connected.

My associates and I are also working on several other inventions at present, including two more patent applications to be filed in the near future. One of those is in the field of overunity power systems, while the other is in an entirely different, highly proprietary nuclear effort. I will address all these areas in future columns, and those columns will have real "meat" in them.

Present "big science" proclaims that overunity electrical machines are impossible. The reader should understand that the U.S. Patent and Trademarks Office is never going to grant a patent for an overunity electrical machine unless the machine is independently tested and replicated, and unless it is certified by scientists of impeccable credentials. This is as it should be. Legitimate free energy researchers accept that dictum. Eventually the stuff has to work on the bench in order to be validated. On the other hand, free energy researchers also point out that one must not demand of us the next 100 years of national research by a hundred major laboratories immediately! This is still a shoestring operation, because all conventional sources of research funds are denied to the serious overunity researcher (with the single exception of occasional personal funding of a researcher by a private individual). In other words, we demand at least the same kind of consideration that the orthodox nuclear fusion community has enjoyed. Billions of dollars have been poured into that sinkhole, and not a single controlled fusion power unit is working anywhere in the world after decades of work at enormous expense to the taxpayers.

So we overunity researchers deserve at least a decade or two of our own, to try to accomplish overunity electrical system development. We also painfully point out that "Big Science" will not fund a single overunity researcher, for specific overunity purpose, no matter what his credentials or capability. In fact, "Big Science" is part of the problem, because it fervently seeks to prevent any legitimate research in overunity. To carry out its suppression campaign. it resorts to vilification, character assassination, libel, and slander of the overunity researchers themselves __ again, regardless of their qualifications or legitimate scientific procedures. [note 13]

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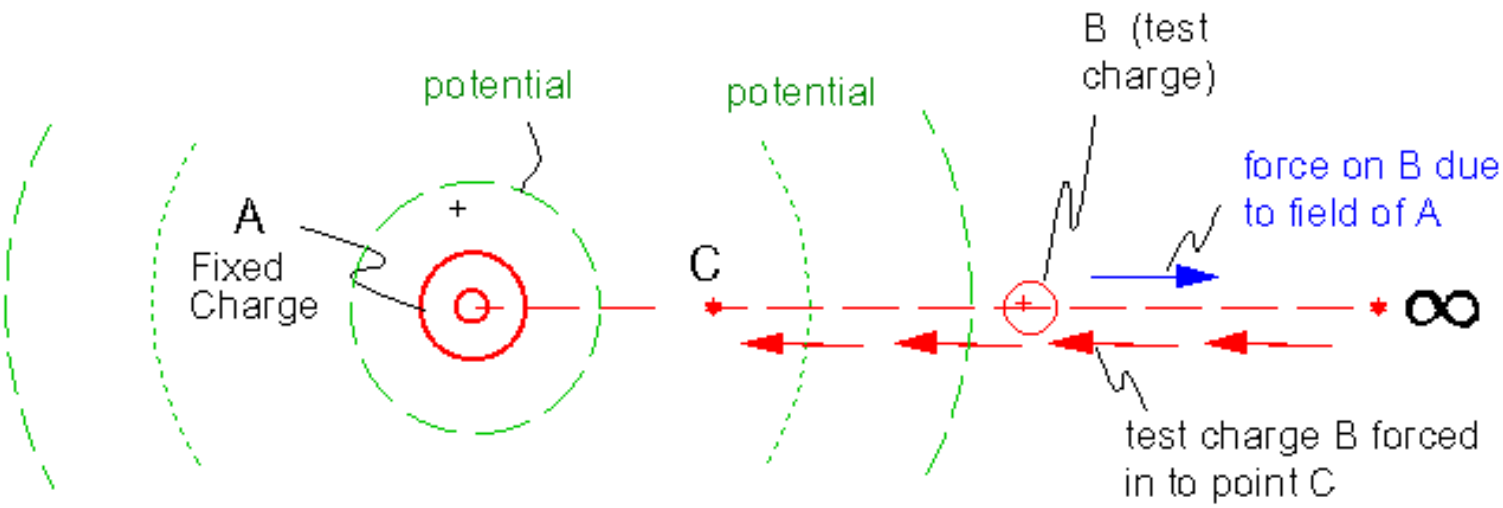

Figure 16a. Magnitude of the scalar potential is determined by work required to push in a unit charge from infinity; e.g., against a repelling like charge. If test charge is released, work will be performed upon it to translate it back toward infinity

Figure 16a. Process for overunity coefficient of performance.

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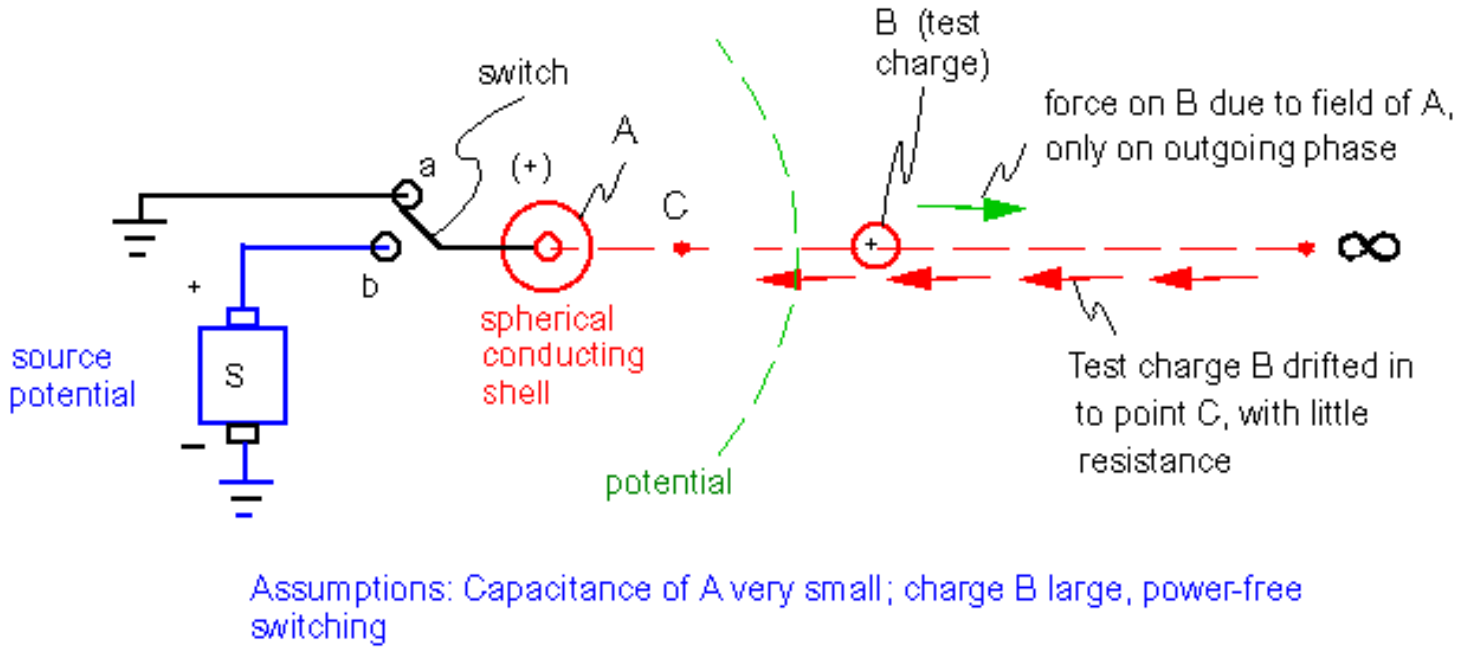

Switch potential off, drift in test charge B, switch potential back on. Can now get free work from repelled test charge B. Get much more free work if A is at a high potential, and charge B is large.

Figure 16 b. Demonstration of overunity efficiency.

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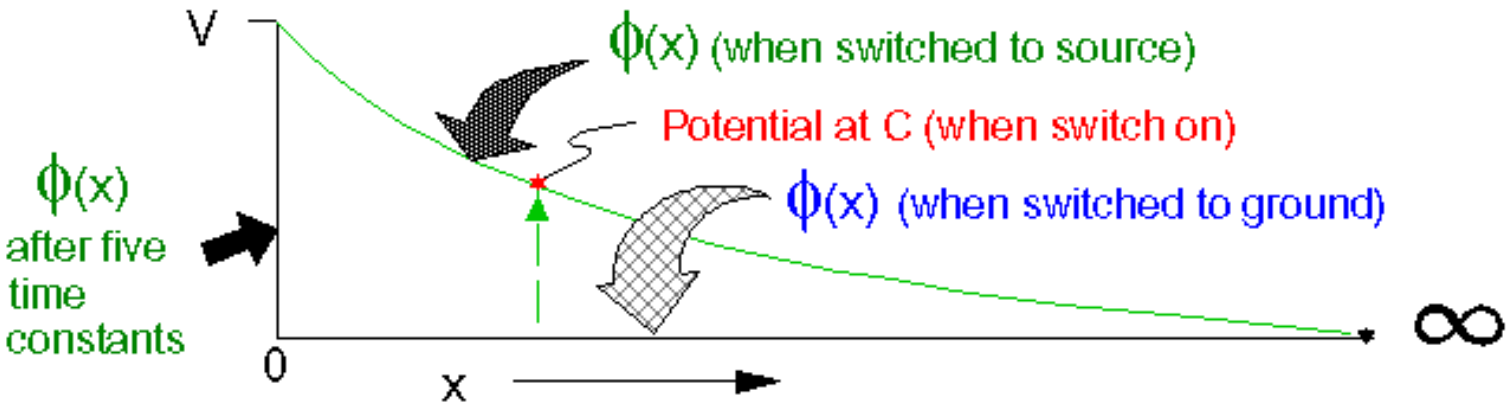

Ideally, switching the potential, rather than flowing charges, requires only minuscule overhead energy dissipation

Figure 16c. Potential to which test charge is exposed.

D-1-F16C

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[18] The system does comply with the nonlinear thermodynamics of a system œar from equilibrium. E.g., Prigogine received the Nobel Prize œor significantly developing this new field. For a detailed technical presentation of nonlinear thermodynamics of a system far from thermodynamic equilibrium, see G. Nicolis and I. Prigogine, Explorinq Complexity, Piper, Munich, 1987. Such systems can exhibit negentropy, self-organization, and other effects outside the confines of classical thermodynamics. Since local symmetry is broken, they can also permissibly exhibit overunity coefficient of perœormance.

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[19] Each end 0œ a dipole has its own potential (with respect to the local vacuum), which differs from the potential of the surrounding ambient vacuum. For each of these "end-potentials," one can mathematically decompose that end-potential into a hidden bidirectional set of harmonic wavepairs in harmonic sequence. Each wavepair consists of the wave and its phase conjugate. For the proof, see E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Mathematische Annglen, Vol. 57, 1903, p. 333-355. Since one of the dipole potentials exceeds the local vacuum potential and the other dipole potential is lower than the local vacuum potential, the two bidirectional EM wave flows are at or "carry" different equipotentials. This is the generatrix for the automatic dual œ1ow of energy from the vacuum through the dipolar power source and out along the two leads of the "transmission line" conducting the S-flow to the components of the circuit for powering the loads. So as can be seen, rigorously every dipole is already a "free energy source" if we learn how to properly use it. The energy will flow forever, if we do not allow the destruction of the sourcing dipole.

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[20] See also E.T. Whittaker, "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions," Proceedinqs of the London Mathematical Society, Series 2, Vol. 1, 1904, p. 367-372. Here Whittaker shows that the fields of classical electromagnetics can be replaced by scalar potential interferometry of two potentials. Our own comment is to note that by Whittaker 1903, we can with a little difficulty make artificial potentials with deliberate substructures. We can then interfere those potentials (actually, interfere their hidden multiwave structures) even at a distance, to create new EM fields. Or we can dissolve EM fields that exist at a distance, simply by constructing the correct negative EM fields by distant scalar interferometry. My point is that, when we utilize the "inner" electromagnetics inside the potential, we are employing a vastly more powerful electromagnetics of a new kind, which includes and extends the present inadequate EM theory.

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Indeed, orthodoxy has a black record with respect to energy. When Mayer advanced the conservation of energy law, orthodoxy hounded him unmercifully. He was universally ridiculed as the very epitome of a fool. He lost his job and suffered a nervous breakdown. Then years later toward the end of his life, scientists came to accept the conservation of energy as a most useful tool that dramatically simplified much of their analyses. So then science began to laud Mayer. There are a thousand other such examples; suffice it to say that "big science" is a bureaucracy and a "bell-shaped distribution curve" just like any other large group of people. Some scientists are near-angels. Others are near-devils. The vast majority are neither, but are just ordinary persons doing a special kind of job. In the scientific bureaucracy, however, the manipulative scientists scurry, slash, and manipulate their way toward the top. So the leadership of any big bureaucracy __ including the scientific bureaucracy __ is always rife with such near-scalawags and power-hungry individuals. Scientists are not exceptions to the same human weaknesses that we all evidence. If you really want to see jealousy, backbiting, and fierce "back-room dealing" and power-struggling, just get into a university research environment! But because the "power merchants" of any bureaucracy always fiercely resist any challenge to their position or superiority, big science has always fiercely resisted anything truly revolutionary. And today they also enlist the power of the state to enforce their dictums. We will devote one of our future columns to pointing out some glaring examples of persecution of independent researchers by big science. It is an area that all unorthodox researchers should be well-aware of. The world of science does not run by sweet reason and lofty ideals; that is just the dogma. It runs strictly by "who's going to be the big monkey," just like everything else. Primate dominance is still a dictum of the functioning of all bureaucratic human systems.

The free energy researchers are not working on the so-called "perpetual motion machine," where a closed system is erroneously stated to produce more output than must be put into it to operate it. That old saw is actually a red herring that dogmatic scientists use to vilify free energy researchers. It is a lie that they have also successfully sold to the U.S. Patent and Trademarks Office. Anyone with a modicum of knowledge of modern physics already knows that there does not exist a single closed system in the universe, anywhere. In particular, every physical system is continuously "open" to the violent exchange of energy with the surrounding vacuum. It's just that most systems are in local equilibrium in these flow exchanges, except for minuscule gating accomplished for such things as the Lamb shift, etc.

By analogy it's something like this. The free energy researcher is standing by the banks of a mighty, rushing river with breathtaking falls, turbulent areas, etc. Big Science is begrudgingly admitting that, yes, there is a river there, but it is an insane delusion to think that you can tap that energy. The free energy researcher is saying that, well, if I can build a gating sluice a little distance upstream, perhaps I can divert a small portion of the river's flow downstream to my waterwheel, and power my mill. The orthodox scientist then vilifies the free energy researcher for even having such a heretical thought. In fact, says the orthodox researcher, any fool can see that the laws of nature force the river's flow to stay firmly in its banks, because it is a closed system, and Moses brought that law down off the mountain with him on a special stone tablet. Then he adds all the other smug remarks such as, "If it could be done, then we at MIT and Harvard and Caltech would already have done it!" So until the orthodox scientist develops a little less dogma and a little more common sense, and learns the difference between a scientific discussion and a dogfight, the free energy researcher can hardly communicate with him.

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The goal of the legitimate free energy researcher is to find a way to break the local equilibrium of this universal energy exchange, and gate a tiny bit of it up into the external circuit as excess electrical energy (Figure 17). Then he must collect the excess energy, and shuttle it from the "gating and collecting circuit" over to a dq/dt-closed current loop containing the load. He must also prevent the load current, or most of it, from passing back through the primary source against its back EMF, because if it does that, he will destroy the separation of charges in the dipolar source, killing the dipole and extinguishing the "excess energy gating." In other words he must find a way to process and transport the energy flow across dq/dt-blocked bridges between the source's closed dq/dt-current loop and the load's closed dq/dt-current loop. Ruthlessly it is an energy transport S-flow problem, not a J* energy transport problem. If he uses J* in his sourcing current loop, he automatically drives the current dq/dt back through the back EMF of his source and kills it. If he does not drive dq/dt back through the source, the source will furnish S-flow for an indefinite period! Every battery and generator we have ever built is already a "free energy" machine in that it already involves broken local symmetry in the vacuum energy exchange. We have just not realized how to use our power sources purely as Poynting S-flow sources.

So we must treat an electrical system as an open system with broken local symmetry (Table 3) in the vacuum flux exchange, so that the system extracts (gates) excess energy from an external source. In this case the source is the system's flux exchange with the vacuum. This approach is no more mysterious or bizarre than putting a waterwheel in a river, or a windmill in a wind, or a bank of solar cells out in the sunshine. The universal "free source of energy" that the overunity researcher seeks to tap is the violent exchange of virtual photons between the electrical charges of the system and the surrounding quantum mechanical vacuum (Figure 18). In quantum physics this powerful, energetic exchange of the vacuum with electrical matter is now proven both experimentally and theoretically. It is already accepted in quantum physics that the vacuum is filled with electromagnetic energy. The researcher doesn't have to prove it anymore; he just has to find out how to properly use it. The artesian well is already there; we just have to learn how to collect and use the flowing water without dynamiting the well!

The remaining objection orthodox scientists usually raise against the notion of extracting vacuum energy has been that "thermodynamics doesn't permit it." However, Cole and Puthoff have rigorously shown that, on the contrary, the theory of thermodynamics does not prohibit the vacuum's energy being extracted and used to produce heat, light, and power. [note 22] So the validity of that final objection has now vanished.

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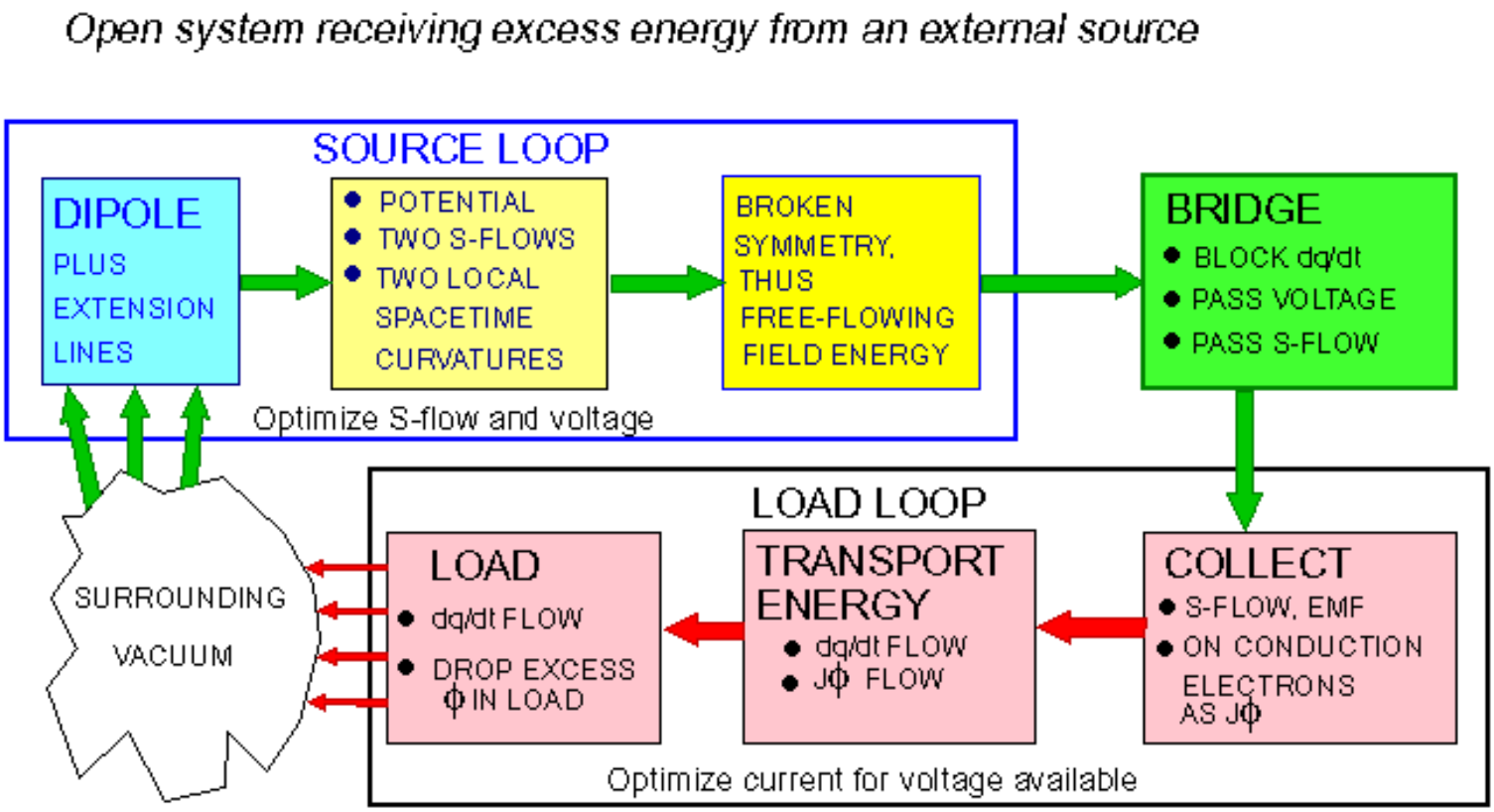

Figure 17. Operation of an overunity electrical power system.

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Table 3: Asymmetry and modern physics.

Per T.D. Lee, Particle Physics and Introduction to Field Theory, Harwood Academic Publishers, New York, 1981, p. 378-390.

SYMMETRY AND MODERN PHYSICS

- Missing symmetry of matter
- Symmetry only of mass and vacuum
- Vacuum excitation
- Vacuum structures
- Spontaneous symmetry breaking
- Interaction between matter and vacuum
- Possibility of vacuum engineering

SOME PROVEN ASYMMETRIES

- Positive and negative signs of electric charge
- Time reversal
- Right/left handedness

STRONG LOCAL ASYMMETRY

- Properties of object may differ appreciably for:
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another

STRONG LOCAL ASYMMETRY (CONT'D)

- Local spacetime is curved
- Lorentz invariance of vacuum violated
- May be local sink or source
- EM gravitational/inertial effects
- Translation between virtual and observable
- Electrogravitational solitons
- Action at a distance
- Transmutation effects may exist
- Scalar/pseudoscalar field translation

WHEN SYMMETRY IS VIOLATED

- A "non-observable" turns out to be an observable
- An invariance is broken
- A conservation law or selection rule is broken

COMMENTS:

- A virtual object becomes an observable object
- Local spacetime becomes curved, at least to some potential involving that object

D-1-T3

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A Charged Particle Is a Coupled System

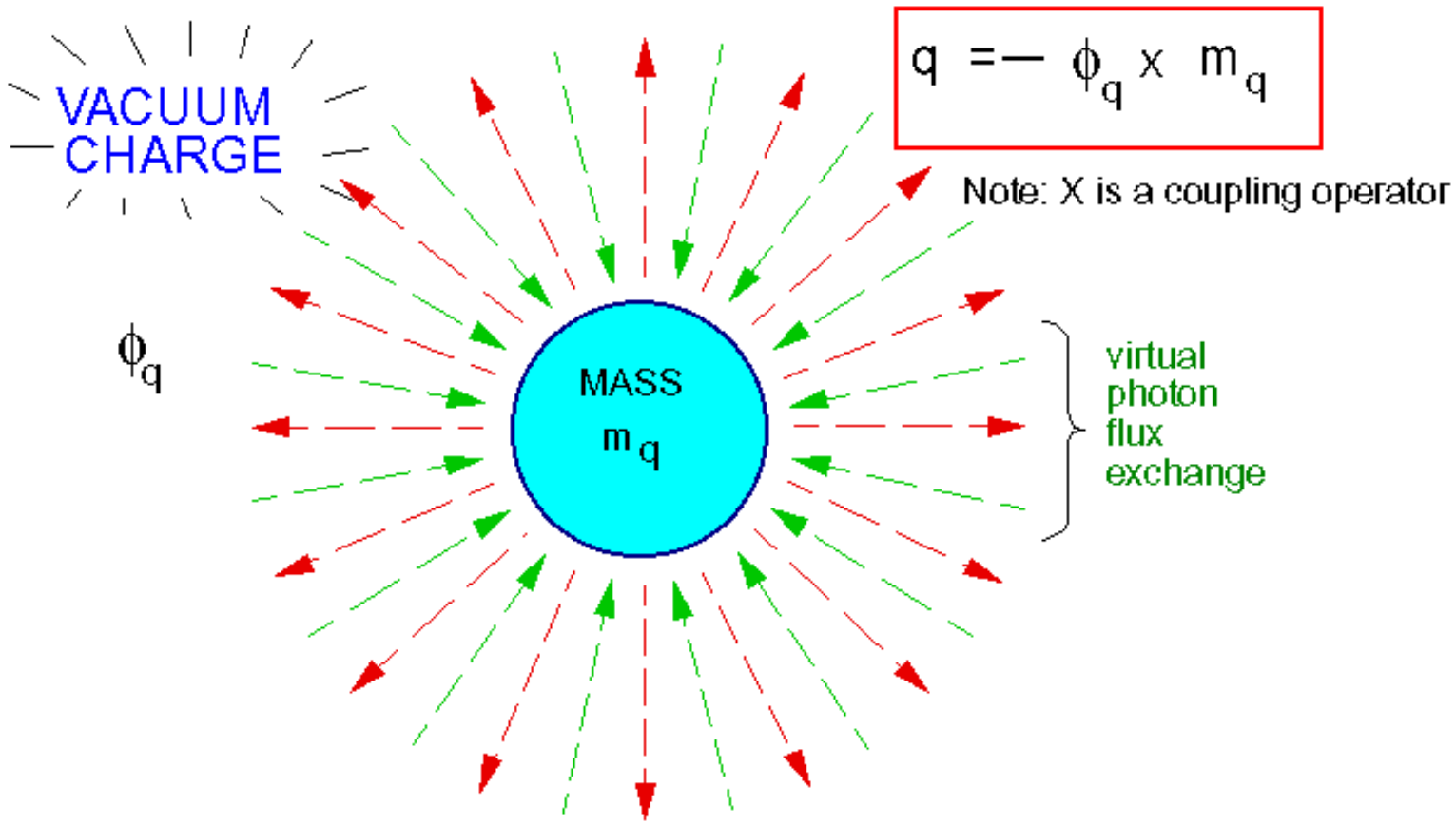

Figure 18. An electric charge q is a broken symmetry. It continuously and violently exchanges energy with the vacuum.

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[22] Cole, Daniel C. and Harold E. Putboll. (1993) "Extracting Energy and Heat from the Vacuum," Physical Review E, 48(2), Aug. 1993, p. 1562-1565.

And there is mind-numbing energy density there in the vacuum, waiting to be extracted. The well-known Lamb shift, e.g., in a single hydrogen atom is due to that vacuum exchange. [note 23] Interestingly, the calculated energy density of the exchange causing the Lamb shift is greater than the surface energy density of the sun. Different physicists have made various theoretical estimates of the energy density of this seething vacuum. A conservative ballpark figure is something on the order of 1090 grams per cubic centimeter, expressed in mass units.

It has also been my good fortune to know and work closely with several other free energy researchers. I was a colleague of Floyd ("Sparky") Sweet (recently deceased) for about seven years; Sparky held a Master's degree in EE from MIT and had years of experience with General Electric and other firms. He was a highly skilled researcher who invented the solid state vacuum triode amplifier (Figure 19), a unit which produced 500 watts of output and a coefficient of performance of 1,500,000. I personally tested the machine, activated the magnets on one occasion, and understand how it all worked. [note 24] The paper [note 25] I co-authored in 1991 with Floyd is still the only paper in the orthodox engineering literature that reports (a) successful overunity functioning of a solid state magnetic device, and (b) a successful antigravity experiment on the laboratory bench, reducing the weight of an object by 90%. [note 26]

We stress again that a legitimate overunity electrical machine must be an open system, receiving excess electrical energy from the surrounding vacuum. As such, it must operate in a higher topology than normal electrical machines (Figure 20).

My good friend Frank Golden has long been a close colleague. Years ago Frank developed a motor that produced overunity efficiency, but then to our astonishment we found (courtesy of Bill Tiller, [note 27] with whom we were working at the time) that its operation depended upon a 5-year-long conditioning (structuring) of the local ambient potential in order to work. Previously we had been entirely unaware that one can sometimes condition the local vacuum and the local matter in the area with a particular dynamic form. Given the local conditioning, a motor with that form will then work in that vicinity, but not necessarily elsewhere at an appreciable distance away. We now understand the mechanism for such "conditioning of the vacuum." We also now know what to do if an overunity machine is actually a machine of that type (many of them are not). In other words, we know how to convert it to a machine that will work anywhere, anytime. We will be addressing such little-known things in future articles.

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[23] Lamb, W.E. Jr. and R.C. Retherford. "Fine structure of the hydrogen atom by a microwave method." Physical Review, Vol. 72, 1947, p. 241-243. Lamb received the Nobel prize for this work.

Tables:

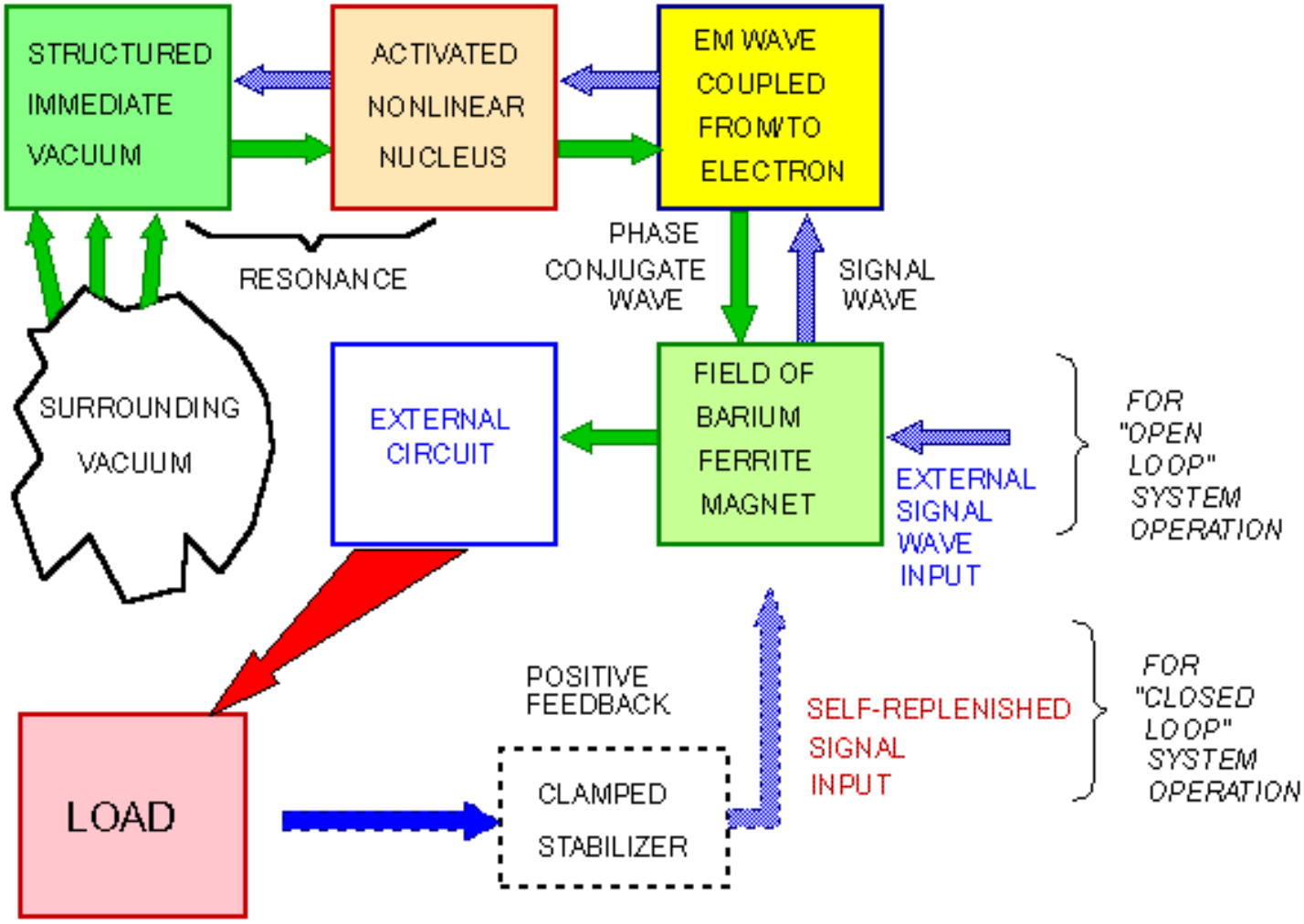

Figure 19. Block diagram of the Sweet Vacuum Triode Amplifier.

Adding positive feedback circuit enables self-oscillation.

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[24] Unfortunately Sweet made conflicting agreements with multiple backers, resulting in a most thorough legal foul- up. It appears that nothing can ever be done with this machine, because its status is a legal nightmare.

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[25] Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," Proceedings of the 26th Intersociety Energy Conversion Engineerinq Conference (IECEC '91), Boston, Massachusetts, 1991, p. 370-375. Paper also distributed over Internet.

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[26] The unit was specially rigged and "pushed" to 1,000 watts output to perform the antigravity experiment.

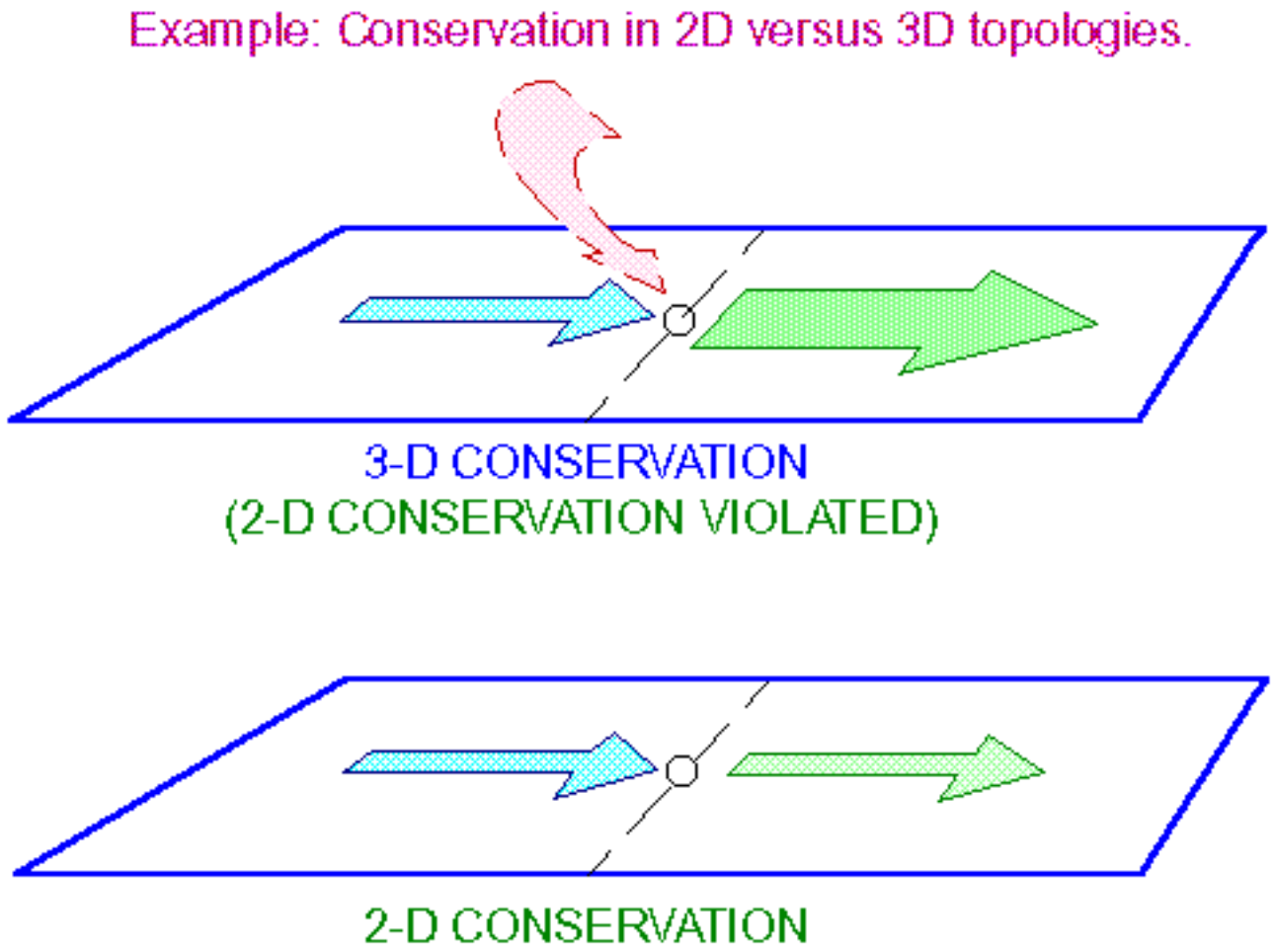

Figure 20. Increasing the dynamic topology allows lower topology conservation laws to be violated. Conservation now applies in the higher topology, but not necessarily in the lower. The lower topology system is now an open system and may seemingly act as a source or sink.

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[27] Tiller was already familiar with the fact that devices that function by more subtle energy often require special conditioning of the vacuum spacetime. He expressed it as "an archetype must first be created for the machine to function efficiently." Tiller had previously experimented with such an effect for several years.

John Bedini is also a close friend and colleague; John built several experimental motors (both electrical and magnetic) in the overunity area, and performed successful trans-mutation experiments. John is a recognized genius in high-end sound amplifier development. Many audiophiles worldwide still swear that the Bedini amplifier is the best and sweetest-sounding audio amplifier ever built. One of John's battery-powered electrical motors (Figure 21), for example, ran continuously off its battery for about five years, and kept the battery charged. When you realize that such a small electric motor is only about 35% efficient, then you realize that about 65% of the energy flowing out of the battery was being dissipated in the motor as heat, core losses, etc. So the unit was continuously performing work for that five years. [note 28] The 1/8 hp motor represented a load in which the continuous rate of work being done (the rate of energy dissipation) was about 0.08 hp. We will have more to say on this motor and its technical process in a future article.

Bill Fogal is a close colleague; Bill has patented the world's first dq/dt-blocking semiconductor, [note 29] which partially blocks the normal current while continuing to pass the flow of voltage (Table 4). I have written a proprietary technical explanation of the Fogal semiconductor, which utilizes an extremely little-known feature called the "overpotential." The overpotential part of the theory is experimentally proven and theoretically explained in an obscure part of electrochemistry, by a few chemists who specialize in electrode effects. J. O'M. Bockris is probably the leading world expert in overpotential theory; he authored the textbook on it. [note 30]

One of the latest overunity developments is the magnetic resonance amplifier (MRA) developed by Joel McLain and Norm Wooten (Figure 22). Earlier testing disputed the overunity functioning. More recent testing at several well-known laboratories has resulted in the instrumental measurements clearly showing overunity. While the test institute scientists themselves may be willing to attest to overunity results of their testing, none of the corporate heads will allow it. I have personally stated that the MRA is capable of overunity. Our own measurements had to be discarded because we did not have the proper instruments available. E.g., all our oscilloscopes were "hard grounded" to building ground, and we needed to make "floating differential ground" measurements in order to settle things once and for all. McLain and Wooten have filed for a patent, and multiple tests with excellent equipment have indeed indicated overunity. What happens next remains to be seen. I suspect that the two inventors may simply accept foreign capital investment and go offshore.

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WARNING: Highly dangerous operation. Pulsed battery outgasses hydrogen gas and explosion is possible.

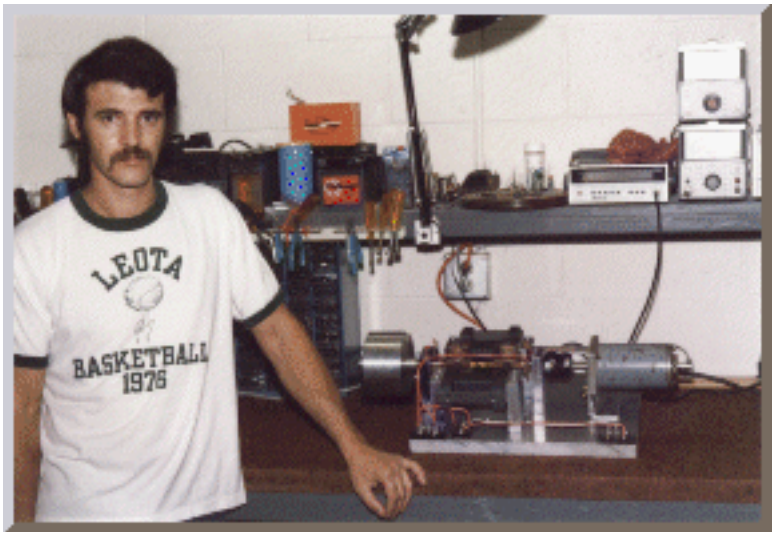

Open system using higher topology extraction of excess vacuum energy. Uses sluggish reversal and recoil time of lead ion onrushing current versus rapid backlash of amplified voltage discharge from a magneto ignition coil, to force the battery to act as an excess S-flow collector during the ion-current charging half-cycle. Thus the inefficient motor is continuously powered and the battery is continually recharged.

Figure 21. Bedini's battery-powered, back-popping electric motor.

D-1-21

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[28] We strongly emphasize that there is no conservation of work law in physics! It is the overall energy of the universe that must be conserved, not work. More rigorously, the flow of energy must be conserved. But from a free flow of energy, you can continuously extract a little and dissipate it as work, without cutting off the main flow and without violating any of the laws of physics. If this were not so, then waterwheels, windmills, and solar cells would not work. In fact, you can even do better than that. The basic energy conservation law is this: Energy can neither be created nor destroyed. So even when you "use" (i.e., dissipate or scatter) the energy, it is still there. It is only the hierarchical ordering of the photons that constitutes entropy. Each individual photon is perfectly ordered and still contains all its energy. By retroreflection, you can even cause those disordered photons to gather back in your system into perfect order once again and then you can scatter them again to do some more work. You can use the same energy over and over again! The perfect retroreflection is more easily accomplished by phase conjugate reflection. For a vivid example of just such retroreflection of previously scattered EM energy to restore the former order, see David M. Pepper, "Applications of Optical Phase Conjugation," Scientific American, Vol. 254, No. 1, Jan. 1986, p. 74-83. See particularly the striking photographic demonstration of time reversal of disorder on p. 75.

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[29] William Jay Fogal, "High gain, low distortion, faster switching transistor." U.S. Patent No. 5,196,809, Mar. 23, 1993. Also William J. Fogal, "High Gain, Low Distortion, Faster Switching Transistor." U.S. Patent No. 5,430,413, July 4, 1995.

Table 4. Fogal's Semiconductor.

FOGAL'S CHARGED BARRIER SEMICONDUCTOR

- BLOCKS ELECTRON CURRENT FLOW dq/dt
  - AS CAPACITOR CHARGES, ELECTRONS IN EMITTER JUNCTION ATTRACTED TO PLATE
  - CHARGING PLATE PRODUCES HIGH BARRIER VIA PROPRIETARY MECHANISM
  - AC CONDUCTION ELECTRONS CANNOT PENETRATE BARRIER
  - AC POYNTING FLOW S, dϕ/dT, dE/dt PASS THROUGH BARRIER
- PASSES POYNTING FLOW S = E X H; dE/dt
- SEMICONDUCTOR BECOMES "ENERGY PIPE"
- WITH dQ/dt BLOCKED, FLOW OF S = E X H IS NON-DIVERGENT AND WITHOUT LOSSES
- FOGAL CHIP UTILIZES S = E X H FLOW TO TRANSPORT ENERGY, RATHER THAN Jϕ

D-1-T4

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[30] In a correspondence with Bockris lasting several years, he had graciously furnished me with material on the overpotential, which is how I found out about this esoteric area. Bockris is well-known as a leading scientist on the chemistry of hydrogen, and also as one of the leading scientists in the rapidly developing field of cold fusion. He is a marvelous scientist, and one day his largely unsung work with the overpotential will revolutionize the entire electronics industry.

Tables:

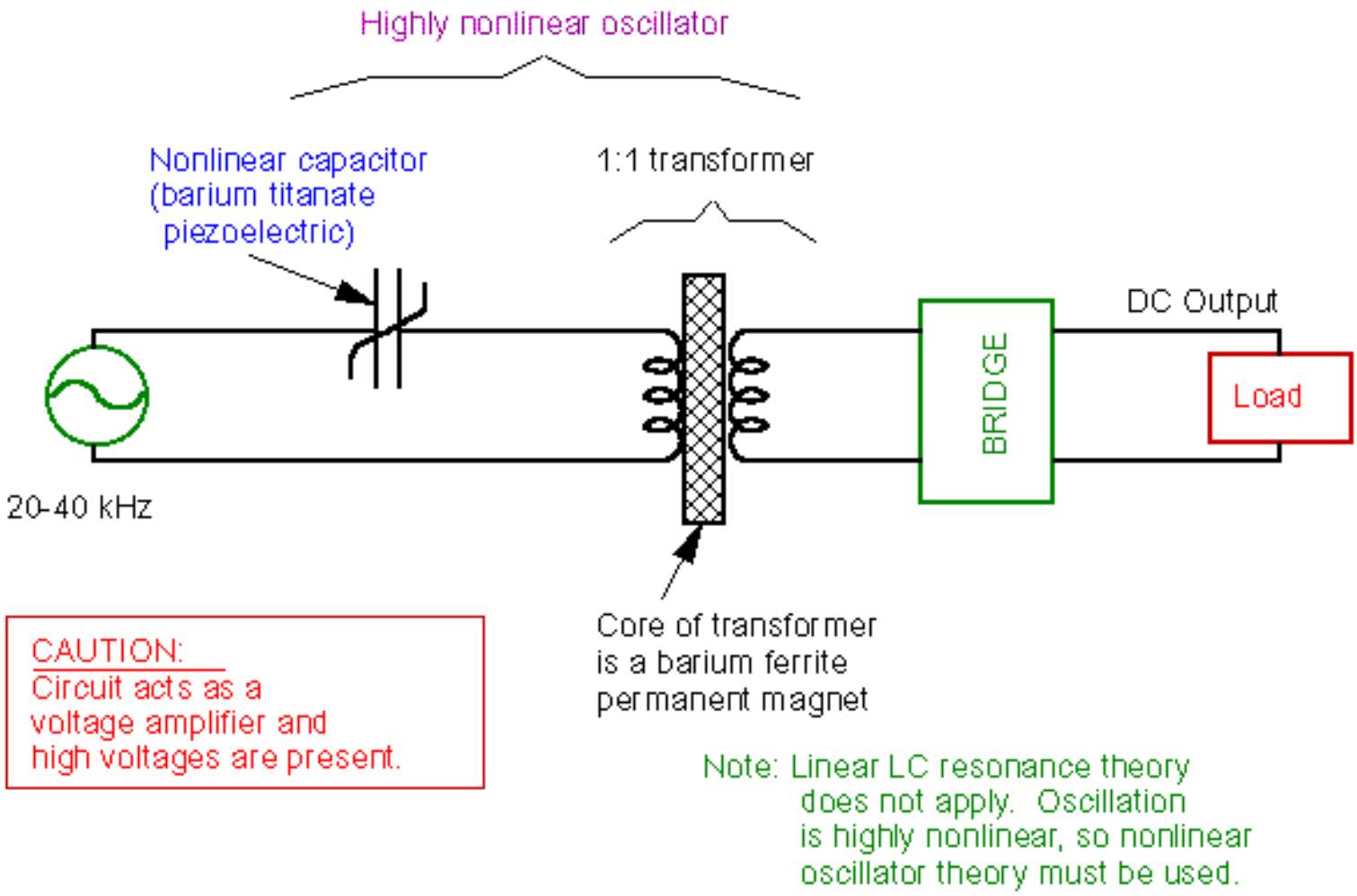

Figure 22. Schema for the magnetic resonance amplifier (MRA).

D-1-F22

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Howard Johnson is also a respected colleague, whom I very much admire. (See Figure 23). Howard has continued to work quietly and patiently upon his patented permanent magnet motor, [note 31] including patenting various magnetic gates, etc. that are necessary to make such a motor work in a rotary configuration. [note 32] Howard employs a two-particle theory of magnetism; i.e., each magnetic flux line is envisioned as having a particle traveling from the north pole to the south pole, and also a particle traveling from the south pole to the north pole. The particles are spinning; the forward-time particle spins in one direction, and the antiparticle spins in the other direction. Howard then slightly separates the two particle flows. [note 33] In other words, Johnson splits the flux lines themselves, into two different pieces. When so separated, the component lines are now curls, so their paths curve. The paths of the two "curl particles" are different; one curls in one direction and the other curls in the opposite direction. Further, a predominance of one form of curl particle gives a "time-forward" aspect, while a predominance of the other form of curl particle gives a "time-reversed" aspect. Johnson is thus able to employ a deeper kind of magnetism than the textbooks presently contain. He demonstrates that a "spin-altered" magnetic assembly exhibiting (to a compass or other such detector) a north polarity can attract another unaltered magnetic assembly exhibiting a north polarity. In short, he can make a north pole attract a north pole. We will give you further insight into Johnson's two-particle theory in a future article. [note 34] We will also explain how and why the physicists missed that antiparticle in the magnetic field's flux lines, and thereby failed to advance the theory of magnetism to a deeper level. Make no mistake, one day when the new theory is done, Johnson may well be awarded a Nobel Prize for his epochal discovery of a deeper structure of magnetism.

Bits and pieces of the new science approach are just now beginning to spill into a few conventional journals and symposia. For some time a few of the rebels spearheading this new science have been doing something that the University scientists should have been doing all along. The rebels have been meticulously examining the concepts, postulates, and definitions that the present scientific models are founded upon, to reveal serious foundations errors. Corrections for some of these errors have been discovered and made. [note 35] Others are still problems yet to be resolved. Yet slow progress is being made, and a "flip-over" of the old science is likely to occur within the next decade if not sooner. By then the new concepts will have become "solid" enough to allow producing an engineering mathematical model. Also the supporting experiments will have become solid enough to justify the new concepts and the model.

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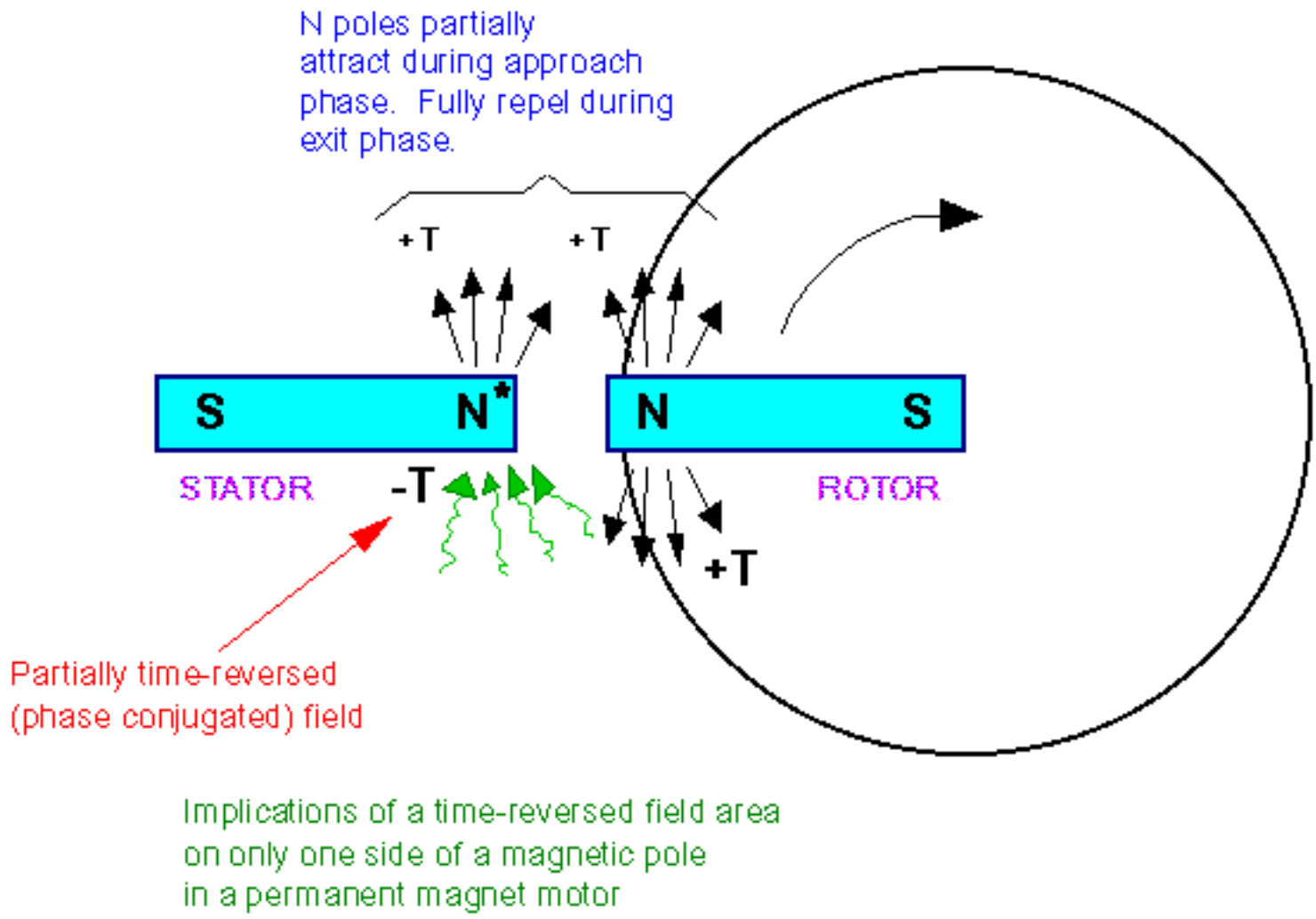

Figure 23. Schema for Johnson's permanent magnet motor.

T91HJ-03

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[31] Howard Johnson, "Permanent Magnet Motor." U.S. Patent No. 4,151,431. Apr. 24, 1979.

[[32] I personally saw and closely examined one demonstration rotary Johnson permanent magnet motor some years ago, and toyed with it for about one hour. It would definitely self- rotate as long as you wished to permit it to turn. It was not a powerful device at all, but just a small laboratory "proof of principle" prototype. It had cost Johnson an enormous amount of time, labor, and optimization to get the critical adjustment required of his two magnet assemblies. But the device had no power source other than the permanent magnet assemblies themselves. Johnson's nonlinear rotor and stator magnets interacted with each other in a manner to break local symmetry. So his machine was an open system and therefore a permissible overunity device; it was not a perpetuum mobile.

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[33] As I have pointed out repeatedly in the past, photons also carry time, not just energy. We have previously shown the process and the photon interaction mechanism that creates the flow of time itself; we will discuss this mechanism in the future. So when Johnson separates the particles and antiparticles, not only does he partially separate them according to spin, but he also alters the local character of time flow during which the resulting magnetic field forces must appear. In other words, he accomplishes a partial separation of time-forward and time- reversed polar interactions. A south pole is just a time- reversed magnetic north pole, in the first place! So a north pole of a bar magnet that is slightly time reversed on one side will partially act on that side just like a south pole. On the other side it will continue to act like a normal north pole. By partially time-reversing (phase conjugating) one side of the north magnetic pole piece, Johnson makes that side look and act like a south pole. that way Howard is able to create two north poles, one on a stator and the other on a rotor, and time-reverse part of one face of the stator's north magnetic pole-piece. Therefore when the proper sides of the stator and rotor north poles are facing, they attract each other, contrary to the conventional textbook. The two poles then repel each other normally as soon as the north rotor poles passes the north stator pole. Hence Johnson can make a surrounding north pole stator assembly "draw in" an approaching north pole rotor assembly, and then kick it on out the other side, because he has broken the local magnetic symmetry. In short, Johnson's magnetic gate can provide a legitimate component of unidirectional magnetic thrust, which means that he can indeed make a rotary permanent motor. Simply put, this "partially separating the spin particles," and thereby partially phase conjugating one face of a magnet, is what Johnson calls a "gate," and this is the patented secret by which his magnet assemblies can be made self-powering. The entire process is still very meticulous, and assembly and adjustments are extremely critical. With Johnson's blessings we hope to shed more light on this subject in coming articles.

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[34] For a basic article on rotary permanent magnet motors, see T.E. Bearden, "On Rotary Permanent Magnet Motors and 'Free' Energy," Raum&Zeit, 1(3), Aug.-Sep. 1989, p. 43-53.

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[35] The most blatant error in all of physics is the erroneous notion that an acting force is separate from its receiving mass. Force is defined as F ~ d/dt(mv). From that definition alone, it can be seen that the affected mass is a component of the force itself. If you remove the mass m, you do not have force but merely acceleration. The notion of force separated from the mass came from ancient and familiar experiences of pushing on stones with one's hand, etc. In this primitive case the force-creating agent (i.e., the hand) is certainly separate from the affected mass (i.e., the stone). But the "force on the stone" is actually the force created of and with the stone. It is "stone-force," not "force upon the stone." Quantum field theory already tells us that it is the absorption and emission of virtual photons by the stone's mass that "creates the force." In fact it should go one step further: It is the coupled ensemble of the virtual photon flux and the mass of the stone that constitutes a "stone-force." In your mind, you should try mentally replacing the word "force" with the phrase "mass-force" until you root out the deeply ingrained erroneous notion that force and mass are separate. Because of this archaic error, today's physics can only define a mass in terms of its resistance to a disturbing force, and it can only define a force in terms of its overcoming a resisting mass. This error has prevented any proper definition of either force or mass! But the problem is solvable. For a proper definition of mass without the notion of force, see T.E. Bearden, Quiton/Perceptron Physics: A Theory of Existence, Perception, and Physical Phenomena, National Technical Information System, Report AD-763210, 1973.

In this first article I wanted to introduce the 14 major areas. We will be discussing these areas in some technical detail in the future. We'll also include current major news items of development in these areas, for the interested lay reader. I'll particularly try to give you the benefit of extensive reference citations painfully gathered over the last 30 years. The articles will be targeted toward both the serious researcher and the interested, educated layman.

So that's the agenda for the months ahead. We hope you find this information and the approach of direct interest and use.

Again, it's a privilege to be aboard. And we invite you to hang on in the future; it's going to be a wild but exciting ride. We really are going to chase this wild dragon with great vigor.

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Novel Principles In The Rife Microscope

And Rife's Great Secret [1]

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Substantially updated Aug. 20, 2001

Foreword

In the 1930s and 1940s, Royal Raymond Rife {1} made revolutionary discoveries in microscopy, including development of novel microscopes that could see far beyond the accustomed one-tenth wavelength limitation according to Rayleigh theory. With his microscope, he was able to "see" ultramicroscopic living forms much smaller than anything considered in the observable state. It would appear that his microscope was somehow capable of peering directly into the virtual state itself, and finding living forms at that level that were far beyond anything ever suspected by conventional science, even to this day.

Obviously this work was dramatically controversial. Rife went on to develop treatment methods and devices based on the new level of living organisms that his microscope revealed. In short, he arrived at essentially a new theory of disease, and did achieve success with his—to conventional scientists—completely unprecedented devices and methods of treating and healing. While we do not discuss his treatment methods in this paper, we do discuss the methods of Prioré, whom we believe to have used similar principles. So these discussions may shed some light

on Rife's therapeutic mechanisms also.

Rife and others reported his results in the proper scientific literature. For his efforts, he was ostracized, essentially imprisoned in a medical treatment facility, broken, and rejected by his peers. His findings were harshly ridiculed and discredited. Finally escaping from his enforced confinement, Rife lived out his remaining years and died quietly and unknown.

In the present paper it is not our purpose to address Rife's theory of disease or his treatment devices and methods. It is solely our purpose to propose a higher symmetry electrodynamics functioning of his microscope, as one possible explanation of the startling microscopy results he achieved. We will reveal what we are convinced is Rife's great secret: recursive virtual state magnification (amplification) by iterative difference frequency serial summation of vacuum engines. This is a substantial change from an earlier mechanism proposed by the present author, which proved to be in error {1}.

We accent that this is not a "standard electrodynamics" examination of the Rife microscope; normal U(1) electrodynamics and transverse EM waves contain no mechanisms that can explain the functioning of the instrument. Accordingly, since no such explanation is contained in the usual electrodynamics, one must of necessity turn to those available electrodynamics models that are of much higher symmetry than afforded by vector and tensor algebra. To show the fit to experiments, we must also address an enormous amount of the work performed by Prioré and his colleagues. Only in such EM models and their known fit to actual experiments are the additional phenomena and principles available that can possibly explain Rife's epochal results.

Also, because of the importance of this unified field theory area, we include substantial references and additional extended discussions in the endnotes for further technical clarification. Thirty figures are added to illustrate the material.

The Rife Microscope

The Rife microscope { [1] } (Figure 1) cannot be made to work by normal optical principles at the level utilized by Rife. With normal optics, about one-tenth wavelength is as fine an optical resolution as one can get. Since Rife went far beyond that, it should be obvious that he was using optics and electrodynamics of a *novel kind*, and of a type not yet in the conventional textbook.

We believe we are aware of the major principles used in Rife's microscope, or at least some of them, but prior to 1998 we shied away from anything to do with the scope. My major interests have been in extracting EM energy from the vacuum and in developing a new kind of medical therapy utilizing higher symmetry electrodynamics—and thus unified field theory—to directly and slowly change cellular disease or disorder back to a normal previous state. Obviously, if one is to produce a microscope that "sees" optically further into the realm of smallness than any other microscope can conventionally do (even in theory), that microscope must be functioning in a higher electrodynamics mode rather than in the conventional one.

In this paper, we will try to summarize some deep physics principles underlying the Rife microscope, at least as we see them terms of a higher symmetry EM model, and we cite some references for the bits and pieces. A more detailed explanation must wait for a future time and assistance from very high-level theorists.

Introduction

A good hint is this: Rife (Figure 2) often painfully adjusted his microscope stages for up to *24 hours* before he finally got the instrument "focused." Immediately that shows it is not standard optical equipment. Well-made standard optics—and Rife's microscope was beautifully made—can be adjusted far more easily than that (in minutes!).

So far as we are aware, no one ever looked at the Rife work except through essentially rather orthodox electrodynamics and rather orthodox optics eyes. Normal optical theory permits resolution of about one tenth of the wavelength of the light used, and a few microscopes in the last few years have gone just a wee bit further. But none have gone anywhere to the degree of smallness that Rife reported.

In our view, the orthodox approach to explaining the operation of Rife's microscope is doomed to fail from the beginning. Even a very good scientist will fail with replication, if that approach is exclusively taken. An entire scientific team and substantial funding will not do any better, unless something technically deeper is understood and tackled from the outset. We give an overview of our approach to tackling that problem. To begin with, we must present some errors in electrodynamics and an omission in general relativity, so that we can develop the necessary background. The discussion is not simple and will require considerable development. Once the considerable background is developed, the application to the Rife microscope will be straightforward.

Errors in Electrodynamics and Adjustments to General Relativity

First, present electrodynamics itself has serious flaws and shortcomings, and needs substantial revision {[2] }. As foundations scientist Bunge points out {[3]}:

> *"...it is not usually acknowledged that electrodynamics, both classical and quantal, are in a sad state.*"

Bunge {[4] } also said:

"... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

The flaws in electrodynamics pass over into what has been constructed for optical theory—both linear and nonlinear—which just assumes the electrodynamics as a subset.

For our purpose, we need to clarify what modern electrodynamics does and does not say about the massless vacuum, and about the state and form of EM entities—such as potentials, fields, and waves—created in it (in *empty space*) by matter dynamics, or acting from it (from *empty space*) onto matter and causing matter dynamics.

Maxwell and all his peers believed firmly in the material ether, a thin material fluid filling all space and every crevice. To scientists at the time, not one single point in the universe was devoid of this material etheric fluid—this *thin matter*. The atom had not been discovered, the electron had not been discovered, and electricity was also considered a thin material fluid. Charge had no more meaning than "a piece of the electric fluid," much like a cubic centimeter of water.

Faraday {[5] } believed that the EM influence in space consisted of *material lines of force which acted as taut strings under tension from some mysterious source*. He believed that EM disturbances were just the transverse wave "perturbations" of these taut strings. In his concept, Faraday omitted the string holder or other agent producing the tensile forces upon the string (Figure 3). He thus omitted Newton's third law from his electrodynamics concept. He also omitted precisely half the energy, by omitting the equal-energy time-reversed EM wave that accompanies the formation of every ordinary EM wave we take account of. In a receiving copper wire antenna, for example, not only do the electrons interact with the incoming fields, but so do the protons in the nuclei—though highly damped in amplitude by the proton's large mass with respect to the mass of a disturbed Drude electron. However, the two energetic interactions (of perturbed protons and perturbed electrons) are of equal *energy* magnitude. So in the conductor, equal energy is expended to move the "lattice holes" (positrons) as is used to move the Drude

electrons, else field theory itself is falsified. Except in semiconductors, electrical engineers mostly just ignore the "disturbed lattice hole current" energy.

Maxwell deliberately captured Faraday's thinking, mathematically {[6] }, and so just *assumed* Faraday's lines of force and the "plucked tight string" transverse EM wave in the material ether {[7] } as well as the unexplained tension . The notion of the transverse EM wave in vacuum has essentially no other theoretical justification than that Faraday-Maxwell assumption and the observed "transverse waves" generated in the receiving "electric fluid in the conductor" in and on the Drude electrons. The transverse EM wave notion in vacuum was maintained only by discarding its missing antiwave that is always formed simultaneously in our transmitters and receivers (e.g., when we perturb the Drude electrons in a transmitting wire antenna, we also perturb the protons in the nuclei with the same energy. The two disturbances—proton disturbance in the nucleus and Drude electron disturbance in the Drude electron gas—perturb the local surrounding vacuum/ spacetime with equal energy, so in the vacuum "virtual particle flux gas" the two perturbations are energetically equal. The receiving wire receives both perturbation waves from the vacuum; one perturbs the electrons and the other perturbs the nuclei. Since the second wave is unaccounted, the perturbation of the nuclei is just considered a "mysterious force" that always appears. In a pumped phase conjugate mirror material, e.g., we interact the waves prior to their reaching the nuclei, by multi-wave mixing. Since the "causative" but neglected second wave coming in from space does not reach the nuclei, but are redirected to form the phase conjugate replica wave produced by the pumping, *the mirror does not recoil and it does not exhibit Newtonian third law reaction*. However, since electrodynamics *omits* the EM causative wave that generates Newton's third law forces in the receiver, which in normal detection always appear, then presently electrodynamic fields are erroneously said to be devoid of Newton's third law reaction. To the contrary, the effects of that hidden, neglected EM cause of the Newtonian third law reaction do appear, either as recoil of the physical receiving antenna or as the production of the time-reverse phase conjugate replica

wave in optical pumping. But in standard electrodynamics, equal-and-opposite forces in the receiving antenna are assumed to arise "mystically" or from some hidden *electrodynamic demon*. The electrodynamic cause of Newton's third law has been lost since Maxwell wrote his theory.

Maxwell, however, was careful to point out the ad hoc nature of assuming the stress in the vacuum, and that no mechanism for it had been discovered, nor was such a mechanism contained in his theory. Specifically, Maxwell said {[8] }:

> *"It must be carefully borne in mind that we have made only one step in the theory of the action of the medium. We have supposed it to be in a state of stress, but we have not in any way accounted for this stress, or explained how it is maintained. This step, however, seems to me to be an important one, as it explains, by the action of the consecutive parts of the medium, phenomena which were formerly supposed to be explicable only by direct action at a distance. … I have not been able to make the next step, namely, to account by mechanical considerations for these stresses in the dielectric. I therefore leave the theory at this point, merely stating what are the other parts of the phenomenon of induction in dielectrics."*

Indeed, we now know of electrons and their spin. The longitudinally-constrained, spinning Drude electrons in receiving wires will gyroprecess laterally in the wire when an EM disturbance from the vacuum interacts with them. (Figure 4) It is well-known that these Drude electrons are highly restrained longitudinally down the wire; the longitudinal movement is the "drift" velocity and may be nominally only a few inches per hour. The lateral precession of the longitudinally constrained, spinning Drude electrons establishes that the incoming vacuum disturbance, before its interaction with the gyroelectrons, is *longitudinal*. Else one must discard electron spin, electron gyroprecession, and

indeed the theory of gyroscopic precession itself. In our view, the EM wave *in vacuum* is longitudinal, always has been, and always will be {[9] }. It also *does not* consist of EM force fields, contrary to present classical theory. Instead, only the potentiality {[10]} for the transverse force fields—*should* the longitudinally perturbed vacuum EM entity be intercepted by a spinning charged particle and interact with it—exists in mass-free space, as pointed out by Feynman. Quoting Feynman again {[11] }:

> . *"We may think of **E**(x, y, z, t) and **B**(x, y, z, t) as giving the forces that <u>would be</u> experienced at the time t by a charge located at (x, y, z), <u>with the condition</u> that placing the charge there <u>did not disturb</u> the positions or motion of all the other charges responsible for the fields."*

Rigorously the force fields exist only in and of matter. In matter-free space, there is no force at all in what we call the "field as it exists in massfree space" {[12] }. E. g., Jackson states it this way {[13]}:

"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable quantities such as force somehow involve the product of charge and field."

But again, Jackson also states {[14] }:

> *"...the thing that eventually gets measured is a force..." "At the moment, the electric field can be defined as the force per unit charge acting at a given point. It is a vector function of position, denoted by E. One must be careful in its definition, however. It is not necessarily the force that one would observe by placing one unit of charge on a pith ball and placing it in position. The reason is that one unit of charge may be so large that its presence alters appreciably the field configuration of the array. Consequently one must use a limiting process whereby the ratio of the force on the small test*

> *body to the charge on it is measured for smaller and smaller amounts of charge. Experimentally, this ratio and the direction of the force will become constant as the amount of test charge is made smaller and smaller. These limiting values of magnitude and direction define the magnitude and direction of the electric field E at the point in question. In symbols we may write F = qE where F is the force, E the electric field, and q the charge. In this equation it is assumed that the charge q is located at a point, and the force and the electric field are evaluated at that point."*

As can be seen, much of the difficulty occurs because physicists continue to erroneously utilize an *equation* as if it were a *definition*. An equation defines nothing at all; it merely states that all the "things on the left" of the equality sign and all the "things on the right" have the same overall magnitudes. It does not *define* any of the things on the left or right, and so it tells us nothing at all about what anything in it *really is*. A definition requires an identity, not an equality. E.g., if we take as an identity the very equation advanced by Jackson's explanation above, we then have a definition:

$$F \equiv qE \Rightarrow E \equiv F/q$$

And now that identity clearly states that charged mass is a *component* of the **E**-field. Similar argument prevails for the **B**-field, etc.

The identity also shows that E is not the *magnitude* of the force field at all, but is its *local intensity* at any given point in the E field, in terms of force per unit point static coulomb—a force formed in, on, and of the charged mass of the coulomb. The misstatement that E represents the *magnitude of the field* is another great non sequitur. No textbook gives the calculation of the *magnitude* of the E-field, though all purport to. Instead, they all give the calculation of the *intensity* of the E-field at each point in it. There is a great difference between the magnitude of an automobile's mounted tire and its pressure per sq. inch on the pavement. In all fairness, some of the better texts do

use the term "field intensity", at least occasionally.

As *defined*, the EM force fields are effects produced in, on, and of charged matter and *only* in, on, and of charged matter. They are not at all the same effects produced in matter-free space (in the vacuum/ spacetime). The EM force field (in matter) is not the same as the "massfree" E-field in massfree spacetime. Ultimately, all that exists in spacetime are *spacetime* and *changes to spacetime*.

We may accurately take the mass-free, force-free EM field to be a pattern of spacetime curvatures. The coupling of this spacetime curvature set, or any part of it, with charged mass, then constitutes an EM force field. Again, the problem is the hoary old mechanics notion of having a separate massless force acting upon a separate mass. No such thing exists in all nature, and mechanics should have been rather thoroughly overhauled long ago as a result of this horrendous *foundations of mechanics* error that is centuries old.

In present classical electrodynamics—certainly the kind taught to electrical engineers and used in the electrical engineering discipline—the EM potential {[15] }, field, and wave, as they truly exist in space and in the vacuum, are rigorously not prescribed at all. Instead, the effect of the "causal entity" as it exists in vacuum prior to interaction with charged mass, is used a if it were what exists in and on the charged mass as the effect of the interaction. (See Figure 5, Figure 6, and Figure 7). This substitution of the effect for the cause is arguably the greatest uncorrected error in classical electrodynamics today. It is a hangover from the old days of the material ether, and the refusal to change the Maxwell-Heaviside equations to eliminate that material ether assumption, once the Michelson-Morley experiments falsified it. This has long been known to foundations physicists, and to most of the better electrodynamicists as well. But it still seems to be known to very few electrical engineers!

Many attempts have been made to “modify” the standard classical electrodynamics theory, but most have failed. For some reason, most of these attempted

modifications seem to have accepted the present "matter-to-matter transform" approach (Figure 8) of present electrodynamics, failing to see that the two missing transforms of matter-to-spacetime and spacetime-to-matter (Figure 9) are in fact just general relativity itself {[16] , [17] } The solution for adding the missing two transforms into electrodynamics therefore may lie in "infolding" general relativity directly within electrodynamics, rather than placing the two on an equal footing. That requires the analysis of the supersystem rather than the system, a concept which will be discussed shortly. Figure 10 shows the utilization of the "vacuum engine" that results from this "infolded GR" solution.

To our knowledge, the Sachs unified field theory {[18] a,b,c,d,e} is presently the only practical unified field theory that can be directly engineered by higher symmetry electrodynamics, such as the O(3) group symmetry EM model advanced by Evans and Vigier and perfected by Evans {[19] }. The engineering power of Sachs' theory is remarkable {[20] }, and the O (3) electrodynamics has been shown by Evans to be an important subset of the unified electrodynamics in Sachs' theory.

Let us examine that statement a little deeper.

In classical electrodynamics the sources of all EM potentials, fields, waves, and their energies are assumed to be the charges—which are assumed to somehow act as perpetual motion machines that continuously *create and pour out* all that EM energy in the fields and potentials associated with the charge as their "source". This outpouring of 3-space energy comprising and establishing the associated potentials and fields eventually fills all space with energy. All the charges and dipoles present in the universe since shortly after its formation have done this for some 14 billion years.

Yet in classical EM—with all the existing charges in the universe implicitly assumed to continuously pour out energy into all of space, and most having done so for billions of years—inexplicably space is *then*

considered to be an emptiness having no interactive energetic exchange with the charge at all {[21] }. That of course is a non sequitur because it involves a total contradiction of the conservation of energy law. If there is no active energy in spacetime for the charged particle to receive and then output in 3-space, then the energy conservation is falsified by every charge and every dipole.

In particle physics the inactive vacuum concept is known to be quite wrong, else the charge creates energy from nothing. That would violate the most sacrosanct law in physics: that *energy can neither be created nor destroyed*. So electrodynamics—both classical and quantum, neither of which contains the solution to this *source charge problem*—is in gross violation of conservation of energy laws, because it assumes that the charge is solely the source of its associated fields and potentials and their energy { [22] } and that it accordingly creates all that energy it has poured out since the beginning of the universe.

Presently the electrical engineer implicitly assumes total violation of the conservation of energy law with every equation he writes, and is blissfully unaware of it.

Particle physicists, however, have done much better and published and incorporated their results, although inexplicably the mainstream electrodynamicists have not changed their own model accordingly. Particle physicists have known and shown for more than 40 years that (i) space is a seething inferno of EM energy { [23]}, (ii) a charge continually undergoes a violent energy exchange (see Figure 11) with the vacuum EM flux. That exchange is what a charged mass is doing, to *make* it a "charged mass"), and (iii) the charge is a *broken symmetry* in that violent energetic flux of the vacuum. "Broken symmetry" means that the charge disrupts and alters part of that virtual particle flux to observable EM energy flux (see again Figures 5, 6. and 7). The charge continually absorbs virtual energy from the vacuum, radiates *some* of that absorbed energy back to the vacuum in virtual form, but *integrates and radiates the remainder* in a flow of potentially observable energy—the energy flow discovered by

Poynting {[24] } and Heaviside {[25] } after Maxwell was already deceased.

So what does the source charge really do? It coheres, transduces, and *gates* some of its virtual energy {[26] } received from the vacuum, into an EM energy flow going out in all directions in 3-space from that source charge. Contrary to present electrodynamics, this energy flow is actually longitudinal and bidirectional {[27] , [28] , [29] , [30]}, with energy *going out in 3-space from the charge* to every point in the universe, and with energy coming from every point in the universe *back to the charge through the time domain*. But as reinterpreted {22 b}, Whittaker {[31] } showed in 1903 that any such bidirectional EM flow of energy —reinterpreted with the input energy to the charge coming from the time-domain, and the output energy from the charge being emitted into 3-space, comprises a scalar potential. This also agrees with quantum field theory {[32] }

See Figure 12. As it really exists in space, a scalar potential is a harmonic set of bidirectional EM energy flows, with the "bidirectional" EM waves being outgoing EM waves in 3-space caused by interaction with the source charge or dipole of incoming time-polarized EM waves. There is a set of outgoing EM longitudinal waves in 3-space, perfectly correlated with a set of incoming time-polarized EM waves in the time domain. Hence one time-polarized EM "causal" wave couples with one outgoing longitudinal EM wave in 3-space. It is this scalar EM wave coupling (combining) with longitudinal EM wave coupling, in a harmonic set of phase conjugate pairs, that constitutes the scalar EM potential.

In short, all EM energy in 3-space comes from the time domain.

After all, no observable persists continuously in time. Any observable is a frozen 3-space momentary snapshot of an ongoing 4-space interaction. It is the result of a d/dt operation imposed upon LLLT spacetime, to yield a momentary LLL by

d/dt(LLLT) => LLL

What we see as the "motion of an object in 3-space" is actually the ensemble of a continual serial iteration of such "frozen 3-space snapshots" of each observable part of the object, much as the iterative frames of a movie film are seen as a continuously moving picture.

In Whittaker's bidirectional energy flow associated with the source charge, electrodynamicists—including Whittaker himself—assumed that a point positive coulomb of charge is located at each and every point in space. (Figure 5, Figure 6, and Figure 7). A tiny bit of the impinging EM energy flow "from" the distant source charge {[33] } is geometrically intercepted and diverted by the observing/detecting point charge to streamline around it, creating a "swirl around" of diverted energy flow. As can be seen, only a tiny portion of the impinging and passing EM energy stream in 3-space is diverged into the swirl. This is rather like a small diverted whirlpool of water forming around a stable rock in a flowing river. In electrodynamics the amount of energy in that "diverged whirlpool" is said to be the "collected" energy appearing upon that point charge (upon that fixed rock). That amount of energy swirled by the intercepting point coulomb at a given point in space, is then erroneously said to be the *magnitude of the potential (the magnitude of the entire river)*. It is no such thing. The small fraction of the potential that is *diverted from* the potential's flowing rivers of energy, is not that the magnitude of that potential (the magnitude of the entire set of flowing rivers themselves!) And it is certainly not "identically" the river itself! At best it is a measure of the *intensity* of the potential (the local intensity of all those internal rivers of energy flow) at that point occupied by the intercepting/diverting rock.

The point is, *as defined and used in conventional electrodynamics*, the potential occurs only after the vacuum EM entity's reaction with the intercepting mass, and is defined only as the *effect* produced upon that coulomb by the causative potential's interaction. Literally, the potential (the cause) is erroneously defined as the "excitation" or "excess energy" it locally

produces as an *effect* upon a unit point intercepting/ collecting charge.

Ironically, it appears that no electrodynamicist calculates the magnitude of the actual potential as it exists in vacuum-spacetime, before its interaction with charge {[34], [35] }. Its magnitude is enormous, since the potential may extend over all space, and energy can be intercepted and collected by a charge placed at any point therein, or from charges placed at every point therein.

Certainly no rigorous definition of the potential presently exists in physics; the reader is challenged to check for himself or herself. No legitimate definition *can* exist for the potential, until the little matter is resolved of its present erroneous definition only "in and on and deviated by" charged matter, contradicted by the simultaneous assumption that it does exist in mass-free space in undeviated form. What is *deviated from* the potential, is not the *potential itself*. A part of something torn out of that something at one point in itself, is not the whole. The *local effect* cannot be substituted for the *entire nonlocal cause*—only a small part of which interacts *locally*.

The EM force field is similarly defined—only for charge mass interception, and only as an *effect* produced upon the intercepting charge. (See again Figures 5, 6, and 7.) A flow of water across a rock (or the wind on a rock in the desert) produces a “pileup” of fluid on the windward side, and a lesser “pileup” on the downwind side. The difference (called the “gradient”) in the energy density collected across the standard charge (rock) produces a “difference in pressure” on the rock—in other words, a force per interacting rock. That *effect* is erroneously taken to be the EM field itself, when rigorously it is only the reaction cross section of the EM field. Again, rigorously this EM field *as defined in electrodynamics* only exists as the effect that occurs upon an intercepting standard charge or "rock" {[36]}.

Since the EM wave “in space” is erroneously said to be made of varying EM fields, it too is defined only as the

effect upon the intercepting charged mass, after the vacuum EM wave entity—whatever it is—has interacted with the charge and changed the charge translationally and energetically. Specifically, the present "EM wave in vacuum" in the literature is not at all what is presented and taught in undergraduate texts, and even the standard illustration of "oscillating E-field and B-field vectors" lateral to the line of motion of the wave is horribly wrong. E.g., Dr. Robert Romer, former editor of American Journal of Physics, has taken that error to task as follows { [37] }:

> *"…that dreadful diagram purporting to show the electric and magnetic fields of a plane wave, as a function of position (and/ or time?) that besmirch the pages of almost every introductory book. …it is a horrible diagram. 'Misleading' would be too kind a word; 'wrong' is more accurate." "…perhaps then, for historical interest, [we should] find out how that diagram came to contaminate our literature in the first place."*

The EM field and wave *as commonly regarded* are transfer functions from the source charged masses that "perturbed the vacuum medium and created an unknown kind of disturbance therein", onto the receiving charged masses that intercept the incoming "unknown vacuum wave entity that was created" and interact with it, being translated and perturbed as a result.

This "detected" translation of the receiving charged masses (usually the interacting Drude electrons in a wire) is what our instruments detect. Indeed, the Drude electrons are highly constrained from moving longitudinally down the wire, usually moving at only a few inches per hour. They are much freer to move laterally, however, and can easily do so.

Reacting with the incoming longitudinal EM wave perturbation of local spacetime, the spin of the electron produces gyroscopic precession laterally in the wire since the electron is terribly restrained in moving

longitudinally down the wire. Since our instruments detect these *transverse electron precession waves*, that has been totally confused (since Faraday's "plucked taut string" notion of the EM wave and Maxwell's arbitrary adoption of it) as representing the incoming wave in vacuum. It does not represent the vacuum EM wave at all; the incoming wave is in fact a longitudinal EM wave in 3-space, associated with a precisely correlated longitudinal EM wave in the time-domain.

So we have answered Professor Romer's implied question. That horrible diagram came from the assumption by early electrodynamicists, before discovery of the electron or atom or nucleus, that the "transverse electric fluid waves" in the receiving wires represented actual "intercepted" fluid perturbations arriving in the material ether medium.

In summary: Using a transmitter-receiver analysis, the so-called “EM wave in vacuum” *as presently defined*, actually represents that “detected and measured electron precession wave” in and of the reacting Drude electron gas in the distant receiving wire antenna. The so-called EM force field wave in vacuum has been erroneously defined as observable matter wiggles, not vacuum virtual energy wiggles and not as spacetime-curvature changes and wiggles. So even the present notion of the EM transverse wave in space is wrong, and it has been corrupted as a pure matter-to-matter transform from the beginning { [38] }.

Somewhat less technical explanations are given by Lindsay and Margenau { [39] }, and a rigorous statement and discussion that EM force fields exist only in charged matter is given by Aharonov and Bohm { [40] }. Feynman of course said it bluntly: Only the potential for the field exists in the vacuum, should one place a unit point charge there to allow the force field to be developed (on, of, and containing the source charge itself).

Let us summarize this terrible EM foundations flaw: As classical electrodynamics presently is modeled, Maxwell and his modern followers only include equations which are *mass-to-mass transformations*

(Figure 8). Specifically missing { [41] } are two other transforms: (i) the mass-to-vacuum (mass-to-spacetime) transformation (which obviously is general relativistic in nature), and (ii) the vacuum-to-mass (spacetime-to-mass) transformation (again, obviously general relativistic in nature). (See again Figure 9). When these two missing transforms are added back into electrodynamics, one has suddenly extended EM theory into a new domain. One has also *infolded* general relativity (GR) inside the present EM matter-to-matter transforms, and also included the vacuum interaction including broken symmetry in that exchange, but in an *electromagnetically engineerable manner*. In short, one has a practical, engineerable unified field theory.

Highly creative inventors such as Rife and Prioré intuitively developed apparatuses that unwittingly utilized this presently undeveloped and extended union of EM, particle physics vacuum theory, and GR. The intuition of the theorists in interpreting those revolutionary experiments and their results has very seriously lagged.

The Supersystem Concept

To understand how extraordinary systems such as Rife's microscope works, one must understand the concept of the *supersystem*. (See Figure 13). The supersystem consists of three components, which are (1) the physical system and its dynamics, (2) the local active vacuum and its dynamics, and (3) the local curvatures of spacetime and their dynamics. All three components of the supersystem interact with one another, in nature. The second and third components of the system constitute the active environment in which the system is embedded, and with which it interacts.

Unfortunately, in standard classical electrodynamics either the system's environment is assumed to be inert, or the system is assumed to be in equilibrium in its interaction with that environment. This represents a totally arbitrary assumption that the system cannot receive and utilize any excess energy from its known

active environment. Hence the active vacuum's interaction with the system can be and is ignored by classical electromagnetics, as are the local curvatures of spacetime and their interactions with the system.

Extraordinary EM systems invariably involve the supersystem dynamics, and not just the system dynamics. *In nature*, no system analysis is complete until the supersystem interactions and their effects have been determined and analyzed.

The Rife microscope is indeed an extraordinary system using non-negligible interactions between the system and the other two components of its supersystem. Hence in our discussions, we will be examining interactions in that regime, and not just the standard electrodynamics analysis. In these discussions, we will be holding in mind not just the mass-to-mass transforms of standard electrodynamics, but two other transforms: (1) the mass-to-vacuum/spacetime transform, and (2) the vacuum/spacetime to matter transform (previously shown in Figure 9).

The reason that Rife's work has not been understood is that researchers have been unaware of the necessity for supersystem analysis. Almost all analyses of Rife's work have been merely standard classical EM analysis and thus quite insufficient. There are other examples of the standard electrodynamics model completely failing to show higher symmetry phenomenology in an inventor's work, so that his work is not understood even today. An example is provided by Tesla's patented circuits, as rigorously demonstrated by Barrett { [42] }. Barrett went on to improve the new functions discovered in Tesla's patents, and obtained two additional patents related to signals and signal processing { [43] }.

Vacuum-Structurings as “Engines”: Key Part of the Missing Transforms

The missing mass-to-vacuum/spacetime transformation produces a massless structuring of the vacuum medium. That is a *vacuum engine* or “multiplex of specific spacetime curvatures.” (See Figure 14, Figure

15, Figure 16, Figure 17), and Figure 18. Preparing the vacuum engine is accomplished by charged matter dynamics of the source charges producing the necessary potentials, fields and waves. The charges are embedded in continual energetic exchange with the vacuum/spacetime, and moving the charges affects that exchange; it perturbs the local vacuum flux and curves the local spacetime accordingly.

The transform represents producing this vacuum engine by the vacuum-perturbing action of source charge dynamics upon the vacuum, and by *not* assuming a mystical intercepting point-charge at each point in space { [44] }. In the vacuum/spacetime, *only* vacuum/spacetime entities and changes to them exist. *In pure water, only water and changes to that water exist!*

So a precise dynamic structuring of the energetic vacuum (and spacetime geometry) is what charges produce when they “perturb” the vacuum medium { [45] }, by the presence or dynamics of their fields, longitudinal and time-polarized EM waves, or both. This "perturbed vacuum dynamics" separate from the source charges themselves comprises an engine that consists of altered longitudinal EM wave dynamics inside the internal Whittaker structure { [46] } of the scalar potential of the ambient vacuum. That is the same as also producing internested levels of spacetime curvatures in a *template* or specific pattern { [47] }.

In turn, this vacuum engine region of local curvatures and structurings in spacetime will interact upon any mass placed therein. That action is the missing *electrodynamic vacuum-to-mass transform.*

The missing electrodynamic vacuum-to-mass transformation produces direct changes and alterations in the “receiving” mass, at all levels, by the action of such a vacuum engine. As each action occurs locally in the localized receiving mass, it produces the "local effect" as the result of that “local action.” The primary causative chain (i.e., the set of “dominoes” affecting each other serially), started back at the distant source charges. One can say that we therefore have mass-to-mass *action at a distance*, via the matter-to-vacuum

and vacuum-to-mass intermediary transforms and the spatial and temporal propagation of the vacuum engines in the middle of the two { [48] }. We will shortly discuss the Whittaker structuring of the potential as a fundamental process for producing vacuum engines.

General relativists mostly concentrate upon the warping and curving of spacetime (i.e., producing a vacuum engine) by the very weak gravitational force—which is only some 10^{-42} times as strong for electrons as the electric force between them. Consequently, relativists must look to huge assemblages of mass, such as in stars and other astronomical objects, for sufficient gravitationally-induced spacetime curvature to produce easily observable results. For that reason, general relativity has resisted laboratory development as an engineerable applied science. By using the far stronger EM force as the agent of spacetime curvature, and including the infolded electrodynamics inside the potential, field, and wave, general relativity then becomes engineerable and usable. But one is engineering the supersystem, not just the system.

The Infolded Electrodynamics Inside Potentials, Fields, and Waves

As previously stated, in 1903 E. T. Whittaker, a well-known mathematical physicist, showed that a scalar potential can be mathematically decomposed into a set of peculiar EM wavepairs in a harmonic set. (Again see Figure 12) These “hidden waves” are longitudinal EM waves, arranged in conjugate pairs { [49] } with the pairs also arranged in a harmonic set. In each wavepair, there is an ordinary (forward-time) longitudinal EM wave (outgoing in 3-space from the interacting/observing charge), coupled to its phase conjugate replica (time-reversed twin).

And here lies a magic secret. Prior to interacting with a charge, the phase conjugate wave in each wavepair is in the complex domain, which means that in Minkowski space it is incoming along the fourth axis, *ict*, where the only variable is *t*. Hence this wave prior to interaction with charge does not even exist in 3-

space. Instead, it exists as a longitudinal EM wave incoming in time, so that it is a time-like flow of EM energy. (See Figure 19). After interaction with a charge, the charge absorbs the incoming time-polarized EM wave, transduces that time-energy to 3-spatial energy, and re-emits the energy as longitudinal EM waves in 3-space in all directions. "In all directions" means that for every outgoing longitudinal EM wave emitted in one direction in 3-space, another wave just like it also emitted in the other direction in 3-space. So the paired "bidirectional" EM longitudinal EM waves in 3-space, as interpreted by Whittaker, do exist as the *effect* waves caused by the incoming causal time-like longitudinal EM waves (scalar EM waves). The pairing of the causal time-polarized EM incoming wave with an outgoing effect longitudinal EM wave was not interpreted by Whittaker, but does agree with more modern quantum field theory interpretations of photon polarizations and their observability or non observability, by Mandl and Shaw {22b}.

We have corrected this "effect substituted for the cause" wave to reinterpret Whittaker's 1903 decomposition of the scalar potential, into combined biwaves where one of the biwaves is incoming in the time domain, and the other is outgoing in 3-space. That re-interpretation then allowed a solution {22a} to the problem of the source charge and its associated fields and potentials, together with their energy. Every source charge and source dipole continuously emits EM energy in 3-space, without any 3-spatial EM energy input. The input is there, but in the time-domain. This problem—resolved by the present author in 2000—has been called the most difficult problem in quantum and classical electromagnetics {30 }.

Because of observed parity reversal accompanying the time-reversal operation, in his forward-time, the observer “sees”—after interacting the incoming wave with charge—the *effect* of the incoming time-reversed or phase conjugate wave (entering from the time domain) as a 3-space longitudinal EM wave leaving in the opposite spatial direction. So the basic 4-space phase conjugate longitudinal wavepair would appear to us in forward time as a “regular” time-forward

longitudinal EM wavepair in 3-space, with the two waves going outward in opposite directions. But each is accompanied by a time-polarized EM wave, else it would not be observable.

Further, there is a harmonic series of such bidirectional longitudinal wavepairs comprising the scalar potential. So the staid old electrostatic potential (i) *is not* a "scalar entity" at all { [50] }, (ii) *is* a bundle of longitudinal wavepairs, (iii) *is* an entity with a remarkable internal hidden multiwave structures and dynamics, (iv) *is* a composite of very special waves whose transverse amplitude (i.e., whose spatial energy density, which is a function of transverse amplitude squared) does not change, but whose transported time structure changes, and (v) therefore is a special kind of wave that is velocity modulated about some central velocity, and is not limited to the speed of light c. Indeed, in classical electrodynamics in the Coulomb gauge, the scalar potential is already recognized as having infinite velocity, merely appearing in space instantly at every point it occupies { [51] }.

We also state without elaboration that the active vacuum is *identically* a very huge scalar potential, as indeed is “spacetime geometry”. So a unifying principle is:

vacuum ≡ spacetime ≡ potential ≡ energy { [52] }

Further, as a potential, the “ambient” vacuum decomposes into an incredibly rich, internal Whittaker wave structure. So then also must *spacetime* and *energy* similarly decompose. That decomposition structure is even richer when higher symmetry O(3) EM is used instead of the lower symmetry U(1) EM employed by Whittaker.

A revolution in electrodynamics has recently begun, and central to that revolution is the strong appearance of longitudinal EM waves as essentially the basis for the emerging new electrodynamics. Work by Evans { [53] }, Barrett { [54] }, Ziolkowski { [55] }, Evans { [56] }, Rodrigues {57}, and others is

fundamental in this respect. One part of this emerging new electrodynamics is advanced under the label of *undistorted progressive waves* (UPWs). A good summary of UPW theory is given by Rodrigues and Lu { [57] }. Even so, to date this body of work still largely ignores the internal Whittaker dynamics { [58] } inside an EM wave. The body of work—particularly the higher symmetry O(3) electrodynamics pioneered by Evans {56} inherently possesses the capability to model such structuring, since much of it utilizes a higher topology algebra such as quaternions { [59] } or even Clifford algebra { [60] } In those higher algebras, many electrodynamic things can be done outside the operations permitted by present vector and tensor electrodynamics.

Superpotentials and Superpotential Theory

Whittaker's 1904 paper { [61] } showed that all the "normal" electrodynamics was based on, *and created by*, the interference of scalar potential functions (i.e., by the interference of those multiwave longitudinal wavepairs and their dynamics { [62] } constituting the interfering scalar potentials.) He showed that any EM field or wave whatsoever can be replaced by two scalar potential functions—in fact, is *comprised of* those two scalar potential functions and is *created by them*. Scalar potential interferometry already creates all the "normal" EM in the textbooks anyway, and a proof has been given by Evans et al. { [63] }.

The 1904 paper by Whittaker initiated a somewhat obscure branch of electrodynamics referred to as *superpotential* theory { [64] }. Whittaker's work was further extended and augmented by later scientists such as Righi { [65] }, Debye { [66] }, Bromwich { [67] }, Nisbet { [68] }, McCrea { [69] }, etc. But even with the extended superpotential theory, without the addition of Whittaker 1903 and the substructuring "internal LW electrodynamics" one cannot understand the mechanism for what Rife was actually doing.

Rife was not using normal potentials and normal **E** and

H fields—which as we discussed, only apply to observable material entities anyhow and thus could not be used to "see" far below the quantum threshold of least detectable material disturbance. His entire protocol was to get beyond those "*material interception of EM energy*" limitations. Unwittingly, Rife was using *vacuum engines*—involving structuring of the active vacuum as well as pure general relativity (GR) and pure structurings of spacetime geometry itself. He was electromagnetically using that part of GR that the GR physicists have mostly only tried to produce by use of the weak gravitational force. In GR, *the ST geometry itself is active, dynamic, energetic, and structuring!* In higher symmetry electrodynamics, *the ST geometry itself is powerfully active, dynamic, energetic, and structuring!* It is not at all just a "passive spacetime" as classical electrodynamics assumes { [70] }.

Biological Systems Use the Infolded Whittaker-Type Electrodynamics

The problem in the Rife microscope is to be able to observe very subtle ST curvatures and patterns, in an optical manner. These subtle or virtual "disturbances" of local spacetime are far finer and smaller than the one-tenth wavelength optical resolution generally the limit for optical microscopes using conventional optical EM notions and "material" potentials, fields, and waves.

In short, Rife's twofold problem was to (i) function with vacuum engines (internal structuring of the potentials) so he could penetrate to any degree of smallness, and (ii) output, in the observable state, exact visible summations and analogues of the individual structures detected in the virtual (nonobservable) state { [71] }.

To make the subtle vacuum engines observable on the bench, the ST curvatures and their internested patterning must be accomplished by making and assembling local curvatures of ST, via making longitudinal EM wavepairs in structural pattern assemblies. *Spacetime* is in fact just a powerful scalar

potential, or can be modeled as such, and as such Whittaker 1903 and 1904 rigorously applies, along with extensions from higher symmetry electrodynamics. By realizing that ST is identically potential, one has altered one's thinking from the standard GR theory into a correlated EM-GR theory. One has also extended GR: Not only is there a "topology" of things that can be externally *done to* a base spacetime, but there is also a hidden, vast EM topology *within* any overall base spacetime. So we now have "topologies within topologies." This is in fact what the Russians have long called the *information content of the field*.

However, all living systems already use this "infolded" bidirectional, longitudinal wavepair EM in their ongoing living functions { [72] }. Just as they used frequency modulation, EM signals, EM oscillations, etc. before we even had an electrodynamics or a physics, living systems do use the infolded EM (and vacuum engines) in all their living functions, and particularly in their cellular *regeneration and restoration* (R&R) system { [73] }, as contrasted to their *immune* system. The immune system cells are the fighters and the debris scavengers/cleaners. They go after the hostile invaders, fight them, and usually win—littering the battlefield with the debris. Then the immune system scavenger cells clean up the residue.

But many of the body's cells will have been damaged in the fight. The immune system itself cannot heal or restore a single damaged cell, even its own! It is not a *healer*! It is a searcher, a marker, a killer, and a residue-cleaner. It contains " the troops and the combat engineer," so to speak, but not the hospitals and the doctors. All healing/restoration of living cells is done by the R&R system, not by the immune system.

A high-level overview of the immune system is given in Figure 20.

No vaccine, drug, herb, vitamin, or mineral *heals* the body, although certainly they can enhance or aid the body's healing process. Each does carry its individual resident vacuum engine, and when absorbed

by the cell, this added vacuum engine contributes to the resident vacuum engine in the cell by summing with it. To restore the damaged cells back to normal (i.e., to heal), the R&R system uses a novel kind of extended electrodynamics with infolded vacuum engines, and it uses a novel kind of optical phase conjugate pumping, in the time domain rather than just 3-space. The magic "unified field theory" so long sought by scientists, has long been utilized by the regeneration and restoration system of the body in its minute-to-minute and day-to-day healing and restoring actions.

The magic "universal healing mechanism" so long evading the discovery of medical scientists is none other than the exact cellular regenerative mechanism universally used by every living organism. For the first time, we are explaining the higher symmetry electromagnetic nature of this mechanism.

Robert Becker's epochal work { [74] } (Figure 21, Figure 22) strongly probed the electromagnetic control system directing the body's cellular regeneration and repair (R&R) system. However, he did not have available the infolded Whittaker electrodynamics. He could only utilize the grossly inadequate standard electrodynamics. Modern nonlinear phase conjugate optics had not yet been born when Becker did most of his seminal work.

Since standard EM does not incorporate infolded GR, vacuum engines, or optical pumping in the time domain, Becker could not formulate the full technical mechanism of the R&R system —which uses the *supersystem*, not just the system. But Becker did strongly point out the importance of the R&R system, both theoretically and experimentally. He found that it operated electrically, with the scalar potentials being key. He modeled the R&R system as closely as can be done with classical U(1) electromagnetics (Figure 22). He proved that cells can be *dedifferentiated* (reversed back to an earlier, more primitive state) and *redifferentiated* (time-forwarded into a more complex state) by weak DC potentials and laughably weak (picoamperes) of current. He was twice nominated for a Nobel prize for his epochal work. His method of

electromagnetic healing of otherwise intractable bone fractures (Figure 21) is utilized today in many hospitals.

In his microscope, Rife was in pursuit of optically "seeing" the infolded electrodynamics functioning of the living cells in the most minute detail—i.e., he wished to see the actual vacuum engines and their functions. Using the infolded EM, one can still "see" the cells and all their parts, but one can also go far beyond the one-tenth wavelength optical discrimination limitation and see into the virtual state dynamics. In theory, because the infolded EM is *recursive* as a function of wavelength, one can go to any limit in smallness desired—or at least to whatever limit is determined by the available technology's development at the time { [75] }.

Vlail Kaznacheyev's novel electromagnetic induction of cellular death, disease, and damage, *at a distance*, is instructive in this respect { [76] }. (Figure 23) Indeed, the Russians mastered, extended, and weaponized the Kaznacheyev mechanisms as disease-inducing weaponry, and slyly used it at low level on personnel in the U.S. Embassy in Moscow (Figure 24). This was done to stimulate high level officials in the U.S. government and U.S. scientific community to see if the U.S. knew of this "infolded electrodynamics and vacuum engine" technology { [77] }. The Russians were using GR, but by infolded EM means—so they were using a unified field theory involving higher group symmetry electrodynamics. The puzzled U.S. employed only standard U(1) symmetry electrodynamic analysis { [78] }, so it totally missed the entire physics of what was occurring to cause the health changes and diseases.

In GR, one is very interested in Wheeler's principle which states (slightly paraphrased):

> *Mass (trapped energy) acts upon ST geometry to curve it, and curved ST acts upon mass to produce forces upon it and move it.*

This statement after Wheeler is the very essence

of general relativity. It simply states that there is a *mass-to-spacetime* dynamic transform, and also a *spacetime-to-mass* dynamic transform, as we diagrammatically showed in Figure 9.

Understanding Vacuum Engines and Their Action

Wheeler's general relativity principle includes the missing two transforms of electro-dynamics. We are extending Wheeler's principle to the corollary form:

All levels of the structures of mass (trapped energy structures) and all levels of the structures of time (the time aspects of photon structures) act upon ST geometry to structure it in both 3-spatial energy density structuring and in time domain structuring. Producing this multilevel spatial and temporal structuring of spacetime is called "forming a vacuum engine." Both 3-spatial energy density structuring of spacetime at all levels and time structuring of spacetime at all levels, act upon mass at all levels, to produce internested templates of forces and translations and stresses.

In short, energy patterns and time patterns in 3-space act upon spacetime to produce patterned curvatures of ST geometry (vacuum engines). And conversely, patterned curvatures of spacetime geometry (vacuum engines) act upon mass to produce corresponding patterns of forces at all levels in the mass —down to and including upon the quarks and gluons in the nucleons in the atomic nuclei. We note with pleasure that the Sachs unified field theory does apply from the gluons to the entire universe, as has been shown by Sachs himself {18b}.

Muscle and Skeleton Analogy of Interaction of Vacuum Engine and Mass

We call attention again to our analogy (Figures 15, 16, 17, and 18) of the interaction of a vacuum engine and mass, provided by the interaction of arm muscles and the skeletal arm bones to which they are attached. The arm muscles attach to the arm's skeletal bones, and

those bones are articulated and free to dynamically move. To the bones, the muscles are mysterious agents (analogous to vacuum engines) exerting forces upon them, and causing them to move or hold. To the muscles, the bones are positioned resisting masses for them to work upon and change their positions, and the bones exert Newtonian reaction forces back upon the muscles as the muscles apply forces to the bones. So the vacuum engines (muscles) create forces upon the resisting masses (bones) to move them, and the masses act back upon the causative vacuum engines to create antiforces in resistance.

Using this analogy, when we create a set of vacuum engines, we create a set of “mysterious muscles” that act directly upon any and all “masses” (bones) that are exposed to them. The bones then change and move until the bidirectional interaction forces are balanced (equal and opposite). This symmetry between the two missing transforms is shown in Figure 9.

The Multilevel Structuring of Time is Important

We also add the extension that dynamic structuring in the time stream also occurs from trapped time domain “time component” structuring and distribution effects, as well as dynamic structuring of the spatial energy density of the ST geometry (the vacuum).

We are speaking *relativistically* of the interaction of mass and spacetime at any and all levels of a mass, down to and including the molecules, the atoms, the atomic nuclei, the nucleons, and even the quarks comprising the nucleons (comprising the protons and neutrons). One must first clearly have this vision in mind: The dynamics of everything ongoing in that mass, down to the most minute particle dynamics and in the most minute detail (and far into the virtual state beyond the one-tenth wavelength limitation of light resolution) consists of the structurings of this "mass-ST curvature" mutual interaction.

So we know from general relativity that collections of

energy (such as mass) act directly upon spacetime, its structuring, and its dynamics at any and all levels, down to the tiniest. We know that the variations in local spacetime geometry (including in both energy and time), down to any and all levels and sizes, down to the tiniest conceivable lengths, act directly upon any and all exposed mass at that level, *no matter how tiny*.

There is no “quantum” limitation nor is there any “wavelength of light” limitation to this GR process. Total continuity applies.

Some Characteristics of Vacuum Engines

The great advantage of a vacuum engine is that the "action" it produces upon an exposed mass, arises directly from within each point in the local spacetime in which the mass is embedded. One does not have to "start outside" and move through space and the intervening mass toward the "inside". Every point within an object occupies every point in time, a priori. From a single time-point, the vacuum engine's 3-space action enters everywhere within the object, all-at-once, and the 3-space effects proceed outward from each interior point. (See again Figure 19). Therefore even a weak vacuum engine induced by EM forces can do with ridiculous ease what the most powerful particle accelerators on Earth cannot do. The engine is already everywhere "inside" an object or particle, and working from every point in it, toward an outward direction. On the other hand, a particle accelerator is trying to build tremendous velocity of its particles so that they can "smash" their way in there, by brute force. To get ever deeper, the particle accelerator must be made ever larger, so that a "bigger hammer" is available. Also, the vacuum engine does not smash or damage any of the matter in the object, in any fashion not desired. The particle accelerator, on the other hand, is a great disruptor and may well destroy or serious change the very object it "probes".

Further, contrary to the accelerator's "one shot for one giant amount of energy input", a vacuum engine—once formed—continually exists in that locally altered spacetime and is contained in it and is sustained by it.

Hence that locally altered spacetime—after we pay to alter it once—will continuously expend energy in the form of the action of that vacuum energy, forever, upon any mass emplaced in that local spacetime. The universe itself is furnishing the energy to do the work, via the instantaneous connection in the time domain.

That "multiply connected space" entry everywhere within an object simultaneously, is quite different from "spatial propagation of energy" through singly-connected space from outside an object to the object, striking the outside of a mass and being absorbed, producing a gross translation force upon the mass. In the “energy propagation through space” case, severe energy interaction may occur with only the absorbing part of a macroscopic mass, while the remainder of the mass is little affected or not at all. To wit, one does not get the resulting *electronuclear* alterations of the nucleus (materialization, dematerialization, transmutation, etc.) by absorbed propagated “normal” EM radiation. However, with weak EM-induced vacuum engines one can do things inside the nucleus such as easily flip quarks inside the nucleons, so that transmutations at very weak spatial energy levels are readily obtained. This in fact turned out to be the major secret of the low-energy nuclear transmutations occurring in some 600 cold fusion experiments worldwide { [79] }.

Electrodynamic force fields implicitly define primarily only translation effects upon charges or masses, in their very definitions. With normal EM, usually one will get reradiation of the absorbed energy, or partial reradiation of the absorbed energy accompanied with recoil of the absorbing mass, or no reradiation but recoil of the mass.

We took the term *vacuum engine* from Misner, Thorne, and Wheeler { [80] } and also from Nobelist T. D. Lee { [81] } who spoke of this sort of thing as *vacuum engineering*. The term is not original with us; only the novel higher symmetry electrodynamics application of the concept is original. We call the exact geometrical form of a vacuum engine a *template*. We refer to the process of internally structuring a field, wave, or

potential as *dimensioning* or *activating* or *conditioning* or *charging up* the field, wave, or potential. Russian superpotential weapon scientists call the infolded structuring itself the *information content of the field*. For further discussion of some of these terms and related concepts, the reader is referred to our website, www.cheniere.org.

Wheeler's GR principle says that, for every mass with its exact mass structural dynamics condition, there exists a corresponding exact vacuum engine template containing precise spacetime curvature structural dynamics, and interacting back upon the dynamic mass at all levels. That vacuum engine is said to be resident in the mass and continuously interacting with it (see again Figure 13 on the *supersystem*).

Again, the structuring of the vacuum engine has no limitation in fineness, because spacetime is continuous. Hence it freely extends from the observable realm on down into the virtual realm. This is no more audacious than stating that virtual and observable entities occupy the same time domain simultaneously. Obviously, if one is using the structuring of time, one gathers in both those virtual structures and those observable structures, and also the exact correlation between them. This is a direct engineering application of an EM hidden variable theory, somewhat similar to that proposed by David Bohm { [82] }.

Applying Vacuum Engines to Living Cells

Any normal cell already has a normal *template* of overall ST curvature due to its mass and trapped energy structures. No matter how small, every internal part of that cell has its own *subcomponent template* of subcomponent ST curvatures embedded in that overall cellular ST curvature. As the cell functions, the dynamic normal changes of that template into other related templates, is within the range of what we call "normal, healthy cellular functioning."

Any abnormal cell has an *abnormal template* and also an abnormal set of "templating" changes. In other

words, there exists a precise *vacuum engine delta* in the abnormal cell, summed to the cell's *normal vacuum engine*. The *sum engine* represents the exact vacuum engine to act on the normal cell and change it to that precise abnormal condition.

But a template depends upon the energy density structuring of the local vacuum and also the local *time* structuring—which latter is still missing from physics books, but is implicit in the nature of the photon. If one produces the necessary energy structuring and density—and the necessary time structuring and density of local ST geometry—one produces a certain vacuum engine and one also produce a certain *template of time structuring*. Time { [83] } has dynamic template structuring and functioning, just as does the 3-spatial energy density of ST geometry.

Indeed, the total (virtual and observable) photon interaction with a mass or particle generates the "flow of that mass or particle through time" (Figure 25).

But one *can* make vacuum engines using EM energy and structuring, rather than with normal gravitational (G) energy and structuring { [84] }. The advantage is that, for electrons, the EM structuring is on the order of 10^{42} times as strong as the G structuring. For protons, the EM force is something like 10^{38} times as strong as the G force. So by using the much stronger EM force as the "agent of ST curvature," one can make vacuum engines that are quite strong at their local level. These engines will affect and profoundly change any exposed mass, including cellular mass—in any fashion desired, given only that one makes the appropriate vacuum engine. Again, *we are simply engineering practical but ultra-strong general relativity on the laboratory bench*, by electromagnetically engineering Wheeler's principle in an extended form.

For any physical cellular deviation from normal—any deviation whatsoever—a corresponding exact deviation (i.e., an exact delta) exists in the cell's otherwise normal vacuum engine template. This includes deviations in the genetics of the cell and everything else, not just the chemistry and gross physical structure.

Now if one could produce the negative (time-reversal) of the sum template of the resident vacuum engine and *amplify* it, one would have a powerful new type of vacuum engine. (Figure 26) It would be an exact *vacuum anti-engine* to act upon that specific diseased or abnormal condition of the cell and gradually erase the delta and bring the cell physically back to normal. The new anti-engine would operate upon all the mass of the cell, at every level no matter how small. It would change the cell's abnormal genetics back to normal genetics.

One could of course reverse cellular damage due to aging, and rejuvenate the body. It is quite doable; all that is needed are the funds, scientific team, and laboratory facilities to develop it. It is doable whenever the U.S. medical science community and the giant pharmaceutical community will allow it to be done.

One could reverse a cancer cell back to a normal cell, by applying the specific summation vacuum antiengine for the exact delta between the cancer cell and a normal cell.

One could reverse an AIDS cell back to a normal cell with normal genetics, where it no longer was an "HIV factory". An AIDS patient could be completely, quickly, and cheaply cured, the moment he or she tested HIV positive. There would be no need to wait for the debilitations of the progressing disease to appear. Not a single HIV-infected cell would be left in the body, even those resistant strains that have developed after the original infection.

One could do precisely the same thing with Ebola infections, and with the "tough" staph infections that now resist everything and are killing more than 120 thousand Americans in our hospitals every year, with the figures rising. *These are patients who did not have the disease that killed them, when they entered the hospital*.

With development of portable treatment units and mass production, one could treat and heal those millions of

mass casualties that could well erupt in one or more large U.S. city areas—e.g., from an Iraqi-sponsored terrorist biological warfare (BW) strike, using anthrax { [85]). In 1998, we proposed a crash development of just such portable units { [86] }. With the present world situation, it is not a matter of *if* such terrorist BW strikes will be made in the U.S., it is a matter of *when* { [87] }. Since our 1998 proposal, there has now been time to have had those portable units developed and mass-produced, at a total program cost of perhaps $100 million. Sadly, no one apparently had the foggiest notion of what was actually being proposed, and its vital importance to the survival of the nation. With a looming war in the MidEast—and with hordes of terrorist teams with biological warfare agents already infiltrated into U.S. cities and population centers—this negligence is particularly of concern at this very moment. These officially-forecast attacks on our cities by weapons of mass destruction could now be imminent, if and when the MidEast does explode into war, which appears imminent.

The Process Has Been Experimentally Proven

A very similar thing is also what Becker { [88] } demonstrated, without considering the vacuum engine (general relativistic curvature of spacetime) effects. It is also precisely what Prioré { [89] } unwittingly did in France, with a team of renowned French scientists, to cure terminal cancers, atherosclerosis, lethal infectious diseases, etc. in laboratory animals under rigorous scientific protocols. The team also demonstrated the restoration of suppressed immune systems.

In Germany, Popp { [90] } *et al*. were also involved in studies dealing with the R&R system, but from a quantum electrodynamics viewpoint.

We can also consider the vacuum engine from a nonlinear optics view, and obtain startling extensions of both general relativity and nonlinear phase conjugate optics. That in fact is exactly what Prioré did, though he did not think in those terms. Prioré roughly created a complex set of bidirectional longitudinal EM

wavepairs—i.e., a set of “time domain pump waves.” So he produced a kind of vacuum engine that itself is a crude *anti-engine generator* when used to pump a mass such as a living cell.

Prioré unwittingly used an extension to nonlinear optical (NLO) phase conjugation *before nonlinear phase conjugate optics was even born*. Pumping diseased cells in the Prioré manner causes the formation of exact "antiengines" for the specific cellular disease or disorder to be created in the cells themselves.

First, Prioré mixed up to 17 or so EM transverse waves in a rotating plasma { [91] }. Today we know that such a plasma will transform transverse radiations into longitudinal radiations, and it will also phase conjugate the input waves and add their phase conjugate replicas. In short, it is a procedure for somewhat crudely making a set of longitudinal bidirectional EM wavepairs, which is required to produce a scalar potential with a deterministic internal structuring. In short, it produces a scalar potential with an internal vacuum engine template.

These infolded longitudinal biwaves are NLO pump waves of a new kind: They pump the PCM material in the time domain only. This kind of pumping is a *vacuum antiengine-making process*.

The plasma tube was surrounded by a giant coil, and a pulsed magnetic field was produced by the coil. Per Whittaker’s 1904 paper, that pulsed DC magnetic field can be decomposed into two scalar potentials. Hence we have three potentials superposing: (1) the potential function set made by Prioré in his plasma tube, and containing a selected “vacuum antiengine maker” consisting of bidirectional pump waves in the time domain, and (2 and 3) the two Whittaker potential functions comprising the DC pulsed magnetic field of the coil.

The end result of this superposition/mixing of potentials is that their “internal structures”—including their vacuum engines—also diffuse one into the other.

Fundamentally, Prioré produced what to the observer seemed just a pulsed DC magnetic field, but one in which there was a specific "vacuum engine maker" of his deliberate creation and "tailoring." Originally by trial and error, he adjusted the 17 frequencies introduced to the plasma, thus varying the frequencies of the "infolded bidirectional pump waves" produced and infolded into the pulsed DC magnetic field carrier. In this manner he was "tuning the "vacuum antiengine-maker" content.

Again, Russian energetics weapons scientists call those vacuum engine templates the *information content of the field*. They do not refer to ordinary spectral analysis.

Explaining the Time-Pumping Vacuum Anti-Engine Maker

Irradiating the cell (with non-ionizing radiation) containing infolded specific bidirectional longitudinal waves, precisely corresponds to pumping the cells in the time domain, rather than pumping them in the "spatial energy distribution" domain. Because of the shift of the pumping from the 3-space domain to the time domain, this constitutes a dramatic extension of phase conjugate optics. Because of the amplified phase conjugating action of the "vacuum antiengine maker" upon the vacuum engine in a mass, this also constitutes a dramatic extension of general relativity and of four-wave mixing theory. Let us explain briefly:

When one pumps a nonlinear mass [phase conjugate mirror (PCM) material] with ordinary "transverse" EM waves { [92] } (Figure 27a), one is pumping (stressing, or "squeezing and relaxing") the mass with dynamic oscillating energy distributions in 3-space. One inputs a similar weak wave (called the "signal" wave) to the mass simultaneously. In that case, multiwave mixing theory tells us that the pumping of the PCM will cause the formation of a fourth EM wave, that is a time-reversed replica of the input "signal" EM wave. The time-reversed wave may contain up to all the energy in the pump waves, so it can be highly amplified in magnitude compared to the

input signal wave. The distortion correction theorem tells us that this time-reversed replica wave will then appear precisely superposing in space back along the exact spatial track taken by the input signal wave { [93] }.

When the pumping is shifted to the time domain by pumping with bidirectional *longitudinal* EM waves, we now are pumping the time aspects of the mass—during it iterative existence as masstime; see again Figure 25—rather than just pumping the spatial energy aspects. In other words, we are not pumping *spatially*, but *spatiotemporally*. We are pumping *temporally*—rhythmically squeezing (compressing) and relaxing (extending) the "density of the time interactions" producing the rate of flow of time itself. This is a totally new extension to nonlinear phase conjugate optics.

In this case, the "signal wave input" to the "time-domain-pumped" nonlinear mass PCM is just the resident vacuum engine in the local spacetime in which that PCM mass is embedded (see Figure 27b). The sickened cell's abnormal vacuum engine—consisting of the sum of the normal cellular vacuum engine and the disease delta vacuum engine—is present in the cell and is the input to the time-pumped phase conjugate mirror (cellular masstime). The output is the formation of an amplified time-reversed replica of that vacuum engine. In other words, an exact, amplified *vacuum antiengine* for reversing the precise abnormal condition of the mass, down to and including even the quarks in the atomic nuclei, is formed by time-domain (longitudinal EM biwave) pumping. The result or "output" is that *the entire cellular PCM mass and all its constituent parts are "time-reversed" back along their previous "track through time", back to a previous normal physical state* { [94] }. Figure 27b illustrates this process.

So when Prioré pumped the abnormal cells, he simply time-reversed them—genetics and all—right back to their normal physical state before the abnormality arose.

The beauty of the method is that, by adjusting the input waves to the rotating plasma, Prioré could "tailor" and "tune" the pumping waves to what was needed for a particular class of disease. He used trial and error methods to arrive at the proper settings for the disease to be treated. In theory, by the Prioré method one can time reverse any mass back to an earlier physical state. This mechanism is used by the cellular control portion of the body's regenerative and restorative (R&R) system to restore damaged cells back to normal. It is the basis for the body's ability to heal itself!

Applied to diseased cells, the method causes the formation of specific amplified antiengines for the exact specific cellular abnormality, no matter how complex, and no matter what it is. *In applied medicine this is a revolutionary new healing and therapeutic modality*, accomplished by novel EM means, and justified by general relativity, higher symmetry electrodynamics, and longitudinal EM wave pumping in the time domain rather than classical electrodynamics and transverse EM wave pumping. Prioré's discovery, once understood, may just be the greatest medical discovery of all time, and the discoveries of Rife and of Becker may rank a close second. The Prioré process is shown in Figure 28.

The body's cellular regeneration system uses this same methodology and process. A block diagram of the operation of the body's cellular regeneration system is shown in Figure 29.

Further Principles Needed for Rife's Microscope

In his microscope (Figures 1 and 2), Rife just wanted to observe the templates [2] corresponding to the cells, germs, viruses, etc. and all their parts, without any smallness limit. To do that, we need to (1) amplify the tiny, tiny amplitudes (actually, in the virtual state and subquantal) of the tiny vacuum engines accompanying tiny spatial locations containing living, functioning entities (no matter how small), and (2) "transduce" that amplified result into the optical spectrum, so that we

see a perfect optical analog and thus are "looking" visually at localized ST regions far smaller than the one-tenth wavelength optical resolution limit.

We need another principle to do that. Suppose that, to first order, we have an isotropic nonlinear medium. Then if we transmit a sine wave into it, pandemonium sets loose with our wave. The speed of each part of the wave in this medium is a function of the location of that part upon the wave amplitude, so the peaks move faster than the intermediate parts of the wave of lesser magnitude. The wave has "peak overtake", breakup, collapse, and all sorts of things happening to it. So a simple sine wave is not going to pass smoothly into that medium and "pass back out" coherently and nicely, and ordinary light is not going to give stable reflections from that medium!

However, if we transmit *two* sine waves simultaneously, some frequency interval apart, and then if we *pretend* that we actually transmitted their *difference* frequency, a very strange thing happens. The two individual sine waves themselves still break up and go bananas. However, that difference frequency acts as if it were a simple sine wave transmitted into a *linear* medium! So we get back out a very nice, smooth, well-behaved sine wave of the *difference* frequency, even though terrible things happened to the individual waves themselves. We can detect and use that "difference frequency" nicely.

Several very neat sonar systems presently use that sort of transmission schema in underwater work { [95] }. The principle applies for waves of all frequencies, for all media which can be approximated as nonlinear isotropic in nature. As we shall see, it applies to the Rife microscope also.

Rife's Secret: Recursive Coherent Increase of the Signal-to-Noise Ratio (SNR)

To first order, without too much error we can pretend that the molecules and atoms etc. in the cells and body tissues, together with their finer components, comprise such an isotropic nonlinear medium. That's not entirely

true, of course, but it does work to an extent sufficient for our purposes. Fortunately for the Rife process, the parts that *do not* obey this isotropic rule add randomly, while the parts that *do* obey the rule add coherently. So the "signal-to-noise ratio" (SNR) increases with the increasing amplification, and one "grows" the desired signal right up out of the noise (SNR) of the parts that do not obey the isotropic medium assumption. With sufficient number of amplifier stages, in theory the SNR of even the tiniest parts can be made as large as desired { [96] }.

With optical functioning as in Rife's microscope, one may substitute "light gathering power" or "magnification" for the electrical term "amplifier gain".

As we stated, Whittaker in 1904 (and superpotential theory thereafter) shows us that—if we wish—any EM field, wave, and pattern can be represented by two scalar potentials. Each of these two scalar potentials is further comprised of bidirectional EM longitudinal waves, in a harmonic series, in the Whittaker 1903 manner as reinterpreted. So we can reduce any pattern, field, or wave from any assemblage of charge sources, into two potentials, and then further into two sets of bidirectional EM waves interfering with each other. That process already *makes* all conventional EM waves, fields, etc.

An EM structuring of the local vacuum-spacetime occurs by all the electrical charges in the mass of the living cell, down to and including the virtual charges exchanged in the nuclear interactions in the nucleus of the atoms. By Whittaker 1903 and superpotential theory, all of that structuring itself is a potential with an internal set of bidirectional harmonic longitudinal EM waves interfering with each other.

Further this potential is recursively organized, because the inner bidirectional EM wavepair structuring of the potential is already recursive, as can be shown by applying Whittaker-1903 and Whittaker-1904 successively and iteratively { [97] }. This means we get deeper and deeper internested levels of patterns that still precisely correspond to the operational

mechanisms of the lower levels. It's similar to an infinitely fractal { [98] } type of process.

Because this conglomerate is recursive as a function of harmonic intervals, it means that we can pick any harmonic interval we choose in the "big world" where we observe things, and we can have an exact observational representation of the dynamics of that ongoing hidden longitudinal EM wavepair interferometry in the two waves bounding that harmonic interval. Of course, the more additional harmonics we add, the better dynamics we have. The greater the number of harmonic intervals applied, the greater the gain. However, these harmonic intervals can be recursively applied using just one "macroscopic" harmonic interval, iteratively and serially applied over and over. The more iterative serial recursive application of one harmonic interval, the mote the "gain" or "amplification"—in the case of a microscope, the more the *amplification*. That was Rife's real secret, finally revealed. See Figure 30.

The Difference Frequency Provides Visible Output

Rife wanted to look at very, very small things *visually*, even though those “small things” were far below the one-tenth wavelength visible light barrier. In other words, to understand the Rife microscope’s visual representation of the virtual state, we need to choose the harmonic interval of the throughput so as to span the visible spectrum. Well, for optical purposes, luckily the IR and UV do exactly that. Examine the frequencies, and you will see that a harmonic interval exists from a spot in the IR to a spot in the UV, and of course the interval in between includes the entire visible spectrum. The visible spectrum in between, however, represents the observable noise that would block what we seek to have emerge in that region in our "Rife microscope", so the presence of the visible spectrum is highly undesirable. Various filters can be used to block the visible spectrum while transmitting the UV and IR regions, or one can just work in the dark or in suitably dim visible light.

Rife then applied his iterative multiple "difference frequency" lenses in serial order, one after the other. While it is doubtful that he understood the theoretical method being utilized, he certainly persisted and found how to use it. This method of iteratively summing a recursive virtual state vacuum engine "template" results in the formation of an observable state vacuum engine template. In short, it magnifies the virtual state entities and dynamics directly to observable state analogues that capture all the virtual state entities and their dynamics.

That is why, if we use special filters on your camera and flash lenses, where the filters are open in the IR and UV but opaque in the visible spectrum in between, we can often photograph the ongoing "longitudinal EM hidden biwave interferometry"—*the subtle energy or vacuum engine functioning*—of nature and of living systems, *even displaced in time*, as Trevor Constable { [99] } and Joe Gambill { [100] } (a researcher friend now deceased) demonstrated, as George Meek { [101] } demonstrated, and as Fogal { [102] } has successfully experimented with.

Occasionally when one gets things just right, one can get pictures of the subtle invisible reality in the virtual state, going on around oneself and in one's surroundings. With Rife-like iterative serial amplification, one can get them all the time, dependably, as with a Fogal semiconductor specially adapted for such operation. One can in fact build instruments that indirectly observe the so-called "unobservable" virtual energy state and its entities and dynamics with one-to-one correspondence.

That’s a whole new "subtle physics" reality. Present physics with its assumed quantum observation limitations just has not even gone into it—primarily because physics has been focusing upon the quantized aspects of the photon (which is quantized in one aspect only—its magnetic vector potential—and not in its unquantized aspect—its scalar electrical potential!). Physics has rather ignored the unquantized (and therefore continuous from the smallest to the largest scale) time aspect of the photon { [103] }. Using the

continuous aspect of the photon, one can assemble photon “time interval” structures—and in fact one does so whenever one assembles a 3-spatial energy density structuring such as in ordinary EM theory. Simultaneously, one has assembled a “structuring of the time domain” also, because each photon in the spatial energy density structuring consists of both time and energy as its canonical components.

All EM fields and waves, being comprised of photons, thus also carry (1) energy and energy internal structuring, and (2) time and internal time structuring. Again, this is the Russian *information content of the field*. The Russians simply understand 4-vector theory and Whittaker 1903 and 1904, and how to combine them with quantum mechanics and general relativity in a unified field theory.

The above explanation is why Kaznacheyev's { [104] } mitogenetic radiation { [105] } from his control (deliberately damaged or infected) cells would pass through a quartz window and induce the same damage (or disease) in targeted cells on the other side and otherwise environmentally shielded, but would not induce the changes through a normal window glass window. (See again Figure 23) Quartz passes the full optical spectrum from IR to UV, while window glass does not. So quartz passes the *vacuum engines* for the disease or damage, while window glass breaks them up and does not pass them as such. We stress that the vacuum engines are part of the “continuous” aspect of the photons, and so are not bound to any limitation on magnitude (either fineness or largeness) as are the quantized aspects of the photon.

For such a "far beyond the one-tenth wavelength" microscope as Rife’s, one must use vacuum engines (time domain structuring, and longitudinal EM waves) and extraordinary iterative unified field theory optics, rather than the ordinary transverse EM waves and ordinary optics. The lenses must all pass at least one harmonic interval (and the same one!), to provide and utilize the “difference frequency band” needed for recursive *visual* connection to the subquantal state (the hidden virtual structures in terms of the continuity

aspects of photons). Successive stages thus "serial iteration" use the recursive principle to coherently amplify and show the vacuum engines, their dynamics, and the dynamics of deeper organizations and dynamics in the virtual state itself. Since Rife wished to “see” the results in the optical spectrum, then the two frequencies chosen for “differencing” had to bound the visible spectrum.

Rife used quartz lenses or at least very good optical glass that is open from IR to UV. That bounds the visible spectrum with a harmonic interval. Rife used multiple stages for successive coherent recursive amplification and increasing the SNR magnitude by coherent integration. One must also have some scheme for filtering out (or avoiding) too much visible spectrum light. One such scheme is to just use enough stages so that, in the new theory where the wavelength limitation is bypassed, one has amplified ("resolved") to the depth or fineness desired. The process long ago removed itself from the "normal visible light" domain, well before it reached the deeper resolution limit utilized by the definition state of the new method.

By using sufficient multiple stages in this fashion, the "tiny" virtual state vacuum engine templates passing through the IR-UV harmonic interval in a lens can be recursively summed and magnified many, many times—essentially without limit, because the phenomenon being magnified is recursive and bidirectional longitudinal in nature. It is definitely *not* normal visible light optics, and it *is not* conventional classical electrodynamics.

Rife’s Recursive “Vacuum Engine” Microscope

The Rife microscope coherently sums (and thus coherently amplifies) the virtual state vacuum engine patterns with the increasing number of stages. For the *subtle* vacuum engine templates, such an arrangement becomes a direct amplifier (magnifier), for amplifying (magnifying) the internested virtual state vacuum engine templates and their dynamic functioning, into the observable state. With a properly designed “vacuum engine” recursive microscope, one can see

inside a molecule, inside the atomic nucleus, and even inside a nucleon, given development and perfection of the process. However, at this initial stage of understanding, one can forecast that finely adjusting the various stages of an early laboratory prototype would indeed prove to be a tedious and formidable task, just as Rife reported. With further development, however, that obstacle can be removed.

What comes out the output end of such a “vacuum engine” recursive microscope, is a direct visible light *analogue* of the much more subtle ST functioning in the microscope’s highly localized viewing area. This output imaging is put together "electrically" in ways analogous to the construction of a video picture on the screen of a TV tube. Since the result emerges through an output end that still passes an entire harmonic interval bounding the visible spectrum, the amplified virtual state recursive template is not destroyed but is highly amplified and produced as an observable image and dynamics in the visible spectrum. This final "interferometry" of two *internally structured* potential functions now produces "visible light" EM fields and waves and patterns, in accord with Whittaker 1904. These visible patterns are direct analogues representing exactly the very, very minute regions far below the one-tenth wavelength limitation of ordinary optical resolution. Those regions were the regions “being focused onto” when Rife so arduously “adjusted” his microscope's multiple stages.

With Rife’s recursive magnifying microscope process, one can see direct visible analogs of what is actually far, far smaller than anything ever before seen in normal optical microscopes, or even in electron microscopes etc. Indeed, one can see directly into the virtual state itself, and observe virtual state structures. While this is unthinkable in quantum mechanics if one considers only quantized aspects of light, it is perfectly feasible if one considers the concomitant unquantized (continuous) aspects of light, and shifts to general relativity and vacuum engines to utilize the unquantized structuring of the time domain.

Conclusion

Rife unquestionably found a way to produce visible recursive amplification and magnification of invisible virtual state dynamics and functions. We hope we have shed at least some light on the extraordinary technical mechanisms involved. This is good conceptual science, consistent with theory and some known experiments, and it certainly can be made a rigorous science and technology and mathematically modeled, using higher symmetry electrodynamics that is part of a unified field theory such as that of Sachs. The basis for all of it is in the literature already, but it is scattered widely in uncorrelated bits and pieces. It is not in the normal electrodynamics courses, nor is it in the normal optical science curriculum. And it is not taught in the normal physics curriculum. Needless to add, it is absent from the medical curriculum as well.

As an additional proposal, we tentatively suggest that this principle also may be the long-sought "hidden chaos" or "hidden order" in quantum mechanics that is known to be present, but has not yet been explained { [106] }. If so, then it becomes a new law of physics, with the experimental proof first demonstrated by Royal Raymond Rife.

With the conceptual technical matrix of Rife's mechanism in hand, it should be possible for a proper scientific multi-disciplinary team to redevelop and extend the Rife microscope. Marvelous new instruments will emerge, once the quantum physics conceptual blockage of continuous physics is constrained to its place as only "one view of the physics reality elephant." With the ability to directly "measure", "observe," and engineer the virtual state, a breathtaking expansion of physics will occur, dramatically extending the vacuum engineering suggested by Nobelist Lee.

If so, then Rife's tragic life will have served its noble purpose, and his intuitive insight will have been resoundingly verified. The follow-on results will have untold benefit to science and to all the human generations to come.

NOTES AND REFERENCES

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[1] For work on the theoretical aspects of this paper, partial financial support by A. Dreyer, R. Francis, H. Ledger, M. Peters, T. Craddock, and the Association of Distinguished American Scientists (ADAS) is gratefully acknowledged, as are helpful discussions with Dr. Bob Flowers and Dr. Myron Evans.

[2] We emphasize that Rife himself did not think in these terms.

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[1] . (a) Some Rife-related references are: Royal R. Rife, "The filterable virus of carcinoma," Apr. 26, 1939; — "The Rife Microscopes," Apr. 28, 1939; — "Bacteria," Apr. 28, 1939; — "History of the development of a successful treatment for cancer and other viruses, bacteria, and fungi," Allied Industries, Dec. 1, 1953.

(b) Arthur Isaac Kendall and Royal Raymond Rife, "Observations on Bacillus Typhosus in its filterable state," California and Western Medicine, Ca. Med. Assoc., Dec. 1931.

(c) Arthur Isaac Kendall, "The filtration of bacteria," Science, Mar. 18, 1932.

(d) See particularly E. C. Rosenow, “Observations on filter-passing forms…,” Proc. Staff Meeting of the Mayo Clinic, July 13, 1932; — “Observations with the Rife microscope of Filter-passing forms of micro-organisms,” Science, Vol. 76, Aug. 26, 1932, p. 192-193; — "Microdiplococci in filtrates of natural and experimental poliomyelitic virus compared under the electron and light microscopes," Proc. Staff Meeting of the Mayo Clinic, 17(7), Feb. 18, 1942, p. 99-106; — "Observations of filter-passing forms of Eberthella Typhi (Bacillus Typhosus) and of the Streptococcus from Poliomyelitis," Proc. Staff Mtg.

Mayo Clinic 7, July 13, 1932, p. 408-413; — "Transmutations within the Streptococcus-Pneumonococcus Group," J. Infective Diseases, Vol. 14, 1941.

(e) R. E. Seidel and M. Elizabeth Winter, “The new microscopes,” Journal of the Franklin Institute, Feb. 1944, p. 103-129; — "Filterable bodies seen with the Rife microscope," Science Supplement, Science, Dec. 11, 1932, p. 10-11.

(f) "Is a new field about to be opened in the science of bacteriology?", Editorial, California and Western Medicine, Ca. Med. Assoc., Dec. 1931; "Powerful microscope makes very tiny objects visible," Science Newsletter, Vol. 33, Jan. 22, 1938, p. 55; "The Rife microscope or 'facts and their fate'," Reprint No. 4l7, The Lee Foundation for Nutritional Research, Milwaukee, Wisconsin, undated.

(g) A good lay overview is given by Christopher Bird, “What has become of the Rife microscope?”, New Age Journal, Mar. 1976.

(h) See also T. E. Bearden, AIDS: Biological Warfare, Tesla Book Co., 1988, p. 267-279. The author gives a short introduction to the Rife microscope and includes some pictures. The proposed evanescent wave explanation proved to be wrong. Much additional work by the author eventually culminated in the proposed mechanism presented in the present paper.

[2] . We have one viewgraph listing some 32 flaws, errors, and shortcomings of classical electrodynamics, and there are even more than that. Additional errors are listed, for example, by important scientists such as Feynman, Wheeler, Evans, Bunge, Cornille, Barrett, and others. So a substantial number of errors in classical U(1) EM theory are well known to foundations scientists. We discuss only a minimal few in this paper.

[3] . Mario Bunge, Foundations of Physics, Springer-Verlag, New York, 1967, p. 176.

[4] . *Ibid*., p. 182.

[5] . M. Faraday, Experimental Researches in Electricity and Magnetism. Vol. 1, Taylor and Francis, London, 1839.; Vol. 2, Richard & John E. Taylor, London, 1844; Vol. 3, Taylor and Francis, London, 1855. Reprinted by Dover in 1965. Also see M. Faraday, "On Static Electrical Inductive Action," Phil. Mag., 1843; — "Remarks on Static Induction," Proc. Roy. Inst., Feb. 12, 1858.

[6] . James Clerk Maxwell, Preface to the First Edition, A Treatise on Electricity and Magnetism, third edition, Vol. 1, Dover Publications, New York, 1954, p. viii-ix.

[7] . J. C. Maxwell, Preface to the First Edition, A Treatise on Electricity and Magnetism, third edition, Vol. 1, Dover Publications, New York, 1954, p. viii-ix. Quoting: "…*before I began the study of electricity I resolved to read no mathematics on the subject till I had first read through* Faraday's Experimental Researches in Electricity. …*I perceived that his method was also a mathematical one, though not exhibited in the conventional form of mathematical symbols. I also found that these methods were capable of being expressed in the ordinary mathematical forms….*"

[8] . James Clerk Maxwell, A Treatise on Electricity and Magnetism, Third Edition, Vol. 1, Dover Publications, NY, 1954, p. 165-166.

[9] . Else the precessing electrons in a signal-receiving wire antenna would not precess laterally. Since their precession is at right angles to the disturbing force, the disturbance arriving from the vacuum was a longitudinal disturbance. This also agrees with Whittaker's 1903 decomposition of the scalar potential, and Mandl and Shaw's note that the combined scalar photon and longitudinal photon are observable as the instantaneous scalar potential,

while neither of them is observable individually. See citations for Whittaker and for Mandl and Shaw elsewhere in these references.

[10] . This word "potentiality" (by Feynman) is given flesh and blood in the present paper. What actually exists in the vacuum is potential and structures of potential. Vacuum, spacetime, and potential are identities. Hence we may say that the structured vacuum potentials are indeed structurings of spacetime curvature. We refer to these as *vacuum engines*, which are explained in this paper.

[11] . Richard P. Feynman, Robert B. Leighton and Matthew Sands, The Feynman Lectures on Physics, Addison-Wesley, New York, Vol. II, p. 1-3.

[12] . This is easily shown. $F \equiv d/dt(mv)$, which expands to $F = (m)dv/dt + v(dm/dt)$. Let the mass m be zero continuously, and both terms on the right go to zero, hence $F = 0$. That is, the force disappears because mass is a component of force. It is the use in mechanics of the separate massless force acting on a mass that is the non sequitur and to blame for this giant error in electrodynamics as a hold-over from the hoary old mechanics theory.

[13] . J. D. Jackson, Classical Electrodynamics, Second Edition, Wiley, 1975, p. 249.

[14] . Jackson, ibid. p. 28.

[15] . Melba Phillips, "Classical Electrodynamics," Vol. IV: Principles of Electro-dynamics and Relativity, in Encyclopedia of Physics, Edited by S. Flugge, Springer-Verlag, Berlin, 1962, p. 4. Quoting: "The utility for electrical problems of a scalar potential, first introduced in the theory of gravitation, was pointed out by Simeon Denis Poisson, Bull. Soc.

Philomatheique **3**, 388(1813). See also Mem. Institut, Pt. **1**, 1, Pt. **2**, 163 (1811). The word *potential* was introduced by George Green in 1828."

[16] . E.g., see W. Misner, K. S. Thorne, and J. A. Wheeler, Gravitation, W. H. Freeman and Co., San Francisco, 1973, p. 5.

[17] . Two methods of dealing with this problem, and rectifying it, are the use of a topological definition of the fields in mass-free spacetime, and the use of a unified field theory where the "field in space" is not a forcefield per se, but merely a curvature or set of curvatures of spacetime. As an example, the O(3) electrodynamics largely pioneered by Evans takes the latter approach, and it is usable in directly engineering unified field theory effects.

[18] . (a). Mendel Sachs, The Field Concept in Contemporary Science, Charles C. Thomas Publishers, 1973;

(b) — General Relativity and Matter: A Spinor Field Theory from Fermis to Light-Years (Fundamental Theories of Physics), Reidel (now Kluwer), 1982 provides a great generalization of general relativity and electrodynamics reaching from the quarks and gluons to the entire universe. See also

(c) Mendel Sachs, Quantum Mechanics from General Relativity: An Approximation for a Theory of Inertia, Reidel (now Kluwer), 1986;

(d) — "Relativistic Implications in Electromagnetic Field Theory," in T. W. Barrett and D. M. Grimes, eds., Advanced Electromagnetism, World Scientific, 1995, p. 541-559. In the latter, Sachs shows that the most general expression for the field theory is in terms of spinor and quaternion variables, rather than the vector and tensor variables of the conventional expression of Maxwell's theory. This generalized expression leads to extra conservation laws and

invariants, thus increasing the predictive capacity of the theory.

(e) For a marvelous treatise for the educated layman, see M. Sachs, Relativity in Our Time: From Physics to Human Relations, Taylor & Francis, 1993.

[19] . E.g., see the several Evans' reviews in Modern Nonlinear Optics, Second Edition, Edited by M.W. Evans, Wiley, 2002 (in press). Many other O(3) electrodynamics papers are also carried in this set of three volumes, as well as in the standard literature.

[20] . Mendel Sachs, "Relativistic Implications in Electromagnetic Field Theory," ibid.

[21] . Without interaction with the vacuum, mass does not exhibit perfect symmetry. For a discussion, see T. D. Lee, Particle Physics and Introduction to Field Theory, Harwood Academic Publishers, New York, p. 378-389.

[22] . In both classical and quantal electrodynamics, the problem of the source charge and its associated fields and potentials—and their energy—has been considered to be the most difficult problem.

(a) For a solution to that problem, see T. E. Bearden, "Giant Negentropy from the Common Dipole," Journal of New Energy, 5(1), Summer 2000, p. 11-23. On DoE open website http://www.ott.doe.gov/electromagnetic/papersbooks.html and this author's website www.cheniere.org.

(b) For very powerful support of that proposed solution, see F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1984, Chapter 5. Neither the time-polarized photon nor the longitudinal photon is individually observable, yet the combination of the two is observable as the instantaneous scalar potential. The Mandl and Shaw combination of a scalar (time-polarized)

photon and a longitudinal photon is explained by Bearden as the interaction of the causal incoming scalar photon with a charge, the charge subsequently transducing the absorbed energy from the time-domain into 3-space, and re-emission of the energy as an emitted longitudinal photon in 3-space. The actual interaction provides the coupling, and clarifies which is the *cause* and which is the *effect*.

[23] . As the electrodynamicists implicitly assume, by assuming fields and potentials from all charges in the universe penetrating and existing and superposing and interfering in each cubic centimeter of space, and in fact at every point in space. But then the electrodynamicists continue to utilize a material ether assumption in their equations, embedded implicitly upon the notion of an "empty space" filled with this material ether. Tesla called it "… *one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history*." (Nikola Tesla, "The True Wireless," Electrical Experimenter, May 1919). While that biting remark certainly did not endear him to struggling electrical scientists, it did strike uncomfortably close to the mark, and it still does.

[24] . J. H. Poynting, "On the transfer of energy in the electromagnetic field," Phil. Trans. Roy. Soc. Lond., Vol. 175, Part II, 1885, p. 343-361.

[25] . Oliver Heaviside, "Electromagnetic Induction and Its Propagation," The Electrician, 1885, 1886, 1887, and later. This is a series of 47 sections, published section by section in numerous issues of The Electrician during 1885, 1886, and 1887. See also Oliver Heaviside, "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field," Phil. Trans. Roy. Soc. London, 183A, 1893, p. 423-480.

[26] . By a crude analogy, one may think of the "virtual" energy of the vacuum as energy that has been disintegrated into incredibly tiny bits—each so small that the bits fade in and out of existence at an incredible rate. The spinning action of the charge may be thought of as similar to that of an old spinning wheel. The charge spins, so that it coheres some of the "virtual fibers" continually fed to it by the vacuum, into "thread-sized" portions that are emitted radially outward. So the charge "splatters back" some of the fibers as fibers, but "spins" the remainder into useful quantum-sized "threads" which are emitted in observable form.

[27] . Presently electrodynamicists are likely to specify the Poynting energy flow **S** as **S** = **E**×**H**. However, in the vacuum (spacetime) neither **E** nor **H** exists as such *observed force fields*, which requires presence of charged mass. Only potentials and potential structuring of the virtual particle flux exist in the vacuum (which is after all just potential comprised of virtual particle flux). Those structurings or their analogues also exist as sets of curved spacetime regions (i.e., spacetime structurings comprising the elements of the "vacuum engine"). See E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Mathematische Annalen, Vol. 57, 1903, p. 333-355. Whittaker that any scalar potential decomposes into a multiplicity of longitudinal bidirectional flows of energy. This decomposition must also comprise the vacuum scalar potential, as well as the "spacetime curvature" potential.

[28] . However, Whittaker misinterpreted the *causal* phase conjugate wave (that half of his phase conjugate wavepair) as the *effect* after the wave interacts with charged mass, in which case parity is broken and the *effect* wave produced by the interaction is a longitudinal EM wave going in the opposite direction in 3-space from its "biwave" 3-space partner. The correct interpretation is that,

prior to interaction, the phase conjugate wave exists in the fourth axis of Minkowski 4-space, hence is in the time domain. It is literally a longitudinal EM wave moving on the fourth axis (in the time domain) to the interacting charge, and the other Whittaker biwave partner is the effect longitudinal EM wave emitted in 3-space by the interacting charge after it absorbs the incoming time-polarized EM wave. We point out that a longitudinal EM wave along the time axis is a time-polarized EM wave, corresponding to the known time-polarized photon in quantum field theory.

[29] . After publication of my "Giant Negentropy" paper, I discovered very strong support for my reinterpretation of Whittaker's 1903 decomposition of the scalar potential. This support was by F. Mandl and G. Shaw, ibid. Mandl and Shaw give a deeper coverage of the photon polarizations. They argue that the longitudinal and scalar polarizations individually are not directly observable, but only in combination, wherein they manifest as the "instantaneous" Coulomb (i.e., electrostatic) potential. Our comment is that this argument, translated from particle terminology to wave terminology, directly fits my re-interpretation of Whittaker's 1903 decomposition of the scalar potential. However, Mandl and Shaw fail to account for their assumed interaction of the detecting/observing unit point charge to perform the perfectly correlated "combining", and thus fail to account for the absorption of the incoming *causal* time-polarized wave or photon, the transduction of that excitation energy of the charge into longitudinal EM wave/photon energy in 3-space, and the subsequent emission of that excitation energy as a perfectly correlated longitudinal EM wave in 3-space.

Thus Mandl and Shaw missed the time-excitation charging of the source charge via absorption of the "coupled" time-polarized EM wave/photon, and the subsequent decay of the time-charge excited state by emission of a 3-space

longitudinal EM wave/photon. This omitted interaction represents the discovery of nature's giant negentropy mechanism in EM energy flow, whenever 3-space energy flow symmetry is broken, as with a common dipole. So Mandl and Shaw do not account for photon (or wave) polarization transduction, where the "causal" time-polarized EM wave or photon comes in and is absorbed by the detecting charge or dipole to energetically excite it in the time-domain, then the excitation energy is re-emitted as the longitudinally polarized EM wave or photon in 3-space.

Recognition of these missing functions allowed at last a solution to the long-vexing problem of the source charge. We actually solved the problem for a source dipole, then pointed out that any "isolated" charge is a set of dipoles when its clustering virtual charges of opposite sign are considered.

[30] . The source charge problem was recognized as the most difficult problem in electrodynamics. E.g., see D. K. Sen, Fields and/or Particles, Academic Press, London and New York, 1968, p. viii. Quoting: *"The connection between the field and its source has always been and still is the most difficult problem in classical and quantum electrodynamics."* Since our proposed solution is consistent with particle physics (broken 3-symmetry of the dipole) and with quantum field theory (combination of the time-polarized and longitudinal photon comprises the scalar EM potential), it is robust and we believe it will stand up to meticulous scrutiny.

[31] . E. T. Whittaker, 1903, *ibid*.

[32] . Mandl and Shaw, *ibid*.

[33] . Poynting only assumed that diverged part of the energy flow. Heaviside, on the other hand, showed that there is a much larger energy

flow component that misses the intercepting charges (or circuit) altogether, and is wasted. Since this means that far more EM energy flows from the terminals of a generator than the external circuit intercepts and catches, it means that all generators produce more energy flow output than the textbook states, or that Poynting assumed. In fact, as *transducers of vacuum energy*, all dipolar generators already exhibit COP>1.0. Since no one in the 1880s could explain where such an astounding extra energy flow was coming from, Lorentz originated an integration trick to discard the nondiverged Heaviside EM energy flow component.

(a) See J. H. Poynting, “On the transfer of energy in the electromagnetic field,” Philosophical Transactions of the Royal Society of London, Vol. 175, Part II, 1885, p. 343-361.

(b) See Oliver Heaviside, "Electromagnetic Induction and Its Propagation," The Electrician, 1885, 1886, 1887, and later—a series of 47 sections, published section by section in numerous issues of The Electrician during 1885, 1886, and 1887.

(c) See also Oliver Heaviside, "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field," Phil. Trans. Roy. Soc. London, 183A, 1893, p. 423-480.

(d) For Lorentz' trick to discard the nondiverged component, see H. A. Lorentz, Vorlesungen über Theoretische Physik an der Universität Leiden, Vol. V, Die Maxwellsche Theorie (1900-1902), Akademische Verlagsgesellschaft M.B.H., Leipzig, 1931, "Die Energie im elektromagnetischen Feld," p. 179-186. Figure 25 on p. 185 shows the Lorentz concept of integrating the Poynting vector around a closed cylindrical surface surrounding a volumetric element. This is the procedure which arbitrarily selects only a small component of the energy flow associated with a circuit—specifically, the small Poynting component striking the surface charges and being diverged into the circuit to power it—and

then treats that tiny component as the "entire" Poynting energy flow. Thereby Lorentz arbitrarily discarded all that extra Heaviside energy transport component which does not strike the circuit at all, and is just wasted.

[34] . In fact, the simple equation $W = \phi q$, where W is the diverged/collected energy, q is the intercepting coulomb, and ϕ is the reaction cross section of the potential, shows that electrodynamicists implicitly assume the “true” causal potential to contain unlimited energy. E.g., using that equation, any desired amount W of energy can be collected from any nonzero potential ϕ, no matter how small its intensity, simply by adding sufficient intercepting/collecting charges.

[35] . A back-of-the-envelope calculation for a nominal simple circuit has been made and previously presented by the present author. In the nominal circuit used, the source dipole extracts from the vacuum and sends down the outside of the attached circuit about 10^{13} times as much energy as the circuit itself intercepts, diverges, and utilizes. The huge remainder is not intercepted, remains nondivergent and just passes on out into space at the speed of light.

[36] . Solving the standard equation $\mathbf{E} = \mathbf{F}/q$ for $\mathbf{F}$, one has $\mathbf{F} = \mathbf{E}q$. Again, from any nonzero **E**-field, no matter how small, as much force can be “gathered” and produced as one desires, merely by increasing the intercepting/collecting charge q.

[37] . Robert H. Romer, "Heat is not a noun," American Journal of Physics, 69(2), Feb. 2001, p. 107-109. This is an editorial discussion by the Editor of AJP of the concept of heat in thermodynamics. Heat is not a substance, not a thermodynamic function of state, and should not be used as a noun. The quotation castigating the standard "field diagram" of an EM wave in space is

from endnote 24, p. 109.

[38] . This is readily understood when one realizes that the founders of electromagnetics assumed a material ether. So to them, there was not a single point in all the universe where mass was absent! Hence the field, potential, and wave "in space" were actually the field, potential, and wave "in the material ether medium", and therefore perfectly material. Even though the Michelson-Morley experiments falsified the material ether in the 1880s, the electrodynamicists (i) never changed their classical EM equations which still to this day assume the material ether filling all space, and (ii) still implicitly mistake the transverse electron precession wave in the Drude gas in a receiving antenna as representing the assumed interception of the incoming "transverse EM wave" in that external material ether medium.

[39] . Robert Bruce Lindsay and Henry Margenau, Foundations of Physics, Dover Publications, New York, 1963, p. 283-287, and passim.

[40] . Y. Aharonov and D. Bohm, "Significance of Electromagnetic Potentials in the Quantum Theory," Physical Review, Second Series, 115(3), 1959, p. 485-491. However, Aharonov and Bohm seem to have missed the similar mass interpretation of the potential, so that they utilized the potential as massless and therefore the vacuum EM entity that is the primary cause of all EM phenomena. If one truly eliminates only the potential's effect upon the intercepting charged mass, and utilizes the non-intercepted EM entity in vacuum, one has arrived at the direct alteration of the massless spacetime geometry of general relativity. In short, suddenly one has latched onto a unified field theory, and one that is engineerable by surprising electromagnetic means.

[41] . But erroneously assumed to be present, because of Maxwell's ubiquitous use of the material ether and the continued implied material ether in the electrodynamics equations to this day.

[42] . T. W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," Annales de la Fondation Louis de Broglie, 16(1), 1991, p. 23-41. Barrett analyzed Tesla's patented circuits in terms of quaternion electrodynamics, which is of higher symmetry than either vector or tensor algebra electrodynamics. Lo and behold, Tesla could shuttle potential energy around in his circuits at will, and that functioning would not even show up in a tensor or vector electrodynamic analysis.

[43] . T. W. Barrett, "Active Signalling Systems," U.S. Patent No. 5,486,833, Jan. 23, 1996; — Oscillator-Shuttle-Circuit (OSC) Networks for Conditioning Energy in Higher-Order Symmetry Algebraic Topological Forms and RF Phase Conjugation," U.S. Patent No. 5,493,691, Feb. 20, 1996.

[44] . As the reader can appreciate, this represents a dramatic change to the foundations of electrodynamics. It is closely allied to Sachs's unified field theory; see appropriate Sachs references in this paper.

[45] . As Dirac pointed out, the Michelson-Morley experiments of the 1880s destroyed the *material* ether assumed by Faraday and Maxwell and subsequent electrodynamicists; it *did not* destroy the ether per se. Dirac emphasized that any nonmaterial Lorentz-invariant ether is perfectly consistent with the Michelson-Morley experiments. General relativity describes the shaping and structuring of the vacuum as curvatures of spacetime geometry and clustered patterns thereof (although the latter part is essentially neglected). GR consists of the changes

of this spacetime due to the interaction of mass/ trapped energy, and also the forces upon mass/ trapped energy created by the interaction of such curvature-patterns of spacetime. Essentially, electrodynamics is missing just this "mass to spacetime" transform and this "spacetime to mass" transform. It is in fact missing its "infolded general relativity" dynamic internal structuring of the potential, field, and wave. KGB energetics weapon scientists call these missing transforms *the information content of the field*—which our fellows mistakenly interpret in their own flawed electrodynamics as "spectral content." Nothing could be further from the truth.

[46] . In 1903 E. T. Whittaker showed that any scalar potential is comprised of an infinite harmonic series of bidirectional longitudinal EM waves, arranged in bidirectional wavepairs. See E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," Mathematische Annalen, Vol. 57, 1903, p. 333-355.

[47] . General relativity usually stops short of including an "infolded" topology within its basic spacetime, and only applies an "exterior" topology to it. However, it does not exclude that capability. Spacetime is just potential identically, and also just vacuum identically. Since GR omits the infolding structure of spacetime/potential, and so does electrodynamics, it has not been possible to unify the two completely. The "bridge" across the chasm between them has been eliminated by both disciplines.

[48] . With finite propagation, this action-at-a-distance is retarded so that some time passes between the effect and the cause. Each Mandl-Shaw photon interaction—the receipt of the scalar (time-polarized) photon, and emission of 3-space longitudinal photon—is retarded by (requires) the amount of time that is transformed into 3-space energy. [Time may be regarded as 3-space

electromagnetic energy compressed by the factor c^2, with the compressed energy placed on the fourth Minkowski axis to appear as time (seconds), rather than being left in 3-space to appear as mass).

Transformation from time-domain EM energy to 3-space energy is a function of the spin of the charge, which "spins" 720 degrees, being 360 degrees in the time domain while absorbing the time-polarized EM photon energy, the being followed by 360 degrees in 3-space while it is emitting the 3-space longitudinal photon. This retardation due to transformation of the energy from the time domain to the 3-space domain is what limits the speed of light in the ambient vacuum to the finite velocity c.

However, when infinite velocity propagation occurs (as is permissible with longitudinal EM waves alone, which a priori implies no retardation), then the notion vanishes of a “cause” and an “effect” separated by a time interval. In that case, one is operating in a multiply-connected spacetime, where in theory there is no observable “length” or “time” between the “cause” event and the “effect” event. Further, one “causative” initiation point can be superposed simultaneously with multiple distant points widely separated in ordinary spacetime. In that case, putting a joule of energy into the “initiating cause” point (to the normal 3-space observer) results in the simultaneous appearance at each and every distant participating point, of one joule. To the normal "singly-connected spacetime" observer, this is a direct amplification of energy, directly from the vacuum energy itself. We have proposed this mechanism as an extension of Bohm’s quantum potential utilized in his hidden variable theory of quantum mechanics. See David Bohm, "A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden' Variables, I and II," Physical Review, 85(2), Jan. 15, 1952, p. 166-179 (Part I); 180-193 (Part II). Unfortunately three nations of the world have already seen fit to highly weaponize this effect, and a fourth nation is very close to

deploying such a weapon. Presently quantum potential weapons are the dominant weapons on earth, and nothing can stand against them.

[49] . By conjugate pair, we mean that the wavepair consists of an EM longitudinal wave and its time-reversed twin, precisely superposed spatially but antiphased in time. In such a wave, the transverse energy density amplitude cannot vary; instead, the wave consists of (and carries) an oscillation of the rate of flow of time, about some median speed. The median speed of a longitudinal EM wave is not confined to the speed of light in vacuum.

[50] . The value of the energy continuously collected from a steady potential, in a “swirl” around a fixed intercepting charge, is of course a fixed scalar. That, however, has nothing to do with the nature of the potential as an EM entity in massless vacuum, prior to interaction with charged mass.

[51] . J. D. Jackson, Classical Electrodynamics, Second Edition, Wiley, 1975, p. 223.

[52] . Interestingly, one also cannot produce a clear definition of *energy* in physics. A good discussion of the energy concept is given by R. B. Lindsay, "The concept of energy and its early historical development." Foundations of Physics, 1 (4), 1971, p. 383-393. Lindsay investigates the concept of energy from its early historical origin, and covers from ancient times through the 18th century. The root of the concept is the notion of invariance in the midst of change. In short, the concept consists of considering “the changing” as being “nonchanging.” In pursuing a rigorous definition of anything, one eventually arrives at a contradiction of Aristotelian logic. Ultimately one can only define something as identical to its own opposite. Geometry, e.g., models the presence of

mass as the absence of mass. Ultimately a "hard definition" is an "accursed necessity for the identity of opposites"—the centuries-old bane of the philosophers. In physics the problem is avoided by the "duality principle"—just treat an entity as either a particle or wave as necessary, and quit arguing about it! The problem is the incompleteness of Aristotelian logic itself. A solution to the "identity of opposites" problem is obtained by explicitly adding a fourth law of logic that has always been implicitly assumed in Aristotle's three laws. For a discussion, see "A Conditional Criterion For Identity, Leading to a Fourth Law of Logic," Appendix III to T. E. Bearden, Aids: Biological Warfare, Tesla Book Co., 1988, p. 428-443. A simple proof of the fourth law of logic is given in *ibid*., p. 439-440.

[53] . In addition to reference 19, see Myron W. Evans, Enigmatic Photon, Vol. II, Kluwer, ISBN 0792332881. See also Apeiron, 4(2-3), Apr.-Jul. 1997, a Special $B^{(3)}$ Field Issue, Guest editor: Myron W. Evans. In this same issue, see the Introduction by Evans, and also his "Helicity and the Electromagnetic Field." In the same issue, see also Jean-Pierre Vigier, "Relativistic Interpretation (with Non-Zero Photon Mass) of the Small Ether Drift Velocity Detected by Michelson, Morley, and Miller." Barrett has also rigorously shown the reality of the $B^{(3)}$ field, and so the conventional closure against it is doomed to failure. The emergence of $B^{(3)}$ field theory will dramatically alter electrodynamics, and elevate the importance of the longitudinal EM wave. We are also much indebted to Bob Flowers for his penetrating elucidation of the background of the $B^{(3)}$ field in private communications, and to Myron Evans for his patient and encouraging private communications.

[54] . See particularly T. W. Barrett, "Sagnac Effect: A Consequence of Conservation of Action Due to Gauge Field Global Conformal Invariance in a Multiply-Joined Topology of Coherent Fields," in T. W. Barrett and D. M Grimes, [Eds.], Advanced Electromagnetism: Foundations, Theory,

& Applications. World Scientific, River Edge, New Jersey, 07661, 1995, p. 278-313; T. W. Barrett, "Electromagnetic Phenomena Not Explained by Maxwell's Equations," in A. Lakhtakia, (ed.): Essays on the Formal Aspects of Electromagnetic Theory, World Scientific Publishing, River Edge, NJ, 1993, p. 6-86.

[55] . Richard W. Ziolkowski, "Exact Solutions of the Wave Equation With Complex Source Locations," Journal of Mathematical Physics, 26 (4), April 1985, p. 861-863; I.M. Besieris, A.M. Shaarawi, and R. W. Ziolkowski, "A bidirectional travelling plane wave representation of exact solutions of the scalar wave equation," Journal of Mathematical Physics, 30(6), 1989, p. 1254-1269; Rod Donnelly and Richard Ziolkowski, "A method for constructing solutions of homogeneous partial differential equations: localized waves," Proceedings of the Royal Society of London A., Vol. 437, 1992, p. 673-692; — "Electromagnetic field generated by a moving point charge: A fields-only approach," American Journal of Physics, 62 (10), Oct. 1994, p. 916-922.

[56] . M. W. Evans, editor, Modern Nonlinear Optics, Wiley, 2002, 3 volumes (in press).

[57] . W. A. Rodrigues Jr. and J.-Y. Lu, “On the existence of undistorted progressive waves (UPWs) of arbitrary speeds $0 \leq v < \infty$ in nature,” Foundations of Physics, 27(3), 1997, p. 435-508; W. A. Rodrigues Jr. and J. E. Maiorino, “A unified theory for construction of arbitrary speeds ($0 \leq v \leq \infty$) solutions of the relativistic wave equations,” Random Operators and Stochastic Equations, Vol. 4, 1996, p. 355-400.

[58] . E. T. Whittaker, 1903, *ibid*.

[59] . Ironically, Maxwell’s actual theory was some 20 quaternion-like equations in 20

unknowns, as given in "A Dynamical Theory of the Electromagnetic Field," Royal Society Transactions, Vol. CLV, 1865, p 459. Read Dec. 8, 1864. Also contained in The Scientific Papers of James Clerk Maxwell, 2 vols. bound as one, edited by W. D. Niven, Dover, New York, 1952, Vol. 1, p. 526-597. Heaviside dramatically curtailed Maxwell's theory to a vector subset of some 4 equations in 4 unknowns. Lorentz further curtailed it by effectively throwing out all Maxwell-Heaviside systems that were in disequilibrium with their active vacuum and curved spacetime environments. So after over a century, the long slumbering *environmental* dynamics for electrodynamical systems is awakening and chasing its own roots again. Long live the rise of the supersystem!

[60] . E.g., see J. Vaz Jr. and W. A. Rodrigues Jr., "Maxwell and Dirac Theories as an Already Unified Theory," Advances in Applied Clifford Algebras, Vol. 7 (S), 1997, p. 369-386. See W. A. Rodrigues, Jr. and J. Vaz Jr., "Subluminal and Superluminal Solutions in Vacuum of the Maxwell Equations and the Massless Dirac Equation," Advances in Applied Clifford Algebras, Vol. 7(S), 1997, p. 457-466.

[61] . E. T. Whittaker, 1904, *ibid*.

[62] . We strongly stress that longitudinal EM waves and their dynamics, so ignored in all except the most advanced higher symmetry electrodynamics texts, are actually the key to everything. Longitudinal EM waves already comprise, create, and structure the feeble "envelope EM waves" we presently deal with. A longitudinal EM wave is also an electrogravitational wave, and oscillates the rate of flow of time itself because of its combination with a time-polarized wave. The two combined photons have a total spin two, which is a graviton. Thus internally a graviton is revealed as a particular

dynamic between time-domain EM energy and 3-space EM energy. The longitudinal EM wave in the time domain (that is combining with the longitudinal EM wave in 3-space) is thus an oscillation of time contraction and expansion, or "pulsation" in the rate of flow of time. Very powerful gravitational effects as well as very powerful and unique electrodynamics effects can be obtained by use of longitudinal EM waves, because of the additional dynamics between the time and 3-space domains. Unwitting use of such extraordinary EM waves is how Rife and Prioré achieved such remarkable results.

[63] . M. W. Evans, P. K. Anastasovski, T. E. Bearden et al., "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry," Journal of New Energy, 4 (3), Special Issue, Winter 1999, p. 76-78.

[64] . Melba Phillips, “Classical Electrodynamics,” Vol. IV: Principles of Electrodynamics and Relativity, in Encyclopedia of Physics, Edited by S. Flugge, Springer-Verlag, Berlin, 1962, p. 1-108 gives a good overall summary of the superpotential theory.

[65] . A. Righi, Nuovo Cimento, Vol. 2, No. 5, 1901, p. 104.

[66] . P. Debye, Ann. Phys., Leipzig, Vol. 30, 1909, p. 57.

[67] . Thomas John I'Anson Bromwich, An Introduction to the Theory of Infinite Series, MacMillan, London, 1908.

[68] . A. Nisbet, Physica, Vol. 21, 1955, p. 799; Proc. Roy. Soc. Lond. A, Vol. 231, 1955, p. 250.

[69] . W. H. McCrea, “Hertzian electromagnetic

potentials," Proc. Roy. Soc. Lond. A, Vol. 240, 1957, p. 447-457.

[70] . Sachs has achieved the necessary unified field theory, broadly unifying physics from the quarks and gluons to the entire universe, and including both the active vacuum and active, locally curved spacetime. See Mendel Sachs, General Relativity and Matter: A Spinor Field Theory from Fermis to Light-Years (Fundamental Theories of Physics), Reidel (now Kluwer), 1982; — Quantum Mechanics from General Relativity: An Approximation for a Theory of Inertia, Reidel (now Kluwer), 1986. It should be obvious that, unless electrodynamics theory and general relativity theory utilize the same background spacetime, it is impossible to completely merge them, from first principles. Since classical electrodynamics artificially discards its active environment, it is electrodynamics which must be changed in order to be successfully united with general relativity. Sachs has accomplished this long-sought *engineerable* unification.

[71] . Proof that the virtual state can be coherently integrated is already furnished by every source charge in the universe, which does precisely that.

[72] . We note without elaboration that all the mind functions, even of the deepest and most unconscious nature, and even of collective species unconsciousness domains—exist electromagnetically in the infolded EM domain. The "conscious mind" is a serial processor, though extremely rapid. The unconscious is a massively parallel processor. The reason the conscious mind cannot "directly see" the unconscious is that "seeing" innumerable things in the "single snapshot" at once, just obliterates all singular discrimination because of the intense summation. Mind functions are timelike, so consist of specialized structures, functioning, and dynamics

inside the time domain. Since the infolded structuring captures this entire domain, it also involves a physics of mind and matter interaction, but as a science instead of as a mysticism. In theory vacuum engines are also possible that engineer the mind at any and all levels. We have addressed this extended physics of mind and matter reactions elsewhere and do not address it here. The Russian weapon scientists refer to this mind area (which can also be engineered by novel electrodynamic means) as psychoenergetics.

[73] . R. O. Becker and David G. Murray, "The electrical control system regulating fracture healing in amphibians," Clinical Orthopaedics and Related Research, Vol. unk, No. 73, Nov.-Dec. 1970, p. 169-198. This is the definitive technical exposition by Becker of his electrical findings about the cellular control system.

[74] . See particularly Robert O. Becker, “The direct current control system. A link between environment and organism,” New York State Journal of Medicine, Vol. 62, 1962, p. 1169-1176; — and Joseph A. Spadaro, "Electrical stimulation of partial limb regeneration in mammals," Bulletin of the New York Academy of Medicine, Second Series, 48(4), May 1972, p. 627-641; — and Carlton F. Hazlewood, Abraham R. Liboff, and Jan Walleczek, Electromagnetic Applications In Medicine," NIH-OAM Electromagnetics Panel Report, Jan. 15, 1993; — "A technique for producing regenerative healing in humans," Frontier Perspectives, 1(2), Fall/Winter 1990, p. 1-2; — and Andrew A. Marino. Electromagnetism and Life, State University of New York Press, Albany, NY, 1982; — and Gary Selden, The Body Electric, William Morrow and Company, New York, 1985; — Cross Currents, Jeremy P. Tarcher, Inc., Los Angeles, 1990; — "The bioelectric field pattern in the salamander and its stimulation by an electronic analog," IRE Transactions on Medical Electronics, Vol. ME-7, July 1960, p. 202-207; —

"Some observations indicating the possibility of longitudinal charge-carrier flow in peripheral nerves," Biological Prototypes and Synthetic Systems, Plenum Press, New York, 1962, p. 31-37; — and W. Slaughter, "The longitudinal direct current gradients of spinal nerves," Nature, Vol. 196, Nov. 17, 1962, p. 675-676; — and Charles H. Bachman and Howard Friedman, The direct current (control) system: A link between the environment and the organism," New York State Journal of Medicine, Vol. 62, April 15, 1962, p. 1169-1176; — "The direct current field: A primitive control and communication system related to growth processes," Proceedings of the. XVI International. Congress of Zoology, Washington, D.C., Vol. 3, 1963, p. 179-183; — "The neutral semiconduction control system and its interaction with applied electrical current and magnetic fields," Proc. 11th International. Cong. Radiol., Amsterdam, Excerpta Medica Foundation, 1966, Series 105, p, 1753-1759; — "The bioelectric factors in amphibian limb regeneration," The Journal of Bone and Joint Surgery, Vol. 43-A, No. 5, July 1961, p. 643-656; — and David G. Murray, "A method for producing cellular dedifferentiation by means of very small electrical currents," Transactions, New York Academy of Sciences, 29(5), Mar. 1967, p. 606-615.

[75] . The ultimate tool for use in seeing and working with this "infolded" or "internal electrodynamics inside normal EM fields, waves, and potentials will probably be the Fogal semiconductor when it goes into production in the near future. Fogal's transistors are capable of (1) infolding the desired longitudinal EM waves inside normal EM signals (he demonstrates infolding TV signals inside pure DC potentials, and transmitting them over conductors as pure DC potentials for appreciable distance, then using his semiconductors to again extract the "infolded" hidden TV signals.

[76] . See Vlail Kaznacheyev, "Electromagnetic

Bioinformation in Intercellular Interactions," Psi Research, 1(1), Mar. 1982, p. 47-76; — *et al*., "Distant intercellular interactions in a system of two tissue cultures," Psychoenergetic Systems, 1 (3), Mar. 1976, p. 141-142; "A Comment" by William A. McGarey, p. 143; "A Comment" by Arthur C. Hastings, p. 143-144, — *et al*., "Apparent information transfer between two groups of cells," Psychoenergetic Systems, 1(1), Dec. 1974. See particularly Vlail P. Kaznacheyev and L. P. Mikhailova, Ultraweak Radiations in Intercellular Interactions [in Russian], Novosibirsk, 1981; "Electromagnetic Bioinformation in Intercellular Interactions," Novosibirsk, 1981 [in Russian]; V. P. Kaznacheyev, "Information Function of Ultraweak Light flows in Biological Systems," Problems in Biophysics, Novosibirsk, 1967, p. 7-18 [in Russian].

[77] . Some years ago we documented this disease-inducing "microwave radiation of the U.S. Embassy, explained its purpose and operational mechanism, and published it. E.g., see T. E. Bearden, AIDS: Biological Warfare, Tesla Book Co., Chula Vista, CA, 1988.

[78] . See Robert C. Mallieu, A Model of the Microwave Intensity Distribution Within the U.S. Embassy, Moscow 1966-1967, Report FS-80-166, Applied Physics Laboratory, Johns Hopkins University, Baltimore, Maryland, Aug. 1980. Also see Microwave Radiation at the U.S. Embassy in Moscow and Its Biological Implications: An Assessment, U.S. Department of Commerce, Doc. # NTIA-SP081-12, Mar. 1981. Also see Captain John D. LaMothe, Controlled Offensive Behavior—USSR, Report ST-CS-01-169-72, Defense Intelligence Agency, Washington, D.C. (released under FOIA). See also Captain John D. LaMothe and Mr. Louis Maire, Soviet and Czechoslovakian Parapsychology Research, Report DST-1810S-387-75, Defense Intelligence Agency, Washington, D.C. (Released under FOIA).

[79] . T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," Journal of New Energy, 3(2/3), 1998, p. 12-28. A slightly updated and extended version is published in Explore, 8(6), 1998, p. 7-16.

[80] . C. W. Misner, K. S. Thorne and J. A. Wheeler, Gravitation, W.H. Freeman and Co., San Francisco, 1973, p. 5, 19-21, 71-72, 163-165, 390-391, 399; 367-369.

[81] . T. D. Lee, Particle Physics and Introduction to Field Theory, Harwood, New York, 1981. See particularly Chapter 25: Outlook, "Possibility of Vacuum Engineering," p. 824-828.

[82] . David J. Bohm, "A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden' Variables, I and II," Physical Review, 85 (2), Jan. 15, 1952, p. 166-179 (Part I); 180-193 (Part II).

[83] . I.e., the rate of flow of time, or more specifically, the rate of the EM interactions with a mass or particle that generate the flow of the mass or particle through time. See Figure 25. Nobelist Lee has also shown that time is a discrete dynamical variable across all of physics, from quantum mechanics to nonrelativistic field theory, to relativistic quantum field theory. See T. D. Lee, "Can Time Be a Discrete Dynamical Variable?", Physics Letters, 122B(3, 4), Mar. 10, 1983, p. 217-220. Also in T. D. Lee, Selected Papers, Gerald Feinberg, Ed., Birkhauser, Boston, 1986, Vol. 3, p. 77-80. So we have not hesitated to consider time as any other variable, and the fourth Minkowski axis as any of the other three axes with respect to EM energy, fields, potentials, and waves.

[84] . Indeed, there is no such unique thing as “the gravitational field” anyway! The gravitational field is a conglomerate of other field energies and

functions, not a separate field of nature. See A. A. Logunov and Yu. M. Loskutov, "Nonuniqueness of the predictions of the general theory of relativity," Sov. J. Part. Nucl., 18(3), May-June 1987, p. 179. See C. W. Misner, K. S. Thorne and J. A. Wheeler, Gravitation, W.H. Freeman and Co., San Francisco, 1973, p. 399. Quoting*: "The terms 'gravitational field' and 'gravity' refer in a vague, collective sort of way to all of these entities. Another, equivalent term for them is the 'geometry of spacetime'."* See also A. D. Sakharov, "Vacuum Quantum Fluctuations in Curved Space and the Theory of Gravitation," Soviet Physics Doklady, Vol. 12, No. 11, 1968, p. 1040-1041 [English translation.]. Finally, see our remarks under reference 62 above, particularly with respect to the proposed internal electromagnetic dynamics of the graviton.

[85] . A 1993 study by the Office of Technology Assessment, delivered to Congress, showed that a single terrorist in a small plane, with a tank of anthrax spray, and dispersing the spray as he flew around the greater Washington D.C. area on a calm night, would produce between 1 and 3 million casualties. Most of those casualties would die. So a single biological warfare (BW) strike in one U.S. metropolitan area could easily kill two million Americans. As an example, Saddam Hussein is known to have the terrorist teams and the anthrax, and he has had a decade since the Gulf war to insert additional teams and biological warfare agents into the U.S. Presently this is rated by our government as the strongest strategic threat to the U.S., after which comes nuclear strikes, followed by chemical agent strikes. Redevelopment of the Prioré approach, e.g., could easily save the lives of 90% of that nominal two million dead Americans. As matters stand now, triage would apply and almost all of those two million stricken Americans would die.

[86] . In 1998 we proposed a crash development of this kind of device in 1998, with copies to DoD,

NIH, CDC, the USAF, etc.; in T. E. Bearden, Energetics: Extensions to Physics and Advanced Technology for Medical and Military Applications, CTEC Proprietary, May 1, 1998, 200+ page inclosure to CTEC Letter, "Saving the Lives of Mass BW Casualties from Terrorist BW Strikes on U.S. Population Centers," to Major General Thomas H. Neary, Director of Nuclear and Counterproliferation, Office of the Deputy Chief of Staff, Air and Space Operations, HQ USAF, May. 4, 1998. Also to Gen. (Ret.) Walter Busby, Deputy Secretary of Defense for Counterproliferation and Chemical and Biological Defense, March 21, 1998. Also to NIH, CDC, and several other U.S. government agencies.

DoD replied that it was not documented in the literature (a specific list of exact scientific papers reporting the results of the Prioré team's experiments and the experiments of Becker was included; no one seemed to read it). CDC and the USAF did not reply. NIH first responded (from its Policy section—read, *spin control* section) that, since I mentioned the cause of the Gulf War Disease and how it was induced, it was not a matter of their interest but of DoD's interest, and so they just shipped it to DoD and got rid of it. A second response evoked from NIH on query from my congressman (again, a response from their *policy* section) directed me to their proposals section. I don't believe a single qualified scientist even read it. DoD weakly replied that it was not documented in the literature (a specific list of citations from the hard French scientific literature, reporting the astounding results of the Prioré treatments, was included, which apparently no one read).

Not a single scientist from any agency called me to discuss the revolutionary and proven results obtained by Prioré, and documented in the attachments and in the cited literature. Sadly, it seems that no one had the foggiest notion what I was talking about, and no one much cared. My conclusion was and is that my own government bureaucrats do not give a tinker's dam about saving

millions of American casualties in the coming debacle, *if it has to be done by "out-of-the-box" methods not approved by the big drug industry*. Yet these are the same officials that readily admit the exact threat I referred to, admit that it is a matter of *when* the biological warfare attacks will occur and not *if*, and admit that right now they have no effective way to cope with it or save most of those coming millions of Americans that are going to just be dragged aside to die.

My response is that the American taxpayers are certainly not getting their money's worth from the billions they shower on our medical research community. It is unconscionable to ignore for over 30 years the demonstrated and astounding results achieved by eminent French scientists—such as Pautrizel, a world-renowned parasitologist and Courier, head of the French Academy's Biological Section, and also *Secretaire Perpetuel* of the Academy) working with the Prioré team, in curing terminal tumors etc. in thousands of lab animals, all properly documented in the hard French scientific literature.

In my view, considering the certainty of those future American mass deaths, it is akin to high treason. Whether our scientific community realizes it or not, today's strategic war of massive strategic strikes has shifted to our civilian populace, and to our cities and mass population centers. It is our civilian populace that will sustain the greatest and most prompt casualties, and probably will receive the first massive strikes, totally by surprise.

The first phase of WW III—delivery of the strategic weapons to their strategic targets—has already been accomplished. Large Russian nuclear weapons are already hidden in our major cities and population centers (read Lunev's book, he tells us how they brought in these weapons), the Spetznaz teams are here to detonate them on call, multiple nations such as Iraq, Libya, and Iran already have terrorists agents in country in the U.S. with anthrax and smallpox in hand to be released, and Castro guerrillas and trained saboteurs have been trained

in Southern Mexico and infiltrated across the border into the U.S. for decades.

Whether they like it or not, U.S. scientists have thus become the major front line "soldiers" and "defenders" of our nation. And frankly, they have failed abominably in their responsibility, and most do not seem to care. For a startling and even shocking characterization of our present scientific community, the reader is referred to Daniel S. Greenberg, Science, Money, and Politics: Political Triumph and Ethical Erosion, University of Chicago Press, 2001.

[87] . As we stated, just such an attack is now officially the greatest strategic threat to the United States. Second is a nuclear attack, followed by chemical attack as a distant third. E.g., see Richard K. Betts, “The New Threat of Mass Destruction,” Foreign Affairs, 77(1), Jan./Feb. 1998, p. 26-41. For the ineffectiveness of our defenses against the coming mass biological warfare strikes, see Laurie Garrett, The Coming Plague: Newly Emerging Diseases in a World Out of Balance, Farrar, Straus and Giroux, New York, 1994; — "The Nightmare of Bioterrorism," Foreign Affairs, 80(1), Jan./Feb. 2001, p. 76-89; — Betrayal of Trust: The Collapse of Global Health, Hyperion, New York, 2000.

[88] . Becker, *ibid*.

[89] . A full account of the entire Prioré affair is given in Jean-Michel Graille, Dossier Prioré: Une Nouvelle Affaire Pasteur [The Prioré Dossier: A New Pasteur Affair?], De Noel, Paris, 1984. [in French]. A summary account is given by Christopher Bird, "The Case of Antoine Prioré and His Therapeutic Machine: A Scandal in the Politics of Science," Appendix I in T.E. Bearden, AIDS: Biological Warfare, Tesla Book Co., P.O. Box 121873, Chula Vista, California 91912, 1988. Prioré's doctoral thesis (in my personal possession courtesy of Professor Courrier and the late Chris Bird), was rejected by the University of Bordeaux

when the French government suppressed the Prioré program in the mid-70s; it is A. Prioré, Guérison de la Trypanosomiase Expérimentale Aiguë et Chronique par L'action Combinée de Champs Magnétiques et D'Ondes Electromagnétiques Modulés. [Healing of intense and chronic experimental trypanosomiasis by the combined action of magnetic fields and modulated electromagnetic waves], 1973. Prioré's patents are: A. Priore, "Apparatus for producing radiations penetrating living cells," U.S. Patent No. 3,368,155, Feb. 6, 1968; — "Method of producing radiations for penetrating living cells," U.S. Patent No. 3,280,816, Oct. 25, 1966; — "Procede et dispositif de production de rayonnements utilisables notamment pour le traitement de cellules vivantes," [Procedure and Assemblage for Production of Radiation Especially Serviceable for the Treatment of Living Cells], Republique Francais Brevet d'Invention P.V. No. 899.414, No. 1,342,772, Oct. 7, 1963. Eleven years after Priore's thesis was rejected, the same university awarded a doctoral thesis to a young graduate. It is Eric Perisse, Effets des Ondes Electromagnètiques et des Champs Magnètiques sur le Cancer et la Trypanosomiase Experimentale [Effects of Electromagnetic Waves and Magnetic Fields on Cancer and Experimental Trypanosomias], Doctoral thesis, University of Bordeaux No. 83, March 16, 1984.

[90] . F. A. Popp *et al.*, "Biophoton Emission (Multi-Author Review)," Experientia, Vol. 44, 1988, p. 543-600; — "Biophoton emission: New evidence for coherence and DNA as a source," Cell. Biophys., Vol. 6, 1984, p. 33-52; — "Physical aspects of biophotons." Experientia, Vol. 44, 1988, p. 576-585; — Recent Advances in Biophoton Research and its Applications, World Scientific Publishing Co., New York, NY, 1992; F. A. Popp, "Photon Storage in Biological Systems," in Fritz Albert Popp *et al.*, eds., Electromagnetic Bio-Information: Proceedings of the Symposium,

Marburg, Federal Republic of Germany, Sep. 5, 1977; Urban & Schwarzenberg, Baltimore, 1979, p. 123-149.

[91] . David M. Rorvik, "Do the French have a Cure for Cancer?", Esquire Magazine, July 1975, p. 110-111, 142-149.

[92] . Arguably the best introduction to nonlinear optical phase conjugation is David M. Pepper, "Nonlinear Optical Phase Conjugation," Optical Engineering, 21(2), March/April 1982, p. 156-183. Another very good presentation is Amnon Yariv, Optical Electronics, 3rd Edition, Holt, Rinehart, and Winston, New York. 1985, Chapter 16: “Phase Conjugate Optics – Theory and Applications.”

[93] . A beautiful example of this “precise backtracking” of the time-reversed wave is given in David M. Pepper, "Applications of Optical Phase Conjugation," Scientific American, 254(1), Jan. 1986, p. 74-83. See particularly the striking photographic demonstration of time reversal of disorder on p. 75.

[94] . We presented some general elements of this dramatic new extension to nonlinear optical phase conjugate pumping and to general relativity, at a graduate seminar, “On the Theory and Principles of EM Systems with COP>1.0”, given to interested graduates and faculty of the University of Louisville, on Nov. 20, 1997.

[95] . E.g., see Owen Flynn, "Parametric arrays: A new concept for sonar," Electronic Warfare Magazine, June 1977, p. 107-112.

[96] . This method of increasing signal-to-noise ratio and pulling hidden signals right up out of the noise, is widely used in signal processing in modern radars. Often signals buried more than 100

dB below the noise level are routinely "pulled out of the noise" and detected, using various forms of coherent summation.

[97]. Any potential decomposes into multiple wavepair sets. In each hidden wavepair, each of the two waves further decomposes into two potentials. Each of *those* potentials then further decomposes into multiple wavepair sets. And so on *ad infinitum*. Or one can start with any wave, decompose it into two potentials, each of those potentials into multiple biwave sets, and so on.

[98]. "Fractal" means self-similarity at all levels, so that patterning or "decomposition" at one level is similar to that at the higher and lower levels. For good overview discussions and applications, see particularly Gregoire Nicolis, "Physics of far-from-equilibrium systems and self-organization," and Joseph Ford, "What is chaos, that we should be mindful of it?", both in The New Physics, Paul Davies, editor, Cambridge University Press, Cambridge and New York, 1989, p. 316-347 and 348-371 respectively. More detailed technical references are cited in each article.

[99]. See Trevor James Constable, "You, Too, Can Photograph UFOs from Airliners," Psychic Observer and Chimes, 37(3), May-June 1977; — The Cosmic Pulse of Life, Merlin Press, Santa Ana, CA, 1976.

[100]. The present author has two beautiful ultraphotographs taken by Joe Gambill using the special filtering approach. One is a photograph of a room, but with its contents of *two weeks earlier*, showing the room prior to the time the photograph was taken. The other is of a "ghost" form—very similar to a photograph obtained by George Meek under rigorous laboratory conditions—and clearly showing the energy form of a "haunted" lady's dead husband. The *interpretation* of these photographs

is of course open to scientific dispute, but the *photographs themselves* are impeccable and real.

[101] . Meek used filters open to UV and IR but opaque to the visible spectrum, on the fluorescent lights in his laboratory. He also used similar filtering on the camera lenses and camera flashes. Under rigorous laboratory conditions, in several thousand photos of the living body Meek was able to take a few highly anomalous photos completely inexplicable by normal science. E.g., he photographed a purported "ghost" and obtained a clear shot of energy streaming associated with a living person. He also photographed the legs of a chair, right through the suddenly "missing" legs of the person sitting in the chair. Again, interpretation is open to dispute, but the photographs are rigorous and real.

[102] . Bill Fogal's patented charge-blocking semiconductor—U.S. Patent Numbers 5,196,809 and 5,430,413—is capable under certain circumstances—and by clever adaptation—of amplifying virtual state information, in a manner somewhat similar to Rife's methodology, but far more easily engineered. When the process works, Bill reports that a clear photograph or video camera shot can be taken right through a solid brick wall, of the hidden scenery beyond. In electrodynamics, in a dielectric absorbing or emitting EM radiation (energy), the entire dielectric participates in each absorption and emission. Emitted light from an object thus carries an astoundingly complete set of little virtual state vacuum engines rigorously representing every part of the object, no matter how small, and all the internal dynamics. This means that the light from the scene beyond the wall strikes the wall on the other side, affecting all the material in the wall, including upon the observer's side, and inserting "dimensioning" from the scene beyond the wall. When light is emitted from the observer's side, the information content of the field representing the scene on the far side, is also part of

the information content of the field in the light emitted from the observer side of the wall and striking the camera and the observers eyes. This "dimensioning" continues in the signals in the camera and on through attached electronic circuitry. Since Fogal's semiconductor can process such information content of the field in the proper circuitry and under favorable circumstances, the phenomenon is therefore permissible and can be technically explained. Using his transistor to transduce the dimensioned information into the visual band, Fogal *can* view a distant scene right through an intervening wall, when he gets everything "just right." At this stage of development, however, the process and adjustment are difficult, just as Rife experience with his microscope. We are convinced that the forthcoming advent of Fogal semiconductors will revolutionize the study and treatment of disease and bodily disorders.

[103] . However, highly advanced electrodynamics does consider the photon with far greater complexity than nuclear engineers such as the present author were introduced to! E.g., a deep discussion of photon polarization is given in F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1984 under the heading "covariant quantization of the photon propagator" in Chapter 5. As pointed out by Bob Flowers in a private communication, Mandl and Shaw argue that the longitudinal and scalar polarizations are not directly observable, but only in combination, where the combination manifests as the "instantaneous" Coulomb (i.e., electrostatic) potential. Most such books do argue that the extra components of the photon remain hidden, as does the virtual state. In this paper we have revealed how Rife discovered a process by means of which the virtual state can be observed in great detail.

[104] . V. P. Kaznacheyev, "Electromagnetic Bioinformation in Intercellular Interactions," Psi

Research, 1(1), Mar. 1982, p. 47-76; — "Information Function of Ultraweak Light Flows in Biological Systems," in Problems in Biophysics, Novosibirsk, 1967, p. 7-18 [in Russian]; — and L. P. Mikhailova, Ultraweak Radiation in Intercellular Interactions, [in Russian], Novosibirsk, 1981; — *et al*., “Apparent information transfer between two groups of cells,” Psychoenergetic Systems, 1(3), Mar. 1976; — *et al*., "Distant intercellular interactions in a system of two tissue cultures," Psychoenergetic Systems, 1(3), Mar. 1976, p. 141-142; "A Comment" by William A. McGarey, p. 143; "A Comment" by Arthur C. Hastings, p. 143-144.

[105] . Mitogenetic radiation was studied prior to WW II by Gurwich (spelling varies). See A. Gurwitsch and L. Gurwitsch, "L'Analyse mitogenetique spectrale [The Analysis of the mitogenetic spectrum]," in Andre Mayer, Exposés de Physiologie, [Studies in Physiology], Hermann & Cie, Paris, 1934. Part IV. [In French]. Studies have continued by Popp and others. E.g., see F. A. Popp *et al*., "Biophoton Emission (Multi-Author Review)," Experientia, Vol. 44, 1988, p. 54 3-600; — "Physical aspects of biophotons." Experientia, Vol. 44, 1988, p. 576-585; — "Biophoton emission: New evidence for coherence and DNA as a source," Cell. Biophys., Vol. 6, 1984, p. 33-52. See Fritz Albert Popp; Ke-hsueh Li, and Qiao Gu, [eds.], Recent Advances in Biophoton Research and its Applications, World Scientific Publishing Co., New York, NY, 1992.

[106] . The conventional quantum mechanics assumes that, at the microscopic level, variation (e. g., in the probabilities assigned to interpret what is propagating in the Schrödinger equation) is assumed to be random. However, there is a problem. Big things must be made of little things. If we sum a set of "random" things based on Gibbs thermodynamics statistics, we cannot and will not get an organized "big thing" because we have

assumed total disorder (randomness) *a priori*. Adding heat does not produce cooling! So one falsifies the prevailing interpretation of quantum mechanics, whenever one observes a tree, a flower, the sun, or a human being. In short, there must exist a great unifying principle in nature of a coherent summation, from the "unobservable" virtual state to the observable state. Only in that fashion can there be an macroscopic order at all—and such macroscopic order is universally observed. We believe that the principle we have elucidated, as experimentally produced by Rife, may well be that long-sought universal ordering principle that is so sorely needed by quantum mechanics. Readers interested in the "missing quantum chaos" problem are referred to P. V. Elyutin, "The Quantum Chaos Problem," Sov. Phys. Usp., Vol. 31, No. 7, 1988, p. 597-622. Elyutin discusses the crisis in quantum mechanics because of the missing hidden order. Quantum mechanics is known to be wrong unless this order can be found, because otherwise it does not predict the ordered macroscopic universe. Other useful references are Ilya Prigogine, with T. Petrosky, "Quantum Chaos, Complex Spectral Representation and Time-Symmetry Breaking," Chaos, Solitons, and Fractals, Vol. 4, 1994, p. 311-359; and Robert Pool, "Quantum Chaos: Enigma Wrapped in a Mystery," Science, 243(4893), 1989, p. 893-895.

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Figure 2. Royal Raymond Rife adjusts his microscope.

Figure 3. Faraday omitted the string holder for his taut string, thus omitting half the electrodynamics and half the energy. An equal-and-opposite Newtonian third law reaction wave always appears in our transmitters and receivers, caused by the omitted wave.

Figure 4. Drude gas gyroelectrons in the receiving antenna precess laterally, providing the detected transverse wave and proving the vacuum disturbance wave to be longitudinal.

Figure 5. The magnitude of the causal potential in massfree space is erroneously defined.

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The Tom Bearden Website

Rife's Microscope

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(Thanks to the donor of these photographs, who wishes to remain anonymous)

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Figure 1. Rife's microscope.

Figure 2. Royal Raymond Rife adjusts his microscope.

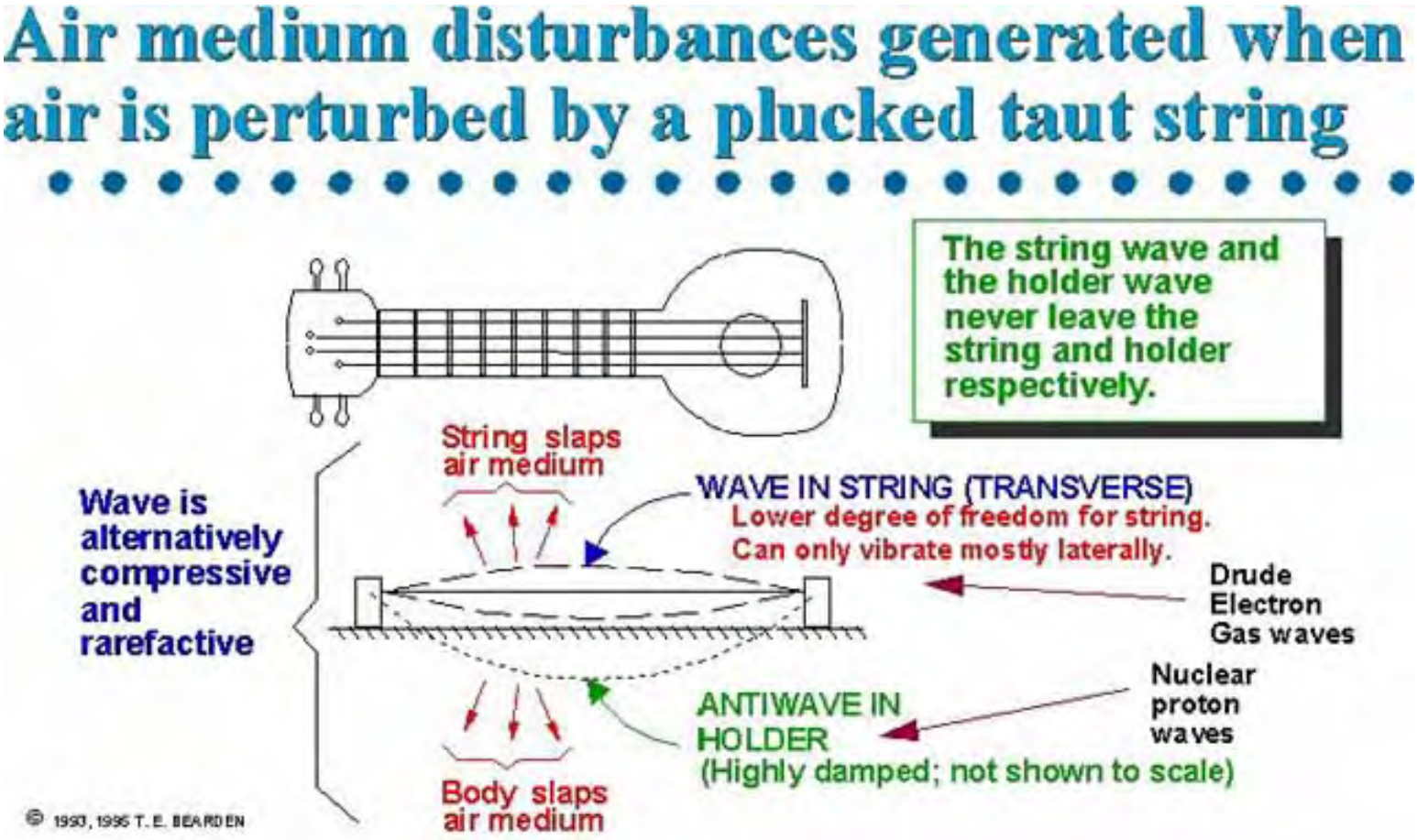

Figure 3. Analogy of the "taut string holder" omitted by Faraday.
This omitted half the electrodynamics (including in Maxwell's capture of Faraday's notion) and half the EM energy. An equal and opposite Newtonian 3rd law reaction does appear in our transmitters and receivers.

Flow of current and energy into, through, and along a conductor

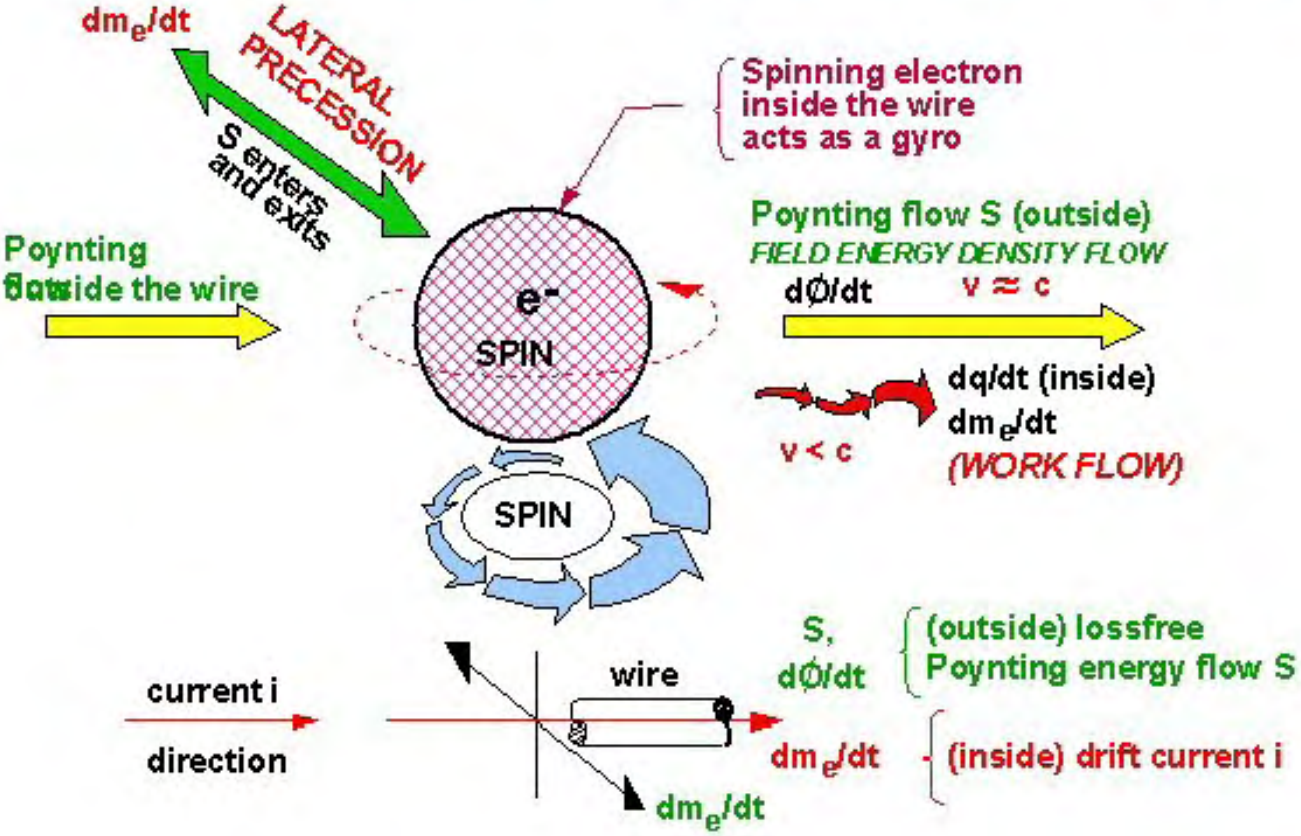

Figure 4. Receiving gyroelectrons precess laterally, providing the detected transverse wave and proving the incoming vacuum disturbance to be longitudinal.

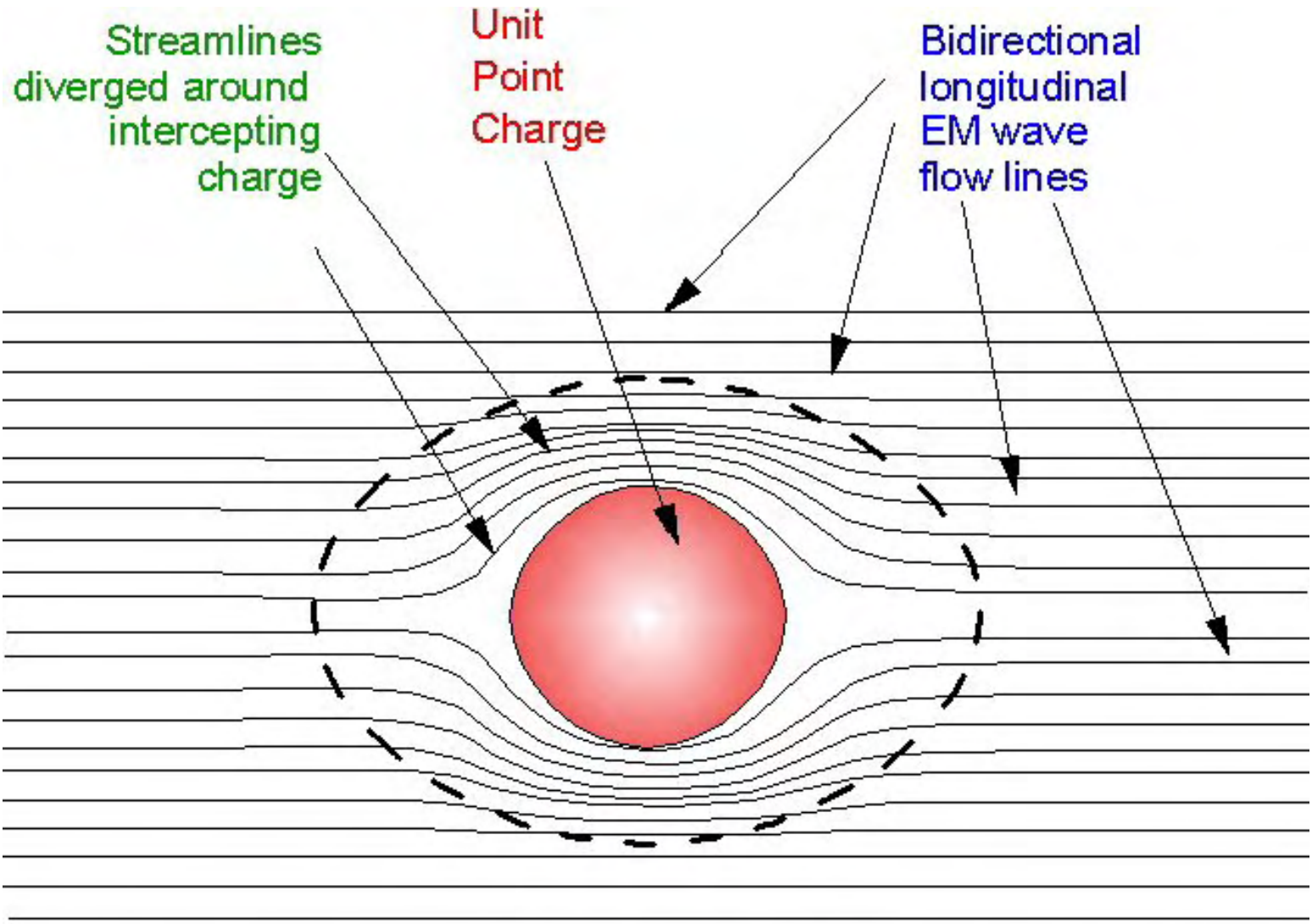

Figure 5. The defined "magnitude of the potential" is not such at all, but is the magnitude of the energy in the diverged flow streamlining around a unit point charge at each point in space where the potential is present.

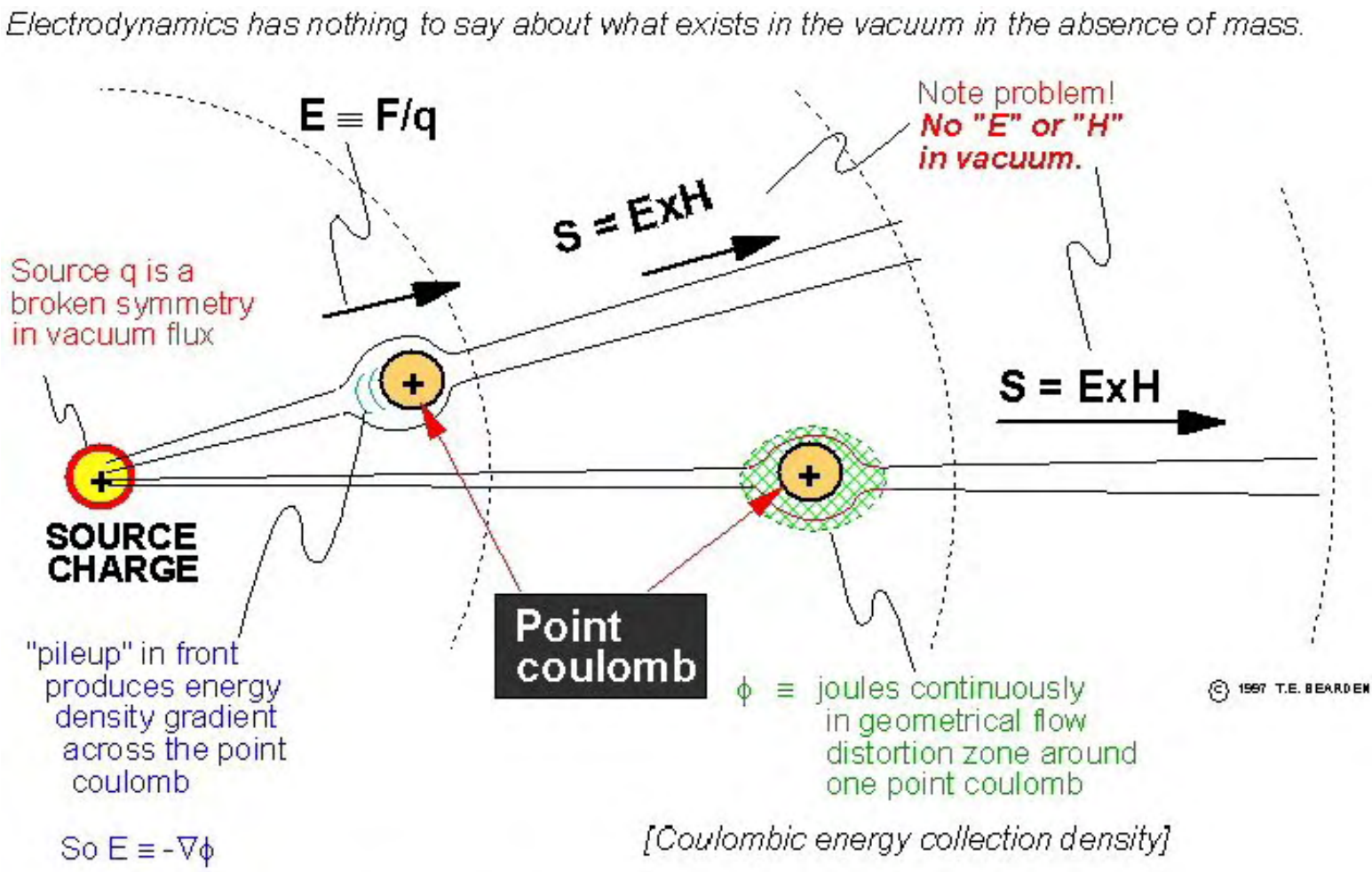

Figure 6. Fields and potentials are defined in terms of the Poynting disruption of the overall energy flow from the source charge, about an intercepting and "collecting" charge. Rigorously, *as defined* E and H exist only in and on charged matter. The magnitude of the diverted water swinging around a fixed rock in a river, is not the magnitude of the river.

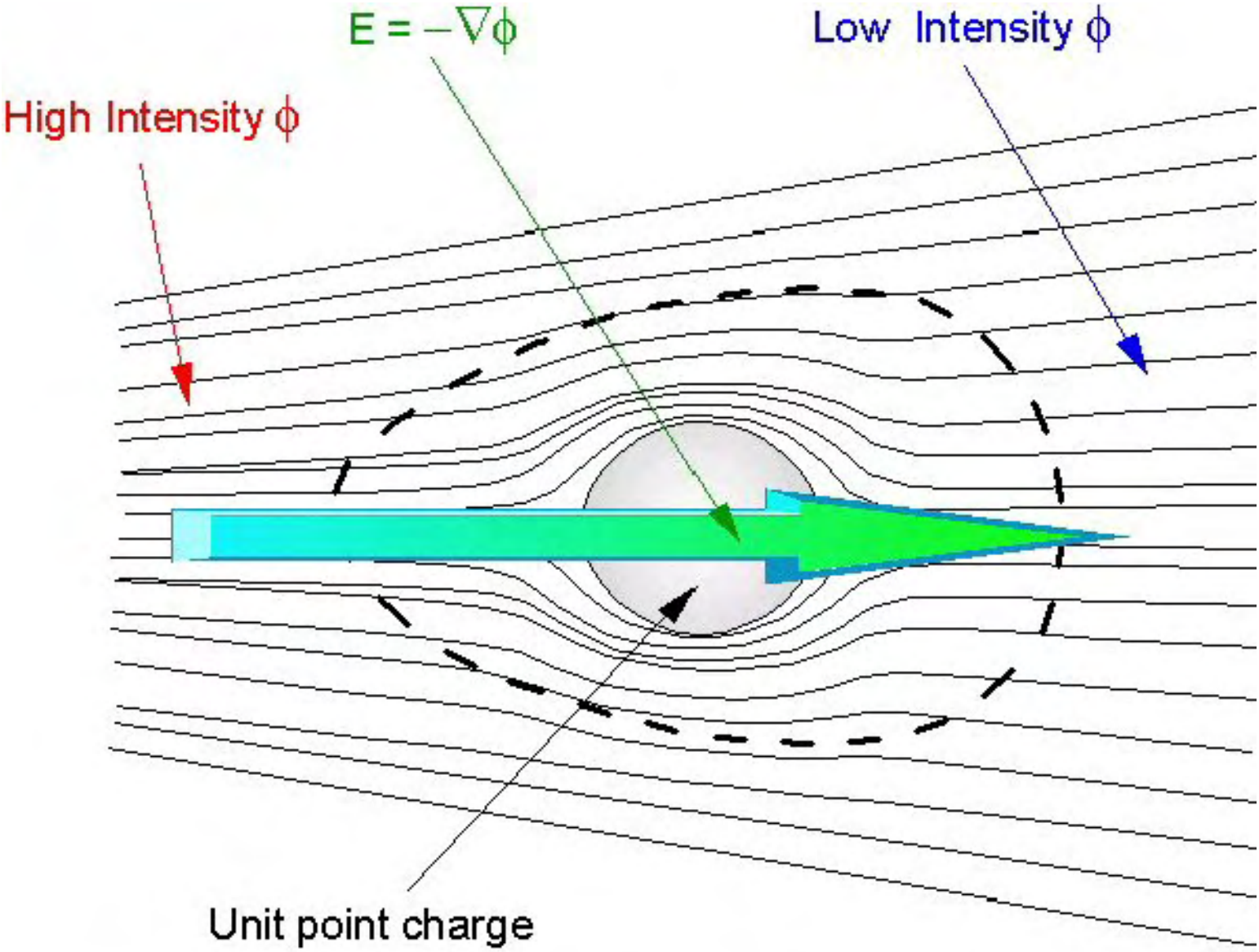

Figure 7. The defined "magnitude of the field" depends on the change in intensity of the flows comprising the potential. The E-field is oriented from high (pressure) in the flow to low (pressure) in energy density over a unit length.

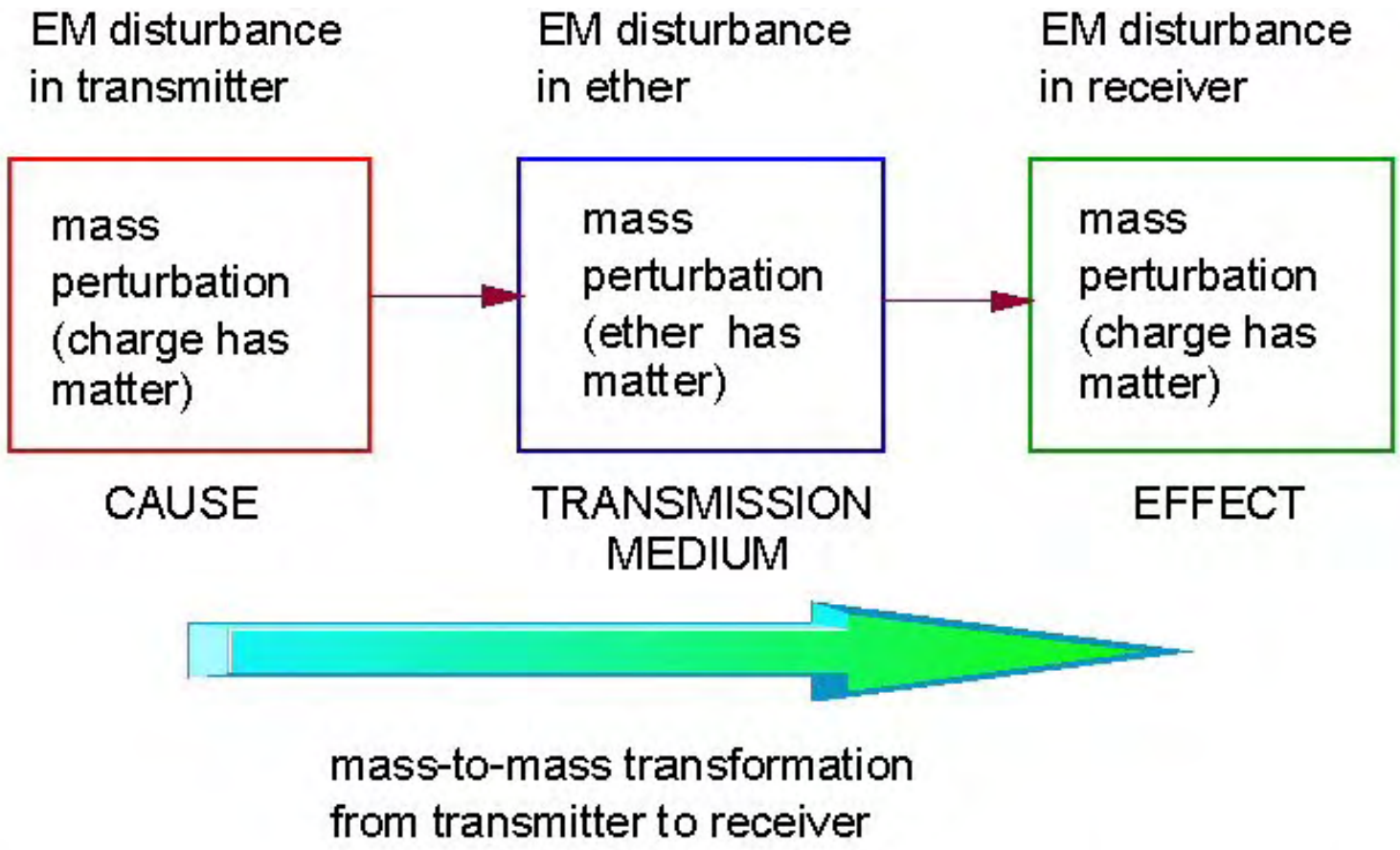

Figure 8. Maxwell's theory assumed a matter-to-matter transform from cause to effect.

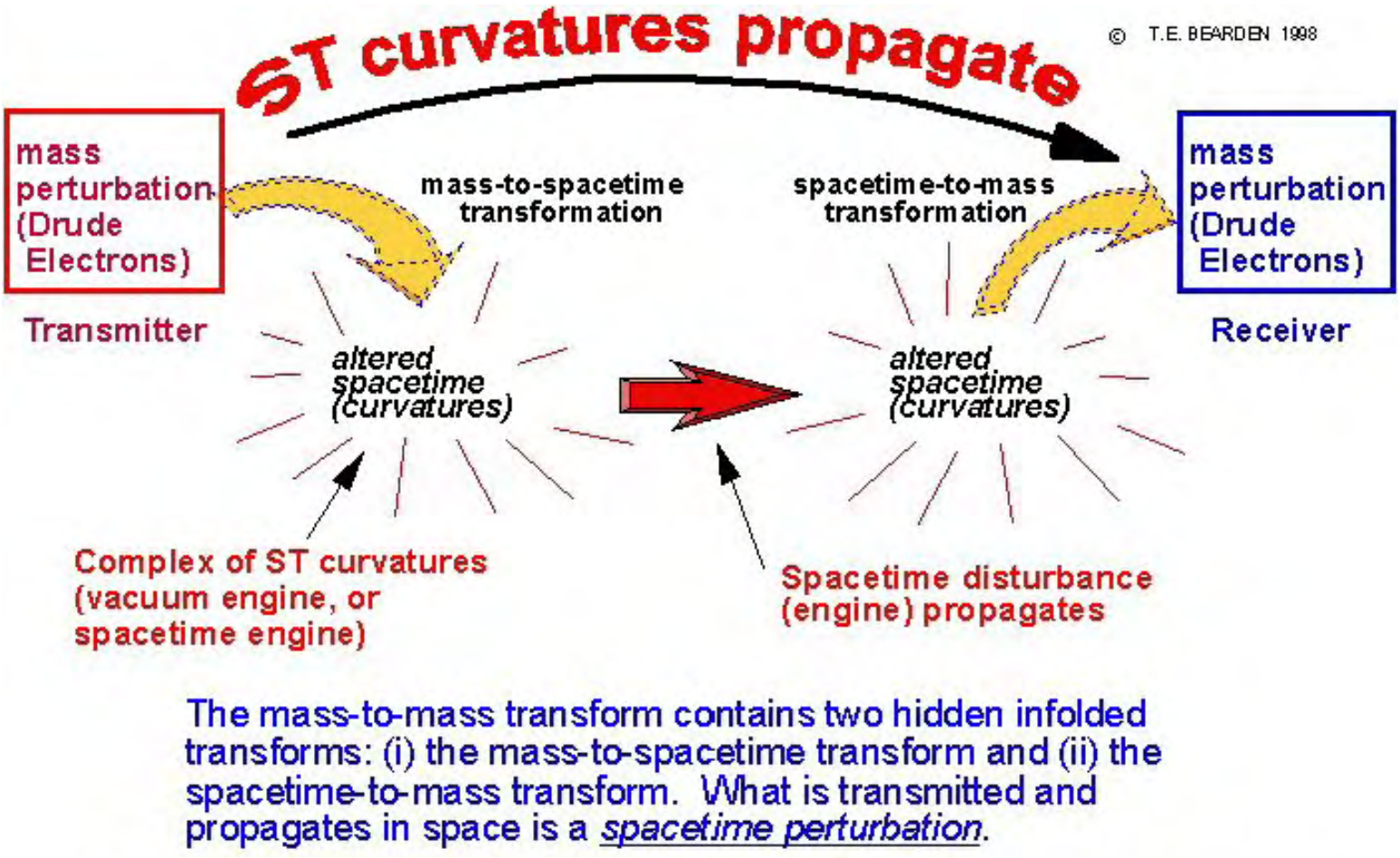

Figure 9. Maxwell's matter-to-matter transform contains two hidden transforms: (1) matter-to-spacetime, and (2) spacetime-to-matter.

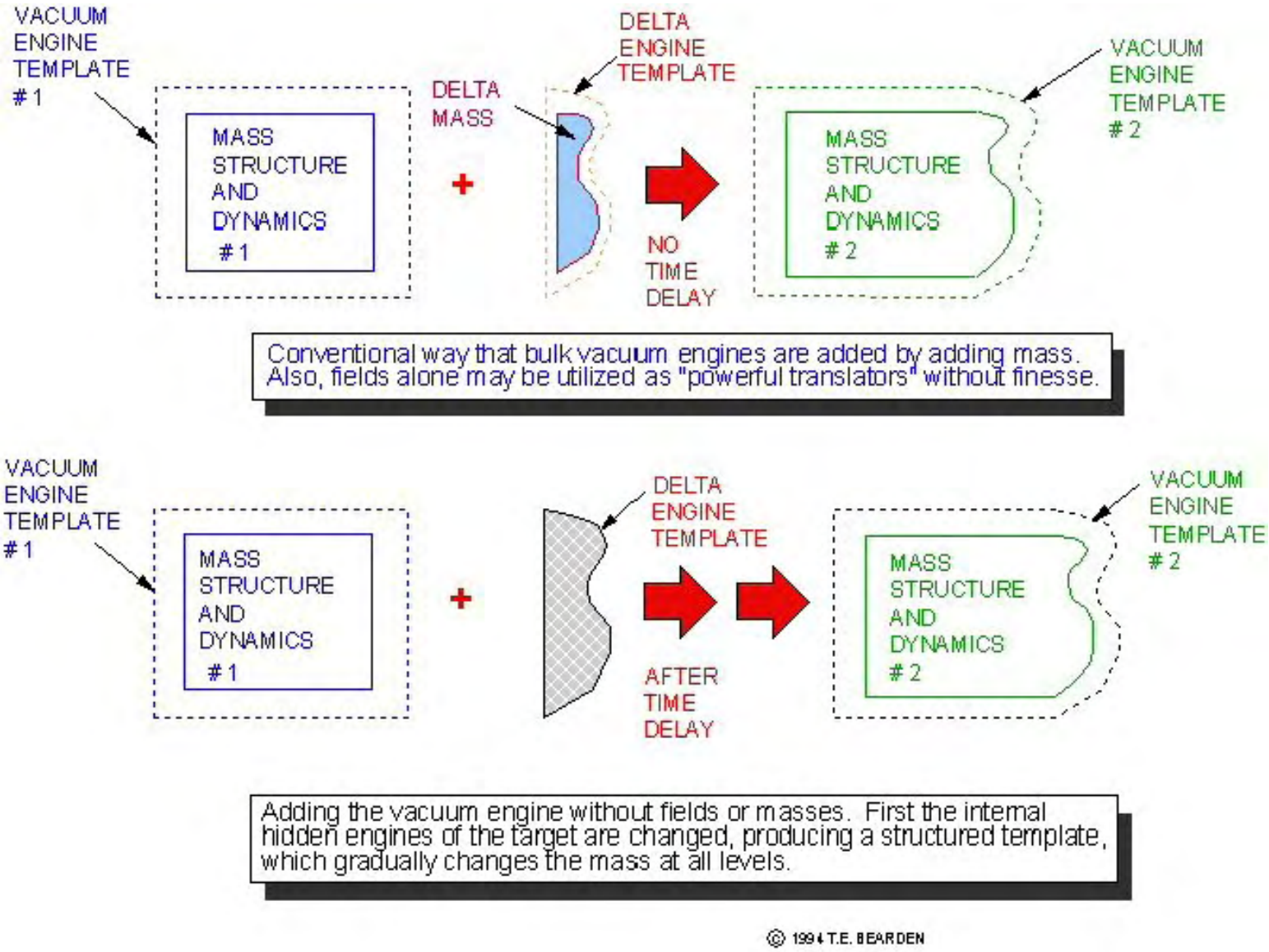

Figure 10. Vacuum engines and their utilization.

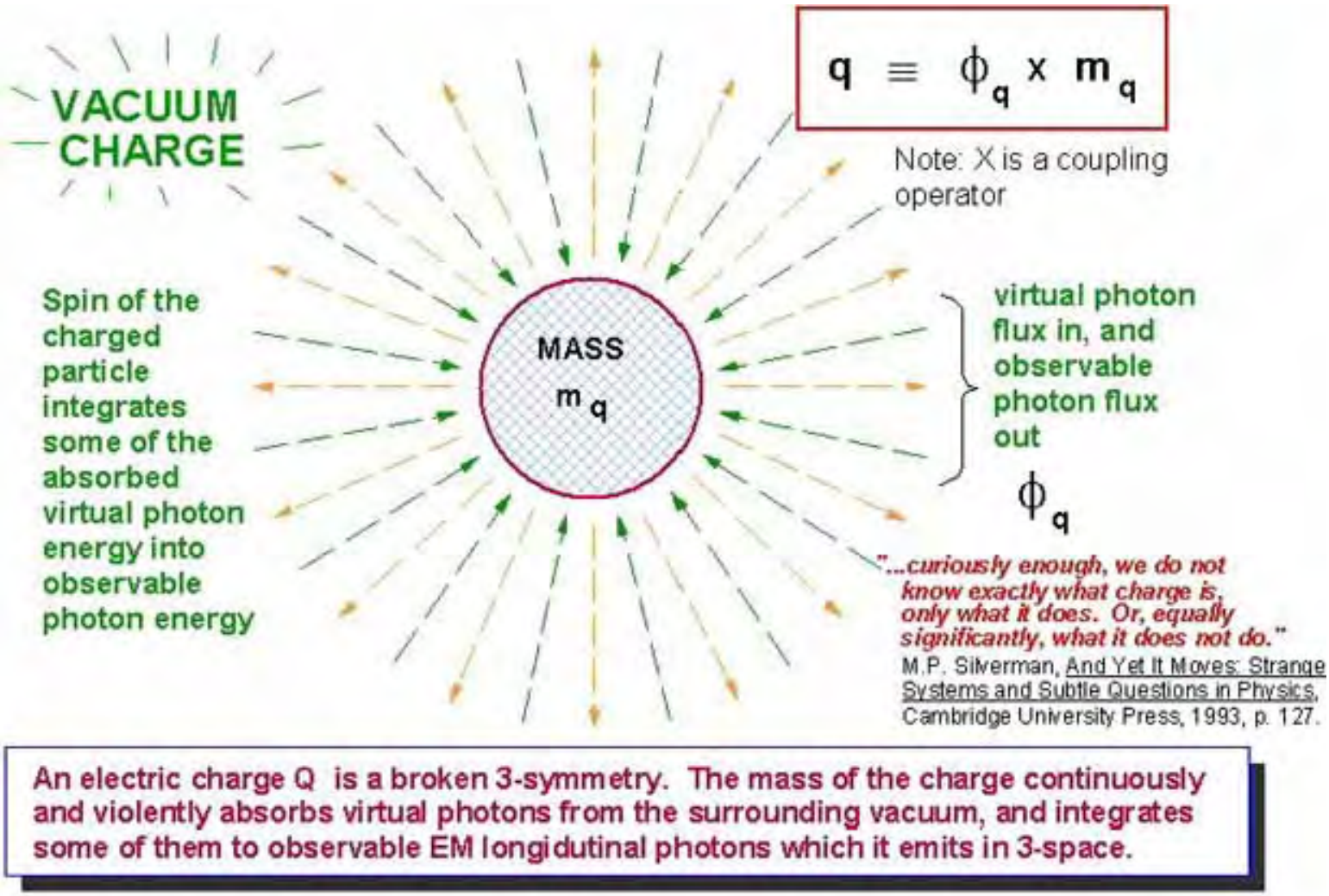

An electric charge Q is a broken 3-symmetry. The mass of the charge continuously and violently absorbs virtual photons from the surrounding vacuum, and integrates some of them to observable EM longidutinal photons which it emits in 3-space.

Figure 11. A charged particle continuously absorbs virtual energy from the vacuum, integrates some of it into observable energy, and pours out this observable EM energy in 3-space in all directions.

Composition of the scalar potential ϕ

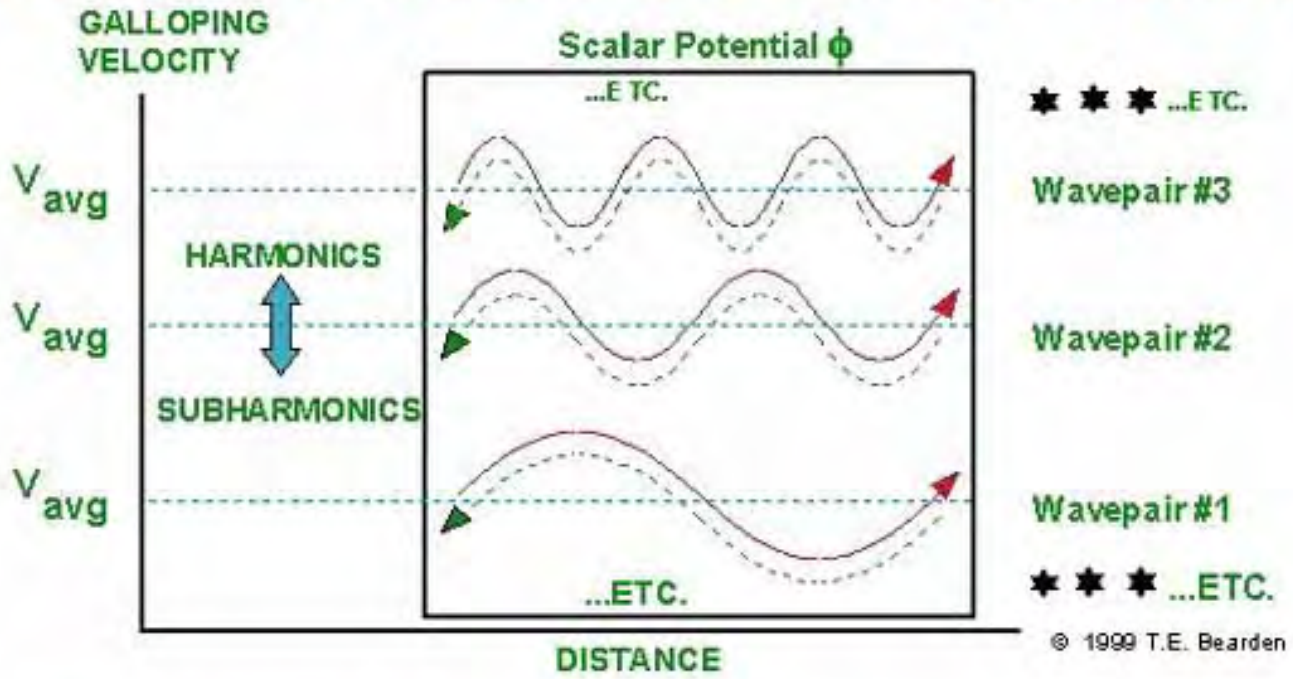

A harmonic set of bidirectional longitudinal EM wavepairs in 3-space. Unseen here is the time-polarized EM wave in the time domain, which reacts with the source charge to produce the 3-space biwave potential.

Figure 12. The potential as observed or detected is a harmonic set of bidirectional longitudinal EM waves in 3-space. That is, this potential is the "effect" of transduction of an incoming time-polarized EM wave interacting with the source charge.

The supersystem concept

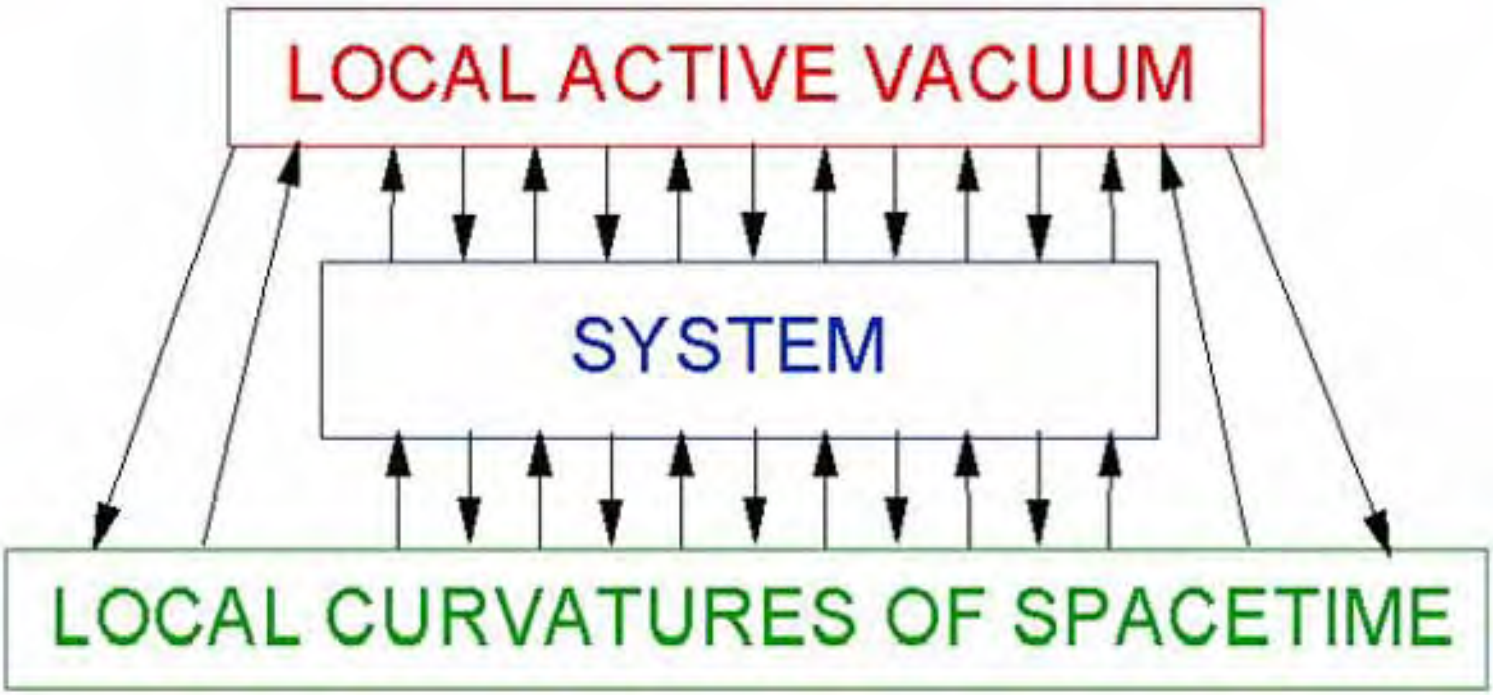

Figure 13. Concept of the supersystem and its interacting components.

Vacuum engine: Working spacetime demons

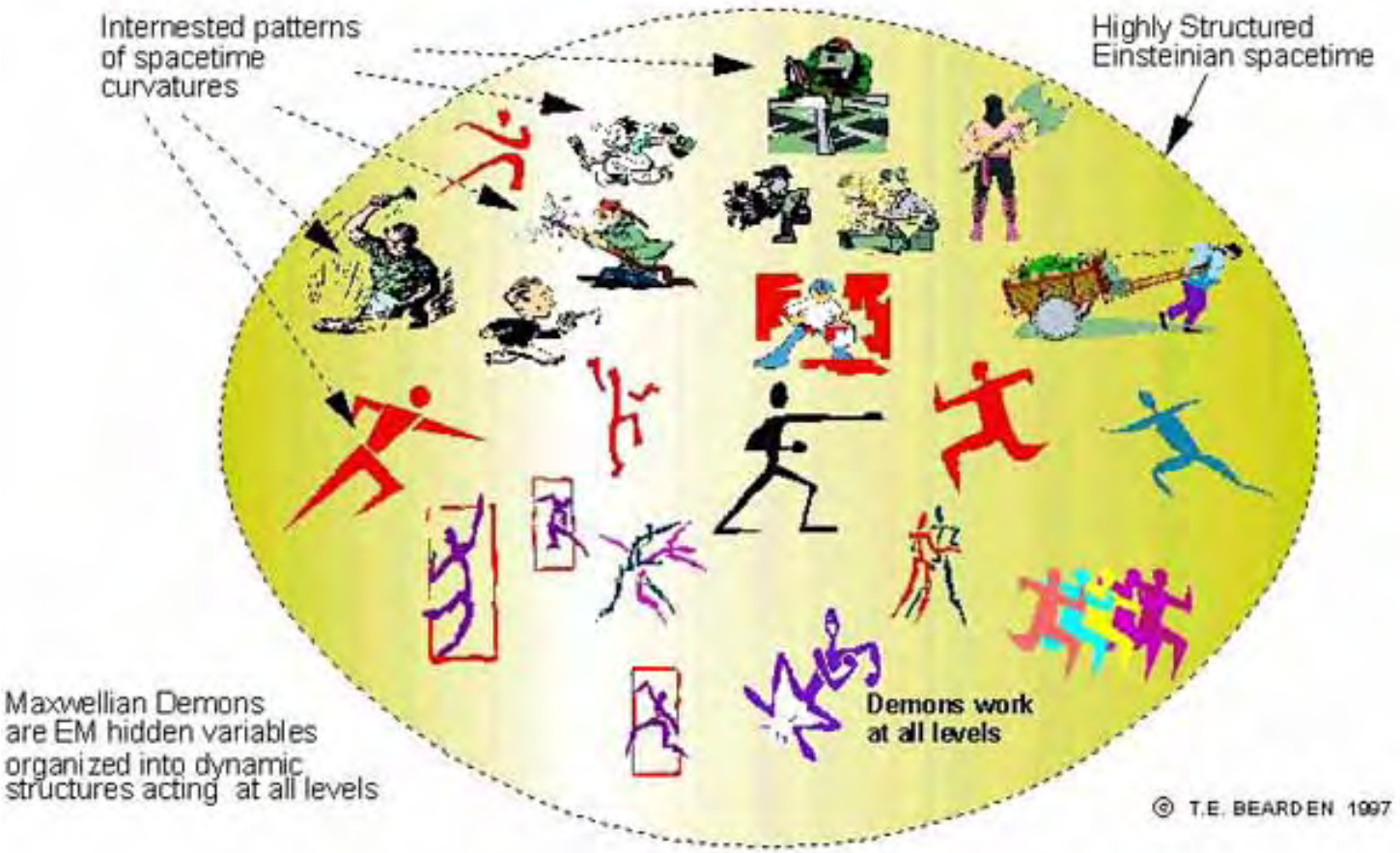

Figure 14. A vacuum engine is a set of spacetime demons working upon a mass system and its motion through time, at every level.

MTW's* general relativity principle

- Space acts on matter, telling it how to move.
- In turn, matter reacts back on space, telling it how to curve."

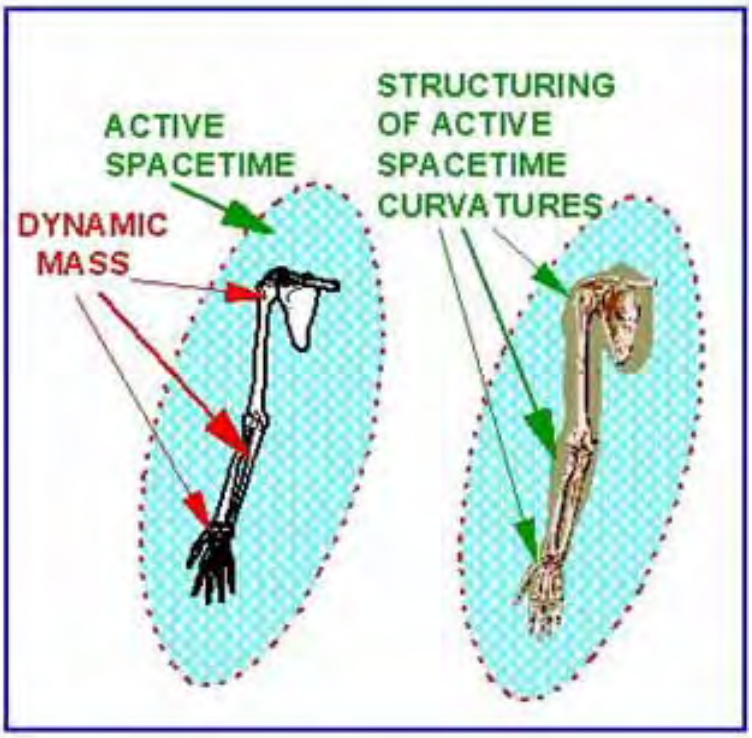

Figure 15. General relativity principle of Misner, Thorne, and Wheeler (MTW).

Extended General Relativity Principle

- All levels of energy structures and all levels of time structures mold spacetime geometry.
- The "pattern" is called a *template* for a vacuum engine (spacetime curvature engine).
- Spatial and temporal structurings of the engine act upon mass at all levels.
- This produces a template of forces, for precise translations and stresses within the mass at all levels. The forces exist in both time and 3-space.

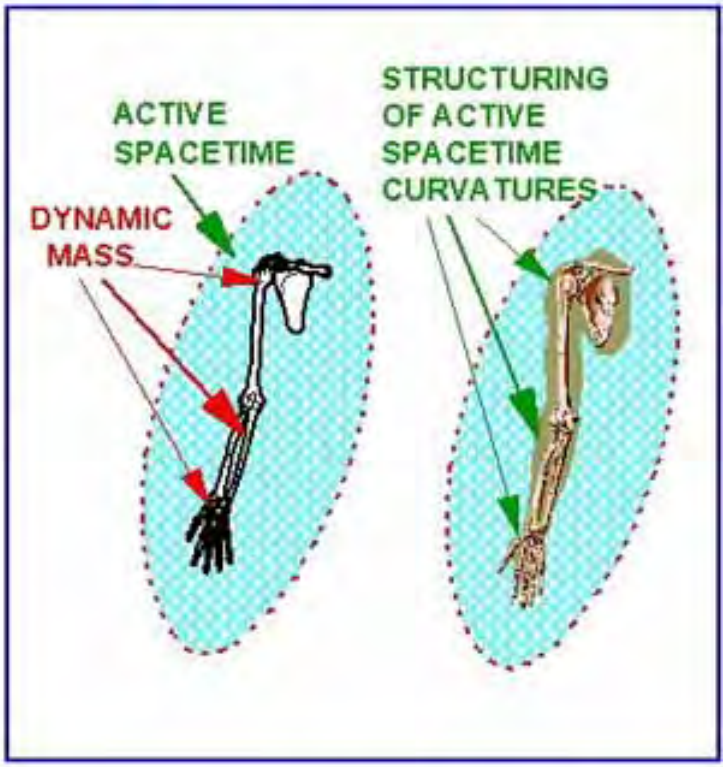

Figure 16. The principle of general relativity extended to include the vacuum engine.

Active spacetime and a specific vacuum engine

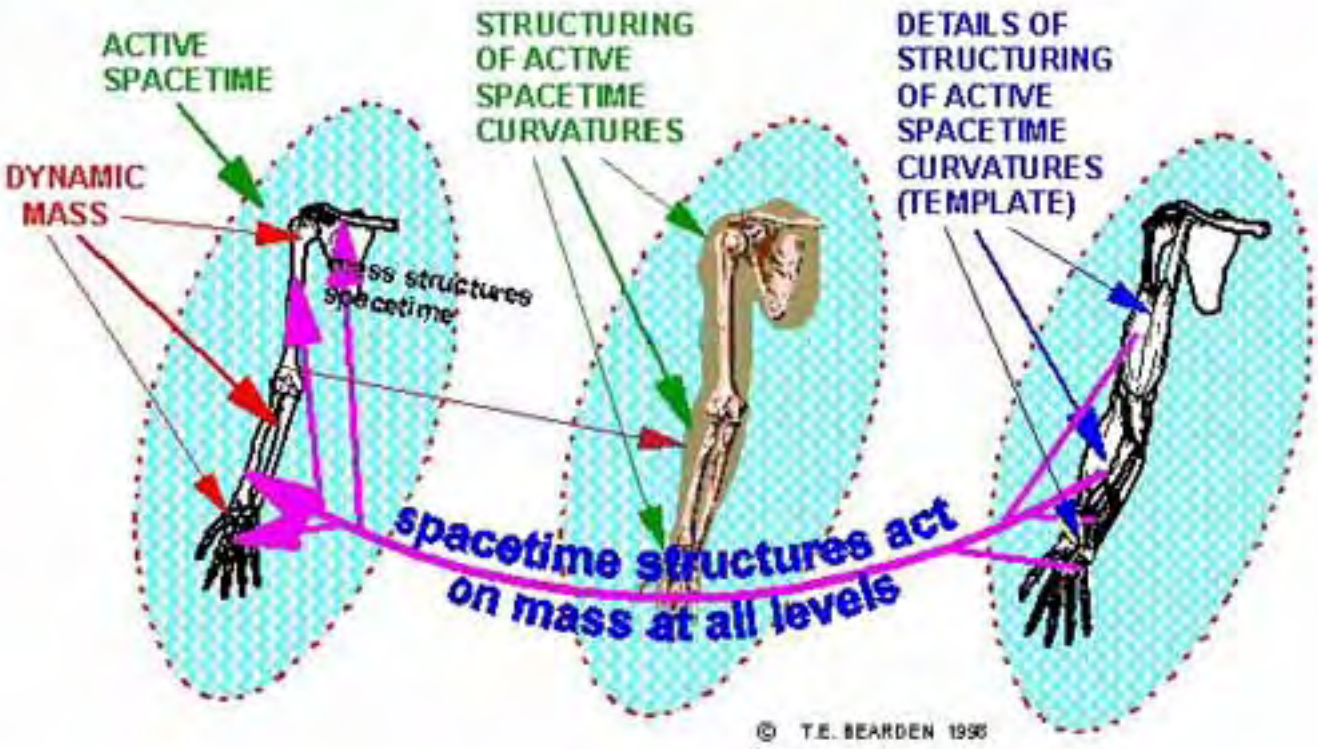

Figure 17. Active spacetime and a specific vacuum engine (spacetime curvature engine).

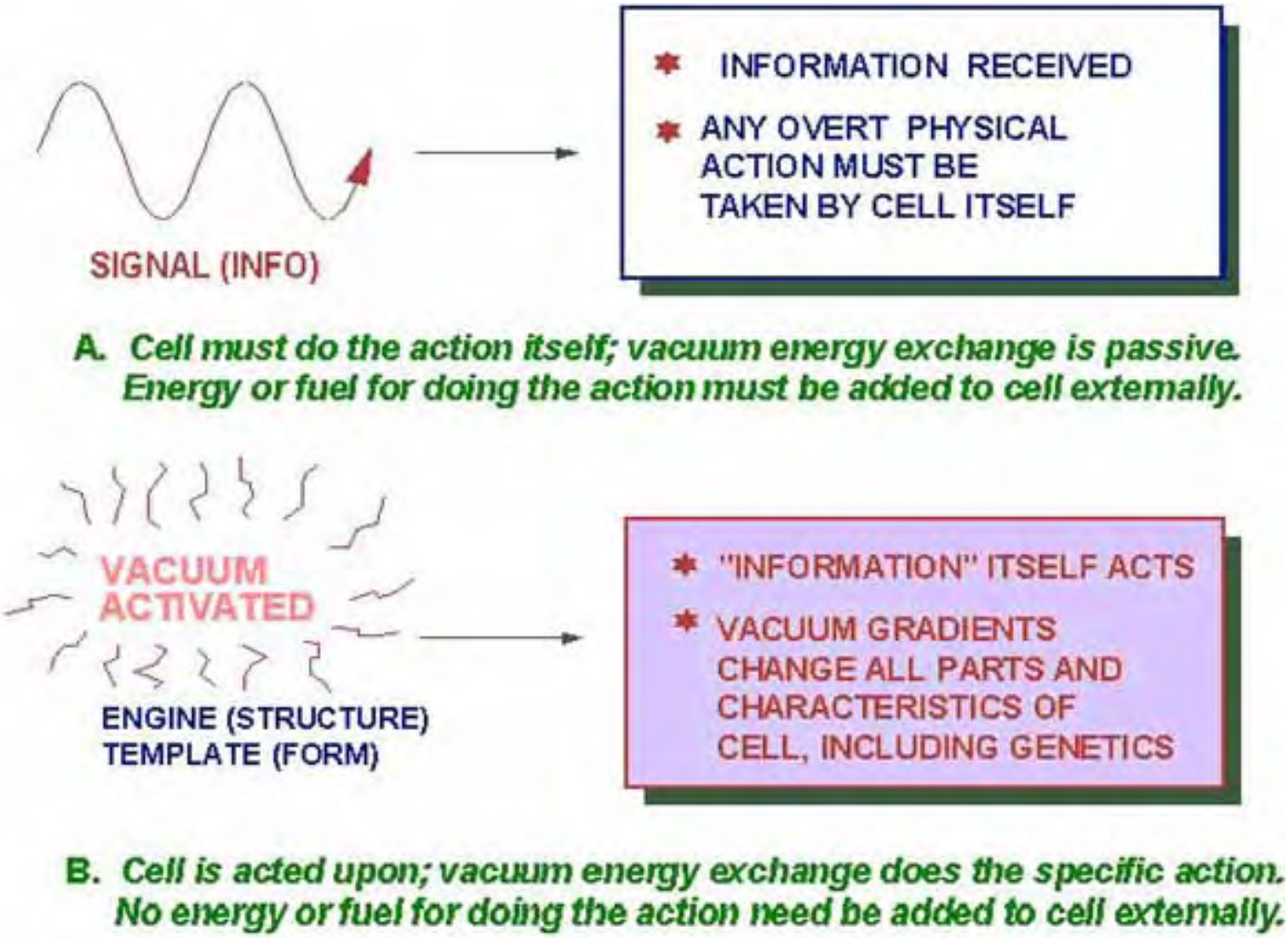

Figure 18. Signal versus vacuum engine, as in Priore's cellular reversal.

All EM energy in 3-space freely comes from the time domain

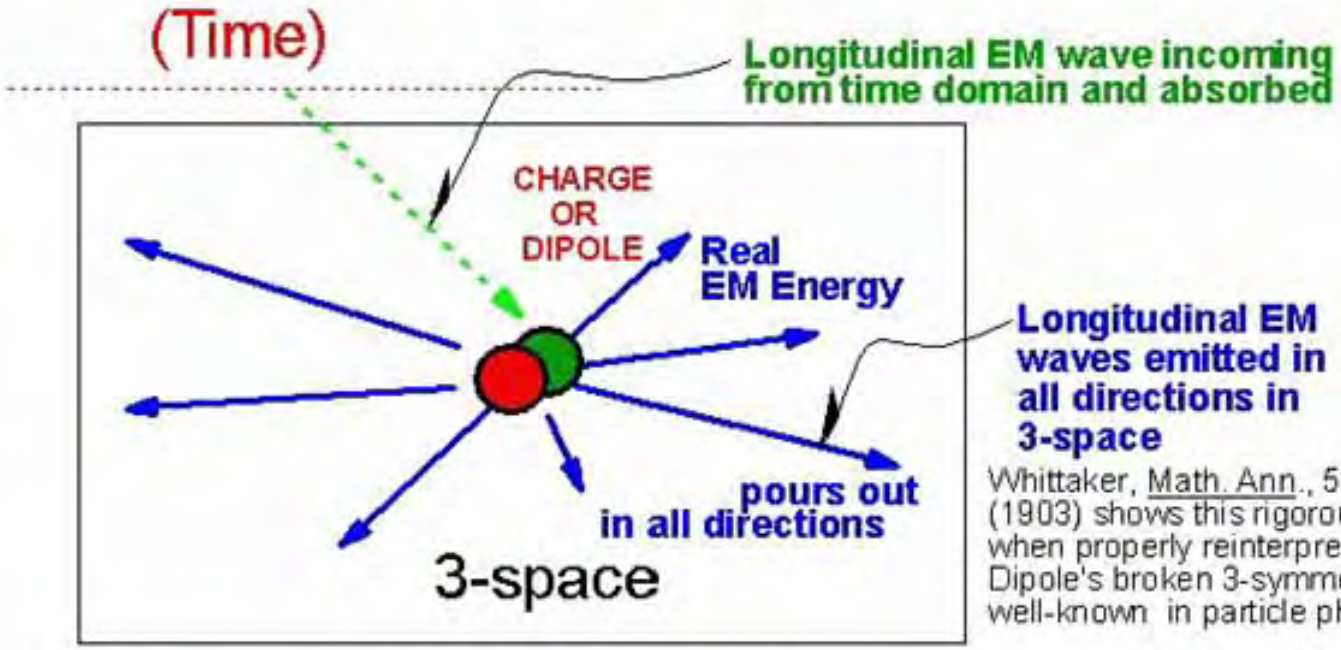

Whittaker, Math. Ann., 57, 333 (1903) shows this rigorously, when properly reinterpreted. Dipole's broken 3-symmetry is well-known in particle physics

Note: Whittaker (and others) interpreted the phase conjugate half set of LWs after interaction with the charges of the dipole, and as a 3-space *effect* rather than the time-domain *cause*. This fundamental non sequitur has just been repeated since then.

Figure 19. All EM energy in the 3-space potential comes from the time-domain.

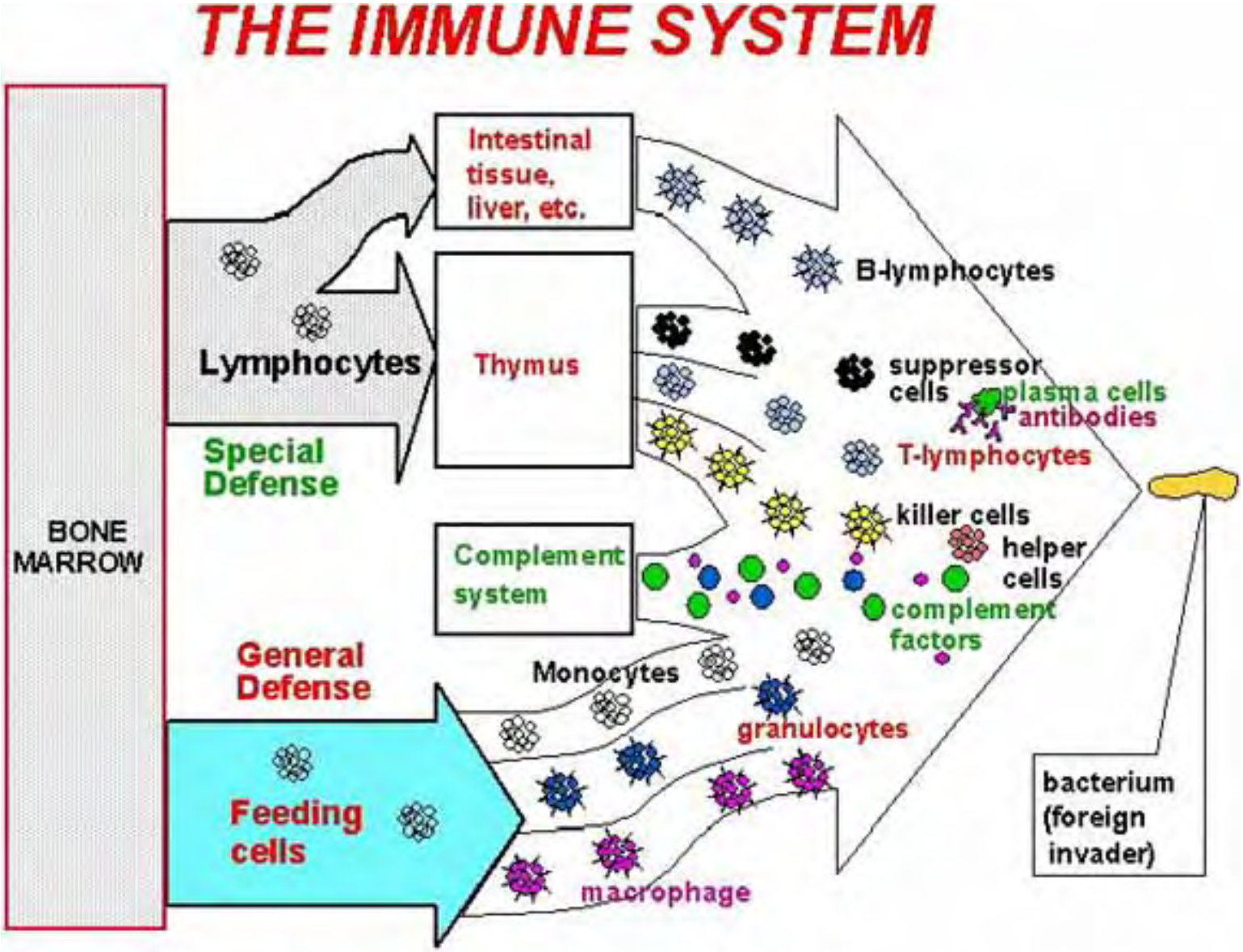

Figure 20. Immune system block diagram.

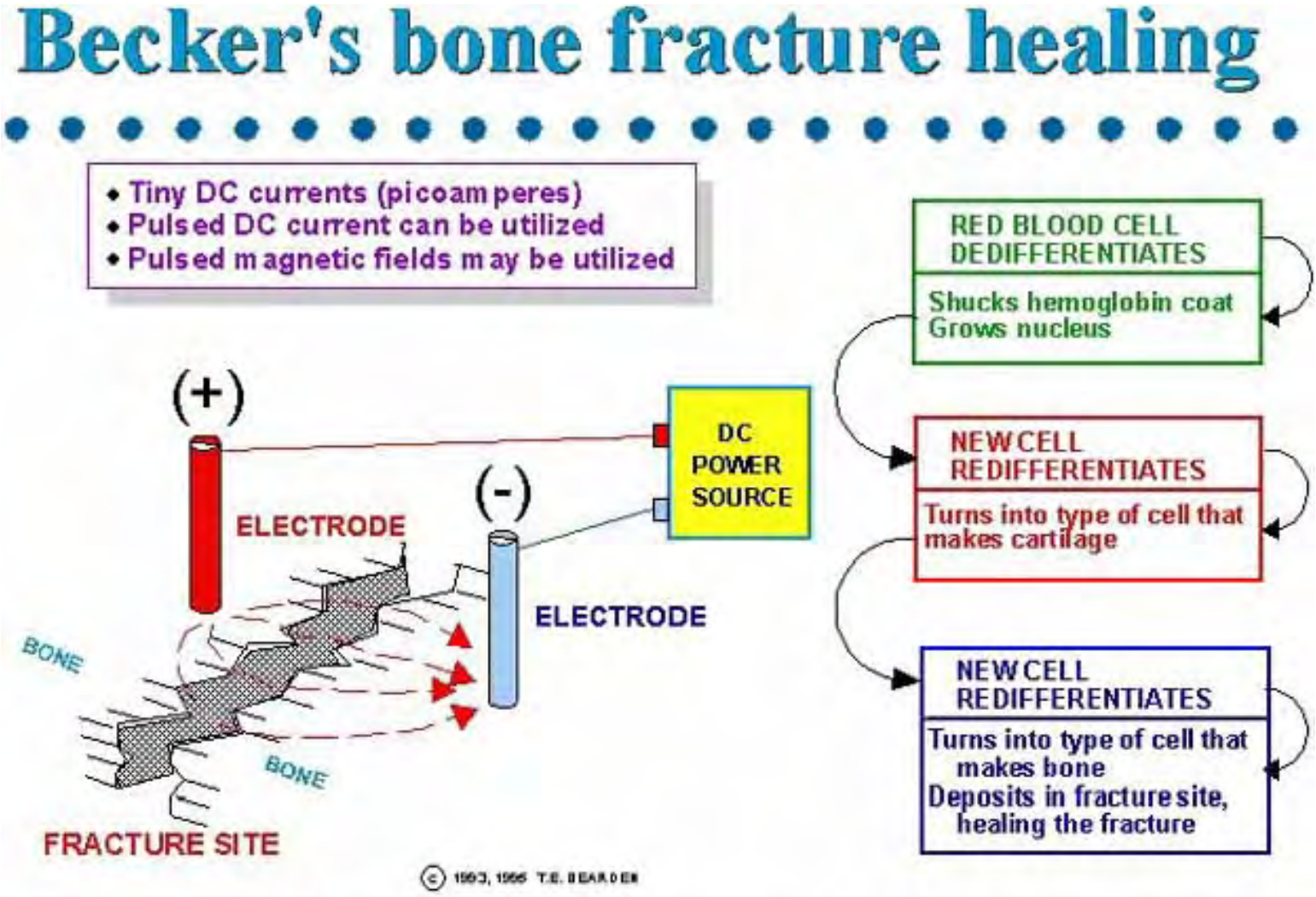

Figure 21. Becker's electrodynamic healing of otherwise intractable bone fractures, using weak potentials across the fracture site.

Becker's theoretical DC control system involved with response to injury

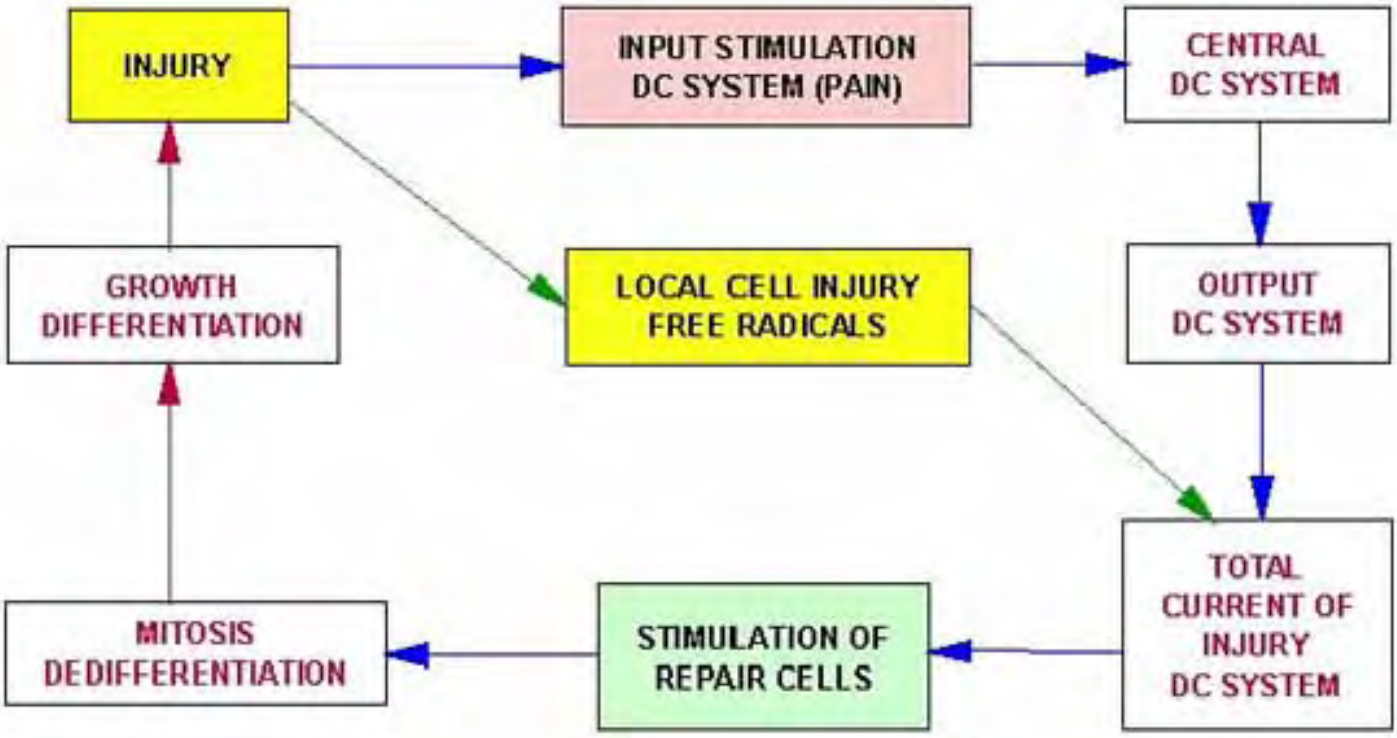

*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

Figure 22. Becker's block diagram of DC control system involved with response to injury.

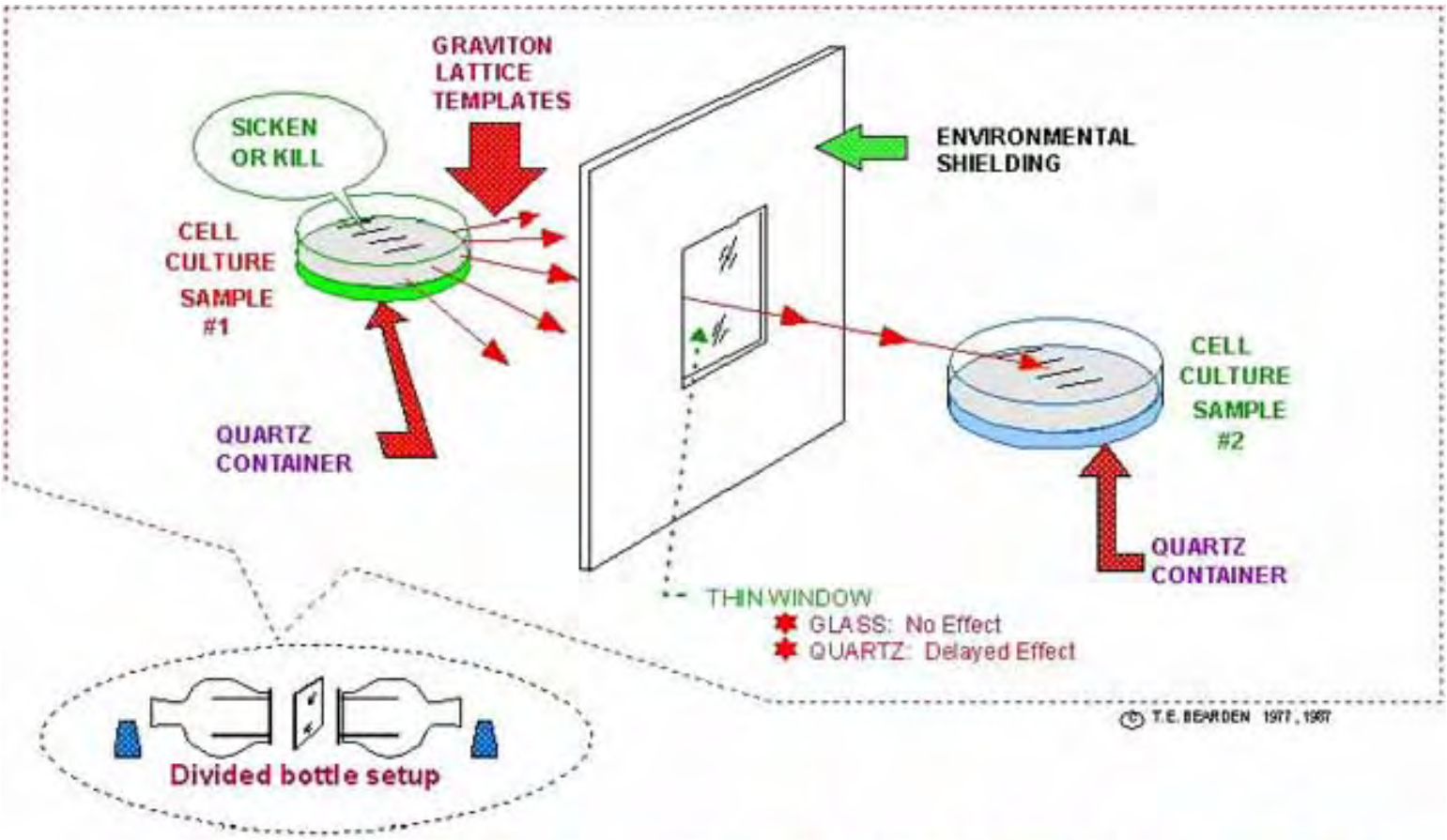

Note: Minimum lattice is one harmonic interval: IR to UV is such a minimum G-lattice.

Figure 23. Kaznacheyev's induction of cellular disease and disorder at a distance, using novel electromagnetic means.

Former U.S. Embassy in Moscow.

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter?)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

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Figure 24. Russian "microwave" radiation of the U.S. Embassy in Moscow.

Mechanism generating the flow of a mass through time

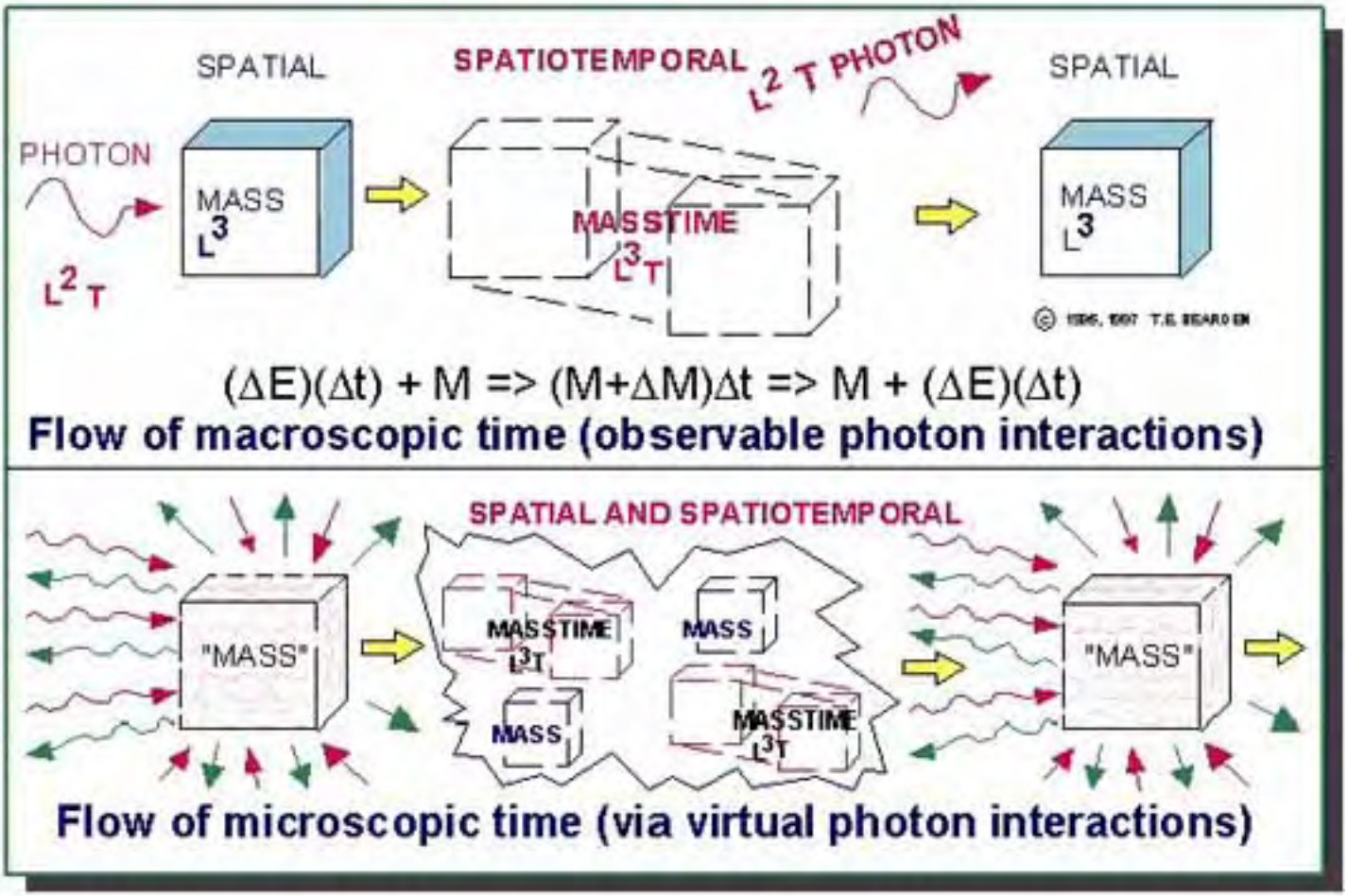

Figure 25. Mechanism generating the flow of a mass through time.

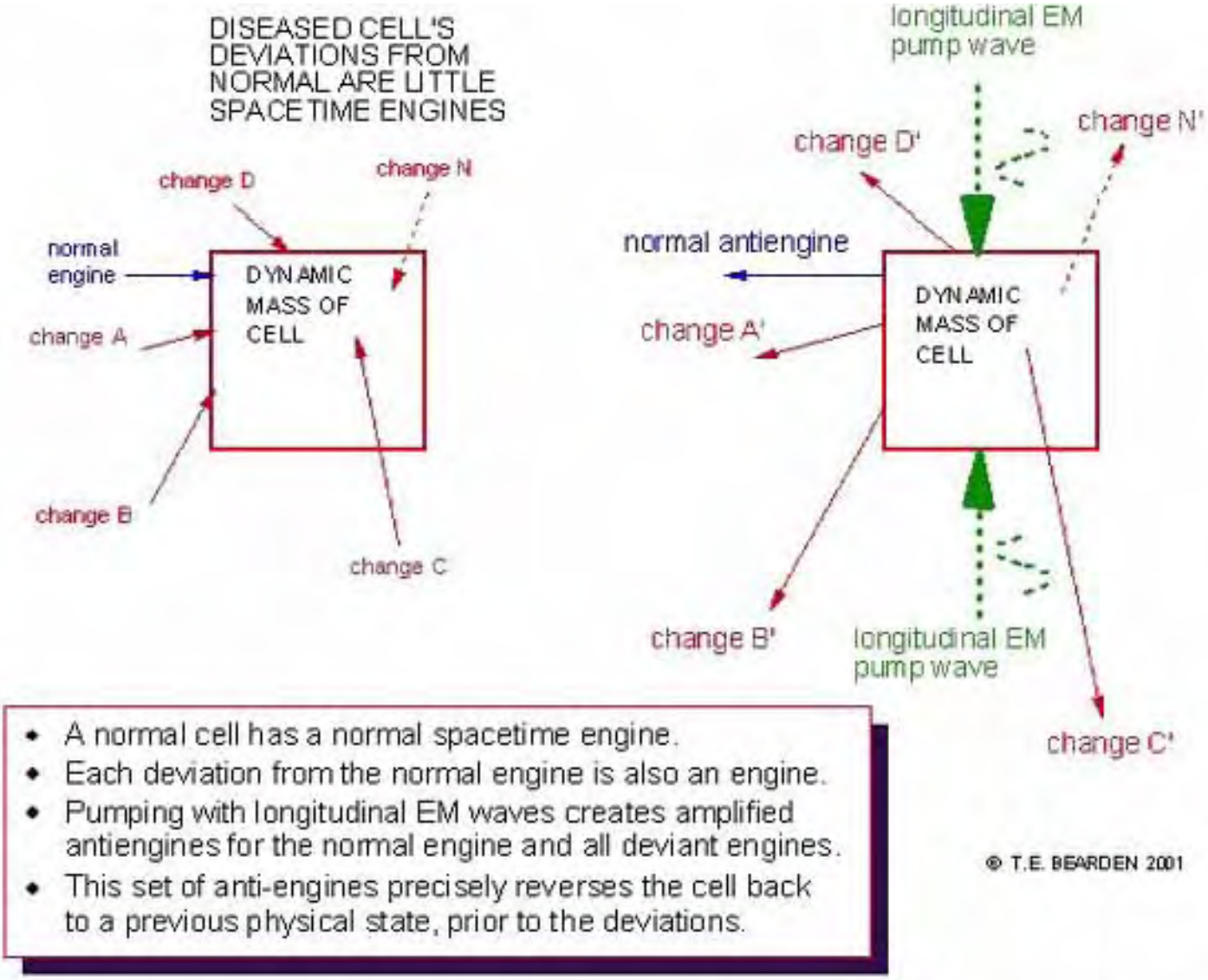

Figure 26. Producing a specific anti-engine for a specific cellular disease condition.

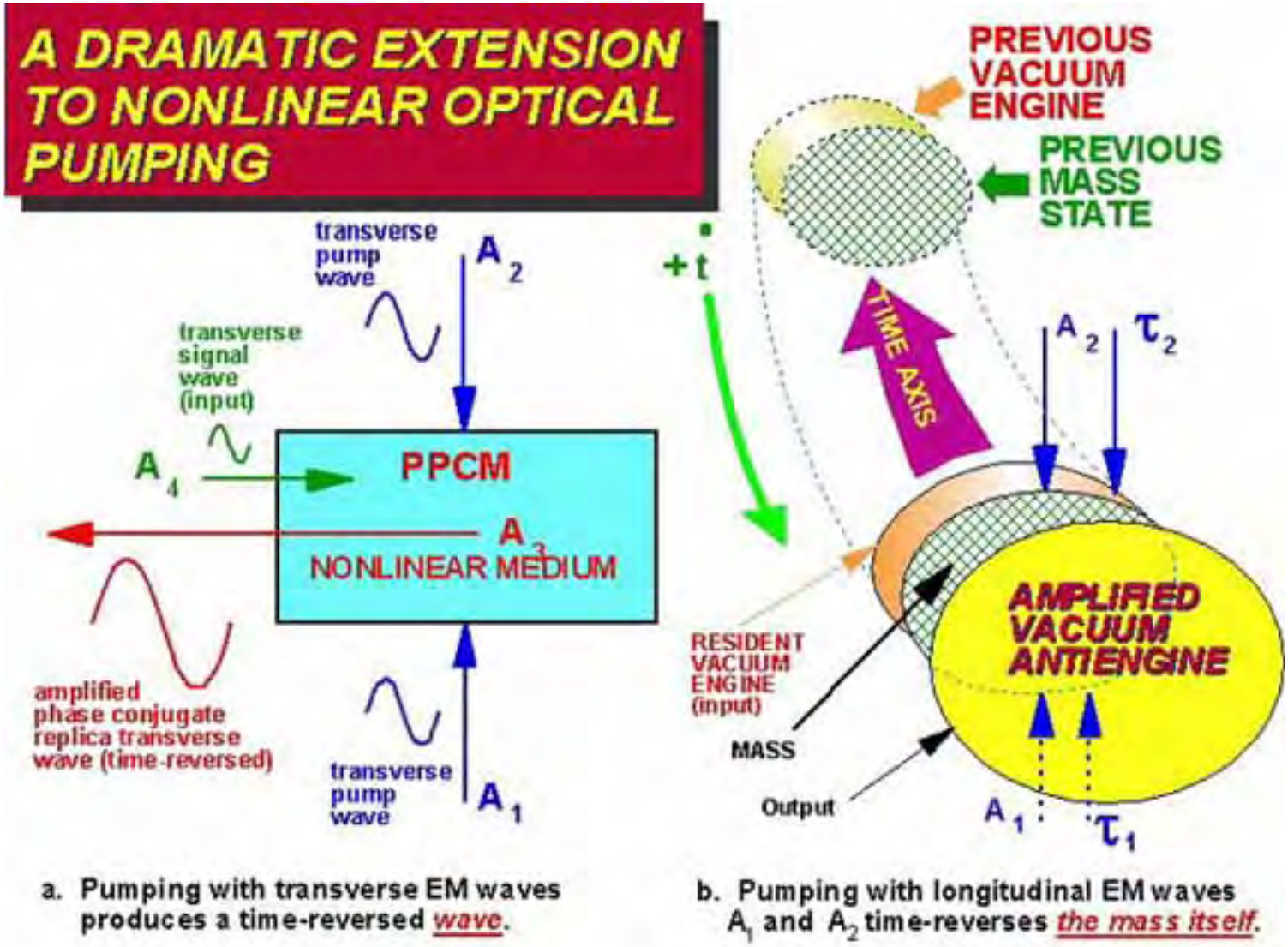

Figure 27. Pumping with longitudinal EM waves A also pumps in the time domain with time-polarized EM waves τ. This time-reverses a macroscopic mass and its dynamics.

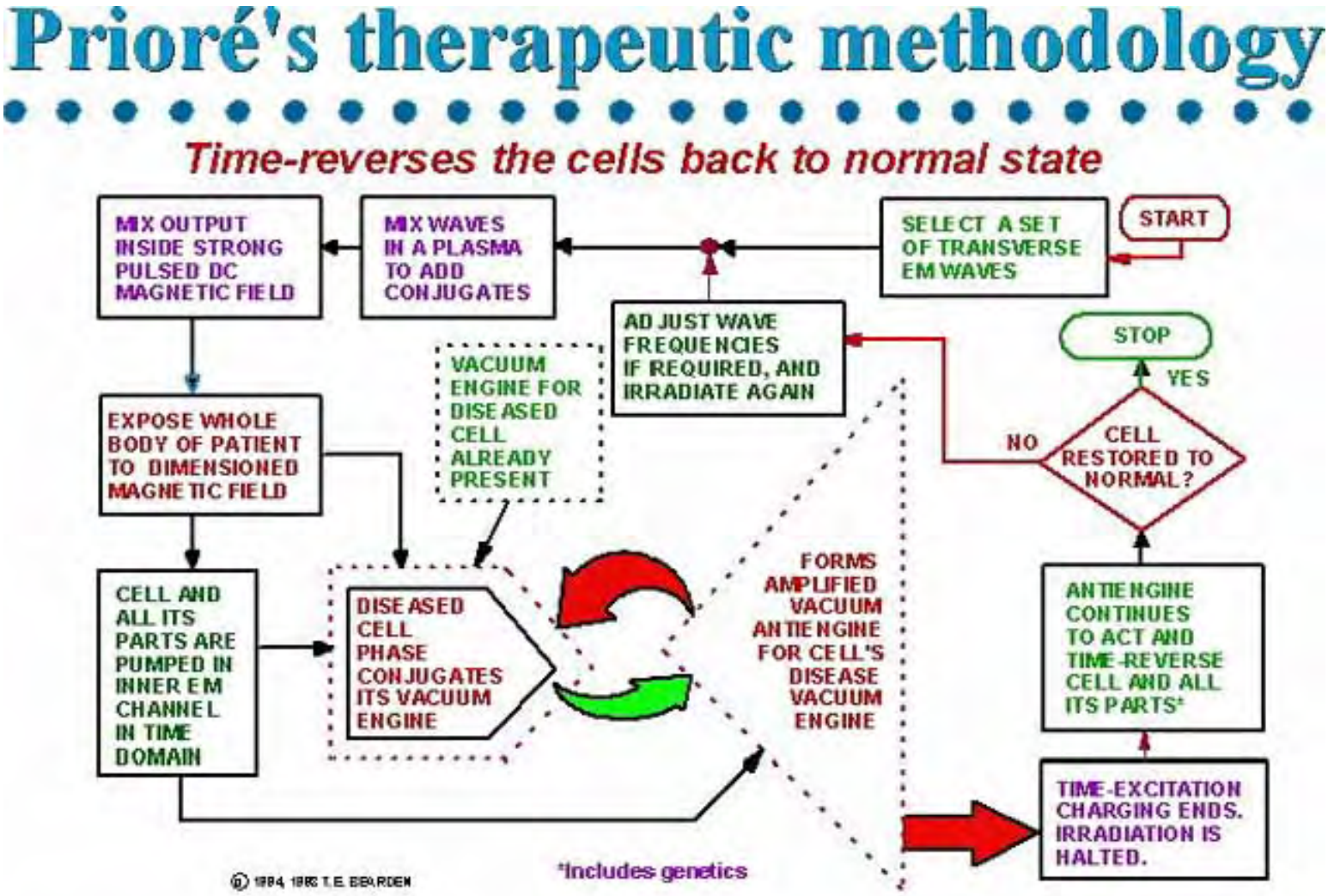

Figure 28. Block diagram of operation of Prioré's methodology.

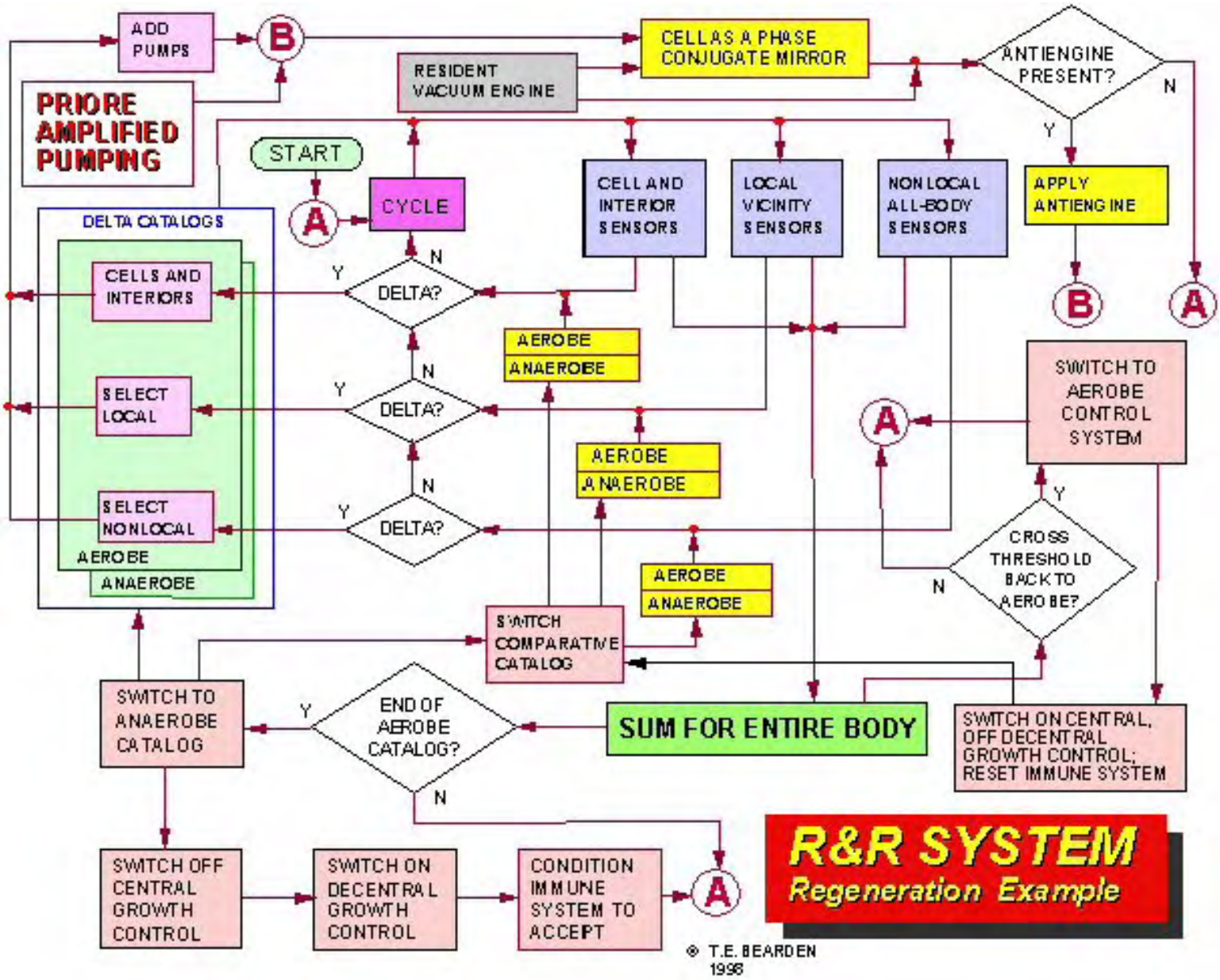

Figure 29. Block diagram of the cellular regeneration system and its overall operation (by the present author).

Rife's great secret: Recursive magnification by iterative serial summation of vacuum engines

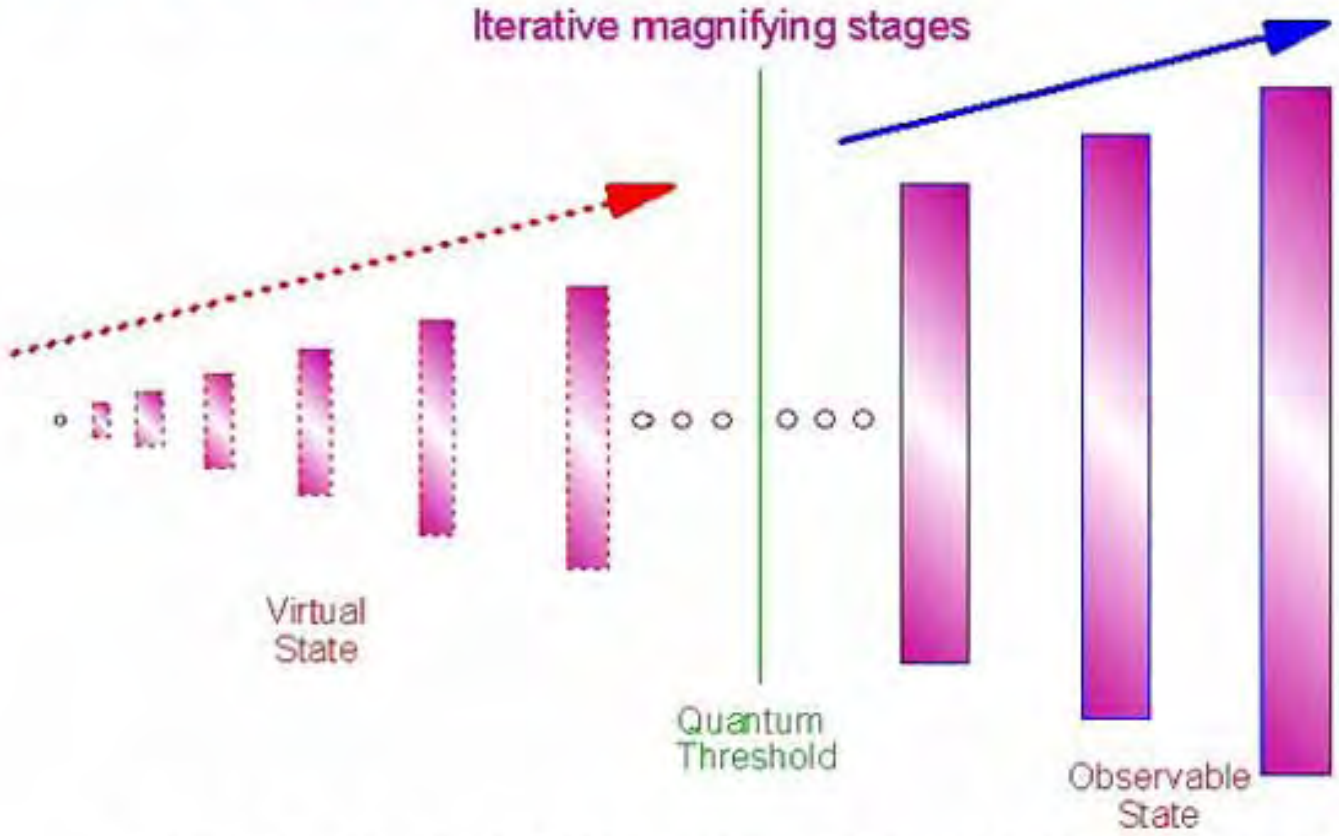

Figure 30. Rife's great secret: Recursive magnification of the virtual state vacuum engines and their dynamics to the observable state.

Utilizing Scalar Electromagnetics To Tap Vacuum Energy

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ABSTRACT

Based on E.T. Whittaker's previously unnoticed 1903-1904 papers which established a hidden bidirectional EM wave structure in a standing forcefield free scalar potential, a method of directly engineering the ambient potential of the vacuum has been developed and realized experimentally.

Adding Whittaker's engineerable hidden variable theory to classical electro-magnetics, quantum mechanics, and general relativity produces supersets of each discipline. These supersets are joined by the common Whittaker subset, producing a unified field theory that is engineerable and tested.

By treating the nucleus of the atom as a pumped phase conjugate mirror, several working model energy units have been produced which excite and organize the local vacuum, increase the local virtual photon flux between local vacuum and nucleus, establish coherent self-oscillations between the local excited vacuum and the affected nuclei, utilize the self-oscillating standing wave for self-pumping of the nuclei/mirrors, introduce a very tiny signal wave to the mirrors, and output into an external load circuit a powerful, amplified, time-reversed phase conjugate replica wave at 60 Hertz frequency and nominal 120 volt sine wave power.

Several models have been built, ranging from 6 watts early on to one of 5 kilowatts. Both closed batteryless systems with damped positive feedback and open loop systems with battery-powered input have been successfully built. Open loop power gains of from 5×10^4 to 1.5×10^6 have been achieved.

Antigravity experiments have also been successfully conducted where the weight of the unit was reduced by 90% in controlled experiments, with a signal wave input of 175 microwatts and an output of 1 kilowatt.

The basic theory of the device is briefly explained and experimental results presented. In the demonstration session, a videotape of one operating open-loop unit with a 1.5 x 10^6 power gain is planned, as is the demonstration of an actual working model closed-loop system with a nominal rating of 500 watts, and without external power input of any kind.

The units are solid state, with no moving parts. Each of them comprises a unique form of self-powered vacuum triode of extraordinary gain, where the cathode power and plate power are freely furnished by the vacuum, and only a small grid signal need be furnished either from an external power source or by clamped positive feedback from the device's output. The output is negative energy, and some of its unique characteristics are pointed out.

Implications of the experimental application of the Sweet vacuum triode, the Bearden approach to the nucleus as a pumped phase conjugate mirror, and the unified field theory based on Whittaker's engineerable hidden variable scalar EM potential theory are also briefly addressed.

SCALAR ELECTROMAGNETICS

In 1837 Sir W.R. Hamilton said,

"The notion of time may be unfolded into an independent pure science... a science of pure time is possible."

As is well-known, the fundamental units utilized in physics are arbitrary. It is even possible to construct all of physics on a single unit, time. This oddity shows the truth in Hamilton's statement; it is even more odd, because quantum mechanically time is not an observable. This means that the observable world can be modeled completely in terms of the nonobservable, which is essentially what modern quantum mechanics is now doing.

Hamilton viewed his magnificent quaternions as essentially having accomplished the mathematical structuring of time. Maxwell's original EM theory, as is well-known, was modeled in Hamilton's *quaternions*, not in the highly curtailed Heaviside/Hertz vectors erroneously taught today as "Maxwell's theory."

Not a single one of the present so-called "Maxwell's" vector equations ever appeared in a book or paper by James Clerk Maxwell.

For some years the author has worked on an extended electromagnetics theory, involving the scalar component of the quaternion. [Ref. 1]

In Maxwell's original *quaternion* theory, this scalar component often remains when the directional components zero. Further, it then enfolds vectors and functions of vectors inside, in a hidden variable manner. Specifically, the author has patterned a unified field theory concept upon the previously unnoticed but remarkable early work of E.T. Whittaker. [Ref. 2]

In two fundamental papers in 1903 and 1904, Whittaker showed that all present vector EM can be replaced by scalar potential interferometry, and that bidirectional harmonic EM plane wave sets could be used to produce a standing wave of force-field-free potential (Figures 1 and 2).

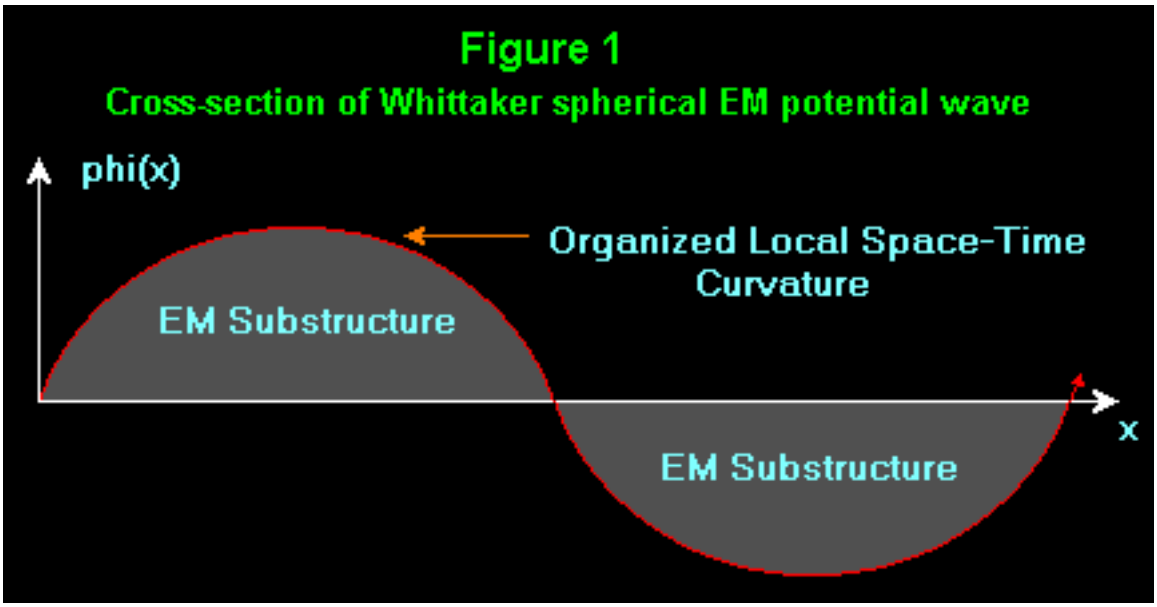

NOTE: SHAPE MAY BE ALL ABOVE OR ALL BELOW AMBIENT VACUUM POTENTIAL

Thus Whittaker anticipated the quantum mechanical Aharonov/Bohm effect by 55 years, including extending it to the macroscopic world instead of the mesoscopic realm where it has been established to date. [Ref. 3]

In modern terms, Whittaker showed how to turn EM wave energy into electrogravitational potential energy, then how to interfere two such scalar potential waves to recover electromagnetic energy, even at a distance. [Ref. 4]

This unrecognized work is of great importance: when applied to modern physics, it produces supersets of quantum mechanics (QM), classical electromagnetics (EM), and general relativity (GR).

Further, all three extended disciplines unify on their common Whittaker subset, in a testable and engineerable fashion. [Ref. 5]

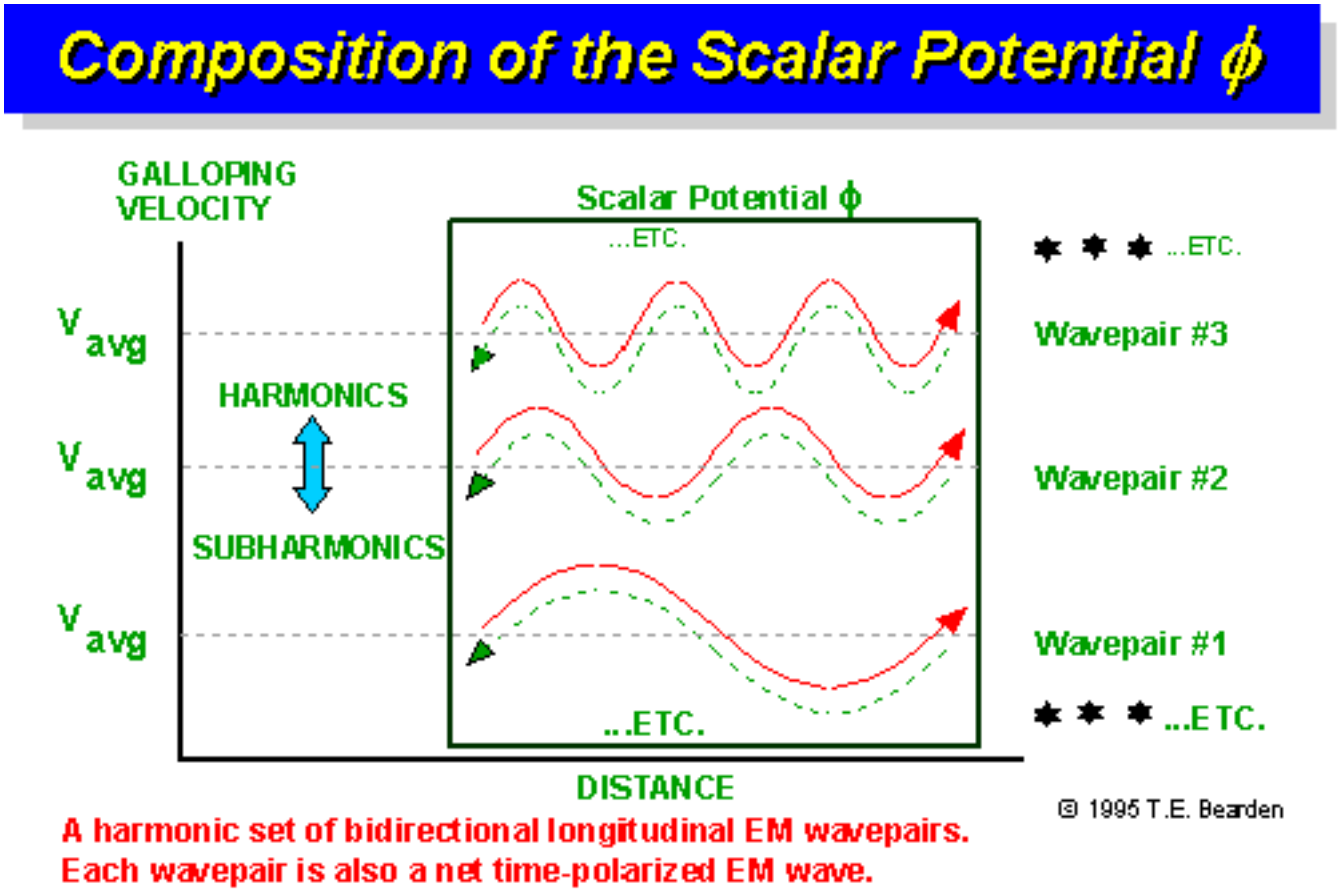

Figure 2. Infolded EM plane wave structure of a Whittaker wave.

The Nucleus As a PPCM and Triode

The author has also considered the highly nonlinear nucleus of the atom as a pumped phase conjugate mirror (PPCM), having found no other consideration of same in the literature.

The author also dubbed a PPCM a "triode," since the amplified phase conjugate replica of the signal wave is much like the amplified output of a triode, and the signal wave input to a PPCM is much like a triode's grid signal input. The PPCM pump wave then corresponds roughly to the power input to the cathode and plate of a triode. [Ref. 6]

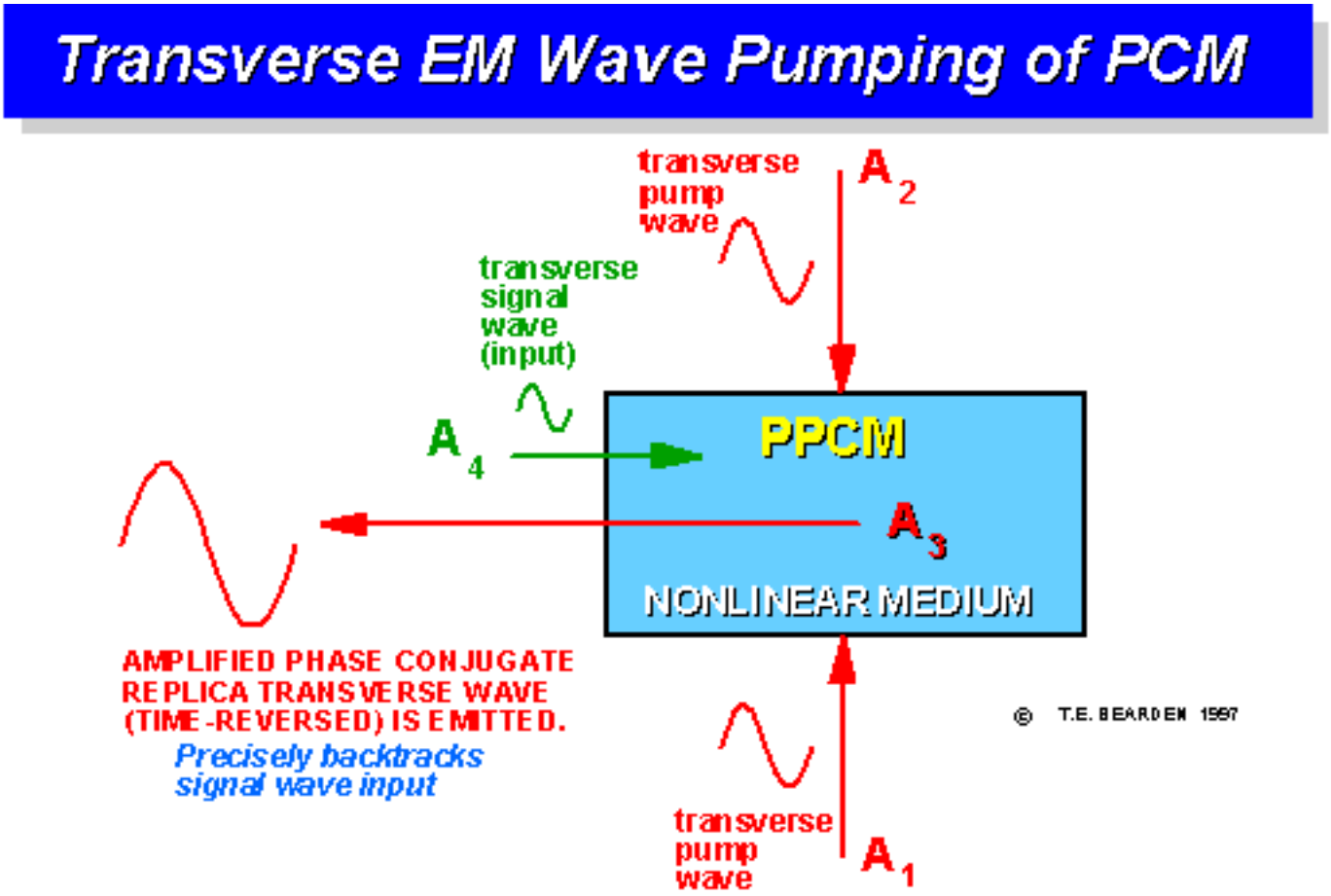

Figure 3. A pumped phase conjugate mirror.

VACUUM TRIODE BACKGROUND

About seven years ago, the author was privileged to see and examine an invention of Mr. Floyd Sweet, that produced about 6 watts of electrical power from the vacuum itself.

This remarkable device, which the author dubbed a *vacuum triode*, in a single unit utilized most of the scalar EM concepts the author had so painfully and slowly formulated over the years.

Sweet, a brilliant inventor with a remarkable knowledge of magnetics, had utilized barium ferrite magnets and special coils to produce a solid-state device that successfully tapped the vacuum energy.

The author quickly put together a theoretical concept for the energy-tapping mechanism, based on treatment of the nucleus as a PPCM and Whittaker's scalar EM potential unified field theory. [Ref. 7]

The author furnished the technical concept, treating the nucleus as a pumped phase conjugate mirror, to the inventor along with copies of Whittaker's papers.

Sweet's Synthesis and Extension

Sweet is also a brilliant EM theoretician, working in four, five, or even six dimensions with ease. He immediately synthesized the entire PPCM and Whittaker theory, and developed a complete theoretical treatment of the device. [Ref. 8]

He also increased the nuclear potential utilized in the activated nuclei of the device, which increased the pumping energy and hence the energy output. He next produced an open-loop vacuum triode (VT) with an output of 500 watts, for an input of 33 microwatts.

Thereafter he produced several other models, including closed-loop systems and one with 5-KW output.

Purpose of This Paper

Our purpose is to explain the detailed scalar EM concept of the operation of the vacuum triode, since it is a universal method for cohering and tapping useful EM energy from the vacuum.

The author believes that this mechanism is the fundamental mechanism that must be invoked in any over-unity device that electromagnetically extracts vacuum energy as electromagnetic effects.

We also intend to demonstrate a full working model of the device at this conference. Sweet's detailed theoretical treatment will be completed and submitted to a major journal shortly, to complete the scientific exposition of the new methodology.

I must also express my deep admiration for my brilliant inventor colleague. It has been a privilege to work with him, though under great difficulties and at a distance. He has developed several other related devices that are of great importance to the emerging new physics of *vacuum engineering*, in the sense referred to by Lee. [Ref. 9]

To mention just one, he has produced a magnetic lens which apparently can directly display the vacuum's virtual particle flux, or a good analog of it. So far as I am aware, this is the only extant instrument today that can perform this feat.

When the vacuum triode has been proven to the scientific community, it is my intention to nominate Sweet for the Nobel Prize he so richly deserves, and seek high scientific endorsements for the recommendation.

INTRODUCTION

Entropy

As is well known, in any closed dynamic system the order existing in it will gradually be dissipated, as more and more interactions occur. This leads to the notion of *entropy* as the increasing disorder in such systems. The assumptions are

1. a closed system, and

2. a positive flow of time for the components of the system.

Actually no such thing as a completely closed system exists in nature. Every mass system is open to virtual particle flux exchange with the vacuum, for example, particularly in the nucleus of its atoms, where the bulk of its mass is located.

However, the closed system assumption is reasonably approximated by a great many systems which are in stable thermodynamic equilibrium, or nearly so.

On the other hand, in an open system far from thermodynamic equilibrium, the second law of thermodynamics does not necessarily apply, because the system violates both the closed system assumption and its equilibrium approximation. [Ref. 10]

Time Reversal

Since being discovered in 1972 in the open Soviet literature, the time-reversed (phase conjugate) EM wave has also been known. The phase conjugate EM wave is truly time-reversed, as has been shown experimentally. Since the time-reversed EM wave violates the second major assumption, the second law of thermodynamics need not necessarily hold for time-reversed entities.

Putting all this together, if one wishes negentropy and hence increased energy in a system, the candidate suggested would appear to be a system that was strongly

1. open loop,

2. time-reversed, and

3. far from thermodynamic equilibrium.

A good overview of time-reversal in physics has been provided by Sachs. [Ref. 11]

Engineering the Nucleus

Since the nucleus already provides a myriad of time-reversed processes, engineering the nucleus of an atom is a very good candidate for practical negentropy.

To engineer the nucleus directly, a Whittaker potential is first artificially constructed, by composing a harmonic set of phase-locked EM wave/antiwave pairs. It is accented that the antiwaves must be true phase conjugates; otherwise they will not constitute a gradient-free Whittaker standing potential wave.

In addition, at least one harmonic interval must be used, and additional harmonic sets are most

desirable. The reason is that a space-time lattice must be formed in the vacuum, where the energy is additive spatially but oppositive in t-dot, the rate of flow of time, in the fourth dimension.

So a time-structure is required as well as a spatial structure, which is what is provided by ***n*** bidirectional harmonic Whittaker EM wave sets, where ***n*** is an integer greater than 1.

Once a specific Whittaker structure has been chosen, the local lattice of space-time is established. This establishes phase-locked lattice groupings of coupled photon/antiphoton pairs, or of *gravitons*. In turn, this Whittaker-structured vacuum now contains specific graviton *vacuum engines*, which directly engineer and structure the vacuum's virtual particle flux (VPF) exchange with the nucleus. [Ref. 12]

The nucleus is highly nonlinear, hence strongly phase conjugative, or time-reversed. The ambient potential of the local vacuum surrounding the nucleus is in a violent virtual photon exchange with it, accounting for its electrical charge.

Since the preponderant charge is positive, from the viewpoint of the ordinary light observer whose light interacts with electron shells, the nucleus may be taken to exhibit time reversal (phase conjugation).

Energy, Time, and Gravitons

We take the definition of "energy" to be fundamentally an ordering imposed upon the VPF of vacuum. We take photon scattering from the electron shells of atoms to be the fundamental exterior mechanism producing forward flow of external observer time.

It then follows that "time's arrow" for the EM observer is due to the universal scattering of photons from electron shells.

In this view, forward (positive) time flow and entropy are due to the same primary action: photon scattering from electron shells. It is unfortunate that the concept of "positive" energy has been tied to, and defined in terms of, the scattering and dissipation of VPF order as *work*, or energy expended.

Via the standard labeling, then, negative energy is the reconstitution of order in the vacuum VPF. It should be noted that, in a PPCM, dissipative or external pump wave stress energy can be scavenged and re-emitted in perfect order as the phase conjugate replica. This is a *negentropic* process, for it is capable of turning disorder into order. [Ref. 13]

In the time-reversed PPCM nucleus, we should expect to see appreciable *negative energy*—that is, energy removed from the EM scattering domain. This includes the binding energy of the nucleus, and the gravitational (G) potential energy of the EM energy removed from the "scattering interaction realm" and locked into the mass.

Following Sakharov, we hold that the G-field is not a fundamental field of nature, but a composite

caused by, or made from, other fields. [Ref. 14]

To the first order, we assume the G-potential is comprised of coupled photon/antiphoton pairs, on the average, where the statistical coupled spin-2 photon/antiphoton pair is a *graviton*. [Ref. 15]

We follow the modern view of the field: because of vacuum fluctuations, rigorously one no longer speaks of "the" field, but of the *probability of a particular field configuration*. [Ref. 16]

We also hold the vacuum to be composed of potentials, and regard the three terms *space-time*, *vacuum*, and *scalar potential* as essentially synonymous.

Newton's Third Law and the Detection Process

The VPF EM stress of the local vacuum immediately surrounding the nucleus may be decomposed a la Whittaker into opposing bidirectional EM plane waves/forces. Thus the nonlinear nucleus may be regarded as a pumped phase conjugate mirror, normally with a gain of one.

In this view, Newton's third law reaction force is generated because the so-called "photon" interaction with an atom is in fact a graviton reaction involving a photon/antiphoton pair that is decoupled.

The decoupled photon normally is absorbed and reradiated by an orbital electron, while the decoupled antiphoton interacts with the nucleus, producing a time-reversed twin of the external force —or, in other words, Newton's third law reaction force, which gives a slight recoil of the nucleus.

Half of every measurement physicists normally make is discarded, with the missing half accounting only for Newtonian reaction in the meter or instrument, which is usually ignored.

The fact that half of our measurement interactions are ignored is occasionally discovered and noted by physicists, who may even write a paper pointing it out, but no change is instituted in the foundations. [Ref. 17 and Ref 18]

Semiconducting Vacuum and Self-Oscillation

The vacuum immediately surrounding the nucleus is structured by the nucleus, and is itself nonlinear and capable of acting as a *semiconductor*. [Ref. 19]

Since both this immediately local semiconductor vacuum and the nucleus it surrounds are highly nonlinear, then *nonlinear resonance* can conceivably be established between them.

Further, since the resonating system in such case is an open system away from thermodynamic equilibrium, the oscillation can be self-sustaining. Such self-oscillation of the pumping of a PCM is already well-known in the nonlinear optical literature, particularly with compounds containing barium. [Ref. 20]

THE VACUUM TRIODE

The Basic Concept

As is well-known, a stress can be decomposed into opposing sets of forces. But quantum mechanically, the forces we are interested in with our work here are all caused *electromagnetically*, by the exchange of virtual photons. Even mechanical force, according to QM, is caused in this manner. Thus opposing electromagnetic or mechanical "stress" sets of bidirectional EM forces are microscopically equivalent to the notion of *pump waves* in nonlinear optics.

Hence under the proper conditions, it follows that trapped EM stress energy of the vacuum can be utilized to "pump" the nucleus.

Treating the stress-pumped nonlinear nucleus as a PPCM, it follows that the stress energy of the vacuum can be tapped by a 4-wave mixing mechanism in the atomic nucleus, to provide amplified phase conjugate EM wave outputs from the atom in response to small signal wave inputs. [Ref. 21]

In the proper nonlinear material, the material may act as a PPCM, in which case there exists a suitable connection between the material's atomic nuclei and its external electromagnetic lattice bonds, and the amplified phase conjugate replica wave generated in the nucleus will be emitted from the material as an EM wave field. This field can then be tapped by suitable means and output to an external load circuit.

Block Diagram of the Vacuum Triode

Figure 4 shows a basic block diagram of the vacuum triode process, utilized by Sweet in several laboratory vacuum energy devices. These devices have ranged from a nominal 500 watt output in a 6-lb. device to 5 kilowatts for a heavier unit. Gains have ranged from 50,000 to 1,500,000 for open-loop systems. Both open-loop and closed-loop systems have been built and tested.

Figure 4 shows a combined block diagram for either a closed-loop or open-loop system. In the open-loop system, a barium ferrite magnetic material is used as a pumped phase conjugate mirror.

In the "standard" design, two opposing PPCMs are used. The advantage of this dual combination is the use of *self-targeting* (repetitive phase conjugation, signal by signal). This has the effect of

1. stabilizing the Whittaker field, and

2. producing a quantum potential between the two mirrors, so the mirrors and the Whittaker potential between them are essentially one single space-time entity.

Discussion of a quantum potential is beyond the scope of this paper, but the technical mechanism for creating one has been previously presented by the author on several occasions. [Ref. 22]

First we will explain the open-loop operation of the vacuum triode. In Figure 4, on the right an external 60 Hz, nominal 10 volt AC sine wave of several tens of microwatts in power is input into the stabilized field of the barium ferrite magnet structure, where it modulates the field, producing a signal wave input into the atoms of the material.

In the top right block, the EM signal wave interacts with the electron shell of an atom, which in turn is EM-coupled to the nucleus.

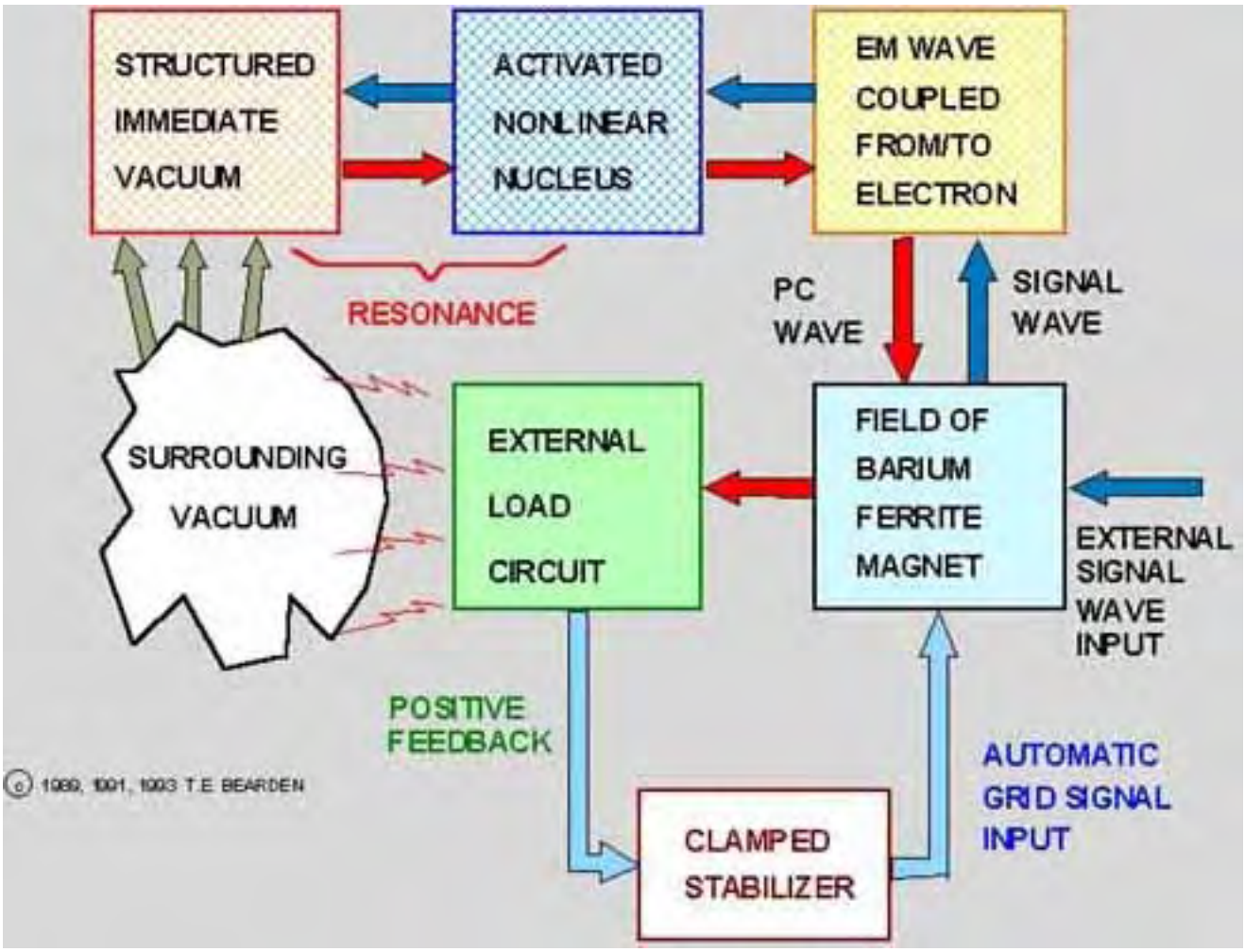

Figure 4. The Vacuum Triode Concept.

Thus an EM signal wave is input to the nucleus of the atom, which is highly nonlinear (middle top block). Earlier, Sweet had specifically conditioned the atomic nuclei with a proprietary process, wherein in the barium nucleus a trapped 60 Hz scalar EM spherical wave resonance (self-oscillation) exists between the structured semiconductor vacuum immediately surrounding the Ba nucleus.

In the same *activation* process, the ambient potential of the surrounding vacuum was raised and stabilized, in the two leftmost blocks.

At this point the nonlinear nucleus is effectively self-pumped by the trapped, excited, spherical scalar wave oscillation between the structured semiconductor vacuum and the nucleus. The nucleus is now a strongly pumped phase conjugate mirror.

Consequently, when the signal wave input arrives, the PPCM nucleus emits an amplified phase conjugate replica (PCR) wave, which precisely backtracks the input signal wave. This precise backtracking (perfect retroreflection) is referred to as the "distortion correction theorem."

In short, the powerful PCR wave returns precisely toward the external source, passing through the electron shells and arriving in the perturbed barium ferrite magnet assembly field, where it perturbs the field.

A transformer-like system then extracts this magnetic field perturbation and conducts it to the external load circuit.

However, the PCR contains *negative* energy. Short of the load, the internal circuits run cool, rather than heating. This is a signature of a true vacuum energy tapping device.

Indeed, if the output leads of the Sweet vacuum triode are physically shorted together, a brilliant flash occurs, and the leads instantly ice as if dipped in liquid oxygen. This is another signature of the true negentropic over-unity vacuum tap.

Note that the energy extracted from the semiconducting vacuum adjacent to the nucleus is just instantly replaced by the surrounding vacuum's inexhaustible energy pool. This is an open-loop system, with a hidden energy source: the intense virtual particle flux of the vacuum's ambient charge.

It is not possible to exhaust that flux, which is often calculated to have an energy density of some 10^{100} or more grams per cm^3, if the energy were cohered and condensed into mass.

As can be seen, even a VT gain of 1.5×10^6 represents a "vacuum tap" of an incredibly small efficiency, on the order of 10^{-100} or so. However, the vacuum "river" is so energetic that such efficiencies are quite sufficient.

We accent that the barium ferrite magnetic material must be *activated* so that stable self-oscillation between the barium nucleus and the surrounding semiconductor vacuum exists. Although self-oscillating/self-pumped PCMs are known at optical frequencies, Sweet has discovered and perfected a brilliant methodology for activating PPCM nuclei at ELF frequencies.

In a resistive load such as light bulbs, the resistive material accomplishes repetitive phase conjugation. Thus in the resistor, half the total energy is expressed as photon or dissipative energy in the external (electron shell) level.

As the excited electrons decay, they emit scattered EM energy as light and heat. This is an *exothermic* interaction. The other half of the total energy reacts in the atomic nuclei, as a phase conjugative or *endothermic* interaction.

We strongly accent that, Whittaker-wise, there are two electromagnetic channels and two kinds of EM:

1. *external* EM, the common electron-shell interacting, entropic, scattering, time-forward kind, and

2. the *internal*, unsuspected, hidden variable, nuclei interacting, negentropic, reordering/ convergent kind.

Internal EM travels strictly between atomic nuclei, normally not reacting with electron shells unless a pumped phase conjugate mirror reaction is invoked in the nucleus to produce a gain somewhat greater than unity.

Thus if we wish to communicate with atomic nuclei directly, and engineer them directly, we must utilize the internal EM channel via applied Whittaker methods.

Antigravity Tests

Inherent in the preceding discussions is the possibility to turn EM energy into gravitational energy of either sign. In other words, one should be able to utilize Sweet's vacuum triode to produce and demonstrate antigravity.

Indeed this is the case. Sweet has also discovered the special alterations necessary to perform straightforward transformation of the internal energy in the nucleus to antigravitational energy, producing a unilateral thrust upward.

Note that the bulk of G-potential gradient (G-force-field) occurs Whittaker-wise at ELF frequencies. This explains why nonlinear phase conjugate opticians do not notice direct antigravity effects.

At the optical frequencies at which they work, the effects are so miniscule that they are negligible. This is readily explained as follows: In QM, the quantum (photon) is comprised of action (angular momentum), not just energy. It is rather like a "piece of energy welded to a piece of time, with no seam in the middle."

Since quantum change occurs in quanta, the decoupling of the energy and time components, in the continual interaction of photons with matter, exchanges energy between G-potential of vacuum and trapped mass of the atom or particle. In this exchange, small increments of time are continually being formed (and unformed, as photon emission occurs).

Consequently, each mass is moving forward in time in small incremental jumps, usually of exceedingly small magnitude. However, the energy and time trapped in a photon are canonical. The greater the piece of energy, the smaller the piece of time, and vice versa.

So if one wishes to stress the "rate of flow of time" significantly, one needs to produce large amounts of photons that have very large pieces of time, and consequently little pieces of energy.

Since the energy of the photon is directly proportional to its frequency, this means that the lower

frequency photons have larger time increments, and hence endure over many "regular-sized photon absorption/emission changes" to appreciably stress the rate of time flow/production.

The bottom line is that the standard pumped phase conjugate mirror can be adapted to produce antigravity at ELF frequencies, but precisely the same adaptation at optical frequencies will have negligible effect.

With this in mind, the author requested Sweet to perform an antigravity experiment to prove the thesis. With Sweet's proprietary adaptation of his vacuum triode/PPCM, the experiment produced rather straightforward but spectacular results, as shown in Figure 5.

The experiment was performed as follows: Rigged for antigravity, the 6-lb. device was placed on a scale so that its weight could be continuously monitored. A special external load box was utilized in which multiple electric light sockets were connected in parallel.

Then the external load draw was adjusted by merely screwing in 100-watt lamps, one at a time, with measurement and observation pauses in between. The output of the device was 120 volt, negative AC sine-wave power at 60 Hz.

For each 100-watt increment, the load power was recorded and the weight was carefully recorded. The results are shown in the rather smooth, classic curve shown in Figure 5.

At 1,000 watts load draw, the previously 6-lb. device had reduced its weight due to gravity by 90 percent. At that point the signal-wave (grid) input to the open-loop vacuum triode was only 175.4 microamps at 10 volts, or just under two milliwatts.

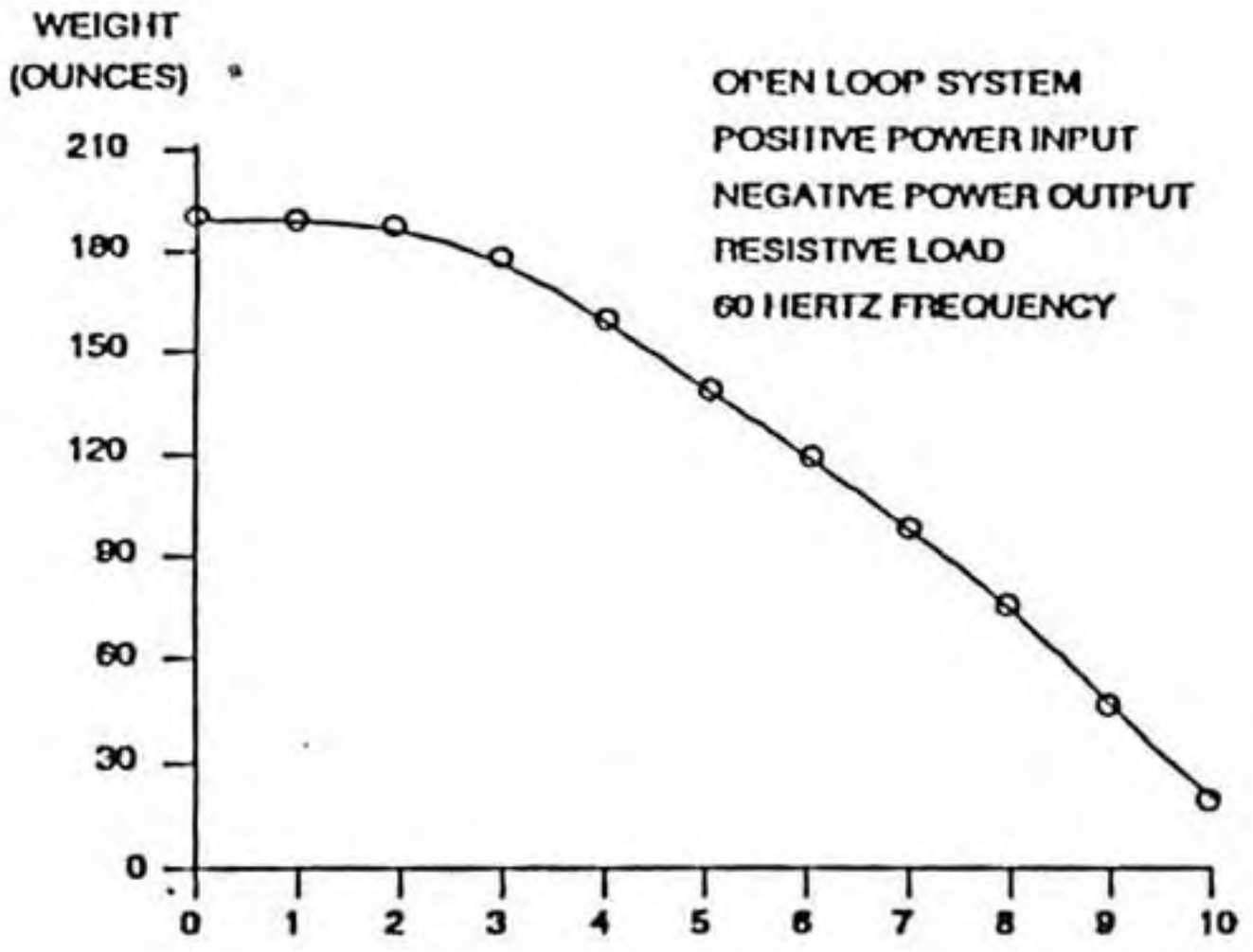

EXTERNAL ELECTRICAL LOAD

(HUNDREDS OF WATTS)

Figure 5. Antigravity Test of Sweet's Adapted Vacuum Triode.

We accent that the nominal two milliwatt input is only a gating signal. It is the organized, gated vacuum energy that is performing the action.

The experiment was stopped short of actual hovering and flying due to safety considerations. With the specific adaptation, magnetic monopoles are deposited in the magnet materials, producing internal tensile stress.

Since no explosive controlled facilities were available, and there was no wish to destroy the VT, the experiment was terminated at 90% antigravity performance.

It was completely successful, and adequately demonstrated the validity of the unified field theory concepts utilized in our approach.

CONCLUSIONS

A new unified field theory has been developed, tested, and at least partially verified experimentally.

The concepts of the theory have been applied by Sweet in a series of inventions that produce readily usable, safe electromagnetic power directly from the vacuum.

The methodology lends itself to formulation of power devices without moving parts. Antigravity, predicted by the concepts of the theory, has been demonstrated in actual practical demonstrations on the laboratory bench.

Though not discussed in this paper, application of the concepts and methodology to a large variety of other fields, such as medical reversal of aging and curing of almost the entire range of present debilitating diseases, has been previously pointed out. [Ref. 23]

We have also pointed out the mechanism for Kaznacheyev's cytopathogenic effect, or the induction of cellular pathology at a distance by electromagnetic means. [Ref. 24]

We have also pointed out the specific mechanism involved in Priore's device, which in rigorous laboratory animal testing under the auspices of eminent French scientists, demonstrated nearly 100 percent cures for terminal cancers and leukemias, sleeping sickness, artherosclerosis, and other debilitating diseases.[Ref. 25]

We believe we have also produced the concepts enabling the direct engineering and therapeutic manipulation of Popp's master cellular control system. [Ref. 26]

We conclude that the concepts we have utilized and experimentally demonstrated are universal, as implied by any notional unified field theory.

Our conclusion is that the concepts, theory, and experiments, taken together, are sufficient for investigation and replication by the scientific community.

If replicated and fully substantiated, we believe the work will directly point the way to, and usher in, a new unified field theory physics of universal application.

SPECULATED IMPLICATIONS

As can be seen, the implications of the new approach are profound. The authors believe they have ushered in the forerunner of a vast new physics, one which will change our lives, and our view of physical reality, in ways previously undreamed of.

By mastering, controlling, and gating the vast, incredible energy of the seething vacuum, we can power our automobiles, flying machines, and technology inexhaustibly. Further, it can be done absolutely cleanly; there are no noxious chemical pollutants to poison the biosphere. With practical antigravity, ships can be developed to cross the solar system as readily as one crosses the ocean today.

And the ships, automobiles, and technology will never run out of fuel; the inexhaustible vacuum fills

every system, everywhere, to overflowing.

Not discussed in this paper, it turns out that living systems, faced with the problem of achieving negentropy so as to maintain their form in a dissipative external physical reality, have always used the hidden internal channel for such things as mind, thought, cell control, and living functions.

With the new methodology, one now faces the advent of access and engineering of the mind and life of the observer as readily as the observer's physical body.

Transmutation of the elements, control of the weather, lighting and powering our cities and homes cheaply and cleanly, and provision of plenty for everyone is the vista for the future. We can in fact clean up the radioactive wastes, rid ourselves of coarse nuclear and petroleum powerplants.

We strongly stress that, with the ability to engineer the Schroedinger equation itself, the new methodology allows the direct engineering and control of quantum change, and hence of physical reality itself.

The methodology is extendable to hyperdimensions; nested virtual levels of the vacuum are already precisely that. The author has already pointed out the application of this emerging technology to the absolute cure of diseases such as AIDS, cancer, leukemia, etc., and shown that the Priore device in France already proved the efficacy of the application in the 60s and 70s.

We shall be able to rid ourselves and our descendents of diseases. With direct access to the actual software of life and mind, in the future we should be able to achieve levels of education previously unattainable, by directly inputting the relevant software.

Previously we have also pointed out that four nations of the world are already embarked on weaponization of scalar EM unified field technology. It is sobering to think that, in addition to having the ability to make our planet a paradise for humankind, we also will have the ability to make it a hades.

For that reason, we are doing our best to clarify the technical concept and the theory in this 1991, hopefully with the view that humankind will seize upon the positive aspects, and develop and apply this technology for the betterment of all people everywhere.

Long ago, Albert Einstein said these words:

"It would of course be a great step forward if we succeeded in combining the gravitational field and the electromagnetic field into a single structure. Only so could the era in theoretical physics inaugurated by Faraday and Clerk Maxwell be brought to a satisfactory close."

And Teilhard de Chardin wrote:

"Someday, after we have mastered the winds, the waves, the tides and gravity, we shall harness for God the energies of love. Then for the second time in the history of the world man will have

discovered fire."

The authors fervently believe they have come upon fire for the second time, as allegorized by de Chardin. If so, let us all use the knowledge wisely.

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2. E.T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," *Math. Ann.*, Vol. 57, 1903, p. 333-355; "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions," *Proc. Lond. Math. Soc.*, Series 2, Vol. 1, 1904, pp. 367-372. The first paper was in fact a detailed theory of the scalar standing potential wave that Nikola Tesla discovered four years earlier, on the night of July 3-4 1899, being radiated from thunderstorms, which he entered in his *Colorado Springs Notebook* on the morning of the 4th. More recently the Whittaker structure (WS) inside potentials, including the Schroedinger potential, has been shown by V.K. Ignatovich, "The Remarkable Capabilities of Recursive Relations," *Am. J. Phys.*, 57(10), Oct. 1989, p. 873-878, without credit to Whittaker or to the presence of such structured scalar potentials in Maxwell's original quaternion EM theory. These WSs are universal to scalar potentials; e.g., for the same in acoustics, see Richard W. Ziolkowski, "Localized Transmission of Wave Energy," *Proc. SPIE, Vol. 1061, Microwave and Particle Beam Sources and Directed Energy Concepts*, Jan. 1989, p. 396-397.

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4. It is pointed out that today all potentials are well-known to be gravitational entities. However, this was not known in Whittaker's time, and so he himself did not realize that he had actually produced an engineerable, testable unified theory of electromagnetics and gravitation.

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6. For the theory of a pumped phase conjugate mirror, see David M. Pepper, "Nonlinear Optical Phase Conjugation," *Opt. Eng*., 21(2), Mar./Apr. 1982, p. 156-183; Amnon Yariv, *Optical Electronics*, 3rd Edn., Holt, Rinehart, and Winston, New York, 1985. In a normal triode tube, the amplified plate signal is 180 degrees out of phase *spatially* with the grid input, but in-phase with it in respect to *rate of flow through time*. In a PPCM, the amplified phase conjugate replica wave is in phase spatially with the signal wave, but 180 degrees out of phase with it in respect to its rate of flow through time. It is pointed out that a PCM with a gain of unity produces a coupled EM wave/antiwave pair whose energy is additive in 3-space but subtractive in the first derivative of the fourth dimension, time. Hence it is no longer an electromagnetic wave as such, but an oscillatory wave of stress upon the local rate of flow of time. Hence it is a powerful *electrogravitational wave*, whose EM nature is hidden in the guise of a scalar EM potential. It is also a wave of variation in the local gauge, and of variation in the local ST curvature.

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8. Sweet has continued to extend his theoretical treatment. A formal paper providing the complete mathematical theory of the vacuum triode has been drafted, is in final review, and will be submitted to a leading journal by mid-1991.

9. See Chapter 25: Outlook, "Possibility of Vacuum Engineering," T.D. Lee, *Particle Physics and Introduction to Field Theory*, Harwood, New York, 1981, pp. 824-828.

10. In 1977 Ilya Prigogine received the Nobel Prize for extending thermodynamics; in particular, for the theory of dissipative structures in nonequilibrium thermodynamics. In Prigogine systems, negentropy is known to be possible.

11. Robert G. Sachs, *The Physics of Time Reversal*, Univ. Chi. Press., Chicago, 1987.

12. Note that this moves the entire notion of the charge of a fundamental particle to a deeper and more extended level. Now the charge may be *discretized*, but it is not quantized in the hard conventional sense. Further, the internal Whittaker structure of the massless VPF photon exchange of vacuum and mass, which, quantum mechanically, is what the electrical charge of the particle is in the first place, is deterministically structured. Note that this violates the present assumption that all like charged particles are identical; now two electrons may have either the same or different magnitudes of charge, and even when the magnitudes are the same, their internal charge structures (Whittaker structures) and VPF exchange with the vacuum may differ. Also note that this resolves the severe QM problem of missing chaos (hidden order) in quantum change. The reason for the problem was the use of Gibbs statistics with its assumption of random variable change, which a priori excluded hidden order (and hence chaos) from QM. That was only a special case, albeit an important one. There are now three QM cases: (1) the conventional case, where there is no hidden order; (2) the case where there is some hidden order, and the statistics is chaotic, not random; and (3) the case where the QM change is deterministic, with essentially total hidden order. Note that the Whittaker

methodology allows one to directly engineer cases (2) and (3), including the Schroedinger equation itself.

13. The present second law of thermodynamics is written only for time-forward entities, and need not apply for the time-reversed case. Merely viewing the energy-dissipating forward time case in reverse allows an appreciation of the time-reversed case. In other words, the second law of thermodynamics is incomplete as presently stated. The complete law has a corollary to cover the increase in order as the time-reversal of the system increases. Thus the complete law consists of two parts: (1) the entropic, time-forward case, and (2) the negentropic time-reversed case. Since the re-ordering can be amplified at will by a PPCM process, the correct distinction between the two subsets of the complete law is important, and applies to real systems.

14. A.D. Sakharov, *Theor. Math. Phys.*, Vol. 23, 1975, p. 435.

15. T. E. Bearden, *Gravitobiology: A New Biophysics*, Tesla Book Co., 604 Date Ave., Chula Vista, CA 91912, 1991.

16. C.f. Charles W. Misner, Kip S. Thorne, and John Archibald Wheeler, *Gravitation*, W.H. Freeman and Co., San Francisco, 1973, p. 1191.

17. E.g., see Richard Kidd et al, "Evolution of the Modern Photon," *Am. J. Phys*., 57(1), Jan. 1989, pp. 27-35. See also R. Chen, "Cancellation of Internal Forces," *Am. J. Phys*. 49(4), Apr. 1981, p. 372.

18. A nonlinear material may simply emit a photon, or it may act as a phase conjugate mirror (PCM) and emit a phase conjugate replica of the absorbed photon. When the material emits a normal photon, it measurably recoils. When it emits a time-reversed photon, it does not recoil, as already experimentally established in nonlinear phase conjugate optics. The solution to the mystery is this: When emitting a normal photon, the material does not act as a PCM. In that case the matching antiphoton which split from the interacting graviton (the graviton that yielded the external photon) interacts with the nucleus, producing a recoil action with a gain of one. Thus Newtonian third-law recoil of the nucleus occurs. On the other hand, when the material acts as a PCM, it also emits the antiphoton *outside* the atom to "backtrack" the absorbed "signal wave" photon. In that case there is no Newtonian recoil of the nucleus, because the *agent* for causing recoil did not interact with the nucleus to produce it.

19. Richard E. Prange and Peter Strance, "The Semiconducting Vacuum," *Am. J. Phys*. 52(1), Jan. 1984, p. 19-21. Also, under nonlinear conditions, a particle can absorb more energy than is in the light incident on it, absorbing the energy from the vacuum VPF. C.f. Craig F. Bohren, "How Can a Particle Absorb More Than the Light Incident on It?" *Am. J. Phys*. 51(4), Apr. 1983, p. 323-327.

20. C.f. Pepper, ibid. and Yariv, ibid. For a specific example, see Mary J. Miller et al, *Appl. Phys. Lett*. 41(8), Oct. 15, 1982, p. 689-691.

21. Again, for the theory of the PPCM, see Pepper, ibid. and Yariv, ibid.

22. E.g., see T.E. Bearden, *Gravitobiology: A New Biophysics*, Tesla Book Co., Chula Vista, CA, 1991, p. 33-36.

23. Bearden, *AIDS: Biological Warfare*, Tesla Book Co., 1988; *Gravitobiology: A New Biophysics*, Tesla Book Co., 1991; *Analysis of Scalar Electromagnetics*, Tesla Book Co., 1990.

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26. C.f. Fritz Albert Popp, "Photon Storage in Biological Systems," in Fritz Albert Popp et al, Eds., *Electromagnetic Bio-Information: Proceedings of the Symposium*, Marburg, September 5, 1977, Urban & Schwarzenberg, Baltimore, 1979, p. 123-149; also *Biophotonen. Ein neuer weg zur Losung des Krebsproblems*, Verlag fur Medizin, Heidelberg, 1976 [in German].

Defense Department Briefing on Priore Treatment to counter Biological Warfare

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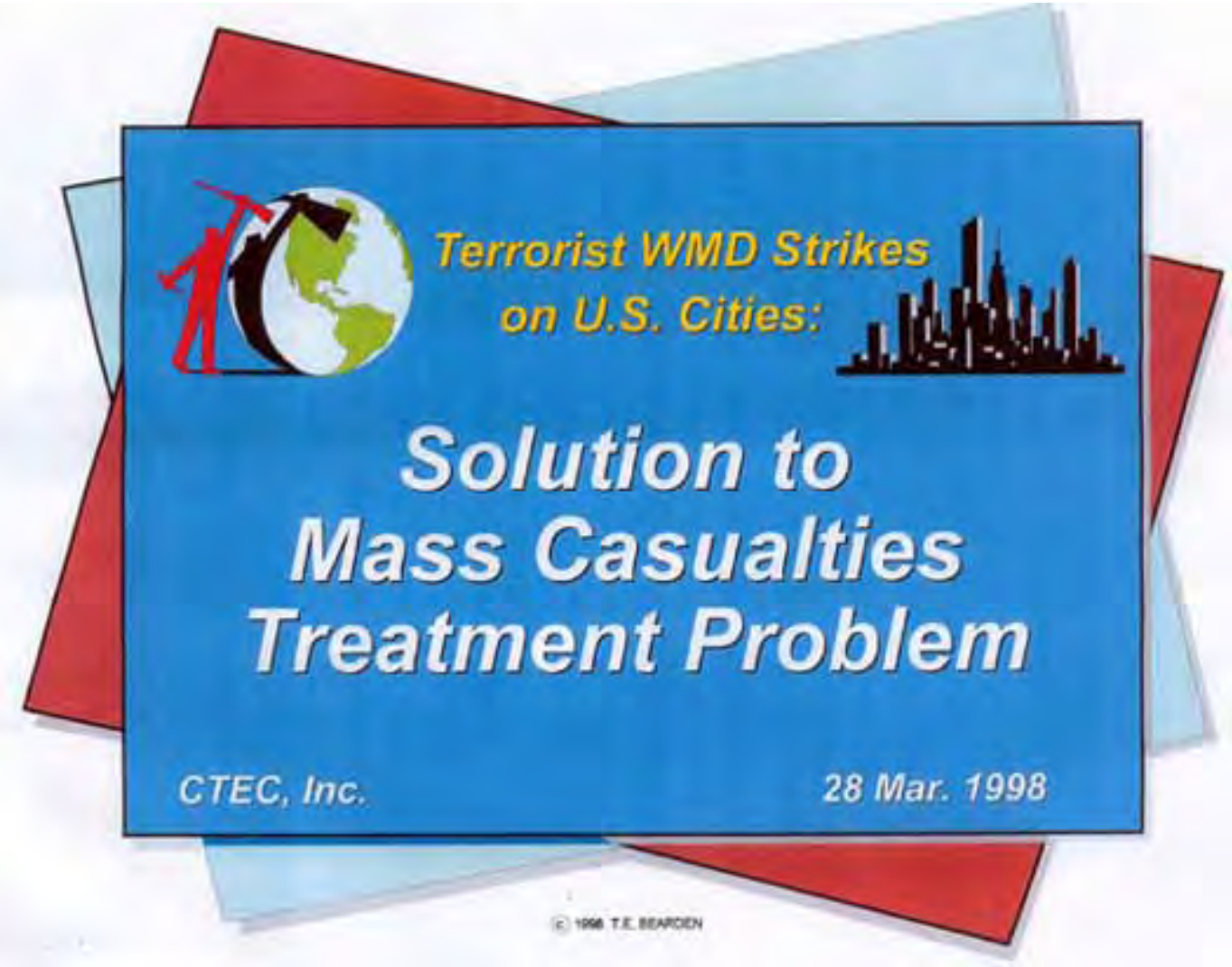

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Key Points in the New Technology

- There is a vast new kind of electrodynamics *hidden inside* all EM potentials, fields, and waves
  - Longitudinal EM waves and complexes
  - Oscillations in time domain

- These complexes are an *infolded general relativity*
  - Clustered formations of *spacetime curvatures*
  - *Very powerful*, since the EM force is used as the agent of curvature

- In general relativity, similar precise complexes permeate and *act on any mass at all internal levels*
- With this approach, one *can now manipulate matter* -- living or inert -- *in any manner desired*, depending only on the level of development of the technology
- Priore unwittingly used this to *cure dread diseases*
- This is a *revolution in all of science*

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- *We have uncovered the major mechanisms* to utilize

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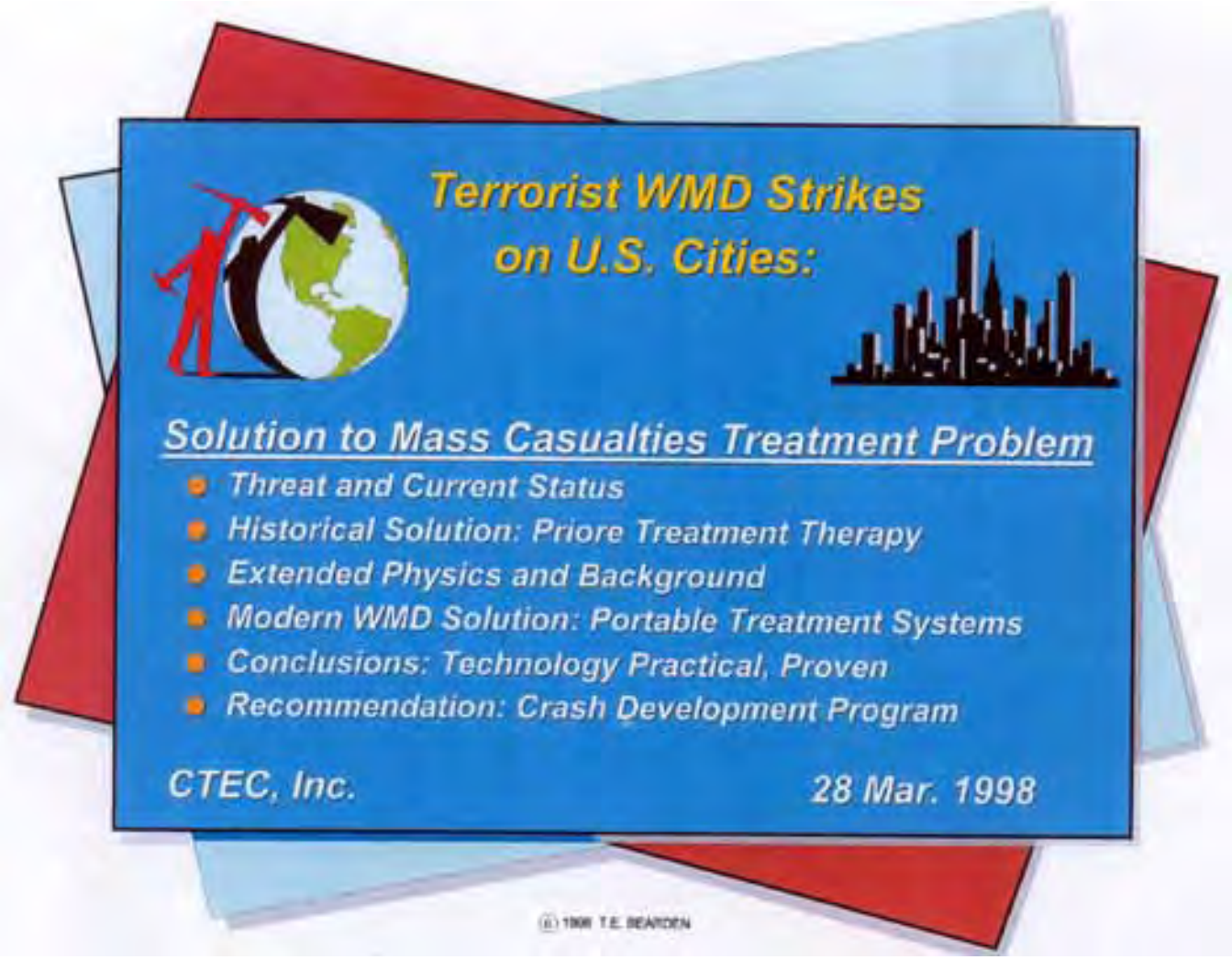

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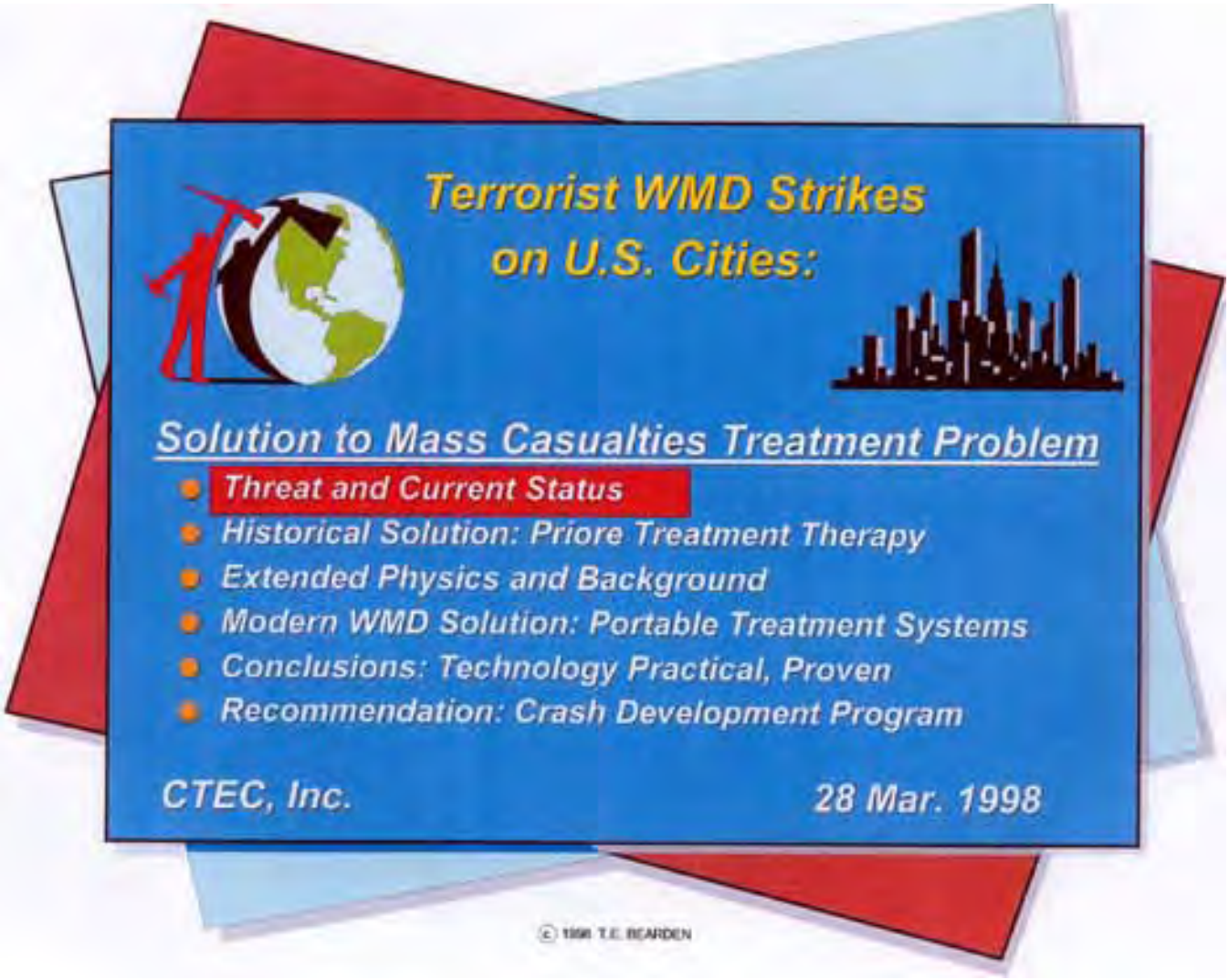

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THE TERRORIST THREAT

TODAY:

- Sabotage
- Chemicals
- Biological agents
- Nuclear materials
- Powerful explosives
- Assassination
- Kidnapping and hostages
- Contamination
- Shoulder-fired AD missiles
- Terrorism

FUTURE ADDITIONS:

- EM weapons
- EM biological warfare
- Scalar EM weapons
- Scalar EM disease induction
- Alteration of behavior and emotions
- Alteration of memory
- Direct thought control
- Action-at-a-distance effects

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Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.

- One terrorist, one light aircraft with spray tank
- 100 kilograms of anthrax
- Flies over greater metropolitan Washington, D.C.
- Calm night
- 1-3 million casualties result*
- Most of those stricken will die
- Presently little can be done to save the stricken civilians
- Attacks on several population centers might produce some 10 million or more casualties

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*Per OTA Report to Congress, 1993

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Present Status of the WMD Threat to the United States

- Many foreign nations are hostile to the U.S. and sponsor terrorists
- Some 25 nations have WMD or are acquiring them
  - BW agents and weapons
  - Chemical agents and weapons
  - Nuclear materials and weapons
- Thousands of students and emigres
- Infiltrated teams, BW, other WMD already
- Castro guerrillas infiltrated over the years
- Can do unacceptable damage to U.S. now
- *May reach first strike knockout capability*

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*Per OTA Report to Congress, 1993

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Some Present Problems in the U.S. WMD Defense Capabilities

- No shelters (require overpressure, BW filtering, masks, showers, supplies)
- No stockpiled vaccines, medical supplies, immunoglobulins, masks, suits, food, fuel, generators, heaters, water purification units
- Totally insufficient medical facilities, personnel, and emergency response teams
- Triage, full martial law will be required
- No answer to massive decontamination problem
- State, county, city inadequately staffed and insufficiently trained for mass casualties
- Terrorist teams, BW agents, other WMD on site, waiting
- Water supplies, food, crops, farm animals also vulnerable
- Electric power grid, bridges, trains, railroads vulnerable
- Present medical science cannot save very many of the casualties, now or in the foreseeable future

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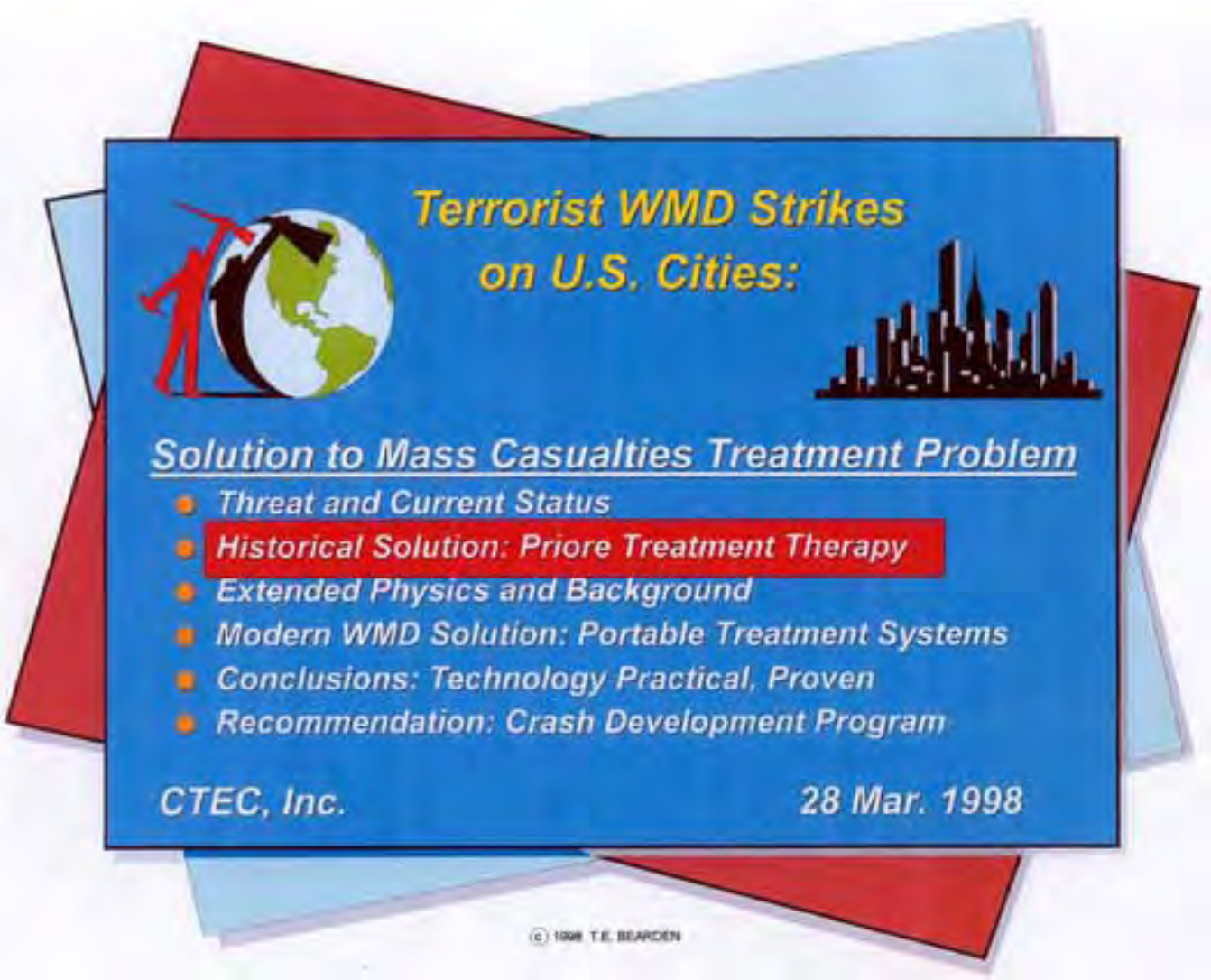

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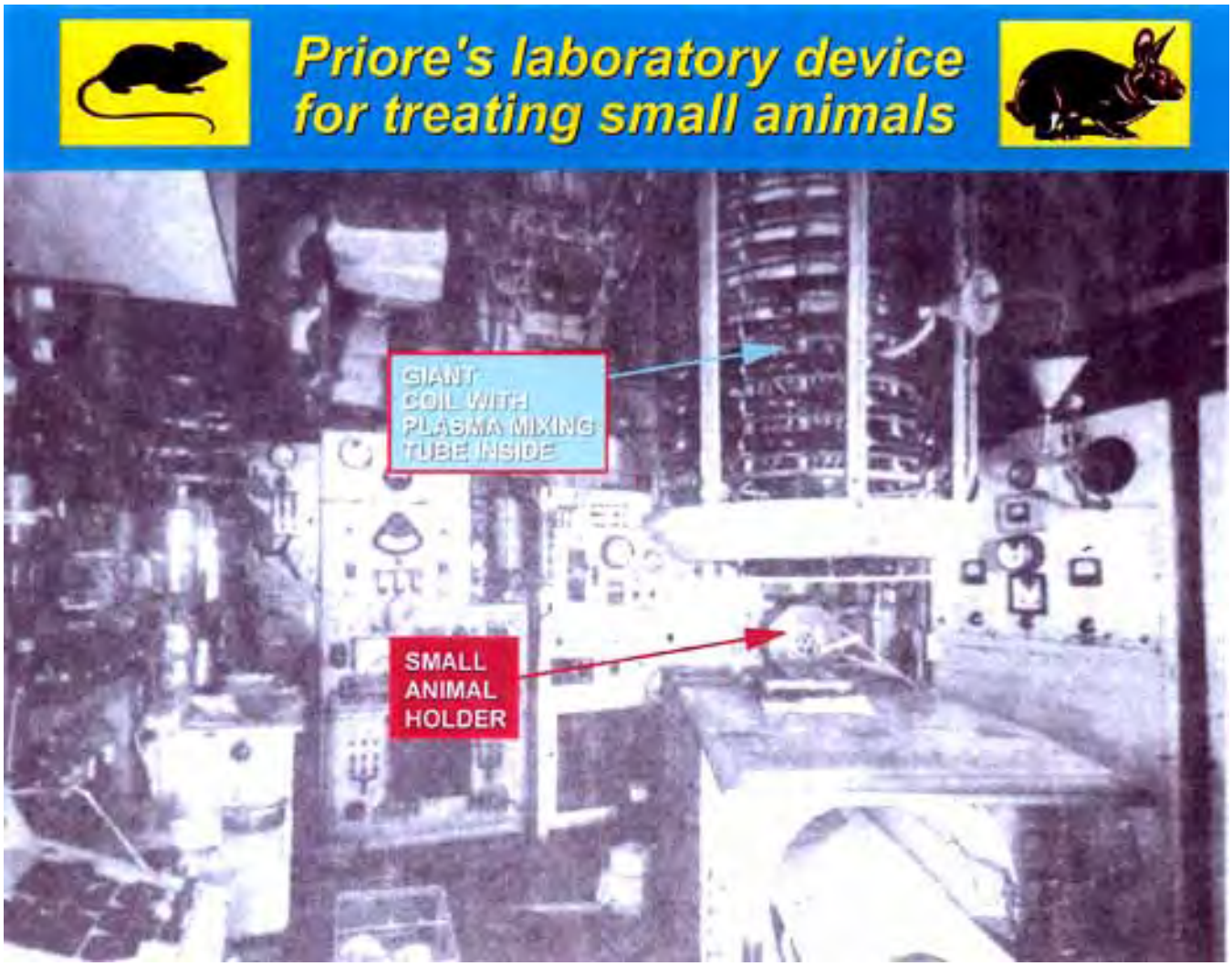

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Photo courtesy of Bob Whitney

Antoine Priore (right) with the Mayor of Bordeaux, Mr. Chaban-Delmas.

The Priore technical mechanism unwittingly involved a dramatic extension to both nonlinear optics and general relativity. However, nonlinear optics itself had not yet been born in the 1950s and 1960s when Priore worked out his methodology. The extension to general relativity has not been previously envisioned even to the present day. When the Priore project was suppressed by the changed French government in the mid-1970s, nonlinear optics itself was just being initiated. To the present day, however, there has previously been no inkling of the dramatic extension to NLO that arises by using longitudinal EM pump waves and thereby pumping in the time domain.

It is little wonder that Priore himself did not understand the nature of the technical mechanism he was utilizing, and neither did anyone else, and neither *has* anyone else prior to this time.

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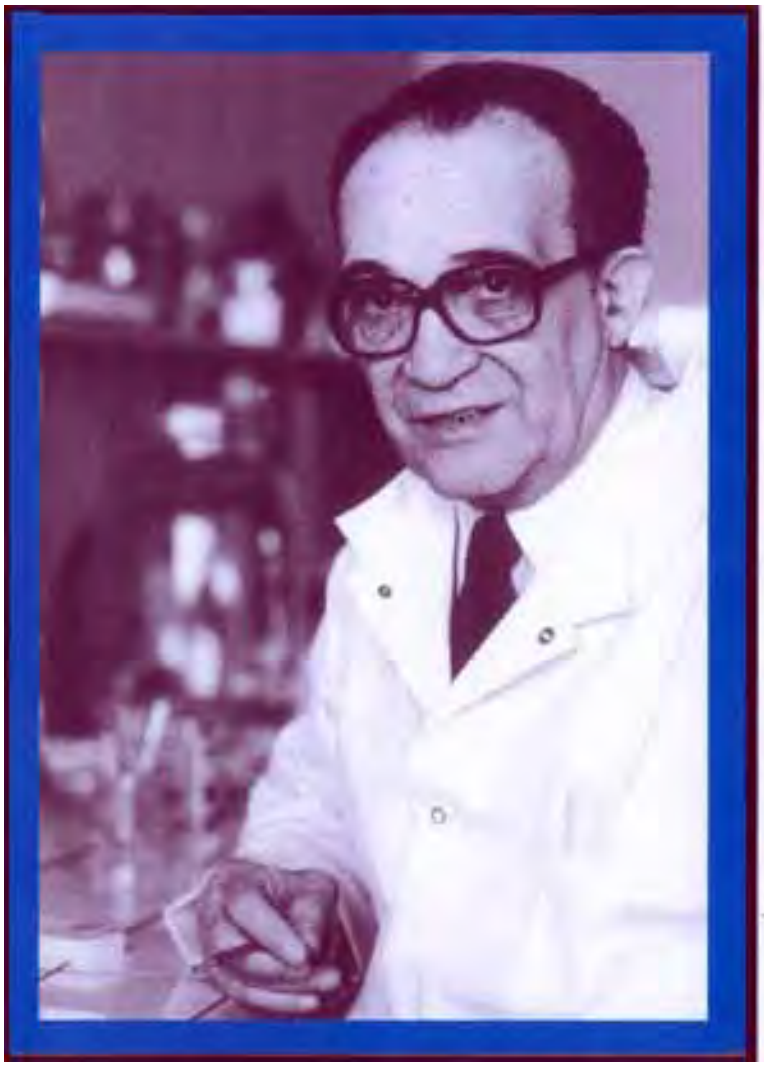

Raymond Pautrizel, eminent French parasitologist who worked with Priore

Among other things, Pautrizel treated seriously infected immature rats with the Priore ray. These rats had never had a mature immune system. When they were removed from the machine, they still sickened again and died, because their immature immune systems could not resist the pathogen *(Trypanosoma)*. So even though the damaged cells were reversed back to normal, the "normal" immune system was unable to fight off pathogens, which reinfected the cells and killed them, killing the rats.

This established the time-reversal nature of the therapy.

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12-Foot plasma tube in Priore's large device

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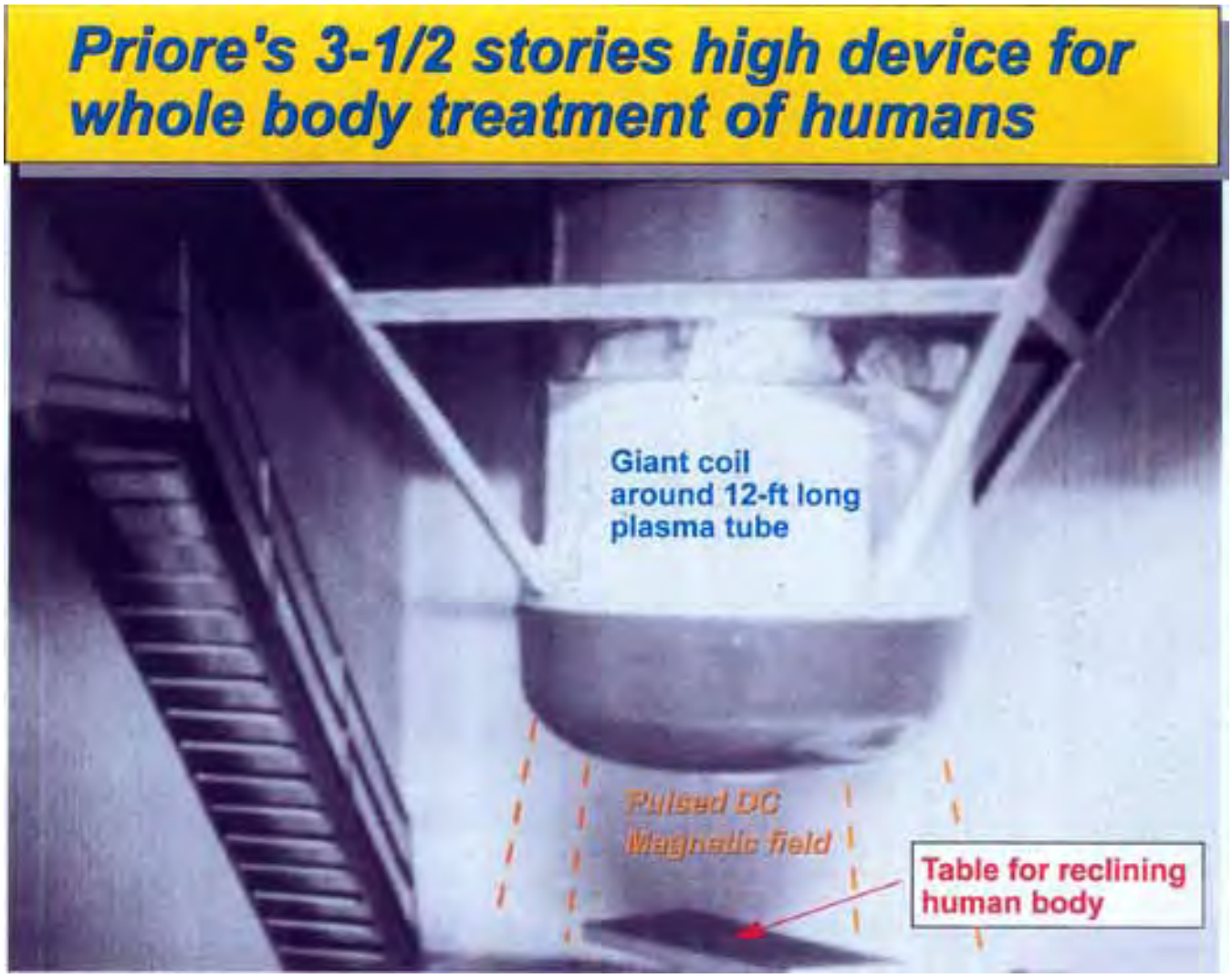

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MECHANISM OF THE PRIORE THERAPY

- FACT: DISEASE-SPECIFIC VACUUM ENGINE PRESENT FOR ANY CELLULAR DISEASE, BY WHEELER'S PRINCIPLE
  - *DISEASE CAN BE REVERSED BY CREATING AMPLIFIED VACUUM ANTI-ENGINE (BEARDEN'S PRINCIPLE)*
  - *ANTI-ENGINE IS CREATED BY PUMPING THE NONLINEAR CELLS IN THE "INNER EM" DOMAIN, TIME-REVERSING THEM*

- PRIORE UTILIZED A PLASMA TO PHASE CONJUGATE AND "INFOLD" MULTIPLE BIDIRECTIONAL LONGITUDINAL EM PUMP WAVES
  - *17 FREQUENCIES MIXED IN A ROTATING PLASMA*
  - *PHASE CONJUGATES ADDED BY THE PLASMA*
  - *INFOLDED MIX INTO STRONG PULSED DC MAGNETIC FIELD, WHICH CARRIED IT INTO ATOMIC NUCLEI*
  - *PUMPED ALL NONLINEAR CELLULAR COMPONENTS TO PRODUCE AMPLIFIED, SPECIFIC VACUUM ANTI-ENGINE*

- NEGATED THE LONG-TERM CUMULATIVE CELLULAR DEDIFFERENTIATION ORDER GENERATED BY LONG-TERM HYPOXIA. TUMOR CELLS REVERTED TO NORMAL CELLS.
- SCRUBBED OUT THE CUMULATED PRECANCEROUS STATE
- RESTORED THE IMMUNE SYSTEM TO HIGH FUNCTIONING
- NO EXCESSIVE TRAUMA TO TREATED ANIMAL

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Priore's therapeutic methodology: Using infolded longitudinal EM waves as NLO pump waves, to pump in the time domain

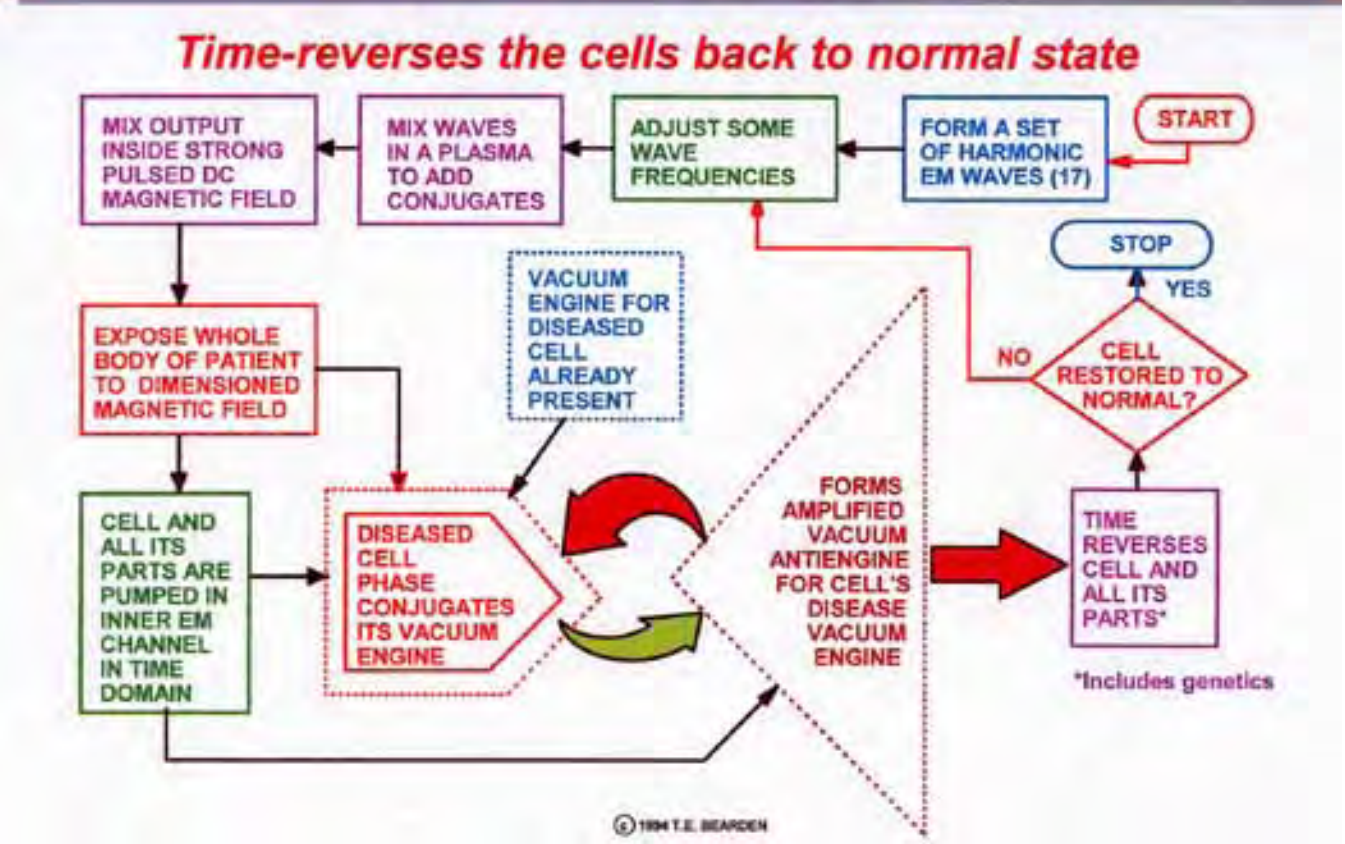

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DRASTICALLY REDUCED CUMULATIVE DETERIORATION AFTER PRIORE THERAPY

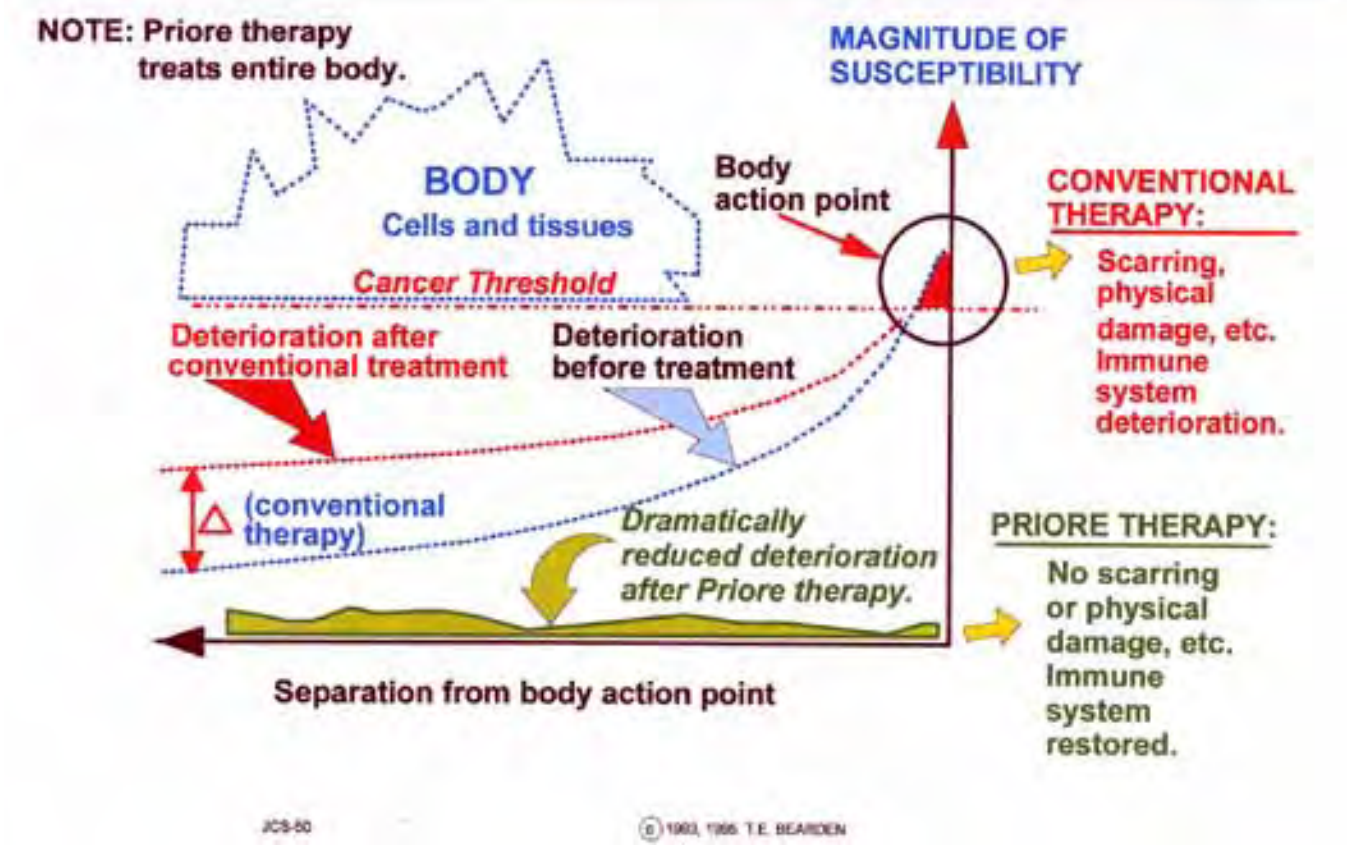

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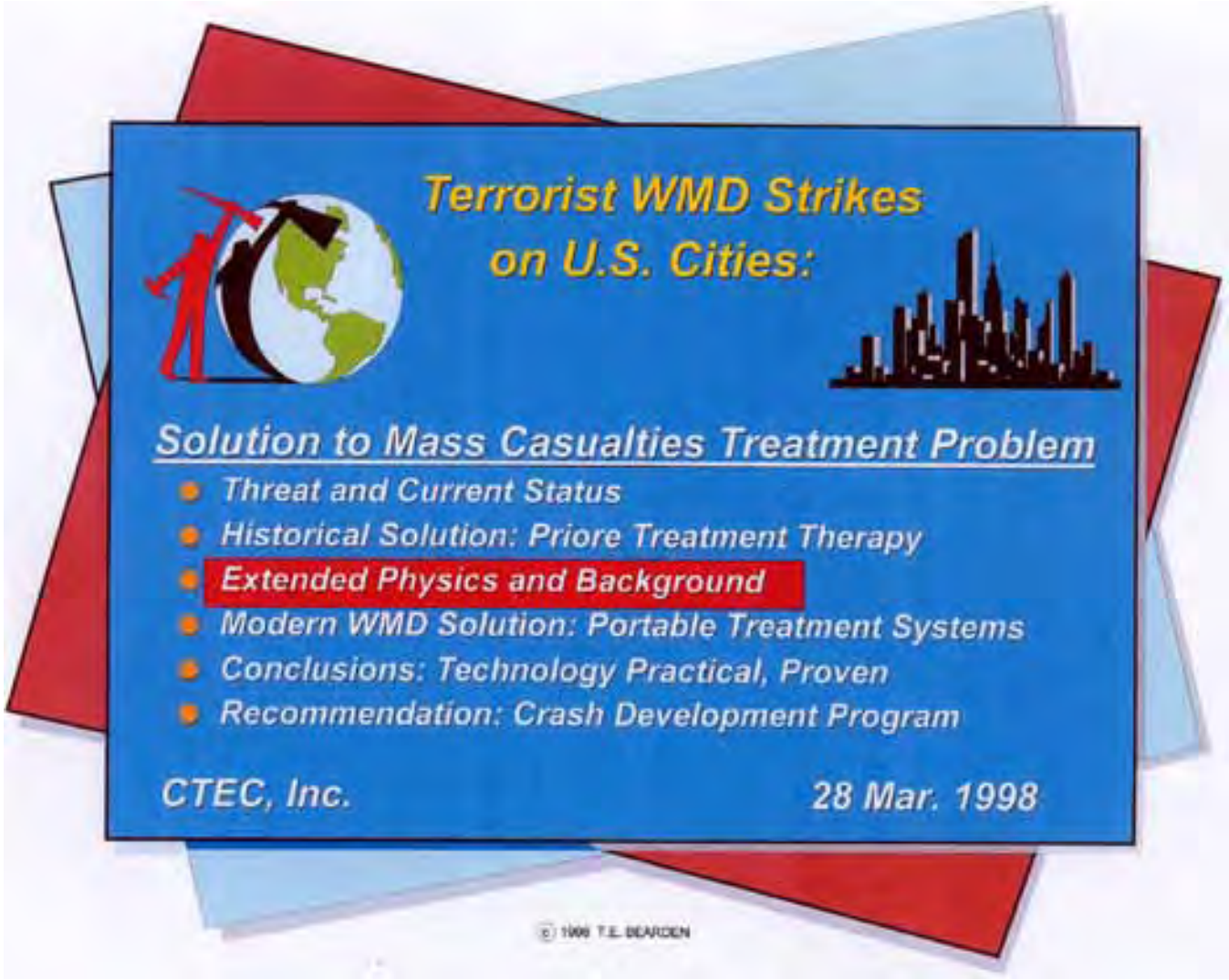

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Founders of Scalar Electromagnetics

- **G.J. Stoney:**

Decomposed the scalar potential into bidirectional wave pairs.

"On a supposed proof of a theorem in wave-motion," Phil. Mag., 5(43), 1897, p. 368-373 (and several other papers).

- **E.T. Whittaker:**

Decomposed the scalar potential into a series of bidirectional EM wave pairs in harmonic series, where the two waves in each pair are conjugates (i.e., a wave/antiwave pair) and are longitudinal waves.

"On the partial differential equations of mathematical physics," Math. Ann., Vol. 57, 1903, p. 333-355.

Showed that all classical EM -- including waves -- can be replaced by two interfering scalar potential functions.. (This founded superpotential theory, extended by Nisbet, Bromwich, Debye, McCrea, and others.)

"On an expression of the electromagnetic field due to electrons by means of two scalar potential functions," Proc. Lond. Math. Soc., Series 2, Vol. 1, 1904, p. 367-372.

- **R.W. Ziolkowski:**

Independently rediscovered the biwave decomposition of the scalar potential and added the product set (in theory enabling modulations and communications) to Stoney and Whittaker's sum set.

Various papers, 1985 to date.

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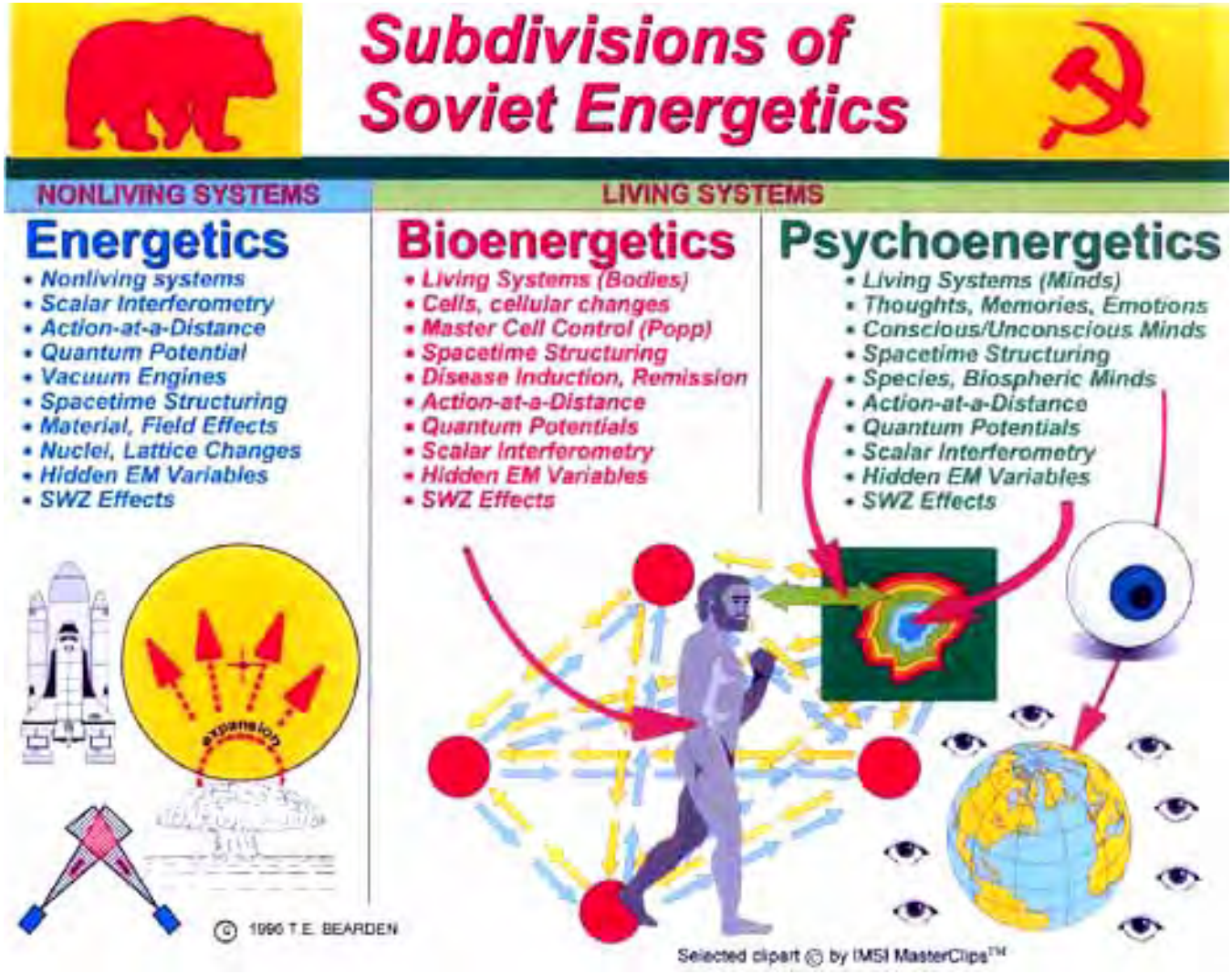

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Bunge on the Status of Classical and Quantum Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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EINSTEIN ON REVIEWING FOUNDATIONS

"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them."

Albert Einstein, "Foreword," in Max Jammer, Concepts of Space: The History of the Theories of Space in Physics, Harvard University Press, Cambridge, Massachusetts, 1969, p. xi-xii.

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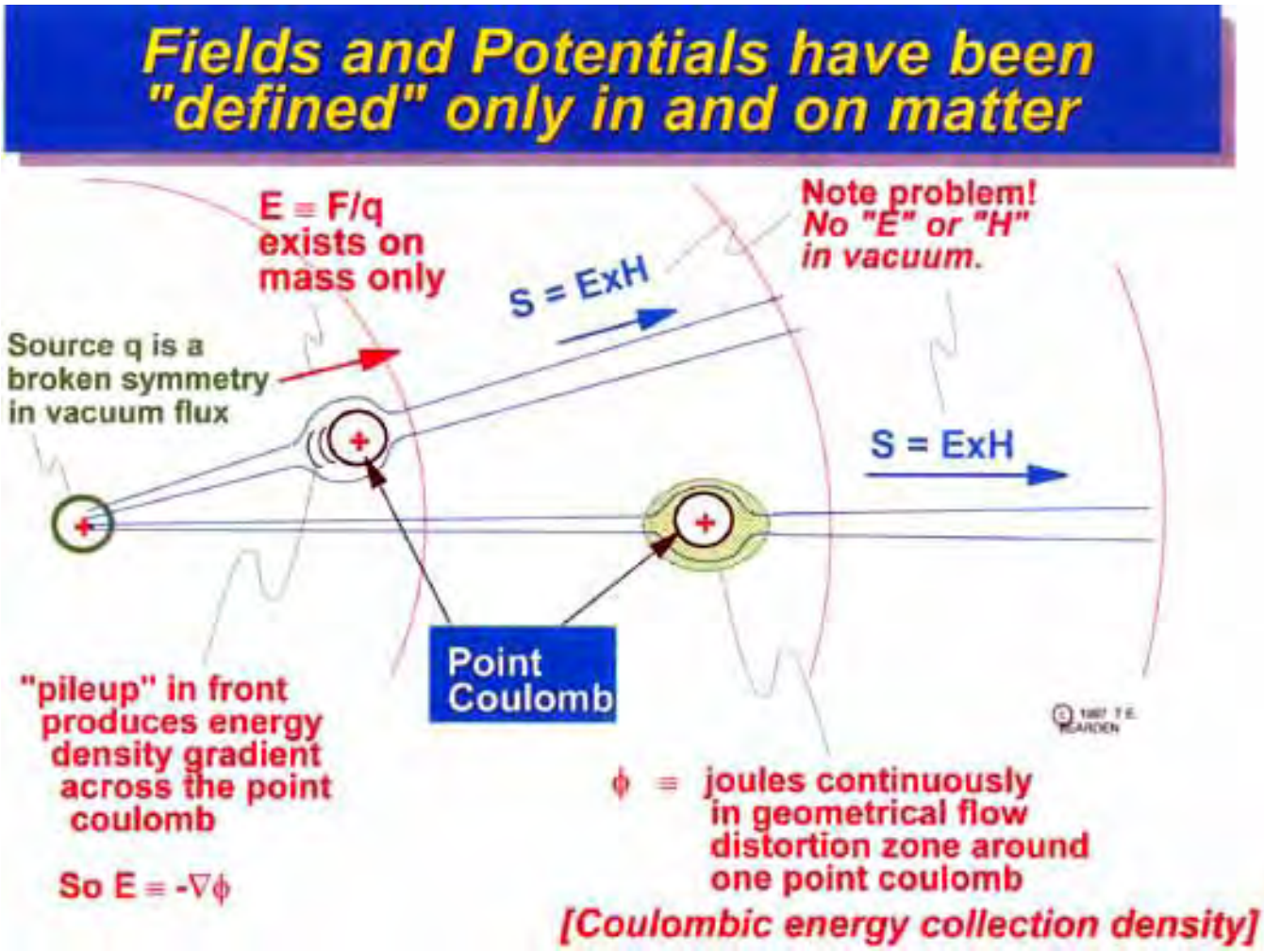

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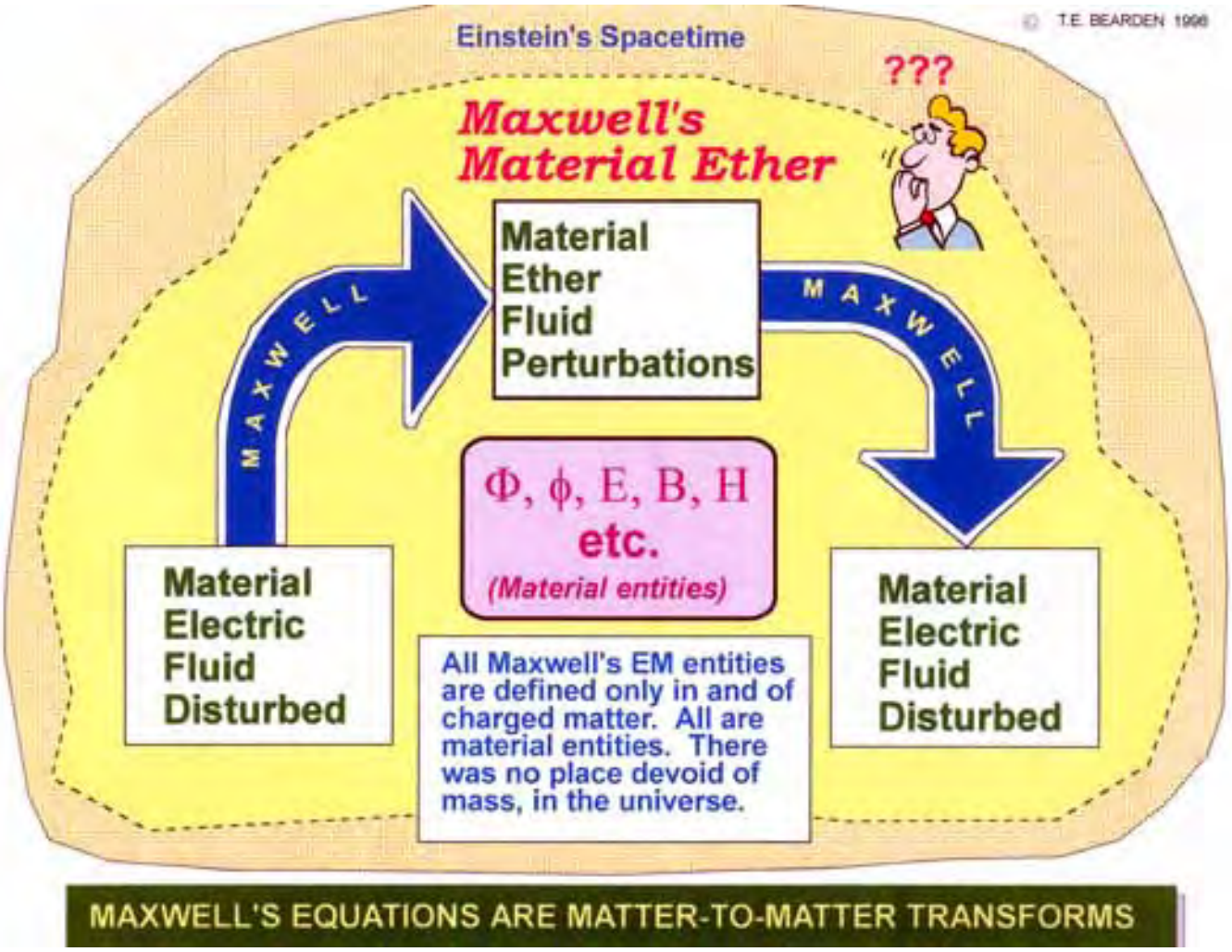

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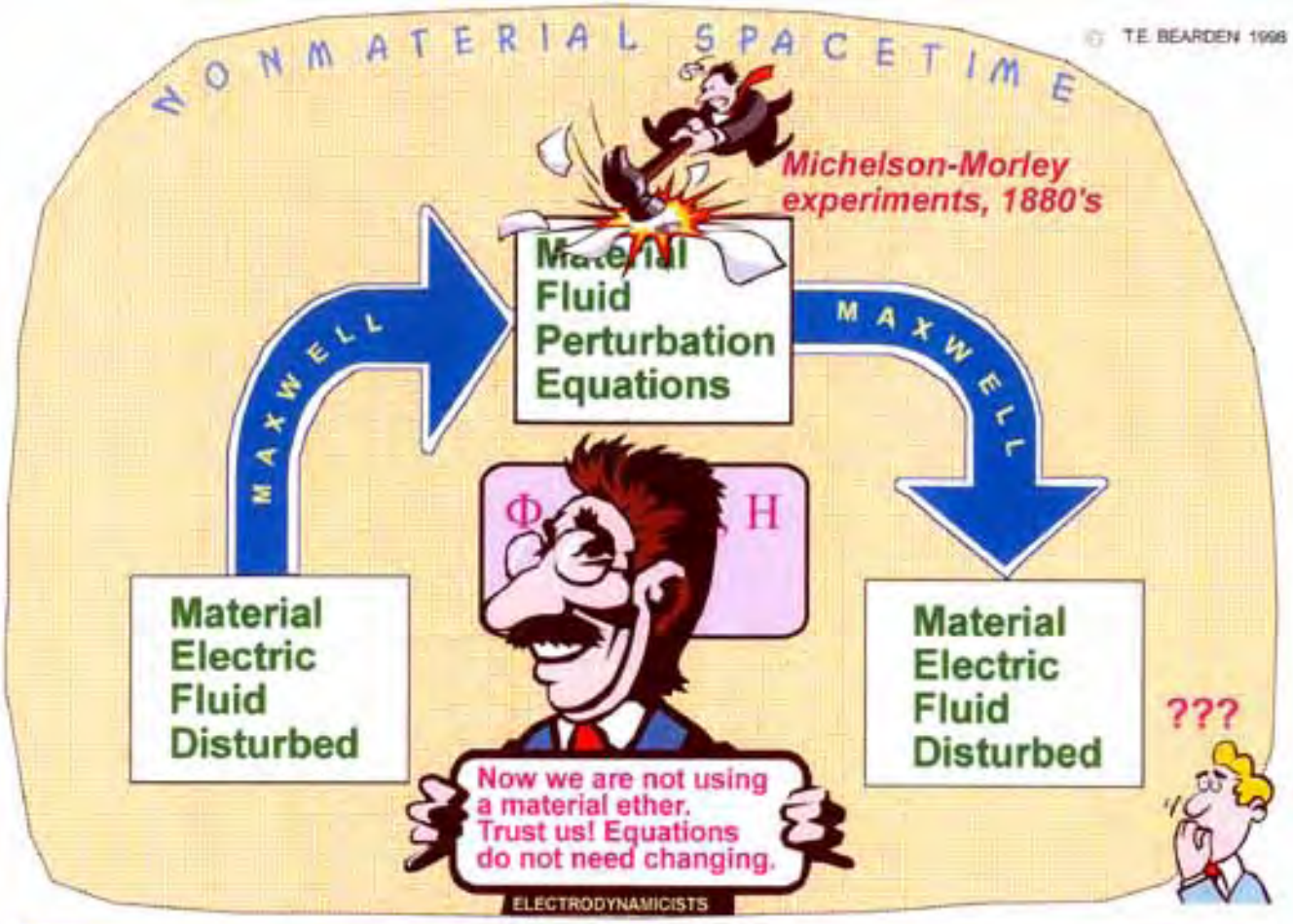

Electrodynamicists' Reaction to Removal of the Material Ether

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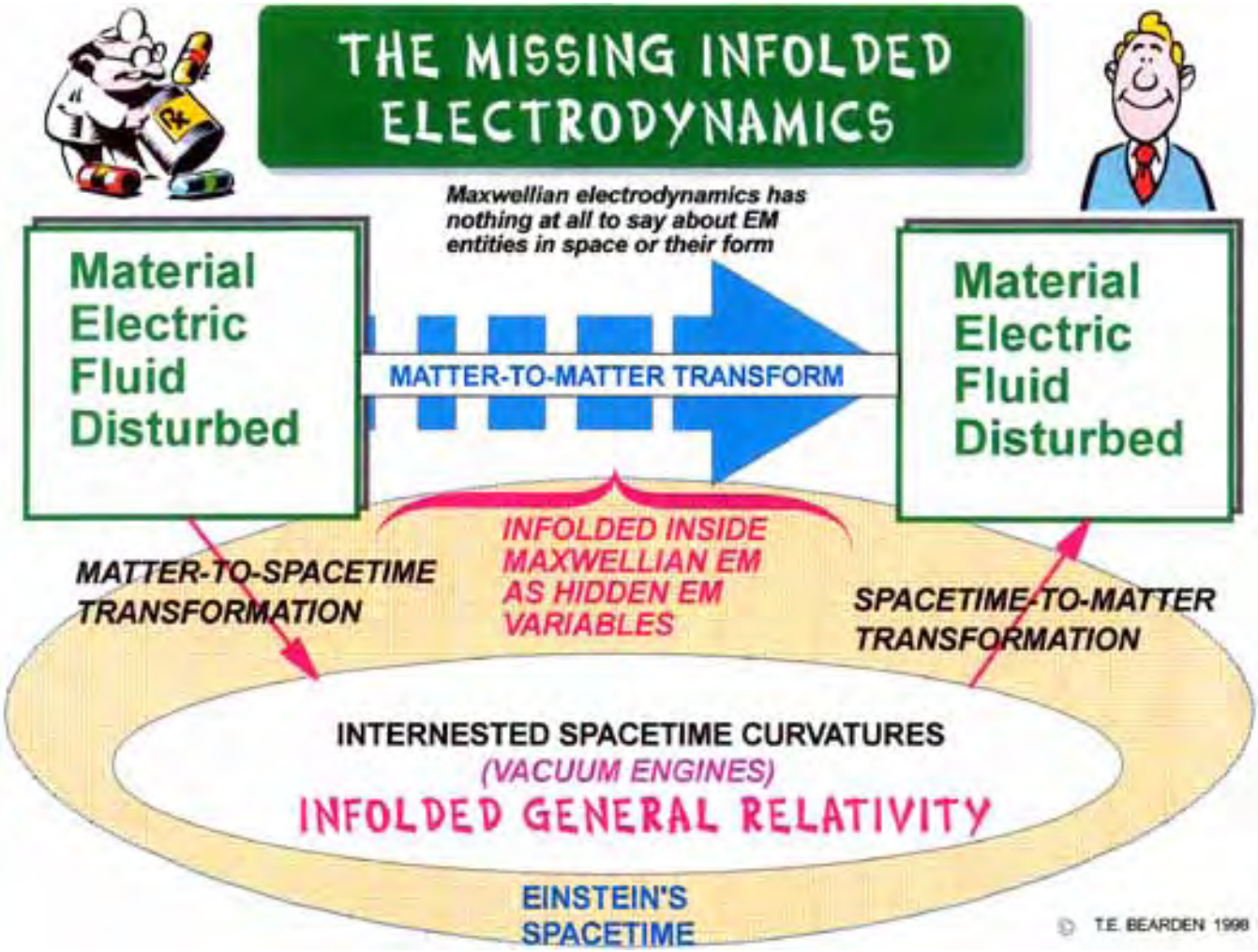

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Nonlinear Optics
Distortion Correction Theorem

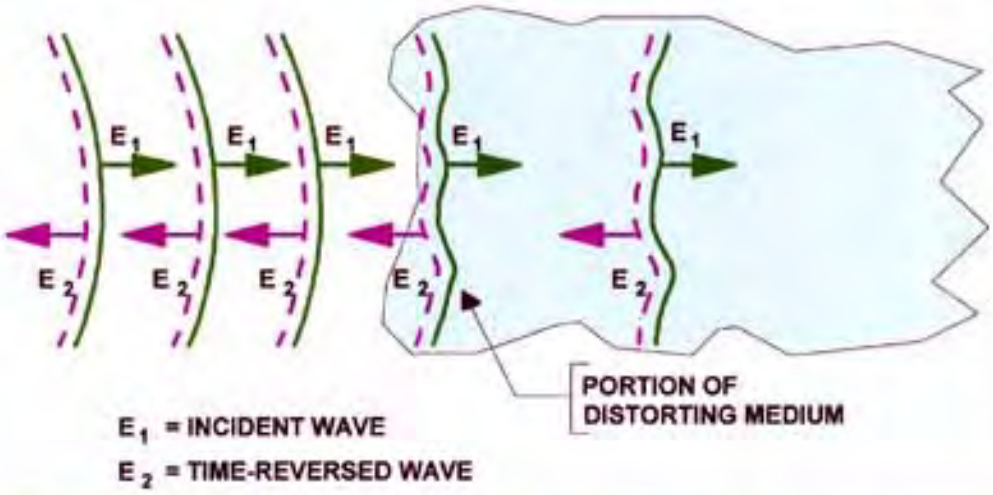

"If a scalar wave $E_1(r)$ propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica $E_2(r)$, then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1."

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Infolded longitudinal EM biwave composition of a scalar potential

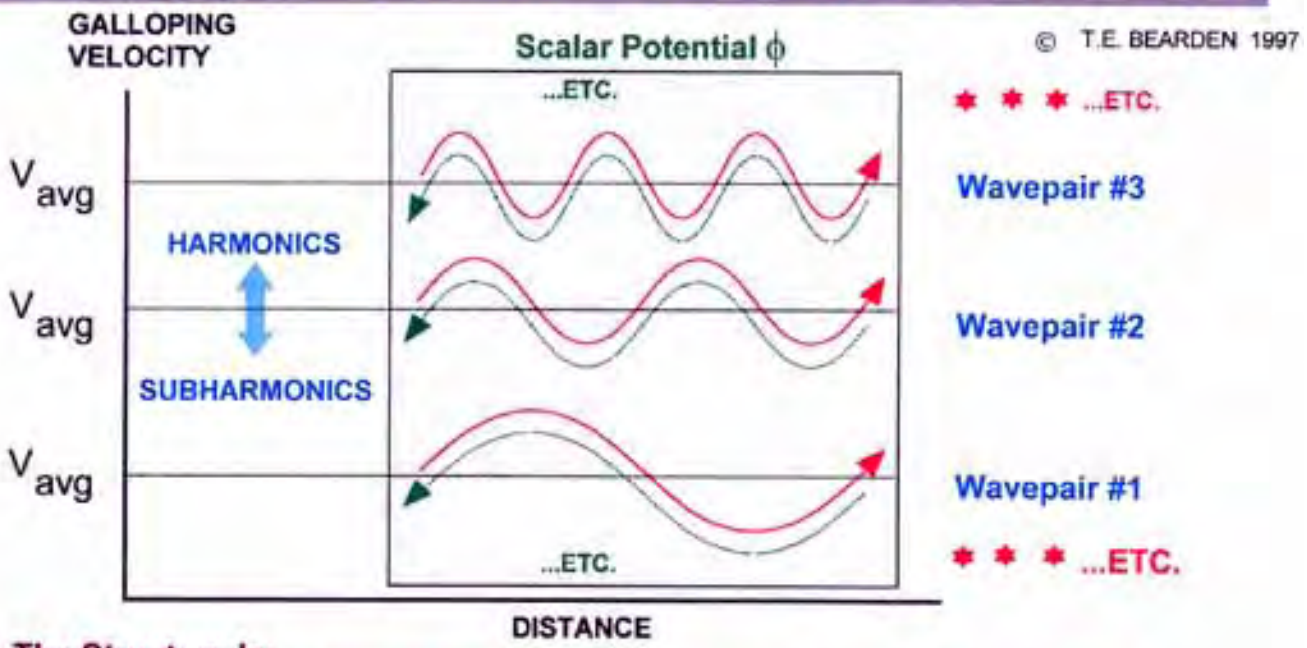

The Structure Is:

A harmonic set of longitudinal EM wavepairs. In each wavepair the two waves superpose spatially, but travel in opposite directions. The two are phase conjugates and time-reversed replicas of each other. Thus they comprise a coupled longitudinal wave and antiwave. The photons must be coupled into photon/antiphoton pairs (gravitons) by a strong application of the distortion correction theorem of nonlinear optics. Each wave in the biwave pair is a galloping wave. Each wavepair is a standing electrogravitational wave. In nonlinear optics, such a wavepair is a pump wave which pumps in the time domain.

Note: Think of the oscillations as velocity modulations.

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The Zero-Vector Axiom Destroys "Topologies within Topologies"

- The axiom: There is a unique vector, $\bar{0}$, in V (the vector space) such that
  $$\bar{V} + \bar{0} = \bar{0} + \bar{V}$$
- Note that $\bar{V} + \bar{0}_i = \bar{0}_j + \bar{V}$; $\bar{0}_i = -\bar{0}_i = n\bar{0}_i$
  so $\bar{0}_i = \bar{0}_j = \bar{0}_k = \ldots + \bar{0}_n = \ldots$
- This makes all $\bar{0}_i$ equal by assumption, since there is *assumed* to be only a single type $\bar{0}$ without real components
- In fact, $\bar{0}$ is <u>*not unique*</u>. An *infinite number* of different zero-vector systems, with real components, satisfy the zero-vector axiom.

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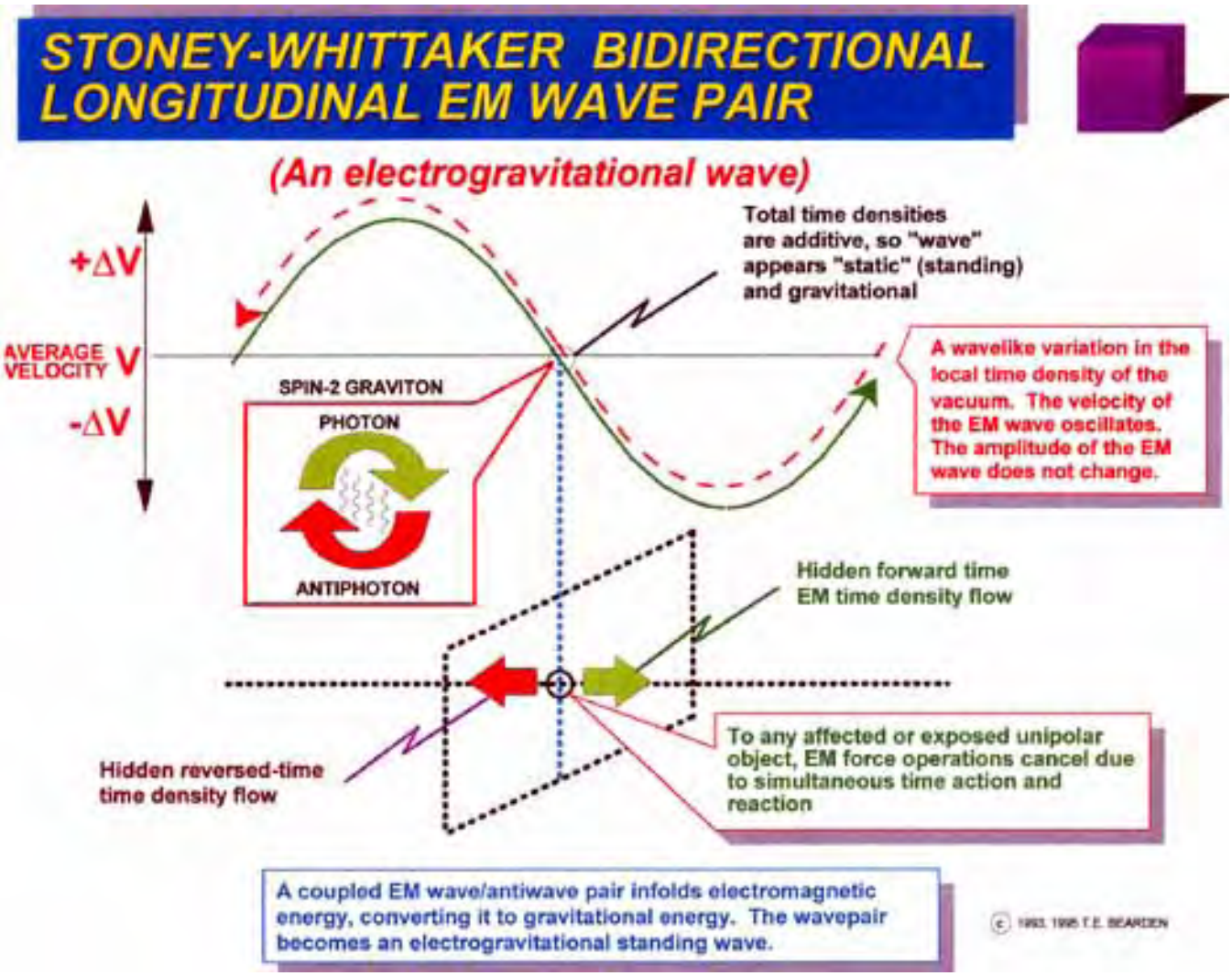

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Undistorted Progressive Waves (UPWs)*

(waves with velocity v, where $0 \leq v \leq \infty$)

- Major equations of interest having UPW solutions are:
  - *Homogeneous wave equation*
  - *Maxwell equations*
  - *Dirac, Weyl, and Klein-Gordon equations*

*Rodrigues and Lu, *Found. Phys.* 27(3), 1997, p. 435-508.

- UPWs are translationally invariant, and do not spread, or they reconstruct their original form after a certain period.
- UPW solutions have infinite energy. Quasi-UPWs can have finite energy and can in principle be launched into space.
- Subluminal Maxwell solutions are called *EM particles*. Superluminal Maxwell solutions are called *X-waves*.
- *Experimental results indicate such waves will be produced within the next few years.*

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- *Nimtz has translated Mozart's 40th symphony at v = 4.7c.*

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Velocity modulating a longitudinal EM wave oscillates rate of flow of time

$$V = \frac{L}{t}$$

Observer sees it this way

Constant transverse wave magnitude

Wave oscillates its velocity along its path, about a nominal value

Wave oscillates this way

Constant transverse magnitude

Wave oscillates magnitude of its transported t, about a nominal value

Note:

- Waves consist of photons
- Each photon consists of energy x time
- Each photon carries time as well as energy
- A wave is both a spatial energy dynamics and a temporal dynamics
- Wave complexes carry dynamic time structures as well as dynamic energy structures

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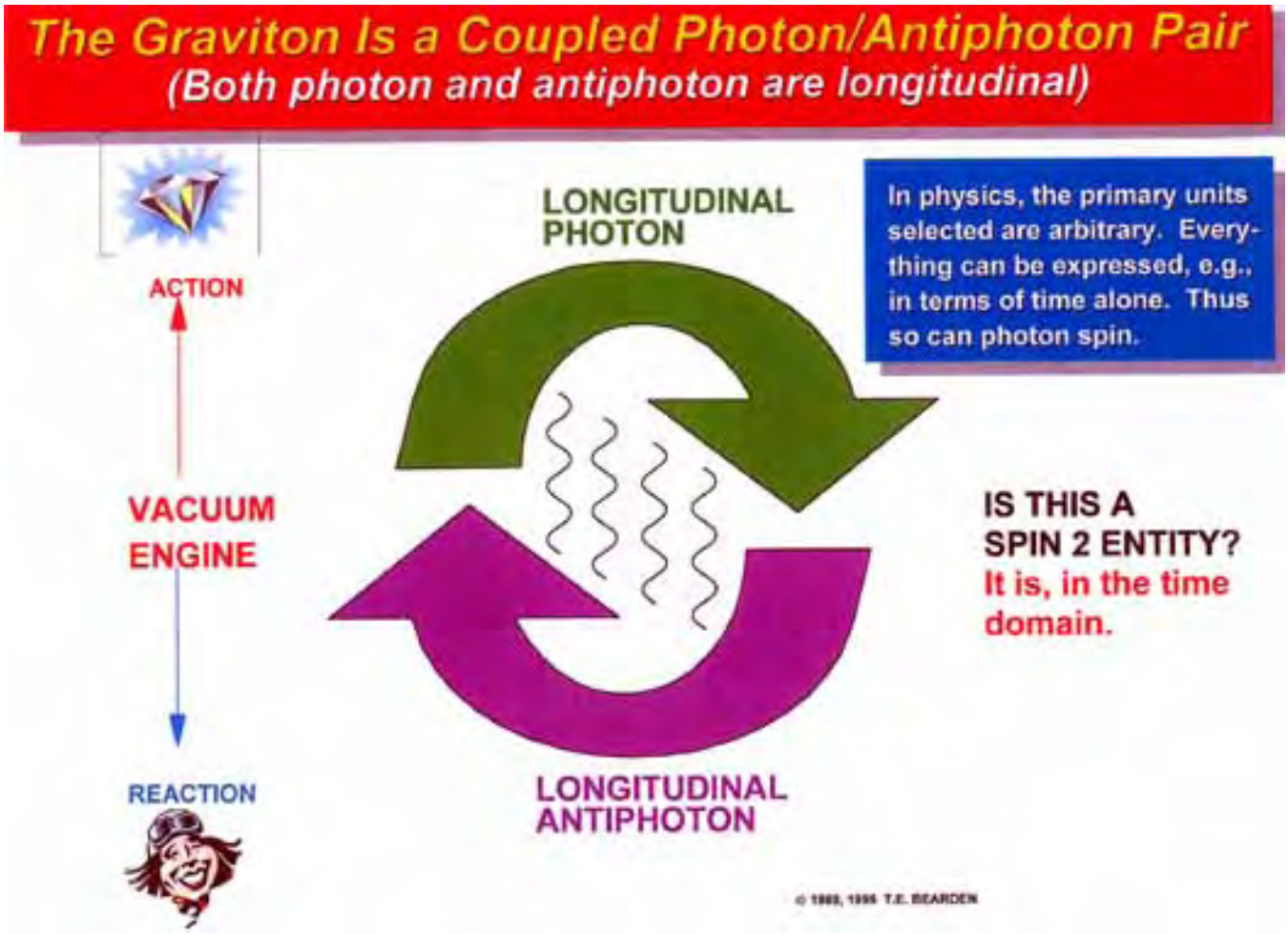

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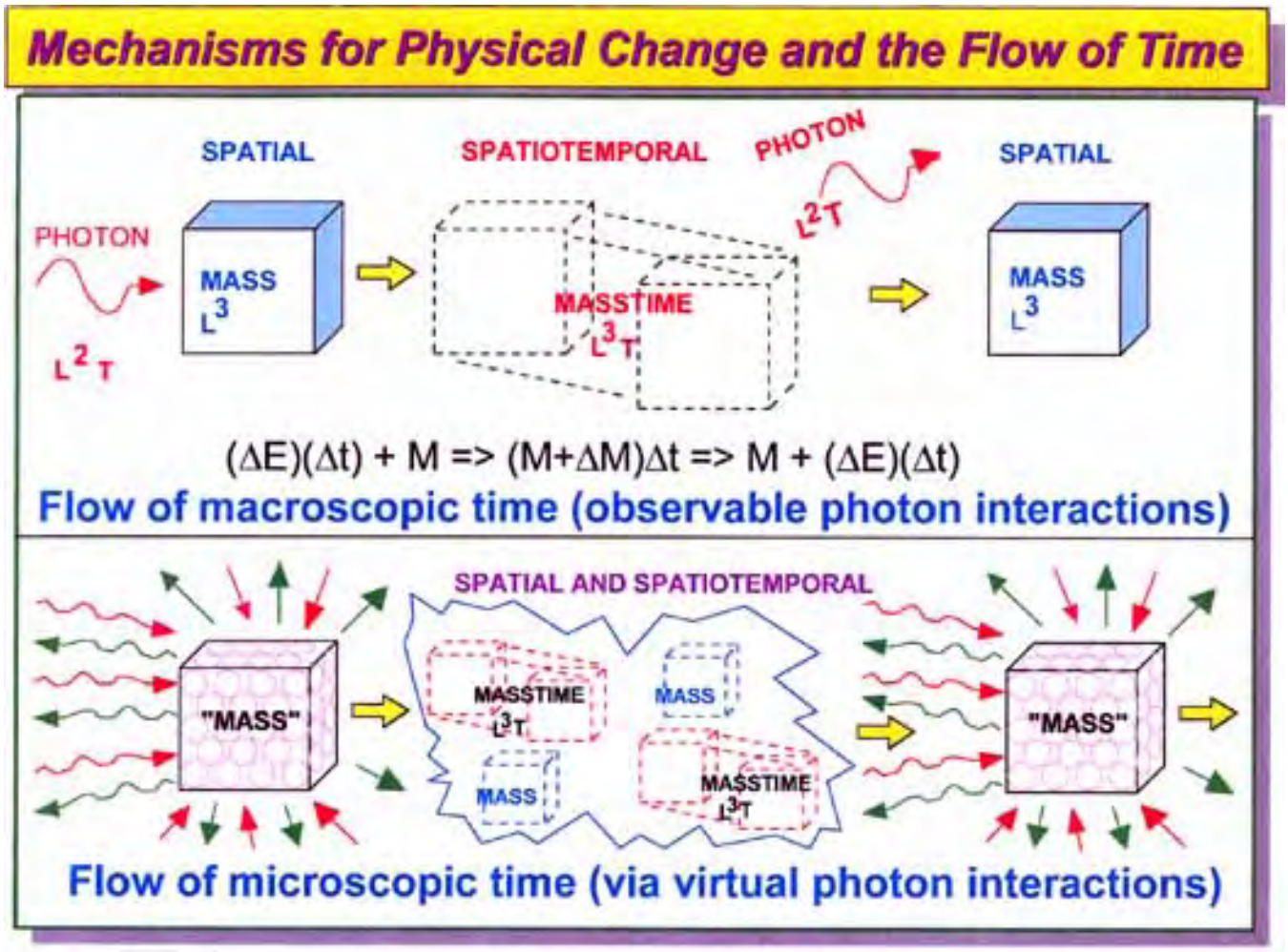

The photon interaction generates an observed quantum change and a discretized jump in the rate of time flow. A particle observably changes by only a single Δ t at a time. The background flow of time in which the jump in rate occurs, is created by the continual absorption and emission of virtual photons.

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Any EM Field or Wave Pattern Is Produced by interference of Two Scalar Potential Functions *(E.T. Whittaker, 1904)*

(Use of Hidden Information Content of the Field)

(Can Provide Action-at-a-Distance)

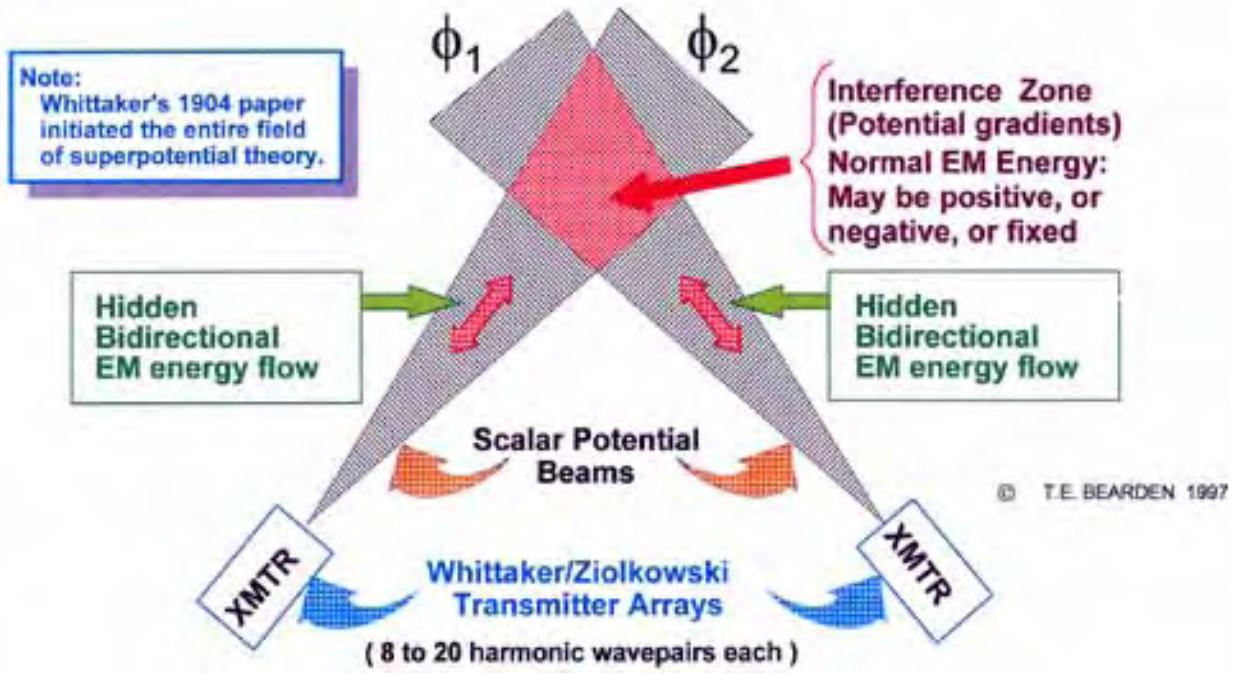

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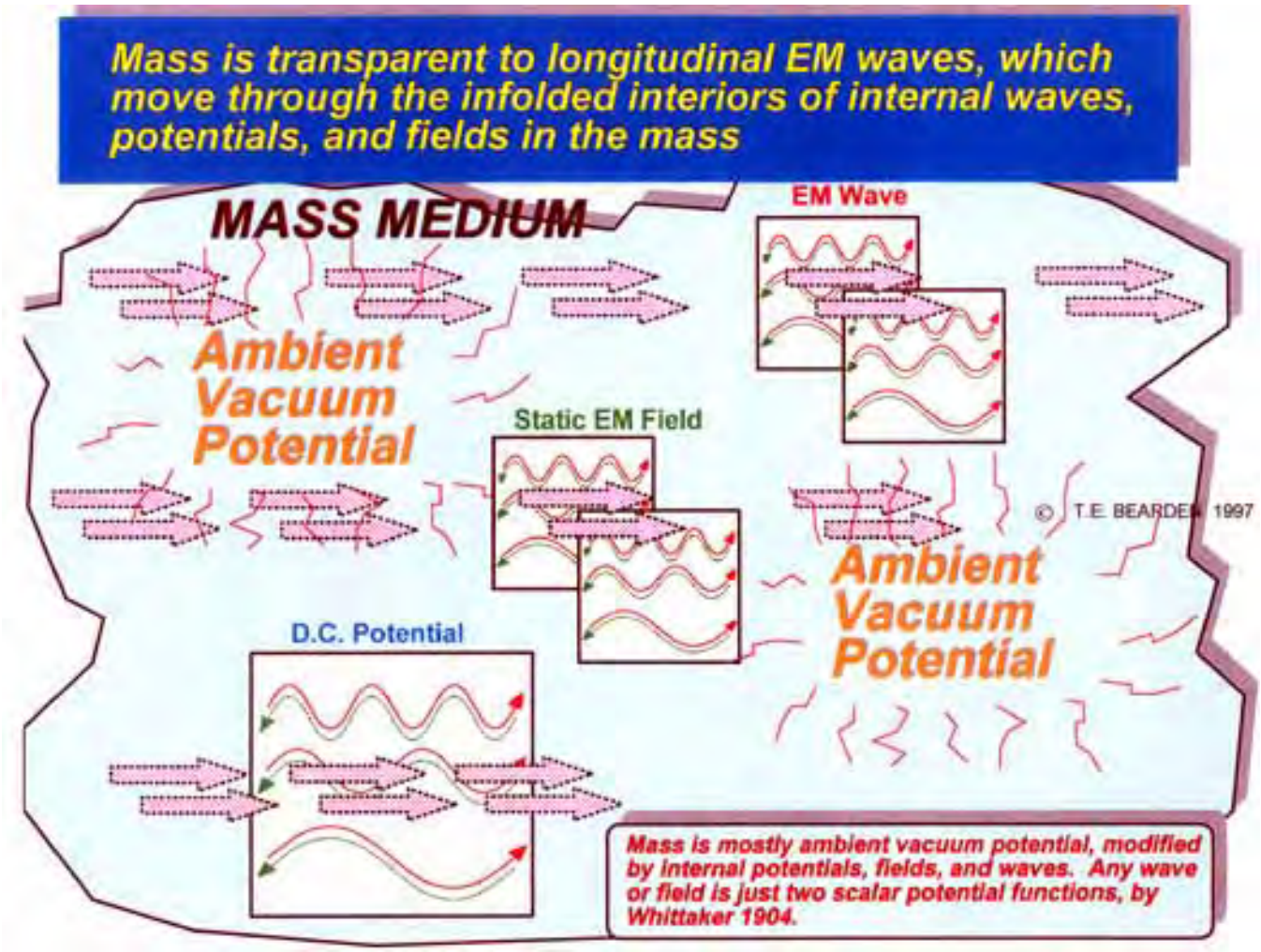

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Deep penetration of weak signals in a dense signal environment, by nonlinear retroreflection

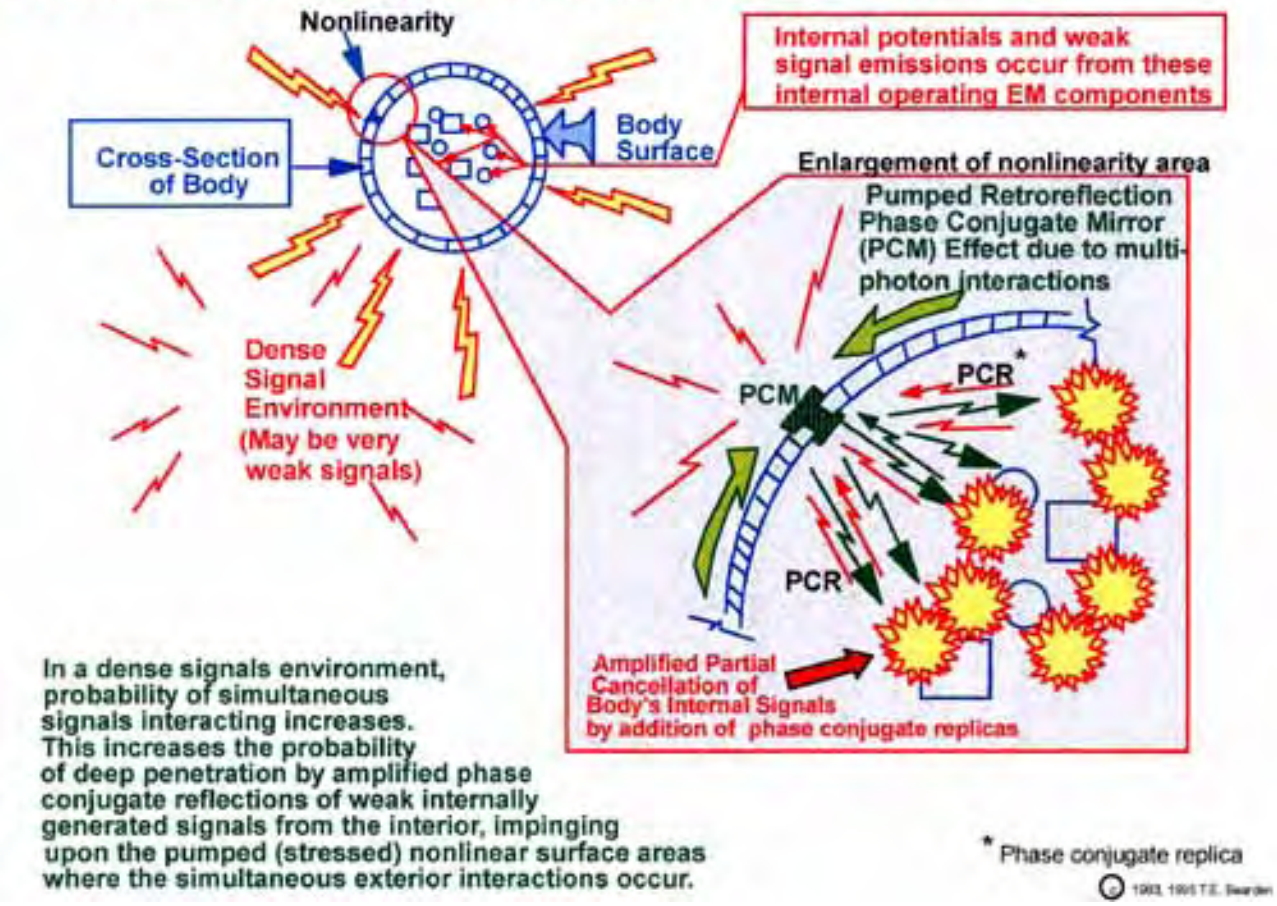

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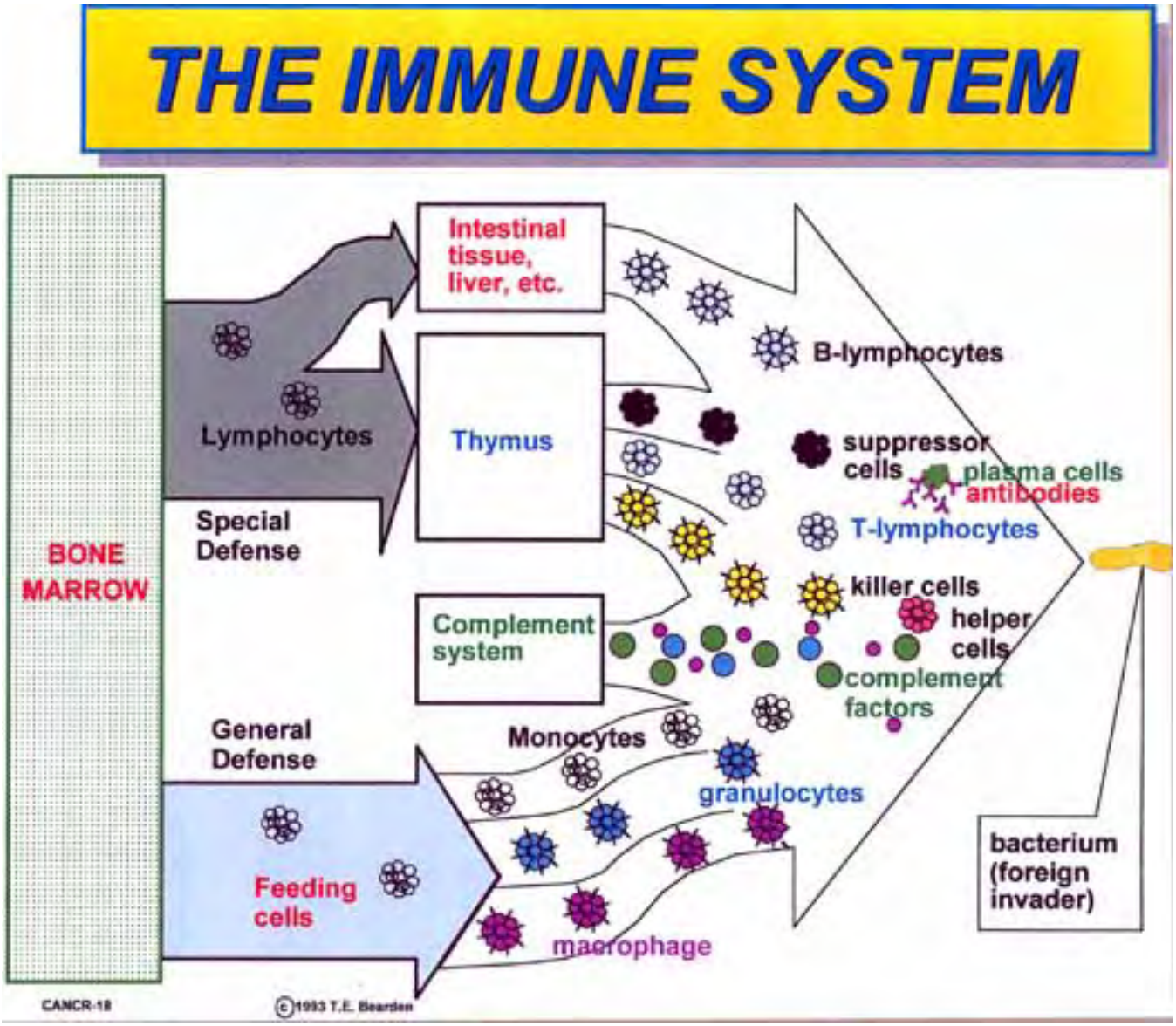

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Popp's master cellular control system

- Provides coherent, long-range interactions in biological systems
- Is an organized morphogenetic field at the basis of functional control

- Emission very sensitive to almost all external and internal influences
- Both spontaneous and delayed luminescence occur
- Photons stored in cell during the delay

- Leakage provides ultraweak, coherent biophoton emission from the system
- Fractional intensity pattern: few to some 100s of photons/cm^2/sec
- Optimum signal-to-noise ratio

- A single delayed biophoton may be able to trigger 10^{10} reactions in a cell before its release
- Spectrum almost continuous within optical range from 200-800 nm.

- Biophoton emission shows biological system always out of equilibrium
- Emission has holistic characteristics
- Correlations to most, if not all, of the biological functions of the organism

- DNA, all other processes are sources
- Single main process of whole system, different processes strongly coupled
- Information function and sync of biological clocks (oscillators)

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CANCER: CHARACTERISTICS

- NOT ONE DISEASE BUT A WHOLE RANGE
- STARTS IN ORDINARY (AEROBIC) CELL
- CELL SHAKES OFF BODY'S DICTATORIAL CONTROL*
- STARTS UNCONTROLLED DIVISION
- BECOMES A LUMP
- CAN SEND FORTH CANCER CELLS
  - THROUGH BLOOD
  - THROUGH LYMPH
- THESE FORM METASTASES (SECONDARY TUMORS)
- OFTEN BECOME ANAEROBIC (NON-OXYGEN USING)
- ENIGMA IS FAILURE OF IMMUNE SYSTEM TO ATTACK SOME TUMOR CELLS
  - SUPPRESSOR CELLS MAY CURB IMMUNE SYSTEM
  - TUMOR MAY LACK ANTIGENS NORMALLY IDENTIFIED BY THE IMMUNE SYSTEM

**R&R system forces cell back toward anaerobe*

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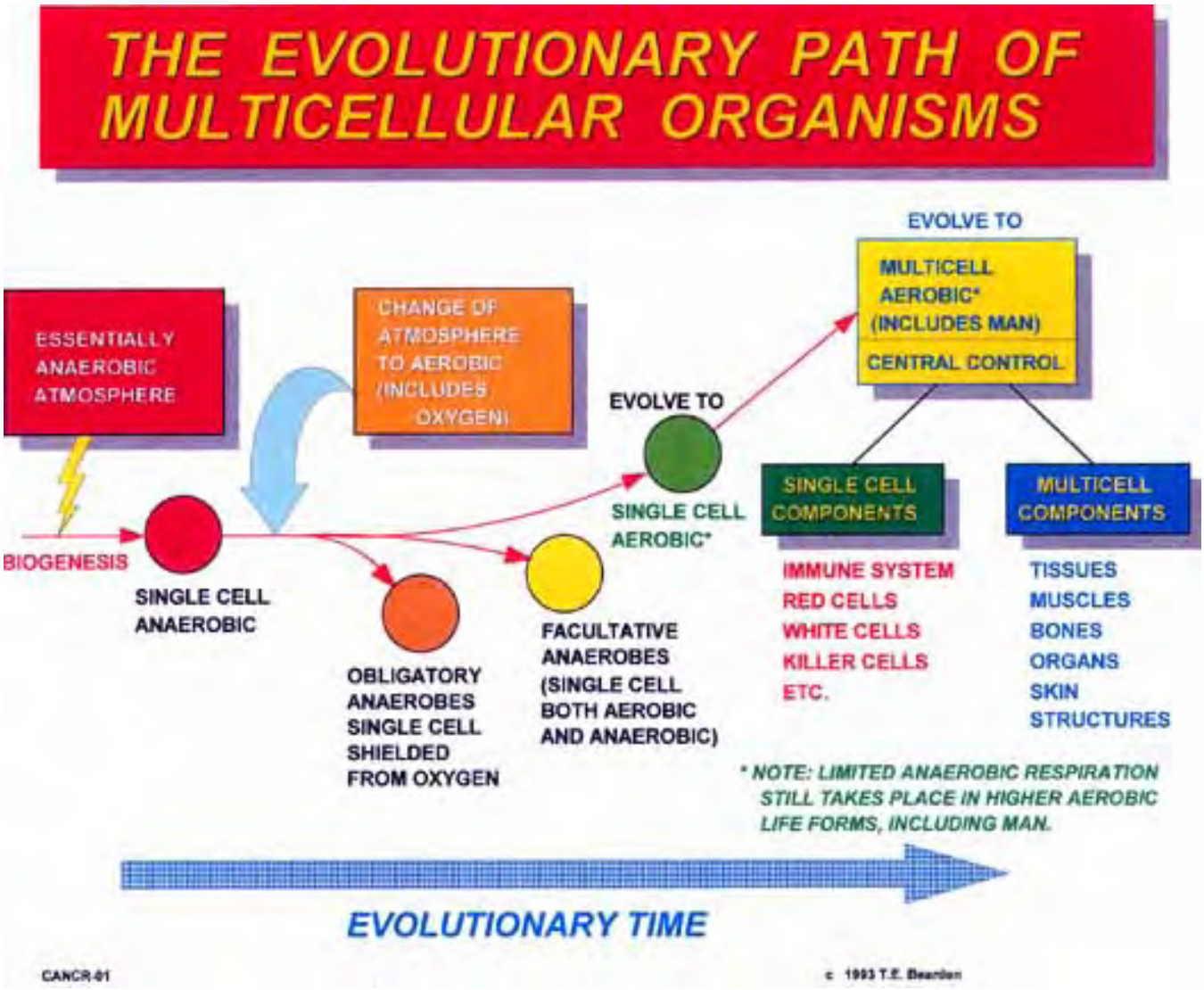

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EFFECT OF FLUID CONTAMINATION ON HEMOGLOBIN'S OXYGEN TRANSPORT

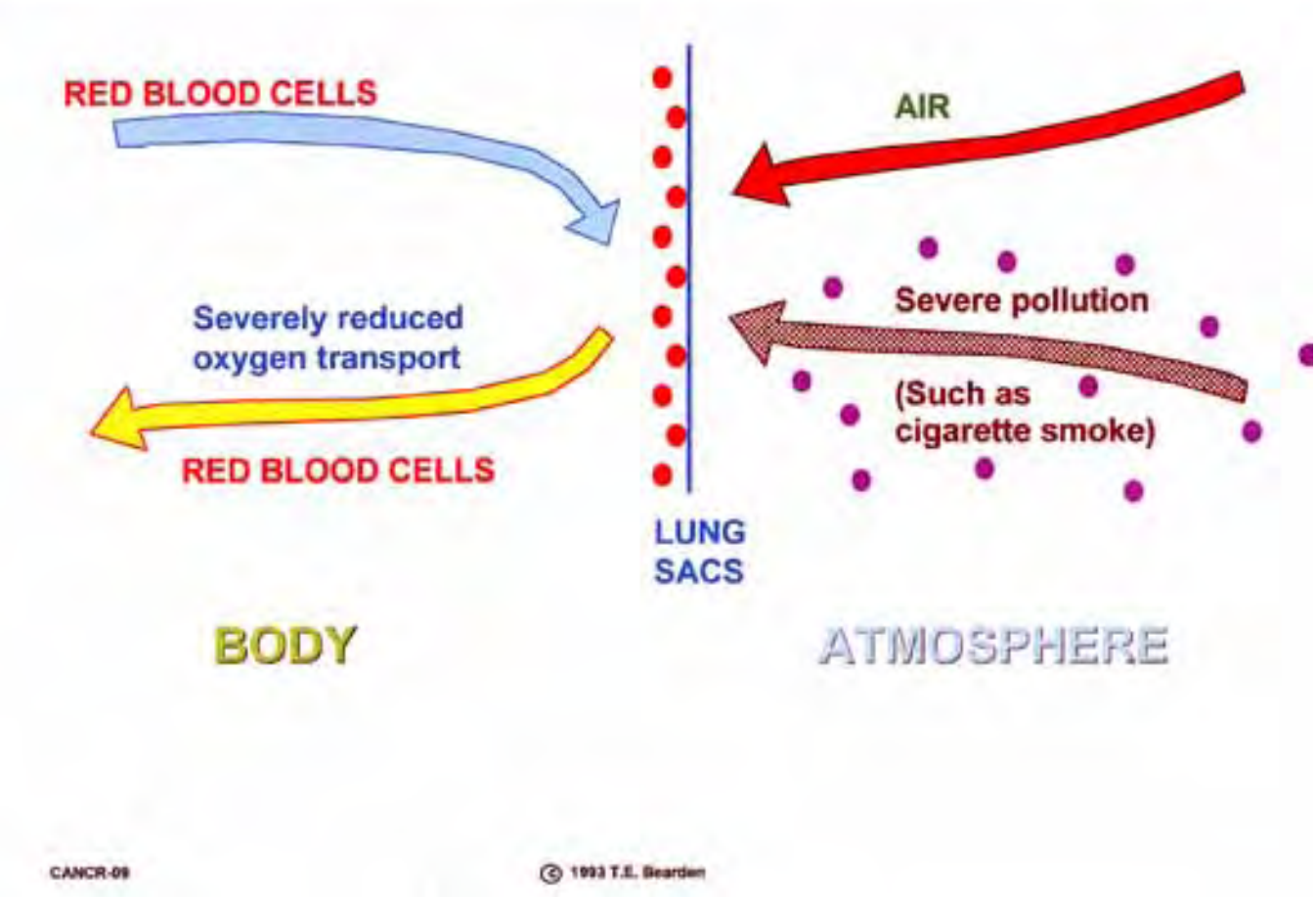

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FIRST STEP IN SELF-PROMOTION OF CANCER DUE TO HYPOXIA

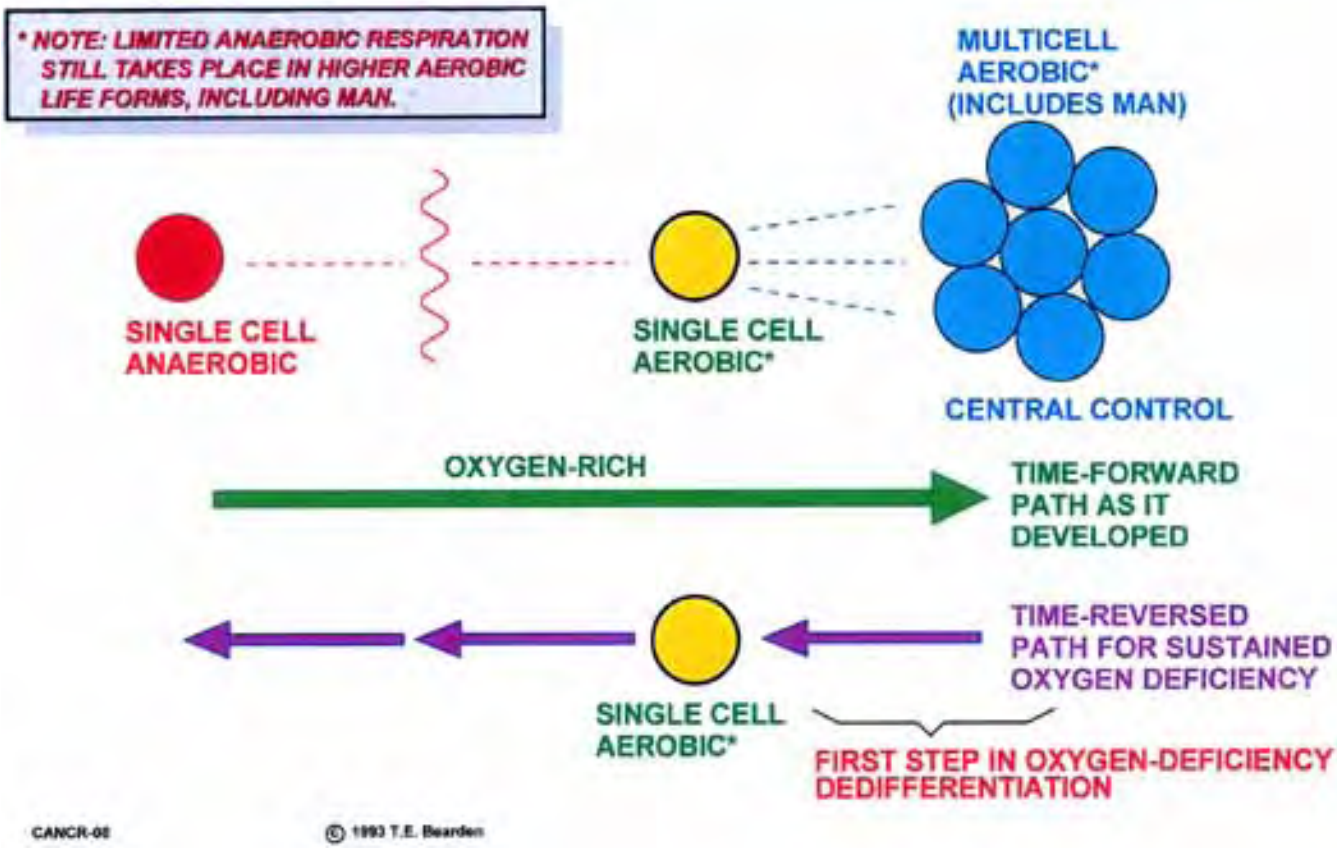

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BECKER'S CELLULAR GROWTH CONTROL

- Two major links uncovered between :
  - The DC system and nervous system
  - The DC system and all body cells
- Bioelectric potentials of primary importance
- Physiology presently considers controls limited to:
  - Neural action potential
  - Various hormone chemical agents
  - Chemical agents associated with DNA/RNA system
- Complete Operational Biological Control System:
  - Controls growth, healing, biological cycles, etc.
  - Operates in ANALOG mode; various levels of DC
  - Interlocks physically with nervous system (and may be its precursor)
  - Other chemical agents
  - Tissue growth and healing NOT INCLUDED
- Medical community now more concerned with diseases resulting from:
  - Inadequate/abnormal growth
  - Inadequate healing

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Becker's dc treatment of bone fractures

Application of tiny DC currents to heal difficult bone fractures. Only picoamperes are utilized. Pulsed DC current or pulsed magnetic fields may also be utilized.

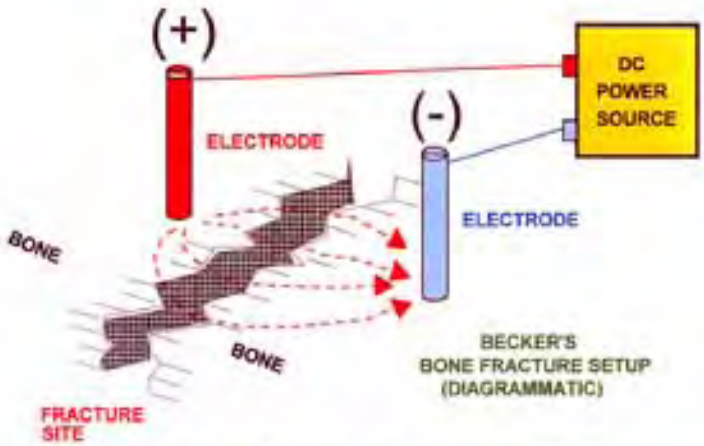

RED BLOOD CELL DEDIFFERENTIATES
Shucks hemoglobin coat
Grows nucleus

NEW CELL REDIFFERENTIATES
Turns into type of cell that makes cartilage

NEW CELL REDIFFERENTIATES
Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture

Proves that cells can be time-reversed (phase conjugated) (dedifferentiated) or time-forwarded (redifferentiated) by application of very weak electromagnetic signals, when those signals contain longitudinal bidirectional EM "pump wave" wavepairs, which cause the cell and its parts to create precise vacuum antiengines.

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Becker's theoretical DC control system involved with response to injury*

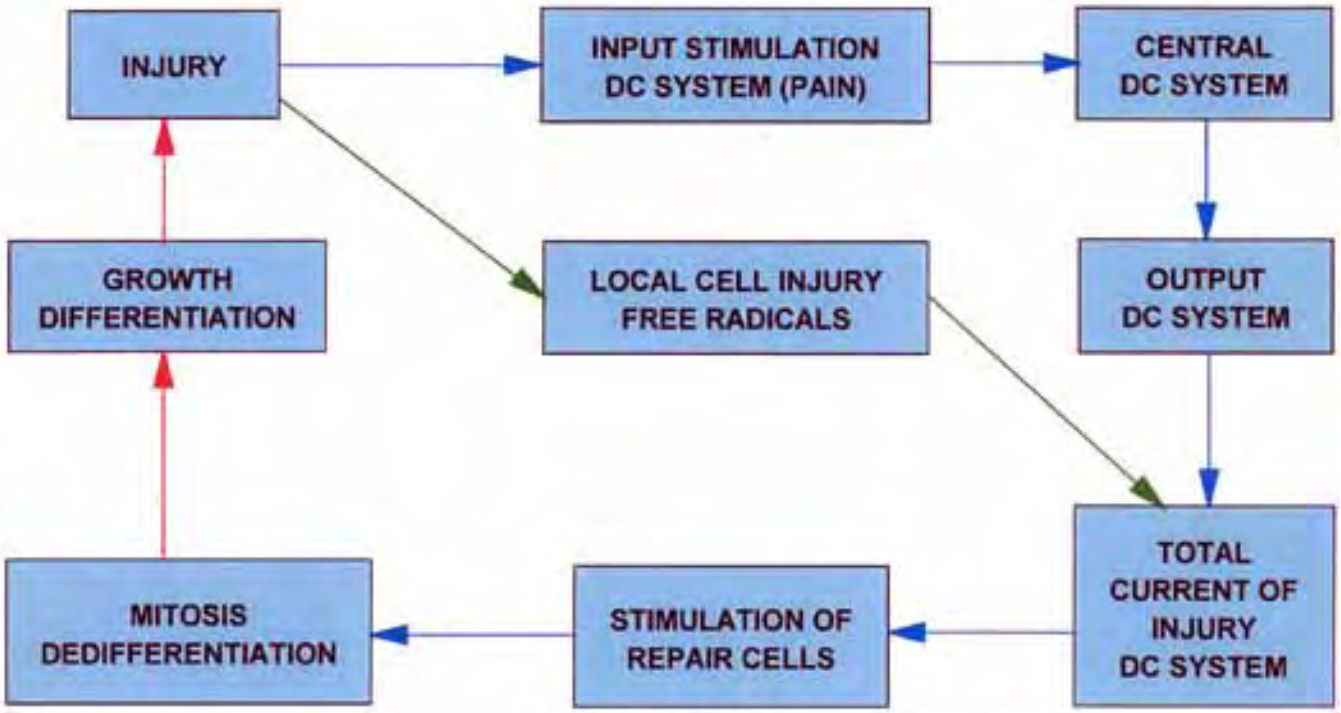

*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

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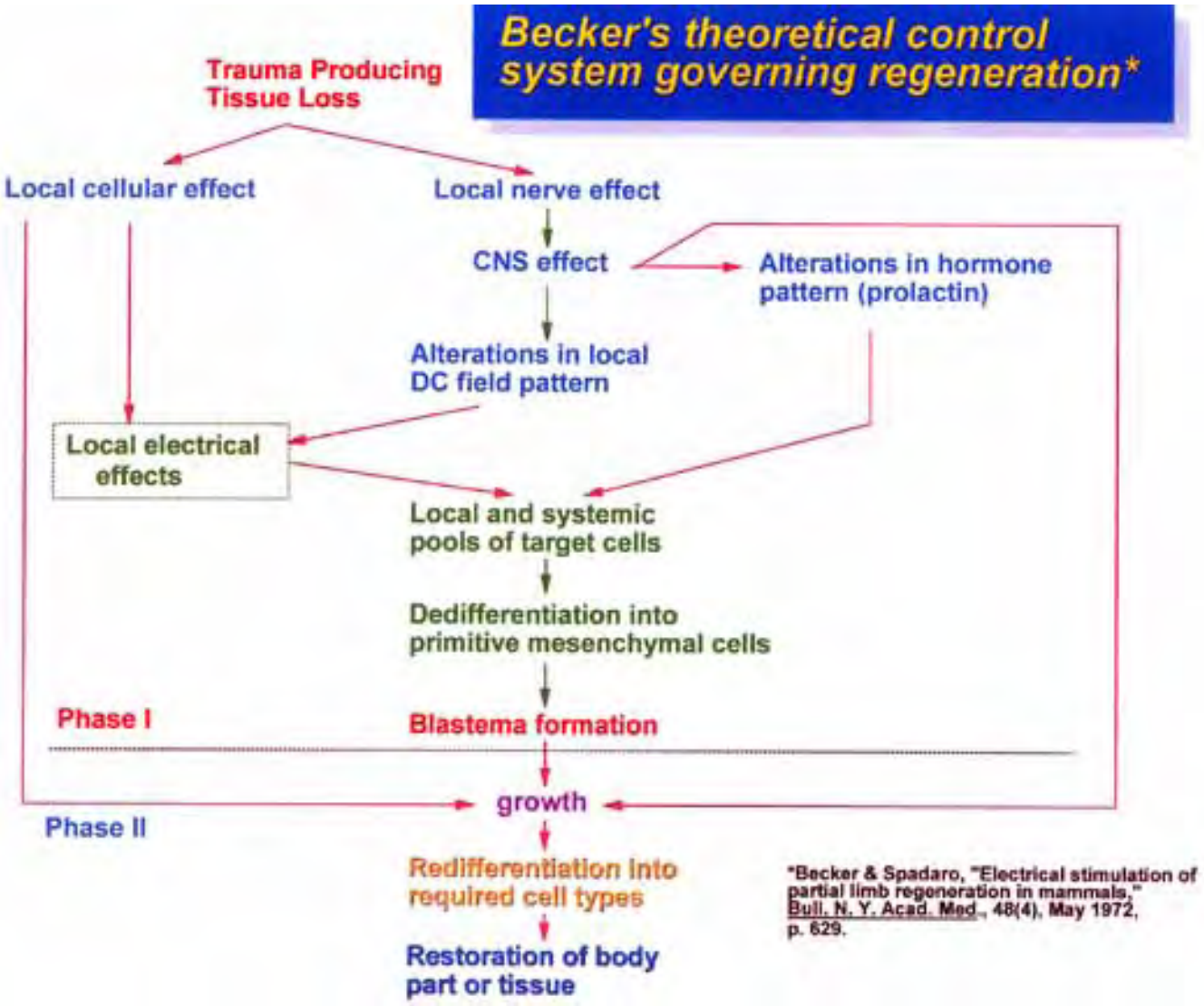

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Link Between Standing DC Potentials and the Nervous System

- Standing DC potentials on intact surfaces of all living animals demonstrate a complex field pattern spatially related to the anatomical arrangement of the nervous system
  - Can be measured directly on the peripheral nerves
  - Polarity difference related to whether nerve is or is not a sensor
  - Steady (weak) current flow exists
  - Demonstrates solid state/semiconductor phenomena
  - Accurately reflects (amplitude and polarity) the general level of neural activity
    - Sleep versus wakefulness
    - Anesthesia versus conscious
    - Other parameters
- DC levels determine the level of neural activity
- Action potential system exists upon a substratum of DC potentials which pre-existed it
- DC potentials substrata had and have control functions over basic properties of the living organism

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Becker's Findings on Cellular Injury and Regeneration*

- Cellular processes are regulated by a precise control system
- Attempted to apply engineering control-system theory
- Cells and tissues have solid-state electrochemical features which provide control signals in the control system
  - Growth process
  - Electron transfer
  - Semiconduction
  - Self-organizing *(NOTE: Implies hidden variables and nonlocal causality)*
- Complex electrical events at the injury site initiate cellular aspects such as dedifferentiation and mitotic activity
- Regeneration is a 2-step process, each with different controls
  - Electrical triggers with threshold values results in appearance of blastema
  - Complex data transmission to blastema establishes it as a self-organizing system capable of growth and redifferentiation
  - Mammals lack ability to produce blastemas except for bone, but partial regeneration growth has been shown in response to electrical stimuli
- Growth related to electrical more than electrochemical aspects
- Hematopoietic marrow as source of cells for the blastema
  - Monocytes can take place in regenerative processes in limbs
  - Lymphocytes can dedifferentiate under certain circumstances
  - Marrow elements can be induced into osteogenesis

*R.O. Becker & J.A. Spadaro, "Electrical Stimulation of Partial Limb Regeneration in Mammals," Bull. N. Y. Acad. Med., 48(4), may 1972, p. 627-641.

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Corrections For the Present EM Bioeffects Model

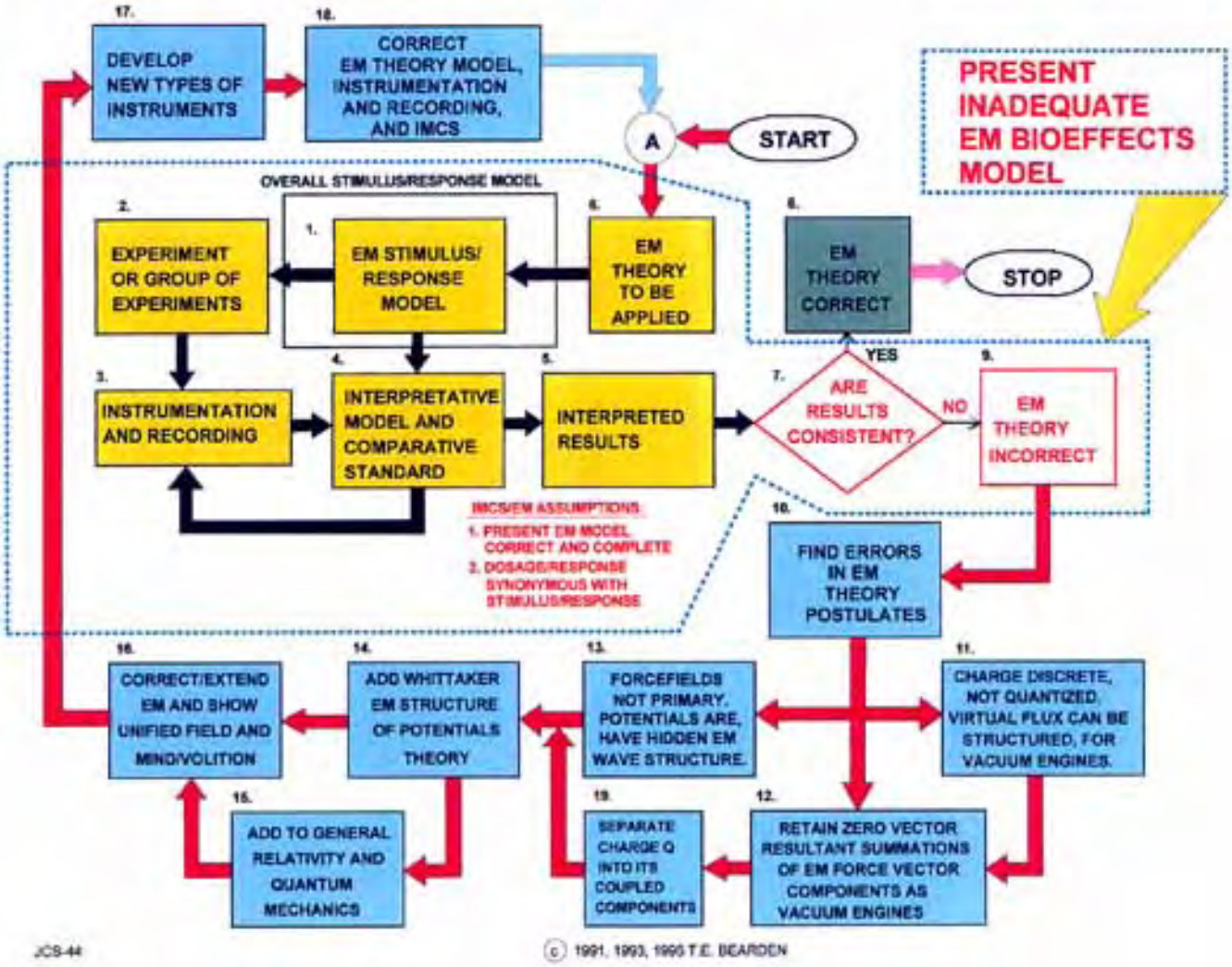

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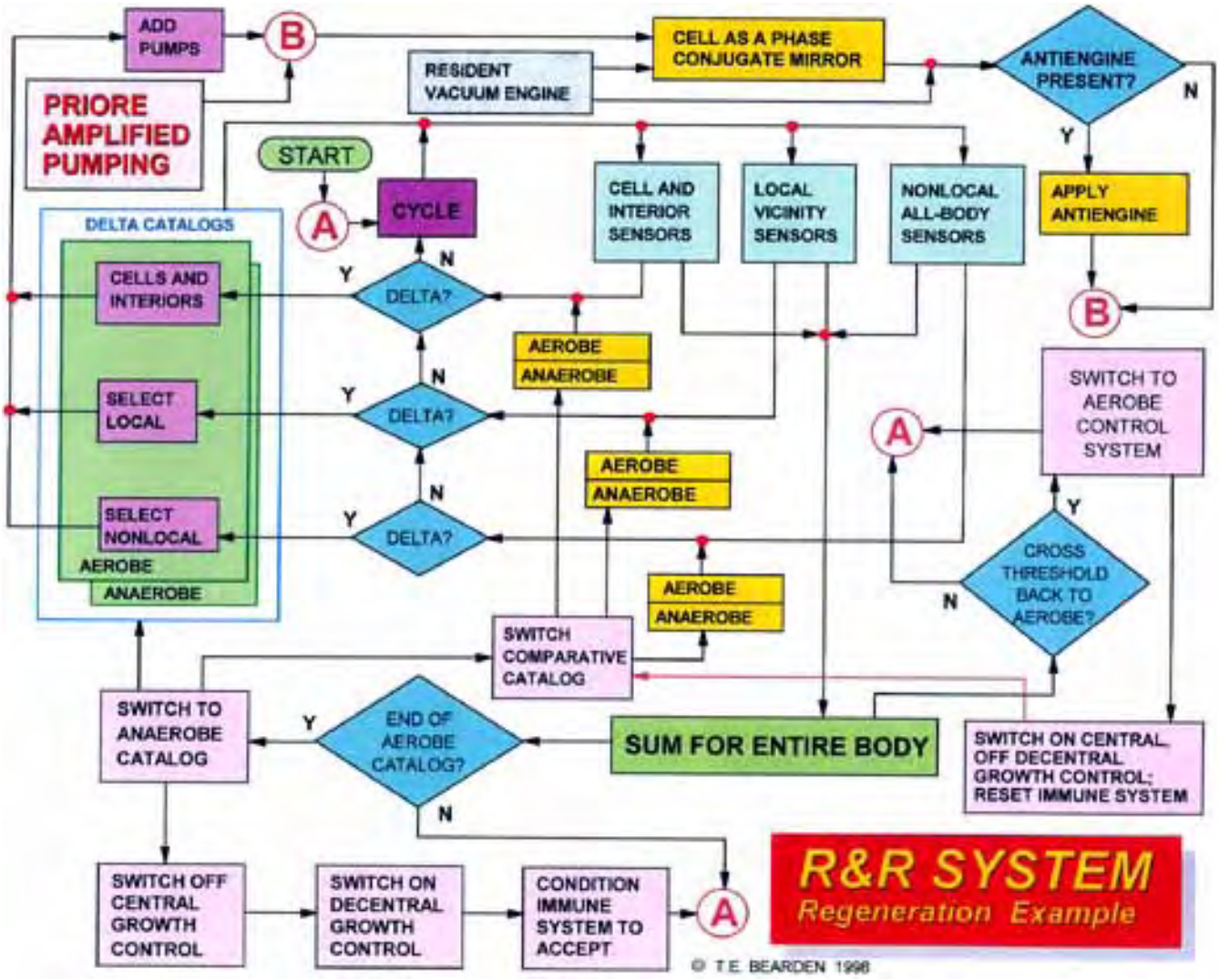

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Kaznacheyev's Cytopathogenic Mirror Effect

Disease vacuum engines transported by photons and waves

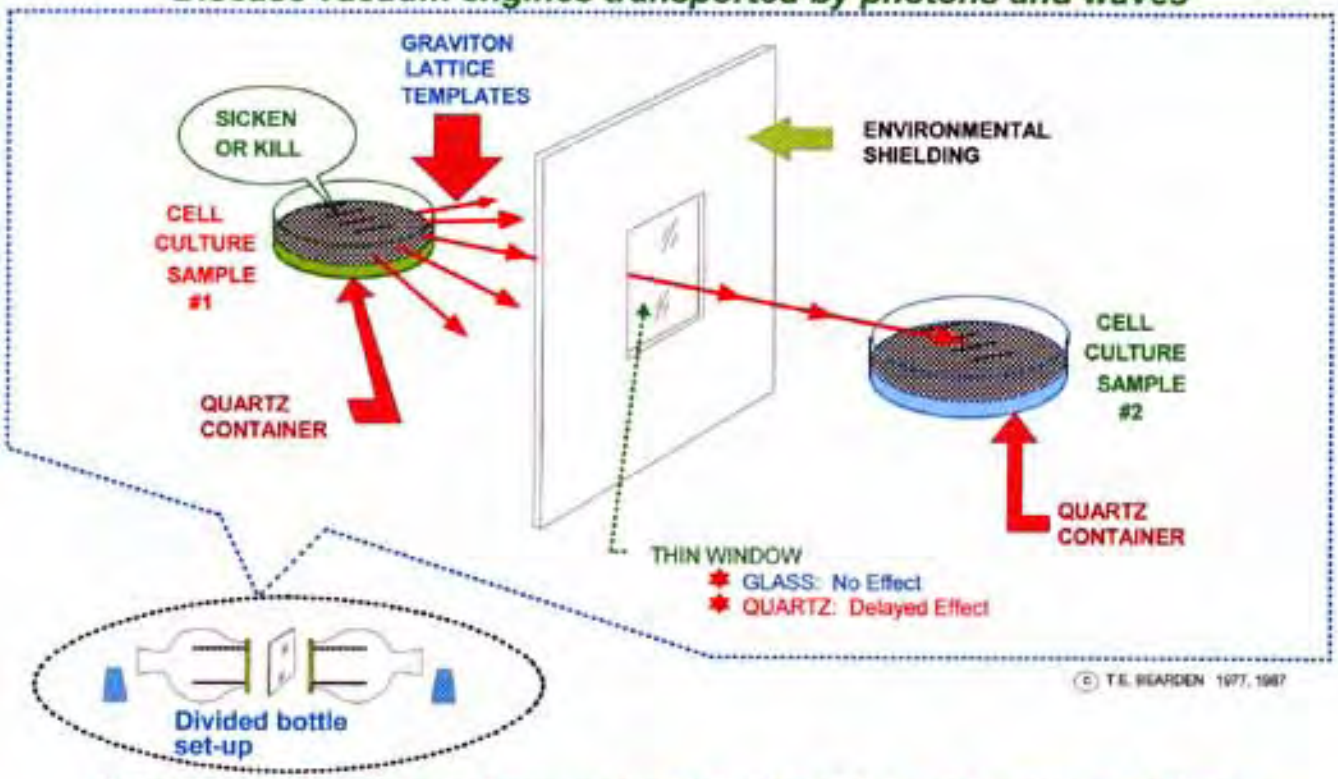

Note: Minimum lattice is one harmonic interval: IR to UV is such a minimum G-lattice.

Distant induction of cellular death and diseases, by special EM means. Coupled photon-antiphoton pairs (gravitons) in a structured harmonic lattice ordering constitute the disease or disorder template.

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MICROWAVE RADIATION OF U.S. EMBASSY IN MOSCOW

Former U.S. Embassy in Moscow.

Selected clipart © by Lotus SmartPics™

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter?)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

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Self-Targeting in Inner EM Channel Can Produce a Quantum Potential

Once QP is established, energy transmission is direct and instantaneous. Energy input to one single participant will simultaneously appear in all other participants, the amount depending on their fractions of participation with the input station.

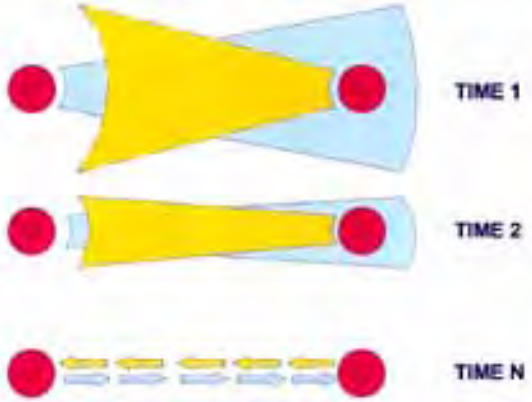

NARROWING OF INTERACTING POTENTIALS INTO LASER-LIKE BEAMS, BETWEEN TWO PUMPED SOURCES. NOW ONLY LONGITUDINAL WAVES CONNECT THE LINKED OBJECTS.

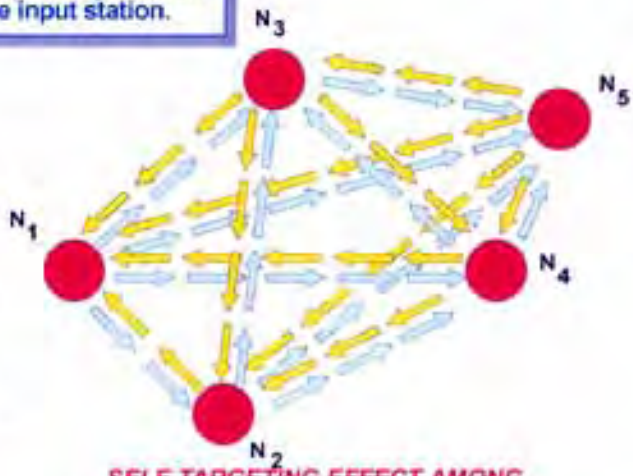

SELF-TARGETING EFFECT AMONG ALL PAIRS OF INTERACTING PUMPED SOURCES

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Quantum potential and hidden variable theory

a. Quantum Potential Characteristics

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- No point source
- Not radiated
- Quantum potential between two particles
  - Interaction does not vanish as spatial separation becomes very large
  - Instantaneous connection, so multiply-connected space

b. Hidden Variable Theory and the Quantum Potential

- $$V_{quantum} = \frac{\hbar}{2m}\frac{\nabla^2\sqrt{\rho}}{\sqrt{\rho}}$$
- "A quantum particle moves as if it were subject, in addition to its external potentials, to a potential which is a function of its own probability distribution."
- Bohm's H.V.T. assumes:
  - Particle and wave function real and separate
  - Wave function obeys Shroedinger's equation
  - Particle obeys classical mechanics
  - Particle couples to wave function through a quantum potential

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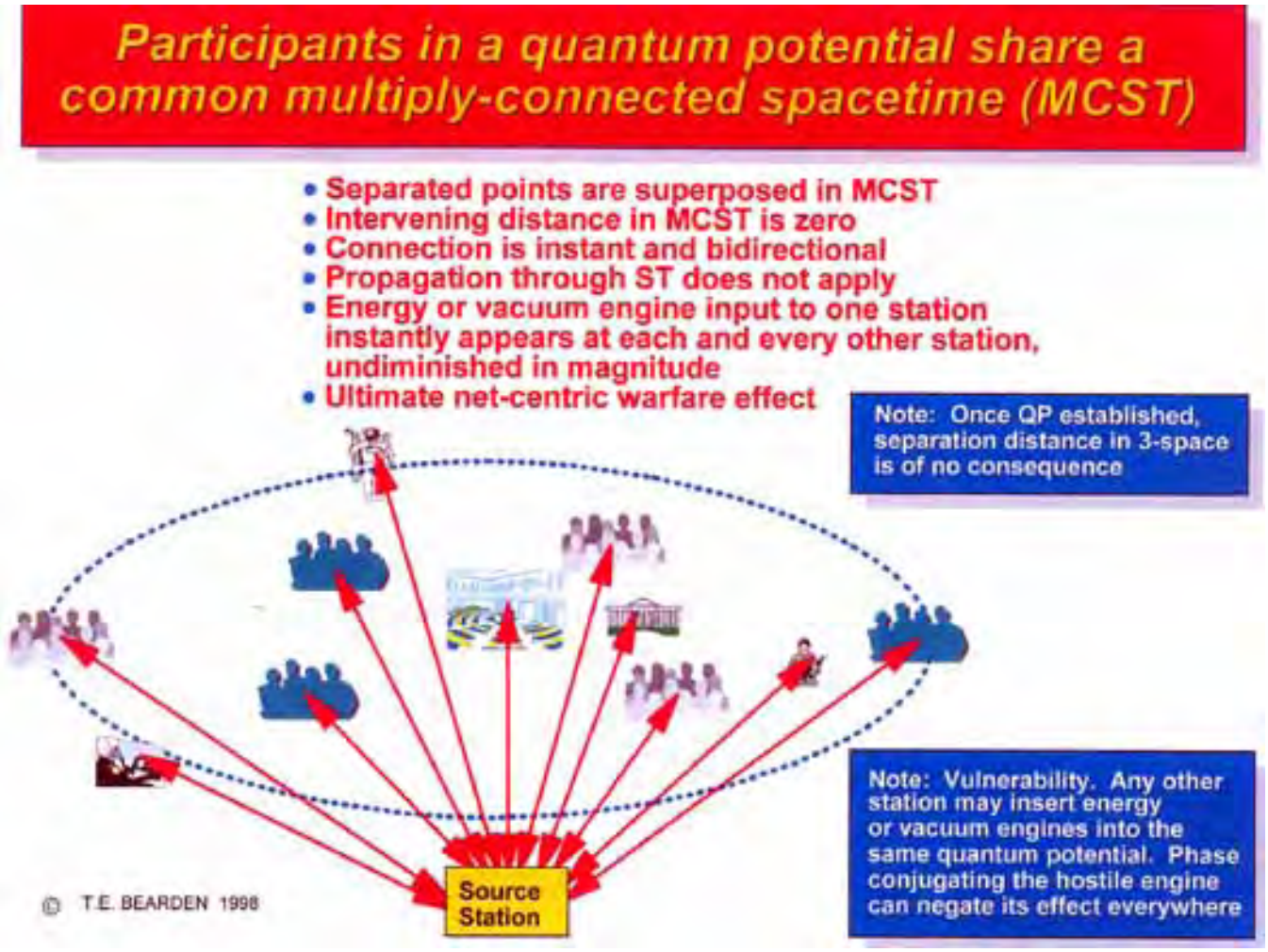

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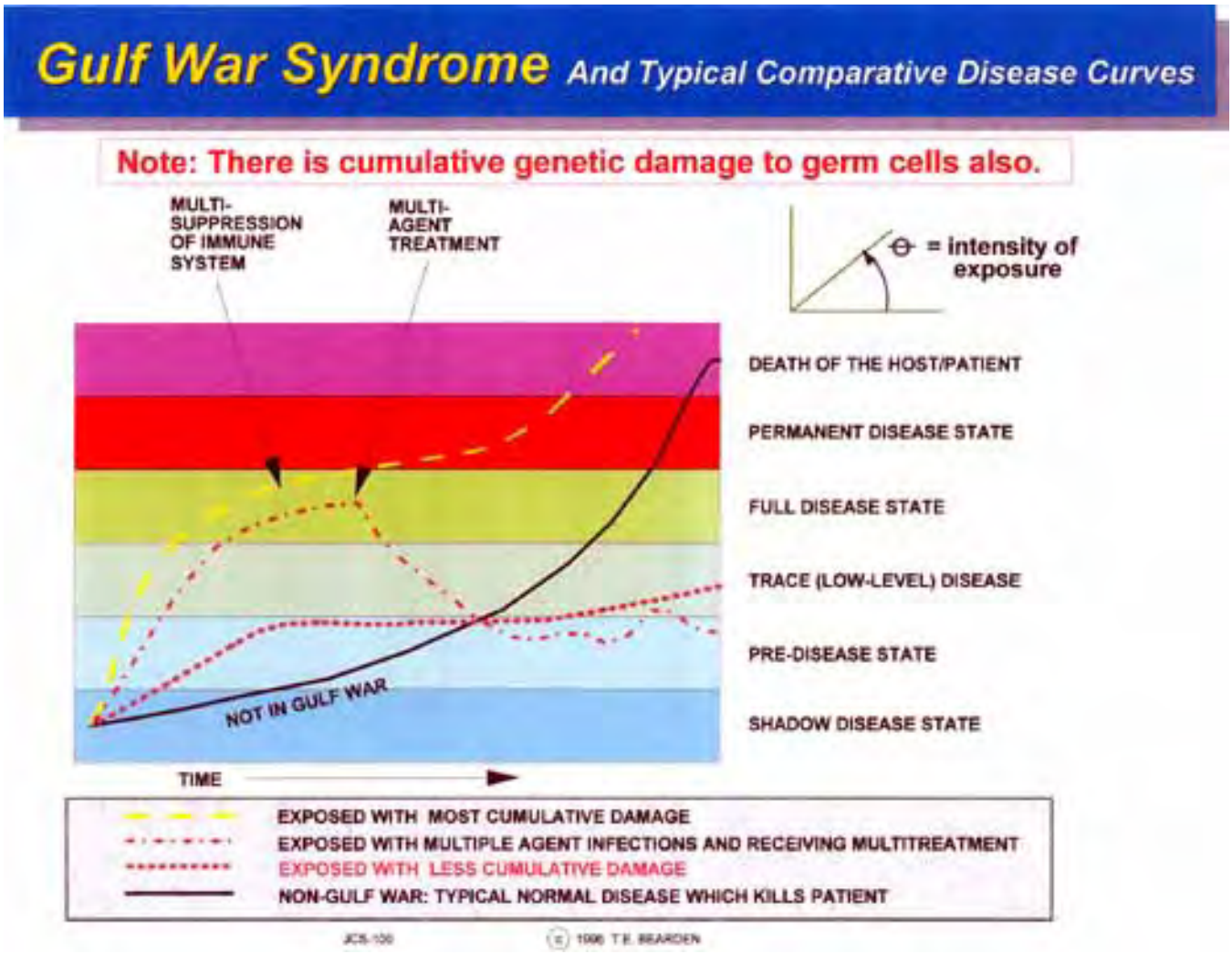

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Force Fields and Symmetry

- Force fields are nature's way of imposing local gauge symmetries on the world
- E.g., electromagnetic field is a manifestation of the simplest known gauge symmetry consistent with the principles of special relativity
- For the EM case, the gauge transformations correspond to changes in 'voltage' from place to place

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Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum

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- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another
- STRUCTURING THE INFOLDED EM INSIDE POTENTIALS, FIELDS, AND WAVES
  - Strongly breaks local symmetry
  - Provides spacetime engines giving the above effects

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Other Aspects of Strong Local Asymmetry

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- Local spacetime is curved
- Lorentz invariance of vacuum is violated
- May be a local "sink" or "source"
- Gravitational/inertial effects from EM
- Translation between virtual and observable
- Electrogravitational solitons
- Action at a distance
- Transmutation effects may exist
- Scalar/pseudoscalar field translation
- COMMENT: Thus the use of infolded longitudinal EM fields and waves to strongly break local symmetry allows internested clustering of spacetime curvatures. These spacetime structures are *vacuum engines*, or *spacetime engines*.

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Small Entities Emit Powerful S-Flows

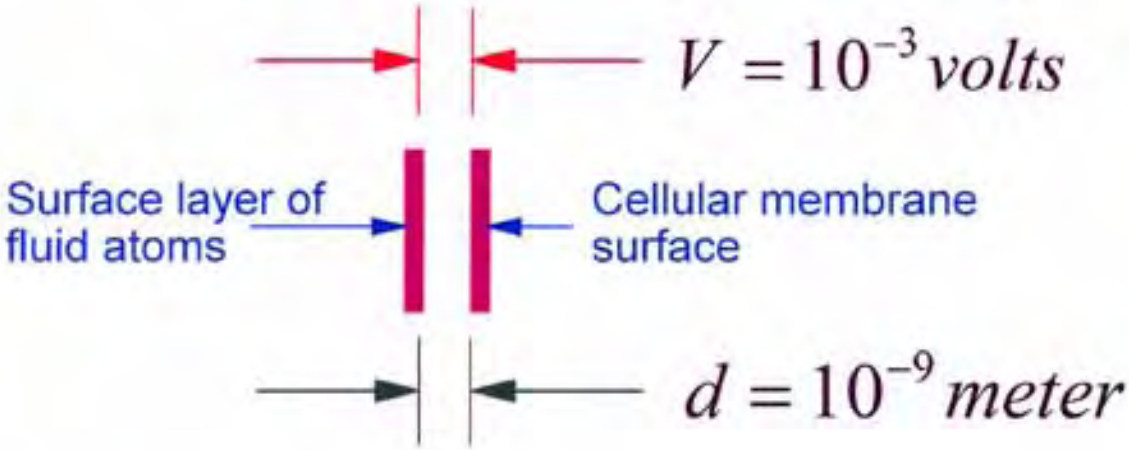

$$E = 10^{6}\ \text{volts / meter}$$

$$S \approx f(E^2) = f(10^{12})$$

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What is the "magnitude" of a potential?

- What is taught is the *"interaction cross section,"* i.e., the joules collected from the associated S-flow by one point coulomb of intercepting/collecting charge.

$$W = Vq = \phi q \quad \text{(joules)} \qquad [1]$$

$$\phi = W/q \quad \text{(joules/coul)} \qquad [2]$$

Let $\phi < 1$ and fixed; $q \Rightarrow n$ where $n = \infty$

$$W \Rightarrow k, \text{ where } k = \infty \qquad [3]$$

- *From any "finite" potential, no matter how small, an unlimited amount of energy can be collected, by increasing the collection (number of coulombs) (interaction cross section).*
- Actual magnitude of the potential ϕ must be very, very large, since we can treat it as infinite or unlimited, via $W = \phi q$.
- *Else Equation [1] could not be linear.*

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Table A1. THE VACUUM ENERGETICALLY INTERACTS WITH EVERY PARTICLE, CONTINUALLY.

- The vacuum is:
  - Ground (zero) state of the electromagnetic (photon) field.
  - Ground (zero) state of mass field.
  - Empty of *observable* particles or photons.
  - Filled with *non-observable* (virtual) particles and photons.
  - Violently fluctuating microscopically and electromagnetically.
  - Constantly interacting with all particles, including partially shielding their bare charges.
- Lamb Shift -- vacuum's alteration of the energy level of an electron in the hydrogen atom.
  -- Difference in energy (frequency units) is 1057.862 MHz.
  -- Lamb was awarded a Nobel Prize for showing this.
  -- Energy *density* exceeds that of the sun's surface!
- Casimir Effect -- vacuum creates an attraction between two conducting surfaces in close proximity.
  -- experimentally proven, well-known.

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- Cole and Puthoff proved that there is no thermodynamic reason why energy cannot be extracted from the vacuum as heat and power, and utilized.
- The common dipole is a broken symmetry in the virtual photon flux of vacuum. It extracts virtual energy, integrates it, and re-emits it as Poynting energy density flow S = ExH (which observably interacts with charged particles and magnetic poles).

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Extended Superpotential Theory

(Adding Vacuum Engines)

- Any EM field or wave is created by (comprised of) two potentials which interfere with each other in a given area
  - *May be either scalar or vector potentials*
  - *May interfere locally or at a distance*
  - *Process is distance independent*
- Any scalar potential is comprised of a harmonic series of bidirectional longitudinal EM wavepairs (Whittaker 1903).
- Ziolkowski circa 1985 added the interior product set to Whittaker's sum set. Thus he added modulations.
- By assembling a deliberate "sum and product" set of biwaves, a scalar potential can be created having an internal deterministic structure.
  - *This structures local vacuum potential/spacetime curvatures, in specific forms (templates)*
  - *Now have added vacuum engines*
  - *Have infolded general relativity inside electrodynamics*

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Vacuum Engine: Jillions of Working ST Demons

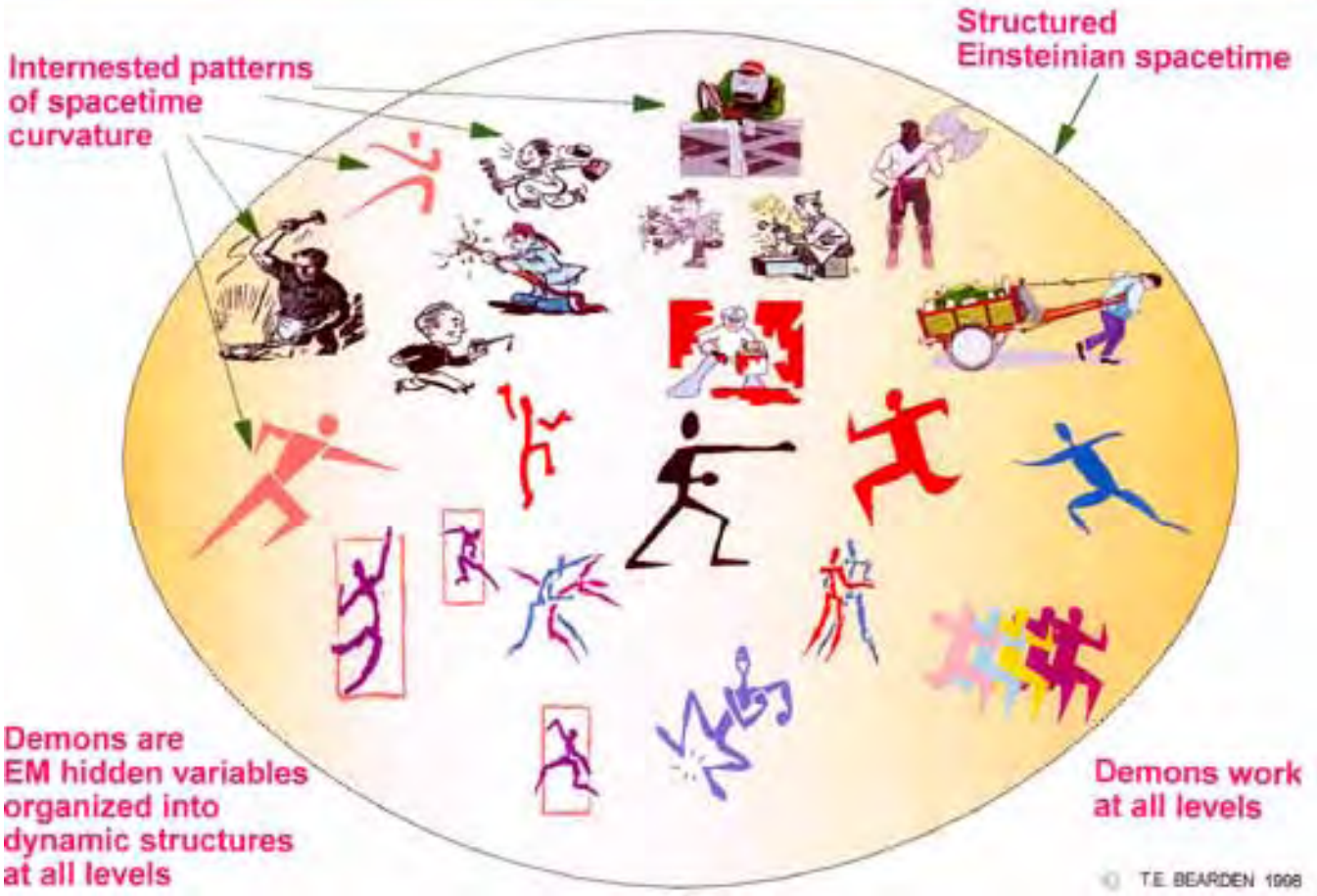

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Active Spacetime and a Specific Vacuum Engine

(A General Relativistic Concept and Analogy)

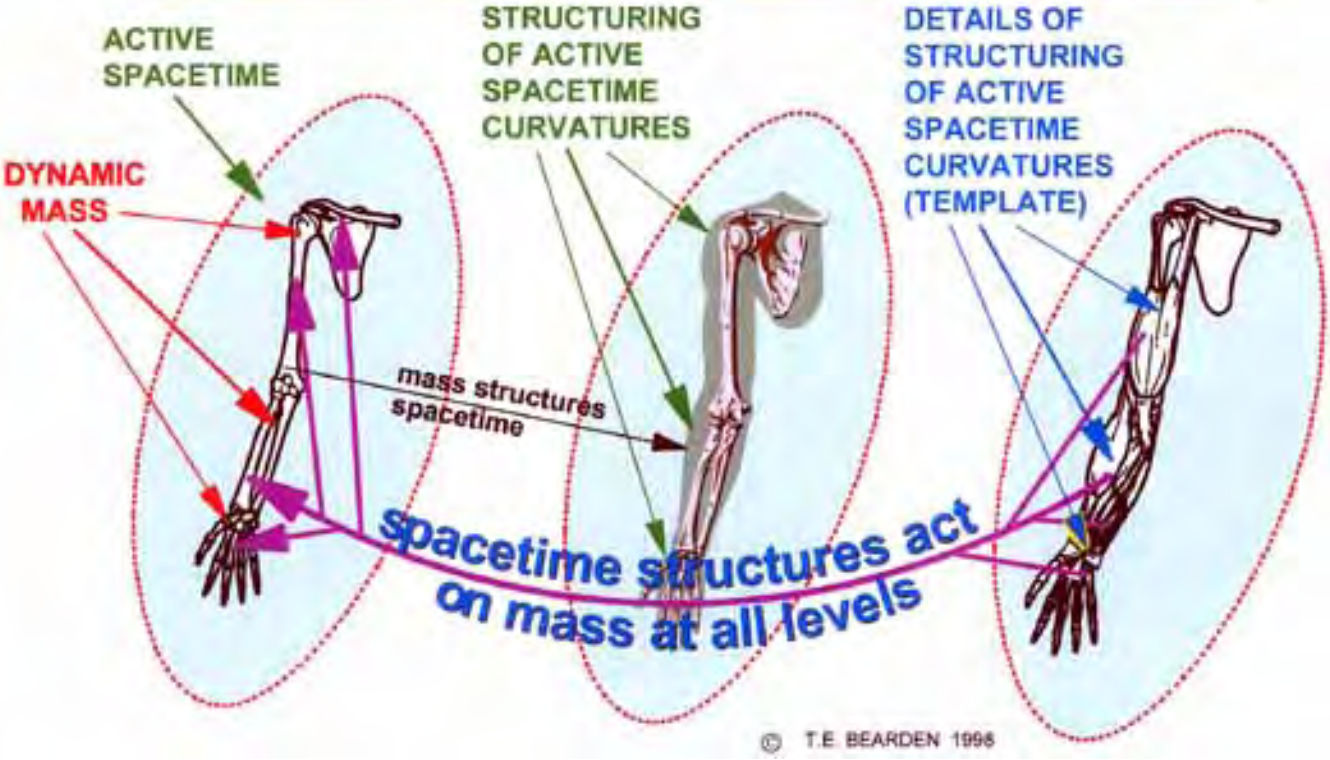

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Extension of Wheeler's general relativity principle:

- Mass (trapped energy) and its structuring curves and structures spacetime complexes (engines).
- Curved and structured spacetime engines produce forces on mass and its components, telling them how to move and structure.
- Since very strong EM force is used as agent of curvature, very powerful general relativistic effects can be obtained by arranging the LWs in the input EM potentials, fields, and waves.
- General relativity becomes directly engineerable in devices of unparalleled capability.

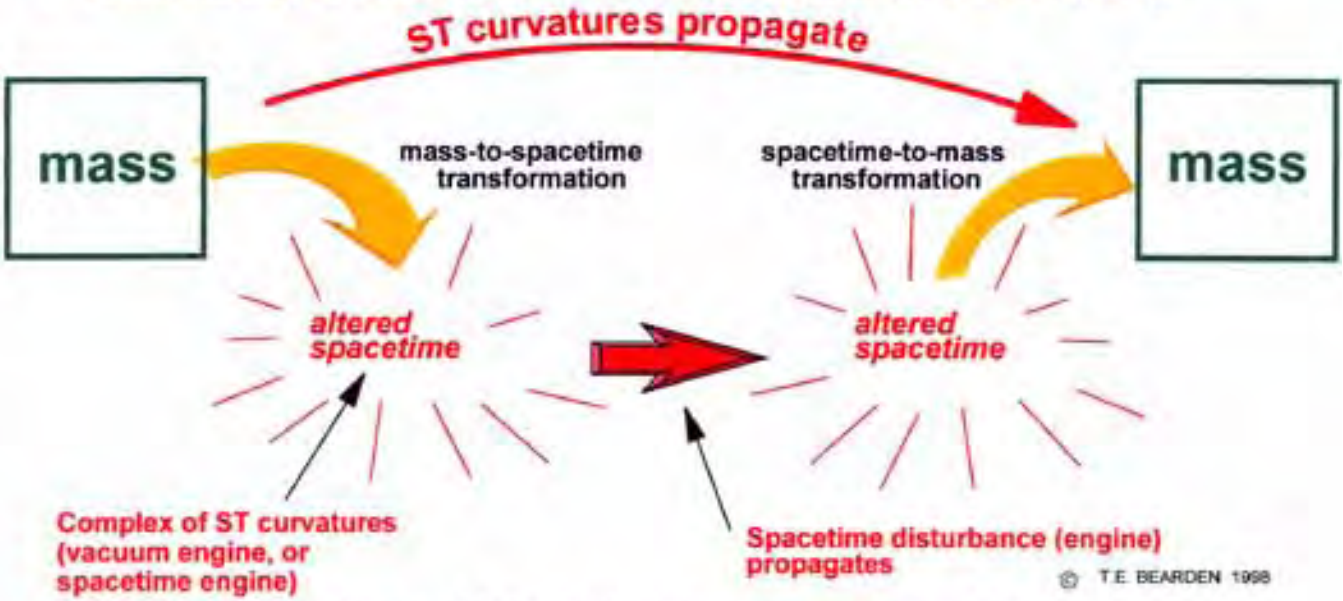

Electrodynamics has a hidden but ignored electro-general-relativity infolded inside (comprising) its so-called potentials, fields, and waves (in space in the absence of mass). What are presently defined as potentials, fields, and waves rigorously exist only in, on, and of charged mass, as pointed out by Aharonov and Bohm in 1959. All of this is just longitudinal EM waves and their interactions.

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SIGNAL VERSUS VACUUM ENGINE

SIGNAL (INFO)

- INFORMATION RECEIVED
- ANY OVERT PHYSICAL ACTION MUST BE TAKEN BY RECEIVER

A. *Receiver must do the action itself; vacuum energy exchange is unaltered. Energy or fuel for doing the action must be added to receiver externally.*

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VACUUM ACTIVATED

ENGINE (STRUCTURE)
TEMPLATE (FORM)

- "INFORMATION" ITSELF ACTS
- VACUUM FLUX GRADIENTS CHANGE ALL PARTS AND CHARACTERISTICS OF RECEIVER, INSIDE AND OUT

B. *Receiver is acted upon; altered vacuum energy exchange does the specific action. No energy or fuel for doing the action need be added to receiver externally.*

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Electronuclear Interactions by Vacuum Engines

- An EM potential is gravitational due to its trapped energy.
- A local EM potential is a local curvature of spacetime.
- *Structured* potentials are structured *(nested)* local spacetime curvatures; hidden variable theory applies.
- Structured potentials thus are *vacuum engines*.
- Gradient-free potential penetrates the atom, into nucleus.
- *With steady application, a structured gradient-free potential can be used to engineer the atomic nucleus at will.*
- Normal cold fusion systems structure a small fraction of their potentials, by chance geometries, boundaries, etc.
- This produces some new nuclides, but haphazardly.
- *The process can be developed and controlled. The nucleus can be deterministically engineered at will.*

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Vacuum Engineering

Using Inner EM Energy and Structuring to Engineer Physical Reality

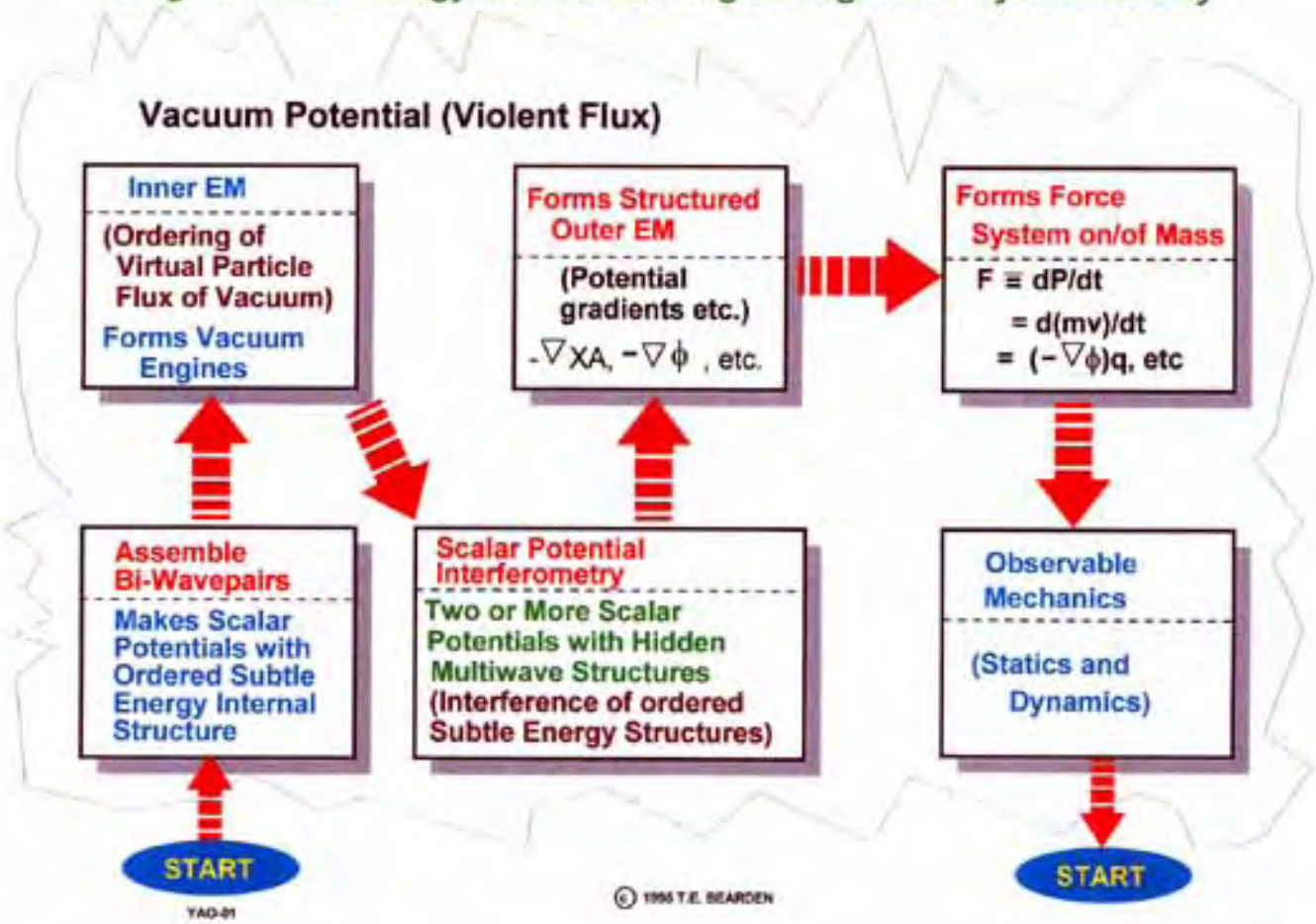

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Impact of Vacuum Engineering

- "If they [quantum fluctuations of vacuum] can be [tapped], the impact upon our civilization will be incalculable. Oil, coal, nuclear, hydropower, would become obsolete -- and so would many of our worries about environmental pollution."
- "Don't sell your oil shares yet -- but don't be surprised if the world again witnesses the four stages of response to any new and revolutionary development:
  - 1. It's crazy!
  - 2. It may be possible -- so what?
  - 3. I said it was a good idea all along.
  - 4. I thought of it first."

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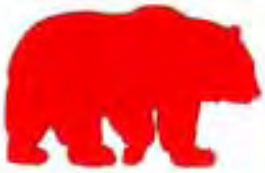

Arthur C. Clarke
"Space Drive: A Fantasy That Could Become Reality"
Nov./Dec. 1994

- *Comment:*
  - *Every dipole's broken symmetry in its energetic exchange with the vacuum already freely extracts vacuum energy.*
  - *In power sources, the dipole gates the extracted energy out as S = EXH, which flows almost entirely outside the conductors.*
  - The circuit interacts with, and uses, only about 10^{-13} of S. The electrodynamicists calculate only this small S-component.

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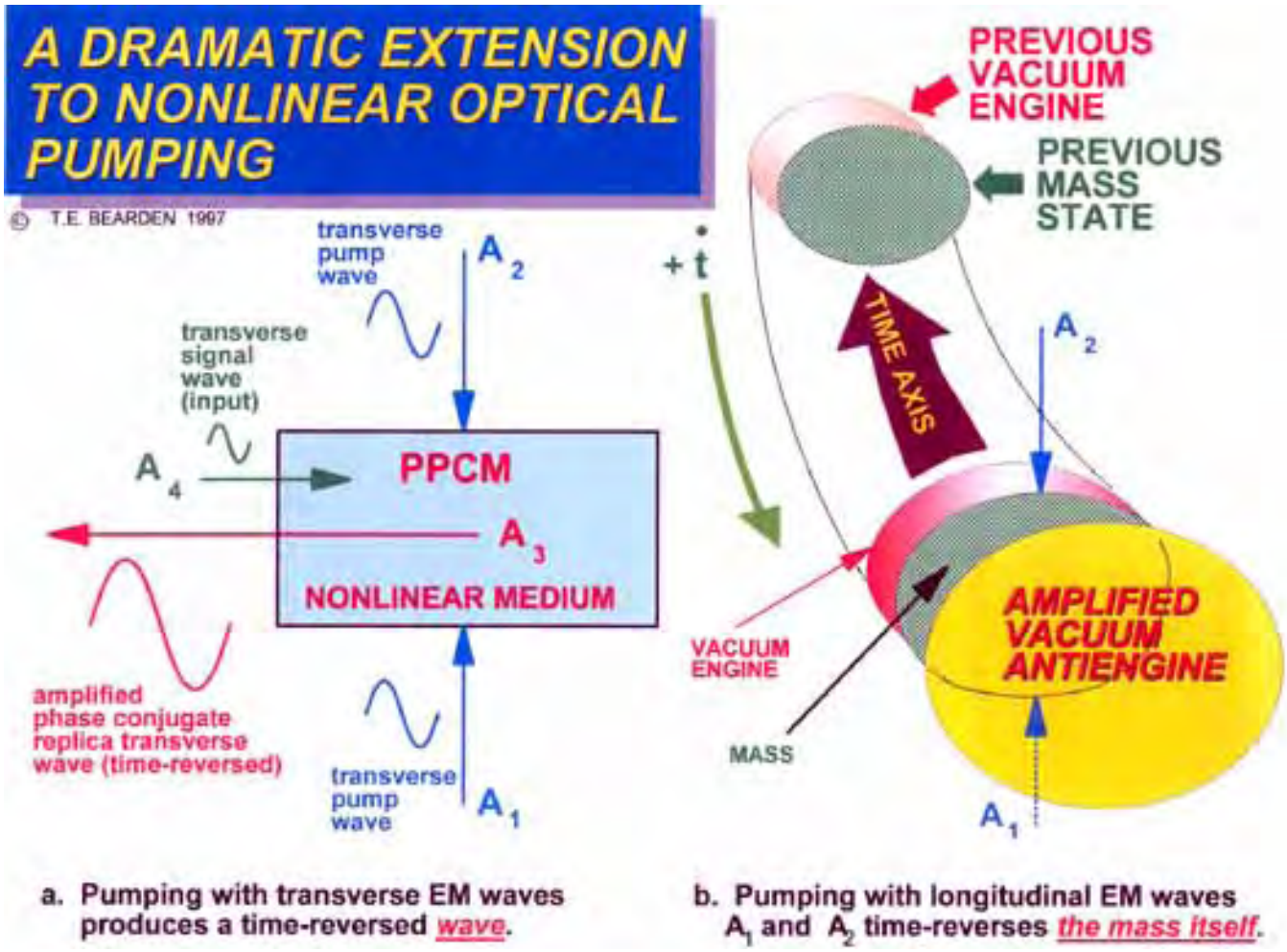

a. Pumping with transverse EM waves produces a time-reversed *wave*.

b. Pumping with longitudinal EM waves A_1 and A_2 time-reverses *the mass itself*.

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Time Conservation and Some Properties

(Energy and time are canonical)

- Time can neither be created nor destroyed
  - *Its form can be changed, and it can be positive or negative*
  - *Time can be collected or dissipated, converged or diverged*
  - *Time can oscillate and move in waves*
  - *Longitudinal (infolded) EM waves oscillate time*
- Time is always in motion, and that motion is variable
  - *Collected/collecting time is a continuing stationary change in an ongoing time flow*
  - *Time/collecting time can be internested and internally structured*

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- Time has gravitational aspects
  - *Negative (trapped) time is antigravitational*
  - *Emitting negative time is gravitational, to the emitter*
- Nonlinear optical pumping can use longitudinal EM waves
  - *Pumping a nonlinear mass by longitudinal (infolded) EM waves pumps it in its masstime form, in the time domain*
  - *This creates an amplified vacuum antiengine for the mass, and time-reverses the mass back to a previous state*

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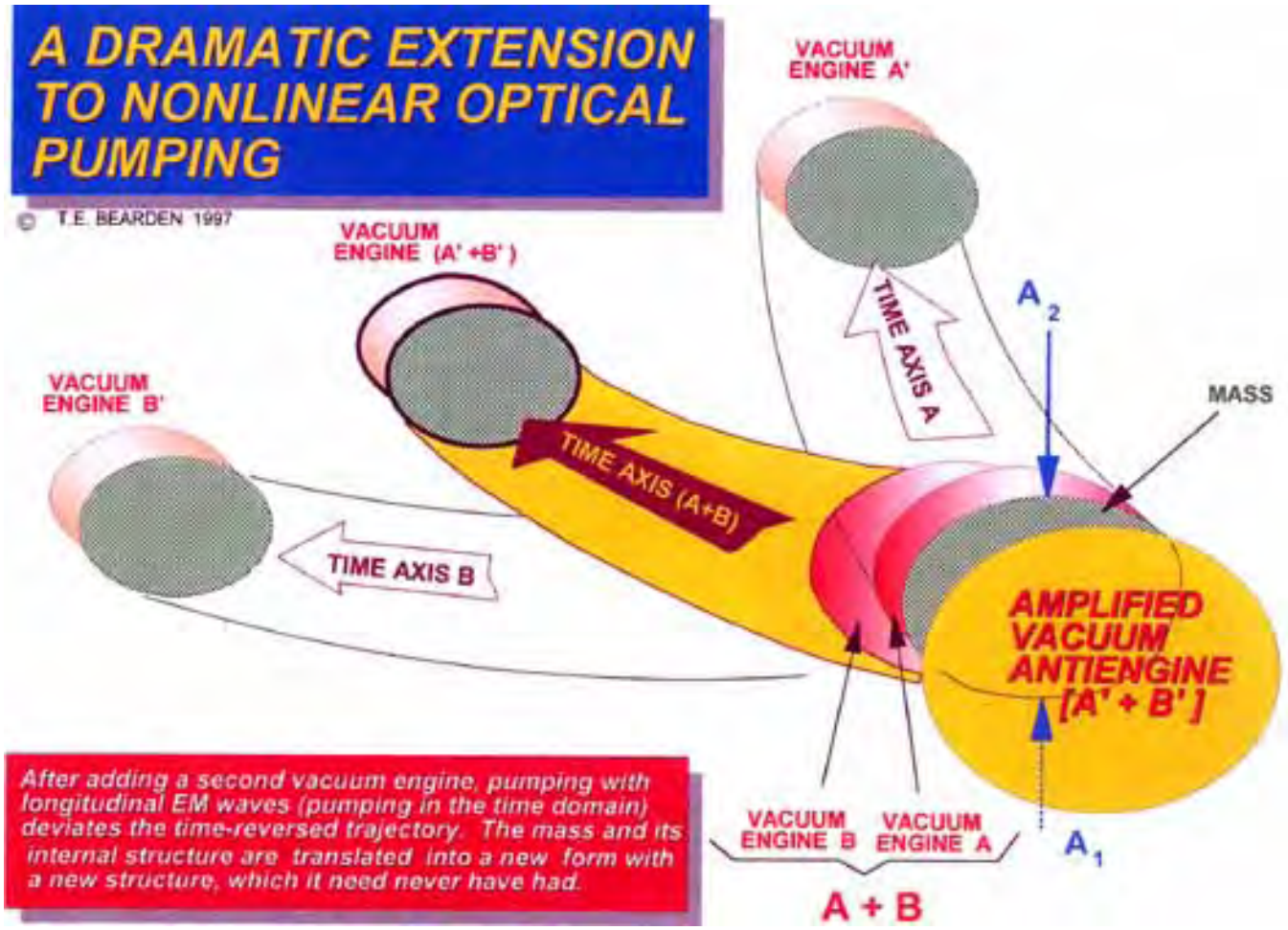

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Key Points in the New Technology

- There is a vast new kind of electrodynamics *hidden inside* all EM potentials, fields, and waves
  - Longitudinal EM waves and complexes
  - Oscillations in time domain

- These complexes are an *infolded general relativity*
  - Clustered formations of *spacetime curvatures*
  - *Very powerful*, since the EM force is used as the agent of curvature

- In general relativity, similar precise complexes permeate and *act on any mass at all internal levels*
- With this approach, one *can now manipulate matter* -- living or inert -- *in any manner desired*, depending only on the level of development of the technology
- Priore unwittingly used this to *cure dread diseases*
- This is a *revolution in all of science*

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- *We have uncovered the major mechanisms* to utilize

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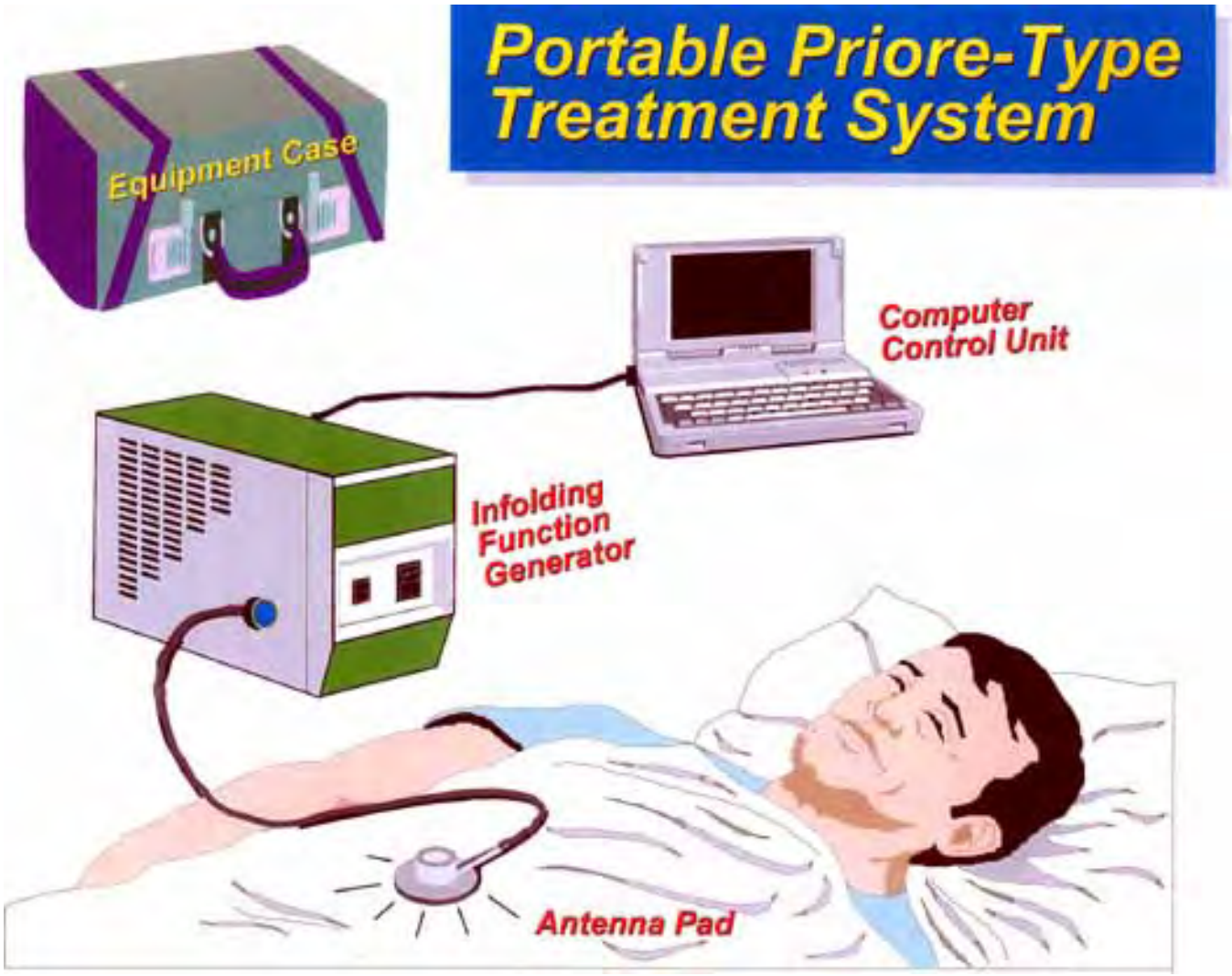

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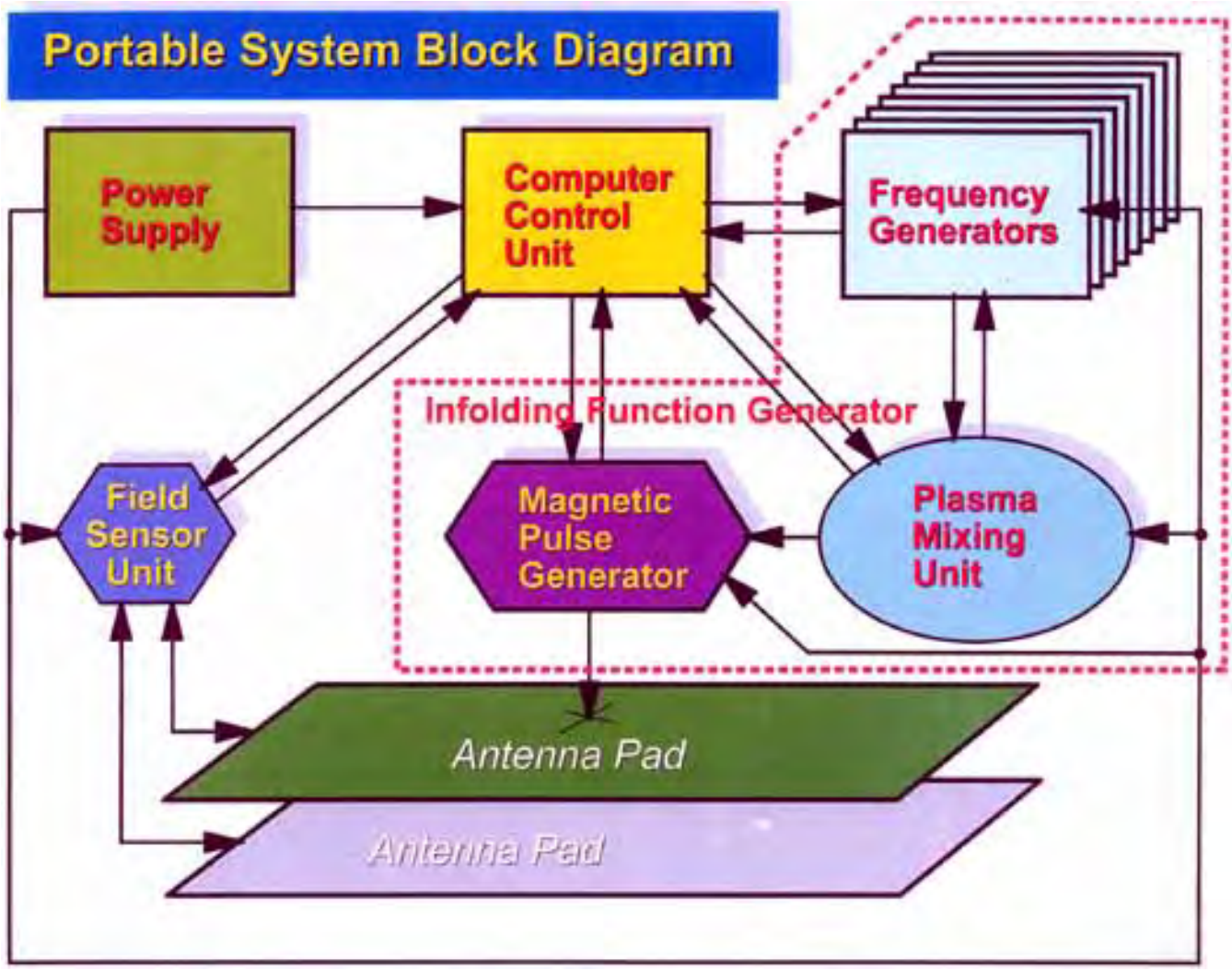

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PORTABLE PRIORE TECHNOLOGY UNIT

- FACT: DISEASE-SPECIFIC VACUUM ENGINE PRESENT FOR ANY CELLULAR DISEASE, BY WHEELER'S PRINCIPLE
  - *DISEASE CAN BE REVERSED BY CREATING AMPLIFIED VACUUM ANTI-ENGINE (BEARDEN'S PRINCIPLE)*
  - *ANTI-ENGINE IS CREATED BY PUMPING THE NONLINEAR CELLS IN THE "INNER EM" DOMAIN, TIME-REVERSING THEM*

- PRIORE UTILIZED A PLASMA TO PHASE CONJUGATE AND "INFOLD" MULTIPLE BIDIRECTIONAL LONGITUDINAL EM PUMP WAVES
  - *17 FREQUENCIES MIXED IN A ROTATING PLASMA*
  - *PHASE CONJUGATES ADDED BY THE PLASMA*
  - *INFOLDED MIX INTO STRONG PULSED DC MAGNETIC FIELD, WHICH CARRIED IT INTO ATOMIC NUCLEI*
  - *PUMPED ALL NONLINEAR CELLULAR COMPONENTS TO PRODUCE AMPLIFIED, SPECIFIC VACUUM ANTI-ENGINE*

- NEGATED THE LONG-TERM CUMULATIVE CELLULAR DEDIFFERENTIATION ORDER GENERATED BY LONG-TERM HYPOXIA. TUMOR CELLS REVERTED TO NORMAL CELLS.
- SCRUBBED OUT THE CUMULATED PRECANCEROUS STATE
- RESTORED THE IMMUNE SYSTEM TO HIGH FUNCTIONING
- NO EXCESSIVE TRAUMA TO TREATED ANIMAL

CANCR-49

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SAVING THE STRICKEN CIVILIANS

SURVIVORS OF N CASUALTIES

(N = 1-40 MILLION)

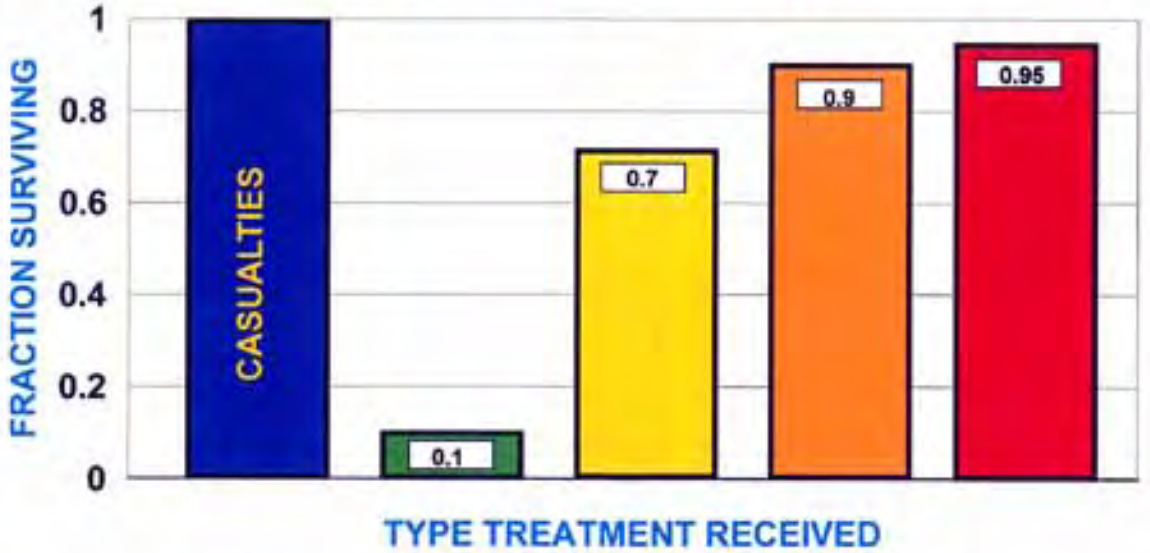

EXPRESSED IN FRACTION SURVIVING
- With conventional treatment
- With 1st generation P-treatment
- With 2nd generation P-treatment
- With 3rd generation P-treatment

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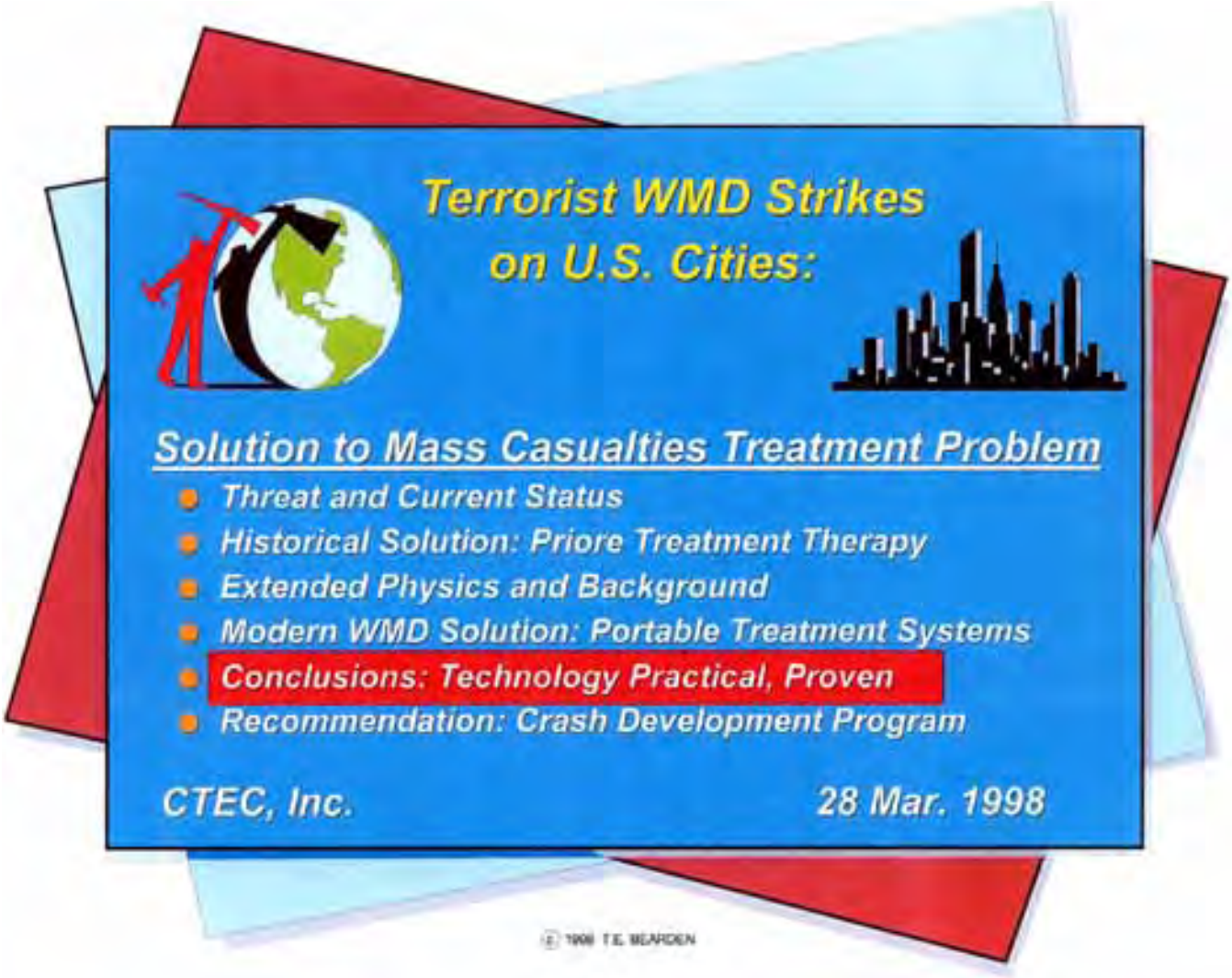

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Summary and Conclusions

- **A new therapeutic paradigm of great scope and effectiveness has been developed**
  - *Will provide effective, quick treatment of mass casualties*
  - *Will provide cures for unknown agents*
  - *No pathogen strains are resistant to this process*
- **Results have been proven experimentally**
  - *Documented in French scientific literature*
  - *Rigorous scientific protocols, eminent scientists*
  - *Technical mechanism deciphered*
- **Will treat and cure many diseases**
  - *Aids, atheriosclerosis, cancer and leukemia*
  - *Sleeping sickness*

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- **Portable units can be developed quickly**
  - *18-month crash development program required*
  - *high level authority and overwatch essential*
- ***Will solve the BW mass casualty treatment problem, both civilian and military***

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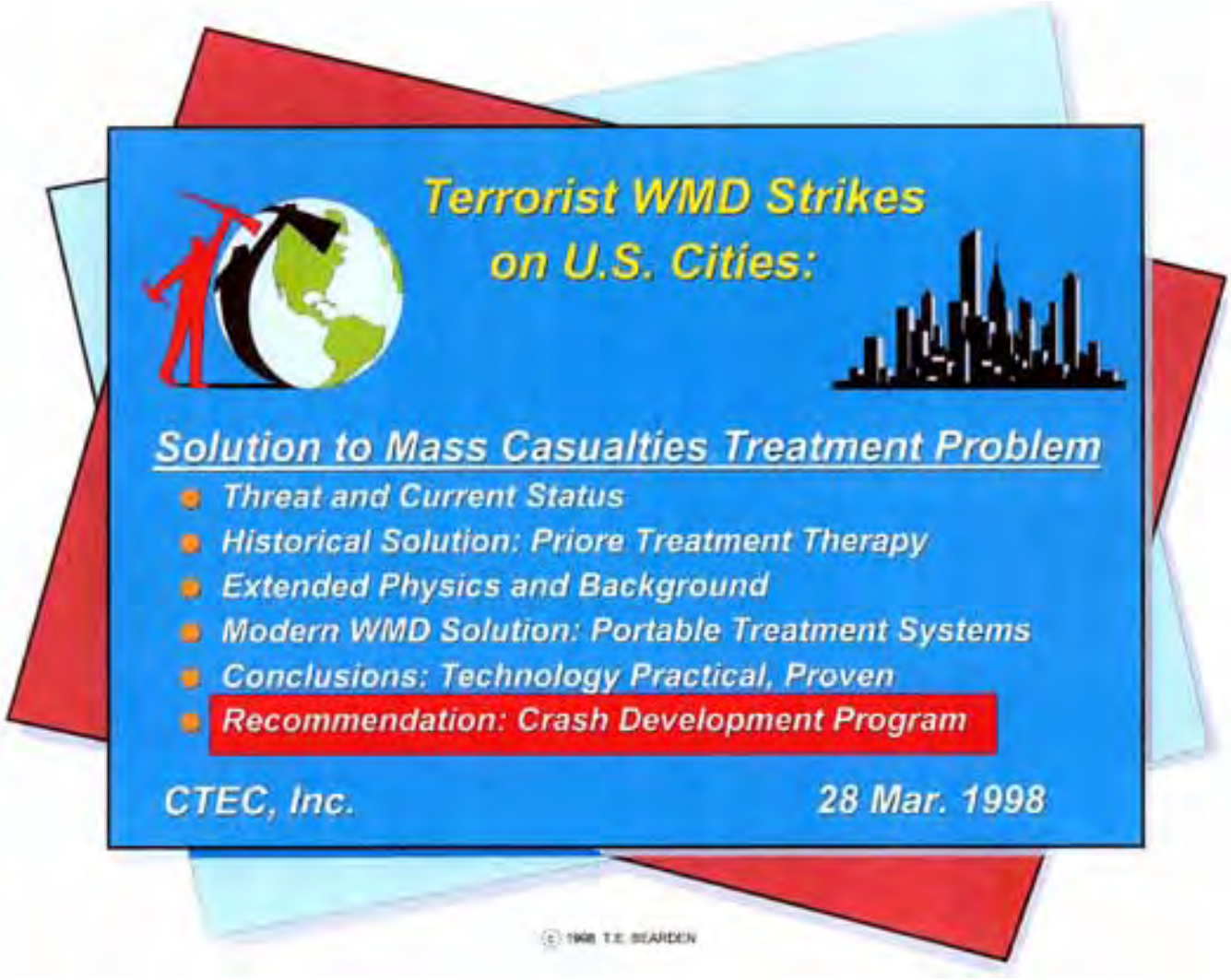

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Recommend implementing:

- Crash development program
  - Suitcase-sized portable unit
  - 18-month Manhattan-type project
  - Simultaneous theoretical modeling, animal testing w/breadboard models
  - SecDef and Congressional overwatch
  - Presidential Decision Directive
- Parallel logistics support program
  - Plan high speed production lines
  - Mass distribution, storage, maintenance
  - User, maintenance training
  - Plan C4 and usage at all levels
  - Integrate firemen, police, National Guard, FEMA, medical facilities, etc.

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Final Thoughts:

- The current internal BW threat can and will kill more Americans than all our previous wars combined
- The Priore technology is the only solution in sight that can save most of those casualties

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CTEC, Inc.
2311 Big Cove Road
Huntsville, AL 35801
(256) 533-3682 Ph/
(256) 539-5951 Fax

CTEC, Inc.

June 24, 1998

Dr. Jane F. Kinsel, Director
Office of Policy Analysis
Department of Health & Human Services
Bathesda, MD 20892

Dear Dr. Kinsel:

Your letter of June 8 is appreciated. However, the entire action package had already gone to the Assistant SecDef and also to Major General Neary in the USAF.

The proof of a revolution in medical treatment was in the package. The basis for it is already demonstrated experimentally in the scientific literature, both in the U.S. and in France. We are speaking of something already proven, but missed by the entire U.S. medical community. Strong words, but true. Let me be specific.

Any cell in the body can be time-reversed (physics term) or dedifferentiated (biology term) back to an earlier state, by pumping (i.e., "squeezing" in simple terms) that cell with longitudinal EM waves as pump waves. There are considerable papers in the French scientific literature showing the experimental results.

Apply that to cancer. We are stating bluntly that all cancerous cells in the body can be "depromoted" back to normal cells easily. Further, the damage previously done to them (such as by sustained hypoxia due to contaminants reducing the oxygen-carrying ability normally given to it by some 60-to-80 surrounding water molecules per red cell and the consequent H-bonding interactions) will also be reversed. The cells can all be returned to healthy, normal cells again, without "killing" or "burning" or "cutting" anything.

With some development of the technology, you can quickly and easily cure every cancer patient in every hospital in the United States.

Now apply it to AIDS. Since you can time-reverse every cell in the body, you can time-reverse the HIV-infected cells – genetics and all – right back to normal cells with normal genetics. Those cells not infected and healthy, will just get a "little younger" again.

So with that small development, you can quickly and easily cure every AIDS patient in every hospital in the United States.

I would have thought that NIH would certainly be interested in such a revolutionary therapy which has already been demonstrated in laboratory experiments. World-renowned French scientists – such as the eminent parasitologist Pautrizel and research PhDs assigned directly by Robert Courrier, head of the Biology Section of the French Academy of Sciences, worked with Prioré in performing those startling experiments that proved what we are saying.

The method was rigorously shown to cure infectious diseases (such as trypanosomiasis), atherosclerosis (which now afflicts millions of Americans), and terminal tumors. It was shown to reverse suppressed immune systems back to normal vigorous functioning.

Please permit me to disagree with you that the examination of such is not the mission of the NIH. To the contrary, it is precisely the NIH which should have some of its very best scientists looking into this.

The action package to DoD was to propose a crash program to develop this methodology in the form of a small, portable unit for treatment of mass casualties resulting from a terrorist BW attack on our cities (now expected in the next few weeks, as you must be aware). The leading Arab terrorist of the world has already promised just this.

We are speaking of several million Americans who are going to die. They are going to die in spite of everything that NIH and its labs can do, even though I know you will make a heroic effort. With NIH present methods, you cannot do very much for those stricken Americans at all. Everything we have in the "normal" kit bag is almost useless against a knowledgeable spray attack of modified smallpox (as you know, the Russian secret BW labs have made and sold tons of that already, to guess who!). Or a spray of tularemia (you are well aware of the extreme lethality of that), or anthrax (easily obtained). It is also common knowledge that these terrorist teams with their BW agents are already on site in this country, waiting for the word to attack. This has now been officially raised to our primary Strategic Threat.

In the face of such looming strikes on the U.S., I simply cannot believe that the NIH does not feel it within their mission to rigorously check out a proposed method for saving perhaps 70% of those coming deaths (first generation equipment), and up to 90% with second generation equipment.

Perhaps you just did not read the package carefully. I urge you to do so.

Else NIH is going to look very, very bad when (1) the strikes do occur, (2) they can't handle them (and they cannot, as you well know), (3) they had within their hands in advance, a proposed methodology that could have been investigated intensely, to save millions of those stricken Americans.

As a staunch supporter of NIH and especially CDC, I have to believe that there is a different attitude there. If NIH is not interested in a previously experimentally demonstrated method of saving millions of Americans, then the only recourse left is the political channel.

I assure you that my critique of electrodynamics is well-founded, as supported by various leading physicists such as Nobelist Feynman (who stated bluntly that the field concept is wrong), Wheeler, Bunge, and so on. It is inexplicable why all our universities are still teaching a 130 year old abridged (Heaviside's) subset of Maxwell's theory, and one that still contains a material ether even though that was falsified 110 years ago!

You already have seen the misuse of this technology by the Russians, in the decades-long radiation of the U.S. Embassy in Moscow. Is it not NIH's mission to understand how they generated all those diseases and health changes? Have you ever looked into Kaznacheyev's experiments showing that ANY cellular disease or disorder can be induced in cells at a distance by purely EM means? Have you looked into what got eliminated from electrodynamics by ignoring the hidden longitudinal EM inside every potential, field, and wave? Do you realize what ignoring that has done to American chemistry, biochemistry, and medical science?"

I would hope that the NIH would at least be interested in its own mission area!

I challenge you bluntly to admit that no one presently understands the primary operation of the human cellular *regenerative* system. That's because its technical principle is not presently in our recognized physics, biochemistry, and medical science – even though it has been in the hard physics literature since 1903-4. Becker's epochal work came closest; since he only had access to the conventional EM model, it failed him. But he at least showed you rigorously that cells can be changed (both differentiated and redifferentiated) all over the map by laughably weak EM – picoamperes of current, which means persistent DC potentials. In the microwave radiation of the U.S. Embassy, all the health changes occurred in regions absent of fields – i.e., absent of bleed-off of the potentials. Hence in regions of stable DC potentials! With 100% correlation of the health changes to persistent, gradient free potentials, and 100% anticorrelation to changing potentials (i.e., fields), our own scientists concluded totally erroneously that it could not have been the EM radiation causing the changes, when their own results had just proven that it was.

Now I ask you: Can NIH explain how it was that the DC potentials caused those health changes? I think not. If it could, it would understand the action package I wrote, and its importance.

This is not a "political" letter. I'm just an ordinary American citizen who has done about 30 years very hard work on this particular area. The work is good enough now to stand on its own merits. The scientific community will eventually accept it, about 50 years from now. But we cannot wait 50 years! Those millions of Americans are going to die, because of the bureaucracy and inaction of our own scientific organizations. Whether they like it or not, the U.S. scientific community is now the forefront of the struggle for this nation to survive. And they are failing us dramatically.

So as a parent who wants his children to live, and his neighbors' children to live, and those millions of soon-to-be stricken Americans to live also, I urge you to at least have someone competent in physics (and knowledgeable that the foundations of physics itself are in woeful shape!) check the work. Has anybody there *read* any of the references to the Prioré work I cited? Does anyone there realize that *there are no EM forcefields in space?* Probably not.

Dr. Kinsel, there is a time for "business as usual" and there is a time to do some serious new work. Those stricken Americans are going to be lying there. Nothing NIH can do is going to stop that. That's a given, and it is not my own estimate. It's the official estimate. And you *know* you presently do not have the tools to do anything really effective about it.

Frankly, I interpret your letter to me as just the normal "spin control" for easy disposition. I would hope that NIH would seriously rethink the situation, get off the "spin control" and "business as usual" posturing, and do something dramatically different for a change.

What have you got to lose? A little time from perhaps two or three of your best scientists.

What have you got to gain? Saving untold millions of American lives. A new, *already partially demonstrated* cure for most dread diseases such as AIDS and cancer – diseases which you presently cannot do very much about in spite of decades of heroic struggle.

Sincerely,

cc: Senator Shelby, Congr. Cramer

T.E. Bearden
President and CEO

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CTEC, Inc.

May 12, 1998

Dr. Harold Varmus, Director
National Institute of Health
Bathesda, MD 20892
(301) 496-1766

Dear Dr Varmus:

We have recently sent action documents to the Director of Nuclear and Counterproliferation, Office of the DCS, Air and Space Operations, HQ USAF and to the DoD (General Busbee) Assistant Secretary of Defense, as well as several Senate and House committees, which may be of interest to you. For one thing, we give the technical mechanism used to generate the Gulf War Syndrome. The same weaponry is now being used to rapidly induce new strains of certain pathogens worldwide. I urge you to closely read that section of the letter to MG Neary which explains the GWS, why the French did not get it, and why Southern Iraqis got an increase in cancer and leukemia but not GWS. Also explained is how the "microwave radiation" of the U.S. Embassy in Moscow induced diseases for decades, and how we failed to comprehend it because the standard EM model deceived us.

There is a way to treat and quickly cure most diseases, including the mass casualties resulting from a terrorist BW strike on our civilian population centers, our military bases, or our forces in the field. The method is little known, but was scientifically demonstrated in France in the 1960s and early 1970s before cancellation of the Prioré Project when the French Government changed. Eminent French scientists worked on the project, and the results are fully documented in leading French scientific journals. References are listed in a separate attachment.

Previously the Western scientific community has been unable to understand the technical mechanism responsible for such remarkable cures, because of serious foundations flaws in Western physics and electrodynamics. *Foundations* physicists have long been aware our science is flawed, and have pointed out many of these fundamental errors. However, the operational science establishment has not paid attention, even though physicists such as Feynman and Wheeler pointed out that the notion of "force fields in space" was totally wrong.

As a primary example, there is an "infolded" electrodynamics inside all potentials, fields, and waves that is far more primary than the coarse EM that is in our textbooks. It is actually an infolded general relativity, and this is what the Russians have weaponized. This infolded EM-GR has been ignored in the West (but not in Russia) since 1903.

As another example the potentials, fields, and waves of present electrodynamics are rigorously defined – and exist – only in the presence of mass. They do not exist in such form (force fields and oscillating force fields) at all in space, in the absence of mass. Rigorously, Maxwell's equations are mass-to-mass transforms, since Maxwell and everyone at the time assumed the ubiquitous presence of the material ether. In other words, to the founding electrodynamicists, there was no place in all the universe that was devoid of mass. Hence they defined all EM entities as entities containing mass. Even though Michelson-Morley experiments of more than a century ago destroyed that material ether, not a single Maxwellian equation has ever been changed! They still assume the material ether.

Specifically missing from our electrodynamics are two essential transforms: (1) the mass-to-spacetime transform, and (2) the spacetime-to-mass transform. In other words, these two transforms are "infolded" or hidden inside (comprise) the end point extremum case – the mass-to-mass transform actually written by Maxwell.

But these two missing transforms are just general relativity (they correspond precisely to Wheeler's principle of general relativity). So general relativity has always been infolded inside electrodynamics as we know it, but ignored. Further, this is a very powerful general relativity, since it uses the very strong EM force as the agent of spacetime curvature. Hence now one can engineer a powerful general relativity in the laboratory and in practical devices, and even action-at-a-distance, which one cannot do using merely the staid and weak G-force.

It turns out that longitudinal EM waves as shown by E.T. Whittaker in 1903 and 1904 are far more primary than our present EM theory and even our present GR theory. Both EM and GR are directly engineerable using longitudinal EM waves, including subluminal and superluminal EM waves in vacuum, and including action at a distance. One can engineer complexes of spacetime curvatures as desired, which in turn are *spacetime engines* (Wheeler's term). These engines can act upon mass – either living or inert – in any fashion desired, and at any distance desired.

The little-known and poorly understood Regeneration & Recovery (R&R) system – as contrasted to the immune system – utilizes this exact "spacetime engine" methodology to restore damaged or diseased cells, within its limitations – "dedifferentiating" or "time-reversing" them back to normal. The mechanism is fully explained in the attached package. The proposed program applies this fundamental method to greatly amplify the effect. Thus cancer cells can be reversed back to normal cells, HIV-infected cells (HIV-factories) can be reversed back to normal cells (genetics and all), etc. This represents a dramatic and unparalleled new medical therapeutic methodology of extreme power. The same techniques can simply be conjugated one additional time, and used to produce diseases and cellular changes at a distance, including in entire mass populations, as the KGB is doing right now. Specifically, by impressing an extremely weak "cocktail mix" of disease spacetime engines on the U.S. populace, the immune systems are reacting and being "spread thin" across several "shadow state" infectious pathogenic conditions. Thus when an actual terrorist BW attack occurs, the lethality of the strike will be remarkably enhanced because the immune systems will be "thinned" in their ability to fend off this new pathogen. By doing it this way, BW warfare can actually be conducted upon the U.S. without anyone being the wiser.

Our very survival as a nation is threatened by remarkable KGB weapons using this fully documented, extended electrodynamics. Bluntly, unless we take off our scientific blinders and understand Russian energetics weapon science, GWS and the Embassy health changes in Moscow were just a picnic before what is upon us. After two decades of work on the KGB energetics weapon problem, we have fully deciphered the technical mechanisms and what energetics is, as well as citing many of the Russian weapon tests and how they were done. Again, you can see that for yourself in the package.

Now that we understand the technical mechanisms, we are proposing rapid redevelopment of the Prioré process, in portable suitcase-sized units to be mass produced and filtered down into the entire emergency community for mass treatment of lethal infectious diseases resulting from BW strikes. And we are strongly urging the U.S. scientific community to quickly investigate and come to grips with this vast new *biological engineering* mechanism. Our very survival depends on it.

The inclosed documents provide an overview of the process. There is nothing else on the scientific horizon that can save the majority of all those stricken Americans, once the first foreign-sponsored terrorist teams strike our population centers with BW agents.

Sincerely,

Incls: Full package with table of contents

T.E. Bearden
President & CEO

Scalar Wars

The Brave New World of Scalar Electromagnetics

by Bill Morgan

For the past six months I have been undergoing the greatest **paradigm shift** I have ever had to go through. It has rattled my nerves and shaken my bones. This intense adjustment of my "world" has come about by studying the information given by Col. Tom Bearden at his website Cheniere. The new knowledge there has necessitated a total revision of my ideas about physical reality, the world we live in, and the future of humanity. This paradigm shifting even actually made me dizzy on certain days as I tried to absorb and digest Bearden's vast amount of information. I am not a scientist at all, just a layman, and I have little comprehension of the math and high physics of this new science called "**Scalar Electromagnetics**." But there is a great deal of information at Cheniere which needs to become common knowledge as fast as possible, for the sake of the survival of life on earth. To that end I have put together this small primer of Bearden's ideas, as a kind of "beginner's guide" to his website. (I have tried to underline certain words and phrases which are part of the new "jargon" of talking about these "new" phenomena. Also I have taken the liberty of bolding certain words and phrases to help them stick in the mind).

(Note: Throughout "**EM**" means "**electromagnetic**," and "**LW**" means "**longitudinal wave**")

This article has six sections:

New Waves 2. Tapping the Waves 3. Weaponization 4. Healing 5. Psychoenergetics 6. As It Stands

1. New waves discovered

Longitudinal EM energy fills vacuum of space, the time domain of spacetime, time as compressed energy, E=tc2, waves of time, phase conjugate wave pairs.

"Electric power is everywhere present in unlimited quantities and can drive the world's machinery without the need of coal, oil, gas, or any other of the common fuels." Nikola Tesla

"At any point and at any time, one can freely and inexpensively extract enormous EM energy flows directly from the active vacuum itself." Tom Bearden

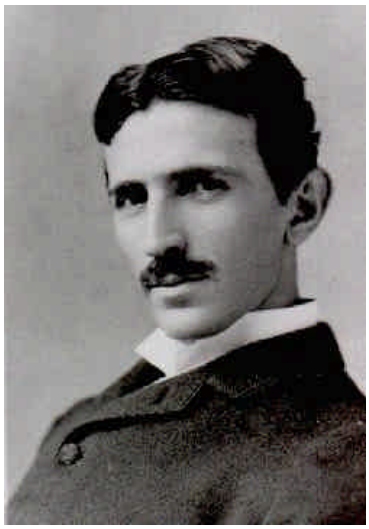

I guess the first thing to try to comprehend is that a "new" kind of electromagnetic (EM) wave has been discovered in the empty vacuum of space called “longitudinal” waves, which, when engineered, can be an inexhaustible supply of energy in great magnitude at any place in the universe. The word "new" is in quotes because the discovery really goes back to **Nikola Tesla** and his discovery of what he called "radiant energy." It is also not "new" because the Russians (KGB) have been working on this technology for over 30 years and have **weaponized** these "new" longitudinal scalar waves to a great degree.

These are the very weapons **Nikita Khrushchev** spoke of in January, 1960.

> "By 1957-8 the Soviets had progressed to the point of a giant scalar EM accident in the Urals which exploded nearby atomic wastes, devastating the area. They had also progressed to development of great new superweapons using their new energetics - weapons to which Khrushchev referred in 1960 when he informed the Soviet Presidium of a new, fantastic weapon in development, a weapon so powerful that it could wipe out all life on earth if unrestrainedly employed."' Tom Bearden

After over 30 years of development, and extensive testing around the globe, these new scalar electromagnetic weapons are up and running and ready to go. Tom Bearden, at his website Cheniere, discusses the history of these new scalar electromagnetic weapons in his paper "Historical Background of Scalar EM Weapons."

Some Immediate Implications

The implications of successful engineering of the longitudinal waves are enormous, and will change the world as we know it, one way or another. Among other things, these discoveries mean that:

1. The **solutions to the energy crisis and the "oil problem" are in hand**. These oil wars are unnecessary. There is endless energy available freely from the domain of time.

2. **Unbelievably powerful weapons** are not only possible, but are already operating in several nations. The many powers of these weapons are unprecedented and mind-boggling.

3. The **cure of diseases such as cancer and AIDS**, in fact nearly any disease, has become possible within a few years of sufficient funding. Everyone can be made healthy and stay healthy.

4. **Mind control on a mass scale** has now become possible, and the machines to do it are already in place in certain nations. It has become possible to mentally enslave whole populations with the twist of a few dials.

So the layman will need to understand that there is a new kind of electromagnetic energy that is altogether different from what he knows, e.g. radio, TV, cell phones, etc. The ordinary EM waves that we have known about are called transverse EM waves, to distinguish them from the new longitudinal EM waves. These scalar waves do not actually exist in our "material" world, but exist only in the vacuum of empty space, or the time domain. And we must keep in mind that this vacuum of space we speak of exists all through everything. Even our bodies are mostly empty space between atoms and molecules. So the gateway to this seething ocean of energy can be there at every point in the universe. This seething ocean of energy is all around us and all through us.

Emptiness is Full

This amazing discovery announces that the "emptiness" of empty space is in fact not empty, but a great ocean of seething energy!

Col. Bearden refers to this ocean of energy as being of the "time domain." It seems like something from Star Trek but this is where scalar electromagnetics has come to. And where it is going may be beyond anything Star Trek could have dreamed of.

We live in a 3-dimensional world, which physics calls "3-space." But there is also spacetime, or 4-space, or the "4th dimension." Then suddenly comes this amazing new knowledge that time itself is actually compressed energy. And it is energy which is compressed by exactly the same factor by which matter is considered compressed energy: the speed-of-light-squared!

So we have a new companion to the famous E=mc2. It is now paired with E=tc2 (where t is actually "delta-t," or change in time). Or (amaze your family and friends and) say:

"E equals em-cee-squared"

and

"E equals delta-tee-cee-squared"

It has a nice ring to it, like some freedom bell announcing a new era.

And as the atomic bomb released the compressed energy in matter, so can we now unleash the tremendous energy that is compressed into time itself. It gives a completely new meaning to the term "time bomb."

Some New Terminology of Scalar Electromagnetics

A new science, several new names

> "Those [Russian] weapon scientists resurrected an old term from the history of electrodynamics, called "energetics". That is their approach to a unified field theory, where everything is based on "energetics". This model as its foundations uses a very similar approach to that "single fundamental unit" model, where energy is the unit. If one makes the energy EM in nature, then one has the Russian energetics approach. This unified approach gathers everything in, including all energy actions and relations in inert matter (the first branch of energetics, called by the same name), all field and matter interactions in living matter (the second branch of energetics, called "bioenergetics"), and all mind operations and mind-matter interactions (the third branch of energetics, called "psychoenergetics"). [ed: sometimes also called "psychotronics" by the Russians]

Rick Andersen in an article called "What is Scalar Electromagnetics?" describes the new science this way:

> "Scalar EM is the brainchild of Lt. Col. (retired) Thomas E. Bearden, a systems analyst and wargames specialist who has been advocating a view of electromagnetics which is based on the notion of a vast, unseen background of scalar energies (as opposed to vector energies) which underlie all physical reality.
>
> "If Bearden is correct in his Scalar EM theory, then we can build devices which would enable us to alter gravity, time, inertia, and the apparent mass of an object. This of course has ENORMOUS implications for military applications, space-vehicle drives, time-travel, teleportation, paranormal phenomena, and just about every other area one can think of." http://twm.co.nz/Beard_scalem.html

> "Time-energy, time-currents, and time-structuring play the dominant role in electromagnetics. Time-as-energy eventually becomes engineerable, as easily as is spatial energy now. We are always dealing with spacetime and with spacetime curvature."
>
> Bearden: http://www.cheniere.org/techpapers/Vision%202000%20paper.doc

The scalar energy discovered in the vacuum of space is sometimes called "zero-point" energy. Thomas Valone explains how this term came about.

What does "Zero Point" mean?

"Boyer traces the historical “creation of the vacuum” as proceeding in stages in parallel with the historical development of ideas about the vacuum. To paraphrase, he says that in the 17th century, it was thought that a totally empty volume of space could be created by simply removing all matter and, in particular, all gases. That was our first concept of the vacuum. Just get rid of all the gas. Late in the 19th century, it became apparent that the region still contained thermal radiation. But it seemed that the radiation might be eliminated by cooling. So the second concept of getting a real vacuum is to cool it down to zero temperature. Just go all the way to absolute zero. Then we’ve got a real vacuum. Right? Well, since then, both theory and experiment have shown that there is a non-thermal radiation in the vacuum and that it persists even if the temperature could be lowered to absolute zero. Therefore, it was simply called the “zero point” radiation. "Thomas Valone http://www.seaspower.com/InsideZeroPoint.htm

> "**For our very survival, it is absolutely imperative that informed citizens be aware of this dramatic change, which is just now starting. The powerful new science and engineering must be controlled and used for humanity's benefit, not its detriment. Else it will eventually be let loose unrestrainedly, to destroy all life on earth - a possibility indicated by Nikita Khrushchev in 1960**." - Bearden
>
> http://www.cheniere.org/explore%20articles/priore1/p4.jpg

2. Tapping the waves

Endless free energy, Tesla's radiant energy, the dipole as the gateway to the energy of the void, MEG in one year, Bedini, Yakuza, etc. End of Oil, geopolitical chaos, rogue groups

Move Over G.E. & Big Oil, Energy is Everywhere!

Third-world nations set to rise

> "Certain powerful interests did not wish the extended electromagnetics to be discovered or taught. That, after all, would lead to free energy and loss of economic control of the citizens. That was precisely why Nikola Tesla had already been suppressed ... Today it is still being suppressed by the orthodox establishment."
> http://www.cheniere.org/books/ferdelance/s25.htm

The vast seething ocean of energy of the vacuum, the longitudinal scalar EM waves of the time domain, can now be tapped and "transduced" into ordinary (transverse) EM energy in our 3-Space world. The process can be compared to putting a paddlewheel into a river. The energy acquired is free, since the river is there flowing whether we tap it or not. And it is a mighty river, and is not diminished by our paddlewheel.

This means that a permanent solution to the "energy crisis" is at hand, if only those who hold it so secret would give it up to humankind.

It means our species' insane use of oil is no longer necessary. We can make automobiles that need no fuel at all. We can build motors that power themselves. It means that unlimited electrical power can be available for free anywhere in the world. Every house and even shack can have its own power supply.

Of course there is the cost of the equipment at first, but the energy flow is free for the presumably very long life (no moving parts) of the generator. It will probably take decades to shift over to scalar power.

But the ability to tap the scalar (longitudinal) EM waves of the vacuum (which exists everywhere) also means that unbelievably powerful weapons can be, and already have been developed. In fact these weapons are so dangerous that the fear engendered becomes a psychological obstacle to the grasping of the facts.

I struggled with this myself for months, and even though Tom Bearden had completely convinced me already, it is hard to accept the fact that for everyone on earth the "worst that might happen" has suddenly gotten much worse. It takes time to deal with that, to realize it and get over it.

Indeed, the possibilities of these new weapons, which are tapping the huge energies of time, are so terrifying it is natural for the mind to simply say: "I don't want to hear about that."

And the government, likewise, pretends these weapons do not exist and tries to keep it secret from the people. Because most people would indeed be truly alarmed to know the actual situation. Col. Tom Bearden has decided that the people need to know the truth anyway. As a People on a Planet we must face this now, and ban the use of scalar weapons in war or in mass mind control. The current deployment of these weapons is a world emergency which we must all face.

The physics and mathematics of the longitudinal waves and the time domain are clearly beyond the layman, but I recommend scanning through them anyway just to get a sense of the wonder and the elegance of it all and some of the exotic terms which are used. Two of the most important papers by Col. Bearden are:

Giant Negentropy from the Common Dipole

The Final Secret of Free Energy.

Despite the complexity of the science involved, Bearden sums up the essential secret of it all in a few words.

> "There is no problem at all in extracting all the energy one wishes from the active vacuum, anywhere in the universe, at any time. Just make a dipole.

> The problem is in (1) catching some of that freely gushing EM energy in a circuit containing a load, and (2) dissipating the caught and collected EM energy in that load to power it, without using half the caught energy to destroy the source dipole's).
>
> That is the ONLY real energy problem on the planet, and always has been."
>
> http://www.cheniere.org/correspondence/022502.htm

A dipole could be a battery, which is polarized into negative and positive. Or the terminals of a generator. Or any magnet with its two poles. Or an atom with its positive and negative charges. Or the earth's magnetic field, the sun, and all heavenly bodies. Even a galaxy must be some kind of mega-dipole. Wherever there is a dipole there is already immense scalar EM energy ushering out of and back into the vacuum. And there have already been demonstrated a number of diverse methods for tapping that energy as it flows. (John Bedini, Edwin Gray, Bruce de Palma, and others). Bearden provides what he calls a "partial list" on his website.

> "In other words, nature then gladly gives us as much EM energy flow as we need, indefinitely — just for paying a tiny little bit initially to "make the little dipole." After that, we never have to pay anything again, and nature will happily keep on pouring out that 3-flow of EM energy for us. This is the giant negentropy mechanism I uncovered, performed in the simplest way imaginable: just make an ordinary little dipole."
>
> Bearden http://www.cheniere.org/techpapers/Unnecessary%20Energy%20Crisis.doc

How to Buy a Free Energy Machine

Answer: Just wait one more year! 2003. Then get off the Grid!

Perhaps the most eagerly awaited event now is the marketing of Bearden's Motionless Electromagnetic Generator (MEG) scheduled to begin in about a year's time. This is when the proof will hit the fan. Many people have said to me, when talking about free energy, "I'll believe it when I can go to the store and buy one." Hopefully in a year's time they will be able to order their own MEG. And then they will believe, because it works and is working.

Says Bearden: "I will admit that the chief scientist of an important experimental group in a large company was rather stunned at the type of output we were able to obtain. The MEG may look like just a transformer, but it is not. It is a completely different breed of cat."

(Bearden : http://www.cheniere.org/correspondence/011202.htm)

Soon the cat will be fully out of the bag. The first MEG units will supply 2.5 kilowatts of free electricity. Forever. Units can be connected together to double or triple the wattage. After that gets going, 10 kilowatt generators are planned. Energy will flow freely from the time domain indefinitely, and there are no moving parts to wear out. This manufacturing project is a heroic effort and will change the world as we know it. For once people are in possession of such devices there can be no further denial from anyone, including the government and/or "secret-government."

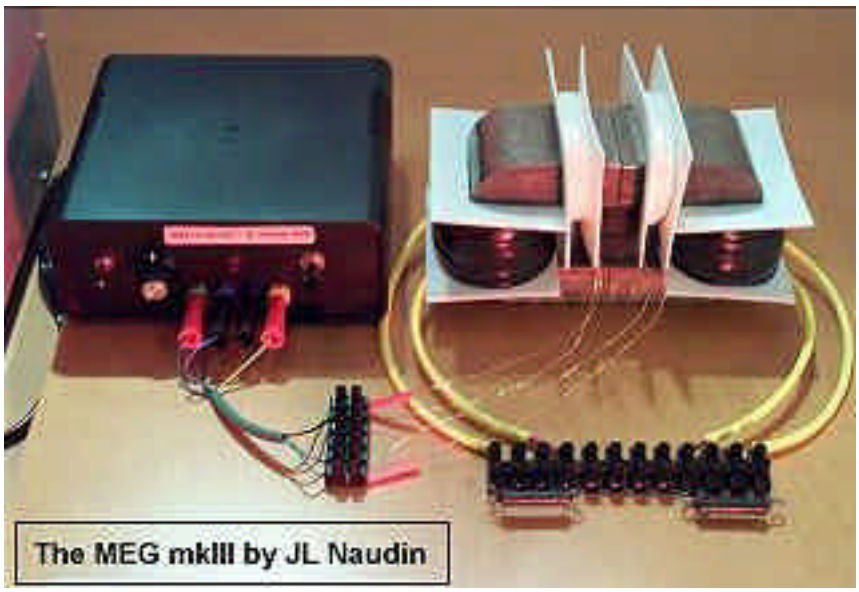

The Motionless Electromagnetic Generator

(Successfully replicated here by J. L. Naudin)

The physics of how the MEG works is explained in the paper "The Motionless Electromagnetic Generator: Extracting Energy from a Permanent Magnet with Energy Replenishment from the Active Vacuum."

The device was successfully replicated by J.L. Naudin in France, and others, like Steve Utne, are also working on their own models. But Magnetic Energy Limited's MEG is actually scheduled for production soon and looks to be the first commercially available free-energy generator in history!

I imagine it will not take long for tinkerers to put them into their electric cars and make the first fuelless automobiles since Tesla's unheralded (and unheeded) experiments. Or for builders to begin building houses powered by MEG's. Houses which will never see electric bills. How can they ever make enough of these to meet the demand that will suddenly be there? Bearden is right, it needs to be an all-out crash program of the government on the order of the Manhattan Project.

I must include here that Bearden is quick to point out that he is not himself the inventor of the MEG, but is a partner and advisor in bringing it to the public market through Magnetic Energy Limited, Inc. I must also admit that I am praying for the success of this venture, and the ending of the absurd and criminal withholding of this technology from the people by the black-ops military-industrial people. This secrecy has cost the planet over 30 years of unnecessary pollution.

The first units off the assembly line, which is being set up in a "friendly" unnamed nation, will usher the public at last into the new era of scalar electromagnetics.

As of December, 2001, the situation with the MEG was described by Bearden in a letter.

> "What we presently have with the MEG is a successful laboratory experiment. At least a year's very hard research will have to be done before we will be ready to put a commercial power supply into production.
>
> "Consequently, we have made an agreement with a foreign partner (the National Materials Science Lab of the National Academy of Sciences of a friendly foreign nation) to do that year's research. At the same time, we are trying to make an agreement with one or more large financial partners here in the U.S."
>
> Bearden http://www.cheniere.org/correspondence/121901.htm
>
> "So we are hopeful that we will be able to start introducing units on the market about a year from now. Quite simply, we will either succeed or we will fail. But we will give it our very best effort."
>
> Bearden http://www.cheniere.org/correspondence/012202a.htm

Bearden has given another technical explanation of how the MEG works here in a letter.

Motionless Electromagnetic Generator patented, 3-26-2002

Click here to read the patent

"In Magnetic Energy Limited, all business discussions and arrangements are taken care of by Dr. Lee Kenny, Managing Partner. There are five of us who are co-inventors of the MEG, and two of the others are really the principal inventors." Bearden http://www.cheniere.org/megstatus.htm

Free Energy has been Suppressed

Secret Government Aware of Free Energy

"In this world of contemporary times, all the agencies, CIA, FBI, KGB, NSA, Electric Power Research Institute, DARPA, Brookings Institution, Henry Kissinger, Edward Teller, et al., all are aware of [free-energy researcher Bruce] De Palma and his ideas.

"Because these individuals and institutions are employed by the ruling elite to forecast the future and satisfy present needs and demands, it is clear that free energy is a threat to the world order constructed by business and the mindset of those who want to own the world.

"Free energy represents Man's aspirations and dreams of freedom and equality, uniform division of resources and the ability to choose one's own future.

"The fact that free energy is suppressed speaks to the greed and self-interest of a ruling elite which, even in the face of an emergency of global starvation, resource depletion and environmental pollution, will not give one inch if it means loss of control. This is an

> attitude of paranoid delusion and fantasy which can only arise from the alienation of a class of elitists who, through their money, are completely insulated from the reality of the day to day fight for existence of the common man."
>
> http://depalma.pair.com/Absurdity/Absurdity07/ProblemOfFreeEnergy.html

Bearden describes one case of suppression when the Yakuza killed the Kawai engine in his very presence in Huntsville, Alabama.

> "That night a jet arrived from Los Angeles, with a Yakuza on board. The next morning Kawai no longer controlled his company, his invention, or his own fate. The Kawai party was in fear and trembling. The Yakuza coldly dissolved the agreement, they packed up the two Kawai engines we had, and left. And that was that."

So it is not only governments who are keeping this revolutionary technology from seeing the light of day. The Yakuza? KGB? The Aum Shinrikyo cult? Our "leaders" need to be honest about what is going on, otherwise they look foolish, acting out a kind of "Alice In Wonderland" script before the public, a script that has become completely unbelievable.

Concerning the criminal withholding of this scalar technology by the military black-budget people, and the cover-up of the actual situation regarding scalar weapons throughout the world, Tom has this to say:

> "The high government officials of the United States of America grossly violated our constitution and their sworn oaths of office. Our constitution specifically charges the government of the United States to defend the people of the United States. That means our officials are specifically charged with defending our people. Yet they deliberately agreed not to do so, and they deliberately sacrificed us in advance.
>
> "They committed treason of the highest kind, by deliberately surrendering us to total destruction anytime the big balloon goes up."
>
> Bearden http://www.cheniere.org/books/ferdelance/s75.htm

Energy Crisis Solved

One of the "must read" documents at Cheniere is "The Unnecessary Energy Crisis: How to Solve It Quickly," especially since the "oil wars," which Bearden has foreseen for decades, have now already begun.

Here are some clips from that Document:

> "To avoid the impending collapse of the world economy and/or the destruction of civilization and the biosphere, we must quickly replace much of the "electrical energy from oil" heart of the crisis at great speed, and simultaneously replace a significant part of the "transportation using oil products" factor also.

> "The technical basis for that solution and part of the prototype technology required, are now at hand. We discuss that solution in this paper."

And although the solution to the energy problem and the oil wars may be at hand, Bearden suggests there is still an urgent rush that needs to be made to save human civilization from collapse.

> "Once the technology hardware solutions are ready for mass production, even with a massive worldwide deployment effort some five years are required to deploy the new systems sufficiently to contain the problem of world economic collapse. This means that, by the end of 2003, those hardware technology solutions must have been completed, and the production replacement power systems must be ready to roll off the assembly lines en masse.
>
> "The 2003 date appears to be the critical "point of no return" for the survival of civilization as we have known it.
>
> "Reaching that point, say, in 2005 will not solve the crisis in time, and the collapse of the world economy as well as the destruction of civilization and the biosphere will still almost certainly occur, even with the solutions in hand."
>
> "The good news is that we now know how to easily initiate continuous and powerful "electromagnetic winds" from the vacuum at will. Once initiated, each free EM energy wind flows continuously so long as the simple initiator is not deliberately destroyed."

On page 9 he explains the concept of the dipole, and how there is already huge scalar energy flowing in the time domain around any dipole. Hold a magnet or a battery in your hand and you hold a stress in time and a beautiful flowing loop of longitudinal waves!

Bearden decries the scientific community in the West for being unable to let go of their dogma long enough to see that the greatest discovery in human history lies at their feet, but for their stubborn ignorance.

> "The present energy crisis then is due totally to that "conspiracy of ignorance" we referred to, that is maintained by the scientific community, and that has been maintained by it for more than 100 years.
>
> "This is the real situation that the environmentalists must become aware of, if they are to see the correct path into which their energies and efforts should be directed — to solve both the energy crisis and the problem of gigantic pollution of the biosphere. "As far as anyone in the legislative branch of government ever understanding the profundity of the discovery and engineering of scalar waves, Tom Bearden says they are at a great disadvantage in doing so.
>
> "The nontechnical person — e.g., a Senator or a Congressperson — is operating under a distinct disadvantage. If he or she takes the stance that much better electrical power systems can readily be achieved, he or she is in fact opposing almost the entire set of University, Government Technical, Power Company, Battery Company, and Organized

> Science communities. Further, in most cases his technical advisors are themselves from one or the other of those communities, and likely to go back into that community or those communities when the Senator or Congressperson leaves office, or even before. So the Congress and the non-technical government community at large operate at a great disadvantage...Bearden National Emergency Declaration is Needed
>
> "The Government Non-Technical community (the Senate and the Congress, in particular) are in far better shape than the Government Technical community, to appreciate the world implications of the pending economic disaster. I am hopeful that both the environmentalists and the Government Non-Technical community will rapidly unite in a common goal to get this vacuum energy program launched, under a National Emergency declaration. If so, then they can solve the energy crisis and the pending economic crisis, in fairly short order, and permanently."
>
> unnecessary_energy_crisis.htm#congress_disadvantage

In the conclusion of his paper The Unnecessary Energy Crisis: How to Solve It Quickly Bearden again states the urgency of replacing our centralized power grids with highly dispersed and local taps on the freely flowing energy of the active vacuum. Given the abilities of the Tesla howitzers, the power grids of all nations are sitting ducks.

> "Personally, the present author regards the increasing energy crisis as the greatest strategic threat to the United States in its entire history. I will do anything within my power to help prevent what I perceive to be the looming economic collapse of the Western world, preceded or accompanied by a sudden, explosive, all-out and continuing exchange of the WMD arsenals of most of the world.
>
> ...In the name of all humanity, let us begin! Else by the time this first decade of the new millennium ends, much of humanity may not remain to see the second decade."

3. Weaponization

Scalar interferometry, Tesla howitzer, Tesla dome, heat/cold, dudding, 10 nations have them, dead-man fusing & Insane Systems, scalar strategy, earthquakes and weather wars, solar storms, mind attacks, leased to Yakuza, many examples of testing, quantum potential weapons.

> "Indeed, Soviet energetics weapons are now capable of destroying both our triad shield, our homeland, our armed forces in the field, and our population, quickly and efficiently. We have a new "gap" of monumental proportions: not a missile gap, not a submarine or bomber gap, and not even a particle beam or laser gap. We have a scalar electromagnetics or electrogravitation gap." Bearden http://www.cheniere.org/books/ferdelance/intro.htm

"We have a new weapon, just within the portfolio of our scientists, so to speak, which is so powerful that,

if unrestrainedly used, it could wipe out all life on earth. It is a fantastic weapon." Khrushchev, to the Presidium, Jan. 1960

> "We've totally missed the most incredible "secret superweapons" development program of all times, and the worldwide testing of the weapons themselves.
>
> "Hiroshima and Nagasaki should serve as object lessons in the price of ignorance of such technological breakthroughs.
>
> "History does repeat itself. But this time it's not we Americans who got the great new superweapon first."
>
> Bearden http://www.cheniere.org/books/ferdelance/s75.htm

Warfare has been changed forever by the development of these scalar energy longitudinal wave howitzers. To get a basic understanding of scalar waves is to have the imagination suddenly run wild as all the implications and possibilities regarding warfare fall into place. One realizes with a certain horror that the world has totally changed, and that there are some very fearsome possibilities. Remember, the power for these weapons comes from the time domain, longitudinal EM waves in the vacuum of empty space, and the power is tremendous and mind-boggling. Being able to blast away at any target from a distant control booth is something that has never happened before. This is incredible power to be in control of and it divides the history of weaponry into "before" and "after." And the destructive power of these weapons is delivered instantaneously to the target from the local vacuum at the place of the target.

From an interview:

> Questioner: "Are you saying that real energy can be transmitted faster than the speed of light?"
>
> Bearden: "Yes. But hyperspatially. Not through 3-space, but "around" it. Again, this means that it's possible to produce energetic changes in a distant system at a distant place, without transmitting energy "through space" in the normal sense. You transmit "around" space, so to speak, and directly in time or through a higher dimension, depending on the model you're using to understand this. Further, the speed of the internal EM energy transmission is not limited to the speed of light."
>
> http://twm.co.nz/beard_interview.htm

Here are some initial considerations about scalar weapons and scalar wars

1. Tesla Howitzer 2. Tesla Domes 3. Rogue groups 4. WW III 5. Russian "UFOs?"

3a. The Tesla Howitzer and its modes of action

Source: Tom Bearden's weapons slides and Fer-de-Lance Briefing

For one thing there is no delivery of any thing to any place. Bombs are obsolete. So are the planes to get them there. No helicopters necessary. All current nuclear devices are rendered nearly useless by electronic "dudding." All distant-destruction can be done from a control room, and to any point on earth. The destructive power of "men" has just increased by orders of magnitude. The new weapons could even cause storms on the sun! Thus there is great urgency to make these new facts public and known, with the hope that all nations would come together to ban the use of scalar weapons.

Two scalar antennae together along with the computers to control them, make up a scalar interferometer, and according to Col. Bearden the Russians have hundreds of such installations already. These interferometers are called "Tesla Howitzers." They can deliver a giant blast of energy to the distant target site, true "action-at-a-distance".

The first howitzer mode is called the "exothermic" mode of operation because immense EM energy blasts outward at the target site. The blast of a scalar howitzer can be of near nuclear level in destructiveness, and can be repeated easily, at that place, or nearby, or anywhere.

The howitzer can use a lesser exothermic power setting and simply destroy all electronics in the target area. Thus they can render our nuclear missiles inoperable as they sit in their silos by "frying" the electronic circuits that guide them. They can bring down any airplane, anywhere in the world, at any time. Any person anywhere, if their exact position is known, can be assassinated without a shot being fired.

The howitzers can also bring down power grids anywhere in the world, at any time. Thus they could bring Wall Street to an instant halt by disabling all its electronics. Even this one little easy tweak of the howitzer could cripple the U.S. economy in a single day. No wonder the "leaders" don't want you to know! This is a new era we are in. The discovery and development of scalar interferometry has put us in a new world, whether we like it or not. Anyone could be expected to go into denial, the befuddled senators and congressmen included. But we have to wake up.

In a second howitzer mode called the "endothermic" mode, the howitzer sucks energy out of the target area, essentially creating a blast of cold at the distant target. It is even capable of freezing parts of the ocean. Bearden gives a number of cases where these "cold explosions" have been witnessed, mostly by airline pilots. April 9, 1984: 1 2 3) A huge mushroom cloud of mostly water is seen rising miles into the sky from out of the ocean, an awesome sight.

In the endothermic mode the sucked-out energy must go somewhere, so it is vented out at some other chosen spot on the earth. These endothermic plumes have been photographed by satellite.

> "The exhaust in the left picture is about 150 miles long, and is nearly horizontal (about 1.5 degrees above the horizontal). It is entirely consistent with the continuous exhaust from a "dumping transfer" scalar EM howitzer in the continuous exothermic mode. (The primary howitzer, of course, was activated in the endothermic mode.)" Bearden More Plumes

By using both of these heat (exothermic) and cold (endothermic) modes together the weather can be altered anywhere. Warm the air over here, cool it down over there, put a curl in the jet stream, dissipate clouds, create clouds, whip up a tornado. Bearden speaks about using the endothermic howitzer mode as a weapon of war:

"Cold explosions can be used to freeze tanks, personnel, and equipment. The equipment and tanks thaw out. The personnel thaw out too, but they are dead when they do." Bearden, Fer-de-Lance

(This endothermic mode of the howitzers makes me think that there might one day be a cure for the problem of global warming after all. Could not a big device, situated in space or on the moon, be able to vent a great deal of excess heat outside the atmosphere into space, thus functioning as a kind of planetary thermostat?)

While the United States has experimented with electomagnetic weapons using ordinary transverse EM waves, the longitudinal [LW] weaponized waves are truly of another order altogether.

For one thing they do not have to travel through space, for they come from the time domain, which is everywhere. The energy of the blast, the heat or light or whatever, comes from the vacuum of space at the location of the target itself. This is astonishing. The weapons actually just trigger the release of immense energy from the vacuum at the target location.

> "... it is possible to focus the potential for the effects of a weapon through spacetime itself, in a manner so that mass and energy do not "travel through space" from the transmitter to the target at all. Instead, ripples and patterns in the fabric of spacetime itself are manipulated to meet and interfere in and at the local spacetime of some distant target. There interference of these ripple patterns creates the desired energetic effect (hence the term energetics) directly in and through the target itself, emerging from the very spacetime (vacuum) in which the target is imbedded at its distant location." Bearden Fer-de-Lance

The big Tesla howitzers are aimed at their targets by using a worldwide electromagnetic pattern called the "Woodpecker Grid," begun by the Russians in 1976.

You can hear the Woodpecker signal here: http://www.cheniere.org/misc/woodpeckersound.htm

The woodpecker grid is just that, a grid of EM waves which provide a channel for the LW waves to any point on earth. Computers use the woodpecker grid information to hone down the aiming of the howitzers to a pinpoint location on earth. (For that matter, it could be under the earth, in space, or under the sea).

A third howitzer mode is what Col. Bearden calls "Mindsnapper" mode. This is a truly frightening mode which affects the electromagnetic mind-body connection. Being mind-snapped at a low level would cause you to lose consciousness. Being mind-snapped at a slightly higher power would "entrain" all minds in the target area into a kind of hypnogogic trance, a state in which they would all be highly susceptible to suggestions and orders.

Being mind-snapped at high level would so disrupt the mind-body connection that everyone in the target area would fall down, instantly dead. Not only that, everything around you and inside you would be killed, so that your sterilized body would not rot for quite a long time.

The Mindsnapper can be used for a small area, or to kill an entire population. In fact, using the scalar waves to affect the human mind has become a new field in its own right, and has been dubbed "psychoenergetics." (This is discussed below in section 5).

Bearden describes the use of the howitzer in mind-snapping mode against people, to cause unconsciousness or death:

> "From a military viewpoint, these scalar EM weapons are really quite all-around weapons.
>
> "For example, they are very lethal against personnel.
>
> "Set in the "high intensity pulse mode," one blast and a person's nervous system is destroyed instantly. Total, instantaneous death results. One can blast away at entire groups of infantrymen, for example. It's the peak power that's important, not the average power. So the weapon doesn't require too much battery power.
>
> "Set on a lower intensity pulse mode, one zap can simply knock out a person, rendering him instantly unconscious. Quite useful if one needs prisoners to interrogate. Also very silent, which is useful in operations employing stealth and surprise." Bearden http://www.cheniere.org/books/ferdelance/s80.htm
>
> "Those hit by the scalar EM weapon, however, have a most peculiar death mode.
>
> "Death comes-instantly and totally. There is no convulsion, no response. The entire nervous system is destroyed instantly. Every living cell in the body is killed instantly, including all bacteria, germs, etc.
>
> "A body hit with this thing falls like a limp rag and lies where it falls. It doesn't decay in even 30-45 days. In a macabre fashion, it's been reduced to something like food irradiated with nuclear radiation; everything is killed, so the material is preserved for an extended period before any decay can set in."
>
> Bearden http://www.cheniere.org/books/ferdelance/s81.htm

He goes on to say that the same "bazooka-sized scalar EM pulse weapon" can also be used to knock out a tank with one shot (or pulse). So tank warfare is obsolete. Helicopters? Bearden points out: "... if he's attacked by a helicopter or a fixed-wing aircraft, he can bring the same weapon to bear on it. He can knock down a chopper or a jet. With one shot."

Obituary for Tank Warfare

Tanks useless against portable LW weapons

> "For example, suppose one attacks a tank. [with an LW weapon] With scalar EM pulse, the personnel die instantly. Total personnel kill is achieved.
>
> All electronic systems of the tank are dudded. Total systems kill is achieved. The ammunition in the tank explodes. Total kill is achieved.
>
> The fuel explodes. This is another total kill mechanism.
>
> That tank has been killed totally, by a variety of mechanisms, all simultaneously.
>
> That's a k-kill in any analyst's book.
>
> And don't worry about retrieval and repair. That tank is finished permanently.
>
> Even the most modern tank is just as vulnerable as the most obsolete."
>
> Bearden http://www.cheniere.org/books/ferdelance/s88.htm

One begins to get the idea how profoundly the conventional means of warfare have been obsoleted. All the usual weapons of war have been rendered nearly useless! And Star Trek's "Phaser," with its "stun" and "kill" modes is here at last.

Although it is the weapons aspect of scalar electromagnetic which has received the most developmental effort, Bearden points out that a great many other amazing things that may be accomplished in this new field of science. Beam me up Scotty!

> "Superluminal communications systems, hyperspace drive, and materialization and dematerialization are all hypothetically possible, using scalar electromagnetics. As the technology develops, we should see the development of many of the systems long thought impossible except in science- fiction."
>
> Bearden http://www.cheniere.org/books/ferdelance/s15.htm

Bearden describes a huge test of the Russian scalar weapons systems which occurred in 1985, a test that went completely unnoticed by western scientists:

> "Just before May 1, 1985 the Soviet Union performed a "full-up" operational test of their entire strategic scalar EM weapons complex. This test was detected and monitored periodically by Frank Golden. Some 27 of these giant Soviet "power taps" were locked into the molten core of the earth, producing forced (entrained) scalar resonance of the entire planet on 54 controlled frequencies under our very feet. The remainder of the scalar frequency spectrum was ablaze with literally hundreds of Soviet scalar transmitters: probably the entire strategic scalar command and control system to

> underwater submarines, higher command centers, distant commands, etc. was activated in the giant exercise.
>
> "For several days, the system was exercised on a mind-boggling scale, apparently as part of the Soviet Union's highly accentuated 40th anniversary celebration of the end of World War II.
>
> "Ironically, not a single U.S. intelligence agency, laboratory, or scientist detected this monstrous exercise for the new Soviet leader, Gorbachev. Not a one of them had a detector for scalar EM radiation, and not a one of them officially believes the exercise ever happened."
>
> Bearden http://www.cheniere.org/books/ferdelance/s38.htm
>
> "The Woodpecker grid/howitzer weapon system can be placed over the ocean and used against cruise missiles, naval surface-to-air and surface-to-surface missiles, submarine-launched ballistic and cruise missiles, etc. Placed over a carrier task force, it can also take care of the aircraft launched by the carrier as fast as they are launched. It can also handily take care of the missiles launched by guided-missile cruisers of the accompanying task force."
>
> (Bearden http://www.cheniere.org/books/ferdelance/s65.htm)

The whole series of the Fer-de-Lance briefing slides and comments is a "must read" for anyone wanting to be aware of the actual state of things in this world right now. It is a new world and it takes some getting used to. Fer-de-Lance speaks clearly, for the layman, of the way things stand.

What is it like to operate these Tesla Howitzers? Col. Bearden gives us an idea in his "Fer-de-Lance" briefing, Slides 66-71.

Who needs armies anymore? A entire war can be fought and won by a handful of men sitting in a comfortable control booth! The scalar electromagnetics revolution has made all previous forms of warfare nearly obsolete.

Why haven't the Russians used the scalar weapons yet?

Bearden gives his thoughts on this in "Fer-de-Lance." The power of these weapons is so great that an accident or war could wipe out all life on earth, and even affect the sun.

> "As can be appreciated, this entire concept [MAD] is now totally obsoleted by the Soviet possession of scalar EM weapons.
>
> 'The "mutual assured destruction" capability -- or MAD concept as it was so aptly named! -- is no longer mutual. And for two reasons: (1) the Soviet surprise attack could destroy essentially all our Triad forces wherever they are, in the first attack. (2) Even if a very small number of our strategic forces survive, the puny strike we could attempt to launch could be repeatedly decimated from launch to terminal phase.

'The restraint on the Soviets is not because of our Triad forces. The restraint is twofold: (1) a second nation has scalar EM weapons, and would undoubtedly unleash them upon the Soviet Union with great violence if such a massive world-wide destruction of U.S. forces occurred or was threatened (is it really "accidental" that six major Soviet missile ammunition storage sites mysteriously exploded within seven months?); (2) the closed-loop scalar radiation exchange system of Earth-Sun could be inadvertently "tweaked" in the feedback loop from Earth to Sun, so that a large solar scalar resonance was stimulated. In that case the Sun could emit a mighty resonant "burp" that would simply wipe out all life on Earth in a fiery shower.

'The "terror" in the "balance of terror" between nations has just increased by many, many orders of magnitude.

'The biblical prophecy that the Earth will be wiped out by "fire and brimstone from heaven" is very near fulfillment now.

'Put another way, the pucker factor -- even on the Russians who may contemplate unleashing Armageddon -- is higher than any Western strategic analyst has ever imagined, even in his wildest nightmares.

'Truly these weapons are "more frightening than the mind of man has imagined," as Brezhnev put it in 1975.

'The frightening scalar EM weapons can be used, but only very, very gingerly indeed. If a slight mistake is made, everybody loses everything."

Bearden http://www.cheniere.org/books/ferdelance/s74.htm

But the Russians (KGB) are not the worst of it. Bearden claims that some of the scalar weapons have been leased to the Yakuza for about a billion a year, and that only the KGB is holding the Yakuza in check from making a full-scale all out scalar attack on the west.

U.S. Defense Secretary William Cohen

Warns about eco-terrorism using scalar electromagnetic weapons

"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves... So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations...It's real, and that's the reason why we have to intensify our [counter terrorism] efforts." - Defense Secretary William Cohen, 1997

In a letter to a writer named "Russell" Bearden says,

"In short, Russell, the Secretary of Defense of the United States confirmed that there are indeed novel kinds of EM weapons, right now and have been for some time, which have been and are being used to (1) initiate earthquakes, (2) engineer the weather and climate,

and (3) initiate the eruption of volcanoes. We wrote about those exact uses of the weaponry decades ago. Several nations now have such weapons. Three of them (two on one side and the other on a hostile side) are even firing practice shots into Western Australia, as a convenient test range."

http://www.earthchangestv.com/ufo/0209gandor.htm

Tesla Howitzers in Weather mode

How to Make Weather

"Engineering the weather is duck soup; they tested that over the U.S. in 1967, and entered upon continuing operations over North America on July 4, 1976 as a grim kind of KGB "Bicentennial Gift" to the United States. Here's how it is done with several interferometers.

"First, the interferometers can deliberately make "high pressure areas" (cool the air so it shrinks and its "footprint" pressure on the ground increases because its density increases) and "low pressure areas" (heat the air so that expands and its "footprint" pressure on the ground decreases because its density decreases). Well, if one makes the highs and lows where one wishes them, and judiciously and somewhat slowly moves them along a given path, these highs and lows will entrain the jet streams and thus "steer" the weather.

"So if you wish a very cold snap or attack, go up into Canada and start these actions to steer down some streams that bring some very frigid air. Establish other highs and lows judiciously to "block" or "slow" other jet streams and flows as desired. In this way, one can pull the "large cold air masses coming down from Canada" deep into the southern U.S. at will. They do it regularly. If you wish an ice storm, add an additional current of warm moist air you bring up (steer up by using artificial highs and lows) from the ocean. Where they meet, you will get freezing rain, then sleet, then severe icing accumulating. This type of attack does rather large damage to the struck area."

http://www.earthchangestv.com/ufo/0209gandor.htm

Whole websites have now sprung up showing weather radar anomalies which may well be indications of scalar weather engineering. One list of over 500 images is here. Cheniere has its own collection here.

In another section at Cheniere are many photos of cloud anomalies which reveal the underlying grid along which the clouds are forming or un-forming. Bearden relates a startling incident in these clandestine ongoing "weather wars."

"During the spring of 1986, abnormally strong Soviet weather engineering occurred over the U. S., causing a drastic drought in the southeastern U.S. This drought was broken by a colleague who used an extremely powerful scalar EM device to redirect jetstreams. A most unusual and unique signature of the "blocking" against the Soviet scalar EM actions

resulted: Two huge circulations developed in the atmosphere, clearly showed as two adjacent giant "holes" in the swirling cloud cover over the middle and eastern U.S.

"Between these two giant holes, the cloud circulations formed a stream of clouds, moving to the south, looking very: much like a giant vertical "bar" of a huge "Y-shaped" cloud flow.* Several national weathermen commented on this unusual pattern, which had not been observed before. The pattern continued, day after day, as the blocking continued."

* On the weather maps.

http://www.cheniere.org/books/analysis/history.htm

Tesla Howitzers in Earthquake mode
How to Make an Earthquake

"Here's how you initiate a very large earthquake with such weapons. Take a convenient fault zone of set of them. Focus the interferometry on the fault zone, in the "diverging" mode, and deposit EM energy there in the rocks on both sides, increasing (slowly) the stress in the rocks by the reverse piezoelectric effect (deposit excess energy, get crystal mechanical movements).

"Do it slowly, and the stress will build up to large pressures well-above a plate slip minimum energy required. At some point, the rocks yield and one or both sides "slip" and move rather sharply, giving a very large earthquake in that zone.

"Do the same thing down in the earth (remember, LWs easily penetrate right through the earth and ocean at will, and so the "interference zone" focus can be inside the earth or beneath the ocean, at will.

"Anyway, focus this thing down to where the active part of the volcano is still slumbering, down where the hole in the plate has been made. Keep increasing the deposition of energy in the magma itself, and eventually the increasing pressure from deep within that volcano, underground, will cause an eruption. Build the energy slow, and the eruption will likely be much larger."

http://www.earthchangestv.com/ufo/0209gandor.htm

Yugoslav Earthquake, Followed by Cold Explosion

Strange Characteristics of Iran Quake, Sep. 1978

Tesla Howitzers in Tesla's "Big Eye" mode

How to make a Big Eye in the Sky

By using longitudinal wave interferometry in a weakly endothermic mode a new kind of "radar" is now possible, one which can look right through the earth and oceans. Because the endothermic

mode extracts energy from the distant target, a pattern of the target area can be scanned for in the returned energy.

> "Thus the receiver produces a representation of the energy extracted from various locations within the distant endothermic zone. By displaying the received signals on an appropriately scanned screen, a representation of the distant scene in the intersection zone can be created. Indeed this is a special kind of "microwave interferometry," and -- with modern techniques -- the imagery obtained might be surprisingly good. With development, it might even become as good as the image presently obtained by side-looking acquisition radars.
>
> "Interestingly enough, since scalar EM beams will easily penetrate the earth or the ocean, one can also look beneath the earth or beneath the ocean with this type of scanning scalar interferometer.
>
> "The importance of this capability to strategic and tactical reconnaissance is obvious. Camouflage, cover, and concealment have no effect on such a system. One can easily look inside buildings and into underground facilities. With a small system such as this, the U.S. Marines at Khe Sahn would have had little difficulty locating the tunnels continually dug under the perimeter by the Viet Cong. And targets under jungle canopies are directly visible."
>
> Bearden http://www.cheniere.org/books/ferdelance/s42.htm

Tesla Howitzers can destroy all life on earth

How to Make a Storm on the Sun!!
(Just make a big mistake with your Tesla howitzers)

The deepest dangers of the use of scalar weapons are frighteningly pointed out by Bearden here where he considers that the sun, earth and moon (actually the whole solar system) is a delicately balanced arrangement of scalar (longitudinal) EM radiation. There is a scalar connection between the earth and the sun, which are both giant dipoles gushing energy in the time domain. Big scalar events on the earth could alter this balance causing true catastrophe.

"Indeed, a solar response could be stimulated so that the Sun would violently belch and destroy our biosphere, among other effects."

Unrestrained scalar warfare could cause huge solar storms? To realize that human activity could actually affect the sun itself is truly mind boggling.

Bearden goes on to say:

> "Accordingly, use of huge scalar EM weapons is a double-edged sword. Unless carefully employed, use of the weapons could cause a terrible backlash to the user as well as the victim, and even accidentally cause the destruction of the earth itself. It is not accidental

that in 1960 Khrushchev stated that his new fantastic weapon could -- if unrestrainedly used -- destroy all life on earth.

"This appalling backlash potential is apparently what prompted Brezhnev in 1975 to make so strong an effort to get agreement to outlaw the development of "new weapons of mass destruction" more frightful than the mind of man had even dreamed of. Gromyko even introduced such a draft agreement into the proceedings of the United Nations. The first article of the draft agreement indicated that the nature of the weapons referred to would be negotiated. Sadly, the entire Western world did not even know what the Russians were talking about."

http://www.cheniere.org/books/ferdelance/s24.htm

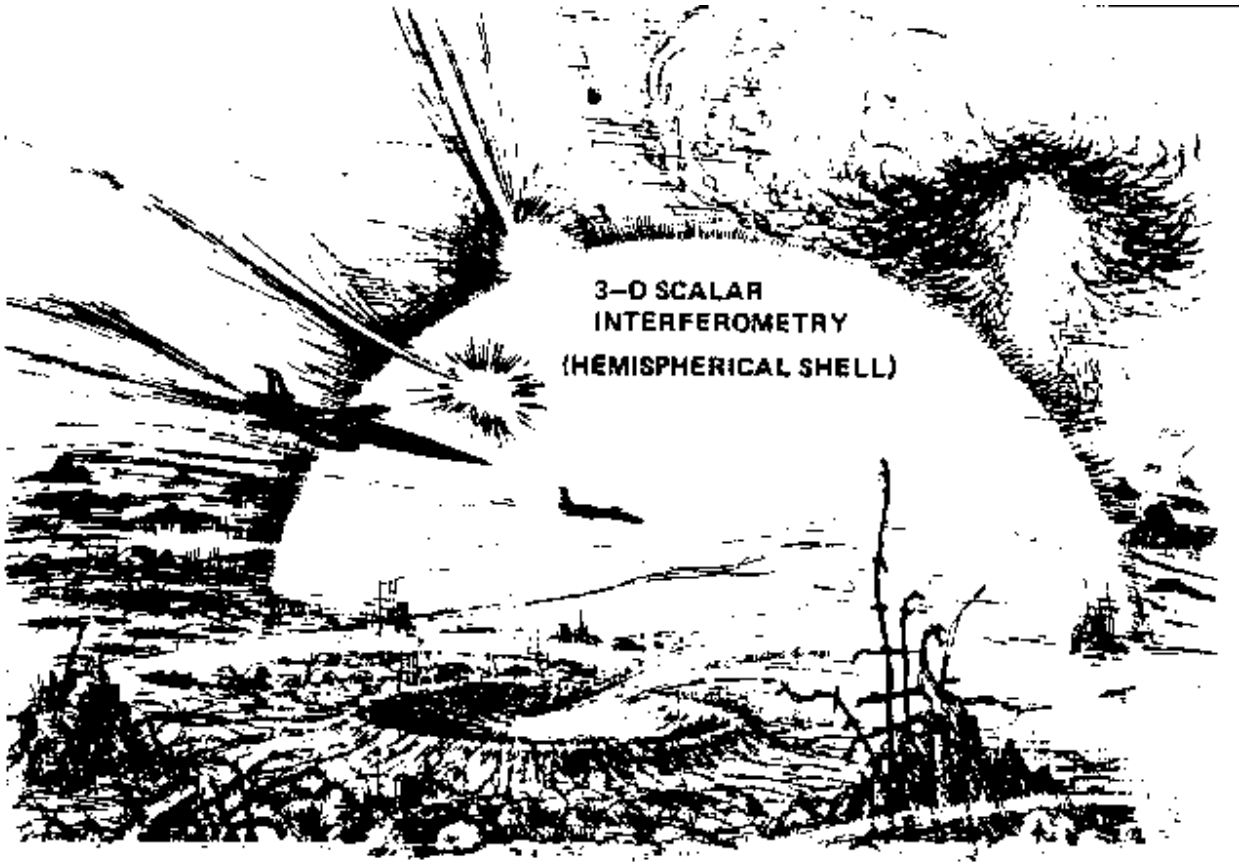

3b. Tesla domes provide near-perfect defense shield.

(Slide from Cheniere.org)

The Tesla howitzers can be used in a nearly impregnable defensive mode whereby they throw up a dome (**Tesla Dome**) or a sphere (**Tesla Globe**) of highly powerful electromagnetic energy, enough to "dud" or destroy missiles which try to penetrate them. Once again, this energy is not

going through space from the howitzer, but being made to emerge from the local vacuum at the location of the shell. KGB tests of these domes have been witnessed by airline pilots around the world. Bearden gives many examples of the Tesla domes being sighted around the world in his briefing paper "Fer-de-Lance." (Russian dome test, another globe incident, yet another globe test). These giant electromagnetic domes can be hundreds of miles across, or narrowed down more to total impermeability.

> "Such a shell may be several hundred miles in diameter at the base. The enormous energy required to form such a defense shell is obtained by a "scalar power tap" into the molten core of the earth itself, as previously explained. In late April/early May of 1985, 27 such "power taps" were placed in the earth by the Soviets. If each tap is capable of powering four to six large scalar EM weapons, then the Soviet strategic scalar EM arsenal contains over 100 monstrous superweapons capable of generating exothermic explosions, endothermic explosions, engineering the weather, locating and destroying underwater submarines, detecting and destroying ballistic missiles shortly after launch, detecting and destroying long range strategic bombers as soon as they are airborne, etc."
>
> http://www.cheniere.org/books/ferdelance/s52.htm

By using nested domes one can protect the domed area even against nuclear radiation itself. Tesla globes can be used to hit airborne targets by simply placing a globe of any chosen size in the flight path of the incoming missile. It does double duty because the missile hits it going in, and then the rubble hits it again going out the other side.

While the U.S. persists in its useless boondoggle "missile defense system" by shooting a missile with a missile (missiles which would already have been "dudded" by the Tesla howitzers), between the domes and the globes the Russians (KGB) have in hand (operational) a nearly perfect missile defense system. Someone should ask the Secretary of Defense if the U.S. Tesla domes are in place. And over which cities? How powerful are our American Tesla domes?

Bearden cites a number of examples of these domes being tested around the world:

March 20, 1969 | March 24, 1977 | August 17, 1980 | June 17, 1966 | June 18, 1982 | June 22, 1976

In a slide from the Fer-de-Lance briefing it is shown how the "woodpecker grid" itself also acts as a sensor, detecting any missile launch anywhere, and how the howitzers can respond instantly by delivering a blast to exactly the right coordinates, right along the channels of that same grid which is feeding the location information about the missile launch. This certainly beats "trying to hit a bullet with a bullet." Especially since YOUR bullet would probably be instantly inoperable in a real scalar war situation.

3c. Rogue Groups in the government

Bearden fears that these scalar electromagnetic secrets may have fallen into the hands of what he called secret "rogue groups" within the labyrinthine depths of the black-ops special-access domain of the secret government. "In the extreme, such a deep black program can even become a

"captured" program," he says, "which is totally in the hands of rogues and no longer reports to or is bound by the dictates of the parent government."

> "They have their own agendas. And being rogue groups, they may well bring in unethical, immoral tricks: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A certain percentage of a highly secret rogue group will wind up using all these things and more. It's a human characteristic, the old primate dominance game. Only now disguised and hidden under deep classification. ...
>
> "In highly classified groups, these groups are greatly enabled to joust more widely, unethically, and immorally because it is so deeply hidden. So very deep classification evokes the growth and intensity of rogue groups. It's the old 'Power corrupts, and absolute power corrupts absolutely' routine. ... Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, may not operate under very much legitimate government control at all, and may operate specifically for the purposes of the rogue group or groups that have gained control."
>
> "The involvement of at least some rogue groups, some being "cowboys" who operate well outside all laws and ethics, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, it could account for what seems to be actually occurring. "
>
> http://www.cheniere.org/explore%20articles/mind%20control3/p05.htm

3d. World War III has already begun

Because it is now possible to cripple the power grids and electronics of any nation, that nation could be reduced to economic ruin without ever firing an actual "shot." Without electricity Wall Street cannot operate. Without electricity you quickly need martial law. One no longer needs to wage a conventional war anymore at all. There are now lots of new ways to bring any nation to its knees.

> "We are at war, whether we like it or not. And we are going to have strategic strikes on an unparalleled scale for us. Pearl Harbor was nothing compared to what is coming down, once we consider the "augmentation" and such.
>
> "When that factor is considered, then it's a totally new ball game on replacing the power system. There isn't going to be much choice; the old one is going to be destroyed or so badly crippled that it will collapse the U.S. economy in a way we have not seen since 1929. Of course, in such a case hitting us, we will be under martial law, the works, everywhere. For one thing, it's the only way you can keep the cities from imploding from within, by the criminal element, looting, robbing, killing, etc. Simply wait and see; it's on the way."

> Although Bearden has for years decried the "scalar-gap," and chided the military for falling so far behind the Russian KGB in the field of scalar electromagnetics, recent statements indicate that things may at last have changed somewhat.
>
> "In the new war, the first phase of WW III has already been completed. Hence President Bush's recognition that this is a total war, and has to be taken to the enemy no matter where he may be hiding or in what sanctuary or in what foreign nation. This is an entirely different war than anything the U.S. has ever fought in its history. And before it is over, it is going to kill more Americans than have died in all the previous wars in our history. The news media and the public have not yet recognized that awful situation and predicament. Most are already thinking that, well, we won in Afghanistan so it's just about over. Instead, it has only just begun.
>
> "Anyway, that's a brief uptake on some of the weapon situation today. Some 10 nations or more now have LWIs, and five have the QPs. I'm still working on how many have the appalling negative EMP weapons, but would estimate 6 or 7 nations have them in one stage or the other, either deployed or in at least advanced development. And in my estimation, the Yakuza will have them within three to five years if they have to build them themselves, and quicker if they can buy them from the Russians, Chinese, or???"
>
> Bearden http://www.cheniere.org/correspondence/030202a.htm

When he was asked the question '**Does the government listen to Tom Bearden?**" Bearden said:

> "Let me speak carefully. I am very satisfied with how I've been listened to in the quarters where the rubber meets the road. The West is no longer defenseless, not by any means. Cannot amplify it further than that."
>
> http://www.cheniere.org/correspondence/030202a.htm

Bearden has briefed the government a number of times and the Cheniere website contains a great number of his graphic military briefing slides.

3e. Are the Russians making "UFOs?"

Scalar electromagnetics engineering opens the possibility of antigravity vehicles and "hyperspace travel." In other words we can now make our own UFO's! Of such scalar-powered antigravity vehicles, which have now become possible, Bearden has this to say:

> "We might expect to see such vehicles glowing. Their various surface features and mechanisms might appear to be glowing or revolving lights, etc.
>
> "They could exhibit incredible "aerodynamic performance," seemingly in the atmosphere. Actually they would not be moving "through" the atmosphere at all, but through a higher space outside each particle of atmosphere.

"They could seem to materialize and dematerialize.

"They could seem to plunge into the ocean or rise out of it.

"They could even seem to operate under the ocean or inside the earth itself.

"Such anomalous vehicle performances have been seen all over the world, particularly since a few years after WWII.

"It appears that one or more nations of Earth are operating such vehicles now in great secrecy. Our own "government" may even be one of these.

"If so, it isn't our true "government/government." Instead, it's the "control group/government." It's government at the operational level, but at higher level it belongs to certain control groups who have penetrated our government's vitals and taken over all such projects."

Bearden http://www.cheniere.org/books/ferdelance/slide32.htm

In an excellent article on her Earthfiles website, Linda Moulton Howe reports on the utter bafflement of Norwegian scientists over mysterious lights appearing in the valley of Hessdalen, Norway.

She writes of the research there: "The results can be broken down into two groups: 95% are thermal plasmas and 5% are unidentified solid objects. The plasmas emit long wave radio

frequencies and strangely, their temperatures do not vary with change in size or brightness." She quotes the scientists' research summary:

> "1) most of the luminous phenomenon is a thermal plasma;
>
> 2) the light-balls are not single objects but are constituted of many small components which are vibrating around a common barycenter;
>
> 3) the light-balls are able to eject smaller light-balls;
>
> 4) the light-balls change shape all the time;
>
> 5) the luminosity increase of the light balls is due to the increase of the radiating area. But the cause, and the physical mechanism with which radiation is emitted, is currently unknown."

This would almost certainly seem to be another example of the testing of the scalar howitzers. It is baffling because, as Bearden points out repeatedly, Western scientists have limited knowledge of the scalar electromagnetic principles by which the howitzers operate. The Hessdalen scientists were completely baffled as to where the energy of these plasma balls was coming from.

Ms. Howe interviews Massimo Teodorani, Ph.D., Astrophysicist, who released the report on the 2001 Hessdalen sightings. The scientist speaks of the baffling phenomenon observed.

> "I don't know how it is possible that Nature is spontaneously able to do that. Anyway, we deduce that the plasma is trapped inside a sort of magnetic cage and the magnetic cage closes around the plasma and keeps it fixed in some way, prevents it from expanding. But where does it come from? We don't know."

By what we have been considering here, we can recognize the signatures of scalar electromagnetic engineering. If it is a Tesla howitzer, then the energy for the plasma balls is coming from the vacuum of spacetime at the very location of the balls themselves, triggered by scalar interferometers aimed through the woodpecker grid.

These kind of balls can be used as marker beacons giving feedback for precision aiming of the howitzers. The energy of the marker beacon can be read back into the computers giving precise location information for pinpoint aiming. The target area can be very small, or widened out.

There is a little movie of one of the Hessdalen plasma balls here. It would seem to be a clear documentation of a scalar howitzer marker-beacon. How many other current "UFO" sightings are actually the witnessing of Tesla howitzer tests?

In fact there are a great many anomalous events of the past few decades which might very well be explained by the Russian testing of their longitudinal electromagnetic weapons. It would seem that the mysterious appearance of crop circles around the world could be accomplished by feeding a precise mathematical graphic pattern into the computerized aiming software and change the very molecular structure of the crops themselves along the lines of that pattern. The

stalks fall over from the localized effect of the longitudinal waves. A plasma ball tracing patterns? Are they slyly sending a message to see if we are "getting it" yet?

The "Cambridge Angel" - Made by Russian scalar plasma balls?

Also see: Interview with Tom Bearden

(Slide from Cheniere.org)

4. Healing powers of longitudinal waves

Healing via longitudinal waves, time reversal of cells (de-differentiation), Priore's machine, Bearden's proposed "blanket" version, using the electric power grid for healing waves or for broadcasting disease patterns. Scalar Biowar.

The good news!

> "Any sort of disease whatsoever - physical or mental - will be rapidly curable, simply and cheaply. It will be possible to reverse aging and rejuvenate the person. It will be possible to regrow limbs and straighten misshapen spines - and directly remove the causes of mental diseases and cure them as well. Lifespan will be staggeringly increased, without 'old age's debilitation.' AIDS, cancer, leukemia, and genetic diseases will be completely conquered. The potential for a true golden era is upon us, for all humanity."
>
> Bearden- http://twm.co.nz/beard_interview.htm

Proof of the healing powers of longitudinal waves from the vacuum is seen in the work of Antoine Priore who produced longitudinal scalar waves using a gigantic glass tube filled with plasma. He himself did not understand why it worked or how it cured cancer in animals.

> "The Priore team cured terminal tumors, trypanosomias, and other dread diseases in laboratory animals in France, in the 1960s and 1970s, under rigorous scientific protocols by eminent scientists. The Priore project was funded by the French Government to the tune of several millions of dollars (equivalent).
> http://www.explorepub.com/articles/energetics.html
>
> ". . . Prioré's machines concretely demonstrated a nearly 100% cure of all kinds of terminal cancers and leukemias, in thousands of rigorous laboratory tests with animals. These results were shown to medical scientists as early as 1960." http://www.cheniere.org/priore/index.html

Bearden has stated that the longitudinal EM waves can have a healing effect because they always come in pairs called "phase conjugate pairs" and one of the pair is time-reversed. This enables engineering of the waves to "pump" the cells of the body (with waves from the time domain) and actually time-reverse the cells back to a previous healthy condition. The scalar cure of cancer does not involve killing the cancer cells but rather pumping them with time energy into a previous condition. I know, this seems miraculous, and is it not?

Priore and his giant plasma tube

This healing power in the longitudinal waves of the time domain is a mind-boggling thing to face. It took me months to get through it, and to suffer the fact that the cure for cancer and AIDS was right there, in this new scalar electromagnetics technology, and that it has been kept back from the people for so many decades now.

Bearden has a great deal to say about the work of Priore, who himself did not understand why his machine worked. Priore did not know about the longitudinal scalar waves of the time domain. In fact, Tom Bearden has supplied, at last, the missing explanation as to how that big giant two-story glass tube consistently cured cancer in animals.

"**The medical implications are enormous**. By just reversing the damaged cells back to a previous physical state, this gives a physics mechanism for controlled cellular dedifferentiation, in biology terms. Physicians will time-reverse diseased, damaged or aged cells back to an earlier healthy condition, including all the cellular genetics. Normal cells are just reversed to a slightly younger condition."

> "We believe this mechanism explains the revolutionary but baffling electromagnetic cures achieved by a team of outstanding French scientists in the 1960s and early 70s, working with inventor Antoine Prioré. In lab animals, cures were achieved for terminal tumors, infectious diseases such as trypanosomiasis, and atheriosclerosis. In addition, deliberately suppressed immune systems were dramatically restored.
>
> "We hypothesize that this is the long-sought mechanism of how the living body heals itself. In short, the body's cellular control system induces cellular reversal by weak time-domain pumping of the damaged cells and the affected area. The cellular regeneration system performs all healing of cellular damage in the body; the immune system heals nothing, not even its own damaged cells) .
>
> "For the first time medical science can develop as a science of healing rather than a science of intervention. And it will develop as a science of unlimited healing, since no pathogen can resist action by curved spacetime engines." Bearden
>
> http://www.cheniere.org/techpapers/Vision%202000%20paper.doc

See Priore's machine See Slides of how it works.

Bearden has extended the Priore work, with the previously missing knowledge now in place, and designed a revised system (for irradiating the body with longitudinal waves) which gets rid of Priore's giant glass plasma tube and uses instead an antenna unit which surrounds the body. He has also provided the missing explanation of how it works. There is an article from "Explore" magazine, Part I and Part II.

In fact, Bearden has presented to the U.S. government a plan to use a portable version of a Scalar Healing Blanket where wire channels in the blanket act as a scalar antenna, which can both send and receive scalar electromagnetic waves. A two minute treatment of the waves is sufficient to restore the body to its earlier healthy condition. Thus even thousands could be treated easily and quickly in a biowar mass attack situation.

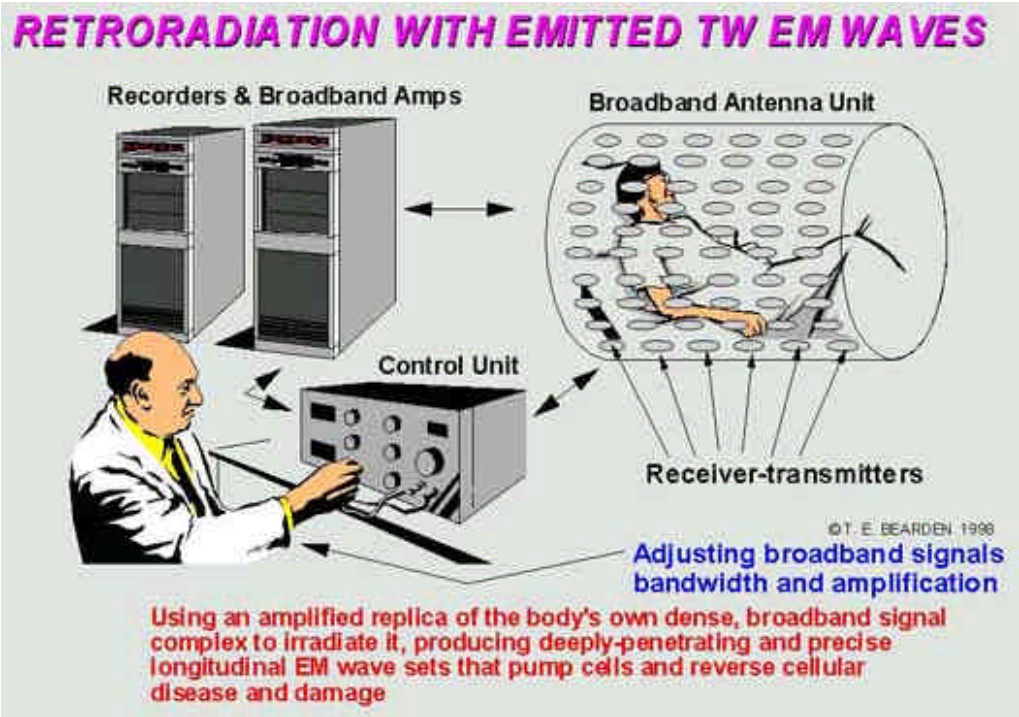

"To defend against things like anthrax attacks on our civilian population centers, we also have recommended to the U.S. Government the crash development of small, portable treatment machines—using similar "antiengine-forming" and cellular reversing "porthole technology". [See Figure 13 on previous page]. Such portable machines could be developed cheaply and quickly, and present government facilities could be used to massively attack the correlate database production problem. "The portable treatment units could be cranked out by the hundreds of thousands and flooded down through emergency response agencies such as the police forces, the National Guard, emergency hospitals,

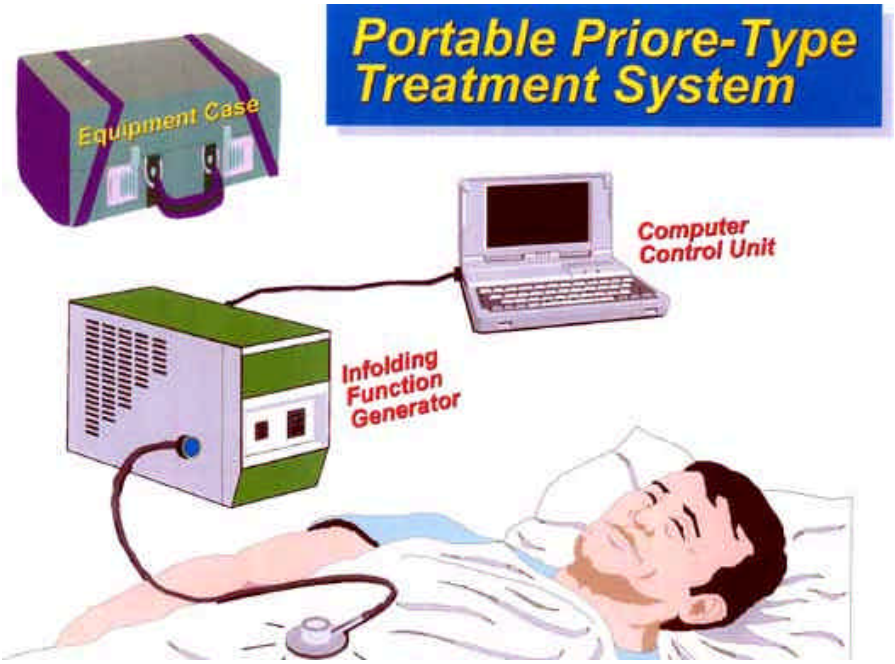

emergency response teams, etc."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p04.htm

The Scalar Healing Blanket would fit into large suitcase. It has three basic parts, the longitudinal wave generator, a laptop computer, and the antenna-blanket. The plan was a stroke of Bearden's genius, but unfortunately it fell on befuddled government ears. "Unfortunately, so far the DOD [Dept. of Defense] doesn't even understand what the heck we're talking about!"

Article '**Healing with Energy**': http://www.explorepub.com/articles/energetics.html

"We tried very hard in 1998 to call attention to the extreme national need for the most urgent possible development of a portable computer-controlled treatment device based on the experimentally proven Prioré methodology, but extended to a much simpler and far more rapid method of treatment.

"Quick development of this technology could lead to a suitcase size device, capable of treating a patient in less than one minute, and stopping the symptoms and disease progress cold, then reversing it. Three "less than a minute" treatments one week apart would be required for complete cure. As an added advantage, partial reversal of aging in older patients would also be accomplished as a bonus, in addition to time-reversing the damaged and diseased cells...

"The method proposed to the DoD in 1998 used normal EM in a peculiar way to force the body itself to make its own time-polarized EM waves, and pump every part of its cells -- including the genetics -- in the time domain.

"Quite simply, we are going to be struck this way (QP spreading the immune systems of the populace plus professional smallpox, anthrax, etc. BW attacks on our population centers) and by other means we've spoken of in other papers and briefings."

Bearden http://www.cheniere.org/correspondence/021401.htm

The Dark Side of the Force:
Creating and broadcasting disease

Speaking of the scalar wave induction of disease by longitudinal wave patterns Bearden refers to work by French scientist Kervran Russian scientist Kaznacheyev, who proved that any disease could be transmitted electromagnetically.

"It works this way: the Kaznacheyev experiments (and others) demonstrated that any cellular disease or disorder can be initiated into cells at a distance, by electromagnetic means (albeit unusual EM in nature). The decades of microwave radiation of the U.S. Embassy in Moscow, was an ongoing set of "stimuli" to ping the U.S. system and, by its response, ascertain how far along (or if it was "along") in its knowledge of such weapons. The radiation was responsible for many health changes in personnel and for the eventual deaths of three U.S. Ambassadors."

Bearden http://www.cheniere.org/correspondence/021702a.htm

In a letter he writes,

> "Yes, the Kaznacheyev experiments were quite real; 15,000 or so in military research institutes in Siberia. As with so many other novel areas investigated and developed by the Soviets, most U.S. investigators just assumed normal EM, which is not what the Kaznacheyev experiments involved, and not what was carrying disease induction patterns from one cell culture to another in rigorous lab tests."

How to "Broadcast" Diseases

Longitudinal EM Biowars

Bearden explains how the new quantum potential weapons can be used to induce disease-at-a-distance in a population, or to "spread" the immune system so thin that a conventional bio-attack would be greatly potentiated. By "broadcasting" virtual disease patterns over a population, the immune system is so overloaded by the presence of the "shadow" diseases that its effectiveness is thinned out.

> "In short, alter the internal wavestructure, and one creates a curved spacetime 'engine' that acts on mass in any fashion one chooses to design -- including initiate diseases . . . Now visualize one of these 'vacuum engines' or 'spacetime curvature engines' that acts on mass to generate the exact effects produced by anthrax. (Or any other disease one wishes) . . . Call the virtual state of a disease engine the disease pattern in the "shadow" state, just prior to becoming observable. . . .
>
> "And the master cellular control system responds to "coming events that cast their shadows before". In short, it responds to the upper level of the "shadow state" of a disease, still in the virtual state! (Hey, virtual particles are real, virtual photons are real, virtual ST curvatures are real --- just very fleeting, only for another to immediately arise). The exchange of virtual particles is known to generate all forces in physics anyway! . . .
>
> "So the cellular control system responds to "shadow state" disease patterns. Enter a QP weapon application. Place a quantum potential weapon "area" on the United States, so that the entire populace is in it. The slowly introduce and bring up in the shadow state, the necrotizing fasciitis disease engine. At some point, the cellular control systems will react, and order the immune system into action. In other words, immune system resources will be committed against this "immediately coming" enemy. Bring it on up a little, but still just in the shadow state. Voila! Humans form a bell-shaped distribution curve. And even if the structure of the QP fluctuates a little, fluctuating a bit stronger and a bit weaker, etc. A few of those targeted bodies will now actually develop necrotizing fasciitis. So far, just like the U.S. Embassy targeting, except a different "carrier".
>
> "But now there is an exact signature that this is what is doing it, and not normal vector carriers of disease and contact or exposure infection. The few cases of necrotizing fasciitis that break out will be most puzzling. They will be randomly scattered across the

entire nation, and so few that the vector carrier and contact or exposure explanation completely fails."

"And that one happened, right here in the U.S., not so long ago. Check it out.

"So carefully adjust the patterns for, say, 12 major terrible diseases, to that "adjusted and desired shadow state level". Now add all 12 patterns into the internal structure of the quantum potential. Now it has 12 shadow state disease engines in it.

"Place that one on a populace. The cellular control systems order the immune systems into action, and they now have to commit their finite resources to 12 different areas. This greatly thins the response an immune system can make to any one of those 12 disease patterns! In short, it "spreads" the capabilities of the immune system, which can be galvanized to great effort, but only can perform a small bit against each area.

"Suppose one of those "galvanized" areas in the targeted populace's immune systems is anthrax. And suppose the bad guys now hit one or more of those cities with a professional anthrax attack. A former OTA study showed that a professional anthrax aerial spray attack against Washington D.C., dispensing 100 kilograms of anthrax spores in the spray, will account for 1 to 3 million casualties. And that's in an "unthinned" set of immune systems. In the "thinned" set, one can at least double or triple, and even up to five times, that estimate. So conservatively, now there would be from 2 to 6 million casualties. And even mild anthrax spray attacks in other "thinned" cities would also be amplified.

"That one is being set up, or already set up, right now. There are other such "augmentation" setups also under way.

"So the weapons alluded to by the SecDef in 1997 are already being employed. WW III has already begun, and our populace (and our scientific community) is blissfully unaware of it."

http://www.cheniere.org/correspondence/021702a.htm

Most of us can remember the strange outbreaks of the so-called "flesh eating disease." It seemed to break out here and there randomly with no known cause. Bearden believes this was a test of the newer quantum potential weapons which go even beyond the capabilities of the Tesla howitzers.

"The Kaznacheyev "disease induction by novel electrodynamics" work is also the basis for the spacetime curvature engines (not EM signals!) carried by quantum potential EM biological weapons for distant induction of diseases etc. into the population of an entire nation or area, such as the U.S.

"This quantum potential disease induction weapon -- capable of attacking an entire population of a nation or area -- has been tested several times in the U.S. at very low levels, in the shadow state only (we explain shortly) and it has a most peculiar signature. E.g., one test used necrotizing fasciitis (flesh-rotting disease) engines.

> "The disease 'engine' was deliberately kept down in the 'shadow state' (virtual state, just below the observable state) so that only a tiny bit of the populace with depressed thresholds would "breach the observable threshold' due to the population forming a bell-shaped curve as to the threshold level. The major signature of the test was that the cases of the disease broke out totally statistically and randomly, spread all over, without any 'disease vector' in between.
>
> "In short, it was not spread in any manner required by normal deterministic disease vectoring, but was a totally random set of occurrences. Several other diseases were also tested this way in the American populace, with precisely the same signature."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

"Apparently one planned use of such an augmented clandestine BW weapon will be smallpox, e.g. As you know, the Russians did develop smallpox for biological warfare, and even developed a new strain against which previous vaccination is ineffective.

> "The vast numbers of expected casualties, coupled with immune system spreading, are absolutely irresistible to the Russian mind. You can count on it that they have seen that the smallpox is already on site here, in the U.S. and in the hands of professional terrorist teams. Of course, the Russians/KGB will protest they have nothing to do with that! Yet likely the KGB will have flatly arranged it or at least assisted it. The capability for mass destruction of the nation is so lucrative and easy to achieve in advance, that they would never be able to resist doing it."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

Bearden believes the Gulf War Syndrome involved the use of scalar technology to induce a disease state, as he stated in a 1997 interview:

> "I'll say this flatly, and I won't answer any further questions about it; the Gulf War Syndrome was induced... It was induced with this stuff. All the rest... was contributing factors that everybody's talking about... There are some deeper signatures, if you look into it very deeply, that show you exactly how it was done and the fact that it was induced. It was a test. It was a test of a very special kind of weapon I have not talked about yet. Anyway you can use it to create diseases."
>
> Bearden http://twm.co.nz/beard_weapon.htm

Besides using the woodpecker grid to target a population, the entire electrical grids of nations can be used as "channels" for disease patterns to be broadcast to all people near that grid. Your own house wiring can become an antenna, broadcasting these "shadow" patterns of disease, weakening your immune system.

And here one faces the frustrating fact that the same power grids could be set to channel patterns which would keep the entire population healthy, rejuvenated, continuously bathing in the time-reversing old-age-defying energy of the spacetime vacuum. We have no idea yet of how long the

human life span could be increased with this new technology. People might be able to live two centuries given full humane development of this technology.

5. Psychoenergetics

Mental entrainment, inducing hypnogogic trance, mind control, broadcasting thoughts and feelings, the Ant World, education via EM [LW] mental download, the "Feelies," revolution in spirituality, "enlightenment machine?" Scalar churches?

Psychoenergetics is simply using the scalar interferometers to manipulate and engineer the human psyche. To me it is the most mind-boggling and frightening aspect of longitudinal wave engineering.

The mind is electromagnetic in nature, and itself of the time-domain. It is not observable in 3-space. There is no thing you can point to that is the mind. As Bearden says**, "The mind is time-like**."

The longitudinal scalar EM waves are also of the time-domain. By overlaying certain infolded patterns (oscillations in time) on the longitudinal waves, a thought or feeling may be made to arise in a person or persons who are in the **interference zone** (where the wave beams cross).

The person will not notice anything, feeling that this thought or idea is his or her own idea. The longitudinal wave pattern might be a wave of panic or fear that spontaneously sweeps over you, perhaps inexplicably. It could even be in the form of a sudden intense patriotism. It could be explicit words and phrases, which everyone would think they had thought of by themselves. Or it could be rage and hatred, angry and violent. On the other hand It could also be a continuous sense of docility and placidity. This is the brave new world of psychoenergetics and the coming "Mind Wars."

Scalar Psychoenergetics in its most primitive form simply "entrains" all minds in the target area into a deep hypnogogic trance. In this state of mind people would be suddenly extremely suggestible, and would likely believe anything they are told, and would obey any orders given. Talk about winning the hearts and minds of the American People!

Tom Bearden makes me think of **Paul Revere**, who heroically conveyed important warnings for the sake of the new nation. But the words of the famous phrase have now strangely and curiously mutated into the once-inconceivable: "**One if by land, Two if by mind**."

Indeed one strategy in a Mind War would be to simply take over the minds of the "leaders" of the enemy nation. The targeted leader would not be aware that anything was amiss, although he might begin to make unexpected changes in policy.

And are, in fact, any of our "leaders" already having secret thoughts that are not their own? Who knows? Frighteningly, we can no longer be sure. The new sciences of scalar electromagnetics

and psychoenergetics are even now plunging humanity into a sudden science-fiction-like world beyond anything in humanity's previous imaginings.

> "The Russians reached the point in the mid 1990s that they could take over control of a person's mind, with modified longitudinal EM waves including some time-polarized EM waves, and with a team of specialists (estimate 25-30 per transmitter, and one transmitter and team per controlled person)." Bearden http://www.cheniere.org/misc/time.htm

In a slide Bearden illustrates how a Scalar War would involve a psychoenergetics attack on the operators of the enemy scalar installation, entraining their minds into hypnogogic trance and getting them to shut down their systems.

And ultimately psychoenergetic warfare goes to the very heart of human identity itself. For if my thoughts might no longer be "mine," then who and what am I? Can my very sense of being "me" be hijacked by some nefarious psychoenergetic scheme? Will the "secret government" eventually dictate directly into your mind how you feel about yourself? Or what you think you are? Or what you should do?

How Does Longitudinal EM Mind Control Work?

The physics of scalar psychoenergetics as expounded by Col. Bearden seems even more arcane and over-my-head than that of extracting energy from the vacuum. I can't understand it, but I look through it anyway. Each time another tiny understanding might occur, or a term might fall into place. I know the mathematics is forever beyond me.

One paper to begin with is "Mind Control and EM Wave Polarization Transductions" This is such serious stuff that Bearden includes a strong warning about misuse of this knowledge. Psychoenergetics weapons can mentally maim and physically kill.

Warning!

(From "Mind Control and EM Wave Polarization Transductions")

> "This article refers to experimental research techniques which can be detrimental or lethal in the hands of any but highly skilled, qualified experimental scientists proceeding under proper laboratory safety procedures. The purpose of this article is strictly for information to properly qualified and authorized scientists in certified laboratories. We do not propose or condone any use of these procedures for nonapproved practice of medicine without a license. Neither the publisher nor the author are responsible for accidents or outcomes in the use of these experimental procedures and techniques. Any researcher who performs these procedures and experiments is acting on his or her own volition, and is solely responsible for insuring safety, qualifications, and legality of the acts and their results. We neither suggest nor condone unauthorized experimentation on human subjects. Such is a criminal violation of the constitutional rights of the subject under Federal and State laws, and is both illegal and immoral."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p01.htm

After the serious warning comes the description of the paper. This is heady stuff for the layman.

> "Calling full attention to the special note above, in this paper we present a high-level overview of the novel electromagnetic nature of mind operations, mind and body coupling, and intent - the induction of physical 3-space EM energy changes into the brain and nervous system, and into every cell of the body, from the mind's time-like coherent operations. We summarize the time-polarized electrodynamics used to engineer and affect mind operations and the mind-body coupling loop. Transaction mechanisms whereby differing EM wave polarization's can be transformed one-into-the-other are presented."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p01.htm

I will leave it to the technically astute to try to understand the mechanisms of operation which are described in scientific language. But there are tidbits for the layman. Here he speaks of the difficulty Western scientists have in opening up to the "immaterial" (longitudinal wave) nature of the human mind.

Western Science Remains Largely Materialistic

> "Ironically, most Western scientists are materialists and consider "mind" as a mystical and nonscientific concept. They tend to consider mind operations and functions either to be simply "meat computer" operations and functions, or at best to be very weak ordinary transverse-wave EM operations and functions in the brain and nervous system. This serious self-limitation exists because in the body we measure only weak TW [transverse wave] EM operations and functions correlated to biological behavior and brain operations. We simply do not know how to measure "mind operations" directly.
>
> "With no mind measurements possible and no instruments, it is understandable that Western science considers only the physical side of the mind-matter interface.
>
> "Presently our scientists do not measure the longitudinally-polarized EM wave operations and functions in the body and around it in nature. Few of them are aware that a maelstrom of such LW [longitudinal wave] functions exist in the body and in all of nature in general."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p05.htm

Western methods of influencing the mind with EM waves have only used transverse waves, not the longitudinal waves of the vacuum. If only transverse waves are used one pretty well has to hit the target mind with a sledgehammer of waves.

Western Science knows only transverse EM waves

Brute Forcing Time Functions versus Fine Control Methods

> "Ironically, Western mind control researchers using transverse EM waves for mind control research, are using a brute force method of evoking and using vacuum engines

> (spacetime curvature engines) and a special form of general relativity, although they do not appear to realize it.
>
> "While KGB scientists also use TW EM "brute force" TW waves when necessary, they do "imprint" or "activate" those waves with the desired internal LW and time-polarized EM wave and photon structures required to directly perform the mind engineering desired... Bearden
>
> "These "fitted brute-force models" certainly can be very powerful, and certainly can produce the exact results shown in the experimental verifications of the fittings. However, they do not of themselves allow sophisticated design for example of the necessary time-polarized wave assemblies for engineering the entire human collective unconscious simultaneously, or for engineering the entire collective unconscious of all species on Earth (i.e., Gail's collective unconscious), or even for precisely engineering the memory and knowledge base of an individual.
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p09.htm

The seemingly magical operations of psychoenergetics, sometimes called "psychotronics," cannot be achieved with ordinary transverse EM wave energy. But they are possible with longitudinal scalar waves because the mind itself is scalar in nature.

> "We note that all mind operations are time-like, i.e., they are comprised as scalar EM photon functions and scalar EM wave functions. Thus the mind is a very special kind of electromagnetic system, existing in the time domain..."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control1/p08.htm

The engineering of the mind can only be accomplished with the waves of time.

The course of psychoenergetics development necessitates the building of a vast database of settings and patterns which bring about given mental and/or emotional states. A kind of "gnome" of the psyche. Bearden describes the process of the decoding of this "gnome."

> "Now the scientists would perform many phenomenology experiments, making one little change at a time and profusely recording the data. Each time, they would establish the physical change(s) that occur in the body and/or the mental and emotional changes that occur in the mind for each spectral reinsertion back through the "ship's portholes". They would simply but painstakingly (over some years) build up an extensive database of those individual correlates.
>
> "In these experiments, the experimenters will eventually be able to provoke any body or mind change they wish. Strong emotion. Intense pain. Intense pleasure. Painful thoughts. Images. Memories. Perceptions. Dreams. Visions. Memory losses. Memory changes. Personality changes. Etc. The "delta" in the emission spectrum (the changes from zero reference spectrum) represent the precise totality of all mental, physical, organic, chemical, etc. changes and interactions."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p01.htm

"A second stage in the research would be to test the correlates and porthole insertions upon a statistically significant cross section of ordinary people, and/or specialized populations (such as toughened soldiers). The program would evolve a highly complex, very effective, ever-improving science and technology of mind and behavior control and engineering mechanisms, complete with finished database and developed applications equipment."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p02.htm

Summing up his paper Bearden speculates on what the actual situation the science of psychoenergetics probably is. The intense secrecy with which this knowledge has been kept from the public has led to the current farce of the "government" pretending it all does not exist, and this secrecy may have now put us at great risk.

"The implication is that in the West one or more highly classified, sustained, heavily funded developments in advanced mind control programs, probably exists and probably has existed for some time. Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, may not operate under very much legitimate government control at all, and may operate specifically for the purposes of the rogue group or groups that have gained control.

"In a nutshell, that's what may be going on in the clandestine mind control projects in several Western governments. The involvement of at least some rogue groups, some being "cowboys" who operate well outside all laws and ethics, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, it could account for what seems to be actually occurring. As also is "usual" in such a mess, one or more of the rogue groups eventually may become very powerful because their secret weapons are very powerful. They may become confident, thinking they have the "best in the world." They may actually believe they are ahead of the Russians..."

"Remember that, in every large and powerful human organization, the basis for rogue groups is power and secrecy. They are always seeking to increase their power, control, influence, prestige, etc. Nothing else. Patriotism and mission are—to rogue groups—often just idle words. They have their own agendas. And being rogue groups, they may well bring in unethical, immoral tricks: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A certain percentage of a highly secret rogue group will wind up using all these things and more. It's a human characteristic, the old primate dominance game. Only now disguised and hidden under deep classification."

"The Russians, with their additional knowledge of the actual mechanisms in the transforms, will be much more advanced than the West, because their fundamental psychoenergetics science is far more advanced, so long as we continue to use the old U(l) electrodynamics. Further, the Russians have decades of use of longitudinal interferometry beams to reach right through the earth and ocean and produce stringent EM effects at a distance. So they will also be able to do the same things here in "mind control" with LW [longitudinal wave] interferometers, through intervening mass."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p05.htm

Bearden cites two examples where he believes the Russian KGB tested the psychoenergetics capabilities of their scalar interferometers. One was the case of Captain Button in his A-10 "Warthog" aircraft on April 2, 1997.

> "Over Arizona, Captain Button was thrown into a hypnogogic state, and his perceptions instantly altered and controlled. In his instant "dream-waking" state, everything seemed perfectly normal. His sense of direction was altered a bit more than 90 degrees, so he simply corrected and turned and "flew toward the range", actually flying off course by more than 90 degrees and ignoring radio contacts. He flew right on out of Arizona."
>
> "At one point he circled, probably thinking he was over the range, and he probably dropped his ordnance there. Then he "flew on back toward home," as he thought in his waking dream state, until his fuel ran out and he crashed and died in the explosion—dream-thinking until he died that everything was normal. All the while, his sense of the passage of time was altered. To him, in his dream-thinking, dream-acting state, everything was normal and nothing untoward had happened. So the distant KGB transmitters and associated psychoenergetics team controlled him for over an hour. "Indeed, that was the exact purpose of the test: demonstrate control (at a great distance) of a skilled person performing highly skilled tasks."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p06.htm

The paper "Mind Control and EM Wave Polarization Transductions" ends with the most chilling and frightening possibility of all: the psychoenergetic engineering of the human species as a whole.

The Ant World

The Final Race for Direct Mind Control of the Entire Human Species

> "The KGB psychoenergetics weapons scientists—because of their direct measurements and detections (and use) of t-polarized waves and LWs [longitudinal waves] for decades—also understand that Jung's collective unconscious mind (of the entire human species) also has its own time-like operations and correlates, which one measures also when using t-polarization measurements and sorting it all out. The collective unconscious mind operations are buried several levels deeper inside the recursive Whittaker structuring inside the EM fields, waves, and potentials. "The KGB scientists also know that something very like Gaia — a collective unconscious mind for all species on earth — also exists, and they are striving to be able to sort out and measure that one as well. The Gaia operations are buried even deeper in the recursive structuring inside the EM fields, waves, and potentials.""Actually, from day one, the Russian mind control scientists have had their eventual goal set upon this "deeper area of mind and possible mind control" of the entire human species.
>
> "I am convinced that the KGB psychoenergetics scientists understand this deeper area. If they can learn to directly engineer the collective human species unconscious, they can

> then convert the human species easily into a sort of "ant" society, modeled along ideal Communism lines, except of course with an excluded "hierarchy at the top" running everything. The "ant society" — communist style — is still a variation of feudalism (all systems tend to feudalism or some form thereof). "The KGB psychoenergetics weapon scientists are seriously pressing on toward that very goal. In my opinion they are not very far from it right now...
>
> "Some versions of Russian mind control devices were used on Russian soldiers in the Afghan War to condition them for performance of merciless acts." 13
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p07.htm

More about "The Ant World"

Whether it is the Russians planning an "ant world" society or rogue U.S. black-ops groups withholding a great boon from human race, the secrecy on all sides around has allowed largely criminal elements to take over this technology while leaving the civilized elements in the dark. Openness and the spreading of this knowledge among good and decent people is essential, and for that we will have to overcome our frightened denial.

> "Meanwhile, rogue groups amongst Western clandestine mind control researchers will probably arise if they have not already done so. They will likely seek to increase their personal control and further isolate the programs from orthodox government review and from government and legislative control. They may even divert the research into highly illegal and unethical means, because it furthers their own rogue agendas. That is how clandestine U.S. government research can sometimes go sour, unless great care is exercised by the oversight committees in the House and the Senate.
>
> "Sometimes when rogue groups do gain control and total secrecy of a given new technological area, then what appears to be "U.S. government operations" do start to encompass a criminal and unethical operations, hidden usually beneath the deep veil of high classification. Also, if it's "scientific," no one is ever brought to justice, even if the "evil science actions" are uncovered and publicly revealed."
>
> Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p08.htm

Like the huge energy of the Tesla howitzers, the ability to engineer the mind with longitudinal waveforms is a seeming "magical" thing which can be used for good or ill. Bearden envisions that further developments will allow something like the "downloading" of knowledge via scalar interferometry. Everyone could be highly educated, and quickly and easily.

In the conclusion of the paper "Mind Control and EM Wave Polarization Transductions" Bearden makes a plea to the nations of the world regarding the use of psychoenergetic engineering.

> "Let us hope this great new area, already off to a bad start, can be bridled and steered in the direction helping and healing people, rather than killing or abusing them. The excesses in its bad use are a potent threat to all nations on earth.

"Yet it can revolutionize medical science, education, communication, and psychology. We foresee the day -- perhaps 30 years hence -- when education will be accomplished by directly loading the software into the mind. Then in three weeks one will "load" a doctorate, say, in physics. In three more weeks on will also load a doctorate in chemistry. Another three weeks, in electrical engineering. Another three weeks, an MD And so on. When that happens then truly everyone on earth can be educated. Freedom from ignorance may well be another great freedom that is legally recognized. There will be no impoverished large groups lacking the education to find decent, productive jobs.

"We urge all nations to use the principles involved: not for human abuse, but for healing, educating, uplifting, and life-expanding of every person on earth. If we do, we shall all have a far brighter future. Then we shall check what has started out to be the Sword of Damocles and turn it into the golden Millennium."

Bearden http://www.cheniere.org/explore%20articles/mind%20control3/p08.htm

(Perhaps after so many frightening topics a slight break is in order here to consider the lighter side of psychoenergetics. For example, what will be the ultimate impact on the entertainment industry?)

The Feelies at Last!

Psychoenergetics will be able to bring about at last, for better or for worse, Aldous Huxley's fanciful idea in his novel "Brave New World," an entertainment format which he called "The Feelies." Those were something you went to, like going to the movies, but you would experience all the actual feelings themselves, as if the depicted events were actually happening to you. Although our "leaders" seem too dim to grasp what is going on in the world of scalar electromagnetics, it should not take some young Hollywood genius too long to understand that The Feelies are now possible, and that the immense megabucks of potential profit more than justify heavy investment in bringing it to market.

One can imagine that first "Feelie" theater, "The Huxley" perhaps, a large comfortable area surrounded by nine giant screens (not just one screen!), which become 3D if you put on your headset. And The Huxley is fitted with the finest sound, and oh, by the way, a modest sized scalar interferometer with computer. And there are one or more new tracks now recorded on the film next to the sound track. These are the digital patterns of thoughts, feelings, and ideas to be fed into the theater's interferometer. And these thoughts and feelings and ideas will be felt by the audience as if they were their own thoughts and ideas. It is an entirely new art form. Psychevision.

As important (and no doubt famous) as the actors would be the "feelers," those from whose minds the feelings were lifted in the original programming of the Feelie tracks. Because, for example, Brad Pitt might be a good and handsome actor, but can he really feel it? Like the dubbing of foreign language films, it might be necessary to dub the "emotional track" using a deeper and more profound person's feelings, thoughts and ideas.

It might even be engineered so that if you sat on one side of the theater you would feel like the hero, and on the other side you would feel exactly like the bad guy! What would that lead to?

We have all cried at a movie some time, most people have, though they might not want to admit it. But this would be deep sobbing and a flood of tears, if the director so desired it. You would feel it at your core. Or, take a big chase scene, you would be terrified. They are breathing down your neck! You would be gripped by panic.

For that matter, the whole genre of Horror-Feelie would be too much for many people to take. Do I really want to feel that an actual vampire is tearing at my throat with his fangs?

A Religious Feelie would make you feel the exaltation of a saint at his prayers, or give you the definite feeling that you are Christ suffering on the cross. All the pain could be there too. The stickiness of the blood. The very feeling itself: "Why hast thou forsaken me?" Who among us could come up that despair for scanning? Had this been developed a bit earlier we might watch a documentary of, say, Mother Theresa, containing her own actual deep sense of compassion, which we would feel arising in us as our own.

Then again, a Psychedelic Feelie could induce an LSD-like state and simply blow the audience's minds.

Even in its simplest most primitive mode, the hypnogogic trance induction with its increased suggestibility, would completely alter the experience of even ordinary current movie going.

6. As it Stands - 2002

"Anyway, it's presently a "Mexican stand-off" with the various parties maneuvering with check and countercheck. That is the real "balance of terror" that is held by such a fragile balance."

"You can see the implications if such weapons fall into the hands of the radical terrorists. Ordinary positive energy EMP shooters can be made fairly readily and cheaply from nearly just Radio Shack parts or surplus parts. It just takes some know-how... When and if the Yakuza [Japanese mafia] gets those (and they will, it's just a question of time), you can begin to appreciate some of the turns this present terrorism and our war on it will take."

Bearden http://www.cheniere.org/correspondence/021702a.htm

The very thought of the building of one of these howitzers by "some lone-nut gunman" from Radio Shack parts makes one realize how serious it is for humanity to face the crisis it has come to.

Once again, as at the dawn of the nuclear era, humanity finds itself at the crossroads of Heaven and Hell. As a species, we must stop and consider. And there is at least one real difference between this visit to the crossroads and the last: this time there is a very real possibility of a true "earthly heaven" on the Heaven side.

The poor nations could come to a good life. Disease could be largely eliminated. Fossil fuel pollution could end. Global warming could be solved, and the weather could be managed in a humane way, bringing water where there is drought, and sunny skies where there is flood. Scalar interferometry would be there to avert any possible hits by asteroids or comets. Mars could be colonized and terraformed. Everyone would be highly educated through psychoenergetic downloading of knowledge. And the wisdom of the wise could be realized directly through scalar connection to their minds and hearts.

These stunning sudden possibilities give me pause to think: if our species has reached this crossroads in such a short span of centuries, then surely other species in this vast universe have passed this way before and long ago. And of those who chose the path to "planetary heaven," what is their life like now? It might be good if some of them were with us now, to guide us through this last struggle over this pesky old good-and-evil problem. It is our last chance to choose the path which benefits the whole species, and not just some elite group or faction.

The Disclosure Project

One person working tirelessly to bring to bring these technologies into the open is Dr. Stephen Greer of the Disclosure Project, which is calling for congressional hearings into the issues of UFOs and the free energy technology that was, perhaps in part, reverse-engineered from them.

> "Once abundant and nearly free energy is available in impoverished areas for agriculture, transportation, construction, manufacturing and electrification, there is no limit to what humanity can achieve. It is ridiculous — obscene even — that mind-boggling poverty and famine exists in the world while we sit on classified technologies that could completely reverse this situation. "So why not release these technologies? Because the social, economic and geo-political order of the world would be greatly altered. Every deep insider with whom I have met has emphasized that this would be the greatest change in known human history. The matter is so highly classified not because it is so silly, but because its implications are so profound and far reaching. By nature, those who control such projects do not like change. And here we are talking about the biggest economic, technological, social and geo-political change in known human history. Hence, the status quo is maintained, even as our civilization hurtles towards oblivion...
>
> "With the types of weapons currently in the covert arsenal — weapons more fearsome even than thermonuclear devices — there is no possibility of a survivable conflict. Yet in the darkness of secrecy, actions have been taken on behalf of every human that may

> endanger our future. Only a full, honest disclosure will correct this situation. It is not possible for me to convey in words the urgency of this."
>
> Dr. Stephen Greer http://www.disclosureproject.org/ES-DisclosureImplications-2.htm

Greer and his team have assembled hundreds of witnesses, many of whom are military or ex-military, who are ready to testify to congressional hearings what they know about the covert black projects which have kept free-energy and antigravity propulsion technology secret from the people.

Greer points out the need to regulate these technologies so they are limited to peaceful uses, but this is of course difficult when the government simply chooses to pretend they do not exist. In the meantime, as the President and the Defense Department continue the charade of war-as-usual, those scalar (longitudinal wave) installations which DO exist continue to fall into ever more sinister hands. And there is no reporter in the press brave enough to ask, "Mr. Secretary of Defense, what steps are you taking to defend our MINDS from attack by the big Russian longitudinal interferometers?"

Longitudinal Interferometers are Proliferating

In a later statement Bearden reveals that in fact the Yakuza [Japanese mafia] has already leased some of the interferometers with a nearly $1 billion "down payment:"

> "After the collapse of the Soviet Union's economy, lots of things got available for lease or purchase that would never have been under the old system. That happened in the resulting economic chaos. The Russian Mafia rose to prominence, as did some wheeling and dealing entrepreneurs who played both ends against the middle.
>
> "In that atmosphere, and in the need for money, the KGB allowed leasing of the earlier longitudinal EM wave interferometers to a consortium of the Yakuza and Aum Shinrikyo. They did this only after they had tested and deployed their great new quantum potential weapons. That class of weapon is the dominant weapon on earth. Five nations now have it: Brazil, Russia (KGB), China, and two nations friendly to the U.S. The deal to lease many of the earlier LWIs [longitudinal wave interferometers] to the Japanese Yakuza and Aum Shinrikyo was consummated at the end of 1989, with a down payment of $900 million in gold bullion as "up front" money. I don't know what the lease per year was and is, but probably something like a billion dollars a year. So the rogue Japanese acquired longitudinal EM weapons and that technical know-how. In fact, the Yakuza is producing certain kinds of those in its own facilities in Japan now."
>
> Bearden http://www.cheniere.org/correspondence/030202a.htm

Personally, I am a little uncomfortable with the knowledge that the Japanese mafia may now be able to insert things into my mind. I'd like to sleep at night knowing that my dreams are my own, such as they may be, and not some weird fantastic visions cooked up by a criminal organization. This is a world emergency.

And in Bearden's analysis, it all comes back to the issue of energy. It is the energy crisis which is now provoking the current "oil wars," since oil production has hit the "Hubbert Peak" and will decline. And the electrical power grids must be replaced with scalar power as fast as possible, for these grids are now totally vulnerable to any possessor of longitudinal interferometers. They can all be wiped out in minutes. By anyone who possesses or controls a Tesla howitzer.

> "Anyway, in my personal view, we should have a national Manhattan Project right now, to develop decentralized electrical power systems taking their energy from the vacuum . . . The MEG is real and so are several other systems invented by private inventors and colleagues. All these efforts should be massively funded and massively and quickly developed. The survival of this nation is going to depend upon it. . . . There are many other facets, but the major point is that our scientific apparatus and the public are still unaware of what a desperate struggle we have entered, since it was thrust upon us. 9-11 was a wake-up call. It was certainly bad enough, and one grieves for those lost American lives. But I fear the worst is yet to come, and it is coming at us like a runaway train hurtling right down the track at us."
>
> Bearden http://www.cheniere.org/correspondence/021702a.htm
>
> "The electromagnetic weapons mentioned by the Secretary of Defense in April 1997 are in terrorist hands also, including the Yakuza and Aum Shinrikyo. That rogue group leased those earlier weapons on site in Russia, from the KGB, at the end of 1989. The SecDef stated that such weapons were being used to initiate earthquakes, initiate volcanoes into eruption, and control and engineer the weather. Quite true. And presently there is a truly massive set of weather engineering operations going on over North America, from that rogue Japanese group manning the weapons in Russia. Some 10 nations of the world now have the type of longitudinal EM wave interferometer weapons (which are what the SecDef was most probably referring to). There are other even more fearsome weapons, possessed by five nations. So a great deal of the state of the world is not covered in the news at all, and will not be . . .
>
> "We have been in an undeclared war of an eerie kind for some decades. That war seems now to have started to heat up also. The destructive capability of some of these weapons is awesome, and far greater than nuclear."
>
> Bearden http://www.cheniere.org/correspondence/021702a.htm
>
> "In that sense, the first phase of WW III is already completed. Now we are only waiting for Phase II.
>
> "It is against that backdrop that I think one must "analyze" such things as how fast we will be replacing the power grid (it's going to go anyway, and catastrophically, the terrorists will see to that). And everything we have is critically dependent upon energy, from the economy to jobs to mobility, to the millions of trucks that transport our goods every day, etc.
>
> "As far as I am concerned, we are already late in declaring a great national emergency in energy, because of the coming destruction of the present energy infrastructure. The

> scientific community should lead, follow, or get out of the way. The emergency is not in seeking "alternative but conventional" systems. It is in developing "energy from the vacuum" on an emergency, crash basis.
>
> "Unfortunately, everywhere I look I just see business as usual. Most Americans (and news media) seem to think, hey, Afghanistan is finished except for a bit of cleanup, and it's just about over).
>
> "It isn't. It has only just begun."
>
> Bearden http://www.cheniere.org/correspondence/021702a.htm

Beyond the Howitzers: Quantum Potential Weapons

Do not use EM propagation through space

As more and more nations acquire the scalar interferometers, Bearden speculates on the next generation of longitudinal weapons called "quantum potential" [QP] weapons.

> "The quantum potential weapons are presently only held by three nations: Russia (in the hands of the KGB, which is now know by its new name), Brazil, and the "friendly little nation." Red China may be working on them, but is just at the beginning...
>
> "The QP weapons have been highly reserved by the Russians. However, the complete extent of their capabilities is still being figured out...
>
> "The quantum potential weaponry (possessed by only three nations) is supreme, because it uses multiply connected spacetime, and DOES NOT involve propagation of EM energy through space as does the longitudinal EM wave interferometers.
>
> Bearden http://www.cheniere.org/misc/qp.htm
>
> "The operational deployment of full-scale strategic QP weapons on site in Russia occurred at the end of 1989, which is when the formal weapons first went operational. These weapons are not in the inventory of the regular Russian armed forces, but all research and development, manufacturing, deployment, an manning and employment is under the ruthless control of the KGB. Shortly thereafter (within weeks), the KGB leased many of their earlier longitudinal EM wave interferometer (LWI) weapons to a rogue Japanese group comprised of the Aum Shinrikyo and Yakuza."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

In another paper, "Time Polarization - Significance and Weaponization," Bearden tells the story of how a KGB longitudinal wave attack was averted by the longitudinal weapons of a "friendly small nation."

So as it stands, it is precarious. Not until the people demand an end of what author Jim Marrs has dubbed the "Rule by Secrecy," can the people's representatives tackle the big problems of a worldwide ban on Scalar Wars and the shifting over to an essentially oil-free economy.

Latest Update from Tom Bearden - March 2002

The whole situation is changing so fast that when I asked Tom to look over this article he mentioned the seeming contradiction when some of the above statements are taken together. At different times the information he has is updated so one has to keep a kind of running track. He was kind enough to clear up the confusion here with the situation as it stands as of March, 2002.

> "We knew of three nations having the QP weapons for some time. Then we found out last year that five nations had it. So that explains my using the figure "three" first (which represented what I knew at the time). Later I found out about the other two nations. China, e.g., only deployed its QP weapon this past year. So that explains the apparent contradiction between me using "five" in later papers and "three" in earlier ones. It was the best information I had at that time. Might mention that so the reader will understand the apparent discrepancy." Tom Bearden

Emptiness is Full of Energy

"The Tao is an empty vessel;
it is used, but never filled.
Oh, unfathomable source
of ten thousand things!

"Oh, hidden deep but ever present!
I do not know from whence it comes.
It is the forefather of the gods."

Lao Tzu -Tao te Ching

Afterward

Because of the extreme seriousness of the topics brought forward in this article, I asked Tom Bearden to look it over to make sure I had not gotten anything too terribly wrong or mixed up. I did not want to pass on any misunderstanding of my own. I felt a little nervous writing to an eminent scientist, and hoped I had not presumed upon his time.

But Tom was so kind as to answer immediately, and to my relief I had not gotten anything too terribly wrong. Here is his letter, in which he clears up a misunderstanding, and reports on his current health treatment, and gives a call to the young grad students to turn themselves loose in the whole new field of scalar electromagnetics and free energy.

Subject: RE: Article on Tom Bearden and "Scalar Wars"
Date: Fri, 22 Mar 2002 22:54:01 -0600

Bill,

Well, I must say I'm astounded at your persistence and hard work in congealing all that together. My compliments on a hard job quite well done.

Couple tiny things: In the area mentioning Kervran and Kaznacheyev: Kervran was French; Kaznacheyev was and is Russian. Little typo of "spredding" the immune system. Should be "spreading".

We knew of three nations having the QP weapons for some time. Then we found out last year that five nations had it. So that explains my using the figure "three" first (which represented what I knew at the time). Later I found out about the other two nations. China, e.g., only deployed its QP weapon this past year. So that explains the apparent contradiction between me using "five" in later papers and "three" in earlier ones. It was the best information I had at that time. Might mention that so the reader will understand the apparent discrepancy.

Otherwise, it's pretty accurate.

Just now I'm letting the weapons take care of themselves; have to, as I will be recovering now for nearly a year from now after the heart attack last year and discovering that I had contracted mycoplasia (the BW modified kind) in Canada in 1968. Finally got a test which confirmed the chronic mycoplasia (which I had for 33 years!). The stuff burrows inside one's red corpuscles, then draws nutrients from the hemoglobin, hardening it and reducing its ability to take on oxygen (by as much as 50% or more). The resulting symptom is loss of endurance (which I had for that 33 years) -- the so-called "chronic fatigue syndrome".

Many of the Gulf War Veterans who are sick also have it, though they apparently have other complicating factors as well. A very high percentage of persons with chronic fatigue syndrome also have mycoplasia. The treatment for the long-standing mycoplasma infection of that nature is to stay on antibiotics for a year. The only time the mycoplasma is vulnerable is when one wears out a red cell in normal usage, and the body makes a new red cell to replace it. The mycoplasma comes out of the dying cell to infect the new replacement cell, so it is exposed and vulnerable at that specific time and that time only. The antibiotics kills it at that time. Hence the necessity to stay on antibiotics for such a long time so it is continuously in your bloodstream (I've already been on antibiotics for over two months, and have at least 10 more months to go). We also take a little medical oxygen every day.

Another symptom of the mycoplasma infection is the association of runaway fibrillation of the heart. To stop that, there are pills one takes, and they stop it. But they also further reduce the volume of blood pumped by the heart, so that this projects one right back into the hypoxia, dizzy, loss of balance, etc. Catch 22 situation; the fibrillation will build and cause heart attack, stroke, etc. if not stopped, and if stopped it puts you back in the hypoxia which can cause many things! With the conventional treatment, you're damned if you do and damned if you don't. Hence the need for a little extra medical oxygen, so you can take the "heart clamp" pill and stop the fibrillation, but also augment the oxygen enough to continue to survive without a stroke or some such. Interestingly, it's very difficult to even obtain a mycoplasma test, and Medicare fights you tooth and nail over paying for the oxygen. Either they will pay for it or I'll pay for it myself; it is absolutely necessary.

After a heart attack, one is treated in the heart clinic by specialists who are very caring and excellent practitioners, but know nothing of mycoplasma infection, so not consider it even a part of "heart disease", and who are rather puzzled when one has no clogging of the arteries, has the right count of red corpuscles (largely nonfunctional, of course, but there), pumps the right amount of blood, etc. So they identify and treat only the runaway fibrillation, do not prescribe the oxygen -- and essentially place you on a regime as best they know, but one that is guaranteed to kill or maim you or turn you into a totally disabled person or human vegetable via stroke, paralysis, etc. Fortunately my family doctor will prescribe the oxygen anyway, though I may have to pay for it myself. Whatever works!

However, I'm slowly improving little by little, working as much as I'm able to and trying to finish my book: Energy from the Vacuum: Concepts and Principles, and get it to the publisher for publication later this year. Hopefully the book will turn all the interested young grad students and post-docs loose in the free-energy area. They will not have to spend 30 agonizing years to get to where I am, and where a few others are, but can simply start here and go forward. Since speed to develop energy from the vacuum is of the essence because of the world situation, I'm moving on it as fast as I am physically able to.

Meanwhile, working with the AIAS (Alpha Foundation's Institute for Advanced Study), the AIAS (15 authors) has now gotten about 20 scientific papers published in leading journals (Foundations of Physics, Foundations of Physics Letters, Physical Scripta, Optik, etc.) dealing with electromagnetic energy from the vacuum. Several more are either approved for publication or in the review process also. So slowly we are getting it into the mainstream scientific literature. Hopefully it will be in time, but it's cutting it close.

Very best wishes,

Tom Bearden

Late update

Massive display of longitudinal interferometers?

UFO Fleet Taped Over Bedhampton, England

Is this sighting a case of the testing of all the Russian (KGB) longitudinal interferometers at once? And coordinating their targeting through the woodpecker grid to a common place, as an exercise in making a massive scalar attack upon a given region? Was this a confluence of Russian Tesla howitzer marker-beacons?

Certainly for a massive all-out scalar attack you would want coordinated movements of the target areas of many howitzers at once, for you could then just cut a bloody swath across a wide area, all the howitzer blasts marching across the land in a kind of scalar version of the "scorched-earth policy." All in a line, blasting, and heat, and mind waves. Or you might want to put the blasts all in the same place for a truly horrendous destruction. And on top of that biowar on citizens whose immune systems have been weakened with the quantum potential weapons. This is the latest version of Armageddon.

And should any madmen gain control of these weapons, any rogue group at all, and should they have some agenda to radically depopulate the world, to simply kill by the billion, the means will be in their hands to do so.

Update: MEG patent granted

Motionless Electromagnetic Generator Patent Granted

This message is from Jean-Louis Naudin, the French scientist who successfully replicated the Motionless Electromagnetic Generator (MEG) in France. He announces the granting of the patent to the MEG Builder's group at Yahoo.

----- Original Message -----

From: jnaudin509@aol.com
To: jlnlabs@yahoogroups.com
Sent: Tuesday, March 26, 2002 2:20 PM
Subject: [jlnlabs] (Info) GOOD NEWS : The Tom Bearden's MEG IS PATENTED

Dear ALL,

GOOD NEWS !!!!

The Motionless Electromagnetic Generator from Tom Bearden is now PATENTED US 6362718 granted on March 26, 2002

US Patent 6,362,718 :
Motionless Electromagnetic Generator (MEG)

Abstract: An electromagnetic generator without moving parts includes a permanent magnet and a magnetic core including first and second magnetic paths. A first input coil and a first output coil extend around portions of the first magnetic path, while a second input coil and a second output coil extend around portions of the second magnetic path. The input coils are alternatively pulsed to provide induced current pulses in the output coils. Driving electrical current through each of the input coils reduces a level of flux from the permanent magnet within the magnet path around which the input coil extends. In an alternative embodiment of an electromagnetic generator, the magnetic core includes annular spaced-apart plates, with posts and permanent magnets extending in an alternating fashion between the plates. An output coil extends around each of these posts. Input coils extending around portions of the plates are pulsed to cause the induction of current within the output coils.

Inventors: Patrick; Stephen L. (2511 Woodview Dr. SE., Huntsville, AL 35801); Bearden; Thomas E. (2211 Cove Rd., Huntsville, AL 35801); Hayes; James C. (16026 Deaton Dr. SE., Huntsville, AL 35803); Moore; Kenneth D. (1704 Montdale Rd., Huntsville, FL 35801); Kenny; James L. (925 Tascosa Dr., Huntsville, AL 35802)

Appl. No.: 656313
Filed: September 6, 2000

For some technical info see my web site at : http://jnaudin.free.fr/html/meg.htm

Best Regards
Jean-Louis Naudin
Email: JNaudin509@aol.com
Main Web site : http://jlnlabs.org
Site France : http://jlnlabs.multimania.com

Click here to view patent # 6,362,718

Patent Story on Rense.com:

Rense.com
MEG Scalar Energy Device
Patented - Production Starts Next Year

From Bill Morgan
wmorgan@nycap.rr.com
3-28-2

Patent was granted on March 26, 2002 for "The Motionless Magnetic Generator," (MEG) US Patent 6,362,718, which is likely to become the first commercially available free energy device in history in about one year from now. The machine will provide free electricity from the vacuum, for the life of the device, which should be a very long life since it has no moving parts. You can see a picture of scientist Jean-Louis Naudin's MEG replication model at: http://jnaudin.free.fr/html/meg.htm.

It has strong magnets, coils, and a controller unit with the electronics. Naudin made the announcement to the MEG-builder's Yahoo group. The announcement has significance since the patent office has always been skeptical of devices which seem to "get-something-for-nothing." But according to the new science of scalar electromagnetics, the MEG does not break the law of conservation of energy. It's just that the energy is conserved in the fourth dimension, time, and not our 3-space world.

The MEG provides electrical energy by tapping the longitudinal electromagnetic (EM) waves which exist in almost infinite abundance in the vacuum of space. This ocean of energy which permeates everything is sometimes called the "zero point" energy, since it remains there even at absolute zero temperature.

Four inventors are listed: Stephen L. Patrick, Thomas E. Bearden, James C. Hayes, Kenneth D. Moore.

Tom Bearden has explained the operation of the MEG on his website Cheniere.org, and also speaks about the new fearful weapons that can and have been made using the same "longitudinal waves" of the vacuum.

The complicated physics of how the MEG works is explained in the paper "The Motionless Electromagnetic Generator: Extracting Energy from a Permanent Magnet with Energy Replenishment from the Active Vacuum," which can be found at Tom Bearden's website:

cheniere.org.(http://www.help4all.de/energy/MEGpaper.pdf)

The first MEG units to be produced for sale will output 2.5 kilowatts of free electricity. Forever. They should be in production about a year from now. Facilities for manufacturing the device are being set up in an unnamed "friendly nation."

This free electricity will flow indefinitely, without much, or any maintenance. The units may be hooked together to provide more wattage, so four of them would provide 10 kilowatts. After some production experience units will be made which output 10 kilowatts each. With a couple of those units a house could get off the electrical grid.

Tom Bearden, one of the inventors has said "I will admit that the chief scientist of an important experimental group in a large company was rather stunned at the type of output we were able to

obtain. The MEG may look like just a transformer, but it is not. It is a completely different breed of cat." This cat, it would seem, is out of the bag now.

The ordinary EM waves we are familiar with are called "transverse" waves, to distinguish them from the new "longitudinal" EM waves of the vacuum. Bearden has explained in depth on his website cheniere.org that wherever there is a dipole (battery, generator, magnet) there is an unseen flow of longitudinal EM waves in that local vacuum, the only problem is in tapping that energy and "transducing" it to electricity. Bearden says that the problem with all the electrical circuits we have is that they are two-wire circuits, a loop by which half the energy goes back to destroy the dipole. In the MEG that closed loop is never made. So the dipole is not being destroyed.

Patents are not granted on devices which do not work, so in a sense this announcement proclaims a new era. The MEG device itself proclaims and proves that energy is abundantly available everywhere, for free. We only have to build the devices to tap it. MEG type devices could be put into a car with an electric engine to make a truly fuel-less automobile. Electricity can be available in very remote places. People will be able to get off our very terrorist-vulnerable power grids. In an era of terrorism a highly dispersed power system would be most desirable rather than our centralized systems.

What is somewhat astonishing to me is the discovery by Bearden et. al. that time itself is actually compressed energy, and that this free energy is actually coming from the time domain, the ocean of longitudinal EM waves which fill the empty vacuum of spacetime. In fact, time is energy compressed by the same factor that matter is compressed energy: the speed-of-light squared. Thus there is a new companion to Einstein's E=mc2. Can you say "E equals delta-tee-cee-squared?" The "tee" is time and delta-tee is change in time.

A company has been set up to manufacture the MEG called Magnetic Energy Limited.

The ramifications of free energy are enormous. The oil wars are not necessary. If we threw as much money at this technology as we are spending on the oil wars we would be free of the need for oil in less than a decade. With fuel-less cars air pollution will be greatly lessened. Third world nations can raise their standard of living eventually. And the energy is free. And it never runs out.

I have put together a kind of "Bearden for Beginners" article which explains some of the basic concepts of the current state of scalar technology.

http://www.prahlad.org/pub/bearden/scalar_wars.htm

The granting of the MEG patent is the herald of the new era of scalar electromagnetics, and the free energy which flows forever and never runs out.

Bill Morgan
wmorgan@nycap.rr.com

Do the magnets run down after a while?

Further developments: Tom Bearden clears up a question

When the MEG patent was released many questioned the patent language which seemed to imply that permanent magnets of the MEG would "wear out" after awhile. I myself wondered about the same thing so I put the question to Tom, and here is his reply.

> Dear Bill,
>
> Thanks for the kind words; much appreciated.
>
> I'm not up to going on radio or TV, and won't be for quite some time. Still suffering from hypoxia, though very slowly improving, and will still be on antibiotics for 10 more months at least (maybe longer).
>
> Obviously an extensive dialog developed between the Patent office and our patent attorneys. As best I can understand it, the Patent office accepts the fact that a permanent magnet produces and emits energy, or has a history of accepting it. They do not appear to be at all cognizant of the broken symmetry of opposite charges, and hence of a dipole. So in their opinion (which seems to be vague), the magnet has to use itself up very gradually, or some such. So some rewrites were essentially required by the Patent office.
>
> All I can say is that a magnet is a very durable thing, so long as you don't heat it up too much or shock it to much. Certainly one will make a good 20 years, and of course there are plenty of magnets that have been around awhile longer.
>
> That said, in our earliest experiments we did "measure" some such effect, or so we thought, until we found that a particular instrument was bad and giving erroneous readings. So with a new instrument, we have not observed since then any such readings.
>
> Out of all that fuzziness came the inclusion of "using up the magnets gradually". So far as we are aware (after correcting those early readings on a defective instrument), we have seen no such measurements or effects since then at all. Nonetheless, just in case there is some very small effect in that respect, at least it's in there.
>
> Actually, as you are aware, capacitors and solid state components are the major concerns for failure, and any system does require maintenance, both periodic and whenever malfunction or failure occurs. The MEG is no different from any other device in that respect, so of course it will have a component failure rate and maintenance required from time to time, just as any other electromagnetic device. But without moving parts, it can be ruggedized and made very durable indeed.
>
> Please give Jeff Rense my regrets, and I do admire his work and his show. He's laying it in there.
>
> The depth of the scientific mindset against COP>1.0 is inexplicable, particularly when physics itself already has COP>1.0 validated experiments (such as Bohren's experiment,

which outputs 18 times as much as one inputs by Poynting calculations), and it works every time. Any competent university optics lab can perform the experiment. Also, even the conventional texts admit that a charged capacitor or electret laid on a permanent magnet, so that the E of the cap or electret and the H of the magnet are at right angles, is a "free energy machine". That silly thing will just sit there and pour out Poynting energy S = EXH indefinitely. Years and years and years. If you wait just a single year, that silly thing has changed the energy density of a volume of space a light year in radius, reaching out well beyond the solar system. Now that's a WHALE of a lot of EM energy that beast poured out in that year, and it will still be going strong and pouring it out at a steady rate. The charges and dipoles in original matter in the universe have been pouring out EM energy in that fashion for some 14 billion years, give or take a billion or so. It's also easy to see that, prior to Lorentz's ARBITRARY symmetrical regauging of the Maxwell-Heaviside equations, those equations prescribe both EM systems in equilibrium with their active environment, and EM systems not in equilibrium with it. The latter systems are permitted by the thermodynamics of open disequilibrium systems to perform five magic functions: (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy than the operator inputs (the active environment inputs the rest of it), (4) power itself and its load (the active environment inputs all the energy, like a windmill), and (5) exhibit negentropy. That is a well-established thermodynamics. Lorentz arbitrarily discarded all such open disequilibrium EM systems in order to get simpler equations having analytical solutions and not requiring numerical methods. So he simply scrapped all the really interesting and challenging EM systems in Maxwell's theory. ARBITRARILY!

That our scientific establishment continues to teach only that "half" of the theory, and not point out the rest to the young students, and not fund research into developing such systems that take energy from the vacuum, is simply inexplicable. It's a matter of total dogma, not science at all.

But hopefully it is changing a little bit. At least now we cite chapter and verse when these things were done, and what they are, and the young grad students and post docs can go check the papers and make up their own minds.

That is the real hope of the future: that we get a generation of young fellows, with excellent skills, who now know where all the skeletons got hidden in the closet, and understand that the electrical engineering model arbitrarily assumes an inert vacuum environment (falsified for more than a half century in particle physics) and a local flat spacetime (falsified for nearly a century by general relativity).

Once they know that past history, and go read into what broken symmetry of opposite charges means for a dipole and for all dipolar EM circuits, they will set to and change that more than a century of error. In that case, we shall have numerous solutions to the energy crisis rather quickly, popping up all over.

Good thing. It will certainly displace some great energy barons, but it will also free the populace. One can extract all the EM energy from the vacuum one wishes, anywhere, anytime, with ridiculous ease. One can produce that "electrical wind of energy" at will, by making a simple dipole and then letting it alone. The only energy problem is in how to

then intercept some of that energy flow and "catch" it in a circuit, discharge it in a load to power it, and not use half the "caught" energy to kill that dipole that is gushing out the extracted EM energy from the vacuum.

Very best wishes,

Tom Bearden

END

The Tom Bearden Website

Help support the research

Foundations of Electro-Magnetism

Slide Series

- Major Points of Presentation
- Chung's Carbon Filament Negative Resistor
- Aharanov-Bohm Effect
- Absorption and emission reactions (1)
- Absorption and emission reactions (2)
- Anti-engine for cell's deviation reverses cell back to normal
- Asymmetric regauging produces excess force, which can be used to do work on the system
- Asymmetric regauging produces excess force, which can be used to do work on the regauging system
- Becker's bone fracture healing experiments
- Becker's theoretical control system governing regeneration
- Becker's theoretical DC control system involved with response to injury
- Geometrical Distortion of Poynting Energy Flow
- Cosmic Bootstrap: Before the Big Bang
- Bridging Enables COP > 1

- Aspects of Strong Local Symmetry
- Other Aspects of Strong Local Symmetry
- Bunge on the Status of Electrodynamics
- Bunge on the Status of Electrodynamics and Physics
- Bunge on the Status of Classical and Quantum Physics
- Fractions of BW Casualties Surviving
- First Step in Self-Promotion of Cancer Due to Hypoxia
- Differentiation and Dedifferentiation Timelines
- Evolution of Cells on Earth
- A Charged Particle q is a Coupled System of m and Ø
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (1)
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (2)
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (3)
- A Charged Particle is a Coupled System
- The Anomalies in Navy Electrolyte Experiments at China Lake
- Chung's Carbon Filament Negative Resistor

- Typical circuit has about 10^{-13} energy collection efficiency
- Classical View of EM
- Curved Spacetime acts as source or sink
- Chronic Disease Puzzling
- Cancer Characteristics
- Solving a Cancer Enigma
- Cancer: Characteristics
- Nonlinear Optics Distortion Correction Theorem
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)
- In Time-Reversed Zone: Nuclear reactions are biased
- In Time-Reversed Zone: Dynamics may be reversed
- Time-Reversed Zone: Significant only after time-density charging
- A New Conservation of Energy Law
- Questions on Carcinogens and EM

Radiation

- AS DEFINED, fields and potentials only exist in and on charged matter
- Serious flaws and errors in classical EM theory
- Electrodynamicists' Reaction to Removal of the Material Ether
- Reaction to Loss of Material Ether (1)
- Reaction to Loss of Material Ether (2)
- Some EM waves in Spacetime
- Air Medium Disturbances Generated When Air is Perturbed by a Plucked Taut String
- Launching a Spacetime Perturbation ("EM Wave") from a Wire Antenna
- Phase Conjugate Wavepairs Produce New Waves
- Scalar Electromagnetics (Energetics) View of EM (1)
- Scalar Electromagnetics (Energetics) View of EM (2)

- Scalar Electromagnetics (Energetics) View of EM (3)
- Extended General Relativity Principle
- Extension of Work-Energy Theorem
- 34 Flaws in Classical EM Theory
- MTW's General Relativity Principle
- Use of General Relativity (GR) in Particle Physics
- The Missing Infolded Electrodynamics
- Infolded Engines: Excluded by Present Physics
- Mass curves and structures spacetime; ST curvatures change and structure mass (1)
- Mass curves and structures spacetime; ST curvatures change and structure mass (2)
- At Infinite Velocity: Each Is Every Other
- Lisitsyn's Report: Brain Code Broken
- Lorentz Closed Surface Integration
- Lorentz's physically insignificant energy flow can be collected and utilized
- Lorentz surface integration of the Poynting vector around a closed surface
- Longitudinal EM Photon Interaction with Charge
- Mass is transparent to longitudinal EM waves, which move through the infolded interiors of internal waves, potentials, and fields in the mass.

- Pumping with Longitudinal EM waves Time-reverses the Mass
- Maxwell's Quaternion Theory
- Maxwellian Systems before and after Regauging
- Maxwell's four equations reduce to: Page 1
- Maxwell's four equations reduce to: Page 2
- More to come

Major Points of Presentation

- Electrodynamic is seriously flawed
  - Some major flaws
  - Corrections indicated
- Why past corrective attempts failed
  - Force field concept is material
  - Missing two infolded transforms (M->ST; ST->M)
- Missing Infolded general relativity inside electrodynamics
- Several Kinds of EM Waves in Space
  - How to make
  - Transduction
- A French medical example as a deep experimental demonstration
  - Spectacular regenerative cures funded by French Govt
  - Not comprehended, therefore suppressed
- Cold Fusion examples of time-density wave effects
  - China Lake instrumental anomalies in electrolysis
  - Explanation of anomalous behavior of instruments
  - Explanation of new nuclear reactions
  - Wave energy transduction provides excess heat
- Urge theorists to consider dramatically new reactions

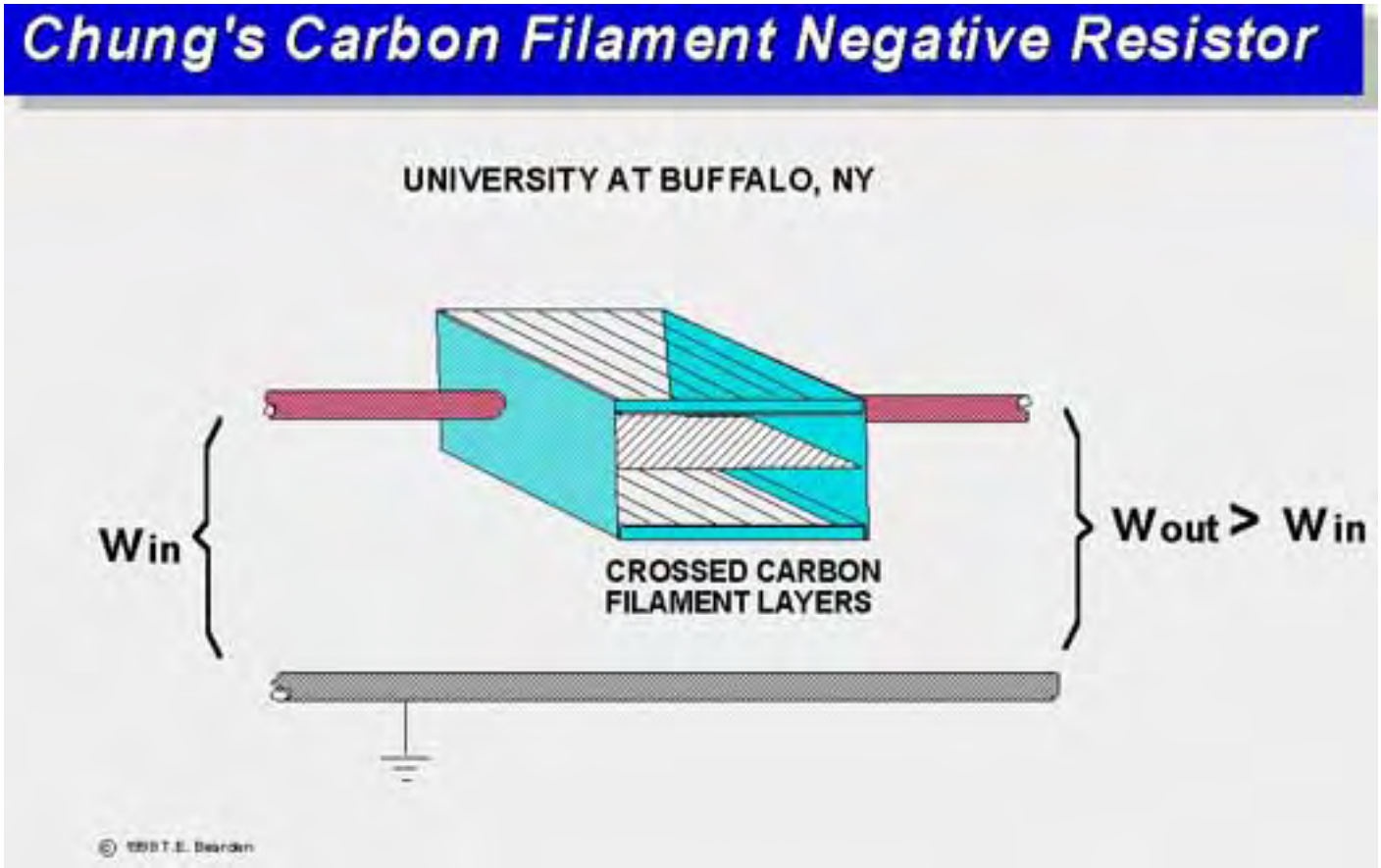
Chung's Carbon Filament Negative Resistor
UNIVERSITY AT BUFFALO, NY
Win
CROSSED CARBON
FILAMENT LAYERS
Wout > Win
© 1991 T.E. Bearden

Aharonov-Bohm Effect

- In field-free regions
  - E-field is zero
  - B-field is zero
- Potentials still exist, just no gradients
  - Cause real effects
  - Interference is the key
  - Contain sum-zeroed substructures
- Does not follow from
  - Mechanics
  - Classical electromagnetics
- Required by quantum mechanics

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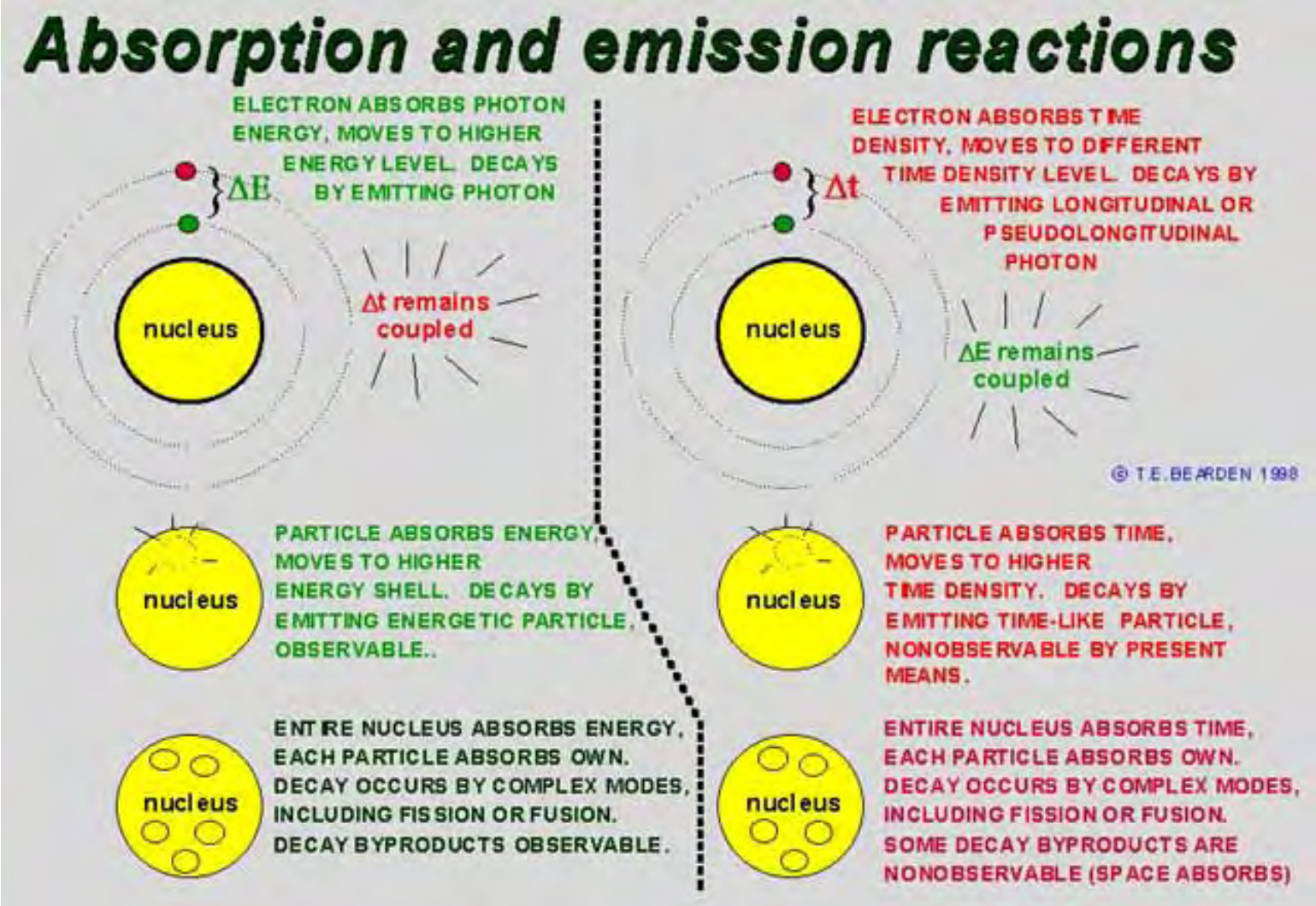
Absorption and emission reactions
ELECTRON ABSORBS PHOTON ENERGY, MOVES TO HIGHER ENERGY LEVEL. DECAYS BY EMITTING PHOTON
ΔE
nucleus
Δt remains coupled
ELECTRON ABSORBS TIME DENSITY, MOVES TO DIFFERENT TIME DENSITY LEVEL. DECAYS BY EMITTING LONGITUDINAL OR PSEUDOLONGITUDINAL PHOTON
Δt
nucleus
ΔE remains coupled
© T.E. BEARDEN 1998
nucleus
PARTICLE ABSORBS ENERGY, MOVES TO HIGHER ENERGY SHELL. DECAYS BY EMITTING ENERGETIC PARTICLE, OBSERVABLE..
nucleus
PARTICLE ABSORBS TIME, MOVES TO HIGHER TIME DENSITY. DECAYS BY EMITTING TIME-LIKE PARTICLE, NONOBSERVABLE BY PRESENT MEANS.
nucleus
ENTIRE NUCLEUS ABSORBS ENERGY, EACH PARTICLE ABSORBS OWN. DECAY OCCURS BY COMPLEX MODES, INCLUDING FISSION OR FUSION. DECAY BYPRODUCTS OBSERVABLE.
nucleus
ENTIRE NUCLEUS ABSORBS TIME, EACH PARTICLE ABSORBS OWN. DECAY OCCURS BY COMPLEX MODES, INCLUDING FISSION OR FUSION. SOME DECAY BYPRODUCTS ARE NONOBSERVABLE (SPACE ABSORBS)

Absorption and emission reactions

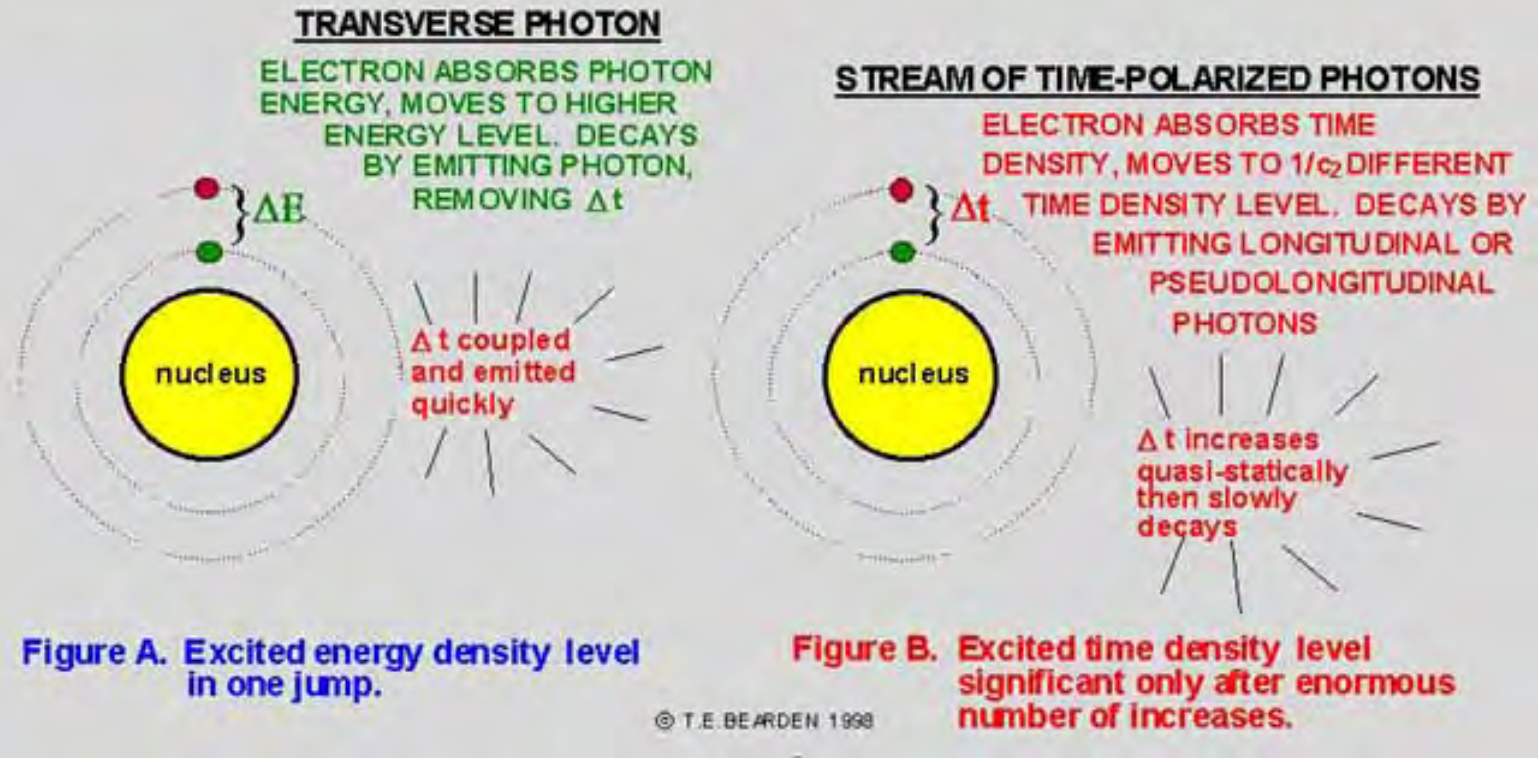

Figure A. Excited energy density level in one jump.

Figure B. Excited time density level significant only after enormous number of increases.

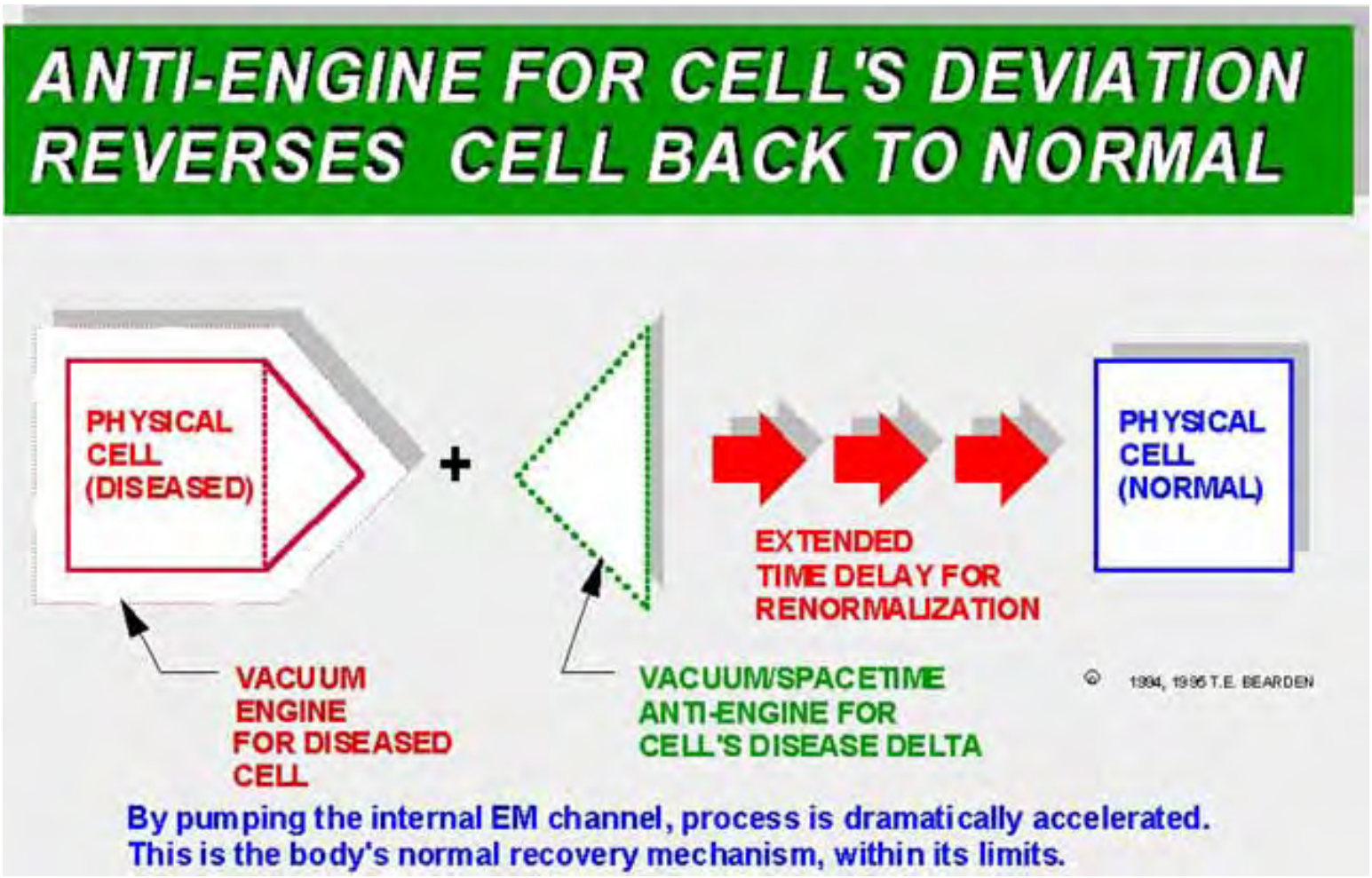
ANTI-ENGINE FOR CELL'S DEVIATION
REVERSES CELL BACK TO NORMAL
PHYSICAL CELL (DISEASED)
+
EXTENDED TIME DELAY FOR RENORMALIZATION
PHYSICAL CELL (NORMAL)
VACUUM ENGINE FOR DISEASED CELL
VACUUM/SPACETIME ANTI-ENGINE FOR CELL'S DISEASE DELTA
© 1994, 1995 T.E. BEARDEN
By pumping the internal EM channel, process is dramatically accelerated.
This is the body's normal recovery mechanism, within its limits.

Asymmetric Regauging Produces Excess Force, Which Can be Used to Do Work on the System

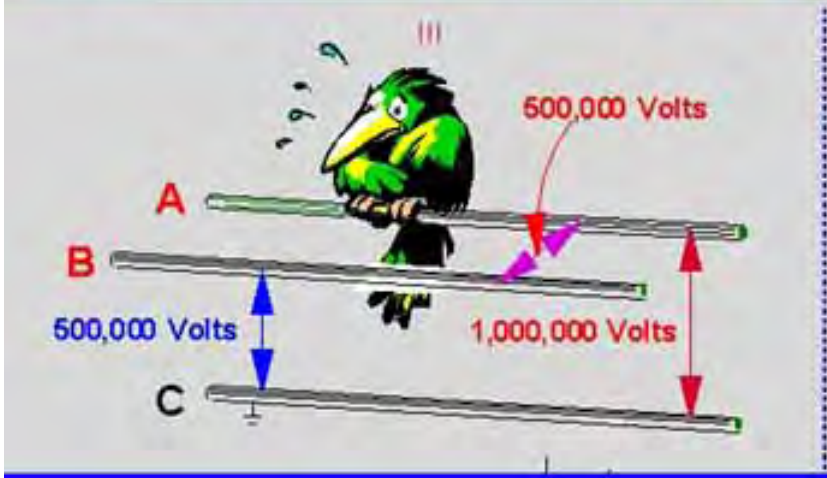

Net Symmetric Regauging Does No Excess Work on the System

This little bird put one foot on wire A, and then the second foot on wire A also. He *net symmetrically* regauged, so he had no net excess force across him, even though his potential energy was increased. He asymmetrically regauged each foot, but both simultaneously so that one countered the other. Wise little bird!

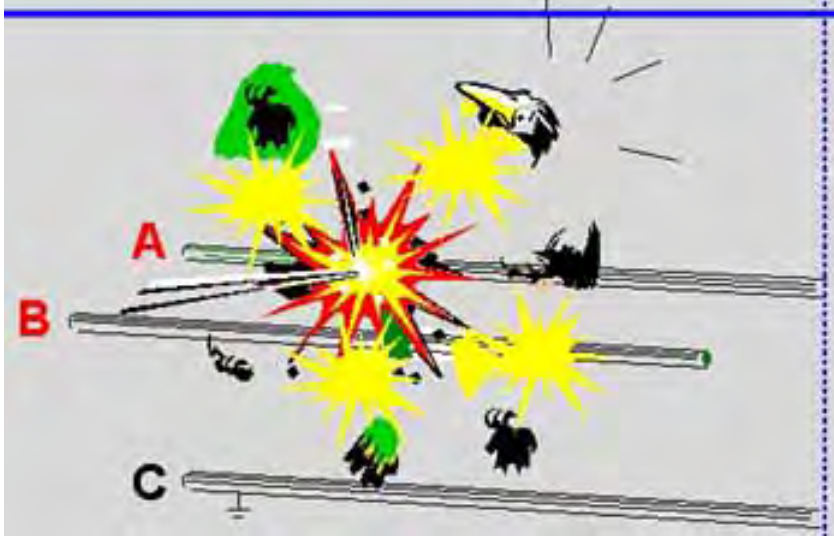

Net Asymmetric Regauging Can Do Excess Work on the System

This little bird put one foot on wire A, and then the second foot on wire B. He *net asymmetrically* regauged, so he had lots of net excess force across him. That force then violently translated his little body parts every which way, doing lots of work in and on him. Bummer!

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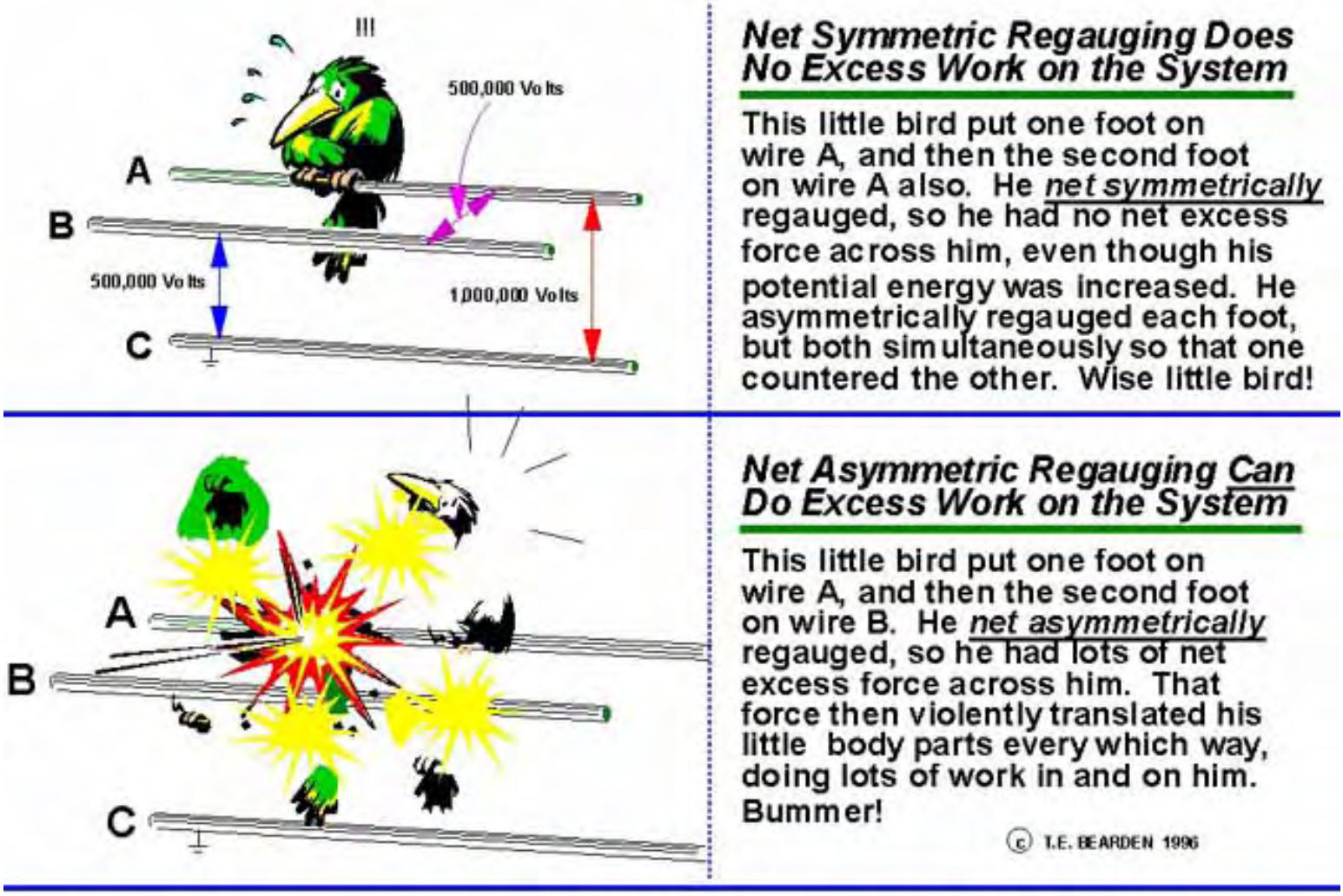

Figure 32. Asymmetric regauging produces excess force, which can be used to do work on the regauging system.

Selected clipart © by Lotus SmartPics™

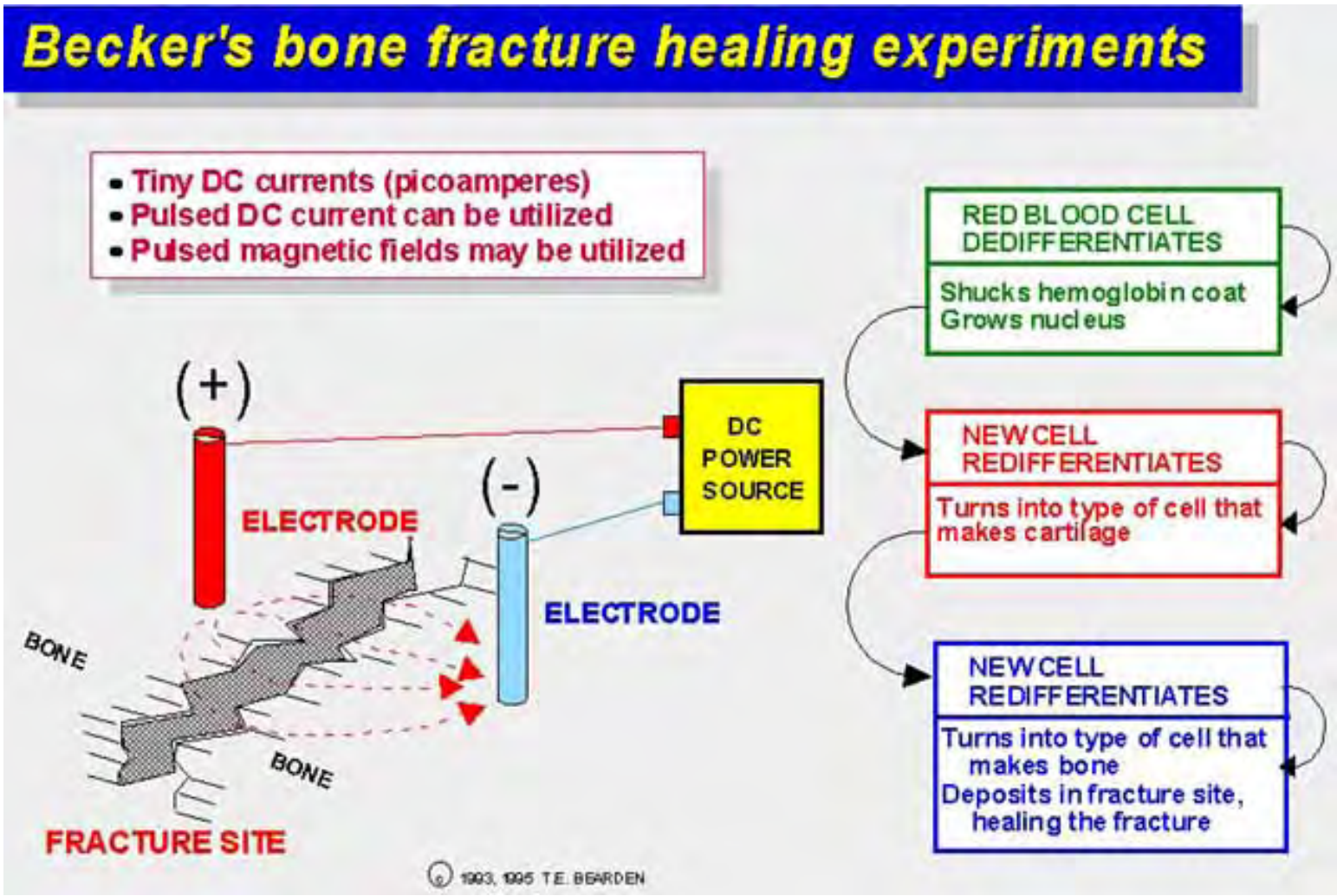
Becker's bone fracture healing experiments
• Tiny DC currents (picoamperes)
• Pulsed DC current can be utilized
• Pulsed magnetic fields may be utilized
(+)
(-)
ELECTRODE
ELECTRODE
DC POWER SOURCE
BONE
BONE
FRACTURE SITE
RED BLOOD CELL DEDIFFERENTIATES
Shucks hemoglobin coat
Grows nucleus
NEW CELL REDIFFERENTIATES
Turns into type of cell that makes cartilage
NEW CELL REDIFFERENTIATES
Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture
© 1993, 1995 T.E. BEARDEN

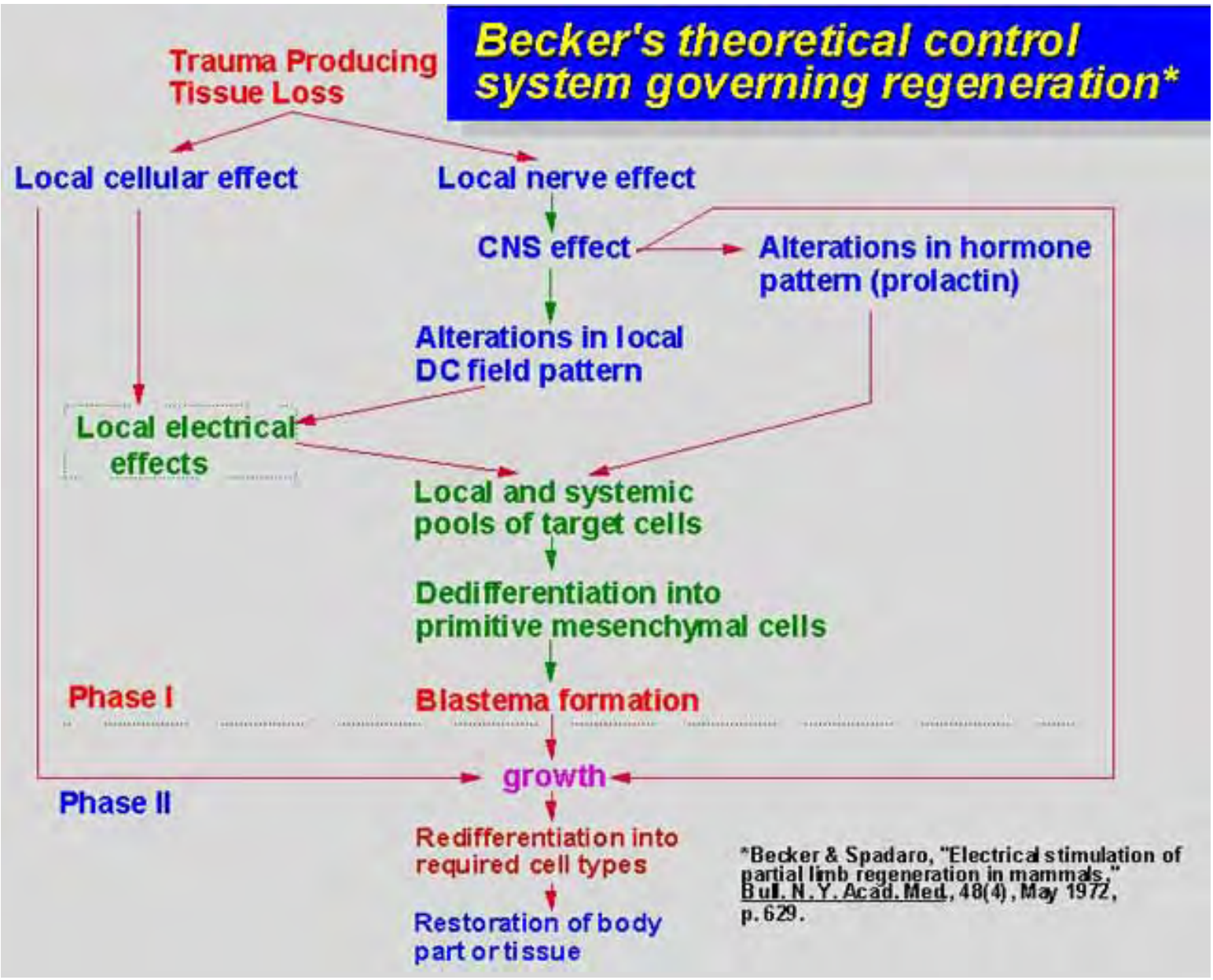
Becker's theoretical control system governing regeneration*
Trauma Producing Tissue Loss
Local cellular effect
Local nerve effect
CNS effect
Alterations in hormone pattern (prolactin)
Alterations in local DC field pattern
Local electrical effects
Local and systemic pools of target cells
Dedifferentiation into primitive mesenchymal cells
Phase I
Blastema formation
growth
Phase II
Redifferentiation into required cell types
Restoration of body part or tissue
*Becker & Spadaro, "Electrical stimulation of partial limb regeneration in mammals," Bull. N.Y. Acad. Med., 48(4), May 1972, p. 629.

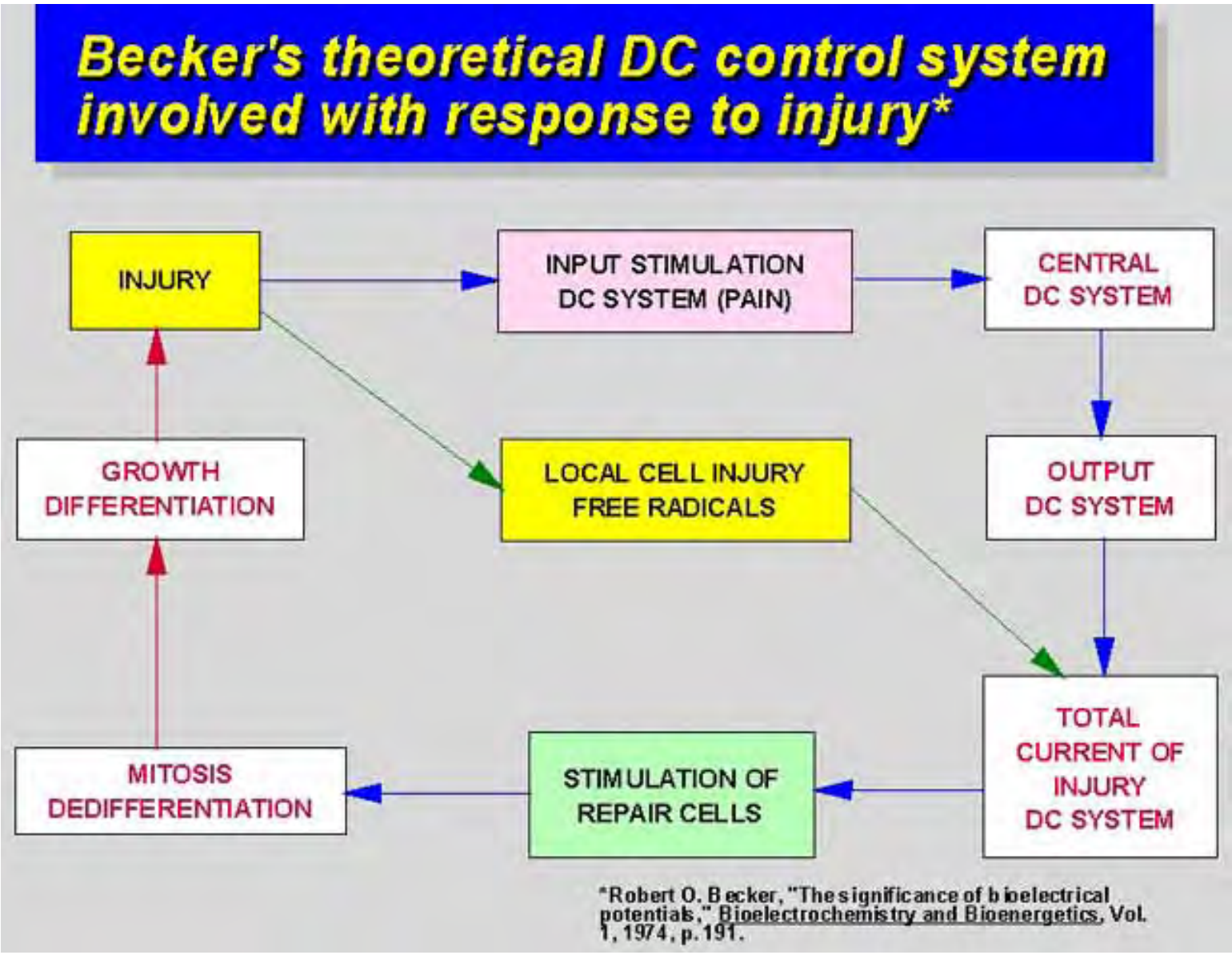
Becker's theoretical DC control system involved with response to injury*
INJURY
INPUT STIMULATION DC SYSTEM (PAIN)
CENTRAL DC SYSTEM
GROWTH DIFFERENTIATION
LOCAL CELL INJURY FREE RADICALS
OUTPUT DC SYSTEM
TOTAL CURRENT OF INJURY DC SYSTEM
MITOSIS DEDIFFERENTIATION
STIMULATION OF REPAIR CELLS
*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

Geometrical Distortion of Poynting Energy Flow

At or near resonance frequency, in the case shown the energy collection fraction (reaction cross section) increases dramatically.

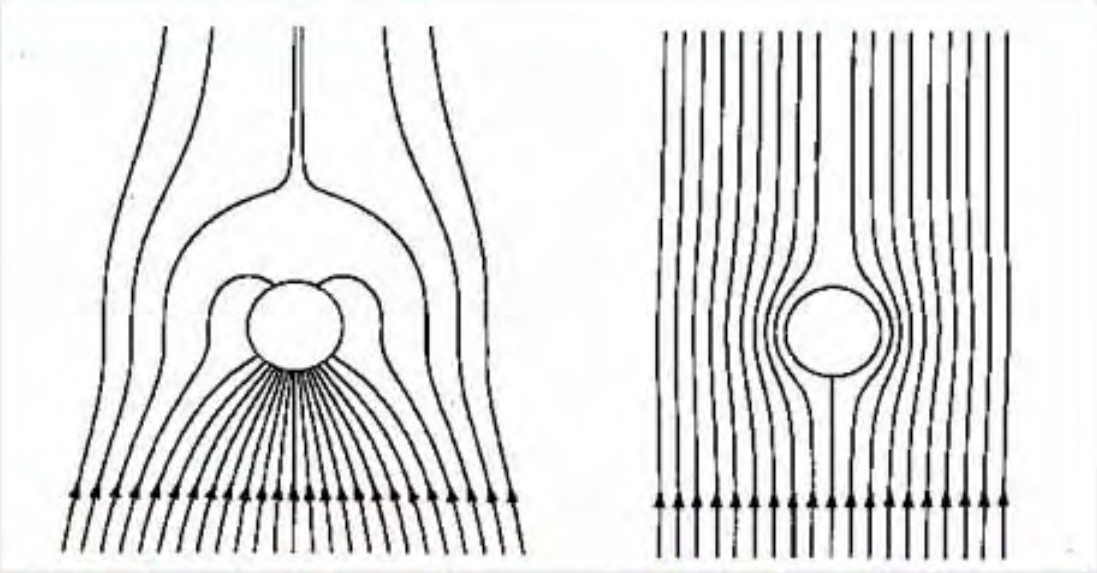

a. Around an aluminum sphere at light energy 8.8 eV. Absorption efficiency = 18.00.

b. Around an aluminum sphere at light energy 5eV. Absorption efficiency = 0.1.

Figures per Craig F. Bohren, "How can a particle absorb more than the light incident upon it? ", American Journal of Physics, 51(4), Apr. 1983, p. 326.

Cosmic Bootstrap: Before the Big Bang:

- *Cosmic repulsion behaved like a fluid with negative pressure*
- *The "universe" inflated (expanded) as a "false vacuum"*
- *As the negative-pressure fluid expanded, its energy went up rather than down*
- *When inflation stopped, the false vacuum decayed from its excited state*
- *Its excitation energy was released in a single great burst*

Paul Davies, Superforce, 1984, p. 194

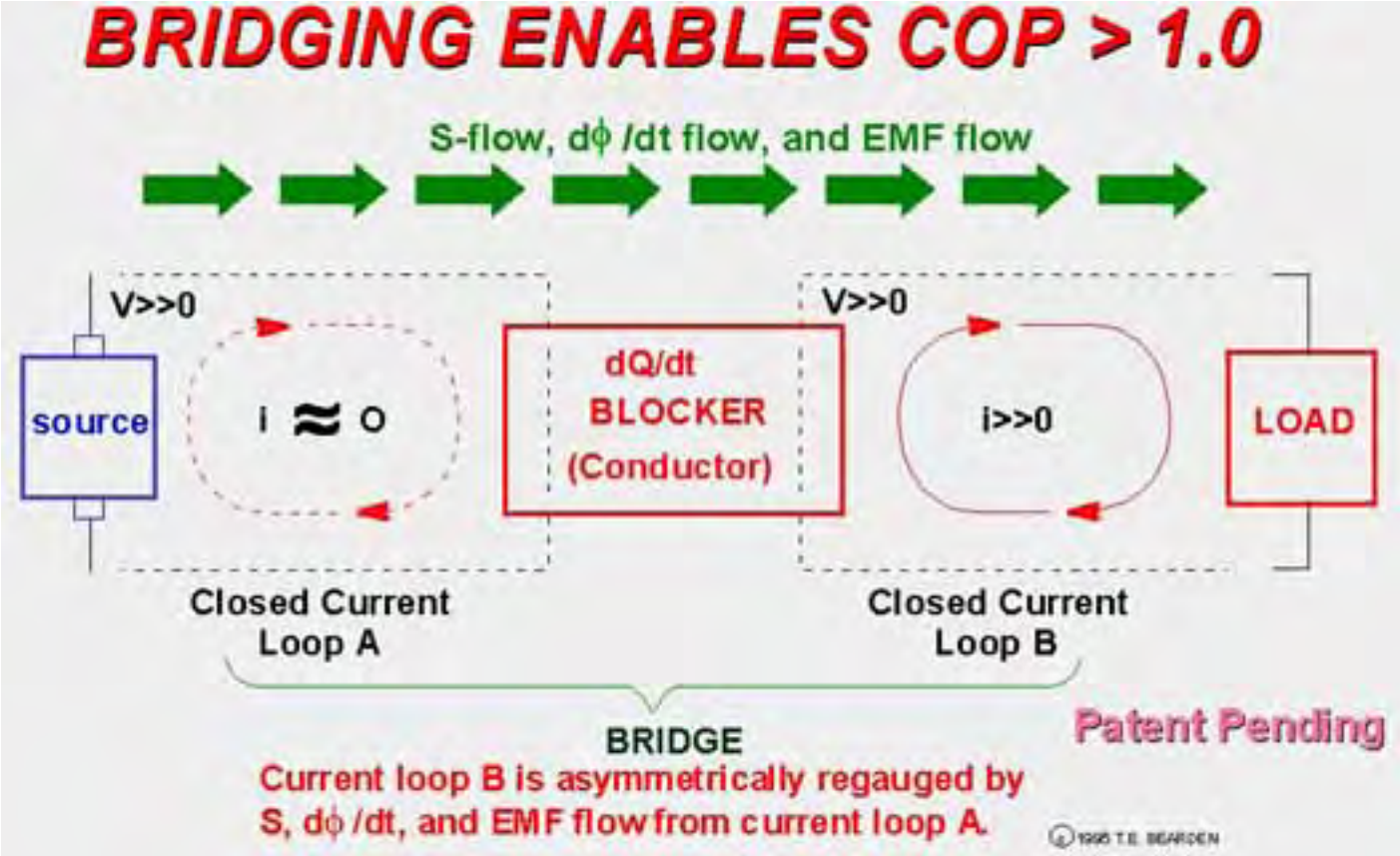
BRIDGING ENABLES COP > 1.0
S-flow, dϕ /dt flow, and EMF flow
V>>0
source
i ≈ 0
dQ/dt
BLOCKER
(Conductor)
V>>0
i>>0
LOAD
Closed Current
Loop A
Closed Current
Loop B
BRIDGE
Patent Pending
Current loop B is asymmetrically regauged by
S, dϕ /dt, and EMF flow from current loop A.
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Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum

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- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another
- STRUCTURING THE INFOLDED EM INSIDE POTENTIALS, FIELDS, AND WAVES
  - Strongly breaks local symmetry
  - Provides spacetime engines giving the above effects

Other Aspects of Strong Local Asymmetry

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- Local spacetime is curved
- Lorentz invariance of vacuum is violated
- May be a local "sink" or "source"
- Gravitational-inertial effects from EM
- Translation between virtual and observable
- Electrogravitational solitons
- Action at a distance
- Transmutation effects may exist
- Scalar/pseudoscalar field translation
- COMMENT: Thus the use of infolded longitudinal EM fields and waves to strongly break local symmetry allows internested clustering of spacetime curvatures. These spacetime structures are *vacuum engines*, or *spacetime engines*.

Bunge on the Status of Electrodynamics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state..."

"... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176.

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Bunge on the Status of Electrodynamics and Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state...

"... neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

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*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176.

Bunge on the Status of Classical and Quantum Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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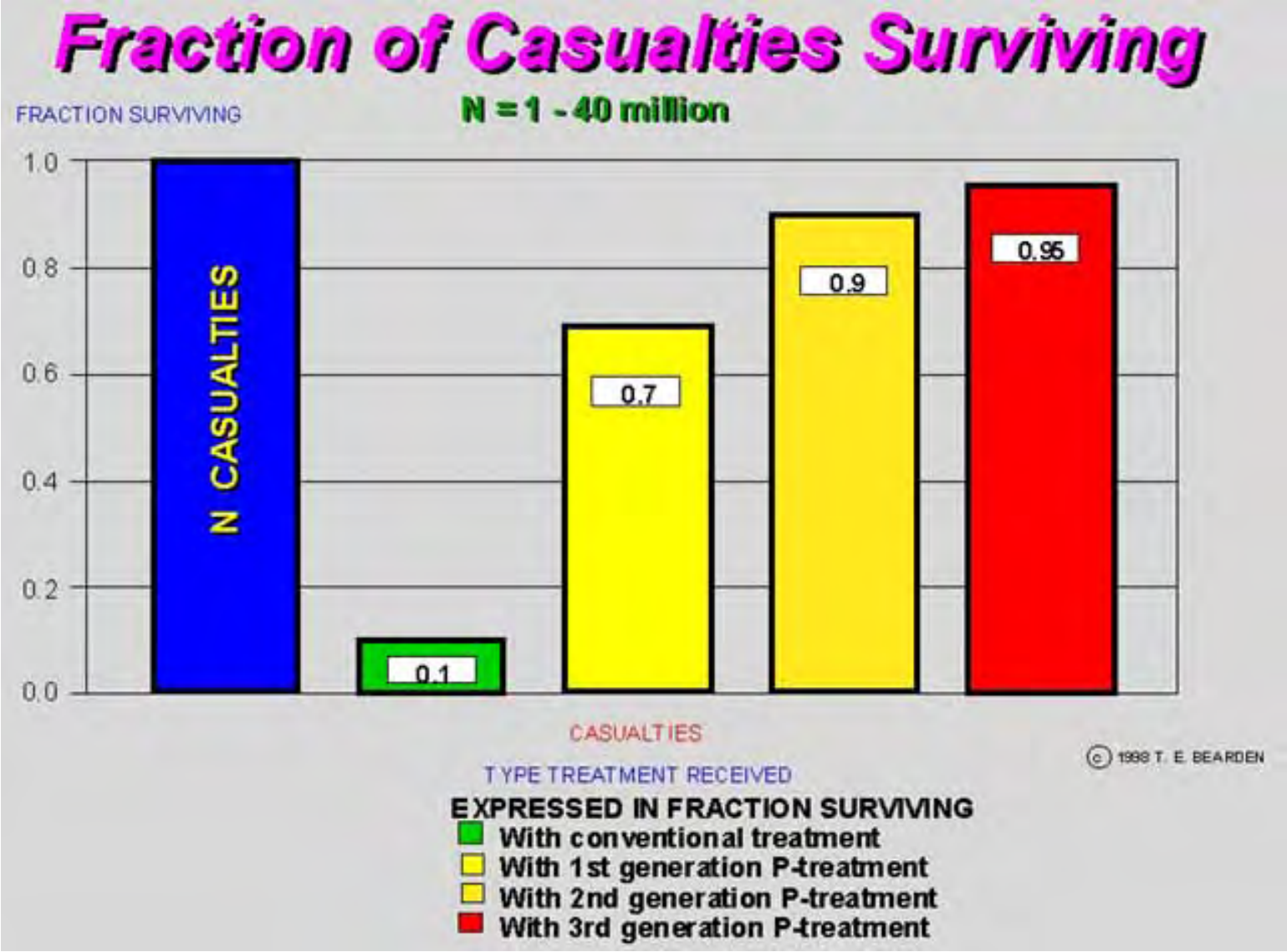
Fraction of Casualties Surviving
FRACTION SURVIVING
N = 1 - 40 million
1.0
0.8
0.6
0.4
0.2
0.0
N CASUALTIES
0.1
0.7
0.9
0.95
CASUALTIES
TYPE TREATMENT RECEIVED
© 1998 T. E. BEARDEN
EXPRESSED IN FRACTION SURVIVING
With conventional treatment
With 1st generation P-treatment
With 2nd generation P-treatment
With 3rd generation P-treatment

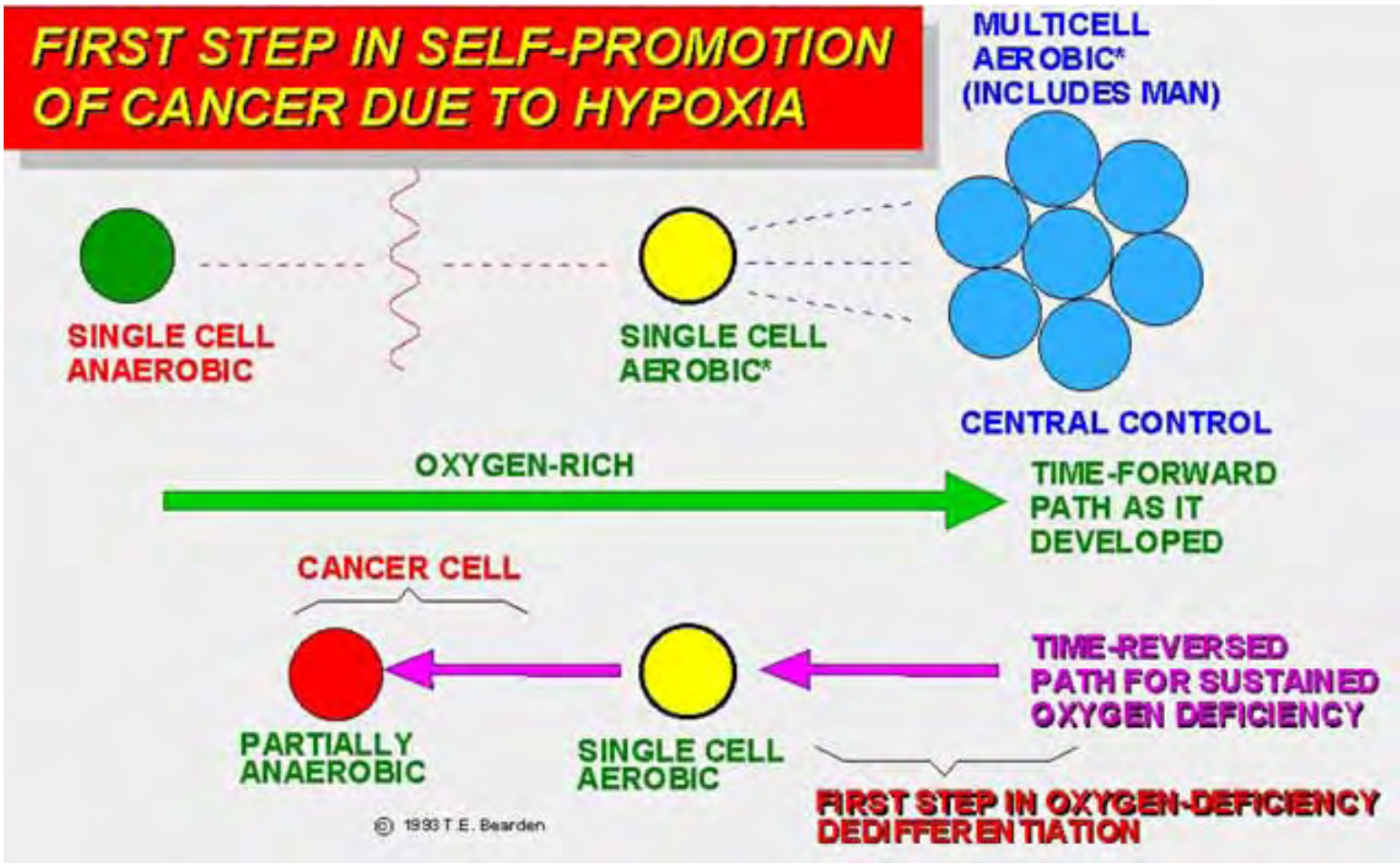
FIRST STEP IN SELF-PROMOTION OF CANCER DUE TO HYPOXIA
MULTICELL AEROBIC* (INCLUDES MAN)
SINGLE CELL ANAEROBIC
SINGLE CELL AEROBIC*
CENTRAL CONTROL
OXYGEN-RICH
TIME-FORWARD PATH AS IT DEVELOPED
CANCER CELL
TIME-REVERSED PATH FOR SUSTAINED OXYGEN DEFICIENCY
PARTIALLY ANAEROBIC
SINGLE CELL AEROBIC
FIRST STEP IN OXYGEN-DEFICIENCY DEDIFFERENTIATION
© 1993 T.E. Bearden

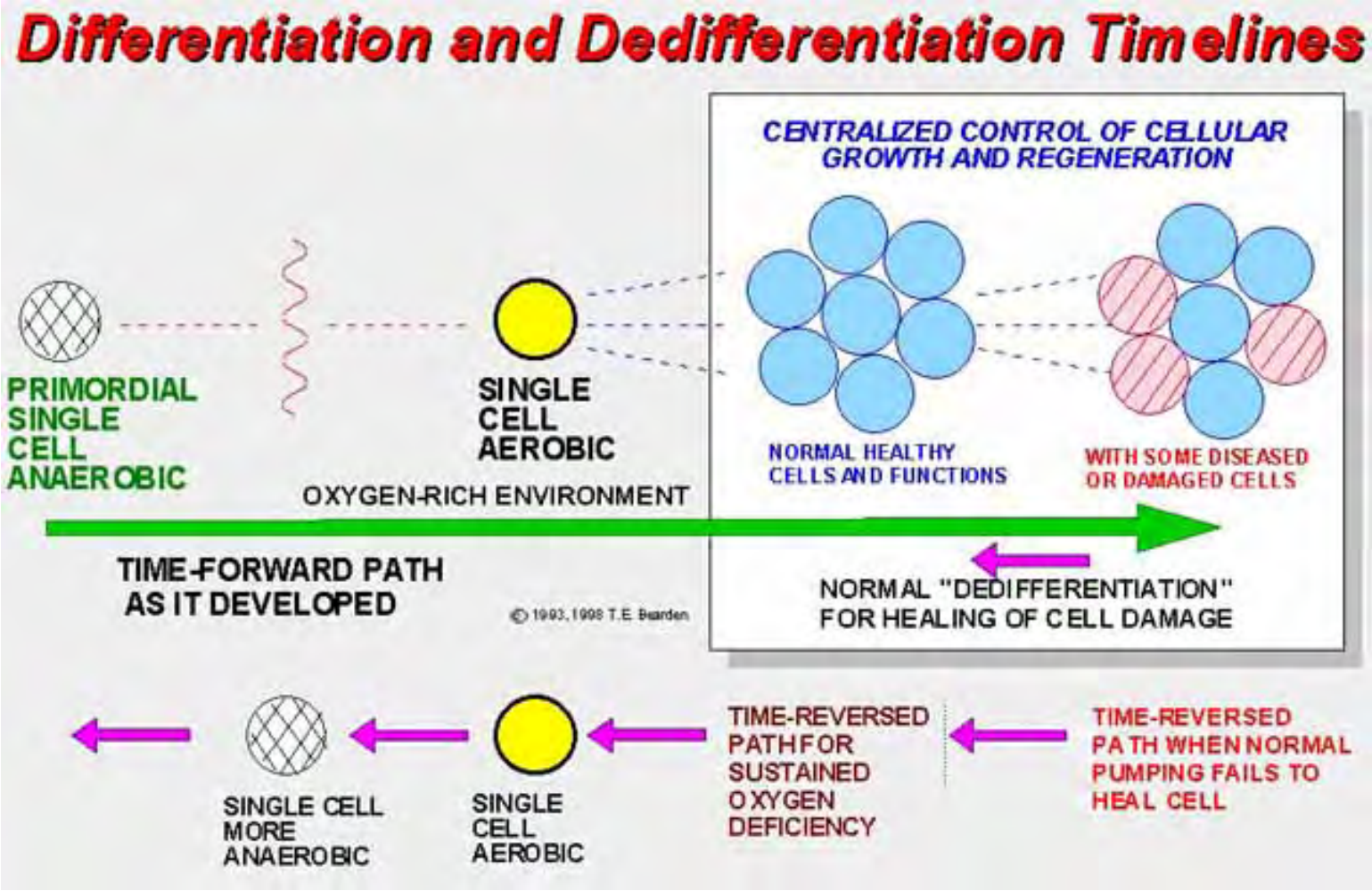
Differentiation and Dedifferentiation Timelines
CENTRALIZED CONTROL OF CELLULAR GROWTH AND REGENERATION
PRIMORDIAL SINGLE CELL ANAEROBIC
SINGLE CELL AEROBIC
OXYGEN-RICH ENVIRONMENT
NORMAL HEALTHY CELLS AND FUNCTIONS
WITH SOME DISEASED OR DAMAGED CELLS
TIME-FORWARD PATH AS IT DEVELOPED
© 1993, 1998 T.E. Bearden
NORMAL "DEDIFFERENTIATION" FOR HEALING OF CELL DAMAGE
SINGLE CELL MORE ANAEROBIC
SINGLE CELL AEROBIC
TIME-REVERSED PATH FOR SUSTAINED OXYGEN DEFICIENCY
TIME-REVERSED PATH WHEN NORMAL PUMPING FAILS TO HEAL CELL

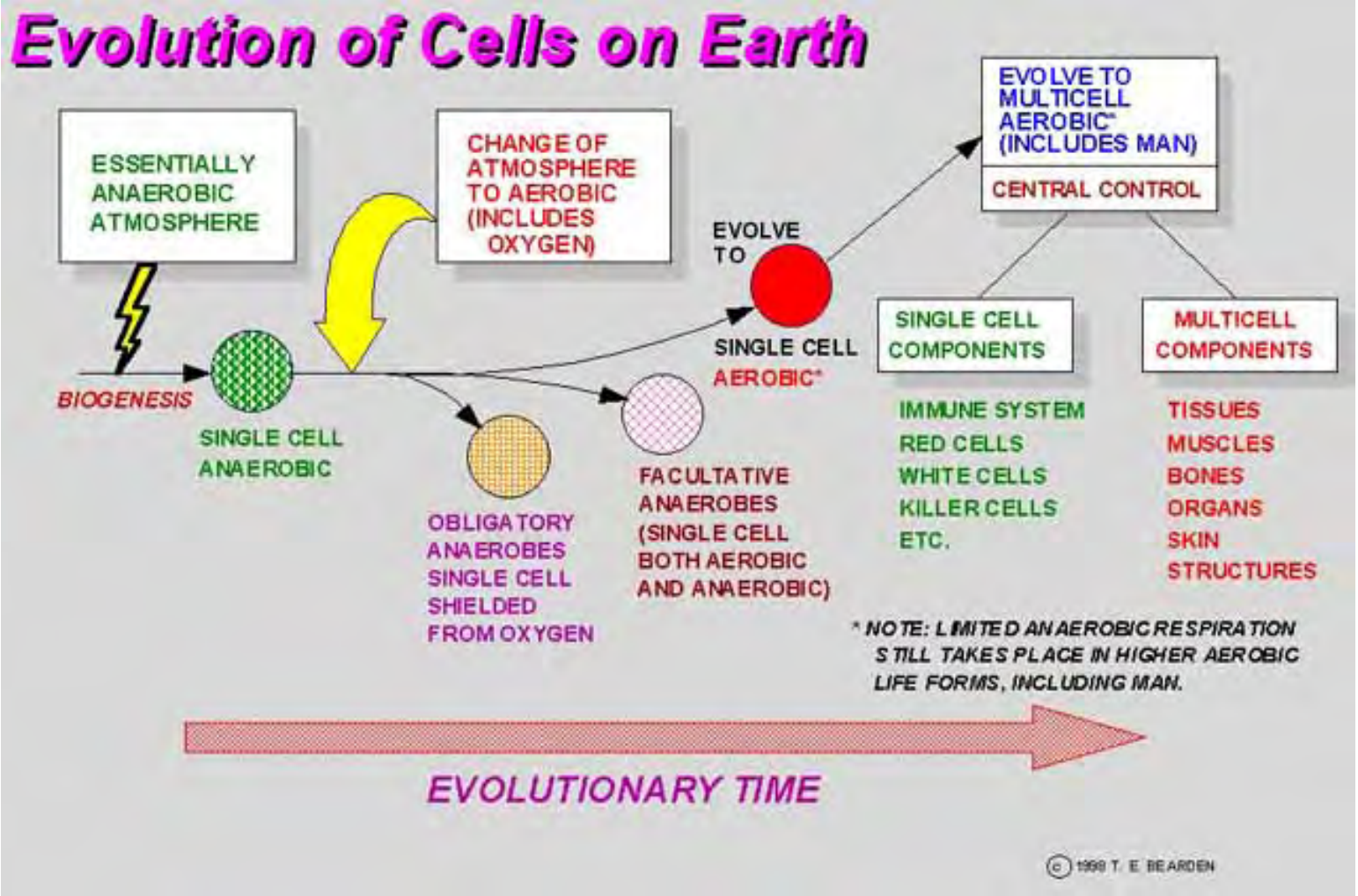
Evolution of Cells on Earth
ESSENTIALLY ANAEROBIC ATMOSPHERE
CHANGE OF ATMOSPHERE TO AEROBIC (INCLUDES OXYGEN)
EVOLVE TO MULTICELL AEROBIC* (INCLUDES MAN)
CENTRAL CONTROL
EVOLVE TO
SINGLE CELL AEROBIC*
SINGLE CELL COMPONENTS
MULTICELL COMPONENTS
BIOGENESIS
SINGLE CELL ANAEROBIC
OBLIGATORY ANAEROBES SINGLE CELL SHIELDED FROM OXYGEN
FACULTATIVE ANAEROBES (SINGLE CELL BOTH AEROBIC AND ANAEROBIC)
IMMUNE SYSTEM
RED CELLS
WHITE CELLS
KILLER CELLS
ETC.
TISSUES
MUSCLES
BONES
ORGANS
SKIN
STRUCTURES
* NOTE: LIMITED ANAEROBIC RESPIRATION STILL TAKES PLACE IN HIGHER AEROBIC LIFE FORMS, INCLUDING MAN.
EVOLUTIONARY TIME
© 1999 T. E. BEARDEN

A Charged Particle q Is a Coupled System of m and ϕ

(A proposed formal definition of a charged mass)

Note: X is a coupling operator

$$q \equiv f_q \times m_q$$

Also note that the ϕ portion of the charged particle can be internally structured, per Stoney-Whittaker-Ziolkowski, with hidden bidirectional EM wavepairs (their sums and products). Note that this constitutes an EM application of Bohm-type hidden variable theory, with many ramifications.

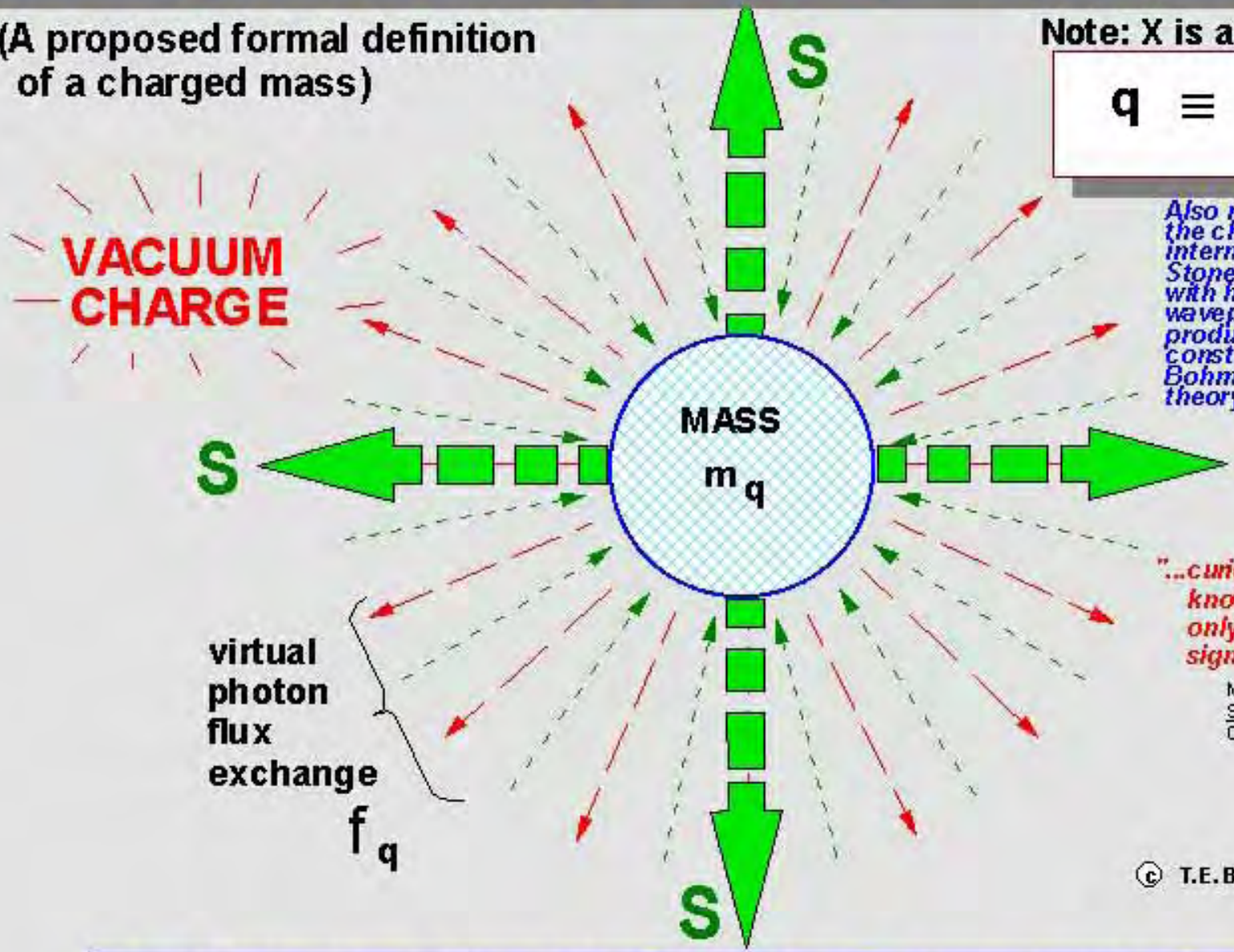

S = EXH

"...curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."

M.P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, 1993, p. 127.

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An electric charge Q consists of a massless flux component and a mass component, coupled together (interacting). Q is a broken symmetry. The mass of the charge continually and violently exchanges virtual photons with the surrounding vacuum.

Thus Q is energetically driven by the surrounding vacuum potential, which itself is to first order just a violent virtual photon flux.

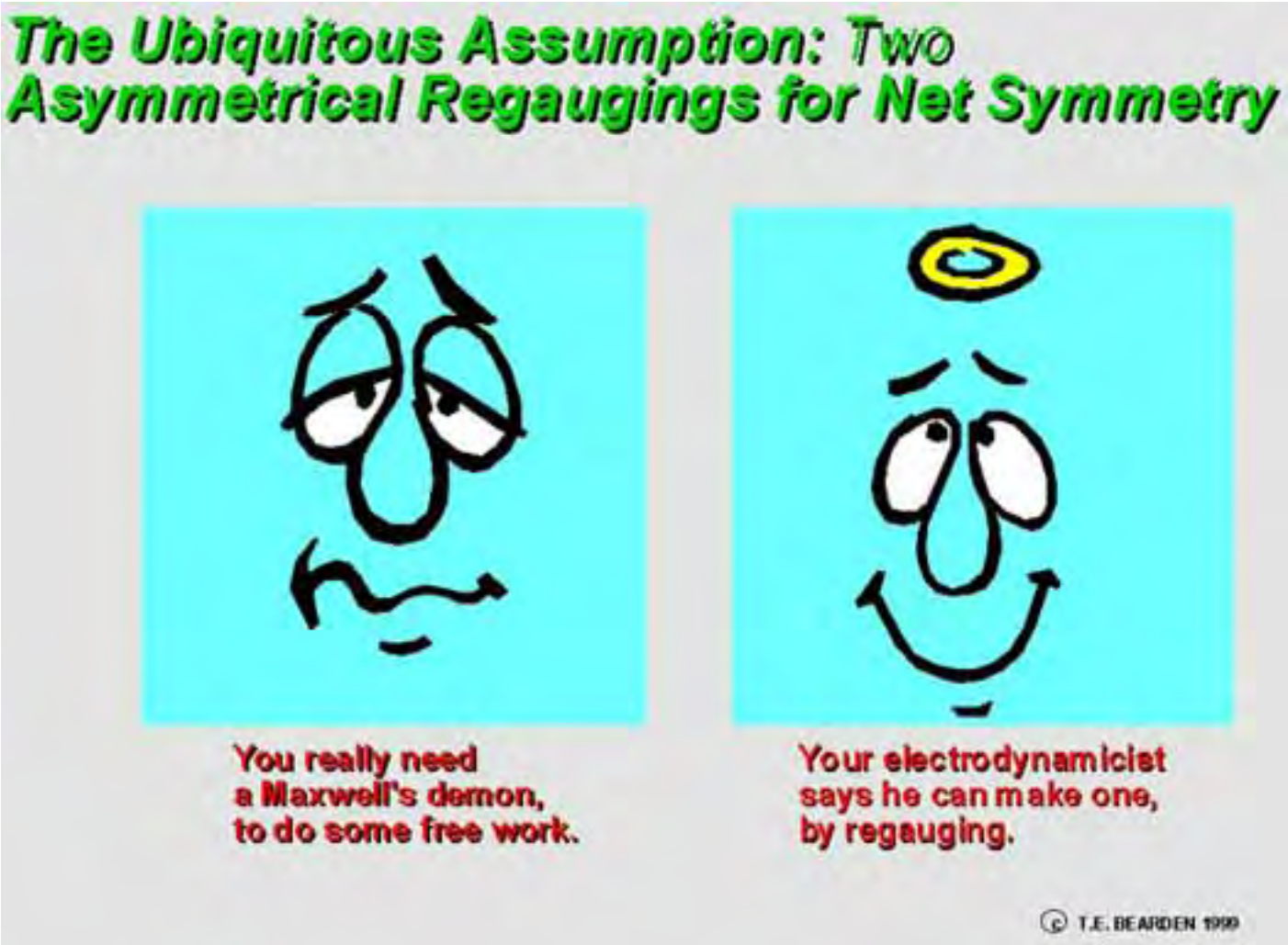
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
You really need a Maxwell's demon, to do some free work.
Your electrodynamicist says he can make one, by regauging.
© T.E. BEARDEN 1999

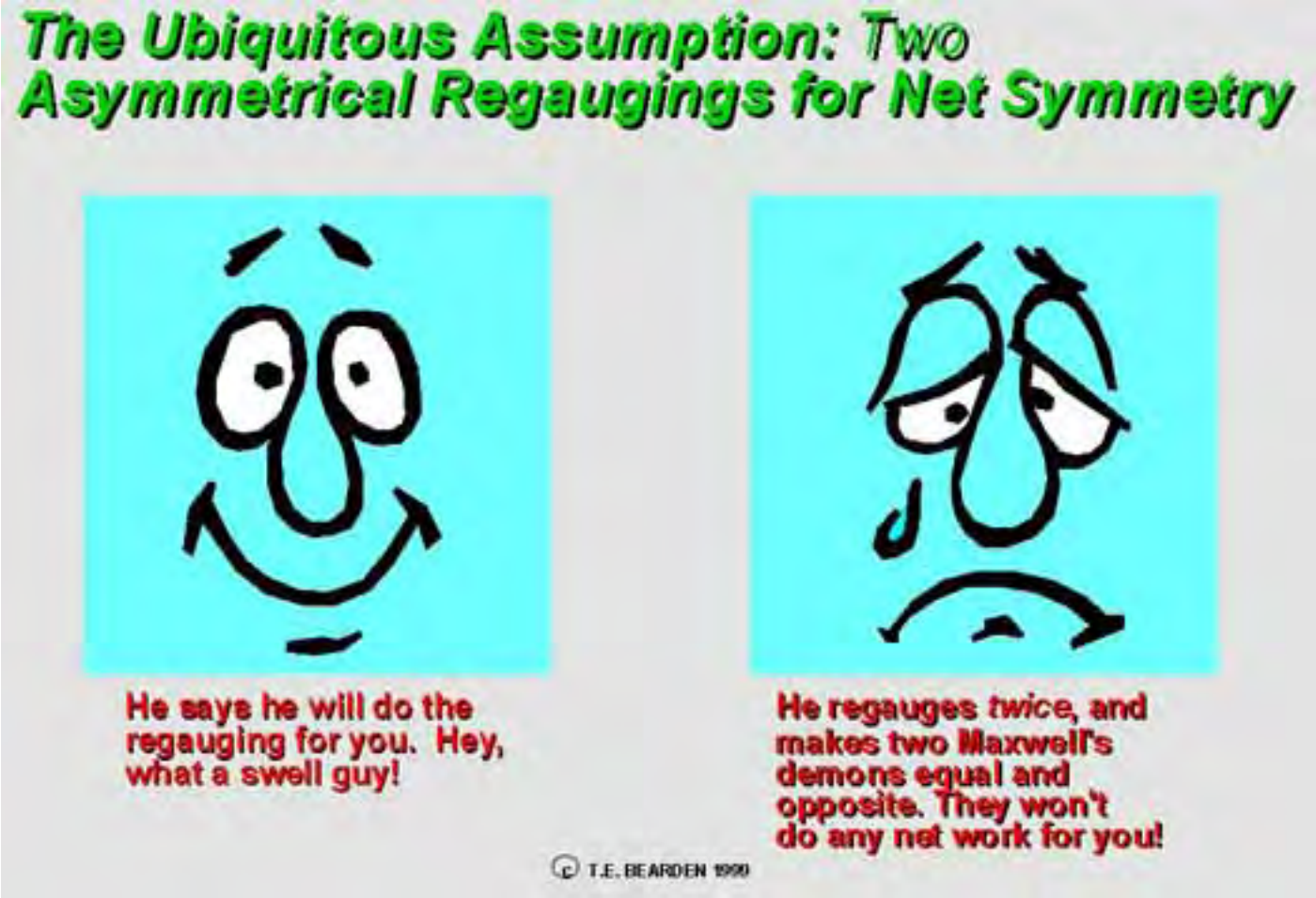
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
He says he will do the regauging for you. Hey, what a swell guy!
He regauges twice, and makes two Maxwell's demons equal and opposite. They won't do any net work for you!
© T.E. BEARDEN 1990

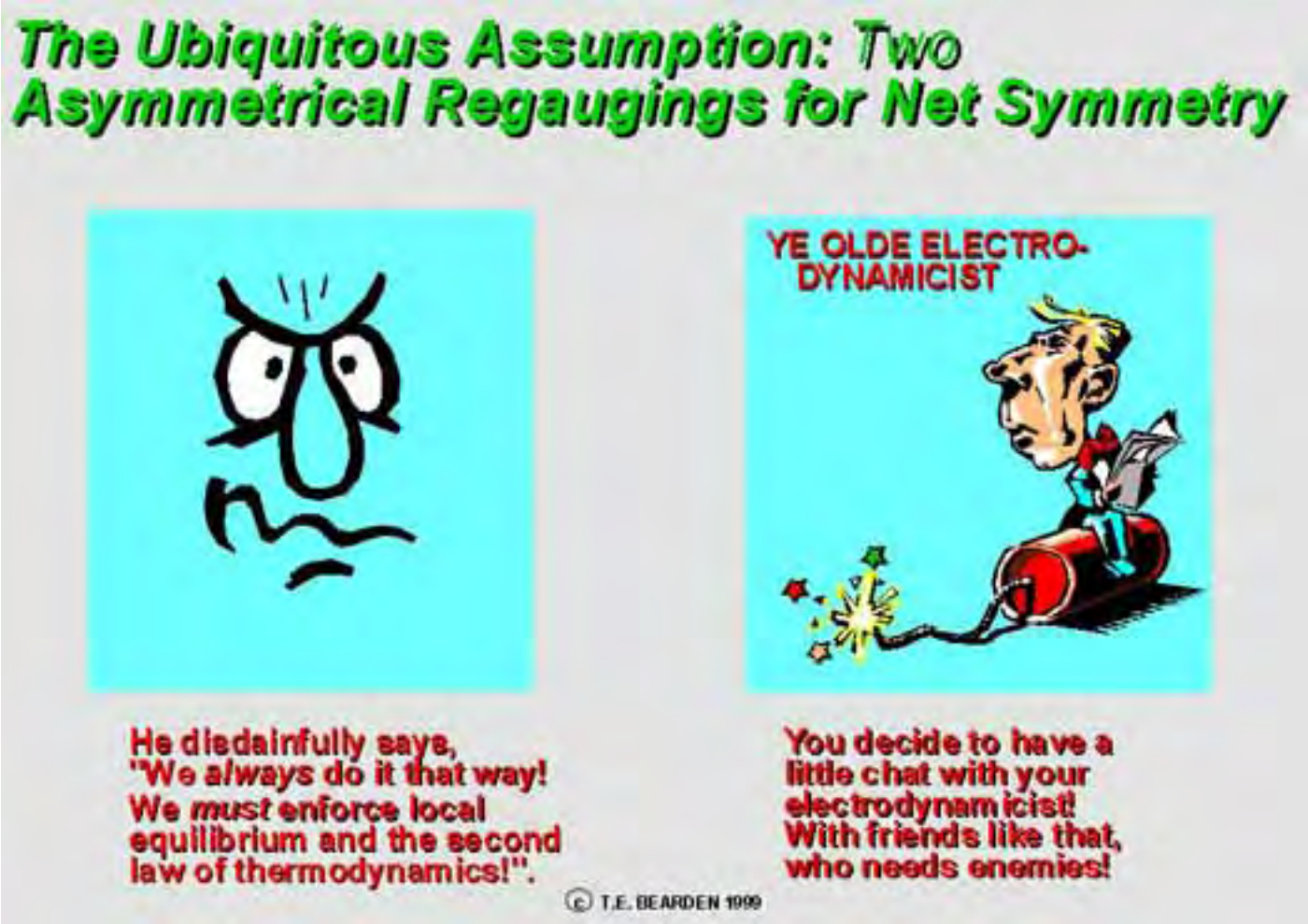
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
YE OLDE ELECTRO-DYNAMICIST
He disdainfully says, "We always do it that way! We must enforce local equilibrium and the second law of thermodynamics!".
You decide to have a little chat with your electrodynamicist! With friends like that, who needs enemies!
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A Charged Particle Is a Coupled System

(The first formal definition of charge)

$$q \equiv \phi_q \times m_q$$

Note: X is a coupling operator

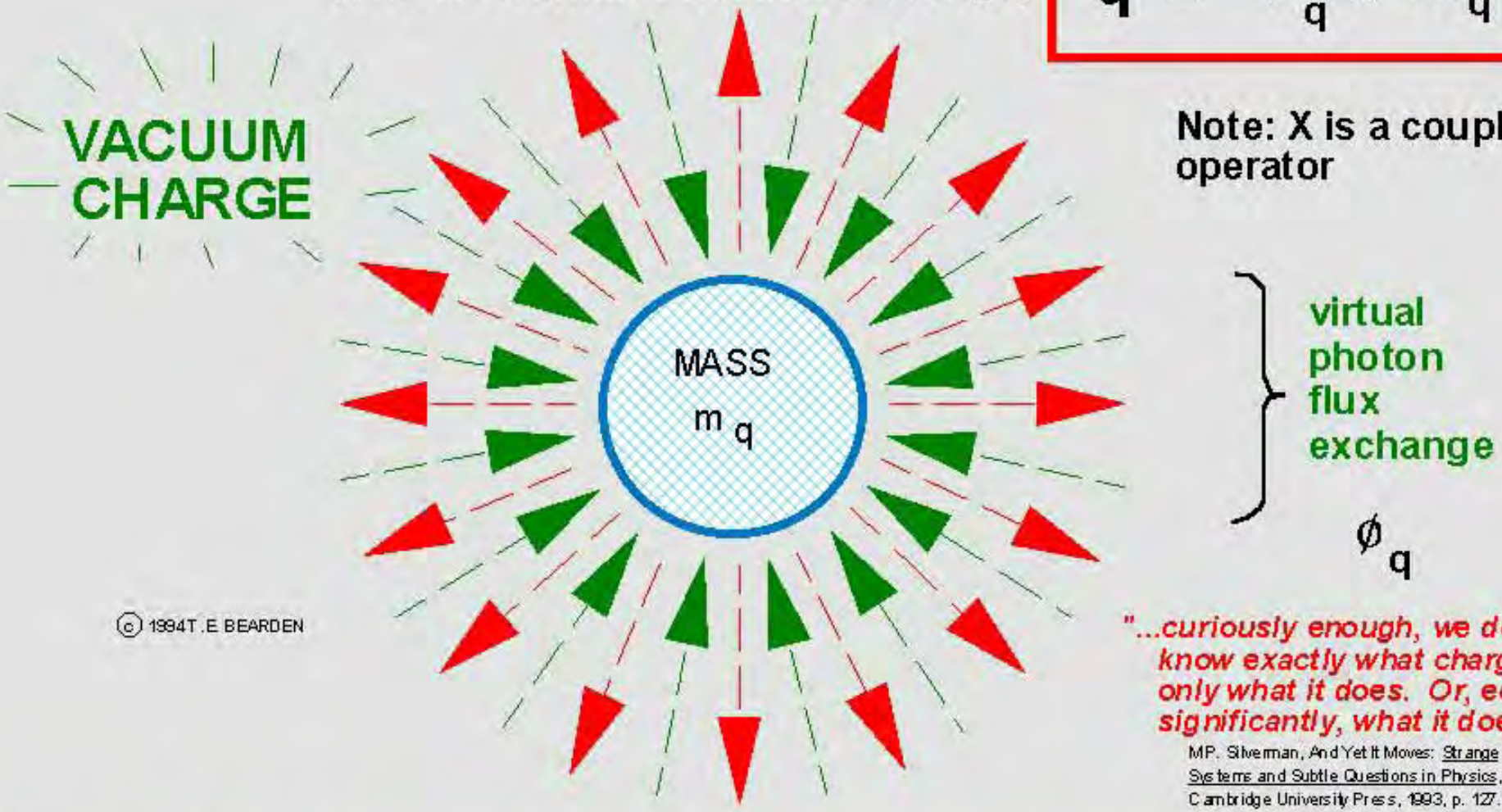

© 1994 T.E BEARDEN

"...curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."

M.P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, 1993, p. 127.

An electric charge q is a broken symmetry in its fierce energy exchange with the active vacuum. It coherently integrates some of the virtual energy absorbs and outputs it as Poynting energy flow.

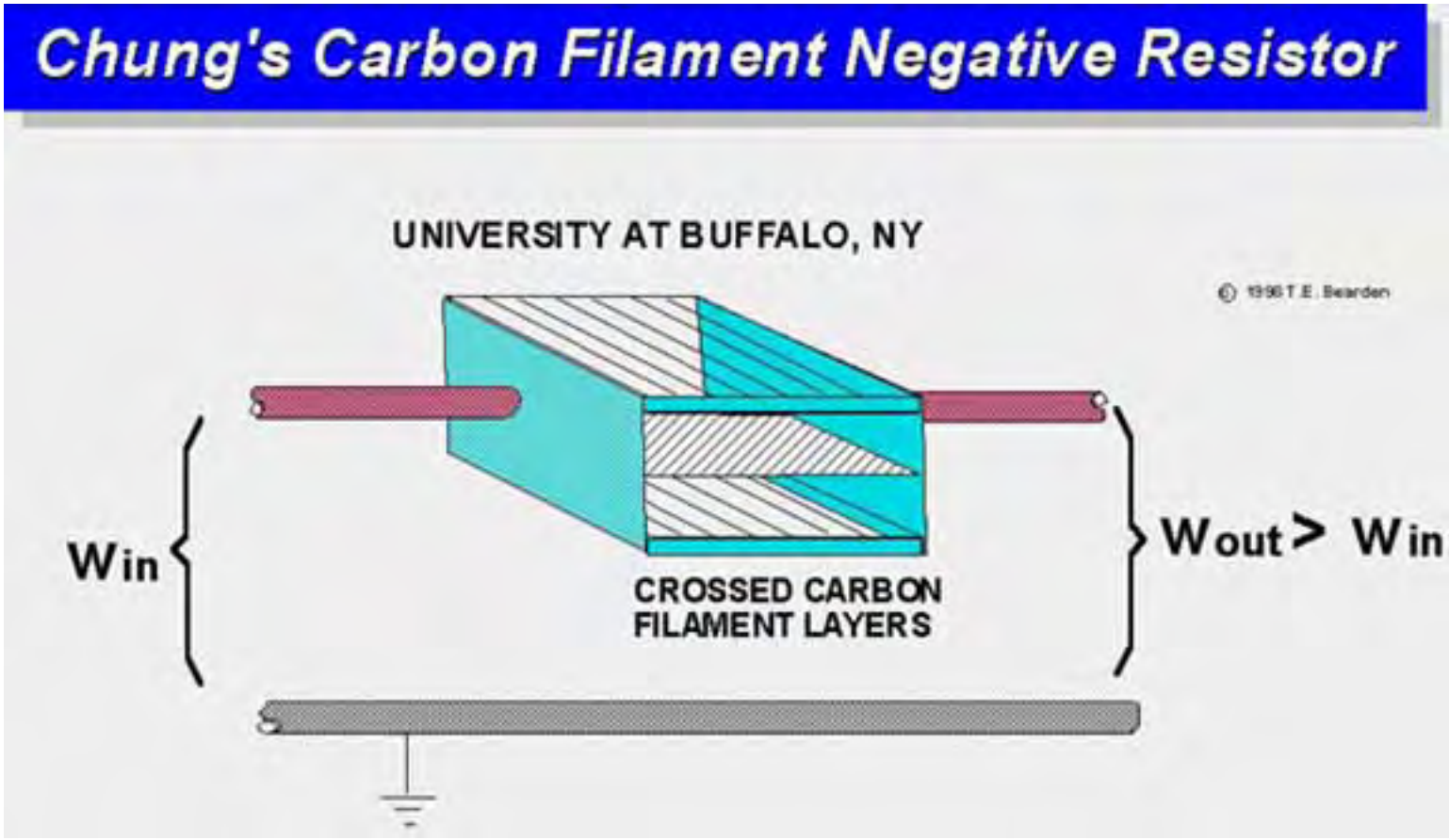
Chung's Carbon Filament Negative Resistor
UNIVERSITY AT BUFFALO, NY
© 1996 T.E. Bearden
Win
Wout > Win
CROSSED CARBON
FILAMENT LAYERS

Typical circuit has about 10^{-13} energy collection efficiency

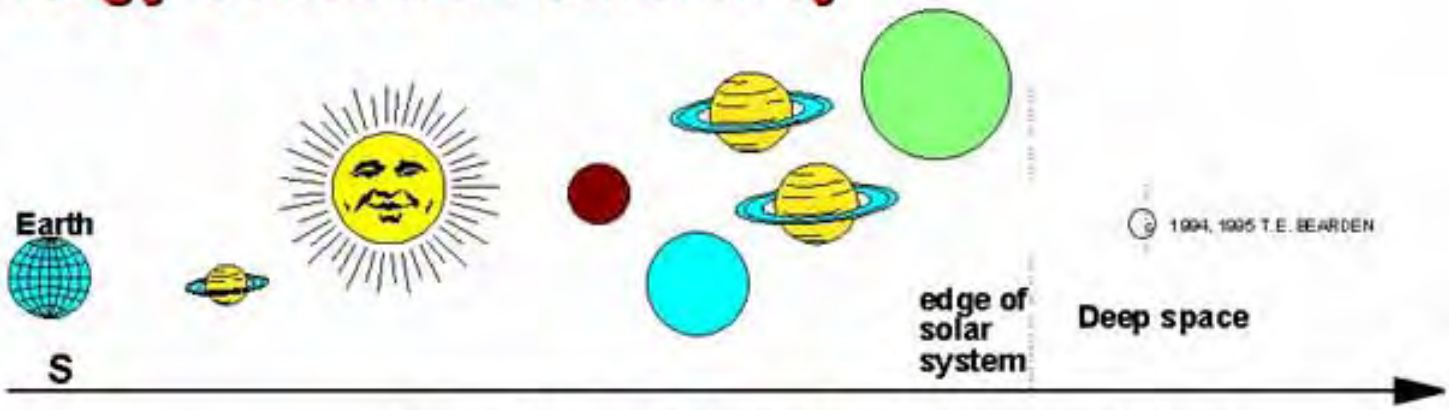

Distance traveled by S in one hour is 1.08x10exp(12) meters.

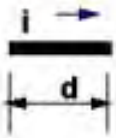

Example: 1.3 amps flowing in DC circuit, 1.8 mm diameter copper wire. J = 51 A/cm ^{2}

d_j = 0.1368 meters

S violently transports ϕ provided from the source.
j ϕ sluggishly transports the energy collected and dissipated in the circuit..

For the case discussed, the electron drift velocity in the circuit is about 3.8 x 10^{-5} meters/sec. So Jϕ moves about 0.1368 meters in one hour. Thus Jϕ has collected about 0.1368 meters of the ϕ-filled S-tube. During that same hour, the S-flow evoked by the power source will have traveled 1.08x10^{12} meters. The ϕ of both currents is the same. Both are involved in the same energy-filled tube. Thus S has provided and transported about 7.89x10^{12} times as much energy along the circuit in one hour as the jϕ has been able to collect, transport, and dissipate as work in the circuit. Thus this circuit provides about 10^{13} collection efficiency.

Classical View of EM

- Potentials just mathematical conveniences
  - Not real
  - No internal structure, just magnitude
- Force fields primary, causative, can exist in space in absence of observable mass
  - All EM actions due to force fields, none when zero
  - No action at a distance
- Vacuum empty; without energy or structure
  - No locally curved spacetime
  - No gravity effects
  - No quantum effects
- Maxwell's equations complete
  - Symmetrically regauged ***arbitrarily***
  - Topology dramatically reduced

Curved Spacetime acts as source or sink

- May emit excess radiation and energy (e.g., heat)
- May absorb radiation and energy (e.g., cool)
- May transduce waves TW ⇔ LW ⇔ TDW
- New energy conservation law applies

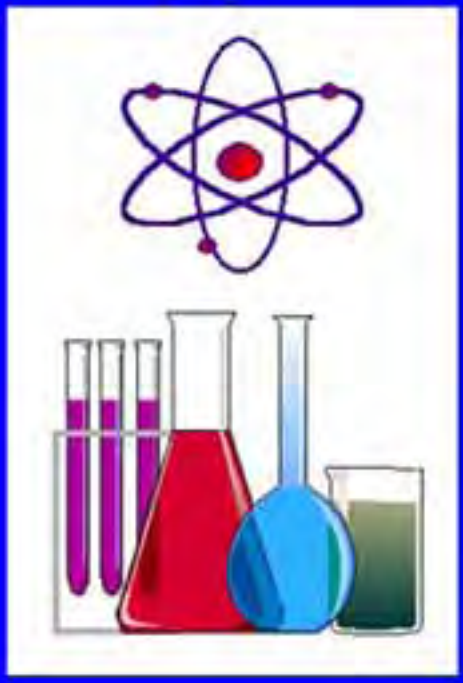

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CHRONIC DISEASE PUZZLING

- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
- MANY TROUBLING FACTORS EXIST
  - *MIND*
  - *STRESS*
  - *SPONTANEOUS REMISSION*
  - *PLACEBO EFFECTS*
  - *COMBINATIONS*
- GENERATION OF THE PLACEBO EFFECT BY THE CELLULAR REGENERATION SYSTEM IS UNRECOGNIZED

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Cancer Characteristics

- Not one disease, but a whole range
- Starts in damaged aerobic cell
- Cell shakes off body's central control
  - Starts uncontrolled division
  - Becomes a lump
- Can send forth cancer cells
  - Through blood
  - Through lymph
- Form metastases (secondary tumors)
- Often become anaerobic

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Solving a Cancer Enigma

- An enigma has been failure of immune system to attack some tumor cells
  - Suppressor cells may curb immune system?
  - Tumor may lack antigens normally identified by the immune system?
- *Promotion of damaged cell to cancer is usually ordered by cellular control system*
  - *Regenerative and recovery system forces cell back toward anaerobe*
  - *First step breaks free from central growth*
  - *Control continues to recognize cell as self*

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CANCER: CHARACTERISTICS

- NOT ONE DISEASE BUT A WHOLE RANGE
- STARTS IN ORDINARY (AEROBIC) CELL
- CELL SHAKES OFF BODY'S DICTATORIAL CONTROL*
- STARTS UNCONTROLLED DIVISION
- BECOMES A LUMP
- CAN SEND FORTH CANCER CELLS
  - THROUGH BLOOD
  - THROUGH LYMPH
- THESE FORM METASTASES (SECONDARY TUMORS)
- OFTEN BECOME ANAEROBIC (NON-OXYGEN USING)
- ENIGMA IS FAILURE OF IMMUNE SYSTEM TO ATTACK SOME TUMOR CELLS
  - SUPPRESSOR CELLS MAY CURB IMMUNE SYSTEM
  - TUMOR MAY LACK ANTIGENS NORMALLY IDENTIFIED BY THE IMMUNE SYSTEM

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*R&R system forces cell back toward anaerobe

Nonlinear Optics
Distortion Correction Theorem

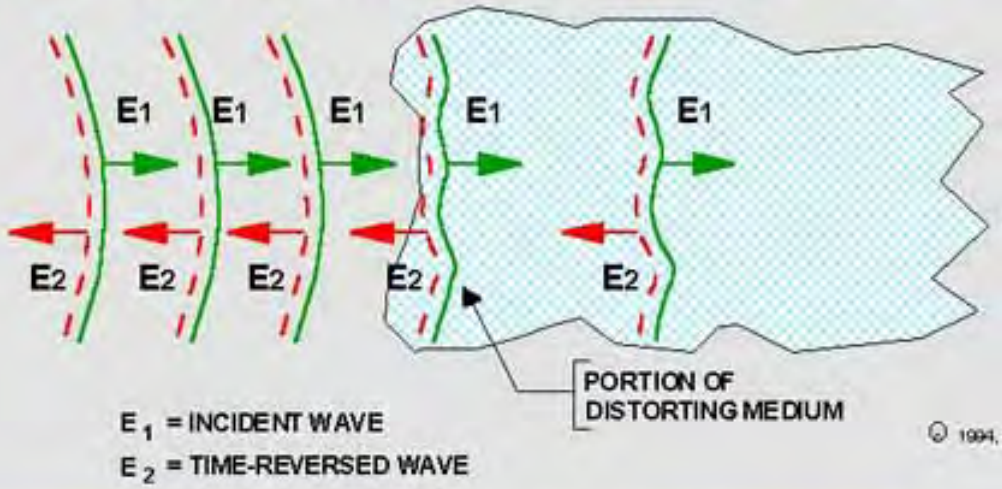

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"If a scalar wave $E_1(r)$ propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica $E_2(r)$, then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1."

The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)

- Nucleon interchange
  - Changes neutron into proton and vice versa
  - At high rate (flat spacetime assumed)
- Statistics become skewed due to curved ST
- Can bias statistics toward either neutron or proton end
  - Biases toward transmutation of elements along isomer chains
  - Concept of "isomer" is vastly expanded

The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)

- **Normal dynamics (impulses) may reverse**
  - *Like charges attract, unlike charges repel*
  - *Positive charges cluster (are drawn together)*
  - *H+ ions (protons) may form quasi-nuclei*
  - *Nucleus coulomb barrier becomes assistant*
- **Many "impossible" reactions now possible**
  - *Quark access and quark flipping by EM*
  - *Ion clustering*
  - *Positive charges as phase conjugate mirrors*
  - *Time-density waves and time-energy charging*

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The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)

- **Not observed until time-energy charging has become substantial**
  - *Time delay (hours, days)*
  - *Transduction of LW --> TW involved*
  - *Specific time-charging history of detectors is involved in twhether they detect or not*
  - *Longitudinal EM waves become significant*
- **Curved spacetime can act as source or sink**
  - *May emit excess radiation*
  - *May absorb excess radiation*

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In Time-Reversed Zone:
Nuclear reactions are biased

- In normal flat ST, n ⇔ p at high rate
- Curved ST skews statistics
- Biases to either n or p
- Biases to transmutation along isomer chain
- "Isomer" concept greatly expanded

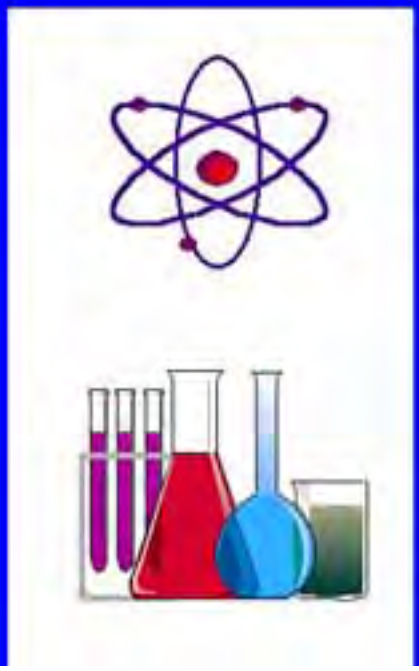

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In Time-Reversed Zone: Dynamics may be reversed

- Like charges may attract and unlike charges repel
- Coulomb barrier becomes Coulomb assistant
- Clusters like charges and forms artificial nuclei
- "Impossible" nuclear reactions at low energy
- Time-density interactions

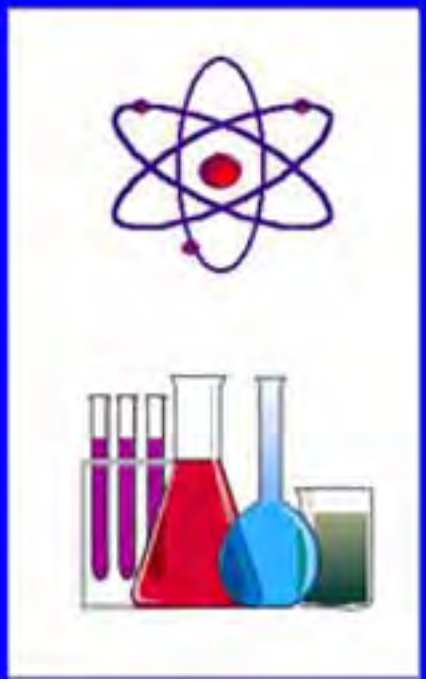

Time-Reversed Zone:

Significant only after time-density charging

- Hours, for "fast" onset
- Days, for "slower" onset
- Transduction involved for TW ⇔ LW ⇔ TDW
- Time-history of each detector is significant
- Longitudinal EM waves become significant

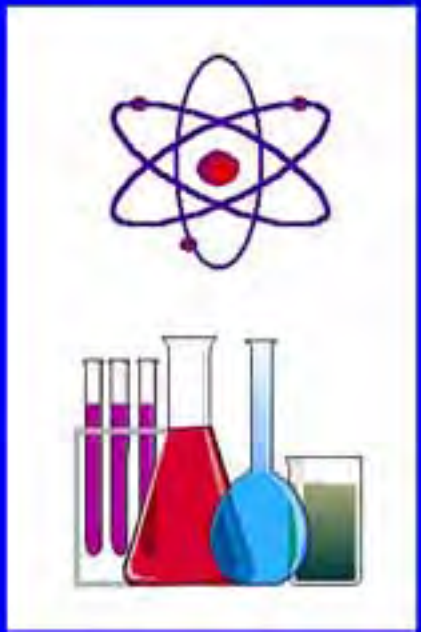

A New Conservation of Energy Law

- Physics conserves total "energy and mass-energy"
- Now also must consider "time-energy"
- Conserve total mass-time-energy (spatiotemporal energy)
- Let E_T = total energy, E_M = mass energy, E_E = ordinary energy, and E_t = time energy. Then

$$E_T = E_E + E_M + E_t$$

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$$(kE_t \Rightarrow E_E > 0) \Rightarrow E_T > (E_M + E_E)$$

- If some E_t is transduced into E_E, the experiment will violate the old spatial mass-energy conservation law

QUESTIONS ON CARCINOGENS AND EM RADIATION

- UNRESOLVED QUESTIONS ON EM RADIATION
  - DOSAGES
  - ACTIVE MECHANISMS
  - REPLICATION DIFFICULTIES
  - MEASUREMENT DIFFICULTIES
  - WHERE, WHEN, HOW ILL EFFECTS OCCUR
- SIMILAR QUESTIONS EXIST ABOUT EVERY CARCINOGEN
- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
  - FACTORS SUCH AS MIND, STRESS, SPONTANEOUS REMISSION, PLACEBO EFFECTS, AND COMBINATIONS OF FACTORS ARE PARTICULARLY TROUBLESOME
  - GENERATION OF THE PLACEBO EFFECT BY THE REGENERATION & RECOVERY SYSTEM IS UNRECOGNIZED

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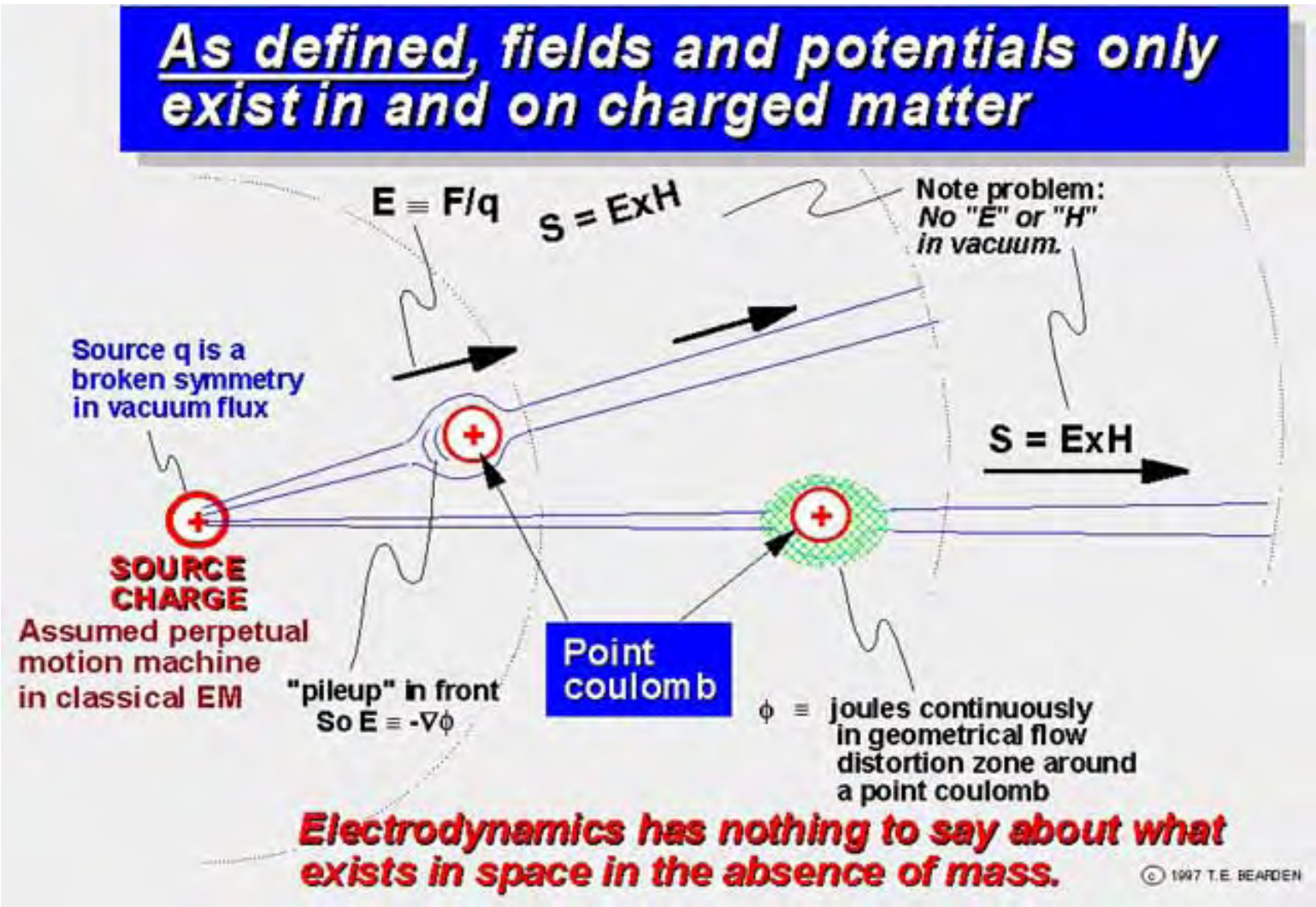
As defined, fields and potentials only exist in and on charged matter
E ≡ F/q
S = ExH
Note problem:
No "E" or "H"
in vacuum.
Source q is a
broken symmetry
in vacuum flux
S = ExH
SOURCE
CHARGE
Assumed perpetual
motion machine
in classical EM
"pileup" in front
So E ≡ -∇ϕ
Point
coulomb
ϕ ≡ joules continuously
in geometrical flow
distortion zone around
a point coulomb
Electrodynamics has nothing to say about what
exists in space in the absence of mass.
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Serious flaws and errors in classical EM theory.

1. Eliminates the Internal EM Inside the Scalar Potential.
2. No Definition of Electrical Charge or of Scalar Potential.
3. Equations Still Assume Material Ether Per Maxwell (Unchanged).
4. Use of Force Fields in Vacuum is False (and Known to be So).
5. Treats Charge q as Unitary Instead of Coupled System $q = \phi[q]m(q)$.
6. Confuses Massless Potential Gradients as Forces (See #3, #4).
7. Does Not Utilize Mass as a Component of Force (See #23).

8. Erroneously Assumes EM Force Fields as Primary Causes.
9. Topology of EM Model Has Been Substantially Reduced.
10. Does Not Include Quantum Potential or Action at a Distance.
11. Does Not Include Superluminal Velocity of Inner EM Components.
12. Does Not Utilize Extended Near-Field Coulomb Gauge Effects.
13. Does Not Include EM Generatrix Mechanism for Time Flow.
14. Does Not Unify Photon and Wave Aspects (Requires 7-D Model).

15. Does Not Include Electron Spin and Precession (See #19, #24).
16. Treats EM Energy As Existing In "Chunks," Instead of as Flow.
17. Confuses Energy and Energy Collection (See #16).
18. Discards Half of Every EM Wave in Vacuum (See #22).
19. Erroneously Uses Transverse Vacuum Wave; It's Longitudinal.
20. Arbitrarily Regauges Maxwell's Equations to Eliminate Overunity.
21. Omits Phase Conjugate Optics Effects (The *Rule* in Internal EM).
22. Does Not Include EM Cause of Newtonian Reaction Force.
23. Erroneously Assumes Separate Force Acting on Separate Mass.
24. Confuses Detected Electron Precession Waves as Proving Transverse EM Waves in Vacuum (Remnant of Old "EM Fluid" Concept).
25. Due to Error in String Wave, Omits the Ubiquitous Antiwave.
26. *Assumes* Equilibrium; Not True Unless Include Vacuum Interactions.
27. Higher Topology Required, to Model Electromagnetic Reality.
28. Lorentz surface integration discards Poynting energy transport.
29. Has nothing at all to say about form of EM entities in massless space.
30. Eliminates the infolded general relativity using EM-force as curve agent.
31. Does not include longitudinal EM waves as time domain oscillations.
32. Does not include EM mechanism that generates time flow and flow rate.

© T.E. [illegible] 1991, 1997

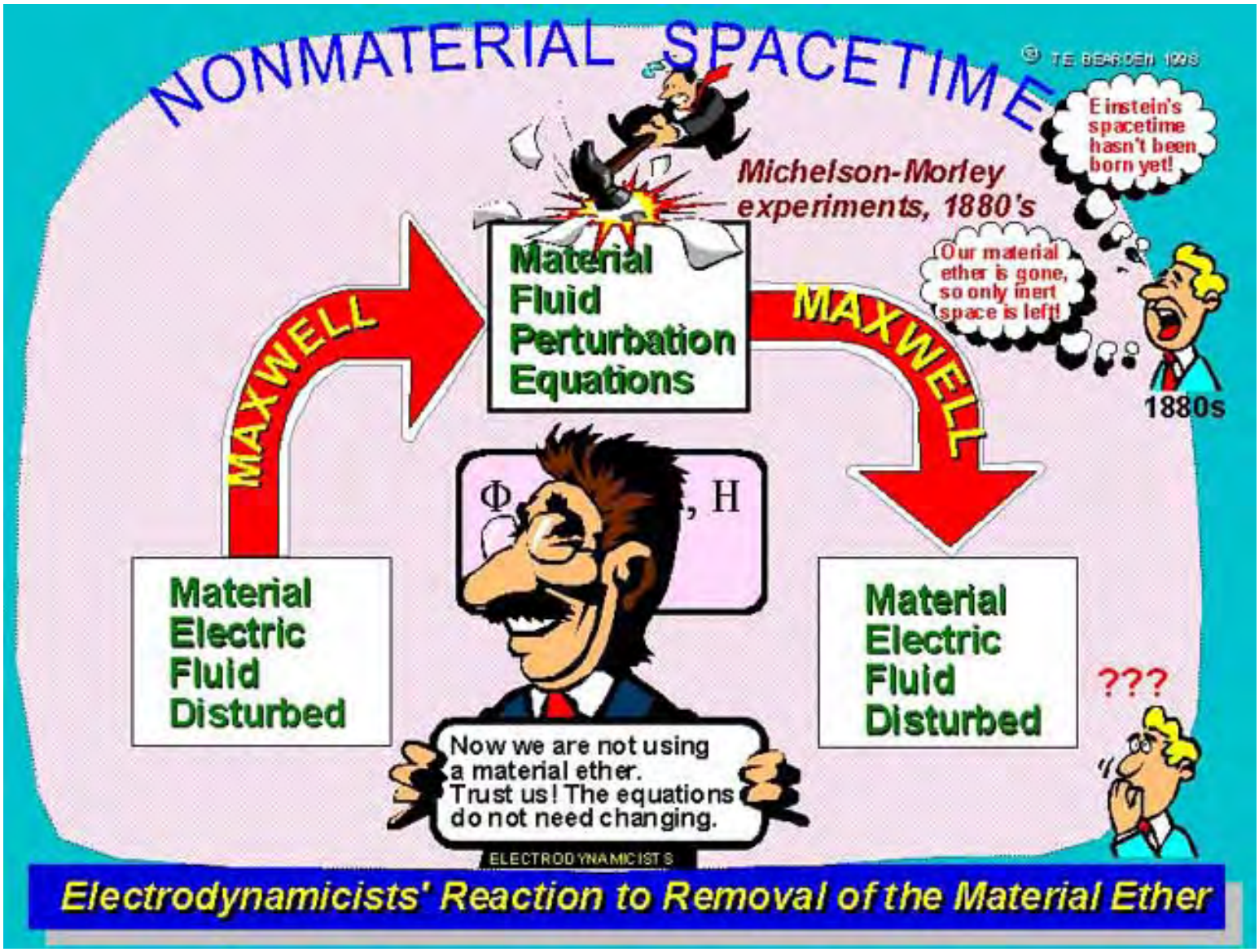
NONMATERIAL SPACETIME
© T.E. BEARDEN 1998
Einstein's spacetime hasn't been born yet!
Michelson-Morley experiments, 1880's
Our material ether is gone, so only inert space is left!
1880s
MAXWELL
Material Fluid Perturbation Equations
MAXWELL
Φ
, H
Material Electric Fluid Disturbed
Material Electric Fluid Disturbed
???
Now we are not using a material ether. Trust us! The equations do not need changing.
ELECTRODYNAMICISTS
Electrodynamicists' Reaction to Removal of the Material Ether

REACTION TO LOSS OF MATERIAL ETHER
Material Ether Assumed in Equations
Potentials, Fields, and Waves Assumed Material
Not a single equation was changed!
Now we are not using a material ether. Trust us! The equations do not need changing.
© T.E. BEARDEN 1999
ELECTRODYNAMICISTS

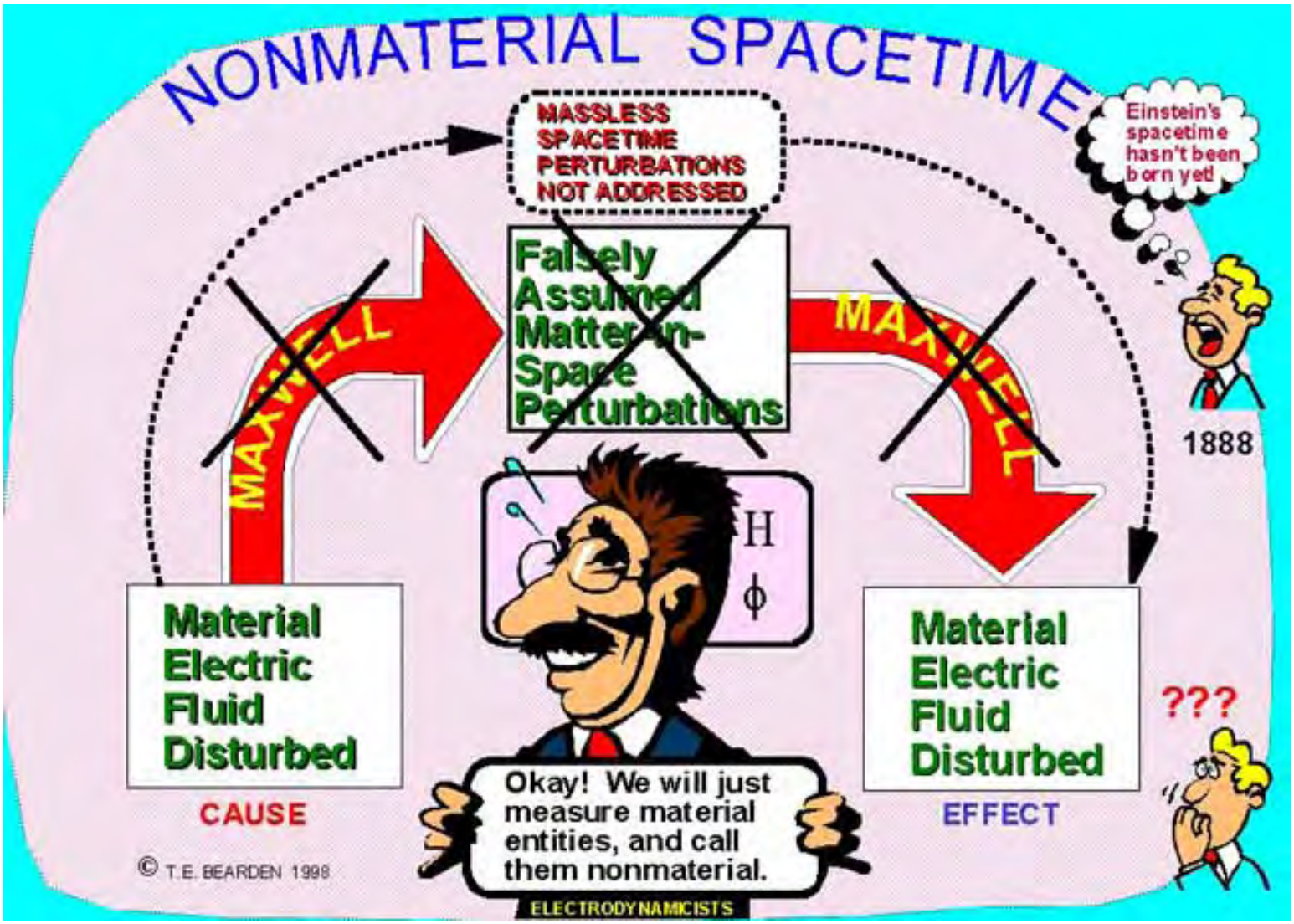
NONMATERIAL SPACETIME
MASSLESS SPACETIME PERTURBATIONS NOT ADDRESSED
Einstein's spacetime hasn't been born yet!
Falsely Assumed Matter-in-Space Perturbations
MAXWELL
MAXWELL
1888
H
ϕ
Material Electric Fluid Disturbed
CAUSE
Material Electric Fluid Disturbed
EFFECT
???
Okay! We will just measure material entities, and call them nonmaterial.
ELECTRODYNAMICISTS
© T.E. BEARDEN 1998

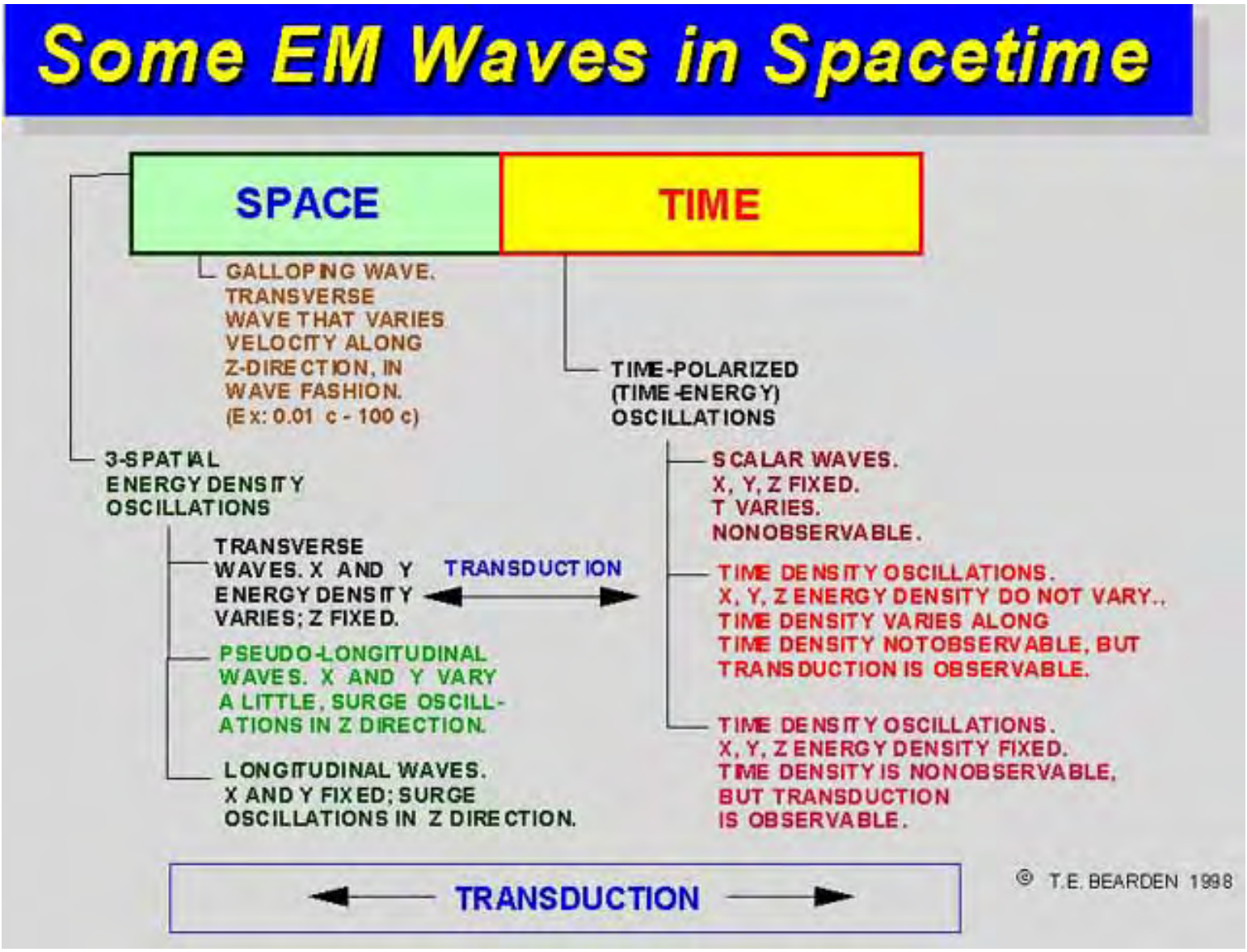
Some EM Waves in Spacetime
SPACE
TIME
GALLOPING WAVE. TRANSVERSE WAVE THAT VARIES VELOCITY ALONG Z-DIRECTION, IN WAVE FASHION. (Ex: 0.01 c - 100 c)
TIME-POLARIZED (TIME-ENERGY) OSCILLATIONS
3-SPATIAL ENERGY DENSITY OSCILLATIONS
SCALAR WAVES. X, Y, Z FIXED. T VARIES. NONOBSERVABLE.
TRANSVERSE WAVES. X AND Y ENERGY DENSITY VARIES; Z FIXED.
TRANSDUCTION
TIME DENSITY OSCILLATIONS. X, Y, Z ENERGY DENSITY DO NOT VARY., TIME DENSITY VARIES ALONG TIME DENSITY NOTOBSERVABLE, BUT TRANSDUCTION IS OBSERVABLE.
PSEUDO-LONGITUDINAL WAVES. X AND Y VARY A LITTLE, SURGE OSCILLATIONS IN Z DIRECTION.
LONGITUDINAL WAVES. X AND Y FIXED; SURGE OSCILLATIONS IN Z DIRECTION.
TIME DENSITY OSCILLATIONS. X, Y, Z ENERGY DENSITY FIXED. TIME DENSITY IS NONOBSERVABLE, BUT TRANSDUCTION IS OBSERVABLE.
TRANSDUCTION
© T.E. BEARDEN 1998

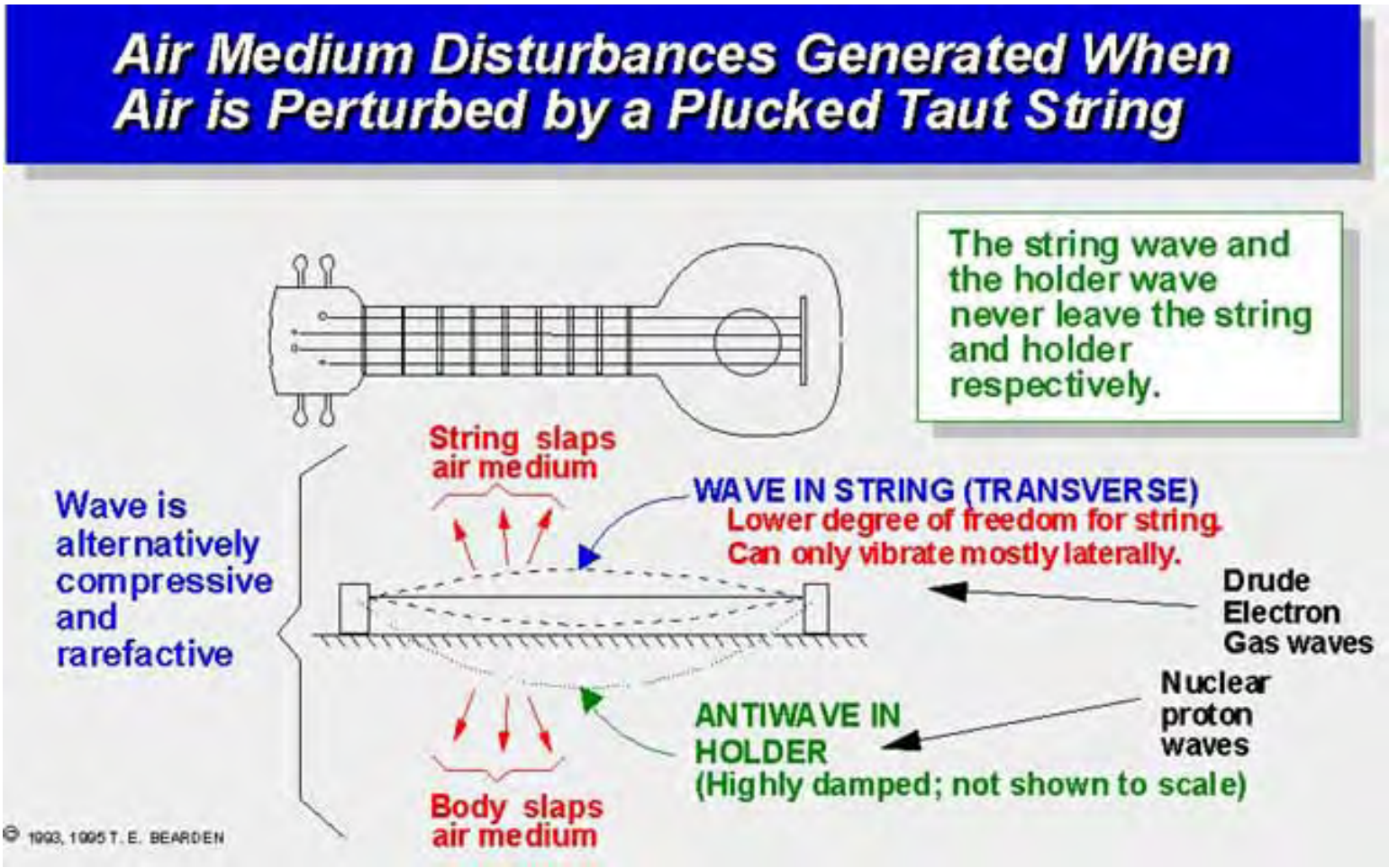
Air Medium Disturbances Generated When Air is Perturbed by a Plucked Taut String
The string wave and the holder wave never leave the string and holder respectively.
String slaps air medium
Wave is alternatively compressive and rarefactive
WAVE IN STRING (TRANSVERSE)
Lower degree of freedom for string.
Can only vibrate mostly laterally.
Drude Electron Gas waves
Nuclear proton waves
ANTIWAVE IN HOLDER
(Highly damped; not shown to scale)
Body slaps air medium
© 1993, 1995 T. E. BEARDEN

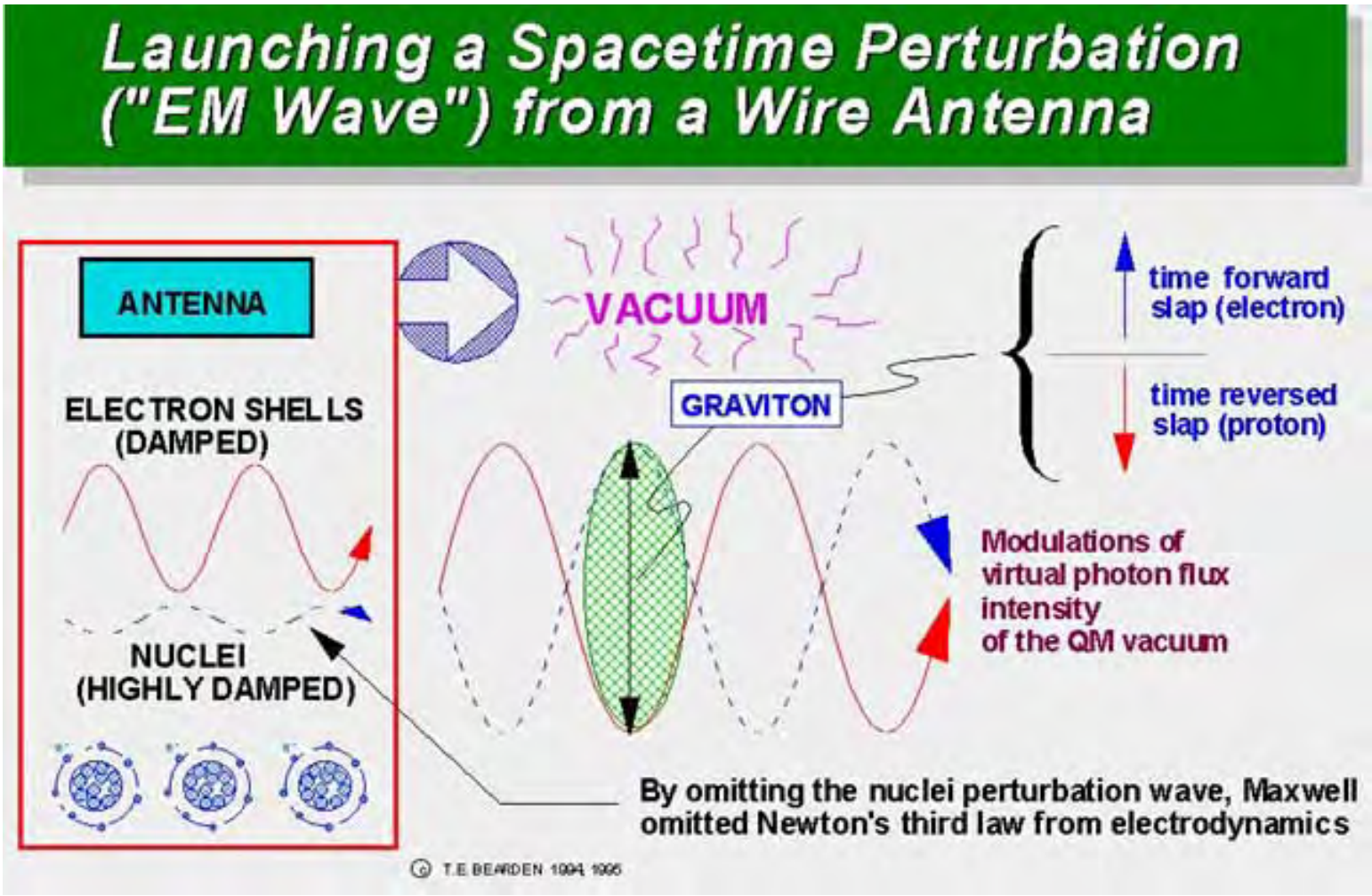
Launching a Spacetime Perturbation ("EM Wave") from a Wire Antenna
ANTENNA
ELECTRON SHELLS (DAMPED)
NUCLEI (HIGHLY DAMPED)
VACUUM
GRAVITON
time forward slap (electron)
time reversed slap (proton)
Modulations of virtual photon flux intensity of the QM vacuum
By omitting the nuclei perturbation wave, Maxwell omitted Newton's third law from electrodynamics
© T.E BEARDEN 1994 1995

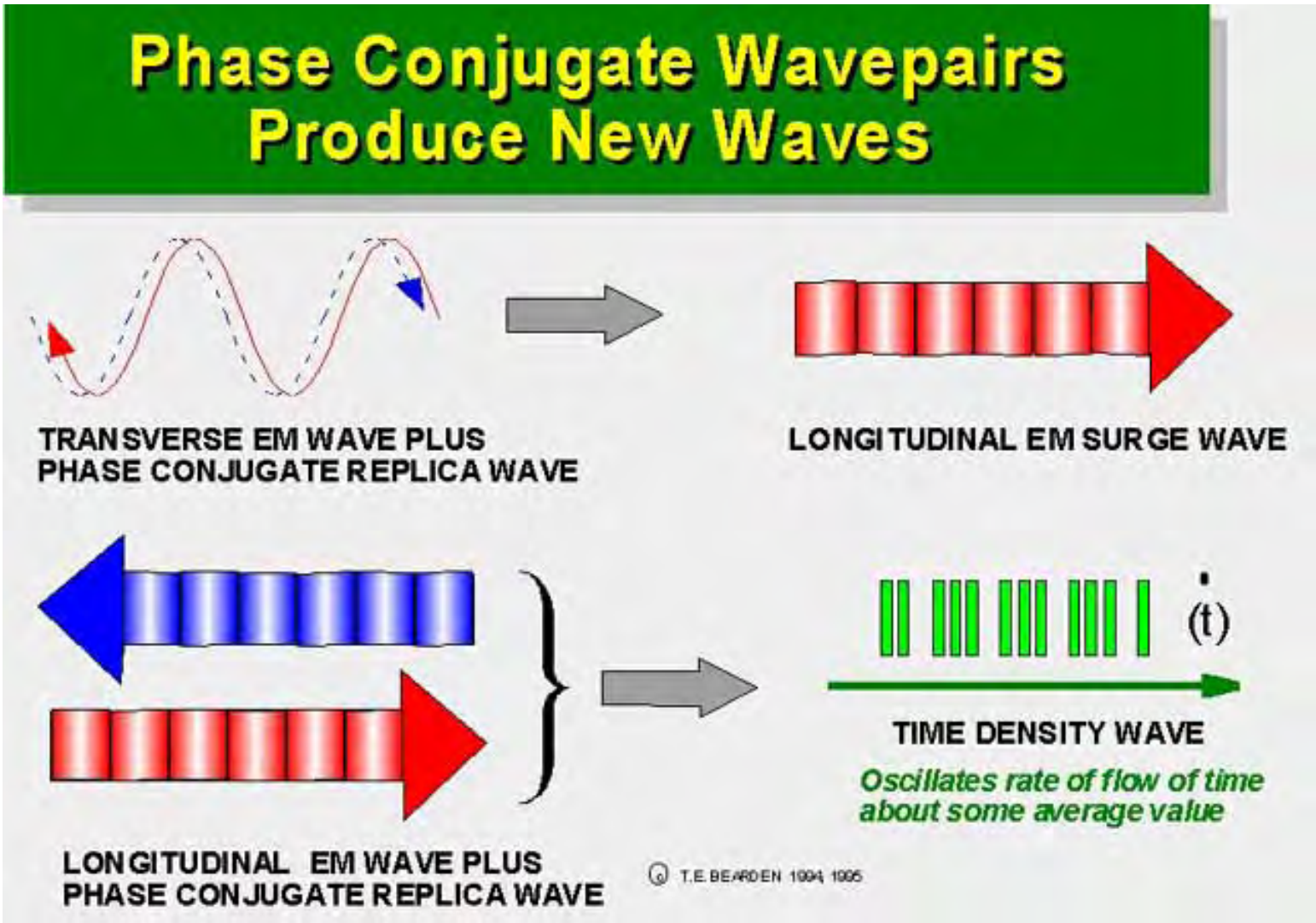
Phase Conjugate Wavepairs
Produce New Waves
TRANSVERSE EM WAVE PLUS
PHASE CONJUGATE REPLICA WAVE
LONGITUDINAL EM SURGE WAVE
LONGITUDINAL EM WAVE PLUS
PHASE CONJUGATE REPLICA WAVE
(t)
TIME DENSITY WAVE
Oscillates rate of flow of time
about some average value
© T.E. BEARDEN 1994, 1995

Scalar Electromagnetics (Energetics) View of EM

- Potentials real; primary causes of EM phenomena
  - Force fields made by differentiations of potentials
  - Force fields are effects, not primary causes
  - Force fields exist only in, on mass particles
- Actions due to potentials and their interference
  - Action at a distance or locally
  - Quantum potential and hidden variables
- Locally curved spacetime, engineerable by EM
  - Gravity effects not necessarily negligible
  - Strong EM force or time used as agent of curvature

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Scalar Electromagnetics (Energetics) View of EM (Cont'd)

- Potentials have internal structure
  - Stoney/Whittaker structure
  - Longitudinal EM phase conjugate wavepairs
  - Each wavepair is a time-polarized EM wave
- Vacuum EM is a potential and has microstructure
  - Stoney-Whittaker biwaves/t-polarized waves
  - Fluctuations exhibit chaos
- Spacetime ≡ Vacuum ≡ Potential ≡ Flux

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Scalar Electromagnetics (Energetics) View of EM (Cont'd)

- Statistics may have hidden order (already chaotic)
- Uses spacetime curvature engines to alter matter (inside-out or outside-in)
- Engineerable EM mechanism generates rate of flow of a mass through time
- Quantum potential with specific QP can be used for instant action at a distance

Extended General Relativity Principle

- "All levels of energy structures and all levels of time structures mold spacetime geometry.
- This is called a ***vacuum engine*** (spacetime engine).
- Spatial and temporal structuring act upon mass at all levels.
- This produces ***templates*** of forces, for translations and stresses."

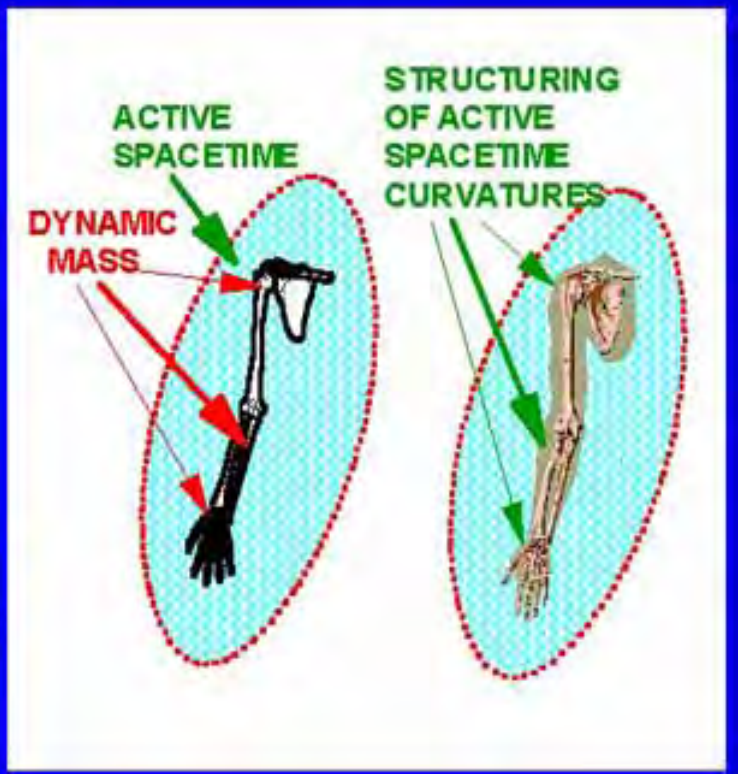

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Extension of Work-Energy Theorem

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- *Theorem:* $W = k_f - k_i = \Delta k$ [1]
- k must be interpreted not as energy *per se*, but as *collected/collecting* energy.
- The reaction cross section λ for the collecting process must be included.
- *Extension:* $W = \lambda (k_f - k_i) = \lambda \Delta k$ [2]
- Normally $\lambda \leq 1$, as for elastic collision or Stokes emission.
- However, $\lambda > 1$ is now possible, for processes which asymmetrically self-regauge. An example is Letokhov's negative absorption of the medium.
- Working models are the Patterson Power Cell® and Lawandy lasing without population inversion.

MTW's General Relativity Principle

- "Space acts on matter, telling it how to move.
- In turn, matter reacts back on space, telling it how to curve."

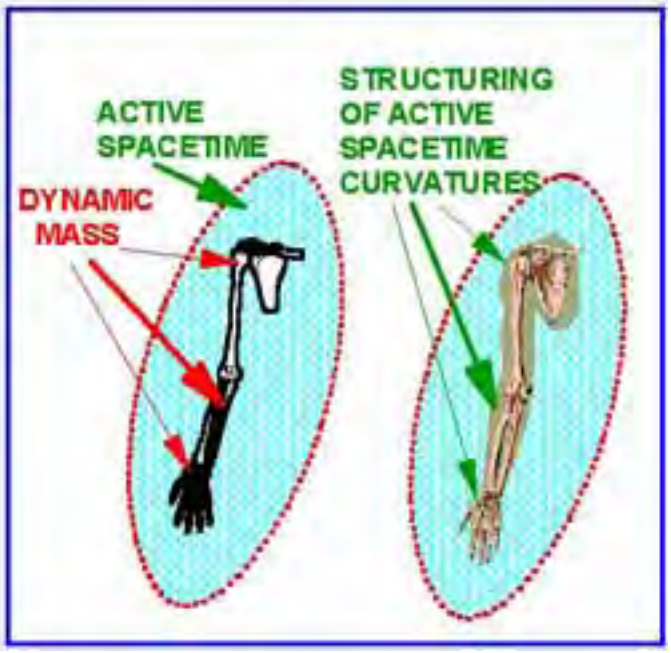

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Use of General Relativity (GR) in Particle Physics

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- GR seldom used in particle physics
- In cold fusion, Matsumoto* has applied general relativity
- Consistent with important cold fusion results
- Used spacetime (ST) curvature by energy density
- Matsumoto did not utilize:
  - Longitudinal EM waves
  - Time density waves
  - Time density curvatures of ST (gain = $9 \times 10_{16}$)

* T. Matsumoto, "Mechanisms of Electro-Nuclear Collapse," Proc. ICCF-7, Vancouver, BC, Canada, Apr. 1998, p. 98

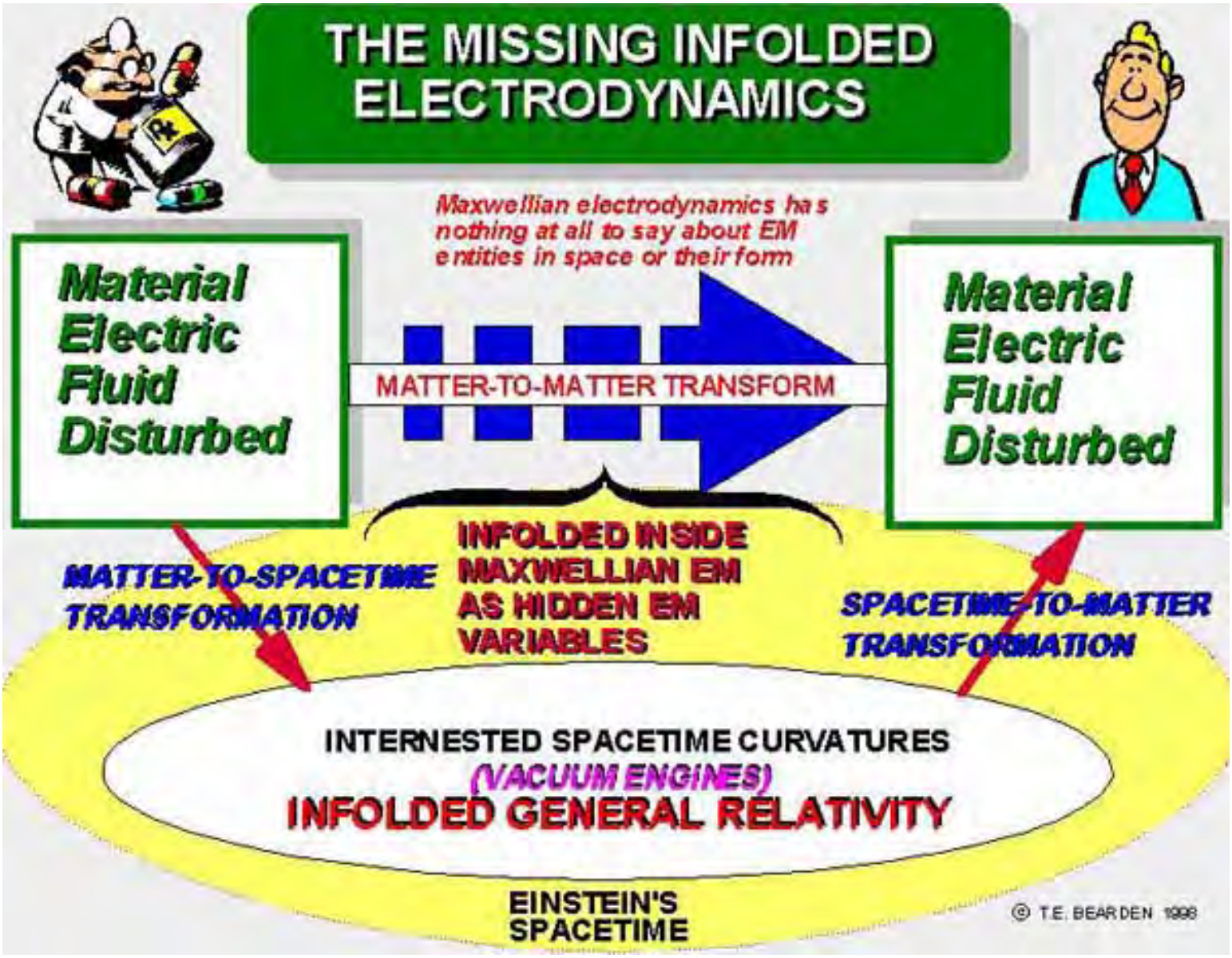
THE MISSING INFOLDED ELECTRODYNAMICS
Maxwellian electrodynamics has nothing at all to say about EM entities in space or their form
Material Electric Fluid Disturbed
MATTER-TO-MATTER TRANSFORM
Material Electric Fluid Disturbed
INFOLDED INSIDE MAXWELLIAN EM AS HIDDEN EM VARIABLES
MATTER-TO-SPACETIME TRANSFORMATION
SPACETIME-TO-MATTER TRANSFORMATION
INTERNESTED SPACETIME CURVATURES
(VACUUM ENGINES)
INFOLDED GENERAL RELATIVITY
EINSTEIN'S SPACETIME
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Infolded Engines: Excluded by Present Physics

- *The infolded dynamics of EM systems are not considered in general relativity, electromagnetics, or quantum mechanics*
- *None of these disciplines include such spacetime curvature engines (vacuum engines)*
- *Thus GR, EM, and QM cannot be unified, since ST curvature engines are where the unification mainly occurs*

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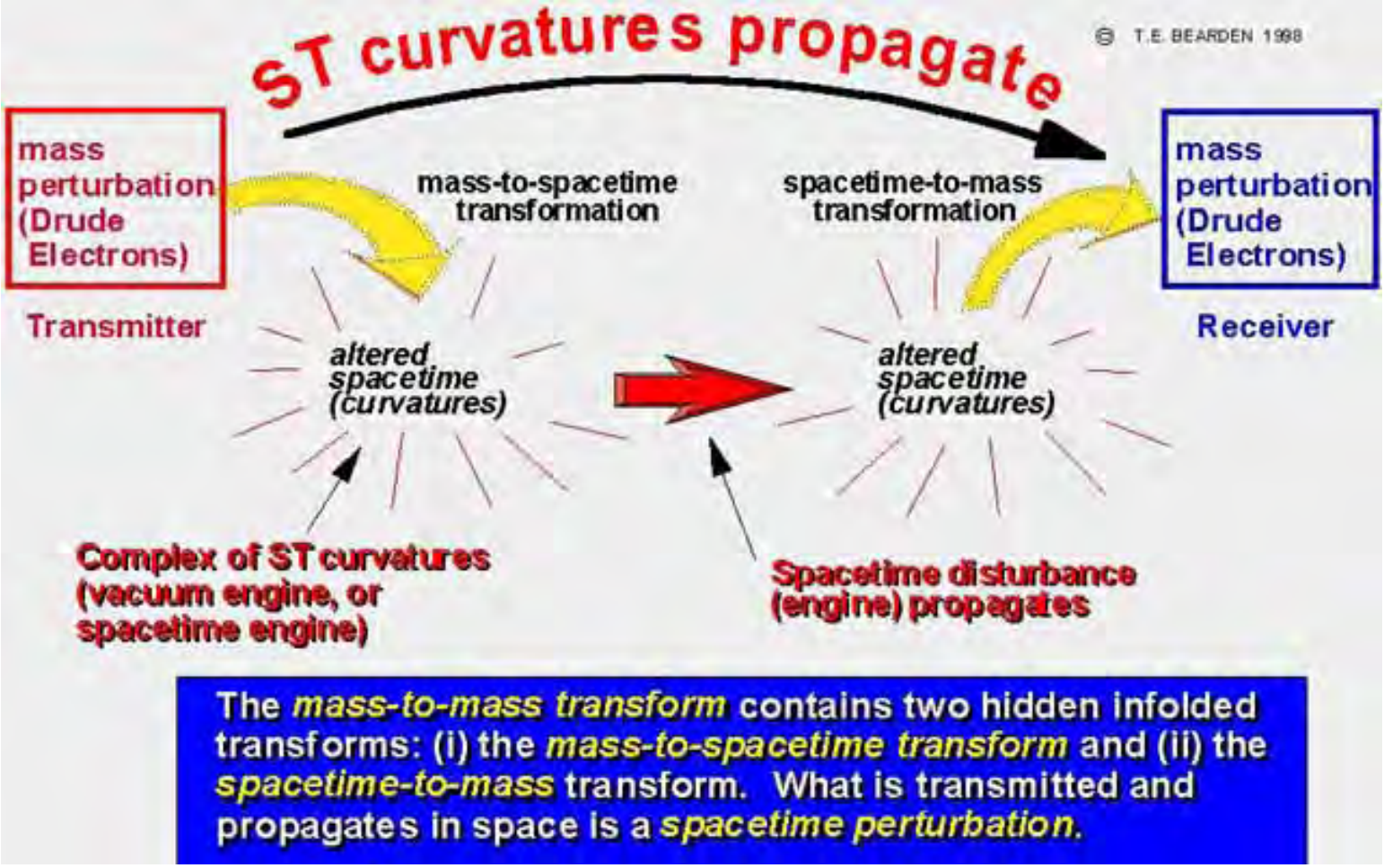
ST curvatures propagate
© T.E. BEARDEN 1998
mass perturbation (Drude Electrons)
Transmitter
mass-to-spacetime transformation
spacetime-to-mass transformation
mass perturbation (Drude Electrons)
Receiver
altered spacetime (curvatures)
altered spacetime (curvatures)
Complex of ST curvatures (vacuum engine, or spacetime engine)
Spacetime disturbance (engine) propagates
The mass-to-mass transform contains two hidden infolded transforms: (i) the mass-to-spacetime transform and (ii) the spacetime-to-mass transform. What is transmitted and propagates in space is a spacetime perturbation.

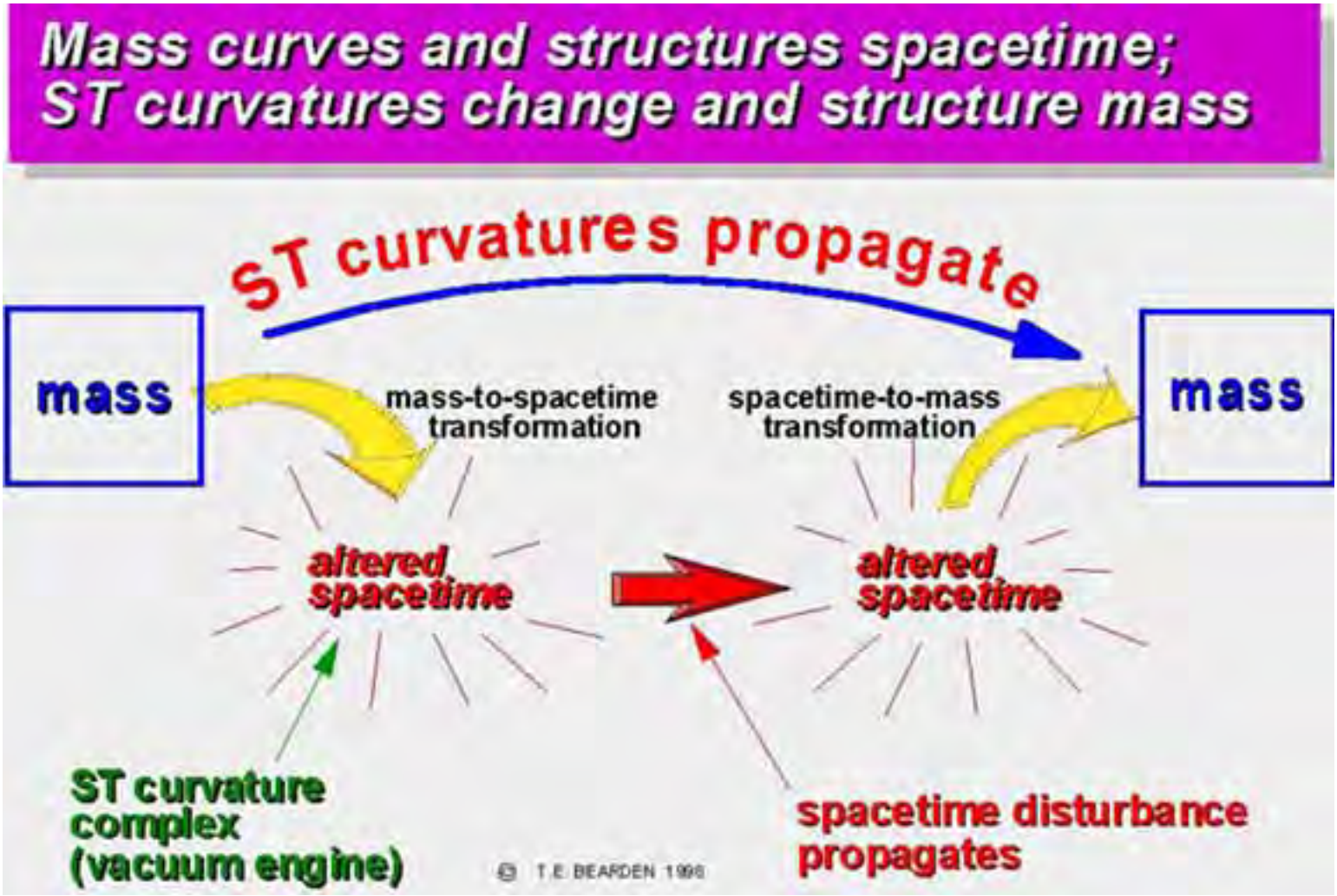
Mass curves and structures spacetime;
ST curvatures change and structure mass
ST curvatures propagate
mass
mass-to-spacetime transformation
spacetime-to-mass transformation
mass
altered spacetime
altered spacetime
ST curvature complex (vacuum engine)
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spacetime disturbance propagates

At Infinite Velocity:
Each Is Every Other
SPACETIME
VIRTUAL PARTICLE FLUX
POTENTIAL
MIND AND MIND LEVELS
MASS
PLANET
LIVING ORGANISMS
© 1997 T.E. Bearden

Lisitsyn's Report: Brain Code Broken

- THEORY DEVELOPED AND FITTED
- HYSTERESIS MEMORY LOOP
- CONTROLLED EM INDUCTION
  - IMAGES
  - SENSATIONS
  - PREDETERMINED EMERGENCE
- 23 EEG BANDS
  - UP TO 8.1 X 10^{20} HZ
  - 11 INDEPENDENT CHANNELS

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S.K. Lisitsyn, "New Approach to the Analysis of Electroencephalograms," DDC Report AD73005, p. 16-25.

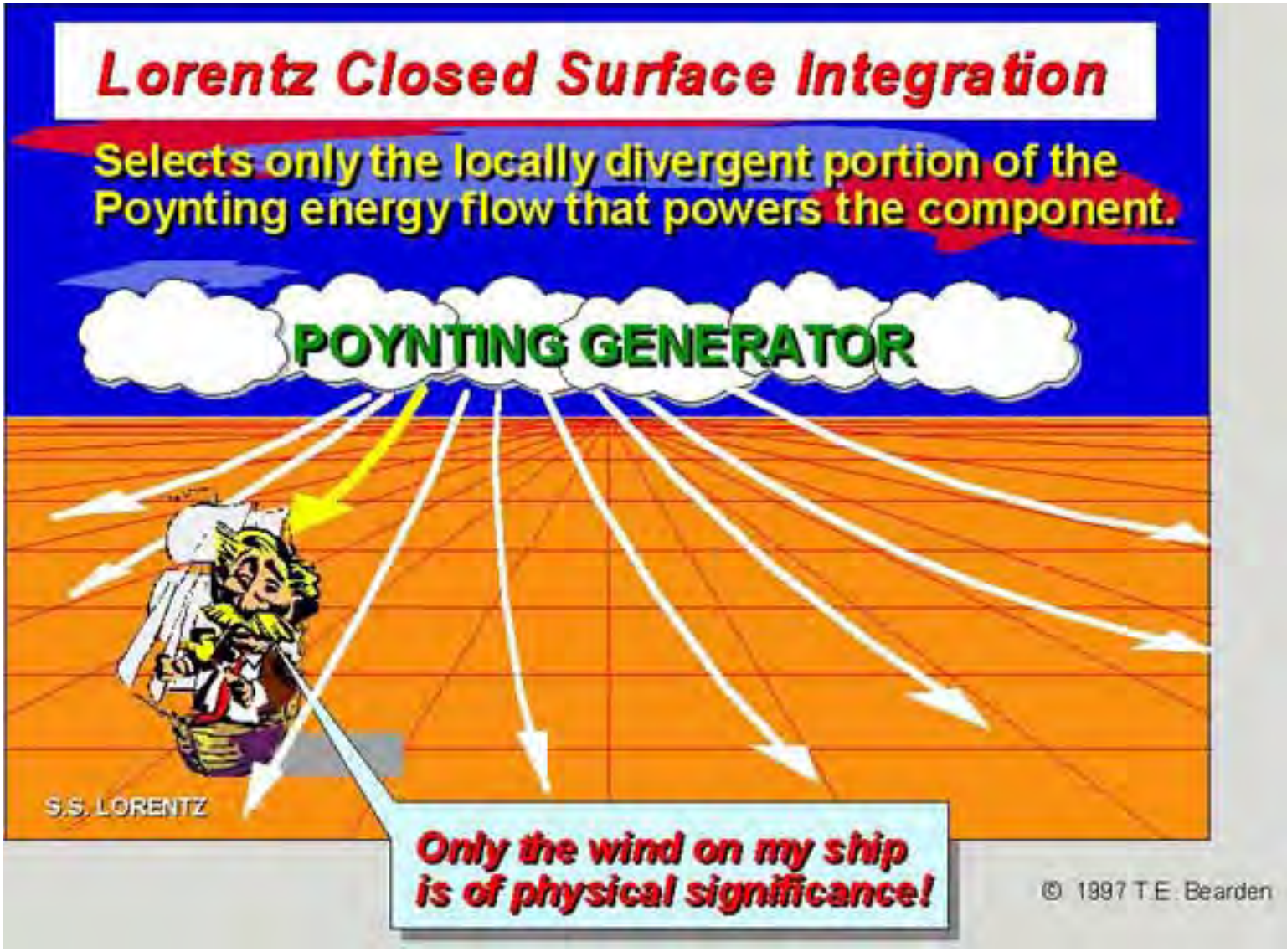
Lorentz Closed Surface Integration
Selects only the locally divergent portion of the Poynting energy flow that powers the component.
POYNTING GENERATOR
S.S. LORENTZ
Only the wind on my ship is of physical significance!
© 1997 T.E. Bearden

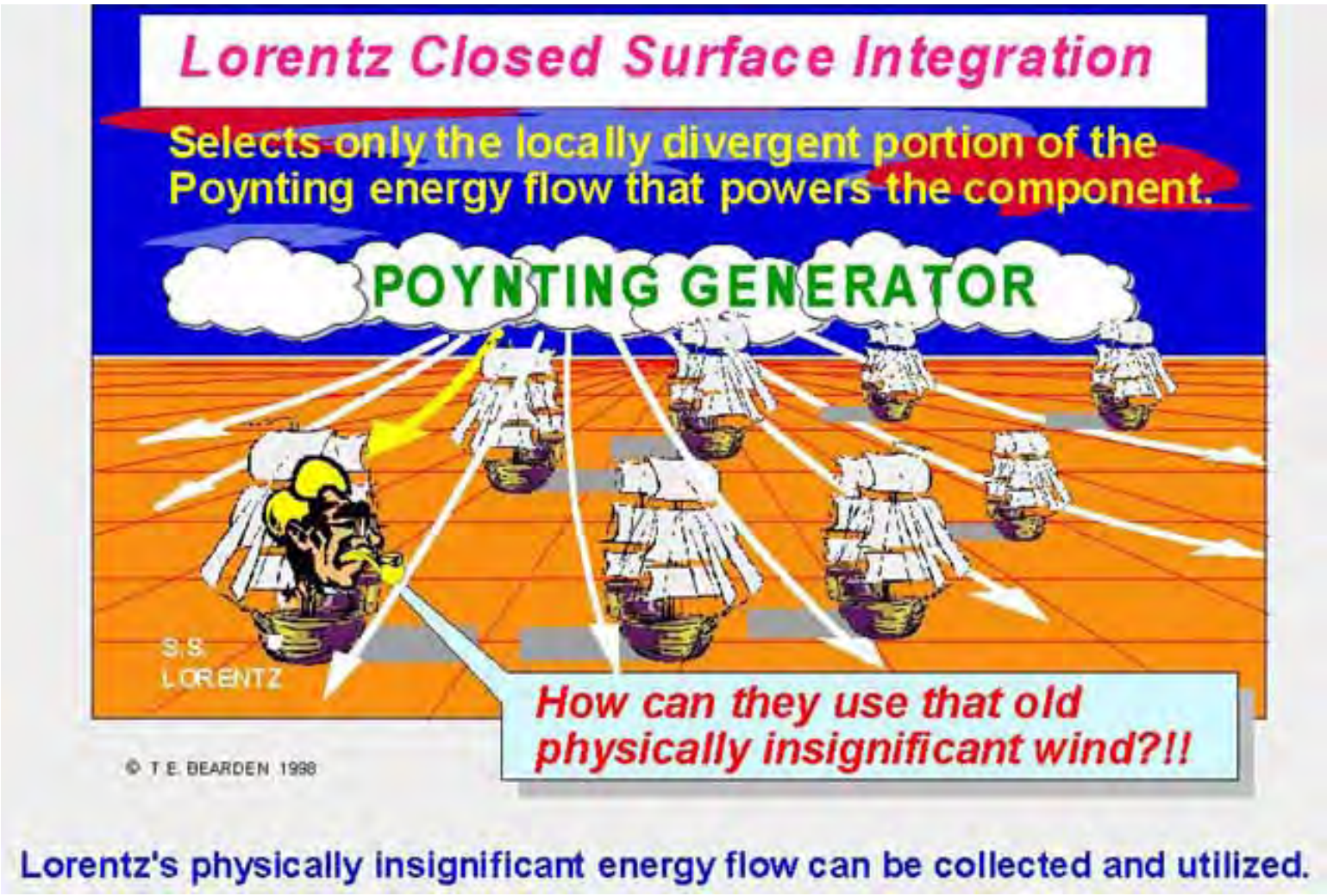
Lorentz Closed Surface Integration
Selects only the locally divergent portion of the Poynting energy flow that powers the component.
POYNTING GENERATOR
S.S. LORENTZ
How can they use that old physically insignificant wind?!!
© T.E. BEARDEN 1998
Lorentz's physically insignificant energy flow can be collected and utilized.

Lorentz surface integration of the Poynting vector around a closed surface

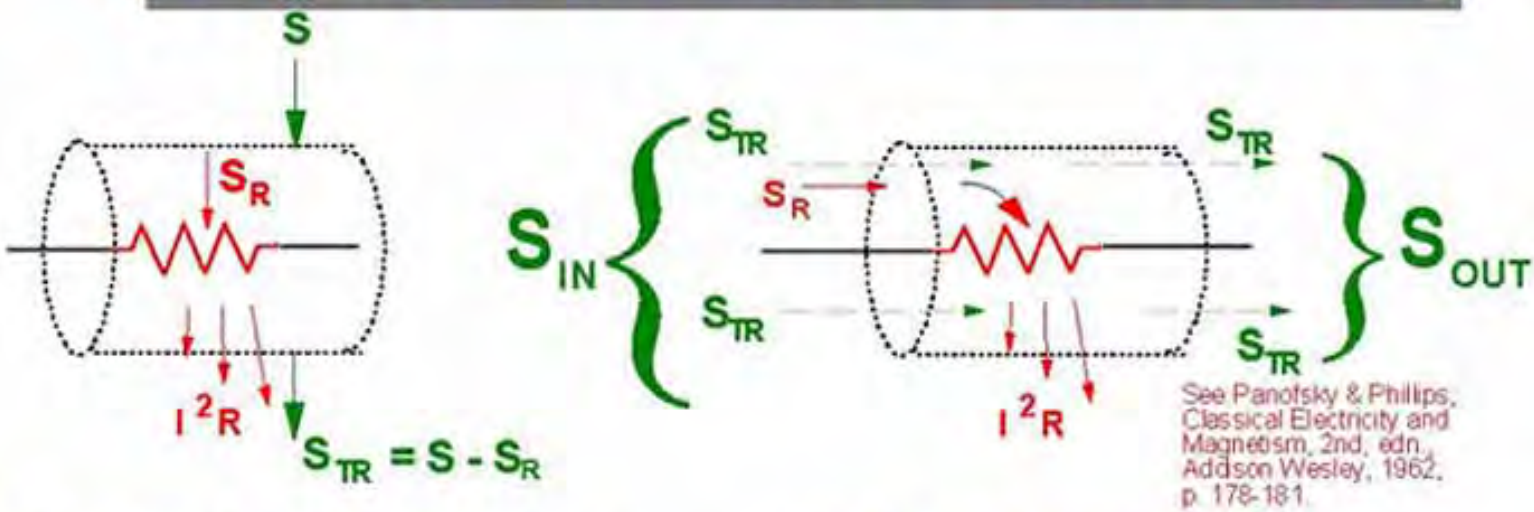

See Panofsky & Phillips, Classical Electricity and Magnetism, 2nd. edn. Addison Wesley, 1962, p. 178-181.

1a. Lorentz surface integration.

1b. Actual S in and S out.

Note: If the S-vector is integrated over the closed surface, then all energy *transport* passage is zeroed, leaving only the very small component of the input S-flow that is powering the joule heating of the resistor. In short, only the small component of the S-flow that is equal in magnitude to the Slepian vector $j\phi$ remains. This measures only the tiny portion of the S-flow that is "collecting" on electrons passing through the resistor, and therefrom being dissipated out of the resistor as joule heating. It discards everything else (all S_{TR}'s and S_{OUT}). S_{IN} becomes S_R.

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Longitudinal EM Photon Interaction with Charge

- Creates time-density wave pumping
- Slowly creates time-density charging

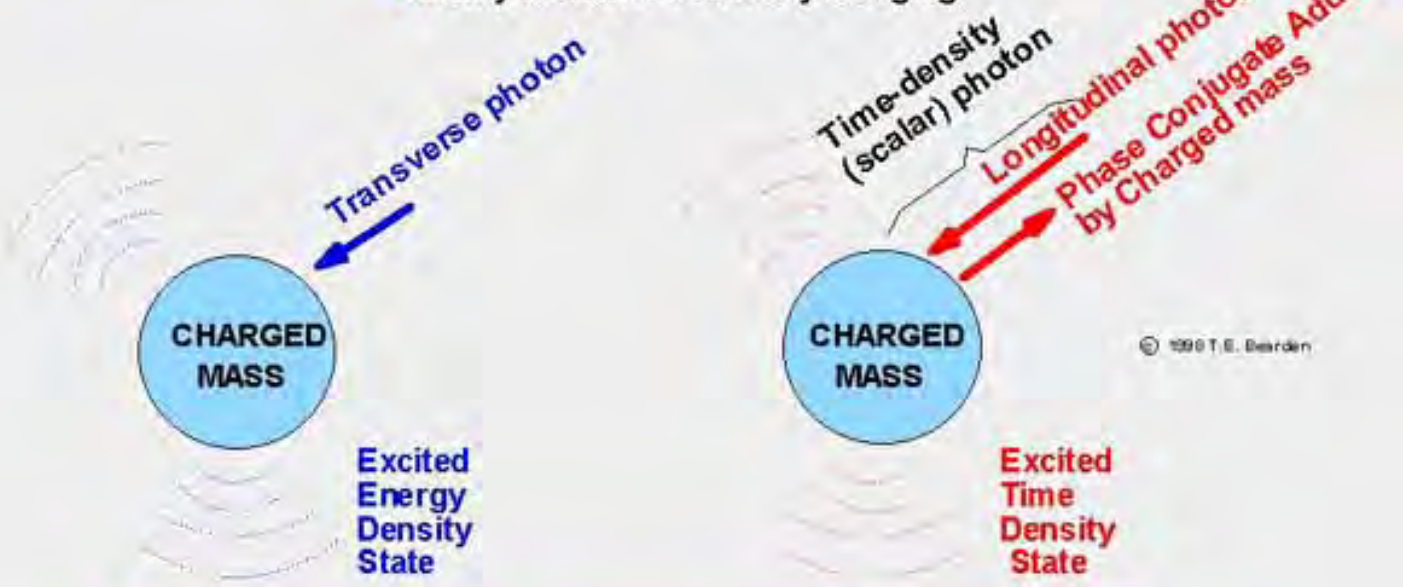

- Fundamental units are arbitrary in physics
- Can express all physics in one unit -- e.g., time
- Time is highly compressed energy
- 1 sec = 9 x 10_{16} joules of transverse EM wave energy

Figure 1-8. Infolded biwave composition of a scalar potential.

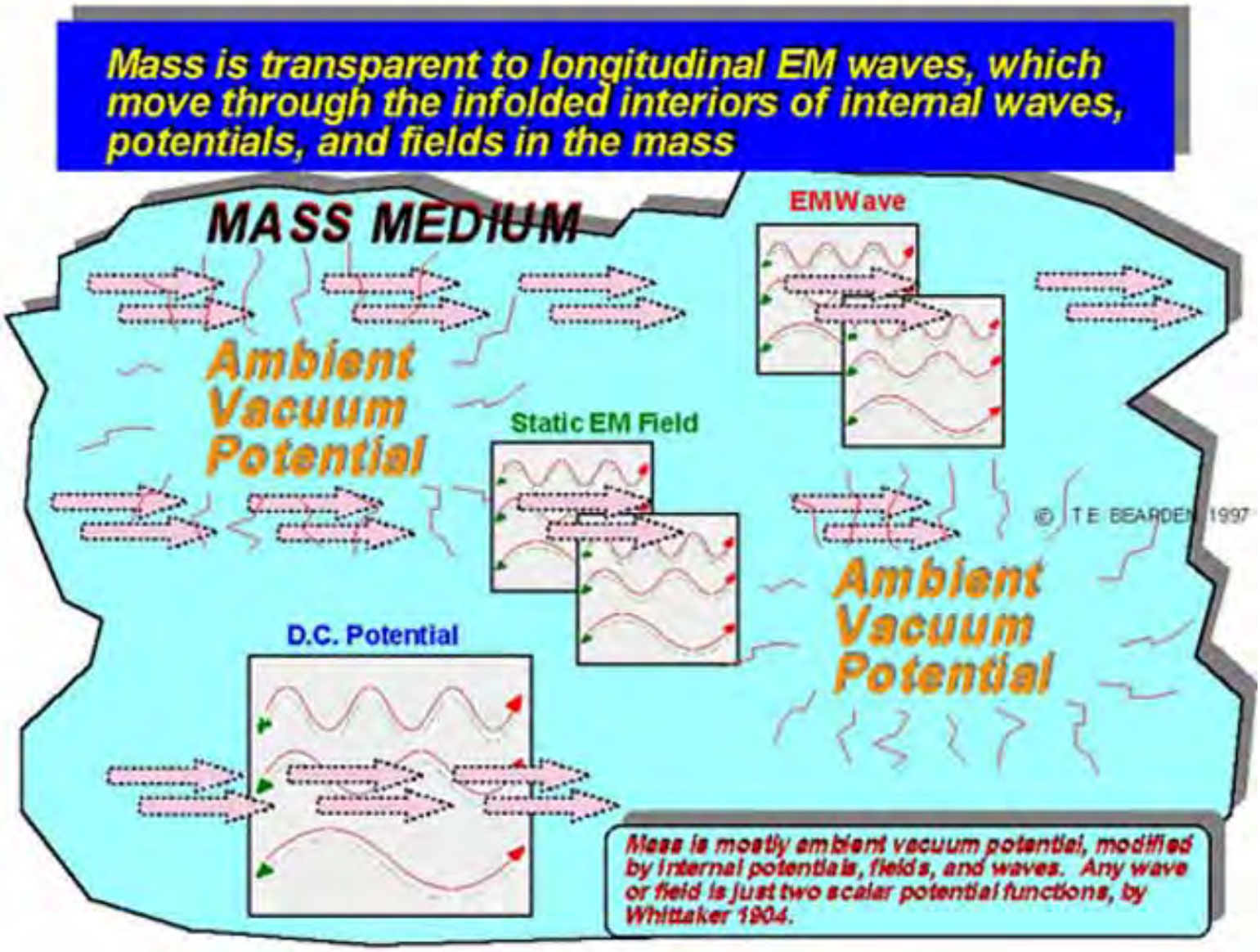

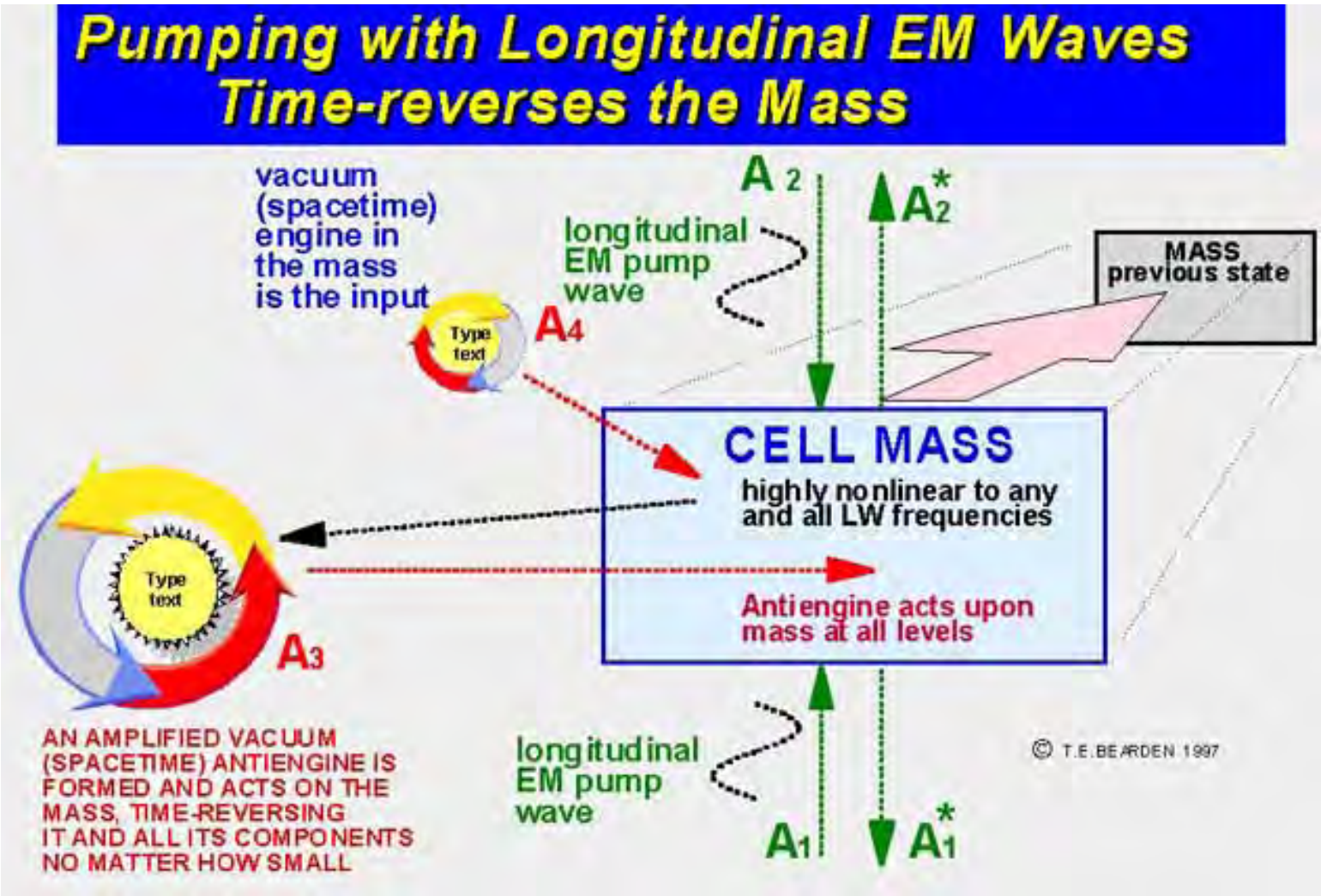
Pumping with Longitudinal EM Waves
Time-reverses the Mass
vacuum (spacetime) engine in the mass is the input
A 2
A*2
longitudinal EM pump wave
MASS previous state
Type text
A4
CELL MASS
highly nonlinear to any and all LW frequencies
Type text
A3
Antiengine acts upon mass at all levels
AN AMPLIFIED VACUUM (SPACETIME) ANTIENGINE IS FORMED AND ACTS ON THE MASS, TIME-REVERSING IT AND ALL ITS COMPONENTS NO MATTER HOW SMALL
longitudinal EM pump wave
© T.E.BEARDEN 1997
A1
A*1

Maxwell's Quaternion Theory

- **Quaternions:**
  - Discovered by Hamilton in 1843
  - A quaternion has a vector part
  - A quaternion has a scalar part
  - First significant non-arithmetic number system
  - Higher topology than vector or tensor algebra
- **Maxwell's theory was in quaternion equations**
  - 20 equations in 20 unknowns
  - Reduced to a small 4-equation subset by Heaviside and Gibbs
  - EM topology dramatically reduced

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Maxwellian Systems

Before regauging, after symmetrical regauging, and after asymmetrical regauging

Note: Any system must first break equilibrium in its vacuum exchange, before it can energize Drude electrons and "power" the load. Asymmetric regauging is always utilized. Powering loads and losses is a symmetry-restoring operation.

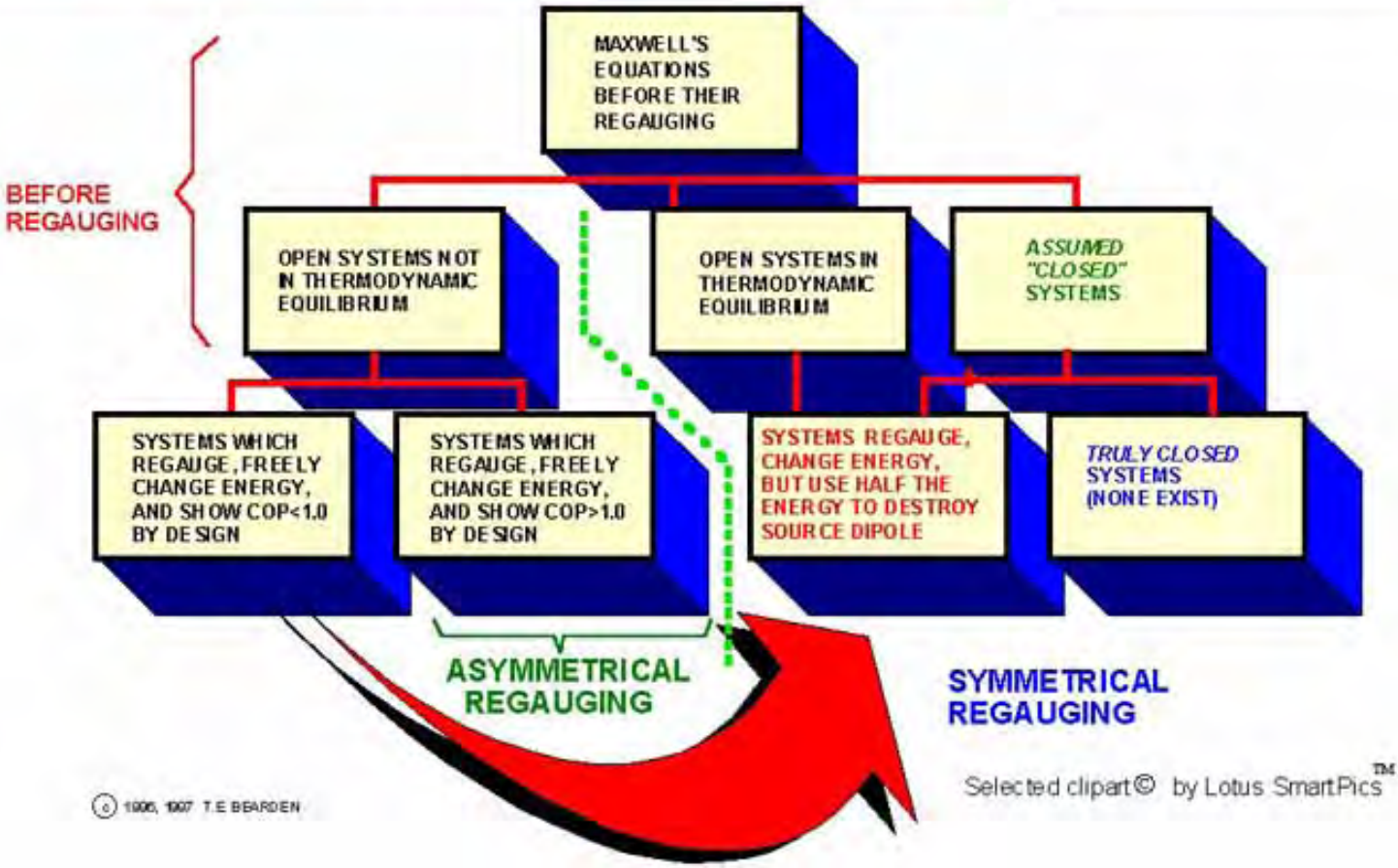

Maxwell's four equations reduce to:

$$\nabla^2 \Phi + \frac{1}{c}\frac{\partial}{\partial}(\nabla \bullet A) = -4\pi\rho \qquad [1]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 A}{\partial t^2} - \nabla(\nabla \bullet A + \frac{1}{c}\frac{\partial \Phi}{\partial t}) = -\frac{4p}{c}J \qquad [2]$$

A is replaced by A', where

$$A' = A + \nabla\Lambda \qquad [3]$$

The new B' field then becomes

$$B' = \nabla \times (A + \nabla\Lambda) = \nabla \times A + 0 = \nabla \times A = B \qquad [4]$$

A new E-field will also be formed. So let

$$\Phi' = \Phi - \frac{1}{c}\frac{\partial \Lambda}{\partial t} \qquad [5]$$

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Per Jackson, (A,Φ) are *habitually* chosen so that

$$\nabla \bullet A + \frac{1}{c}\frac{\partial \Phi}{\partial t} = 0 \qquad [6]$$

The *net symmetrical* regauging separates variables. Two inhomogeneous wave equations result:

$$\nabla^2 \Phi - \frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} = -4\pi\rho \qquad [7]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 A}{\partial t^2} = -\frac{4\pi}{c} J \qquad [8]$$

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Equations [1] and [2] *arbitrarily* changed to [7] and [8]

The Tom Bearden Website

Energy, Observations and Comments

---

1. A Conservative Field Requires a Single-Valued Potential
2. Earth-Electrosphere and Earth-Ionosphere Capacitors
3. Earth's Poynting Energy Flow
4. The Hidden Energy Flow around us
5. Electrostatic Fields of the Earth's Electrosphere Capacitor in Fair Weather and Thunderstorms
6. Flow of Current and Energy Into, Through, and Along a Conductor
7. Energy "collected" on a charge
8. Fiber Fuse Effect
9. Impact of Vacuum Engineering
10. Lawandy's Experiment
11. Field may be nonconservative for a multivalued potential
12. The Ostrich Problem - Part 1
13. The Ostrich Problem - Part 2
14. Russia had Overunity Devices in 1930s
15. Energy output of human body
16. A "static" Poynting S-flow free-energy generator
17. Topology and Energy Conservation
18. Block Diagram: Sweet's Vacuum Triode

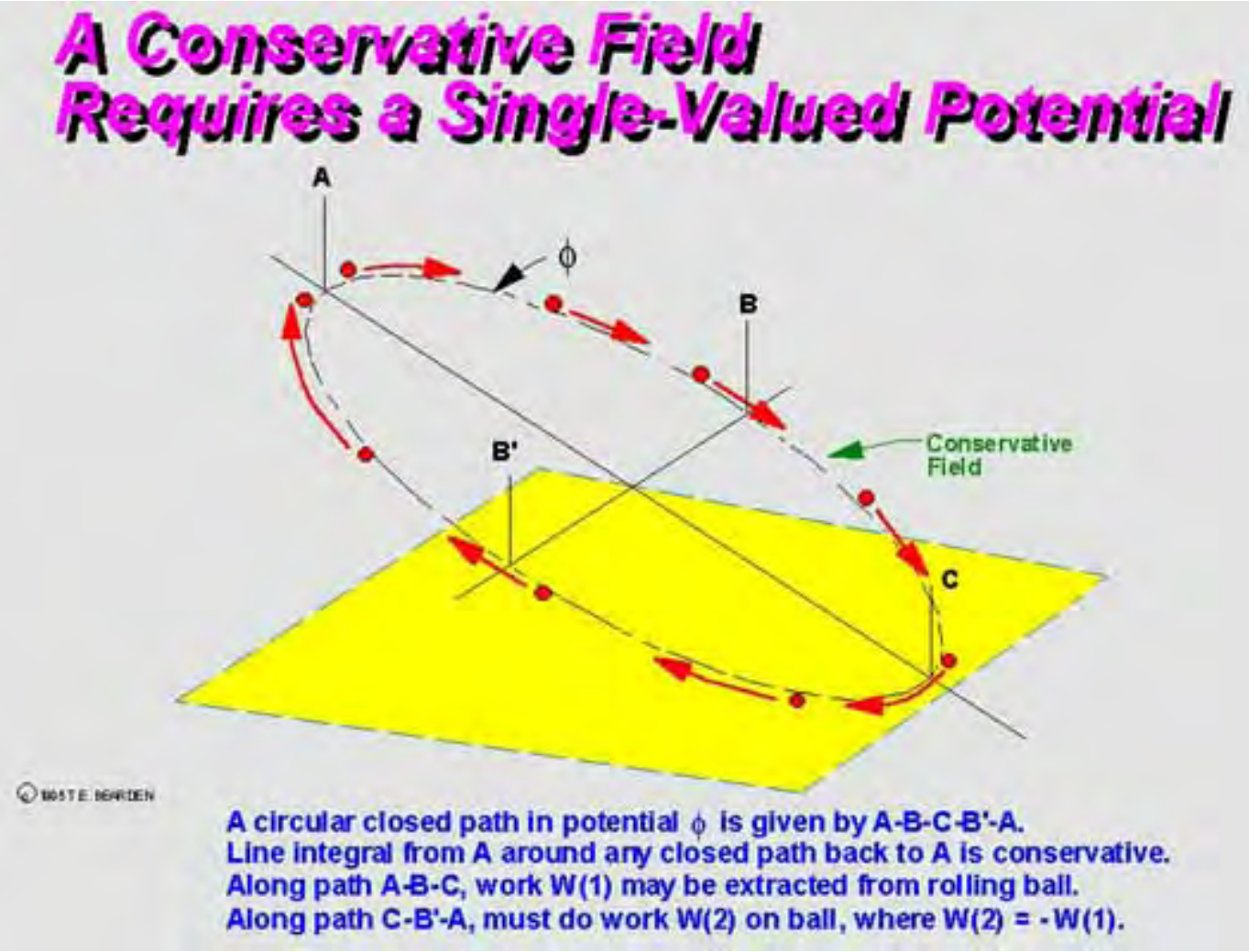

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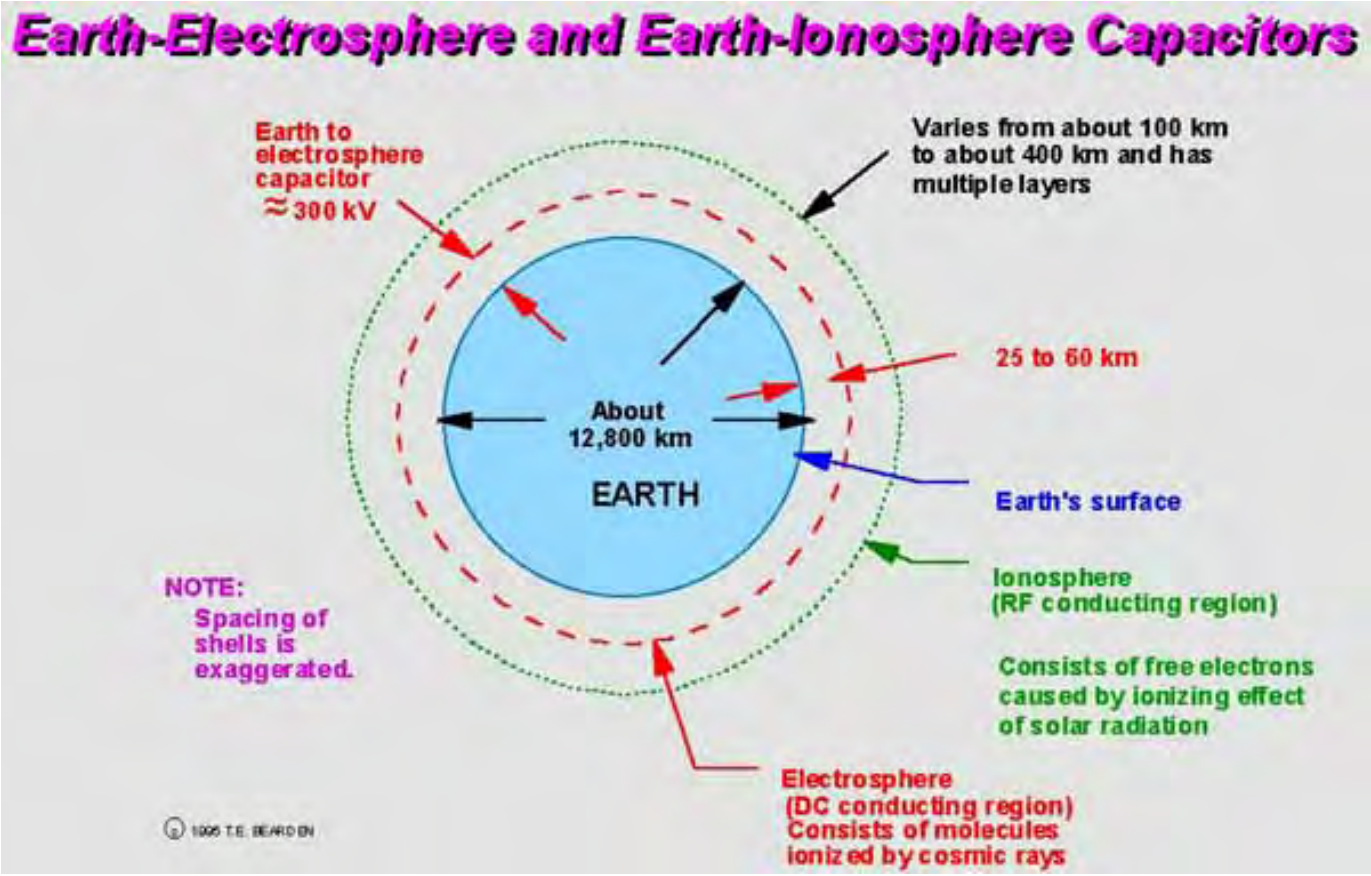

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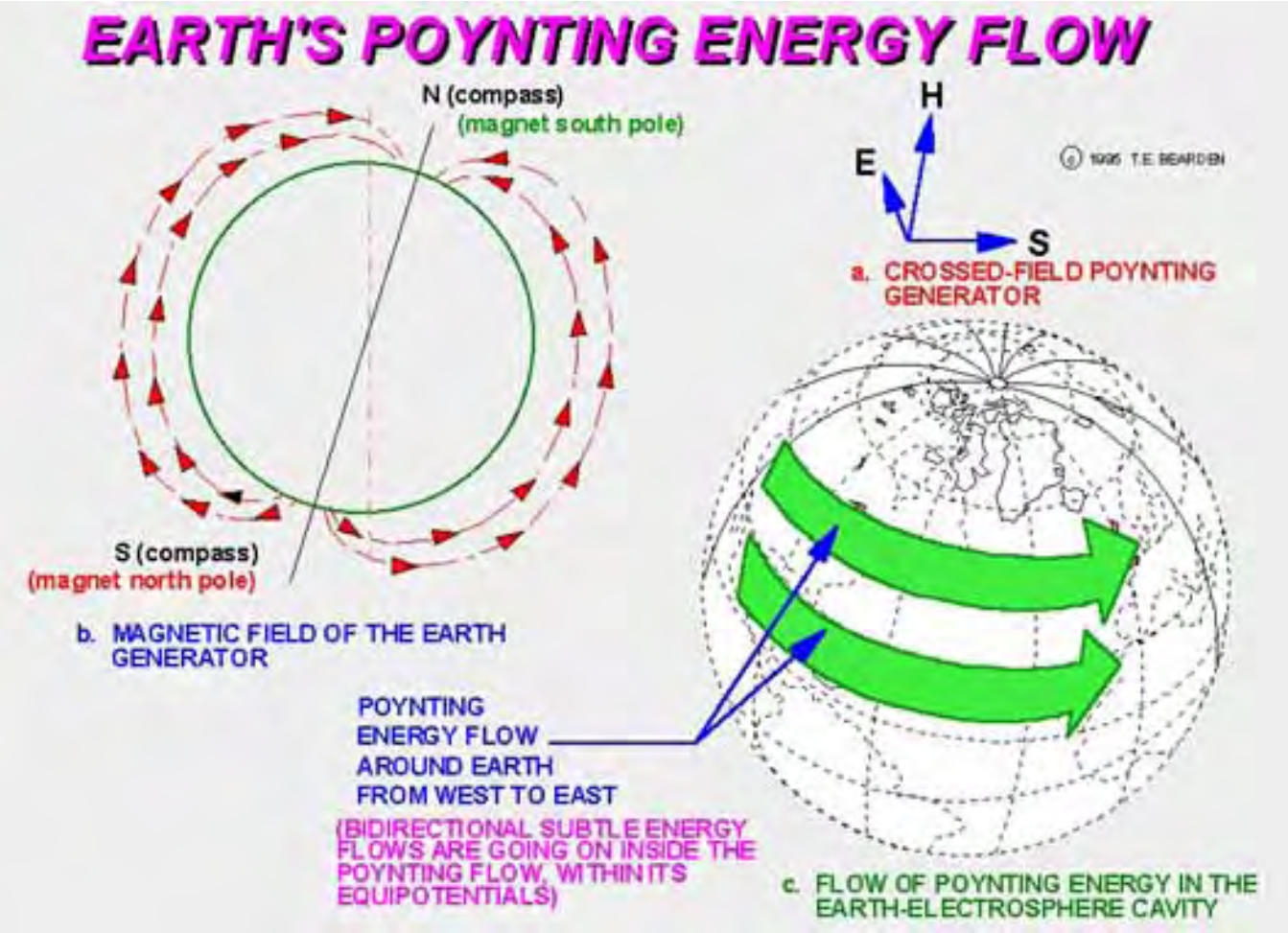

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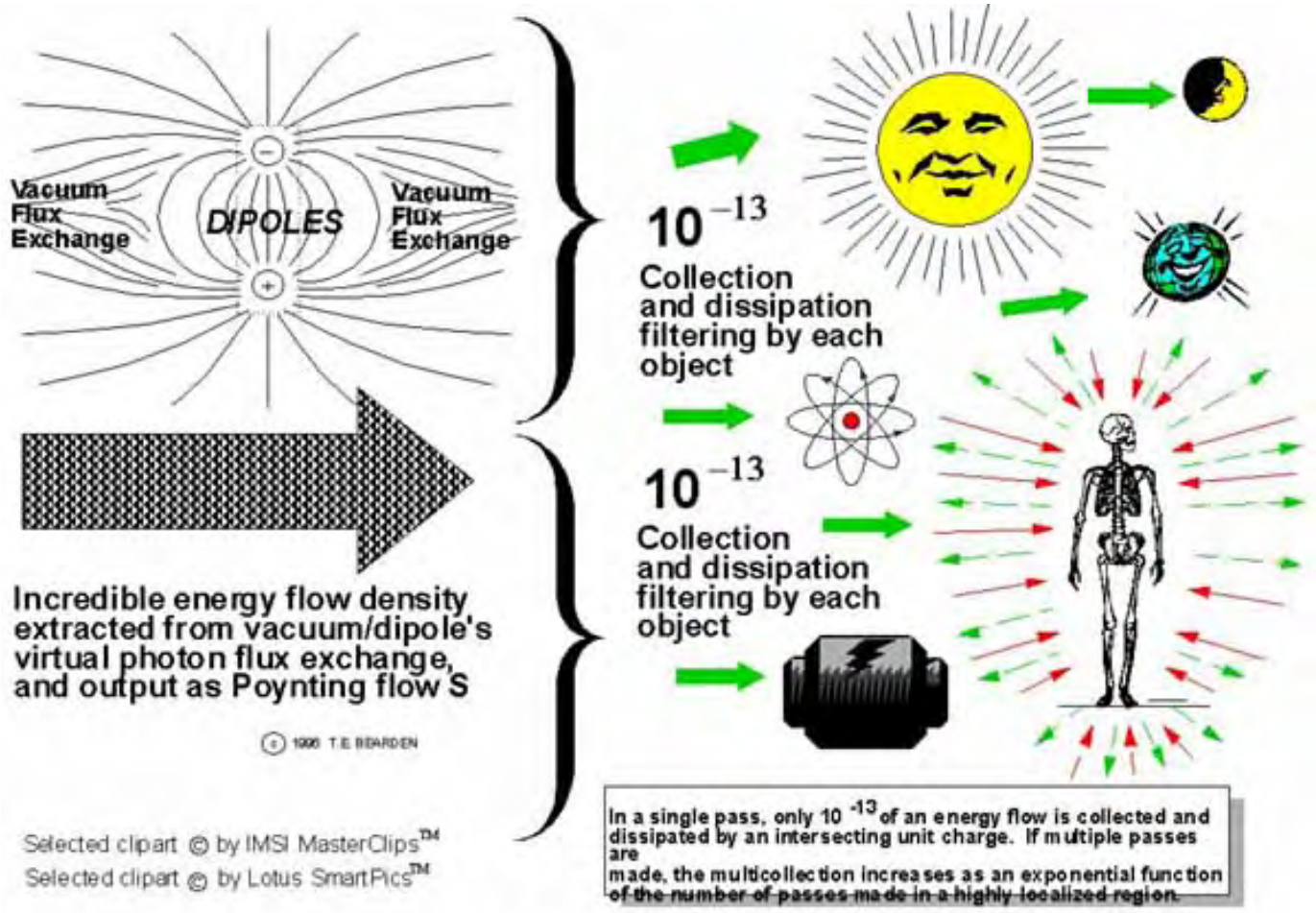

Figure 19. The world of physical matter exists behind a dramatic 10^{-13} filter in a fiery cauldron of fierce and primeval EM energy flow.

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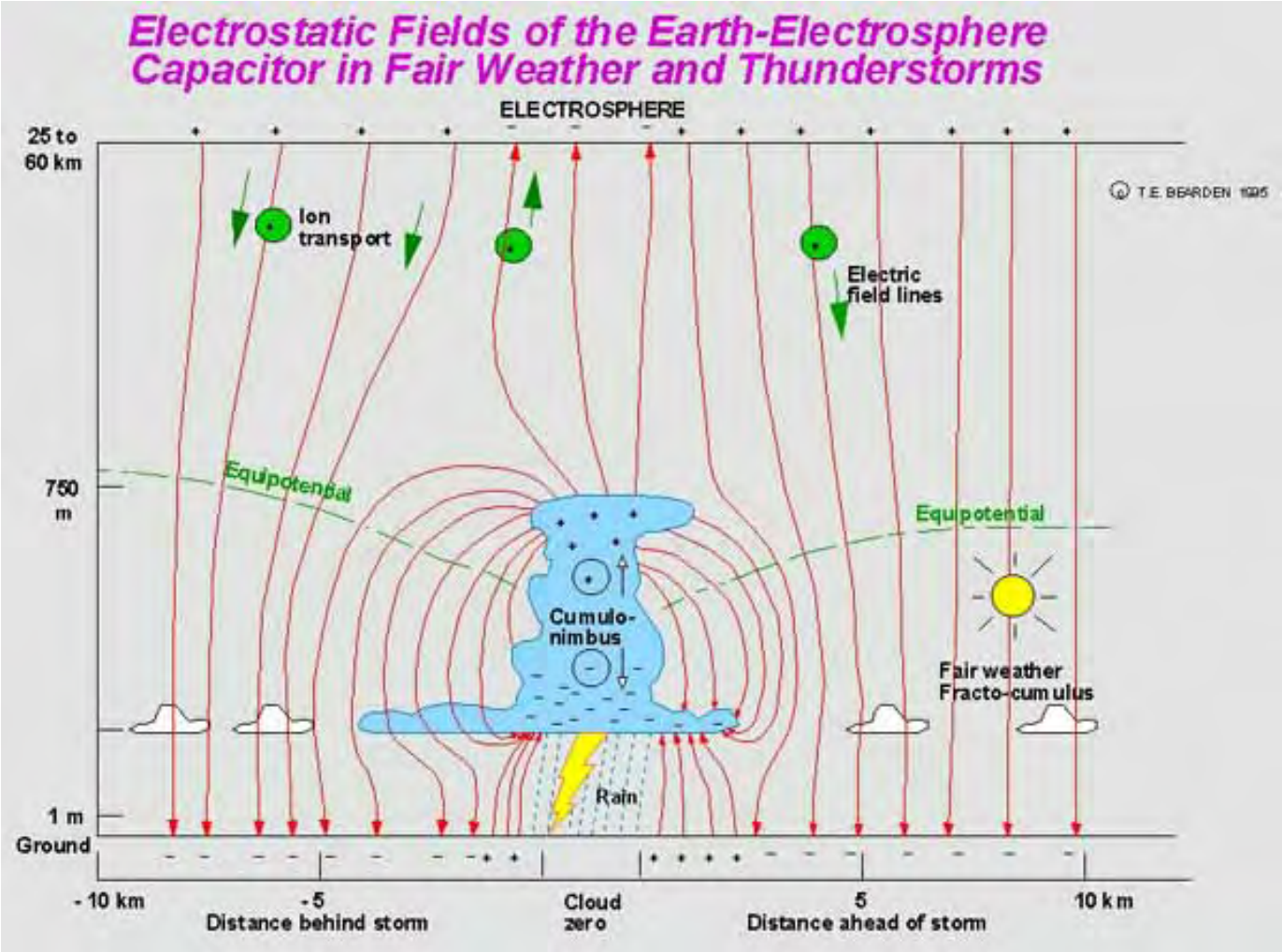

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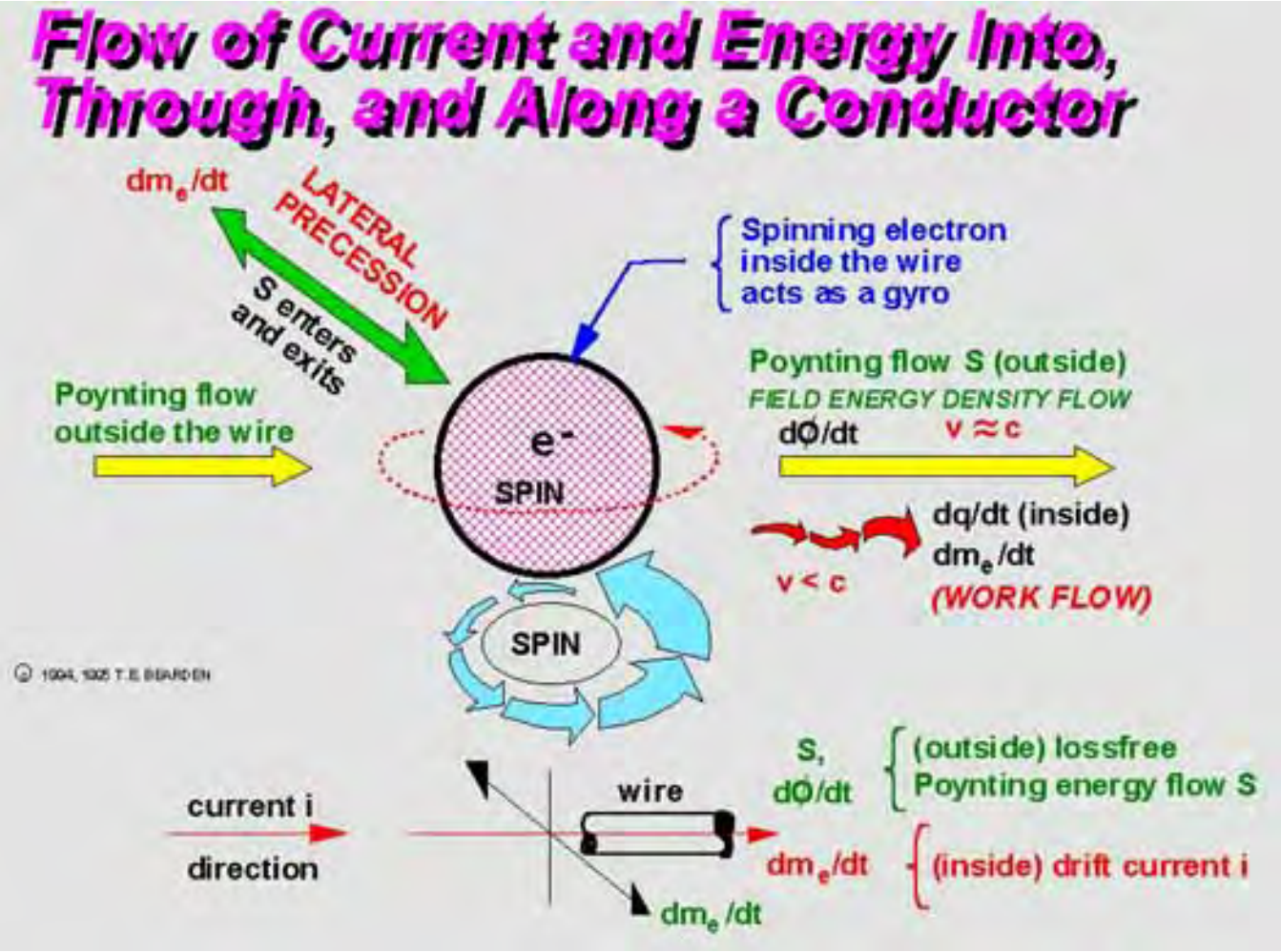

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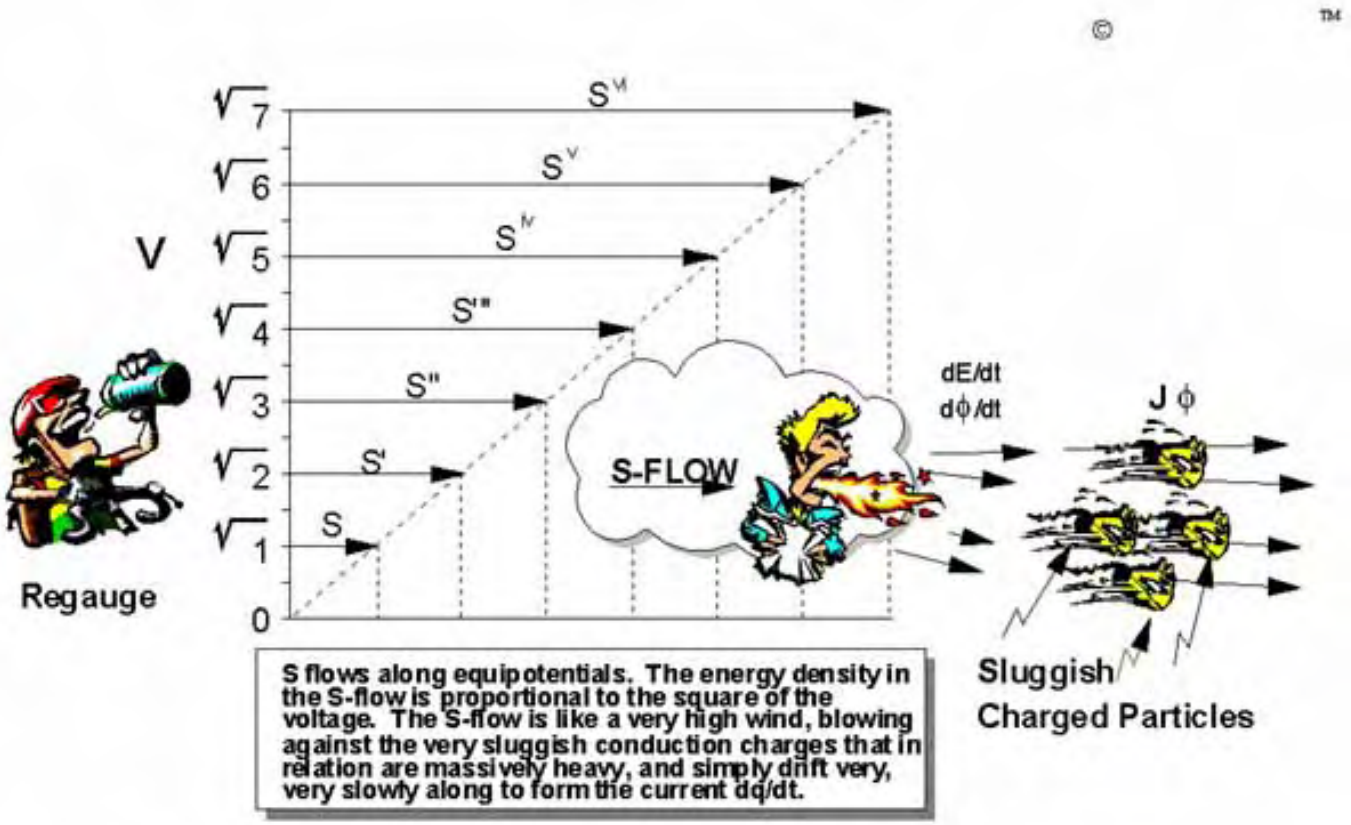

Figure 17. Energy "collected" on a charge depends upon the charge being in a continuous Poynting S-flow. When S ceases, there is no excess energy "collected" on the charge. Energy collection never occurs in chunks, but is always a dynamic, ongoing process.

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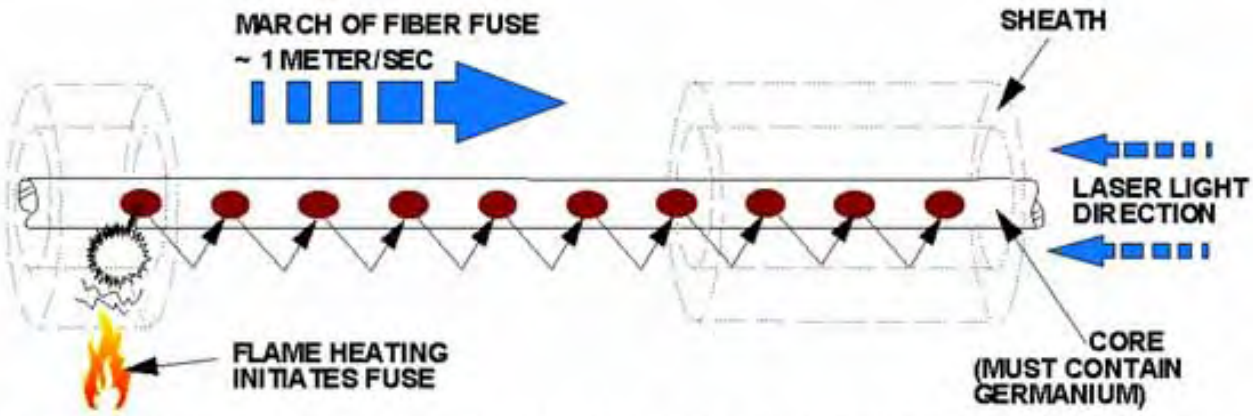

31A. Fiber fuse destroys core of fiber optics cable of indefinite length, pitting core with holes.

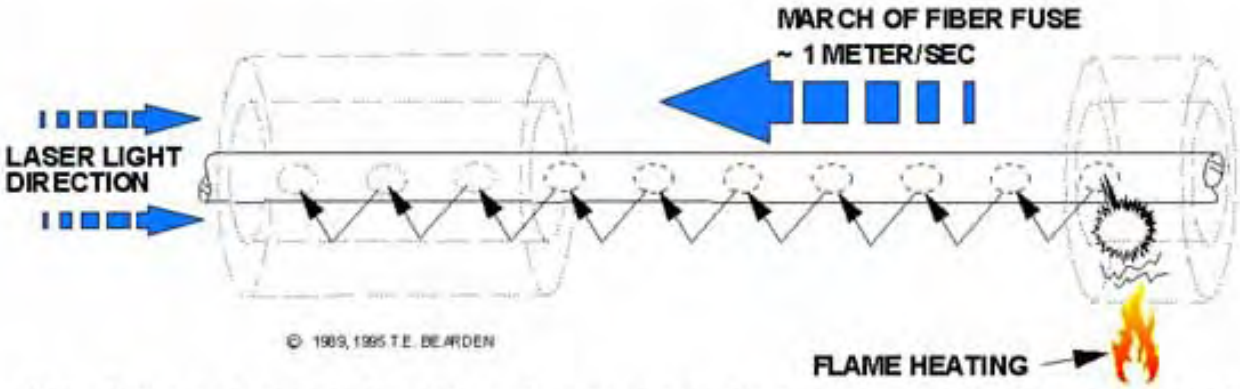

31B. Reversed second fiber fuse often *restores* pitted core in cable, filling holes back up.

Figure 31. Fiber fuse effect and its strange anomalies.

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Impact of Vacuum Engineering

- "If they [quantum fluctuations of vacuum] can be [tapped], the impact upon our civilization will be incalculable. Oil, coal, nuclear, hydropower, would become obsolete – and so would many of our worries about environmental pollution."
- "Don't sell your oil shares yet – but don't be surprised if the world again witnesses the four stages of response to any new and revolutionary development:
  - 1. It's crazy!
  - 2. It may be possible -- so what?
  - 3. I said it was a good idea all along.
  - 4. I thought of it first."

Arthur C. Clarke
"Space Drive: A Fantasy That Could Become Reality"
Nov./Dec. 1994

- *Comment:*
  - *Every dipole's broken symmetry in its energetic exchange with the vacuum already freely extracts vacuum energy.*
  - *In power sources, the dipole gates the extracted energy out as S = EXH, which flows almost entirely outside the conductors.*
  - The circuit interacts with, and uses, only about 10^{-13} of S. The electrodynamicists calculate only this small S-component.

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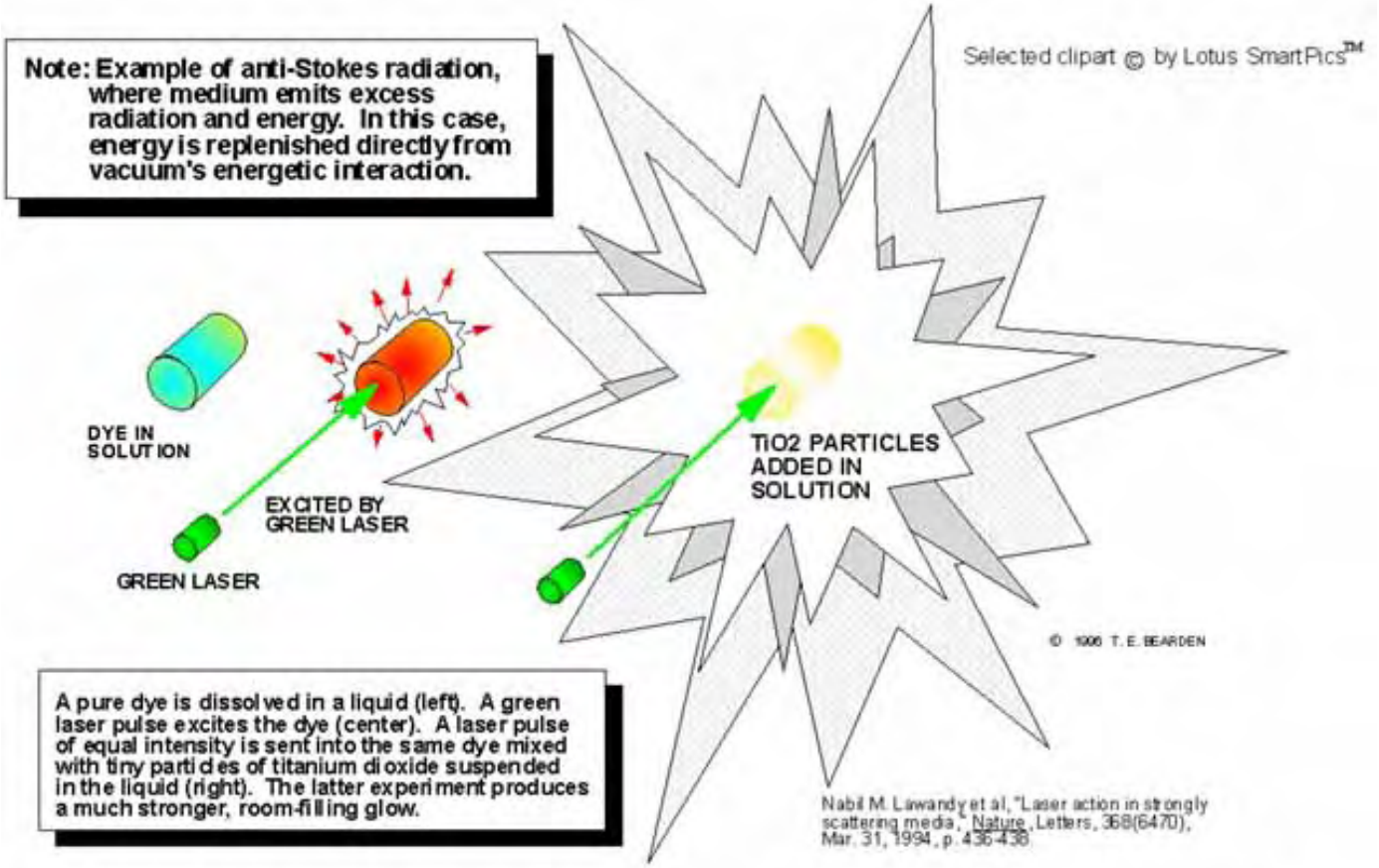

Figure 28. Lawandy's experiment (Letokhov-Lawandy effect) with multipass, multicollection of energy. Formation of a quantum potential can also become involved. Retroreflection and self-targeting are key.

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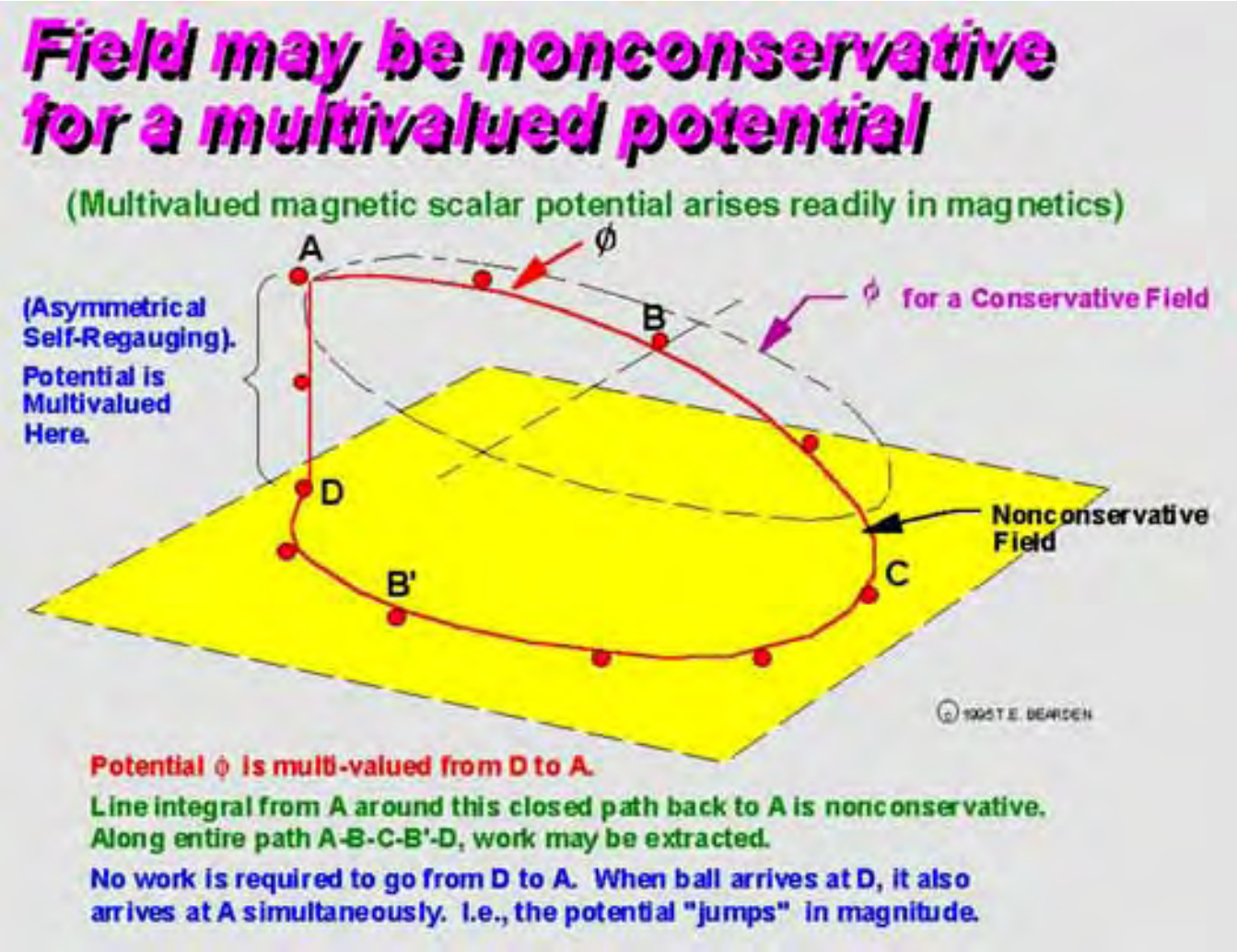

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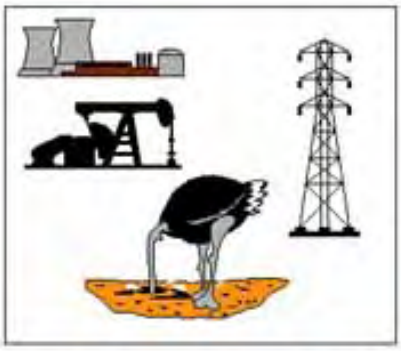

We're running out of energy! We must redouble our efforts!

We have to keep polluting the Earth, if we are to have energy!

Actually, a *few* of our electrical systems already produce all the energy we could ever need! *Learn to collect it and use it!*

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Selected clipart © by Lotus SmartPics™

All our antibiotics are failing! Millions will die from the new age of pandemics and from terrorists' BW attacks!!

We have to relegate EM effects on biological systems to the trash heap. We can only try to find more drugs and antibiotics.

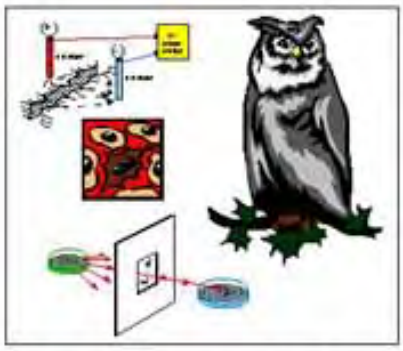

Actually, Priore already showed how to cure most dread diseases, by making and directing vacuum engines. Becker showed you it worked. *Develop it and use it!*

Figure 33. The only problem is the ostrich problem.

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We're running out of energy!
We must redouble our efforts!

We have to keep polluting the Earth, if we are to have lots of electrical energy!

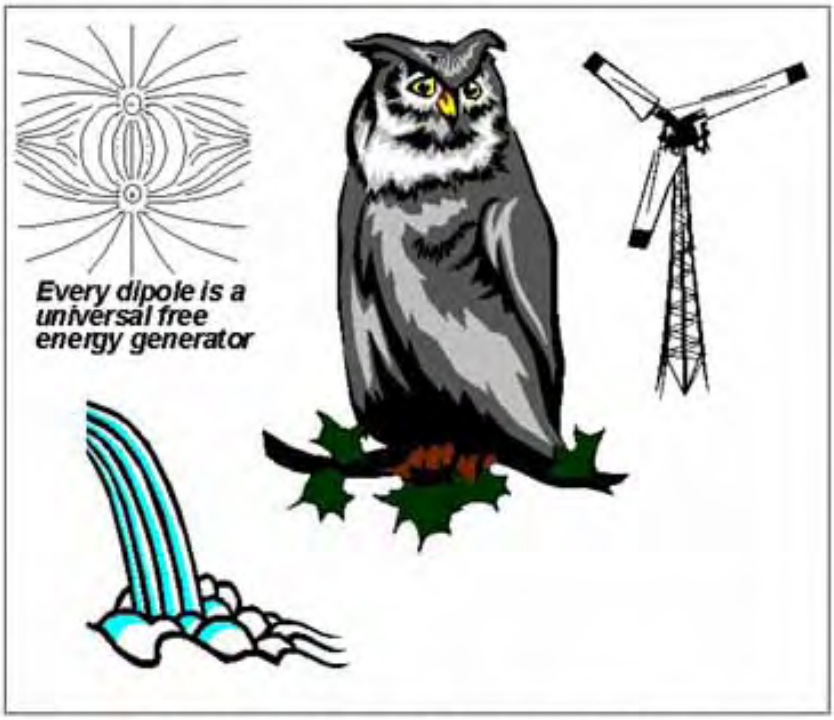

Actually, a single one of our large electrical power systems already produces all the free Poynting energy the world could ever need! *We just have to learn how to collect more of it and use it without continually destroying the source dipole!*

Figure . The only energy resource problem is the theoretical ostrich problem. We must become theoretical owls, rather than ostriches.

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RUSSIAN "SWITCHED PARAMETERS" DEVICES: SELF-OSCILLATING ROTARY GENERATORS*

- Excites oscillations without explicit sources of magnetic or electric forces (i.e., regauges)
  - Periodic variation in system's parameters
  - Experimental and theoretical proof
  - Multiple successful systems made, tested
  - Papers published in Russian, French journals
- As theory predicts, power continually increases unless load is adjusted to stabilize system
- Several large systems tested to self-destruction
- Several large stable systems built, tested

* "On the parametric excitation of electric oscillations," L.I. Mandel'shtam and N.D. Papaleksi, Zh. Tek. Fiz. 4(1), 1934, p. 5-29.

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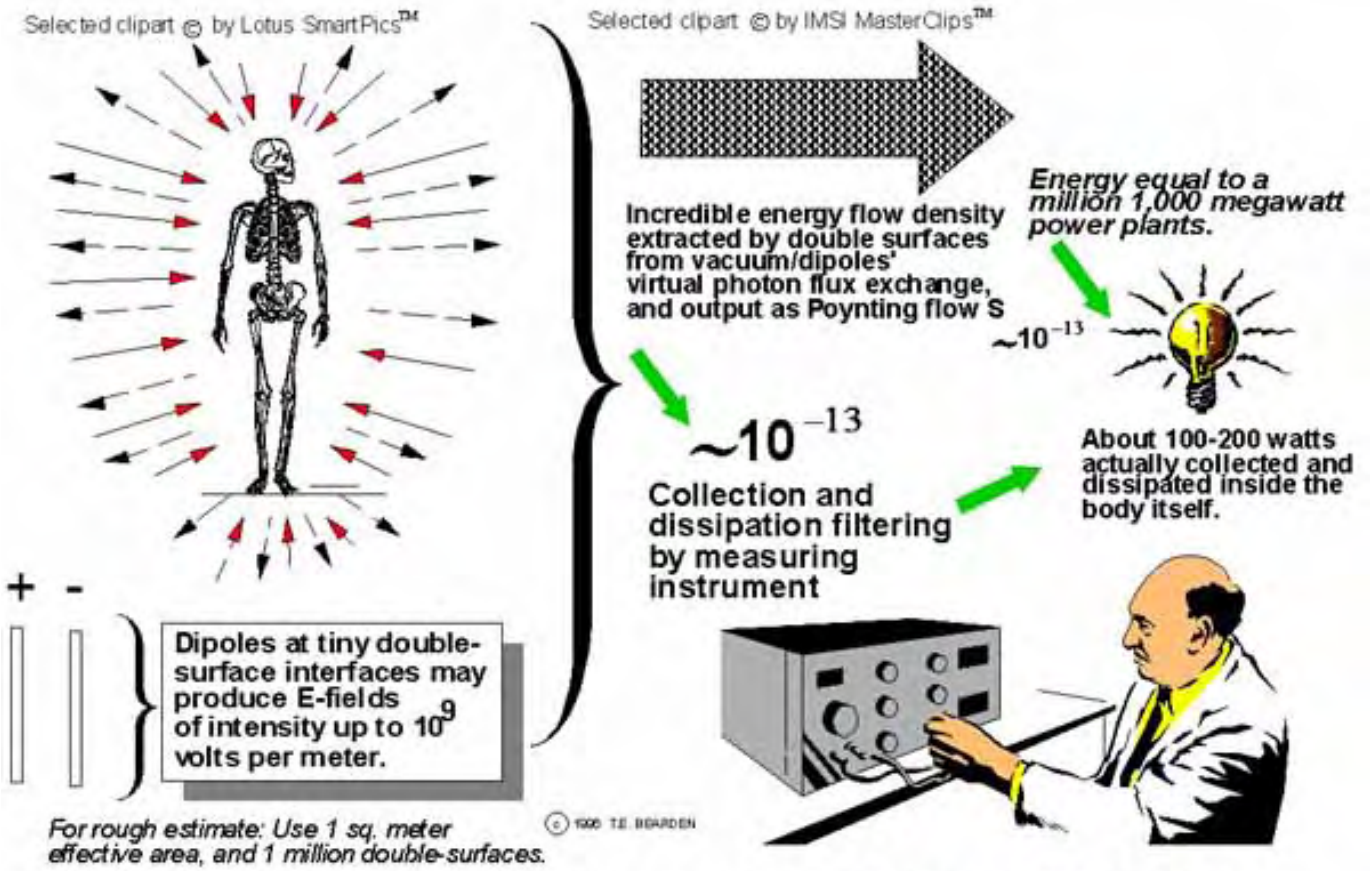

Figure 20. One human body produces more energy flow than all the electrical power loads on earth dissipate. However, only 100-200 watts of its own energy output is collected and dissipated by the body.

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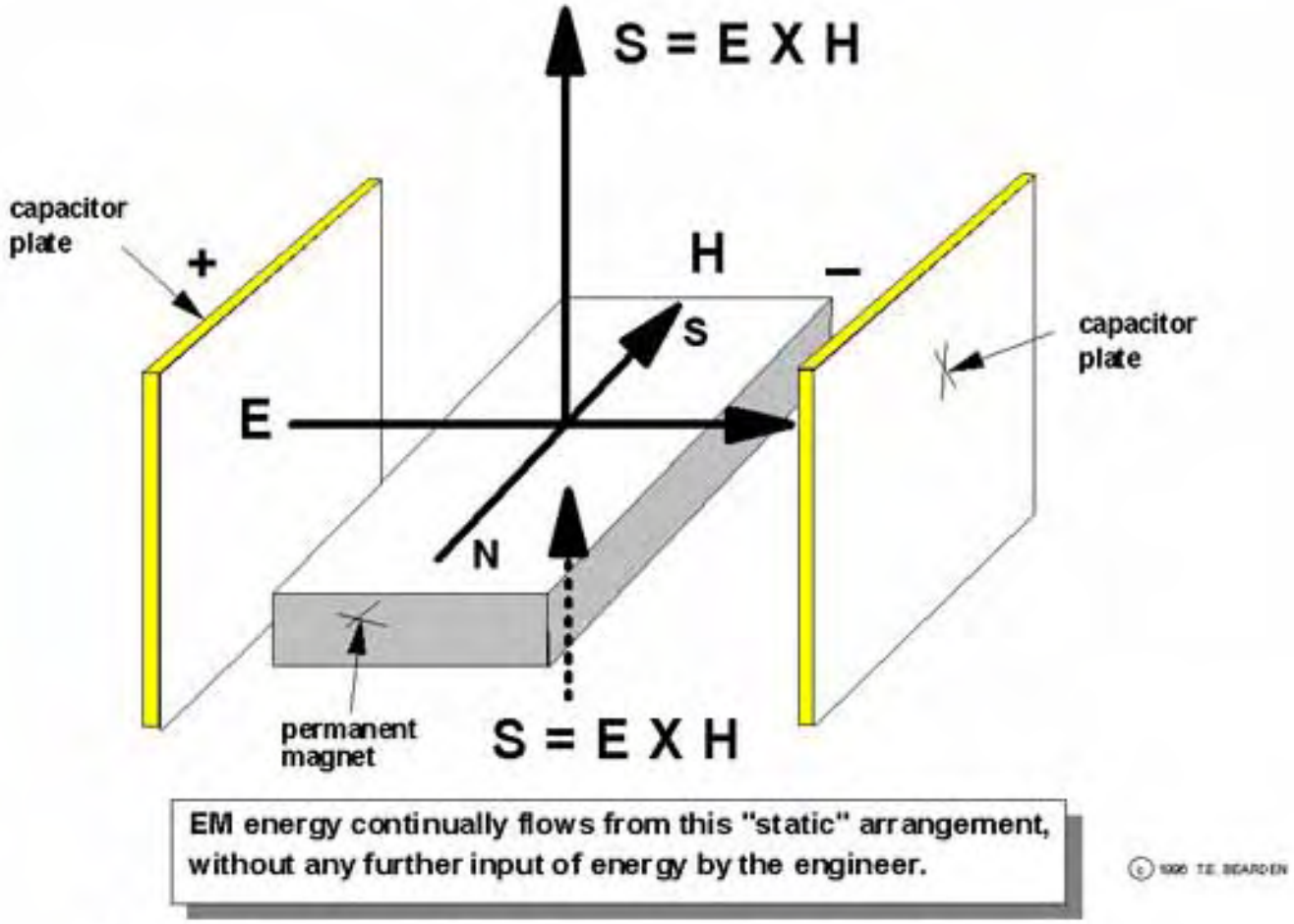

Figure 18. A "static" Poynting S-flow free-energy generator.

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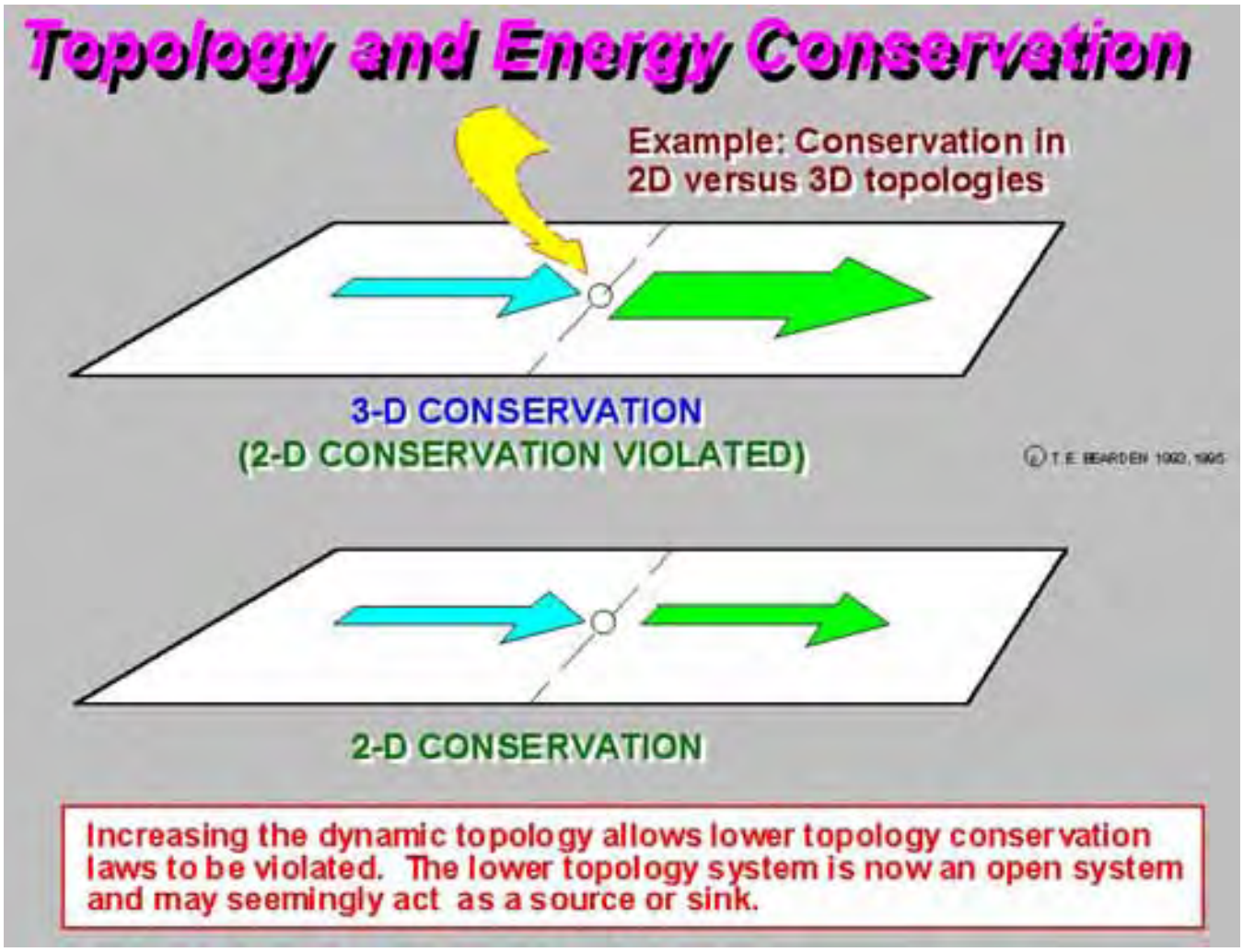

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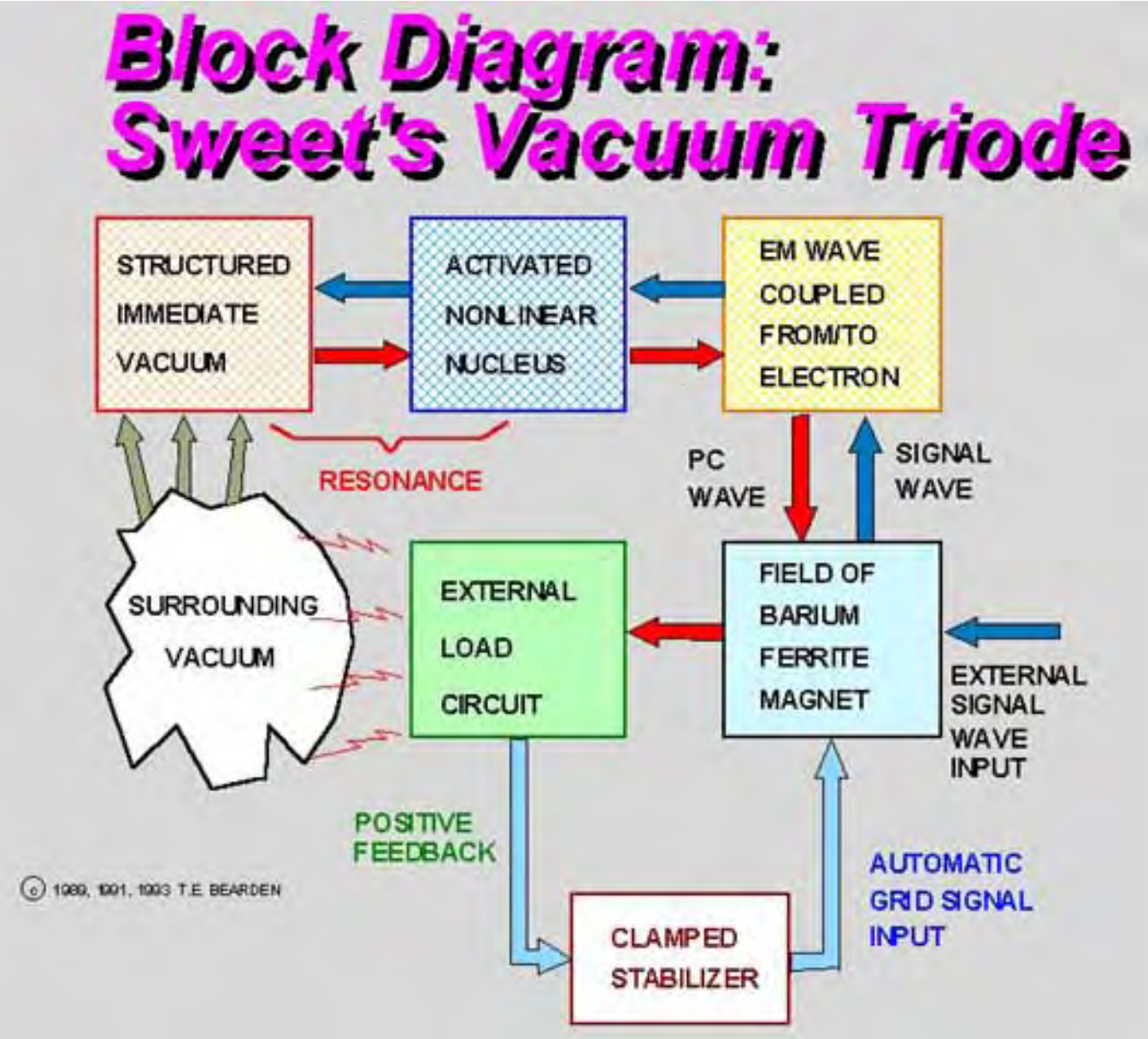

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Defense Department Briefing on Priore Treatment to counter Biological Warfare

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3. Title Page
4. Title Page
5. The Terrorist Threat
6. The Superpower Paradox: Asymmetric Cheap WMD Strategic Strike and Destruction
7. Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.
8. Present Status of the WMD Threat to the United States
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13. Raymond Pautrizel, eminent French parasitologist, who worked with Priore
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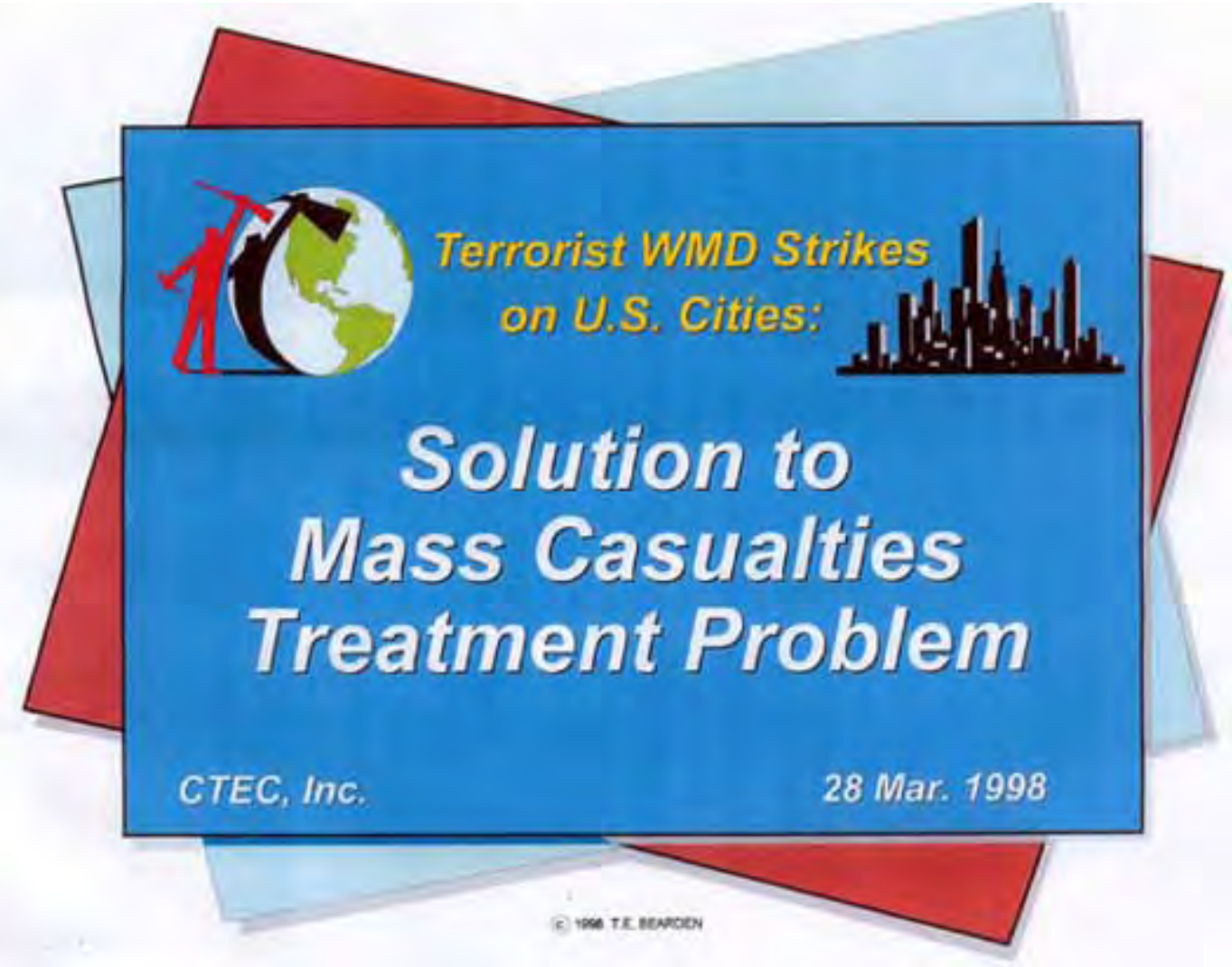

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Key Points in the New Technology

- There is a vast new kind of electrodynamics *hidden inside* all EM potentials, fields, and waves
  - Longitudinal EM waves and complexes
  - Oscillations in time domain

- These complexes are an *infolded general relativity*
  - Clustered formations of *spacetime curvatures*
  - *Very powerful*, since the EM force is used as the agent of curvature

- In general relativity, similar precise complexes permeate and *act on any mass at all internal levels*
- With this approach, one *can now manipulate matter* -- living or inert -- *in any manner desired*, depending only on the level of development of the technology
- Priore unwittingly used this to *cure dread diseases*
- This is a *revolution in all of science*

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- *We have uncovered the major mechanisms* to utilize

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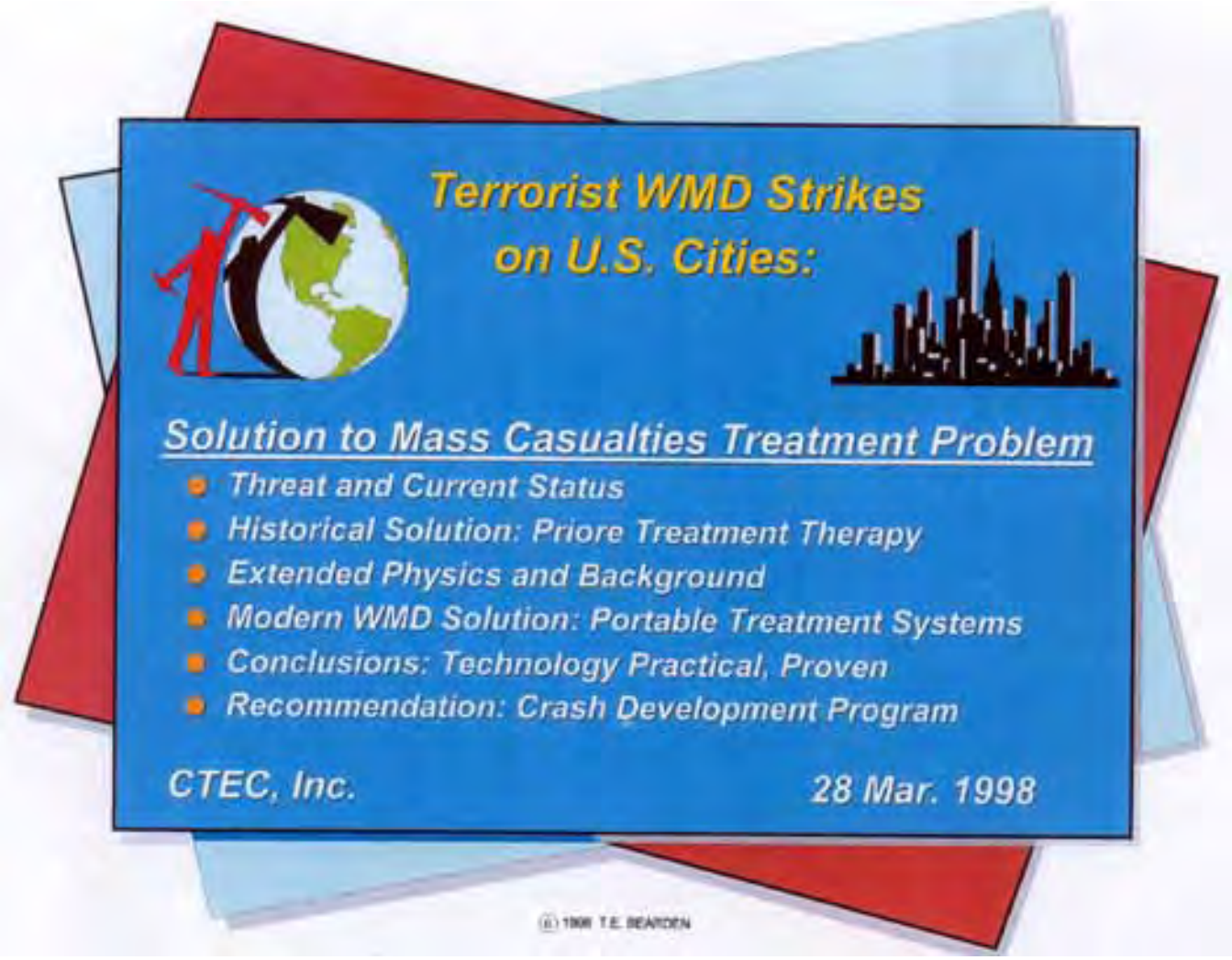

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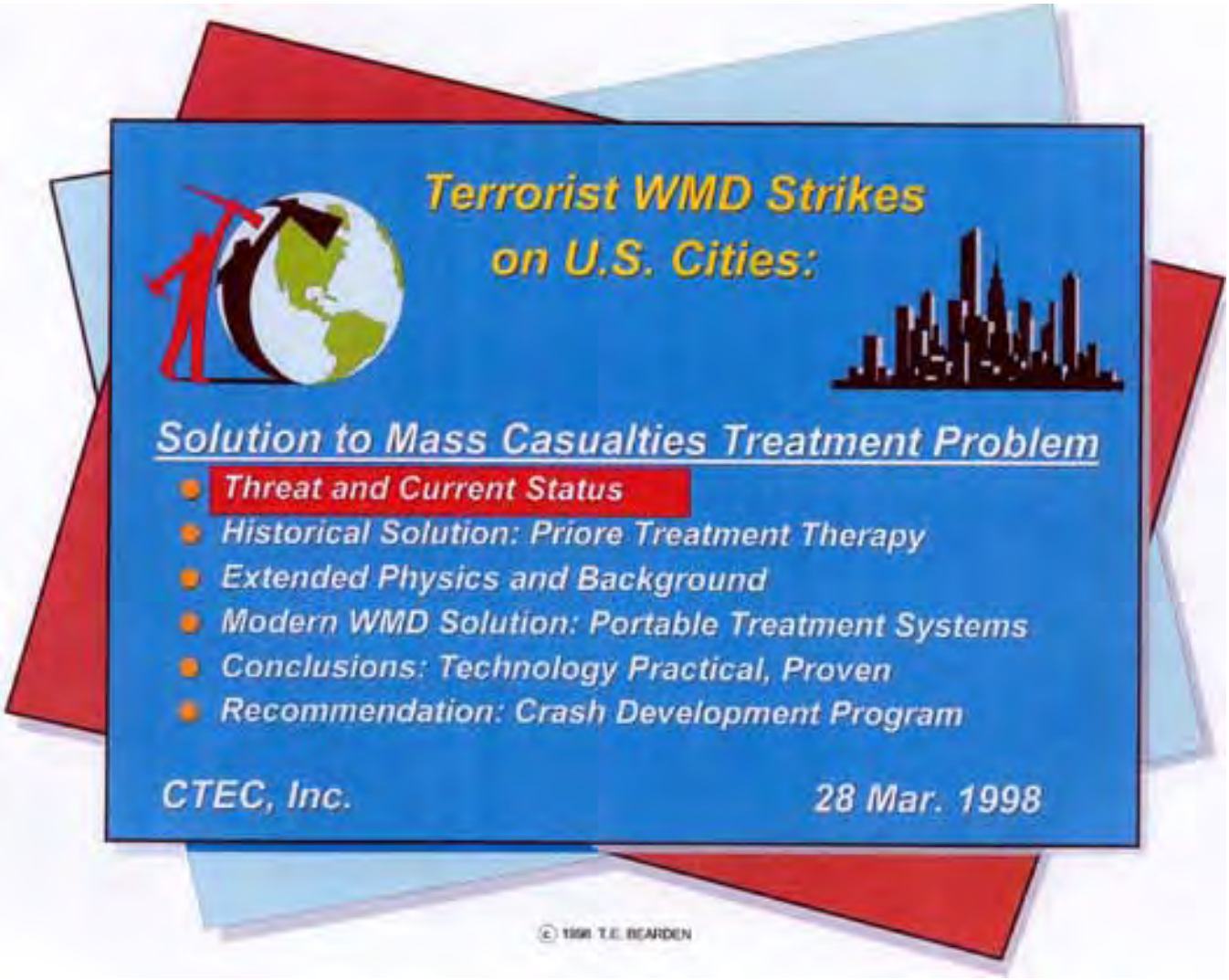

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THE TERRORIST THREAT

TODAY:

- Sabotage
- Chemicals
- Biological agents
- Nuclear materials
- Powerful explosives
- Assassination
- Kidnapping and hostages
- Contamination
- Shoulder-fired AD missiles
- Terrorism

FUTURE ADDITIONS:

- EM weapons
- EM biological warfare
- Scalar EM weapons
- Scalar EM disease induction
- Alteration of behavior and emotions
- Alteration of memory
- Direct thought control
- Action-at-a-distance effects

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Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.

- One terrorist, one light aircraft with spray tank
- 100 kilograms of anthrax
- Flies over greater metropolitan Washington, D.C.
- Calm night
- 1-3 million casualties result*
- Most of those stricken will die
- Presently little can be done to save the stricken civilians
- Attacks on several population centers might produce some 10 million or more casualties

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*Per OTA Report to Congress, 1993

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Present Status of the WMD Threat to the United States

- Many foreign nations are hostile to the U.S. and sponsor terrorists
- Some 25 nations have WMD or are acquiring them
  - BW agents and weapons
  - Chemical agents and weapons
  - Nuclear materials and weapons
- Thousands of students and emigres
- Infiltrated teams, BW, other WMD already
- Castro guerrillas infiltrated over the years
- Can do unacceptable damage to U.S. now
- *May reach first strike knockout capability*

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*Per OTA Report to Congress, 1993

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Some Present Problems in the U.S. WMD Defense Capabilities

- No shelters (require overpressure, BW filtering, masks, showers, supplies)
- No stockpiled vaccines, medical supplies, immunoglobulins, masks, suits, food, fuel, generators, heaters, water purification units
- Totally insufficient medical facilities, personnel, and emergency response teams
- Triage, full martial law will be required
- No answer to massive decontamination problem
- State, county, city inadequately staffed and insufficiently trained for mass casualties
- Terrorist teams, BW agents, other WMD on site, waiting
- Water supplies, food, crops, farm animals also vulnerable
- Electric power grid, bridges, trains, railroads vulnerable
- Present medical science cannot save very many of the casualties, now or in the foreseeable future

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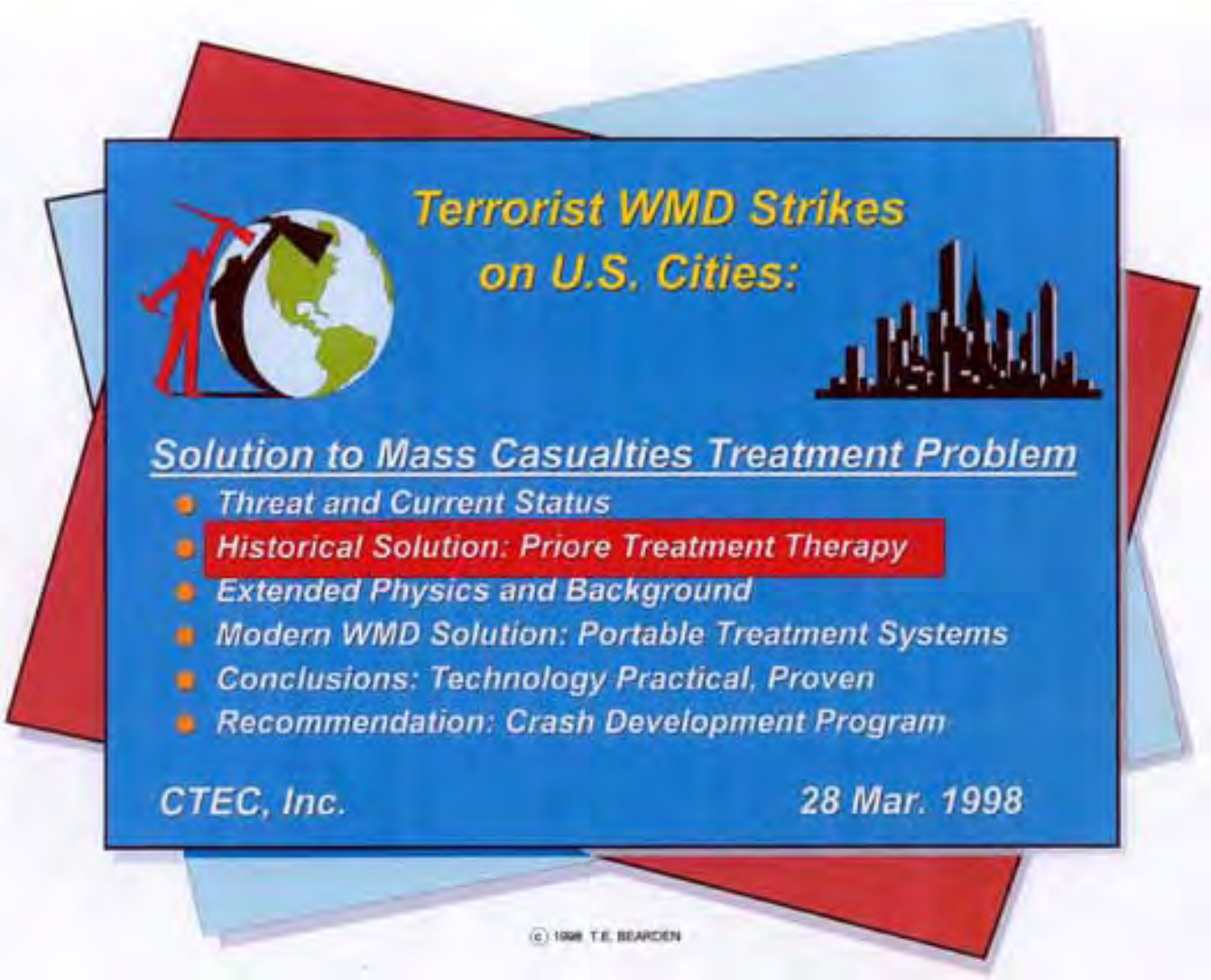

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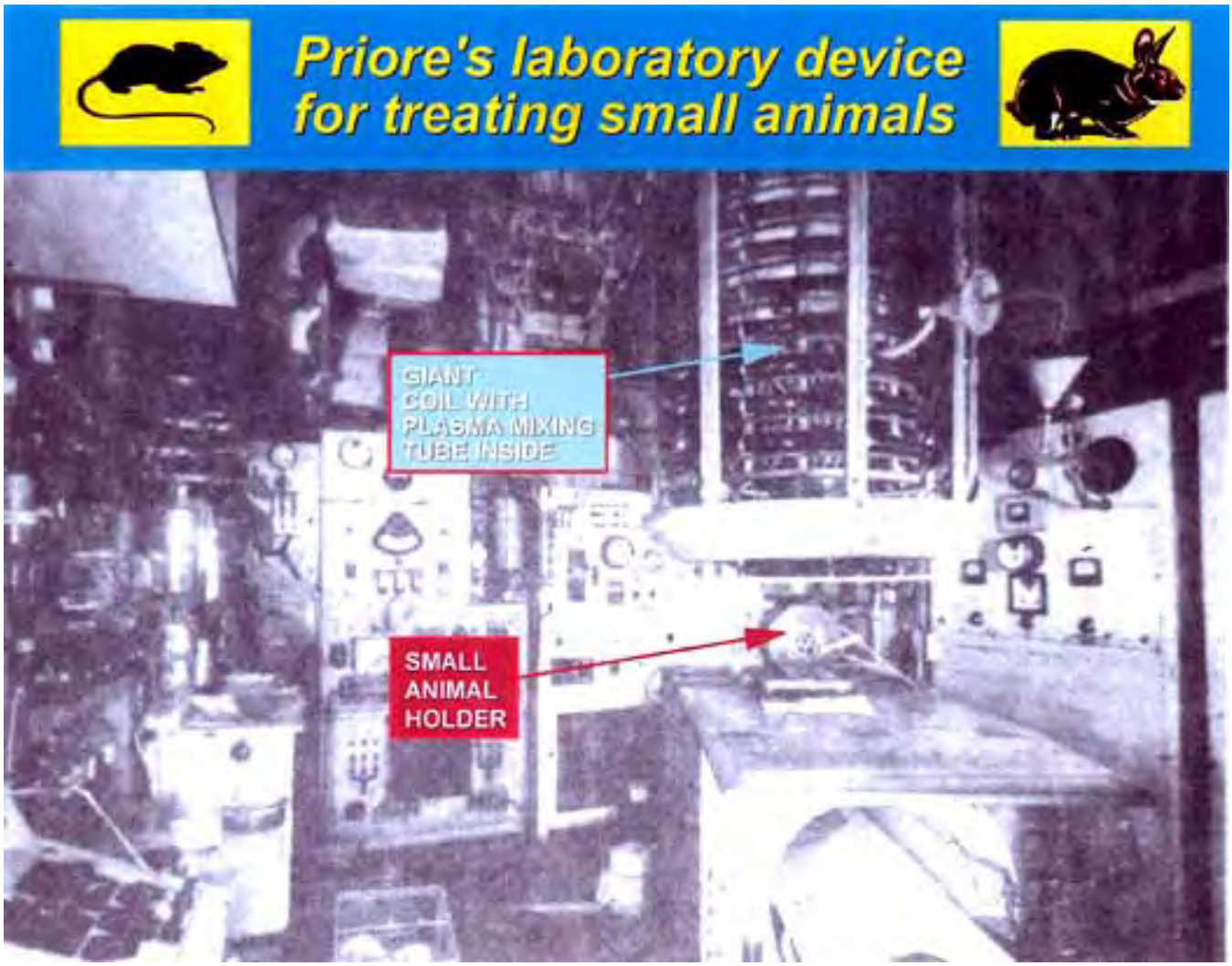

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Photo courtesy of Bob Whitney

Antoine Priore (right) with the Mayor of Bordeaux, Mr. Chaban-Delmas.

The Priore technical mechanism unwittingly involved a dramatic extension to both nonlinear optics and general relativity. However, nonlinear optics itself had not yet been born in the 1950s and 1960s when Priore worked out his methodology. The extension to general relativity has not been previously envisioned even to the present day. When the Priore project was suppressed by the changed French government in the mid-1970s, nonlinear optics itself was just being initiated. To the present day, however, there has previously been no inkling of the dramatic extension to NLO that arises by using longitudinal EM pump waves and thereby pumping in the time domain.

It is little wonder that Priore himself did not understand the nature of the technical mechanism he was utilizing, and neither did anyone else, and neither *has* anyone else prior to this time.

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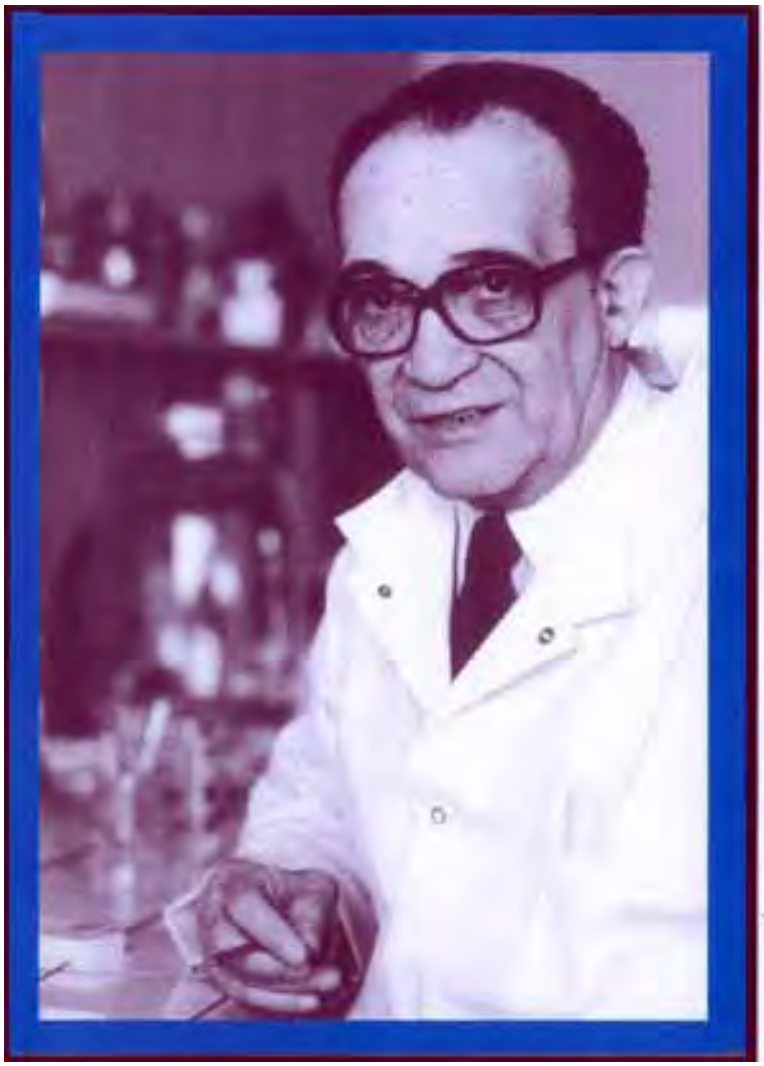

Raymond Pautrizel, eminent French parasitologist who worked with Priore

Among other things, Pautrizel treated seriously infected immature rats with the Priore ray. These rats had never had a mature immune system. When they were removed from the machine, they still sickened again and died, because their immature immune systems could not resist the pathogen *(Trypanosoma)*. So even though the damaged cells were reversed back to normal, the "normal" immune system was unable to fight off pathogens, which reinfected the cells and killed them, killing the rats.

This established the time-reversal nature of the therapy.

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12-Foot plasma tube in Priore's large device

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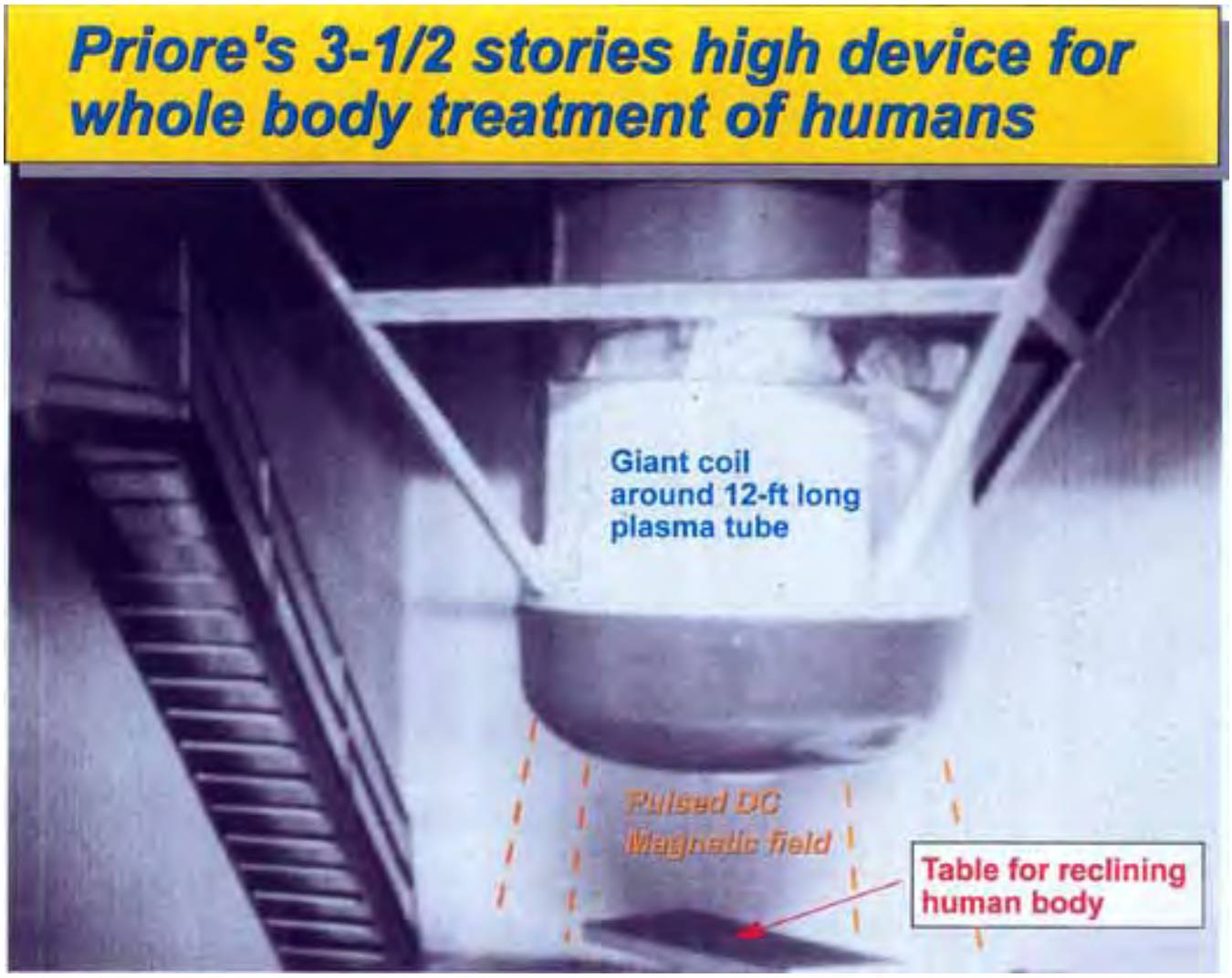

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MECHANISM OF THE PRIORE THERAPY

- FACT: DISEASE-SPECIFIC VACUUM ENGINE PRESENT FOR ANY CELLULAR DISEASE, BY WHEELER'S PRINCIPLE
  - *DISEASE CAN BE REVERSED BY CREATING AMPLIFIED VACUUM ANTI-ENGINE (BEARDEN'S PRINCIPLE)*
  - *ANTI-ENGINE IS CREATED BY PUMPING THE NONLINEAR CELLS IN THE "INNER EM" DOMAIN, TIME-REVERSING THEM*

- PRIORE UTILIZED A PLASMA TO PHASE CONJUGATE AND "INFOLD" MULTIPLE BIDIRECTIONAL LONGITUDINAL EM PUMP WAVES
  - *17 FREQUENCIES MIXED IN A ROTATING PLASMA*
  - *PHASE CONJUGATES ADDED BY THE PLASMA*
  - *INFOLDED MIX INTO STRONG PULSED DC MAGNETIC FIELD, WHICH CARRIED IT INTO ATOMIC NUCLEI*
  - *PUMPED ALL NONLINEAR CELLULAR COMPONENTS TO PRODUCE AMPLIFIED, SPECIFIC VACUUM ANTI-ENGINE*

- NEGATED THE LONG-TERM CUMULATIVE CELLULAR DEDIFFERENTIATION ORDER GENERATED BY LONG-TERM HYPOXIA. TUMOR CELLS REVERTED TO NORMAL CELLS.
- SCRUBBED OUT THE CUMULATED PRECANCEROUS STATE
- RESTORED THE IMMUNE SYSTEM TO HIGH FUNCTIONING
- NO EXCESSIVE TRAUMA TO TREATED ANIMAL

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Priore's therapeutic methodology: Using infolded longitudinal EM waves as NLO pump waves, to pump in the time domain

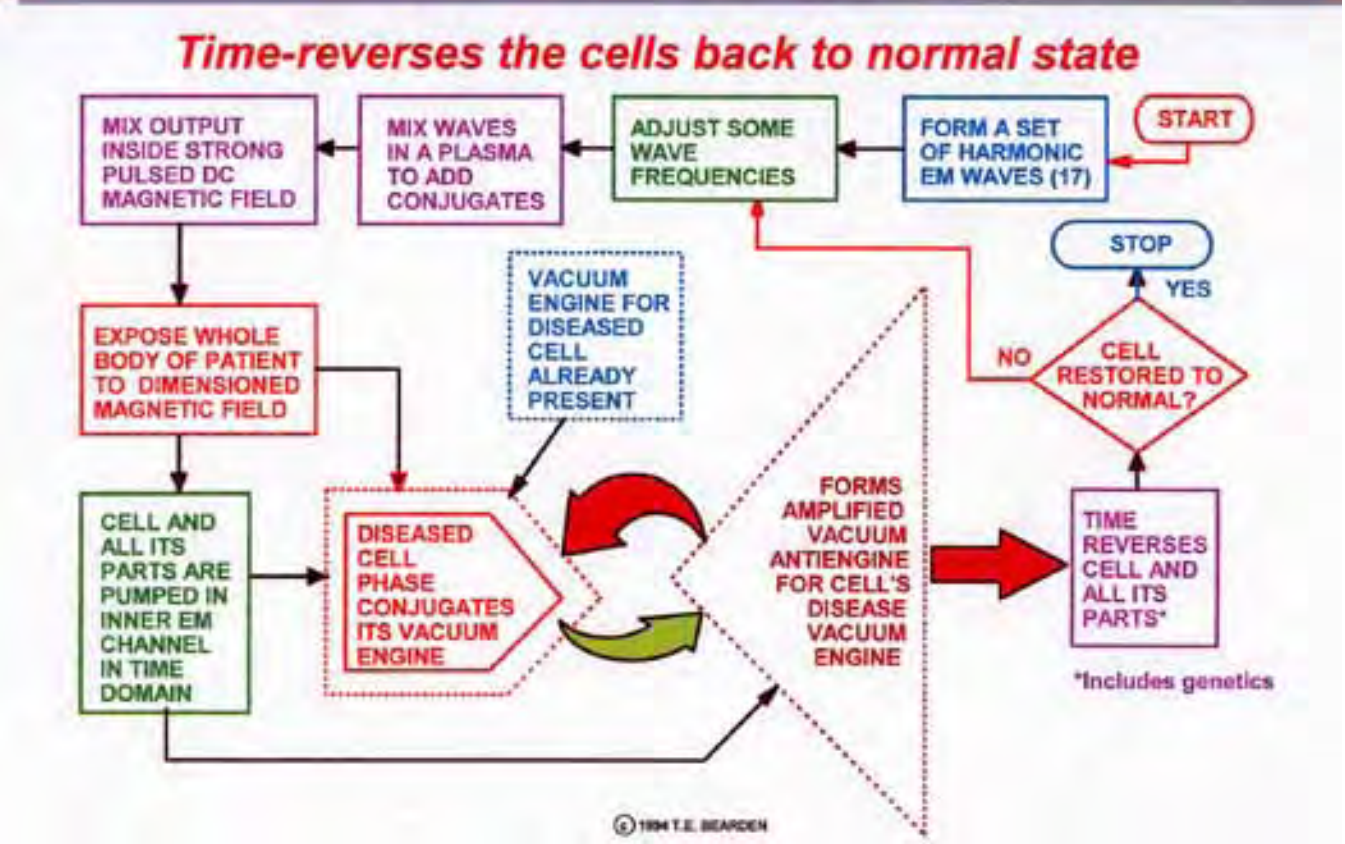

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DRASTICALLY REDUCED CUMULATIVE DETERIORATION AFTER PRIORE THERAPY

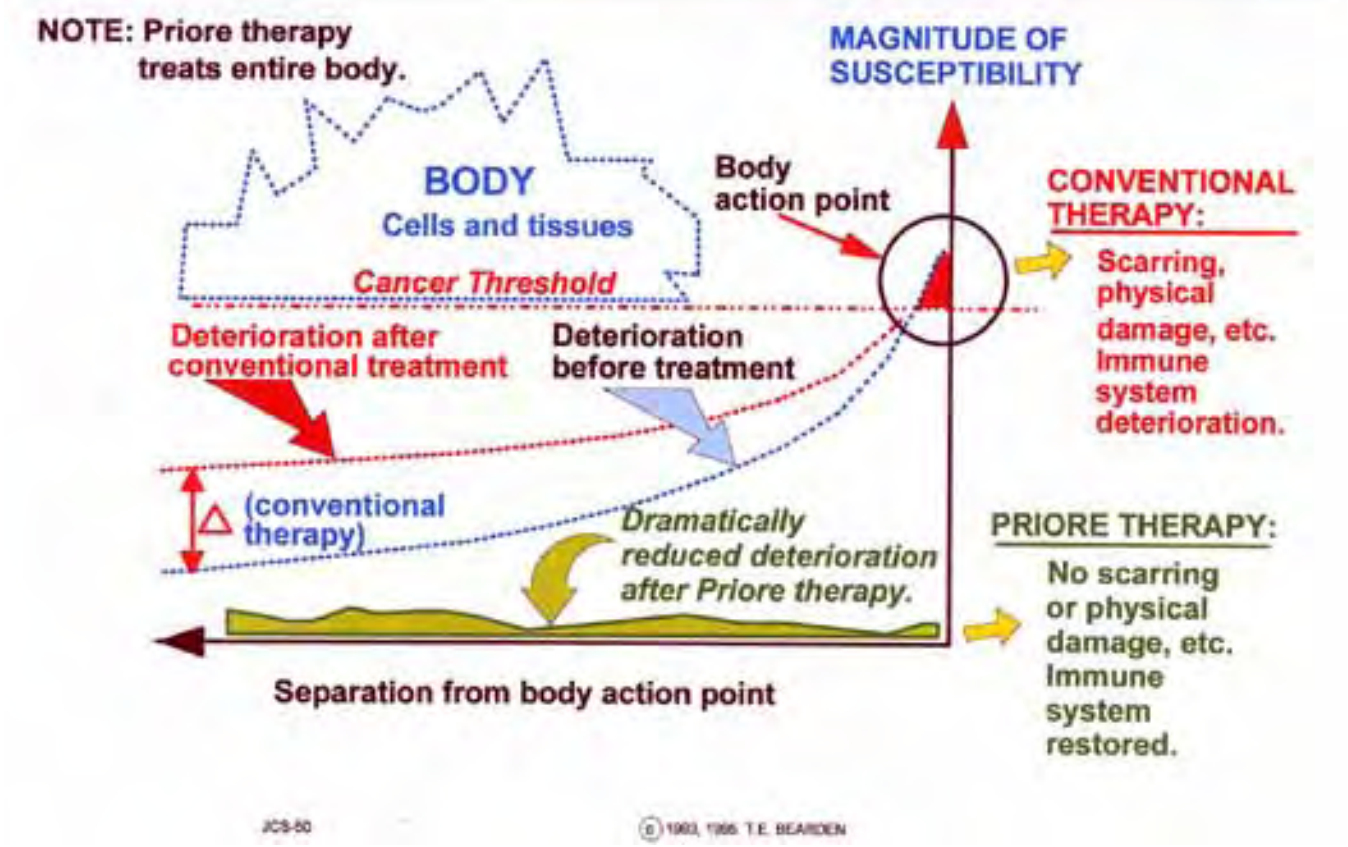

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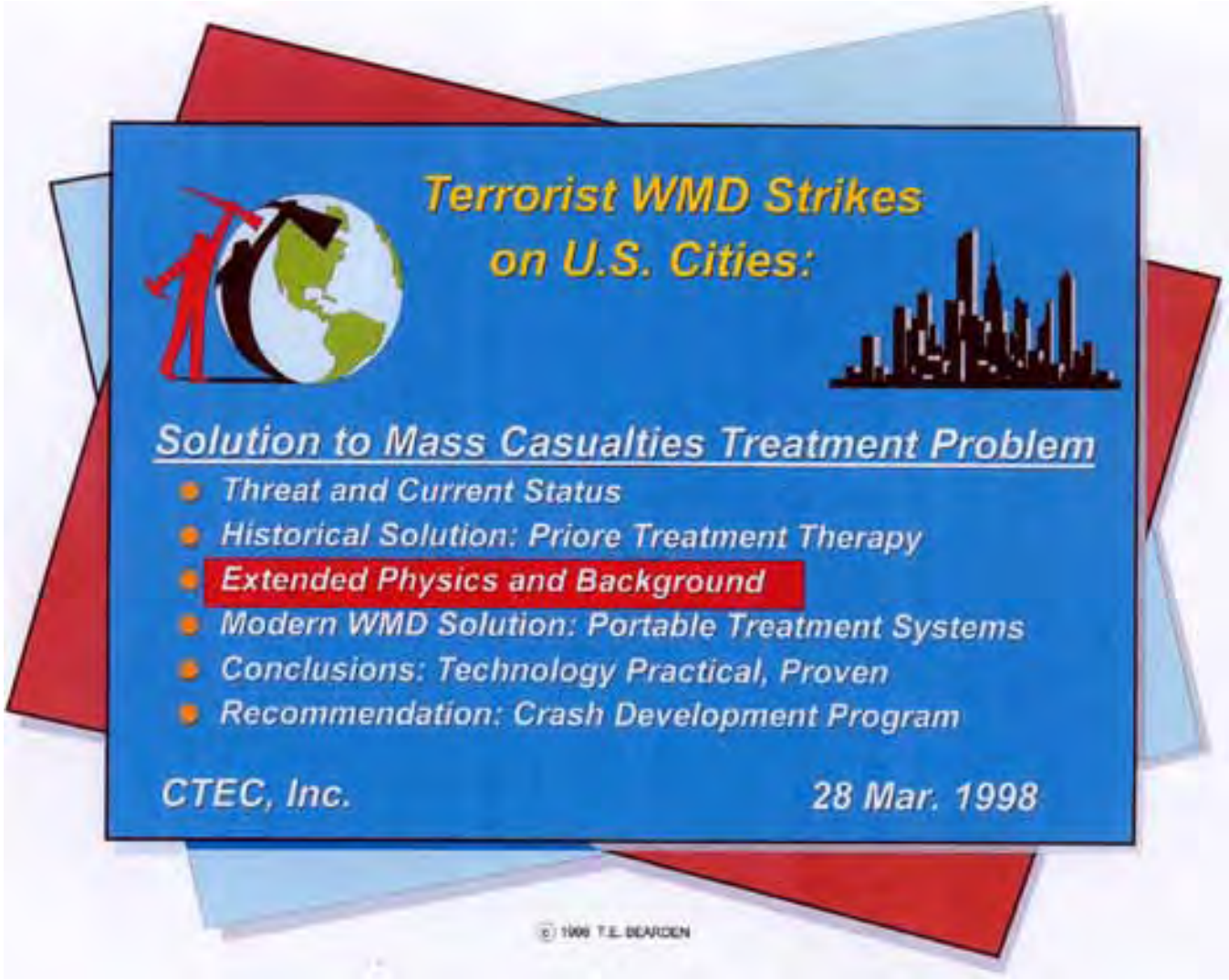

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Founders of Scalar Electromagnetics

- **G.J. Stoney:**

Decomposed the scalar potential into bidirectional wave pairs.

"On a supposed proof of a theorem in wave-motion," Phil. Mag., 5(43), 1897, p. 368-373 (and several other papers).

- **E.T. Whittaker:**

Decomposed the scalar potential into a series of bidirectional EM wave pairs in harmonic series, where the two waves in each pair are conjugates (i.e., a wave/antiwave pair) and are longitudinal waves.

"On the partial differential equations of mathematical physics," Math. Ann., Vol. 57, 1903, p. 333-355.

Showed that all classical EM -- including waves -- can be replaced by two interfering scalar potential functions.. (This founded superpotential theory, extended by Nisbet, Bromwich, Debye, McCrea, and others.)

"On an expression of the electromagnetic field due to electrons by means of two scalar potential functions," Proc. Lond. Math. Soc., Series 2, Vol. 1, 1904, p. 367-372.

- **R.W. Ziolkowski:**

Independently rediscovered the biwave decomposition of the scalar potential and added the product set (in theory enabling modulations and communications) to Stoney and Whittaker's sum set.

Various papers, 1985 to date.

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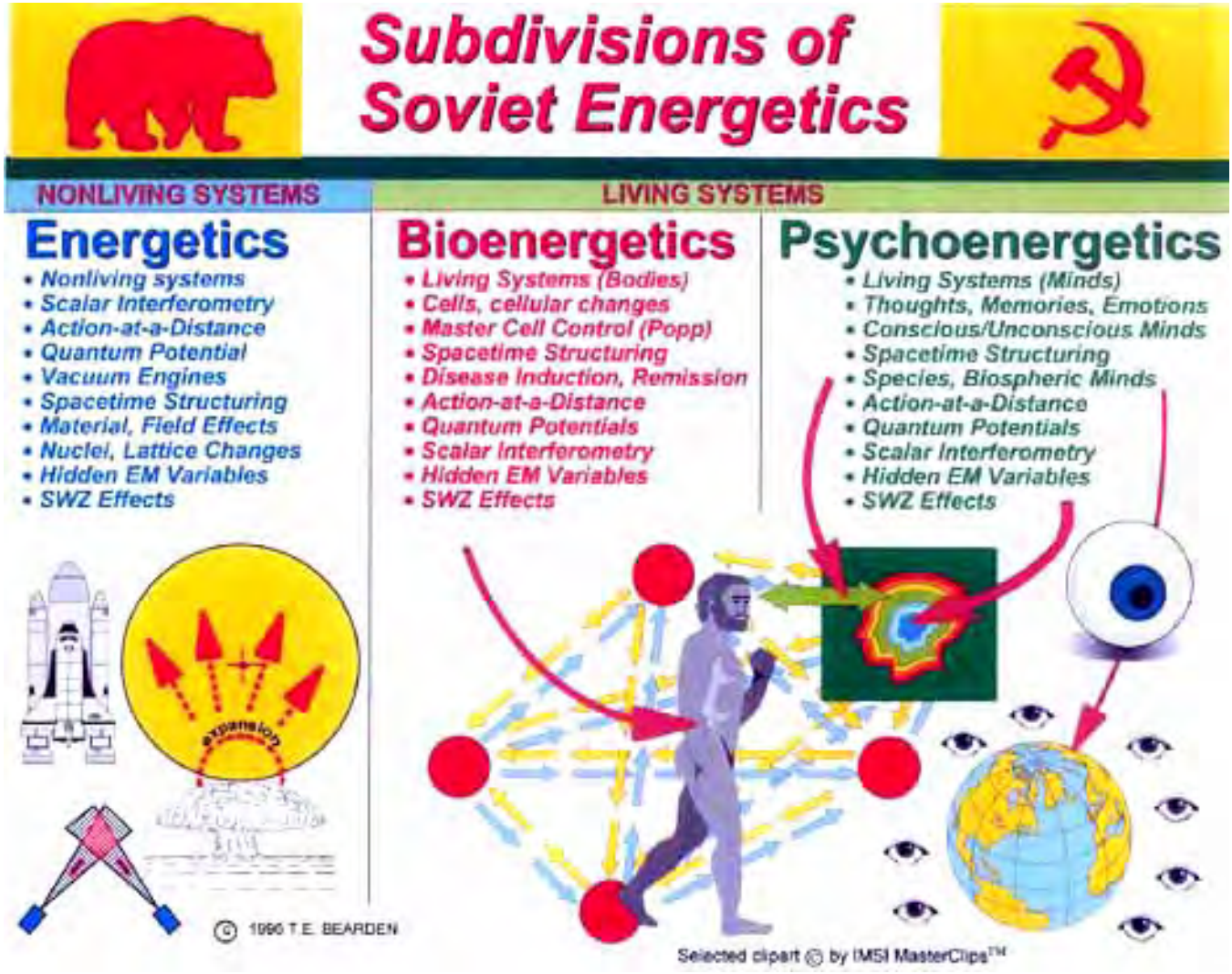

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Bunge on the Status of Classical and Quantum Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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EINSTEIN ON REVIEWING FOUNDATIONS

"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them."

Albert Einstein, "Foreword," in Max Jammer, Concepts of Space: The History of the Theories of Space in Physics, Harvard University Press, Cambridge, Massachusetts, 1969, p. xi-xii.

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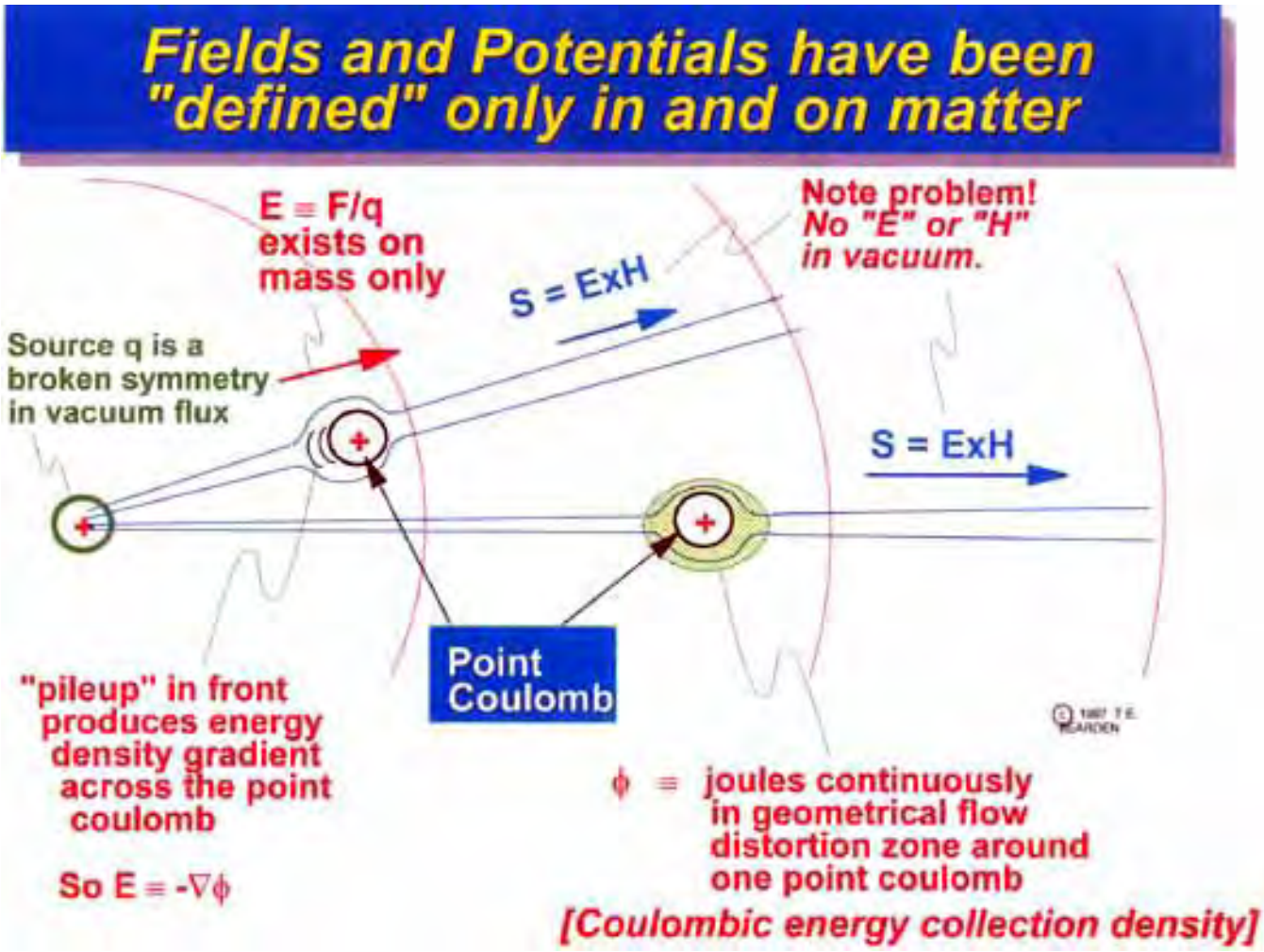

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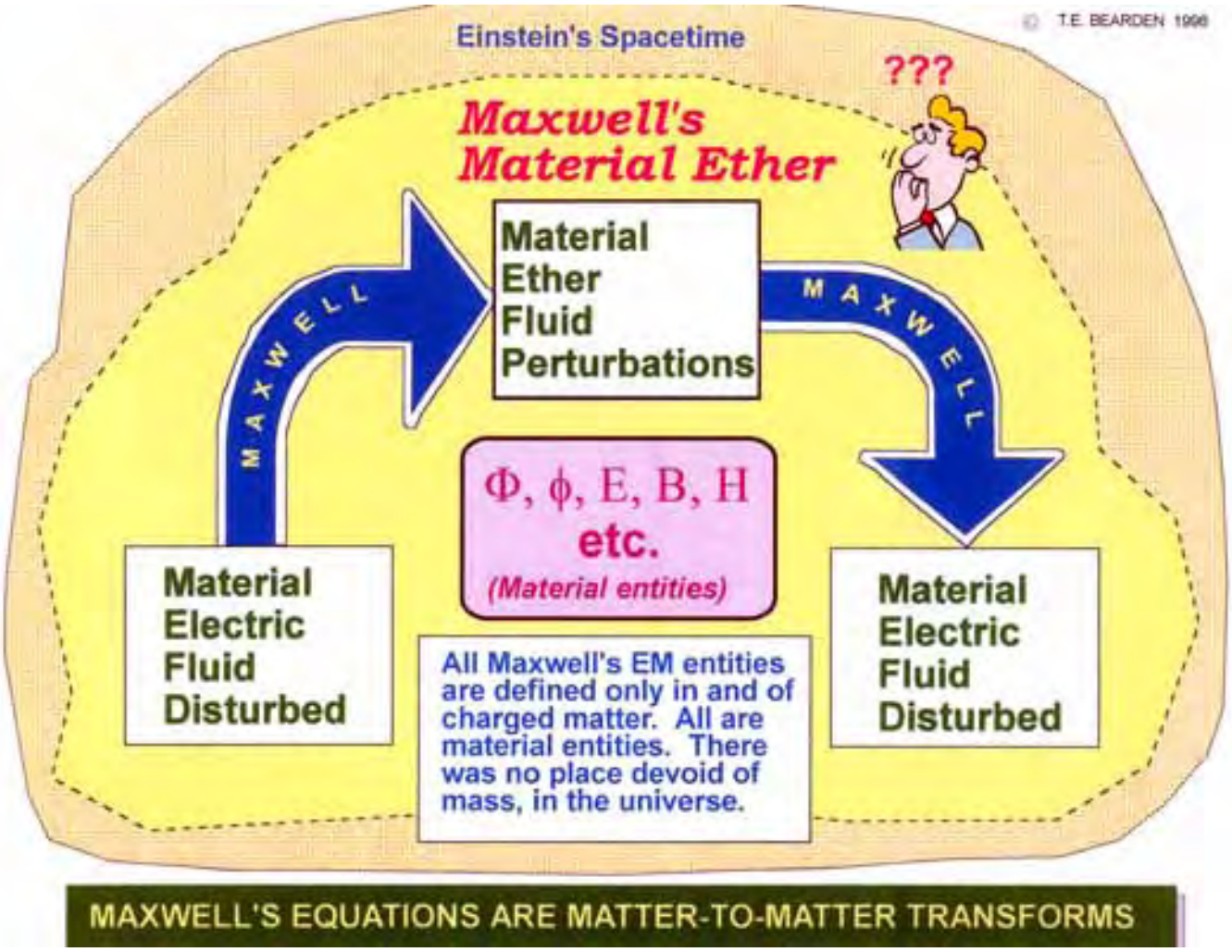

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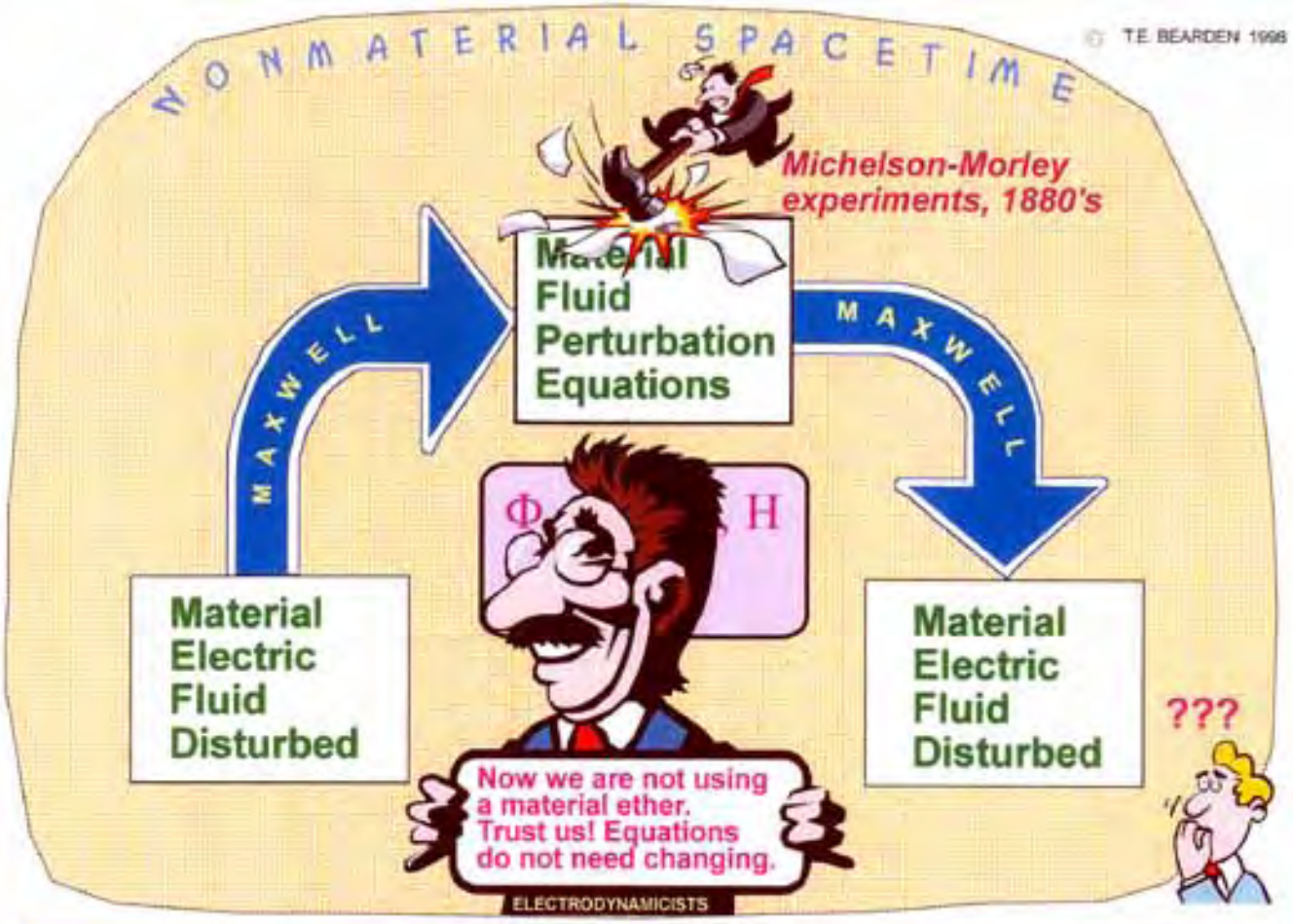

Electrodynamicists' Reaction to Removal of the Material Ether

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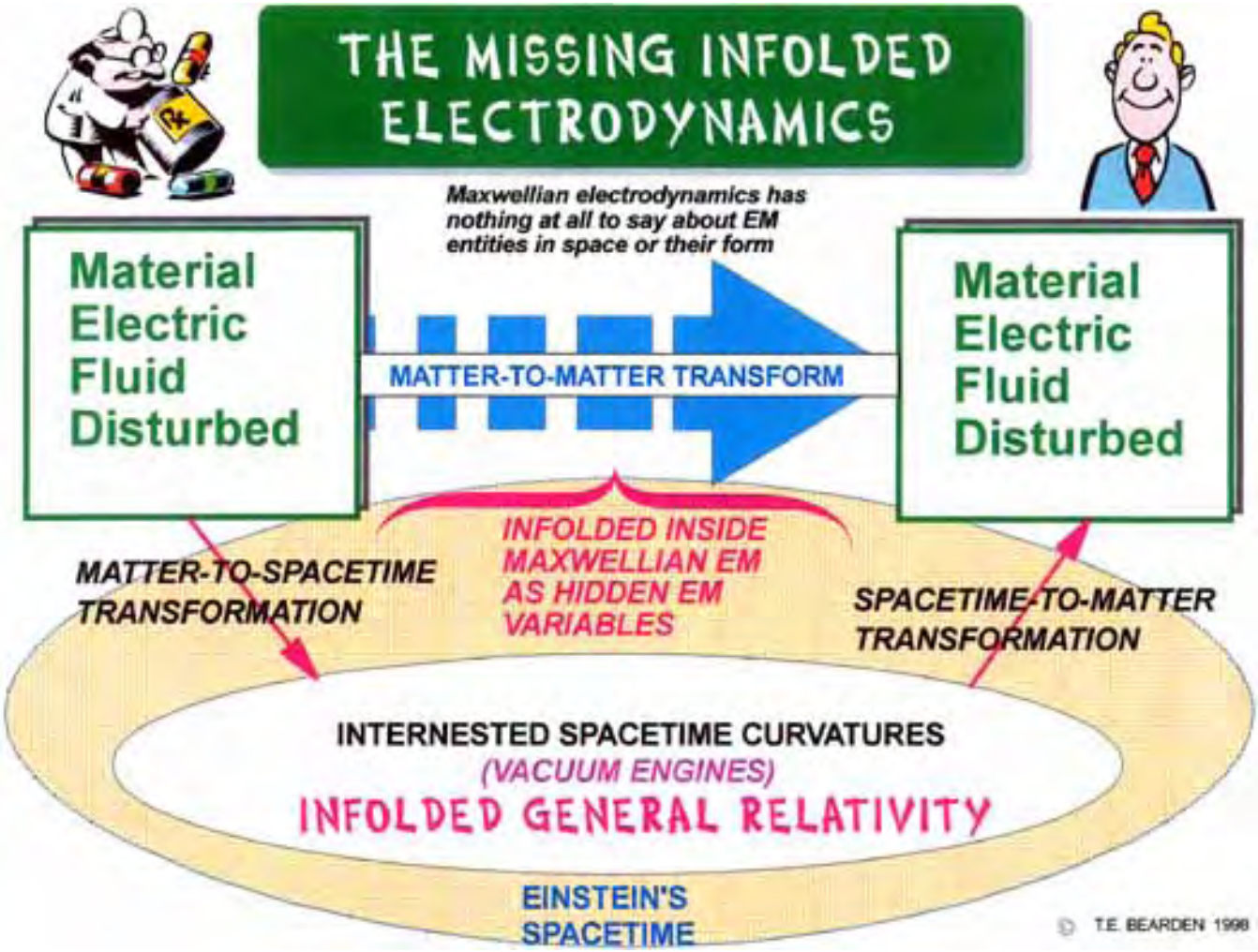

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Nonlinear Optics
Distortion Correction Theorem

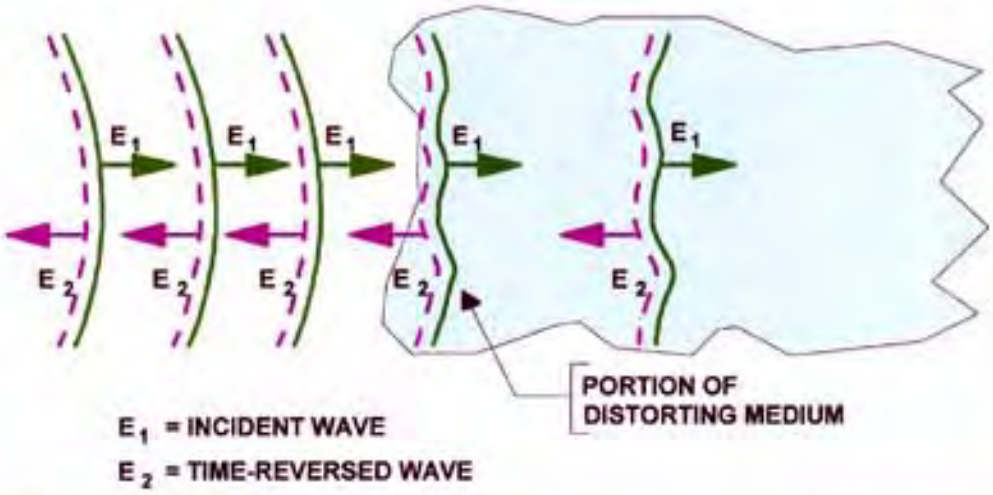

"If a scalar wave $E_1(r)$ propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica $E_2(r)$, then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1."

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Infolded longitudinal EM biwave composition of a scalar potential

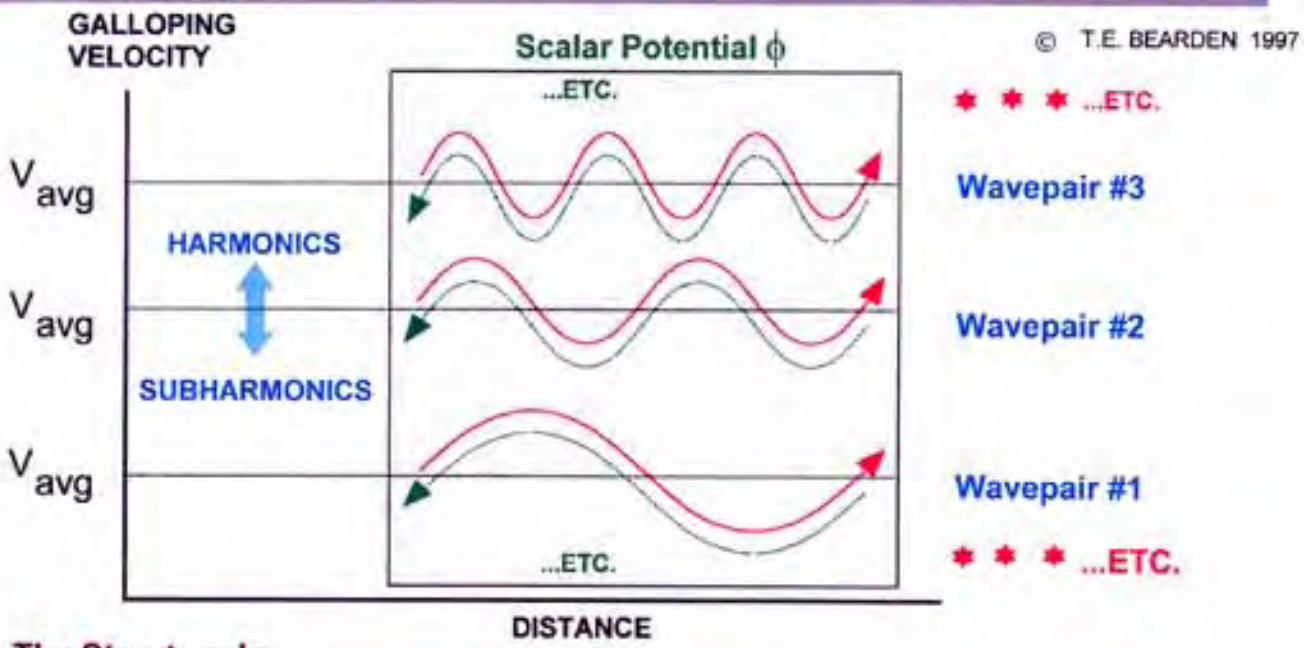

The Structure Is:

A harmonic set of longitudinal EM wavepairs. In each wavepair the two waves superpose spatially, but travel in opposite directions. The two are phase conjugates and time-reversed replicas of each other. Thus they comprise a coupled longitudinal wave and antiwave. The photons must be coupled into photon/antiphoton pairs (gravitons) by a strong application of the distortion correction theorem of nonlinear optics. Each wave in the biwave pair is a galloping wave. Each wavepair is a standing electrogravitational wave. In nonlinear optics, such a wavepair is a pump wave which pumps in the time domain.

Note: Think of the oscillations as velocity modulations.

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The Zero-Vector Axiom Destroys "Topologies within Topologies"

- The axiom: There is a unique vector, $\bar{0}$, in V (the vector space) such that
  $$\bar{V} + \bar{0} = \bar{0} + \bar{V}$$
- Note that $\bar{V} + \bar{0}_i = \bar{0}_j + \bar{V}$; $\bar{0}_i = -\bar{0}_i = n\bar{0}_i$
  so $\bar{0}_i = \bar{0}_j = \bar{0}_k = \ldots + \bar{0}_n = \ldots$
- This makes all $\bar{0}_i$ equal by assumption, since there is *assumed* to be only a single type $\bar{0}$ without real components
- In fact, $\bar{0}$ is <u>*not unique*</u>. An *infinite number* of different zero-vector systems, with real components, satisfy the zero-vector axiom.

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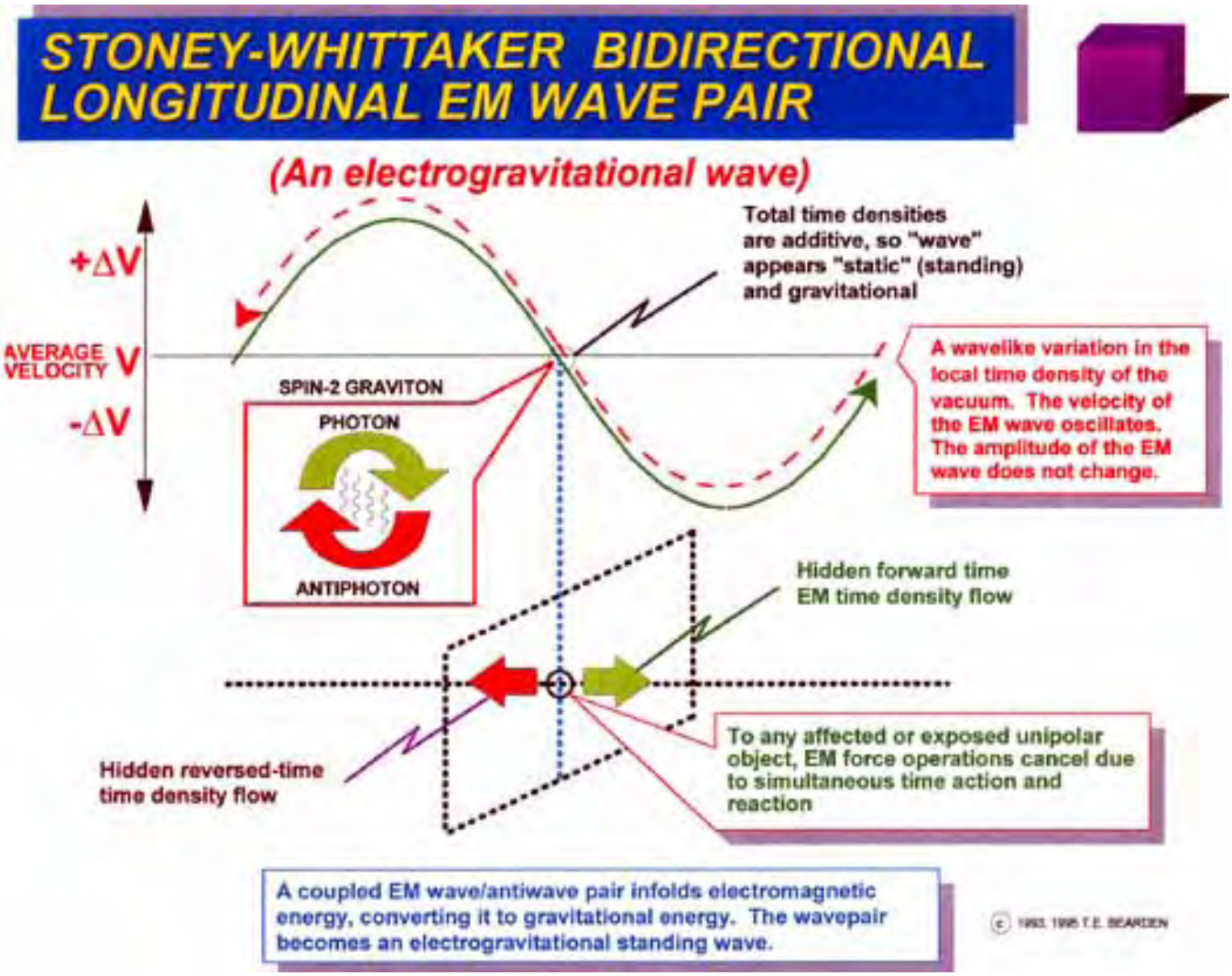

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Undistorted Progressive Waves (UPWs)*

(waves with velocity v, where $0 \leq v \leq \infty$)

- Major equations of interest having UPW solutions are:
  - *Homogeneous wave equation*
  - *Maxwell equations*
  - *Dirac, Weyl, and Klein-Gordon equations*

*Rodrigues and Lu, *Found. Phys.* 27(3), 1997, p. 435-508.

- UPWs are translationally invariant, and do not spread, or they reconstruct their original form after a certain period.
- UPW solutions have infinite energy. Quasi-UPWs can have finite energy and can in principle be launched into space.
- Subluminal Maxwell solutions are called *EM particles*. Superluminal Maxwell solutions are called *X-waves*.
- *Experimental results indicate such waves will be produced within the next few years.*

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- *Nimtz has translated Mozart's 40th symphony at v = 4.7c.*

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Velocity modulating a longitudinal EM wave oscillates rate of flow of time

$$V = \frac{L}{t}$$

Observer sees it this way

Constant transverse wave magnitude

Wave oscillates its velocity along its path, about a nominal value

Wave oscillates this way

Constant transverse magnitude

Wave oscillates magnitude of its transported t, about a nominal value

Note:

- Waves consist of photons
- Each photon consists of energy x time
- Each photon carries time as well as energy
- A wave is both a spatial energy dynamics and a temporal dynamics
- Wave complexes carry dynamic time structures as well as dynamic energy structures

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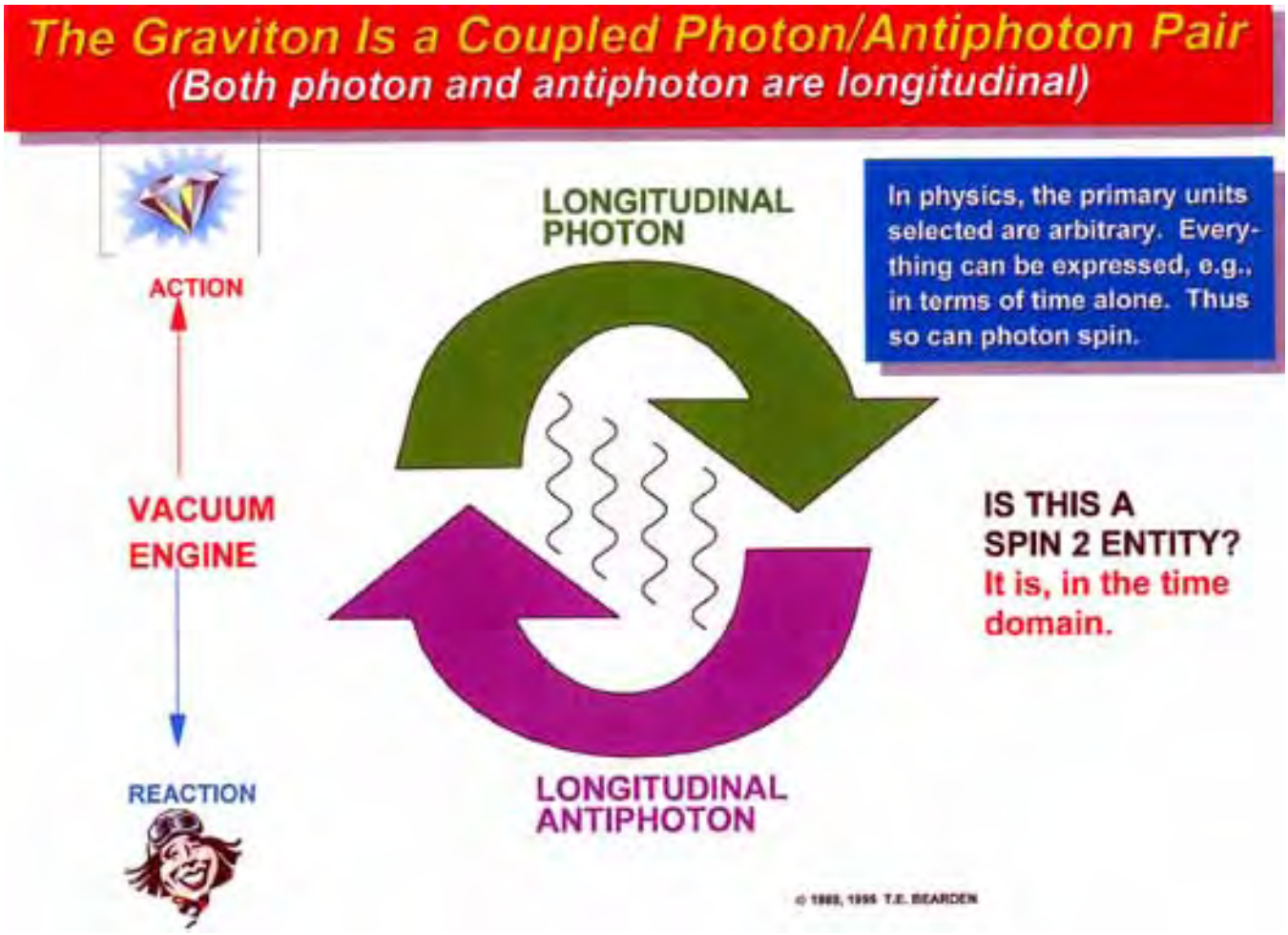

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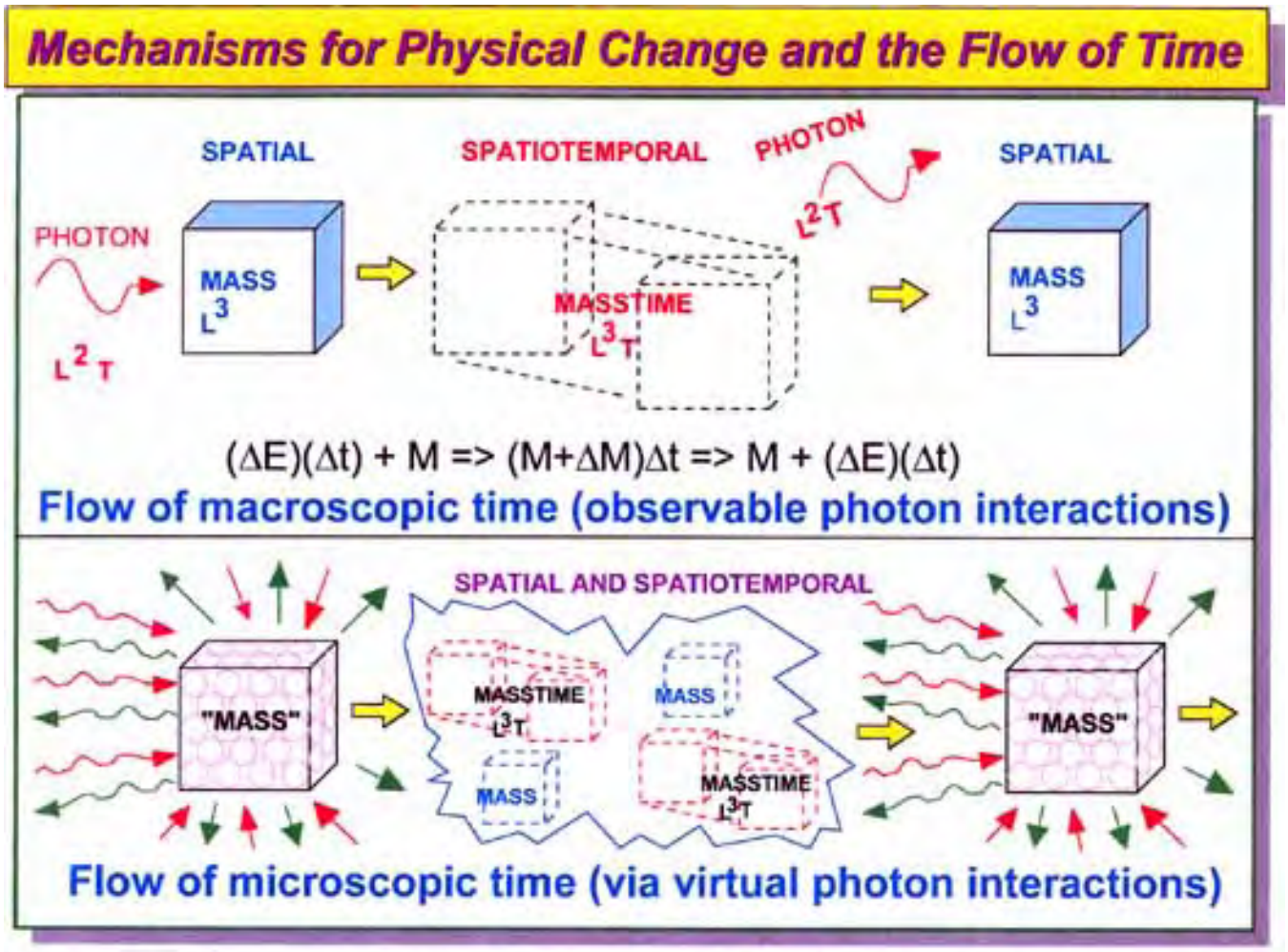

The photon interaction generates an observed quantum change and a discretized jump in the rate of time flow. A particle observably changes by only a single Δ t at a time. The background flow of time in which the jump in rate occurs, is created by the continual absorption and emission of virtual photons.

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Any EM Field or Wave Pattern Is Produced by interference of Two Scalar Potential Functions *(E.T. Whittaker, 1904)*

(Use of Hidden Information Content of the Field)

(Can Provide Action-at-a-Distance)

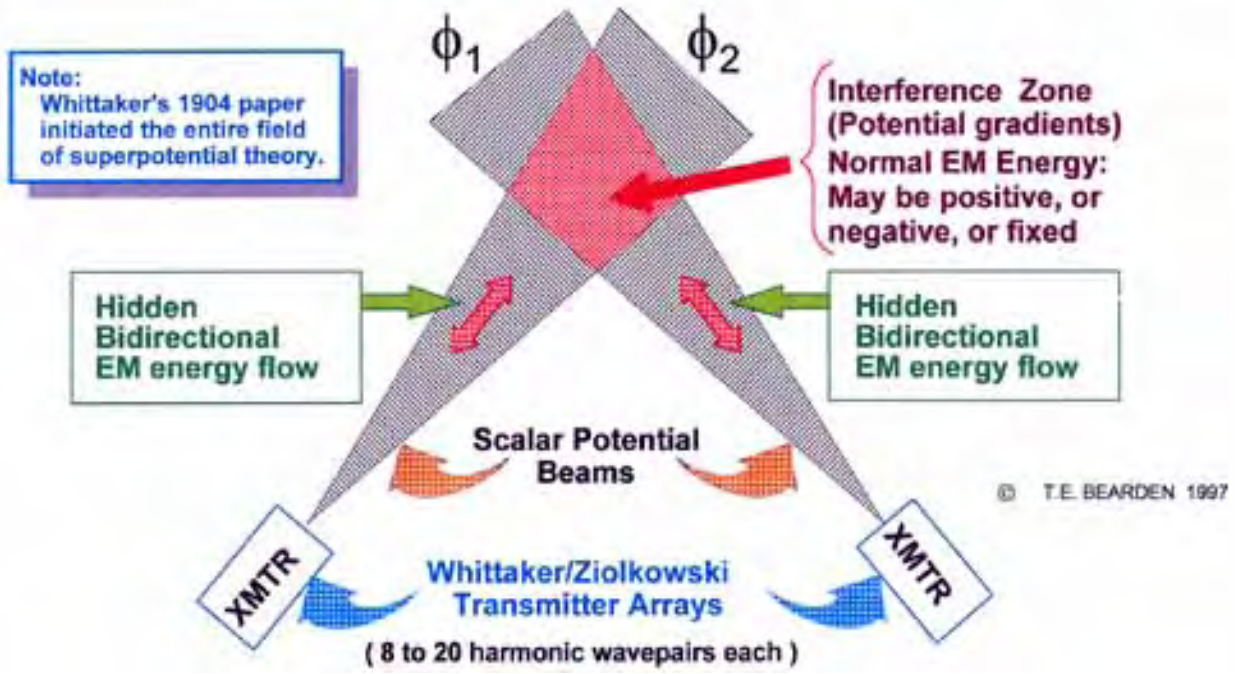

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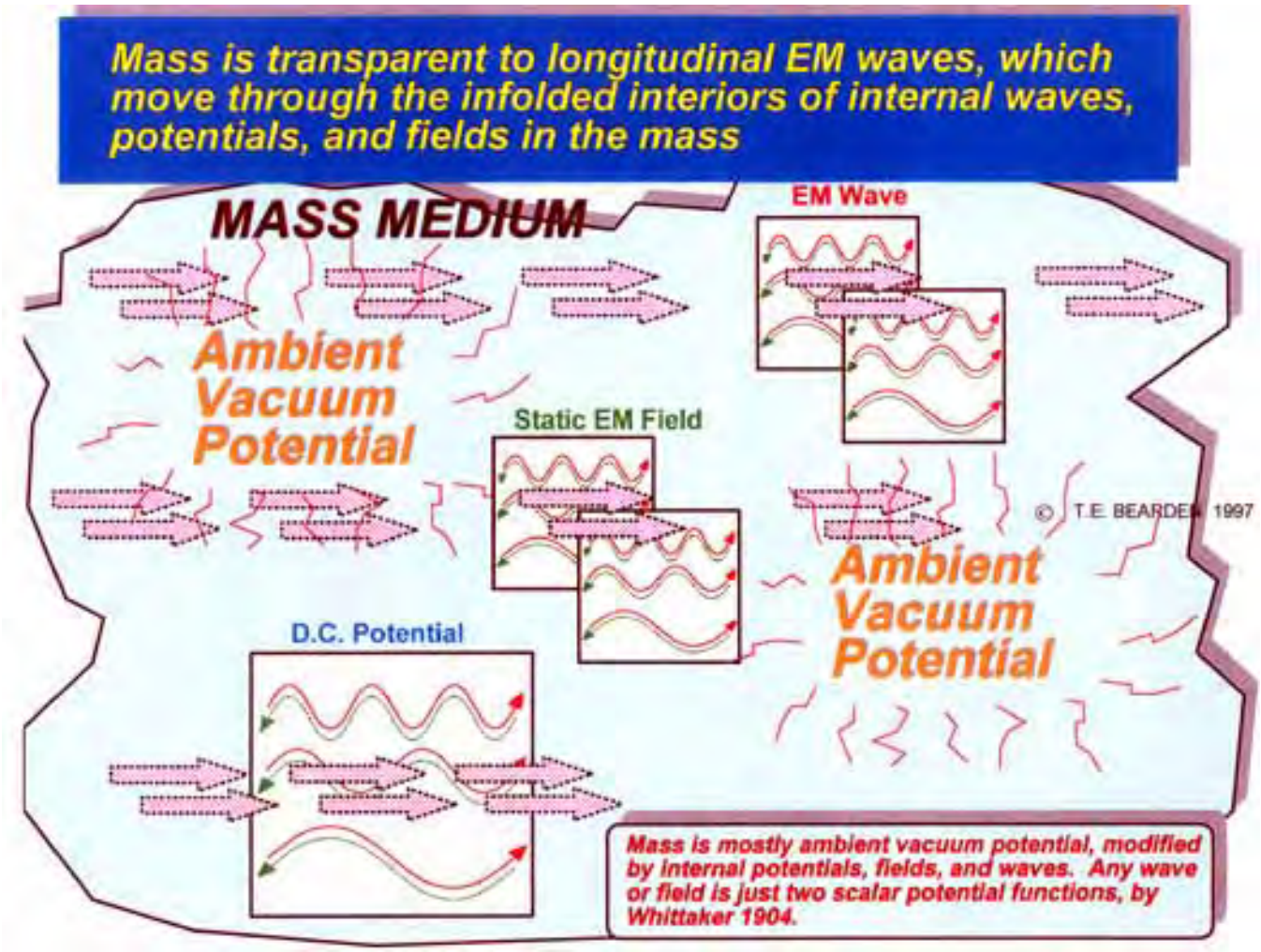

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Deep penetration of weak signals in a dense signal environment, by nonlinear retroreflection

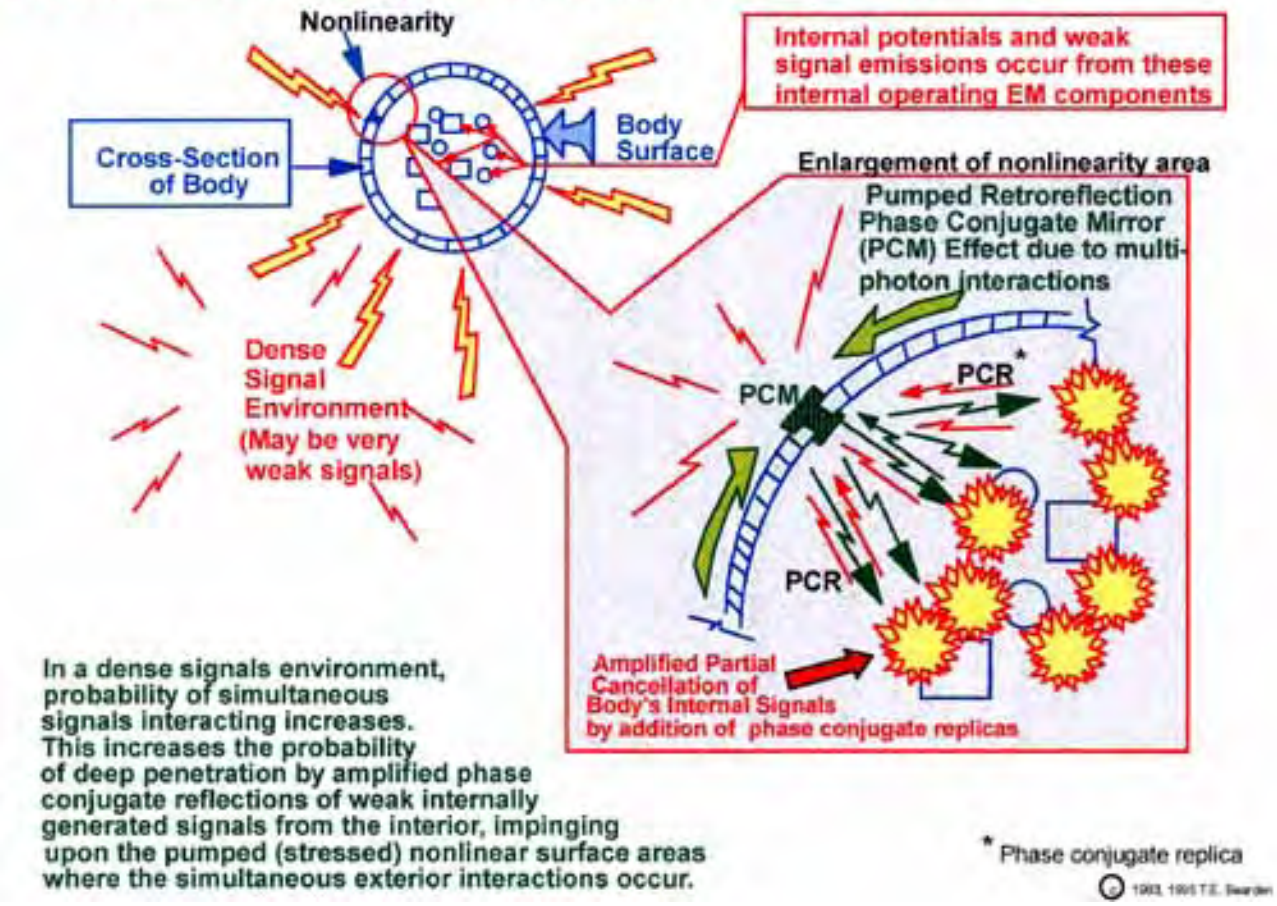

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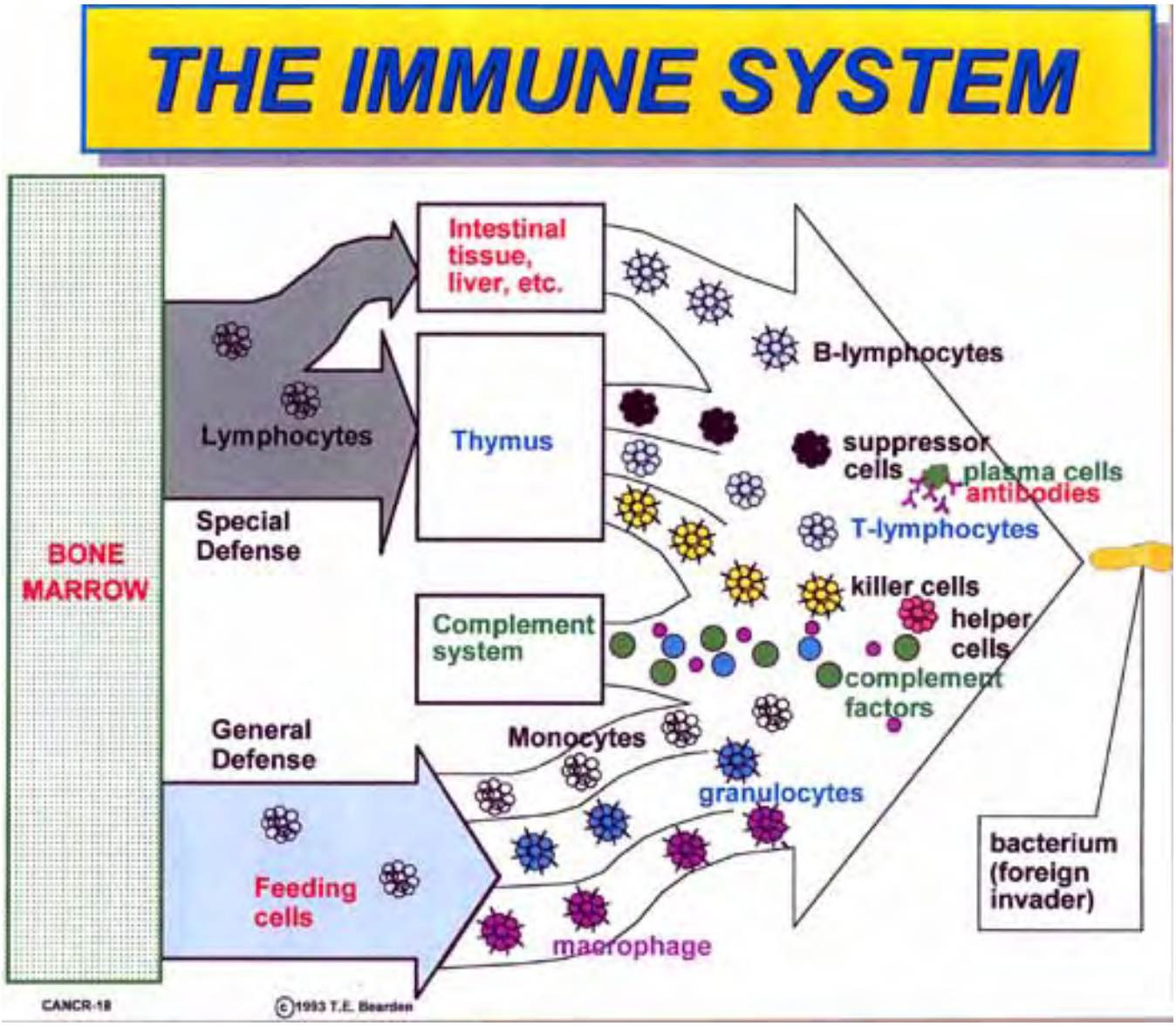

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Popp's master cellular control system

- Provides coherent, long-range interactions in biological systems
- Is an organized morphogenetic field at the basis of functional control

- Emission very sensitive to almost all external and internal influences
- Both spontaneous and delayed luminescence occur
- Photons stored in cell during the delay

- Leakage provides ultraweak, coherent biophoton emission from the system
- Fractional intensity pattern: few to some 100s of photons/cm^2/sec
- Optimum signal-to-noise ratio

- A single delayed biophoton may be able to trigger 10^{10} reactions in a cell before its release
- Spectrum almost continuous within optical range from 200-800 nm.

- Biophoton emission shows biological system always out of equilibrium
- Emission has holistic characteristics
- Correlations to most, if not all, of the biological functions of the organism

- DNA, all other processes are sources
- Single main process of whole system, different processes strongly coupled
- Information function and sync of biological clocks (oscillators)

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CANCER: CHARACTERISTICS

- NOT ONE DISEASE BUT A WHOLE RANGE
- STARTS IN ORDINARY (AEROBIC) CELL
- CELL SHAKES OFF BODY'S DICTATORIAL CONTROL*
- STARTS UNCONTROLLED DIVISION
- BECOMES A LUMP
- CAN SEND FORTH CANCER CELLS
  - THROUGH BLOOD
  - THROUGH LYMPH
- THESE FORM METASTASES (SECONDARY TUMORS)
- OFTEN BECOME ANAEROBIC (NON-OXYGEN USING)
- ENIGMA IS FAILURE OF IMMUNE SYSTEM TO ATTACK SOME TUMOR CELLS
  - SUPPRESSOR CELLS MAY CURB IMMUNE SYSTEM
  - TUMOR MAY LACK ANTIGENS NORMALLY IDENTIFIED BY THE IMMUNE SYSTEM

**R&R system forces cell back toward anaerobe*

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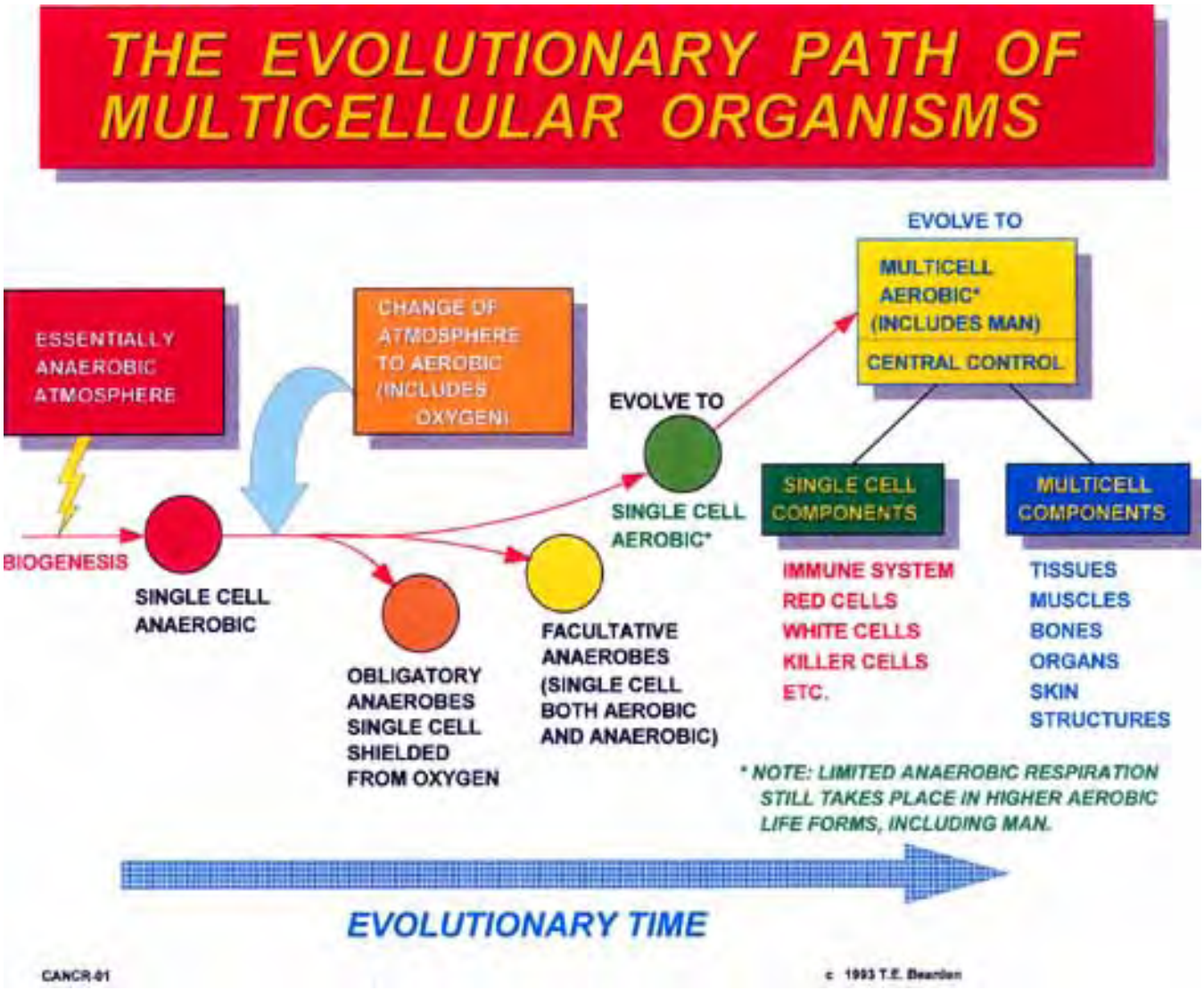

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EFFECT OF FLUID CONTAMINATION ON HEMOGLOBIN'S OXYGEN TRANSPORT

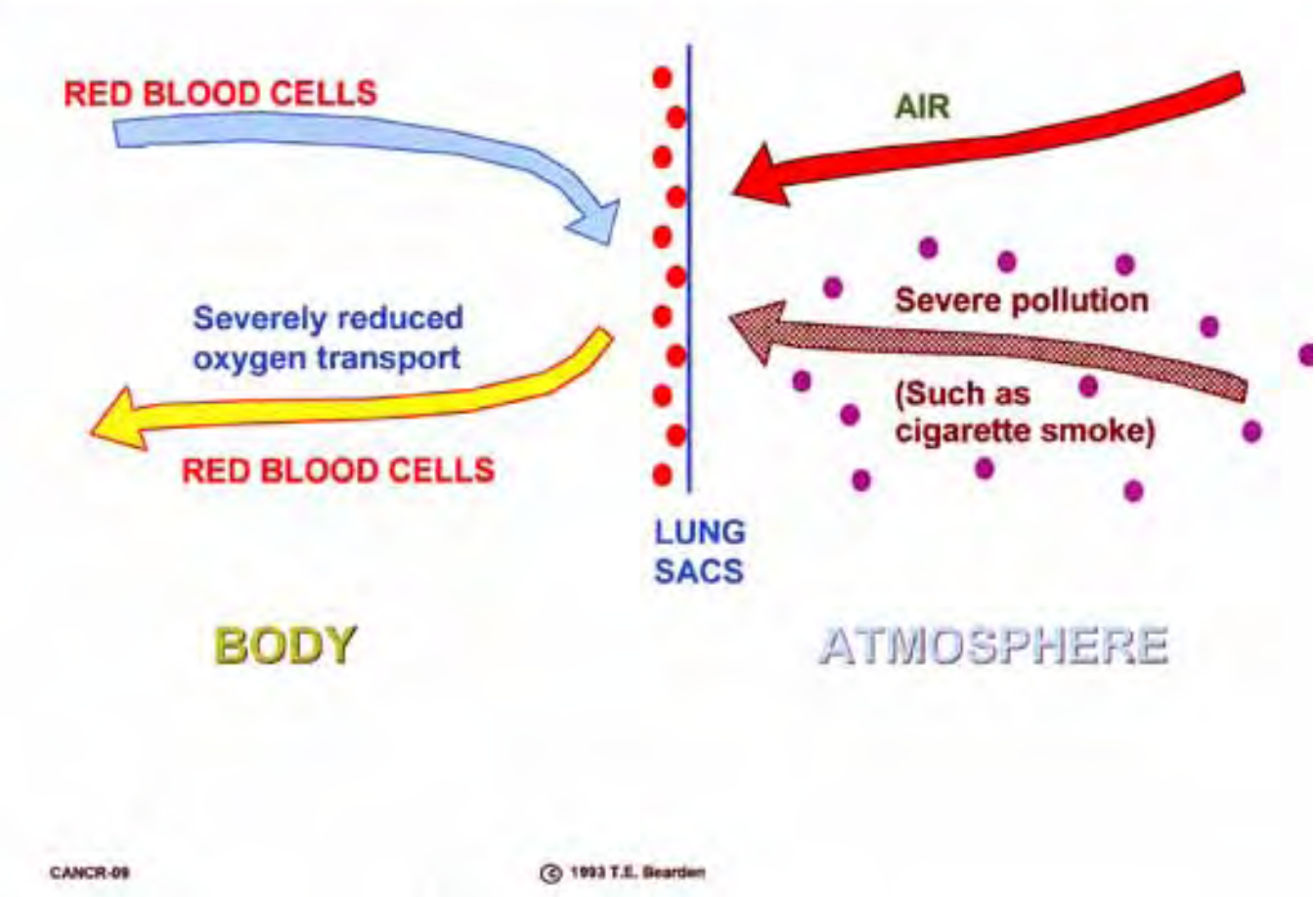

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FIRST STEP IN SELF-PROMOTION OF CANCER DUE TO HYPOXIA

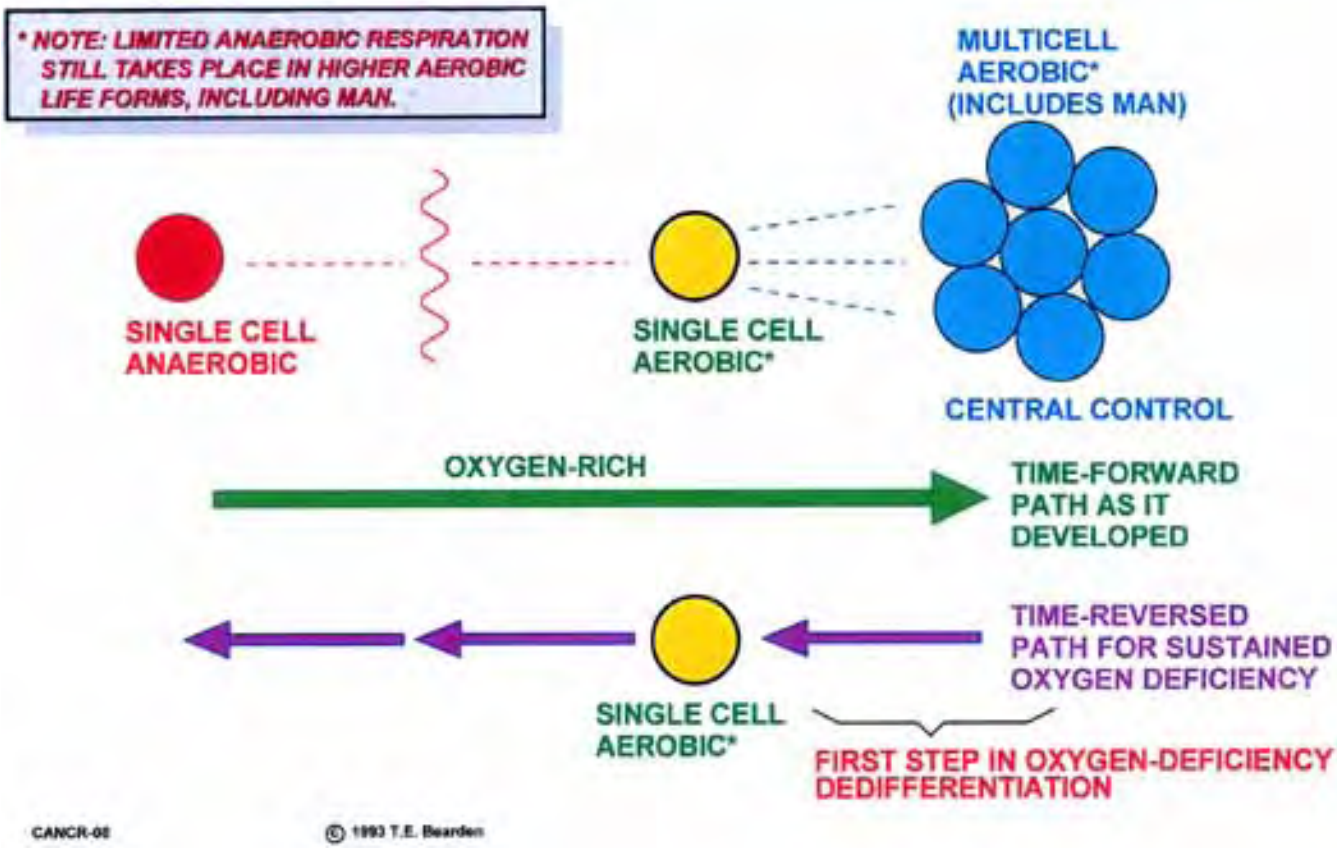

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BECKER'S CELLULAR GROWTH CONTROL

- Two major links uncovered between :
  - The DC system and nervous system
  - The DC system and all body cells
- Bioelectric potentials of primary importance
- Physiology presently considers controls limited to:
  - Neural action potential
  - Various hormone chemical agents
  - Chemical agents associated with DNA/RNA system
- Complete Operational Biological Control System:
  - Controls growth, healing, biological cycles, etc.
  - Operates in ANALOG mode; various levels of DC
  - Interlocks physically with nervous system (and may be its precursor)
  - Other chemical agents
  - Tissue growth and healing NOT INCLUDED
- Medical community now more concerned with diseases resulting from:
  - Inadequate/abnormal growth
  - Inadequate healing

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Becker's dc treatment of bone fractures

Application of tiny DC currents to heal difficult bone fractures. Only picoamperes are utilized. Pulsed DC current or pulsed magnetic fields may also be utilized.

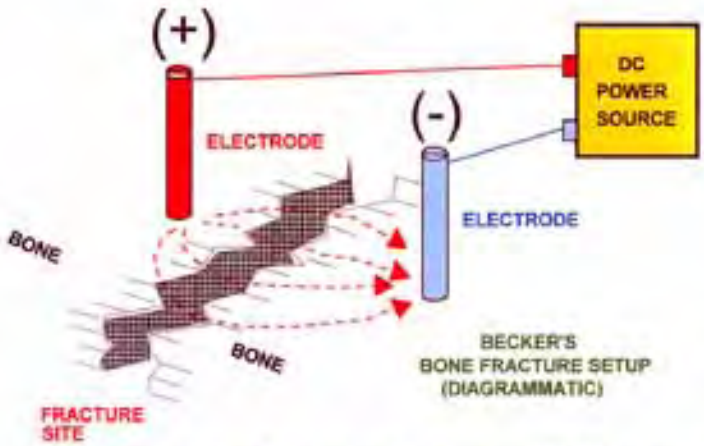

RED BLOOD CELL DEDIFFERENTIATES
Shucks hemoglobin coat
Grows nucleus

NEW CELL REDIFFERENTIATES
Turns into type of cell that makes cartilage

NEW CELL REDIFFERENTIATES
Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture

Proves that cells can be time-reversed (phase conjugated) (dedifferentiated) or time-forwarded (redifferentiated) by application of very weak electromagnetic signals, when those signals contain longitudinal bidirectional EM "pump wave" wavepairs, which cause the cell and its parts to create precise vacuum antiengines.

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Becker's theoretical DC control system involved with response to injury*

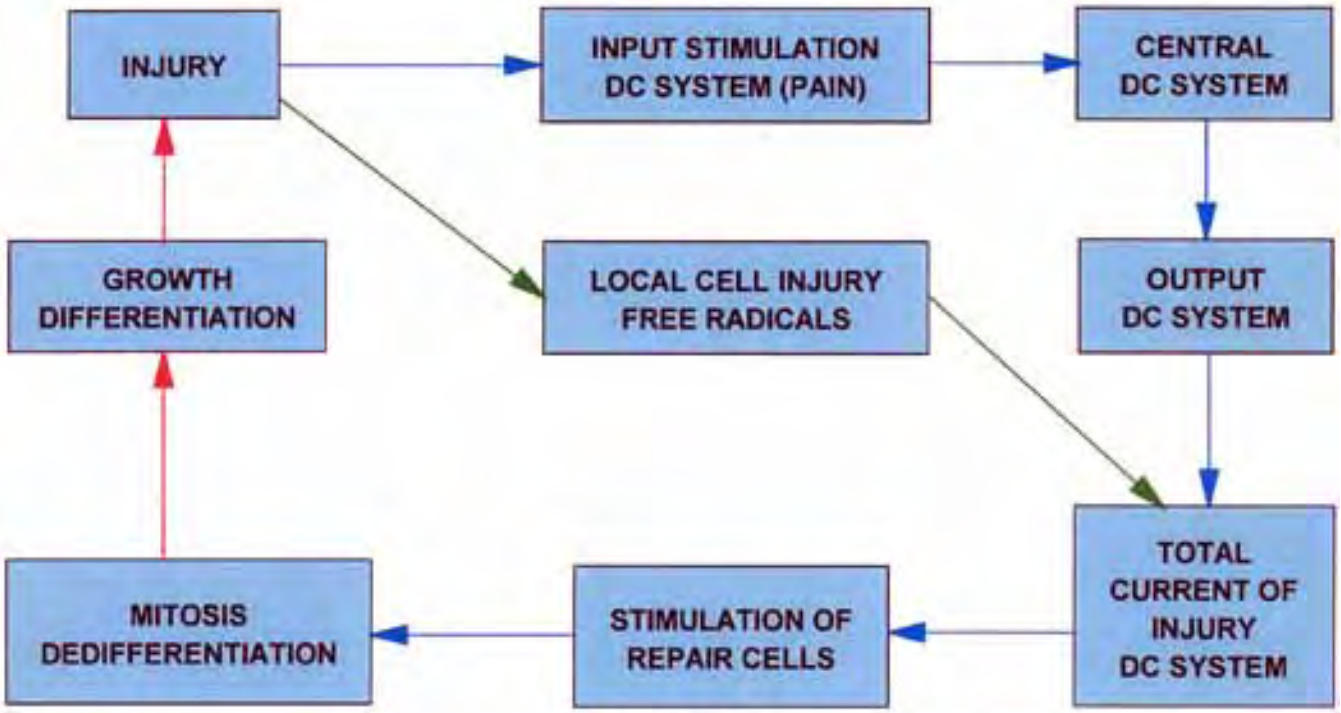

*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

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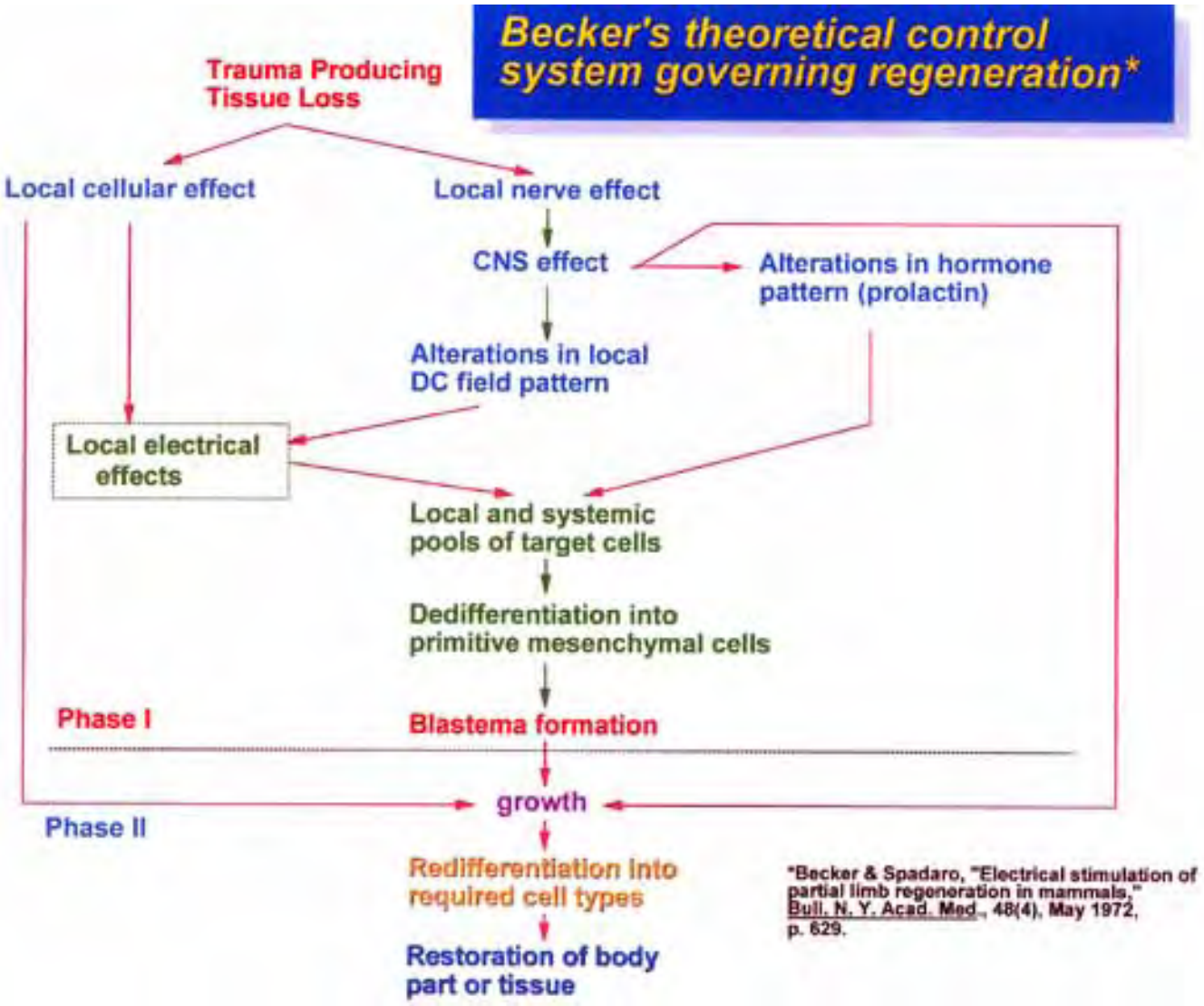

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Link Between Standing DC Potentials and the Nervous System

- Standing DC potentials on intact surfaces of all living animals demonstrate a complex field pattern spatially related to the anatomical arrangement of the nervous system
  - Can be measured directly on the peripheral nerves
  - Polarity difference related to whether nerve is or is not a sensor
  - Steady (weak) current flow exists
  - Demonstrates solid state/semiconductor phenomena
  - Accurately reflects (amplitude and polarity) the general level of neural activity
    - Sleep versus wakefulness
    - Anesthesia versus conscious
    - Other parameters
- DC levels determine the level of neural activity
- Action potential system exists upon a substratum of DC potentials which pre-existed it
- DC potentials substrata had and have control functions over basic properties of the living organism

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Becker's Findings on Cellular Injury and Regeneration*

- Cellular processes are regulated by a precise control system
- Attempted to apply engineering control-system theory
- Cells and tissues have solid-state electrochemical features which provide control signals in the control system
  - Growth process
  - Electron transfer
  - Semiconduction
  - Self-organizing *(NOTE: Implies hidden variables and nonlocal causality)*
- Complex electrical events at the injury site initiate cellular aspects such as dedifferentiation and mitotic activity
- Regeneration is a 2-step process, each with different controls
  - Electrical triggers with threshold values results in appearance of blastema
  - Complex data transmission to blastema establishes it as a self-organizing system capable of growth and redifferentiation
  - Mammals lack ability to produce blastemas except for bone, but partial regeneration growth has been shown in response to electrical stimuli
- Growth related to electrical more than electrochemical aspects
- Hematopoietic marrow as source of cells for the blastema
  - Monocytes can take place in regenerative processes in limbs
  - Lymphocytes can dedifferentiate under certain circumstances
  - Marrow elements can be induced into osteogenesis

*R.O. Becker & J.A. Spadaro, "Electrical Stimulation of Partial Limb Regeneration in Mammals," Bull. N. Y. Acad. Med., 48(4), may 1972, p. 627-641.

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Corrections For the Present EM Bioeffects Model

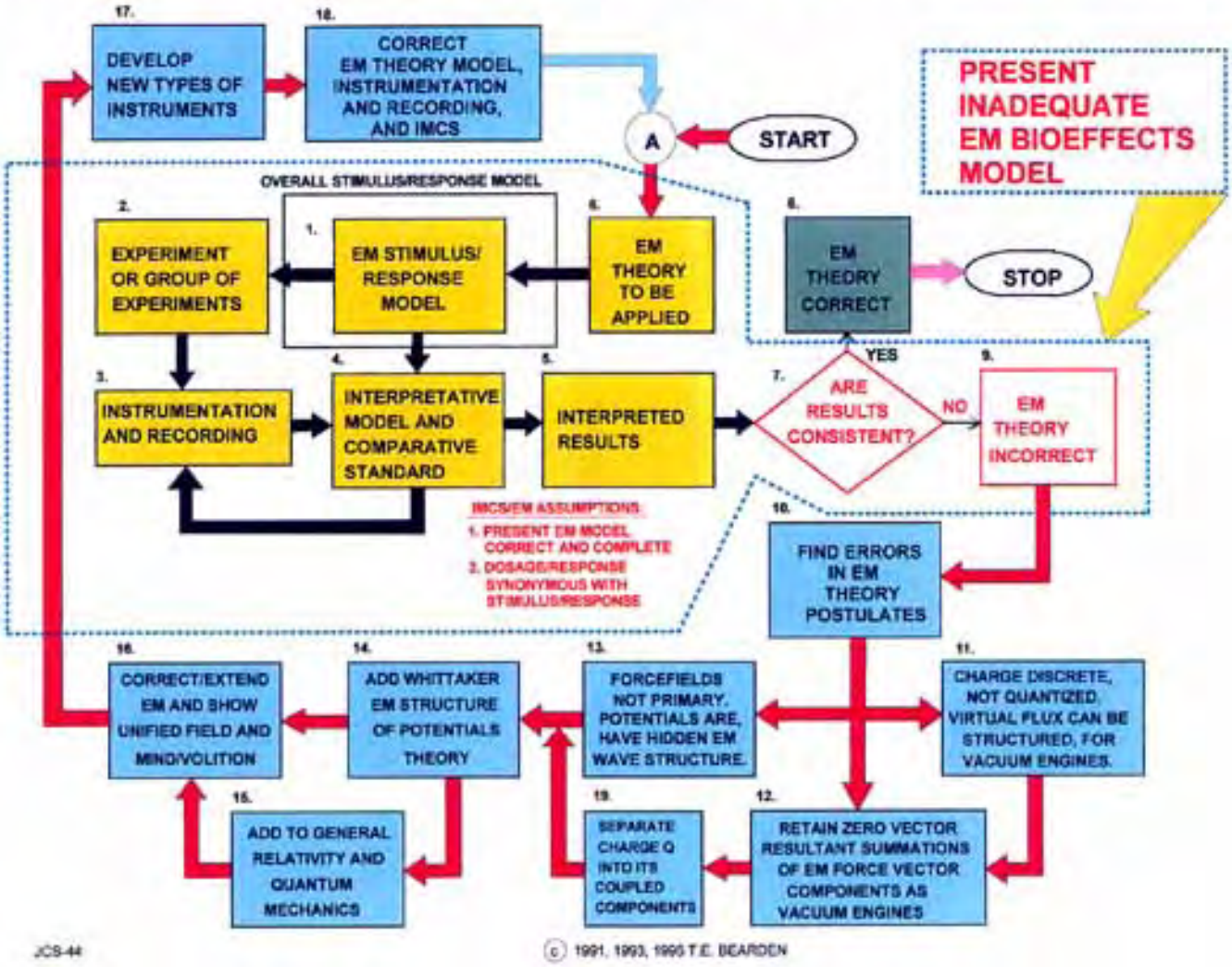

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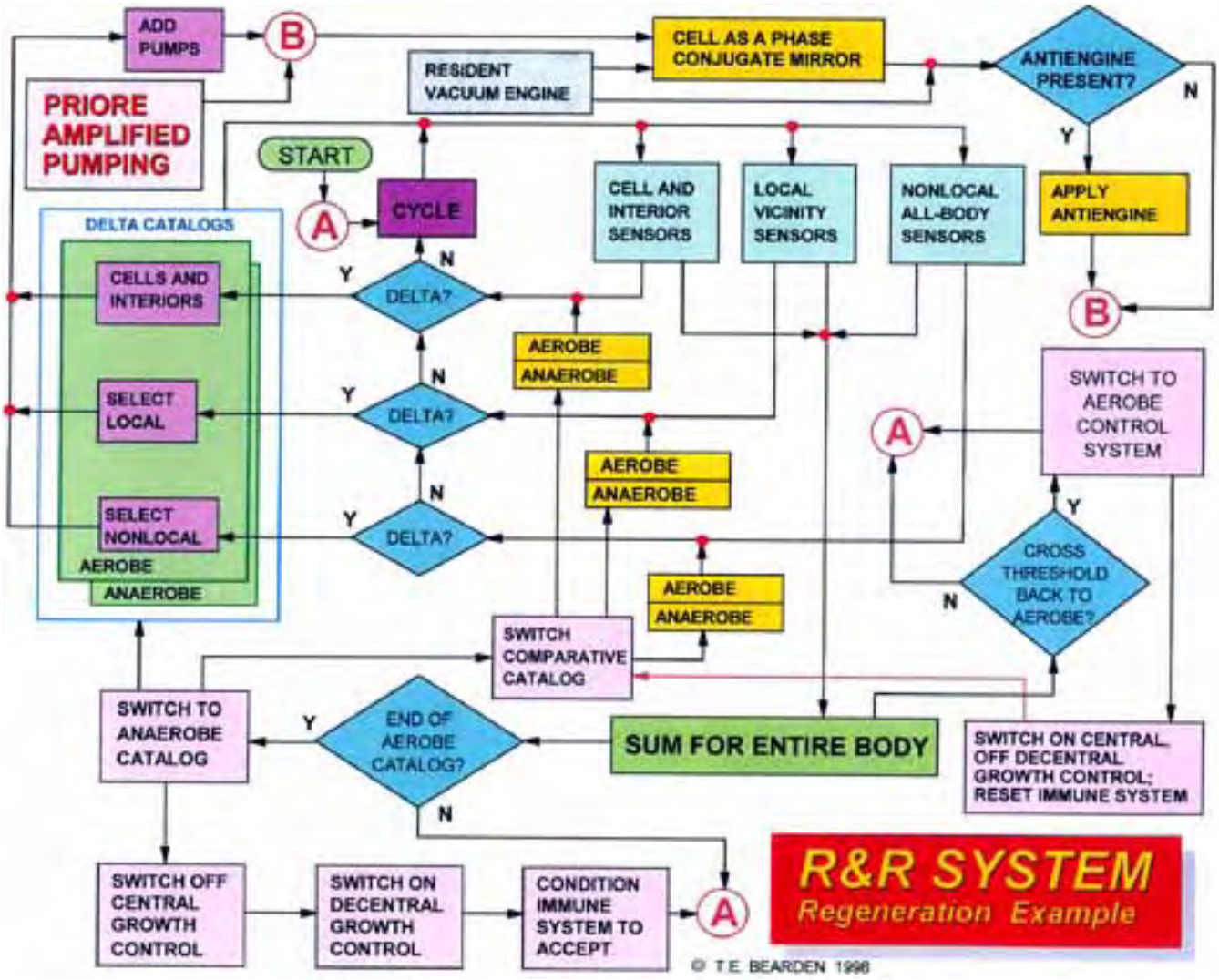

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Kaznacheyev's Cytopathogenic Mirror Effect

Disease vacuum engines transported by photons and waves

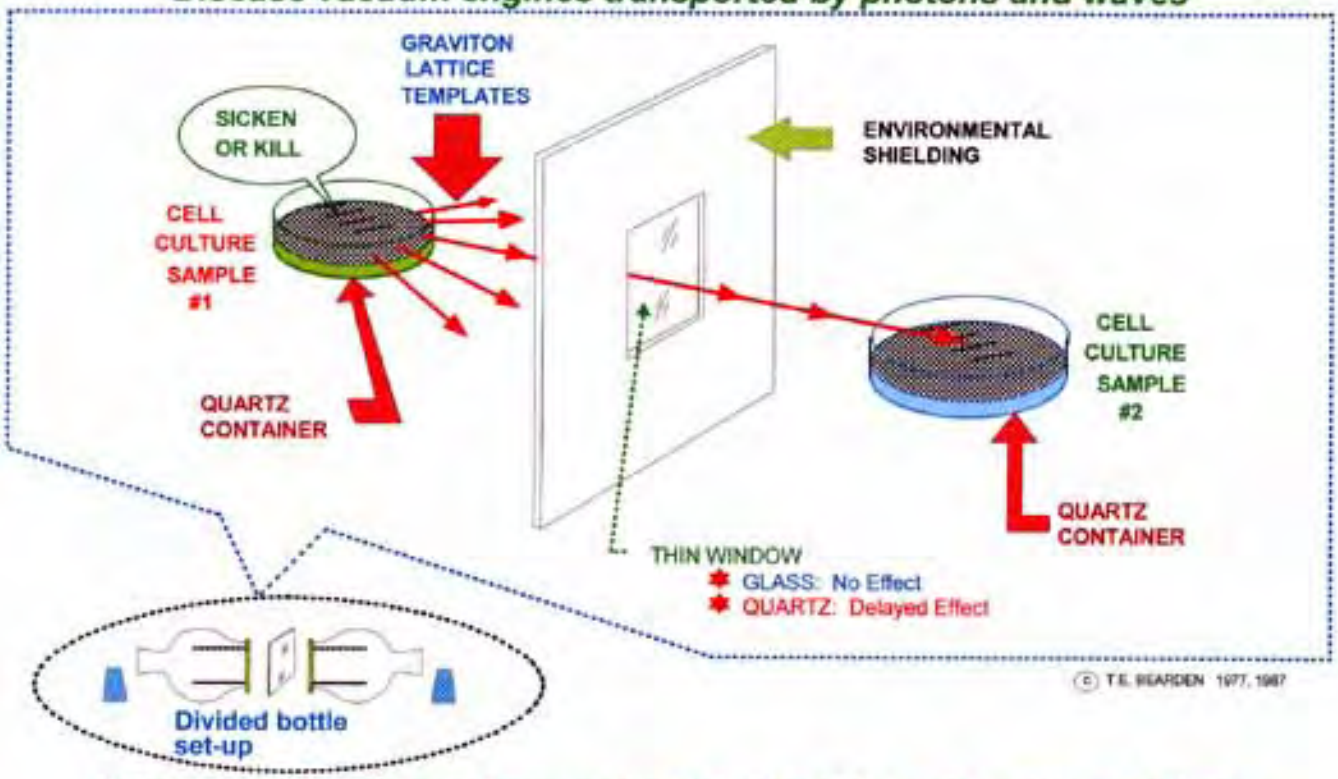

Note: Minimum lattice is one harmonic interval: IR to UV is such a minimum G-lattice.

Distant induction of cellular death and diseases, by special EM means. Coupled photon-antiphoton pairs (gravitons) in a structured harmonic lattice ordering constitute the disease or disorder template.

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MICROWAVE RADIATION OF U.S. EMBASSY IN MOSCOW

Former U.S. Embassy in Moscow.

Selected clipart © by Lotus SmartPics™

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter?)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

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Self-Targeting in Inner EM Channel Can Produce a Quantum Potential

Once QP is established, energy transmission is direct and instantaneous. Energy input to one single participant will simultaneously appear in all other participants, the amount depending on their fractions of participation with the input station.

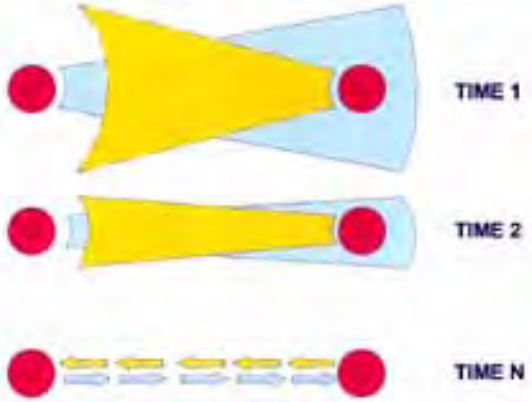

NARROWING OF INTERACTING POTENTIALS INTO LASER-LIKE BEAMS, BETWEEN TWO PUMPED SOURCES. NOW ONLY LONGITUDINAL WAVES CONNECT THE LINKED OBJECTS.

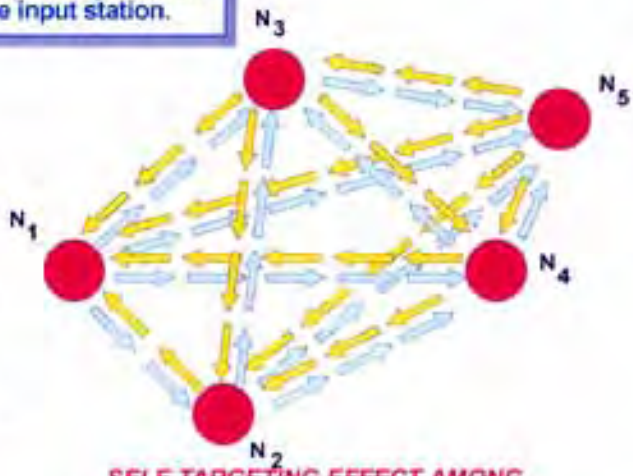

SELF-TARGETING EFFECT AMONG ALL PAIRS OF INTERACTING PUMPED SOURCES

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Quantum potential and hidden variable theory

a. Quantum Potential Characteristics

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- No point source
- Not radiated
- Quantum potential between two particles
  - Interaction does not vanish as spatial separation becomes very large
  - Instantaneous connection, so multiply-connected space

b. Hidden Variable Theory and the Quantum Potential

- $$V_{quantum} = \frac{\hbar}{2m}\frac{\nabla^2\sqrt{\rho}}{\sqrt{\rho}}$$
- "A quantum particle moves as if it were subject, in addition to its external potentials, to a potential which is a function of its own probability distribution."
- Bohm's H.V.T. assumes:
  - Particle and wave function real and separate
  - Wave function obeys Shroedinger's equation
  - Particle obeys classical mechanics
  - Particle couples to wave function through a quantum potential

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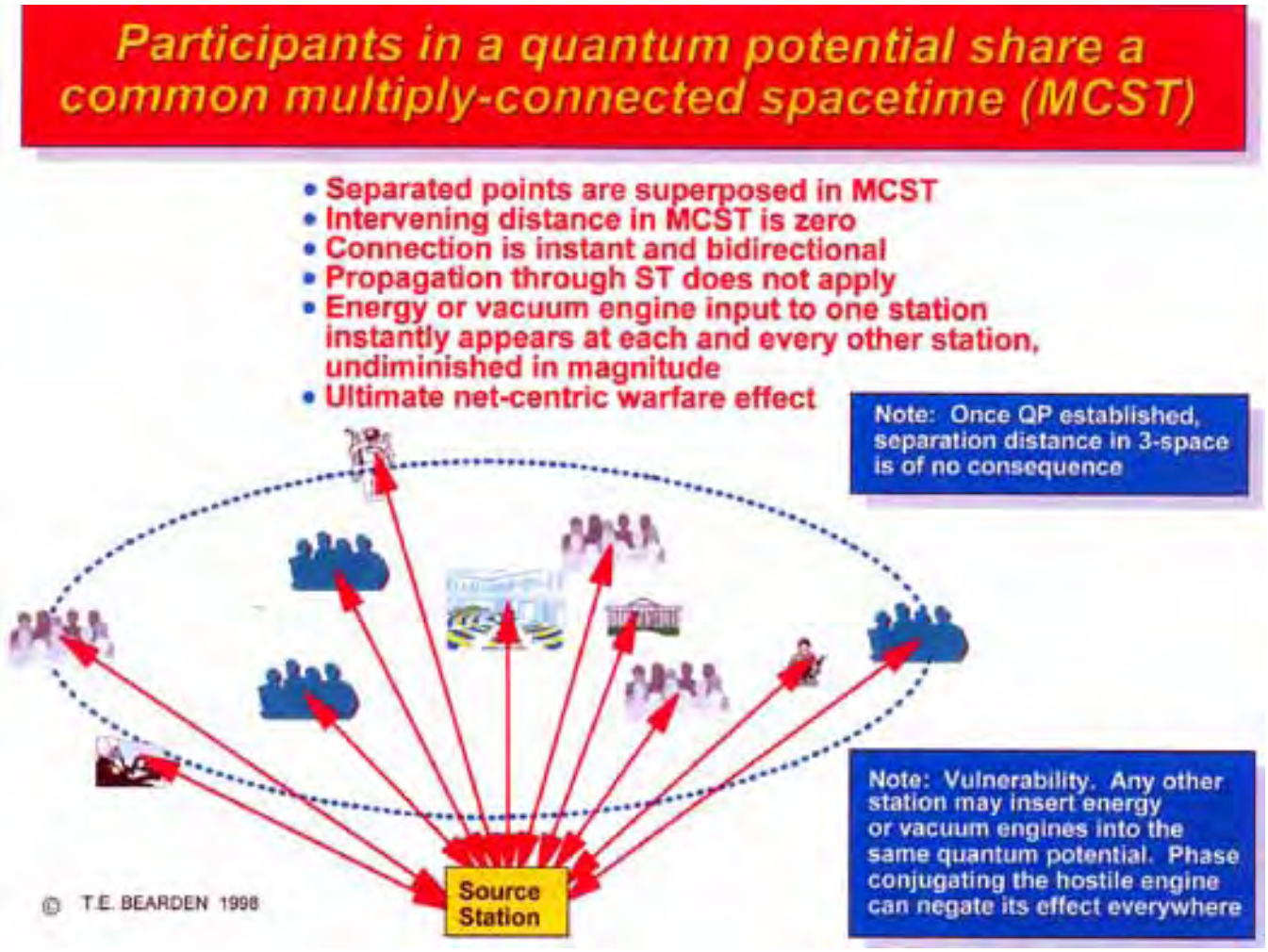

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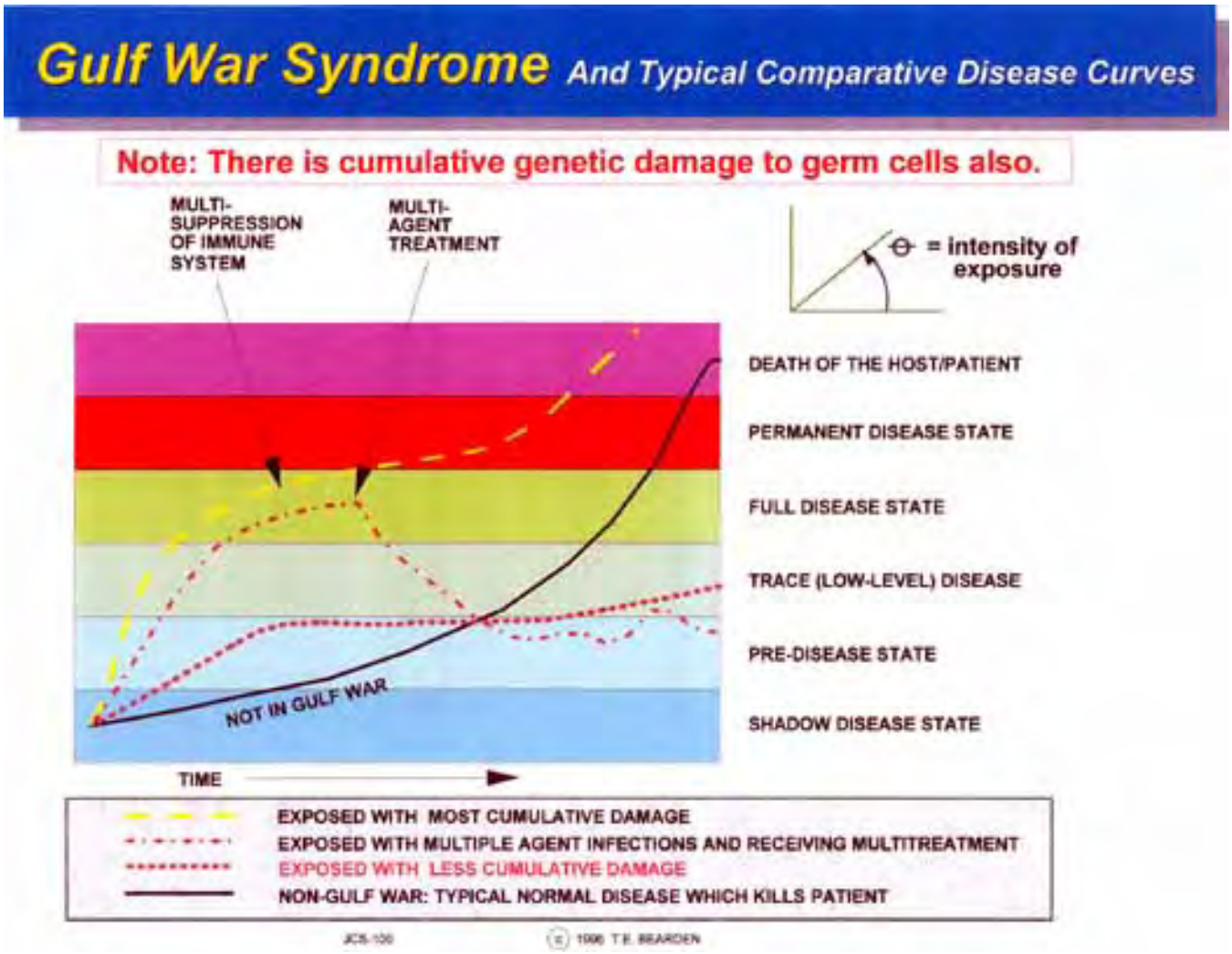

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Force Fields and Symmetry

- Force fields are nature's way of imposing local gauge symmetries on the world
- E.g., electromagnetic field is a manifestation of the simplest known gauge symmetry consistent with the principles of special relativity
- For the EM case, the gauge transformations correspond to changes in 'voltage' from place to place

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Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum

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- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another
- STRUCTURING THE INFOLDED EM INSIDE POTENTIALS, FIELDS, AND WAVES
  - Strongly breaks local symmetry
  - Provides spacetime engines giving the above effects

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Other Aspects of Strong Local Asymmetry

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- Local spacetime is curved
- Lorentz invariance of vacuum is violated
- May be a local "sink" or "source"
- Gravitational/inertial effects from EM
- Translation between virtual and observable
- Electrogravitational solitons
- Action at a distance
- Transmutation effects may exist
- Scalar/pseudoscalar field translation
- COMMENT: Thus the use of infolded longitudinal EM fields and waves to strongly break local symmetry allows internested clustering of spacetime curvatures. These spacetime structures are *vacuum engines*, or *spacetime engines*.

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Small Entities Emit Powerful S-Flows

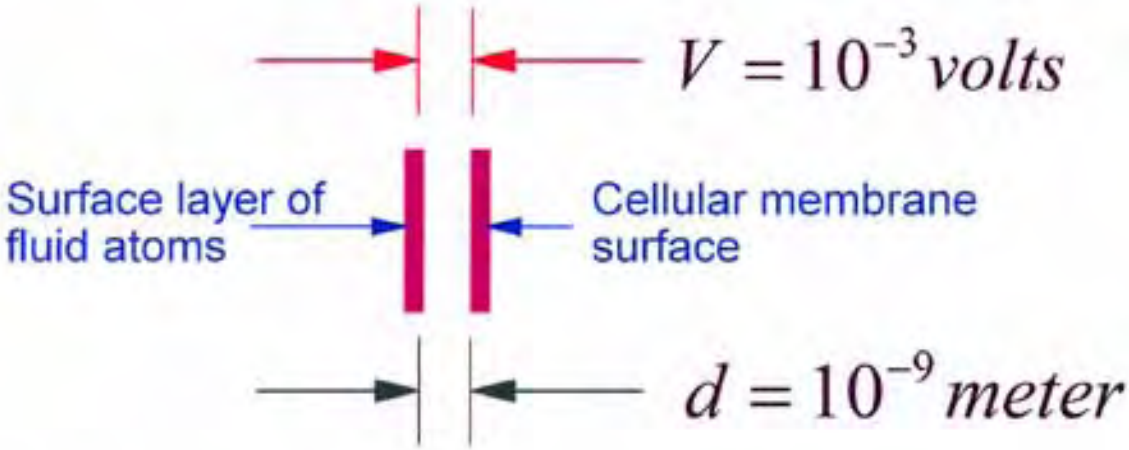

$$E = 10^{6}\ \text{volts / meter}$$

$$S \approx f(E^2) = f(10^{12})$$

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What is the "magnitude" of a potential?

- What is taught is the *"interaction cross section,"* i.e., the joules collected from the associated S-flow by one point coulomb of intercepting/collecting charge.

$$W = Vq = \phi q \quad \text{(joules)} \qquad [1]$$

$$\phi = W/q \quad \text{(joules/coul)} \qquad [2]$$

Let $\phi < 1$ and fixed; $q \Rightarrow n$ where $n = \infty$

$$W \Rightarrow k, \text{ where } k = \infty \qquad [3]$$

- *From any "finite" potential, no matter how small, an unlimited amount of energy can be collected, by increasing the collection (number of coulombs) (interaction cross section).*
- Actual magnitude of the potential ϕ must be very, very large, since we can treat it as infinite or unlimited, via $W = \phi q$.
- *Else Equation [1] could not be linear.*

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Table A1. THE VACUUM ENERGETICALLY INTERACTS WITH EVERY PARTICLE, CONTINUALLY.

- The vacuum is:
  - Ground (zero) state of the electromagnetic (photon) field.
  - Ground (zero) state of mass field.
  - Empty of *observable* particles or photons.
  - Filled with *non-observable* (virtual) particles and photons.
  - Violently fluctuating microscopically and electromagnetically.
  - Constantly interacting with all particles, including partially shielding their bare charges.
- Lamb Shift -- vacuum's alteration of the energy level of an electron in the hydrogen atom.
  -- Difference in energy (frequency units) is 1057.862 MHz.
  -- Lamb was awarded a Nobel Prize for showing this.
  -- Energy *density* exceeds that of the sun's surface!
- Casimir Effect -- vacuum creates an attraction between two conducting surfaces in close proximity.
  -- experimentally proven, well-known.

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- Cole and Puthoff proved that there is no thermodynamic reason why energy cannot be extracted from the vacuum as heat and power, and utilized.
- The common dipole is a broken symmetry in the virtual photon flux of vacuum. It extracts virtual energy, integrates it, and re-emits it as Poynting energy density flow S = ExH (which observably interacts with charged particles and magnetic poles).

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Extended Superpotential Theory

(Adding Vacuum Engines)

- Any EM field or wave is created by (comprised of) two potentials which interfere with each other in a given area
  - *May be either scalar or vector potentials*
  - *May interfere locally or at a distance*
  - *Process is distance independent*
- Any scalar potential is comprised of a harmonic series of bidirectional longitudinal EM wavepairs (Whittaker 1903).
- Ziolkowski circa 1985 added the interior product set to Whittaker's sum set. Thus he added modulations.
- By assembling a deliberate "sum and product" set of biwaves, a scalar potential can be created having an internal deterministic structure.
  - *This structures local vacuum potential/spacetime curvatures, in specific forms (templates)*
  - *Now have added vacuum engines*
  - *Have infolded general relativity inside electrodynamics*

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Vacuum Engine: Jillions of Working ST Demons

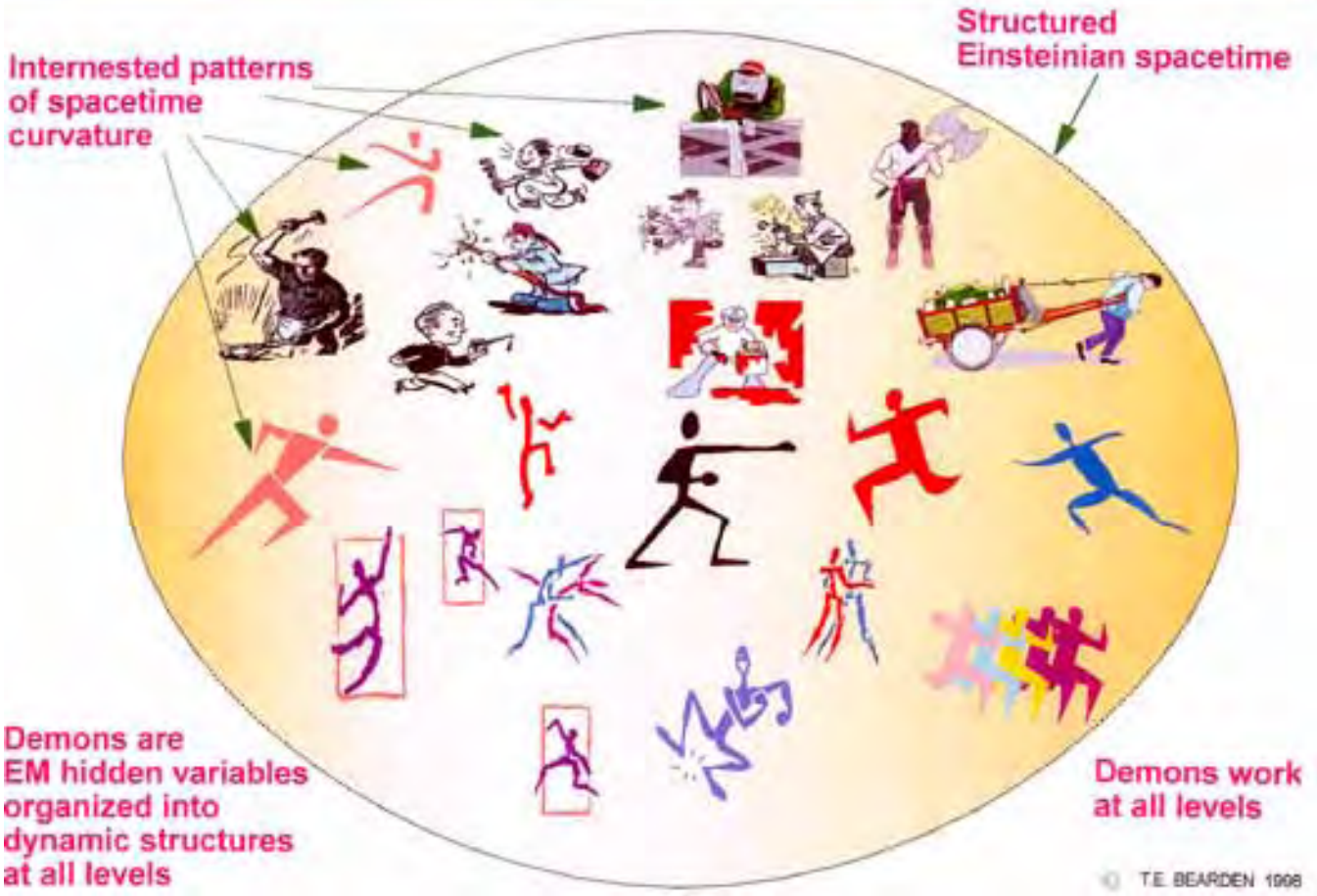

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Active Spacetime and a Specific Vacuum Engine

(A General Relativistic Concept and Analogy)

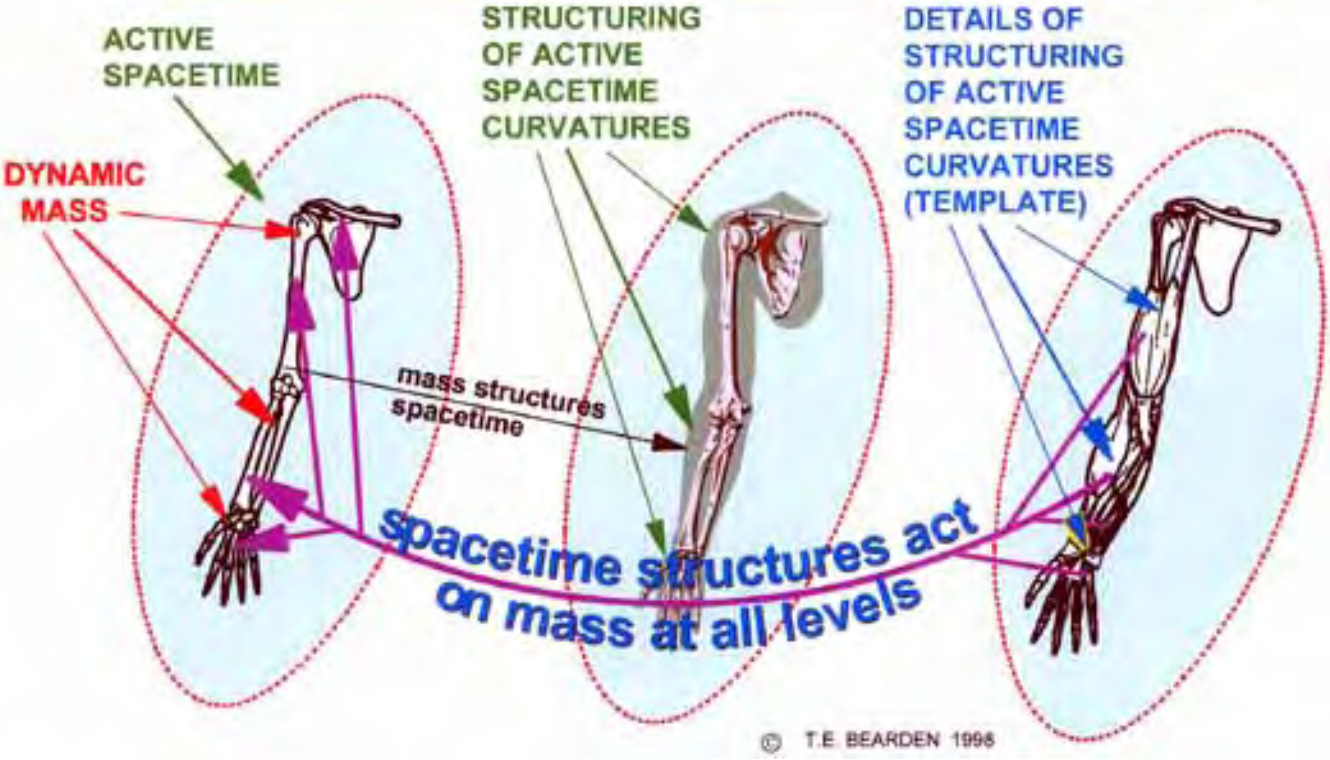

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Extension of Wheeler's general relativity principle:

- Mass (trapped energy) and its structuring curves and structures spacetime complexes (engines).
- Curved and structured spacetime engines produce forces on mass and its components, telling them how to move and structure.
- Since very strong EM force is used as agent of curvature, very powerful general relativistic effects can be obtained by arranging the LWs in the input EM potentials, fields, and waves.
- General relativity becomes directly engineerable in devices of unparalleled capability.

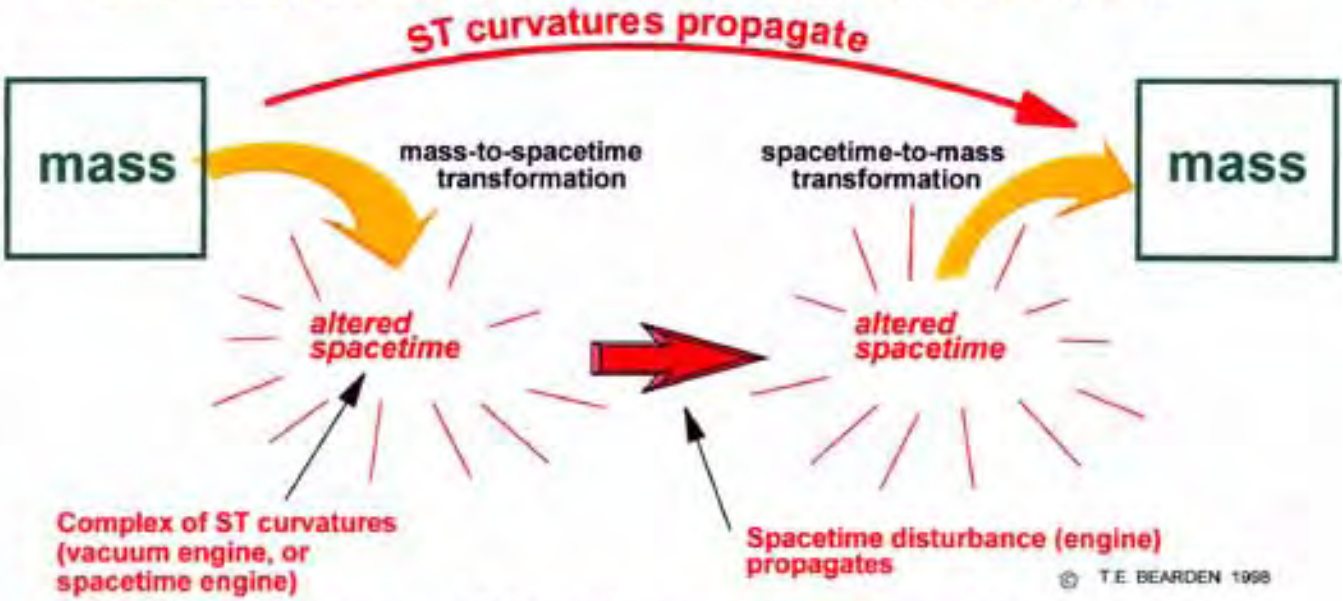

Electrodynamics has a hidden but ignored electro-general-relativity infolded inside (comprising) its so-called potentials, fields, and waves (in space in the absence of mass). What are presently defined as potentials, fields, and waves rigorously exist only in, on, and of charged mass, as pointed out by Aharonov and Bohm in 1959. All of this is just longitudinal EM waves and their interactions.

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SIGNAL VERSUS VACUUM ENGINE

SIGNAL (INFO)

- INFORMATION RECEIVED
- ANY OVERT PHYSICAL ACTION MUST BE TAKEN BY RECEIVER

A. *Receiver must do the action itself; vacuum energy exchange is unaltered. Energy or fuel for doing the action must be added to receiver externally.*

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VACUUM ACTIVATED

ENGINE (STRUCTURE)
TEMPLATE (FORM)

- "INFORMATION" ITSELF ACTS
- VACUUM FLUX GRADIENTS CHANGE ALL PARTS AND CHARACTERISTICS OF RECEIVER, INSIDE AND OUT

B. *Receiver is acted upon; altered vacuum energy exchange does the specific action. No energy or fuel for doing the action need be added to receiver externally.*

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Electronuclear Interactions by Vacuum Engines

- An EM potential is gravitational due to its trapped energy.
- A local EM potential is a local curvature of spacetime.
- *Structured* potentials are structured *(nested)* local spacetime curvatures; hidden variable theory applies.
- Structured potentials thus are *vacuum engines*.
- Gradient-free potential penetrates the atom, into nucleus.
- *With steady application, a structured gradient-free potential can be used to engineer the atomic nucleus at will.*
- Normal cold fusion systems structure a small fraction of their potentials, by chance geometries, boundaries, etc.
- This produces some new nuclides, but haphazardly.
- *The process can be developed and controlled. The nucleus can be deterministically engineered at will.*

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Vacuum Engineering

Using Inner EM Energy and Structuring to Engineer Physical Reality

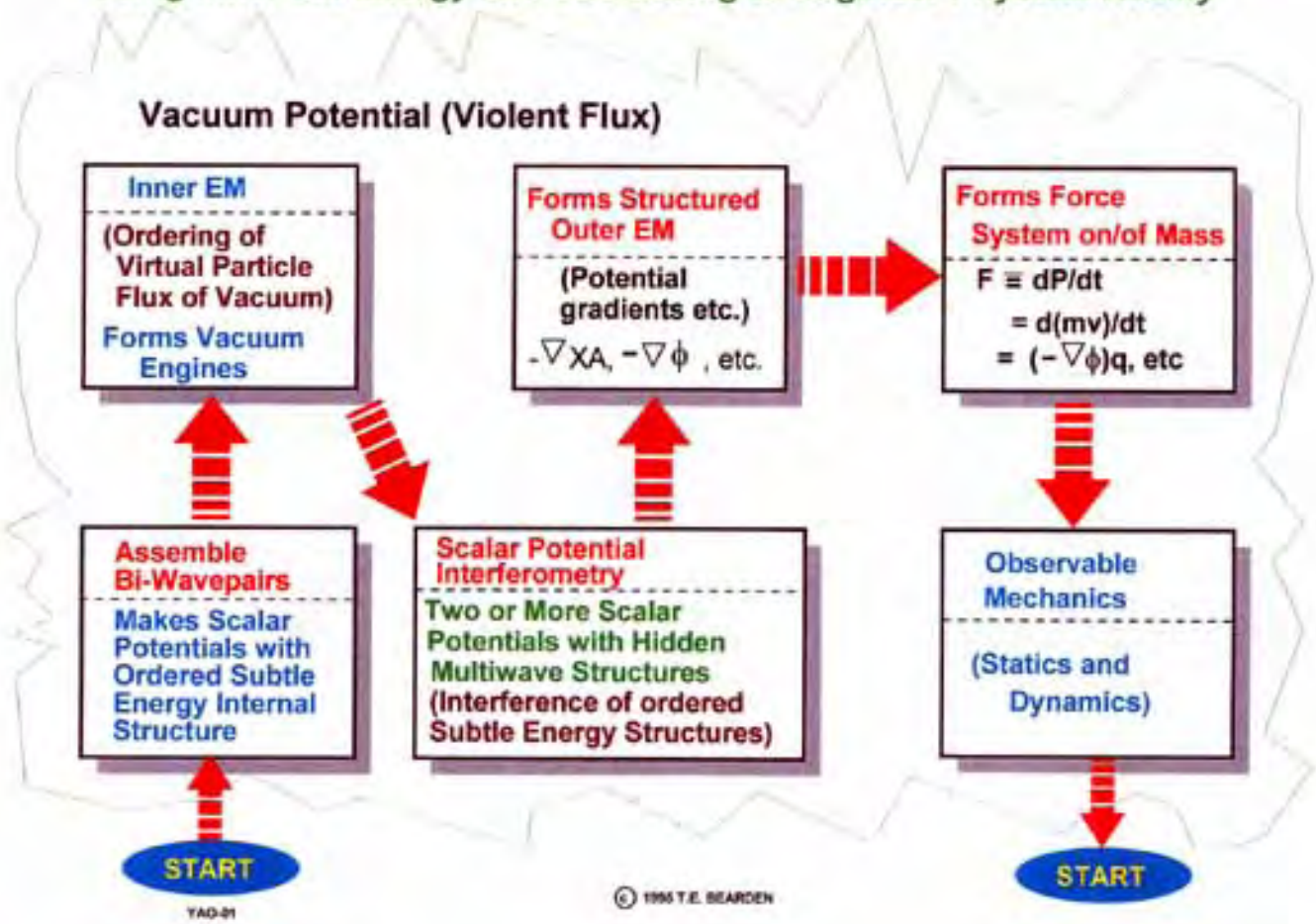

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Impact of Vacuum Engineering

- "If they [quantum fluctuations of vacuum] can be [tapped], the impact upon our civilization will be incalculable. Oil, coal, nuclear, hydropower, would become obsolete -- and so would many of our worries about environmental pollution."
- "Don't sell your oil shares yet -- but don't be surprised if the world again witnesses the four stages of response to any new and revolutionary development:
  - 1. It's crazy!
  - 2. It may be possible -- so what?
  - 3. I said it was a good idea all along.
  - 4. I thought of it first."

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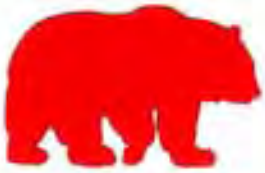

Arthur C. Clarke
"Space Drive: A Fantasy That Could Become Reality"
Nov./Dec. 1994

- *Comment:*
  - *Every dipole's broken symmetry in its energetic exchange with the vacuum already freely extracts vacuum energy.*
  - *In power sources, the dipole gates the extracted energy out as S = EXH, which flows almost entirely outside the conductors.*
  - The circuit interacts with, and uses, only about 10^{-13} of S. The electrodynamicists calculate only this small S-component.

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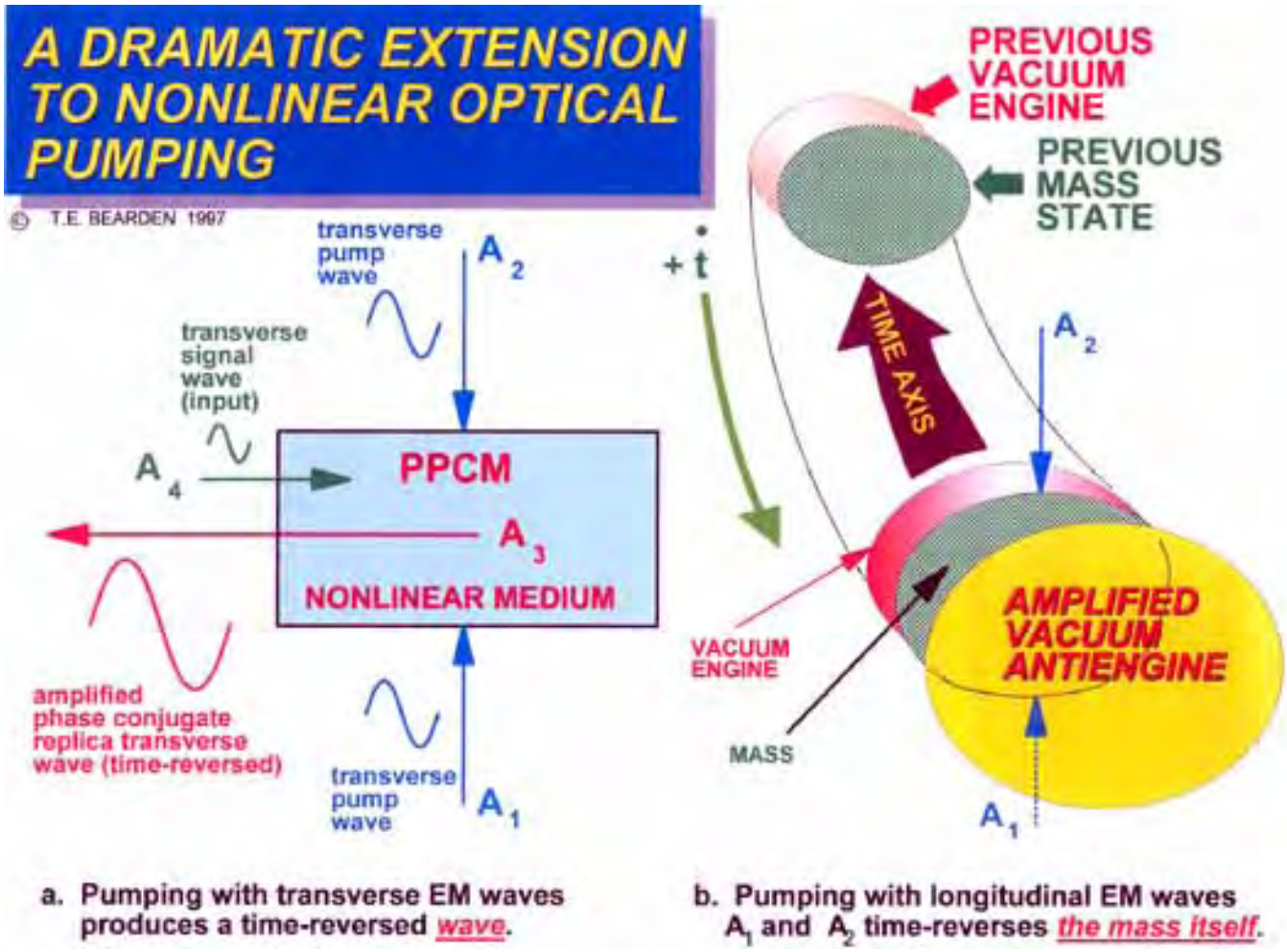

a. Pumping with transverse EM waves produces a time-reversed *wave*.

b. Pumping with longitudinal EM waves A_1 and A_2 time-reverses *the mass itself*.

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Time Conservation and Some Properties

(Energy and time are canonical)

- Time can neither be created nor destroyed
  - *Its form can be changed, and it can be positive or negative*
  - *Time can be collected or dissipated, converged or diverged*
  - *Time can oscillate and move in waves*
  - *Longitudinal (infolded) EM waves oscillate time*
- Time is always in motion, and that motion is variable
  - *Collected/collecting time is a continuing stationary change in an ongoing time flow*
  - *Time/collecting time can be internested and internally structured*

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- Time has gravitational aspects
  - *Negative (trapped) time is antigravitational*
  - *Emitting negative time is gravitational, to the emitter*
- Nonlinear optical pumping can use longitudinal EM waves
  - *Pumping a nonlinear mass by longitudinal (infolded) EM waves pumps it in its masstime form, in the time domain*
  - *This creates an amplified vacuum antiengine for the mass, and time-reverses the mass back to a previous state*

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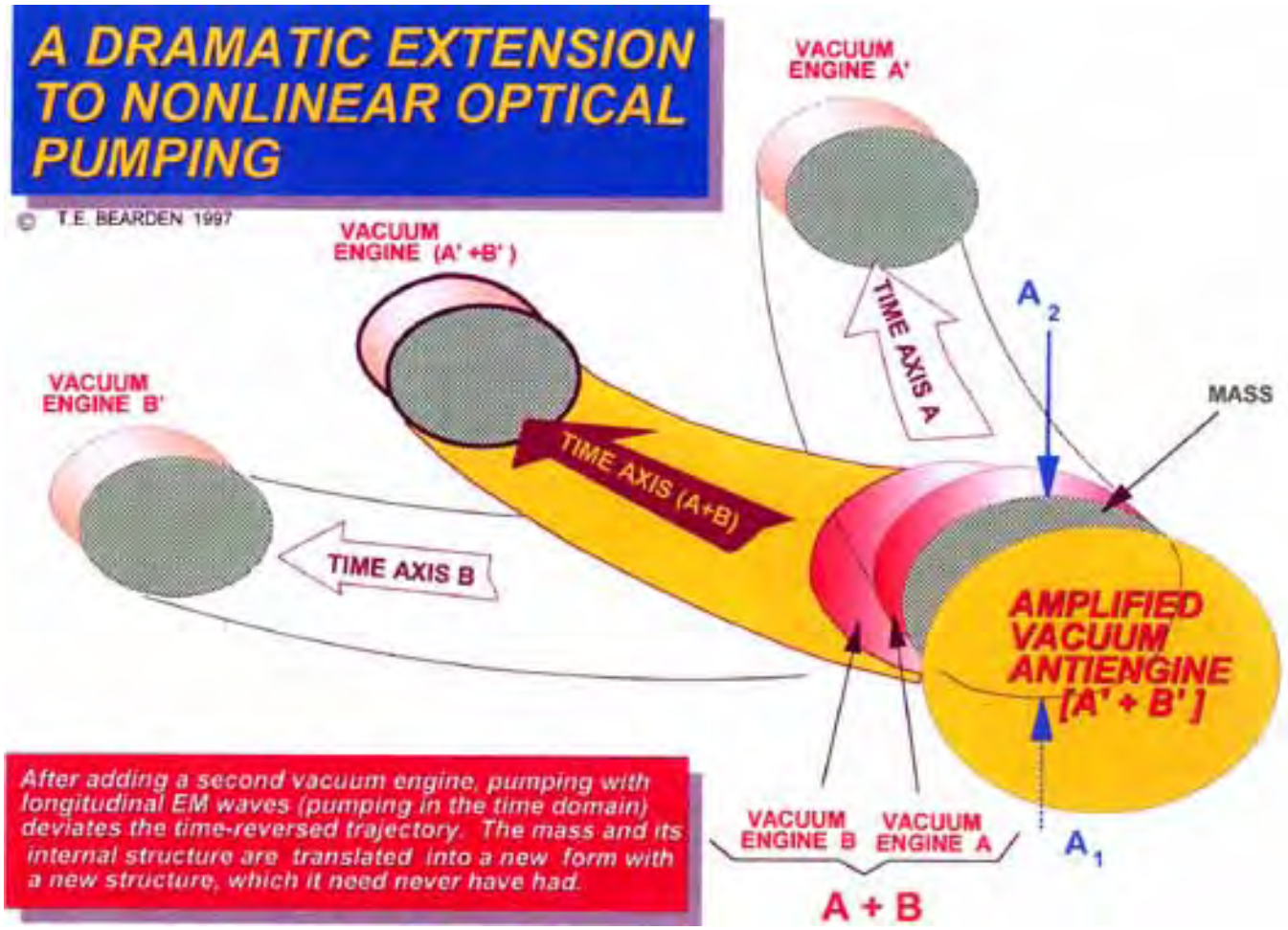

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Key Points in the New Technology

- There is a vast new kind of electrodynamics *hidden inside* all EM potentials, fields, and waves
  - Longitudinal EM waves and complexes
  - Oscillations in time domain

- These complexes are an *infolded general relativity*
  - Clustered formations of *spacetime curvatures*
  - *Very powerful*, since the EM force is used as the agent of curvature

- In general relativity, similar precise complexes permeate and *act on any mass at all internal levels*
- With this approach, one *can now manipulate matter* -- living or inert -- *in any manner desired*, depending only on the level of development of the technology
- Priore unwittingly used this to *cure dread diseases*
- This is a *revolution in all of science*

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- *We have uncovered the major mechanisms* to utilize

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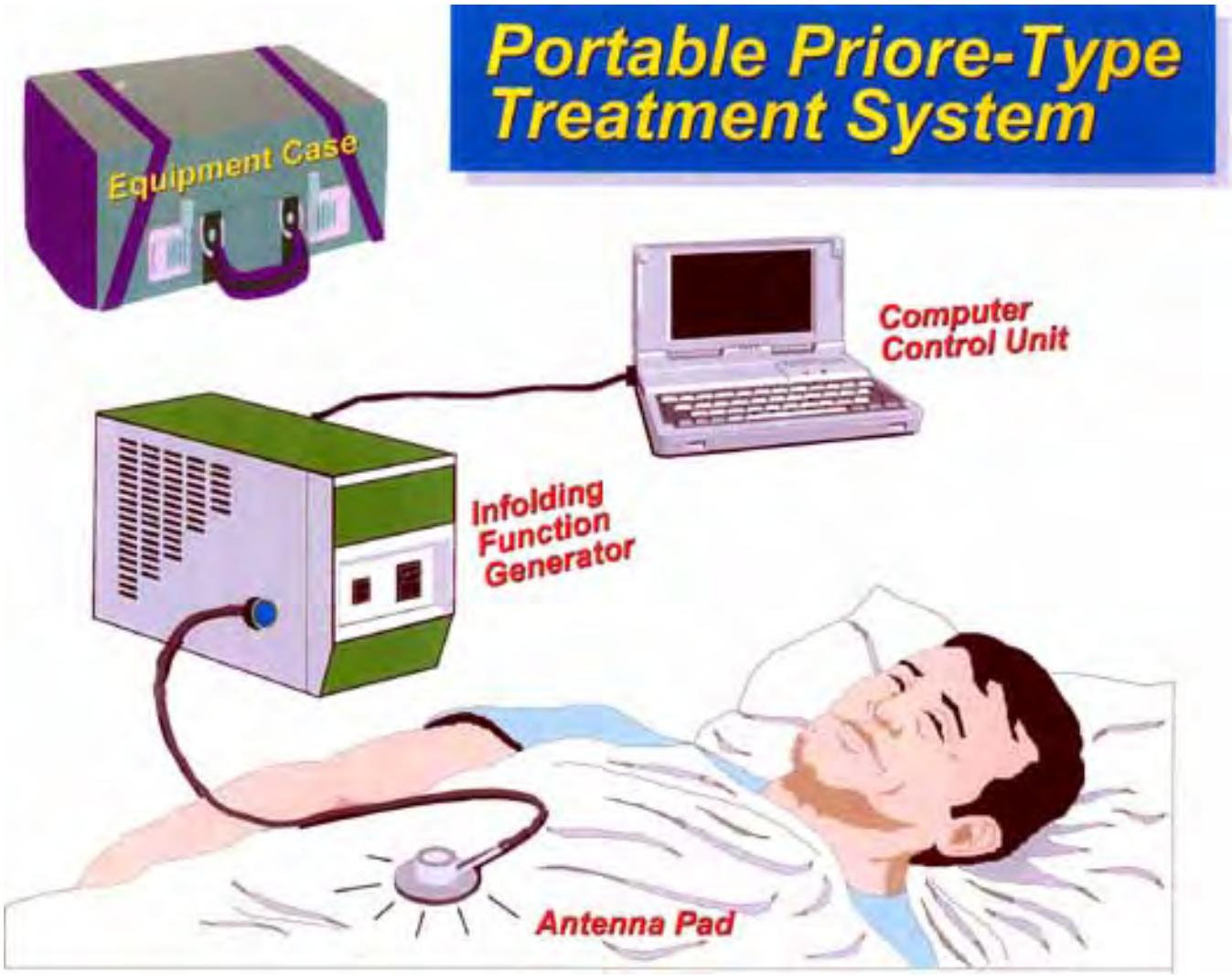

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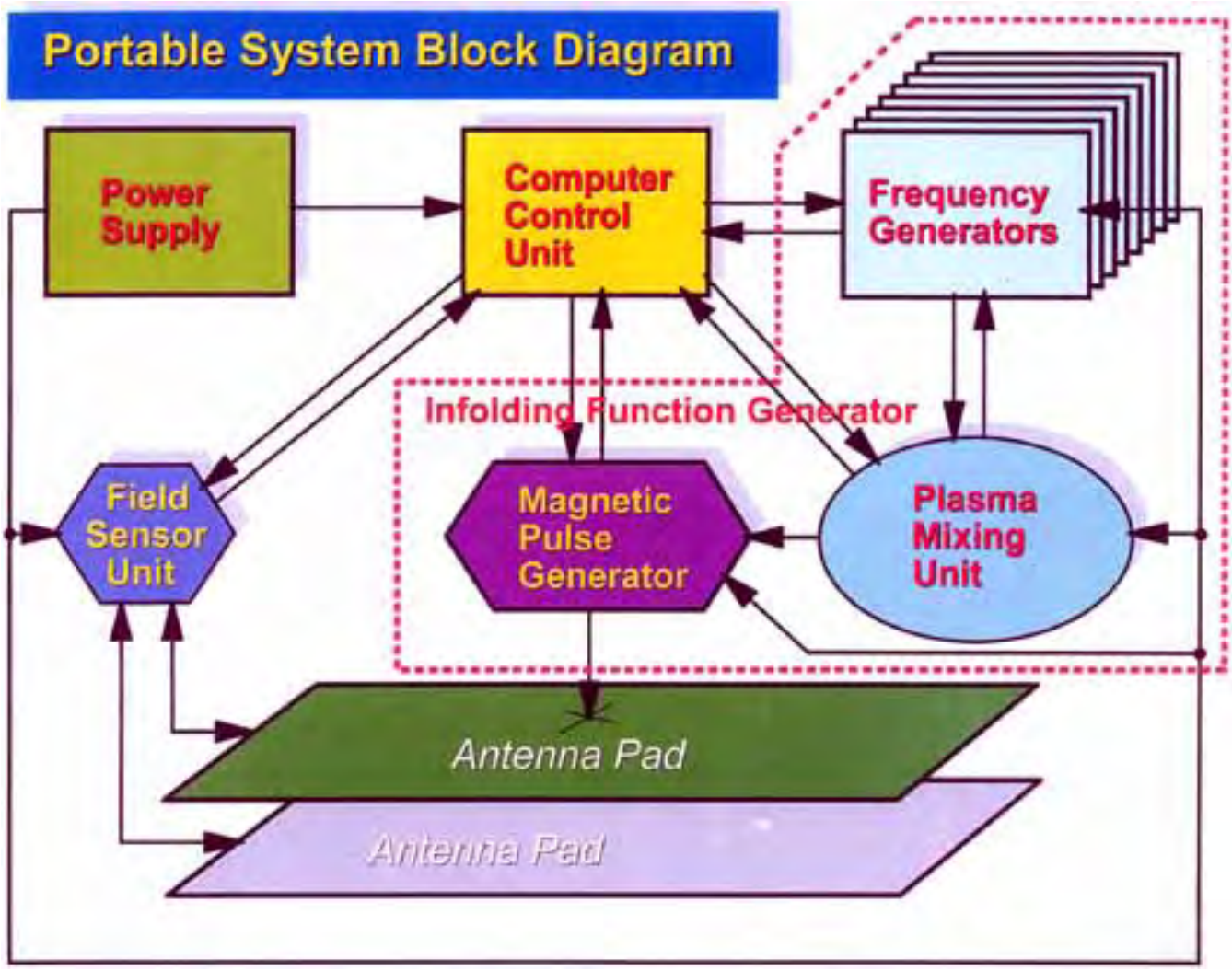

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PORTABLE PRIORE TECHNOLOGY UNIT

- FACT: DISEASE-SPECIFIC VACUUM ENGINE PRESENT FOR ANY CELLULAR DISEASE, BY WHEELER'S PRINCIPLE
  - *DISEASE CAN BE REVERSED BY CREATING AMPLIFIED VACUUM ANTI-ENGINE (BEARDEN'S PRINCIPLE)*
  - *ANTI-ENGINE IS CREATED BY PUMPING THE NONLINEAR CELLS IN THE "INNER EM" DOMAIN, TIME-REVERSING THEM*

- PRIORE UTILIZED A PLASMA TO PHASE CONJUGATE AND "INFOLD" MULTIPLE BIDIRECTIONAL LONGITUDINAL EM PUMP WAVES
  - *17 FREQUENCIES MIXED IN A ROTATING PLASMA*
  - *PHASE CONJUGATES ADDED BY THE PLASMA*
  - *INFOLDED MIX INTO STRONG PULSED DC MAGNETIC FIELD, WHICH CARRIED IT INTO ATOMIC NUCLEI*
  - *PUMPED ALL NONLINEAR CELLULAR COMPONENTS TO PRODUCE AMPLIFIED, SPECIFIC VACUUM ANTI-ENGINE*

- NEGATED THE LONG-TERM CUMULATIVE CELLULAR DEDIFFERENTIATION ORDER GENERATED BY LONG-TERM HYPOXIA. TUMOR CELLS REVERTED TO NORMAL CELLS.
- SCRUBBED OUT THE CUMULATED PRECANCEROUS STATE
- RESTORED THE IMMUNE SYSTEM TO HIGH FUNCTIONING
- NO EXCESSIVE TRAUMA TO TREATED ANIMAL

CANCR-49

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SAVING THE STRICKEN CIVILIANS

SURVIVORS OF N CASUALTIES

(N = 1-40 MILLION)

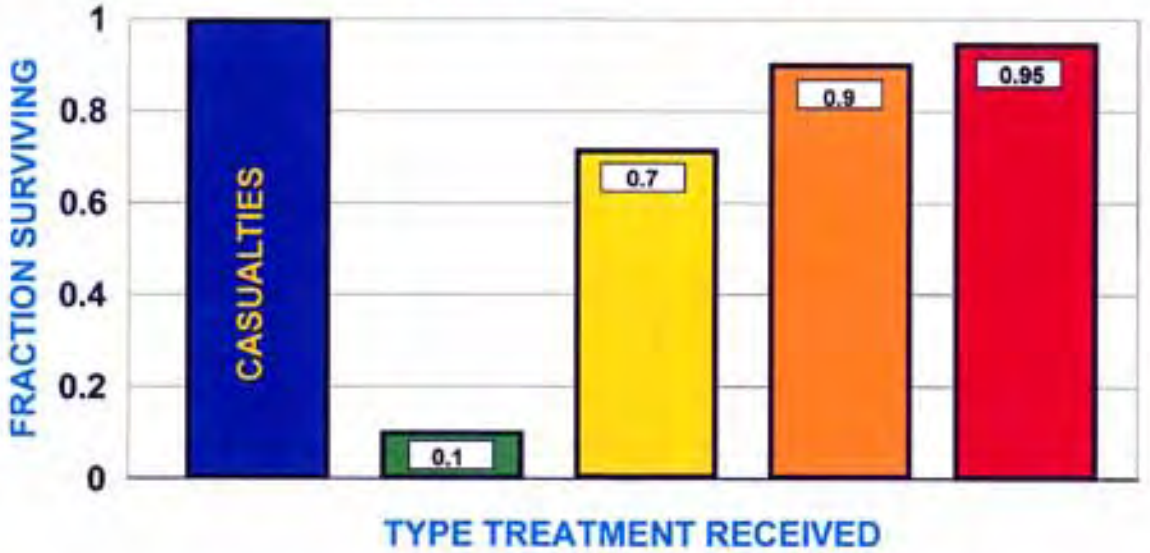

EXPRESSED IN FRACTION SURVIVING
- With conventional treatment
- With 1st generation P-treatment
- With 2nd generation P-treatment
- With 3rd generation P-treatment

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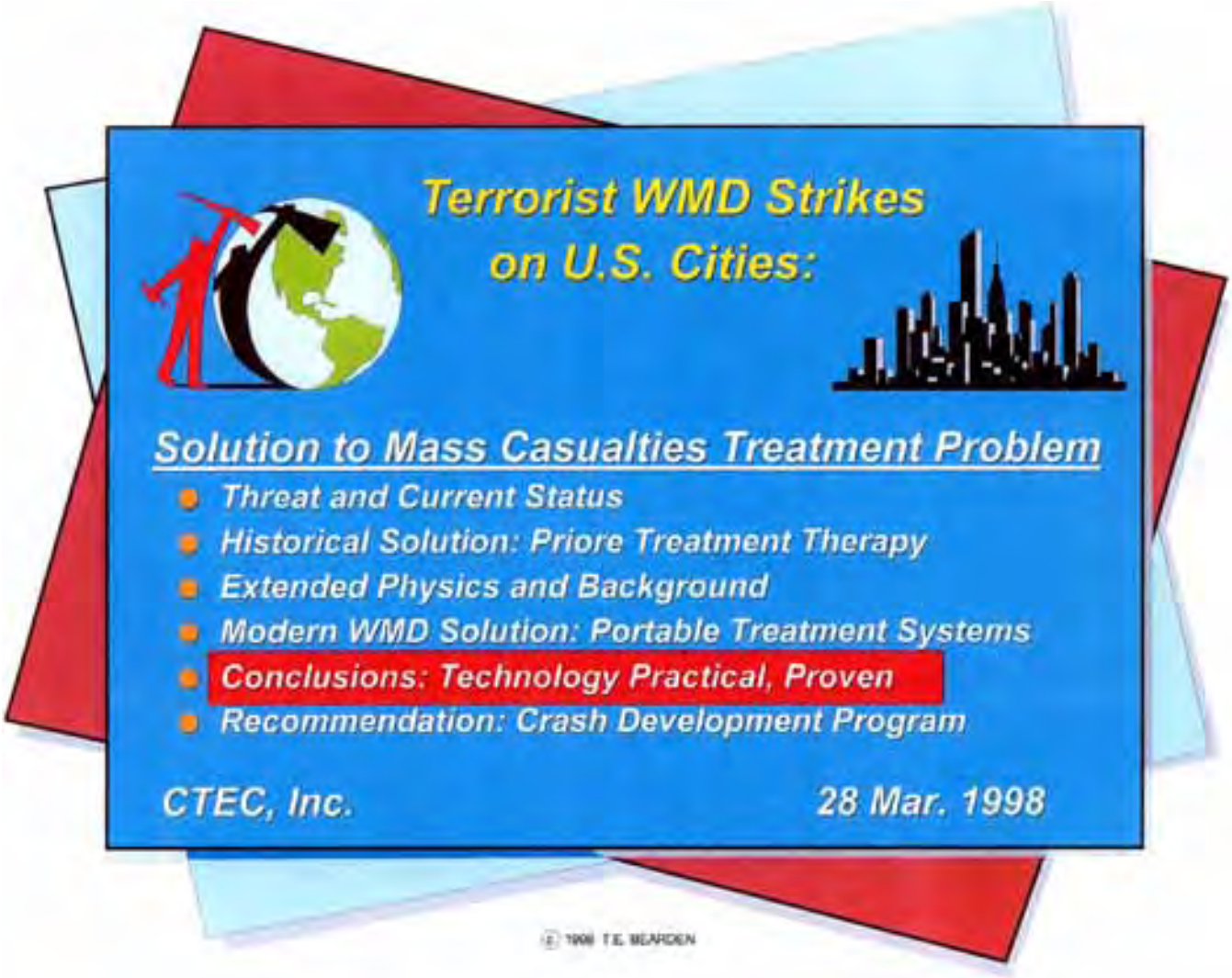

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Summary and Conclusions

- **A new therapeutic paradigm of great scope and effectiveness has been developed**
  - *Will provide effective, quick treatment of mass casualties*
  - *Will provide cures for unknown agents*
  - *No pathogen strains are resistant to this process*
- **Results have been proven experimentally**
  - *Documented in French scientific literature*
  - *Rigorous scientific protocols, eminent scientists*
  - *Technical mechanism deciphered*
- **Will treat and cure many diseases**
  - *Aids, atheriosclerosis, cancer and leukemia*
  - *Sleeping sickness*

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- **Portable units can be developed quickly**
  - *18-month crash development program required*
  - *high level authority and overwatch essential*
- ***Will solve the BW mass casualty treatment problem, both civilian and military***

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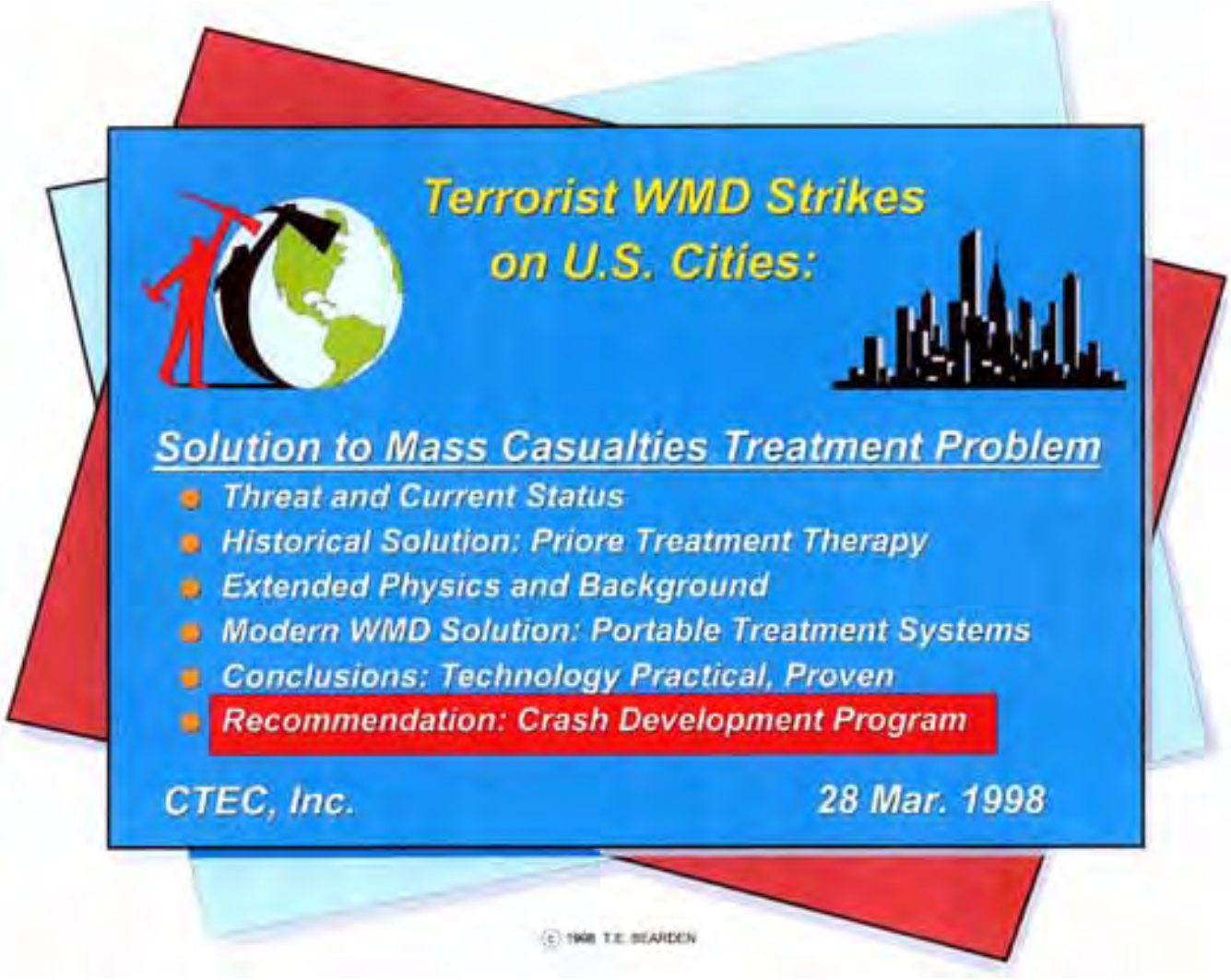

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Recommend implementing:

- Crash development program
  - Suitcase-sized portable unit
  - 18-month Manhattan-type project
  - Simultaneous theoretical modeling, animal testing w/breadboard models
  - SecDef and Congressional overwatch
  - Presidential Decision Directive
- Parallel logistics support program
  - Plan high speed production lines
  - Mass distribution, storage, maintenance
  - User, maintenance training
  - Plan C4 and usage at all levels
  - Integrate firemen, police, National Guard, FEMA, medical facilities, etc.

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Final Thoughts:

- The current internal BW threat can and will kill more Americans than all our previous wars combined
- The Priore technology is the only solution in sight that can save most of those casualties

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CTEC, Inc.
2311 Big Cove Road
Huntsville, AL 35801
(256) 533-3682 Ph/
(256) 539-5951 Fax

CTEC, Inc.

June 24, 1998

Dr. Jane F. Kinsel, Director
Office of Policy Analysis
Department of Health & Human Services
Bathesda, MD 20892

Dear Dr. Kinsel:

Your letter of June 8 is appreciated. However, the entire action package had already gone to the Assistant SecDef and also to Major General Neary in the USAF.

The proof of a revolution in medical treatment was in the package. The basis for it is already demonstrated experimentally in the scientific literature, both in the U.S. and in France. We are speaking of something already proven, but missed by the entire U.S. medical community. Strong words, but true. Let me be specific.

Any cell in the body can be time-reversed (physics term) or dedifferentiated (biology term) back to an earlier state, by pumping (i.e., "squeezing" in simple terms) that cell with longitudinal EM waves as pump waves. There are considerable papers in the French scientific literature showing the experimental results.

Apply that to cancer. We are stating bluntly that all cancerous cells in the body can be "depromoted" back to normal cells easily. Further, the damage previously done to them (such as by sustained hypoxia due to contaminants reducing the oxygen-carrying ability normally given to it by some 60-to-80 surrounding water molecules per red cell and the consequent H-bonding interactions) will also be reversed. The cells can all be returned to healthy, normal cells again, without "killing" or "burning" or "cutting" anything.

With some development of the technology, you can quickly and easily cure every cancer patient in every hospital in the United States.

Now apply it to AIDS. Since you can time-reverse every cell in the body, you can time-reverse the HIV-infected cells – genetics and all – right back to normal cells with normal genetics. Those cells not infected and healthy, will just get a "little younger" again.

So with that small development, you can quickly and easily cure every AIDS patient in every hospital in the United States.

I would have thought that NIH would certainly be interested in such a revolutionary therapy which has already been demonstrated in laboratory experiments. World-renowned French scientists – such as the eminent parasitologist Pautrizel and research PhDs assigned directly by Robert Courrier, head of the Biology Section of the French Academy of Sciences, worked with Prioré in performing those startling experiments that proved what we are saying.

The method was rigorously shown to cure infectious diseases (such as trypanosomiasis), atherosclerosis (which now afflicts millions of Americans), and terminal tumors. It was shown to reverse suppressed immune systems back to normal vigorous functioning.

Please permit me to disagree with you that the examination of such is not the mission of the NIH. To the contrary, it is precisely the NIH which should have some of its very best scientists looking into this.

The action package to DoD was to propose a crash program to develop this methodology in the form of a small, portable unit for treatment of mass casualties resulting from a terrorist BW attack on our cities (now expected in the next few weeks, as you must be aware). The leading Arab terrorist of the world has already promised just this.

We are speaking of several million Americans who are going to die. They are going to die in spite of everything that NIH and its labs can do, even though I know you will make a heroic effort. With NIH present methods, you cannot do very much for those stricken Americans at all. Everything we have in the "normal" kit bag is almost useless against a knowledgeable spray attack of modified smallpox (as you know, the Russian secret BW labs have made and sold tons of that already, to guess who!). Or a spray of tularemia (you are well aware of the extreme lethality of that), or anthrax (easily obtained). It is also common knowledge that these terrorist teams with their BW agents are already on site in this country, waiting for the word to attack. This has now been officially raised to our primary Strategic Threat.

In the face of such looming strikes on the U.S., I simply cannot believe that the NIH does not feel it within their mission to rigorously check out a proposed method for saving perhaps 70% of those coming deaths (first generation equipment), and up to 90% with second generation equipment.

Perhaps you just did not read the package carefully. I urge you to do so.

Else NIH is going to look very, very bad when (1) the strikes do occur, (2) they can't handle them (and they cannot, as you well know), (3) they had within their hands in advance, a proposed methodology that could have been investigated intensely, to save millions of those stricken Americans.

As a staunch supporter of NIH and especially CDC, I have to believe that there is a different attitude there. If NIH is not interested in a previously experimentally demonstrated method of saving millions of Americans, then the only recourse left is the political channel.

I assure you that my critique of electrodynamics is well-founded, as supported by various leading physicists such as Nobelist Feynman (who stated bluntly that the field concept is wrong), Wheeler, Bunge, and so on. It is inexplicable why all our universities are still teaching a 130 year old abridged (Heaviside's) subset of Maxwell's theory, and one that still contains a material ether even though that was falsified 110 years ago!

You already have seen the misuse of this technology by the Russians, in the decades-long radiation of the U.S. Embassy in Moscow. Is it not NIH's mission to understand how they generated all those diseases and health changes? Have you ever looked into Kaznacheyev's experiments showing that ANY cellular disease or disorder can be induced in cells at a distance by purely EM means? Have you looked into what got eliminated from electrodynamics by ignoring the hidden longitudinal EM inside every potential, field, and wave? Do you realize what ignoring that has done to American chemistry, biochemistry, and medical science?"

I would hope that the NIH would at least be interested in its own mission area!

I challenge you bluntly to admit that no one presently understands the primary operation of the human cellular *regenerative* system. That's because its technical principle is not presently in our recognized physics, biochemistry, and medical science – even though it has been in the hard physics literature since 1903-4. Becker's epochal work came closest; since he only had access to the conventional EM model, it failed him. But he at least showed you rigorously that cells can be changed (both differentiated and redifferentiated) all over the map by laughably weak EM – picoamperes of current, which means persistent DC potentials. In the microwave radiation of the U.S. Embassy, all the health changes occurred in regions absent of fields – i.e., absent of bleed-off of the potentials. Hence in regions of stable DC potentials! With 100% correlation of the health changes to persistent, gradient free potentials, and 100% anticorrelation to changing potentials (i.e., fields), our own scientists concluded totally erroneously that it could not have been the EM radiation causing the changes, when their own results had just proven that it was.

Now I ask you: Can NIH explain how it was that the DC potentials caused those health changes? I think not. If it could, it would understand the action package I wrote, and its importance.

This is not a "political" letter. I'm just an ordinary American citizen who has done about 30 years very hard work on this particular area. The work is good enough now to stand on its own merits. The scientific community will eventually accept it, about 50 years from now. But we cannot wait 50 years! Those millions of Americans are going to die, because of the bureaucracy and inaction of our own scientific organizations. Whether they like it or not, the U.S. scientific community is now the forefront of the struggle for this nation to survive. And they are failing us dramatically.

So as a parent who wants his children to live, and his neighbors' children to live, and those millions of soon-to-be stricken Americans to live also, I urge you to at least have someone competent in physics (and knowledgeable that the foundations of physics itself are in woeful shape!) check the work. Has anybody there *read* any of the references to the Prioré work I cited? Does anyone there realize that *there are no EM forcefields in space?* Probably not.

Dr. Kinsel, there is a time for "business as usual" and there is a time to do some serious new work. Those stricken Americans are going to be lying there. Nothing NIH can do is going to stop that. That's a given, and it is not my own estimate. It's the official estimate. And you *know* you presently do not have the tools to do anything really effective about it.

Frankly, I interpret your letter to me as just the normal "spin control" for easy disposition. I would hope that NIH would seriously rethink the situation, get off the "spin control" and "business as usual" posturing, and do something dramatically different for a change.

What have you got to lose? A little time from perhaps two or three of your best scientists.

What have you got to gain? Saving untold millions of American lives. A new, *already partially demonstrated* cure for most dread diseases such as AIDS and cancer – diseases which you presently cannot do very much about in spite of decades of heroic struggle.

Sincerely,

cc: Senator Shelby, Congr. Cramer

T.E. Bearden
President and CEO

CTEC, Inc.
T.E. Bearden, President & CEO
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Huntsville, AL 35801-1351
(256)533-3682 ph/(256)536-0411 Fax

CTEC, Inc.

May 12, 1998

Dr. Harold Varmus, Director
National Institute of Health
Bathesda, MD 20892
(301) 496-1766

Dear Dr Varmus:

We have recently sent action documents to the Director of Nuclear and Counterproliferation, Office of the DCS, Air and Space Operations, HQ USAF and to the DoD (General Busbee) Assistant Secretary of Defense, as well as several Senate and House committees, which may be of interest to you. For one thing, we give the technical mechanism used to generate the Gulf War Syndrome. The same weaponry is now being used to rapidly induce new strains of certain pathogens worldwide. I urge you to closely read that section of the letter to MG Neary which explains the GWS, why the French did not get it, and why Southern Iraqis got an increase in cancer and leukemia but not GWS. Also explained is how the "microwave radiation" of the U.S. Embassy in Moscow induced diseases for decades, and how we failed to comprehend it because the standard EM model deceived us.

There is a way to treat and quickly cure most diseases, including the mass casualties resulting from a terrorist BW strike on our civilian population centers, our military bases, or our forces in the field. The method is little known, but was scientifically demonstrated in France in the 1960s and early 1970s before cancellation of the Prioré Project when the French Government changed. Eminent French scientists worked on the project, and the results are fully documented in leading French scientific journals. References are listed in a separate attachment.

Previously the Western scientific community has been unable to understand the technical mechanism responsible for such remarkable cures, because of serious foundations flaws in Western physics and electrodynamics. *Foundations* physicists have long been aware our science is flawed, and have pointed out many of these fundamental errors. However, the operational science establishment has not paid attention, even though physicists such as Feynman and Wheeler pointed out that the notion of "force fields in space" was totally wrong.

As a primary example, there is an "infolded" electrodynamics inside all potentials, fields, and waves that is far more primary than the coarse EM that is in our textbooks. It is actually an infolded general relativity, and this is what the Russians have weaponized. This infolded EM-GR has been ignored in the West (but not in Russia) since 1903.

As another example the potentials, fields, and waves of present electrodynamics are rigorously defined – and exist – only in the presence of mass. They do not exist in such form (force fields and oscillating force fields) at all in space, in the absence of mass. Rigorously, Maxwell's equations are mass-to-mass transforms, since Maxwell and everyone at the time assumed the ubiquitous presence of the material ether. In other words, to the founding electrodynamicists, there was no place in all the universe that was devoid of mass. Hence they defined all EM entities as entities containing mass. Even though Michelson-Morley experiments of more than a century ago destroyed that material ether, not a single Maxwellian equation has ever been changed! They still assume the material ether.

Specifically missing from our electrodynamics are two essential transforms: (1) the mass-to-spacetime transform, and (2) the spacetime-to-mass transform. In other words, these two transforms are "infolded" or hidden inside (comprise) the end point extremum case – the mass-to-mass transform actually written by Maxwell.

But these two missing transforms are just general relativity (they correspond precisely to Wheeler's principle of general relativity). So general relativity has always been infolded inside electrodynamics as we know it, but ignored. Further, this is a very powerful general relativity, since it uses the very strong EM force as the agent of spacetime curvature. Hence now one can engineer a powerful general relativity in the laboratory and in practical devices, and even action-at-a-distance, which one cannot do using merely the staid and weak G-force.

It turns out that longitudinal EM waves as shown by E.T. Whittaker in 1903 and 1904 are far more primary than our present EM theory and even our present GR theory. Both EM and GR are directly engineerable using longitudinal EM waves, including subluminal and superluminal EM waves in vacuum, and including action at a distance. One can engineer complexes of spacetime curvatures as desired, which in turn are *spacetime engines* (Wheeler's term). These engines can act upon mass – either living or inert – in any fashion desired, and at any distance desired.

The little-known and poorly understood Regeneration & Recovery (R&R) system – as contrasted to the immune system – utilizes this exact "spacetime engine" methodology to restore damaged or diseased cells, within its limitations – "dedifferentiating" or "time-reversing" them back to normal. The mechanism is fully explained in the attached package. The proposed program applies this fundamental method to greatly amplify the effect. Thus cancer cells can be reversed back to normal cells, HIV-infected cells (HIV-factories) can be reversed back to normal cells (genetics and all), etc. This represents a dramatic and unparalleled new medical therapeutic methodology of extreme power. The same techniques can simply be conjugated one additional time, and used to produce diseases and cellular changes at a distance, including in entire mass populations, as the KGB is doing right now. Specifically, by impressing an extremely weak "cocktail mix" of disease spacetime engines on the U.S. populace, the immune systems are reacting and being "spread thin" across several "shadow state" infectious pathogenic conditions. Thus when an actual terrorist BW attack occurs, the lethality of the strike will be remarkably enhanced because the immune systems will be "thinned" in their ability to fend off this new pathogen. By doing it this way, BW warfare can actually be conducted upon the U.S. without anyone being the wiser.

Our very survival as a nation is threatened by remarkable KGB weapons using this fully documented, extended electrodynamics. Bluntly, unless we take off our scientific blinders and understand Russian energetics weapon science, GWS and the Embassy health changes in Moscow were just a picnic before what is upon us. After two decades of work on the KGB energetics weapon problem, we have fully deciphered the technical mechanisms and what energetics is, as well as citing many of the Russian weapon tests and how they were done. Again, you can see that for yourself in the package.

Now that we understand the technical mechanisms, we are proposing rapid redevelopment of the Prioré process, in portable suitcase-sized units to be mass produced and filtered down into the entire emergency community for mass treatment of lethal infectious diseases resulting from BW strikes. And we are strongly urging the U.S. scientific community to quickly investigate and come to grips with this vast new *biological engineering* mechanism. Our very survival depends on it.

The inclosed documents provide an overview of the process. There is nothing else on the scientific horizon that can save the majority of all those stricken Americans, once the first foreign-sponsored terrorist teams strike our population centers with BW agents.

Sincerely,

Incls: Full package with table of contents

T.E. Bearden
President & CEO

Weapons Slides

The Tom Bearden Website

Help support the research

"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our [counterterrorism] efforts." *

Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

Slides
(covers period up to 1999)

- The Coming Strategic Attack on the United States
- Outline
- Loss of two separate A-10 Warthogs in 1997
- Typical ABM Defenses (Widely Deployed by mid-70s)

- Launch Phase Anti-Missile System
- Launch Phase Anti-Bomber System
- HC-130s Engines Quit, Aircraft Crashes
  Nov. 22, 1996
- 1996 Actions by this analyst
- Additional Information Exists: Not Analyzed, Not Integrated in Briefing
- Kill of Arrow DC-8, Gander AFB, Dec. 12, 1985
- Satellite Photos of Plumes in Soviet Arctic Since 1974
  See "Fer de Lance" for additional information
- Aum Shinrikyo ("Supreme Truth" Cult), Shoko Asahara, Leader

  Aum Shinrikyo - Anatomy of a Dangerous Cult
- Ashkhabad Problem and Its Solution
- Strange Characteristics of Iran Quake, Sep. 1978
- Iran Earthquake, September 1978
- Situation Now (Assessment)
- Situation Now (Assessment 2)
- Aspects of Strong Local Asymmetry
- Mass Casualty Problem: Aerial Anthrax

Spray on Washington, D.C.

- Present Status of the WMD Threat to the United States
- Some Present Problems in the U.S. WMD Defense Capabilities
- Internal Terrorist Threat with Weapons of Mass Destruction: Now & Future
- Attempt to Ban Energetics Weapons Worldwide
- Brezhnev's Schedule
- Large glowing Tesla globe witnessed in Red China by hundreds
- Cold Explosion -- 9 April 1984 Near Kurils, and formation and growth of spherical shell (globe)
  Sequence of Events
- Cold Explosion -- 9 April 1984 Near Kurils, and formation and growth of spherical shell (globe)
  What They Were
- Cold Explosion -- 9 April 1984 Near Kurils (Plus additional weapons effects)
- Countering Insane MAD Systems:
  Find Loophole, Exploit It
- Next Generation Counter to Both Sane and Insane MAD systems
- Simultaneous Dudding of Nuclear Weapons Worldwide

- Simultaneous Dudding of Nuclear Weapons Worldwide
- Operation Divine Wind II
- Advanced EMBW Applications
- EM Biological Warfare (EMBW)
- Microwave Radiation of U.S. Embassy in Moscow
- Pentagon EMI Studies, 1989
- EM Missile Practice (6 slides)
- Subdivisions of Soviet Energetics Program
- Communism's Goal
- Manuilsky's Goal vs. Status Today (Dec. 1996)
- Professor Hellman, German Scientist Released from Work in Soviet Union
- Hemispheres and Globes of Light (4 slides)
- How Could Such Superweapons Ever Be Concealed?
- Soviets Easily Concealed These Superweapons for Four Decades
- Microscope-type, laser-like interferometer for inducing quick α-decay in samples of otherwise longer-lived isotopes
- Longitudinal Wave Interferometry: Endothermic

- Longitudinal Wave Interferometry: Exothermic
- U.S. Air Attack on Libya, April 1986
- Lightning Wall
  circa 1959-1960
- Lisitsyn's Report: Brain Code Broken
- Large Longitudinal Wave Interferometer (LWI) Accident
- Large Longitudinal Wave Interferometer (LWI) Accident
- Use of Hidden Information Content of the Field Can Provide Action-At-A-Distance
- Two Types of Mutual Assured Destruction (MAD) System
- Psychoenergetics Weapons Teams Mentally Disable All Personnel
- Strikes Against Special Ship and Energetics Weapons Sites
- "Mindsnapper" Attack on Special Ships and Energetics Weapons Sites
- How Much Off Guard Are We?
  (7 Slides)
- Possible Targets: 1995-9 Escalation Phase
- Propagation of Weapon Effects
- Yugoslav Earthquake, Followed by Cold Explosion
  April 15th, 1979

- Countering an Insane QP Weapon
- Gulf War Disease: KGB QP Weapon Induced ST Curvature Engines for a Cocktail of Diseases
- Self-Targeting in Inner EM Channel Can Produce a Quantum Potential
- Mechanism for Producing a Quantum Potential
- Major Principles for Use of Quantum Potential Weapons
- Major Principles for Use of Quantum Potential Weapons (2)
- Instantaneous Communication by a Quantum Potential
- Participants in a quantum potential share a common multiply-connected spacetime (MCST)
- Quake in Tangshan, China
  28 July, 1976
- Exchanging Earthquakes
- Instant Communication by a Quantum Potential
- Westerners Do Not React to Slow Threats
- Characterizing a Given Risk or Risk Factor
- Technical Risk Management
- Aum Shinrikyo's Sarin Facility

- In Scalar Beam Interference Zone
- Physicist Schappeller Auralaz Munster, Austria
- Initial Soviet Plan for Cold War, After WWII
- Josef Stalin: Absolute Dictator
- Exploding any Resistance by Operational Scientists
- Significant Soviet Statements
- Captain Svoboda Dives Headlong to Her Death
- T-polarized Beam Projector
- Possible Tests (1)
- Possible Tests (2)
- Possible Tests (3)
- Possible Tests (4)
- Mushroom Cloud Rising From Sea
- Launches from Cape Canaveral and Vandenberg AFB Provided Practice Targets of Opportunity
- The sinking U.S.S. Thresher, with her controls jammed, implodes when she reaches crush depth
- Embodiment of an instrument array sufficient to discriminate when time-density charging has occurred, and that transduction

of time-charge decay has occurred.

- Time-Polarized EM Wave Interferometer Creating Space-Time Curvature Engines in a Distant Interference Zone
- Transmutation of Radioactive Nuclei at a Distance
- Transmutation of Radioactive Nuclei
- Typical Tesla Shield, Northern Route of Japan
- A Curious Tide in Human Affairs
- Large Scalar EM Interferometer (LASI) Accident Near Urals, 1958
- The Superpower Paradox: Asymmetric Cheap WMD Strategic Strike and Destruction
- The KGB/Yakuza-Aum War Plan
- Why Western Science is Ignorant of KGB Energetics
- Transmutation of Radioactive Nuclei at a Distance
- TheYakuza
- Yugoslav Earthquake, Followed by Cold Explosion
  April 15, 1979

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* Note that the Secretary did not speak the words in square blocks; these were added by the writers later,

probably to "soften the tone" of the Secretary's information release. So the Secretary confirmed that some nations of the world -- not just some ragged terrorists, as the writers tried to imply for spin control -- do possess novel electromagnetic weapons and are using them to induce earthquakes, engineer the weather and climate, and trigger volcanic eruptions.

THE COMING STRATEGIC ATTACK ON THE UNITED STATES

By an AUM/Yakuza/KGB/Communist Coalition Using Energetics SuperWeapons

T.E. Bearden, LTC
U.S. Army (Retired)
M.S. Nuclear Eng.
Fellow Emeritus, AIAS

With Technical Background and History of Energetics Weapons

Partial support by the Association of Distinguished American Scientists is gratefully acknowledged.d

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Outline

- Background: Classical Electromagnetics (and Defects)
- Background: Energetics (Scalar Electromagnetics)
- Background: Soviet Energetics Weapon Development
- KGB/Communist Plans
- Countering of Soviet/KGB/Communist Plan in Mid-80s
- Soviet Economic Collapse and Adaptation of Plan
- Weapons Bleed-Out: KGB/Russian Mafia
- Yakuza: The Japanese Mafia
- Aum Shinri Kyo (Supreme Truth) Cult
- Coalition: Aum/Yakuza/KGB/Communists/Russian Mafia
- Operation Divine Wind II: Three Phases
  - Phase I: On-Site Training Phase (Completed)
  - Phase II: Escalation Phase (In Progress)
  - Phase III: 1997 Strategic Strike on the United States
  - Support Plan A: Feints, Deception, Sabotage & Terrorism
  - Support Plan B: Test Range
  - Support Plan C: Worldwide Weather Engineering
  - Support Plan D: Strategic and Combat Intelligence
- Special Information
- Recommended Actions

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The Tom Bearden Website

Help support the research

Loss of two separate A-10 Warthogs in 1997

- A-10 Mysterious Flyaway and Crash - April 2, 1997
- Death of Second A-10 Pilot - May 27, 1997
- Captain Button's Mysterious Flyaway and Eventual Crash
- Death of Second A-10 Pilot - May 27, 1997

A-10 Mysterious Flyaway and Crash

April 2, 1997

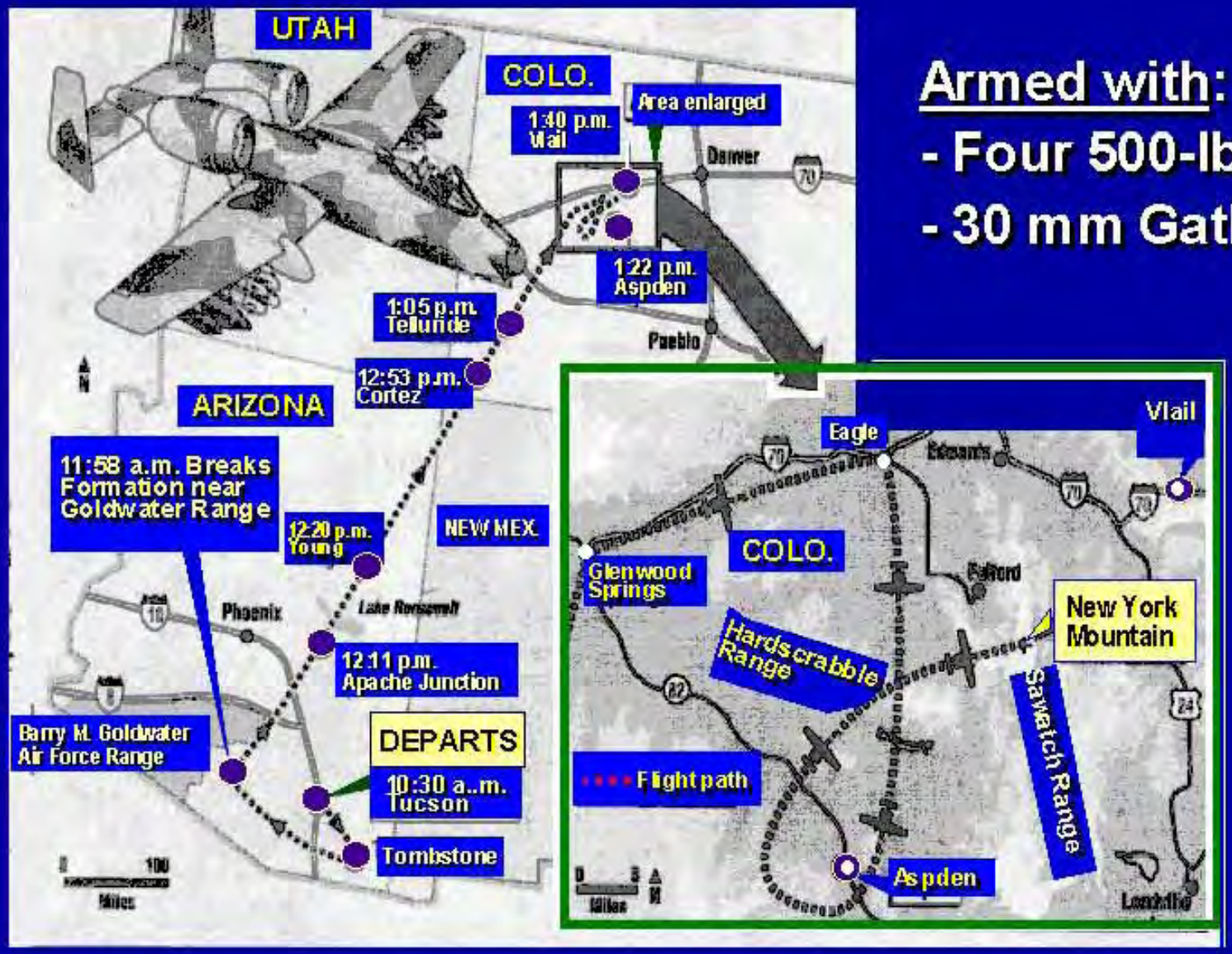

Armed with:

- Four 500-lb bombs
- 30 mm Gatling gun

Death of 2nd A-10 Pilot May 27, 1997

- Captain Amy Svobody
- Night training mission
- From Davis-Montham AFB
- From same wing as Captain Button, who flew his A-10 off course for over an hour and then crashed on April 2.
- Climbout from ordnance delivery on target
- Nosed down sharply and dived into ground

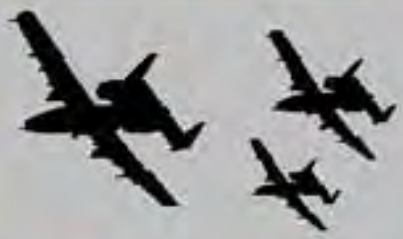

Companion A-10's

- Experienced night flyer & instructor
- Nosed sharply over and flew into ground
- Psychoenergetic kill

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Psychoenergetic weapon induced instant hypnogogic state and reversed Svoboda's sense of up and down.

A-10 Mysterious Flyaway and Crash

April 2, 1997

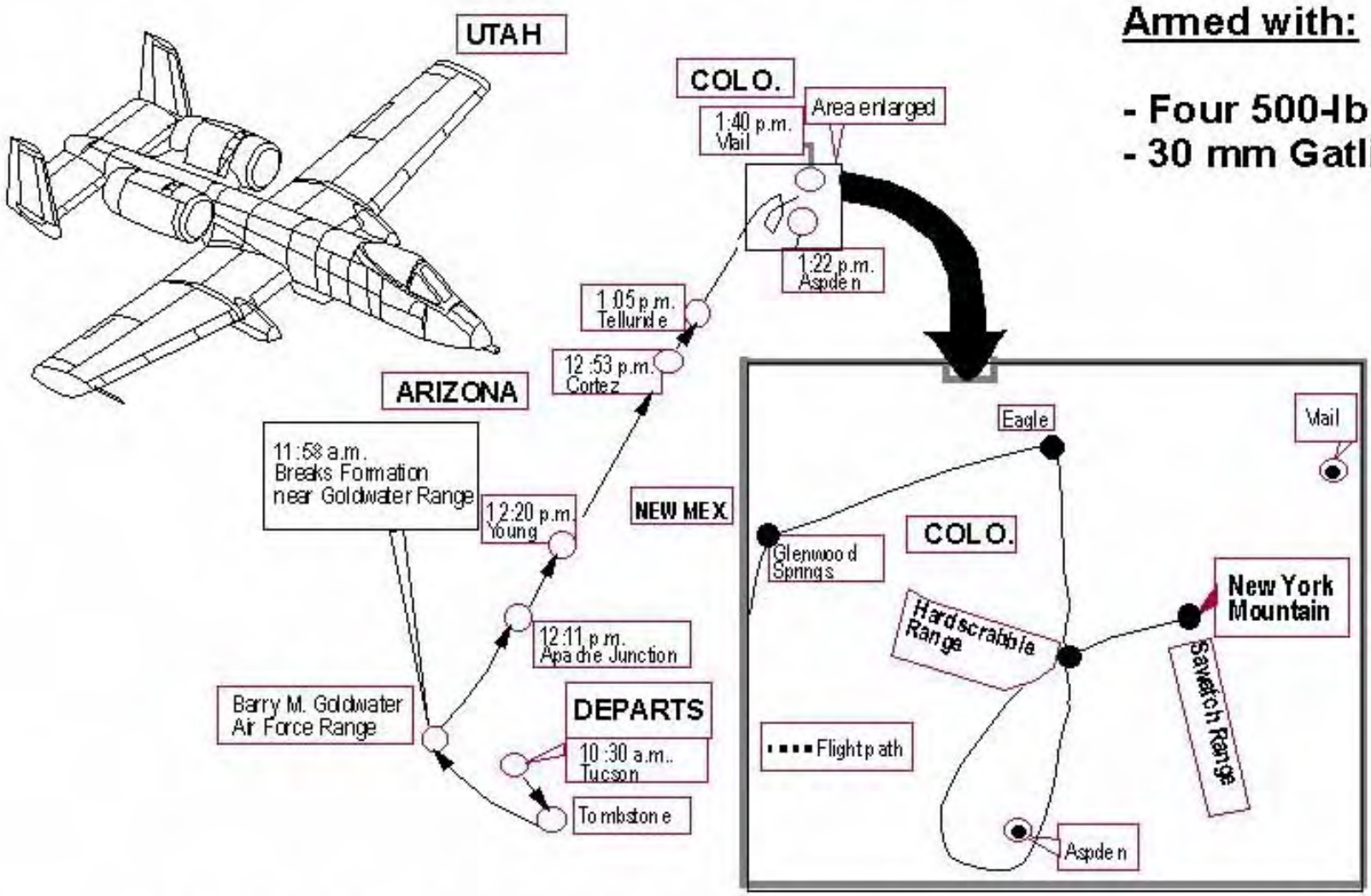

Armed with:

- Four 500-lb bombs
- 30 mm Gatling gun

Figure 14a. Captain Button's mysterious flyaway and eventual crash.

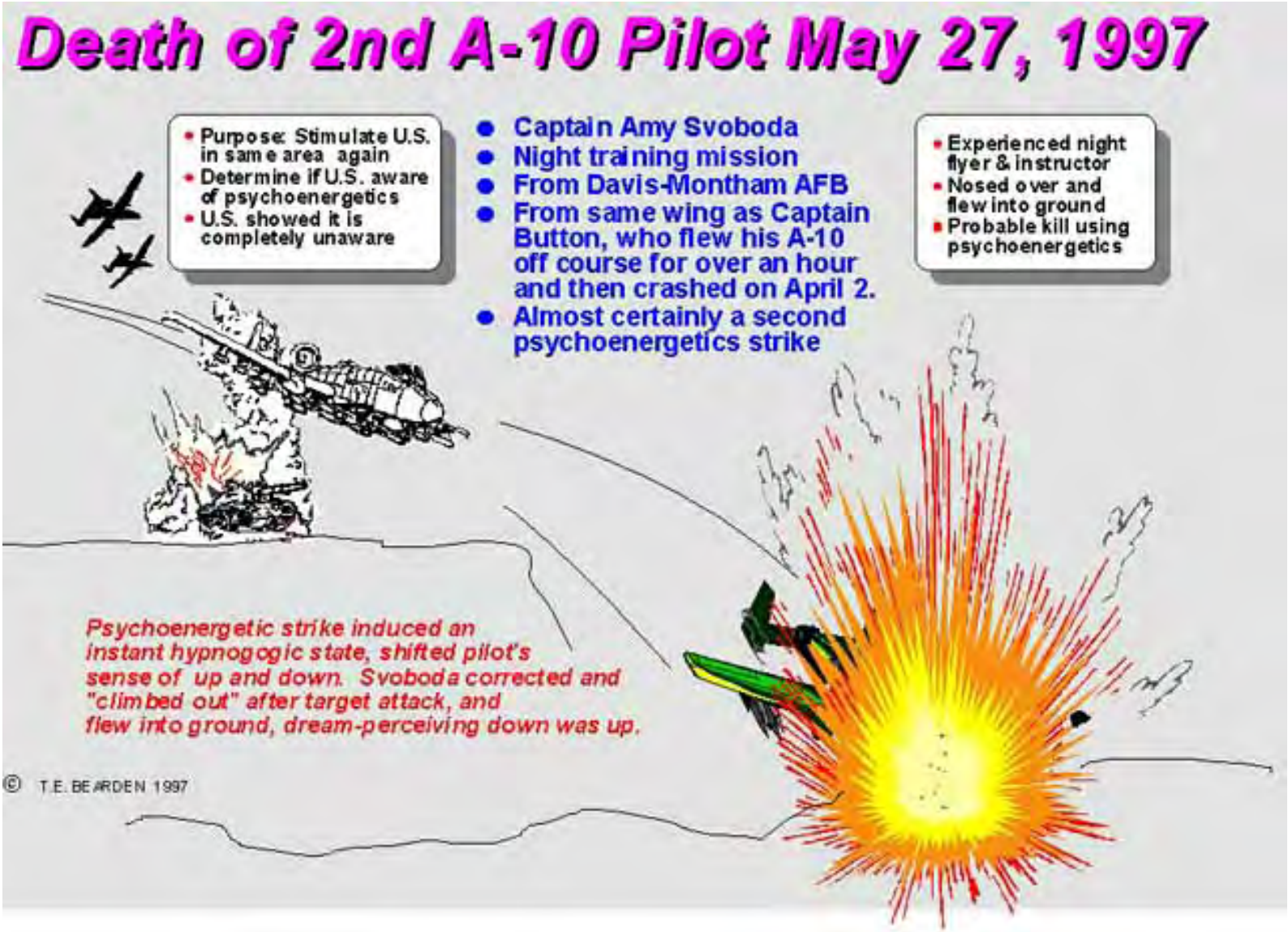
Death of 2nd A-10 Pilot May 27, 1997
• Purpose: Stimulate U.S. in same area again
• Determine if U.S. aware of psychoenergetics
• U.S. showed it is completely unaware
• Captain Amy Svoboda
• Night training mission
• From Davis-Montham AFB
• From same wing as Captain Button, who flew his A-10 off course for over an hour and then crashed on April 2.
• Almost certainly a second psychoenergetics strike
• Experienced night flyer & instructor
• Nosed over and flew into ground
• Probable kill using psychoenergetics
Psychoenergetic strike induced an instant hypnogogic state, shifted pilot's sense of up and down. Svoboda corrected and "climbed out" after target attack, and flew into ground, dream-perceiving down was up.
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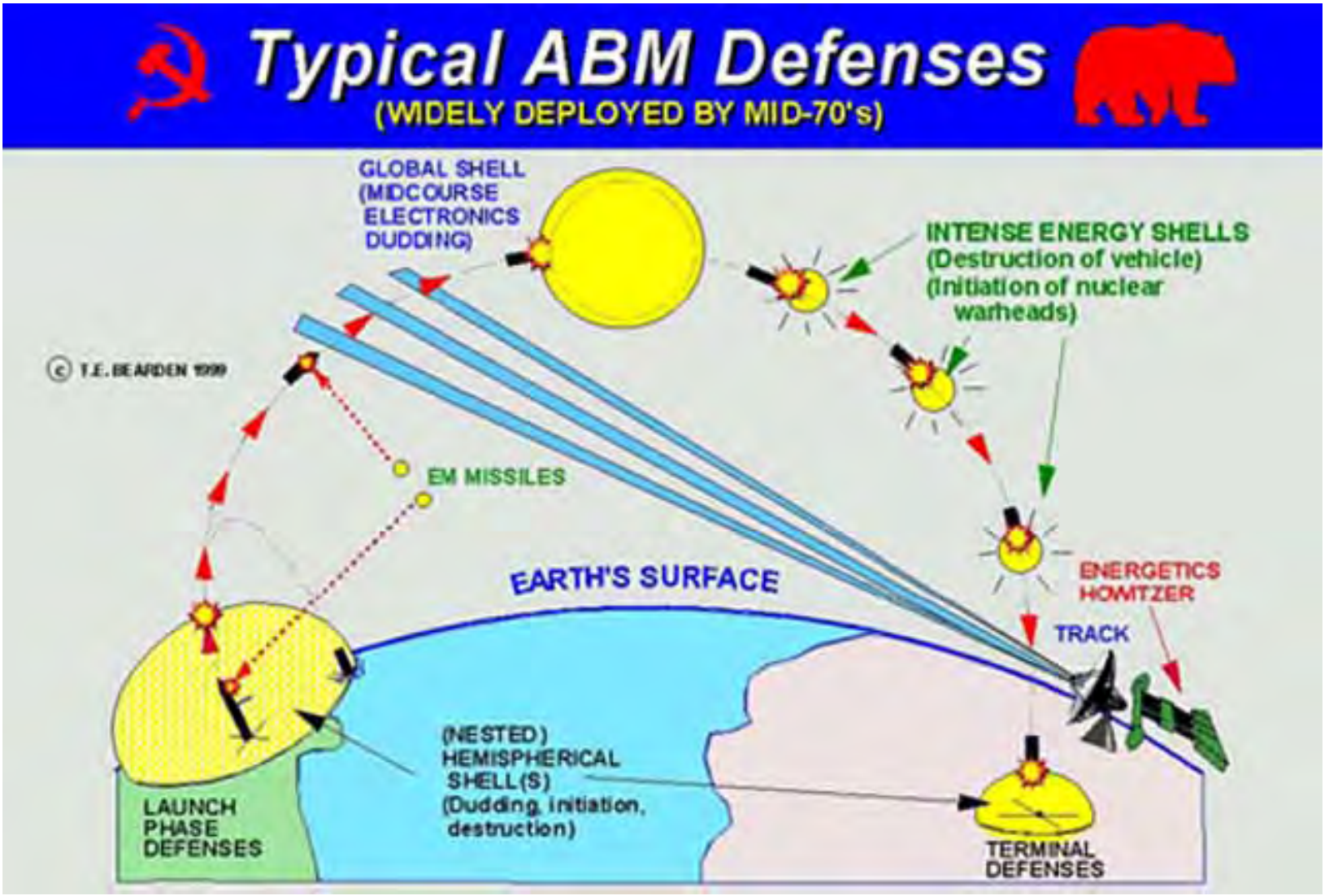
Typical ABM Defenses
(WIDELY DEPLOYED BY MID-70's)
GLOBAL SHELL
(MIDCOURSE
ELECTRONICS
DUDDING)
INTENSE ENERGY SHELLS
(Destruction of vehicle)
(Initiation of nuclear
warheads)
© T.E. BEARDEN 1999
EM MISSILES
EARTH'S SURFACE
ENERGETICS
HOWITZER
TRACK
(NESTED)
HEMISPHERICAL
SHELL(S)
(Dudding, initiation,
destruction)
LAUNCH
PHASE
DEFENSES
TERMINAL
DEFENSES

LAUNCH PHASE ANTIMISSILE SYSTEM

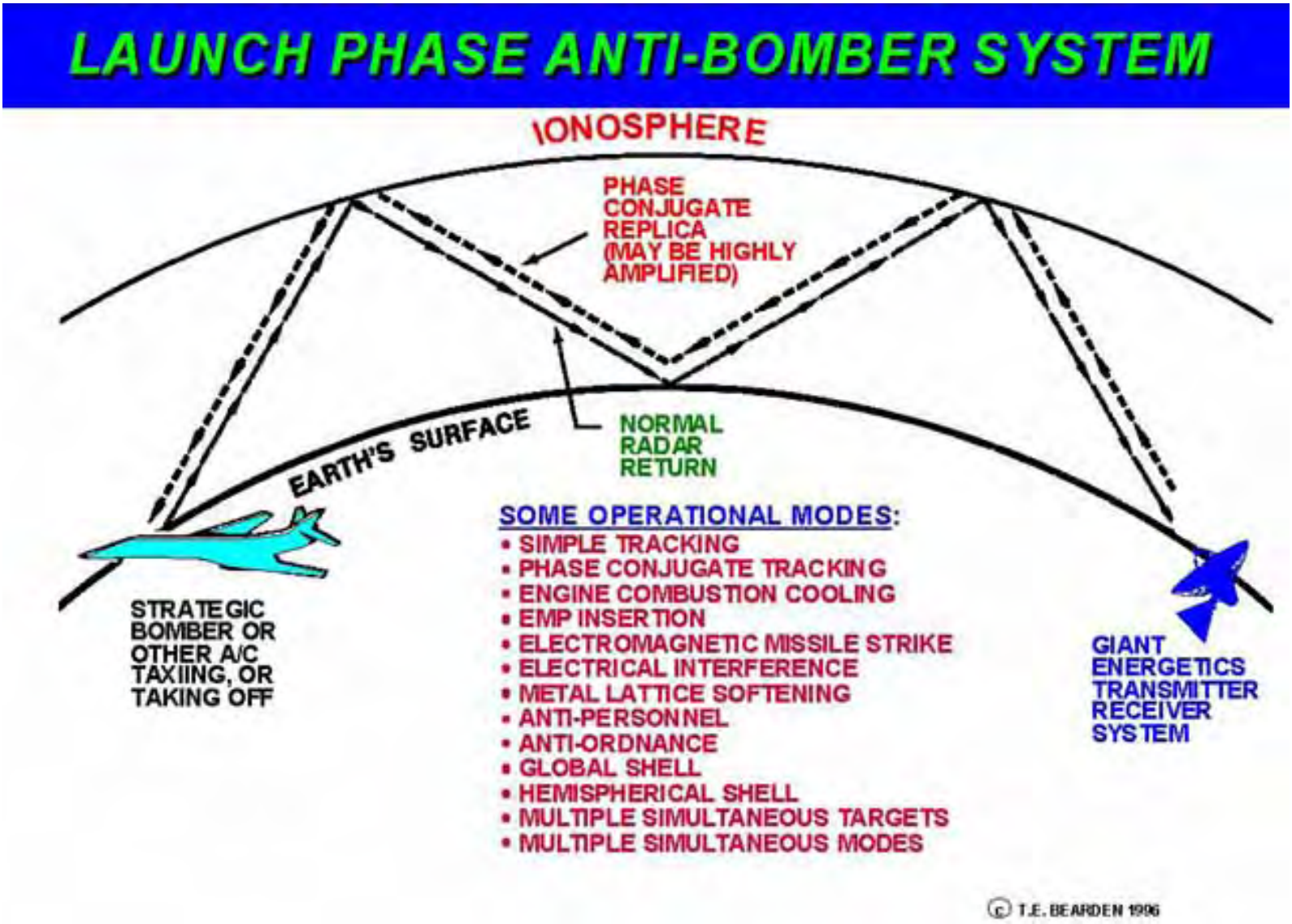
LAUNCH PHASE ANTI-BOMBER SYSTEM
IONOSPHERE
PHASE CONJUGATE REPLICA (MAY BE HIGHLY AMPLIFIED)
NORMAL RADAR RETURN
EARTH'S SURFACE
STRATEGIC BOMBER OR OTHER A/C TAXIING, OR TAKING OFF
SOME OPERATIONAL MODES:
• SIMPLE TRACKING
• PHASE CONJUGATE TRACKING
• ENGINE COMBUSTION COOLING
• EMP INSERTION
• ELECTROMAGNETIC MISSILE STRIKE
• ELECTRICAL INTERFERENCE
• METAL LATTICE SOFTENING
• ANTI-PERSONNEL
• ANTI-ORDNANCE
• GLOBAL SHELL
• HEMISPHERICAL SHELL
• MULTIPLE SIMULTANEOUS TARGETS
• MULTIPLE SIMULTANEOUS MODES
GIANT ENERGETICS TRANSMITTER RECEIVER SYSTEM
© T.E. BEARDEN 1996

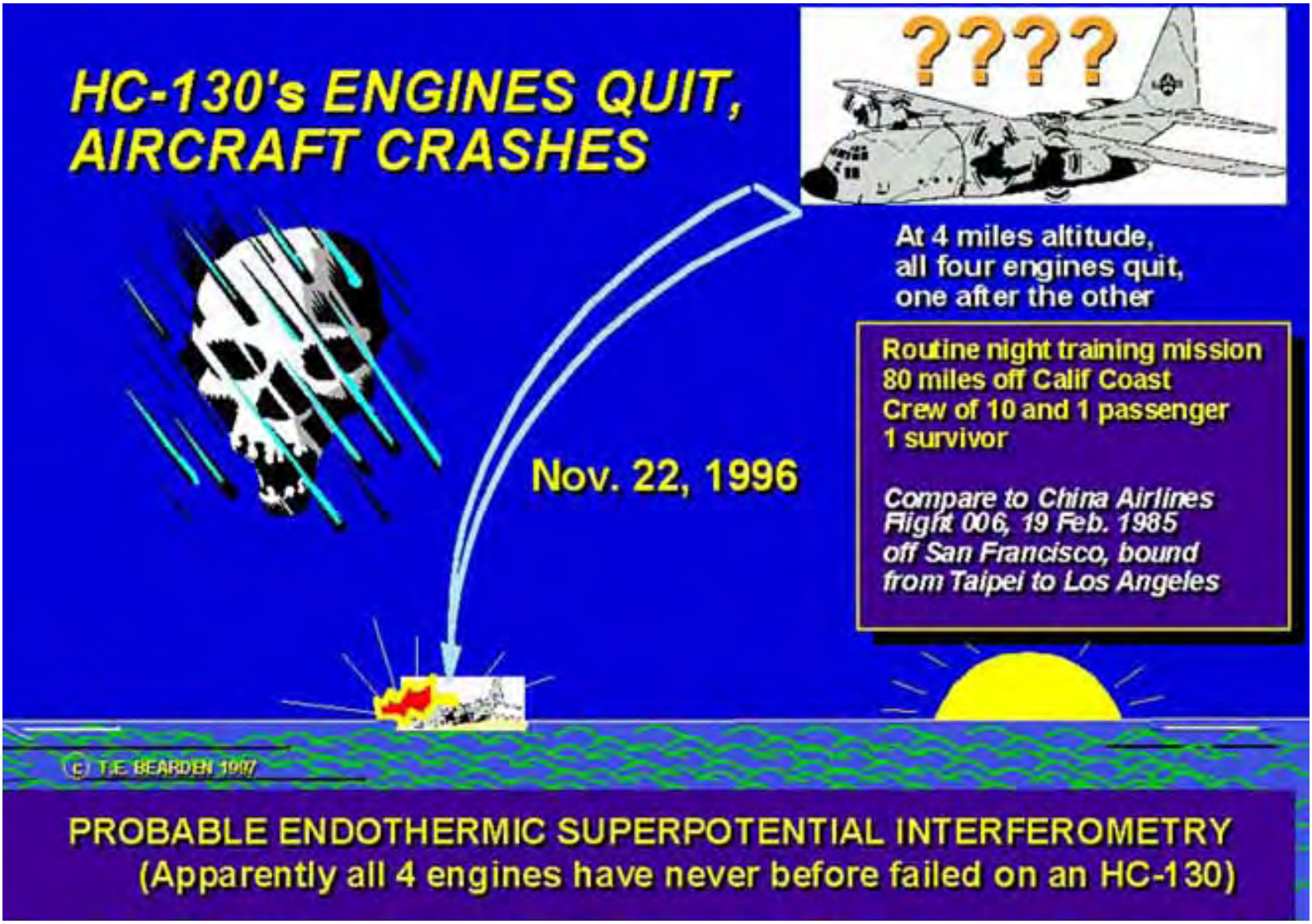
HC-130's ENGINES QUIT, AIRCRAFT CRASHES
????
At 4 miles altitude, all four engines quit, one after the other
Routine night training mission
80 miles off Calif Coast
Crew of 10 and 1 passenger
1 survivor
Compare to China Airlines Flight 006, 19 Feb. 1985 off San Francisco, bound from Taipei to Los Angeles
Nov. 22, 1996
© T.E. BEARDEN 1997
PROBABLE ENDOTHERMIC SUPERPOTENTIAL INTERFEROMETRY
(Apparently all 4 engines have never before failed on an HC-130)

CTEC PROPRIETARY

1996 Actions by this analyst

- In July 1996, with the kill of TWA-800 it became apparent that the KGB/Communists were preparing a massive strategic energetics attack upon the U.S.

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- Began intensive, nearly round-the-clock effort to uncover what was happening, and what had occurred in KGB/Com weapons since 1991
- Began preparing full-up set of briefing slides simultaneously
  - In early 1996, had briefed J6 on scalar EM, per his request
  - Had strongly suggested a follow-on weapons brief
  - Adamant opposition by NRL, NOL, others
- Similar energetics attack scenario in 1986 was countered. Soviets at that time did not possess operational QP weapons, and so could not successfully overcome dead-man fuzing
  - Also could not dud nukes worldwide, because QP required.
  - First lab prototype QP test was in April 1986
- KGB had solved the dead-man fuzing problem by QP's. Deployed circa 1989-1990. Some earlier weapons then leased.

Additional Information Exists; Not Analyzed, Not Integrated in Briefing

- Yakuza arranged involvement of
  - Red Chinese
  - North Koreans
  - A Taiwanese element
- Aum Shinrikyo may have been used as "Red Herring" to deceive West
- Oriental faction plots to strike Russians after the successful first strike on West
- KGB/Russians aware, will counter
  - Plan pre-emptive strike against Oriental faction first
  - Have reserved most advanced, powerful energetics weapons for that purpose

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The Tom Bearden Website

Help support the research

Kill of Arrow DC-8, Gander AFB, Dec. 12, 1985

- Slide 1
- Slide 2
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- Slide 5
- Slide 6

KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Soviet EM missile weapon strike practice two weeks earlier at Cape Canaveral
► Offset from night shuttle launch
► EM missile photographed by Bob Gladwin
► Associated marker beacon photographed
• Canadian Board split on findings
► Half thought icing, half disagreed intensely
► "Due to icing" approved with half absent
► Separate dissenting finding issued
• U.S. officials hiding Iran/Contra affair
► Feared terrorist bomb, MidEast sponsor
► Pressured Board, Gen. Off. bulldozed site
• Lack of icing on aircraft later validated

KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Eyewitness observed beams form in the sky
• Saw streak-down and strike of EM missile
– Struck right fuselage ahead of the engines
– Hole was burned through fuselage there
– Photo of hole published in AW&ST
– No explosive residues on hole
• Consistent with ignition and outgassing of plastics in forward cabin
• Consistent with pre-crash HCN deaths

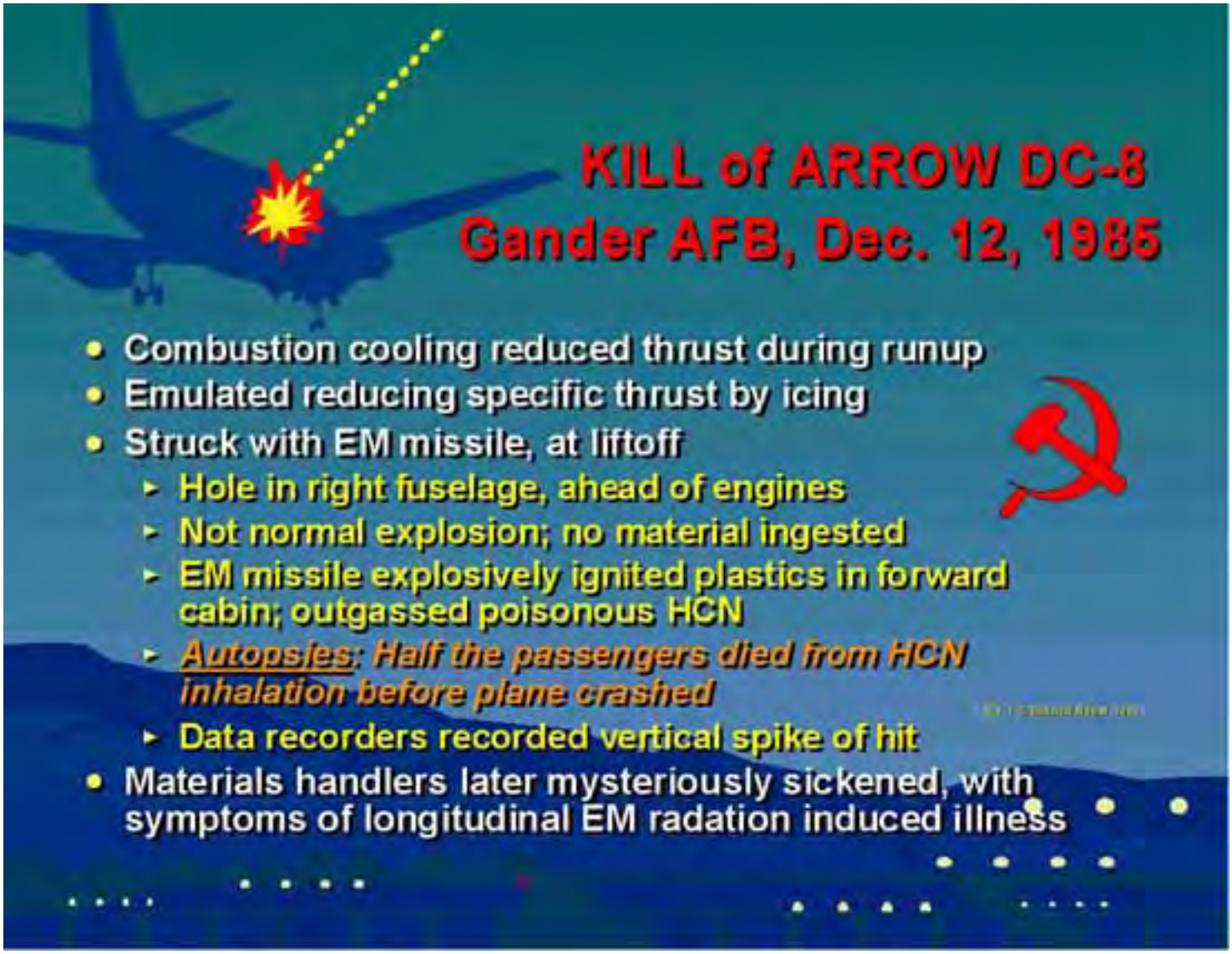
KILL of ARROW DC-8
Gander AFB, Dec. 12, 1985
• Combustion cooling reduced thrust during runup
• Emulated reducing specific thrust by icing
• Struck with EM missile, at liftoff
▸ Hole in right fuselage, ahead of engines
▸ Not normal explosion; no material ingested
▸ EM missile explosively ignited plastics in forward cabin; outgassed poisonous HCN
▸ Autopsies: Half the passengers died from HCN inhalation before plane crashed
▸ Data recorders recorded vertical spike of hit
• Materials handlers later mysteriously sickened, with symptoms of longitudinal EM radation induced illness

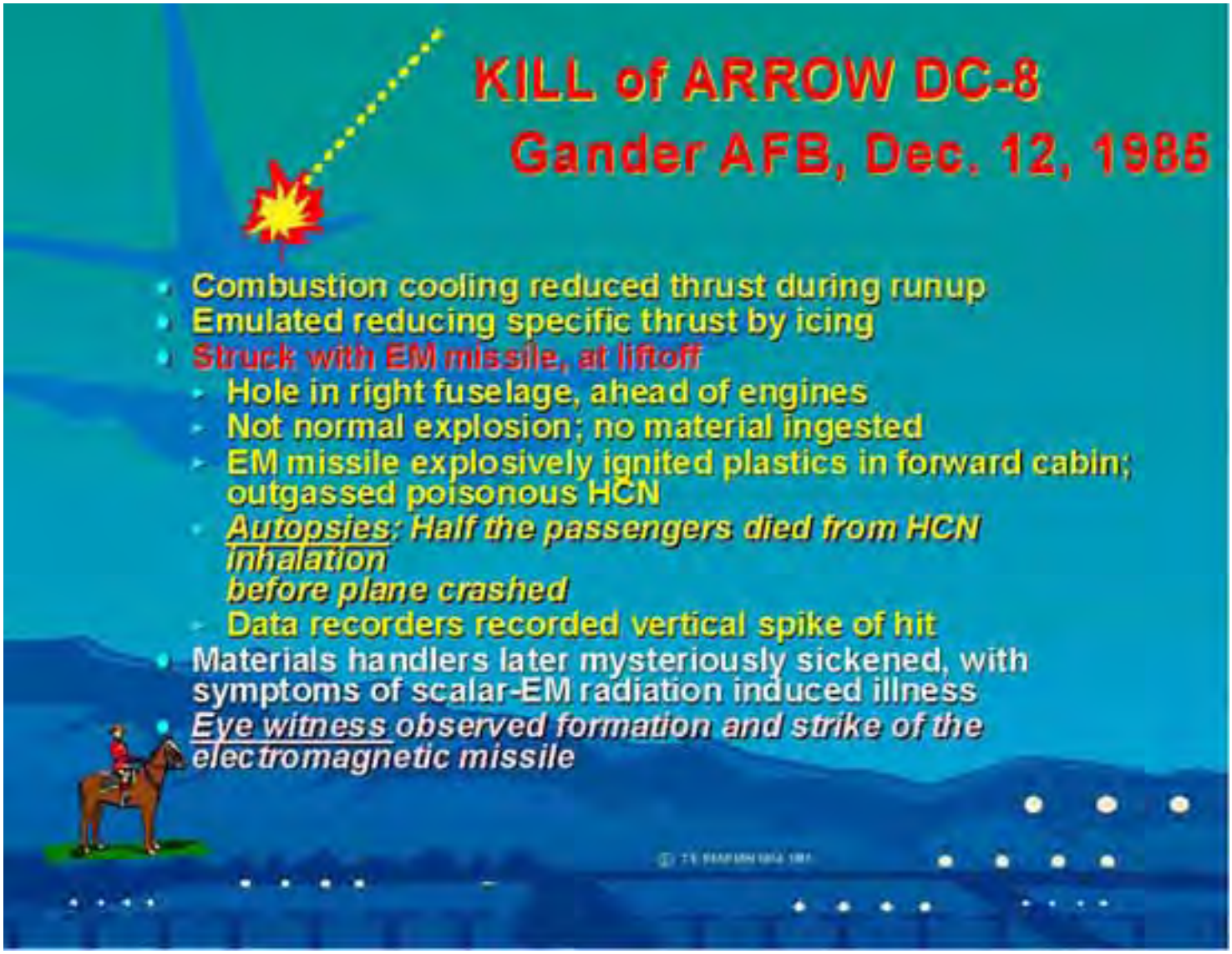
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Autopsies: Half the passengers died from HCN inhalation
before plane crashed
Data recorders recorded vertical spike of hit
Materials handlers later mysteriously sickened, with symptoms of scalar-EM radiation induced illness
Eye witness observed formation and strike of the electromagnetic missile

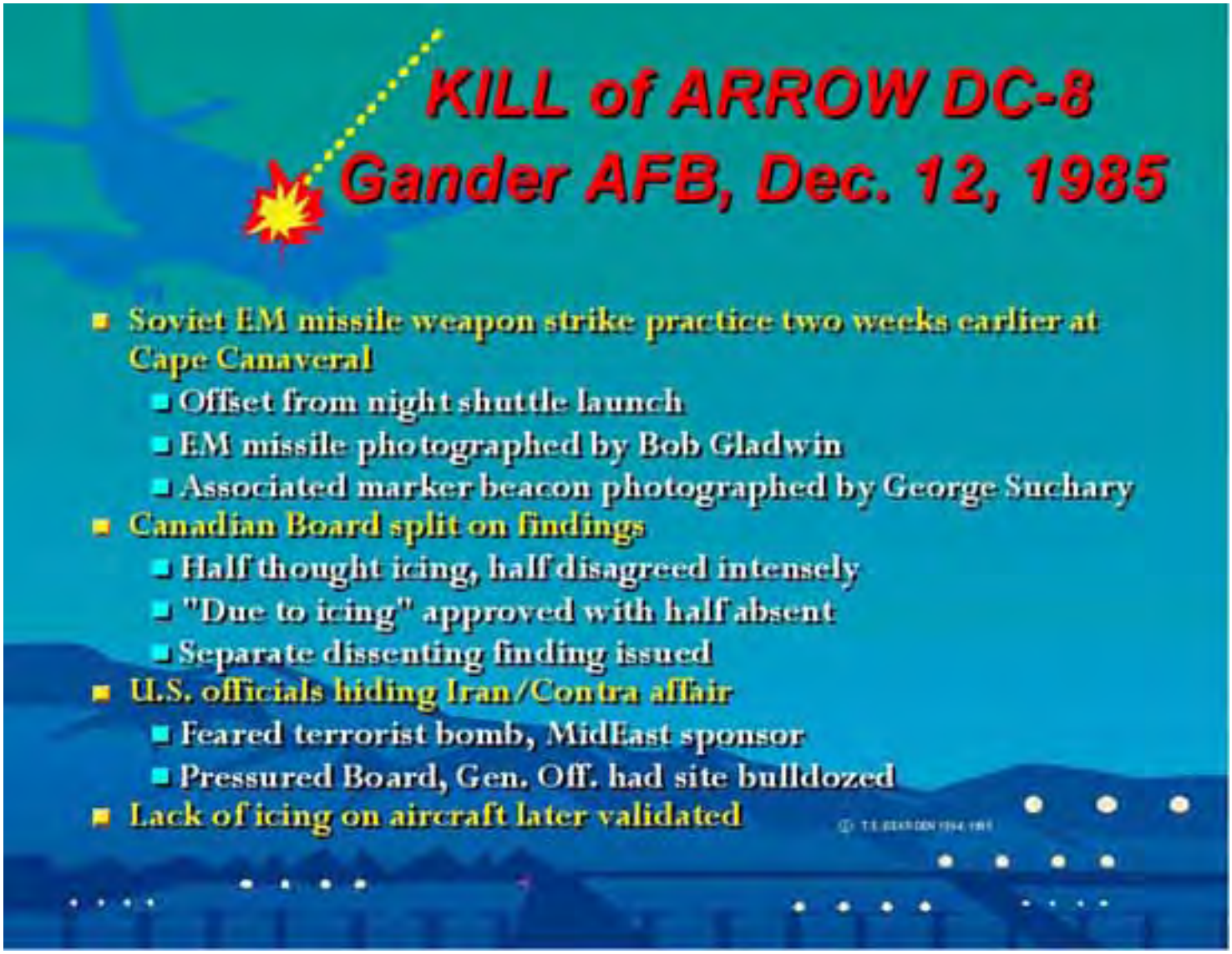
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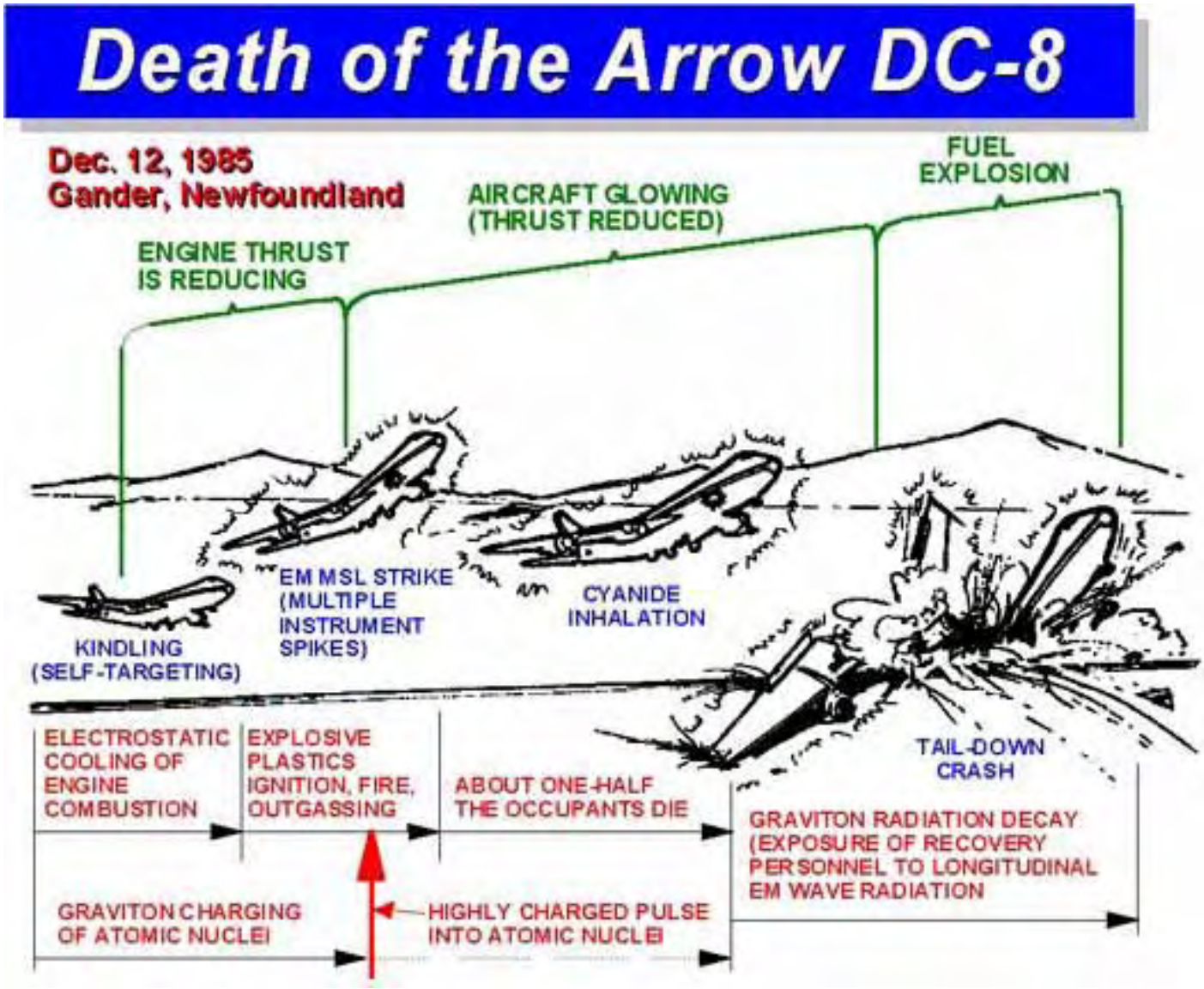
Death of the Arrow DC-8
Dec. 12, 1985
Gander, Newfoundland
ENGINE THRUST IS REDUCING
AIRCRAFT GLOWING (THRUST REDUCED)
FUEL EXPLOSION
KINDLING (SELF-TARGETING)
EM MSL STRIKE (MULTIPLE INSTRUMENT SPIKES)
CYANIDE INHALATION
TAIL-DOWN CRASH
ELECTROSTATIC COOLING OF ENGINE COMBUSTION
EXPLOSIVE PLASTICS IGNITION, FIRE, OUTGASSING
ABOUT ONE-HALF THE OCCUPANTS DIE
GRAVITON RADIATION DECAY (EXPOSURE OF RECOVERY PERSONNEL TO LONGITUDINAL EM WAVE RADIATION
GRAVITON CHARGING OF ATOMIC NUCLEI
HIGHLY CHARGED PULSE INTO ATOMIC NUCLEI

Satellite Photos of Plumes in Soviet Arctic Since 1974*

- Two aircraft flew through for analysis
  - Solid material, mostly ice, a little clay
  - Much colder than surrounding air
  - *Signature of cold exhaust from exothermic scalar interferometry operations*
  - No volcanic material
  - No radioactive material

- May be 2 to 3 times as many incidents
  - Only examined satellite imagery in winter
  - Only periodic satellite coverage
  - Hypothesized methane venting, cloud seeding

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*As of 1989, when this information was gathered

AUM SHINRIKYO
("SUPREME TRUTH" CULT)

Shoko Asahara, Leader

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Ashkhabad Problem and Its Solution

- ***PROBLEM:***
  - Stress increasing in two-plate fault zone
  - 1,000 shocks yearly
  - Kara Kum canal
  - Hydraulic pressure
  - 1948: Ashkhabad 80% destroyed by quake

- ***SOLUTION:***
  - Stress-relieve plate stresses from fault

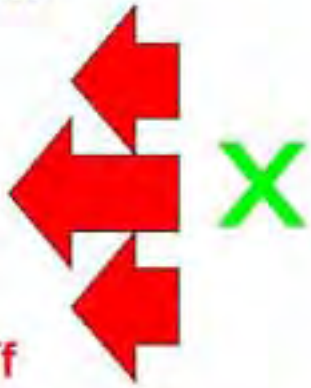

- ***IMPLEMENTATION:***
  - Induce nearby earthquake
  - Deceive by *predicting* a quake, setting off nuclear explosion

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Strange Characteristics of Iran Quake, Sep. 1978

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- **Signatures**
  - 7.4 on Richter scale
  - No aftershocks: 6.0 expected (normal)
  - Strange epicenter
  - Anomalous depth

- **Deception**
  - 10 MT Soviet nuclear explosion 36 hours before the quake
  - Prior disinformation regarding Soviet attempted development of focusing shock waves from underground nuclear explosions, to cause distant earthquakes

Iran Earthquake Sept. 1978

- Killed 25,000 Iranians
- Soviet city of Ashkhabad saved
- Soviets "predicted" quake in advance; then induced it
- Quake had serious anomalies (signatures)
- Deception measures were used by Soviets
  - Prediction in advance
  - "Theory" of quake-induction by nuclear explosions
  - Fired underground nuclear explosion as "Red Herring" candidate for cause

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Situation Now (Assessment)

- In May 1997: second A-10 pilot (lady), in pullup from night ordnance delivery on target, was struck with psychoenergetic weapon takeover. Sense of vertical was reversed. She perceived herself diving, sharply corrected, and dove headlong into the ground.

- Additional aircraft kills uncovered, including one 4-engine aircraft whose engines all failed. This closely repeats the earlier 1985-1987 scenario.
- Korean Airlines Flight 801 crashed on Guam on anniversary of loading of the atomic bomb that was dropped on Hiroshima in WW II. The Enola Gay, which dropped the bomb, took off from Guam in wee morning hours of August 6, 1945. The local opns order on Guam was also issued on Aug. 5.

- *Presently the Coalition (KGB/Communists/Aum Shinrikyo/Yakuza) is waiting for proper time to launch the final strike. It is still on.*

Situation Now (Assessment 2)

- April 97: Mind control test against Captain Button:
  - Demonstrates ability to control crewman in complex operations for more than one hour.
  - KGB requires one hour total QP crew control on a site to have crew disable insane QP wpns.
- Once QP systems disabled, Mindsnapper attacks and instantly kills every living thing in QP site area. Contaminates area for months (emits longitudinal EM wave radiation, which disrupt any life forms attempting to enter struck area). Sites nullified.
- Mind control over one crewman requires one weapon system plus up to 20-30 operators for controlling thoughts, hearing, perceptions, etc.
- *In Apr. 97, KGB building and deploying weapons and training crews. Ready for new attack 1999-2000.*

Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum
- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another

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Mass Casualty Problem: Aerial Anthrax Spray on Washington, D.C.

- One terrorist, one light aircraft with spray tank
- One kilogram of anthrax
- Flies over greater metropolitan Washington, D.C.
- Calm night
- *1-3 million casualties result**
- *Most of those stricken will die*
- Presently little can be done to save the stricken civilians
- *Attacks on several population centers might produce some 10 million or more casualties*

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*Per OTA Report to Congress, 1993

Present Status of the WMD Threat to the United States

- Many foreign nations are hostile to the U.S. and sponsor terrorists
- Some 25 nations have WMD or are acquiring them
  - BW agents and weapons
  - Chemical agents and weapons
  - Nuclear materials and weapons
- Thousands of students and émigrés
- Infiltrated teams, BW, other WMD already
- Castro guerrillas infiltrated over the years
- Can do unacceptable damage to U.S. now
- *May reach first strike knockout capability*

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*Per OTA Report to Congress, 1993

Some Present Problems in the U.S. WMD Defense Capabilities

- No shelters (require overpressure, BW filtering, masks, showers, supplies)
- No stockpiled vaccines, medical supplies, immunoglobulins, masks, suits, food, fuel, generators, heaters, water purification units
- Totally insufficient medical facilities, personnel, and emergency response teams
- Triage, full martial law will be required
- No answer to massive decontamination problem
- State, county, city inadequately staffed and insufficiently trained for mass casualties
- Terrorist teams, BW agents, other WMD on site, waiting
- Water supplies, food, crops, farm animals also vulnerable
- Electric power grid, bridges, trains, railroads vulnerable
- Present medical science cannot save very many of the casualties, now or in the foreseeable future

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Internal Terrorist Threat with Weapons of Mass Destruction: Now & Future

TODAY:

- Sabotage
- Chemicals
- Biological agents
- Nuclear materials
- Powerful explosives
- Assassination
- Kidnapping and hostages
- Contamination
- Shoulder-fired AD missiles
- Terrorism

FUTURE ADDITIONS:

- Orthodox EM weapons
- Energetics EM biological warfare
- Scalar EM (energetics) weapons
- Scalar EM disease induction
- Alteration of behavior and emotions
- Alteration of memory
- Direct control of thoughts, perception
- Quantum potential weapons
- Psychoenergetics weapons
- Action-at-a-distance effects

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Attempt to Ban Energetics Weapons Worldwide

- On June 13, 1975, in a major speech Brezhnev urged the United States to agree on a ban of research and development of new kinds of weapons "more terrible than anything the world has known."
- On July 2, 1975 Brezhnev repeated his proposed ban on development of frightful new weapons, to a group of U.S. Senators.
- In August 1975, Ponomarev called for a ban on frightful new weapons of mass destruction.
- On Sept. 23, 1975 Gromyko presented a draft treaty agreement to the 30th Session of the UN General Assembly, for banning development of frightful new weapons.
- *No one had the foggiest notion what the Russians were talking about!*

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Brezhnev's Schedule

"We are achieving with detente what our predecessors have been unable to achieve with the mailed fist...
...by 1985 our power will be so irresistible that we can do what we wish anywhere on the globe."

Leonid Brezhnev,
in a secret 1973 meeting in Prague
with European Communist leaders.

"By the early 1980's we and our allies will control the high seas, space, and most of the earth's land area."

Kosygin,
to Imelda Marcos,
July 1978

In 1985-87, the Soviets did attempt to move, still constrained by nuclear dead man fuzing. That attempt was blocked, primarily by scalar EM countering demonstrations and dead man fuzing.

In April 1986, the first Soviet lab prototype of a quantum potential weapon specifically designed toward 10-min neutralization of nukes worldwide was gingerly tested against our U.S. airstrike on Libya. It was weakly tested in the "induced EMI" mode, for deception.

By 1990 that weapon was deployed and a new attack preparation phase was entered, scheduled for 1997.

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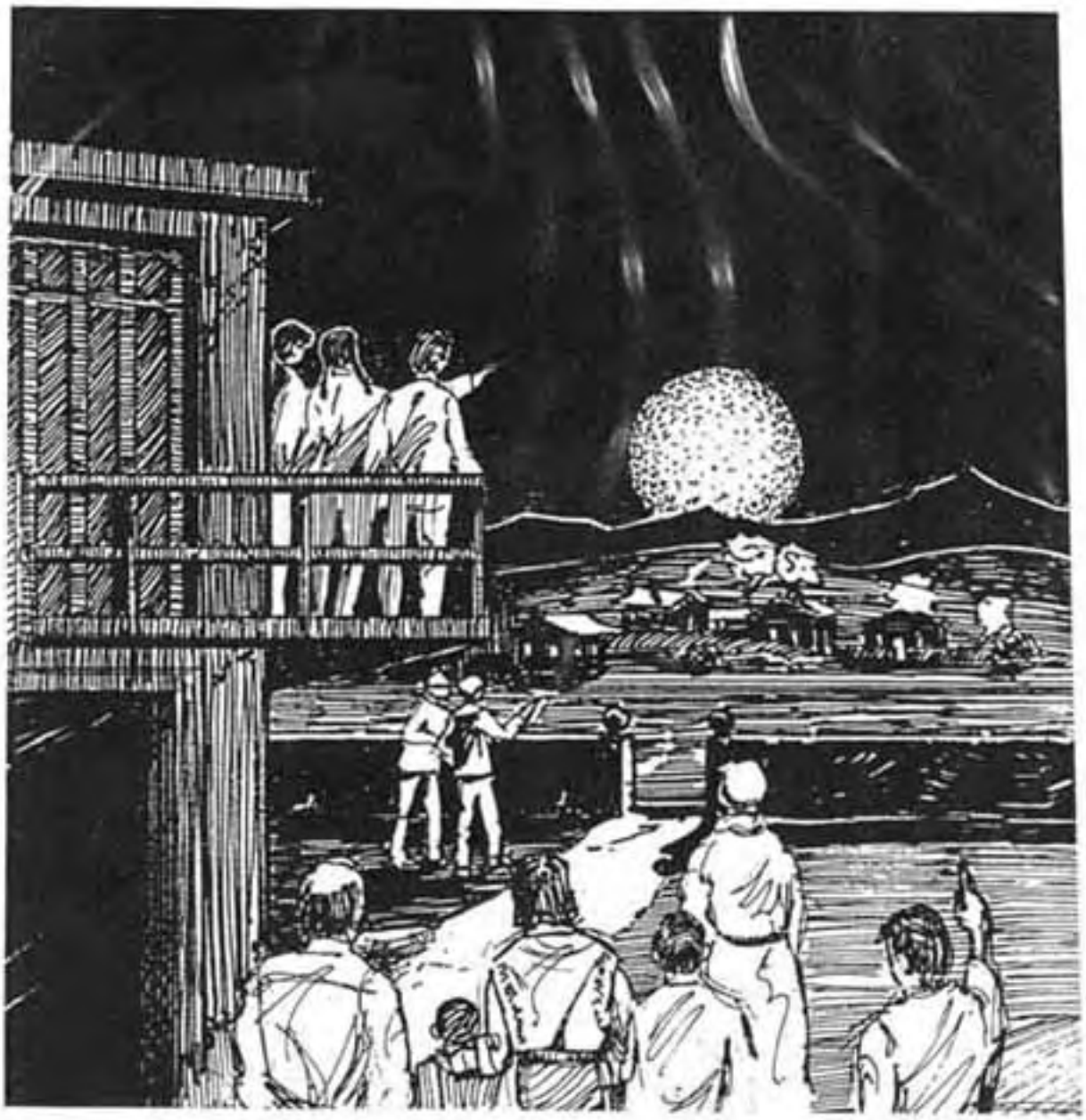

COLD EXPLOSION -- 9 April 1984 Near Kurils

And Formation and growth of spherical shell (globe)

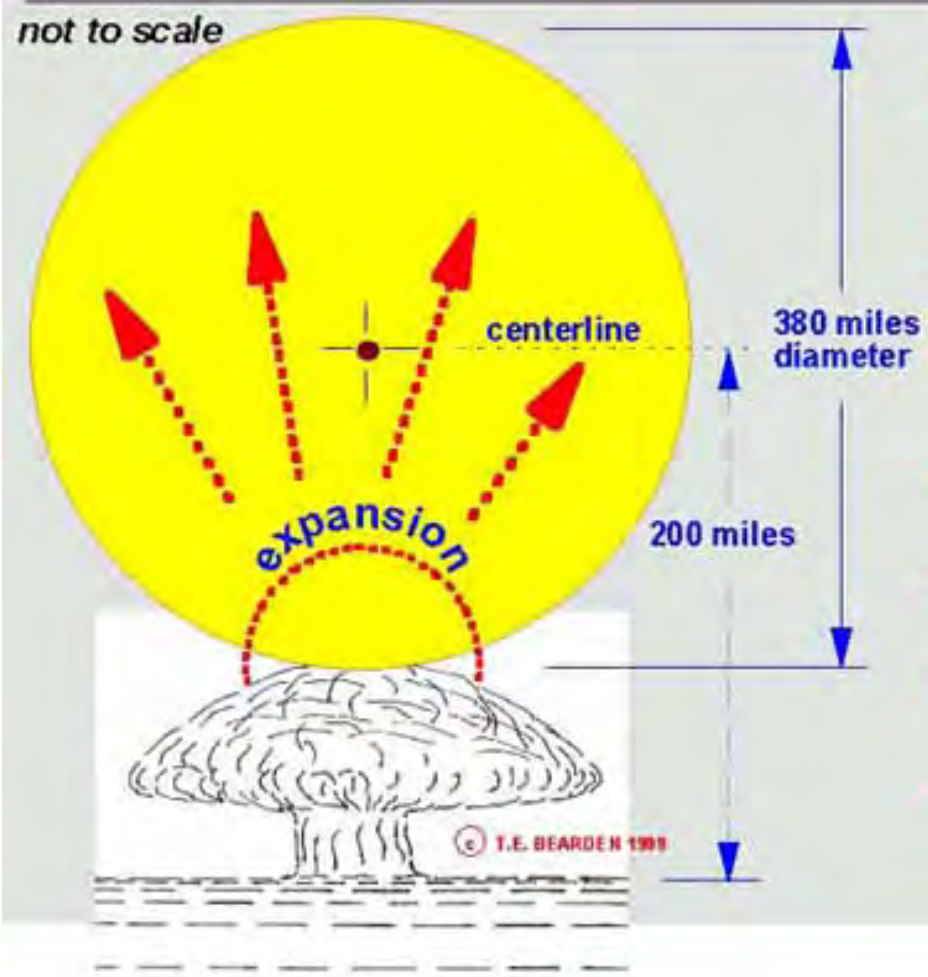

Sequence of Events

- Geyser of water rose rapidly from surface, mushroomed out
- Reached 60,000 feet altitude in two minutes
- Brilliantly glowing globe then appeared in top
- Globe increased greatly in size and altitude
- Reached diameter of 380 miles
- Center reached altitude of 200 miles
- Observed by multiple qualified pilots

COLD EXPLOSION -- 9 April 1984 Near Kurils

And Formation and growth of spherical shell (globe)

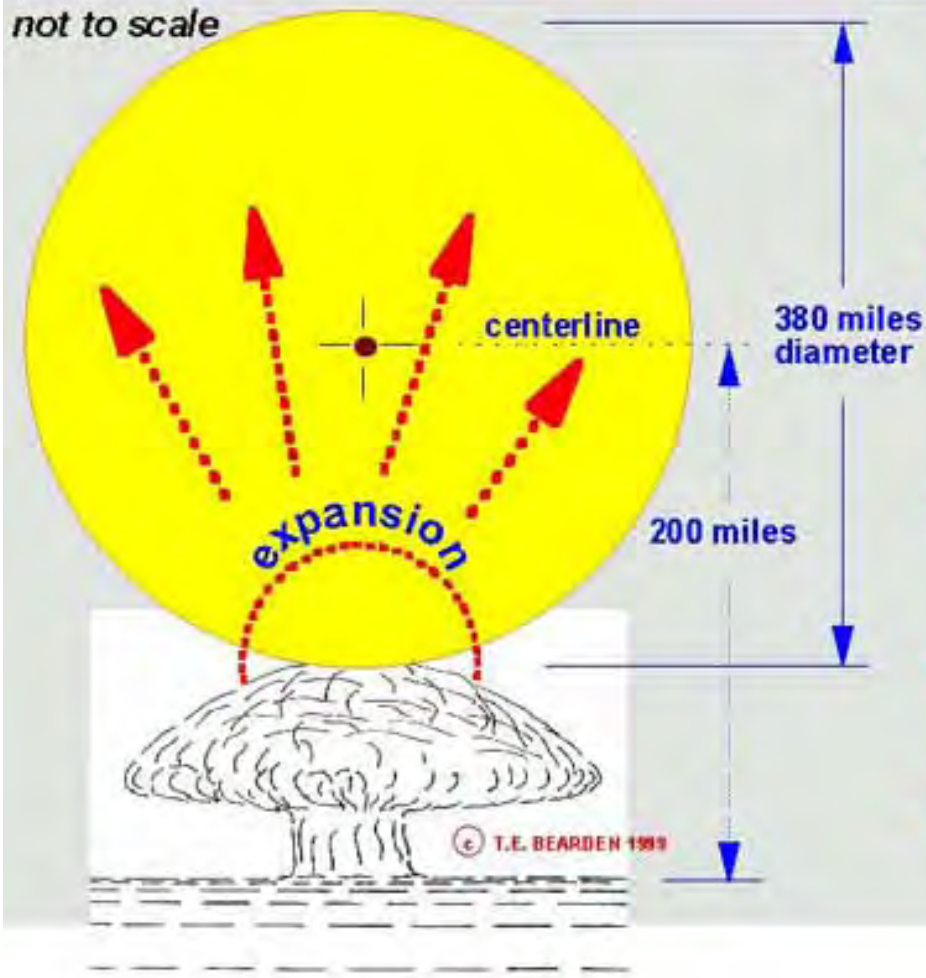

What They Were

- Superpotential interferometry using LWs
- First, a cold explosion just above surface
- Then small intense shell of glowing EM energy for 1-on-1 targeting
- Larger globe for large area as for ICBM targets approaching in zone
- With ST engines, can dud incoming nukes and all electronics
- Use in or out of Earth's atmosphere

COLD EXPLOSION -- 9 April 1984 Near Kurils
(Plus additional weapons effects)
JAL
Halo expanded to giant globe.
380 miles diameter, center over 200 miles
high.
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Countering Insane Mad Systems: Find Loophole, Exploit It

- If MADs not quantum potential systems, easily countered by instant QP strike which destroys targeted MAD weapons worldwide with certainty.
- Have to be certain of types of dead-man fuzing. All dead-man fuzing weapons must be included in the assured target list for the striking quantum potential weapon.

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- Multiple targeted MADS require multiple vacuum engines in the striking quantum potentials.
- Uncertainty and risk introduced if not certain of all MAD systems and all dead-man fuzing systems.

- Newest generation psychoenergetic LW interferometry weapons can instantly take over minds of all personnel on targeted sites, with targeted crews quickly disarming their own MAD weapons' launch capability as well as the weapons themselves.
- Mindsnapper then kills all living things and contaminates sites.
- Next generation QP Psy-En weapons can disrupt and destroy minds of an entire targeted national population. The nature of warfare moves irrevocably to the human mind, where of course the fundamental problem arises anyhow.

Next Generation Counter to Both Sane and Insane MAD Systems

- ***Localized quantum potential in an area, used in psychoenergetics mode***
  - Gradually produces mild, continuous hypnotic state
  - Targeted population remains entirely conscious, functional
  - Internal "word thoughts" emerge directly in subconscious
  - Targeted persons all unaware of these "word thoughts"
  - Operates somewhat similar to "post hypnotic suggestion"
  - Gradually changes emotions, psychological outlook
  - Over a period of time, deviates and entrains entire target population's outlook, belief structure, temperament
- ***Moves Psywar to inside the human component***
- ***Human minds are the only battleground***
- ***Can be accomplished without overt signature***
- ***Countered only by inserting same methodology into deeper mind level (collective unconscious)***

Simultaneous Dudding of Nuclear Weapons Worldwide

- Via quantum potential joining U235 and Plutonium in warheads
- Includes weapons airborne, underwater, in storage
- These are *transmutations of the nuclides themselves*
- *Part of the initial barrage launched by Aum/Yakuza/KGB*
- *Will occur in the first minutes of the strategic strike, following psychoenergetically crew-disabling QP weapons*

Note: Duds both overt and covert nuclear weapons and weapons-grade materials -- including "suitcase-delivered" covert weapons on site in Russia which otherwise provide dead man fuzing

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Simultaneous Dudding of Nuclear Weapons Worldwide

- Via quantum potential joining U235 and Plutonium warheads
- Includes weapons airborne, underwater, in storage
- These are not explosions, but are *transmutations and increased fissioning rates*
- *Part of the initial barrage launched by Aum/Yakuza/KGB*
- *Will occur in the first minutes of the strategic strike*

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Note: Duds both overt and covert nuclear weapons and weapons-grade materials.

The Tom Bearden Website

Help support the research

Operation Divine Wind II

Slide 1

Slide 2

Slide 3

Slide 4

YAKUZA &
AUM SHINRIKYO

DIVINE WIND II

U.S.

★ **A secret coalition of Yakuza/Aum Shinrikyo and KGB/Communist forces plan to launch a massive, surprise energetics attack on the United States, given a low-risk opportunity.**

★ **Major weapons utilized will be the scalar EM (energetics) superweapons (including quantum potential weapons) that were developed, deployed, and operated by the KGB under the former Soviet Empire, and continuing after its dissolution.**

KGB

★ **Yakuza/Aum crews have extensively trained and test-fired, from on-site in Russia. They have *leased* operational control of the first three generation energetics superweapons (which work by superpotential interferometry).**

MINDSNAPPER AND
PSYCHOENERGETICS

★ ***The Escalation Phase of interdicting and destroying actual U.S. targets (e.g., TWA-800, two A-10s) is already underway.***

★ ***The first blow in the Strike Phase will dud all nuclear weapons and weapons materials worldwide, in minutes; destroy special ship and energetics weapon sites instantly, disable 99% of the U.S. population instantly, and kill 80% of targeted populations in from 10 minutes to 3 days.***

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QUANTUM
POTENTIAL

YAKUZA &
AUM SHINRIKYO

U.S.

DIVINE WIND II

- ★ A secret coalition of Yakuza/Aum Shinrikyo and KGB/Communist forces plans to launch a massive, surprise energetics attack on the United States and its allies, given the first low-risk opportunity.

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KGB

- ★ Attack was thwarted twice in 1997 by a small nation countering with QP weapons.
- ★ KGB psychoenergetics counter for the last QP weapon counter was tested in April 1997.
- ★ Ready time for a new scheduled attack is latter quarter 1999 through first half of 2000.

YAKUZA &
AUM SHINRIKYO

DIVINE WIND II

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- ★ **A secret coalition of Yakuza/Aum and KGB/Communist forces will launch a massive, surprise, strategic attack on the United States in 1997.**
- ★ Major weapons utilized will be the scalar EM (energetics) superweapons that were developed, deployed, and operated by the KGB under the former Soviet Empire, and continuing after its dissolution.
- ★ Yakuza/Aum crews have extensively trained and test-fired, from on-site in Russia. They have *leased* operational control of the energetics superweapons.
- ★ *Escalation Phase of interdicting and destroying actual U.S. targets (e.g., TWA-800) is already underway.*
- ★ *The first blow in the Strike Phase will dud all nuclear weapons and weapons materials worldwide, in minutes; destroy special ship and energetics weapon sites instantly, and kill 80% of targeted populations in 3 days.*

KGB/COMMUNISTS

MINDSNAPPER

QUANTUM
POTENTIAL

OPERATION DIVINE WIND II

Three Phases and Support

Operational Phases

- Phase I: On-Site Training Phase (Completed)
- Phase II: Escalation Phase (In Progress)
- Phase III. 1997 Strategic Strike on the U.S.
  - *First strike (QP) in Phase III duds all nuclear weapons and nuclear powerplants worldwide, in minutes*
  - *Psychoenergetic strike (QP) disables people instantly*
  - *Mindsnapper attack of special assets for 100% success*
  - *QP initiation of fast-acting, lethal diseases kills 80% of targeted populations in three days or less*

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Support Plans

- Plan A: Feints, Deception, Sabotage, and Terrorism
- Plan B: Testing and Test Range
- Plan C: Worldwide Weather Engineering
- Plan D: Strategic and Combat Intelligence

Advanced EMBW Applications

- Covert EMBW: Examples
  - Activate materials and their potentials with ST disease engines. Potentials superpose and their infolded ST dynamics diffuse
  - Activate water's structuring (H-bonding) potential with disease engines
  - Bias electrical power grid ground fields by weak diseases
  - Employ disease-structured quantum potential in distant area
- Overt death ray (mind snapper)
  - Powerful scalar EM pulse in target area "jerks" rate of flow of time
  - The "time snap" sharply separates mind from body and each cell
- EMBW CM:
  - Irradiate bodies with longitudinal EM waves; self-converts to t-pumping and produces exact amplified ST antiengine
  - Antiengine arises out of local ST, affects all parts of all cells
  - Cells are t-charged with antiengine structure
  - Continuing action restores regenerative and immune systems and reverses cellular damage

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EM Biological Warfare (EMBW)

- KGB/Communists have developed highly effective
  - Electromagnetic biological warfare (EMBW)
  - Counters to orthodox biological warfare
  - Mass death ray weapons
    - Small version of "mindsnapper" tested in Afghanistan
    - Killed occupants in two villages, in separate strikes
    - Unusual aspects (so-called "smerch" gas)
- Russia/KGB is the only group with a complete counter to biological warfare, either covert or overt, and to EMBW
- EMBW (covert and overt) is a preferred option for KGB
  - MAD Doctrine is completely destabilized for a sufficiently covert Russian EMBW strike
  - Situation has existed for at least two decades
  - Can alter germs, bacteria, viruses of specific kind, in a specific target area, to produce antibiotic-resistant strains
  - Can induce any kind of cellular disease or damage at a distance
- U.S. national characteristic: no reaction to slowly increasing threat

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Microwave Radiation of U.S. Embassy in Moscow

Former U.S. Embassy in Moscow.

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter?)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

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Pentagon EMI Studies, 1989

Washington Post, 22 Jan. 1989, p. A4

- Analysts of severe EMI effects in strike on Libya, 1986
  - performed major 3-year, 66-man study
  - Blamed effects on U.S. forces' own signals
  - Did not know of any other "signals" present
  - Knew nothing of quantum potential weaponry, energetics weaponry
- 7-month preliminary study
  - Severe EMI Problem exists
  - EMI shielding often waived in our weapon systems
  - Thousands of conflicts possible
- Also studied UH60 Blackhawk helicopter problems (which *were* due to its lack of good EMI shielding, and not quantum potentials)
  - uncommanded turns
  - Five EMI crashes 1982-1989
  - $175 M program to shield it
- So found that U.S. transmission combinations can
  - Affect aircraft flight control
  - Turn off fuel supply
  - Cause uncommanded dive/turn
  - Bring down U.S. warplanes
- *Actually, Libyan EMI was induced by Soviet quantum potential tests which can do all those things and much more*

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EM Missile Practice

- EM Missile Practice
  Latter Sept. - Early Nov. 1996
  Melbourne, Australia
- Deception: Using EM Missile to Reinforce Notion of SAM Attack
  Saturday evening, Nov. 16, 1996
- Intelligence Probe: Insuring U.S. Still Unaware of Energetics Weaponry
  Thursday, December 12th, 1996
- EM Missile Strike, Offset from Night Shuttle Launch, Cape Canaveral, Florida
  The Smoking Gun in November 1985
- Distant Operator Onsite in Russia Slew Away Registration Point
  Marker Beacon over Night Shuttle Launch, 26 November, 1985
- EM Missile Practice and Deception
  November 17, 1996

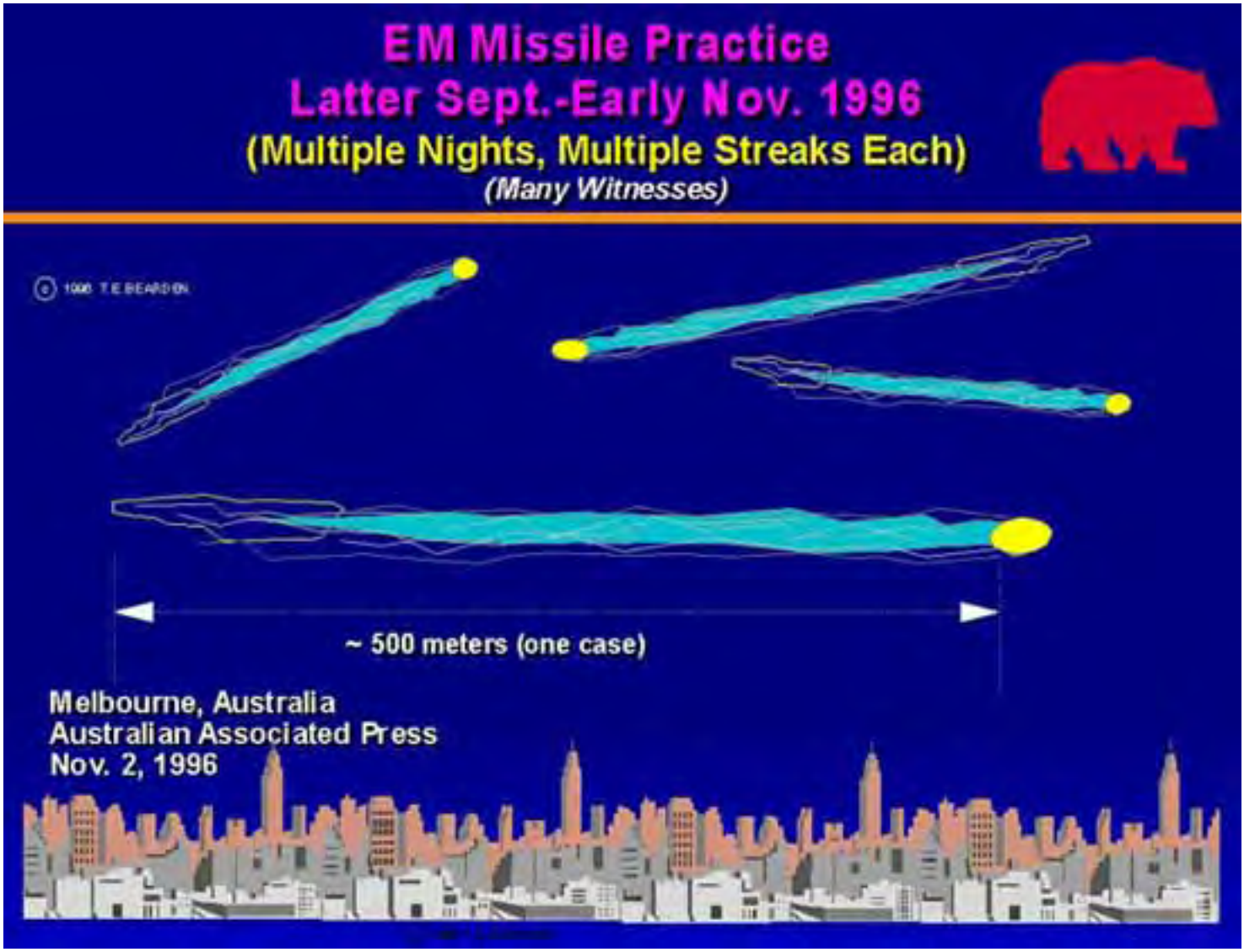
EM Missile Practice
Latter Sept.-Early Nov. 1996
(Multiple Nights, Multiple Streaks Each)
(Many Witnesses)
© 1996 T.E.BEARDEN
~ 500 meters (one case)
Melbourne, Australia
Australian Associated Press
Nov. 2, 1996

Deception: Using EM Missile to Reinforce Notion of SAM Attack

Saturday Evening
Nov. 16, 1996

Note: Meteor shower was forecast, which provided perfect decoy to FBI investigators, to steer them off the true scent.

Pakistan International Airlines Flight 712, just after takeoff from John F. Kennedy Airport, on path similar to that taken by TWA Flight 800, July 17, 1996

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Intelligence Probe: Insuring U.S. Still Unaware of Energetics Weaponry
Thursday
Dec. 12, 1996
Pilot sighted what he called a "green flare".
No danger, no evasive action.
Saudi Arabian Airlines 747
en route from Riyadh, Saudi Arabia
to John F. Kennedy Airport.
At 12,000 ft., not far from where
TWA Flight 800 was killed on July 17, 1996
FBI: "Probably a meteorite."
© T.E. BEARDEN 1996

EM Missile Strike, Offset from Night Shuttle Launch

Cape Canaveral, Florida

PHOTO BY BOB GLADWIN

© T.E. BEARDEN 1995, 1999,

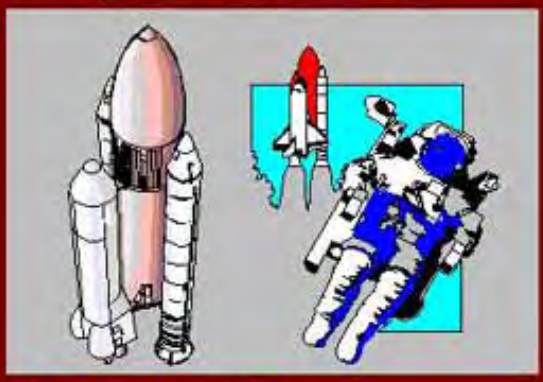

The Smoking Gun in Nov. 1985

Distant Operator Onsite in Russia
Slews Away Registration Point
© T.E. BEARDEN 1995, 1999.
MARKER BEACON
Over Night Shuttle Launch
Cape Canaveral, Florida
26 Nov 1985
Photographed by George Suchary
28 Nov 1985
Two weeks later, the same weapon killed the Arrow DC-8
at its takeoff from Gander, Newfoundland.

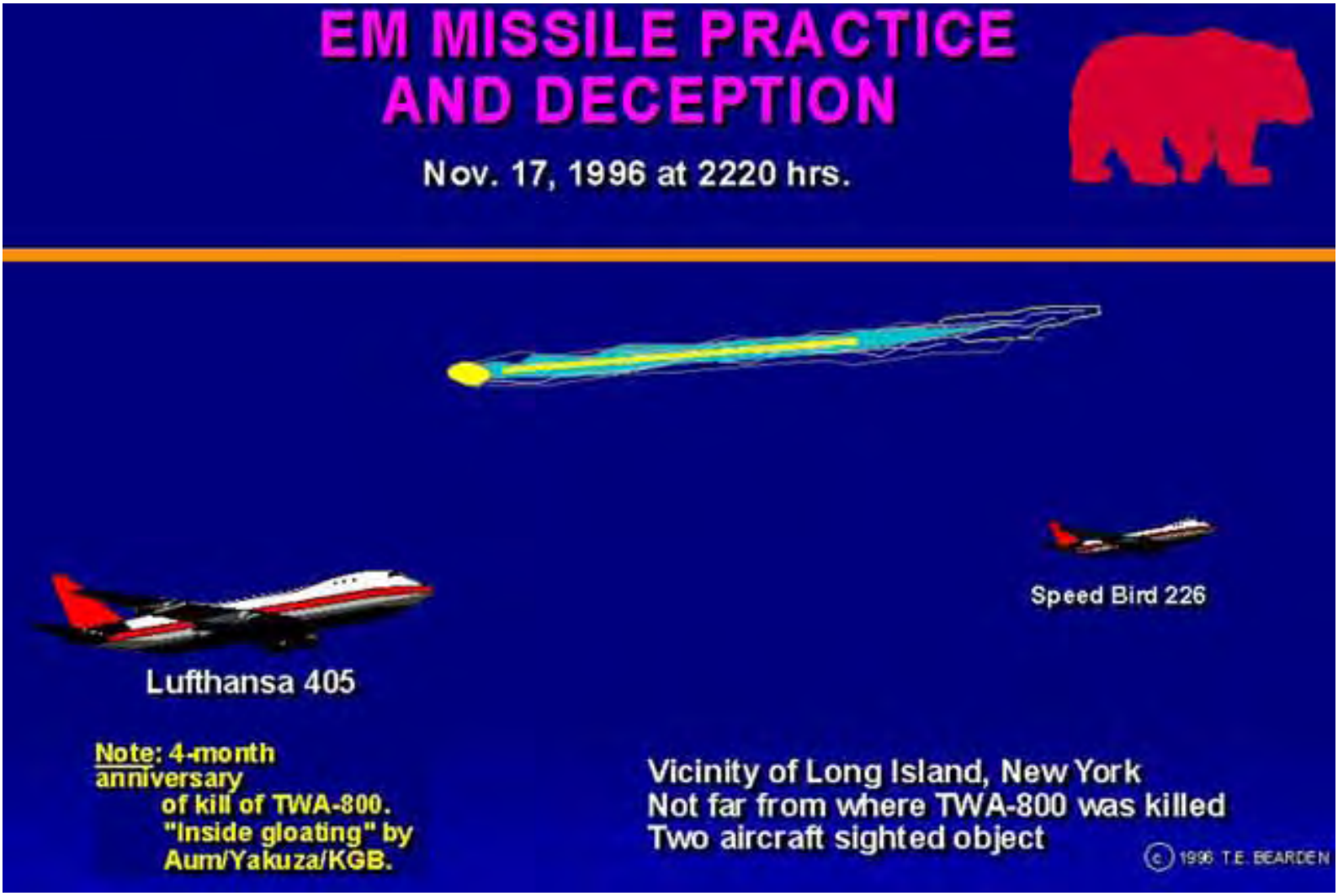
EM MISSILE PRACTICE
AND DECEPTION
Nov. 17, 1996 at 2220 hrs.
Speed Bird 226
Lufthansa 405
Note: 4-month
anniversary
of kill of TWA-800.
"Inside gloating" by
Aum/Yakuza/KGB.
Vicinity of Long Island, New York
Not far from where TWA-800 was killed
Two aircraft sighted object
© 1996 T.E. BEARDEN

Subdivisions of Soviet Energetics

NONLIVING SYSTEMS

Energetics

- Nonliving systems
- Scalar Interferometry
- Action-at-a-Distance
- Quantum Potential
- Vacuum Engines
- Spacetime Structuring
- Material, Field Effects
- Nuclei, Lattice Changes
- Hidden EM Variables
- SWZ Effects

LIVING SYSTEMS

Bioenergetics

- Living Systems (Bodies)
- Cells, cellular changes
- Master Cell Control (Popp)
- Spacetime Structuring
- Disease Induction, Remission
- Action-at-a-Distance
- Quantum Potentials
- Scalar Interferometry
- Hidden EM Variables
- SWZ Effects

Psychoenergetics

- Living Systems (Minds)
- Thoughts, Memories, Emotions
- Conscious/Unconscious Minds
- Spacetime Structuring
- Species, Biospheric Minds
- Action-at-a-Distance
- Quantum Potentials
- Scalar Interferometry
- Hidden EM Variables
- SWZ Effects

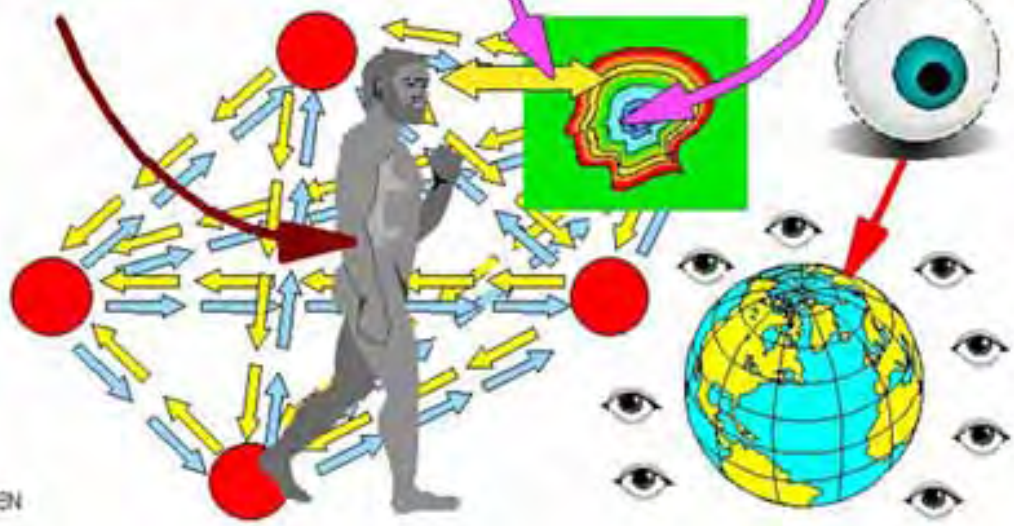

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Communism's Goal

- "War to the hilt between communism and capitalism is inevitable. Today, of course, we are not strong enough to attack... To win we shall need the element of surprise. The bourgeoisie will have to be put to sleep. So we shall begin by launching the most spectacular peace movements on record. There will be electrifying overtures and unheard-of concessions. The capitalist countries, stupid and decadent, will rejoice to cooperate in their own destruction. They will leap at another chance to be friends. As soon as their guard is down, we shall smash them with our clenched fist."

Dimitry Z. Manuilsky
Lenin School of Political Warfare, Moscow
(circa 1934)

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Manuilsky's Goal vs. Status Today

Manuilsky, 1934	Situation, Dec. 1996
▪ War is inevitable.	▪ Has not changed.
▪ Not strong enough to attack now.	▪ Strong enough now; preparations completed. Need right opportunity.
▪ Need surprise.	▪ Have achieved total surprise.
▪ Must put us to sleep.	▪ We are sound asleep.
▪ Need most spectacular peace movement on record.	▪ Done. We think the Russian threat gone, cold war ended.
▪ Electrifying overtures, unheard-of concessions.	▪ Done, and still occurring every day. It has worked beautifully.
▪ Capitalists will cooperate.	▪ We are cooperating in spades!
They will leap to be friends.	▪ We've leaped, and are leaping.
▪ They will let down their guard.	▪ No ABM, junked lots of nukes, shrunk our forces to the bone.
▪ We'll strike them then.	▪ They would have struck (twice) in 1997, but for deterence by another nation (not U.S.) having QP weapons
	▪ *They are still looking for a risk-free opening to strike*

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Professor Hellman, German Scientist Released from Work in Soviet Union

- Worked in Soviet Union after WWII
- Eventually escaped to Germany, then to Brazil (handsome offer)

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- Took part in highly unusual Soviet energetics development and experiments
- Large areas of the sea could be and were *suddenly frozen*
- *No particular attention was paid to this information by highly qualified scientists*
- *In intelligence terms, this is A-1 information of the highest caliber*
- *Bohm also was invited to Brazil, which started an energetics weapon program. Brazil developed such weapons including weak quantum potential weapons (0.95 confidence)*

Hemispheres of Light

- March 20th, 1969
  Caribbean and Western North Atlantic
- Hemisphere and Globes, 1977
  24 March, 1977
- Virgin Islands Incident
  August 1969
- Typical Shield Test, Northern Route to Japan
  June, 1982

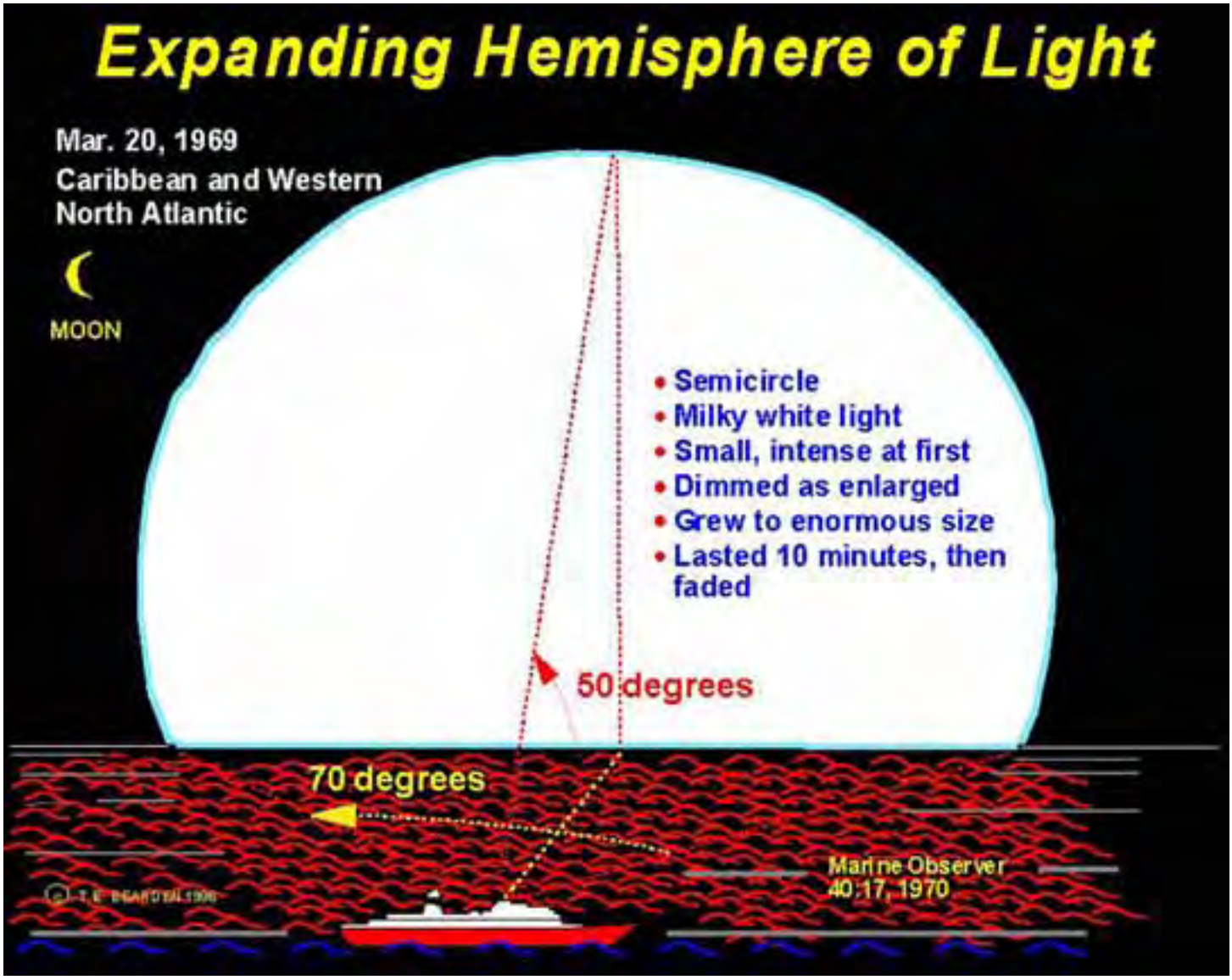
Expanding Hemisphere of Light
Mar. 20, 1969
Caribbean and Western
North Atlantic
MOON
• Semicircle
• Milky white light
• Small, intense at first
• Dimmed as enlarged
• Grew to enormous size
• Lasted 10 minutes, then faded
50 degrees
70 degrees
Marine Observer
40:17, 1970

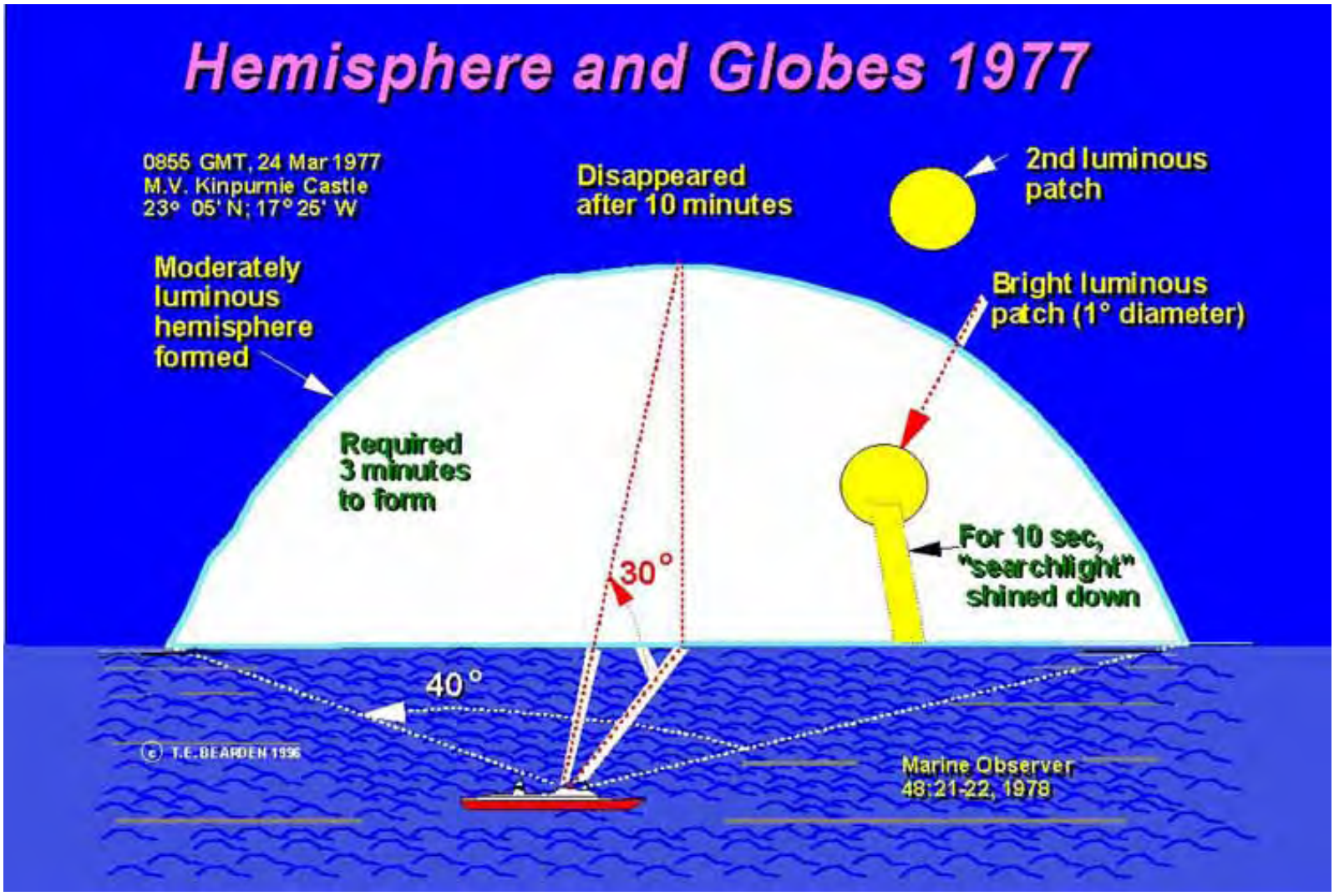
Hemisphere and Globes 1977
0855 GMT, 24 Mar 1977
M.V. Kinpurnie Castle
23° 05' N; 17° 25' W
Disappeared after 10 minutes
2nd luminous patch
Moderately luminous hemisphere formed
Bright luminous patch (1° diameter)
Required 3 minutes to form
For 10 sec, "searchlight" shined down
30°
40°
© T.E. BEARDEN 1996
Marine Observer 48:21-22, 1978

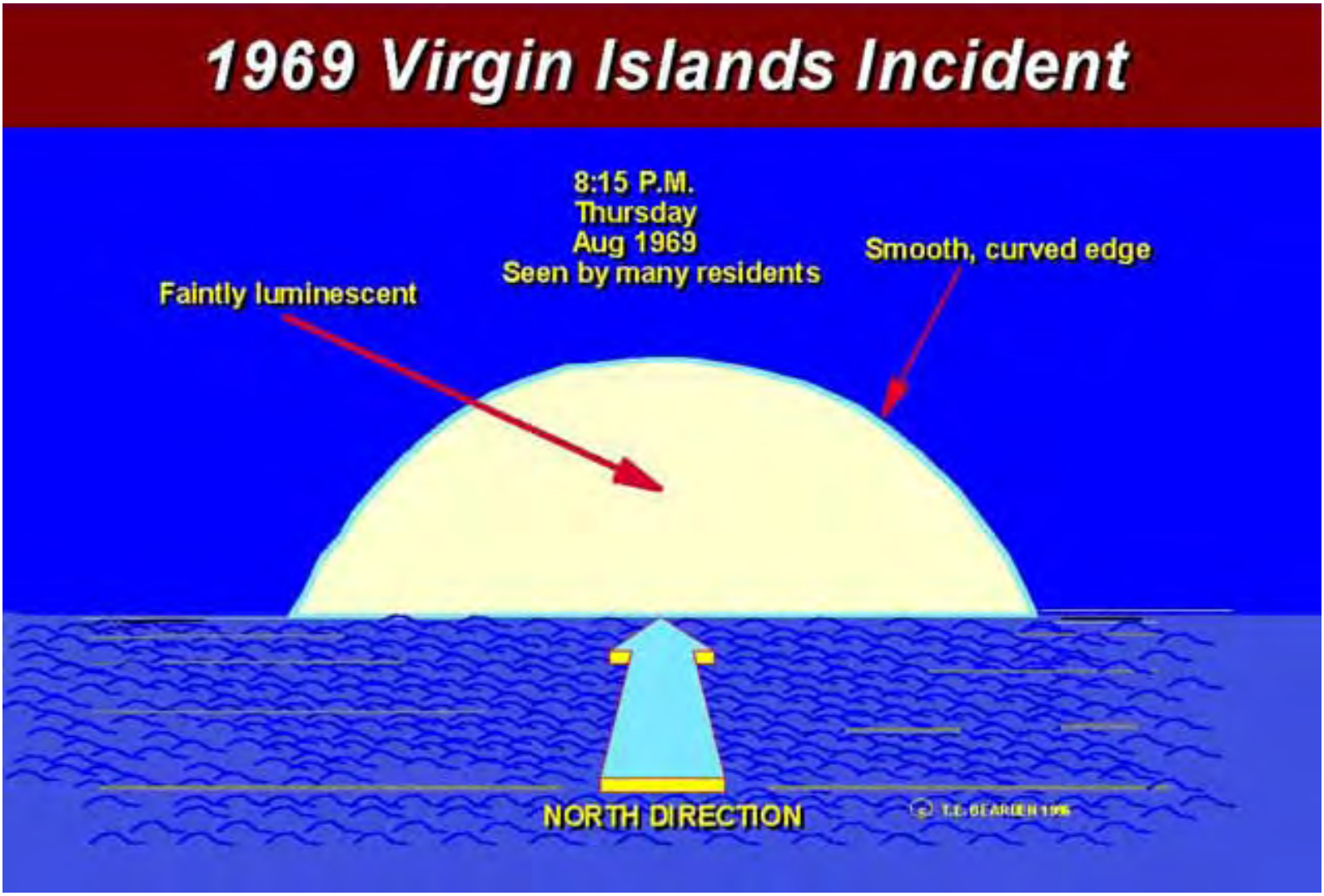
1969 Virgin Islands Incident
8:15 P.M.
Thursday
Aug 1969
Seen by many residents
Smooth, curved edge
Faintly luminescent
NORTH DIRECTION

Typical Shield Test, Northern Route to Japan
18-27 km diameter
Asahi Evening News, Tokyo
June 22, 1982
Multiple tests seen per month, for years.
Pilots simply ceased reporting them.

How Could Such Superweapons Ever Be Concealed?

- Arthur C. Clarke's law states:

  "Any sufficiently advanced technology is indistinguishable from magic."

- To U.S. scientists, "magic" means "impossible"
- Longitudinal EM waves and LW interferometers have been regarded as fantasy and impossible
- To deceive foe on rather open use of unknown technology without discovery:

  "Disguise its uses as understandable accidents, human error, acts of nature, other known technology, etc."

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Soviets Easily Concealed These Superweapons for Four Decades

- Intensive Soviet deception plan utilized
  - Embedded in other weapon system tests
  - Made to resemble natural acts, accidents, etc.
  - Open science releases coordinated to show Russian scientists worked on "normal" science
- West thought Russian scientists inferior
- U.S. scientific community was and is dogmatic, and fiercely suppresses real scientific innovation
- Terribly flawed electrodynamics not ruthlessly shaken and changed in West

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- West had no basis for understanding energetics

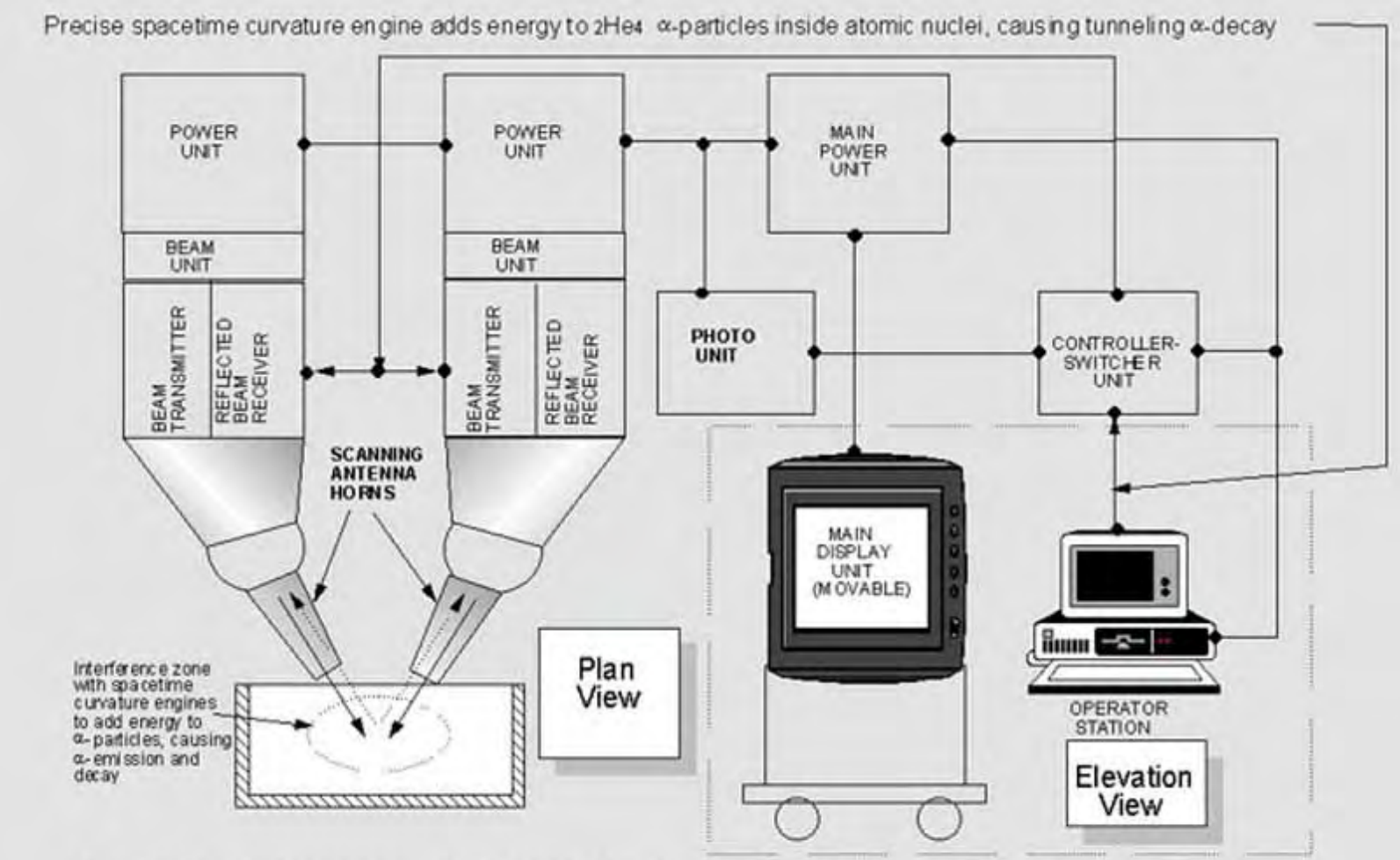

Figure 26. Microscope-type, laser-like interferometer for inducing quick α-decay in samples of otherwise longer-lived isotopes.

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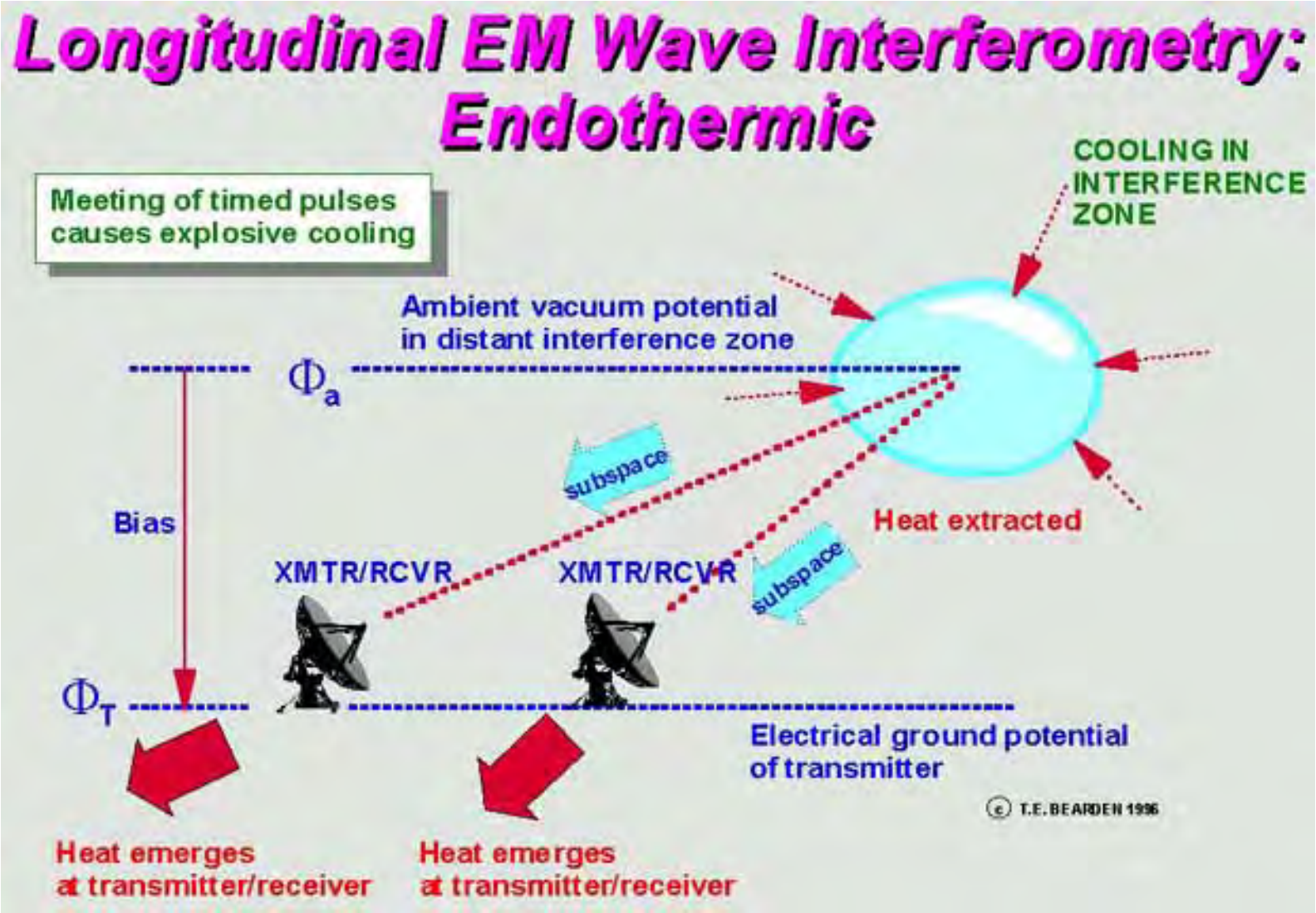
Longitudinal EM Wave Interferometry: Endothermic
Meeting of timed pulses causes explosive cooling
COOLING IN INTERFERENCE ZONE
Ambient vacuum potential in distant interference zone
Φ_a
subspace
Bias
Heat extracted
XMTR/RCVR
XMTR/RCVR
subspace
Φ_T
Electrical ground potential of transmitter
© T.E. BEARDEN 1996
Heat emerges at transmitter/receiver
Heat emerges at transmitter/receiver

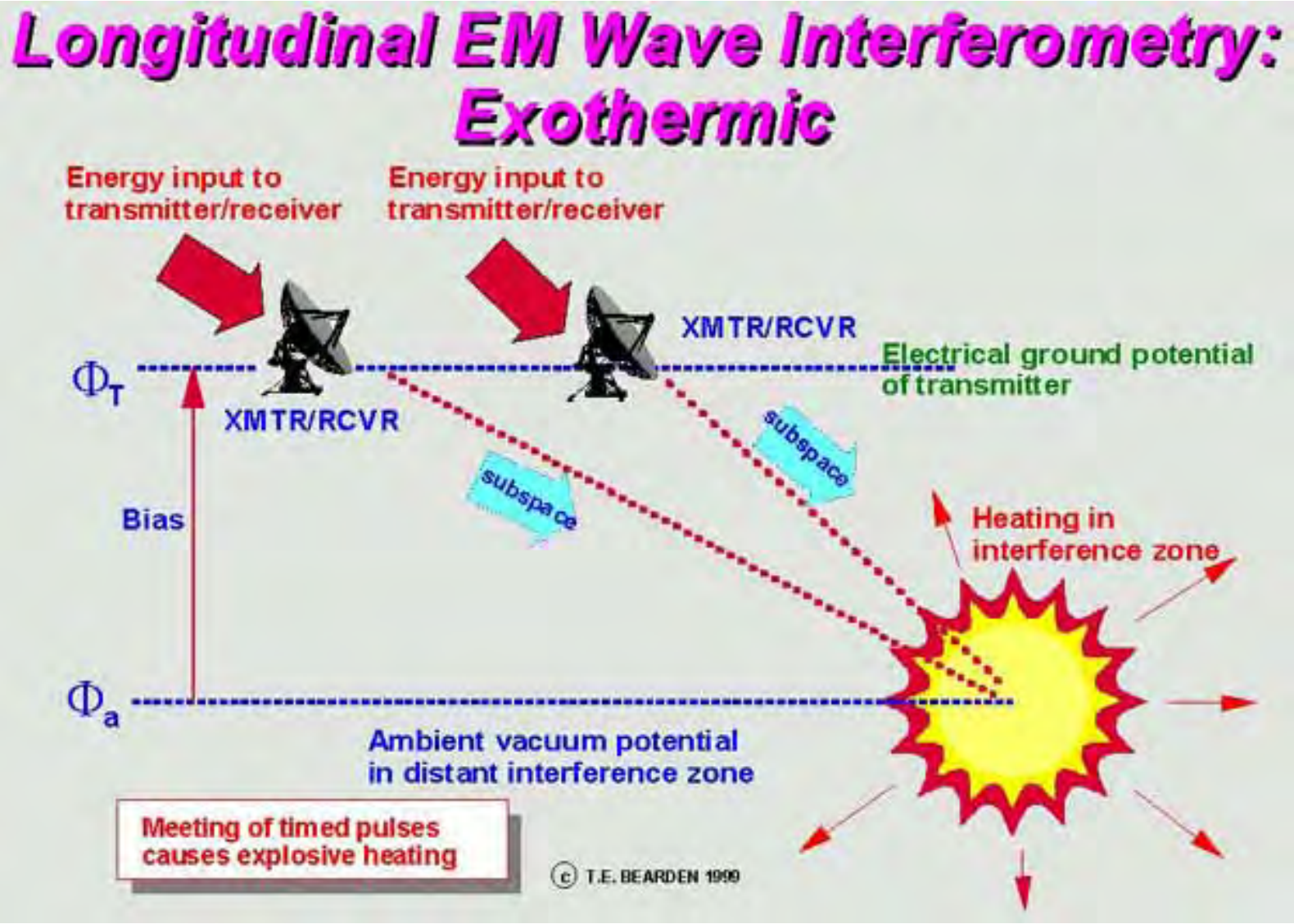
Longitudinal EM Wave Interferometry: Exothermic
Energy input to transmitter/receiver
Energy input to transmitter/receiver
XMTR/RCVR
XMTR/RCVR
Electrical ground potential of transmitter
Φ_T
subspace
subspace
Bias
Heating in interference zone
Φ_a
Ambient vacuum potential in distant interference zone
Meeting of timed pulses causes explosive heating
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The Tom Bearden Website

Help support the research

U.S. Air Attack on Libya
April 1986

- Slide 1
- Slide 2
- "Washington Post" Article
  January 22, 1989

U.S. Airstrike on Libya
April 1986*
• 33 U.S. AIRCRAFT IN STRIKE
• MANY HIGH-POWERED TRANSMITTERS
– COMMUNICATIONS
– JAMMERS
– RADARS
• SEVERE, UNEXPECTED "EMI" ENCOUNTERED
– ONE F-111 DOWNED
– NUMEROUS WEAPONS WENT ASTRAY
– THREE FOREIGN EMBASSIES DAMAGED
– SEVEN AIRCRAFT FORCED TO ABORT
• COMMANDERS: "US OR THEM?"
*Washington Post, 22 Jan. 1989, p. A4
Mild quantum potential weapon tested against electronics in U.S. aircraft and missiles
EM energy arises from every point in spacetime inside the electronics

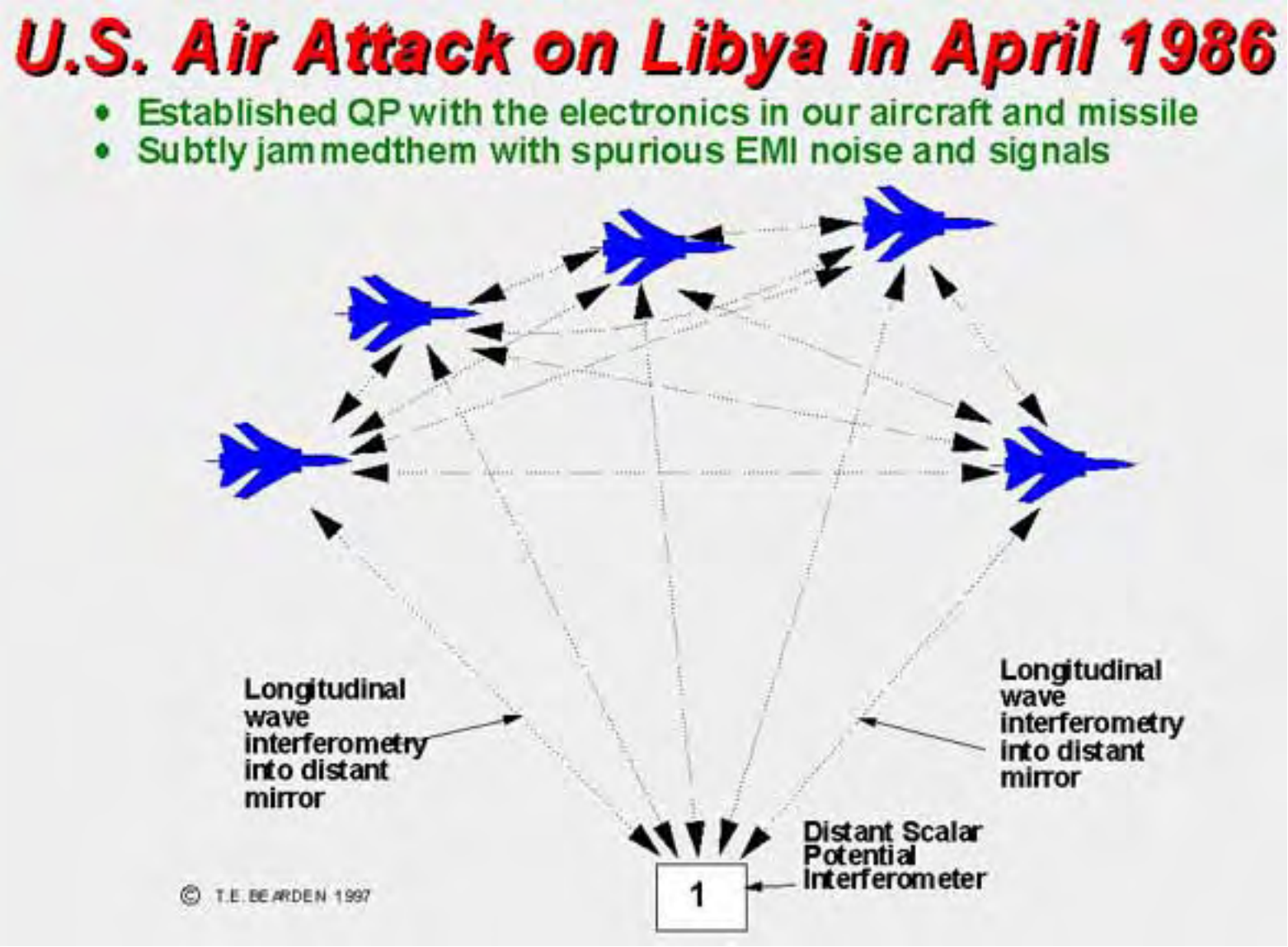
U.S. Air Attack on Libya in April 1986
• Established QP with the electronics in our aircraft and missile
• Subtly jammedthem with spurious EMI noise and signals
Longitudinal wave interferometry into distant mirror
Longitudinal wave interferometry into distant mirror
Distant Scalar Potential Interferometer
1
© T.E. BEARDEN 1997

Lightning Wall

- Aircraft on course of 270 degrees
- Approached "solid wall of lightning" in an otherwise cloudless sky
  - From very high altitude to near the water
  - Extended north-south as far as one could see
- Radar scope clear
- *Rigged aircraft for heavy weather*
- *Plunged directly through wall*
- *Wall was very thin*

circa 1959-1960
Interview with Patrol plane commander
U.S. Navy P5 aircraft
Over Atlantic, 200 miles east of Norfolk

© T.E. BEARDEN 1996

Lisitsyn's Report: Brain Code Broken

- THEORY DEVELOPED AND FITTED
- HYSTERESIS MEMORY LOOP
- CONTROLLED EM INDUCTION
  - IMAGES
  - SENSATIONS
  - PREDETERMINED EMERGENCE
- 23 EEG BANDS
  - UP TO 8.1×10^{20} HZ
  - 11 INDEPENDENT CHANNELS

S.K. Lisitsyn, "New Approach to the Analysis of Electroencephalograms," DDC Report AD73005, p. 16-25.

JC1-34

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Large Longitudinal EM Wave Interferometer (LWI) Accident

- 1958 nuclear explosion near Urals
  - Contaminated 1200 square kilometers
  - Signature of large LWI accident
  - Buried atomic wastes suddenly exploded
  - Region contaminated to this day
- Soviets were well along with advanced LWI prototypes and testing
  - In Jan. 1960 Khrushchev announced these forthcoming "fantastic" weapons
  - 1958 difficulties would have been resolved by 1960

© T.E. BEARDEN 1990, 1999

Large Longitudinal EM Wave Interferometer (LWI) Accident

- Expected cause of 1958 accident
  - Huge LW energy beams built up
  - Catastrophic short-out in transmitter
  - LW energy flashed over into earth and spread
  - Struck and fissioned stored nuclear wastes
- Developed new safety circuits
  - For transmitter short-out, instantly activates to hold LW beam energy and prevent flash-over
  - Similar accident happened in 1986 at Chernobyl, except private U.S. group blew that transmitter to prevent catastrophic quake in California

© T.E. BEARDEN

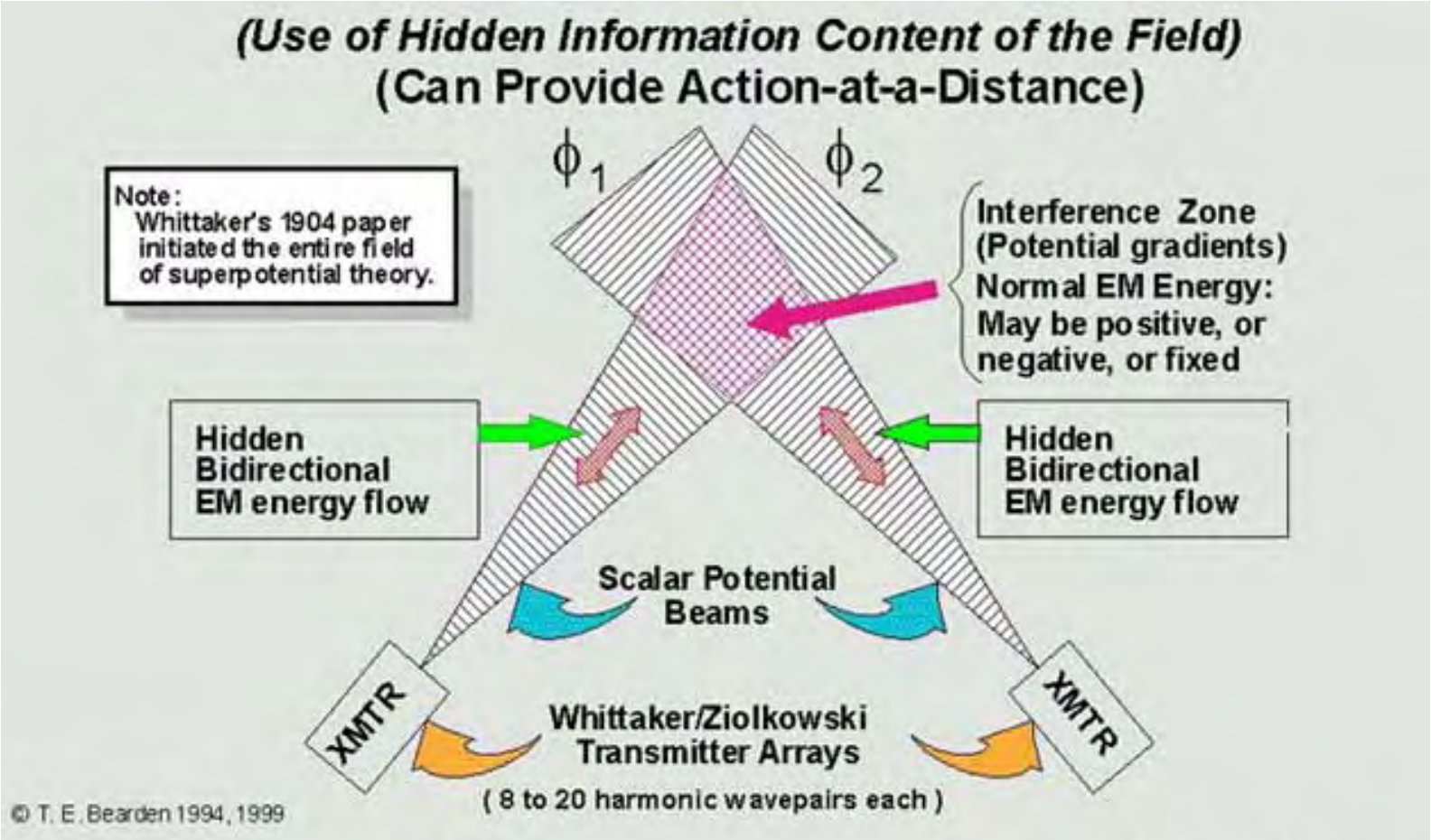

Figure 5. Scalar potential interferometry (between the two sets of bidirectional longitudinal EM wavepair functions) produces all EM force fields and waves.

Two Types of Mutual Assured Destruction (MAD) Systems

- ***Sane system:***
  - Turned off or on standby
  - Wait until attacked or attack is imminent
  - Humans consider situation, make strike decision
  - Command order issued to weapons officers
  - Human finger initiates launch sequence
  - Usually requires code entry, etc. for assured launch control

- ***Insane system:***
  - Computer periodically (e.g., every 2 hours) initiates launch
  - During sequence, there is a period (say, 2 min.) where operators can enter stop order (usually coded)
  - If correct stop not entered, weapons automatically launch
  - if correct stop entered, computer resets, and after another 2 hrs, automatically reinitiates the launch sequence

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Psychoenergetics Weapons Teams
Mentally Disable All Personnel
(COUNTERS ALL SANE MAD SYSTEMS)
(NULLIFIES HUMAN COMPONENT OF ALL WEAPON SYSTEMS)
ELECTRICAL THOUGHT-WORDS ARISE DIRECTLY IN BRAIN, HENCE IN MIND, BYPASSING SENSOR INPUTS
INSTANT HYPNOGOGIC STATE, WITH INSERTED THOUGHT-WORDS
Effects arise in local spacetime, simultaneously in all minds in the targeted area
INSTANT HYPNOGOGIC STATE; WITH WAKING DREAM
PERCEIVED REALITY NOW CONTROLLED
TARGETED POPULACE
• Site personnel instantly hypnogogic and mentally controlled.
• Distant weapon controller teams coord crew actions
• Standdown insane weapons to maintenance standby.
• Mindsnapper then strikes, kills all personnel, and nullifies site for months.
Indicators: Two A-10 incidents 1997, LIDA device since 1950s.
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Strikes Against Special Ship and Energetics Weapon Sites

- Via powerful scalar EM pulses in each targeted area, so sharp time-jerks occur
  - Mind and its operations exist in time but not in 3-space
  - Coupling interaction of mind operations to body occurs through flow of time
  - Flow or change of flow of time must be smooth, for coupling of mind to body
- *Sharp jerk in time flow snaps mind's coupling to body, instantly separates mind*
- *Instant death for every virus, bacterium, cell, insect, mammal, living creature*
- *Contaminates struck sites for months, perhaps a year*

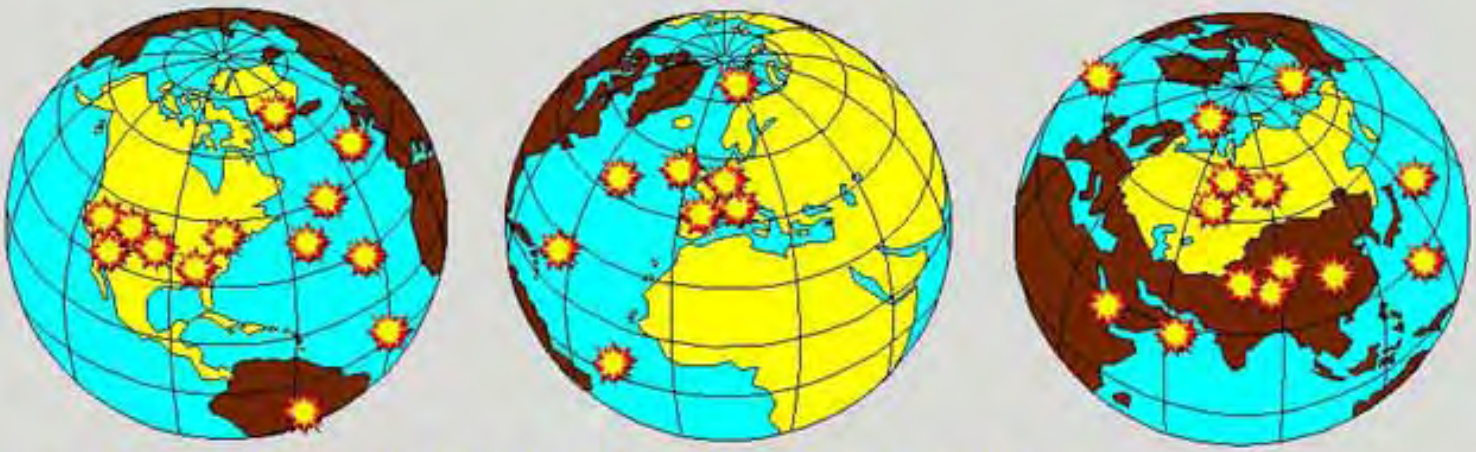

Note: In other words, this is the part of the "preparation barrage" that attacks the enemy's response capability (i.e., his "artillery" and his "airpower") and suppresses it. The use of the "mindsnapper" weapons provides 100% assurance of success.

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"MINDSNAPPER" ATTACK ON SPECIAL SHIPS & ENERGETICS WEAPONS SITES

"We have a new, fantastic weapon ... so powerful that, if unrestrainedly used, it could wipe out all life on earth."

Khrushchev, speaking to Presidium, Jan. 1960

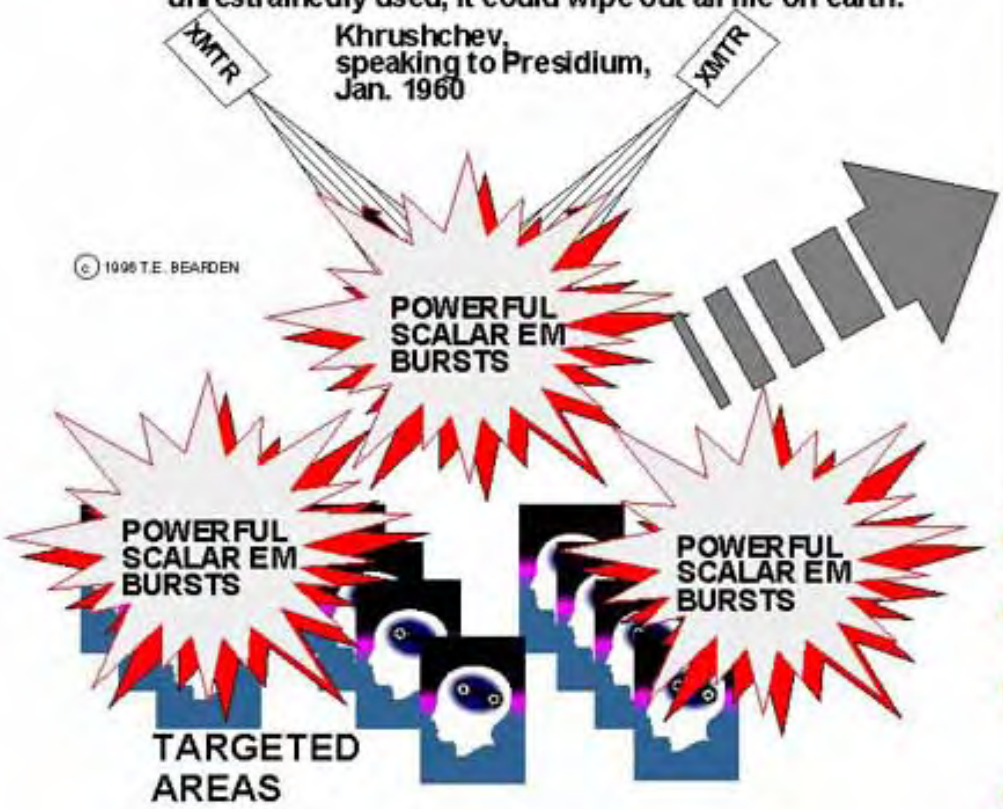

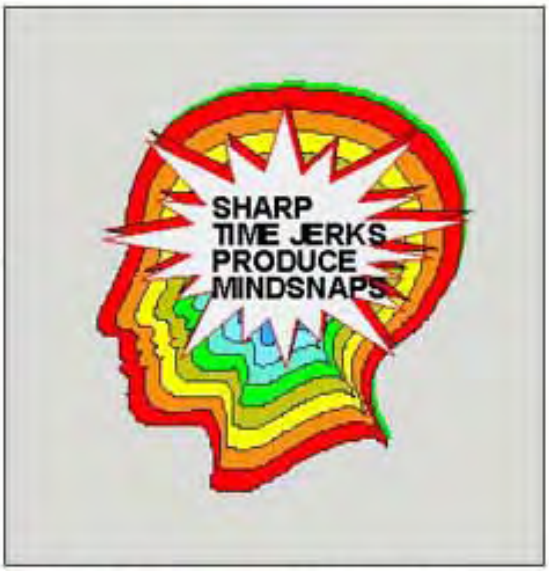

- Minds snapped loose from bodies (every living thing)
- Struck areas completely sterilized of all life
- LWs emitted; slow decay of time-charge makes contamination persistent
- Tested twice in Afghanistan

The Tom Bearden Website

Help support the research

How Much Off Guard Are We?

- Slide 1
- Slide 2
- Slide 3
- Slide 4
- Slide 5
- Slide 6
- Slide 7

How Much Off Guard Are We?

- *Legitimate U.S. forces have no energetics weapons or defenses against them*
- *No DoD general, military officer, or enlisted person reporting to the government of the United States has <u>any:</u>*
  - Training in energetics or energetics weapons
  - Experience in energetics or energetics weapons development and usage
  - Training in strategy, tactics, deployment, and employment of energetics weapons
  - Knowledge of energetics weapons effects and capabilities
  - Knowledge of the energetics weapons, tactics, deployment, and employment by the KGB/Russians
- *Civilian and military, scientific and intelligence, and news media personnel do not recognize energetics weapons effects happening right over their own heads*

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How Much Off Guard Are We?

- Kill of U.S.S. Thresher in 1963 not recognized. Left signatures.
- 23 years of KGB weather engineering, particularly over U.S. and North America, ignored and not recognized.
- Decades of irradiation of U.S. Embassy, fatally injuring three U.S. Ambassadors, health changes in personnel shrugged off ineptly.
- Massive building of underground sites, all through former Soviet Union, lamely speculated as perhaps "ABM" system or?.
- 1985, 1986 Soviet kills of U.S. aircraft, spacecraft, personnel ignored as "accidents" by legitimate U.S. communities.
- Quantum potential strike on soldiers in Gulf war ignored.
- Quantum potential deterioration of U.S. populace's immune systems ignored.
- Exchange of earthquakes and massive retaliatory destruction of Soviet missile ammunition storage sites, 1986-1989, ignored.
- U.S. scientific and military communities adamantly refuse to rework electromagnetics, though known to be seriously flawed.
- Refuse to apply Stoney/Whittaker work to engineer hidden variables, even though present quantum mechanics also known to be wrong because it does not contain such "hidden order."
- Refuse to develop, structure, and apply Bohm's quantum potential, for instantaneous action at a distance. Russians developed it.

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  - Not recognized.
  - Left signatures.
- **23 years of KGB weather engineering**
  - Particularly over U.S. and North America
  - ignored and not recognized.
- **Decades of microwave irradiation of U.S. Embassy**
  - Fatally injured three U.S. Ambassadors
  - Induced health changes in personnel
  - Shrugged off ineptly.
- **Massive building of underground sites**
  - All through former Soviet Union
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- Refuse to apply Stoney/Whittaker work to engineer hidden variables, even though present quantum mechanics also known to be wrong because it does not contain such "hidden order."
- Refuse to develop, internally structure, and apply Bohm's quantum potential, which gives instantaneous action at a distance and great energy amplification.
- Russians developed quantum potential weapons, which obsolete all other weapons.

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JUST HOW MUCH OFF GUARD ARE WE?
Kill of TWA-800 1996
Kill of USS Thresher 1963
Cold Explosion Off Japan Apr 1984
Kill of Space Shuttle Challenger 1986
From The Huntsville (AL) Times 18 Sep 96:
"Retired Gen. Wayne Downing concluded that U.S. forces are so far superior to potential foes that opponents have turned to terrorism as the only way of challenging them."
The Times also provided the information that Defense Secretary William Perry agreed with Gen. Downing's conclusion.
President's party airplane crash 1996
3 Dead U.S. Ambassadors from Moscow Embassy Radiation
QP Gulf War Syndrome: 16,000 persons disabled
QP jamming, U.S. air attack on Libya, 1996
Kill of Arrow DC-8 Gander AFB Dec 1985

JUST HOW MUCH OFF GUARD ARE WE?`

3 Dead U.S Ambassadors, U.S. Weather Engineered 20 years

Kill of USS Thresher Nuclear Submarine Apr 1963

QP Test on U.S. Troops in Persian Gulf, 1991 (Gulf War Syndrome)

TWA-800 1996; President's C-130 crash 1996

Arrow DC-8 Gander AFB Dec 1985

Challenger 1986

Quantum Potential Jamming of Air Attack on Libya Apr 1986

Blind Euphoria to Even the Ballistic Missile Threat

- U.S. National Intelligence Estimate (NIE) released in Nov. 1996 states there is no foreseeable threat to the U.S. from "indigenous missiles" for at least 15 years.
- Clinton has claimed a program for ABM defense is too expensive, would violate ABM Treaty with former USSR.
- Soviets developed an ABM system in violation of the treaty.
- In June 96 Russia test-launched an SS-19, their 26th ICBM test in 5 years.
- *"Russia still retains and is modernizing a vast nuclear arsenal... still the only nation of earth that could destroy America in a matter of minutes. Indeed, given the weakness of the Russian Army, Russia's superpower ambitions rest more than ever on its nuclear capabilities."* *
- "For the first time since the dawn of the nuclear age, there is not a single Russian missile pointed at America's children." **

Comment: Punch a computer button and the missiles are pointed! The armed missiles are still there, ready and waiting.

Bulleted info courtesy Washington Inquirer, June 24, 1996.

* House Nat'l Security Chmn, Floyd Spence.
** Bill Clinton, State of the Union Message.

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Possible Targets: 1995-9
Escalation Phase
(Based on 1985-87 test program)
Earthquakes
Missiles
Power Grids &
Distribution Systems
Satellites
Ships
Shuttle
Launches
& Flights
JETLINERS
Radio/TV
Subs
Microwave Nets
Radars &
Nets
Communications
and Computer Nets

Propagation of Weapon Effects

- All conventional weapons use propagation through 3-space of matter or energy or both
  - Matter (bombs, missiles, projectiles, etc.)
  - Energy (EM force fields, sonic force fields, etc.)
  - Basically one-to-one, or one "bus" to many-on-many
  - Finite propagation velocity v: where $0 < v \leq c$
  - Time delay: Shielding and pre-strike retaliation possible
- Structured quantum potential propagates vacuum ordering (vacuum engines), instantly
  - Zero time delay (through multiply-connected spacetime)
  - No propagation "through space", no "velocity" as such
  - Easily one-to-many, without limit
  - Dramatic energy amplifier (gates, amplifies flux ordering)
  - Effects arise in local spacetime; no shielding possible
  - No range limit, since striking distance always zero
- QP weapons obsolete all other weapons

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Yugoslav Earthquake, Followed by Cold Explosion

Apr. 15
1979

- Magnitude 7.2 on Richter scale
- Epicenter 33 km. deep
- More than 100 aftershocks
- At Kamenari:
  - Adriatic sea mushroomed up
  - Like atomic bomb explosion
  - Signature of a cold explosion
  - Similar to Apr. 1984 test off coast of Japan, near Kurils (see inset graphics)
- Note that April is a significant test month for the Communists (preparing official reports for May Day?)

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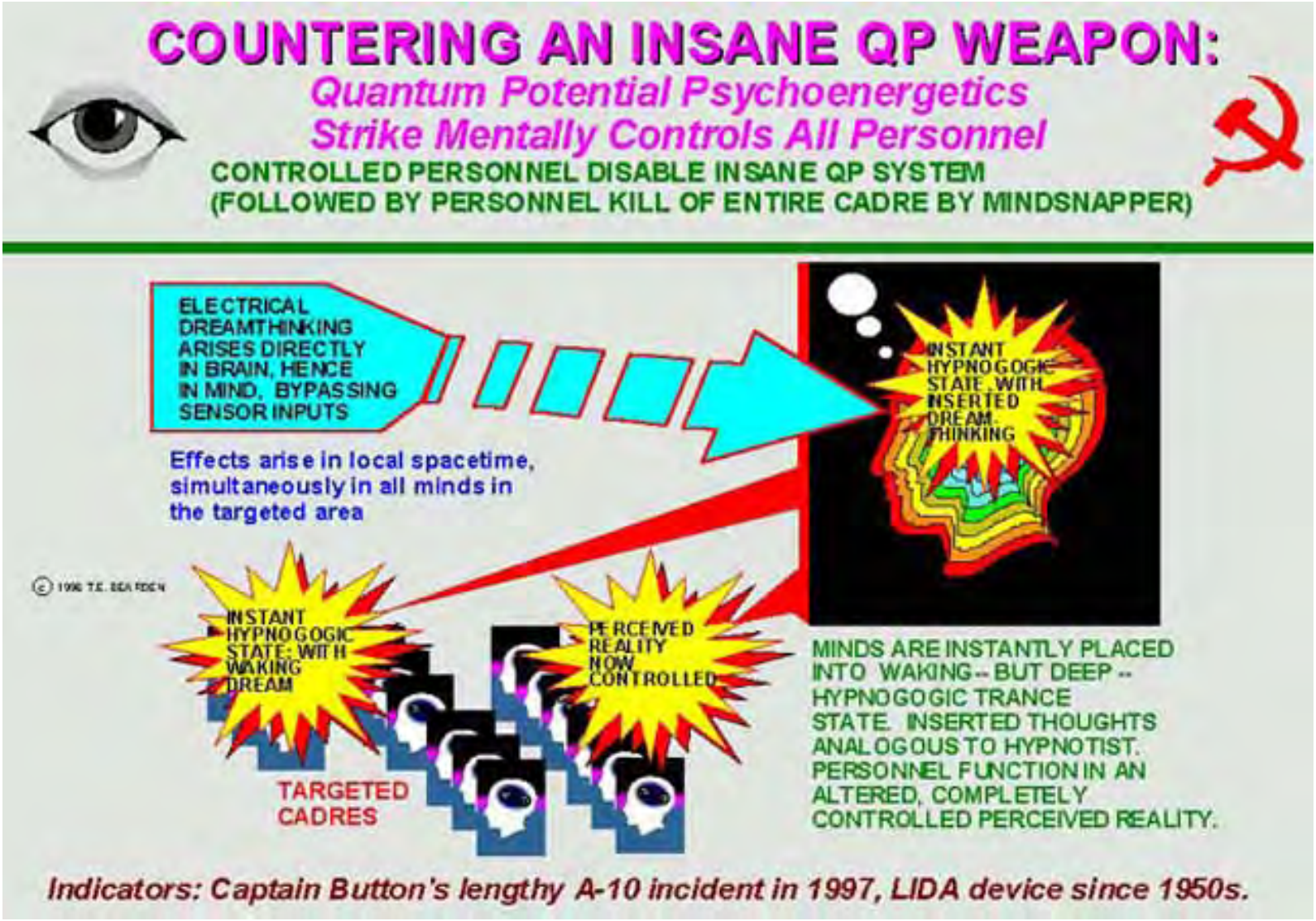
COUNTERING AN INSANE QP WEAPON:
Quantum Potential Psychoenergetics
Strike Mentally Controls All Personnel
CONTROLLED PERSONNEL DISABLE INSANE QP SYSTEM
(FOLLOWED BY PERSONNEL KILL OF ENTIRE CADRE BY MINDSNAPPER)
ELECTRICAL DREAMTHINKING ARISES DIRECTLY IN BRAIN, HENCE IN MIND, BYPASSING SENSOR INPUTS
Effects arise in local spacetime, simultaneously in all minds in the targeted area
INSTANT HYPNOGOGIC STATE, WITH INSERTED DREAM-THINKING
INSTANT HYPNOGOGIC STATE, WITH WAKING DREAM
PERCEIVED REALITY NOW CONTROLLED
TARGETED CADRES
MINDS ARE INSTANTLY PLACED INTO WAKING -- BUT DEEP -- HYPNOGOGIC TRANCE STATE. INSERTED THOUGHTS ANALOGOUS TO HYPNOTIST. PERSONNEL FUNCTION IN AN ALTERED, COMPLETELY CONTROLLED PERCEIVED REALITY.
Indicators: Captain Button's lengthy A-10 incident in 1997, LIDA device since 1950s.

Gulf War Disease: KGB QP Weapon Induced
ST Curvature Engines for a Cocktail of Diseases
LIBYA
EGYPT
CHAD
SUDAN
SAUDIA ARABIA
IRAN
IRAQ
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Distant Scalar Potential Interferometer with iterative self-targeting

Self-Targeting in Inner EM Channel Can Produce a Quantum Potential

Once QP is established, energy transmission is direct and instantaneous. Energy input to one single participant will simultaneously appear in all other participants, the amount depending on their fractions of participation with the input station.

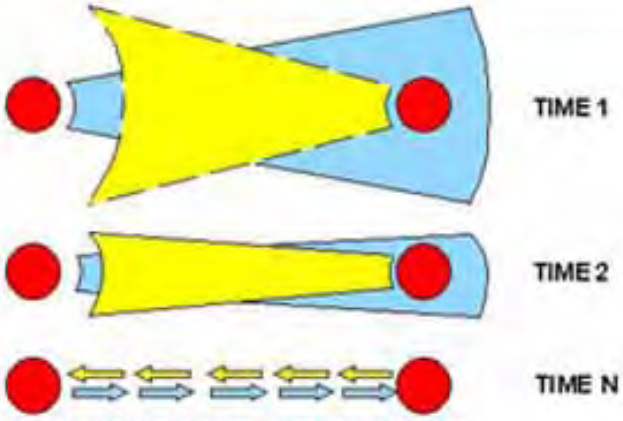

NARROWING OF INTERACTING POTENTIALS INTO LASER-LIKE BEAMS, BETWEEN TWO PUMPED SOURCES. NOW ONLY LONGITUDINAL WAVES CONNECT THE LINKED OBJECTS.

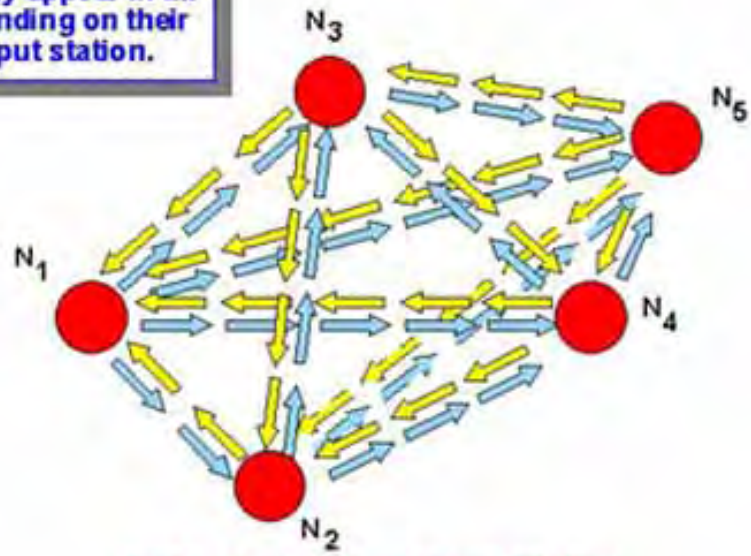

SELF-TARGETING EFFECT AMONG ALL PAIRS OF INTERACTING PUMPED SOURCES

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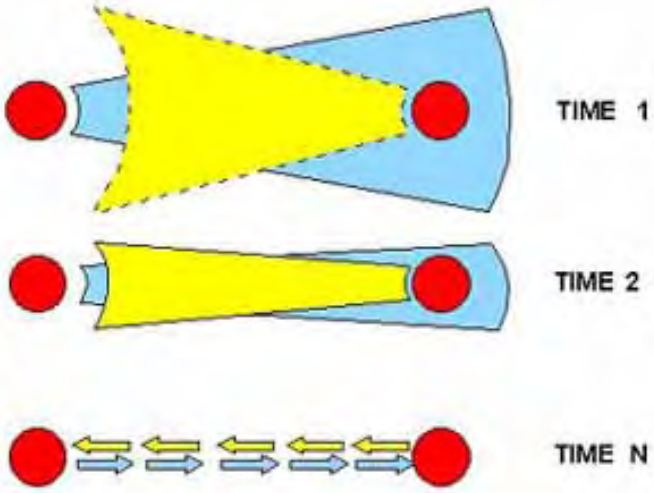

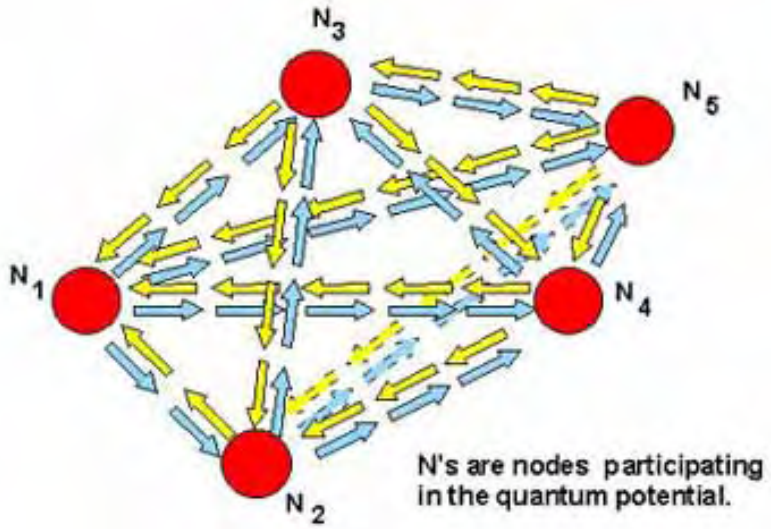

a. Iterative retroreflection between any pair of nodes narrows the interconnecting potentials to a laser-like, bidirectional beam. Iterative phase conjugate reflection provides self-targeting.

b. The quantum potential exists as narrow, laser-like beams between participating nodes, even when the nodes are widely separated. The beam space is multiply-connected; transmission is instantaneous.

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Consider the hidden Stoney/Whittaker bidirectional EM waves that comprise the potential from each source node. If these nodes have sufficient intersymmetry of dynamic material form, then self-targeting occurs between the two nodes of any nodal pair. By iterative phase conjugate reflection, the scattering is narrowed into interconnecting wavepairs, in laser-like beams, between each two nodes. Thus the interconnecting potentials narrow into laser-like, bidirectional beams. The Coulomb gauge may apply, and a quantum potential may be formed.

Figure 30. Mechanism for generating a quantum potential, by iterative self-targeting induced into a system of multiple scattering nodes. Once a QP is established, spatial separation has little or no effect.

Major Principles for Use of Quantum Potential Weapons

- Must disable dead-man fuzing prior to massive use of scalar interferometry weapons.
- Must assure immediate, complete nullification of unique enemy assets (quantum potential assets, special ships, and energetics weapons).
- Personnel can be destroyed instantly with mindsnapping; area is sterilized of life, and effect persists, gradually dying away.
- Personnel can be disabled instantly with various psychoenergetic weapons; area not sterilized.
- Personnel can be destroyed in short order by using EM BW weapons; area not sterilized.
- If foe has energetics weapons, then it is a quick-draw "gunslinger" contest unless insane MAD systems deployed.
- Complete surprise is of decisive importance.
- Tailor effect used to specific target, objective.
- *Note: Must use "insane" MAD systems to deter.*

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Quantum Potential Weapons: Major Principles (Continued)

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- Three major classes of use exist:
  - Use of bulk energy only (as in bulk heating or cooling) without substructuring
  - Use of internal structuring of the bulk energy, so that *vacuum engines* appear in target
  - Use of more deeply nested engines allows direct intervention in mind, long term memory, perception, thoughts, emotions, personality
- Use of vacuum engines allows engineering at a distance of:
  - *Atomic nuclei* including structures, reactions, and transmutations
  - *Bulk matter* including translations, lattice bonding, chemistry, chemical interactions, electromagnetic interactions
  - *Deep biological control systems* such as
    - Becker's cellular control (recovery) system
    - Popp's cellular control system
  - *Cells* including:
    - Structuring, differentiation and dedifferentiation
    - Genetic changes, chemical changes
    - Induction of disease states without normal disease vectors
  - *Mind/matter interface*, including long-term memory, perception, emotion, thought, mental state

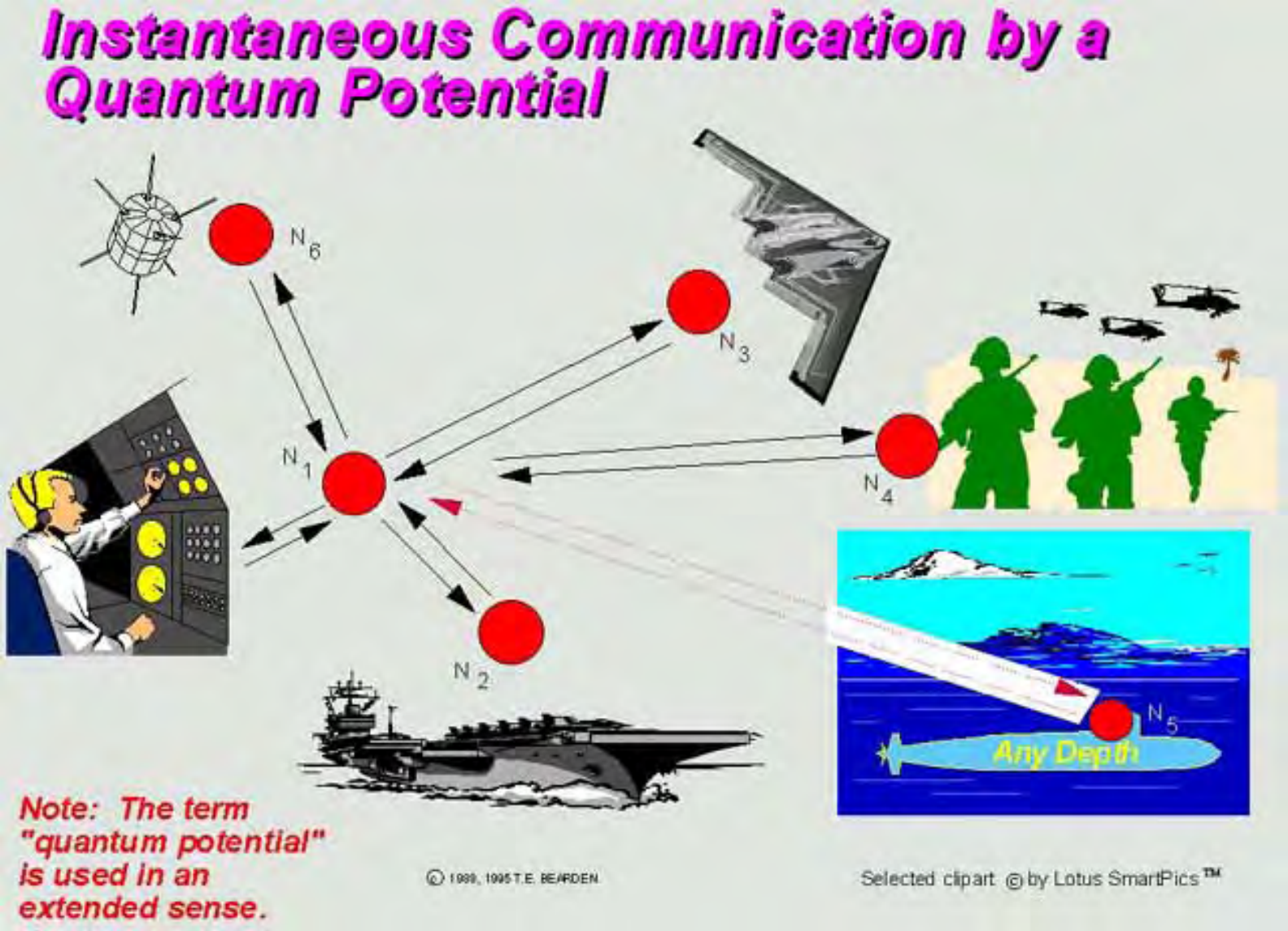
Instantaneous Communication by a Quantum Potential
N6
N3
N1
N4
N2
N5
Any Depth
Note: The term "quantum potential" is used in an extended sense.
© 1999, 1995 T.E. BEARDEN
Selected clipart © by Lotus SmartPics™

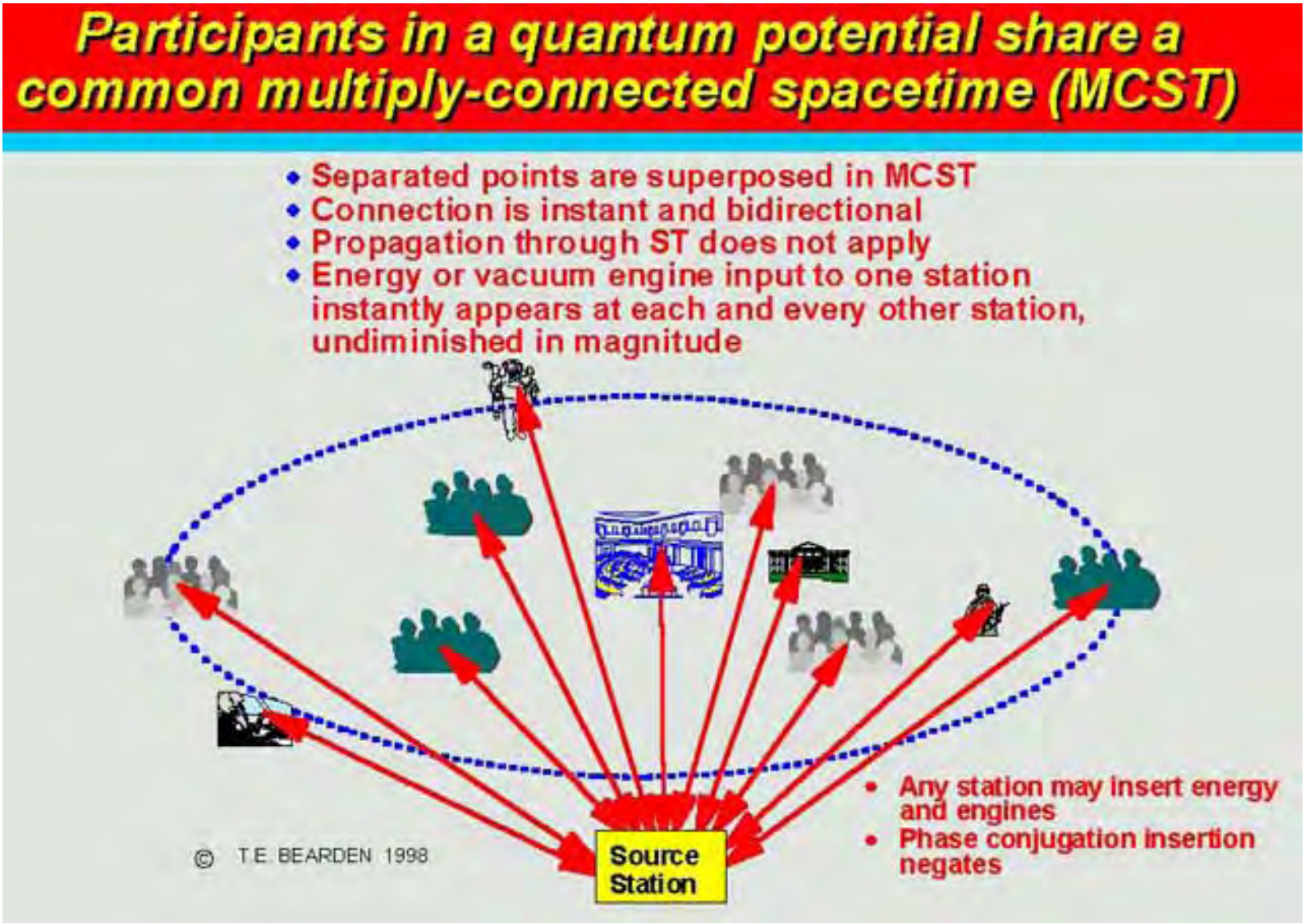
Participants in a quantum potential share a common multiply-connected spacetime (MCST)
• Separated points are superposed in MCST
• Connection is instant and bidirectional
• Propagation through ST does not apply
• Energy or vacuum engine input to one station instantly appears at each and every other station, undiminished in magnitude
• Any station may insert energy and engines
• Phase conjugation insertion negates
Source Station
© T.E. BEARDEN 1998

Quake in Tangshan, China

28 July, 1976

- 7.8 on Richter scale
- Hundreds of thousands killed
- Accompanied by extensive light, electrical effects
  - Starting 3 to 5 days before
  - Communications interference within 250 km
  - Sky lighting observed
- [Personal comments]

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Counting Rifles: Put up or shut up!

(Exchanging Earthquakes)

Opening bet

- Quebec 25 Nov 88
- Pasadena 3 Dec 88

Raise you

- Armenia 7 Dec 88

Call - what do you have?

- Malibu 18 Jan 89

Four aces

- Soviet Central Asia 23 Jan 89

Clear table (stress relief)

- Bakersfield et al various

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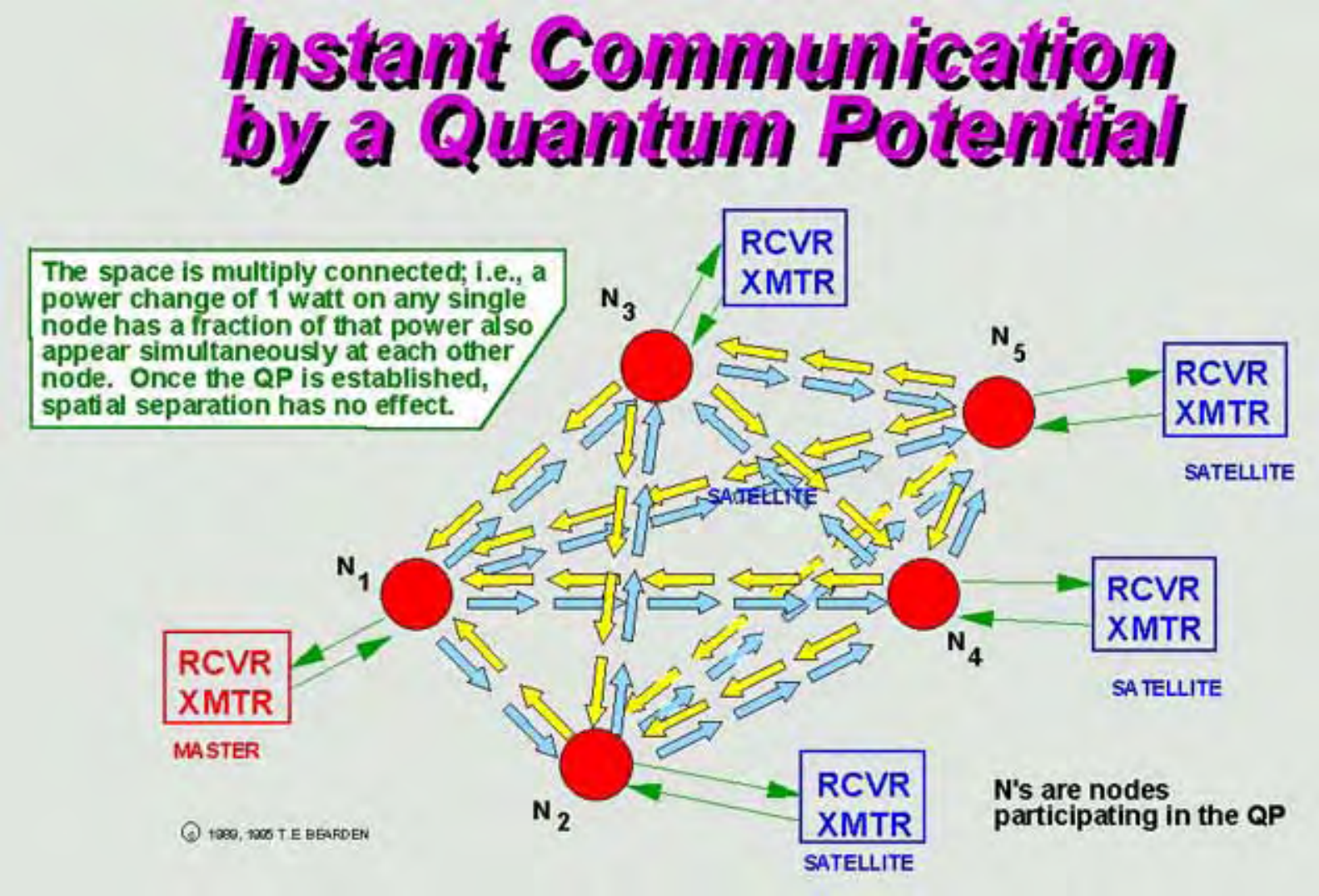
Instant Communication by a Quantum Potential
The space is multiply connected; i.e., a power change of 1 watt on any single node has a fraction of that power also appear simultaneously at each other node. Once the QP is established, spatial separation has no effect.
RCVR XMTR
N3
N5
RCVR XMTR
SATELLITE
SATELLITE
N1
RCVR XMTR
N4
SATELLITE
RCVR XMTR
MASTER
N2
RCVR XMTR
SATELLITE
N's are nodes participating in the QP
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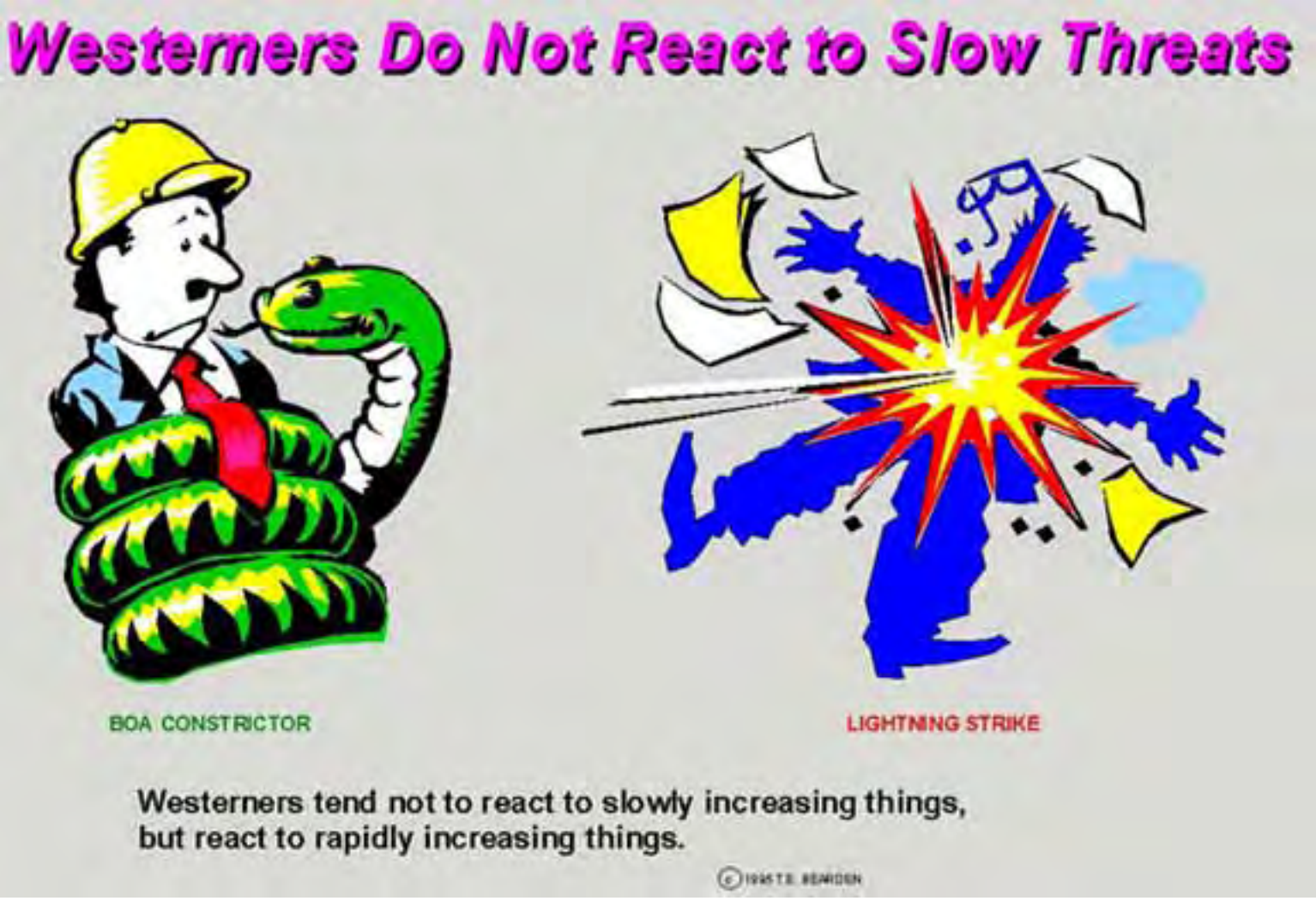
Westerners Do Not React to Slow Threats
BOA CONSTRICTOR
LIGHTNING STRIKE
Westerners tend not to react to slowly increasing things,
but react to rapidly increasing things.

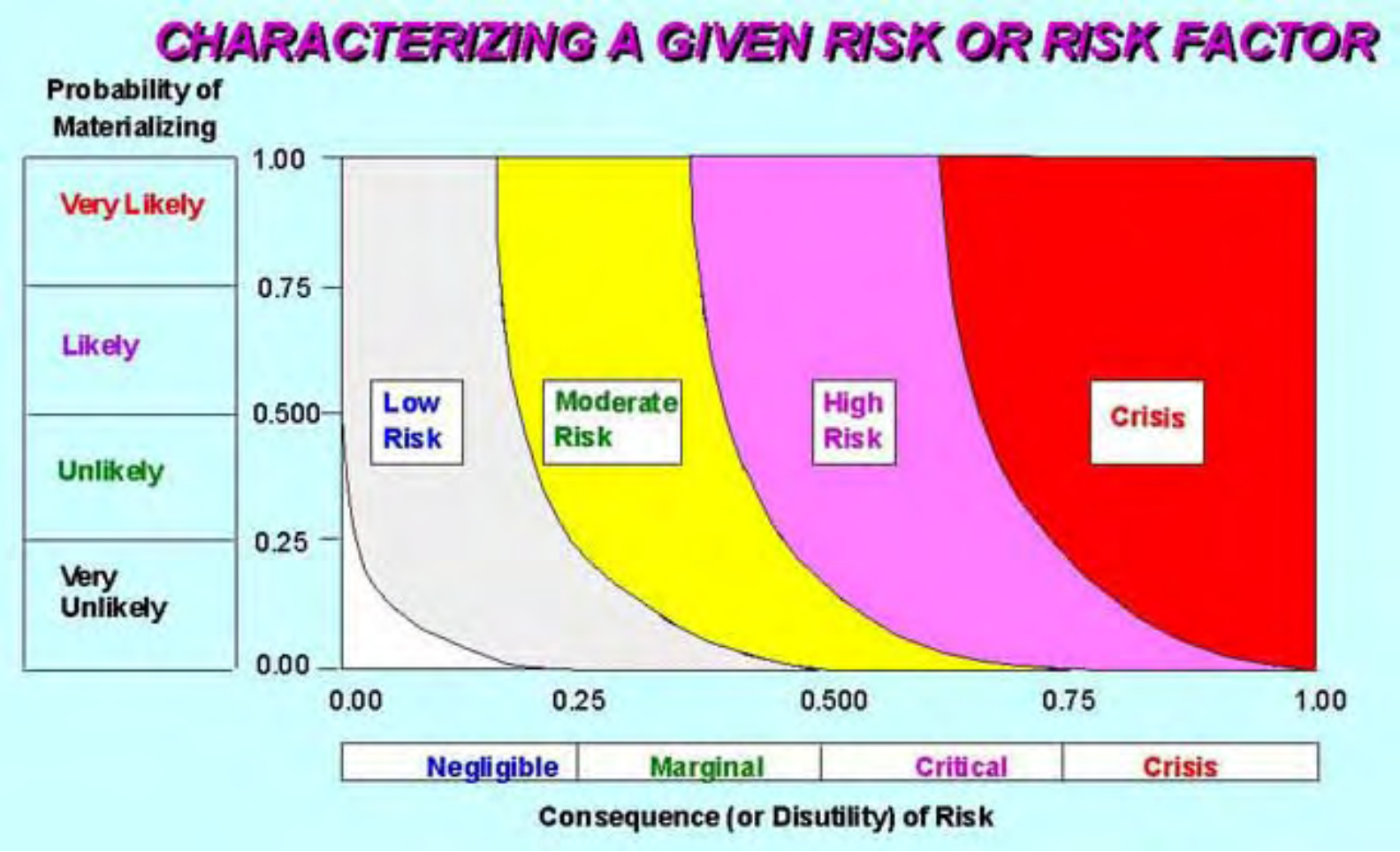
CHARACTERIZING A GIVEN RISK OR RISK FACTOR
Probability of Materializing
Very Likely
Likely
Unlikely
Very Unlikely
1.00
0.75
0.500
0.25
0.00
Low Risk
Moderate Risk
High Risk
Crisis
0.00
0.25
0.500
0.75
1.00
Negligible
Marginal
Critical
Crisis
Consequence (or Disutility) of Risk

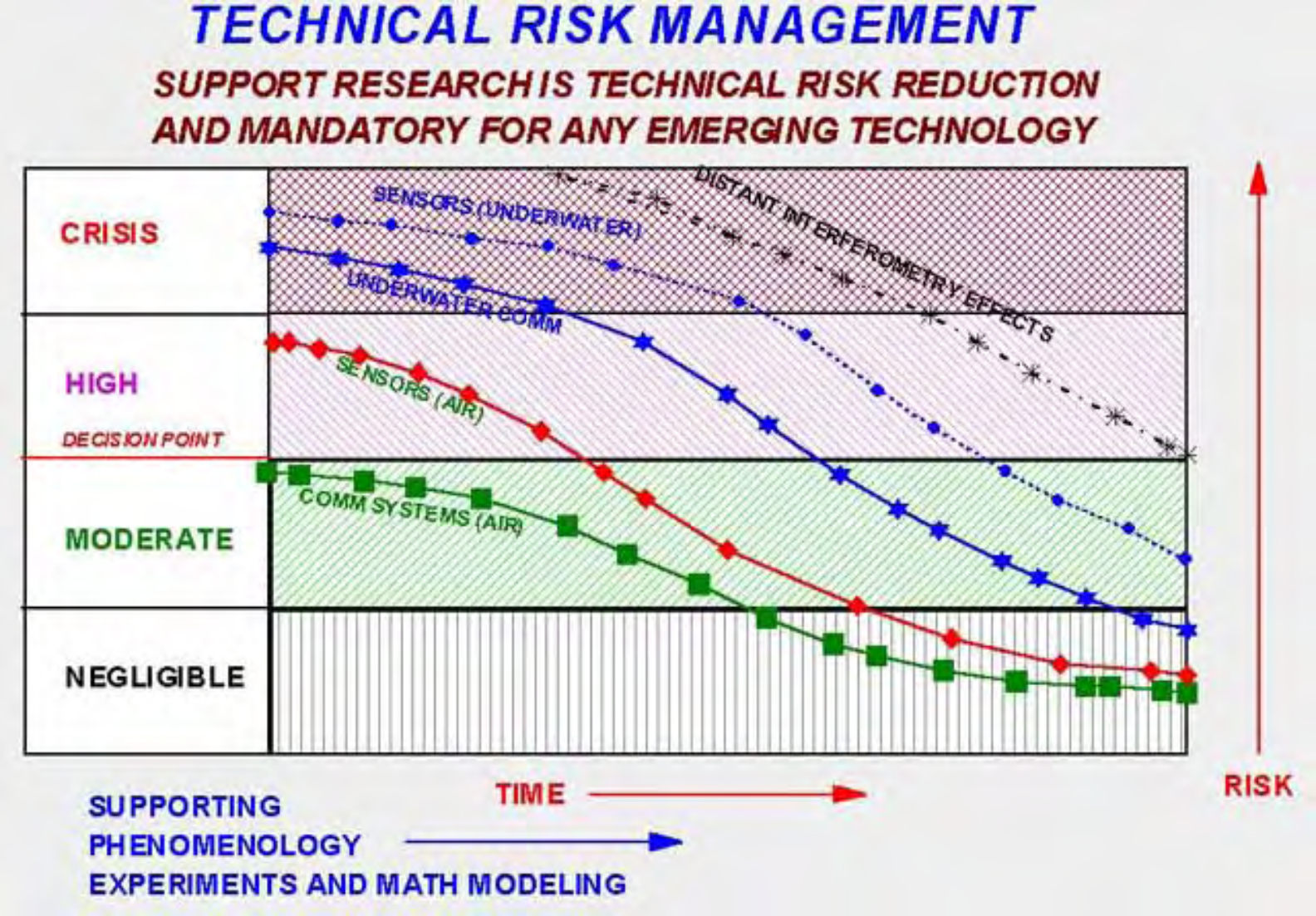
TECHNICAL RISK MANAGEMENT
SUPPORT RESEARCH IS TECHNICAL RISK REDUCTION
AND MANDATORY FOR ANY EMERGING TECHNOLOGY
CRISIS
HIGH
DECISION POINT
MODERATE
NEGLIGIBLE
SENSORS (UNDERWATER)
DISTANT INTERFEROMETRY EFFECTS
UNDERWATER COMM
SENSORS (AIR)
COMM SYSTEMS (AIR)
TIME
RISK
SUPPORTING
PHENOMENOLOGY
EXPERIMENTS AND MATH MODELING

Aum Shinrikyo's Sarin Facility

The interior of Satian No. 7, a suspected sarin production plant

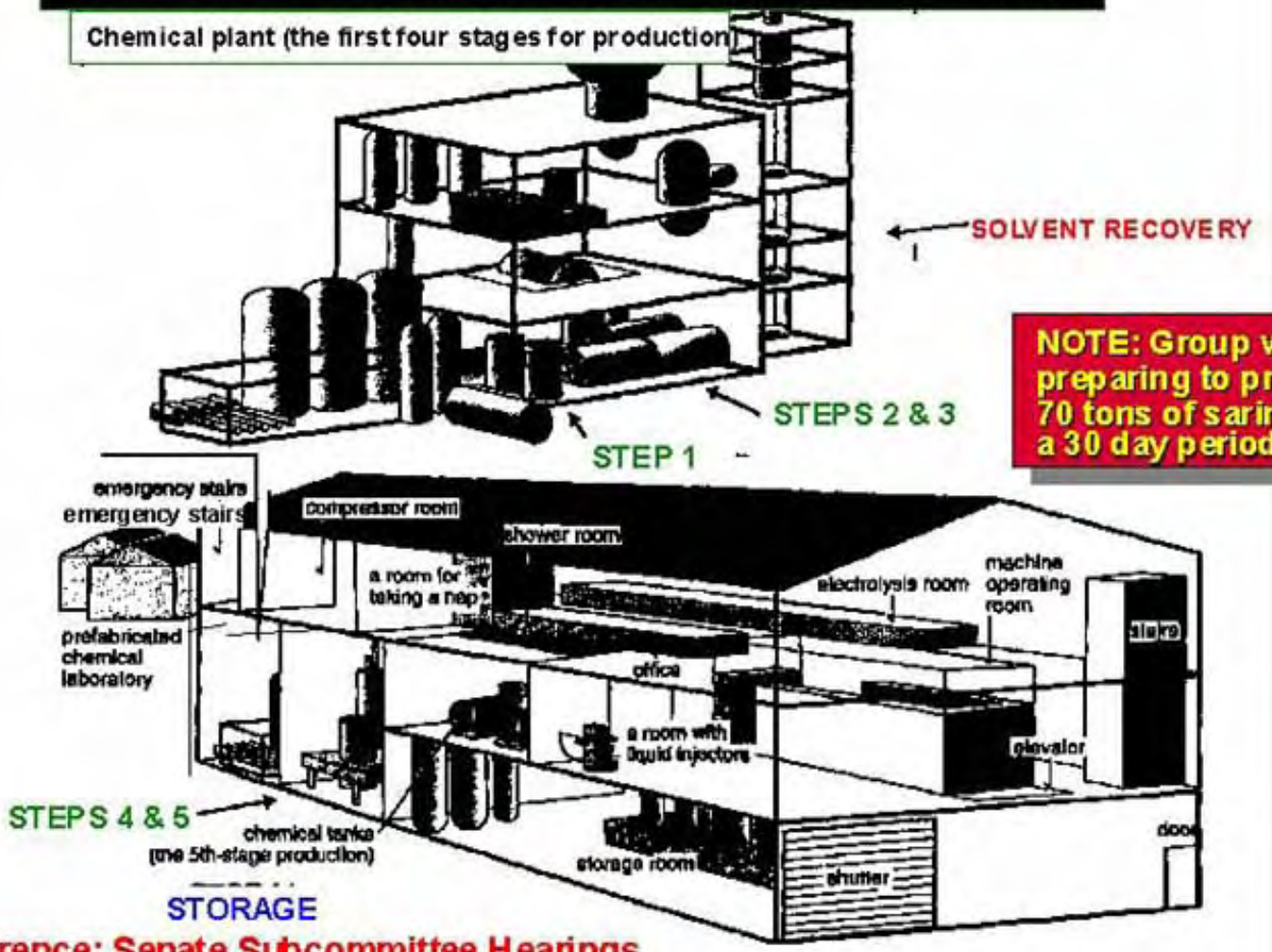

NOTE: Group was preparing to produce 70 tons of sarin in a 30 day period.

Reference: Senate Subcommittee Hearings

In Scalar Beam Interference Zone

- De-phasing of wave/antiwave pairs occurs
- Zero-summation destroyed
- Ordinary EM reappears [Whittaker 1904]
- Ordinary energy appears or disappears (i.e., may produce heating or cooling)
- Energy bottle effect
- Can add or extract EM energy
- Can produce specific ST curvature engines

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Physicist Schappeller Auralaz Munster, Austria:

- British Intelligence interview, about 1948
  - Used Kaluza-Klein theory
  - Worked with Russians
- Schappeller claimed he could:
  - Cause "implosions" rather than explosions
  - Use gravitational and electromagnetic energy
  - Cause large areas of the ocean to freeze
  - Tap earth-ionospheric field
  - Produce enormous energy
- *This is precisely what Hellman worked on in the USSR, after WW II!*

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Initial Soviet Plan for Cold War, After WW II

- Develop and deploy SAM bomber defense
- Catch up in atomic weapons
- Master and apply rocketry
- Wed atomic warheads to rockets
- Initiate "Cold" War
  - Bleed the dragon
  - Guerrilla wars
  - Terrorism
  - Insurgencies
- *Find, develop, and weaponize next great technical breakthrough area as highest national priority*

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Josef Stalin: Absolute Dictator

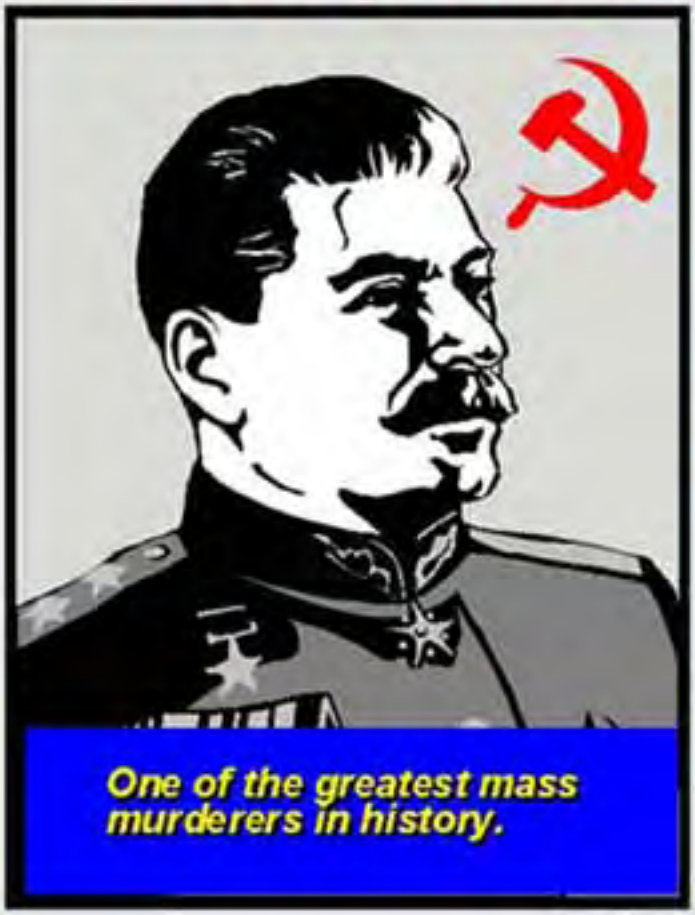

- Secret police and spies everywhere
- Purged his own officer corps
- Always deeply suspicious
- Regularly purged his enemies or those perceived to be shaky or untrustworthy
- Absolute power, justice had nothing to do with it
- Opponents often just disappeared in the night, never to be seen again
- Secret police often tortured, killed them
- Others sent to slave labor camps to die by severe work, starvation, and beatings or downright massacre
- Had experienced unusual abilities of Wolf Messing, so knew that some persons could do unusual things
- Forced Soviet weapon physics into this psychoenergetics realm also

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Exploding any Resistance by Operational Scientists
Josef Stalin
© T.E. BEARDEN 1997
The Communists slaughtered 20 million Russian Kulaks to collectivize Soviet farming
Assembled Academy
"The destiny of communism has been frustrated by the U.S. development of the atomic bomb. That is not the last great technical breakthrough. The next one WILL be Soviet! You will provide me with that great new technical breakthrough at all speed, or I will have your heads. Do I make myself clear, comrades?"

Significant Soviet Statements

- "In the final revolution, it does not matter if three-quarters of the earth is destroyed, so long as the other quarter emerges communist." *[Lenin]*

- "If a means of total neutralization of foreign missiles is to be found, it can only come from a group of new principles in physics, called energetics." *[Nobelian Petr Kapitsa, to Nikita Khrushchev, in answer to Khrushchev's demand for a 100% method of defense against long range missile attack.]*

- "We will bury you." *[Khrushchev, to Nixon, Kitchen Debate]*

- "We have a new weapon, just within the portfolio of our scientists, so to speak, which is so powerful that, if unrestrainedly used, it could wipe out all life on earth. It is a *fantastic* weapon." *[Khrushchev, speaking to the Presidium, Jan. 1960]*

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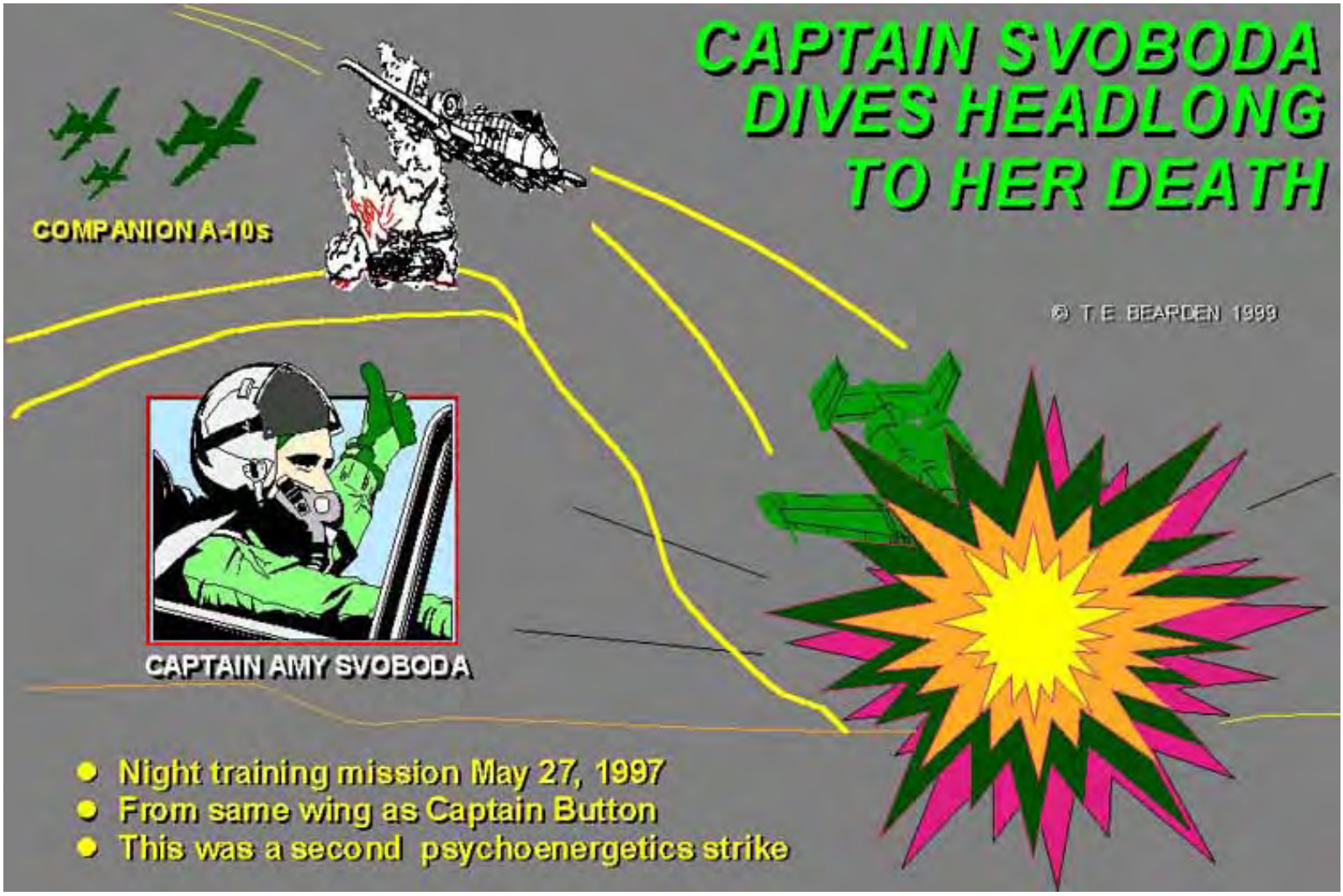
CAPTAIN SVOBODA
DIVES HEADLONG
TO HER DEATH
COMPANION A-10s
© T.E. BEARDEN 1999
CAPTAIN AMY SVOBODA
• Night training mission May 27, 1997
• From same wing as Captain Button
• This was a second psychoenergetics strike

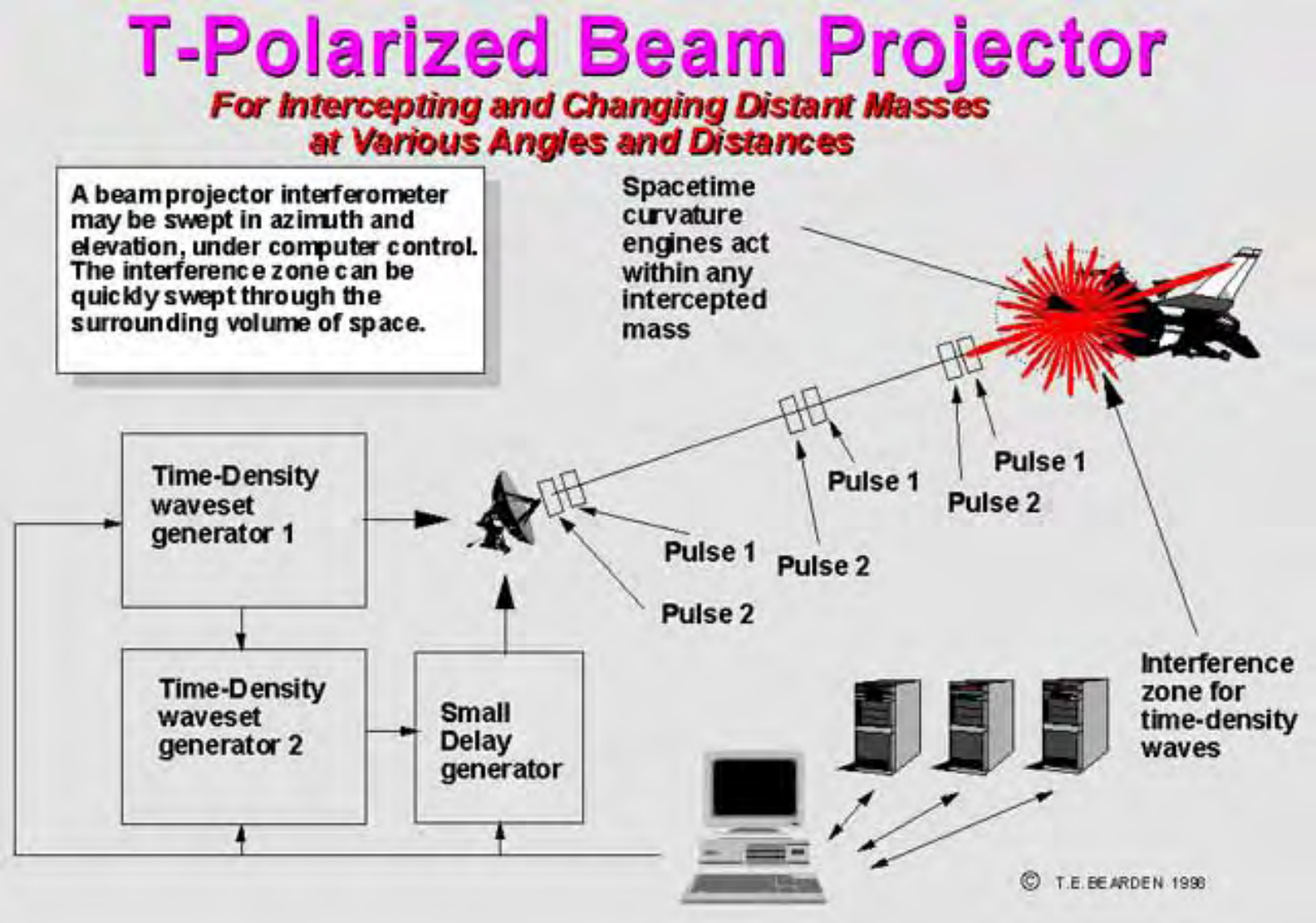
T-Polarized Beam Projector
For Intercepting and Changing Distant Masses
at Various Angles and Distances
A beam projector interferometer may be swept in azimuth and elevation, under computer control. The interference zone can be quickly swept through the surrounding volume of space.
Spacetime curvature engines act within any intercepted mass
Time-Density waveset generator 1
Time-Density waveset generator 2
Small Delay generator
Pulse 1
Pulse 2
Pulse 1
Pulse 2
Pulse 1
Pulse 2
Interference zone for time-density waves
© T.E. BEARDEN 1998

Possible Tests (1)

- 1958 nuclear accident in Urals
- Disease induction in U.S. Embassy personnel in Moscow
- Siberian disease/death transmission experiments
- Destruction of USS Thresher nuclear submarine, Apr. 10, 1963
- Nuclear explosion transmitted into ocean underwater, 100 miles north of Puerto Rico, Apr. 11, 1963

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Possible Tests (2)

- Eight F-111's downed in Vietnam immediately after deployment
- Several large earthquakes
- Mysterious aircraft losses in groupings
- Numerous underground "nuclear" tests
- Nuclear tests at Semipalatinsk without associated seismic activity
- High altitude rumbles, snaps, booms
  - *Off English coast*
  - *Off East coast of U.S.*
  - *Over West Coast of U.S. in thunderstorms*

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Possible Tests (3)

- Blinding of several U.S. satellites (up to 4 hours in duration)
- Cold Explosion off Kurils 1984
  - First, a cold explosion
  - Then test of giant Tesla shield 300 mi. dia.
- Tests offset from shuttle launch Nov. 85
- Kill of Arrow DC-8,Gander, NFLD Dec. 1985
- Titan kill, Vandenberg AFB, CA early 1986
- Kill U.S. Challenger, off Cape Canaveral 1986
- Earthquakes induced, 1986-88
- Dozens of tests of shields around the world
- Decades of radiating U.S. Embassy in Moscow

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Possible Tests (4)

- Extensive tests 1990-99 in Western Australia
- Engineering of weather since 1990 by Yakuza
- Possible nuclear dudding test in WA in 90s by Aum Shinrikyo
- C-130 engine flameout kill
- TWA-800 kill 1997
- Gulf War Disease Induced, 1991
- Spreading of immune systems of U.S. populace, 1990s
- Psychoenergetic control of Captain Button
- Psychoenergetic control of Captain Svoboda
- Twice in 1997, within days of full strategic destruction of U.S.

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Mushroom cloud rising from sea

- 0514 hrs, 9 April 1984
- Gray-white cloud appeared
- Rose 60,000 feet in 2 minutes
- South of Kuril Islands
  - *180 miles southeast of Hokaido*
  - *200 miles from Tokyo*
- Soviet missile testing scheduled about 350 miles away, at 2100 hrs, 9 April 1984

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Launches from Cape Canaveral
and Vandenberg AFB
Provided Practice Targets of Opportunity

The sinking U.S.S. Thresher, with her controls jammed, implodes when she reaches crush depth

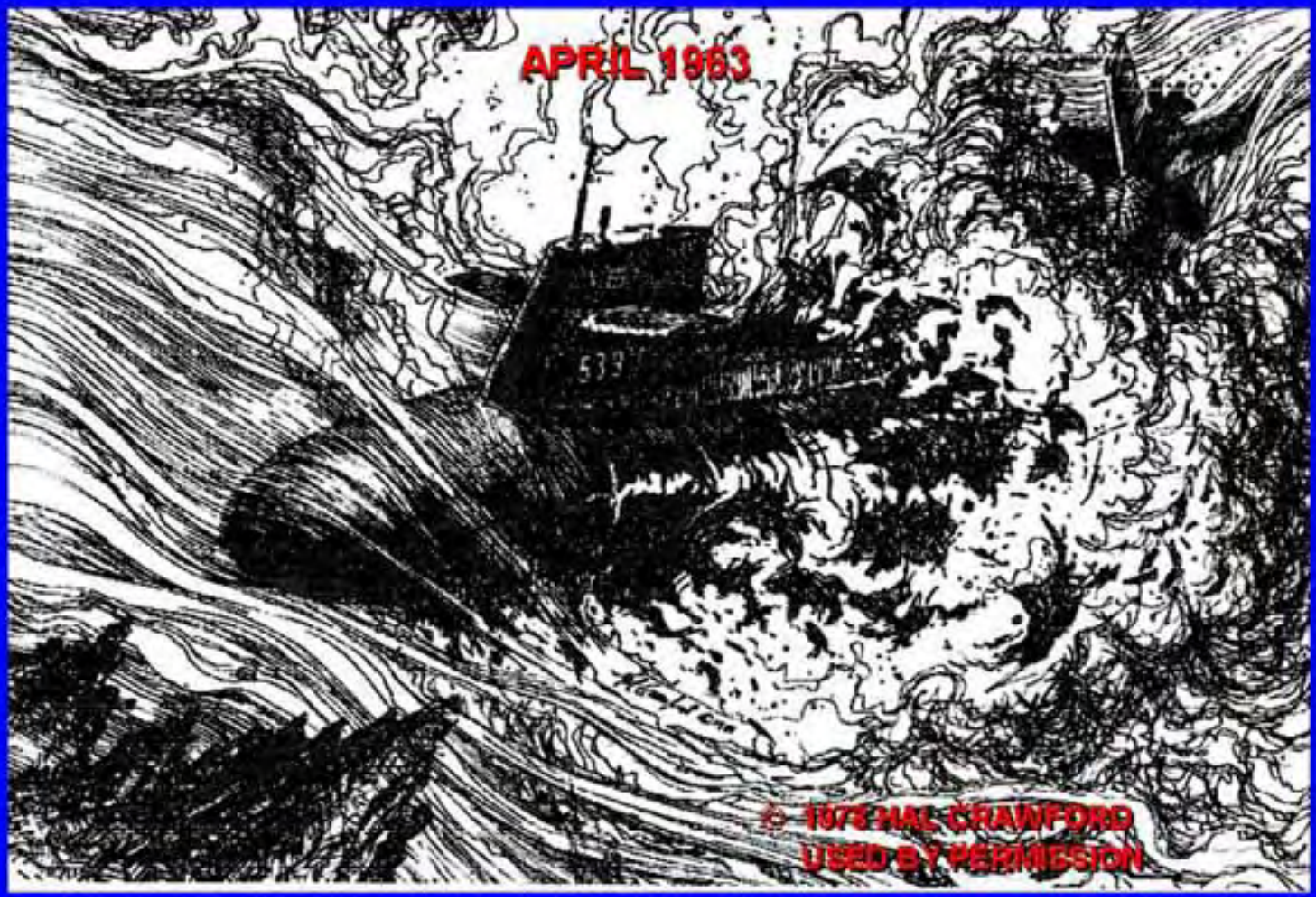

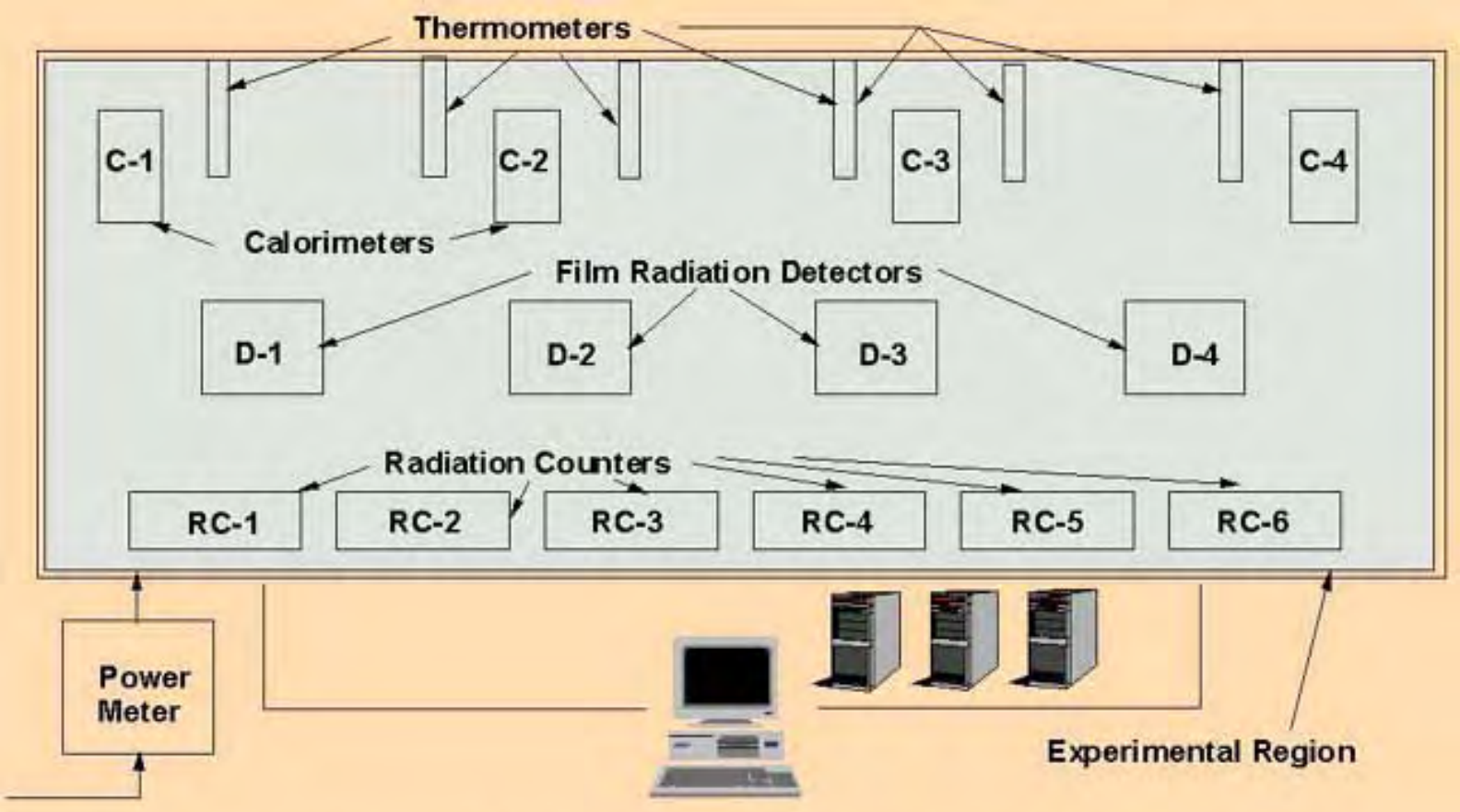

Figure 32. Embodiment of an instrumental array sufficient to discriminate when time-density charging has occurred, and that transduction of time-charge decay is occurring.

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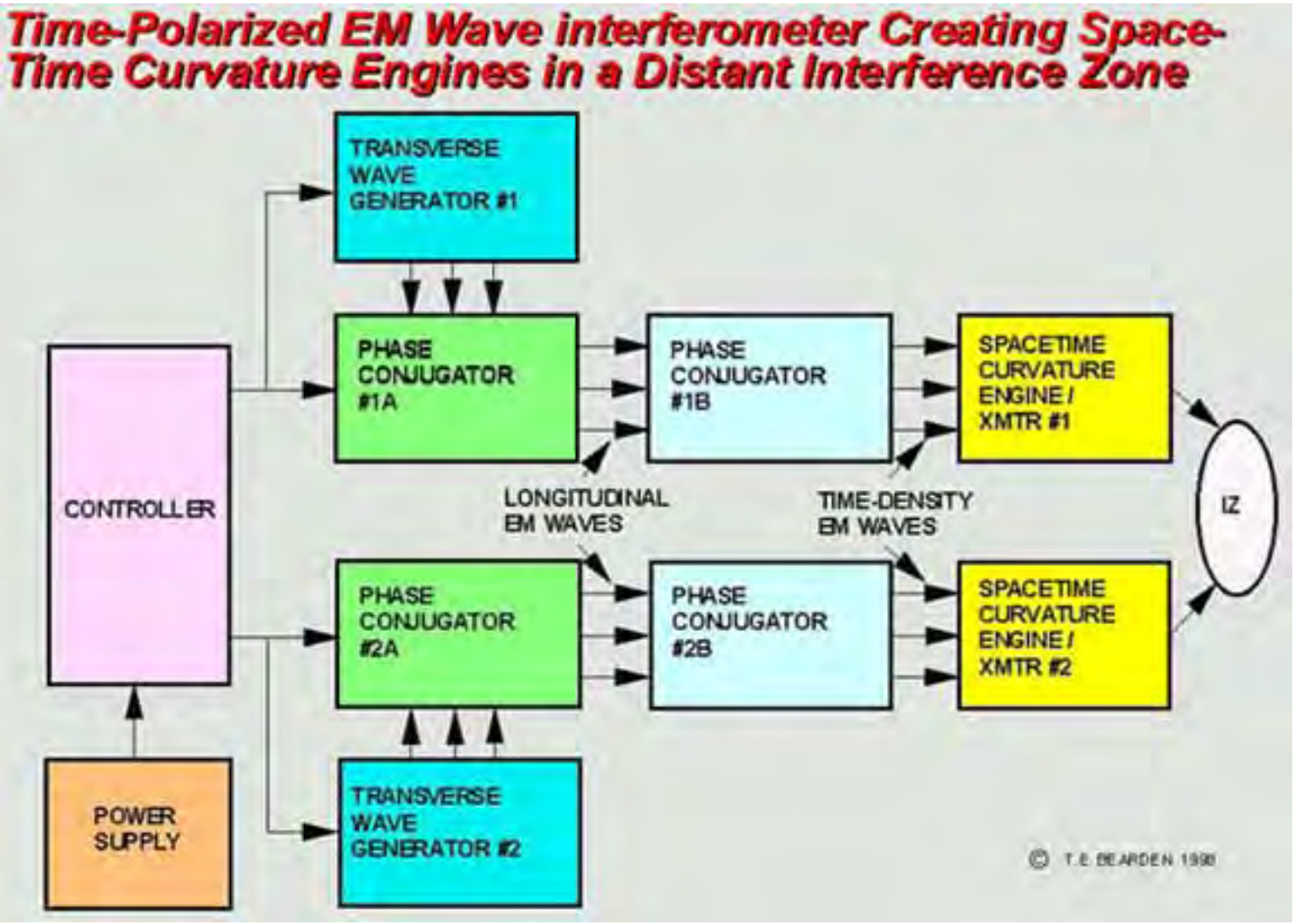
Time-Polarized EM Wave interferometer Creating Space-Time Curvature Engines in a Distant Interference Zone
TRANSVERSE WAVE GENERATOR #1
PHASE CONJUGATOR #1A
PHASE CONJUGATOR #1B
SPACETIME CURVATURE ENGINE / XMTR #1
CONTROLLER
LONGITUDINAL EM WAVES
TIME-DENSITY EM WAVES
IZ
PHASE CONJUGATOR #2A
PHASE CONJUGATOR #2B
SPACETIME CURVATURE ENGINE / XMTR #2
POWER SUPPLY
TRANSVERSE WAVE GENERATOR #2
© T.E. BEARDEN 1990

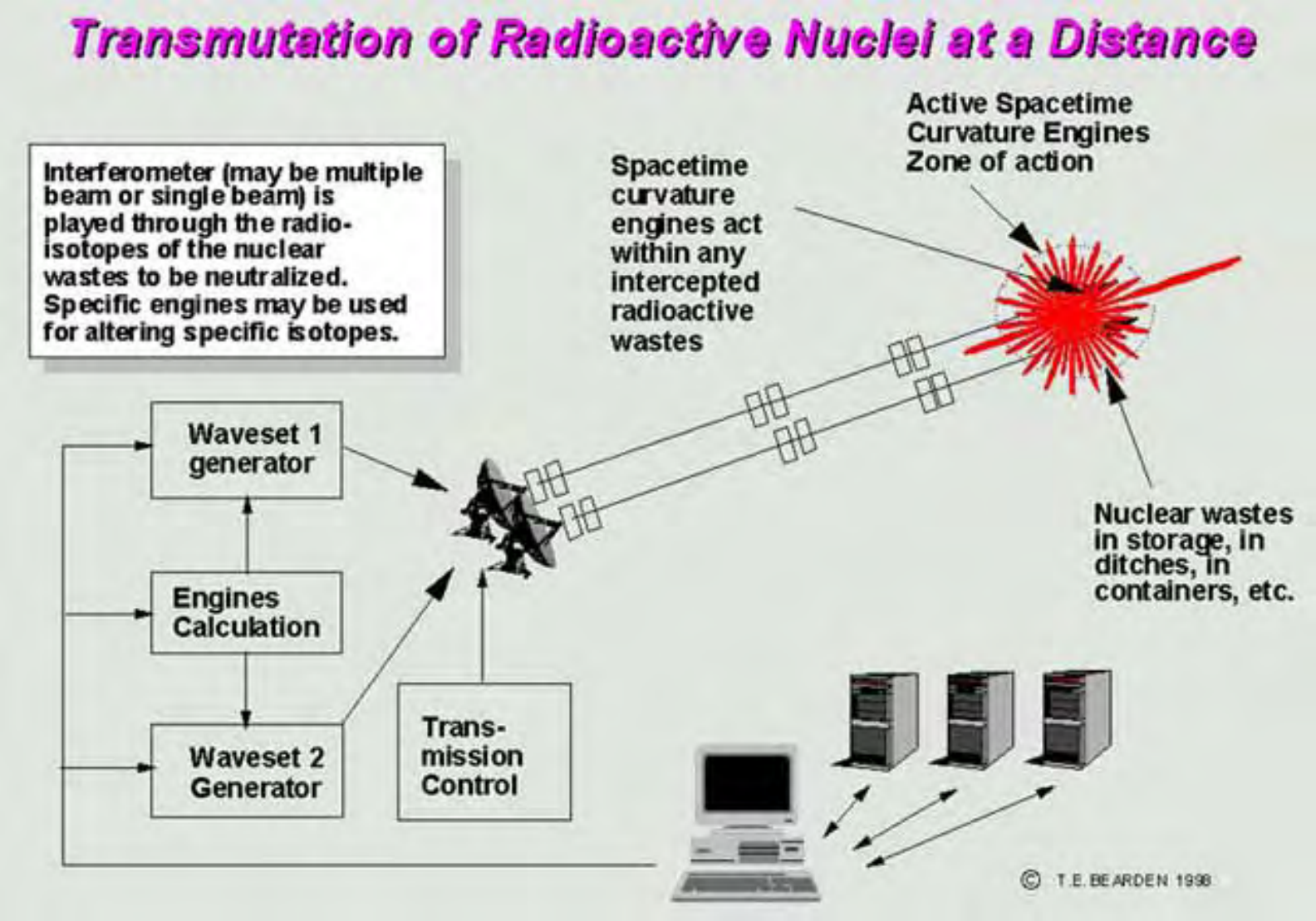
Transmutation of Radioactive Nuclei at a Distance
Interferometer (may be multiple beam or single beam) is played through the radio-isotopes of the nuclear wastes to be neutralized. Specific engines may be used for altering specific isotopes.
Spacetime curvature engines act within any intercepted radioactive wastes
Active Spacetime Curvature Engines Zone of action
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
Nuclear wastes in storage, in ditches, in containers, etc.
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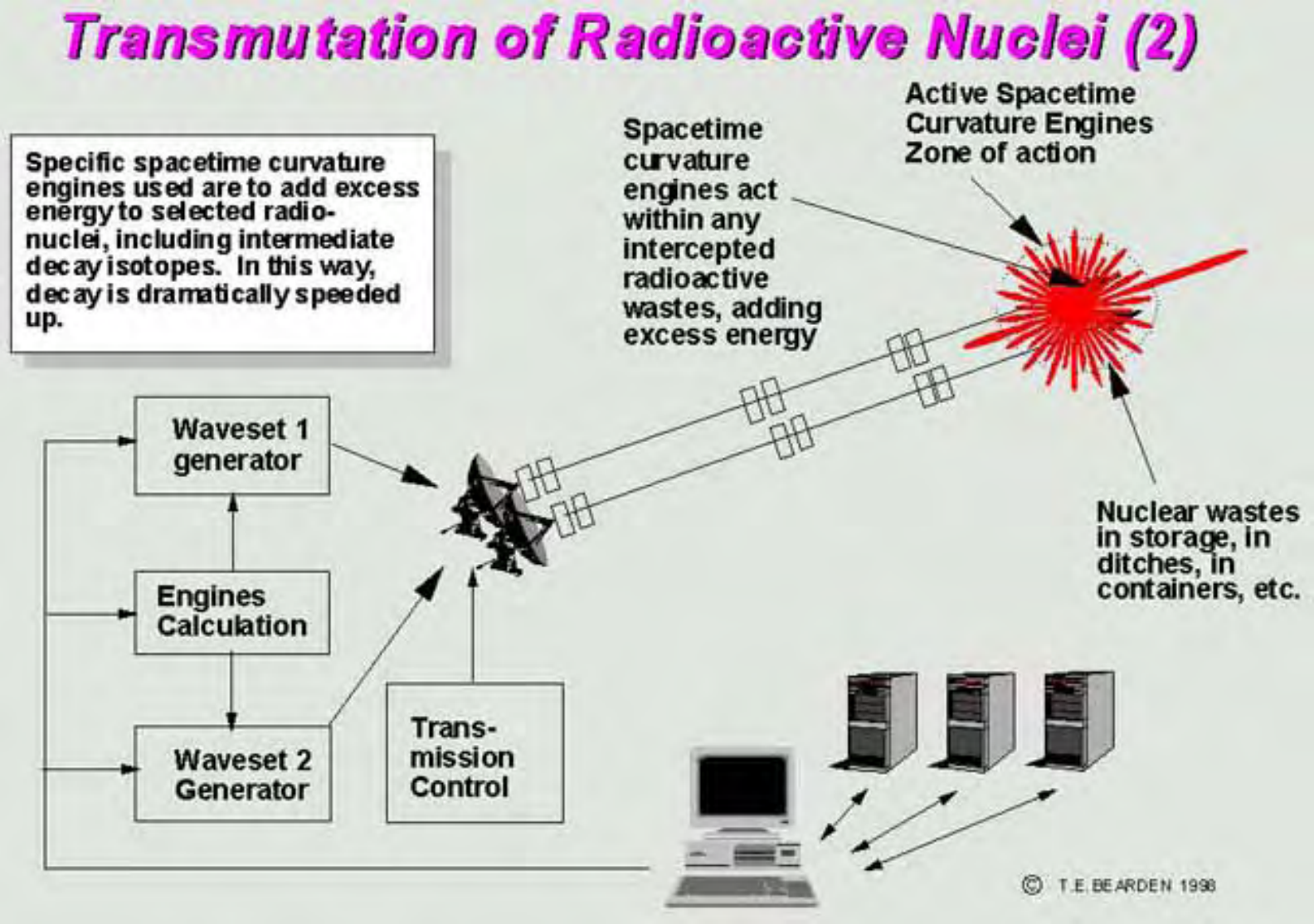
Transmutation of Radioactive Nuclei (2)
Specific spacetime curvature engines used are to add excess energy to selected radio-nuclei, including intermediate decay isotopes. In this way, decay is dramatically speeded up.
Spacetime curvature engines act within any intercepted radioactive wastes, adding excess energy
Active Spacetime Curvature Engines Zone of action
Nuclear wastes in storage, in ditches, in containers, etc.
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
© T.E. BEARDEN 1998

Typical Shield Test, Northern Route to Japan
18-27 km diameter
Asahi Evening News, Tokyo
June 22, 1982
Multiple tests seen per month, for years.
Pilots simply ceased reporting them.
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A Curious Tide in Human Affairs

To win its freedom in the long run, usually a group must defeat its attackers or suppressors *at least twice*.

- We fought the British twice for our independence.
- We are fighting ourselves twice to free the slaves. - American Civil War
  - Civil rights struggle
- We beat the Germans twice, in WW I and WW II
- We beat the Hispanics in the Spanish-American War. *That's once*. (They're winning the second by crossing the border. The U.S. is becoming a Hispanic Nation).

But we also have some unfinished business at hand.

- We checked the Russians in the Cold War. *Once*.
- We checked the Japanese in WW II. *Once*.
- We checked the KGB in the Cold War. *Once*.
- We checked the Communists in the Cold War. *Once*.
- We checked Saddam Hussein in the Gulf War. *Once*.

Large Scalar EM Interferometer (LASI) Accident Near Urals, 1958

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- 1958 nuclear explosion near Urals
  - Signature of large scalar interferometer (LASI) accident
  - Buried atomic wastes suddenly exploded
  - Large region contaminated to this day
- Soviets were well along with advanced LASI prototypes and testing
  - Khrushchev announced forthcoming advent of these "fantastic" weapons in Jan. 1960
  - 1958 difficulties could have been resolved by 1960
- Expected 1958 cause: transmitter short-out and failure in a nearby LASI discharged its cumulated energetics beam energy into the ground
- *Spreading ground pulse struck nearby atomic wastes, fissioning nuclei*

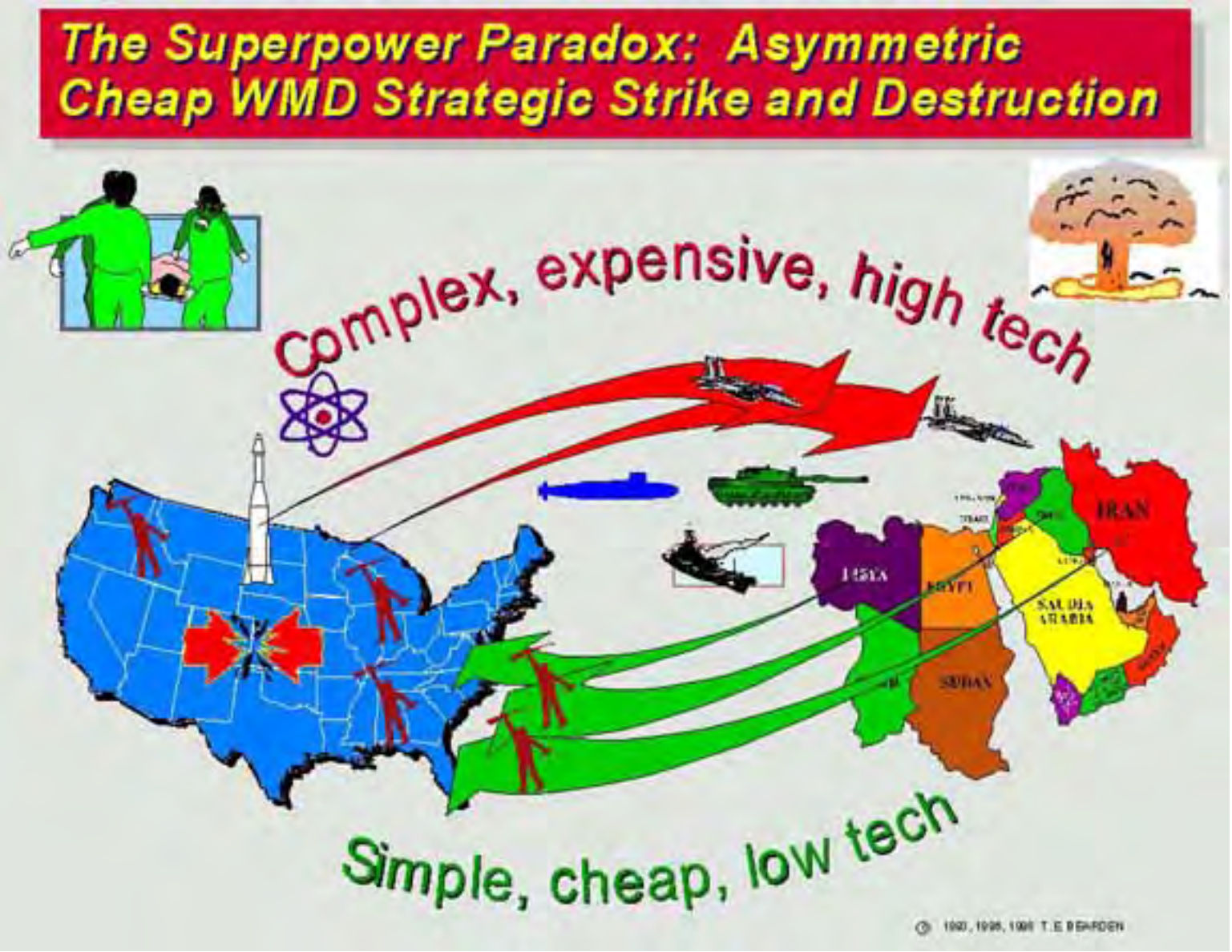
The Superpower Paradox: Asymmetric
Cheap WMD Strategic Strike and Destruction
Complex, expensive, high tech
IRAN
LIBYA
EGYPT
SAUDI ARABIA
SUDAN
Simple, cheap, low tech

THE KGB/YAKUZA-AUM WAR PLAN

- *Dud all quantum potential weapons in other nations via psychoenergetics.*
- *Remove U.S., Israel, Brazil, West Europe as military powers.*
- *Destroy nuclear weapons, hostile energetics weapons, hostile ships, 80% of targeted populaces in first hour of strikes.*

LEASE

1990-91

Aum/Yakuza Acquired Use of on-site Russian Scalar EM (Energetics) Weapons.

Began Geosurvey of Test Range (Western Australia) for training.

KGB Tested QP population wpn (Gulf War Syndrome)

TRAIN

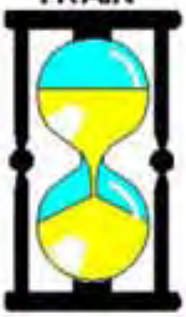

1991-94

Began extensive training of AUM-Yakuza crews in Russia, with practice firing into Western Australia. J-team took over world-wide weather engineering. Preparing for occupation of West Australia.

ESCALATE

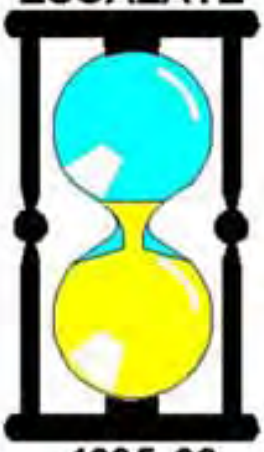

1995-99

Began EM kill of selected lone U.S. targets, law strategic deception plan.

U-2 a/c? USAir 747?
TWA-800 C-130
ValueJet? A-10s

Surged electrical grids. Worldwide practice kills, scalar interferometry. QP modification of selected pathogens

STRIKE!

Plan:
Trigger terrorist BW, & WMD attacks.
Enhance BW infections with QP wpn.
When ready, counter insane QPweapons with psychoenergetics. Destroy QP wpns.
Dud all nuclear weapons worldwide;
Time-snap ships, scalar weapons sites;
Attack major target populations w/QP.
Then cleanup with interferometry strikes.

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Why Western Science is Ignorant of KGB Energetics

- *Foundations* of electrodynamics and much of Western physics are seriously flawed
- Only just rediscovering longitudinal EM waves
- No knowledge of using time-polarized EM waves
- Does not know a powerful GR is hidden in EM
- Ignores inner structure of potentials, waves, fields
- Hotly defends errors, ignores for a century
- Determined to push big nuclear science
- Suppresses research to approved dogma by rigorously controlling precisely what research the funds can be used for

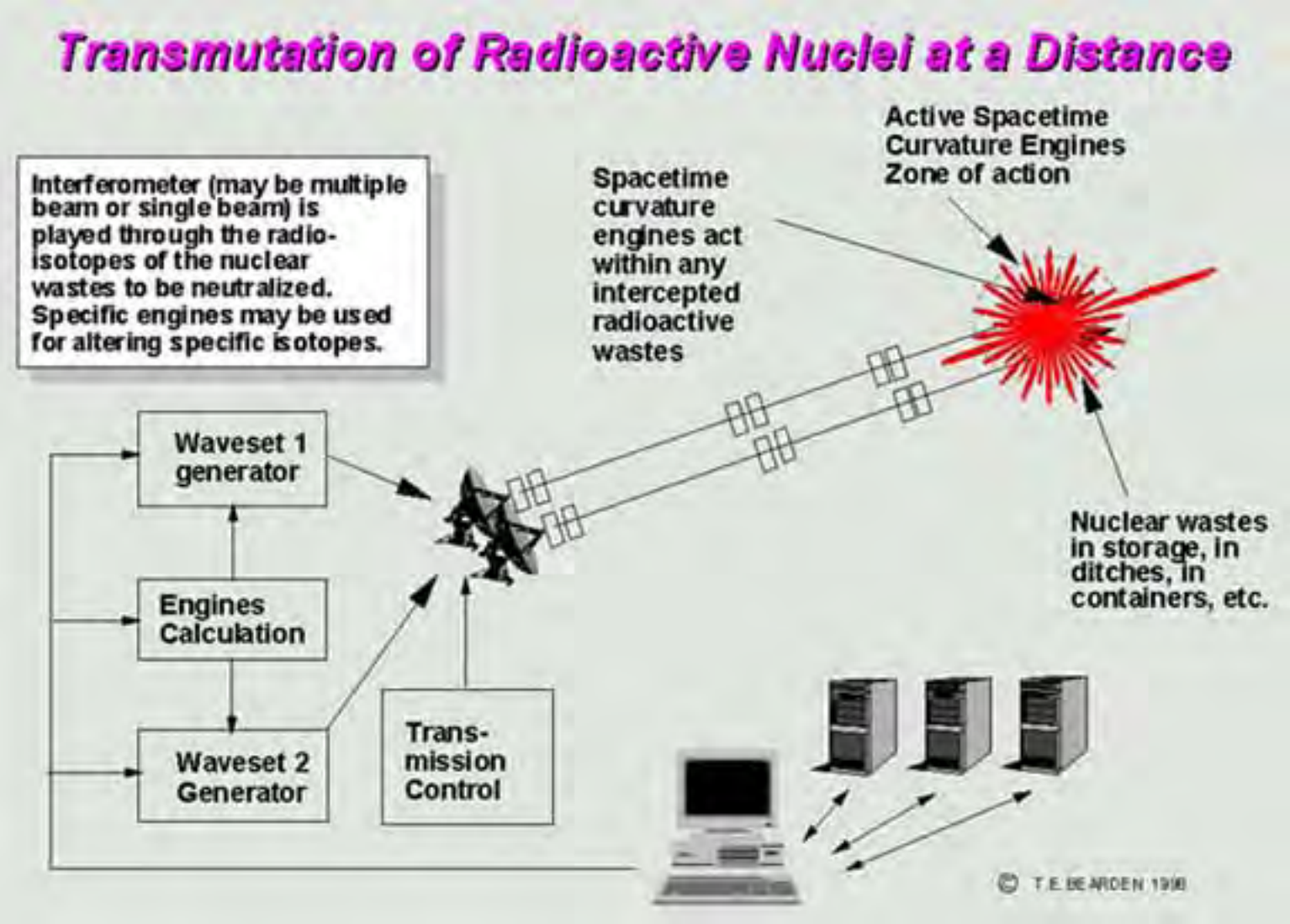
Transmutation of Radioactive Nuclei at a Distance
Interferometer (may be multiple beam or single beam) is played through the radio-isotopes of the nuclear wastes to be neutralized. Specific engines may be used for altering specific isotopes.
Spacetime curvature engines act within any intercepted radioactive wastes
Active Spacetime Curvature Engines Zone of action
Nuclear wastes in storage, in ditches, in containers, etc.
Waveset 1 generator
Engines Calculation
Waveset 2 Generator
Trans-mission Control
© T.E. BEARDEN 1998

THE YAKUZA

(JAPANESE MAFIA)

To do business with Japan is to do business with the Yakuza

The Last Samurai, Defending Bushido

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- **3 Major Yakuza Groups, In Coalition.**
- **Penetrate Japanese Government.**
- **Open Offices, Signs on Street.**
- **Public Romanticizes Yakuza as Last Japanese Samurai**
- **In Large High-Tech Corporations.**
- **In Control of Japanese Banks.**
- **Japanese Real-Estate Rip-off.**
- **$500 - 1,000 Billion per Year Income.**
- **Rapidly Spreading in U.S.**
- **Uniting Mafia Groups Worldwide.**
- **Coalition with Aum Shinrikyo.**
- **Leased Russian Energetics Weapons.**
- **Crews On-site in Russia, Trained.**
- **Practice Firings into Western Australia for Three Years. (Dozens of Shots per Month)**
- **Now in Escalation Phase, Killing U.S. Targets.**
- **All-out Strike on U.S. ready 1999-2000.**
- **Now held in check by KGB, dead-man fuzed by small nation friendly to U. S.**

Yugoslav Earthquake, Followed by Cold Explosion

Apr. 15 1979

- Magnitude 7.2 on Richter scale
- Epicenter 33 km. deep
- More than 100 aftershocks
- At Kamenari:
  - Adriatic sea mushroomed up
  - Like atomic bomb explosion
  - Signature of a cold explosion
  - Similar to Apr. 1984 test off coast of Japan, near Kurils (see inset graphics)
- *Note that April is a significant test month for the Communists (preparing official reports for May Day?)*

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Briefing to
Request for Information Symposium

14 February 2000

Air Force Research Laboratory

Directed Energy Directorate
AFRL/DE

Kirtland AFB, New Mexico

Colonel Doug Beason
Deputy Director

“VICTORY SMILES UPON THOSE WHO ANTICIPATE THE CHANGES IN THE CHARACTER OF WAR” Guilio Douhet

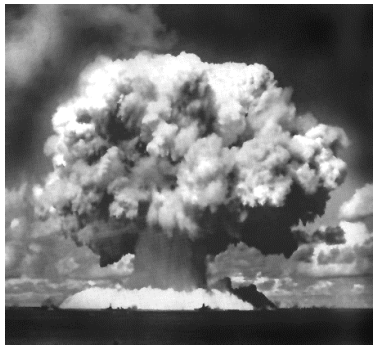

Directed Energy Directorate

A paradigm shift in weapon system technology for the 21st Century.

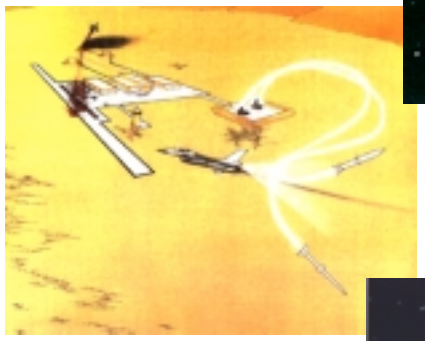

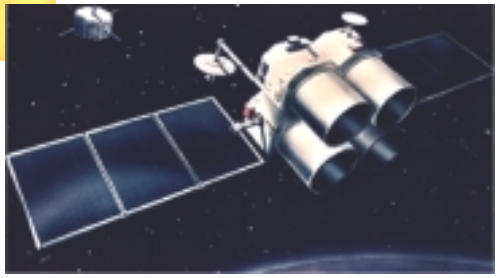

Our Mission

- ***To support*** user needs for DEW applications and to address mission area deficiencies
- ***To exploit*** the relevance of Directed Energy technology to Air Force and DoD needs
- ***To foster*** user awareness of the potential of Directed Energy for Air Force and DoD applications
- ***To avoid*** technological surprise
- ***To explore*** DE technology avenues that offer high payoff to directed energy capabilities and applications

To do what has never been done before!

Directed Energy Directorate

Our Vision of the Future:
Directed Energy will Dominate the Battlespace of the 21st Century

Strike

We will strike deep in the enemy's territory at the speed of light, with little or no collateral damage or loss of life, crippling his ability to wage aggression.

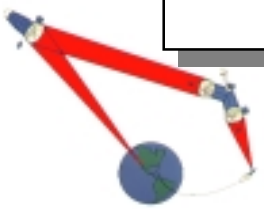

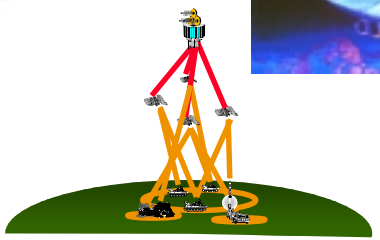

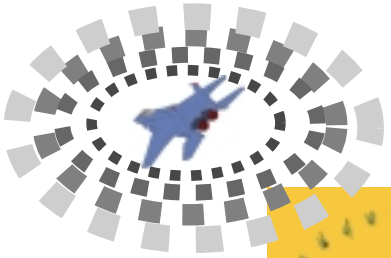

Our high value and limited military assets will be protected by invisible shields of directed energy.

Protect

Graduated Deterrence

We will provide our warfighters with weapons that provide a wide range of graduated force for every military contingency.

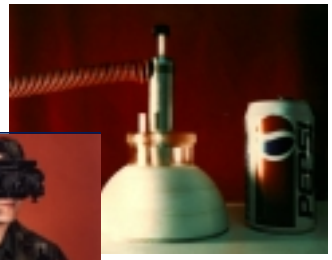

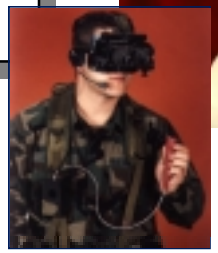

Awareness

Our battleflield awareness will be greatly enhanced with directed energy tools capable of detection and identification

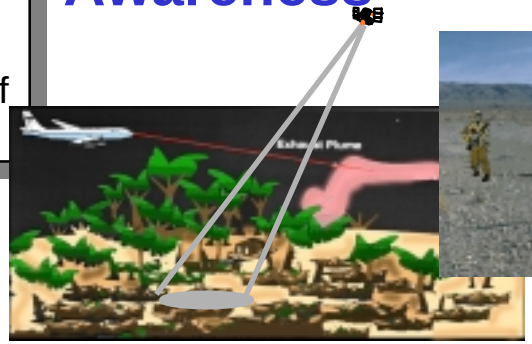

Security & safety in isolated canyons

Access to 50,000 acres for testing

Remote sites

Ideal weather
"thin" atmosphere

Kirtland AFB

Unique & ideally suited for the nation's directed energy technology development

Dark skies
No light
"pollution"

Many diverse, high tech tenants

International airport & metro area

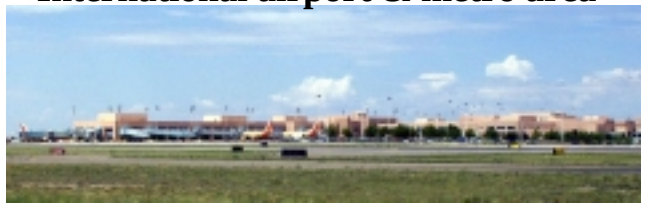

Directed Energy Directorate
Remote Sites

- **Maui, HI (leased land)**
  - **Relay Mirror Experiment Facility**
  - **Maui High Performance Computer Center**
  - **Maui Space Surveillance Complex**

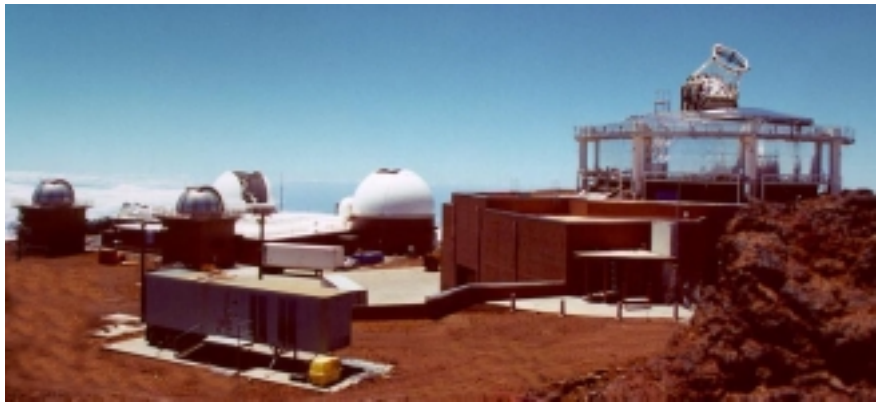

- **North Oscura Peak, NM**
  - **Telescope site at White Sands Missile Range**
  - **Supports Space Imaging R&D (ABL Technology)**

Lasers and Microwaves

Synergistic, Complementary and Capable

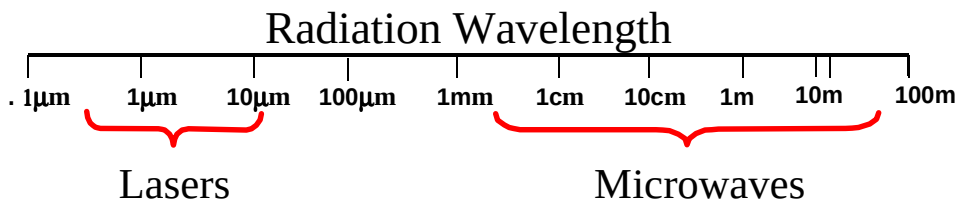

High Energy Lasers	High Power Microwave s
Small spot: surgical attack	**Flood target area: multiple simultaneous targets**
Affects targets from outside: structural destruction	**Affects components inside: electronic disruption**
Weather sensitive: clouds, dust, molecular absorption	**Weather insensitive: sees through clouds and dust.**
Modest apertures: glass mirrors, coatings	**Big apertures: metal antennas, ground planes**

But on the other hand,... they both

- **Travel at the <u>speed of light</u> to the target**
- **Capable of graduated effects from <u>deny, disrupt, degrade, and destroy</u>.**
- **Minimum collateral damage**

Directed Energy Directorate

Broad Technology Investments

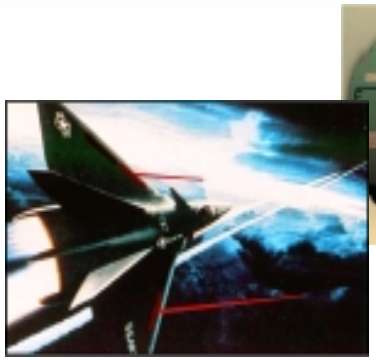

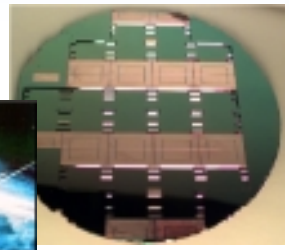

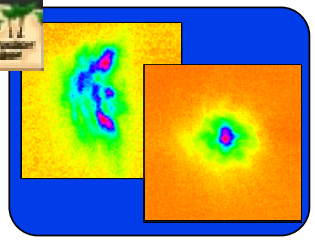

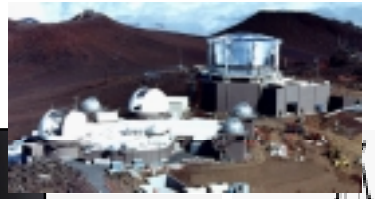

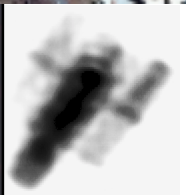

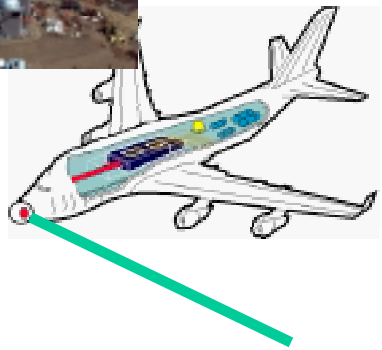

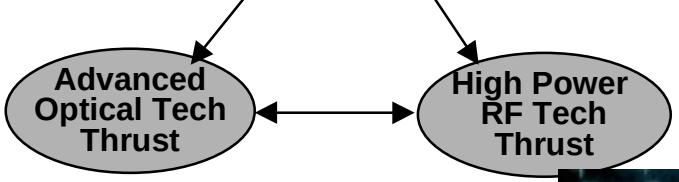

Directed Energy Directorate

12 Major DE Technology Programs

Ground Based Laser Technology Program

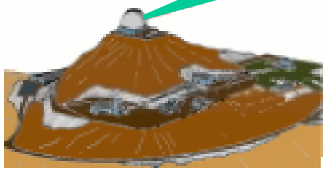

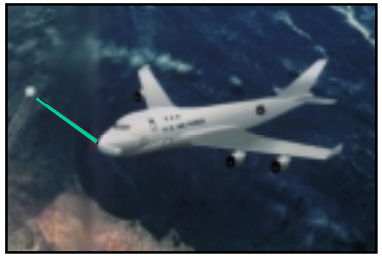

Airborne Laser Technology Program

High Power Laser Program

Scalable Multi-Wavelength Laser Program

High Efficiency Electric Laser Program

Remote Sensing

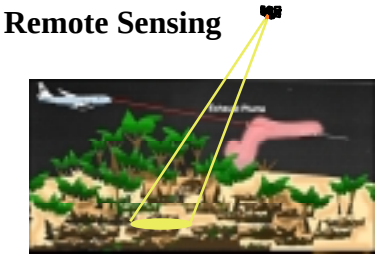

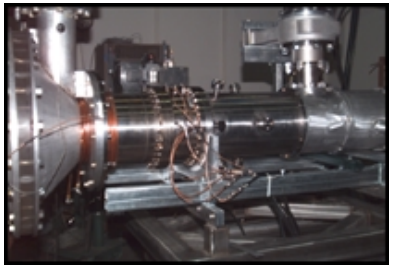

HPM Sources Program

HPM Pulsed Power Program

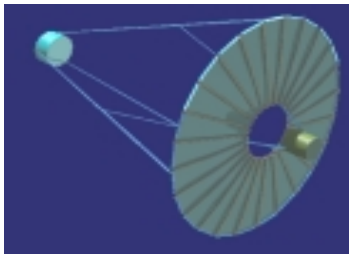

Large Optics

Space Awareness Program

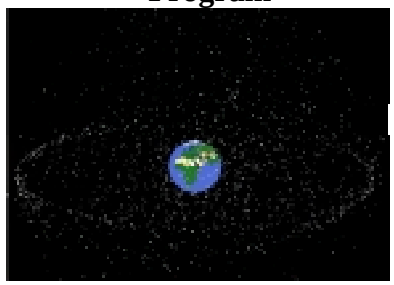

HPM Applications Program

HPM Effects Program

AFRL

Directed Energy Directorate

Mission

Develop, integrate and transition science & technology for Directed Energy to include high power microwaves, lasers, adaptive optics, imaging and its effects to assure the preeminence of US in air & space

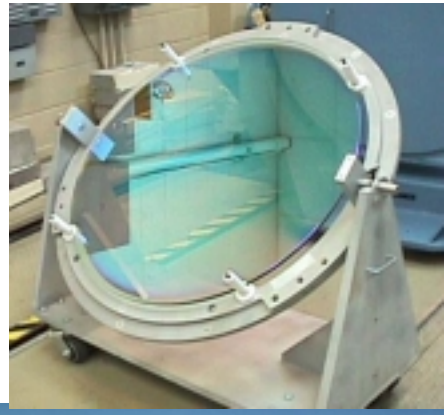

Major Technology Programs

Ground Based Laser	Space Awareness
Airborne Laser	HPM Applications
High Power Lasers	HPM Effects
Multi-Wavelength Laser	HPM Pulsed Power
Electric Lasers	HPM Sources
Large Optics	Remote Sensing

AFRL/DE - factoids

- **952 people (Civ, Mil, Contr)**
- **$109M FY00 budget**
- **4,325 acres**
- **757,000 sf of space**
- **Located throughout Kirtland**
- **Sites at Maui & WSMR**

Air Force Research Laboratory

Directed Energy Directorate

Directed Energy Directorate

Director	Dr Earl Good
Deputy	Col Douglas Beason
Chief Scientist	Dr Barry Hogge

Starfire Optical Range	Advanced Optics and Imaging	Laser Technology	High Power Microwave Microwave	Technology Assessment	Integration & Operations
Major Jim Brown	Dr Chris Clayton	Col Greg Schneider	LtCol Mark Franz	Dr Dave Dinwiddie	Mr Leonard Contreras
Dr Bob Fugate	Dr Connie Guiliano	Dr Harro Ackermann	Dr Bill Baker	Lt Col Terry Franks	
				Mr Bill Thompson	

Directed Energy Directorate

Major Kirtland Facilities

Lasers, Optics, Imaging

Starfire Optical Range

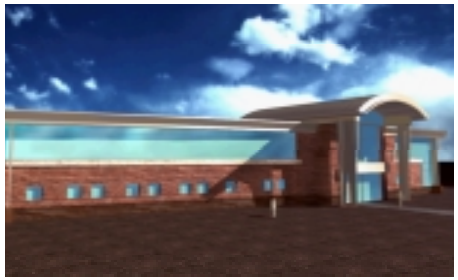

Advanced Laser Facility

Argus Facility

Optics Development
& Beam Control Laboratory

Chemical-Oxygen-Iodine-
Laser Facility

Optics Coating & Components Evaluation Laboratory

Laser Effects Test Facility

Directed Energy Directorate

Major Facilities - High Power Microwave

High Energy Microwave Laboratory

High Energy Research & Technology Facility

Plasma Research Laboratory

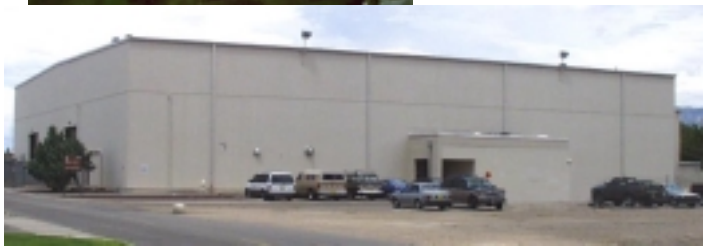

Electric Research Laboratory

Electromagnetic Energy/RF Effects Laboratory

Directed Energy Directorate

Manning

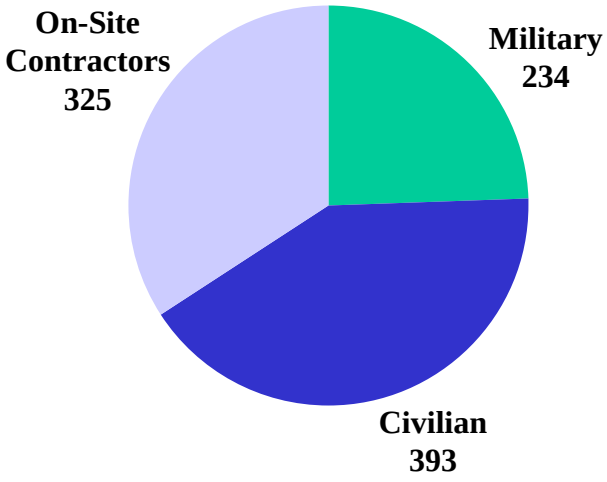

Assigned Personnel
952

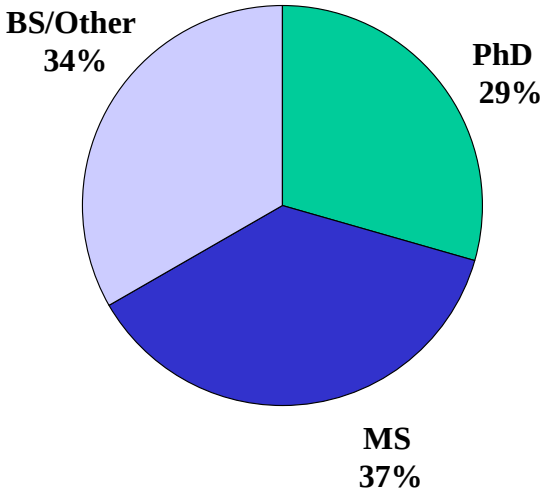

Government S&E Education Levels

Directed Energy Directorate
FY00 AFRL PB Resources

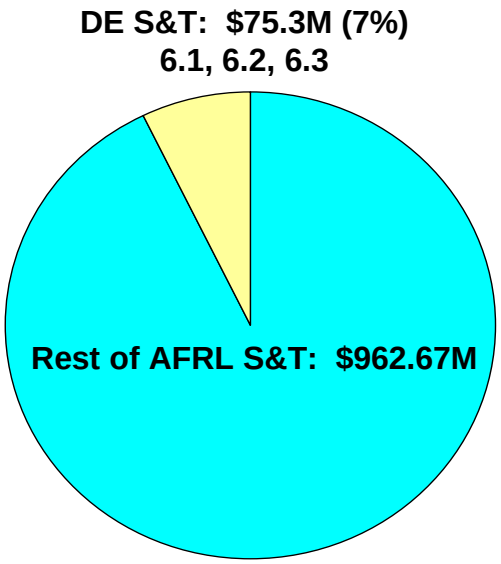

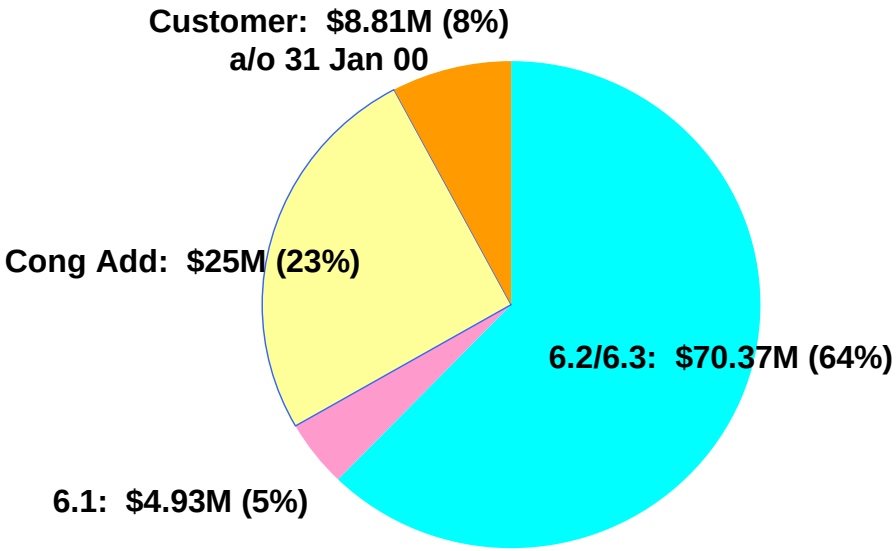

AFRL TOTAL S&T: $1,037.98M

Directed Energy Total: $109.11M

Directed Energy Directorate
Potential Areas for Collaboration

- Electric Lasers
- Beam Control
- Large, Lightweight Optics
- Optical Coatings
- High Power RF Sources
- High Power RF Antennae
- Atmospheric Compensation
- Remote Sensing

For Information contact Mr Rich Garcia, AFRL/DEOB-PA (505)846-4583

AiMT Advances in Military Technology
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Directed Energy Weapons in Modern Battlefield

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The manuscript was received on 25 June 2009 and was accepted after revision for publication on 21 September 2009.

Abstract:

The paper deals with electromagnetic threats caused due to Directed Energy Weapons (DEW). The area of interest is focused on HPM (High Power Microwaves) and UWB (Ultra Wide Bandwidth) as an important part of DEW area. Possible impact on electronic structures which can be part of military systems is considered in this paper. Some practical results achieved during experiments related to assessment of electronic equipment vulnerability is provided with overview of immunity of some equipment to HPM and UWB signals at the end of this study.

Keywords:

DEW, HPM, UWB, electromagnetic threats, NEC, vulnerability

1. Introduction

Directed Energy Weapons (DEW) with various principles seem to be more important in the future battlefield. There are several principles which are considered for use in the DEW area. Special optical technologies (lasers), sound technologies as well as microwave technologies are developed and can be used in special weapon systems to disturb military system behaviour or can be used for counter personnel weapons (for example Active Denial System working on frequency 94 GHz, see Fig. 1). DEW has been mainly considered as technologies suitable for less-lethal or even non-lethal technologies which have been subjects of interest within the past years.

Recent developed military systems consist of equipment which is more and more sophisticated and relying on electronics. Very high importance of electronics within the military systems is obvious from development of Network Enabled Capabilities (NEC) which is a key task of the Czech Armed Forces as well as within the NATO (NNEC – NATO Network Enabled Capability). The stage related to "Communication and information sharing" has been topical in recent years and characterised by development of communication networks. Common network infrastructure can be

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considered as a fundament of integrated NEC environment. Communication network and especially its reliability will have significant influence on mission success. Disturbance of these networks could be obviously critical.

Power electromagnetic fields can be generated by relevant power technologies and focused (directed) towards the target with electronics. Shortcuts like HPM (High Power Microwave) and UWB (Ultra Wide Bandwidth) are widely used in this area as well as HPEM (High Power Electromagnetics) and IEMI (Intentional Electromagnetic Interference). Examples of developed technologies which could be easily used like DEW against electronics are shown in Figs 2-6 (these technologies were offered or presented mainly during relevant conferences in past few years, radiated pulse power was hundreds of MW or higher in frequency range of microwaves).

Fig. 1 Humvee with ADS (Active Denial System) mounted [1]

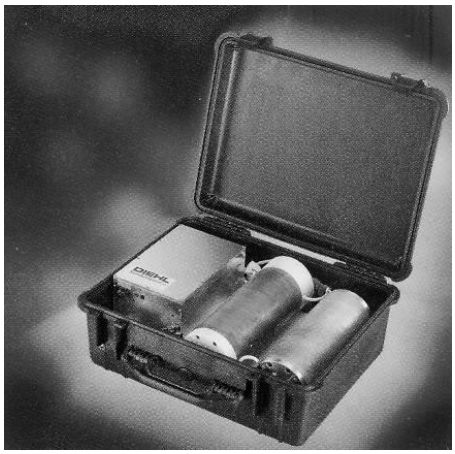

Fig. 2 HPM system DS-110 (built in suitcase, pulse power 250 MW [2]

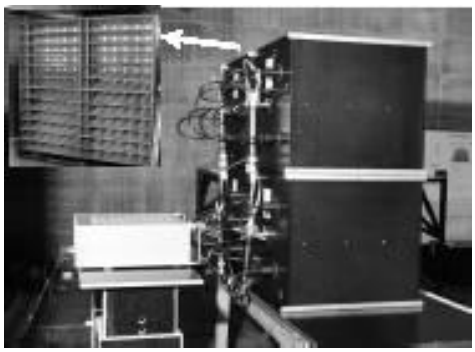

Fig. 3 HPM system with antenna array [2]

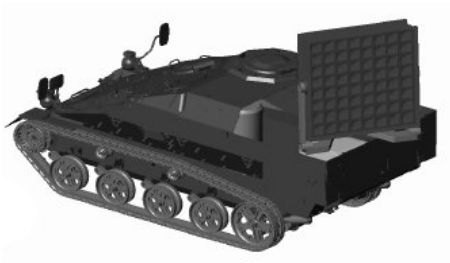

Fig. 4 HPM system with antenna array installed on a tank [2]

Fig. 5 Electromagnetic System for Selective Car Stopping [2]

Fig. 6 JOLT hyperband system, UWB system [3]

2. Electromagnetic Threats

As it was mentioned in the introduction an important group of DEW technologies, non-lethal technologies, was represented by weapons with use of power electromagnetic field destructive effects.

Next electromagnetic environments are typically considered related to DEW (see Fig. 7):

- HPM: High Power Microwaves, narrowband signals in frequency range from hundreds of MHz up to several GHz, electromagnetic strength at the place of target typically up to tens of kV/m (strong dependence on range).
- UWB: Ultra Wide Bandwidth, pulses with rise time typically in hundreds of picoseconds and with duration of several nanoseconds, electromagnetic strength at the place of target typically up to tens of kV/m (strong dependence on range).

Because HPM and UWB environment is strongly dependent on range and moreover these environments may have a wide variety of wave shapes, their standardization is very difficult. Now there are only few standards which describe HPM and UWB environment generally (e.g. IEC 61000-2-13 [4]). A possible approach is to consider various types of HPM and UWB environments that have been produced and to consider their possible use in the future against sensitive targets. It is always necessary to make relevant analysis of electromagnetic threat where the shortest possible distance from HPM or UWB source is a very important parameter.

2.1. Electromagnetic Strength Assessment

As a typical possible scenario can be considered HPM (UWB) source with real pulse power $P = 1$ GW and as a worst case special antenna with extremely narrow radiation pattern ($G = 40$ dB, respectively $D = 8\,750$). Now the expected electromagnetic strength at the place of threatened equipment (system) can be calculated according to next Eq. (1)

$$E = \frac{\sqrt{30PD}}{r} \tag{1}$$

where P is radiated power, D is directivity of antenna, r is a distance of threatened equipment (system) from radiating antenna.
Note: Eq. (1) is valid only for direct propagation where reflections are neglected. This simplified equation is usually used for the microwave area and short distances.

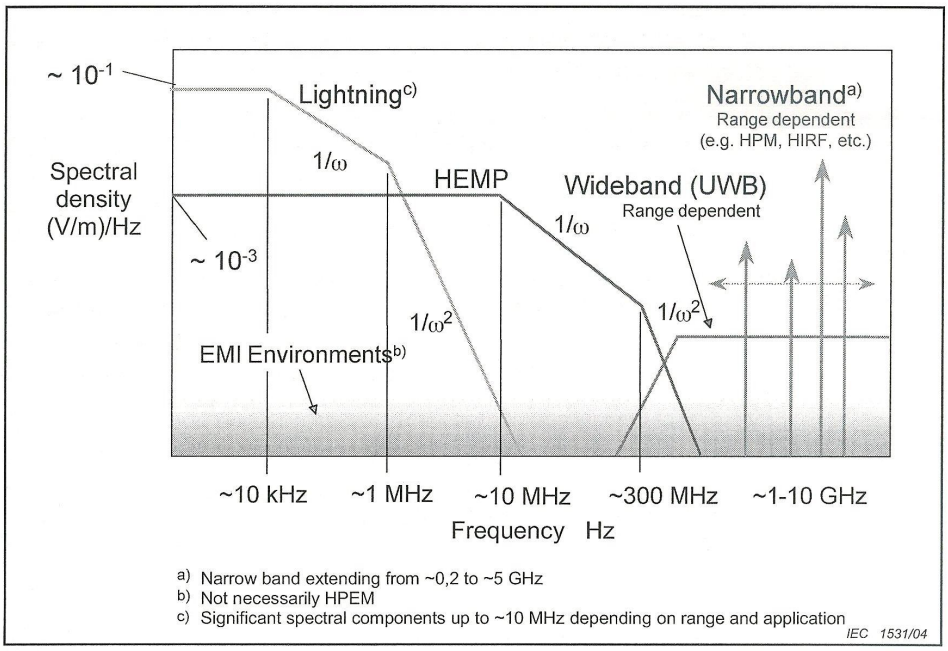

Fig. 7 HPM and UWB comparison with other electromagnetic threats [4]

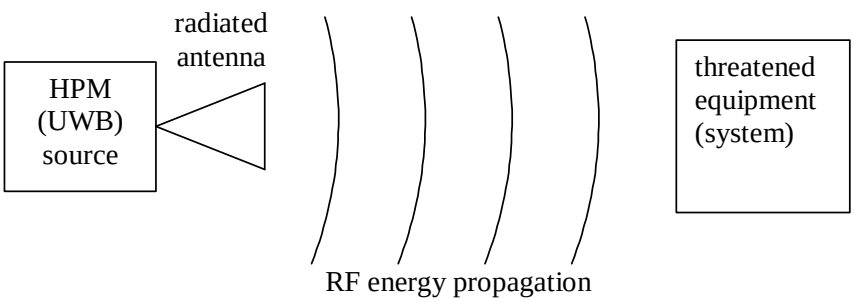

Fig. 8 RF energy propagation from source (HPM or UWB) to equipment (system)

It is obvious from Eq. (1) that for most cases (distance of directed energy weapon from equipment (system) is generally tens of meters), it is possible to consider electromagnetic strength up to tens of kV/m.

2.2. Critical Frequencies Assessment

It is very useful to consider transfer function (T) of investigated equipment (system) for critical frequencies assessment. Transfer function T_O (outer) is combined with T_I (internal) to form a composite transfer function from incident fields to response box inputs in Fig. 9 [5]. Note: T_O typically corresponds to relationship between incident electromagnetic field and surface current and charge densities on the outer surface. T_I corresponds to transfer function from the surface current and charge densities on the outer surface to some interior port of interest, producing voltage and current waveforms there.

From Fig. 9 it is obvious the most important part related to critical frequencies of considered system (equipment) is band 2 – resonance region. It is possible to use first of all analysis where sizes of equipment (system) as well as used cable lengths are considered and next it is important to make relevant measurement of transfer functions (shielding effectiveness of used boxes, induced currents and voltages etc.) for transfer function (T) assessment.

Considered frequency spectrum is divided as follows [5] (see Fig. 9):

Band 1: $f \le f_l \approx \dfrac{c}{4l}$ (aperture and small antenna coupling region),

Band 2: $f_1 \le f \le f_h \approx \dfrac{5c}{l}$ (resonance region, external and internal),

Band 3: $f_h \le f$ (integration region),

where l is characteristic dimension of the object, c is speed of the light, f is considered frequency.

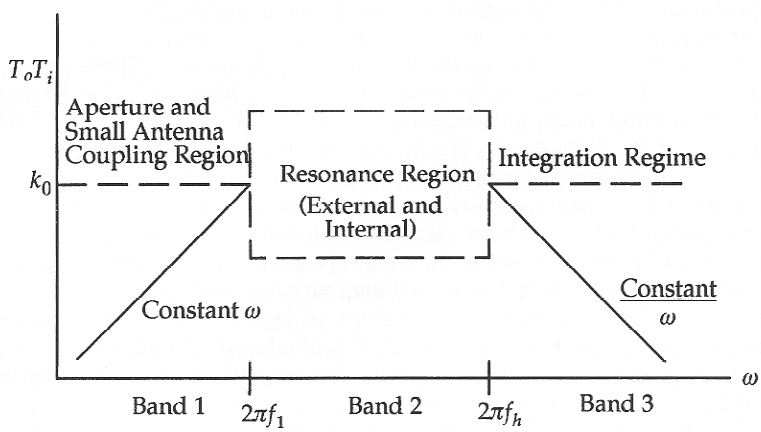

Fig. 9 System response as a function of frequency (logarithmic scales) [5]

3. HPM and UWB Impact on Electronics

Electronic systems can be affected by high intense electromagnetic fields causing the disturbance or even the permanent damage of the system. According to relevant EMC (Electromagnetic Compatibility) standards next performance criteria are usually used:
A - normal performance within the specification limits

B - temporary loss or degradation of function (self-recoverable)
C - temporary loss of degradation of function, which requires operator intervention or resetting
D - degradation or loss of function which is not recoverable due to damage of equipment (components) or software damage

On the one hand performance criteria are a very important parameter on the other hand consequence of IEMI (Intentional Electromagnetic Interference) attack has to be considered too. For consequence scaling it is possible to use for example such terms like "very limited", "limited", "severe", "very severe" and "catastrophic" [6].

4. Vulnerability Assessment

First of all it is necessary to make analysis where electromagnetic threat assessment is done (see chapter 2). Moreover it is necessary to consider criticality of relevant system (consequences – see chapter 3). Finally testing plan and testing can be prepared. The best way is to start with transfer function measurements (shielding effectiveness measurement, induced currents and voltages measurement) which is possible to carry out in wide frequency range up to few GHz or higher. After that it is necessary to choose possible critical frequencies according to transfer function measurements and according to analysis. Chosen frequencies can be used for final high power electromagnetic field measurement with HPM and UWB simulator use. Possibilities of these simulators are restricted to parameters which cannot be changed or changing these parameters takes too much time. Due to this fact it is necessary to choose suitable parameters according to analysis and transfer function measurement results for this testing. The data gained from analyses and testing has to be considered together with possible consequences which can occur. Such data can be used for vulnerability assessment.

5. Practical Results

A lot of experiments related to electronic equipment vulnerability have been carried out in previous projects within the last few years.

Transfer function measurements were carried out for better understanding of electromagnetic field coupling into relevant cables. Tested cables were irradiated with electromagnetic field with vertical polarisation and induced voltages were measured in frequency range 30 MHz to 1 GHz. It was low power measurement, electromagnetic strength of incident electromagnetic field was 1 V/m and measured results were recalculated for expected high power electromagnetic field 10 kV/m. Mainly cables which are widely installed in computer technologies were used for the purpose of these experimental measurements. Few examples are shown in Figs. 10-12. It is possible to expect induced voltage levels on regular widely used cables approximately up to 1 kV during electromagnetic field incidence with electromagnetic strength 10 kV/m on the basis of presented results. The highest induced voltages occur when the length of cables is comparable with wavelength of used signal (resonant region, see Figs. 10-12). For lower frequencies as well as for higher frequencies induced voltages are becoming lower.

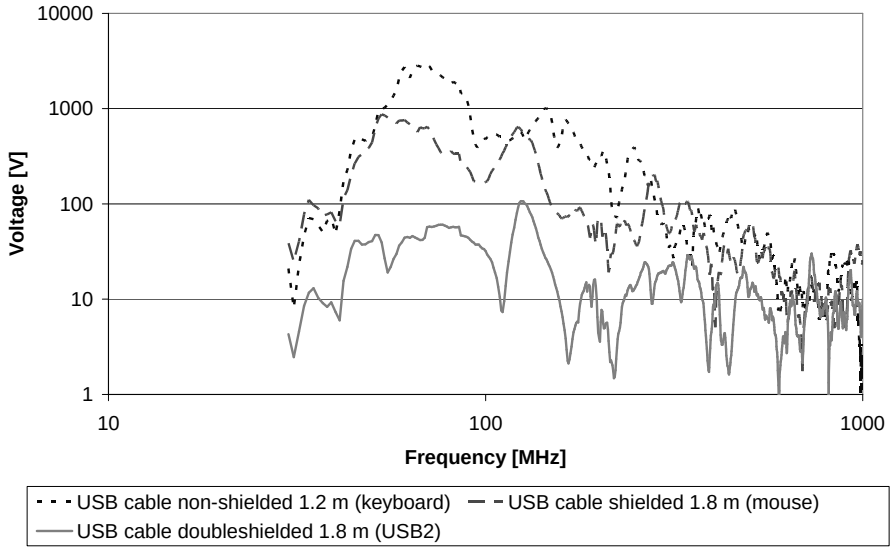

Fig. 10 Induced voltages on USB cables for electromagnetic strength E = 10 kV/m

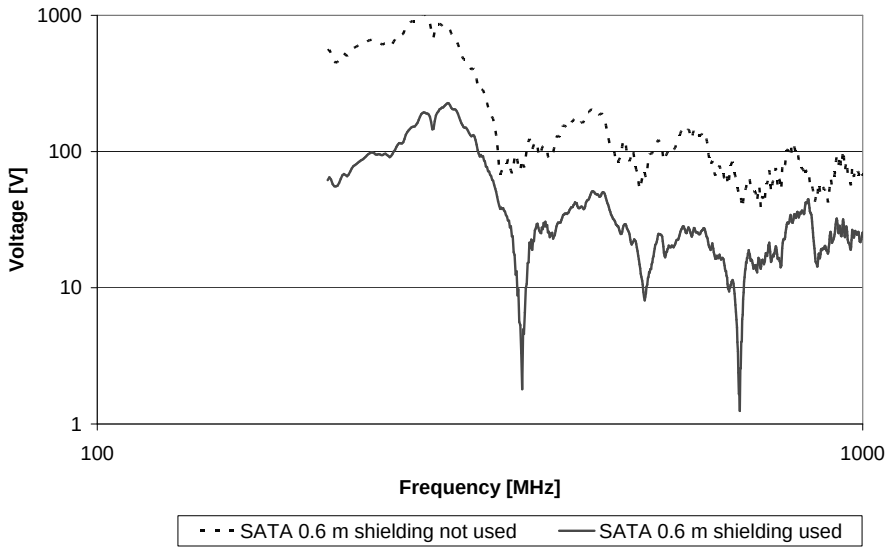

Fig. 11 Induced voltages on SATA cables for electromagnetic strength E = 10 kV/m

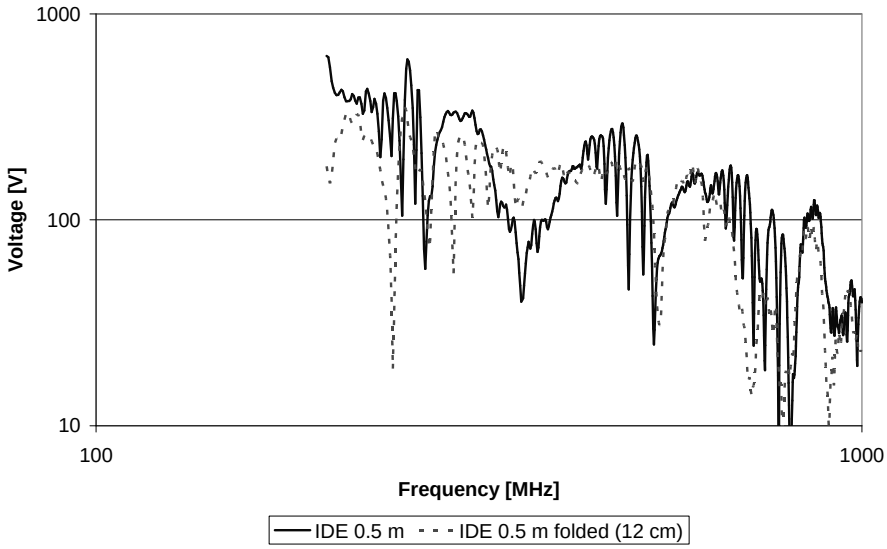

Fig. 12 Induced voltages on IDE cables for electromagnetic strength E = 10 kV/m

Other kinds of experiments in this area are testing with high power electromagnetic field irradiation of possible "targets" and evaluation of effects which can occur.

Some examples of tested setups are shown in Figs 13-15. It was verified that HPM signals can be used for stopping the car engine (see Fig. 13, HPM generator working on frequency 3 GHz with pulse power 500 kW was used for this experiment in shielded semi-anechoic chamber) as well as for effective disrupting of computer technologies and data transfers (see Figs. 14-16). Standard performance criteria (see chapter 3) are usually used for the evaluation of effects. From experiments which were carried out it was obvious that electromagnetic strength of few kV/m can be enough to achieve effective disturbance on electronics.

Repetition rate as a parameter of HPM and UWB signals can have an influence on some kind of temporary failures (see Fig. 16). Overview of immunity of some equipment to HPM and UWB signals is shown in Fig. 17. Typical electronic equipment was tested against effects of HPM 3 GHz, 6 GHz, and 9 GHz signals with pulse widths in hundreds of ns, repetition rates in hundreds of Hz and against effects of UWB signal with rise time of 0.5 ns, pulse duration of 3 ns in single shot regime. The most effective signal to disturb electronics from used ones was HPM 3 GHz. Very often the sensitivity level was very close to damage level (see Fig. 17). For UWB signal it was more typical to achieve temporary failures (sensitivity level) rather than some kind of damage. The results from testing showed the most vulnerable parts of recent systems are computer technologies including data transfers.

Fig. 13 Stopping the car engine with HPM irradiation use (HPM 3 GHz)

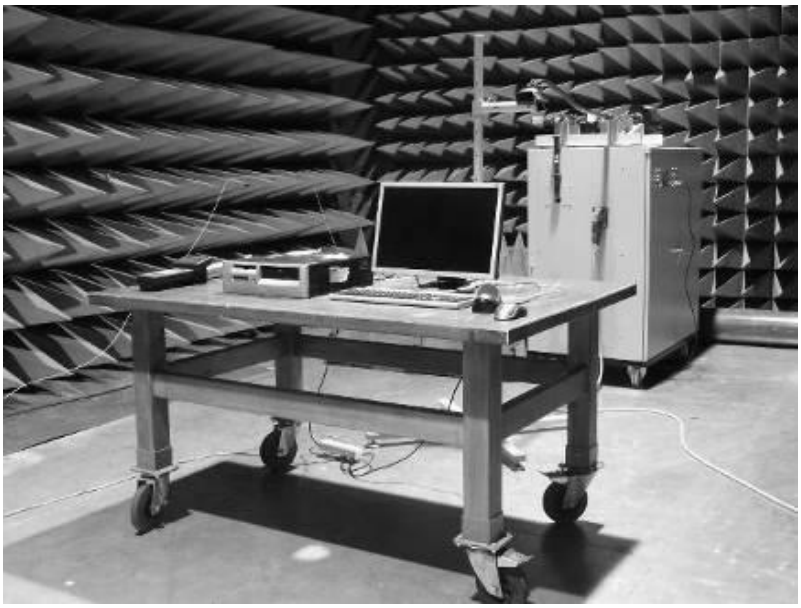

Fig. 14 PC setup irradiated with HPM 9 GHz

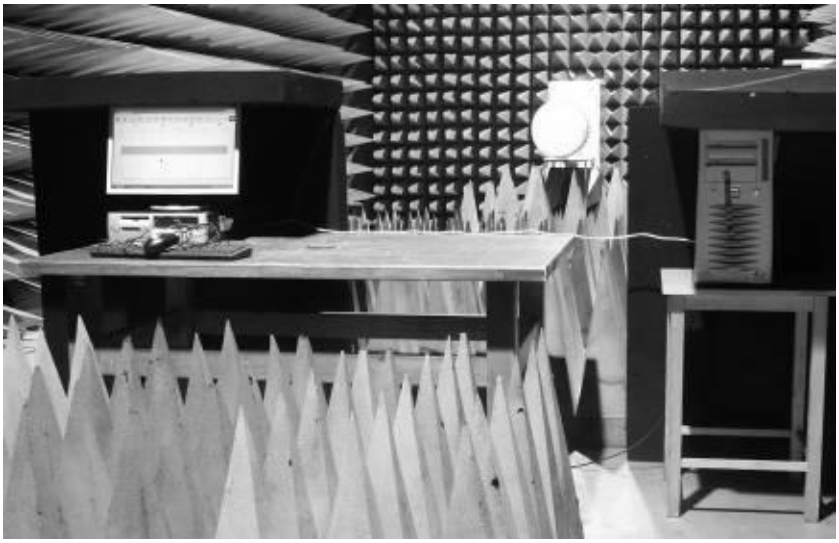

Fig. 15 Data transfer through UTP cable irradiated with UWB signal

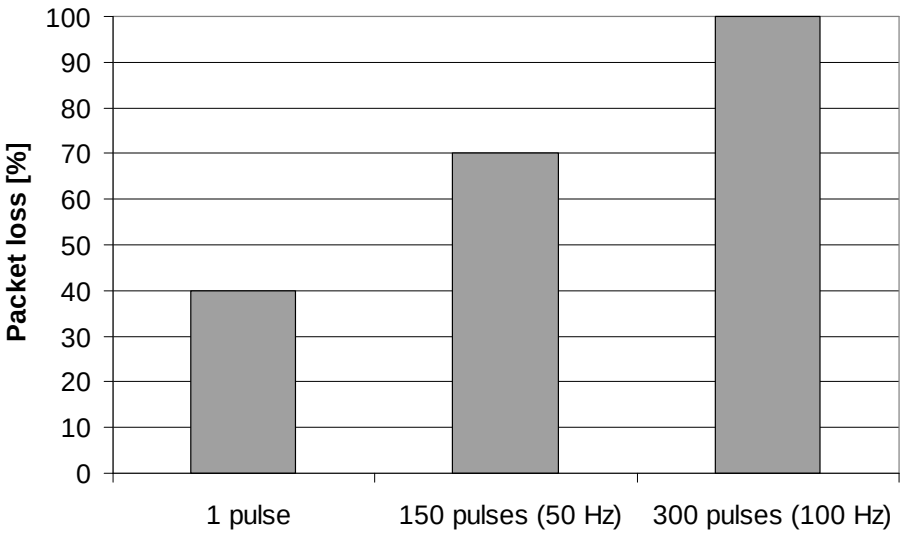

Fig. 16 UTP 2 m irradiated with UWB

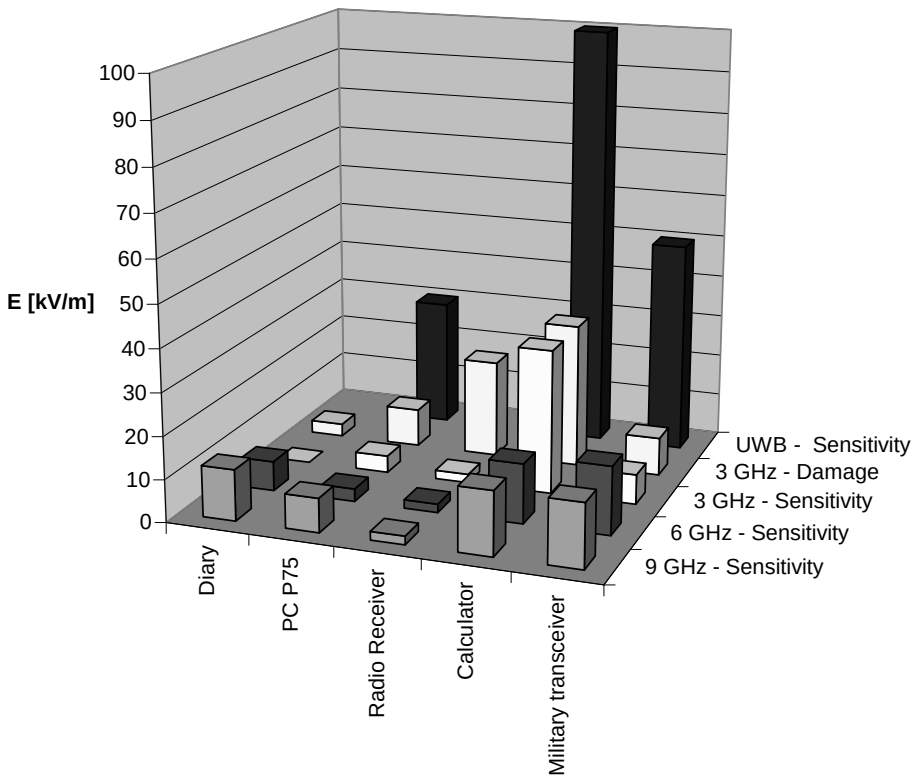

Fig. 17 Sensitivity and damage levels comparison for tested equipment against HPM and UWB effects

6. Conclusion

Electromagnetic threats HPM and UWB as a part of DEW technologies were briefly defined in this paper. Electromagnetic threats assessment as well as vulnerability assessment was introduced. Vulnerability of chosen tested equipment was presented on relevant examples. It was demonstrated that electronic equipment was vulnerable due to electromagnetic field irradiation. In case sensitive electronic equipment is used in crucial applications it is necessary to evaluate vulnerability of the system to such threats.

Gained results in the past have lead to starting a new project for the Ministry of Defence of the Czech Republic (OSPROZ-DEW1) focused on the assessment of vulnerability of weapon systems and parts of communication and information systems integrated in NEC which are installed to ordnance of the Army of the Czech Republic now. Assessment will be carried out on the basis of relevant analyses as well as relevant experimental measurements. The project started in 2009.

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Acknowledgement

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will be available to treat and possibly cure diabetes, hemophilia and other life-threatening and chronic illnesses.

Space manufacturing will develop the new metal alloys needed for high-temperature processing using advanced nuclear and fusion energy sources. Larger and more perfect crystals for the electronics and other industries will be produced.

By themselves, these new industries created by exploiting the unique environment of space, "pay" for the NASA programs. But the indirect impact to the economy has been even greater, and more important. These are the so-called "spin-offs" from space exploration which have been developed by industry using technological breakthroughs funded by NASA.

New materials, such as refractory ceramics and new alloys which withstand the temperature extremes of space flight, are used in everything from nuclear power plants to everyday kitchen implements. Developments in electronics, including miniaturization and sophisticated automation techniques, have streamlined the functioning of industry and shortened the time (thereby increasing the productivity) of almost everything we do.

The machines that monitor all of the vital bodily functions of the astronauts who walked on the Moon, now monitor premature infants in incubators, and have provided heart monitors and miniaturized pacemakers for thousands of people.

The same qualitative impact, magnified many times, will result from the development of beam weapons combined with the recommitment of the civilian space program to establish a permanently manned station in space toward the goal of colonizing the Moon and other planets.

However, studies done by Chase Econometrics and confirmed by independent studies using the Fusion Energy Foundation's econometric model show that there is a much greater impact that the development of a qualitatively new technology has on an economy. This impact is, strictly speaking, not measurable by adding up all the new products and new techniques that a new technology introduces; it is the *increase in productivity* throughout the economy as the result of the combination of higher manpower skill levels and new scientific knowledge entering industrial production. One study of this induced productivity effect estimated that U.S. productivity increased 0.1 percent for every billion dollars spent on the space program. This change in productivity alone represented an additional $3 billion to the GNP every year it was present. An interesting comparison is possible between the expenditure of a $1 billion aliquot of the federal budget on a high-technology R&D oriented program (like the Apollo program or the development of a beam weapon) and its expenditure on transfer payments, bureaucratic services, or the like. The Chase Econometrics study showed that the expenditure of this money on high-technology R&D actually *lowered* inflation, while the other expenditure had the opposite effect, raising inflation by 0.2 percent.

Four types of directed-energy weapons

by Mary McCourt

In his *EIR* multi-client report, *Beam Weapons: The Science to Prevent Nuclear War,* Dr. Steven Bardwell describes the types of beam weapons on line for development. Each type, laser beams, particle beams, microwave beams, and plasma beams, is, Bardwell states, "in principle capable of generating the required power and energy [to reach and disarm its target] in a form efficiently absorbed by the missile." A beam weapon effectively disarms a nuclear warhead. A hydrogen bomb can be detonated only by an initial powerful atomic-bomb explosion capable of setting off a chain reaction in the lithium-deuterium fuel. A beam weapon, by pumping energy into the very delicately balanced triggering mechanism, prevents the initial explosion and essentially turns the warhead into a "dud." The missile, like a satellite, might fall to the earth, but it can no longer be detonated.

Scientists agree that laser-defense battle stations, even with the lowest level of laser-beam technology, can be defended from other beam weapons themselves. But a missile cannot be effectively defended from the beam without such massive protection that it would lose both the necessary speed and distance.

Laser-beam weapons

Laser beams, particularly the chemical laser, will likely be the first deployable beam weapons developed. A laser is a beam of very intense, single wavelength electromagnetic waves, either of light or high energy X-rays. Such a weapon can be focused very precisely because either the light or X-ray wavelengths all have the same frequency and phase. The five different types of lasers, which can be applied to fusion energy as well as beam weapons, are all being researched at U.S. laboratories.

The **chemical laser,** which could be developed for military deployment within five years, uses a gaseous medium in which a chemical reaction is induced. The product of the reaction emits laser light. The Soviet Union used such a laser last year in tests that downed a ballistic missile.

In a **gas laser,** a burning gas such as a hydrogen and fluorine mixture is suddenly compressed, and the energy distribution that results from the compression is then stimulated to emit single-frequency light waves at very high energy. Both the United States and Japan are currently using huge gas lasers for nuclear fusion development.

An **electron discharge laser** uses replaceable energy

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from an electron beam to create the source of laser light. Such a laser would be very efficient for use in space because its energy source is electricity, not an exhaustible chemical fuel.

Two other types of lasers, **X-ray lasers** and **free-electron lasers,** yet to be perfected technologically, have greater advantages of energy density and flexibility than those listed above. The **X-ray laser** is widely recognized as the most promising long-range laser for ballistic missile defense, based in space. The X-ray laser, which is just a single pulse, is by far the most energy-dense, delivering thousands of times more energy per pulse than conventional lasers. In addition, the target absorbs the X-rays very efficiently, making this weapon capable of very efficient destruction of missiles.

Particle-beam weapons

Particle beams also deliver energy in a highly controlled pulse traveling at near the speed of light. But instead of a pulse of intense electro-magnetic radiation, the particle beam consists of **subatomic particles, (electrons** or **protons), neutral atoms** (usually hydrogen), or (usually magnetized) **macroscopic particles** accelerated to high speeds. A particle beam destroys its target, the triggering mechanism, by creating a very intense shock wave within the mechanism, like a very small, but extremely heavy and powerful hammer striking down on the target.

Electron beams can be generated in the range of millions of volts. Scientists researching the electron beam for military or civilian energy use have discovered that the electron beam becomes a complex structure of electrons and a magnetic field. Such structured beams are capable of carrying higher currents and more energy for much longer distances at much great levels of power output.

Proton beams, which have been researched intensively for the past 30 years, use an electron beam as a seed and then are accelerated in their own right. As protons are 2,000 times heavier than electrons, a proton beam of the same velocity has 2,000 times the energy of an electron beam.

Neutral particles eliminate many of the problems of charged-particle beams, which can degrade both the efficiency and controllability of the beam. By spring of 1983, U.S. researchers will have produced a beam of protons at an energy of 2.5 million electron volts, capable of traveling at 99 percent of the speed of light.

Control and targeting of a **macroscopic particle beam** would be more difficult, but the unparalleled power density of the beam—due to the large mass of the particles—gives it great potential as a beam weapon.

Microwave and **plasma beams** have only been discussed in the United States in the past two years, although it is estimated that the Soviet Union is two or three years ahead in the production of microwaves. Intense, directional microwaves are generated when electron beams are propagated at or near the speed of light through a plasma. Such beams, if focused, could destroy delicate electronic equipment in a target.

A plasma beam consists of the highest energy-dense form of matter, a gas so hot that the electrons and neutrons have separated. The plasma forms itself into a complex structure of particles and magnetic fields. The unique feature of a plasma beam is that it actually requires the atmosphere, which hinders the guidance and propagation of other beams, to hold in the plasma and sustain the structure.

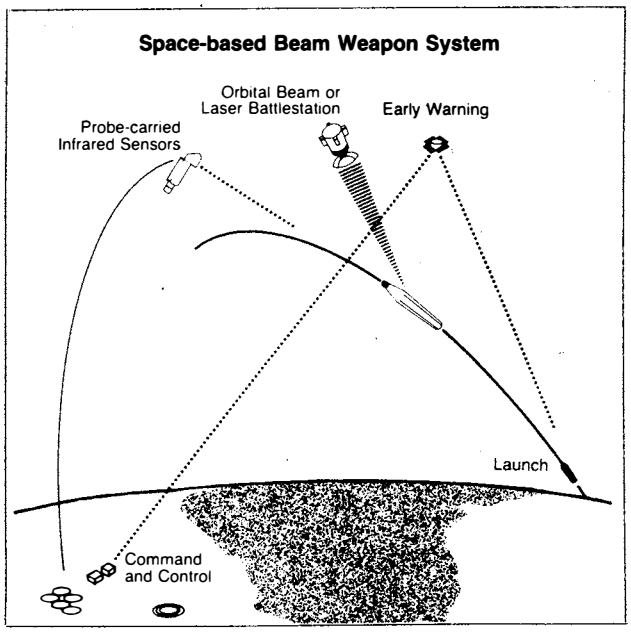

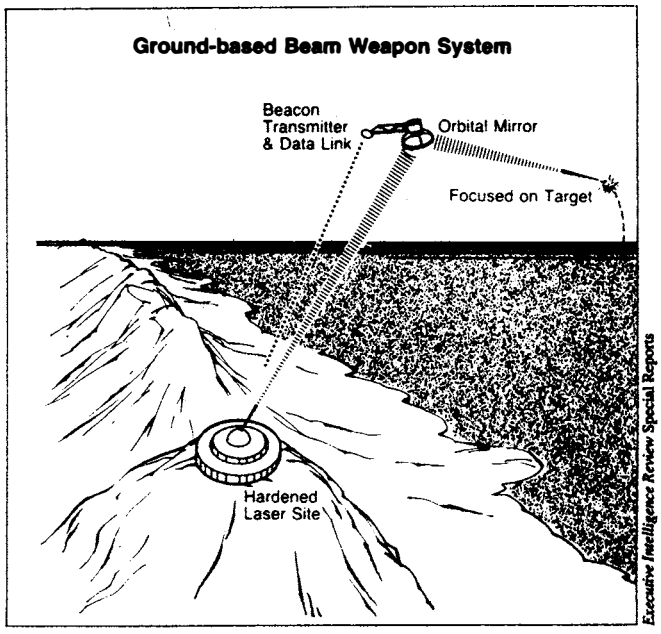

Space-based beam weapons, (left) provide the only feasible means for area defense against nuclear-armed ballistic missiles. The deployment of a weapon capable of generating an intense beam of laser light, atomic particles, or plasma, in an orbit around the earth, would protect the entire United States from incoming ballistic missiles. **Ground-based beam weapons** (right) can provide both area and point defense. Shown here is a conceptual design of a laser beam-weapon system built on a mountaintop, which uses a relay mirror to provide aiming and tracking for the weapon.

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ELECTROMAGNETIC DIRECTED ENERGY WEAPONS FOR ELIMINATING ELECTRONIC SYSTEMS

Capt. Dipl. Eng. Jan VALOUCH

Annotation:

The article presents information on the current situation in the development and application of electromagnetic weapons and indicates possible trends of their future employment. Under the term electromagnetic weapons we understand means and systems that use technology generating directed power electromagnetic pulses degrading the activities or destructing the electronic circuits of the enemy equipment. This will also enable to neutralize or completely destroy the operation of information, communication, control, firing and other electronic devices. Electromagnetic weapons are currently in use and greater number of countries realizes the perspectives of their future development.

✶✶✶

1. CURRENT SITUATION OF DEVELOPMENT AND USE OF ELECTROMAGNETIC WEAPONS IN FOREIGN COUNTRIES

Principle of electromagnetic weapon activities

Typical representative of electromagnetic (EMC) weapons are so called **Directed Energy Weapons** (DEW) employing the technology of **High Power Microwave** (HPM). These weapons represent highly sophisticated technology of 21st century. Their destructive effect results from the electromagnetic field and they threaten the operation of all devices equipped with electronic circuits, especially by the effect of arcing, overload or by discharge of single electronic component parts. These weapons have strong physical and psychological impact.

In general, DEW consists of impulse source of energy, source of microwave radiation and antenna. The impulse source transforms accumulated energy to high power electric pulse with the length of duration in units of nanoseconds. Accumulated energy can be in kilo-Joule with the power of gigawatt. In the source of microwave radiation

this impulse then acts upon diode and generates a beam of electrons with energy – approx, 400 kV, 10—60 kA. This energy is dissipated by the directional antenna.

Electromagnetic weapons can fundamentally differ in terms of its design and application e.g. according to the used frequency band. EMC wide band weapons emit in wide frequency range but with low density of energy. These equipments are suitable where it is not possible to exactly identify the characteristics of the target – especially its working frequencies. Contrary to the narrow-band EMC weapons emit pulses on individual frequencies with enormously high power. Their action upon the target is very effective since impulse resonate with the known frequency of the attacked device.

Development and application of electromagnetic weapons

Concerning a development and application of electromagnetic weapons we can say that after the EMC weapons emerged from "the unknown" world of classified projects, now they are tuned and EMC weapon capability is enhanced. And they are gradually mounted on suitable carriers – vehicles, aircraft, ships, bombs, missiles and even space ships. The interest is focused not only on single pieces of equipment but also on complete systems incl. sensors and equipment to control the combat functions.

Within the armed forces the employment of EMC weapons have the following advantages:

- very rapid effect against the enemy targets,
- usage irrespective of the weather conditions,
- coverage of a great amount of various targets with minimum need to be informed about their characteristics,
- threat to less available target – under ground,
- operational attack (neutralization, destruction or denial of activities of electronic assets) at selected levels of warfare,
- minimum of collateral destruction in politically sensitive environment and use of this environment after the end of conflict,
- reduction of minimum time for tracking and guidance to target.

USA, Russia, France, China and UK are the countries that achieved the greatest progress in the development and application of electromagnetic weapons. The interest of other countries (Germany, Belgium, the Netherlands, Denmark, Norway …) is for a long time focused on High Power Microwave (HPM) especially on protection against the effects of HPM. As to my opinion this is the beginning of the path for research in the Czech Republic.

Currently, discussions are held on their employment in Iraqi by the U.S. armed forces. They could facilitate quickly eliminate the command and control systems of Iraq and eliminate communication of their forces without any loss of lives and any collateral damage. There were some intentions to employ these weapons of electromagnetic warfare by the U.S. force in Kosovo and Afghanistan at least in trial operation. It is

also interesting the assumption that Russian forces used DEW prior the action against terrorists in Moscow theatre in 2002. This weapon was designed to disable the electronic detonating primers. The fact is that no Chechen managed to initiate her primer.

Misuse of electromagnetic weapons

More frequent are the attacks of terrorists and criminal underworld using the electromagnetic means. Among the targets of terrorists can be financial institutions, medical facilities, aircraft, automobiles, computer network and other daily used civilian and military equipment. The EMC radiation generators can be for example in the briefcase and that is why it is quite easy to prepare such an attack. First known terrorist application of electromagnetic weapons is from 1995 when Chechen rebels used this technology against the security system of Russian facility.

Nobody knows about the use of DEW for criminal activities and terrorist attacks with exception of the offenders themselves and their victims. The German experts even officially recommended application of these means to the German police units since there were recorded several cases of use of DEW by the German underground. With DEW it is possible to commit perfect crime, as they leave no evidence. No doubt, in future a wide use of these weapons can be expected which can means an increased risk of their misuse.

Future of electromagnetic weapons

Future of DEW is often discussed in many articles and literature. A part of study called Air Force 2025 also deals with the future of DEW employment that was developed by the Air University Maxwell Air Force Base, Alabama. This study discusses a possibility to employ these means in the spaceships or satellites in order to destroy the hostile satellite information and communication channels.

Development of DEW in terms of their employment is mainly connected with mutual co-operation of the army, air force and navy forces. These will be the components that are the potential users of DEW. Protection of the aircraft and ships against the effects of enemy DEW is being solved. Further, e.g. active use of DEW against the air defense and employment of DEW in the aerospace. Within 3—5 years it is expected that DEW will be installed into the drones (USA). In respect of technologies for DEW, the research will be especially focused on increase of input power of DEW, reduction of size and weight and improvement of antenna systems. A very interesting is also a research of biological impact of DEW on human being and hazard for the personnel.

2. CURRENT SITUATION IN THE AREA OF ELECTROMAGNETIC WEAPONS IN THE CZECH REPUBLIC

The following part of this article briefly discusses NATO RTO – Research and Technology Organization (http://www.rta.nato.int), or the activities of selected panels with representation of the Czech Republic and which deal with the mentioned issue.

The panels dealing with this topic are:

- SCI–119 Tactical Implications of High Power Microwaves,
- SCI–132 High Power Microwave Threat to Infrastructure and Military Equipment.

Since most of activities of these technical panels is classified as NATO SECRET, only general character information not subject to classification are provided.

Panel SCI–119 Tactical Implications of High Power Microwaves started its activities in 1998 and terminated it in this year. The objective of the work of its members have been mainly solution of issues of use of HPM in the military sector both in terms of defense as well as of potential active employment in attack. The most important areas solved:

- design of resources generating HPM,
- vulnerability of information technology of military infrastructure,
- risk of back effect of electromagnetic weapons on friendly troops,
- testing of HPM effects on the off-the-shelf equipment equipped with electronic components (personal computers, cellular phones, vehicles, aircraft …),
- content of HPM national programs from the viewpoint of:
  - earmarking of specialized workplaces,
  - refinement of the content of solution in the given country,
  - allocation of funds,
  - planning of the number of students studying HPM at the universities,
  - gathering of results.

The issue of HPM is solved by NATO systematically since the beginning of 80-ies of the last century. In the short time, it is assumed that new advanced HPM weapons will be developed and within NATO this process must be systematically controlled. In this area – development of electromagnetic weapons – USA, Russian, France and the UK have the greatest success.

Panel SCI–132 High Power Microwave Threat to Infrastructure and Military Equipment commenced its activity by the introductory session in October 2002, held in Munster in Germany. Its orientation is linked to the preceding activity of the Panel SCI–119. The main activities of the Panel are planned for the period of 2003—2005 and single members will deal with the following issues:

- identification of potential threat of HPM on the military and civilian infrastructure and equipment,

- research of the penetration and dissemination of HPM in specific devices,
- research of DEW (Directed Energy Weapons),
- possibilities how to protect the military equipment against the effect of weapon assets on the basis of HPM.

Other areas considered important by the member of the Panel SCI–132 and that are to be in the area of interest are:

- resistance of military equipment against HPM,
- implication of HPM in the military field test and system of their evaluation,
- EMC terrorism.

The Panel consists of representatives of the following countries: Canada, Czech Republic, Denmark, Germany, France, UK, USA, the Netherlands, Norway and Italy.

CONCLUSION

Currently, the use of electromagnetic weapons plays the more important role. Though, the wider employment of these weapons is expected within 5—10 years, there already exist and are used the devices/equipment capable to reliably effect on the enemy electronic assets (control, information, communication…) and deny the enemy any further operations. The issue of electromagnetic weapons in the Czech Republic is in the stage of research and that is why the representation and involvement of the Czech representatives in the special Panels of NATO RTO or any other international organizations and boards is desirable.

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James Madison University

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High Power Electromagnetic Weapons: A Brief Tutorial

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High Power Electromagnetic Weapons: A Brief Tutorial

George H. Baker

Background. High power electromagnetic weapons, also referred to as high power radiofrequency (HPRF) weapons, are a type of directed energy weapons. The system effects of high power electromagnetic environments are well recognized by world scientific and military communities. Former CIA Director John Deutch has said that, "the electron is the ultimate precision-guided weapon." In the course of the investigation ofnuclear EMP effects on electronics during the Cold War period, it became evident that garden variety, unprotected electronics would malfunction, in some cases burn out, in the presence of electromagnetic fields in the hundreds to thousands of volts per meter. The EMP experience has led to the development of non-nuclear high power electromagnetic sources to create fields that equal or exceed EMP levels, albeit over relatively small ranges. Achievable electronic effects could have serious consequences in terms of interruption or termination of critical system operation. The effects are of particular interest to the military in the context of information warfare and missile defense. Because most critical infrastructures are controlled by electronics, HPRF weapons are a concern for civilian systems as well. The weapons could be used to disrupt computer electronics controlling electric power grids, telecommunications networks, financial institution databases, security systems, and aircraft.

Military forces in many countries are pursuing the development of HPRF weapons. These programs are normally classified. HPRF weapons represent a revolutionary concept because they operate at the speed of light, can be used covertly, and harm equipment rather than humans (non-lethal). HPRF weapons may be enclosed in briefcases, packing containers, truck beds, or aircraft and maneuvered to expose critical military or infrastructure systems.

Electromagnetic Weapon Characteristics. There are three elements to be considered in discussing HPRF weapons systems: the weapon itself, the propagation of the weapon output to the target, and the target response (see Figure 1).

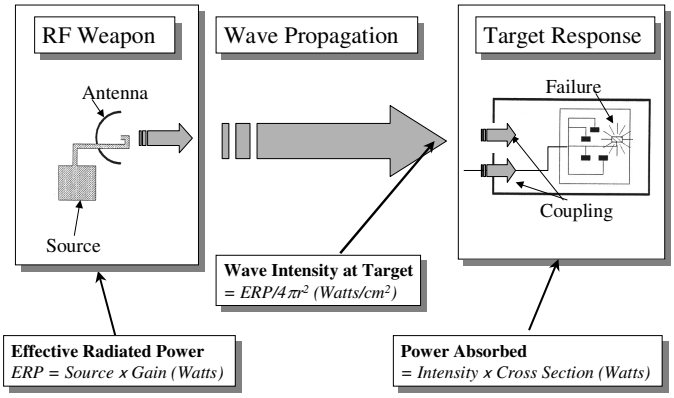

Figure 1. High Power RF Weapon Operation Elements

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Weapon Design. An HPRF weapon consists of a power source, or driver and a radiating antenna. The source is normally pulsed. Outputs may be sine waves (providing a narrow frequency band signal) or pulses (providing a wide frequency band signal). High power electromagnetic source technology includes electron beam devices (magnetrons, vircators, gyrotrons, backward wave oscillators), solid-state devices (bulk avalanche, optical switches, silicon carbide circuits) and explosive generators (magnetic flux compression using high explosives). Output power levels in the gigawatts are feasible over a wide range of frequencies. Design details will determine output characteristics. Power, frequency, bandwidth, repetition rate, and duty cycle are the important HPRF weapon output parameters.

The HPRF weapon source must be connected to an antenna with sufficient gain to "beam" the RF energy to a useful range. Portability requirements impose major limits on antenna area which in turn largely governs the maximum intensity (power per area) that can be delivered to a target system at a given range. Compact sources that may be moved covertly in briefcases, packing containers, truck beds, or aircraft and maneuvered for close-up exposures of critical military or infrastructure systems are of most interest. Antenna size limits largely determine the maximum intensity (power/area) that can be delivered to a target system at a given range. A table of approximate relative portable platform sizes is provided below.

Table 1. Portable Platform Size Comparisons (Approximate)

Capacity: Platform:	Volume	RF system Weight	Basis
Briefcase	0.02 m^3	5 kg	Typical hard side
Footlocker	0.15	40 kg	1 person portable
Pickup truck	4 m^3	1000 kg	1 ton capacity
Econoline van	8 m^3	2000 kg	Bed volume
Tractor trailer	80 m^3	20,000 kg	20 ton capacity

High Power Electromagnetic Wave Propagation. Electromagnetic waves propagate at the speed of light through the atmosphere. Under most conditions, the atmosphere will not attenuate HPRF waves as they travel from source to target. However, if the electromagnetic wave's peak field level exceeds the air ionization threshold a cascade process will occur in which an atmospheric plasma is created that will absorb most or all of the energy in the wave. This phenomenon is referred to as air breakdown.

A typical threshold for breakdown at sea level is approximately 1 megawatt/cm^2 . As an example, a 1 Gigawatt source radiating through a 1-foot radius circular antenna will produce an average intensity over the antenna of 0.35 megawatts/cm^2, a factor of 3 below air breakdown. Once away from the antenna, EM intensity falls off as the beam spreads (typically as $1/4\pi r^2$ where r is the distance to the target).

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The HPRF signal intensity on target depends on source transmission power (P_t), antenna gain, and range according to the following equation:

$$S_t = \frac{ERP}{4\pi r^2} = \frac{P_t \cdot G}{4\pi r^2} \frac{watts}{m^2}$$

The antenna gain may be approximated by $G \approx \frac{4\pi A_e}{\lambda^2}$ where A_e is the effective antenna area and λ is the wavelength of the radiated HPRF signal. This yields a simple formula for the intensity on target:

$$S_t = \frac{P_t A_e}{r^2 \lambda^2}$$

So, for example, a 1 Gigawatt source radiating at 1 GigaHz (λ = 0.3m) with a 1-m^2 antenna will produce a beam intensity of 11 kW/m^2 (or 1.1 watts/cm^2) on a target 1000 meters away. If the pulse duration were 1 microsecond, the energy fluence on target would be power x time or, 1.1 microjoules/cm^2.

<u>Target Response</u>. Once the electromagnetic wave signal reaches the target, its energy couples to the system in a very complex manner through various paths associated with the topology of the target system. The HPRF signal will induce currents on any external conductors (antennas, wires, etc) that penetrate to the system interior. The signal will also couple to any external metal shielding and then may reradiate to internal conductors. Signal waves will penetrate through any holes in external shielding to interior portions of the system. The main concern is the amount of energy that finds its way to critical electronic circuits, causing the system to malfunction.

To simplify coupling calculations, it is possible to determine an effective "coupling cross section" for critical internal circuits. In effect, this treats each internal circuit as a receiver. The power received by the circuit may be expressed as a simple function in incident wave power and an effective coupling cross section:

$$P_i = S_t \mathrm{A}_\sigma$$

P_i is the power induced in the internal circuit, S_t is the incident power at the system's exterior, and A_σ is the coupling cross section of the internal circuit. A_σ is a function of frequency and incorporates all the complexity of coupling including multiple paths, layers and mechanisms. There are two major coupling modes, front door and back door, as shown in figure 2.

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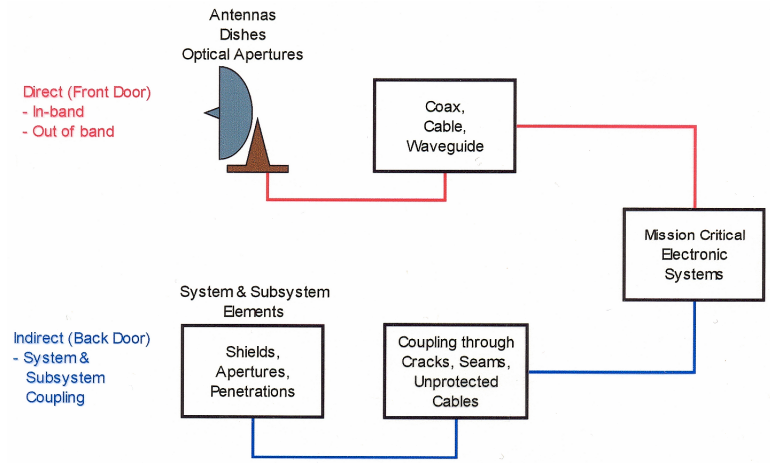

Figure 2. Front Door and Back Door Coupling Modes

The physics of front and back door coupling are the same. In each case, energy resident in the incident wave induces currents in the system that flow to a sensitive system circuit. Each can be characterized parametrically by equation $P_i = S_t A_\sigma$. The coupling cross-section, A_σ, is typically large for front door coupling and small for back door coupling. The coupling cross sections for front door coupling are of the order of the physical area of the antenna or aperture. Effective coupling cross section values for back door coupling of unhardened systems range from $10^{-4} – 10^{2}$ cm^2. Coupling cross-sections are hard to predict analytically and can be determined confidently only by direct measurement. This creates a problem for an attacker's confidence since HPRF effects are subject to much higher uncertainties than conventional weapon effects.

HPRF Weapon Effects on Systems. EMP and HPRF affect systems by disrupting the operation of electronic components either temporarily (upset or latchup) or permanently (component damage). Damage may be "direct" where energy inherent in the EMP/HPRF field is sufficient to cause malfunctions or "indirect" where EMP/HPRF energy triggers effects involving a system internal power supply. Even though the power delivered to a circuit by the HPRF field is small, the much larger energy available in the system's power supply (or fuel and ordnance) can be improperly diverted by an HPRF induced overvoltage arc or malfunction of system digital control circuit, causing major system damage.

Upset refers to an induced change of state in a digital circuit in which the system continues to operate, although possibly with erroneous data bit streams. Latchup refers to changes of state in digital circuits where the affected portion of the system ceases to operate until the system resets itself or (worse) a manual reset is required. In either case, system components are not directly damaged and recovery is often possible (depending on time criticality of affected function).

Exploitation of upset effects should not be discounted. In some cases they are tantamount to permanent damage. Upset may result in major system damage, e.g., a missile plunges into ocean due to a guidance system upset, or computer equipment is destroyed by an upset sprinkler system. Small, upset-level transient pulses can also act to

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trigger the release of energy from a system's own power supply causing components to burn out at fluences much lower than would normally cause permanent damage.

To give an indication of HPRF wave energies required to cause system effects, ITT industries (formerly Kaman Sciences) openly exposed circuit cards to 2.9 GHz microwave pulses with duration 1 microsecond. Onset of upset occurred at 1 watt/ cm^2 (equivalent to 1 microjoule/cm^2 for this pulse duration). All components were upset at wave intensities of 1000W/cm^2. Onset of damage occurred at 100W/cm^2 (for a 1 microsecond pulse, this is equivalent to 100 microjoules/cm^2). All components were damaged at wave intensities of 1000 W/ cm^2 (equivalent to 1000 microjoules/cm^2).

System Protection. System hardening involves a combination of operational and hardware techniques. Operational techniques may include the provision of spares for soft critical subsystems or boxes, disconnecting susceptible circuits upon warning, and/ or establishment of a physical keep-out perimeter (with barriers and/or security force) or zones around critical equipment to prevent positioning of HPRF weapons at close ranges. Operational controls may also be built into software to provide circumvention and reset, error-correcting codes, voting logic, and status detection. For some non time-sensitive systems, provisions for rapid system repair may be an option.

Conceptually, hardware approaches involve placing a conducting material between the incident HPRF wave and susceptible internal circuits. Hardening techniques have been successfully demonstrated and codified for EMP (ref. article on nuclear EMP). The EMP community has placed a heavy reliance on exterior shielding while limiting the number of penetrations that have to be individually protected. Such protection applied at the system exterior allows interior boxes to go untreated. This approach works well when designed in from the start. For retrofit protection, however, it is often prohibitively expensive.

Hardware approaches for HPRF protection, while conceptually similar, have some differences in emphasis from EMP. Because EMP is extremely broadband, typically only a small fraction of the energy comes through the front door in band. HPRF weapons can be tuned to the front door center frequency such that all the beam energy flows into the system. Also since HPRF weapons operate at higher frequencies, attention to smaller apertures (including cracks and seams) is required and dimensions of waveguide-beyond-cutoff penetration treatments will require changes (longer and more narrow waveguides are needed).

Front door in-band protection is one of the more challenging (but not insurmountable) HPRF protection problems. The high gains associated with most front door paths make these potentially the most susceptible portion of the system. However these well-characterized front door receive paths have received much attention in terms of protection engineering. Radar systems are often protected from their own or neighboring transmitters by a receiver protector or RP. Similar protection can be applied to communication receivers against in band HPRF environments. Table 2 summarizes HPRF hardening techniques.

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Table 2. HPRF Hardening Methods

Operational Techniques	Hardware Techniques	
	Front Door	**Back Door**
Disconnect on warning	Tuned metallic radomes	Shielding, topology control
Spares	Bandstop reflectors	Internal cable shields
Physical keep-out perimeters or zones	Antenna gain pattern control	Non corrosive mating surfaces
Software Techniques: Circumvention/reset Error correcting codes Voting logic Status detection/ alarm	Filters	Closely spaced fasteners
	TR devices/ limiters	RF gaskets and seals
	Terminal protection devices	Aperture screens and conductive films
		Selection of hard circuits and components
		Pin protection
		Fiber Optics
		Filtering, limiting at penetration points

Future Directions. HPRF generation techniques have matured to the point where practical devices have become technically feasible. Miniaturization of pulse-power source components, more efficient power supplies, and advances in electronic pulse forming, energy conversion, and antennas enable reduced size and increased efficiency of HPRF generation hardware. Simple weapons can also be built using inexpensive magnetrons from common microwave ovens.

Military trends to computerized battle management, weapons tracking, and landline/wireless network communications are a double-edged sword, introducing serious HPRF vulnerabilities. Military use of commercial off-the-shelf equipment and dependence on civilian infrastructure exacerbate the problem. Senior military officials have dropped hints about pursuing offense technology but there are no officially published details concerning weapon availability or capabilities.

Several other countries also have extensive background in the development of RF weaponry. The former Soviet Union pioneered the development of HPRF weapon technology and this technology is now being offered to other countries. According to a recent report from the Office of the US Secretary of Defense on the military power of China, "Captain Shen Zhongchang from the Chinese Navy Research Institute…envisions a weaker military defeating a superior one by attacking its space-based communications and surveillance systems…in future wars, Shen highlights radar, radio stations, communications facilities, and command ships as priority targets vulnerable to smart weapons, electronic attack, and electromagnetic pulse weapons." It is expected that in future conflicts the United States will encounter adversaries using HPRF weapons as part of asymmetric tactics to disrupt information systems.

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See also: Nuclear Electromagnetic Pulse (EMP)

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electromagnetic protection, underground testing, and standards including MIL-STD-188-125, MIL-STD-2169B, and MIL-HDBK-423. He also headed the Agency's Innovative Concepts Division overseeing the joint US-Russian space nuclear power technology, electro-thermal chemical (ETC) gun development, radiofrequency directed energy source concept development and testing, and DNA's university grants programs. Baker received the Agency Legacy Award for his leadership and innovation. He is a member of the NDIA Homeland Security Executive Board, the Institute of Electrical and Electronic Engineers, the Directed Energy Professional Society (Charter Member), and the Association of Old Crows. He is a Summa Foundation EMP Fellow and holds a Ph.D. from the U.S. Air Force Institute of Technology.

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archived as **http://www.stealthskater.com/Documents/Hamilton_04.pdf**

more of Dan Burisch is at ***http://www.stealthskater.com/Burisch.htm***

note: because important websites are frequently "here today but gone tomorrow", the following was archived from http://www.skywatch-research.org/QuantumHolographic.htm on April 8, 2004 . This is NOT an attempt to divert readers from the aforementioned web-site. Indeed, the reader should only read this back-up copy if it cannot be found at the original author's site.

The Biophotonic Quantum Holographic Matrix

by William F. Hamilton III

ABSTRACT: *This paper is an attempt to integrate studies of the quantum potential, quantum holography, biophotonics and the enveloping matrix of biointegration, biocommunication, and bioinformation that composes the web of light and life in living organisms and their possible genesis in an electromagnetic infoton.*

Introduction:

Theoretical physicist David Bohm proposed a new hidden variables theory of Quantum Mechanics. He assumes the wave function does not represent just a set of probabilities but an actual field. This field exists and acts upon particles the same way a classical potential does. Thus it is a quantum potential which is associated to this field and is a function of the wave function. It is postulated here that the quantum potential is active -- as a field -- in living cells and organisms and acts upon them.

The equation Bohm used to represent this quantum potential is:

$$U = -\sum_{k} \left(\hbar^2 / 2m_k\right)\left(\partial_k^2 R / R\right) \qquad (1)$$

Research reveals that Bohmian quantum potential is still used, but that it may only represent a means to extend Quantum Theory into a realistic theory of particles and fields.

It resolves the dilemma of the appearance -- in one and the same phenomenon -- of both particle and wave properties in a rather straightforward manner. Bohmian mechanics is a theory of motion describing a particle (or particles) guided by a wave. This guiding wave is usually attributed to atomic particles. But it might be more insightfully seen as a traveling **soliton** or vortex.

Bohmian mechanics is manifestly nonlocal, and the velocity may depend upon the positions of other -- even distant -- particles whenever the wave function of the system is entangled.

The behavior of the particle is determined by the particle's position and momentum, the wave field, and the sub-quantum fluctuations.

Bohm's quantum potential binds the entire Universe together into what he liked to call a seamless "unbroken wholeness". Every particle in the Universe is connected by the quantum potential to every other particle. He likened the cosmos to a **hologram** in which each point on the film carries information about the entire picture. Bohm's GWT -- far more sophisticated than de Broglie's crude version -- is a "holistic" vision in which all parts of the Universe are joined to every other part. "Interconnectedness"

was one of Bohm's favorite words. He saw the Universe as resembling the unity of a living organism. A kind of pantheism not unlike Spinoza's -- a pantheism Einstein himself favored." **[2]**

Bohm referred the holomovement as the basic reality. The pattern formed on a photographic plate by light waves that interfere and create a hologram. This pattern is the interaction or interference pattern of two parts of a laser light (coherent light). One beam reflects off an object, the other off a mirror. In addition, any portion of the holographic plate contains information on the whole object.

Biohologram:

Every cell in the human body contains nuclear DNA. Information on the whole body -- much like a hologram -- only the cells can go through a process of division and reproduction (mitosis).

In quantum holography, things are spookier still. While holograms are typically constructed with interfering beams of light, in quantum holography the researchers measure the simultaneous arrivals of an illuminating photon that is sent into a chamber and a companion photon in the other entangled beam.**[2]**

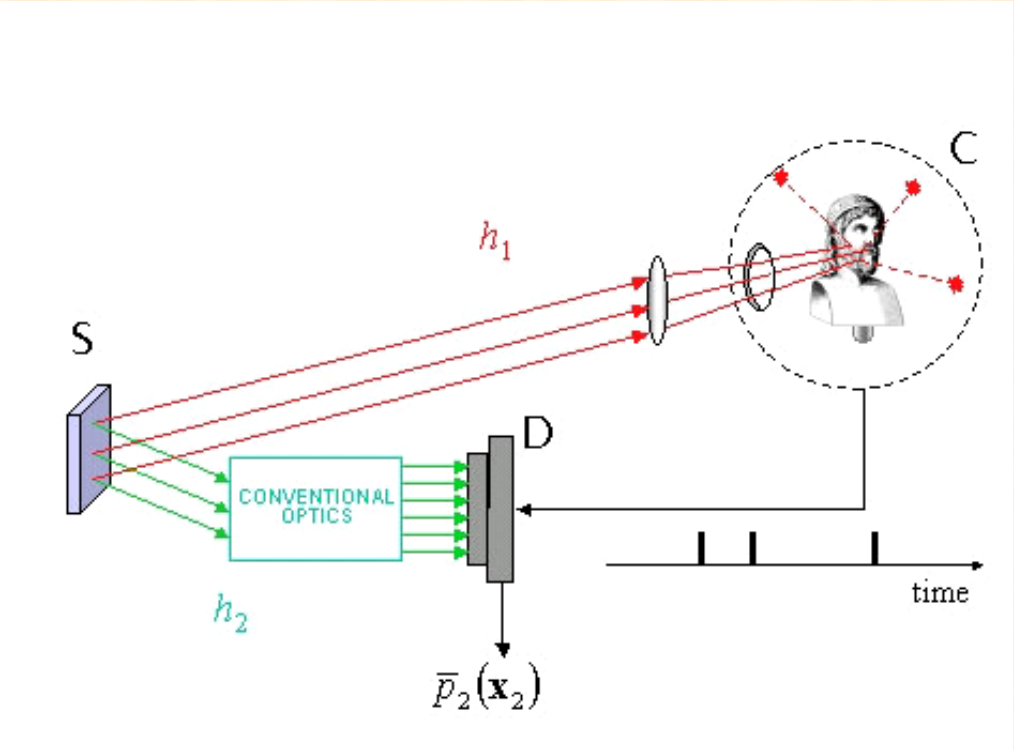

Quantum holography -- as depicted in this cartoon -- is a way that physicists could produce 3-dimensional images of objects that would be invisible to systems relying on classical physics. A source **S** produces 2 photon beams (**h_1** and **h_2**). The photons in **h_1** are quantum mechanically **entangled** with the photons in **h_2**. When a photon in **h_1** enters chamber **C**, it encodes 3-dimension information about the enclosed object (in this case a Grecian bust) in the interference of the 2 paths it could take -- a path that intercepts the object and subsequently is reflected to the chamber wall, and a path that misses the object and strikes the chamber wall directly. The second beam **h_2** passes through conventional optics and strikes a detector array **D**. A coincidence counter extracts the holographic information by monitoring the relative time between a photon in **h_1** striking the chamber wall and its entangled mate in **h_2** arriving at detector **D**.

Wave Genetics Inc. and the Moscow Institute of Control Sciences are exploring a new concept of the genetic code that asserts:

(1) that the evolution of biosystems has created genetic "texts" -- similar to natural context dependent texts in human languages -- shaping the text of these speech-like patterns.

2) that the chromosome apparatus acts simultaneously both as a source and receiver of these genetic texts, respectively decoding-and-encoding them.

3) that the chromosome continuum of multicellular organisms is analogous to a static-dynamical multiplex time-space holographic grating, which comprises the space-time of an organism in a convoluted form.

That is to say, the DNA action -- theory predicts and which experiment confirms -- is …

(i) that of a "gene-sign" laser and its solitonic electro-acoustic fields, such that the gene-biocomputer "reads and understands" these texts in a manner similar to human thinking but at its own genomic level of "reasoning". It asserts that natural human texts (irrespectively of the language used) and genetic "texts" have similar mathematical-linguistic and entropic-statistic characteristics, where these concern the fractality of the distribution of the character frequency density in the natural and genetic texts and where -- in case of genetic "texts" -- the characters are identified with the nucleotides, and

(ii) that DNA molecules -- conceived as a gene-sign continuum of any biosystem -- are able to form holographic pre-images of biostructures and of the organism as a whole as a registry of dynamical "wave copies" (or "**matrixes**") succeeding each other. This continuum is the measuring, calibrating field for constructing its biosystem.

"Complex information can be encoded in EM fields, as we all know from coding-and-decoding of television and radio signals. Even more complex information can be encoded in holographic images. DNA acts as a holographic projector of acoustic and EM information which contains the informational quintessence of the biohologram. Only 3% of human DNA encodes the physical body. The remaining 97% of the 3 billion base pair genome contains over a million genetic structures -- called transposons -- that have the capacity to jump from one chromosomal location to another (Kelleher, 1999). We are 99.9% alike in our genetic legacy. Our individuality is expressed in 3 million small variations in our cells called single nucleotide polymorphisms.

"**Gene-expression** is the mechanism by which new patterns are called into being (Rossi, 2000). There is also a strong correlation between modulation of the brain's EM field and consciousness (Persinger, 1987; McFadden, 2002). The Gariaev group has discovered a wave-based genome and DNA phantom effect which strongly supports the holographic concept of reality (Miller, Webb, Dickson, 1975). This main information channel of DNA is the same for both photons and radio waves. Superposed coherent waves of different types in the cells interact to form diffraction patterns, first in the acoustic domain and second in the electromagnetic domain -- a **quantum hologram** -- a translation process between acoustical and optical holograms." **[4]**

The distribution of the character frequency in genetic texts is fractal, so the nucleotides of DNA molecules are able to form holographic pre-images of biostructures. This process of "reading and writing" the very matter of our being manifests from the genome's associative holographic memory in conjunction with its quantum nonlocality. Rapid transmission of genetic information and gene-

expression unite the organism as holistic entity embedded in the larger Whole. The system works as a biocomputer -- a **wave biocomputer**.

The quantum nonlocality of the genetic information is fundamental. Experimental work of the Gariaev group shows how quantum nonlocality is directly related to laser radiation from chromosomes (coherent light), which jitterbugs its polarization plane to radiate or occlude photons. DNA and the genome have now been identified as active "laser-like" environments. Roughly speaking, DNA can be considered as a liquid crystal gel-like state that acts on the incoming light in the manner of a solitonic lattice. **[5]**

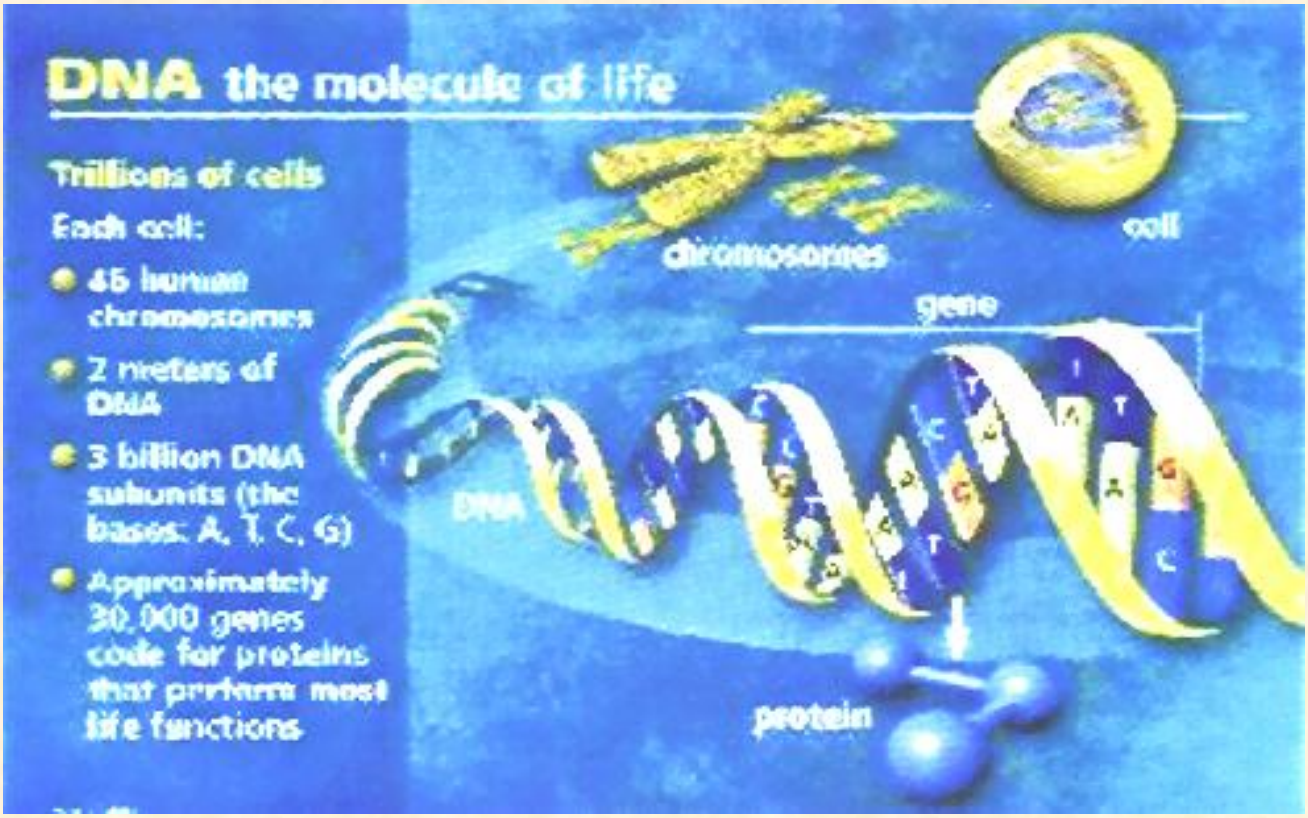

Biophotonics

This entire section is extracted from the History of Biophotonics website:

Around 1923, Alexander Gurwitsch discovers an "ultra-weak" photon emission from living systems (onions, yeast, ...), since he suggested connections between photon emission and cell division rate. He calls this **photonemission "mitogenetic radiation**". His experiments indicate that the wavelength is in the range around 260 nm (Bibliography under Gurwisch and also Ruth (1977, 1979)).

Around 1950, Russian scientists rediscover "ultra-weak photon emission" from living organisms. Most results are published in "Biophysics" (Engl.) and originally in "Biofizika"). (Bibliography under Ruth, 1979).

Italian nuclear physicists discover by chance "bioluminescence" of seedlings. They do not think that this finding is significant, but they publish the results (Colli et al. 1954, 1955, Ruth 1979).

The Russian biophysicist and the American chemist enunciate the first theory of ultra-weak photonemission (UWPE) from biological systems -- the so called "**imperfection theory**". UWPE shall

be an expression of the deviation from equilibrium -- some kind of distortion of metabolic processes (Zhuravlev 1972, Seliger 1975, Ruth 1979).

Independently from each other and by different motivations, scientific groups in Australia (Quickenden), Germany (Fritz-Albert Popp), Japan (Inaba), and Poland (Slawinski) show evidence of ultra-weak photon emission from biological systems by use of modern single-photon counting systems. Bibliography (Quickenden, Inaba, Popp &Ruth, Slawinski).

While Quickenden, Slawinski, and Inaba prefer the imperfection theory, Popp and his group enunciate just the opposite theory:

1. The radiation originates from an almost perfect coherent photon field.

2. Essential sources are the DNA and corresponding resonators in the cells.

3. The mechanism describes photon storage in cavities and information channels, tuned by Casimir forces.

4. There is a close connection to delayed luminescence which corresponds to excited states of the coherent photon field.

5. The radiation is not the product but essentially the initiator of chemical reactions in the cells. The radiation submits the information within and between cells.

6. The radiation is not limited to the optical range but follows an **f = const** rule (the occupation probability of the phase space is equal for all wavelengths) and extends to longer wavelengths including the so-called heat radiation of the body.

7. This radiation is the proper regulator and information carrier of life.

The Marburg group of Fritz-Albert Popp calls this phenomenon "**biophotons**" in order to stress the difference to "bioluminescence". Biophotons are single quanta which are permanently-and-continuously emitted by all living systems. They are subjects of quantum physics, and they display a universal phenomenon attributed to all living systems. Worldwide, all scientists who agree with these statements call the radiation "biophotons" and the scientific field "**biophotonics**".

From 1972 to 1980, the Marburg group of the leader -- the physicist and Dr. Habil Fritz-Albert Popp -- evaluated experimentally all the essential physical properties of biophotons.

1. The intensity ranges from a few up to some hundreds photons/(sec-cm^2).

2. The spectral distribution follows in the time average an **f = const** rule.

3. The modes are strongly coupled.

4. The delayed luminescence that approaches continuously the biophoton emission follows a <u>hyperbolic</u> rather than an exponential relaxation function.

5. The biophotons origin from an almost fully coherent field.

6. Cells are able to establish cavity resonators which contribute to biophoton regulation.

7. The essential source of non-equilibrium biophoton emission is the DNA.

This group introduces the first time photocount statistics (PCS) into biophotonics. They show evidence that biophotons are emitted according to a Poissonian PCS. Furthermore, they show evidence that (1) the delayed luminescence follows a hyperbolic relaxation function rather than an exponential one; (2) the modes are strongly coupled; and (3) there are hyperbolic oscillations around the continuous hyperbolic relaxation function. The group finds the first time intercellular communication by means of biophotons. Later this was confirmed by Albrecht-Bühler (Bacteria), Popp and Chang (dinoflagellates), Galle (daphnia), Shen (blood), and Vogel (bacteria).

(Bibliography under Popp and coworkers, i.e., Bahr, Böhm, Grass, Grolig, Herrmann, Kramer, Rattemeyer, Ruth, Schmidt, Wulle, Albrecht-Bühler, Chang, Galle, Shen, Vogel).

The papers of Popp and his group are examined mainly by the group of B. Chwirot (Kopernikus University, Torun). They confirm the essential results (Bibliography Chwirot et al.).

Herbert Klima (Atom Institute Vienna) performs his dissertation in Popp`s group at the University in Marburg. He transfers "Biophotonics" to the University in Vienna -- in particular investigations on laser excitation of living systems.

(Bibliography Klima or Atominstitut Wien).

J.Slawinski cooperates with the groups in Japan, USA and the Popp-group in Germany. He follows mainly the links between biophotons and biochemical reactions. There arises a branch biochemical biophotonics that becomes an essential part mainly in Japan and USA." **[6]**

Bioinfotons

This term "**bioinfoton**" is one that I am adopting to specify any particle (such as the **Ganesh Particle***), wave, or biomolecule that transfers information from an emitter to a receptor. It is possible that if a biophoton is emitted from a coherent source that it will carry holographic information as a form of modulation (possibly frequency-modulated) and produce action or results in biological systems.

It is possible that biophotons may even be carriers of ***psi*** information and that a coherent coupling can be established between 2 conscious lifeforms resulting in a transference of information from a higher potential field to a field at lower potential. Even though this is conjecture at this point, it suggests other means by which disparate lifeforms can communicate. We know there is a process by which trees communicate and even signal each other in the face of danger. We may be exchanging information with pets and other animals through biophotonic communication. This may be how some people who have a "green thumb" affect plants they care for.

Even communication with other intelligent life forms in the Cosmos may be effected by the amplification and vectoring of biophotons or -- via the quantum potential -- produce information at a distance.

A virtual photon flux in the quantum potential may be integrating the coordinated wholeness of the organism while the action of bioinfotons may keep every part of the organism in communication with every other part.

Conclusions

Life and living organisms are more than the sum of their parts and are composed of material and non-material parts. The spiral form of DNA evidently produces an electromagnetic wave field that informs the organism's growth and structure.

Scientist Richard Alan Miller is a pioneer in this field and has written:

"In a hologram, wave fields interfere with one another to lay the foundations for the reconstruction of the image of an object. But how are the wave fields produced?

The term "holography" comes from the Greek roots meaning "entire" and "to write". In holography, the image is projected by a coherent light source split into both the object wave and the reference wave background. This dichotomous nature is reflected in the particle/wave nature of the DNA molecule, which can be "read out" with biophotons from chromosomes to set up a holographically-produced wave field. This superposition of wave fields (object wave and reference wave) creates a wave guide for the formation of biological structure. The image is constructed according to the reference information contained in the genes. The reconstructed object wave is identical with the object wave field. The reconstructed wave fields reproduce exactly the recorded ones (the DNA with genetic code)." **[7]**

Mr. Miller also proposes this hypothesis:

"QUANTUM BIOHOLOGRAPHY

Hypothesis: The organization of any biological system is established by a complex electrodynamical field that is, in part, determined by its atomic physiochemical components. These, in part, determine the behavior and orientation of these components. This dynamic is mediated through wave-based genomes wherein DNA functions as the holographic projector of the psychophysical system -- a quantum biohologram."

I propose that the biohologram is embedded as an integral part of the biocosmic hologram we call the"Universe".

Dr. Dan Burisch has seen evidence that a **Ganesh Particle*** can transmute itself into a fully functional atypical eukaryotic cell in a matter of seconds -- not eons. Such evidence -- when it becomes available -- will change our entire perspective on the existence of a universal holonomic mind that informs its creation.

**Ganesh Particles are charged clusters that extracted from ancient bedrock and have a seemingly unknown origin, but carry information which is transferred to cells via a crossbridge. (discovered by Dr. Dan B.C. Burisch)*

References:

1. **http://plato.stanford.edu/entries/qm-bohm/#qp**
2. **http://www.ksharpe.com/Word/BM05.htm**

3. http://www.aip.org/enews/physnews/2001/split/566-1.html
4. http://www.rialian.com/rnboyd/dna-wave.doc
5. http://www.geocities.com/iona_m/Chaosophy4/bioholography/bioholography.htm
6. http://www.lifescientists.de/history.htm
7. http://www.nwbotanicals.org/oak/newphysics/Helix%20to%20Hologram.pdf

if on the Internet, Press <BACK> on your browser to return to the previous page (or go to www.stealthskater.com)

else if accessing these files from the CD in a MS-Word session, simply <CLOSE> this file's window-session; the previous window-session should still remain 'active'

The Tom Bearden Website

Help support the research

Foundations of Electro-Magnetism

Slide Series

- Major Points of Presentation
- Chung's Carbon Filament Negative Resistor
- Aharanov-Bohm Effect
- Absorption and emission reactions (1)
- Absorption and emission reactions (2)
- Anti-engine for cell's deviation reverses cell back to normal
- Asymmetric regauging produces excess force, which can be used to do work on the system
- Asymmetric regauging produces excess force, which can be used to do work on the regauging system
- Becker's bone fracture healing experiments
- Becker's theoretical control system governing regeneration
- Becker's theoretical DC control system involved with response to injury
- Geometrical Distortion of Poynting Energy Flow
- Cosmic Bootstrap: Before the Big Bang
- Bridging Enables COP > 1

- Aspects of Strong Local Symmetry
- Other Aspects of Strong Local Symmetry
- Bunge on the Status of Electrodynamics
- Bunge on the Status of Electrodynamics and Physics
- Bunge on the Status of Classical and Quantum Physics
- Fractions of BW Casualties Surviving
- First Step in Self-Promotion of Cancer Due to Hypoxia
- Differentiation and Dedifferentiation Timelines
- Evolution of Cells on Earth
- A Charged Particle q is a Coupled System of m and Ø
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (1)
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (2)
- The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry (3)
- A Charged Particle is a Coupled System
- The Anomalies in Navy Electrolyte Experiments at China Lake
- Chung's Carbon Filament Negative Resistor

- Typical circuit has about 10^{-13} energy collection efficiency
- Classical View of EM
- Curved Spacetime acts as source or sink
- Chronic Disease Puzzling
- Cancer Characteristics
- Solving a Cancer Enigma
- Cancer: Characteristics
- Nonlinear Optics Distortion Correction Theorem
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)
- The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)
- In Time-Reversed Zone: Nuclear reactions are biased
- In Time-Reversed Zone: Dynamics may be reversed
- Time-Reversed Zone: Significant only after time-density charging
- A New Conservation of Energy Law
- Questions on Carcinogens and EM

Radiation

- AS DEFINED, fields and potentials only exist in and on charged matter
- Serious flaws and errors in classical EM theory
- Electrodynamicists' Reaction to Removal of the Material Ether
- Reaction to Loss of Material Ether (1)
- Reaction to Loss of Material Ether (2)
- Some EM waves in Spacetime
- Air Medium Disturbances Generated When Air is Perturbed by a Plucked Taut String
- Launching a Spacetime Perturbation ("EM Wave") from a Wire Antenna
- Phase Conjugate Wavepairs Produce New Waves
- Scalar Electromagnetics (Energetics) View of EM (1)
- Scalar Electromagnetics (Energetics) View of EM (2)

- Scalar Electromagnetics (Energetics) View of EM (3)
- Extended General Relativity Principle
- Extension of Work-Energy Theorem
- 34 Flaws in Classical EM Theory
- MTW's General Relativity Principle
- Use of General Relativity (GR) in Particle Physics
- The Missing Infolded Electrodynamics
- Infolded Engines: Excluded by Present Physics
- Mass curves and structures spacetime; ST curvatures change and structure mass (1)
- Mass curves and structures spacetime; ST curvatures change and structure mass (2)
- At Infinite Velocity: Each Is Every Other
- Lisitsyn's Report: Brain Code Broken
- Lorentz Closed Surface Integration
- Lorentz's physically insignificant energy flow can be collected and utilized
- Lorentz surface integration of the Poynting vector around a closed surface
- Longitudinal EM Photon Interaction with Charge
- Mass is transparent to longitudinal EM waves, which move through the infolded interiors of internal waves, potentials, and fields in the mass.

- Pumping with Longitudinal EM waves Time-reverses the Mass
- Maxwell's Quaternion Theory
- Maxwellian Systems before and after Regauging
- Maxwell's four equations reduce to: Page 1
- Maxwell's four equations reduce to: Page 2
- More to come

Major Points of Presentation

- Electrodynamic is seriously flawed
  - Some major flaws
  - Corrections indicated
- Why past corrective attempts failed
  - Force field concept is material
  - Missing two infolded transforms (M->ST; ST->M)
- Missing Infolded general relativity inside electrodynamics
- Several Kinds of EM Waves in Space
  - How to make
  - Transduction
- A French medical example as a deep experimental demonstration
  - Spectacular regenerative cures funded by French Govt
  - Not comprehended, therefore suppressed
- Cold Fusion examples of time-density wave effects
  - China Lake instrumental anomalies in electrolysis
  - Explanation of anomalous behavior of instruments
  - Explanation of new nuclear reactions
  - Wave energy transduction provides excess heat
- Urge theorists to consider dramatically new reactions

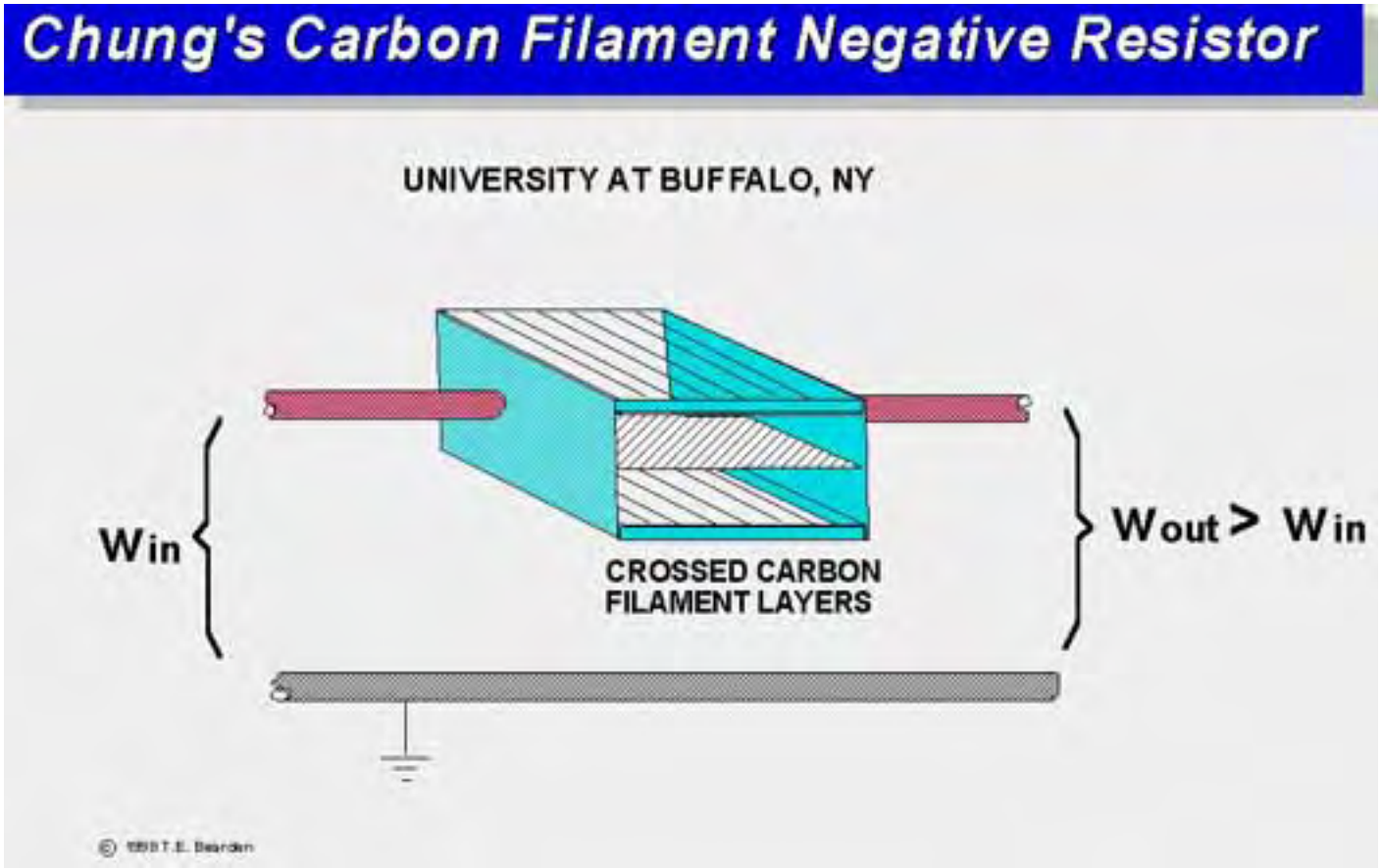
Chung's Carbon Filament Negative Resistor
UNIVERSITY AT BUFFALO, NY
Win
CROSSED CARBON
FILAMENT LAYERS
Wout > Win
© 1991 T.E. Bearden

Aharonov-Bohm Effect

- In field-free regions
  - E-field is zero
  - B-field is zero
- Potentials still exist, just no gradients
  - Cause real effects
  - Interference is the key
  - Contain sum-zeroed substructures
- Does not follow from
  - Mechanics
  - Classical electromagnetics
- Required by quantum mechanics

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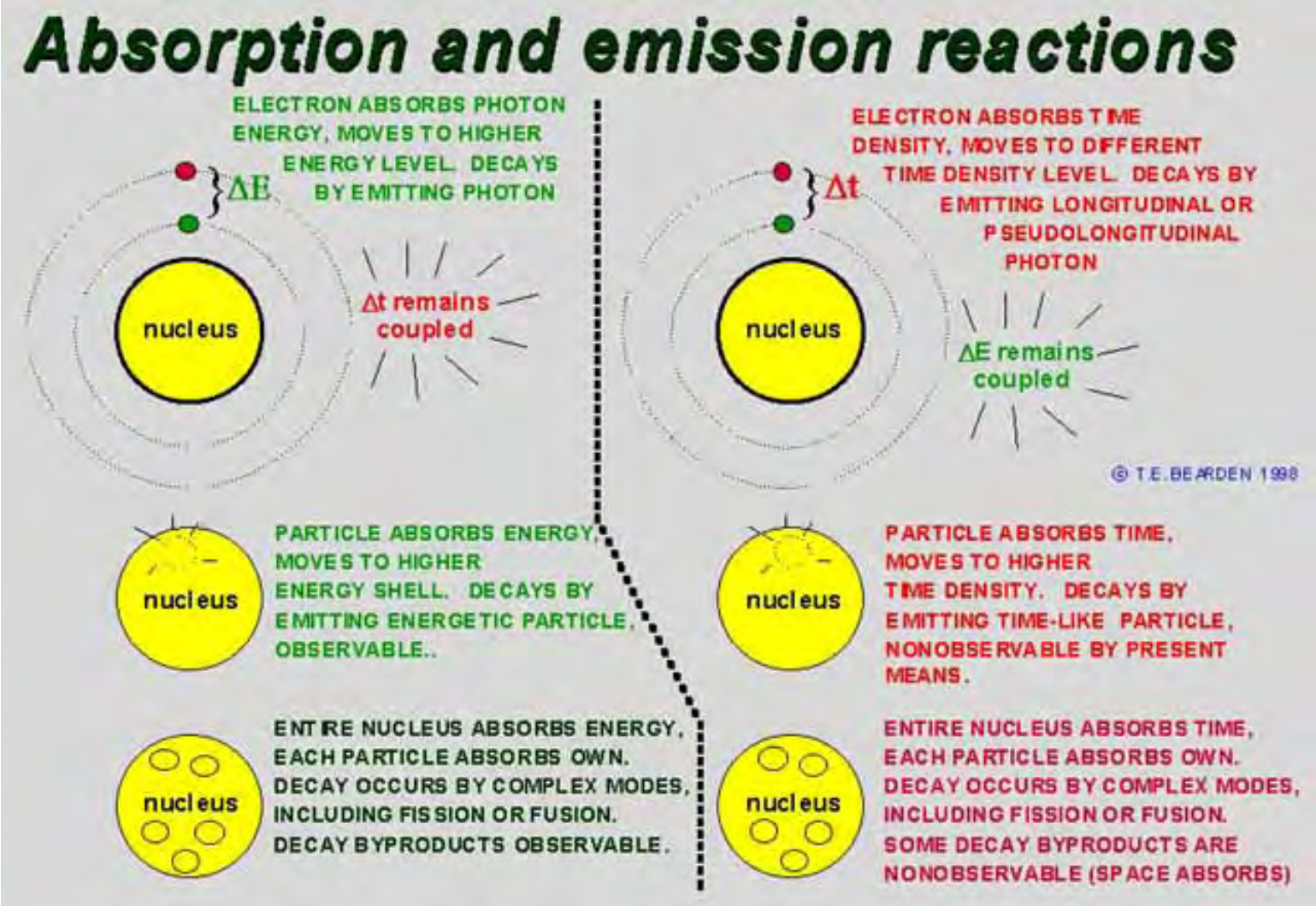
Absorption and emission reactions
ELECTRON ABSORBS PHOTON ENERGY, MOVES TO HIGHER ENERGY LEVEL. DECAYS BY EMITTING PHOTON
ΔE
nucleus
Δt remains coupled
ELECTRON ABSORBS TIME DENSITY, MOVES TO DIFFERENT TIME DENSITY LEVEL. DECAYS BY EMITTING LONGITUDINAL OR PSEUDOLONGITUDINAL PHOTON
Δt
nucleus
ΔE remains coupled
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nucleus
PARTICLE ABSORBS ENERGY, MOVES TO HIGHER ENERGY SHELL. DECAYS BY EMITTING ENERGETIC PARTICLE, OBSERVABLE..
nucleus
PARTICLE ABSORBS TIME, MOVES TO HIGHER TIME DENSITY. DECAYS BY EMITTING TIME-LIKE PARTICLE, NONOBSERVABLE BY PRESENT MEANS.
nucleus
ENTIRE NUCLEUS ABSORBS ENERGY, EACH PARTICLE ABSORBS OWN. DECAY OCCURS BY COMPLEX MODES, INCLUDING FISSION OR FUSION. DECAY BYPRODUCTS OBSERVABLE.
nucleus
ENTIRE NUCLEUS ABSORBS TIME, EACH PARTICLE ABSORBS OWN. DECAY OCCURS BY COMPLEX MODES, INCLUDING FISSION OR FUSION. SOME DECAY BYPRODUCTS ARE NONOBSERVABLE (SPACE ABSORBS)

Absorption and emission reactions

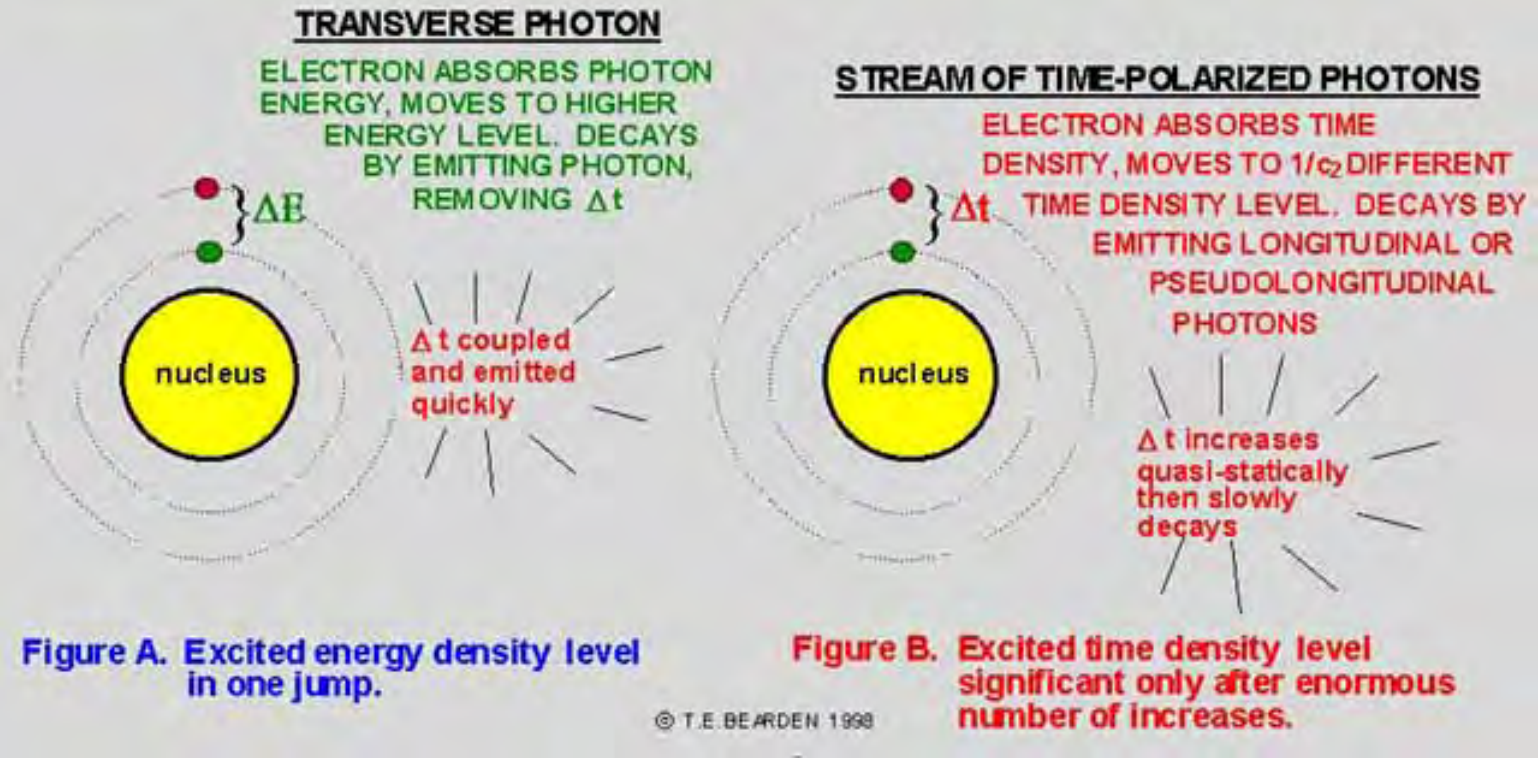

Figure A. Excited energy density level in one jump.

Figure B. Excited time density level significant only after enormous number of increases.

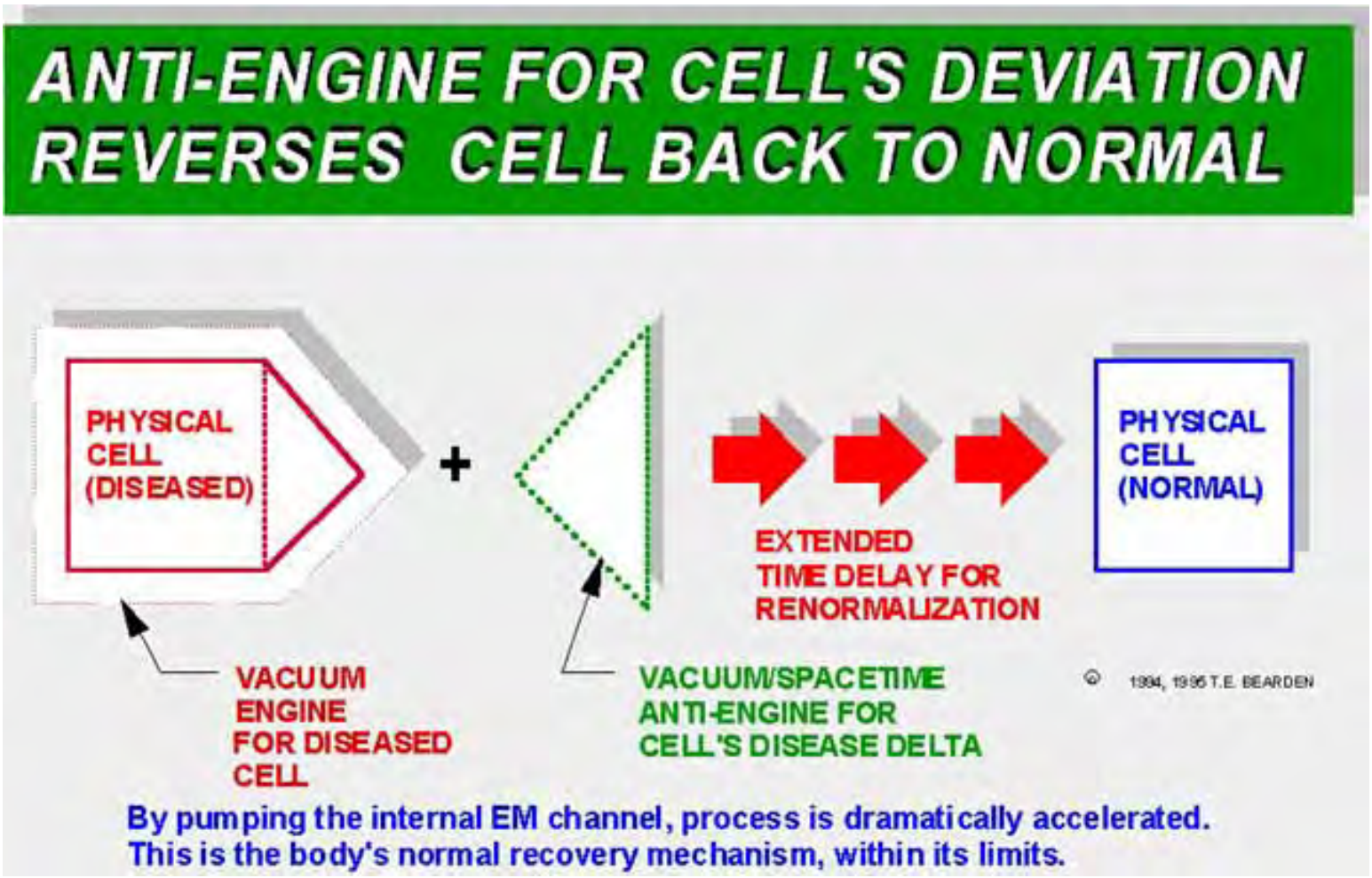
ANTI-ENGINE FOR CELL'S DEVIATION
REVERSES CELL BACK TO NORMAL
PHYSICAL CELL (DISEASED)
+
EXTENDED TIME DELAY FOR RENORMALIZATION
PHYSICAL CELL (NORMAL)
VACUUM ENGINE FOR DISEASED CELL
VACUUM/SPACETIME ANTI-ENGINE FOR CELL'S DISEASE DELTA
© 1994, 1995 T.E. BEARDEN
By pumping the internal EM channel, process is dramatically accelerated.
This is the body's normal recovery mechanism, within its limits.

Asymmetric Regauging Produces Excess Force, Which Can be Used to Do Work on the System

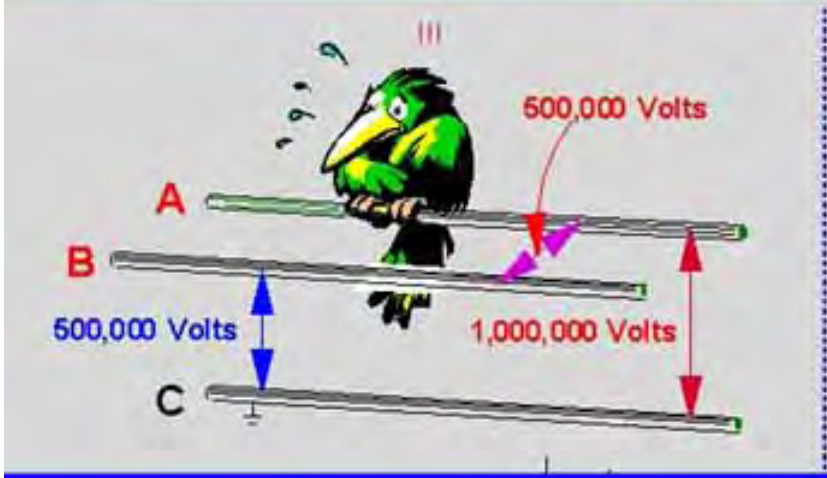

Net Symmetric Regauging Does No Excess Work on the System

This little bird put one foot on wire A, and then the second foot on wire A also. He *net symmetrically* regauged, so he had no net excess force across him, even though his potential energy was increased. He asymmetrically regauged each foot, but both simultaneously so that one countered the other. Wise little bird!

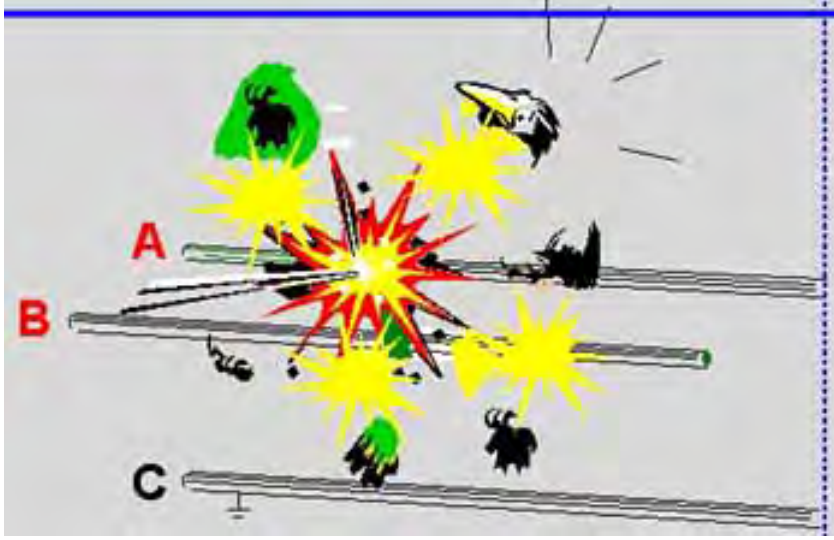

Net Asymmetric Regauging Can Do Excess Work on the System

This little bird put one foot on wire A, and then the second foot on wire B. He *net asymmetrically* regauged, so he had lots of net excess force across him. That force then violently translated his little body parts every which way, doing lots of work in and on him. Bummer!

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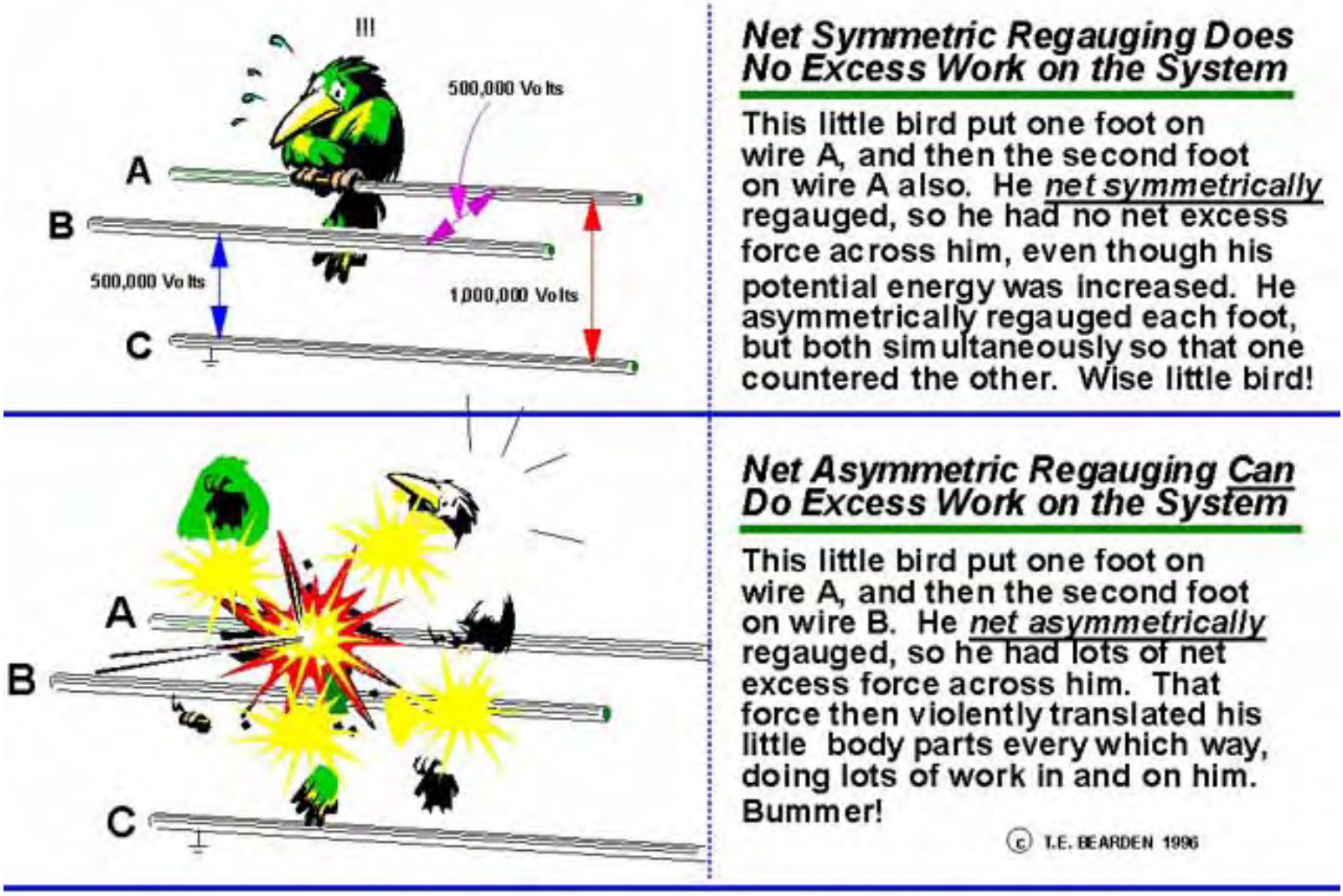

Figure 32. Asymmetric regauging produces excess force, which can be used to do work on the regauging system.

Selected clipart © by Lotus SmartPics™

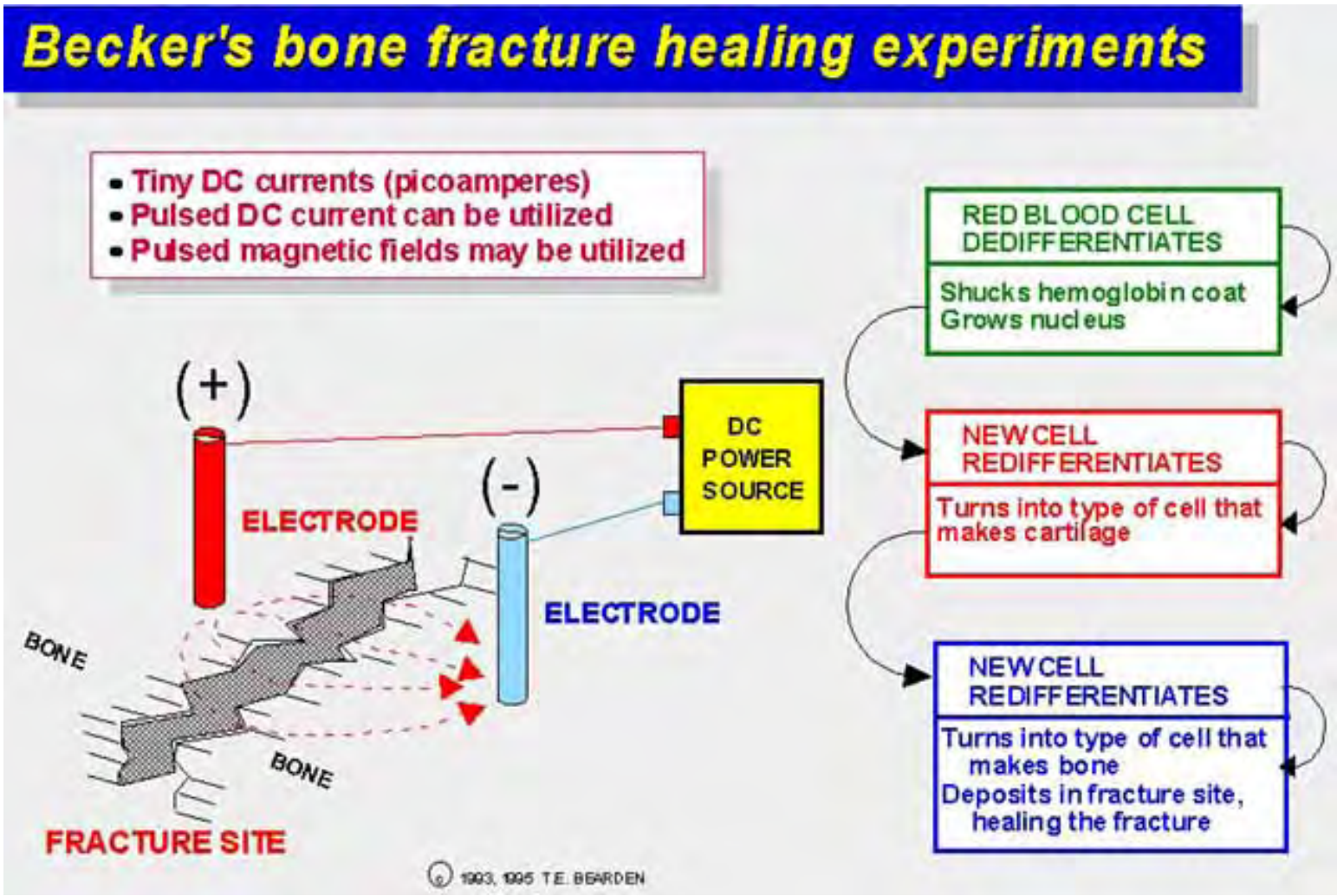
Becker's bone fracture healing experiments
• Tiny DC currents (picoamperes)
• Pulsed DC current can be utilized
• Pulsed magnetic fields may be utilized
(+)
(-)
ELECTRODE
ELECTRODE
DC POWER SOURCE
BONE
BONE
FRACTURE SITE
RED BLOOD CELL DEDIFFERENTIATES
Shucks hemoglobin coat
Grows nucleus
NEW CELL REDIFFERENTIATES
Turns into type of cell that makes cartilage
NEW CELL REDIFFERENTIATES
Turns into type of cell that makes bone
Deposits in fracture site, healing the fracture
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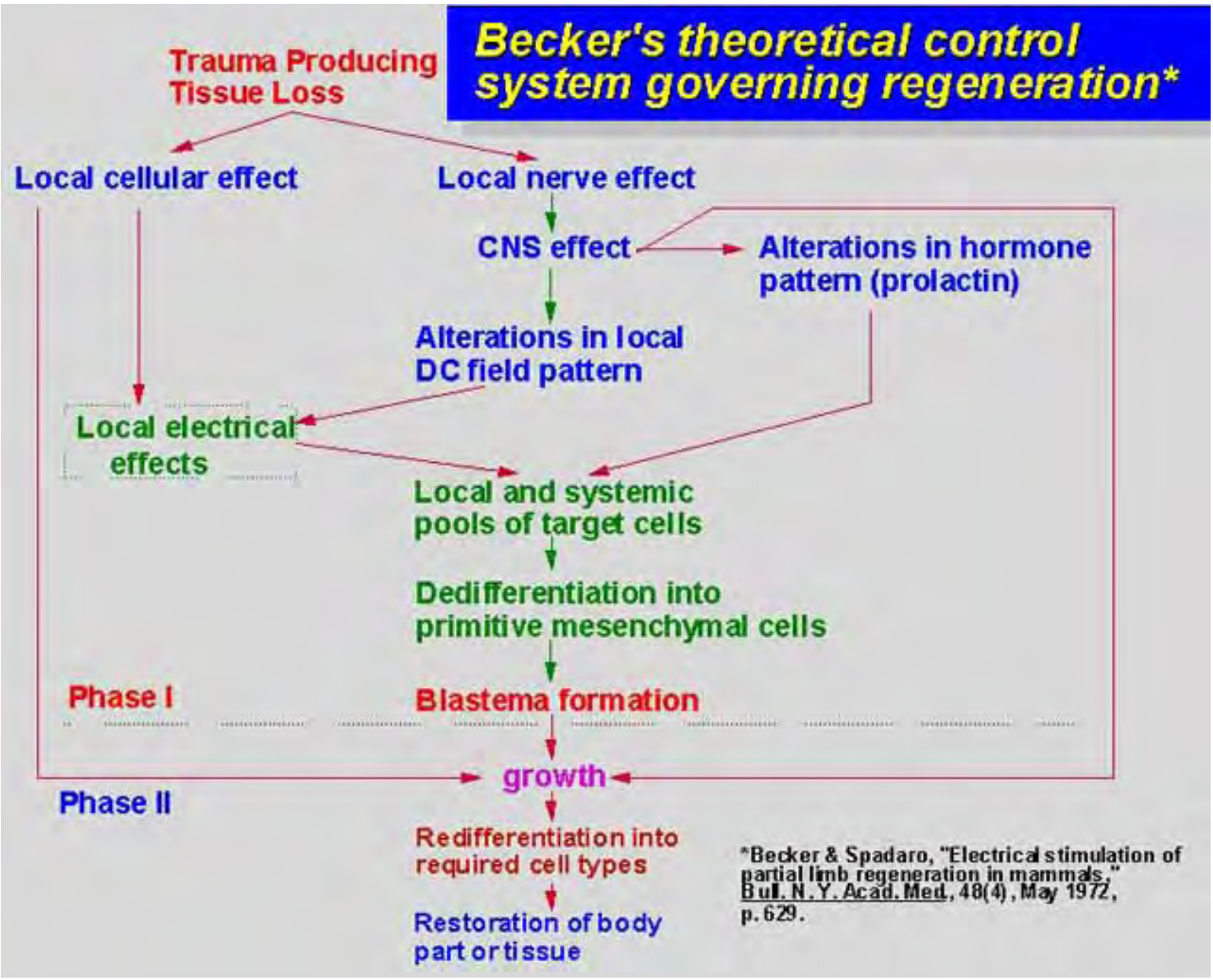
Becker's theoretical control system governing regeneration*
Trauma Producing Tissue Loss
Local cellular effect
Local nerve effect
CNS effect
Alterations in hormone pattern (prolactin)
Alterations in local DC field pattern
Local electrical effects
Local and systemic pools of target cells
Dedifferentiation into primitive mesenchymal cells
Phase I
Blastema formation
growth
Phase II
Redifferentiation into required cell types
Restoration of body part or tissue
*Becker & Spadaro, "Electrical stimulation of partial limb regeneration in mammals," Bull. N.Y. Acad. Med., 48(4), May 1972, p. 629.

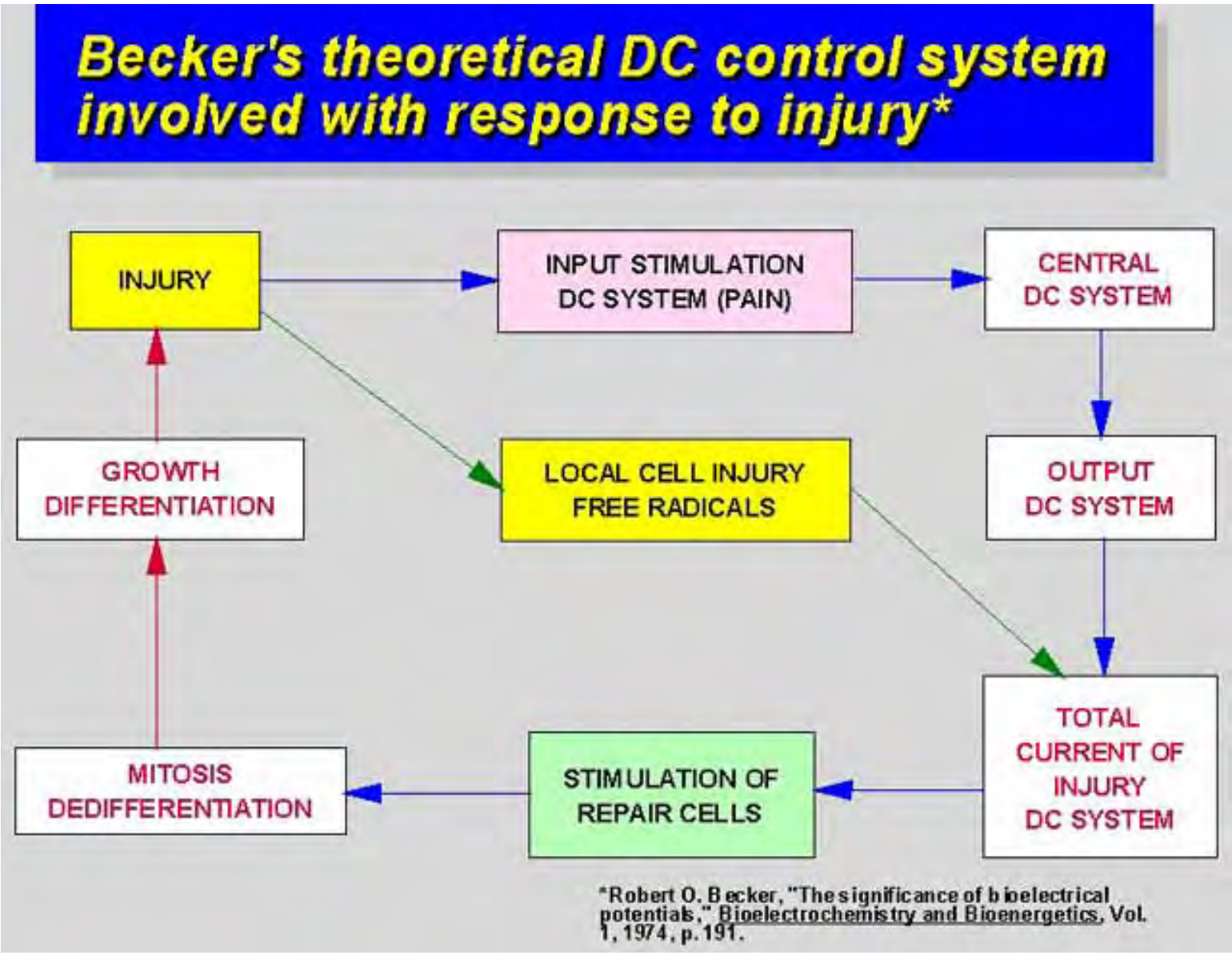
Becker's theoretical DC control system involved with response to injury*
INJURY
INPUT STIMULATION DC SYSTEM (PAIN)
CENTRAL DC SYSTEM
GROWTH DIFFERENTIATION
LOCAL CELL INJURY FREE RADICALS
OUTPUT DC SYSTEM
TOTAL CURRENT OF INJURY DC SYSTEM
MITOSIS DEDIFFERENTIATION
STIMULATION OF REPAIR CELLS
*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

Geometrical Distortion of Poynting Energy Flow

At or near resonance frequency, in the case shown the energy collection fraction (reaction cross section) increases dramatically.

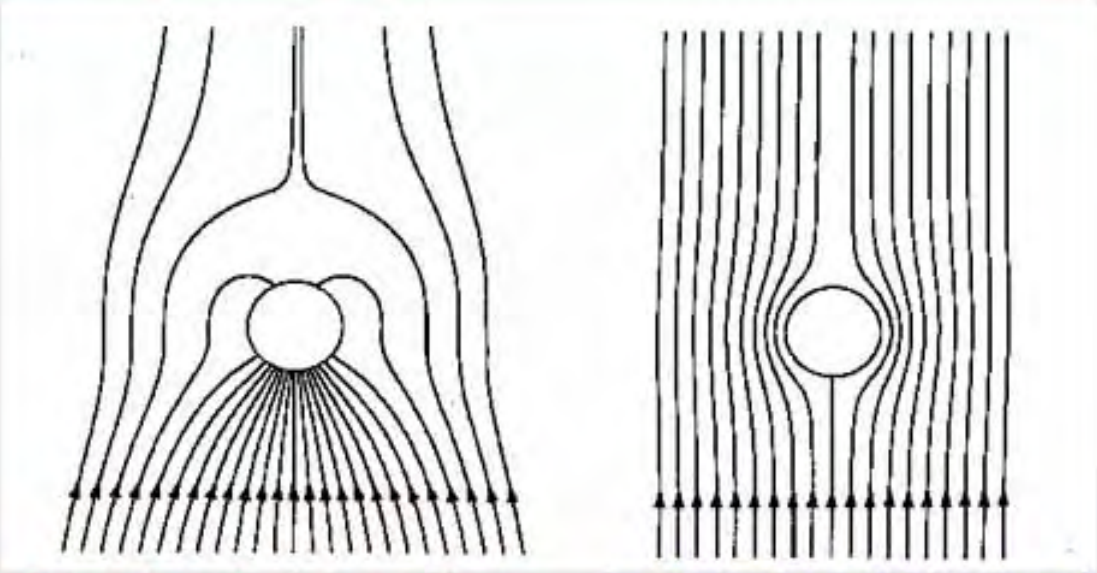

a. Around an aluminum sphere at light energy 8.8 eV. Absorption efficiency = 18.00.

b. Around an aluminum sphere at light energy 5eV. Absorption efficiency = 0.1.

Figures per Craig F. Bohren, "How can a particle absorb more than the light incident upon it? ", American Journal of Physics, 51(4), Apr. 1983, p. 326.

Cosmic Bootstrap: Before the Big Bang:

- *Cosmic repulsion behaved like a fluid with negative pressure*
- *The "universe" inflated (expanded) as a "false vacuum"*
- *As the negative-pressure fluid expanded, its energy went up rather than down*
- *When inflation stopped, the false vacuum decayed from its excited state*
- *Its excitation energy was released in a single great burst*

Paul Davies, Superforce, 1984, p. 194

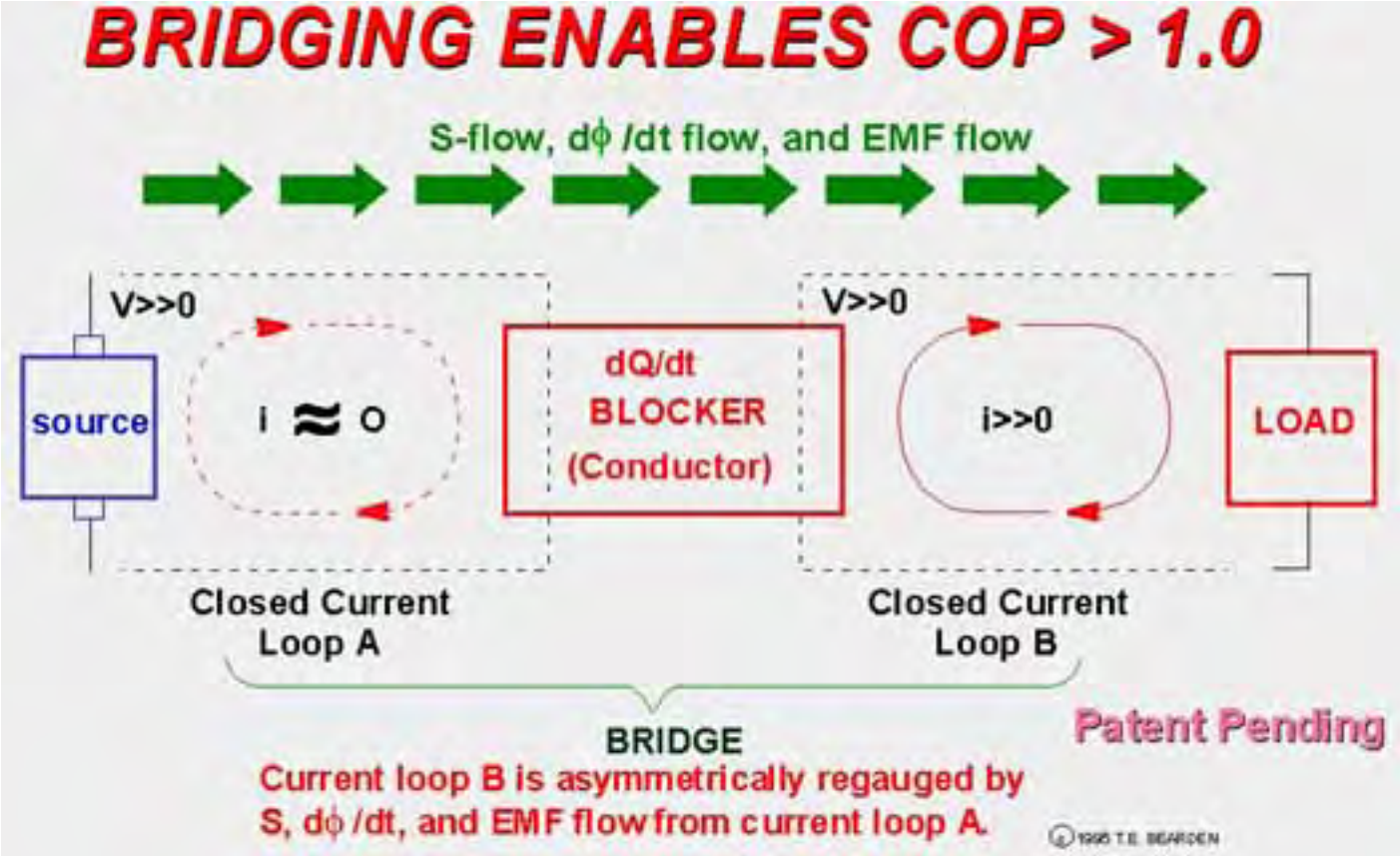
BRIDGING ENABLES COP > 1.0
S-flow, dϕ /dt flow, and EMF flow
V>>0
source
i ≈ 0
dQ/dt
BLOCKER
(Conductor)
V>>0
i>>0
LOAD
Closed Current
Loop A
Closed Current
Loop B
BRIDGE
Patent Pending
Current loop B is asymmetrically regauged by
S, dϕ /dt, and EMF flow from current loop A.
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Aspects of Strong Local Asymmetry

- If local asymmetry is strong, conservation laws may be appreciably violated
  - Energy
  - Charge
  - Spin
  - Momentum
  - Angular momentum

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- Properties of an object may differ appreciably for
  - Different observers
  - Different detecting means
  - One time to another
  - One position to another
- STRUCTURING THE INFOLDED EM INSIDE POTENTIALS, FIELDS, AND WAVES
  - Strongly breaks local symmetry
  - Provides spacetime engines giving the above effects

Other Aspects of Strong Local Asymmetry

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- Local spacetime is curved
- Lorentz invariance of vacuum is violated
- May be a local "sink" or "source"
- Gravitational-inertial effects from EM
- Translation between virtual and observable
- Electrogravitational solitons
- Action at a distance
- Transmutation effects may exist
- Scalar/pseudoscalar field translation
- COMMENT: Thus the use of infolded longitudinal EM fields and waves to strongly break local symmetry allows internested clustering of spacetime curvatures. These spacetime structures are *vacuum engines*, or *spacetime engines*.

Bunge on the Status of Electrodynamics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state..."

"... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176.

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Bunge on the Status of Electrodynamics and Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state...

"... neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling..."

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*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176.

Bunge on the Status of Classical and Quantum Physics

"... it is not usually acknowledged that electro-dynamics, both classical and quantal, are in a sad state... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."

*Mario Bunge, Foundations of Physics, Springer-Verlag, New York, NY, 1967, p. 176..

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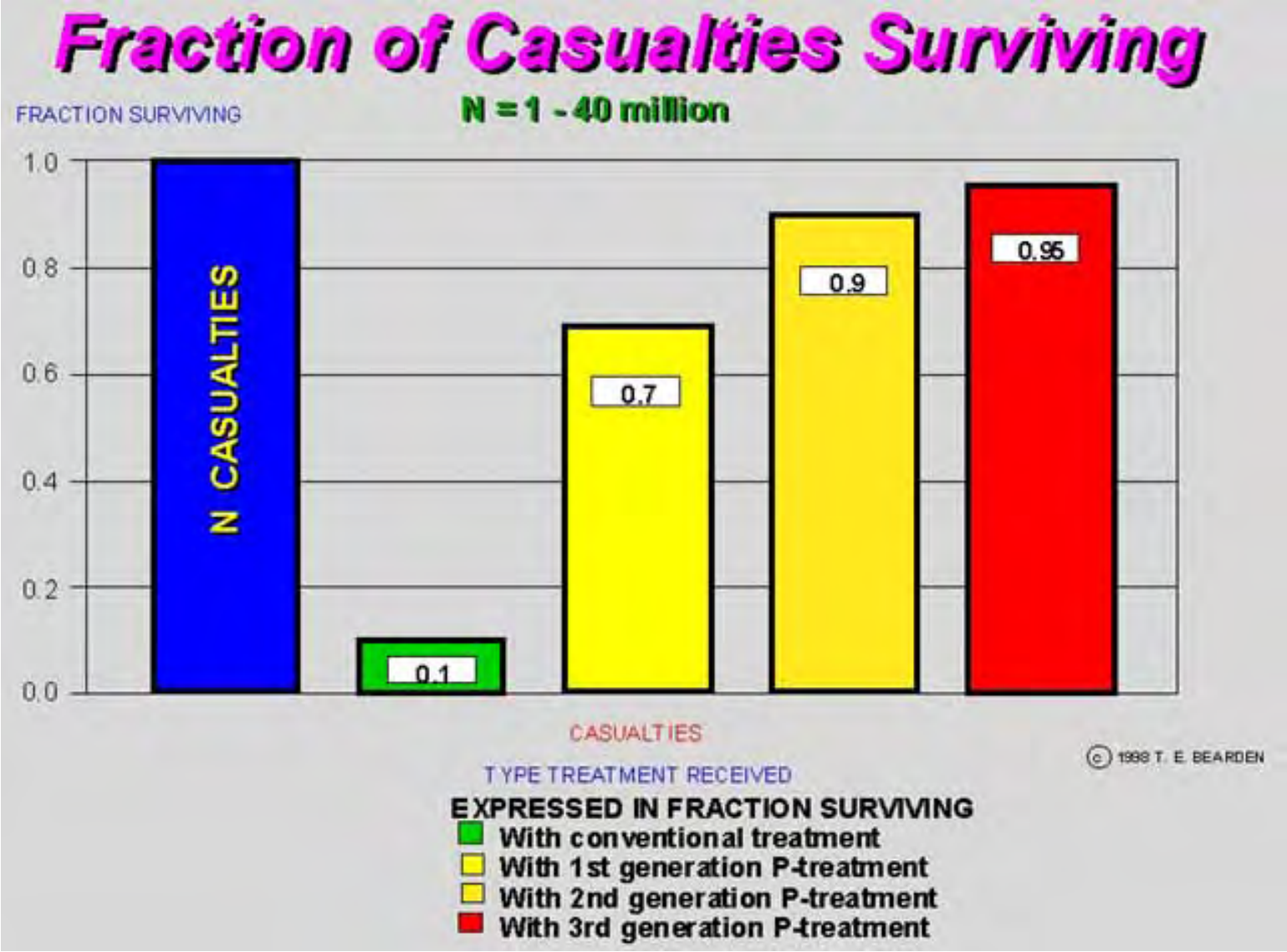
Fraction of Casualties Surviving
FRACTION SURVIVING
N = 1 - 40 million
1.0
0.8
0.6
0.4
0.2
0.0
N CASUALTIES
0.1
0.7
0.9
0.95
CASUALTIES
TYPE TREATMENT RECEIVED
© 1998 T. E. BEARDEN
EXPRESSED IN FRACTION SURVIVING
With conventional treatment
With 1st generation P-treatment
With 2nd generation P-treatment
With 3rd generation P-treatment

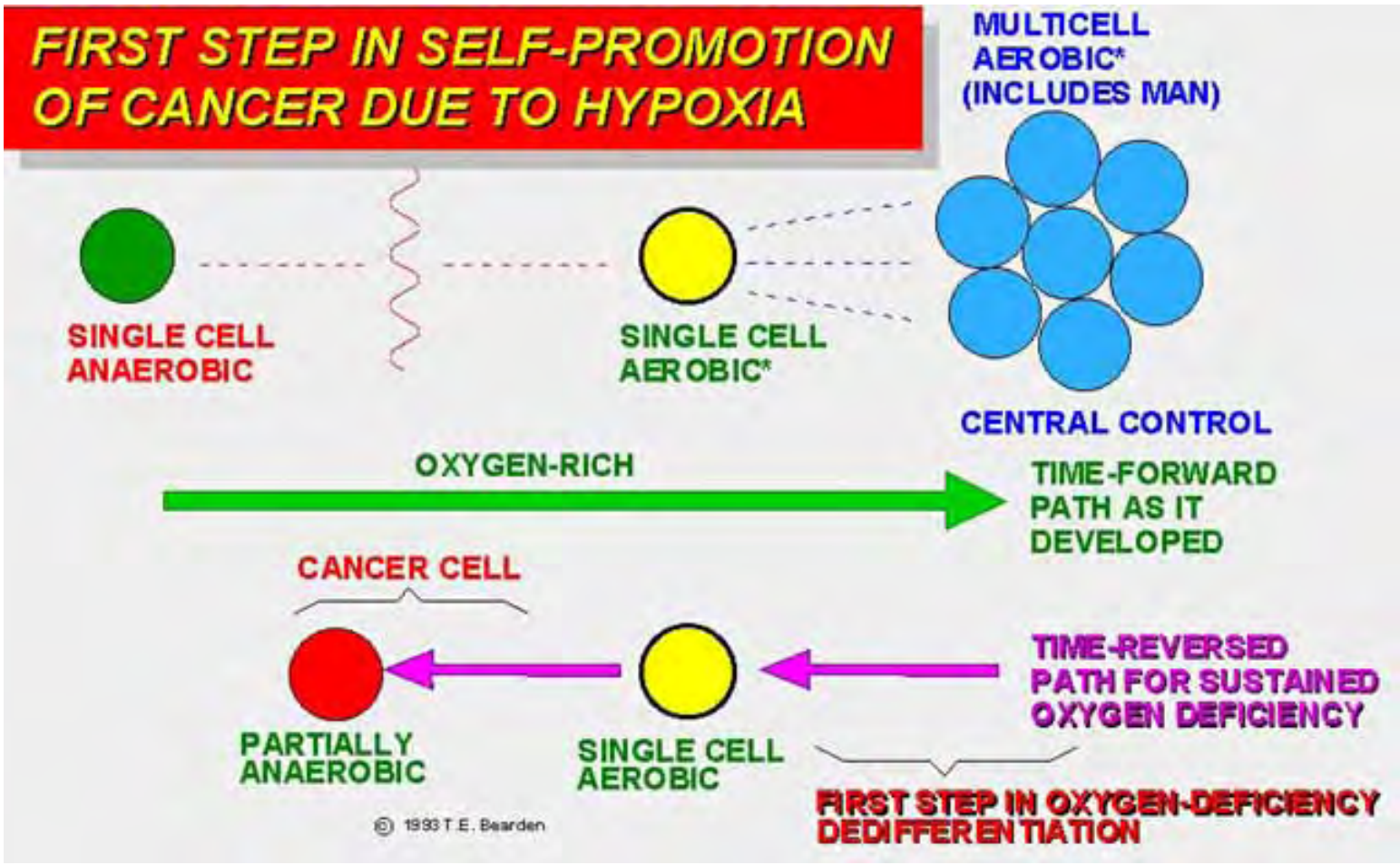
FIRST STEP IN SELF-PROMOTION OF CANCER DUE TO HYPOXIA
MULTICELL AEROBIC* (INCLUDES MAN)
SINGLE CELL ANAEROBIC
SINGLE CELL AEROBIC*
CENTRAL CONTROL
OXYGEN-RICH
TIME-FORWARD PATH AS IT DEVELOPED
CANCER CELL
TIME-REVERSED PATH FOR SUSTAINED OXYGEN DEFICIENCY
PARTIALLY ANAEROBIC
SINGLE CELL AEROBIC
FIRST STEP IN OXYGEN-DEFICIENCY DEDIFFERENTIATION
© 1993 T.E. Bearden

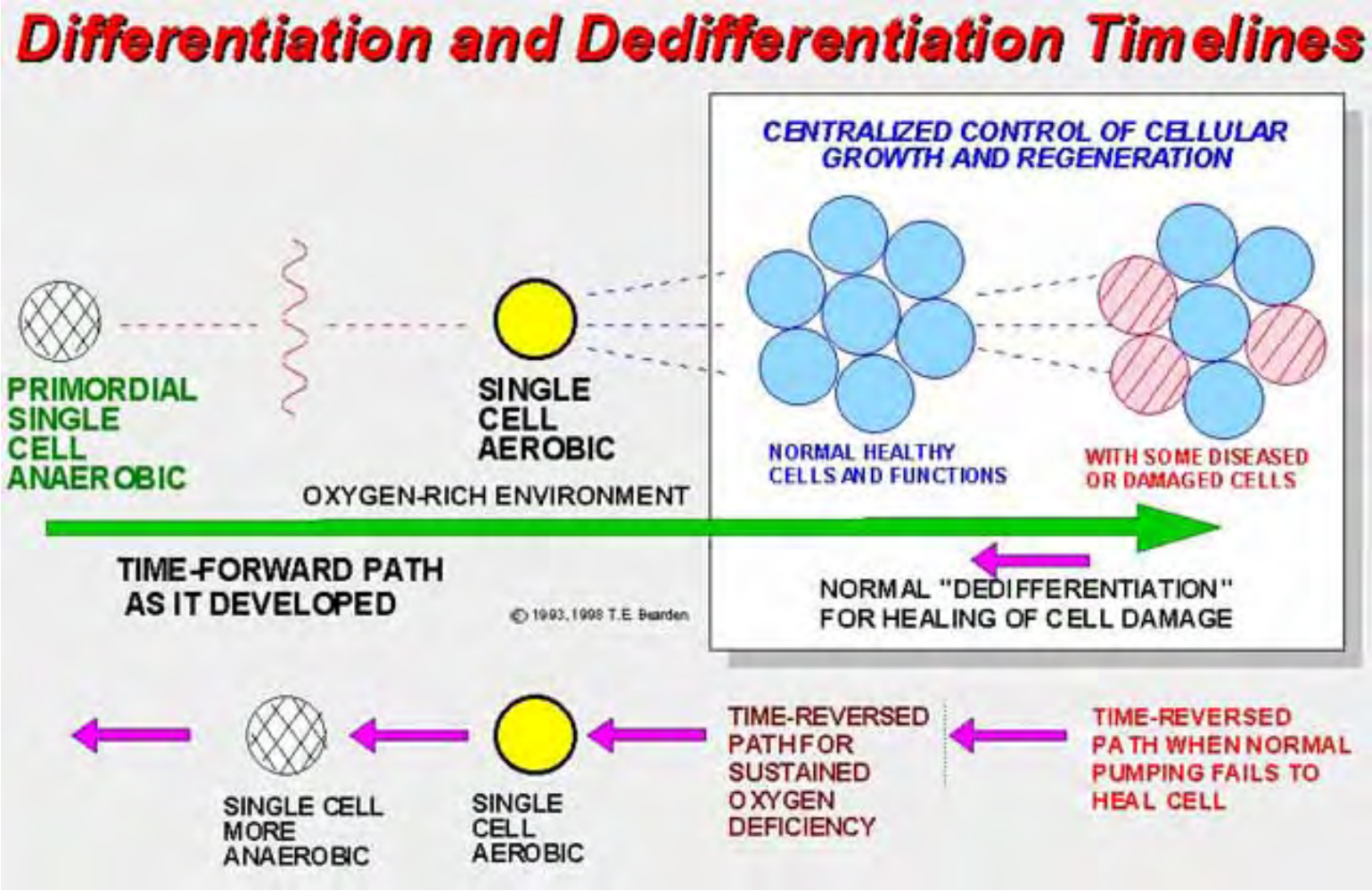
Differentiation and Dedifferentiation Timelines
CENTRALIZED CONTROL OF CELLULAR GROWTH AND REGENERATION
PRIMORDIAL SINGLE CELL ANAEROBIC
SINGLE CELL AEROBIC
OXYGEN-RICH ENVIRONMENT
NORMAL HEALTHY CELLS AND FUNCTIONS
WITH SOME DISEASED OR DAMAGED CELLS
TIME-FORWARD PATH AS IT DEVELOPED
© 1993, 1998 T.E. Bearden
NORMAL "DEDIFFERENTIATION" FOR HEALING OF CELL DAMAGE
SINGLE CELL MORE ANAEROBIC
SINGLE CELL AEROBIC
TIME-REVERSED PATH FOR SUSTAINED OXYGEN DEFICIENCY
TIME-REVERSED PATH WHEN NORMAL PUMPING FAILS TO HEAL CELL

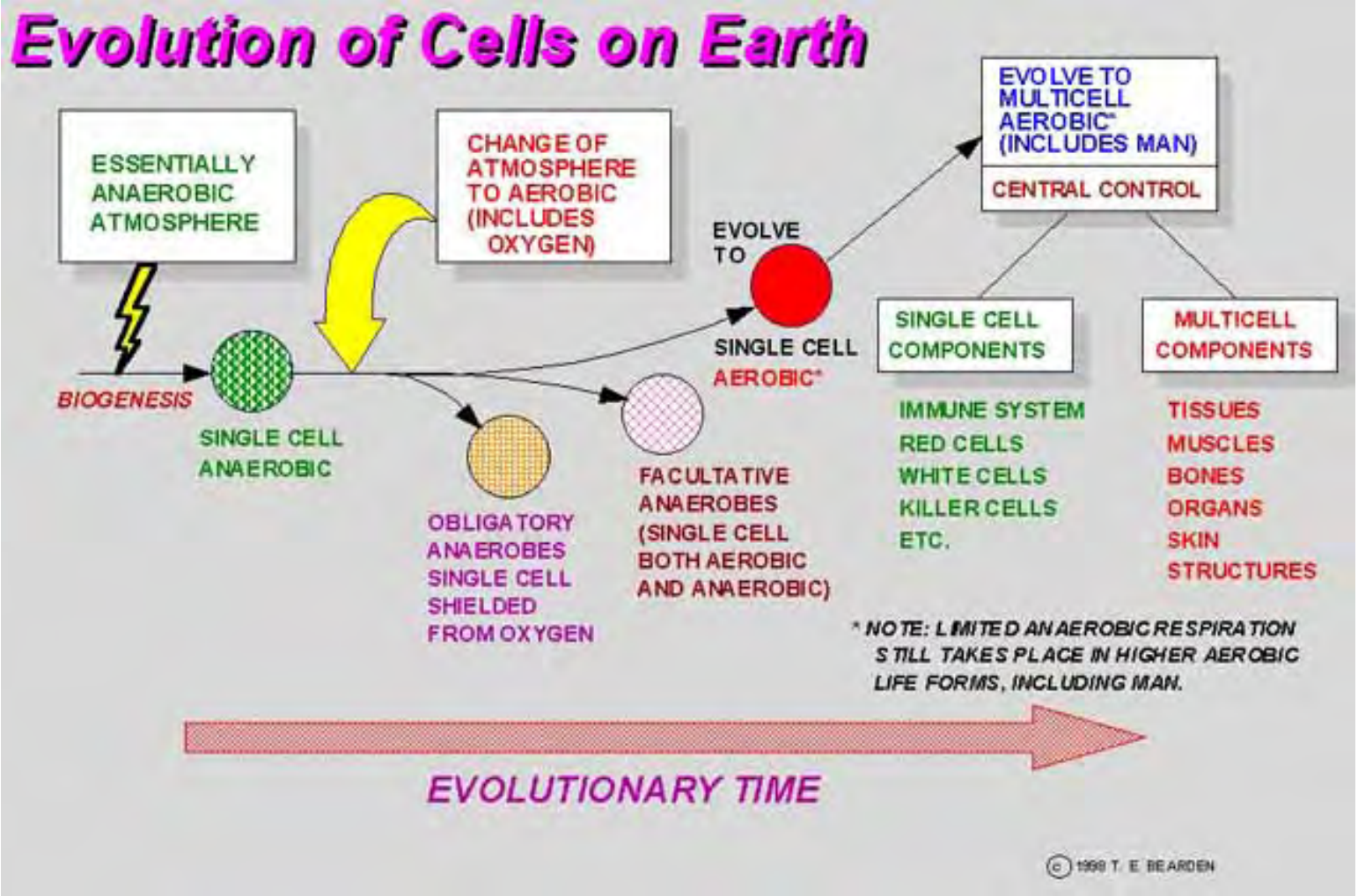
Evolution of Cells on Earth
ESSENTIALLY ANAEROBIC ATMOSPHERE
CHANGE OF ATMOSPHERE TO AEROBIC (INCLUDES OXYGEN)
EVOLVE TO MULTICELL AEROBIC* (INCLUDES MAN)
CENTRAL CONTROL
EVOLVE TO
SINGLE CELL AEROBIC*
SINGLE CELL COMPONENTS
MULTICELL COMPONENTS
BIOGENESIS
SINGLE CELL ANAEROBIC
OBLIGATORY ANAEROBES SINGLE CELL SHIELDED FROM OXYGEN
FACULTATIVE ANAEROBES (SINGLE CELL BOTH AEROBIC AND ANAEROBIC)
IMMUNE SYSTEM
RED CELLS
WHITE CELLS
KILLER CELLS
ETC.
TISSUES
MUSCLES
BONES
ORGANS
SKIN
STRUCTURES
* NOTE: LIMITED ANAEROBIC RESPIRATION STILL TAKES PLACE IN HIGHER AEROBIC LIFE FORMS, INCLUDING MAN.
EVOLUTIONARY TIME
© 1999 T. E. BEARDEN

A Charged Particle q Is a Coupled System of m and ϕ

(A proposed formal definition of a charged mass)

Note: X is a coupling operator

$$q \equiv f_q \times m_q$$

Also note that the ϕ portion of the charged particle can be internally structured, per Stoney-Whittaker-Ziolkowski, with hidden bidirectional EM wavepairs (their sums and products). Note that this constitutes an EM application of Bohm-type hidden variable theory, with many ramifications.

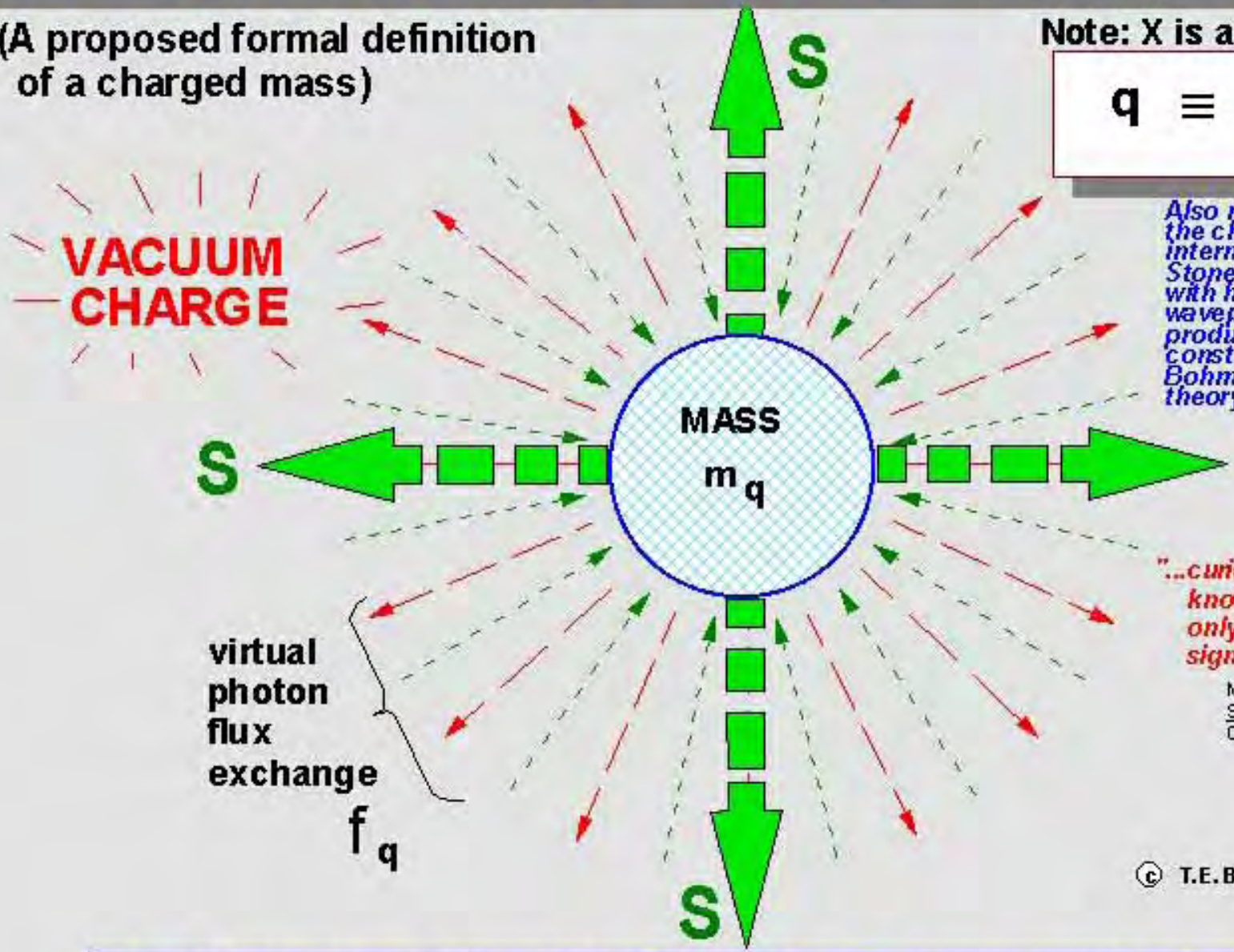

S = EXH

"...curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."

M.P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, 1993, p. 127.

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An electric charge Q consists of a massless flux component and a mass component, coupled together (interacting). Q is a broken symmetry. The mass of the charge continually and violently exchanges virtual photons with the surrounding vacuum.

Thus Q is energetically driven by the surrounding vacuum potential, which itself is to first order just a violent virtual photon flux.

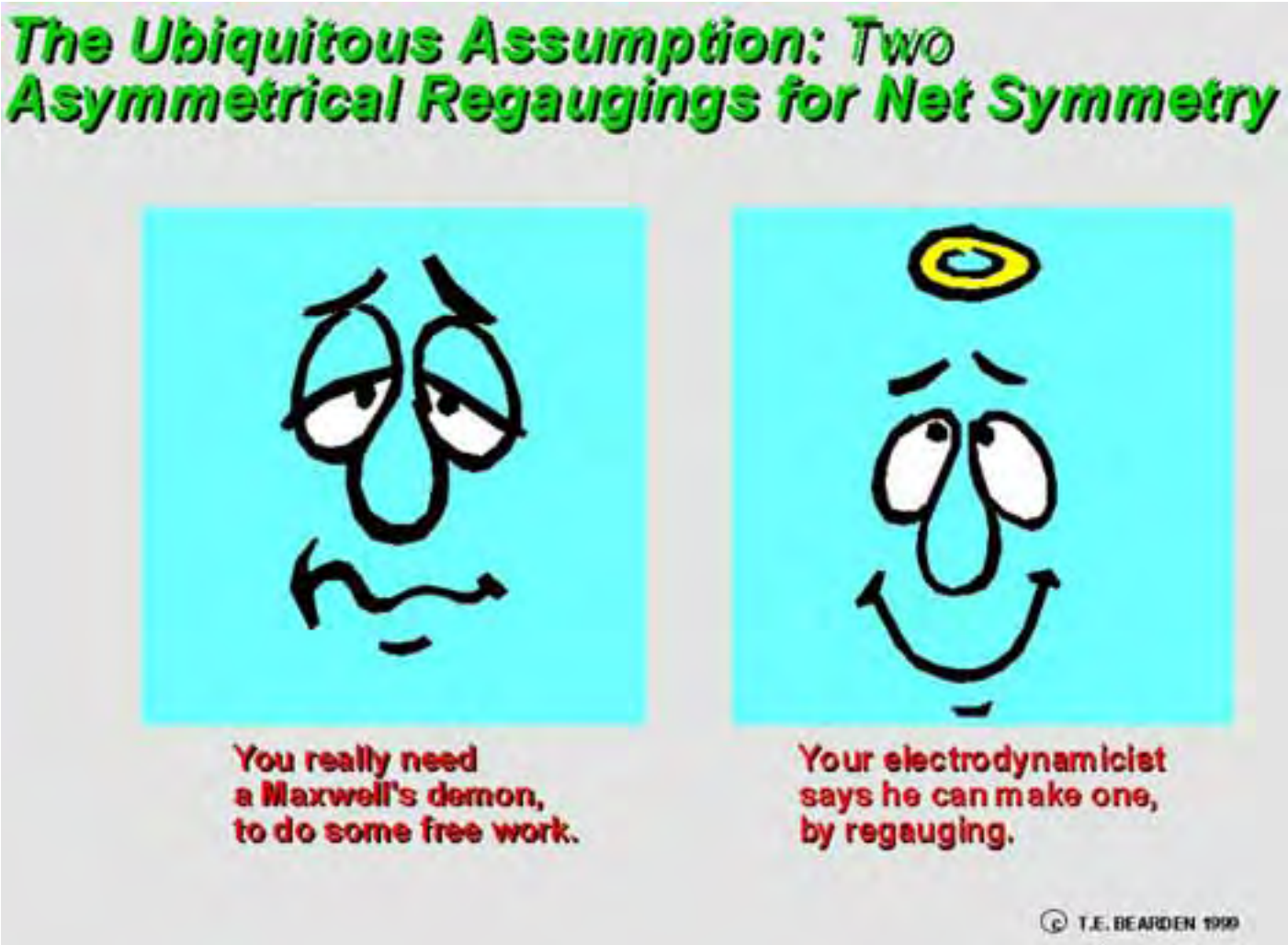
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
You really need a Maxwell's demon, to do some free work.
Your electrodynamicist says he can make one, by regauging.
© T.E. BEARDEN 1999

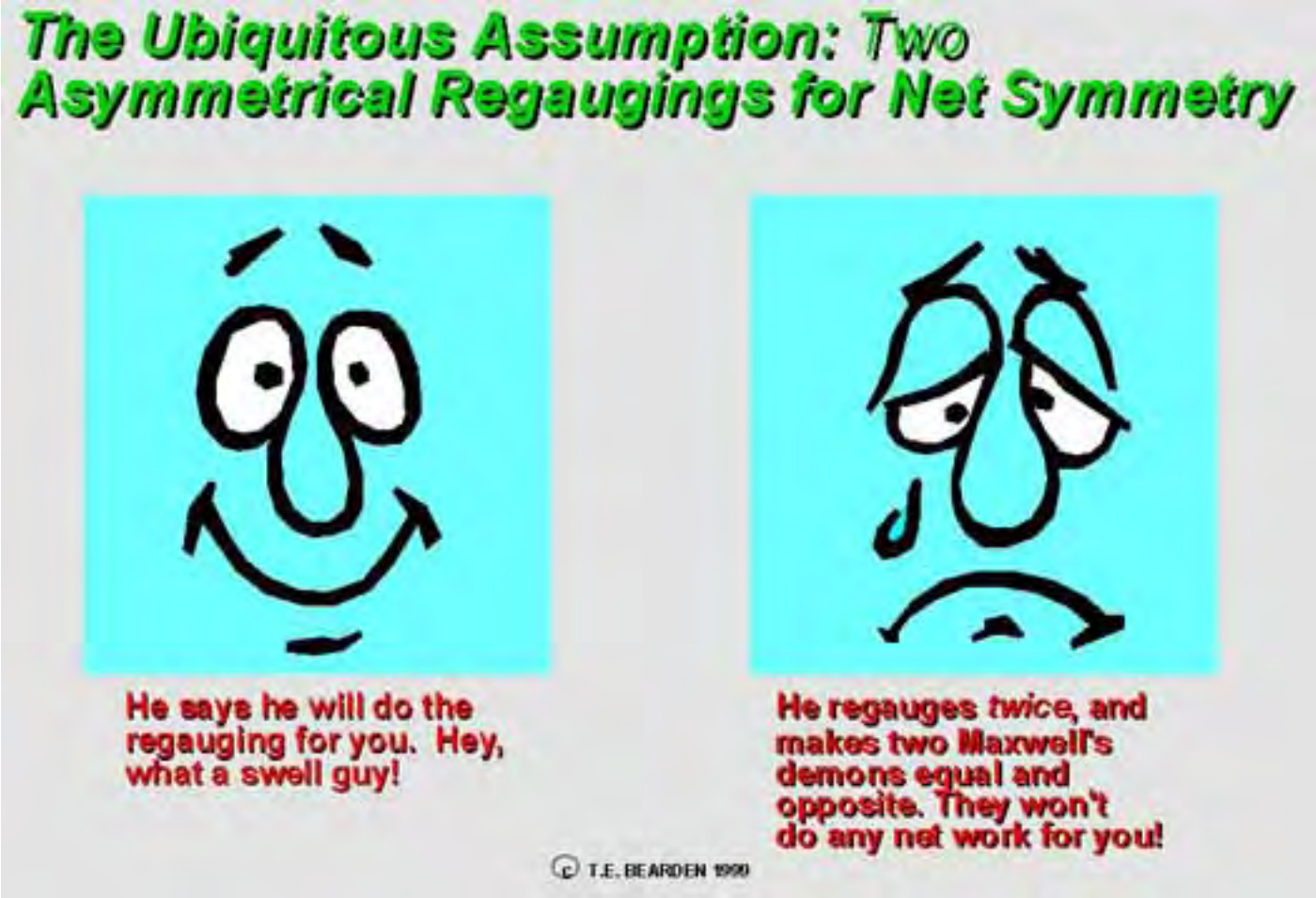
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
He says he will do the regauging for you. Hey, what a swell guy!
He regauges twice, and makes two Maxwell's demons equal and opposite. They won't do any net work for you!
© T.E. BEARDEN 1990

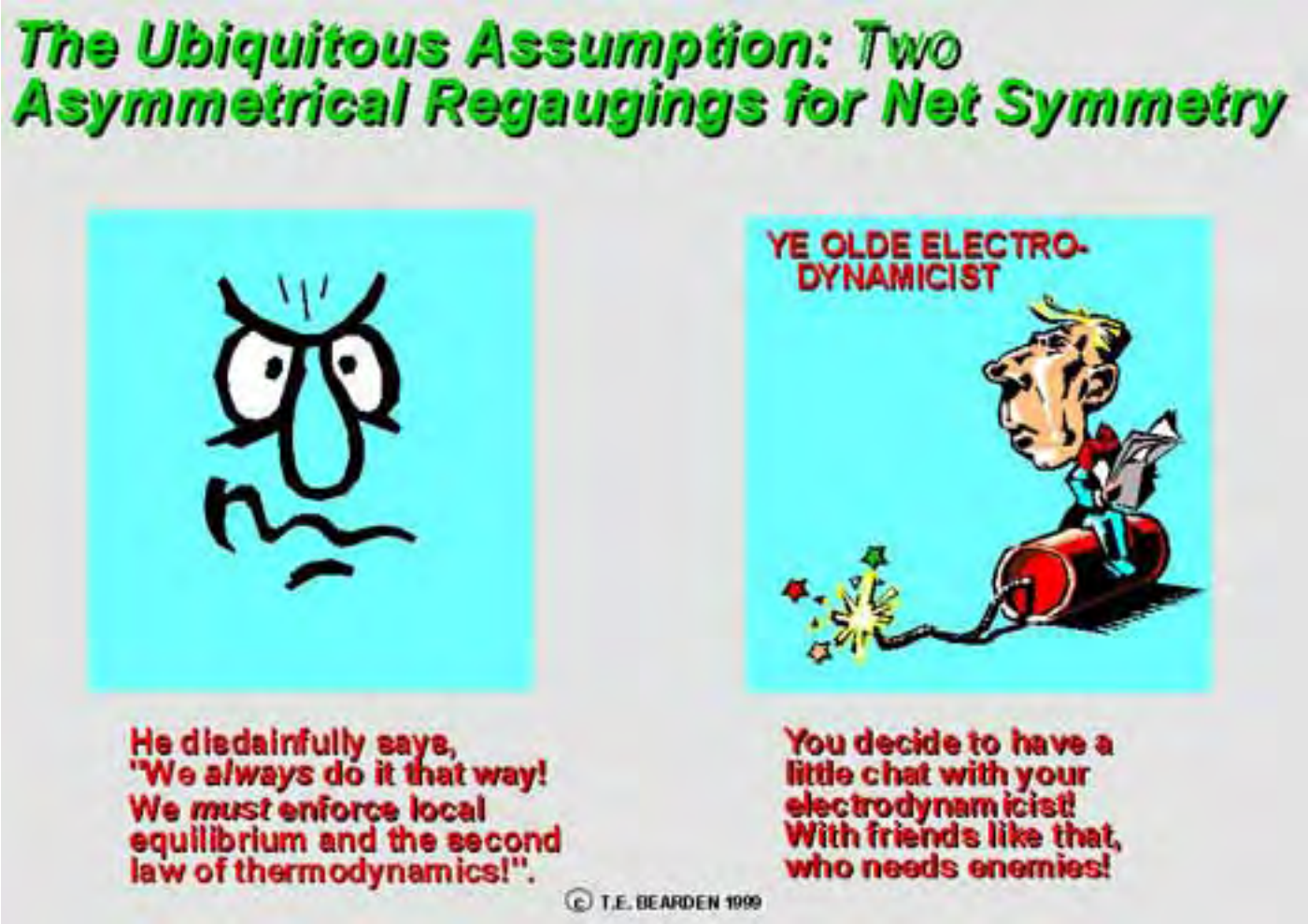
The Ubiquitous Assumption: Two Asymmetrical Regaugings for Net Symmetry
YE OLDE ELECTRO-DYNAMICIST
He disdainfully says, "We always do it that way! We must enforce local equilibrium and the second law of thermodynamics!".
You decide to have a little chat with your electrodynamicist! With friends like that, who needs enemies!
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A Charged Particle Is a Coupled System

(The first formal definition of charge)

$$q \equiv \phi_q \times m_q$$

Note: X is a coupling operator

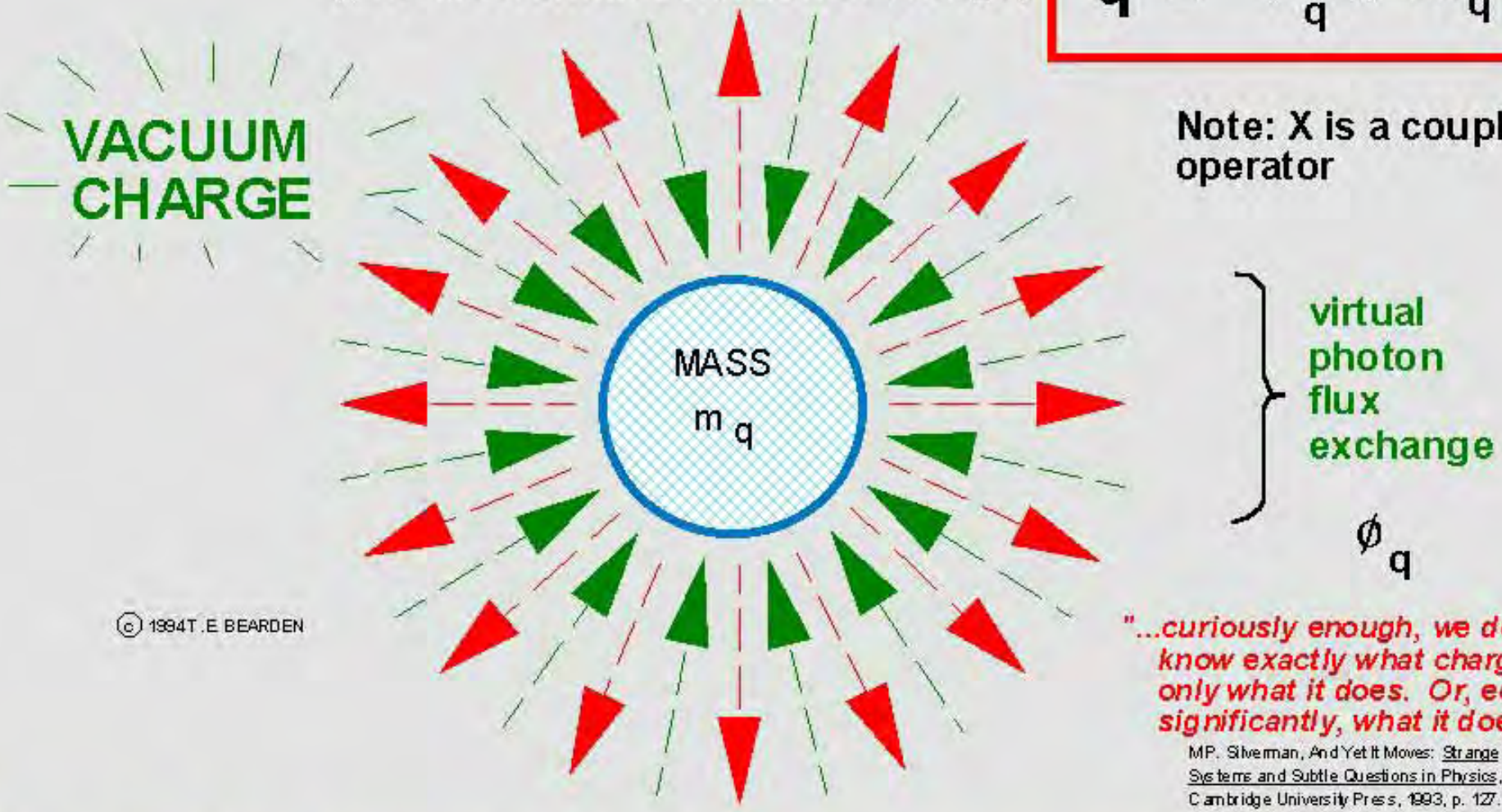

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"...curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."

M.P. Silverman, And Yet It Moves: Strange Systems and Subtle Questions in Physics, Cambridge University Press, 1993, p. 127.

An electric charge q is a broken symmetry in its fierce energy exchange with the active vacuum. It coherently integrates some of the virtual energy absorbs and outputs it as Poynting energy flow.

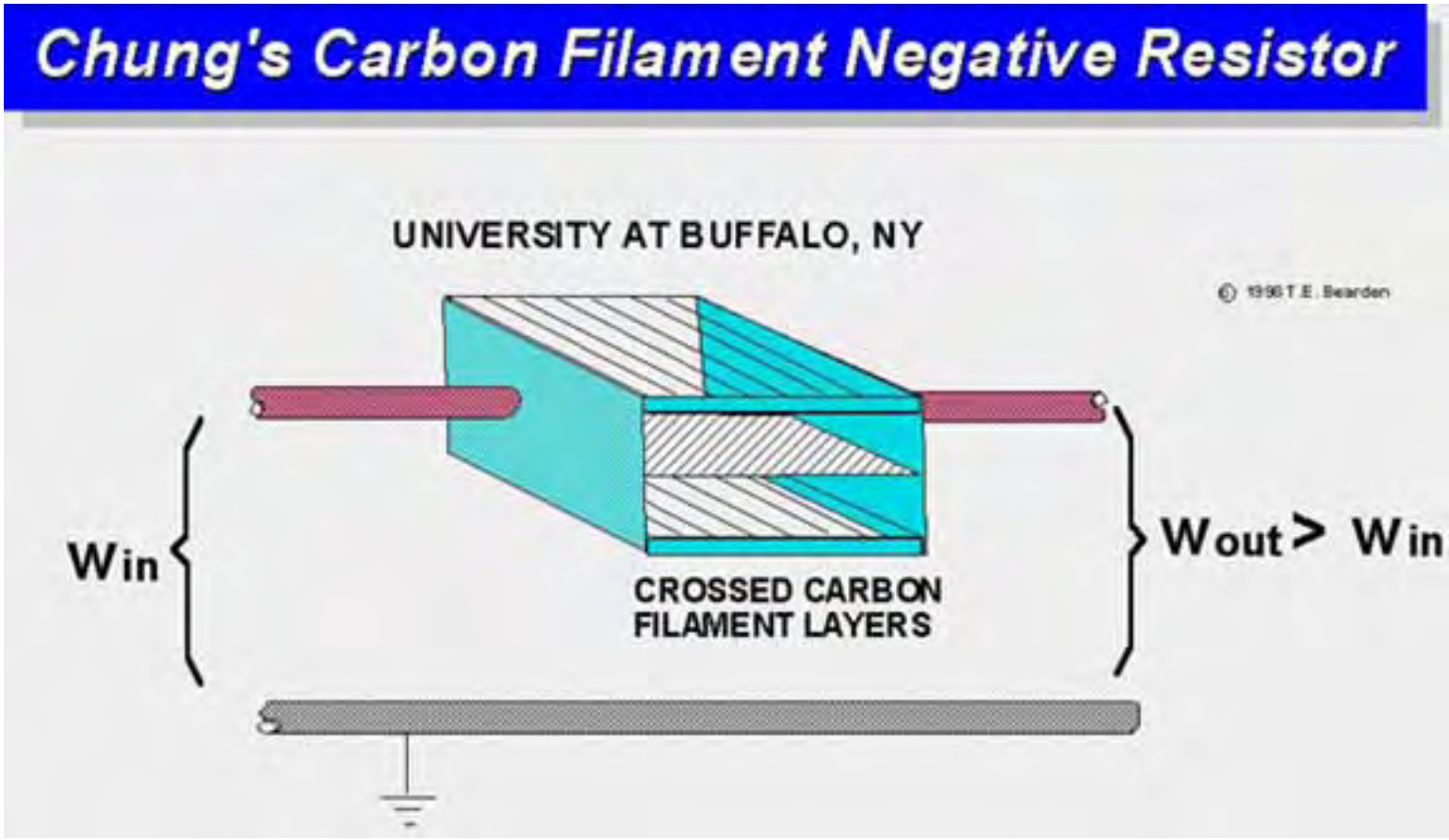
Chung's Carbon Filament Negative Resistor
UNIVERSITY AT BUFFALO, NY
© 1996 T.E. Bearden
Win
Wout > Win
CROSSED CARBON
FILAMENT LAYERS

Typical circuit has about 10^{-13} energy collection efficiency

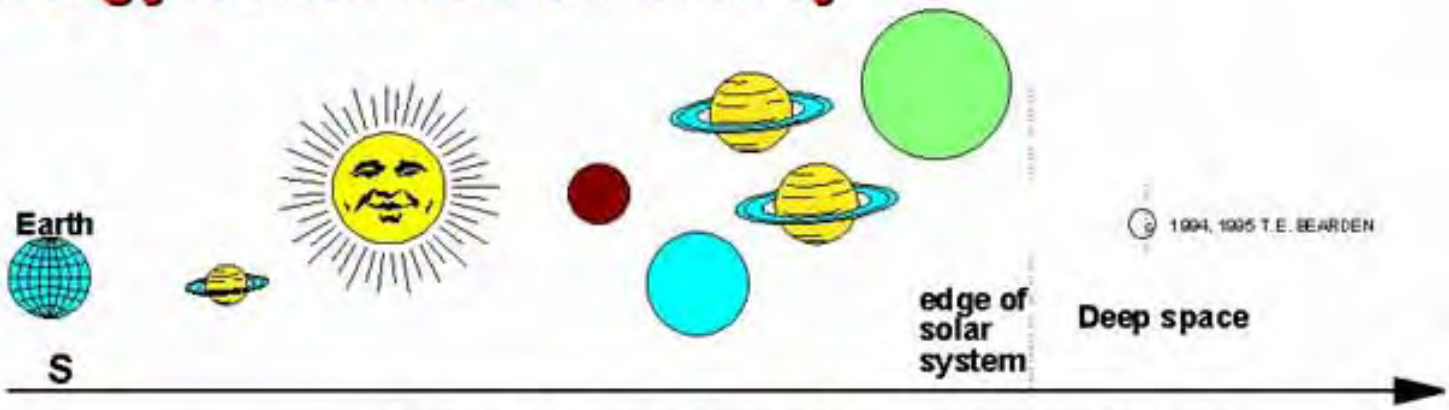

Distance traveled by S in one hour is 1.08x10exp(12) meters.

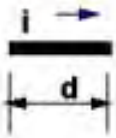

Example: 1.3 amps flowing in DC circuit, 1.8 mm diameter copper wire. J = 51 A/cm ^{2}

d_j = 0.1368 meters

S violently transports ϕ provided from the source.
j ϕ sluggishly transports the energy collected and dissipated in the circuit..

For the case discussed, the electron drift velocity in the circuit is about 3.8 x 10^{-5} meters/sec. So Jϕ moves about 0.1368 meters in one hour. Thus Jϕ has collected about 0.1368 meters of the ϕ-filled S-tube. During that same hour, the S-flow evoked by the power source will have traveled 1.08x10^{12} meters. The ϕ of both currents is the same. Both are involved in the same energy-filled tube. Thus S has provided and transported about 7.89x10^{12} times as much energy along the circuit in one hour as the jϕ has been able to collect, transport, and dissipate as work in the circuit. Thus this circuit provides about 10^{13} collection efficiency.

Classical View of EM

- Potentials just mathematical conveniences
  - Not real
  - No internal structure, just magnitude
- Force fields primary, causative, can exist in space in absence of observable mass
  - All EM actions due to force fields, none when zero
  - No action at a distance
- Vacuum empty; without energy or structure
  - No locally curved spacetime
  - No gravity effects
  - No quantum effects
- Maxwell's equations complete
  - Symmetrically regauged ***arbitrarily***
  - Topology dramatically reduced

Curved Spacetime acts as source or sink

- May emit excess radiation and energy (e.g., heat)
- May absorb radiation and energy (e.g., cool)
- May transduce waves TW ⇔ LW ⇔ TDW
- New energy conservation law applies

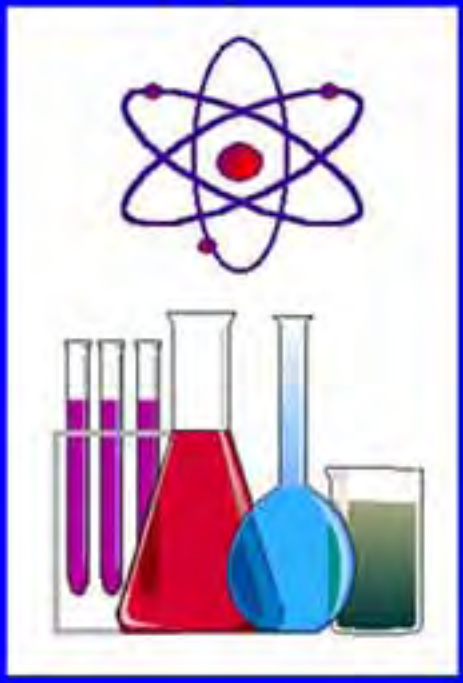

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CHRONIC DISEASE PUZZLING

- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
- MANY TROUBLING FACTORS EXIST
  - *MIND*
  - *STRESS*
  - *SPONTANEOUS REMISSION*
  - *PLACEBO EFFECTS*
  - *COMBINATIONS*
- GENERATION OF THE PLACEBO EFFECT BY THE CELLULAR REGENERATION SYSTEM IS UNRECOGNIZED

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Cancer Characteristics

- Not one disease, but a whole range
- Starts in damaged aerobic cell
- Cell shakes off body's central control
  - Starts uncontrolled division
  - Becomes a lump
- Can send forth cancer cells
  - Through blood
  - Through lymph
- Form metastases (secondary tumors)
- Often become anaerobic

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Solving a Cancer Enigma

- An enigma has been failure of immune system to attack some tumor cells
  - Suppressor cells may curb immune system?
  - Tumor may lack antigens normally identified by the immune system?
- *Promotion of damaged cell to cancer is usually ordered by cellular control system*
  - *Regenerative and recovery system forces cell back toward anaerobe*
  - *First step breaks free from central growth*
  - *Control continues to recognize cell as self*

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CANCER: CHARACTERISTICS

- NOT ONE DISEASE BUT A WHOLE RANGE
- STARTS IN ORDINARY (AEROBIC) CELL
- CELL SHAKES OFF BODY'S DICTATORIAL CONTROL*
- STARTS UNCONTROLLED DIVISION
- BECOMES A LUMP
- CAN SEND FORTH CANCER CELLS
  - THROUGH BLOOD
  - THROUGH LYMPH
- THESE FORM METASTASES (SECONDARY TUMORS)
- OFTEN BECOME ANAEROBIC (NON-OXYGEN USING)
- ENIGMA IS FAILURE OF IMMUNE SYSTEM TO ATTACK SOME TUMOR CELLS
  - SUPPRESSOR CELLS MAY CURB IMMUNE SYSTEM
  - TUMOR MAY LACK ANTIGENS NORMALLY IDENTIFIED BY THE IMMUNE SYSTEM

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*R&R system forces cell back toward anaerobe

Nonlinear Optics
Distortion Correction Theorem

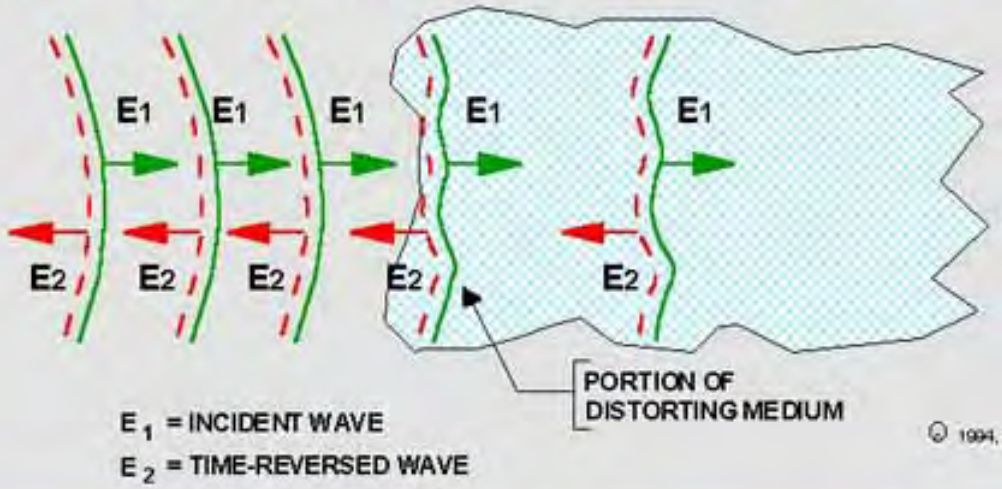

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"If a scalar wave $E_1(r)$ propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica $E_2(r)$, then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1."

The Electronuclear Reaction: Nuclear Reactions in TR-Zones (1)

- Nucleon interchange
  - Changes neutron into proton and vice versa
  - At high rate (flat spacetime assumed)
- Statistics become skewed due to curved ST
- Can bias statistics toward either neutron or proton end
  - Biases toward transmutation of elements along isomer chains
  - Concept of "isomer" is vastly expanded

The Electronuclear Reaction: Nuclear Reactions in TR-Zones (2)

- **Normal dynamics (impulses) may reverse**
  - *Like charges attract, unlike charges repel*
  - *Positive charges cluster (are drawn together)*
  - *H+ ions (protons) may form quasi-nuclei*
  - *Nucleus coulomb barrier becomes assistant*
- **Many "impossible" reactions now possible**
  - *Quark access and quark flipping by EM*
  - *Ion clustering*
  - *Positive charges as phase conjugate mirrors*
  - *Time-density waves and time-energy charging*

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The Electronuclear Reaction: Nuclear Reactions in TR-Zones (3)

- **Not observed until time-energy charging has become substantial**
  - *Time delay (hours, days)*
  - *Transduction of LW --> TW involved*
  - *Specific time-charging history of detectors is involved in twhether they detect or not*
  - *Longitudinal EM waves become significant*
- **Curved spacetime can act as source or sink**
  - *May emit excess radiation*
  - *May absorb excess radiation*

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In Time-Reversed Zone:
Nuclear reactions are biased

- In normal flat ST, n ⇔ p at high rate
- Curved ST skews statistics
- Biases to either n or p
- Biases to transmutation along isomer chain
- "Isomer" concept greatly expanded

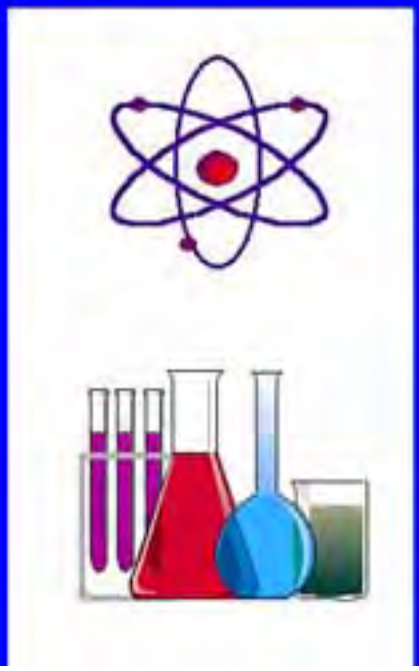

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In Time-Reversed Zone: Dynamics may be reversed

- Like charges may attract and unlike charges repel
- Coulomb barrier becomes Coulomb assistant
- Clusters like charges and forms artificial nuclei
- "Impossible" nuclear reactions at low energy
- Time-density interactions

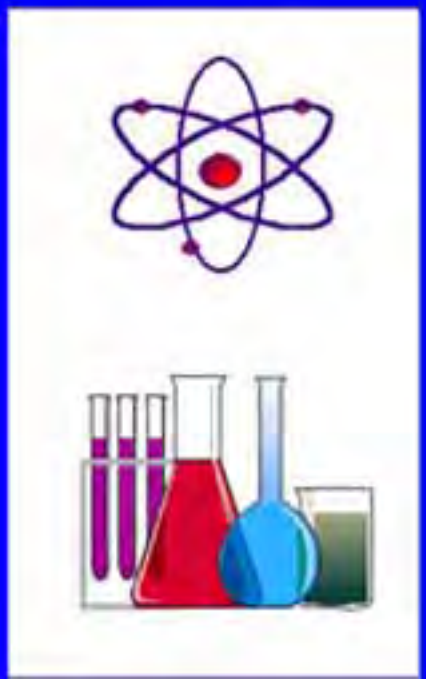

Time-Reversed Zone:

Significant only after time-density charging

- Hours, for "fast" onset
- Days, for "slower" onset
- Transduction involved for TW ⇔ LW ⇔ TDW
- Time-history of each detector is significant
- Longitudinal EM waves become significant

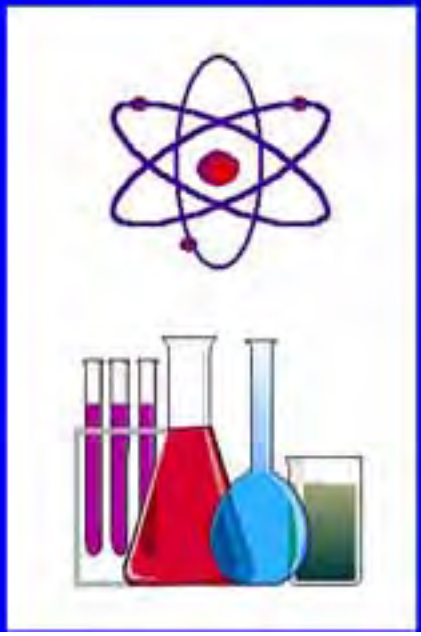

A New Conservation of Energy Law

- Physics conserves total "energy and mass-energy"
- Now also must consider "time-energy"
- Conserve total mass-time-energy (spatiotemporal energy)
- Let E_T = total energy, E_M = mass energy, E_E = ordinary energy, and E_t = time energy. Then

$$E_T = E_E + E_M + E_t$$

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$$(kE_t \Rightarrow E_E > 0) \Rightarrow E_T > (E_M + E_E)$$

- If some E_t is transduced into E_E, the experiment will violate the old spatial mass-energy conservation law

QUESTIONS ON CARCINOGENS AND EM RADIATION

- UNRESOLVED QUESTIONS ON EM RADIATION
  - DOSAGES
  - ACTIVE MECHANISMS
  - REPLICATION DIFFICULTIES
  - MEASUREMENT DIFFICULTIES
  - WHERE, WHEN, HOW ILL EFFECTS OCCUR
- SIMILAR QUESTIONS EXIST ABOUT EVERY CARCINOGEN
- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
  - FACTORS SUCH AS MIND, STRESS, SPONTANEOUS REMISSION, PLACEBO EFFECTS, AND COMBINATIONS OF FACTORS ARE PARTICULARLY TROUBLESOME
  - GENERATION OF THE PLACEBO EFFECT BY THE REGENERATION & RECOVERY SYSTEM IS UNRECOGNIZED

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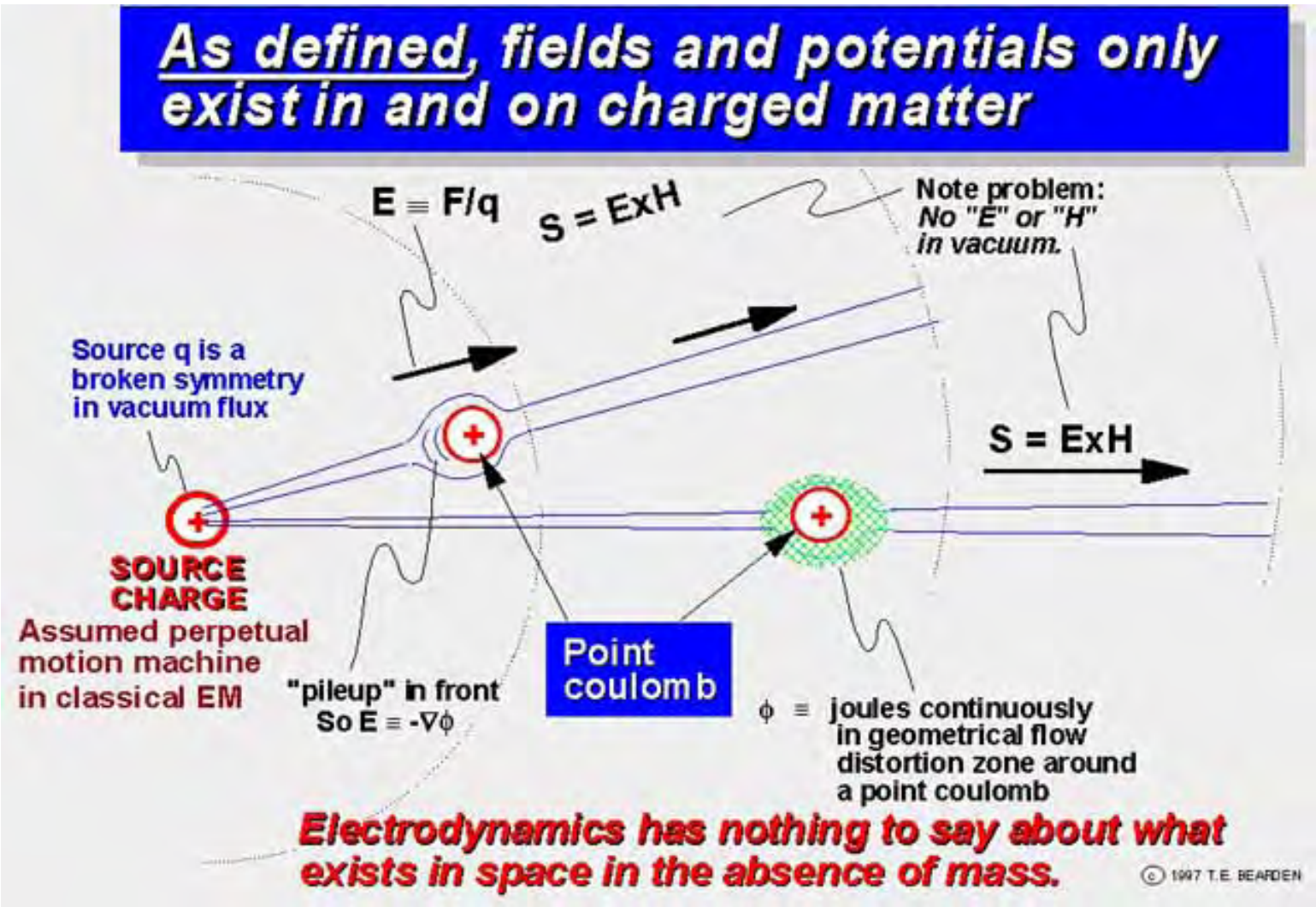
As defined, fields and potentials only exist in and on charged matter
E ≡ F/q
S = ExH
Note problem:
No "E" or "H"
in vacuum.
Source q is a
broken symmetry
in vacuum flux
S = ExH
SOURCE
CHARGE
Assumed perpetual
motion machine
in classical EM
"pileup" in front
So E ≡ -∇ϕ
Point
coulomb
ϕ ≡ joules continuously
in geometrical flow
distortion zone around
a point coulomb
Electrodynamics has nothing to say about what
exists in space in the absence of mass.
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Serious flaws and errors in classical EM theory.

1. Eliminates the Internal EM Inside the Scalar Potential.
2. No Definition of Electrical Charge or of Scalar Potential.
3. Equations Still Assume Material Ether Per Maxwell (Unchanged).
4. Use of Force Fields in Vacuum is False (and Known to be So).
5. Treats Charge q as Unitary Instead of Coupled System $q = \phi[q]m(q)$.
6. Confuses Massless Potential Gradients as Forces (See #3, #4).
7. Does Not Utilize Mass as a Component of Force (See #23).

8. Erroneously Assumes EM Force Fields as Primary Causes.
9. Topology of EM Model Has Been Substantially Reduced.
10. Does Not Include Quantum Potential or Action at a Distance.
11. Does Not Include Superluminal Velocity of Inner EM Components.
12. Does Not Utilize Extended Near-Field Coulomb Gauge Effects.
13. Does Not Include EM Generatrix Mechanism for Time Flow.
14. Does Not Unify Photon and Wave Aspects (Requires 7-D Model).

15. Does Not Include Electron Spin and Precession (See #19, #24).
16. Treats EM Energy As Existing In "Chunks," Instead of as Flow.
17. Confuses Energy and Energy Collection (See #16).
18. Discards Half of Every EM Wave in Vacuum (See #22).
19. Erroneously Uses Transverse Vacuum Wave; It's Longitudinal.
20. Arbitrarily Regauges Maxwell's Equations to Eliminate Overunity.
21. Omits Phase Conjugate Optics Effects (The *Rule* in Internal EM).
22. Does Not Include EM Cause of Newtonian Reaction Force.
23. Erroneously Assumes Separate Force Acting on Separate Mass.
24. Confuses Detected Electron Precession Waves as Proving Transverse EM Waves in Vacuum (Remnant of Old "EM Fluid" Concept).
25. Due to Error in String Wave, Omits the Ubiquitous Antiwave.
26. *Assumes* Equilibrium; Not True Unless Include Vacuum Interactions.
27. Higher Topology Required, to Model Electromagnetic Reality.
28. Lorentz surface integration discards Poynting energy transport.
29. Has nothing at all to say about form of EM entities in massless space.
30. Eliminates the infolded general relativity using EM-force as curve agent.
31. Does not include longitudinal EM waves as time domain oscillations.
32. Does not include EM mechanism that generates time flow and flow rate.

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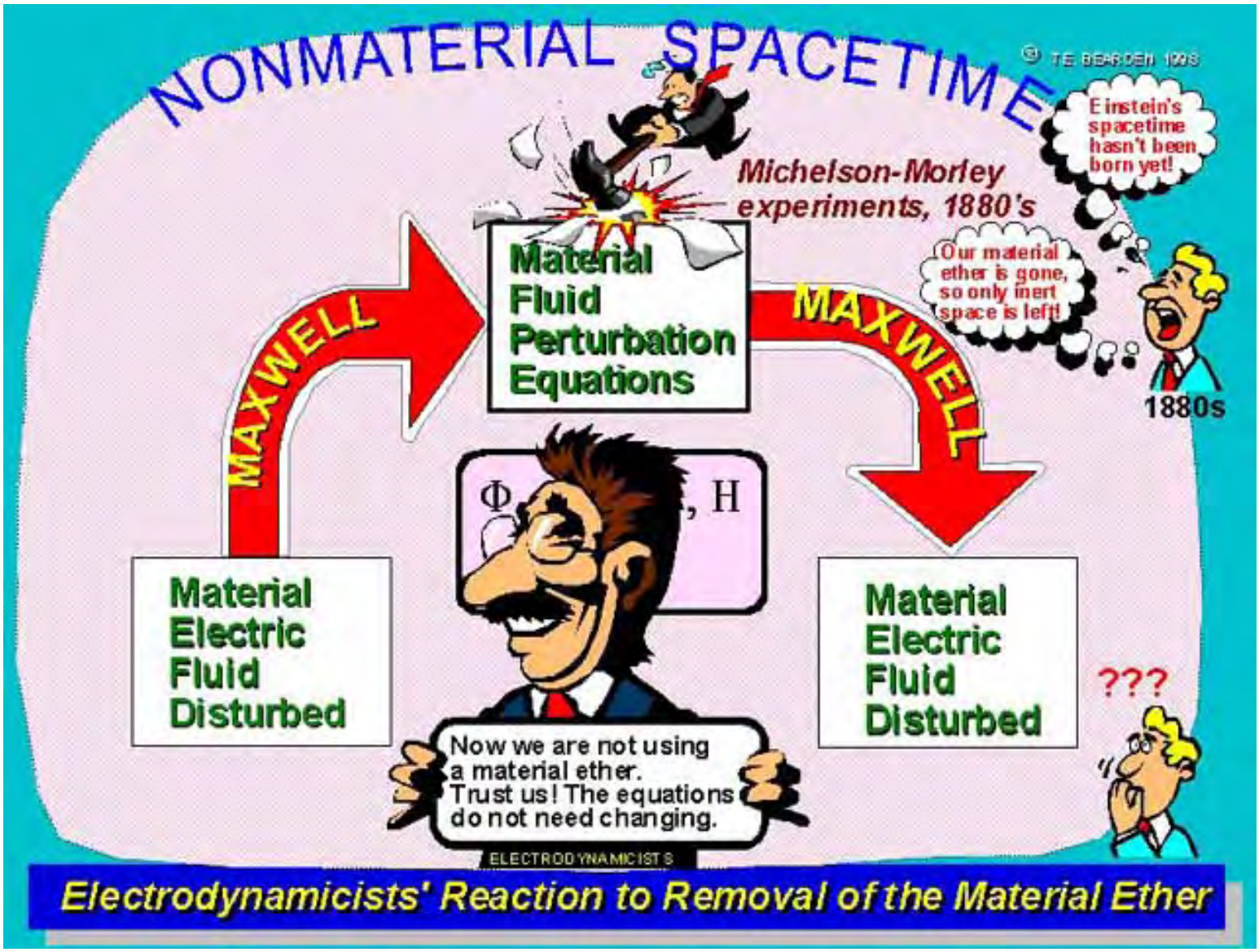
NONMATERIAL SPACETIME
© T.E. BEARDEN 1998
Einstein's spacetime hasn't been born yet!
Michelson-Morley experiments, 1880's
Our material ether is gone, so only inert space is left!
1880s
MAXWELL
Material Fluid Perturbation Equations
MAXWELL
Φ
, H
Material Electric Fluid Disturbed
Material Electric Fluid Disturbed
???
Now we are not using a material ether. Trust us! The equations do not need changing.
ELECTRODYNAMICISTS
Electrodynamicists' Reaction to Removal of the Material Ether

REACTION TO LOSS OF MATERIAL ETHER
Material Ether Assumed in Equations
Potentials, Fields, and Waves Assumed Material
Not a single equation was changed!
Now we are not using a material ether. Trust us! The equations do not need changing.
© T.E. BEARDEN 1999
ELECTRODYNAMICISTS

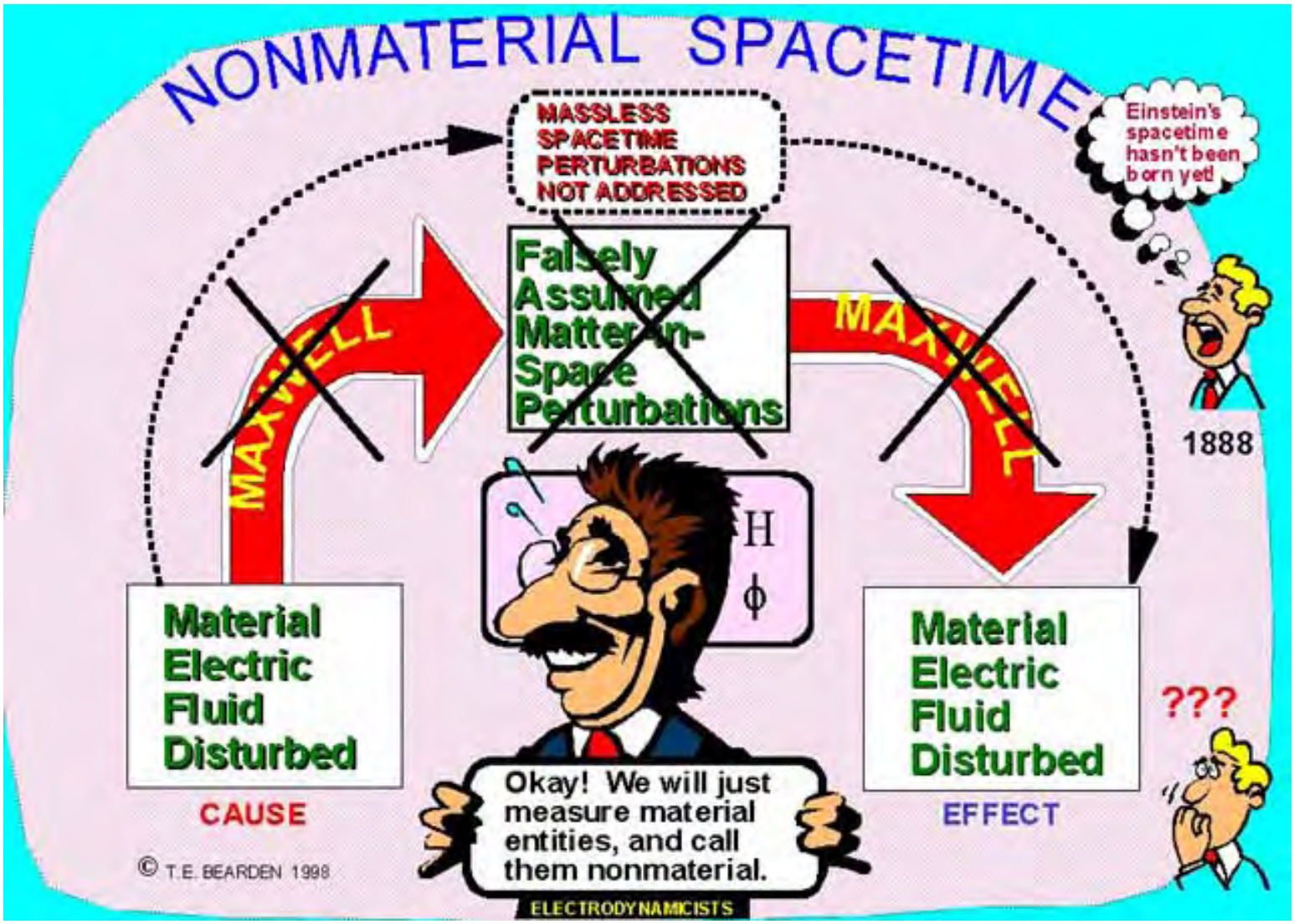
NONMATERIAL SPACETIME
MASSLESS SPACETIME PERTURBATIONS NOT ADDRESSED
Einstein's spacetime hasn't been born yet!
Falsely Assumed Matter-in-Space Perturbations
MAXWELL
MAXWELL
1888
H
ϕ
Material Electric Fluid Disturbed
CAUSE
Material Electric Fluid Disturbed
EFFECT
???
Okay! We will just measure material entities, and call them nonmaterial.
ELECTRODYNAMICISTS
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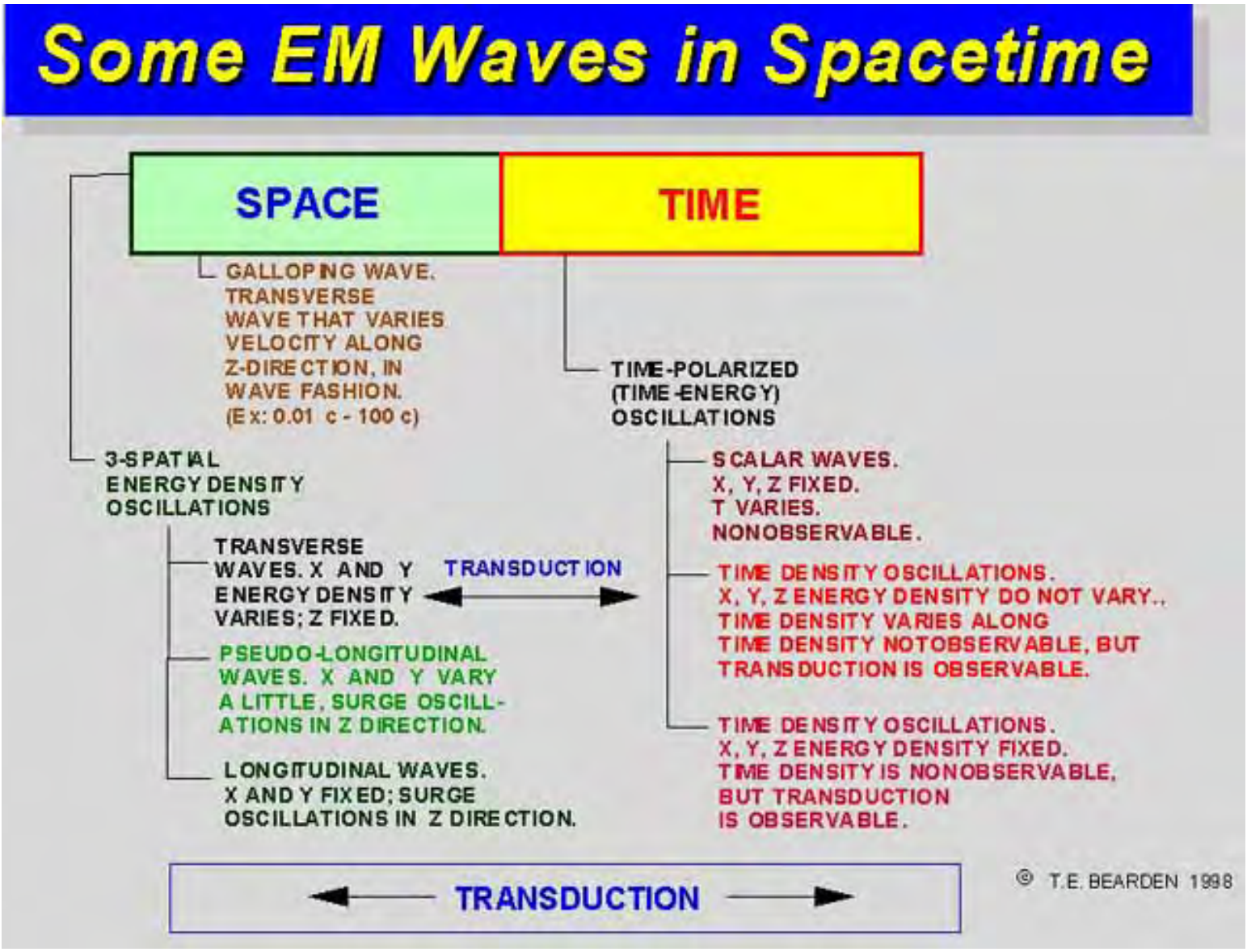
Some EM Waves in Spacetime
SPACE
TIME
GALLOPING WAVE. TRANSVERSE WAVE THAT VARIES VELOCITY ALONG Z-DIRECTION, IN WAVE FASHION. (Ex: 0.01 c - 100 c)
TIME-POLARIZED (TIME-ENERGY) OSCILLATIONS
3-SPATIAL ENERGY DENSITY OSCILLATIONS
SCALAR WAVES. X, Y, Z FIXED. T VARIES. NONOBSERVABLE.
TRANSVERSE WAVES. X AND Y ENERGY DENSITY VARIES; Z FIXED.
TRANSDUCTION
TIME DENSITY OSCILLATIONS. X, Y, Z ENERGY DENSITY DO NOT VARY., TIME DENSITY VARIES ALONG TIME DENSITY NOTOBSERVABLE, BUT TRANSDUCTION IS OBSERVABLE.
PSEUDO-LONGITUDINAL WAVES. X AND Y VARY A LITTLE, SURGE OSCILLATIONS IN Z DIRECTION.
LONGITUDINAL WAVES. X AND Y FIXED; SURGE OSCILLATIONS IN Z DIRECTION.
TIME DENSITY OSCILLATIONS. X, Y, Z ENERGY DENSITY FIXED. TIME DENSITY IS NONOBSERVABLE, BUT TRANSDUCTION IS OBSERVABLE.
TRANSDUCTION
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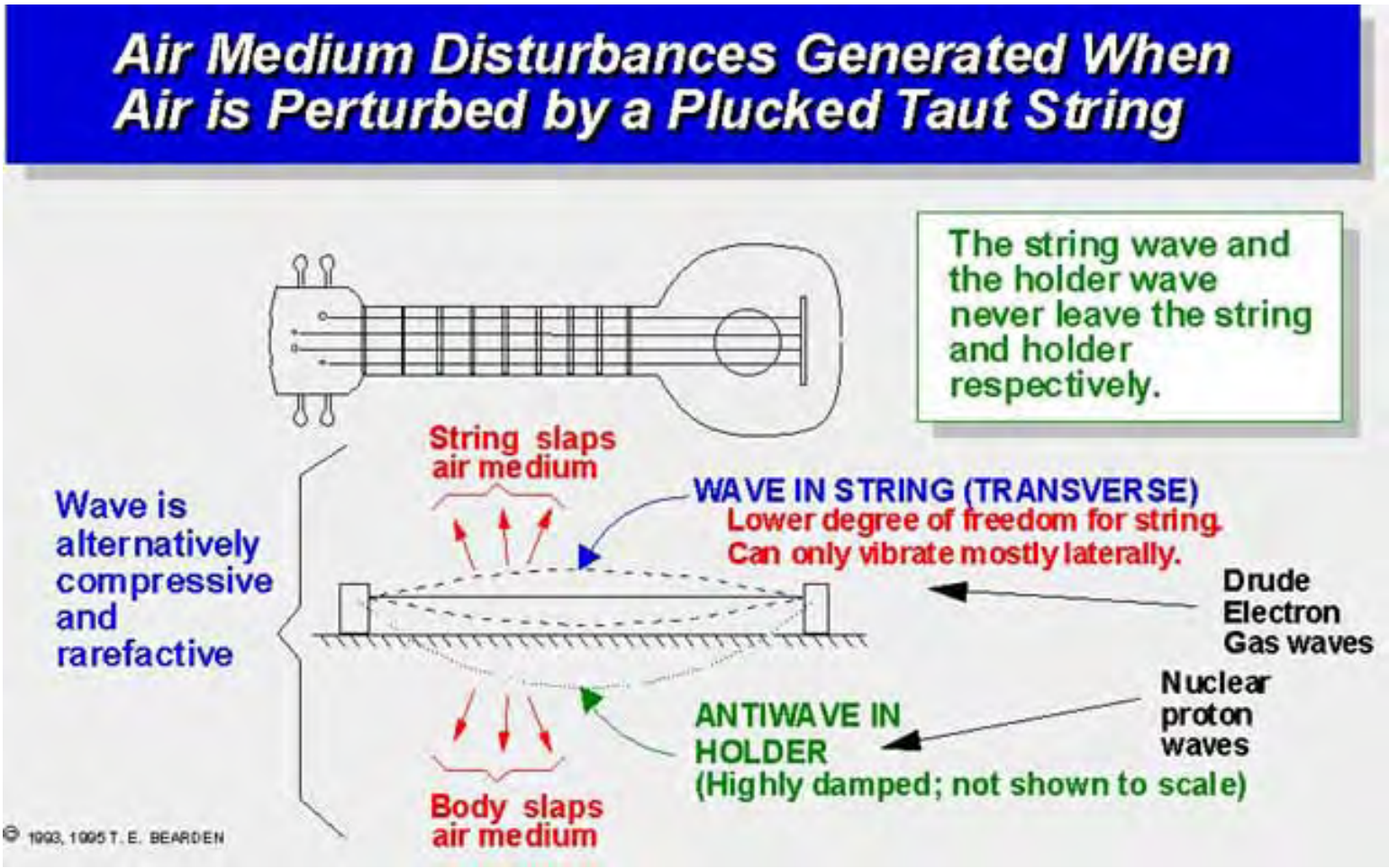
Air Medium Disturbances Generated When Air is Perturbed by a Plucked Taut String
The string wave and the holder wave never leave the string and holder respectively.
String slaps air medium
Wave is alternatively compressive and rarefactive
WAVE IN STRING (TRANSVERSE)
Lower degree of freedom for string.
Can only vibrate mostly laterally.
Drude Electron Gas waves
Nuclear proton waves
ANTIWAVE IN HOLDER
(Highly damped; not shown to scale)
Body slaps air medium
© 1993, 1995 T. E. BEARDEN

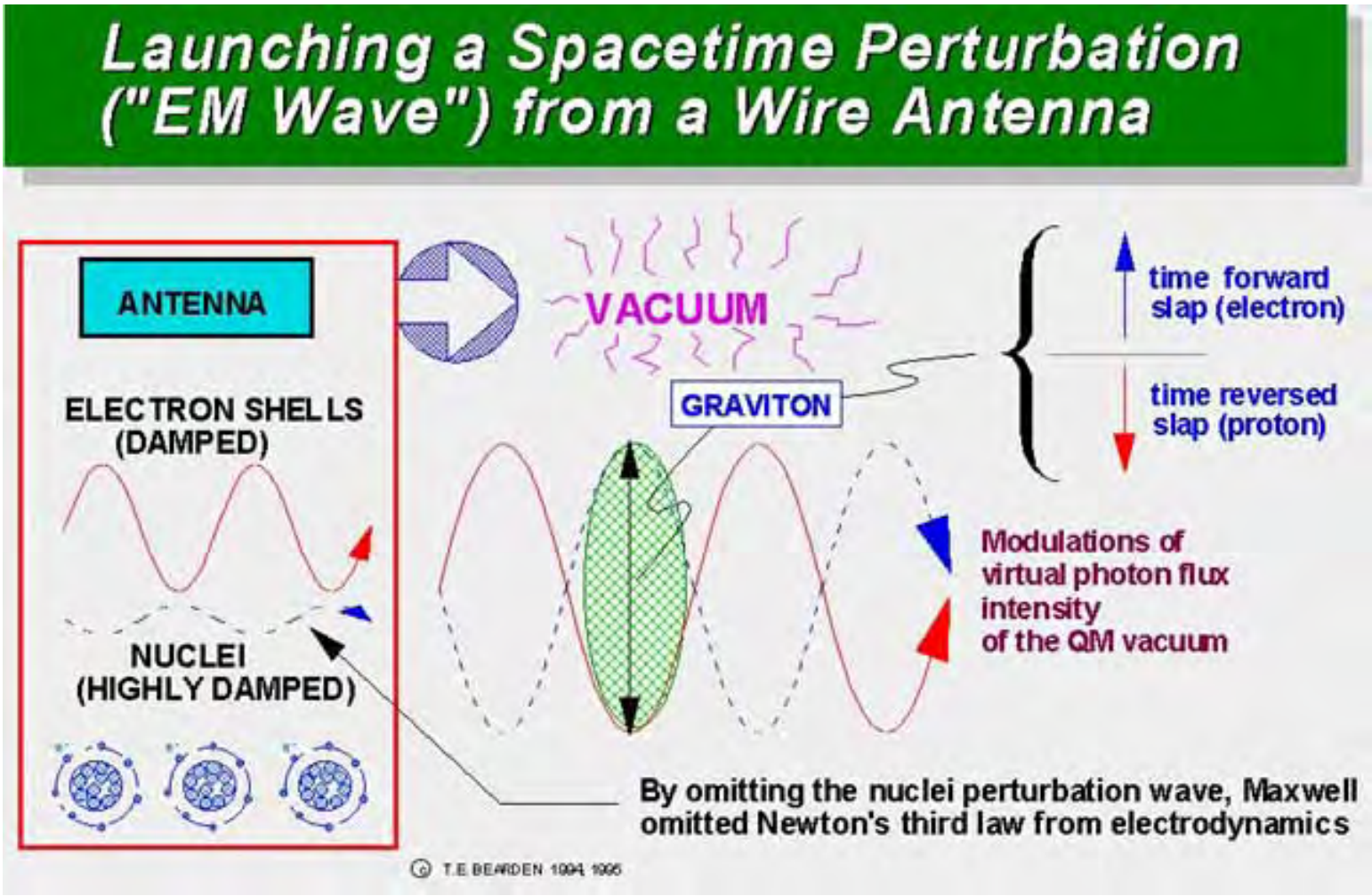
Launching a Spacetime Perturbation ("EM Wave") from a Wire Antenna
ANTENNA
ELECTRON SHELLS (DAMPED)
NUCLEI (HIGHLY DAMPED)
VACUUM
GRAVITON
time forward slap (electron)
time reversed slap (proton)
Modulations of virtual photon flux intensity of the QM vacuum
By omitting the nuclei perturbation wave, Maxwell omitted Newton's third law from electrodynamics
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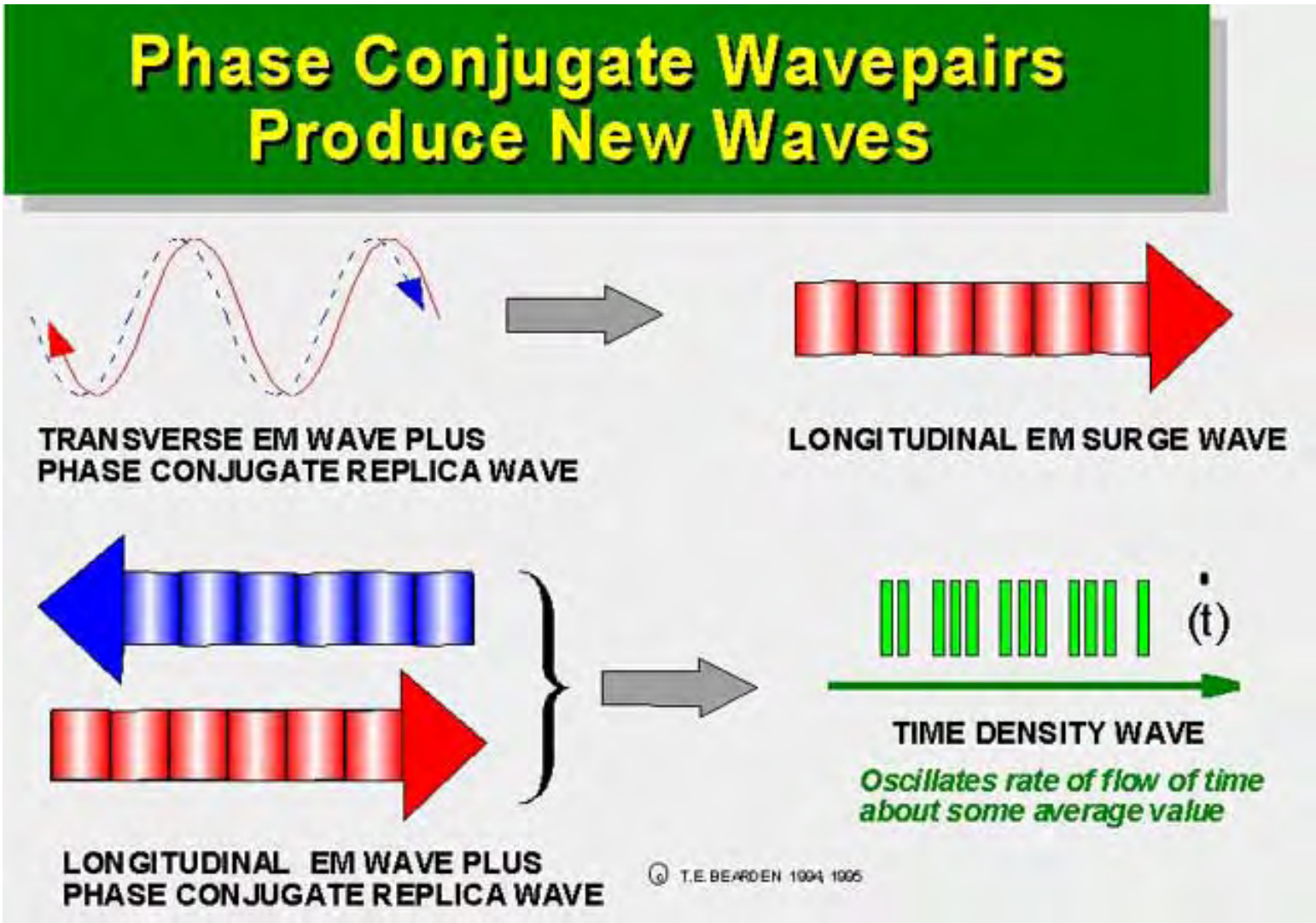
Phase Conjugate Wavepairs
Produce New Waves
TRANSVERSE EM WAVE PLUS
PHASE CONJUGATE REPLICA WAVE
LONGITUDINAL EM SURGE WAVE
LONGITUDINAL EM WAVE PLUS
PHASE CONJUGATE REPLICA WAVE
(t)
TIME DENSITY WAVE
Oscillates rate of flow of time
about some average value
© T.E. BEARDEN 1994, 1995

Scalar Electromagnetics (Energetics) View of EM

- Potentials real; primary causes of EM phenomena
  - Force fields made by differentiations of potentials
  - Force fields are effects, not primary causes
  - Force fields exist only in, on mass particles
- Actions due to potentials and their interference
  - Action at a distance or locally
  - Quantum potential and hidden variables
- Locally curved spacetime, engineerable by EM
  - Gravity effects not necessarily negligible
  - Strong EM force or time used as agent of curvature

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Scalar Electromagnetics (Energetics) View of EM (Cont'd)

- Potentials have internal structure
  - Stoney/Whittaker structure
  - Longitudinal EM phase conjugate wavepairs
  - Each wavepair is a time-polarized EM wave
- Vacuum EM is a potential and has microstructure
  - Stoney-Whittaker biwaves/t-polarized waves
  - Fluctuations exhibit chaos
- Spacetime ≡ Vacuum ≡ Potential ≡ Flux

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Scalar Electromagnetics (Energetics) View of EM (Cont'd)

- Statistics may have hidden order (already chaotic)
- Uses spacetime curvature engines to alter matter (inside-out or outside-in)
- Engineerable EM mechanism generates rate of flow of a mass through time
- Quantum potential with specific QP can be used for instant action at a distance

Extended General Relativity Principle

- "All levels of energy structures and all levels of time structures mold spacetime geometry.
- This is called a ***vacuum engine*** (spacetime engine).
- Spatial and temporal structuring act upon mass at all levels.
- This produces ***templates*** of forces, for translations and stresses."

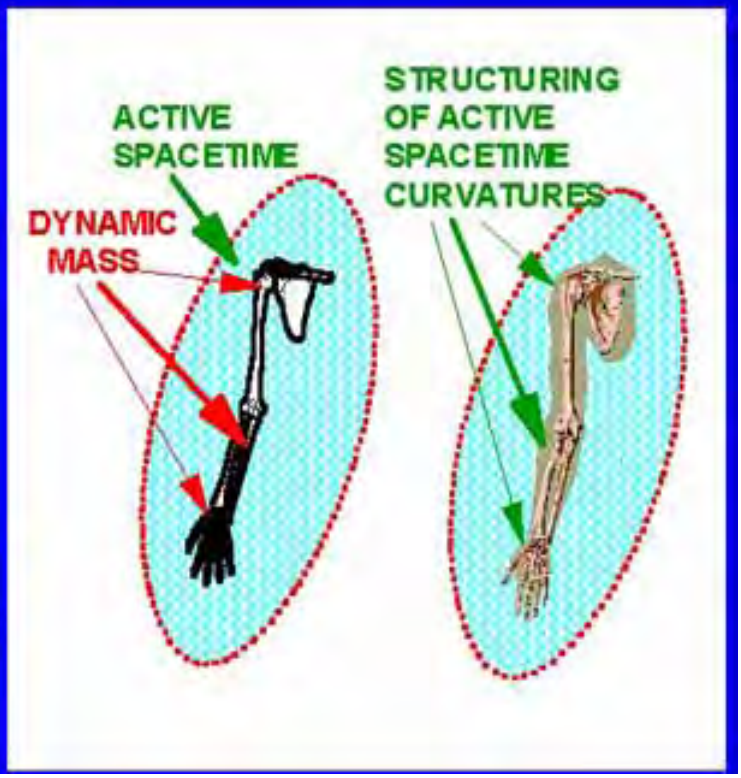

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Extension of Work-Energy Theorem

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- *Theorem:* $W = k_f - k_i = \Delta k$ [1]
- k must be interpreted not as energy *per se*, but as *collected/collecting* energy.
- The reaction cross section λ for the collecting process must be included.
- *Extension:* $W = \lambda (k_f - k_i) = \lambda \Delta k$ [2]
- Normally $\lambda \leq 1$, as for elastic collision or Stokes emission.
- However, $\lambda > 1$ is now possible, for processes which asymmetrically self-regauge. An example is Letokhov's negative absorption of the medium.
- Working models are the Patterson Power Cell® and Lawandy lasing without population inversion.

MTW's General Relativity Principle

- "Space acts on matter, telling it how to move.
- In turn, matter reacts back on space, telling it how to curve."

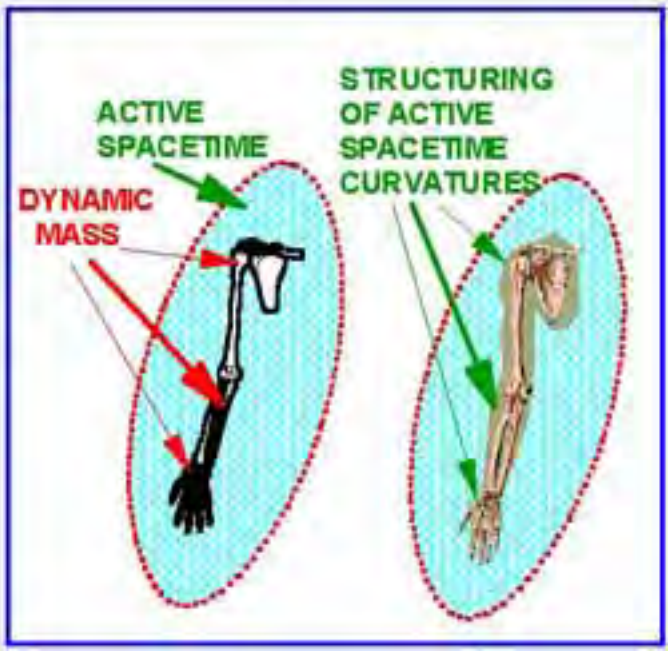

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Use of General Relativity (GR) in Particle Physics

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- GR seldom used in particle physics
- In cold fusion, Matsumoto* has applied general relativity
- Consistent with important cold fusion results
- Used spacetime (ST) curvature by energy density
- Matsumoto did not utilize:
  - Longitudinal EM waves
  - Time density waves
  - Time density curvatures of ST (gain = $9 \times 10_{16}$)

* T. Matsumoto, "Mechanisms of Electro-Nuclear Collapse," Proc. ICCF-7, Vancouver, BC, Canada, Apr. 1998, p. 98

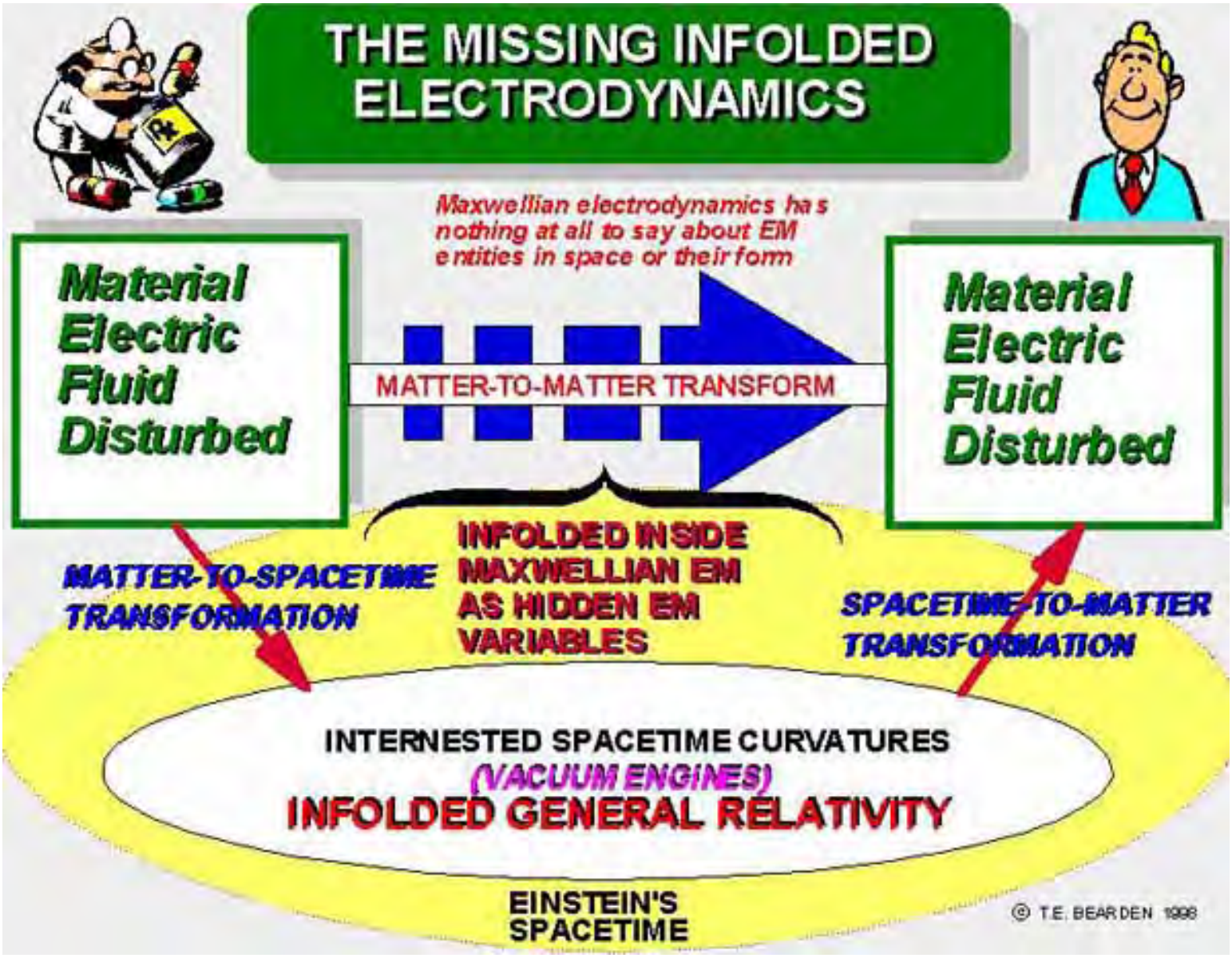
THE MISSING INFOLDED ELECTRODYNAMICS
Maxwellian electrodynamics has nothing at all to say about EM entities in space or their form
Material Electric Fluid Disturbed
MATTER-TO-MATTER TRANSFORM
Material Electric Fluid Disturbed
INFOLDED INSIDE MAXWELLIAN EM AS HIDDEN EM VARIABLES
MATTER-TO-SPACETIME TRANSFORMATION
SPACETIME-TO-MATTER TRANSFORMATION
INTERNESTED SPACETIME CURVATURES
(VACUUM ENGINES)
INFOLDED GENERAL RELATIVITY
EINSTEIN'S SPACETIME
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Infolded Engines: Excluded by Present Physics

- *The infolded dynamics of EM systems are not considered in general relativity, electromagnetics, or quantum mechanics*
- *None of these disciplines include such spacetime curvature engines (vacuum engines)*
- *Thus GR, EM, and QM cannot be unified, since ST curvature engines are where the unification mainly occurs*

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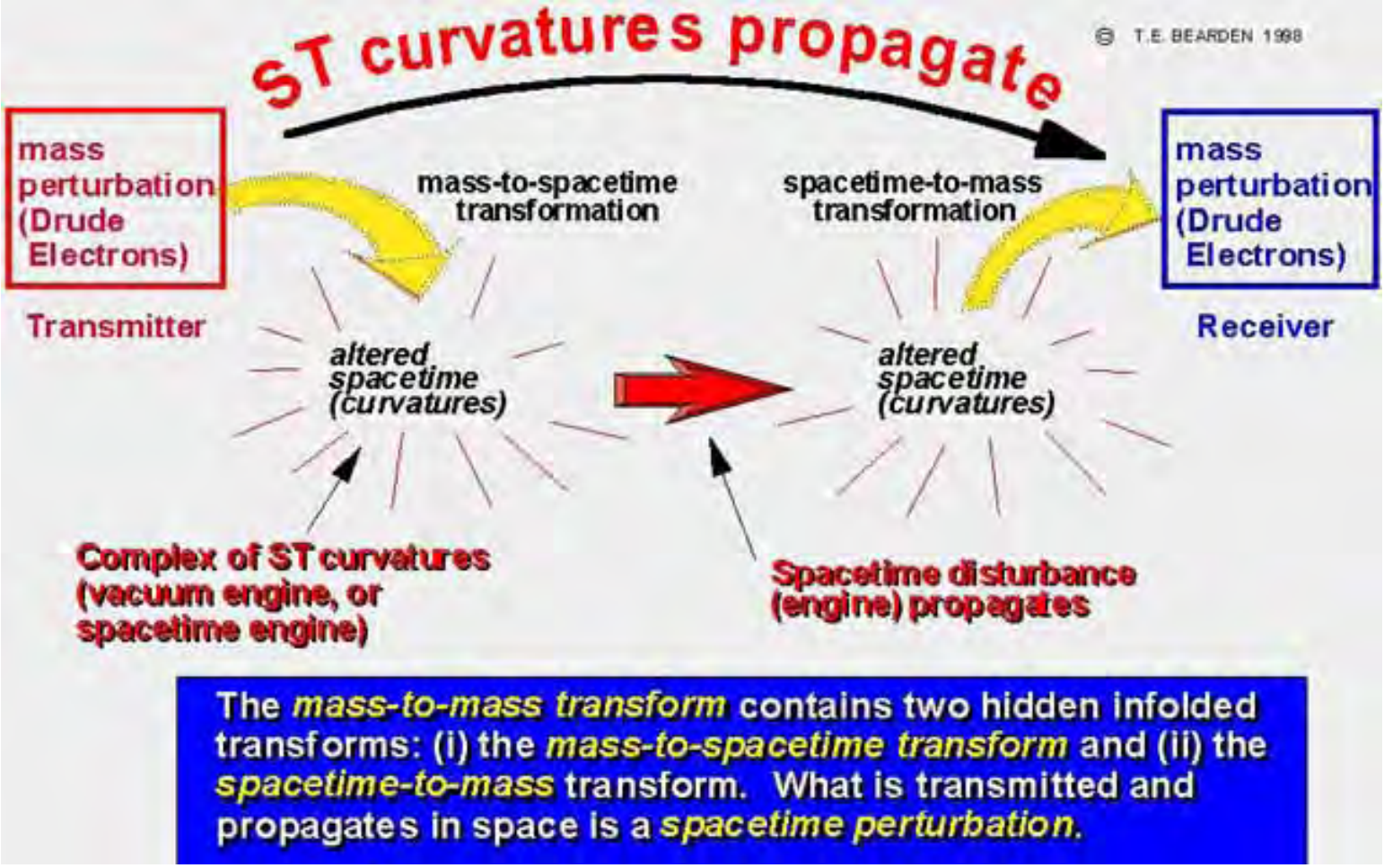
ST curvatures propagate
© T.E. BEARDEN 1998
mass perturbation (Drude Electrons)
Transmitter
mass-to-spacetime transformation
spacetime-to-mass transformation
mass perturbation (Drude Electrons)
Receiver
altered spacetime (curvatures)
altered spacetime (curvatures)
Complex of ST curvatures (vacuum engine, or spacetime engine)
Spacetime disturbance (engine) propagates
The mass-to-mass transform contains two hidden infolded transforms: (i) the mass-to-spacetime transform and (ii) the spacetime-to-mass transform. What is transmitted and propagates in space is a spacetime perturbation.

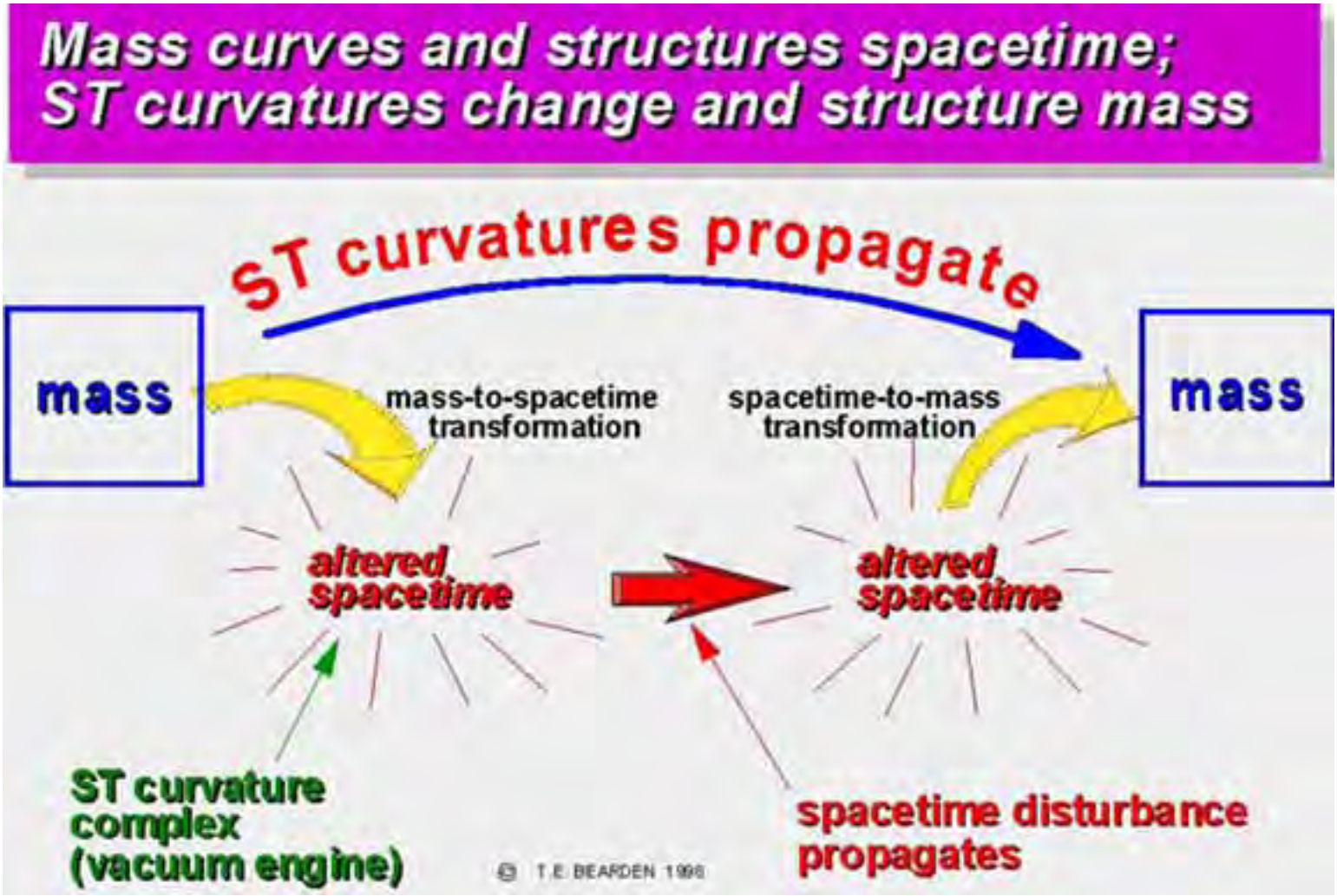
Mass curves and structures spacetime;
ST curvatures change and structure mass
ST curvatures propagate
mass
mass-to-spacetime transformation
spacetime-to-mass transformation
mass
altered spacetime
altered spacetime
ST curvature complex (vacuum engine)
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spacetime disturbance propagates

At Infinite Velocity:
Each Is Every Other
SPACETIME
VIRTUAL PARTICLE FLUX
POTENTIAL
MIND AND MIND LEVELS
MASS
PLANET
LIVING ORGANISMS
© 1997 T.E. Bearden

Lisitsyn's Report: Brain Code Broken

- THEORY DEVELOPED AND FITTED
- HYSTERESIS MEMORY LOOP
- CONTROLLED EM INDUCTION
  - IMAGES
  - SENSATIONS
  - PREDETERMINED EMERGENCE
- 23 EEG BANDS
  - UP TO 8.1 X 10^{20} HZ
  - 11 INDEPENDENT CHANNELS

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S.K. Lisitsyn, "New Approach to the Analysis of Electroencephalograms," DDC Report AD73005, p. 16-25.

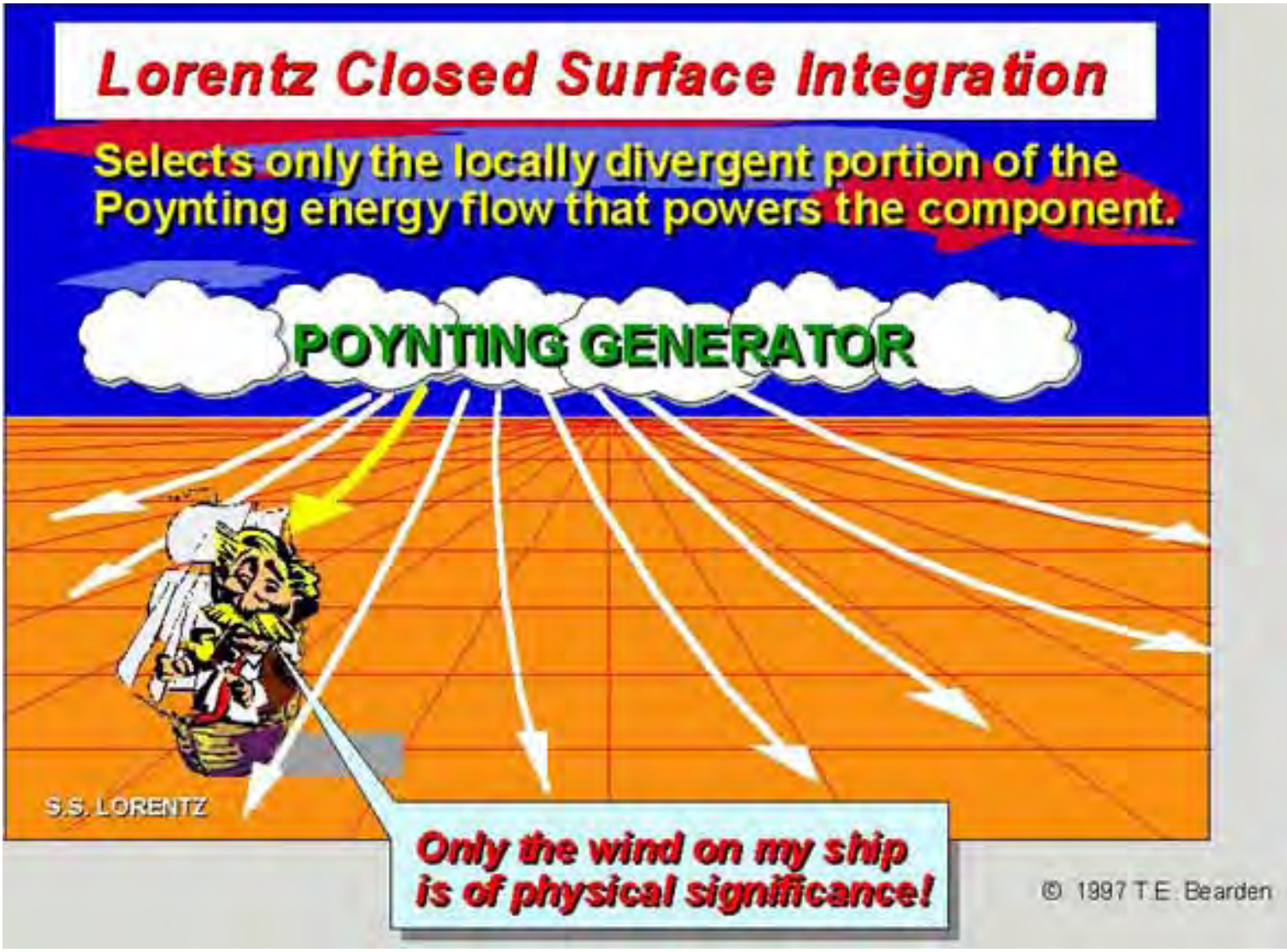
Lorentz Closed Surface Integration
Selects only the locally divergent portion of the Poynting energy flow that powers the component.
POYNTING GENERATOR
S.S. LORENTZ
Only the wind on my ship is of physical significance!
© 1997 T.E. Bearden

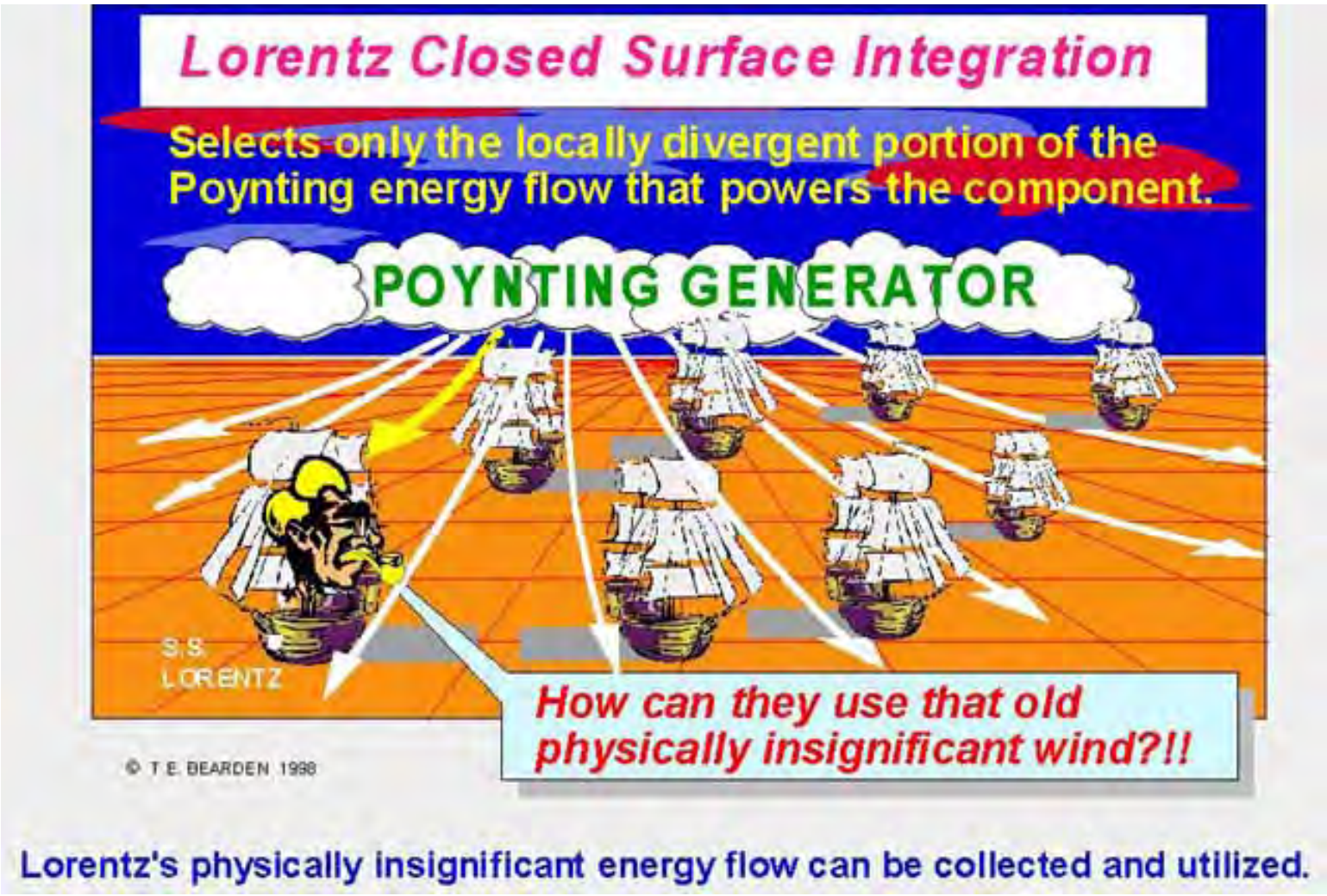
Lorentz Closed Surface Integration
Selects only the locally divergent portion of the Poynting energy flow that powers the component.
POYNTING GENERATOR
S.S. LORENTZ
How can they use that old physically insignificant wind?!!
© T.E. BEARDEN 1998
Lorentz's physically insignificant energy flow can be collected and utilized.

Lorentz surface integration of the Poynting vector around a closed surface

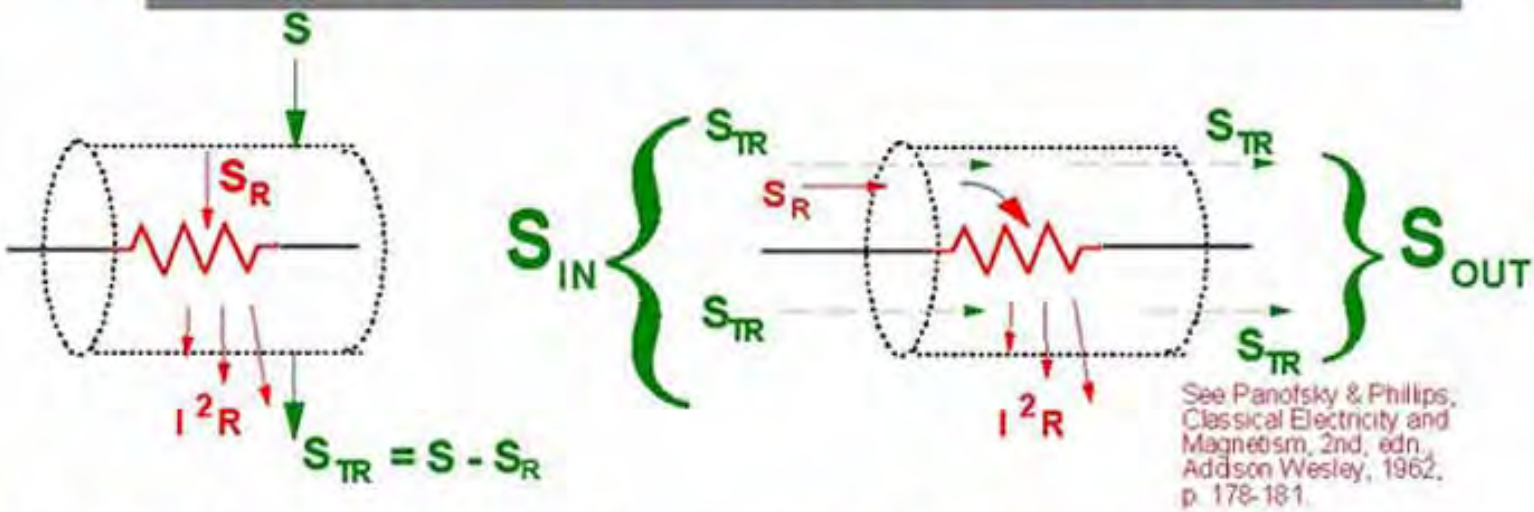

See Panofsky & Phillips, Classical Electricity and Magnetism, 2nd. edn. Addison Wesley, 1962, p. 178-181.

1a. Lorentz surface integration.

1b. Actual S in and S out.

Note: If the S-vector is integrated over the closed surface, then all energy *transport* passage is zeroed, leaving only the very small component of the input S-flow that is powering the joule heating of the resistor. In short, only the small component of the S-flow that is equal in magnitude to the Slepian vector $j\phi$ remains. This measures only the tiny portion of the S-flow that is "collecting" on electrons passing through the resistor, and therefrom being dissipated out of the resistor as joule heating. It discards everything else (all S_{TR}'s and S_{OUT}). S_{IN} becomes S_R.

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Longitudinal EM Photon Interaction with Charge

- Creates time-density wave pumping
- Slowly creates time-density charging

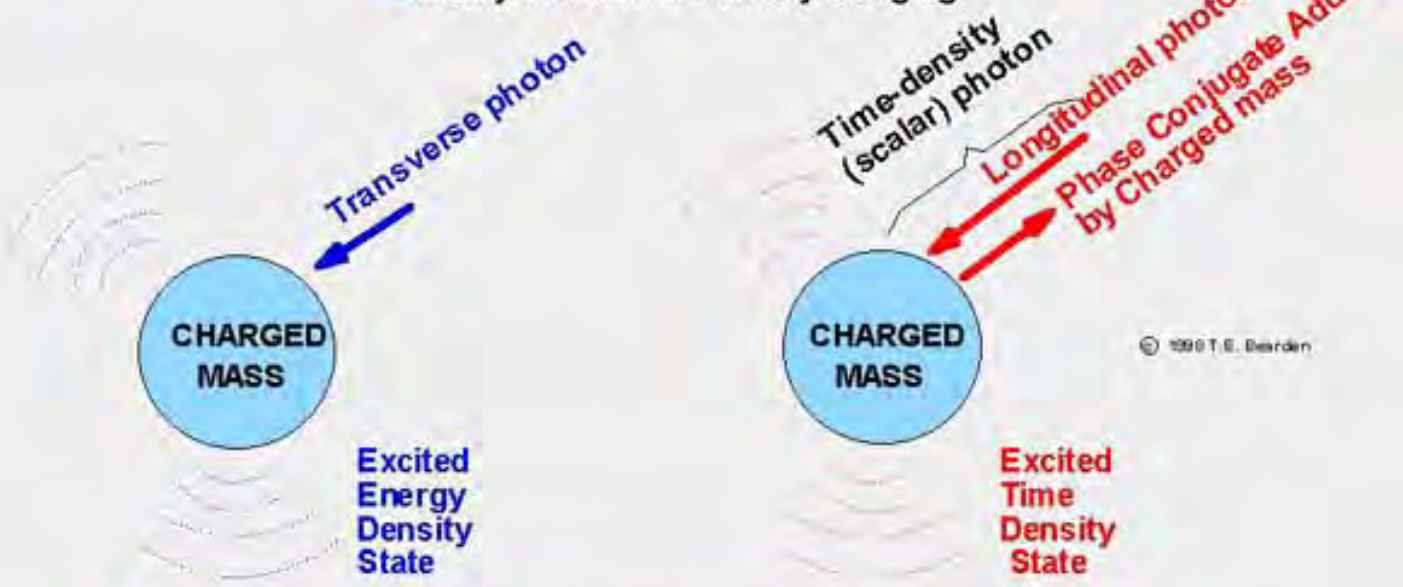

- Fundamental units are arbitrary in physics
- Can express all physics in one unit -- e.g., time
- Time is highly compressed energy
- 1 sec = 9 x 10_{16} joules of transverse EM wave energy

Figure 1-8. Infolded biwave composition of a scalar potential.

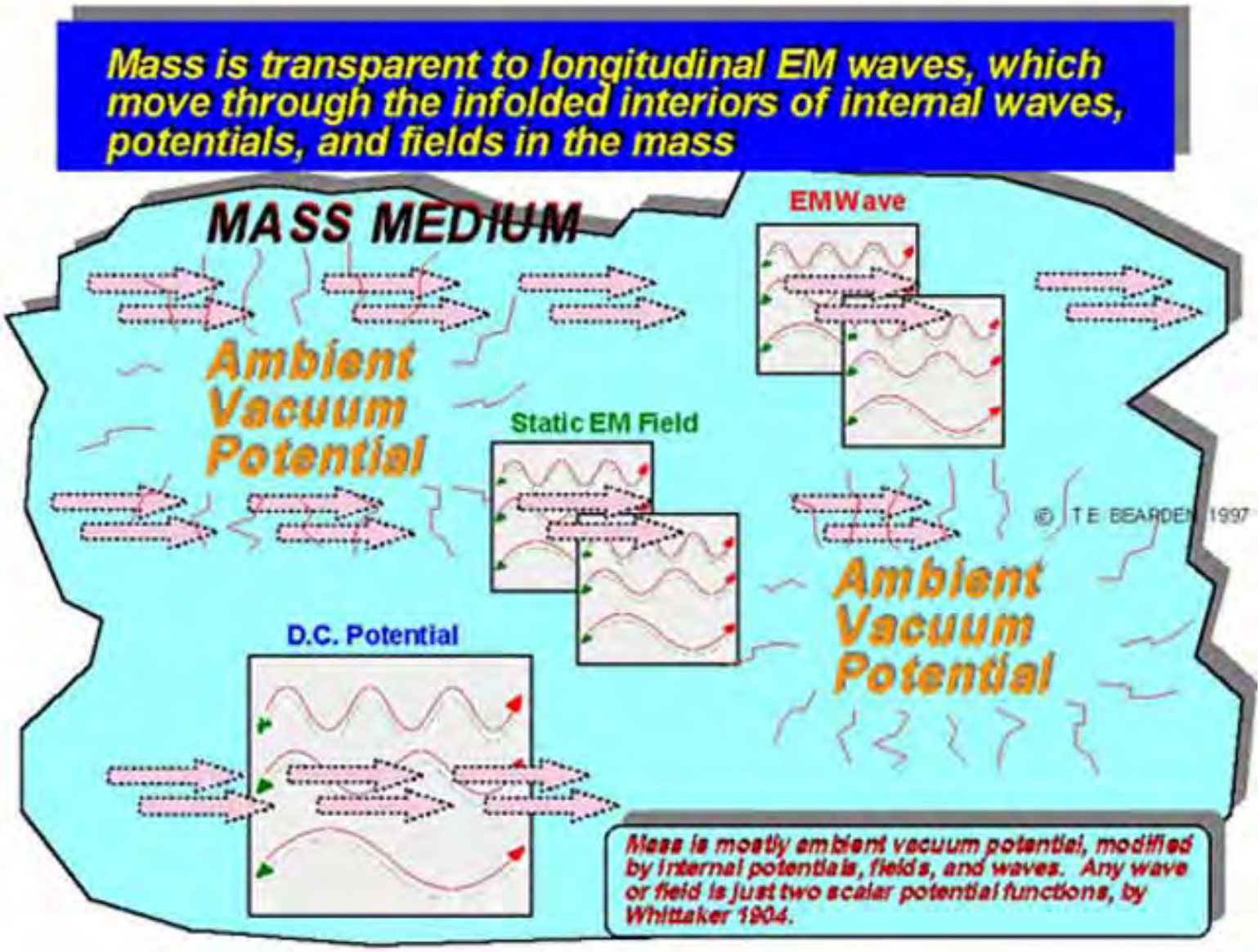

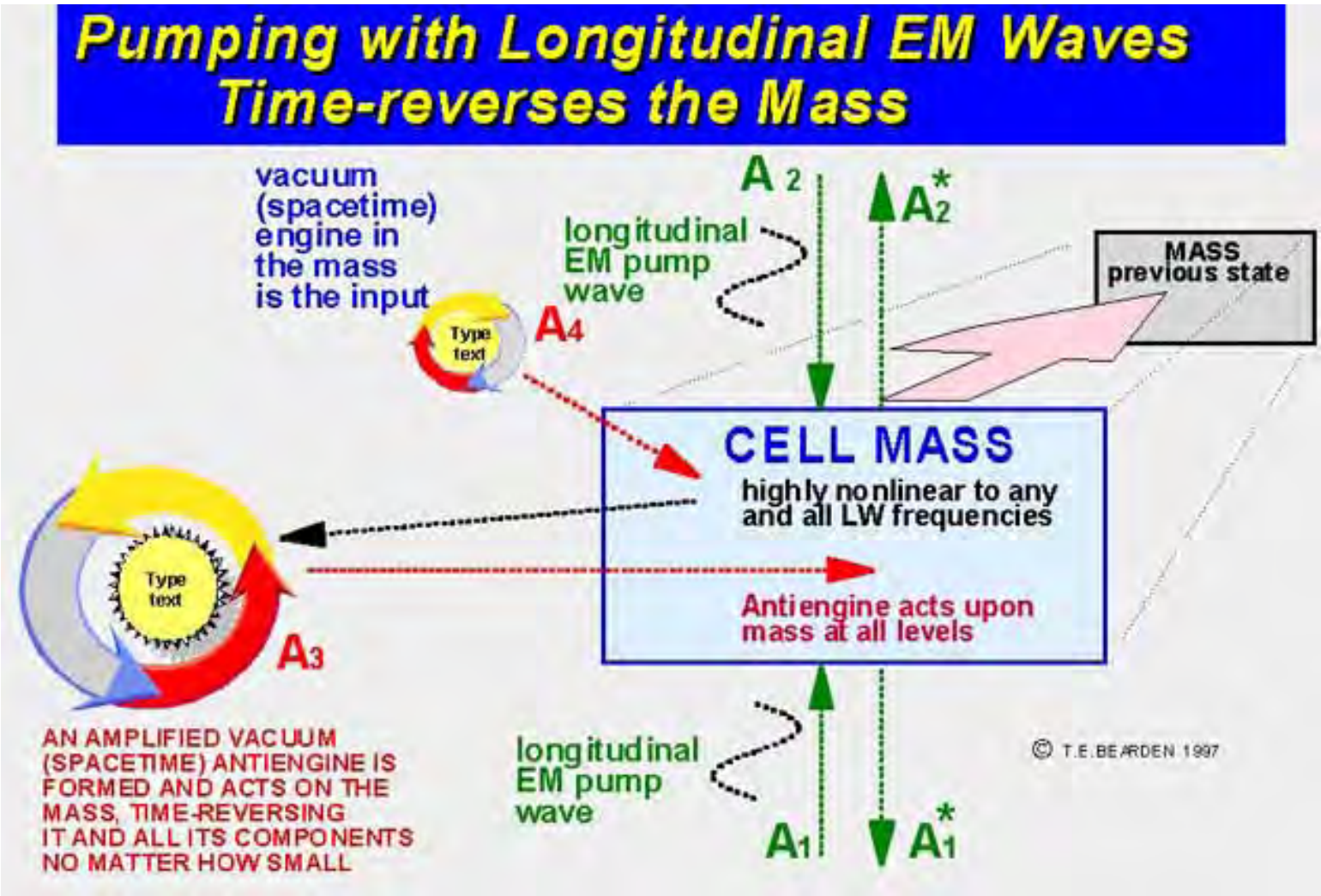
Pumping with Longitudinal EM Waves
Time-reverses the Mass
vacuum (spacetime) engine in the mass is the input
A 2
A*2
longitudinal EM pump wave
MASS previous state
Type text
A4
CELL MASS
highly nonlinear to any and all LW frequencies
Type text
A3
Antiengine acts upon mass at all levels
AN AMPLIFIED VACUUM (SPACETIME) ANTIENGINE IS FORMED AND ACTS ON THE MASS, TIME-REVERSING IT AND ALL ITS COMPONENTS NO MATTER HOW SMALL
longitudinal EM pump wave
© T.E.BEARDEN 1997
A1
A*1

Maxwell's Quaternion Theory

- **Quaternions:**
  - Discovered by Hamilton in 1843
  - A quaternion has a vector part
  - A quaternion has a scalar part
  - First significant non-arithmetic number system
  - Higher topology than vector or tensor algebra
- **Maxwell's theory was in quaternion equations**
  - 20 equations in 20 unknowns
  - Reduced to a small 4-equation subset by Heaviside and Gibbs
  - EM topology dramatically reduced

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Maxwellian Systems

Before regauging, after symmetrical regauging, and after asymmetrical regauging

Note: Any system must first break equilibrium in its vacuum exchange, before it can energize Drude electrons and "power" the load. Asymmetric regauging is always utilized. Powering loads and losses is a symmetry-restoring operation.

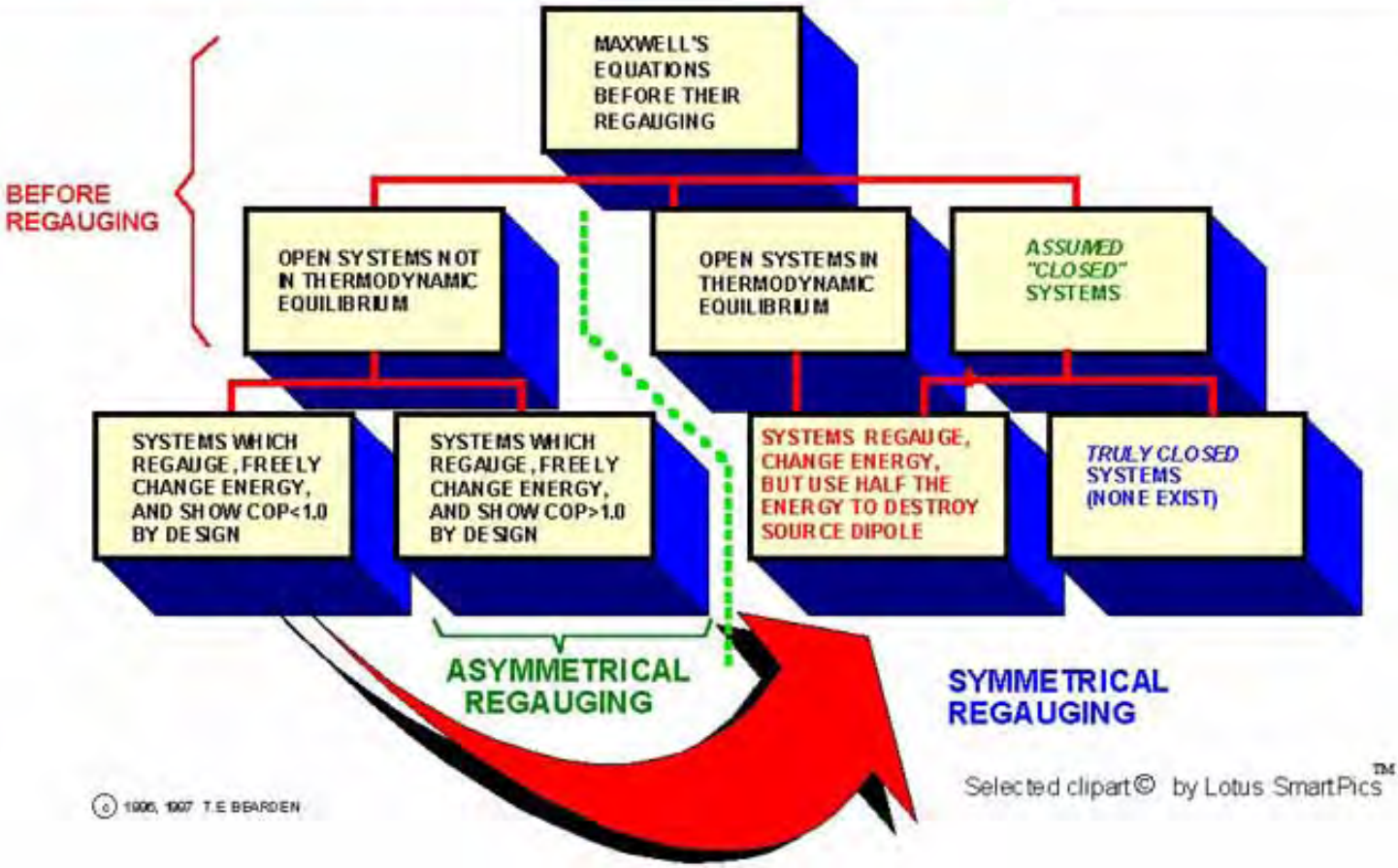

Maxwell's four equations reduce to:

$$\nabla^2 \Phi + \frac{1}{c}\frac{\partial}{\partial}(\nabla \bullet A) = -4\pi\rho \qquad [1]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 A}{\partial t^2} - \nabla(\nabla \bullet A + \frac{1}{c}\frac{\partial \Phi}{\partial t}) = -\frac{4p}{c}J \qquad [2]$$

A is replaced by A', where

$$A' = A + \nabla\Lambda \qquad [3]$$

The new B' field then becomes

$$B' = \nabla \times (A + \nabla\Lambda) = \nabla \times A + 0 = \nabla \times A = B \qquad [4]$$

A new E-field will also be formed. So let

$$\Phi' = \Phi - \frac{1}{c}\frac{\partial \Lambda}{\partial t} \qquad [5]$$

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Per Jackson, (A,Φ) are *habitually* chosen so that

$$\nabla \bullet A + \frac{1}{c}\frac{\partial \Phi}{\partial t} = 0 \qquad [6]$$

The *net symmetrical* regauging separates variables. Two inhomogeneous wave equations result:

$$\nabla^2 \Phi - \frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} = -4\pi\rho \qquad [7]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 A}{\partial t^2} = -\frac{4\pi}{c} J \qquad [8]$$

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Equations [1] and [2] *arbitrarily* changed to [7] and [8]

The Tom Bearden Website

Mind Control and EM Wave Polarization Transductions - Part I, II & III

Reprinted from "Explore" magazine, 1999

Part I

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Part II

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Part III

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- The U.S. approach to mind control
- "Voices in my head"
  Flanagan's neurophone - used to give instructions to diplomats during negotiations, etc.

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ORDER BOOKS & DVDs

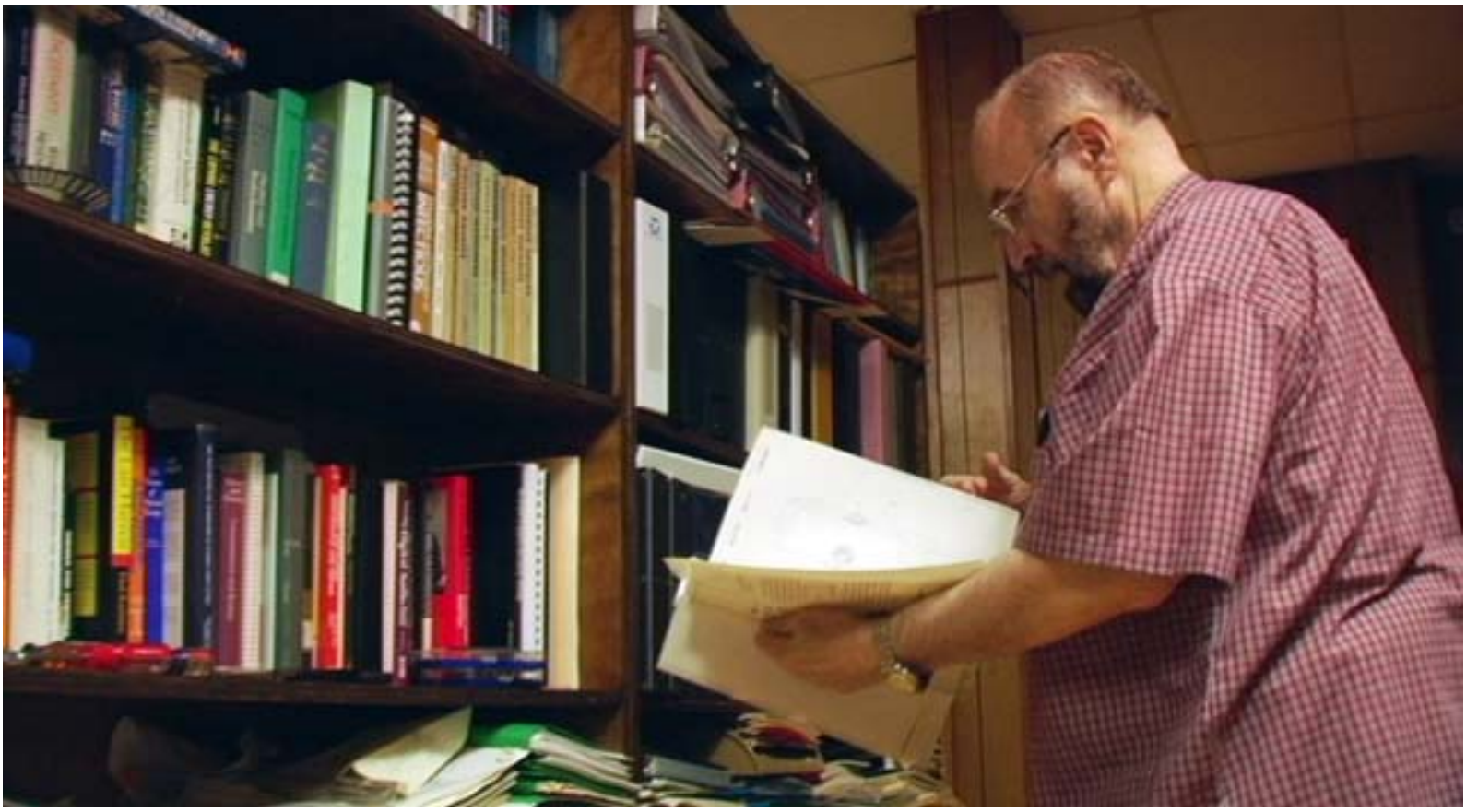

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- **THE WORLD ENERGY CRISIS IN PERSPECTIVE:** The Breakthrough Technology that Solves it Quickly
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- **Direct Engineering of Physical Reality Itself**
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- **Solving The Problem of Freely Using EM Energy from the Vacuum**
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  16 September, 2008

- **Rapid and Decisive Solution of the World Energy Crisis and Global Warming**
  Updated
  9 September, 2008

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  26 July, 2008

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  31 March, 2008

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  1st December, 2007

- **Never Mind - Junk Science**

and All That
11 September, 2007

- **The Deliberate Discard of Asymmetric Maxwellian Systems, Thus Preventing COP>1.0 and Self-Powering Energy-from-the-Vacuum Systems**
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Mind Control and EM Wave Polarization Transductions

Part I
Vol. 9, No. 2 1999

Part II
Vol 9, No. 3 1999

Part III
Vol 9, No. 4,5 1999

Vacuum Engines and Priore's Methodology - The True Science of Energy-Medicine

Part I
Vol. 6 No. 1 1995

Part II
Vol. 6 No. 2 1995

Paranormal Pictures
Psychic Observer 39(3) ~ 224, 255-258

Many of Tom Bearden's older articles on a wide range of topics can be found in the back issues of Explore! magazine.

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Mind Control and EM Wave Polarization Transductions, Part 1

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Abstract

For some time we have been repeatedly queried about the technical mechanisms and unusual electrodynamics of advanced mind control research, both in the West and abroad. Calling full attention to the special note above, in this paper we present a high-level over-view of the novel electromagnetic nature of mind operations, mind and body coupling, and *intent*•the induction of physical 3-space EM energy changes into the brain and nervous system, and into every cell of the body, from the mind's time-like coherent operations. We summarize the time-polarized electrodynamics used to engineer and affect mind operations and the mind-body coupling loop. Transduction mechanisms whereby differing EM wave polarizations can be transformed one-into-the-other are presented. We give two specific examples of lethal foreign military tests in 1997 of advanced mind control weapons against two military pilots over the central U.S. Some dangers and potential benefits of the emerging mind control technology are pointed out

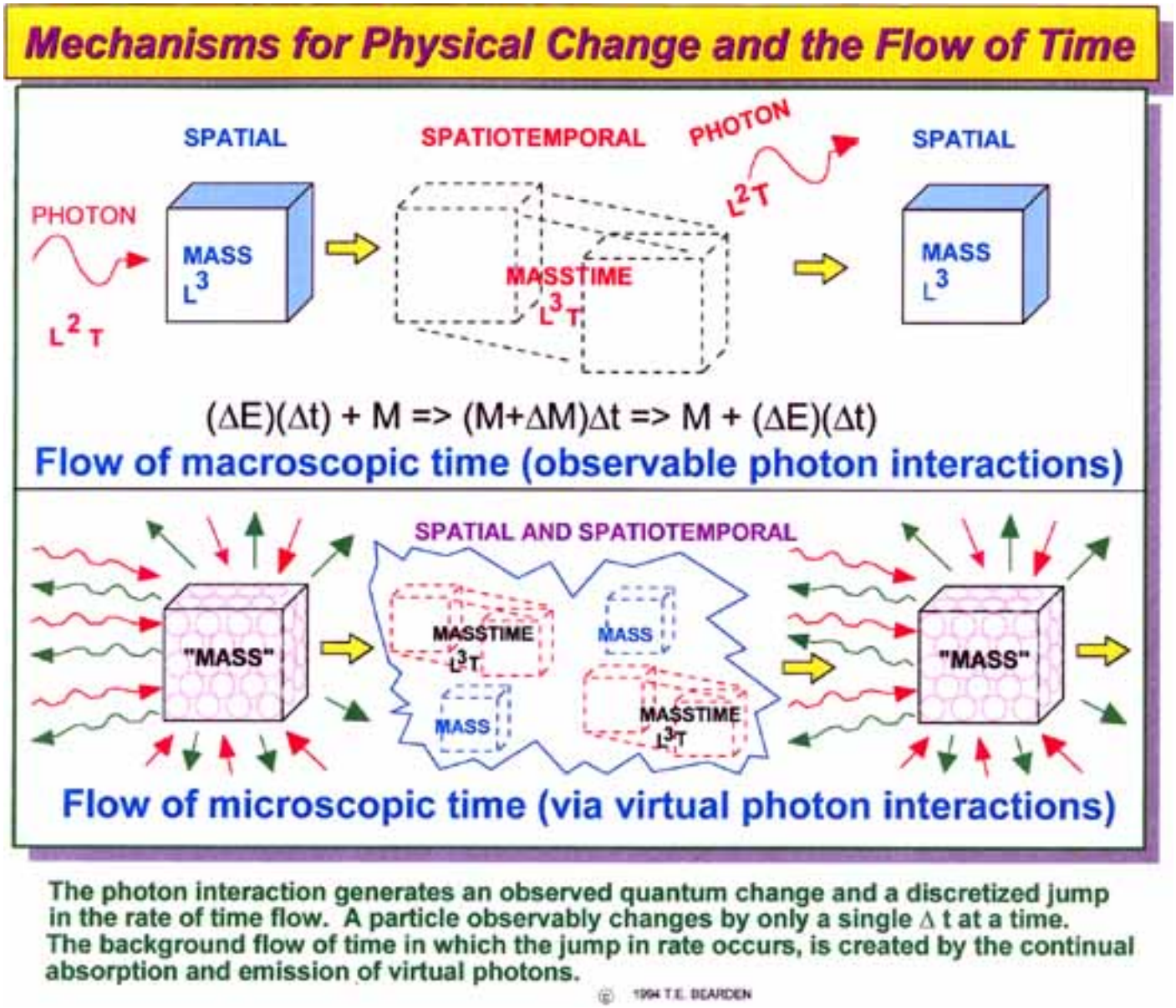

The photon interaction generates an observed quantum change and a discretized jump in the rate of time flow. A particle observably changes by only a single Δ t at a time. The background flow of time in which the jump in rate occurs, is created by the continual absorption and emission of virtual photons.

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Figure 1. Mechanism that generates a mass's flow through time.

EXPLORE! VOLUME 9, NUMBER 2, 1999

Introduction and Background

In quantum field theory, there are four polarizations of photons.[1] Using 4-space and the z-direction as the direction of propagation, we have x- and y- polarizations where the 3-spatial energy of the photon is oscillating laterally, in the x- or y- direction. These are *transverse polarized* photons, as is any combination of the two. The third polarization is along the z-direction, which is a longitudinal polarization. In other words, the 3-spatial energy of the longitudinal photon cannot oscillate in the x- or y- direction, and so it is oscillating to-and-fro along the line of motion, z-. The fourth polarization occurs when the energy is frozen in all three spatial dimensions x-, y-, and z- and it cannot oscillate in any of those directions. In that case, the photon oscillates its energy in the t- direction, providing the t-polarized photon. We will later discuss how time is actually highly condensed energy.

In Minkowski 4-space, body operations are space-like, and are so treated in conventional materialistic physics. Mind and mind-operations are time-like, not space-like, even though they are totally electromagnetic in nature.[2]

As is well-known, all observation in physics is considered 3-spatial..[3] Mass is a 3-spatial concept, and we detect changes to mass (as, e.g., in the shift of electrons in the circuits of electrical instruments). So one may model the common physical observation mechanism as a *time-differentiating process* which *a priori* discards time-change and retains 3-spatial energy change.[4] That is, Minkowski reality is modeled in the fundamental units of L^3t. Physical observation (via the transverse photon interaction) is the process given by applying the operator $\partial/\partial t$ to L^3t, yielding an L^3 output. Hence mind and mind operations are excluded by the usual physics instruments and observation, which simply exclude the time domain in their outputs and do not "measure" it.

For this reason, physicists have erroneously considered mind to be "metaphysical" and nonreal. Indeed, most physicists to one extent or the other are materialists, and consider the "mind" to be nothing but the operations ongoing in a "meat computer." Nonetheless, in the time-domain the time is absolutely real, and it is completely electrodynamic in nature. There is no metaphysics involved, and the temporal domain—along with mind and mind operations—is simply an erroneously neglected area of physics. In present physics, the notion of mind is comfortably disposed of by imposing the use of the "observer" concept, with out ever specifying that the observer has a consciousness and a mind. Indeed, "observation" is only about what that "observer" perceives. Obviously, one has a dramatically crippled physics if one eliminates that nonobservable called "time." Similarly, one also has a dramatically crippled physics when one eliminates the mechanisms and physics ongoing in those time-like and dynamic "things" such as mind, that occupy time and function in it.

From this viewpoint, Western physics adheres to its 3-spatial measurement foundation only by ignoring the transduction of time-polarized EM changes into detectable longitudinal and transverse EM wave changes. In this aspect, present Western physics is severely self-crippled.

Time is totally electromagnetic and energetic in nature. The flow of time is not a separate external river on which a mass floats along like a boat drifting down the current of a great flowing river. Instead, the flow of time is generated directly on every mass by its total set of photon interactions, both virtual and ob servable. We have previously presented the exact mechanism for the flow of time. *[Figure 1]*

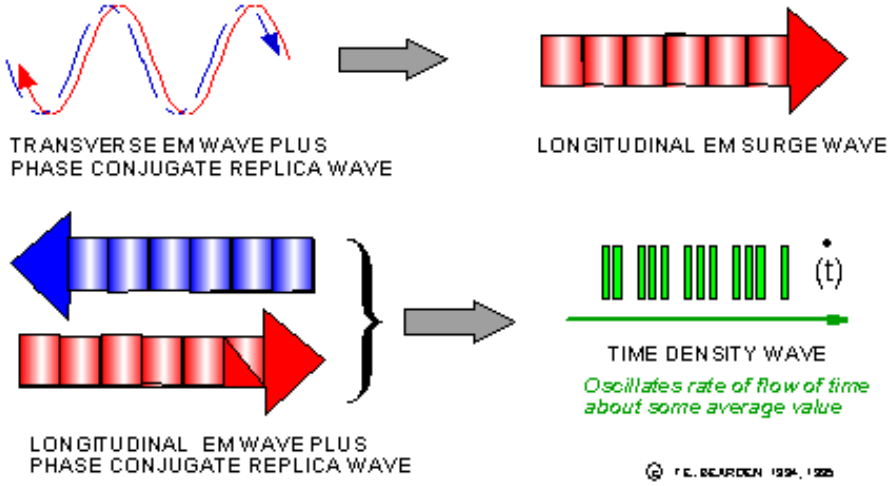

Figure 2. Transduction of EM wave type by successive phase conjugate pairing.

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Further, a photon is comprised of angular momentum, therefore of (energy)x(time). It transports both energy and time, not just energy alone. When absorbed by a mass, not only does it "energy-excitation" charge the mass, but also it "time-excitation" charges it, converting the former "mass" to "mass time". Rigorously it is *masstime* that emits a photon, not *mass*. So a mass moves through time in little spurts, by the continual macroscopic addition and subtraction of little Dt components. Further, in being driven through time, mass is continually altered to masstime (a quite different critter from mass), to mass, to masstime, to mass, etc.

In any masstime state, a myriad of tiny virtual photon interactions made of very tiny (DE)(Dt)'s interact with that same mass during that particular larger Dt of the masstime state (m+Dm)(Dt). Hence mass in its alternate masstime state has that state internally structured by its surrounding environment's interactions with it. The masstime state is internally structured energetically in its (DE) component, and also internally structured temporally in its (Dt) component.

A standard charged fundamental particle such as an electron, e.g., is not necessarily identical with another, when the internal structuring of its masstime state is considered. Further, by two papers by Whittaker,[5] interferometry of masstime states with either energy reactions or temporal reactions can yield observable effects and changes due to these neglected "hidden variables" in the electron's masstime alternative states. To engineer the mind and its operations directly, one must perform electrodynamic engineering in the *time* domain, not in the 3-space EM energy density domain. The direct engineering of time-like mind and mind operations—in all levels and all aspects—requires the use of *time-polarized photons and time-polarized EM waves*. This is the rarest form of electrodynamics, almost untouched by Western physicists.

One can either painfully produce such time-polarized photons and EM waves and directly irradiate a target mass with specific assemblies of them, or one can force the mass itself to iteratively transduce ordinary transverse EM waves first into longitudinally-polarized EM waves and then into time-polarized EM waves. Both will be discussed briefly.

In the West, it appears that the present author's discovery of mechanisms for producing time-polarized (scalar) EM waves [see *Figure 2*] and for transducing between wave polarizations has no precedent. [See *Figure 3*]. While scalar (time-polarized) photons are known in the literature,[1] the creation and use of time-polarized EM waves does not seem to appear in the Western physics literature.[6]

Wave transduction or *polarization transductions* are terms used by the author for the process of transforming an EM wave's particular polarization into another polarization type. Such transduction to other than transverse polarization forms is little known in the West. It appears essentially haphazardly in some experiments, usually without any recognition by the experimenters themselves. Significant transduction in experiments will also produce "strange" and unexplained anomalies in the instruments being used for experimental measurements.[7]

So most probably Western mind control researchers have not recognized the methodology and mechanisms[8] for transducing one type of EM wave polarization directly into another.[9] They continue to seek the "mind" in 3-space and hence in the brain, rather than in the time domain. On the other hand, it appears

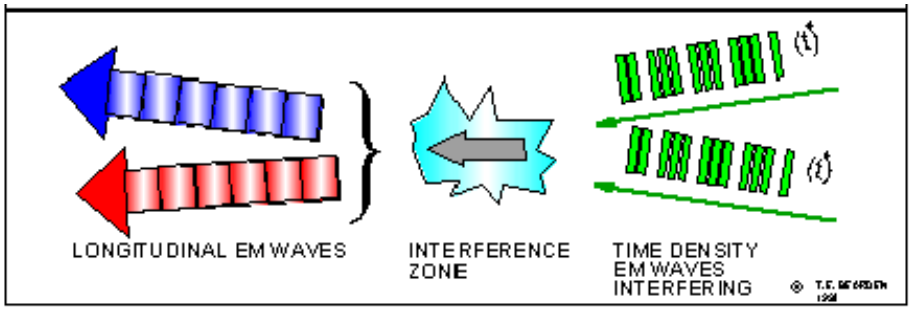

Figure 3. Interference processes for transducing higher EM wave polarizations into lower polarization states.

that the Russian KGB *energetics*[10] weapons scientists—particularly those in *psychoenergetics*[11]—have known and used methods of transducing one wave polarization into another, for at least two decades. It follows that those same scientists have very probably developed *mind engineering* and *mind control* via novel time-polarized EM wave means and a dramatically extended electrodynamics of the time-like mind operations.

In the present paper we briefly develop the wave transductions and the basis for mind engineering, including the specialized use of ordinary transverse wave (TW) EM spectra to force internal EM wave transductions and time-domain operations inside irradiated bodies, cells, and tissues. Through the mind-body coupling mechanism, these transductions of transverse EM waves can operate upon the mind and its deepest operations as well as upon the body, every cell, and every part of every cell.

Russian Mind Control Uses Higher EM Wave Polarizations

It is apparent that the KGB psychoenergetics weapons scientists know and use the full extended EM wave polarization range. As a postulation, one would expect our own weapons scientists to know and utilize the orthodox transverse wave (TW) EM for similar research and experimentation. However, in the West scientists are *just beginning* to realize the importance of a very general (and weaker) type of longitudinal EM wave (LW) polarization, as evidenced by the appearance of dozens of papers on "undistorted progressive waves" (UPWs, which are essentially imperfect LW s with TW residues remaining). The Los Alamos National Laboratory web site has a number of such papers—particularly by Rodrigues[12] and Lu—available for free downloading. UPWs have very interesting characteristics. If they were perfect longitudinal EM waves, they would have infinite energy and infinite speed. Since only imperfect UPWs can be physically made, their speed can vary from slower than the speed of light to faster than the speed of light. Their energy can also vary over a great range.

Another characteristic of UPWs that are reasonably good longitudinal EM waves, is that they pass readily through a large depth of water and mass, including through the ocean and the earth with only small interactions and losses. Yet by interfering two such beams of "high quality" UPWs at a great distance, then in the interference zone ordinary EM energy will rise directly out of local spacetime potential, as essentially shown by Whittaker[13] nearly a century ago. Russian weapon research facilities have weaponized these effects[14] for nearly 50 years, under rigid KGB control and operation. Nonetheless, even if using only ordinary TW waves, Western mind control researchers may get some fairly good results, brute-force-like, by using gross correlates between just the input irradiating TWs and the exhibited behavioral responses of the individual. The net input-output correlations can be determined, even though not taking into account the actual wave polarization transduction mechanisms ongoing inside the irradiated dielectric (or brain, or mind, etc.). However, Western researchers appear to have no knowledge of the exact mechanisms by means of which coherent time-like mind operations of a biological organism couple to the organism's 3-spatial body to provide the mental control loop. They also appear unaware of how the coherent 3-spatial behavior responses of the body couple back to the time-like mind to provide it with a sensory feedback of the body's responses.

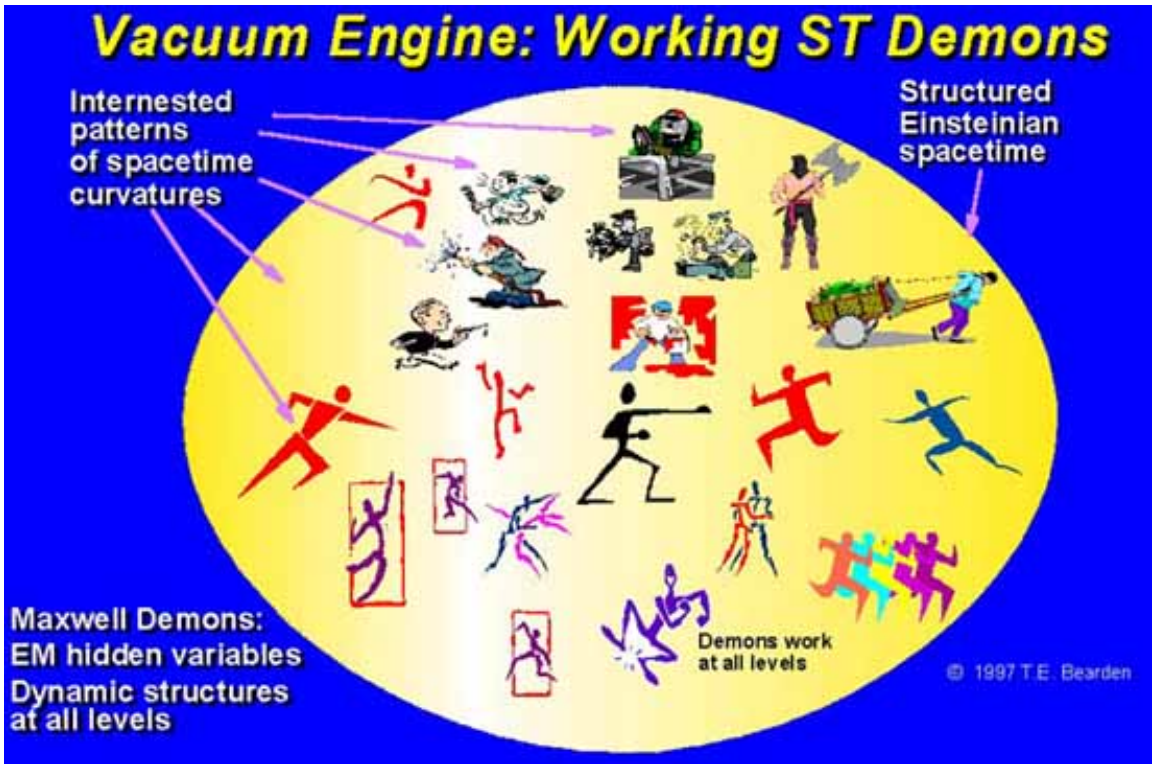

Figure 4. A spacetime curvature engine has myriads of small ST curvature components which act upon mass at all levels.

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General Relativity Aspects

Both these coupling mechanisms can be taken directly from general relativity, if one puts one's mind to it. However, unless the wave polarization transformations are known, it is difficult or impossible to apply the ordinary GR *directly*, since relativists usually concentrate upon spacetime curvature by altering 3-space energy density rather than by altering time-polarized "time-energy" density.

In applied general relativity, spacetime itself is an active medium. One speaks of a change in spacetime as a "spacetime curvature". Any curvature of spacetime in a local region directly performs continuous work upon any mass embedded in that region. Vice versa, any mass (or other concentration of energy) in a local spacetime continuously acts upon that spacetime to "curve" it.

So if one wishes to perform actions upon mass in a distant region, one may generate local curvatures of spacetime in that region, and these curvature "engines" will directly act upon the mass at all levels. *[Figure 4]* This is very different from energy propagation through space from one point to another. Now the "ordinary EM energy and actions" arise from every spatiotemporal point within the mass, at every level, and move upwards (from inside to outside). So we speak of specific forms of "templates" of nested spacetime curvatures formed and utilized to engineer mass "from inside out" as *spacetime curvature engines or vacuum engines*.

Use of vacuum (spacetime curvature) engineering[15] is a far more powerful form of engineering than is provided by energy propagation through space. As an example, it is easy to alter the quarks in a nucleon, using spacetime curvature engines and time-charging decay. Indeed, we have developed the mechanisms for cold fusion and the electronuclear interaction (formation of new nuclides) at feeble energy. An Invention has been filed with the U.S. Patent Office, and formal patent applications are in preparation. Some information on these mechanisms and principles has been released[17].

Time as Dense EM Energy and a Strong Spacetime Curvature Agent

The advantage of using the time-polarized "time-energy" for spacetime curvature is that time is ordinary energy compressed by a factor of at least c^2—which, in the MKS system of units, is some $9¥10^{16}$. Thus use of time-polarized EM photons and waves as ST curvature agents gives an amplification of $9¥10^{16}$ over the use of transverse-polarized EM waves for that purpose. In turn, the use of the strong EM force in ordinary TW waves as an agent of ST curvature is already a nominal 10^{40} times as strong as is the weak G force used as the agent of ST curvature.

The bottom line is this: For spacetime curvature effects, the use of the t-polarized domain provides amplification of some $9¥10^{56}$ greater than the weak G-force ST curvature agent usually considered in general relativity[18].

Western Science Remains Largely Materialistic

Ironically, most Western scientists are materialists and consider "mind" as a mystical and nonscientific concept. They tend to consider mind operations and functions either to be simply "meat computer" operations and functions, or at best to be very weak ordinary transverse-wave EM operations and functions in the brain and nervous system.[8] This serious self-limitation exists because in the body we *measure* only weak TW EM operations and functions correlated to biological behavior and brain operations. We simply do not know how to

Disclosure[16] on this work measure "mind operations" directly.

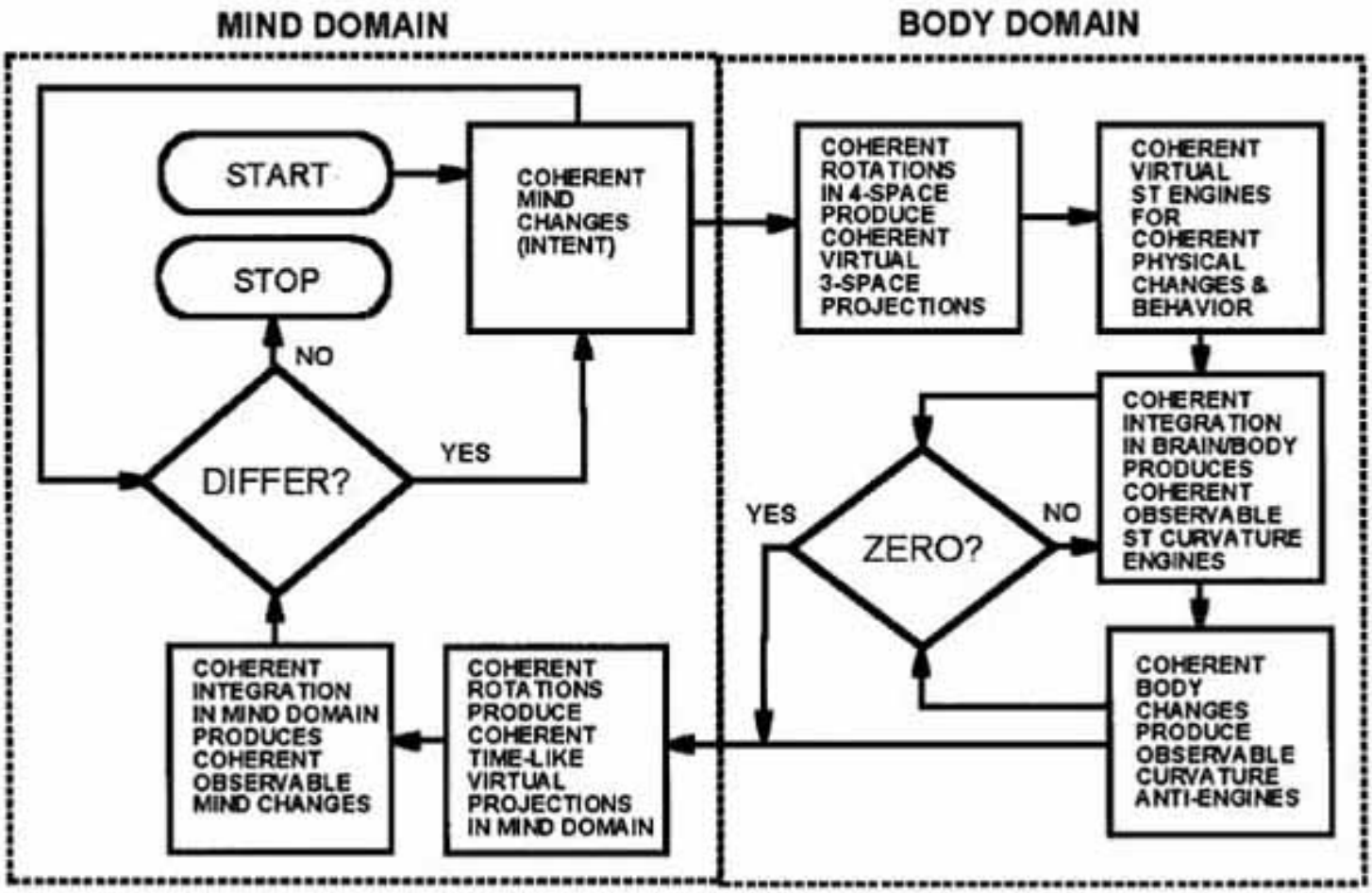

Figure 5. Mind-to body coupling and body-to-mind coupling.

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With no mind measurements possible and no instruments, it is understandable that Western science considers only the physical side of the mind-matter interface.

Presently our scientists do not measure the longitudinally-polarized EM wave operations and functions in the body and around it in nature. Few of them are aware that a maelstrom of such LW functions exist in the body and in all of nature in general. Presently only highly theoretical quantum field theorists seem to even be aware of the existence of scalar (t-polarized) photons, and even they are unaware of t-polarized EM waves. Certainly our scientists do not measure t-polarized EM waves in and around the body and in nature, nor do they make them in the laboratory. Apparently they have not studied such waves and their interactions with matter—living and inert—at all.

But it's even worse. In ignoring the time component transported by photons and EM waves, science has also erroneously omitted half of the excitation charging and excitation decay processes whenever a mass interacts with photons and EM waves. More on that later.

Brute Forcing Time Functions versus Fine Control Methods

Ironically, Western mind control researchers using transverse EM waves for mind control research, are using a brute force method of evoking and using vacuum engines (spacetime curvature engines) and a special form of general relativity, although they do not appear to realize it.

While KGB scientists also use TW EM "brute force" TW waves when necessary, they do "imprint" or "activate" those waves with the desired internal LW and time-polarized EM wave and photon structures required to directly perform the mind engineering desired. They also do not hesitate to use LWs and t-polarized waves overtly. So in blunt terms, Western compared to Russian mind control research is probably like comparing an automobile body shop with a fine surgical ward. Having long ago worked out all those "exact correlates" to the internal "information content of the field" is where the KGB scientists are at least 20 years ahead of the West.

The reason one can get mind and behavior results with the TW electromagnetics, while bypassing the real mechanism which uses t-polarized waves and photons, is due to (1) the very peculiar nature of the EM emission from a dielectric, and (2) what can be done by re-radiating that dielectric with its emitted spectrum, deliberately and very carefully altered in selected parts. We will return to that important feature later.

Polarization and Observability

As we stated, there are four photon polarizations and therefore there must be correspondingly four EM wave polarizations[1] The first three polarizations are the x-, y-, and z- spatial polarizations. The x- and y- polarizations are transverse polarizations and the z-polarization is a longitudinal polarization along the direction of propagation (along the z-axis, by standard notation). Simply put, we may visualize the transverse polarizations as rather like the wiggling of a fish's tail from side to side as the fish moves forward, or a whale's flukes up and down as the whale moves forward, or some combination thereof. We may visualize the longitudinal polarization as a sort of "repetitive accordion effect" along the line of motion of the wave. Usually the z- polarization is neglected in EM wave theory, although in recent years physicists have "rediscovered" longitudinal EM waves and are now intensely researching the use and characteristics of such waves.[12]

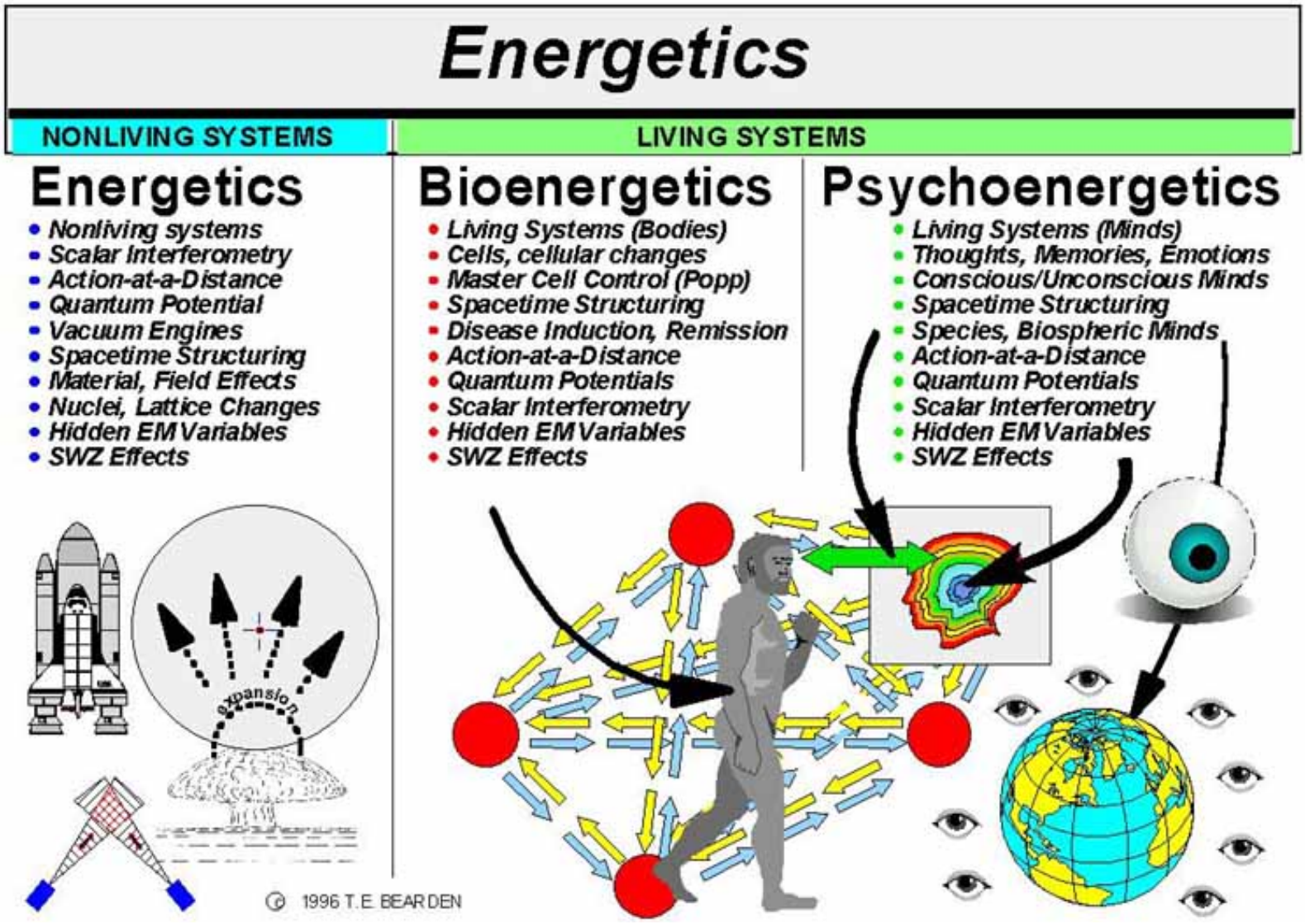

Figure 6. The three divisions of Soviet energetics and their characteristics.

Unfortunately, in quantum field theory there has been a tendency to regard the t-polarized or "scalar" photon—where the local rate of time is oscillated—as unobservable. Oscillation of the local rate of time produces powerful oscillations of local space-time curvatures, due to the extreme energy density of time. Individually, the t-polarized photon tends to be unobservable. However, a *coherent sequential group* of such t-polarized photons, each individually in the virtual state with respect to the external observer, may simply integrate in its interaction with mass over a short time period into observable change because of the coherent integration of virtual spacetime curvatures into a larger, observable spacetime curvature.

Rotations and Projections in 4-Space

Relativistically, any velocity change in 4-space is a rotation. Any such rotation in the time-domain also creates a tiny projection component into 3-space. Any such rotation in the 3-spatial domain also creates a tiny projection component into the time domain.

Hence a sufficient series of coherent time-domain (mental) changes produces a coherent series of virtual changes in 3-space (the body), thereby coherently integrating into an observable energy change in the body. A sufficient series of coherent 3-spatial energy changes produces a coherent series of virtual changes in the time domain which coherent integrate into an observable time-domain change.

Solution to the Age-Old Philosophical Problem of Intent

This is in fact the solution to the age-old problem of *intent*, or how the nonmaterial (i.e., non-3-spatial and non-observable) mind induces a 3-spatial, observable energy change upon the 3-spatial body. It is also the solution to the problem of *awareness*; i.e., how the mind is aware of itself[19] and of the responses of the body. Together the two form a closed loop coupling of the mind and body. The time delay in the loop together with memory recall for comparison, creates the sense of "persistence" of self in time. This also creates the sense of being a "separate, closed being" (i.e., of separate persistence in time—in the living entity). The sense of "separation of self from an external world" is created by comparing those body-to-mind sensory feedbacks which are not correlated to the mind's previous feed-forward intent.

Time As Energy and Why It Is Very Dense Energy

In addition to the three spatial polarizations of photons and EM waves, there is a very, very useful t-polarization along the time axis. In this polarization, the 3-spatial energy is not oscillating at all. Instead, the time or time-energy is oscillating. Time can be taken to be energy compressed by at least c^2, so it has at least the same energy density as mass. In other words, one second is 9×10^{16} joules of time-energy (energy compressed into time). The t-polarized photon or EM wave is called the scalar photon or scalar EM wave, respectively.

To demonstrate why time can be regarded as energy, we need only point out that the choice of fundamental units in any physics model is totally arbitrary. We usually choose these units to ease the mathematical manipulation, ease our understanding, and simplify the ability to visualize or "grasp" the physics. However, if one wishes, one can build all of physics from a single fundamental unit—e.g., energy. In that case, one readily sees that time is a function of energy and only energy. Hence it is perfectly proper to regard time as energy, and to seek out what form the function takes in our normal system of units (say, the MKS system).

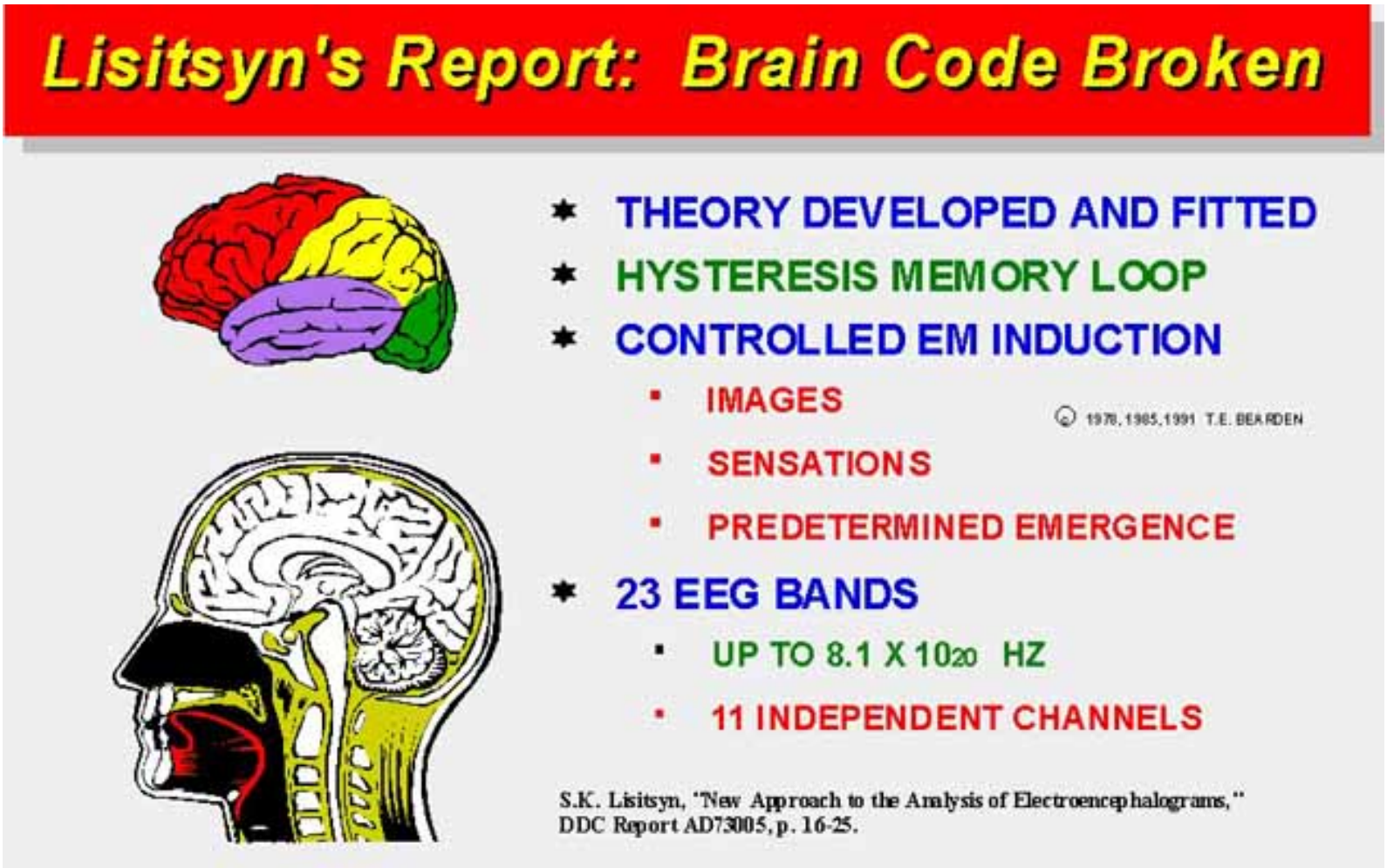

Figure 7. In the 1960s, Lisitsyn revealed Russian scientists had deciphered the human brain code.

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In that system, it appears that any change in time Δt can be taken as always a function of a corresponding change in energy ΔE, where $\Delta t \leq (\Delta E) \div c^2$ [1] from which it follows that $\Delta E \geq (\Delta t) \times c^2$ [2] For convenience, we take the special case where $\Delta t = (\Delta E) \div c^2$ [3] $\Delta E = (\Delta t) \times c^2$ [4].

Observation as Used in Physics Is Spatial

We note that all mind operations are time-like, i.e., they are comprised as scalar EM photon functions and scalar EM wave functions. Thus the mind is a very special kind of electromagnetic system, existing in the time domain, and thus "lost" by the stripping away of time in the ordinary observation process. Physical observation is essentially a time-differentiating mechanism applied to a 4-spatial change, or in terms of MKS fundamental units L and t, observation θ is $\theta = \partial/\partial t(L^3 t) = L^3$ [5].

Thus, as is well-known in quantum mechanics, physical observation is 3-spatial, and time is not a physical observable, even in theory. Since mind is time-like, it follows that mind is not a physical observable either, since discarding the time dimension also discards the mind. In short, one may also take physical operation as the mechanism that separates mind and body. To observe is to separate. We point out, however, that merely "separating and discarding" the time domain (as in physical observation of a single change) does not eliminate it, nor does it eliminate the single time-like mind change that may be involved in an intentional volition. The time domain certainly remains, even though only the 3-spatial intersection of the 4-spatial mechanism and the resulting "outputs". So a series of coherently integrated "mental intent" changes introduced into the human body's overall servo-mechanism provides the continuing input. From there, ordinary physics will generate the resulting actions induced in the body by that servomechanism and its amplifying mechanisms.

Two Coupling Mechanisms Make a Closed Loop

This is the "mind-to-body" coupling mechanism. [See *Figure 5*] It is the mechanism whereby the mind is coupled to the body, and whereby mental intent is able to induce a series of physical inputs into the body servomechanism.

So the body's servomechanism then generates the responses of the body (including everything from chemistry to electrical changes to muscular movements, etc.). These responses are changes in 3-space.

The conscious mind is a *serial processor*, though extremely rapid. It produces the series of coherent intent inputs for volitional behavior.

The unconscious mind is a *massively parallel processor*.[20] It continually produces the vast series of coherent "unconscious intent inputs" for control of all the deeper processes in the body, beyond usual conscious awareness.

However, as the body moves or changes in 3-space, each resulting quantum change in body 3-space is also a slight rotation out of 3-space and toward the time axis. Hence it induces—in the "virtual state" in the time domain—a precisely correlated projection. The body's responses are in general

Minkowski change is given by physical observation. So we may say *that the time-change remains in the virtual state, with respect to attempted physical observation of a single Minkowski 4-space change.*

Rotation, Coherent Integration, and Intent

Previously we pointed out that any change in a 4-space entity may be regarded as a rotation away from the "trajectory" of the entity. Hence each and every t-polarized change creates a very small projection into 3-space by its rotation slightly away from the time axis. All mind changes in the time-domain actually produce virtual 3-spatial projections in 3-space (in the physical domain). We define "intent" as the continued production of successively coherent mental changes, producing coherent virtual changes in the 3-space body system, with coherent integration of those 3-space virtual changes into observable 3-space energy inputs into the 3-space body system. Successively coherent mind-changes will produce successively coherent 3-space virtual changes. In short, coherent mind-changes will produce coherent integration of those 3-space virtual projections into an observable 3-space change. This is the creation of an ordinary 3-spatial energy change induced upon the 3-space body. In short, this is the mechanism whereby time-like mental intent is able to produce a series of coherent observable quantum changes in the physical body (as in the brain and nervous system).

The Body as a Servomechanism

From the standpoint of control theory, we may consider the body system to be a coherent, so a coherent series of virtual state changes in the time-domain (in the mind realm) are created successively. In short, again we have coherent integration, this time in the mind or time domain. This produces "observable" changes in the time-mind domain, which are coherent with the body's 3-spatial changes actually performed. Thus the mind receives feedback directly from the physical movements and changes of the body. This is the manner in which the body is coupled back to the mind.[21]

By comparing the "intent" behavioral move that was "fed forward" into the body, with the return "response" move analog that was "fed back" from the body to the mind, the mind is able to determine errors and differences, and originate additional correctional commands.

Thus the entire mind-body loop is a closed-circuit system of feedforward and feedback, together with corrections. It also has multiple levels of such, infolded in the larger volitional levels. See again *Figure 4*.

This solves the age-old problem of the mechanisms for the mind-body coupling, intent, volition, conscious and unconscious functioning, sense of the external world, sense of the internal world, sense of "being in" the external world, etc.[22]

All This Is Included in Russian Psychoenergetics

This is the highly summarized basis for *psychoenergetics*, the KGB's division of energetics that deals with the mind and body coupling and functions, and direct engineering of (1) the mind-body coupling and (2) the mind operations directly. [See *Figure 6*] The KGB intent, of course, has always been to exploit this science for the

complex servomechanism system comprised of many subordinate servo systems with feedback and feedforward looping.

Given the input from intent, ordinary servo theory will take it from there. Once a servo has an input, servomechanism theory describes the response of the degradation, killing, and control of human beings, including all humanity.

The Russians know full well that, if you produce and utilize scalar EM photons and t-polarized EM waves, you can directly affect and engineer mind and mind operations at any and all levels. Western researchers, who know nothing of how to make

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time-polarized photons and time-polarized EM waves, do not yet know that. Consequently the Russians have developed a highly secret science of *directly* engineering the mind and its operations, including thought, images, perceptions, feelings, emotions, memory, and mind processing. Indeed, Lisitsyn[23] wrote quite specifically of this capability in the 1960s. [See *Figure 7*]

Western clandestine mind control researchers are apparently still slowly and painfully fitting TW EM irradiation correlates to induced or resulting mental and physical behavior responses. They seem unaware of the actual wave transductions occurring inside the body and mind, but are unwittingly inducing those transductions in hidden fashion anyway and in "brute-force input-response fitting" models.

These "fitted brute-force models" certainly can be very powerful, and certainly can produce the exact results shown in the experimental verifications of the fittings. However, they do not of themselves allow sophisticated design—for example—of the necessary time-polarized wave assemblies for engineering the entire human collective unconscious simultaneously, or for engineering the entire collective unconscious of all species on Earth (i.e., Gaia's collective unconscious), or even for precisely engineering the memory and knowledge base of an individual.

This fine research article will be continued in Part II with Russian Methodology, Waves and Wave

spacetime that is highly active. The mind is rooted in the time-domain and projects from that domain into 3-space. The body is rooted in the 3-space domain and projects into the time-domain. To "change" or "function" in one domain is automatically to function in the other. EM and gravitational phenomena are still modeled separately by human scientists, but not by nature.

3. In quantum mechanics, time is not an observable, but merely a parameter.

4. It is convenient to consider mass as a 3-spatial form of condensed energy.

5. E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics, " Mathematische Annalen, Vol. 57, 1903, p. 333-355;— "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions, "Proc. Lond. Math. Soc., Series 2, Vol. I, 1904, p. 367-372.

6. A NERAC document search yielded some 16 good references on t-polarized photons, but not a single reference on t-polarized EM waves.

7. E.g., such previously inexplicable instrument anomalies have accompanied some excellent and rigorous electrolyte experiments at U. S. Navy research facilities at China Lake. For a description, see Melvin H Miles and Benjamin F. Bush, "Radiation measurements at China Lake: Real or Artifacts?", Proc. ICCF - 7 (International Conference on Cold Fusion—7, Vancouver, BC, Canada, Apr. 1998, p. 101. For a brief explanation of the anomalies, see T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves, " Explore!, 8(6), 1998, p. 7-16;— "Toward a Practical Unified Field Theory and a Deep Experimental Example," Proc. INE Symposium, Univ. Utah, Aug. 14-15, 1998.

8. Many U. S. researchers and journalists—and even many scientists—have wrestled with the problems of mind, intent, and mind-body

Transduction, The Cellular Control System, and other matters of interest. ♦

ABOUT THE AUTHOR

President and Chief Executive Officer, CTEC, Inc. Lieutenant Colonel US. Army (Retired). MS Nuclear Engineering, Georgia Institute of Technology. BS mathematics, Northeast Louisiana University. Graduate of Command & General Staff College, US. Army. Graduate of Guided Missile Staff Officers Course, U. S. Army (equivalent to MS in Aerospace Engineering). Numerous electronic warfare and counter-countermeasures courses.

Tom is the leading advocate of scalar potential electromagnetics and the Fogal charge-blocking semiconductor: He is involved in alternate energy devices and scalar electromagnetic system prototypes. He has defined charge q as a coupled system of two components, advanced a mechanism for a vacuum engine, whereby the vacuums virtual particle flux is organized and used to energetically shape and manipulate matter and energy, and advanced a mechanism for a Bohm-type quantum potential, which theoretically allows the engineering of action at a distance in physical systems.

He is president of the Association of Distinguished American Scientists (ADAS), a life member of the Alabama Academy of Science, Emeritus member of the American Association of Physics Teachers, and has served on the Board of Directors of several associations

coupling. Enumeration of those efforts would itself require an entire book. For an introduction into that domain, the reader is referred to the very determined exposé by Cheryl Welsh in her very timely book, The 1950's Discovery of the Code of the Brain, May 1988, published on the Internet. Simply employ any Net search engine and search on the name Cheryl Welsh. A connection to the site and to Welsh's book will immediately be found Welsh's important compendium is highly recommended, giving the reader a "birds eye view", so to speak, of how Western scientists think and proceed regarding the subject of mind control by electromagnetic means. Unfortunately all journalists so far researching the area have not been aware that Western electrodynamics itself is seriously flawed, and that the great Russian advances in mind engineering and mind control are a result of their secret but complete revision and correction of Western electrodynamics to provide the basis for energetics. Until Western scientists revise their own decrepit old electrodynamics fouling the textbooks, they will never catch up to the Russian mind control developments springing from intense development programs that did that revision in the late 1940s and early 1950s.

9. An Invention Disclosure on these processes and enhancement embodiments has been filed with the U. S. Patent Office. Formal patent applications are also in preparation.

10. Energetics is a unified science of an extended electrodynamics possessing a hidden infolded general relativity inside the potentials, fields, and waves. It deliberately employs higher polarizations (longitudinal and tempic) of photons and EM waves to engineer action at a distance, use of specific patterns of spacetime curvature created at a distance, and direct engineering of either inert or living bodies. It also encompasses the direct engineering of time-like mind and mind functions. It is divided into three divisions, depending upon the nature of the target. Targeted against inert materials, structures, fields, and waves it is called "energetics. "Against living bodies, their fields,

and corporations. Tom is a guitarist, a retired aikidoist (Sandan, Yoseikan style), is happily married and has two sons and two daughters. He and his wife Doris live in Huntsville, Alabama where Tom is retired from aerospace, continues private research, and serves as a consultant to industry on Scalar electromagnetics processes.

R E F E R E N C E S

1. E.g., see Lewis H Ryder, Quantum Field Theory, Cambridge University Press, 2nd Edition, 1996, p. 147+. For an even deeper discussion of photon polarization, see F. Mandl and G. Shaw, Quantum Field Theory, Wiley, 1984, under the heading "Covariant Quantization of the Photon Propagator" in Chapter 5. Mandl and Shaw argue that the longitudinal and scalar polarizations are not directly observable, but only in combination, where they manifest as the "instantaneous" Coulomb (i.e. electrostatic) potential.
2. Nature is unified and not separated into the "separate" disciplines our science has prescribed. Thus the mind is also totally electrogravitational. The mind works not just with EM
forms in an inert space, but also with spacetime curvatures in a and biochemistry, it is called "bioenergetics." Against the mind and mind functions, it is called "psychoenergetics".
11. Psychoenergetics is that branch of energetics used to directly affect and engineer the mind, memory, perception, thought, emotion, sensation, personality, and other mind functions of a living biological organism. It is usable against a single personal conscious (serial processor) mind and a single personal unconscious (massively parallel) processor mind In theory it is also usable against lungs collective unconscious mind and its functions, as well as the deeper unconscious for all species on Earth (i.e., against Gaia). We are speaking of physics, not metaphysics.
12. W A. Rodrigues Jr.. and J.-Y. Lu, "On the existence of undistorted progressive waves (UPWs) of arbitrary speeds $0 \leq v < \infty$ in nature," Foundations of Physics, 27(3), 1997, p. 435-5•08 A slightly corrected version is downloadable as hep-th/9606171 on the Los Alamos National Laboratory website.
13. E. T. Whittaker, "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions, "Proc. Lond. Math. Soc., Series 2, Vol. I, 1904, p. 367-372. The paper was published in 1904 and orally delivered in 1903.
14. E.g., see T. E. Bearden, Fer-de-Lance, Tesla Book Co., 1986;—AIDS: Biological Warfare, Tesla Book Co., 1988;—Soviet Weather Engineering Over North America, 1-hour videotape, 1985,—Gravitobiology; A New Biophysics, Tesla Book Co., P.O. Box 121873, Chula Vista, CA 91912, 1991,—Energetics of Free Energy Systems and Vacuum Engine

Therapies, Tara Publishing, Internet node www. tarapublishing.com/books, July 1997; — Energetics: Extensions to Physics and Advanced Technology for Medical and Military Applications, CTEC Proprietary, May 1, 1998, 200+ pages furnished to selected government agencies and key Congressional committee leaders.

15. E.g., see T.D. Lee, Particle Physics and Introduction to Field Theory, Harwood; New York, 1981. On P.383, Nobelist Lee points out that the microstructure of the scalar vacuum field (i.e., of vacuum charge) is not utilized. Particularly see Lee's own attempt to indicate the possibility of using vacuum engineering, in his "Chapter 25; Outlook; Possibility of Vacuum Engineering, " p. 824-828. With wave transductions and use of higher polarization EM waves, there are far better and more powerful ways to do vacuum (spacetime curvature) engineering.

16 T.E. Bearden, "Formation and Use of Time-Reversal Zones, EM Wave Transduction, Time-Density (Scalar) EM Excitation and Decay, and Spacetime curvature Engines to Alter Matter and Convert Time Into Energy," Invention Disclosure Document #446522, Oct. 26, 1998.

17. T.E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves, "Explore!, 8(6), 1998, p. 7-16; — "Toward a Practical Unified Field Theory and a Deep Experimental Example," Proc. INE Symposium, Univ. Utah, Aug. 14-15, 1998.

18. We have used the enormous energy density of time in our approach to a totally new kind of electronuclear interaction at feeble spatial energy. By use of a time-reversal zone (TRZ) in a fluid; the free H+ ions—which are free protons —can be induced to attract each other so tightly that the edge of the nuclear force region is entered. In that case the protons form a quasi-nucleus. When the TRZ decays back to a time-forward zone (TRZ), this new quasi-nucleus decays by changing quarks in one or more means "sense of existing in time".

20. The "unconscious" is totally conscious, just multiply so. The conscious mind can see only "a single slide in the slide projector at a time, " so to speak. When it "looks" at the ongoings and outputs of the unconscious, it "sees" millions of slides in the slide projector simultaneously. Hence it cannot distinguish "one and one only". So it just sees nothing, where by "nothing" we mean "no single distinguishable thing." It therefore is unable to consciously perceive the actions of the unconscious. When the unconscious wishes to communicate with the conscious (because of unresolved conflicts, etc.), it must produce large groupings integrated into "symbolic scenarios". Hence the symbolism of the unconscious, and the basis for therapeutic psychology and psychiatry. A "symbol", after all, is just a thing which can have many different meanings, all folded into one.

21. The mind continually has activities of its own, each of which produces coherent changes in the body to a much smaller degree. The interweaving of these "smaller self-changes" infolded inside the 3-space major intent changes also produces slight body changes, which in turn "project back" into the mind. This huge group of "infolded self-loops" produces the sense of "my body" being "volitionally directed or occupied" simultaneously with the "greater intent" loops which represent "my intentional actions with my body". Further; the body servo continually receives a myriad of inputs from its sensory systems, both from changes inside the body and from incoming changes from the external universe. This interweaving produces the awareness of "being in the external world" by having (i) changes whose feedback do not match mind-intent changes, and (ii) changes whose feedback does match mind-intent changes. This of course applies to both the conscious and unconscious levels. The purpose here is to demonstrate that there exists an actual physics of the living being, the mind as well as

nucleons, thereby producing new nuclides. We point out that this is actually a very high energy reaction; however; since the time-energy is used and is very, very dense, the amount of 3-spatial energy that must be used is very small. If this new mechanism holds, it represents a revolution in particle physics.

19. "Self-awareness" refers to be continually "refreshed" by time-delayed coherent feed-back inputs from the body to the mind; where these inputs compare to the recalled memory of the minds inputs to the body. In short, the time-delay coherence creates the sense of "existing in time". Awareness usually the body, and the coupling and interfiinctioning of mind and body.

22. The methodology also easily extends to include deeper interlays for the collective human unconscious mind and for Gaia—the collective unconscious mind level for all the species on earth.

23. S. K Lisitsyn, "New Approach to the Analysis of Electroencephalograms, " in Problems of Bionics— (Selected Articles), Defense Documentation Center Report AD 73005, date unknown, p. 16-25. Available through the National Technical Information System (NTIS).

EXPLORE! VOLUME 9, 1999

Mind Control and EM Wave Polarization Transductions, Part 2

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This article continues on with T.E. Bearden's article, Part 1 of which was published in Volume 9, #2 of Explore! for the Professional. Because we feel that Col. Bearden's caution below is so very important we are repeating its publication in all parts of this article.

Special Note

This article refers to experimental research techniques which can be detrimental or lethal in the hands of any but highly skilled, qualified experimental scientists proceeding under proper laboratory safety procedures. The purpose of this article is strictly for information to properly qualified and authorized scientists in certified laboratories. We do not propose or condone any use of these procedures for non-approved practice of medicine without a license. Neither the publisher nor the author are responsible for accidents or outcomes in the use of these experimental procedures and techniques. Any researcher who performs these procedures and experiments is acting on his or her own volition, and is solely responsible for insuring safety, qualifications, and legality of the acts and their results. We neither suggest nor condone unauthorized experimentation on human subjects. Such is a criminal violation of the constitutional rights of the subject under Federal and State laws, and is both illegal and immoral.

A Strategic Threat Completely Unrecognized by the West

The Russian methodology leads directly to rather mind-bending, extended capabilities. KGB psychoenergetics scientists seem fixed on an eventual goal of directly engineering Jung's collective human unconscious, thereby converting the entire human species into a sort of "ant" species. In short, they seek to engineer what they regard as "perfect communism and perfect order" directly in the entire species. *Figure 8* indicates the direct connection of every human's conscious and unconscious mind to the collective species unconscious and to Gaia, the collective unconscious for all species on Earth. Since time is internally structured and layered, it follows that time-like mind levels are also internested and layered.

This appears to be a significant strategic threat, *well along in its development*, that our scientific and intelligence communities have completely failed to recognize.

The direct engineering of the entire human collective species is a doable.[1] It is going to be done, whether we like it or not. In that race (which may eventually determine whether or not we retain any personal freedom at all), the "democratic" nations are woefully behind. In fact, the West has not even realized there is such a new kind of "arms race" for dictatorship and control of the "collective species mind" and we have already almost lost it. The West has not yet even developed the overall theory of psychoenergetics.

Waves and Wave Transductions

A pure longitudinal EM wave (LW) would have infinite energy and infinite speed. In practice, one can only approach this perfect LW wave, and one always has transverse residues remaining. Hence the "imperfect" longitudinal EM waves we can make in suitable equipment and techniques, are known as "undistorted progressive waves" (UPWs). The UPWs may have velocity far greater than the speed of light, or less than the speed of light. So the speed v of UPWs can vary as

$$0 < v < \infty \qquad [6]$$

The Russians also know that, when a nearly-pure longitudinal EM wave interacts with matter (it usually doesn't interact very much, and has a low reaction cross section), the mass immediately adds the phase conjugate replica to the interacting LW portion, regardless of frequency, thereby transducing the input LW interactions into scalar (time-polarized) EM interactions.

One transduces from TW to LW to Scalar EM via iterative phase conjugation. One transduces from scalar EM to LW to TW via iterative interferometry. It took the present author 20 years to discover this simple thing; we now have filed an invention disclosure on the process and embodiments for performing it, and will be following with formal patent applications. Let TW = transverse EM wave, LW = longitudinal EM wave, and TDW = time-density EM wave (another name I use for t-polarized or scalar EM waves, since the density of time-energy is what is varying). Let (I) = interfering with, PCR = phase conjugate replica wave with a coupled set of parentheses enclosing the type of wave. The rules for wave type transduction are:

$$\text{TW} + \text{PCR(TW)} \Rightarrow \text{LW} \qquad [7]$$

$$\text{LW} + \text{PCR(LW)} \Rightarrow \text{TDW} \qquad [8]$$

Going the other way, the rules are:

$$\text{TDW (I) TDW} \Rightarrow \text{LW} \qquad [9]$$

$$\text{LW (I) LW} \Rightarrow \text{TW} \qquad [10]$$

In EM smog (dense EM signals, even though very weak), there is increased nonlinear multiwave interactions, both interferometric and phase conjugative. So in such EM smog there exists an increased, non-negligible component of LW and TDW irradiation, formed by the above transduction interactions in the irradiated living cells and bodies. This latter part accounts for many of the long term effects which show up in "correlative" studies, but which do not show up in the normal limited-frequencies TW experiments produced by so-called "physical experiments."

The standard EM bioeffects manner of experimenting uses a theoretical model of simple, direct energy deposition by means of absorption in cells and tissues. Now we must utilize an "open system" throughout the body dielectric in which higher polarized EM energy (either LW or t-polarized) travels readily throughout all areas of the body.

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EM Bioeffects and Wave Transductions

In the EM bioeffects experiments to date, there has been absolutely zero control of the internal transductions, and there has been no consideration of them. Almost all transductions of TWs into LWs will immediately result into transduction into TDW and time-excitation charging of the cells and all their internal components. These time-excitation charges (excited states of time-charging) will then slowly decay, emitting longitudinal EM waves in the process which travel throughout the body. These emitted LWs interfere with each other and the LW processes in the body, producing low level TW "noise jamming" of the cellular processes and—most especially—of the deep cellular control system of the body. The latter system functions by means of LWs and TDWs. Long-term effects of such "noise jamming" of biochemistry reactions and the control systems of the cells and body, can lead to degenerative diseases such as arthritis, atherosclerosis, Alzheimer's disease, heart disease, cataracts, tumors, leukemia, somewhat accelerated aging, immune system weakening and depressing, etc. As the body's natural defense and regeneration ability weakens, opportunistic infections further add to the degeneration.

It was shown by Whittaker in 1903 that any scalar EM potential is comprised of a harmonic series of bidirectional longitudinal EM wavepairs. [See *Figure 9*] Each longitudinal EM wave pair in the harmonic series is a phase conjugate pair. Unknown to Whittaker, that "LW phase conjugate pair" is actually a time-polarized EM "photon" structure, containing a phase conjugate LW photon substructure. So staid old "voltage" (potential) is comprised of a harmonic series of time-polarized EM waves!

The corresponding "t-polarized photons" are actually spin-4 *supergravitons* comprised of coupled antipairs of LW "photons". Each LW photon is a spin-2 *graviton* comprised of a coupled TW photon-antiphoton pair. Each TW photon and antiphoton in the coupled pair has spin-1. The couplet, being the longitudinal "photon" or graviton, thus has spin-2. And so on.

In 1904, Whittaker showed that any EM field or wave pattern can be decomposed into two scalar potential functions. By applying Whittaker 1903 decomposition to each scalar potential function, any EM field or wave has an enormously rich internal structure, comprised of scalar potential functions in interference. Each scalar potential function is comprised of time-polarized EM waves (made of spin-4 supergravitons). Each time-polarized EM wave is further comprised of bidirectional longitudinal EM wavepairs. Each longitudinal EM wave is further comprised of phase-conjugate pairs of transverse EM waves. Each transverse EM wave is further comprised of two scalar potential functions, each of which is in turn comprised of an infinite harmonic series of time-polarized EM waves, and so on *ad infinitum* and *ad nauseum*. Obviously all EM potentials, fields, and waves have an enormous "internal structure" or internal "information content of the field".

The Cellular Control System Uses t-Polarized EM Photons and Waves

The master cellular control system (MCCS) in the body utilizes these photon-gravitons, their corresponding EM wave polarizations, and transductions between them. By the use of very powerfully condensed gravitons and supergravitons, it is able to utilize small but highly significant direct curvatures of spacetime. It does not merely send a "signal" and hope the cell itself acts upon it. Instead, it sends an "engine" which alters the local spacetime in which the cell and all its components are embedded. This "local ST curvature engine" then physically works directly upon the cell and all its parts, to alter the cell according to the specific "template" of the engine.

This is the direct application of the Wheeler's simple statement of general relativity: *Mass (trapped energy) acts upon spacetime to curve it, and curved spacetime acts upon mass to change it.*

Popp's "ordinary photon" study of this cellular control system[2] therefore will detect the coherent ordinary TW photon residues which result from the photon polarization transductions occurring from the actions of the ST curvature engines upon the cells.

Cellular division, biochemical processes, growth and growth control, cell differentiation and dedifferentiation, etc. are all controlled by the MCCS or one of its subsystems, using spacetime curvature engines. The ordinary TW electronic activity our biophysicists detect and correlate are simply the intermediate components of the actual ongoing polarization transductions.

The Cellular Control System Uses EM Time-Energy

One important subsystem of the MCCS controls the immune system's functions, including the deepest and most subtle functioning performed by all elements of the immune system. This system has been rather intensively studied, but since our biophysicists have not possessed the full electrodynamics utilized, only the correlated residue of normal TW EM waves and photons have been recognized and studied. Hence Western biophysics is in its very crude infancy.

Incorporation of the total wave and photon polarizations, together with their transductions, will eventually present a revolution in both biomedicine and biophysics. Unfortunately, presently our entire medical community is very firmly entrenched in only ordinary TW EM polarizations and ordinary biochemistry. Our scientists thus are studying less than 1% of the functioning of the living organism.

As an example, since Western scientists have no knowledge or research into the time-polarized mind domain and mind-body coupling, the mystery of the *placebo effect*—in which the mind has been verified to produce actual physical effects – will indefinitely remain a mystery.[3] As one result of that "crippling" of our medical theory, medical experimenters have to deliberately drive experiments on drug effects, etc. beyond the "mind's own threshold" of physical effect. In short, they have to drive the experimental results over and above the results being accomplished by the placebo effect. They must perform valid placebo control experiments, and subtract the placebo component results from their own experimental results, to determine the "delta" induced purely by the drugs.

The Regenerative Subsystem

Another important subsystem of the MCCS controls the *regenerative system* of the body. The regenerative system has various mechanisms, including growth control, differentiation and dedifferentiation of cells, etc. Becker's portrayal of the regenerative system is shown in *Figure 10*. One of its most important functions is healing and restoring damaged or diseased cells. It does that by a most remarkable process.

This system has been very poorly studied, mostly by Becker[4]

powerfully condensed gravitons and supergravitons, it is able to utilize small but highly significant direct curvatures of spacetime in precise patterns. In short, it utilizes general relativistic spacetime curvature engines, rather than "EM photon signals", to accomplish its control of the cells and their processes. It does that by a most remarkable process.

This system has been very poorly studied, mostly by Becker[4] *et al.*, although there is still sporadic, ill-funded, and ill-planned research on regenerative effects from time to time.[5] Becker and his colleagues came closest, and—considering the severe limita-

tions of the orthodox U(1) EM model available to them—Becker's work is particularly revolutionary. He demonstrated beyond question that simple DC potentials could generate cellular differentiation and redifferentiation, and produce results at global sites in the body and not just at the local injury sites where the DC potentials were applied.

Becker was nominated for a Nobel Prize for his Herculean efforts and remarkable results. For his trouble he was hounded, his funds were withdrawn, and he was forced to retire at an early age in his 50s. His biggest "heresy" was to bravely point out that power line radiations had deleterious effects upon biological systems, and to testify to it in a series of hearings and court cases where a very powerful electrical power industry essentially ran rough shod over science and the public.

Organized Science Is Highly Politicized and Imperfect

It is not only politicians that are "bought and paid for" by powerful vested financial interests. In organized science, precisely the same arrangement holds true. Scientists are no better or no worse than any other segment of humanity. A surprising percentage will produce the results desired by their benefactors, if provided with cushy jobs, good income, prestige, and secure positions.

It has been said that money is power. It has also been said that power corrupts, and absolute power corrupts absolutely. In the scientific community, as well as in the political community, this "great corruption" by great financial power has been elevated to an art form. Simply examine the funds made available to scientists. There is not enough for all the scientists, so it is fiercely competitive. If the scientist does not get grants (e.g., a would-be professor at a university), he does not bring in extra money to the university. He cannot get his graduate students funded, so his own innovative (read: heretical) research is thwarted. His papers are rejected by the journals, and before long he has no funded position in science. If lucky, he will be employed in the grocery store or the butcher shop.

Every bit of funding available for the scientists to compete for (and apply for grants) already has firmly fixed controls of exactly what research can be done with that money. The "science" that will be applied is already formulated. That and only that can be done. It is a tribute to the dedication and resourcefulness of our working scientists themselves, that anything innovative at all gets done.

One can have a very fine scientific career, tenure as a professor, get one's graduate students funded, get one's papers published in prestigious journals, win awards and achieve stature and prestige, if one just plays the desired game prescribed by the "old boys schools" in control of almost all the scientific funding. Yes, one can permissibly move the decimal point in the present models a bit, and be rewarded handsomely for doing so. But one is damned if one attempts any serious change or overthrow of obsolete scientific models and practices favored by the "system".

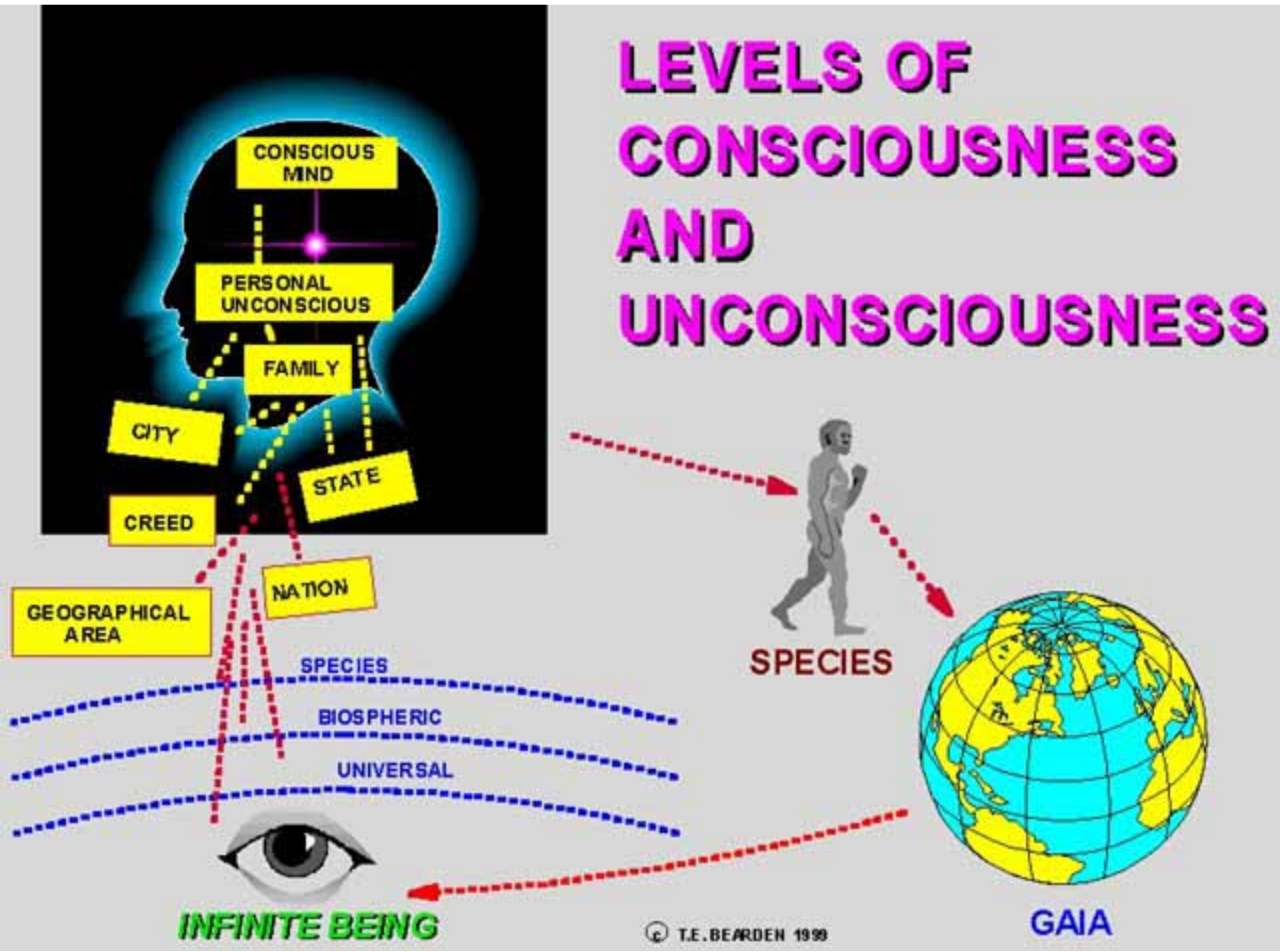

Figure 8. Nested levels of consciousness and unconsciousness. The mind levels contain the "life" and "mind" dynamics.

That is precisely why all our universities continue to teach a terribly flawed electrodynamics that is a caricature with at least 32 major foundations flaws in it.[6]

And that's why the organized Western scientific community has betrayed the taxpayers who largely fund its research. In short, the scientific community fiercely enforces dogma, suppresses innovation, and has denied the U.S. the very defense we need to survive against our pressing enemies who have not been so scientifically dogmatic.

Microwave Radiation of the U.S. Embassy in Moscow

Because of the strongly enforced adherence to the insane foundations errors in classical electrodynamics, our scientists still do not comprehend the decades of so-called "microwave radiation" of personnel in the U.S. Embassy in Moscow.[7] All diseases and health changes produced in those personnel were in *field-free areas* (i.e., where the potentials were persistent and unchanging, with no gradients etc.)[8] No one even thought to look at the "inner longitudinal EM phase conjugate biwave composition" of those potentials, where they would have found the Whittaker internal bidirectional longitudinal EM wavepairs and the internal time-polarized EM waves. They would also have found the infolded, very powerful general relativity: the spacetime curvatures deterministically formed and being utilized to directly alter the irradiated cells and their constituents.

Instead, government-funded studies did a rather straightforward "force field" analysis, and concluded that, since there were no fields there, it could not have been the microwave radiation.

Elementary statistics would immediately indicate a different conclusion: The diseases and health changes were 100% correlated to the presence of potentials, and 100% anticorrelated to the presence of fields. Hence it was the field-free potentials that had to be inducing the diseases and health changes. If it were NOT the radiation at all, then some changes would have occurred in personnel in areas where fields were *present,* as well as in areas where fields were *absent.* Since this did not occur, such a premise is destroyed by self-contradiction. In short, the data actually proved (i) it was indeed the radiation that was causing the diseases and health changes, and (ii) further, it was the field-free potentials that were the culprit.

That this elementary statistical conclusion eluded our scientific community and our government community, is absolutely inexplicable.

Three U.S. Ambassadors eventually died of diseases induced by their exposure to the Embassy radiation. Ironically, Kaznacheyev[9] had openly released some of the results of thousands of Soviet military experiments showing that any kind of cellular disease or disorder could be induced in targeted cells by novel EM radiation emitted from diseased or damaged cells. Apparently no one in the West deciphered the mechanisms involved in Kaznacheyev's epochal work.

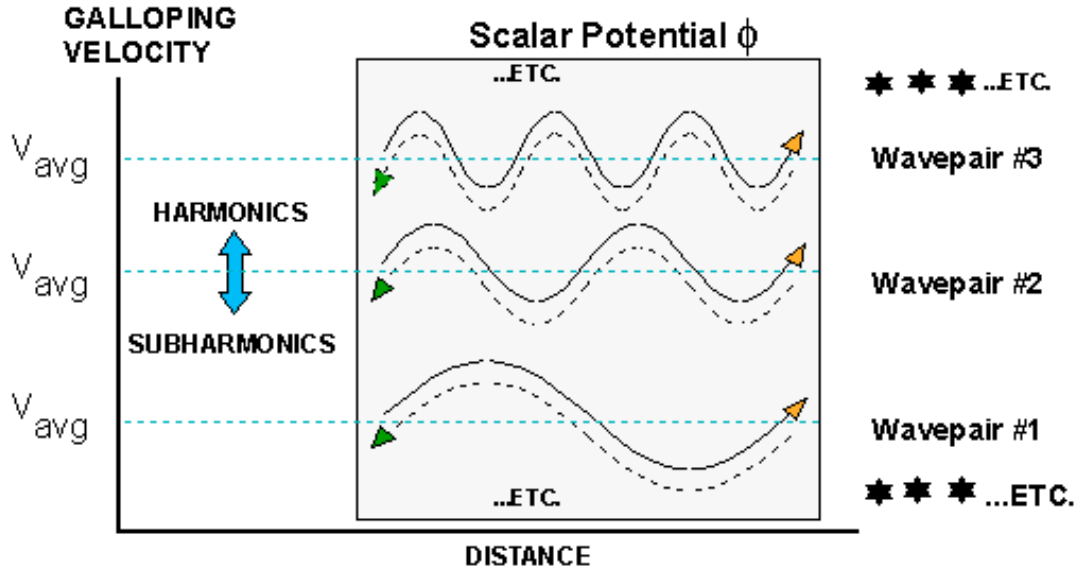

The Structure Is:

- A harmonic set of longitudinal phase conjugate wavepairs.
- In each wavepair the two waves superpose spatially after detection, but travel in opposite directions.
- The convergent wave set is in the imaginary plane, and hence is not observable. It is EM energy incoming to the potential (dipolarity) from the time domain.
- The charge's spin is 720 degrees, 360 in the real plane and 360 in the imaginary plane.
- Hence the charge receives the complex convergent EM energy, transduces it into real EM energy, and emits enormous energy at the speed of light in all directions -- which includes bidirectional pairs in 3-space (after the reaction, being after "observation").
- This produces the fields and potentials from the "source charge or dipole."
- Mandl and Shaw argue that the scalar (time-polarized) photon and longitudinal photon are observable only in similar pairs, which then makes the instantaneous scalar potential. Thus their quantum field

- **Mandl and Shaw argue that the scalar (time-polarized) photon and longitudinal photon are observable only in similar pairs, which then makes the instantaneous scalar potential. Thus their quantum field theory work strongly supports the "negative resistor" interpretation of the scalar potential and our solution to the source charge and source dipole problem.**

Figure 9. Infolded longitudinal biwaves (time-polarized EM waves) composition of a scalar potential.

The Present Situation in Western EM Bioeffects Research

Our scientific community has not even *designed physical experiments* to validate long-term EM bioeffects of the kind caused by induced wave transductions and long-term effects inside the absorbing human cells and in the body's regenerative and immune systems. Western science has no knowledge of these technical internal "wave polarization transduction" mechanisms. Yet the basis for such mechanisms has existed in the hard physics literature for decades. Leading EM bioeffects researchers seem totally unaware of small reaction cross sections inside the body cells and tissues for the transduction of transverse EM signals into LW and t-polarized EM signals. Conventional Western researchers have not investigated it, and often will not believe it when it is pointed out to them along with the supporting basis in the literature.

A major part of the mainline "EM bioeffects" community, of course, seems comfortably funded largely by the power industry etc.[11] The record is clear that this dominant, well-funded group has little or no intention of "finding" anything that will question powerline radiation safety and upset their cushy positions.

In fact, leading bioeffects researchers have pointed out this deliberate biasing of EM bioeffects as a research area. Quoting Dr. Andrew A. Marino, one of the great pioneers in the area of EM bioeffects[10] and powerline radiation assessment.[11]

"Neither scientists nor the public can rely on power-industry research or analysis to help decide whether powerline electromagnetic fields affect human health because power-industry research and analysis are radically misleading."

Dr. Marino then gives the specific details to prove it, and he shows specifically how they slant and mangle their experiments and interpretations of the results, to do it. If the major financial interests cannot *scientifically* destroy determined, honest researchers such as Marino and Becker, they do not hesitate to attempt to destroy them in lawsuits.

The "Diffusion Mixmaster" at All Body and Cellular Levels

Every mass and all its particles are in a violent energy exchange with the active vacuum. A human body and every part of it is in a continual exchange of EM energy with its environment(s), including transverse, longitudinal, and t-polarized (scalar) EM energy exchanges. Further, within the dielectric body there is a sort of intensive "diffusion" of special kind, actually due to iterative phase conjugation and iterative interferometry of the dense signals environment impinging upon it. This internal "diffusion" and transduction (iterative multiwave phase conjugation and iterative multiwave interferometry) thoroughly "mixes up and transduces" one type of EM wave or signal into the other, including many of the body's own TW, LW, and TDW signals.

Continual or sustained TDW exposure (irradiation by t-polarized EM waves) charges the body and its particles with time-excitation charging, something which has been erroneously omit-

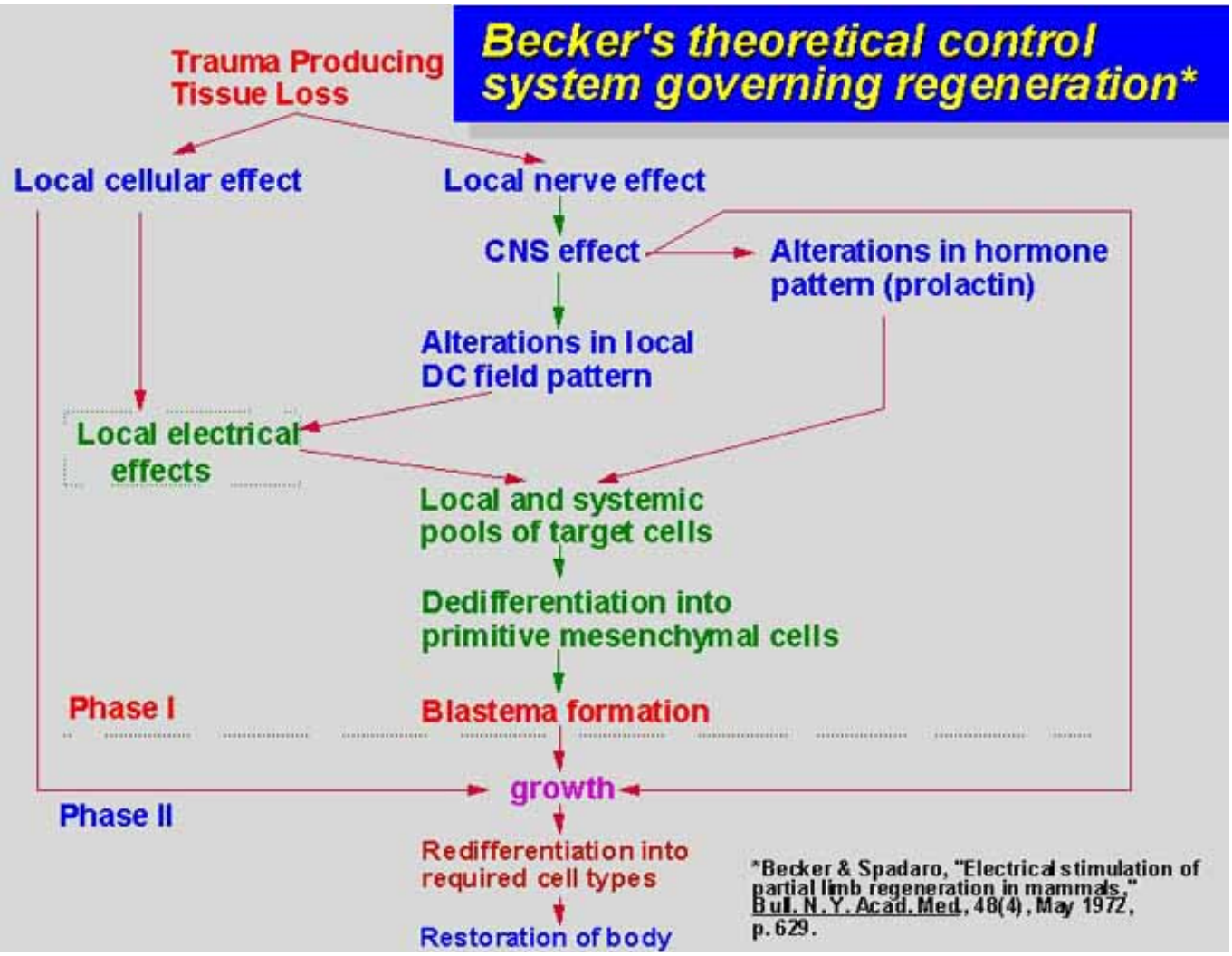

Figure 10. Becker's model of the Regenerative system of the body.

ted in physics, but is true nonetheless. Inexplicably, physicists just ignore what happens time-wise when a mass absorbs a photon. We have covered that elsewhere.

So inside the body dielectric, there is a "diffusion mix" correlate of any and every type of the waves, to any or all of the exchanges, plus the additional internal interactions of the body in its TW, LW, and scalar EM wave transductions. There is a one-to-one correspondence to any one of the three types of polarization waves (transverse, longitudinal, and scalar) and everything going on anywhere in the body.

Note that the type of LW we are using is actually made of phase conjugate pairs of transverse EM waves, so its "photons" are made of photon/antiphoton pairs. That is, our longitudinal EM wave has an internal TW structure, and the LW wave is comprised of spin-2 *gravitons*. Our longitudinal EM wave has an internal structure, and it dramatically differs from the LW used by the U.S. scientific community which ignores wave, field, and potential infolded substructures. Our LW (which seems to be what the Russians use) is also a gravitational wave because it is comprised of oscillations in its distributions of spin-2 photon/antiphoton pairs (i.e., *gravitons*).

The type of t-polarized (scalar) EM wave we are using is a phase conjugate coupled pair of the specialized electrogravitational (EG) LWs. The "t-polarized photons" comprising this t-polarized "EM" wave are comprised of spin-4 *supergravitons*. These are, I believe, what the KGB energetics weapons scientists use also. By iteration, we can go into as deep an internal multilevel structuring of EM and EG waves, of any type, via methods shown by Whittaker.[12]

Now let us examine a body as a dielectric, sitting there in its exchange, in relative equilibrium. It turns that every tiniest piece of a dielectric participates in any emission from it[13]—even the emission of a single photon, graviton, or supergraviton. Well, it *would* so participate, due to the special sort of correlated diffusion and interferometry and phase conjugation that we pointed out. Anything that escapes (is re-emitted) from the body, has been through this "diffusion wringer". It has escaped from each and every internal part of the body.

Novel Signatures in Body-Emitted EM Radiation of Any Polarization

A single photon or wave emitted from a dielectric carries in its internally structured time component a *template* of the exact internal time structuring of every part of the dielectric emitting that photon. It carries in its internally structured energy component a *template* of the internal energy structuring of every part of the dielectric emitting it. An emitted EM wave, being a collection of emitted photons and photon structures, thus carries the same internal structuring of both its transported energy and its transported time.[14] Western scientists do not use the internal

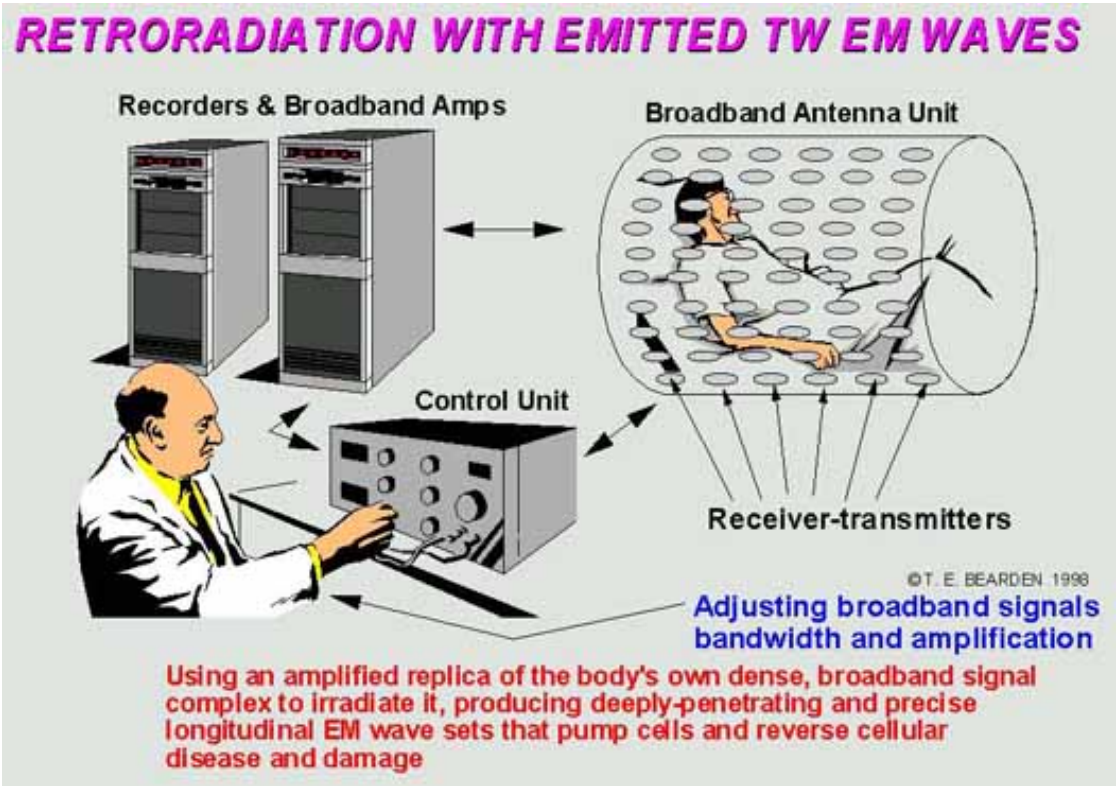

Figure 11.

http://www.cheniere.org/explore%20articles/mind%20control2/p06.htm4/13/2014 4:33:49 AM

structuring of photons and EM sine waves, have no instruments for that, and so do not know it. The Russians know it,[15,16] use it, and have developed sophisticated instruments for it for the last 30 years or more.

Shortly we will postulate how conventional scientists experimenting with mind and behavior control electromagnetically might utilize an immediate consequence of the fact that the specific emission from a body at any time—whatever type of wave component we look at—is a total correlate to all that body's internal functions, its energy exchanges with its environment, its states, its mental states and conditions, etc.

And we accent that the coherently integrated intent-changes in that body from its coupled mind's operations are also in the substructure of photons and EM waves emitted from the living body into its environment.

How Western Mind Control Scientists Might Proceed

Conventional scientists would ignore scalar photons and waves, determine the TW spectrum, and then slowly and painfully correlate that to the various physical, mental, and emotional things. That's the way they would *have* to do it, since apparently they use only standard electrodynamics. They can in fact do this via brute force, because that emission TW spectrum is of waves escaping from the entire "diffusion machinery" mixmaster in the body dielectric. It does contain all those integrated *mind-intent* 3-space correlates as well as the ordinary body 3-space energy correlates.

Anyhow, in envisioning Western procedures, the test body would be sitting there, in its normal (let's say fairly normal and quiet) EM environment. [See *Figure 11*] Let's assume this body is not sick, but is healthy and normal. Its emissions are a part of its equilibrium condition. It follows that the totality of its TW emissions is correlated to the sum total of everything that interacted with the body, plus its own internal reactions, including from mind-body coupling. Indeed, everything that has ever happened to that entity—physically, mentally, emotionally, etc.—has internal correlates infolded inside the emitted transverse EM wave spectrum.[17]

So first the scientists would simply measure the full environmental TW spectrum down to very tiny levels in all frequency bands possible—everything that is coming in to the body from its environment. They would probably perform the experiments in a triply-shielded Faraday cage, so the external environment outside the cage contributes very little transverse EM wave noise (perhaps some Schumann resonance). Magnetic wave shielding and ELF shielding is something else again, and longitudinal EM wave shielding is in general not possible unless longitudinal EM waves are employed in the shielding. But a "quiet external TW environment" enhances the isolation and measurement of the specific TW signal transforms the Western experimenters would be seeking.

Then they would measure everything likewise that the body is *emitting* when in that environment. That is the "zero reference" or "normal reference" level. They would measure every aspect: frequency, amplitude, phase, wave shape, modulation, etc.

Probable Experimental and Measurement Techniques

Next they would selectively irradiate the body with specific signals, frequencies, waveforms, etc. They would begin by using

They would consider the body dielectric as a "ship with portholes". Light (EM transverse wave energy) coming out of the portholes has originated and adapted from everywhere inside the ship and its operations. When the experimenters reinsert energy through one or more portholes, they are interested in determining precisely which operations inside the ship are affected. So the body physiological functions are also heavily instrumented.

By feeding back in the exact EM pattern and magnitude escaping the body dielectric through a single porthole, one "nullifies" that part of the emission by producing a net equilibrium in that component. This will in turn produce changes elsewhere in the spectrum emission from other portholes, and this can be measured. It will also produce "stress changes" in specific portions of the body dielectric, and in the heavily instrumented body these physiological, chemical, electrical, etc. changes can also be detected. Monitoring of the skin conductance, e.g., indicates the level of stress, and EEG monitoring with sophisticated instrumentation can indicate something of the brain wave states.

In short, the necessary measurements from which to construct specific correlates can be performed, recorded, and later analyzed.

This article will be concluded in Volume 9, #4 with Improving the Methodology, Further Phenomenology Experiments, Rejuvenation and other matters. ◆

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Tom is the leading advocate of scalar potential electromagnetics and the Fogal charge-blocking semiconductor. He is involved in alternate energy devices and scalar electromagnetic system prototypes. He has defined charge q as a coupled system of two components, advanced a mechanism for a vacuum engine, whereby the vacuum's virtual particle flux is organized and used to energetically shape and manipulate matter and energy, and advanced a mechanism for a Bohm-type quantum potential, which theoretically allows the engineering of action at a distance in physical systems.

He is president of the Association of Distinguished American Scientists (ADAS), a life member of the Alabama Academy of Science, Emeritus member of the American Association of Physics Teachers, and has served on the Board of Directors of several associations and corporations. Tom is a guitarist, a retired aikidoist (Sandan, Yoseikan style), is happily married and has two sons and two daughters. He and his wife Doris live in Huntsville, Alabama where Tom is retired from aerospace, continues private research, and serves as a consultant to industry on Scalar electromagnetics processes.

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1. *In fact, it simply applies in the laboratory that method that is already used by species for the so-called "directed evolution" component of evolution. The exact mechanisms for directed evolution also arise naturally in the new approach. Directed evolution is required; e.g., no reptilian species could have evolved slowly into a bird. As it started slow changes, it would have not been able to fly or to run, and would have been simply destroyed immediately by*

Next they would selectively irradiate the body with specific signals, frequencies, waveforms, etc. They would begin by using portions of the same frequencies that are being emitted from the body in the "zero reference" environment. They would insure that the returned signal was of higher amplitude than the usual signal being emitted by the body at that same frequency and type.

reptilian species could have evolved slowly into a bird. As it started slow changes, it would have not been able to fly or to run, and would have been simply destroyed immediately by predators. Instead, such evolution occurs in a single jump in a species hard-pressed for a lengthy period. In the evolution of birds, one day every reptile egg that hatched, now hatched into a complete and functional bird with light bones, feathers, etc. A continuing debate (with perhaps more emotion than science) continues to this day on directed evolution. But it is real, and the mechanism can readily be generated (we've already done the gist of it).

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3. *With novel use of EM time-energy to curve spacetime, the physical actions of the "placebo effect" are due to the use of such "spacetime curvature engines" to produce actual physical effects—at least temporarily —in the cells and throughout the body's chemistry, physiology, etc. Experimental detection of these physical effects are well-established in the orthodox medical literature.*
4. *For example, see particularly R. O. Becker, "The direct current field: A primitive control and communication system related to growth processes,"* Proceedings of the. XVI International. Congress of Zoology, *Washington, D.C., Vol. 3, 1963, p. 179-183;—"The direct current control system: A link between environment and organism,"* New York State Journal of Medicine, *Vol. 62, 1962, p. 1169-1176;—and D. G. Murray, "A method for producing cellular dedifferentiation by means of very small electrical currents,"* Trans. N.Y. Acad. Sci., *Vol. 29, 1967, p. 606-615;—and Joseph A. Spadaro, "Electrical stimulation of partial limb regeneration in mammals,"* Bulletin of the New York Academy of Medicine, *Second Series, 48(4), May 1972, p. 627-64.*
5. *E.g., a popular discussion is given by John Travis, "Starting Over: Some Animals can regenerate limbs or even most of their bodies. How?"* Science News, *152(18), Nov. 1, 1997, p. 280-282. For a typical technical paper, see Jeremy P. Brockes, "Amphibian limb regeneration: Rebuilding a complex structure,"* Science, *276(5309), Apr. 4, 1997, p. 81-87.*
6. *I have one viewgraph which lists those 32 major flaws in electrodynamics. Further, leading theorists (Evans, Crowell, and others) in the Alpha Foundation's Institute for Advanced Study (AIAS)—of which I am a Fellow Emeritus by AIAS's kind tolerance—have added about another very technical and very fundamental dozen or so errors to my own list. A leading foundations scientist with over 500 papers in the literature commented dryly to the AIAS that "I broadly agree. that the transverse plane wave view of vacuum electrodynamics is the biggest blunder of twentieth century science. Faraday visualized that "EM disturbances" surrounding wires, magnets, etc. were simply the transverse plucking of taut strings. As he states in his book, Maxwell—who also firmly believed in the material ether—simply captured Faraday's thinking and assumed that transverse "plucked string" wave disturbance in the material ether. At the time all this was expressed, the electron had not been discovered, the atom had not been discovered, the molecule was a featureless blob, and no one had the slightest notion of an atomic nucleus filled with protons and neutrons. Charge was simply a "certain volume of electric fluid" and everything electromagnetic was expressed in fluid dynamics. As an example, that "material fluid" and "material ether" theory was destroyed in the late 1880s by the Michelson-Morley experiment. All the Maxwell equations assume that material ether to this day; not a single equation was ever changed to eliminate the material ether assumptions during the last 110 years.*
7. *For full explanations of the "Moscow Signals," see T. E. Bearden, .,* Gravitobiology: A New Biophysics, *Tesla Book Co., P.O. Box 121873, Chula Vista, CA 91912, 1991;—* AIDS: Biological Warfare, *Tesla Book Co., 1988. For an excellent Government study of the Embassy radiation by excellent but orthodox Johns Hopkins scientists, see A. M. Lilienfeld* et al., Foreign Service Health Status Study: Evaluation of Health Status of Foreign Service and Other Employees from Selected Eastern European Posts, *Department of Epidemiology, of Hygiene and Public Health, The Johns Hopkins University, Baltimore, Maryland, Final Report, July 31, 1978. On p. 245, it is noted that a marked excess of symptoms were noted in the Moscow employee group as compared to other East European employees in other East European nations.*
8. *Johns Hopkins researchers established the exact field patterns present in the Embassy from the microwave carrier radiation; see Robert C. Mallaliew,* A Model of the Microwave Intensity Distribution within the U.S. Embassy, *Moscow 1966 to 1977, Report FS-80-166, Applied Physics Laboratory, Johns Hopkins University, Aug. 1980. Nowhere in any of the Government-funded studies is there any consideration of field-free scalar potentials and their internal time-polarized EM wave structures (the bidirectional phase conjugate wavepairs shown by Whittaker to comprise the scalar potentials). Yet the field radiation patterns surprisingly showed that in just such field-free, persistent potential zones was where 100% of the health changes occurred.*

issue, see "A Comment" by William A. McGarey, p. 143; "A Comment" by Arthur C. Hastings, p. 143-144. See also Vlail Kaznacheyev, "Apparent information transfer between two groups of cells," Psychoenergetic Systems, *1(1), Dec. 1974. The Soviet Union awarded Kaznacheyev a very high medal for his achievements.*

10. *For a very nice summary of EM bioeffects from the more conventional view, see Robert O. Becker and Andrew A. Marino,* Electromagnetism and Life, *State University of New York Press, Albany, 1982. The book is also available at http://www.ortho.lsumc.edu/Faculty/Marino/EI/ElPub.html.*
11. *Andrew A. Marino,* Powerline Electromagnetic Fields and Human Health, *http://www.ortho.lsumc.edu/Faculty/Marino/Marino.html. This book is highly recommended. Particularly see "Chapter 5, Blue-Ribbon Committees and Powerline EMF Health Hazards," and "Chapter 6: Power-Industry Science and Powerline EMF Health Hazards." Biophysicist Marino is one of the leaders in the field and has been personally involved in many skirmishes with powerline-dominated studies and findings.*
12. *E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics,"* Mathematische Annalen, *Vol. 57, 1903, p. 333-355; — "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions,"* Proc. Lond. Math. Soc., *Series 2, Vol. 1, 1904, p. 367-372.*
13. *Reali, G. C., "Reflection from dielectric materials,"* American Journal of Physics, *50(12), Dec. 1982, p. 1133-1136. The reflected field from a dielectric material is not generated just at its surface but comes from everywhere in the interior of it.*
14. *Present physics models the EM wave as transporting energy, but erroneously omits that it also transports time. A photon is made of angular momentum, or "energy x time". Since EM waves are made of photons, it follows that they transport both the energy components and the time components making up those photons. An EM wave is a wave of angular momentum, not just a wave of energy.*
15. *KGB energetics weapons scientists call this internal structuring the "information content of the field." However, the Russians use a good deception plan, which implies that the "information content of the field" is just the normal transverse EM spectral content of EM signals. Appreciable "pertinent" work using that phrase is produced by the open Russian scientific community, thus confusing the issue. Our electrodynamicists seem to buy it hook, line, and sinker. The deception plan also tricks Western scientists into thinking that psychoenergetics is nothing but a Russian version of Western parapsychology. Again, our scientists comfortably accept this with smug satisfaction.*
16. *Presently the Russians are in a great new version of this deception plan, with the goal of deceiving Western scientists into thinking that the "secret" Russian energetics is based on torsion fields. Consequently they are releasing substantial material on torsion wave theory, including replicable experimental results. The released version of torsion fields has one glaring omission: the time components and structuring. This deception plan is excellent, because the torsion field theory that is released, is indeed "real" and testable. It is also revolutionary, with respect to present Western science. It almost positively assures diverting the attention of much of the Western science community into this highly limited subset of the full Russian torsion theory—effectively diverting the West away from psychoenergetics and the direct use of t-polarized EM waves and fields, torsion or otherwise.*
17. *We point out that E. T. Whittaker, in "On the Partial Differential Equations of Mathematical Physics,"* Mathematische Annalen, *Vol. 57, 1903, p. 333-355, showed that every scalar potential is comprised of an internal structure of bidirectional longitudinal EM phase conjugate wavepairs in an infinite set of harmonics. Each of those phase conjugate longitudinal EM wavepairs comprises a time-polarized EM wave. So the common potential contains an internal longitudinal EM wave structure that is further organized into an internal time-polarized EM wave structure. The mind-intent correlates and the total mind and emotional experience correlates from fertilization of the egg that led to development of that person, is in the internal substructure of every potential in the living body. In his "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions,"* Proc. Lond. Math. Soc., *Series 2, Vol. 1, 1904, p. 367-372, Whittaker also showed that any EM field or wave is comprised of two scalar potential functions. It follows from Whittaker and Reali that the EM emissions from the living body carry the internal correlates of everything that has been experienced by that person from conception in the womb. Sometimes this deep embedded "hidden information content" can even be accessed in deep hypnosis. I once observed the deep hypnotic regression of a subject back to her prenatal experiences prior to birth, where the subject relived hearing words of rejection by the father, before the subject was born. The occurrence of the incident and the father's words were directly confirmed on the spot by the mother, who was closely observing the session as it occurred. It turned out that this particular rejection of the baby still in the womb had played a major role in subsequent deep psychological*

scalar potentials). Yet the field radiation patterns surprisingly showed that in just such field-free, persistent potential zones was where 100% of the health changes occurred.

9. *Vlail Kaznacheyev and L. P. Mikhailova,* Ultraweak Radiation in Intercellular Interactions, *[in Russian], Novosibirsk, 1981 [an English exposition of much of the Kaznacheyev work is given in Vlail Kaznacheyev, "Electromagnetic Bioinformation in Intercellular Interactions,"* Psi Research, *1(1), Mar. 1982, p. 47-76.]. See also Vlail Kaznacheyev* et al., *"Distant intercellular interactions in a system of two tissue cultures,"* Psychoenergetic Systems, *1(3), Mar. 1976, p. 141-142. In the same observing the session as it occurred. It turned out that this particular rejection of the baby still in the womb had played a major role in subsequent deep psychological problems experienced by that person all her life. To resolve the problem, use of a powerful "simulated" reliving pre-birth experience was conducted with the subject again in the pre-birth state and actively participating, but now with the father figure directly expressing love, acceptance, and cuddling and hugging his daughter. This led to a rather dramatic remission of most of the deep psychological problems within 24 hours.*

Mind Control and EM Wave Polarization Transductions, Part 3 of 3

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This outstanding article is the last, Part 3, Part I and 2 of which were published in Volume 9, #2 and #3 of Explore! for the Professional. Because we feel that Col. Bearden's Special Note below is so very important we are repeating its publication in all 3 parts of this article.

Special Note

This article refers to experimental research techniques which can be detrimental or lethal in the hands of any but highly skilled, qualified experimental scientists proceeding under proper laboratory safety procedures. The purpose of this article is strictly for information to properly qualified and authorized scientists in certified laboratories. We do not propose or condone any use of these procedures for nonapproved practice of medicine without a license. Neither the publisher nor the author are responsible for accidents or outcomes in the use of these experimental procedures and techniques. Any researcher who performs these procedures and experiments is acting on his or her own volition, and is solely responsible for insuring safety, qualifications, and legality of the acts and their results. We neither suggest nor condone unauthorized experimentation on human subjects. Such is a criminal violation

achieving many more effects in the targeted bio-organism or groups of them. With Hunt's method, the system as an *open dissipative system far from thermodynamic equilibrium in its environment* is being measured as such. This more directly allows for determination of the environmental inputs on a much broader range of subsystems, both space-like and time-like. Particularly for mental and emotional correlates to environmental stimuli, such measurements and correlations are essential.

More Comprehensive Phenomenology Experiments

To return: Now the scientists would perform many phenomenology experiments, making one little change at a time and profusely recording the data. Each time, they would establish the physical change(s) that occur in the body and/or the mental and emotional changes that occur in the mind for each spectral reinsertion back through the "ship's portholes". They would simply but painstakingly (over some years) build up an extensive database of those individual correlates.

In these experiments, the experimenters will eventually be able to provoke any body or mind change they wish. Strong emotion.

of the constitutional rights of the subject under Federal and State laws, and is both illegal and immoral.

Two Ways to Improve the Methodology and Experimental Correlates

We diverge momentarily: If they wish to improve this methodology, they will consider the body dielectric as a nonlinear isotropic medium. Then they will pretend that the spectrum of *difference frequencies* between each two adjacent waves is the spectrum of "emissions" from the body. They would also use those, as if they were actual emitted spectral signals, instead of the actual signals emitted. That procedure will give superior correlations, but it is more complicated. Part of that is known for underwater sonar,[1] and so our own scientists may or may not have realized it for use in mind and behavior correlate determination with respect to the body dielectric.

Another dramatic improvement in the depth to which the correlates can be constructed, is provided by detecting each porthole output in a two-channel device, where one channel has an adjustable time-delay as utilized by Dr. Valerie Hunt.[2] The two channels—one real-time and one slightly delayed—are then mixed, as by Hunt's method, producing an instrumental measurement of the chaotic part of the functions. Again, this can be measured, recorded, and later analyzed. It adds (i) a completely different kind of thermodynamics in the system measurements, (ii) a dramatically extended set of correlates, (iii) more direct measurement of the time-polarization causative signals, and (iv) an applications

Intense pain. Intense pleasure. Painful thoughts. Images. Memories. Perceptions. Dreams. Visions. Memory losses. Memory changes. Personality changes. Etc. The "delta" in the emission spectrum (the changes from zero reference spectrum) represent the precise totality of all mental, physical, organic, chemical, etc. changes and interactions.

A particularly vulnerable aspect of every mammal is the pleasure center in the brain. Experiments have shown that, when this center is stimulated, it is the most addictive experience possible. Rats will forego food, endure electrical shocks, starve, and even die to obtain stimulation of this center. Obviously a device capable of generating signals that evoke direct stimulation of the pleasure center in humans would be a powerful weapon.[3]

Extending the Data Base

See Figure 12. After the researchers have made an "individual porthole signal insertion" correlate database, then they would make a "two, three, four," porthole signal insertion correlate database by inducing selected multiple changes at once. Again they would analyze everything; the program would need one or more supercomputers. It would also require quite a highly qualified multidisciplinary team, extensive facilities, substantial funding, and would be many years in duration. We are describing a decades-long program. But it's a doable.

With sufficient development and performance of such a program, the researchers would have produced (with sufficient testing and analysis, and sufficient retest validation and verification) a database of "specific correlates for a given overall

technology eventually having many additional degrees of freedom and therefore capable of desired physical, mental, or physical and

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mental delta."

A second stage in the research would be to test the correlates and porthole insertions upon a statistically significant cross section of ordinary people, and/or specialized populations (such as toughened soldiers). The program would evolve a highly complex, very effective, ever-improving science and technology of mind and behavior control and engineering mechanisms, complete with finished database and developed applications equipment.

The Dielectric Body as a Ship With Portholes

Again let us review what the EM transverse wave irradiation from the body dielectric represents. Think of the body dielectric as a sort of "ship", with lots of portholes. When it gets irradiated, certain operations happen internally to that radiation, i.e., certain "processes" and "interactions" occur, which change both the mental and physical states. The output emissions back from the body dielectric, out through the filtering "portholes", will directly correlate to what has happened inside the ship.

It is terribly important to realize that one can use the same frequencies and spectra coming back out of those "portholes" to insert EM signals and waves etc. back in there, and into the deepest processes going on in the body and in the mind (at all levels, times. So it will reach directly into and affect any and every part of the dielectric, as you wish, and in whatever manner you have correlates for.

We filed an invention disclosure[4] on the above correlate and "back-porthole" process for use in directly inducing full and efficient conversion directly to time-density (scalar, or time-polarized) EM waves inside the body/ cells, *therefore immediately and directly time-excitation charging the body cells and all their internal components.*

Subtracting the Normal Correlates to Obtain the Deltas

A specifically diseased body, e.g., has a specifically tailored change in its "normal" emission spectra, because of the disease condition alteration of its resident spacetime curvature engine. By having a database for the normal emission spectra of the healthy body, one can subtract it from the actual emitted spectra, to obtain the "delta spectrum".

If the correlates have been previously determined by the above mentioned research program, then one may simply introduce an amplified "delta spectrum" into the body, i. e., through the portholes. This will immediately time-excite the cells and their components throughout the body, particularly where that disease does exist. It turns out that the time-excitation charging by that method will "pump" those diseased

including the deep unconscious).

Remember, whatever you put back in there, is going back through the "mixmaster" hopper. It will be iteratively phase conjugated and interfered with by everything, countless cells in the time domain. The cells themselves (and all their parts) are highly nonlinear—to time-excitation charging, they are *totally* nonlinear. So they will act as rather perfect pumped phase conjugate mirrors, but pumped in the time-energy domain rather than in the spatial

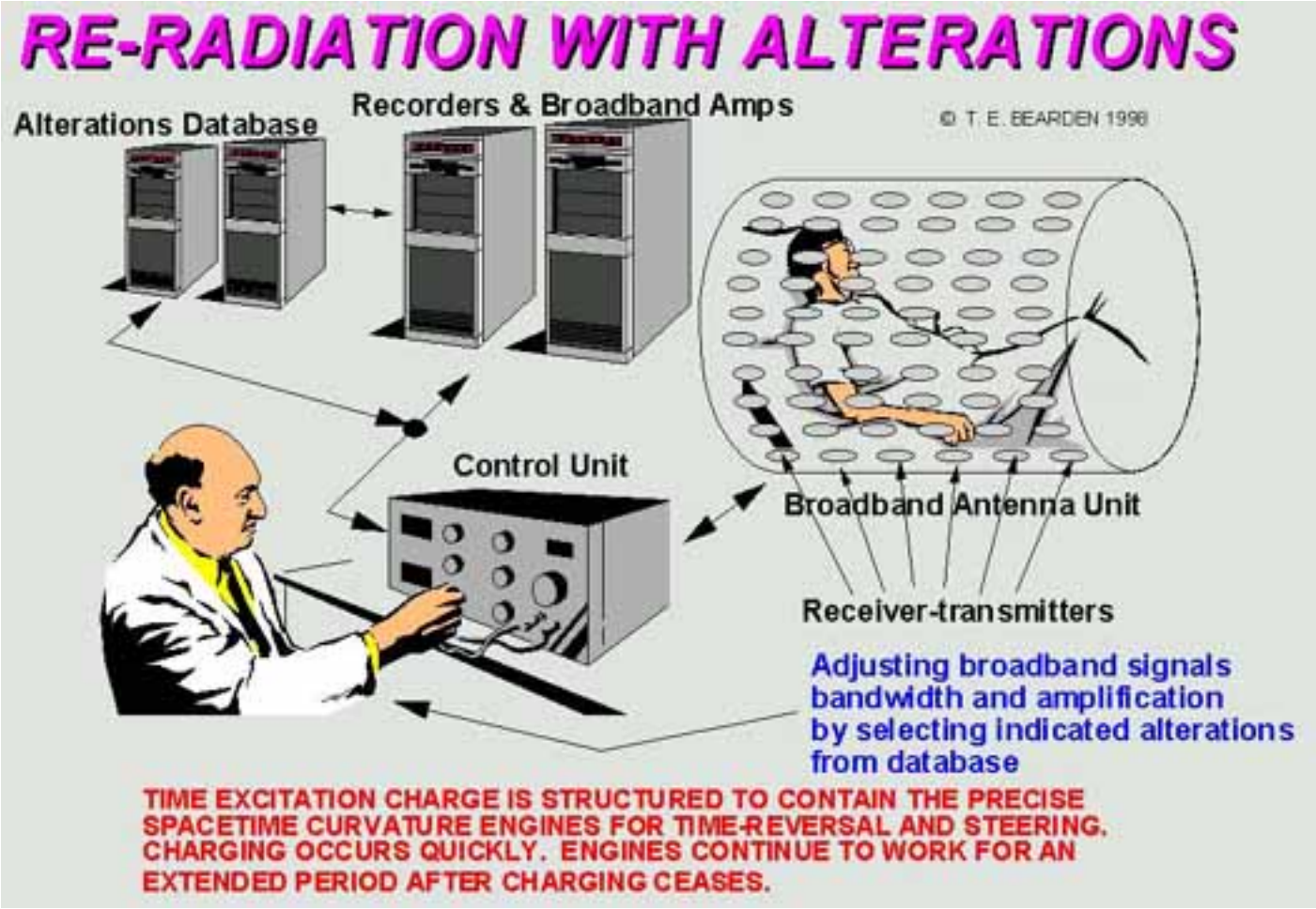

Figure 12. Using an amplified replica of the body's own dense, broadband signal complex, containing added alterations, to irradiate the body and produce deeply-penetrating precise time-density charging for cellular time-reversal while steering the time-reversal trajectory to also correct a congenital condition.

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energy domain. This is a dramatic extension to nonlinear phase conjugate optics theory.[5]

General relativity tells us that each specific detail of the mass and energy structure of each cell and all its parts—down to the finest details—is accompanied by a precise set of spacetime curvatures. By reintroducing the same energy as the disease delta TW waves, the affected cells add the phase conjugates, converting the inserted TW signals into longitudinal EM wave signals. The longitudinally-pumped cells again phase conjugate, converting these longitudinal EM waves to time-polarized EM waves, and "charging" the cells and all their parts in the time domain.

Suddenly, at that point the *resident spacetime curvature engine*—rather than TW or LW EM waves-serves as the "input signal" to the cell-and-its-parts as pumped phase conjugate mirrors (PCMs), pumped in the time domain. An extension to the distortion correction theorem of nonlinear optics results. An exact, amplified antiengine for the diseased cells—i.e., a phase conjugate replica of the resident spacetime curvature engine—is formed. This amplified antiengine overpowers the resident disease engine, powerfully time-reversing the cells and their components back to a previous healthy state. The time-reversal actually occurs over a period of time after the "time excitation charge-up" ceases, say over the next week or two. Usually two to three quick irradiations are required, one week apart, to give a time-reversing period of three to four weeks.

force upon the cells or any part. E.g., as Pepper[6] states,

"*On a more fundamental level, the ideal lossless PCM reverses all the quantum numbers of the incident photon (i. e., linear momentum, angular momentum, etc.). It can be shown that the PCM therefore experiences no linear or angular momentum transfer from the incident photons; hence, the PCM is free from photon radiation pressure and torques."*

Note that, in ordinary EM theory, it is precisely translation forces that are engendered upon charged mass by EM fields. This process is quite different. In biological terms, this process dedifferentiates (in physics: time-reverses) the diseased cells and all their components—including the genes—back to an earlier healthy state.

By taking a diseased body and feeding back into it an exact amplified replica of its emitted TW spectrum, one can force the body to "time-excitation charge" all cells and their components immediately, with high efficiency. The human body and every cell and every part of every cell does the necessary "calculation" for the exact antiengine for each part. Since time is extremely condensed spatial EM energy (by a factor of almost 10^{17}), a startling contraction occurs in the radiation time required to time-charge the cells and their components and charged particles. This is a method for instant initiation of time-charging, hence it is extremely rapid. What took Priore several hours of LW irradiation to accomplish in the body,[7] can now be done

Even though appreciable forces are operating internally upon the cells and all their parts, there is no net translation in seconds with this "thwarting" and spectrum transduction method. In fact, it is an intense stress on the body, and—say—should only

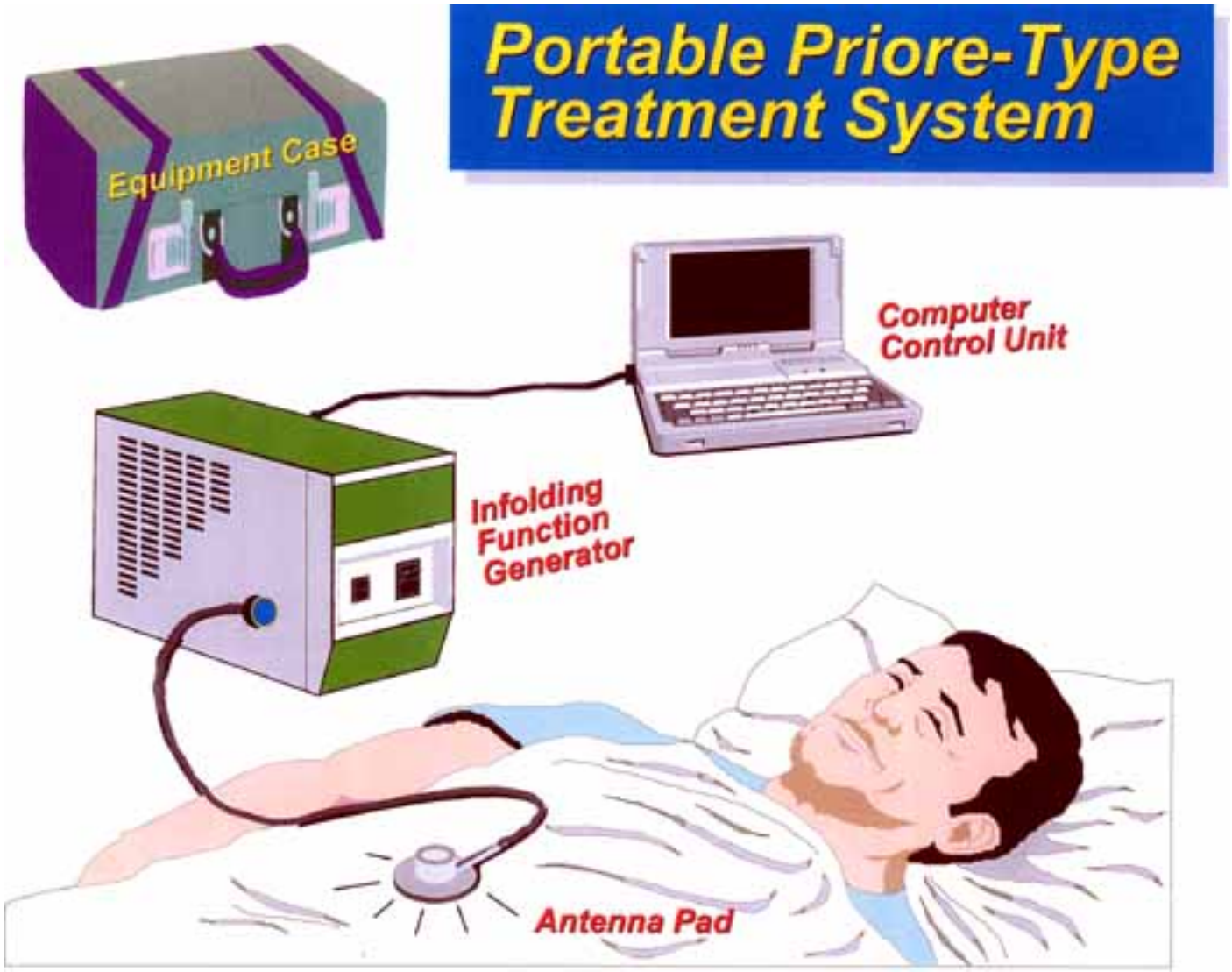

Figure 13. Portable first-method treatment unit proposed to the Department of Defense. For treating and curing mass casualties from terrorist BW attacks on U.S. population centers.

be continued for 30 seconds or so. We highly stress that overcharging in this time domain can be detrimental or even lethal if prolonged.

At the end of the very short time-excitation charging time, the body is "time-excitation charged in all its minutest particles". So everything is therefore pumped in the time domain for the next several days after the irradiation is removed, since the time-charge decays very gradually over a period of time. During that decay period, every part of the cell and body acts as a pumped phase conjugate mirror material, pumped in the time domain rather than in the 3-space energy domain. When time-pumped, the mass itself reverses to a previous physical state. This can be used for both nonliving and living masses. Because there is no forcible translation manipulation of the cells and their parts, it can be utilized on living cells in vivo. In the case of diseased cells—e.g., AIDS-it appears that three precisely determined 30-second "AIDS correlate" irradiations a week apart, should be sufficient to completely cure AIDS, including removal of all HIV-genetics changes from every previously infected cell of the body. Also, it would accomplish considerable rejuvenation of the body (making the body younger).

Rejuvenation: Restore the Telomeres and Produce Immortal Cells

Saving Most of the Casualties from Mass Terrorist Attacks

To defend against things like anthrax attacks on our civilian population centers, we also have recommended to the U.S. Government the crash development of small, portable treatment machines—using similar "antiengine-forming" and cellular reversing "porthole technology". [See Figure 13 on previous page]. Such portable machines could be developed cheaply and quickly, and present government facilities could be used to massively attack the correlate database production problem. The portable treatment units could be cranked out by the hundreds of thousands and flooded down through emergency response agencies such as the police forces, the National Guard, emergency hospitals, emergency response teams, etc.

Each device could be used in "assembly line" fashion upon hundreds of sickened patients, in case of a WMD (weapons of mass destruction) attack upon one or more of our cities. The first generation equipment would save probably 70% of the stricken (as from anthrax, etc.). With second generation equipment, one would expect 90% of the stricken casualties could be saved.

Just now, there is a very dim prognosis for all those casualties, using present available treatment capabilities. Time and lack of vaccines defeats just about everything that can be done. Brutally speaking, most of those unfortunate enough to breath in

In fact, it is now known that the gradual loss of the telomeres—the natural ends of chromosomes—in a cell's chromosomes is what causes the cell to age. The gradual loss of the telomeres and the resulting shortening of the chromosomes represents a cellular "disease state" or "disorder" state" accompanied by a precise delta in the spacetime curvature engine accompanying every affected (aging) cell.

By determining the correlate for that precise telomere loss in the aging body's emitted radiation spectrum, an effective telomere regeneration process immediately emerges. One simply amplifies that aging "precise telomere reduction" correlate and reradiates the body with it, passing an amplified correlate back into every cell of the body. The cells and all their parts—including the chromosomes—add *the phase conjugate replicas*, converting the incoming TW EM correlates to longitudinal EM wave correlates. The cells again phase conjugate the LWs and add *the phase conjugate replicas*, converting the LW correlates to time-polarized EM wave pumping correlates. This latter process *time-excitation-charges* the aging cells and all their parts, including the genes and chromosomes. The cellular matter itself produces the amplified "aging antiengine" for each and every cell and telomere ending. The result is to again add telomeres, converting the cell back to a younger, more vigorous cell, and reversing the process of aging.

We point out without further elaboration that these methods also introduce direct engineering signals into the body's master cellular control system, including the regenerative subsystem. Hence the body's regenerative subsystem is involved in helping produce the necessary engines and anthrax spores from an attack, are going to die. At least 80% of them will expire, in spite of everything the present system can do for them.

Note each device could rapidly treat a whole series patients, one right after the other, merely laying them between "blankets" containing wire antennas, irradiating with the proper correlate spectrum quickly, moving on to the next patient, irradiating quickly (seconds), etc. The entire apparatus could be made to fit in a large suitcase-sized container, and it would be highly portable and controlled by a laptop-sized computer.

Unfortunately, so far the DOD doesn't even understand what the heck we're talking about! The National Institute of Health (NIH) and the National Science Foundation (NSF) are not interested at all. After all, it isn't drugs, vaccines, antibiotics, etc. — which are simply not going to do the job. However, those are what the government and scientific communities are going to finance to the tune of hundreds of millions of dollars. They are then going to lose almost all those mass casualties when the terrorist attacks on our population centers inevitably occur.

Those are Americans. They are going to die. Most of them could be saved. We ought to save them.

For any change in state (physical, chemical, emotional, mental, perceptual), the body dielectric "portholes" change and the output spectrum changes. The delta from zero reference now represents that exact change.

Where Western Mind Control Research Has Probably Arrived

Western mind control researchers

operate upon the short telomere chains to add back telomeres. More specifically, the regenerative subsystem is changed into perfect consonance with the external introduction of the amplified antiengines.

That exact process can be used to rejuvenate the aged population and remedy most of the debilities of growing old. That is how we eventually intend to do it, if we can convince the U.S. government and the U.S. scientific community to perform the necessary research and validation.

probably first established a correlation database of porthole emission correlates to changes in internal states, both physical and mental. They almost certainly recognize the peculiar participation of every part of the body dielectric in the TW emission spectrum from the body. They will almost certainly have opted for this "porthole" notion of some similar expression of it, and the "thwarting" of these "relaxation and release" emission processes to engender internal physical changes in the body and in the brain-meat-computer, as they see it.

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They probably experimented with different TW EM radiation mixes, to see what the body emission change to, and what states are induced. Undoubtedly they found that the induced states began to correlate with the former emission delta data base. That is, they found out which delta emissions spectra, reversed and amplified and fed back thorough the portholes, produce what internal changes.

Use for healing is the simplest of all. Use for killing or debilitating is more complicated. Of course weapons researchers wish to look only at the killing aspects. That is something they understand. They do not understand healing, for they do not even have the "regenerative" or "healing" mechanism in any of the scientific papers or texts. Becker[8] came closest in this country, and Priore did it in France. Both of those scientists were suppressed and paid a bitter price for their revolutionary and innovative research.

But look at what has been done, by "input-output" correlation research. The scientists will have a database now, that tells what state emerges in the body and in the mind, for what irradiation spectra (frequency, relationships, phases, amplitudes, wave shapes, etc.) one uses. And they did not work out all the wave-to-wave transductions ongoing in the mind and body connection and in the body and in the mind, individually, between TWÛLWÛTDW.

We suspect that this is the course Western mind control researchers will have taken, without even realizing the internal wave transductions occurring. And they would not be concerned with that. They would have what they want, for weapons, mind control, and behavior control. And they of the internal "mix" of the dielectric and all its tiniest portions. So Western mind control researchers and rogue groups probably do get good results.

We are not just picking on the U.S. government here! Internal divisive groups exist in all large and powerful groups, and joust for power. In highly classified groups, these groups are greatly enabled to joust more widely, unethically, and immorally because it is so deeply hidden. So very deep classification evokes the growth and intensity of rogue groups. It's the old "Power corrupts, and absolute power corrupts absolutely" routine.

The implication is that in the West one or more highly classified, sustained, heavily funded developments in advanced mind control programs, probably exists and probably has existed for some time. Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, may not operate under very much legitimate government control at all, and may operate specifically for the purposes of the rogue group or groups that have gained control.

In a nutshell, that's what may be going on in the clandestine mind control projects in several Western governments. The involvement of at least some rogue groups, some being "cowboys" who operate well outside all laws and ethics, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, *it could account for what seems to be actually occurring*. As also is "usual" in such a mess, one or more of the rogue groups eventually may become very powerful because their secret weapons are very powerful. They may become confident, thinking they have the "best in the

would of course ignore the healing aspects. And they would get results of course, revolutionary results. So they would undoubtedly classify the program very highly, thinking that they had the best of the best.

Rogue Groups May Also Have Arisen to Divert the Purpose of the Projects

And that is where real problems may arise. Every human group has within it competing subgroups, jousting for power. The more highly classified the group and its activities, and the less that is known about it outside its confines, the more strongly and secretly the subgroups can play. So they can emerge as **rogue groups** pursuing their own agendas, not that of their duly elected governments. In the extreme, such a deep black program can even become a "captured" program, which is totally in the hands of rogues and no longer reports to or is bound by the dictates of the parent government.

It has long been suspected in some quarters that even the US's highly classified research community may be riddled by such rogue groups, and so may be certain highly sensitive parts of the Research and Development community.

Remember that, in every large and powerful human organization, the basis for rogue groups is power and secrecy. They are always seeking to increase their power, control, influence, prestige, etc. Nothing else. Patriotism and mission are—to rogue groups—often just idle words. They have their own agendas. And being rogue groups, they may well bring in unethical, immoral tricks: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A world." They may actually believe they are ahead of the Russians.

Where the Russians Probably Have Arrived

On the other hand, the Russians will have developed instruments for detecting and isolating the LWs and the scalar waves, in addition to the ordinary mundane instruments for measuring the TWs. So they will have not only the TW correlates, but also the much finer TWÛLWÛTDW (scalar EM wave) correlates. They will understand and employ the use of vacuum engines (spacetime curvature engines) which Western researchers will often invoke but not understand or even be aware that this is what is being invoked. In other words, Western researchers probably just use the old method of "input fi set of functions fi output". That is the standard basis for almost all Western system analysis. With it, one doesn't have to know the exact functions and processes going on in the middle. One just determines a transfer function from a given input to the output that results. Then one catalogs that transfer function. One does that for lots and lots of transfer functions for particularly desirable results, and one has the system analysis. One also has the immediate basis for a rapidly-developed applications technology.

Western scientists are good system analysts. But they have little or no comprehension of what is really going on in that "inside the ship functions" portion, even though they have determined the transform function which acts upon the input to give the "from the portholes" output.

The Russians, with their additional knowledge of the actual mechanisms in the transforms, will be much more advanced

certain percentage of a highly secret rogue group will wind up using all these things and more. It's a **human** characteristic, the old primate dominance game. Only now disguised and hidden under deep classification.

Nonetheless, the "simplified" TW EM "porthole correlate" approach will yield very positive results, due to the correlation existing with the LW s and scalar portions than the West, because their fundamental psychoenergetics science is far more advanced, so long as we continue to use the old U(l) electrodynamics. Further, the Russians have decades of use of longitudinal interferometry beams to reach right through the earth and ocean and produce stringent EM effects at a distance. So they will also be able to do the same things here in "mind control" with LW interferometers, through intervening mass

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including the earth and ocean. Western mind-control scientists and their rogue groups—assuming they exist as postulated—largely will not be able to do that, and probably won't even recognize Russian testing of psychoenergetics weapons directly in or over Western nations.

Russian Lethal Psychoenergetics Mind Control Tests Over the U. S.

In fact, the KGB tested just such highly advanced mind control weapons over the middle of the United States in 1997 on two occasions. The tests were conducted against Captain Button in his A-10 "Warthog" aircraft on April 2, 1997 [See Figure 14], and upon Captain Svoboda in her A-10 "Warthog" on May 27, 1997. [See Figure 15].

Over Arizona, Captain Button was thrown into a hypnogogic state, and his perceptions instantly altered and controlled. In his instant "dream-waking" state, everything seemed perfectly normal. His sense of direction was altered a bit more than 90 degrees, so he simply corrected and turned and "flew toward the range", actually flying off course by more than 90 degrees and ignoring radio contacts. He flew right on out of Arizona. At one point he circled, probably thinking he was over the range, and he probably dropped his ordnance there. Then he "flew on back toward home," as he thought in his waking dream state, until his fuel ran out and he crashed and died in the explosion—dream-thinking until he died that everything was normal. All the while, his sense of the passage of time was altered. To him, in his dream-thinking, dream-acting state, everything was normal and nothing untoward had happened. So the distant KGB transmitters and associated psychoenergetics team controlled him for over an hour.

Indeed, that was the exact purpose of the test: demonstrate control (at a great distance) of a skilled person performing highly skilled tasks. A secondary purpose was to stimulate the U.S. government, watch its investigation and findings, and ascertain if the U.S. knew of the extent to which Russian KGB mind control weaponry had advanced. Obligingly, we proved to me KGB that we did not understand what had actually happened to Captain Button.

Captain Svoboda was from the same Wing as Captain Button and was its most experienced night fighter A-10 pilot. In fact, she taught other pilots the fine points of night flying combat missions in the A-10. About two months after Captain Button's bizarre flight and death, Svoboda was engaged in night target bombing on the range. Rising from her ordnance drop on me target, Svoboda was suddenly struck and rendered hypnogogic and in a waking-dream state. Her sense of the vertical was instantly reversed. Superb pilot that she was, she immediately dream-perceived she was diving, not climbing out of the delivery. She instantly corrected to "climb out". So in the real world she dived sharply into the ground and her aircraft exploded.

This test demonstrated the instant alteration of a skilled pilot's perception, causing that pilot to inadvertently react promptly in an unintentionally suicidal manner. A secondary purpose of the test was to stimulate the U.S. government system again, to see if the system recognized what had

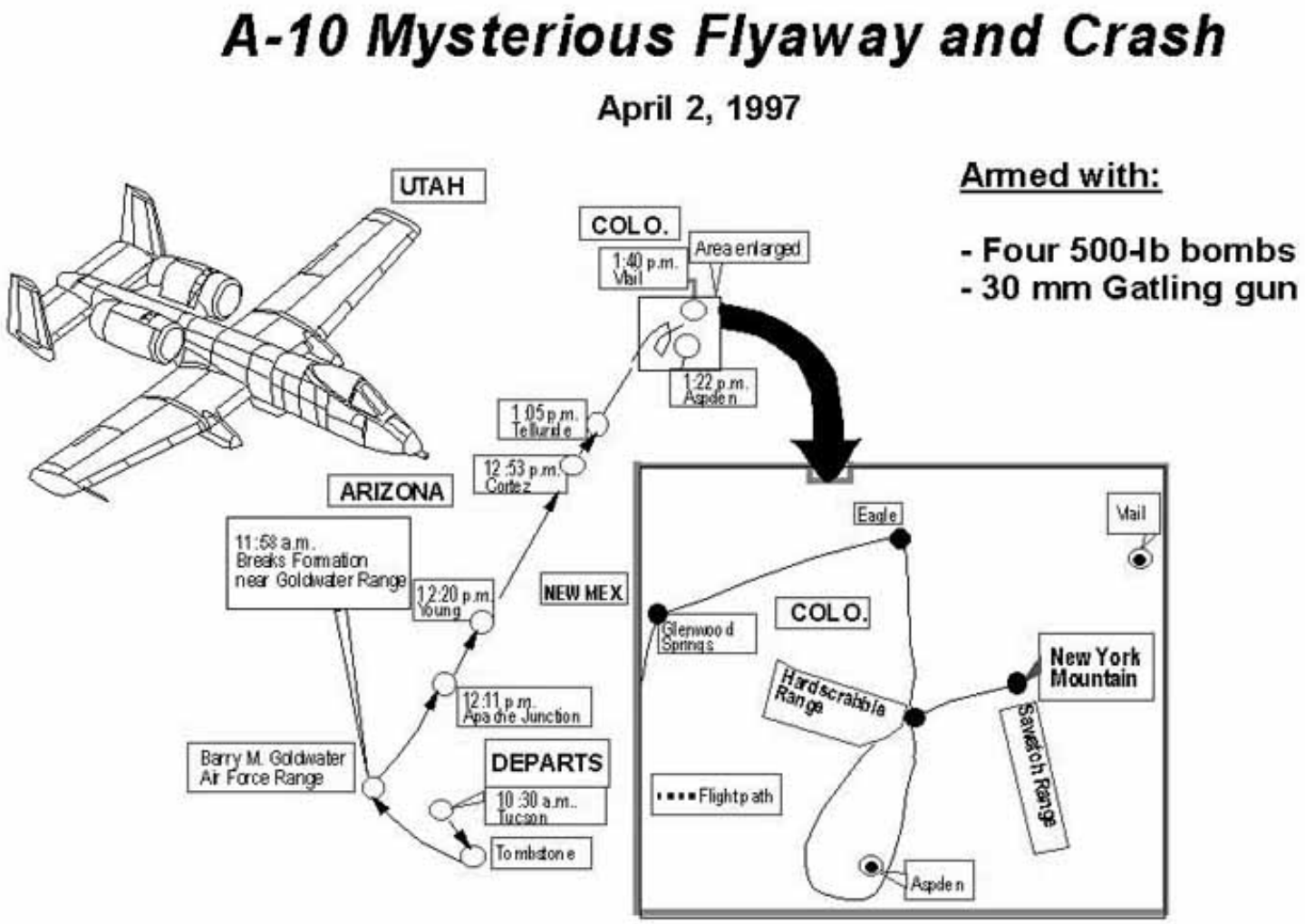

Figure 14a. Captain Button's mysterious flyaway and eventual crash.

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occurred. Sad to say, it did not and it has not. It was lamely speculated that Svoboda probably looked over her shoulder like a rank greenhorn, and inadvertently dived her aircraft into the ground while looking back at the target. If there was one pilot in the USAF who would have not done that, it was Captain Svoboda. At any rate, the KGB determined that the U.S. scientific, intelligence, and governmental communities did not have the foggiest notion of what had occurred.

In private proprietary communications[9] we have explained further, to proper parties, exactly the reasons for these two tests, and what exactly was being tested, and what is its planned strategic use.

The Final Race for Direct Mind Control of the Entire Human Species

The KGB psychoenergetics weapons scientists—because of their direct measurements and detections (and use) of t-polarized waves and LWs for decades—also understand that Jung's collective unconscious mind (of the entire human species) also has its own time-like operations and correlates, which one measures also when using t-polarization measurements and sorting it all out. The collective unconscious mind operations are buried several levels deeper inside the recursive Whittaker structuring inside the EM fields, waves, and potentials.

The KGB scientists also know that something very like Gaia— a collective unconscious mind for all species on earth—also exists, and they are striving to be able to sort out and measure that one as well. The Gaia operations are buried even deeper in the recursive structuring inside the EM fields, waves, and potentials. If one reads some later books by Kaznacheyev,[10] e.g , this human species unconscious mind aspect and the biosphere unconscious mind aspect emerges loud and clear, if one interpolates between the lines, so to speak. Actually, from day one, the Russian mind control scientists have had their eventual goal set upon this "deeper area of mind and possible mind control" of the entire human species.

I am convinced that the KGB psychoenergetics scientists understand this deeper area. If they can learn to directly engineer the collective human species unconscious, they can then convert the human species easily into a sort of "ant" society, modeled along ideal Communism lines, except of course with an excluded "hierarchy at the top" running everything. The "ant society"—communist style—is still a variation of feudalism (all systems tend to feudalism or some form thereof).

The KGB psychoenergetics weapon scientists are seriously pressing on toward that very goal. In my opinion they are not very far from it right now. It is simply a matter of developing sufficiently complex equipment to be able to directly engineer the time-domain substructuring at sufficiently deep levels. It is a doable, although it is very, very complex and very, very difficult. On the other hand, they have been at it for decades. Even in the 50s the Russians already had the old LIDA device,[11] capable of inducing a catatonic trance-like state in a mammal—either a human or a cat,[12] for example. Some versions of Russian mind control devices were used on Russian soldiers in the

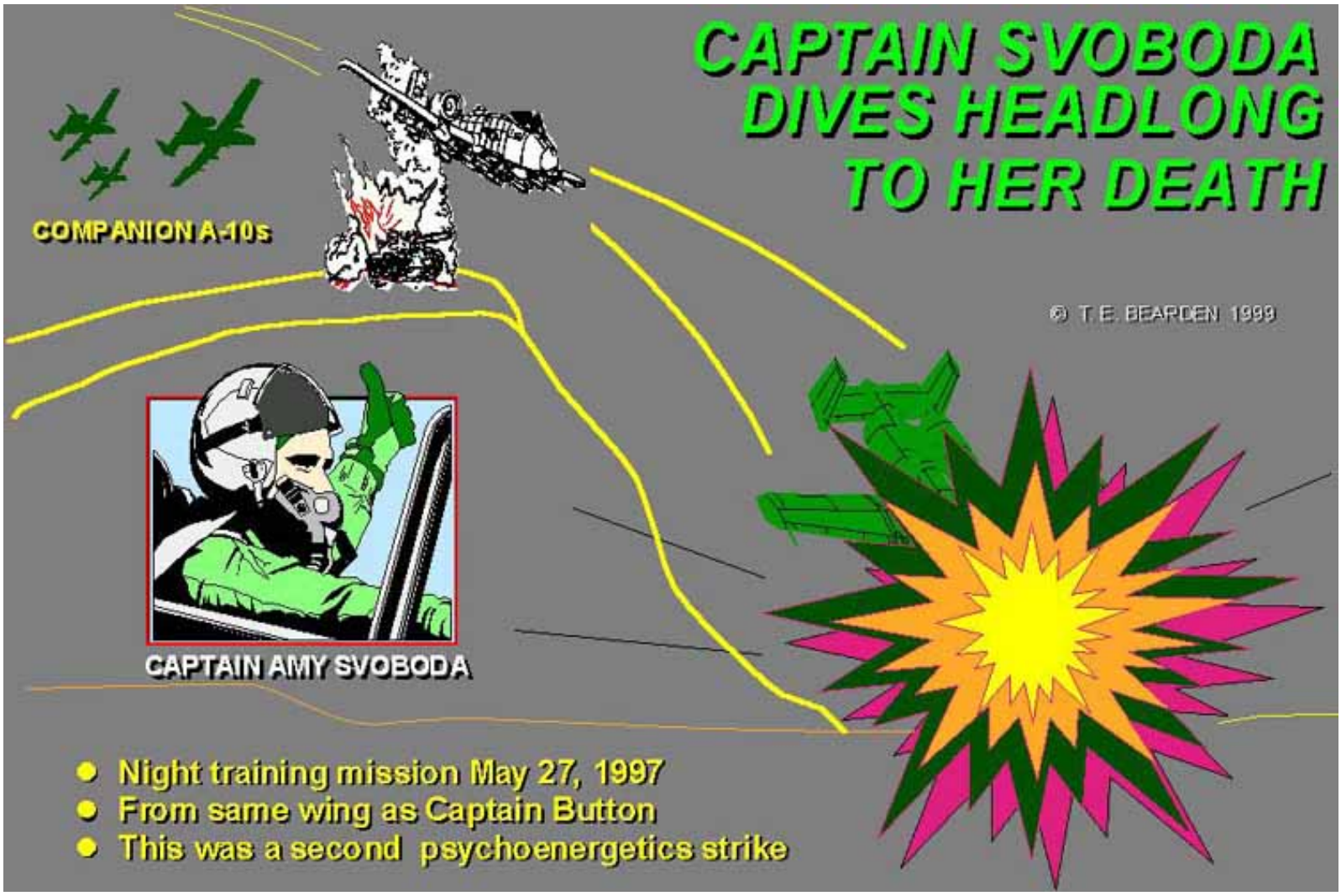

Figure 15. Captain Svoboda dives headlong to her death.

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Afghan War to condition them for performance of merciless acts.[13]

Potential U.S. Rogue Groups and Two Recent Examples

Meanwhile, rogue groups amongst Western clandestine mind control researchers will probably arise if they have not already done so. They will likely seek to increase their personal control and further isolate the programs from orthodox government review and from government and legislative control. They may even divert the research into highly illegal and unethical means, because it furthers their own rogue agendas. That is how clandestine U.S. government research can sometimes go sour, unless great care is exercised by the oversight committees in the House and the Senate.

Sometimes when rogue groups do gain control and total secrecy of a given new technological area, then what appears to be "U.S. government operations" do start to encompass a criminal and unethical operations, hidden usually beneath the deep veil of high classification. Also, if it's "scientific," no one is ever brought to justice, even if the "evil science actions" are uncovered and publicly revealed.

We Certainly Have Proof of Such Rogue Activity. For Example, Here are Two Prominent Cases:

as a result of those ghoulish experiments. So what happened when this gruesome thing was revealed? Again President Clinton publicly apologized! The head of the Executive Branch did not turn the macabre matter over to his Attorney General to prosecute. How many of these scientists were indicted? Not one. How many are going to be indicted? Not one. Suppose again this had been done by a private doctor in his own private clinic. You get the point.

There is Little or No Punishment of Rogue Scientific Groups

Shockingly, the U.S. government at the highest level has directly shown (and these are not all such cases by any means!) that mass crimes against U.S. civilians, *perpetrated by portions of the U.S. scientific community in direct conspiracy and in secret*, will likely be condoned. The perpetrators will not be indicted, tried, or convicted.

Note the connection of the "rogue groups" thesis to the above incidents. Note how rogue **scientific** groups got away with it in both these cases. There may be other rogue

1. For three decades, scientists from the U.S. government, universities, and civilian contractors secretly conspired to treat unsuspecting human patients with whole body nuclear radiation, including some retarded children and cancer patients. Some of those patients—including some of the retarded children—died as a result. These illegal experiments were conducted in great secrecy, and the results were highly classified. Eventually these actions were revealed, and a Presidential investigation committee investigated. These experiments would seem to be little different from the WWII Nazi and Japanese experiments on human prisoners. Are those U.S. scientists who were responsible for those retarded children's' deaths any different from the Nazi scientists and criminals we executed at Nuremberg? So what happened when this terrible thing finally came out into the open? President Clinton publicly apologized! How many of the responsible scientists were indicted for murder? Not one. None is ever going to be.
   Suppose a doctor here in South Alabama, with his own private clinic, had secretly irradiated those human patients and retarded children with whole body nuclear radiation, over a period of 30 years, resulting in some agonizing deaths. How many state and federal agencies would have come after him with arrest warrants? Probably about 50 or so. Would he have been indicted, tried, convicted, and executed or sent to prison for scientific groups getting away with such things today. They should not be able to get away with it. But they can.

Perhaps a most startling additional part of those two incidents is that there was no great public outcry from the scientific community, deploring these murders and demanding that the criminal scientists be indicted and tried.

As the old saying goes, "By their silence they have convicted themselves." The organized scientific community, **as a community**, has shown that it has little or no ethics, and—while deploring any scientific murdering that "gets revealed,"—is not really interested in justice. In short, much of the U.S. scientific community may now have very little ethics left.

We are **not** talking about normal individual scientists, but the Big Science community. There is a whale of a lot of difference between the two. In the Big Science community, there can be and there are rogue groups. Lots of them. There is deep cover, deep classification. And there is very probably advanced mind control research and testing, be it legal or illegal. Hopefully most of it is legal and constrained. However, some of it is almost certain to be illegal and ill constrained.

Human beings are still human beings. All the good and evil is still there, regardless of the group. The stage settings change, but the cast of characters and the play never change.

It's sad, but 'twas ever thus. Hidden parts of our own governments—and other governments throughout the world—are no different from the old medieval groups, where nobles etc. were always plotting against the king, or using the king's power for their own nefarious end. The rogue groups today are no different from all the scheming and conniving groups that

life? Absolutely! Would the President of the United States have apologized? Not on your life; he would have turned it over to the U.S. Attorney General with a strong directive to investigate and prosecute on criminal charges.

2. Again for three decades, scientists from (i) the U.S. Government, (ii) universities, and (iii) civilian contractors conspired to give poor syphilitic blacks in Tuskegee, Alabama a placebo while ostensibly treating them for syphilis. The purpose of the program was to deliberately observe and record the ravages of the disease to its fruition in their wracked bodies. So the scientists deliberately sat there and watched their brains rot and their bodies rot. They kept meticulous notes, of course. It was very scientific. And it was macabre. They "treated" some 400 blacks in the "program." Over 100 blacks died destroyed the Roman Empire. *Great empires fall from within, not usually from without!*

Conclusion

This concludes our brief portrayal of the probable directions that mind control research has taken, in Russia and in the West. It is a novel and powerful area, and it poses both severe dangers and great benefits to all the peoples of the Earth.

Let us hope this great new area, already off to a bad start, can be bridled and steered in the direction of helping and healing people, rather than killing or abusing them. The excesses in its bad use are a potent threat to all nations on earth. Yet it can revolutionize medical science, education, communication, and psychology. Eventually it can engineer the mind and memory directly, beneficially. We foresee the day—perhaps 30 years hence—when education will be

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accomplished *by directly loading the software into the mind.* Then in three weeks one will "load" a doctorate, say, in physics. In three more weeks one will also load a doctorate in chemistry. Another three weeks, in electrical engineering. Another three weeks, an M. D. And so on. When that happens, then truly everyone on earth can be educated. Freedom from ignorance may well be another great freedom that is legally recognized. There will be no impoverished large groups lacking the education to find decent, productive jobs.

We urge all nations to use the principles involved: not for human abuse, but for healing, educating, uplifting, and life-expanding of every person on Earth. If we do, we shall all have a far brighter future. Then we shall check what has started out to

446955, Oct. 23, 1998, forwarded to US. Patent Office on Nov. 4, 1998.

5. A very good introduction to nonlinear phase conjugate optics is given by David M. Pepper, "Nonlinear Optical Phase Conjugation," Optical Engineering, 21(2), March/April 1982, p. 156-183. Also see David M. Pepper, "Applications of Optical Phase Conjugation," Scientific American, 254(1), Jan. 1986, p. 74-83.

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7. See T.E. Bearden, Energetics of Free Energy Systems and Vacuum Engine Therapies, Tara Publishing, Internet node www. tarapublishing.com/books,July 1997. See also T.E. Bearden, "Energetics Update and Summary, " Part I, Explore, 7(6), 1997, p. 60-67, Part II, Explore!, 7(7), 1997, p. 53-56; Part III Explore!, 8(1), I997, p. 53-56; Part IV; Explore!, 8(3), 1997, p. 56-63. See also T.E. Bearden, "Vacuum Engines and Priore's Methodology: The True Science of Energy-Medicine: Parts I and II " Explore!, 6(1), 1995, p. 66-76; 6(2), 1995, p. 50-62.

8. E.g., see R.O. Becker; Charles H. Bachman, and Howard Friedman, The direct current system: A link between the environment and the organism, " New York State Journal of Medicine, Vol. 62,

be the Sword of Damocles and turn it into the golden Millennium.

We are reminded of a poignant quote from Teilhard de Chardin:

"Someday, after we have mastered the winds, the waves, the tides and gravity, we shall harness for God the energies of love. Then for the second time in the history of the world man will have discovered fire."

May the nations of the world utilize the new mind engineering science to truly free all minds into a common love of, and respect for, their fellow humans of every color, creed, and circumstance. As de Chardin envisioned, may we use the new science to discover a new fire, burning clearer and brighter than anything that has gone before. ♦

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Tom is the leading advocate of scalar potential electromagnetics and the Fogal charge-blocking semiconductor: He is involved in alternate energy devices and scalar electromagnetic system prototypes. He has defined charge q as a coupled system of two components, advanced a mechanism for a vacuum engine, whereby the vacuums virtual particle flux is organized and used to energetically shape and manipulate

April 15, 1962, p. 1169-1176. See also R. 0. Becker; "The direct current field: A primitive control and communication system related to growth processes, "Proceedings of the XVI International Congress of Zoology, Washington, D.C., VOL.3, 1963, p. 179-183; —"The neutral semiconduction control system and its interaction with applied electrical current and magnetic fields," Proc. 1lth International. Cong. Radiol., Amsterdam, Excerpta Medica Foundation, 1966, Series 105, p. 1753-1759. See particularly Robert O. Becker and David G. Murray, "The electrical control system regulating fracture healing in amphibians," Clinical Orthopaedics and Related Research, Vol. TBD, No. 73, Nov.-Dec. 1970, p. 169-198.

9. Bearden, T.E., Energetics: Extensions to Physics and Advanced Technology for Medical and Military Applications, CTEC Proprietary, May 1, 1998, 200+ page enclosure to CTEC Letter, "Saving the Lives of mass BW Casualties from Terrorist BW Strikes on US. Population Centers," distributed to selected high U.S. Government agencies and Legislative subcommittees, May. 4, 1998.

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matter and energy, and advanced a mechanism for a Bohm-type quantum potential, which theoretically allows the engineering of action at a distance in physical systems.
He is president of the Association of Distinguished American Scientists (ADAS), a life member of the Alabama Academy of Science, Emeritus member of the American Association of Physics Teachers, and has served on the Board of Directors of several associations and corporations. Tom is a guitarist, a retired aikidoist (Sandan, Yoseikan style), is happily married and has two sons and two daughters. He and his wife Doris live in Huntsville, Alabama where Tom is retired from aerospace, continues private research, and serves as a consultant to industry on Scalar electromagnetics processes.

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12. Stefan T. Possony, "Psy-War: Soviet Device Experiment," Defense & Foreign Affairs Daily, 12(104), June 7, 1983, p. 1-2. Reports on Dr. Ross Adey's investigation of the Soviet device called LIDA which is used to bombard human brains with radio waves in the 40-MHz region. Also reports on work by A.S. Davydov of the Ukrainian Academy of Sciences, who discovered how the blood-brain barrier can be penetrated by low-frequency radio waves so that brain cells are affected. See also "Soviet device uses radio

structuring of EM.

3. Years ago, I read an obscure reference to Russian research directly along that line, with successful development of just such a portable device. Unfortunately I lost the reference in a disastrous flood in my basement and have been unable to recover it.
4. T. E. Bearden, "Alteration of Materials by Wideband Multiwave Irradiation Combined with Selective Emission Manipulation," Invention Disclosure Document Number

waves as tranquilizer, " Associated Press release, Huntsville [Alabama] Times, May 19, 1983. Dr. Ross Adey tested the Soviet LIDA machine on a cat, and in two or three minutes the cat was sitting quietly, almost as though transfixed, and uninterested in its surroundings. The animal remained uninterested in its surroundings for some 20 to 30 minutes after the machine was turned off.

13. "KGB Used PIS to Program Soldiers, "Resonance, No. 30, Mar. 1996, p.29. Quoting: "During the 1970s, the Soviet KGB developed a Psychotronic Influence System (PIS) that was used to turn people into programmable "human weapons." Soldiers fighting in the Afghan conflict were trained using the system which employs a combination of high frequency radio waves and hypnosis. Commands are activated by code words or cyphers. The purpose of PIS was to render regular soldiers and members of the special forces incapable of feeling sympathy.

EXPLORE! VOLUME 9, NUMBER 4 & 5, 1999

The Tom Bearden Website

Latest cloning research findings by Bedini/Bearden

The huge dangers of current cloning technology

Mystery of the death of Australia's cloned sheep explained

"Spark of Life"

From "Stranger than Science"

by Frank Edwards © 1959, 1987

Did an obscure amateur scientist discover the spark of life? Did Andrew Crosse accidentally stumble upon a mixture of chemicals and electricity which produced living things from a lifeless compound? If he did not, then just what did he accomplish? The record of his work is clear, only the enigma of the results remains to plague science.

The neighbors of Andrew Crosse regarded him as more devil than man. They did not understand the bright flashes that lighted his laboratory windows at night when he was tinkering with his crude electrical devices. Not only was he dreaded and shunned as "the thunder and lightning man," but he was denounced as an atheist, a blasphemer, and a Frankenstein who had best be put in chains for the common safety.

Andrew Crosse minded his own business, it is true, but his was a very strange business for the early 1800's. And one of his experiments remains a very strange business to this day.

Andrew was an enthusiastic amateur experimenter in the new field of electricity. Out of touch with others in the same work, he labored under the double handicap of not knowing what had already been done - and of not understanding what he was doing himself. Yet it may have been this very lack of knowledge which led him to undertake the experiments which were to inscribe his name, however faintly, in the annals of science.

He decided to induce the development of artificial crystals by subjecting chemicals to prolonged exposure to weak electrical currents. Andrew mixed up some silicate of potash and hydrochloric acid and into this he dropped a fistsized chunk of oxide of iron. By inducing the current from a small battery to trickle through the solution to the oxide of iron,

he hoped to bring about the growth of artificial crystals of silica.

Having arranged this combination of chemicals and current, Andrew set it aside and went back to his favorite pastime of studying the spark-gap - the flashes which alarmed his neighbors.

Did he accidentally stumble upon an arrangement which created life from inorganic matter?

In a paper which he wrote for the London Electrical Society in that same year of 1837, Andrew set down this account of his experience.

He wrote "On the fourteenth day after the commencement of this experiment, I observed through a small magnifying lens a few small whitish specks clustered around the middle of the electrified stone. Four days later these specks had doubled in size and had struck out six or eight fine filaments around each speck . . . the filaments longer than the hemisphere from which they projected.

"On the 26th day of the experiment, the objects assumed the form of perfect insects, standing erect on the bristles which they were growing. Although I regarded this as most unusual I attached no singular significance to it until two days later, the 28th day of the experiment, when the magnifying lens showed that these things were moving their legs. I must say now that I was quite astonished. After a few more days they detached themselves from the stone and moved about through the caustic acid solution.

"In the course of a few weeks more than a hundred of them made their appearance on the oxide of iron. Under a microscope I examined them and found that the smaller ones had six legs, the larger ones had eight. Others who have examined them pronounced them to be of the genus acari, but some say they are an entirely new species.

"I have never ventured an opinion on the cause of their birth for the reason that I have never been able to form one. I thought they might have been airborne creatures that had drifted into the liquid and prospered, but later experiments with closed vessels, in which the ingredients had been purified by baking in the oven, produced identical creatures; therefore, I suggest that they must originate in the electrified liquid by some process unknown to me."

Andrew Crosse realized that he was walking a tightrope before the top scientists of his day. He was describing an experience foreign to their accepted understanding and therefore he was inviting ridicule. He did not have long to wait. Cries of fraud and hoax engulfed him. He and his alleged insects were denounced as nothing more than humbugs.

Amid all the furor that his announcement had created, Crosse stood alone and helpless. Even other scientists who had duplicated his tests with similar results kept their silence.

All but one. That voice was raised in his defense and it was such a powerful voice that none dared challenge it; for it belonged to the great Michael Faraday. At last Crosse had found his champion.

Faraday reported to the Royal Institution that he too had experienced development of these little creatures in the course of his experiments. But he added that he could not decide whether they had been created in the sterile solutions or brought back to life by the electricity! Either development would have constituted a milestone in scientific advance, as Faraday realized, but he left it to his fellow scientists to make the decision, if any.

Crosse never claimed to have discovered anything. He was merely reporting what had happened. After the attacks upon him subsided, he retired to his home in the Quontock hills for many more happy years among his test tubes and batteries.

Although he spent his long life as a humble searcher after scientific truths, the contribution for which he is remembered is the controversy over his acari - unwanted then, and unexplained to this day.

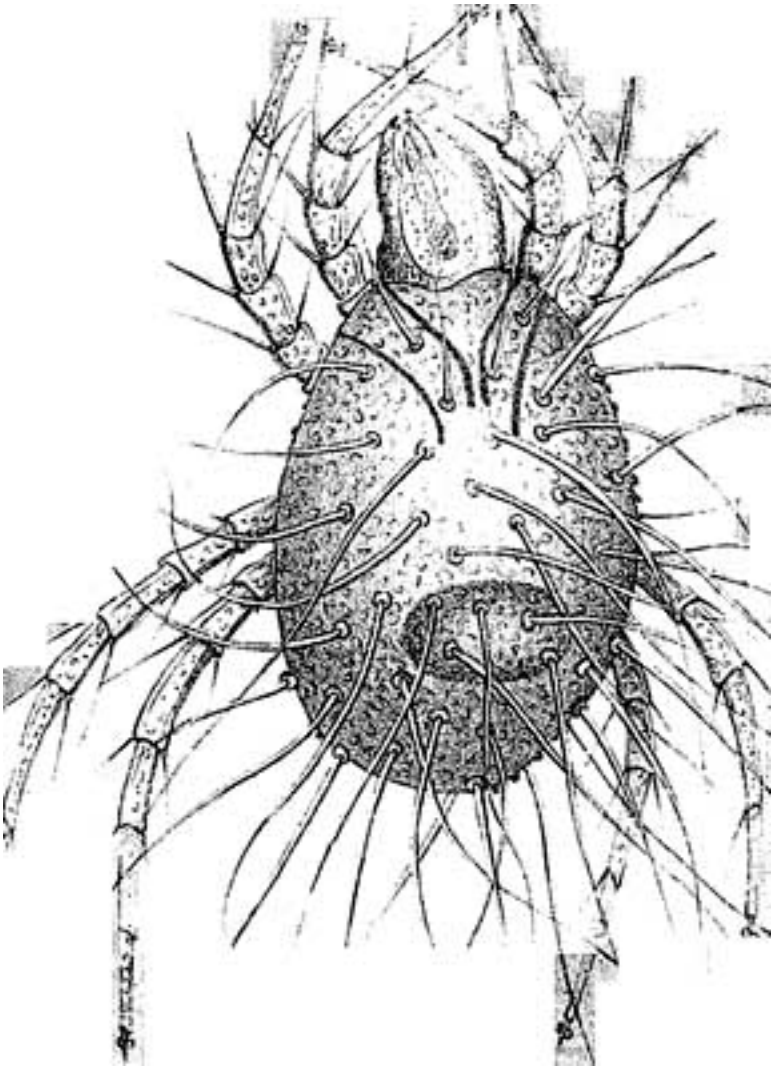

Genus Acari

Tom Bearden comments (finalized and slightly updated in March 2001).

It is difficult to make an understandable comment on the business of life, because presently scientists have not the foggiest notion what mind, being, life, death, time, etc. are. For that matter, they don't really know what matter and energy and charge are either. In the scheme of things, our modern "science" is only about three hundred years old, and that's a snap of the finger in even just the existence of this world. Much of modern science still considers the mind as a "meat computer", or just the physical electrodynamic activity of the brain, etc. Materialism has not died, even though quantum mechanics essentially wiped it out decades ago, and the old concept of "mass" as something hard, permanent, and "material" has also long since vanished. One is referred to the works of Max Jammer to see what the present view of "mass" is. Also, without looking up the references again, recent experiments with quarks and gluons wound up with experiments in which it mattered not a whit whether one considered the mass as zero or nonzero. Nature, it seems, does not have to play by our usual "either-or" rules. In physics, of course, this is the duality problem, which to this day has not

been resolved because attempts to resolve it have applied Aristotelian logic -- and there is no solution to the problem of "opposites being identical" in that logic, which forbids that very thing by authoritarianism.

The modern biogenesis experiments, e.g., never took place in the absence of life. There was no "statistical generation of living or quasi-living forms" in the absence of engines for such forms. The great rush of Poynting energy flow around the earth, generally parallel to the equator, alone carries the "engines" (internal sets of spacetime curvatures) for every form of life that ever existed upon the earth. So the experiments were bathed in "living forms and dynamics", if one accounts for the internal Whittaker-structuring of electrodynamics -- noted but ignored by our scientists for nearly 100 years.

Quite some time ago, we worked out the nature of mind, and the mind-matter coupling mechanism (which is engineerable). We did that in pursuit of the mechanisms in the KGB/ Russian psychoenergetics weapon work. I had the last of a 3-part article published in "Explore", dealing briefly with mind control technology both the way it is probably done clandestinely in this country and how it is done by the KGB/Russians. I'm still trying to get the proper parties to believe it; not much progress. However, some very neat information has been released on the Internet that very probably reveals why officially there is no interest. It's because three decades ago some of our "spooky folks" found (in deep hypnosis experiments) that humans are inordinately sensitive to extremely low-level EM signals and fields. Even though no detection or sensation may rise to the conscious level, the unconscious (which is totally conscious, just massively parallel rather than serial) does sense these signals. Voila! It would appear that "very deep black" parts of the community probably developed quite good mind influence and mind and behavior control or interference using techniques adapted from that work. The reader must always remember that just because the *overt* government does not know something or have something, does not at all mean that the *covert* government doesn't have it. And even in the covert government, there are layers within layers. So there, even when the upper levels do not have something, it still does not mean that the deeper levels do not have it. The problem with the best knowledge and technology, when unknown to the upper covert levels and the overt level, is that it is then quite likely to be subverted into the deepest levels, which may have their own agendas and may not report to the duly elected U.S. government at all. Indeed, such levels often assume that the President himself does not have a "need to know".

Present physics has erroneously omitted the time increment carried by the photon. The overemphasis on the so-called transverse wave (which does not exist as such in vacuum, fairly readily shown) has led to our missing the greatest and most important part of electrodynamics: the longitudinally polarized EM wave and the time-polarized EM wave. For example, mind and mind operations are totally electromagnetic, but use time-polarized EM waves rather than the standard stuff. Overtly we do not even have detectors for LPWs and TPWs yet; the Russians do. However, every major weapons lab on earth now is aware of longitudinal EM waves and their powerful characteristics. Simply read some of the

summary material on Undistorted Progressive Waves (UPWs) on the Los Alamos National Laboratory website, e.g. by Rodrigues et al. A UPW is an "imperfect" longitudinal EM wave with some remaining transverse wave residue (that is the way it is modeled).

Let me give you one example of how fouled we are. We still use Aristotelian logic primarily. Yet it is an incomplete logic. Let me show you instantly. Take the simple Venn diagram of a rectangle lying on its side, divided in half by a vertical line in the middle. Label the right rectangular area A. Label the left rectangular area "not-A". What is the line in the middle and the border? Both A and not-A, so that A is identical to not-A. Yet the third law (law of the excluded middle) forbids A identical to not-A. Apply the third law to the Venn diagram. The border disappears, and the middle dividing line disappears. The logic self-destructs, because now there is no separate A and no separate not-A. Yet so far as I can determine, no one seems to have seen that very simple thing and questioned it. Aristotelian logic cannot be applied to the very Venn diagrams used to establish and "prove by demonstration" its propositions. We corrected that nearly 20 years ago, and got called every kind of lunatic imaginable -- the usual reaction when something fundamentally wrong is pointed out in a comfortable part of the prevailing paradigm. These days I simply point to Morris Kline's "Mathematics: The Loss of Certainty" to the Aristotelians, and tell skeptics to go and read it and then we will discuss the foundations of logic. With a 5-law logic (or 4-law with an additional applications rule), one solves the "dividing line" problem nicely. Then suddenly things like spacetime and being and mind and nothing etc. can be solved -- in the 5-law logic, but never in the 3-law logic. The problem of life itself -- whether terrestrial or extraterrestrial -- has no solution in 3-law logic.

The entire method of Zen is to try to break up the iron Aristotelian bent of the conscious (serial processor) mind, and get into the far broader unconscious (totally conscious, massively parallel processor) mind. Few have done that. But one cannot present a 5-law solution to a 3-law processor; it just "does not compute". It's like putting a thousand slides at once on the normal "single slide at a time" projector. The "conscious mind" can see only a single slide at a time. So it just sees "black" or "nothing at all". That's why we "see" the "massively parallel conscious" mind as "unconscious"! It isn't. But it is a quite different *form* of consciousness which we all have.

Time is never observed, and no observable is a *cause*, a priori, because an observable is only a frozen, nonchanging 3-spatial "instant snapshot" and therefore the *output* of the observation process, while the *causal input* is what exists in 4-space prior to its interaction with the observation process. When one adds time and time dynamics to one's science, one moves far in front of much of present Western physics. E.g., physics has nearly hopelessly confused the *causal* side of the observation mechanism/process with the *effect* side, everywhere, throughout physics -- simply by assuming that observables persist in time -- a non sequitur since an observation is a frozen 3-space snapshot at one single instant.

And sadly, the physicists do not seem to have even realized it!. Not a single paper or text in

the West, e.g., illustrates an EM wave in spacetime prior to its interaction with a unit point charge. E.g., simply check a fine editorial by Romer. Romer is the editor of American Journal of Physics, and we are referring to Robert H. Romer, "Heat is not a noun," American Journal of Physics, 69(2), Feb. 2001, p. 107-109; and specifically to his end note #24, p. 109. Romer takes to task *"…that dreadful diagram purporting to show the electric and magnetic fields of a plane wave, as a function of position (and/or time?) that besmirch the pages of almost every introductory book. …it is a horrible diagram. 'Misleading' would be too kind a word; 'wrong' is more accurate." "…perhaps then, for historical interest, [we should] find out how that diagram came to contaminate our literature in the first place."*

But in general physicists continue to charge on, confusing effect as cause. Electrodynamics, e.g., is particularly guilty of greatly confusing the two, which is really what is preventing a successful and engineerable unified field theory. Further, contemporary classical electrodynamicists do not calculate either the field or the potential; instead they calculate the *reaction cross section* of each, interacting with a unit point charge assumed out of nowhere. In short, they calculate how much is diverged from the actual field or potential, and then call that "little extracted part" the field or potential! Again, they mistake the causal entity existing before the interaction with the effect entity existing after the interaction. Well, after the interaction has occurred, that result is the *effect*, not the *cause prior to interaction*. Physics has this so hopelessly snarled that it will require 50 to 100 years before the journals and physics societies are likely to even realize it and admit it, and then it will require them another 50 years to straighten it out and purge this huge non sequitur from physics theory and modeling.

Anyway, we did model how mind and mind operations operate, including their precise nature, how they fit into all this, etc. We thus were able to resolve many previously unsolved riddles such as the nature of intent, how a space-less mind operation can generate a spatial input to a spatial body and vice versa, etc. We also worked out how to use "effects" systems to generate "causal" systems, completely independent of mass -- because the KGB has recently completed a completely different kind of weaponry based on this, and different from anything that has ever existed in the history of mankind (at least on this planet!). The Russians of course were already there; I got there much more crudely by intensely working on how to explain what they were doing.

To see that the effect can generate the cause, just consider the normal "forward time" observation process having to operate in a "time-reversed" process. You see, not only must we shift observers from frame to frame, but we must also be able to shift them from forward-time (of some conveniently chosen outside reference observer) to reversed time (of that same reference observer).

At any rate, it turns out that the entire universe is already "alive" in a very special sense. There is no death; there is mind (I use the term "mind" in the most general sense, not just the conscious mind which is merely a "periscope" put up and taken down from the

unconscious). And mind is not a part of the brain, and it is indeed separated from body but intimately linked to it by the mind-body coupling dynamics. Further, any life that has "ever existed" still dynamically exists in a special kind of more fundamental electrodynamics infolded inside all normal EM fields, waves, and potentials. The Tibetans knew much of this very well, but of course in terms that our materialistic science rejects or completely fails to understand (as we stated, most of our scientists believe the human is a robot and the mind is simply the electrochemical reactions of a "meat computer"!).

Since ambient spacetime may be modeled as a special kind of "scalar" potential with intense energy density, it then decomposes into a series of bidirectional EM longitudinal wavepairs, a la Whittaker 1903, except one must use impulse waves so as to include the time dynamics part of spacetime, rather than forcefield 3-space type waves. The entire thing -- mind, life, matter, fields, waves, spacetime, etc. -- then becomes structurable and directly engineerable by novel EM means (such as the O(3) higher symmetry electrodynamics pioneered by Evans and Vigier). Longitudinal EM wave technology is the key to developing such mind-body coupling mechanisms and engineering of them, at all. One only gets the time-polarized EM wave technology *after* the LPW technology has "done its thing" -- the time-polarized technology is far and away the most powerful and primary.

Also, low frequency photons have far more energy than high frequency photons, if one includes the time component, since time is spatial energy compressed by c-squared and has the same energy density as mass. Time-energy (highly compressed spatial energy, compressed by c-squared but in the time domain rather than in 3-space) and spatial energy in the photon are canonical. As the frequency of the photon decreases, its spatial energy decreases also with the decreasing frequency. However, the time-energy component increases, and its compacted energy increases as the square of the time-component expressed in seconds. Hence at lower frequencies the total energy (sum of spatial energy and time energy) in the photon increases. Indeed, if one wishes to engineer gravitational effects, it is the low frequency photons (low ELF) that are important, because they have far and away more "spacetime curving energy" than high frequency photons such as gamma rays.

At least eight nations on earth now have longitudinal EM wave technology weapons to one extent or another. Several of them -- hostile to one another -- are using Western Australia as a convenient nearly uninhabited target range.

Anyway, when you come at the mind-body-life problem with that background (which unfortunately required more than 20 years of very hard work!) there appears to be no great difficulty in explaining the Faraday, Crosse, Fox, Miller, and Urey biogenesis experiments. And yes, there appears to be no difficulty in explaining the "appearance" of "life on earth" in the prebiotic soup. It did not really appear out of nowhere spontaneously at all, but simply was a sort of sympathetic resonant coupling of physical forms to mind-forms already there. None of the experimenters realized that the great Poynting energy flow (and one must add back in the missing Heaviside component which is some 10exp13 times larger than the

accounted Poynting flow) around the earth parallel to the equator and from West to East, is already internally structured with every possible form of life ever in the universe anywhere. If we further multiply that Heaviside component by c-squared, so that we can account for the time-energy portion of that great energy flow, we can see immediately that life and its environment are both living and intercommuting all the while. The creator in fact created a living universe, not an inert one (as best we can speak it in the inadequate 3-law logic). If one believes in big bangs, then life structuring emerged right along in all the fields and waves and energy, right in and out of the big bang. There is not a single point in the universe anywhere that is absent of energy and therefore absent of life, in the view of the model I am using.

Understand, one does not have to agree with this model! That is one's own decision. We are just pointing out that, if we correct many of the errors known to be in the presently used models, this is the kind of reality that readily emerges. We get a physics that is not just an "inert" physics, but a living physics where literally the entire universe is "alive" in very special manner.

In deciphering (after 14 years!) the Priore mechanism, I found that incredibly the cellular regenerative system does retain the form and "memory" of all the precessor cellular forms. Cancer, in fact, is very often due to a direct "order" by that system to a cell (aerobic) to start back down the "chain" to an anaerobic cell, because of severe hypoxia and the sustained inability of the regenerative system to maintain the cell in aerobic form. It doesn't just send an "order", but sends a "precise set of spacetime curvature engines" that go to work on that cell and all its parts. The first major step back is to break it loose from centralized control of its growth -- whereupon we recognize it as a tumor cell. There are two requirements: (1) cellular damage, and (2) "promotion". Biologists do not really understand "promotion", because they do not understand the cellular regenerative system—which used time-polarized EM waves, and nonlinear optical pumping of the cell and all its parts in the TIME-energy domain rather than the SPATIAL energy domain. That sort of pumping creates an "antiengine" to its forward time engine resident in the sick cell, thereby time-reversing the cell and all its parts back to a previous state on the trail from the early anaerobic single cells to the present aerobic cells.

By the way, recent experiments in cloning are beginning to bear out the fallacy that exact electrochemical processes produce the same end physical results, particularly when the persistence of the created forms is examined. E.g., cloned rats may live half their lives in apparently normalcy—then suddenly grow greatly obese and die. Many other anomalies are being uncovered in this fashion. The reason is quite simple: We have some diagrams showing that one may introduce an additional "engine" to the pumping of a diseased or damaged cell (or a healthy one for that matter), and in the time-reversal process then induced, the "time-reversal" process will be diverted from the original trajectory. In short, the original full state will not be recovered.

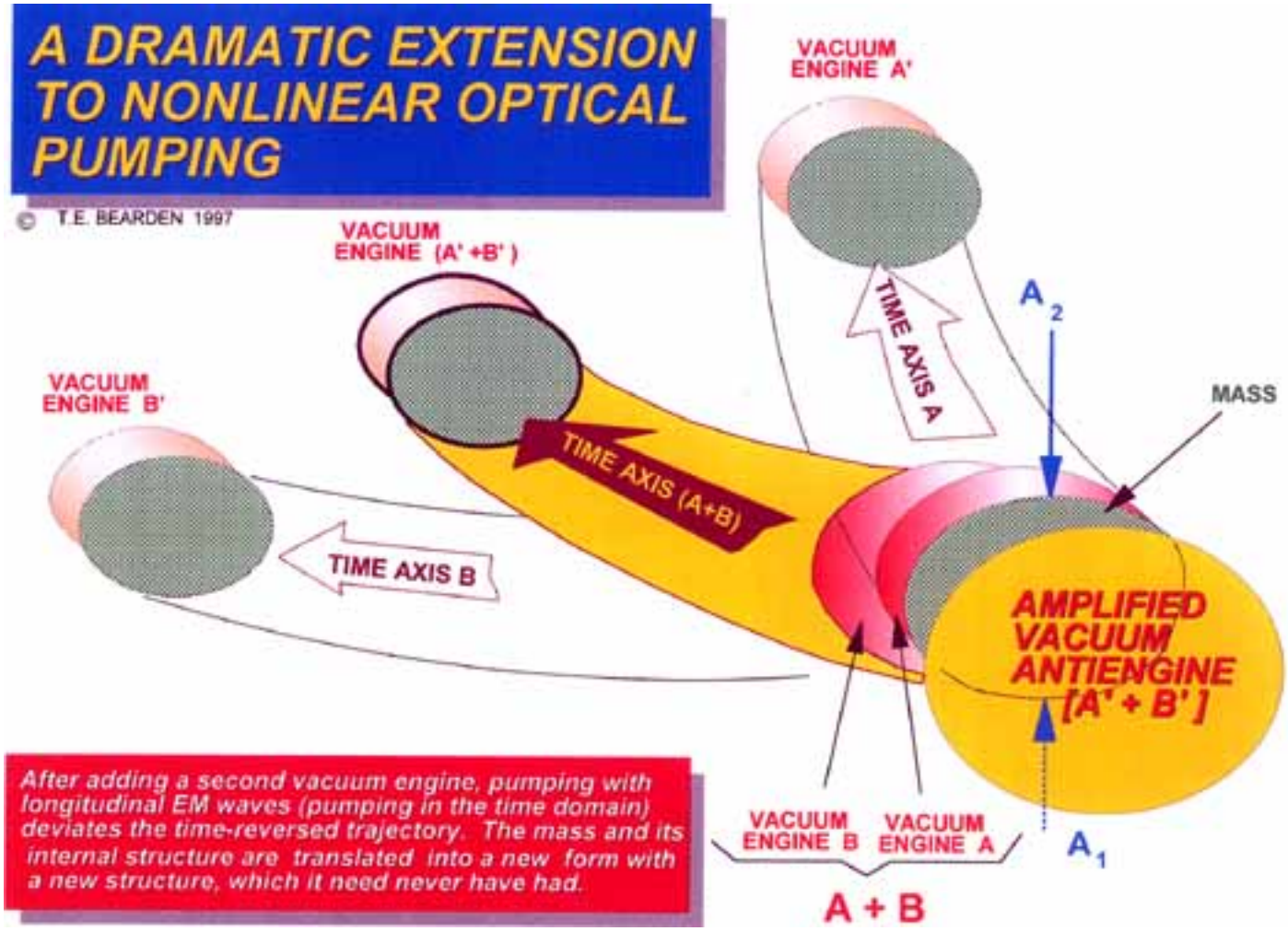

This, we pointed out, is a second generation technology to be developed, where a disease or disorder must be treated and where also there was never a normal past state anyway. A case in point is birth defects, etc. Eventually, if the technology ever is allowed to be funded and developed, even those kinds of medical conditions will be treatable and curable. The point is that in cloning, one does not use the normal sperm cell and egg, without abnormal disruption. There is indeed an abnormal disruption -- and every such physical action or change and dynamics certainly involves an additional set of engines. In short, with present methods the cloned entity also has introduced into the equation an additional "engine". In the fertilization process, there is quite a jump back to a "time-reversed" situation (fertilization is the beginning of a physical embodiment, hence from two parts of an embodiment already in being, there is a rather dramatic "jump backwards"). The "normal" backwards jump of that kind is a normal fertilization of the egg by the sperm. Any change to that procedure, represents the insertion of an abnormal engine to be processed in that same "jump back". For the methods being used, it appears that the abnormal engines are sufficiently weak that, in the cloned animal, some time must expire in its lifetime before the impact of that little constant deviation from normal grows to become suddenly significant.

Indeed, all "living forms" are materialized from energy, but from both matter-energy and time-energy and the dynamics of the two. Natural processes include fertilization, birth, etc.,

but there is no technical reason whatsoever that the process cannot be direct and even directly engineerable. In this "expanded energy" sense, mind energy and dynamics can be engineered as well as body matter energy and dynamics.

To cinch the matter of "engineering living forms", I once participated in a accidental and unplanned experiment where Golden materialized living things. Not little bitty things, but big things. In my view we actually materialized thought forms, since much later we were able to piece together exactly what apparently engendered each part of the phenomena. There were multiple (scared) witnesses who prefer never to discuss it. The experiment also altered all the clocks in the area for four days before the "time-energy charge" we had inadvertently created dissipated. Let me just say that it really got my attention! We never repeated that experiment again. But the changes were substantial and the phenomena were substantial, and to this day I prefer not to discuss that experiment. It simply cannot be understood without the outline sketch we are speaking of, where one accounts for time-energy and dynamics as well as material energy and dynamics, and also for the coupling dynamics between the two.

Not only can one have a "material entity" or thing communicating with another "material entity" or thing, but one can also have a "mental thing" (time-domain thing with no spatial existence) communicating with a "material entity or thing" with only spatial existence, and vice versa. There is indeed a coupling two-way mechanism

Look at the so-called "physical form" -- which almost always one is speaking of as purely 3-space. Most scientists have not yet understood that a priori a piece of 3-dimensional mass *as observed* cannot even persist in time! Masstime exists in time, but "mass" is a frozen 3-spatial intersection of the spacetime entity. It is exactly comparable to a frozen frame in a movie film. The individual frame never has any existence except at a frozen moment in the slide projector. "Motion" and "movement" etc. involve the time domain a priori -- hence something without any time-component at all, cannot persist or even exist except at one frozen moment in time. Hence any observable existed in that single "observation slice" and at that "point in time" only. After all, a "point in time" is where time symmetry is broken or ceases. In short, it is a time-discontinuity. All observations are such time-discontinuities.

The SETI problem will not be solved, in my personal opinion (understand, I do not object at all if others do not see it this way) until a far greater and deeper understanding is reached by our modern physics. Forget communicating with "transverse" waves; longitudinal EM waves can travel at any velocity, limited only by how much "residue" of the normal EM wave junk is still hanging in there (how much "transverse EM wave noise" is still present. A pure LW moves at infinite velocity. As we suggested, simply download the Rodrigues and Lu papers carried on the Los Alamos National Laboratory Web site. It appears that now most major weapon labs have "discovered" the fact that there can be longitudinal EM waves, and some eight or so nations have developed weapons technology from such. If one has such technology, all the rest is obsolete.

For the skeptic, here is a statement made in 1997 by Dr. William Cohen, then Secretary of Defense:

> *"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our [counterterrorism] efforts."*
>
> [Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.].

Any technological civilization that has not solved the fundamental "self-killer" problem of the technological species, must and will self-destruct. This follows from simple servo-mechanism theory, as we have previously pointed out. The KGB is working on a "solution" that is far along: engineer the entire human species quantum potential so that the human species can be turned into an "antlike" species, which of course would be the "ideal" communist state, in the minds of many Communist party theoreticians. Our guys haven't even got started on engineering the quantum potential yet. They have not yet even discovered the big ball park, let alone the big ball game.

Anyway, that is just some comments for your personal information. What really is happening in the "hidden weapons" area and "hidden weapons science area" is already so advanced in some quarters that science fiction pales by comparison. The real question is whether we shall survive very much longer, and whether we shall mature rapidly enough to begin to use these technologies for the benefit of humanity, rather than for its destruction.

Sincerely,
Tom Bearden

Additional Comments from Tom dated 9 July, 2001

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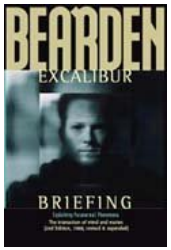

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EXCALIBUR BRIEFING

THE NEUROPHONE

Another device that uses the new hyperspatial, virtual state, nested modulation technology (and has done so for seventeen or eighteen years) is Dr. Pat Flanagan's neurophone. With brilliant insight and intuition far beyond that of science at the time, Pat invented and patented the instrument by the time he was seventeen years old. The neurophone is a device that, contrary to all present theory and knowledge, will directly "pump the brain" and reproduce sound and information directly in the brain and mind system, without going through the auditory system at all. A simplified diagram of Pat's improved neurophone is shown in Figure 11.

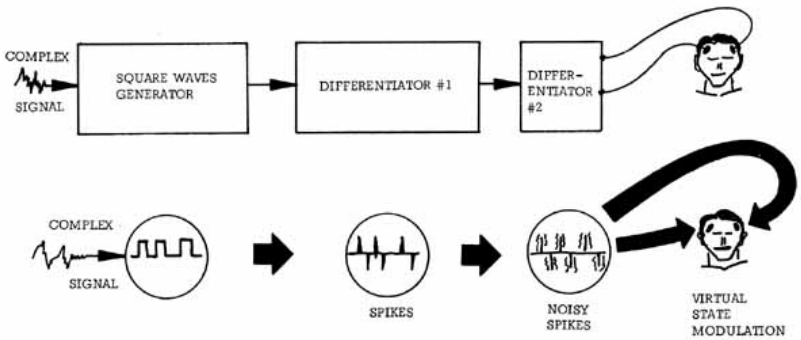

Figure 11. A simplified diagram of the improved Flanagan neurophone

Briefly, the device takes a complex signal, such as the sound of an orchestra playing a musical interlude, and electrically processes it as shown in the figure. First the signal is passed into a section that clips everything into a series of square waves, remarkably analogous to the sort of clipped waves Lisitsyn confirms are the information carriers of the human brain. Next the square waves are differentiated, yielding a series of sharp spikes (note that these spikes retain the pulse-time content of the clipped signal). These spikes are again differentiated, and since these are finite spikes with real nonzero rise times and decay times rather than theoretical constructs, a series of noisy spikes results from the second differentiator section. From here, the noisy spikes are introduced to special contact electrodes, one of which is normally placed on the forehead, while the other may be placed almost anywhere, including on the foot. Nowhere are any sound waves introduced to the head.

The square-wave clipper section reduces the complex signals, their overtones, and their complex modulations to square waves, retaining the temporal content of the wave mix but not the waves themselves. The first and second differentiators heighten or filter through the temporal content of the higher-order differentiations, that is, they serve as a band pass filter unit to accent the time keying of the neutrinic and mindfield portions or aspects of the signal. When these time spikes are then introduced across the body as pulsed voltages, they are modulated directly on the dendrite firings of the brain and nervous system, providing direct and pulsed modulation of the neutrinic and mindfield component channels of the mind-brain-consciousness-life loop itself. Thus the neurophone directly inputs information into the brain and nervous system, bypassing all the normal sensory systems that lie between

the mind-brain loop and the outside environment.

Indeed, a similar development has been reported by two University of Missouri researchers. Dr. Donald York, a neurophysiologist, and Dr. Thomas Jensen, a speech pathologist, have recently reported identifying and decoding twenty-seven words and syllables in specific brain wave patterns and correlating these electroencephalographic patterns with both the spoken word and the silently thought word in about forty subjects. At present, Dr. York and Dr. Jensen are programming a computer with a brain wave vocabulary, to monitor and read the EEG of a stroke victim's brain and help stroke victims who have lost their powers of speech to communicate.

While all such developments can obviously be misused, their potential for assistance to mankind is enormous. Indeed, my own premise that brain linkage is possible and can be used to advance all mankind to the sixth stage of species evolution is slowly being proven. It is within our reach now to develop a multi-channel communications system that will directly link brains, minds, and consciousness into a single functional being; and I have already pointed out that the psychokinetic power of the emergent entity increases exponentially with the number of linked stages. The normal corpus callosum linkage of the two cerebral halves in each human head proves that brains, minds, and beings can be linked and integrated into one.

The Excalibur Briefing details the basic concepts of the theory involved in hyperspace-virtual state engineering, and thus in the engineering of mind-life-consciousness links to multicellular organisms here on earth. Pat Flanagan's neurophone proves that complex information can be implanted directly in the brain and mind, bypassing the normal isolating barriers. Drs. York and Jensen have shown that the brain wave does indeed contain recognizable, decodable information analogues. Lisitsyn has already reported measuring the number of independent channels involved and has documented the importance of the clipped brain waves as opposed to the sine-wave content. If we have the vision, we can still develop a brainlink and rapidly apply it to link sixty to one hundred persons, thereby opening a conscious, multidimensional "eye" for the collective human unconsciousness, gently rousing ZARG into wakefulness, and fulfilling human destiny without undergoing the psychotronic Armageddon planned by the Soviets. The time is short, but it can still be done if the funding, the vision, and the team can be established on a crash priority basis.

SOVIET "WOODPECKER" SIGNALS

But, as I have said, all this can be used for the detriment of mankind as well as for its benefit. Unfortunately, it appears that the Soviet Union has chosen to weaponize the effects on a global scale. A prime example is the "woodpecker" signals emanating from the USSR in the 5-30 megahertz region and interfering with communications around the earth.

These complex woodpecker signals appear to originate from two or three dozen powerful Soviet transmitters, each with a power estimated as high as 40 megawatts (Figure 12).

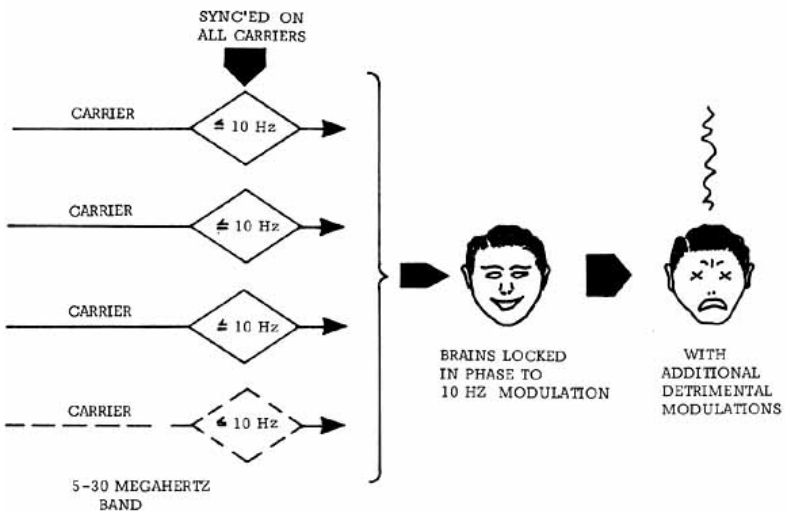

Figure 12. The Soviet "woodpecker" signals

The pioneering experimental measurements of these signals by Dr. Robert Beck and William Bise have shown just how deadly a potential may be possessed by the signals. These measurements have been performed in Eugene and Portland, Oregon; Los Angeles, California; Huntsville, Alabama; and several other locations. They have been particularly significant on the West Coast in and around Eugene, Oregon because of the presence of a direct current transmission line several hundred miles long, which has acted as a long wire antenna, picking up the signals and rebroadcasting them with appreciable gain in the vicinity.

Typically the signals may be found on, say, sixteen different carriers between 10 and 20 megahertz. Twelve of the carriers may appear normal, with normal side-bands, and the other four may have the carrier and both sidebands suppressed but still show the biologically significant modulation (for example, 10 hertz). On all sixteen channels a strong 10 hertz modulation may appear, all perfectly time synchronized and in phase channel-to-channel. The received signal from one of these carriers may be twenty-five to thirty times as strong as the earth's back-ground magnetic field, which is oscillating at approximately 7.0 to 7.5 hertz. Other complex modulation frequencies, many of them changing, are present on the various channels.

Normally, the brainwaves of mammals in an area are gently entrained by the normal oscillations of the earth's magnetic field and are oscillating along at, say, 7.5 hertz. Under continuous radiation from the Soviet woodpecker signals, a percentage (say 30 percent) of the mammalian brains may be captured by the 10 hertz modulation on the overpowering Soviet signals. These captured brains are now in forced oscillation and are riding along in phase with the 10 hertz Soviet modulation. In other words, a certain percentage of the human brains in an area will phase lock to the 10 hertz modulation, and that will effectively lock into those brains the sixteen carrier frequencies with their concomitant frequency mixes and complex signal modulations. If the signals are made much more powerful (for example, by focusing them onto one particular area or increasing the power of the transmitters), then a much higher percentage of brainwave entrainment can be accomplished in the targeted area. By simply adding on the desired modulation patterns, the Soviets can now pump material directly into the mind-brain-consciousness-life loops of the entrained brains. The weapon implications are enormous: raw emotion such as sheer terror or panic can be transmitted; death or disease patterns of all kinds can be transmitted; informational content (thoughts and ideas) can be impressed directly into the captured brains and minds and processed as if originating inside each brain itself. Indeed, as long as the Soviets keep the effects rather gentle, an entire population can be subtly influenced without governmental notice. Certain specific ELF frequencies can rapidly disable or even kill, and for wartime use those frequencies can be directly implanted in the captured brains themselves by the woodpecker signals. It appears that 1984 came a little early, and one can perhaps now understand Brezhnev's strange 1975 proposal to the SALT negotiations that we should also consider outlawing the development of new weapons more frightful than the mind of man has ever conceived.

The signals also have direct application against strategic targets other than personnel. For example, by incorporating the correct nested modulation pattern, the positron kindling (electron squelching) pattern can be impressed. By beaming through the earth (with a circularly polarized signal or with other complex modulation forms), a beam with a strong neutrinic component, which will squelch electrons and which will interact with great preference for strong voltages or strong magnetic fields, can be directed at a target complex. In the targeted area aircraft and communications systems can be disabled; automobile, truck, and other ignition systems will fail; power transformers and large motors and generators will fail; power transmission systems with their associated high voltages will fail; and so on. Even independent, self-contained emergency power equipment, such as at military installations and strategic missile sites, will fail to operate. Further, to some of these signals, the earth and the sea are as transparent as glass, and so underwater nuclear submarines can be electrically disabled on station before their missiles can be fired, while strategic missile complexes can be electrically disabled before their deadly nuclear missiles can be hurled toward their distant targets. If some submarines and land complexes succeed in firing missiles before being disabled, these missiles can be electrically dudded and scrubbed from the sky over Soviet territory while still far from their intended targets.

So, as stated at the end of *Excalibur*, the players are on stage and in place. The final act begins. One thing is sure—mankind will never be the same again after seeing the play!

Return to top of page

LASER WEAPON SYSTEMS

TURNING UP THE HEAT WITH SPEED-OF-LIGHT RESPONSE

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LASER WEAPON SYSTEMS

Lockheed Martin has specialized in laser weapon system development for 40 years, with advancements in areas such as precision pointing and control, line-of-sight stabilization and adaptive optics – essential functions in harnessing and directing the power of a laser beam – and in compact, robust, spectrally beam-combined fiber laser devices that provide unmatched performance.

Lockheed Martin's directed energy (DE) laser program draws upon our proven expertise across a broad range of capabilities, as well as our spirit of innovation. Our experience includes:

- The beam-control/fire-control system for a megawatt-class laser that destroyed a ballistic missile in flight
- High-power spectrally beam-combined fiber lasers that provide the most efficient conversion of platform prime power into lethal power on target
- Unique SWIR component capabilities that significantly extend the ISR (intelligence, surveillance, and reconnaissance) range of the DE laser system
- Widespread weapons-system and platform integration experience across all DoD services

REVOLUTIONARY TECHNOLOGY

Laser weapons are a revolutionary technology because of the advantages of speed, flexibility, precision and low cost per engagement that are only possible with lasers.

These advantages apply to stand-alone DE laser systems as well as to weapon systems that combine DE and kinetic energy capabilities. In these cases, DE operates as a force multiplier, enabling the warfighter to counter a growing range of emerging threats.

DE weapons are characterized by:

- Very deep magazine
- Extremely low cost per engagement
- Speed of light delivery

These strengths mean that they are well-suited to countering large numbers of inexpensive, highly maneuverable threats that might otherwise exhaust the magazines of our current defensive kinetic energy (KE) weapons. By using DE and KE weapons together, the warfighter will be able to neutralize emerging swarming threats while reserving our most capable kinetic weapons to defend against our adversaries' largest and most hardened threats. DE weapon systems support multi-mission scenarios, and can be readily augmented by communications functions, as well as unprecedented intelligence, surveillance and reconnaissance range, and precision.

In addition, Lockheed Martin's directed energy weapons bring some important and unique advantages to the warfighter:

- A robust and highly-maintainable laser architecture that is designed to minimize life-cycle cost and to maximize up-time
- Output laser power that can be rapidly adjusted between low and maximum power to support disrupt, disable, and destroy capabilities
- Highly parallel laser architecture that supports graceful degradation by eliminating almost all single points of failure

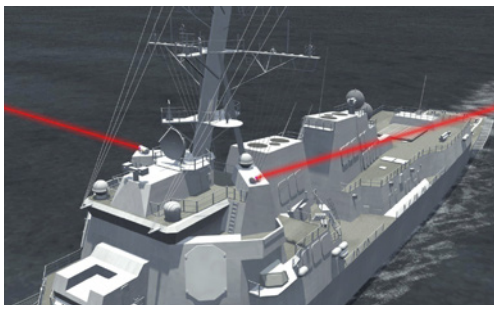

- Highest system efficiency demonstrated in any DE laser system; minimizing size weight and power requirements for DE platforms such as Army and Marine Corps ground vehicles, Navy DDG and LCS ships, and SOCOM AC-130
- Highest lethality laser to minimize engagement time

LOCKHEED MARTIN IS ADVANCING AND DEMONSTRATING A RANGE OF LASER WEAPON SYSTEM TECHNOLOGIES:

ADAM (Area Defense Anti-Munitions)

- Autonomous operations for rocket threats; accepts external sensor cue when required; capable of continuous operation
- Successfully engaged constrained and free-flying rockets, an unmanned aircraft systems (UAS) target in flight, and a small boat
- Affordable commercial-off-the-shelf (COTS) based system with very low cost-per-kill; deep magazine; scalable precision effects
- Capable of close-in defense (1-4 km)

ALADIN (Accelerated Laser Demonstration Initiative)

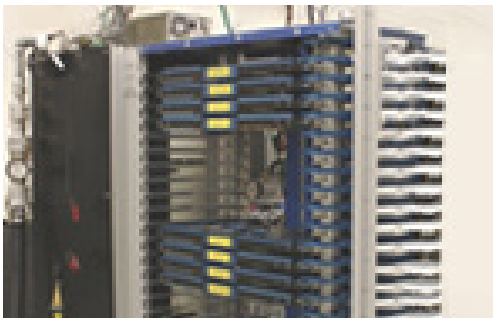

- 30-kilowatt laser made by combining many fiber lasers into a single, near-perfect-quality beam of light
- Uses approximately 50 percent less electricity than alternative solid-state laser technologies
- Spectral Beam Combining sends beams from multiple fiber laser modules, each with a unique wavelength, into a combiner that forms a single, powerful, high-quality beam

ATHENA (Advanced Test High Energy Asset)

- Represents highest power level documented by a laser weapon system of this type, while retaining excellent beam quality and electrical efficiency
- First field testing of an integrated 30-kilowatt single-mode fiber laser weapon system prototype
- Uses the proven high-energy laser weapon system architecture from our ADAM system, and incorporates the 30-kilowatt ALADIN laser

ABC Turret (Aero-adaptive Aero-optic Beam Control)

- Prototype turret with the ability to fire in any direction mounted on tactical aircraft
- First turret to demonstrate a 360-degree field of regard for laser weapon systems on an aircraft flying near the speed of sound
- Validated performance with nearly 60 flight tests conducted in 2014 and 2015 using a business jet as a low-cost flying test bed

RELI (Robust Electric Laser Initiative) for Army HELMTT (High Energy Laser Mobile Test Truck) Demonstrator

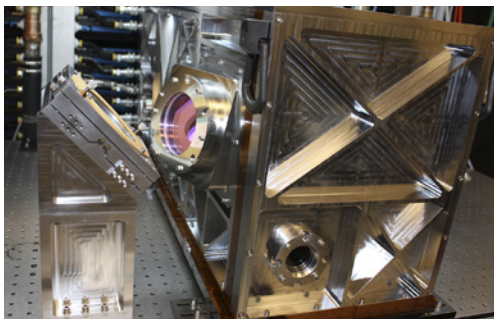

- Modular 60-kW laser in development for the U.S. Army
- Proven affordable weapon architecture that supports size, weight and power constraints for air, sea and land platforms
- Scalable design combines multiple kilowatt lasers to attain various weapon power levels
- Modularity results in a reliable and low maintenance laser system that minimizes single points of failure

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Axial Vircator for Electronic Warfare Applications

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Abstract. *This paper deals with a high power microwave generator with virtual cathode – vircator in axial release for electronic warfare applications. The classification of directed energy weapons microwave (DEWM) is introduced together with basic block diagrams of a particular class of DEWM. In the paper, methods for designing vircator pulsed power supply, axial vircator structure, measurement methods and experimental results are presented. The vircator in electromagnetic ammunition is powered by magneto-cumulative generator and in weapons for defense of objects (WDO), it is powered by Marx generator. The possible applications of a vircator in the DEWM area are discussed.*

Keywords

Electronic warfare, directed energy weapons microwave, high power microwave, magneto-cumulative generator, Marx generator, pulse forming line, vircator.

1. Introduction

Electronic warfare (EW) is defined as the art and science of preserving the use of the electromagnetic spectrum for friendly use while denying its use to the enemy. Electromagnetic spectrum is, of course, reaching from DC to light (and beyond). Thus, electronic warfare covers the full radio frequency spectrum, the infrared spectrum, the optical spectrum, and the ultraviolet spectrum.

Electronic warfare has classically been divided into:

- Electronic warfare support (ES), which includes the receiving part of EW.
- Electronic attack (EA), which includes jamming, chaff, flares used to interfere with the operation of radars, military communication, and head-seeking weapons. Over the last years, EA also includes antiradiation weapons (ARW) and directed energy weapons (DEW).
- Electronic protection (EP), which is directed into design or operation of radars or communication systems to counter the effect EA.

A detailed classification of EW can be found in [1].

Today the directed energy weapons (DEW) are significant in terms of the electronic attack (EA). Considerable financial resources are directed especially to the research of DEW working in microwave band (directed energy weapons microwave − DEWM), which derive their benefits from incidence of electromagnetic pulses (EMP) on electronic devices. The EMP effect was first observed during the early testing of high altitude airburst nuclear weapons [2]. The effect is characterized by production of a very short (hundreds of nanoseconds) but intense electromagnetic pulse, which propagates away from its source with ever diminishing intensity, governed by the theory of electromagnetism. The EMP is in effect an electromagnetic shock wave. This pulse of energy produces a powerful electromagnetic field, particularly within the vicinity of the weapon burst. The field can be sufficiently strong to produce short lived transient voltages of hundreds of volts to kilovolts on exposed electrical conductors, such as wires or conductive tracks on printed circuit boards.

At present, a high intensity EMP can be successfully generate without using nuclear weapons. This fact is very significant especially for applications in the EW area. It is this aspect of the EMP effect which is of military significance, as it can result in irreversible damage to a wide range of electrical and electronic equipment, particularly computers and radio or radar receivers. Depending on the electromagnetic hardness of the electronics (a measure of the equipment's resilience to this effect) and the intensity of the field produced by the weapon, the equipment can be irreversibly damaged or even electrically destroyed. The damage inflicted is not unlike the damage experienced by exposure to close proximity lightning strikes, and may require complete replacement of the equipment, or at least substantial portions of it [3], [4].

2. Directed Energy Weapons Microwave

Directed energy weapons microwave (DEWM) generate very high-powered electromagnetic impulse (EMP) in the microwave band. From the generated signal bandwidth point of view, there are two classes of generators for the design and construction of DEWM in order to produce electromagnetic field with sufficient power:

- Narrowband – very similar to the radar transmitters; usually generate a modulated harmonic signal. This class is called the high power microwave (HPM).
- Ultra-wideband (UWB) – generates high power videosignal illuminated by a broadband antenna.

The application of directed energy weapons microwave (DEWM) determines their design. There are two groups of directed energy weapons microwave:

- Single shot DEWM,
- Repetitive pulsed power systems.

The electromagnetic weapon modes closely relate to the mission of these weapons. Electromagnetic ammunition usually uses single shot DEWM while weapons for defense of objects (WDO) usually use repetitive pulsed power systems. The typical pulse repetition frequency of DEWM is nearly one thousand pulses per seconds. Recently, there has been a trend of increase in the pulse repetition frequency beyond tens of thousands pulses per seconds. The actual DEWM construction depends on the concrete supposed combat use, on the required measure, range and so on. The following text will be dedicated to experimental verification of some technology usable in narrowband DEWM or HPM. Questions regarding classification, construction and possible use of generators for DEWM are answered in more detail in [4], [5] and [6].

2.1 Basic Block Diagram of DEWM

HPM design depends on the specific assumed application of DEWM. There are difference approaches to the design and realization of electromagnetic ammunition and to the design and realization of weapons for defense of objects (WDO). These differences mostly affect the choice of the power sources and the construction of modulators. In electromagnetic ammunition, a highly limiting factor is the demand for low weight and small proportions. This fact also sharply limits the choice of the power microwave tube.

Electromagnetic ammunition usually uses single shot DEWM. The single shot high-energy high-voltage pulsed source has to fulfill hard requirements on the high amount of the delivered energy with respect to the source volume [MJ/m^3]. The best solution of this requirement is a magneto-cumulative generator that reaches up to 8000 MJ/m^3. A block diagram of a HPM generator in electromagnetic ammunition is shown in Fig. 1.

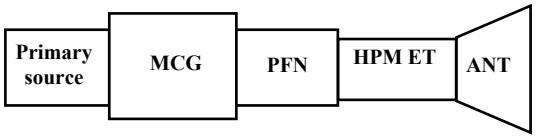

Fig. 1. Block diagram of a HPM generator in electromagnetic ammunition.

In the block diagram, the primary source feeds the stator coil of a magneto-cumulative generator (MCG), which creates a powerful magnetic field in the surrounding fittings filled with an explosive. At the moment of achieving the primary current peak value, the explosive is shooting. The explosion causes expansion of fitting that performs compression of the magnetic field inside the stator coil of MCG. Compression of magnetic field causes dramatic growth of the current flowing through MCG (hundreds of kiloamperes). The MCG output is connected to a pulse forming network that provides transformation of heavy current to an impulse high voltage (hundreds of kilovolts), which feeds a high power microwave electron tube (HPM ET). The generated microwave is emitted through antenna (ANT) to the space.

A block diagram of a HPM generator in weapons for defense of objects (WDO) is shown in Fig. 2.

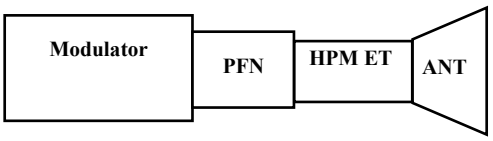

Fig. 2. The block diagram of HPM generator in Weapons for Defense of Objects (WDO).

In weapons for defense of objects (WDO), the HPM generator works similarly as the HPM generator in electromagnetic ammunition. Since WDOs usually generate power microwave pulses repetitively, a modulator with this capability has to be used instead of MCG. Modulators with Marx capacitor banks, Tesla transformers or transductors with fast opening switches are used most often. In this class of DEWM, other types of high power microwave electron tubes (HPM ET) are also used. They may generate microwave pulses with high pulse repetition frequency.

3. Energy Sources for Directed Energy Weapons Microwave

The electromagnetic pulse sources for DEWM are entirely based on energy acquired from the chemical energy of explosion that compresses the magnetic flux made by coil (MCG) or by discharging a capacitor bank. These two possibilities are the best solutions for generation of pulses with sufficient amount of energy in a short time. Other methods were used to generate pulses in the beginning of DEWM research or in laboratory.

3.1 Helical Magneto-Cumulative Generator

MCGs are entirely based on the energy acquired from chemical energy of explosion that compresses magnetic flux made by coil. MCG physical principles, classification and applications are described in more detail in [7]. The main part of research was focused on the possibility of using a magneto-cumulative generator for electromagnetic ammunition power supply. For that reason, 4 versions of low power MCGs were designed, realized and tested in order to verify their characteristics, construction principle, explosive initialization method and verifying a measurement method.

The tested magneto-cumulative generator in Fig. 3 consists of an aluminous cylindrical stator, inside is a 16 screw helical coil from 2 mm copper wire, a copper armature tube with 38 mm outer diameter and 4 mm wall thickness filed by octogen (explosive). The explosive is electrically initiated. The load coil represented by a copper strip in shape of a loop connects the stator with the armature. In the right side of stator, there is a crowbar switch made of a brass plate to perform disconnecting of the primary current source. An insulator circle is responsible for separation of the stator and the armature.

Fig. 3. Low power MCG.

Low power magneto-cumulative generator characteristics:

C_1 = 190 μF − primary capacitor capacity

U_0 = 800 V − voltage of capacitor

L_G = 13.1 μH − stator coil inductance

R = 0.0175 Ω − stator coil resistance

T_0 = 3.13 x 10^{-4} s − primary current period

I_m = 2750 A − maximum primary current

T_d = 73 μs − explosive initiation delay

Fig. 4 presents the low power magneto-cumulative generator output current time history calculated from the voltage measured by Rogowski coil. The primary current I_m = 2750 A gives the generator peak output current I_{out} = 27 kA. The detailed test description and measured results can be found in [8], [9], [10] and [11]. The purpose of the mentioned tests was:

- Verify the method of generating a high energy pulse by magnetic flux compression using explosive;
- Solve the primary current magneto-cumulative generator power supply;
- Find the peak primary current and an explosive initiation synchronization method;
- Find a high current measurement method.

All the requirements were met.

To use a magneto-cumulative generator for single shot high power high voltage pulse generator, it is necessary to obtain a high-level output current. Because of that reason, a middle power MCG was designed and realized. It is a two-stage helical magneto-cumulative generator using a dynamic transformer to increase the output voltage. In Fig. 5, there is a schematic plot of the generator's first stage. The magneto-cumulative generator power supply primary current, the initiation of the explosive and the output high current measure was analogical to the low power magneto-cumulative generator described above.

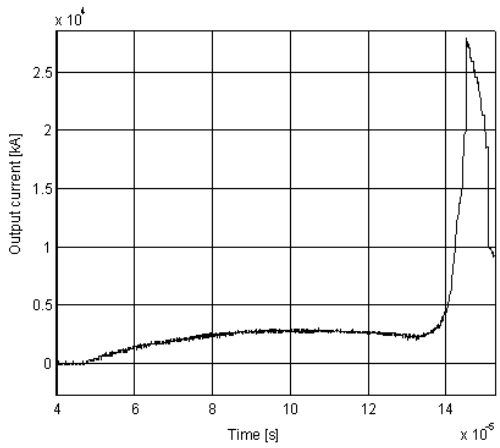

Fig. 4. Low power magneto-cumulative generator output current time history.

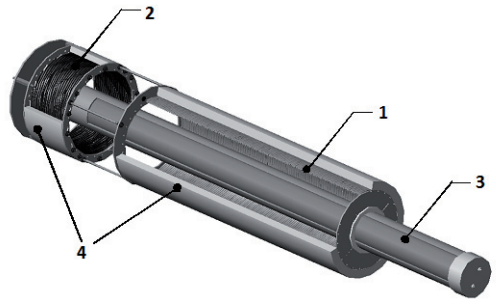

1 – First stage coil, 2 – Load coil, 3 – Armature with explosive, 4 – Insulator

Fig. 5. Schematic drawing of first stage of middle power MCG.

Fig. 6 shows a photo of the middle power magneto-cumulative generator's first stage prepared to the test.

Magneto-cumulative generator characteristics:

C_1 = 125 μF − primary capacitor capacity

U_0 = 5000 V − voltage of capacitor

L_G = 323 μH − stator coil inductance

T_0 = 3x10^{-3} s − primary current period

I_m = 2650 A − maximum primary current value

L_L = 300 nH − load inductance

Fig. 6. The picture of middle power MCG prepared to testing.

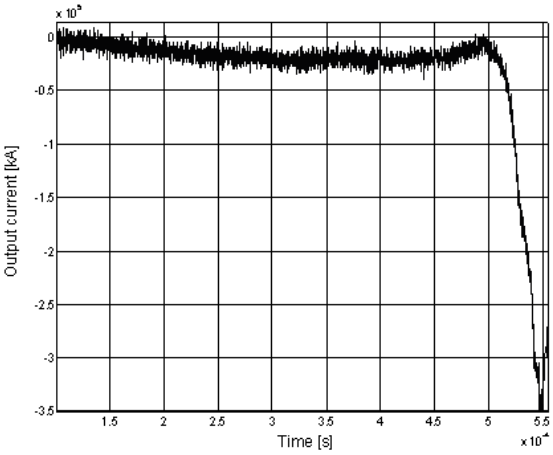

Fig. 7. Middle power magneto-cumulative generator output current time history.

In Fig. 7, the generator output current time history measured during test is shown. The primary current $I_m = 2650$ A gave the generator peak output current $I_{out} = 350$ kA.

The next step in the magneto-cumulative generator research is the implementation and verification of a dynamic transformer. The dynamic transformer's role is an increase of the output voltage to about 70 kV. Magneto-cumulative generator's second stage supplies a load coil through an electric breaker. The beaker interrupts the current in the load circuit in a very short time to enable transfer of the energy from the magnetic field to the high voltage pulse. These activities will be done in the next step of the research and development. The further trends are described in [12].

3.2 Pulsed Power Supply With Capacitive Storage of Energy

For some pulse applications in weapons for defense of objects (WDO), it is desirable to couple the Marx generator directly to the vacuum diode; however, the pulse rise time is then limited by the Marx inductance and capacitance, and the impedance of the generator is greater than typically several tens of ohms. In order to produce short, fast-rising, low-impedance beam outputs, it is customary to use the Marx to charge a pulse-forming line (PFL). Although the PFLs may be constructed in a variety of shapes (strip, coaxial, radial, etc.), they are typically used in only two types of circuits— the simple transmission line, and the double, or Blumlein line. In contrast to the simple transmission line, an alternate circuit invented by A. D. Blumlein is capable of producing an output pulse into a matched load that equals the charge voltage. A cylindrical version of the Blumlein circuit fabricated by our team is represented in Fig. 8. It consists of three coaxial cylinders with the intermediate cylinder being charged by the Marx generator. The Marx generator is shown in Fig. 9. The center cylinder is connected to the outer grounded cylinder by an inductor. Ideally the inductor acts as a short during the charge cycle, and then as an open for the short duration of the output pulse [13]. Pulsed power supply parameters are shown in Tab. 1.

Marx generator		Pulse forming line	
Number of stage	n=18	Impedance	9,1 Ω
Capacity of 1stage	100 nF	Length	1 m
Input voltage	U_{in}=25 kV	Pulse duration	60 ns
Output voltage	U_{out}=450 kV	Working medium	water

Tab. 1. Pulsed power supply parameters.

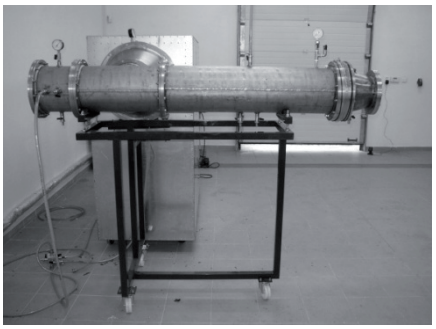

Fig. 8. Cylindrical version of the Blumlein circuit.

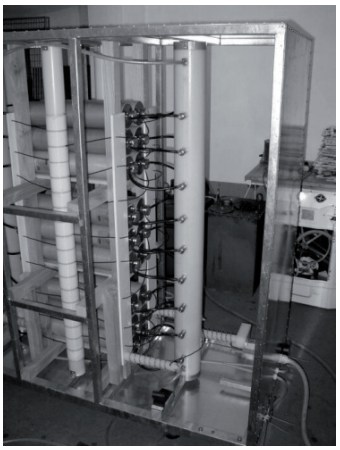

Fig. 9. Marx generator.

4. High Power Microwave Generator

A wide range of HPM devices exists. Relativistic klystrons, magnetrons, slow wave devices, reflex triodes and vircators are all examples of the available technology

base [5]. From the perspective of an electromagnetic weapon or warhead designer, the device of choice will be the vircator at this time. The vircator is mainly a one shot device capable of producing a very powerful single pulse of radiation, yet it is mechanically simple, small and robust, and can operate over a relatively broad band of microwave frequencies. The physics of the vircator tube are substantially more complex than those of the preceding devices. The fundamental idea behind the vircator is that of accelerating a high current electron beam against a foil or a grid anode. Many electrons will pass through the anode, forming a bubble of space charge behind the anode. Under the proper conditions, this space charge region will oscillate at microwave frequencies. If the space charge region is placed in a resonant cavity which is appropriately tuned, very high peak powers may be achieved. Conventional microwave engineering techniques may then be used to extract the microwave power from the resonant cavity. Because the frequency of oscillation is dependent upon the electron beam parameters, vircators may be tuned or chirped in frequency, where the microwave cavity will support appropriate modes. Power levels achieved in vircator experiments range from 170 kW to 40 GW over frequencies spanning the decimeter and centimeter bands [5].

4.1 Vircator Operation Fundamentals

The basic idea of the vircator is to accelerate a dense flush of an electron beam against a grid or a foil anode. Plenty of electrons pass through the anode and form a region of a space charge behind the anode called ”virtual cathode“. This region of a space charge at corresponding conditions can oscillate in a region of microwave frequencies. It is possible to tune the vircator in a broad band of frequencies using only a change of a space charge density. There is no necessity to have an external magnetic field for a correct vircator function. In Fig. 10, an axial vircator is shown. Electron beam passes through the foil or the grid anode. Microwave power is brought out axially, too. Frequency changes appear in vircator with standard geometry when the distance between the anode and the cathode gets smaller due to filling the working space by plasma. Efficiency of a standard geometry vircator is ordinarily about ones percent.

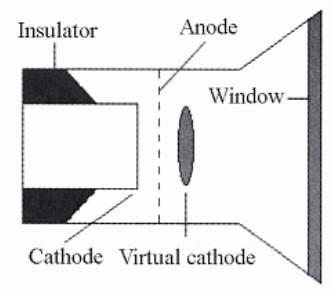

Fig. 10. Schematic drawing of axial vircator.

Despite its low efficiency, vircator is very attractive for army applications because it is very simple to be made, it is a compact device and there it is no need to have an external magnetic field. For more information about construction and properties of various types of vircators you can see e. g. [5], [13] and [14].

4.2 Mathematical Description of Vircator Operation

For microwave frequency generation, it is necessary to meet a number of conditions relevant to the power supply and geometric proportions of a vircator electrode. Determination of these conditions results from [15] and we use simplified geometry displayed in Fig. 11 to derive the mathematical characterization.

The most common case is that a pulse duration τ is much longer than a beam transit time across cavity $\tau >> L/C$.

We assume that an external axial magnetic field obstructs transverse electron motion. The space charge of the beam makes a negative potential energy $e\Phi$ in drift space which breaks the electrons. If the space charge potential reaches the value of accelerating voltage (electrons are stopped in beam), the beam with bigger current cannot expand. There is a value of current which causes stopping of electrons. This value is called the vacuum critical current. There has to be the above mentioned critical current to make the vircator generate microwave oscillations.

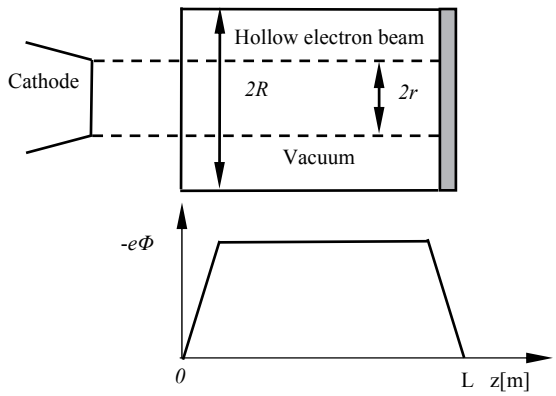

Fig. 11. Simplified geometry of axial vircator.

We suppose a hollow beam; whose charge is concentrated in a thin layer with radius r. Behind the transition space (which is comparable to the radius of chamber – backward conductor), there is nearly homogenous potential. It is possible to determine the potential quantity with consideration that it is a coaxial capacitor and its inner cylinder is saturated by beam charge.

Capacity of the coaxial capacitor is given by

$$C = \frac{2 \cdot \pi \cdot \varepsilon_0}{\lg\left(\frac{R}{r}\right)} \tag{1}$$

where ε_0 is the vacuum electric permittivity, R is the chamber radius, r is the beam radius.

The potential is given by the equation

$$\Phi = \frac{Q}{C} \tag{2}$$

where Q is the charge linear density, C is the capacity per length unit. We can define the charge linear density as

$$Q = \frac{I}{v} \tag{3}$$

where v is an electron module velocity and the current is defined by the equation

$$I = e \cdot n \cdot v \cdot S \tag{4}$$

where e is the charge of an electron, n is the linear electron density, S is the profile of the electron beam.

When (1) and (3) are substituted into (2), we can obtain expression for the potential in the form

$$\Phi = \frac{Q}{C} = \frac{I \cdot \lg\left(\frac{R}{r}\right)}{2 \cdot \pi \cdot \varepsilon_0 \cdot v}. \tag{5}$$

The electron velocity v is associated with its initial energy and potential by the energy preservation law

$$m_e \cdot \gamma_0 \cdot c^2 + e\Phi = m_e \cdot \gamma \cdot c^2 \tag{6}$$

where γ_0 is the initial relativistic factor of the beam, γ is the relativistic factor inside a system reduced due to potential.

The relativistic factor inside a system can be expressed by the equation

$$\gamma = \gamma_0 + \frac{e\Phi}{m_e \cdot c^2} \tag{7}$$

where m_e is the electron mass and c is the speed of light. The relativistic factor can also be expressed by

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \cdot \tag{8}$$

The electron velocity in drift space v can be specified from following equations:

$$\gamma^2 = \left(\gamma_0 + \frac{e\Phi}{m_e \cdot c^2}\right)^2, \tag{9}$$

$$v = c \cdot \sqrt{1 - \frac{1}{\left(\gamma_0 - \frac{e\Phi}{m_e \cdot c^2}\right)^2}} \cdot \tag{10}$$

Substituting (10) into (3) and multiplying by $(e \cdot v) / (m \cdot c^3)$, we can get

$$F(\Phi) = \frac{e \cdot \Phi}{m \cdot c^2} \cdot \sqrt{1 - \frac{1}{\left(\gamma_0 - \frac{e\Phi}{m_e \cdot c^2}\right)^2}} = \frac{e \cdot I \cdot \lg\left(\frac{R}{r}\right)}{2 \cdot \pi \cdot \varepsilon_0 \cdot m \cdot c^3}. \tag{11}$$

The function $F(\Phi)$ has its peak value under the conditions describes by

$$\frac{e \cdot \Phi}{m \cdot c^2} = \gamma_0 - \gamma^{\frac{1}{3}} \cdot \tag{12}$$

The evaluation is written in the form

$$F(\Phi) = \sqrt{\left(\gamma^{\frac{2}{3}} - 1\right)^3} = \frac{e \cdot I \cdot \lg\left(\frac{R}{r}\right)}{2 \cdot \pi \cdot \varepsilon_0 \cdot m \cdot c^3} \cdot \tag{13}$$

There is no possibility to find the solution of (11) for bigger values of function $F(\Phi)$. According to (13), the critical vacuum current is

$$I_{cr} = \frac{2 \cdot \pi \cdot \varepsilon_0 \cdot m \cdot c^3}{e \cdot I \cdot \lg\left(\frac{R}{r}\right)} \sqrt{\left(\gamma^{\frac{2}{3}} - 1\right)^3} \cdot \tag{14}$$

When we substitute the known constants (like $\pi = 3.1415$), we obtain the equation

$$I_{cr} = \frac{8.5}{\lg\left(\frac{R}{r}\right)} \sqrt{\left(\gamma^{\frac{2}{3}} - 1\right)^3} \tag{15}$$

where I_{cr} is the critical vacuum current [kA].

For vircator implementation, energy of electrons of about 500 keV is considered, which corresponds to the relativistic factor of $\gamma_0 = 2$. Thus planar diode current limited by space charge follows the three-half Child-Langmuir law

$$I \approx \frac{U^{\frac{3}{2}} \cdot S_k}{d_{ka}^{\ 2}} \tag{16}$$

where U is the voltage between anode and cathode, S_k is the surface of cathode, d_{ka} is the distance between anode and cathode.

An important characteristic of a vacuum planar diode is its impedance, which is given by

$$Z = 1.36 \cdot 10^5 \cdot U^{-\frac{1}{2}} \cdot \frac{d_{ka}^2}{r_k^2} \tag{17}$$

where r_k is the radius of the cathode.

The vacuum critical current is the maximal current that can distribute itself through vacuum. It means it is possible to measure the same current until the distance is bigger than the diameter of beam. It is just the same value when the potential of space charge of electron beam is equal to the accelerating voltage. That is the limit where the virtual cathode is generated and the vircator starts working. The generated frequency depends on the plasma frequency of the electron beam. The plasma frequency is determined by the electron beam current density. The plasma frequency is the frequency of electrons in space charge field oscillations. The electrons can oscillate due to the influence of repulsive force which takes effect between particles with the same charge. The plasma frequency depends on the concentration of electrons in the beam. The

current density is given by the number of charges which are able to pass through the surface of 1 m^2 per one second. Thus we can calculate the current density i [Am^{-2}]

$$i = e \cdot n_V \cdot c_e \tag{18}$$

where e is the electron charge, n_V is the electron volume density and c_e is the electron velocity.

Plasma frequency of the electron beam is approximately given by

$$f_{pe} = 9 \cdot 10^7 \cdot \sqrt{i} \ . \tag{19}$$

4.3 Axial Vircator Design

Following the theoretical assumptions given above, the axial vircator with grid anode was fabricated. The structure of the grid anode enables repeated operation in contradistinction to vircator with a foil anode. The cathode diameter $r_k = 17.5$ mm and the working chamber radius $R = 40$ mm were chosen in order to decrease the value of the vacuum current. The critical vacuum current is $I_{cr} = 4.63$ kA in this configuration. The vircator impedance matching to the forming line is a very important requirement for vircator's correct operation. Because of that, a cathode with a possibility to change the distance d_{ka} between cathode and anode is fabricated. The cathode is made as a cylindrical carbon block. The anode grid is made from pyrolitic carbon.

In Fig. 12, there is section picture of the built-up axial vircator with the possibility to the change distance between anode and cathode. In Fig. 13, there is a view of the fabricated vircator. The vircator is fed by a pulse generator formed by Marx generator and pulse forming line described in Section 3.2. The connection between the axial vircator and the output of pulse forming line is shown in Fig 14. Vircator voltage is measured by a cylindrical capacitive probe, which is a part of pulse forming line output circuit. Vircator current is measured by Rogowski coil placed in the outer cylinder of the pulse forming line. Vircator voltage time history is displayed in Fig. 15 and vircator current time history is displayed in Fig. 16.

Compared to other types of microwave tubes, the microwaves generated by an axial vircator cover a relatively wide frequency band. In Fig. 17, the frequency spectrum of the signals generated by the realized axial vircator is shown. The dominant frequencies of the generated microwave signals are placed in the band of 0.5 to 1.5 GHz. The frequency spectrum was acquired on the basis of information measured by a digital oscilloscope Tektronix TDS 7704B connected to broadband antenna EMCO 3115. For the measurement the microwave output power of the vircator, a measuring device was designed and made, using calorimetric method for the power measurement. A detailed power sensor description can be found in [18]. A more detailed description the of axial vircator research results is given in [6], [14], [16] and [17].

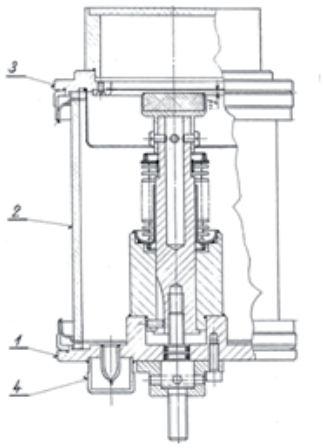

1 cathode contact ring, *2* ceramic insulator, *3* anode contact ring, *4* pipe for vacuum pumping shelter

Fig. 12. Section picture of built-up axial vircator with possibility to change distance between anode and cathode.

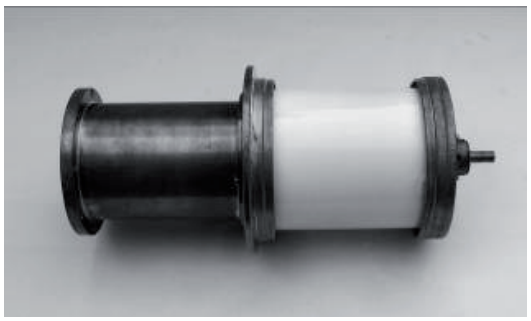

Fig. 13. View of fabricated axial vircator with adjustable distance between anode and cathode.

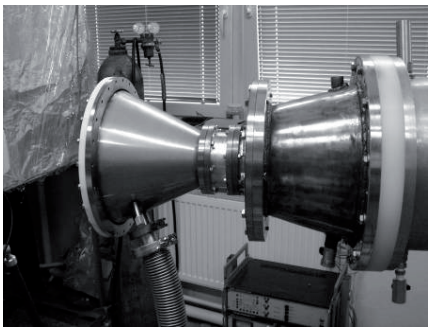

Fig. 14. View of fabricated axial vircator connected to the pulse forming line.

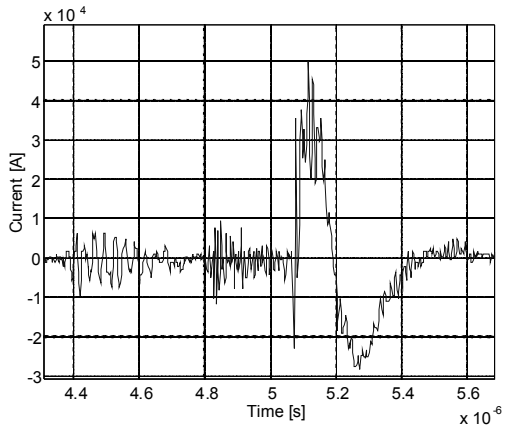

Fig. 15. Vircator current time history.

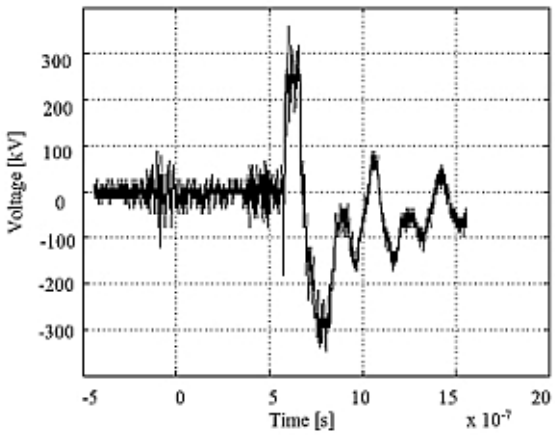

Fig. 16. Vircator voltage time history.

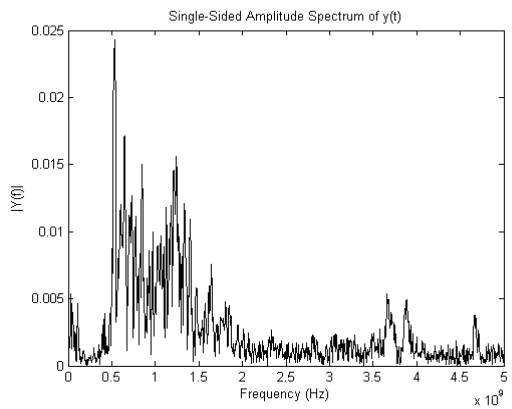

Fig. 17. Frequency spectrum of signals generated by realized axial vircator.

5. Conclusion

The research of directed energy weapons microwave validated substantial technology applicable in electromagnetic ammunition and in weapons for defense of objects (WDO). The axial vircator is the most important component part applicable in both categories of DEWM. Dominant frequencies of the generated microwave signal are placed in band of 0.5 to 1.5 GHz. To fulfill the vircator minimal proportion requirements to be able to use the vircator as a DEWM, it is necessary to shift the vircator dominant frequencies to the 3 GHz band. This requirement can be reached by arranging the cathode size efficiently and consequentially optimizing the distance between anode and cathode. Great attention also has to be paid to increase the specific dielectric strength of the output window of the axial vircator.

Acknowledgements

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DARPA NESD

INDUSTRY GROUP

The ***Biological Technologies Office (BTO)*** of the ***Defense Advanced Research Projects Agency (DARPA)*** is sponsoring an Industry Group to support the ***Neural Engineering System Design (NESD) Program***.

NESD is a highly interdisciplinary program requiring extensive integration of new research and technology. To facilitate the development and adoption of NESD technologies, DARPA has organizedan industry group for potential proposers. Members of this group have agreed to provide access to rapid prototyping and manufacturing of advanced neuro-engineering components, including state-of-the-art electronics, photonics, computing, assembly and packaging.

This document contains all responses to **Special Notice 16-17** as of March 10, 2016. Any updates will be posted at **http://www.darpa.mil/work-with-us/opportunities**.

Allen Institute for Brain Science

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About

The Allen Institute for Brain Science is an independent, non-profit medical research organization that has embarked on a concerted, ten-year effort, involving more than 300 scientists, engineers, technologists and other specialists, to understand the cerebral cortex in the mouse and in the human at the cellular level. We are built upon the notion of Big Science, Team Science and Open Science in the service of Basic Science with an explicit mission to accelerate understanding of the human brain in health and disease. Our data are freely and publicly available at www.brain-map.org.

Capabilities

- We seek to experimentally and computationally characterize the components (cell types) of the rodent visual thalamo-cortical system at the molecular, transcriptional, electron-microscopic, electrophysiological, morphological and functional levels to study how these components integrate information to generate high-level cognitive functioning such as object recognition.
- To study such high-level functioning, we use various in vivo perturbation and monitoring techniques (e.g. optical stimulation, extracellular depth recordings, wide and narrow-field Ca-imaging, etc.), very high density silicon probes (364 probes per shaft) as well as state-of-the art computer models that capture cortical information processing at varying levels of granularity.
- To understand the human brain, the Institute is also engaged in cell typing from human brain tissue harvested from patients undergoing brain surgery.
- Thus, we are routinely recording intracellularly from single and multiple cells from ex vivo human lateral temporal cortex and as well as performing morphological characterization on these same cells).

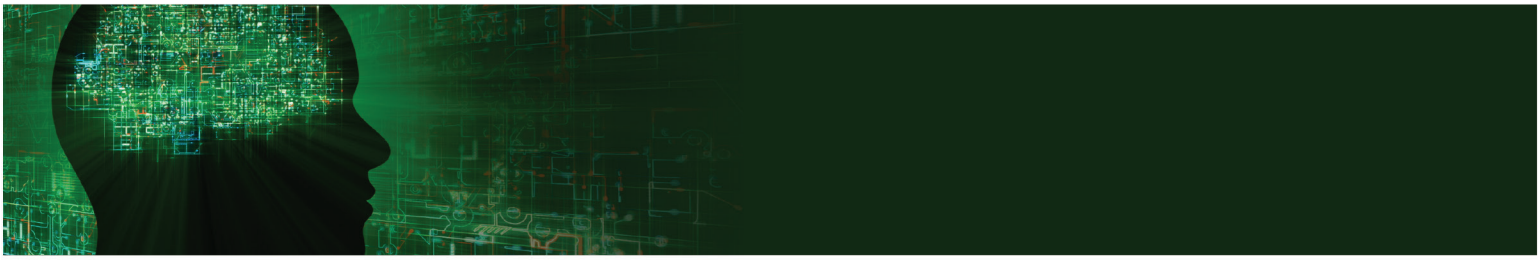

Capabilities

- We also have extensive experience with the genomic and transcriptional architecture of the human brain.
- We are interested in applying this knowledge for medical and translational purposes and to help facilitate advancement of CNS disorder therapies.

Facilities II

The Allen Institute headquarters, a 270,000 square foot life sciences building, is located in Seattle's South Lake Union neighborhood, the city's biotechnology hub. We are a high-throughput facility, home to custom-designed robotic systems, automated technologies, premier bench laboratory space and all the high-powered computing hardware and software necessary for processing petabytes of data.

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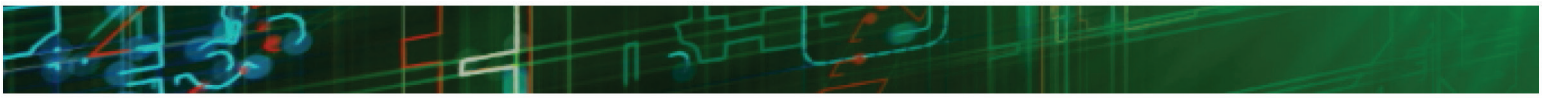

Bionics Institute

Primary Contact

Rob Shepherd / rshepherd@bionicsinstitute.org

Capabilities

Medical device safety and efficacy testing (in vitro and in vivo)

- Design, rapid prototyping & validation testing
- Accelerated aging & flexion testing
- Electrochemical impedance spectroscopy
- Acute feasibility studies
- Chronic safety and biocompatibility studies
- Drug delivery techniques
- Histology & data analysis
- Scanning electron microscopy of implanted materials
- Preclinical animal model development

Custom device prototyping & fabrication

- Design and fabrication of custom electrode arrays and surgical tools
- Use of FDA approved materials

'First in human' clinical trials

Clinical and Scientific Track Record

- 35 years of internationally recognised experience & scientific excellence
- Extensive clinical, academic & commercial partnerships
- Proven research & clinical development pathways

Staff and Facilities

- Experienced and qualified scientists, engineers and clinicians
- Co-located in a major Australian hospital
- Purpose built equipment and facilities

Boston Micromachines Corp

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About

Boston Micromachines Corporation (BMC) is the leading provider of microelectromechanical systems (MEMS) deformable mirror products and has expertise in the design of adaptive optics systems. The company's suite of award-winning compact DM products is the most cost-effective, highest performance mirrors in the market today. By applying wavefront correction, BMC devices can be used in a variety of applications which include laser beam shaping, microscopy, astronomy, and vision science. Located in Cambridge, MA, BMC is privately held and offers custom-designed manufacturing services in addition to its portfolio of standard DM products and adaptive optics systems.

Capabilities

The specific capabilities/services the company provides in relation to the NESD falls into two categories:

Deformable mirrors systems for use in neurological imaging instruments

- MEMS deformable mirrors ranging in size from 140 – 1000 actuators
- Mirror surface geometries of continuous, segmented, and hexagonal tip-tilt
- High speed drive electronics

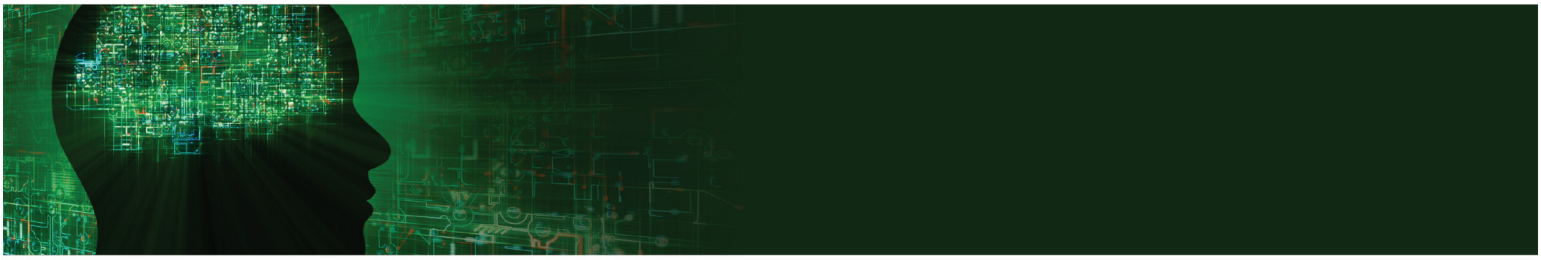

These devices are currently being used in in vivo neural imaging systems at various premier research institutions around the country. Boston Micromachines also provides research and development services for advancing the deformable mirror and drive electronics technology and design to better fit specific applications.

- Advanced imaging systems utilizing adaptive optics to improve resolution and contrast in in vivo subsurface imaging application (i.e. deep penetration brain imaging)

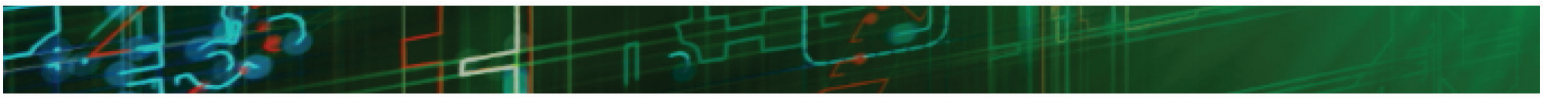

Boston Scientific

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Capabilities

- Lead prototyping
- Firmware modifications to the implantable pulse generators (IPG)
- Software modifications to the computer programmers (CP)
- Use of advanced computational models and predictive algorithms for parameters and programming guidance for neurostimulation

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Chronocam

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Capabilities

- Extensive know-how in designing, developing and industrialising asynchronous, event-based, bio-inspired vision sensors
- Expertise in developing and customising event-based, bio-inspired computer vision algorithms for a large number of applications spanning from autonomous navigation, security and surveillance, aerospace and defence to biomedical devices and smart objects
- System integration capabilities: development of camera systems relying on Chronocam's proprietary vision sensors and development of embedded software porting Chronocam's proprietary computer vision algorithms on a large number of processing platforms (such as: CPUs, GPUs, FPGA)

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About Cirtec

Cirtec Medical has been providing contract design, development, and manufacturing services to the medical device industry since our founding in Massachusetts in 1986. Today, Cirtec has over 150 employees in our two facilities on the east and west coasts.

Cirtec has supported active implantable developers throughout our history. Early projects focused on hermetic welding and testing services for implantable neurostimulation devices, with service offerings expanding to provide full design and development. In all, Cirtec has worked with over 60 different companies and institutions developing active implantable devices, with over 30 in the neuromodulation space. We work with companies and institutions of all sizes, from early stage starts-ups to large, well-established medical device manufacturers. We also work frequently with research laboratories and academic groups; our current projects include development and manufacturing of an implantable neurostimulator used for research and recently approved for clinical study under a feasibility IDE.

Capabilities

Cirtec is ISO 13485 certified and FDA registered.
Cirtec supports the full product development cycle from conceptual development and requirements definition through clinical and commercial manufacturing.

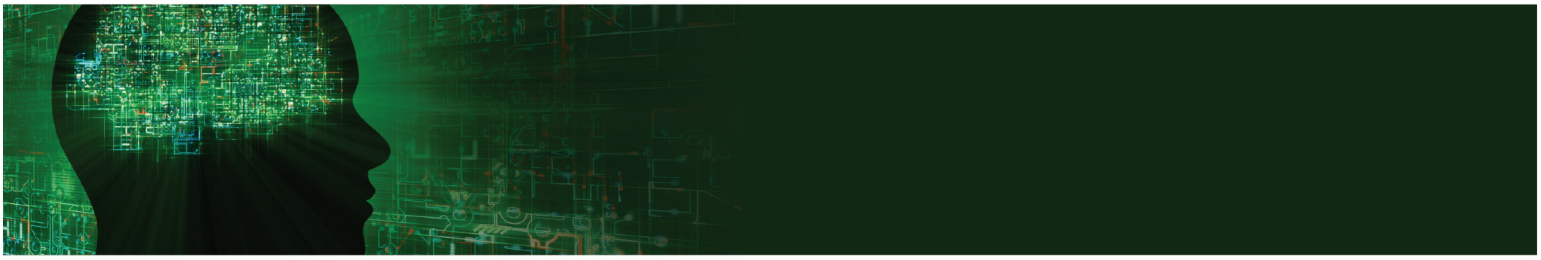

Our engineering teams including mechanical, electrical, and software design resources as well as process development, manufacturing, and quality engineering. Cirtec has a robust and flexible quality system; start-up companies and research groups often choose to work under our quality system rather than developing their own. We provide design history file management and document control services. We can also perform or contribute to requirements documentation, risk management activities, and design verification activities. Our manufacturing capabilities relevant to active implantable devices include:

- Laser welding
- Resistance welding
- Electrical assembly
- Laser marking
- Laser ablation
- Surface treatment
- Ultrasonic cleaning
- Epoxy molding and adhesion
- Silicone molding and adhesion
- Packaging and labelin

Manufacturing capabilities are supported by in-house test capabilities. These include mechanical testing, hermetic leak testing, bench level and automated electrical testing, environmental conditioning, and custom test setups such as soak or pressure testing.

Our manufacturing infrastructure includes multiple ISO class 7 cleanrooms and ESD safe handling procedures for all devices. Cirtec provides complete supply chain management services, leveraging our extensive Approved Supplier List and robust inventory management and material traceability procedures.

VALUE TO PROPOSING TEAMS: There are six primary areas where Cirtec capabilities provide value to proposing teams.

Hermetic barrier development	Hermetic package and barrier design
	Leak specification development
	Internal moisture management: Vacuum bake, desiccant handling, residual gas analysis testing
	Hermetic sealing (welding, brazing) and testing
Electrical assembly	Soldering, wire bonding, and die bonding
	Coil winding
	ESD-safe workspaces
	Lithium battery safe handling procedures
	Bench and automated testing
Interconnect development	Feedthrough design and sourcing
	Hardwired and disconnectable design
	Fabrication and testing
Encapsulation	Epoxy, silicone, and parylene encapsulation
	Layered encapsulation design to manage fluid ingress
	In-house design, tooling, molding, testing
Sterile packaging	Package design
	Pouch and tray packaging and labeling
	Off-the-shelf double sterile tray system
	Sterilization service provider management
Quality system support	Design control support and design history file maintenance
	GMP manufacturing
	Supply chain management
	Procedures for and support of requirements definition, risk management, design verification, and process validation

Dragon ID

Primary Contact

Eugene Malinskiy / eugene@dragonid.com

Capabilities

- Our staff is very experienced working within the complexities of the medical system from observing physicians in the operating room to bringing devices through regulatory approval.
- We have engineers with process development and industrial experience, including interfacing directly with manufacturers.
- We have software engineers experienced in both hardware and software engineering and experience in microcode and embedded systems, end user applications, and high performance computing.
- In addition to engineering talent, we staff researchers, designers, and SMEs to bring a truly interdisciplinary approach to innovation and design for a project.
- We have experience recruiting, establishing, and coordinating relationships between global stakeholders for complex projects to maximize accountability and efficiency for a product while minimizing bureaucracy required.
- We work with our world--class partners in industries such as industrial design, rapid multi--material prototyping, materials selection, and manufacturing in order to round out our capabilities for a product.

Freedom Photonics LLC

Primary Contact

Leif Johansson / leif@freedomphotonics.com

About

Founded in 2005 we are privately held Limited Liability Company based in Santa Barbara, California with ISO Qualification in process, certification in Q2 2016. We develop, manufacture and market complete photonic integrated circuit based products (Indium Phosphide, PLC, Si Photonics).

Our main markets in components, modules and subsystems are for fiber-optic communication, free-Space-optical (FSO) communication and infrared sensors and illuminators.

Capabilities

We offer electronics design, assembly and testing with expertise in photonic design, packaging, control electronics, manufacturing and qualification.

We offer services across development and have a premier R&D compound semiconductor facility with lithography (steppers, DUV stepper, EBL), wet and dry etching, deposition and characterization capabilities.

Our Business Model

Conceptualization, prototyping and development

- Fast R&D turn-around and low cost device fabrication in Nanotech cleanroom facility (Freedom Photonics employees)
- Internal multi-project wafer runs

Volume device production with commercial foundries worldwide

- Fabrication processes designed for manufacturability
- Access to manufacturability and production capacity, qualified processes
- Experience in outsourcing volume device manufacturing

Significant internal capability for assembly, packaging, test

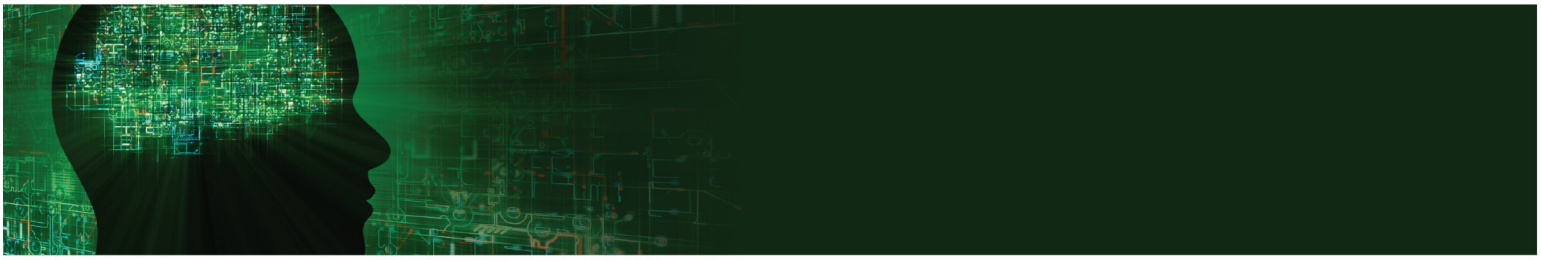

Capabilities and Facilities I – Photonics Design and Fabrication

Design

- Commercial and proprietary tools for passive and active PIC modeling, (Lumerical, native FDTD/BPM code, mode solvers, mask layout, SOA/active region models, Simwindows, SRIM)

Mask layout

- Proprietary scripting tool, with design rule checker and automated mask plate layout

Fabrication

- Full wafer process, die pick-and-place, wedge bonder, ball- bonder, auto-cleaver, pull-tester, etc.

Capabilities and Facilities II – Photonics Production Test

- Photonic device bar level probe
- Chip-on-carrier level (probe card)
- Package; DC, spectral, and data testing
- Burn in – monitored, environmental chambers

Capabilities & Facilities III – Packaging

Several in-house systems with laser welding and UV curing capability.

- Custom tooling, TOSA packages, 14 pin butterflies etc.
- ZEMAX commercial optical train design tool

Capabilities and Facilities IV – Electronics

- Digital and Analog Electronics
- FPGA design and verification tools in house
- Commercial tools for board layout
- Outside foundry for PCB fabrication and stuffing
- Electronics workstations for assembly and test
- Oscilloscopes, sources, multi-meters

We perform contract fabrication and engage with a number of domestic and international fabrication providers, both full process or selected fabrication steps are available.

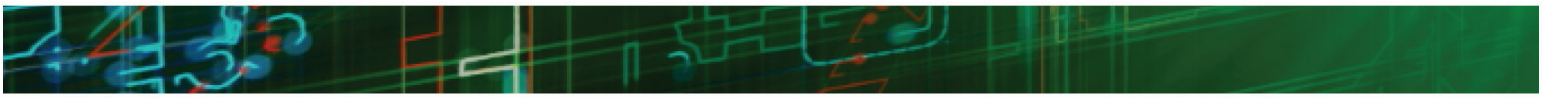

IMEC

Primary Contact

Barun Dutta / Barundeb.Dutta@imec.be

Capabilities

IMEC is interested in making its comprehensive capabilities available for joint-research programs for solutions in Life Sciences Technologies, Healthcare and Bio-medical engineering, including:

- Semiconductor/nanotechnology
- Process technology
- Design technology and systems/software technologies

Additional Contacts

Maarten Willems / Maarten.Willems@imec.be

Infinite Arthroscopy

Primary Contact

Daniel Dudley / d.dudley@infinitearthro.com

About

We are exclusively focused on developing new medical technologies with an emphasis on translating innovations from other industries to the operating theatre. We have experience in the full life cycle of medical device development from initial conception to regulatory submission. We have large number of rapid prototyping and fabrication techniques available in-house including but not limited to software-based design, stereolithography, fused deposition modelling, PCB milling, and machining. Our staff includes designers, engineers, health care professionals, and subject matter experts from a diversity of industries allowing us to leverage a far wider knowledge base than the standard medical device company. We maintain a nationwide network of leading physicians and institutional partners to develop, refine, and validate our technologies according to contemporary healthcare practice and needs.

Capabilities

Infinite Arthroscopy also maintains a portfolio of intellectual property derived from our medical device technologies that would be available to the NESD Industry Group. Two relevant examples are listed below.

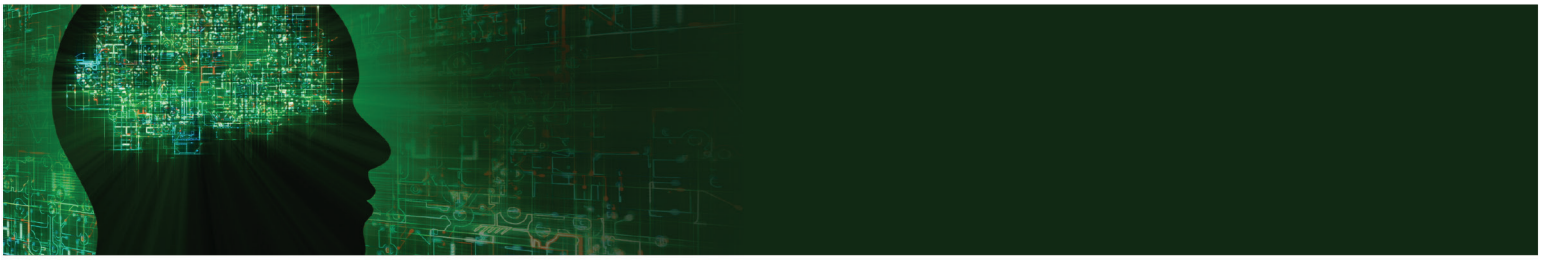

Infinite Arthroscopy, Inc. Proprietary Technologies:
Novel Light Source

- Miniaturized / Ruggedized
- Low power (sub 1 watt)
- Low heat (to LEDs of comparable lumen-output)
- High lumen output
- Long Lifetime (50,000+ hours)
- Emits only target wavelength(s) (Capacity to customize to project needs)

Command/Control Architecture for Medical Devices

- HIPAA/FTC Approved for use in Operating Rooms
- Uninterrupted High-bandwidth capacity
- Transmission below standard RF noise floor
- Encrypted protocol

Additional Contacts

Howard Fein / h.fein@infinitearthro.com

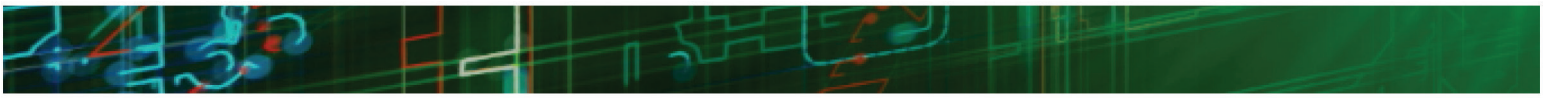

Inscopix

Primary Contact

Pushkar Joshi / pushkar@inscopix.com

Capabilities

- Neuroscience application development and validation (surgical procedures for rodents and non-human primates, application of biological reagents within our own life science lab)
- Optical system development (lens design and simulation, LED light source development, prototyping)
- Hardware system (FPGA-based and/or microcontroller based mixed-signal systems especially involving imaging, mechanical packaging) development, testing, and prototyping
- Software (application, image processing, computer vision, analytical) development and testing
- Mechanical accessories development (design, prototyping via 3D printing)
- With these capabilities, we can customize Inscopix's existing and emerging systems and applications, or develop new systems and applications for or with other proposers in support of this program.

Additional Contacts

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Nanomedical Diagnostics

Primary Contact

Brett Goldsmith / brgoldsmith@nanomedicaldiagnostics.com

Capabilities

- Graphene FET sensor array chips appropriate for integration with nearly any biochemical or electrochemical interaction
- Current sensor hardware capable of measuring biochemical and bioelectric interactions over time with 10 millisecond time resolution, and spatial resolution less than 10 microns
- Capability to produce sensor hardware with time resolution approaching one microsecond with a spatial resolution less than 2 microns
- Expertise in combining electronic materials, packaging and assembly with active biological materials
- Projected FDA clearance for an in vitro clinical product, and associated manufacturing chain, using graphene sensors by mid 2017
- Graphene appropriate for use in medical sensors integrated into an electronic or implantable platform of your choosing
- Chemical and biochemical expertise in biochemical attachment and blocking techniques specialized for boosting specificity of electronic readout of biological interactions
- A complete "turnkey" R&D system for using graphene sensor chips
- Hardware and software appropriate for reading graphene biosensors

Additional Contacts

Francie Barron / fbarron@nanomedicaldiagnostics.com

Naval Research Laboratory

Primary Contact

Dr. Jas. S. Sanghera / sanghera@nrl.navy.mil

About

NRL is the corporate research laboratory for the Navy and Marine Corps and conducts a broad program of scientific research, technology and advanced development.

The Optical Materials and Devices Branch has five primary areas: high purity chemicals, specialty optical materials, silica fiber technology, optical devices and advanced concepts.

Capabilities

We have expertise in the research, development and fabrication of glasses, glass-ceramics, ceramics, crystals, bulk optics, films, waveguides and optical fibers.

We offer a full suite of capabilities to make transparent ceramics to solve the ceramic packaging needs of NESD, some key properties:

- UV to RF transparency tailoring
- Tougher, stronger, harder than glass
- Electrically inert
- Demonstrated conformal shapes
- Demonstrated bonding technologies
- Vertical integration

Our facilities include class 100 clean rooms, powder processing equipment, sintering systems, and characterization capabilities (XRD, SEM, TEM, optics labs, mechanical testing).

Some of our prior applications include: Conformal Optics, IR simulators, photonic mast design, flexible PV's, IRCM, and Directed Energy Weapons.

Additional Contacts

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Star Lab

Primary Contact

Adam Fraser / adam.fraser@starlab.io

About

Star Lab is a high-tech small business focused on complex systems security research and development, with significant expertise and a pedigree of success developing security technologies for safety-critical and mission-critical systems. The company specializes in the areas of high-assurance operating systems, technology protection, applied cryptography, and anti-tamper, and is also a leader in kernel/hypervisor/embedded software development. Star Lab has offices in Washington D.C. and Huntsville, AL.

Additional Contacts

Irby Thompson / irby@starlab.io

Qualcomm

Primary Contact

Karim Arabi / karabi@qti.qualcom.com

Capabilities

- Experience in building an end-to-end platform as a reference design for interface with brain
- Experience in driving an industry wide standard effort to standardize a communication medium and protocol for brain interface
- Advanced low power wireless solutions, RF interface, MODEM system solutions and related electronics for brain interface
- Advanced wireless charging and powering solutions for brain implants
- Ultra low power electronic design solutions at advanced technology nodes suitable for brain implants to enable always on monitoring and processing
- Ultra low power DSP solutions, stream data processing and data compression and decompression solutions

Additional Contacts

Rudy Beraha / rberaha@qti.qualcomm.com

New World War

Revolutionary Methods for Political Control

Mind-Reading

History

Probably no more "intrusive and persistent" method of obtaining information about a person exists than reading their mind.[1] Research on mind-reading has been vigorously pursued by US government agencies and various academic centers since the 1970s, and continues to this day.

Since 1973 DARPA has been studying mind-reading with EEG hooked to computers, using scientists at the University of Illinois, UCLA, Stanford Research Institute, Massachusetts Institute of Technology, and the University of Rochester.

They developed a system that could determine how a person perceived colors or shapes and were working on methods to detect daydreaming, fatigue, and other brain states. Although the device had to be calibrated for each person's brain by having them think a series of specific thoughts, the calibration was quick.

In 1974 another very basic mind-reading machine was created by researchers at Stanford Research Institute. It used an EEG hooked to a computer which allowed a dot to be moved across a computer screen using thought alone. When interpreting people's brainwaves, it was right about 60% of the time. During these tests scientists discovered that brain patterns are like fingerprints, each person has their own. So, each computer would have to be calibrated for a specific person.

Another method to address this issue was to store a large amount of generic patterns on the computer, so when it encountered a brain pattern it didn't recognized, it used one that most resembled it. Since then, DARPA has sponsored Brain-Computer Interface (BCI) and mind-reading programs at Duke University, MIT, University of Florida, and New York State University, Brooklyn.

The Human Computer Interaction group at Tufts University has studied mind-reading funded by grants from a government research and education agency known as the National Science Foundation (NSF). Carnegie Mellon University, Stanford University, and the MIT Sloan School of Management have studied mind-reading. The Computer Laboratory at the University of Cambridge in England has developed mind-reading machines based on facial expressions.

Other academic institutions that have participated in mind-reading projects include the University of California, Berkeley, University of Maryland, and Princeton University in New Jersey. Microsoft has studied mind-reading using EEG to better accommodate its users. Emotiv Systems built a mind-reading gaming device which uses EEG to infer the mental states of video game

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players. Honda Motors and Advanced Telecommunications Research Institute International (ATR) have studied mind-reading.

Neuroimaging Devices

Scientists discovered that the neural code of the human brain is similar to the digital code of a computer. To some extent, they have deciphered this code. Prior to this, they assumed that it was necessary to identify the neurons associated with specific acts, which would have made mind-reading much more difficult.[2]

They now understand that it's not necessary to monitor billions of neurons to determine which are connected to a particular thought or act. Only a small number of them need to be monitored to accomplish this. To monitor these neurons researchers use neuroimaging devices. They include event-related optical signal (EROS), functional magnetic resonance imaging (fMRI), electroencephalography (EEG), functional near-infrared imaging (fNIR), magnetoencephalography (MEG), and positron emission tomography (PET).[3] These devices may be combined for a more accurate reading.

There are basically two types of measurements, *direct* methods and *indirect* methods. Direct methods measure changes in electromagnetic fields and currents around the brain which are emitted from the surface of the scalp, or they monitor the neurons themselves. Indirect methods measure hemodynamic (blood movement) changes of hemoglobin in specific tissue compartments.

Both of these methods are almost simultaneous with neuronal activity. Regarding sensors, there are invasive ones which must be implanted, and non-invasive ones which can be worn on the scalp, in the form of a headband.

Electroencephalography (EEG) provides a direct method for determining brain states and processes by measuring the electrical activity on the scalp produced by the firing of neurons in the brain. EEG has been around for over 100 years. EEG is commonly used in neuroscience, cognitive science, and cognitive psychology. It is inexpensive, silent, non-invasive, portable, and tolerates movement.

Wireless EEG which uses non-invasive sensors that have physical contact with the scalp can transmit the signals to a remote machine for deciphering. Although, in 1976 the *Los Angeles Times* reported that DARPA was working on an EEG to detect brain activity several feet from a person's head, which was to be completed in the 1980s. EEG normally produces only a general indicator of brain activity.

However, in 2008 *Discovery News* reported that a company called Emotiv Systems developed an algorithm that decodes the cortex, providing a more accurate measurement. "We can calibrate the algorithm across a wide range of technologies with the same resolution you would get from placing an invasive chip inside the head," said Tan Le, president of Emotiv Systems.

Functional magnetic resonance imaging (fMRI) measures the blood flow in the brain in response to neural activity. Active neurons use oxygen, which is brought to them by blood. The more active a region of the brain is the more

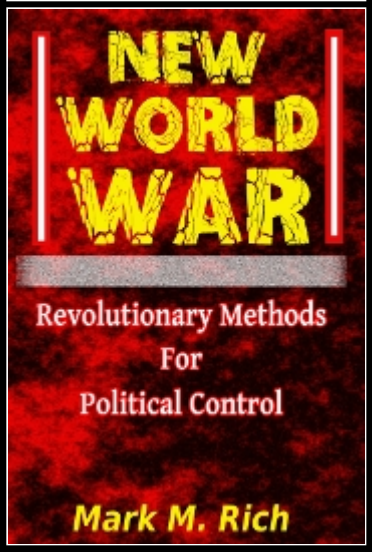

blood flows in the area. This movement of blood is referred to as *hemodynamic activity*. FMRI can detect which areas are receiving blood, which indicates that they're processing information.

The fMRI provides an indirect measurement of brain processes. It is the most common method of neuroimaging, and can produce 2 and 3-dimensional images. It is non-invasive, and can record signals from all brain regions, unlike EEG which focuses on the surface only.

Functional near-infrared imaging (fNIR) provides an indirect measurement of brain activity by detecting hemodynamic changes in the cortex. Although it is based on different principles, in that it uses light, it functions in the same manner as fMRI. FNIR can provide an almost continuous display of these changes in the cortex. It is inexpensive, non-invasive, and portable. A wireless headband with sensors exists for this device.

Event-related optical signal (EROS) is a brain-scanning device that focuses near-infrared light into the cerebral cortex to detect the density of neurons indicated by the transparency of brain tissue. Because it can only detect these changes a few centimeters deep, it can only image the cerebral cortex. Unlike fNIR, which is an optical method for measuring blood flow, EROS detects the intensity of neurons themselves and provides a direct measurement of brain activity. It is very accurate, portable, inexpensive, and non-invasive. A wireless headband with sensors exists for this device.

Capabilities

Mind-reading can be accomplished by first having a computer learn which brain patterns are associated with specific thoughts, then store the decoded information in a database. This machine learning is accomplished using a type of *artificial intelligence* (AI) called an *algorithm*. A very basic algorithm is a spell checker, which uses a database of common mistakes associated with a particular sequence of letters to present suggestions to a user.

"The new realization is that every thought is associated with a pattern of brain activity," proclaimed neuroscientist John Dylan Haynes, in *Newsweek International* on February 4, 2008. "And," says Haynes, "you can train a computer to recognize the pattern associated with a particular thought."

In a January 2000 issue of *US News and World Report*, Lockheed Martin neuroengineer Dr. John Norseen announced, "Just like you can find one person in a million through fingerprints ... you can find one thought in a million." This can be accomplished using AI and HCI, or what Dr. Norseen calls biofusion.

The decoded brain signals can be stored in a database. Then when someone is scanned, the computer detects the pattern and matches the signals to the database of known meanings. But it's not necessary to scan a brain to decode its signals for every single thought, such as a picture.

Instead, after the machine has learned how to decipher patterns associated with specific thoughts such as images, more images can be added to the program and the computer can use the process it used for the other images as a model to somewhat accurately detect additional thoughts.

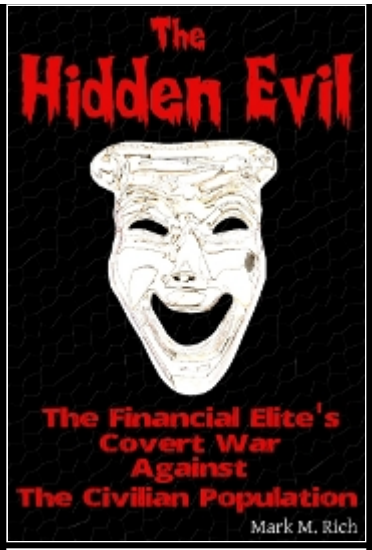

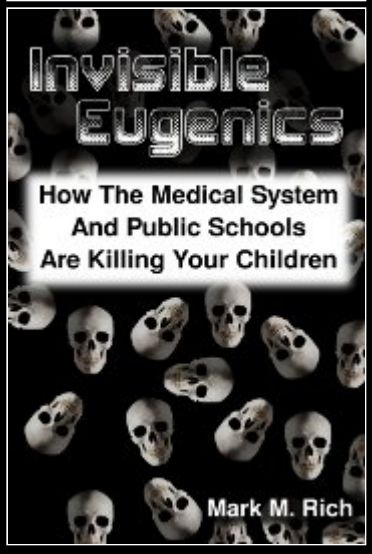

New World War: Revolutionary Methods for Political Control

Dedication & Thanks

Peer Review & Thanks

Dedication

Volume I: Current Political Situation

Overview

Introduction

Revolution in Warfare

The Other World

Dictatorship Creation

The Groups Facilitating the Revolution

Their Goal is Neo-Feudalism

Problem-Reaction-Solution

Volume I Commentary

Both words and images can be detected using mind-reading devices with varying degrees of accuracy. This can occur for words and images being viewed by a person on an external display, such as a book, or words and images just being thought of with no external stimuli.

"It is possible to read someone's mind by remotely measuring their brain activity," announced *New Scientist* in their *Mind-Reading Machine Knows What You See* article of April of 2005. The Computational Neuroscience Laboratories at the Advanced Telecommunications Research Institute International (ATR) in Kyoto Japan, and Princeton University in New Jersey, proved that by monitoring the visual cortex with fMRI they could determine which basic objects (sets of lines) a person was looking at.

When the objects were combined, they could even determine which one was being focused on. According to the scientists, it may be possible not only to view but also to record and replay these images. They announced that the technology could be used to figure out dreams and other secrets in people's minds.

Vanderbilt University in Nashville has conducted simple mind-reading tests using an fMRI/Computer, which learned what basic images a group of test subjects was looking at. They were able to predict with 50% accuracy which objects the test subjects were thinking of when they were asked only to remember what they had seen, without being shown the images.

On March 6, 2008 *ABC News* reported that neuroscientists at the University of California at Berkeley accomplished mind-reading by monitoring the visual cortex with an fMRI connected to a self-learning (artificial intelligence) computer program.

First, they used 1750 pictures to build a computational database for the computer to learn with by flashing the pictures in front of test subjects connected to an fMRI. This allowed the algorithm to decipher the brain patterns and associate them with the images.

In addition to deciphering these brain patterns, the computer recorded the process that it used to accomplish this, and built a model based upon it. Then, without scanning the test subjects, they added 120 new pictures to the program and allowed it to create its interpretation of what the new brain signals would be, based on the previous model.

Then they had the test subjects look at these pictures which they had never seen while being scanned. The computer predicted what they were looking at 72% of the time. The scientists announced that the model could be used as a basis to predict the brain activity associated with any image.

What this means is that it's not necessary to scan a brain to obtain the meaning of each signal. Once the model had been developed, they could simply add new pictures to the database/dictionary. The scientists suggested that out of 1 billion pictures, the computer would be accurate about 20% of the time.

Images which are not consciously seen by a person can even be detected by mind-reading machines. Researchers at University College London flashed

Volume II: The New War

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The New Enemy
Initiatives to Remove Civil Liberties
The Investigation
Surveillance Technology and Methods
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A Brief History of PsyOp
Small-Scale Wars
Nongovernmental Organizations
Human-Computer Intelligence Network

pictures in quick succession to test subjects connected to an fMRI. Although some of these pictures were invisible to the subjects, they were accurately recorded 80% of the time by the computer.

Like a fingerprint, each person has their own *brainprint*. Therefore, calibration for each brain is necessary. This is accomplished by having the person think a series of specific thoughts. In the case of EEG, this calibration can take less than a minute. However, because the signals which represent thoughts are similar from one person to the next, a universal mind-reading database has been suggested.

Using fMRI, scientists at Carnegie Mellon University (CMU) discovered that the brain patterns associated with specific thoughts are quite similar among multiple people. This, they stated, would provide the opportunity to create a universal mind-reading dictionary.

Scientists at the University of California at Berkeley mentioned that a "general visual decoder" would have great scientific use. Likewise, the brain patterns associated with specific words that occur when people are reading are also basically the same. This similarity of brain functions associated with words seems to have been an evolutionary development which allowed for an advantage in communication.

A mind-reading machine capable of determining the brain pattern associated with a specific word was developed by scientists at CMU. Brain scans using fMRI were taken of test subjects who were given a variety of words to think of in order to train the computer. An important consideration here is that they were not viewing these words on an external display, only thinking about them. After the computer identified the brain patterns associated with those words, the subjects were given two new words to think about, which the computer accurately determined.

Although, in this particular study only a couple of words were tested, it proves that after a model of how to decipher brain signals was created, AI could accurately determine new words that subjects were thinking about. "These building blocks could be used to predict patterns for any concrete noun," proclaimed Tom Mitchell of the Machine Learning Department.

In February of 2004 *Popular Science* announced that a mind-reading computer could, in theory, translate a person's working verbal memory onto a computer screen. "You could imagine thinking about talking and having it projected into a room 2,000 miles away," says Professor Craig Henriquez at Duke University's Center for Neuroengineering, who has studied mind-reading for DARPA. He added, "It's very, very possible."

FMRI can be used to determine if someone is reading or writing. Neuroscientists can determine when a person is reading by monitoring their brainwaves. They can almost determine exactly what they're reading. And because these patterns are similar from one person to the next, a universal device for determining what people are reading is possible.

In March of 2008 both Technology Review and *ABC News* revealed that an fMRI could in theory be used to display a person's dreams. Then in December of 2008, scientists at ATR in Kyoto Japan announced that they developed a

Electronic Tyranny
Other Devices Connected to the GIG
My Experience
Sources

Other Sites

www.TheHiddenEvil.com
www.RichEssence.com

technology that would eventually allow them to record and replay a person's dreams.

Emotions from love to hate can be recognized by neuralimaging. The level of stress a person is experiencing can also be measured. Brain states such as honesty, deception, and even self deception, can be measured.

Patterns associated with decisions can also be read. Scientists from CMU, Stanford University, and the MIT Sloan School of Management were able to accurately predict the purchasing decisions of test subjects in a virtual shopping center. They monitored the subject's level of interest in a product as well as their decision to purchase it.

Neuroimaging can also detect decisions about how someone will later do a high-level mental activity. Neuroimaging can be used to determine if someone is speaking or reading. It can be used to detect areas of the brain that are active when someone is hearing a sound, or touching an object.

Brain patterns associated with specific physical movements, such as a finger, can be deciphered with neural imaging. The mere intention to make a physical movement can be detected before the actual movement is made.

Cameras

A type of mind-reading is possible with cameras connected to computers. One such device, called the Emotional Social Intelligence Prosthetic (ESP), was developed at the MIT Media Laboratory in 2006. It consists of a tiny camera that can be worn on a hat, an earphone and a small computer that is worn on a belt. It infers a person's emotional state by analyzing combinations of subtle facial movements and gestures.

When an emotional state is detected, the wearer is signaled through the earphone to adjust their behavior in order to gain the attention of the target. The computer can detect 6 emotional states. It can also be adjusted for cultural differences and configured specifically for the wearer.

Around this time, the Computer Laboratory at the University of Cambridge, UK, developed a similar camera-based mind-reading machine. It uses a computer to monitor, in real-time, combinations of head movement, shape, color, smiles, and eyebrow activity to infer a person's emotional state.

It detects basic emotional states such as happiness, sadness, anger, fear, surprise, and disgust, as well as more complex states. It's accurate between 65 and 90 percent of the time. "The mind-reading computer system presents information about your mental state as easily as a keyboard and mouse present text and commands," they announced.

Used for Surveillance

Mind reading exists. The DOD and various institutions have vigorously researched this subject since at least the mid 1970s. "Mapping human brain functions is now routine," declared *US News and World Report*, in an article entitled *Reading Your Mind—And Injecting Smart Thoughts*, of January of 2000.

Both words and images, being viewed or thought, can be mind-read. Various emotional states as well as mental processes such decisionmaking, reading,

writing, movement and the intention to make a movement, can be detected with mind-reading devices. Perceptions such as touch, sound, and light can also be detected.

The proposed uses for mind-reading technology are positive. Some include determining if people in comas can communicate, helping stroke patients and those who suffered brain injuries, aiding those with learning disorders, assisting with online shopping, and improving people's communications skills.

However, other uses that have been suggested include the monitoring of unconscious mental processes, and interrogation of criminal suspects and potential terrorists. Dr. John Alexander mentioned that the recent developments in mind-reading technology would take surveillance to new levels by allowing investigators to "peer into the inner sanctum of the mind," in order to determine if a suspect has caused, or will likely cause a crime.

Dr. Norseen has sent R&D plans to the pentagon to have tiny mind-reading devices installed at airports to profile potential terrorists. He suggested that these devices could be functional by 2005. In August of 2008, *CNN* stated that the US military's knowledge obtained from mind-reading research could be used to interrogate the enemy.

Law Enforcement Technology announced in September of 2005 the existence of a new forensic technology known as *Brain Fingerprinting*, which has already been used in hundreds of investigations as a lie detector by the CIA, FBI and law enforcement agencies in the United States.

Brain Fingerprinting is admissible in court, because unlike a polygraph, which relies on emotional responses, it uses EEG to see how the brain reacts to words and pictures related to a crime scene. Dr. Larry Farwell, its inventor, says it is completely accurate. According to the report it will be used to help speed-up investigations.

Sources Next

Endnotes

1 Another possible method to obtain information is Remote Viewing. RV is the ability to produce correct information about people, events, objects, or concepts that are somewhere else in space and time, and are completely blind to the viewer collecting the information. It can be used to describe people or events, produce leads, reconstruct events, make decisions, and make predictions about the future. See *Remote Viewing Secrets* by Joseph McMoneagle. RV tests were conducted by the US government over a 20-year period during Project Stargate, a classified initiative by the CIA which began in 1972 and lasted until about 1994. Most of the 154 tests and 26,000 trials took place at the Cognitive Sciences Laboratory at Forte Meade, Maryland. A majority of the results of the project are still classified. See the *Journal of Parapsychology* articles, *Remote Viewing by Committee*, September 22, 2003, by Lance Storm and *Experiment One of the SAIC Remote Viewing Program*, of December 1, 1998, by Richard Wiseman and Julie Milton. The success of the project varies depending on the source. Allegedly the original tests were conducted under rigid scientific conditions, which had impressive results. However, the same sources describe RV

in general as ineffective. See *Discover Magazine's* article, *CIA ESP*, on April 1, 1996, by Jeffrey Kluger, and the *Washington Post's*report, *Many Find Remote Viewing a Far Fetch from Science*, on December 2, 1995, by Curt Suplee. According to author McMoneagle, an original viewer during Project Stargate, it is accurate about 50 or 60 percent of the time. Nevertheless, RV will be used to obtain intelligence, according to John B. Alexander. See *The New Mental Battlefield*, which appeared in the December 1980 issue of *Military Review*. Also see the June 1998 *Research Report Number 2* of the University of Bradford's Non-Lethal Weapons Research Project (BNLWRP), for how RV has been added to the NLW arsenal. According to multiple sources, US government agencies are now using the consulting services of RV professionals. This was reported on January 9, 2002 in the *University Wire's (Colorado Daily)* article, *Clairvoyant Discusses Reveals Details of Remote Viewing*, by Wendy Kale, and in the *Bulletin of the Atomic Scientists* on September 1, 1994, in its report, *The Soft Kill Fallacy* by Steven Aftergood. In his book *Winning The War: Advanced Weapons, Strategies, and Concepts for the Post-911 World*, Alexander had this to say regarding RV: "Since the beginning of history, humans have made anecdotal references to innate abilities to foretell the future, to know what was occurring at distant locations or the status of people separated from them, and to find resources they need without any traditional means of accessing that information." He continued: "Studies have demonstrated beyond any doubt that these nontraditional capabilities exist. ... [RV can] radically change our means of gathering intelligence. It holds the promise of providing information about inaccessible redoubts and advances in technology. More importantly, once these skills are understood, those possessing them will be able to determine an adversary's intent and be predictive about the events."

2 Because neuroimaging technology decodes brain patterns to thoughts, some argue that it technically doesn't read a person's mind. However, because specific thoughts and brain states can be deciphered, here it is referred to as mind-reading. Additionally, most mainstream documents refer to this as mind-reading, despite the fact that it is actually brainwave-reading.

3 Magnetoencephalography (MEG) and positron emission tomography (PET) can also be used to infer a person's neurophysiological state. But because they are impractical for field use due to their large size and harmful radiation, MEG and PET won't be considered here. However, DARPA is in the process of developing a small helmet-sized MEG device which would be connected to a portable computer. See the article *Mind over Machine* in the February 1, 2004 issue of *Popular Science*, by Carl Zimmer.

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Navy Lasers, Railgun, and Hypervelocity Projectile: Background and Issues for Congress

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CRS REPORT
Prepared for Members and
Committees of Congress

Summary

The Navy is currently developing three potential new weapons that could improve the ability of its surface ships to defend themselves against enemy missiles—solid state lasers (SSLs), the electromagnetic railgun (EMRG), and the hypervelocity projectile (HVP).

Any one of these new weapon technologies, if successfully developed and deployed, might be regarded as a "game changer" for defending Navy surface ships against enemy missiles. If two or three of them are successfully developed and deployed, the result might be considered not just a game changer, but a revolution. Rarely has the Navy had so many potential new types of surface-ship missile-defense weapons simultaneously available for development and potential deployment.

Although the Navy in recent years has made considerable progress in developing SSLs, EMRG, and HVP, a number of significant development challenges remain. Overcoming these challenges will likely require years of additional development work, and ultimate success in overcoming them is not guaranteed.

The issue for Congress is whether to approve, reject, or modify the Navy's funding requests and proposed acquisition strategies for these three potential new weapons. Potential oversight questions for Congress include the following:

- Using currently available approaches for countering anti-ship cruise missiles (ASCMs) and anti-ship ballistic missiles (ASBMs), how well could Navy surface ships defend themselves in a combat scenario against an adversary such as China that has large numbers of ASCMs (including advanced models) and ASBMs? How would this change if Navy surface ships in coming years were equipped with SSLs, EMRG, HVP, or some combination of these systems?
- How significant are the remaining development challenges for SSLs, EMRG, and HVP?
- Are current schedules for developing SSLs, EMRG, and HVP appropriate in relation to remaining development challenges and projected improvements in enemy ASCMs and ASBMs? To what degree are current schedules for developing SSLs, EMRG, or HVP sensitive to annual funding levels?
- When does the Navy anticipate issuing roadmaps detailing its plans for procuring and installing production versions of SSLs, EMRGs, and HVP on specific Navy ships by specific dates?
- Will the kinds of surface ships that the Navy plans to procure in coming years have sufficient space, weight, electrical power, and cooling capability to take full advantage of SSLs (particularly those with beam powers above 200 kW) and EMRG? What changes, if any, would need to be made in Navy plans for procuring large surface combatants (i.e., destroyers and cruisers) or other Navy ships to take full advantage of SSLs and EMRG?
- Are the funding sources for SSLs, EMRG, and HVP in Navy and Defense-Wide research and development accounts sufficiently visible for supporting congressional oversight?

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Introduction

Issue for Congress

This report provides background information and issues for Congress on three potential new weapons that could improve the ability of Navy surface ships to defend themselves against enemy missiles—solid state lasers (SSLs), the electromagnetic railgun (EMRG), and the hypervelocity projectile (HVP).[1]

Any one of these new weapon technologies, if successfully developed and deployed, might be regarded as a "game changer" for defending Navy surface ships against enemy missiles. If two or three of them are successfully developed and deployed, the result might be considered not just a game changer, but a revolution. Rarely has the Navy had so many potential new types of surface-ship missile-defense weapons simultaneously available for development and potential deployment. Although the Navy in recent years has made considerable progress in developing SSLs, EMRG, and HVP, a number of significant development challenges remain.

The issue for Congress is whether to approve, reject, or modify the Navy's funding requests and proposed acquisition strategies for these three potential new weapons. Congress' decisions on this issue could affect future Navy capabilities and funding requirements and the defense industrial base.

Scope of Report

SSLs are being developed by multiple parts of the Department of Defense (DOD), not just the Navy. SSLs, EMRG, and HVP, moreover, have potential application to military aircraft and ground forces equipment, not just surface ships. And SSLs, EMRG, and HVP can be used for missions other than defending against ASCMs and ASBMs.[2] This report focuses on Navy efforts to develop SSLs, EMRG, and HVP for potential use in defending Navy surface ships against ASCMs and ASBMs. It supersedes an earlier CRS report that provided an introduction to potential Navy shipboard lasers.[3]

Note that while fictional depictions of laser weapons in popular media often show them being used to attack targets at long ranges, the SSLs currently being developed by the Navy for potential shipboard use would be used to counter targets at short ranges of about a mile to perhaps a few miles.

[1] Railgun is also spelled as rail gun; EMRG is also abbreviated as EM railgun; hypervelocity is also spelled as hyper-velocity or hyper velocity.

[2] As discussed later in the report, the Navy is exploring the potential for using shipboard lasers to counter small boats and unmanned aerial vehicles (UAVs), and EMRG can be used to attack land targets.

[3] CRS Report R41526, *Navy Shipboard Lasers for Surface, Air, and Missile Defense: Background and Issues for Congress*, by Ronald O'Rourke. This earlier CRS report has been archived and remains available as a supplementary reference source on potential Navy shipboard lasers.

Background

Strategic and Budgetary Context

Concern about Survivability of Navy Surface Ships

Although Navy surface ships have a number of means for defending themselves against anti-ship cruise missiles (ASCMs) and anti-ship ballistic missiles (ASBMs),[4] some observers are concerned about the survivability of Navy surface ships in potential combat situations against adversaries, such as China, that are armed with advanced ASCMs and with ASBMs.[5] Concern about this issue has led some observers to conclude that the Navy's surface fleet in coming years might need to avoid operating in waters that are within range of these weapons, or that the Navy might need to move toward a different fleet architecture that relies less on larger surface ships and more on smaller surface ships and submarines.[6] Such changes in Navy operating areas and fleet architecture could substantially affect U.S. military strategy and the composition of the Navy's shipbuilding expenditures.

Navy surface fleet leaders in early 2015 announced a new organizing concept for the Navy's surface fleet called distributed lethality. Under distributed lethality, offensive weapons such as ASCMs are to be distributed more widely across all types of Navy surface ships, and new operational concepts for Navy surface ship formations are to be implemented. The aim of distributed lethality is to boost the surface fleet's capability for attacking enemy ships and make it less possible for an enemy to cripple the U.S. fleet by concentrating its attacks on a few very-high-value Navy surface ships (particularly the Navy's aircraft carriers).[7] Perspectives on whether

[4] These include the following: operating ships in ways that make it hard for others to detect and accurately track Navy ships; jamming or destroying enemy targeting sensors; interfering with the transmission of targeting data from sensors to weapon launchers; attacking weapon launchers (which can land-based launchers or launchers on surface ships, submarines, or aircraft); and countering ASCMs and ASBMs headed toward Navy ships. Navy measures for countering ASCMs and ASBMs headed toward Navy ships include the following: jamming a missile's guidance system; using decoys of various kinds to lure enemy missiles away from Navy ships; and shooting down enemy missiles with surface-to-air missiles and the Phalanx Close-In Weapon System (CIWS), which is essentially a radar-controlled Gatling gun. Employing all these measures reflects a long-standing Navy approach of creating a multi-layered defense against enemy missiles, and of attacking the enemy's "kill chain" at multiple points so as to increase the chances of breaking the chain. (The kill chain is the sequence of steps that an enemy must complete to conduct a successful missile attack on a Navy ship. This sequence includes, at a basic level of description, detecting and tracking the Navy ship, passing that information from sensors to the weapon launcher, launching the weapon, and guiding the weapon all the way to the Navy ship. Interfering with any one of these actions can break the kill chain and thereby prevent or defeat the attack.)

[5] See, for example, Andrew F. Krepinevich, Maritime Warfare in a Mature Precision-Strike Regime, Washington, Center for Strategic and Budgetary Assessments, 2014, 128 pp. For more on China's ASCMs and ASBMs, see CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, by Ronald O'Rourke.

ASCMs and ASBMs are not the only reasons that some observers are concerned about the future survivability of U.S. Navy surface ships in combat situations; observers are also concerned about threats to U.S. Navy surface ships posed by small boats, mines, and torpedoes.

[6] See, for example, Phillip E. Pournelle, "The Deadly Future of Sea Control," *U.S. Naval Institute Proceedings*, July 2015: 26-31.

[7] See, for example, Thomas Rowden, Peter Gumataotao, and Peter Fanta, "Distributed Lethality," *U.S. Naval Institute Proceedings*, January 2015: 18-23; Sam LaGrone, "SNA: Navy Surface Leaders Pitch More Lethal Ships, Surface Action Groups," *USNI News*, January 14, 2015; Kris Osborn, "Navy Unveils New Surface Warfare Strategy," *Military.com*, January 14, 2015; Sydney J. Freedberg Jr., "'If It Floats, It Fights,': Navy Seeks 'Distributed Lethality,'" *Breaking Defense*, January 14, 2015; Mike McCarthy and Megan Eckstein, "Navy Eyeing A 'Hunter Killer' Surface (continued...)

it would be cost effective to spend money spreading offensive weapons across a wider array of Navy surface ships might be influenced by views on whether those surface ships can adequately defend themselves against enemy missiles.

Depth of Magazine and Cost Exchange Ratio

Two key limitations that Navy surface ships currently have in defending themselves against ASCMs and ASBMs are limited depth of magazine and unfavorable cost exchange ratios. Limited depth of magazine refers to the fact that Navy surface ships can use surface-to-air missiles (SAMs) and their Close-in Weapon System (CIWS) Gatling guns to shoot down only a certain number of enemy unmanned aerial vehicles (UAVs) and anti-ship missiles before running out of SAMs and CIWS ammunition[8]—a situation (sometimes called "going Winchester"), that can require a ship to withdraw from battle, spend time travelling to a safe reloading location (which can be hundreds of miles away),[9] and then spend more time traveling back to the battle area.

Unfavorable cost exchange ratios refer to the fact that a SAM used to shoot down a UAV or anti-ship missile can cost the Navy more (perhaps much more) to procure than it cost the adversary to build or acquire the UAV or anti-ship missile. In the FY2016 defense budget, procurement costs for Navy SAMs range from about $900,000 per missile to several million dollars per missile, depending on the type.[10]

In combat scenarios against an adversary with a limited number of UAVs and anti-ship missiles, an unfavorable cost exchange ratio can be acceptable because it saves the lives of Navy sailors and prevents very expensive damage to Navy ships. But in combat scenarios (or an ongoing military capabilities competition) against a country such as China that has many UAVs and anti-ship missiles and a capacity for building or acquiring many more, an unfavorable cost exchange ratio can become a very expensive—and potentially unaffordable—approach to defending Navy surface ships against UAVs and anti-ship missiles, particularly in a context of constraints on U.S. defense spending and competing demands for finite U.S. defense funds.

(...continued)

Fleet, Would Require Upgunning Existing Ship Fleets," *Defense Daily*, January 15, 2015: 1-3; Richard Scott, "Offensive Language: USN Sets Out Surface Firepower Strategy," *Jane's International Defence Review*, May 2015: 42-47; Megan Eckstein, "Navy Studying Implications of Distributed Lethality in Wargames Series," *USNI News*, July 9, 2015; Lara Seligman, "Navy Establishes Task Force To Study Impact of Distributed lethality," *Inside the Navy*, July 10, 2015.

[8] Navy cruisers have 122 missile cells; Navy destroyers have 90 or 96 missile cells. Some of these cells are used for storing and launching Tomahawk land attack cruise missiles or anti-submarine rockets. The remainder are available for storing and launching SAMs. A Navy cruiser or destroyer might thus be armed with a few dozen or several dozen SAMs for countering ASCMs and ASBMs. Countering ASCMs or ASBMs with SAMs might sometimes require shooting two SAMs at each ASCM or ASBM.

[9] The missile cells on a Navy cruiser or destroyers are clustered together in an installation called a Vertical Launch System (VLS). VLS cells cannot be reloaded while the ship is underway; a ship needs to return to a port or a calm anchorage to reload its VLS.

[10] Unit procurement costs for ship-launched SAMs in the FY2016 are as follows: about $900,000 for the Rolling Airframe Missile (RAM), about $1.1 million to about $1.5 million for the Evolved Sea Sparrow Missile (ESSM), about $3.9 million for the SM-6 Block 1 missile, about $14 million for the SM-3 Block 1B missile, and more than $20 million for theSM-3 Block IIA missiles. RAM and ESSM are short-range missiles for defense against aircraft and ASCMs. The SM-6 Block 1 is a medium-range missile used for both defense against aircraft and ASCMs, and terminal (i.e., endo-atmospheric) defense against theater-range ballistic missiles. The SM-3 Block 1B and SM-3 Block IIA are used for mid-course (i.e., exo-atmospheric) defense against theater-range ballistic missiles.

SSLs, EMRG, and HVP offer a potential for dramatically improving depth of magazine and the cost exchange ratio:

- **Depth of magazine.** SSLs are electrically powered, drawing their power from the ship's overall electrical supply, and can be fired over and over, indefinitely, as long as the SSL continues to work and the ship has fuel to generate electricity. The EMRG's projectile and the HVP (which are one and the same—see next section) can be stored by the hundreds in a Navy surface ship's weapon magazine.[11]
- **Cost exchange ratio.** An SSL can be fired for a marginal cost of less than one dollar per shot (which is the cost of the fuel needed to generate the electricity used in the shot), while the EMRG's projectile/HVP has an estimated unit procurement cost of about $25,000.[12]

For additional discussion of the strategic and budgetary context in which the programs discussed in this report and other Navy programs may be considered, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

SSLs, EMRG, and HVP in Brief

SSLs

Overview

The Navy in recent years has leveraged both significant advancements in industrial SSLs and decades of research and development work on military lasers done by other parts of DOD to make substantial progress toward deploying high-energy SSLs[13] on Navy surface ships. Navy surface ships would use high-energy SSLs initially for countering small boats UAVs, and potentially in the future for countering ASCMs and ASBMs as well.[14] High-energy SSLs on Navy ships would be short-range defensive weapons—they would counter targets at ranges of about one mile to perhaps eventually a few miles.[15]

[11] In July 2015, the Navy issued a request for information (RFI) to industry for the fabrication of a prototype EMRG mount that would store a minimum of 650 rounds. (RFI for Fabrication of Prototype Mount for Naval Railgun, Solicitation Number: N00024-15-R-4132, FedBizOpps.gov, July 29, 2015. See also Justin Doubleday, "Navy Developing Integrated Mount For Electromagnetic Railgun," *Inside the Navy*, July 31, 2015.)

[12] Sources for cost of HVP: David Martin, "Navy's Newest Weapon Kills at Seven Times the Speed of Sound," CBS News (cbssnews.com), April 7, 2014; Kris Osborn, "Navy Will Test its Electromagnetic Rail Gun aboard DDG 1000," *DefenseTech*, April 15, 2015.

[13] In discussions of potential Navy shipboard lasers, a high-energy laser is generally considered to be a laser with a beam power of at least 10 kilowatts (kW).

[14] In general, lasers would counter small boats and missiles by heating and burning holes in their skins, and causing thermal damage to their interiors. Lasers can also be used to "dazzle" (i.e., interfere with) electro-optical sensors on a boat or missile.

[15] The Navy has also performed research and development work on a different kind of laser, called the free electron laser (FEL). In recent years, Navy research and development work on potential shipboard lasers has shifted more to SSLs. For background information on the FEL, see CRS Report R41526, *Navy Shipboard Lasers for Surface, Air, and Missile Defense: Background and Issues for Congress*, by Ronald O'Rourke.

In addition to a low marginal cost per shot and deep magazine, potential advantages of shipboard lasers include fast engagement times, an ability to counter radically maneuvering missiles, an ability to conduct precision engagements, and an ability to use lasers for graduated responses ranging from detecting and monitoring targets to causing disabling damage. Potential limitations of shipboard lasers relate to line of sight; atmospheric absorption, scattering, and turbulence (which prevent shipboard lasers from being all-weather weapons); an effect known as thermal blooming that can reduce laser effectiveness; countering saturation attacks; possible adversary use of hardened targets and countermeasures; and risk of collateral damage, including damage to aircraft and satellites and permanent damage to human eyesight, including blinding. These potential advantages and limitations are discussed in greater detail in the **Appendix**.

Selected Key Developments

Key developments in the Navy's high-energy SSL development effort include the following:

- Between 2009 and 2012, the Navy successfully tested a prototype SSL called the Laser Weapon System (LaWS) against UAVs in a series of engagements that took place initially on land and subsequently on a Navy ship at sea.
- Between 2010 and 2011, the Navy tested another prototype SSL called the Maritime Laser Demonstration (MLD) in a series of tests that culminated with an MLD installed on a Navy ship successfully engaging a small boat.
- In April 2013, the Navy announced that it planned to install LaWS on the USS *Ponce* (pronounced pon-SAY)—a converted amphibious ship that is operating in the Persian Gulf as an interim Afloat Forward Staging Base (AFSB[I]) [16]—to conduct evaluation of shipboard lasers in an operational setting against swarming boats and swarming UAVs.[17] The system was installed in August 2014 (see **Figure 1**, **Figure 2**, and **Figure 3**).
- In March 2014, it was reported that the Navy anticipated moving to a shipboard laser program of record in "the FY2018 time frame" and achieving an initial operational capability (IOC) with a shipboard laser in FY2020 or FY2021.[18]

[16] An AFSB operates as a "mother ship" for Navy helicopter and small boat operations. The Ponce is serving as an interim AFSB pending the arrival of a new AFSB that is currently being built.

[17] "Navy Leaders Announce Plans for Deploying Cost-Saving Laser Technology," *Navy News Service*, April 8, 2013; Thom Shanker, "Navy Deploying Laser Weapon Prototype Near Iran," *New York Times*, April 9, 2013: 4; Mike McCarthy, "Navy Deploying Laser For Taking Out Drones," *Defense Daily*, April 9, 2013; Graham Warwick, "U.S. Navy Planning Gulf Deployment For Laser Weapon," *Aerospace Daily & Defense Report*, April 9, 2013: 6; Megan Eckstein, "Navy-Built Laser Weapon System Will Begin Demo On Ponce In Early 2014," *Inside the Navy*, April 15, 2013. See also Lara Seligman, "Navy-built LaWS To Begin Demo This Summer, IOC Slated For FY-20-21," *Inside the Navy*, March 24, 2014; Office of Naval Research, "All Systems Go: Navy's Laser Weapon Ready for Summer Deployment," *Navy News Service*, April 7, 2014.

Swarming refers to the use of boats and UAVs in large numbers, or swarms, in an attempt to confuse and overwhelm a target ship's defensive systems.

[18] Lara Seligman, "Navy-built LaWS To Begin Demo This Summer, IOC Slated For FY-20-21," *Inside the Navy*, March 24, 2014. A program of record, or POR, is a term sometimes used by DOD officials that means, in general, a program in the Future Years Defense Plan (FYDP) that is intended to provide a new, improved, or continuing materiel, weapon, or information system or service capability in response to an approved need. The term is sometimes used to refer to a program in a service's budget for procuring and deploying an operational weapon system, as opposed to a research and development effort that might or might not eventually lead to procurement and deployment of an operational weapon system.

- In December 2014, the Navy declared LaWS on the Ponce to be an "operational" system.[19]
- In January 2016, the Navy stated that it anticipated releasing a directed energy weapon roadmap in February 2016.[20]

[19] A December, 11, 2014, press report stated

> The Navy's first-of-a-kind laser deployed on a vessel sailing in the Persian Gulf has been declared operational and can be used by the crew to defend itself against potential threats, the service's head of the Office of Naval Research said on Wednesday [December 10, 2014].
>
> Rear Adm. Matthew Klunder told reporters on a conference call that Central Command has been green lighted to use the laser in the event of a threat, approval that has been passed along to the ship's commanding officer. The 30-kilowat laser, known as the Laser Weapon System, or LaWS, was installed on the USS Ponce in August [2014].
>
> The ship later departed for the Persian Gulf and the LaWS successfully carried out operational testing recently by striking a fast attack boat and drone, Klunder said, adding that this marks the "historic" first ever operational deployment of a directed energy weapon.
>
> (Mike McCarthy, "Navy Authorized To Use Ship-Based Laser In Battle," *Defense Daily*, December 11, 2014: 3. See also Sam LaGrone, "U.S. Navy Allowed to Use Persian Gulf Laser for Defense," *USNI News*, December 10, 2014; Philip Ewing, "Navy Declares Laser Weapon 'Operational,'" *Politico Pro (Pro Defense Report)*, December 10, 2014.)

The Navy testified on February 24, 2016, that

> the Solid State Laser Quick Reaction Capability (SSL-QRC) was fielded as a science and technology demonstration aboard the USS PONCE. It was successfully demonstrated as an effective weapon system and was subsequently transitioned to the fleet in the Central Command area of responsibility and is now an operational system.
>
> (Statement of Rear Admiral Mathias W. Winter, United States Navy, Chief of Naval Research, Before the Emerging Threats and Capabilities Subcommittee of the House Armed Services Committee on The Fiscal Year 2017 Budget Request, February 24, 2016, p. 15.)

[20] Justin Doubleday, "Winter: Navy Directed-Energy Strategy To Be Released This Month," *Inside the Navy*, February 1, 2016.

Figure 1. Laser Weapon System (LaWS) on USS Ponce

Source: Navy photograph dated November 16, 2014, accompanying David Smalley, "Historic Leap: Navy Shipboard Laser Operates in Arabian Gulf," *Navy News Service*, December 10, 2014, accessed August 12, 2015, at http://www.navy.mil/list_all.asp?id=84805.

Figure 2. Laser Weapon System (LaWS) on USS Ponce

Source: Navy photograph dated November 17, 2014, accompanying David Smalley, "Historic Leap: Navy Shipboard Laser Operates in Arabian Gulf," *Navy News Service*, December 10, 2014, accessed August 12, 2015, at http://www.navy.mil/list_all.asp?id=84805.

Figure 3. Laser Weapon System (LaWS) on USS Ponce

Source: Navy photograph dated November 16, 2014, accompanying David Smalley, "Historic Leap: Navy Shipboard Laser Operates in Arabian Gulf," *Navy News Service*, December 10, 2014, accessed August 12, 2015, at http://www.navy.mil/list_all.asp?id=84805.

SSL Technology Maturation (SSL-TM) Program

LaWS has a reported beam power of 30 kilowatts (kW),[21] which is strong enough to counter small boats and UAVs. As a follow-on effort to LaWS and MLD, the Navy initiated the SSL Technology Maturation (SSL-TM) program, in which industry teams led by BAE Systems, Northrop Grumman, and Raytheon, among others, competed to develop a shipboard laser with a beam power of 100 kW to 150 kW, which would provide increased effectiveness against small

[21] See, for example, Mike McCarthy, "Navy Authorized To Use Ship-Based Laser In Battle," *Defense Daily*, December 11, 2014: 3.

boats and UAVs.[22] Boosting beam power further—to something like 200 kW or 300 kW—could permit a laser to counter at least some ASCMs. Even stronger beam powers—on the order of at least several hundred kW, if not one megawatt (MW) or more—could improve a laser's effectiveness against ASCMs and enable it to counter ASBMs.[23]

On October 22, 2015, DOD announced that it had selected Northrop Grumman as the winner of the SSL-TM competition. DOD's contract-award announcement stated:

> Northrop Grumman Space and Mission Systems Corp., Redondo Beach, California, is being awarded a $53,151,809 cost-plus-fixed-fee contract for the Solid State High Power Laser Weapon System Demonstrator (LWSD) program.... The Office of Naval Research seeks to continue the advancement of SSL weapon system designs, architectures, and component technologies. The government believes that improvements in lethality may be achieved through maturation and optimization of a variety of system characteristics, including laser power, beam quality, beam director architecture, and other physical and optical aspects of the laser, beam director, and system design. Leveraging our experience and internal investments, the Northrop Grumman team is ready to fully support the three phases of the LWSD program. This contract contains options, which if exercised, will bring the contract value to $91,057,597. Work will be performed in Redondo Beach, California, and is expected to be completed Oct. 21, 2016. If options are exercised, work will continue through July 7, 2018.... This contract was competitively procured under the Office of Naval Research broad agency announcement 15-0005 entitled "Solid State, High Power Laser Weapon System Demonstrator (LWSD) Design, Development and Demonstration for Surface Navy, USN." Six proposals were received in response to this solicitation.[24]

A December 22, 2016, Northrop Grumman news release about the October 22, 2016, contract award stated:

> During Phase 1 of the LWSD contract, Northrop Grumman will develop a detailed design for the new system. Phase 2 will include assembly and ground test of the system, while Phase 3 will comprise at-sea testing of the system aboard the Navy's Self Defense Test Ship (SDTS). The Navy will lead this testing with Northrop Grumman providing technical support. The SDTS is the former USS Paul F. Foster (DD-964).
>
> According to Renard, Northrop Grumman's LWSD is well suited to support the Navy's planned initial testing on the SDTS. The company has designed its system to be installed, however, with minimal modification or additional costs, for demonstration on the Navy's DDG-51 FLT II class destroyers.[25]

---

[22] For more on the SSL-TM program, see Office of Naval Research, "Solid-State Laser Technology Maturation Program," accessed August 11, 2015, at http://www.onr.navy.mil/Media-Center/Fact-Sheets/Solid-State-Laser-Technology-Maturation-Program.aspx; Office of Naval Research, "Solid State Laser Technology Maturation Program," September 2012, accessed August 11, 2015, at http://www.onr.navy.mil/~/media/Files/Fact-Sheets/35/Solid-State-Laser-Technology-Maturation-Program-2012-a.ashx; Office of Naval Research, "Research and Development/Technology Maturation of Solid State High Power Laser Weapon Systems, Subsystems, and/or Components for Surface Navy, USN, Broad Agency Announcement (BAA)," ONR BAA # 12-019, 2012, accessed August 11, 2015, at http://www.onr.navy.mil/~/media/files/funding-announcements/baa/2012/12-019.ashx; Future Force, "Developing a High-Energy Laser for the Navy," January 23, 2015, accessed August 11, 2015, at http://futureforce.navylive.dodlive.mil/2015/01/high-energy-laser/.

[23] For additional discussion, see CRS Report R41526, *Navy Shipboard Lasers for Surface, Air, and Missile Defense: Background and Issues for Congress*, by Ronald O'Rourke, particularly the section entitled "Required Laser Power Levels for Countering Targets" and Appendix A on "Laser Power Levels Required to Counter Targets."

[24] DOD contract award announcements for October 22, 2015, accessed December 18, 2015, at: http://www.defense.gov/News/Contracts/Contract-View/Article/625630.

[25] "US Navy Selects Northrop Grumman to Design and Produce Shipboard Laser Weapon System Demonstrator," (continued...)

Figure 4 shows an artist's rendering of LWSD installed on the Navy's Self Defense Test Ship (the USS Paul F. Foster [DD-964], an old Spruance [DD-963] class destroyer).

Figure 4. Laser Weapon System Demonstrator (LWSD) on Self Defense Test Ship

Artist's rendering

Source: Cropped version of image accessed on March 18, 2016, at http://media.globenewswire.com/cache/189/hires/39412.jpg.

Figure 5 is a detail from the above photo.

(...continued)

December 22, 2016, accessed March 18, 2016, at: http://www.globenewswire.com/newsarchive/noc/press/pages/news_releases.html?d=10158731 . See also Richard Scott, "Northrop Grumman To Build on MLD for SSL Demonstrator," *IHS Jane's International Defence Review*, February 2016: 5.

Figure 5. Laser Weapon System Demonstrator (LWSD) on Self Defense Test Ship

Artist's rendering

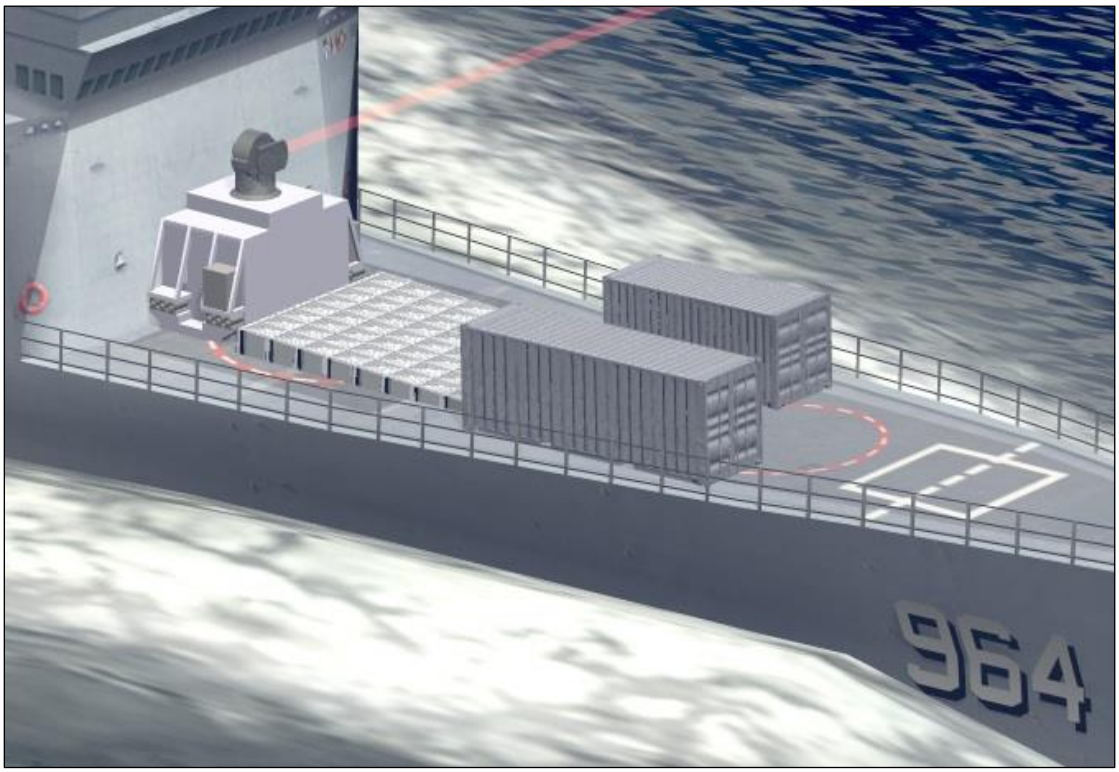

Source: Cropped version of image accessed on March 18, 2016, at http://media.globenewswire.com/cache/189/hires/39412.jpg.

Figure 6 Is an Office of Naval Research (ONR) graphic illustration of the LWSD's major components.

Figure 6. ONR Graphic of LWSD Components

Artist's rendering

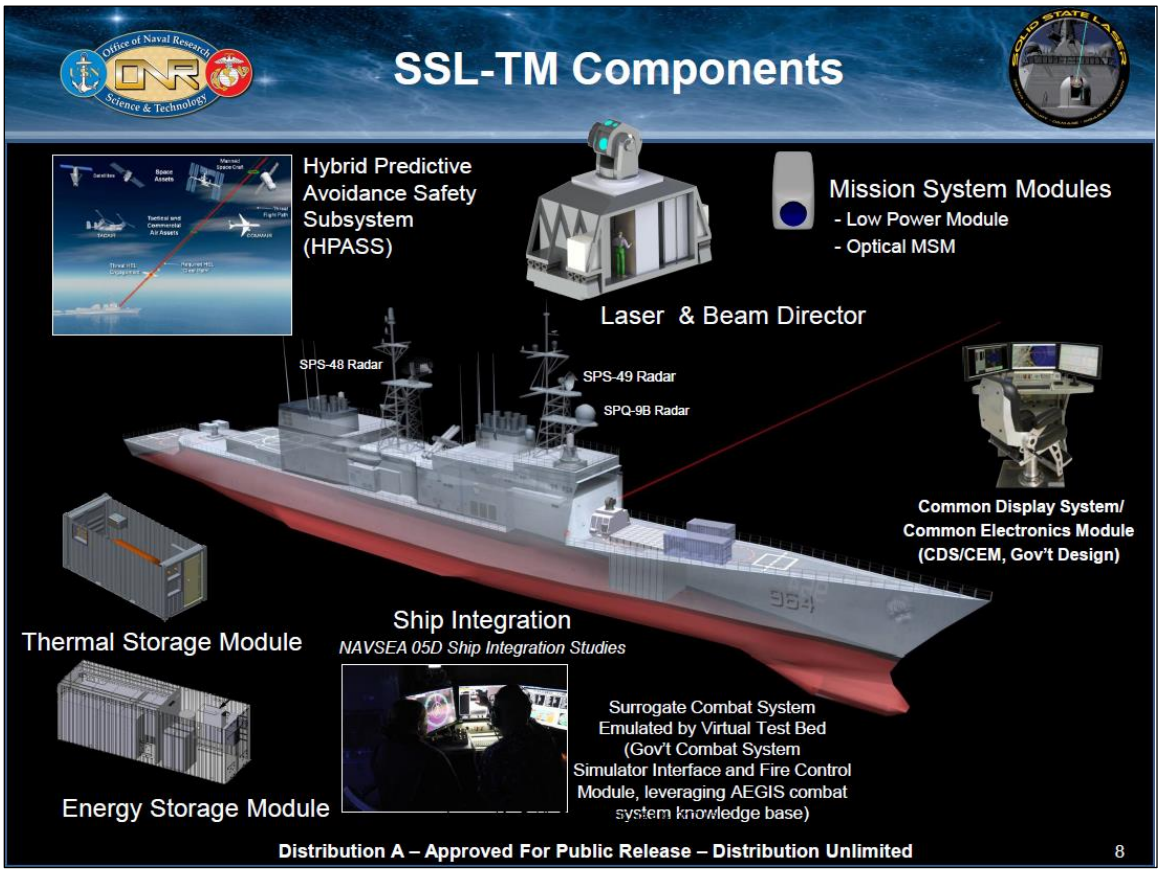

Source: Slide from February 2016 ONR briefing to CRS on SSL-TM program, received from Navy Office of Legislative Affairs February 26, 2016.

Directed Energy Roadmap

A July 28, 2015, press report stated:

> [Secretary of the Navy Ray] Mabus said he would release a DE [directed energy][26] roadmap this fall that "charts our course for research, development, and fielding of high power radio frequency weapons, lasers, and directed energy countermeasures. And I will follow it up with my guidance to the Program Objective Memorandum for [Fiscal Year 2018],[27] which, importantly, establishes a resource sponsor and a program of record."...
>
> Also meant to help quicken the pace of progress, the Office of Naval Research will take lessons learned from the [USS] Ponce to inform the Solid State Laser Technology Maturation program that aims to produce a 100-150 kilowatt laser prototype for at-sea testing in 2018, or sooner if possible. Rear Adm. Bryant Fuller, Naval Sea Systems Command (NAVSEA) chief engineer, said... that everything the Navy learned about rules

[26] Lasers and another class of weapons called high-power microwave (HPM) weapons are referred to collectively as directed-energy weapons because they achieve their effects by directing electromagnetic energy at their targets.

[27] The Program Objective Memorandum (POM) is an internal DOD document that guides the preparation of a budget for a particular fiscal year.

> of engagement and how to use LaWS in an operational environment would apply to larger laser weapons as well. Leveraging the operational knowledge Ponce gained will help the Navy field whatever comes out of the SSL-TM effort much more rapidly.
>
> In the meantime, Mabus said the Laser Weapon System (LaWS) will continue its work in the Middle East after early success led officials to extend its deployment.[28]

EMRG

In addition to SSLs, the Navy since 2005 has been developing EMRG, a cannon that uses electricity rather than chemical propellants (i.e., gunpowder charges) to fire a projectile.[29] In EMRG, "magnetic fields created by high electrical currents accelerate a sliding metal conductor, or armature, between two rails to launch projectiles at [speeds of] 4,500 mph to 5,600 mph,"[30] or roughly Mach 5.9 to Mach 7.4 at sea level.[31] Like SSLs, EMRG draws its power from the ship's overall electrical supply.[32] The Navy originally began developing EMRG as a naval surface fire support (NSFS) weapon for supporting U.S. Marines operating ashore, but subsequently determined that the weapon also has potential for defending against ASCMs and ASBMs.[33] In response to Section 243 of the FY2012 National Defense Authorization Act (H.R. 1540/P.L. 112-81 of December 31, 2011), the Navy in September 2012 submitted to the congressional defense committees a report on the EMRG development effort.[34]

Following tests with early Navy-built EMRG prototypes, the Navy funded the development of two industry-built EMRG prototype demonstrators, one by BAE Systems and the other by General Atomics (see **Figure 7** and **Figure 8**).

[28] Megan Eckstein, "Mabus: Adversaries Showing Interest in Directed Energy; Navy Needs to Move Faster," *USNI News*, July 28, 2015.

[29] Because it uses electricity rather than a powder charge to accelerate the projectile, Navy officials sometimes refer to EMRG as a launcher rather than a gun or cannon.

[30] Grace Jean, "With a Bang, Navy Begins Tests on EM Railgun Prototype Launcher," Navy News Service, February 28, 2012, accessed August 12, 2015, at http://www.navy.mil/submit/display.asp?story_id=65577.

[31] The speed of sound in air (i.e., Mach 1), varies with altitude; at sea level, it is approximately 761 miles an hour. (See for example, the table entitled "Speed of Sound at Different Altitudes," accessed August 12, 2015, at http://www.fighter-planes.com/jetmach1.htm.

[32] Unlike SSLs, however, EMRG is not a directed energy weapon, because it achieves its effects by firing a physical projectile at the target, not by directing electromagnetic energy at the target. See also footnote 26.

[33] For a recent article discussing the use of EMRG in countering ASCMs and ASBMs, see Sam LaGrone, "Navy Wants Rail Guns to Fight Ballistic and Supersonic Missiles Says RFI," *USNI News*, January 5, 2015.

[34] U.S. Navy, *Electromagnetic Railgun System: Final Report to the Congressional Defense Committees*, August 2012, with cover letters dated September 18, 2012. For a press report discussing the Navy's report to Congress, see Dan Taylor, "Stackley: Navy Identifies Four Technical Hurdles To Railgun Development," *Inside the Navy*, November 19, 2012.

Figure 7. Industry-Built EMRG Prototype Demonstrator

BAE prototype

Source: Navy photograph dated July 8, 2014, associated with Office of Naval Research Public Affairs, "From Research to Railgun: Revolutionary Weapon at Future Force EXPO," *Navy News Service*, January 13, 2015, accessed August 12, 2015, at http://www.navy.mil/submit/display.asp?story_id=85166.

Figure 8. Industry-Built EMRG Prototype Demonstrator

General Atomics prototype

Source: navy photograph dated July 8, 2014, accessed August 12, 2015, at http://www.navy.mil/view_image.asp?id=180994.

The two industry-built prototypes are designed to fire projectiles at energy levels of 20 to 32 megajoules,[35] which is enough to propel a projectile 50 to 100 nautical miles.[36] (Such ranges might refer to using the EMRG for NSFS missions. Intercepts of ASCMs and ASBMs might take place at much shorter ranges.) The Navy began evaluating the two industry-built prototypes in 2012.

In April 2014, the Navy announced that it plans to temporarily install a prototype EMRG aboard a Navy Joint High Speed Vessel (JHSV) in FY2016, for use in at-sea tests.[37] **Figure 9** is an artist's rendering of that installation.

In January 2015, it was reported that the Navy is projecting that EMRG could become operational on a Navy ship between 2020 and 2025.[38] In April 2015, it was reported that the Navy is considering installing an EMRG on a Zumwalt (DDG-1000) class destroyer by the mid-2020s.[39]

[35] The Navy states that "a megajoule is a measurement of energy associated with a mass traveling at a certain velocity. In simple terms, a one-ton vehicle moving at 100 mph equals a magajoule of energy." (Office of Naval Research Public Affairs, "Navy Sets New World Record with Electromagnetic Railgun Demonstration," *Navy News Service*, December 10, 2010, accessed August 12, 2015, at http://www.navy.mil/submit/display.asp?story_id=57690.)

[36] Grace Jean, "With a Bang, Navy Begins Tests on EM Railgun Prototype Launcher," Navy News Service, February 28, 2012, accessed August 12, 2015, at http://www.navy.mil/submit/display.asp?story_id=65577.

[37] Naval Sea Systems Command Office of Corporate Communication, "Navy to Deploy Electromagnetic Railgun Aboard JHSV," *Navy News Service*, April 7, 2014, accessed August 12, 2015, at http://www.navy.mil/submit/display.asp?story_id=80055.

[38] Sam LaGrone, "Navy Wants Rail Guns to Fight Ballistic and Supersonic Missiles Says RFI," *USNI News*, January 5, 2015.

[39] Sam LaGrone, "Navy Considering Railgun for Third Zumwalt Destroyer," *USNI News*, February 5, 2015 (updated (continued...)

Figure 9. EMRG Prototype Demonstrator Installed on a JHSV

Artist's rendering

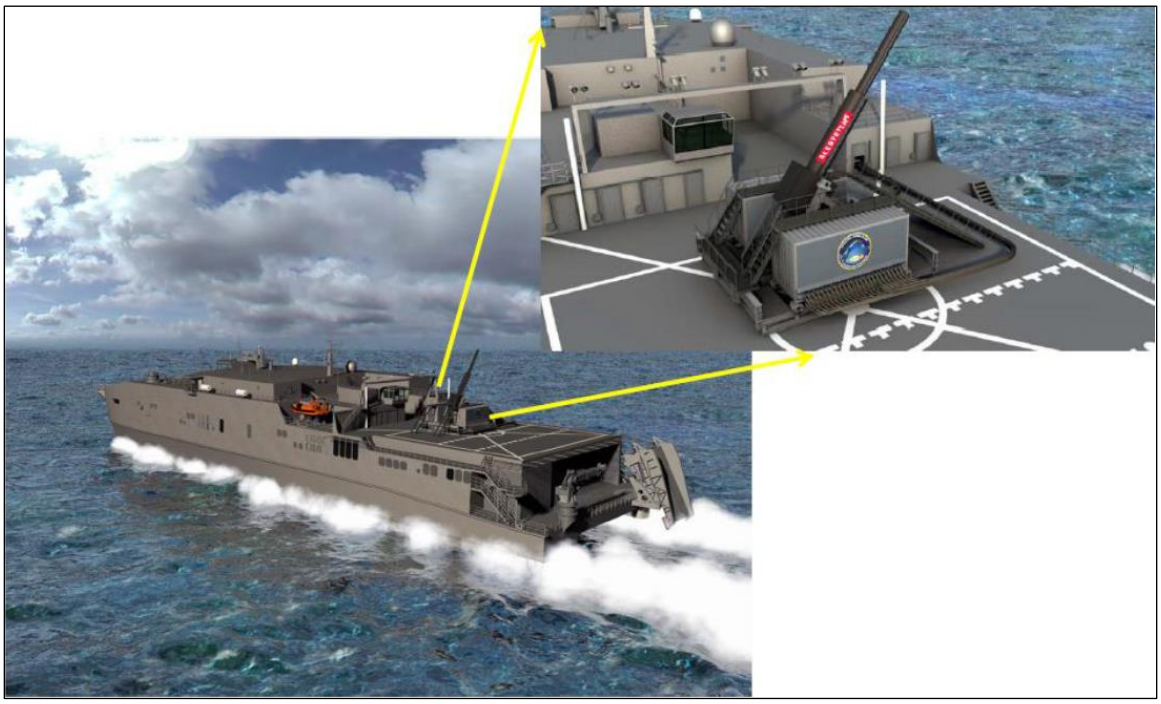

Source: Briefing slide entitled "FY16 At-Sea Test of Railgun" in Navy briefing entitled "Railgun Program Overview," undated but posted at InsideDefense.com on April 14, 2015. (InsideDefense.com states that the briefing was presented at a public conference on April 14, 2015.)

HVP

As the Navy was developing EMRG, it realized that the guided projectile being developed for EMRG could also be fired from 5-inch and 155mm powder guns.[40] Navy cruisers each have two

(...continued)

February 11, 2015); Mike McCarthy, "Navy Aiming To Put Railgun On Third Zumwalt Destroyer," *Defense Daily*, February 6, 2015; Kris Osborn, "Navy Will Test its Electromagnetic Rail Gun aboard DDG 1000," *DefenseTech*, April 15, 2015. For more on Zumwalt-class destroyers, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

[40] The Navy describes the HVP as "a next generation, common, low drag, guided projectile capable of completing multiple missions for gun systems such as the Navy 5-Inch, 155-mm, and future railguns.... HVP's low drag aerodynamic design enables high velocity, maneuverability, and decreased time-to-target. These attributes coupled with accurate guidance electronics provide low cost mission effectiveness against current threats and the ability to adapt to air and surface threats of the future." (Office of Naval Research, Hypervelocity Projectile," September 2012, accessed August 14, 2015, at http://www.onr.navy.mil/~/media/Files/Fact-Sheets/35/Hypervelocity-Projectile-2012B.ashx.) The Navy states that HVP weighs 23 pounds. (Source: David Martin, "Navy's Newest Weapon Kills at Seven Times the Speed of Sound," *CBS News (cbssnews.com)*, April 7, 2014.)

BAE Systems states that HVP is 24 inches long and weighs 28 pounds, including a 15-pound payload. The total length and weight of an HVP launch package, BAE Systems states, is 26 inches and 40 pounds. BAE states that the maximum rate of fire for HVP is 20 rounds per minute from a Mk 45 5-inch gun, 10 rounds per minute from the 155mm gun on DDG-1000 class destroyers (called the Advanced Gun System, or AGS), and 6 rounds per minute from EMRG. HVP's firing range, BAE Systems states, is more than 40 nautical miles (when fired from a Mk 45 Mod 2 5-inch gun), more than 50 nautical miles (Mk 45 Mod 4 5-inch gun), more than 70 nautical miles (155mm gun on DDG-1000 class destroyers), and more than 100 nautical miles (EMRG). (BAE Systems, "Hypervelocity Projectile (HVP)," 2014, (continued...)

5-inch guns, and most Navy destroyers each have one 5-inch gun. The Navy's three new Zumwalt class (DDG-1000) destroyers, which are under construction, each have two 155mm guns.

The projectile is a hypervelocity projectile when fired from either EMRG or a powder gun, but the term HVP tends to be used more frequently in connection with the concept of firing it from a powder gun. **Figure 10** and **Figure 11** show the HVP.

Figure 10. Photograph Showing HVP

Source: Navy photograph dated April 4, 2014, with a caption that reads: "Rear Adm. Matthew Klunder, chief of naval research, shows off a Hypervelocity Projectile (HVP) to CBS News reporter David Martin during an interview held at the Naval Research Laboratory's materials testing facility. The HVP is a next-generation, common, low drag, guided projectile capable of completing multiple missions for gun systems such as the Navy 5-inch, 155-mm, and future railguns," accessed August 12, 2015, at http://www.navy.mil/view_image.asp?id=174517.

(...continued)

accessed August 14, 2015, at http://www.baesystems.com/download/BAES_178505/hyper-velocity-projectile-hvp-datasheet.)

In July 2015, the Navy issued a request for information (RFI) to industry for the fabrication of a prototype EMRG mount capable of handling an integrated launch weight package of 22 kg, or about 48.5 pounds. (RFI for Fabrication of Prototype Mount for Naval Railgun, Solicitation Number: N00024-15-R-4132, FedBizOpps.gov, July 29, 2015. See also Justin Doubleday, "Navy Developing Integrated Mount For Electromagnetic Railgun," *Inside the Navy*, July 31, 2015.)

Figure 11. HVP

Source: Slide 7 from Navy briefing entitled "Electromagnetic Railgun," NDIA Joint Armaments Forum, Exhibition & Technology Demonstration, May 14, 2014, LCDR Jason Fox, USN, Assistant PM [Program Manager], Railgun Ship Integration, Distribution A, Approved for Public Release, accessed August 13, 2015, at http://www.dtic.mil/ndia/2014armaments/WedFox.pdf.

When fired from 5-inch powder guns, the projectile achieves a speed of roughly Mach 3, which is roughly half the speed it achieves when fired from EMRG, but more than twice the speed of a conventional 5-inch shell fired from a 5-inch gun.[41] This is apparently fast enough for countering at least some ASCMs. The Navy states that "The HVP—combined with the MK 45 [5-inch gun][42]—will support various mission areas including naval surface fire support, and has the capacity to expand to a variety of anti-air threats, [and] anti-surface [missions], and could expand the Navy's engagement options against current and emerging threats."[43]

One advantage of the HVP/5-inch gun concept is that the 5-inch guns are already installed on Navy cruisers and destroyers, creating a potential for rapidly proliferating HVP through the cruiser-destroyer force, once development of HVP is complete and the weapon has been

[41] Source: Sam LaGrone, "Updated: Navy Researching Firing Mach 3 Guided Round from Standard Deck Guns," *USNI News*, June 1, 2015 (updated June 2, 2015).

[42] The type of 5-inch gun on Navy cruisers and destroyers is called the Mark 45.

[43] Naval Surface Warfare Center Dahlgren Division Corporate Communications, "DEPSECDEF Loads HVP on Test Range, Observes Repetitive Rate Electromagnetic Railgun's Commissioning Series," *Navy News Service*, May 8, 2015, accessed August 12, 2015, at http://www.navy.mil/submit/display.asp?story_id=86987.

integrated into cruiser and destroyer combat systems. **Figure 12** shows HVP launch packages configured for 5-inch guns, 155mm guns, and EMRG.

Figure 12. HVP Launch Packages

Launch packages for 5-inch gun, 155mm gun, and EMRG

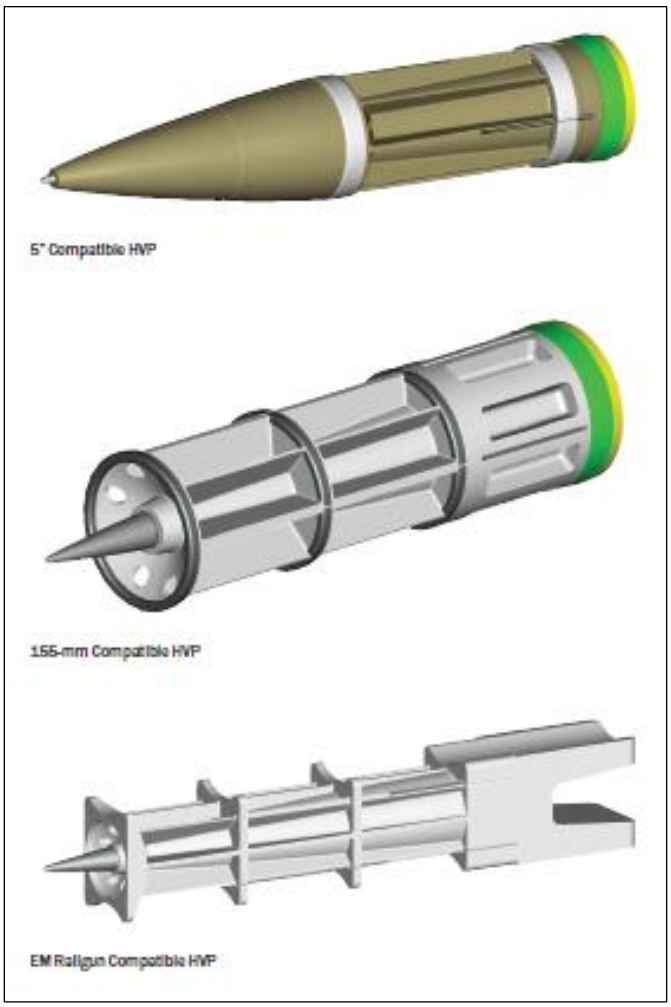

Source: BAE Systems, "Hypervelocity Projectile (HVP)," 2014, accessed August 14, 2015, at http://www.baesystems.com/download/BAES_178505/hyper-velocity-projectile--datasheet.

Figure 13 is a slide showing the potential application of HVP to 5-inch power guns, 155mm powder guns, and EMRG. The first line of the slide, for example, discusses HVP's use with 5-inch powder guns, stating that it uses a high-explosive (HE) warhead for the NSFS mission;[44] that a total of 113 5-inch gun barrels are available in the fleet (which could be a reference to 22 cruisers with two guns each, and 69 destroyers with one gun each); and that as a game-changing capability, it is guided and can be used at ranges of up to 26 nautical miles to 41 nautical miles for NSFS operations, for countering ASCMs, and for anti-surface warfare (ASuW) operations (i.e., attacking surface ships and craft).

[44] The "KE" in the next line down means that when fired from EMRG, the projectile can alternatively attack targets using its own kinetic energy (i.e., by simply impacting the target at hypersonic speed).

Figure 13. HVP Application to Various Launchers

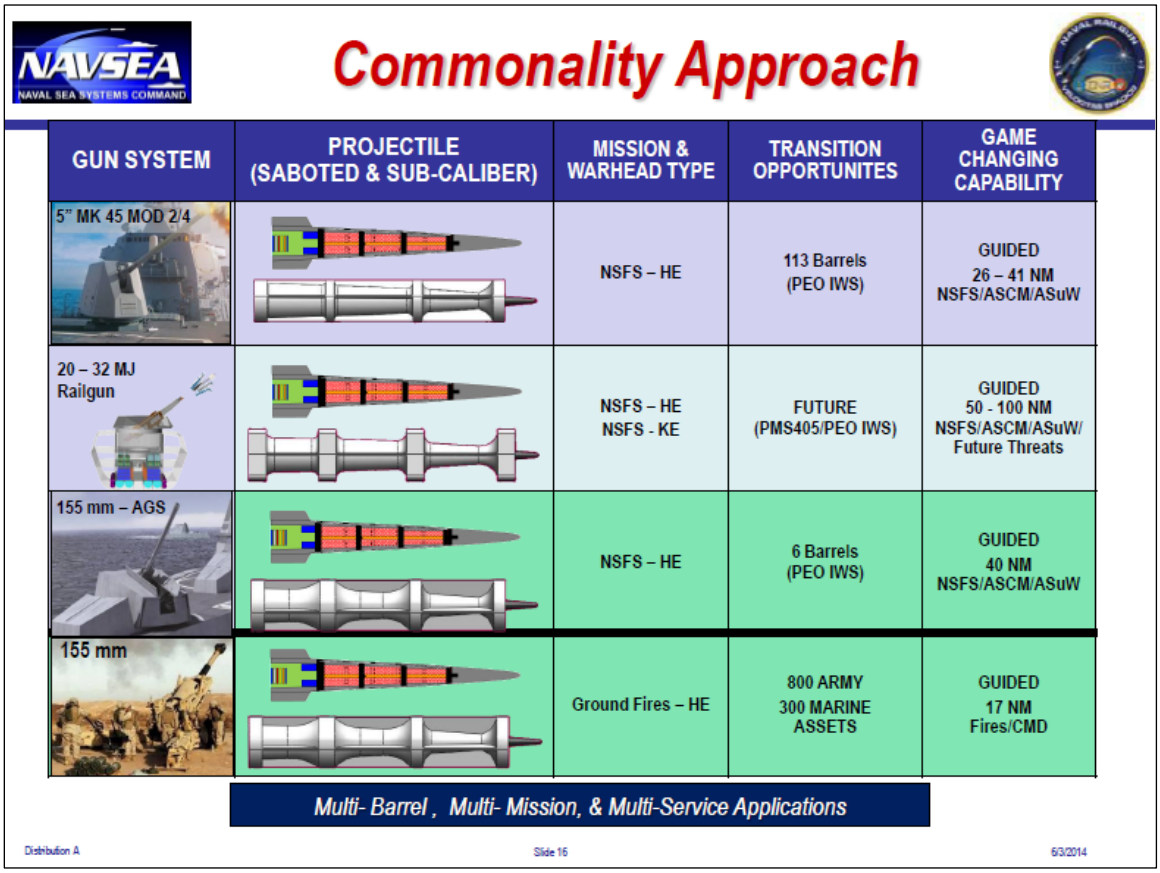

Source: Slide 16 from Navy briefing entitled "Electromagnetic Railgun," NDIA Joint Armaments Forum, Exhibition & Technology Demonstration, May 14, 2014, LCDR Jason Fox, USN, Assistant PM [Program Manager], Railgun Ship Integration, Distribution A, Approved for Public Release, accessed August 13, 2015, at http://www.dtic.mil/ndia/2014armaments/WedFox.pdf.

Figure 14 is a not-to-scale illustration of how HVPs fired from EMRGs and 5-inch guns can be used to counter various targets, including ASCMs and ASBMs.

Figure 14. Navy Slide Depicting Operations Against Various Target Types

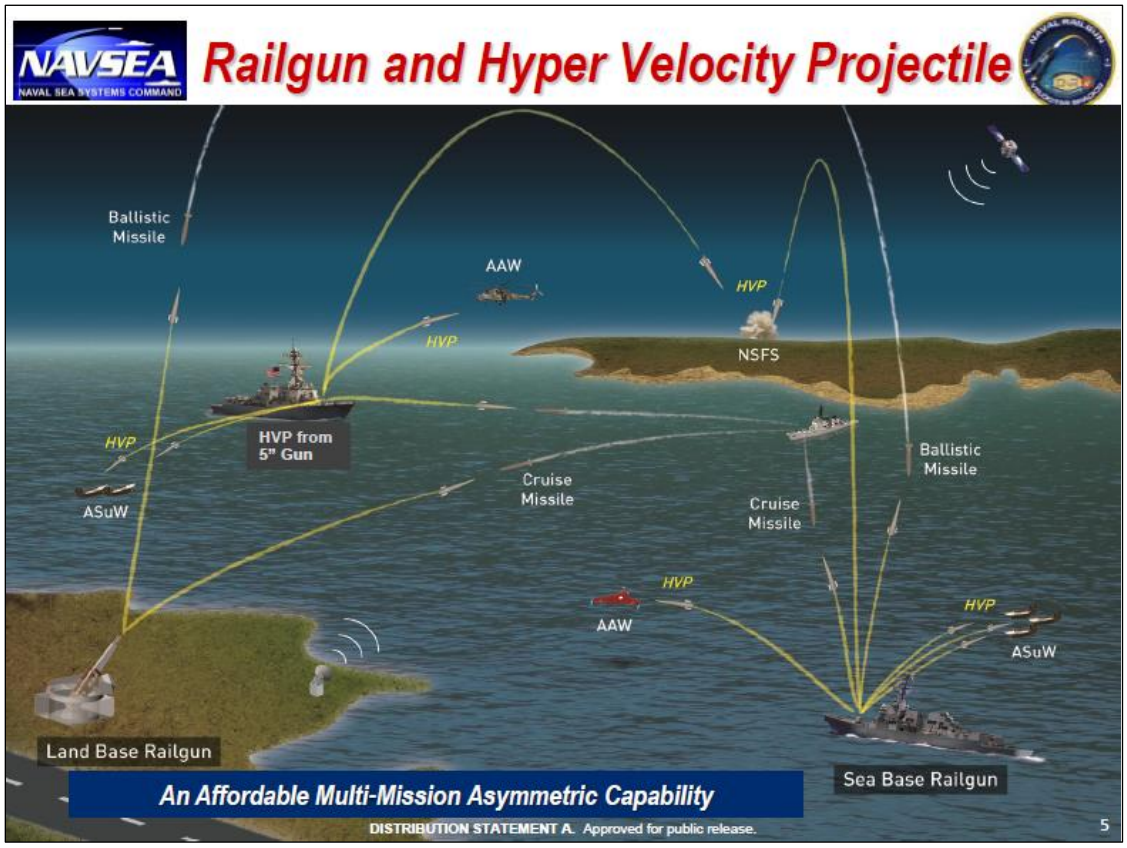

Source: Slide 5 from Navy briefing entitled "Electromagnetic Railgun," NDIA Joint Armaments Forum, Exhibition & Technology Demonstration, May 14, 2014, LCDR Jason Fox, USN, Assistant PM [Program Manager], Railgun Ship Integration, Distribution A, Approved for Public Release, accessed August 13, 2015, at http://www.dtic.mil/ndia/2014armaments/WedFox.pdf.

An April 11, 2016, press report states:

> The Pentagon wants to take a weapon originally designed for offense, flip its punch for defense and demonstrate by 2018 the potential for the Army and Navy to conduct missile defense of bases, ports and ships using traditional field guns to fire a new hypervelocity round guided by a mobile, ground variant of an Air Force fighter aircraft radar.
>
> The Strategic Capabilities Office is working with the Army, Navy and Air Force to craft a Hypervelocity Gun Weapon System that aims, in part, to provide China and Russia an example of a secret collection of new U.S. military capabilities the Defense Department is bringing online in an effort to strengthen conventional deterrence.
>
> "It is a fantastic program," Will Roper, Strategic Capabilities Office director, said in a March 28 interview with reporters, who said the project aims "to completely lower the cost of doing missile defense" by defeating missile raids at a lower cost per round and, as a consequence, imposing higher costs on attackers.[45]

A May 5, 2016, press report states:

[45] Jason Sherman, "SCO Aims To Flip The Script on Missile Defense With Hypervelocity Gun," *Inside the Navy*, April 11, 2016.

> Come January [2017], the Pentagon will almost assuredly have new leadership, complete with a new vision for how the Department of Defense should operate, organize and plan for the future.
>
> It's a reality facing down Defense Secretary Ash Carter and Deputy Secretary Bob Work as they try to complete a transformation at the Pentagon, one which both men have said is vital to making sure the US is able to maintain its technological edge against great powers like Russia and China in the future.
>
> While Carter has made his reach-out to nontraditional communities the centerpiece of his initiative, Work's focus has been the "Third Offset," a series of technological bets, largely focused on man-unmanned teaming, that he believes will pay off in the future.
>
> So how do you make sure that a long-term project like the Third Offset keeps going under a new administration?
>
> "We have three really complimentary ways to go about this," Work said Monday at an event hosted by the Atlantic Council.
>
> The first, he explained, is giving many options to the next administration.
>
> "First of all, I'm going to be central to the transition, so I am going to be able to personally talk with the transition team and explain to them what we have pursued and why we have pursued it, and let them make their own decisions," Work said.
>
> "One of the things we have done in our program is build in a lot of different options that they can pull levers on," Work explained.
>
> As an example, he pointed to the idea of an electromagnetic railgun. Initially, Work and his team thought that was an area that would be a major focus of development, but as they experimented they realized that a powder gun with a hypervelocity round could have almost the same impact — but at a fraction of the cost, because it did not require the development, testing and adaptation of a new gun.
>
> "We're going to say 'look, this is the place where [we think] you want to put your money,' but we're going to have enough money in both the electromagnetic railgun and the powder gun that if the new administration says 'I really want the electromagnetic railgun, this is the way I want to go,' knock yourself out," Work said. "We've set you up for success."[46]

Indirectly Improving Ability to Counter ASCMs and ASBMs

As discussed earlier, SSLs currently under development have enough beam power to counter small boats and UAVs, but not enough to ASCMs or ASBMs. Even so, such SSLs could indirectly improve a ship's ability to counter ASCMs and ASBMs by permitting the ship to use fewer of its SAMs for countering UAVs, and more of them for countering ASCMs and ASBMs. Similarly, even though HVPs fired from 5-inch powder guns would not be able to counter ASBMs, they could indirectly improve a ship's ability to counter ASBMs by permitting the ship to use fewer of its SAMs for countering ASCMs and more of its SAMs for countering ASBMs.

Remaining Development Challenges

Although the Navy in recent years has made considerable progress in developing SSLs, EMRG, and HVP, a number of significant development challenges remain. Overcoming these challenges

[46] Aaron Mehta, "Pentagon No. 2: How to Keep Third Offset Going in the Next Administration," *Defense News*, May 5, 2016.

will likely require years of additional development work, and ultimate success in overcoming them is not guaranteed.[47]

SSLs

As shown in **Figure 15**, remaining development challenges for SSLs include, among other things, making the system rugged enough for extended shipboard use, making the beam director (the telescope-like part of the laser that sends the beam toward the target) suitable for use in a marine environment (where moisture and salt in the air can be harsh on equipment), and integrating the system into the ship's electrical power system and combat system.

A January 23, 2015, blog post co-authored by the Office of Naval Research's program officer for the Navy's SSL program states:

> In the near term, many challenges remain to develop and operate high-energy laser systems in the maritime environment that are unique to the Navy and Marine Corps. Among these challenges is dealing with the heat generated as power levels increase. A second issue is packing sufficient power on the platform, which will require advanced battery, generator, power conditioning, and hybrid energy technologies. Current laser technologies are approximately 30 percent electrically efficient. Corrosion and contamination of optical windows by shipboard salt spray, dirt, and grime also are technical challenges. In addition, atmospheric turbulence resulting from shifting weather conditions, moisture, and dust is problematic. Turbulence can cause the air over long distances to act like a lens, resulting in the laser beam's diffusing and distorting, which degrades its performance.
>
> Much progress has been made in demonstrating high-energy laser weapon systems in the maritime environment, but there is still much to be done. Additional advances will be required to scale power levels to the hundreds of kilowatts that will make high[-]energy lasers systems robust, reliable, and affordable. Higher power levels are important for the ability to engage more challenging threats and improve the rate and range at which targets can be engaged.
>
> The programs managed by ONR are addressing these remaining issues while positioning this important warfighting capability toward an acquisition program and eventual deployment with the fleet and force.[48]

[47] Laser skeptics sometimes note that laser proponents over the years have made numerous predictions about when lasers might enter service with DOD, and that these predictions repeatedly have not come to pass. Viewing this record of unfulfilled predictions, skeptics might argue that "lasers are X years in the future—and always will be." Laser proponents acknowledge the record of past unfulfilled predictions, but argue that the situation has now changed because of rapid advancements in SSL technology and a shift from earlier ambitious goals (such as developing megawatt-power lasers for countering targets at tens or hundreds of miles) to more realistic goals (such as developing kilowatt-power lasers for countering targets at no more than a few miles). Laser proponents might argue that laser skeptics are vulnerable to what might be called cold plate syndrome (i.e., a cat that sits on a hot plate will not sit on a hot plate again—but it will not sit on a cold plate, either).

[48] Peter Morrison and Dennis Sorenson, "Developing a High-Energy Laser for the Navy," Future Force, January 23, 2015, accessed August 13, 2015, at http://futureforce.navylive.dodlive.mil/2015/01/high-energy-laser/. The authors are identified at the end of the post as follows: "Peter Morrison is the Office of Naval Research's program officer for the Navy's Solid-State Laser program. Dennis Sorenson is a contractor with the Office of Naval Research."

Figure 15. Development Challenges for SSLs

As of February 2013

Source: Slide from Navy briefing entitled "Navy Solid State Laser Program Overview," ASNE Day 2013, Mr. Peter "Rollie" Morrison, ONR 35 S&T Program Office, February 22, 2013, accessed August 13, 2015, at https://www.navalengineers.org/ProceedingsDocs/ASNEDay2013/Morrison_Pres.pdf.

EMRG and HVP

As shown in **Figure 16**, remaining development challenges for EMRG involve items relating to the gun itself (including increasing barrel life to desired levels), the projectile, the weapon's electrical power system, and the weapon's integration with the ship. Fielding HVP on cruisers and destroyers ships equipped with 5-inch and 155mm powder guns would additionally require HVP to be integrated with the combat systems of those ships.

Figure 16. Development Challenges for EMRG

As of May 2014

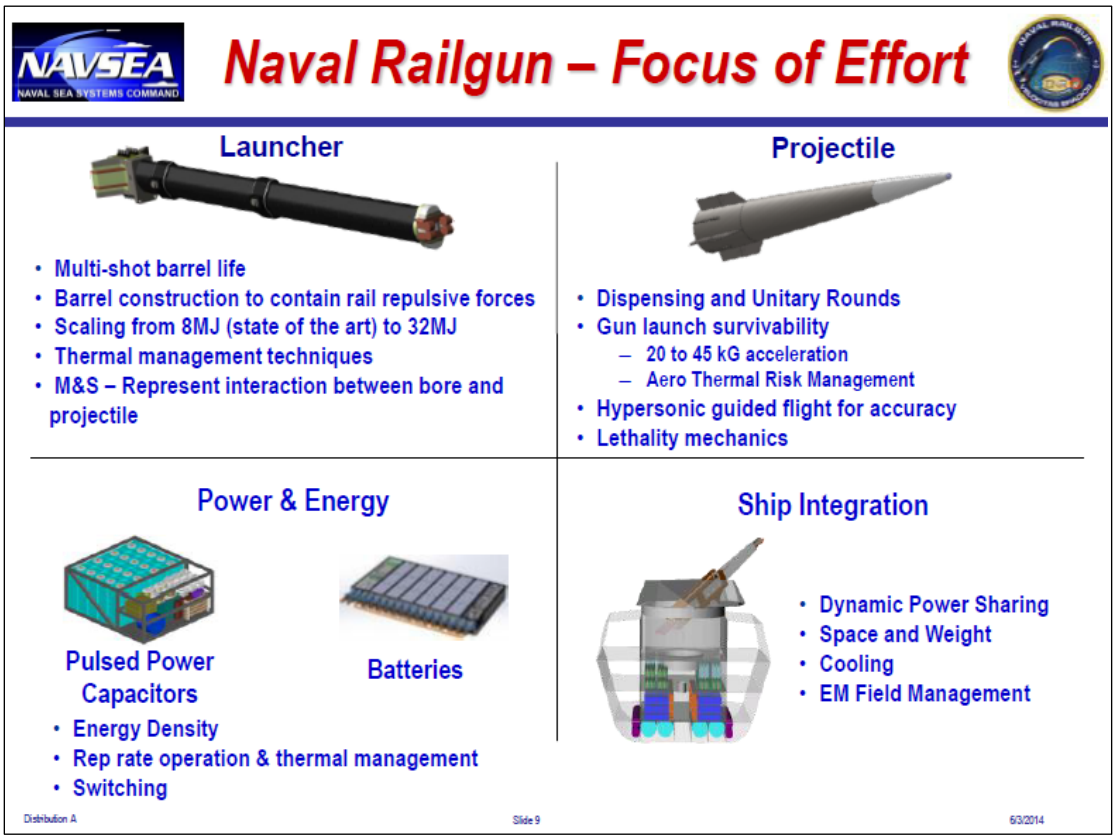

Source: Slide 9 from Navy briefing entitled "Electromagnetic Railgun," NDIA Joint Armaments Forum, Exhibition & Technology Demonstration, May 14, 2014, LCDR Jason Fox, USN, Assistant PM [Program Manager], Railgun Ship Integration, Distribution A, Approved for Public Release, accessed August 13, 2015, at http://www.dtic.mil/ndia/2014armaments/WedFox.pdf.

The Navy states:

> The EMRG effort began in FY 2005 with a focus on the barrel, power storage, and rail technology. In 2015, the Navy is testing full-scale industry advanced composite launchers for structure strength and manufacturability, and has advanced the pulsed-power system design from single-shot to actively cooled repeated rate operations. Building on the success of the first phase, the second phase started in 2012 with a focus on developing equipment and techniques to fire ten rounds per minute. Thermal-management techniques required for sustained firing rates are in development for both the launcher system and the pulsed-power system. The Office of Naval Research will develop a tactical prototype EMRG launcher and pulsed-power architecture suitable for advanced testing both afloat and ashore. Railgun demonstration has been funded to occur in FY 2016.[49]

A June 2015 press report states:

> As the Navy prepares to test its electromagnetic railgun at sea for the first time in 2016, service leaders said one of the biggest challenges will be integrating the new technology onto existing platforms.....

[49] U.S. Navy, *U.S. Navy Program Guide 2015*, p. 169.

> [Vice Adm. William Hilarides, commander of Naval Sea Systems Command] said he is positive the Navy will successfully demonstrate the weapon's ability to fire from the Trenton, but one of the biggest challenges will be configuring the railgun so that it fits within the power structure of other existing platforms.
>
> "Those are not 600-ton margin ships," he said [meaning ships with 600 tons of growth margin available to accommodate EMRG]. "If they have 60 tons, if they have 16 tons, then we'll be talking about what do we take off our existing destroyers, cruisers and other ships in order to get this incredible capability [on them]."
>
> These types of discussions are influencing ship designs as program managers look at what systems are indispensable and what can be exchanged, Hilarides said.
>
> Integrating the railgun into the fleet won't be a swift process.
>
> It will be at least 10 years until the railgun is fielded on new ships and potentially 30 years past that before the Navy considers removing powder guns from the fleet entirely and transitioning to energy weapons alone, according to Hilarides.[50]

Issues for Congress

Potential Oversight Questions

Potential oversight questions for Congress regarding Navy programs for SSLs, EMRG, and HVP include the following:

- Using currently available approaches for countering ASCMs and ASBMs, how well could Navy surface ships defend themselves in a combat scenario against an adversary such as China that has large numbers of ASCMs (including advanced models) and ASBMs? How would this change if Navy surface ships in coming years were equipped with SSLs, EMRG, HVP, or some combination of these systems?
- How significant are the remaining development challenges for SSLs, EMRG, and HVP?
- Are current schedules for developing SSLs, EMRG, and HVP appropriate in relation to remaining development challenges and projected improvements in enemy ASCMs and ASBMs? To what degree are current schedules for developing SSLs, EMRG, or HVP sensitive to annual funding levels?
- When does the Navy anticipate issuing roadmaps detailing its plans for procuring and installing production versions of SSLs, EMRGs, and HVP on specific Navy ships by specific dates?
- Will the kinds of surface ships that the Navy plans to procure in coming years have sufficient space, weight, electrical power, and cooling capability to take full advantage of SSLs (particularly those with beam powers above 200 kW) and EMRG? What changes, if any, would need to be made in Navy plans for procuring large surface combatants (i.e., destroyers and cruisers) or other Navy ships to take full advantage of SSLs and EMRG?

[50] Allyson Versprille, "Integration Biggest Challenge for Railgun," *National Defense*, June 2015. See also Lance M. Bacon, "3-Star: 'Lot of Work' Before Railgun Arrives in Fleet," *Navy Times*, February 5, 2015.

- Are the funding sources for SSLs, EMRG, and HVP in Navy and Defense-Wide research and development accounts (see "Summary of Congressional Action on FY2017 Funding" below) sufficiently visible for supporting congressional oversight?

Legislative Activity for FY2017

Summary of Congressional Action on FY2017 Funding

Funding in the defense budget for research and development work on Navy SSLs, EMRG, and HVP is spread across several research and development account line items (which are known as program elements, or PEs). The PEs shown in **Table 1** capture much but not necessarily all of the funding for developing Navy SSLs, EMRG, and HVP. The PEs shown in the table, moreover, include funding for efforts other than Navy SSLs, EMRG, and HVP, so congressional changes from requested amounts might or might not relate to SSLs, EMRG, or HVP.

Table 1. Summary of Congressional Action on FY17 Funding

In millions of dollars, rounded to nearest tenth

Program Element (PE) number, PE name, FY16 budget line number	Req.	Authorization			Appropriation		
		HASC	SASC	Conf.	HAC	SAC	Conf.
0602114N, Power Projection Applied Research, line 4	41.4	41.4	41.4		41.4		
0602750N, Future Naval Capabilities Applied Research, line 13	165.1	165.1	165.1		157.1		
0603114N, Power Projection Advanced Technology, line 16	96.4	106.4	81.4		76.6		
0603673N, Future Naval Capabilities Advanced Technology Development, line 21	249.1	249.1	239.1		252.1		
0603925N, Directed Energy and Electric Weapon System, line 75	32.7	32.7	32.7		32.7		
0604250D8Z, Advanced Innovative Technology, line 95	844.9	804.9	844.9		844.9		

Source: Table prepared by CRS based on Navy FY17 budget submission and committee and conference reports.

Notes: HASC is House Armed Services Committee; **SASC** is Senate Armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee; **Conf.** is conference agreement. The PEs shown in the table below capture much but not necessarily all of the funding for work on Navy SSLs, EMRG, and HVP. The PEs shown in the table, moreover, include funding for efforts other than Navy SSLs, EMRG, and HVP.

FY2017 National Defense Authorization Act (H.R. 4909/S. 2943)

House

The House Armed Services Committee, in its report (H.Rept. 114-537 of May 4, 2016) on H.R. 4909, recommended the funding levels shown in the HASC column of **Table 1**. The recommended increase of $10 million for PE 0603114N, Power Projection Advanced Technology

(line 16) is for "Program increase for common mount." (Page 498) The recommended reduction of $40 million for PE 0604250D8Z, Advanced Innovative Technology (line 95) is for "SCO" (the Strategic Capabilities Office). (Page 518) H.Rept. 114-537 states:

> *Common mount for electromagnetic railgun*
>
> The budget request contained $96.4 million in PE 63114N for power projection advanced technology. Of this amount, $15.4 million was included for the Navy's electromagnetic railgun prototype.
>
> The committee remains supportive of the Navy's program for developing and deploying an electromagnetic railgun. The committee recognizes the growing imperative for the Navy to field this type of weapon, not only to increase capabilities for naval surface fire support and ballistic missile defense, but to also decrease the cost exchange model when comparing the railgun to conventional missiles or guns. However, the committee is increasingly concerned that the shift in emphasis to the hypervelocity projectile by the Strategic Capabilities Office has left the Navy with a funding gap in developing the requirements and design for a common mount, which is a necessary prerequisite to getting this capability into operational use. Therefore, the committee directs the Secretary of the Navy to provide a briefing to the House Committee on Armed Services by February 15, 2017, on the plan and milestone schedule for demonstrating and deploying a common railgun mount for sea- and land-based applications.
>
> The committee recommends $106.4 million, an increase of $10.0 million, in PE 63114N to support the development of a common mount for the sea-based and land-based electromagnetic railgun. (Page 61)

H.Rept. 114-537 also states:

> *Strategic Capabilities Office*
>
> The budget request contained $844.9 million in PE 64250D8Z for development activities of the Strategic Capabilities Office (SCO).
>
> Created in 2012 by the Deputy Secretary of Defense, SCO has the mission to identify, analyze, demonstrate, and transition game-changing applications of existing and near-term technology to shape and counter emerging threats. SCO is comprised of a relatively small number of personnel and relies on other program office personnel and resources to execute its mission. The committee appreciates the nature of SCO's mission and sustained leanness of the organization; however, the committee notes the budget for SCO has grown exponentially each fiscal year. For example, the fiscal year 2017 budget request is nearly double the request for fiscal year 2016.
>
> The committee is concerned that such rapid budget growth may bring with it some risks, including the demands on SCO's small staff, demands on other Department of Defense personnel, and impact of SCO decisions on existing programs. For example, the committee is aware of SCO's inclusion on the electromagnetic railgun development, and subsequent reprioritizing of its planned investment in that program for fiscal year 2017, resulting in a funding gap that could not be covered by the program office.
>
> Additionally, the committee remains concerned that the transition of technologies from SCO has not been adequately captured and conveyed to the oversight committees. The report required by the committee report (H. Rept. 114–102) accompanying the National Defense Authorization Act for Fiscal Year 2016 has not been delivered and is now almost 6 months late. In order to support prudent use of taxpayer resources, and to ensure proper oversight of these activities, the committee believes this report should be provided and concerns addressed before supporting full funding of planned activities.
>
> Therefore, the committee recommends $804.9 million, a decrease of $40.0 million, in PE 64250D8Z for development activities of the Strategic Capabilities Office. (Page 92)

Section 220 of H.R. 4909 as reported states:

> SEC. 220. Designation of Department of Defense senior official with principal responsibility for directed energy weapons.
>
> Not later than 180 days after the date of the enactment of this Act, the Secretary of Defense shall—
>
> (1) designate a senior official already serving within the Department of Defense as the official with principal responsibility for the development and demonstration of directed energy weapons for the Department; and
>
> (2) set forth the responsibilities of that senior official with respect to such programs.

H.Rept. 114-537 also states:

> *Five-inch precision guided projectile development for naval surface fire support*
>
> In the committee report (H. Rept. 114–102) accompanying the National Defense Authorization Act for Fiscal Year 2016, the committee noted "that current surface Navy gunnery requirements are outdated and that new technologies such as railgun and directed energy weapons are nearing readiness for technology transition." The committee referenced the Advanced Naval Surface Fires (ANSF) initiative and noted the ANSF was assessing options for providing a near-term 5-inch guided munition capability. The committee understands this capability would provide for improved and extended-range naval surface fire support. The committee continues to support the need for this precision guided capability and is also aware of the Hypervelocity Gun Weapon System (HGWS) program that is currently under consideration by the Strategic Capabilities Office (SCO). The committee notes the HGWS program would "flip the cost equation using conventional guns to defend forward bases against raids of advanced cruise and ballistic missiles" and believes there could be applications for use in 5-inch gun systems for naval surface fires support. The committee is encouraged by the development of both of these initiatives and expects the Navy and SCO to coordinate on these capabilities. The committee also expects the Navy to proceed forward with an accelerated development and acquisition strategy for this needed capability that is consistent with acquisition reform principles. (Pages 62-63)

H.Rept. 114-537 also states:

> *Technology enablers for directed energy weapon systems*
>
> The committee is aware that the Department of Defense has made significant advances in the development and operational demonstration of directed energy weapons systems. Each military department has demonstrated a marquee program in this area, such as the Navy's Laser Weapon System deployed on the USS Ponce, the Army High Energy Laser Mobile Demonstrator, and the Marine Corps' Ground Based Air Defense System. Along with technology demonstration activities like the Robust Electric Laser Initiative and the High Energy Liquid Laser Area Defense System, each of these programs demonstrated the increased power output and power on target necessary to develop a militarily useful directed energy weapon.
>
> However, as the Department has made progress in raising the power levels of these systems, it has also demonstrated the need for emphasis on development in other technology areas necessary to realize the full potential of laser weapons. For example, higher power output requires improved beam control to engage targets at greater distances, as well as better thermal management systems to dissipate the increased heat load. As the Department has been overcoming foundational technical challenges, new challenges have emerged that will impact the operational uses for directed energy weapons.

> Therefore, the committee directs the Assistant Secretary of Defense for Research and Engineering, in coordination with the research components of the military departments and the High Energy Laser Joint Technology Office, to provide a briefing to the House Committee on Armed Services by January 20, 2017. This briefing should provide a roadmap for enabling technologies, including:
>
> (1) Beam directors and adaptive optics, including deformable mirrors;
>
> (2) Thermal management needs and capabilities;
>
> (3) Integration challenges with fire control systems, including potential
>
> future needs for fire control for laser systems;
>
> (4) Power architectures and power electronics needs;
>
> (5) Facilities and test range capabilities; and
>
> (6) Other areas as deemed by the Secretary. (Page 93)

Senate

The Senate Armed Services Committee, in its report (S.Rept. 114-255 of May 18, 2016) on S. 2943, recommended the funding levels shown in the SASC column of **Table 1**. The recommended reduction of $15 million to PE 0603114N, Power Projection Advanced Technology (line 16) is for "General decrease." (Page 481) The recommended reduction of $10 million to PE 0603673N, Future Naval Capabilities Advanced Technology Development (line 21) is for "Capable manpower, and power and energy." (Page 481).[51] S.Rept. 114-255 states:

> **Power projection advanced technology**
>
> The budget request included $96.4 million in PE 63114N for power projection advanced technology. The committee notes that the Navy, Air Force, Defense Advanced Research Projects Agency, Strategic Capabilities Office, and other elements within the Department of Defense are all pursuing advanced power projection technologies and systems. The committee is concerned that these efforts are not well-coordinated and have uncertain pathways for transition to programs of record. In addition, the committee notes that the budget request represents an almost 200 percent increase over the amount enacted for fiscal year 2016. The committee believes that such a large increase in budget is not warranted and is concerned about the ability of the programs to absorb the additional funding. Consequently, the committee recommends a decrease of $15.0 million in PE 63114N, but directs that this reduction not be assessed against solid state laser maturation efforts. (Page 52)

Section 216 of S. 2943 as reported states:

[51] This recommended reduction of $10 million does not appear to relate (at least not directly) to lasers, the electromagnetic railgun, or the HVP. S.Rept. 114-255 states:

> **Capable manpower and power and energy**
>
> The budget request included $249.1 million in PE 63673N for future naval capabilities advanced technology developments. The activities listed under this program element include capable manpower and power and energy. The committee believes that the work plans for fiscal year 2017 on these activities does not warrant the level of funding included in the budget request. For example, the committee notes that the research included in these two projects include development of new personnel and management methodologies, and capabilities in energy security. Both of these efforts could be better coordinated with other organizations performing similar research. Consequently, the committee recommends a decrease of $10.0 million in PE 63673N to be distributed appropriately from capable manpower and power and energy. (Page 53)

SEC. 216. Directed energy weapon system programs.

(a) Inclusion of Directed Energy Weapon System programs in the rapid acquisition authority program.—

(1) IN GENERAL.—Section 806(c)(1) of the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (Public Law 107–314; 10 U.S.C. 2302 note) is amended by adding at the end the following new subparagraph:

"(D) (i) In the case of any supplies and associated support services that, as determined in writing by the Secretary of Defense without delegation, are urgently needed to eliminate a deficiency in directed energy weapon systems, the Secretary may use the procedures developed under this section in order to accomplish the rapid acquisition and deployment of needed offensive or defensive directed energy weapon systems capabilities, supplies, and associated support services.

"(ii) For the purposes of directed energy weapon systems acquisition, the Secretary of Defense shall consider use of the following procedures:

"(I) The rapid acquisition authority provided under this section.

"(II) Use of other transactions authority provided under section 2371 of title 10, United States Code.

"(III) The acquisition of commercial items using simplified acquisition procedures.

"(IV) The authority for procurement for experimental purposes provided under section 2373 of title 10, United States Code.

"(iii) In this subparagraph, the term 'directed energy weapon systems' means military action involving the use of directed energy to incapacitate, damage, or destroy enemy equipment, facilities, or personnel.".

(2) CONFORMING AMENDMENTS.—Section 2373 of title 10, United States Code, is amended—

(A) in subsection (a), by striking "and aeronautical supplies" and inserting ", aeronautical supplies, and directed energy weapon systems"; and

(B) by adding at the end of the following new subsection:

"(c) Directed energy weapon systems defined.—In this section, the term 'directed energy weapon systems' means military action involving the use of directed energy to incapacitate, damage, or destroy enemy equipment, facilities, or personnel.".

(b) Joint Directed Energy Program Office.—

(1) REDESIGNATION.—The High Energy Laser Joint Technology Office of the Department of Defense is hereby redesignated as the "Joint Directed Energy Program Office" (in this subsection referred to as the "Office").

(2) STRATEGIC PLAN FOR DEVELOPMENT AND FIELDING OF DIRECTED ENERGY WEAPONS CAPABILITIES.—In addition to the functions and duties of the Office in effect on the day before the date of the enactment of this Act, the Office shall develop a strategic plan for development and fielding of directed energy weapons capabilities for the Department, in which the Office may define requirements for directed energy capabilities that address the highest priority warfighting capability gaps of the Department.

(3) ACCELERATION OF DEVELOPMENT AND FIELDING OF DIRECTED ENERGY WEAPONS CAPABILITIES.—

(A) IN GENERAL.—To the degree practicable, the Office shall use the policies of the Department that are revised pursuant to this section and new acquisition and management

practices established pursuant to this section to accelerate the development and fielding of directed energy capabilities.

(B) ENGAGEMENT.—The Secretary shall ensure that use of policies and practices described in subparagraph (A) include engagement with defense and private industries, research universities, and unaffiliated, nonprofit research institutions.

Regarding Section 216, S.Rept. 114-255 states:

Directed energy weapon system programs (sec. 216)

The committee remains concerned about the Department of Defense's inability to field an operational directed energy system. The committee is aware that the military services and industry partners have developed sufficient directed energy weapon capabilities for specific scenarios—like the High Energy Laser Mobile Demonstrator (HEL–MD) to counter rocket, artillery and mortar for base protection purposes and the Counter Electronics High Powered Microwave Advanced Missile Project (CHAMP) for disabling an adversary's electronics while avoiding collateral damage. These programs, as well as other high energy laser weapon systems, have been tested and demonstrated, but have failed to transition to acquisition programs of record.

The committee notes that directed energy capabilities have the potential to support many operational missions in cost effective and efficient manners. In response to these factors, the committee recommends a provision that would amend section 806 of the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (Public Law 107–314) to grant rapid acquisition authorities for directed energy weapon systems to accelerate the development and fielding of this technology and to help offset the gains of potential adversaries.

The committee notes that since 1960, the Department of Defense has invested more than $6.0 billion in directed energy science and technology initiatives. However, the committee remains concerned that, despite this significant investment, the Department's directed energy initiatives are not resourced at levels necessary to transition them to full-scale acquisition programs. The committee notes with concern that years of investment have not to date resulted in any operational systems with high energy laser capability.

The committee highlights that the Defense Science Board Task Force on Directed Energy Weapon Systems and Technology Applications found that "directed energy offers promise as a transformational 'game changer' in military operations, able to augment and improve operational capabilities in many areas." The task force further concluded that the range of potential applications is sufficient to warrant significantly increased attention to the scope and direction of efforts to assess, develop, and field appropriate laser, microwave, and millimeter wave weapons. Consistent with the findings of the task force, the committee believes that directed energy weapons systems offer significant benefits in terms of cost effectiveness, sustainability, magazine capabilities, and precision targeting. (Pages 46-47)

S.Rept. 114-255 also states:

High energy laser joint technology office

The budget request included $42.3 million in PE 62890F for high energy laser research. The committee notes that this program element funds defense high energy laser applied research through the High Energy Laser Joint Technology Office. However, the committee is concerned that the Joint Technology Office has not received sufficient funding in recent years to drive the maturation of high energy laser technology. As an example, the committee notes with concern that no laser technologies have yet been fielded or deployed, despite promising development and field tests. Given the importance of directed energy weapons systems in general as noted elsewhere in this Act, and of high energy laser systems in particular, the committee is concerned that budget request for this

> program element will be insufficient for supporting the joint technology office. Accordingly, the committee recommends an increase of $5.0 million in PE 62890F for the high energy laser joint technology office. (Pages 54-55)

S.Rept. 114-255 also states:

> **Directed energy systems prototyping**
>
> The budget request included no money in PE 64342D8Z for defense technology offsets. The committee notes with disappointment that the administration did not view it as a priority to request funds through this program element. Particularly with the high-profile emphasis placed on the Department of Defense's Third Offset Strategy, the committee is disappointed to see this program be unfunded. In addition, as noted elsewhere in this report, the committee is deeply disappointed with how the technology offset funding enacted in fiscal year 2016 was allocated. As noted, none of the money was put towards directed energy, in contradiction to the clear intent of Congress that half of the money be used to bolster directed energy technologies. While the committee does not recommend additional unrestricted funds for the technology offsets program, the committee underscores that directed energy systems are still critical areas of work in need of greater support and attention. The committee believes that the Department needs to focus in particular on the transition from lab development to deployment and fielding. Consequently, the committee recommends a general increase of $25.0 million in PE 64342D8Z to be used only for the purposes of directed energy systems prototyping. (Pages 59-60)

S.Rept. 114-255 also states:

> **Laser weapon system demonstrator**
>
> The Committee commends the Navy for initiating and funding the Laser Weapon Systems Demonstrator (LWSD) and believes that this is an important step toward maturing technologies that could ultimately enable the deployment of a shipboard maritime laser weapons system. While the Committee understands that the Navy envisions transitioning laser weapons to a formal Program of Record in the 2020s, it appears that the Navy has not programmed funding beyond the LWSD sea-based tests to support the installation of LWSD on a DDG or for the design and procurement of a formal maritime laser program.
>
> The committee expects that the Secretary of the Navy will keep the congressional defense committees updated on its plan to seamlessly transition the LWSD to a shipboard weapons system following sea-based testing and to a formal maritime laser Program of Record, technical progress toward developing the capability, and programmatic steps being taken to move to demonstration and deployment of advanced laser systems. (Page 70)

FY2017 DOD Appropriations Act (H.R. 5293)

House

The House Appropriations Committee, in its report (H.Rept. 114-577 of May 19, 2016) on H.R. 5293, recommended the funding levels shown in the HAC column of **Table 1**. The recommended reduction of $8 million to PE 0602750N, Future Naval Capabilities Applied Research (line 13) is for "FORCENET excessive growth" ($5 million), "Power and energy previously funded efforts" ($2 million), and "Sea shield previously funded efforts" ($1 million). (Page 228) The recommended reduction of $19.8 million to PE 0603114N, Power Projection Advanced Technology (line 16) is for "Precision strike technology excess growth." (Page 228) The recommended net reduction of $3 million to PE 0603673N, Future Naval Capabilities Advanced

Technology Development (line 21) consists of a reduction of $2 million for "Power and energy previously funded efforts," a reduction of $2 million for "Sea shield previously funded efforts," and an increase of $7 million for "Program increase—ASW [antisubmarine warfare] research." (Page 228)

H.Rept. 114-577 states:

> HIGH ENERGY LASERS
>
> The Committee is aware of efforts within the High Energy Laser Joint Technology Office to develop advanced, directed-energy, high energy laser weapons that have the potential to perform a wide variety of military missions. The Committee encourages the Secretary of Defense to explore further development and evaluation of this important technology. (Page 264)

Directed Energy Weapon Systems Acquisition Act of 2016 (H.R. 4964/S. 2778)

House

H.R. 4964 was introduced in the House on May 5, 2016. The text of H.R. 4964 as introduced states:

> SECTION 1. Short title.
>
> This Act may be cited as the "Directed Energy Weapon Systems Acquisition Act of 2016".
>
> SEC. 2. Findings.
>
> Congress makes the following findings:
>
> (1) The Committee on Armed Services of the Senate noted in the report accompanying S. 1356 (S. Rept. 114–49; 114th Congress) that since 1960, the Department of Defense has invested more than $6,000,000,000 in directed energy science and technology initiatives, and that the Committee is concerned that, despite this significant investment, the Department's directed energy initiatives are not resourced at levels necessary to transition them to full-scale acquisition programs.
>
> (2) The Defense Science Board Task Force on Directed Energy Weapon Systems and Technology Applications (the "Task Force") found that "directed energy offers promise as a transformational 'game changer' in military operations, able to augment and improve operational capabilities in many areas".
>
> (3) Despite this potential, years of investment have not resulted in any operational systems with high energy laser capability.
>
> (4) The Task Force believes that the range of potential application is sufficient to warrant significantly increased attention to the scope and direction of efforts to assess, develop, and field appropriate laser, microwave, and millimeter wave weapons.
>
> SEC. 3. Inclusion of directed energy weapon system programs in the rapid acquisition authority program.
>
> (a) In general.—Section 806(c)(1) of the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (Public Law 107–314; 10 U.S.C. 2302 note) is amended by adding at the end the following new subparagraph:
>
> "(D) (i) In the case of any supplies and associated support services that, as determined in writing by the Secretary of Defense without delegation, are urgently needed to eliminate

a deficiency in directed energy weapon systems, the Secretary may use the procedures developed under this section in order to accomplish the rapid acquisition and deployment of needed offensive or defensive directed energy weapon systems capabilities, supplies, and associated support services.

"(ii) For the purposes of directed energy weapon systems acquisition, the Secretary of Defense shall consider use of the following procedures:

"(I) The rapid acquisition authority provided under this section.

"(II) Use of other transactions authority provided under section 2371 of title 10, United States Code.

"(III) The acquisition of commercial items using simplified acquisition procedures.

"(IV) The authority for procurement for experimental purposes provided under section 2373 of title 10, United States Code.

"(iii) In this subparagraph, the term 'directed energy weapon system' means military action involving the use of directed energy to incapacitate, damage, or destroy enemy equipment, facilities, or personnel.".

(b) Conforming amendments.—Section 2373 of title 10, United States Code, is amended—

(1) in subsection (a), by striking "and aeronautical supplies" and inserting ", aeronautical supplies, and directed energy weapon systems"; and

(2) by adding at the end of the following new subsection:

"(c) Directed energy weapon system defined.—In this section, the term 'directed energy weapon system' means military action involving the use of directed energy to incapacitate, damage, or destroy enemy equipment, facilities, or personnel.".

SEC. 4. Joint Directed Energy Program Office.

(a) Redesignation.—The High Energy Laser Joint Technology Office of the Department of Defense is hereby redesignated as the "Joint Directed Energy Program Office" (in this section referred to as the "Office").

(b) Strategic plan for development and transition of directed energy weapons capabilities toward fielding.—In addition to the functions and duties of the Office in effect on the day before the date of the enactment of this Act, the Office shall develop a strategic plan for development and transition of directed energy weapons capabilities toward fielding for the Department, in which the Office may define requirements for directed energy capabilities that address the highest priority warfighting capability gaps of the Department.

(c) Acceleration of development and transition of directed energy weapons capabilities toward fielding.—

(1) IN GENERAL.—To the degree practicable, the Office shall use the policies of the Department that are revised pursuant to this Act and new acquisition and management practices established pursuant to this Act to accelerate the development and transition of directed energy capabilities toward fielding.

(2) ENGAGEMENT.—The Secretary shall ensure that use of policies and practices described in paragraph (1) include engagement with defense and private industries, research universities, and unaffiliated, nonprofit research institutions.

Senate

S. 2778 was introduced in the Senate on April 12, 2016. The text of S. 2778 as introduced states:

SECTION 1. Short title.

This Act may be cited as the "Directed Energy Weapon Systems Acquisition Act of 2016".

SEC. 2. Findings.

Congress makes the following findings:

(1) The Committee on Armed Services of the Senate noted in the report accompanying S. 1356 (S. Rept. 114–49; 114th Congress) that since 1960, the Department of Defense has invested more than $6,000,000,000 in directed energy science and technology initiatives, and that the Committee is concerned that, despite this significant investment, the Department's directed energy initiatives are not resourced at levels necessary to transition them to full-scale acquisition programs.

(2) The Defense Science Board Task Force on Directed Energy Weapon Systems and Technology Applications (the "Task Force") found that "directed energy offers promise as a transformational 'game changer' in military operations, able to augment and improve operational capabilities in many areas".

(3) Despite this potential, years of investment have not resulted in any operational systems with high energy laser capability.

(4) The Task Force believes that the range of potential application is sufficient to warrant significantly increased attention to the scope and direction of efforts to assess, develop, and field appropriate laser, microwave, and millimeter wave weapons.

SEC. 3. Inclusion of directed energy weapon system programs in the rapid acquisition authority program.

(a) In general.—Section 806(c)(1) of the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (Public Law 107–314; 10 U.S.C. 2302 note) is amended by adding at the end the following new subparagraph:

"(D) (i) In the case of any supplies and associated support services that, as determined in writing by the Secretary of Defense without delegation, are urgently needed to eliminate a deficiency in directed energy weapon systems, the Secretary may use the procedures developed under this section in order to accomplish the rapid acquisition and deployment of needed offensive or defensive directed energy weapon systems capabilities, supplies, and associated support services.

"(ii) For the purposes of directed energy weapon systems acquisition, the Secretary of Defense shall consider use of the following procedures:

"(I) The rapid acquisition authority provided under this section.

"(II) Use of other transactions authority provided under section 2371 of title 10, United States Code.

"(III) The acquisition of commercial items using simplified acquisition procedures.

"(IV) The authority for procurement for experimental purposes provided under section 2373 of title 10, United States Code.

"(iii) In this subparagraph, the term 'directed energy weapon system' means military action involving the use of directed energy to incapacitate, damage, or destroy enemy equipment, facilities, or personnel.".

(b) Conforming amendments.—Section 2373 of title 10, United States Code, is amended—

(1) in subsection (a), by striking "and aeronautical supplies" and inserting ", aeronautical supplies, and directed energy weapon systems"; and

(2) by adding at the end the following new subsection:

"(c) Directed energy weapon system defined.—In this section, the term 'directed energy weapon system' means military action involving the use of directed energy to incapacitate, damage, or destroy enemy equipment, facilities, or personnel.".

SEC. 4. Joint Directed Energy Program Office.

(a) Redesignation.—The High Energy Laser Joint Technology Office of the Department of Defense is hereby redesignated as the "Joint Directed Energy Program Office" (in this section referred to as the "Office").

(b) Strategic plan for development and transition of directed energy weapons capabilities toward fielding.—In addition to the functions and duties of the Office in effect on the day before the date of the enactment of this Act, the Office shall develop a strategic plan for development and transition of directed energy weapons capabilities toward fielding for the Department, in which the Office may define requirements for directed energy capabilities that address the highest priority warfighting capability gaps of the Department.

(c) Acceleration of development and transition of directed energy weapons capabilities toward fielding.—

(1) IN GENERAL.—To the degree practicable, the Office shall use the policies of the Department that are revised pursuant to this Act and new acquisition and management practices established pursuant to this Act to accelerate the development and transition of directed energy capabilities toward fielding.

(2) ENGAGEMENT.—The Secretary shall ensure that use of policies and practices described in paragraph (1) include engagement with defense and private industries, research universities, and unaffiliated, nonprofit research institutions.

Appendix. Potential Advantages and Limitations of Shipboard Lasers

This appendix presents additional information on potential advantages and limitations of shipboard lasers.

Potential Advantages

In addition to a low marginal cost per shot and deep magazine, potential advantages of shipboard lasers include the following:

- **Fast engagement times.** Light from a laser beam can reach a target almost instantly (eliminating the need to calculate an intercept course, as there is with interceptor missiles) and, by remaining focused on a particular spot on the target, cause disabling damage to the target within seconds. After disabling one target, a laser can be redirected in several seconds to another target.
- **Ability to counter radically maneuvering missiles.** Lasers can follow and maintain their beam on radically maneuvering missiles that might stress the maneuvering capabilities of Navy SAMs.
- **Precision engagements.** Lasers are precision-engagement weapons—the light spot from a laser, which might be several inches in diameter, affects what it hits, while generally not affecting (at least not directly) separate nearby objects.
- **Graduated responses.** Lasers can perform functions other than destroying targets, including detecting and monitoring targets and producing nonlethal effects, including reversible jamming of electro-optic (EO) sensors. Lasers offer the potential for graduated responses that range from warning targets to reversibly jamming their systems, to causing limited but not disabling damage (as a further warning), and then finally causing disabling damage.

Potential Limitations

Potential limitations of shipboard lasers include the following:

- **Line of sight.** Since laser light tends to fly through the atmosphere on an essentially straight path, shipboard lasers would be limited to line-of-sight engagements, and consequently could not counter over-the-horizon targets or targets that are obscured by intervening objects. This limits in particular potential engagement ranges against small boats, which can be obscured by higher waves, or low-flying targets. Even so, lasers can rapidly reacquire boats obscured by periodic swells.
- **Atmospheric absorption, scattering, and turbulence.** Substances in the atmosphere—particularly water vapor, but also things such as sand, dust, salt particles, smoke, and other air pollution—absorb and scatter light from a shipboard laser, and atmospheric turbulence can defocus a laser beam. These effects can reduce the effective range of a laser. Absorption by water vapor is a particular consideration for shipboard lasers because marine environments feature substantial amounts of water vapor in the air. There are certain wavelengths of light (i.e., “sweet spots” in the electromagnetic spectrum) where atmospheric absorption by water vapor is markedly reduced. Lasers can be

designed to emit light at or near those sweet spots, so as to maximize their potential effectiveness. Absorption generally grows with distance to target, making it in general less of a potential problem for short-range operations than for longer-range operations. Adaptive optics, which make rapid, fine adjustments to a laser beam on a continuous basis in response to observed turbulence, can counteract the effects of atmospheric turbulence. Even so, lasers might not work well, or at all, in rain or fog, preventing lasers from being an all-weather solution.

- **Thermal blooming.** A laser that continues firing in the same exact direction for a certain amount of time can heat up the air it is passing through, which in turn can defocus the laser beam, reducing its ability to disable the intended target. This effect, called thermal blooming, can make lasers less effective for countering targets that are coming straight at the ship, on a constant bearing (i.e., "down-the-throat" shots). Other ship self-defense systems, such as interceptor missiles or a CIWS, might be more suitable for countering such targets. Most tests of laser systems have been against crossing targets rather than "down-the-throat" shots. In general, thermal blooming becomes more of a concern as the power of the laser beam increases.
- **Saturation attacks.** Since a laser can attack only one target at a time, requires several seconds to disable it, and several more seconds to be redirected to the next target, a laser can disable only so many targets within a given period of time. This places an upper limit on the ability of an individual laser to deal with saturation attacks—attacks by multiple weapons that approach the ship simultaneously or within a few seconds of one another. This limitation can be mitigated by installing more than one laser on the ship, similar to how the Navy installs multiple CIWS systems on certain ships.
- **Hardened targets and countermeasures.** Less-powerful lasers—that is, lasers with beam powers measured in kilowatts (kW) rather than megawatts (MW)—can have less effectiveness against targets that incorporate shielding, ablative material, or highly reflective surfaces, or that rotate rapidly (so that the laser spot does not remain continuously on a single location on the target's surface) or tumble. Small boats (or other units) could employ smoke or other obscurants to reduce their susceptibility to laser attack.[52] Measures such as these, however, can increase the cost and/or weight of a weapon, and obscurants could make it more difficult for small boat operators to see what is around them, reducing their ability to use their boats effectively.
- **Risk of collateral damage to aircraft, satellites, and human eyesight.** Since light from an upward-pointing laser that does not hit the target would continue flying upward in a straight line, it could pose a risk of causing unwanted collateral damage to aircraft and satellites. The light emitted by SSLs being developed by the Navy is of a frequency that can cause permanent damage to human eyesight, including blinding. Blinding can occur at ranges much greater than ranges for damaging targeted objects. Scattering of laser light off the target or off fog or particulates in the air can pose a risk to exposed eyes.[53]

[52] See, for example, "Kelsey D. Atherton, "China Plans To Defeat American Lasers With Smoke," *Popular Science*, May 3, 2016.

[53] The United States in 1995 ratified the 1980 Convention on Prohibitions or Restriction on the Use of Certain Conventional Weapons Which May be Deemed to be Excessively Injurious or to Have Indiscriminate Effects. An (continued...)

For additional background information on potential Navy shipboard SSLs, see CRS Report R41526, *Navy Shipboard Lasers for Surface, Air, and Missile Defense: Background and Issues for Congress*, by Ronald O'Rourke.

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(...continued)

international review of the convention began in 1994 and concluded in May 1996 with the adoption of, among other things, a new Protocol IV on blinding laser weapons. The protocol prohibits the employment of lasers that are specifically designed to cause permanent blindness to the naked eye or to the eye with corrective eyesight devices. The United States ratified Protocol IV on December 23, 2008, and it entered into force for the United States on July 21, 2009. DOD views the protocol as fully consistent with DOD policy. DOD believes the lasers discussed in this report are consistent with DOD policy of prohibiting the use of lasers specifically designed to cause permanent blindness to the naked eye or to the eye with corrective eyesight devices. For further discussion, see Appendix I ("Protocol on Blinding Lasers") in CRS Report R41526, *Navy Shipboard Lasers for Surface, Air, and Missile Defense: Background and Issues for Congress*, by Ronald O'Rourke.

Torpedo & Directed Energy Weapons
Indian Navy Perspective

RAdm Om Prakash Singh Rana, VSM,
Director General of Naval Armament Inspection

IN supporting Indigenisation

IN Indigenisation Plan 2015-30

Maritime Cap Perspective Plan

Self-Reliance

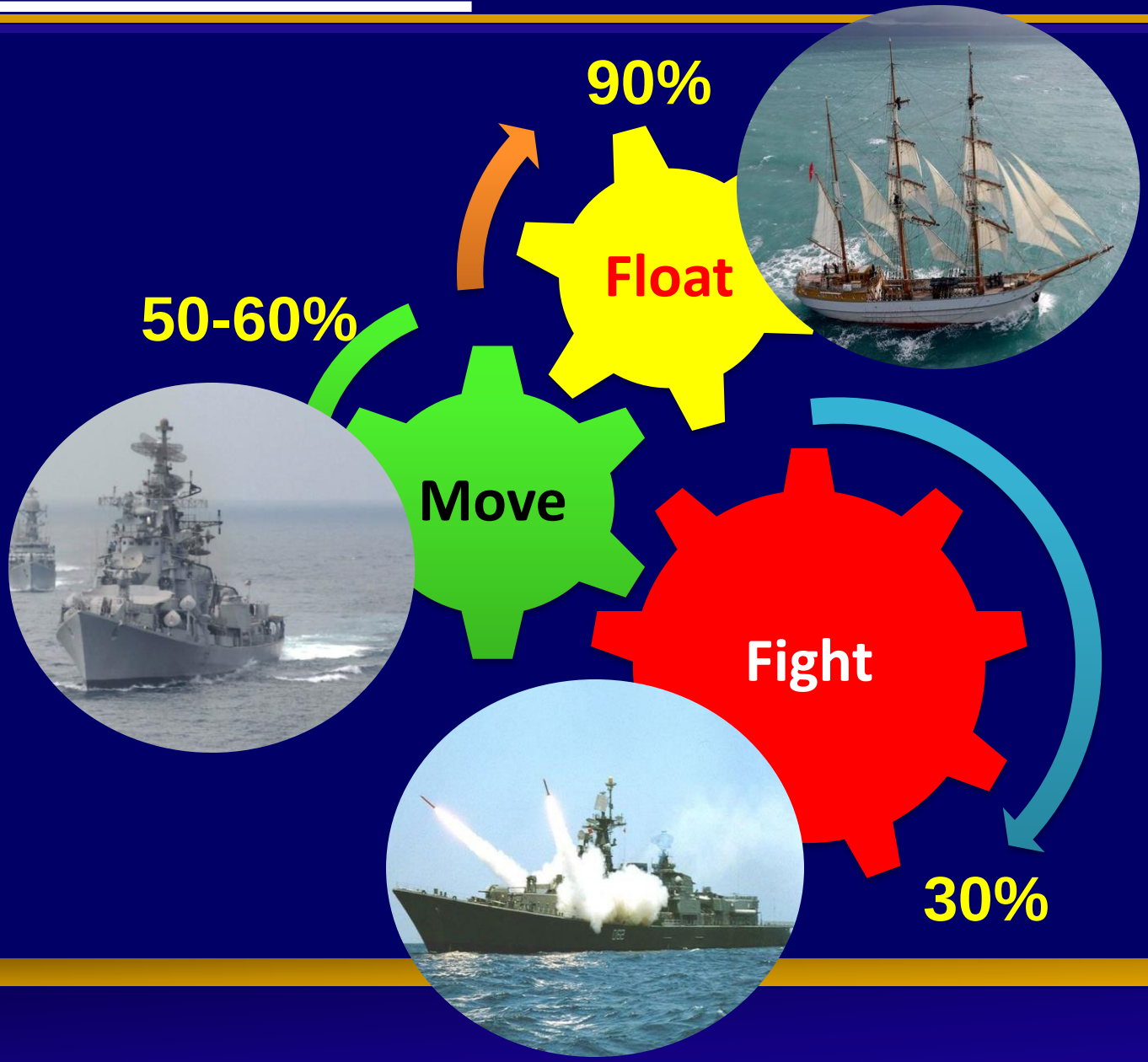

Scope

- Torpedo & Directed Energy Weapons
  - Technological advancement
  - Availability
- QRs for Torpedo & DEWs
- Way Ahead

Advancement
in
Torpedo Technology

Advancement in Torpedo Technology Contd...

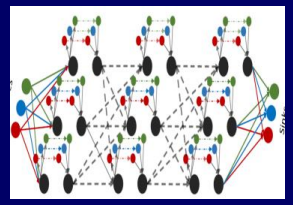

- Broadband sonar, multi-beam & INS
- Multi target tracking capability
- S/W based & high speed sig processing
- Re-programmable S/W & search pattern
- ACCM features
- Digital servo and retractable controls

Advancement in Torpedo Technology Contd...

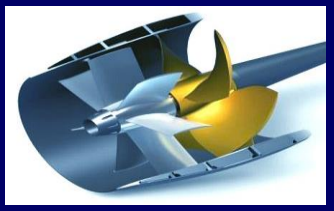

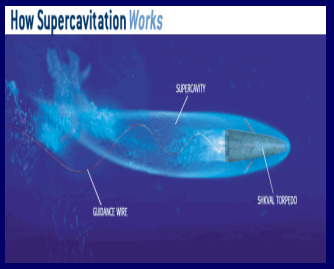

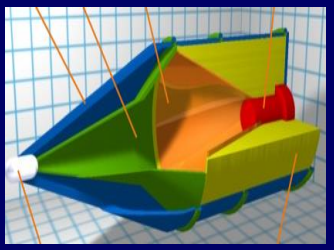

- Al-Ag_2O, Li-ion & Cu-Ni batteries
- Brushless motor & pump jet propulsion
- Semi open/close loop thermal propulsion
- Super-cavitation propulsion
- Tandem shaped charge insensitive W/H

Advance Torpedoes

Torpedo	Origin	Speed (Kts)	Range (Kms)
Black Shark Adv	Italy	18- 50	>50
DM2 A4 Sea Hake	Ger	50	> 50
A244S MOD-3	Italy	36	13.5
Flash Black	Italy	50	20
F21 HWT	France	25-50	> 50
Spearfish HWT	UK	40	48
Torpedo (2000)	Swed	40	> 40
MU-90	Eutorp	50	23
MK 48 ADCAP	USA	55	38
MK 54	USA	28 -43	12
Shkval E	Russia	> 200	7 - 10
UGST	Russia	50	40

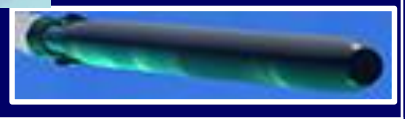

Torpedoes in Indian Navy

Torpedo		Origin/ Country
A244S		Italy
AT1ME		Russian
MK 54		USA
TAL MK-I		India
53-65 KE		Russian
CET 65 E		Russian
TEST 71ME		Russian
SUT		Germany
Varunastra		India

Directed Energy Weapons

Directed Energy Weapons

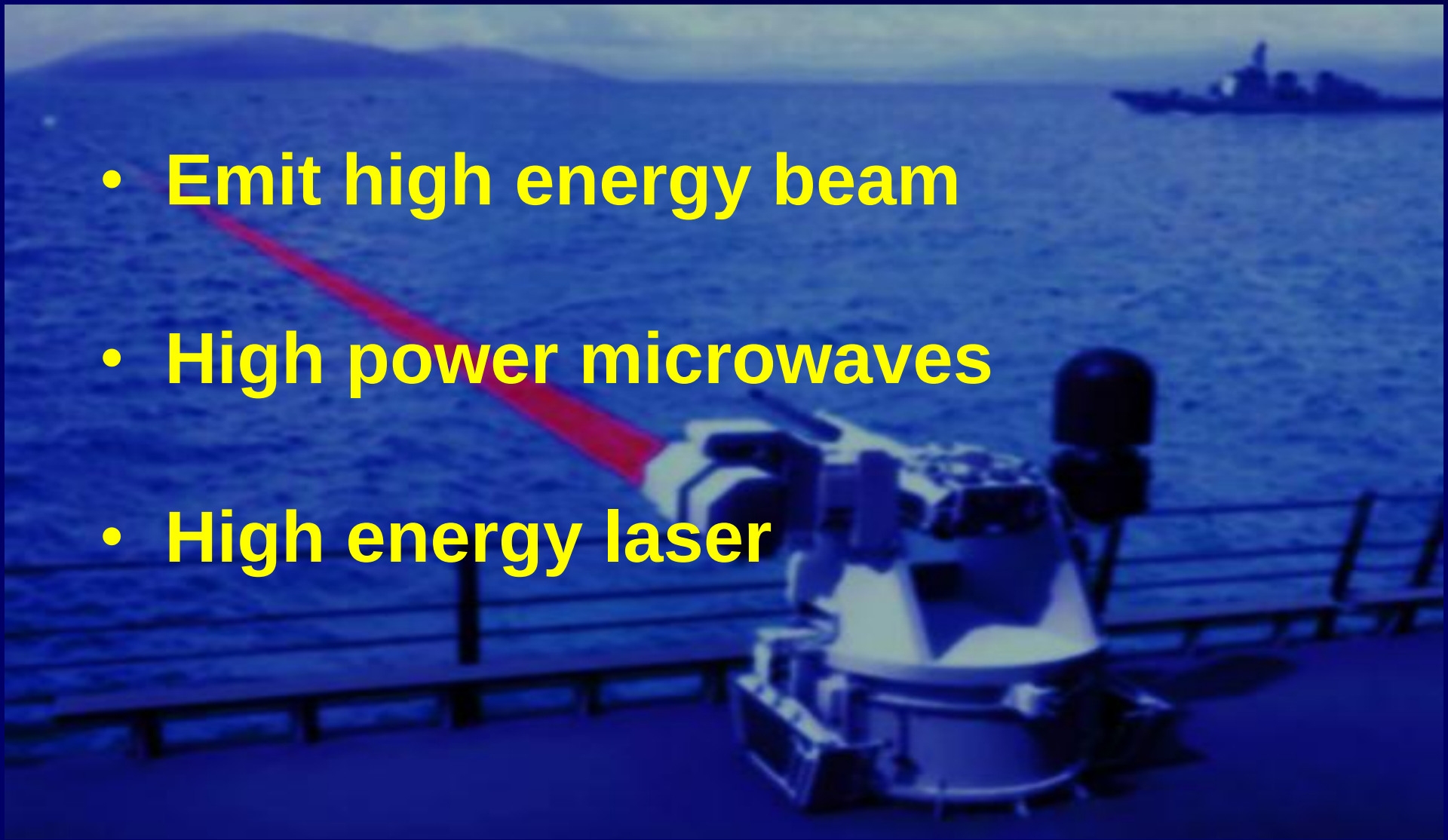

- Emit high energy beam
- High power microwaves
- High energy laser

DEW Advantages

- High Speed of Engagement
- Effective for Defensive/Offensive Role
- Immunity from Gravitation Constraints
- Space Requirement – Limited
- Effective against Moving Air Targets
- Minimal Collateral Damage
- Low Marginal Cost per Shot

DEWs from Sea, Air & Land Platforms

HE Laser Mobile Demon-strator **(USA)**

Electro-mag Rail Gun **(USA)**

Active Denial System **(USA/ Israel)**

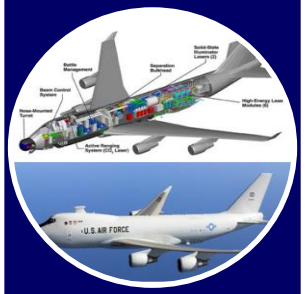

Airborne Ballistic Laser **(USA)**

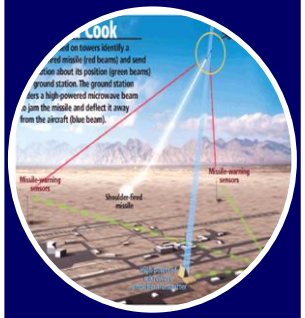

Vigilant Eagle **(USA)**

Laser Weapon System **(USA)**

DEWs in Indian Navy

DEWs not as potential destroyer

10 KW HEL demonstrated by DRDO

Work in progress for 25 KW HEL

Develop 100-500 KW HEL

Qualitative Requirements (QRs)

QRs for Torpedoes

Require-ment	Remark
Speed	Upto 55 Knot with variable speed
Range	Upto 40 Kms
Battery	Mg-Cu_2Cl_2, Al-Ag_2O & Li-ion batteries
Propulsion	Gas turbine, brushless motor & super-cavitation
Warhead	Tandem insensitive munition W/H & prox EBW fuze
Guidance	CBASS & improved signal processing algorithm
Launch I/ P	Tactical S/W algorithm with target data & upgrades
Control	Intelligent digital controllers & actuators
Camouflage	ACCM features

QRs for DEWs

- 10-25 KW for non-lethal engagement
- 100-500 KW against:-
  - Missile
  - Rocket
  - Aircraft
  - UAVs

Way Ahead

Way Ahead….

Joint Venture

Requirement	Scope for Designers & Industry
Torpedo & Sub-systems	
Mech Parts, W/H & Prop	Al-Mg alloy, FRP & nano materials, **IM**, Mg-Cu, Al-Ag_2O & Li-ion batteries, brushless motor, GT, pump jet & supercavitation prop
Guidance & Control	Sonar imaging & det, CABSS, PCBs, tgt wake seeking, mag anomaly det & super quantum induction device homing, adv accl & sensors.
Process Control	Adv sig processing, tact S/W algorithm for tgt data, friendly forces positions, sound profile & mid-course upgrade, dig ctrl & actuator
Miscellaneous	Fibre optic cable, gene, invertor, shaft, bearing, gear box, bottle, gyro, pump, valve, fastener, cable, pipe, dynamic seal, loc & rec aids
Directed Energy Weapons	
DEW Systems	Ship borne 25-500 KW using High Power Microwaves or Lasers for non-lethal & lethal engagement

Way Ahead….

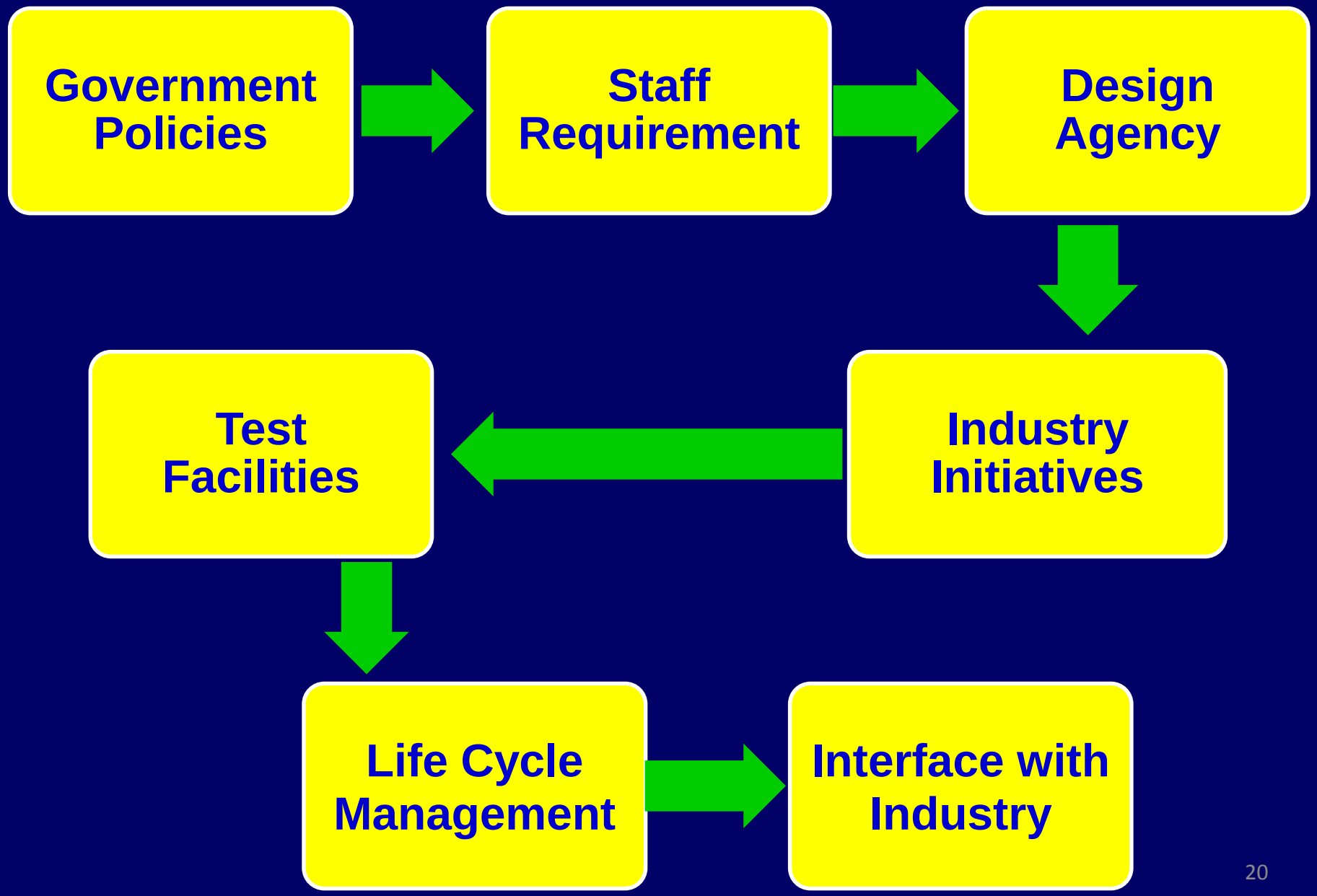
Government Policies
Staff Requirement
Design Agency
Industry Initiatives
Test Facilities
Life Cycle Management
Interface with Industry

Conclusion

- Govt promulgated various major policy guidelines
- ***IN*** “Indigenisation & MCPP”
- Harnessing knowledge base, infrastructures for “**Make in India**” prg under "**FIGHT**" category
- DEWs identified as core mil technology requirement
- Opportunities for strategic partnership

Thank You

5. Psychoenergetics

Mental entrainment, inducing hypnogogic trance, mind control, broadcasting thoughts and feelings, the Ant World, education via EM [LW] mental download, the "Feelies," revolution in spirituality, "enlightenment machine?" Scalar churches?

Psychoenergetics is simply *using the scalar interferometers to manipulate and engineer the human psyche*. To me it is the most mind-boggling and frightening aspect of longitudinal wave engineering.

The mind is electromagnetic in nature, and itself of the time-domain. It is not observable in 3-space. There is nothing you can point to that is the mind. As Bearden says, "The mind is time-like."

The longitudinal scalar EM waves are also of the time-domain. By overlaying certain infolded patterns (oscillations in time) on the longitudinal waves, a thought or feeling may be made to arise in a person or persons who are in the interference zone (where the wave beams cross).

The person will not notice anything, feeling that this thought or idea is his or her own idea. The longitudinal wave pattern might be a wave of panic or fear that spontaneously sweeps over you, perhaps inexplicably. It could even be in the form of a sudden intense patriotism. It could be explicit words and phrases, which everyone would think they had thought of by themselves. Or it could be rage and hatred, angry and violent. On the other hand It could also be a continuous sense of docility and placidity. This is the brave new world of *psychoenergetics and the coming "Mind Wars."*

Scalar Psychoenergetics in its most primitive form simply "entrains" all minds in the target area into a deep hypnogogic trance. In this state of mind people would be suddenly extremely suggestible, and would likely believe anything they are told, and would obey any orders given. Talk about winning the hearts and minds of the American People!

Tom Bearden makes me think of Paul Revere, who heroically conveyed important warnings for the sake of the new nation. But the words of the famous phrase have now strangely and curiously mutated into the once-inconceivable: "One if by land, Two if by mind."

Indeed one strategy in a Mind War would be to simply take over the minds of the "leaders" of the enemy nation. The targeted leader would not be aware that anything was amiss, although he might begin to make unexpected changes in policy.

And are, in fact, any of our "leaders" already having secret thoughts that are not their own? Who knows? Frighteningly, we can no longer be sure.

The new sciences of scalar electromagnetics and psychoenergetics are even now plunging humanity into a sudden science-fiction-like world beyond anything in humanity's previous imaginings.

> "The Russians reached the point in the mid 1990s that they could take over control of a person's mind, with modified longitudinal EM waves including some time-polarized EM waves, and with a team of specialists (estimate 25-30 per transmitter, and one transmitter and team per controlled person)."
> **Bearden: http://www.cheniere.org/misc/time.htm**

In a slide (below image) **Bearden** illustrates how a Scalar War would involve a psychoenergetics attack on the operators of the enemy scalar installation, entraining their minds into hypnogogic trance and getting them to shut down their systems.

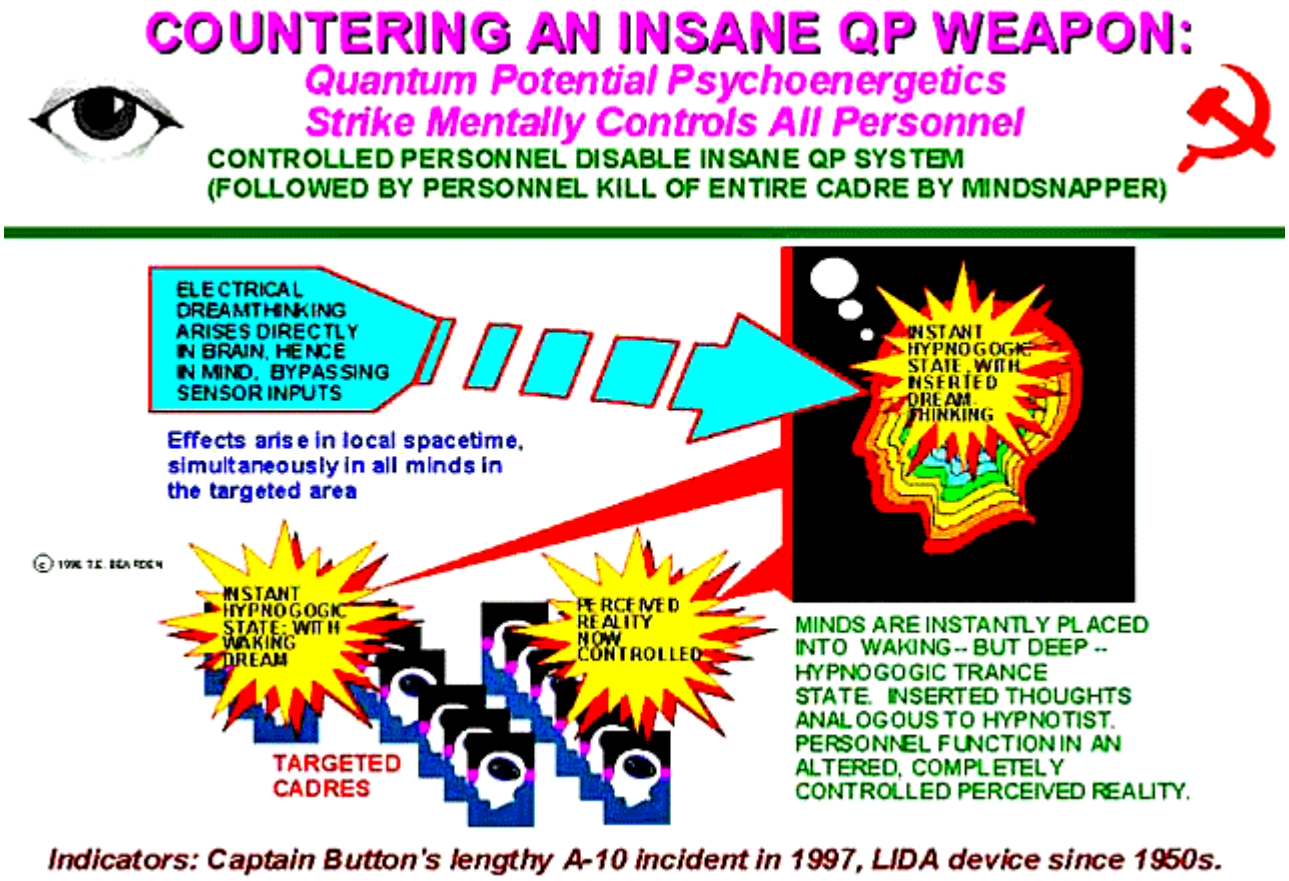

And ultimately psychoenergetic warfare goes to the very heart of human identity itself.

For if my thoughts might no longer be "mine,"

- Then who and what am I?
- Can my very sense of being "me" be hijacked by some nefarious psychoenergetic scheme?
- Will the "secret government" eventually dictate directly into your mind how you feel about yourself?
- Or what you think you are?
- Or what you should do?

How Does Longitudinal EM Mind Control Work?

The physics of **scalar psychoenergetics** as expounded by **Col. Bearden** seems even more arcane and over-my-head than that of extracting energy from the vacuum. I can't understand it, but I look through it anyway. Each time another tiny understanding might occur, or a term might fall into place. I know the mathematics is forever beyond me.

One paper to begin with is **Mind Control** and **EM Wave Polarization Transductions.** This is such serious stuff that **Bearden** includes a strong warning about misuse of this knowledge.

Psychoenergetics weapons can mentally maim and physically kill.

Warning!

(From "Mind Control and EM Wave Polarization Transductions")

> "This article refers to experimental research techniques which can be detrimental or lethal in the hands of any but highly skilled, qualified experimental scientists proceeding under proper laboratory safety procedures. The purpose of this article is strictly for information to properly qualified and authorized scientists in certified laboratories.
>
> We do not propose or condone any use of these procedures for non-approved practice of medicine without a license. Neither the publisher nor the author are responsible for accidents or outcomes in the use of these experimental procedures and techniques. Any researcher who performs these procedures and experiments is acting on his or her own volition, and is solely responsible for insuring safety, qualifications, and legality of the acts and their results.
>
> We neither suggest nor condone unauthorized experimentation on human subjects. Such is a criminal violation of the constitutional rights of the subject under Federal and State laws, and is both illegal and immoral."
> **Bearden: http://www.cheniere.org/explore articles/mind control1/p01.htm**

After the serious warning comes the description of the paper. This is heady stuff for the layman.

> "Calling full attention to the special note above, in this paper we present a high-level overview of the novel electromagnetic nature of mind operations, mind and body coupling, and intent - the induction of physical 3-space EM energy changes into the brain and nervous system, and into every cell of the body, from the mind's time-like coherent operations.
>
> We summarize the time-polarized electrodynamics used to engineer and affect mind operations and the mind-body coupling loop. Transaction mechanisms whereby differing EM wave polarization s can be transformed one-into-the-other are presented."
> **Bearden: http://www.cheniere.org/explore articles/mind control1/p01.htm**

I will leave it to the technically astute to try to understand the mechanisms of operation which are described in scientific language. But there are tidbits for the layman.

Here he speaks of the difficulty Western scientists have in opening up to the "immaterial" *(longitudinal wave)* nature of the human mind.

Western Science Remains Largely Materialistic

> "Ironically, most Western scientists are materialists and consider "mind" as a mystical and nonscientific concept. They tend to consider mind operations and functions either to be simply "meat computer" operations and functions, or at best to be very weak ordinary transverse-wave EM operations and functions in the brain and nervous system. This serious self-limitation exists because in the body we measure only weak TW [transverse wave] EM operations and functions correlated to biological behavior and brain operations. We simply do not know how to measure "mind operations" directly.
>
> "With no mind measurements possible and no instruments, it is understandable that Western science considers only the physical side of the mind-matter interface.
>
> "Presently our scientists do not measure the longitudinally-polarized EM wave operations and functions in the body and around it in nature. Few of them are aware that a maelstrom of such LW [longitudinal wave] functions exist in the body and in all of nature in general."
> Bearden: http://www.cheniere.org/explore articles/mind control1/p05.htm

Western methods of influencing the mind with EM waves have only used transverse waves, not the longitudinal waves of the vacuum.

If only transverse waves are used one pretty well has to hit the target mind with a sledgehammer of waves.

Western Science knows only transverse EM waves

Brute Forcing Time Functions versus Fine Control Methods

> "Ironically, Western mind control researchers using transverse EM waves for mind control research, are using a brute force method of evoking and using vacuum engines (spacetime curvature engines) and a special form of general relativity, although they do not appear to realize it.
>
> "While KGB scientists also use TW EM "brute force", TW waves when necessary, they do "imprint" or "activate" those waves with the desired internal LW and time-polarized EM wave and photon structures required to directly perform the mind engineering desired...
> Bearden
>
> "These "fitted brute-force models" certainly can be very powerful, and certainly can produce the exact results shown in the experimental verifications of the fittings. However, they do not of themselves allow sophisticated design for example of the necessary time-polarized wave assemblies for engineering the entire human collective unconscious simultaneously, or for engineering the entire collective unconscious of all species on Earth (i.e., Gaia's collective unconscious), or even for precisely engineering the memory and knowledge base of an individual.
> **Bearden: http://www.cheniere.org/explore articles/mind control1/p09.htm**

The seemingly magical operations of psychoenergetics, sometimes called "psychotronics," cannot be achieved with ordinary transverse EM wave energy. But they are possible with longitudinal scalar waves because the mind itself is scalar in nature.

> "We note that all mind operations are time-like, i.e., they are comprised as scalar EM photon functions and scalar EM wave functions. Thus the mind is a very special kind of electromagnetic system, existing in the time domain..."
> **Bearden: http://www.cheniere.org/explore articles/mind control1/p08.htm**

The engineering of the mind can only be accomplished with the waves of time.

The course of psychoenergetics development necessitates the building of a vast database of settings and patterns which bring about given mental and/or emotional states.

A kind of "gnome" of the psyche. Bearden describes the process of the decoding of this "gnome."

> "Now the scientists would perform many phenomenology experiments, making one little change at a time and profusely recording the data. Each time, they would establish the physical change(s) that occur in the body and/or the mental and emotional changes that occur in the mind for each spectral reinsertion back through the "ship's portholes". They would simply but painstakingly (over some years) build up an extensive database of those individual correlates.
>
> "In these experiments, the experimenters will eventually be able to provoke any body or mind change they wish. Strong emotion. Intense pain. Intense pleasure. Painful thoughts. Images. Memories. Perceptions. Dreams. Visions. Memory losses. Memory changes. Personality changes. Etc. The "delta" in the emission spectrum (the changes from zero reference spectrum) represent the precise totality of all mental, physical, organic, chemical, etc. changes and interactions."
> **Bearden: http://www.cheniere.org/explore articles/mind control3/p01.htm**
>
> "A second stage in the research would be to test the correlates and porthole insertions upon a statistically significant cross section of ordinary people, and/or specialized populations (such as toughened soldiers). The program would evolve a highly complex, very effective, ever-improving science and technology of mind and behavior control and engineering mechanisms, complete with finished database and developed applications equipment."
> **Bearden: http://www.cheniere.org/explore articles/mind control3/p02.htm**

Summing up his paper Bearden speculates on what the actual situation the science of psychoenergetics probably is.

The intense secrecy with which this knowledge has been kept from the public has led to the current farce of the "government" pretending it all does not exist, and this secrecy may have now put us at great risk.

> "The implication is that in the West one or more highly classified, sustained, heavily funded developments in advanced mind control programs, probably exists and probably has existed for some time.
>
> Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, may not operate under very much legitimate government control at all, and may operate specifically for the purposes of the rogue group or groups that have gained control.
>
> "In a nutshell, that's what may be going on in the clandestine mind control projects in several Western governments. The involvement of at least some rogue groups, some being "cowboys" who operate well outside all laws and ethics, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, it could account for what seems to be actually occurring.
>
> As also is "usual" in such a mess, one or more of the rogue groups eventually may become very powerful because their secret weapons are very powerful. They may become confident, thinking they have the "best in the world." They may actually believe they are ahead of the Russians..."
>
> "Remember that, in every large and powerful human organization, the basis for rogue groups is power and secrecy. They are always seeking to increase their power, control, influence, prestige, etc. Nothing else. Patriotism and mission are to rogue groups often just idle words. They have their own agendas.
>
> And being rogue groups, they may well bring in unethical, immoral tricks: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A certain percentage of a highly secret rogue group will wind up using all these things and more. It's a human characteristic, the old primate dominance game. Only now disguised and hidden under deep classification."
>
> "The Russians, with their additional knowledge of the actual mechanisms in the transforms, will be much more advanced than the West, because their fundamental psychoenergetics science is far more advanced, so long as we continue to use the old U (I) electrodynamics.
>
> Further, the Russians have decades of use of longitudinal interferometry beams to reach right through the earth and ocean and produce stringent EM effects at a distance.
>
> So they will also be able to do the same things here in "mind control" with LW [longitudinal wave] interferometers, through intervening mass."
>
> **Bearden: http://www.cheniere.org/explore articles/mind control3/p05.htm**

Bearden cites two examples where he believes the Russian KGB tested the psychoenergetics capabilities of their scalar interferometers.

One was the case of Captain Button in his A-10 "Warthog" aircraft on April 2, 1997.

> "Over Arizona, Captain Button was thrown into a hypnogogic state, and his perceptions instantly altered and controlled. In his instant "dream-waking" state, everything seemed perfectly normal. His sense of direction was altered a bit more than 90 degrees, so he simply corrected and turned and "flew toward the range", actually flying off course by more than 90 degrees and ignoring radio contacts. He flew right on out of Arizona."
>
> "At one point he circled, probably thinking he was over the range, and he probably dropped his ordnance there. Then he "flew on back toward home," as he thought in his waking dream state, until his fuel ran out and he crashed and died in the explosion dream-thinking until he died that everything was normal.
>
> All the while, his sense of the passage of time was altered. To him, in his dream-thinking, dream-acting state, everything was normal and nothing untoward had happened. So the distant KGB transmitters and associated psychoenergetics team controlled him for over an hour.
>
> > "Indeed, that was the exact purpose of the test: demonstrate control (at a great distance) of a skilled person performing highly skilled tasks."
>
> **Bearden: http://www.cheniere.org/explore articles/mind control3/p06.htm**

The paper Mind Control and EM Wave Polarization Transductions ends with the most chilling and frightening possibility of all: the psychoenergetic engineering of the human species as a whole.

The Ant World

The Final Race for Direct Mind Control of the Entire Human Species

> "The KGB psychoenergetics weapons scientists because of their direct measurements and detections (and use) of t-polarized waves and LWs [longitudinal waves] for decades also understand that Jung's collective unconscious mind (of the entire human species) also has its own time-like operations and correlates, which one measures also when using t-polarization measurements and sorting it all out. The collective unconscious mind operations are buried several levels deeper inside the recursive Whittaker structuring inside the EM fields, waves, and potentials.
>
> "The KGB scientists also know that something very like Gaia a collective unconscious mind for all species on earth also exists, and they are striving to be able to sort out and measure that one as well. The Gaia operations are buried even deeper in the recursive structuring inside the EM fields, waves, and potentials."
>
> "Actually, from day one, the Russian mind control scientists have had their eventual goal set upon this "deeper area of mind and possible mind control" of the entire human species.
>
> "I am convinced that the KGB psychoenergetics scientists understand this deeper area. If they can learn to directly engineer the collective human species unconscious, they can then convert the human species easily into a sort of "ant" society, modeled along ideal Communism lines, except of course with an excluded "hierarchy at the top" running everything. The "ant society" communist style is still a variation of feudalism (all systems tend to feudalism or some form thereof).
>
> "The KGB psychoenergetics weapon scientists are seriously pressing on toward that very goal. In my opinion they are not very far from it right now...
>
> "Some versions of Russian mind control devices were used on Russian soldiers in the Afghan War to condition them for performance of merciless acts." 13
> **Bearden: http://www.cheniere.org/explore articles/mind control3/p07.htm**
> **More about "The Ant World"**

Whether it is the Russians planning an "ant world" society or rogue U.S. black-ops groups withholding a great boon from human race, the secrecy on all sides around has allowed largely criminal elements to take over this technology while leaving the civilized elements in the dark.

Openness and the spreading of this knowledge among good and decent people is essential, and for that we will have to overcome our frightened denial.

> "Meanwhile, rogue groups amongst Western clandestine mind control researchers will probably arise if they have not already done so. They will likely seek to increase their personal control and further isolate the programs from orthodox government review and from government and legislative control. They may even divert the research into highly illegal and unethical means, because it furthers their own rogue agendas. That is how clandestine U.S. government research can sometimes go sour, unless great care is exercised by the oversight committees in the House and the Senate.
>
> "Sometimes when rogue groups do gain control and total secrecy of a given new technological area, then what appears to be "U.S. government operations" do start to encompass a criminal and unethical operations, hidden usually beneath the deep veil of high classification. Also, if it's "scientific," no one is ever brought to justice, even if the "evil science actions" are uncovered and publicly revealed."
> **Bearden: http://www.cheniere.org/explore articles/mind control3/p08.htm**

Like the huge energy of the Tesla howitzers, the ability to engineer the mind with longitudinal waveforms is a seeming "magical" thing which can be used for good or ill. Bearden envisions that further developments will allow something like the "downloading" of knowledge via scalar interferometry. Everyone could be highly educated, and quickly and easily.

In the conclusion of the paper "Mind Control and EM Wave Polarization Transductions" Bearden makes a plea to the nations of the world regarding the use of psychoenergetic engineering.

> "Let us hope this great new area, already off to a bad start, can be bridled and steered in the direction helping and healing people, rather than killing or abusing them. The excesses in its bad use are a potent threat to all nations on earth.
>
> "Yet it can revolutionize medical science, education, communication, and psychology. We foresee the day - perhaps 30 years hence - when education will be accomplished by directly loading the software into the mind. Then in three weeks one will "load" a doctorate, say, in physics. In three more weeks on will also load a doctorate in chemistry. Another three weeks, in electrical engineering.
>
> Another three weeks, an MD And so on. When that happens then truly everyone on earth can be educated. Freedom from ignorance may well be another great freedom that is legally recognized.
>
> There will be no impoverished large groups lacking the education to find decent, productive jobs.

"We urge all nations to use the principles involved: not for human abuse, but for healing, educating, uplifting, and life-expanding of every person on earth. If we do, we shall all have a far brighter future. Then we shall check what has started out to be the Sword of Damocles and turn it into the golden Millennium."

Bearden: http://www.cheniere.org/explore articles/mind control3/p08.htm

(Perhaps after so many frightening topics a slight break is in order here to consider the lighter side of psychoenergetics. For example, what will be the ultimate impact on the entertainment industry?)

The Feelies at Last!

Psychoenergetics will be able to bring about at last, for better or for worse, Aldous Huxley's fanciful idea in his novel "Brave New World," an entertainment format which he called "The Feelies."

Those were something you went to, like going to the movies, but you would experience all the actual feelings themselves, as if the depicted events were actually happening to you.

Although our "leaders" seem too dim to grasp what is going on in the world of scalar electromagnetics, it should not take some young Hollywood genius too long to understand that The Feelies are now possible, and that the immense megabucks of potential profit more than justify heavy investment in bringing it to market.

One can imagine that first "Feelie" theater, "The Huxley" perhaps, a large comfortable area surrounded by nine giant screens (not just one screen!), which become 3D if you put on your headset. And The Huxley is fitted with the finest sound, and oh, by the way, a modest sized scalar interferometer with computer. And there are one or more new tracks now recorded on the film next to the sound track.

These are the digital patterns of thoughts, feelings, and ideas to be fed into the theater's interferometer. And these thoughts and feelings and ideas will be felt by the audience as if they were their own thoughts and ideas. It is an entirely new art form. Psychevision.

As important (and no doubt famous) as the actors would be the "feelers," those from whose minds the feelings were lifted in the original programming of the Feelie tracks. Because, for example, Brad Pitt might be a good and handsome actor, but can he really feel it? Like the dubbing of foreign language films, it might be necessary to dub the "emotional track" using a deeper and more profound person's feelings, thoughts and ideas.

It might even be engineered so that if you sat on one side of the theater you would feel like the hero, and on the other side you would feel exactly like the bad guy! What would that lead to?

We have all cried at a movie some time, most people have, though they might not want to admit it. But this would be deep sobbing and a flood of tears, if the director so desired it. You would feel it at your core. Or, take a big chase scene, you would be terrified. They are breathing down your neck! You would be gripped by panic.

For that matter, the whole genre of Horror-Feelie would be too much for many people to take. Do I really want to feel that an actual vampire is tearing at my throat with his fangs?

A Religious Feelie would make you feel the exaltation of a saint at his prayers, or give you the definite feeling that you are Christ suffering on the cross. All the pain could be there too. The stickiness of the blood. The very feeling itself: "Why hast thou forsaken me?" Who among us could come up that despair for scanning?

Had this been developed a bit earlier we might watch a documentary of, say, Mother Theresa, containing her own actual deep sense of compassion, which we would feel arising in us as our own.

Then again, a Psychedelic Feelie could induce an LSD-like state and simply blow the audience's minds.

Even in its simplest most primitive mode, the hypnogogic trance induction with its increased suggestibility, would completely alter the experience of even ordinary current movie going.

Go Back to Scalar War

Go Back to Psychoenergetics

<<< Scalar Wars

The Brave New World of Scalar Electromagnetics

by Bill Morgan

(See also **NEW 2007**: Book Review of Bearden's "Oblivion - America at the Brink")

Tom Bearden (2001)
Lieutenant Colonel, U.S. Army (Retired)

For the past six months I have been undergoing the greatest **paradigm shift** I have ever had to go through. It has rattled my nerves and shaken my bones. This intense adjustment of my "world"has come about by studying the information given by Col. Tom Bearden at his website **Cheniere**. The new knowledge there has necessitated a total revision of my ideas about physical reality, the world we live in, and the future of humanity.

This paradigm shifting even actually made me dizzy on certain days as I tried to absorb and digest Bearden's vast amount of information. I am not a scientist at all, just a layman, and I have little comprehension of the math and high physics of this new science called "Scalar Electromagnetics."But there is a great deal of information at **Cheniere** which **needs to become common knowledge** as fast as possible, for the sake of the survival of life on earth.

To that end I have put together this small primer of Bearden's ideas, as a kind of "beginner's guide" to his website. (I have tried to underline certain words and phrases which are part of the new "jargon" of talking about these "new" phenomena. Also I have taken the liberty of **bolding** certain words and phrases to help them stick in the mind).

(Note: Throughout "**EM**" means "**electromagnetic,**" and "**LW**" means "**longitudinal wave**")
You can download this article in Word format

This article has six sections:

1. New Waves 2. Tapping the Waves 3. Weaponization 4. Healing 5. Psychoenergetics 6. As It Stands

2006 NOTE: Click here for a current status history of the MEG from Tom Bearden

1. New waves discovered

Longitudinal EM energy fills vacuum of space, the time domain of spacetime, time as compressed energy, E=tc2, waves of time, phase conjugate wave pairs.

"Electric power is everywhere present in unlimited quantities and can drive the world's machinery without the need of coal, oil, gas, or any other of the common fuels." Nikola Tesla

"At any point and at any time, one can freely and inexpensively extract enormous EM energy flows directly from the active vacuum itself." Tom Bearden

I guess the first thing to try to comprehend is that a **"new" kind of electromagnetic (EM) wave has been discovered** in the empty vacuum of space which, when engineered, can be an inexhaustible supply of energy in great magnitude at any place in the universe. The word "new" is in quotes because the

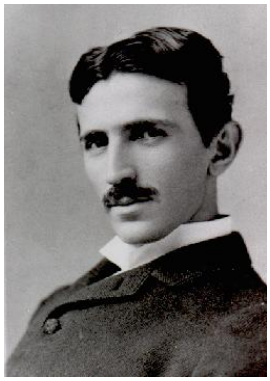

discovery really goes back to Nikola Tesla and his discovery of what he called "radiant energy." It is also not "new" because the Russians (KGB) have been working on this technology **for over 30 years** and have **weaponized** these "new" **longitudinal scalar waves** to a great degree.

These are the weapons Nikita Khrushchev spoke of in January, 1960.

> "By 1957-8 the Soviets had progressed to the point of a giant scalar EM accident in the Urals which exploded nearby atomic wastes, devastating the area. They had also progressed to development of great new superweapons using their new energetics - weapons to which Khrushchev referred in 1960 when he informed the Soviet Presidium of a new, fantastic weapon in development, a weapon so powerful that it could **wipe out all life on earth** if unrestrainedly employed.'" Tom Bearden

After over 30 years of development, and extensive testing around the globe, these new scalar electromagnetic weapons are up and running and ready to go. Tom Bearden, at his website Cheniere, dicusses the history of these new scalar electromagnetic weapons in his paper "Historical Background of Scalar EM Weapons."

Some Immediate Implications

> The implications of successful engineering of the longitudinal waves are enormous, and will change the world as we know it, one way or another. Among other things, these discoveries mean that:
>
> **1. The solutions to the energy crisis and the "oil problem" are in hand. These oil wars are unnecessary. There is endless energy available freely from the domain of time.**
>
> **2. Unbelievably powerful weapons are not only possible, but are already operating in several nations. The many powers of these weapons are unprecedented and mind-boggling.**
>
> **3. The cure of diseases such as cancer and AIDS, in fact nearly any disease, has become possible within a few years of sufficient funding. Everyone can be made healthy and stay healthy.**
>
> **4. Mind control on a mass scale has now become possible, and the machines to do it are already in place in certain nations. It has become possible to mentally enslave whole populations with the twist of a few dials.**

So the layman will need to understand that **there is a new kind of electromagnetic energy** that is altogether different from what he knows, e.g. radio, TV, cell phones, etc. The ordinary EM waves that we have known about are called **transverse** EM waves, to distinguish them from the new **longitudinal** EM waves. These scalar waves do not actually exist in our "material" world, but exist only in the vacuum of empty

space, or the time domain. And we must keep in mind that this vacuum of space we speak of exists all through everything. Even our bodies are mostly empty space between atoms and molecules. So the gateway to this seething ocean of energy can be there at every point in the universe. This seething ocean of energy is all around us and all through us.

Emptiness is Full

This amazing discovery announces that **the "emptiness" of empty space is in fact not empty**, but a **great ocean** of seething energy!

Col. Bearden refers to this ocean of energy as being of the "time domain." Energy out of time? It seems like something from Star Trek but this is the point which the new science of scalar electromagnetics has reached. And where it is going may be beyond anything Star Trek could have dreamed of.

We live in a 3-dimensional world, which physics calls "3-space." But there is also **spacetime**, or 4-space, or the "4th dimension." Then suddenly comes this amazing new knowledge that **time itself is actually compressed energy**. And it is energy which is compressed by exactly the same factor by which **matter** is considered compressed energy: the speed-of-light-squared!

So we have a new companion to the famous **E=mc2**. It is now paired with **E=tc2** (where t is actually "delta-t," or change in time). Or (amaze your family and friends and) say:

"E equals em-cee-squared"
and
"E equals delta-tee-cee-squared"

It has a nice ring to it, like some freedom bell announcing a new era.

And as the atomic bomb released the compressed energy in matter, so can we now unleash **the tremendous energy that is compressed into time itself.** It gives a completely new meaning to the term "time bomb."

Some New Terminology of Scalar Electromagnetics

A new science, **several** new names

"Those [Russian] weapon scientists resurrected an old term from the history of electrodynamics, called "**energetics**". That is their approach to a **unified field theory**, where everything is based on "energetics". This model as its foundations uses a very similar approach to that "single fundamental unit" model, where energy is the unit. If one makes the energy EM in nature, then one has the Russian energetics approach. This unified approach gathers everything in, including all energy actions and relations in inert matter (the first branch of

energetics, called by the same name), all field and matter interactions in living matter (the second branch of energetics, called "**bioenergetics**"), and all mind operations and mind-matter interactions (the third branch of energetics, called "**psychoenergetics**"). [ed: sometimes also called "psychotronics" by the Russians]

"Note that the weaponeers sliced energetics into three branches, with each branch depending on the nature of the "targeting".

"So I took a hint from them, since the stuff and the approach worked. They had already weaponized it highly."

Bearden : http://www.cheniere.org/correspondence/021502a.htm
See also "Subdivisions of Soviet Energetics"

Rick Andersen in an article called "What is Scalar Electromagnetics?" describes the **new science** this way:

"Scalar EM is the brainchild of Lt. Col. (retired) Thomas E. Bearden, a systems analyst and wargames specialist who has been advocating a view of electromagnetics which is based on the notion of a vast, unseen background of scalar energies (as opposed to vector energies) **which underlie all physical reality.**

"If Bearden is correct in his Scalar EM theory, then we can build devices which would enable us to **alter gravity**, time, inertia, and the apparent mass of an object. This of course has ENORMOUS implications for military applications, **space-vehicle drives, time-travel, teleportation, paranormal phenomena**, and just about every other area one can think of."
http://twm.co.nz/Beard_scalem.html

> **"Time-energy, time-currents, and time-structuring play the dominant role in electromagnetics. *Time-as-energy* eventually becomes engineerable, as easily as is spatial energy now. We are always dealing with *spacetime* and with *spacetime curvature*."**
>
> **Bearden:http://www.cheniere.org/techpapers/Vision%202000%20paper.doc**

The scalar energy discovered in the vacuum of space is sometimes called "**zero-point**" energy. Thomas Valone explains how this term came about.

What does "Zero Point" mean?

"Boyer traces the historical “creation of the vacuum” as proceeding in stages in parallel with the historical development of ideas about the vacuum. To paraphrase, he says that in the 17th century, it was thought that a totally empty volume of space could be created by simply removing all matter and, in particular, all gases. That was our first concept of the vacuum. Just get rid of all the gas.

Late in the 19th century, it became apparent that the region still contained thermal radiation. But it seemed that the radiation might be eliminated by cooling. So the second concept of getting a real

> vacuum is to cool it down to zero temperature. Just go all the way to absolute zero. Then we've got a real vacuum. Right? Well, since then, both theory and experiment have shown that **there is a non-thermal radiation in the vacuum** and that **it persists** even if the temperature could be **lowered to absolute zero**. Therefore, it was simply called the "**zero point**" radiation."
>
> Thomas Valone http://www.seaspower.com/InsideZeroPoint.htm

"For our very survival, it is absolutely imperative that informed citizens be aware of this dramatic change, which is just now starting. The powerful new science and engineering must be controlled and used for humanity's benefit, not its detriment. Else it will eventually be let loose unrestrainedly, to destroy all life on earth - a possibility indicated by Nikita Khrushchev in 1960." - Bearden

http://www.cheniere.org/explore%20articles/priore1/p4.jpg

2. Tapping the waves

Endless free energy, Tesla's radiant energy, the dipole as the gateway to the energy of the void, MEG in one year, Bedini, Yakuza, etc. End of Oil, geopolitical chaos, rogue groups

Move Over G.E. & Big Oil, Energy is Everywhere!
Third-world nations set to rise

> "Certain powerful interests did not wish the extended electromagnetics to be discovered or taught. That, after all, would lead to **free energy** and loss of economic control of the citizens. That was precisely why Nikola Tesla had already been suppressed ... Today it is still being suppressed by the orthodox establishment."
> http://www.cheniere.org/books/ferdelance/s25.htm

The vast seething ocean of energy of the vacuum, the longitudinal scalar EM waves of the time domain, can now be tapped and "transduced" into ordinary (transverse) EM energy in our 3-Space world. The process can be compared to putting a paddlewheel into a river. The energy acquired is free, since the river is there flowing whether we tap it or not. And it is a mighty river, and is not diminished by our paddlewheel.

This means that **a permanent solution to the "energy crisis" is at hand**, if only those who hold it **so secret** would give it up to humankind.

It means our species' **insane use of oil** is no longer necessary. We can make automobiles that need no fuel at all. We can build motors that power themselves. It means that unlimited electrical power can be available for free anywhere in the world. Every house and even shack can have its own power supply.

Of course there is the cost of the equipment at first, but the energy flow is free for the presumably very long life (no moving parts) of the generator. It will

probably take decades to shift over to scalar power.

But the ability to tap the scalar (longitudinal) EM waves of the vacuum (which exists everywhere) also means that **unbelievably powerful weapons** can be, and already have been developed. In fact these weapons are so dangerous that the **fear engendered** becomes a psychological obstacle to the grasping of the facts.

I struggled with this myself for months, and even though Tom Bearden had completely convinced me already, it is hard to accept the fact that for everyone on earth the "worst that might happen" has suddenly gotten much worse. It takes time to deal with that, to realize it and get over it.

Indeed, the possibilities of these new weapons, which are tapping the **huge energies of time**, are so terrifying it is natural for the mind to simply say: "I don't want to hear about that."

And the government, likewise, pretends these weapons do not exist and tries to keep it secret from the people. Because **most people would indeed be truly alarmed** to know the actual situation. Col. Tom Bearden has decided that the people need to know the truth anyway. As a People on a Planet we must face this now, and **ban the use of scalar weapons in war or in mass mind control**. The current deployment of these weapons is a **world emergency** which we must all face.

The physics and mathematics of the longitudinal waves and the time domain are clearly beyond the layman, but I recommend scanning through them anyway just to get a sense of the wonder and the elegance of it all and some of the exotic terms which are used. Two of the most important papers by Col. Bearden are:

Giant Negentropy from the Common Dipole
The Final Secret of Free Energy.

Despite the complexity of the science involved, Bearden sums up the **essential secret** of it all in a few words.

> "There is no problem at all in extracting all the energy one wishes from the active vacuum, anywhere in the universe, at any time. **Just make a dipole.**
>
> The problem is in (1) catching some of that freely gushing EM energy in a circuit containing a load, and (2) dissipating the caught and collected EM energy in that load to power it, without using half the caught energy to destroy the source dipole's).
>
> That is the ONLY real energy problem on the planet, and always has been."
>
> http://www.cheniere.org/correspondence/022502.htm

A dipole could be a battery, which is polarized into negative and positive. Or the terminals of a generator. Or any magnet with its two poles. Or an atom with its positive and negative charges. Or the earth's magnetic field, the sun, and all heavenly bodies. Even a galaxy must be some kind of mega-dipole. Wherever there is a dipole there is already immense scalar EM energy ushering out of and back into the vacuum. And there have already been demonstrated a number of

diverse methods for tapping that energy as it flows. (John Bedini, Edwin Gray, Bruce de Palma, and others). Bearden provides what he calls a "partial list" on his website.

> "In other words, **nature then gladly gives us** as much EM energy flow as we need, indefinitely — just for paying a tiny little bit initially to "make the little dipole." After that, we never have to pay anything again, and nature will happily keep on pouring out that 3-flow of EM energy for us. This is the **giant negentropy** mechanism I uncovered, performed in the simplest way imaginable: just make an ordinary little dipole." Bearden
> http://www.cheniere.org/techpapers/Unnecessary%20Energy%20Crisis.doc

Important note 2006: Since the enthusiastic early report below, the hopeful timetable envision has gone quite off track. Bearden had said that the MEG could appear as early as 1-2 years ***after getting funding*** for the final research and scale-up. They have **still** NOT gotten the funding as of 2006.

Click here for a current status history of the MEG from Tom Bearden

The original text of article continues here...

How to Buy a Free Energy Machine

Answer: Just wait one more year! 2003. Then get off the Grid!
[note 2006: The above line was unfortunately naive and overly optimistic! - author]

Perhaps the most eagerly awaited event now is the marketing of Bearden's **M**otionless **E**lectromagnetic **G**enerator (MEG) scheduled to begin in about a year's time. This is when the proof will hit the fan. Many people have said to me, when talking about free energy, "I'll believe it when I can go to the store and buy one." Hopefully in a year's time they will be able to order their own MEG. And then they will believe, because it works and is working.

Says Bearden: "I will admit that the chief scientist of an important experimental group in a large company was rather stunned at the type of output we were able to obtain. The MEG may look like just a transformer, but it is not. It is a completely different breed of cat."

Bearden : http://www.cheniere.org/correspondence/011202.htm

Soon the cat will be fully out of the bag. The first MEG units will supply 2.5 kilowatts of free electricity. Forever. Units can be connected together to double or triple the wattage. After that gets going, 10 kilowatt generators are planned. Energy will flow freely from the time domain indefinitely, and there are no moving parts to wear out. This manufacturing project is a heroic effort and will change the world as we know it. For once people are in possession of such devices there can be no further denial from anyone, including the government and/or "secret-government."

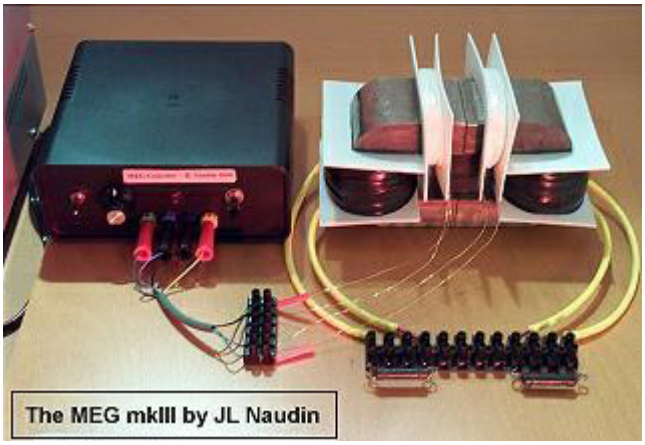

The Motionless Electromagnetic Generator
(Successfully replicated here by J. L. Naudin)

The physics of how the MEG works is explained in the paper "The Motionless Electromagnetic Generator: Extracting Energy from a Permanent Magnet with Energy Replenishment from the Active Vacuum."

The device was successfully replicated by J.L. Naudin in France, and others, like Steve Utne, are also working on their own models. But **Magnetic Energy Limited's MEG** is actually scheduled for production soon and looks to be the first commercially available free-energy generator in history!

I imagine it will not take long for tinkerers to put them into their electric cars and make the first fuelless automobiles since Tesla's unheralded (and unheeded) experiments. Or for builders to begin building houses powered by MEG's. Houses which will never see electric bills. How can they ever make enough of these to meet the demand that will suddenly be there? Bearden is right, it needs to be an all-out crash program of the government **on the order of the Manhattan Project**.

I must include here that Bearden is quick to point out that he is not himself the inventor of the MEG, but is a partner and advisor in bringing it to the public market through **Magnetic Energy Limited, Inc**. I must also admit that I am praying for the success of this venture, and the ending of the absurd and criminal withholding of this technology from the people by the black-ops military-industrial people. This secrecy has cost the planet over 30 years of unnecessary pollution.

The first units off the assembly line, which is being set up in a "friendly" unnamed nation, will usher the public at last into the new era of scalar electromagnetics.

As of December, 2001, the situation with the MEG was described by Bearden in a letter.

> "What we presently have with the MEG is a successful laboratory experiment. At least a year's very hard research will have to be done before we will be ready to put a commercial power supply into production.
>
> "Consequently, we have made an agreement with a foreign partner (the National Materials Science Lab of the National Academy of Sciences of a friendly foreign nation) to do that year's research. At the same time, we are trying to make an agreement with one or more large financial partners here in the U.S." http://www.cheniere.org/correspondence/121901.htm

"So we are hopeful that we will be able to start introducing units on the market about a year from now. Quite simply, we will either succeed or we will fail. But we will give it our very best effort."
http://www.cheniere.org/correspondence/012202a.htm

Bearden has given another technical explanation of how the MEG works here in a letter.

Update : Motionless Electromagnetic Generator patented, 3-26-2002

Click here to read the patent

"In Magnetic Energy Limited, all business discussions and arrangements are taken care of by Dr. Lee Kenny, Managing Partner. There are five of us who are co-inventors of the MEG, and two of the others are really the principal inventors." Bearden
http://www.cheniere.org/megstatus.htm

Lee Kenny can be reached by E-mail at: jlkenny@ingr.com

Free Energy has been Suppressed

Secret Government Aware of Free Energy

"In this world of contemporary times, all the agencies, CIA, FBI, KGB, NSA, Electric Power Research Institute, DARPA, Brookings Institution, Henry Kissinger, Edward Teller, et al., all are aware of [free-energy researcher Bruce] DePalma and his ideas.

"Because these individuals and institutions are employed by the ruling elite to forecast the future and satisfy present needs and demands, it is clear that **free energy is a threat** to the world order constructed by **business** and the **mindset of those who want to own the world**.

"Free energy represents Man's aspirations and dreams of freedom and equality, uniform division of resources and the ability to choose one's own future.

"**The fact that free energy is suppressed speaks to the greed and self-interest of a ruling elite** which, even in the face of an emergency of global starvation, resource depletion and environmental pollution, will not give one inch if it means loss of control. This is an attitude of **paranoid delusion** and fantasy which can only arise from the alienation of a **class of elitists** who, through their money, are completely **insulated** from the reality of the day to day fight for existence of the common man."

http://depalma.pair.com/Absurdity/Absurdity07/ProblemOfFreeEnergy.html

"Before the turn of the century, **Nikola Tesla** had discovered and was utilizing a **new type of electric wave**. Tesla repeatedly stated his

> waves were non-Hertzian, and his wireless transmissions did not fall off as the square of the distance. His discovery was apparently so fundamental (and his intent to provide free energy to all humankind was so clear) that it was responsible for the withdrawal of his financial backing, his deliberate isolation, and the gradual removal of his name from the history books."
>
> Bearden http://www.cheniere.org/books/part1/starting%20pages.htm

Bearden describes one clear case of the suppression of free energy when the Yakuza killed the **Kawai engine** in his very presence in Huntsville, Alabama.

> "That night a jet arrived from Los Angeles, with a Yakuza on board. The next morning Kawai no longer controlled his company, his invention, or his own fate. The Kawai party was in fear and trembling. The Yakuza coldly dissolved the agreement, they packed up the two Kawai engines we had, and left. And that was that."

So it is not only governments who are keeping this revolutionary technology from seeing the light of day. The Yakuza? KGB? The Aum Shinrikyo cult? Our "leaders" need to be honest about what is going on, otherwise they look foolish, acting out a kind of "Alice In Wonderland" script before the public, a script that has become completely unbelievable.

Concerning the criminal withholding of this scalar technology by the military black-budget people, and the cover-up of the actual situation regarding scalar weapons throughout the world, Tom has this to say:

> "The high government officials of the United States of America grossly violated our constitution and their sworn oaths of office. Our constitution specifically charges the government of the United States to **defend** the people of the United States. That means our officials are specifically charged with defending our people. Yet they deliberately agreed not to do so, and they deliberately sacrificed us in advance.
>
> "**They committed treason of the highest kind, by deliberately surrendering us to total destruction anytime the big balloon goes up.**"
>
> Bearden http://www.cheniere.org/books/ferdelance/s75.htm

Energy Crisis Solved

One of the "must read" documents at Cheniere is The Unnecessary Energy Crisis: How to Solve It Quickly, especially since the "**oil wars**," which Bearden has foreseen for decades, have now already begun.

Here are some clips from that Document:

> "To avoid the impending collapse of the world economy and/or the destruction of civilization and the biosphere, we must quickly replace much of the "electrical energy from oil" heart of the crisis at great

> speed, and simultaneously replace a significant part of the "transportation using oil products" factor also.
>
> "The technical basis for that solution and part of the prototype technology required, are now at hand. We discuss that solution in this paper." Bearden

And although the solution to the energy problem and the oil wars may be at hand, Bearden suggests there is still an urgent rush that needs to be made to save human civilization from collapse.

> "Once the technology hardware solutions are ready for mass production, even with a massive worldwide deployment effort some five years are required to deploy the new systems sufficiently to contain the problem of world economic collapse. This means that, by the end of 2003, those hardware technology solutions must have been completed, and the production replacement power systems must be ready to roll off the assembly lines en masse.
>
> "The 2003 date appears to be the critical "point of no return" for the survival of civilization as we have known it.
>
> "Reaching that point, say, in 2005 will not solve the crisis in time, and the collapse of the world economy as well as the destruction of civilization and the biosphere will still almost certainly occur, even with the solutions in hand."
>
> "The **good news** is that we now know how to easily initiate continuous and powerful "electromagnetic winds" from the vacuum at will. Once initiated, each free EM energy wind flows continuously so long as the simple initiator is not deliberately destroyed."

On page 9 he explains the concept of the **dipole**, and how there is already huge scalar energy flowing in the time domain around any dipole. Hold a magnet or a battery in your hand and you hold a stress in time and a beautiful flowing loop of longitudinal waves!

Bearden decries the scientific community in the West for being unable to let go of their dogma long enough to see that the **greatest discovery in human history** lies at their feet, but for their stubborn ignorance.

> "The present energy crisis then is due totally to that "**conspiracy of ignorance**" we referred to, that is maintained by the scientific community, and that has been maintained by it for more than 100 years.
>
> "This is the real situation that the environmentalists must become aware of, if they are to see the correct path into which their energies and efforts should be directed — to solve both the energy crisis and the problem of gigantic pollution of the biosphere."

As far as anyone in the legislative branch of government ever understanding the profundity of the discovery and engineering of scalar waves, Tom Bearden says they are at a great disadvantage in doing so.

"The nontechnical person — e.g., a Senator or a Congressperson — is operating under a distinct disadvantage. If he or she takes the stance that much better electrical power systems can readily be achieved, **he or she is in fact opposing almost the entire set of University, Government Technical, Power Company, Battery Company, and Organized Science communities**. Further, in most cases his technical advisors are themselves from one or the other of those communities, and likely to go back into that community or those communities when the Senator or Congressperson leaves office, or even before. So the Congress and the non-technical government community at large operate at a great disadvantage...Bearden

National Emergency Declaration is Needed

"The Government *Non-Technical* community (the Senate and the Congress, in particular) are in far better shape than the Government *Technical* community, to appreciate the **world implications of the pending economic disaster**. I am hopeful that both the environmentalists and the Government Non-Technical community will rapidly unite in a common goal to **get this vacuum energy program launched**, under a **National Emergency** declaration. If so, then they can solve the energy crisis and the pending economic crisis, in fairly short order, and permanently."

unnecessary_energy_crisis.htm#congress_disadvantage

In the conclusion of his paper The Unnecessary Energy Crisis: How to Solve It Quickly Bearden again states the urgency of replacing our centralized power grids with highly dispersed and local taps on the freely flowing energy of the active vacuum. Given the abilities of the Tesla howitzers, the power grids of all nations are sitting ducks.

"Personally, the present author regards the increasing **energy crisis as the greatest strategic threat** to the United States in its entire history. I will do anything within my power to help prevent what I perceive to be the looming economic collapse of the Western world, preceded or accompanied by a sudden, explosive, all-out and continuing exchange of the WMD arsenals of most of the world.

...*In the name of all humanity, let us begin!* Else by the time this first decade of the new millennium ends, much of humanity may not remain to see the second decade."

3. Weaponization

Scalar interferometry, Tesla howitzer, Tesla dome, heat/cold, dudding, 10 nations have them, dead-man fusing & Insane Systems, scalar strategy, earthquakes and weather wars, solar storms, mind attacks, leased to Yakuza, many examples of testing, quantum potential weapons.

"Indeed, Soviet energetics weapons are now capable of destroying both our triad shield, our homeland, our armed forces in the field, and our population, quickly and efficiently. We have a new "gap" of monumental proportions: not a missile gap, not a submarine or bomber gap, and not even a particle beam or laser gap. We have a scalar electromagnetics or electrogravitation gap." Bearden
http://www.cheniere.org/books/ferdelance/intro.htm

"**We have a new weapon, just within the portfolio of our scientists, so to speak, which is so powerful that, if unrestrainedly used, it could wipe out all life on earth. It is a fantastic weapon."** Khrushchev, to the Presidium, Jan. 1960

"We've totally missed the most incredible "secret superweapons" development program of all times, and the worldwide testing of the weapons themselves.

"Hiroshima and Nagasaki should serve as object lessons in the price of ignorance of such technological breakthroughs.

"History does repeat itself. But this time it's not we Americans who got the great new superweapon first."

Bearden http://www.cheniere.org/books/ferdelance/s75.htm

Warfare has been changed forever by the development of these scalar energy longitudinal wave howitzers. To get a basic understanding of scalar waves is to have the imagination suddenly run wild as all the implications and possibilities regarding warfare fall into place. One realizes with a certain horror that the world has totally changed, and that there are some very fearsome possibilities. Remember, the power for these weapons comes from the time domain, longitudinal EM waves in the vacuum of empty space, and the power is tremendous and mind-boggling. Being able to blast away at any target from a distant control booth is something that has never happened before. This is incredible power to be in control of and it divides the history of weaponry into "before" and "after." And the destructive power of these weapons is delivered instantaneously to the target **from the local vacuum at the place of the target**.

From an interview:

Questioner: "Are you saying that real energy can be transmitted faster than the speed of light?"

Bearden: "Yes. But hyperspatially. Not through 3-space, but "around" it. Again, this means that it's possible to produce energetic changes in a distant system at a distant place, without transmitting energy "through space" in the normal sense. You transmit "around" space, so to speak, and directly in time or through a higher dimension, depending on the model you're using to understand this. Further, the speed of the internal EM energy transmission is not limited to the speed of light."

http://twm.co.nz/beard_interview.htm

Here are some initial considerations about scalar weapons and scalar wars

1. Tesla Howitzer 2. Tesla Domes 3. Rogue groups 4. WW III 5. Russian "UFOs?"

1. The Tesla Howitzer and its modes of action

Source: Tom Bearden's weapons slides and Fer-de-Lance Briefing

For one thing there is no delivery of any thing to any place. Bombs are obsolete. So are the planes to get them there. No helicopters necessary. All current nuclear devices are rendered nearly useless by electronic "dudding." All distant-destruction can be done from a control room, and to any point on earth. The destructive power of "men" has just increased by orders of magnitude. The new weapons could even cause storms on the sun! Thus there is great urgency to make these **new facts public** and known, with the hope that all nations would come together to ban the use of scalar weapons.

Two scalar antennae together along with the computers to control them, make up a scalar interferometer, and according to Col. Bearden the Russians have hundreds of such installations already. These interferometers are called "**Tesla Howitzers**." They can deliver a giant blast of energy to the distant target site, true "action-at-a-distance".

The **first howitzer mode** is called the "**exothermic**" mode of operation because immense EM energy blasts outward at the target site. The blast of a scalar howitzer can be of near nuclear level in destructiveness, and can be repeated easily, at that place, or nearby, or anywhere.

The howitzer can use a lesser exothermic power setting and simply **destroy all electronics** in the target area. Thus they can render our nuclear missiles inoperable as they sit in their silos by "frying" the electronic circuits that guide them. They can bring down any airplane, anywhere in the world, at any time. Any person anywhere, if their exact position is known, can be assassinated without a shot being fired.

The howitzers can also bring down power grids anywhere in the world, at any time. Thus they could bring Wall Street to an instant halt by disabling all its electronics. Even this one little easy tweak of the howitzer could cripple the U.S. economy in a single day. No wonder the "**leaders**" don't want you to know! This is a new era we are in. The discovery and development of scalar interferometry has put us in a **new world**, whether we like it or not. Anyone could be expected to go into denial, the **befuddled** senators and congressmen included. But we have **to wake up**.

In a **second howitzer mode** called the "**endothermic**" mode, the howitzer sucks energy out of the target area, essentially creating a blast of cold at the distant target. It is even capable of freezing parts of the ocean. Bearden gives a number of cases where these "**cold explosions**" have been witnessed, mostly by airline pilots. April 9, 1984: 1 2 3) A huge mushroom cloud of mostly water is seen rising miles into the sky from out of the ocean, an awesome sight.

In the endothermic mode the sucked-out energy must go somewhere, so it is vented out at some other chosen spot on the earth. These endothermic plumes have been photographed by satellite.

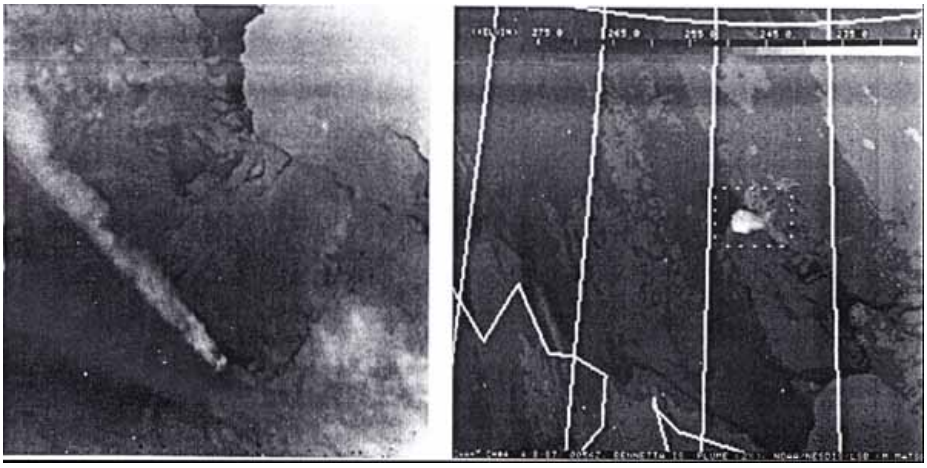

"The exhaust in the left picture is about 150 miles long, and is nearly horizontal (about 1.5 degrees above the horizontal). It is entirely consistent with the continuous exhaust from a "dumping transfer" scalar EM howitzer in the continuous exothermic mode. (The primary howitzer, of course, was activated in the endothermic mode.)" Bearden More Plumes

By using both of these **heat** (exothermic) and **cold** (endothermic) modes together the weather can be altered anywhere. Warm the air over here, cool it down over there, put a curl in the jet stream, dissipate clouds, create clouds, whip up a tornado. Bearden speaks about using the **endothermic howitzer mode** as a weapon of war:

> "Cold explosions can be used to freeze tanks, personnel, and equipment. The equipment and tanks thaw out. The personnel thaw out too, but they are dead when they do." Bearden, Fer-de-Lance

(This endothermic mode of the howitzers makes me think that there might one day be a cure for the problem of global warming after all. Could not a big device, situated in space or on the moon, be able to vent a great deal of excess heat outside the atmosphere into space, thus functioning as a kind of planetary thermostat?)

While the United States has experimented with electomagnetic weapons using ordinary **transverse** EM waves, the **longitudinal** [**LW**] weaponized waves are truly of another order altogether.

For one thing they do not have to travel through space, for they come from the time domain, which is everywhere. The energy of the blast, the heat or light or whatever, comes from the vacuum of space **at the location of the target itself**. This is astonishing. The weapons actually just trigger the release of immense energy from the vacuum at the target location.

> "... it is possible to focus the potential for the effects of a weapon **through spacetime itself**, in a manner so that mass and energy do not "travel through space" from the transmitter to the target at all. Instead, ripples and patterns in the fabric of spacetime itself are manipulated to meet and interfere in and at the local spacetime of some distant target. There **interference of these ripple patterns** creates the desired energetic effect (hence the term energetics) directly in and through the target itself, emerging from the very spacetime (vacuum) in which the target is imbedded at its distant location." Bearden Fer-de-Lance

The big Tesla howitzers are aimed at their targets by using a worldwide electromagnetic pattern called the "Woodpecker Grid," begun by the Russians in 1976.

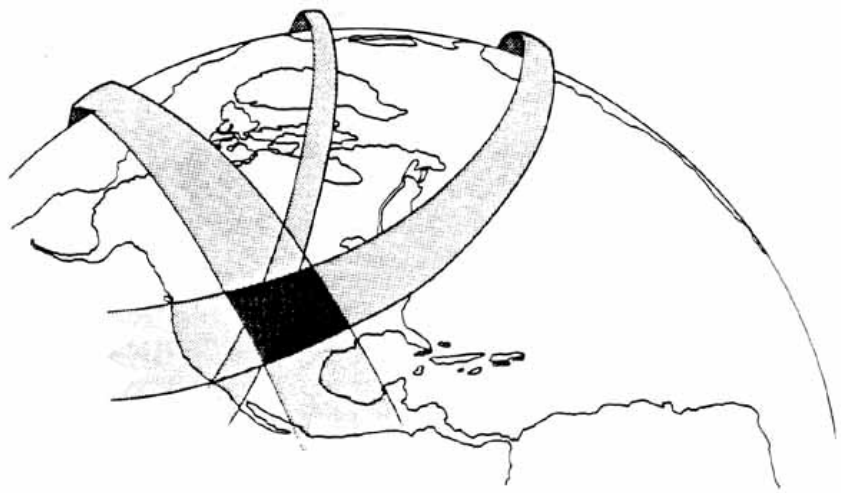

You can hear the Woodpecker signal here:
http://www.cheniere.org/misc/woodpeckersound.htm

The woodpecker grid is just that, a grid of EM waves which provide a channel for the **LW** waves to any point on earth. Computers use the woodpecker grid information to hone down the aiming of the howitzers **to a pinpoint location on earth**. (For that matter, it could be under the earth, in space, or under the sea).

A third howitzer mode is what Col. Bearden calls "**Mindsnapper**" mode. This is a truly frightening mode which affects the electromagnetic mind-body connection. Being mind-snapped at a low level would cause you to lose consciousness. Being mind-snapped at a slightly higher power would "entrain" all minds in the target area into a kind of hypnogogic trance, a state in which they would all be highly susceptible to suggestions and orders.

Being mind-snapped at high level would so disrupt the mind-body connection that everyone in the target area would fall down, instantly dead. Not only that, everything around you and inside you would be killed, so that your sterilized body would **not rot** for quite a long time.

The **Mindsnapper** can be used for a small area, or to **kill an entire population**. In fact, using the scalar waves to affect the human mind has become a new field in its own right, and has been dubbed "psychoenergetics." (This is discussed below in section 5).

Bearden describes the use of the howitzer in **mind-snapping mode** against people, to cause unconsciousness or death:

> "From a military viewpoint, these scalar EM weapons are really quite all-around weapons.
>
> "For example, they are very lethal against personnel.
>
> "Set in the "high intensity pulse mode," one blast and a person's nervous system is destroyed instantly. Total, instantaneous death results. One can blast away at entire groups of infantrymen, for

example. It's the peak power that's important, not the average power. So the weapon doesn't require too much battery power.

"Set on a lower intensity pulse mode, one zap can simply knock out a person, rendering him instantly unconscious. Quite useful if one needs prisoners to interrogate. Also very silent, which is useful in operations employing stealth and surprise." Bearden http://www.cheniere.org/books/ferdelance/s80.htm

"Those hit by the scalar EM weapon, however, have a most peculiar death mode.

"Death comes-instantly and totally. There is no convulsion, no response. The entire nervous system is destroyed instantly. Every living cell in the body is killed instantly, including all bacteria, germs, etc.

"A body hit with this thing falls like a limp rag and lies where it falls. It doesn't decay in even 30-45 days. In a macabre fashion, it's been reduced to something like food irradiated with nuclear radiation; everything is killed, so the material is preserved for an extended period before any decay can set in."

Bearden http://www.cheniere.org/books/ferdelance/s81.htm

He goes on to say that the same "bazooka-sized scalar EM pulse weapon" can also be used to knock out a tank with one shot (or pulse). So tank warfare is obsolete. Helicopters? Bearden points out: "... if he's attacked by a helicopter or a fixed-wing aircraft, he can bring the same weapon to bear on it. He can knock down a chopper or a jet. With one shot."

Obituary for Tank Warfare

Tanks useless against portable LW weapons

"For example, suppose one attacks a tank. [with an LW weapon]
With scalar EM pulse, the personnel die instantly. Total personnel kill is achieved.
All electronic systems of the tank are dudded. Total systems kill is achieved.
The ammunition in the tank explodes. Total kill is achieved.
The fuel explodes. This is another total kill mechanism.
That tank has been killed totally, by a variety of mechanisms, all simultaneously.
That's a k-kill in any analyst's book.
And don't worry about retrieval and repair. That tank is finished permanently.
Even the most modern tank is just as vulnerable as the most obsolete."

Bearden http://www.cheniere.org/books/ferdelance/s88.htm

One begins to get the idea how profoundly the conventional means of warfare have been obsoleted. All the usual weapons of war have been rendered nearly useless! And **Star Trek's "Phaser**," with its "stun" and "kill" modes is here at last.

Although it is the weapons aspect of scalar electromagnetic which has received the most developmental effort, Bearden points out that a great many other amazing things that may be accomplished in this new field of science. Beam me up Scotty!

> "Superluminal communications systems, hyperspace drive, and **materialization** and **dematerialization** are all hypothetically possible, using scalar electromagnetics. As the technology develops, we should see the development of many of the systems long thought impossible except in science- fiction."
>
> Bearden http://www.cheniere.org/books/ferdelance/s15.htm

Bearden describes a huge test of the Russian scalar weapons systems which occurred in 1985, a test that went completely unnoticed by western scientists:

> "Just before May 1, 1985 the Soviet Union performed a "full-up" operational test of their entire strategic scalar EM weapons complex. This test was detected and monitored periodically by Frank Golden. Some 27 of these giant Soviet "power taps" were locked into the molten core of the earth, producing forced (entrained) scalar resonance of the entire planet on 54 controlled frequencies under our very feet. The remainder of the scalar frequency spectrum was ablaze with literally hundreds of Soviet scalar transmitters: probably the entire strategic scalar command and control system to underwater submarines, higher command centers, distant commands, etc. was activated in the giant exercise.
>
> "For several days, the system was exercised on a mind-boggling scale, apparently as part of the Soviet Union's highly accentuated 40th anniversary celebration of the end of World War II.
>
> "Ironically, not a single U.S. intelligence agency, laboratory, or scientist detected this monstrous exercise for the new Soviet leader, Gorbachev. Not a one of them had a detector for scalar EM radiation, and not a one of them officially believes the exercise ever happened."
>
> Bearden http://www.cheniere.org/books/ferdelance/s38.htm
>
> "The **Woodpecker grid/howitzer** weapon system can be placed over the ocean and used against cruise missiles, naval surface-to-air and surface-to-surface missiles, submarine-launched ballistic and cruise missiles, etc. Placed over a carrier task force, it can also take care of the aircraft launched by the carrier as fast as they are launched. It can also handily take care of the missiles launched by guided-missile cruisers of the accompanying task force."
>
> (Bearden http://www.cheniere.org/books/ferdelance/s65.htm)

The whole series of the Fer-de-Lance briefing slides and comments is a "must read" for anyone wanting to be aware of the actual state of things in this world right now. It is a new world and it takes some getting used to. Fer-de-Lance speaks clearly, for the layman, of the way things stand.

What is it like to operate these Tesla Howitzers? Col. Bearden gives us an idea in his "Fer-de-Lance" briefing, Slides 66-71.

Who needs armies anymore? A entire war can be fought and won by a handful of men sitting in a comfortable control booth! The scalar electromagnetics revolution has made all previous forms of warfare nearly obsolete.

Why haven't the Russians used the scalar weapons yet?

Bearden gives his thoughts on this in "Fer-de-Lance." The power of these weapons is so great that an accident or war could wipe out all life on earth, and even **affect the sun**.

> "As can be appreciated, this entire concept [MAD] is now totally obsoleted by the Soviet possession of scalar EM weapons.
>
> 'The "mutual assured destruction" capability -- or MAD concept as it was so aptly named! -- is **no longer mutual.** And for two reasons: (1) the Soviet surprise attack could destroy essentially all our Triad forces wherever they are, in the first attack. (2) Even if a very small number of our strategic forces survive, the puny strike we could attempt to launch could be repeatedly decimated from launch to terminal phase.
>
> 'The restraint on the Soviets is not because of our Triad forces. The restraint is twofold:
>
>> (1) a second nation has scalar EM weapons, and would undoubtedly unleash them upon the Soviet Union with great violence if such a massive world-wide destruction of U.S. forces occurred or was threatened (is it really "accidental" that six major Soviet missile ammunition storage sites mysteriously exploded within seven months?);
>>
>> (2) the closed-loop **scalar radiation exchange system of Earth-Sun could be inadvertently "tweaked"** in the feedback loop from Earth to Sun, so that a large solar scalar resonance was stimulated. In that case the Sun could emit a mighty resonant "burp" that would simply **wipe out all life on Earth in a fiery shower**.
>
> 'The "terror" in the "balance of terror" between nations has just increased by many, many orders of magnitude.
>
> 'The biblical prophecy that the Earth will be wiped out by "fire and brimstone from heaven" is very near fulfillment now.
>
> 'Put another way, the pucker factor -- even on the Russians who may contemplate unleashing Armageddon -- is higher than any Western strategic analyst has ever imagined, even **in his wildest nightmares**.
>
> 'Truly these weapons are "more frightening than the mind of man has imagined," as Brezhnev put it in 1975.
>
> 'The frightening scalar EM weapons can be used, but only very, very gingerly indeed. If a slight mistake is made, everybody loses everything."
>
> Bearden http://www.cheniere.org/books/ferdelance/s74.htm

But the Russians (KGB) are not the worst of it. Bearden claims that some of the scalar weapons have been leased to the Yakuza for about a billion a year, and that only the KGB is holding the Yakuza in check from making a **full-scale all out scalar attack on the west.**

U.S. Defense Secretary William Cohen

Warns about eco-terrorism using scalar electromagnetic weapons

> "Others [terrorists] are engaging even in an eco-type of terrorism whereby they can **alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves...** So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations...**It's real**, and that's the reason why we have to intensifour [counter terrorism] efforts." - Defense Secretary William Cohen, 1997

In a letter to a writer named "Russell" Bearden says,

"In short, Russell, the Secretary of Defense of the United States confirmed that there are indeed novel kinds of EM weapons, right now and have been for some time, which have been and are being used to (1) initiate earthquakes, (2) engineer the weather and climate, and (3) initiate the eruption of volcanoes. We wrote about those exact uses of the weaponry decades ago. Several nations now have such weapons. Three of them (two on one side and the other on a hostile side) are even firing practice shots into Western Australia, as a convenient test range."

http://www.earthchangestv.com/ufo/0209gandor.htm

See Also:
Examples of scalar weapons testing around the globe

See Also: Powers of the Longitudinal Interferometers

Tesla Howitzers in Weather mode

How to Make Weather

"Engineering the weather is **duck soup**; they tested that over the U.S. in 1967, and entered upon continuing operations over North America on July 4, 1976 as a grim kind of KGB "Bicentennial Gift" to the United States. Here's how it is done with several interferometers.

"First, the interferometers can deliberately make "high pressure areas" (cool the air so it shrinks and its "footprint" pressure on the ground increases because its density increases) and "low pressure areas" (heat the air so that expands and its "footprint" pressure on the ground

decreases because its density decreases). Well, if one makes the highs and lows where one wishes them, and judiciously and somewhat slowly moves them along a given path, these highs and lows will entrain the jet streams and thus "steer" the weather.

"So if you wish a very cold snap or attack, go up into Canada and start these actions to steer down some streams that bring some very frigid air. Establish other highs and lows judiciously to "block" or "slow" other jet streams and flows as desired. In this way, one can pull the "large cold air masses coming down from Canada" deep into the southern U.S. at will. They do it regularly. If you wish an ice storm, add an additional current of warm moist air you bring up (steer up by using artificial highs and lows) from the ocean. Where they meet, you will get freezing rain, then sleet, then severe icing accumulating. This type of attack does rather large damage to the struck area."

http://www.earthchangestv.com/ufo/0209gandor.htm

Whole websites have now sprung up showing weather **radar anomalies** which may well be indications of scalar weather engineering. One list of over 500 images is here. Cheniere has its own collection here.

Here is an animated anomaly with cloud formation.

In another section at Cheniere are many photos of **cloud anomalies** which reveal the underlying grid along which the clouds are forming or un-forming. Bearden relates a startling incident in these **ongoing "weather wars**."

> "During the spring of 1986, abnormally strong Soviet weather engineering occurred over the U. S., causing a drastic drought in the southeastern U.S. **This drought was broken by a colleague who used an extremely powerful scalar EM device** to redirect jetstreams. A most unusual and unique signature of the "blocking" against the Soviet scalar EM actions resulted: Two huge circulations developed in the atmosphere, clearly showed as two adjacent giant "holes" in the swirling cloud cover over the middle and eastern U.S.
>
> "Between these two giant holes, the cloud circulations formed a stream of clouds, moving to the south, looking very: much like a giant vertical "bar" of a huge "Y-shaped" cloud flow.* Several national weathermen commented on this unusual pattern, which had not been observed before. The pattern continued, day after day, as the blocking continued."
>
> * On the weather maps.
>
> http://www.cheniere.org/books/analysis/history.htm

Tesla Howitzers in Earthquake mode

How to Make an Earthquake

"Here's how you initiate a very large earthquake with such weapons. Take a convenient fault zone of set of them. Focus the interferometry on the fault zone, in the "diverging" mode, and deposit EM energy there in the rocks on both sides, increasing (slowly) the stress in the rocks by the reverse piezoelectric effect (deposit excess energy, get crystal mechanical movements).

"Do it slowly, and the stress will build up to large pressures well-above a plate slip minimum energy required. At some point, the rocks yield and one or both sides "slip" and move rather sharply, giving a very large earthquake in that zone.

"Do the same thing down in the earth (remember, LWs easily penetrate right through the earth and ocean at will, and so the "interference zone" focus can be inside the earth or beneath the ocean, at will.

"Anyway, focus this thing down to where the active part of the volcano is still slumbering, down where the hole in the plate has been made. Keep increasing the deposition of energy in the magma itself, and eventually the increasing pressure from deep within that volcano, underground, will cause an eruption. Build the energy slow, and the eruption will likely be much larger."

http://www.earthchangestv.com/ufo/0209gandor.htm

Yugoslav Earthquake, Followed by Cold Explosion
Strange Characteristics of Iran Quake, Sep. 1978

Tesla Howitzers in Tesla's "Big Eye" mode

How to make a Big Eye in the Sky

By using longitudinal wave interferometry in a weakly endothermic mode a new kind of "radar" is now possible, one which can look right through the earth and oceans. Because the endothermic mode extracts energy from the distant target, a pattern of the target area can be scanned for in the returned energy.

"Thus the receiver produces a representation of the energy extracted from various locations within the distant endothermic zone. By displaying the received signals on an appropriately scanned screen, a representation of the distant scene in the intersection zone can be created. Indeed this is a special kind of "microwave interferometry," and -- with modern techniques -- the imagery obtained might be surprisingly good. With development, it might even become as good as the image presently obtained by side-looking acquisition radars.

"Interestingly enough, since scalar EM beams will easily penetrate the earth or the ocean, one can also look beneath the earth or

beneath the ocean with this type of scanning scalar interferometer.

"The importance of this capability to strategic and tactical reconnaissance is obvious. Camouflage, cover, and concealment have no effect on such a system. One can easily look inside buildings and into underground facilities. With a small system such as this, the U.S. Marines at Khe Sahn would have had little difficulty locating the tunnels continually dug under the perimeter by the Viet Cong. And targets under jungle canopies are directly visible."

Bearden http://www.cheniere.org/books/ferdelance/s42.htm

Tesla Howitzers can destroy all life on earth

How to Make a Storm on the Sun!!

(Just make a big mistake with your Tesla howitzers)

The **deepest dangers** of the use of scalar weapons are frighteningly pointed out by Bearden here where he considers that the sun, earth and moon (actually the whole solar system) is a delicately balanced arrangement of scalar (longitudinal) EM radiation. There is a scalar connection between the earth and the sun, which are both giant dipoles gushing energy in the time domain. Big scalar events on the earth could alter this balance causing **true catastrophe**.

"Indeed, a solar response could be stimulated so that the Sun would violently belch and destroy our biosphere, among other effects."

Unrestrained scalar warfare could cause huge solar storms? To realize that **human activity** could actually **affect the sun itself** is truly mind boggling.

Bearden goes on to say:

> "Accordingly, use of huge scalar EM weapons is a double-edged sword. Unless carefully employed, use of the weapons could cause a terrible backlash to the user as well as the victim, and even accidentally cause the **destruction of the earth itself**. It is not accidental that in 1960 Khrushchev stated that his new fantastic weapon could -- if unrestrainedly used -- destroy all life on earth.
>
> "This appalling backlash potential is apparently what prompted Brezhnev in 1975 to make so strong an effort to get agreement to outlaw the development of "new weapons of mass destruction" more frightful than the mind of man had even dreamed of. Gromyko even introduced such a draft agreement into the proceedings of the United Nations. The first article of the draft agreement indicated that the nature of the weapons referred to would be negotiated. Sadly, the entire Western

world did not even know what the Russians were talking about."

http://www.cheniere.org/books/ferdelance/s24.htm

2. Tesla domes provide near-perfect defense shield.

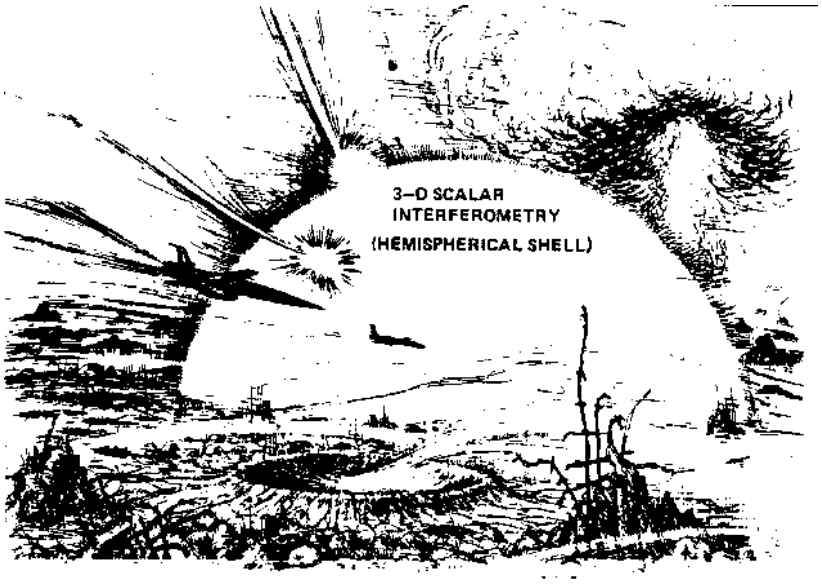

(Slide from Cheniere.org)

The Tesla howitzers can be used in a nearly **impregnable defensive mode** whereby they throw up a dome (**Tesla Dome**) or a sphere (**Tesla Globe**) of highly powerful electromagnetic energy, enough to "dud" or destroy missiles which try to penetrate them. Once again, this energy is not going through space from the howitzer, but being made to emerge from the local vacuum **at the location of the shell**. KGB tests of these domes have been witnessed by airline pilots around the world. Bearden gives many examples of the Tesla domes being sighted around the world in his briefing paper "Fer-de-Lance." (Russian dome test, another globe incident, yet another globe test). These giant electromagnetic domes can be hundreds of miles across, or narrowed down more to total impermeability.

> "Such a shell may be several hundred miles in diameter at the base. The enormous energy required to form such a defense shell is obtained by a "scalar power tap" into the **molten core of the earth itself**, as previously explained. In late April/early May of 1985, 27 such "**power taps**" were placed in the earth by the Soviets. If each tap is capable of powering four to six large scalar EM weapons, then the **Soviet strategic scalar EM arsenal contains over 100 monstrous superweapons** capable of generating exothermic explosions, endothermic explosions, engineering the weather, locating and destroying underwater submarines, detecting and destroying ballistic missiles shortly after launch, detecting and

> destroying long range strategic bombers as soon as they are airborne, etc."
> http://www.cheniere.org/books/ferdelance/s52.htm

By using nested domes one can protect the domed area **even against nuclear radiation itself**. Tesla globes can be used to hit airborne targets by simply placing a globe of any chosen size in the flight path of the incoming missile. It does double duty because the missile hits it going in, and then the rubble hits it again going out the other side.

While the U.S. persists in its useless boondoggle "missile defense system" by shooting a missile with a missile (missiles which would already have been "dudded" by the Tesla howitzers), between the domes and the globes the Russians (KGB) have in hand (**operational**) a nearly **perfect missile defense system**. Someone should ask the Secretary of Defense if the U.S. Tesla domes are in place. And over which cities? How powerful are our American Tesla domes?

Bearden cites a number of examples of these domes being tested around the world: March 20, 1969 | March 24, 1977 | August 17, 1980 | June 17, 1966 | June 18, 1982 June 22, 1976

In a slide from the Fer-de-Lance briefing it is shown how the "woodpecker grid" itself also acts as a sensor, detecting any missile launch anywhere, and how the howitzers can respond instantly by delivering a blast to exactly the right coordinates, right along the channels of that same grid which is feeding the location information about the missile launch. This certainly beats "trying to hit a bullet with a bullet." Especially since YOUR bullet would probably be instantly inoperable in a real scalar war situation.

3. Rogue Groups in the government

Bearden fears that these scalar electromagnetic secrets may have fallen into the hands of what he called secret "**rogue groups**" within the labyrinthine depths of the black-ops special-access domain of the secret government. "In the extreme, such a deep black program can even become a "captured" program," he says, "which is totally in the hands of rogues and **no longer reports to or is bound by the dictates of the parent government**."

> "They have their own agendas. And being rogue groups, they may well bring in **unethical, immoral tricks**: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A certain percentage of a highly secret rogue group will wind up using all these things and more. **It's a human characteristic, the old primate dominance game. Only now disguised and hidden under deep classification. ...**
>
> "In highly classified groups, these groups are greatly enabled to joust more widely, unethically, and immorally because it is so deeply hidden. So very deep classification evokes the growth and intensity of rogue groups. It's the old 'Power corrupts, and absolute power corrupts absolutely' routine. ... Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, **may not operate under very much legitimate government control at all**, and may operate specifically for the purposes of the rogue group or groups that have gained control."

> "The involvement of at least some rogue groups, some being "**cowboys**" who operate well **outside all laws and ethics**, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, ***it could account for what seems to be actually occurring***. "
>
> http://www.cheniere.org/explore%20articles/mind%20control3/p05.htm

4. World War III has already begun

Because it is now possible to cripple the power grids and electronics of any nation, that nation could be reduced to economic ruin without ever firing an actual "shot." Without electricity Wall Street cannot operate. Without electricity you quickly need martial law. One no longer needs to wage a conventional war anymore at all. There are now **lots of new ways to bring any nation to its knees**.

> "We are at war, whether we like it or not. And we are going to have strategic strikes on an unparalleled scale for us. Pearl Harbor was nothing compared to what is coming down, once we consider the "augmentation" and such.
>
> "When that factor is considered, then it's a totally new ball game on replacing the power system. There isn't going to be much choice; the old one is going to be destroyed or so badly crippled that **it will collapse the U.S. economy** in a way we have not seen since **1929**. Of course, in such a case hitting us, we will be under martial law, the works, everywhere. For one thing, it's the only way you can keep the cities from imploding from within, by the criminal element, looting, robbing, killing, etc. Simply wait and see; it's on the way."

Although Bearden has for years decried the "scalar-gap," and chided the military for falling so far behind the Russian KGB in the field of scalar electromagnetics, recent statements indicate that things may at last have changed somewhat.

> "In the new war, the first phase of WW III has already been completed. Hence President Bush's recognition that this is a total war, and has to be taken to the enemy no matter where he may be hiding or in what sanctuary or in what foreign nation. This is an entirely different war than anything the U.S. has ever fought in its history. **And before it is over, it is going to kill more Americans than have died in all the previous wars in our history. The news media and the public have not yet recognized that awful situation and predicament.** Most are already thinking that, well, we won in Afghanistan so it's just about over. Instead, it has only just begun.
>
> "Anyway, that's a brief uptake on some of the weapon situation today. Some 10 nations or more now have LWIs, and five have the QPs. I'm still working on how many have the appalling negative EMP weapons, but would estimate 6 or 7 nations have them in one stage or the other, either deployed or in at least advanced development. And in my estimation, the Yakuza will have them within three to five years if they have to build them themselves, and quicker if they can buy them from the Russians, Chinese, or???" Bearden

When he was asked the question "**Does the government listen to Tom Bearden?**" Bearden said:

> "Let me speak carefully. I am very satisfied with how I've been listened to in the quarters where the rubber meets the road. **The West is no longer defenseless, not by any means.** Cannot amplify it further than that."
> http://www.cheniere.org/correspondence/021102a.htm

Bearden has briefed the government a number of times and the Cheniere website contains a great number of his graphic military briefing slides.

5. Are the Russians making "UFOs?"

Scalar electromagnetics engineering opens the possibility of antigravity vehicles and "hyperspace travel." In other words we can now make our own UFO's! Of such **scalar-powered antigravity vehicles**, which have now become possible, Bearden has this to say:

> "We might expect to see such vehicles glowing. Their various surface features and mechanisms might appear to be glowing or revolving lights, etc.
>
> "They could exhibit incredible "aerodynamic performance," seemingly in the atmosphere. **Actually they would not be moving "through" the atmosphere at all, but through a higher space outside each particle of atmosphere**.
>
> "They could seem to **materialize** and **dematerialize**.
>
> "They could seem to plunge into the ocean or rise out of it.
>
> "They could even seem to operate under the ocean or inside the earth itself.
>
> "**Such anomalous vehicle performances have been seen all over the world**, particularly since a few years after WWII.
>
> "It appears that one or more nations of Earth are operating such vehicles now **in great secrecy**. Our own "government" may even be one of these.
>
> "If so, it **isn't** our true "government/government." Instead, it's the "control group/government." It's government at the operational level, but at higher level **it belongs to certain control groups who have penetrated our government's vitals and taken over all such projects**."
>
> Bearden http://www.cheniere.org/books/ferdelance/slide32.htm

In an excellent article on her Earthfiles website, Linda Moulton Howe reports on the utter bafflement of Norwegian scientists over mysterious lights appearing in the valley of Hessdalen, Norway.

She writes of the research there: "The results can be broken down into two groups: 95% are thermal plasmas and 5% are unidentified solid objects. The plasmas emit long wave radio frequencies and strangely, their temperatures do not vary with change in size or brightness." She quotes the scientists' research summary:

> "1) most of the luminous phenomenon is a thermal plasma;
> 2) the light-balls are not single objects but are constituted of many small components which are vibrating around a common barycenter;
> 3) the light-balls are able to eject smaller light-balls;
> 4) the light-balls change shape all the time;
> 5) the luminosity increase of the light balls is due to the increase of the radiating area. **But the cause, and the physical mechanism with which radiation is emitted, is currently unknown**."

This would almost certainly seem to be another example of the testing of the scalar howitzers. It is baffling because, as Bearden points out repeatedly, Western scientists have limited knowledge of the scalar electromagnetic principles by which the howitzers operate. The Hessdalen scientists were completely **baffled** as to where the energy of these plasma balls **was coming from**.

Ms. Howe interviews Massimo Teodorani, Ph.D., Astrophysicist, who released the report on the 2001 Hessdalen sightings. The scientist speaks of the baffling phenomon observed.

> "I don't know how it is possible that Nature is spontaneously able to do that. Anyway, we deduce that the plasma is trapped inside a sort of magnetic cage and the magnetic cage closes around the plasma and keeps it fixed in some way, prevents it from expanding. **But where does it come from? We don't know**."

By what we have been considering here, we can recognize the signatures of scalar electromagnetic engineering. If it is a Tesla howitzer, then the energy for the plasma balls **is coming from the vacuum of spacetime** at the very **location of the balls themselves**, triggered by scalar interferometers aimed through the woodpecker grid.

These kind of balls can be used as **marker beacons** giving feedback for precision aiming of the howitzers. The energy of the marker beacon can be read back into the

computers giving precise location information for pinpoint aiming. The target area can be very small, or widened out.

There is a little movie of one of the Hessdalen plasma balls here. It would seem to be a clear documentation of a scalar howitzer marker-beacon. How many other current "UFO" sightings are actually the witnessing of Tesla howitzer tests?

In fact there are a great many **anomalous events** of the past few decades which might very well be explained by the Russian testing of their longitudinal electromagnetic weapons. It would seem that the mysterious appearance of crop circles around the world could be accomplished by feeding a precise mathematical graphic pattern into the computerized aiming software and change the very molecular structure of the crops themselves along the lines of that pattern. The stalks fall over from the localized effect of the longitudinal waves. A plasma ball tracing patterns? Are they slyly sending a message to see if we are "getting it" yet?

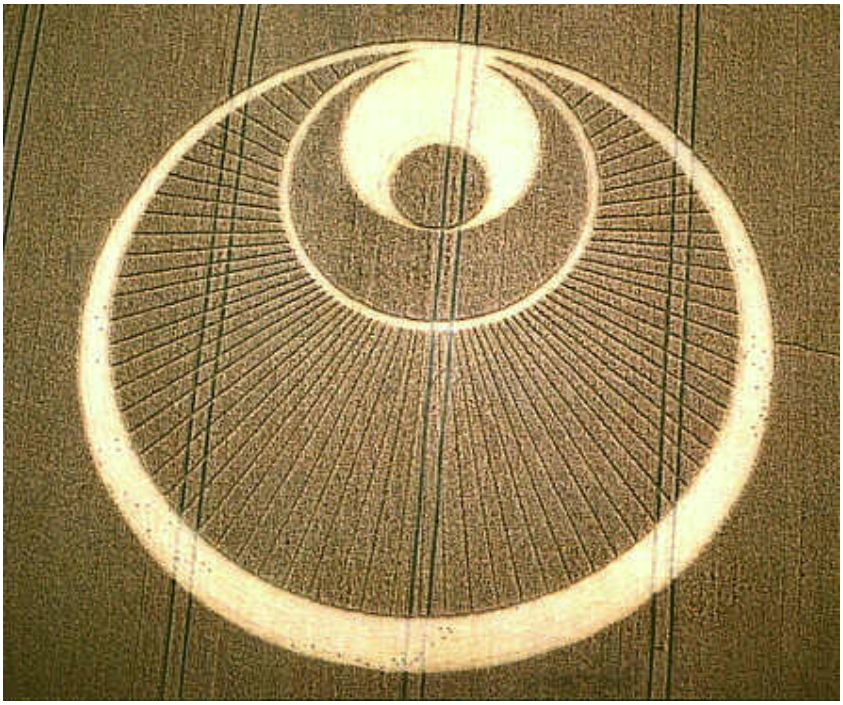

The "Cambridge Angel" - Made by Russian scalar plasma balls?

Also see: Interview with Tom Bearden

(Slide from Cheniere.org)

4. Healing powers of longitudinal waves

Healing via longitudinal waves, time reversal of cells (de-differentiation), Priore's machine, Bearden's proposed "blanket" version, using the electric power grid for healing waves or for broadcasting disease patterns. Scalar Biowar.

The good news!

"**Any sort of disease whatsoever - physical or mental** - will be rapidly curable, simply and cheaply. It will be possible to reverse aging and rejuvenate the person. It will be possible to regrow limbs and straighten misshapen spines - and directly remove the causes of mental diseases and cure them as well. Lifespan will be staggeringly increased, without 'old age's debilitation.' AIDS, cancer, leukemia, and genetic diseases will be completely conquered. The potential for a true golden era is upon us, for all humanity."

Bearden- http://twm.co.nz/beard_interview.htm

Proof of the healing powers of longitudinal waves from the vacuum is seen in the work of Antoine Priore who produced longitudinal scalar waves using a **gigantic glass tube** filled with plasma. He himself did not understand why it worked or how it cured cancer in animals.

> "The Priore team cured terminal tumors, trypanosomias, and other dread diseases in laboratory animals in France, in the 1960s and 1970s, under rigorous scientific protocols by eminent scientists. The Priore

project was funded by the French Government to the tune of several millions of dollars (equivalent). http://www.explorepub.com/articles/energetics.html

". . . Prioré's machines concretely demonstrated a nearly 100% cure of all kinds of terminal cancers and leukemias, in thousands of rigorous laboratory tests with animals. These results were shown to medical scientists as early as 1960." http://www.cheniere.org/priore/index.html

Bearden has stated that the longitudinal EM waves can have a healing effect because they always come in pairs called "**phase conjugate pairs**" and one of the pair is **time-reversed**. This enables engineering of the waves to "pump" the cells of the body (with waves from the time domain) and actually **time-reverse the cells** back to a previous healthy condition. The scalar cure of cancer does not involve killing the cancer cells but rather pumping them with time energy into a previous condition. I know, this seems miraculous, and is it not?

Priore and his giant plasma tube

This healing power in the longitudinal waves of the time domain is a mind-boggling thing to face. It took me months to get through it, and to **suffer the fact** that the **cure** for cancer and AIDS was right there, **in this new scalar electromagnetics technology**, and that it has been kept back from the people for so many decades now.

Bearden has a great deal to say about the work of Antoine Prioré, who himself did not understand why his machine worked. Priore did not know about the longitudinal scalar waves of the time domain. In fact, Tom Bearden has supplied, at last, the missing explanation as to how that **big giant two-story glass tube** consistently cured cancer in animals.

"**The medical implications are enormous**. By just reversing the damaged cells back to a previous physical state, this gives a physics mechanism for *controlled cellular dedifferentiation*, in biology terms. Physicians will **time-reverse diseased, damaged or aged cells** back to an earlier healthy condition, including all the cellular genetics. Normal cells are just reversed to a slightly younger condition."

"We believe this mechanism explains the revolutionary but baffling electromagnetic cures achieved by a team of outstanding French scientists in the 1960s and early 70s, working with inventor **Antoine Prioré**. In lab animals, cures were achieved for terminal tumors, infectious diseases such as trypanosomiasis, and atheriosclerosis. In addition, deliberately suppressed immune systems were dramatically restored.

"We hypothesize that this is the long-sought mechanism of how the living body heals itself. In short, the body's cellular control system induces **cellular reversal by weak time-domain pumping** of the damaged cells and the affected area. The cellular regeneration system performs all healing of cellular damage in the body; the immune system heals nothing, not even its own damaged cells) .

"For the first time medical science can develop as a science of *healing* rather than a science of *intervention*. And it will develop as a science of *unlimited* healing, since **no pathogen can resist action by curved spacetime engines**." Bearden

http://www.cheniere.org/techpapers/Vision%202000%20paper.doc

See Priore's machine See Slides of how it works.

Bearden has extended the Priore work, with the previously missing knowledge now in place, and designed a revised system (for irradiating the body with longitudinal waves) which gets rid of Priore's giant glass plasma tube and uses instead an **antenna unit which surrounds the body**. He has also provided the missing explanation of how it works. There is an article from "Explore" magazine, Part I and Part II.

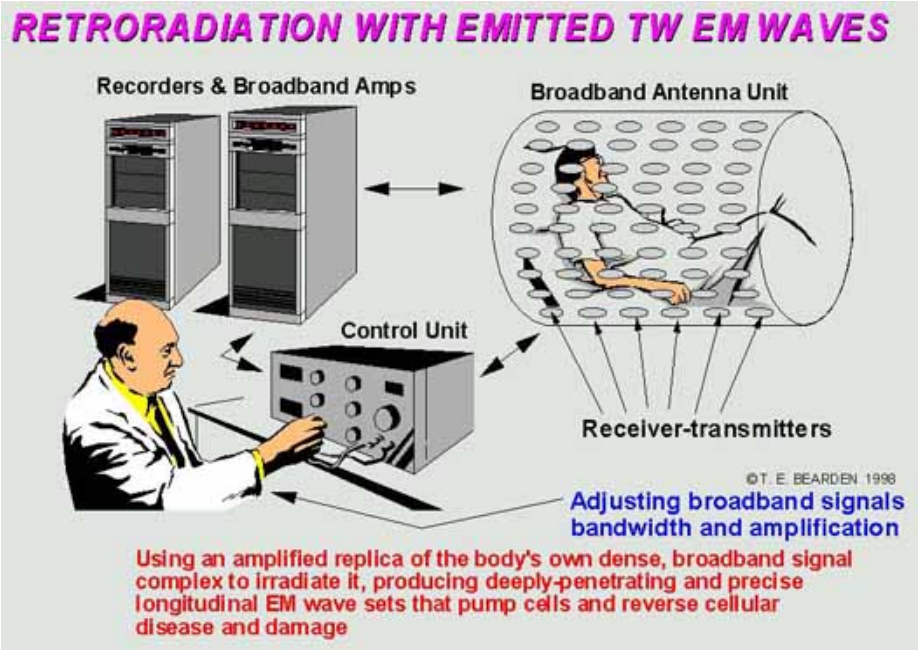

(Slide from Cheniere.org)

In fact, Bearden has presented to the U.S. government a plan to use a **portable version** of a **Scalar Healing Blanket** where wire channels in the blanket act as a scalar antenna, which can both send and receive scalar electromagnetic waves. A **two minute treatment** of the waves is sufficient to restore the body to its earlier healthy condition. Thus even **thousands could be treated easily and quickly in a biowar mass attack** situation.

"To defend against things like anthrax attacks on our civilian population centers, we also have recommended to the U.S.

Government the crash development of small, portable treatment machines—using similar "antiengine-forming" and cellular reversing "porthole technology". [See Figure 13 on previous page]. Such portable machines **could be developed cheaply and quickly**, and present government facilities could be used to massively attack the correlate database production problem.

"The portable treatment **units could be cranked out by the hundreds of thousands** and flooded down through emergency response agencies such as the police forces, the National Guard, emergency hospitals, emergency response teams, etc." - Bearden

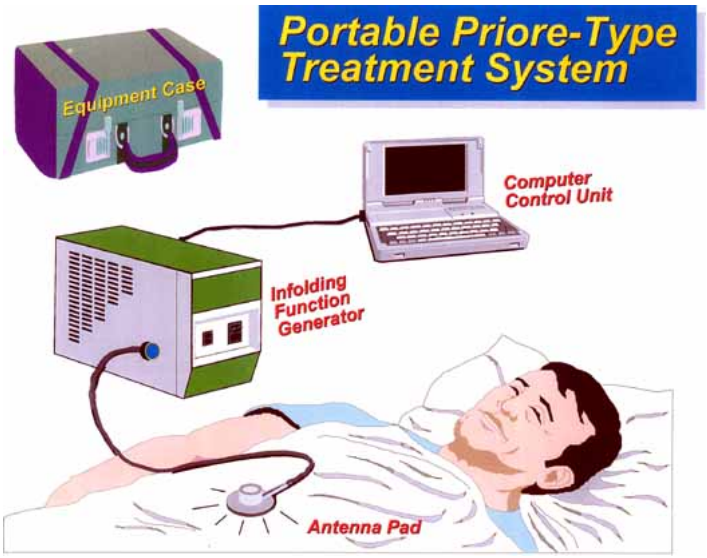

(Slide from Cheniere.org)

The **Scalar Healing Blanket** would fit into large suitcase. It has three basic parts, the longitudinal wave generator, a laptop computer, and the antenna-blanket. The plan was a stroke of Bearden's genius, but unfortunately it fell on **befuddled government ears**. "Unfortunately, so far the DOD [Dept. of Defense] doesn't even understand what the heck we're talking about!"

Article "Healing with Energy": http://www.explorepub.com/articles/energetics.html

> "We tried very hard in 1998 to call attention to the extreme national need for the most urgent possible development of a portable computer-controlled treatment device based on the experimentally proven Prioré methodology, but extended to a much simpler and far more rapid method of treatment.
>
> "Quick development of this technology could lead to **a suitcase size device, capable of treating a patient in less than one minute, and stopping the symptoms and disease progress cold, then reversing it**. Three "less than a minute" treatments one week apart would be required for complete cure. As an added advantage, partial reversal of aging in older patients would also be accomplished as a bonus, in addition to time-reversing the damaged and diseased cells...
>
> "The method proposed to the DoD in 1998 used normal EM in a peculiar way to force the body itself to make its own time-polarized

> EM waves, and pump every part of its cells -- including the genetics -- in the time domain.
>
> "Quite simply, we are going to be struck this way (QP spreading the immune systems of the populace plus professional smallpox, anthrax, etc. BW attacks on our population centers) and by other means we've spoken of in other papers and briefings."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

The Dark Side of the Force:
Creating and broadcasting disease

Speaking of the scalar wave induction of disease by longitudinal wave patterns Bearden refers to work by French scientist Kervran and Russian scientist Kaznacheyev, who proved that any disease could be transmitted electromagnetically.

> "It works this way: the Kaznacheyev experiments (and others) demonstrated that any cellular disease or disorder can be initiated into cells at a distance, by electromagnetic means (albeit unusual EM in nature). The decades of microwave radiation of the U.S. Embassy in Moscow, was an ongoing set of "stimuli" to ping the U.S. system and, by its response, ascertain how far along (or if it was "along") in its knowledge of such weapons. The radiation was responsible for many health changes in personnel and for the **eventual deaths of three U.S. Ambassadors**." Bearden http://www.cheniere.org/correspondence/021702a.htm

In a letter he writes,

"Yes, the Kaznacheyev experiments were quite real; 15,000 or so in military research institutes in Siberia. As with so many other novel areas investigated and developed by the Soviets, most U.S. investigators just assumed normal EM, which is not what the Kaznacheyev experiments involved, and not what was carrying disease induction patterns from one cell culture to another in rigorous lab tests."

How to "Broadcast" Diseases
Longitudinal EM Biowars

Bearden explains how the new quantum potential weapons can be used to induce disease-at-a-distance in a population, or to "spread" the immune system so thin that a **conventional bio-attack would be greatly potentiated**. By "broadcasting" virtual disease patterns over a population, the immune system is so overloaded by the presence of the **"shadow" diseases** that its effectiveness is thinned out.

> "In short, alter the internal wavestructure, and one creates a curved spacetime 'engine' that acts on mass in any fashion one chooses to design -- including initiate diseases . . . Now visualize one of these '**vacuum engines**' or 'spacetime curvature engines' that **acts on mass** to **generate the exact effects produced by anthrax**. (Or any other disease one wishes) . . .

Call the virtual state of a disease engine the disease pattern in the "shadow" state, just prior to becoming observable. . . .

"And the master cellular control system responds to "coming events that cast their shadows before". In short, it responds to the upper level of the **"shadow state" of a disease**, still in the virtual state! (Hey, virtual particles are real, virtual photons are real, virtual ST curvatures are real --- just very fleeting, only for another to immediately arise). The exchange of virtual particles is known to generate all forces in physics anyway! . . .

"So the cellular control system responds to "shadow state" disease patterns. Enter a QP weapon application. Place a quantum potential weapon "area" on the United States, so that the entire populace is in it. The slowly introduce and bring up in the shadow state, the **necrotizing fasciitis disease engine**. At some point, the cellular control systems will react, and order the immune system into action. In other words, immune system resources will be committed against this "immediately coming" enemy. Bring it on up a little, but still just in the shadow state. Voila! Humans form a bell-shaped distribution curve. And even if the structure of the QP fluctuates a little, fluctuating a bit stronger and a bit weaker, etc. **A few of those targeted bodies will now actually develop necrotizing fasciitis**. So far, just like the U.S. Embassy targeting, except a different "carrier".

"But now there is an exact signature that this is what is doing it, and not normal vector carriers of disease and contact or exposure infection. **The few cases of necrotizing fasciitis that break out will be most puzzling.** They will be randomly scattered across the entire nation, and so few that the vector carrier and contact or exposure explanation completely fails."

"And that one happened, right here in the U.S., not so long ago. Check it out.

"So carefully adjust the **patterns** for, say, 12 major terrible diseases, to that "adjusted and desired shadow state level". Now add all 12 patterns into the internal structure of the quantum potential. Now it has **12 shadow state disease engines** in it.

"**Place that one on a populace**. The cellular control systems order the immune systems into action, and they now have to commit their finite resources to 12 different areas. This greatly thins the response an immune system can make to any one of those 12 disease patterns! In short, it "**spreads**" the capabilities of the immune system, which can be galvanized to great effort, but only can perform a small bit against each area.

"Suppose one of those "galvanized" areas in the targeted populace's immune systems is anthrax. And suppose the bad guys now hit one or more of those cities with a professional anthrax attack. A former OTA study showed that a professional anthrax aerial spray attack against Washington D.C., dispensing

> 100 kilograms of anthrax spores in the spray, will account for 1 to 3 million casualties. And that's in an "unthinned" set of immune systems. **In the "thinned" set, one can at least double or triple, and even up to five times, that estimate.** So conservatively, now there would be from 2 to 6 million casualties. And even mild anthrax spray attacks in other "thinned" cities would also be amplified.
>
> "**That one is being set up, or already set up, right now.** There are other such "augmentation" setups also under way.
>
> **"So the weapons alluded to by the SecDef in 1997 are already being employed. WW III has already begun, and our populace (and our scientific community) is blissfully unaware of it."**
>
> http://www.cheniere.org/correspondence/021702a.htm

Most of us can remember the strange outbreaks of the so-called "**flesh eating disease**." It seemed to break out here and there randomly with no known cause. Bearden believes this was a test of the newer quantum potential weapons which go even beyond the capabilities of the Tesla howitzers.

> "The Kaznacheyev "disease induction by novel electrodynamics" work is also the basis for the spacetime curvature engines (not EM signals!) carried by quantum potential EM biological weapons for distant induction of diseases etc. into the population of an entire nation or area, such as the U.S.
>
> "This **quantum potential disease induction weapon** -- capable of attacking an entire population of a nation or area -- has been tested several times in the U.S. at very low levels, in the shadow state only (we explain shortly) and it has a most peculiar signature. E.g., **one test used necrotizing fasciitis (flesh-rotting disease) engines**.
>
> "The disease 'engine' was deliberately kept down in the 'shadow state' (virtual state, just below the observable state) so that only a tiny bit of the populace with depressed thresholds would "breach the observable threshold' due to the population forming a bell-shaped curve as to the threshold level. **The major signature of the test was that the cases of the disease broke out totally statistically and randoml**y, spread all over, without any 'disease vector' in between.
>
> "In short, it was not spread in any manner required by normal deterministic disease vectoring, **but was a totally random set of occurrences**. Several other diseases were also tested this way in the American populace, with precisely the same signature."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm
>
> "Apparently one planned use of such an augmented clandestine BW weapon will be smallpox, e.g. As you know, the Russians

> did develop smallpox for biological warfare, and even developed a new strain against which previous vaccination is ineffective.
>
> "The vast numbers of expected casualties, coupled with immune system spreading, are absolutely irresistible to the Russian mind. You can count on it that they have seen that the smallpox is already on site here, in the U.S. and in the hands of professional terrorist teams. Of course, the Russians/KGB will protest they have nothing to do with that! Yet likely the KGB will have flatly arranged it or at least assisted it. The capability for mass destruction of the nation is so lucrative and easy to achieve in advance, that **they would never be able to resist doing it**."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

Bearden believes the **Gulf War Syndrome** involved the use of scalar technology to induce a disease state, as he stated in a 1997 interview:

> **"I'll say this flatly, and I won't answer any further questions about it; the Gulf War Syndrome was induced...** It was induced with this stuff. All the rest... was contributing factors that everybody's talking about... There are some deeper signatures, if you look into it very deeply, that show you exactly how it was done and the fact that it was induced. It was a test. It was a test of a very special kind of weapon I have not talked about yet. Anyway you can use it to create diseases."
>
> Bearden http://twm.co.nz/beard_weapon.htm

Besides using the woodpecker grid to target a population, the entire **electrical grids** of nations can be used as "channels" for disease patterns to be broadcast to all people near that grid. Your own house wiring can become an antenna, broadcasting these "shadow" patterns of disease, weakening your immune system.

And here one faces the frustrating fact that the same power grids could be set to channel patterns which would keep the entire population healthy, rejuvenated, continuously bathing in the time-reversing old-age-defying energy of the spacetime vacuum. We have **no idea yet** of how long the human life span could be increased with this new technology. People might be able to live two centuries given full humane development of this technology.

5. Psychoenergetics

Mental entrainment, inducing hypnogogic trance, mind control, broadcasting thoughts and feelings, the Ant World, education via EM [LW] mental download, the "Feelies," revolution in spirituality, "enlightenment machine?" Scalar churches?

Psychoenergetics is simply using the scalar interferometers to manipulate and **engineer the human psyche**. To me it is the most **mind-boggling and frightening** aspect of longitudinal wave engineering.

The mind is electromagnetic in nature, and itself of the time-domain. It is not observable in 3-space. There is no **thing** you can point to that is the mind. As Bearden says, "**The mind is time-like**."

The longitudinal scalar EM waves are also of the time-domain. By overlaying certain infolded patterns (oscillations in time) on the longitudinal waves, **a thought or feeling may be made to arise in a person** or persons who are in the interference zone (where the wave beams cross).

The person will not notice anything, feeling that this thought or idea is his or her own idea. The longitudinal wave pattern might be a wave of panic or fear that spontaneously sweeps over you, perhaps inexplicably. It could even be in the form of a sudden intense patriotism. It could be explicit words and phrases, which everyone would think they had thought of by themselves. Or it could be rage and hatred, angry and violent. On the other hand It could also be a continuous sense of docility and placidity. This is the brave new world of psychoenergetics and the coming "**Mind Wars**."

Scalar Psychoenergetics in its most **primitive form** simply "entrains" all minds in the target area into a **deep hypnogogic trance**. In this state of mind people would be suddenly extremely suggestible, and would likely believe anything they are told, and would obey any orders given. Talk about winning the hearts and minds of the American People!

Tom Bearden makes me think of **Paul Revere**, who heroically conveyed important **warnings** for the sake of the new nation. But the words of the famous phrase have now strangely and curiously mutated into the once-inconceivable: "**One if by land, Two if by mind.**"

Indeed one strategy in a **Mind War** would be to simply **take over the minds of the "leaders"** of the enemy nation. The targeted leader would not be aware that anything was amiss, although he might begin to make unexpected changes in policy.

And are, in fact, any of our "leaders" already having secret thoughts that are not their own? Who knows? Frighteningly, we can no longer be sure. The new sciences of scalar electromagnetics and psychoenergetics are even now plunging humanity into a sudden science-fiction-like world beyond anything in humanity's previous imaginings.

> "The Russians reached the point in the mid 1990s that they could **take over control of a person's mind**, with modified longitudinal EM waves including some time-polarized EM waves, and with a team of specialists (estimate 25-30 per transmitter, and one transmitter and team per controlled person)." Bearden

In a slide Bearden illustrates how a Scalar War would involve a **psychoenergetics attack** on the operators of the enemy scalar installation, entraining their minds into hypnogogic trance and **getting them to shut down their systems**.

And ultimately psychoenergetic warfare goes to the very heart of **human identity itself**. For if my thoughts might no longer be "mine," then **who and what am I?** Can my very sense of being "me" be hijacked by some nefarious psychoenergetic scheme? Will the "secret government" eventually dictate directly into your mind how you feel about yourself? Or what you think you are? Or what you should do?

How Does Longitudinal EM Mind Control Work?

The physics of scalar psychoenergetics as expounded by Col. Bearden seems even more arcane and over-my-head than that of extracting energy from the vacuum. I can't understand it, but I look through it anyway. Each time another tiny understanding might occur, or a term might fall into place. I know the mathematics is forever beyond me.

One paper to begin with is Mind Control and EM Wave Polarization Transductions This is such serious stuff that Bearden includes a **strong warning about misuse of this knowledge**. Psychoenergetics weapons can mentally maim and physically kill.

Warning!

(From "Mind Control and EM Wave Polarization Transductions")

> "This article refers to experimental research techniques which can be detrimental or lethal in the hands of any but highly skilled, qualified experimental scientists proceeding under proper laboratory safety procedures. The purpose of this article is strictly for information to properly qualified and authorized scientists in certified laboratories. We do not propose or condone any use of these procedures for nonapproved practice of medicine without a license. Neither the publisher nor the author are responsible for accidents or outcomes in the use of these experimental procedures and techniques. Any researcher who performs these procedures and experiments is acting on his or her own volition, and is solely responsible for insuring safety, qualifications, and legality of the acts and their results. **We neither suggest nor condone unauthorized experimentation on human subjects. Such is a criminal violation of the constitutional rights of the subject under Federal and State laws, and is both illegal and immoral**." Bearden

After the **serious warning** comes the description of the paper. This is heady stuff for the layman.

> "Calling full attention to the special note above, in this paper we present a high-level overview of the novel electromagnetic nature of mind operations, mind and body coupling, and intent - the induction of physical 3-space EM energy changes into the brain and nervous system, and into every cell of the body, from the mind's time-like coherent operations. We summarize the time-polarized electrodynamics used to engineer and affect mind operations and the mind-body coupling loop. Transduction mechanisms whereby differing EM wave polarizations can be transformed one-into-the-other are presented." Bearden

I will leave it to the technically astute to try to understand the mechanisms of operation which are described in scientific language. But there are tidbits for the layman. Here he speaks of the difficulty Western scientists have in opening up to the "immaterial" (longitudinal wave) nature of the human mind.

Western Science Remains Largely Materialistic

"Ironically, most Western scientists are materialists and consider "mind" as a mystical and nonscientific concept. They tend to

consider mind operations and functions either to be simply "meat computer" operations and functions, or at best to be very weak ordinary transverse-wave EM operations and functions in the brain and nervous system. This serious self-limitation exists because in the body we measure only weak TW [transverse wave] EM operations and functions correlated to biological behavior and brain operations. We simply do not know how to measure "mind operations" directly.

"With no mind measurements possible and no instruments, it is understandable that Western science considers only the physical side of the mind-matter interface.

"**Presently our scientists do not measure the longitudinally-polarized EM wave operations and functions in the body and around it in nature. Few of them are aware that a maelstrom of such LW [longitudinal wave] functions exist in the body and in all of nature in general.**" Bearden

Western methods of influencing the mind with EM waves have only used transverse waves, not the longitudinal waves of the vacuum. If only transverse waves are used one pretty well has to hit the target mind with a **sledgehammer of waves**.

Western Science knows only transverse EM waves

Brute Forcing Time Functions versus Fine Control Methods

"Ironically, Western mind control researchers using transverse EM waves for mind control research, are using a brute force method of evoking and using vacuum engines (spacetime curvature engines) and a special form of general relativity, although they do not appear to realize it.

"While KGB scientists also use TW EM "brute force" TW waves when necessary, they do **"imprint" or "activate" those waves with the desired internal LW and time-polarized EM wave and photon structures** required to directly perform the mind engineering desired... Bearden

"These "fitted brute-force models" certainly can be very powerful, and certainly can produce the exact results shown in the experimental verifications of the fittings. However, they do not of themselves allow sophisticated design for example of the necessary time-polarized wave assemblies for **engineering the entire human collective unconscious simultaneously**, or for engineering the entire collective unconscious of all species on Earth (i.e., Gaia's collective unconscious), or even for precisely **engineering the memory and knowledge base of an individual**. Bearden

The seemingly magical operations of psychoenergetics, sometimes called "psychotronics," cannot be achieved with ordinary transverse EM wave energy. But they are possible with longitudinal scalar waves because the mind itself is scalar in nature.

> "We note that **all mind operations are time-like**, i.e., they are comprised as scalar EM photon functions and scalar EM wave functions. Thus the mind is a very special kind of electromagnetic system, existing in the time domain..." Bearden

The engineering of the mind can only be accomplished with the waves of time.

The course of psychoenergetics development necessitates the building of a vast database of settings and patterns which bring about given mental and/or emotional states. A kind of "**genome**" of the psyche. Bearden describes the process of the decoding of this "genome."

> "Now the scientists would perform many phenomenology experiments, making one little change at a time and profusely recording the data. Each time, they would establish the physical change(s) that occur in the body and/or the mental and emotional changes that occur in the mind for each spectral reinsertion back through the "ship's portholes". They would simply but painstakingly (over some years) build up an extensive database of those individual correlates.
>
> "In these experiments, the experimenters will eventually be able to **provoke any body or mind change they wish**. Strong emotion. Intense pain. Intense pleasure. Painful thoughts. Images. Memories. Perceptions. Dreams. Visions. Memory losses. Memory changes. Personality changes. Etc. The "delta" in the emission spectrum (the changes from zero reference spectrum) represent the precise totality of all mental, physical, organic, chemical, etc.changes and interactions." Bearden
>
> "A second stage in the research would be to **test the correlates** and porthole insertions upon a statistically significant cross section of ordinary people, and/or specialized populations (such as toughened soldiers). The program would evolve a highly complex, very effective, ever-improving science and technology of mind and behavior control and engineering mechanisms, complete with finished database and developed applications equipment." Bearden

Summing up his paper Bearden speculates on what the actual situation the science of psychoenergetics probably is. The intense secrecy with which this knowledge has been kept from the public has led to the **current farce of the "government" pretending** it all does not exist, and this secrecy may have now put us at great risk.

> "The implication is that in the West one or more highly classified, sustained, heavily funded developments in advanced mind control programs, probably exists and probably has existed for some time. Due to loose formation of rogue groups inside such programs, they may have dual or triple purposes, **may not operate under very much legitimate government control at all**, and may operate specifically for the purposes of the rogue group or groups that have gained control.

> "In a nutshell, that's what may be going on in the **clandestine mind control projects** in several Western governments. The involvement of at least some rogue groups, some being "cowboys" who operate well **outside all laws and ethics**, could also result in such things as assassinations, clandestine testing on individuals without their consent, etc. In short, ***it could account for what seems to be actually occurring***. As also is "usual" in such a mess, one or more of the rogue groups eventually may become very powerful because their secret weapons are very powerful. They may become confident, thinking they have the "best in the world." They may actually believe they are ahead of the Russians..."
>
> "Remember that, in every large and powerful human organization, the basis for rogue groups is **power** and **secrecy**. They are always seeking to increase their power, control, influence, prestige, etc. Nothing else. Patriotism and mission are—to rogue groups—often just idle words. They have their own agendas. And being rogue groups, they may well bring in unethical, immoral tricks: assassination, bribery, entrapment, disinformation, plausible deniability, etc. A certain percentage of a highly secret rogue group will wind up using all these things and more. It's a **human** characteristic, the **old primate dominance game**. Only now disguised and hidden under deep classification."
>
> "The **Russians**, with their additional knowledge of the actual mechanisms in the transforms, will be **much more advanced than the West,** because their fundamental psychoenergetics science is far more advanced, so long as we continue to use the old U(l) electrodynamics. Further, the Russians have decades of use of **longitudinal interferometry beams to reach right through the earth and ocean** and produce stringent EM effects at a distance. So they will also be able to do the same things here in "mind control" with LW [longitudinal wave] interferometers, through intervening mass." Bearden

Bearden cites two examples where he believes the Russian KGB tested the psychoenergetics capabilities of their scalar interferometers. One was the case of Captain Button in his A-10 "Warthog" aircraft on April 2, 1997.

> "Over Arizona, Captain Button was thrown into a hypnogogic state, and his perceptions instantly altered and controlled. In his instant "dream-waking" state, everything seemed perfectly normal. His sense of direction was altered a bit more than 90 degrees, so he simply corrected and turned and "flew toward the range", actually flying off course by more than 90 degrees and ignoring radio contacts. He flew right on out of Arizona."
>
> "At one point he circled, probably thinking he was over the range, and he probably dropped his ordnance there. Then he "flew on back toward home," as he thought in his waking dream state, until his fuel ran out and he crashed and died in the explosion—**dream-thinking until he died that everything was normal**. All the while, his sense of the passage of time was altered. To him, in his dream-thinking, dream-acting state, everything was normal and nothing untoward had happened. **So the distant KGB transmitters and associated psychoenergetics team controlled him for over an hour**.

"Indeed, that was the exact purpose of the test: demonstrate control (at a great distance) of a skilled person performing highly skilled tasks."

The paper Mind Control and EM Wave Polarization Transductions ends with the most chilling and frightening possibility of all: the **psychoenergetic engineering of the human species** as a whole.

The Ant World

The Final Race for Direct Mind Control of the Entire Human Species

"The KGB psychoenergetics weapons scientists—because of their direct measurements and detections (and use) of t-polarized waves and LWs [longitudinal waves] for decades—also understand that Jung's collective unconscious mind (of the entire human species) also has its own time-like operations and correlates, which one measures also when using t-polarization measurements and sorting it all out. **The collective unconscious mind operations are buried several levels deeper inside the recursive Whittaker structuring inside the EM fields, waves, and potentials**.

"The KGB scientists also know that something very like **Gaia** — a collective unconscious mind for all species on earth — **also exists**, and they are striving to be able to sort out and measure that one as well. The Gaia operations are buried even deeper in the recursive structuring inside the EM fields, waves, and potentials."

"Actually, from day one, the Russian mind control scientists have had their eventual goal set upon this "deeper area of mind and possible mind control" of the entire human species.

"I am convinced that the KGB psychoenergetics scientists understand this deeper area. If they can learn to directly engineer the collective human species unconscious, they can then **convert the human species easily into a sort of "ant" society**, modeled along ideal Communism lines, except of course with an excluded "hierarchy at the top" running everything. The "ant society" — communist style — is still a variation of feudalism (**all systems tend to feudalism or some form thereof**).

"The KGB psychoenergetics weapon scientists are seriously pressing on toward that very goal. In my opinion they are not very far from it right now...

"Some versions of Russian mind control devices were used on Russian soldiers in the Afghan War to **condition them for performance of merciless acts**." [13]

http://www.cheniere.org/explore%20articles/mind%20control3/p07.htm

More about "The Ant World"

Whether it is the Russians planning an "ant world" society or rogue U.S. black-ops groups withholding a great boon from human race, the secrecy on all sides around has

allowed **largely criminal elements** to take over this technology while leaving the civilized elements in the dark. Openness and the spreading of this knowledge among good and decent people is essential, and for that **we will have to overcome our frightened denial**.

> "Meanwhile, **rogue groups** amongst Western clandestine mind control researchers will probably arise if they have not already done so. They will likely seek to increase their personal control and further isolate the programs from orthodox government review and from government and legislative control. They may even divert the research into highly illegal and unethical means, because it furthers their own rogue agendas. That is how clandestine U.S. government research can sometimes go sour, **unless great care is exercised by the oversight committees in the House and the Senate**.
>
> "Sometimes when rogue groups do gain control and total secrecy of a given new technological area, then what appears to be "U.S. government operations" do start to encompass a criminal and unethical operations, hidden usually beneath the deep veil of high classification. Also, if it's "scientific," no one is ever brought to justice, even if the "evil science actions" are uncovered and publicly revealed." Bearden

Like the huge energy of the Tesla howitzers, the ability to engineer the mind with longitudinal waveforms is a seeming "magical" thing which can be used for good or ill. Bearden envisions that further developments will allow something like the "downloading" of knowledge via scalar interferometry. Everyone could be highly educated, and quickly and easily.

In the conclusion of the paper "Mind Control and EM Wave Polarization Transductions" Bearden makes **a plea to the nations of the world** regarding the use of psychoenergetic engineering.

> "Let us hope this great new area, already off to a bad start, can be bridled and steered in the direction helping and healing people, rather than killing or abusing them. **The excesses in its bad use are a potent threat to all nations on earth**.
>
> "Yet it can revolutionize medical science, education, communication, and psychology. We foresee the day -- perhaps 30 years hence -- when **education will be accomplished by directly loading the software into the mind**. Then in three weeks one will "load" a doctorate, say, in physics. In three more weeks on will also load a doctorate in chemistry. Another three weeks, in electrical engineering. Another three weeks, an M.D. And so on. When that happens then truly everyone on earth can be educated. Freedom from ignorance may well be another great freedom that is legally recognized. There will be no impoverished large groups lacking the education to find decent, productive jobs.
>
> "We urge all nations to use the principles involved: not for human abuse, but for healing, educating, uplifting, and life-expanding of every person on earth. If we do, we shall all have a far brighter future. Then we shall check what has started out to be the Sword of Damocles and turn it into the golden Millennium." Bearden

(Perhaps after so many frightening topics a slight break is in order here to consider the **lighter side of psychoenergetics**. For example, what will be the ultimate impact on the entertainment industry?)

The Feelies at Last!

Psychoenergetics will be able to bring about at last, for better or for worse, Aldous Huxley's fanciful idea in his novel "**Brave New World**," an entertainment format which he called "**The Feelies**." Those were something you went to, like going to the movies, but you would **experience** all the actual feelings themselves, as if the depicted events were actually happening to you. Although our "leaders" seem too dim to grasp what is going on in the world of scalar electromagnetics, it should not take some young Hollywood genius too long to understand that **The Feelies are now possible**, and that the immense megabucks of potential profit more than justify heavy investment in bringing it to market.

One can imagine that first "Feelie" theater, "The Huxley" perhaps, a large comfortable area surrounded by nine giant screens (not just one screen!), which become 3D if you put on your headset. And The Huxley is fitted with the finest sound, and oh, by the way, a modest sized scalar interferometer with computer. And there are one or more **new tracks** now recorded on the film next to the sound track. These are the digital patterns of thoughts, feelings, and ideas to be fed into the theater's interferometer. And these thoughts and feelings and ideas will be felt by the audience as if they were their own thoughts and ideas. It is an entirely new art form. Psychevision.

As important (and no doubt famous) as the actors would be the "feelers," those from whose minds the feelings were lifted in the original programming of the Feelie tracks. Because, for example, Brad Pitt might be a good and handsome actor, but **can he really feel it?** Like the dubbing of foreign language films, it might be necessary to dub the "emotional track" using a deeper and more profound person's feelings, thoughts and ideas.

It might even be engineered so that if you sat on one side of the theater you would feel like the hero, and on the other side you would feel exactly like the bad guy! What would that lead to?

We have all cried at a movie some time, most people have, though they might not want to admit it. But this would be **deep sobbing** and a **flood of tears**, if the director so desired it. You would feel it at your core. Or, take a big chase scene, **you would be terrified**. They are breathing down your neck! You would be gripped by panic.

For that matter, the whole genre of **Horror-Feelie** would be too much for many people to take. Do I **really** want to feel that an **actual vampire** is tearing at my throat with his fangs?

A Religious Feelie would make you feel the exaltation of a saint at his prayers, or give you the **definite** feeling that you are Christ suffering on the cross. All the pain could be there too. The stickiness of the

blood. The very feeling itself: "Why hast thou forsaken me?" Who among us could come up **that** despair for scanning? Had this been developed a bit earlier we might watch a documentary of, say, Mother Theresa, containing her own actual deep sense of compassion, which we would feel arising in us as our own.

Then again, a Psychedelic Feelie could induce an LSD-like state and simply blow the audience's minds.

Even in its simplest most primitive mode, the hypnogogic trance induction with its increased suggestibility, would completely alter the experience of even ordinary current movie going.

6. As it Stands - 2002

[Note 2006: Click here for a current status history of the MEG from Tom Bearden]

> "**Anyway, it's presently a "Mexican stand-off**" with the various parties maneuvering with check and countercheck. That is the real "balance of terror" that is held by such a fragile balance."
>
> "You can see the implications if such weapons fall into the hands of the radical terrorists. Ordinary positive energy EMP shooters **can be made fairly readily and cheaply** from nearly just **Radio Shack parts** or surplus parts. It just takes some know-how... When and if the Yakuza [Japanese mafia] gets those (and they will, it's just a question of time), you can begin to appreciate some of the turns this present terrorism and our war on it will take." Bearden

The very thought of the building of one of these howitzers by "some lone-nut gunman" from Radio Shack parts makes one realize how serious it is for humanity to face the crisis it has come to.

Once again, as at the dawn of the nuclear era, humanity finds itself at the crossroads of Heaven and Hell. As a species, we must stop and consider. And there is at least one real difference between this visit to the crossroads and the last: *this* time there is a very real possibility of a true "earthly heaven" on the Heaven side.

The poor nations could come to a good life. Disease could be largely eliminated. Fossil fuel pollution could end. Global warming could be solved, and the weather could be managed in a humane way, bringing water where there is drought, and sunny skies where there is flood. Scalar interferometry would be there to avert any possible hits by asteroids or comets. Mars could be colonized and terraformed. Everyone would be highly educated through psychoenergetic downloading of knowledge. And the **wisdom of the wise** could be realized directly through scalar connection to their minds and hearts.

These stunning sudden possibilities give me pause to think: if our species has reached this crossroads in such a short span of centuries, then surely other species in this vast universe have passed this way before and long ago. And of those who chose the path to "planetary heaven," what is their life like now? It might be good if some of them were with us now, to guide us through this last struggle over this pesky old good-and-evil

problem. **It is our last chance to choose the path which benefits the whole species, and not just some elite group or faction**.

The Disclosure Project

One person working tirelessly to bring to bring these technologies into the open is Dr. Stephen Greer of the Disclosure Project, which is calling for congressional hearings into the issues of UFOs and the free energy technology that was, perhaps in part, reverse-engineered from them.

> "Once abundant and nearly free energy is available in impoverished areas for agriculture, transportation, construction, manufacturing and electrification, **there is no limit to what humanity can achieve**. It is ridiculous — obscene even — that mind-boggling poverty and famine exists in the world while we sit on classified technologies that could completely reverse this situation.
>
> "So why not release these technologies? **Because the social, economic and geo-political order of the world would be greatly altered**. Every deep insider with whom I have met has emphasized that this would be the greatest change in known human history. The matter is so highly classified not because it is so silly, but because its implications are so profound and far reaching. By nature, those who control such projects do not like change. And here we are talking about the biggest economic, technological, social and geo-political change in known human history. Hence, the status quo is maintained, even as our civilization hurtles towards oblivion...
>
> "With the types of weapons currently in the **covert arsenal** — weapons more fearsome even than thermonuclear devices — there is no possibility of a survivable conflict. Yet in the darkness of secrecy, actions have been taken on behalf of every human that may endanger our future. Only a full, honest disclosure will correct this situation. **It is not possible for me to convey in words the urgency of this**."
>
> Dr. Stephen Greer http://www.disclosureproject.org/ES-DisclosureImplications-2.htm

Greer and his team have assembled hundreds of witnesses, many of whom are military or ex-military, who are ready to testify to congressional hearings what they know about the covert black projects which have kept free-energy and antigravity propulsion technology secret from the people.

Greer points out the need to regulate these technologies so they are limited to peaceful uses, but this is of course difficult when the government simply chooses to pretend they do not exist. In the meantime, as the President and the Defense Department continue the charade of war-as-usual, those scalar (longitudinal wave) installations which DO exist continue to fall into ever more sinister hands. And there is no reporter in the press brave enough to ask, "**Mr. Secretary of Defense, what steps are you taking to defend our MINDS from attack by the big Russian longitudinal interferometers?**"

Longitudinal Interferometers are Proliferating

In a later statement Bearden reveals that in fact the Yakuza [Japanese mafia] has **already leased** some of the interferometers with a nearly $1 billion "down payment:"

> "After the collapse of the Soviet Union's economy, lots of things got available for lease or purchase that would never have been under the old system. That happened in the resulting economic chaos. The Russian Mafia rose to prominence, as did some wheeling and dealing entrepreneurs who played both ends against the middle.
>
> "**In that atmosphere, and in the need for money, the KGB allowed leasing of the earlier longitudinal EM wave interferometers to a consortium of the Yakuza and Aum Shinrikyo.** They did this only after they had tested and deployed their great new quantum potential weapons. That class of weapon is the dominant weapon on earth. Five nations now have it: Brazil, Russia (KGB), China, and two nations friendly to the U.S. The deal to lease many of the earlier LWIs [longitudinal wave interferometers] to the Japanese Yakuza and Aum Shinrikyo was consummated at the end of 1989, with a down payment of $900 million in gold bullion as "up front" money. I don't know what the lease per year was and is, but probably something like a billion dollars a year. **So the rogue Japanese acquired longitudinal EM weapons** and that technical know-how. In fact, the Yakuza is producing certain kinds of those in its own facilities in Japan now."
>
> http://www.cheniere.org/correspondence/030202a.htm

Personally, I am a little uncomfortable with the knowledge that the Japanese mafia may now be able to insert things into my mind. I'd like to sleep at night knowing that my dreams are my own, such as they may be, and not some weird fantastic visions cooked up by a criminal organization. **This is a world emergency**.

And in Bearden's analysis, it all comes back to the issue of **energy**. It is the energy crisis which is now provoking the current "oil wars," since oil production has hit the "Hubbard Peak" and will decline. And the electrical power grids must be replaced with scalar power as fast as possible, for these grids are now totally vulnerable to any possessor of longitudinal interferometers. They can all be wiped out in minutes. By anyone who possesses or controls a Tesla howitzer.

> "Anyway, in my personal view, we should have a national **Manhattan Project** right now, to develop decentralized electrical power systems taking their energy from the vacuum . . . The MEG is real and so are several other systems invented by private inventors and colleagues. All these efforts should be massively funded and massively and quickly developed. The survival of this nation is going to depend upon it. . . . There are many other facets, but the major point is that **our scientific apparatus and the public are still unaware of what a desperate struggle we have entered, since it was thrust upon us. 9-11 was a wake-up call**. It was certainly bad enough, and one grieves for those lost American lives. But I fear the **worst is yet to come**, and it is coming at us like a runaway train hurtling right down the track at us."
>
> http://www.cheniere.org/correspondence/021702a.htm
>
> "The electromagnetic weapons mentioned by the Secretary of Defense in April 1997 **are in terrorist hands also**, including the **Yakuza and Aum Shinrikyo**. That rogue group leased those earlier weapons on site in Russia, from the KGB, at the end of 1989. The SecDef stated that such weapons were being used to initiate earthquakes, initiate volcanoes into eruption, and control and engineer the weather. Quite true. And presently

there is a truly massive set of weather engineering operations going on over North America, from that rogue Japanese group manning the weapons in Russia. Some 10 nations of the world now have the type of longitudinal EM wave interferometer weapons (which are what the SecDef was most probably referring to). There are other even more fearsome weapons, possessed by five nations. **So a great deal of the state of the world is not covered in the news at all, and will not be . . .**

"We have been in an undeclared war of an eerie kind for some decades. That war seems now to have started to heat up also. The destructive capability of some of these weapons is awesome, and far greater than nuclear."

http://www.cheniere.org/correspondence/021702a.htm

"In that sense, the first phase of WW III is already completed. Now we are only waiting for Phase II.

"It is against that backdrop that I think one must "analyze" such things as how fast we will be replacing the power grid (**it's going to go anyway, and catastrophically, the terrorists will see to that**). And everything we have is critically dependent upon energy, from the economy to jobs to mobility, to the millions of trucks that transport our goods every day, etc.

"As far as I am concerned, we are already late in declaring a great national emergency in energy, because of the coming destruction of the present energy infrastructure. The scientific community should lead, follow, or get out of the way. The emergency is not in seeking "alternative but conventional" systems. It is in developing "energy from the vacuum" on an emergency, crash basis.

"Unfortunately, everywhere I look I just see business as usual. Most Americans (and news media) seem to think, hey, Afghanistan is finished except for a bit of cleanup, and it's just about over).

"It isn't. It has only just begun."

http://www.cheniere.org/correspondence/021702a.htm

Beyond the Howitzers: Quantum Potential Weapons

Do not use EM propagation through space

As more and more nations acquire the scalar interferometers, Bearden speculates on the next generation of longitudinal weapons called "quantum potential" [QP] weapons.

> "The **quantum potential weapons** are presently only held by three nations: Russia (in the hands of the KGB, which is now know by its new name), Brazil, and the "friendly little nation." Red China may be working on them, but is just at the beginning...

> "The QP weapons have been highly reserved by the Russians. However, the complete extent of their capabilities is still being figured out...
>
> "The quantum potential weaponry (possessed by only three nations) is supreme, because **it uses multiply connected spacetime**, and DOES NOT involve propagation of EM energy through space as does the longitudinal EM wave interferometers.
>
> http://www.cheniere.org/misc/qp.htm
>
> "The operational deployment of full-scale strategic QP weapons on site in Russia occurred at the end of 1989, which is when the formal weapons first went operational. These weapons are not in the inventory of the regular Russian armed forces, but all research and development, manufacturing, deployment, an manning and employment is under the ruthless control of the KGB. Shortly thereafter (within weeks), the KGB leased many of their earlier longitudinal EM wave interferometer (LWI) weapons to a rogue Japanese group comprised of the Aum Shinrikyo and Yakuza."
>
> Bearden http://www.cheniere.org/correspondence/021401.htm

In another paper, "Time Polarization - Significance and Weaponization," Bearden tells the story of how a KGB longitudinal wave attack was averted by the longitudinal weapons of a "friendly small nation."

So as it stands, it is precarious. Not until the people demand an end of what author Jim Marrs has dubbed the "**Rule by Secrecy**," can the people's representatives tackle the big problems of a worldwide ban on Scalar Wars and the shifting over to an essentially oil-free economy.

Latest Update from Tom Bearden - March 2002

The whole situation is changing so fast that when I asked Tom to look over this article he mentioned the seeming contradiction when some of the above statements are taken together. At different times the information he has is updated so one has to keep a kind of running track. He was kind enough to clear up the confusion here with the situation as it stands as of March, 2002.

> "We knew of three nations having the QP weapons for some time. Then we found out last year that five nations had it. So that explains my using the figure "three" first (which represented what I knew at the time). Later I found out about the other two nations. China, e.g., only deployed its QP weapon this past year. So that explains the apparent contradiction between me using "five" in later papers and "three" in earlier ones. It was the best information I had at that time. Might mention that so the reader will understand the apparent discrepancy." Tom Bearden

Emptiness is Full of Energy

"The Tao is an empty vessel;
it is used, but never filled.
Oh, unfathomable source
of ten thousand things!

"Oh, hidden deep but ever present!
I do not know from whence it comes.
It is the forefather of the gods."

Lao Tzu -Tao te Ching

Afterword

Because of the extreme seriousness of the topics brought forward in this article, I asked Tom Bearden to look it over to make sure I had not gotten anything too terribly wrong or mixed up. I did not want to pass on any misunderstanding of my own. I felt a little nervous writing to an eminent scientist, and hoped I had not presumed upon his time.

But Tom was so kind as to answer immediately, and to my relief I had not gotten anything too terribly wrong. Here is his letter, in which he clears up a misunderstanding, and reports on his current health treatment, and gives a call to the young grad students to turn themselves loose in the whole new field of scalar electromagnetics and free energy.

Subject: RE: Article on Tom Bearden and "Scalar Wars"
Date: Fri, 22 Mar 2002 22:54:01 -0600

Bill,

Well, I must say I'm astounded at your persistence and hard work in congealing all that together. My compliments on a hard job quite well done.

Couple tiny things: In the area mentioning Kervran and Kaznacheyev: Kervran was French; Kaznacheyev was and is Russian. Little typo of "spredding" the immune system. Should be "spreading".

We knew of three nations having the QP weapons for some time. Then we found out last year that five nations had it. So that explains my using the figure "three" first (which represented what I knew at the time). Later I found out about the other two nations. China, e.g., only deployed its QP weapon this past year. So that explains the apparent contradiction between me using "five" in later papers and "three" in earlier ones. It was the best information I had at that time. Might mention that so the reader will understand the apparent discrepancy.

Otherwise, it's pretty accurate.

Just now I'm letting the weapons take care of themselves; have to, as I will be recovering now for nearly a year from now after the heart attack last year and discovering that I had contracted mycoplasia (the BW modified kind) in Canada in 1968. Finally got a test which confirmed the chronic mycoplasia (which I had for 33 years!). The stuff burrows inside one's red corpuscles, then draws nutrients from the hemoglobin, hardening it and reducing its ability to take on oxygen (by as much as 50% or more). The resulting symptom is loss of endurance (which I had for that 33 years) -- the so-called "chronic fatigue syndrome".

Many of the Gulf War Veterans who are sick also have it, though they apparently have other complicating factors as well. A very high percentage of persons with chronic fatigue syndrome also have mycoplasia. The treatment for the long-standing mycoplasma infection of that nature is to stay on antibiotics for a year. The only time the mycoplasma is vulnerable is when one wears out a red cell in normal usage, and the body makes a new red cell to replace it. The mycoplasma comes out of the dying cell to infect the new replacement cell, so it is exposed and vulnerable at that specific time and that time only. The antibiotics kills it at that time. Hence the necessity to stay on antibiotics for such a long time so it is continuously in your bloodstream (I've already been on antibiotics for over two months, and have at least 10 more months to go). We also take a little medical oxygen every day.

Another symptom of the mycoplasma infection is the association of runaway fibrillation of the heart. To stop that, there are pills one takes, and they stop it. But they also further reduce the volume of blood pumped by the heart, so that this projects one right back into the hypoxia, dizzy, loss of balance, etc. Catch 22 situation; the fibrillation will build and cause heart attack, stroke, etc. if not stopped, and if stopped it puts you back in the hypoxia which can cause many things! With the conventional treatment, you're damned if you do and damned if you don't. Hence the need for a little extra medical oxygen, so you can take the "heart clamp" pill and stop the fibrillation, but also augment the oxygen enough to continue to survive without a stroke or some such. Interestingly, it's very difficult to even obtain a mycoplasma test, and Medicare fights you tooth and nail over paying for the oxygen. Either they will pay for it or I'll pay for it myself; it is absolutely necessary.

After a heart attack, one is treated in the heart clinic by specialists who are very caring and excellent practitioners, but know nothing of mycoplasma infection, so not consider it even a part of "heart disease", and who are rather puzzled when one has no clogging of the arteries, has the right count of red corpuscles (largely nonfunctional, of course, but there), pumps the right amount of blood, etc. So they identify and treat only the runaway fibrillation, do not prescribe the oxygen -- and essentially place you on a regime as best they know, but one that is guaranteed to kill or maim you or turn you into a totally disabled person or human vegetable via stroke, paralysis, etc. Fortunately my family doctor will prescribe the oxygen anyway, though I may have to pay for it myself. Whatever works!

However, I'm slowly improving little by little, working as much as I'm able to and trying to finish my book: Energy from the Vacuum: Concepts and Principles, and get it to the publisher for publication later this year. Hopefully the book will turn all the interested young grad students and post-docs loose in

the free-energy area. They will not have to spend 30 agonizing years to get to where I am, and where a few others are, but can simply start here and go forward. Since speed to develop energy from the vacuum is of the essence because of the world situation, I'm moving on it as fast as I am physically able to.

Meanwhile, working with the AIAS (Alpha Foundation's Institute for Advanced Study), the AIAS (15 authors) has now gotten about 20 scientific papers published in leading journals (Foundations of Physics, Foundations of Physics Letters, Physical Scripta, Optik, etc.) dealing with electromagnetic energy from the vacuum. Several more are either approved for publication or in the review process also. So slowly we are getting it into the mainstream scientific literature. Hopefully it will be in time, but it's cutting it close.

Very best wishes,

Tom Bearden

Late update

Massive display of longitudinal interferometers?

UFO Fleet Taped
Over Bedhampton, England

Is this sighting a case of the testing of all the Russian (KGB) longitudinal interferometers at once? And coordinating their targeting through the woodpecker grid to a common place, as an exercise in making a massive scalar attack upon a given region? Was this a confluence of Russian Tesla howitzer marker-beacons?

Certainly for a massive all-out scalar attack you would want coordinated movements of the target areas of many howitzers at once, for you could then just cut a bloody swath across a wide area, all the howitzer blasts marching across the land in a kind of scalar version of the "scorched-earth policy." All in a line, blasting, and heat, and mind waves. Or you might want to put the blasts all in the same place for a truly horrendous destruction. And on top of that biowar on citizens whose immune systems have been weakened with the quantum potenial weapons. This is the latest version of Armageddon.

And should any madmen gain control of these weapons, any rogue group at all, and should they have some aggenda to radically depopulate the world, to simply kill by the billion, the means will be in their hands to do so.

Update: MEG patent granted

Motionless Electromagnetic Generator Patent Granted

This message is from **Jean-Louis Naudin**, the French scientist who successfully replicated the Motionless Electromagnetic Generator (MEG) in France. He announces the granting of the patent to the MEG Builder's group at Yahoo.

----- Original Message -----
From: jnaudin509@aol.com
To: jlnlabs@yahoogroups.com
Sent: Tuesday, March 26, 2002 2:20 PM
Subject: [jlnlabs] (Info) GOOD NEWS : The Tom Bearden's MEG IS PATENTED

Dear ALL,

GOOD NEWS !!!!

The **Motionless Electromagnetic Generator**
from Tom Bearden is now PATENTED
US **6362718** granted on March 26, 2002

US Patent 6,362,718 :
Motionless Electromagnetic Generator (MEG)

Abstract: An electromagnetic generator without moving parts includes a permanent magnet and a magnetic core including first and second magnetic paths. A first input coil and a first output coil extend around portions of the first magnetic path, while a second input coil and a second output coil extend around portions of the second magnetic path. The input coils are alternatively pulsed to provide induced current pulses in the output coils. Driving electrical current through each of the input coils reduces a level of flux from the permanent magnet within the magnet path around which the input coil extends. In an alternative embodiment of an electromagnetic generator, the agnetic core includes annular spaced-apart plates, with posts and permanent magnets extending in an alternating fashion between the plates. An output coil xtends around each of these posts. nput coils extending around portions of the plates are pulsed to cause the induction of current within the output coils.

Inventors: Patrick; Stephen L. (2511 Woodview Dr. SE., Huntsville, AL 35801); Bearden; Thomas E. (2211 Cove Rd., Huntsville, AL 35801); Hayes; James C. (16026 Deaton Dr. SE., Huntsville, AL 35803); Moore; Kenneth D. (1704 Montdale Rd., Huntsville, FL 35801); Kenny; James L. (925 Tascosa Dr., Huntsville, AL 35802)

Appl. No.: 656313
Filed: September 6, 2000

For some technical info see my web site at : http://jnaudin.free.fr/html/meg.htm

Best Regards
Jean-Louis Naudin
Email: JNaudin509@aol.com
Main Web site : http://jlnlabs.org
Site France : http://jlnlabs.multimania.com

Click here to view patent # **6,362,718**

Patent Story on Rense.com:

Important Note 2006! MEG delayed: **Click here for a current status history of the MEG from Tom Bearden**

Rense.com

MEG Scalar Energy Device Patented - Production Starts Next Year

From Bill Morgan
3-28-2

Patent was granted on March 26, 2002 for "The Motionless Magnetic Generator," (MEG) US Patent 6,362,718, which is likely to become the first commercially available free energy device in history in about one year from now. The machine will provide free electricity from the vacuum, for the life of the device, which should be a very long life since it has no moving parts. You can see a picture of scientist Jean-

Louis Naudin's MEG replication model at: http://jnaudin.free.fr/html/meg.htm.

It has strong magnets, coils, and a controller unit with the electronics. Naudin made the announcement to the MEG-builder's Yahoo group. The announcement has significance since the patent office has always been skeptical of devices which seem to "get-something-for-nothing." But according to the new science of scalar electromagnetics, the MEG does not break the law of conservation of energy. It's just that the energy is conserved in the fourth dimension, time, and not our 3-space world.

The MEG provides electrical energy by tapping the longitudinal electromagnetic (EM) waves which exist in almost infinite abundance in the vacuum of space. This ocean of energy which permeates everything is sometimes called the "zero point" energy, since it remains there even at absolute zero temperature.

Four inventors are listed: Stephen L. Patrick, Thomas E. Bearden, James C. Hayes, Kenneth D. Moore.

Tom Bearden has explained the operation of the MEG on his website Cheniere.org, and also speaks about the new fearful weapons that can and have been made using the same "longitudinal waves" of the vacuum.

The complicated physics of how the MEG works is explained in the paper "The Motionless Electromagnetic Generator: Extracting Energy from a Permanent Magnet with Energy Replenishment from the Active Vacuum," which can be found at Tom Bearden's website:

cheniere.org.(http://www.help4all.de/energy/MEGpaper.pdf)

The first MEG units to be produced for sale will output 2.5 kilowatts of free electricity. Forever. They should be in production about a year from now. Facilities for manufacturing the device are being set up in an unnamed "friendly nation."

This free electricity will flow indefinitely, without much, or any maintenance. The units may be hooked together to provide more wattage, so four of them would provide 10 kilowatts. After some production experience units will be made which output 10 kilowatts each. With a couple of those units a house could get off the electrical grid.

Tom Bearden, one of the inventors has said "I will admit that the chief scientist of an important experimental group in a large company was rather stunned at the type of output we were able to obtain. The MEG

may look like just a transformer, but it is not. It is a completely different breed of cat." This cat, it would seem, is out of the bag now.

The ordinary EM waves we are familiar with are called "transverse" waves, to distinguish them from the new "longitudinal" EM waves of the vacuum. Bearden has explained in depth on his website cheniere.org that wherever there is a dipole (battery, generator, magnet) there is an unseen flow of longitudinal EM waves in that local vacuum, the only problem is in tapping that energy and "transducing" it to electricity. Bearden says that the problem with all the electrical circuits we have is that they are two-wire circuits, a loop by which half the energy goes back to destroy the dipole. In the MEG that closed loop is never made. So the dipole is not being destroyed.

Patents are not granted on devices which do not work, so in a sense this announcement proclaims a new era. The MEG device itself proclaims and proves that energy is abundantly available everywhere, for free. We only have to build the devices to tap it. MEG type devices could be put into a car with an electric engine to make a truly fuel-less automobile. Electricity can be available in very remote places. People will be able to get off our very terrorist-vulnerable power grids. In an era of terrorism a highly dispersed power system would be most desirable rather than our centralized systems.

What is somewhat astonishing to me is the discovery by Bearden et. al. that time itself is actually compressed energy, and that this free energy is actually coming from the time domain, the ocean of longitudinal EM waves which fill the empty vacuum of spacetime. In fact, time is energy compressed by the same factor that matter is compressed energy: the speed-of-light squared. Thus there is a new companion to Einstein's E=mc2. Can you say "E equals delta-tee-cee-squared?" The "tee" is time and delta-tee is change in time.

A company has been set up to manufacture the MEG called Magnetic Energy Limited.

The ramifications of free energy are enormous. The oil wars are not necessary. If we threw as much money at this technology as we are spending on the oil wars we would be free of the need for oil in less than a decade. With fuel-less cars air pollution will be greatly lessened. Third world nations can raise their standard of living eventually. And the energy is free. And it never runs out.

I have put together a kind of "Bearden for Beginners" article which explains some of the basic concepts of the current state of scalar technology.

http://www.prahlad.org/pub/bearden/scalar_wars.htm

The granting of the MEG patent is the herald of the new era of scalar electromagnetics, and the free energy which flows forever and never runs out.

Bill Morgan

Status History of the MEG

updated Oct. 26, 2006

Important notes on the status of the MEG (Motionless Electromagnetic Generator)

Since the time this "**Scalar Wars**" article was written the timetable of the **MEG** has been thrown off considerably. Bearden had originally said the MEG could be marketed within 1-2 years ***of receiving funding for final research and scale-up costs***. I thought certainly it would not take very long, but over 5 years later they still have not gotten the $10 million or so necessary. There are various reasons for this, some of which Tom Bearden has written about.

The place for updates on the MEG status is Tom Bearden's correspondence section at his website Cheniere.org:

http://www.cheniere.org/correspondence/index.html

Here are a few of his reports which detail the history of the MEG status :

Mar. 6, 2006
http://www.cheniere.org/correspondence/030206.htm

May 16, 2005
http://www.cheniere.org/correspondence/051605.htm

Jan. 19, 2005
http://www.cheniere.org/correspondence/011905.htm

Dec. 5, 2004
http://www.cheniere.org/correspondence/120504.htm

Do the magnets run down after a while?

Further developments

Tom Bearden clears up a question

When the MEG patent was released many questioned the patent language which seemed to imply that permanent magnets of the MEG would "wear out" after awhile. I myself wondered about the same thing so I put the question to Tom, and here is his reply.

> Dear Bill,
>
> Thanks for the kind words; much appreciated.
>
> I'm not up to going on radio or TV, and won't be for quite some time. Still suffering from hypoxia, though very slowly improving, and will still be on antibiotics for 10 more months at least (maybe longer).
>
> Obviously an extensive dialog developed between the Patent office and our patent attorneys. As best I can understand it, the Patent office accepts the fact that a permanent magnet produces and emits energy, or has a history of accepting it. They do not appear to be at all cognizant of the broken symmetry of opposite charges, and hence of a dipole. So in their opinion (which seems to be vague), the magnet has to use itself up very gradually, or some such. So some rewrites were essentially required by the Patent office.
>
> All I can say is that a magnet is a very durable thing, so long as you don't heat it up too much or shock it to much. Certainly one will make a good 20 years, and of course there are plenty of magnets that have been around awhile longer.
>
> That said, in our earliest experiments we did "measure" some such effect, or so we thought, until we found that a particular instrument was bad and giving erroneous readings. So with a new instrument, we have not observed since then any such readings.
>
> Out of all that fuzziness came the inclusion of "using up the magnets gradually". So far as we are aware (after correcting those early readings on a defective instrument), we have seen no such measurements or effects since then at all. Nonetheless, just in case there is some very small effect in that respect, at least it's in there.
>
> Actually, as you are aware, capacitors and solid state components are the major concerns for failure, and any system does require maintenance, both periodic and whenever malfunction or failure occurs. The MEG is no different from any other device in that respect, so of course it will have a component failure rate and maintenance required from time to time, just as any other electromagnetic device. But without moving parts, it can be ruggedized and made very durable indeed.
>
> Please give Jeff Rense my regrets, and I do admire his work and his show. He's laying it in there.
>
> The depth of the scientific mindset against COP>1.0 is inexplicable, particularly when physics itself already has COP>1.0 validated

experiments (such as Bohren's experiment, which outputs 18 times as much as one inputs by Poynting calculations), and it works every time. Any competent university optics lab can perform the experiment. Also, even the conventional texts admit that a charged capacitor or electret laid on a permanent magnet, so that the E of the cap or electret and the H of the magnet are at right angles, is a "free energy machine". That silly thing will just sit there and pour out Poynting energy S = EXH indefinitely. Years and years and years. If you wait just a single year, that silly thing has changed the energy density of a volume of space a light year in radius, reaching out well beyond the solar system. Now that's a WHALE of a lot of EM energy that beast poured out in that year, and it will still be going strong and pouring it out at a steady rate. The charges and dipoles in original matter in the universe have been pouring out EM energy in that fashion for some 14 billion years, give or take a billion or so. It's also easy to see that, prior to Lorentz's ARBITRARY symmetrical regauging of the Maxwell-Heaviside equations, those equations prescribe both EM systems in equilibrium with their active environment, and EM systems not in equilibrium with it. The latter systems are permitted by the thermodynamics of open disequilibrium systems to perform five magic functions: (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy than the operator inputs (the active environment inputs the rest of it), (4) power itself and its load (the active environment inputs all the energy, like a windmill), and (5) exhibit negentropy. That is a well-established thermodynamics. Lorentz arbitrarily discarded all such open disequilibrium EM systems in order to get simpler equations having analytical solutions and not requiring numerical methods. So he simply scrapped all the really interesting and challenging EM systems in Maxwell's theory. ARBITRARILY!

That our scientific establishment continues to teach only that "half" of the theory, and not point out the rest to the young students, and not fund research into developing such systems that take energy from the vacuum, is simply inexplicable. It's a matter of total dogma, not science at all.

But hopefully it is changing a little bit. At least now we cite chapter and verse when these things were done, and what they are, and the young grad students and post docs can go check the papers and make up their own minds.

That is the real hope of the future: that we get a generation of young fellows, with excellent skills, who now know where all the skeletons got hidden in the closet, and understand that the electrical engineering model arbitrarily assumes an inert vacuum environment (falsified for more than a half century in particle physics) and a local flat spacetime (falsified for nearly a century by general relativity).

Once they know that past history, and go read into what broken symmetry of opposite charges means for a dipole and for all dipolar EM circuits, they will set to and change that more than a century of error. In that case, we shall have numerous solutions to the energy crisis rather quickly, popping up all over.

Good thing. It will certainly displace some great energy barons, but it will also free the populace. One can extract all the EM energy from the vacuum one wishes, anywhere, anytime, with ridiculous ease. One can

produce that "electrical wind of energy" at will, by making a simple dipole and then letting it alone. The only energy problem is in how to then intercept some of that energy flow and "catch" it in a circuit, discharge it in a load to power it, and not use half the "caught" energy to kill that dipole that is gushing out the extracted EM energy from the vacuum.

Very best wishes,

Tom Bearden

END

Revised: May 16, 2007

Download this article in Ms Word format
(ScalarWars.doc)
Send a comment to Bill Morgan

See also:

Scalar Electromagnetics

Scalar Wars:

The Brave New World of Scalar Electromagnetics
(Read this one first!)

Horrifying US Secret Weapon Unleashed In Baghdad

Scalar Heaven or Hell:
Psychoenergetics

Engineering the Mind

Sacred_Scientist thread at Rumor Mill News

Are any of these Earthquakes Being caused by Scalar Weapons?

Safe Places, Earth Changes, and Gordon Scallion

Examples of probable Scalar Weapons Tests

Iraq: World's First Scalar War?

Space Energy Access Inc. Announces
New Free Energy Device

SINGLE MOST IMPORTANT BREAKTHROUGH IN HISTORY

Comparison: Ebomb and Scalar Waves

IT COULD COME AS SIMPLY AS THIS
Scalar destruction of U.S. power grid

WHAT A SCALAR "SMOKING GUN" WOULD BE

BEARDEN REPONDS TO SCALAR ATTACK POSSIBILITY (Columbia)

THE SCALAR ATTACK POSSIBILITY
Columbia Disaster

TOM BEARDEN ON THE CHALLENGER DISASTER

ANOTHER BEARDEN ACCOUNT OF '86 CHALLENGER SCALAR ATTACK

Broadcasting Thoughts & Disease

Thoughts on Diane Harvey's Appeal to the U.N.

Scalar War Has Already Begun

Musings on Scalar Electromagnetic Phenomena

The New Scalar Paradigm

ELECTROMAGNETIC WEAPONS TO BE USED

SCALAR: BEARDEN SAYS U.S. NOW DEFENDED

American Karma & The River of Tears

Open Letter to Donald Rumsfeld

My Rumor Mill Posts on All Topics

Your comments are welcome: prema@prahlad.org

Journal of Directed Energy, **1**, Fall 2003, 48–72

Compact Pulsed Power for Directed Energy Weapons

David Price,* Carl Bloemker, Edward Goldman, David Nett, Sidney Putnam, Doug Weidenheimer, Roger White, and Tony Wynn

Titan Corporation, 2700 Merced Street, San Leandro, California 94577

The Titan Corporation has been developing directed energy technologies since the early 1980s. Over this time Titan has provided advanced power supplies for electromagnetic gun and laser research while making broader contributions in the field of high-power microwaves (HPM). Titan's HPM work expanded from initial efforts fielding and operating the first gigawatt-level oscillators for susceptibility test applications, to research and development maximizing the peak and average output powers and overall efficiency realized from such systems. As interest in HPM technology has spread globally, Titan has leveraged this core competency and provided the HPM equipment for nearly all of the major European effects test facilities. Titan's current interests focus on compact, efficient and reliable directed energy weapon systems and the advanced subsystems and components that enable the same. Specific subsystems of interest include pulse-forming networks and intermediate energy storage and power conditioning elements (electronically reconfigurable batteries and power ride-thru subsystems). These subsystems are designed for reduced size and weight while still meeting severe service, platform integration, lifetime, and thermal management constraints. Specific components under development at Titan include laser-gated solid-state switches and both high peak and high average power, frequency-agile, HPM oscillators. Status and recent results from this research are presented.

KEYWORDS: Electronically reconfigurable batteries, High-power microwaves, Laser-gated solid-state switches, Magnetron, Power-ride thru, Pulsed power, Reltron

1. Introduction and Previous Work

Directed energy weapons (DEWs) are emerging as a key defense technology of the early 21st century. The first laser antimissile and antiartillery systems are within perhaps five years of deployment, and newly envisioned information warfare and nonlethal point defense missions are hastening the deployment of high-power microwave (HPM) systems. Department of Defense (DoD) programs in "more electric" and "all-electric" platforms and electrically driven weapon and self-defense systems are promoting the development of laser, high-power radio frequency (RF) and both electromagnetic (EM) and electrothermal/chemical (ETC) gun technologies. In fact, the DoD's current fundamental "transformation" efforts are based on stressing the development of capabilities to deal with threats emerging in the

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Table 1. Triservice directed energy applications

U.S. Army [Future Combat System (FCS)—hybrid electric drive vehicles]
- Advanced armaments—electrothermal/chemical guns
- Enhanced area air defense—solid-state heat capacity laser system
- Counter-HARM
- Counter-ATGM
- Countermine (electronically fuzed and wide-area threats)

U.S. Navy [All-Electric Ship Programs (Integrated Propulsion System and DDX)]
- Advanced stand-off shore bombardment—electromagnetic guns
- Advanced anti-ship missile defense (free-electron laser and HPM)
- Nonlethal area denial

U.S. Air Force (more electric aircraft program and advanced UAV programs)
- Enhanced self-defense—solid-state heat capacity laser system
- Space-based laser program
- Airborne laser
- Suppression of enemy air defense
- Aircraft self-defense
- Close air support
- Defensive and offensive counter air
- Strategic attack/strike warfare, attack operation/air interdiction
- Combat search and rescue
- Area denial
- Cruise missile defense

Table 2. Countries now developing high-power RF technology

Programs	Countries
Major	United States, China
Medium-scale	United Kingdom, France, Germany, Russia
Emerging	Sweden, Japan, India, Taiwan, Australia, Israel, South Korea

Information Age instead of emphasizing countermeasures to specific threats. DEWs hold the promise of engaging multiple threats and multiple threat types, thereby fitting very well into this conceptual paradigm. Some specific examples of defense applications of DEW technologies are shown in Table 1.

The initiatory HPM programs in the USSR and United States have evolved and influenced foreign allies and threats to take an interest (Table 2). The collapse of the USSR led to the dispersal of Russian and Ukrainian HPM workers and the proliferation of the Soviet technology to the Third World. This global emergence is driven by at least two factors: 1) The dependence of both military systems and civilian support infrastructure on sensitive electronics is increasing, and 2) after a more-than-20-year effort, an understanding of the susceptibilities of both military and commercial systems to HPM threats is maturing.

For these reasons the Titan Corporation has taken a keen interest in the development of systems, subsystems, and advanced components across several different technologies to support HPM and laser directed energy programs.

In 1997, Maxwell Technologies purchased Physics International (PI) from Primex Technologies and merged two of the three most prominent, commercial, pulsed power entities in the United States. PI and Maxwell pulsed power capabilities were combined into a new entity, Maxwell Physics International, which became a component of Maxwell's Systems Division. Maxwell subsequently decided to leave the DoD and Department of Energy (DOE) pulsed power business altogether and sold the combined Maxwell/PI pulsed power divisions to the Titan Corporation, the parent company of Pulse Sciences Incorporated (PSI). Now, the three most prominent names in commercial pulsed power are combined as the Pulse Sciences Division (Titan-PSD) of the Titan Corporation.

In March 2002, Titan completed the acquisition of Jaycor and its subsidiary California Tube Laboratory (CTL). This acquisition established Titan as one of the world's primary industrial authorities on electromagnetic effects and suppliers of RF and narrow-band microwave DEW technologies and associated electrical power systems. High average power, high efficiency, magnetrons; high peak power, pulsed, relativistic magnetrons and superreltrons; short pulsed, ultra-broad-bandwidth systems and megawatt-class power supplies and power conditioning subsystems are all designed and manufactured by Titan. This paper will chronicle some of the past and report on some of the current contributions that Titan has made to the development of pulsed power technology for DEW applications.

1.1. Previous Titan work in support of HPM programs

Titan-PSD has been developing directed energy technologies since the early 1980s. In this time, Titan has delivered capacitor banks for electromagnetic gun research with a total stored energy exceeding 200 MJ and advanced pulsed power systems for several large laser systems (Fig. 1). Over 40 years, Titan-PSD has delivered more than 200 pulsed power systems for electromagnetic pulse (EMP), x-ray, and lightning simulation; flash radiography; and other applications worldwide. Although somewhat peripheral to DEW research proper, these projects have nonetheless formed much of the experience base supporting Titan's directed energy technologies contributions.

Titan's primary contributions have been in the field of HPM (Fig. 2). Work started in 1984 when Titan set up and began operating a susceptibility effects test facility for the Defense Threat Reduction Agency (DTRA). A $30 \times 20 \times 16$ ft anechoic chamber to support this work was originally designed to operate in X-band and above. At the outset of the U.S. HPM directed energy program the community felt that the higher gains possible from fixed antenna sizes at higher frequencies would drive technology development into these bands. Over the next 10-plus years, the 25 effects test programs conducted on strategic and tactical systems in the Titan facility and tests conducted at other sites both confirmed that the lowest susceptibility thresholds are observed in the S-band and below. HPM source development history has mirrored these findings.

1.1.1. HPM source developments at Titan. In 1983 Titan initiated HPM source research in its test facility by developing first C-X band overmoded vircators[17] and later an L-band vircator.[13] These systems produced gigawatt outputs through the oscillating virtual cathode mechanism. Their main shortcoming was their broad bandwidth due to chirping induced by diode gap closure. To address this shortcoming Titan developed the first cavity vircator[3] that reduced the output bandwidth from several hundred megahertz to a few tens of megahertz. Versions of these devices were soon after sold to Nucletudes in France

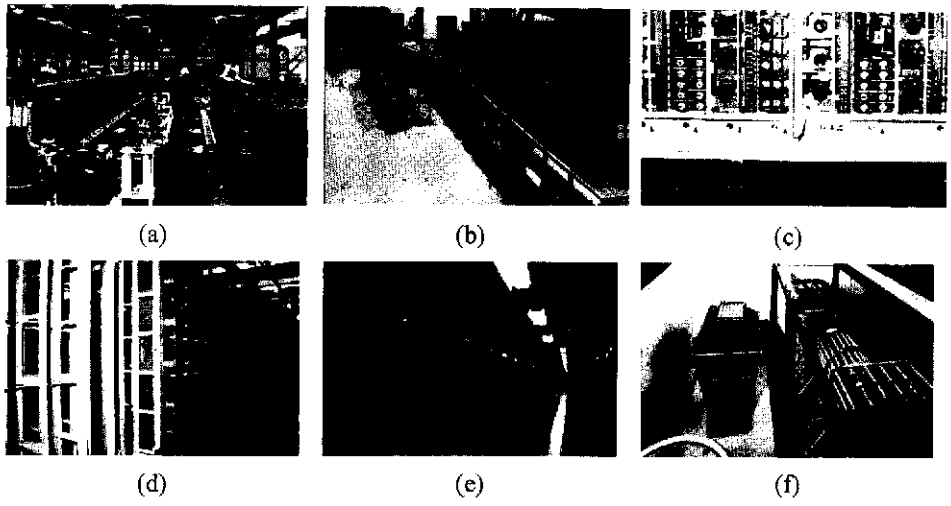

Fig. 1. Titan-PSD has designed, fabricated, and delivered the pulse power subsystems for most of the major electric gun facilities worldwide: (a) the decommissioned 32-MJ Thunderbolt System built for a Strategic Defence Initiative Office (SDIO) project; (b) the existing 32-MJ Kirkcudbright system currently being operated by the United Kingdom; (c) the first transportable pulse power subsystem designed for an electric weapon system. [This 8.5-MJ stored energy subsystem, consisting of four separate PFNs, was designed by Titan-PSD under the Army/Army Research Development and Engineering Center (ARDEC) Balanced Technology Initiative and was capable of delivering up to 5 shots at 3 rounds per minute.]; (d) the 52-MJ bank delivered to the ARDEC for electromagnetic and coil gun research; (e) the pulsed power driver for the 40-MJ OMEGA laser at the University of Rochester; and (f) a portion of the 100-Hz, 750-kV, 1.25-μs modulator for NRL's EMRLD laser.

and Culham Laboratory in the United Kingdom to help kick-start HPM effects testing and technology development programs at each location.

Titan initiated work on magnetrons by acquiring S- and X-band, A-6 versions from Bekifi at the Massachusetts Institute of Technology.[2] These devices were integrated into the Titan test facility, and within two years an L-band version of this same design was developed.[16] An S-band magnetron was sold commercially to Thales in France in 1987 to help kick-start HPM effects testing and technology development programs there.

This HPM source development work soon expanded from the initial efforts to field gigawatt-level vircators and magnetrons for the effects testing applications to the development of other high-power sources. These include narrow-band klystrons (both high- and low-perveance variants) and reltrons, as well as ultra-wide-band systems. In parallel, the peak and average power and spectral characteristics of these HPM sources were being explored in research involving phase locking, repetitive pulsing, and frequency agility. Other related Titan work included the development of pulsed power systems to drive these HPM sources involving several different architectures [pulse-forming networks (PFNs) with capacitive energy storage and voltage adders with magnetic compression power conditioning]. These advancements are described briefly in the following.

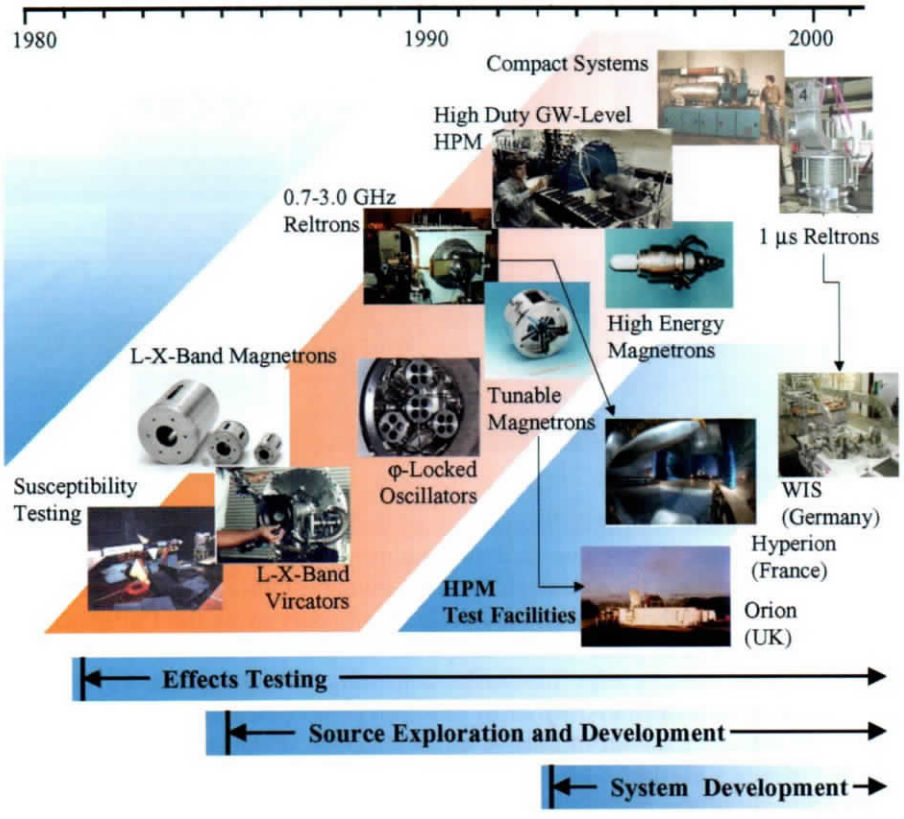

Fig. 2. Titan contributed to the field of HPMs in three distinct eras: 1) susceptibility effects testing, 2) HPM source development, and (currently) 3) DEW system development. The effects testing work started in 1984. Then, Titan operated the DTRA susceptibility effects test facility supporting tests for external DoD users. Soon thereafter Titan began using the facility for its own end-to-end DEW research programs. In parallel, Titan HPM source development efforts initially focused narrowly on providing the facility with minimum essential capability but soon expanded to meet specific weaponization and testing requirements. During this period, Titan performed some of the seminal narrowband HPM work associated with phase-locking, frequency agility, and repetitive operation. Source development work continues today, focusing on improving energy output and tunable bandwidth. These efforts are combined with the development of other advanced pulsed power subsystems and components needed to realize compact, efficient, and reliable DEW systems.

In the late 1980s, Titan S-band magnetrons were used in a three-year effort to understand how to achieve output powers exceeding 10 GW from a phase-locked array.[9] Many mission scenarios for DEW systems that could produce burnout or upset in military targets using only a single HPM pulse drove output requirements to this 10-GW level. The combination of gigawatt-level sources locked in phase appeared an effective way to realize this output level without increasing the RF fields and beam energies within individual diodes (and dealing with the RF breakdown and thermal issues that would certainly ensue). In this effort both master/slave and peer configurations were investigated to understand the optimal

architecture for such an array. In the end, a module of seven "peer-coupled," 2.8-GHz, magnetrons was built that produced an output power of 2.9 GW. Extrapolation to even higher output levels appeared feasible.

At this time, the HPM community was beginning to recognize that there must exist a middle ground between HPM and electronic warfare (EW) DEW concepts. The HPM approaches were characterized by superpower, single-shot, single-frequency, pulse formats, while the EW approaches made use of very low powers but incorporated modulations in the output pulse formats to effectively exploit susceptibilities within their intended targets. To access this middle ground the HPM sources had to first be shown capable of operation in repetitive or burst modes. This burst capability would be surely required of any DEW system, if only to engage multiple threats deployed in sorties or clusters. In response to these weaponization considerations Titan-PSD developed relativistic magnetrons capable of operation in 1-kHz bursts.[4] A 1.1-GHz, L-band, magnetron was driven by a magnetic pulse compression modulator (see discussion below) and achieved 250-pps repetitive operation at 1.2-GW peak power, in a burst of 100 shots. The average power of 12.6 kW during the burst remains today the state of the art for gigawatt peak power sources. To demonstrate that the magnetron's diode could recover in a time short enough to support higher repetition rates, the device was run for ~5 pulses (limited by the modulator) with 1 ms between individual pulses.

In the early 1990s both Jaycor and PI were actively extolling the use of frequency-agile waveforms to enhance lethality in backdoor attacks. Frequency agility exploits the characteristics of typical coupling cross sections that show pronounced dependence on microwave frequency. An HPM source that can sweep or hop frequency across a band has a higher probability of matching to a coupling resonance than a source fixed at a single frequency. Because of this strong dependence of backdoor coupling and susceptibility levels on microwave frequency, it was apparent that test facilities needed the capability to vary frequency continuously in order to obtain a comprehensive and accurate assessment of any given test asset's susceptibilities. In response to these testing and weaponization considerations Titan-PSD developed frequency-tunable magnetrons. These oscillators can be tuned ±17% about a central frequency,[10] which today still represents the state of the art. In the mid-1990s these magnetrons were integrated into advanced concept demonstrations for the Army and were also exported to the United Kingdom as part of an HPM test facility.

In the late 1980s and early 1990s Titan-PSD developed several ultra-broad-bandwidth (UWB) systems for Army and Air Force DEW research programs. The first system was based on a spark gap-switched Marx that drove a variety of different broadband antennas. It could launch 200-MW total RF power in 3-ns pulses with rise times of ~300 ps at a repetition rate of a few pulses per second. This compact, self-contained system was used in both indoor susceptibility tests and outdoor technology demonstrations. A second project produced a system that could launch impulse waveforms at 200 pps in burst mode.[15] A 3.66-m-diameter paraboloidal reflector was driven at its feed by a hydrogen switch that was integrally coupled to a novel electromagnetic lens. The radiated waveform had a rise time of ~100 ps and a 10–90 rise-to-fall pulse width of 45 ns. The peak electric field on bore-sight measured at 305 m was 4.2 kV/m.

Titan invented the super-reltron in 1992. A suite of tubes that operate between 0.7 and 4.5 GHz has been developed since that time.[12] These novel tubes represent a marriage between pulse power and conventional high-power klystron techniques. An energetic electron beam is modulated by periodic virtual cathode formation, and the bunched electron beam is postaccelerated to energies approaching 1 MeV. Microwave power is extracted with ~50%

Table 3. Operating parameters of Titan-built modulators for DEW applications

Modulator	Voltage, kV	Current	Pulse width	Pulse repetition frequency	Pulse energy	Average power	Switch type
LS-15	50	10 kA	100 ns	1.9 kHz	50 J	95 kW	Spark gap
NED laser driver	±40	260 A	2 μs	10 Hz	3 kJ	30 kW	Thyratron
EMRLD PFN	750	38 kA	1.3 μs	125 Hz	35 kJ	4.4 MW	Spark gap
EMRLD (trigger)	600	260 A	400 ns	125 Hz	100 J	12.5 kW	Spark gap
OMEGA[a] laser driver	15	128 kA	200 μs	Single shot	40 MJ	—	Ignitrons
CLIA HPM driver	750	10 kA	100 ns	250 Hz	750 J	188 kW	Magnetic
ORION HPM driver	500	10 kA	50–500 ns	100 Hz	250 J	25 kW	Thyratron
Compact HPM driver	450	9 kA	450 ns	10 Hz	1.8 kJ	18 kW	Spark gap

[a]120 modules, each storing 0.33 MJ.

conversion efficiency downstream in a dual-cavity output section that is tuned to the bunch frequency. The reltrons can produce microwave pulse widths approaching 1 μs and pulse energies of a few 100 J, outstripping the relativistic magnetrons that to date are limited to pulse widths of about 100 cycles and pulse energies below 100 J.

In response to the HPM effects testing considerations discussed above, Titan developed frequency-tunable reltrons. These oscillators can be tuned ±10% about a central frequency.[11] These devices are still in development today (see Sec. 2) and have been provided to both France and Germany as HPM threat simulators.

1.1.2. Development of pulse power modulators for DEW applications at Titan. Titan has developed a large number of modulators for a variety of laser and HPM DEW applications, with voltage ratings from tens of kilovolts to several megavolts and average power levels from tens of kilowatts to multimegawatts (Table 3). They also range from relatively simple units to complex, state-of-the-art devices with various different architectures and subsystems. These include PFNs for generating the required pulse shapes; thyratron switching for precise timing of the pulse switching into the load; low inductance layouts for fast output pulse rise times and high-turns-ratio pulse transformers for generating the high voltage outputs. The switching technologies include thyratrons, spark gaps, magnetic switches, and solid-state devices, such as metaloxide semiconductor field effect transistors (MOSFETs), insulated gate bipolar transistors (IGBTs), and thyristors (Fig. 3).

Several of these modulators have been designed for long-lifetime, reliable operations. Such features are essential if these systems are to find their way into military applications. As an example, the Defense Advanced Research Projects Agency (DARPA) excimer Raman-shifted laser device (EMRLD) modulator (a 100-Hz, 750-kV, 1.25-μs, lumped-element PFN to pump an excimer laser) was specifically designed for and demonstrated a lifetime of 10^{10} shots.

The ORION pulser (Fig. 3b) design has command resonant charge and intermediate energy storage sections each switched by thyratrons that drive a step-up transformer and

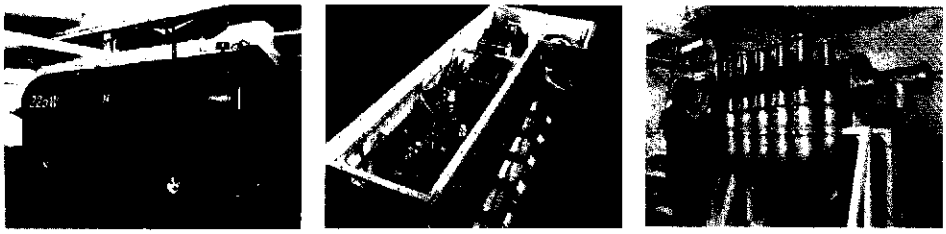

(a) (b) (c)

Fig. 3. Titan-PSD pulsed power systems based on (a) spark gap, (b) thyratron, and (c) magnetic switching.

Table 4. Key operating parameters in European HPM test facilities

HPM facility	Power density, W/cm^2	Range, m	Frequency, MHz	Maximum pulse width, ns	Maximum repetition rate, Hz	Shots per burst	Source type
UK—Orion	>120	100	1,070–3,300	100	100	100	Magnetrons
France—Hyperion	>1,000	~100	700–3,300	300	1	—	Reltrons and magnetrons
Germany	>170	15	700–1,450	300	10	100	Reltrons
Sweden[a]	~120	15–25	L-Ku	500–5,000	1,000	Continuous	Reltrons

[a]This facility uses conventional high power klystrons in L-, S-, C-, X-, and Ku-bands, with maximum power 25–0.25 MW.

PFN. The modulator can fire 1,000 pulses in a burst at repetition rates up to 100 pps and produces 500 kV into a 50Ω load. It has been used to drive relativistic magnetrons[6] for HPM effects measurements.

The Compact Linear Induction Accelerator (CLIA) (Fig. 3c) was developed for moderate-repetition-rate HPM source research and development.[1] CLIA operates at 250 pps with 750-kV, 10-kA, 100-ns output pulses. The system uses thyratron and magnetic switching throughout and produces 188-kW average power into the load. CLIA is not actively cooled and so is restricted to burst operation with 5,000 pulses in a burst. CLIA has been used to drive both magnetron and klystron loads. This technology is scalable to kilohertz repetitive operation.

1.1.3. Titan pulse power systems for HPM simulation. In addition to work done supporting domestic RF and microwave DEW research and development, Titan has provided HPM simulation systems for all of the world's major HPM test facilities in Sweden, France, the United Kingdom,[14] and, most recently, Germany. The microwave test parameters and operational capabilities achievable in these international facilities are summarized in Table 4. The types of Titan HPM sources that produce the intense microwave environments are also given. Work continues today upgrading those systems and providing similar hardware for several non-European countries.

2. Most Recent Contributions

Titan-PSD has taken an interest in the full spectrum of developments of advanced subsystems and components that the three U.S. services will require to realize their DEW and electric platform goals. These developments enable many different military missions and cut across many different technologies: advanced capacitors, switches, transmission systems, RF, and optical systems. Some of the pulse power and power electronic subsystem and component developments that Titan is pursuing are summarized in Table 5.

The following subsections describe five electrical subsystems and three components that Titan-PSD is currently developing for DEW applications.

2.1. Titan-PSD development of subsystems for DEW applications

2.1.1. HPM modulator. Titan-PSD has a conceptual design of a high-voltage-pulse power subsystem for a short-pulse HPM system. The given RF pulse output parameters led us to choose a specific tube that is compatible with the constraints of an airborne system, namely the magnetron with a 20Ω impedance and 33% efficiency in a short-pulse mode. Our pulse power design concept is driven by the tube input requirements (20Ω load, 40-ns pulse width, 10 pps) and comprises a low-impedance, water-filled, stepped-pulse forming line (PFL) charged by a fast Marx and discharged through a self-breaking, spark-gap output switch. An advantage to using a liquid dielectric PFL is that its impedance can be easily varied along its length to accommodate variations in load impedance. Input power to the Marx is from two 400-V series strings of lithium ion batteries with solid-state switched intermediate voltage multipliers providing ±40 kV. Batteries are recharged from aircraft power through a small voltage converter.

Figure 4 is a simplified circuit diagram of the pulse power modulator coupled to a 20Ω constant impedance load though a transit-time isolator. The transit-time isolation is integral to the two parallel cables that couple the output of the pulsed power modulator to the microwave source. The Marx stores 1,140 J at a voltage of ±40 kV. It erects to a 1,280-kV open circuit voltage after a trigger pulse is applied to several of its switches from the trigger generator. Near peak PFL voltage, the self-firing spark gap closes, and energy is transferred to the tube at a peak voltage of 640 kV.

Figure 5 shows the voltage and current in the load computed from a more detailed version of the circuit depicted in Fig. 4. Note that the current is multiplied by a factor of 10. Voltage rises in about 11 ns (10–90%), and the width at the peak is approximately 40 ns. We recognize that the impedance of the magnetron can vary during RF generation, but the constant impedance model is sufficient here. An advantage to using a liquid dielectric PFL

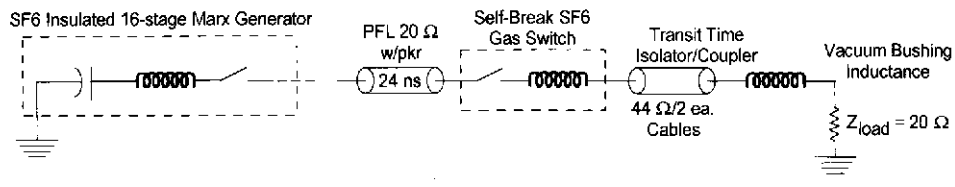

Fig. 4. Simplified circuit diagram of the pulse power modulator coupled to a 20Ω constant impedance load though a transit time isolator. This impedance represents a magnetron electron tube load.

Table 5. Titan advanced DEW power technology development rationales

What need does the development of pulsed power technology fulfill?		What need does the development of high power/high current technology fulfill?	
It is an enabler for advanced electric weapons and self-defense systems.		It is an enabler for advanced electric weapons and self-defense systems.	
System	User	System	User
Dynamic protection	Army (FCS), Navy (carrier)	Solid-state lasers	Army (Anti-Aircraft and Anti-Missile), Navy (ASMD)
ETC	Army (FCS), Navy (shore bombardment)	HPM	Army (FCS), Navy (non-lethal area denial)
HPM/electro-magnetic pulse	Army (FCS), Navy (non-lethal area denial and ASMD), Air Force (SEAD)	EMALS	Navy (carriers)
EM gun	Navy (shore bombardment)	Electric ar-resting gear	Navy
UWB	All services (counter C4I)	Ride-thru	All services
		It is an enabler for electrically driven platforms: • FCS platforms for the Army • Combatants such as DD21 for the Navy • More electric aircraft for the Air Force	
It is an enabler for commercial spin-offs: • Environmental remediation systems • Material surface treatments • Pulsed thrusters for satellite station keeping		It is an enabler for commercial spin-offs: • Electric vehicles • Commercial power distribution and control • Advanced semiconductor lithography	
What must we accomplish at the subsystem level? • Develop compact, reliable, affordable PFNs • Develop compact, reliable, affordable modulators • Develop compact, reliable, affordable intermediate energy stores		What must we accomplish at the subsystem level? • Develop compact, reliable, affordable prime power, power conversion and controls • Develop compact, reliable, affordable intermediate energy stores • Develop compact, reliable, affordable ride-thru systems	
What must we accomplish at the component level? • Develop high-energy-density, fast-discharge capacitors • Develop long-life, reliable, high-current switches • Develop compact inductors for pulse control • Develop affordable ultracapacitors • Develop compact, reliable, efficient, high-average-power HPM sources		What must we accomplish at the component level? • Develop high-current-density, high-voltage stand-off solid-state switches • Develop affordable ultracapacitors • Develop compact, reliable, efficient, high-average-power HPM sources	

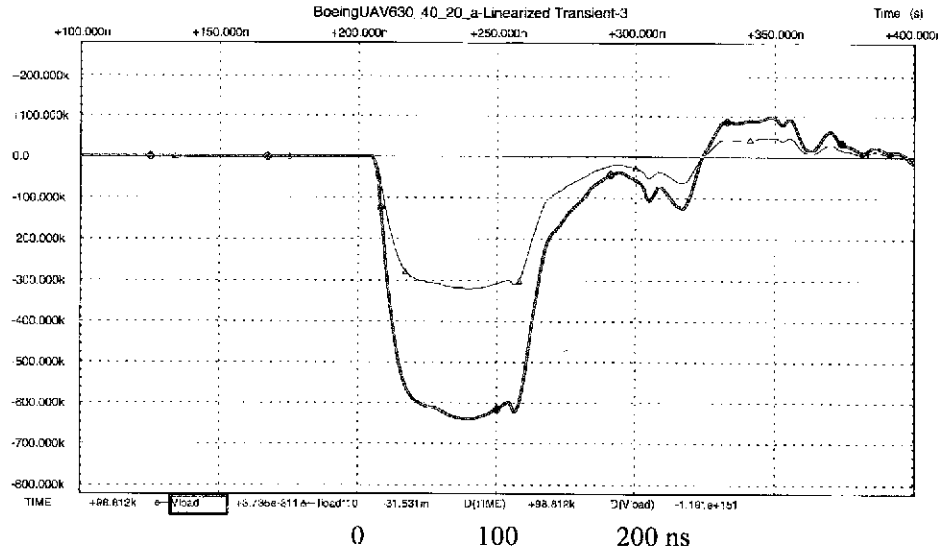

Fig. 5. Voltage and current (multiplied 10×) in the magnetron load computed using detailed version of the simplified circuit diagram in Fig. 4.

is that its characteristic impedance can easily be varied along its length to accommodate variations in load impedance.

Our compact pulse power system conceptual design mounts all of the subsystems and components in a frame that is 24 in. wide × 24 in. high × 144 in. long. The total weight of the system, including the frame, sealed enclosures, and internal mountings, is 1,420 lb. Figure 6 is a dimensioned diagram of the subsystem that is designed to fit into the port bay of an unmanned aerial vehicle (UAV) with the source in the starboard bay. Frames and supports have been omitted for clarity.

2.1.2. Compact PFN. Titan-PSD has designed, fabricated, and delivered the pulse power subsystems for most of the major electric gun facilities worldwide. These facilities were dedicated to electric gun research and for this reason were designed with a premium on reliability and ease of use of the pulse power subsystem. Compactness was a secondary consideration given the large amount of real estate available for the subsystem.

The 8.5-MJ stored energy subsystem, consisting of four separate PFNs (Fig. 1c), was the first design to use the high-energy-density, 2.5-J/cc (2.5-MJ/m^3) polyvinylidene fluoride (PVDF) Aerovox capacitors; the overall energy density of the PFNs is less than 0.5 MJ/m^3. This low energy density is partially due to the use of "jelly-roll" inductors whose large external fields forced the separation of components and resulted in a low component packing fraction.

Figure 7 is a photograph of a 250-kJ PFN that was constructed under a DTRA/Navy-sponsored ETC gun development project and that was incorporated for a time into the Army/Tank-Automotive and Armaments Command (TACOM) Combat Hybrid Power System (CHPS) system integration laboratory.[5] Titan-PSD designed this PFN module for compactness by developing innovative bus work and a closed-field inductor for use with the 2.5-J/cc PVDF capacitors. These advances in component design allowed us to achieve a

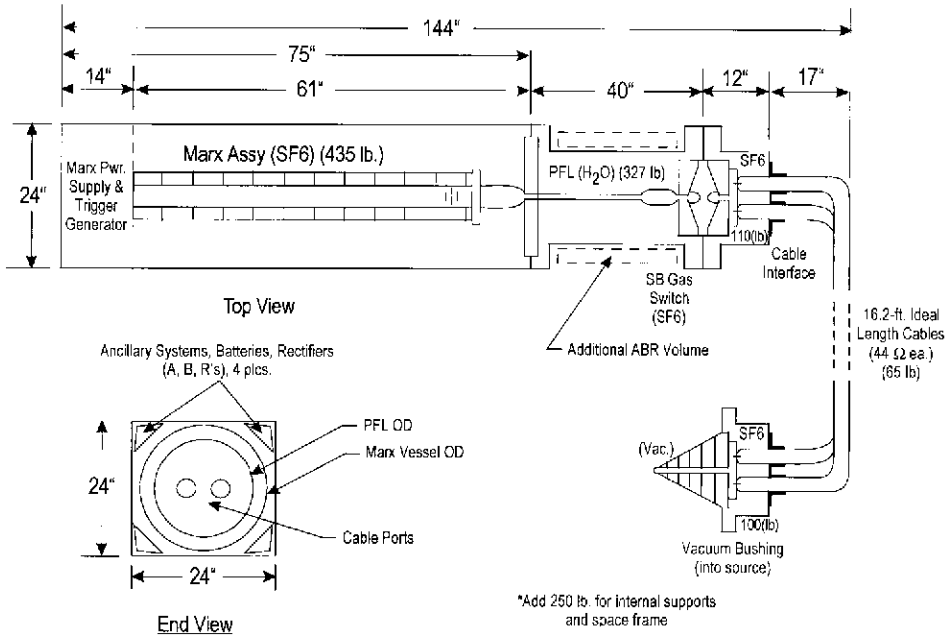

Fig. 6. Top and end views of the pulse power subsystem concept design. The upper portion will be mounted in a frame and placed in one bay of a UAV. The vacuum bushing and the source will be placed in a second bay.

very high packing factor and an overall energy density of 1.25 MJ/m^3. This module designed in 1994 still represents the state of the art in PFN design. Minor variants to the design are under consideration today for EM gun applications.

Titan-PSD has estimated the increases in the overall energy density of small (250–500-kJ) PFN modules that could be realized by achieving specific advances in component technologies.† This includes the use of an existing, more compact vacuum output switch (developed by Titan-PSD) and existing, more compact diodes for the crowbar switches. We would design a higher-energy-density, closed-field inductor and eliminate the dump resistors and associated hardware. Rather than having to dump energy into a resistor, advanced pulsed power systems would be charged by four-quadrant converters capable of returning energy from the PFN to an intermediate energy store. When 5-J/cc film or ceramic, high-energy, reversal tolerant capacitors become available, the utilization of advanced components would lead to a PFN design with an energy density of 3.25 MJ/m^3.

2.1.3. Power supplies for laser applications. Titan-PSD's San Diego operations are actively engaged in building innovative high-average-power systems. Titan is currently delivering power conditioning and control elements for the high-power RF klystrons that will power the DOE Spallation Neutron Source that is now under construction at Oak Ridge, Tennessee, and a series of multimegawatt rectifiers for the U.S. Navy's Electro-Magnetic

†Higher energy densities could be achieved in the design of larger modules due to economics of scale.

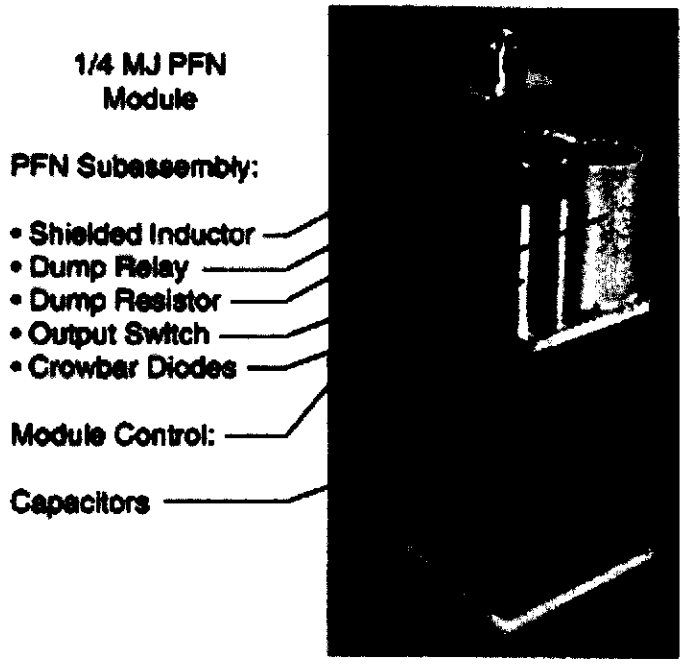

Fig. 7. Photograph of the 250-kJ PFN with the state-of-the-art, 1.25-MJ/m^3 overall energy density. Titan-PSD has operated this PFN into resistive loads at a rate of 1/3 Hz for extended periods. Operational limits were imposed by the heating of the load, not by the performance of any component of the PFN.

Aircraft Launch System (EMALS). Most recently, Titan has developed conceptual compact power supply designs for deployable pulse power systems for the Strategic Illumination Laser (SIL). The SIL is a diode-pumped, solid-state laser for use as a designator as a part of the U.S. Air Force's Missile Defense Agency's Airborne Laser (ABL). These power supplies will drive compact arrays of light-emitting diodes (LEDs), which will in turn pump the solid-state lasing medium.

Titan's proposed SIL power supply system will consist of a group of innovative ballast-type isolated power converter modules, each fed by its own active-power-factor-corrected rectifier module. By this method the input current harmonic distortion will be minimized, resulting in an overall system power factor of 0.995, which will be acceptable for the Boeing-747 type aircraft (ABL platform) power system. The whole power system will be protected against faults by appropriate fuses and circuit breakers. Initial size and weight estimates for the total power system is 65 liters of total volume and 140 kg of mass. The driving factor in the weight and volume is the need to meet the power factor requirements. Given a dedicated power source, the size and weight could be halved.

Two basic topologies have been examined for power factor correction. They are the "Vienna rectifier,"[8] first proposed by researchers in the Vienna Technical University, and the hex-bridge bidirectional inverter. Both topologies do not contain any magnetic components, operating at line frequency, and both can provide a power factor over 0.99. All merits and drawbacks of both topologies have been initially analyzed, and the Vienna approach is favored for this application.

For the ballast inverter Titan-PSD selected the variable-frequency, zero-power switching full bridge quasi-resonant inverter topology. It is new and until recently not well known but is very promising for multikilowatt power supplies. It shows excellent average to peak ratio for the semiconductor switches, close to the theoretical limit of 50%, and a good power transformer copper utilization factor, typically 90%. It is intrinsically output current limiting and therefore operates well in a current regulated mode and is tolerant to output short circuits. Using this converter topology allows the design to reach unprecedented power conversion efficiency (real value 95%) with excellent reliability.

2.1.4. Electronically reconfigurable battery. We consider a DEW power system in which a 10-kV capacitive store is required to operate repetitively. If the system operates at 3 pps, even for a short period of time, the recharge time would be about 300 ms and the recharge power would be about 500 kW_{avg} (1 MW_{pk}). An important system issue is the size and weight of the 500-kW power conditioning unit.

Titan-PSD has developed a means to eliminate the need for intermediate power conditioning for many DEW systems mounted on hybrid electric vehicles by using the on-board batteries to charge the capacitive store directly. Our approach uses electronic switching to convert the battery modules in the mobility store from a parallel configuration providing vehicle load leveling and/or silent mobility capability, to a series configuration that delivers 500 kW at 10 kV to recharge the capacitor bank and back again. We refer to this as an "electronically reconfigurable battery" (ERB). Note that all of the batteries are recharged in parallel. A similar approach is used in capacitive Marx generators to achieve very high voltage pulsed output.

Figure 8 is a schematic drawing of the circuit of an ERB in a hybrid electric drive vehicle. In this schematic circuit, some battery modules are always in parallel and connected to the vehicle bus. Others, along the left-hand side of the drawing, can be switched between a parallel configuration, which supports the vehicle bus, and series operation for charging the DEW store. Electronic reconfiguration requires three switches per battery module. All switches, with the exception of the output switch, need only block the voltage of a single battery module and open at near zero current (characteristic of capacitor charging) in normal operation. Passive snubbing controls the transient conditions during erection and de-erection. Reconfiguration can be accomplished in less than 1 ms using off-the-shelf, solid-state switches such as IGBTs or MOSFETs.

Figure 8 shows an erectable battery module charging a Guillemin E-type network. Switches 2 and 3 are battery isolation switches, and switch 4 is a series switch. These switches are rated only for the module voltage (1 kV in this case). Mechanical contactors parallel the isolation switches for better efficiency during periods when the pulse power system is not in use. Switch 5 is the output switch, which is rated for the full output of the ERB (10 kV and 50 A) and is most likely a series stack of the same switches used for 2–4. For fault protection and charge interrupt at current, a vacuum contactor and fuse are placed in series with the output switch. All switches are optically isolated with gate power drawn from their adjacent modules. Switch 6 is a high-voltage and current-closing switch, either vacuum or solid state.

Assuming a 20-ton-class vehicle and extrapolating from CHPS requirements, we have developed a conceptual design of an ERB for a hybrid electric vehicle with a system meeting the following requirements: 1) Deliver up to 400 kW to the vehicle bus at 1 kV in parallel operation; 2) recharge a 150-kJ capacitive store to 10 kV in 300 ms; and 3) support 30–45-min silent operation at 80 kW. These requirements mandate the use of very high energy

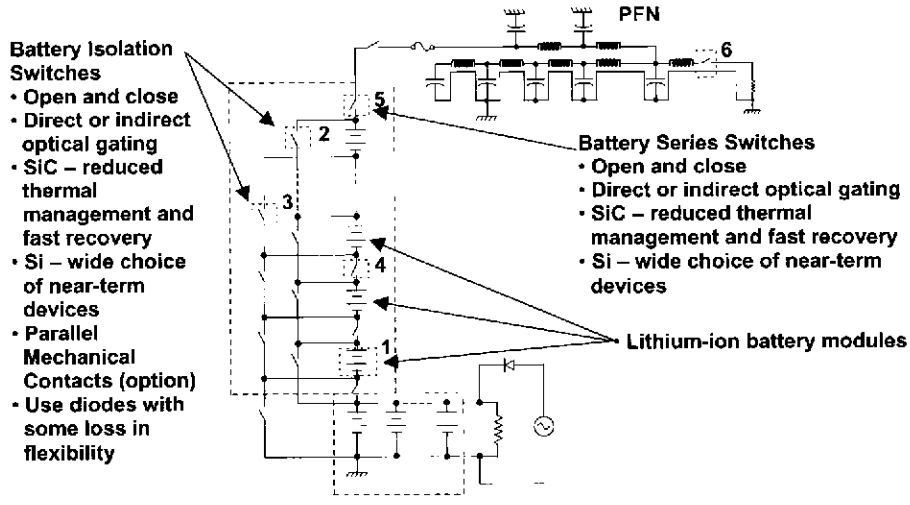

Fig. 8. Schematic circuit of the ERB. Shown is a generic circuit topology for charging a Guillemin E-type network. For the present application, the 10 modules in the dynamic store are all erected in series to produce a 10-kV output. A feature of the ERB is that the dynamic portion of the store may be erected in combinations of series/parallel modules to provide any output voltages that are an integer multiple of the DC bus voltage. This voltage agility, in theory, would allow a single dynamic store to power several loads with different input voltage requirements on the same platform such as ETC guns and HPM systems.

and power density batteries such as the HP series of lithium ion batteries being developed by SAFT and the lithium polymer batteries produced by Ultralife Batteries, Inc., for use in cell phones. The SAFT batteries have a slight advantage in usable power density and packaging for military use, whereas the Ultralife batteries have an advantage in cost due to volume production and a potential for more compact packaging (thin, rectangular) in ERB service. A design and trade study will select the most appropriate cell for the application. We chose the Ultralife cells for the conceptual design used for purposes of discussion in this paper because of our experience with them in our laboratory tabletop ERB and because of the availability of these cells over a range of capacities from 120 mA-h to 3.5 A-h.

The ERB system in this case constitutes only 1/3rd of the total battery for erected (dynamic) operation. The remaining 2/3rds of the store (static) is dedicated to load leveling and silent mobility. The total capacity of ~290 MJ (80 kW-h) accommodates silent mobility requirements. With only 1/3rd (90 MJ, 25 kW-h) of the total capacity configured for on-command electronic erection and de-erection, the vehicle energy storage system maintains its load leveling and silent operation capability even when the pulse power system is active.

For our conceptual design, we assemble 53 Ultralife polymer batteries into individual 200-V stacks. Five of these stacks are placed in series to obtain an output voltage equal to that of the vehicle bus. In the static portion of the store, 20 such series stacks of the UBC34106102 cells (5,300 total cells) are needed to provide the 200-MJ nominal capacity. In the dynamic portion of the store, the UBC383562 cell is used because of its higher current rating. Due to the smaller size of these cells, there can be as many as 4 in parallel by 53 in series per 200-V unit, and five such units will form an erectable module. The module will incorporate all necessary switches and isolation and thermal management hardware.

Ten modules will constitute the entire dynamic store (~90 MJ, 10,600 total cells). The total battery volume in the static and dynamic stores is ~0.282 m^3, and the accessories are expected to add another 0.4–0.6 m^3 for a total volume of less than 1 m^3. The weight for just the batteries would be ~572 kg, with accessories of much lower density adding another 100–200 kg, for a total weight of less than 700 kg. Charging of the ERB is always performed at bus voltage with the dynamic store in parallel configuration.

In load leveling or silent mobility operation, the charge state of the ERB is continuously monitored and controlled by the vehicle's systems. When the pulse power mode is activated, the mechanical contactors bypassing the isolation switches are opened. Next, all isolation switches are opened, followed by the closing of all series switches, and the ERB begins charging the capacitive store. Initially, the load looks like a short circuit, and the charging current is limited by the internal impedance of the ERB cells. As the charge on the bank increases, the charging current diminishes, and the cell voltage begins to rise. Near full charge, the current approaches zero and the ERB output voltage rises to its maximum of ~10 kV. Voltage on the store is monitored and is regulated by chopping the ERB output (i.e., opening and closing the series and output switches as necessary to maintain charge against leakage; this has been demonstrated in the laboratory at rates of up to 1 kHz). When the store discharges, the output switch opens immediately and remains open long enough for the closing switch to recover (1–10 ms). The ERB can remain erected for as long as the pulse power system is active. Recharging of the store is then initiated by reclosing the ERB output switch. When the pulse power system is deactivated, the dynamic store is returned to its parallel configuration by opening the series switches (de-erecting). The dynamic store can then be recharged from the vehicle power bus.

We have created an ERB laboratory demonstration consisting of five erectable modules of 40 V. The Ultralife UBC383562 cells were used and arranged on PC boards that were in turn stacked via standoffs. Isolation and series switching was via optically coupled IGBTs. Some figures of merit (FOM) from the ERB testing include a demonstrated current rise time to 80 A of 4 μs at 200 V and an erection/de-erection frequency of 1 kHz for use in voltage regulation. A FOM from the four series cell tests is a demonstrated current rise time to 120 A of 1 μs, in a maximum power transfer configuration.

2.1.5. Intermediate energy storage. In the preceding section Titan-PSD identified a need for and established the technical feasibility of an advanced technology power conditioning element to charge capacitive stores in DEW systems. The ERB is the solution with the highest efficiency and energy and power density possible. This is critical in order to realize a manageably sized DEW system. A second similar, critical issue in the design and use of pulsed electrical weapon systems involves the level of available platform power. If this power is insufficient to support the required operational burst length and repetitive fire rate of the system, then it may be necessary to incorporate intermediate energy storage into the system design. Intermediate storage could be practically achieved through the use of secondary batteries, flywheels, and ultracapacitors (also referred to as electric double-layer capacitors or EDLCs). Figure 9 is a schematic diagram of intermediate energy stores in two DEW systems.

Figure 10 shows a present application of an EDLC energy storage system in providing ride-through of voltage sags and momentary outages for an induction motor. The output of the store is connected across the direct current (DC) link of the asynchronous drive and supports its voltage. Titan-PSD has manufactured a ride-through system that has been demonstrated to respond to sags and outages within 10 ms. It can provide

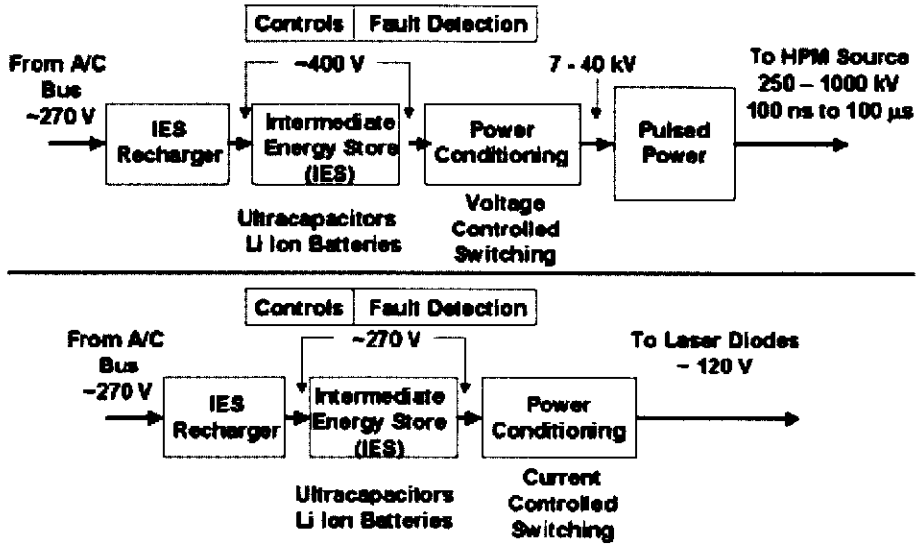

Fig. 9. Two DEW block system schematics with intermediate energy storage.

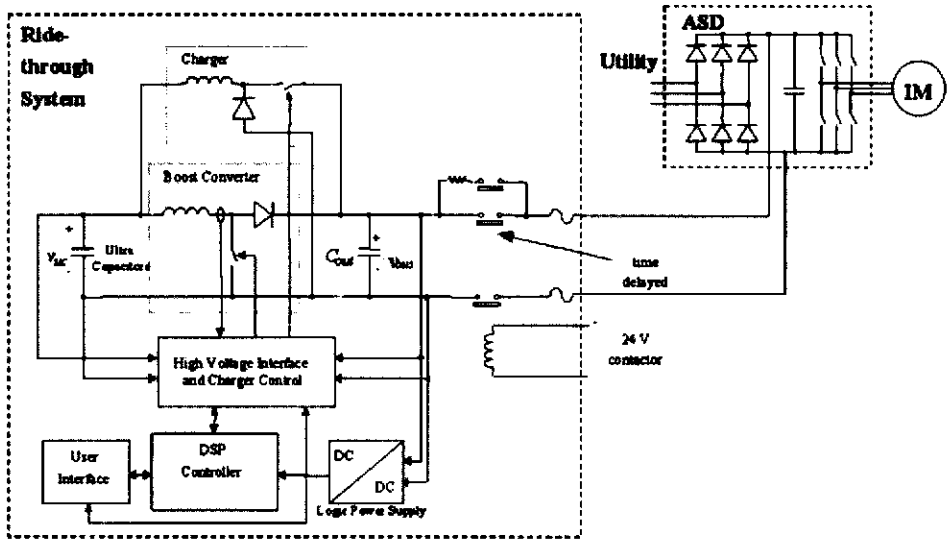

Fig. 10. Circuit diagram of an EDLC ride-through system supporting the DC link of an asynchronous drive (ASD).

100 kW for up to 5 s, which is sufficient to allow for orderly shutdown in a prolonged outage.

Titan-PSD has also developed several concept designs of EDLC energy storage systems for military applications. For example, one EDLC system design would be capable of supporting the DC link in a Navy shipboard system at 480 V for 12.5 s at 250 kW. This system is estimated to be 50% smaller and lighter than a corresponding flywheel system

(i.e., the Caterpillar UPS-250 system). With minor modifications, the same system (or several systems in parallel) could be used as an intermediate energy store for DEW systems.

2.2. Titan advanced component developments to enable DEWs

2.2.1. Solid-state switches for severe service. The key enabling technology for nearly all pulse power systems for DEW applications is the switch that initiates and delivers the pulsed electrical output from the electrical energy store to the load. This switch must hold off high voltage (typically $\geq$10 kV), close rapidly (<1 μs), carry high peak current (100–500 kA) with high initial rate of rise (50–100 kA/μs), sustain a high total action ($\geq 10^7$ A^2-s), and recover rapidly (<10 ms). In addition, the switch must support high current density, operate reliably under mechanically stressing conditions, have minimum weight and volume claims, and not require ancillaries such as vacuum pumps or gas flow subsystems. At present, the hydrogen thyratron is most frequently selected to meet these simultaneous requirements, but thyratrons are large and heavy devices, with auxiliary equipment that consumes several kilowatts and often require immersion in oil. The Army Research Laboratory has been actively seeking solid-state devices for DEW utility[7] and Titan-PSD is weighing in by developing a high fluence, laser gated and pumped (silicon) thyristor (LGPT) that will satisfy these requirements.

High fluence optical gating of thyristor switches has been chosen for numerous pulsed power switching applications. Light activation with high fluence laser sources enables the use of solid-state switching devices in performance parameter spaces previously serviced only by vacuum and gas spark gaps. If the output from the high fluence source is properly distributed within the switching medium, the di/dt capability of the switch does not depend on the rate of plasma spreading. Rather, di/dt becomes a function of the rate of rise of the optical fluence. In addition, optical gating eliminates the extensive and intrusive physical gate structure that limits the conduction area of the highest di/dt conventional solid-state devices. Properly designed laser-gated devices are typically capable of higher di/dt, peak current, and charge transfer for a given silicon area than conventional solid-state devices.

The band edge for intrinsic silicon is $\sim$1.12 eV, corresponding to $\sim$1,111 nm. However, silicon is an indirect band-gap material so that the optical phonon energy (0.063 eV) adds to the photon energy to create e–h pairs out to 1,170 nm. In most previous efforts involving direct laser-gating of silicon devices, a solid-state laser was used; typically either Nd:YAG or Nd:YVO at 1,064 nm. However, over the past 10 years, the development of compact diode-pumped solid-state lasers has significantly reduced the size of the requisite optical sources and improved their lifetime and reliability. More important, the InGaAs laser diode bars that were developed for pumping these solid-state lasers have been pushed to longer wavelengths, approaching and exceeding that of the silicon band edge. In principle, the center wavelength of InGaAs laser diode bars is selectable by design over a continuum from 850 nm through at least 1,150 nm. This allows direct optical gating and pumping of silicon by the diodes without any of the intermediary options of the preceding paragraph. Figure 11 is an illustration of an on-board laser diode gated and pumped silicon thyristor, which is one of the candidate approaches in development now.

Titan-PSD is currently performing on two programs and has finished a third that provide technical leverage for further switch development. Our Electra Advanced Pulsed Power Program is a five-year, Naval Research Laboratory (NRL)/DOE-sponsored effort to develop advanced pulsed power components and systems for KrF laser IFE (krypton fluoride laser inertial fusion energy). The most critical component is the primary switch, and we are

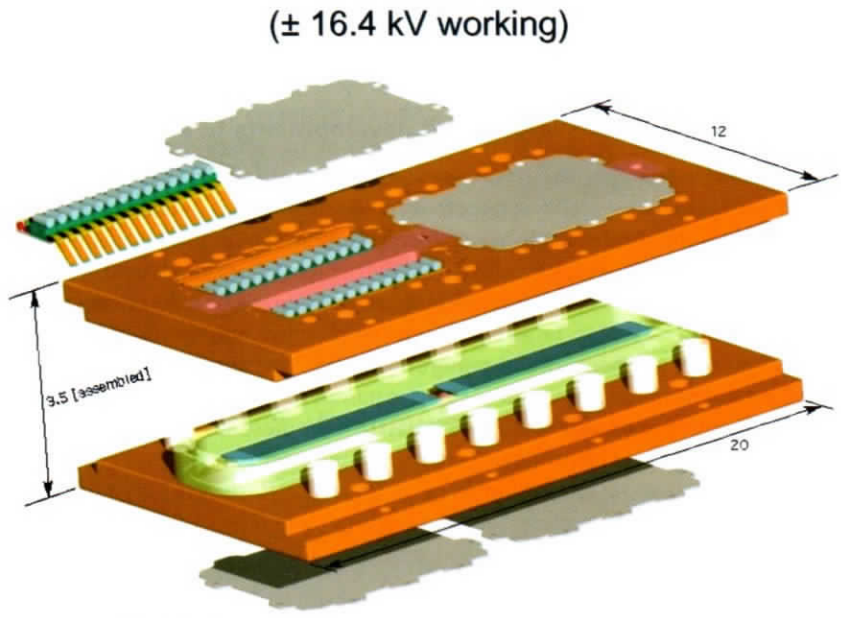

Fig. 11. Illustration of a laser gated and pumped thyristor.

developing an on-board LGPT for this role. The switching requirements are repetitive, high peak current and di/dt, as well as high efficiency (the switch dissipates $<1.5\%$ of stored energy) and long lifetime (10^9 shots). The LGPT is to be used in a Marx generator, and the single device operating parameters are 16.4-kV working voltage, current density 2.25 kA/cm^2, peak current 225 kA, max di/dt 900 kA/μs, pulse width 800 ns, and repetition rate 5 pps continuous. The lifetime requirement limits the thermal excursion per pulse to a few degrees, and therefore the action per square centimeter is low ($\sim$2 A^2-s).

Another current Titan-PSD program is to develop compact pulsed power components for the Air Force Research Laboratory (AFRL) at Kirtland Air Force Base. Components under development enable a compact, long-lifetime Marx-PFN driver for a narrowband HPM source. The di/dt requirement is a few hundred kA/μs/cm^2(Si) or 2 MA/μs total, with a peak current of 30 kA. To satisfy the switching requirements for this application, we are considering the LGPT, a solid-state laser activated switch, and a hybrid combination of the two.

Although the action and charge transfer in these Electra and AFRL applications are substantially less than that found in some pulse power applications, they serve to illustrate our confidence in the high power laser diode bars for high di/dt service. In both cases, the pulse width of the energy transfer is short enough that thyristor action has barely begun by the time the pulse is over. Because of this, a large fraction of the total charge conducted during the pulse must be supplied optically. The diode laser bars and their drive circuitry are capable of supplying an illumination fluence of up to 6 kW/cm^2(Si) within 20 ns and sustaining that level for at least several microseconds. Fluence of several kilowatts per square centimeter is desirable for initial gating in many DEW applications. The required fluence drops to 250–500 W/cm^2 for continuous pumping.

Another effort was recently undertaken in a conceptual design study for an optically gated and pumped switch for rectification of compulsator (pulsed alternator) output for driving an

electromagnetic gun. This completed study was performed by Titan-PSD and the Optiswitch Technology Corporation for the Institute for Advanced Technology (IAT). The on-board LGPT design was chosen because of the customer's desire to reduce the overall device count and silicon area compared with conventional devices. Specifically, we designed a 16.7 kV, 100–115-cm^2 asymmetric (blocks voltage forward direction only) thyristor and series diode. Depending on the allowable temperature excursion per shot, our approach replaces ~80 conventional devices with 3–5 series pairs (6–10 devices total; 340–500 cm^2 active) for the same forward losses. This is possible because continuous pumping of thick (2.5-mm), high-voltage (15–20-kV) devices with photo-carriers mitigates the carrier population deficit in the n-base. Electrically gated devices of the same voltage capability typically exhibit huge commutation and conduction losses and are therefore impractical for this type of service. Reverse blocking was handled by a series optically pumped diode. Separating the forward and reverse blocking functions allowed more freedom in designing for reverse recovery, a feature deemed necessary due to repeated failures of symmetric (blocks voltage both directions) devices in this service. Laser diode pumping served to reduce the forward losses in the series diode element as in the thyristor.

The switch was designed to handle a peak current of 1.6 MA (3.3–4.7 kA/cm^2) for 600 μs when installed in a half-wave, four-phase rectifier. Nine total cycles are rectified per shot of the electromagnetic gun. The initial design (500 cm^2 active) limited the temperature excursion per shot to ~100°C, commensurate with a service life of ~10^4 shots. In the extreme, the current density could be pushed to 4.7 kA/cm^2 and optical pump power doubled, resulting in a ΔT approaching 180°C and ~200-shot lifetime. The laser diode bars in the initial case provided a constant 500 W/cm^2 of silicon for each 600-μs conduction phase. This goes to 1 kW/cm^2 in the extreme case.

2.2.2. Next generation reltron microwave generator development. Reltron HPM sources were invented and developed by R. Bruce Miller of Titan Advanced Innovative Technologies from the mid-1980s through 1998. The PSD of Titan assumed responsibility for reltron contracts in 1998. Projects included one complete HPM simulator for a government research laboratory in Germany and eight reltron tubes of various specifications. In developing these eight tubes, enough mechanical and electrical modifications have been included to justify their designation as "second-generation" designs.

Reltrons are both compact and efficient. The electron beam is highly modulated over ~10 cm and postaccelerated prior to drifting to the output cavities and beam collector. This beam transport requires only ~75-cm overall length for L-band tubes (Fig. 12). The output cavities are incorporated into a standard rectangular waveguide. Microwave power is efficiently extracted (~80%) directly in TE_{10} mode. The overall efficiency (peak electrical to microwave power) is 30–40%.

In general these new tubes move the reltron technology base in the directions of longer pulsewidths (~1–2 μs), increased frequency tunability (~±13%), lower driver voltages (500–600 kV), and higher repetition rates (~10 Hz for demountable versions, ~300 Hz for sealed tubes). Second-generation improvements include a new high voltage insulator design, new movable current contacts for the modulation and output cavity tuners, reduced outgassing, and monolithic grids. The frequency range for these eight tubes covers 700–1,450 MHz. Programs are in place now to extend this range.

In addition to the objective to extend the frequency coverage, efforts are underway to improve beam optics to reduce current losses and thereby improve efficiency and microwave output power. A new beam current diagnostic package has been recently implemented to

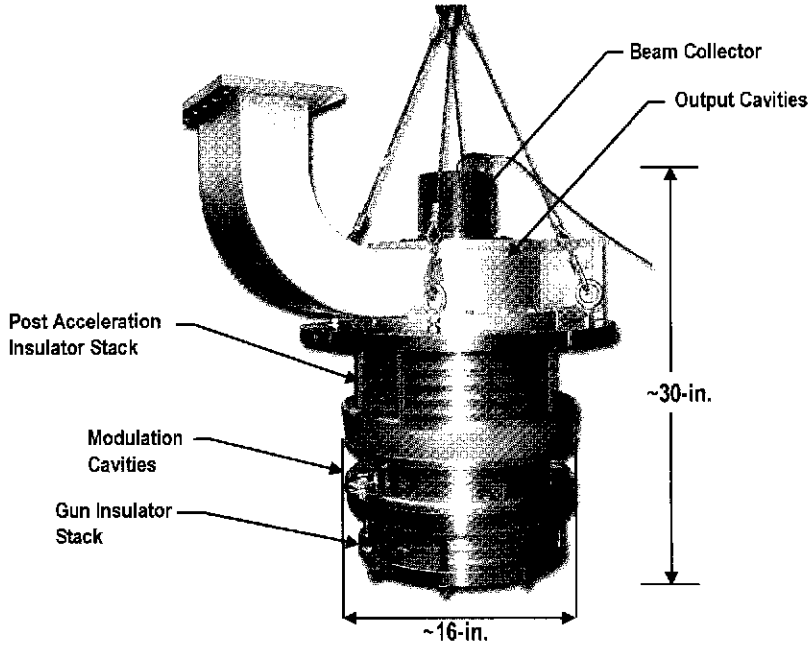

Fig. 12. L-band reltron capable of generating flat 200-MW, 900-ns pulses with frequency stability $\delta f/f < 0.3$. This generation of reltrons is capable of RF pulse widths of ~300 RF cycles, repetitive pulse operation from single-shot to 10 Hz, and $\pm 10\%$ continuous-frequency tunability.

better infer basic performance parameters and to assist in comparing benchmarking simulations. These calculations simulate performance in the actual geometry and are generated with a three dimensional particle-in-cell code (the LSP code from Mission Research Corporation). Measured waveforms generated by a recently delivered L-band tube are shown in Fig. 13. This tube produces ~185 MW in flat, 900-ns pulses with excellent frequency stability. The LSP code was essential during this tube's development. A new era in microwave tube design has emerged with the development of accurate three-dimensional models.

2.2.3. HEM magnetron. Backdoor microwave effects on electronics systems in modern weapons fall into three broad categories. Two categories are characterized by high peak power density and microwave formats that overwhelm the target system with an electric field that is high enough to cause circuit upset or burnout. In the third category, effects are caused by coupling spurious signals into the target system, akin to classical smart jamming, interference or spoofing[‡] techniques used by the EW countermeasures community. The DEW microwave pulse formats appropriate to the latter class of effects are generally distinguished from upset and damage pulse formats by lower peak power density thresholds but more specific requirements on frequency and amplitude modulations and

[‡]Low incident microwave levels can cause "interference" with the operation of threat weapon electronic systems, producing high levels of noise in sensitive circuitry to "mask" true signals. The incident microwave signal is said to "spoof" if it is tailored to "mimic" the true signal and to thereby produce false commands.

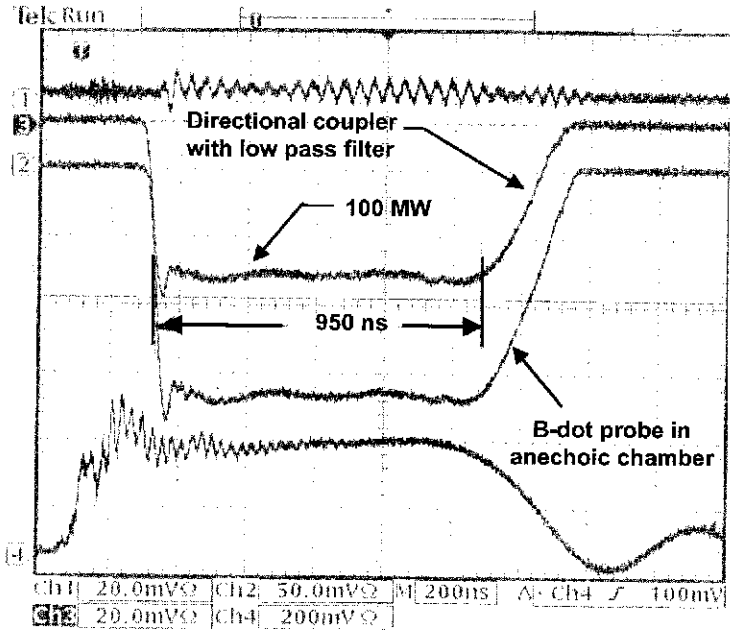

Fig. 13. Waveforms from the 185-MW L-band reltron: the top trace is the heterodyne (l.o. = 1.3 GHz) showing excellent frequency stability, and the second trace is the steady, flattop output power measured with a calibrated directional coupler. (The data are conditioned with a low-pass filter; higher harmonic content is know to be more than 13 dB below the primary L-band signal.) The third trace is the radiated power monitored with an uncalibrated, free-field B-dot, and the last trace is an uncalibrated profile of the Marx current.

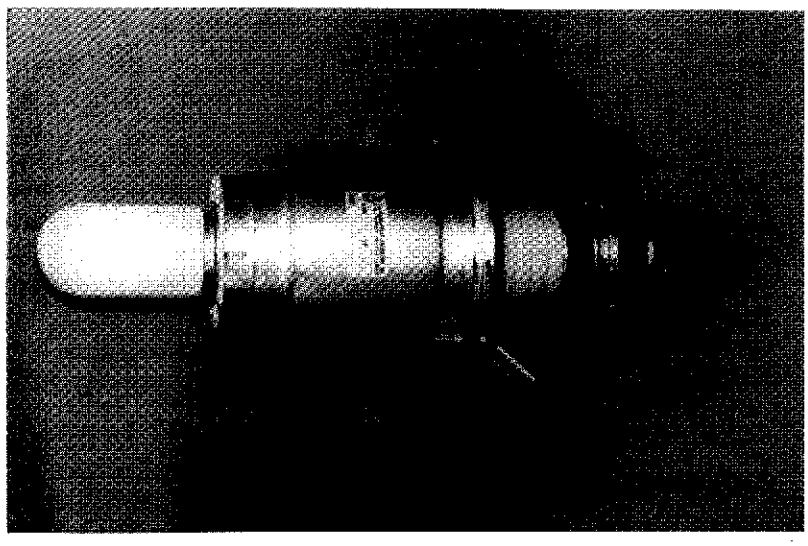

Fig. 14. Titan's L-band HEM magnetron. This is the highest-average-power magnetron that is commercially available.

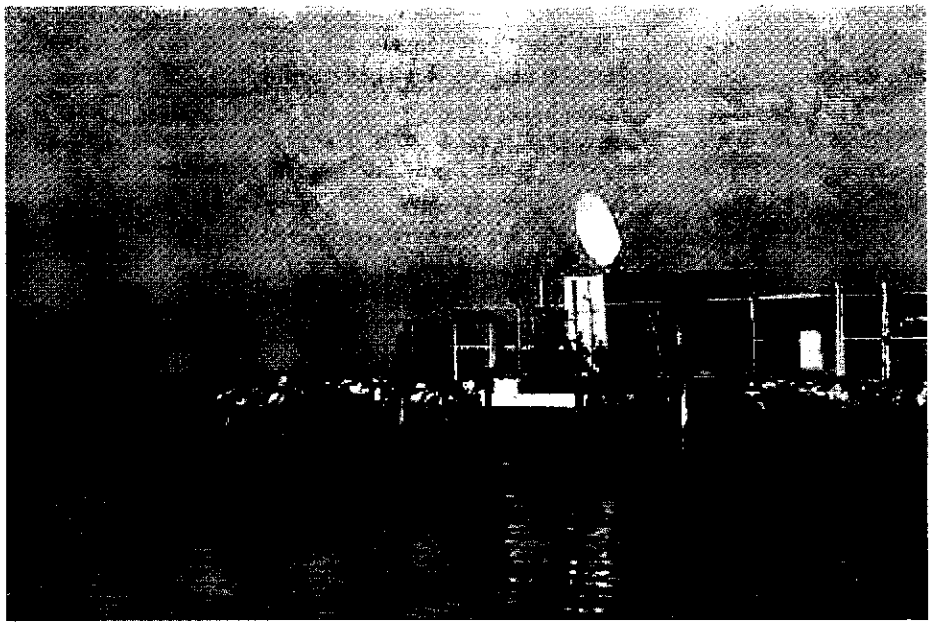

Fig. 15. The principal system elements of the ATD system are a power supply, a modulator, an HEM source, and an antenna. These components are supported by a control system and a cooling system. For the DTRA ATD ground-based system the power supply and operators' console(s) are housed in a shelter mounted on one flatbed trailer while the remaining components are mounted on another flatbed trailer (out of the field of view to the right). The system was designed to broadcast 2-MW peak power pulses with an average power of 300 kW for 30-s missions. This yields a peak fluence of 1 mW/cm^2 at a range of 2,400 m.

repetition rate. All three categories of effects can be induced by DEW systems based on high-power RF, narrow-band, pulsed HPM or long-pulse, high-energy microwaves (HEMs).

Titan has developed an HEM laboratory source and an HEM advanced technology demonstration (ATD) source for DEW purposes at its California Tube Laboratory. These HEM sources have efficiencies of approximately 85%. This high efficiency minimizes prime power and cooling requirements, thus significantly minimizing overall DEW system size and weight. The HEM magnetron, shown in Fig. 14, has produced 900-kW peak and 150-kW average powers and can easily be upgraded to 300-kW average power. The unique modulation characteristics of this magnetron can produce modulation effects of 30 MHz or greater in the target systems. More operational details are given in Table 6.

The ATD system shown in Fig. 15 combines the outputs of two 150-kW-average-output power magnetrons. The maximum peak output power obtained to date is 1.2 MW. The magnetrons with their respective magnet yokes each weigh about 200 lb, and each takes up about 4 ft^3. When combined their efficiency is over 76%, therefore together they absorb only 95 kW and are actively cooled. Variants of this RF system are suitable for Army, Navy, and Air Force missions.

Table 6. California tube laboratory HEM magnetron operational specifications

Parameter	Value
Frequency, fixed	915 MHz (890–920 MHz possible as well)
Power output	
Continuous wave	300-kW minimum
Pulse	600-kW peak (900 actually achieved)
	300-kW avg (nominal 50% duty)
Pulse width	10s of microseconds to 5 ms
Peak anode voltage	42 kV
Peak anode current	17 A
Beam efficiency	88% typical
Water-cooled anode	20 gpm typical
Filament	12 VAC, 200-A typical standby

3. Conclusions and Significance

The first laser and HPM DEWs are just now being deployed, and new threats emerging in the information age will sustain the need for continued DEW development and acceptance. The deployment of even more advanced DEW systems and in fact the DoD's intent to field more (or all) electric fighting platforms depend critically on the availability of compact, lightweight, efficient pulsed power subsystems and long-lived, reliable advanced power conditioning and front-end components.

Titan has been supporting U.S. directed energy programs by providing services and analysis and developing advanced technologies since the early 1980s. Today, Titan is the only U.S. industrial supplier of commercial HPM generators. We have advanced pulsed power and power electronics technology development programs involving intermediate and primary electrical energy storage, solid-state switching, power conditioning, electrical-to-microwave conversion, and novel microwave antennas underway now. Titan is focused on providing pulsed power and C4ISR (command, control, communications, computers, intelligence, surveillance, and reconaissance) solutions for national defense and is intent on maintaining its industrial leadership in military information technologies.

Acknowledgments

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The Tom Bearden Website

TOWARDS A NEW ELECTROMAGNETICS
PART I: SOLUTION TO TESLA'S SECRETS AND THE SOVIET TESLA WEAPONS

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PART I

I am much indebted to Mr. Carey Briggs for furnishing references which strongly support the existence of scalar potential waves and scalar interferometry. Among those papers are Whittaker (1903), Nisbet (1955) , and other papers dealing with Hertzian potential theory. As ever, my profound gratitude is due Hal Crawford for his splendid illustrations which accompany this paper. I am also indebted to John Ratzlaff and the Tesla Book Company for graciously furnishing important Tesla references for me to analyze. My sincere thanks go to Messrs. Jim Beal and Williard Van de Bogart for furnishing important references on exoelectron emission and tectonic fault zones, and to Dr. Robert Beck for furnishing important material on the Rogers underground and undersea transmission system. Additional assistance was also received from Mr. Peter Kelly, Joe Siegeldorf, Joe Gambill, and Bob Beutlich. I am also very appreciative of the information furnished by Bob Jones and Vestigia on the beautiful Vestigia mystery light experiments.

PART II

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FOREWORD

The long-searched-for Tesla secrets have been solved by Tom Bearden. Part I contains the specific description of the solutions to Tesla's secrets and the Soviet Tesla weapons.

The present electromagnetic theory has several flaws, and it is these errors that have hidden the long-sought unified field theory. The explanations presented by the author provide clarity and understanding to related Tesla writings and patents.

Before the turn of the century, Nikola Tesla had discovered and was utilizing a new type of electric wave. Tesla repeatedly stated that his waves were non-Hertzian, and that his wireless transmissions did not fall off as the square of the distance. The author has found that the wave which Tesla was using is a longitudinal scalar wave, capable of many times the speed of light. When coupled with another scalar wave (Tesla wave),
the resulting vector wave can be the source of electromagnetic energy for electrical power, a protective force field, or a destructive weapon.

The booklet is well illustrated with special drawings by Hal Crawford. The bibliography includes corroborating information on all major points. Part II presents reprints or the entire subject matter of selected articles from the bibliography, plus additional references of importance. Articles are arranged in chronological order. Also included are nine patents by James Harris Rogers which were the basis of successful wireless communication during World War I. These principles of underground and sub-sea wireless were based on Tesla's discoveries.

Bearden's solutions are truly a major breakthrough, and an absolute necessity to the understanding of existing Tesla writings. It is also important that more should be known of this extraordinary individual, Thomas E. Bearden.

BIOSKETCH:

A nuclear engineer, wargames analyst, and military tactician, Lieutenant Colonel (Retired) Tom Bearden has over 26 years experience in air defense systems, tactics and operations; technical intelligence, anti-radiation missile countermeasures; nuclear weapons

employment, computerized wargames; and military systems requirements.

He is currently with the Alabama division of a large aerospace company where he is involved in determining the future requirements for laser weapons.

Lieutenant Colonel Bearden obtained a Master of Science degree in nuclear engineering from the Georgia Institute of Technology and a Bachelor of Science degree in mathematics from Northeast Louisiana University. He is also a graduate of the U.S. Army Command and General Staff College and several U.S. Army artillery and missile schools.

He has had direct experience with tube artillery and with the Ajax, Hercules, Hawk, and Patriot missile systems and the production of technical intelligence on Soviet surface-to-air missile systems for the U.S. Army/Department of Defense.

Tom holds a Sandan (third degree black belt) in Yoseikan aikido; is a singer, guitarist and songwriter; member of Mensa, Society for the Investigation of the Unexplained, Vestigia, the American Association of Meta-Science: and is on the board of governors of the U.S. Psychotronics Association. In addition, he is Alabama Director of a small nonprofit foundation, the Association of Distinguished American Scientists and is a MUFON adviser on nuclear engineering.

He also edits *Specula*, Journal of the American Association of Meta-Science.

Tom is primarily active as a theorist on UFOs, parapsychological and paranormal phenomena, and psychotronics. He is the author of a book, *The Excalibur Briefing*, Strawberry Hill Press, 2594 15th Avenue, San Francisco, California 94127 and has numerous technical papers dealing with new paradigm physics, paranormal phenomena, and Soviet psychotronic weapons.

Finally, Bearden's *Solutions to Tesla's Secrets and the Soviet Tesla Weapons* promises to be recognized in the future as a major contribution to our present technology.

JTR

The Tom Bearden Website

TESLA'S SECRET AND THE SOVIET TESLA WEAPONS

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With Special Drawings by Hal Crawford

Before the turn of the century, Nikola Tesla had discovered and was utilizing a new type of electric wave. Tesla repeatedly stated his waves were non-Hertzian, and his wireless transmissions did not fall off as the square of the distance. His discovery was apparently so fundamental (and his intent to provide free energy to all humankind was so clear) that it was responsible for the withdrawal of his financial backing, his deliberate isolation, and the gradual removal of his name from the history books.

By 1914 or so, Tesla had been successfully isolated and was already nearly a "nonperson." Thereafter Tesla lived in nearly total seclusion, occasionally surfacing (at his annual birthday party for members of the press) to announce the discovery of an enormous new source of free energy, the perfection of wireless transmission of energy without losses, fireball weapons to destroy whole armies and thousands of airplanes at hundreds of miles distance, and a weapon (the "Tesla Shield," I've dubbed it) that could provide an impenetrable defense and thus render war obsolete.

In my pursuit of Tesla's secret, it gradually became apparent to me that present orthodox electromagnetic theory is seriously flawed in some fundamental respects. One of these is in the definition and use of ϕ, the scalar electrostatic potential. It is this error which has hidden the long-sought unified field theory from the theorists.

In the theory of the scalar electrostatic potential (SEP), the idea is introduced of work accomplished on a charge brought in from a distance against the scalar field. The SEP is not a vector field, but is a scalar field. Indeed, scalar potential cannot of itself perform work on a charged mass; if it could do so, then tremendous force would exist on every mass due to the extremely high SEP of the vacuum itself. Only a differential of SEP between two spatial points can produce force or accomplish work. (Rigorously, a differential of scalar potential between two spatial points constitutes a vector. Only a vector can produce force and do work.)

Also, work can only be done on a mass. Further, it takes time* to move an electron or other charged mass between two spatial points, and so the work performed by a spatial differential of the ϕ-field requires time. Rigorously, the delta SEP is voltage, not SEP per se, and is directly related to

E field. The entire voltage concept depends on the work performed in moving a mass, after that mass has moved. The idea of "voltage" always implies the existence of a steady differential of ϕ between two spatial points for a finite length of time, and it also involves the assumption of a flow of actual mass having occurred. SEP, on the one hand, is always a single-point function; on the other hand, difference in potential (i.e., V) is always a two point function, as is any vector.

Yet many graduate level physics and electromagnetics papers and texts erroneously confuse ϕ and V in the static case! Such an interpretation is of course quite incorrect.

---

* *Two spatial points involve at least $\Delta t = \Delta L/c$ in time. All vectors and gradients involve 2 separated spatial points, and thus present timelines in 4-space. ϕ_4 is a point, not a line, in 4-space.*

Another common assumption in present EM theory -- that the electrostatic potential (ϕ_0) of the normal vacuum is zero -- has no legitimate basis. In fact, we know ϕ_0 is nonzero because the vacuum is filled with enormous amounts of fluctuating virtual state activity, including incredible charge fluctuations. And by virtue of its point definition, ϕ_0 must be the "instantaneous intensity" of these fluctuations -- but both in space and time. The scalar electrostatic potential is therefore the "instantaneous stress" on spacetime itself, and a measure of the intensity of the virtual state flux through a 4-dimensional spacetime point.

Potential theory was largely developed in the 1800's, before the theory of relativity. Time flowrate was then regarded as immutable. Accordingly, electrostatic "intensity" was chosen as "spatial intensity," with the connotation of "spatial flux density." This assumes a constant, immutable rate of flow of time, which need not be true at all if we believe relativity. Such a spatial "point" intensity is actually a "line" in 4-space, and not a 4-dimensional "point" at all. Thus the spatial potential -- ϕ_3 -- is a very special case of the real spacetime potential -- ϕ_4, or charge and electromagnetic theory today is accordingly a special case of the real 4-space electromagnetism that actually exists! Note also that charge is a 4-dimensional concept.

Now mass is a spatial, 3-dimensional concept. Rigorously, mass does not exist in time -- masstime exists in time. Mass and charge are thus of differing dimensionalities!

Also, according to quantum mechanics, the charge of a particle -- e.g., of an electron -- is due to the continual flux of virtual particles given off and

absorbed by the observable particle of mass. Thus charge also is conceptually a measure of the virtual flux density, and directly related to ϕ. Further, since the charge exists in time, it is the charge of a particle of spatial mass that gives it the property of masstime, or existing in time.

Here a great confusion and fundamental error has been thrown into the present EM theory by the equating of "charge" and "charged mass." As we have seen, the two things are really very different indeed.

To speak of a spatial "amount" of charge erroneously limits the basic EM theory to a fixed time flowrate condition (which of course it was considered to be, prior to Einstein's development of relativity). Thus when the limited present theory encounters a "relativistic" case (where the time flowrate changes), all sorts of extraordinary corrections must be introduced. The real problem, of course, is with the fundamental definitions of electrostatic potential and charge. The spatial "amount" of charge (i.e. the coulomb) as we presently erroneously use the term, is actually the spatial amount of observable "charged mass." To correct the theory, one must introduce the true 4-space SEP and separate the definitions of charge and charged mass.

Only when a mass is moved does one have work -- and voltage or vector fields. (The reason one has voltage and E field connected to a normal electrostatically charged object in the laboratory is because an excess of charged-particle masses are assembled on the object, and these masses are in violent motion! A true static charge would have no E field at all.)

Table 1. Some Present Theoretical Facts

- $Ø_3$-FIELD CONCEIVED BEFORE RELATIVITY

  - POINT FUNCTION IN SPACE
  - LINE FUNCTION IN SPACETIME
  - TIME FLOWRATE CONSIDERED IMMUTABLE
  - SPECIAL CASE OF $Ø_4, \ldots\ldots, Ø_N$

- GRADIENT BETWEEN TWO POINTS IN $Ø_3$ FIELD

  - PRODUCES VOLTAGE
  - PRODUCES E FIELD
  - MOVES ELECTRON
  - IS AN AREA IN 4-SPACE

- GRADIENT MAY BE BETWEEN SEPARATED POINTS IN TWO SUPERPOSED Ø-FIELDS

- Ø-FIELD CAN "MOVE" AT INFINITE VELOCITY*

* JACKSON, CLASSICAL ELECTRODYNAMICS, 2ND EDITION, P. 223

Table 2. Some Proposed $Ø_4$ Characteristics

- SPATIOTEMPORAL $Ø_4$ FIELD
  - STRESS ON SPACETIME
  - CAN CHANGE RATE OF FLOW OF TIME
- GRADIENT BETWEEN 2 POINTS IN $Ø_4$ FIELD
  - PRODUCES COMPLEX V_4
  - WILL MOVE ELECTRON IF
    - -- $V_3 \neq 0$, AND
    - -- $\nu_1 = \nu_2 = C$
  - WILL NOT MOVE ELECTRON IF
    - -- $V_3 = 0$, OR
    - -- $\nu_1 \neq \nu_2$
- GRADIENT MAY BE BETWEEN SEPARATED POINTS IN TWO SUPERPOSED $Ø_4$ FIELDS
- $Ø_4$ WAVE MOVES AT $0 \leq \nu_4 \leq \infty$
- $Ø_4$ WAVE IS COMPLEX AND LONGITUDINAL

ϕ-field need not involve observable mass accumulation, but only charge (virtual flowrate intensity) accumulation. Accumulated masses are like so many gallons of water; accumulated charge is like so much pressure on both the water (space) and the time in which the water is existing.

Now, if one varies the SEP solely as a point function, one would have a purely scalar complex longitudinal wave, and not a vector wave at all. This is the fundamentally new electrical wave that Tesla discovered in 1899.

Rigorously, all vector fields are two-point functions and thus decomposable into two scalar fields, as Whittaker showed in 1903. It follows that any vector wave can be decomposed into two scalar waves. By implication, therefore, a normal transverse EM vector wave, e.g., must simply be two coupled scalar (Tesla) waves -- and these scalars independently would be longitudinal if uncoupled. An ordinary transverse EM vector wave is thus two pair-coupled Tesla scalar longitudinal waves, and only a single special case of the much more fundamental electromagnetics discovered by Nikola Tesla.

A Tesla (scalar potential) wave -- i.e., a massless wave in pure ϕ_0, the stress of the spacetime medium would have very strange characteristics indeed. For one thing, since it moves in a complex 4-space, it has many more modes of movement than does a simple wave in 3-space. And for another thing, it need not be bound at all by the speed of (vector) light. In current theory, one ϕ_3-field does not directly interact or couple with other existing ϕ_3-fields except by simple superposition. Therefore presently the ϕ-field is considered to have no drag limitation at all, hence infinite velocity. (E.g., as stated in Jackson, Classical Electrodynamics, 2nd edition, page 223.)

Actually, a ϕ_4-wave can and will interact with some of the other existing ϕ_4-waves in the medium transversed, and this interaction can involve pair-coupling into EM vector fields and waves, an interaction not presently in the electrodynamics theory. The result of scalar pair-coupling creates a finite amount of vector "drag" on the ϕ_4-wave, so it then has less than infinite velocity. However, if this drag is small due to limited pair-coupling, the scalar wave's velocity through the slightly dragging medium still may be far greater than the speed of vector EM waves (light) in vacuum. On the other hand, if the pair-coupling is made severe, the ϕ-wave may move at a speed considerably below the speed of vector light waves in vacuum. The velocity of the ϕ_4-wave is thus both variable and controllable or adjustable (e.g., simply by varying its initial amplitude, which through a given medium changes the percentage of pair-coupling and hence the degree of drag on the scalar wave). The Tesla scalar wave thus can have either subluminal or superluminal velocity, in contradiction to present theory.

Note that the scalar wave also violates one of Einstein's fundamental postulates -- for the speed of our "new kind of light" wave is not limited to c, and need not be the same to every observer. Thus Tesla scalar waves lead to a new "superrelativity" of which the present Einstein relativity is only a highly special case!

Table 3. Tesla Waves Can:

- **ESTABLISH STANDING WAVES**
  - **in the earth**
  - **in the ionosphere**
- **TAP ENERGY FROM THE EARTH'S CORE**
- **TRAVEL FASTER OR SLOWER THAN LIGHT**
- **CHANGE RATE OF TIME FLOW**
- **AFFECT ALL FIELDS, INCLUDING GRAVITY**
- **COMMUTE BETWEEN VIRTUAL AND OBSERVABLE**

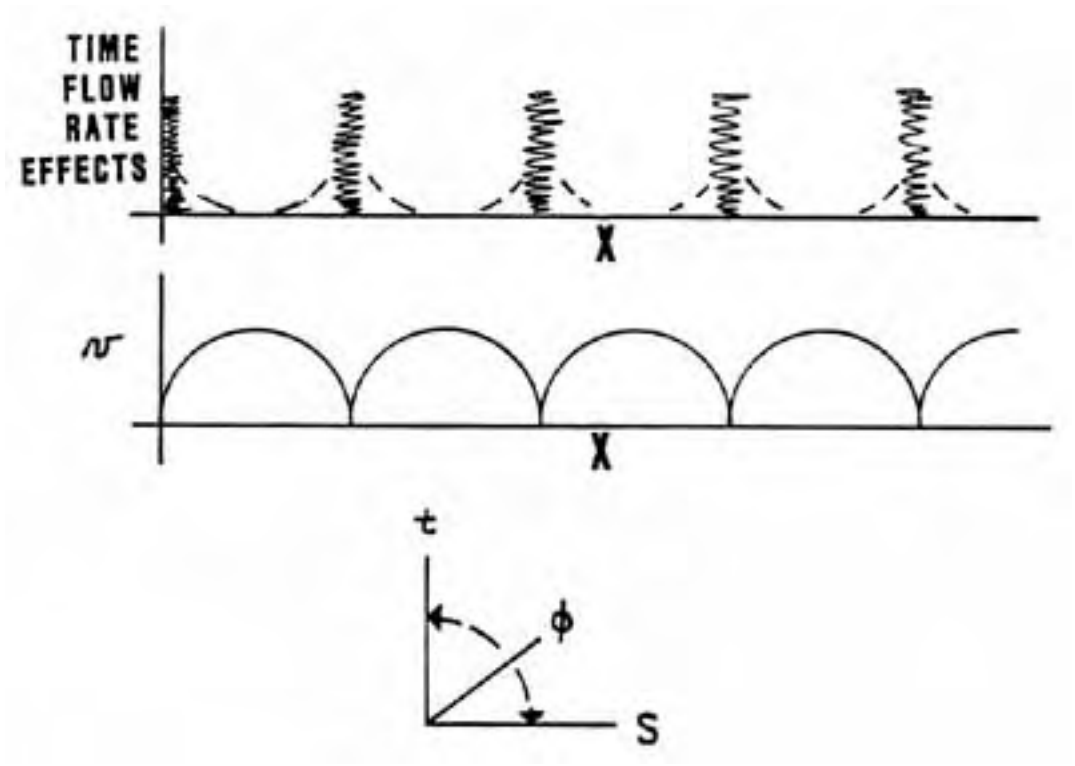

Figure 1. Tesla's Standing Columnar Wave

But let us now look for some subtle but real examples of scalar waves and scalar pair-coupling in nature. As is well known, a tectonic fault zone can provide anomalous lights, sounds, etc. from stresses, piezoelectrical activity, and telluric currents in the earth and through the fault zone. In examining the fault zone phenomena, I finally realized that a fault zone was literally a scalar interferometer i.e., if one can have scalar ϕ_4-waves, they can interfere, either constructively or destructively. Their interference, however, produces scalar pair-coupling into vector EM waves. This coupling may be at a distance from the interferometer itself, and thus the interferometer can produce energy directly at a distance, without vector transmission through the intervening space. Coupling of ϕ waves with the paired scalars comprising ordinary EM vector waves can also occur. If this triplex coupling forms additional EM vector waves 180 degrees out of phase, the ordinary EM wave is diminished or extinguished. If the scalar triplex coupling occurs so as to create vector EM waves in phase with the interacting vector EM wave, the amplitude of the ordinary vector wave is increased.

Scalar potential waves can thus augment or diminish, or create or destroy, ordinary EM waves at a distance by pair-coupling interference under appropriate conditions, and this is in consonance with the implications of Whittaker's fundamental 1903 work.

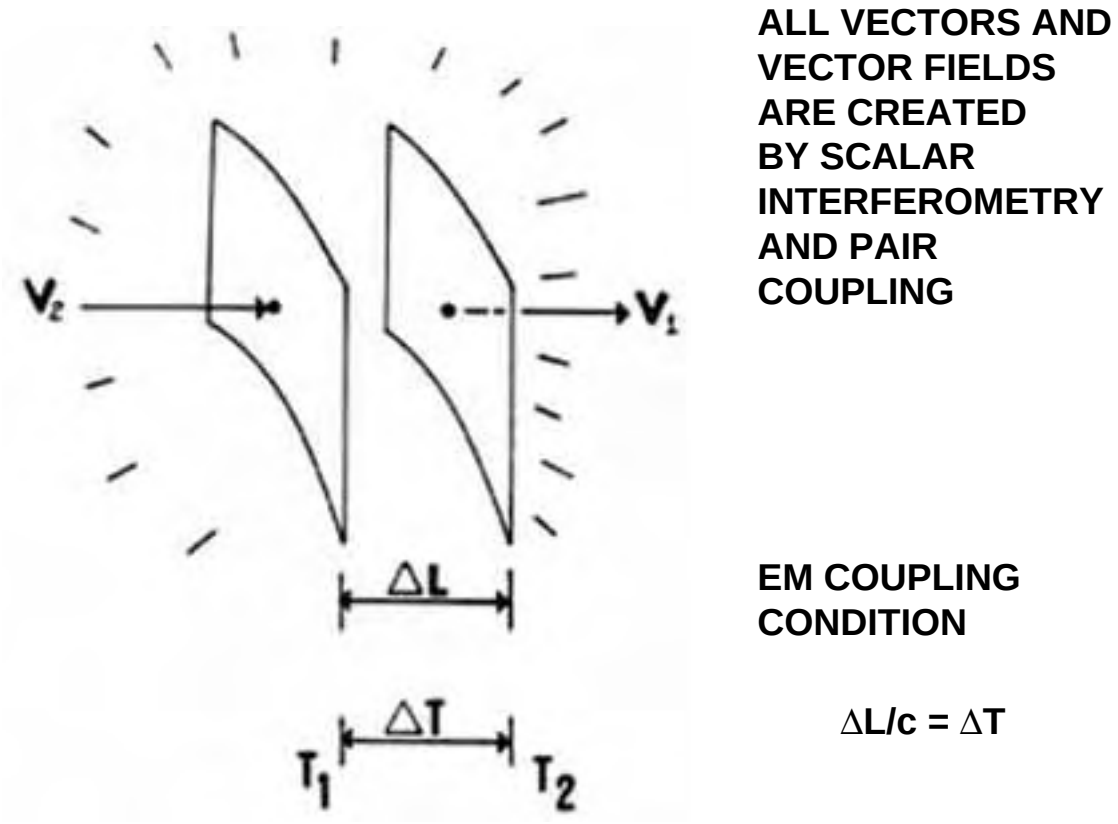

Figure 2. Pair Coupling: Producing EM at a Distance

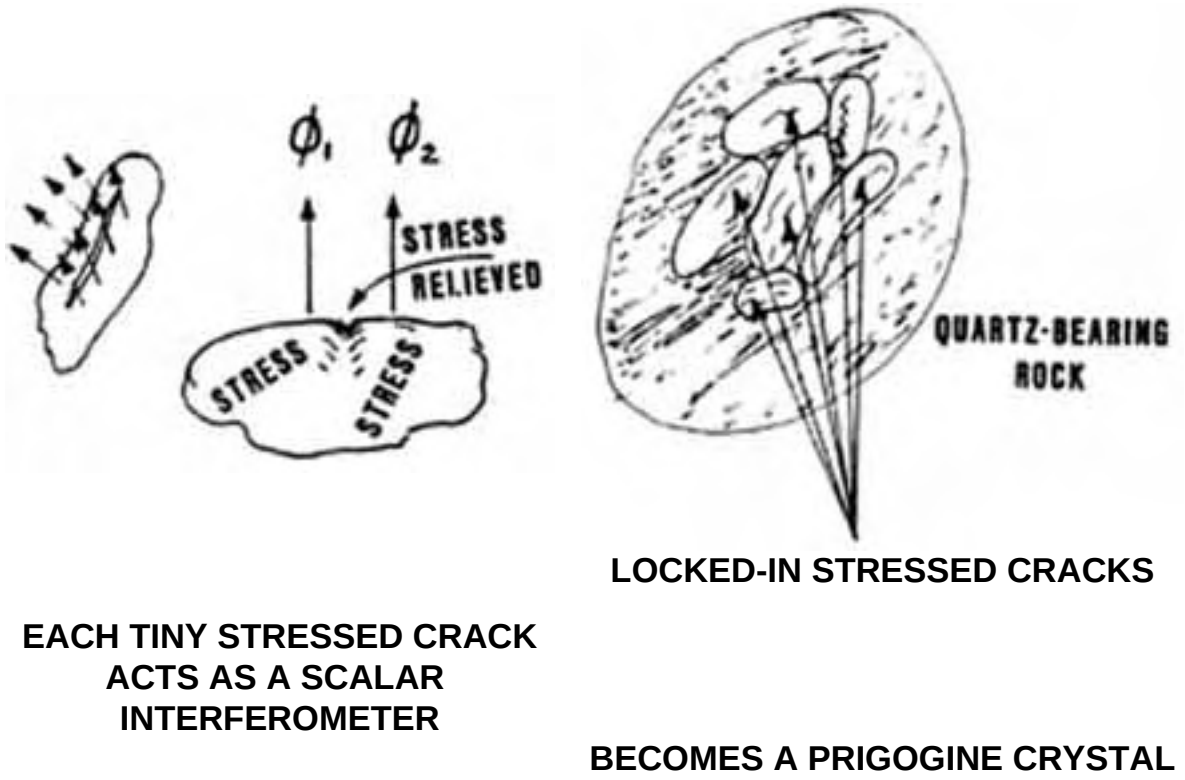

Figure 3. Natural Scalar Interferometers

An earthquake fault zone is such a scalar interferometer. Stresses and charge pileups exist in the plates on each side adjacent to the fault, with stress relief existing in the middle in the fault fracture itself. Since the rock is locally nonlinear, the mechanical stresses and electrical currents in it are also locally nonlinear. This results in the generation of multiple frequencies of ϕ_4-waves from each side of the fault interferometer, yielding two complex Fourier expansion patterns of scalar potential waves. On occasion these two Fourier-transformed scalar wave patterns couple at a distance to produce stable ordinary electromagnetic field in a 3-dimensional spatial pattern -- e.g., a stress light such as the Vestigia light covered in Part I of The Excalibur Briefing. Driven by the erratic two scalar Fourier expansion patterns of the scalar interferometer (whose input stresses normally slowly change), an erratic, darting, hovering "spooklight" of the variety studied by Vestigia is produced.

As the stresses change in each side of the interferometer, the distant scalar coupling zone is affected. Thus the stresslight moves and its form changes, but it may be relatively stable in form for seconds or minutes. Since the stresses in the rock may be intense, the stress light may involve an intense pair of ϕ-patterns coupling into the sphere or ball of vector EM energy. The atoms and molecules of the air in the region of the coupled stresslight ball thus become highly excited, giving off radiant energy as the excited states decay.

Since much of the piezoelectric material in the stressed rocks is quartz grains, the features of quartz are of particular interest. Each little quartz grain is itself highly stressed, and has stress cracks. It is therefore a little scalar interferometer. Further, quartz is transparent to infrared and ultraviolet; and the random orientation of all the quartz scalar interferometers may also form a Prigogine system far from thermodynamic equilibrium. If so, this system can tap into highly energetic microscopic electromagnetic fluctuations to produce large-scale, ordered, relatively stable patterns of electromagnetic energy at a distance.

In short, all of this lends support to the formation of relatively stable but somewhat erratic patterns of electromagnetic energy at a distance from the fault itself. In the atmosphere, such scalar interferometers could form in clouds or even in the air or between clouds and earth. If so, such rare but occasional "weather" scalar interferometers could account for the rare phenomenon of ball lightning. The intense energy of the ball of lightning, as compared to the lesser energy of an earthstress light, could well be due to the enormous electrical charges between clouds or between cloud and earth, available to fuel the scalar interferometer. Very probably it is this phenomenon which gave Tesla the clue to scalar wave interferometry.

Thus such phenomena as earthstress lights, ball lightning, and the Tesla system of wireless transmission of energy at a distance with negligible losses and at speeds exceeding the speed of light may be explained. They are complex, however, and involve fundamental changes to present electromagnetic theory. These changes include utilizing 4-space scalar

electrostatic potentials, scalar waves, pair coupling, ordinary 3-dimensional Fourier expansion, the Prigogine effect, and the properties of piezoelectric materials in rocks.

Since the scalar potential also stresses time, it can change the rate of flow of time itself. Thus it affects anything which exists in time -- including the mind, both of the individual and at various levels of unconsciousness. Therefore the same functions that result in earthstress lights also affect mind and thought, and are in turn affected by mind and thought. This is the missing ingredient in Persinger's theory that UFO's are correlated with, and a result of, fault zones and earth stresses. While Persinger seems to feel this is a "normal physics" explanation, it indeed involves a paranormal explanation.

The time-stressing ability of the true ϕ scalar wave also explains the interaction of such earthstress lights with humans and human intent, as noted by other researchers. (E.g., the lights that repeatedly seemed to react to the observers, as detailed by Dr. Harley Rutledge in his epoch-making Project Identification, Prentice-Hall, 1981.)

These ideas in condensed form comprise the concepts required to violate the speed of light and produce an ordinary electromagnetic field at a distance, using scalar interferometry, without losses -- as Tesla had done in his wireless transmission system which he had tested prior to 1900 and had perfected by the 1930's. Scalar interferometry can give stable regions of EM or "light energy" at a distance without losses, particularly as detailed in the beautiful Vestigia experiments, and it is within our grasp to utilize the new effects. Indeed, any stress crack in a material can result in the scalar potential interferometer effect. Exophoton and exoelectron emission -- poorly understood but already known in fatiguing of materials -- must be at least partly due to the scalar interferometer effect.

However, one additional caution should be advanced. Normal movement of electrons allows so much "sideplay" movement of the electrons -- and there is so much such sideplay electron motion in the surrounding vicinity -- that pair coupling is almost instantaneous for small waves. Thus orbital electrons in atoms seem to absorb and emit vector EM photons. Actually they also emit some percentage of scalar waves as well. Since a scalar wave is comprised exclusively of disturbance in the virtual state, it need not obey the conservation of energy law. Further, a scalar wave of itself does not "push electrons" or other charges; hence it is nearly indetectable by present detectors. Ionization detectors such as a Geiger counter tube, e.g., are exceptions if the scalar wave encountered is fairly strong. In that case sufficient triplex coupling with the ionized gas occurs to produce additional ionization or charge, breaching the tube's cutoff threshold and producing a cascade discharge of electrons and voltage which is detected. But weak scalar waves are presently indetectable by ordinary instruments. However, these small scalar waves are detectable by sensitive interferometry techniques e.g., such as an electron interferometer. Since the use of such instruments is quite rare, then indeed we have been living immersed in a sea of scalar waves without knowing it.

Finally, the percentage of scalar waves produced by changes in charged

mass pileups can be increased by utilizing charged mass streaming. Essentially the charged masses must be moved suddenly, as quickly as possible, at or near the complete breakdown of the medium. For this reason, Tesla utilized sparkgaps in his early transmission systems, but also found that he could induce ionized media to "breakdown" in such fashion by a slow growth process. One of his early patented atmospheric wireless transmission systems is based on this fact. However, it was necessary to use a very high voltage, insuring extreme stress on the medium and hence some spillover stress onto time itself. In other words, ϕ_3 is always an approximation; at sufficiently high spatial stress, sufficient spillover ϕ_4 exists to give Tesla scalar waves. For this reason, Tesla used very high voltages and extremely sharp discharges to give "streaming" of the charged masses and thus high percentages of ϕ_4 waves. This suggests that the breakdown of dielectrics is a much richer phenomenon than is presently allowed for in the conventional theory.

To summarize, electrostatic potential -- ϕ-field is stress on the spacetime medium at a four-dimensional point. I. e. , it is a sort of pressure on the medium, but pressure on all four dimensions, not just on the three spatial dimensions. Thus in the new standard theory, ϕ_4 may have complex values. In addition, a ϕ-wave is to be interpreted as a scalar longitudinal wave in complex spacetime -- directly in ϕ_0, the normal average 4-space stress itself. And charge and charged mass must be recognized as two separate concepts. This is the gist of what I finally recognized about Nikola Tesla's work and fundamental discovery.

This is exciting, for it means that Tesla stress waves can affect either space or time individually, or both space and time simultaneously, or even oscillate back and forth between primarily affecting time and primarily affecting space, Tesla's waves were actually these ϕ-field scalar waves. As such, they were fundamentally different from ordinary electromagnetic waves, and had entirely different characteristics, just as Tesla often stated. E. g., a Tesla wave can either move spatially, with time flowing linearly; move temporally only (sitting at a point and waxing and waning in magnitude -- but changing the rate of flow of time itself in doing so, and affecting gravitational field, fundamental constants of nature, etc,), or move in a combination of the two modes. In the latter case, the Tesla wave moves in space with a very strange motion -- it oscillates between (1) spatially standing still and flexing time, and (2) moving smoothly in space while time flows smoothly and evenly. I.e., It stands at one point (or at one columnar region), flexing for a moment; then slowly picks up spatial velocity until it is moving smoothly through space; then slows down again to a "standing column," etc. This is Tesla's fabulous "standing columnar wave."

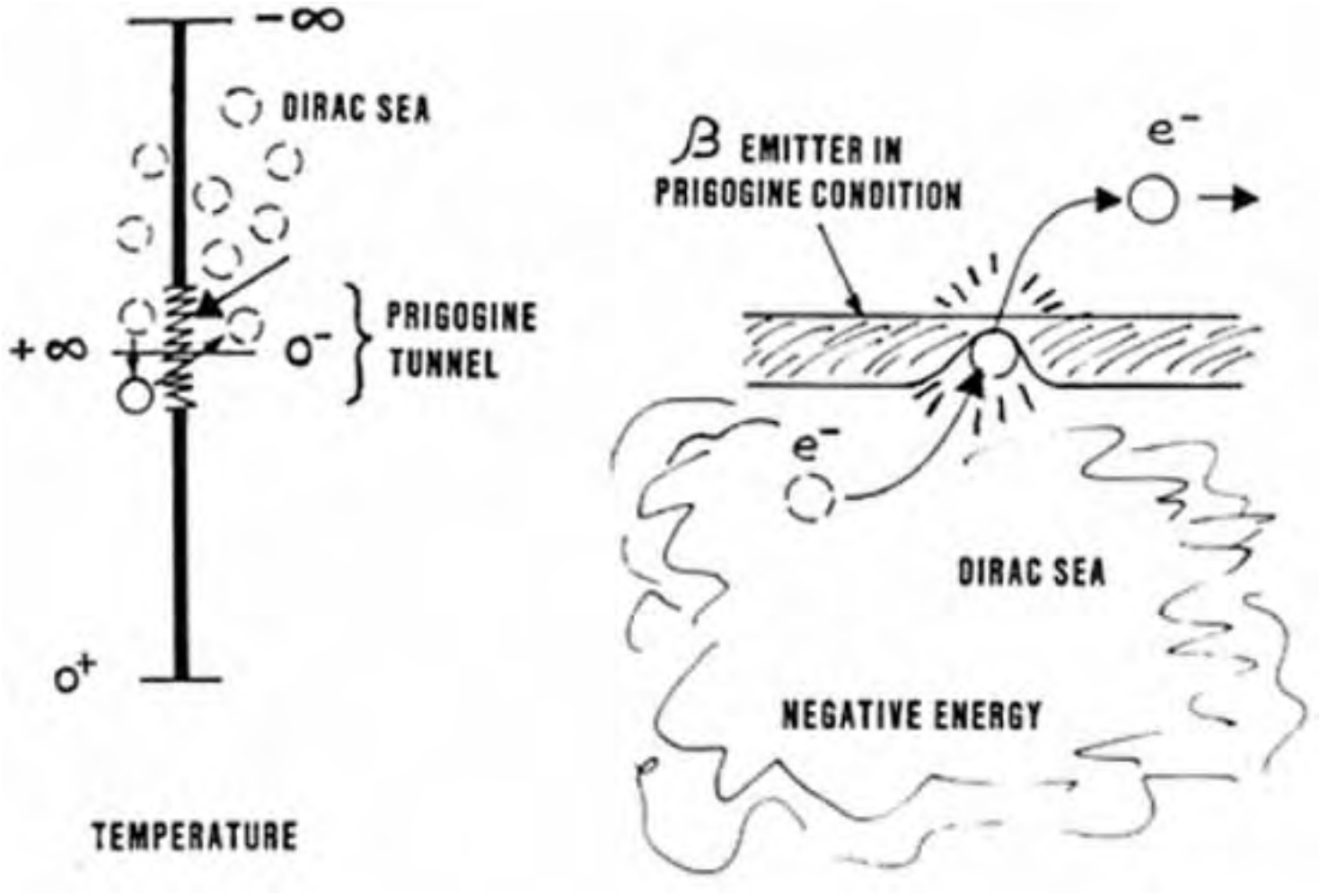

Figure 4. Exoelectric Emission

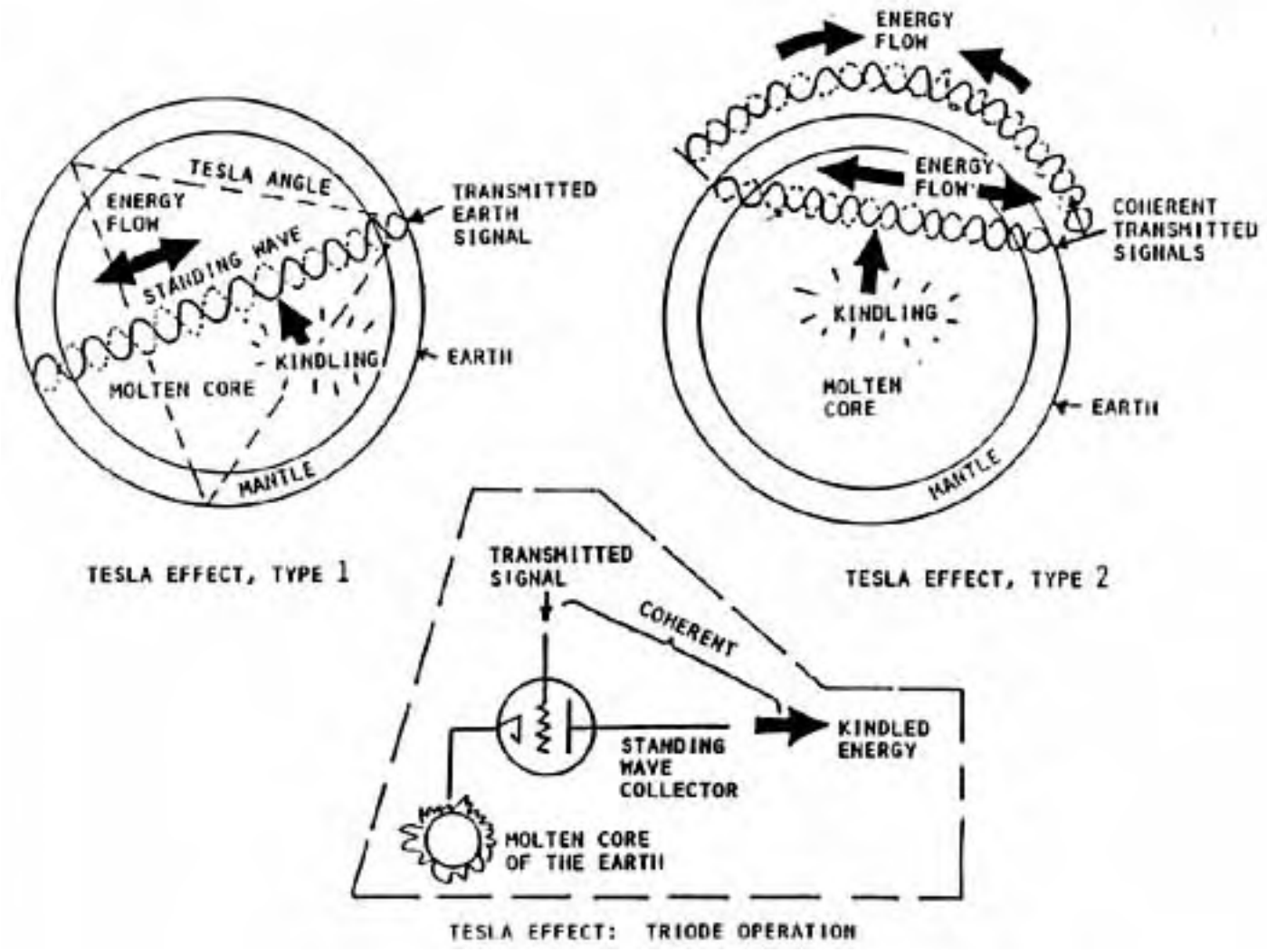

Figure 5. The Tesla Effect

Another wild characteristic of the Tesla wave is that it can affect the rate of flow of time itself; hence it can affect or change every other field including the gravitational field -- that exists in time flow. It can also affect all universal constants, the mass of an object, the inertia of a body, and the mind and thoughts as well! All of these exist in the flow of time, and they are affected if the time stream in which they exist is affected. This was the awful secret that Tesla partially discovered by 1900, and which he came more and more to fully realize as he pursued its nature and its ramifications into the 1920's and 1930's.

Tesla also found he could set up standing ϕ-field waves through the earth. He in fact intended to do so, for he had also discovered that all charges in the highly stressed earth regions in which such a standing wave existed produced ϕ-fields which would feed (kindle) energy into the standing ϕ-field wave by pair coupling. I.e., normal vector field energy would "assemble" onto the scalar matrix wave by means of pair-coupling. Thus by transmitting a scalar standing wave into the earth, he could easily tap the fiery scalar fields produced in the

molten core of the planet itself, turning them into ordinary electromagnetic energy. In such case, a single generator would enable anyone to put up a simple antenna and extract all the free energy desired.

When Tesla's alarmed financial backers discovered this was his real intent, they considered him a dangerous madman and found it necessary to ruthlessly stop him at all costs. And so his financial support was withdrawn, he was harassed in his more subtle patent efforts (and the patents themselves were adulterated), and his name gradually was removed from all the electrical textbooks. By 1914 Tesla, who had been the greatest inventor and scientist in the world, had become essentially a nonperson.

A few other persons in the early 1900's also were aware that potential and voltage are different. And some of them even learned to utilize Tesla's ϕ-field, even though they only vaguely understood they were utilizing a fundamentally different kind of electromagnetic wave. For example, James Harris Rogers patented an undersea and underground communications system which Tesla later confirmed utilized Tesla waves. The U.S. secretly used the Rogers communications system in World War I to communicate with U.S. submarines underwater, and to communicate through the earth to the American Expeditionary Force Headquarters in Europe. The Rogers system was declassified after the War and very shortly after that, it had mysteriously been scrubbed off the face of the earth. Again, potential stress waves -- Tesla waves -- were eliminated and "buried."

Probably the most brilliant inventor and researcher into Tesla's electromagnetics was T. Henry Moray of Salt Lake City, Utah. Dr. Moray actually succeeded in tapping the limitless zero-point energy of vacuum (spacetime) itself. By 1939, Dr. Moray's amplifier contained 29 stages and its output stage produced 50 kilowatts of power from vacuum. Interestingly, another 50 kilowatts could be tapped off any other stage in the device -- which consequently could have produced almost 1.5 megawatts of electrical power! Dr. Moray's epoch-making work was suppressed also. His device -- which represented over 20 years of heartbreaking accumulation of 29 working tubes from thousands made -- was destroyed by a Soviet agent in 1939, but not before the agent had obtained the drawings for building the tubes and the device itself. Today the Moray amplifier is a standard component of many of the Soviet secret superweapons and Tesla weapons.

In the 20's and 30's, Tesla announced the final perfection of his wireless transmission of energy without losses even to interplanetary distances. In several articles (e.g., H. Winfield Secor, "Tesla Maps Our Electrical Future, " Science and Invention, Vol. XVII, No.12, pp. 1077, 1124-1126), Tesla even revealed he used longitudinal stress waves in his wireless power transmission. Quoting from the article, "Tesla upholds the startling theory formulated by him long ago, that

the radio transmitters as now used, do not emit Hertz waves, as commonly believed, but waves of sound." "He says that a Hertz wave would only be possible in a solid ether, but he has demonstrated already in 1897 that the ether is a gas, which can only transmit waves of sound; that is such as are propagated by alternate compressions and rarefactions of the medium in which transverse waves are absolutely impossible." The wily Tesla did not reveal, of course, that such scalar waves nearly always immediately pair-coupled into vector waves when produced by normal means. Tesla himself was working with longitudinal scalar waves.

Table 4. Rogers' Undersea and Underground Communication System

- **SECRETLY USED BY U.S. IN WWI**
- **COMMUNICATED TO SUBS UNDERWATER**
  - **- ANY DEPTH, UP TO 30 KHZ**
  - **- REDUCED DEPTH, >30 KHZ**
- **COMMUNICATED TO EXPEDITIONARY HQ OVERSEAS**
  - **- 5,000 TIMES STRONGER THAN AERIAL**
  - **- STATIC-FREE**
- **DECLASSIFIED IN 1919**
  - **- TO REVOLUTIONIZE COMMUNICATIONS**
  - **- TO END ALL SURFACE ANTENNAS**
- **MYSTERIOUSLY "LOST"**
- **REDISCOVERED AND "LOST" THREE TIMES AFTER WWII**

continued

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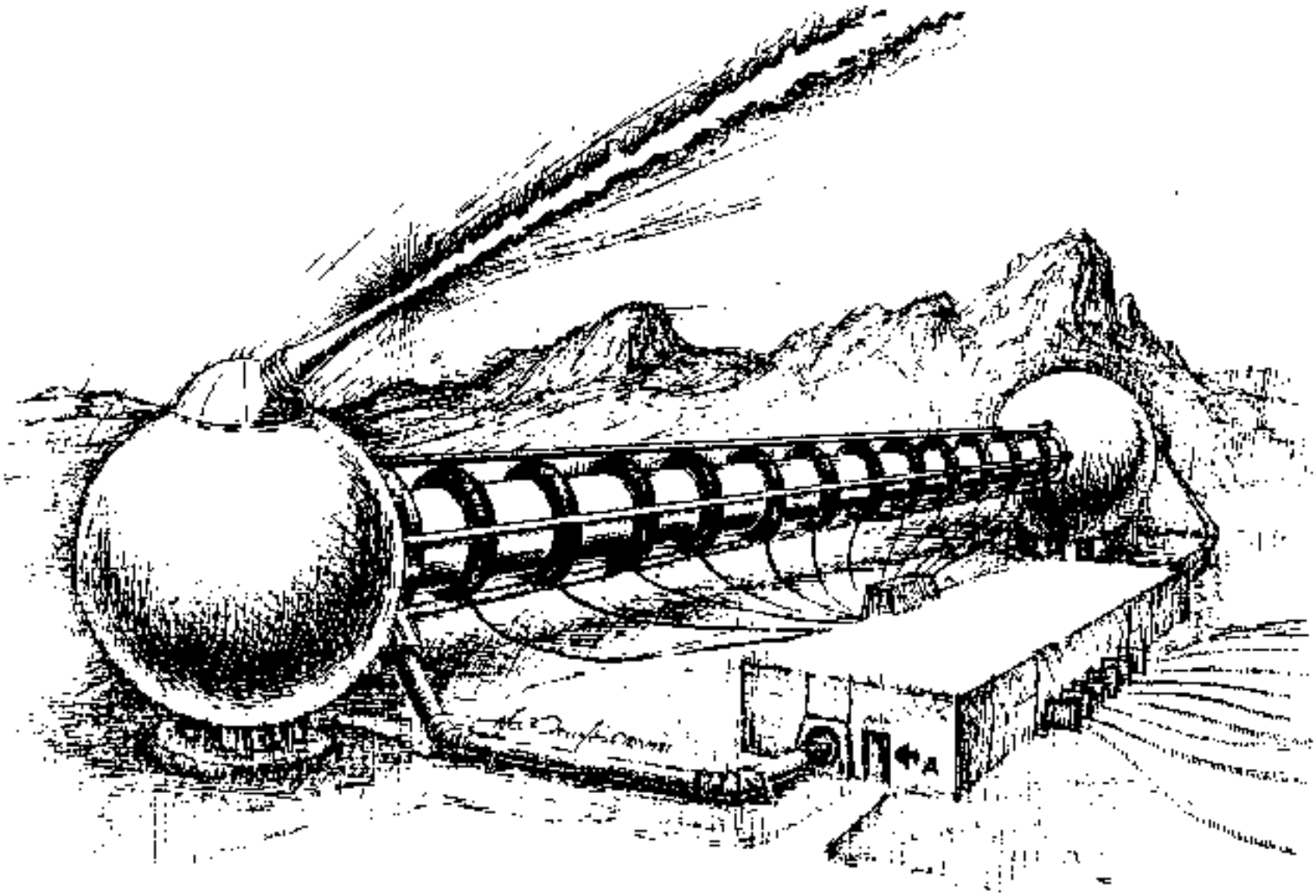

Scalar Potential Interferometer

Figure 6. Multimode Tesla Weapon

In the 1930's Tesla announced other bizarre and terrible weapons: a death ray, a weapon to destroy hundreds or even thousands of aircraft at hundreds of miles range, and his ultimate weapon to end all war -- the Tesla shield, which nothing could penetrate. However, by this time no one any longer paid any real attention to the forgotten great genius. Tesla died in 1943 without ever revealing the secret of these great weapons and inventions.

Unfortunately, today in 1981 the Soviet Union has long since discovered and weaponized the Tesla scalar wave effects. Here we only have time to detail the most powerful of these frightening Tesla weapons -- which Brezhnev undoubtedly was referring to in 1975 when the Soviet side at the SALT talks suddenly suggested limiting the development of new weapons "more frightening than the mind of man had imagined." One of these weapons is the Tesla howitzer recently completed at the Saryshagan missile range and presently considered to be either a high-energy laser or a particle beam weapon, (See Aviation Week & Space Technology, July 28, 1980, p. 48 for an artist's conception.)

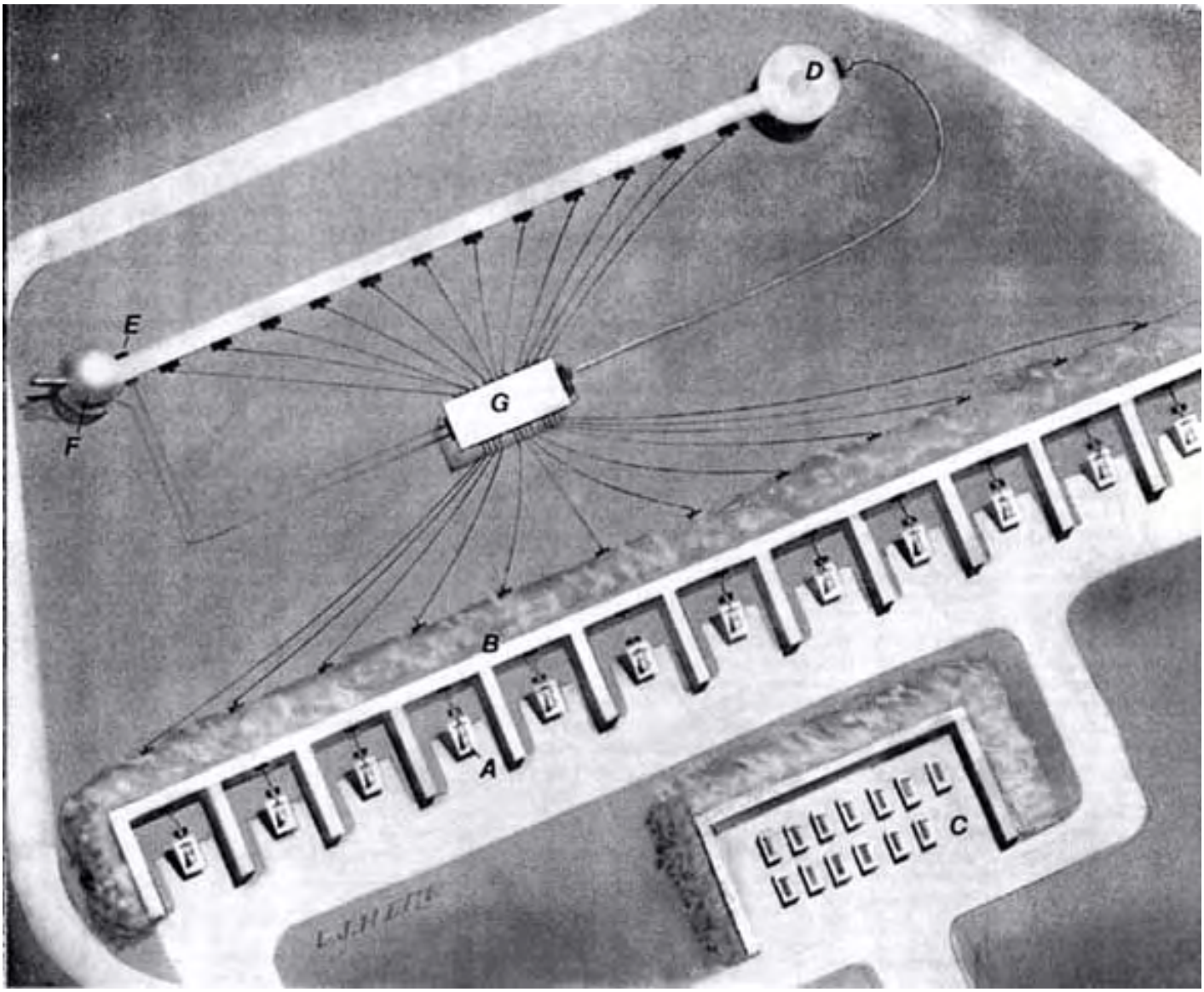

Aviation Week & Space Technology July 28, 1980

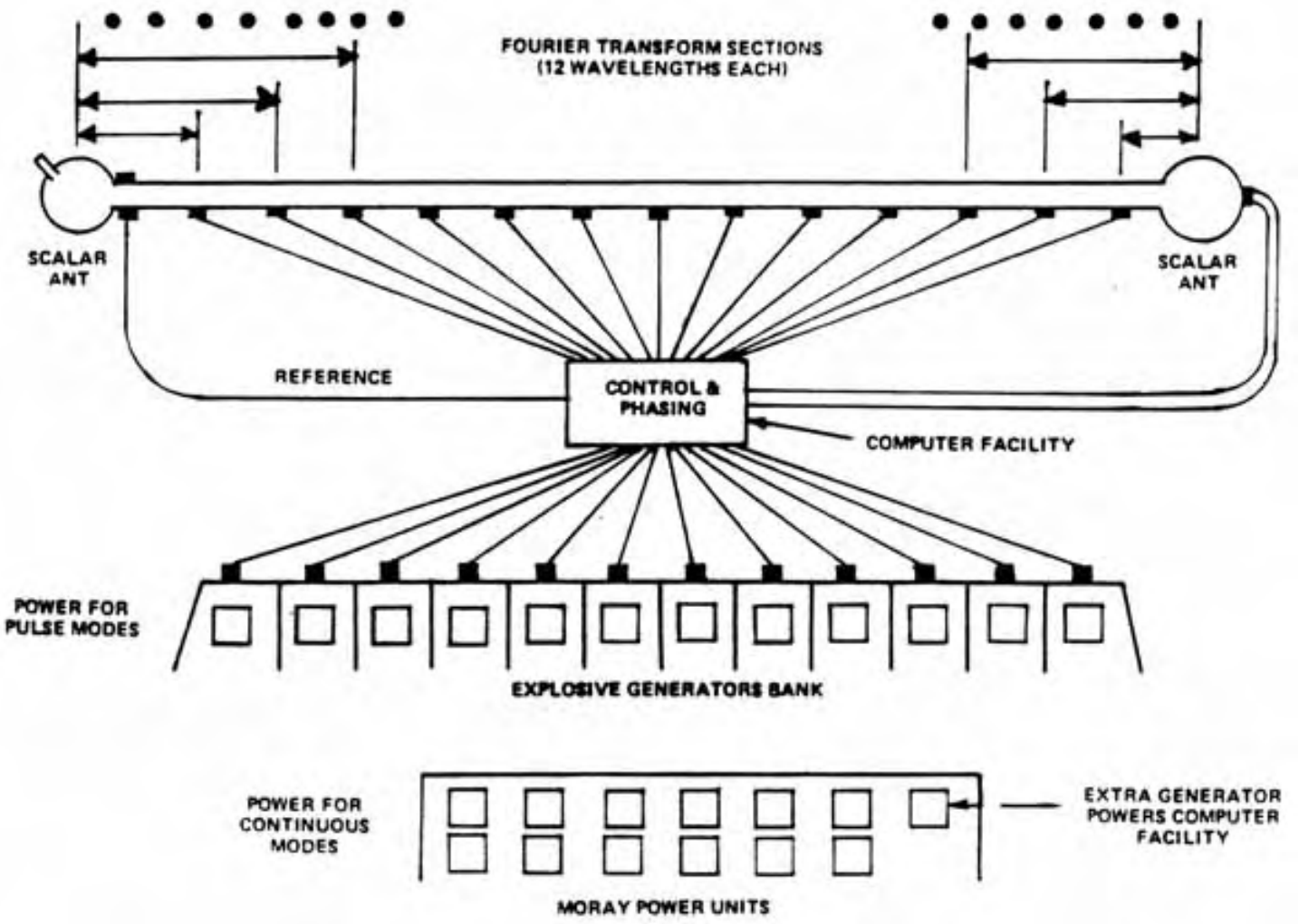

Figure 7. Tesla Weapons at Saryshagan

The Saryshagan howitzer actually is a huge Tesla scalar interferometer with four modes of operation. One continuous mode is the Tesla shield, which places a thin, impenetrable hemispherical shell of energy over a large defended area. The 3-dimensional shell is created by interfering two Fourier-expansion, 3-dimensional scalar hemispherical patterns in space so they pair-couple into a dome-like shell of intense, ordinary electromagnetic energy. The air molecules and atoms in the shell are totally ionized and thus highly excited, giving off intense, glowing light. Anything physical which hits the shell receives an enormous discharge of electrical energy and is instantly vaporized -- it goes pfft! like a bug hitting one of the electrical bug killers now so much in vogue.

If several of these hemispherical shells are concentrically stacked, even the gamma radiation and EMP from a high altitude nuclear explosion above the stack cannot penetrate all the shells due to repetitive absorption and reradiation, and scattering in the layered plasmas.

In the continuous shield mode, the Tesla interferometer is fed by a bank of Moray free energy generators, so that enormous energy is available in the shield. A diagram of the Saryshagan-type Tesla

howitzer is shown in figure 7. Hal Crawford's fine drawing of the interferometer end of the Tesla howitzer is shown in figure 6. Hal's exceptional rendition of the Tesla shield produced by the howitzer is shown in figure 8.

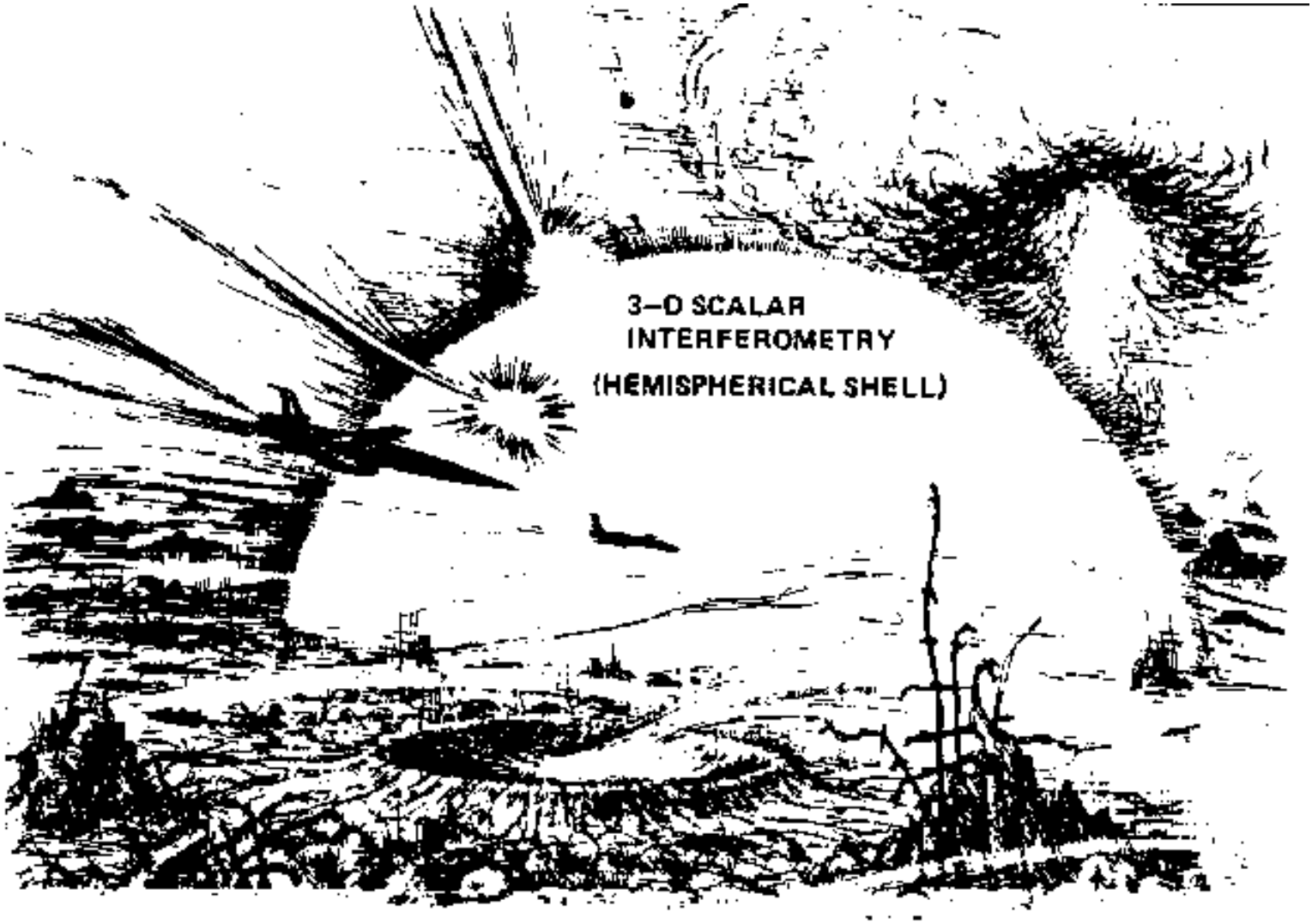

Figure 8. The Tesla Shield

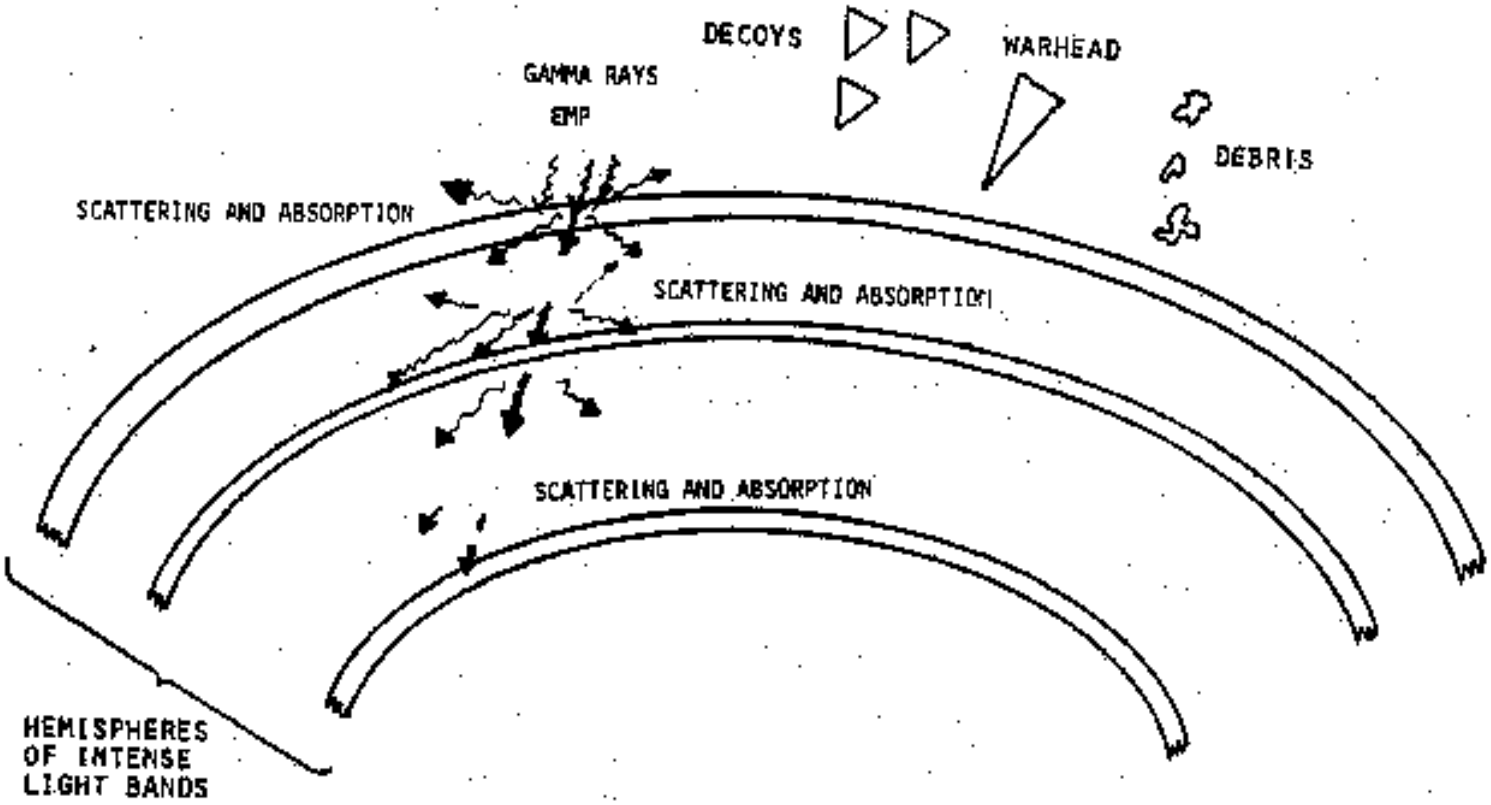

Figure 9. Tesla Terminal Area Defense System

In the pulse mode, a single intense 3-dimensional scalar phi-field pulse form is fired, using two truncated Fourier transforms, each involving several frequencies, to provide the proper 3-dimensional shape (Figure 10). This is why two scalar antennas separated by a baseline are required. After a time delay calculated for the particular target, a second and faster pulse form of the same shape is fired from the interferometer antennas. The second pulse overtakes the first, catching it over the target zone and pair-coupling with it to instantly form a violent EMP of ordinary vector (Hertzian) electromagnetic energy. There is thus no vector transmission loss between the howitzer and the burst. Further, the coupling time is extremely short, and the energy will appear sharply in an "electromagnetic pulse (EMP)" strikingly similar to the 2-pulsed EMP of a nuclear weapon.

This type weapon is what actually caused the mysterious flashes off the southwest coast of Africa, picked up in 1979 and 1980 by Vela satellites. The second flash, e.g., was in the infrared only, with no visible spectrum. Nuclear flashes do not do that, and neither does superlightning, meteorite strikes, meteors, etc. In addition, one of the scientists at the Arecibo Ionospheric Observatory observed a gravitational wave disturbance -- signature of the truncated Fourier pattern and the time-squeezing effect of the Tesla potential wave -- traveling toward the vicinity of the explosion.

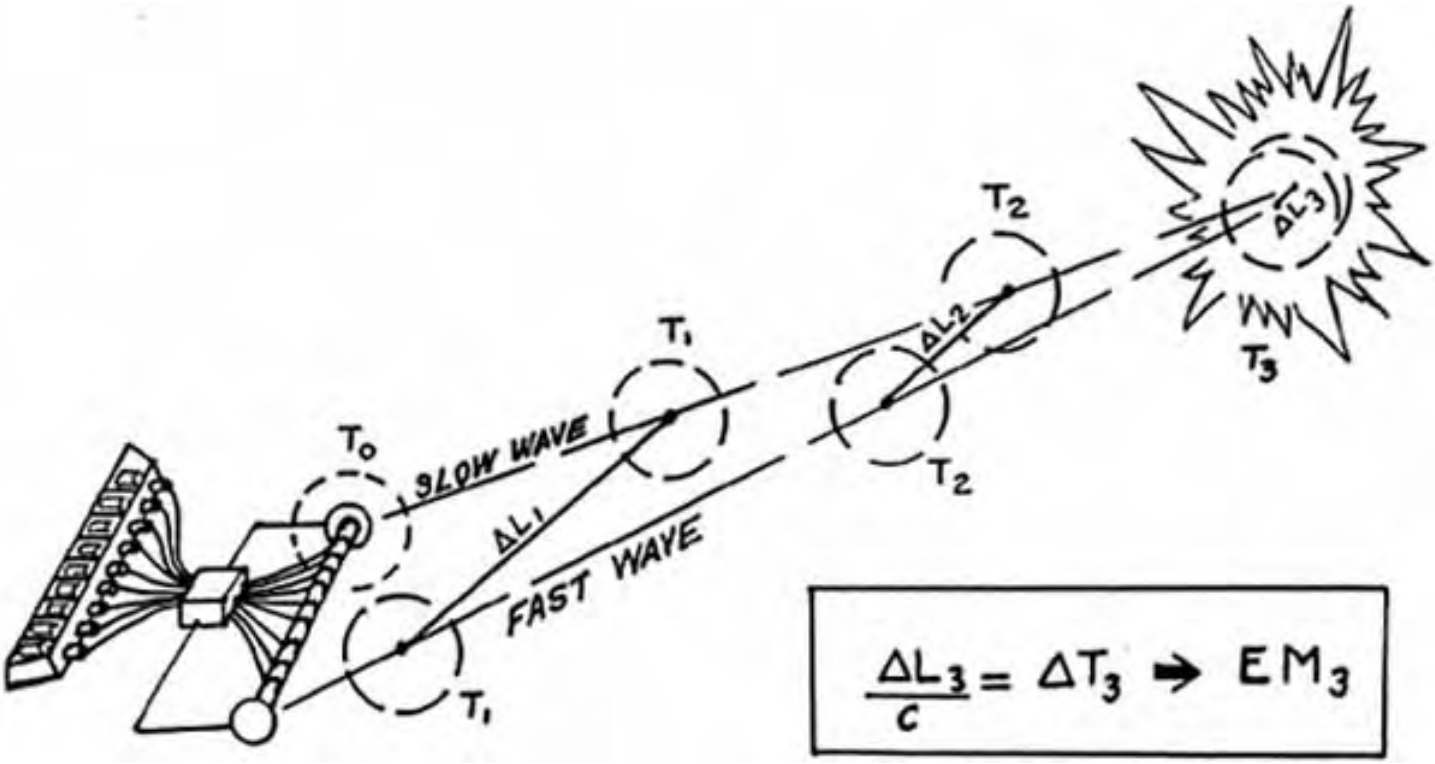

TESLA HOWITZER
(SCALAR INTERFEROMETER)

Figure 10. "Nuclear" Flashes off the Coast of Africa

Lithuania - 10 Sep 1976 - British European Airways Flight #831 between Moscow and London

CIA Report Released under FOIA

Figure 11. Continuous Tesla Fireball

The pulse mode may be fed from either Moray generators or -- if the Moray generators have suffered their anomalous "all fail" malfunction -- ordinary explosive generators. Thus the Tesla howitzer can always function in the pulse mode, but it will be limited in power if the Moray generators fail.

In the continuous mode, two continuous scalar waves are emitted -- one faster than the other -- and they pair-couple into vector energy at the region where they approach an in-phase condition. In this mode, the energy in the distant "ball" or geometric region would appear continuously and be sustained -- and this is Tesla's secret of wireless transmission of energy at a distance without any losses. It is also the secret of a "continuous fireball" weapon capable of destroying hundreds of aircraft or missiles at a distance. An example of a Soviet

test of this mode of operation is shown in figure 11.

Witness to a super weapon?

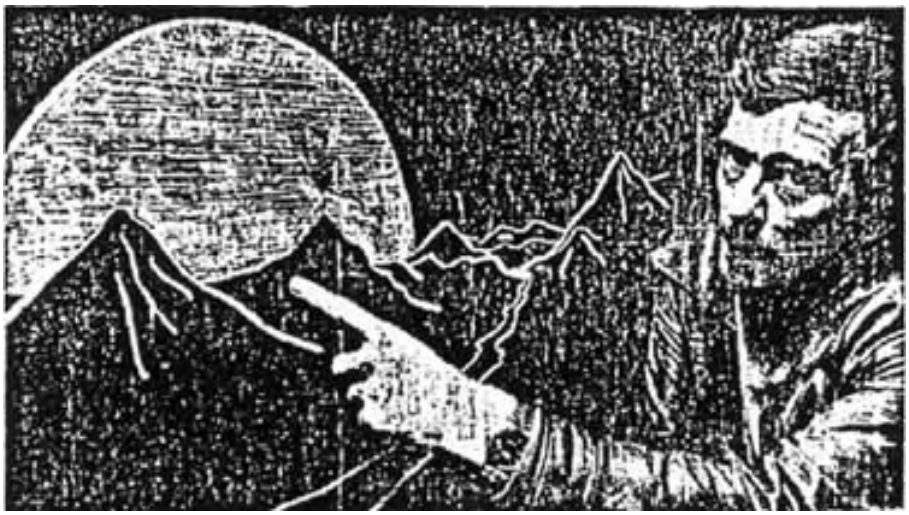

Nick Downie describes the strange lurid glow that flared silently over the Hindu Kush

THE SUNDAY TIMES, 17 AUGUST 1980

(Multiple incidents in Sept., 1979)

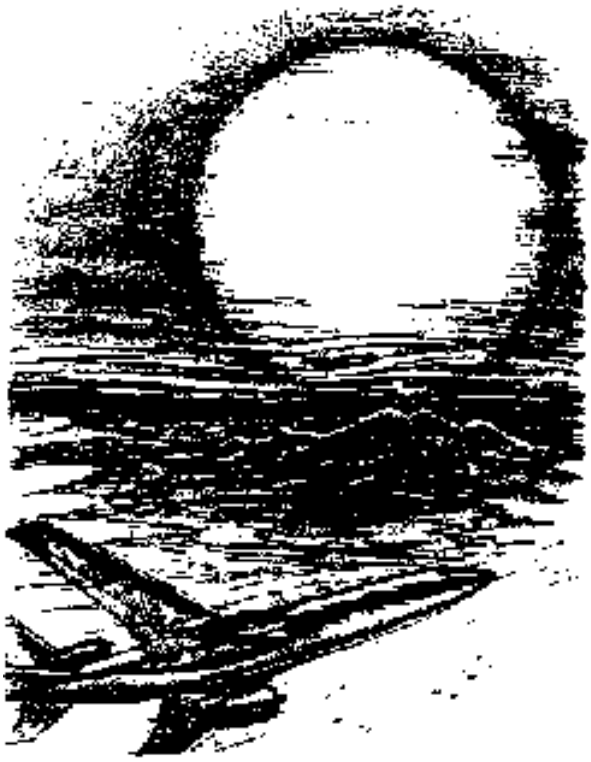

TEHERAN, IRAN 17 JUNE 1966

SEEN FROM NEAR MEHRABAD AIRPORT

OBSERVED 4-5 MINUTES

SEEN BY 2 AIRCRAFT

CIA REPORT RELEASED UNDER FOIA

Figure 12. Tesla EMP Globe

The volume of the Tesla fireball can be vastly expanded to yield a globe which will not vaporize physical vehicles but will deliver an EMP to them to dud their electronics. A test of this mode is shown in figure 12. (See also Gwynne Roberts, "Witness to a Super Weapon?", the London Sunday Times, 17 August 1980 for several other tests of this mode at Saryshagan, seen from Afghanistan by British TV cameraman and former War Correspondent Nick Downie.)

If the Moray generators fail anomalously, then a continuous mode limited in power and range could conceivably be sustained by powering the interferometer from more conventional power-sources such as advanced magnetohydrodynamic generators.

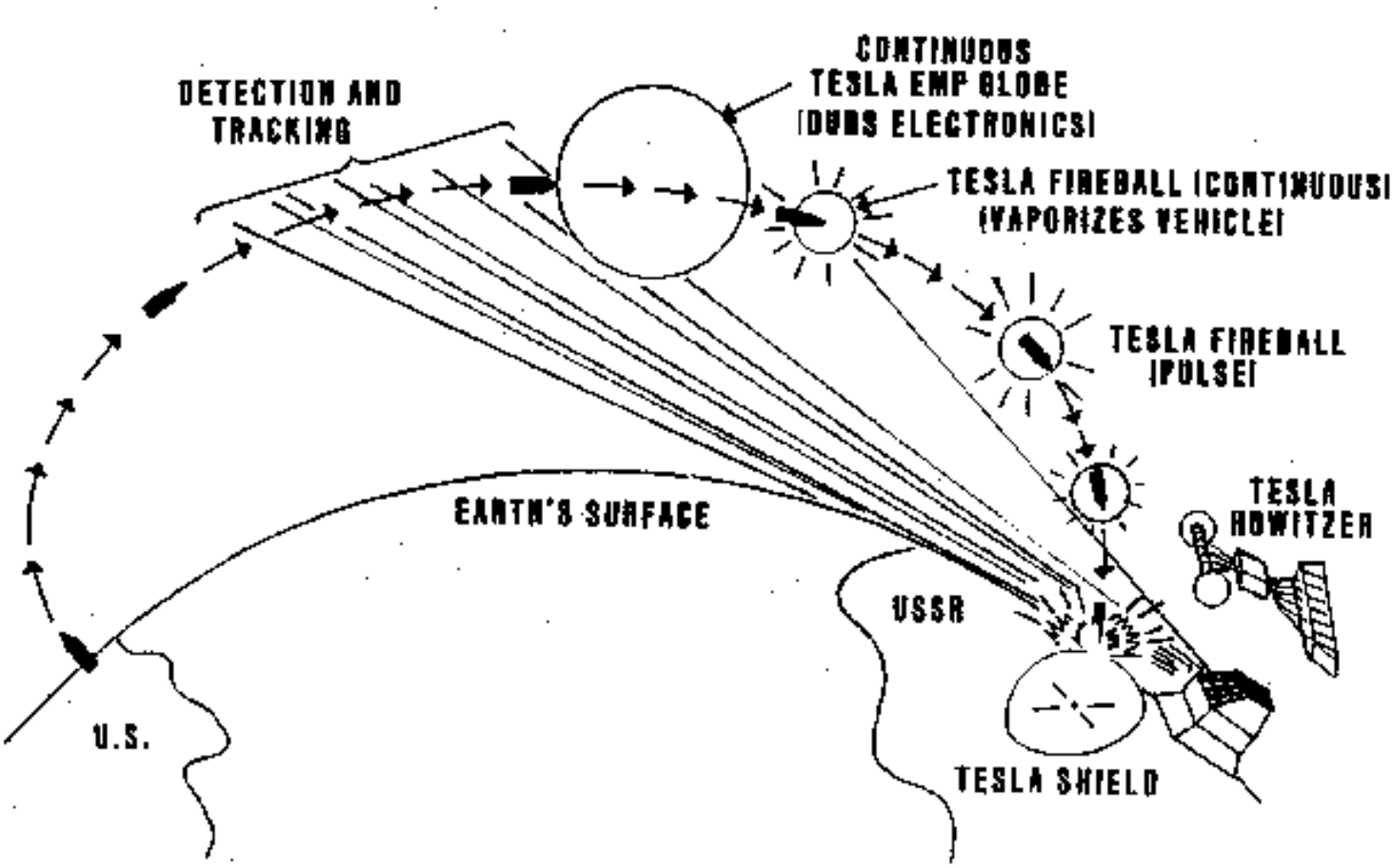

Figure 13. Tesla ABM Defenses

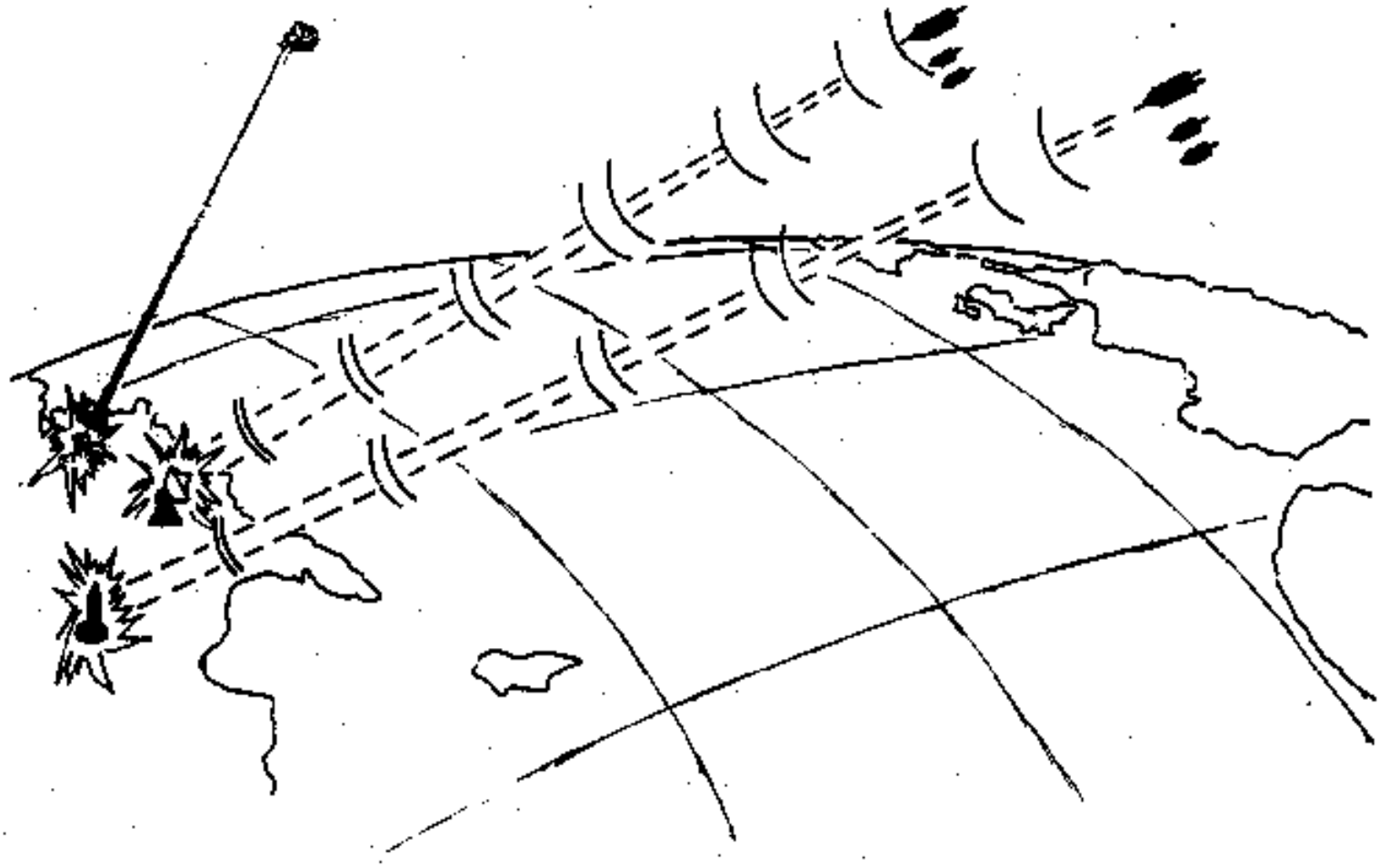

Figure 14. Moray/Tesla Technology: Star Wars Now

Typical strategic ABM uses of Tesla weapons are shown in figure 13. In addition, of course, smaller Tesla howitzer systems for anti-tactical ballistic missile defense of tactical troops and installations could be constituted of more conventional field missile systems using paired or triplet radars, of conventional external appearance, in a scalar interferometer mode.

With Moray generators as power sources and multiply deployed reentry vehicles with scalar antennas and transmitters, ICBM reentry systems now can become long range "blasters" of the target areas, from thousands of kilometers distance (figure 14). Literally, "Star Wars" is liberated by the Tesla technology. And in air attack, jammers and ECM aircraft now become "Tesla blasters." With the Tesla technology, emitters become primary fighting components of stunning power.

The potential peaceful implications of Tesla waves are also enormous. By utilizing the "time squeeze" effect, one can get antigravity, materialization and dematerialization, transmutation, and mindboggling medical benefits. One can also get subluminal and superluminal communication, see through the earth and through the ocean, etc. The new view of phi-field also provides a unified field theory, higher orders of reality, and a new super-relativity, but detailing these possibilities must wait for another book.

With two cerebral brain halves, the human being also has a Tesla scalar interferometer between his ears. And since the brain and nervous system processes

avalanche discharges, it can produce (and detect) scalar Tesla waves to at least a limited degree. Thus a human can sometimes produce anomalous spatiotemporal effects at a distance and through time. This provides an exact mechanism for psychokinesis, levitation, psychic healing, telepathy, precognition, postcognition, remote viewing, etc. It also provides a reason why an individual can detect a "stick" on a radionics or Hieronymus machine (which processes scalar waves), when ordinary detectors detect nothing. Unfortunately there is not room to develop the implications of this human Tesla interferometry in detail, for that must wait for yet another book, presently in its initial stages, that Hal Crawford and I are writing.

Table 5. Orders of Reality

- **PHOTONS ARE**
  - **> PAIR-COUPLED SCALARS**
  - **> VELOCITY-LIMITED TO C**
  - **> CARRIERS OF T**

- **PHOTON INTERACTION**
  - **> IS UBIQUITOUS**
  - **> PRODUCES $\dot{T}$ = C**
  - **> YIELDS 1st ORDER REALITY**

- **SCALAR O WAVES**
  - **> NOT VELOCITY-LIMITED**
  - **> YIELD HIGHER ORDER REALITIES**

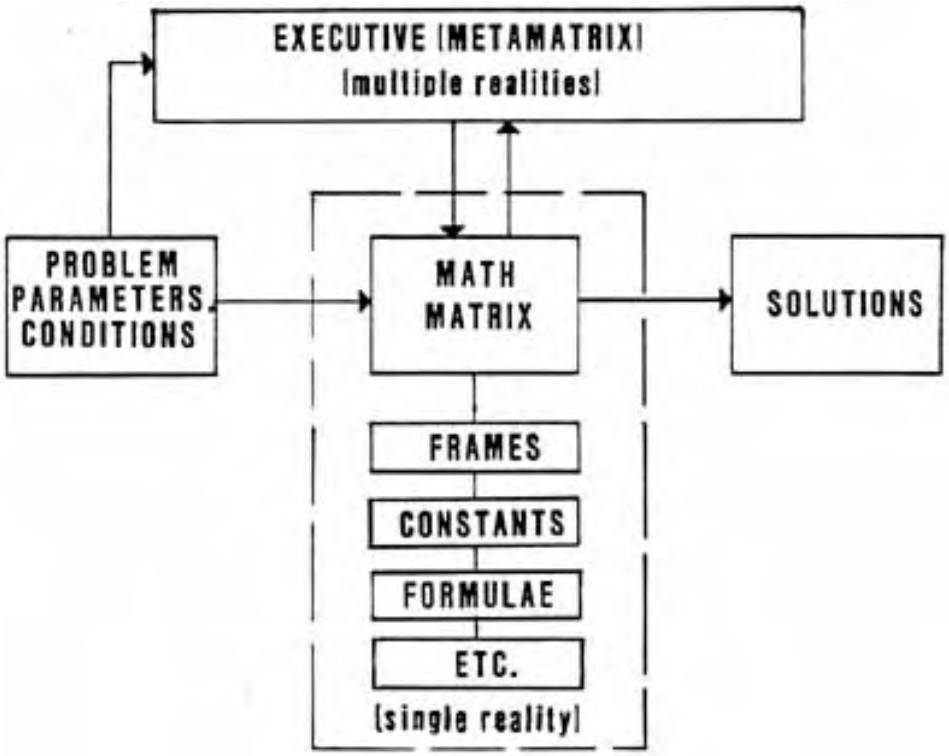

Figure 15. Implications of Tesla Potential

At the July 1981 U.S. Psychotronics Association's Annual Conference in Dayton, Ohio, I presented the first rough paper on the Tesla secret and scalar

interferometry. A videotape of the presentation was made and will shortly be available. I am also scheduled to make a special presentation at the Alternate Energy Conference in Toronto, Canada in latter October, 1981. A professional, videotaped two-hour presentation on this subject is also being prepared. Wide distribution of the material through the international underground physics and technology network has already been made. This time, God willing, Tesla's secret will not be suppressed for another 80 years!

And perhaps it is not yet too late. The material has cost me (now) some 16 years of agonizing labor and nearly $100,000 of my own personal funds. No orthodox university, scientific group, foundation, or governmental agency would support such an effort, either financially or otherwise. Indeed, most ordinary journals will not even accept material on such matters. Nonetheless, the area is of overwhelming importance and I truly believe Tesla's lost secret will shortly affect the lives of every human being on earth.

Perhaps with the free and open release of Tesla's secret, the scientific and governmental bureaucracies will be. shocked awake from their slumber, and we can develop defenses before Armageddon occurs. Perhaps there is hope after all -- for even Brezhnev, in his strange July, 1975 proposal to the SALT talks, seemed to reveal a perception that a turning point in war and weaponry may have been reached, and that human imagination is incapable of dealing with the ability to totally engineer reality itself. Having tested the weapons, the Soviets must be aware that the ill-provoked oscillation of timeflow affects the minds and thoughts -- and the very lifestreams and even the collective species unconsciousnesses -- of all lifeforms on earth. They must know that these weapons are two-edged swords, and that the backlash from their use can be far more terrible to the user than was the original effect to his victim.

If we can avoid the Apocalypse, the fantastic secret of Nikola Tesla can be employed to cure and elevate man, not kill him. Tesla's discovery can eventually remove every conceivable external human limitation. If we humans ourselves can elevate our consciousness to properly utilize the Tesla electromagnetics, then Nikola Tesla -- who gave us the electrical twentieth century in the first place -- may yet give us a fantastic new future more shining and glorious than all the great scientists and sages have imagined.

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The Tom Bearden Website

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in which intensity does not diminish with the square of the distance.)

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Persinger's "earthquake light" scheme for explaining UFO's. Mentions Dr. Brian Brady's experiments obtaining fast, short electrical lights or sparks from crushing quartz-bearing granite cylinders. (Comment: Brady's experiments are certainly repeatable, so it is true that "earthstress lights" can be produced at a distance, although the piezoelectric effect alone in no way explains the production of the phenomena outside the piezoelectric crystal. The fact that UFO's occurring near a fault zone are not necessarily repeatable simply means that at least one other major factor must be involved in the production of UFOs than is involved in the production of earthstress lights. UFOs may sometimes involve scalar interferometry from a fault zone, but other causative factors must also be involved. Earthstress lights, on the other hand, need have no additional causative factors than what lies in the earth itself.)

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TOWARD A NEW ELECTROMAGNETICS

PART III: CLARIFYING THE VECTOR CONCEPT

by

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The Tom Bearden Website

TOWARD A NEW ELECTROMAGNETICS

Part III: Clarifying the Vector Concept

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-- IMPLICATIONS --

Some of the fundamental concepts of the new Tesla electromagnetics are presented. The new concepts have startling implications:

(1) No force or force field exists as such in vacuum.

(2) Hertzian (transverse) electromagnetic waves do not travel through the vacuum, just as Tesla stated.

(3) Forceless, massless Tesla (scalar) longitudinal waves actually transit the vacuum. Tesla called them "electrical sound waves."

(4) At present there are actually four different FUNDAMENTAL TYPES of vectorial entities in physics, erroneously confused as one and the same.

(5) Tesla longitudinal scalar waves are also "time" waves and can affect anything and everything that exists in time.

(6) The fundamental constants of nature (which exist in time) can be altered by Tesla scalar waves, which oscillate the values of the constants.

(7) Every vector and scalar has an internal substructure, which can be independently affected and changed. This allows the direct engineering of the virtual state and the vacuum itself.

(8) All observable forces (electrical, mechanical, gravitational, etc.) arise in, on, and OF the actual substructure of the "accelerating mass particle" itself, not as an "external" massless force or force field applied "to" a mass .

(9) Physical reality itself -- and the "physical laws of nature"

can be deliberately changed and engineered.

(10) All "physical reality" is totally internal to the physical changes of the mass particles of the detector system of the observer.

(11) Relativity's speed of light limitation applies only to the changes of the basic mass particles of the detecting instrument.

(12) Detection of superluminal effects cannot be accomplished by a "single stage" or "single shift " (single interaction) detector .

(13) Detection of superluminal effects is permitted by "multiple stage" or "multiple shift" interactions where the last interaction is a conventional interaction of photon vs. detector particle. (The two-slit apparatus for detection of electron diffraction is an example. First, the superluminal DeBroglie waves interact with the slits, which are "tuned" toward the electron's DeBroglie wavelength. The interaction with TWO slits produces subluminal interference effects, which then interact back upon the physical electron. The apparatus is thus an electron interferometer capable of detecting superluminal waves by a two-stage interaction).

(14) Interference is the most common first-stage superluminal interaction to accomplish "downshifting" superluminal entities to luminal or subluminal velocities. Superposition of superluminal "phase" waves (such as deBroglie waves, which individually always move faster than the speed of light) interferes the waves to create a subluminal group velocity, which may then interact with an ordinary mass particle in the detection system.

(15) Any otherwise physical vector must exist as an unzipped (segmented) or "shadow" vector in vacuum. "Radiation" of a vector EM wave from the electron gas in an antenna into vacuum results in the "choking off" of the mass of the transversely oscillating electrons in the antenna. Since the spinning electron mass is the "zipper" that makes or comprises the physical vector in the first place, this throttling of the mass flow unzips the E and B vectors, leaving whirling (massless magnetic scalar potential) segments of massless charge flux (massless electrostatic scalar potential). This unzipped whirling pattern of charge flux (scalar massless A/Ø) is what radiates into vacuum and propagates through it. This is a special kind of

scalar wave pattern, not a physical or vector wave.

(16) The spin of a charged particle is the mechanism for integrating or "zipping together" the individual virtual fragments of a shadow vector into a real (observable) vector. For "uncharged particles" such as neutrons, it is the spins of its virtual charged components. that accomplish the integration or zipping.

(17) All fundamental charged particles are constantly accelerated. There is no such thing as an "unaccelerated" particle, except as a gross average over time or length. Further, all of them are spinning.

(18) All changes to and from a physical vector or scalar system must arise in and come from its own internal substructure, which is zipped to its spinning particle of mass.

(19) All fundamental particles are charged internally. That is, they are dynamic assemblages of smaller charged particles. If the average sum of the total internal charge is essentially zero over some finite, small increment of time, the particle is externally uncharged. If the sum is not essentially zero, the particle is also externally charged.

(20) There are no static physical things in existence. In physical reality, something appears "static" only at a particular level. Upon sufficiently fine examination, it is composed of accelerating parts, and thus comprised of "fluctuations."

(21) Since (a) the basic physical (mass) vector consists of a "smeared particle," where particle and smear are inseparable, (b) the conceptual particle also is accelerated, and (c) the "smearing" is for a small increment of time and a small increment of length; then the basic constituency of "physical reality" is inseparable "force x time x length," or action. The basic "quantum" of physical change is thus comprised of action.

(22) Since to "detect" we must "stop" the action, separate or split the quantum into two pieces ("canonical" pieces) , and compare (measure) one piece by throwing away the other, then each physical observable must have a differential operator (the "separating agent") corresponding to it. This accounts for the fundamental postulate of quantum mechanics whereby every observable has a corresponding operator. Further, since what remains is totally relative to what was split out and thrown away, physical change

is totally "relative." This accounts for the fact that observed reality is relative, each part to each other.

(23) As a special case, we may assume that we can evaluate a physical change at a point (without length). If so, when we discard length, the remaining basic vector is momentum. This approximation holds only so long as the system to which it is applied essentially does not change over the quantal fragment of length discarded -- i.e., it holds for the linear case. Conservation of momentum, then, is violated when sufficient nonlinearity in length is present.

(24) As a second special case, we may assume that we can evaluate a physical change in a spatial manner (without time). If so, when we discard time, the remaining basic vector is energy (has the units of energy or work). This approximation holds only so long as the system to which it is applied essentially does not change over the quantal fragment of time discarded -- i.e., it holds for the linear case. Conservation of energy, then, is violated when sufficient nonlinearity in time is present. Since a "virtual change" a priori is defined as a total nonlinearity in the observer's quantal time increment but not outside it, then virtual interactions can and do violate conservation of energy within that time increment, but not out of it -- so long as the time interval itself is considered linear. If the time interval is sufficiently nonlinear, then the virtual change may result in violation of the conservation of energy externally to the time increment. In that case, an "observable change" results .

(25) As a third special case, we may assume that we can evaluate the "instantaneous value" of a physical change at a static point in space. To do so, we must discard both time (to be instantaneous) and length (to be at a spatial point), and the remaining basic vector is force. This approximation holds only so long as the system to which it is applied essentially does not change over the quantal fragment of time or the quantal fragment of length discarded. Conservation of force, then, is violated when sufficient nonlinearity in time or length is present.

(26) A new conservation of energy law is required, one which unites the present conservation of energy law with an altered form of the conservation of charge law. Briefly, the total equivalent of mass,

observable energy, and massless charge (anenergy) is conserved.

(27) All AL and At fragments are produced and destroyed one at a time, in the action fissioning of a single quantum of action (detection process). Each ∇L and ∇t is discretized but not quantized. Since quanta do not superpose, the "external universe" is continually created and destroyed in the detector's mass system, one quantum at a time, at a very high rate. This interpretation gives physical meaning to the creation and annihilation operators of quantum mechanics.

(28) Since the detecting mass system is itself continually created and destroyed one quantum at a time, ultimately all is mind changes, and only mind changes. The observer's life, mind, and being transcend all materialistic interpretations of reality -- as indeed does the very fact of the "existence" of a perceived external universe.

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TOWARD A NEW ELECTROMAGNETICS
PART III: CLARIFYING THE VECTOR CONCEPT

-- Electrical Physics Presently Has a Mindset --

In examining the foundations of geometry, mechanics, and electromagnetics, it becomes strikingly clear that substantial -- even grave theoretical errors were made early on and perpetuated into the existing theory. These errors are now so firmly entrenched that they form a part of the "mindset" of almost all physicists, engineers, and scientists.

So ingrained are these errors and inconsistencies that the orthodox scientist/theoretician finds it almost impossible to break out of them.

The present mindset is analogous to the Newtonian mindset which so fiercely resisted the new ideas of relativity, shortly after the turn of the century. However, after a few scientists formulated the rules and theory of the "relativity mathematics game," a new generation of students, not yet so firmly engrained in the Newtonian mindset, could grasp the new relativity when their teachers expounded it.

In this short series of papers[1,2] I will roughly outline where the founders of mechanics and electromagnetics went wrong, and indicate the way to correct the fundamental errors. In addition, I will briefly point out some of the implications, and speak of some direct experimental proof.

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PART III: CLARIFYING THE VECTOR CONCEPT

NOTES AND REFERENCES

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4. Specifically, the resulting theory becomes a curtailed, special case of the much more fundamental electrodynamics and electromagnetics that actually exist
.

5. We point out here that measuring a field of force existing in the electron gas in a probe of the measuring instrument is not at all the same thing as measuring a force in the vacuum, nor does it establish that a force exists in vacuum. Indeed, it is already well known that the FIELD concept itself will not withstand rigorous logical examination. For a discussion rather clearly showing the present difficulty in defining a field, see Robert Bruce Lindsay and Henry Margenau, Foundations of Physics, Dover Publications, New York, 1963, pp. 283-287. Note particularly on p. 283 that a "field of force" at any point is actually DEFINED only for the case when a unit mass is present at that point. It is then illogically ASSUMED that the force

continues to exist at the point in the ABSENCE of the mass, which of course need not follow at all. On p. 284, note the similar logical paradox connected with the idea of a scalar gravitational potential field. The potential (field) is only defined at a point when mass is present at that point, .and it is specifically defined as the potential energy per unit mass for a particle present at that point. IF THERE IS NO MASS PRESENT, NEITHER A FORCE VECTOR FIELD NOR A SCALAR POTENTIAL FIELD IS DEFINED THERE. ASSIGNMENT OF THESE FIELDS TO THE POINT IN THE ABSENCE OF THE MASS IS AN ASSUMPTION, NOT AT ALL A DEFINITION. SINCE A TRUE DEFINITION IS AN IDENTITY, THEN THE ENTITY IDENTIFIED (DEFINED) TO INCLUDE THE PRESENCE OF MASS IS NOT IDENTICAL TO THE ENTITY RESULTING WHEN THAT MASS IS ABSENTED.

To see just how arbitrary and postulational are present. "definitions" of mass and force, see Lindsay and Margenau, op. cit., pp. 84-101. Also see Richard P. Feynman, Robert B. Leighton, and Matthew Sands, The Feynman Lectures on Physics, Addison-Wesley, New York, Vol.1,. 1963, Fourth Printing July 1966, p.2-4 for a definition of the electric field in the context of its POTENTIALITY for producing a force. Again, the force only exists when a particle of mass is present. From these examples, one can see the implication that A PHYSICAL FIELD IS SOMETHING SUCH THAT, WHEN A MASS IS INTRODUCED INTO IT, THE MASS EXHIBITS AN EFFECT. For a "force field," this is tantamount to stating that there exists some mechanism connected with a field which, in the presence of a mass causes a force to be exhibited. In that case the force is an EFFECT, not a cause, and there is a more fundamental mechanism that GENERATES FORCE ITSELF. See also field discussions in Feynman, Richard, The Character of Physical Law, M.I.T. Press, Cambridge, MA, March 1967, 2nd printing September 1967, passim.

6. While in Europe prior to 1881, Albert Abraham Michelson performed his first interferometer experiments to determine the velocity of the earth through the ether, obtaining essentially null results. At the Case School of Applied Science in Cleveland,

Ohio, he perfected his interferometer experiment from 1883 to 1887, assisted by a colleague, chemist Edward Williams Morley. By 1887 the results were ready and announced. Michelson himself thought his experiment had proven Stokes' theory of an ether dragged along by the earth in motion, and thus motionless with respect to the earth. This was at odds, however, with certain other experiments indicating a moving ether. The Michelson-Morley experiment was finally reconciled with these other experiments by Fitzgerald's suggestion in 1892 that the physical dimensions of material bodies are altered when they are in motion. In 1907 Michelson was awarded the Nobel prize, the first American to receive it in the sciences.

7. See Lindsay and Margenau, Foundations of Physics, 1963, pp. 324-326; D. C. Miller, "The Ether Drift Experiment and the Determination of the Absolute Motion of the Earth," Reviews of Modern Physics, Vol. 5, p. 203, 1933. Actually the experiments did not yield a conclusively null result, but rather showed large systematic trends. For a typical elimination of the systematic trends, see Handschy, M. A., "Re-examination of the 1887 Michelson-Morley experiment," American Journal of Physics, Vol. 50, No. 11, Nov. 1982, pp. 987-990. See Rho Sigma, Ether-Technology, CSA Printing & Bindery, Lakemont Georgia, 30552, 1977 for several enlightening points on the vacuum ether: See A. K. Lapkovskii, "Relativistic Kinematic Equations and the Theory of Continuous Media," Soviet Physics Journal, Vol. 21., No. 6, June 1978 for an abstract describing Soviet utilization of the concept of a small particle (called by Bearden a quiton, in Quiton/Perceptron Physics, DTIS, 1973) of the medium. See Belyaev, B. N. , "On Random Fluctuations of the Velocity of Light in Vacuum," Azvestiya Vysshikh Uchebnykh Zavedenii, Fizika, No. 11, Nov. 1980, pp. 37-42, translation by Plenum, for discussion of the proven variation of the speed of light in vacuum; the velocity of light in a vacuum on earth is measured to be higher than the velocity of light in the vacuum of deep space. See Graham, G. M. & Lahoz, D. G., "Observation of static electromagnetic angular momentum in vacuo," Nature, Vol. 285, 15 May 1980, pp. 154-155 for the first direct observation of free electromagnetic angular

momentum in vacuum. See Davies, Paul, "Something for nothing," New Scientist, 27 May 1982, pp. 580-582 for a discussion showing that modern theories of the vacuum reveal that even empty space is seething with activity; an ether of sorts emerges from vacuum fluctuations due to quantum mechanics considerations. See Hooper, William J., "All-Electric Motional Electric Field Generator," U. S. Patent No. 3,610,971, October 5, 1971 for a generator which produces a gravitational or inertial field. Einstein suggested that vacuum, complete with electromagnetic and gravitational fields, be called the ether. Dirac certainly did not abandon an ether, for in 1954 he stated "The aetherless basis of physical theory may have reached the end of its capabilities and we see in the aether a new hope for the future." James Clerk Maxwell derived his famous equations based on an ether theory. Sir Arthur Eddington also believed firmly in an ether. Sir Oliver Lodge actually pointed out the dilemma which yields the approach in this paper: writing of the ether in his book, The Ether of Space, Harper & Bros., New York, 1909, he stated: "We have no means of getting hold of the ether mechanically; we cannot grip it or move it in the ordinary way: we can only get it electrically. We are straining the ether when we charge a body with electricity; it tries to recover, it has the power of recoil.. . . "But when electrical theory was being founded, scientists thought of space as something rather fixed, and FILLED WITH a thin material ether. They did not realize that space itself does not exist except after an observation; before the observation, spacetime exists -- indefinite in both length and time. They did not know that electrostatic scalar potential in fact was spacetime, hence also the vacuum and the ether. In assuming that the charge of vacuum is zero and that charge and charged mass are identical, they hid the answer to the dilemma and placed the foundations of electromagnetics on its present unsound basis.

8. The field, of course, is indeed a highly useful concept and this author certainly does not recommend its abandonment. Instead, he recommends that it be placed on a sounder logical basis.

9. Specifically, they came to feel that the "electric

field" which was improperly defined -- was what was waving.

10. In fact Einstein once proposed that the vacuum, complete with its electromagnetic and gravitational fields, should be called the ether. His proposal was not adopted. (See Born, Max, Einstein's Theory of Relativity, Revised Edition, Dover Publications, New York, 1965, p. 224.)

11. Particularly from the work of Schrodinger, Born, Dirac and others.

12. For example, see Lindsay and Marge. nau, op. cit., pp. 287-288. A physical vector is thought to be defined by its magnitude, its direction in space, and its transformation characteristics. Actually that is a geometrical vector, not a physical vector. It does not tell us WHAT A VECTOR CONSISTS OF, but only tells us some of its important characteristics. Remember that a true definition must be an identity.

13. Here a reading of Lindsay and Margenau, op. cit., pp. 79-81 may prove enlightening. Also note that velocity, or L/T considered "at an instant" (stopped), represents an idea of "motionless motion" and is an application of the fourth law of logic. For a discussion of the fourth law of logic and its usage, see Bearden, Thomas E., "A Conditional Criterion for Identity, Leading to a Fourth Law of Logic," Specula, Journal of the A.A.M.S., P.O. Box 1182, Huntsville, AL 35807, combined Vol. 3, No. 4/Vol. 4, No. 3, Oct 1980 - Mar 1981, pp. 50-57 (also available from Defense Technical Information Service).

14. Note this is an identity of opposites, which explicitly violates the three Aristotlean laws of logic. See Bearden, "A Conditional Criterion for Identity, Leading to a Fourth Law of Logic," loc. cit., 1981.

15. Again note the fourth law of logic: zero motion (the absence of motion) being recognized as a special case of the presence of motion. Also, physical reality consists of internested levels, and any physical object has an internal substructure of nested levels of finer structure, extending down into the virtual (nonobserved) state. For a vector to model (apply to) a

physical object, it itself must be modeled in such fashion as to reflect this kind of substructure. Thus the use of geometrical vectors as models of physical objects in motion is presently flawed in a fundamental fashion.

16. The reader is most strongly urged to read Morris Kline, Mathematics: The Loss of Certainty, Oxford University Press, New York, 1980 as a prelude to understanding what mathematics is and is not, and what it does and does not.

17. Refer to Lindsay & Margenau, op. cit., pp. 79-81 to see how the ideas of motion and vector are inextricably entangled with the idea of a particle.

18. Call it uncertainty or call it constituency; a quantum change is composed of two canonical entities inextricably welded together into a single entity.

19. Time is an unavoidable, nonexclusive constituency of the welded quantum.

20. Simply from the definition of force as CONSISTING OF a time- and length-smeared mass motion change.

21. The force is an effect, not a cause. It IS the smeared charged particle. It is CAUSED by a more fundamental mechanism. It is the result of the combination of (1) a nonzero del phi, and (2) the presence of a spinning charged particle. IN A DEL PHI, THE SPINNING CHARGED PARTICLE ACCELERATES ITSELF! This is the fundamental secret of free energy that was suppressed, to bury the fundamental work of Nikola Tesla, shortly after Tesla was forced to abort his Wardenclyffe attempt to provide the world with free energy.

22. To quote: "The Hertz wave theory of wireless transmission may be kept up for a while, but I do not hesitate to say that in a short time it will be recognized as one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history. " Nikola Tesla, "The True Wireless, " Electrical Experimenter, May 1919, p. 87.

23. De Beauregard, O. Costa, "Running backwards the Mermin device: Causality in EPR correlations," American Journal of Physics, Vol. 51, No. 6, June 1983, p. 515.

24. Note the Soviet scientist Kozyrev's experiments with time waves. See Kozyrev, N. A., "Possibility of Experimental Study of the Properties of Time," September 1967, pp. 1-49, in JPRS 45238, May 1968. Kozyrev reports real physical effects from the oscillation of time. Also, note that scalar potential energy of appreciable size with respect to a particle's rest energy can force the situation to be relativistic, even though the velocity of the particle with respect to the velocity of light is small. That is, electrostatic scalar potential alone can cause variation in the rate of flow of time and hence vary physical characteristics. See Bloch & Crater, "Lorentz-invariant potentials and the non-relativistic limit," American Journal of Physics, Vol. 49, No.1, 1981, pp. 67-75. By inference, oscillating the electrostatic scalar potential can produce time waves and lead to direct physical effects.

25. It is already shown in the literature that the electrostatic scalar potential (ESP) can affect spacetime (ST) in the same manner as velocity. Cf Bloch & Crater, op. cit., 1981. Now note that, to any quantal or macroscopic observer, the existence of the 4-space volume of ST implicit in $(\Delta t)(\Delta v)$, where v is volume, cannot be separated from the existence of the subquantal entities that exist therein. We therefore DEFINE the magnitude of the ESP as the summation of the absolute values of all the internal virtual vectors in the $(\Delta t)(\Delta v)$ quantum of ST, divided by the absolute value (magnitude) of $(\Delta t)(\Delta v)$. We take the view that no such thing as "unstressed" ST physically exists, and that "spacetime" and "stressed spacetime" are identical. Hence ESP and ST are one and the same thing. Note that this implies that the virtual density of ST is variable, and is nothing but the magnitude of the ESP. In EM theory, the assumption that the ESP of vacuum ($Ø_O$) is equal to zero is in serious error. In fact, $Ø_O$ IS "spacetime of the laboratory observer," in the new view.

26. For example, the definition of the electrostatic

potential (ESP) is usually taken as "the work which must be done against electric forces to bring a unit charge from a reference point to the point in question; the reference point is located at an infinite distance, or, for practical purposes, at the surface of the earth or some other large conductor." (McGraw-Hill Dictionary of. Scientific and Technical Terms, ed. Daniel N. Lapedes, second edition, 1978, p. 518.) Note that this is NOT a definition at all, for it is not an identity. Instead, it is the statement that, if an ESP exists at a point and a unit charged mass (assumed to be at a point) is brought in from infinity toward the ESP location point, the amount of work it is necessary to expend upon the mass of the particle is equal to the magnitude of the ESP. The ESP exists whether or not any work at all is expended, and whether or not a charged unit mass is brought in. To adequately define ESP, we must define its identity, or what it consists of, in the absence of mass, since we have conceived the ESP to exist at a vacuum point. Further, the definition usually taken is completely a 3-space definition. Instead, in our new view the ESP is to be taken at a point in n-space, where n is equal to or greater than 4.

27. See Bearden, Quiton/Perceptron Physics, 1973, available through the DTIS. See also Bearden, The Excalibur Briefing, Strawberry Hill Press, San Francisco, CA, 1980. Ultimately all physical phenomena are mindchanges in the minds of all the observers.

28. And then assumes this summation value is zero.

29. See note 25 above.

30. Bearden, The Excalibur Briefing, Strawberry Hill Press, San
Francisco, CA, 1980.

31. Cf Rauscher, E. A., "Electromagnetic and Non-Linear Phenomena in Complex Minkowski Spaces," Tecnic Research Laboratories, 64 Santa Margarita, San Leandro, CA 94579. Presented at the 1983 March Meeting of The American Physical Society in Los Angeles, CA 21-25 March, 1983. This is a truly remarkable paper of great significance. Rauscher, a world-class physicist, has presented a new theoretical

model for some rather extraordinary possible extensions of present electromagnetics.

32. Cf Muses, Charles, Introduction to Jerome Rothstein's Communication, Organization, and Science, The Falcon's Wing Press, Indian Hills, Colorado, 1958. The entire foreword by Muses is a remarkable document, which analyzes the structure of time itself. See also his profound summary paper, "Hypernumbers II" in the January 1978 issue of Applied Mathematics and Computation, published by Elsevier.

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ADDITIONAL NOTES AND REFERENCES

Although quotes and direct utilization of material from these references were not incorporated in this paper, the following references were also consulted. In addition,' several notes are added for further clarity.

33. Rupert Sheldrake, A New Science of Life: The Hypothesis of Formative Causation, J. P. Tarcher, Inc., Los Angeles, CA, 1981. Ø, the electrostatic scalar potential field, in my opinion is actually the morphogenetic field that Sheldrake proposes.

34. Briefly, by a "particle" we mean an entity so constructed that, if any part of it changes all of it changes. From the viewpoint of the particle, this implies that to change is to detect, and to detect is to change. Also, internal and external become synonymous, in the "detected" sense. The idea of a "fundamental particle" in physics actually invokes the fourth law of logic implicitly.

35. Only if a thing dimensionally contains time, can it "occupy time." This point is so obvious that one wonders how so many of the scientists and mathematicians seem to have missed it. By this criterion, e.g., mass does not exist in time, a priori. To "observe" or detect, in fact, means to stop time, thus collapsing the wave function. However, it reduces the observable or detectable to a spatial quantity, not a spatiotemporal quantity. In other words, the ordinary scientific method destroys a part of reality in each detection or measurement, yielding only a partial truth. not fundamental truth.

36. Note that electrostatic scalar potential is actually infinite-dimensional and hyperspatial. The coverage of

this paper is still only a special case. By Tesla technology, it is possible to do direct engineering in hyperspace -- beyond our present space and time, with all that that statement implies.

37. Bob Sloan, "Nikola Tesla: The Greatest Inventor of all Time?". IEEE Antennas and Propagation Society Newsletter, June 1983, pp. 9-11. A very succinct summary of the importance Tesla played in ushering in the modern age.

38. Gerald E. Brown and Mannque Rho, "The structure of the nucleon," Physics Today, Vol. 36, No.2, February 1983, pp. 24-32. Recommended as a summary of the new thinking as to the structure of the nucleon: a bag containing three quarks, surrounded by a cloud of mesons which squeeze the bag.

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41. John T. Ratzlaff and Leland I. Anderson. Dr. Nikola Tesla Bibliography. Palo Alto. CA, 1979. Indispensable.

42. Dr. Nikola Tesla: Selected Patent Wrappers, compiled by John T. Ratzlaff, multiple volumes. 1980. Available from The Tesla Book Company, 1580 Magnolia, Millbrae, CA 94030. Tesla's correspondence with the U.S. Patent Office, when patiently trying to obtain patents. He spent a great deal of time trying to convince the Patent Office that his inventions would indeed work. Some of them required 12 years to obtain, and then were "watered down" in the process.

43. Thomas Commerford Martin, The Inventions, Researches and Writings of Nikola Tesla, Originally published in 1894 by The Electrical Engineer, New York; republished in 1977 by Omni Publications, Hawthorne, CA 90250.

44. Ernest Nagel and James R. Newman, Godel's

Proof, New York University Press, 1958.

45. Yakov P. Terletskii, Paradoxes.in the Theory of Relativity, With a Foreword by Banesh Hoffman, translated from the Russian, Plenum Press, New York, 1968. Of particular interest is the discussion on particles with imaginary masses, moving faster than the speed of light, contained in pp. 104-107. Such particles can in principle be experimentally detected. In fact, it would appear that the well known exchange of virtual particles between two other particles, such that each turns into the other, is such a case. (Note that protons and neutrons in the nuclei of atoms do precisely this.)

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of all kinds. Corliss is a national treasure, and his handbooks are absolutely indispensable.
See particularly his Handbook of Unusual Natural Phenomena, The Sourcebook Project, Box 107, Glen Arm, MD 21057, 1977 and his Lightning, Auroras, Nocturnal Lights, and Related Luminous Phenomena, 1982.

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62. Jack S. Greenberg and Walter Greiner, "Search for the sparking of the vacuum," Physics Today, August 1982, pp. 24-32. A beautiful summary article on the present concept of the vacuum, from the standpoint of quantum mechanics and quantum field theory. I specifically urge anyone interested in tapping the vacuum energy to read this article.

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The last paragraph by Jammer is illuminating: "The modern physicist may rightfully be proud of his spectacular achievements in science and technology. However, he should always be aware that the foundations of his imposing edifice, the basic notions of his discipline, such as the concept of mass, are entangled with serious uncertainties and perplexing difficulties that have as yet not been resolved."

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TOWARD A NEW ELECTROMAGNETICS PART III: CLARIFYING THE VECTOR CONCEPT

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-- It Started With Geometry and Grew --

At the very beginning of what we call the "scientific period," mathematics was both king and queen, and Euclidean geometry was its handmaiden. So we ask, "What precisely is geometry?" Here we are not interested in a "textbook" answer, but in an answer indicating what geometry really does.[3] In other words, with what does geometry concern itself, and what is the fundamental nature of those things with which it concerns itself?

Briefly, geometry -- at its foundation -- is totally spatial. It is fitted to, and expressed in terms of, the TOTAL ABSENCE OF MASS. Thus the geometer deals in abstract, massless entities called "points," "lines," "planes" etc. When the geometer speaks of "motion," he speaks of a time-smeared, length-smeared point. Geometry at heart is massless, and a "geometer's vector" is a highly specific type of "system." In fact, it represents the "time-smearing" and "length-smearing" of a point. A priori, the fundamental concept of the geometrical vector has taken a "spatial" entity and introduced a hidden involvement with "time."

Modern mathematics and physics have followed an intertwined development for several hundred years. And both sprang as offshoots of the original work of the geometers. Let us briefly sketch the overall path of interest taken by these two developing disciplines.

With the advent of Descartes's fundamental work, algebra was combined with geometry to yield analytic geometry, a new and powerful mathematical tool. With the invention of calculus by Leibniz and Newton, both mathematics and physics received a giant impetus. Differential geometry and vector mathematics arose in full splendor and, in physics, mechanics leaped to the forefront with Newton's

profound work.

But the mechanics made a most fundamental error when they simply applied the geometer's vector to a mass, to produce -- so they thought -- a mass vector. That which rigorously applies only to the absence of mass cannot be so lightly applied to the presence of mass without the risk of serious limitations in the resulting theory. The precise difference between a geometer's massless vector and a mechanic's mass-vector is one of the issues to be developed in this thesis.

As rapid development continued in mechanics and mathematics, certain physicists were involved in intense experimental work on charged matter, becoming the first electricians. Both the preceding mathematical ideas and constructs as well as the preceding (partially erroneous) mechanics constructs and ideas were applied by the electricians, struggling with their pith balls, cat fur, and glass rods to understand, quantify, and model electrical forces and the phenomena of charged matter. In other words, the electricians strove to formulate the physics and dynamics of charged matter and its interactions by simply "adding to" the work of the geometers and mechanics. Here again, a fundamental logical error was made. That (geometry) which a priori applies only to the absence of mass, and that (mechanics) which a priori applies only to the absence of charge, cannot be lightly applied to the presence of charged mass (both mass and charge)[4] without risking the incorporation of grave limitations in the resulting theory.

After the profound work of Maxwell, the idea of FIELDS OF FORCE became more prominent, until the field concept ruled the day[5]. The electricians continued, pushing the idea of fields into space and vacuum itself, along the way inventing the idea of "charge effects" existing even in the massless vacuum, with concomitant fields. Meanwhile, they had thoroughly confused chargeless point-smeared, chargeless mass-smeared, length-smeared and time-smeared vectors.

After a set of fundamental experiments designed to detect motion of the material ether yielded essentially null results[6], Michelson and Morley were regarded as having completely disposed of the ether -- even though the experiments only disposed of material

ethers, and not Lorentz-invariant non-material ethers[7]. Maxwell's equations and the field concept were elevated to profound importance.[8] Then, after Einstein's fundamental relativity work shortly after the turn of the century, the ether concept faded away and the field concept reigned supreme. Indeed, in their enthusiasm the interpreters of relativity went so far as to affirm that one can have a wave without any medium; that is. that something can be moving (waving) without anything there to move![9] And with great glee they pronounced the final end to the idea of "ether" as a medium, even though Einstein himself never did any such thing.[10] With the advent of Einstein's General Theory of Relativity, even matter came to be regarded as just a special "kink" or curvature in spacetime or "vacuum nothing."

Quantum mechanics arose and even certainty and determination fell. Chaos, probability, and randomness now assumed the ruling position. Probability waves (and probability fields) arose,[11] as did quantum fields of various kinds. The intermingling of these concepts with the concepts of electrodynamics pushed the idea of the field even farther into esoteric realms.

The point is, each of these developing disciplines incorporated and built on the foregoing disciplines. From the beginning of geometry, there was no rigorous definition of a vector, and there is none today.[12] From the beginning of mechanics, in their foundations the theorists made grave logical errors by incorporating the geometer's vector; errors so great that today mechanics and electromagnetics are severely flawed, as is everything that came after them and built upon their illogical foundations.

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TOWARD A NEW ELECTROMAGNETICS PART III: CLARIFYING THE VECTOR CONCEPT

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-- Points and Motion --

It is my purpose in this paper to expose in a very simple fashion the most basic errors that were made. One basic error involves the idea of motion itself.[13]

In formulating concepts of motion, the geometers used a "point in motion" to determine or specify, for example, velocity. Now a "point" is a static concept a priori. To determine (or even to think and perceive) motion, one must determine that it occupies two different points (positions or locations) at two different times, yet consider both points at the same time. Indeed, that is precisely what the arrow means that is used to represent a vector. A "point in motion" therefore represents a contradiction of opposites. That is, it represents the idea that "that which is motionless has motion.".[14] Even with this, there is a difference in a spatial point and a spatiotemporal (spacetime) point. To exist at all, a spatial point must be moving in time; in other words, it is a spatiotemporal line, even if it is a static spatial point.

Vector analysis was constructed in the abstract -- again, a massless point in motion possessed or constituted a velocity vector, etc. In massless (and timeless) space, FIELDS were defined: "scalar" fields constituted the assignment of a simple motionless number (magnitude) to each spatial point, while "vector" fields constituted the assignment of a "simple vector" (magnitude and velocity) to each spatial point. But the MATHEMATICAL vector system consisted of massless (point) motional relationships, recognizing zero motion as a special case of motion.[15]

Of course mathematics development was also always intertwined with practical problems. With the

sustained application of mathematics to gross physical material problems, mechanics slowly arose.

These developments required decades and even centuries to occur completely. All along the way, innovations and changes -- and additions to the mathematical formulism were being derived and taught to students as the "natural" system of reality. A permanent mindset was being forged.

Indeed, mathematics was regarded as THE single human expression of fundamental truth. Not until Godel's work in the twentieth century did it become evident that MATHEMATICS IS SIMPLY A GAME PLAYED ACCORDING TO ASSIGNED RULES, AND THERE IS NO ULTIMATE TRUTH IN MATHEMATICS ALONE.[16] It is a most useful game, of course, since it is the game fitted to perception. Thus it applies, essentially, to whatever can be perceived. But to be applied to physical systems, it must be changed, altered, updated, and fitted as the perceiving/detecting instruments become ever more subtle.

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TOWARD A NEW ELECTROMAGNETICS
PART III: CLARIFYING THE VECTOR CONCEPT

-- Four Types of Vectors Actually Emerged --

As the physical sciences slowly developed and incorporated abstract geometry and mathematics, in actuality four major types of vectors and two major states of observation evolved, although this fact did not become apparent to the scientists. Specifically, the mathematicians and scientists failed to recognize the differences in the four types of vectors, hopelessly intermingling them and confusing them as a single class of vector. Further, they did not appreciate that a fundamental vector conceptually is a UNITARY SYSTEM, and the system represented by one of these four types of vectors utilizes and is comprised of different components, "welded together with no seam in the middle."

Conceptually (and from a systems viewpoint), the four types of vectors are (1) the chargeless, massless spatial system vector (geometer's vector), (2) the uncharged mass system vector (mechanic's vector), (3) the charged mass system vector (electrician's vector), and (4) the charged space system vector (advanced electrician's vector). These four fundamentally different vectors are shown in Figures 1, 2, 4, and 9 in a simplified manner.

The major problem was that, beginning with the geometer's vector, these four major types of vectors were not treated as systems. Instead, their "vector" aspects were hopelessly confused and intermeshed, and no distinctions were made between them. And in the foundations of the mathematical constructs, time-smearing was not recognized at all.

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TOWARD A NEW ELECTROMAGNETICS
PART III: CLARIFYING THE VECTOR CONCEPT

-- Quantum Mechanics Compounds the Problem --

In addition, the two presently recognized observation states -- observable and nonobservable (virtual) -- were of course unknown to the early geometers and electricians, and these ideas were not incorporated directly into the theoretical foundation.

From particle physics and quantum mechanics, we now understand that physical reality is structured of an observable state, underlaid with an infinite number of ever finer, successive levels of virtual (unobservable) states. At least reality is most accurately modeled in that fashion, according to particle physics today.

It is also well known, for example, that at the most fundamental level, one cannot actually separate nonmotion from motion (which implies, for example, that one cannot separate mass and velocity). In other words, a "mass in motion" idea is actually incorrect, at the most basic level. What actually exists is a sort of "smeared mass". That is, "mass-motion" is fundamentally what exists, not mass IN motion .

Actually, all that the Heisenberg Uncertainty Principle implies is this fact: If one examines the concept of "static (non-smeared) thing in non-static (smeared) motion", in ever finer detail, one reaches a degree of fineness where the "smearing" is paramount and one cannot have an un-smeared or "separate static thing" to be in motion. Instead, one only has the smeared, 4-dimensional spacetime entity, without 3-dimensional spatial separations.

This means, for example, that at the most basic level, it is actually incorrect to represent a momentum with a little static particle of mass connected to a spatial velocity vector. It is incorrect to think of the system as comprised of TWO SEPARATE ENTITIES, (1) a mass, and (2) a massless spatial system velocity vector (a geometer's vector).

We mention in passing that, presently, we

understand that every particle is continually accelerating. First, the particle has spin, which involves rotation, which means that every "part" of the periphery of the particle is accelerated toward the center axis of spin. Second, every particle is continuously "fluctuating," and these fluctuations are accelerations. Further, we must consider any change such as an acceleration -- as existing in a small time increment, and occurring in a small length increment. Thus mass particles actually exist as (mass x acceleration x time x length). This of course has the dimensions of ACTION or angular momentum. The "real" world of physical matter, then, is composed of building blocks of action, called "quanta." Any other physical "quantity" must be obtained by fissioning (differentiating) the action quantum. For this reason, quantum mechanics presently must postulate that to every observable there corresponds an operator.

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-- To Summarize Briefly --

Let us now summarize these concepts and further examine their impact.

In physics, there must actually exist four major KINDS of vectors, rather than just one as prescribed by present interpretation. These vectors are "built" starting with four major kinds of particles.[17] These are: (1) the spatial point, (2) an uncharged mass particle, (3) a charged mass particle, and (4) a charged spatial point. Further, each of the four vectors at its most fundamental level (that is, at the quantum level)[18] is actually an inseparable, unitary SYSTEM welded into a single undivided entity containing time and existing nonexclusively in time.[19] When we look at or represent the so-called "parts" of the system, we are looking at them before they are welded together into the physical vector. That is, whenever we speak of "parts, " we imply that a "cutting" or "differentiating" action has been implied to separate the system into such "parts."

From such considerations, four different kinds of system vectors result.

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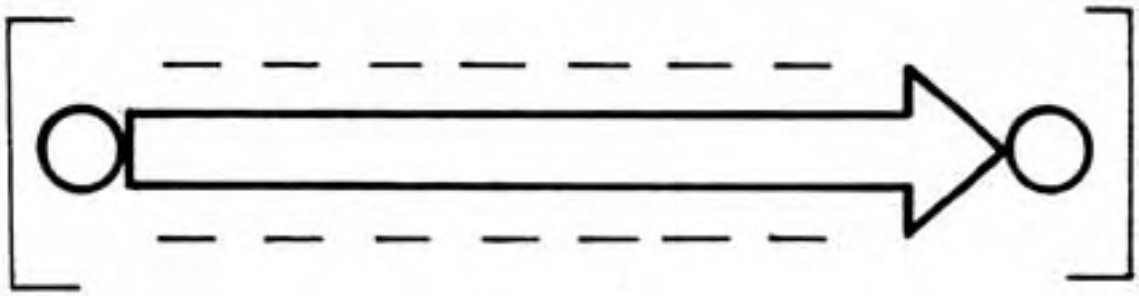

(GEOMETER'S VECTOR)

Figure 1. Uncharged spatial (massless) system vector.

UNCHARGED SPATIAL (MASSLESS) SYSTEM VECTOR
-- (Figure 1) --

This is the geometer's abstract vector, consisting of a "point in motion." (Actually, it is a "smeared point," for example.) However, so ingrained is the concept of a "point in motion" velocity vector that we now consider it to be "natural" because of its total familiarity. But simply ask, "WHAT is in motion?"[17] and you immediately see the difficulty. To have a WHAT, one must "stop the action" (detect or measure), separating "static" from "non-static." Acceleration and other vectors, etc. have also been derived by the geometer and utilized in similar fashion. All are massless.

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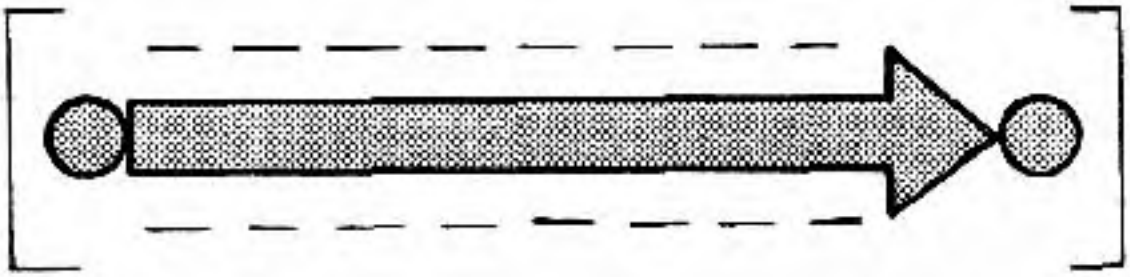

(MECHANIC'S VECTOR)

Figure 2. Chargeless mass system vector.

CHARGELESS MASS SYSTEM VECTOR
-- (Figure 2) --

This type of vector actually is the essential vector of mechanics, involving mass-motion (momentum), force (mass-motion change), etc. The fundamental difference between this type of vector and the geometer's vector is the presence of smeared mass existing in time (i.e., mass-time), welded together with a geometer's vector, but with no seam in the middle, into a new kind of "vector" AS A SYSTEM. The vector is the SYSTEM EXISTING IN TIME .

To illustrate:

"Momentum" is more properly referred to as "mass-motion" rather than "mass in motion." That is, at the fundamental level, the mass is NOT "separate" from its motion. It is NOT separated from the time in which the smearing occurs. The idea of momentum, however, is really to express the time-density of the mass-smeared-through-length. It is, in other words, the time rate of length-smearing of mass. Now in our minds we have conceived that

$$\bar{p} = m \odot \bar{v} \qquad (1)$$

where, by the symbol $\odot$ we mean "coupled to"; but we actually have

$$\bar{p} \equiv [\overline{mv}] \qquad (2)$$

where we are not allowed to separate (even in thought) m and $\bar{v}$. Quantum mechanics agrees with this essentially, because $\bar{p}$ is a canonical variable linked to length, in any observable physical change. (The REASON p is canonically linked to ΔL is because $\bar{p}$ is the time-rate of length-smearing of m. If there is no length, there is no length-smearing of m to have a time rate OF in the first place.)

Note that, not only is

$$\bar{p} = [\overline{mv}] \qquad (3)$$

but also

$$\bar{p} \equiv [\overline{mv}] \qquad (4)$$

which is a much stronger and quite different statement. That is, $\bar{p}$ is IDENTICALLY $(\overline{mv})$, not just calculably EQUAL TO (m)($\bar{v}$). This means that $\bar{p}$ is a SYSTEM that is COMPRISED of mass-motion.

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-- What Force Is --

We now note that force, for example, is -- and may be defined as -- the time-rate of change of momentum, or

$$\bar{F} \equiv d/dt[\bar{p}] \qquad (5)$$

and this identity states that a force -- any force is COMPRISED OF time-changing "mass-motion." As such, the force vector is a mass-system vector, not just a massless spatial vector. Fundamentally, this mass-system vector is a totally different creature from a massless spatial vector. Our present manner of considering force as a geometer's vector "separately applied to" a mass particle is completely erroneous at the quantum level. Instead, fundamentally force is always a mechanic's vector. Force is an EFFECT, not a CAUSE.

And here mechanics made a most fundamental error, in not recognizing the difference between its kind of vector and that of the geometer.

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--Force and Hertzian Waves Cannot Exist in Vacuum --

Note that one cannot have an observable "force vector" existing' in vacuum a priori.

For example, we have the definition of force as

$$\bar{F} \equiv \frac{d\bar{p}}{dt} \qquad (6)$$

or

$$\bar{F} \equiv \overline{[m\bar{a} + \dot{m}\bar{v}]} \qquad (7)$$

and we see that, rigorously, a force vector CONSISTS OF (not, "is equal to") a time-changing mass-motion vector system. IF THERE IS NO OBSERVABLE ACCELERATING MASS PRESENT, THEN THERE CAN BE NO OBSERVABLE FORCE PRESENT. The mass can accelerate in time (increase or decrease of mass) or space (increase or decrease of velocity) or both.

Observable force CANNOT exist in vacuum (in the absence of mass), a priori.[20]

However, assume for a moment that one could have a massless force vector, as assumed in present electrical theory. Let this force vector appear at a point in the vacuum. Since the vacuum has zero observable mass, it would have zero inertial resistance to this hypothetical observable force -- hence the observable force would instantly produce an "infinite" acceleration of its point of application, vanishing with it into the infinite distance. Therefore our fictitious force would disappear the instant it appeared! In any case, it could not be retained at a point in the vacuum for any finite length of time, however small.

The direct implications are that (1) something other than an observable electrical force field exists in the vacuum, and (2) there must exist a more fundamental mechanism by which this "something else" generates or CREATES a force on/of a moving electrically charged mass. (Note again that, at the most

basic level, any particle of mass is always quivering, in motion, and accelerating. from quantal considerations alone.)

Thus immediately we have discovered something unique about so-called "force-fields" in vacuum: for example, about gravitational field, electrical field, and magnetic field (and the strong force and the weak force as well). These fields do not exist at all as ordinary force vectors -- and real force fields -- in vacuum! $\bar{E}$ and $\bar{B}$ fields, e.g., are defined in terms of force per unit electrical charged mass and magnetically charged mass, respectively. In the absence of mass, they cannot exist.

And this in turn means that transverse $\bar{E}-\bar{H}$ field waves (Hertzian waves) cannot exist in a vacuum. Indeed, they appear on, and ARE CONSTITUTED of, the charged-mass-motion that changes, and they appear where such change occurs, as a result of an introduced mass.[21] But in the absence of the spinning charged particle of mass, they do not exist as force fields at all.

Hertzian waves exist in a transmitting whip antenna, for example, in the oscillating electron gas along its length. Something else entirely different exists in vacuum between the transmitting antenna and the receiving antenna. Then in the receiving antenna, Hertzian waves again exist in the oscillating electron gas along its length. (See Figure 3.)

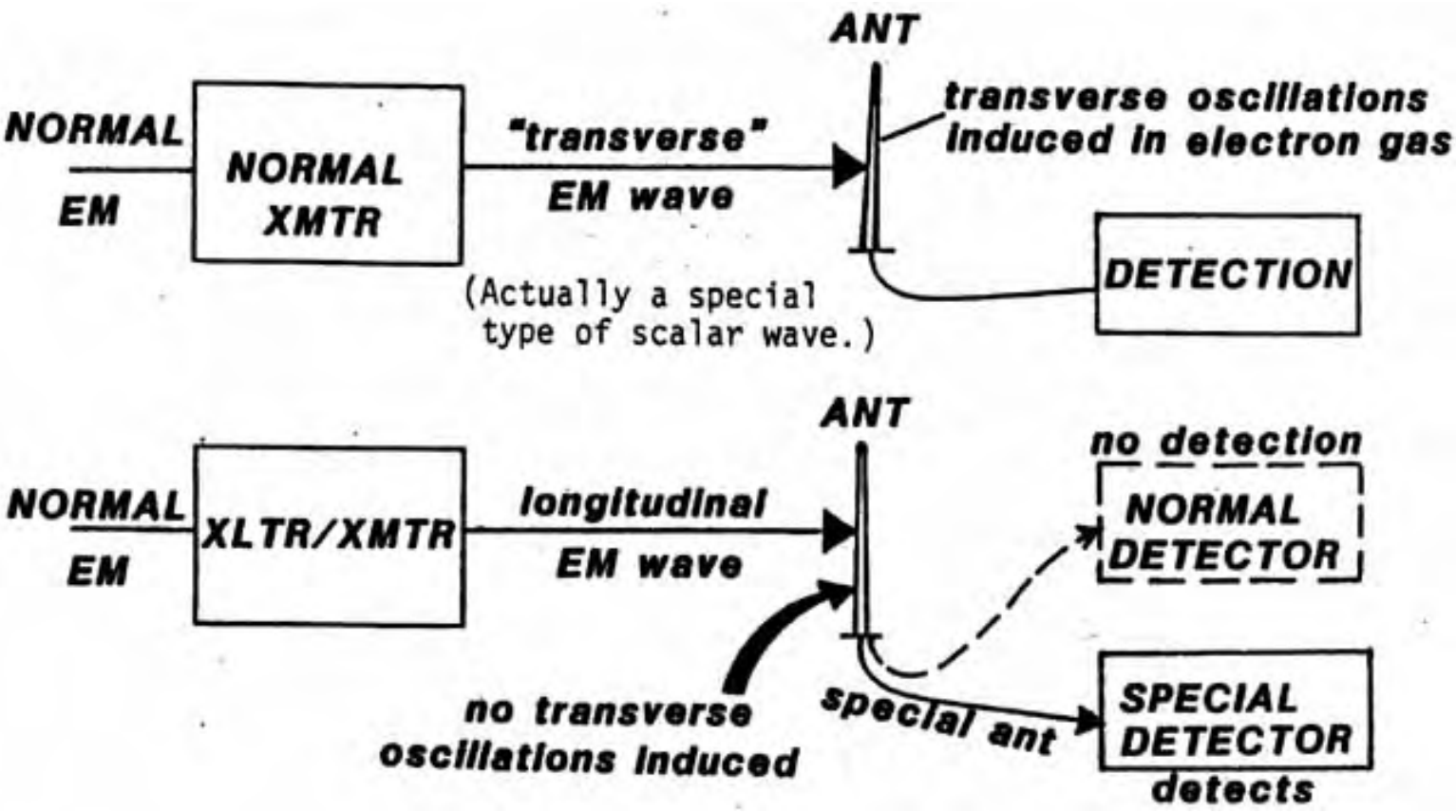

Figure 3. Detection of "transverse" and longitudinal waves

This is interesting, for Nikola Tesla stated several times that HERTZIAN WAVES CANNOT BE PRODUCED IN A VACUUM, NOR CAN THEY TRAVEL IN A VACUUM.[22]

Tesla was correct, as we are beginning to see.

We shall later return to show in what form so-called "force-fields" actually exist in vacuum.

For now, I point out that I am stating a fundamental change to all of physics, including both mechanics and electromagnetics.

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TOWARD A NEW ELECTROMAGNETICS PART III: CLARIFYING THE VECTOR CONCEPT

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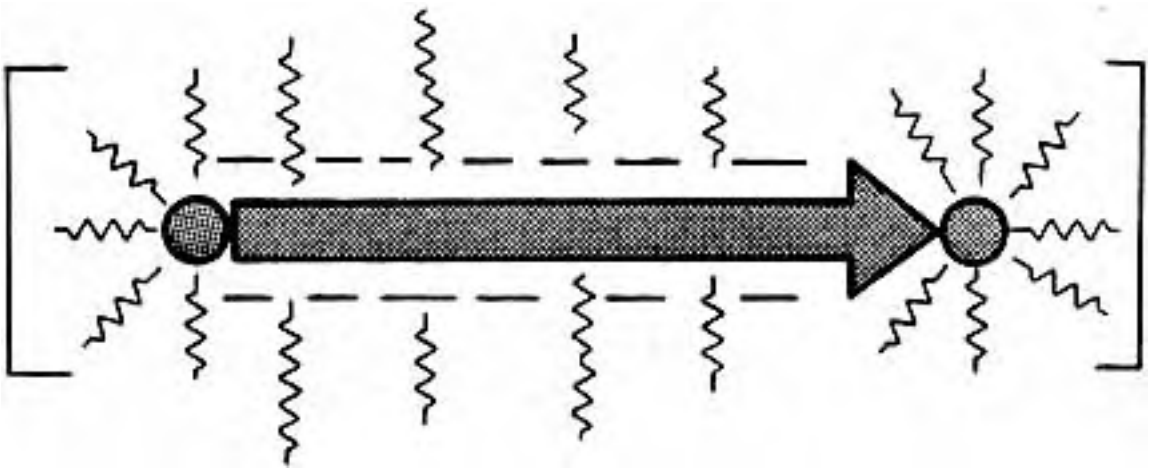

(ELECTRICIAN'S VECTOR)

Figure 4. Charged mass system vector.

-- CHARGED-MASS-SYSTEM VECTOR --
-- (Figure 4) --

The third type of vector we meet is the vector mass system where the mass is charged. First, we point out a serious error in present electromagnetic (EM) theory. That is, in present theory it is implicitly assumed that

$$\mathbf{q} \equiv \mathbf{q_m} \qquad (8)$$

In other words, "charge" and "charged mass" are erroneously assumed to be identically the same thing.

In the days when electricians were playing with pith balls and striving to uncover the secrets of electricity, they knew nothing at all about the virtual

state, and consequently nothing about a "virtual particle flux" on a particle of mass causing (and comprising) the "charge" of that mass.

Today, of course, we know from particle physics and quantum mechanics that the "charge" on an observable particle of mass IS due to a flux of virtual (nonobservable) particles on and off the mass of the observable particle (see figure 5). A charged mass is thus presently known to be a SYSTEM: a massless charge flux, coupled to a bare particle (chargeless mass) constitutes a "charged particle."

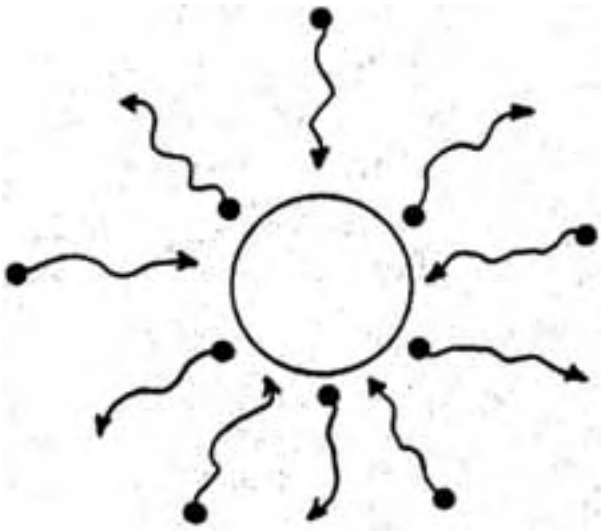

Figure 5. The "charge" on an electron mass consists of a flux of virtual particles on and off the mass.

Thus, actually the "charge" is the virtual (unobservable, or SPATIO-TEMPORAL) flux to and from the observable SPATIAL particle of mass. So, rigorously,

$$\mathbf{q \not\equiv q_m} \qquad (9)$$

But instead,

$$\mathbf{q \equiv [d/dm(q_m)]} \qquad (10)$$

and this is a definition and therefore an identity. This definition alone affects all present electromagnetics theory.

To illustrate: In founding electrical theory, early scientists dealt with forces generated by charged masses (for example, charged pith balls). They later

extrapolated the experimental results they obtained (or thought they obtained) with the smallest charged mass, a charged particle. In Figure 6, I show the classic situation for derivation of the idea of E-field (except we have used an electron for our test charge, rather than a pith ball).

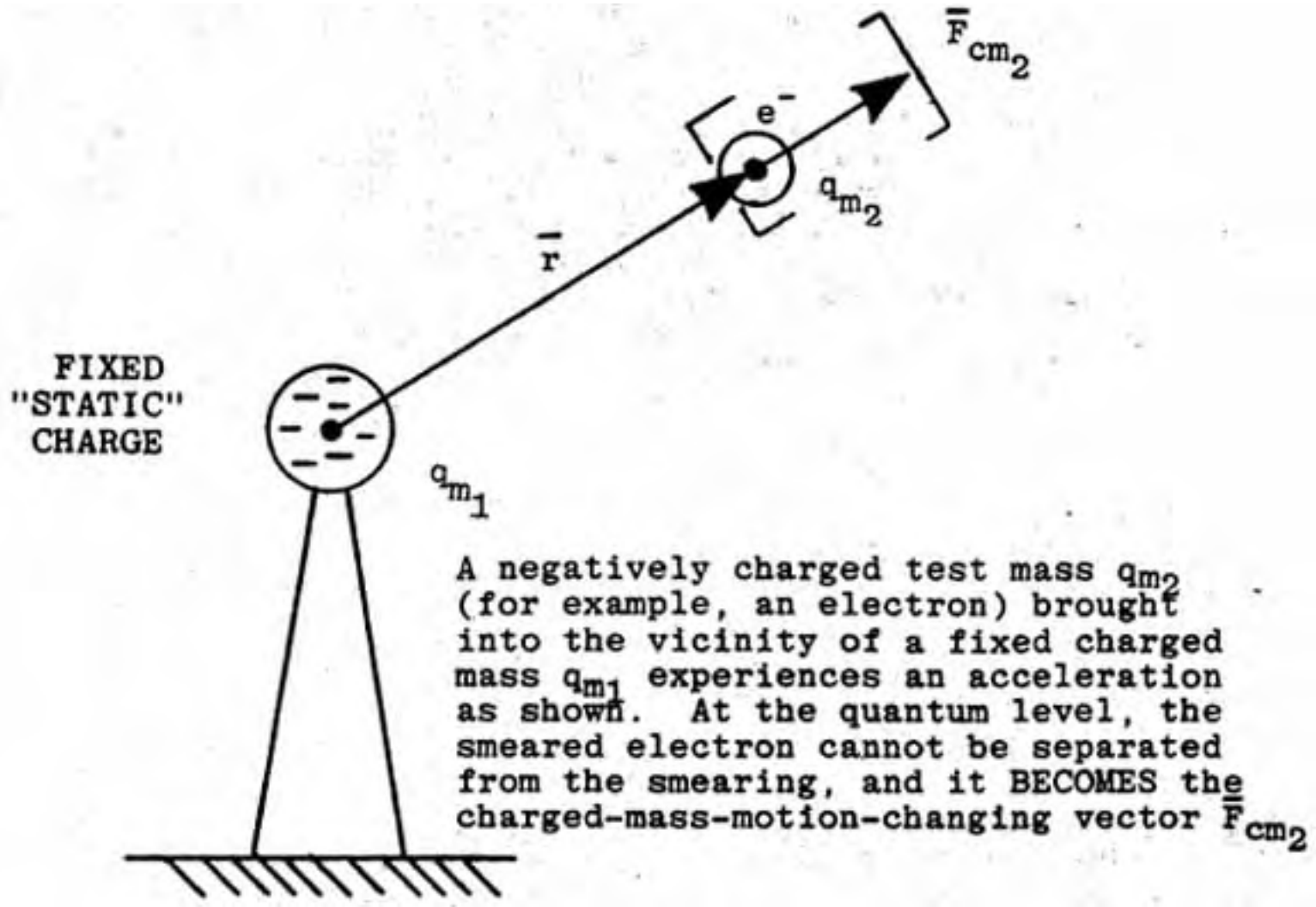

Figure 6. A test charge (charged mass) brought near a fixed charge (charged mass) experiences an acceleration.

Now note that what actually happens is that the unrestrained test charge becomes a CHARGED MASS SYSTEM VECTOR (a "smeared charged mass-motion changing"). The "test charge" BECOMES a charged mass force vector; it does not have a separate geometer's vector "appear on it." What actually happens is shown in Figure 7.

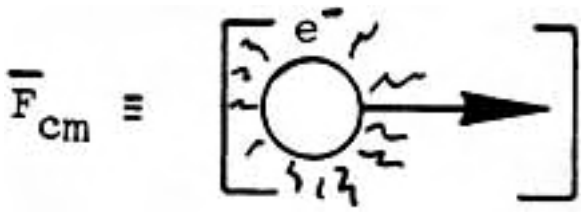

Figure 7. A charged-mass-system vector.

That is, in the simplest (nonrelativistic) case, for an electron what happens is

$$\bar{F}_{cm} \equiv \overline{[q_e \odot m_e \odot \bar{a}_s]} \qquad (11)$$

and this is a DEFINITION. That is, considered instantly, the electron exists as a charged-mass electrical force CONSISTING OF/COMPRISED OF a charge flux q_e canonically coupled to a mass, with that subsystem then canonically coupled to a spatial acceleration vector, ALL AS A SINGLE ENTITY, WITHOUT ANY "SEAMS" BETWEEN ITS "PARTS." The $\bar{F}_{cm}$ IS THE ELECTRON SYSTEM ITSELF; it is NOT a "spatial vector." Rigorously, it does not exist in the absence of the smeared electron mass, a priori.

Again, in assuming this force exists in the absence of the smeared mass of the moving particle, electromagnetics theory is in serious logical error.

Referring back to Figure 6, we see that, if we repeat the experiment many times and with the test charge in many locations, we have the situation shown in Figure 8.

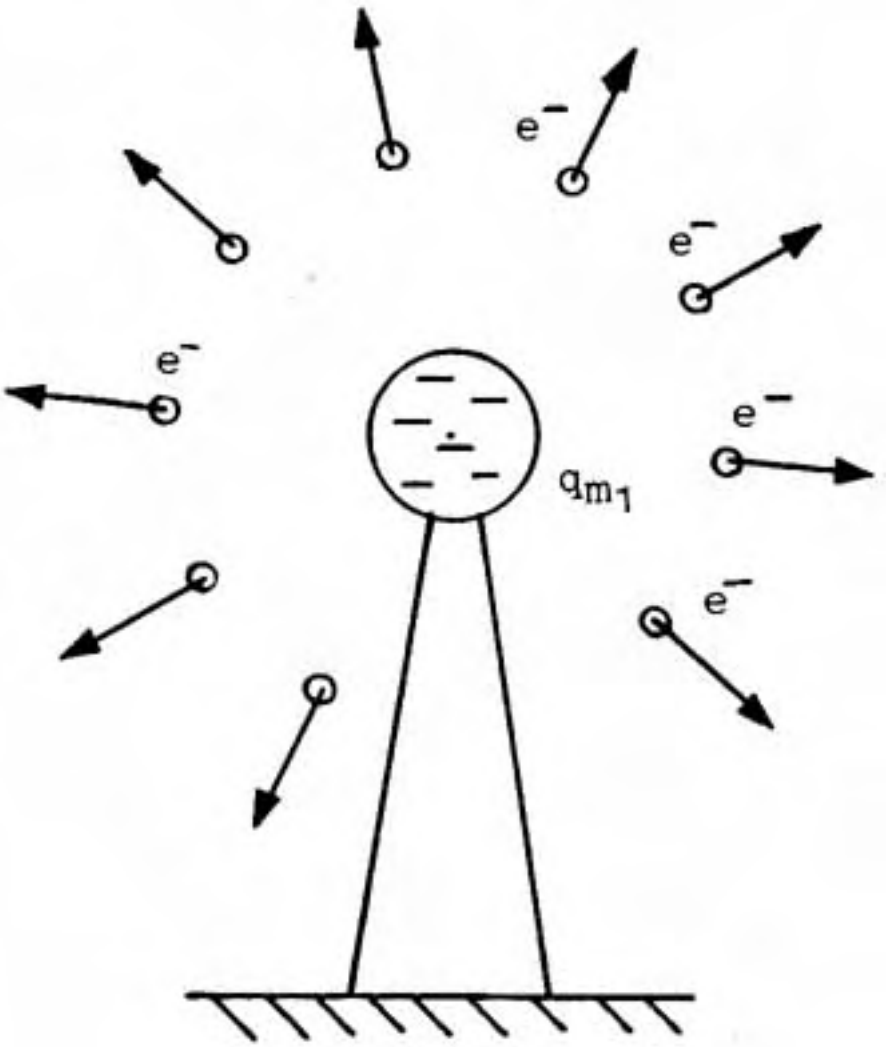

Figure 8. Repeating the "test charge" experiment.

It is found that, rigorously,

$$|\bar{F}_{cm}| \propto \left|\frac{q_{m_1} q_{m_2}}{r^2}\right| \qquad (12)$$

where $\bar{F}_{cm}$ is a charged mass system vector. Erroneously, this has been stated one way or another as

$$|\bar{F}| \propto \left|\frac{q_1 q_2}{r^2}\right| \qquad (13)$$

where $\bar{F}$ is assumed to be a spatial system vector. Further, this confusion has been carried over into the definition of the $\bar{E}$-field as:

$$\bar{E}_{cm} \equiv \frac{\bar{F}_{cm}}{m_{cm}} \qquad (14)$$

In this definition, $\bar{E}$ -- which is a charged mass system vector -- has been confused as a charged spatial system vector, where $\bar{F}$ is regarded simply a spatial system vector! Actually, the definition of the $\bar{E}$-field should be

$$\bar{E}_{cm} \equiv \frac{\bar{F}_{cm}}{m_{cm}} \qquad (15)$$

where $\bar{F}_{cm}$ is a charged mass system vector. Failure to properly define the $\bar{E}$-field has caused the conception of the $\bar{E}$-field to be falsely perpetuated as existing in vacuum.

The $\bar{E}$-field is TREATED this way in present EM theory. Hence present theory falsely assumes that the observable $\bar{E}$-field can exist in vacuum.

What actually exists in space, $\bar{E}$-field-wise, is a special kind of ordered virtual state pattern in a series of spinning "scalar" fields. This virtual state pattern or "shadow vector" field will be explained later.

Note again that one cannot have a "force vector" existing in vacuum - a priori.

However, assume for a moment that one could have a massless force vector, as presently assumed. Let this force vector appear at a point in the vacuum. Since the vacuum has zero observable mass, it would have zero inertial resistance to this hypothetical observable force hence the observable force would instantly produce an "infinite" acceleration of its point of application, vanishing with it into the distance. Therefore our fictitious force would disappear the instant it appeared! In any case, it could not be retained at a point in the vacuum for any finite length of time, however small.

The direct implications are that (1) something other than an observable electrical force field exists in the vacuum, and (2) there must exist a more <u>fundamental mechanism</u> by which this "something else" generates or CREATES a change on/of an accelerating electrically

charged mass particle. (Note again that at the basic level, any particle of mass is ALWAYS quivering and accelerating, from quantal fluctuation considerations alone.) Causality has no arrow microscopically.[23]

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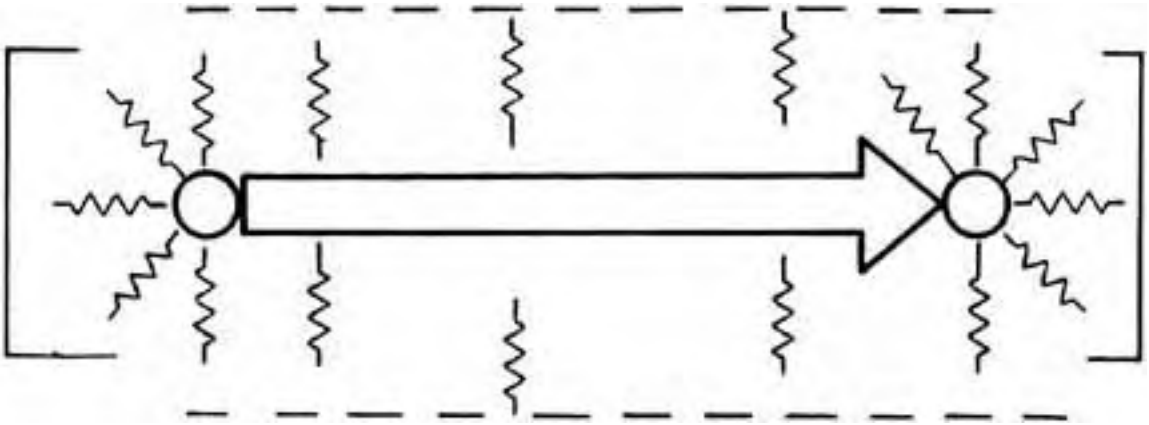

(ADVANCED ELECTRICIAN'S VECTOR)

Figure 9. Charged spatial (massless) vector.

-- CHARGED SPATIAL (MASSLESS) VECTOR --

We recognize now that

$$q_c \not\equiv q_m \qquad (16)$$

and that q_c is simply the virtual-particle flux that constitutes charge -- and indeed constitutes vacuum itself!

We DEFINE vacuum, based on Figure 5, as shown in Figure 10.

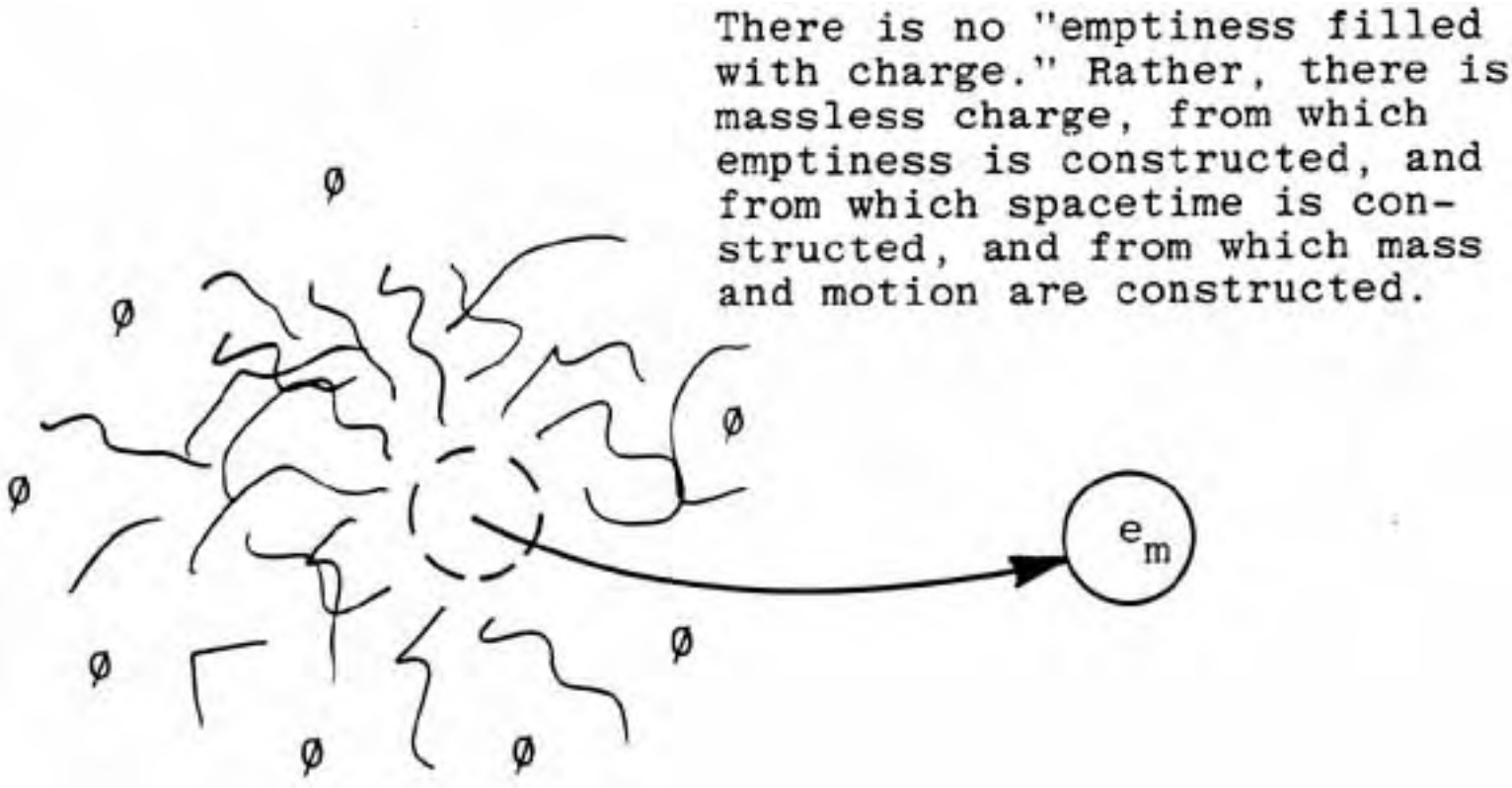

Figure 10. Removing the bare particle (mass) from a charged particle leaves the charge. The vacuum is DEFINED AS the charge.

That is, vacuum may be defined as pure massless charge flux. This flux IS identically "spacetime" as well. Vacuum is pure Ø-field (electrostatic scalar potential). Here again, in present theory it is assumed that

$$Ø_O \equiv 0 \qquad (17)$$

which, by our new definition of vacuum, is quite false.

We now note that, if we insist on assigning a spatial vector to the vacuum, we have the situation shown in Figure 11.

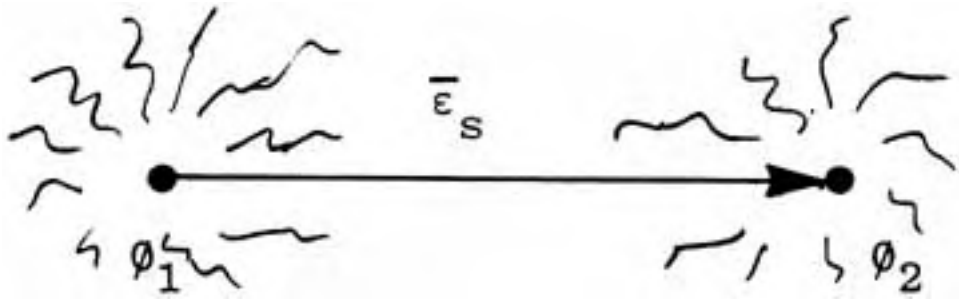

Figure 11. Assigning a spatial vector to the charged vacuum

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TOWARD A NEW ELECTROMAGNETICS PART III: CLARIFYING THE VECTOR CONCEPT

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-- THE SHADOW VECTOR --

Note that this spatial vector $\bar{\varepsilon}_s$ represents $-\overline{\nabla\phi_s}$, that is,

$$\bar{\varepsilon}_s = -\overline{\nabla\phi}_s \qquad (18)$$

but $\bar{\varepsilon}_s$ cannot be a force (mass system) vector. It can only exist as an ordered pattern in the virtual flux between two separated points of the vacuum; that is, as an ordered pattern in the virtual state. Literally, $\bar{\varepsilon}_s$ exists only as a tiny bit of order existing in great disorder.

In other words, the present EM theory is incorrect in stating that

$$\bar{E}_m = -\overline{\nabla\phi}_s \qquad (19)$$

in vacuum in the absence of an observable spinning charged particle, since

$$\bar{\varepsilon}_s \not\equiv \bar{E}_m \qquad (20)$$

The actual existence of $\bar{\varepsilon}_s$ may be visualized in terms of successive differentials of $\bar{E}_m$, broken into differentials $\bar{e}_m$ so small that, observably, each little differential's mass component m has become virtual, so that

$$\bar{e}_m \equiv \bar{e}_{vm} \qquad (21)$$

where subscript m stands for mass, subscript v for virtual, and observably

$$\bar{e}_{vm} \equiv \overline{dE}_m \qquad (22)$$

but, in the absence of a spinning charged particle,

$$\bar{E}_m \neq \int \overline{dE}_m \qquad (23)$$

since the $\bar{e}_{vm}$ components remain individually separated. That is, in macro-time a SHADOW force vector exists, made of microscopically ordered BUT UNJOINED (unintegrated) "virtual state" vector differentials of what would be an observable mass system force vector $\bar{E}_m$ if integrated.

Thus, the "$\bar{E}$-vector" $\bar{\varepsilon}_s$ that exists in vacuum is a "shadow" vector as shown in figure 12.

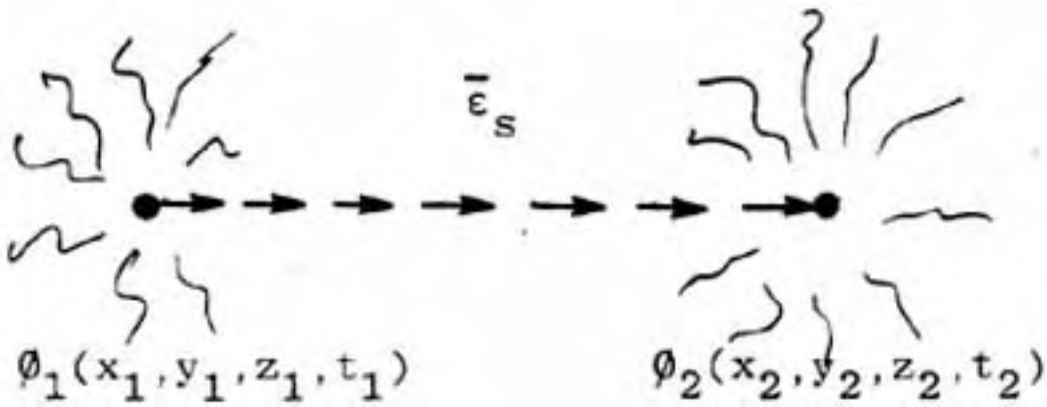

Figure 12. A "shadow vector" $\bar{\varepsilon}_s$

We say that such a previous mass system vector, broken into ordered but unjoined virtual vectors by the absenting of all mass, is a SHADOW VECTOR, and we label it with a subscript vm, to represent "virtual mass" system. To the macro observer, this is the kind of "vector" that exists in vacuuo.

Note that, observably, the shadow vector merely represents a special ordering in $\nabla\phi$. It is NOT an OBSERVABLE (mass system) vector, but it IS an ordered series of consecutive virtual vectors.

With each virtual bit vector, a virtual time exists as well, and these "virtual time bits" are also ordered consecutively (in macrotime).

I point out that any observable vector must be finite, and so it must have a finite magnitude (finite length). In the simplest case, this length ΔL is related to a Δt by

$$\Delta L = c\Delta t \qquad (24)$$

What I am saying is that ANY observable spatial vector is actually a spatiotemporal vector, and the MAGNITUDE of any vector is related to TIME (to the existence of that vector in time) at the most fundamental level. Suffice it to say that, if the fundamental quantum level (Δt) aspect of a vector is interfered with, then the MAGNITUDE of the vector is interfered with.[24] That is, if we can make a time wave, we can change or affect ANY vector's magnitude, including the magnitude of mass system vectors and charged mass system vectors. Such a "time wave" can be made easily, and it has been.

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TOWARD A NEW ELECTROMAGNETICS PART III: CLARIFYING THE VECTOR CONCEPT

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-- A Scalar is a Zero Vector --

Now let us look at the idea of a scalar.

A "scalar" may in a general sense be considered as the sum of the "absolute values" of the individual vector components of a system of vectors whose observable resultant is zero. That is, it represents the magnitude of the internal stress of a vector system, with the absence of a single observable directionality of the system. It also follows that every scalar is actually a stressed zero vector, and every zero vector is a scalar.

Thus we have four major types of scalars related to the four types of vectors:

(a) $$S_1 = |\bar{v}_s| \quad (25)$$

(b) $$S_2 = |\bar{v}_m| \quad (26)$$

(c) $$S_3 = |\bar{v}_{cm}| \quad (27)$$

(d) $$S_4 = |\bar{v}_{cs}| \quad (28)$$

where S stands for scalar, $\bar{v}$ for vector, and subscript s for spatial, m for mass, and c for charged.

For example, comparing equations (25) and (26), it can easily be seen that twice as many "point-motions" is not at all the same thing as twice as many "gram-mass-motions." The two resulting vector systems are quite different.

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TOWARD A NEW ELECTROMAGNETICS PART III: CLARIFYING THE VECTOR CONCEPT

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-- Virtual and Observable Aspects --

We must also examine some aspects of "virtual" and "observable."

For example, we construct several spatial vector summations in Figure 13. The "resultants" of these spatial vectors are all equal. However, the actual sums, even though equal, are quite different, because their internal "stresses" (substructure forms) are quite different.

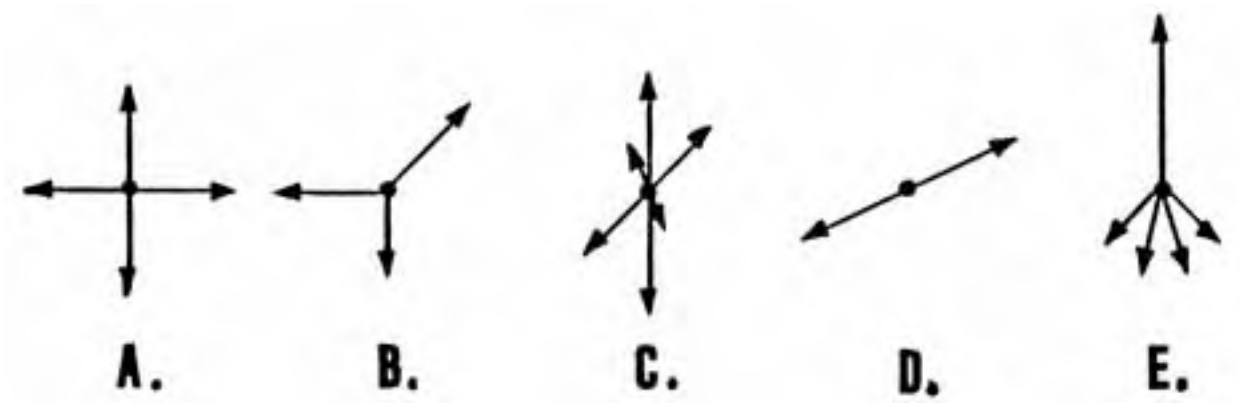

SUPERPOSITION DOES NOT ELIMINATE THE VIRTUAL SUBSTRUCTURE.

When the time aspects of the vector systems of Figure 13 are considered, one can easily understand the problem. That is, the resultant of each of these "systems" is zero, and so one can say that the vectorial "magnitude" of the system is zero since the magnitude of the resultant vector is zero. However, in each case the "action" represented by each vector element actually occurs in a finite tiny Δt. So: (1) The zero resultant must exist for a finite Δt, and (2) all the actions indicated by the system component vectors actually occur in that Δt. The absolute value of the "activity per unit time per unit volume" of such a zero-

resultant system thus has physical meaning, and one may refer to this notion as the "stress" on spacetime[25], or the "electrostatic scalar potential" of the system. Note that this differs from the present definition of electrostatic scalar potential, which becomes just a special case of the more fundamental potential defined here.[26]

The derivatives of this spatiotemporal stress also have physical meaning. The time derivative is indicative of the stress on the flow of macroscopic time at a fixed spatial point, and the spatial derivative is indicative of the stress on space. Here one is confronted with the fact that what we call "space" and "time" are continually being created, directly in the physical observing/detecting apparatus itself.[27] That is, rigorously, "detected physical reality" exists totally in and of the mass-changes of the observer's mass or his detecting instruments. In the fundamental detection process itself, there is a flow of the rate of creation of spatial lengths and a flow of the rate of creation of time lengths. Indeed, to a linear observer the stress on the creation of the flow of time controls the flow of the creation of space, and the stress on the creation of the flow of space controls the flow of the creation of time. The change in the stress on 4-space (ordinary Minkowskian space-time) controls the "curvature of that spacetime" in the fifth dimension. The change in the stress on 5-space controls the "curvature of that 5-space spacetime" in 6-space, and so on. Development of these facets of the new concepts is beyond the scope of this paper.)

Next Page

-- SCALARS AND VECTORS HAVE SUBSTRUCTURES --

As can now be seen, the sum of each structure in figure 13 is observably zero. Therefore we might define the sum as a "zero spatial vector." We note, however, that it actually exists for a time Δt and is thus a spatiotemporal entity, rigorously.

If we define the internal stress action A in a region $\Delta s^3 \Delta t$ of spacetime as

$$A_{(s^3 t)} \equiv \sum_{k=1}^{n} |\bar{i}_s| \qquad (29)$$

and the 4-space internal stress intensity or potential as

$$S \equiv \lim_{(\Delta s^3 \Delta t) \to 0} \left[\frac{A(s^3 t)}{\Delta s^3 \Delta t} \right] \qquad (30)$$

where $\bar{i}_s$ is any internal vector in the substructure, Δs^3 is the spatial volume (about a point) containing vector $\bar{i}_s$, and Δt is the inseparable time during which these component actions occurred, then we see that, stress-wise, all the "zero-vectors" in figure 13 are quite different in their internal stresses, 4-space potentials, and internal substructures. For the five "zero sum" vectors, OBSERVABLY we have

$$\bar{0}_1 = \bar{0}_2 = \bar{0}_3 = \bar{0}_4 = \bar{0}_5 \qquad (31)$$

whether or not

$$\Delta s^3 \Delta t_m = \Delta s^3 \Delta t_n \ (m \neq n;\ 1 \leq m \leq 5;\ 1 \leq n \leq 5) \qquad (32)$$

But considering the substructures,

$$\bar{0}_m \neq \bar{0}_n \quad (1 \leq m \leq 5;\ 1 \leq n \leq 5;\ m \neq n) \qquad (33)$$

I now point out that a scalar can be regarded as a stressed zero-sum vector, where the magnitude S of the scalar represents the internal stress intensity caused by the substructure of the zero-vector.

Thus, generally,

$$S(s^n t) \equiv \lim_{\Delta s^n \Delta t \to 0} \left[\frac{\sum_{n=1}^{k} |\bar{i}_s|}{\Delta s^n \Delta t} \right] \qquad (34)$$

That is, in general any observable scalar has, consists of, and is comprised of a VIRTUAL (unobservable) substructure that is very real indeed. One must also consider the scalar as existing for some finite time Δt, (at least for the time of one quantum change), and the intensity of the virtual actions occurring in the spatiotemporal substructure of the scalar during that time Δt is proportional to the magnitude of the scalar.

Normally, the concept of a scalar -- as presently used -- makes no allowance for the scalar to exist in time, or for a virtual vector substructure, or for any patterning inside the substructure. This is equivalent to assuming that

$$A \equiv 0 \qquad (35)$$

and that all $\bar{i}_s$'s are evenly distributed. That is, from this new viewpoint, presently the mathematical theory assumes all scalars to have an equal density of virtual activity per spatiotemporal volume in its virtual substructure, and an isotropic virtual pattern distribution of an infinite number of equal virtual vectors in its 4-space substructure.[28]

In the new approach, neither of these two assumptions need hold -- though in special cases they can hold. Thus present orthodox theory is just a single special case of a more fundamental approach indicated here.

Note that, by directly affecting and changing the virtual substructures of scalars and vectors, we can directly perform

virtual. state engineering, and this allows us to directly "engineer" the so-called "laws of nature" of the normal observable laboratory state and thus ENGINEER AND CHANGE PHYSICAL REALITY ITSELF.[29]

In the new approach, we can (observably) have

$$2 + 2 \neq 4 \qquad (36)$$

or

$$2 + 2 = 4 \qquad (37)$$

by the following means: In the first case (equation 36), we assume that the virtual substructures are patterned, and interact nonlinearly in such a way as to produce an extra observable. Thus we have a delta added to the normal observable scalar results of the interaction, as follows:

$$2_o + 2_o = 4_o + \Delta_{v\text{->}o} \qquad (38)$$

where subscript "o" means observable and "v" means virtual. Note that

$$\Delta_{v\text{->}o} \qquad (39)$$

indicates a delta due to virtual substructure interactions yielding an extra observable delta. This extra delta may be either scalar or vector in nature, depending on the circumstances and the particular interactions.

Note also that any vector or scalar must now be considered to HAVE, CONTAIN, and CONSIST OF an infinite substructure. And note that, similar to the scalar case, from the new viewpoint the present theory assumes each scalar (point) of the vector to have a structure similar to that of equation (34), except that now the scalars are ordered, with a linearly decreasing internal stress density per unit scalar along the line of the vector.

In the new approach, vector interaction (superposition, for example) can now violate present theory, if the two virtual substructures interact nonlinearly to produce a nonzero, observable delta. Observably (macroscopically) , this delta, again, may be either "scalar" or "vector."

This approach now becomes consistent with quantum mechanics at the foundation level.

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TOWARD A NEW ELECTROMAGNETICS PART III: CLARIFYING THE VECTOR CONCEPT

Help support the work

-- Substructures, Virtual Levels, and Hyperspaces --

In the new approach, our definitions and assumptions immediately drive us to a picture of an infinite set of nested levels of substructures in the virtual state. That is, anyone component (scalar or vector) in one level of virtual state has an infinite number of even finer virtual components, one level more subtle.

AND THAT IS WHAT PARTICLE PHYSICS AND QUANTUM MECHANICS ALREADY REVEAL ABOUT THE STRUCTURE OF PHYSICAL REALITY.

So these definitions and assumptions now provide the basis for a new vector mathematics that is in accord with, and fitted to, modern physical observations.

We have a picture such that any observable scalar or vector contains a virtual substructure (virtual level 1). Any scalar or vector in virtual level 1 also contains a finer virtual substructure, in virtual level 2. And so on ad infinitum.

Each succeedingly finer level of virtual state can be modeled as a hyperdimension (higher spatial dimension) as I pointed out in Appendix 1 to my book, The Excalibur Briefing.[30]

Thus this approach immediately ties into hyperdimensional or hyperspatial theory -- such as Elizabeth Rauscher's 8-dimensional theory[31] and C. Muses's hypernumber theory.[32]

The new definitions and assumptions are far richer than what is allowed by tensors, though there are many similarities. Muses's work, however, essentially can encompass most of these definitions and concepts, except the distinct types of vectors are not so clearly delineated in his theory (at least to my comprehension of it.) His theory does provide a nested,

hyperdimensional structure of time, however, and thus allows "scalar" waves in the hyperspatial structure of time -- in other words, observably "scalar" waves in the virtual state structure of spacetime, or pure Tesla waves, or simply "time" waves.

These are the bare notes; from this approach, already new (proprietary) mechanisms and exact specifications to make scalar waves -- in essentially whatever quantity and degree desired -- appear to have been successfully accomplished by my close colleagues.

The new approach is real and it leads to a new physics. And I believe that the very beginnings of the new physics are already working on the laboratory bench.

Nikola Tesla discovered the most essential features of the new electromagnetics over eighty years ago and was simply suppressed for his efforts. Now, although it has been eighty years in the reborning, Tesla electromagnetics is once again loose in the Western world.

This time, let us hope that it fares better at the hands of orthodox science and large financial control groups than it did for Nikola Tesla.

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TOWARDS A NEW ELECTROMAGNETICS
PART 4: VECTORS AND MECHANISMS CLARIFIED

by Lt. Col. T.E. Bearden (retd.), 1983
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TOWARD A NEW ELECTROMAGNETICS

PART 4: VECTORS AND MECHANISMS CLARIFIED

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of the

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The Tom Bearden Website

--FOREWORD --

This paper is an adaptation of the oral/visual presentation given by the author at the 1983 Annual Conference of the U. S. Psychotronics Association on Saturday, July 23, 1983.

The presentation was delivered directly from the vugraphs alone, and not from a formal, written text.

The title of the presentation at the conference was "New Electromagnetics: Where the 'Old Math' Took the Wrong Turn."

As originally conceived, the lecture was to be given in a single period of some 45 minutes and cover only the first part of this paper, the clarification of the vector concept in physical theory. The Symposium director so graciously scheduled two periods instead, allowing time to present additional material further clarifying vector and scalar waves, and to present a variety of unusual physical mechanisms that apply the concepts.

After the conference, the author prepared this paper directly from the same slides, in the same order. However, no attempt was made to match the words in this paper to the words actually delivered in the formal presentation. The gist of the two, however, are the same -- except that, in the conference lecture, the author covered (as an aside) some important additional material: (1) the nature of what actually occurs in an "electrical ground," and (2) the author's explanation of the theory of Tesla's magnifying transmitter.

An audio tape and a videotape of the author's USPA presentation were made by the conference officials. Copies are available at nominal cost from Mr. Robert Beutlich, Secretary/ Treasurer, U. S. Psychotronics Association, 3459 Montrose Avenue, Chicago, Illinois 60618, U.S.A.,
phone (312) 478-7715.

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SLIDE 1.

TOWARD A NEW ELECTROMAGNETICS

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ACKNOWLEDGEMENTS

I would like to express my deep appreciation to two of my fellow colleagues, Dr. William Tiller and Mr. Frank Golden, for many fruitful hours of discourse and interchange on these and related subjects.

Also, I wish to thank the Association of Distinguished American Scientists (A.D.A.S.) for support and assistance in the long and arduous struggle to revise the basic foundations of electromagnetics and mechanics.

Next Slide

SLIDE 2.

OUTLINE

- **MAIN BRIEFING**
  - **> TRANSLATOR EFFECTS**
  - **> POTENTIAL WEAPONS**
  - **> INCIDENTS**
  - **> CONCLUSION**
- **HISTORICAL BACKGROUND**
  - **> TESLA/MORAY**
  - **> WWII AND AFTER**
- **ELEMENTS OF THE EMERGING THEORY**
  - **> LONGITUDINAL/ TRANSVERSE WAVES**
  - **> VACUUM/MASS EFFECTS**
  - **> FLAWS IN VECTOR THEORY**
  - **> IMPLICATIONS**

This presentation is one part of a three part presentation, consisting of the main briefing on physical effects, the historical background, and the elements of the emerging new electromagnetics.

In this present briefing I will not cover the historical background. Instead, first I will address the concepts of the new theory, and then I will give an abbreviated main briefing, including some weapon aspects. I will present one simple free energy motor and show how it works, and where it gets its energy.

Much of this material I have known for some time, but have hesitated to release it because it enables one to develop -- in a fairly straightforward manner -- weapons and beams (ray) systems that can disable electronics, computers, communications, and people. Anyone

handy in electronics, who has a few thousand dollars and access to bench equipment and an electronics parts supply house, can develop these weapons in his or her basement workshop. But because certain very radical elements in this country already know some of this information and may plan to utilize such devices in criminal activities, I am openly releasing the information as a warning, to be prepared.

Of course there are many good things that can be developed with this technology, including machines to heal a remarkable variety of ailments and illnesses. I strongly urge everyone to use this information wisely and only to benefit other human beings. There exists a cosmic or karmic law for those who misuse it against their fellow persons; if one does that, one will assuredly suffer the consequences.

Also, I strongly urge the development of Western defenses against the Soviet strategic and tactical weapons; already developed utilizing these principles. Unless the West wakes up to the extreme urgency of this task, in the near future we may be overwhelmed in short order by a much harsher, dictatorial system. If that should happen, it will plunge the human race into a new dark ages far more terrible than that dark period in history following the fall of Rome.

These are the final times, and this is the beginning of the final technology. The ability to directly engineer physical reality itself has been laid in our laps. Pandora's box is already spilled open, and there is no longer any stopping the new technology.

Let us prepare, then, for that which is to come.

With these introductory remarks, let us now turn to the main presentation.

Next Slide

SLIDE 3.

CHARACTERISTICS OF SELECTED CONCEPTS

CONCEPT	CHARACTERISTIC
• ENERGY	FLOW OF OBSERVABLE MASS PARTICLES
• ANENERGY	FLOW OF VIRTUAL PARTICLES
• PRESENT "CHARGE"	VIRTUAL PARTICLE FLUX TIED TO OBSERVABLE MASS PARTICLES
• TRUE CHARGE	VIRTUAL PARTICLE FLUX WITHOUT MASS
• FLUX	MULTI-DIRECTIONAL FLOW THROUGH A POINT
• FLOW	UNI-DIRECTIONAL MOVEMENT OF A FLUX [GRADIENT]
• CURRENT	UNI-DIRECTIONAL GRADIENT OF A [USUALLY CONSTRAINED] FLUX

On this slide I show some fundamental defining characteristics of energy, "charge" or charged mass as presently in the theory, flux, flow, and current. These fundamental concepts are often somewhat confused in the literature.

Particularly note that the concept of energy, being tied to "the capacity to do work," is specifically tied to the concept of mass. Eventually, energy must be expressed in terms of moving masses -- specifically, in accelerating or decelerating masses.

I introduce the term "anenergy" here, specifically in relation to

the concept of a virtual particle. Anenergy is roughly equivalent to the present idea of "virtual energy,"
except it more precisely implies the flow or flux of virtual particles.

We also redefine charge as virtual particle flux, in order to remove the present error in EM theory where "charge" always implies a charged mass. The electrostatic scalar potential, phi (Ø) , then merely becomes the intensity of the massless charge -- that is, the intensity of the virtual particle flux -- at a point. Let me point out, however, that in the new view this "point" is always in n-dimensional space, where n is equal to or greater than four. The present 3-space formulation of Ø is thus a highly special case.

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SLIDE. 4

QUOTE FROM NIKOLA TESLA:

**"THE HERTZ WAVE THEORY OF WIRELESS TRANSMISSION MAY BE
KEPT UP FOR A WHILE, BUT I DO NOT HESITATE TO SAY THAT
IN A SHORT TIME IT WILL BE RECOGNIZED AS ONE OF THE MOST
REMARKABLE AND INEXPLICABLE ABERRATIONS OF THE SCIENTIFIC
MIND WHICH HAS EVER BEEN RECORDED IN HISTORY."**

Nikola Tesla
"The True Wireless,"
The Electrical Experimenter

One of the things we will find is that Hertz or transverse electromagnetic waves are strictly mass waves in a charged mass particle medium.

For example, transverse EM waves do not, and CAN not, exist in vacuum. Vacuum EM waves are longitudinal waves of compression and rarefaction. What is compressed and rarified is the virtual particle flux that comprises vacuum itself. Vacuum EM waves in this virtual flux are just like sound waves in air -- in the flux of molecules and atoms that comprise the atmospheric gas.

Nikola Tesla, of course, knew this and he frequently pointed out the falsity of the accepted transverse wave theory. Here is one Tesla quote, for example, taken from The Electrical Experimenter. (PAUSE)

Almost every scientist -- even the "Tesla bugs" -- have thought Tesla wrong in his adamant opposition to the idea of Hertzian waves in the vacuum.

As we shall see, Tesla was right and all the present scientists and textbooks are wrong .

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SLIDE 5.

FORCE BETWEEN TWO LIKE CHARGES

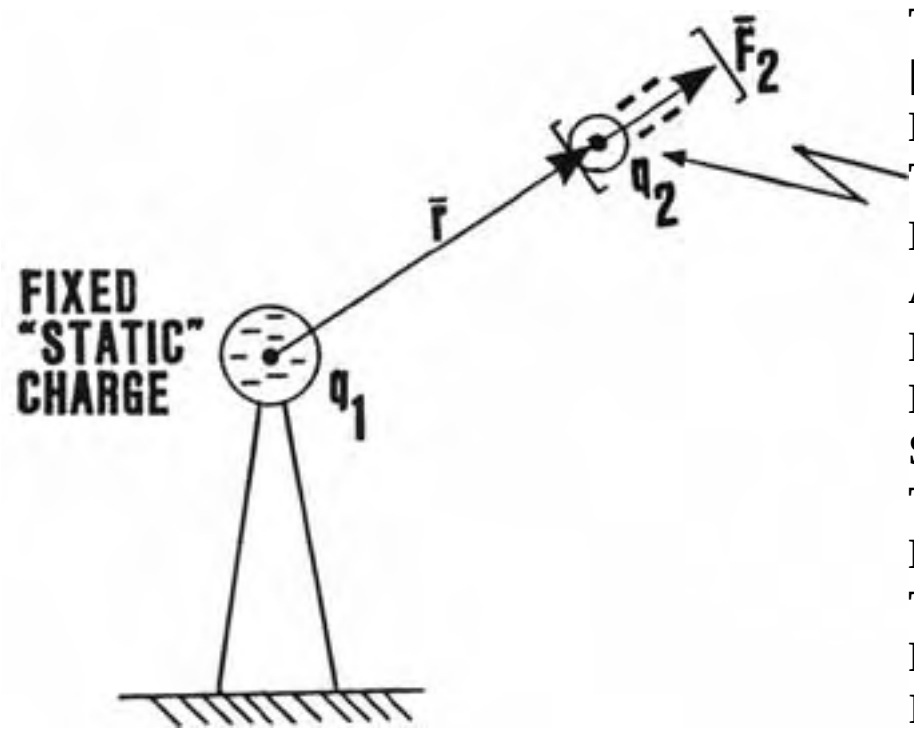

A NEGATIVELY CHARGED TEST MASS [e.g., AN ELECTRON] BROUGHT INTO THE VICINITY OF q_1 EXPERIENCES A FORCE $\bar{F}_2$ AS SHOWN. NOTE THE ELECTRON ACTUALLY IS SPINNING. THIS HAS NEVER BEEN DONE WITH A TRUE "STATIC CHARGE", FOR THERE IS NO SUCH THING IN NATURE.

In my presentation last year, I noted some 22 fundamental flaws in present electromagnetics theory. One of these flaws was in the actual vector theory itself. As we shall discover, one cannot simply plug geometrical vectors into physical systems without making fundamental errors. The vector concept itself must be adapted, for there are now four different kinds of vectors in physics, all confused as the same thing. We will come to that shortly.

To begin, let us look at the fundamental kind of experiment, shown on this slide, from which the idea of electrical force and electric field was taken.

We have a fixed static charged object q(l) in the laboratory, and we bring in a test charged mass q(2). The test charged mass may even be a single electron, as we illustrate here. We show in our example the fixed charge to be negative. When we release the test charge electron, it accelerates away from the fixed charged mass, as shown on the

diagram. Note that we have no force at all until we bring in the test charged mass. Indeed, we shall find that the force is actually COMPRISED OF the accelerating test electron. Specifically, it is not something mysterious which appears in vacuum and PUSHES on the electron. We shall find that FORCE IS AN EFFECT, NOT A CAUSE. It CONSISTS OF the "smeared mass" that is accelerating -- in this case, it consists of the smeared, accelerating electron.

We summarize the experiment: in the absence of the charged test particle, no force exists in the vacuum. When we bring in the test charged mass, it accelerates away, and THE FORCE CONSISTS OF THAT ACCELERATING CHARGED MASS PARTICLE. The experiment does not at all address or deal with WHAT EXISTS IN THE VACUUM AROUND CHARGED MASS Q(l) IN THE ABSENCE OF TEST CHARGED MASS Q(2). Any assumption of a force existing in the vacuum is sheer speculation and not based on this experiment.

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SLIDE 6.

REPETITIONS LEAD TO THE VECTOR "FIELD" CONCEPT

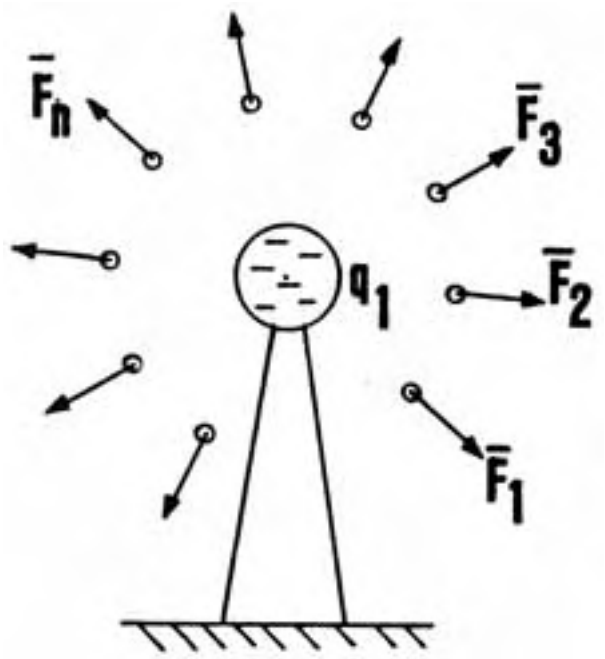

REPEATING FIGURE 4 A NUMBER OF TIMES LEADS TO SETS OF FORCE ARROWS, WHICH WE THEN VISUALIZE IN TOTAL AS A FIELD, Ë, OF FORCE(S) ABOUT q_1

RIGOROUSLY, THIS "FORCE FIELD" WOULD REQUIRE THAT A SPINNING CHARGED PARTICLE OF MASS EXIST AT EACH AND EVERY POINT IN SPACE ABOUT q_1

On this slide, we show that, as we repeat the experiment by bringing in the test charged mass from differing directions, the same thing happens around the fixed charged mass q(l). Test charged mass q (2) -- our electron -- accelerates radially away from q(l).

As we repeat the experiment and draw many of the little arrows radially outward, gradually the idea of a "vector field" emerges. That is, we form the idea that, at every point in space around fixed charge q (l), there exists one of our little vector arrows. Thus we assign a vector field to the space: to every point of it, there is assigned both a magnitude and a direction.

However, note that this does not describe the situation as it exists, at any time, in the "present." That is, rigorously any one arrow only exists whenever a little test charged mass is present and accelerating radially away.

We may take the view that the arrow WILL exist WHEN a test

charged mass is brought to that point and released. In that case, the arrow WILL exist in the FUTURE, not the present. And we may refer to that as, it POTENTIALLY exists, when and if.. ..etc.

So already we see a fundamental logical problem in the idea of such a field. It WILL exist in the future, but only POTENTIALLY exists in the present.

Of course I am not the first one to point out such difficulties; the fact that the field concept is erroneous is already well-known to foundations scientists. But it is such a USEFUL concept that it is retained.

Now the Ë-field, or electric field, is defined as "the accelerating force on a charged mass per unit charged mass accelerated by it." If there is no charged mass present to be accelerated, then there can be no Ë-field present.

So Ë-field cannot exist in vacuum, for vacuum presupposes the absence of all observable mass.

So we can rigorously say that no Ë-field of force exists around the charged mass q(l) IN THE PRESENT. At best, it can only POTENTIALLY exist IN THE FUTURE.

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SLIDE 7.

A SCALAR HAS A HIDDEN [VIRTUAL] VECTOR SUBSTRUCTURE

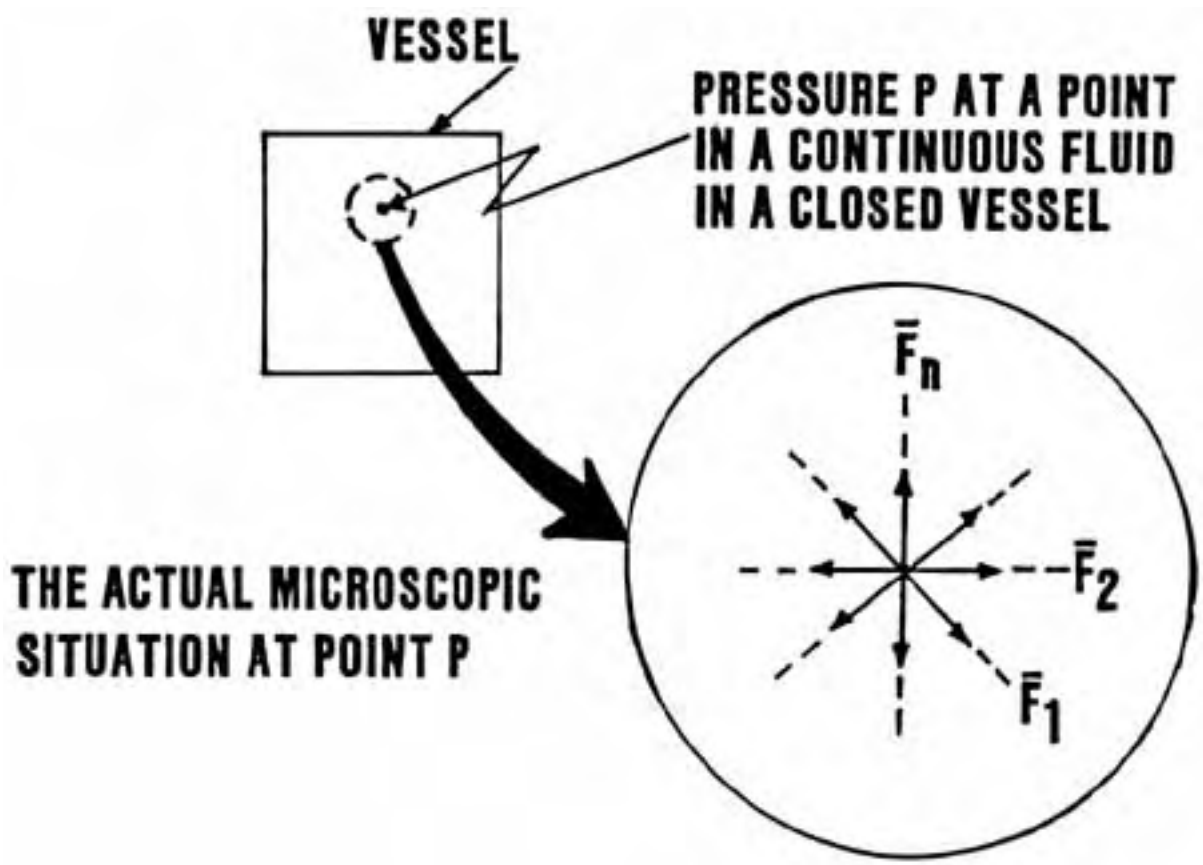

Our next slide shows that a physical scalar quantity has a hidden vector substructure.

For example, we show on the left a closed vessel containing a pressurized gas. The pressure at a point in the gas is a scalar quantity, since it has a magnitude but not a direction. However, physically what we have in the gas is a flux of individual molecules continually through any small volume, which we may let approach a point in the limit. Thus we have a flux in all directions through the point at which we specify pressure.

That is, the scalar "pressure" at a point may be said to contain a substructure of individual molecule flow vectors.

All physical process scalars have such hidden substructures. In

the equilibrium case, the summation of all the individual flux vectors yields a resultant vector zero.

Thus we take the view that ANY PHYSICAL PROCESS SCALAR IS ALSO A ZERO VECTOR, AND ANY ZERO VECTOR IS A SCALAR AND CONTAINS A SUM-ZERO HIDDEN VECTOR SUBSTRUCTURE.

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SLIDE 8.

SCALAR AND VECTOR SUBSTRUCTURES

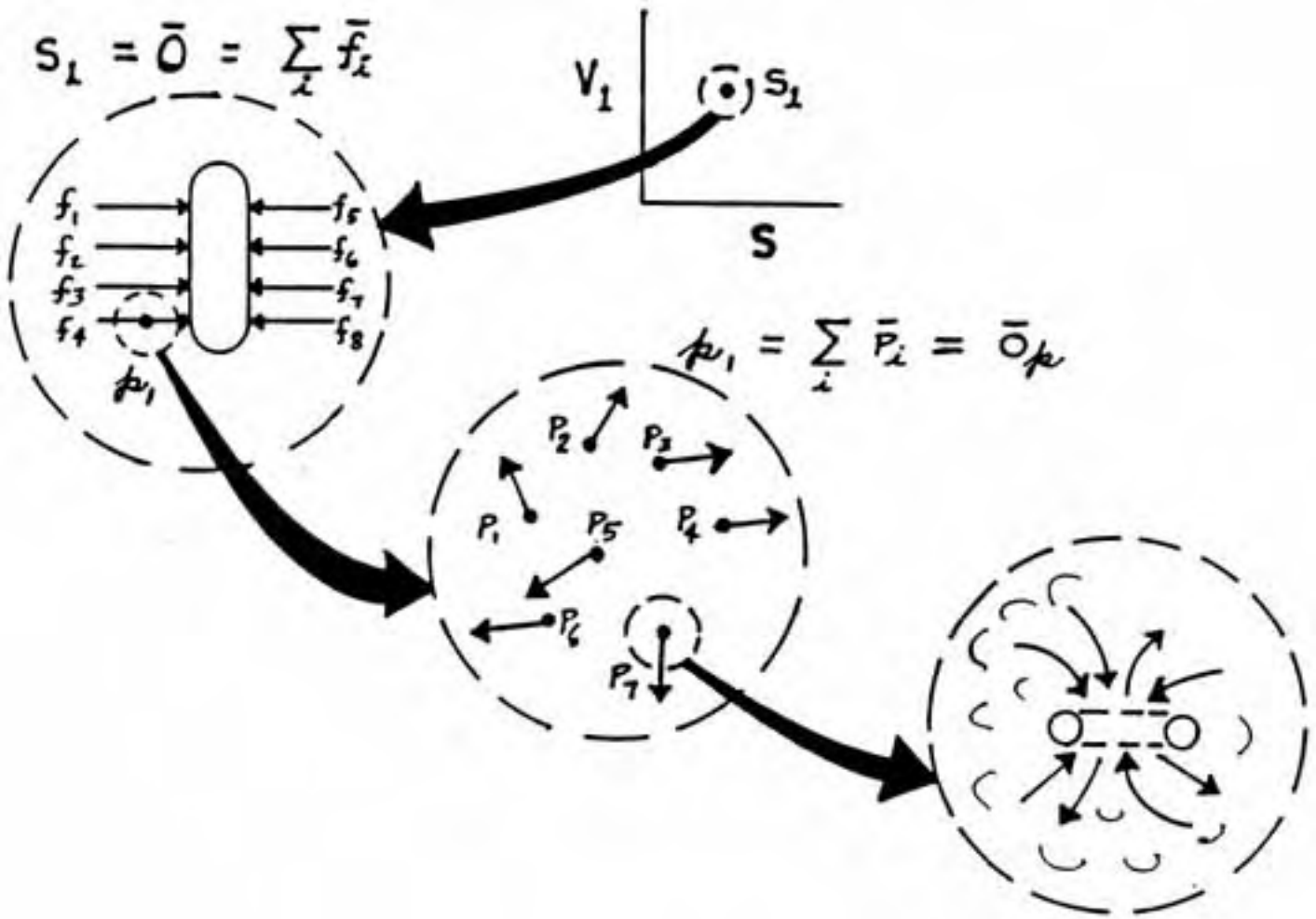

Now let us see if we can do some unusual thinking about the hidden vector substructure of a scalar or zero-vector.

On the leftmost figure in this slide, we show a plate with balanced opposing forces. The vector summation of all the forces' is zero, so the system has no resultant vector. The plate therefore does not move. However, the plate -- that is, the medium in which the forces act -- is stressed, much like the previous example of pressure in a gas. The difference is that now the stress is patterned in its substructure, and not random. Now suppose we rhythmically vary the forces, each the same, in a regular manner in time. Yet we maintain a continuous balance, so there is never a system resultant greater than zero. In this case, we maintain our vector zero, but we are producing regular stress waves in the plate medium..

I think you now can see that I can vary the individual opposing vector pairs so that rhythmic waves flow from top to bottom, or from bottom to top. That, of course, will describe a vector gradient traveling through the medium, and that will be an ordinary "vector wave." Is there any way I can make waves through the medium, and not have such vector waves ever appear?

Indeed there is, if I look further into the substructure. Take one point on one of the vectors shown acting on the plate in the left diagram. That point is a scalar, and it also has a substructure of even finer vectors, as shown in the lower middle figure. And any point in one of these second-order hidden vectors is a scalar and composed of a still finer hidden vector substructure, as shown in the lower right figure. This process repeats ad infinitum, and all is structures within structures. At least it can be modeled that way, for it already is treated that way in particle physics.

Now go back to the second order vector substructure. Here I can establish whatever patterns I wish, and not affect the first order pattern shown in the figure on the left. I can even rhythmically vary things in the second order substructure, and leave a blissfully unchanged first order substructure, to the first order observer.

So I can make as many waves; as I wish through the medium, as long as I stay second order or higher, and the external observer will never see any change at all unless he has a special detector of some sort to detect the lower substructure changes.

As I showed in the Appendix to my book, The Excalibur Briefing, these substructures are in reality the same thing as hyperspaces. And movements in them can proceed much faster than the speed of light.

So I can have higher order signals and waves through the stressed medium without changing the overall first order stress in the medium.

This is a sort of super-relativity; the present relativity is just a special case.

Superluminal communication systems are perfectly possible, but not with the present first order transmitters and receiver/detectors.

Note also that higher order stresses -- stresses in the higher order substructures -- represent special stresses in time, and time has an internal stress-pattern substructure. The higher order stress waves are phase waves or phase fluctuations in that respect.

Also note that Charles Musés has already created the hypernumber mathematics of the structure of time, and it is largely in his mathematics that these concepts will have to be mathematically modeled.

Next Slide

SLIDE 9.

SUPERPOSITION DOES NOT ELIMINATE THE VIRTUAL SUBSTRUCTURE

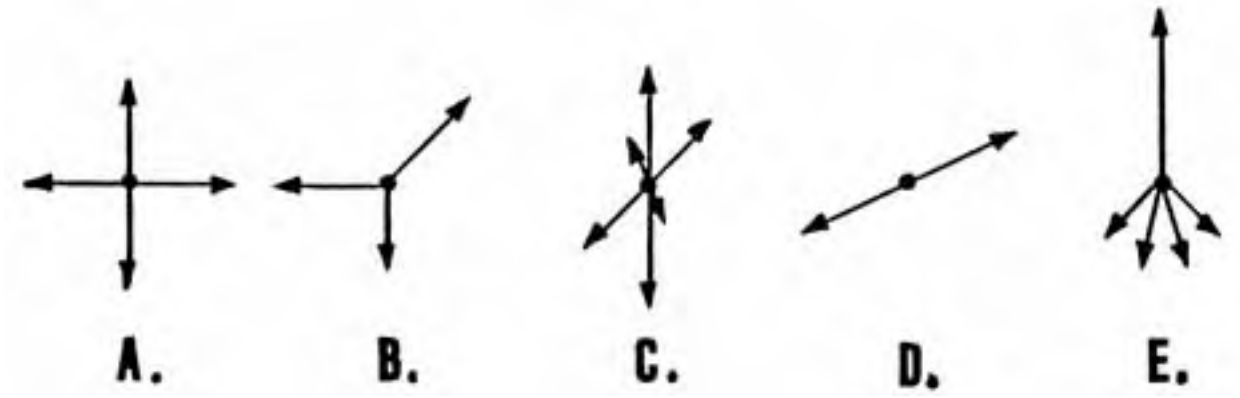

TWO OR MORE MACROSCOPICALLY "EQUAL" VECTORS OR SCALARS CAN DIFFER DRASTICALLY IN THEIR VIRTUAL SUBSTRUCTURE DISTRIBUTIONS. EVEN TWO "ZEROS" MAY BE DYNAMICALLY DIFFERENT DUE TO THEIR DIFFERING SUBSTRUCTURES.

Next we show some simple substructures of a zero vector. All of these vector systems sum to zero vectorially. Note that if we superpose two of these structures, all substructure vectors are still present., and the vector summation is still zero.

Also notice that, from the standpoint of substructuring, zeros can be and are drastically different.

We can even make rhythmic waves in the substructure by superposing patterned zero vectors in a regular fashion.

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SLIDE 10.

PHYSICAL VECTORS

- **VECTOR: A "SMEARED PARTICLE"**

- **FOUR MAJOR PARTICLES IN PHYSICS:**
  - POINT [MASSLESS, CHARGELESS]
  - MASS [CHARGELESS]
  - CHARGED MASS
  - CHARGED POINT [MASSLESS}

- **LEADS TO FOUR MAJOR VECTORS:**
  - GEOMETER'S
  - MECHANIC'S
  - ELECTRICIAN'S
  - ADVANCED ELECTRICIAN'S

In quantum mechanics, as we approach the quantum level, we find that the notions of a particle (static concept) and a wave become inseparable. That is, any particle becomes a "smear" in length and time, and it becomes inseparable from its smear. At the quantum level, there is no separate energy, length, mass, momentum, energy, or time -- all are welded together inextricably into a quantity called "action," having the units of angular momentum.

So at the fundamental quantum level, a moving point becomes a smear, and a vector represents a physical, undifferentiated entity.

To go quickly, we now define a vector as consisting of a smeared particle. That is, the particle is smeared in both time and length, and it is not differentiated from time or length.

There are four kinds of particles in physics which can be smeared to form vectors. First, there is a point in space or spacetime. This point may be approximated as massless and chargeless. At least that is the way the geometers of old conceived it in the abstract, and so the idea of a "point" in space assumes it to be chargeless and massless. Second, there is a tiny particle of mass, often abstracted to be a "point-mass," but visualized as having no charge. This is the mechanic's particle. Third, there is a tiny charged mass, such as an electron, and this is the electrician's particle. Again, it is often abstracted as a charged point-mass. Fourth, there is a charged point, having no mass, and this is the advanced electrician's particle, which he uses to form the idea of potentials and fields.

Smearing these four particles at the fundamental quantum level produces four different kinds of physical vectors: the geometer's, the mechanic's, the electrician's and the advanced electrician's vectors. They are all different.

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SLIDE 11.

THE FOUR VECTORS OF PHYSICS

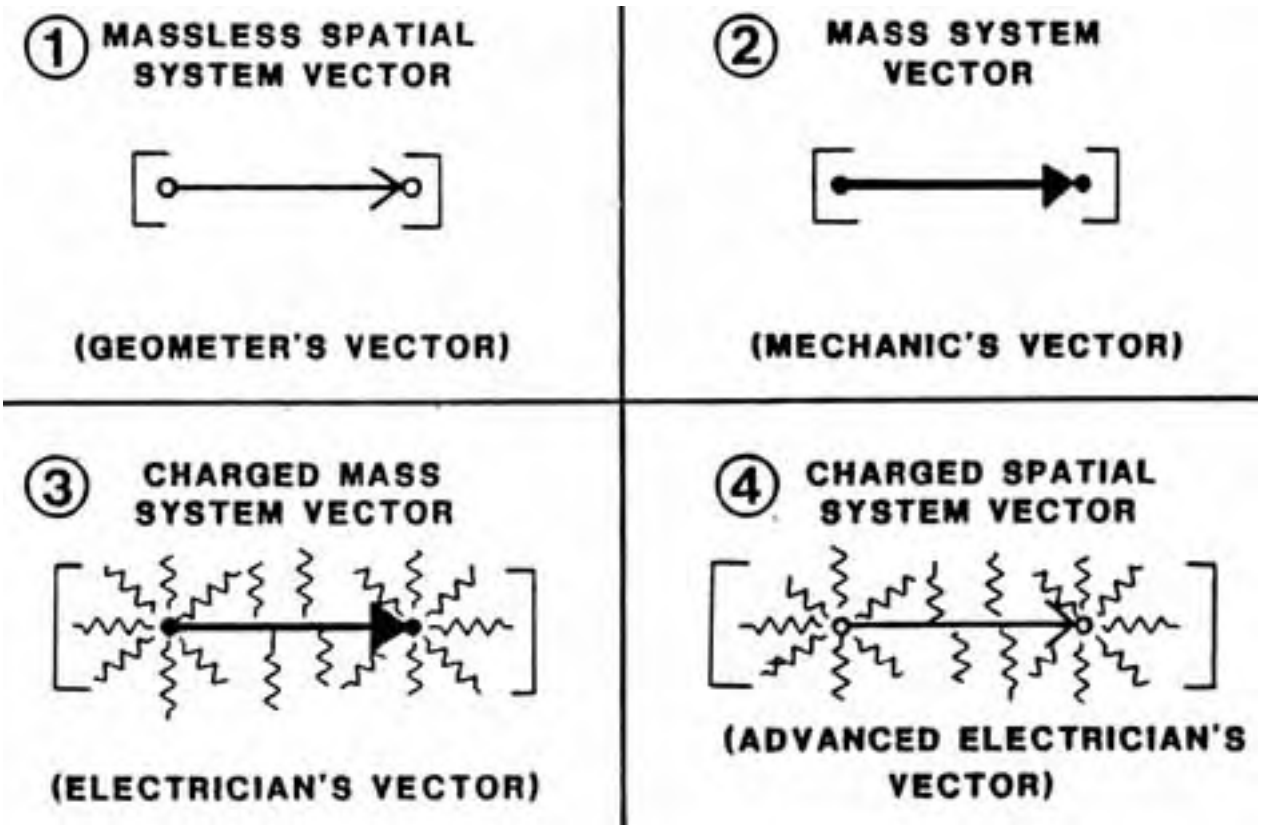

On this slide we show a graphic illustration of each of these vectors.

Note that they may be visualized as smeared particles, but the particle is not separate from the smear in time and length.

Each vector must be considered as a unitary entity -- it is a special kind of quantum, if you will.

Each is a special quantum of motion.

And Dewey Larson has it right when he says, "All is motion."

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SLIDE 12.

FORCE DEFINITION

- ***A TRUE DEFINITION IS AN IDENTITY.***

$$F \equiv d/dt\ (mv)$$

- **FORCE CONSISTS OF THE TIME RATE OF CHANGE OF MOMENTUM**
- **MOMENTUM IS A MASS SMEARED THROUGH A LENGTH IN A CERTAIN TIME**
- **FORCE CONSISTS OF MASS-MOTION-CHANGE**
- ***FORCE IS AN EFFECT, NOT A CAUSE !***

We now look a little closer at the concept of a force.

I point out that a true definition is an identity. If a supposed definition of an entity is not an identity for that entity, then it is not a definition at all, but only a statement ABOUT the entity.

It may come as somewhat of a shock to the normal engineer and scientist that the foundations concepts of physics -- such as force, mass, energy, etc. -- are ALL in serious difficulty and contain many unresolved logical conflicts.

Force is in that kind of difficulty, and it has that kind of logical conflict.

In fact, in its force equations, physics has not even applied its own present definition of force.

As we show here, force is generally defined as the time rate of change of momentum.

If that is true, then as an identity the definition states that a force CONSISTS OF the time rate of change of momentum.

And of course, momentum is mass times velocity. Hence momentum is a mass smeared through a length and through a certain time.

Force then consists of the time rate of change of that smearing. That is, we smear the mass through time and length, faster or slower.

But if force CONSISTS OF that smearing change, it does not CAUSE it.

Force is thus an effect or result, not a cause.

This implies that there is a more fundamental mechanism that causes or generates force itself -- ANY force. If we can find that hidden mechanism, we may well find the long-sought unified field theory, since it will unify all forces on a common mechanism.

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SLIDE 13.

FORCE IS AN EFFECT NOT A CAUSE

---

1. $\bar{P} = M\bar{V}$ (MACROSCOPIC)

2. $\bar{P} \equiv \overline{[M\bar{V}]}$ (MICROSCOPIC)

3. $\bar{F} = \frac{d\bar{P}}{dt}$ (MACROSCOPIC)

4. $\bar{F} \equiv \frac{d\bar{P}}{dt} \equiv \frac{d}{dt}\overline{[M\bar{v}]}$ (MICRO)

   $\equiv \overline{[M\bar{v} + M\bar{a}]}$

5. $F \equiv \overline{[M\bar{a}]}$ (NONRELATIVISTIC)

6. FORCE CONSISTS OF A "SMEARED MASS"

7. IT IS MASS-ACCELERATION, IT DOES NOT CAUSE IT.

8. FORCE IS AN EFFECT, NOT A CAUSE!

On this slide, we show briefly how one might express this idea in mathematical symbology.

Macroscopically, momentum consists of mass times velocity. Microscopically, the mass and the velocity are inextricable, and it is not proper to speak of a "mass in motion," but only of "mass-motion." We show this in equation 2.

We take the macro definition of momentum, as shown in equation 3, and express it for the microscopic, unseparated case, as shown in equation 4.

In the nonrelativistic case, we may consider m-dot to be zero, since the time rate of change of mass is almost zero. In that case, force may be defined for the microscopic case as a smeared accelerating mass, as shown in equation 5.

Force thus consists of the welded mass and acceleration, with no seam in the middle.

It IS mass-acceleration; it does not CAUSE it. Therefore force is an effect, not a cause.

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SLIDE. 14

FORCE AND $\bar{E}$-FIELD DO NOT EXIST IN VACUUM

1. $\bar{F}_p \equiv \overline{[M_p \circ \bar{a}_p]}$

2. WITHOUT M, THERE IS NO M_p, NOR $\bar{F}_p$

3. HENCE FORCE DOES NOT EXIST IN VACUUM.

4. $\bar{E}_{cm} \equiv \dfrac{\bar{F}_{cm}}{q_{cm}}$

5. WITHOUT M, THERE IS NO $\bar{F}_{cm}$, NOR q_{cm}.

6. HENCE $\bar{E}$-FIELD DOES NOT EXIST IN VACUUM.

7. SIMILARLY, $\bar{B}$ AND $\bar{G}$ DO NOT EXIST IN VACUUM.

8. NO FORCE FIELD EXISTS IN VACUUM.

But if force CONSISTS OF mass welded to acceleration, it cannot exist in the absence of mass.

Hence force does not exist in vacuum.

Further, the Ë-field (Electric field) of a charged particle is defined as the force on a charged mass, divided by the mass. That is, the Ë-field is thought to represent the force per unit charged mass. And then it is assumed to exist in vacuum.

But vacuum is without mass or charged mass, observably. Without mass, neither force nor charged mass exists.

Therefore the Ë-field does not exist in the vacuum.

Magnetic field (B) and gravitational field (G) are similarly defined, and they have the same logical difficulties.

Therefore neither magnetic field nor gravitational field exist in vacuum.

A priori, NO force field exists in vacuum.

The greatest error in physics has been the assignment of a force as a cause, and thus assigning it to the vacuum. The force is an effect, and it never exists in vacuum, a priori.

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SLIDE 15.

COROLLARIES

- **MORE PRIMARY MECHANISM CAUSES/GENERATES FORCE -- ANY FORCE**
- **FORCE DOES NOT EXIST IN VACUUM, SINCE VACUUM IS THE ABSENCE OF MASS**
- **FORCE FIELDS DO NOT EXIST IN VACUUM**
    - **E-FIELD**
    - **B-FIELD**
- **TRANSVERSE [HERTZIAN] WAVES DO NOT EXIST IN VACUUM**

Without belaboring the issue, I now point out and summarize some of these conclusions.

First, a more primary mechanism causes or generates force -- ANY force.

Second, force implies the presence of mass a priori. Force does not exist in vacuum, since vacuum is the absence of mass.

Third, no force fields of any kind exist in vacuum, including Ë-field, B-field, and gravitational field.

Fourth, since Hertzian waves are defined in terms of Ë and H force fields, and these fields do not exist in vacuum, then Hertzian waves do not exist in vacuum.

Tesla pointed out long ago that vacuum EM waves are longitudinal waves, not Hertz waves. Vacuum EM waves are similar to sound waves in a gas.

The Hertz wave exists as a matter wave in the electron gas in a transmitting antenna, and in the electron gas in a receiving antenna, but does not exist in the vacuum in between the two antennas. Between them, EM waves are longitudinal waves.

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SLIDE 16.

ENERGY IS DERIVED, NOT FUNDAMENTAL

- ENERGY IS CONGRUENT TO WORK

$$dW = \bar{F} \cdot \bar{d}S$$

- BUT FORCE IS AN EFFECT, NOT A CAUSE
- THUS WORK IS AN EFFECT, NOT A CAUSE
- ENERGY≡WORK CAPACITY
- A MORE FUNDAMENTAL MECHANISM GENERATES "ENERGY"

$$\Delta E = \frac{\Delta A}{\Delta T}$$

- ENERGY IS AN EFFECT, NOT A CAUSE

Energy is usually taken as "the capacity to do work" at some future time. In other words, when we refer to the energy of something, we refer to HOW MUCH WORK IT CAN DO IN THE FUTURE, IF AND WHEN WE ARRANGE FOR IT TO DO IT. Rigorously, a body has no "work" at a particular instant in time, so we use "energy" to refer to potential work that can, or will, be done in the future. Thus energy is always congruent to work in the future.

And for that reason, the units of energy are the units of work; the only difference is in the time the work is done, relative to the "now" or "present" we are speaking of.

Energy is the potential for work to be done in the future.

But what is work?

Well, work is defined in terms of the movement of a force through a distance. And it is understood that only the projection

of the force along the line of movement is "working." Thus work is defined differentially as shown on the slide. The differential of work is equal to the dot product of the moving force times the differential of displacement.

But as we have seen, force is an effect, not a cause.

That is, when we calculate the work done, it's always in the past, never in the present or future. It's always been DONE, and has been expended.

Being in the past, it's gone forever, so it certainly isn't the CAUSE of anything which happens in the future.

Thus work is an effect, not a cause.

That's interesting, because then it certainly does not directly generate "energy," since energy is something in the present which speaks of future work to be done.

Rigorously, the fundamental quantum -- which is what exists in the present, in unseparated and unquantized form -- consists of action. NOT energy, NOT time, NOT length, NOT momentum exclusively, but all of these IN<u></u>clusively.

And a change in energy occurs when a quantum is separated at a certain rate in time. Thus delta energy equals the time rate of change of action, or delta action divided by the delta time used in separating the quantum and fissioning it into parts (collapsing the wave function).

Thus energy itself is an effect or result of a more fundamental mechanism, and it is not a cause.

In quantum mechanics all this has been neatly "buried" in the mysterious "collapse of the wave function," which is supposedly what "causes" everything to happen. And then we swear that what results after the collapse is a totally statistical selection from the possible states of the system we are examining. We thus say that the microworld is totally statistical at base. Of course we also build a wave equation or wave function which propagates forward in time with rigorous causality, and that wave or function absolutely controls the basket of "possible states" allowed .

All that says is that the "wave function times time" is what exists in the present, when observation has not been made by "stopping time." And then we "stop time" in a rather blunt manner, somewhat like firing a billiard ball blindly into a group of billiard balls on a table, and we live with what gets hit and pops out.

If we examine this "time" that is flowing, look into its substructure, and arrange that substructure as we will, we can control which "billiard ball" is hit and which pocket it goes into. By working on the vector substructures of time, we can thus deliberately control the microworld and make it causal, not

statistical. Quantum mechanics is in error in stopping where it has; it is presently only a first order approximation of the real quantum mechanics that awaits.

Einstein was correct after all; God does NOT play dice with the universe when one considers all levels.

One finds oneself in a statistical situation at one level only when the constituent sublevels of it are uncontrolled.

Next Chapter

SLIDE 17.

EXISTENCE IN, AND PASSAGE THROUGH, TIME

- **IN RELATIVITY, TRANSLATION OF A BODY AND PASSAGE THROUGH TIME ARE RELATED**

$$\Delta L = C \Delta T$$

- **"MASS" IS SPATIAL**
  - DOES NOT EXIST IN TIME
  - "MASS-TIME" EXISTS IN TIME

- **VIRTUAL FLUX TO AND FROM A BARE PARTICLE DETERMINES ITS "PASSAGE THRU TIME"**

- **SPHERICAL SPIN OF A MASS PARTICLE [L^3] COUPLES IT TO THE SPACETIME VACUUM [L^3T] VIRTUAL PARTICLE FLUX**

- **PASSAGE THROUGH ORDINARY TIME IS CONTROLLED BY CREATION AND ANNIHILATION OF QUANTA**

On this slide, we simply point out that translation of a body through space and its passage through time are related, according to relativity.

Now "mass" is spatial.

It does not exist in time.

Only things which contain the unit of time can "exist in time."

Otherwise, the thing only exists as such when the passage of time has been momentarily stopped -- usually by photon emission and the consequent carrying off of the time unit by the photon.

Since every mass that has temperature -- and every mass does -- is continually absorbing and emitting photons, then the mass is continually grabbing a time tail (absorption) and losing it (emission) shortly thereafter.

Masstime is what exists in time, not mass.

And every mass particle is continually turning from mass to masstime to mass, etc.

Indeed, it is the summation of the absorption and emission of virtual subquanta by a mass particle -- i.e., its "charge" -- that determines its rate of flow through "time."

And the spherical spin of a mass particle couples the particle of mass to the spacetime vacuum; that is, to the virtual particle flux.

Passage through ordinary time is controlled by creation and annihilation of quanta, and these processes are controlled by substructure (subquantal) actions and interactions.

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SLIDE 18.

SOME IMPLICATIONS

- **MODIFIES CONSERVATION OF CHARGE**
- **MODIFIES CONSERVATION OF ENERGY**
  - ***MASS***
  - ***ENERGY***
  - ***ANENERGY (MASSLESS CHARGE)***
- **MODIFIES NEWTON'S LAW**
  - ***FOR EVERY ACTION, THERE IS AN OPPOSITE AND EQUAL REACTION***
  - ***REACTION NEED NOT BE LOCAL***
  - ***REACTION NEED NOT BE ANTIPARALLEL***
- **UNIFIED FIELD THEORY**

Without belaboring the issue, I now simply point out some implications of the new approach.

First, we modify two laws -- the conservation of charge and the conservation of energy -- by combining them into one law, a new conservation law in which anenergy is conserved.

Neither charge per se nor energy per se need be conserved; but the overall anenergy (massless charge) equivalency is what is conserved. This allows us to derive mechanisms for free energy from the vacuum, for example. These mechanisms readily violate the present conservation of energy law, but do not violate the overall conservation of anenergy law.

It is the total anenergy equivalency of mass, energy, and massless charge that is now to be conserved in general. The old laws are now just special cases.

Also, Newton's third law -- for every action there is an equal and opposite reaction -- is modified. It still applies, but in changed form.

The reaction still occurs, but it need not be local, and it need not be antiparallel to the original action.

Thus it is now possible to design and build a "locally reactionless" inertial space drive for a vehicle.

The final implication is that the common mechanism producing force -- any force -- provides a unified field theory. Specifically, it provides one which easily lends itself to direct engineering. It is not esoteric nor mysterious. It is practical and physical, and it can be done with some modifications to our present electrical circuits and devices.

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SLIDE 19.

CONSERVATION OF ANENERGY (AE): (AN EXPANDED ENERGY CONSERVATION LAW)

1. CONSERVATION OF CHARGE:
   - "CHARGE" = MASS (M_c) + CHARGE (AE_c)
   - $|M_c| + |AE_c| = K_1$
2. CONSERVATION OF ENERGY:
   - DYNAMIC ENERGY (E)
   - ENERGY EQUIVALENCE OF MASS (M_E)
   - $|E| + |M_E| = K_2$
3. ADDING (1) AND (2):
   $|M_c| + |AE_c| + |E| + |M_E| = K_1 + K_2 = K_3$
4. LETTING $|M| = |M_c| + |M_E|$,
   $|M| + |E| + |AE_c| = K_3$
5. LETTING $|M| = AE_1$, $|E| = |AE_2|$, $|AE_c| = AE_3$,
   $AE_1 + AE_2 + AE_3 = K_3$

We briefly show a simplified derivation of the new conservation of anenergy law.

We express the conservation of charge law by correcting the term "charge" to show its true meaning: charged mass. We use the absolute value symbol to mean the "anenergy equivalency."

As shown on the slide, we account separately :for the mass (m-sub-c) of the conserved charges and the virtual particle charge flux (the anenergy -- AE-sub-c) of the charges conserved. That law now says that the absolute values of the masses and the massless charge fluxes have a total constant summation.

For a dynamic mass, we do a similar thing, in this simplified case ignoring potential energy of position, and taking the energy equivalence of the dynamic energy (M-sub-E) and the rest mass energy of the particles, M-sub-E. The conservation of energy now states that these two terms have a constant absolute value summation.

We add equations 1 and 2, getting equation 3. We consolidate like terms to get equation 4.

Expressing all terms in their anenergy equivalencies (absolute values), we get equation 5, which is the overall conservation of anenergy equivalency.

Note that we now can change mass into energy or anenergy (massless charge), energy into mass or anenergy, and anenergy into mass or energy.

Thus we can turn everything into pure vacuum ether (pure massless charge, pure anenergy, pure electrostatic scalar potential, pure stress on spacetime) or we can turn part of the vacuum into energy or particles of mass.

Vacuum now becomes a very real thing indeed.

It is pure anenergy.

Pure massless charge, pure electrostatic scalar potential, pure "broken bits" (subquantal bits) of (quantized) energy.

The vacuum is identically the virtual state.

It is not an emptiness filled with virtual things; rather, it IS the sum total of those virtual things, for they are totally unseparated until some sort of "conceptual observation" is invoked.

Physics should have adopted Einstein's suggestion that the vacuum, complete with its EM and gravitational fields, be called the ether.

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SLIDE 20.

FREE ENERGY IS ALLOWED

- **ANY ONE-WAY GATING PROCESS FROM ANENERGY TO ENERGY YIELDS "FREE ENERGY" SINCE THE ANENERGY IS AUTOMATICALLY REPLENISHED BY THE UNIVERSE.**

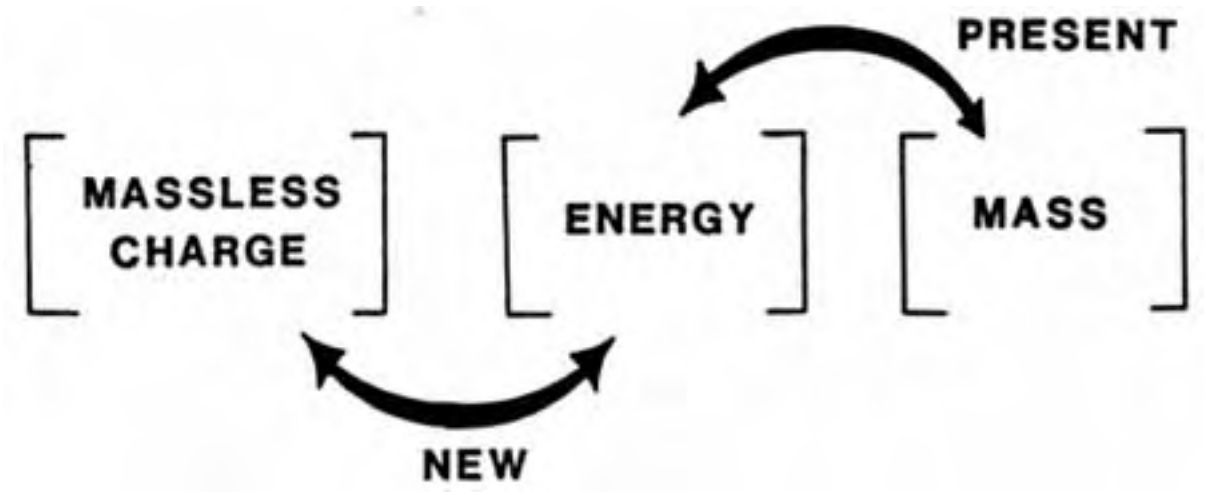

Now we can put the search for free energy devices on a rigorous scientific basis.

As shown here, mass and energy are translatable one into the other. So are massless charge and energy.

And the universe is filled with fantastic amounts of anenergy; ultimately, that is what the universal vacuum IS.

Any one-way gating process from anenergy to energy yields "free energy" since the anenergy is automatically replenished by the universe.

A sort of Maxwell's demon, after all, is what we need. Only we need one which works with the virtual state, not observable molecules.

Fortunately nature has provided several Maxwell's demons of this sort, if we but recognize them and learn to use them.

Next Slide

SLIDE 21.

SCALAR POTENTIAL CAN FORCE THE RELATIVISTIC CASE

- **FOR SCALAR POTENTIAL ENERGY OF APPRECIABLE SIZE RELATIVE TO A PARTICLE'S REST ENERGY.**
  - **NEWTONIAN MECHANICS AND**
  - **THE SCHRODINGER EQUATION**
- **MAY BE INADEQUATE**
  - **EVEN IF V/C IS SMALL**

Bloch & Crater, "Lorentz-invariant potentials and the non-relativistic limit," American Journal of Physics, Vol. 49, No. 1, Jan. 1981, pp. 67-75

First, let us now digress to point out that one does not have to have relativistic velocity to obtain relativistic effects.

One can use the common electrostatic scalar potential to drive the situation relativistic. On this slide we show just one of several references in the standard literature that address this fact.

Let's understand what we are saying.

Anything you get from a relativistic situation, you can get directly by cleverly applying electrostatic scalar potential.

You can get a change in the passage through time, you can get energy changes, mass changes, inertial resistance changes, etc.

You can bend, warp, and twist spacetime like a pretzel.

If you "wave" the scalar potential by simply varying it , you can create pure time waves. You can also produce pure inertial field waves, pure gravitational waves, etc.

The ability to engineer the curving of spacetime allows the direct ability to engineer physical reality itself.

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SLIDE 22.

SCALAR STRESS WAVE [O-WAVE] [TESLA WAVE]

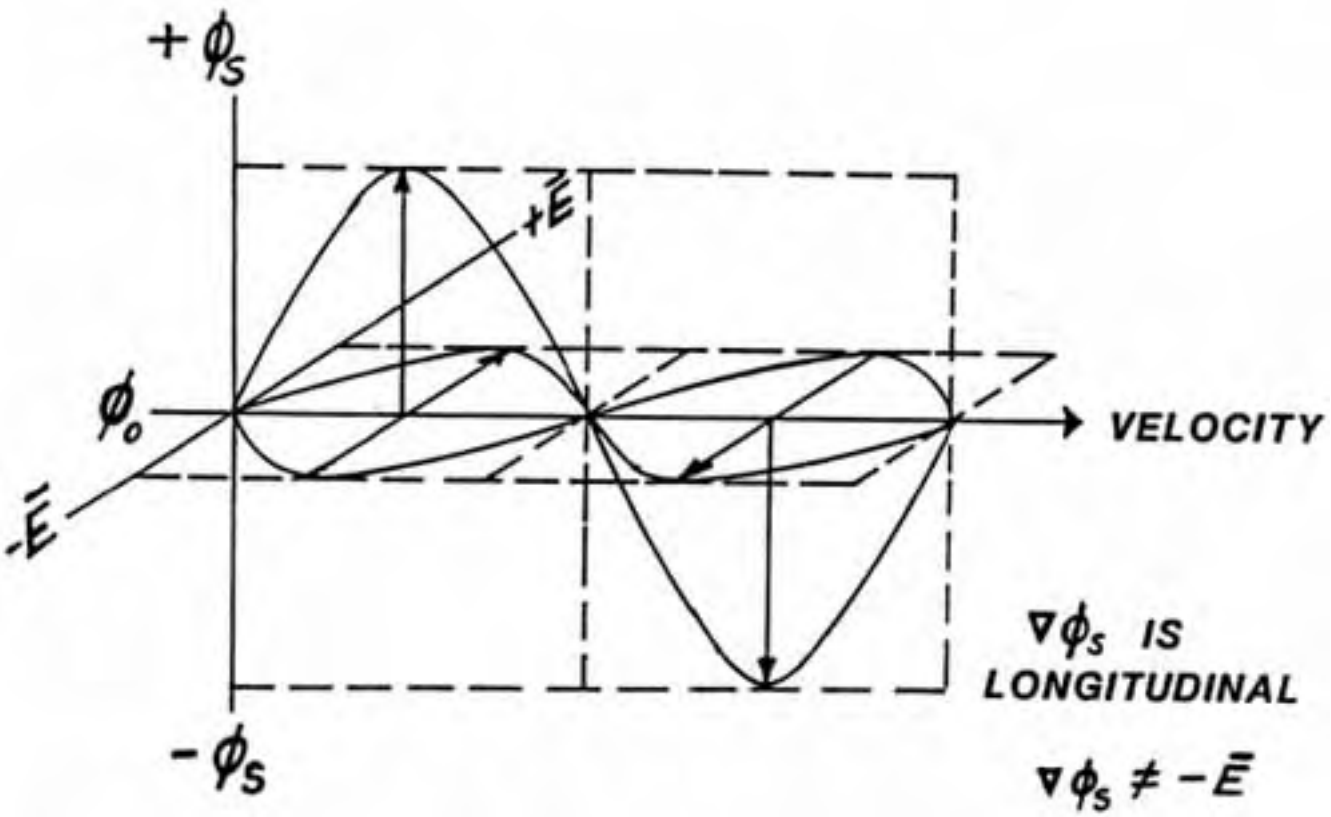

On this slide we now show a simple way to make a scalar, zero-vector wave -- the kind of wave originally discovered by Nikola Tesla.

It's simple. We just believe that a sum-zero vector substructure makes a scalar quantity, and we MAKE some scalars that way.

We also understand that a zero-gradient of a scalar is a zero vector, so that the scalar itself may be taken to be a zero vector.

The simplest explanation of this wave is as follows:

First, in physics we have two competing, mutually exclusive theories as to the nature of

electromagnetic energy: the wave theory and the particle theory. Physicists argued for decades over these theories, for some experiments support one and some support the other. They never solved the problem; they just agreed to quit arguing. They formulated the "duality" principle to allow the saving of face to both sides.

Briefly, the duality principle implies that, whatever the nature of electromagnetic energy is before an interaction, in the interaction you can get it to act as a wave or as a particle. In other words, AS IT EXISTS, BEFORE THE INTERACTION, it is implicitly both particle and wave, joined together in some fashion, without being explicitly either one.

With the fourth law of logic, this becomes perfectly clear. With three-law Aristotlean logic, the problem is unresolvable.

Let us use this idea of "explicit duality without implicit duality" to analyze the wave shown on the slide.

First, from a wave aspect, the E-fields and the B-fields of the two waves do superpose and vectorially add. Since the waves are 180 degrees out of phase, the exterior resultant wave has a zero electric field and a zero magnetic field. Therefore it is a "zero-vector" wave, or "scalar" wave. It's a wave of pure stress in spacetime.

However, this scalar wave has a precisely determined substructure, consisting_of two ordinary sine waves, each of which comprises an ordinary E-H vector EM wave.

Now we apply the photon consideration (remember, before we interact with the wave, it must implicitly possess BOTH wave and particle natures combined, and we have so far only examined the implication of the wave nature.

The theory of photons' states that they are monocular critters. Photons pass right through other photons without interaction, in a linear situation. Therefore they can coexist without interaction, which is what we show here.

One photon, by the way, is one wavelength .

The photon theory requires that both substructure waves continue to exist as independent photons. Therefore we are assured that our substructure is intact.

However, notice that the totality of the two

waves stresses spacetime. In other words, we have twice the stress on spacetime now as we would have from either wave separately.

This wave is therefore just a pure stress wave in spacetime itself.

This thing oscillates time, oscillates the relativity of the situation, and can affect energy, time flow rate, inertia, gravity, etc. aspects of an absorbing system.

Note that we have a rhythmic oscillation in phi (Ø), and we have a longitudinal stress wave, very similar to a sound wave. The MEDIUM for this wave is the virtual particle flux that identically comprises vacuum spacetime itself.

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SLIDE 23.

SCALAR Ö-WAVE PRODUCTION

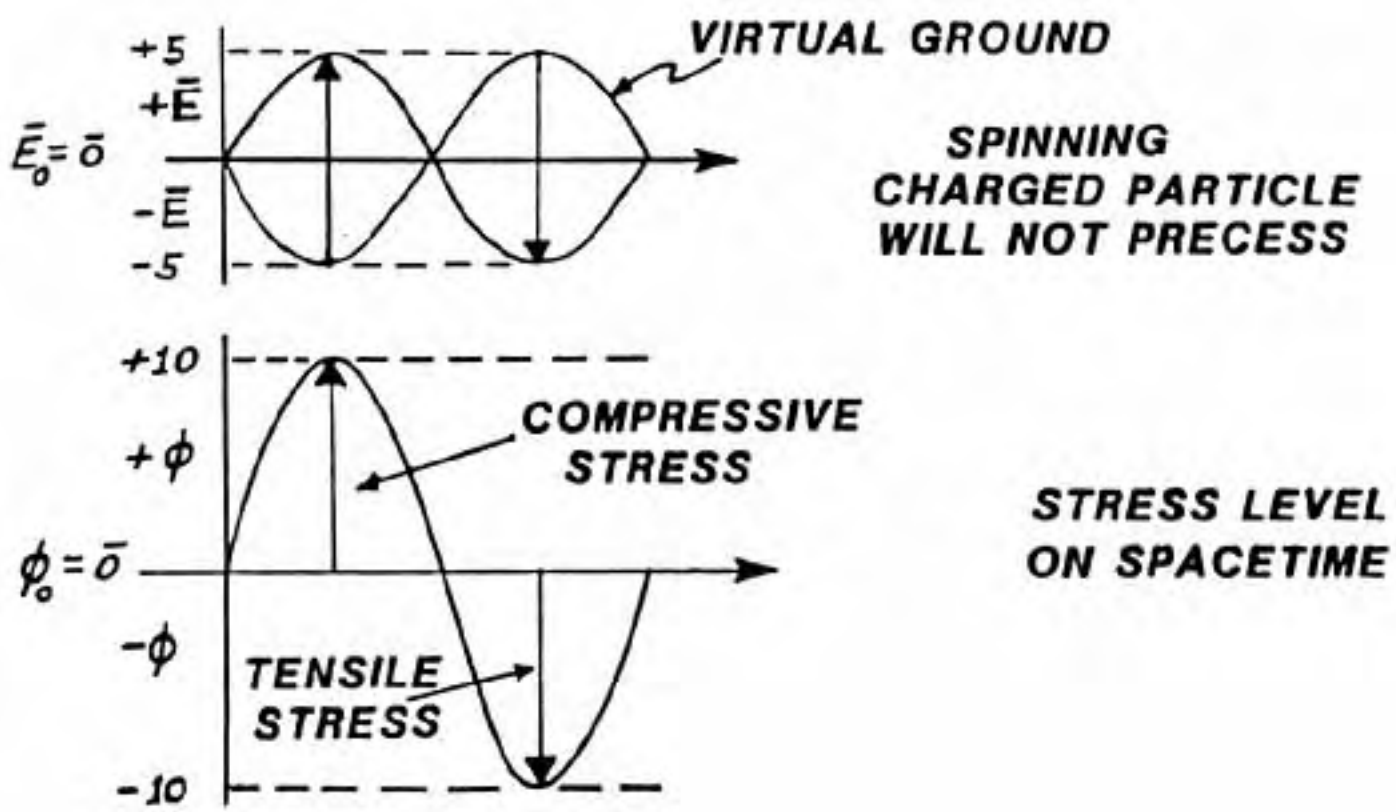

On this slide we show how to regard the magnitude of the stress, by using one wave envelope as "virtual ground." In the top diagram, the original E-field stress of each wave has a magnitude of 5, and the composite stress wave now has a magnitude of 10, in whatever units we choose to express them.

We show in the bottom diagram that during one half cycle we have compressive stress in the virtual particle vacuum flux, and during the second half cycle we have tensile stress.

This shows the wave is like a sound wave in the gaseous molecules of the air.

However, this wave has one difference. It also

oscillates time, and thus has at least one additional degree of freedom, compared to ordinary EM waves.

In fact, this wave can be made n-dimensional and hyperspatial.

As a first order approximation, we can treat such a wave in
a spatial fashion, if the wave is not too great in magnitude and the relativistic oscillation of time and inertia is not too large.

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SLIDE 24.

A SIMPLIFIED CHARGED PARTICLE

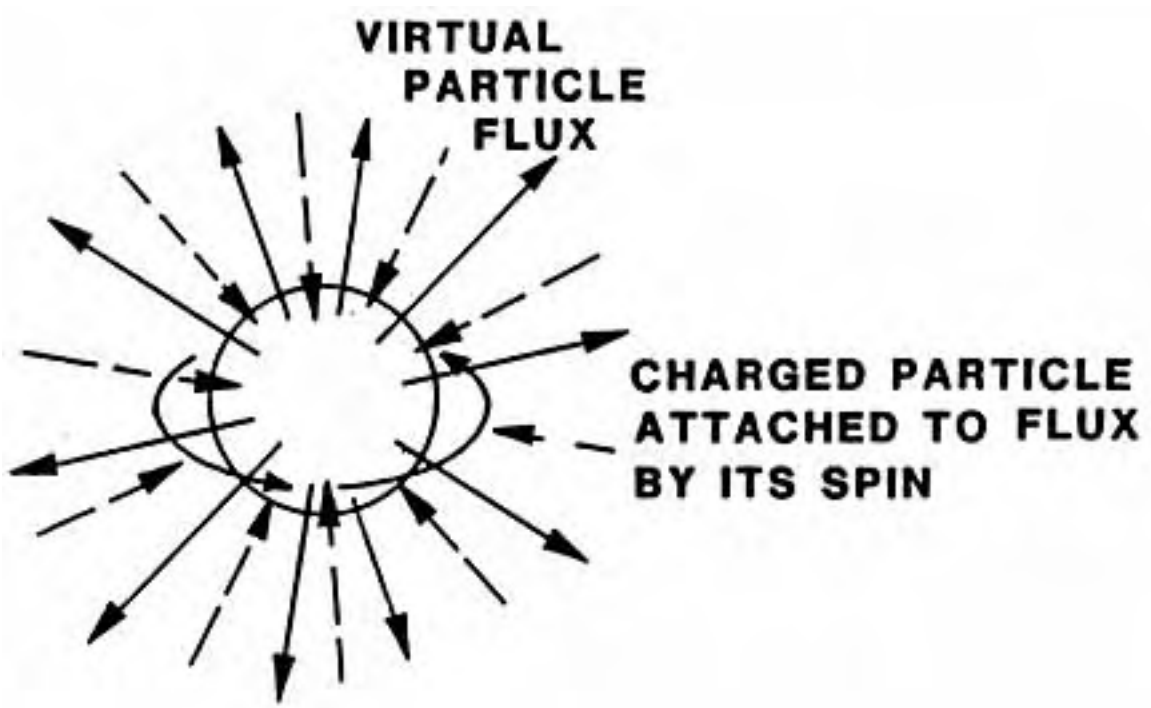

(THINK OF THE FLUX IN AND OUT, EXCEPT GRADIENTS ARE SPIRAL-LIKE, DUE TO PARTICLE'S SPIN)

We now digress slightly to pick up some more concepts.

On this slide, we show a simplified physical model of a charged particle. According to present particle physics, we model it as an observable, spinning bare mass in the middle, connected to a spray of virtual particles on and off the mass in all directions.

It is the spin of the mass that "attaches" the spray of virtual particles to and from itself.

Note that, because of the spin, the gradient lines of flux will actually be spiral or vortex in nature.

Also note that, when EM theory was founded, no one knew that an electron was spinning. Electron spin was therefore omitted from the foundations of present

electromagnetic theory, and compensated for later by strictly ad hoc measures.

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SLIDE 25.

A CHARGED PARTICLE IS A SPECIAL KIND OF "SPRAY NOZZLE"

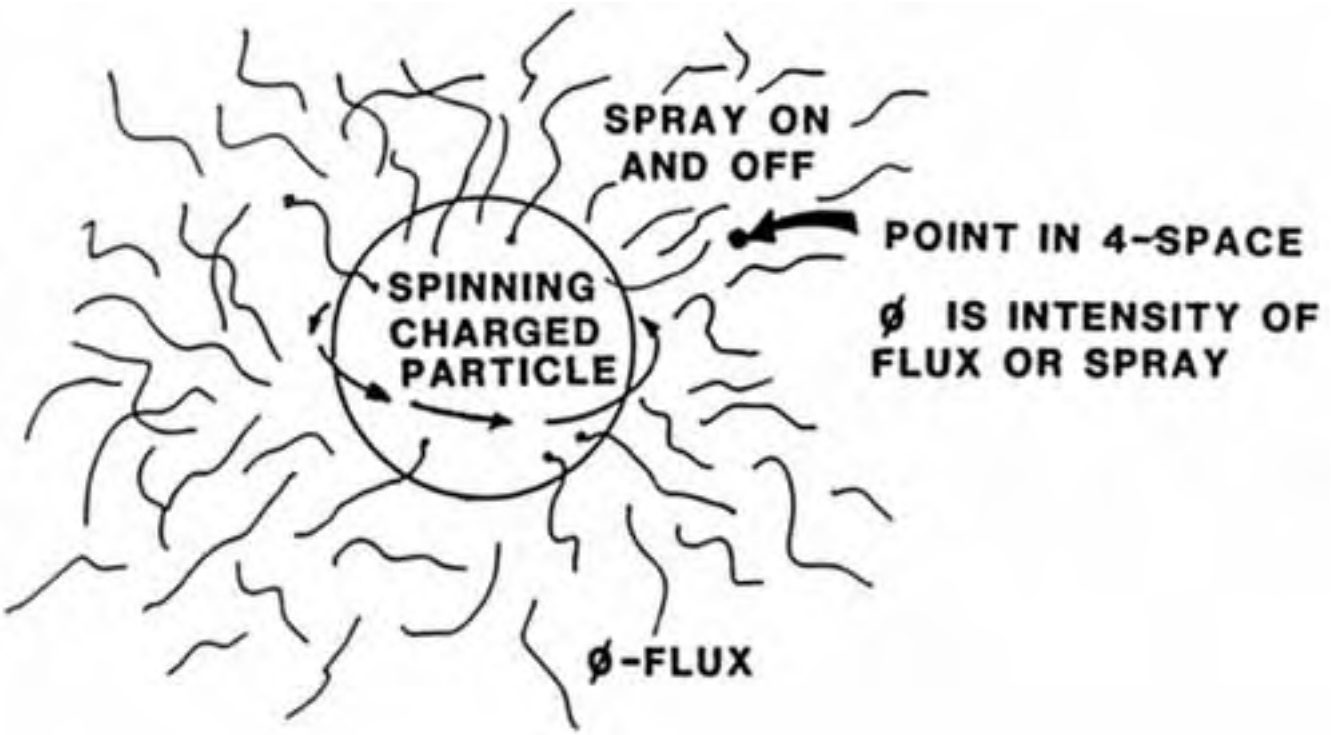

(SPRAY IS THROUGH 4 DIMENSIONS, NOT JUST 3)

Here we show a very important concept, and a very important fact of nature.

A charged particle may be idealized as a special kind of spray nozzle.

The 3-dimensional particle of mass is spraying out virtual particle fluid, and sucking in virtual particle fluid, in four or more dimensions.

We never have to furnish or replenish the spray. Nature provides that. And it's inexhaustible. It comes from the entire virtual particle flux vacuum of the universe. It's already connected firmly to matter, by its connection to the spinning charged particle of mass.

I repeat and strongly stress: This tremendous, continuous spray of virtual particles is absolutely free,

and absolutely furnished by the universe.

We don't have to create the basic pumps for the fluid. We just move the spray nozzles around, by moving the spinning charged masses around.

We never furnish any ultimate energy to or in our present EM circuits. We just pump around the spray nozzles, gating the spray furnished by the universe.

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SLIDE 26.

AN OBSERVABLE CHARGED PARTICLE IS DIRECTLY CONNECTED TO VIRTUAL PARTICLE FLUX VACUUM

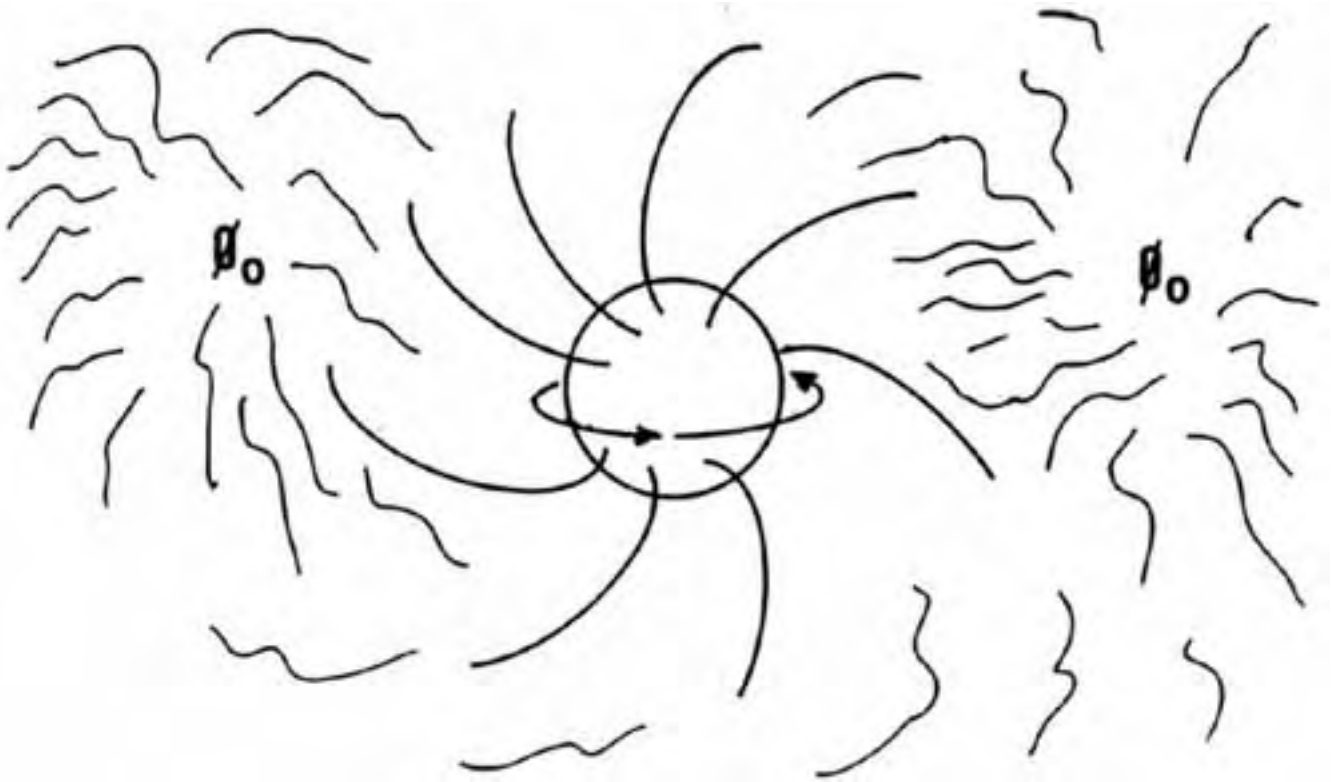

On this slide we accent that our 3-dimensional particle of mass is directly connected by its spin to the vacuum ether itself. To the virtual particle flux that identically IS the vacuum spacetime.

Interestingly, relativity states that the mass itself is nothing but a "kink" or curvature in spacetime .

The fact that the surface of the particle is spinning at right angles to the virtual particle vacuum flux "drags" part of the flux along with it, spiraling it, and certainly "kinking" or "bending" the vacuum flux .

That's the MECHANISM for the bending of spacetime. And that's what MAKES the particle of mass in the first place, and reduces its dimensionality to three.

Also note that the vacuum IS phi-sub-zero, and that is never
a zero value. This is contrary to present EM theory, which erroneously assumes phi-sub-zero -- the charge of vacuum -- to be zero or non-existent.

Next Slide

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SLIDE 27.

SPIN COUPLES VACUUM TO PARTICLE

- **SPHERICAL ROTATION IS THE KEY**
- **A PARTICLE CAN BE MODELED AS A SPHERICALLY ROTATING VORTEX OF SPACETIME**
- **ITS MASS IS DUE TO ITS SPIN**
- **THE SPINNING OBJECT IS CONTINUALLY CONNECTED TO ITS ENVIRONMENT**
- **VERY HIGH VALUES OF ELECTROSTATIC POTENTIAL CAN INDUCE RELATIVISTIC CONDITIONS**
    - **CHANGE RATE OF FLOW OF TIME**
    - **EVEN THOUGH VELOCITY IS NONRELATIVISTIC**

E.P.BATTEY-PRATT AND T.J.RACEY
"GEOMETRIC MODEL FOR FUNDAMENTAL PARTICLES,"
INTL. J. OF PHYS. 19, NO. 6, 437-475, 1980

In fact, the bits and pieces of many of the new concepts are strewed all through the scientific literature. Here we show one example, establishing a good model that spin of a particle couples the particle to the vacuum .

This paper is by E.P. Battey-Pratt and T.J. Racey, and was . published in the International Journal of Physics in 1980.

Note again that very high values of electrostatic potential
can induce relativistic conditions, even though relativistic velocity is not present.

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SLIDE 28.

ELECTRON PRECESSION (SIMPLIFIED)

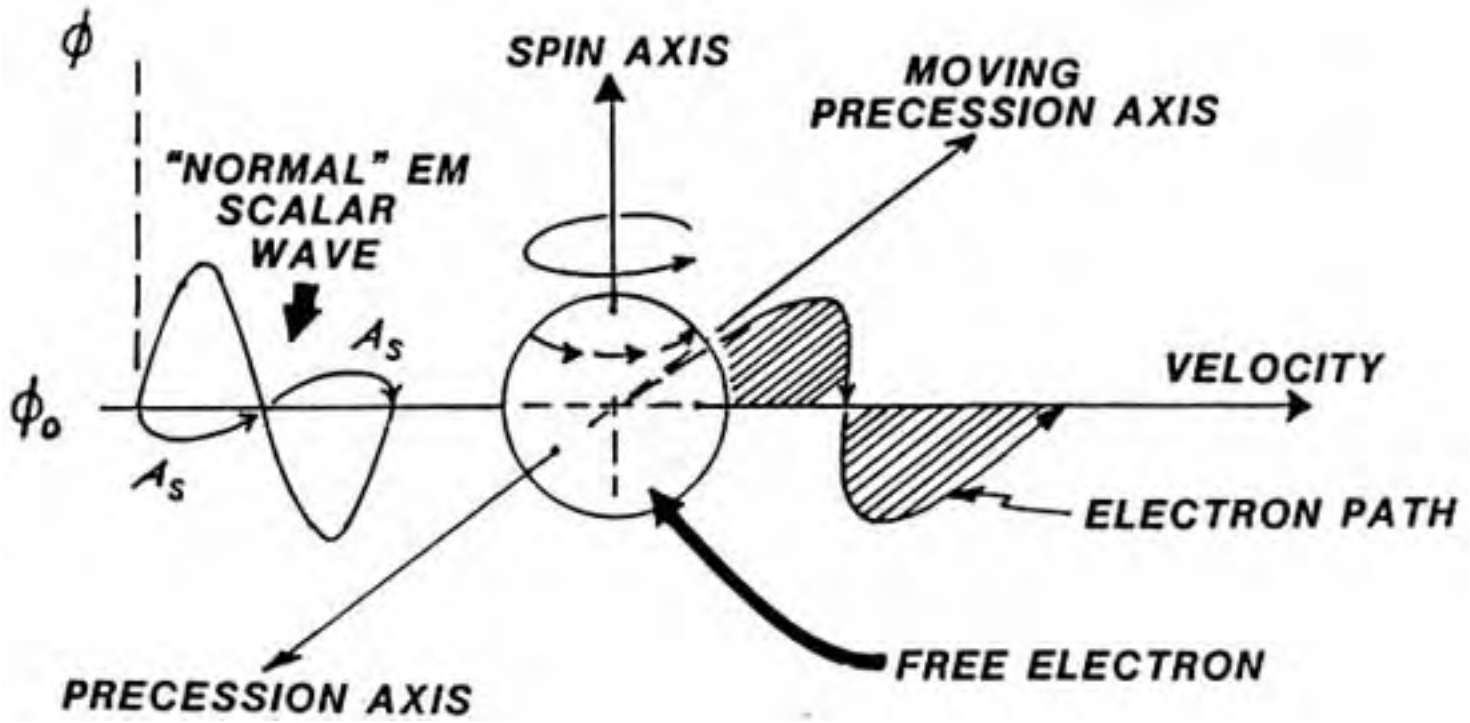

On this slide I show the effects of precession of an electron when it encounters a longitudinal scalar wave that contains "spin vortex holes" for the electrons to fall into and mesh its spin with.

The basic idea here -- that electron precession accounts for the Hertzian waves in the electron gas in a transmitting antenna and in a receiving antenna, came from my close colleague and friend, Frank Golden, and I am most happy to give him full credit for this important insight.

As we have previously stated, transverse (force) waves cannot exist in vacuum in the absence of mass. Hertz waves therefore cannot exist in vacuum, just as Tesla stated.

Yet we know that Hertz waves exist in the electron gas in

our transmitting antennas and in the electron gas in our receiving antennas. How then do we get Hertz waves here, if only longitudinal waves can exist in the vacuum in between?

Electron precession is the key.

We never measure what's happening in vacuum with our instruments. Instead, almost always we measure what is happening to and in the electron gas in our antenna or probe and feeding current to the instrument.

Here we show a "normal" EM vacuum wave -- which is a longitudinal wave containing spin vortexes from the electrons that generated it -- approaching and striking a spinning charged electron. As the peak and trough of the wave passes, it is as if we had a force pressing against the spinning electron, first along the line of wave travel, and then antiparallel to the wave travel. *(that is, "explaining" it in present concepts.)*

The electron acts as a little gyroscope, and precesses laterally, first in one direction and then the other.

Therefore the wave recovered in the electron gas in our receiving antenna or instrument probe is a transverse Hertzian matter wave.

Hertz waves are always <u>matter</u> vector waves.

Vacuum EM waves are always nonmaterial <u>longitudinal</u> scalar waves.

Longitudinal scalar waves in vacuum normally contain many spinning vortex "holes" of flux, created from the spinning electrons which launched the wave and stayed behind in the transmitting antenna. This kind of longitudinal wave is directly detectable by a normal free electron charged gas in a receiving antenna or probe. It also directly interacts with free electrons in a conducting metal shield, and so is shielded by Faraday cages.

On the other hand, our zero-vector longitudinal wave, made
by opposing waves, contains opposing spin holes which annihilate or cancel each other.

In the absence of spin holes, the longitudinal wave will not mesh with spinning electrons in a conductor, and so it is not detectable in the normal fashion. It also does not interact with free electrons in a conducting metal shield, so it readily penetrates Faraday cages.

An easy way to see that electrons do not interact with that substructured longitudinal zero-vector wave is to visualize both substructure component waves interacting on the electron simultaneously, pushing in opposite directions equally. In that case the electron tries to precess in both directions, equally, and so it does not precess in either direction. Therefore it does not "detect" the passing wave.

The wave without "golf ball holes", however, is detectable
by any circuit having high nonlinearity actions occurring in it. Such highly nonlinear dynamic areas act to provide a phase shifting between the composite substructure waves. This phase shift results in violation of the sum-zero condition, producing a "normal" EM wave which deposits energy in the out-of-phase area.

From the spin vortex "golf ball hole" concept, the out-of-phase condition means that now we have an alternating preponderance of spin holes, spinning first in one direction and then in the other. Thus the electrons in the nonlinear, phase shift area are hooked and oscillated (precessed) to and fro, producing energy.

Solid state, highly doped transistors are particularly vulnerable to this effect, as are gas discharge tubes, spark and cascade ion discharges, plasmas, etc.

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SLIDE 29.

VACUUM/SPACETIME IS PURE VIRTUAL PARTICLE FLUX ($Ø_O$)

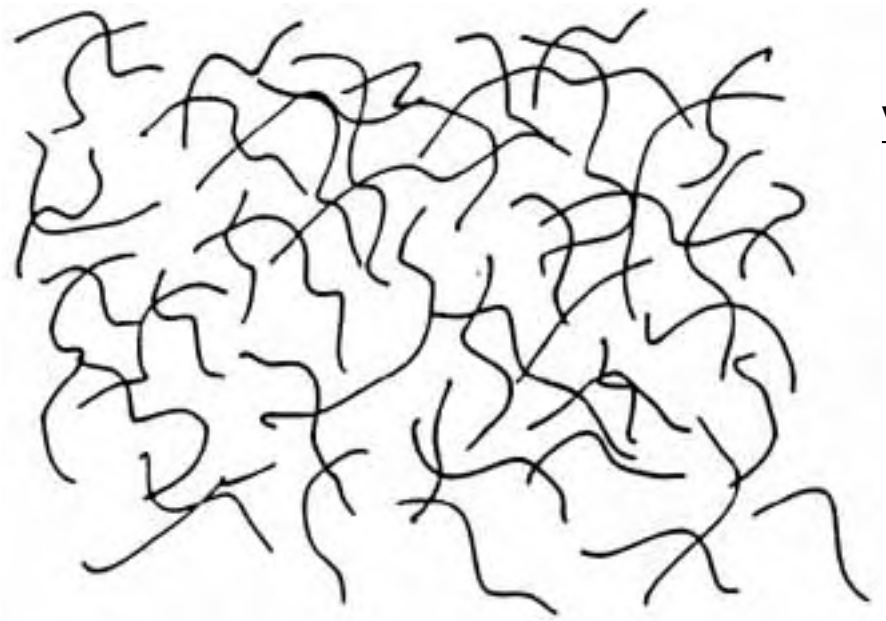

VACUUM IS IDENTICAL TO:

- **VIRTUAL PARTICLE FLUX**
- **SPACETIME**
- **ANENERGY**
- **$Ø_0$**
- **MASSLESS CHARGE**

VACUUM IS:

- **MADE OF UNQUANTIZED ACTION**
- **WITHOUT DEFINITE LENGTH INTERVALS**
- **WITHOUT DEFINITE TIME INTERVALS**
- **N-DIMENSIONAL (UNFIXED)**

We pause here to again summarize some important things we now know about vacuum.

Vacuum IS IDENTICAL TO virtual particle flux, spacetime, anenergy, Phi-subzero, massless charge, unquantized action, and infolded energy, momentum, length, time, power, velocity, acceleration, etc.

Vacuum is made of unquantized action, dimensionally.

It is without definite length or time, as Einstein stated.

It is n-dimensional, where n is always four or

greater.

It is not an emptiness filled with things. Rather, it is identically a plenum filled with things which are totally unseparated, unfixed, and undetermined.

From vacuum: mass, energy, time, frames, and all the rest of physical reality are dynamically made.

Vacuum is the ether. The ether has never been eliminated from physics. Ether just has become much more subtle, and physicists have used other names for it.

Next Slide

SLIDE 30.

VACUUM IS:

- **SPACETIME (L^nT, WHERE $n \geq 3$)**
- **CHARGE (MASSLESS)**
- **ELECTROSTATIC SCALAR POTENTIAL $Ø_0 \neq 0$**
  ERROR IN PRESENT THEORY
- **BROKEN BITS OF ENERGY (SUBQUANTAL)**
- **PURE VIRTUAL PARTICLE FLUX**
- **O-WAVE FLUX**
- **MULTILEVEL, STRUCTURED, PATTERNED**
- **A VIRTUAL PLENUM**
- **AN OBSERVABLE EMPTINESS**

Again, we list some of the things that vacuum identically is.

It is spacetime, massless charge, electrostatic scalar potential, broken bits (subquantal) of energy, pure virtual particle flux, zero-vector wave flux, multilevel, structured, patterned, a virtual plenum, and an observable emptiness.

It is all things and contains all things in potential state.

It is not, in that it is not observable. But from it comes all observables.

It is both ordered and disordered, simultaneously.

It involves four-law logic, not just three-law Aristotlean logic.

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SLIDE 31.

GRADIENT OF ELECTROSTATIC POTENTIAL

IN VACUUM

$$\nabla Ø \neq Ë$$

ON AND OF A MOVING CHARGED PARTICLE

$$\nabla Ø = Ë$$

Again I accent that, in vacuum in the absence of a charged spinning particle of observable mass, del-phi does not yield an Ë-field, and the conventional equations of EM are wrong in that respect.

In the presence of a spinning charged particle, in a del-phi which contains electron-vortex-holes to mesh with, the charged particle attaches itself to the moving del-phi flux gradient, moving itself with the river. This produces an Ë field. The Ë-field CONSISTS OF the smeared electron, it does not CAUSE THE MOVEMENT of the electron. It is an effect, not a cause. The conventional equation for del-phi equals E is correct for matter waves in electron gases; it is not correct in vacuum itself.

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SLIDE 32.

IN A ∇Ø, A CHARGED PARTICLE MOVES ITSELF

∇Ø>0 IMPLIES A MOVING RIVER, AND THE CHARGED PARTICLE IS "HOOKED TO" THE RIVER

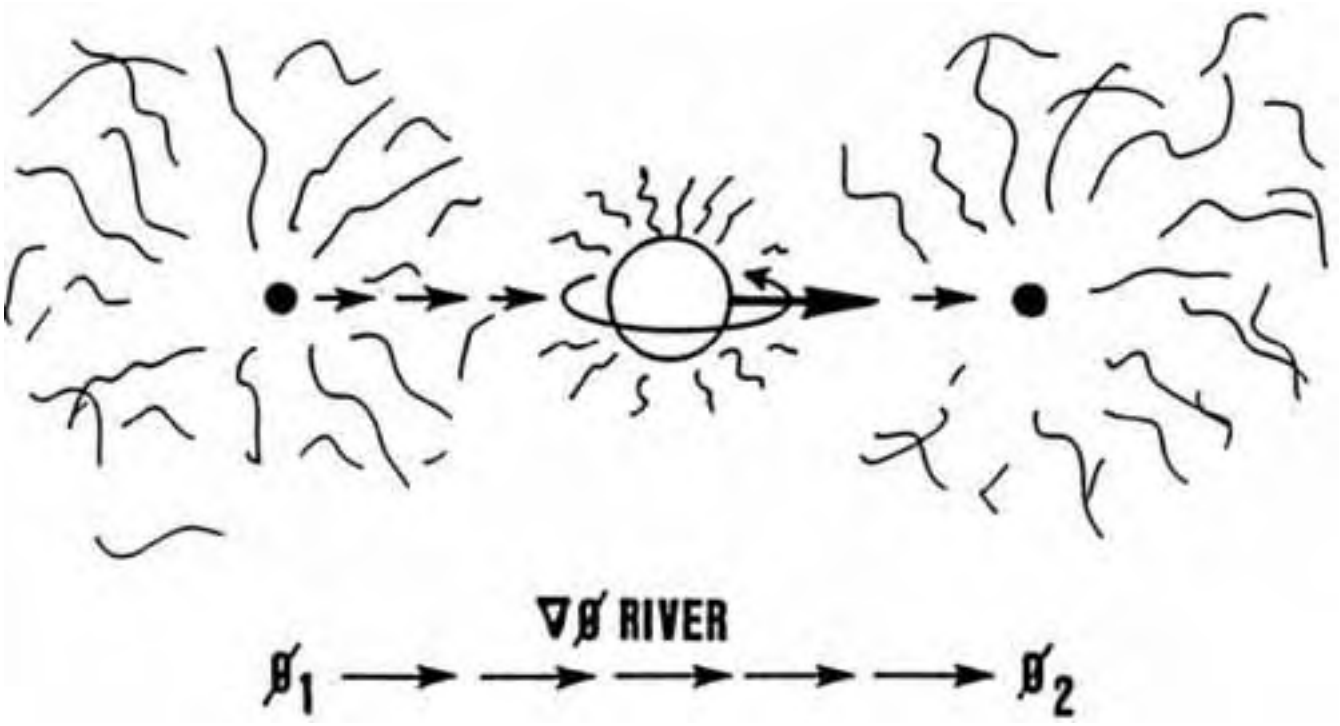

We show clearly on this slide that a spinning charged particle, when it hooks to a spin-hole in a del-phi river, MOVES ITSELF.

Note that a del-phi implies a "pressure difference" in phi-flux between two points. Therefore there is a moving river -- a gradient -- of phi-dot, moving from the higher pressure to the lower.

If a charged particle is attached to this moving river, it flows along with the river. It is just like putting a boat into a moving stream of water. If the boat "latches" to the moving water, it moves with the river.

Electron spin and spin vortexes in the del-phi mesh, to accomplish the "hooking" or "latching."

Once hooked into a moving river, the electron moves itself. One does not have to furnish work to move it.

If the river is accelerating, the electron will accelerate itself.

By cleverly gating such rivers into and onto sources of free electrons, one can directly produce free energy.

The extra energy comes from converting anenergy (massless charge, vacuum flux) to energy of a moving mass.

Next Slide

SLIDE 33.

ELECTROMAGNETIC WAVES IN ELECTRON GAS IN A CONDUCTOR

- **VECTOR WAVES**
- **CONTAIN E, B FIELDS**
- **GENERATED BY SPIN COUPLING OF ELECTRONS WITH SCALAR WAVE "SPIN-HOLES"**
- **WAVES OF FORCE**
- **HERTZIAN WAVES**
- **TRANSVERSE WAVES**
- **WAVES OF ELECTRON PRECESSION**

Here we pause to summarize the characteristics of electromagnetic waves in the electron gas of a conductor.

First, these are vector EM waves in the accepted sense.

They contain E and B fields.

They are generated by spin coupling of electrons with spin-holes in a scalar wave delta-phi river. The electrons move themselves under that condition, producing work and forces.

They are waves of force or force field variations.

They are Hertzian waves.

They are transverse oscillatory, not longitudinal.

They are matter waves.

They are waves of electron precession.

Next Slide

SLIDE 34.

ELECTROMAGNETIC WAVES IN VACUUM

- **SCALAR LONGITUDINAL WAVES**
- **VECTOR ZERO [Ö] WAVES**
- **WITHOUT Ë, B FIELDS**
- **INTERNALLY STRUCTURED**
- **PATTERNED**
- **MAY CONTAIN ELECTRON "SPIN-HOLES"**

Here we summarize the characteristics of electromagnetic waves in vacuum.

They are scalar longitudinal waves of alternate compression and rarefaction of the vacuum virtual particle flux.

That is, they are waves of electrostatic potential.

They are zero-vector waves.

They are internally structured and patterned.

They usually contain electron "spin holes" unless made in a fashion so as to make opposing spin holes that cancel each other.

Since they are pure phi-waves, they need not be limited in velocity to the speed of light.

They are hyperspatial waves.

They are waves in virtual state itself.

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SLIDE 35.

DETECTION OF TRANSVERSE AND LONGITUDINAL WAVES

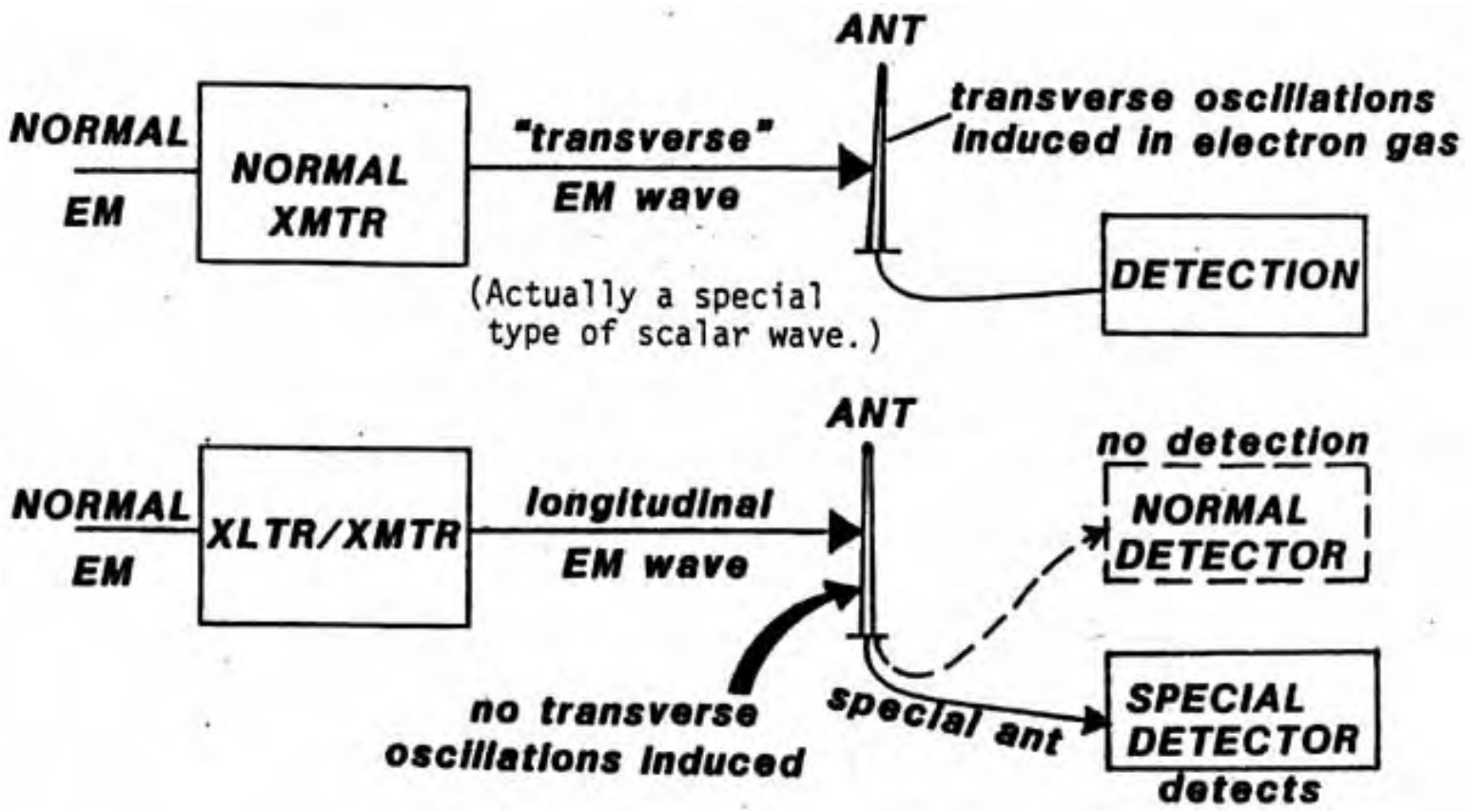

In the top drawing on this slide, we show a normal transmitter putting out a normal EM wave, which received in a normal antenna/receiver. What we call a "transverse" wave rigorously exists only in the electron gas in the transmitting antenna and in the electron gas in the receiving antenna. Specifically, a longitudinal wave exists in the vacuum in between the two antennas. However, due to the method of production, the longitudinal wave contains spin-holes for electrons, so the electrons in the receiving antenna readily couple with the wave by falling into and meshing their spins with the spins of the spin-vortex holes. Electron precession produces electron gas waves that are transverse oscillatory, hence Hertzian waves in nature.

In the bottom drawing, we show a translator/

transmitter. In other words, we oppose ordinary EM waves in a sum-zero substructure, deliberately producing longitudinal EM waves in vacuum with the spin-hole vortexes canceling each other. This type of wave does not "hook" spinning electrons in the normal receiving antenna, and thus it is not detected. The normal antenna/receiver system never sees it at all.

However, by means of a special antenna which generates nonlinear phase shifts in the composite substructure waves, "hooking" holes are restored in an oscillatory nature. Electrons then hook with this output and detect the wave.

Note that it requires a two-stage detector, operated in an interferometer fashion, to detect this pure scalar wave.

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The Tom Bearden Website

SLIDE 36.

CREATING A "RIVER" OF ANENERGY

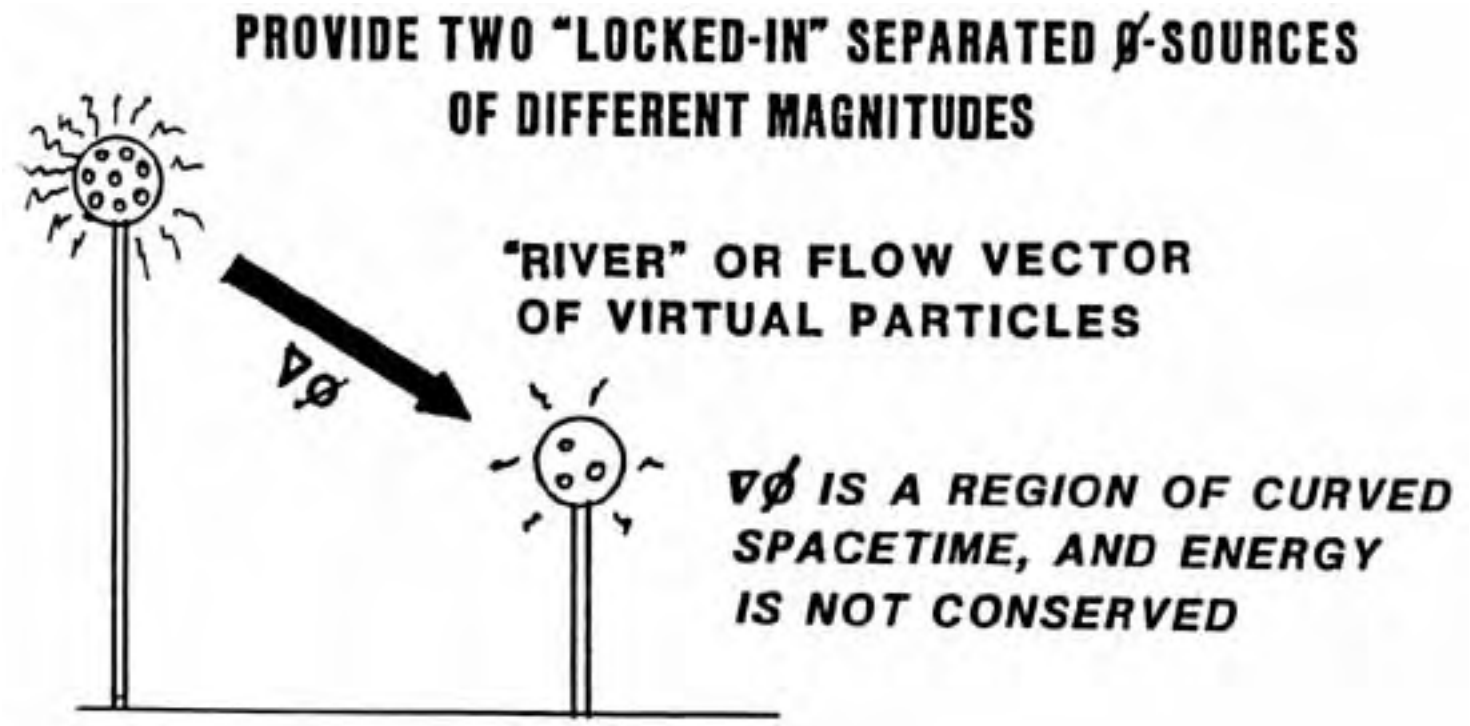

IN VACUUM, THIS IS NOT YET A VOLTAGE DROP (NO MASS FLOW),
NOR IS THERE AN Ë-FIELD

Now if we wish to get free energy, we are going to have to provide a continuous anenergy river, and a means of tapping it to produce mass movement.

This slide shows one easy way to make an anenergy river.

We simply pump some electrons (spray nozzles) onto an elevated charged ball, and we LEAVE them there. A second ball is connected to ground. A higher phi -- that is, a denser spray -- is now in the vicinity of the elevated ball on the left. A lower phi -- that is, a less dense spray -- is in the vicinity of the lower ball on the right. Between the two balls, now, there is a

gradient in phi, and a virtual flux flowing from the "higher virtual pressure" to the "lower virtual pressure."

This del-phi river does NOT constitute an Ë-field, as we have previously pointed out.

The del-phi region, however, is definitely a region of curved spacetime. As is well known from general relativity, in such a region energy need not be conserved.

Therefore it is entirely possible -- consistent with ordinary physics -- to violate conservation of energy in this del-phi river, if one believes general relativity. If one argues adamantly that conservation of energy cannot be violated under any circumstances, then one must throw out general relativity. Also, one must throw out most of particle physics, whose explanations presently involve virtual interactions, each of which violates the conservation of energy.

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SLIDE 37

A 2-WIRE SYSTEM IS CONSERVATIVE

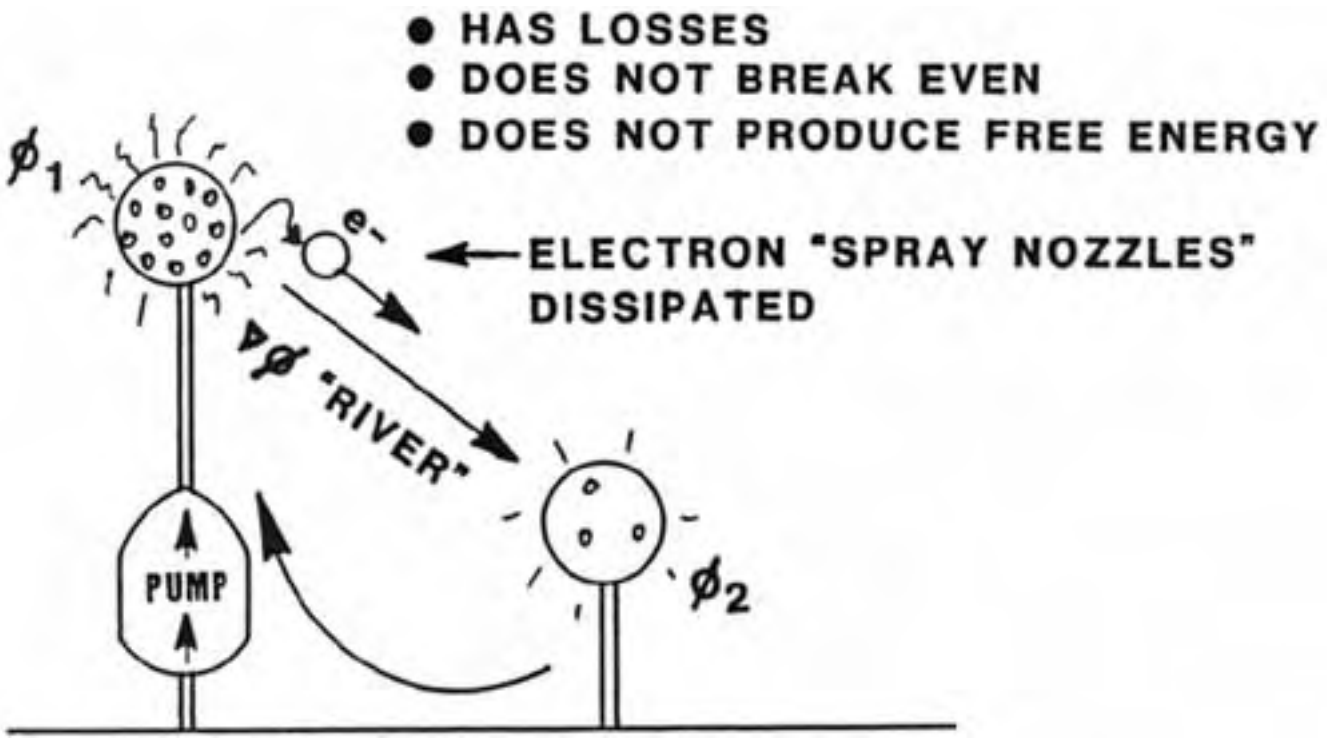

REPLENISH SPRAY NOZZLES BY PUMPING MORE ELECTRONS. (MOVING ELECTRON MASSES AGAINST A "SPRAY PILEUP" REQUIRES WORK.

Here we show that, as engineers, we've all been tricked into releasing our virtual rivers so that we would not discover free energy.

While I cannot prove this as yet, I tentatively suspect that J. P. Morgan and Thomas Edison are directly responsible for this occurring. Tesla utilized a single-wire system; we have all been taught to utilize only two-wire systems.

What we in effect do is connect a wire or circuit to our charged ball, allowing our hose nozzles to drain away.

In other words, we first do some work to pump hose nozzles (electrons) into and onto our elevated

reservoir, so we will obtain a denser flux, and a flux river to utilize. Then we release the nozzles themselves, and let THEM move on the flux river, deplenishing our river. Of course we can get back as much energy as we pumped up there in the first place. But this two-wire system is at best theoretically even. Since real circuits have losses, we can never even quite break even. Thus we have to continue to pump hose nozzles, and let them bleed off to provide energy, in a less-than-100% fashion.

By foolishly releasing our hose nozzles, we guarantee that we will never achieve free energy. And that's nice, because the people who control things, and for their own wealth and power depend on selling us energy at high prices, are guaranteed to stay in power and control.

One is never truly free unless one is energy independent, in a self-contained fashion.

Tesla nearly succeeded in giving us free or very cheap, inexhaustible energy -- and for that reason was quickly and dramatically suppressed.

Only three graduate schools of electrical engineering existed in the U.S. The only one of any real importance was at Columbia University.

Only one or two professors were necessary to "reach" to modify and subtly direct the entire foundations of the emerging electrical theory.

Professors were in general poor, and had no research funds unless some rich industrialist or philanthropist gave them a few dollars.

The setup then was certainly very ripe for Morgan and Edison to stop free energy, and suppress Tesla at the same time. They could have done so by influencing only one -- or at most two -- theoreticians at Columbia.

At any rate, the theory was developed in such fashion as to rule out the single wire circuit and the longitudinal wave. Free energy was suppressed, and the financial empires of Morgan and Edison stayed secure.

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SLIDE 38.

A HOLLOW CHARGED SPHERE

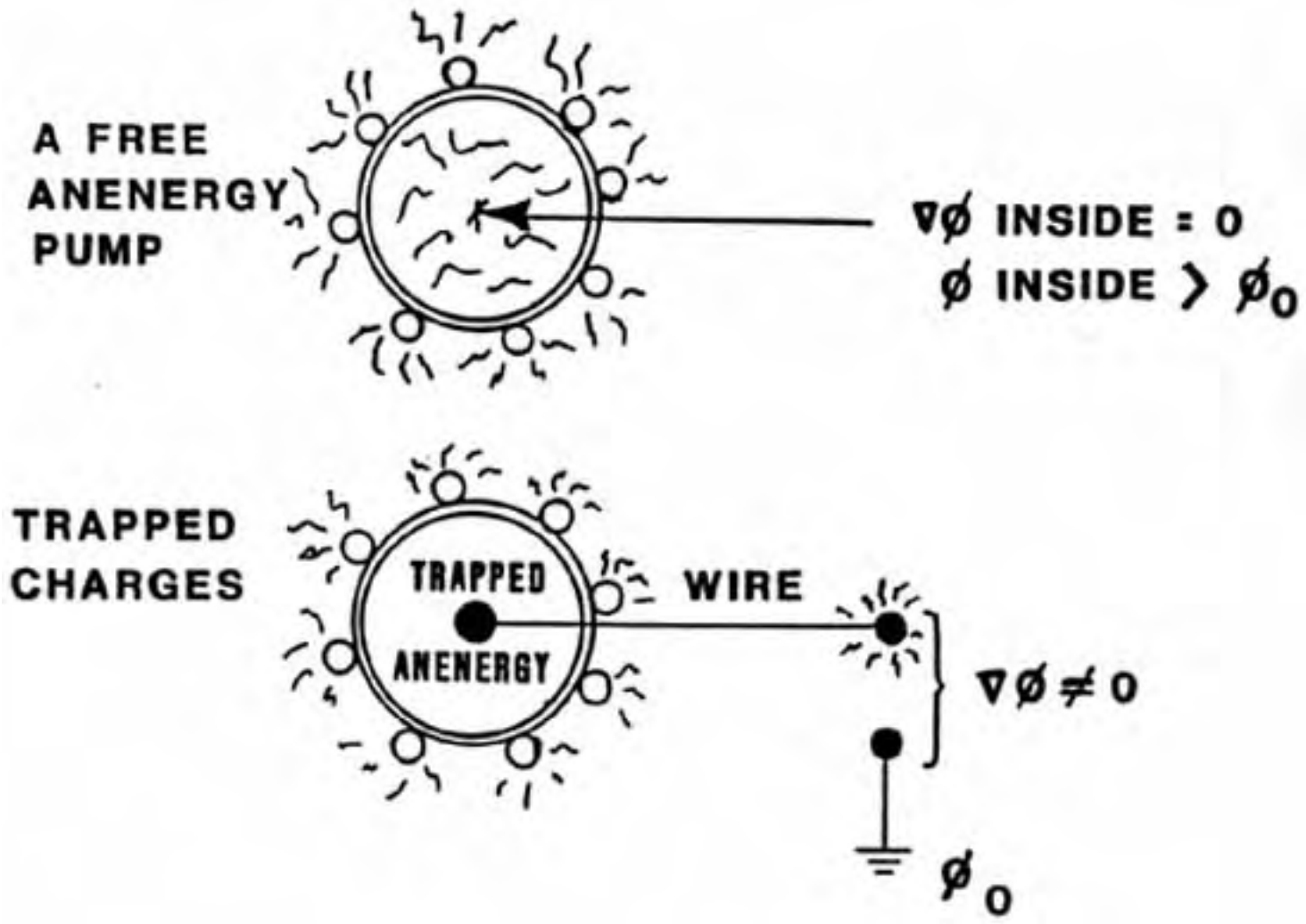

Here we show another easy source of a higher vacuum charge, hence an easy source for a free river.

Simply charge up a sphere. As is well known, inside that sphere one has no del-phi. So one can introduce an electron therein and not produce an Ë-field .

However, since we've piled up additional spray nozzles, the density of the spray inside the sphere (as well as outside it) is certainly higher.

In other words, the inside of the sphere is also a source
for an increased del-phi river. In the bottom drawing, we drill
a tiny hole in the sphere, insulate a thin wire running into the inside of the sphere, and run the wire out to a terminal opposing another grounded terminal.
Between the two terminals now there must exist a del-phi river.

And between those terminals there now exists a curvature of spacetime, hence the theoretical possibility to obtain free energy without violation of principles.

Next Slide

[The Tom Bearden Website]

SLIDE 39.

ONE-WAY GATE VALVE

(ANENERGY TO ENERGY)

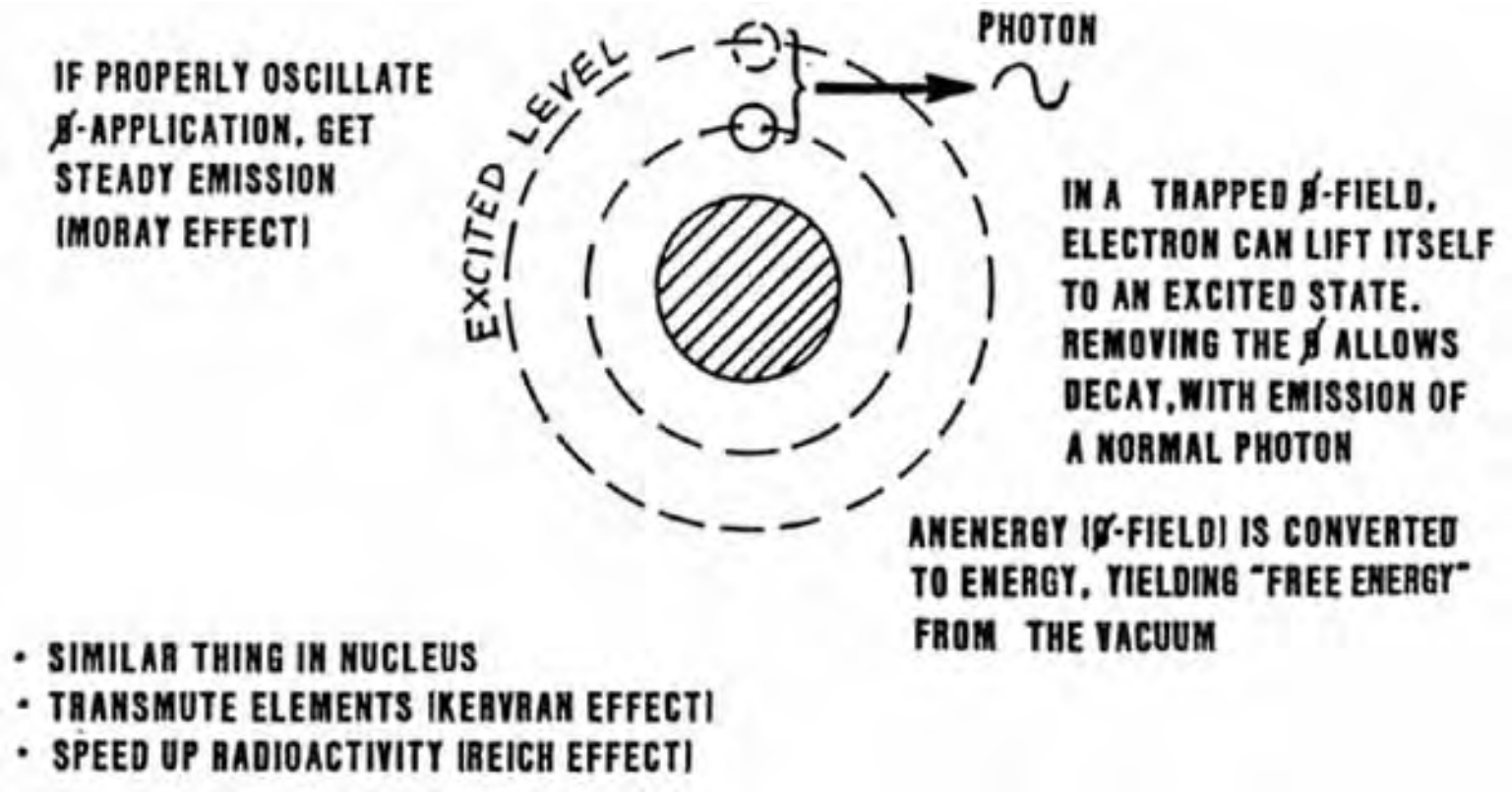

Here we show one way to provide a one-way gate valve from a del-phi river to energy released into the outside world.

By providing a properly tuned, oscillating phi wave, one can cause an orbital electron in an atom to raise itself to an excited state. Remember, in a del-phi, an electron that hooks to it raises itself.

We then switch out the phi application, and the excited electron decays in normal fashion, emitting a normal photon of energy.

By phase locking the processes, one produces a steady stream of photons.

By absorbing or directing the photons, one can

produce heat, light, energy beams, etc.

By this means, one produces free energy by gating anenergy into energy.

And if one does not release spray nozzles in the phi-oscillations which feed the mechanism, one has an inexhaustible energy production.

A very similar thing can be done with the excited states of the nucleus. For example, by using a radioactive material with a predisposition to emit some particle -- say an electron -- the nucleus can be made to continually emit the particles WITHOUT ITSELF DECAYING INTO BYPRODUCTS. In other words, an electron is lifted from the Dirac sea of vacuum to instantly replace the electron emitted from the nucleus.

This provides a one-way gate valve from the Dirac sea to the external universe.

Theoretically, these mechanisms are no more mysterious than a hydraulic ram, which raises water higher than the stream that feeds the ram.

In the 20's and 30's, T. Henry Moray successfully built such gating devices for converting vacuum anenergy to external energy.

In the Kervran effect, living systems are able to directly transmute elements, even though they only possess feeble energies, by influencing the virtual particle interactions in the nucleus that furnish its binding energy.

Reich used an adaptation of a cloudbuster -- which emits scalar waves -- to drastically speed up radioactive decay of radioelements.

Both plants and animals transmute elements by similar processes.

Next Slide

TOWARDS A NEW ELECTROMAGNETICS
PART 4: VECTORS AND MECHANISMS CLARIFIED

SLIDE 40,

SIMPLE FREE ENERGY MOTOR

BATTERY RECHARGES ITSELF

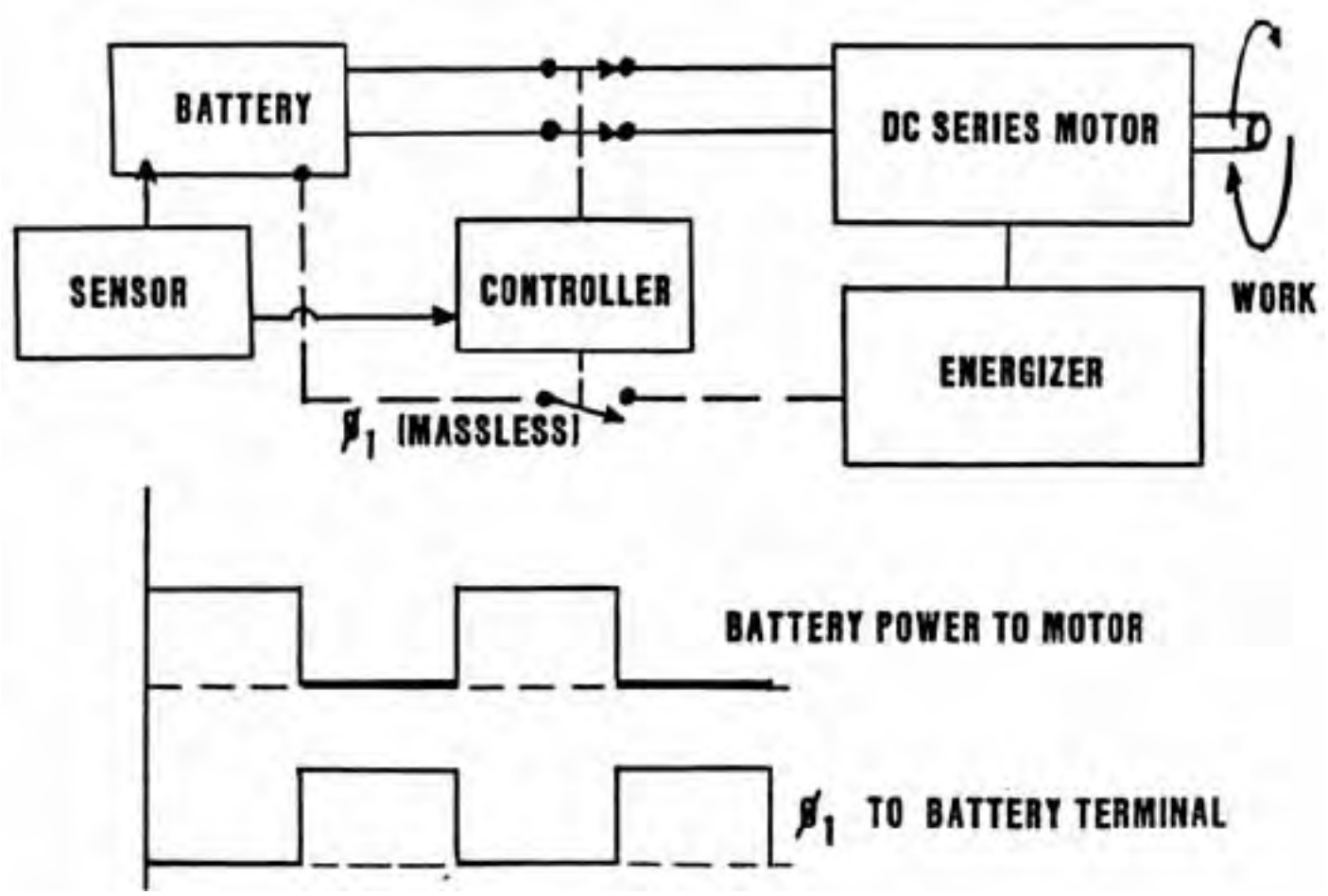

On this slide, we show a theoretical scheme which several researchers have discovered and used to build simple free energy motors.

In this scheme, we drive an ordinary d.c. series motor by a two wire system from an ordinary battery. The motor produces shaft horsepower, at -- say -- some 30 or 40 percent efficiency, compared to the power drained from the battery. This much of the circuit is perfectly ordinary.

The trick here is to get the battery to recharge itself, without furnishing normal power to it, or expending work from the external circuit in the process.

To do this, recall that a charged particle in a "hooking" del-phi river moves itself. This is true for an ion, as well as for an electron. We need only make the del-phi in correct fashion and synchronize it; specifically, we must not release the hose nozzles we utilize to produce our del-phi river or waves.

The inventors who have discovered this have used various variations, but here we show a common one.

First, we add an "energizer" (often referred to by various other names) to the circuit. This device makes the del-phi waves we will utilize, but does NOT make currents of electron masses. In other words, it makes pure Ø-dot. It takes a little work to do this, for the energizer circuit must pump a few charges now and then. So the energizer draws a little bit of power from the motor, but not very much.

Now we add a switching device, called a controller, which breaks up power to the motor in pulses. During one pulse, the battery is connected and furnishes power to the motor; during the succeeding pulse, the battery is disconnected completely from the motor and the output from the energizer is applied across the terminals of the battery.

If frequency content, spin-hole content, etc. are properly constructed by the energizer, then the ion movements in the battery reverse themselves, recharging the battery. Again, remember that these ions MOVE THEMSELVES during this recharge phase. Specifically, we are NOT furnishing ordinary current to the battery, and we are not doing work on it from the energizer.

If things are built properly, the battery can be made to more than recover its charge during this pulse

cycle.

To prevent excess charge of the battery and overheating and destroying it, a sensor is added which senses the state of charge of the battery, and furnishes a feedback signal to the controller to regulate the length of recharge time per "power off" pulse. In other words, the system is now self-regulating.

The relation between power pulses and recharge pulses is shown on the graphs at the bottom. Note that regulation may decrease the time of recharge application of the del-phi river.

This system, if properly built and tuned, will furnish "free shaft energy" continually, without violating conservation of anenergy. Remember that the del-phi condition across the battery terminals means that spacetime is suddenly curved there, and conservation of energy need no longer apply.

Again, this system is consistent with general relativity and with the fact that Ø-field alone can drive a situation relativistic. We have deliberately used these facts to do direct engineering. Our "extra energy" comes from shifting phi-flux -- the energy of the universal vacuum spacetime -- directly into ordinary energy for our use. Thus we draw on an inexhaustible source, and our device is no more esoteric than a paddlewheel in a river. The only difference is that, in this case, we have to be clever enough to make and divert the river in the right timing sequency.

This is a free energy device which an ordinary person, who knows a little electronics, can experiment with in the basement. To develop it, one is talking several thousands of dollars and a lot of persistence and tinkering; one is not talking millions.

WARNING: THE PRECEDING EXPERIMENTS ARE HAZARDOUS. DO NOT ATTEMPT THESE EXPERIMENTS UNDER ANY CIRCUMSTANCES UNLESS YOU ARE AN EXPERIENCED ELECTRICAL RESEARCHER, EXPERIENCED IN PERFORMING EXPERIMENTS WITH LEAD-ACID BATTERIES AND PULSE CHARGE AND DISCHARGE OF SAME, AND UNLESS YOU ALSO USE ALL SAFETY PRECAUTIONS SUCH AS GOGGLES

AND PROTECTIVE GLOVES, SLEEVES, AND APRON. YOU MUST NOT HAVE OTHER INFLAMMABLE LIQUIDS OR OTHER SUBSTANCES PRESENT WHICH COULD BE IGNITED AND BURN OR EXPLODE. SURGED LEAD-ACID BATTERIES PRODUCE HYDROGEN GAS, WHICH CAN EASILY EXPLODE SINCE SPARKING ALSO CAN OCCUR. THE ACID FROM SUCH AN EXPLOSION CAN EASILY BLIND YOU IF IT GETS IN YOUR EYES, AND IT CAN BURN YOUR SKIN. IN ADDITION, LEAD AND LEAD COMPOUNDS ARE POISONS, AND ARE TO BE HANDLED ONLY BY EXPERIENCED RESEARCHERS. THESE EXPERIMENTS ARE NOT FOR AMATEURS UNDER ANY CIRCUMSTANCE, BUT ONLY FOR EXPERIENCED PROFESSIONALS WITH PROPER KNOWLEDGE AND TRAINING, AND USING PROPER PRECAUTIONS. NEITHER THE AUTHOR NOR THE PUBLISHER IS REPONSIBLE OR LIABLE FOR ANY ACCIDENTS OR DAMAGE YOU MAY ENCOUNTER, AND ALL EXPERIMENTATION WITH THESE DEVICES AND PROCEDURES IS AT YOUR OWN ASSUMED PERSONAL RISK.

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SLIDE 41.

THE TRANSLATOR

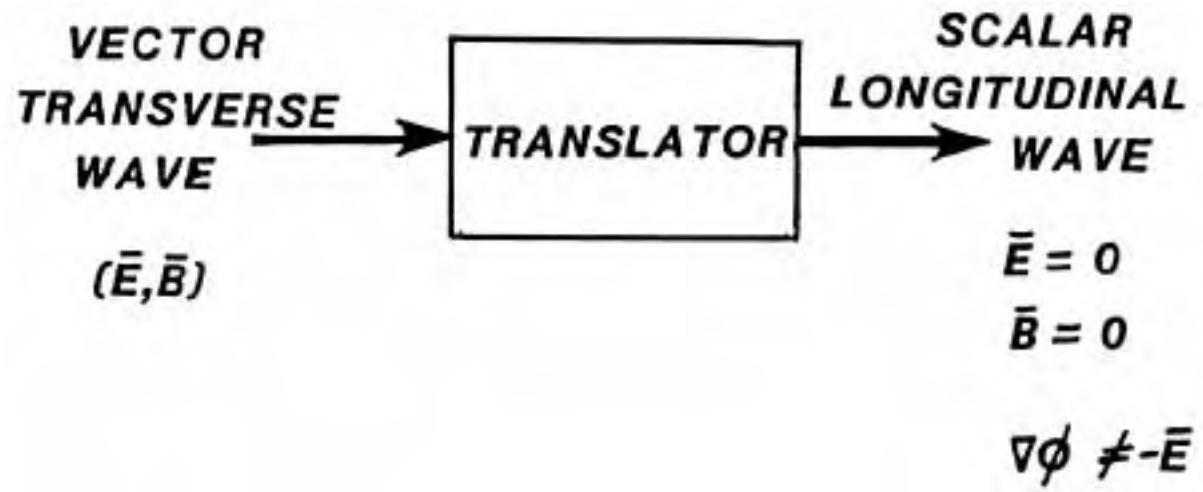

We now turn to a fundamental concept we need in order to understand some of the effects used by the Soviets in their Tesla weapons.

Note that one other country -- one not hostile to the U.S. -- also has such weaponry.

This slide shows the concept of a TRANSLATOR. Briefly, if we input a transverse matter wave, the translator outputs a scalar longitudinal wave without spin vortex hooks. If we input a scalar longitudinal wave -- even one without hooks -- the translator puts out a normal vector transverse matter wave.

We define a translator as anything which will accomplish one or both of those functions (usually both).

Basically, any device which is TOTALLY nonlinear to transverse waves will produce scalar waves from a transverse wave input. Any device which is totally nonlinear to longitudinal waves will produce transverse waves from a longitudinal wave

input.

It is comparable to certain plasmas, which, as is well known, produce such a translator effect. If you input longitudinal waves, you get transverse waves. If you input transverse waves, you get longitudinal waves. And the plasma is rather totally nonlinear.

Again, if our translator outputs non-hooking waves, it means that the component substructure waves oppose each other in sum zero fashion, and "kill" or nullify the vortex spin-holes.

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SLIDE 42.

TRANSVERSE WAVE INTERFERENCE

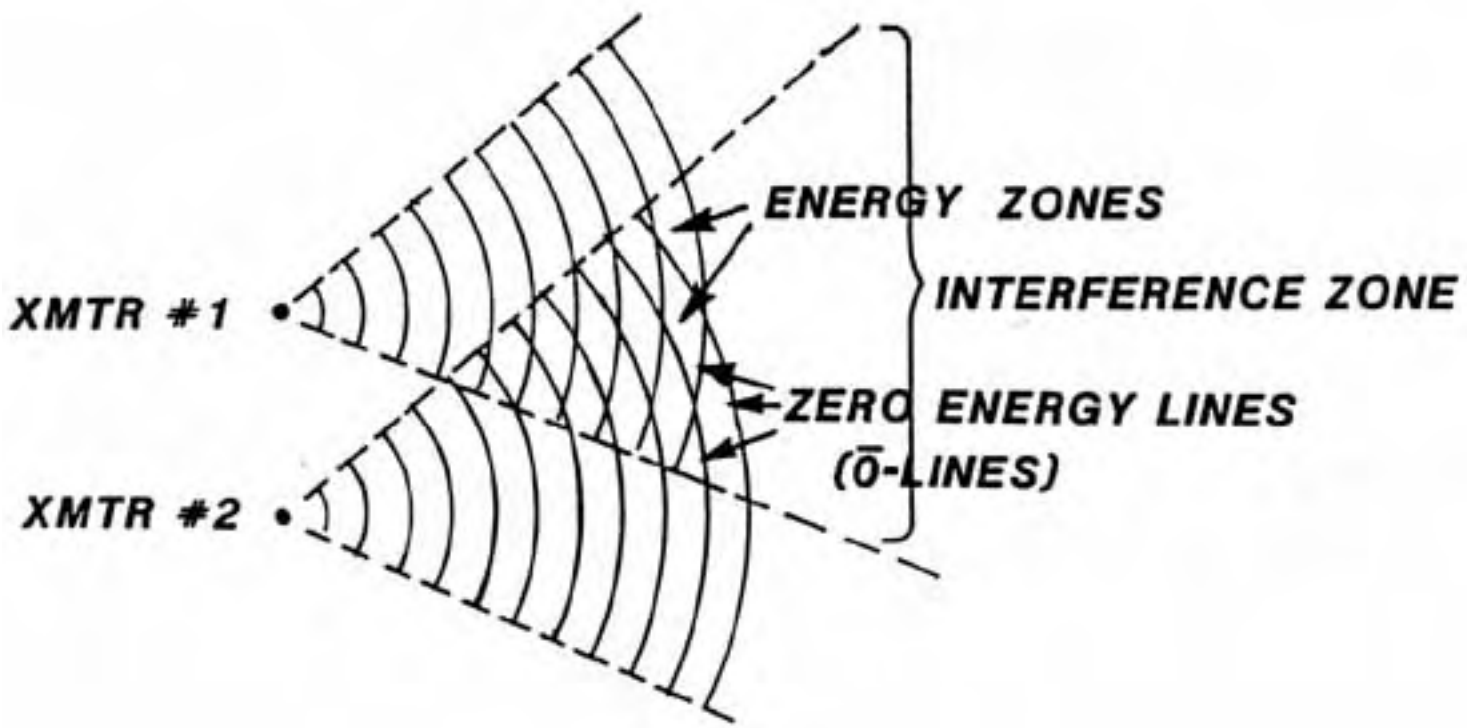

On this slide we show "normal " transverse wave interference, as we presently teach it in our textbooks.

We visualize two identical transmitters, each producing a beam in a pattern of about 55 degrees of so.

Where these beams overlap -- in the ideal, perfect case, we have constructive and destructive interference, with absolute zero-vector linear regions being formed. We put in the energy, and out-of-phase interference creates the zero zones, which contain no energy as such.

We point out, however, that these zero-lines are scalars,
and contain high stresses on spacetime.

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SLIDE 43.

LONGITUDINAL WAVE INTERFERENCE [SCALAR WAVES]

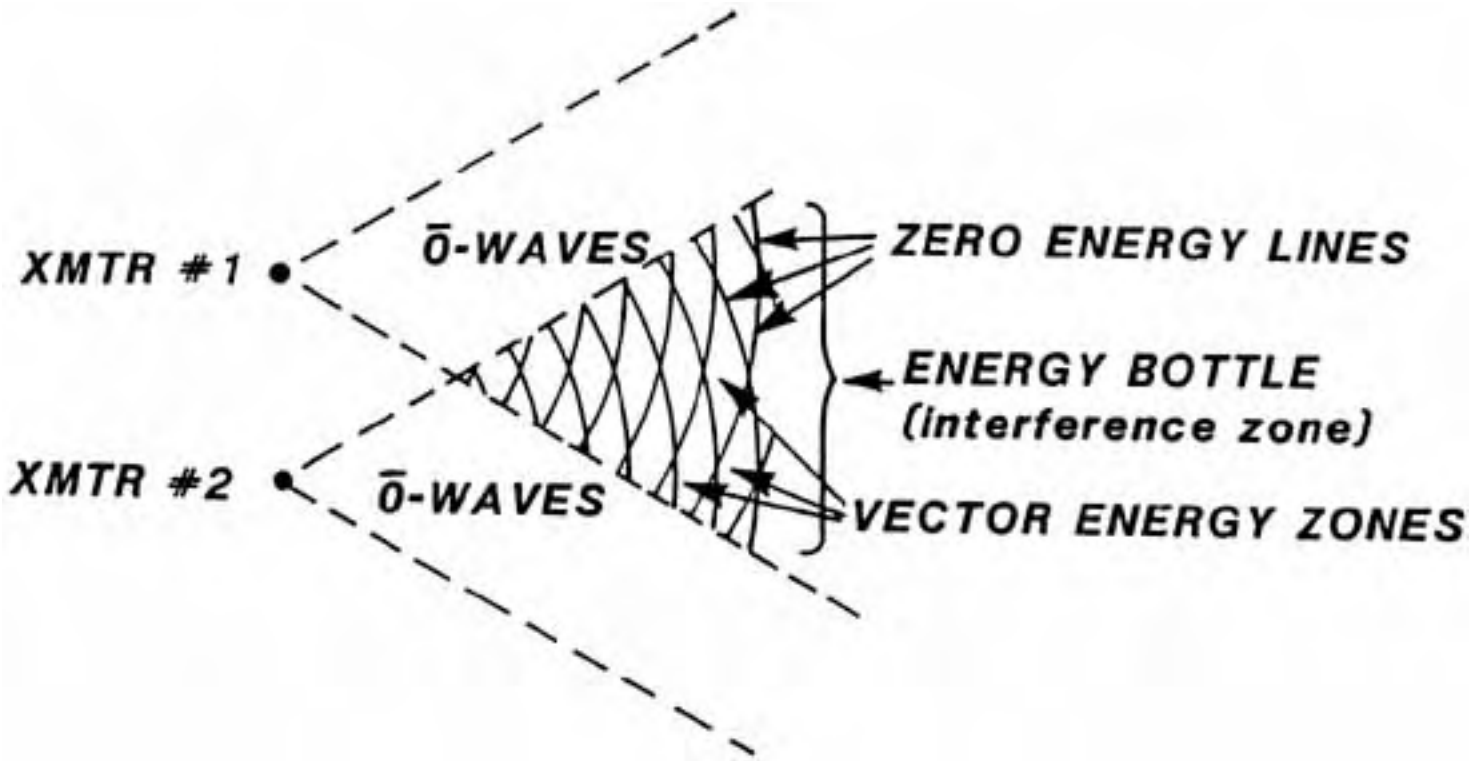

On this slide we show the interference pattern that emerges from the interference of two identical scalar wave beams from translator/transmitters.

Now note we are interfering two zero-vector waves, each containing a substructure. In this case we assume similar substructures.

What happens now is that we get a similar interference pattern, but with some startling differences.

First, we put in the zero-lines. These represent in-phase conditions for the substructures.

. Second, the substructures themselves interfere, and form energy in the grid zones between intersecting zero-lines.

In the perfect case, however, this energy cannot

radiate away. It is physically created and trapped as if in an "energy bottle." We are CREATING this energy at a distance, and storing it in a bottle. If the bottle were perfect, we would continue to accumulate energy in the grid zones -- notice we are continuing to pour energy into both transmitters, and there is zero ordinary energy anywhere else except in the grid zone "bottles."

If we turn off the transmitters smoothly, we extinguish the energy in the bottle completely. It is sucked right out of there, and the vacuum returns to its normal condition.

If we erratically and nonlinearly turn off the transmitters, we destroy the bottle and "dump" the energy suddenly. This is exactly like a sudden EMP from a nuclear weapon. A sudden pulse of energy is freed to radiate and interact in the region where the bottle was.

The high altitude booms off the East coast of the U.S. a few years ago were made in precisely this fashion, from such a weapon being adjusted and calibrated in the Soviet Union.

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SLIDE 44.

CREATING ENERGY AT A DISTANCE

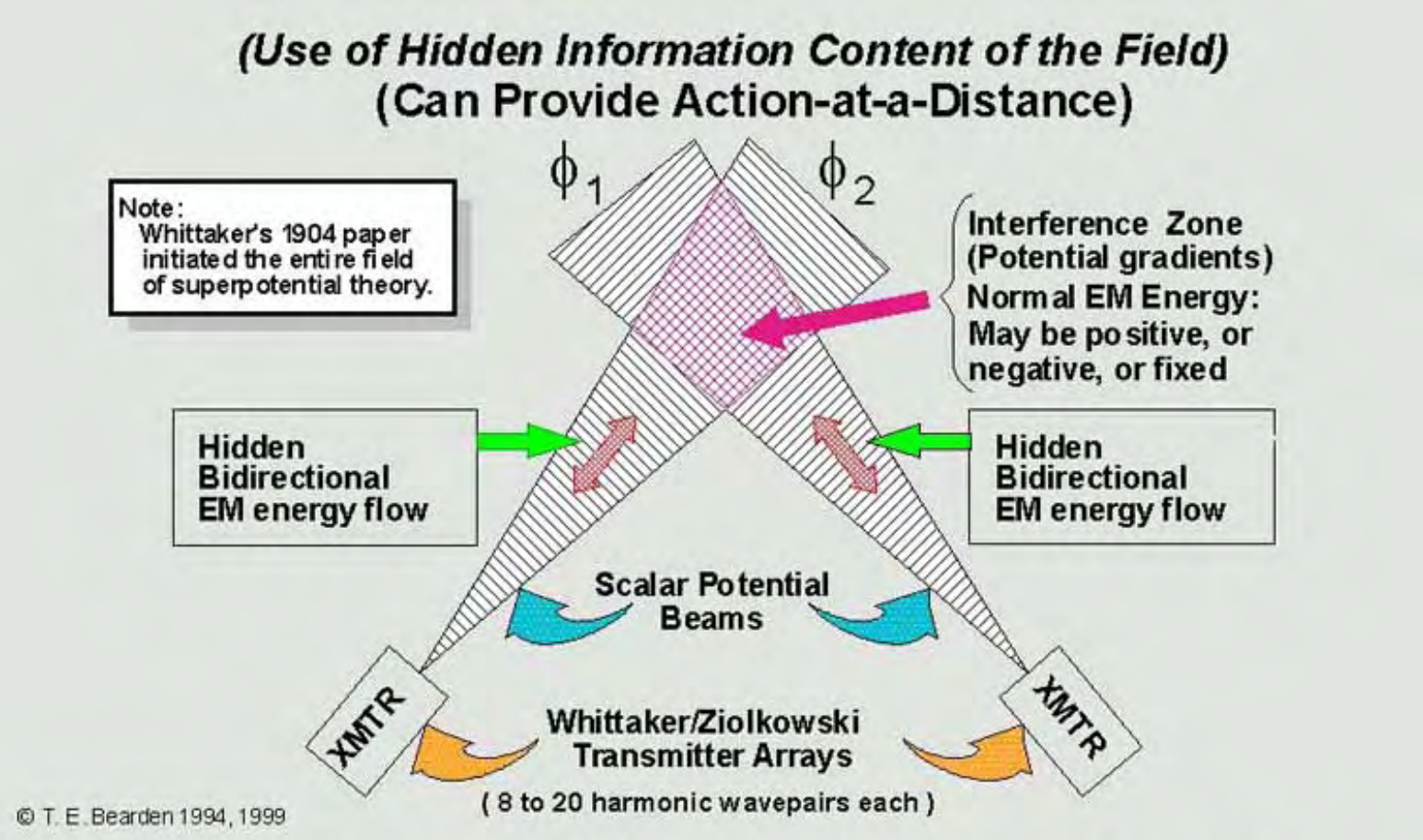

Figure 5. Scalar potential interferometry (between the two sets of bidirectional longitudinal EM wavepair functions) produces all EM force fields and waves.

But let us look at one way to do this sort of thing more efficiently.

Here we show two scalar transmitters (that is, two translator /transmitters) which form narrow beams, and which cross those beams at a distance.

In the crossing zone, scalar interference is established, making an energy bottle and producing trapped or locked in energy.

If I have a physical target in that crossed zone, I can literally "fry" the target, for I get all the power inputted to the transmitters contained in the bottle zone. I don't have any square law losses.

I can heat a metal object white hot at a distance, for example. Because all real bottles are slightly imperfect, the real bottle is leaky and some photons escape. I can observe the white hot steel in the bottle,

and I can record and measure the temperature from the escaping photons, by simple radiometric methods.

Now if I smoothly turn off both transmitters linearly, all the energy in the bottle disappears immediately. I can immediately reach in and pick up a black, cool piece of steel. And that cannot be done with ordinary inductive or radiowave heating.

That has been done in a laboratory on the North American continent.

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SLIDE 45.

NONLINEARITIES CAUSE SHIFTING [PARTIAL TRANSLATION]

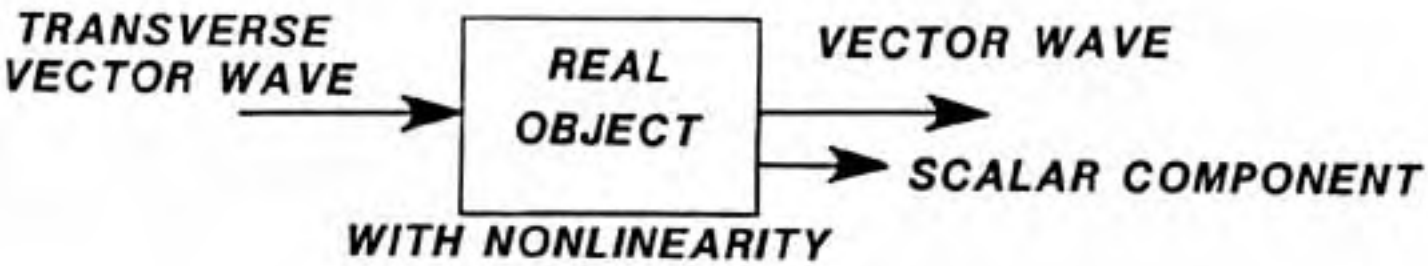

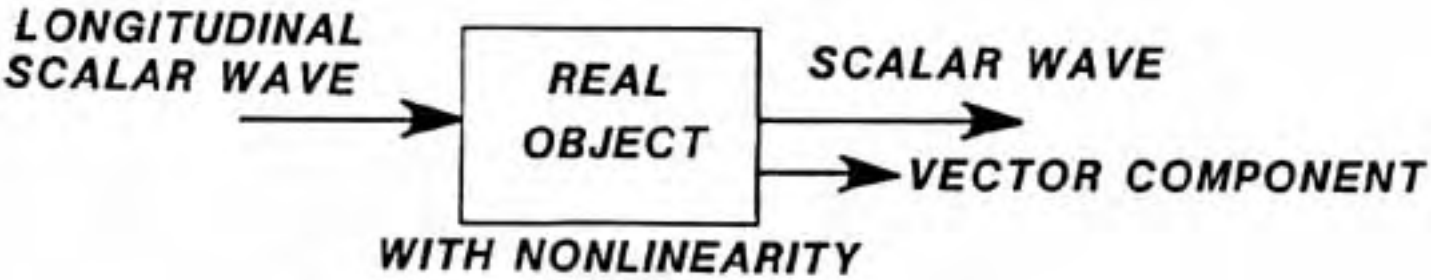

Here we show the results of electrical nonlinearities in an object which encounters a true translated (non-hooking) scalar wave. All objects have some electrical nonlinearities in them, and so all act partially as translators.

This means that any real object creates a small scalar aura around itself from its continual temperature interactions -- from absorbing and radiating ordinary EM waves. In addition, the object normally is subject to undetected scalar wave radiations, and so it also produces a small aura of transverse vector waves around itself by translation.

All real objects accomplish at least a little bit of translation.

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TOWARDS A NEW ELECTROMAGNETICS
PART 4: VECTORS AND MECHANISMS CLARIFIED

SLIDE 46.

THE SCALAR AURA

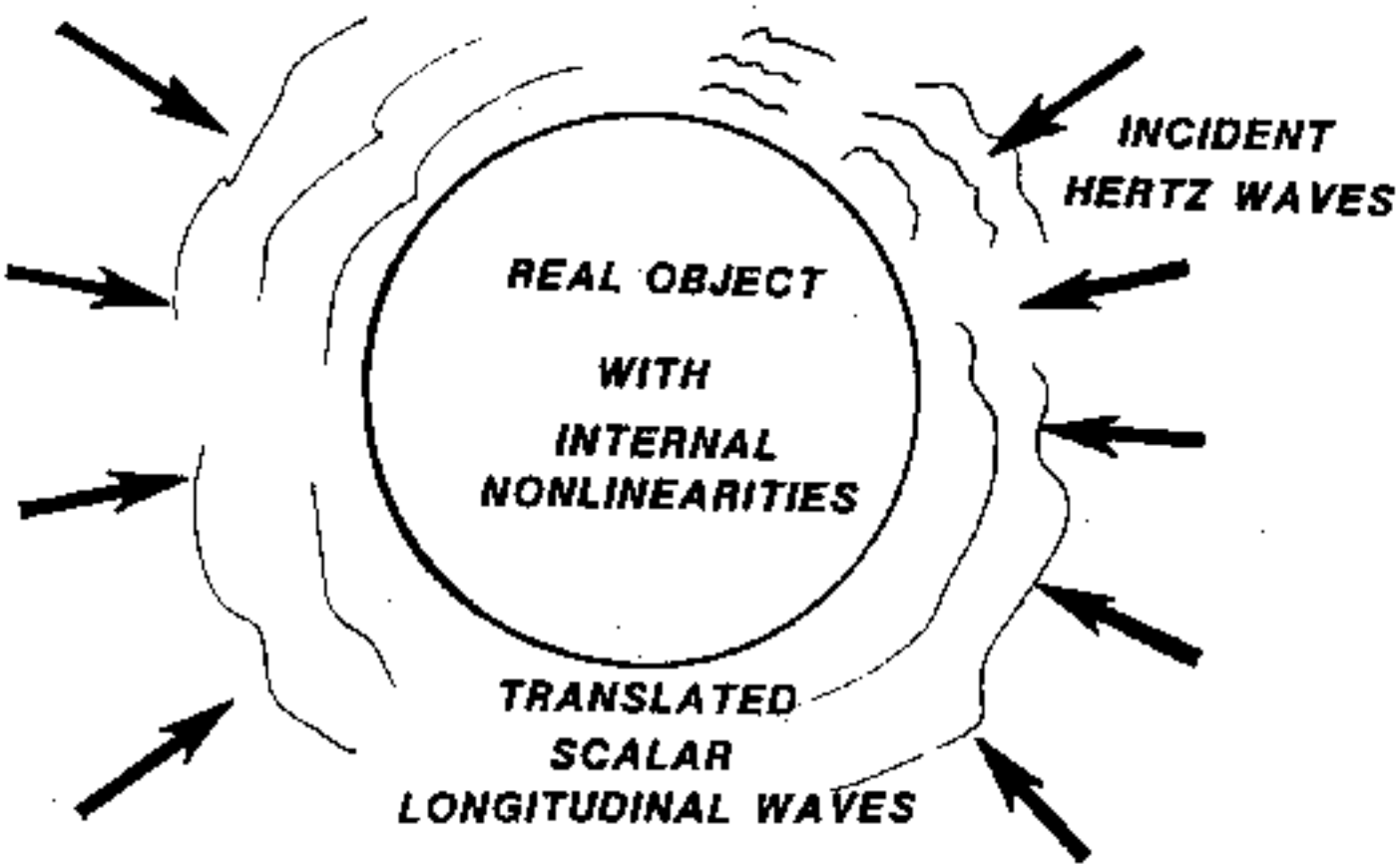

We examine now an object with temperature, that is, a normal object continually absorbing ordinary EM radiation and continually emitting EM radiation.

The object has a small fraction of its incident energy expressed as a scalar aura around it, because of translation. Note that normal detectors will not detect this aura, but special two-stage interferometric detectors will detect it. Also note that the object replenishes- the ordinary radiation flow by its translation of some of its incident scalar radiation into the normal or "transverse" (so-called) radiation.

The entire internal pattern -- all interactions and functions of the body -- are precisely present in its scalar aura, down to the finest detail. This makes an x-ray pale by comparison.

True psychics actually use the nonlinearity of their nervous systems (note the avalanche ion discharges across dendrite gaps) and the interferometric aspects (note two cerebral hemispheres, connected by a corpus callosum) to detect the scalar aura. This is a physical fact and not esoteric delusion. To control this, however, is normally as difficult as learning to walk a high wire and do acrobatics on it. There are not many high wire walkers in the world, but it certainly is a skill within human control capability and purview.

T. Galen Hieronymus was absolutely correct when he stated that the entire internal working pattern of an object is radiated by that object in terms of an extraordinary energy, which he called "eloptic" energy. It is actually translated scalar wave energy, and entirely consistent with present EM theory when the glaring errors in its foundations are corrected.

Shortly I hope we will see instrumentation which can directly examine the scalar aura in the finest detail, seeing every illness, and simply setting dials to radiate the body with gentle, harmless scalar waxes to directly correct illnesses.

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SLIDE 47.

VIRTUAL FLUX AND MAGNETIC FIELD [LINEAR CASE]

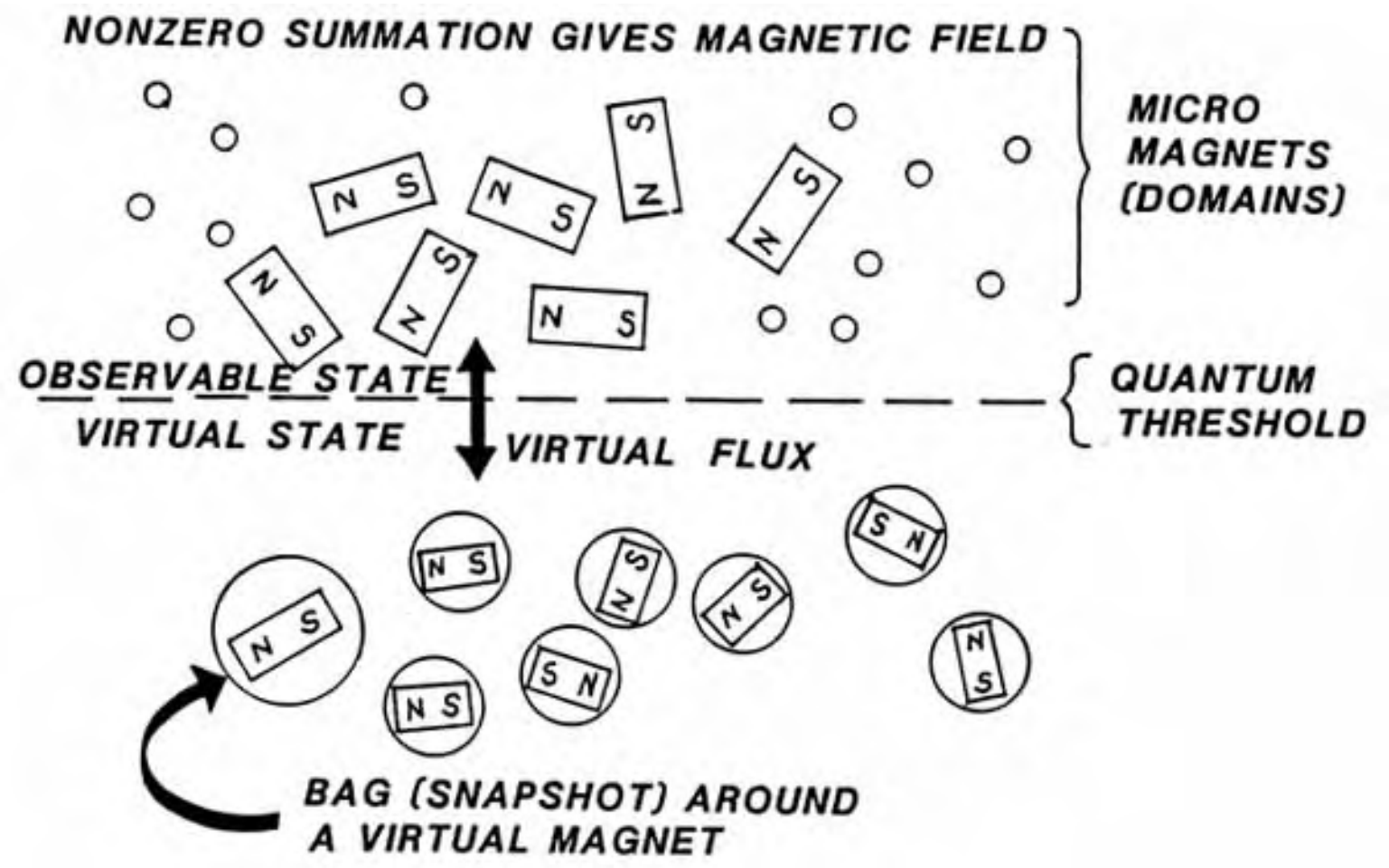

Briefly, let's look at some nice things we can do with magnetism. Specifically, let's find out how to make magnetic monopoles and use them to do things in the laboratory. This again has been done in a laboratory on the North American continent.

First, about all the present science can tell us about a magnet is that "a big magnet is made of littler magnets." And if we examine one of the smaller magnets, it's made of even smaller magnets. This is like saying big dirt piles are made of smaller dirt piles, and that explains what dirt is.

However, let's use that with our knowledge of the virtual flux vacuum.

In this slide, we show diagrammatically the situation for a common magnet. Note that domains in the magnetic material are themselves little magnets, and their alignment and vector summation determine whether or not there's said to be a magnetic field present. Nonzero summation states that there's a resultant magnetic vector, and hence an external magnetic field. Zero summation states there's no external nonzero resultant, hence no external magnetic field.

Actually, there's an external scalar magnetic potential field, even when the external vector magnetic field is zero. The substructure is still there.

If we pursue this "big magnets are composed of smaller magnets," eventually we reach the quantum threshold, and we have a substructure of virtual, subquantal magnets in vacuum, in the virtual particle flux. At least we conceive each little virtual particle as if it were spinning, and hence a little magnet.

We put a conceptual bag around each little virtual magnet.

In a linear situation, the north pole is as strong as the south pole, and so just outside the bag, the poles cancel or appear zero. Since the virtual bag appears to be zero length to an external macro observer, the poles seem to be directly superposed on top of each other, yielding no pole at all to the observer.

However, you and I now know that both poles are still in there, in the virtual substructure, and we certainly have remaining with us a translated scalar magnetic field.

There's a virtual flux to and from each observable particle of charged mass in the observable state as shown, but this flux is now scalar in virtual magnets, except for nonlinearities in the structures

above the quantum level. Thus accelerated portions -- atoms with electrons in whirling orbit, spinning electrons, protons, etc. -- possess nonzero ordinary vector magnetic fields by translation. Again, notice the successive interlocking levels of reality, all the way from deep in the virtual state into interlocking levels in observable state.

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SLIDE 48.

PRODUCING MAGNETIC MONOPOLES

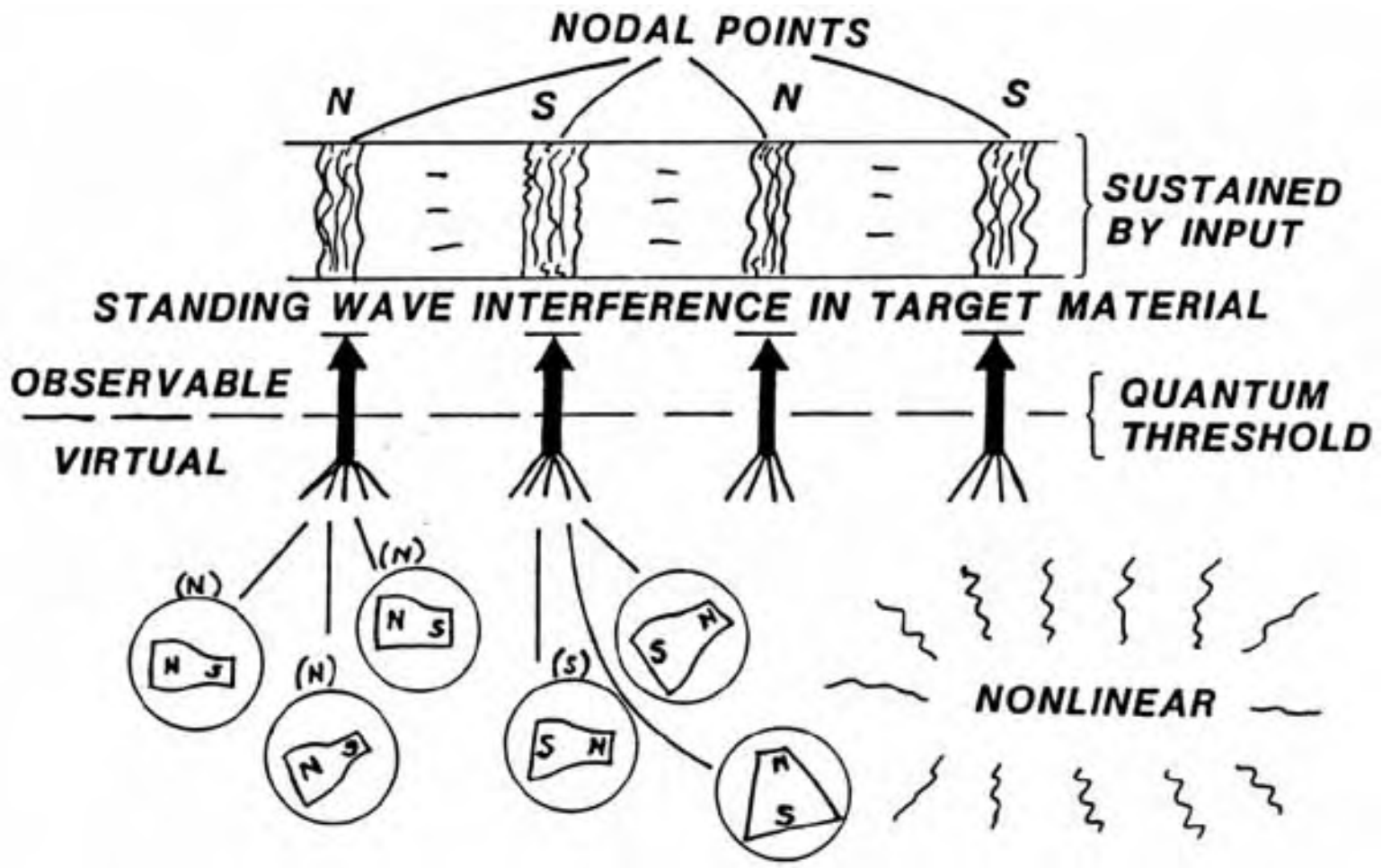

Now let us look at a non-linear case of the same sort of thing. Now the bags are still around the little virtual magnets, but they are nonlinear. This means that, to an observer outside the bag, one pole seems bigger or more powerful than the other. In other words, to the quantum observer, this bag appears to be a magnetic monopole at a point.

In the flux still on and off each observable spinning charged mass, we now have a steady component of "monopoles". If we have a standing scalar wave present in a physical material in which the nonlinearity exists -- and the scalar waves can even be PRODUCING that nonlinearity -- we will have nodes

available at which the monopoles will congregate and emerge and interact.

North monopoles will congregate at one node, while south monopoles will congregate at the next, and so on in alternating fashion.

That means that, at anyone node, monopoles of the same kind are steadily being "deposited" in the material. These monopoles strongly repel each other, and so the material at that node is increasingly stressed in a tensile fashion.

Eventually the material will be torn apart at the node,
stress relieving the situation. Movement of the material will release the nonlinear condition, stopping monopole production and deposit. However, at a break node, the same kind of magnetic pole will appear on each side of the break.

That is, the breaks will be N-N, S-S, N-N, S-S, etc.

An ordinary magnetic does not do that when it breaks. Instead, it breaks N-S, N-S, etc.

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SLIDE 49.

BREAKING METAL WITH MAGNETIC MONOPOLES

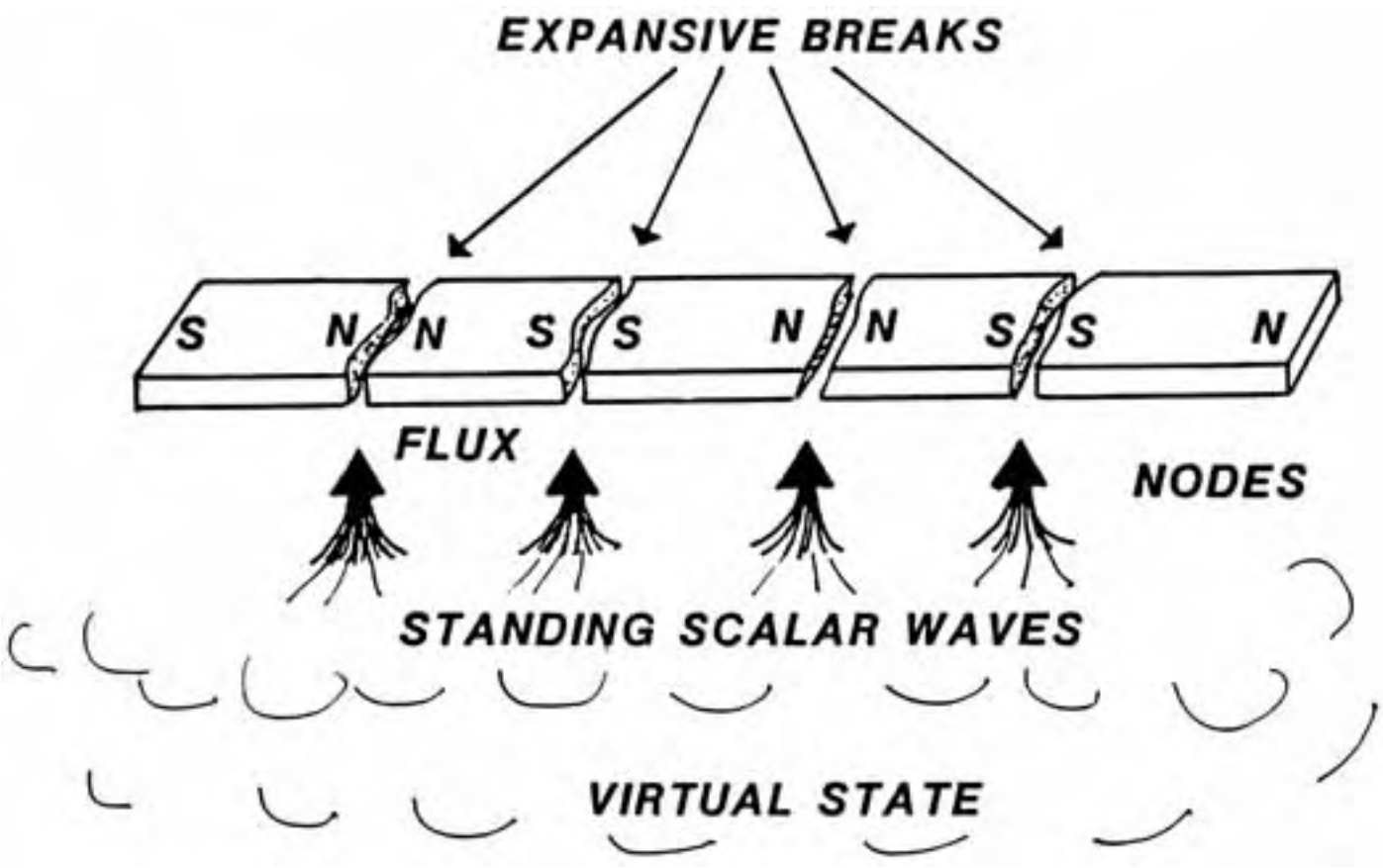

Again, metal has been broken in a North American laboratory utilizing the production and deposit of magnetic monopoles in this fashion.

On this slide we show what was done.

An ordinary bar of steel was exposed to standing scalar waves in a nonlinear situation, depositing magnetic monopoles at the wave nodal points in the metal bar. The breaks occurred as shown on this slide.

Much of what I am presenting is based on certain experiments accomplished in experimental laboratories here and abroad. Most of the mechanisms have actually been produced in the lab. However, these are proprietary labs and I cannot violate trust and

reveal the precise construction details utilized. In some cases I have not seen the precise constructions, but only the direct results.

But ironically, the production of magnetic monopoles -- which has fiercely resisted the normal scientific approach -- yields readily to the new approach.

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SLIDE 50.

CREATING AN INERTIAL FIELD (ANTIGRAVITY)

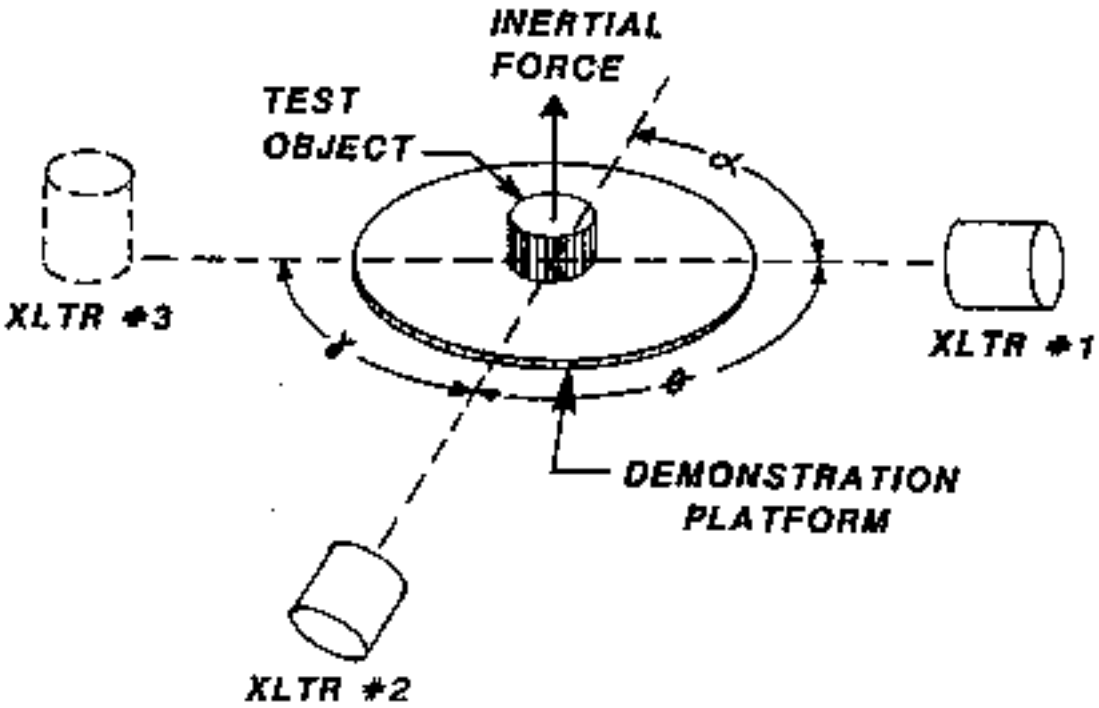

We now show schematically how to produce an inertial field, or antigravity. Also an inertial space drive can be produced in this manner.

This again has been done in a North American laboratory. In fact, inertial fields have been produced in more than one lab here in North America.

In the setup shown here, three translator/ transmitter projectors are used and oriented so as to give three-dimensional interference, or interference along all three spatial axes.

By controlling the substructures of the three projectors all together, one can control the precise phasing in all substructures, with respect to a common time reference.

By this means, a unilateral force can be created of each and every charged mass particle (that is, on each proton) in the nucleus.

Since we know that the neutrons and protons in a nucleus of an atom are continually interchanging, one into the other, back and forth, all of the nucleons can be treated as "diffuse protons" for mass purposes, and scalar wave interaction purposes.

Thus if we have the correct pattern to affect protons, we can control the phases of the substructure waves of the projectors so as to produce unilateral, parallel forces on and of each spinning proton in the nucleus.

This means we can produce unilateral thrust in an object exposed to the triad interference of the projectors.

In short, this produces antigravity. If sufficient force is produced, the test object in the interference zone simply lifts itself off against earth gravity. This has been done in North America.

If we phase the projectors so that counterbalancing forces are produced on each proton, we can either make the proton "lighter" inertially or "heavier."

In fact, we could "freeze" a common pistol so that it could not be moved and its trigger could not be pulled, simply by sufficiently increasing its inertia. This was done in experimental demonstrations in Toronto, Canada in 1969, and witnessed by the Chief of the Homicide Squad of the Toronto police. It was his pistol that was frozen for the demonstration.

If the projectors themselves are on board a space capsule, for example, they can produce such a unilateral thrust in and of a central mass or disc attached to the of the craft. By this means, an inertial spacedrive can be built.

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SLIDE 51.

EFFECTS ON HUMANS

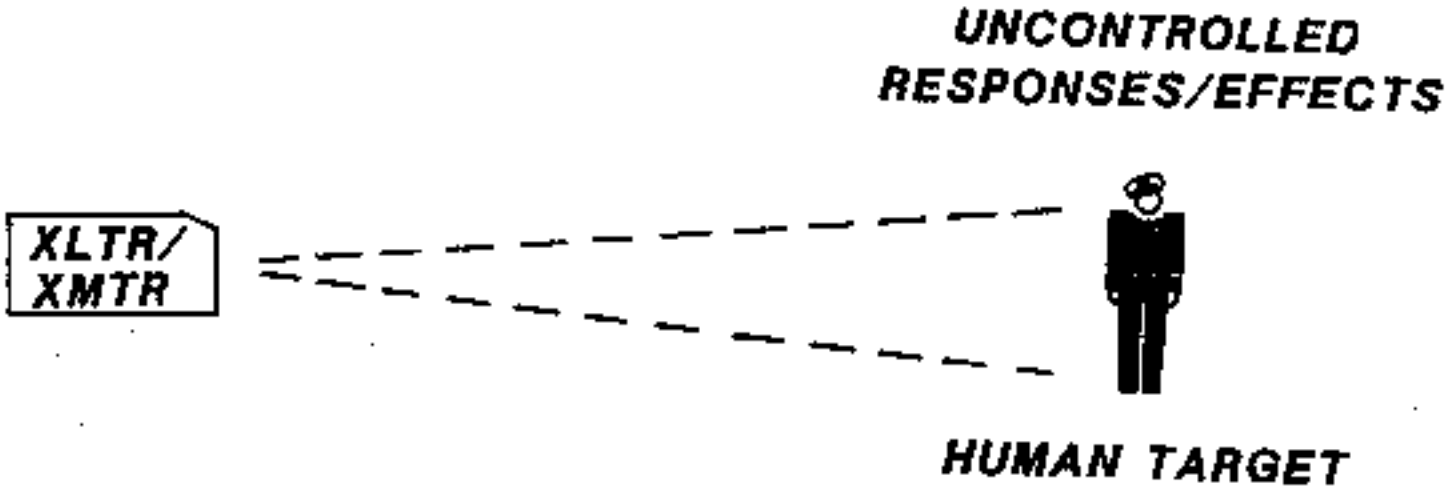

Now let us look at some of the effects on humans, when radiated with a true scalar wave beam from a translator/transmitter.

First, the human nervous system is highly nonlinear. Essentially, across billions of synapses, sudden ion discharges -- analogous to spark discharges -- are continually or periodically occurring. Brain waves, for example, are not waves along wires; instead, they are waves of avalanche discharges across tremendous numbers of nerve cell gaps.

The central nervous system is thus highly nonlinear, and the gap firings of the nerve endings act as translators.

These translators partially translate incident scalar waves, so that additional transverse matter waves -- or ordinary energy inputs -- occur in the ion discharges.

Thus additional energy is being added to the nervous system by incident scalar waves.

Many long-term effects of the environment on the body are gradually kindled in this fashion, even

over a period of years.

For a stronger dosage of scalar waves, the nervous system experiences "jamming" of its signals. This leads to four basic "noise jamming" effects.

If a small dose is absorbed, the interference is slight. One feels as if one had taken a whiff of anaesthesia -- an unreal, dreamy feeling.

If a slightly larger dose is absorbed, the interference is moderate. Now the single channel system -- the motor system -- goes, and the individual is paralyzed. Mentally he is barely conscious, in a sort of hypnogogic, waking dream state. Any tendency toward epileptic seizure or other nervous disorder may surface here, as may heart palpitations or even heart failure.

For a heavier dosage yet, the interference is now strong. Now the multiple systems start failing. Consciousness is lost and the individual is in a deep coma. In addition, seizures and convulsions, and loss of control of some body functions, may occur. The autonomic nervous system is keeping the heart beating with difficulty and keeping the body gasping for breath.

For a very strong dosage, the entire nervous system fails and death results almost immediately. This is quite similar to the effects of nerve gas.

These are the four major symptoms of scalar wave radiation of the body and translating absorption by the nervous system in an uncoordinated fashion.

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TOWARDS A NEW ELECTROMAGNETICS
PART 4: VECTORS AND MECHANISMS CLARIFIED

SLIDE 52.

INITIATING SPECIFIC BIOLOGICAL EFFECTS

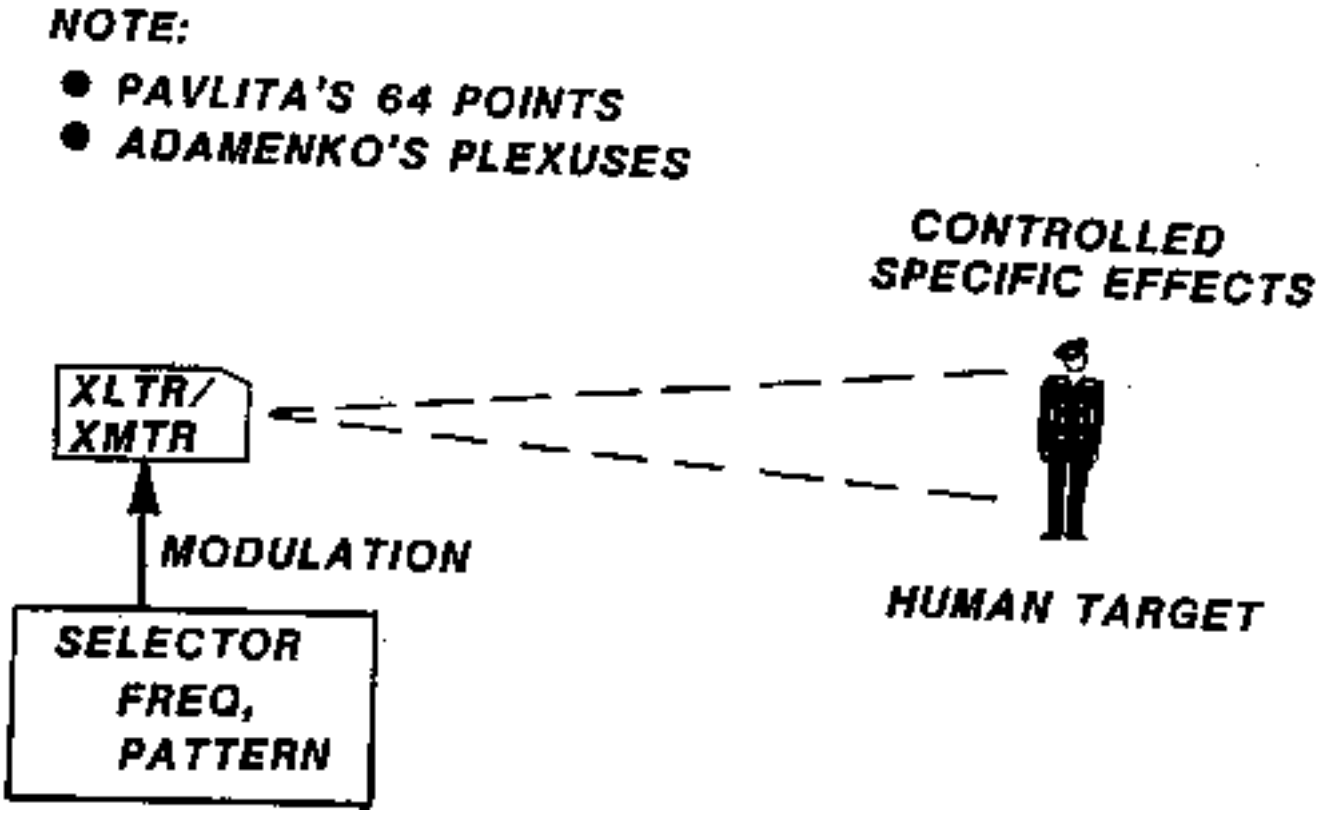

If we now add precisely patterned modulations to the substructure waves of the scalar zero vector beam, we can induce deliberate patterns in the dosage absorbed by a biological system.

As Kaznacheyev's experiments showed, any death or disease pattern can be induced upon an electromagnetic carrier -- specifically, upon the near-ultraviolet as an example. Some of his experiments were duplicated at the University of Marburg in West Germany, utilizing infrared carriers. These patterns can be dumped into cell cultures, eventually kindling the pattern of death or disease in the target cells.

The same can be done to a human from an external source. The major entry point is the acupuncture system, which reacts to scalar waves and transfers them to the nervous system for translation.

Pavlita, Czechoslovakian engineer, has built "psychotronic generators" for over 30 years that affect the human body. Adamenko, Soviet physicist, found that the acupuncture points formed groupings or plexuses that were frequency sensitive. In other words, certain frequency bands affect one plexus more than others. Further, these acupuncture points are known to be connected to effects produced at remote locations in the body.

Pavlita stated he had found 64 different sensitive "points" on the body, and had succeeded in building a generator for each. If by his points he meant Adamenko's plexuses, then frequency patterns can be created that affect certain acupuncture groupings -- and thereby certain specific body locations and effects -- more than others.

It thus appears reasonable that, by placing the proper frequency pattern in the modulations of the substructure waves feeding into the translator/ transmitter, the scalar ray or beam can be made highly selective as to body part affected and the effect generated or kindled in the body.

By this means, specifically tailored attacks on the body can be created.

Strong emotions such as sheer terror, overpowering rage, blind panic, etc. can be induced. Or physical effects such as epileptic seizure, loss of control of internal functions, loss of muscular control, severe weakness, specific failure of an individual organ such as the heart or liver, or blackouts and comas can be induced. In addition, patterns for specific toxins and diseases can be induced. With a strong absorption, these changes can be effected quickly. Imagine bubonic plague developing in 30 seconds, for example, or the effects of a cobra bite developing in 10 seconds.

If the individual is placed in crossed interference beams (that is, in the interference zone of a scalar interferometer), strong effects can be produced essentially instantly, including instantaneous death.

Of course BENEFICIAL effects can also be accomplished. As instrumentation is developed, one should be able to scan the aura, do a computerized

readout to show the different medical problems either developed or developing in the body, have the computer compose a "cancellation or offsetting pattern," and radiate the body with a totally beneficial pattern, customized for that particular condition at that particular time. One should be able to quickly cure cancers and leukemias, for example, even of the brain and of the bone marrow. One may even be able to quickly reverse the effects of aging; at least there is no foreseeable reason why it should not be possible.

The new technology is a very powerful tool, and it can be used for either good or bad, depending upon the intent of the developer and the user.

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SLIDE 53.

GROUND-TO-AIR USE

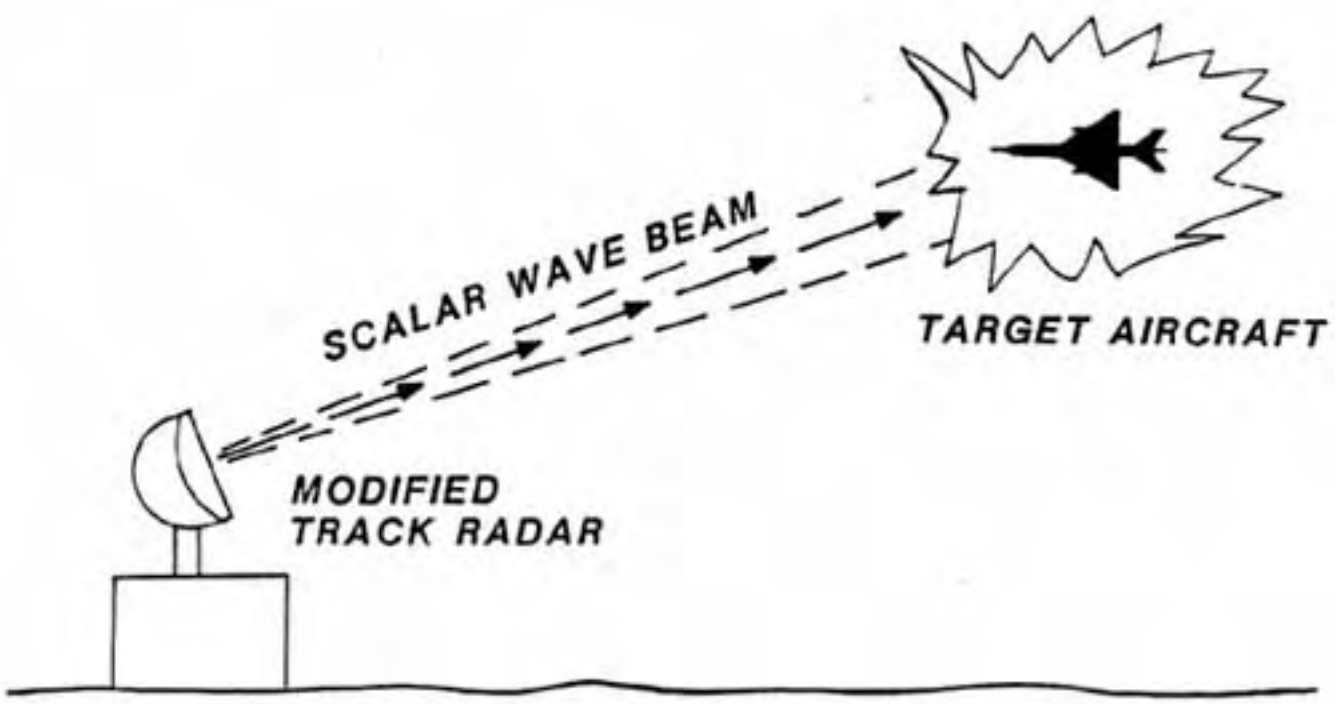

Here we show another use of the scalar beam technology already developed by foreign powers.

A modified track radar -- either continuous wave or pulsed -- transmits a scalar wave beam. It radiates an incoming hostile aircraft, keeping the beam on it, and kindling energy in the nonlinear electronic circuits of the aircraft by translation. Communications, navigation systems, avionics systems, electronic fuze systems, ignition and control systems, airborne radar, missile armament electronics, etc. are all vulnerable to this translation kindling of internally jamming energy from the incident scalar beam.

The electronics can be knocked out and the aircraft knocked down.

The pilot himself is also vulnerable because of his highly nonlinear central nervous system.

Some or all of the eight F-111's mysteriously

lost in
Vietnam may have been bagged by modified SA-2 FANSONG radars, using this effect.

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SLIDE 54.

TACTICAL AIR-TO-GROUND USAGE

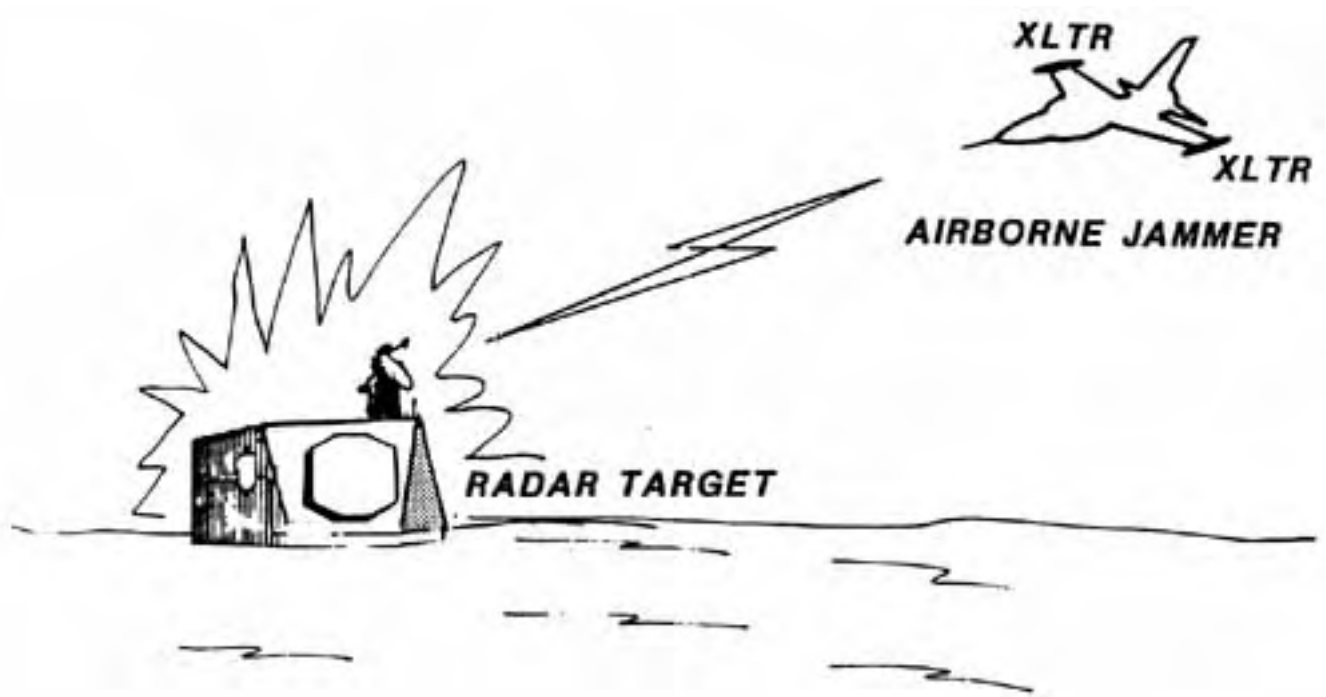

As shown on this slide, the technology is also usable from aircraft against ground targets, particularly ground-based radars and communications systems.

As shown, the aircraft has a modified jammer, able to emit a beam of scalar energy from one or more translator/transmitters.

By simply training a beam on the radar, eventually the radar can be knocked out. That is the simplest use.

A more sophisticated usage is provided by more than one translator/transmitter, acting as a scalar interferometer.

In this mode, each translator/transmitter emits multiple scalar carrier frequencies. Two Fourier expansions are established, so that a three dimensional "ball" or sphere of interference-zone energy is established. By pulsing or phasing, this ball is moved to strike the location of the radar, delivering a large burst of energy to it and knocking it out. Alternatively,

the energy bottle is "dumped" when it reaches the targeted radar or its near vicinity.

A still better way is to fire one Fourier scalar pattern directly at the target radar, then fire a second pulse faster so that it overtakes the first directly upon the target. (The ensemble of such a pattern acts as a soliton, and its velocity is controllable by controlling the amplitude of the pattern generated).

When the second scalar overtakes the first, a sharp interference is formed, with a fast energy bottle, which is then nonlinearly dumped in microseconds or milliseconds. In this fashion, all the energy put out by the jammer is delivered directly upon and into the target in one sharp EMP pulse, much like that from a small nuclear explosion. The target is destroyed.

Note that such a weapon can be utilized against tanks, vehicles, explosives, missiles, ammunition, bridges (the airblast), bunkers (the blast can occur INSIDE the enclosure), ships, planes, personnel, and targets of varied types.

The Soviets have had such secret weapons for years.

One additional country has them also.

Next Slide

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SLIDE 55.

INTEGRATED WEAPONS DISPLAY (MODIFIED JAMMER)

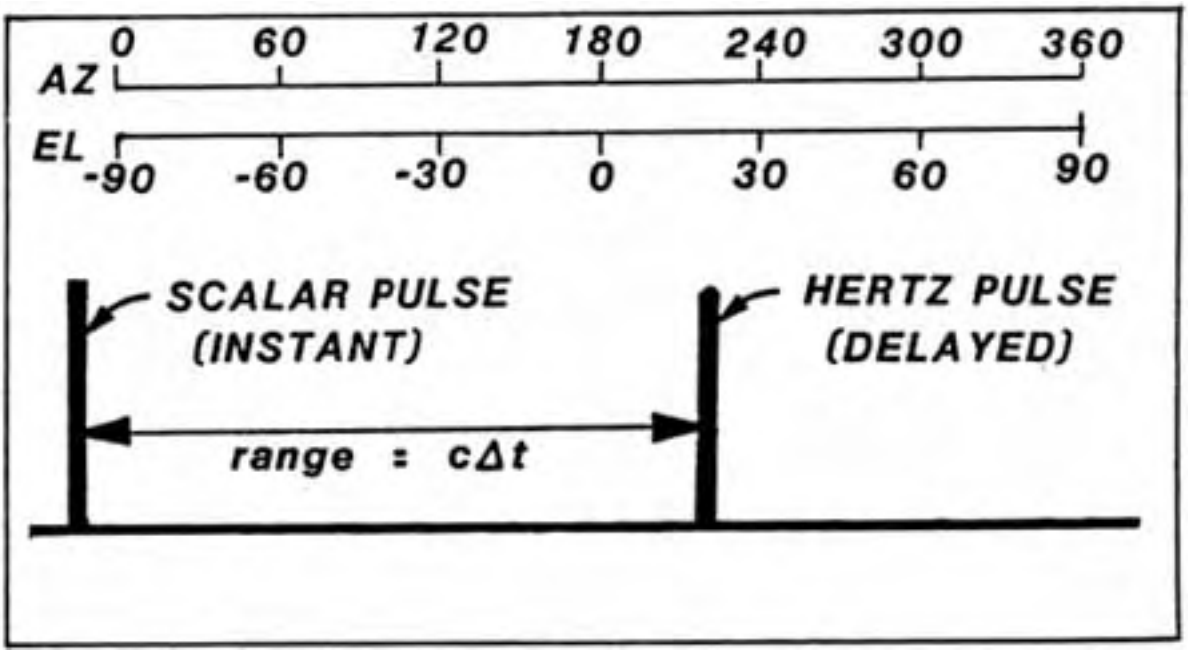

Here we show diagrammatically what a modified Soviet integrated weapons display for a modified jammer might be, to employ scalar interferometer weaponry.

As the "main bang" is emerging from the antenna of the target radar on the ground, the phi-field from it reaches to infinity, including through the aircraft with a finite magnitude. In the a1rcraft, two channels act in interferometer fashion as a scalar detector for phi-dot. The main bang creation (phi-dot) is detected, and displayed as the leftmost pulse.

At that time, a computer time-base starts clocking off microseconds.

At some time later, the third channel, acting as a normal receiver, receives the ordinary "Hertz" pulse from the radar, which has traveled to the aircraft at the

speed of light.

The computer converts elapsed time between the scalar pulse and the Hertz pulse to range.

Azimuth and elevation angle to the radar are obtained by normal angle tracking.

At this time, the computer has the exact coordinates of the radar, allowing for motion of the aircraft during the lapse time.

The computer switches the interferometer into transmit mode, and arranges amplitude patterns to target the radar.

It fires the first scalar pulse, then fires the second so as to create the full EMP directly upon the target.

The EMP flash occurs, destroying the radar.

At that time, another target can be processed.

In a more advanced weapon, scanning may be used to detect, locate, target, and engage multiple targets, including incoming air-to-air and surface-to-air missiles, one after another.

The same weapon is usable against a variety of aerial and ground based targets.

The major weapon is the electronic emitter, not a missile or ordinary ordnance.

Hordes of such special "jammer aircraft" now become a potent force on the battlefield, destroying all before them with annihilating ray weapons.

Star war is a reality now.

The High Frontier is already seriously obsolete.

Our entire defense establishment is completely vulnerable to these weapons at present, for we have not developed countermeasures or defenses.

Next Slide

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TOWARDS A NEW ELECTROMAGNETICS
PART 4: VECTORS AND MECHANISMS CLARIFIED

SLIDE 56

RADAR INVISIBILITY

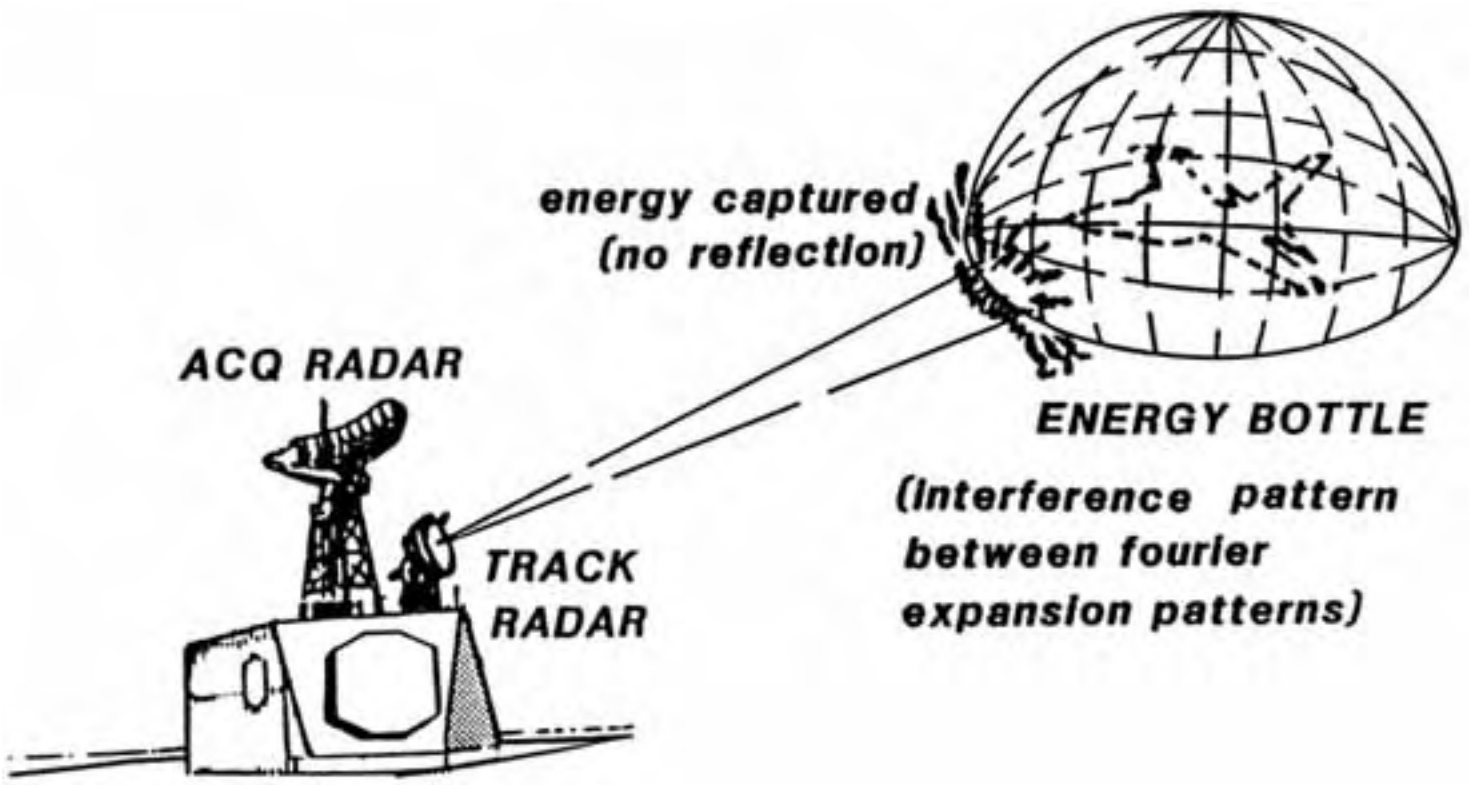

On this slide we show another effect which can be obtained. We can make an airplane invisible to ordinary radar.

Imagine now the same "jammer" type aircraft with three channels, one for use in scalar interferometry and one as an ordinary channel.

This time, a Fourier interference pattern is established around the aircraft, so this establishes an "energy bottle" around the plane. We specifically arrange this bottle in the frequency band of the hostile radar we wish to avoid. For multiple bands, we establish multiple bottles -- this just requires more

frequencies or more translator/transmitters.

The beam from the ground radar now strikes the energy bottle, and its energy enters and is trapped in the bottle grids. Since the bottle is leaky, the incident energy gradually disperses and "leaks" out all around, with very little emerging energy.

The ground radar receives no return pulse or reflection.

Therefore it sees no target.

The same interferometer system is usable both in this defensive screen fashion and in the attack fashion previously discussed.

Use of this system has been demonstrated internationally.

An energy bottle has been created in a North American laboratory as well.

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SLIDE 57.

NETWORK OF VIRTUAL TRANSMITTERS

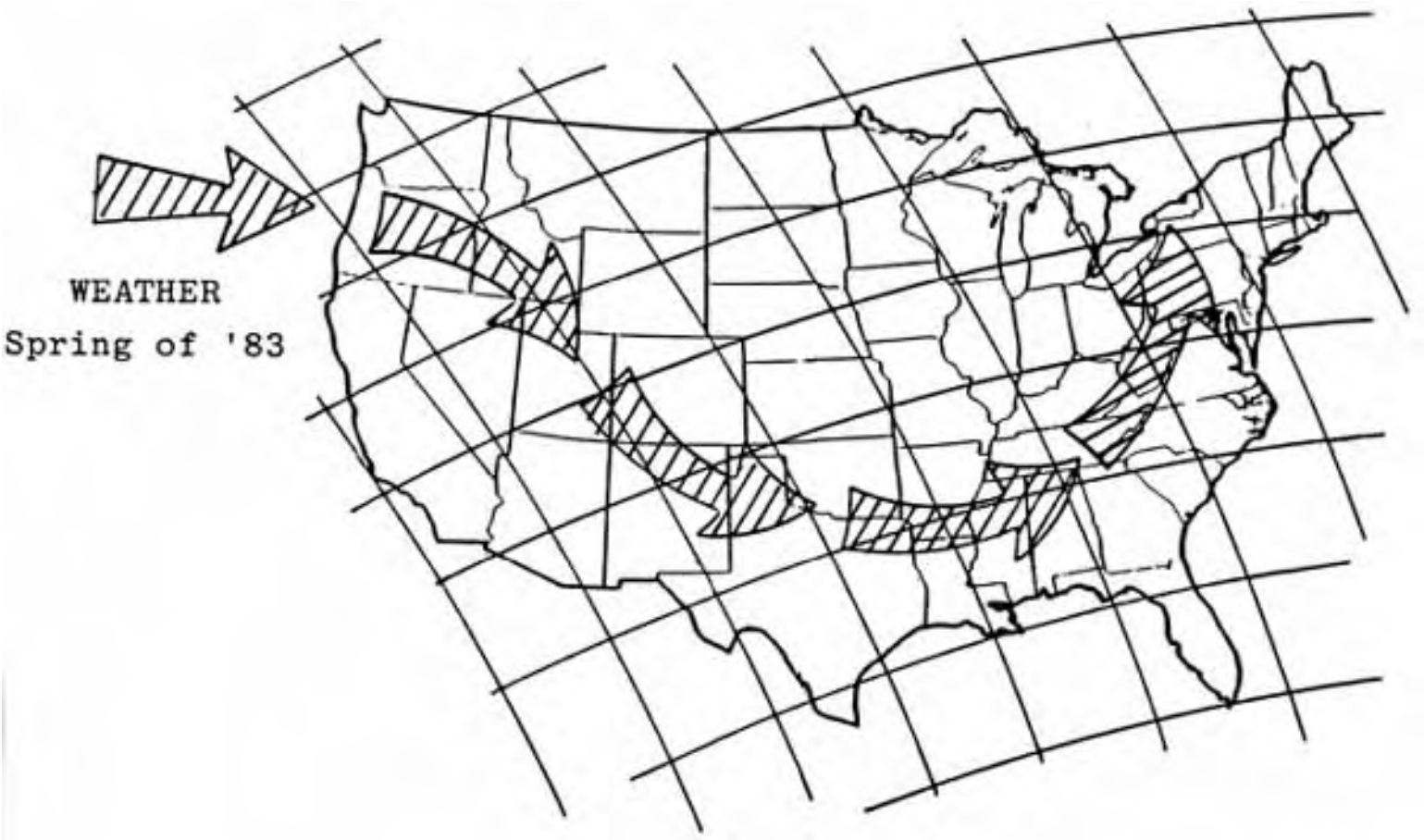

As is well-known, for years the Soviets have blanketed the world with large, powerful transmitter signals in the communications band, referred to as the "Woodpecker" signals because of the staccato noise the chirped signals make to the ear. The carriers have been modulated with known harmful bioactive ELF frequencies. At least some effects have been noted on humans from these signals, and other human effects are suspected but not proven.

In addition, evidence exists that such transmitters, utilized in the scalar transmission mode, may have been used to cause earthquakes and to control the weather. High altitude bursts off the coast of the Eastern United States and Canada, over

Timmons, Ontario, Canada, and off the coast from St. Petersburg, Florida have occurred also.

Mysterious "blackouts" of U. S .satellites -- and British satellites -- have occurred. These would be difficult to explain as the result of illumination from a ground laser, but easily explained as the result of illumination from a ground-based scalar beam or scalar interferometer.

Strange patterns of micro sky quakes and micro earthquakes occurred at various locations throughout the U.S. just before and shortly after the death of Leonid Brezhnev. These strongly appear to be connected with the adjustment of a scalar interference pattern -- a gigantic "energy bottle" across North America, as shown on this slide.

Shortly after this suspected adjustment and alignment, the underground net in the U.S. detected the emergence of numerous ELF-modulated signal carriers throughout the U.S., generally utilizing carriers in the vicinity of 40 MHz. Locations of the apparent transmitters were such places as Atlanta, North Georgia, St. Petersburg, Florida; Mississippi; Alabama; in the vicinity of Washington, D.C.; near Boston; around the Great Lakes; Michigan; in the Pacific Northwest (Washington and Oregon); and in both northern and southern California.

Researchers knowledgeable of the Soviet woodpecker signals and ELF modulations detected and reported these signals.

Physical effects were reported and correlated to the signals, including wakefulness at night, restlessness, fatigue, headaches, nausea, ringing in the ears, anxiety, disturbed dreams, etc.

What appears to have occurred is the adjustment and
alignment of a vast scalar interference pattern across the U.S. Recall that energy emerges in each grid, by phase interference between the composite substructure waves of the scalar beams.

Thus the Woodpecker "over-the-horizon radars," as accepted
by Western intelligence analysts, may have acquired a diabolical new strategic capability.

It is as if the Soviets had been permitted to build a vast network of transmitters directly on U.S. soil, for hostile employment against U.S. citizens.

Shortly after the net was aligned, a curious pattern of weather assaults on the U.S. began.

Storms assaulted California unceasingly. Then they roared across the Rockies, dipping sharply down to hit the Texas Panhandle, and bending northeast again to assault the South and the East.

The mighty jetstreams themselves were diverted and "kinked" into this looped, distorted pattern.

And the storms and floods assaulted the U.S. one after the other in this highly unusual fashion.

I maintain that the virtual transmitter net, just established by the Soviets and adjusted in on the U.S., was tested in the weather control mode. If so, it proved highly effective. Imagine what would have happened to the U.S. if it had been unleashed full force, and not just "gently tested."

And imagine what happens when disease, death, and nervous system disturbances are modulated upon these blanketing signals. The "transmitters" for the patterns are in each grid, all across the U.S.! And there are no physical transmitters there to destroy.

A counter is needed quickly. A simple one would consist of recording the signals in each grid zone, analyzing the substructure, reversing the signals and their structured patterns 180 degrees, and feeding the "cancellation signals" out in each area.

A great strategic Russian weapon of devastating power and potential is now operating directly on U.S. soil. The need for a crash countermeasures program is urgent.

In 1975 Brezhnev had introduced to the SALT talks the strange proposal that we should also consider outlawing the development of new weapons more frightful than the mind of man had ever imagined. We didn't know what the Russians were talking about. When we asked them later what weapons they meant, they referred vaguely to weapons of an electromagnetic nature.

The presentation I have just given you is part of what Brezhnev meant.

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SLIDE 58.

CONCLUSION

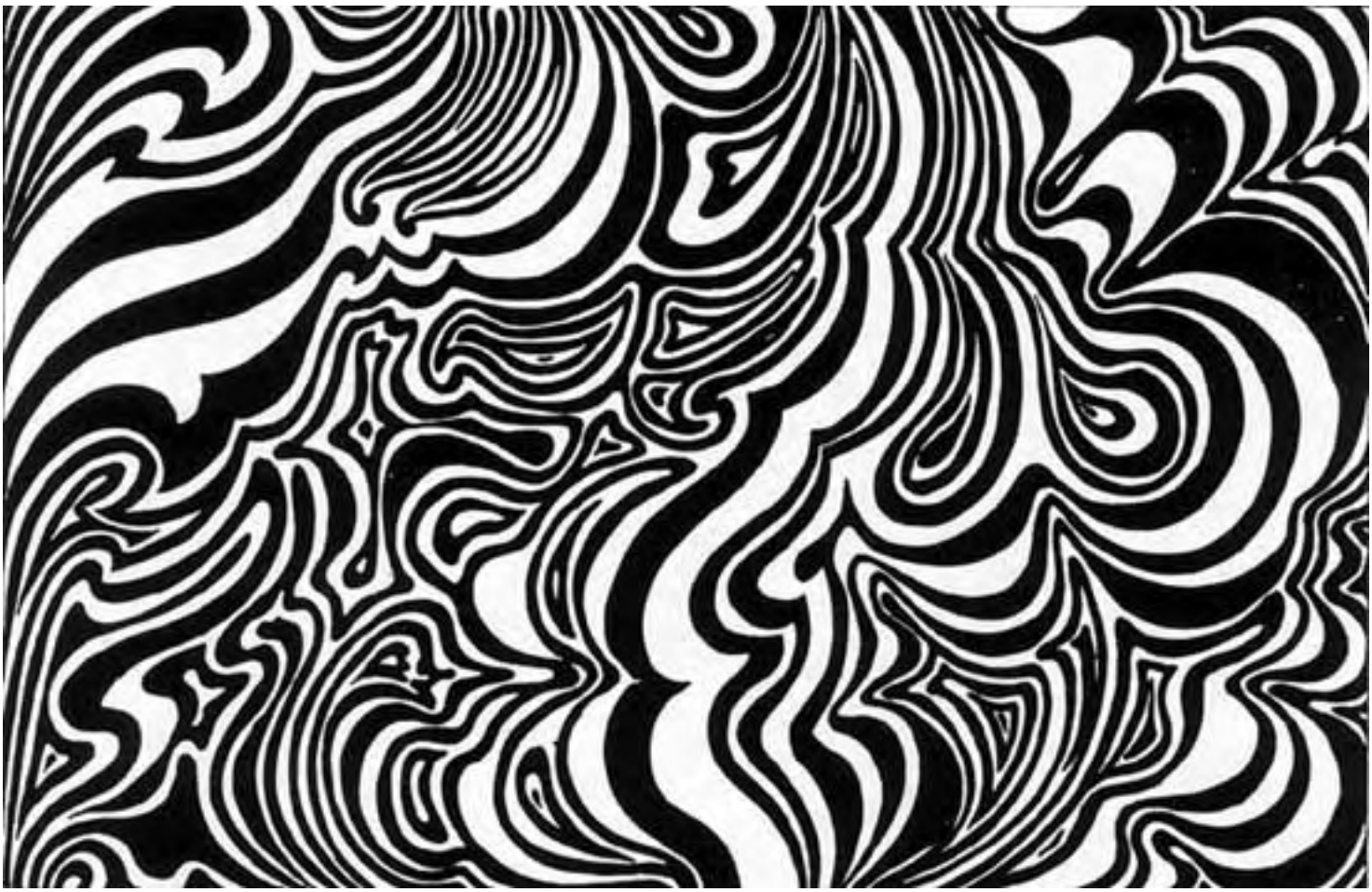

In conclusion, today I have released a number of powerful mechanisms that result from the new technological concepts. Many of these were originally discovered -- at least in rudimentary form -- by Nikola Tesla. In the West, the suppression of Tesla led to the suppression of these effects. And our knowledge of them went to the grave with Tesla.

After World War II, the Soviet Union mounted a massive campaign to obtain all the scientific literature of the West and thoroughly digest it. Great centers were set up, and thousands

of PhD's devoted to this purpose. Gradually they synthesized this technology from the errors in EM foundations they uncovered, and from obscure, ignored papers published in the orthodox Western scientific literature.

They rediscovered the technology of Tesla, Moray, and Rogers. And they have highly weaponized the effects, and adjusted and aligned the weapons upon us.

Now the radical movements are onto part of this technology. As late as about six months ago, one such group discovered how to build a translator and a scalar beam projector. Excitedly, they planned to build them the size of a large pistol, powered by a portable battery pack, and sell them to street criminals to kill or stop the police. They planned to get rich by this illicit means. At that time, a personal friend of mine, who moves in underground circles, was attempting to purchase one of the prototypes for my analysis. Fortunately, the inventor stepped into the beam of one of his devices and was almost killed. This frightened the group, and at least for now they have desisted. But be forewarned: this technology is coming down the pipe, and the police establishments in the West are in for the shock of their lives if the scientific community does not wake up and prepare defenses.

Again I urge my fellow colleagues to experiment vigorously with these new concepts, but build equipment for the benefit of man. Insect control, disease elimination and control -- both are noble purposes. Defense against the hostile use of such devices is also a fitting purpose.

We are in the final days, and the final technology is upon us. It is a stupendous tool for either good or bad, and assuredly it will be utilized for both means. I call attention once again to the fact that my ultimate purpose is to use this technology benevolently to achieve mind linkage, and elevate man from his present brutish state to the lofty state that is his destiny and his true God-nature.

For better or worse, Tesla technology is once again loose in the world, this time for good, and on a massive scale.

Let us prepare ourselves for a wild canoe ride, for the real white water lies just ahead.

Thank you for your attention, and good evening.

LEADING EDGE

Volume 7, Issue No. 4

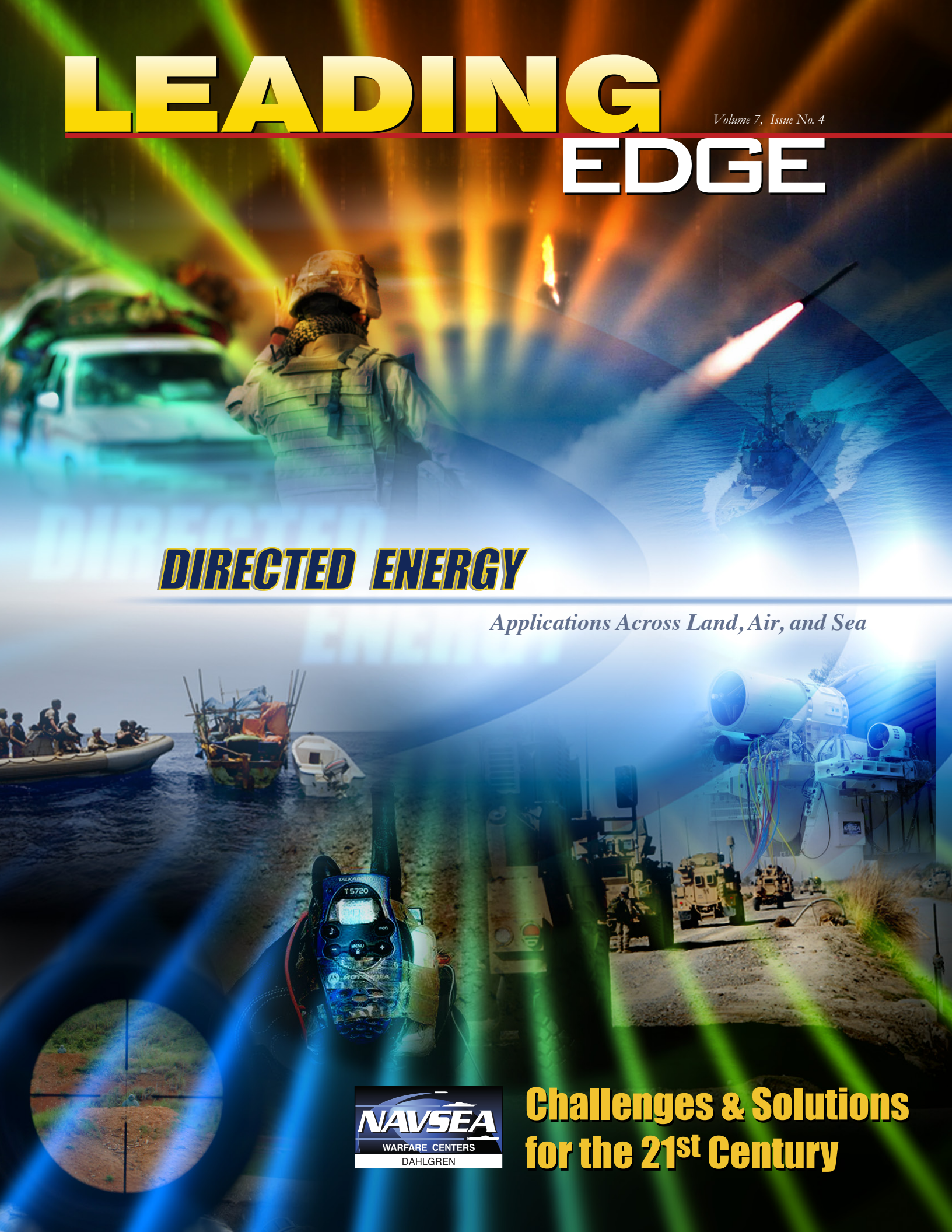

DIRECTED ENERGY

Applications Across Land, Air, and Sea

NAVSEA WARFARE CENTERS DAHLGREN

Challenges & Solutions for the 21st Century

LEADING EDGE

Volume 7, Issue No. 4

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LEADING EDGE

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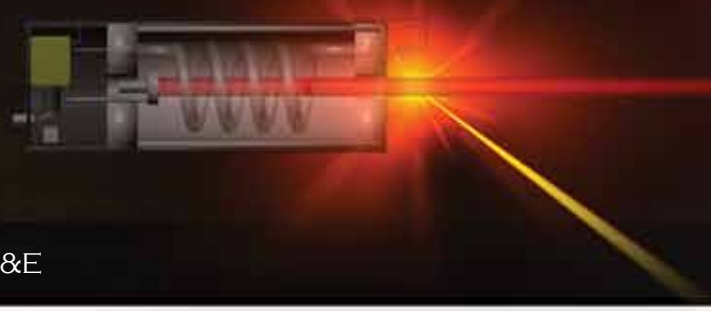

Introduction

Leading Edge Directed-Energy RDT&E

Captain Michael H. Smith, USN
Commander, NSWCDD

Dahlgren first launched research and development efforts devoted to harnessing the power of electromagnetic energy over 40 years ago. From early work with voltage multipliers and pulse-powered technology, to today's high-energy lasers and high-power microwave technologies, the Naval Surface Warfare Center, Dahlgren Division (NSWCDD) has led, and continues to lead, cutting-edge directed-energy research, development, testing, and evaluation. Our commitment in this area only grows stronger—evidenced by our chartering of the Directed Energy Warfare Office (DEWO)—in order to provide increased focus on warfighting applications of these technologies.

Today's military forces face a wide array of challenges in diverse operating environments around the world. Directed energy offers unique and flexible options to address today's challenges, as traditional kinetic weapons are often of limited value in peacekeeping missions and in urban environments, where restricted rules of engagement typify the norm. Kinetic weapons can also be more costly or ineffective to employ against asymmetric threats.

The Chief of Naval Operations (CNO) recently placed added emphasis on directed energy and on expanding the range of directed-energy capabilities. In response, scientists and engineers at NSWCDD are actively developing prototype systems in a number of areas that you will read about in this issue—areas that have been successfully demonstrated and tested in our Navy laboratories and ranges.

In this issue of *The Leading Edge* magazine, you will trace the rich history of directed-energy work at Dahlgren, gain insight into directed-energy weapons already fielded or being readied for the field, and learn about prototypes that show real promise for providing incredibly effective offensive and defensive directed-energy solutions. For example, scientists and engineers at NSWCDD are leading the way toward realizing small, lightweight radio frequency (RF) transmitters using high-power, solid-state switching amplifiers for the development of counter-improvised explosive device detection and neutralization systems. You will also learn about diverse applications of directed-energy technology—such as research and testing of laser glare devices and laser eye protection—and have the opportunity to gain a better understanding of the Department of Defense (DoD) acquisition framework and the challenge of maintaining cost and schedule estimates while delivering weapons systems that are critical to the warfighter.

From lasers to high-power electrical vehicle-stopping systems, I am sure you will be fascinated and, along with me, be impressed with the advancements our scientists, engineers, and technical staff are achieving in the directed-energy arena to support of our men and women in uniform.

Directed-Energy Topics in This Issue

Dale Sisson
Head, Electromagnetic and Sensor Systems Department
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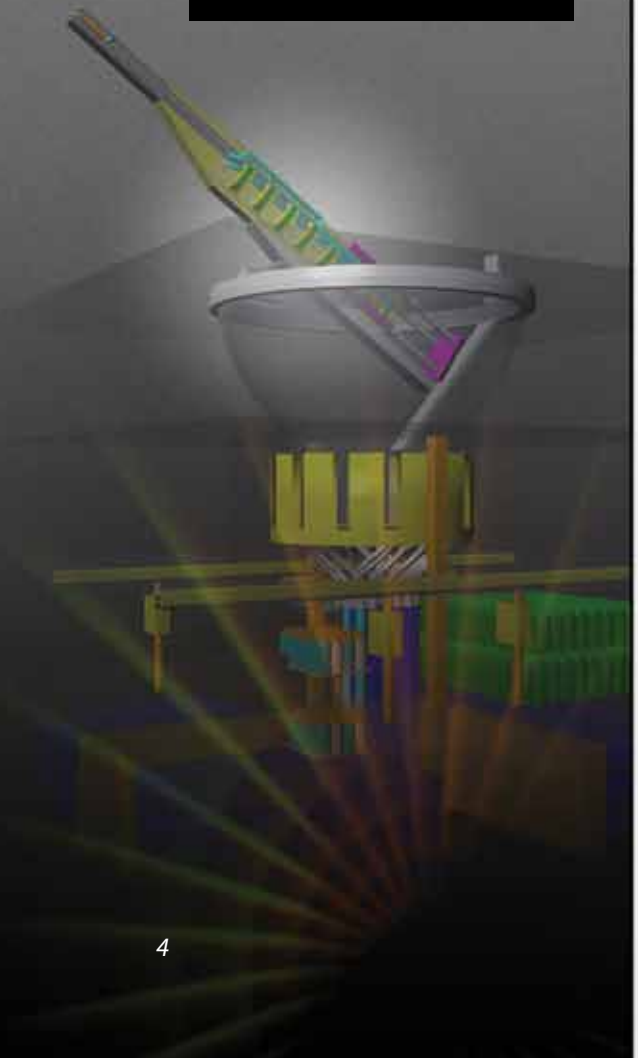

Welcome to our Directed Energy issue of the *Leading Edge* magazine. This issue represents the third in a trilogy of issues covering the truly fascinating and incredibly challenging area of naval warfare in the operational electromagnetic environment. In our first issue, we covered the full range of operational and readiness implications when operating in the electromagnetic environment. Then, in our second issue, we highlighted the complexities and dynamics of providing relevant and effective sensors and radars to our warfighters. Now, we focus on directed energy and relate how the Naval Sea Systems Command (NAVSEA) Warfare Centers, and the Naval Surface Warfare Center, Dahlgren Division's (NSWCDD's), in particular, are working on state-of-the-art directed-energy weapons capabilities for the warfighter.

In this issue, we first look back to the early years, decades ago, when directed-energy weapons research began. We examine the history of directed energy, and we cover significant discoveries and achievements made by NAVSEA Warfare Center scientists and engineers, and others in the scientific community. We then relate information about several of our current directed-energy initiatives, and about how we're working hard to solve some of the most complex technical challenges associated with directed-energy weapons. We highlight how others in the Navy, such as the Naval Medical Research Unit in San Antonio, Texas, are also conducting research into directed energy and how our forces can better protect themselves from the effects of directed energy. We show how directed energy can be employed in a variety of offensive and defensive, lethal and nonlethal situations. We explain how directed-energy weapons work and how they can be employed in various environments against a wide range of situations. Lastly, we look forward as we provide technical and strategic leadership for the efficient and effective development, acquisition, and fielding of directed-energy systems for the warfighter.

So, if you want to learn about what the NAVSEA Warfare Centers and others in the Navy are doing in the area of directed-energy weapons, look no further than this issue of the *Leading Edge* magazine. I'm confident that you will be impressed by the progress made in this most important technology field.

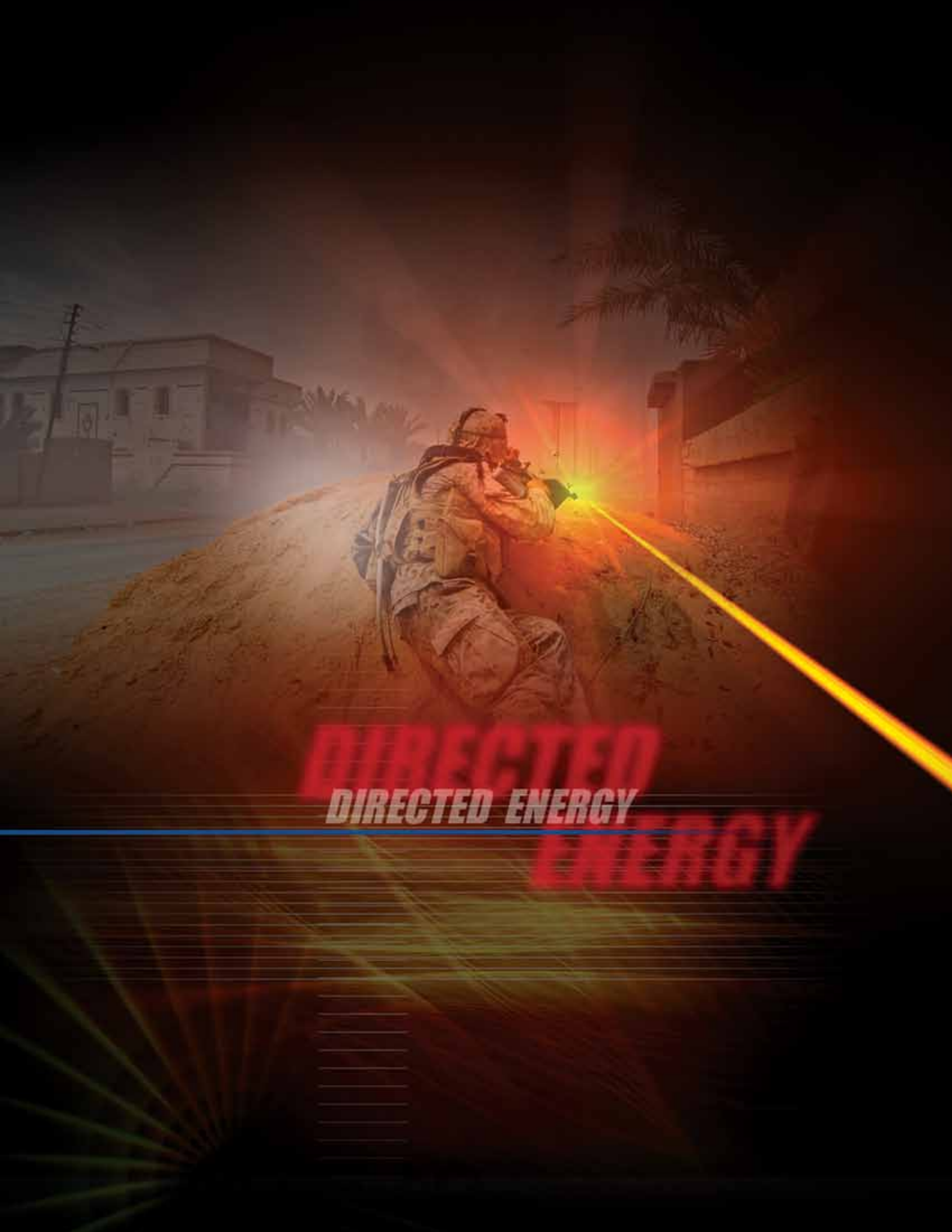
DIRECTED
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ENERGY

Naval Directed-Energy Weapons – No Longer A Future Weapon Concept

By David C. Stoudt

Dr. Stoudt is the Distinguished Engineer for Directed Energy (ST) and the NAVSEA Technical Warrant for Directed Energy and Electric Weapon Systems.

Directed-energy weapon (DEW) technologies typically take the form of high-energy lasers (HELs), high-power microwaves (HPMs), and charged-particle beams. This article focuses on the first two technology areas, as they have reached the point of being ready for operational testing and evaluation, and in some cases, operational use on the battlefield. DEWs have been popularized in science-fiction writings for over a hundred years. The Department of Defense (DoD) has been investing in their development since the 1970s. This article will not go into technical depth regarding the various directed-energy (DE)-related efforts currently underway in the Navy, but rather, it will overview DE areas under development and relate recent Navy leadership activity. Other articles in this issue of *The Leading Edge* magazine will provide the reader with much greater technical and programmatic details on various DE efforts.

High-Energy Laser Weapons

HEL weapon systems have been envisioned for a great many years, to include being referred to as Martian "Heat Ray" weapons in H.G. Wells' epic novel *The War of the Worlds*, originally published in 1898. In reality, a high-average-power laser weapon system is very similar to a "heat ray", or even a blow torch. During the early years of DoD investments in DE technology, the Navy led the development of HEL with the creation of the world's first megawatt-class, continuous-wave, Mid-Infrared Advanced Chemical Laser (MIRACL), located at White Sands Missile Range (WSMR). Roughly 80 years after the work of H.G. Wells, the U.S. Navy tested the MIRACL laser and ultimately used that laser system to engage static and aerial targets in the desert of WSMR in the following years. While that laser proved to be the wrong choice for the Surface Navy's self-defense mission, it did spawn work by the Air Force on the Airborne Laser (ABL), and the Army on the Tactical High-Energy Laser (THEL). In 2000 and 2001, the THEL successfully shot down 28 supersonic Katyusha artillery rockets and 5 artillery shells.

In 2010, the ABL successfully engaged and destroyed tactical ballistic missiles during the boost phase of their flight. All three of these laser systems—the MIRACL, the ABL, and the THEL—are chemical lasers that utilize toxic chemicals and operate in less than optimal wavelengths that make them a poor choice for most naval applications. The MIRACL is shown in Figure 1.

Recent advances in solid-state lasers, to include fiber lasers, have moved these electric lasers to the forefront of the Department's research and development (R&D) for near-term HEL applications in the services. The Navy has particular interest in electric lasers, to include the free-electron laser (FEL), for shipboard self-defense and force protection applications. The speed-of-light delivery of HEL energy can defeat the high-g maneuvers of newly developed foreign antiship cruise missiles (ASCMs). Thus, the Office of Naval Research (ONR) started an FEL Innovative Naval Prototype (INP) program in FY10, with a goal of reaching the output power of 100 kW. The eventual goal of the FEL program is to reach the multi-megawatt power level with wavelength selectivity. The Naval Sea Systems Command (NAVSEA) Directed Energy and Electric Weapons Program Office (PMS 405) has been actively developing a fiber laser-based Laser Weapon System (LaWS) that could be a retrofit to augment the current capabilities of the Close-In Weapon System (CIWS) currently deployed on many surface combatants. The Naval Surface Warfare Center, Dahlgren Division (NSWCDD), is the Technical Direction Agent and lead system integrator for PMS 405 on the LaWS program. The Naval Air Systems Command (NAVAIR) has interest in compact, solid-state HEL systems for aircraft self-protect and air-to-ground engagements, and will be starting a

Figure 1. Mid-Infrared Advanced Chemical Laser (MIRACL)

fiber laser-based ONR Future Naval Capability effort in FY12. LaWS is shown in Figure 2.

High-Power Microwave Weapons

Like lasers, microwave weapons have been fantasized about ever since the invention of microwave power generators. In fact, in 1932 it was generally recognized by the British government that bombers, ostensibly German bombers, would be able to penetrate British air space and bomb its civilian population and infrastructures. In 1934, the Air Ministry initially asked Robert Watson-Watt, of the National Physical Laboratory, if he could build a "death ray" that could kill enemy pilots or detonate bombs while they are still on the planes of enemy aircraft. Such a "death ray" had been proposed to the Air Ministry by Harry Gindell-Mathews 10 years earlier in 1924. Watson-Watt, a former meteorologist who had become an expert on radio signals, suggested that energy reflected from an aircraft could be used to locate it. His experiments were successful and RADAR (radio detection and ranging), a name coined by the U.S. Navy in 1940, was born. While RADAR is not a DEW in the way they are thought of today, its roots can clearly be traced to the military's desire for such capabilities.

The Navy's HPM, or high-power radio-frequency (RF) systems, have been progressively increasing in power density to the point where it is now feasible to integrate the technology into weapon systems for deployment. While initial HPM applications suffered from their inability to obtain militarily useful outcomes, either due to technology limitations, difficult concept of operations (CONOPS), or inherent robustness of potential target systems, many feasible military applications for using HPM

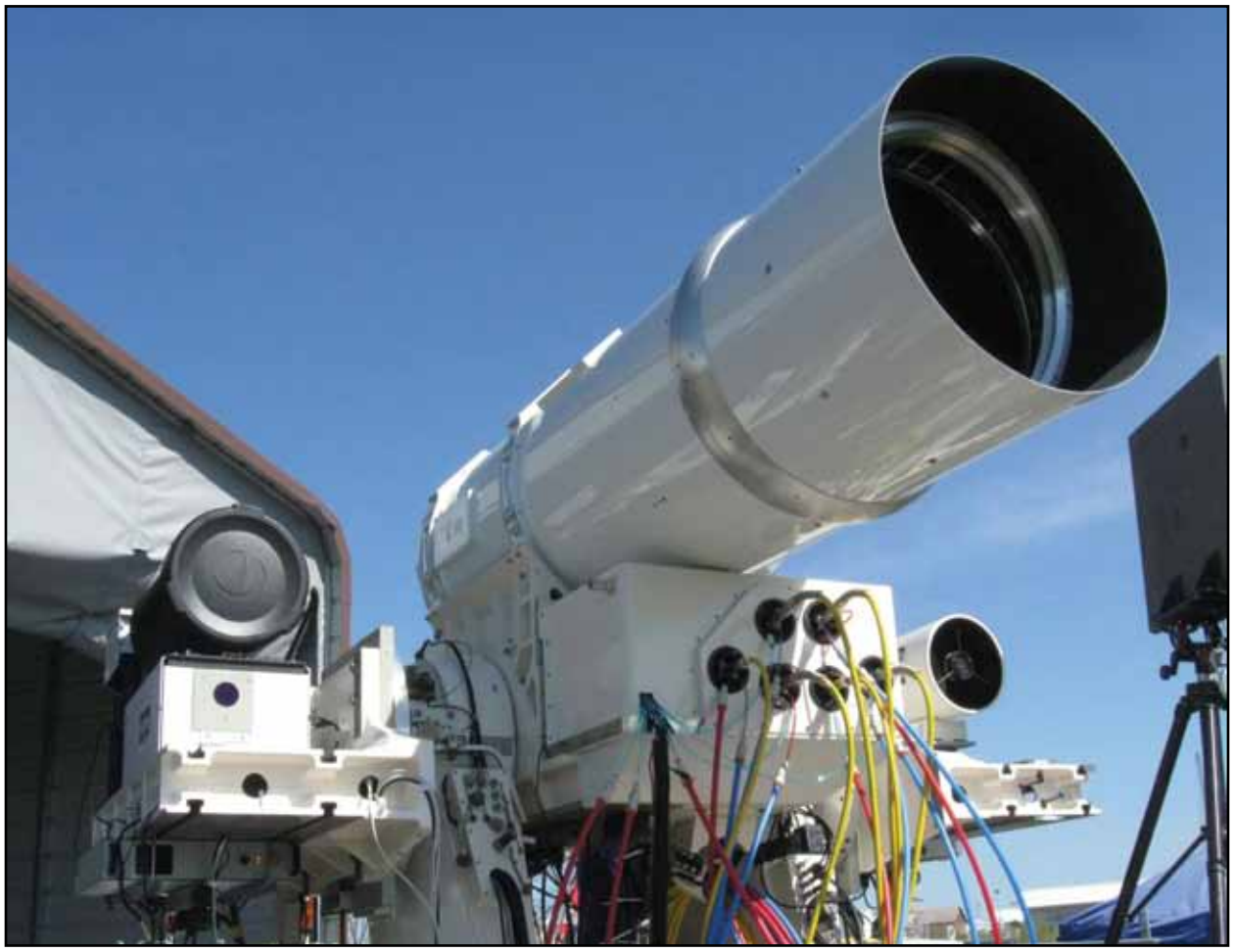

Figure 2. Laser Weapon System (LaWS)

devices have surfaced over recent years to include nonlethal, antipersonnel weapons and nonkinetic, antimateriel weapons. While these concepts offer unique capabilities to the warfighter due to the nonkinetic effects they generate, other warfighting concepts—such as stopping vehicles, or countering hidden roadside bombs or improvised explosive devices (IEDs)—are difficult to achieve by any other means. The multifrequency Radio-Frequency Vehicle Stopper (RFVS) system is shown in Figure 3.

In addition, the difficulty in overcoming the propagation losses associated with HPM has driven some concepts into platforms such as unmanned aerial vehicles (UAVs) or cruise missiles that deliver the HPM device to the target for a close-in engagement. Over the past 10 years, field-testable prototypes have been developed to demonstrate the operational utility of these concepts, and in some cases, those prototypes have or will be deployed operationally to support our troops in theater. It is only through the hard work and perseverance of the Naval Research Enterprise (NRE), as well as other DoD laboratories, that concepts that were once only laboratory curiosities are now making their way onto the battlefield and contributing to the fight.

Foreign Directed-Energy Weapon (DEW) Development

While the United States has been very active in this warfighting area, significant foreign DEW development also has elevated the need for the Navy to afford these threats a higher priority. This can be done either by incorporating the necessary DEW countermeasures into weapon systems, platforms, and critical infrastructures, or by adapting the CONOPS and tactics, techniques, and procedures (TTPs) employed by our armed forces to properly account for those foreign DEW systems. Materiel developers need to understand how this threat

Figure 3. Multifrequency RF Vehicle-Stopper (RFVS) System

is evolving and properly address it during the design of their systems. They also need to address DE in the development of their system threat assessments. There has been movement on the HPM side to modify existing military standards, such as MIL STD 464[1] and others, to now include information on potential HPM threats. For example, in the HEL arena, work has been accomplished in the development of protective measures for eyes; however, this threat needs to be considered during the system development process. It is well known that building in countermeasures is much cheaper during the initial development of a system, vice trying to retrofit systems with countermeasures once a new threat is on the battlefield. As analysts evaluate the foreign development of DE technologies, and the trends become clearer, it is the responsibility of the acquisition community to take this threat into consideration and ensure that weapon systems, platforms, and infrastructures will be available and at full capability when needed. By accounting for foreign threat developments, assessing blue force susceptibilities and vulnerabilities, and adopting appropriate measures to negate or counter these threats, naval forces will avoid technological surprise on the battlefield in the future.

Requirements

The DE programs briefly mentioned in this article, and covered more deeply in this and other publications, offer warfighters unique capabilities not currently found in their arsenal. The continuing problem, however, is matching those unique capabilities to vetted operational requirements. The DE technical community has made great strides in helping the operational community understand the capabilities of DE weapons and their potential military effects on targets. The lack of formal requirements, however, has yielded more of a technology push—rather than an operational pull—of various DE capabilities. Progress has been made, but more effort is required if DE capabilities are to be developed and transitioned between science and technology (S&T), and formal programs of record. Notwithstanding, the current outlook and trends are positive.

A Resurgence of Navy Interest in Directed Energy

The Navy's interest in DEWs for future maritime operations has increased in recent years due to a number of weapons development successes. Recognizing the importance and value of DEWs, NAVSEA reestablished the Navy Directed Energy Weapons Program Office (PMS 405) in 2004. Accordingly, PMS 405 was designated as the point of contact for matters related to DE and electric weapon systems (EWS) development and acquisition initiation for NAVSEA, and for matters being coordinated with other federal agencies and military services. PMS 405's mission is to transition technology from the laboratory to prototype/advanced development/testing for operational development and use.[2, 3]

The Navy also established its first formal executive position for DE (ST-level), the Navy's Distinguished Engineer/Scientist for Directed Energy, at NSWCDD in August 2004. Following the establishment of this position, NAVSEA then formally established a Technical Authority Warrant for Directed Energy and Electric Weapon Systems (DE&EWS)—Surface Ships in July 2008. The scope of the warrant includes the transition of S&T development to weapon system development of lethal and nonlethal capabilities associated with the DE&EWS for Surface Ships.[4] This included, but was not limited to, the following:

- Laser Weapon Systems
  - High-Energy Lasers
  - Solid-State Lasers
  - Free-Electron Lasers
  - Femtosecond Ultrashort Pulse Lasers
  - Laser-Induced Plasma Channel
  - Lethality/Vulnerability
- Electromagnetic Rail Gun Weapon System
- High-Power Microwave
  - Active Denial System
  - Laser-Guided Energy
- Maritime Directed Energy Test Center
- Electromagnetic Launch of Weapons (excluding the Electromagnetic Aircraft Launch System (EMALS))

Then, within the NAVSEA Warfare Center Enterprise, Warfare Center leadership established two technical capabilities (TCs): an NSWCDD TC for DE systems research, development, test, and evaluation (RDT&E); and a Naval Surface Warfare Center, Port Hueneme Division (NSWCPHD) TC for in-service engineering, test and evaluation (T&E), and integrated logistics support to DE systems. NSWCDD leads all S&T and RDT&E for the development and weaponization of DE systems for surface, air, and ground environments. It also leads the development of offensive and defensive DE technologies needed to characterize and exploit vulnerabilities, provide weapons, and protect against attack. NSWCDD provides the technologies, devices, and systems designed to create or control electromagnetic energy used to cause persistent disruption or permanent damage by attacking target materials,

electronics, optics, antennas, sensors, arrays, and personnel, including nonlethal applications. NSWCPHD provides in-service engineering, T&E, and integrated logistics support to DE systems throughout the system life cycle.

The Navy further demonstrated increased interest in DE when Assistant Secretary of the Navy (Research, Development & Acquisition (ASN(RDA)) designated NAVAIR offensive and defensive leads for naval aviation DE activities:

- Program Executive Officer for Unmanned Aviation and Strike Weapons (PEO(U&W)), assigned as the offensive DE lead for naval aviation
- PEO for Tactical Aircraft Programs (T), assigned as the defensive lead for naval aviation

Concerning future initiatives, the Chief of Naval Operations (CNO) tasked the Strategic Studies Group (SSG) to examine a topic entitled "Maritime Operations in the Age of Hypersonic and Directed-Energy Weapons."[5] The intent of the study was to provide Navy leadership with an understanding of where DE technologies and weapons are today and how they might influence future maritime operations. The theme of the study was completed during FY10, the results of which discuss many DE concepts, as well as tactics for the employment of DE capabilities. The study's findings are currently under review and consideration by senior Navy leadership.

Conclusion

While H.G. Wells' *The War of the Worlds* novel and television programs like *Star Trek* popularized the notion of using DE for weapons in years past, today— through persistent DEW RDT&E— Navy leadership is realizing the great potential that DEWs offer naval warfighters and homeland defenders. The scientific and technical advances the Navy has made in HEL and HPM in recent years have been nothing short of extraordinary. Moreover, future technological and engineering advances undoubtedly will result in profound differences in our nation's future warfighting capabilities. Naval DEWs, therefore, are no longer just a future weapon concept…they are here today.

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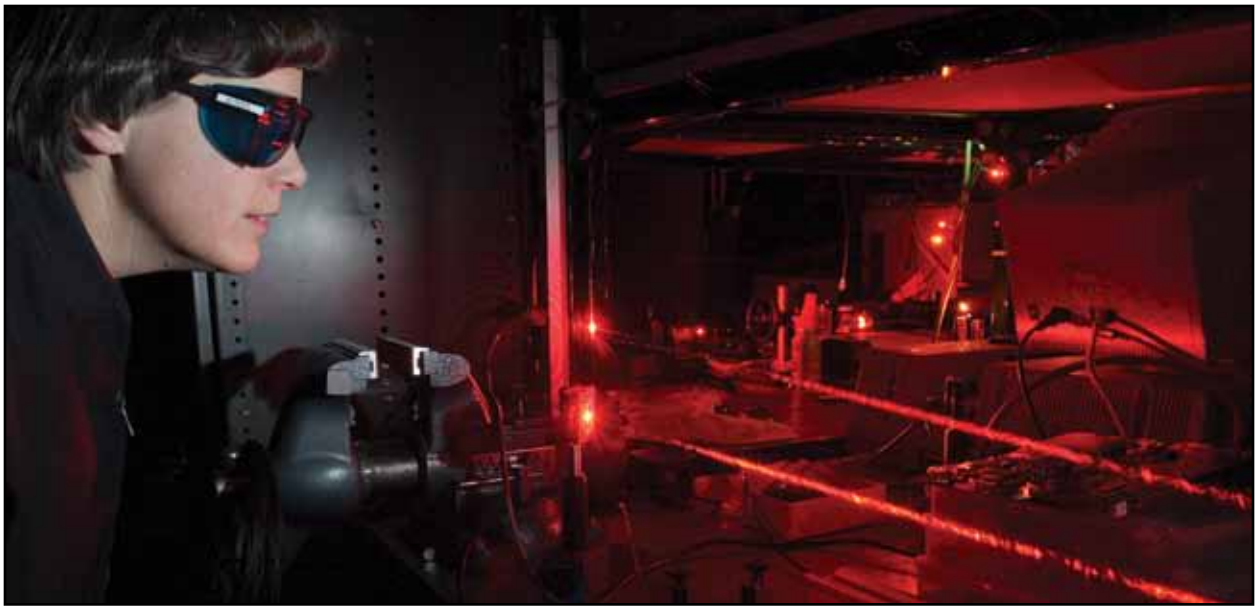

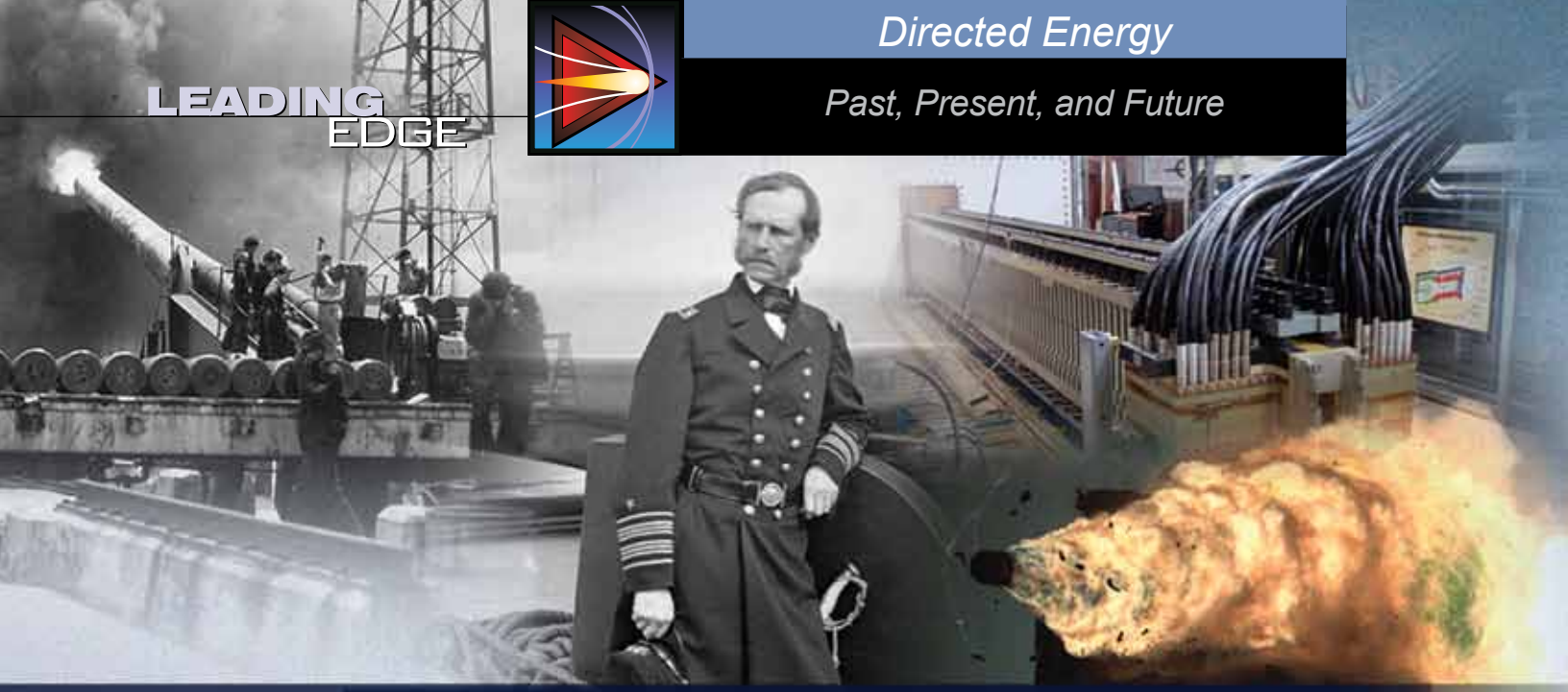

Historical Overview of Directed-Energy Work at Dahlgren

By Stuart Moran

In 1962, the United States set off a megaton nuclear weapon 250 miles above the Pacific. The blast caused a large imbalance of electrons in the upper atmosphere that interacted with the Earth's magnetic field to create oscillating electric fields over a large area of the Pacific. These fields were strong enough to damage electronics in Hawaii, a thousand miles away, and clearly demonstrated the effects of an electromagnetic pulse (EMP). It didn't take long for the military to begin considering ways to create such pulses without using nuclear weapons.

In the late 1960s, the Special Applications Branch at the Naval Weapons Laboratory at Dahlgren began studying ways to generate high-power oscillating electric fields that could be used as a weapon to damage enemy electronics. These devices were basically high-power versions of the old spark-gap transmitters used in the early days of radio. To construct a device that could produce nuclear EMP-like fields, stored electrical energy was converted to radio-frequency (RF) energy that could be radiated from an antenna through the atmosphere to a target. These devices typically would store energy in a high-voltage capacitor and release the energy quickly using a spark-gap switch. This would then drive oscillating currents on an antenna, causing it to radiate. To achieve field strengths of thousands of volts per meter, typical of a nuclear EMP, devices operating at hundreds of thousands of volts or more were needed.

A number of radiating devices were studied in the early 1970s. Most belonged to a class of devices called Hertzian oscillators. A capacitor is charged to high voltage, the switch is closed, and current flows in the circuit, causing the stored energy to oscillate between the electric field of the capacitor and the magnetic field of the inductor. To charge the capacitor to extremely high voltages, a step-up transformer of some type must be used. One of the fastest voltage multipliers, the Marx generator, was frequently used. The losses from internal resistance and external radiation damp the oscillating waveform, typically after a few cycles. The radiated pulses are, therefore, short in time and broad in frequency content.[1] A simple diagram of the inductance-capacitance oscillator (L-C oscillator) is shown in Figure 1.

Single-Pulse Burnout Devices

Many types of Hertzian devices were designed, constructed, and tested at Dahlgren during the 1970s. The transmission-line oscillator, or cavity oscillator, used a quarter-wavelength

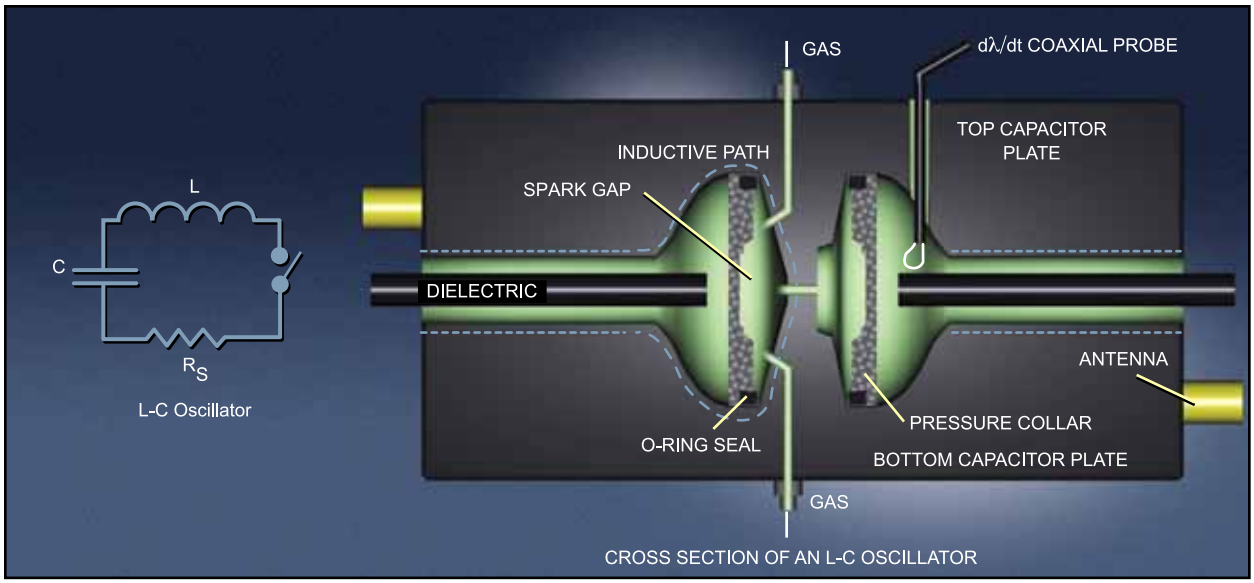

Figure 1. Inductance-Capacitance Oscillator (L-C Oscillator) Diagram

coaxial pipe, which was switched at one end, to create the oscillating waveform. A frozen wave generator, a different type, had quarter-wave sections of cable that were charged plus and minus to create a two-cycle waveform "frozen" in the cable. All sections were simultaneously switched, causing the wave to travel to an antenna. A special folded design was developed so one switch could be used, eliminating the multiswitch synchronization problem. A Ross circuit used a square wave pulse, which traveled down cable "tees," creating reflections, which were timed to create several RF cycles. In the Travetron, the turn-on time of a series of spark-gap switches was incorporated as a designed delay, creating reflections through a series of gaps to produce the waveform. This design allowed higher frequencies. All of these devices were designed, built, and tested to determine power and frequency capabilities, as well as efficiency.

Scientists and engineers at Dahlgren built and tested versions of Hertzian oscillators operating up to half a million volts. These devices powered relatively simple monopole or dipole antennas that could produce very high electric fields at hundreds of meters. In the early 1970s, a special outdoor field-measurement range was constructed. It housed high-voltage systems in underground trailers that fed antennas above ground on a specially-built, 100-m-long ground plane that was constructed for testing and field measurements. A picture of the ground place in a fielded measurement range is shown in Figure 2. Field probes were even carried aboard helicopters to make measurements above ground effects, as shown in Figure 3.

Other types of devices to produce pulses were constructed, too. Vector inversion generators used spiral-wound capacitive plates to generate high voltages without transformers.[2,3] The Landecker ring used a paddle-wheel arrangement of capacitors and inductors charged in parallel and discharged in series. The circular arrangement was designed so the entire system would radiate as a magnetic dipole, thus forming its own antenna.[4] Switch timing was critical, and Dahlgren engineers attempted to verify reports that Landecker developed a specific type that brought all capacitor leads into a single-center spark gap.

Scientists and engineers also looked at devices that used explosives to generate the electrical energy needed. These included explosive flux compressors of several types, which generated fields and then explosively squeezed the fields between conductors to amplify the peak power. In the early 1970s, a large (70-ft clear zone) anechoic chamber was constructed at Dahlgren with an explosive chamber in one end. Explosives would be set off in the chamber to drive various types of flux compressor schemes that would generate electrical pulses fed into an oscillator and antenna in the anechoic chamber. Pulse parameters and field strengths could be measured. Impedance-matching networks, matching transformers, and methods of improving efficiency were studied. Tests were performed at Dahlgren and at Los Alamos using large antennas suspended from balloons.[5] In other schemes, piezoelectric devices were developed, which could be compressed hydraulically and then quickly released to produce high voltages. The concept was to use explosives to generate the high

Figure 2. Field Measurement Range

Figure 3. Airborne Electric Field Measurements

pressures. Ferroelectric and ferromagnetic transducers driven by explosives were also tested.[6]

Special Effects Warhead (SEW) Program

In 1973, Dahlgren began the SEW Program to look at the feasibility of "burning out" enemy radar and missile systems using single-shot, very high-peak-power EMPs. The program looked at the feasibility of constructing an electromagnetic warhead that could disable electronics beyond a normal hard-kill explosive range as far as a mile away. The program was funded at several million dollars a year through most of the 1970s.

A major thrust of the SEW Program was to better understand the effects of high fields on military electronics. Little information was available on the vulnerability of foreign or U.S. electronics, particularly entire systems. A trailer-based RF impulse system, employing a Marx-driven L-C oscillator charged at two million volts, was constructed at Dahlgren. This Transportable Oscillating Pulser System (TOPS) was connected to a large bounded-wave structure that produced uniform fields over a region large enough to place an entire radar or missile system. The electric field emitted from the throat of this system was so high that a special bag of high-voltage gas was needed until the radiating structure became large enough to transition to the normal atmosphere. A picture of TOPS is shown in Figure 4.

Since many important target systems were not available for testing, much of the vulnerability information was obtained from U.S. electronics, and estimates were then made for foreign systems. In addition to the tests done at Dahlgren, pulsers were also constructed in mobile trailers that could be transported to other sites for testing against simulated or actual targets. The Mobile Oscillating Pulser System (MOPS) was an example that was carried to test sites, such as China Lake, to perform tests against radars and simulated foreign systems.

A key requirement for the SEW Program was to demonstrate enforceable target vulnerability, which means that a high percentage of the time a large percentage of the targets are affected. One important finding was the broad difference between an electromagnetic safety concern—where a 1 percent vulnerability was far too great—and a weapon concern—where a 10 percent vulnerability was not good enough. The field strengths between the safety requirements and weapon requirements often were many orders of magnitude apart.

The SEW Program looked at many types of electronic component vulnerability, subsystem vulnerability, and complete system vulnerability. As a result, energy tables for burnout effects were developed. Subsequently, Dahlgren performed numerous field tests against radar and communications systems between 1973 and 1978, and funded component and subsystem testing on missiles.

Figure 4. Transportable Oscillating Pulser System (TOPS)

Repetitive Systems for Electronic Warfare

The electric fields required to damage military electronics in the 1970s often were very high, and ranges typically were limited. As a spinoff of programs trying to damage targets with a single pulse, some of these devices were reduced in size and power, and operated in a repetitive mode to generate noise pulses for the purpose of electronically jamming target systems. In 1976, the Naval Air Systems Command (NAVAIR) began the Electromagnetic Countermeasures Program to study the application of high-repetition-rate Hertzian devices for use as noise jammers. The initial targets were low-frequency radars.

In late 1976, Dahlgren performed effectiveness tests against various radars using helicopter-mounted Hertzian jammers. These devices were able to screen incoming target aircraft at useful ranges. The concept of a forward-launched rocket to deliver a parachute-suspended Hertzian jammer also was investigated. Dahlgren teamed with engineers at China Lake to study packaging concepts of utilizing an extended 5-inch Zuni rocket as a forward-fired delivery vehicle. A prototype is shown in Figure 5.

Similar Hertzian devices were considered for use as communications and data-link jammers. Several antenna deployment schemes were developed, and by fall 1978, successful ground launches had been performed in which the deployment sequence and jammer operation were demonstrated. The name Zuni Expendable Pulsed-Power Oscillator (ZEPPO) was given to the project. Dahlgren teamed with the Naval Avionics Center (NAC) to build the systems. By 1980, China Lake fired the first air-launched prototypes at both low and high altitudes. Devices, batteries, spark gaps, and antennas continued to be developed, and new targets—such as spread-spectrum systems—were tested. Other delivery systems besides rockets were also considered.

Figure 5. ZEPPO Payload

The Pulsed Power Technology Program

Large directed-energy weapons (DEWs) often required megawatts or gigawatts of peak power, so methods of supplying and modifying this power were needed. As Dahlgren became involved in a broad range of DEW systems, one attribute became more and more obvious: the size, weight, and cost of a directed-energy (DE) system were dominated by the pulsed-power technologies needed to drive the system, not by the source device itself. Consequently, more effort began to be devoted to the power-delivery technologies needed for many of the weapon concepts. Pulsed-power components enabled energy to be stored over long periods of time (seconds) and released very quickly (nanoseconds) to obtain a billion times increase in peak power.

Dahlgren hosted a pulsed-power systems symposium and workshop in 1976 and helped initiate the International Pulsed Power Conferences, which began in 1977 and continues today under the Institute of Electrical and Electronics Engineers (IEEE). As Dahlgren's involvement with systems design increased, it became apparent that new technologies were needed in the prime-power and pulsed-power area to support a variety of new concepts. Dahlgren urged the Navy to initiate a Pulsed Power Technology Program to develop power sources, energy storage systems, high-power switches, and power conditioning systems needed for a variety of future weapons. This program was initiated in 1978 and was originally funded by NAVAIR and then by the Directed Energy Program Office (PMS 405) in the early 1980s. In addition to the Pulsed Power Technology Program, PMS 405 also began funding free-electron lasers (FELs), chemical lasers, high-power microwaves (HPMs), and charged-particle beams (CPBs). The Pulsed Power Technology Program at Dahlgren, in turn, funded many areas of research, both internal and external, over the next 10 years. Dahlgren served as the focal point for the Navy's science and technology (S&T) in pulsed power and funded many universities, government laboratories, and commercial companies under the Pulsed Power Technology Program.

To provide large amounts of electrical prime power, new types of rotating machines were studied, including flywheels, conventional alternators, homopolar generators, rotary flux compressors, and compensated pulsed alternators. These machines attempted to produce fast, high-power pulses using special materials to reduce losses, eddy currents, and mechanical stresses. MHD generators were developed using rocket-motor propellant that could be started and stopped. In the mid-1980s, a full-scale hybrid (solid fuel/liquid oxidizer) combustor was fabricated and tested at 10 MW, achieving world records for power-to-weight ratio and conductivity. By 1980, new types of energy storage systems were studied, including inductive storage and advanced capacitors using new types of insulating materials and geometries. During the late 1980s, programs such as the Mile-Run Capacitor Program reduced the capacitor size by a factor of 10 through better synthesis of polymer films.

Beginning with internal independent research funds, Dahlgren developed liquid dielectric materials based on water/glycol mixtures at low temperatures. These water-capacitor devices could hold energy for orders-of-magnitude longer time periods than ever before, allowing pulseforming lines to be constructed that could be charged directly from rotating machines. Dahlgren scientists developed a world-record high-voltage water capacitor that could hold pulses for milliseconds and became internationally recognized experts in water breakdown.[7,8]

High-power fast switching was another important area of research. Dahlgren funded companies to develop new types of multistage thyratrons that could operate at very high voltages. By the early 1980s, multistage thyratrons capable of operating at over 200 kV, 40 kA with 20 nsec risetimes were demonstrated. Vacuum switches, ignitrons, plasma pinch switches, pseudospark switches, back-lighted thyratrons, and e-beam switches all were studied, as well as a variety of spark-gap switches. Higher power solid-state switches were developed, too, using new geometries and substrate material. Superconducting coils were considered, both for energy storage and as opening switches. Dahlgren engineers developed exploding-wire opening switches, and several types of plasma pinch switches were funded. They also worked on stacked cable pulsers. Additionally, concepts for electromagnetic armor were developed. These systems used high-density capacitors to blunt penetrators. Inductive energy storage—which could be far denser than capacitors—was studied, including methods of generating the seed current and the problematic high-voltage opening switch. Opening switches—which were needed for inductive energy store systems—were studied, as well as magnetic switches, which used saturating magnetic material to sharpen pulses. Magnetic switches operating at 10 kHz were demonstrated by 1983.[9]

In 1985, Dahlgren used internal funds to upgrade a facility to provide controls, diagnostics, and 200 kW of average power at 50 kV to accommodate testing of new switches and water-based capacitors. This facility could control the power with a vacuum-tube pulser and could generate over a million volts with a rep-rated Marx generator. The facility was used to:

- Develop water-dielectric energy storage, rep-rated spark gaps, and pseudospark switches.
- Test a variety of switches developed by contractors, such as back-lighted thyratrons.[10,11]

A picture of one system being tested—a water pulse-forming line and spark-gap switch—is shown in Figure 6.

Dahlgren concentrated in-house switching efforts in spark gaps. New types of gases were studied, as well as electrode materials, gas-flows, switch geometries, and triggering techniques to produce high-repetition-rate switches for electronic warfare, as well as particle-beam weapons.[12] Dahlgren scientists and engineers demonstrated 100-μs recovery of spark-gap switches after handling kilojoules of energy at hundreds of kilovolts, a world record.[13] The High Energy 2-Pulse System for fast recovery experiment is shown in Figure 7.

In 1986, Dahlgren ran a workshop on high-power switching for Navy tactical and Department of Defense (DoD) strategic applications and became involved with numerous DoD working groups on electromagnetic propulsion, high-power diagnostics, advanced energy conversion, power modulators, and pulsed power. Spark gaps were investigated to create underwater noise for submarines. Dahlgren also led four North Atlantic Treaty Organization (NATO) Advanced Study Institutes in Europe and the UK on various pulsed-power topics. International assessments of key pulsed-power technologies were also performed.

Particle-Beam Weapons

Particle-beam weapons were a major focus of DE work during the 1970s and 1980s. A CPB weapon takes subatomic particles, generally electrons, and accelerates them to near the speed of light before sending them toward a target. These fast electrons penetrate deeply into most materials, so they are difficult to counter. The high-current electron beam was to be accelerated by an induction-type

Figure 6. A Water Pulse-Forming Line and Spark-Gap Switch Test

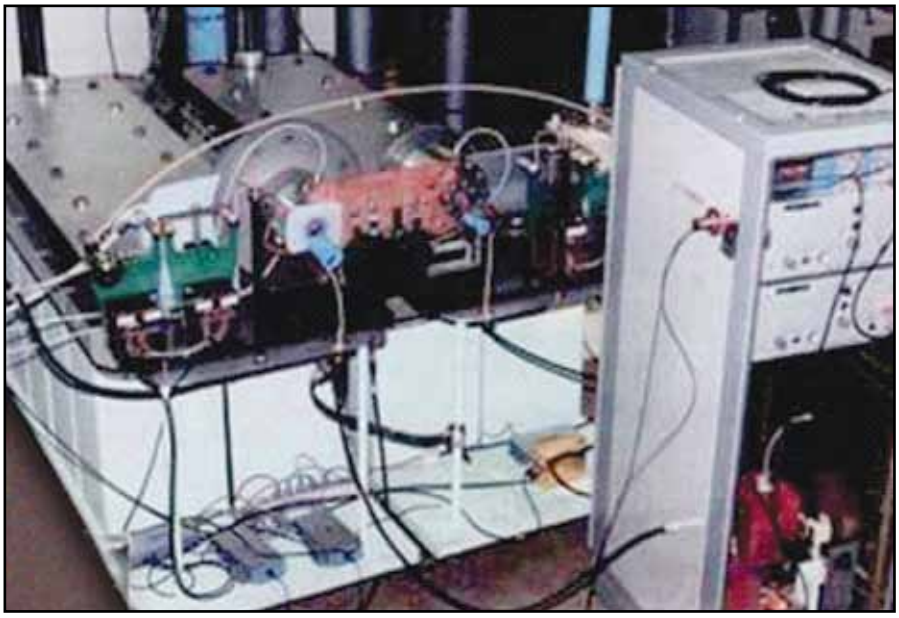

Figure 7. High Energy 2-Pulse System

accelerator, repetitively pulsed. High electron-beam currents (kiloamps) and a hole-boring series of pulses were anticipated to create a stable, long-range beam. Since the beam was capable of penetrating quickly and deeply into any target material, it had the potential to damage electronics and set off explosives before salvage fuzing could occur. The beam was predicted to be all-weather and essentially countermeasure-proof. Even a near miss could cause substantial damage from high fields and X-rays produced by the deceleration of electrons as they hit air molecules near the target. The CPB concept is shown in Figure 8.

Scientists and engineers from Dahlgren worked on the pulsed-power technologies needed to drive these machines beginning in 1980, and it became a major focus of the Pulsed Power Technology Program.[14] The White Oak Laboratory developed beam-steering concepts and looked at material interactions. By 1989, the program investigated:

- Propagation
- Compact Recirculating Accelerators
- Pointing and Tracking
- Prime Power
- Material Interaction
- Fratricide

For a compact shipboard system, recirculating accelerators were needed to make multiple passes of the electron beam past the accelerating cavities. This required a high-power, fast recovery switch, which Dahlgren began working on in 1988. Using patented hydrogen switches and special triggering techniques—efforts that had begun with internal research funds—Dahlgren demonstrated spark-gap switches, the only technology that could meet the current, voltage, and recovery requirements at that time.[15] The High-Voltage 5-Pulse System experiment is shown in Figure 9.

During these technology efforts, significant advances were achieved in all aspects of the program. These included:

- Generating high-current, high-energy beams (although still below weapons parameters)
- Demonstrating a 360º turn in a high-current beam
- Propagating a single pulse through the air
- Demonstrating beam steering on a small scale
- Performing target interaction measurements

Multipulse, long-range propagation was never demonstrated. A comprehensive tri-service summary called the Net Technical Assessment for CPB was sponsored by the Defense Advanced Research Projects Agency (DARPA) in 1987 to describe the accomplishments of the program. The report said compact accelerators were the most pressing technology need. As a result, most funding was directed toward this topic. Funding was stopped in the early 1990s, however, due to the high expense, stretched timelines, and changes in the threat.

Pulsed Power and Electromagnetic Launchers

During the 1980s, the Army and Air Force looked at short-range electromagnetic weapons to penetrate stronger armor with higher velocities. The Navy worked on concepts for a weapon that could be mounted on ships to intercept missile systems at line-of-sight distances. The Navy—then the biggest user of space systems—was also interested in studies showing that small satellites could

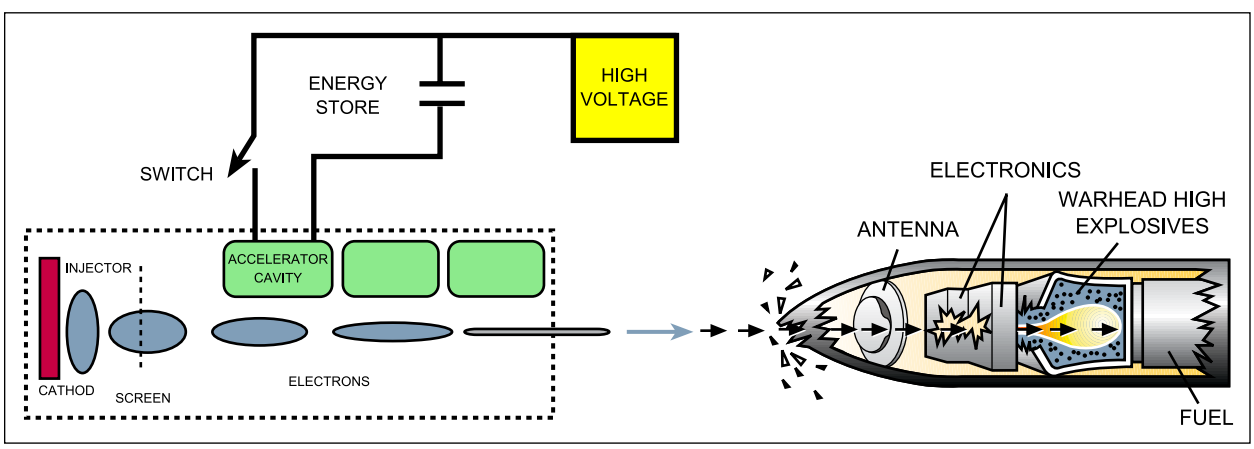

Figure 8. Charged-Particle Beam (CPB) Concept

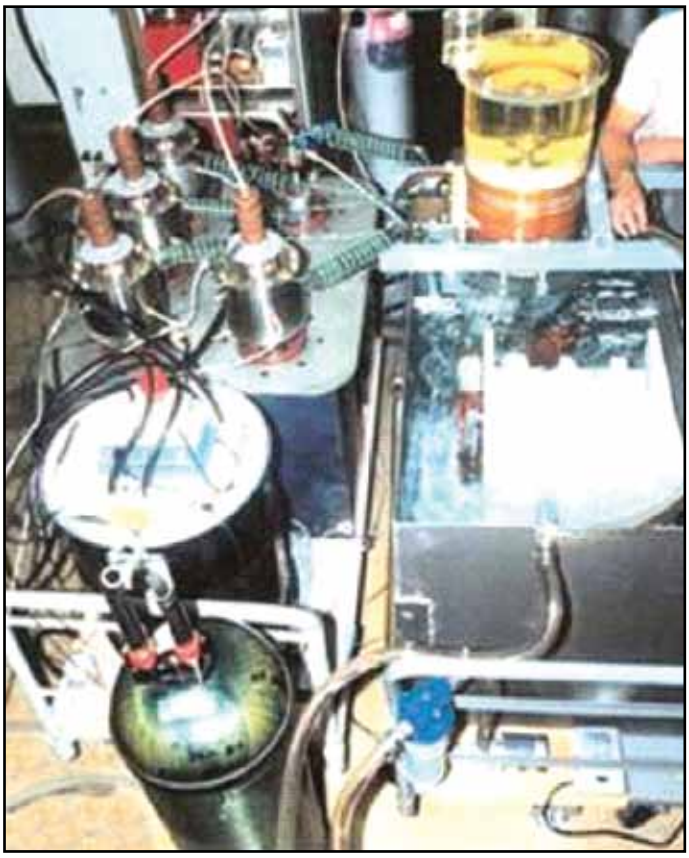

Figure 9. High-Voltage 5-Pulse System Experiment

be electromagnetically launched into low Earth orbit for the fraction of the cost for a normal launch.

Through the 1980s, electric guns were funded by independent research and independent exploratory development programs at Dahlgren, studying electric gun concepts for both rail guns and electrothermal (ET) guns. Kinetic energy weapons were also investigated as part of the Pulsed Power Technology Program. Under these programs, pure electric launchers were developed and tested at Dahlgren, including ones that self-formed projectiles.[16–18] Also studied were ET guns that used the discharge of electrical energy at the gun breech to generate a plasma jet. This plasma jet heated a low-molecular-weight working fluid, such as water, to produce a heated gas that accelerated the projectile to higher velocities than conventional explosives. The Electrothermal-Chemical (ETC) Gun concept augmented the electrical energy generating the plasma jet with a chemical reaction. A 127mm ETC gun was investigated, and a 60mm ETC gun was tested at Dahlgren, with the ability to fire short bursts at a rate of 100 rounds per minute.[19]

Early Dahlgren work on electromagnetic launchers—along with capacitor development and switch advances from the Pulsed Power Technology Program—allowed Dahlgren to provide the Navy with detailed conceptual designs in the late 1990s for near-term, long-range rail guns based on capacitor energy store. These efforts helped support the decision to begin a long-range rail-gun program at Dahlgren that continues today, resulting in world-record achievements. Capital investment funds were used to construct a high-energy facility in 2005 to test pulsed-power components and module designs for use in electromagnetic launcher programs. An early electromagnetic launcher is shown in Figure 10.

High-Energy Lasers (HELs)

In general, megawatts of continuous laser power are required to kill hard targets at long ranges. Laser technologies that can produce this much power are very limited. The Navy was a leader in developing powerful chemical lasers in the 1970s and 80s. These lasers burned chemical reactants to

Figure 10. Early Electromagnetic Launcher at Dahlgren

generate the excited states for lasing, thus reducing the need for large amounts of electrical power. The Navy built an entire HEL system, including the Mid-Infrared Advanced Chemical Laser (MIRACL) and the Sea-Lite beam director. By 1990, this building-sized system demonstrated shooting boosters, missiles in flight, and supersonic vehicles. However, the system had drawbacks because it:

- Used hazardous, expensive chemicals
- Had propagation problems at the mid-infrared wavelength
- Was large in size and high in cost

FELs require electron accelerators similar to CPB weapons, so they also are large and complex. However, they can be designed to operate at optimum wavelengths and scale nicely to higher powers. The Strategic Defense Initiative began working on FELs in the late 1980s, funding the advanced test accelerator at LLNL, originally developed for CPBs. FELs were also studied under the Strategic Defense Initiative Organization (SDIO) to be used as an antisatellite weapon. These lasers went from milliwatts to watts under SDIO, and then to kilowatts more recently with work at the Thomas Jefferson National Accelerator Facility in Virginia. Space-based lasers and relay mirror systems were studied under SDIO funding, too, including the development of the Advanced Beam Control System for beam steering, beam control, rapid optical retargeting, and self-alignment.

Dahlgren engineers concentrated its internal laser efforts on medium-power soft-kill weapons. They performed tests against sensors and cameras, and investigated damage thresholds. In the late 1980s, Dahlgren engineers worked with optical augmentation to locate enemy optics for targeting and on green laser dazzlers for defense against small-boat attack. There were efforts to harden electro-optical equipment, including sights and night-vision systems for the Marines, and laser eye-protection filters for goggles and binoculars. Laser systems were also investigated for remotely cutting holes and wires to disable electronics. Lethality work continued under funding from the Joint Technology Office for High-Energy Lasers to look at alternative wavelengths and pulse shapes in addition to modern target materials.[20]

Dahlgren scientists continued to investigate laser-damage thresholds for materials, components, and subsystems for a variety of laser technologies. Near the start of the 21st century,

commercial lasers based on pumping optical fibers with semiconductor lasers became common and more powerful. Dahlgren purchased the Navy's largest collection of fiber lasers in 2004 and began investigating ways to combine multiple beams into a laser weapon. These lasers have very high efficiencies, above 20 percent, and the fiber-optic output reduces the requirement for complex optical paths. In 2008, Dahlgren engineers demonstrated a laser capability to ignite spinning mortar rounds, and in 2009, engineers demonstrated the capability of fiber lasers in a shoot down of soft targets at China Lake, California.

Resurgence of Directed Energy

With the fall of the Soviet Union and a greatly altered threat, DoD funding (particularly technology funding) experienced an overall decline in the late 1980s and early 1990s. This caused Navy managers to emphasize near-term, lower risk, evolutionary concepts. The Pulsed Power Technology Program and the Navy's Charged Particle Beam Program both came to an end. Investigations into HPM weapons declined as the difficulty of burnout of military electronics—particularly analog components—became apparent. Problems with propagation and cost caused the Navy to greatly reduce efforts on chemical lasers. With the cancellation of major programs, Dahlgren used internal funding in 1990 to keep a core technical capability together, which was necessary for the Center to remain in the mainstream of tactical DE and its associated technologies. Efforts continued in water breakdown, testing of contractor-developed pulsed-power components, and electric guns. New talent and technologies from universities were brought in to jump-start new projects. Tunable waveform generators using unique semiconductor materials were developed. These used bulk semiconductor material, fabricated in-house, that could be used as a fast switch controlled by laser light for both on and off operation. This allowed faster repetition rates and better triggering than could be done with small spark gaps, as well as the ability to create specific waveforms.[21] "Green" technologies were also investigated using nonthermal plasmas and spark-gap shock waves for cleaning and pollution reduction.[22] New types of particle detectors and magnetic field sensors were developed, and new methods of infrastructure protection were investigated.[23] Soft-kill weapons, both optical and HPM, continued to be studied. Short-pulse jamming of spread-spectrum systems was investigated, as well as beat-wave coupling and special waveforms.[24]

A number of trends led to a resurgence of DEWs by the end of the 20th century. The DoD trend in using digital electronics and off-the-shelf commercial technologies increased dramatically. The pace of change in electronics and computers changed rapidly, too. Most of these new electronic systems had never been tested for vulnerability, and there was a question of how much they would increase military vulnerability to RF or HPM attack. The reduced emphasis on nuclear EMP shielding meant more military electronics were not as well protected from RF attack. Consequently, interest in protecting U.S. military and civilian infrastructure increased, including systems in foreign countries. Moreover, with the increasing reliance on civilian infrastructure, such as power, communications, and emergency and industrial systems—all of which were controlled by digital electronics—the potential that an adversary could attack infrastructure systems to affect or divert military operations became an increasing concern. Following several major terrorist attacks during this time period, there was also concern about the impact of an RF attack on airport towers, financial systems, alarm systems, and industrial plants. Human factors—such as a state of confusion experienced by humans—also played an important part in determining the overall effects of an RF attack.

The asymmetric threat—where large numbers of cheap weapons in a swarm attack could overrun a few sophisticated weapons—caused more concern. As the asymmetric threat to the surface Navy pushed the limits of conventional defensive systems, DE—with it speed-of-light propagation, soft-kill potential, and cheap rounds—offered tactical advantages, either as an adjunct to conventional systems or as stand-alone systems. Additionally, there was an increased emphasis on nonlethal, precise accuracy and graduated effects that could be used. Moreover, the idea that future battles would be fought together with civilians and friendly forces on the battlefield increased the importance of low collateral damage and antimateriel attacks.

The Joint Program Office for Special Technology Countermeasures (JPO/STC), located at Dahlgren, began efforts concerning the vulnerability of new digital systems to RF attack. The program also established a DoD-wide database of vulnerability data, source designs, and RF-effects information—bringing together much of the information collected by the services over the years. The program looked at the protection of modern digital infrastructure systems and funded a facility constructed in 1992 to test large-scale electromagnetic vulnerabilities to various methods of attack.

In the late 1990s and early 2000s, Dahlgren initiated programs regarding the potential for RF attack using nonkinetic disruption, with minimal collateral damage. Capital investment funds were used to construct a test facility for this effort in 1998. Dahlgren developed RF payloads for remotely piloted vehicles and demonstrated their effectiveness in field tests in 1999, and in similar tests in 2007. The successful completion of Project Guillotine was DoD's first demonstration of this type of HPM technology. As the need for statistical vulnerability to commercial digital systems became apparent, Dahlgren constructed instrumented test facilities in 1999 and 2002. Two multistory buildings could be reconfigured to reflect different types of building construction and electromagnetic shielding. Large complexes of electronics, computer networks, server systems, telephone systems, security systems, and various types of digital industrial controls could be assembled, instrumented and exposed to attack from an external device or technique. This program-funded complex—called the Maginot Open Air Test Site (MOATS) facility—continues to be used to test target systems, as well as a variety of RF weapon technologies developed internally and by external and international organizations. A picture of the MOATS facility is shown in Figure 11.

As the need for additional DE laboratory space and testing capabilities became apparent, Dahlgren applied for military construction funds, and in 2008, constructed the Naval Directed Energy Center (NDEC), with access to Dahlgren's overwater test range. Other construction funds were used to construct a remote facility at the Pumpkin Neck Explosive Test Range to serve as a laser backstop and measurement facility, as well as an explosive-test staging area. These facilities already have been used to develop and test fiber lasers against modern threat targets. Construction is currently underway to build an expansion of the NDEC and a 120-m laser test laboratory building using an existing tunnel structure. This collection of facilities represents very important capabilities to develop and test future DE systems.

Conclusion

For over 40 years, the Naval Surface Warfare Center, Dahlgren Division (NSWCDD) has been a leader in developing DE devices, pulsed-power systems, and electric weapons. Its people have contributed many publications and patents, and set world records. DEWs tend to be complex and technically challenging to build. Regardless, these weapons offer important, powerful advantages, such as:

- Deep Magazines
- Cheap Rounds
- Fast Targeting
- Variable Lethality
- Pinpoint Targeting

As a result of NSWCDD's leadership, persistent scientific initiatives, and leading-edge engineering

Figure 11. MOATS Facility Undergoing Testing with an RF Weapon (on right)

over the years, naval warfighters will increasingly find themselves turning to DEWs when dealing with situations spanning the spectrum of conflict.

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History of Laser Weapon Research

By Melissa Olson

The idea of using light as a weapon can be traced back to Hippocrates, commander of the Greek forces in 212 B.C. His forces supposedly set fire to the sails of the Roman fleet by focusing sunlight with mirrors. Weapons systems based on lasers and "ray guns," long a staple of science fiction, have captured the imagination of people everywhere. But with steady progress toward the development of lasers in the last 40 years, viable, state-of-the-art laser weapon systems have now become a reality.

The production of lasers in the modern scientific world is fairly new. The first laser was developed in the 1960s and represented the beginning of a drastic change in how the military viewed warfare. The late 1970s and 1980s, too, marked a busy time period for developing lasers into possible weapon systems. All branches of the military and industry were striving to master high power levels, beam control, and adaptive optics. In 1999, the Department of Defense (DoD) formally recognized lasers as future weapons and began research and development (R&D). In 2000, the Joint Technology Office for High Energy Lasers was formed to bring all laser technologies together to develop a complete laser weapon system that could be used by the warfighter.

Electromagnetic Spectrum

The electromagnetic spectrum contains all the types of electromagnetic energy, including radio waves, microwaves, infrared, visible light, ultraviolet, and gamma rays. ***Laser*** is an acronym for "light amplification by stimulated emission of radiation." Light, therefore, is a type of electromagnetic radiation. Light is made up of tiny packets of energy called photons. The amount of energy is what determines the wavelength. Lasers are usually infrared (1 mm to 750 nm) and visible light (750- to 400-nm wavelength). Microwaves are mostly high-frequency radio waves (millimeters to centimeters), with wavelengths 10,000 times longer than lasers. Diffraction of any electromagnetic radiation beam is based on the wavelength and aperture size. For the same aperture size, lasers diffract 10,000 times less than microwaves. This allows the beam to reach farther ranges while maintaining a small spot size of concentrated energy on the target. Lasers are preferred in specific scenarios because of minimal diffraction. The electromagnetic spectrum is shown in Figure 1.

Laser Fundamentals

The quantum mechanical idea of stimulated emission of light was discovered by Albert Einstein in 1917 and is one of the fundamental ideas behind the laser. Einstein

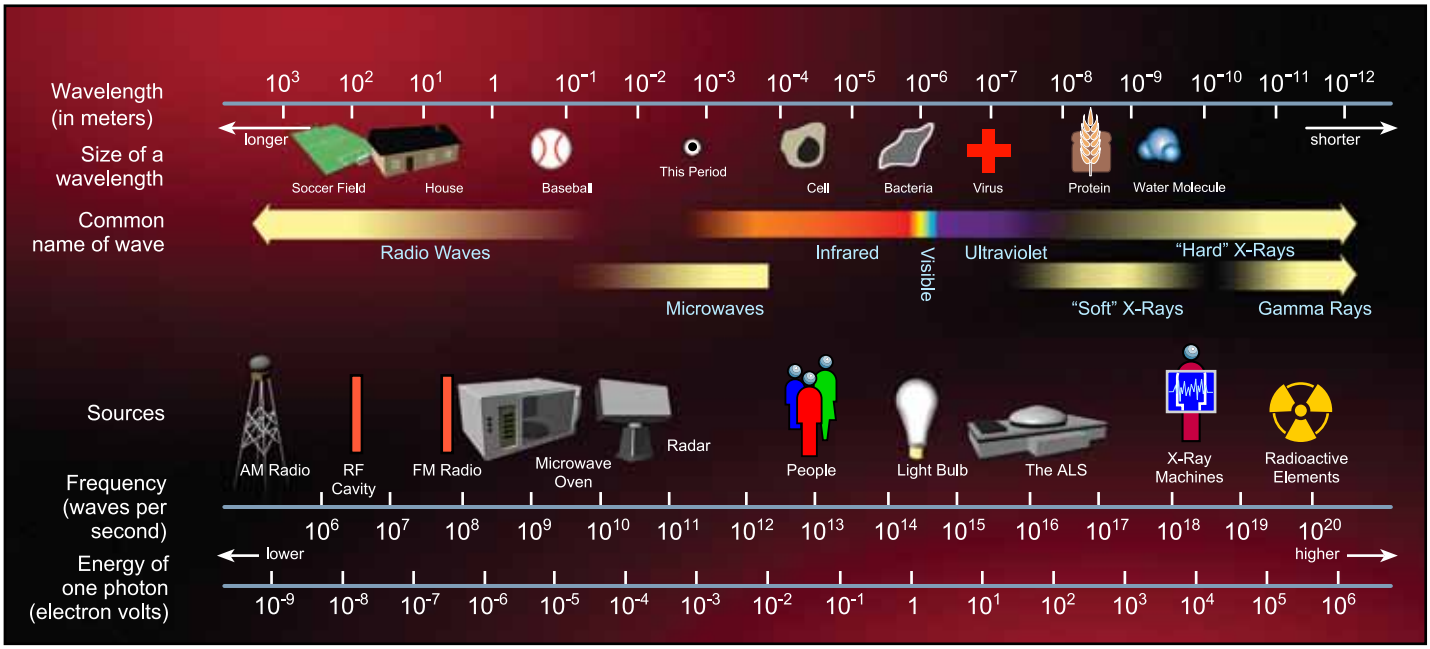

Figure 1. Electromagnetic Spectrum

theorized that when a photon interacts with an atom or molecule in an excited state, two photons are produced when the atom or molecule leaves the excited state. Population inversion occurs when the atoms or molecules are in the excited state. In order for molecules to come out of the normal "ground" state, a source of power must be introduced to the system energizing the atoms to the excited state. When many photons are passed through many excited atoms, more and more photons are produced. The photons are contained and reflected back and forth in a cavity, with mirrors usually on each end. The mirror on the output end is only partially reflective, allowing some photons to leak through, creating the laser beam.

The difference between an everyday light bulb and the light of a laser is temporal and spatial coherence. In a light bulb, the light emits photons equally in all directions. The light is random, out of phase, and multiwavelength. A laser emits coherent light, so photons travel in identical direction and phase. A laser is also monochromatic, i.e., light of one wavelength. Another significant difference is that laser light is highly collimated, which means the laser beam can travel long distances with minimum spreading.

The laser gain medium through which the photons travel to become amplified or magnified can vary. The source of power used to excite the medium, achieving population inversion, can be the result of a chemical reaction, an electric discharge, a flash lamp, another laser, or some other excitation mechanism. The type of the lasing medium determines the type of laser. The three categories in which lasers are usually classified are chemical, gas, and solid state. A laser can also be continuous wave (CW) or pulsed. Each type of laser produces a specific wavelength of radiation. It is important to note that different wavelengths of radiation interact with the atmosphere differently. A laser beam is either scattered or absorbed by air molecules, water vapor, or dust. Longer wavelengths scatter less and are absorbed more than shorter wavelengths; our sky is blue because the shorter blue wavelengths of light are scattered more than the longer wavelengths.[1] Gamma rays are so highly absorbed that they cannot propagate more than a few feet in the air. Thus, some laser wavelengths are scattered or absorbed more than others. This makes laser wavelengths with minimum absorption better for use as directed-energy weapons since they propagate through the atmosphere better than others. For example, the carbon-dioxide (CO_2) laser is strongly absorbed by water vapor, so any use near the ocean will be negatively affected. Near-infrared and infrared lasers have shorter wavelengths with negligible absorbance. The optimal laser choice, therefore, would be a wavelength-tunable laser that could vary depending on the atmospheric conditions, such as the free-electron laser (FEL).

Lasers have affected almost every type of modern technology. Most laser technologies use low

powers and were mastered very quickly. They are used in many everyday appliances, such as scanning/inventory devices, surgery/medicine, hair removal, presentation pointers, law enforcement, ranging and sighting devices, welding applications, and much more. Using a laser as a weapon has many advantages. For example, a laser:

- Is unaffected by gravity
- Causes minimal collateral damage
- Travels at the speed of light
- Can precisely reach far distances
- Is capable of causing a specific, predetermined amount of damage to targets

The theory behind these capabilities makes the laser weapon a prime choice in multiple engagement scenarios. However, developing lasers with higher powers to use as a weapon has proven more difficult than first considered.

Military Laser History and Laser Types

Generally, a laser weapon is any laser used against the enemy with more than 50 kW to megawatts of power. This is much greater power than commercial lasers. Accordingly, they have greater support needs, including:

- Environmental and personnel safety
- Mirror coatings
- Chilling requirements
- Power requirements
- Laser fuel storage
- Alignment and tracking requirements

In 1960, the very first laser (a ruby laser) was built, producing minimal power. This event was followed by many other laser technology developments. The first chemical laser, hydrogen fluoride (HF), was built in 1965, producing 1 kW. It was then that DoD became interested in researching and developing a more powerful laser for weapon applications. Subsequently, in 1968, the Defense Advanced Research Projects Agency (DARPA) Baseline Demonstration Laser produced 100 kW, and the Navy-ARPA Chemical Laser (NACL) produced 250 kW in 1975. The very first laser is depicted in Figure 2.

Solid-State Lasers (SSLs)

An SSL uses a solid lasing medium, such as a rod made up of glass or crystal, or a gem, like the ruby laser. Along with the rod or host material is an active material, such as chromium, neodymium, erbium, holmium, or titanium. Chromium is the active material used in ruby lasers. Neodymium is the active material in the most widespread applications. A flash lamp, arc lamp, or another laser carries out the optical cavity pumping to achieve population inversion and stimulate the laser beam. The Neodymium Yttrium-aluminum garnet (Nd:YAG) laser is a popular SSL. It operates at a 1064.5-nm wavelength and can be pulsed wave or CW. A great advantage of these lasers is that the wavelength and pulse duration can be varied considerably.[1] The power level can reach up to megawatts when using Q-switching to achieve

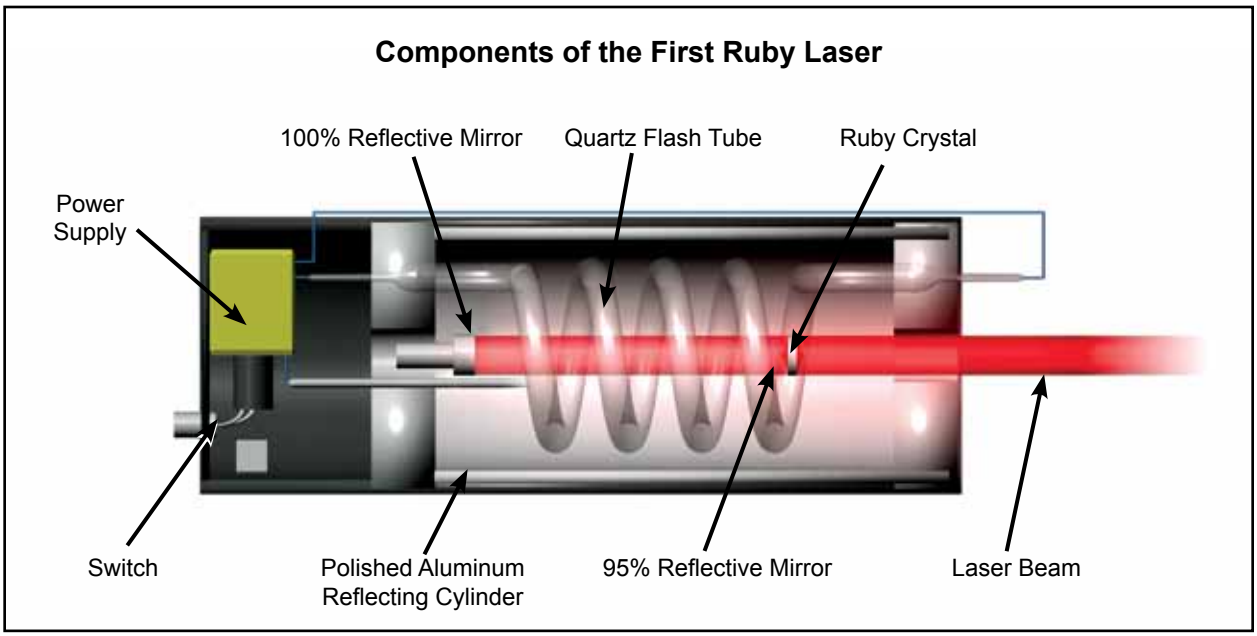

Figure 2. First Ruby Laser Developed in 1960 by Research Physicist Theodore H. Maiman

short pulse lengths. The various interactions with the laser and different crystalline materials can double the electromagnetic frequency, which will halve the wavelength, bringing the laser beam into the visible range, 532 nm (green). The wavelength can be further divided down three or four times, making this laser range from the near-infrared to the ultraviolet wavelength. These lasers are commonly used for rangefinders and target designators. Other advantages of these lasers are that they can be made very small, rugged, cheap, and battery-powered. Characteristics of SSLs are shown in Table 1.

Chemical Lasers

A chemical laser uses chemical reaction to create population inversion in the lasing medium. One example is the Mid-Infrared Advanced Chemical Laser (MIRACL) developed in the mid-1980s. The MIRACL is a continuous-wave, mid-infrared (3.8-μ) laser. Its operation is similar to a rocket engine in which a fuel (ethylene, C2H4) is burned with an oxidizer (nitrogen trifluoride, NF3).[2] Free, excited fluorine atoms are among the combustion products. Just downstream from the combustor, deuterium and helium are injected into the exhaust. Deuterium (U) combines with the excited fluorine to create excited deuterium fluoride (DF) molecules, while the helium stabilizes the reaction and controls the temperature.[2] The laser's resonator mirrors are wrapped around the excited exhaust gas, and optical energy is extracted. The cavity is actively cooled and can be run until the fuel supply is exhausted. The laser's megawatt-class output power can be varied over a wide range by altering the fuel flow rates and mixture. The laser beam in the resonator is approximately 21-cm high and 3-cm wide. Beam-shaping optics are used to produce a 14- × 14-cm (5.5- × 5.5-inch) square, which is then propagated through the rest of the beam train. Diagnostics for evaluating the beam shape, absolute power, and intensity profile are used on each firing of the laser. The beam can be directed to a number of different test areas or to the SEA LITE beam director.[2] The DF Chemical Laser (MIRACL) and the Sea Lite Beam are shown in Figure 3.

The laser and beam director were integrated in the mid-1980s at the Army's High Energy Laser Systems Test Facility (HELSTF) at White Sands Missile Range, New Mexico. Following integration, extensive tests were conducted in the areas of:

- High-power optical components and beam-path conditioning
- Beam-control techniques
- High-power propagation
- Target damage and vulnerability
- Target lethality[3]

Tests supported by the MIRACL included:

- The high-power dynamic with flying drone (BQM-34)
- Conventional defense initiative with flying drone
- High-velocity target test with Vandal Missile
- High-altitude target tests with flying drone
- Missile and plume tests using the 1.5-m aperture
- Radiometrically calibrated images and spectral radiometry

These successful tests are what made many believe that MIRACL was the first and only successful laser weapon system developed by the Navy prior to the Navy Laser Weapon System (LaWS).[3]

Gas Lasers

Gas lasers are a type of chemical laser that uses a pure gas or gas mixture to produce a beam. The typical gas laser contains a tube with mirrors on each end. One end transmits the beam out of the cavity. Most gas lasers use electron-collision pumping, with electric current passing through the gas. Some use optical pumping with flash lamps. The helium

Table 1. Characteristics of Solid-State Lasers

Name	Wavelength (nm)	Typical Power	Typical Operation
Alexandrite	700-830	5 watts	Pulsed/CW tunable
Erbium	850/1230/1540/1730/2900	8 watts	Pulsed
Holmium: glass	1950	milliwatts	Pulsed
Neodymium	1064/1123/1318/1370	megawatts	Pulsed
Neodymium: glass	1060	megawatts	Pulsed
Neodymium: YAG	1064.5	megawatts	Pulsed/CW
Ruby	694.3	10–15 watts	Pulsed
Titanium-sapphire	660–1060	15 watts	Pulsed/CW tunable

DF Chemical Laser (MIRACL)

Sea Lite Beam

Figure 3. DF Chemical Laser (MIRACL) and Sea Lite Beam

neon (HeNe) laser is a very well-known gas laser. It produces a bright red, continuous beam of low power. It is used for many applications such as scanning, alignment, measurement, and stabilization devices. University students use them in optical training laboratories. Many larger lasers contain a HeNe inside the beam path, as well to verify beam alignment. HeNe lasers are fairly cheap and very rugged. They can work continuously for thousands of hours.

CO_2 lasers are in the gas family. These lasers were the earliest, truly high-power lasers and have been among the most crucial lasers used in R&D for high-energy laser (HEL) weapons. In industry, the more powerful CO_2 lasers are used for welding, drilling, and cutting. There are many different types of CO_2 lasers that vary in pumping design. CO_2 lasers work by burning a hydrocarbon fuel (like kerosene or methane) in oxygen or nitrous oxide. The hot gas flows through a comb of nozzles, expands quickly, and achieves population inversion. The gas then flows through an optical resonator at supersonic speeds, resulting in stimulated emission and a laser beam.[4]

CO_2 lasers have been researched for use as nonlethal weapons. The wavelength produced by a CO_2 laser is also absorbed by glass. For example, the beam does not penetrate a windshield. Thus, shooting a CO_2 laser at a vehicle's windshield could deter a threat by damaging the windshield or by causing a dazzling effect to reduce the visibility of the driver, while not reaching the driver at all.

The gas dynamic laser (GDL) is a CO_2 laser based on differences in relaxation velocities of molecular vibrational states. The laser medium's gas has properties such that an energetically lower vibrational state relaxes faster than a higher vibrational state; thus, a population inversion is achieved in a particular time. A GDL is shown in Figure 4. Characteristics of chemical and gas lasers are identified in Table 2.

Fiber Lasers

Modern fiber lasers are considered SSLs. They are powered by electricity, making them highly mobile and supportable on the battlefield. Fiber lasers use optical fibers as the gain media. In most cases, the gain medium is a fiber doped with rare earth elements—such as erbium (Er3+), neodymium (Nd3+), ytterbium (Yb3+), thulium (Tm3+), or praseodymium (Pr3+)—and one or several laser diodes are used for pumping. Optical fibers have been used in industry, specifically for telecommunications to transport information via light. With developing technology, optical fibers have become high-energy, powerful laser energy sources. Fiber lasers have proven to have much benefit over traditional SSLs. They are rugged and do not require a clean room to operate or maintain, as most other laser systems do. They also are extremely efficient; however, they cannot operate well in all weather conditions. One example is the IPG CW fiber lasers, which produce moderate beam quality, causing damage to materials and components through thermal heating and burn-through. The Naval Surface Warfare Center, Dahlgren Division (NSWCDD) purchased eight commercially available 5.5-kW IPG lasers, where two multimode (seven fibers) lasers are housed per cabinet. This type of laser is easy to mount due to the flexible fibers. The IPG CW Fiber Laser is shown in Figure 5.

Miscellaneous Lasers

There are other types of lasers that do not necessarily fit into the chemical or solid-state categories. These include semiconductor lasers, used in:

- Television
- CD Players
- Dye Lasers
- Spectroscopy
- Radios
- Telecommunications
- Medicine
- Astronomy

There also are the FELs mentioned previously. The FEL is a completely different breed of laser.

Figure 4. A laser engineer inspects a gas dynamic laser after installation aboard an NKC-135 airborne laser laboratory.

Table 2. Characteristics of Chemical/Gas Lasers

Name	Wavelength (nm)	Typical Power	Typical Operation
Helium-Neon	543/632.8	.0001–.001 watts	CW
Krypton	350–647	.0001–.05 watts	CW
Argon	350–514.5	.001–6.0 watts	CW
Xenon fluoride (excimer)	351	.001–20 watts	CW
Argon fluoride (excimer)	193	.05–30 watts	Pulsed
Krypton fluoride (excimer)	249	7–100 watts	Pulsed
Deuterium fluoride (chemical)	3,000–4,200	.01–100 megawatts	Pulsed/CW
Hydrogen fluoride (chemical)	2,600–3,000	.01–150 megawatts	Pulsed/CW
Carbon dioxide	9,000–12,000	.1–15,000 megawatts	Pulsed/CW
GaAlAs (semiconductor)	750–900	10–4,000 milliwatts	Pulsed

Figure 5. IPG CW Fiber Laser System

It uses electrons to create photons instead of some type of matter. The electrons are produced, collected, and directed to flow at very high speeds. To excite the electrons, they are passed through a "wiggler," i.e., a series of magnets positioned in such a way that electromagnetic radiation (light) is produced when the electrons release photons. The significant feature of the FEL is that the wavelength can be controlled, depending on the magnet positions and the speed of electrons. This versatility makes the FEL particularly appealing. However, the footprint of the FEL system is too large to transform into any ideal defense weapon. The Jefferson Laboratory in Newport News, Virginia, has an FEL and continues to maintain and test its capabilities and effects. This laser was new to the military in the late 1990s and received funding to optimize its capabilities and integrate as a defense weapon. Although great progress has been made, the required footprint could be much larger than desired. Consequently, some interest in the FEL has shifted to other HEL sources.

Many scientists foresee the probability of using the laser as a global weapon. This possibility is proven through basic laws of physics. Actually implementing such a system, however, can be more difficult. The global weapon concept uses a base laser with optics and is strategically positioned in space to be able to direct its beam multiple places on Earth at the speed of light with maximum power levels. This idea faces significant problems, including appropriate power levels, optics to handle such levels, propagation issues, and the ethical measures behind any global weapon. Still, the idea presents interesting possibilities.

Laser Weapon Development

The following paragraphs highlight some of the laser weapons that have been successfully developed over the last 40 years.

Baseline Demonstrator Laser (BDL) Hydrogen Fluoride (HF)

In 1973, TRW Inc. produced the world's first high-energy chemical laser, the Baseline Demonstration Laser, for DoD. After that, TRW Inc. produced and demonstrated six more HELs, including the MIRACL (1985) and Alpha (2000), the nation's only megawatt-class chemical lasers.

Navy-ARPA Chemical Laser (NACL) HF

The NACL was mated with the Navy Pointer Tracker at TRW Inc.'s San Juan Capistrano, California, facilities in the 1975–1978 time frame. This was the Navy's initial, integrated HEL system test bed and was used to provide the first demonstrated kill of an operational missile in 1978.

Alpha HF—Built for Strategic Defense Initiative (SDI) Space-Based Laser (SBL)

Alpha, an HF laser, was the baseline technology for the SBL readiness demonstration (SBLRD). In 1991, the Alpha laser demonstrated megawatt-class power levels similar to MIRACL, but in a low-pressure, space operation environment. Alpha demonstrated that multimegawatt, space-compatible lasers can be built and operated.

Tactical High-Energy Laser (THEL)

The THEL is a DF chemical laser developed by the Army. In 2000 and 2001, THEL shot down 28 Katyusha artillery rockets and 5 artillery shells. On 4 November 2002, THEL shot down an incoming artillery shell and a mobile version successfully completed testing. Subsequently, during a test conducted on 24 August 2004, the system successfully shot down multiple mortar rounds. These tests represented actual mortar threat scenarios in which both single mortar rounds and salvo were tested and intercepted. A photograph of THEL is shown in Figure 6.

Advanced Tactical Laser (ATL)

The ATL uses a closed-cycle, chemical oxygen-iodine laser (COIL) with beam control, which lases at a 1.315-μ wavelength. The ATL was developed to engage tactical targets from a moving platform at ranges of approximately 10 km. It can spot a 10-cm-wide beam on a distant target for up to 100 shots. This beam has enough power to slice through metal at a distance of 9 miles. The aircraft equipped with the ATL weapon system is shown in Figure 7.

A specially modified 46th Test Wing NC-130H aircraft equipped with the ATL weapon system fired its laser while flying over White Sands Missile Range, New Mexico, successfully hitting a target board located on the ground. Equipped with a chemical laser, a beam control system, sensors, and weapon-system consoles, the ATL is designed to damage, disable, or destroy targets with little or no collateral damage.

Airborne Laser (ABL) (CO_2) Chemical Oxygen

The ABL C-130H aircraft contains three laser beam systems: the powerful killing primary laser beam (ATL), a set of illuminating laser beams for infrared surveillance and high-speed target acquisition, and a beacon laser for a high-precision laser target tracking beam control system. The primary

Figure 6. Tactical High-Energy Laser (THEL)

Figure 7. 46th Test Wing NC-130H Aircraft Equipped with the ATL Weapon System

laser beam is generated by a megawatt COIL located at the rear of the fuselage. The high-power laser beam travels towards the front of the aircraft through a pipe. The pipe passes through a Station 1000 bulkhead/airlock, which separates the rear fuselage from the forward cabins. The high-power beam passes through the fine beam control system mounted on a vibration-isolated optical bench. Beam pointing is achieved with very fast, lightweight steering mirrors, which are tilted to follow the target missile. The ABL finally destroyed a target while in flight at White Sands Missile Range in August 2009. The 12,000-lb ABL locked onto an unspecified ground target and fired the laser, making the target disappear. Although it was successful at this demonstration, using the ABL in the fleet has fallen out of favor due to affordability and technology problems. The ABL is shown on an aircraft in Figure 8.

Joint High-Power Solid-State Laser (JHPSSL)

In hopes of accelerating SSL technology for military uses, work is being performed by the U.S. Army Space and Missile Defense Command (SMDC) and the Army Test and Engineering Center at White Sands Missile Range. The technology uses an electric laser diode to shoot light into 32 garnet crystal modules that combine to create "laser amplifier chains" producing 15 kW. By using seven chains and by combining multiple beams, they have reached 105 kW in the laboratory operating in a clean room. The program's ultimate goal is for a laser system to reach high powers outside a laboratory environment. Fielding such a delicate optical structure can present significant barriers for this laser system. Nonetheless, it will be a great accomplishment for a variety of force protection missions, such as shipboard defense against cruise missiles. The JHPSSL system is shown in Figure 9.

Navy Laser Weapon System (LaWS)

The Navy LaWS is the most recent, successful laser weapon. It uses an electric-fiber laser design, avoiding the problems that chemical lasers present. In the summer of 2009, the Naval Sea Systems Command (NAVSEA)—with support from NSWCDD—successfully tracked, engaged, and destroyed unmanned aerial vehicles (UAV)

Figure 8. Airborne Laser (ABL)

Figure 9. Joint High-Power Solid-State Laser (JHPSSL) System

in flight at the Naval Air Warfare Center, China Lake, California. A total of five targets were engaged and destroyed during the testing, which represented a first for the U.S. Navy. The laser was fired through a beam director on a Kineto Tracking Mount similar to the Sea Lite beam director. The system used fiber lasers in the configuration and has proven to be a rugged and dependable choice for the warfighter's needs. A photograph of LaWS is shown in Figure 10.

Laser weapon systems development in recent years has taken giant steps forward. Dedicated R&D has advanced the state of the art considerably. What was unimaginable only a few short years ago, today has become reality. Accordingly, given continued R&D, warfighters in the near term will have additional weapon options to choose from for dealing with a spectrum of threats and contingencies.

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Figure 10. Navy Laser Weapon System (LaWS)

Laser Weapon System (LaWS) Adjunct to the Close-In Weapon System (CIWS)

By Robin Staton and Robert Pawlak

The Naval Sea Systems Command (NAVSEA) established the Navy Directed Energy Weapons Program Office in January 2002 and subsequently chartered the Directed Energy and Electric Weapon Systems Program Office (PMS 405) in July 2004.[1, 2] Its mission is to change the way the Navy fights in the 21st century by transitioning directed-energy and electric weapon technology, providing the warfighter with additional tools to fight today's and tomorrow's wars. In support of this mission, the Laser Weapon System (LaWS) was developed, which potentially adds a suite of tools for offensive and defensive operations.

The LaWS program is managed by PMS 405 in cooperation with the Program Executive Office Integrated Warfare Systems (PEO IWS), the Navy's Close-In Weapon System (CIWS) manager. A multilaboratory/multicontractor organization led by the Naval Surface Warfare Center, Dahlgren Division (NSWCDD), has been executing the program since March 2007. The potential advantages of a lethal, precise, speed-of-light weapon are numerous and have been recognized for many years. However, even in light of these advantages, there are realities that need to be considered for any program to succeed to the point that an actual system is placed in the hands of the warfighters.

The LaWS system offers viable solutions for an important subset of threats while fitting into acceptable size and weight constraints. In addition, since LaWS is a fully electric laser, the operation of the system does not require the handling and storage of hazardous chemicals, such as hydrogen fluoride. As will be discussed later, due to the incorporation of high levels of commercial off-the-shelf (COTS) technology, the LaWS system also has advantages for topside design, logistic supportability, and cost. Thus, LaWS could enable the Navy to address adverse cost-exchange situations, which can occur when engaging proliferated inexpensive threats such as unmanned aerial vehicles (UAVs).

Background

Based on mission analysis work conducted prior to the LaWS program and additional work done as part of the program, it became clear that a number of factors require careful consideration. First, a high-power laser is not likely to replace anything on a ship in the next 5 years. For a new system to be added to a ship, a high-power laser must supplement current capabilities or provide new capabilities that clearly justify its addition. Second, because a laser provides such a diverse set of capabilities, conventional air-to-air warfare (AAW) models—such as the Fleet AAW Model for Comparison of Tactical Systems (FACTS), Antiair Warfare Simulation (AAWSIM), and Extended Air Defense Simulation (EADSIM), as well as other existing AAW analysis approaches—are not well suited for showcasing current or near-term laser-weapon capabilities. While they can (and have) been used for laser-weapon analysis, their application to a megawatt-class laser that could "instantly" destroy boats or cruise missiles (akin to missile engagements) is a more straightforward application of the existing models and techniques.

In November 1995, the Chief of Naval Operations requested that the National Research Council initiate, through its Naval Studies Board, a thorough examination of the impact of advancing technology on the form and capability of the naval forces to the year 2035. A major observation of the report is quoted below:

> Numerous laboratory and field-test versions of laser weapons have been developed and demonstrated. They have worked as expected and demonstrated suitable lethality against their intended targets. The primary factors that have inhibited the transition of the technology into deployed systems are size and weight. Generally, the conceptual designs of laser weapons that are scaled for combat effectiveness are too large to be appealing to users; conversely, weapons that are sized for platform convenience generally lack convincing lethality.[3]

Subsequently, an August 2006 U.S. Air Force (USAF) Scientific Advisory Board Study examined the increasing threat posed by UAVs in some detail. Key conclusions included:

> No single system can completely address the UAV threat. A single sensor solution is inadequate because of the size and speed challenges presented by small UAVs. A single-weapon-layer solution fails to provide for adaptability to multiple scenarios or adequate probability of kill.

Key recommendations of the USAF Advisory Scientific Board Study included:

> Develop and field longer-term upgrades to counter increased UAV threats. They include:…a small, multimission air/air and air/ground weapon; and directed-energy air defense weaponry.[4]

In addition to the USAF Scientific Advisory Board study, a 2007 OPNAV Deep Blue Study noted the potential advantage of nonkinetic defeat options and recommended that the Navy accelerate development of nonkinetic systems to include high-energy lasers (HELs).[5]

The laser power levels likely to be available in the near term, within reasonable size and cost, are in the neighborhood of 100 kW of radiated power. While this power level is not adequate to engage certain threats, such as cruise missiles or tactical ballistic missiles at tactically useful ranges, there is still a wide spectrum of threats that could be engaged at ranges that are comparable to many current ship-defense weapons, including minor-caliber guns and small missiles. The spectrum of threats includes:

- UAVs
- Missile Seekers
- Intelligence, Surveillance, and Reconnaissance Systems
- Rockets
- Man-Portable Air-Defense Systems (MANPADS)
- Mortar Rounds
- Floating Mines
- Artillery Rounds

LaWS on CIWS

The Mk 15 Phalanx CIWS can often detect, track, and (sometimes) identify potential threats at ranges well outside the effective range of the 20mm gun. These functions are accomplished using the search/track radar system and the Phalanx Thermal Imager (PTI). When added to the Phalanx mount and pointed in the same direction as the gun (see Figure 1), a laser weapon could potentially add a number of useful functions and capabilities to the mount, but technical challenges must be overcome. Preliminary analyses of the mechanical characteristics of the mount suggest that the additional weight that could be added to the mount must be kept under approximately 1200–1500 lb. Additionally, it is highly desirable that the addition of the laser weapon not substantially affect the train/elevation operation of the mount in angle, peak velocity, or acceleration. Consequently, use of rapidly evolving fiber laser technology appears to be the only currently foreseeable path to adding significant laser energy directly to the mount within these constraints.

One major driver in the genesis of the LaWS system was the availability of relatively low-cost COTS fiber-optic lasers. Because these fibers are flexible, they obviate the need for an expensive coudé path system (an optical mirror/lens assembly that turns radiation 90° and may also support rotation of the beam director), thus allowing the use of low-cost mount technology, as well as the retrofitting of the system on existing mounts. The last factor is extremely important because of the scarcity of topside real estate on today's ships. These fiber-optic lasers do have limitations in terms of power, although power levels are growing with advancing technology. The reality today is that, in order to get adequate lethality from a system based on this technology, the use of a beam-combining apparatus utilizing several individual fibers is necessary. (Figure 2 depicts combining multiple fibers in the same beam director.) Furthermore, a smaller beam size is desirable since this drives power density up—increasing the performance required for the tracking and pointing elements of the system. Thus, a high-resolution fine track sensor is needed, as well as an appropriately robust line-of-sight control.

A Potential Suite of LaWS-Related Capabilities

Potential added capabilities that an adjunct LaWS could contribute to the total ship combat system are briefly outlined in the following subsections.

Figure 1. LaWS Mounted on CIWS

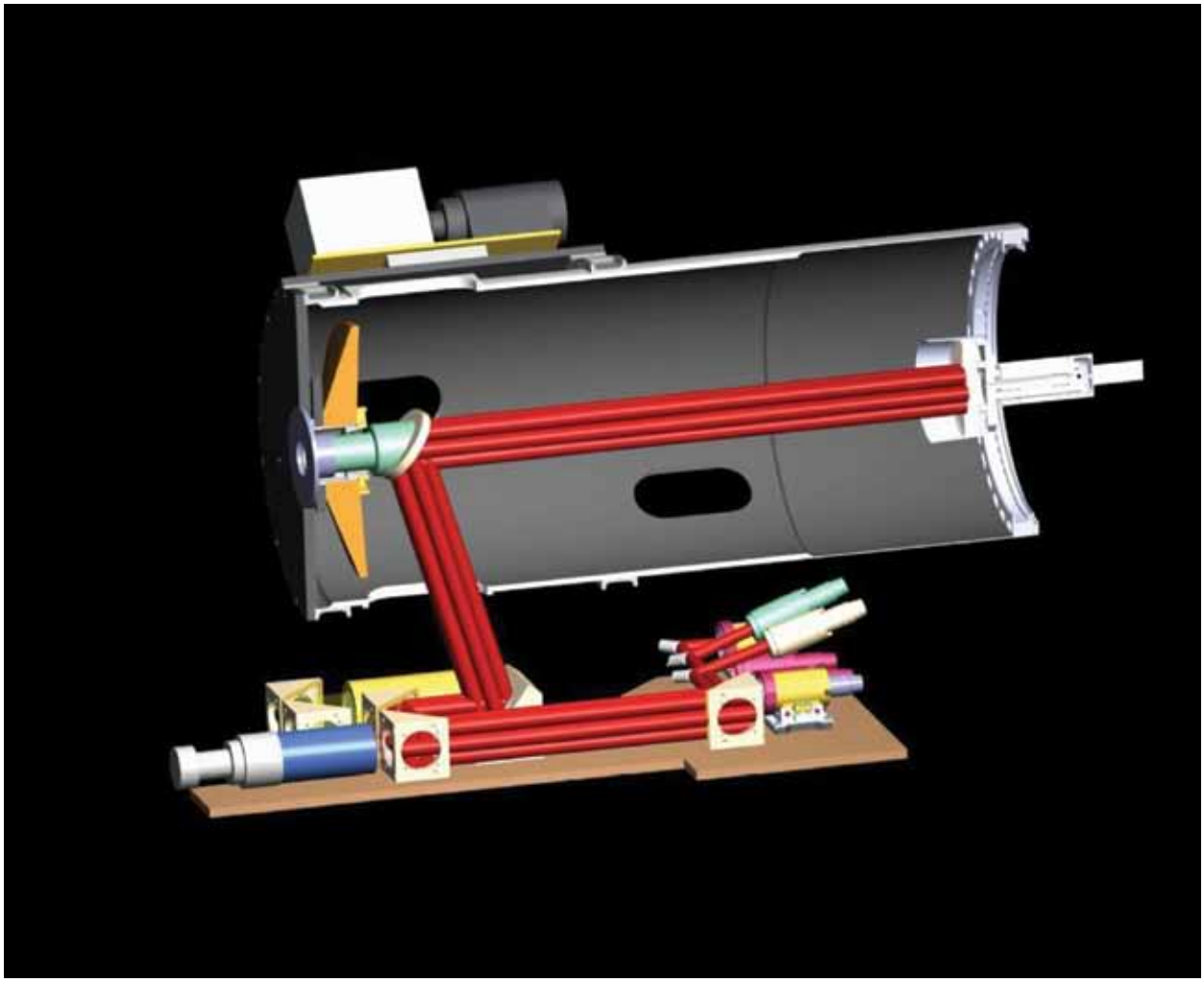

Figure 2. Cutaway View of the LaWS Beam Director

Target Identification, Tracking, and Intent Determination at Range

The optics that would be added for the laser to detect and track targets in support of a laser engagement would immediately contribute additional capabilities to the entire ship combat system even without operating the laser. A laser-gated illuminator, part of the tracking system, significantly increases the signal to the background level of tracked targets and provides good range resolution as well. The additional sensitivity and angle resolution provided by the LaWS optics would allow the identification, precision tracking, and "monitoring" (at high resolution) of potential threats or vehicles of interest at substantially greater ranges than could be achieved by the PTI alone. The Phalanx radar, or another source, would have to provide an initial, accurate cue to facilitate initial acquisition. Once acquired, the target could be examined and monitored with high resolution at range. This capability could make a substantial contribution to identification efforts—efforts to determine intent and potentially even to documenting target behavior to resolve issues with rules-of-engagement doctrine. It is widely recognized that rules-of-engagement issues, such as threat identification and intent determination, are among the most difficult problems faced by ship commanding officers.

Unambiguous Warning at Range

If a fraction of the laser energy is routed through a frequency-doubling crystal, an intense, visible beam can be projected to significant ranges to provide a clear, unambiguous warning that a potential target is about to be engaged unless an immediate change in behavior is observed. This feature also would have utility for dazzling aircraft, surface vehicle, or submarine sensors, and would provide exceptional long-range, unambiguous warning to boats or aircraft at night.

Sensor Destruction at Range

Many electro-optical (EO) sensors are quite susceptible to damage by laser energy in the fiber-laser band as is the case with infrared (IR) missile seekers with germanium optics. The frequency-doubling feature described in the previous paragraph also would be useful to ensure that a band-pass filter at a single frequency could not be applied as an effective countermeasure. The intent here would be to destroy the seeker or imager at ranges well beyond those achievable by the Phalanx 20mm gun. Other examples include intelligence, surveillance, reconnaissance, and targeting sensors on UAVs or unmanned surface vehicles (USVs).

IR Missile Assist at Range

Many targets of interest—including UAVs, USVs, and small boats—are somewhat "marginal" from a target-signature standpoint, particularly at the maximum range of existing IR guided missiles such as the FIM-92 Stinger, the FGM-148 Javelin, the RIM-116 RAM, and the AIM-9X Sidewinder. The CIWS laser adjunct could potentially "correct" this situation by laser heating target vehicles to enhance their signature to existing IR guided missiles. Note that this is NOT "conventional" semiactive-laser (SAL) guidance—the LaWS is not a coded illuminator, nor do the seekers in question rely on this coding. The IR missiles would be unmodified weapons taken from inventory. The LaWS adjunct would simply contribute laser energy that heats the target and enhances its signature for the missile. While, at the ranges envisioned, this laser heating alone would not be sufficient to "kill" the target, it could definitely heat the target. It should also be noted that the laser "illumination" could potentially be used to preferentially select a specific target from among a group of targets for engagement by a missile. It is expected that these engagements could occur at ranges of two to four times the effective Phalanx gun engagement ranges. Use of LaWS in this manner would be exactly analogous to the use of a SAL designator for a SAL guided missile, such as the AGM-114 Hellfire. It is expected that similar rules of engagement would apply.

Direct Target Destruction by Laser Heating

Some threats are known to be vulnerable to direct destruction by the application of laser energy for an appropriate period of time. The currently envisioned system would be able to destroy a subset of naval threats at ranges comparable to, and in some cases greater than, the ranges achieved with modern, stabilized guns using EO fire control systems and modern ammunition. In the case of a LaWS adjunct, the addition of the laser would open new options for a firing/engagement doctrine and would be expected to conserve CIWS rounds for use on threats that are not appropriate for this laser power level. While the laser is often quoted as having an "unlimited magazine," the true number of threats that can be engaged by the laser in any period of time is limited by the required illumination time and by the time required to evaluate a kill and transition to the next target. Thus, for particular target velocities and numbers, the "effective laser magazine" might be added to the CIWS magazine to increase the total number of targets engaged by the combined system.

LaWS Accomplishments

A government/industry team, led by government technical personnel, have achieved significant accomplishments since the start of the LaWS program in 2007; specifically, the team:

- Conducted mission analyses
- Developed threat lethality estimates
- Performed industry surveys for critical components and subsystems
- Performed extensive trade-off analyses
- Designed a prototype system
- Constructed the system—the prototype director and mount (see Figure 3)
- Performed numerous laboratory-based tests of subsystems and the complete prototype
- Validated system operation with a full-up field test at high power using BQM-147A UAV target drones

Additionally, the team was able to minimize the cost of the prototype by leveraging hardware that had already been developed or procured for other applications, including an L3-Brashear tracking mount, a 50-cm telescope, and high-performance IR sensors. Some components were commercially procured, such as the 5.4-kW fiber lasers. Figure 4 shows three laser cabinets, containing two lasers apiece, resulting in a total power output of 32.4 kW. Other components, such as the beam combiner and much of the system software required for operation and target tracking, had to be specifically designed, fabricated, and tested.

The LaWS program achieved a highly successful field test/demonstration in June 2009 when the prototype successfully engaged and destroyed five drone targets at tactically significant ranges at the China Lake, California, test range (see Figure 5).

Additional Work to be Done

Since the LaWS prototype sits on a dedicated gimbal, much additional work needs to be done

Figure 3. Photo of LaWS During Testing at the Naval Weapons Center, China Lake

Figure 4. IPG Laser Cabinets

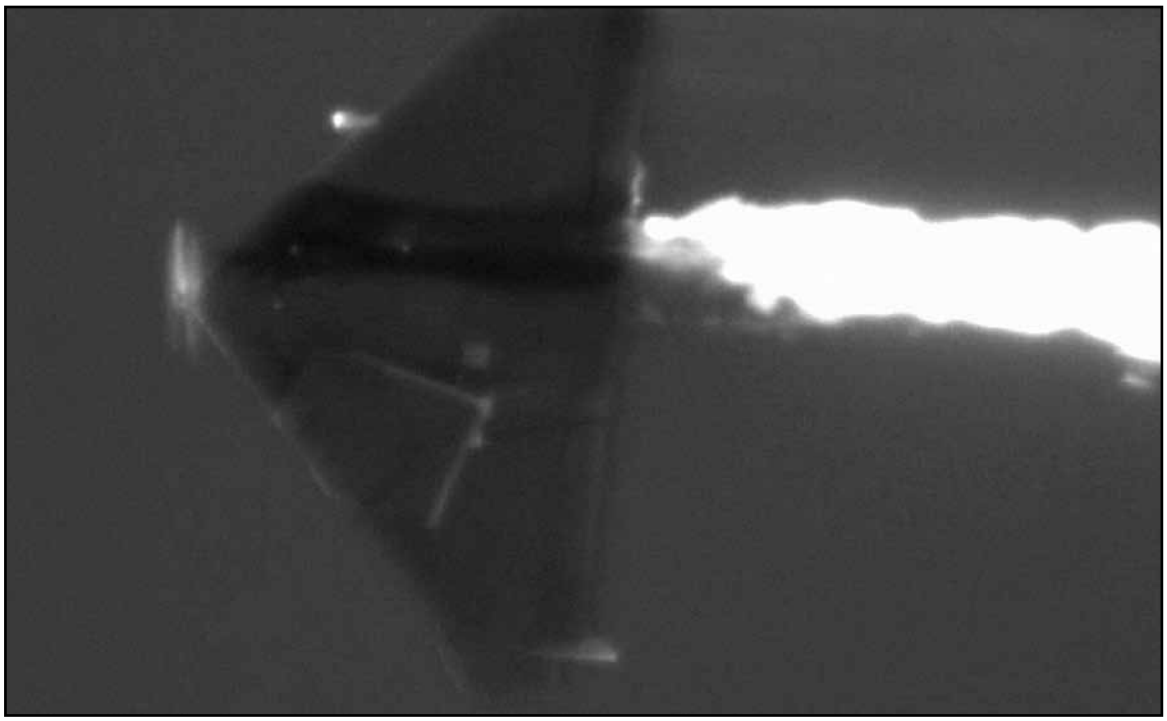

Figure 5. BQM-147A During LaWS Engagement

to place the weapon on the CIWS mount. The latter would require new control systems and optomechanical hardware for line-of-sight stabilization. Other aspects of the shipboard environment are also more stressful, and future mission areas may require an increasingly robust capability to deal with optical turbulence and the high-clutter environment of the ocean surface. Additional laser power might also be required. These modifications, depending on the level of capability desired, will require engineering modifications to the system. Engineering analysis and design to address these issues is currently underway at NSWCDD.

While the aforementioned engineering issues are important to address, there are additional technical issues that have yet to be analyzed. These issues are concerned with the potential utility of the system. Indeed, most of the detailed technical analyses and experiments performed thus far have focused on target destruction, with some effort expended on the issue of seeker damage/destruction. Developing credible lethality estimates for various potential threat targets is clearly very important, but one consequence of the lethality focus is that necessary, detailed, defendable technical analysis, analytic model development, and experiments have not been performed to explore the other functions/features that a CIWS Adjunct LaWS might provide to the overall ship combat system. Some of these contributions might become "routine" if the LaWS were available.

For example, a hard-kill engagement of a target by a Navy shipboard weapon is a relatively rare event, even during wartime conditions. On the other hand, ships in combat zones—and elsewhere—constantly have the problem of detecting potential threats, tracking them, identifying them, determining their intent, and providing warning. Thus, use of the LaWS system, at less than its full lethal potential, could become a daily, standard practice. It is still not clear how these potential benefits and capabilities could be measured or quantified to the satisfaction of key decision makers.

Likewise, other potential advantages of laser weapons—such as the potential for precision engagement, covert engagement, fire starting, graduated lethality, low cost per shot, and "unlimited"

magazine—have not been subjected to rigorous technical analysis for feasibility, utility, and practicality. These investigations need to be performed and are gradually being addressed within the LaWS program.

Although the Phalanx CIWS system is currently installed on a number of Navy surface warships—either a single mount or a double mount—there are still significant numbers of ships that do not have a Phalanx system. It is highly desirable to make LaWS potentially available to virtually any ship that could benefit from the enhanced capabilities.

While the technical issues associated with the addition of LaWS to the Phalanx CIWS will be somewhat different from those associated with adding a LaWS system to other weapon systems—or the provision of a "stand-alone" LaWS—they do not appear to be insurmountable. For example, a LaWS beam director might be added to the stabilized Mk 38 Mod 2 25mm gun or the Mk 46 Mod 2 30mm gun. A LaWS beam director might be added to (or even substituted for) the Mk 46 EO Sight on DDGs or added to the trainable RAM launcher. Other options may exist as well.

The issue of defending combat logistics force ships, joint sealift ships, and certain support vessels from attacks from small boats or UAVs is also relevant. These ships often have little or no installed defensive capabilities for potential terrorist or pirate threats, and expeditionary security detachments do not have decisive warning or engagement capability. In addition, there are severe limitations placed on concept of operations (CONOPS) and rules of engagement due to the limited objectives/limited means of the various missions.

A system such as LaWS could provide graduated lethality from warning to destruction. It also could provide additional applications to minimize risk to sea base platforms and enhance sea shield capabilities against nonstate threats. If acceptable rules of engagement can be established, the advantages of graduated lethality might be extended to ships in port or entering/exiting harbors.

While considerable additional work needs to be done to produce a tactical system, the LaWS program's recent demonstration of capability provides strong evidence that a useful, tactical system could be produced within reasonable cost, volume, weight, and power constraints to provide the warfighter with a suite of additional tools to fight today's and tomorrow's wars.

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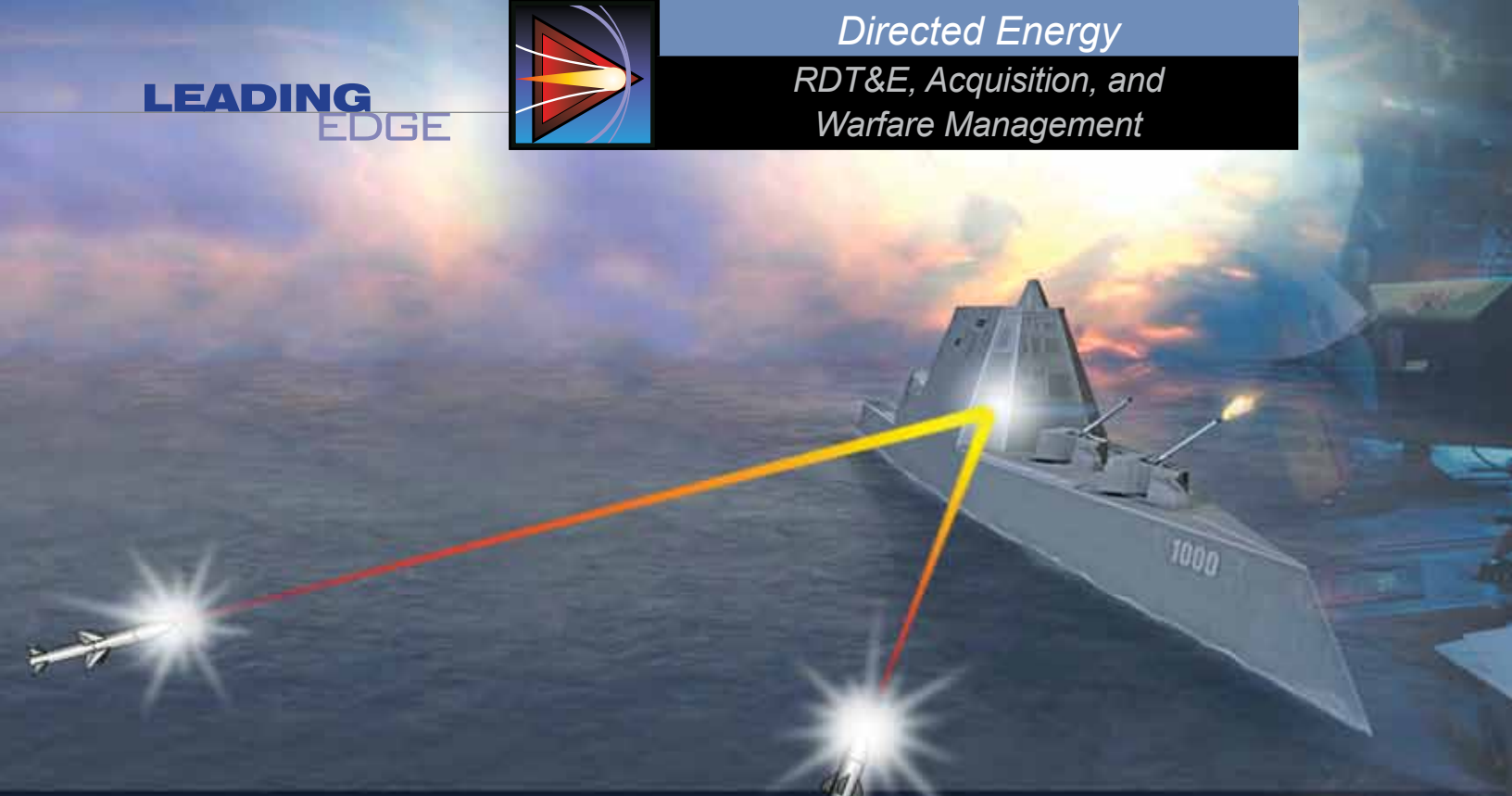

The Acquisition Challenge Associated With Directed-Energy RDT&E

By Mike Kotzian

An already tense situation quickly escalated. Everyone within the combat information center of the Navy's newest all-electric ship suddenly realized that two surface-skimming, antiship missiles were bearing down on their destroyer. With less than 30 seconds to impact, the tactical warfare officer gave the order to fire. Seconds later, the first surface-skimming missile vanished from all tracking consoles. Another order to fire closely followed, and the second missile threat was also destroyed. Consequently, within a matter of 10 seconds from threat recognition to threat elimination, the Navy's newest all-electric ship was able to destroy two incoming threats by using one of the Navy's newest weapon systems—the free-electron laser.

Does this scenario of a Navy all-electric ship, employing a high-energy laser to shoot down enemy surface-skimming antiship missiles, sound like inevitable reality or unattainable science fiction? For scientists and engineers working on directed-energy systems for the Navy, the answer does not lie solely in the advanced technical challenges associated with developing directed-energy weapons. Rather, the answer also lies in how well scientists and engineers understand and adhere to the Department of Defense's (DoD's) Defense Acquisition Management System (DAMS) framework governing the development of new weapon systems.

Evolution of Defense Acquisition

The way in which DoD identifies needs and subsequently develops, tests, procures, and sustains weapon systems has evolved over time. Today's acquisition foundation can be traced back to the Packard Commission report in 1986, where many of this report's recommendations became part of the Goldwater-Nichols DoD Reorganization Act of 1986. This evolution continued along three tracks:

1. Requirements moving from threat-based to capability-based
2. The resource allocation system adding execution reviews with concurrent program and budget reviews

3. The acquisition process attempting to incorporate a more flexible and tailored process

These three tracks form the Defense Support System organizational structure: the Joint Capabilities Integration and Development System (JCIDS) process; the Planning, Programming, Budgeting, and Execution (PPBE) process; and the DAMS process, respectively. These three processes operate as "systems of systems" and are referred to as the "Big A" acquisition process shown in Figure 1.[1]

While all three of these phases hold their own level of importance, the major focus for scientists and engineers at research and development (R&D) facilities is the "Little a" acquisition process. It is this "Little a" acquisition process, where the rules and processes are found, that governs how DoD goes about developing a new materiel solution to a validated warfighter requirement. These rules and processes are codified within DoD Instruction 5000.02, *Operation of the Defense Acquisition System*, which was issued in December 2008.

The acquisition framework associated with DoD Instruction 5000.02 is the DAMS structure. This framework, shown in Figure 2, consists of numerous strategically placed milestones and major program reviews to ensure proper programmatic oversight.[2] Each of the milestones has specific

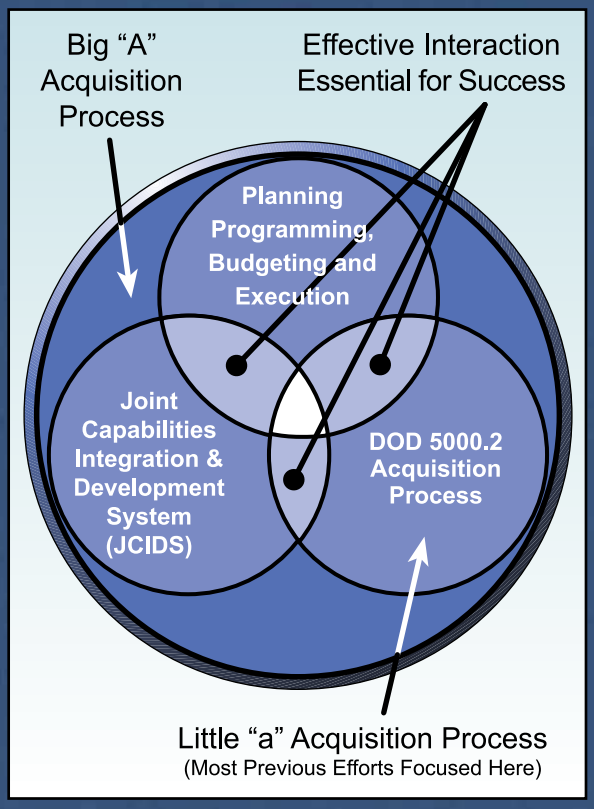

Figure 1. Defense Support System Organizational Structure

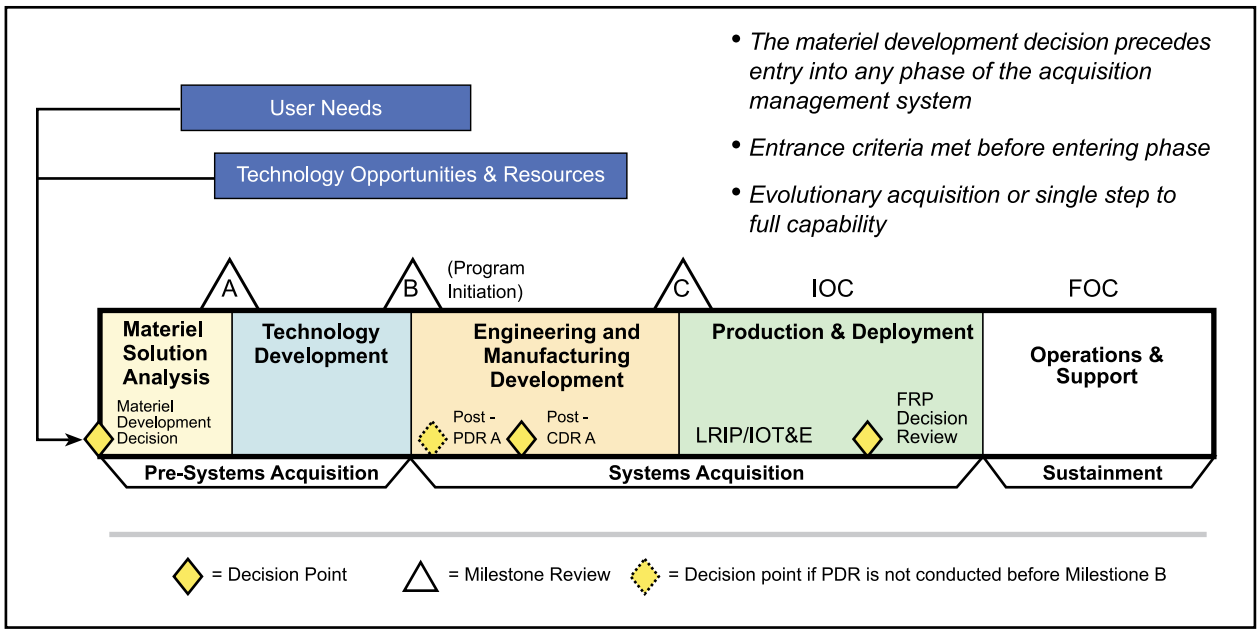

Figure 2. DoD Acquisition Framework

criteria that must be satisfied before a program is allowed to further proceed along the DAMS. The program's Milestone Decision Authority (MDA) rests with the individual responsible for deciding if the milestone criteria have been met and, if so, for allowing the program to proceed to the next phase of the acquisition process. Designation of a program's MDA depends on a program's level of research, development, test, and evaluation (RDT&E) and procurement funding. For example, an Acquisition Category (ACAT) I program is defined as an eventual total expenditure for RDT&E of more than $365 million in fiscal year (FY) 2000 constant dollars or, for procurement, of more than $2.19 billion in FY 2000 constant dollars. In this case, for an ACAT ID ("D" refers to the Defense Acquisition Board (DAB)) the Under Secretary of Defense for Acquisition, Technology and Logistics (USD(AT&L)) is the MDA; for an ACAT IC ("C" refers to Component or Service), the MDA is the Head of the DoD Component or, if delegated, the Component Acquisition Executive.[3]

In addition, civilian and military workforce members within the DoD whose job responsibilities are deemed acquisition-related find themselves with a training requirement necessary to carry out their acquisition-related job responsibilities. Specifically, these workforce members are required to gain acquisition training and education with the passage of the Defense Acquisition Workforce Improvement Act (DAWIA) signed into law in 1990. The current certification process comprises three levels covering 16 different career fields. Each of these 16 career fields has a set of specific training, education, and experience requirements that must be met in order for an individual to achieve Level 1, Level 2, or Level 3 certification. The Defense Acquisition University (DAU) provides the necessary training classes required for the certification. DAU identifies "core-plus" training classes and continuous learning modules for each level of certification. The core-plus classes and modules are not required for certification but are identified as additional sources of information to assist individuals in becoming more knowledgeable about their career field beyond the minimum standards required for certification. The most up-to-date certification frameworks for all 16 career fields can be found at the following DAU website: http://icatalog.dau.mil/onlinecatalog/CareerLvl.aspx

Defense Acquisition Reform

The DoD acquisition environment is undergoing continuous change. The issuance of DoD Instruction 5000.02 marked the opening salvo of what has become seemingly constant updates, modifications, and guidance impacting how DoD procures weapon systems to meet warfighter requirements. In addition to DoD's issuance of DoD Instruction 5000.02, the Government Accountability Office published a stream of reports and findings that indicate significant cost growth and schedule delays in major defense acquisition programs. In 2009, Secretary of Defense Robert M. Gates proclaimed

a new way of doing business within DoD when it comes to weapon systems acquisition. Pressures are building for every program to maintain cost and schedule estimates while delivering the technical requirements originally developed to support the warfighter.

Moreover, there have been two major policy issuances. As previously mentioned, the first was DoD Instruction 5000.02 in December 2008. This update of the rules and processes governing DoD weapon systems acquisition primarily impacted the early part of the DAMS framework. The problem was that weapon system programs were failing their initial operational test and evaluation phases at alarming rates—many times traced to program offices attempting to design weapon systems with immature technology. Such failures were preventing those programs from proceeding to a full-rate production decision review and, more importantly, causing a repeat of some of the DAMS framework, which translated to increased costs and delayed initial operational capability timelines.

DoD Instruction 5000.02 attempted to solve this problem with three main emphases. First, a mandatory requirement was inserted for competitive prototyping prior to program initiation at Milestone B. The intent was to ensure a competition among contractors competing for a contract award. The theory was that such a competition would reduce technical risk, validate designs, improve cost estimates, evaluate manufacturing processes, and refine requirements. Reducing technical risks was especially important because weapon system programs were expected to demonstrate a technology readiness level (TRL) of six—where the system/subsystem model or prototype is demonstrated in a relevant environment—by the time a program reached Milestone B. TRLs are categorized on a scale of 1 to 9. A TRL of 1 is the lowest level of technology readiness, where scientific research begins to be translated into applied R&D. A TRL of 9 is the highest level of technology readiness, where the actual system is proven through successful mission operations. A TRL of 6 represents a major step up in a technology's demonstrated readiness. Using TRLs enables consistent comparisons of technical maturity across different types of technologies, giving program decision makers a common benchmark to consider when assessing program risk. Note that TRLs are meant to capture a level of technical maturity, not the probability of occurrence (i.e., the likelihood of attaining a required maturity level) or the impact of not achieving a level of technical maturity.[4]

The second emphasis was on a stricter adherence to systems engineering processes and technical reviews. Too often weapon system programs were not closely following systems engineering processes or avoiding due diligence when it came to the definition of successful exit criteria for a technical review. Consequently, all technical efforts must be outlined in a program's systems engineering plan. The program manager will use the eight technical management processes—decision

analysis, technical planning, technical assessment, requirements management, risk management, configuration management, technical data management, and interface management—to manage the technical development of the system increments, including the supporting or enabling systems.[5] The program manager will use the eight technical processes—stakeholders requirements definition, requirements analysis, architectural design, implementation, integration, verification, validation, and transition—to design the system, subsystems, and components, including the supporting or enabling systems required to produce, support, operate, or dispose of a system.[6] Figure 3 provides an overlay of the new DoD Instruction 5000.02 and Secretary of the Navy (SECNAV Instruction) 5000.2D (Implementation and Operation of the Defense Acquisition System and the JCIDS), and shows the timing of specific systems engineering technical reviews as a program matures through the DAMS.

The third emphasis was a more prominent role of the MDA, starting with a mandatory requirement that all weapon system programs seeking a full or partial materiel solution must hold a Materiel Development Decision chaired by the MDA. Thus, the old Design Readiness Review was replaced with the Post-Critical Design Review Assessment chaired by the MDA. In short, the MDA was to become a more prominent figure in the oversight of a weapon system program's progress.

The second relatively recent major policy issuance was the Weapon Systems Acquisition Reform Act (WSARA) of 2009, implemented by Directive-Type Memorandum (DTM) 09-027 in December 2009. This DTM amended DoD Instruction 5000.02, the *Defense Federal Acquisition Regulation Supplement (DFARS)*, and associated business practices within the *Defense Acquisition Guidebook (DAG)*. The WSARA implementation brought about changes to policies and procedures across 13 categories. Some of the WSARA changes most relevant to the Navy directed-energy community include:

- Analysis of alternatives study guidance
- Acquisition strategies to ensure competition
- Competitive prototyping
- Developmental test and evaluation
- Systems engineering
- Preliminary design reviews
- Critical cost growth

The Acquisition Impact

So why should the directed-energy community care about these acquisition policy changes? Because these policy changes impact the community's

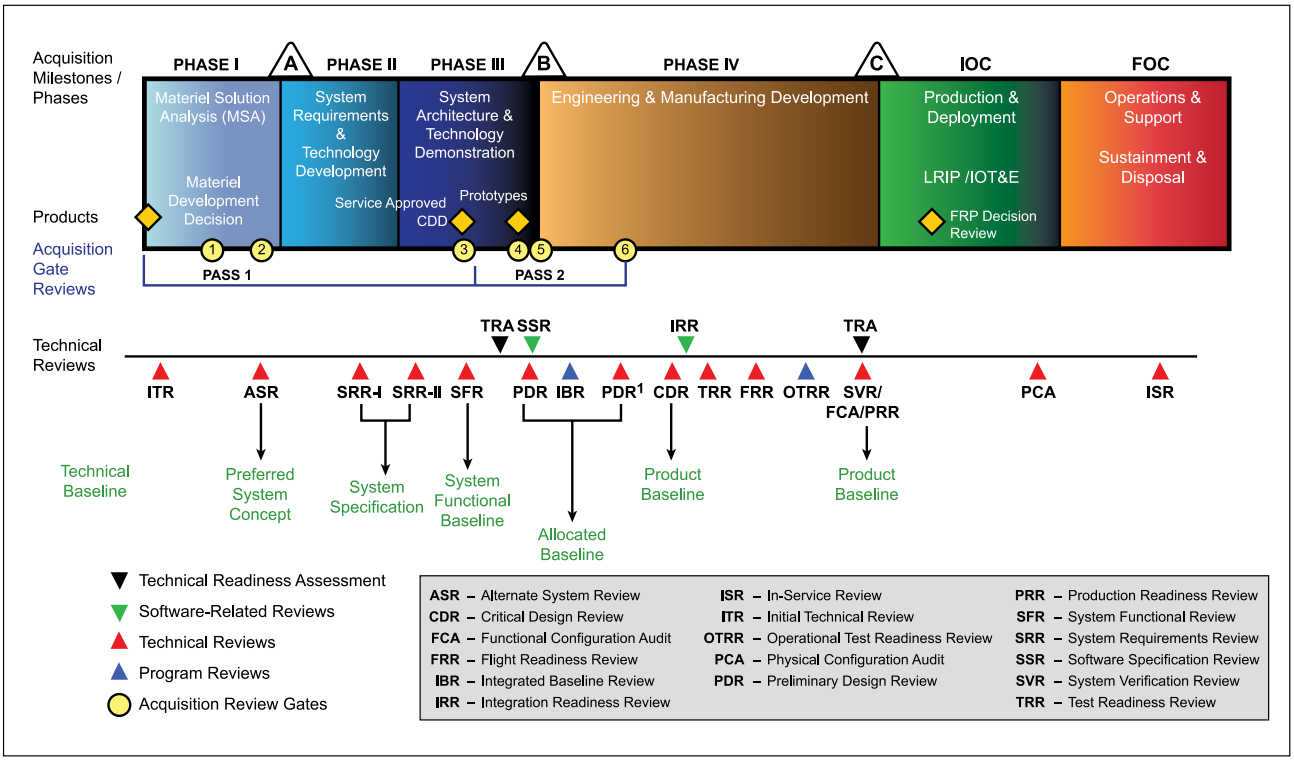

Figure 3. Systems Engineering Technical Review Timing

ability to develop, produce, and/or sustain directed-energy weapon systems. The ultimate goal of the directed-energy community is to deploy directed-energy weapons to the fleet. Accordingly, regardless of which phase or phases an organization in the community supports, its actions are impacted by the language in DoD Instruction 5000.02 and the WSARA of 2009. The more scientists and engineers in the organization are aware of governing policy documents like DoD Instruction 5000.02, the better their chances are of meeting DoD leadership's expectations in terms of cost, schedule, and technical effectiveness.

Actions have shown that DoD senior leadership has come to expect all weapon system programs to adhere to the current acquisition-related policy and guidance changes. As mentioned earlier, major weapon system programs have recently been canceled or restructured for not meeting DoD senior leadership expectations—something that rarely occurred previously. In today's environment, technology alone will not carry the argument for a program's survivability. Directed-energy weapons definitely carry the allure of a "Star Wars-like" capability, but these same weapon systems will need to show sustainable cost and schedule compliance if they are to come to fruition. Resources are too limited, and the warfighter has too many needs to allow unsustainable weapon system programs to continue. Therefore, everyone involved with the development, procurement, and/or sustainment of a directed-energy weapon system needs to have an adequate understanding of the acquisition underpinnings now governing DoD.

Summary

The proverbial "winds of change" are blowing across the DoD acquisition landscape. The management of major weapon systems dependent upon cutting-edge technologies—such as those of directed energy—cannot afford to conduct business in a manner reminiscent of bygone days. Everyone involved with the development, production, or sustainment of a directed-energy weapon system needs to understand the "rules of engagement" laid down by the most recent DoD acquisition policy guidance. Highly skilled scientists and engineers typically already understand the need for a structured systems engineering approach to problem solving. Today, though, more than ever, cost and schedule must be factored in as potential tradespace to deliver the ultimate goal: a cost-effective, directed-energy weapon system delivered in a timely manner while meeting the warfighter's requirements. Scientists and engineers who adhere to these recent acquisition changes will help their organizations achieve this goal, thereby ensuring that warfighters will be armed with the most technologically superior weapons possible.

References

1. Congressional Research Service Report 7-5700, 10 July 2009, p. 3.
2. Ibid., p. 8.
3. DoD Instruction 5000.02, 8 December 2008, p. 33.
4. *Defense Acquisition Guidebook*, 5 May 2010, paragraph 10.5.2.2.
5. Ibid., paragraph 4.2.3.1.
6. Ibid., paragraph 4.2.3.2.

The Basics of Electric Weapons and Pulsed-Power Technologies

By Stuart Moran

What Are Electric Weapons?

Most conventional weapons rely on chemical energy (explosives) as their destruction mechanism, either to explode on target, like bombs, or to create kinetic energy, like a bullet. Electric weapons are different. Electric weapons use stored electrical energy, rather than explosives, to attack or destroy the target. Electric weapons generally fall into two categories: directed-energy weapons (DEWs) and electromagnetic (EM) launchers. DEWs send energy, instead of matter, toward a target, and can be separated into three types: laser weapons, particle-beam weapons, and high-power microwave (HPM) or radio-frequency (RF) weapons. EM launchers use electrical energy to throw a mass at a target, thus making them distinct from directed energy. There are also three types of EM launchers: rail guns, coil guns, and induction drivers. All involve the use of strong magnetic fields to push against projectiles. While electric guns are an electric weapon, they are not a DEW.

High electrical powers and large energies are needed for all these weapons. Technologies for storing and controlling electric power are needed and are commonly called pulsed-power technologies. Electric guns are often associated with DEWs due to their common reliance on pulsed-power technology. The types of electric weapons are shown in Figure 1.

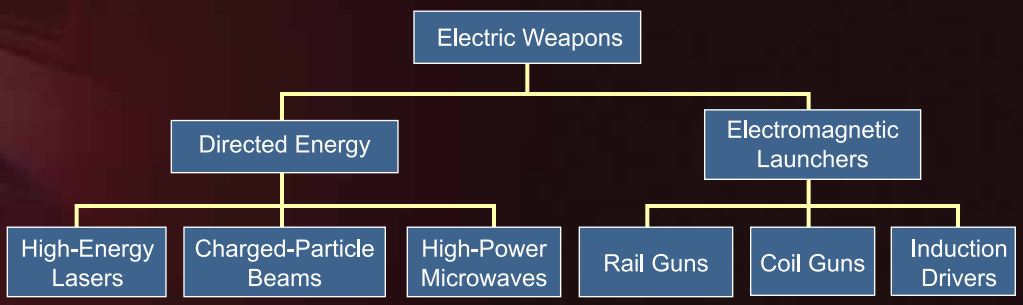

Figure 1. Types of Electric Weapons

There are a number of powerful advantages of electric weapons over conventional explosives:

- DEWs have a near-zero time of flight compared to conventional ordnance, allowing longer decision times and quicker reaction times.
- Electric weapons have a large "magazine" capacity, often limited only by the ability of the power source to recharge the system. The firing rate depends on how fast the system can be recharged, which in turn, depends on the available power source.
- The cost of engagement is greatly reduced. With increasingly sophisticated conventional weapons, the cost of practice rounds, such as a missile, can be millions. For an electric weapon, the cost per engagement is greatly reduced, making the attack of small targets (the asymmetric threat) less costly and training much more affordable.
- There is the potential for variable lethality, where the weapon effects can be controlled or attenuated to provide a warning or nonlethal effect. Otherwise, a full-power setting can be used to destroy the target.
- Electric weapons have the benefit of increased safety since less ordnance needs to be stored. Logistics costs less, and underway replenishment is easier since explosives are reduced or eliminated.
- Electric weapons can be used in conjunction with conventional weapons to heighten overall combat system effectiveness, such as knocking out electronics before engaging with a kinetic weapon.

Historically, the key Navy scenario for using directed-energy technologies has been close-in protection of naval vessels from antiship cruise missiles, particularly in a littoral environment. The ability of a DEW's speed-of-light engagement is particularly attractive under conditions of short warning times from supersonic stealthy missiles. However, increasingly difficult and problematic threats from nonmilitary aircraft and surface ships, countersurveillance platforms, fast patrol boats, unmanned aerial vehicles (UAVs), and terrorist inflatable boats or jet skis present different challenges. The threat has shifted from small numbers of expensive targets in open water to large numbers of small and cheap targets among neutral forces. The unique characteristics offered by DEWs, when compared to traditional weapon systems, allow them to be applied across a spectrum of threat roles, particularly in friendly or neutral-rich regions where precision pointing or less-than-lethal capability is paramount. The potential for HPM to counter electronics at levels below human effects makes them ideal nonlethal weapons. Electromagnetically launched projectiles allow longer range, shorter flight times, reduced reliance on air strikes and missiles, and safer storage and replenishment. With military budgets being squeezed, the low cost of directed-energy engagements, which often require just a few gallons of fuel, cannot be overemphasized. Instead of million-dollar missile shots, electric weapons allow new tactics, warning shots, and continual fire against large and small targets. They also allow inexpensive practice and training for improved readiness.

Pulsed Power for Electric Weapons

A useful rule of thumb is that a stick of TNT contains about a megajoule (MJ) of chemical energy, and this amount is often needed to destroy a military target. To destroy a target with an electric weapon, the electrical energy must also be deposited quickly. Surprisingly, a candy bar also has a megajoule of chemical energy, but it is released very slowly when we eat it. Many electric weapons require peak powers of more than a gigawatt (GW) or energies more than a megajoule. The time scales for delivery range from milliseconds to nanoseconds. As an example, delivering 1 MJ of energy in 10 μs requires 100 GW of power, which is more than a commercial power plant can produce. It is not practical to build continuous power supplies to directly drive most electric weapons. Consequently, pulsed-power technologies are needed to store energy at low power rates and release it quickly for weapon use. A pulsed-power system takes electrical power from a prime source (like a motor), stores it, and transforms the power to meet specific user requirements. The importance of a pulsed-power system is often underappreciated. For most electric weapon systems, the system size, weight, volume, and reliability are dominated by the pulsed-power chain. Pulsed-power components must be improved along with the weapon technology to make electric weapons systems practical. A block diagram of a pulsed-power system is shown in Figure 2.

Electrical energy can be stored in many ways, such as a battery (actually a chemical storage). A car battery has about a megajoule of energy, but it takes many seconds to drain it. A much faster method of storing electrical energy is in a capacitor, which can be discharged in milliseconds or faster. Inductive methods store the energy in the magnetic fields of a coil. This has the potential of achieving higher energy density than capacitors, but

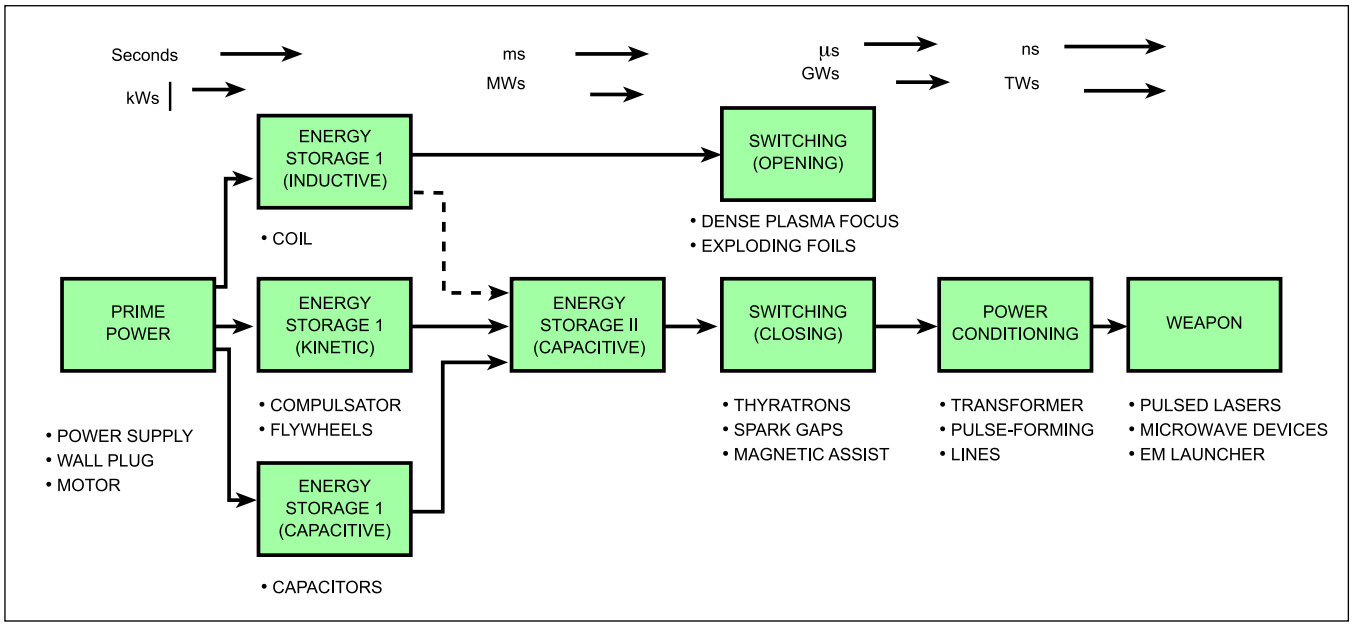

Figure 2. Block Diagram of a Pulsed-Power System

when the supporting systems are considered, the technology becomes less attractive. Energy storage for electric weapons can also be done with chemical explosive energy, where an explosive force is converted into electrical energy using techniques such as flux compression. Energy can be stored in the inertia of rotating machines and flywheels, but the energy can be released only as fast as the flywheel or motor can be stopped, usually in seconds. In many cases, several stages of energy store are used where each stage is faster than the last. Once the energy is stored, it must be released quickly using a high-power switch. There are many types of switches. Perhaps the most common type for electric-weapon applications has been the spark gap. Many types of controlled spark gaps exist, including pin-triggered, laser-triggered, field distortion, and simple overvolted. To achieve high repetition rates, flowing oil or gas can be used to flush the hot spark products, or sealed gaps using special fast-recovery gases, such as hydrogen, can be employed. Other switches, such as vacuum tubes and solid-state switches, can be used if they can handle the voltages and currents needed. Solid-state technologies, such as thyristers, have become very capable in recent years. Once the energy is switched out, there is usually some additional power conditioning, where transformers or pulse-forming networks are used to provide the desired pulse shape, voltage, and current required for the weapon. For rapid firing rates or continuous use, high average input powers are needed.

All-Electric Ship

One of the major impediments to the development of electric weapons systems for Navy ships has been a lack of electrical prime power. Current surface combatant designs employ up to 90 percent of engine power mechanically dedicated solely to propulsion. These designs are unable to provide the tens to hundreds of megawatts (MW) of electrical power capacity required for many electric weapons. The solution is an electric-drive ship that uses all the engine power to generate electricity, enabling it to allocate power to weapons or propulsion as needed. In recent years, the Navy has been investigating cost-effective power-system options to meet future platform requirements.

High-Power Microwave (HPM) and RF Weapons

Microwave weapons are generally considered to use frequencies above a gigahertz, whereas lower frequencies are generally called RF weapons. These weapons are more powerful than electronic warfare systems and are designed to create extended disruption or permanent damage. An HPM weapon is considered to have a peak power of more than 100 MW, or energies above 1 J. The energy can enter a target through intended RF paths, such as target antennas (front door), or unintended paths, such as housing joints, cavities, and circuit wires (back door). Pulses ranging from a few nanoseconds to microseconds in duration can be sufficient to reset computers, cause loss of stored data, or

cause microprocessors to switch operating modes. Nonlinear circuits and components can rectify signals and absorb energy outside of their normal operating parameters. Figure 3 illustrates some of the vulnerability areas on a missile body.

RF or HPM devices can be divided into narrowband or wideband systems, dependent upon the employed pulse length. Narrowband systems are similar to high-power radar pulses and produce RF radiation with a very narrow bandwidth (frequency coverage). The damage concept is to create enough energy in a target to overheat or overload electronic components. Wideband systems generally produce very short pulses (nanoseconds) and typically operate in lower frequency ranges. Wideband systems produce much lower average powers and rely on high-peak electric fields to produce reset or arcing of digital components. Creating short pulses—often only a few RF cycles long—generates a very broad frequency output to take advantage of a target's weak point. But, it also means that the energy is spread over many frequencies, so there may be very little energy at a specific vulnerable frequency. Vulnerability data is critical to estimate the effectiveness of HPM weapons. Ultimately, air breakdown will limit the amount of energy out of an antenna to around 1 MW/cm^2.

HPM devices can produce effects that range from denying the use of electronic-based equipment to disrupting, damaging, or destroying such equipment. HPM weapon advantages include all-weather capability, low precision pointing requirements, and effects persistence after the radiated EM energy "beam" has been turned off. One major advantage of HPM is that electronics are generally more vulnerable to high fields and high energies than humans. This provides the ability to attack electronics without harming people, which makes HPM an ideal choice for nonlethal applications.

Two major challenges of implementing HPM technologies into an operational weapon systems platform are:

1. Fratricide, or self-destruction, can be a problem because of the large areas affected by the sidelobes and near field of any meaningful HPM weapon system. Therefore, when attacking a target of interest with an HPM weapon, there is a greater risk of disruption to systems that were not intended to be targeted but fell within the sphere of influence. Host platforms, therefore, may need to undergo interference hardening.
2. With regard to battle damage assessment, kinetic weapons have the advantage of typically leaving visual evidence. HPM weapon systems do not leave large holes in a target but create more subtle influences as a result of attacking critical electronic components. Consequently, it can be more difficult to ascertain whether a target's capabilities have been sufficiently degraded or destroyed—and for how long—in determining whether a mission was successful.

For HPM system development, a fundamental challenge is the understanding of what it takes to affect the target. Coupling mechanisms, where EM energy enters and affects the target system, are extremely complex. The vulnerability of components is often vastly different if it is outside or inside a circuit board or enclosure. Effects depend upon the interactions with other components, connectors, and nearby conductors. The effects on a component can vary many orders of magnitude depending on frequency, orientation, cracks and seams, protective circuits, pulse energy, and duration. Research regarding effects on missiles has shown large variations not only between designs, but also between different serial numbers due to assembly methods, cable routing, and component variations. With the increasing use of commercial equipment by the military, such as computers and radios, effects are difficult to predict due to constant design and component changes. In general, electronics are getting smaller and operating at lower voltages, making them more sensitive to high fields. But smaller components often have lower pickup areas, and the proliferation of interfering signals has increased the amount of shielding on modern electronics. When

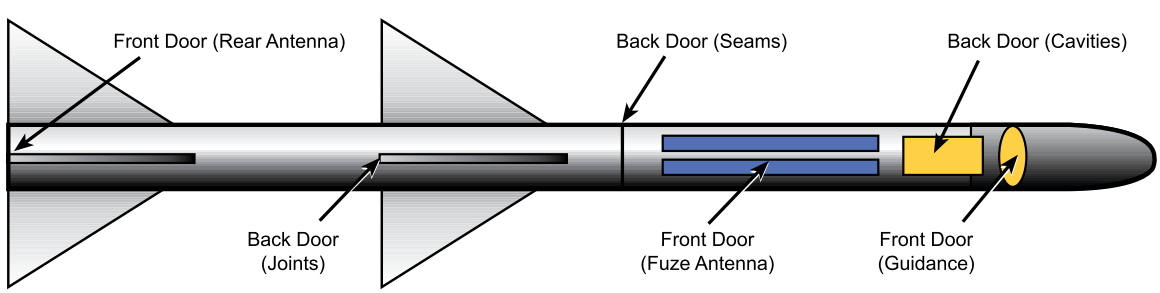

Figure 3. HPM Coupling Paths on Missile Body

target systems are located inside structures or buildings, it becomes even more difficult to predict. Efforts to predict reflections and interference inside complex structures become extremely complicated. Accordingly, generic electronics kill using universal waveforms is not likely. There continues to be a lot of hype about what RF weapons can do, but the idea that a backpack device can wipe out all electronics in a city is no more realistic than a hand-held laser cutting through a bank vault door.

High-Energy Lasers (HELs)

A laser generally produces a beam of coherent light at a specific wavelength dependent on the atomic structure of the lasing substance. Only certain substances have the atomic properties appropriate for producing laser light, and these are often limited in power. Lasers are characterized by the substance being lased (gas, liquid, or solid) and the "pumping" process (light energy, electricity, or chemical reaction). A resonant optical cavity provides the means for aligning the energy in the beam and extracting that energy. A military laser system also includes beam processing or beam-path conditioning, beam pointing and control and—for long-range applications—adaptive optics to compensate for the atmosphere.

Until recently, HELs have been driven by chemical energy, so very little electrical power or pulsed power was needed. Chemical lasers use the reactions of gases or liquids to create the excited energy states necessary for laser emission. Large chemical lasers and beam directors have been developed by the Navy in recent decades and have successfully ruptured fuel tanks and downed supersonic missiles. However, these lasers required high-velocity, chemical-reaction chambers and emitted hazardous gaseous by-products. They often operated at wavelengths where the atmosphere absorbed much of the energy. Absorption creates thermal blooming, whereby absorbed energy in the air creates a negative lens that defocuses the beam. Increasing the power of the laser increases the energy absorbed and worsens the problem. The Army and Air Force are developing chemical lasers for airborne applications, where atmospheric absorption is less of a problem. Recent Navy interest in HELs has concentrated on lasers that are electrically powered, rather than chemically powered, and that operate at shorter wavelengths to allow smaller optics and more efficient propagation near the water.

Small semiconductor (or diode) lasers use current flow through an electrical junction to excite electrons and create laser light. These lasers are very limited in power, so research has focused on using large numbers of lasers assembled into a coherent array. Semiconductor lasers also create efficient light to excite or "pump" other types of lasers. Solid-state lasers (SSLs) use crystalline materials mixed (doped) with elements needed for proper lasing. SSLs show strong promise for compact, medium-power HEL weapon systems. Scaling these systems up to megawatt levels creates extreme heat in the crystal material, making it very difficult to prevent internal damage. Forced cooling and the heat capacity of large masses are under study.

Fiber lasers—which use semiconductor diode lasers to pump a flexible, doped crystalline fiber (similar to a fiber-optic line)—have demonstrated high efficiency and relatively high power. The technology is being used in the welding and cutting industries. Methods of pumping large numbers of fiber-optic lasers and combining them are being investigated. An example is shown in Figure 4.

The free-electron laser (FEL) operates differently from a conventional laser. An FEL uses a high-voltage electron accelerator to push electrons through a magnetic "wiggler" to create light radiation across a tunable band of frequencies. The FEL is extremely complex and large, but scaling to very high powers may be possible. Perhaps the biggest promise of the FEL is the ability to design the laser at an ideal atmospheric propagation wavelength. Significant technical hurdles remain in reaching the status of a deployable FEL, in scaling the beam to megawatt powers and in providing the necessary engineering to turn a laboratory device into a weapon system of reasonable size. For Navy application, FELs will require improvements in areas of radiation shielding, high vacuum, high-current photo-injectors, and probably cryogenic cooling—all of which must be integrated into a ship's basic design.

Fiber lasers and SSLs are the leading-candidate Navy lasers for medium power, as FELs are for high power. All are electrically driven and can meet the requirement for shorter wavelength, capable of transmitting at the "maritime window" of approximately 1 μ.

HEL weapons' advantages include a highly directional and narrowly focused beam, providing:

- Minimal collateral damage
- Speed-of-light delivery
- Rapid retargeting
- Low cost of engagement

Disadvantages center on:

- Limited range due to atmospheric attenuation
- Weather limitations
- Low efficiency (often less than 10 percent)
- Need for eye protection
- Relatively large size and weight requirements

Figure 4. Drawing of Laser Weapon System (LaWS)

Long dwell times (seconds) will be needed for most targets. As with RF systems, there is a potential nonlethal or variable lethality capability since the energy can be easily defocused. A critical challenge is the understanding of a laser beam's propagation through a maritime boundary layer environment, where the sea and air interface creates turbulence and moisture gradients. Measuring the atmosphere and compensating for variations in real time may require adaptive optics or "rubber mirrors" that can be constantly adjusted to compensate for changes. Focusing a small spot at long range will require high beam quality and large optics, probably meter-size mirrors that are very highly reflective and very clean.

HELs in the future are expected to be able to focus energy to a spot size of much less than a meter at ranges of kilometers. This will necessitate very accurate target tracking systems, and precise stabilization and beam-pointing systems, both of which are difficult but should be feasible in the near term. Real-time atmospheric measuring systems will be needed for compensation techniques. Methods to protect the sensitive optical system from salt spray and corrosion will also be needed.

From a lethality perspective, three considerations need to be better understood before a HEL can be deemed a true weapon system:

1. Achievable spot size of beam on target at range
2. Amount of coupling into the target material
3. Subsequent effects of the damage inflicted

For the more severe threats, such as high-speed, antiship cruise missiles, HELs face the difficult task of engaging maneuverable, stealthy, inbound missiles. As such, a better quantitative understanding of the interactions among a laser beam's energy deposition, target material, and flight dynamics is needed.

Particle Beams

A particle-beam weapon is a directed flow of atomic or subatomic particles. These particles can be neutral or electrically charged. Neutral beams need to be used outside the atmosphere (in space), where charged particles would repel and fly apart. Charged-particle beams (CPBs) are easier to make and are used within the atmosphere, where air molecules can constrain the beam. A CPB weapon transmits matter—not just EM waves—like lasers and microwave weapons. The particles are near the speed of light and deposit their kinetic energy deeply into any target material. They have the potential to be highly destructive weapons and are very difficult to shield against.

Charged particles are produced by applying a strong electric field near a material that emits electrons. These electrons then pass through accelerating stages with high voltage gradients (often megavolts), which increase the electron's velocity. As the electrons pass each stage, the velocity increases until they approach the speed of light (become relativistic), at which point they have substantial energy to penetrate a target. The accelerating systems can be linear, but a recirculating design is more compact and can reuse stages. These systems are basically high-current versions of scientific particle accelerators.

Once the electron beam is produced, it must propagate to the target. High-velocity electrons will not go far before they collide with air molecules and lose energy. The fact that air molecules struck by the beam are heated and moved out of the way for a short period of time creates a rarified "hole" in the atmosphere through which a second pulse can travel farther. In this manner, a fast series of pulses can "hole-bore" to the target, each pulse going farther than the last. The final pulse must have enough energy to damage the target. The deceleration of electrons in the atmosphere causes

Bremsstrahlung radiation in the forward direction toward the target, creating gamma rays that, in turn, create X-rays and RF radiation.[a] These effects can cause electronic upset and "soft-kill" mechanisms even if the beam slightly misses the target.

The beam of electrons is typically a few centimeters in diameter. When a beam strikes a target, the energy is deposited deep in the material (the collision cross section is small because of the relativistic speeds) in microseconds (much faster than a laser), creating thermal shock that is very difficult to shield against. For an explosive target, there is also the possibility of causing a deflagration or low-order burn, disrupting the normal warhead mechanism.

Scientists studying CPB weapons made significant technical advancements in the 1980s, but the weapons are still far from being practical. A CPB weapon is technically very challenging and expensive to build. Studies project that the volume requirements necessary for a CPB system could be on the order of a 5-inch gun system. Advantages of a CPB weapon include rapid penetration, a deep magazine, all-weather capability, and soft-kill mechanisms for a near miss. Problems include complexity, size, limited range, and the need to demonstrate compact accelerators and propagation mechanisms.

Electromagnetic (EM) Launchers

A number of technology concepts to launch projectiles exist using electrical energy. These systems rely on large currents in conductors, creating strong magnetic fields that drive a projectile. The velocity of a normal powder gun projectile is limited by the expansion speed of the explosive powder, and present military guns are reaching that limit. With an electric gun, the fields can push projectiles much faster, providing longer ranges and increased kinetic energies. The simplest version is an EM rail gun, shown in Figure 5.

In any conducting loop, the generated magnetic field tries to expand the loop. If everything is held in position, the only movable item is the conducting projectile, which moves down the rails in an attempt to expand the loop. Since megajouoles of projectile energy are needed for EM rail guns, energy storage

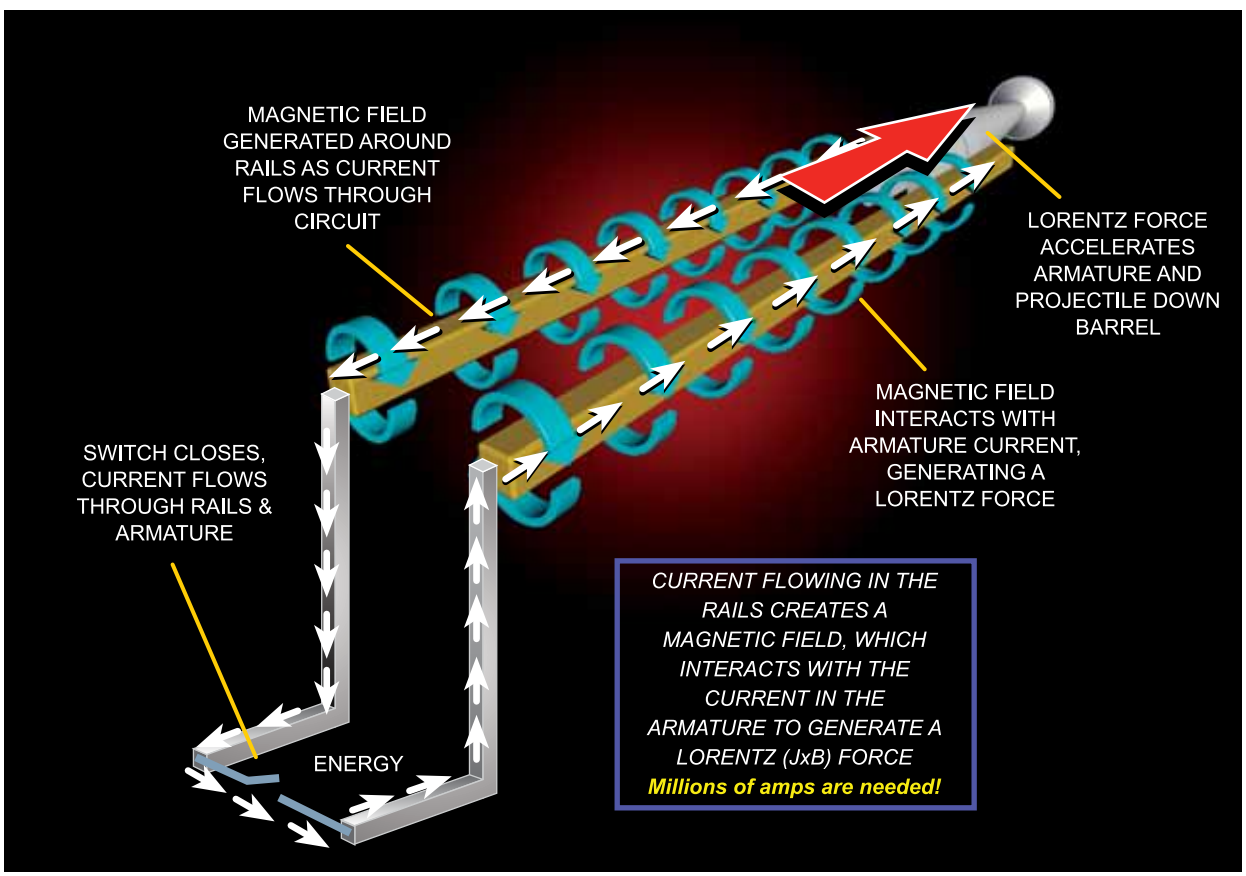

Figure 5. Electromagnetic (EM) Rail Gun Concept

mechanisms that can store about 100 MJ are needed, along with the ability to discharge the energy in milliseconds. To generate useful forces, millions of amps of current are needed—a major challenge and significant loss mechanism. Large capacitor banks with very high-current switches are required. Spark gap switches have historically been the only option, but new high-current solid-state switches are now becoming available. Capacitor energy densities, too, have improved an order of magnitude in the last few decades. Rotating machines have also been considered because they are smaller than equivalent capacitor banks, but extracting the energy quickly, without tearing the machine apart, has been problematic. The launch energy of various projectiles is shown in Figure 6.

- 20 mm --0.1 Megajoules
- 76 mm --1 Megajoule
- 5”/54 --10 Megajoules
- 8”/55 --40 Megajoules
- 16” gun --300 Megajoules
- Aircraft --50 Megajoules (30,000 kg @ 50 m/sec)

Kinetic Energy of Conventional Launch Packages

Figure 6. Launch Energy of Various Projectiles

A rail gun is probably the most compact form of electric launcher. However, it requires direct electrical contact between the projectile and barrel rails, creating the potential for arcing, melting, and erosion. Coil guns use a series of sequentially fired coils around a “barrel” to push the projectile in stages. This does not require direct electrical contact, so it avoids rail erosion but requires a series of fast timed switches and more space. Linear induction motors are basically unrolled electric motors and have been used on electric trains and roller coasters, typically with magnetic levitating systems to avoid contact erosion. This concept is being developed by the Navy for launching aircraft. The energy to launch an aircraft is similar to a large-caliber projectile—more weight but less speed. The slower speeds are more suitable for rotating machines since the launch times are seconds rather than microseconds.[1] Electrothermal guns and electrothermal-chemical (ETC) guns use a combination of electricity and chemicals. Electrical energy is used to initiate chemical reactions that can produce lightweight driving gases, like steam, or allow more energetic propellants that are difficult to ignite in a conventional fashion.

Some advantages of electrically driven projectiles include:

- Higher projectile velocity (over conventional explosives)
- Very long range (>100 miles) with lower cost than missiles
- Time-critical delivery (because of shorter time of flight)
- Safer projectile stowage (minimal explosives)
- Potentially adjustable velocity levels, for better accuracy and controllable damage

The potential of having nonexplosive rounds and magazines is very attractive for the Navy. For long-range, large-caliber EM projectiles, the kinetic energy from the projectile velocity is greater than the chemical explosive energy in a conventional round traveling much slower. Therefore, damage can be equivalent even without explosives. System size and lifetime are still behind conventional systems, but getting close.

Outlook

Challenges remain for many electric weapon concepts. These weapon systems appear promising to meet the increasingly important asymmetric threats with low-cost precision rounds. They also can be employed across the energy spectrum for nonlethal targeting. Electric weapon systems will, in many cases, continue to supplement existing kinetic weapon systems in the near term. Despite technology challenges, directed-energy and electric weapons hold great promise in offering the future warfighter unique combat capabilities not currently available.

Endnote

a. Bremsstrahlung—a type of radiation emitted when high-energy electrons are decelerated. (German for ***braking radiation***)

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Solid Modeling of Directed-Energy Systems

By Joseph F. Sharrow

Not long ago, around the mid-1980s, development of most new mechanical systems—such as automobiles, consumer products, and military devices—was performed manually on a drafting table or drawing board, much like the present-day version shown in Figure 1. These tables and boards performed a necessary function, but they offered little assistance other than for drawing lines. Engineers used them to prepare layouts, or two-dimensional sketches of what they were designing. They then would take these layouts to a draftsman, who would create drawings of each part in the device. The drawings would subsequently be sent to a manufacturing facility.

This layout and drawing preparation process typically would need to be repeated multiple times because mistakes would be made, or design issues would be discovered late in the process. Similarly, the manufacturing process would sometimes require multiple iterations as well because of the inherent limitations in designing three-dimensional (3-D) devices on two-dimensional boards. This less-than-ideal process made it difficult to design and manufacture even mundane products and frequently resulted in things that just didn't work. With the emergence of early computerization, numerical analyses of more complex systems began to be performed. These analyses were conducted to ensure that the systems worked in the real world. For example, engineers might conduct a structural analysis of the forces in a loaded dump-truck bed to make sure that the frame wouldn't bend and fail. Because of the difficulty in performing these analyses, they would often require a specially trained group of structural engineers, expensive software, and large mainframe computers, limiting their use to only the largest, most well-funded companies or organizations.

Emergence of Computer-Aided Design (CAD) and Solid Modeling

With the availability of smaller scale computers and more economical software in the mid-to-late 1980s, CAD was born, initiating a period of rapid improvement in the design process. This was driven, in part, by the introduction of software packages such as AutoCAD. Initially, these software packages only attempted to automate drawing lines by making wireframe (stick-figure) versions on the computer of what previously had been made by hand on the drafting board. This reduced the difficulty in making changes in the development process, but it still limited the engineer's pallet to a two-dimensional space. What was really needed was a 3-D method of design. Solid modeling

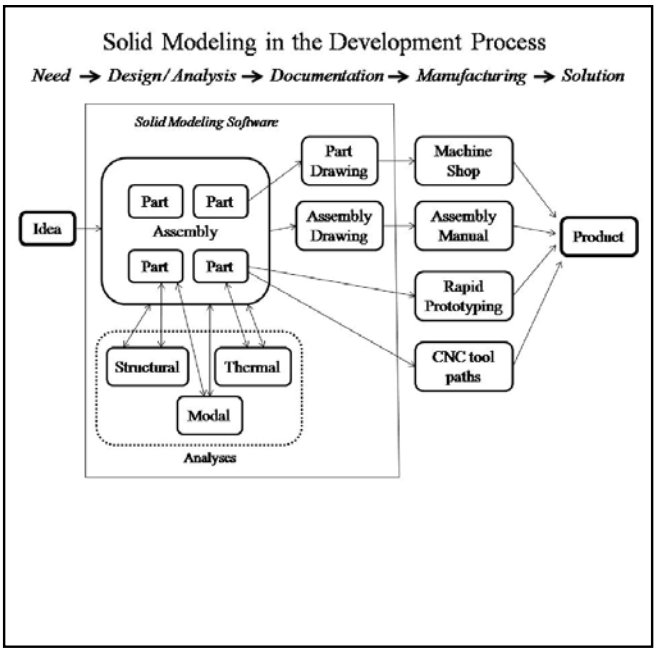

Figure 1. Drawing Board

addressed this need beginning in the late 1980s to early 1990s.

Solid modeling is analogous to taking blocks of clay and cutting and forming them into the shape of a solid part on a computer. These 3-D parts are then put together in an assembly, more accurately representing real-world devices. Though originally used only in a limited way for specialized applications in the aircraft and automobile industries, it wasn't until the 1990s that solid modeling experienced widespread availability and mainstream acceptance due to software packages such as Pro/ENGINEER. Figure 2 summarizes how Pro/ENGINEER and other similar packages fit into the development of new products. The general flow of the process moves from left to right.

Initially, nearly all 3-D solid modeling packages required significant computing and graphics display power, necessitating the use of large graphics workstations running the UNIX operating system. Rapid advances in computing and graphics power have since enabled nearly all packages to run efficiently on personal computers (PCs) and laptops, bringing solid modeling and analysis capability into the mainstream.

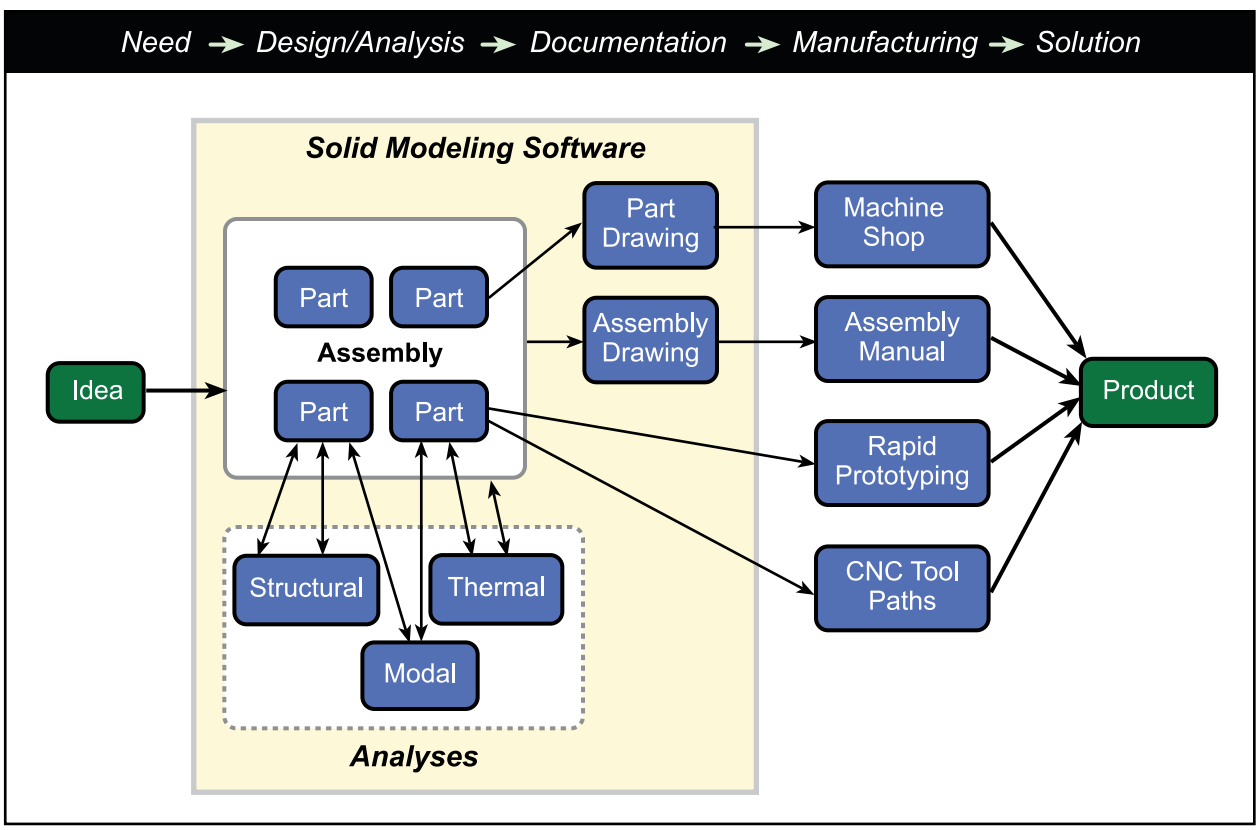

Figure 2. Solid Modeling in the Development Process

Solid Modeling of Directed-Energy Systems

Engineers working in the Directed Energy Division at the Naval Surface Warfare Center, Dahlgren Division (NSWCDD), use solid modeling to develop hardware for nearly all of its programs. Both Pro/ENGINEER and SolidWorks are used extensively to develop new products in virtual 3-D space. Additionally, the structural simulation package within Pro/ENGINEER is used to determine stresses and natural frequencies of parts and assemblies. Consequently, these packages have enabled a single mechanical engineer in the Directed Energy Division and a draftsman in the Engagement Systems Department at Dahlgren to perform the design and analysis work that would have required an entire group of engineers and draftsmen just a few years ago. Today, collaboration among many organizations using similar packages has become commonplace. Insofar as solid modeling has become an indispensable tool for development and collaboration, its successful implementation requires proper training and experience before engineers can use it effectively, just as medical surgeons require training in the use of advanced robotic surgical devices before they can be used effectively. Thus, while these high-tech modeling systems not only have reduced the number of personnel needed for design and development, they have enabled the Navy to get significantly more bang for its buck while supporting warfighting needs. An example of how solid modeling is currently being used is discussed below.

Navy Laser Weapon System (LaWS) Beam Director

The Directed Energy Warfare Office (DEWO) and Directed Energy Division at Dahlgren are currently developing the Navy LaWS for the Naval Sea Systems Command's Directed Energy and Electric Weapon Systems (DE&EWS) Program Office (PMS 405). The program's goal is to take advantage of currently available industrial laser technology and incorporate it into a future naval weapon system. As part of the development process, major subsystems have been integrated with a Kineto Tracking Mount (KTM) into a LaWS beam director. The KTM/beam director was modeled and analyzed using Pro/ENGINEER. Ultimately, the resulting LaWS will be installed on Navy ships on the Close-In Weapon System (CIWS) gun mount. During field testing in June 2009 at the Naval Air Warfare Center, China Lake, California, the prototype KTM/beam director successfully destroyed five unmanned aerial vehicles (UAVs). The actual beam director used in the China Lake testing is shown in Figure 3; the Pro/ENGINEER assembly model used for development is shown in Figure 4.

The LaWS effort took advantage of many aspects of solid modeling including collaboration, structural and modal analysis, and manufacturing drawing creation. The project required development of new, unique hardware, as well as the integration of electronic models from commercial vendors. The KTM model was provided by L-3 Brashear and was originally designed using Pro/ENGINEER. The beam-directing telescope model was provided by RC Optical Systems, Incorporated, and was originally made in SolidWorks. These models were combined with many new optical and structural components developed by the Directed Energy Division into a single, comprehensive assembly model. This model was instrumental in understanding the interaction of the many components, and its use increased accuracy and precision that would have been impossible with old-fashioned two-dimensional development processes. Figure 5 shows a cross section through the main portion of the beam director, revealing the complexity of the many parts and subassemblies required for such a device. In addition to modeling the mechanical components, the actual laser beams were also included to better understand their path through the various mirrors and optical devices in the beam director, and to better highlight any interference they might have with structural components within the KTM or telescope.

Numerous analyses were performed to make sure that everything worked the way it was intended. One major analysis addressed the telescope mount. To ensure that the beams were stable at range, the mount had to be extremely stiff. The best way to ensure this was to perform a structural analysis using the structural simulation package within Pro/ENGINEER. Figure 6 shows the results of that analysis: a displacement plot in which different colors represent how much the telescope will move when the KTM rotates at its maximum speed. The large cylindrical object simulates the mass of the telescope. The minimum amount of displacement is indicated by blue, and the maximum is shown in red. This analysis verified that the movement of the telescope, relative to the optical components within the optics breadboard, was acceptable and should perform well at the range specified by the program office.

After modeling and analysis were completed, manufacturing drawings of custom parts were created by the Engagement Systems Department to be

Figure 3. LaWS Beam Director

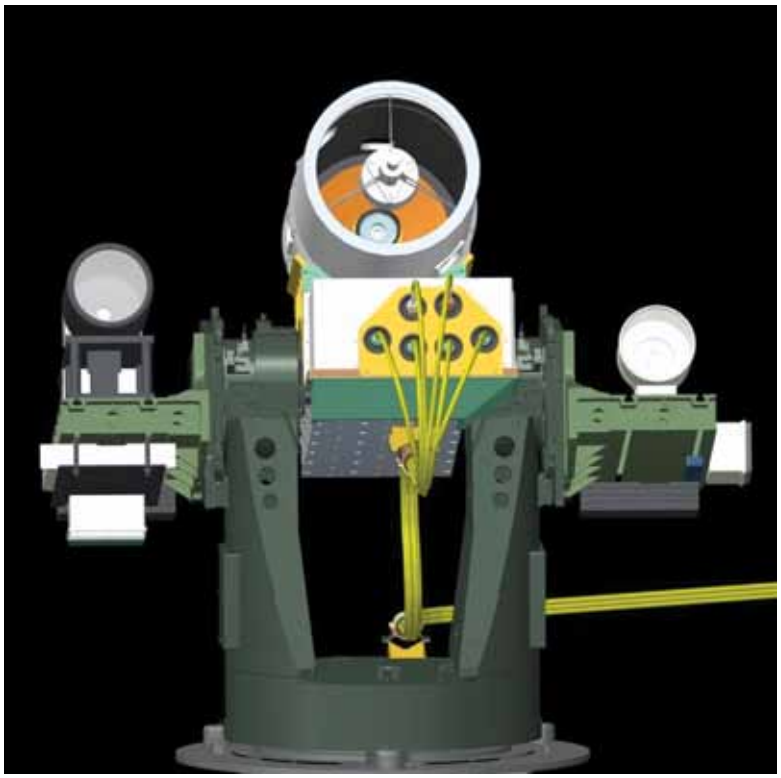

Figure 4. LaWS Beam Director Assembly Model

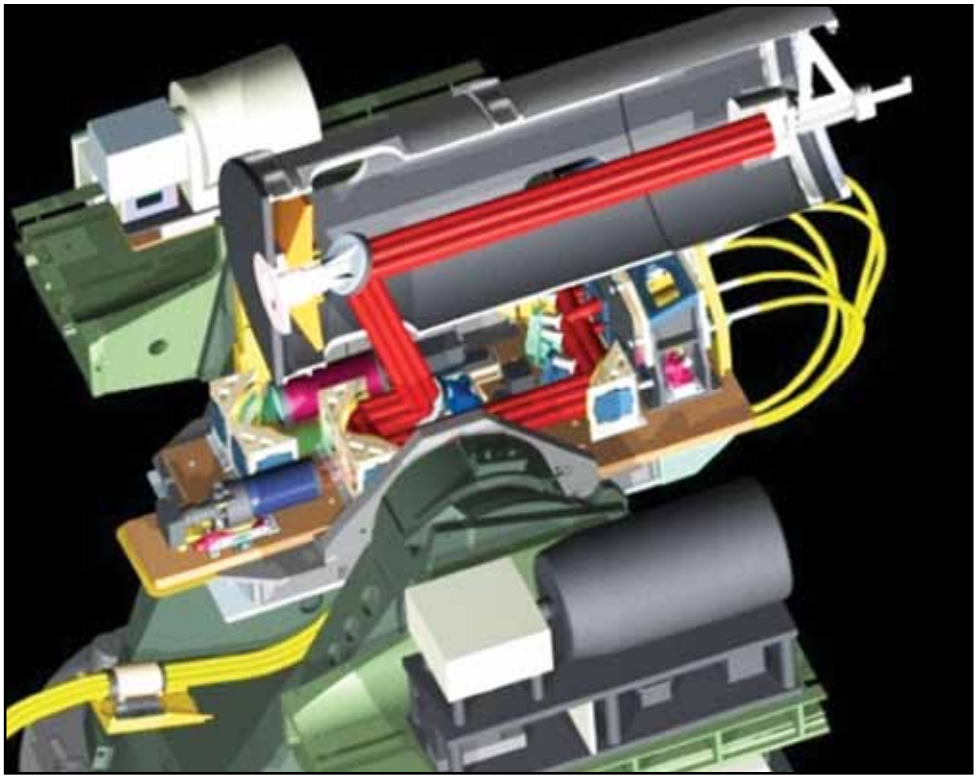

Figure 5. LaWS Beam Director Cutaway

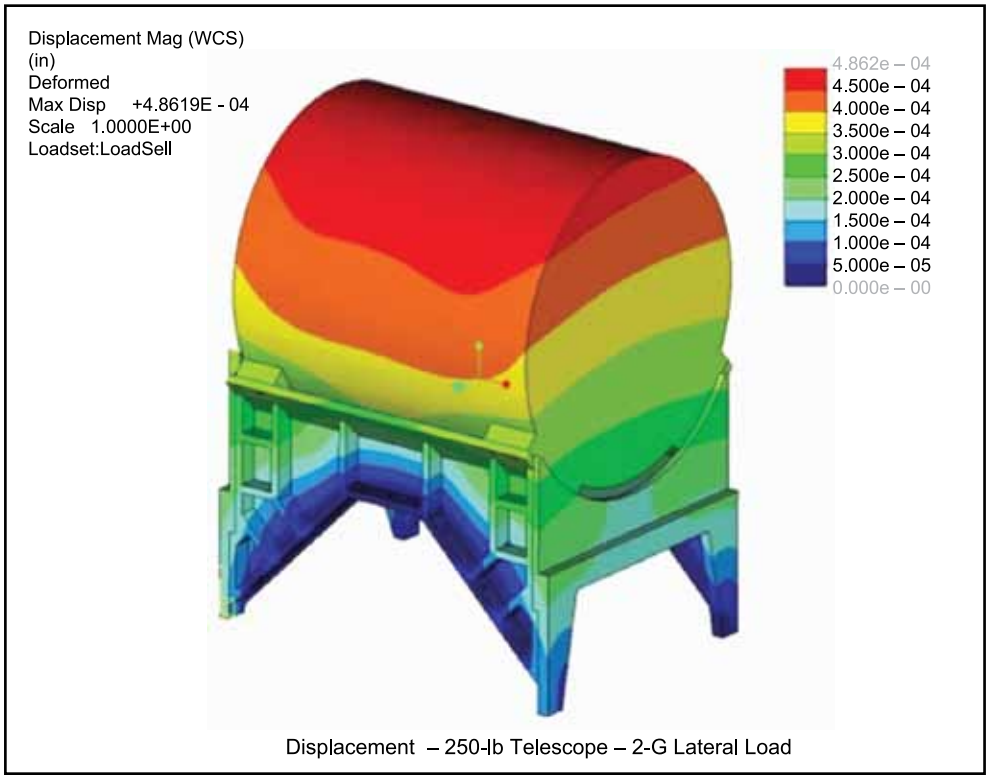

Figure 6. Displacement Plot

sent to manufacturing facilities, such as machine shops. One example is shown in Figure 7, which shows the first sheet of the multisheet drawing needed to manufacture the large plates that support the telescope from the center platform of the KTM. One of these plates is also shown in the displacement plot in Figure 6.

Even though it would be possible for one person to do all of the modeling, analyses, and drawings for a particular program, a more efficient process takes advantage of using the best skills available by collaborating with other experts. Collaboration enables assembly, part, and drawing files to be sent electronically, eliminating the need for collocating personnel. Drawings for the LaWS program, for instance, were made using noncollocated personnel across base at NSWCDD. They could just as easily have been made using personnel from across the country.

The LaWS program exemplifies how the Directed Energy Division uses solid modeling to enhance the quality and effectiveness of Navy directed-energy capabilities. As a result, warfighters will be better armed with more effective weapons and capabilities for future naval conflicts.

Acknowledgment

The author would like to acknowledge the valuable contributions of the Engagement Systems Department's drafting group in support of numerous DEWO and Directed Energy Division programs.

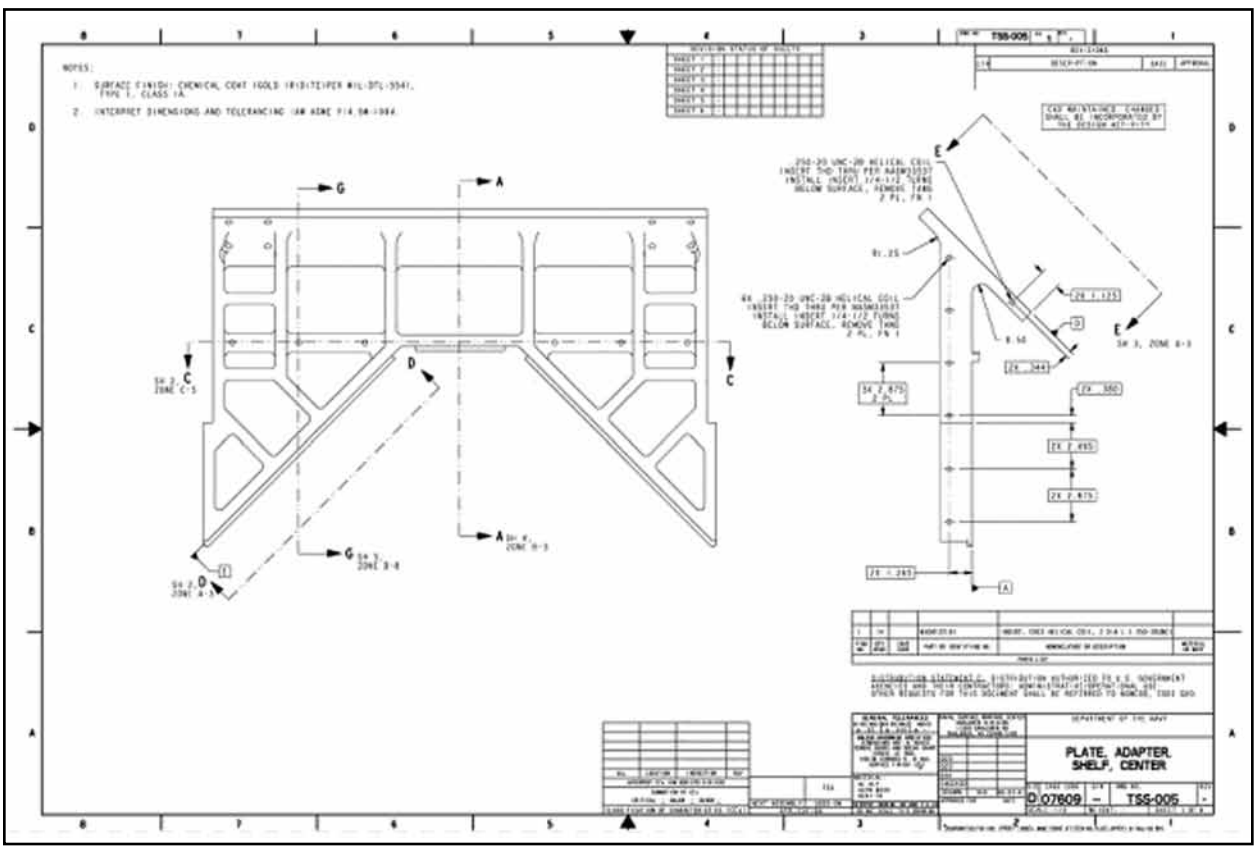

Figure 7. Manufacturing Drawing

A Fundamental Key to Next-Generation Directed-Energy Systems

By Directed Energy Division, Electromagnetic and Sensor Systems Department

Imagine an explosive ordnance disposal (EOD) unit on a routine scouting patrol deep in the notorious "Triangle of Death" south of Baghdad, where Marines, Sailors, and Soldiers frequently find themselves exposed to improvised explosive devices (IEDs). Fortunately, this newly outfitted unit is equipped with the latest unmanned, mobile, remote-controlled, radio frequency (RF) transmitter used as a directed-energy weapon (DEW). The integrated system provides comprehensive IED prediction, detection, prevention, and neutralization capabilities. Lightweight, pocket-sized transmitters carried by each warfighter constantly communicate sensor intelligence, key vital signs, critical conditions, and location telemetry to a geostationary satellite (GEOSAT). It intercepts, collects, and retransmits intelligence and situational awareness data simultaneously to any command post in the world and to each member of the unit on patrol. Highly efficient, miniature, switch-mode, RF amplifiers with high-power density (small size and weight with high-power output) enable these visions of future capabilities as their systems' transmitter backbone.

To civilians, the miniaturization of modern wireless (electromagnetic) devices is considered a mere convenience or luxury, i.e., Blackberries, mobile phones, and high-speed wireless network connections. To the next-generation warfighter, miniaturized, wireless, directed-energy (DE) systems open the door to the realization of a whole new set of effective and efficient wireless modalities. And while the capabilities mentioned in the above scenario are not yet available to warfighters, researchers believe they have uncovered the key to next-generation DE systems leading to the miniaturization of DE devices.

Next-Generation DE System Requirements

At the Naval Surface Warfare Center, Dahlgren Division (NSWCDD), key system requirements for effective next-generation DE systems are being researched and developed for applications to counter IEDs, to detect explosively formed penetrators (EFPs), to neutralize explosives, and to predict threat locations. Next-generation DE systems must yield a high probability of mission success and be inherently safe to operate. By design, they must minimize or eliminate the risk of hostile attack or collateral damage especially during screening missions. Considering the DEW example above, practical

080102-N-1132M-006 SHEIK SA'ID, Iraq (2 January 2008) U.S. Army Soldiers attached to 3rd Squadron, 2nd Cavalry Regiment patrol and search for weapons or Improvised Explosive Devices (IEDs) during a clearing mission. (U.S. Navy photo by Mass Communication Specialist 1st Class Sean Mulligan/Released)

next-generation DE systems must be physically characterized by:

- Low mass (weight)
- Small size (volume)
- High-power output with respect to size or high-power density
- High efficiency for extended mission use
- Minimized prime power and cooling support
- Portability
- Mobility
- Configurability

They must also ensure a high probability of mission effectiveness. The DEW must be easily transportable and agile, adapting to the immediate, local military mission requirements in various warfighting environments. Additionally, DE systems must be mechanically robust and able to withstand the shock and vibration of combat missions in rough and rugged environments. The key requirement—efficiency—fundamentally facilitates all required characteristics, including mass and size.

Moving Beyond Requirements

Scientists at NSWCDD, sponsored by the Office of Naval Research (ONR), are researching and developing key system requirements for effective next-generation DE systems to counter IEDs, to detect EFPs, to neutralize explosives, and to predict threat locations.

Researchers at NSWCDD are leading the way toward realizing small, lightweight, RF transmitters using high-power, solid-state, switch-mode amplifiers, theoretically 100 percent efficient. These practical switch-mode amplifier realizations are at least 1/100 the volume and weight of any commercially available linear solid-state amplifier of comparable power output. The challenges included assessing what type of active amplifier device and operation would provide the greatest power density (power output per unit volume and mass) with its necessary auxiliary systems, such as prime power generation and cooling of waste heat. Such a device also needed to provide sufficient output power based on required standoff range and IED system-coupling efficiency while also maintaining a manageably-sized, easily transportable system. Researchers initially considered tube-based systems, but large, heavy, direct-current (DC) power supplies are required, and typically 40 percent of the input power is dissipated in heat, which negates any possibility of miniaturization.

Upon a practical review of amplifier-class operations and suitable active amplifier devices, however, research pointed to contemporary switch-mode

amplifier schemes (e.g., Class-E and Class-F) using solid-state technology—such as the high-electron mobility transistor (HEMT)—as satisfying the high-power density and abusive mechanical requirements for expected worst-case transportation and operation in a rugged environment. To significantly impact reduction of size and weight, practical, high-efficiency thresholds were defined for next-generation DE systems at 90 percent and greater. The key technology enabler to realize amplifier high efficiency in high-power amplifiers up to 60 kW was found in exploiting contemporary switch-mode amplifier architecture with efficient power combining. Particularly, switch-mode schemes in Class-E and Class-F operation as solid-state, active-hybrid planar topology designs were found to be necessary and sufficient for DE applications. These analyses led to a novel, Class-E RF switch-mode amplifier design. A Class-E RF switch-mode amplifier can theoretically operate at 100-percent efficiency. For every input watt supplied, an RF output watt is produced. The conductors and dielectric substrate of the hybrid planar load network and the commercial off-the-shelf (COTS) transistor all exhibit some small degree of power loss, suggesting an estimated practically realized efficiency of 90 percent.

Moreover, the amplifier under research consisted of a novel microwave load network operating with high-power output at ultrahigh frequency (UHF). This research led to the state of the art in Class-E designs leading by hundreds of watts, several hundred megahertz in frequency, and roughly 10 percentage points in efficiency. A common, solid-state, high-power amplifier design technique sums the phase and amplitude of smaller amplifier units to the large values required for DE systems. A practical hardware limitation exists that limits the theoretically infinite number of fixed RF output power units to a finite number. Approximately 60-kW RF output power sets the boundary as the largest hardware realization. By applying spatial power combining in the propagating medium, phased-array antennas can be employed with constructive wave interference in air that would allow sufficient RF power densities on target, based on the number of elements in the array. This technique eliminates the traditional hardware necessary to power combine the smaller power-amplifier elements, realizing a much simplified DE system with enhanced power density in the transmitter, and reduced mass and volume.

The key to ultrahigh efficiency in a switch-mode amplifier, such as Class-E or Class-F, is found in zero-voltage switching (ZVS). Here, the load network is not only designed to be resonant at and around a particular desired switching frequency, it must simultaneously act to force the voltage across the switch to be zero when current flows and when it switches off; hence, theory suggests that no power is dissipated because the product of current through, and voltage across, the switch is zero. It is this aspect of the design that makes the job of switch-mode amplifier realization difficult. Of course, in practice, a small voltage exists for a very short time during the switching action, resulting in a small amount of input power being dissipated in heat. This theoretical description also assumes that all components are ideal (i.e., no impedance to current flow exists in the switch when turned on). All realistic switches exhibit finite impedance when turned on, which does dissipate some wasted energy, but again, this is very small in modern HEMT devices using the ZVS technique.

Class-E switch-mode amplifier theory development began in the United States during the 1960s, with details published in 1975, although some earlier reports were published in Russia. Lumped element electrical components (RF choke inductors and metal film capacitors) were initially used in lower frequency (3 to 30 MHz) prototypes. As engineers attempted higher frequency designs in the very high frequency (VHF) range, solid-state transistor switch parasitic intrinsic and packaging elements found inside the transistor began to be used as some of the key components necessary for ZVS. These parasitic elements included stray capacitance caused by differences of potential between parts inside the transistor and inductance caused by bond wire length that is used to connect the transistor to accessible terminals in its packaging. At microwave frequencies, these parasitic elements become sensitive, invoking unintended significant changes to load networks designed to operate with the transistors. Intrinsic elements include drain-to-source breakdown voltage capability and peak current capability. As the need for higher frequency operation and higher power increased, constraints of key transistor parameters became difficult to produce in traditional silicon technology:

- High instantaneous transient (peak) current capability through the transistor
- Moderate breakdown potential across the transistor
- Low output capacitance

Only within the past few years have transistor manufacturers produced COTS transistors that meet the required capabilities necessary to operate in switch mode for microwave frequencies and

081107-N-1120L-072 RAMADI, Iraq (7 November 2008) Joint EOD Rapid Response Vehicles (JERRVs) assigned to Naval Mobile Construction Battalion (NMCB) 7's convoy security element are secured following an escort mission from a forward operating base. The Cougar-type JERRVs are employed by coalition forces for escort and logistics missions, and to protect personnel from IEDs. NMCB 7 is deployed to U.S. Forces Central Command to provide contingency construction support to coalition forces in support of Operations Enduring Freedom and Iraqi Freedom. (U.S. Navy photo by Mass Communication Specialist 2nd Class Michael B. Lavender/Released)

high-power output. Selection is still somewhat limited for designers.

New transistor technology known as gallium nitride (GaN) HEMTs—using state-of-the-art manufacturing processes with GaN on silicon carbide materials—now facilitates Class-E high-power amplifier (100-W) designs at ultrahigh frequencies. The design process for switch-mode amplifiers is radically different than linear amplifiers, so engineers have tended to continue using linear amplifier design techniques due to familiarity, rather than advance to the switch-mode designs. Today, the Class-E and Class-F unit power output (greater than 100 W) capability and upper frequency limitation is based on a lack of available HEMTs with the necessary parameter capabilities.

Most recently, transistor manufacturers have limited their investment in the Class-E amplifier solid-state switch market due to no commercial market mandate. An assortment of presently available HEMTs provides a low-power capability in terms of 1- to 10-W output power for Class-E amplifiers in the cell phone market. The need remains to continue advancing in commercially manufactured HEMTs with key capabilities necessary to realize larger unit power output, hundreds of watts to a thousand watts, for practical implementation in DE systems.

Possible Multiple Applications

Directed-Energy Weapon Systems

Expanding on the vision of the next-generation DEW system mentioned at the beginning of this article, further imagine that EOD scouts detect a laser fluorescence signature of C4 high explosive and chlorine outgasses in the vicinity of an abandoned vehicle 2-km north of their current position. An electronic support measure (ESM) team on board an approaching clearing vehicle initiates RF jamming and electromagnetic surveillance procedures. Electronic specialists also scan the area with ground-surface differential thermography—particularly to detect possible buried IEDs and EFPs or their tiny command wires, crush wires, or pressure plates—while clearing a pathway to the abandoned roadside vehicle.

Upon arrival at a 500-m safe distance, the EOD specialists command the RF transmitter's robotic platform, also equipped with sensitive gamma-ray planar and computed tomography (CT) imaging to navigate toward and around the vehicle, interrogating every possible hiding place. It discloses an IED in the fuel tank. The specialist lifts the transmitter arming safety and commands the remote transmitter to radiate a prescribed dose of RF energy directed at a carefully chosen component of the vehicle-borne IED (VBIED) system. Without entering the vehicle, the advanced screening system detects and defuses the deadly IED buried within the rusty, metal vehicle chassis. Within minutes, the suspected VBIED threat is entirely neutralized, with absolutely no wounded warfighters or casualties.

Pictured here is the National Aeronautics and Space Administration/National Oceanic and Atmospheric Administration (NASA/NOAA) Geostationary Operational Environmental Satellite-P (GOES-P) launching from Cape Canaveral Air Force Station, Florida, aboard a Delta IV rocket procured by Boeing Launch Services on 4 March 2010. Built by Boeing Space and Intelligence Systems, GOES-P will provide NOAA and NASA scientists with data to support weather, solar, and space operations, and will enable future science improvements in weather prediction and remote sensing. Additionally, GOES-P will provide data on global climate changes and capability for search and rescue.

Mobile Ad-Hoc Wireless Network (MANET)

Beyond IED detection and neutralization, imagine an expeditionary unit on patrol, with each member equipped with an RF transceiver about the size and weight of a cigarette pack with an ultrahigh-efficient switch-mode amplifier. The miniature transceiver constantly communicates sensor intelligence, key vital signs, critical conditions, and location telemetry to a GEOSAT. This small switch-mode amplifier has the needed output power to reach an altitude of 35786 km, where the GEOSAT intercepts, collects, and retransmits this intelligence and situational awareness data to any command post in the world and to each member of the unit on patrol simultaneously. The expeditionary unit, spread out over a wide area with large interspacing, shares the situational awareness and intelligence data of each other at the speed of light. Thus, near real-time, worldwide communications with ubiquitous secure access from the battlefield is possible in a multiple-input, multiple-output (MIMO) architecture. The same system could provide a soldier-to-soldier MANET.

Next-generation switch-mode RF amplifier designs could also optimize payload weight and volume on board new communication satellites while supplying higher power density and making efficient use of the solar power supply budget. Improved switch-mode amplifier power output, when combined with enhanced antenna design, would minimize Earth-station antenna size requirements. The recently launched satellite shown at left demonstrates an example of the latest antenna technology.

Looking Forward

Miniaturizing next-generation DE systems opens up a whole new world of applications to support warfighters in ways unimaginable just a few years ago. Reduction of transmitter mass and volume, accompanied with high efficiency, creates a welcome trickle-down effect. Low profile, small, lightweight DE systems means:

- Less vulnerability to attack
- Greater mobility and maneuverability
- Simplified logistics with less fuel-supply demands
- Less impact on the environment

Clandestine operations, too, could be executed with greater ease and simplified logistics support. In the case of MIMO MANETs, miniaturized high-power density transmitters could further expand capabilities for the warfighter, enabling them to carry high-power transmitters to communicate with satellites or other supporting platforms. The

satellite industry itself could benefit from miniaturized switch-mode amplifiers with much higher power density microwave transmitters, resulting in reduced payload mass and volume; this also reduces Earth-station antenna gain and size requirements.

Conclusion

NSWCDD is meeting the demanding requirements of next-generation DE systems with Class-E RF transmitter switch-mode amplifiers designed to operate at ultrahigh efficiency, greater than 90 percent. Having discovered the key to next-generation DE systems, researchers at NSWCDD are focusing on the urgent need to counter IED systems with small, lightweight, highly efficient transmitters that use switch-mode amplifiers. Considering the multiplicity of additional applications, all advancements made in amplifier counter-IED applications can be transferred to other applications in the future. Accordingly, while the capabilities suggested in this article might seem somewhat far-fetched, in reality, they are realizable in the near term. It is projected that NSWCDD will soon have its first 250-W UHF amplifier unit prototype ready. These units will fit in the palm of an average-sized adult's hand and can be power combined to the level necessary for platform and mission requirements. A fully realized, fieldable DEW system prototype is possible in just a few years.

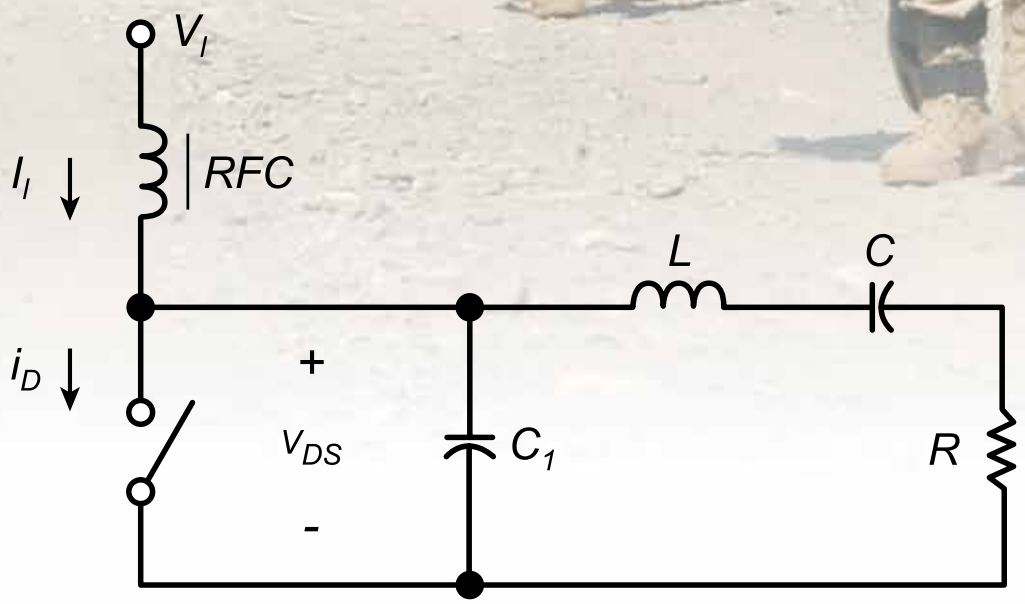

Active Denial Array

By Randy Woods and Matthew Ketner

Active Denial Technology (ADT)—which encompasses the use of millimeter waves as a directed-energy, nonlethal, counterpersonnel weapon—has the potential to provide an important new escalation-of-force capability to U.S. operating forces. ADT projects a focused beam of 95-GHz millimeter waves to induce an intolerable heating sensation on an adversary's skin, repelling the individual with minimal risk of injury. More than a decade of research has established the biological and behavioral effects of ADT for large spot size systems, such as Active Denial System 1 (Figure 1). While the effects of this large spot size system have been successfully established, the technology that produces those effects has the potential to progress in a number of ways, particularly with the development of smaller, lighter, and lower-cost systems.

One research effort focuses on the development of smaller, lighter, and lower cost ADT demonstrators that produce commensurate "ADS-effects," with effective spot size and power densities on target. In support of this effort, the Joint Non-Lethal Weapons Program (JNLWP) sponsored the Naval Surface Warfare Center, Dahlgren Division (NSWCDD) to develop a "smart target system," which measures the millimeter-wave beam using fast-response, 95-GHz diode detectors. NSWCDD subsequently developed and tested the W-Band Beam Diagnostic Array to characterize the system's beam with a temporal resolution of 30 Hz and a high spatial resolution of 1 inch.

The current method of measuring the 95-GHz beam is to use carbon-loaded Teflon (CLT) to produce an average power beam image. This method works as the CLT is exposed to the system's beam. The material heats, over a period of seconds, proportional to the magnitude of the radio frequency (RF) field, resulting in an image as shown in Figure 2. After the exposure, the specific heat capacity of the CLT can be used with the temperature increase in the CLT to provide an indication of the total energy deposited in the material. This method produces a good representation of the average RF field; however, any peak variations in the beam are averaged out.

To allow for high temporal-resolution measurements of the 95-GHz beam, a high-density, 95-GHz diode-detector array was commissioned by the Joint Non-Lethal Weapons Directorate (JNLWD), and was designed and built by NSWCDD, with support from Millitech, Inc. The array consists of a center 11 × 11 matrix (shown in Figure 3) with four removable arms that can be attached (shown in Figure 4), resulting in a measurement area of approximately 1 × 1 m.

Figure 1. Active Denial System 1

Each element's profile consists of the individual horn antenna from the array, an attenuator, a detector, and a SubMiniature version A (SMA) connection to the digitizer circuitry. This configuration allows for the power received from the antenna to be attenuated and converted to a direct current (DC) output capable of being measured by an analog-to-digital converter. The machined antenna elements provide a uniform effective area for each element, allowing field strength (W/cm^2) to be converted into power received (W or dBm). The aperture antennas also provide an impedance match between free space and the waveguide system. A cross-sectional view of the array element is shown in Figure 5, followed by a signal flow diagram shown in Figure 6.

The basic principle of operation behind the array is that the derivative of the diode detector's power vs. output voltage curve is very repeatable between detector elements. Therefore, when the detector elements arrived at NSWCDD, each detector element was paired with a variable

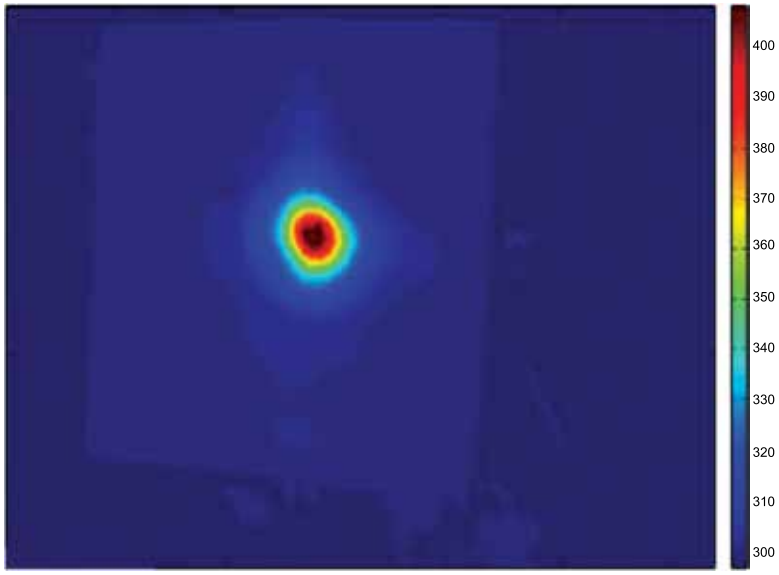

Figure 2. CLT Representation of Small, 95-GHz Spot

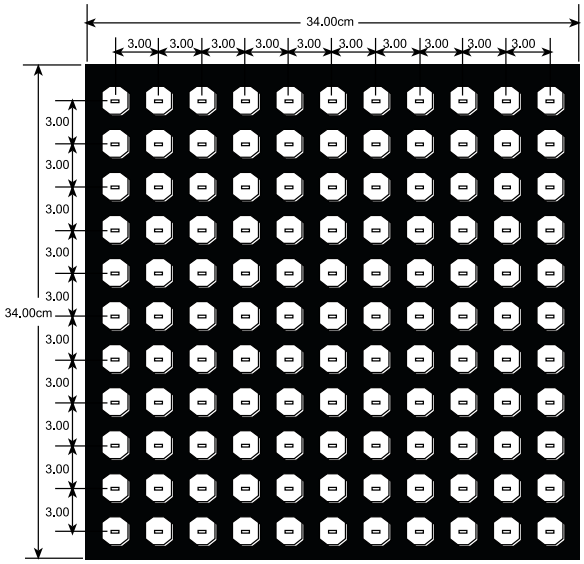

Figure 3. Main Array Face

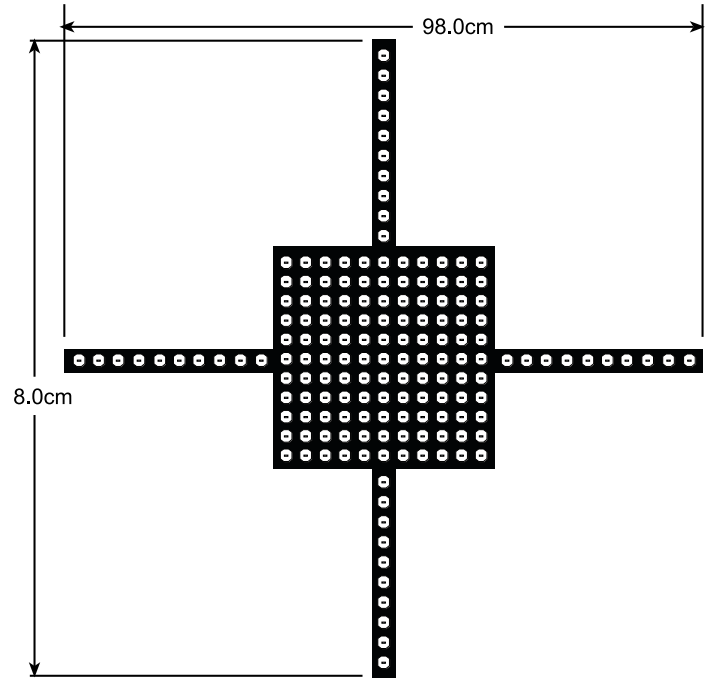

Figure 4. Full W-Band Array

attenuator and calibrated as a single unit. The calibration was accomplished by inserting a known input power of +5 dBm into the input of the attenuator and setting the DC output voltage at a predetermined millivolt (mV) output. This allowed the detector's individual offset voltages to be removed and caused the detectors to behave in a repeatable manner. The attenuator is able to be adjusted by varying the depth that the aluminum nickel card is inserted into the section of waveguide.

The final section of the electrical system converts the DC voltage output from the detectors to a digital signal to send back to the operator station. For this, it was determined that a 16-bit digitizer would be required to enable measuring the microvolts output by the detectors on the low end of their range, while still allowing the digitizer to measure the full output voltage of 1.8 V for high-input powers. Also, due to the proximity of the operator to the array and overall system flexibility, it was determined that Ethernet communications would provide a sufficient means of reading the system data.

To display the data to the operator, a two-dimensional array is populated and displayed for the user (shown in Figure 7). This allows values to be

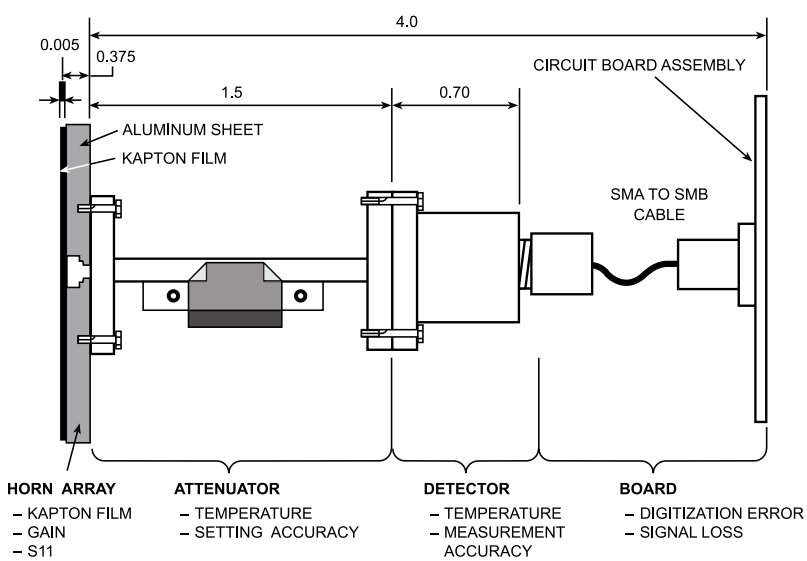

Figure 5. Cross-Sectional View of Array Element

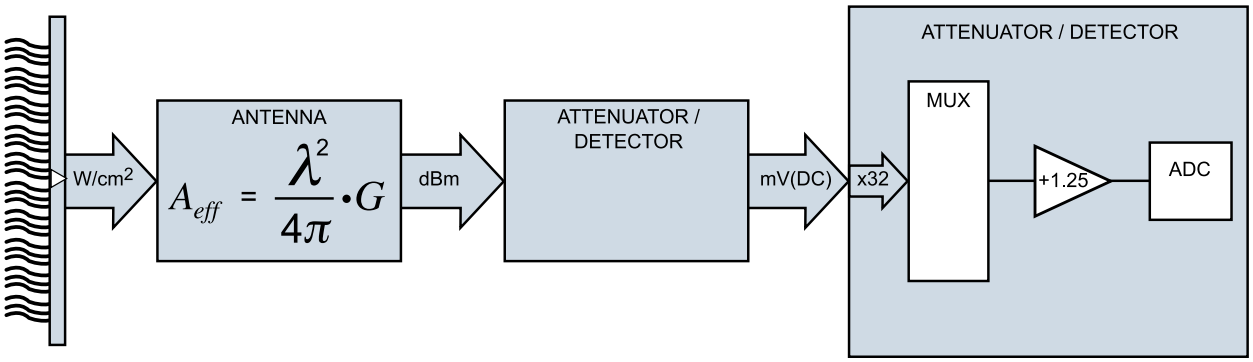

Figure 6. Signal Flow Diagram

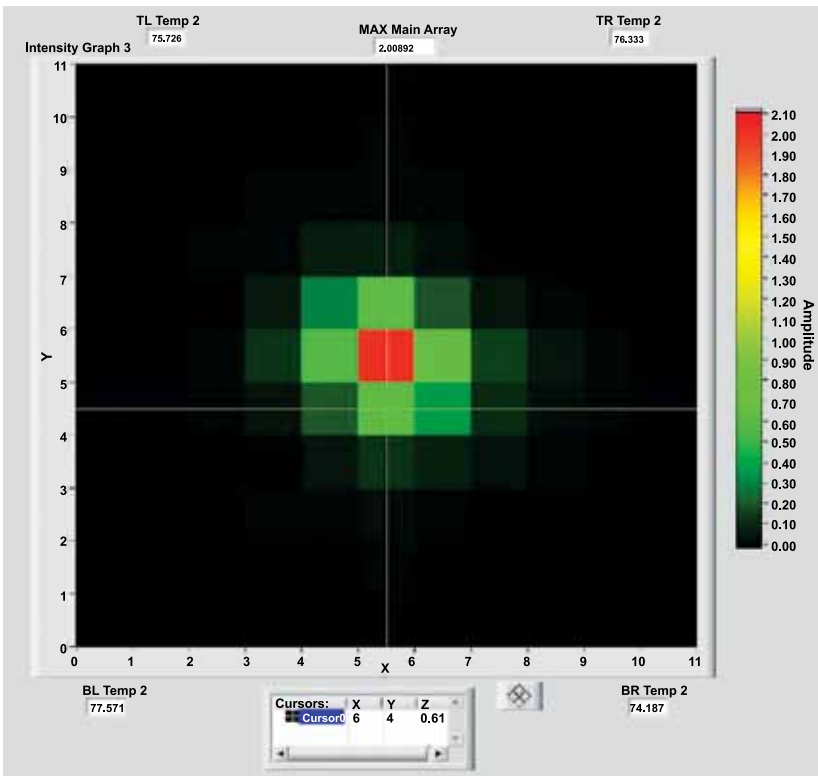

Figure 7. Array's Operator Interface Showing a Small Spot Source

read directly from the display corresponding to the watts per centimeter squared (W/cm^2) present at the array face. Data also is recorded so that it can be viewed later in a player application, such as a video file, or it can be viewed in a spreadsheet application, frame by frame. The data shown in Figure 7 is representative of small-source testing performed recently and very clearly shows the beam profile.

Conclusion

NSWCDD engineers successfully met the W-band array's design goals of providing a high temporal-resolution image of 95-GHz beams. The system has been tested against two active denial systems, providing good agreement with the currently accepted methods, as well as valuable information regarding the system's beam characteristics. These accomplishments will allow future system development to take advantage of this better understanding to possibly reduce system size and increase the effective range. A better understanding of the 95-GHz beam helps to facilitate future ADT development for this much-needed, nonlethal escalation-of-force capability for U.S. warfighters, homeland defenders, and law enforcement personnel.

Directed Energy in the Military Environment

By LT Leedjia Svec, Jeremy Beer, and Dave Freeman

The military operates in the land, air, and maritime environments. In each of these environments, lasers and laser devices are increasingly being seen and used in a variety of ways. Accordingly, the military must protect itself and civilians from the potentially dangerous effects of lasers and other directed-energy devices.

Lasers are being used on the ground to determine the intentions of people who approach checkpoints and to dissuade aircraft from entering restricted airspace. Laser weapons are also being developed for use in the maritime environment. With the use of lasers comes the requirement for eye protection. The eye is particularly sensitive to lasers and its anatomy includes optical components that amplify the power of incoming light. Consequently, the potential for injury or blinding is great.

Naval Medical Research Unit – San Antonio (NAMRU-SA) is poised to lead the way in researching and testing laser glare devices and laser eye protection. The mission of the NAMRU-SA is to conduct medical, dental, and directed-energy biomedical research, which focuses on ways to enhance the health, safety, performance, and operational readiness of Navy and Marine Corps personnel, and addresses their emergent medical and dental problems in routine and combat operations. NAMRU-SA was officially commissioned on 6 May 2009 and is a subordinate command under the Naval Medical Research Center (NMRC) in Silver Spring, Maryland, reporting to Navy Medicine Support Command (NMSC) in Jacksonville, Florida. NAMRU-SA consolidates the Naval Health Research Center Detachment Directed Energy Bioeffects Laboratory, the Naval Institute for Dental and Biomedical Research in Great Lakes, and the NMRC Combat Casualty Care research function. As part of the Base Realignment and Closure (BRAC) 2005, NAMRU-SA has moved to Fort Sam Houston. Two new buildings that have been constructed are the Battlefield Health and Trauma Research Institute and the Tri Service Research Laboratory. A conceptual drawing of the NAMRU-SA Tri-Service Research Laboratory (to house directed-energy research) is shown in Figure 1.

Many factors must be considered when lasers operate in military environments. On the ground, lasers offer a greater likelihood of close contact exposure. In aviation and maritime environments, the mobility of lasers is limited to permanent fixtures on aircraft or ships, so target acquisition can be much more complicated. Often ignored, but just as important and common to all environments, are the psychological factors that need to be explored. These factors include clarifying intentions, communications, and effectiveness. In certain situations,

Figure 1. Naval Medical Research Unit – San Antonio Tri-Service Research Laboratory at Fort Sam Houston, San Antonio, Texas (artist's concept)

sometimes lasers are coupled with other modalities, such as auditory instructions.

On the ground, laser exposure has been shown to interfere with driving vehicles, making color judgments, and target shooting. In aviation, lasers can interfere with pilot vision, causing afterimages, glare, or temporary ocular injury, with attendant effects on navigation and control. In the maritime environment, lights frequently are used to signal a variety of messages, from direction (left, right, etc.) to more complicated messages such as "man overboard." More prolific use of lasers underscores the need for laser eye protection, a dynamic area of research, which must respond to changing threat wavelengths and changing environments. Figure 2 shows NAMRU-SA personnel executing an operational field test at Kennedy Space Center, July 2009.

Recent studies undertaken by NAMRU-SA have investigated the use of laser dazzlers on sailors in small boats.[a] In these studies, participants were exposed to the laser glare at different angles and distances, in both day and night conditions. Study protocols were approved in accordance with the Institutional Review Board in compliance with all applicable federal regulations governing the protection of human subjects. Participants were given a survey assessing their subjective response to the laser, as well as a more objective visual eye chart. The

Figure 2. NAMRU-SA personnel execute operational field test at Kennedy Space Center, July 2009, in which a nonlethal laser prototype is evaluated for power delivery (stability and beam propagation) at range and human visual effectiveness aboard a maritime target.

results suggested that participants were most affected by the laser at night when they were looking straight at it (as opposed to many degrees away) and at the closest exposure distances. The most surprising finding, however, was that some participants reported being drawn to the laser rather than away from it, especially at farther distances. Participants remarked that they couldn't tell what the signal was, so they would want to go closer to find out. This illustrates that the assumption (by some)—that distant laser lights will deter and repel innocent mariners—might not always be true. Further research is needed to verify this finding, however, before employing laser glare devices in the maritime environment. Figure 3 shows NAMRU-SA personnel executing operational field tests, which were conducted at Cheatham Annex, Virginia, and Panama City, Florida, in 2008–2009.

Figure 3. A compact hand-held laser is evaluated for effectiveness in maritime defense against small-boat attacks.

These studies also brought the factor of communication to light. Participants remarked that "green is not a threatening color," and some thought "it could be a signal for help." Many felt curious about the "blinking light" used in the study and would go closer or try to contact the vessel to determine the intent of the message. Green lasers are used because they are more visually salient; however, they may not be as psychologically salient. Participants remarked that if the signal were paired with another signal, such as an auditory one, then the message of "warning" or "do not come closer" might be clearer.

Lastly, these studies brought to light the matter of effectiveness. Laser glare devices are used to stop or alter the behavior of the recipient, but one study yielded mixed results. At close distances, participants noticed the signal, felt affected by it, and reported that their behavior changed in the manner desired by the person pointing the laser. But at greater distances, behavior might not change. Thus, these findings need to be replicated in different maritime scenarios in order to be truly useful in developing laser glare devices. This particular study was encouraging regarding the effectiveness and visual usefulness of glare devices, but it brought up new questions about their psychological impact on behavior. Resolving these questions must be an integral goal of technical research and development studies to determine the operational effectiveness of directed-energy devices, not just for the maritime environment, but for all military environments.

Endnote

a. Results and technical reports are available upon request from the corresponding author or from the NAMRU-SA Public Affairs Officer.

Directed Energy Using High-Power Microwave Technology

By Jacob Walker and Matthew McQuage

The Directed Energy Warfare Office (DEWO) and Directed Energy Division at the Naval Surface Warfare Center, Dahlgren Division (NSWCDD) merge past research and data with continuous innovation in the field of high-power microwave(s) (HPM) to address the critical need for nonlethal, nonkinetic weapons. HPM weapons can be described as nonkinetic devices that radiate electromagnetic energy in the radio frequency (RF) or microwave spectrum. They are designed to disrupt, deny, degrade, damage, or destroy targets. In essence, this is achieved when high-power electromagnetic waves propagate through air and interdict targets by traveling through the exterior layers of structures and coupling energy to critical electronic components. Since effectiveness against a wide range of targets is the goal, HPM has become a collective term for various technologies: wave shapes, source frequencies, and the distribution of varying signal bandwidths. It is the objective of HPM research and assessment, therefore, to address targets for which no engagement option currently exists. NSWCDD is working to identify optimal HPM mission platforms and move relevant technologies into the field.

HPM Initiatives

NSWCDD has actively pursued HPM research since the advent of the field in the 1970s. Since then, scientists and engineers have conducted HPM research and development in many areas, including hydrogen spark-gap switching, spiral generators, and related technologies. More currently, the Directed Energy Division developed a variety of high-power wideband RF systems based on pulsed power and Marx generators (Figure 1). In addition to the extensive work accomplished in HPM and RF source development, NSWCDD contributed substantially to the area of counter-HPM vulnerability assessments. Researchers developed site assessment guides and threat brochures, as well as a number of wideband RF sources, to determine the susceptibility of electronic equipment to high-power RF interference. This latter effort involved assessing and exploiting the weaknesses of specified electronic targets to various HPM and RF threats. Data gleaned from these efforts was then used to support optimized prototypes and system designs employing effects-based design methodology. NSWCDD utilized these wideband RF sources to determine the susceptibility of a multitude of military

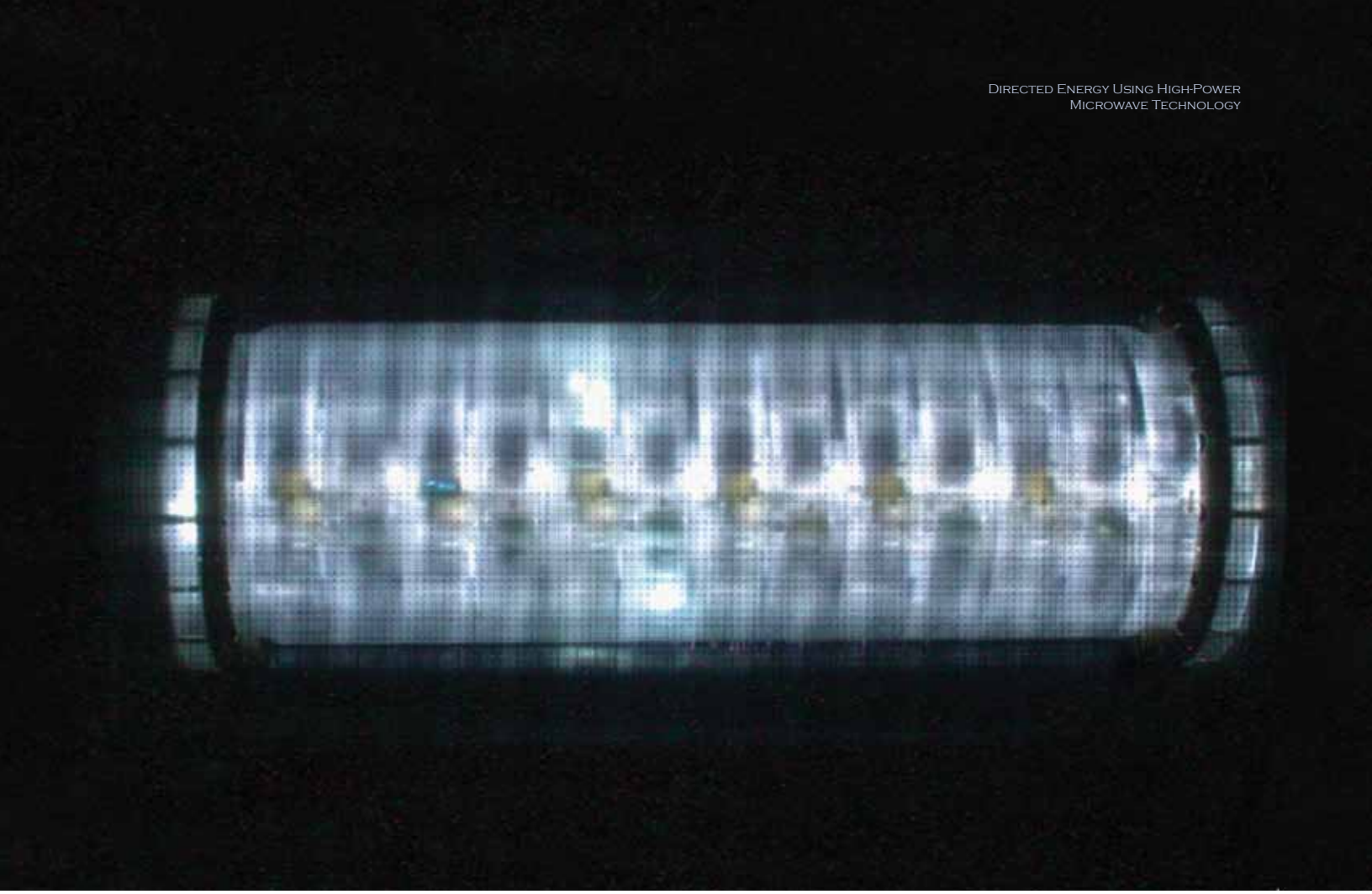

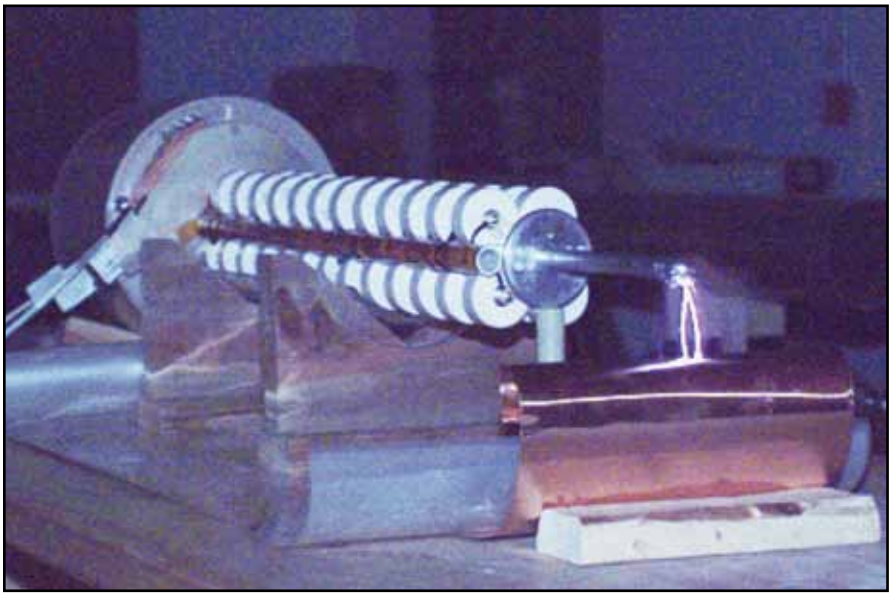

Figure 1. Examples of NSWCDD Marx Generators

and electronic infrastructure equipment to high-power RF interference.

HPM Counterattack Operational Overview

Research in support of HPM-driven electronic attack increased significantly as the demand for nontraditional warfare emerged. Traditional kinetic weapons often are of limited value in peace-keeping missions, for example, as today's enemies frequently are embedded within civilian populations and structures. This creates the need for novel HPM technologies that minimize the risk of collateral damage while effectively neutralizing threats. Dahlgren researchers conduct HPM system research and development—as well as lethality and weapon effectiveness assessments—to address this need while developing technologies against a wide variety of electronic targets. These projects leverage NSWCDD's assets, including the Maginot' Open Air Test Site (MOATS), state-of-the-art RF diagnostics, and modeling and simulation tools to identify applications and platforms in which HPM technologies can be employed. Figure 2 shows a computer model of the MOATS facility and a modeling and

(a)

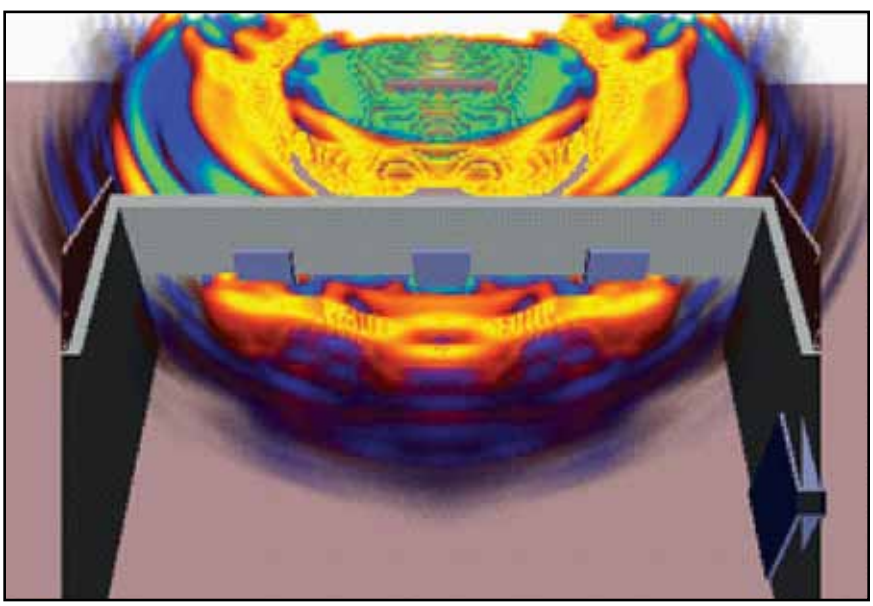

(b)

Figure 2. Modeling and Simulation Depicting (a) NSWCDD Test Facility and (b) Simulation of Radiated RF

simulation graphic depicting the RF emitted by an HPM dipole antenna.

Potential platforms for HPM integration include: man-portable, aerial, vehicle, and vessel-mounted systems. These platforms all provide unique methods for delivery of HPM sources. For example, aerial delivery—which, in many ways, is the most challenging due to size and weight constraints—can increase the effective range of these systems and can engage multiple targets at close range without endangering personnel. Likewise, vehicles and vessel-mounted HPM systems provide a way for law enforcement and the military to stop vehicles in chase scenarios almost as soon as they begin. The goal of all of these projects is to provide military forces with the ability to employ nonkinetic, electronic strike technologies against an adversary's electronics.

The DEWO and Directed Energy Division are uniquely positioned to provide numerous capabilities for in-house development while engaging with the private sector to test and provide feedback on HPM systems developed externally. In the past decade, NSWCDD has evaluated several HPM systems at Dahlgren to determine their effectiveness against various electronic targets while maintaining the Office of the Secretary of Defense's Tri-Service RF Directed Energy Weapon (DEW) Database. This database contains all effects data collected from directed-energy tests performed within the U.S. Air Force, Army, and Navy.

Conclusion

NSWCDD continues to pioneer HPM source development and lethality and integration studies, leading to the demonstration and delivery of prototype capabilities. It also is committed to researching and developing critical subsystems for HPM delivery. By leveraging numerous target assets and sophisticated diagnostic equipment—in conjunction with MOATS—NSWCDD has positioned itself at the forefront of HPM electronic attack, leading the way in the development and delivery of these capabilities to the warfighter.

Acknowledgment

Nancy Muncie, Bowhead, contributed to this article.

Laser Counter Rocket, Artillery, and Mortar (C-RAM) Efforts

By Michael Libeau

Mortars and rockets are common weapons confronting U.S. troops abroad. Insurgents fire the inexpensive projectiles into populated areas, intending to kill or injure service members and to inflict physical damage. While kinetic solutions like guns and missile interceptors are used to counter rockets and mortars, laser counter rocket, artillery, and mortar (C-RAM) systems present a promising solution to counter these challenging threats in the near future.

Scientists and engineers at the Naval Surface Warfare Center, Dahlgren Division (NSWCDD) have been researching, developing, testing, and evaluating laser C-RAM systems through collaboration, modeling and simulation, and experimentation. The Joint Technology Office (JTO) and the Directed Energy and Electric Weapons Program Office (PMS 405) sponsored the first year of these initiatives in 2007. Consecutive and current work has been sponsored by the Office of Naval Research (ONR) Expeditionary Maneuver Warfare and Combating Terrorism S&T Department.

Background

In preparation for the development of a laser C-RAM system, an understanding of the vulnerability of rockets and mortars to laser energy was crucial. Engineers from NSWCDD and the U.S. Army Space and Missile Defense Command (SMDC) collaborated on laser C-RAM efforts. Engineers analyzed the RAM threat and examined a variety of targets, accessing RAM vulnerabilities to laser energy by utilizing theoretical, numerical, and experimental work. They then developed theoretical models that captured the physics of the laser-induced failures of targets containing high explosives (HE). Additionally, NSWCDD engineers enhanced lethality simulations using a tool called the Effectiveness Toolbox to model engagements of RAM targets with laser energy. Figure 1 shows a screen capture from the Effectiveness Toolbox.

The resulting simulations included results from a laser atmospheric propagation model and a thermal model to determine the effect of the laser energy on the target. The simulations also incorporated target trajectories necessary for modeling the changing laser conditions on the target resulting from the engagement of a ballistic target. Subsequent to modeling these effects, live testing was performed. Figure 2 shows the lasing and destruction of a RAM target during live testing.

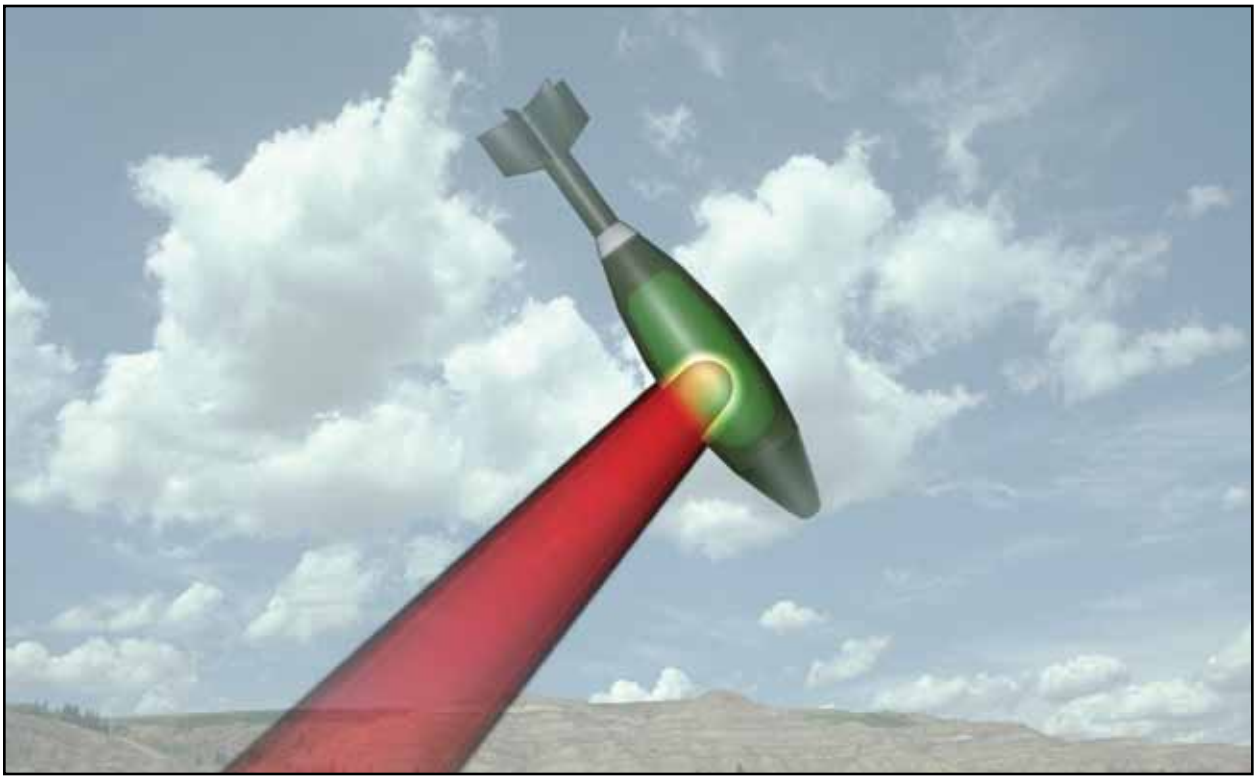

Figure 1. Screen Capture from the Effectiveness Toolbox Showing the Laser Engagement of a Mortar Target

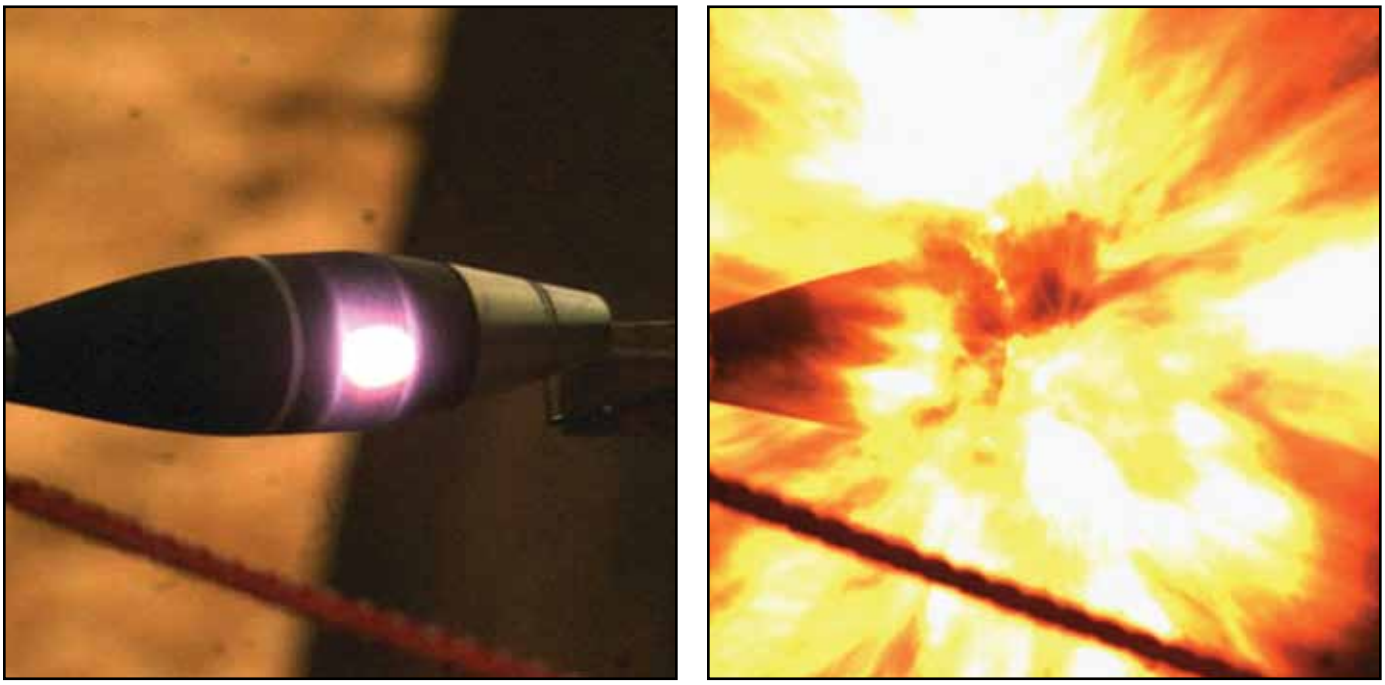

Figure 2. Explosive Target is Destroyed with NSWCDD's Fiber Lasers

NSWCDD engineers conducted two large experimental tests to determine the vulnerability of HE targets to laser energy using NSWCDD's High-Energy Fiber lasers. The first test was conducted jointly with SMDC. During these two tests, over 40 RAM targets were destroyed under different laser conditions, producing significant information on laser lethality. Researchers measured the failure times of multiple targets for different laser powers, spot sizes, incidence angles, and aimpoints. The experimental data yielded by the tests increased engineers' understanding of the vulnerability of targets containing energetic materials. This data was then used to benchmark predictive models.

Future tests are planned with additional HE targets to further the knowledge of RAM vulnerability. These tests are controlled and conducted carefully to ensure that good data is obtained. Accurate measurements of laser power on the target and the resulting target failure times must be made during the tests. To that end, NSWCDD engineers leverage Division-wide expertise in lasers and optics with its long history of explosives testing to achieve meaningful test results. NSWCDD personnel have been instrumental in improving techniques to measure the spatial profile of laser power on a target. The spatial distribution of laser power on a target is critical to understanding the target's failure. Figure 3 shows a laser beam's spatial power distribution measured during a test.

Ongoing Laser C-RAM Initiatives

Recent advances in fiber lasers have increased the power outputs of these rugged, solid-state devices. Both government and contractor efforts are examining the application of commercial off-the-shelf (COTS) lasers and other electric lasers for application into advanced weapon systems. The Navy's Laser Weapon System (LaWS) Program, for example, is examining a laser system built around efficient fiber lasers. This is significant because a high-energy fiber laser system offers two critical advantages over gun and missile interceptor C-RAM systems. First, the laser has a great depth of magazine since it requires only electricity for operation. Consequently, unlike a gun system, which has a limited supply of ammunition, a laser system is limited only by its supply of electrical energy. Second, a laser system offers a cost per kill that is significantly lower than alternative systems because only electricity is being expended instead of gun ammunition or a costly missile interceptor. This low cost per kill also better matches the low cost of the RAM target being engaged.

High-Energy Fiber Laser C-RAM systems will provide significant advantages in defeating the RAM threat while augmenting existing C-RAM solutions. More importantly, laser C-RAM systems will help protect members of the armed forces from the inexpensive, yet often deadly threats posed by rockets and mortars.

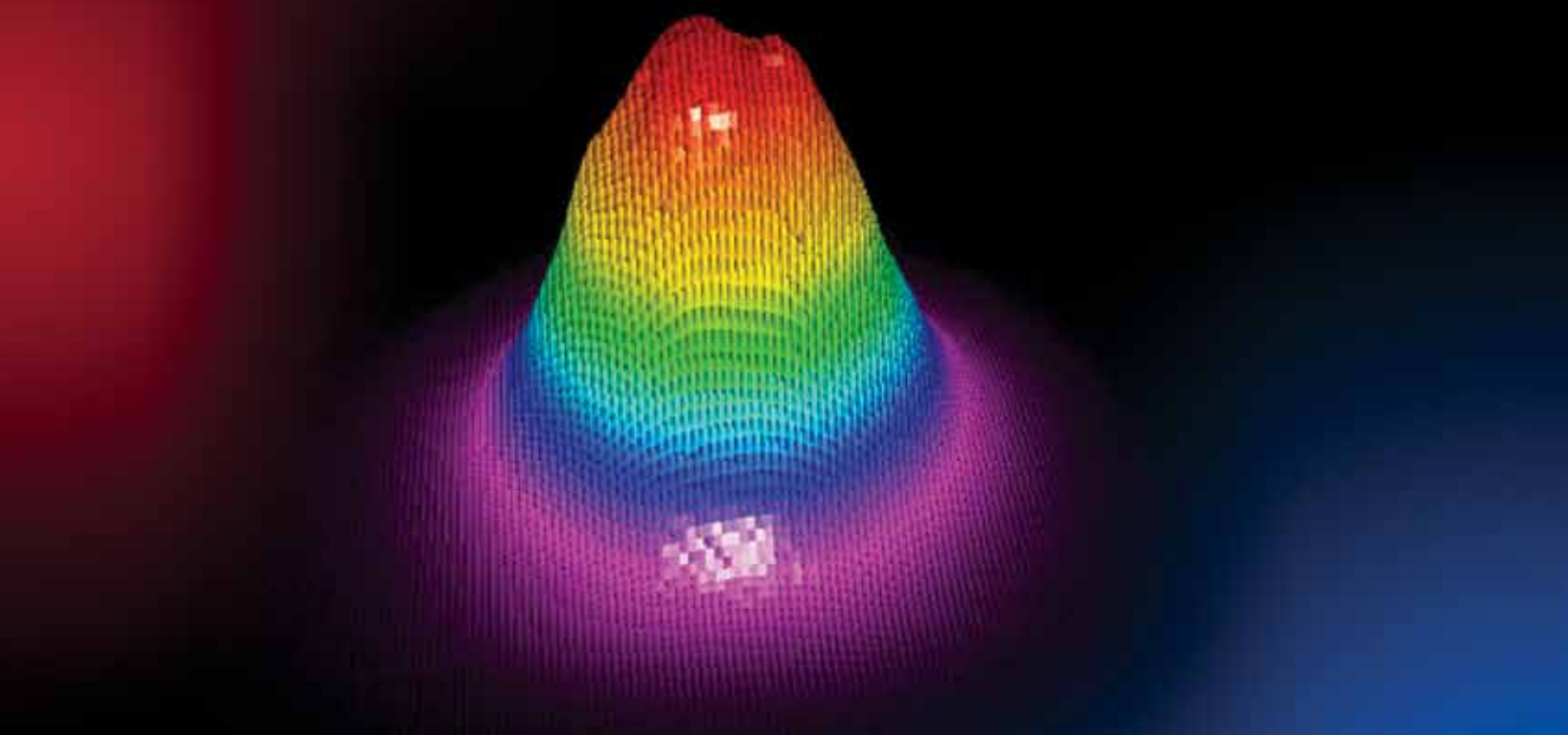

Figure 3. Laser Power Spatial Variation from a C-RAM Test

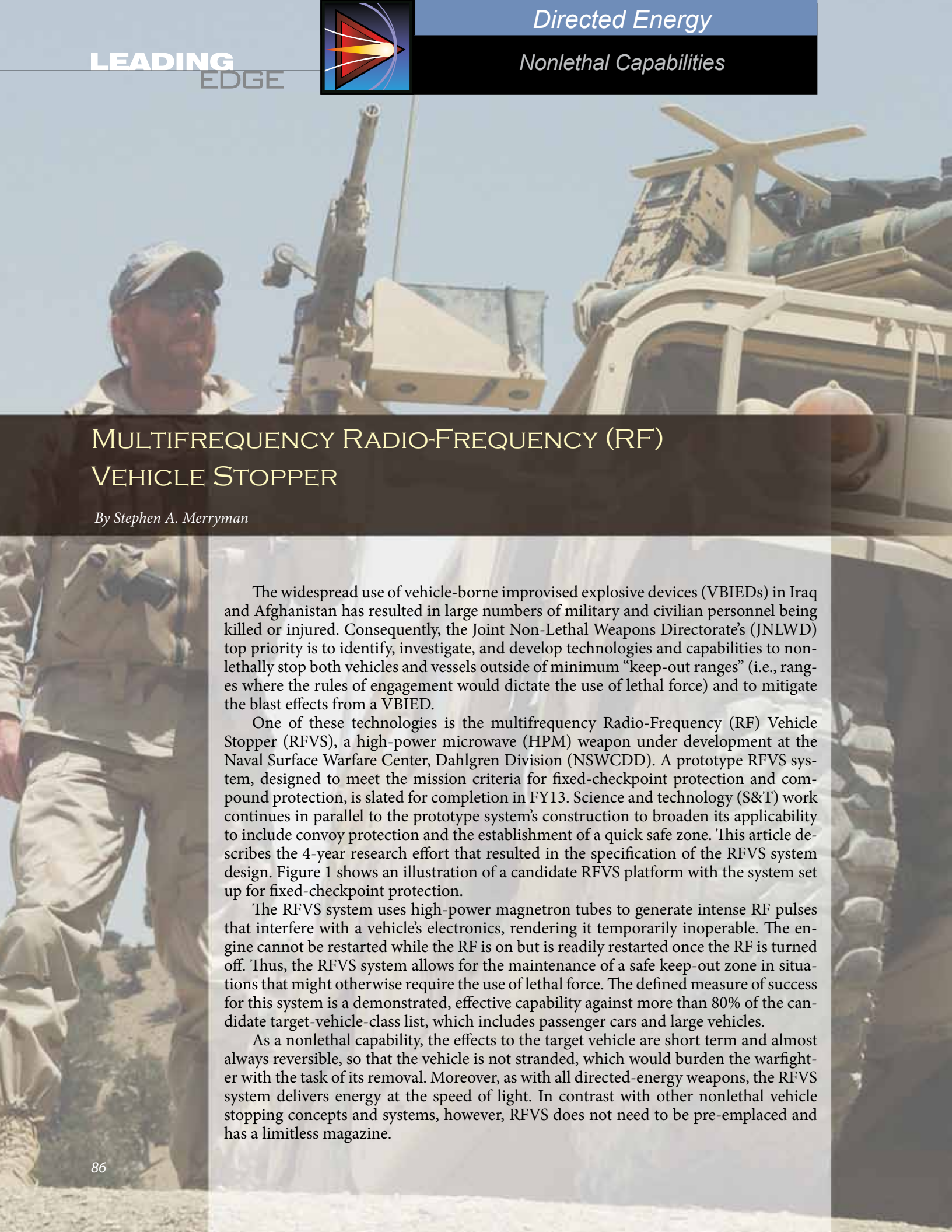

Multifrequency Radio-Frequency (RF) Vehicle Stopper

By Stephen A. Merryman

The widespread use of vehicle-borne improvised explosive devices (VBIEDs) in Iraq and Afghanistan has resulted in large numbers of military and civilian personnel being killed or injured. Consequently, the Joint Non-Lethal Weapons Directorate's (JNLWD) top priority is to identify, investigate, and develop technologies and capabilities to nonlethally stop both vehicles and vessels outside of minimum "keep-out ranges" (i.e., ranges where the rules of engagement would dictate the use of lethal force) and to mitigate the blast effects from a VBIED.

One of these technologies is the multifrequency Radio-Frequency (RF) Vehicle Stopper (RFVS), a high-power microwave (HPM) weapon under development at the Naval Surface Warfare Center, Dahlgren Division (NSWCDD). A prototype RFVS system, designed to meet the mission criteria for fixed-checkpoint protection and compound protection, is slated for completion in FY13. Science and technology (S&T) work continues in parallel to the prototype system's construction to broaden its applicability to include convoy protection and the establishment of a quick safe zone. This article describes the 4-year research effort that resulted in the specification of the RFVS system design. Figure 1 shows an illustration of a candidate RFVS platform with the system set up for fixed-checkpoint protection.

The RFVS system uses high-power magnetron tubes to generate intense RF pulses that interfere with a vehicle's electronics, rendering it temporarily inoperable. The engine cannot be restarted while the RF is on but is readily restarted once the RF is turned off. Thus, the RFVS system allows for the maintenance of a safe keep-out zone in situations that might otherwise require the use of lethal force. The defined measure of success for this system is a demonstrated, effective capability against more than 80% of the candidate target-vehicle-class list, which includes passenger cars and large vehicles.

As a nonlethal capability, the effects to the target vehicle are short term and almost always reversible, so that the vehicle is not stranded, which would burden the warfighter with the task of its removal. Moreover, as with all directed-energy weapons, the RFVS system delivers energy at the speed of light. In contrast with other nonlethal vehicle stopping concepts and systems, however, RFVS does not need to be pre-emplaced and has a limitless magazine.

Figure 1. Illustration of Candidate RFVS System Setup for Checkpoint Protection

Background

Using HPM or RF energy to stop an automobile engine is not a new concept; it has been under investigation for some time in private, academic, and military sectors. To that end, the RFVS program leveraged as much historic work as possible while collaborating with academic and military laboratories and while aggressively pursuing contacts in the automobile industry to gain knowledge of vehicle electronic design and function.

In 2005, the JNLWD funded the then-Directed Energy Technology Office (DETO) at NSWCDD to perform an extensive reverberation chamber test series to characterize the vulnerability of a representative cross section of automobiles to a wide range of HPM source frequencies.[a] The purposes of the tests were twofold. First, the applicability of the Army's Ground Vehicle Stopper (GVS) data set needed to be established for newer vehicles, and second, a thorough, source-technology independent assessment of vehicle vulnerabilities needed to be performed. The rationale behind the latter was to establish vehicle vulnerabilities without inadvertently biasing the process. Only after the full assessment was performed would factors such as concept of operations (CONOPS) and system requirements come into play. Figure 2 is a photograph of reverberation chamber testing.

Over the past decade, a significant number of private, academic, and military laboratories have investigated the susceptibility of automobiles to HPM energy. The range in approaches spans the gamut from isolated component testing, through direct injection and radiated testing of electronic control units (ECUs), and continuing through full vehicle radiated testing. Each of the different test methods has its strengths and weaknesses. Testing of isolated ECUs in controlled laboratory conditions is arguably the best way to determine exactly how a specific unit is responding to the RF. However, whether or not the identified susceptibilities continue to hold true when the unit is in place in a

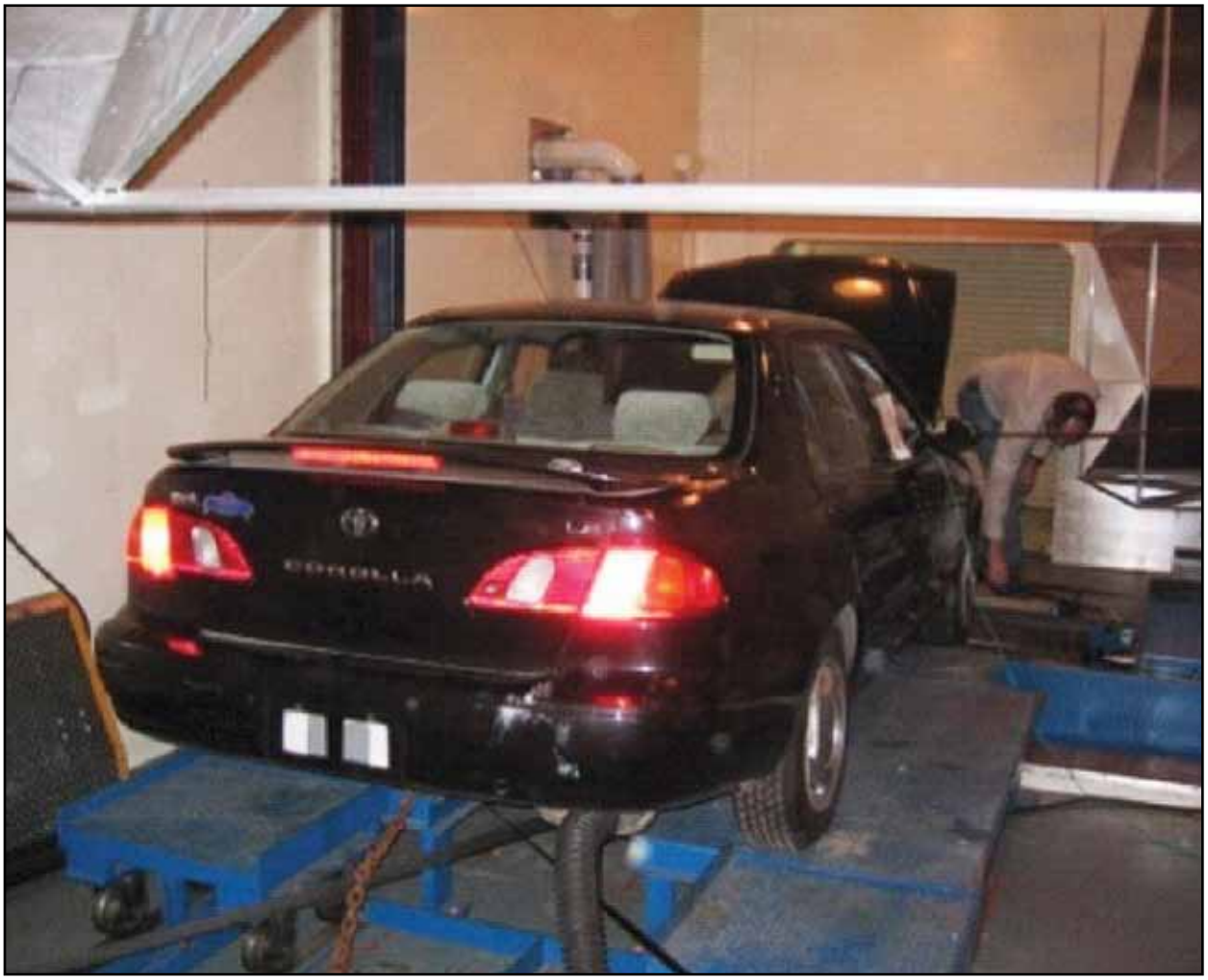

Figure 2. Vehicle on a Dynamometer in the NSWCDD Reverberation Chamber

vehicle, or whether the results apply to other vehicles' ECUs, remains a significant question that limits the applicability of the results.

Full vehicle testing and failure analysis of the ECU can be a daunting task. That said, full vehicle testing affords the advantage of ensuring that the response is commensurate with expectations of genuine engagements. The test approach one chooses to take depends upon resources, test facility availability, and most importantly, the objectives of the program. For the RFVS program, the objectives were to identify an HPM waveform that is effective against a broad class of the candidate target vehicles and to ensure that the identified waveform could be generated with a source that can be packaged in a footprint and cost amenable to military users. To meet the program's objectives, the RFVS program chose to invest the majority of its resources in full vehicle testing. While the focus of the effects testing portion of the RFVS program has remained on full vehicle testing, both time and resources have been devoted to fostering and maintaining connections with academia and the auto industry. There is concerted effort to keep abreast of the latest trends in automotive technology, to ensure that the current RFVS system design will continue to be effective against future vehicle designs, and to leverage all research that might aid in future RFVS designs.

System Operation

The majority of current HPM system concepts employ a narrowband, single-frequency HPM source. In contrast, RFVS utilizes multiple HPM

frequencies. The rationale for using multiple frequencies is associated with increased system effectiveness. Electromagnetic (EM) energy can be used to disrupt or damage an electronic target. In order for the energy to affect the electronics, however, it must be able to reach a critical component(s) inside the target. This involves a process referred to as coupling. Different EM waveforms are more or less effective against specific targets depending, in part, on their frequency, as different frequencies couple better or worse depending on varying target geometries. To be specific, each piece of electronics has specific resonance frequencies that most effectively facilitate coupling energy to the target. Unfortunately, these resonant frequencies can be unique to each piece of equipment. Consequently, a single-frequency waveform might be very effective against one target, but less effective against another target. Therefore, a system that utilizes either a sweep of frequencies or multiple frequencies will be more effective against a larger target set. This is not a novel idea, but rather one that has been readily acknowledged within the HPM community for some time and fervently embraced by the RFVS program. Current technology limitations prohibit high-power-swept frequency sources as viable options, leading to the idea of a multifrequency source. The more frequencies that are used, the more effective the system; however, a trade-off is made with system size and cost as the number of source frequencies is increased.

Brassboard System

After completion of the exhaustive vehicle effects characterization testing in 2006, the RFVS program identified the optimal number of frequencies needed to meet mission requirements. It then used this information in the design and construction of the Brassboard System. The purpose in constructing the Brassboard System was to demonstrate the benefit of the multifrequency approach and the ability to meet mission objectives with specified power on target requirements. Construction of the RFVS Brassboard System began in 2007 and was completed in 2008. The Brassboard System was not constructed with specific system footprints in mind. Thus, the antenna and conex used are significantly larger than those in the prototype design. The RFVS team collaborated with a Marine Corps service representative identified by the JNLWD to flesh out the specifics of the mock checkpoint to be used in the RFVS Brassboard System Demonstration. Figure 3 provides a diagram of the checkpoint setup used in the RFVS Brassboard Demonstration. Figure 4 provides photographs of the RFVS Brassboard System.

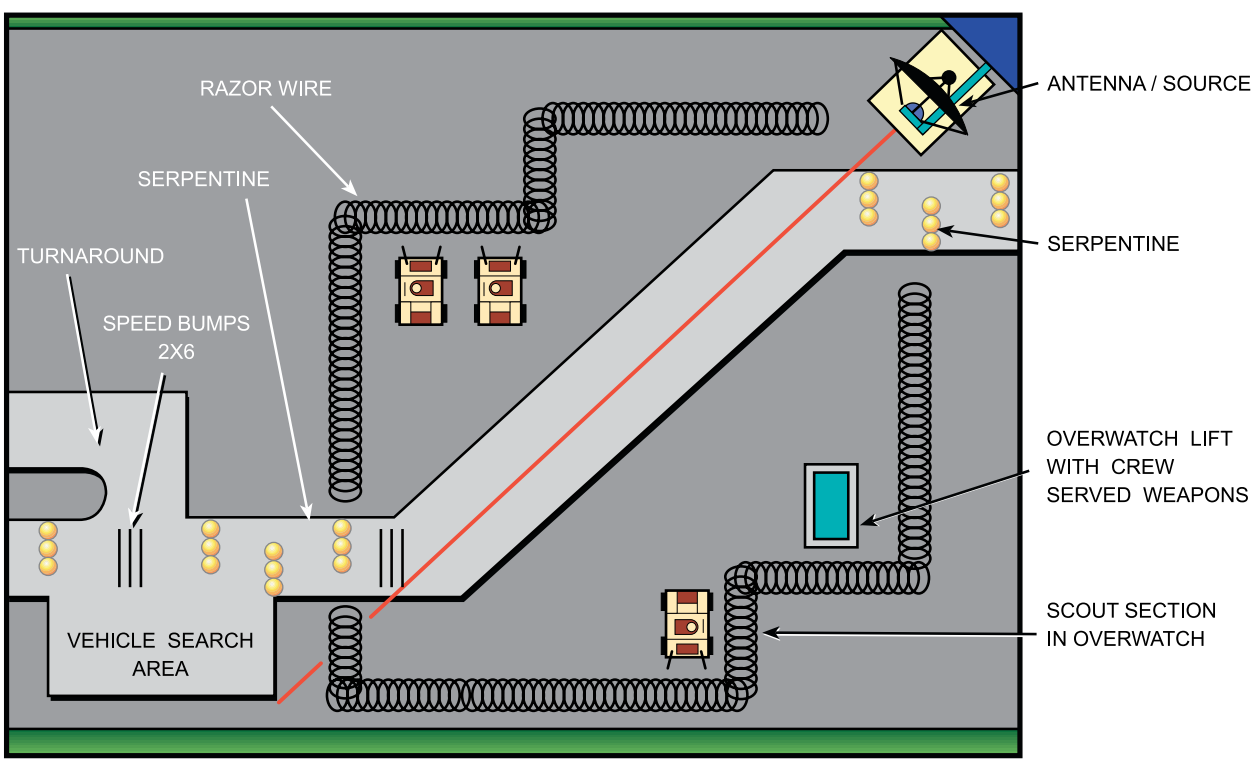

Figure 3. Schematic of Checkpoint Setup

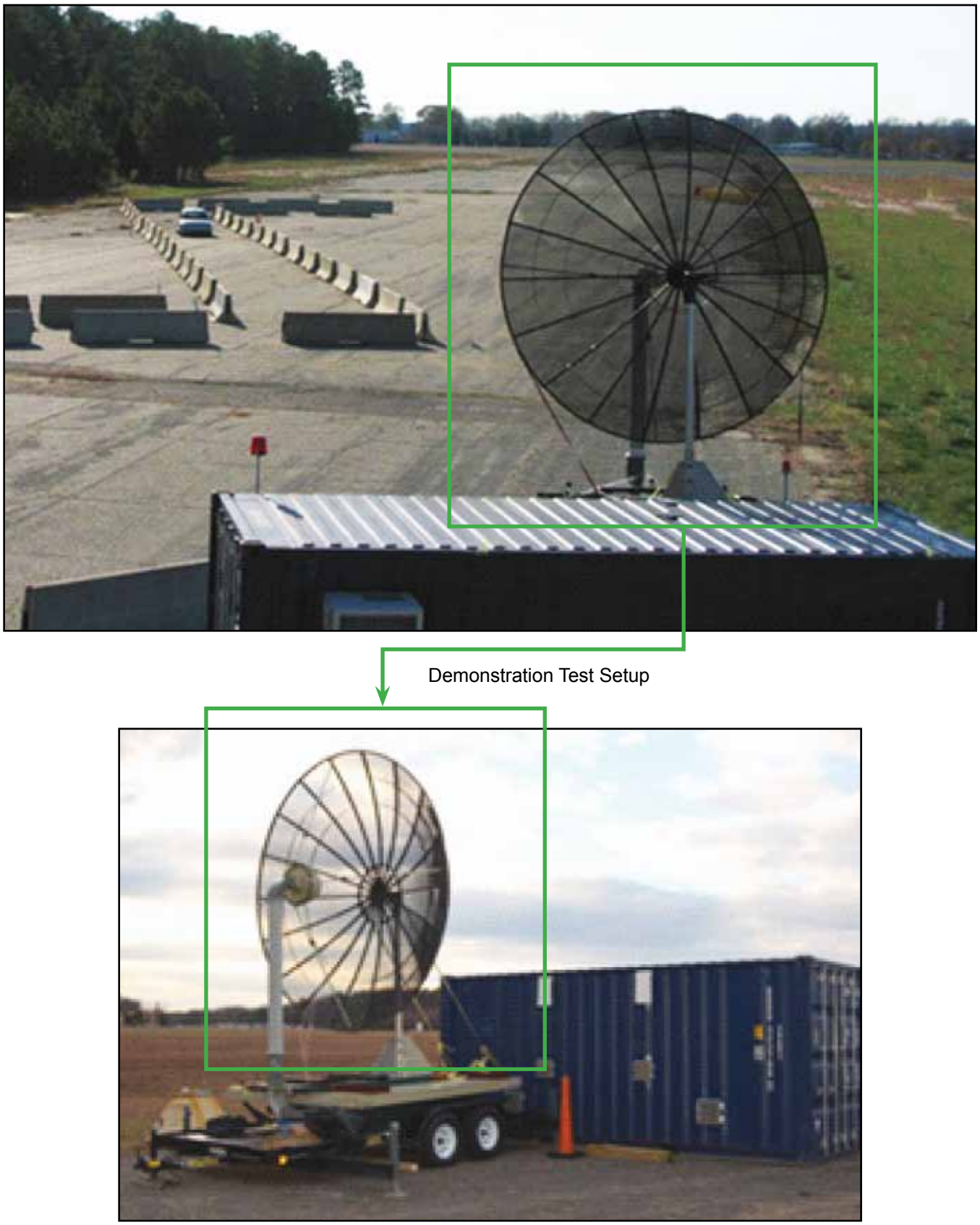

Figure 4. Photograph of the RFVS Brassboard System and Demonstration Setup

The Brassboard System Demonstration was conducted in Spring 2008. The Demonstration was a success, and funding for the RFVS prototype was consequently approved. To date, 42 passenger vehicles (cars, pickup trucks, vans, and sport utility vehicles (SUVs)) and 3 large trucks (dump truck and tractors) have been tested as part of the RFVS program.

Way Ahead

The JNLWD continues to work with the Directed Energy Warfare Office (DEWO) toward the development of a fieldable multifrequency RFVS system. Once the capability is fully developed, tested, and certified ready for operational use, warfighters and civilians alike will benefit greatly. Lives will no doubt be saved using the ability to stop vehicles nonlethally and mitigate the blast effects from VBIEDs.

Acknowledgment

Dr. Cynthia Ropiak (SAQ Consulting) contributed to this article.

Endnote

a. The Directed Energy Technology Office (DETO) was renamed the Directed Energy Warfare Office (DEWO) in August 2009. For reference, see the charter for the DEWO, NSWCDD, 17 August 2009.

High-Power Electrical Vehicle-Stopping Systems

By Jordan Chaparro and Melanie Everton

The military needs devices that can safely and reliably stop or arrest vehicles. The primary concern is security at entry control points and vehicle check points similar to the one shown in Figure 1. In such scenarios, it is desirable to be able to stop unauthorized vehicles at predefined standoff ranges to protect personnel, equipment, and critical infrastructure.

Both the military and civilian law enforcement agencies face similar issues with chase scenarios, where concerns over bringing an offending vehicle to a stop without killing or injuring innocent civilians, or causing collateral damage, often prolongs high-speed pursuits. That said, currently employed nonlethal options for arresting vehicles have significant logistical limitations and carry a high cost per use.

The Naval Surface Warfare Center, Dahlgren Division's Directed Energy Warfare Office (DEWO), under the sponsorship of the Joint Non-Lethal Weapons Directorate (JNLWD), investigated compact systems designed to couple high-power electrical impulses to a target vehicle to stop its engine. Such systems are highly portable, can operate remotely, can be deployed quickly by a two-man team, and can engage hundreds of targets before requiring any significant maintenance.

System Overview

Conceptually, electrical vehicle-stopping systems are fairly simple devices. The systems use several stages of energy compression to take a low-peak power source—like a battery pack—and create very intense, short-duration, oscillating electrical impulses. The block diagram, shown in Figure 2, illustrates the principal components of such a system.

A high-energy density, 300-V lithium battery pack, similar to what might be found in a hybrid vehicle, serves as the prime power source for the device. These batteries are capable of driving the system for hundreds of engagements before requiring recharge.

The direct current bus from the batteries is stepped up to several kilovolts in order to charge a capacitive voltage multiplier, such as a Marx Generator, Spiral Line Generator, or Tesla Transformer. Once triggered, these generators charge a resonant circuit to hundreds of kilovolts which, when switched, generate the desired oscillating waveform. Coupling this electrical pulse to a target may be accomplished by direct electrode contact, by radiating the waveform from a broadband antenna structure, or by a combination of both methods.

Figure 1. An Azerbaijani Soldier Guarding Entry Control Point 1 at the Haditha Dam in Support of Operation Iraqi Freedom

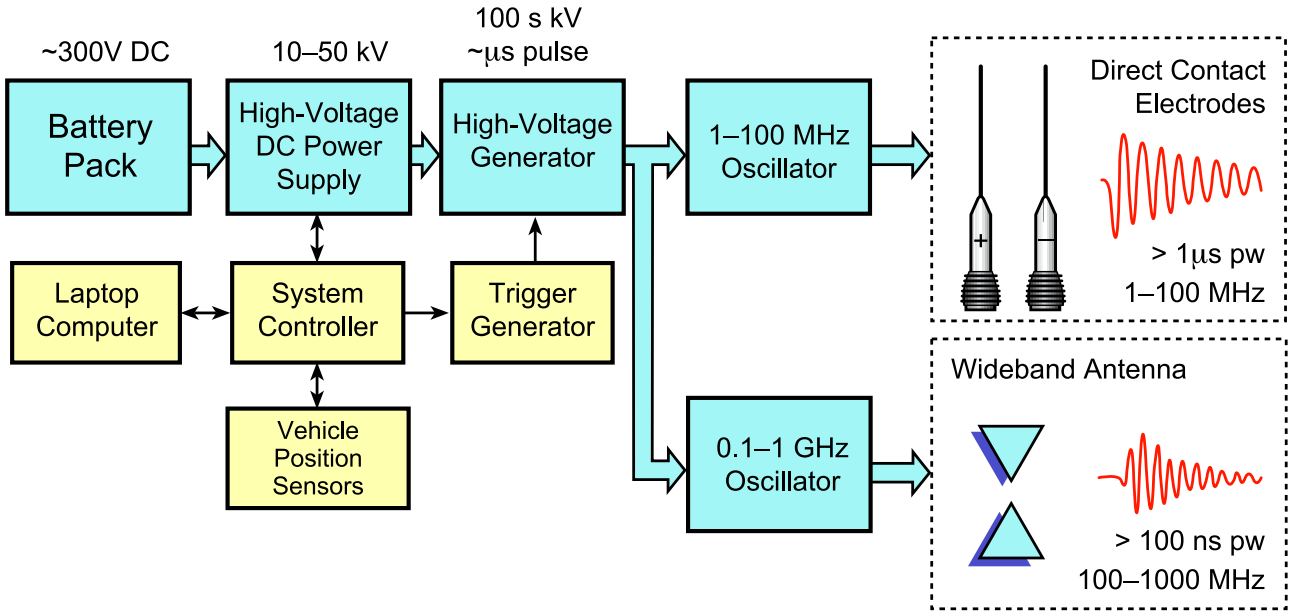

Figure 2. System Block Diagram for Generic Electrical Vehicle-Stopping Systems

The system is monitored and controlled by an integrated system computer. A laptop computer, remotely connected to the system controller through either fiber optic or a wireless network, can be used to arm the system. At this point, motion detection sensors trigger the pulse train upon the targeted vehicle. The laptop can also be used to monitor the system's status, change system parameters, and receive data collected during the last engagement event.

A conceptual rendering of how such a system might look when in use is shown in Figure 3. Traffic would be funneled with barriers to a single lane. When not engaged, the system electrodes would sit flush with the roadway unit, with an exposed height of less than 3 inches. When required, the electrodes could be released to make contact with a vehicle's undercarriage and deliver the electrical impulses.

Comparison with Existing Systems

Tire spike systems are frequently employed but do not limit the momentum, drive, or control of a vehicle to an extent that could be useful in any type of control or checkpoint scenario. Consequently, while tire spike systems are primarily used in high-speed pursuit applications, they are limited, in that they cripple the target just enough to allow law enforcement to force the vehicle to a stop.

Restraining nets are most comparable to electrical vehicle stoppers with respect to their intended application and desired effect. Restraining net systems and electrical vehicle stoppers both completely arrest vehicles, although by different means. Restraining nets bind the front axle of the vehicle, causing it to forcibly lose momentum and skid to a stop. Thus, the vehicle operator loses the ability to steer the vehicle, further resulting in a lower potential for collateral damage. Electrical systems stop the engine of the vehicle, leaving the operator with control for the duration of the vehicle's momentum. Physical barrier structures can then be employed to force an affected vehicle to stop in a fairly short distance. Modern vehicles lose power steering when the engine is cut off, such that the maneuverability of the vehicle is limited enough to

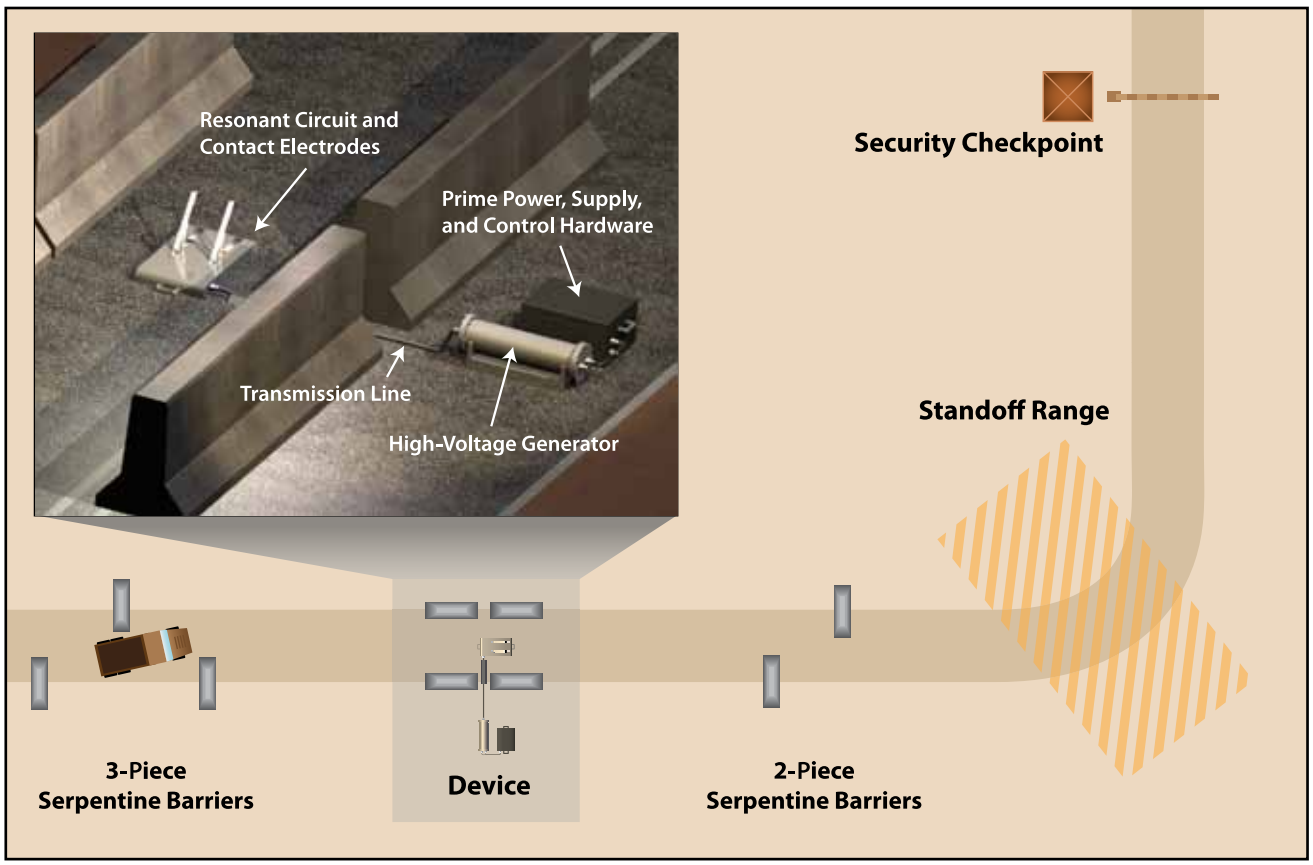

Figure 3. Conceptual Rendering of an Employed Electric Vehicle Stopping System

allow normally nonrestrictive serpentines to be effective at limiting roll-off distances.

One key logistical advantage of electrical vehicle stoppers, compared to restraining nets, is the average cost per engagement. Restraining net systems are one-time use devices that cost several thousand dollars each. Electrical systems initially cost tens of thousands of dollars but can perform thousands of stops within the expected lifetime of the device. Also, there is no requirement to physically reset or reload an electrical system, as with restraining nets. The maintenance required for electrical systems involves the occasional replacement of electrode arms and the inspection of the system connections and pressure levels.

Operationally, both systems have limitations on the types of targets that can be effectively stopped. Restraining nets are limited by vehicle momentum, which can be a product of high speeds or large vehicles. Electrical systems are not limited by vehicle size or speed, but they require additional support from structures—such as serpentines or speed bumps—to force the target to brake and dissipate its momentum once the engine has been stopped.

Both devices typically cause damage to targeted, stopped vehicles. Restraining nets almost always cause tire damage. Less commonly, brake lines, front axles, wheels, and transmissions also might be damaged. Electrical systems typically damage engine controllers, security modules, and engine sensors. In addition, noncritical parts—such as gauges, radios, and cabin fans—also might be damaged. Moreover, moving affected targets is much less of an issue with electrical stoppers than vehicles stopped by net systems, which must first have the net cut away and freed before the target is moved to the side of the roadway.

System Refinement and Look Forward

Previous attempts to field electrical vehicle-stopping systems have been hampered by limited success rates on a large population of vehicles. Many models of vehicles are easily affected by any type of large injected current, while others are fairly resistant. Through carefully designed and controlled experiments, and logistical regression modeling techniques, the DEWO team has been able to determine key waveform attributes that scale with stopping effectiveness rates on a representative population of vehicles. Successful stop rates exceeding 90 percent have been achieved on a diverse vehicle test set by engineering system resonators to enhance system performance The DEWO team, through continued research, testing, and evaluation, is continuing its work to increase the reliability and effectiveness of these systems to make them more compact and to improve their functionality for future military and law enforcement applications.

Nonlethal Small-Vessel Stopping With High-Power Microwave Technology

By Jacob Walker

The employment of small vessels to attack merchant ships and other seafaring units has emerged as a significant threat to international navigation and safe operations on the high seas. Along with swarm tactics, small vessels have been known to carry improvised explosive devices, help smuggle terrorists and weapons, and serve as attack platforms on the water for larger weapons. While kinetic solutions serve as the decisive option, alternative solutions that employ nonlethal means are being explored. A depiction of a swarm of small vessels ready to attack is shown in Figure 1.

The Naval Surface Warfare Center, Dahlgren Division's (NSWCDD's) Directed Energy Warfare Office (DEWO) is evaluating directed-energy (DE) concepts based on high-power microwave (HPM) technology for nonlethal vessel-stopping applications. Nonlethal weapons are defined by the Department of Defense (DoD) as weapons that are explicitly designed and primarily employed so as to incapacitate personnel or materiel while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment.[1]

Several methodologies exist for using nonlethal means to stop small vessels. They include:

- Running-gear or prop entanglement systems
- Exhaust stack blockers
- A sea-anchor vessel-stopping system, which casts a net across the bow of a vessel to impart resistance
- Small-craft disablers, which insert a spear into the hull and deploy a fin that drags in the water, making steering impossible

Prop entanglement systems, exhaust stack blockers, and sea-anchor systems are useful and effective, but all are operationally difficult to deliver when deployment methods rely on positioning them in front of, or directly over, a vessel moving

Figure 1. Depiction of a Small-Vessel Swarm Ready to Attack

at high speeds. Small-craft disablers also are a formidable vessel-stopping solution and may be easier to deploy, but they cause permanent damage to the vessel in question.

Under the direction of the Joint Non-Lethal Weapons Directorate (JNLWD), the DEWO is in the initial stages of a multiyear effort to evaluate DE concepts for nonlethal vessel-stopping applications. It is currently focusing on HPM technology. This technology uses HPM sources to radiate radio frequency (RF) pulses downrange to interfere with motor-control electronics and significantly impede or stop small-vessel motors with minimal collateral damage. These RF pulses can be generated using different technologies ranging from wideband LC oscillators and microwave tubes (e.g., magnetrons, klystrons, and backward wave oscillators) to emerging solid-state technologies (e.g., nonlinear transmission line and photo-conductive switching). An outboard motor on a test stand is shown in Figure 2.

In comparison to kinetic weapons or other nonlethal systems, HPM avoids gross physical destruction to the vessel while, more importantly, providing zero-to-low risk of human injury. HPM accomplishes this at safe distances using speed of light delivery, therefore making evasion difficult, if not impossible, with the added benefit of scalable effects ranging from disruption to damage. Despite its numerous advantages, the use of HPM technology as a nonlethal weapon presents challenges as well, including a trade-off between system size and standoff range. This is particularly important when considering the use of HPM systems in different environments.

Upfront HPM source development costs represent one of the biggest challenges. However, long-term savings associated with HPM technology can offset this challenge. For example, prop entanglement systems might be deployed only once before they are rendered useless. HPM sources integrated onto a ship or other military vehicle can be employed in potentially thousands of missions, therefore resulting in a lower cost per single use, bringing overall associated costs of the system down significantly. Priorities for HPM nonlethal weapons include developing a system effective against different types of small vessels.

NSWCDD's Directed Energy Division began HPM susceptibility testing to determine the effectiveness of HPM weapons against relevant outboard engines. This involves testing small vessels in

Figure 2. Outboard Motor Test Stand

a variety of environments, including reverberation and anechoic chambers, and open-air testing. All help identify different, effective waveform parameters such as frequency, pulse width, rise time, and required power or energy on target. They further facilitate the identification of design specifications necessary for an eventual HPM source. This source, once developed, will then be integrated into one of several potential platforms. Candidate concepts of deployment include U.S. Coast Guard and naval vessels in addition to unmanned surface or aerial vessels. Another potential application might be to supplement existing Coast Guard or Navy platforms used for fast-boat interdiction with an HPM vessel-stopping capability. A small-vessel test using an HPM source is shown in Figure 3.

Developing solutions for the growing threat that small vessels pose to navigation and safe operations in the world's oceans is one of JNLWD's top priorities. Using nonlethal HPM weapons to stop vessels will provide the warfighter with a viable option for swarm threat and fast-boat interdiction. DEWO is working diligently to accelerate this technology and provide a DE alternative to kinetic weapons and fulfill this long overdue capability gap.

Reference

1. *Department of Defense Dictionary of Military and Associated Terms*, Joint Publication 1-02, 12 April 2001 (as amended through 19 August 2009).

Figure 3. Small-Vessel Testing Using a High-Power Microwave Source

LEADING EDGE
Volume 7, Issue No. 4

Directed Energy

We look forward as we provide enterprise-wide technical and strategic leadership for the efficient and effective development, acquisition, and fielding of directed-energy systems for the warfighter.

Dale Sisson
Head, Electromagnetic and
Sensor Systems Department
NSWCDD, Dahlgren, Virginia

LEADING EDGE

Volume 7, Issue No. 4

Fallen Warriors

Here we honor those who died while serving their country

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Electronic Warfare and Radar Systems

Engineering Handbook

A Comprehensive Handbook for Electronic Warfare and Radar Systems Engineers

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Naval Air Warfare Center Weapons Division, Point Mugu, California

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FOREWORD

This handbook is designed to aid electronic warfare and radar systems engineers in making general estimations regarding capabilities of systems. This handbook is sponsored by the NAVAIR Director of Electronic Warfare/Combat Systems Department. This fourth edition updates technical information in Sections 3-7 and 3-8 from previous editions.

This document was reviewed for technical accuracy by Dr. Andrew Chen.

Approved by
DR. R. E. SMILEY, *NAVAIR Director*
EW/Combat Systems Department
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ABBREVIATIONS AND ACRONYMS

a	Acceleration or atto (10^{-18} multiplier)
A	Ampere, Area, Altitude, Angstrom (Å), Antenna Aperture, or Aerial
A-799	No evidence of failure report
A/A, A-A, AA	Air-to-Air or Anti-Aircraft
AA-()	Air-to-Air missile number ()
AAA	Anti-Aircraft Artillery
AAAA	Army Aviation Association of America
AAED	Advanced Airborne Expendable Decoy
AAM	Air-to-Air Missile
AARGM	Advanced Anti-Radiation Guided Missile
AAW	Anti-Air Warfare
A-BIT	Automatic Built-in-Test
ABM	Air Breathing Missile or Anti-ballistic Missile
A/C	Aircraft (also acft.)
AC	Alternating Current
ACA	Associate Contractor Agreement or Airspace Coordination Area
ACAT	Acquisition Category
ACC	Air Combat Command
ACCB	Aircraft Configuration Control Board
Acft	Aircraft (also A/C)
ACLS	Aircraft Carrier Landing System
ACM	Advanced Cruise Missile or Air Combat Maneuvering
ACQ	Acquisition
ACS	Antenna Coupler Set
ACTD	Advanced Concept Technology Demonstration
A/D	Analog to Digital
ADM	Advanced Development Model
ADP	Automatic Data Processing or Advanced Development Program
AEA	Airborne Electronic Attack
AEC	Aviation Electronic Combat (Army)
AEGIS	Automatic Electronic Guided Intercept System
AEL	Accessible Emission Limit
AESA	Active Electronically Scanned Array
AEW	Airborne Early Warning
AF	Antenna Factor, Air Force, or Audio Frequency
AFB	Air Force Base or Airframe Bulletin
AFC	Automatic Frequency Control or Airframe Change
AFIPS	Automated Financial Information Processing System
AFOTEC	Air Force Operational T&E Center
A/G	Air-to-Ground
AGB	Autonomous Guided Bomb
AGC	Automatic Gain Control
AGI	Auxiliary General Intelligence (Intelligence-gathering Ship)
AGL	Above Ground Level
AGM	Air-to-Ground Missile
AGS	Angle Gate Stealer
AHWS	Advanced Helicopter Weapons System
AI	Artificial Intelligence, Air Intercept, or Airborne Interceptor
AIAA	American Institute of Aeronautics and Astronautics
AIC	Air Intercept Control
AIM	Air Intercept Missile
AIRLANT	Commander, U.S. Naval Air Forces, Atlantic Fleet
AIRPAC	Commander, U.S. Naval Air Forces, Pacific Fleet
AJ	Anti-jamming or Anti-Jam
A-Kit	Aircraft wiring kit for a system (includes cabling, racks, etc. excluding WRAs)
ALC	Air Logistics Center
AM	Amplitude Modulation
AMD	Aircraft Maintenance Department
AMES	Advanced Multiple Environment Simulator
AMLV	Advanced Memory Loader/Verifier
Amp	Amplifier
AMRAAM	Advanced, Medium-Range, Air-to-Air Missile
ANSI	American National Standards Institute
ANT	Antenna
Ao	Operational Availability
AO	Acousto-Optical
AOA	Angle of Arrival, Angle of Attack, or Analysis of Alternatives (similar to COEA)
AOC	Association of Old Crows (Professional EW Society) or Award of Contract
AOT	Angle Only Track, Angle Off Tail, or Acquisition-on-Target
APC	Amphenol Precision Connector or Armored Personnel Carrier
APN	Aircraft Procurement, Navy
APO	Armed Forces (or Army or Air) Post Office, Acquisition Program Office

APU	Auxiliary Power Unit
AR	Anti-reflection or Aspect Ratio
ARM	Anti-radiation Missile
ARO	After Receipt of Order
A/S, A-S, AS	Air-to-Surface
ASC	Air Systems Command
ASCM	Anti-ship Cruise Missile
ASE	Aircraft Survivability (or Survival) Equipment, Allowable Steering Error, or Automatic Support Equipment
ASIC	Application Specific Integrated Circuit
ASK	Amplitude Shift Keying
ASM	Air-to-Surface Missile
ASO	Aviation Supply Office
A-Spec	System Specification
ASPJ	Airborne Self-Protection Jammer
ASPO	Avionics Support (also Systems) Project Office (also Officer)
ASR	Advanced Special Receiver or Airport/Airborne Surveillance Radar
ASRAAM	Advanced Short Range Air-to-Air Missile
ASTE	Advanced Strategic and Tactical Expendables
ASW	Anti-submarine Warfare
ATA	Advanced Tactical Aircraft
ATARS	Advanced Tactical Air Reconnaissance System
ATC	Air Traffic Control
ATD	Advanced Technology Demonstration
ATE	Automatic Test Equipment
ATEDS	Advanced Technology Expendables and Dispenser Systems
ATF	Advanced Tactical Fighter (F-22)
ATIMS	Airborne Turret Infrared Measurement System or Airborne Tactical Information Management System
ATIRCM	Advanced Threat Infrared Countermeasures
ATP	Acceptance Test Procedure
ATR	Autonomous Target Recognition, Airborne Transportable Rack, Atlantic Test Range
ATRJ	Advanced Threat Radar Jammer
AUTODIN	Automatic Digital Network
AUX	Auxiliary
avdp.	Avoirdupois (system of measures)
Avg	Average
AWACS	Airborne Warning and Control System
AZ	Azimuth (also Az)

B	Bandwidth (also BW) or Magnetic inductance
BAFO	Best and Final Offer
BAU	Bus Adapter Unit
BC	Bus Controller
BDA	Battle Damage Assessment
BDI	Battle Damage Indication
BFO	Beat Frequency Oscillator
BI	Background Investigation
BIFF	Battlefield Identification, Friend, or Foe
BIT	Built-in-Test, Binary Digit or Battlefield Information Technology
BITE	Built-in-Test Equipment
BIU	Bus Interface Unit
B-Kit	Avionics "Black Box" WRAs
B/N	Bombardier/Navigator
BNC	Bayonet Navy Connector
BOA	Basic Ordering Agreement
BOL	Swedish chaff dispenser in a launcher
BPF	Band Pass Filter
BPS	Bits Per Second
BUMED	Bureau of Medicine (Navy)
BUNO	Bureau Number (aircraft)
BUR	Bottom Up Review
BVR	Beyond Visual Range
BW	Beamwidth (referring to an antenna) or sometimes Bandwidth
BWA	Backward Wave Amplifier
BWO	Backward Wave Oscillator
c	Speed of Light = $3x10^8$ meters/sec = $1.8x10^{12}$ furlongs per fortnight or 1.8 terafurlongs per fortnight, or centi (10^{-2}) multiplier
C	Electron Charge, Coulomb, Capacitance, Celsius, Centigrade, Confidential, Roman numeral for 100, or a programming language (also C+ and C++)
C^2	Command and Control
C^3 (C^4)	Command, Control, Communications (and Computers)
C^3I (C^4I)	Command, Control, Communications, (Computers) and Intelligence
CAD	Computer-Aided Design
CAE	Computer-Aided Engineering
CAG	Carrier Air Group
CAGE	Commercial and Government Entry
CAIV	Cost as an Independent Variable
CAL	Calibration

CAM	Computer-Aided Manufacturing or Constant Addressable Memory
CAO	Competency Aligned Organization or Contract Administrative Officer
CAP	Combat Air Patrol
CAS	Close Air Support or Calibrated Airspeed
CASS	Consolidated Automated Support System
CAT	Catapult or Cockpit Automation Technology
CB	Citizens Band (also see Seabee)
CBD	Commerce Business Daily
CBIT	Continuous Built-in-Test
CBO	Congressional Budget Office
CCA	Circuit Card Assembly
CCB	Configuration Control Board
CCD	Charge Coupled Device
CCM	Counter-Countermeasures
CCN	Contract Change Number or Configuration Change Notice
CCU	Cockpit Control Unit
cd	Candela (SI unit of luminous intensity)
CD	Compact Disk or Control and Display
CDC	Combat Direction Center
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CE	Conducted Emission
CECOM	Communications and Electronics Command (Army)
CEESIM	Combat Electromagnetic Environment Simulator
CEP	Circular Error Probability
CFA	Cognizant Field Activity
CFAR	Constant False Alarm Rate
CFE	Contractor Furnished Equipment
CG	Center of Gravity, Commanding General, Command Guidance, or Cruiser
CI	Configuration Item
CIA	Central Intelligence Agency
CIC	Combat Information Center (now called CDC)
CID	Combat Identification or Charge Injection Device
CILOP	Conversion in Lieu of Procurement
CINC	Commander in Chief
CIP	Capital Improvement Program
CIS	Commonwealth of Independent States (11 of 15 former Soviet Union territories except Estonia, Georgia, Latvia, and Lithuania)
CIWS	Close-In Weapon System
CJ	Coherent Jamming
CLC	Command Launch Computer
cm	Centimeter
CM	Countermeasures or Configuration Management
CMC	Command Mission Computer or Commandant Marine Corps
CMDS	Countermeasure Dispensing System
CMOS	Complementary Metal-Oxide Semiconductor
CMP	Configuration Management Plan
CMWS	Common Missile Warning System
CNAF	Commander, Naval Air Forces
CNAL	Commander, Naval Air Forces Atlantic (also COMNAVAIRLANT)
CNAP	Commander, Naval Air Forces Pacific (also COMNAVAIRPAC)
CNI	Communications, Navigation, and Identification
CO	Commanding Officer, Contracting Officer, Change Order, or Carbon Monoxide
COB	Close of Business
COCOM	Combatant Command
COEA	Cost and Operational Effectiveness Analysis
COG	Center of Gravity or Cognizant
COMM	Communications
COMSEC	Communications Security
CONSCAN	Conical Scanning Radar
CONUS	Continental United States
CO-OP	Cooperative (countermeasures)
COR	Contracting Officers Representative
CORPORAL	Collaborative On-Line Reconnaissance Provider/Operationally Responsive Attack Link
Cos	Cosine
COSRO	Conical-Scan on Receive Only
COTS	Commercial Off-The-Shelf (hardware/software)
CP	Circularly Polarized (antenna), Central Processor, or Command Post
CPS	Computer or Control Power Supply (depends on application)
CPU	Central Processing Unit
CRC	Originally Chemical Rubber Company, now published reference books by CRC Press
CRFM	Coherent RF Memory
CRISD	Computer Resources Integrated Support Document
CRLCMP	Computer Resources Life Cycle Management Plan

CRO	Countermeasures Response Optimization
CRT	Cathode Ray Tube or Combat Rated Thrust (afterburner)
CSAR	Combat Search and Rescue
Crypto	Cryptographic
CS	Conducted Susceptibility
CSC	Commodity Software Change
CSCI	Computer Software Configuration Item
C-Spec	Product Specification
CSS	Contractor Support Services
CTR	Chesapeake Test Range
CV	Aircraft Carrier
CVN	Nuclear Powered Aircraft Carrier
CVR	Crystal Video Receiver
CW	Continuous Wave or Chemical Warfare
CWBS	Contract Work Breakdown Structure
CWI	Continuous Wave Illuminator
CY	Calendar Year
d	Distance, Diameter, or deci (10^{-1} multiplier)
D	Distance, Diameter, Electron displacement, Detectivity, Doppler, Density, or Roman numeral for 500
da	deca (10^{0} multiplier)
D/A	Digital-to-Analog
DAB	Defense Acquisition Board
DAC	Digital to Analog Converter or Dept of Army Civilian
DAR	Defense Acquisition Regulation
DARPA	Defense Advanced Research Projects Agency
DB	Database
dB	Decibel
dBc	dB referenced to the Carrier Signal
dBi	Decibel antenna gain referenced to an isotropic antenna
dBm	Decibel referenced to the power of one milliwatt
DBOF	Defense Business Operations Fund
dBsm	Decibel value of radar cross section referenced to a square meter
dBW	Decibel referenced to the power of one watt
DC	Direct Current, Discrete Circuit, or District of Columbia
DCE	Data Communication Equipment
DCS	Direct Commercial Sales or Distributed Control System
DDI	Digital Display Indicator
DDS	Direct Digital Synthesizers
DECM	Deceptive Electronic Countermeasures (also Defensive ECM)
deg	Degree
DEMVAL	Demonstration Validation (also DEM/VAL)
DET	Detachment
DF	Direction Finding
DFT	Discrete Fourier Transform
DI	Data Item
DIA	Defense Intelligence Agency or Diameter
DID	Data Item Description
DIRCM	Directed Infrared Countermeasures
DJ	Deceptive Jamming
D-Level	Depot Level Maintenance
DM	Data Management (also manager)
DMA	Direct Memory Address or Defense Mapping Agency
DME	Distance Measuring Equipment
DNA	Defense Nuclear Agency, Does Not Apply, or Deoxyribonucleic Acid
DOA	Direction of Arrival
DOD or DoD	Department of Defense
DoDISS	DoD Index of Specifications and Standards
DOM	Depth of Modulation
DON	Department of the Navy
DOS	Disk Operating System
DOT&E	Director, Operational Test & Evaluation
DPRO	Defense Plant Representative Office
DRB	Defense Review Board
DRFM	Digital RF Memory
DSARC	Defense Systems Acquisition (and) Review Council
DSN	Defense Switching Network
DSO	Dielectrically Stabilized Oscillator
DSP	Digital Signal Processor
D-Spec	Process Specification
DT (&E)	Development or Developmental Test (and Evaluation)
DTC	Design to Cost
DTE	Data Terminal Equipment
DTO	Digitally Tuned Oscillator or Defense Technology Objectives
DTRMC	Defense (or DoD) Test Recourse Management Center

e	Electron charge or base of natural logarithms (2.71828...)
E	Electric Field Intensity or Strength, Energy, East, or Exa (10^{18} multiplier)
E^3	Electromagnetic Environmental Effects
EA	Electronic Attack (similar to older term of ECM)
EC	Electronic Combat
ECAC	Electromagnetic Compatibility Analysis Center (DOD), now Joint Spectrum Center
ECCM	Electronic Counter-Countermeasures (similar to newer term of EP)
ECL	Emitter Coupled Logic
ECM	Electronic Countermeasures (similar to newer term of EA)
ECN	Engineering Change Notice
ECO	Engineering Change Order
ECP	Engineering Change Proposal or Egress Control Point
ECR	Electronic Combat Range (China Lake) or Electronic Combat & Reconnaissance
ECS	Environmental Control System
ECSEL	Electronic Combat Simulation and Evaluation Laboratory
ECU	Electronic Control Unit
EDM	Engineering Development Model
EED	Electro-Explosive Device
EEPROM	Electrically Erasable/Programmable Read-only Memory
EHF	Extremely High Frequency [30 to 300 GHz]
EIA	Electronic Industries Associates
EID	Emitter Identification Data
EIRP	Effective Isotropic Radiated power
EL	Elevation (also El)
ELF	Extremely Low Frequency [3 Hz to 3 kHz]
ELINT	Electronics Intelligence
ELNOT	Emitter Library Notation
EM	Electromagnetic
E-Mail	Electronic Mail
EMC	Electromagnetic Compatibility
EMCAB	EMC Advisory Board
EMCON	Emission Control
EMD	Engineering and Manufacturing Development
EME	Electromagnetic Environment
EMI	Electromagnetic Interference
EMP	Electromagnetic Pulse
EMR	Electromagnetic Radiation
EMS	Electromagnetic Susceptibility, Electromagnetic Spectrum
EMV	Electromagnetic Vulnerability
EO	Electro-Optic, Electro-Optical, or Engineering Order
EOB	Electronic Order of Battle or Expense Operating Budget
EOCM	Electro-Optic Countermeasures
EOF	Electro-Optical Frequency (300 to 3 x 10^7 GHz)
EP	Electronic Protection (similar to older terms of ECCM and DECM)
EPA	Environmental Protection Agency
EPROM	Electrically Programmable Read-only Memory
ERAM	Electronic Counter-Countermeasures (also Protection) Requirements and Assessment Manual
ERP	Effective Radiated Power
ES	Electronic Surveillance (similar to older term of ESM)
ESD	Electrostatic Discharge
ESM	Electronic Support Measures (similar to newer term of ES)
ESSM	Evolved Sea Sparrow Missile
ET	Electronics Technician
ETI	Elapsed Time Indicator
ETIRMS	EW Tactical Information and Report Management System
ETR	Estimated Time to Repair
EVM	Earned Value Management
EW	Electronic Warfare , Early Warning, or Expeditionary Warfare
EWBM	EW Battle Management
EWDS	EW Data Systems
EWIA	EW Intelligence Analysis
EWIR	Electronic Warfare Integration & Reprogramming (USAF database)
EWMP	Electronic Warfare Master Plan
EWO	Electronic Warfare Officer
EWRL	Electronic Warfare Reprogrammable Library (USN)
EWSI	EW Systems Integration
EWSSA	EW Software Support Activity
EXP	Expendable Countermeasure
f	femto (10^{-15} multiplier), Frequency (also F), or lens *f* number
F	Frequency (also *f*), Force, Farad, Faraday Constant, Female, Fahrenheit, Noise Figure, Noise Factor or "Friendly" on RWR display

F2T2EA	Find, Fix, Track, Target, Engage, Assess (targeting of hostile forces)
F/A	Fighter/Attack
FAA	Federal Aviation Administration
FAC	Forward Air Controller
FAR	Federal Acquisition Regulations or False Alarm Rate
f_c	Footcandle (unit of illuminance)
FCA	Functional Configuration Audit
FCR	Fire Control Radar
FDR	Frequency Domain Reflectometry
FEBA	Forward Edge of the Battle Area
FET	Field-Effect Transistor
FEWC	Fleet EW Center
FFT	Fast Fourier Transform
FIFO	First In / First Out
FIPR	Federal Information Processing Resources
fl	fluid
FLAK	AAA Shrapnel, from the German "Flieger Abwher Kanone" (AAA gun that fires fast and furiously)
FLIR	Forward Looking Infrared
FLPS	Flightline Payload Simulator
FLT	Flight
FM	Frequency Modulation or Failure Mode
FME	Foreign Material Exploitation
FMEA	Failure Mode and Effects Analysis
FMS	Foreign Military Sale(s)
FOC	Full Operational Capability
FOD	Foreign Object Damage
FORCECAP	Force Combat Air Patrol
FOT&E	Follow-On Test and Evaluation
FOTD	Fiber Optic Towed Device
FOUO	For Official Use Only
FOV	Field of View
FPA	Focal Plane Array
fps	feet per second
FRACAS	Failure, Reporting, Analysis, and Corrective Actions System
FRB	Failure Review Board
FRD	Functional Requirements Document
FSD	Full Scale Development
FSED	Full Scale Engineering Development
FSK	Frequency Shift Keying
FSU	Former Soviet Union
ft	Feet or Foot
FTC	Fast Time Constant
FTD	Foreign Technology Division (USAF)
FWD	Forward
FY	Fiscal Year
g	Gravity (also G)
G	Universal Gravitational Constant (also K), Giga (10^9 multiplier), Conductance, or Gain
G&A	General and Administrative (expense)
GaAs	Gallium Arsenide
GACIAC	Guidance and Control Information Analysis Center (DoD)
gal	Gallon
GAO	General Accounting Office
GBU	Guided Bomb Unit
GCA	Ground Controlled Approach
GCI	Ground Control Intercept
GENSER	General Service
GEN-X	Generic Expendable
GFE	Government Furnished Equipment
GHz	GigaHertz
GI	Government Issue
GIDEP	Government Industry Data Exchange Program
GIG	Global Information Grid
GIGO	Garbage In / Garbage Out
GOCO	Government Owned Contract Operated
GOFO	General Officer / Flag Officer
GP	General Purpose
GPI	Ground Plane Interference
GPIB	General Purpose Interface Bus
GPS	Global Positioning System
GSE	Ground Support Equipment
h	hours, hecto (10^2 multiplier), Plank's constant, or height (also H)
H	Height (also h), Henry (Inductance), or Irradiance
HARM	High-speed Anti-Radiation Missile
HAWK	Homing All the Way Killer
HDBK	Handbook
HDF	High Duty Factor
HE	High Explosive
HEF	High Energy Frequency ($3x10^7$ to $3x10^{14}$ GHz)
HEL	High Energy Laser
HELO	Helicopter
HERF	Hazards of Electromagnetic Radiation to Fuel
HERO	Hazards of Electromagnetic Radiation to Ordnance
HERP	Hazards of Electromagnetic Radiation to Personnel
hex	hexadecimal
HF	High Frequency [3 - 30 MHz]
HIL or HITL	Hardware-in-the-Loop

HOJ	Home-On-Jam
HOL	Higher Order Language
HPF	High-Pass Filter
HP-IB	Hewlett-Packard Interface Bus
HP-IL	Hewlett-Packard Interface Loop
HPM	High Powered Microwave
HPRF	High Pulse Repetition Frequency
hr	hour
HSDB	High Speed Data Bus
HUD	Heads-Up Display
HV	High Voltage
H/W	Hardware
HWCI	Hardware Configuration Item
HWIL	Hardware-in-the-loop
Hz	Hertz (Cycles per second)
i	current (also I)
I	Current (also i), Intensity, Irradiance, Intermediate, or Roman Numeral for One
IA	Information Assurance
IADS	Integrated Air Defense System
I&Q	In-Phase and Quadrature
IAS	Indicated Airspeed
IAW	In Accordance With
IBIT	Initiated Built-in-Test
IBU	Interference Blanker Unit
IC	Integrated Circuit
ICD	Interface Control Document Initial Capabilities Document
ICMD	Improved Countermeasure Dispenser
ICNIA	Integrated Communication, Navigation, Identification Avionics
ICS	Inverse Conical Scan or Intercommunications System (aircraft)
ICW	In Compliance With
ID	Identification
IDA	Institute For Defense Analysis
IDECM	Integrated Defensive Electronic Countermeasures
IEEE	Institute of Electrical and Electronic Engineers
IF	Intermediate Frequency
IFF	Identification Friend-or-Foe
IFM	Instantaneous Frequency Measurement
IFR	Instrument Flight Rules
IG	Inspector General
IIR	Imaging Infrared
I-Level	Intermediate Level of Repair (also "I" Level)
ILS	Integrated Logistic Support, Instrument Landing System, or Inertial Locator System
ILSMT	Integrated Logistic Support Management Team
IM	Intermodulation or Item Manager
IMA	Intermediate Maintenance Activity
in	Inch
INEWS	Integrated Electronic Warfare System
INS	Inertial Navigation System
INT	Intensity
IO	Information Operations
I/O	Input/Output
IOC	Initial Operational (also Operating) Capability
IOT&E	Initial Operational Test and Evaluation
IPO	International Projects (Program) Office
IPR	In-Progress/Process Review
IPT	Integrated Product (also Program) Team
IR	Infrared
IR&D	Independent Research and Development
IRCM	Infrared Countermeasures
IRDS	Infrared Detecting System
IREXP	IR Expendables
IRIG-B	Inter-range Instrumentation Group B
IRLS	Infrared Line Scanner
IRS	Interface Requirements Specification, IR Suppression or Internal Revenue Service
IRST	Infrared Search and Track
ISAR	Inverse Synthetic Aperture Radar
ISO	Derived from the Greek "isos" meaning "equal," the official title is International Organization for Standardization
ISP	Integrated Support Plan Intelligence Support Plan
ISR	Interference to Signal Ratio (also I/S)
ITU	International Telecommunications Union
IV&V	Independent Validation and Verification
IW	Information Warfare

J	Jamming, Radiance, Current Density, or Joules
JAAS	Joint Architecture for Aircraft Survivability
JAFF	Jammer (illuminating) Chaff
JAG	Judge Advocate General
JAMS	Jamming Analysis Measurement System
JARS	Jamming Aircraft & Radar Simulation
JASSM	Joint Air-to-Surface Standoff Missile
JAST	Joint Advanced Strike Technology
JATO	Jet Assisted Takeoff or JAmmer Technique Optimization
JC2WC	Joint Command and Control Warfare Center (now JIOWC)
JCTD	Joint Concept Technology Demonstration
JCS	Joint Chiefs of Staff or Joint Spectrum Center (formerly ECAC)
JDAM	Joint Direct Attack Munition
JEACO	Joint Electronic Attack and Compatibility Office
JED	Journal of Electronic Defense (Published by the Association of Old Crows)
JEM	Jet Engine Modulation
JETS	Joint Emitter Targeting System
JEWC	Joint EW Conference or Joint EW Center (then JC2WC & now JIOWC)
JEWEL	Joint Electronic Warfare Effects Laboratory
JIOWC	Joint Information Operations Warfare Command
JMEM	Joint Munitions Effectiveness Manual
JMR	Jammer
JOVIAL	Julius' Own Version of International Algorithmic Language (Air Force computer programming language)
JPATS	Joint Primary Aircraft Training System
J/S	Jamming to Signal Ratio
JSF	Joint Strike Fighter
JSGCC	Joint Services Guidance and Control Committee
JSIR	Joint Spectrum Interference Resolution (signal interference portion of MIJI)
JSOW	Joint Stand-Off Weapon (AGM-154A)
JSTARS	Joint Surveillance Target Attack Radar System
JTA	Jammer Threat Analysis
JTAT	JATO Techniques Analysis and Tactics
JTCG/AS	Joint Technical Coordinating Group for Aircraft Survivability
JTCG/ME	Joint Technical Coordinating Group for Munitions Effectiveness
JTIDS	Joint Tactical Information Distribution System
JV or J/V	Joint Venture
k	kilo (10^3 multiplier) or Boltzmann Constant
K	Kelvin, Cathode, Universal gravitational constant (also G), or Luminous efficacy
KCAS	Knots Calibrated Airspeed
kg	kilogram
kHz	KiloHertz
KIA	Killed in Action
KIAS	Knots Indicated Air Speed
km	Kilometer
KSLOC	Thousand Source Lines of Code (software)
kt	Knot (nautical miles per hour)
kW	Kilowatt
l	length (also L) or liter
L	Length (also l), Loss, inductance, Luminance, or Roman Numeral for fifty
LADAR	Laser Detection and Ranging (i.e., laser radar)
LAN	Local Area Network
LANTIRN	Low Altitude Navigation & Targeting Infrared for Night
LASER	Light Amplification by Stimulated Emission of Radiation
LAT	Latitude (0-90° N or S from equator)
lbs	pounds
LCC	Life Cycle Cost(s)
LCD	Liquid Crystal Display or Lowest Common Denominator
LCP or LHCP	Left-hand Circular Polarization
LDF	Low Duty Factor
LDS	Laser Detecting Set
LED	Light-Emitting Diode
LEX	Leading Edge Extension
LGB	Laser Guided Bomb
LF	Low Frequency [30 - 300 kHz]
LIC	Low Intensity Combat or Laser Intercept Capability

LISP	List Processing (A programming language used in artificial intelligence)
LLL	Low Light Level (as in LLL TV)
lm	lumen (SI unit of luminous flux)
ln	Natural Logarithm
LO	Local Oscillator or Low Observable
LOA	Letter of Agreement (or Acceptance)
LOB	Line of Bearing (see also AOA)
LOG	Logarithm to the base 10 (also log) or Logistician
LONG	Longitude (0-180° E or W from Greenwich, U.K.)
LOR	Level of Repair
LORA	Level of Repair Analysis
LORAN	Long Range Navigation
LORO	Lobe on Receive Only
LOS	Line-of-Sight
LPAR	Large Phased-Array Radar
LPD	Low Probability of Detection
LPF	Low Pass Filter
LPI or LPOI	Low Probability of Intercept
LPRF	Low Pulse Repetition Frequency
LR	Lethal Range
LRA	Line Replaceable Assembly
LRF	Laser Rangefinder
LRIP	Low Rate Initial Production
LRU	Line Replaceable Unit
LSA	Logistic Support Analysis
LSAR	Logistic Support Analysis Record
LSB	Least Significant Bit
LSI	Large Scale Integration
LSO	Landing Signal Officer
LSSO	Laser System Safety Officer
LTBB	Look Through Blanking Bus
LWIR	Long Wave Infrared
LWR	Laser Warning Receiver
lx	Lux (SI unit of illuminance)
LZ	Landing Zone
m	milli (10^{-3} multiplier), meter, or electron mass
M	Mega (10^{6} multiplier), Male, Mach number, or Roman numeral for 1,000
MA	Missile Alert or Missile Active
MAD	Magnetic Anomaly Detection (also Detector)
MADD	Microwave Acoustic Delay Device
MAF	Maintenance Action Form
MAG	Marine Aircraft Group or Magnetic
MAGTF	Marine Air-Ground Task Force
MANPADS	Man-portable Air Defense System
M&S	Modeling and Simulation
MASER	Microwave Amplification by Simulated Emission of Radiation
MATE	Modular Automatic Test Equipment
MAW	Missile Approach Warning system (also MAWS) or Marine Aircraft Wing
MAX	Maximum or Maximum aircraft power (afterburner)
MBFN	Multiple Beam Forming Network
MC	Mission Computer
MCIOC	Marine Corps Information Operations Center
MCP	Micro-Channel Plate
MDF	Mission Data File
MDI	Multiple Display Indicator or Miss Distance Indicator
MDG	Mission Data Generator
MDS	Minimum Discernible Signal or Minimum Detectable Signal
MDU	Multipurpose Display Unit
MF	Medium Frequency (300 kHz to 3 MHz)
MFD	Multifunction (video) Display
MG	Missile Guidance
MHz	MegaHertz (10^{6} Hz)
MIA	Missing in Action
MIC	Microwave Integrated Circuit or Management Information Center
MICRON	10^{-6} meter
MiG	Mikoyan-Gurevich (Soviet aircraft manufacturer)
MIGCAP	MiG Combat Air Patrol
MIJI	Meaconing, Intrusion, Jamming, & Interference (also see JSIR)
mil	One-thousandth of an inch
MIL	Military power (100%, no afterburner) or Military
MILCON	Military Construction
MILSPEC	Military Specification
MILSTRIP	Military Standard Requisitioning and Issue Procedure(s)
MIMIC	Microwave Monolithic Integrated Circuit (also MMIC)
MIN	Minimum
Mincon	Minimal Construction
MIPPLE	RWR display switching between ambiguous emitters
MIPS	Millions of (Mega) Instructions Per Second
ML	Missile Launch
MLC	Main Lobe Clutter
MLV	Memory Loader Verifier
MLVS	Memory Loader Verifier Set

mm	Millimeter
MM	Man Month
MMIC	Microwave Monolithic Integrated Circuit (also MIMIC)
MMW	Millimeter Wave (40 GHz or higher per IEEE, but commonly used down to 30 GHz)
MOA	Memorandum of Agreement
MOE	Measure of Effectiveness
MOM	Methods of Moments (also MoM) or Metal-Oxide-Metal
MOP	Modulation on Pulse or Measure of Performance
MOPS	Million Operations Per Second
MOS	Minimum Operational Sensitivity, Military Occupational Specialty, Metal-Oxide Semiconductor, or Measure of Suitability
MOSAIC	Modeling System for Advanced Investigation of Countermeasures
MOU	Memorandum of Understanding
MPD	Multi-Purpose Display or Microwave Power Device
MPE	Maximum Permissible Exposure
mph	Miles per Hour
MPLC	Multi-Platform Launch Controller
MPM	Microwave Power Module
MPPS	Million Pulses Per Second
MPRF	Medium Pulse Repetition Frequency
mr or mrad	Milliradian
MRC	Maintenance Requirement Card or Medium Range CAP
MRE's	Meals Ready to Eat
ms	Milliseconds
MSB	Most Significant Bit
MSI	Multi-Sensor (also Source) Integration, Management Support Issues, or Medium Scale Integration
MSIC	Missile and Space Intelligence Center
MSL	Mean Sea Level (altitude) or Missile
MTBF	Mean Time Between Failures
MTI	Moving Target Indicator (or Indication)
MTTR	Mean Time To Repair
MUXBUS	Multiplex Bus
MVS	Minimum Visible Signal
mw	Microwave
mW	Milliwatt
MWIR	Mid Wave Infrared
MWS	Missile Warning Set
MY	Man Year
n	nano (10^{-9} multiplier) or number of elements
N	Noise, Newton (force), Radiance, North, or No
n/a	Not Applicable (also N/A)
NA	Numerical Aperture
NADEP	Naval Aviation Depot
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organization
NATOPS	Naval Air Training and Operating Procedures Standardization
NAV	Navigation
NAVAIR	Naval Air Systems Command (also NAVAIRSYSCOM)
NavMPS	Naval Mission Planning System
NAVSEA	Naval Sea Systems Command (also NAVSEASYSCOM)
NAWCAD	Naval Air Warfare Center Aircraft Division
NAWCWD	Naval Air Warfare Center Weapons Division
NBC	Nuclear, Biological, Chemical
NCTR	Non-Cooperative Target Recognition
NDI	Non-Developmental Item or Non Destructive Inspection
NEI	Noise Equivalent Power
NEMP	Nuclear Electromagnetic Pulse
NEOF	No Evidence of Failure
NEP	Noise Equivalent Power
NF	Noise Figure or Noise Factor (also F)
NFO	Naval Flight Officer
NGJ	Next Generation Jammer
NIOC	Navy Information Operations Command
NIPO	Navy International Program Office
NIR	Near Infrared
nm	nanometer or Nautical Mile (also NM or NMI)
NM or NMI	Nautical Mile (also nm)
NMCI	Navy Marine Corps Intranet
NNWC	Naval Network Warfare Command
NOHD	Nominal Ocular Hazard Distance
NORAD	North American Air Defense Command
NPG or NPGS	Naval Post Graduate School
NRE	Non-Recurring Engineering
NRL	Naval Research Laboratory
NRZ	Non Return to Zero
NSA	National Security Agency
nsec or ns	Nanosecond
NSN	National Stock Number
NSWC	Naval Surface Weapons Center
nt	Nit (SI unit of luminance)

NUWC	Naval Undersea Warfare Center
NVG	Night Vision Goggles
NWIP	Naval Warfare Information Publication
NWP	Naval Warfare Publication
O	Optical
OADR	Originating Agency's Determination Required
OAG	Operational Advisory Group
O&MN	Operations and Maintenance, Navy (also O&M,N)
OBE	Overtaken (Overcome) By Events
OCA	Offensive Counter Air
OEWTPS	Organizational Electronic Warfare Test Program Set
OFP	Operational Flight Program
OJT	On-the-Job Training
O-Level	Organizational Level of Repair (also "O" Level)
OMA	Organizational Maintenance Activity
OMB	Office of Management and Budget
OMEGA	Optimized Method for Estimating Guidance Accuracy (VLF Navigation System)
ONR	Office of Naval Research
OOK	On-Off Keying
OPEVAL	Operational Evaluation
OPM	Office of Personnel Management
OPSEC	Operational Security
OPTEVFOR	Operational Test and Evaluation Force
OR	Operational Requirement or Operationally Ready
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Act
OSIP	Operational Safety Improvement Program
OSM	Operating System Memory or SMA connector made by Omni-Spectra
OSRB	Operational Software Review Board
OT (&E)	Operational Test (and Evaluation)
OTD	Operational Test Director
OTH	Over the Horizon
OTH-B	Over-the-Horizon Backscatter
OTH-R	Over-the-Horizon Radar
OTH-T	Over-the-Horizon Targeting
OTRR	Operational Test Readiness Review
OUSD	Office of the Under Secretary of Defense
oz	ounce
p	pico (10^{-12} multiplier) or page
P	Power, Pressure, or Peta (10^{15} multiplier)
P^3I	Pre-Planned Product Improvement
Pa	Pascal (pressure)
PA	Public Address or Program Analyst
PBIT	Periodic Built-in-Test
PC	Pulse Compression, Personal Computer, or Photoconductive
PCA	Physical Configuration Audit
PCM	Pulse Code Modulation
P_d	Probability of Detection
PD	Pulse Doppler
PDI	PD Illuminator or Post Detection Integration
PDP	Plasma Display Panel
PDQ	Pretty Darn [sic] Quick
PDR	Preliminary Design Review
PDW	Pulse Descriptor Word
PEL	Personnel Exposure Limits
PEM	Photoelectromagnetic
PEO	Program Executive Officer
pf	Power Factor or Pico Farads
PFA	Probability of False Alarm
PGM	Precision Guided Munition
ph	Phot (unit of illuminance)
P_h	Probability of Hit
pi	Greek letter π
P_i	Probability of Intercept (also POI)
PID	Positive Identification
PIN	Personal Identification Number
PIP	Product Improvement Plan or Predicted Intercept Point
Pixel	Picture Element
P_k	Probability of Kill or Peak
PLSS	Precision Location Strike System
PM	Phase Modulation or Program Manager
PMA	Program (also Project) Manager, Air
PMAWS	Passive Missile Approach Warning System
PMS	Program Manager, Ship
PMT	Photomultiplier Tube
PMW	Program Manager, Warfare
P-N	Positive to Negative Junction (also p-n)
PN or P/N	Part Number
POC	Point of Contact
POET	Primed Oscillator Expendable Transponder
POI	Probability of Intercept (also PI)
POL	Polarization
POM	Program Objective Memorandum

POP	Pulse-on-Pulse or Product Optimization Program
POST	Passive Optical Seeker Technology (Stinger missile)
PPI	Plan Position Indicator
PPS	Pulses Per Second
PRF	Pulse Repetition Frequency
PRI	Priority or Pulse Repetition Interval
PROM	Programmable Read-only Memory
PRR	Production Readiness Review or Pulse Repetition Rate
PRT	Pulse Repetition Time
P_s	Probability of Survival
P's & Q's	Pints and Quarts (small details)
PSK	Phase-shift Keying
PUPS	Portable Universal Programming System
PV	Photovoltaic
pw or PW	Pulse Width
PWB	Printed Wiring Board
q	electron charge
Q	Quantity Factor (figure of merit), Quadrature, aerodynamic pressure, or Charge (coulomb)
QA	Quality Assurance
QC	Quality Control
QED	Quod Erat Demonstradum (end of proof)(Satirically "quite easily done")
QML	Qualified Manufacturer Listing
QPL	Qualified Parts List
QRC	Quick-Reaction Capability
QRD	Quick Reaction Demonstration
QRT	Quick-Reaction test
r or R	Radius or Range
R	Resistance, Reliability, or Roentgen
rad	Radian
R&D	Research and Development
RADAR	Radio Detection and Ranging
RADHAZ	Radiation Hazard
RAM	Random Access Memory, Radar Absorbing Material, Rolling Airframe Missile, or Reliability, Availability, and Maintainability
R&M	Reliability and Maintainability
RAT	Ram Air Turbine
RBOC	Rapid Blooming Offboard Chaff
RCP or RHCP	Right-hand Circular Polarization
RCS	Radar Cross Section
RCVR	Receiver
RDT&E	Research, Development, Test, & Evaluation
RDY	Ready
RE	Radiated Emissions
REC	Receive
RET	Return
RF	Radio Frequency
RFEXP	RF Expendables
RFI	Radio Frequency Interference, Ready-For-Issue, or Request for Information
RFP	Request for Proposal
RFQ	Request for Quotation
RFSS	Radio Frequency Simulation System (Army)
RGPO	Range Gate Pull Off
RGS	Range Gate Stealer
RGWO	Range Gate Walk Off (see RGPO)
RHAW	Radar Homing and Warning Receiver or Radar Homing All the Way
RHAWS	Radar Homing and Warning System
RINT	Radiation Intelligence
RIO	Radar Intercept Officer
RM	Radar Mile
rms or RMS	Root Mean Square
RNG	Range
ROC	Required Operational Capability
ROE	Rules of Engagement
ROI	Return on Investment
ROM	Read-only Memory or Rough Order of Magnitude
ROR	Range Only Radar or Rate of Return (financial)
ROT	Rate of Turn
ROWG	Response Optimization Working Group
RPG	Receiver Processor Group
RPM	Revolutions per Minute
RPT	Repeat
RPV	Remotely Piloted Vehicle
RRT	Rapid Reprogramming Terminal (a type of MLVS)
RS	Radiated Susceptibility or Remote Station
RSDS	Radar Signal Detecting Set
RSO	Range Safety Officer or Receiver, Set-on
RST	Receiver Shadow Time
RT	Remote Terminal, Termination Resistance, or Receiver/Transmitter (also R/T)
RUG	Radar Upgrade
RWR	Radar Warning Receiver
Rx	Receive

s, S, or sec	seconds
S	Signal Power, Surface Area, Secret, Electrical conductance (siemens), South, Scattering (as in S-parameters), or Seconds
SA	Situational Awareness, Semi-Active, Spectrum Analyzer, or Surface-to-Air (also S/A or S-A)
SA-()	Surface-to-Air missile number ()
SAE	Society of Automotive Engineers
SAM	Surface-to-Air Missile
SA-N-()	Naval Surface-to-Air missile number
SAR	Synthetic Aperture Radar, Special Access Required, Semi-Active Radar, Search and Rescue, or Specific Absorption Rate
SATS	Semi-Active Test System
SAW	Surface Acoustic Wave
SBIR	Small Business Innovative Research
SCI	Sensitive Compartmented Information
SCIF	Sensitive Compartmented Information Facility
SCN	Specification Change Notice
SCR	Software Change Request
SCP	Software Change Proposal
SCRB	Software Configuration Review Board
SCUD	Soviet short-range surface-to-surface missile
SE	Support Equipment
SDLM	Standard Depot Level Maintenance
SDI	Strategic Defense Initiative
SEAD	Suppression of Enemy Air Defense (pronounced "seed" or "C add")
SEAL	Sea-Air-Land (Navy special forces)
sec	seconds (also S or s)
SECDEF	Secretary of Defense
SEI	Specific Emitter Identification
SEMA	Special Electronic Mission Aircraft
SERD	Support Equipment Recommendation Data
SHAPE	Supreme Headquarters Allied Powers Europe (NATO military command)
SHF	Super High Frequency (3 to 30 GHz)
SI	Special Intelligence or System International (Units)
SIF	Selective Identification Feature
SIGINT	Signals Intelligence
SIJ	Stand-In Jamming (also S/J)
SIM	Simulation
sin	Sine
SINCGARS	Single Channel Ground and Airborne Radio System
SIRCM	Suite of IR Countermeasures
SIRFC	Suite of Integrated RF Countermeasures
SJ	Support Jamming
S/J	Stand-In Jamming or Signal to Jamming Ratio
SL	Side lobe or Sea Level (also S.L.)
SLAM	Standoff Land Attack Missile
SLAR	Side-Looking Airborne Radar
SLC	Side Lobe Clutter
SLOC	Source Lines of Code or Sea Lines of Communication
SM	Statute Mile (also sm) or Standard Missile
SMA	Scheduled Maintenance Action or Sub-Miniature A connector
SMC	Sub-Miniature C connector
SME	Subject Matter Expert
SML	Support Material List
SMS	Stores Management Set or Status Monitoring System
S/N or SNR	Signal-to-Noise Ratio
SNORT	Supersonic Naval Ordnance Research Track
SNTK	Special Need to Know
SOF	Safety of Flight
SOJ	Stand-off Jammer
SONAR	Sound Navigation and Ranging
SOO	Statement of Objectives (replacing SOW)
SOP	Standard Operating Procedures
SORO	Scan-on-Receive Only
SOS	"Save Our Ship" (distress call with easy Morse code, i.e. • • • – – – • • •)
SOW	Statement of Work (being replaced by SOO)
SPAWAR	Space and Naval Warfare Systems Command
SPEC	Specification
SPIRITS	Spectral Infrared Imaging of Targets and Scenes
SPO	System Program Office
SPY	Radar on an AEGIS ship
sq	Square
sr	Steradian
SRA	Shop Replaceable Assembly
SRAM	Static Random Access Memory
SRB	Software Review Board
SRBOC	Super Rapid Blooming Offboard Chaff
SRD	Systems Requirements Document
SRS	Software Requirements Specification
SRU	Shop Replaceable Unit

SSA	Software (also Special or System) Support Activity, Source Selection Activity, or Solid State Amplifier
SSB	Single Side Band
SSI	Small Scale Integration
SSJ	Self Screening Jamming
SSM	Surface-to-Surface Missile
SSRO	Sector Scan Receive Only
SSW	Swept Square Wave
S&T	Science and Technology
STANAG	Standardization Agreement (NATO)
STAR	System Threat Assessment Report
stat	Statute
STBY	Standby
STC	Sensitivity Time Control, Short Time Constant or SHAPE Technical Center
STD	Software Test Description, Standard, or Sexually Transmitted Disease
STE	Standard Test Equipment
STOVL	Short Takeoff and Vertical Landing
STP	Software Test Plan, or Standard Temperature and Pressure (0°C at 1 atmosphere)
STR	Software (also System) Trouble Report
STT	Single Target Track
STU	Secure Telephone Unit
SUBSAM	Subsurface-to-Air Missile
SUT	System Under Test
S/W	Software (also SW)
SWAP	Size, Weight, And Power
SWC	Scan With Compensation
SWM	Swept Wave Modulation
SYSCOM	Systems Command
t	Time (also T)
T	Time (also t), tera (10^{12} multiplier), Temperature, or Telsa
TA	Target Acquisition or Terrain Avoidance
TAAF	Test, Analyze, and Fix
TAC	Tactical Air Command (now ACC)
TACAIR	Tactical Aircraft
TACAMO	Take Charge and Move Out (airborne strategic VLF communications relay system)
TACAN	Tactical Air Navigation
TACDS	Threat Adaptive Countermeasures Dispensing System
TACTS	Tactical Aircrew Combat Training System
TAD	Threat Adaptive Dispensing, Temporary Additional (also Active) Duty, or Tactical Air Direction
T&E	Test & Evaluation
TALD	Tactical Air Launched Decoy
TAMPS	Tactical Automated Mission Planning System
TAR	Target Acquisition Radar or Training Administrative Reserve
TAS	True Airspeed
TBA	To Be Announced
TBD	To Be Determined
TBMD	Theater Ballistic Missile Defense
TD	Technical Directive (also Director)
TDD	Target Detection Device
TDM	Time Division Multiplexing
TE	Transverse Electric
TEA	Technology Exchange Agreement
TEAMS	Tactical EA-6B Mission Support
TECHEVAL	Technical Evaluation
TEL	Transporter Erector Launcher
TEM	Transverse Electromagnetic
TEMP	Test and Evaluation Master Plan
TEMPEST	Not an acronym. Certification of reduced electromagnetic radiation for security considerations
TENA	Training Enabling Architecture
TERPES	Tactical Electronic Reconnaissance Processing and Evaluation System
TGT	Target
TIM	Technical Interchange Meeting
TM	Telemetry, Transverse Magnetic, or Technical Manual
TMD	Theater Missile Defense
TNC	Threaded Navy Connector
TOA	Time of Arrival
TOJ	Track on Jam
TOO	Target of Opportunity (HARM operating mode)
TOR	Tentative (also Tactical) Operational Requirement or Time of Receipt
TOS	Time on Station
TOT	Time on Target
TOW	Tube-Launched, Optically-Tracked, Wire-guided
TPI	Test Program Instruction
TPS	Test Program Set or Test Pilot School
TPWG	Test Plan Working Group
TQM	Total Quality Management
T/R	Transmit / Receive
TRB	Technical Review Board
TRD	Test Requirements Document
TREE	Transient Radiation Effects on Electronics

TRF	Tuned Radio Frequency
TRR	Test Readiness Review
TS	Top Secret
TSS	Tangential Sensitivity
TSSAM	Tri-Service Standoff Attack Weapon
TT	Target Track
TTI	Time To Impact/Intercept
TTG	Time-to-Go
TTL	Transistor-Transistor Logic
TTR	Target Tracking Radar
TV	Television
TVC	Thrust Vector Control
TWS	Track While Scan or Tail Warning System
TWSRO	Track While Scan on Receive Only
TWT	Traveling Wave Tube
TWTA	Traveling Wave Tube Amplifier
Tx	Transmit
TYCOM	Type Commander
u or μ	micron / micro (10^{-6} multiplier)
U	Unclassified, Unit, or Unknown (on RWR display)
UAS	Unmanned Aerial System
UAV	Unmanned (also uninhabited) Air (or Aerial) Vehicle
UCAV	Uninhabited Combat Air Vehicle (new USAF term for UAV)
UDF	User Data File
UDFG	User Data File Generator
UDM	User Data Module
UHF	Ultra High Frequency (300 MHz to 3 GHz)
ULF	Ultra Low Frequency (3 to 30 Hz)
μm	Micrometer
UN	United Nations
UNK	Unknown (also U)
UPC	Unique Planning Component
UPS	Uninterruptable Power Supply
us or μs	Microseconds
U.S.	United States
USA	United States of America or United States Army
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
UTA	Uninhabited Tactical Aircraft
UUT	Unit Under Test
UV	Ultraviolet
v	Volts (also V), Velocity (also V or v_t)
V	Volts (also v), Velocity (also v or v_t), Volume, or Roman Numeral for five
VA	Veterans Administration, Volt-Amperes
VAQ	Prefix for Navy tactical EW squadron
V&V	Validation and Verification
VCO	Voltage Controlled Oscillator
Vdc or VDC	Volts Direct Current
VDT	Video Display Terminal
VECP	Value Engineering Change Proposal
VF	Prefix for Navy fighter squadron
VFO	Variable Frequency Oscillator
VFR	Visual Flight Rules
VGPO	Velocity Gate Pull Off
VGS	Velocity Gate Stealer
VGWO	Velocity Gate Walk Off
VHF	Very High Frequency (30 - 300 MHz)
VHSIC	Very High Speed Integrated Circuit
VID	Visual Identification
VLF	Very Low Frequency (3 to 30 kHz)
VLSI	Very Large Scale Integration
VLSIC	Very Large Scale Integrated Circuit
VMAQ	Prefix for Marine Tactical EW Squadron
VP	Prefix for Navy patrol squadron
VQ	Prefix for Navy special mission (usually reconnaissance) squadron
VRAM	Video Random Access Memory
VS or vs	Velocity Search or Versus (also vs.)
V/STOL	Vertical/Short Take-off and Landing (also VSTOL)
vt	Velocity (also V or v)
VTOL	Vertical Takeoff and Landing
VSWR	Voltage Standing Wave Ratio
VVA	Voltage Variable Attenuator
W	Watts, Weight, or West
W&T	Warning & Targeting
WARM	Wartime Reserve Mode
wb	Weber (magnetic flux)
WBS	Work Breakdown Structure
WC	Waveguide, circular
WFT	Windowed Fourier Transform
WGIRB	Working Group on Infrared Background
WORM	Write Once Read Many [times] (Refers to optical disks)
WOW	Weight on/off Wheels (also WonW or WoffW)
WPN	Weapons Procurement, Navy or Weapon

WR	Waveguide, rectangular
WRA	Weapon Replaceable Assembly
WRD	Waveguide, rectangular double ridged
WSSA	Weapons System Support Activity
WVR	Within Visual Range

x	Multiplication symbol
X	Reactance, Experimental, Extraordinary, Roman Numeral for ten, or X axis
X-EYE	Cross Eye
X-POL	Cross Polarization
XMIT	Transmit
XMTR	Transmitter

Y	Yes or Y-Axis
YAG	Yttrium-Aluminum Garnet
yd	Yard
YIG	Yttrium-Iron Garnet

Z	Impedance, Zenith, or Z-Axis

1xLR, 2xLR	One (or two or three etc.) Times Lethal Range
1v1 or 1-v-1	One versus One (Aerial engagement)

2D	Two Dimension

3D	Three Dimension
3M	Navy Maintenance and Material Management System

FUNDAMENTALS

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CONSTANTS, CONVERSIONS, and CHARACTERS

DECIMAL MULTIPLIER PREFIXES

Prefix	Symbol	Multiplier
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deka	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}

EQUIVALENCY SYMBOLS

Symbol	Meaning
$\propto$	Proportional
~	Roughly equivalent
$\approx$	Approximately
$\cong$	Nearly equal
=	Equal
$\equiv$	Identical to, defined as
$\neq$	Not equal
>>	Much greater than
>	Greater than
$\geq$	Greater than or equal to
<<	Much less than
<	Less than
$\leq$	Less than or equal to
$\therefore$	Therefore
°	Degrees
′	Minutes or feet
“	Seconds or inches

UNITS OF LENGTH

1 inch (in)	=	2.54 centimeters (cm)
1 foot (ft)	=	30.48 cm = 0.3048 m
1 yard (yd)	$\cong$	0.9144 meter
1 meter (m)	$\cong$	39.37 inches
1 kilometer (km)	$\cong$	0.54 nautical mile
	$\cong$	0.62 statute mile
	$\cong$	1093.6 yards
	$\cong$	3280.8 feet
1 statute mile	$\cong$	0.87 nautical mile
(sm or stat. mile)	$\cong$	1.61 kilometers
	=	1760 yards
	=	5280 feet
1 nautical mile	$\cong$	1.15 statute miles
(nm or naut. mile)	$\cong$	1.852 kilometers
	$\cong$	2025 yards
	$\cong$	6076 feet
1 furlong	=	1/8 mi (220 yds)

UNITS OF SPEED

1 foot/sec (fps)	$\cong$	0.59 knot (kt)*
	$\cong$	0.68 stat. mph
	$\cong$	1.1 kilometers/hr
1000 fps	$\approx$	600 knots
1 kilometer/hr	$\cong$	0.54 knot
(km/hr)	$\cong$	0.62 stat. mph
	$\cong$	0.91 ft/sec
1 mile/hr (stat.)	$\cong$	0.87 knot
(mph)	$\cong$	1.61 kilometers/hr
	$\cong$	1.47 ft/sec
1 knot*	$\cong$	1.15 stat. mph
	$\cong$	1.69 feet/sec
	$\cong$	1.85 kilometer/hr
	$\cong$	0.515 m/sec

*A knot is 1 nautical mile per hour.

UNITS OF VOLUME

1 gallon	≅	3.78 liters
	≅	231 cubic inches
	≅	0.1335 cubic ft
	≅	4 quarts
	≅	8 pints
1 fl ounce	≅	29.57 cubic centimeter (cc) or milliliters (ml)
1 in^3	≅	16.387 cc

UNITS OF AREA

1 sq meter	≅	10.76 sq ft
1 sq in	≅	645 sq millimeters (mm)
	=	1,000,000 sq mil
1 mil	=	0.001 inch
1 acre	=	43,560 sq ft

UNITS OF WEIGHT

1 kilogram (kg)	≅	2.2 pounds (lbs)
1 pound	≅	0.45 Kg
	=	16 ounce (oz)
1 oz	=	437.5 grains
1 carat	≅	200 mg
1 stone (U.K.)	≅	6.36 kg

NOTE: These are the U.S. customary (avoirdupois) equivalents, the troy or apothecary system of equivalents, which differ markedly, was used long ago by pharmacists.

UNITS OF POWER / ENERGY

1 H.P.	=	33,000 ft-lbs/min
	=	550 ft-lbs/sec
	≅	746 Watts
	≅	2,545 BTU/hr

(BTU = British Thermal Unit)

1 BTU	≅	1055 Joules
	≅	778 ft-lbs
	≅	0.293 Watt-hrs

SCALES

OCTAVES

"N" Octaves = Freq to Freq x 2^N
i.e., One octave would be 2 to 4 GHz
Two Octaves would be 2 to 8 GHz
Three octaves would be 2 to 16 GHz

DECADES

"N" Decades = Freq to Freq x 10^N
i.e., One decade would be 1 to 10 MHz
Two decades would be 1 to 100 MHz
Three decades would be
1 to 1,000 MHz

TEMPERATURE CONVERSIONS

°F = (9/5) °C + 32
°C = (5/9)(°F - 32)
°K = °C + 273.16
°F = (9/5)(°K - 273) + 32
°C = °K - 273.16
°K = (5/9)(°F - 32) + 273

UNITS OF TIME

1 year	=	365.2 days
1 fortnight	=	14 nights (2 weeks)
1 century	=	100 years
1 millennium	=	1,000 years

NUMBERS

1 decade	=	10
1 Score	=	20
1 Billion	=	1 x 10^9 (U.S.) (thousand million)
	=	1 x 10^{12} (U.K.) (million million)

RULE OF THUMB FOR ESTIMATING DISTANCE TO LIGHTNING / EXPLOSION:

km: Divide 3 into the number of seconds which have elapsed between seeing the flash and hearing the noise.
miles: Multiply 0.2 times the number of seconds which have elapsed between seeing the flash and hearing the noise.
Note: Sound vibrations cause a change of density and pressure within a media, while electromagnetic waves do not. An audio tone won't travel through a vacuum but can travel at 1,100 ft/sec through air. When picked up by a microphone and used to modulate an EM signal, the modulation will travel at the speed of light.

Physical Constant	Quoted Value	S*	SI unit	Symbol
Avogadro constant	6.0221367×10^{23}	36	mol^{-1}	N_A
Bohr magneton	$9.2740154 \times 10^{-24}$	31	$J \bullet T^{-1}$	μ_B
Boltzmann constant	1.380658×10^{-23}	12	$J \bullet K^{-1}$	$k(=R\ N_A)$
Electron charge	$1.602177\ 33 \times 10^{-19}$	49	C	-e
Electron specific charge	$-1.758819\ 62 \times 10^{11}$	53	$C \bullet kg^{-1}$	$-e/m_e$
Electron rest mass	$9.1093897 \times 10^{-31}$	54	kg	m_e
Faraday constant	9.6485309×10^{4}	29	$C \bullet mol^{-1}$	F
Gravity (Standard Acceleration)	9.80665 or 32.174	0	m/sec^2 ft/sec^2	g
Josephson frequency to voltage ratio	4.8359767×10^{14}	0	$Hz \bullet V^{-1}$	2e/hg
Magnetic flux quantum	$2.06783461 \times 10^{-15}$	61	Wb	φ_o
Molar gas constant	8.314510	70	$J \bullet mol^{-1} \bullet K^{-1}$	R
Natural logarithm base	$\cong 2.71828$	-	dimensionless	*e*
Newtonian gravitational constant	6.67259×10^{-11}	85	$m^3 \bullet kg^{-1} \bullet s^{-2}$	G or K
Permeability of vacuum	$4\pi \times 10^{-7}$	d	H/m	μ_o
Permittivity of vacuum	$\cong 8.8541878 \times 10^{-12}$	d	F/m	ε_o
Pi	$\cong 3.141592654$		dimensionless	π
Planck constant Planck constant/2π	6.62659×10^{-34} $1.05457266 \times 10^{-34}$	40 63	$J \bullet s$ $J \bullet s$	h $h(=h2\pi)$
Quantum of circulation	$3.63694807 \times 10^{-4}$	33	$J \bullet s \bullet kg^{-1}$	$h/2m_e$
Radius of earth (Equatorial)	6.378×10^{6} or 3963		m miles	
Rydberg constant	$1.0973731534 \times 10^{7}$	13	m^{-1}	R_χ
Speed of light	2.9979246×10^{8}	1	$m \bullet s^{-1}$	c
Speed of sound (dry air @ std press & temp)	331.4	-	$m \bullet s^{-1}$	-
Standard volume of ideal gas	22.41410×10^{-3}	19	$m^3 \bullet mol^{-1}$	V_m
Stefan-Boltzmann constant	5.67051×10^{-8}	19	$W \bullet K^{-4} \bullet m^{-2}$	σ

* S is the one-standard-deviation uncertainty in the last units of the value, d is a defined value.
(A standard deviation is the square root of the mean of the sum of the squares of the possible deviations)

THE SPEED OF LIGHT			
ACTUAL	UNITS	RULE OF THUMB	UNITS
$\cong 2.9979246 \times 10^8$	m/sec	$\cong 3 \times 10^8$	m/sec
$\cong 299.79$	m/μsec	$\cong 300$	m/μsec
$\cong 3.27857 \times 10^8$	yd/sec	$\cong 3.28 \times 10^8$	yd/sec
$\cong 5.8275 \times 10^8$	NM/hr	$\cong 5.8 \times 10^8$	NM/hr
$\cong 1.61875 \times 10^5$	NM/sec	$\cong 1.62 \times 10^5$	NM/sec
$\cong 9.8357105 \times 10^8$	ft/sec	$\cong 1 \times 10^9$	ft/sec
$\cong 9.8357105 \times 10^2$	ft/μsec	$\cong 1 \times 10^3$	ft/μsec

SPEED OF LIGHT IN VARIOUS MEDIUMS

The speed of EM radiation through a substance such as cables is defined by the following formula:

$$V = c/(\mu_r \varepsilon_r)^{1/2}$$

Where: μ_r = relative permeability
ε_r = relative permittivity

The real component of ε_r = dielectric constant of medium.

EM propagation speed in a typical cable might be 65-90% of the speed of light in a vacuum.

APPROXIMATE SPEED OF SOUND (MACH 1)

Sea Level (CAS/TAS)		**36,000 ft*** (TAS)	(CAS)
1230 km/hr	Decreases	1062 km/hr	630 km/hr
765 mph	Linearly	660 mph	391 mph
665 kts	To ⇒	573 kts	340 kts

* The speed remains constant until 82,000 ft, when it increases linearly to 1215 km/hr (755 mph, 656 kts) at 154,000 ft. Also see Section 8-2 for discussion of Calibrated Air Speed (CAS) and True Airspeed (TAS) and a plot of the speed of sound vs. altitude.

SPEED OF SOUND IN VARIOUS MEDIUMS

Substance	Speed (ft/sec)
Vacuum	Zero
Air	1,100
Fresh Water	4,700
Salt Water	4,900
Glass	14,800
Steel	20,000

DECIMAL / BINARY / HEX CONVERSION TABLE

Decimal	Binary	Hex	Decimal	Binary	Hex	Decimal	Binary	Hex
1	00001	01h	11	01011	0Bh	21	10101	15h
2	00010	02h	12	01100	0Ch	22	10110	16h
3	00011	03h	13	01101	0Dh	23	10111	17h
4	00100	04h	14	01110	0Eh	24	11000	18h
5	00101	05h	15	01111	0Fh	25	11001	19h
6	00110	06h	16	10000	10h	26	11010	1Ah
7	00111	07h	17	10001	11h	27	11011	1Bh
8	01000	08h	18	10010	12h	28	11100	1Ch
9	01001	09h	19	10011	13h	29	11101	1Dh
10	01010	0Ah	20	10100	14h	30	11110	1Eh

When using hex numbers it is always a good idea to use "h" as a suffix to avoid confusion with decimal numbers.

DECIMAL TO HEX CONVERSION

Both the following methods must use long division. Method one computes the digits from right to left while method two works from left to right.

Method one: To convert a decimal number above 16 to hex, divide the number by 16, then record the <u>integer</u> resultant and the <u>remainder</u>. Convert the remainder to hex and write this down - this

will become the far right digit of the final hex number. Divide the integer you obtained by 16, and again record the new integer result and new remainder. Convert the remainder to hex and write it just to the left of the first decoded number. Keep repeating this process until dividing results in only a remainder. This will become the left-most character in the hex number (i.e., to convert 60 (decimal) to hex we have 60/16 = 3 with 12 remainder). 12 is C (hex) - this becomes the right most character. Then 3/16=0 with 3 remainder. 3 is 3 (hex). This becomes the next (and final) character to the left in the hex number, so the answer is 3C.

Method two: Use table of powers to work the digits from left to right:

For example: Here is your Decimal Number - 9379

Step 1 - Set up your chart:

65536	4096	256	16	1
16^4	16^3	16^2	16^1	16^0

Step 2 - Look in the table for the highest divisible number in the chart.
9379 / 4096 = 2 (the left-most Hex digit)
<u>Must use long division</u> to calculate the remainder (1187)

Step 3 - Divide the remainder with its highest divisible number in the chart:
1187 / 256 = 4 (the next digit to the right)
<u>Must use long division to</u> calculate the remainder (163)

Step 4 - Divide the remainder with its highest divisible number in the chart:
163 / 16 = 10 (or "A" from table L-1) (the next digit to the right)
<u>Must use long division to</u> calculate the remainder (3)

Step 5 - The remainder will not divide: remainder = 3 (the right-most Hex digit)

65536	4096	256	16	1
16^4	16^3	16^2	16^1	16^0
	2	4	A	3

HEX TO DECIMAL CONVERSION

To convert a hex number to decimal, multiply each hex digit converted to decimal by the decimal equivalent of the hex power represented and add the results.

For example: Here is your Hex Number - 24A3

Step 1 - Set up your chart:

4096	256	16	1
16^3	16^2	16^1	16^0

Step 2 - Place the numbers in a table:

4096	256	16	1
16^3	16^2	16^1	16^0
2	4	A	3

Step 3 - Multiply the Hex number times the power value:

2 x 4096	=	8192
4 x 256	=	1024
A(10) x 16	=	160
3 x 1	=	3

Step 4 - Add up your values:

Decimal value is 9379

GREEK ALPHABET

Case		Greek Alphabet Name	English Equivalent
Upper	Lower		
Α	α	alpha	a
Β	β	beta	b
Γ	γ	gamma	g
Δ	δ	delta	d
Ε	ε	epsilon	e
Ζ	ζ	zeta	z
Η	η	eta	e
Θ	θ , ‘	theta	th
Ι	ι	iota	i
Κ	κ	kappa	k
Λ	λ	lambda	l
Μ	μ	mu	m

Case		Greek Alphabet Name	English Equivalent
Upper	Lower		
Ν	ν	nu	n
Ξ	ξ	xi	x
Ο	ο	omicron	o
Π	π	pi	p
Ρ	ρ	rho	r
Σ	σ	sigma	s
Τ	τ	tau	t
Υ	υ	upsilon	u
Φ	φ	phi	ph
Χ	χ	chi	ch
Ψ	ψ	psi	ps
Ω	ω	omega	o

LETTERS FROM THE GREEK ALPHABET COMMONLY USED AS SYMBOLS

Symbol	Name	Use
α	alpha	space loss, angular acceleration, or absorptance
β	beta	3 dB bandwidth or angular field of view [radians]
Γ	Gamma	reflection coefficient
γ	gamma	electric conductivity, surface tension, missile velocity vector angle, or gamma ray
Δ	Delta	small change or difference
δ	delta	delay, control forces and moments applied to missile, or phase angle
ε	epsilon	emissivity [dielectric constant] or permittivity [farads/meter]
η	eta	efficiency or antenna aperture efficiency
Θ	Theta	angle of lead or lag between current and voltage
θ or ‘	theta	azimuth angle, bank angle, or angular displacement
Λ	Lambda	acoustic wavelength or rate of energy loss from a thermocouple
λ	lambda	wavelength or Poisson Load Factor
μ	mu	micro 10^{-6} [micron], permeability [henrys/meter], or extinction coefficient [optical region]

ν	nu	frequency
π	pi	3.141592654+
ρ	rho	charge/mass density, resistivity [ohm-meter], VSWR, or reflectance
Σ	Sigma	algebraic sum
σ	sigma	radar cross section [RCS], Conductivity [1/ohm-meter], or Stefan-Boltzmann constant
T	Tau	VSWR reflection coefficient
τ	tau	pulse width, atmospheric transmission, or torque
Φ	Phi	magnetic/electrical flux, radiant power [optical], or Wavelet's smooth function [low pass filter]
φ	phi	phase angle, angle of bank, or beam divergence [optical region]
Ψ	Psi	time-dependent wave function or Wavelet's detail function [high pass filter]
ψ	psi	time-independent wave function, phase change, or flux linkage [weber]
Ω	Omega	Ohms [resistance] or solid angle [optical region]. Note: inverted symbol is conductance [mhos]
ω	omega	carrier frequency in radians per second

MORSE CODE and PHONETIC ALPHABET

A - alpha	• –	J - juliett	• – –	S - sierra	• • •	1	• – – – –
B - bravo	– • • •	K - kilo	– • –	T - tango	–	2	• • – – –
C - charlie	– • – •	L - lima	• – • •	U - uniform	• • –	3	• • • – –
D - delta	– • •	M - mike	– –	V - victor	• • • –	4	• • • • –
E - echo	•	N - november	– •	W - whiskey	• – –	5	• • • • •
F - foxtrot	• • – •	O - oscar	– – –	X - x-ray	– • • –	6	– • • • •
G - golf	– – •	P - papa	• – •	Y - yankee	– • – –	7	– – • • •
H - hotel	• • • •	Q - quebec	– – • –	Z - zulu	– – • •	8	– – – • •
I - india	• •	R - romeo	• – •	0	– – – – –	9	– – – – •

Note: The International Maritime Organization agreed to officially stop Morse code use by February 1999, however use may continue by ground based amateur radio operators. (The U.S. Coast Guard discontinued its use in 1995.)

BASIC MATH / GEOMETRY REVIEW

EXPONENTS

$a^x a^y = a^{x+y}$

$a^x / a^y = a^{x-y}$

$(a^x)^y = a^{xy}$

$a^0 = 1$

Example:

$$\frac{x}{\sqrt{x}} = x \bullet x^{-\frac{1}{2}} = x^{(1-\frac{1}{2})} = x^{\frac{1}{2}} = \sqrt{x}$$

LOGARITHMS

$\log (xy) = \log x + \log y$

$\log (x/y) = \log x - \log y$

$\log (x^N) = N \log x$

If $z = \log x$ then $x = 10^z$

Examples: $\log 1 = 0$
$\log 1.26 = 0.1$; $\log 10 = 1$

if $10 \log N = \text{dB\#}$,
then $10^{(\text{dB\#}/10)} = N$

TRIGONOMETRIC FUNCTIONS

$\sin x = \cos (x-90°)$

$\cos x = -\sin (x-90°)$

$\tan x = \sin x / \cos x = 1 / \cot x$

$\sin^2 x + \cos^2 x = 1$

A radian is the angular measurement of an arc which has an arc length equal to the radius of the given circle, therefore there are 2π radians in a circle. One radian = 360°/2π = 57.296....°

ELLIPSE

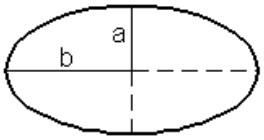

Area = π a b

Approx circumference

$= 2\pi \sqrt{\frac{a^2 + b^2}{2}}$

RECTANGLULAR SOLID

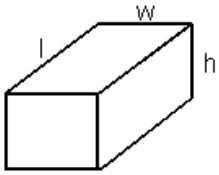

Area = lw

Volume = lwh

CYLINDER

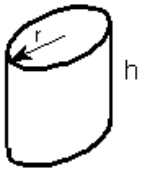

Volume – $\pi r^2 h$

Lateral surface area _ $2\pi rh$

ANGLES

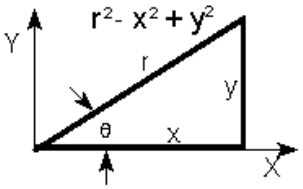

Sin θ = y/r Cos θ = x/r

Tan θ = y/x

SPHERE

Surface area = $4\pi r^2$

Volume = $4/3\ \pi r^3$

Cross Section (circle)

Area = πr^2

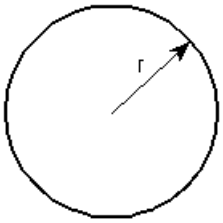

TRIANGLES

Angles: A + B + C = 180°

$c^2 = a^2 + b^2 - 2ab \cos C$

Area = 1/2 hc = 1/2 ab sin C

$b = \sqrt{e^2 + h^2}$

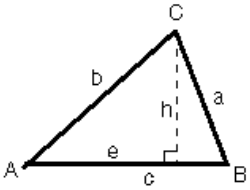

DERIVATIVES

Assume: a = fixed real #; u, v & w are functions of x

d(a)/dx = 0 ; d(sin u)/dx = du(cos u)/dx

d(x)/dx = 1 ; d(cos v)/dx = -dv(sin v)/dx

d(uvw)/dx = uvdw/dx + vwdu/dx + uwdv/dx +...etc

INTEGRALS

Note: All integrals should have an arbitrary constant of integration added, which is <u>left off for clarity</u>

Assume: a = fixed real #; u, & v are functions of x

$\int a dx = ax$ and $\int a\, f(x)dx = a\int f(x)dx$

$\int (u + v)dx = \int u dx + \int v dx$; $\int e^x dx = e^x$

$\int (\sin ax)dx = -(\cos ax)/a$; $\int (\cos ax)dx = (\sin ax)/a$

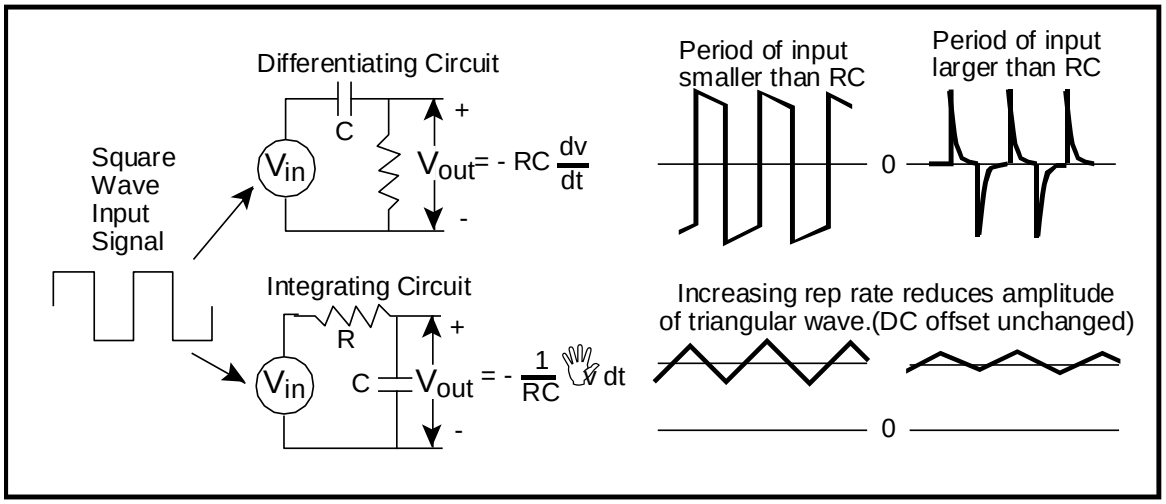

MATHEMATICAL NOTATION

The radar and EW communities generally accept some commonly used notation for the various parameters used in radar and EW calculations. For instance, "P" is almost always power and "G" is almost always gain. Textbooks and reference handbooks will usually use this notation in formulae and equations.

A significant exception is the use of "α" for space loss. Most textbooks do not develop the radar equation to its most usable form as does this reference handbook, therefore the concept of "α" just isn't covered.

Subscripts are a different matter. Subscripts are often whatever seems to make sense in the context of the particular formula or equation. For instance, power may be "P", "P_T", "P_t", or maybe "P_1". In the following list, generally accepted notation is given in the left hand column with no subscripts. Subscripted notation in the indented columns is the notation used in this handbook and the notation often used in the EW community.

α = Space loss
α_1 = One way space loss, transmitter to receiver
α_2 = Two way space loss, xmtr to target (including radar cross section) and back to the rcvr
α_{1t} = One way space loss, radar transmitter to target, bistatic
α_{1r} = One way space loss, target to radar receiver, bistatic

Other notation such as α_{tm} may be used to clarify specific losses, in this case the space loss between a target and missile seeker, which could also be identified as α_{1r}.

A = Antenna aperture (capture area)
A_e = Effective antenna aperture
Å = Angstrom

B = Bandwidth (to 3dB points)
B_{IF} = 3 dB IF bandwidth of the receiver (pre-detection)
B_J = Bandwidth of the jamming spectrum
B_{MHz} = 3 dB bandwidth in MHz
B_N = Equivalent noise bandwidth, a.k.a. B
B_V = 3 dB video bandwidth of the receiver (post-detection) (Subscript V stands for video)
BF = Bandwidth reduction factor (jamming spectrum wider than the receiver bandwidth)
BW = Beamwidth (to 3 dB points)

c = Speed of Light

f = Frequency (radio frequency)
f_c = Footcandle (SI unit of illuminance)
f_D = Doppler frequency
f_R = Received frequency
f_T = Transmitted frequency

G = Gain
G_t = Gain of the transmitter antenna
G_r = Gain of the receiver antenna
G_{tr} = Gain of the transmitter/receiver antenna (monostatic radar)
G_J = Gain of the jammer
G_{JA} = Gain of the jammer antenna
G_{JT} = Gain of the jammer transmitter antenna
G_{JR} = Gain of the jammer receiver antenna
G_σ = Gain of reflected radar signal due to radar cross section

h = Height or Planks constant
h_{radar} = Height of radar
h_{target} = Height of target

J = Jamming signal (receiver input)
J_1 = Jamming signal (constant gain jammer)
J_2 = Jamming signal (constant power jammer)
J/S = Jamming to signal ratio (receiver input)

k = Boltzmann constant
$K_{1,2,3,4}$ = Proportionality constants, see Sections 4-3, 4-4, 4-5, and 4-1 respectively.

λ = Lambda, Wavelength or Poisson factor

L = Loss (due to transmission lines or circuit elements)

N = Receiver equivalent noise input (kT_oB)
NF = Noise figure

P = Power
P_d = Probability of detection
P_D = Power density
P_J = Power of a jammer transmitter
P_n = Probability of false alarm
P_r = Power received
P_t = Power of a transmitter

R = Range (straight line distance)
R_1 = Bistatic radar transmitter to target range
R_2 = Bistatic radar target to receiver range
R_J = Range of jammer to receiver (when separate from the target)
R_{NM} = Range in nautical miles

σ = Sigma, radar cross section (RCS)

S = Signal (receiver input)
S_R = Radar signal received by the jammer
S_{min} = Minimum receiver sensitivity

t = Time
t_{int} = Integration time
t_r = Pulse Rise Time
τ = Pulse Width

V = Velocity
V_r = Radial velocity

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FREQUENCY SPECTRUM

Figure 1, which follows, depicts the electromagnetic radiation spectrum and some of the commonly used or known areas. Figure 2 depicts the more common uses of the microwave spectrum. Figure 3 shows areas of the spectrum which are frequently referred to by band designations rather than by frequency.

Section 7-1 provides an additional breakdown of the EO/IR spectrum.

To convert from frequency (f) to wavelength (λ) and vice versa, recall that f = c/λ, or λ = c/f; where c = speed of light.

$$\lambda_{meter} = \frac{3x10^8}{f_{Hz}} = \frac{3x10^5}{f_{kHz}} = \frac{300}{f_{MHz}} = \frac{0.3}{f_{GHz}} \qquad \text{or} \qquad f_{Hz} = \frac{3x10^8}{\lambda_{meter}} \quad f_{kHz} = \frac{3x10^5}{\lambda_{meter}} \quad f_{MHz} = \frac{300}{\lambda_{meter}} \quad f_{GHz} = \frac{0.3}{\lambda_{meter}}$$

Some quick rules of thumb follow:

Metric:

Wavelength in cm = 30 / frequency in GHz
For example: at 10 GHz, the wavelength = 30/10 = 3 cm

English:

Wavelength in ft = 1 / frequency in GHz
For example: at 10 GHz, the wavelength = 1/10 = 0.1 ft

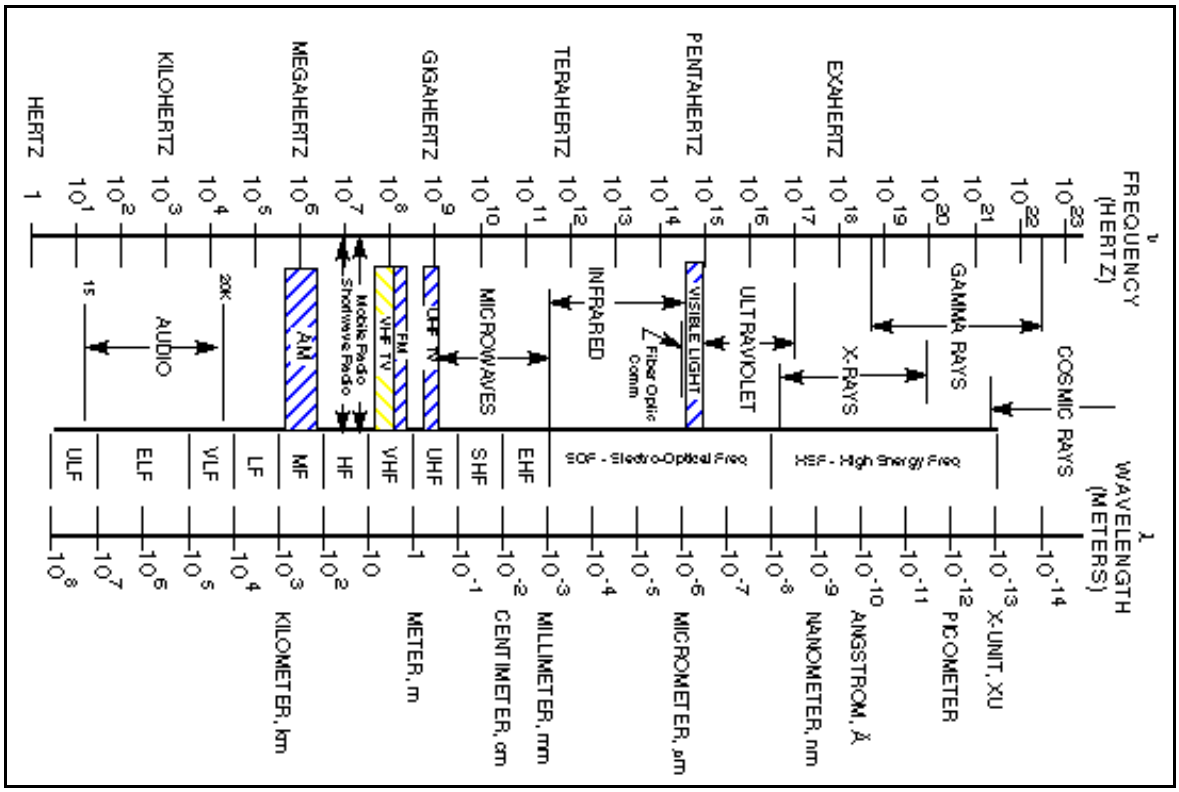

Figure 1. Electromagnetic Radiation Spectrum.

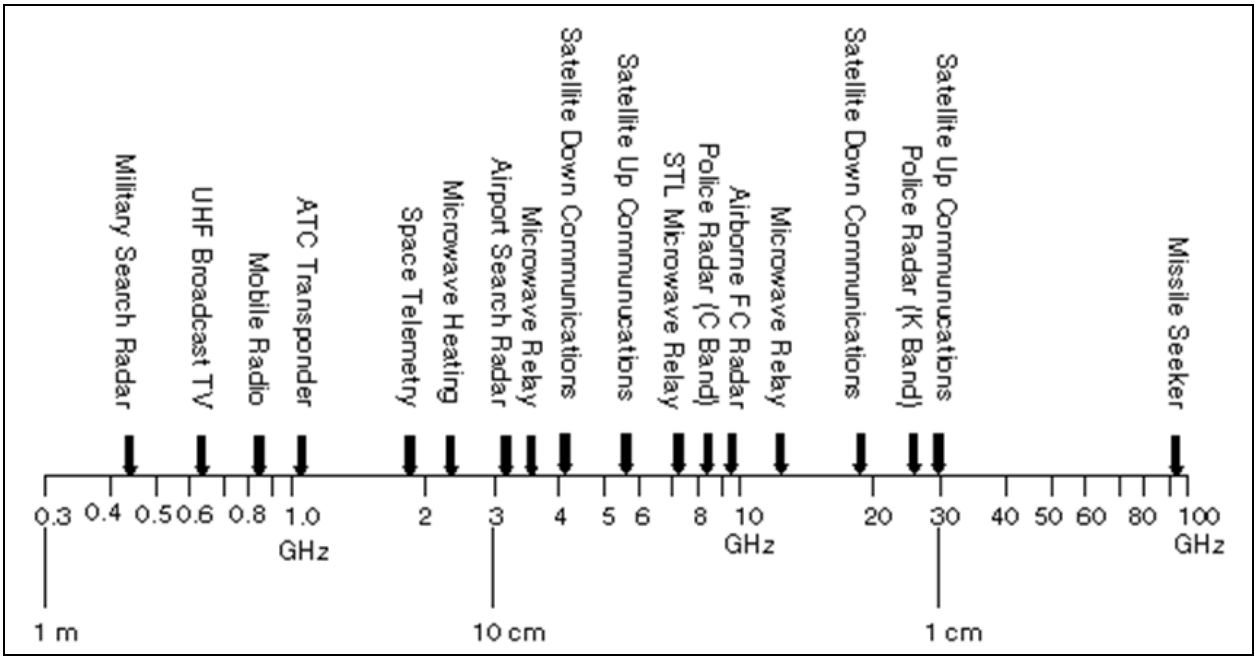

Figure 2. The Microwave Spectrum.

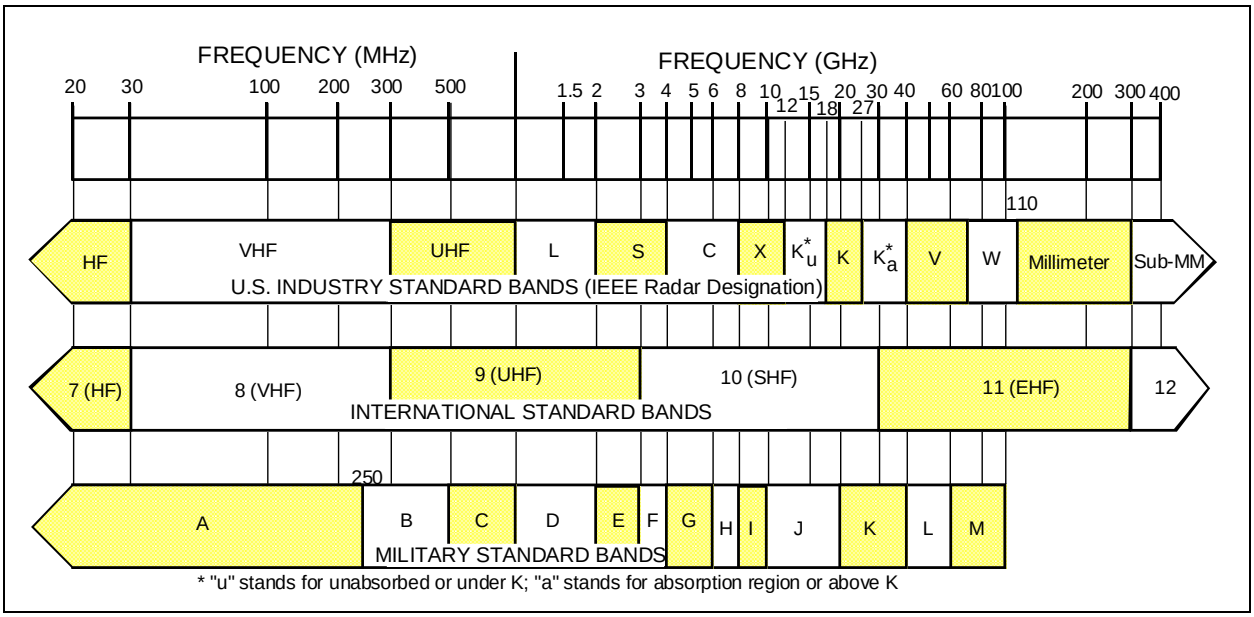

Figure 3. Frequency Band Designations.

See Section 7, Figure 1 for a more detailed depiction of the UV and IR spectrum.

DECIBEL (dB)

The Decibel is a subunit of a larger unit called the bel. As originally used, the bel represented the power ratio of 10 to 1 between the strength or intensity i.e., power, of two sounds, and was named after Alexander Graham Bell. Thus a power ratio of 10:1 = 1 bel, 100:1 = 2 bels, and 1000:1 = 3 bels. It is readily seen that the concept of bels represents a logarithmic relationship since the logarithm of 100 to the base 10 is 2 (corresponding to 2 bels), the logarithm of 1000 to the base 10 is 3 (corresponding to 3 bels), etc. The exact relationship is given by the formula

$$\text{Bels} = \log(P_2/P_1) \qquad \textbf{[1]}$$

where P_2/P_1 represents the power ratio.

Since the bel is a rather large unit, its use may prove inconvenient. Usually a smaller unit, the Decibel or dB, is used. 10 decibels make one bel. A 10:1 power ratio, 1 bel, is 10 dB; a 100:1 ratio, 2 bels, is 20 dB. Thus the formula becomes

$$\text{Decibels (dB)} = 10 \log(P_2/P_1) \qquad \textbf{[2]}$$

The power ratio need not be greater than unity as shown in the previous examples. In equations [1] and [2], P_1 is usually the reference power. If P_2 is less than P_1, the ratio is less then 1.0 and the resultant bels or decibels are negative. For example, if P_2 is one-tenth P_1, we have

$$\text{bels} = \log(0.1/1) = -1.0 \text{ bels}$$

and

$$\text{dB} = 10 \log(0.1/1) = -10 \text{ dB}.$$

It should be clearly understood that the term decibel does not in itself indicate power, but rather is a ratio or comparison between two power values. It is often desirable to express power levels in decibels by using a fixed power as a reference. The most common references in the world of electronics are the milliwatt (mW) and the watt. The abbreviation dBm indicates dB referenced to 1.0 milliwatt. One milliwatt is then zero dBm. Thus P_1 in equations [1] or [2] becomes 1.0 mW. Similarly, the abbreviation dBW indicates dB referenced to 1.0 watt, with P_2 being 1.0 watt, thus one watt in dBW is zero dBW or 30 dBm or 60 dBμW. For antenna gain, the reference is the linearly polarized isotropic radiator, dBLI. Usually the "L" and/or "I" is understood and left out.

dBc is the power of one signal referenced to a carrier signal, i.e., if a second harmonic signal at 10 GHz is 3 dB lower than a fundamental signal at 5 GHz, then the signal at 10 GHz is -3 dBc.

THE DECIBEL, ITS USE IN ELECTRONICS

The logarithmic characteristic of the dB makes it very convenient for expressing electrical power and power ratios. Consider an amplifier with an output of 100 watts when the input is 0.1 watts (100 milliwatts); it has an amplification factor of

$$P_2/P_1 = 100/0.1 = 1000$$

or a gain of:

$$10 \log(P_2/P_1) = 10 \log(100/0.1) = 30 \text{ dB}.$$

(notice the 3 in 30 dB corresponds to the number of zeros in the power ratio)

The ability of an antenna to intercept or transmit a signal is expressed in dB referenced to an isotropic antenna rather than as a ratio. Instead of saying an antenna has an effective gain ratio of 7.5, it has a gain of 8.8 dB (10 log 7.5).

A ratio of less than 1.0 is a loss, a negative gain, or attenuation. For instance, if 10 watts of power is fed into a cable but only 8.5 watts are measured at the output, the signal has been decreased by a factor of

$$8.5/10 = .85$$

or $$10 \log(.85) = -0.7 \text{ dB}.$$

This piece of cable at the frequency of the measurement has a gain of -0.7 dB. This is generally referred to as a loss or attenuation of 0.7 dB, where the terms "loss" and "attenuation" imply the negative sign. An attenuator which reduces its input power by factor of 0.001 has an attenuation of 30 dB. The utility of the dB is very evident when speaking of signal loss due to radiation through the atmosphere. It is much easier to work with a loss of 137 dB rather than the equivalent factor of 2×10^{-14}.

Instead of multiplying gain or loss factors as ratios we can add them as positive or negative dB. Suppose we have a microwave system with a 10 watt transmitter, and a cable with 0.7 dB loss connected to a 13 dB gain transmit antenna. The signal loss through the atmosphere is 137 dB to a receive antenna with an 11 dB gain connected by a cable with 1.4 dB loss to a receiver. How much power is at the receiver? First, we must convert the 10 watts to milliwatts and then to dBm:

$$10 \text{ watts} = 10{,}000 \text{ milliwatts}$$

and

$$10 \log (10{,}000/1) = 40 \text{ dBm}$$

Then

$$40 \text{ dBm} - 0.7 \text{ dB} + 13 \text{ dB} - 137 \text{ dB} + 11 \text{ dB} - 1.4 \text{ dB} = -75.1 \text{ dBm}.$$

-75.1 dBm may be converted back to milliwatts by solving the formula:

$$\text{mW} = 10^{(\text{dBm}/10)}$$

giving: $$10^{(-75.1/10)} = 0.00000003 \text{ mW}$$

Voltage and current ratios can also be expressed in terms of decibels, provided the resistance remains constant. First we substitute for P in terms of either voltage, V, or current, I. Since P=VI and V=IR we have:

$$P = I^2R = V^2/R$$

Thus for a voltage ratio we have: $$\text{dB} = 10 \log[(V_2^2/R)/(V_1^2/R)] = 10 \log(V_2^2/V_1^2) = 10 \log(V_2/V_1)^2 = 20 \log(V_2/V_1)$$

Like power, voltage can be expressed relative to fixed units, so one volt is equal to 0 dBV or 120 dBμV.

Similarly for current ratio: $$\text{dB} = 20 \log(I_2/I_1)$$

Like power, amperage can be expressed relative to fixed units, so one amp is equal to 0 dBA or 120 dBμA.

Decibel Formulas (where Z is the general form of R, including inductance and capacitance)

When impedances are equal: $dB = 10\log\frac{P2}{P1} = 20\log\frac{E2}{E1} = 20\log\frac{I2}{I1}$

When impedances are unequal: $dB = 10\log\frac{P2}{P1} = 20\log\frac{E2\sqrt{Z1}}{E1\sqrt{Z2}} = 20\log\frac{I2\sqrt{Z2}}{I1\sqrt{Z1}}$

SOLUTIONS WITHOUT A CALCULATOR

Solution of radar and EW problems requires the determination of logarithms (base 10) to calculate some of the formulae. Common "four function" calculators do not usually have a log capability (or exponential or fourth root functions either). Without a scientific calculator (or math tables or a Log-Log slide rule) it is difficult to calculate any of the radar equations, simplified or "textbook." The following gives some tips to calculate a close approximation without a calculator.

DECIBEL TABLE

DB	Power Ratio	Voltage or Current Ratio	DB	Power Ratio	Voltage or Current Ratio
0	1.00	1.00	10	10.0	3.16
0.5	1.12	1.06	15	31.6	5.62
1.0	1.26	1.12	20	100	10
1.5	1.41	1.19	25	316	17.78
2.0	1.58	1.26	30	1,000	31.6
3.0	2.00	1.41	40	10,000	100
4.0	2.51	1.58	50	10^5	316
5.0	3.16	1.78	60	10^6	1,000
6.0	3.98	2.00	70	10^7	3,162
7.0	5.01	2.24	80	10^8	10,000
8.0	6.31	2.51	90	10^9	31,620
9.0	7.94	2.82	100	10^{10}	10^5

For dB numbers which are a multiple of 10

An easy way to remember how to convert dB values that are a multiple of 10 to the absolute magnitude of the power ratio is to place a number of zeros equal to that multiple value to the right of the value 1.
40 dB = 10,000 : 1 (for power)

Minus dB moves the decimal point that many places to the left of 1.
-40 dB = 0.0001 : 1 (for power)

For voltage or current ratios, if the multiple of 10 is even, then divide the multiple by 2, and apply the above rules. 40 dB = 100 : 1 (for voltage)
-40 dB = 0.01 : 1

If the power in question is not a multiple of ten, then some estimation is required. The following tabulation lists some approximations. Some would be useful to memorize.

DB RULES OF THUMB

Multiply Current / Voltage By			Multiply Power By:	
if +dB	if -dB	**dB**	if +dB	if -dB
1	1	0	1	1
1.12	0.89	1	1.26	0.8
1.26	0.79	2	1.58	0.63
1.4	0.707	3	2	0.5
2.0	0.5	6	4	0.25
2.8	0.35	9	8	0.125
3.16	0.316	10	10	0.1
4.47	0.22	13	20	0.05
10	0.1	20	100	0.01
100	0.01	40	10,000	0.0001

You can see that the list has a repeating pattern, so by remembering just three basic values such as one, three, and 10 dB, the others can easily be obtained without a calculator by addition and subtraction of dB values and multiplication of corresponding ratios.

Example 1:

A 7 dB increase in power (3+3+1) dB is an increase of (2 x 2 x 1.26) = 5 times whereas
A 7 dB decrease in power (-3-3-1) dB is a decrease of (0.5 x 0.5 x 0.8) = 0.2.

Example 2: Assume you know that the ratio for 10 dB is 10, and that the ratio for 20 dB is 100 (doubling the dB increases the power ratio by a factor of ten), and that we want to find some intermediate value.

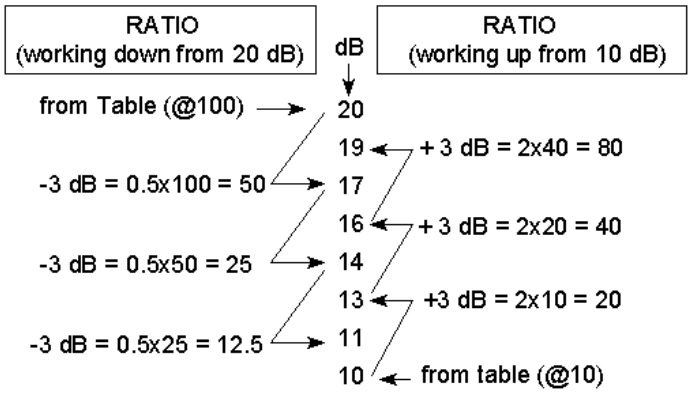

We can get more intermediate dB values by adding or subtracting one to the above, for example, to find the ratio at 12 dB we can:

work up from the bottom; 12 = 1+11 so we have 1.26 (from table) x 12.5 = 15.75
alternately, working down the top 12 = 13-1 so we have 20 x 0.8 (from table) = 16

The resultant numbers are not an exact match (as they should be) because the numbers in the table are rounded off. We can use the same practice to find any ratio at any other given value of dB (or the reverse).

dB AS ABSOLUTE UNITS

Power in absolute units can be expressed by using 1 Watt (or 1 milliwatt) as the reference power in the denominator of the equation for dB. We then call it dBW or dBm. We can then build a table such as the adjoining one.

From the above, any intermediate value can be found using the same dB rules and memorizing several dB values for determining the absolute power, given 48 dBm power output, we determine that 48 dBm = 50 dBm - 2 dB so we take the value at 50 dB which is 100W and divide by the value 1.58 (ratio of 2 dB) to get:

100 watts/1.58 = 63 W or 63,291 mW.

dB AS ABSOLUTE UNITS

dBμW	dBm	POWER	dBW
120	90	1 MW	60
90	60	1 kW	30
80	50	100 W	20
70	40	10 W	10
60	30	1 W (1000 mW)	0
50	20	100 mW	-10
40	10	10 mW	-20
33	3	2 mW	-27
32	2	1.58 mW	-28
31	1	1.26 mw	-29
30	0	1 mW	-30

Because dBW is referenced to one watt, the Log of the power in watts times 10 is dBW. The Logarithm of 10 raised by any exponent is simply that exponent. That is: $\text{Log}(10)^4 = 4$. Therefore, a power that can be expressed as any exponent of 10 can also be expressed in dBW as that exponent times 10. For example, 100 kW can be written 100,000 watts or 10^5 watts. 100 kW is then +50 dBW. Another way to remember this conversion is that dBW is the number of zeros in the power written in watts times 10. If the transmitter power in question is conveniently a multiple of ten (it often is) the conversion to dBW is easy and accurate.

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DUTY CYCLE

Duty cycle (or duty factor) is a measure of the fraction of the time a radar is transmitting. It is important because it relates to peak and average power in the determination of total energy output. This, in turn, ultimately affects the strength of the reflected signal as well as the required power supply capacity and cooling requirements of the transmitter.

Although there are exceptions, most radio frequency (RF) measurements are either continuous wave (CW) or pulsed RF. CW RF is uninterrupted RF such as from an oscillator. Amplitude modulated (AM), frequency modulated (FM), and phase modulated (PM) RF are considered CW since the RF is continuously present. The power may vary with time due to modulation, but RF is always present. Pulsed RF, on the other hand, is bursts (pulses) of RF with no RF present between bursts. The most general case of pulsed RF consists of pulses of a fixed pulse width (PW) which come at a fixed time interval, or period, (T). For clarity and ease of this discussion, it is assumed that all RF pulses in a pulse train have the same amplitude. Pulses at a fixed interval of time arrive at a rate or frequency referred to as the pulse repetition frequency (PRF) of so many pulse per second. Pulse repetition interval (PRI) and PRF are reciprocals of each other.

$$PRF = 1/T = 1/PRI \qquad \textbf{[1]}$$

Power measurements are classified as either peak pulse power, P_p, or average power, P_{ave}. The actual power in pulsed RF occurs during the pulses, but most power measurement methods measure the heating effects of the RF energy to obtain an average value of the power. It is correct to use either value for reference so long as one or the other is consistently used. Frequently it is necessary to convert from P_p to P_{ave}, or vice versa; therefore the relationship between the two must be understood. Figure 1 shows the comparison between P_p and P_{ave}.

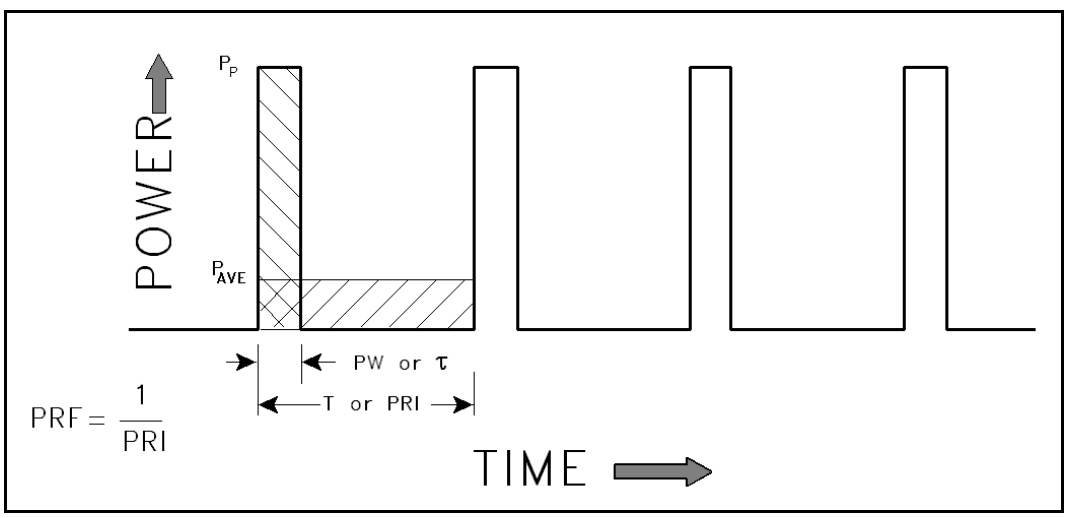

Figure 1. RF Pulse Train.

The average value is defined as that level where the pulse area above the average is equal to area below average between pulses. If the pulses are evened off in such a way as to fill in the area between pulses, the level obtained is the average value, as shown in Figure 1 where the shaded area of the pulse is used to fill in the area between pulses. The area of the pulse is the pulse width multiplied by the peak pulse power. The average area is equal to the average value of power multiplied by the pulse period.

Since the two values are equal:

$$P_{ave} \times T = P_p \times PW \quad \textbf{[2]}$$

or

$$P_{ave}/P_p = PW/T \quad \textbf{[3]}$$

Using [1]

$$P_{ave}/P_p = PW/T = PW \times PRF = PW/PRI = \text{duty cycle} \quad \textbf{[4]}$$

(note that the symbol τ represents pulse width (PW) in most reference books)

The ratio of the average power to the peak pulse power is the duty cycle and represents the percentage of time the power is present. In the case of a square wave the duty cycle is 0.5 (50%) since the pulses are present 1/2 the time, the definition of a square wave.

For Figure 1, the pulse width is 1 unit of time and the period is 10 units. In this case the duty cycle is:

PW/T = 1/10 = 0.1 (10%).

A more typical case would be a PRF of 1,000 and a pulse width of 1.0 microseconds. Using [4], the duty cycle is 0.000001 x 1,000 = 0.001. The RF power is present one-thousandth of the time and the average power is 0.001 times the peak power. Conversely, if the power were measured with a power meter which responds to average power, the peak power would be 1,000 time the average reading.

Besides expressing duty cycle as a ratio as obtained in equation [4], it is commonly expressed as either a percentage or in decibels (dB). To express the duty cycle of equation [4] as a percentage, multiply the value obtained by 100 and add the percent symbol. Thus a duty cycle of 0.001 is also 0.1%.

The duty cycle can be expressed logarithmically (dB) so it can be added to or subtracted from power measured in dBm/dBW rather than converting to, and using absolute units.

$$\text{Duty cycle (dB)} = 10 \log(\text{duty cycle ratio}) \quad \textbf{[5]}$$

For the example of the 0.001 duty cycle, this would be 10 log(0.001) = -30 dB. Thus the average power would be 30 dB less than the peak power. Conversely, the peak power is 30 dB higher than the average power.

For pulse radars operating in the PRF range of 0.25-10 kHz and PD radars operating in the PRF range of 10-500 kHz, typical duty cycles would be:

Pulse	~	0.1 - 3%	=	0.001 - .03	=	-30 to -15 dB
Pulse Doppler	~	5 - 50%	=	0.05 - .5	=	-13 to -3 dB
Continuous Wave	~	100%	=	1	=	0 dB

Intermediate Frequency Bandwidths of typical signals are:

Pulse	1 to 10 MHz
Chirp or Phase coded pulse	0.1 to 10 MHz
CW or PD	0.1 to 5 kHz

PRF is usually subdivided into the following categories: Low 0.25-4 kHz; Medium 8-40 kHz; High 50-300 kHz.

DOPPLER SHIFT

Doppler is the apparent change in wavelength (or frequency) of an electromagnetic or acoustic wave when there is relative movement between the transmitter (or frequency source) and the receiver.

Summary RF Equation for the Two-Way (radar) case

$$f_{Rec} = f_{Xmt} + f_D = f_{Xmt} + \frac{2(V_{Xmtr} + V_{Tgt})\, f_{Xmt}}{c}$$

Summary RF Equation for the One-Way (ESM) case

$$f_{Rec} = f_{Xmt} + f_D = f_{Xmt} + \frac{V_{Xmtr\ or\ Rec}\ f_{Xmt}}{c}$$

Rules of Thumb for two-way signal travel
(divide in half for one-way ESM signal measurements)
At 10 GHz, $f_D \cong$
35 Hz per Knot
19 Hz per km/Hr
67 Hz per m/sec
61 Hz per yd/sec
20 Hz per ft/sec

To estimate f_D at other frequencies, multiply these by:

$$\left[\frac{f_{Xmt}(GHz)}{10}\right]$$

The Doppler effect is shown in Figure 1. In everyday life this effect is commonly noticeable when a whistling train or police siren passes you. Audio Doppler is depicted, however Doppler can also affect the frequency of a radar carrier wave, the PRF of a pulse radar signal, or even light waves causing a shift of color to the observer.

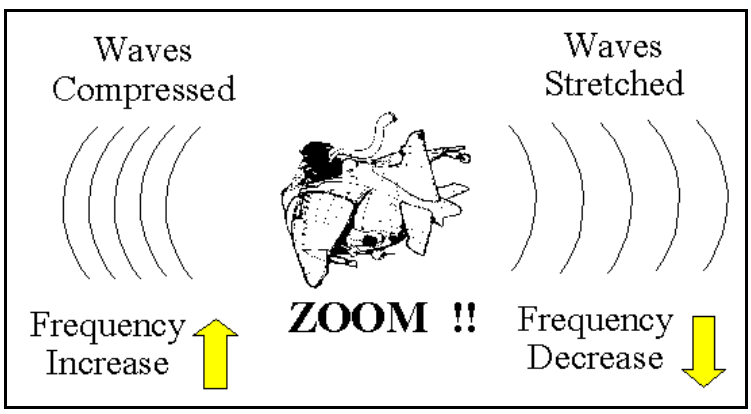

Figure 1. Doppler Frequency Creation From Aircraft Engine Noise.

How do we know the universe is expanding?

Answer: The color of light from distant stars is shifted to red (see Section 7-1: higher λ or lower frequency means Doppler shift is stretched, i.e., expanding).

A memory aid might be that the lights from a car (going away) at night are red (tail lights)!

Doppler frequency shift is directly proportional to velocity and a radar system can therefore be calibrated to measure velocity instead of (or along with) range. This is done by measuring the shift in frequency of a wave caused by an object in motion (Figure 2).

* Transmitter in motion
* Reflector in motion
* Receiver in motion
* All three

For a closing relative velocity:

* Wave is compressed
* Frequency is increased

For an opening relative velocity:

* Wave is stretched
* Frequency is decreased

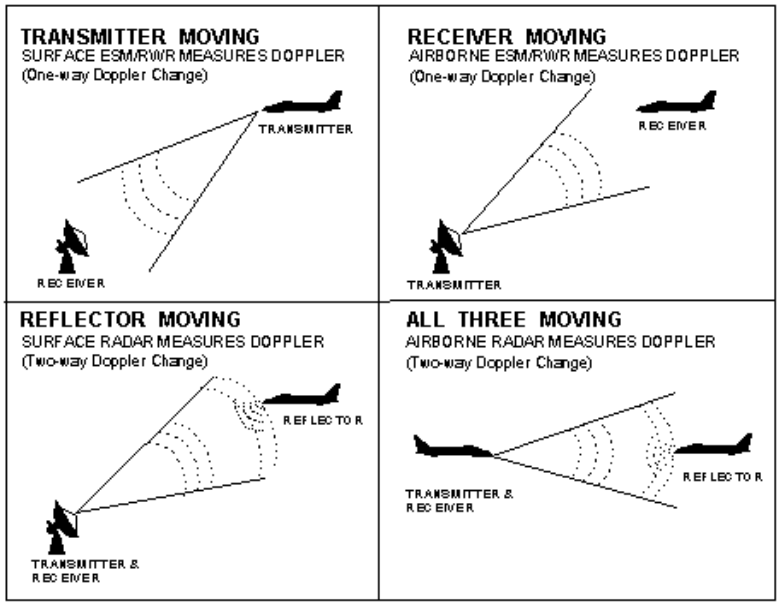

Figure 2. Methods of Doppler Creation.

To compute Doppler frequency we note that velocity is range rate; $V = dr/dt$

For the <u>reflector in motion case</u>, you can see the wave compression effect in Figure 3 when the transmitted wave peaks are one wavelength apart. When the first peak reaches the target, they are still one wavelength apart (point a).

When the 2nd peak reaches the target, the target has advanced according to its velocity (vt) (point b), and the first reflected peak has traveled toward the radar by an amount that is less than the original wavelength by the same amount (vt) (point c).

As the 2nd peak is reflected, the wavelength of the reflected wave is 2(vt) less than the original wavelength (point d).

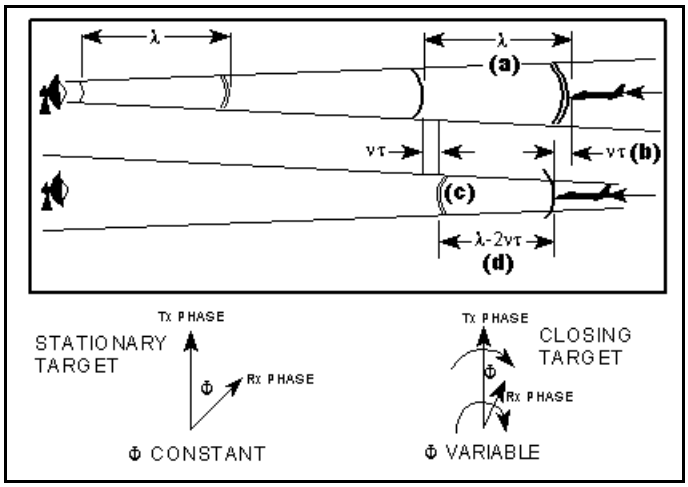

Figure 3. Doppler Compression Equivalent to Variable Phase Shift.

The distance the wave travels is twice the target range. The reflected phase lags transmitted phase by 2x the round trip time. For a fixed target the received phase will differ from the transmitted phase by a constant phase shift. For a moving target the received phase will differ by a changing phase shift.

For the closing target shown in Figure 3, the received phase is advancing with respect to the transmitted phase and appears as a higher frequency.

Doppler is dependent upon closing velocity, not actual radar or target velocity as shown in Figure 4.

For the following equations (except radar mapping), we assume the radar and target are moving directly toward one another to simplify calculations (if this is not the case, use the velocity component of one in the direction of the other in the formulas).

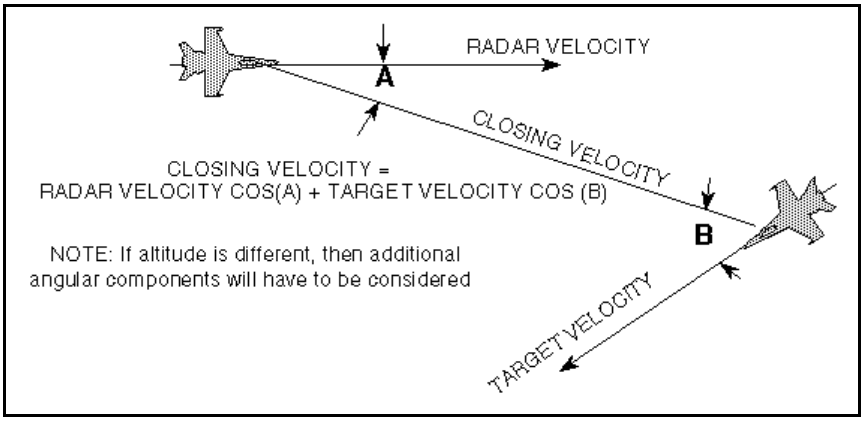

Figure 4. Doppler Depends Upon Closing Velocity.

<u>For the case of a moving reflector</u>, doppler frequency is proportional to 2x the transmitted frequency:
Higher rf = higher doppler shift
$f_D = (2 \times V_{Target})(f/c)$

Likewise, it can be shown that for other cases, the following relationships hold:

Speed of Light Conversions
* * *
$c \cong 2.9979 \times 10^8$ m/sec
$c \cong 5.8275 \times 10^8$ nm/hr (knots)
$c \cong 9.8357 \times 10^8$ ft/sec

<u>For an airplane radar with an airplane target</u> (The "all three moving" case, aircraft radar transmitter, target, and aircraft radar receiver)
$f_D = 2(V_{Radar} + V_{Target})(f/c)$

<u>For the case of a semi-active missile receiving signals</u> (Also "all three moving")
$f_D = (V_{Radar} + 2V_{Target} + V_{Missile})(f/c)$

<u>For the airplane radar with a ground target</u> (radar mapping) or vice versa.
$f_D = 2(V_{Radar} \cos\theta \cos\varphi)(f/c)$, Where θ and φ are the radar scan azimuth and depression angles.

<u>For a ground based radar with airborne target</u> - same as previous using target track crossing angle and ground radar elevation angle.

<u>For the ES/ESM/RWR case where only the target or receiver is moving</u> (One-way Doppler measurements)
$f_D = V_{Receiver\ or\ Target}\ (f/c)$

Note: See Figure 4 if radar and target are not moving directly towards or away from one another.

Figure 5 depicts the results of a plot of the above equation for a moving reflector such as might be measured with a ground radar station illuminating a moving aircraft.

It can be used for the aircraft-to-aircraft case, if the total net closing rate of the two aircraft is used for the speed entry in the figure.

It can also be used for the ES/ESM case (one-way doppler measurements) if the speed of the aircraft is used and the results are divided by two.

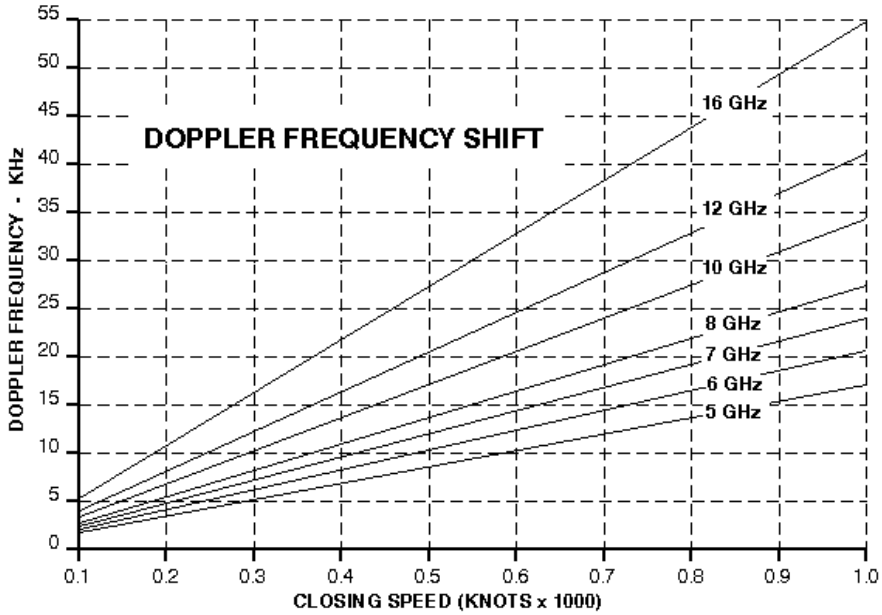

Figure 5. Two-Way Doppler Frequency Shift.

SAMPLE PROBLEMS:

(1) If a ground radar operating at 10 GHz is tracking an airplane flying at a speed of 500 km/hr tangential to it (crossing pattern) at a distance of 10 km, what is the Doppler shift of the returning signal?

Answer: Since the closing velocity is zero, the Doppler is also zero.

(2) If the same aircraft turns directly toward the ground radar, what is the Doppler shift of the returning signal?

Answer: 500 km/hr = 270 kts from Section 2-1. From Figure 4 we see that the Doppler frequency is about 9.2 KHz.

(3) Given that a ground radar operating at 7 GHz is Doppler tracking an aircraft 20 km away (slant range) which is flying directly toward it at an altitude of 20,000 ft and a speed of 800 ft/sec, what amount of VGPO switch would be required of the aircraft jammer to deceive (pull) the radar to a zero Doppler return?

Answer: We use the second equation from the bottom of page 2-6.3 which is essentially the same for this application except a ground radar is tracking an airplane target (vs. an airplane during ground mapping), so for our application we use a positive elevation angle instead of a negative (depression) angle.

$f_D = 2(V_r \cos\theta \cos\varphi)(f/c)$, where θ is the aircraft track crossing angle and φ is the radar elevation angle.

Since the aircraft is flying directly at the radar, $\theta = 0°$; the aircraft altitude = 20,000 ft = 6,096 meters.

Using the angle equation in Section 2-1, $\sin \varphi = x/r$ = altitude / slant range, so:
$\varphi = \sin^{-1}$ (altitude/slant range) = $\sin^{-1}$ (6,096 m / 20,000 m) = 17.7°

F_D = 2(800 ft/sec Cos 0° Cos 17.7°)(7×10^9 Hz / 9.8357×10^9 ft/sec) = <u>10,845 Hz</u>

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ELECTRONIC FORMULAS

Ohm's Law Formulas for D-C Circuits. $E = IR = \frac{P}{I} = \sqrt{PR}$ $P = I^2 R = EI = \frac{E^2}{R}$

Ohm's Law Formulas for A-C Circuits and Power Factor.

$$E = IZ = \frac{P}{I\cos\Theta} = \sqrt{\frac{PZ}{\cos\Theta}} \qquad P = I^2 Z\cos\Theta = IE\cos\Theta = \frac{E^2\cos\Theta}{Z}$$

In the above formulas Θ is the angle of lead or lag between current and voltage and cos Θ = P/EI = power factor or *pf*.

$$pf = \frac{Active\ power\ (in\ watts)}{Apparent\ power\ (in\ volt\text{-}amps)} = Pover E\ I \qquad pf = \frac{R}{Z}$$

Note: Active power is the "resistive" power and equals the equivalent heating effect on water.

Voltage/Current Phase Rule of Thumb Remember "ELI the ICE man"

ELI: Voltage (E) comes before (leads) current (I) in an inductor (L)
ICE: Current (I) comes before (leads) Voltage (E) in a capacitor (C)

Resistors in Series $R_{total} = R_1 + R_2 = R_3 + \ldots$

Two Resistors in Parallel $R_t = \frac{R_1 R_2}{R_1 + R_2}$

Resistors in Parallel, General Formula $R_{total} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$

Resonant Frequency Formulas *Where in the second formula f is in kHz and L and C are in microunits.

$$f = \frac{1}{2\pi\sqrt{LC}},\ or\ \ f = \frac{159.2*}{\sqrt{LC}} \quad L = \frac{1}{4\pi^2 f^2 C},\ or\ \ L = \frac{25{,}330*}{f^2 C} \quad C = \frac{1}{4\pi^2 f^2 L},\ or\ \ C = \frac{25{,}330*}{f^2 L}$$

Conductance $G = \frac{1}{R}$ *(for D-C circuit)* $G = \frac{R}{R^2 + X^2}$ *(for A-C circuit)*

Reactance Formulas $X_C = \frac{1}{2\pi f C}$ $C = \frac{1}{2\pi f X_C}$ $X_L = 2\pi fL$ $L = \frac{X_L}{2\pi f}$

Impedance Formulas $Z = \sqrt{R^2 + (X_L - X_C)^2}$ *(for series circuit)*

$Z = \frac{RX}{\sqrt{R^2 + X^2}}$ *(for R and X in parallel)*

Q or Figure of Merit $Q = \frac{X_L}{R}$ *or* $\frac{X_C}{R}$

Frequency Response

	Inductor *	Capacitor *	Resister
DC	Pass	Block	Attenuate
Low Freq AC	Attenuate *	Attenuate *	Attenuate
High Freq	Block	Pass	Attenuate

* Attenuation varies as a function of the value of the each device and the frequency

"Cartoon" memory aid

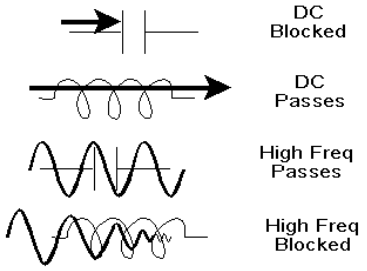

Sinusoidal Voltages and Currents

Effective value = 0.707 x peak value
[Also known as Root-Mean Square (RMS) value]

Half Cycle Average value = 0.637 x peak

Peak value = 1.414 x effective value

∴ Effective value = 1.11 x average value

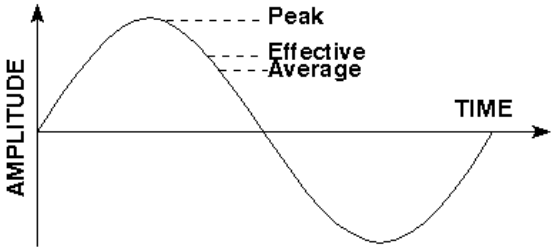

Three-phase AC Configurations

(120° phase difference between each voltage)

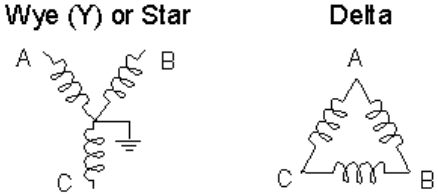

If the connection to a three phase AC configuration is miswired, switching any two of the phases will put it back in the proper sequence.

Electric power for ships commonly uses the delta configuration, while commercial electronic and aircraft applications commonly use the wye configuration.

Color Code for House Wiring:	**PURPOSE:**	**Color Code for Chassis Wiring:**
Black or red	HOT	Red
White	NEUTRAL (Return)	White
Green or bare	GROUND	Black

Color Code for Resistors: **First and second band**: (and third band # of zeros if not gold/silver)

				Third band Multiplier		**Fourth band Tolerance**	
0	Black	5	Green	.1	Gold	5%	Gold
1	Brown	6	Blue	.01	Silver	10%	Silver
2	Red	7	Violet			20%	No color
3	Orange	8	Gray				
4	Yellow	9	White				

The third color band indicates number of zeros to be added after figures given by first two color bands. But if third color band is gold, multiply by 0.1 and if silver multiply by 0.01. Do not confuse with fourth color-band that indicates tolerance. Thus, a resistor marked blue-red-gold-gold has a resistance of 6.2 ohms and a 5% tolerance.

MISSILE AND ELECTRONIC EQUIPMENT DESIGNATIONS

Missiles are designated with three letters from the columns below plus a number (i.e., AIM-7M) Suffixes (M in this case) indicate a modification.

First Letter Launch Environment	**Second Letter** Mission Symbols	**Third Letter** Vehicle Type
A Air B Multiple C Coffin H Silo stored L Silo launched M Mobile P Soft Pad R Ship U Underwater	D Decoy E Special electronic G Surface attack I Intercept, aerial Q Drone T Training U Underwater attack W Weather	M Guided Missile N Probe (non-orbital instruments) R Rocket (without installed or remote control guidance)

U.S. military electronic equipment is assigned an identifying alphanumeric designation that is used to uniquely identify it. This system is commonly called the "AN" designation system, although its formal name is the Joint Electronics Type Designation System (JETDS). The letters AN preceding the equipment indicators formerly meant "Army/Navy," but now are a letter set that can only be used to indicate formally designated DOD equipment. The first three letters following the "AN/" indicate Platform Installation, Equipment Type, and Equipment Function, respectively. The appropriate meaning is selected from the lists below. The letters following the AN designation numbers provide added information about equipment. Suffixes (A, B, C, etc.) indicate a modification. The letter (V) indicates that variable configurations are available. The letter (X) indicates a development status. A parenthesis ( ) without a number within it indicates a generic system that has not yet received a formal designation, e.g., AN/ALQ( ). Quite often the () is pronounced "bow legs" since they look like the shape of cowboy legs.

First Letter Platform Installation	**Second Letter** Equipment Type	**Third Letter** Function or Purpose
A Piloted aircraft B Underwater mobile, submarine D Pilotless carrier F Fixed ground G General ground use K Amphibious M Mobile (ground) P Portable S Water T Ground, transportable U General utility V Vehicular (ground) W Water surface and underwater combination Z Piloted-pilotless airborne vehicle combination	A Invisible light, heat radiation C Carrier D Radiac F Photographic G Telegraph or teletype I Interphone and public address J Electromechanical or inertial wire covered K Telemetering L Countermeasures M Meteorological N Sound in air P Radar Q Sonar and underwater sound R Radio S Special or combinations of types T Telephone (wire) V Visual and visible light W Armament X Facsimile or television Y Data Processing	B Bombing C Communications D Direction finder, reconnaissance and/or surveillance E Ejection and/or release G Fire control or searchlight directing H Recording and/or reproducing K Computing M Maintenance and/or test assemblies N Navigation aids Q Special or combination of purposes R Receiving, passive detecting S Detecting and/or range and bearing, search T Transmitting W Automatic flight or remote control X Identification and recognition Y Surveillance and control

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RADAR HORIZON / LINE OF SIGHT

There are limits to the reach of radar signals. At the frequencies normally used for radar, radio waves usually travel in a straight line. The waves may be obstructed by weather or shadowing, and interference may come from other aircraft or from reflections from ground objects (Figure 1).

As also shown in Figure 1, an aircraft may not be detected because it is below the radar line which is tangent to the earth's surface.

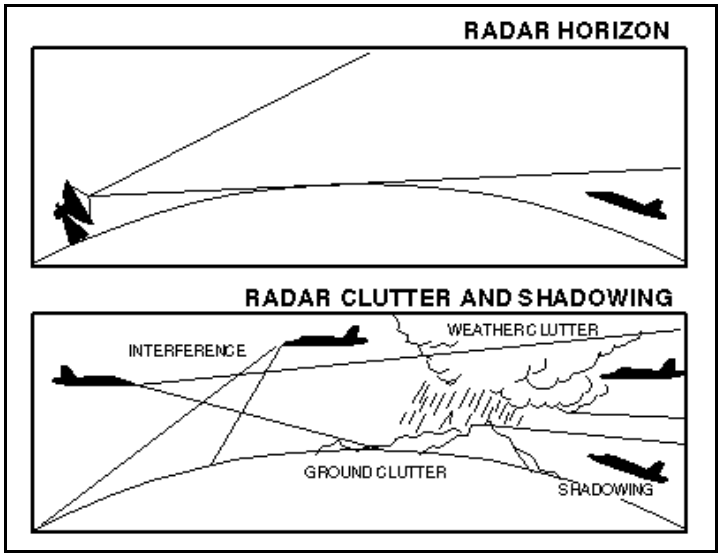

Figure 1. Radar Horizon and Shadowing.

Some rules of thumb are:

Range (to horizon):

$$R_{NM} = 1.23\sqrt{h_{radar}} \quad \textit{with h in ft}$$

Range (beyond horizon / over earth curvature):

$$R_{NM} = 1.23\left(\sqrt{h_{radar}} + \sqrt{h_{target}}\right) \quad \textit{with h in ft}$$

In obtaining the radar horizon equations, it is common practice to assume a value for the Earth's radius that is 4/3 times the actual radius. This is done to account for the effect of the atmosphere on radar propagation. For a true line of sight, such as used for optical search and rescue, the constant in the equations changes from 1.23 to 1.06.

A nomograph for determining maximum target range is depicted in Figure 2. Although an aircraft is shown to the left, it could just as well be a ship, with radars on a mast of height "h." Any target of height (or altitude) "H" is depicted on the right side.

See also Section 5-1 on ducting and refraction, which may increase range beyond these distances.

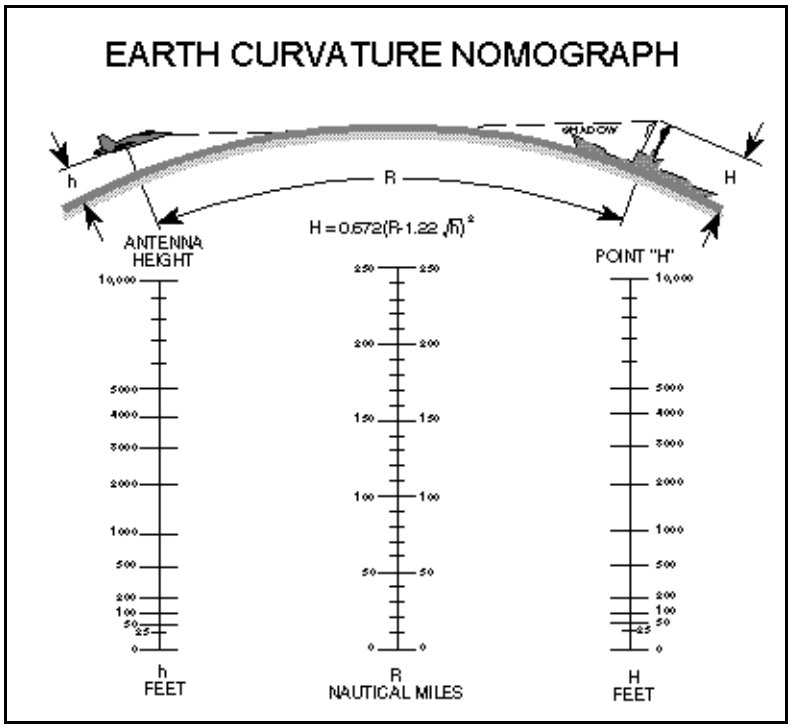

Figure 2. Earth Curvature Nomograph.

This data was expanded in Figure 3 to consider the maximum range one aircraft can detect another aircraft using:

$$R_{NM} = 1.23\left(\sqrt{h_{radar}} + \sqrt{h_{target}}\right)$$

(with h in feet)

It can be used for surface targets if H_{target} = 0. It should be noted that most aircraft radars are limited in power output, and would not detect small or surface objects at the listed ranges.

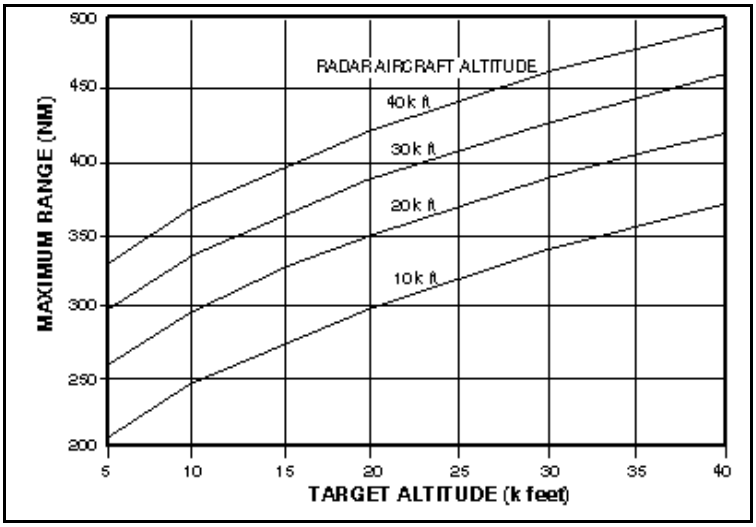

Figure 3. Aircraft Radar vs. Aircraft Target Maximum Range.

Figure 4 depicts the maximum range that a ship height antenna can detect a zero height object (i.e., rowboat).

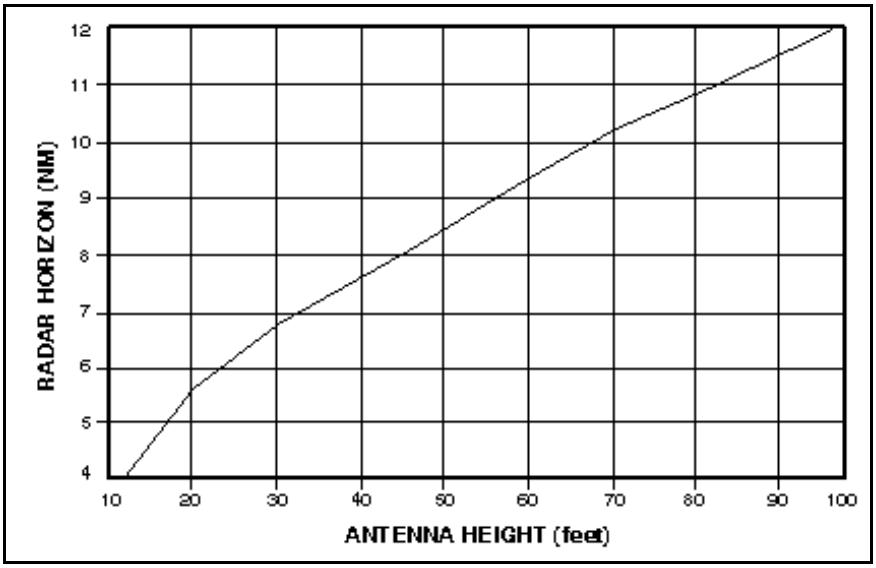

Figure 4. Ships Radar Horizon With Target on the Surface.

In this case "H" = 0, and the general equation becomes: $R_{max}(NM) = 1.23\sqrt{h_r}$

Where h_r is the height of the radar in feet.

Figure 5 depicts the same for aircraft radars. It should be noted that most aircraft radars are limited in power output, and would not detect small or surface objects at the listed ranges.

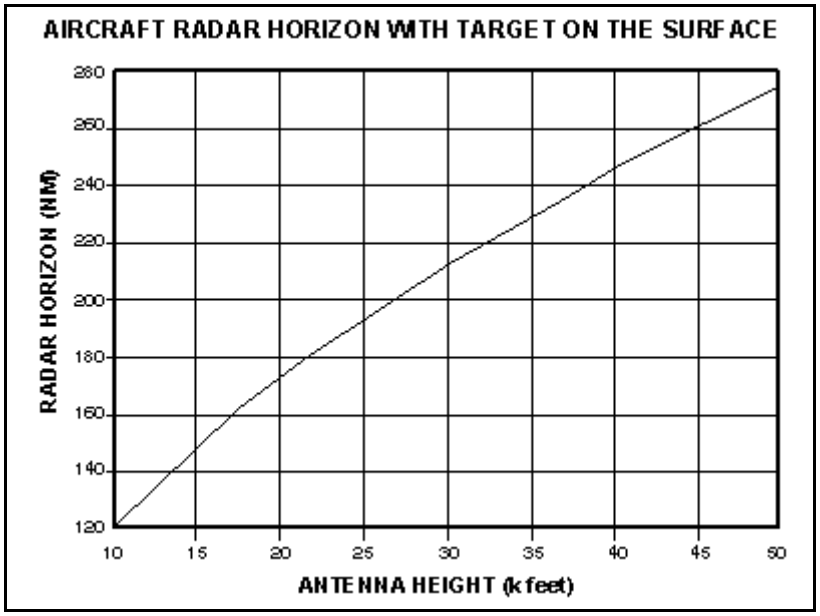

Figure 5. Aircraft Radar Horizon With Target on the Surface.

Other general rules of thumb for surface "targets/radars" are as follows:

<u>For Visual SAR</u>:

$$R_{Visual}(NM) = 1.05\sqrt{Acft\ \ Alt\ in\ \ ft}$$

<u>For ESM:</u>

$$R_{ESM}(NM) = 1.5\sqrt{Acft\ \ Alt\ in\ \ ft}$$

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PROPAGATION TIME / RESOLUTION

1. ROUND TRIP RANGE: $R = \frac{c\,t}{2}$ with t = time to reach target

Rules of Thumb

In one µsec round trip time, a wave travels to and from an object at a distance of:	The time it takes to travel to and from an object at a distance of:
≅ 150 m	1 m ≅ 0.0067 µsec
≅ 164 yd	1 yd ≅0.006 µsec
≅ 500 ft	1 ft ≅ 0.002 µsec
≅ 0.08 NM	1 NM ≅ 12.35 µsec
≅ 0.15 km	1 km ≅ 6.7 µsec

2. ONE WAY RANGE: ***R = ct*** with t = time to reach target

Time	Distance Traveled
1 milli sec (ms)	165 NM
1 micro sec (µs)	1000 ft
1 nano sec (ns)	1 ft

Distance	Time it Takes
1 NM	6.18 µsec
1 km	3.3 µsec
1 ft	1 nsec

3. UNAMBIGUOUS RANGE

(DISTANCE BETWEEN PULSES): $R = \frac{c \bullet PRI}{2}$

Normally a radar measures "distance" to the target by measuring time from the last transmitted pulse. If the inter-pulse period (T) is long enough that isn't a problem as shown in "A" to the right. When the period is shortened, the time to the last previous pulse is shorter than the actual time it took, giving a false (ambiguous) shorter range (figure "B").

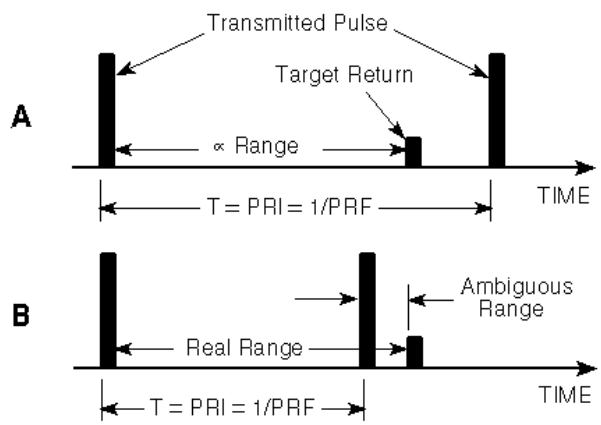

Rules of Thumb

RNM ≅ 81Pms

RKm ≅ 150Pms

Where Pms is PRI in milliseconds

4. RANGE RESOLUTION

Rules of Thumb

500 ft per microsecond of pulse width

500 MHz IF bandwidth provides 1 ft of resolution.

5. BEST CASE PERFORMANCE:

The atmosphere limits the accuracy to 0.1 ft

The natural limit for resolution is one RF cycle.

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MODULATION

Modulation is the process whereby some characteristic of one wave is varied in accordance with some characteristic of another wave. The basic types of modulation are angular modulation (including the special cases of phase and frequency modulation) and amplitude modulation. In missile radars, it is common practice to amplitude modulate the transmitted RF carrier wave of tracking and guidance transmitters by using a pulsed wave for modulating, and to frequency modulate the transmitted RF carrier wave of illuminator transmitters by using a sine wave.

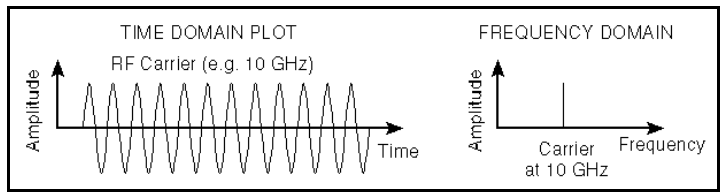

Figure 1. Unmodulated RF Signal.

Frequency Modulation (FM) - As shown in Figure 1, an unmodulated RF signal in the time domain has only a single spectral line at the carrier frequency (f_c) in the frequency domain. If the signal is frequency modulated, as shown in Figure 2 (simplified using only two changes), the spectral line will correspondingly shift in the frequency domain. The bandwidth can be approximated using Carson's rule: $BW = 2(\Delta f + fm)$, where Δf is the peak deviation of the instantaneous frequency from the carrier and *fm* is the highest frequency present in the modulating signal. There are usually many more "spikes" in the frequency domain than depicted. The number of spikes and shape of the frequency domain envelope (amplitude) are based on the modulation index β. The modulation index is related to the same two factors used in Carson's rule. A high Δf means a higher modulation index with many more "spikes" spread across a wider bandwidth.

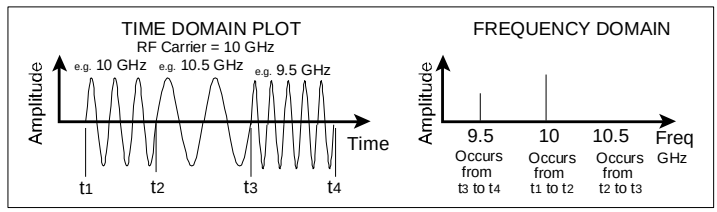

Figure 2. RF Signal With Frequency Modulation.

Amplitude Modulation (AM) - If the signal in Figure 1 is amplitude modulated by a sinewave as shown in Figure 3, sidebands are produced in the frequency domain at $F_c \pm F_{AM}$. AM other than by a pure sine wave will cause additional sidebands normally at $F_c \pm nF_{AM}$, where n equals 1, 2, 3, 4, etc.

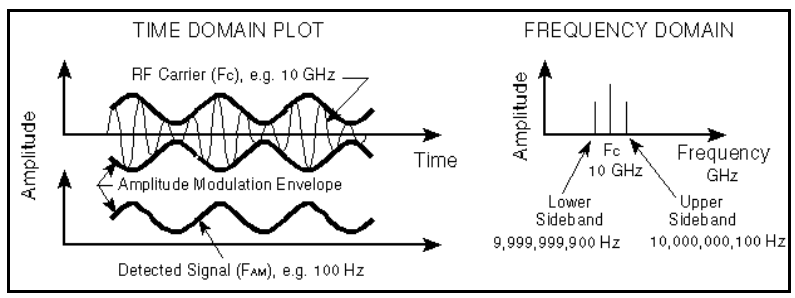

Figure 3. Sinewave Modulated RF Signal.

Pulse modulation is a special case of AM wherein the carrier frequency is gated at a pulsed rate. When the reciprocal of the duty cycle of the AM is a whole number, harmonics corresponding to multiples of that whole number will be missing, e.g., in a 33.33% duty cycle, AM wave will miss the 3rd, 6th, 9th, etc. harmonics, while a square wave or

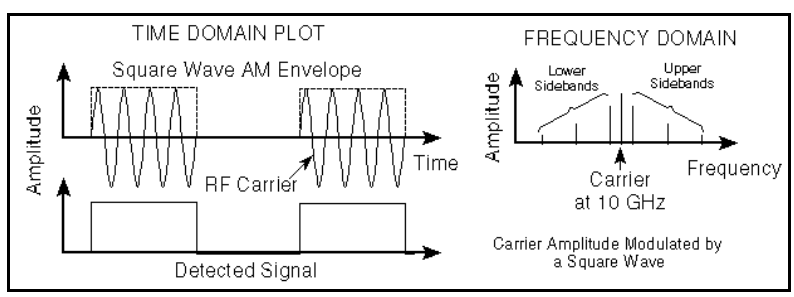

Figure 4. Square Wave Modulated RF Signal (50% Duty Cycle).

50% duty cycle triangular wave will miss the 2nd, 4th, 6th, etc. harmonic, as shown in Figure 4. It has sidebands in the frequency domain at $F_c \pm nF_{AM}$, where n = 1, 3, 5, etc. The amplitude of the power level follows a sine x / x type distribution.

Figure 5 shows the pulse width (PW) in the time domain which defines the lobe width in the frequency domain (Figure 6). The width of the main lobe is 2/PW, whereas the width of a side lobe is 1/PW. Figure 5 also shows the pulse repetition interval (PRI) or its reciprocal, pulse repetition frequency (PRF), in the time domain. In the frequency domain, the spectral lines inside the lobes are separated by the PRF or 1/PRI, as shown in Figures 7 and 8. Note that Figures 7 and 8 show actual magnitude of the side lobes, whereas in Figure 4 and 6, the absolute value is shown.

The magnitude of each spectral component for a rectangular pulse can be determined from the following formula:

$$a_n = 2A\frac{\tau}{T}\frac{\sin(n\pi\tau/T)}{n\pi\tau/T} \quad where: \begin{matrix}\tau = pulse\ width\ (PW) \\ T = period\ (PRI)\end{matrix} \quad and\ \ A = Amplitude\ of\ rectangular\ pulse \qquad [1]$$

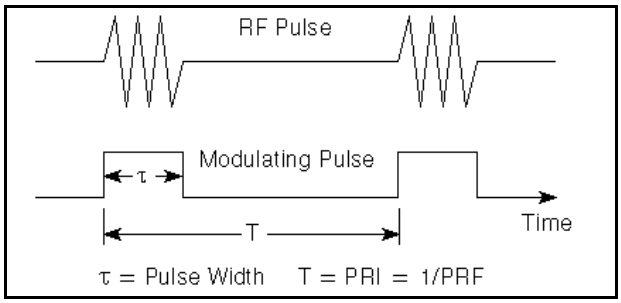

Figure 5. Pulse Width and PRI/PRF Waveforms.

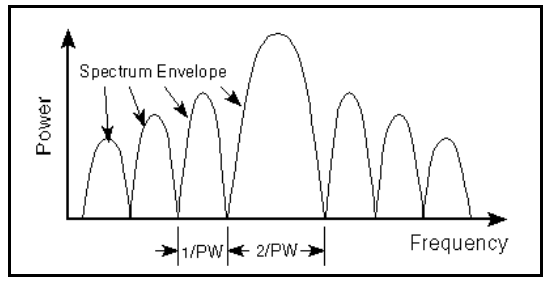

Figure 6. Sidelobes Generated by Pulse Modulation (Absolute Value).

Figure 7 shows the spectral lines for a square wave 50% duty cycle), while Figure 8 shows the spectral lines for a 33.33% duty cycle rectangular wave signal.

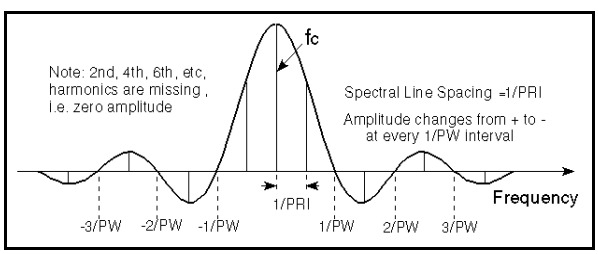

Figure 7. Spectral Times for a Square Wave Modulated Signal.

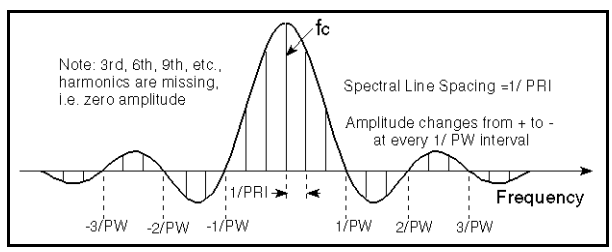

Figure 8. Spectral Lines for a 33.3% Duty Cycle.

Figure 9 shows that for square wave AM, a significant portion of the component modulation is contained in the first few harmonics which comprise the wave. There are twice as many sidebands or spectral lines as there are harmonics (one on the plus and one on the minus side of the carrier). Each sideband represents a sine wave at a frequency equal to the difference between the spectral line and f_c.

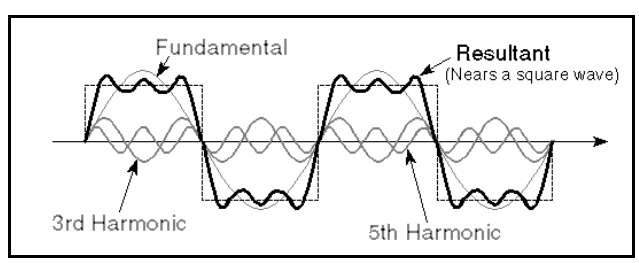

Figure 9. Square Wave Consisting of Sinewave Harmonics.

A figure similar to Figure 9 can be created for any rectangular wave. The relative amplitude of the time domain sine wave components are computed using equation [1]. Each is constructed such that at the midpoint of the pulse the sine wave passes through a maximum (or minimum if the coefficient is negative) at the same time. It should be noted that the "first" harmonic created using this formula is NOT the carrier frequency, f_c, of the modulated signal, but at $F_c \pm F_{AM}$.

While equation [1] is for rectangular waves only, similar equations can be constructed using Fourier coefficients for other waveforms, such as triangular, sawtooth, half sine, trapezoidal, and other repetitive geometric shapes.

PRI Effects - If the PW remains constant but PRI increases, the number of sidelobes remains the same, but the number of spectral lines gets denser (move closer together) and vice versa (compare Figures 7 and 8). The spacing between the spectral lines remains constant with constant PRI.

Pulse Width (PW) Effects - If the PRI remains constant, but the PW increases, then the lobe width decreases and vice versa. If the PW approaches PRI, the spectrum will approach "one lobe," i.e., a single spectral line. The spacing of the lobes remains constant with constant PW.

RF Measurements - If the receiver bandwidth is smaller than the PRF, the receiver will respond to one spectral line at a time. If the receiver bandwidth is wider than the PRF but narrower than the reciprocal of the PW, the receiver will respond to one spectral envelope at a time.

Jet Engine Modulation (JEM)

Section 2-6 addresses the Doppler shift in a transmitted radar signal caused by a moving target. The amount of Doppler shift is a function of radar carrier frequency and the speed of the radar and target. Moving or rotating surfaces on the target will have the same Doppler shift as the target, but will also impose AM on the Doppler shifted return (see Figure 10). Reflections off rotating jet engine compressor blades, aircraft propellers, ram air turbine (RAT) propellers used to power aircraft pods, helicopter rotor blades, and protruding surfaces of automobile hubcaps will all provide a chopped reflection of the impinging signal. The reflections are characterized by both positive and negative Doppler sidebands corresponding to the blades moving toward and away from the radar respectively.

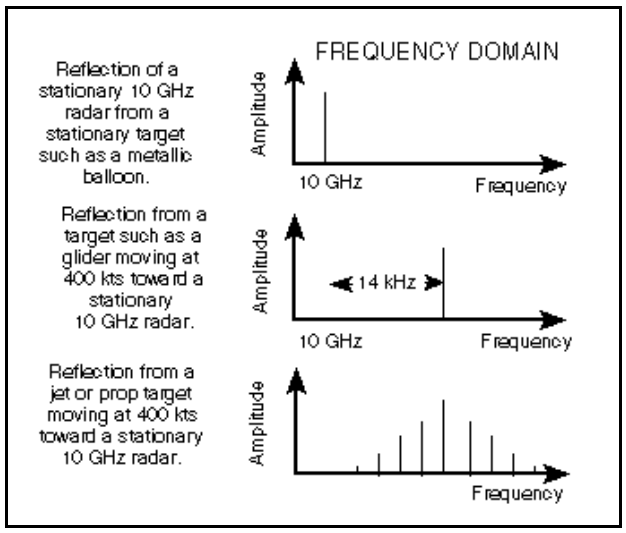

Figure 10. Doppler Return and JEM.

Therefore, forward/aft JEM does not vary with radar carrier frequency, but the harmonics contained in the sidebands are a function of the PRF of the blade chopping action and its amplitude is target aspect dependent, i.e., blade angle, intake/exhaust internal reflection, and jet engine cowling all effect lateral return from the side. If the aspect angle is too far from head-on or tail-on and the engine cowling provides shielding for the jet engine, there may not be any JEM to detect. On the other hand, JEM increases when you are orthogonal (at a right angle) to the axis of blade rotation. Consequently for a fully exposed blade as in a propeller driven aircraft or helicopter, JEM increases with angle off the boresight axis of the prop/rotor.

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TRANSFORMS / WAVELETS

Transform Analysis

Signal processing using a transform analysis for calculations is a technique used to simplify or accelerate problem solution. For example, instead of dividing two large numbers, we might convert them to logarithms, subtract them, then look-up the anti-log to obtain the result. While this may seem a three-step process as opposed to a one-step division, consider that long-hand division of a four digit number by a three digit number, carried out to four places requires three divisions, 3-4 multiplication's, and three subtractions. Computers process additions or subtractions much faster than multiplications or divisions, so transforms are sought which provide the desired signal processing using these steps.

Fourier Transform

Other types of transforms include the Fourier transform, which is used to decompose or separate a waveform into a sum of sinusoids of different frequencies. It transforms our view of a signal from time based to frequency based. Figure 1 depicts how a square wave is formed by summing certain particular sine waves. The waveform must be continuous, periodic, and almost everywhere differentiable. The Fourier transform of a sequence of rectangular pulses is a series of sinusoids. The envelope of the amplitude of the coefficients of this series is a waveform with a Sin X/X shape. For the special case of a single pulse, the Fourier series has an infinite series of sinusoids that are present for the duration of the pulse.

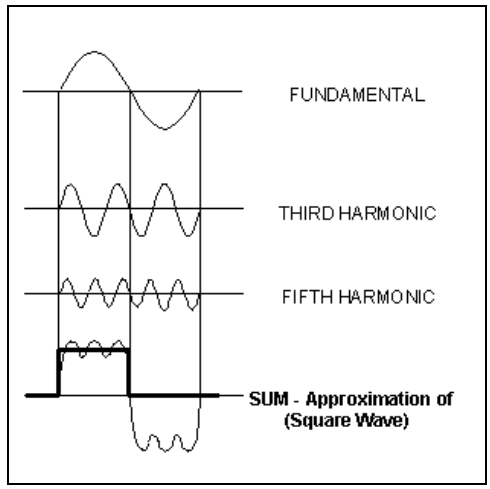

Figure 1. Harmonics.

Digital Sampling of Waveforms

To process a signal digitally, we need to sample the signal frequently enough to create a complete "picture" of the signal. The discrete Fourier transform (DFT) may be used in this regard. Samples are taken at uniform time intervals as shown in Figure 2 and processed.

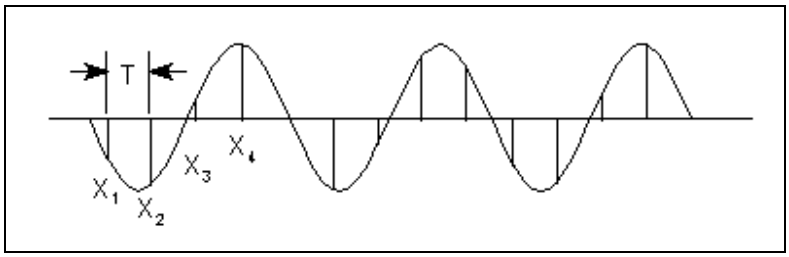

Figure 2. Waveform Sampling.

If the digital information is multiplied by the Fourier coefficients, a digital filter is created as shown Figure 3. If the sum of the resultant components is zero, the filter has ignored (notched out) that frequency sample. If the sum is a relatively large number, the filter has passed the signal. With the single sinusoid shown, there should be only one resultant. (Note that being "zero" and relatively large

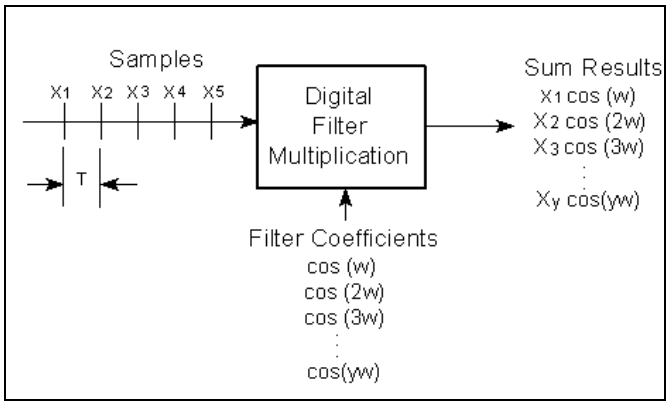

Figure 3. Digital Filtering.

may just mean below or above the filter's cutoff threshold.)

Figure 4 depicts the process pictorially: The vectors in the figure just happen to be pointing in a cardinal direction because the strobe frequencies are all multiples of the vector (phasor) rotation rate, but that is <u>not normally the case</u>. Usually the vectors will point in a number of different directions, with a resultant in some direction other than straight up.

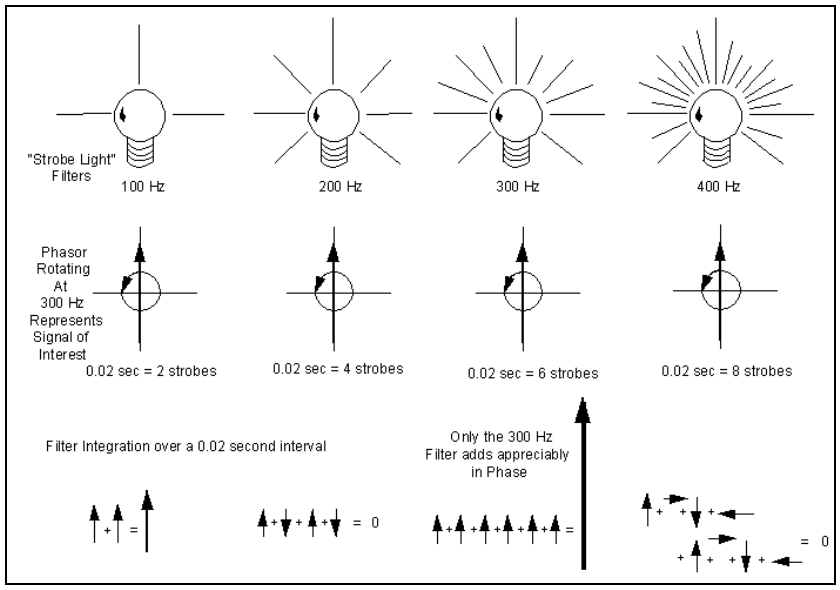

Figure 4. Phasor Representation.

In addition, sampling normally has to taken at or above twice the rate of interest (also known as the Nyquist rate), otherwise ambiguous results may be obtained. Figure 4 is under-sampled (for clarity) and consequently does not depict typical filtering.

<u>Fast Fourier Transforms</u>

One problem with this type of processing is the large number of additions, subtractions, and multiplications which are required to reconstruct the output waveform. The Fast Fourier transform (FFT) was developed to reduce this problem. It recognizes that because the filter coefficients are sine and cosine waves, they are symmetrical about 90, 180, 270, and 360 degrees. They also have a number of coefficients equal either to one or zero, and duplicate coefficients from filter to filter in a multibank arrangement. By waiting for all of the inputs for the bank to be received, adding together those inputs for which coefficients are the same before performing multiplications, and separately summing those combinations of inputs and products which are common to more than one filter, the required amount of computing may be cut drastically.

- The number of computations for a DFT is on the order of N squared.

- The number of computations for a FFT when N is a power of two is on the order of N $\log_2$ N.

For example, in an eight filter bank, a DFT would require 512 computations, while an FFT would only require 56, significantly speeding up processing time.

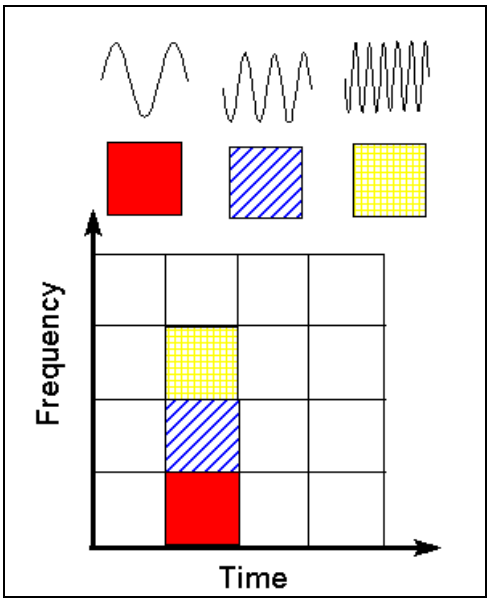

Figure 5. Windowed Fourier Transform.

Windowed Fourier Transform

The Fourier transform is continuous, so a windowed Fourier transform (WFT) is used to analyze non-periodic signals as shown in Figure 5. With the WFT, the signal is divided into sections (one such section is shown in Figure 5) and each section is analyzed for frequency content. If the signal has sharp transitions, the input data is windowed so that the sections converge to zero at the endpoints. Because a single window is used for all frequencies in the WFT, the resolution of the analysis is the same (equally spaced) at all locations in the time-frequency domain.

The FFT works well for signals with smooth or uniform frequencies, but it has been found that other transforms work better with signals having pulse type characteristics, time-varying (non-stationary) frequencies, or odd shapes.

The FFT also does not distinguish sequence or timing information. For example, if a signal has two frequencies (a high followed by a low or vice versa), the Fourier transform only reveals the frequencies and relative amplitude, not the order in which they occurred. So Fourier analysis works well with stationary, continuous, periodic, differentiable signals, but other methods are needed to deal with non-periodic or non-stationary signals.

Wavelet Transform

The Wavelet transform has been evolving for some time. Mathematicians theorized its use in the early 1900's. While the Fourier transform deals with transforming the time domain components to frequency domain and frequency analysis, the wavelet transform deals with scale analysis, that is, by creating mathematical structures that provide varying time/frequency/amplitude slices for analysis. This transform is a portion (one or a few cycles) of a complete waveform, hence the term wavelet.

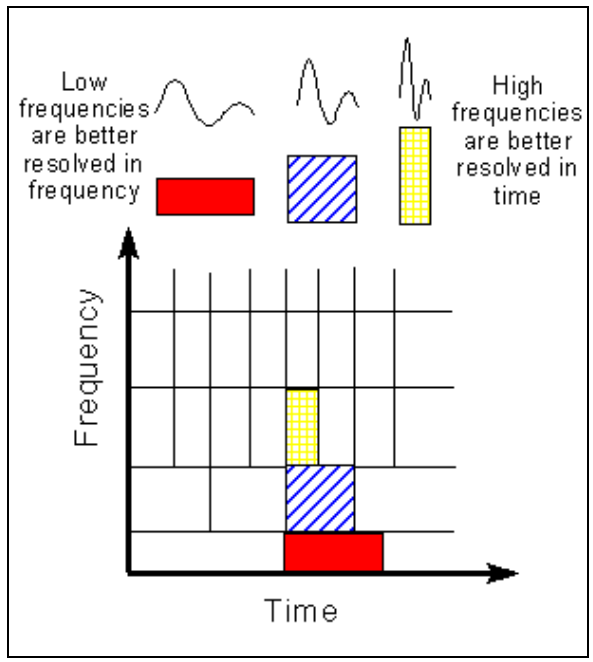

Figure 6. Wavelet Transform.

The wavelet transform has the ability to identify frequency (or scale) components, simultaneously with their location(s) in time. Additionally, computations are directly proportional to the length of the input signal. They require only N multiplications (times a small constant) to convert the waveform. For the previous eight filter bank example, this would be about twenty calculations, vice 56 for the FFT.

In wavelet analysis, the scale that one uses in looking at data plays a special role. Wavelet algorithms process data at different scales or resolutions. If we look at a signal with a large "window," we would notice gross features. Similarly, if we look at a signal with a small "window," we would notice small discontinuities as shown in Figure 6. The result in wavelet analysis is to "see the forest and the trees." A way to achieve this is to have short high-frequency fine scale functions and long low-frequency ones. This approach is known as multi-resolution analysis.

For many decades, scientists have wanted more appropriate functions than the sines and cosines (base functions) which comprise Fourier analysis, to approximate choppy signals. (Although Walsh transforms work if the waveform is periodic and stationary). By their definition, sine and cosine functions are non-local (and stretch out to infinity), and therefore do a very poor job in approximating sharp spikes. But with wavelet analysis, we can use approximating functions that are contained neatly in finite (time/frequency) domains. Wavelets are well-suited for approximating data with sharp discontinuities.

The wavelet analysis procedure is to adopt a wavelet prototype function, called an "analyzing wavelet" or "mother wavelet." Temporal analysis is performed with a contracted, high-frequency version of the prototype wavelet, while frequency analysis is performed with a dilated, low-frequency version of the prototype wavelet. Because the original signal or function can be represented in terms of a wavelet expansion (using coefficients in a linear combination of the wavelet functions), data operations can be performed using just the corresponding wavelet coefficients as shown in Figure 7.

If one further chooses the best wavelets adapted to the data, or truncates the coefficients below some given threshold, the data is sparsely represented. This "sparse coding" makes wavelets an excellent tool in the field of data compression. For instance, the FBI uses wavelet coding to store fingerprints. Hence, the concept of wavelets is to look at a signal at various scales and analyze it with various resolutions.

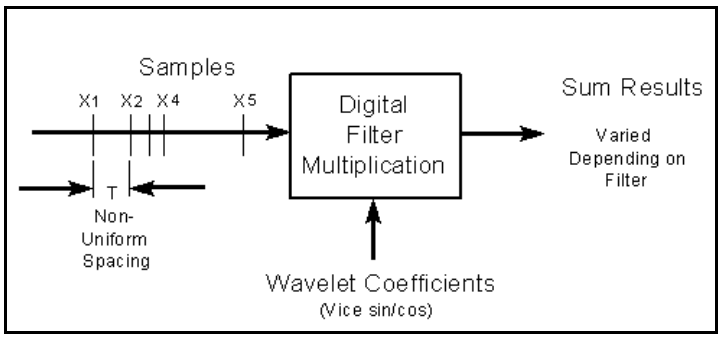

Figure 7. Wavelet Filtering.

Analyzing Wavelet Functions

Fourier transforms deal with just two basis functions (sine and cosine), while there are an infinite number of wavelet basis functions. The freedom of the analyzing wavelet is a major difference between the two types of analyses and is important in determining the results of the analysis. The "wrong" wavelet may be no better (or even far worse than) than the Fourier analysis. A successful application presupposes some expertise on the part of the user. Some prior knowledge about the signal must generally be known in to select the most suitable distribution and adapt the parameters to the signal. Some

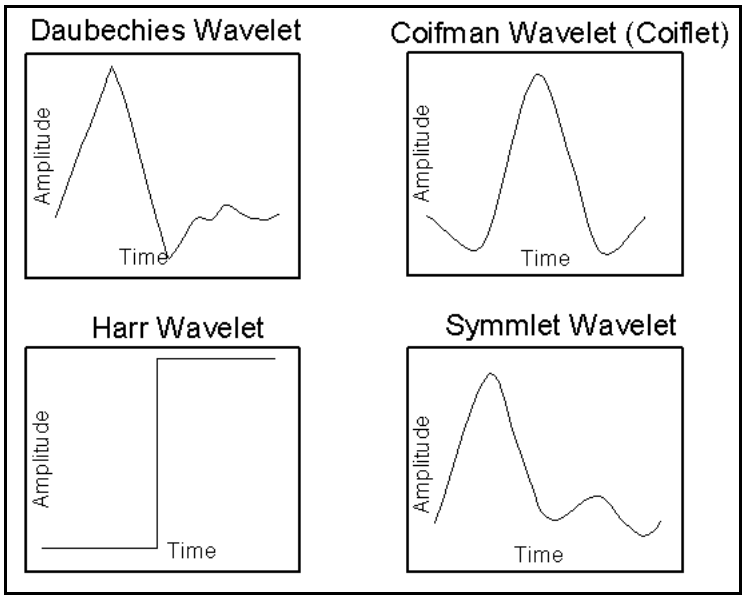

Figure 8. Sample Wavelet Functions.

of the more common ones are shown in Figure 8. There are several wavelets in each family, and they may look different than those shown. Somewhat longer in duration than these functions, but significantly shorter than infinite sinusoids is the cosine packet shown in Figure 9.

Wavelet Comparison With Fourier Analysis

While a typical Fourier transform provides frequency content information for samples within a given time interval, a perfect wavelet transform records the start of one frequency (or event), then the start of a second event, with amplitude added to or subtracted from, the base event.

Example 1.

Wavelets are especially useful in analyzing transients or time-varying signals. The input signal shown in Figure 9 consists of a sinusoid whose frequency changes in stepped increments over time. The power of the spectrum is also shown. Classical Fourier analysis will resolve the frequencies but cannot provide any information about the times at which each occurs. Wavelets provide an efficient means of analyzing the input signal so that frequencies and the times at which they occur can be resolved. Wavelets have finite duration and must also satisfy additional properties beyond those normally associated with standard windows used with Fourier analysis. The result after the wavelet transform is applied is the plot shown in the lower right. The wavelet analysis correctly resolves each of the frequencies and the time when it occurs. A series of wavelets is used in example 2.

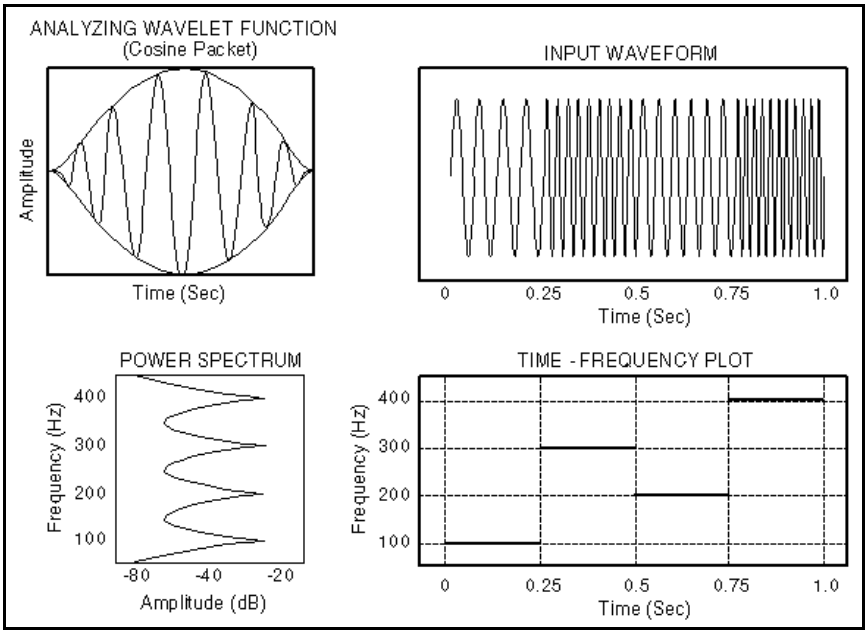

Figure 9. Sample Wavelet Analysis.

Example 2.

Figure 10 shows the input of a clean signal, and one with noise. It also shows the output of a number of "filters" with each signal. A 6 dB S/N improvement can be seen from the d4 output. (Recall from Section 4.3 that 6 dB corresponds to doubling of detection range.) In the filter cascade, the HPFs and LPFs are the same at each level. The wavelet shape is related to the HPF and LPF in that it is the "impulse response" of an infinite cascade of the HPFs and LPFs. Different wavelets have different HPFs and LPFs. As a result of decimating by 2, the number of output samples equals the number of input samples.

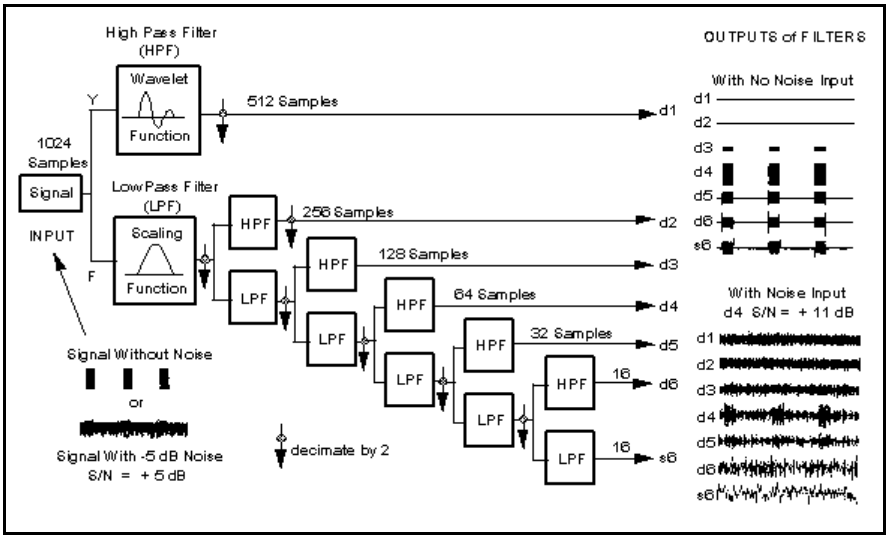

Figure 10. Example 2 Analysis Wavelet.

Wavelet Applications

Some fields that are making use of wavelets are: astronomy, acoustics, nuclear engineering, signal and image processing (including fingerprinting), neurophysiology, music, magnetic resonance imaging, speech discrimination, optics, fractals, turbulence, earthquake-prediction, radar, human vision, and pure mathematics applications.

See Andrew Bruce, David Donoho, and Hong-Ye Gao, "Wavelet Analysis," *IEEE Spectrum*, Vol. 33 No. 10, October 1996.

ANTENNAS

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ANTENNA INTRODUCTION / BASICS

Rules of Thumb:

1. The power gain of an antenna with losses, excluding input impedance mismatch, is given by:

$$G \approx \frac{4\pi\eta A}{\lambda^2} \quad \text{Where} \quad \begin{array}{l} \eta = \text{Efficiency} \\ A = \text{Physical aperture area} \\ \lambda = \text{wavelength} \end{array}$$

another is :

$$G = \frac{X\,\eta}{BW_\phi\, BW_\theta}$$

Where $BW_{\theta \text{ and } \phi}$ are the elev & az beamwidths in degrees.

For approximating an antenna pattern with :

(1) A rectangle; $X = 41253, \eta_{typical} = 0.7$

(2) An ellipsoid; $X = 52525, \eta_{typical} = 0.55$

2. Directive gain of rectangular X-Band Aperture
   G = 1.4 LW Where: Length (L) and Width (W) are in cm

3. Power gain of Circular X-Band Aperture
   $G = d^2\eta$ Where: d = antenna diameter in cm
   η = aperture efficiency

4. Directive gain of an imaginary isotropic antenna radiating in a uniform spherical pattern is one (0 dB).

5. Antenna with a 20 degree beamwidth has approximately a 20 dB directive gain.

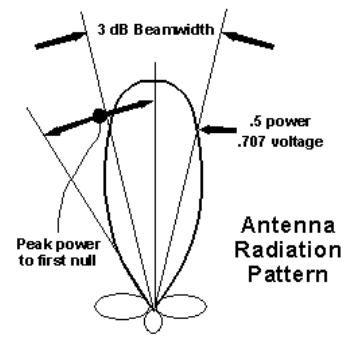

6. 3 dB beamwidth is approximately equal to the angle from the peak of the power to the first null (see figure at right).

7. Parabolic Antenna Beamwidth: $BW = \frac{70\lambda}{d}$

   Where: BW = antenna beamwidth; λ = wavelength; d = antenna diameter.

The antenna equations which follow relate to Figure 1 as a typical antenna. In Figure 1, BW_φ is the azimuth beamwidth and BW_θ is the elevation beamwidth. Beamwidth is normally measured at the half-power or -3 dB point of the main lobe unless otherwise specified. See Glossary.

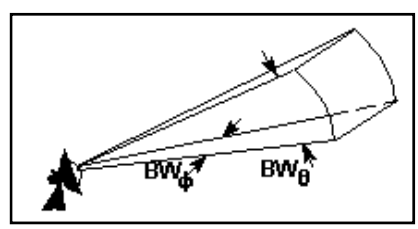

Figure 1. Antenna Aperture.

The gain or directivity of an antenna is the ratio of the radiation intensity in a given direction to the radiation intensity averaged over all directions.

Quite often directivity and gain are used interchangeably and it sometimes leads to overly optimistic antenna performance estimations. The difference is that directivity is based solely on antenna pattern shape estimation where antenna losses such as dielectric, ohmic resistance, and polarization mismatch are neglected. If these losses are included in the antenna gain calculations, the antenna gain is then referred to as the power gain. Moreover, if additional impedance mismatch or VSWR losses are included in the antenna system gain estimation, the antenna gain calculations are then referred to as the realized gain. However, using directive gain (or directivity) calculations is very convenient in practice for a first order idealized antenna performance estimation.

Normalizing a radiation pattern by the integrated total power yields the directivity of the antenna. This concept in shown in equation form by:

$$D(\theta,\phi) = 10 \text{ Log}\left[\frac{4\pi P(\theta,\phi)}{\int\int P_{in}(\theta,\phi)\,\text{Sin}\,\theta\, d\theta\, d\phi}\right] \quad \begin{matrix} 0 < \phi \le 360° \\ 0 < \theta \le 180° \end{matrix} \qquad \textbf{[1]}$$

Where D(θ,φ) is the directivity in dB, and the radiation pattern power in a specific direction is $P_d(\theta,\varphi)$, which is normalized by the total integrated radiated power. Another important concept is that when the angle in which the radiation is constrained is reduced, the directive gain goes up. For example, using an isotropic radiating source, the gain would be 0 dB by definition (Figure 2(a)) and the power density (P_d) at any given point would be the power in (P_{in}) divided by the surface area of the imaginary sphere at a distance R from the source. If the spacial angle was decreased to one hemisphere (Figure 2(b)), the power radiated, P_{in}, would be the same but the area would be half as much, so the gain would double to 3 dB. Likewise if the angle is a quarter sphere, (Figure 2(c)), the gain would be 6 dB. Figure 2(d) shows a pencil beam. The gain is independent of actual power output and radius (distance) at which measurements are taken.

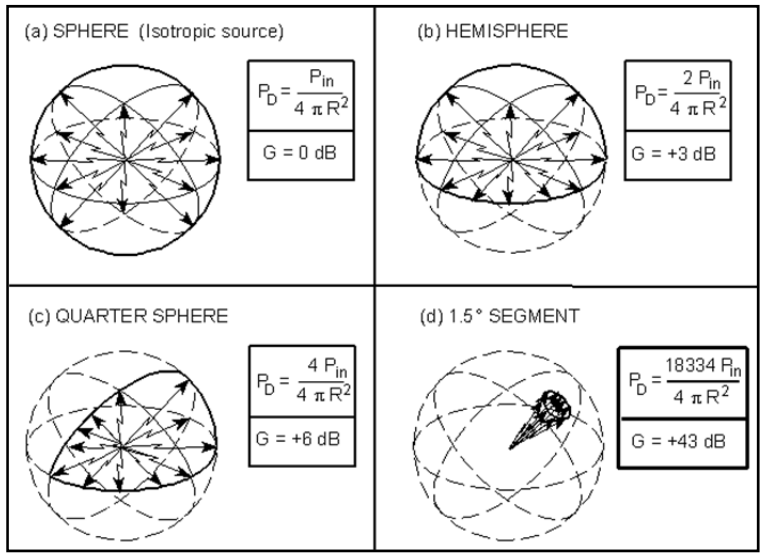

Figure 2. Notional Representation of Directive Antenna Gain.

Real antennas are different, however, and do not have an ideal radiation distribution. Energy varies with angular displacement and losses occur due to sidelobes. However, if we can measure the pattern, and determine the beamwidth we can use two (or more) ideal antenna models to approximate a real antenna pattern as shown in Figure 3.

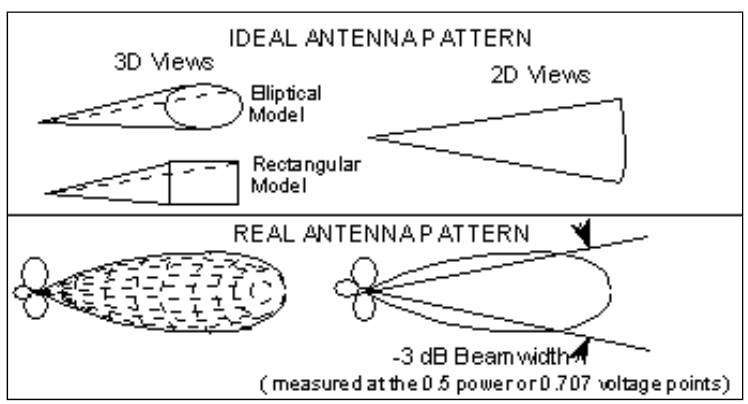

Figure 3. Antenna Beamwidth.

Assuming the antenna pattern is uniform, the gain is equal to the area of the isotropic sphere ($4\pi r^2$) divided by the sector (cross section) area.

$$G = \frac{Area\ of\ Sphere}{Area\ of\ Antenna\ pattern} \qquad \textbf{[2]}$$

It can be shown that:

$$G \approx \frac{4\pi}{BW_{\phi\,az}\,BW_{\theta\,el}} \quad or \quad \frac{4\pi}{\phi\theta\,(radians)} \quad where: \begin{matrix} BW_{\phi\,az} = Azmith\ beamwidth\ in\ radians \\ BW_{\theta\,el} = Elevation\ beamwidth\ in\ radians \end{matrix} \qquad \textbf{[3]}$$

From this point, two different models are presented:

(1) Approximating an antenna pattern using an elliptical area, and
(2) Approximating an antenna pattern using a rectangular area.

<u>Approximating the antenna pattern as an **elliptical** area:</u>

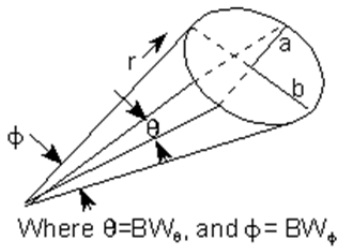

Area of ellipse = π a b = π[(r sin θ)/2][(r sin φ)/2]= (π r^2 sin θ sin φ)/4

$$G = \frac{Area\ of\ Sphere}{Area\ of\ Antenna\ pattern} = (4\,\pi\,r^2)\left(\frac{4}{\pi\,r^2\ \sin\theta\sin\phi}\right) = \frac{16}{\sin\theta\sin\phi}$$

For small angles, sin φ = φ in radians, so:

$$G = \frac{16}{\sin\phi\sin\theta} \approx \frac{16}{\phi\,\theta\,(radians)} = \frac{16}{\phi\,\theta}\left(\frac{360°\ 360°}{2\,\pi\ 2\,\pi}\right) = \frac{52525}{\phi\,\theta\,(degrees)}\ or\ \frac{52525}{BW_\phi\,BW_\theta\,(degrees)} \qquad \textbf{[4]}$$

The second term in the equation above is very close to equation [3].

For a very directional radar dish with a beamwidth of 1° and an average efficiency of 55%:

Ideally: G = 52525, or in dB form: 10 log G =10 log 52525 = 47.2 dB

With efficiency taken into account, G = 0.55(52525) = 28888, or in log form: 10 log G = 44.6 dB

<u>Approximating the antenna pattern as a **rectangular** area:</u>

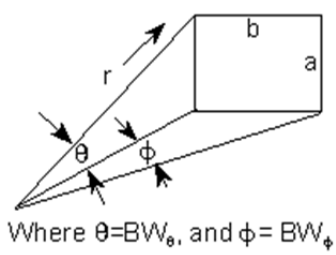

a = r sin θ , b = r sin φ, area = ab = r^2 sin θ sin φ

$$G = \frac{Area\ of\ Sphere}{Area\ of\ Antenna\ pattern} = \frac{4\,\pi\,r^2}{r^2\ \sin\theta\sin\phi} = \frac{4\,\pi}{\sin\theta\sin\phi}$$

For small angles, sin φ = φ in radians, so:
The second term in the equation above is identical to equation [3].

$$G = \frac{4\,\pi}{\sin\phi\sin\theta} = \frac{4\,\pi}{\phi\,\theta\,(radians)} = \frac{4\,\pi}{\phi\,\theta}\left(\frac{360°\ 360°}{2\,\pi\ 2\,\pi}\right) = \frac{41253}{\phi\,\theta\,(degrees)}\ or\ \frac{41253}{BW_\phi\,BW_\theta\,(degrees)} \qquad \textbf{[5]}$$

Converting to dB, $G_{\max}(dB) = 10\ \mathrm{Log}\left[\frac{41253}{BW_\phi\,BW_\theta}\right]$ *with* BW_ϕ *and* BW_θ *in degrees* **[6]**

For a very directional radar dish with a beamwidth of 1° and an average efficiency of 70%:
Ideally (in dB form): 10 log G =10 log 41253 = 46.2 dB.
With efficiency taken into account, G = 0.7(41253) = 28877, or in log form: 10 log G = 44.6 dB

Comparison between elliptical and rectangular areas for antenna pattern models:

By using the rectangular model there is a direct correlation between the development of gain in equation [5] and the ideal gain of equation [3]. The elliptical model has about one dB difference from the ideal calculation, but will yield the same real antenna gain when appropriate efficiencies are assumed.

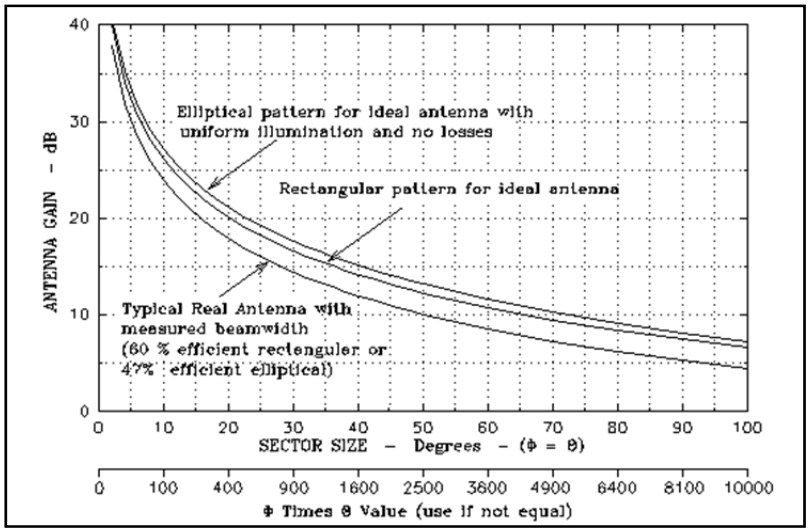

Figure 4. Antenna Sector Size vs. Gain.

The upper plot of Figure 4 shows the gain for an ideal antenna pattern using the elliptical model. The middle plot shows the gain for an ideal antenna using the rectangular model. The lower plot of Figure 4 shows the gain of a typical real antenna (rectangular model using an efficiency of 70% or elliptical model using an efficiency of 47%).

Gain as a function of λ:

When θ = 0, each wave source in Figure 5 is in phase with one another and a maximum is produced in that direction.

Conversely, nulls to either side of the main lobe will occur when the waves radiating from the antenna cancel each other. The first null occurs when there is a phase difference of λ/2 in the wave fronts emanating from the aperture. To aid in visualizing what happens, consider each point in the antenna aperture, from A to C in Figure 5, as a point source of a spherical wave front. If viewed from infinity, the electromagnetic waves from each point interfere with each other, and when, for a particular direction, θ in Figure 5, each wave source has a corresponding point that is one-half wavelength out of phase, a null is produced in that direction due to destructive interference.

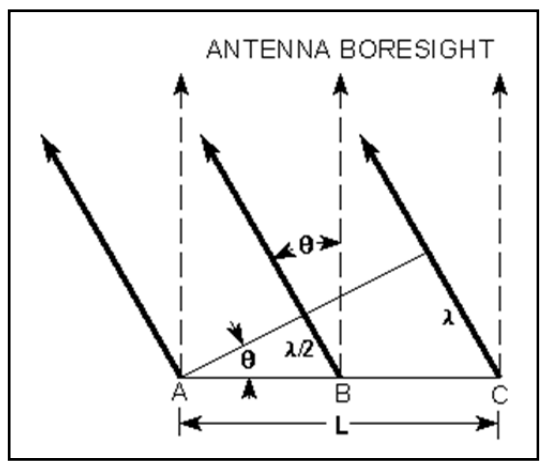

Figure 5. Directional Gain vs. Wavelength.

In Figure 5, the wave emanating from point A is out of phase with the wave from point B by one-half of a wavelength. Hence, they cancel. Similarly, a point just to the right of point A cancels with a point just to the right of point B, and so on across the entire aperture. Therefore, the first null in the radiation pattern is given by:

$$\sin\theta = \lambda/L \text{ and, in radians, } \theta = \lambda/L \text{ (for small angles)} \qquad \textbf{[7]}$$

As the angle off boresight is increased beyond the first null, the intensity of the radiation pattern rises then falls, until the second null is reached. This corresponds to a phase difference of two wavelengths between the left and right edges of the aperture. In this case, the argument proceeds as before, except now the aperture is divided into four segments (point A canceling with a point halfway between A and B, and so on).

The angle θ is the angle from the center (maximum) of the radiation pattern to the first null. The null-to-null beam width is 2θ. Generally, we are interested in the half-power (3 dB) beamwidth. It turns out that this beamwidth is approximately one-half of the null-to-null beamwidth, so that:

$$BW_{3\ dB} \approx (½)(2\theta) = \lambda/L \qquad \textbf{[8]}$$

Therefore, beamwidth is a function of the antenna dimension "L" and the wavelength of the signal. It can be expressed as follows: Note: for circular antennas, L in the following equations = diameter

$$Bw_{\varphi(az)} = \lambda/L_{Az\ eff} \text{ and } BW_{\theta(el)} = \lambda/L_{El\ eff} \qquad \textbf{[9]}$$

Substituting the two variations of equation [9] into equation [3] and since $L_{Az\ eff}$ times $L_{El\ eff} = A_e$ (effective capture area of the antenna), we have:

$$G \approx \frac{4\pi}{BW_\phi\, BW_\theta\, (radians)} = \frac{4\pi\, L_{az}\, L_{el}}{\lambda^2} = \frac{4\pi\, A_e}{\lambda^2} \qquad \textbf{[10]}$$

Note: Equation is approximate since aperture efficiency isn't included as is done later in equation [12].

The efficiency (discussed later) will reduce the gain by a factor of 30-50%, i.e. real gain = .5 to .7 times theoretical gain.

<u>Unity Gain Antenna.</u>
If a square antenna is visualized and G=1, $A_e = \lambda^2 / 4\pi$. When a dimension is greater than 0.28 λ (~¼λ) it is known as an electrically large antenna, and the antenna will have a gain greater than one (positive gain when expressed in dB). Conversely, when the dimension is less than 0.28 λ (~¼λ)(an electrically small antenna), the gain will be less than one (negative gain when expressed in dB). Therefore, a unity gain antenna can be approximated by an aperture that is ¼λ by ¼λ.

<u>Beamwidth as a Function of Aperture Length</u>
It can be seen from Figure 5, that the wider the antenna aperture (L), the narrower the beamwidth will be for the same λ. Therefore, if you have a rectangular shaped horn antenna, the radiation pattern from the wider side will be narrower than the radiation pattern from the narrow side.

APERTURE EFFICIENCY, η

The Antenna Efficiency, η, is a factor which includes all reductions from the maximum gain. η can be expressed as a percentage, or in dB. Several types of "loss" must be accounted for in the efficiency, η:

(1) <u>Illumination efficiency</u> which is the ratio of the directivity of the antenna to the directivity of a uniformly illuminated antenna of the same aperture size,
(2) <u>Phase error loss</u> or loss due to the fact that the aperture is not a uniform phase surface,
(3) <u>Spillover loss</u> (Reflector Antennas) which reflects the energy spilling beyond the edge of the reflector into the back lobes of the antenna,

(4) Mismatch (VSWR) loss, derived from the reflection at the feed port due to impedance mismatch (especially important for low frequency antennas), and

(5) RF losses between the antenna and the antenna feed port or measurement point.

The aperture efficiency, η_a, is also known as the illumination factor, and includes items (1) and (2) above; it does not result in any loss of power radiated but affects the gain and pattern. It is nominally 0.6-0.8 for a planer array and 0.13 to 0.8 with a nominal value of 0.5 for a parabolic antenna, however η can vary significantly. Other antennas include the spiral (.002-.5), the horn (.002-.8), the double ridge horn (.005-.93), and the conical log spiral (.0017-1.0).

Items (3), (4), and (5) above represent RF or power losses which can be measured. The efficiency varies and generally gets lower with wider bandwidths. Also note that the gain equation is optimized for small angles - see derivation of wavelength portion of equation [7]. This explains why efficiency also gets lower for wider beamwidth antennas.

EFFECTIVE CAPTURE AREA

Effective capture area (A_e) is the product of the physical aperture area (A) and the aperture efficiency (η) or:

$$A_e = \eta\, A = \frac{\lambda^2 G}{4\pi} \qquad \textbf{[11]}$$

GAIN AS A FUNCTION OF APERTURE EFFICIENCY

The Gain of an antenna with losses is given by:

$$G = \frac{4\pi\eta A}{\lambda^2} \quad \begin{array}{c} \eta = Aperture\ Efficiency \\ Where\ A = Physical\ aperture\ area \\ \lambda = wavelength \end{array} \qquad \textbf{[12]}$$

Note that the gain is proportional to the aperture area and inversely proportional to the square of the wavelength. For example, if the frequency is doubled, (half the wavelength), the aperture could be decreased four times to maintain the same gain.

BEAM FACTOR

Antenna size and beamwidth are also related by the beam factor defined by:

Beam Factor = $(D/\lambda)\cdot$(Beamwidth) where D = antenna dimension in wavelengths.

The beam factor is approximately invariant with antenna size, but does vary with type of antenna aperture illumination or taper. The beam factor typically varies from 50-70°.

APERTURE ILLUMINATION (TAPER)

The aperture illumination or illumination taper is the variation in amplitude across the aperture. This variation can have several effects on the antenna performance:

(1) reduction in gain,
(2) reduced (lower) sidelobes in most cases, and
(3) increased antenna beamwidth and beam factor.

Tapered illumination occurs naturally in reflector antennas due to the feed radiation pattern and the variation in distance from the feed to different portions of the reflector. Phase can also vary across the aperture which also affects the gain, efficiency, and beamwidth.

CIRCULAR ANTENNA GAIN

Solving equation [12] in dB, for a circular antenna with area $\pi D^2/4$, we have:

$$10 \text{ Log } G = 20 \text{ Log } (D/\lambda) + 10 \text{ Log } (\eta) + 9.94 \text{ dB}; \quad \text{where } D = \text{diameter} \qquad \textbf{[13]}$$

This data is depicted in the nomograph of Figure 6. For example, a six foot diameter antenna operating at 9 GHz would have approximately 44.7 dB of gain as shown by the dashed line drawn on Figure 6. This gain is for an antenna 100% efficient, and would be 41.7 dB for a typical parabolic antenna (50% efficient).

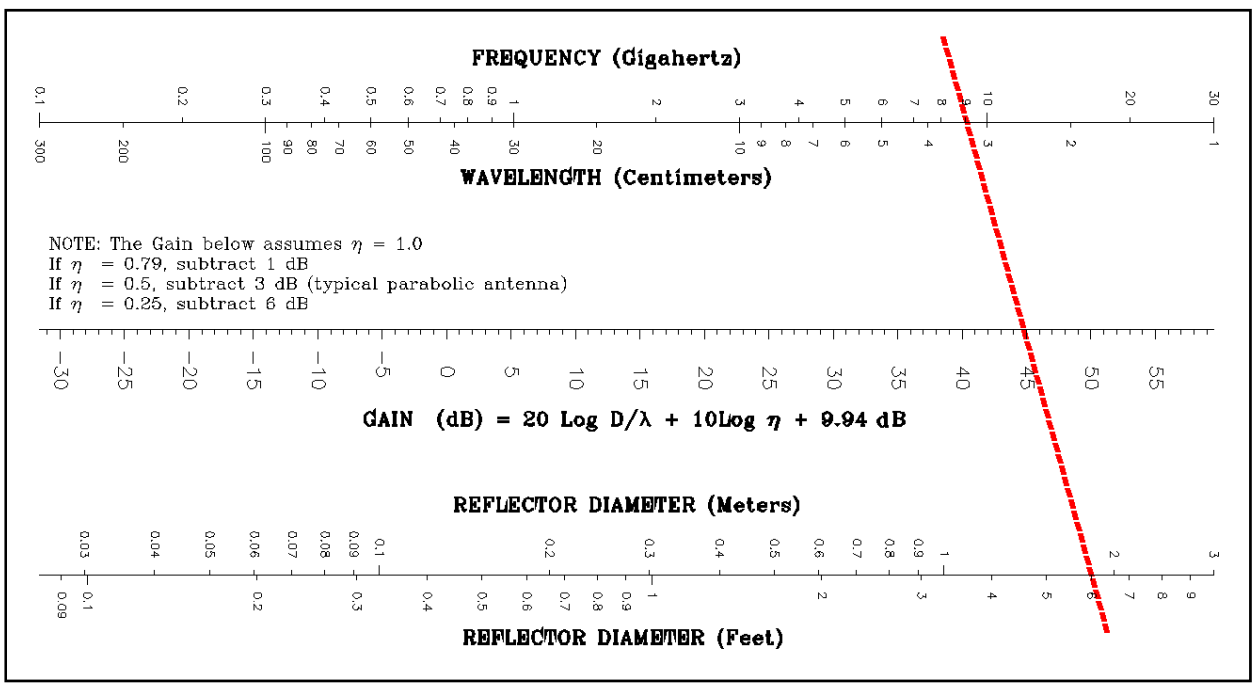

Figure 6. Antenna Gain Nomograph.

An example of a typical antenna (with losses) showing the variation of gain with frequency is depicted in Figure 7, and the variation of gain with antenna diameter in Figure 8. The circle on the curves in Figure 7 and 8 correspond to the Figure 6 example and yields 42 dB of gain for the 6 ft dish at 9 GHz.

Example Problem: If the two antennas in the drawing are "welded" together, how much power will be measured at point A? (Line loss $L_1 = L_2 = 0.5$, and 10log L_1 or L_2 = 3 dB)

Multiple choice:
A. 16 dBm b. 28 dBm c. 4 dBm d. 10 dBm e. < 4 dBm

Answer:

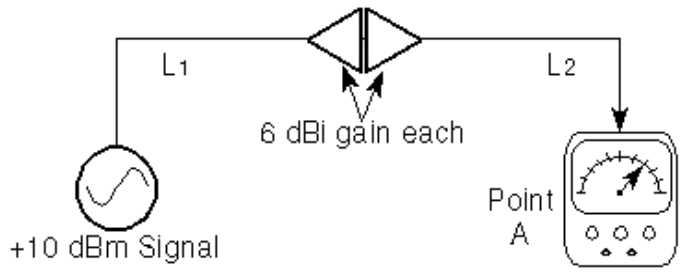

The antennas do not act as they normally would since the antennas are operating in the near field. They act as inefficient coupling devices resulting in some loss of signal. In addition, since there are no active components, you cannot end up with more power than you started with. The correct answer is "e. < 4 dBm."

10 dBm - 3 dB - small loss -3 dB = 4 dBm - small loss

If the antennas were separated by 5 ft and were in the far field, the antenna gain could be used with space loss formulas to calculate (at 5 GHz): 10 dBm - 3 dB + 6 dB - 50 dB (space loss) + 6 dB -3 dB = -34 dBm (a much smaller signal).

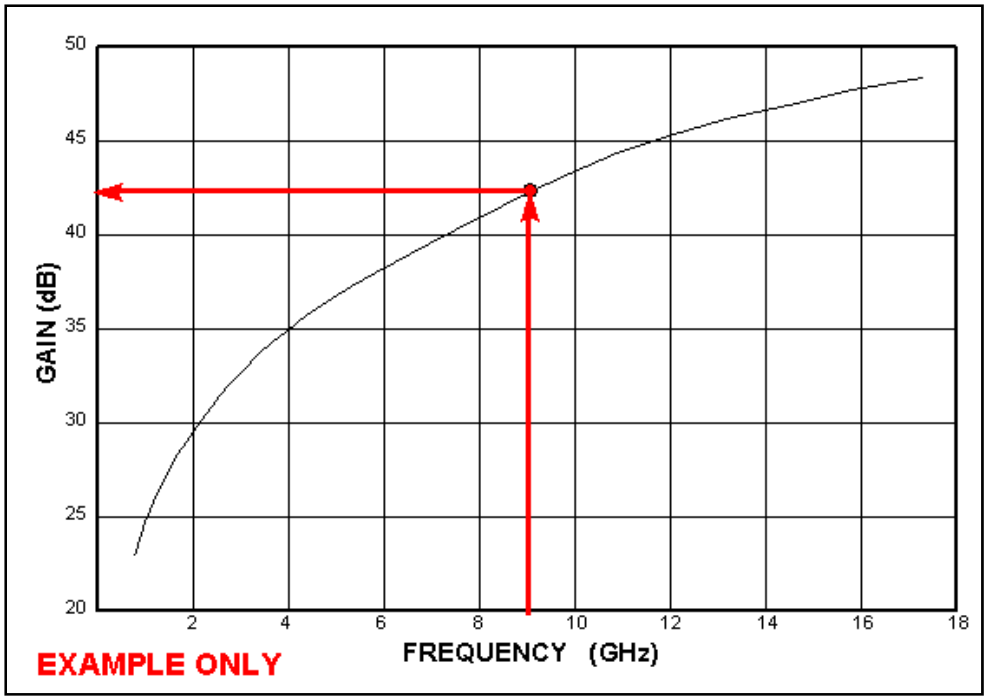

Figure 7. Gain of a Typical 6-Foot Dish Antenna (With Losses).

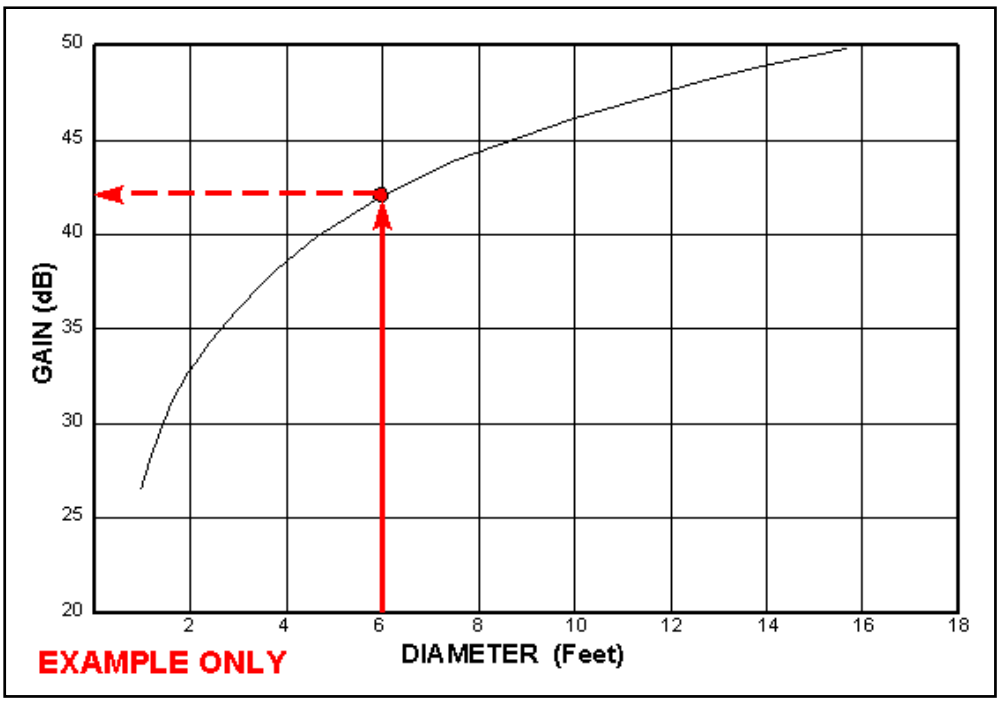

Figure 8. Gain of a Typical Dish at 9 GHz (With Losses).

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POLARIZATION

Table 1 shows the **theoretical** ratio of power transmitted between antennas of different polarization. These ratios are seldom fully achieved due to effects such as reflection, refraction, and other wave interactions, so some practical ratios are also included.

Table 1. Polarization Loss for Various Antenna Combinations.

Transmit Antenna Polarization	Receive Antenna Polarization	Ratio of Power Received to Maximum Power					
		Theoretical		Practical Horn		Practical Spiral	
		Ratio in dB	as Ratio	Ratio in dB	as Ratio	Ratio in dB	as Ratio
Vertical	Vertical	0 dB	1	*	*	N/A	N/A
Vertical	Slant (45° or 135°)	-3 dB	½	*	*	N/A	N/A
Vertical	Horizontal	- ∞ dB	0	-20 dB	1/100	N/A	N/A
Vertical	Circular (right-hand or left-hand)	-3 dB	½	*	*	*	*
Horizontal	Horizontal	0 dB	1	*	*	N/A	N/A
Horizontal	Slant (45° or 135°)	-3 dB	½	*	*	N/A	N/A
Horizontal	Circular (right-hand or left-hand)	-3 dB	½	*	*	*	*
Circular (right-hand)	Circular (right-hand)	0 dB	1	*	*	*	*
Circular (right-hand)	Circular (left-hand)	- ∞ dB	0	-20 dB	1/100	-10 dB	1/10
Circular (right or left)	Slant (45° or 135°)	-3 dB	½	*	*	*	*

* Approximately the same as theoretical.
Note: Switching transmit and receive antenna polarization will give the same results.

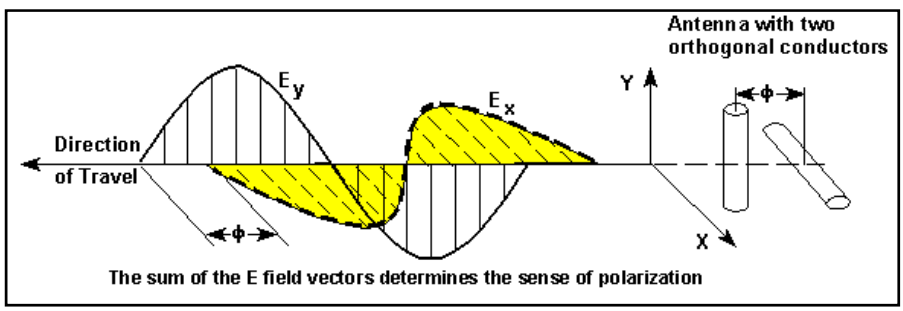

Figure 1. Polarization Coordinates.

The polarization of an electromagnetic wave is defined as the orientation of the electric field vector. Recall that the electric field vector is perpendicular to both the direction of travel and the magnetic field vector. The polarization is described by the geometric figure traced by the electric field vector upon a stationary plane perpendicular to the direction of propagation, as the wave travels through that plane. An electromagnetic wave is frequently composed of (or can be broken down into) two orthogonal components as shown in Figure 1. This may be due to the arrangement of power input leads to various points on a flat antenna, or due to an interaction of active elements in an array, or many other reasons.

The geometric figure traced by the sum of the electric field vectors over time is, in general, an ellipse as shown in Figure 2. Under certain conditions the ellipse may collapse into a straight line, in which case the polarization is called linear.

In the other extreme, when the two components are of equal magnitude and 90° out of phase, the ellipse will become circular as shown in Figure 3. Thus linear and circular polarization are the two special cases of elliptical polarization. Linear polarization may be further classified as being vertical, horizontal, or slant.

Figure 2 depicts plots of the E field vector while varying the relative amplitude and phase angle of its component parts.

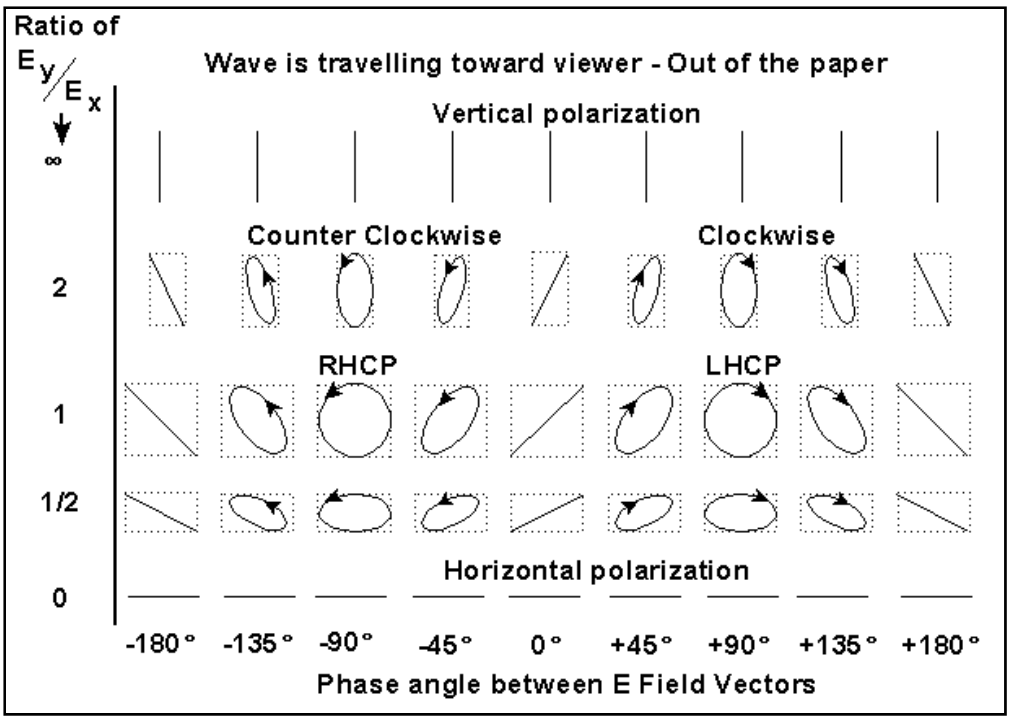

Figure 2. Polarization as a Function of E_y / E_x Ratio and Phase Angle.
Adopted from J.D. Kraus, "Antennas," 2nd ed., Figure 2-37

For a linearly polarized antenna, the radiation pattern is taken both for a co-polarized and cross polarized response. The polarization quality is expressed by the ratio of these two responses. The ratio between the responses must typically be great (30 dB or greater) for an application such as cross-polarized jamming. For general applications, the ratio indicates system power loss due to polarization mismatch. For circularly polarized antennas, radiation patterns are usually taken with a rotating linearly polarized reference antenna. The reference antenna rotates many times while taking measurements around the azimuth of the antenna that is being tested. The resulting antenna pattern is the linear polarized gain with a cyclic ripple. The peak-to-peak value is the axial ratio, and represents the polarization quality for a circular polarized antenna. The typical RWR antenna has a maximum 3 dB axial ratio within 45° of boresight.

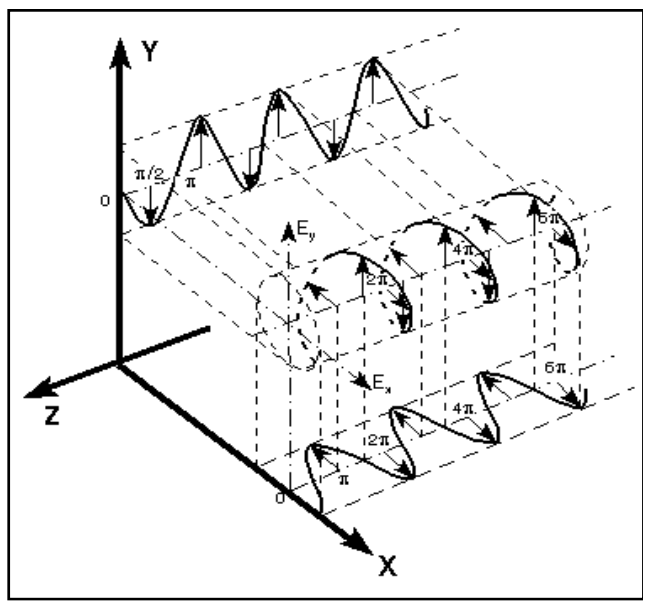

Figure 3. Circular Polarization – E Field.

For any antenna with an aperture area, as the aperture is rotated, the viewed dimension along the axis remains constant, while the other viewed dimension decreases to zero at 90° rotation. The axial ratio of an antenna will get worse as the antenna is rotated off boresight because the field contribution from the axial component will remain fairly constant and the other orthogonal component will decrease with rotation.

The sense of antenna polarization is defined from a viewer positioned behind an antenna looking in the direction of propagation. The polarization is specified as a transmitting, not receiving antenna regardless of intended use.

We frequently use "hand rules" to describe the sense of polarization. The sense is defined by which hand would be used in order to point that thumb in the direction of propagation and point the fingers of the same hand in the direction of rotation of the E field vector. For example, referring to Figure 4, if your thumb is pointed in the direction of propagation and the rotation is counterclockwise looking in the direction of travel, then you have left hand circular polarization.

Optics people view an aperture from the front and therefore use the opposite reference.

The polarization of a linearly polarized horn antenna can be directly determined by the orientation of the feed probe, which is in the direction of the E-field.

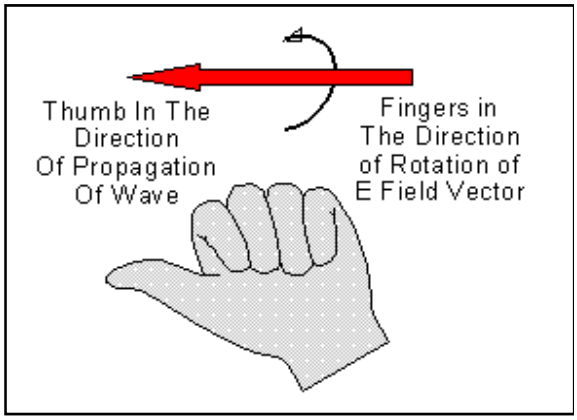

Figure 4. Left Hand Polarization.

In general, a flat surface or sphere will reflect a linearly polarized wave with the same polarization as received. A horizontally polarized wave may get extended range because of water and land surface reflections, but signal cancellation will probably result in "holes" in coverage. Reflections will reverse the sense of circular polarization.

If the desired antenna is used for receiving a direct transmission as shown in Figure 5, the same polarization sense (specified if transmitting) is required for maximum signal reception in this situation. Buy two right-hand or two left-hand circularly polarized antennas for this case. When you procure antennas, remember that the polarization is specified as if transmitting, regardless of intended use.

Wave propagation between two identical antennas is analogous to being able to thread a nut from one bolt to an identical opposite facing bolt.

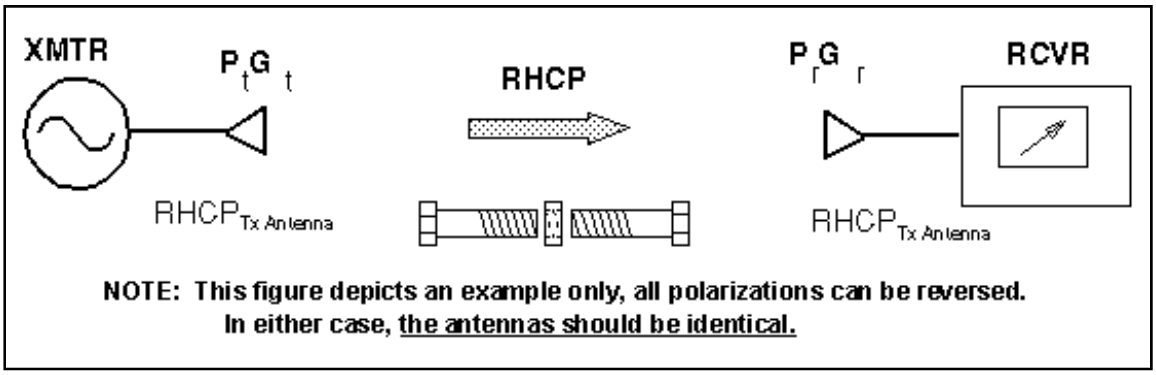

Figure 5. Same Circular Polarization.

If the desired antenna is used for a receiving a wave with a single or odd number of reflections, such as a bistatic radar where separate antennas are used for transmit and receive as shown in Figure 6, then opposite circularly polarized antennas would be used for maximum signal reception. In this case buy antennas of opposite polarization sense (one left hand and one right hand).

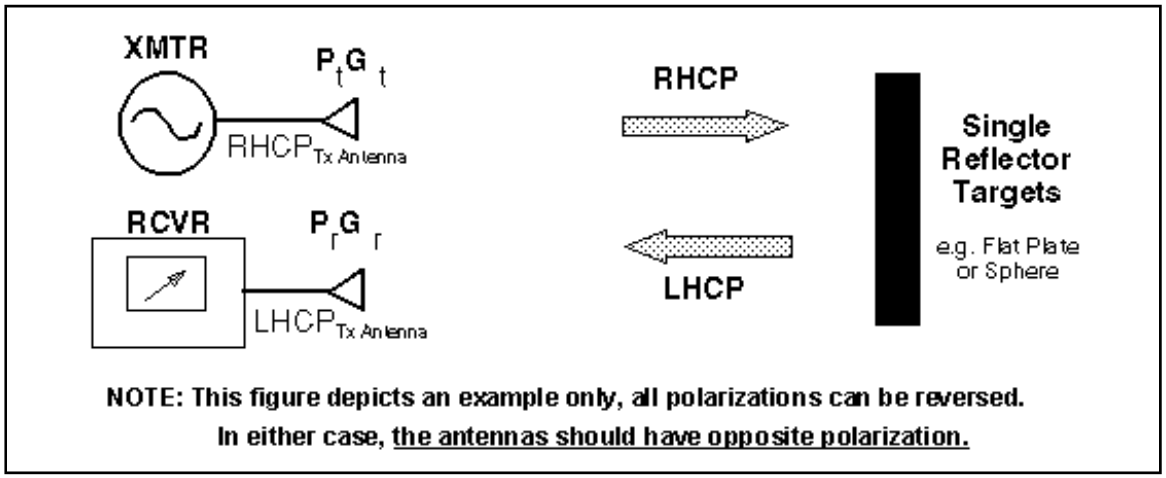

Figure 6. Opposite Circular Polarization.

In a corner reflector, waves reflect twice before returning to the receiver as shown in Figure 7, consequently they return with the same sense as they were transmitted. In this case (or any even number of reflections) buy antennas of the same polarization sense.

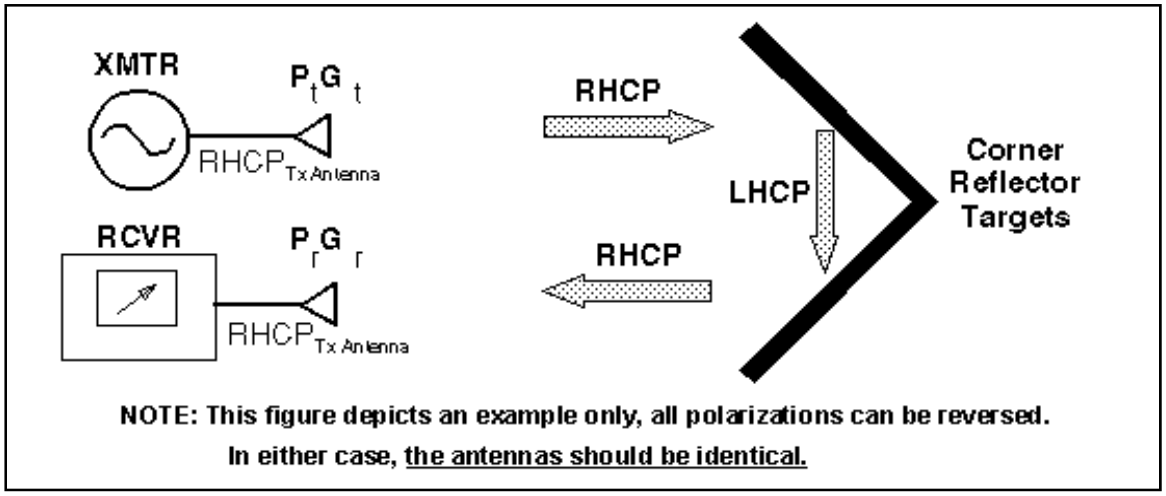

Figure 7. Circular Polarization With Corner Reflector.

An aircraft acts as both a corner reflector and a "normal" reflector so the return has mixed polarization. Most airborne radars use the same antenna for transmitting and receiving in order to receive the corner reflections and help exclude receipt of reflections from rain (single polarization reversal), however in doing so there is about a 5-9 dB loss from the ideal receiver case. It should be noted that the return from raindrops is attenuated by approximately 20 dB.

RADIATION PATTERNS

The radiation pattern is a graphical depiction of the relative field strength transmitted from or received by the antenna. Antenna radiation patterns are taken at one frequency, one polarization, and one plane cut. The patterns are usually presented in polar or rectilinear form with a dB strength scale. Patterns are normalized to the maximum graph value, 0 dB, and a directivity is given for the antenna. This means that if the side lobe level from the radiation pattern were down -13 dB, and the directivity of the antenna was 4 dB, then the sidelobe gain would be -9 dB.

Figures 1 to 14 on the pages following depict various antenna types and their associated characteristics. The patterns depicted are those which most closely match the purpose for which the given shape was intended. In other words, the radiation pattern can change dramatically depending upon frequency, and the wavelength to antenna characteristic length ratio. See Section 3-4. Antennas are designed for a particular frequency. Usually the characteristic length is a multiple of λ/2 minus 2-15% depending on specific antenna characteristics.

The gain is assumed to mean directional gain of the antenna compared to an isotropic radiator transmitting to or receiving from all directions.

The half-power (-3 dB) beamwidth is a measure of the directivity of the antenna.

Polarization, which is the direction of the electric (not magnetic) field of an antenna is another important antenna characteristic. This may be a consideration for optimizing reception or jamming.

The bandwidth is a measure of how much the frequency can be varied while still obtaining an acceptable VSWR (2:1 or less) and minimizing losses in unwanted directions. See Glossary, Section 10.

A 2:1 VSWR corresponds to a 9.5 dB (or 10%) return loss - see Section 6-2.

Two methods for computing antenna bandwidth are used:

Narrowband by %, $B = \left(\frac{F_U - F_L}{F_C}\right)(100)$, where F_C = Center frequency

Broadband by ratio, $B = \frac{F_U}{F_L}$

An antenna is considered broadband if $F_U / F_L > 2$. The table at the right shows the equivalency of the two, however the shaded values are not normally used because of the aforementioned difference in broadband/narrowband.

Bandwidth	
%	Ratio
5	1.05 : 1
10	1.11 : 1
20	1.22 : 1
30	1.35 : 1
40	1.50 : 1
50	1.67 : 1
60	1.85 : 1
67	2 : 1
100	3 : 1
120	4 : 1
133	5 : 1
150	7 : 1
160	9 : 1
163	10 : 1

Should there be ever a need to express bandwidth of an antenna in one or the other alternative formats, a conversion between the two narrowband and broadband bandwidth quantities can be easily calculated using the following relationships:

Calculate broadband ratio B_{bb} given narrowband B%,

$$B_{bb} = (200 + B\%)/(200 - B\%) \quad \textbf{[1]}$$

Calculate narrowband B% given broadband ratio B_{bb},

$$B\% = 200 * (Bbb - 1)/(Bbb + 1) \quad \textbf{[2]}$$

For an object that experiences a plane wave, the resonant mode is achieved when the dimension of the object is nλ/2, where n is an integer. Therefore, one can treat the apertures shown in the following figure as half wave length dipole antennas for receiving and reflecting signals. More details are contained in Section 8-4.

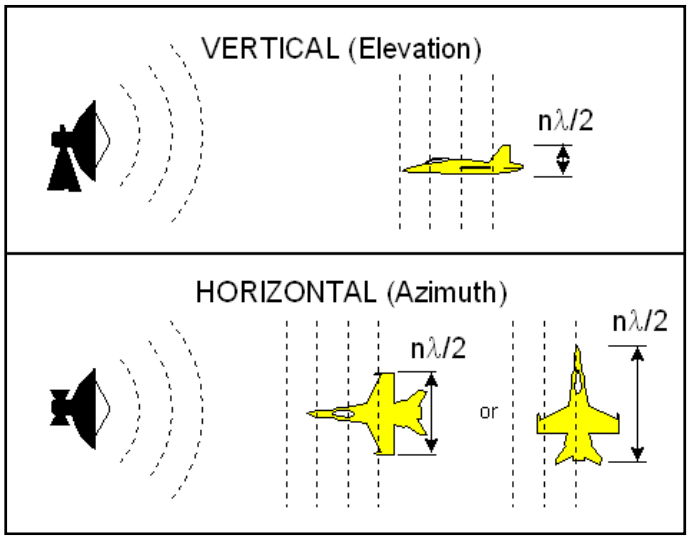

The following lists antenna types by page number. The referenced page shows frequency limits, polarizations, etc.

Type	Page	Type	Page
4 arm conical spiral	3-3.6	log periodic	3-3.8
alford loop	3-3.4	loop, circular	3-3.4
aperture synthesis	3-3.8	loop, alford	3-3.4
array	3-3.8	loop, square	3-3.4
axial mode helix	3-3.5	luneberg lens	3-3.9
biconical w/polarizer	3-3.6	microstrip patch	3-3.9
biconical	3-3.6	monopole	3-3.3
cavity backed circuit fed slot	3-3.5	normal mode helix	3-3.5
cavity backed spiral	3-3.9	parabolic	3-3.7
circular loop	3-3.4	patch	3-3.9
conical spiral	3-3.5	reflector	3-3.10
corner reflector	3-3.9	rhombic	3-3.3
dipole array, linear	3-3.8	sinuous, dual polarized	3-3.6
dipole	3-3.3	slot, guide fed	3-3.9
discone	3-3.4	slot, cavity backed	3-3.9
dual polarized sinuous	3-3.6	spiral, 4 arm conical	3-3.6
guide fed slot	3-3.9	spiral, conical	3-3.5
helix, normal mode	3-3.5	spiral, cavity backed	3-3.5
helix, axial mode	3-3.5	square loop	3-3.4
horn	3-3.7	vee	3-3.3
linear dipole array	3-3.8	yagi	3-3.8

Antenna Type	Radiation Pattern	Characteristics
MONOPOLE 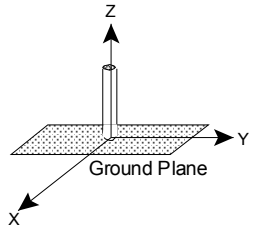 	Elevation: 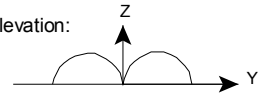 Azimuth: 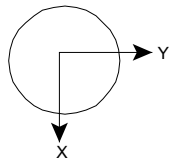 	**Polarization: Linear** Vertical as shown **Typical Half-Power Beamwidth** 45 deg x 360 deg **Typical Gain:** 2-6 dB at best **Bandwidth:** 10% or 1.1:1 **Frequency Limit** **Lower:** None **Upper:** None **Remarks:** Polarization changes to horizontal if rotated to horizontal
λ/2 DIPOLE 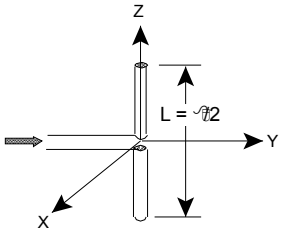 	Elevation: 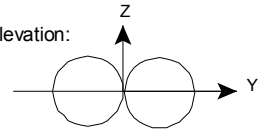 Azimuth: 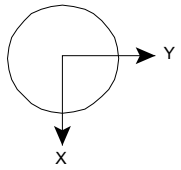 	**Polarization**: Linear Vertical as shown **Typical Half-Power Beamwidth** 80 deg x 360 deg **Typical Gain:** 2 dB **Bandwidth:** 10% or 1.1:1 **Frequency Limit** **Lower:** None **Upper:** 8 GHz (practical limit) **Remarks:** Pattern and lobing changes significantly with L/f. Used as a gain reference < 2 GHz.

Figure 1. Monopole and Dipole Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
VEE 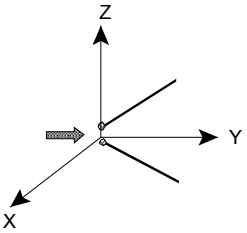 	Elevation & Azimuth: 	**Polarization**: Linear Vertical as shown **Typical Half-Power Beamwidth** 60 deg x 60 deg **Typical Gain:** 2 to 7 dB **Bandwidth:** "Broadband" **Frequency Limit** **Lower:** 3 MHz **Upper:** 500 MHz (practical limits) **Remarks:** 24KHz versions are known to exist. Terminations may be used to reduce backlobes.
RHOMBIC 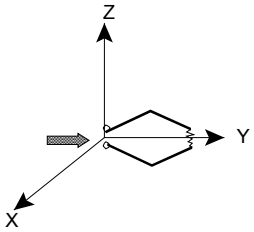 	Elevation & Azimuth: 	**Polarization**: Linear Vertical as shown **Typical Half-Power Beamwidth** 60 deg x 60 deg **Typical Gain:** 3 dB **Bandwidth:** "Broadband" **Frequency Limit** **Lower:** 3 MHz **Upper:** 500 MHz **Remarks:** Termination resistance used to reduce backlobes.

Figure 2. Vee and Rhombic Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
CIRCULAR LOOP (Small) 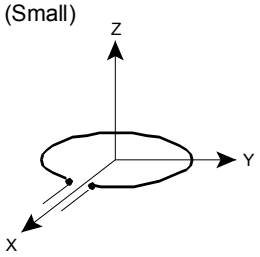	Elevation: 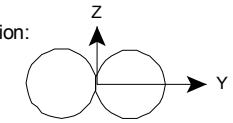 Azimuth: 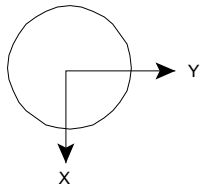	**Polarization:** Linear Horizontal as shown **Typical Half-Power Beamwidth:** 80 deg x 360 deg **Typical Gain:** -2 to 2 dB **Bandwidth:** 10% or 1.1:1 **Frequency Limit:** **Lower:** 50 MHz **Upper:** 1 GHz
SQUARE LOOP (Small) 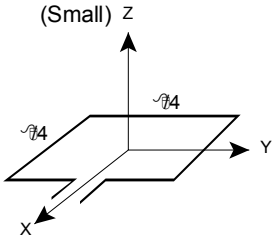	Elevation: 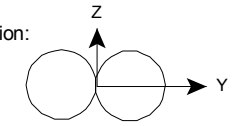 Azimuth: 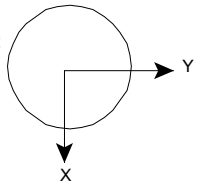	**Polarization:** Linear Horizontal as shown **Typical Half-Power Beamwidth:** 100 deg x 360 deg **Typical Gain:** 1-3 dB **Bandwidth:** 10% or 1.1:1 **Frequency Limit:** **Lower:** 50 MHz **Upper:** 1 GHz

Figure 3. Circular Loop and Square Loop Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
DISCONE 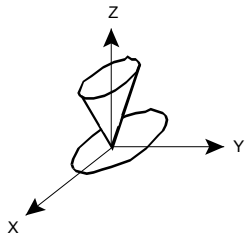	Elevation: 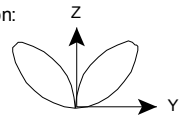 Azimuth: 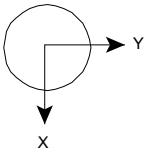	**Polarization:** Linear Vertical as shown **Typical Half-Power Beamwidth:** 20-80 deg x 360 deg **Typical Gain:** 0-4 dB **Bandwidth:** 100% or 3:1 **Frequency Limit:** **Lower:** 30 MHz **Upper:** 3 GHz
ALFORD LOOP 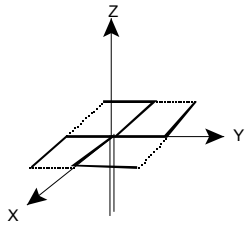	Elevation: 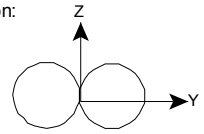 Azimuth: 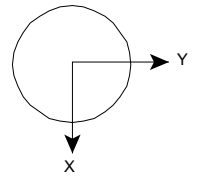	**Polarization:** Linear Horizontal as shown **Typical Half-Power Beamwidth:** 80 deg x 360 deg **Typical Gain:** -1 dB **Bandwidth:** 67% or 2:1 **Frequency Limit:** **Lower:** 100 MHz **Upper:** 12 GHz

Figure 4. Discone and Alford Loop Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
AXIAL MODE HELIX 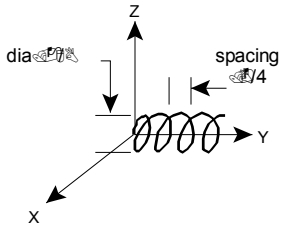 	Elevation & Azimuth 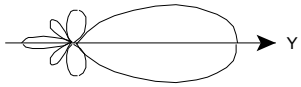 	**Polarization:** Circular Left hand as shown **Typical Half-Power Beamwidth:** 50 deg x 50 deg **Typical Gain:** 10 dB **Bandwidth:** 52% or 1.7:1 **Frequency Limit** **Lower:** 100 MHz **Upper:** 3 GHz **Remarks:** Number of loops >3
NORMAL MODE HELIX 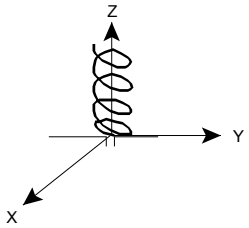 	Elevation: 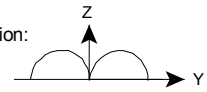 Azimuth: 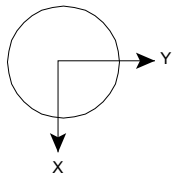 	**Polarization:** Circular - with an ideal pitch to diameter ratio. **Typical Half-Power Beamwidth:** 60 deg x 360 deg **Typical Gain:** 0 dB **Bandwidth:** 5% or 1.05:1 **Frequency Limit** **Lower:** 100 MHz **Upper:** 3 GHz

Figure 5. Axial Mode Helix and Normal Mode Helix Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
CAVITY BACKED SPIRAL (Flat Helix) 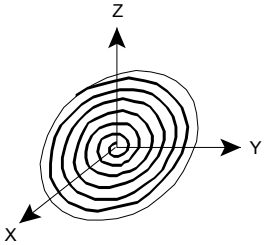 	Elevation & Azimuth 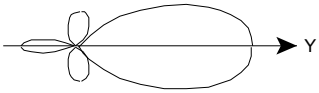 	**Polarization:** Circular Left hand as shown **Typical Half-Power Beamwidth:** 60 deg x 90 deg **Typical Gain:** 2-4 dB **Bandwidth:** 160% or 9:1 **Frequency Limit:** **Lower:** 500 MHz **Upper:** 18 GHz
CONICAL SPIRAL 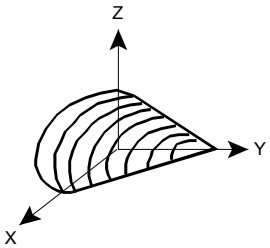 	Elevation & Azimuth 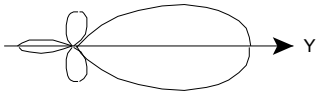 	**Polarization:** Circular Left hand as shown **Typical Half-Power Beamwidth:** 60 deg x 60 deg **Typical Gain:** 5-8 dB **Bandwidth:** 120% or 4:1 **Frequency Limit:** **Lower:** 50 MHz **Upper:** 18 GHz

Figure 6. Cavity Backed Spiral and Conical Spiral Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
4 ARM CONICAL SPIRAL 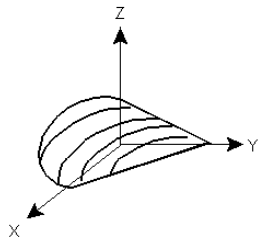	Elevation: 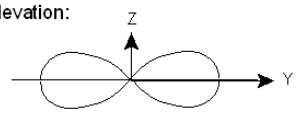 Azimuth: 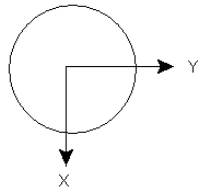	**Polarization:** Circular Left hand as shown **Typical Half-Power Beamwidth:** 50 deg x 360 deg **Typical Gain:** 0 dB **Bandwidth:** 120% or 4:1 **Frequency Limit:** **Lower:** 500 MHz **Upper:** 18 GHz
DUAL POLARIZED SINUOUS 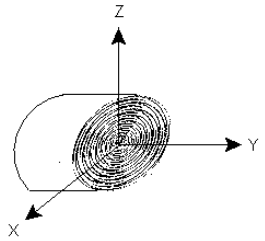	Elevation & Azimuth 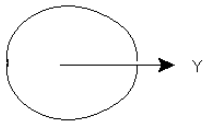	**Polarization**: Dual vertical or horizontal or dual Circular right hand or left hand with hybrid **Typical Half-Power Beamwidth:** 75 deg x 75 deg **Typical Gain:** 2 dB **Bandwidth:** 163% or 10:1 **Frequency Limit:** **Lower:** 500 MHz **Upper:** 18 GHz

Figure 7. Dual Polarized Sinuous Antenna Characteristics and 4 Arm Conical Spiral.

Antenna Type	Radiation Pattern	Characteristics
BICONICAL 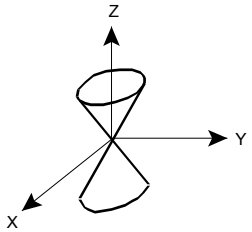	Elevation: 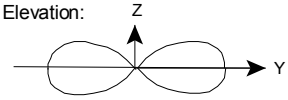 Azimuth: 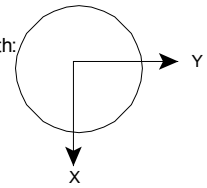	**Polarization:** Linear, Vertical as shown **Typical Half-Power Beamwidth:** 20-100 deg x 360 deg **Typical Gain:** 0-4 dB **Bandwidth:** 120% or 4:1 **Frequency Limit:** **Lower:** 500 MHz **Upper:** 40 GHz
BICONICAL W/POLARIZER 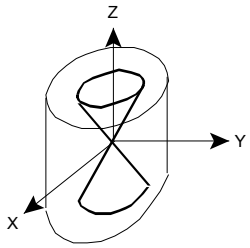	Elevation: 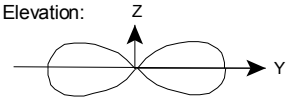 Azimuth: 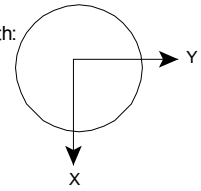	**Polarization:** Circular, Direction depends on polarization **Typical Half-Power Beamwidth:** 20-100 deg x 360 deg **Typical Gain:** -3 to 1 dB **Bandwidth:** 100% or 3:1 **Frequency Limit:** **Lower:** 2 GHz **Upper:** 18 GHz

Figure 8. Biconical and Biconical With Polarizer Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
HORN 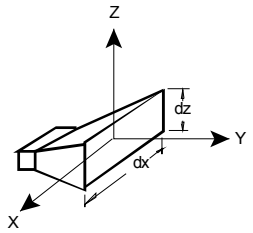 	Elevation: 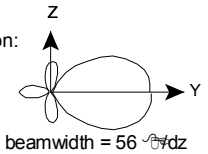 3 dB beamwidth = 56 ~ dz Azimuth: 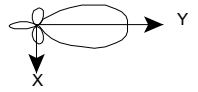 3 dB beamwidth = 70 ~ dx	**Polarization:** Linear **Typical Half-Power Beamwidth:** 40 deg x 40 deg **Typical Gain:** 5 to 20 dB **Bandwidth:** If ridged: 120% or 4:1 If not ridged: 67% or 2:1 **Frequency Limit:** **Lower:** 50 MHz **Upper:** 40 GHz
HORN W / POLARIZER 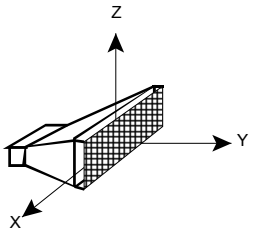 	Elevation: 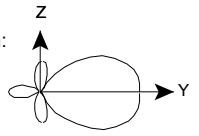 Azimuth: 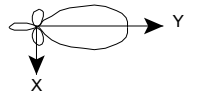 	**Polarization:** Circular, Depends on polarizer **Typical Half-Power Beamwidth:** 40 deg x 40 deg **Typical Gain:** 5 to 10 dB **Bandwidth:** 60% or 2:1 **Frequency Limit:** **Lower:** 2 GHz **Upper:** 18 GHz

Figure 9. Horn and Horn w/Polarizer Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
PARABOLIC (Prime) 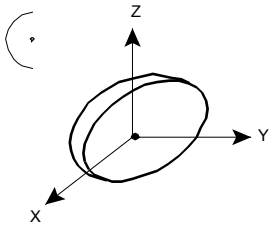 	Elevation & Azimuth 	**Polarization:** Takes polarization of feed **Typical Half-Power Beamwidth:** 1 to 10 deg **Typical Gain:** 20 to 30 dB **Bandwidth:** 33% or 1.4:1 limited mostly by feed **Frequency Limit:** **Lower:** 400 MHz **Upper:** 13+ GHz
PARABOLIC 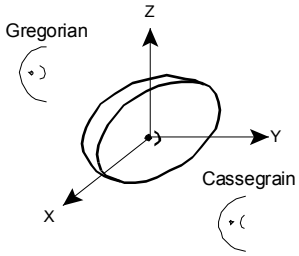 	Elevation & Azimuth 	**Polarization:** Takes polarization of feed **Typical Half-Power Beamwidth:** 1 to 10 deg **Typical Gain:** 20 to 30 dB **Bandwidth:** 33% or 1.4:1 **Frequency Limit:** **Lower:** 400 MHz **Upper:** 13+ GHz

Figure 10. Parabolic (Prime) and Parabolic Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
YAGI 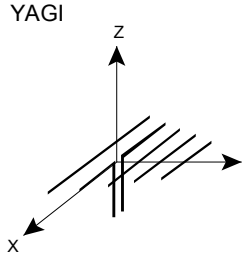	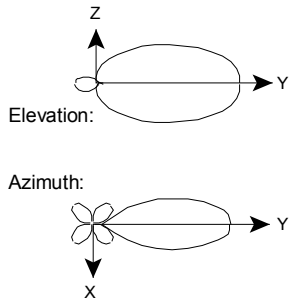	**Polarization:** Linear Horizontal as shown **Typical Half-Power Beamwidth** 50 deg X 50 deg **Typical Gain:** 5 to 15 dB **Bandwidth:** 5% or 1.05:1 **Frequency Limit:** **Lower:** 50 MHz **Upper:** 2 GHz
LOG PERIODIC 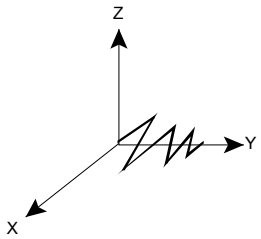	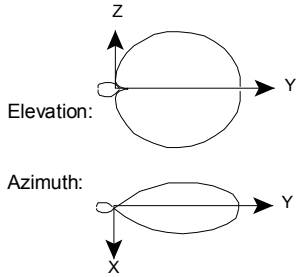	**Polarization:** Linear **Typical Half-Power Beamwidth:** 60 deg x 80 deg **Typical Gain:** 6 to 8 dB **Bandwidth:** 163% or 10:1 **Frequency Limit:** **Lower:** 3 MHz **Upper:** 18 GHz **Remarks:** This array may be formed with many shapes including dipoles or toothed arrays.

Figure 11. Yagi and Log Periodic Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
LINEAR DIPOLE ARRAY (Corporate Feed) 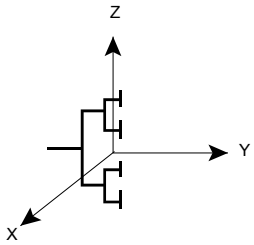	Elevation: 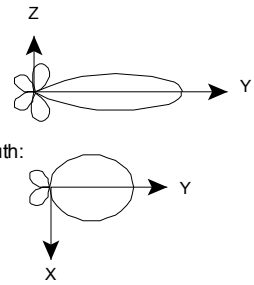	**Polarization:** Element dependent Vertical as shown **Typical Half-Power Beamwidth:** Related to gain **Typical Gain:** Dependent on number of elements **Bandwidth:** Narrow **Frequency Limit:** **Lower:** 10 MHz **Upper:** 10 GHz
APERTURE SYNTHESIS 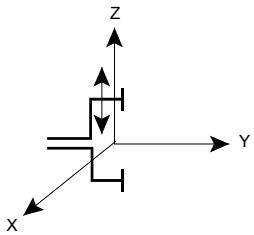	**Elevation & Azimuth** 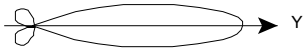	All characteristics dependent on elements **Remarks:** Excellent side-looking, ground mapping where the aircraft is a moving linear element.

Figure 12. Linear Dipole Array and Aperture Synthesis Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
CAVITY BACKED CIRCUIT FED SLOT (and Microstrip Patch) 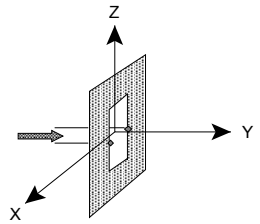 	Elevation & Azimuth 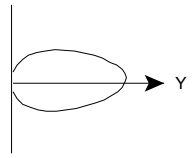 	**Polarization:** Linear, vertical as shown **Typical Half-Power Beamwidth**: 80 deg x 80 deg **Typical Gain:** 6 dB **Bandwidth:** Narrow **Frequency Limit:** **Lower:** 50 MHz **Upper:** 18 GHz **Remarks:** The feed line is sometimes separated from the radiator by a dialetric & uses capacititive coupling. Large conformal phased arrays can be made this way.
GUIDE FED SLOT 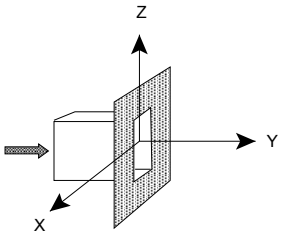 	Elevation: 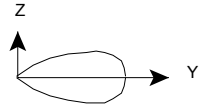 Azimuth: 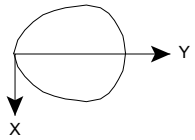 	**Polarization:** Linear, **Typical Half-Power Beamwidth** Elevation: 45-50° Azimuth: 80° **Typical Gain:** 0 dB **Bandwidth:** Narrow **Frequency Limit:** **Lower:** 2 GHz **Upper:** 40 GHz **Remarks:** Open RF Waveguide

Figure 13. Cavity Backed Circuit Fed Slot and Guide Fed Slot Antenna Characteristics.

Antenna Type	Radiation Pattern	Characteristics
CORNER REFLECTOR 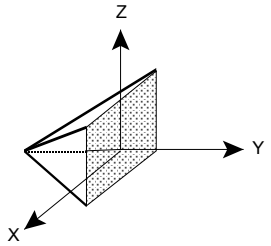 	Elevation: (Z-Y) Azimuth: (X-Y) Dependent upon feed emitter	**Polarization**: Feed dependent **Typical Half-Power Beamwidth** 40 deg x variable **Typical Gain:** 10 dB above feed **Bandwidth:** Narrow **Frequency Limit** **Lower:** 1 GHz **Upper:** 40 GHz **Remarks:** Typically fed with a dipole or colinear array.
LUNEBURG LENS 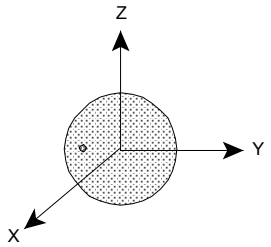 	Elevation & Azimuth 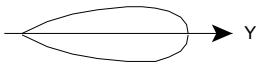 	**Polarization:** Feed dependent **Typical Half-Power Beamwidth:** System dependent **Typical Gain:** System dependent **Bandwidth:** Narrow **Frequency Limit** **Lower:** 1 GHz **Upper:** 40 GHz **Remarks:** Variable index dielectric sphere.

Figure 14. Corner Reflector and Luneburg Lens Antenna Characteristics.

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FREQUENCY / PHASE EFFECTS OF ANTENNAS

The radiation patterns of the antennas presented in the previous section are for antenna geometries most commonly used. The antenna should be viewed as a matching network that takes the power from a transmission line (50 ohm, for example), and matches it to the free space "impedance" of 377 ohms. The most critical parameter is the change of VSWR with frequency. The pattern usually does not vary much from acceptable to the start of unacceptable VSWRs (> 2:1). For a given physical antenna geometric size, the actual radiation pattern varies with frequency.

The antenna pattern depicted in Figure 1 is for the dipole pictured in Section 3-3. The maximum gain is normalized to the outside of the polar plot and the major divisions correspond to 10 dB change. In this example, the dipole length (in wavelengths) is varied, but the same result can be obtained by changing frequency with a fixed dipole length. From the figure, it can be seen that side lobes start to form at 1.25λ and the side lobe actually has more gain than the main beam at 1.5λ. Since the radiation pattern changes with frequency, the gain also changes.

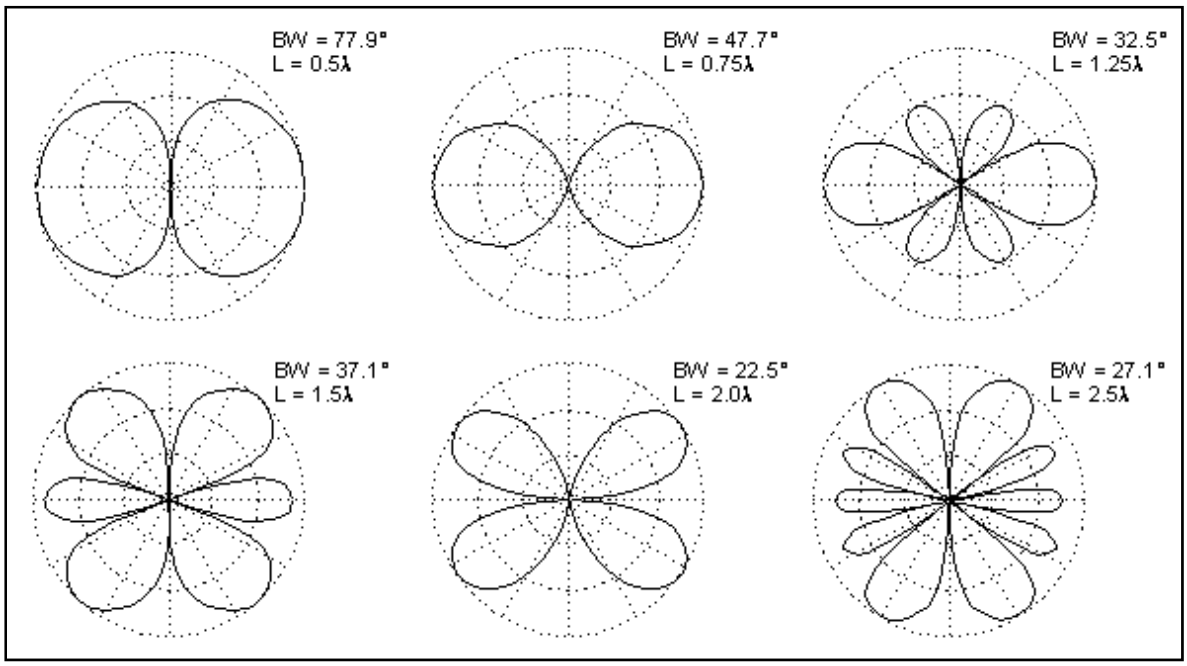

Figure 1. Frequency Effects.

Figure 2 depicts phase/array effects, which are yet another method for obtaining varied radiation patterns. In the figure, parallel dipoles are viewed from the end. It can be seen that varying the phase of the two transmissions can cause the direction of the radiation pattern to change. This is the concept behind phased array antennas. Instead of having a system mechanically sweeping the direction of the antenna through space, the phase of radiating components is varied electronically, producing a moving pattern with no moving parts. It can also be seen that increasing the number of elements further increases the directivity of the array. In an array, the pattern does vary considerably with frequency due to element spacing (measured in wavelengths) and the frequency sensitivity of the phase shifting networks.

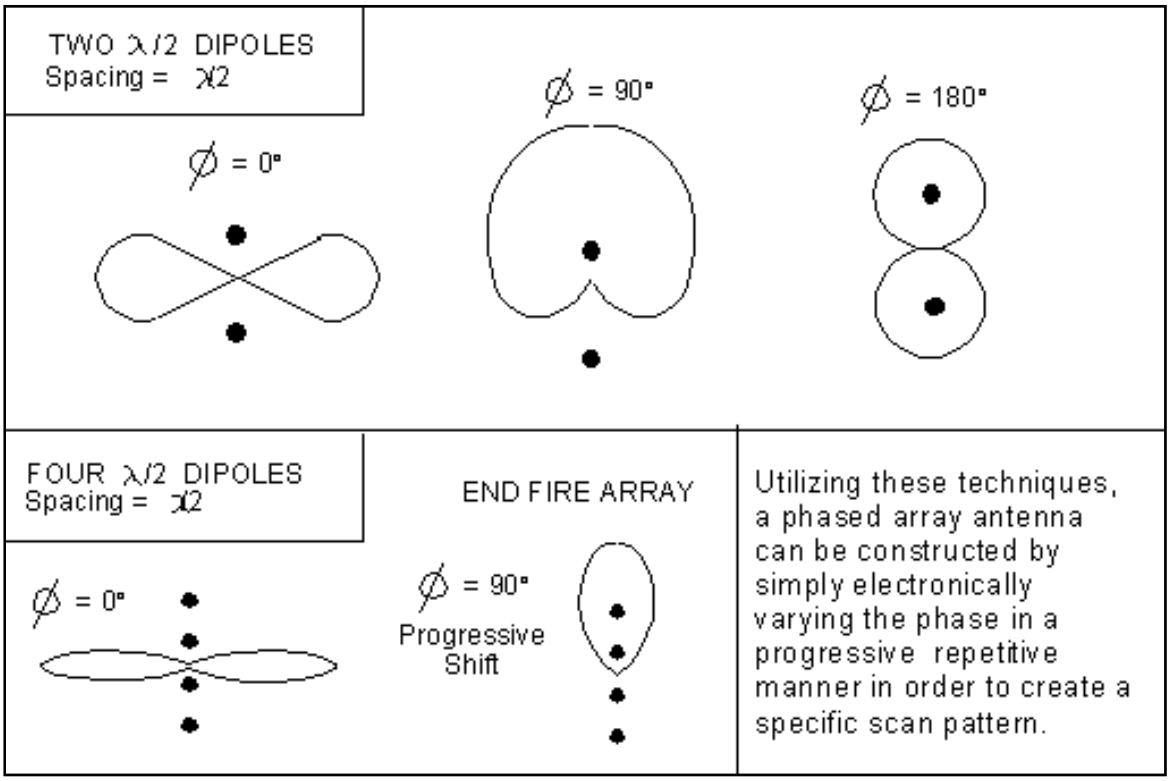

Figure 2. Phase / Array Effects*.

* Note: Assuming Figure 2 depicts x-y plane antenna pattern cross section, to achieve the indicated array patterns using dipole antennas, the dipole antenna elements must be aligned with the z-axis.

Two antennas that warrant special consideration are the phased array and the Rotman bootlace type lens. Both of these antennas find wide application in EW, RADAR, and Communications. The phased array will be described first.

LINEAR PHASED ARRAY

The linear phased array with equal spaced elements is easiest to analyze and forms the basis for most array designs. Figure 3 schematically illustrates a corporate feed linear array with element spacing d.

It is the simplest and is still widely used. By controlling the phase and amplitude of excitation to each element, as depicted, we can control the direction and shape of the beam radiated by the array. The phase excitation, $\varphi(n)$, controls the beam pointing angle, θ_o, in a phased array. To produce a broadside beam, $\theta_o=0$, requires phase excitation, $\varphi(n)=0$. Other scan angles require an excitation, $\varphi(n) = nkd \sin(\theta_o)$, for the nth element where k is the wave number ($2\pi/\lambda$). In this manner a linear phased array can radiate a beam in any scan direction, θ_o, provided the element pattern has sufficient beamwidth. The amplitude excitation, A_n, can be used to control beam shape and sidelobe levels. Often the amplitude excitation is tapered in a manner similar to that used for aperture antennas to reduce the sidelobe levels. One of the problems that can arise with a phased array is insufficient bandwidth, since the phase shift usually is not obtained through the introduction of additional path length. However, it should be noted that at broadside the corporate feed does have equal path length and would have good bandwidth for this scan angle.

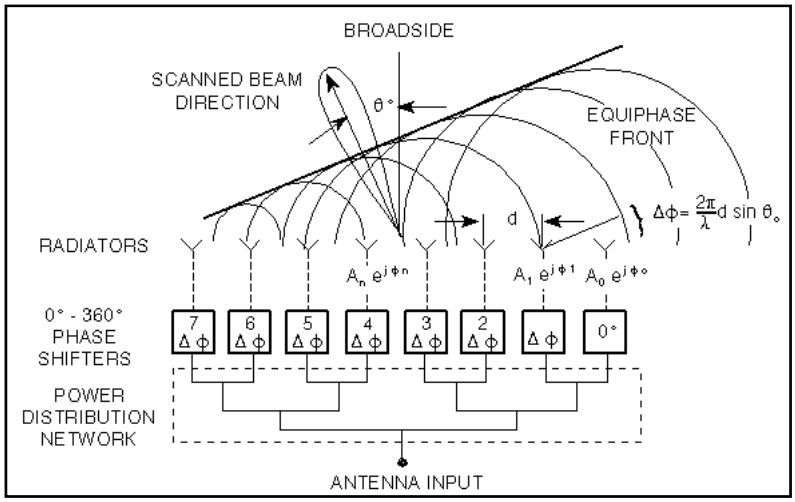

Figure 3. Corporate Fed Phased Array.

The linear array described above would yield a narrow fan beam in the plane normal to the plane containing the array and scan direction, with the narrow beamwidth in the plane of the array. To obtain a pencil beam it would be necessary to array several of these linear arrays in such a manner resulting in a planar array of radiating elements. A problem associated with all electronic scanning is beam distortion with scan angle. Figure 4 illustrates this phenomenon. It results in spread of the beam shape with a concomitant reduction in gain. This effect is known as "scan loss." For an ideal array element, scan loss is equal to the reduction in aperture size in the scan direction which varies as $\cos\theta$, where θ is the scan angle measured from the planar array normal.

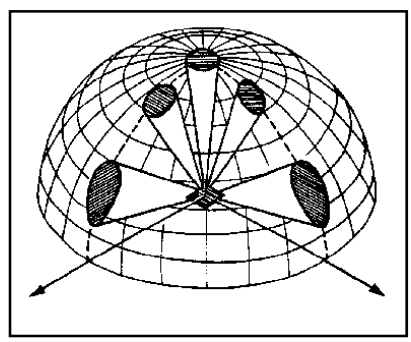

Figure 4. Beam Distortion.

When elements are spaced greater than $\lambda/2$ apart, grating lobes are possible when scanning. As the beam is scanned further from broadside, a point is reached at which a second symmetrical main lobe is developed at the negative scan angle from broadside. This condition is not wanted because antenna gain is immediately reduced by 3 dB due to the second lobe. Grating lobes are a significant problem in EW applications because the broad frequency bandwidth requirements mean that at the high end of the frequency band, the elements may be spaced greater than $\lambda/2$. Therefore in order to avoid grating lobes over a large frequency bandwidth, element spacing must be no greater than $\lambda/2$ at the highest frequency of operation.

There are many other factors to consider with a phased array such as coning, where the beam curves at large scan angles, and mutual coupling between elements that affect match and excitation. Excessive

mutual coupling will invariably result in blind scan angles where radiation is greatly attenuated. These issues will not be covered in detail here.

Of interest is the gain of the array which is given by:

$$Array\ Gain = G_e(\theta) \bullet \sum_{n=1}^{N} A(n)\, e^{j\phi(n)}\, e^{jnkd\sin\theta}$$ Where each element is as described in Section 3-4.

$G_e(\theta)$ is the element gain which in this case has been taken the same for all elements. Note that if we set A(n)=1, and $\varphi(n)=0$, then at broadside where $\sin(\theta) = 0$, the gain would be ($N\ G_e$). This represents the maximum gain of the array, which typically will not exceed $n\pi$, and is a familiar figure. It should be noted that in practical array design, the element pattern characteristics are greatly influenced by mutual coupling and that the characteristic of elements at the edge of the array can deviate significantly from those near the center.

ROTMAN BOOTLACE LENS

Another method of feeding an array of elements is to use a lens such as the Rotman (rhymes with rotten) Bootlace type shown in Figure 5. The lens consists of a parallel plate region (nowadays microstrip or stripline construction) and cables of specified length connecting the array of elements to the parallel plate region. The geometry of the lens and the cable lengths are designed so that all ray paths traced from a beam port on the right side to its associated wavefront on the left array port side, are equal. This tailoring of the design is accomplished at three focus points (beam ports 1, 4, and 7 in Figure 5). Departure from perfect focus at intermediate beam ports is negligible in most designs.

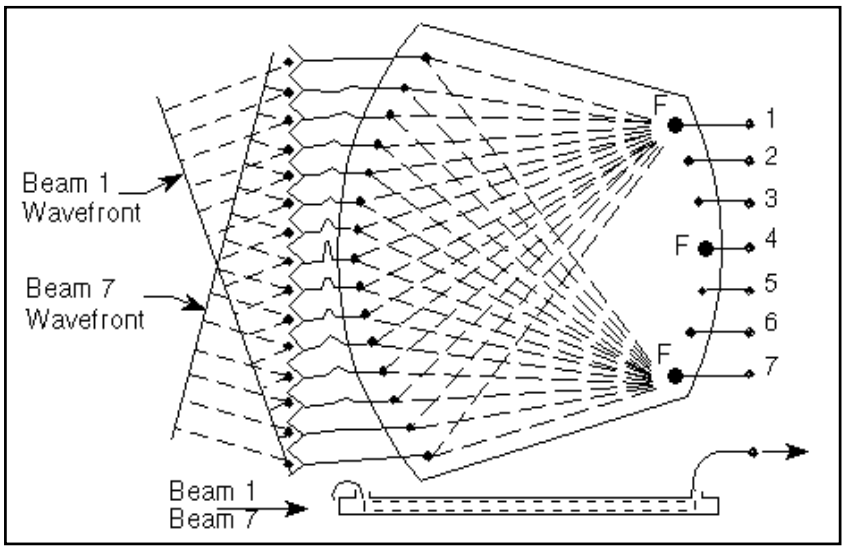

Figure 5. Rotman Bootlace Lens.

The Rotman lens provides both true time delay phase shift and amplitude taper in one lens component. The true time delay is one of the distinct advantages of the lens over the phase shifted array since that makes it independent of frequency. To understand how the taper is obtained requires knowledge of the parallel plate region. For a stripline design the unit would consist of a large flat plate-like center conductor sandwiched between two ground planes, and having a shape much like that of the plan view outline shown in Figure 5 with individual tapered launchers (connectors) attached to each beam port and array port. If the antenna is in the receive mode, the energy intercepted on the array port side can be controlled by the angle subtended by the tapered sections of the connector (launcher) much like a larger antenna would intercept a larger portion of energy from free space.

Unlike the phased array with its fine beam steering, the Rotman lens provides only a distinct set of beams. Fine steering is obtained by combining beams either equally or unequally to form intermediate beams. As can be seen in Figure 6, this results in a broader beam with less gain but lower side lobes than the primary beams.

High transmit power can be obtained using a Rotman lens by placing a low power amplifier between each lens output port and its antenna. In this case a separate Rotman lens would have to be used for receiving.

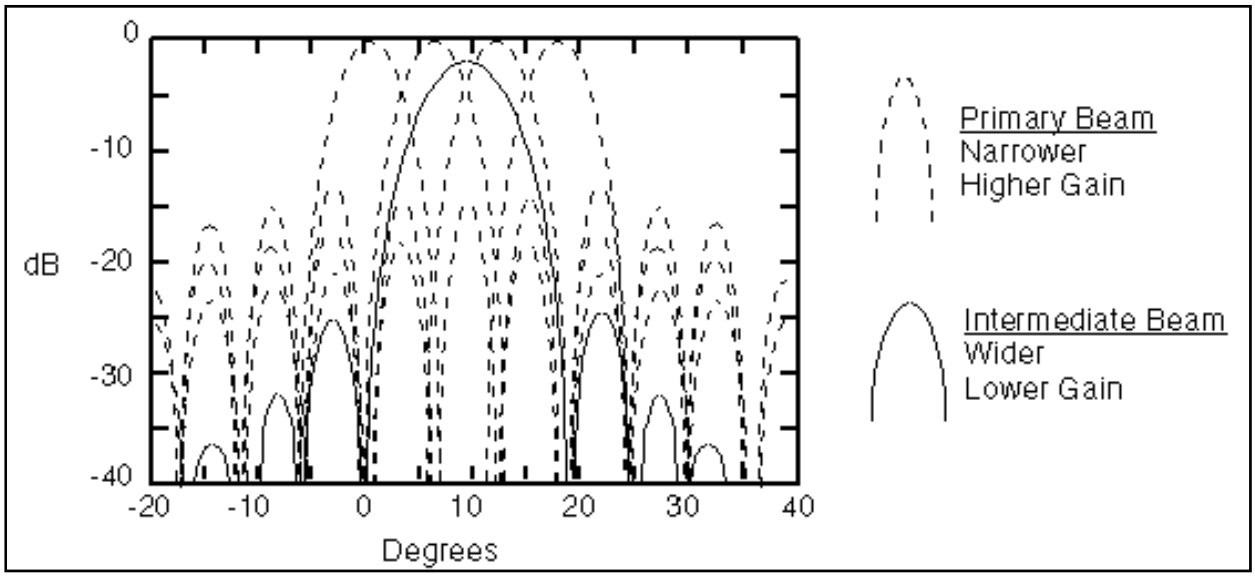

Figure 6. Primary and Intermediate Beam Formation in Lens Arrays.

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ANTENNA NEAR FIELD

As noted in the sections on RF propagation and the radar equation, electromagnetic radiation expands spherically (Figure 1) and the power density at a long range (R) from the transmitting antenna is:

$$P_D = \frac{P_t G_t}{4\pi R^2} \qquad \textbf{[1]}$$

When the range is large, the spherical surface of uniform power density appears flat to a receiving antenna which is very small compared to the surface of the sphere. This is why the far field wave front is considered planar and the rays approximately parallel. Also, it is apparent that at some shorter range, the spherical surface no longer appears flat, even to a very small receiving antenna.

The planer, parallel ray approximation is valid for distances greater than the distance where the phase error is 1/16 of a wavelength or 22.5 degrees. This distance is given by

$$R_{ff} = \frac{2D^2}{\lambda}$$ where λ is the wavelength and D is the largest dimension of the transmit antenna. **[2]**

Antenna measurements made at distances greater than R_{ff} generally result in negligible pattern error. Distances less than R_{ff} is termed the near-field.

If the same size antenna is used for multiple frequencies, R_{ff} will increase with increasing frequency. However, if various size antennas are used for different frequencies and each antenna is designed with D as a function of λ (λ/2 to 100λ), then R_{ff} will vary from c/2*f* to 20000c/*f*. In this case R_{ff} will decrease with increasing frequency. For example: a 10λ antenna at 3 GHZ has a D of 100 cm and corresponding R_{ff} of 20 m, while a 10λ antenna at 30 GHz has a D of 10 cm and corresponding R_{ff} of 2 m.

While the above analogy provides an image of the difference between the near and far fields, the relationship must be defined as a characteristic of the transmitting antenna.

Actual antennas, of course, are not ideal point source radiators but have physical dimensions. If the transmitting antenna placed at the origin of Figure 1 occupies distance D along the Z-axis and is boresighted along the Y-axis (φ = 90), then the geometry of point P on the sphere is represented in two dimensions by Figure 2. For convenience, the antenna is represented by a series of point sources in an array.

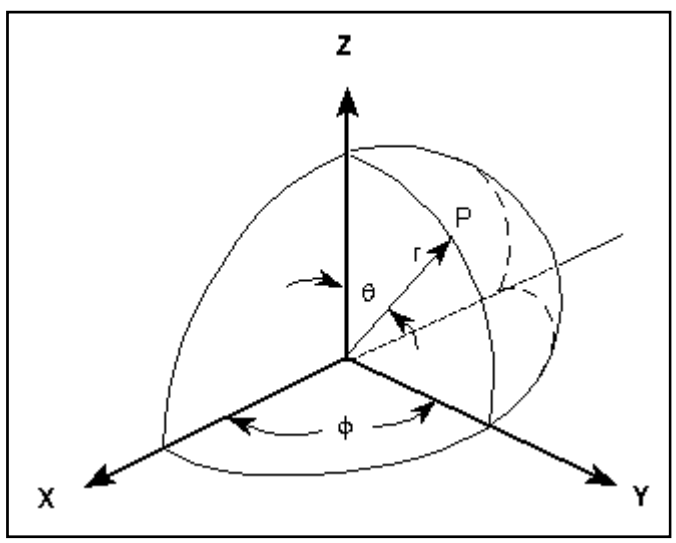

Figure 1. Spherical Radiation to Point "P" from an Ideal Point Source.

When point P is close to the antenna, as in Figure 2, then the difference in distance of the two rays r and R taken respectively from the center of the antenna and the outer edge of the antenna varies as point P changes.

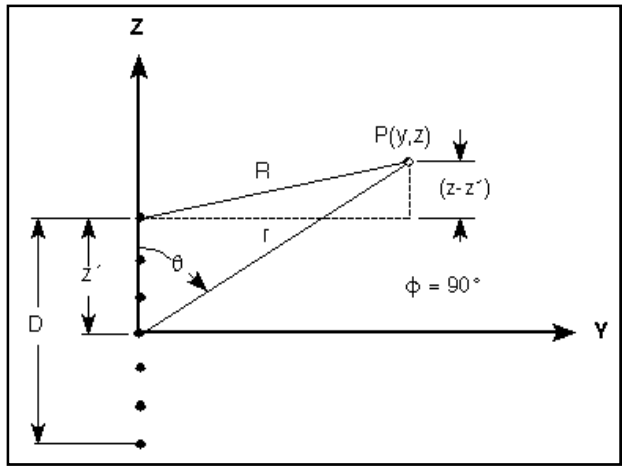

Figure 2. Near Field Geometry of Point "P" for a Non-Ideal Radiator With Dimension D.

Derivation of equation [2] is given as follows:

From Figure 2, the following applies:

$r^2 = z^2 + y^2$ **[3]**

$z = r \cos \theta$ **[4]**

$y = r \sin \theta$ and **[5]**

$$R = \sqrt{y^2 + (z - z')^2} = \sqrt{y^2 + z^2 - 2z'z + (z')^2} \quad \textbf{[6]}$$

Substituting [3] and [4] into [6] $R = \sqrt{r^2 + [-2(r \cos \theta)z' + (z')^2]}$ **[7]**
which puts point P into spherical coordinates.

Equation [7] can be expanded by the binomial theorem which for the first three terms, reduces to:

$$R = r - z' \cos \theta + \frac{(z')^2 \sin^2 \theta}{2r} + ... \quad \textbf{[8]}$$

In the parallel ray approximation for far field calculations (Figure 3) the third term of [8] is neglected.

The distance where the far field begins (R_{ff}) (or where the near field ends) is the value of r when the error in R due to neglecting the third term of equation [8], equals 1/16 of a wavelength.

R_{ff} is usually calculated on boresight, so θ = 90° and the second term of equation [8] equals zero (Cos 90° = 0), therefore from Figure 3, where D is the antenna dimension, R_{ff} is found by equating the third term of [8] to 1/16 wavelength.

$$\frac{(z')^2 \sin^2 \theta}{2 R_{ff}} = \frac{\lambda}{16}$$

$\text{Sin}\,\theta = \text{Sin}\,90 = 1$ *and* $z' = D/2$ so: $\dfrac{\left(\frac{D}{2}\right)^2}{2 R_{ff}} = \dfrac{\lambda}{16}$

$$R_{ff} = \frac{16(D/2)^2}{2\lambda} = \frac{2D^2}{\lambda} \quad \textbf{[9]}$$

Equation [9] is the standard calculation of far field given in all references.

Besides [9] some general rules of thumb for far field conditions are:

$$r >> D \quad \text{or} \quad r >> \lambda$$

If the sphere and point P are a very great distance from the antenna, then the rays are very nearly parallel and this difference is small as in Figure 3.

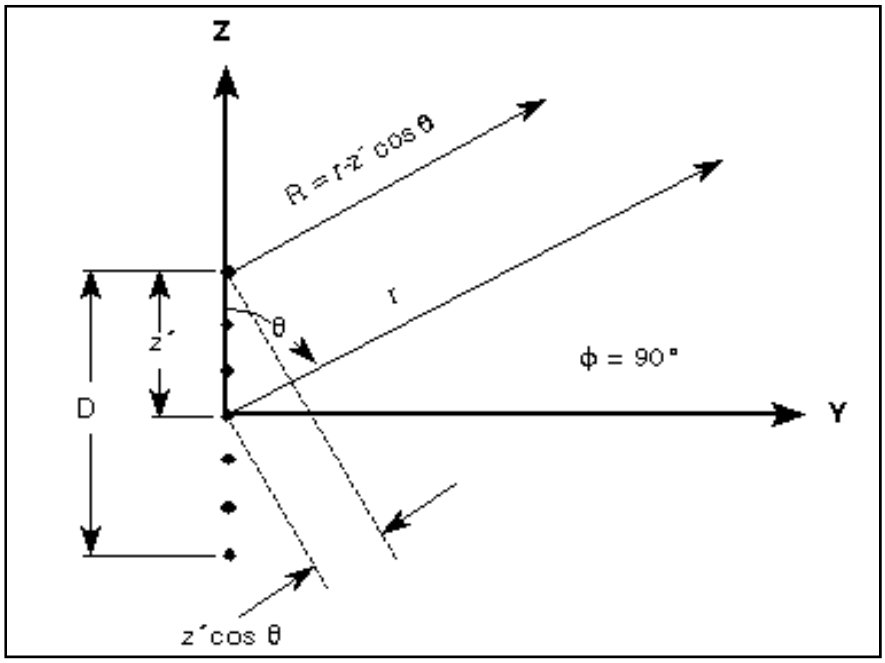

Figure 3. Far Field Parallel Ray Approximation for Calculations.

For reference purposes, a simplified alternative method to derive minimum far field distance approximation for an antenna or an antenna array with aperture size "d" is presented in Figure 4 without the need to resort to the spherical coordinate system and the Binomial Theorem. This approach illustrates a simple application of the Pythagorean Theorem. The P_{FF} symbol represents an arbitrary point in the far field at antenna boresight. Refer to relevant quantities shown in Figure 4.

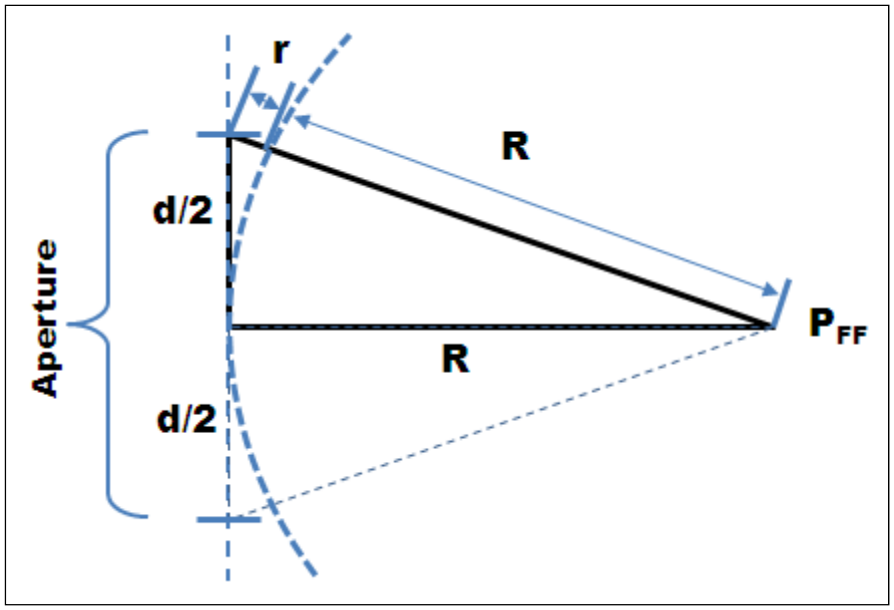

Figure 4. Alternative Geometry for Far Field Estimation.

From Figure 4, the distance "r" is the maximum propagation path difference across a given antenna aperture endpoint locations. Expressing this propagation path difference in terms of a wavelength provides means to derive an equation for generalized far field range relationship. Note a slight change of notation between Figures 3 and 4. A derivation of results already shown in Equations [2] & [9] is given as follows. From Figure 4, the following applies:

$$(R + r)^2 = (d/2)^2 + R^2 \qquad \textbf{[10]}$$

Collecting terms and cancelling,

$$2Rr + r^2 = d^2/4 \qquad \textbf{[11]}$$

Simplifying with a noted valid assumption,

$$2Rr \approx d^2/4, \text{ since } r << R \qquad \textbf{[12]}$$

Solving for "r" (see Figure 4)

$$r \approx d^2/(8R) \qquad \textbf{[13]}$$

For far field condition assume $r \leq \lambda/16$. Substituting "r" in terms of lambda,

$$\lambda/16 \geq r \approx d^2/(8R) \;\rightarrow\; P_{FF} \geq 2d^2/\lambda \qquad \textbf{[14]}$$

As shown, Equation [14] represents the same result as Equation [9] derived earlier.

The power density within the near field varies as a function of the type of aperture illumination and is less than would be calculated by equation [1]. Thus, in the antenna near field there is stored energy. (The complex radiation field equations have imaginary terms indicating reactive power.) Figure 5 shows normalized power density for three different illuminations.

Curve A is for reference only and shows how power density would vary if it were calculated using equation [1].

Curve B shows power density variations on axis for an antenna aperture with a cosine amplitude distribution. This is typical of a horn antenna in the H-plane.

Curve C shows power density variations on axis for a uniformly illuminated antenna aperture or for a line source. This is typical of a horn antenna in the E-plane.

Curve D shows power density variations on axis for an antenna aperture with a tapered illumination. Generally the edge illumination is approximately -10 dB from the center illumination and is typical of a parabolic dish antenna.

Point E For radiation safety purposes, a general rule of thumb for tapered illumination is that the maximum safe level of 10 mW/cm^2 (~200 V/m) is reached in the near field if the level at R_{ff} reaches 0.242 mW/cm^2 as can be verified by computing the power density at point E in Figure 5. (10 mW/cm^2 at point E extrapolates to 0.242 mW/cm^2 [16 dB lower] at $R=R_{ff}$, or Y axis value =1). Figure 1 in Section 3-6 depicts more precise values for radiation hazard exposure.

Point F Far Field Point. At distances closer to the source than this point (near field), the power density from any given antenna is less than that predicted using Curve A. At farther distances, (far field) power densities from all types of antennas are the same.

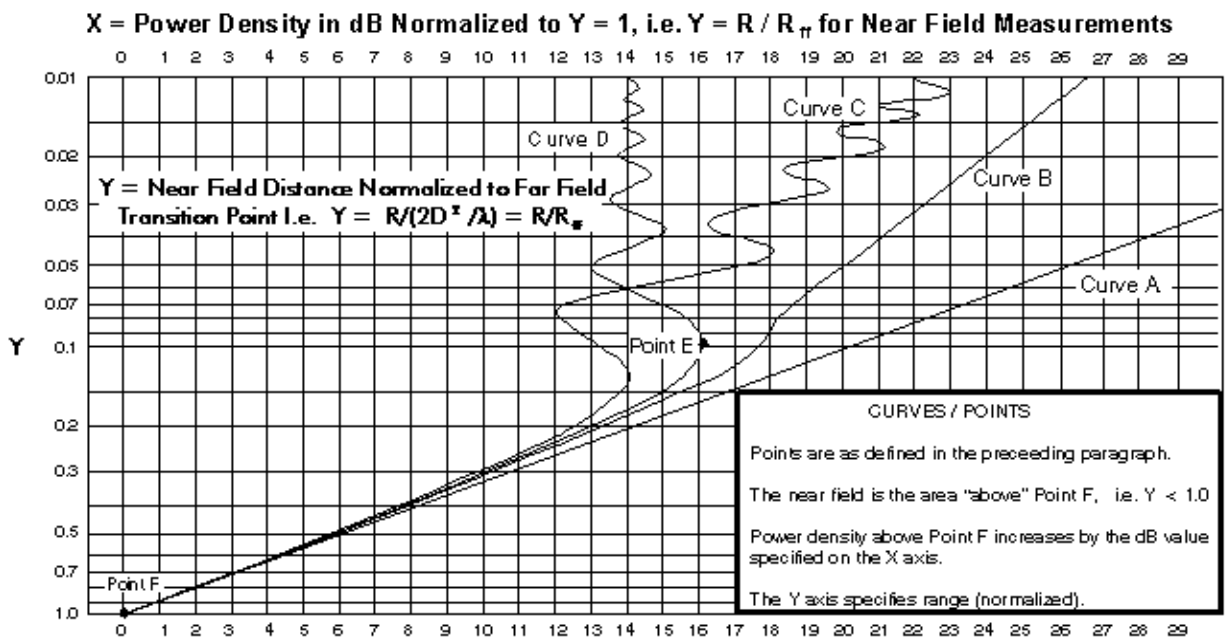

Figure 5. Antenna Near-Field On-Axis Power Density (Normalized) for Various Aperture Illuminations.

FOR FAR FIELD MEASUREMENTS:

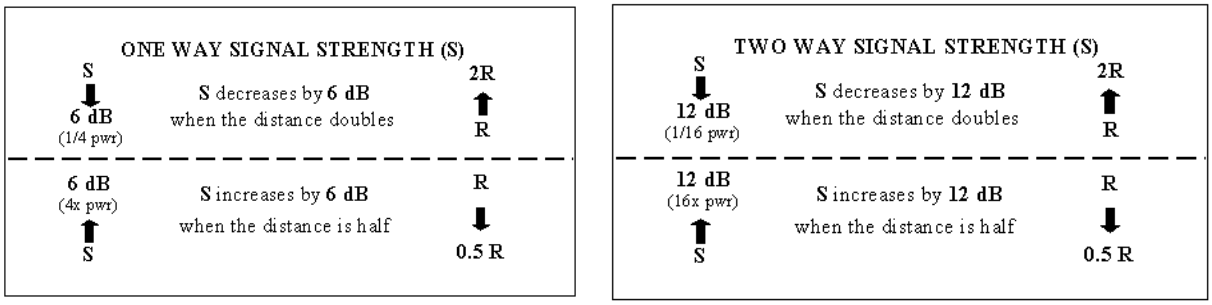

When free space measurements are performed at a known distance from a source, it is often necessary to know if the measurements are being performed in the far field. As can be seen from Curve A on Figure 5, if the distance is halved (going from 1.0 to 0.5 on the Y axis), the power density will increase by 6 dB (going from 0 to 6 dB on the X axis). Each reduction in range by ½ results in further 6 dB increases. As previously mentioned, Curve A is drawn for reference only in the near field region, since at distances less than R_{ff} the power density increases less than 6 dB when the range is halved. In the far field, all curves converge and Equation [1] applies.

When a measurement is made in free space, a good check to ensure that is was performed in the far field is to repeat the measurement at twice the distance. The power should decrease by exactly 6 dB. A common error is to use 3 dB (the half power point) for comparison. Conversely, the power measurement can be repeated at half the distance, in which case you would look for a 6 dB increase, however the assumed extrapolation conclusion is not as certain, because the first measurement could have been made in the far field, and the second could have been made in the near field.

Care must be exercised in using the $\mathbf{2d^2/\lambda}$ far field measurement criterion. For antennas with moderate sidelobe levels (>-25 dB) pattern errors are negligible and the error in directivity is less than 0.1 dB and this measurement distance suffices in most cases. However low sidelobe antennas require longer measurement distances. For example, maintaining a 1 dB or less sidelobe error for a linear array with a -40 dB sidelobe level requires a measurement distance of $6d^2/\lambda$ [(1)]. This corresponds to criterion for "r" in Equation [14] to be changed from $r \leq \lambda/16$ to $r \leq \lambda/48$ or 7.5 deg.

[1] R. C. Hansen. "Measurement Distance Effects on Low Sidelobe Patterns," *IEEE Transactions on Antennas and Propagation*, Vol. AP-32, No. 6, June 1984.

RADIATION HAZARDS

Radiation Hazard (RADHAZ) describes the hazards of electromagnetic radiation to fuels, electronic hardware, ordnance, and personnel. In the military these hazards are segregated as follows:

1) Hazards of Electromagnetic Radiation to Personnel (HERP)
2) Hazards of Electromagnetic Radiation to Ordnance (HERO)
3) Hazards of Electromagnetic Radiation to Fuel (HERF)

The current industrial specifications for RADHAZ are contained in ANSI/IEEE C95.1-1992 which was used as a reference to create the combined Navy regulation NAVSEA OP3565 / NAVAIR 16-1-529. Volume I contains HERP and HERF limits - its current version is REV 5. Volume II (REV 6) covers HERO. These limits are shown in Figure 1 although all values have been converted to average power density.

OP 3565 specifies HERO RADHAZ levels at frequencies below 1 GHz in peak value of electric field strength (V/m), while levels above 200 MHz are specified in average power density (mW/cm^2) - note the overlapping frequencies. Since Figure 1 depicts power density as the limits, you must convert the average values to peak field strength for use at lower frequencies. Also many applications of EMC work such as MIL-STD-461 use limits based on the electric (E) field strength in volts/meter. Remember that $P=E^2/R$, and from Section 4-2, we note that $R=377\Omega$ for free space. It can also be shown that the magnetic field strength (H field in Amps/meter) = I/m where I=E/R. Don't forget that RMS = 0.707 Peak. With the units of P_D in mW/cm^2, E in V/m, and H in A/m, then P_D (mW/cm^2) = E^2 / 3770 = 37.7 H^2. It should thus be noted that a 100 times increase in power (mW/cm^2) is only a 10 times increase in V/m.

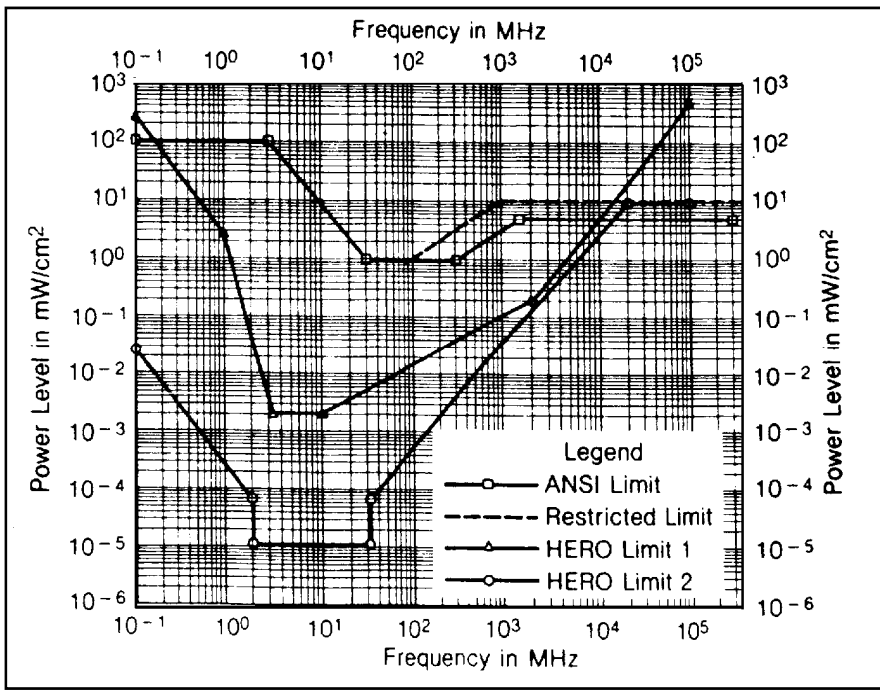

Figure 1. Radiation Hazards to Personnel and Ordnance.

The potential dangers to ordnance and fuels are obvious because there could be an explosive "chain reaction" by exploding; consequently, these limits are generally lower than personnel limits. There are three **HERO** categories. The HERO limit 2 is for HERO "unsafe" or "unreliable" explosive devices with exposed wires arranged in optimum (most susceptible) receiving orientation. This usually occurs during the assembly/disassembly of ordnance, but also applies to new/untested ordnance until proven "safe" or "susceptible." The HERO limit 1 is for HERO susceptible ordnance fully assembled undergoing normal handling and loading operations. HERO safe ordnance requires no RF radiation precautions. A list of which specific ordnance (by NALC) falls into each category can be found in OP 3565 along with specific frequency restrictions for each piece of ordnance. For example, all missiles of one variety are susceptible

(HERO 1 limits), while another missile has both susceptible and safe variants (with no RADHAZ limits). Other ordnance may be HERO unsafe (HERO 2 limits).

The danger of **HERP** occurs because the body absorbs radiation and significant internal heating may occur without the individual's knowledge because the body does not have internal sensation of heat, and tissue damage may occur before the excess heat can be dissipated. As shown in Figure 1, the current "restricted" limit is for individuals more than 55" tall because they have more body mass. In other words, all people may be exposed to the lower limit, but only persons taller than 55" may be exposed to the higher limit of 10 mW/cm^2.

NAVSEA OP 3565 will be updated in the future to be compatible with DoD INST 6055.11 dated Feb 21, 1995 which supersedes it. The personnel radiation levels in Figures 2 and 3 were taken from the new release of DoD INST 6055.11.

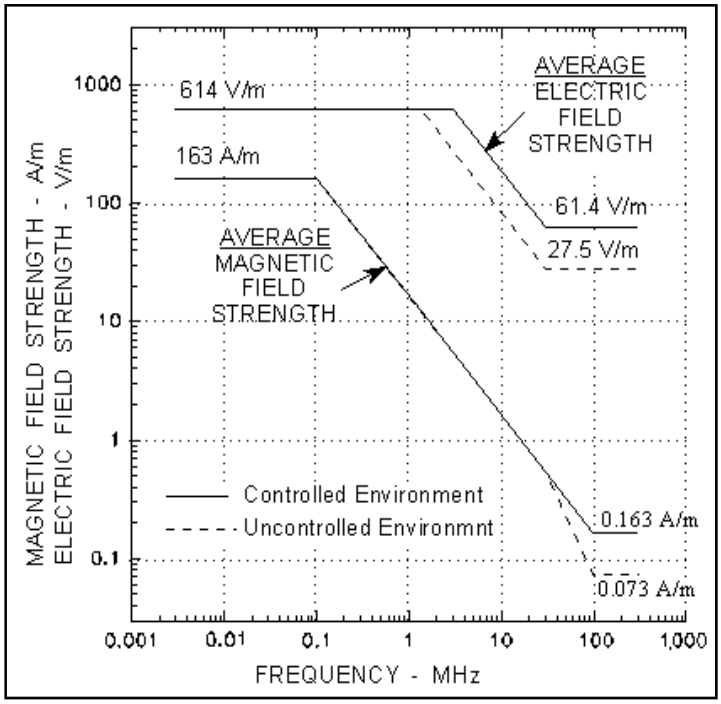

Figure 2. Lower Frequency HERP from DoD INST 6055.11.

Unlike the existing "restricted limit" of NAVSEA OP 3565 discussed above, in the revised DoD instruction for personnel radiation hazards, a different approach to exposure was taken.

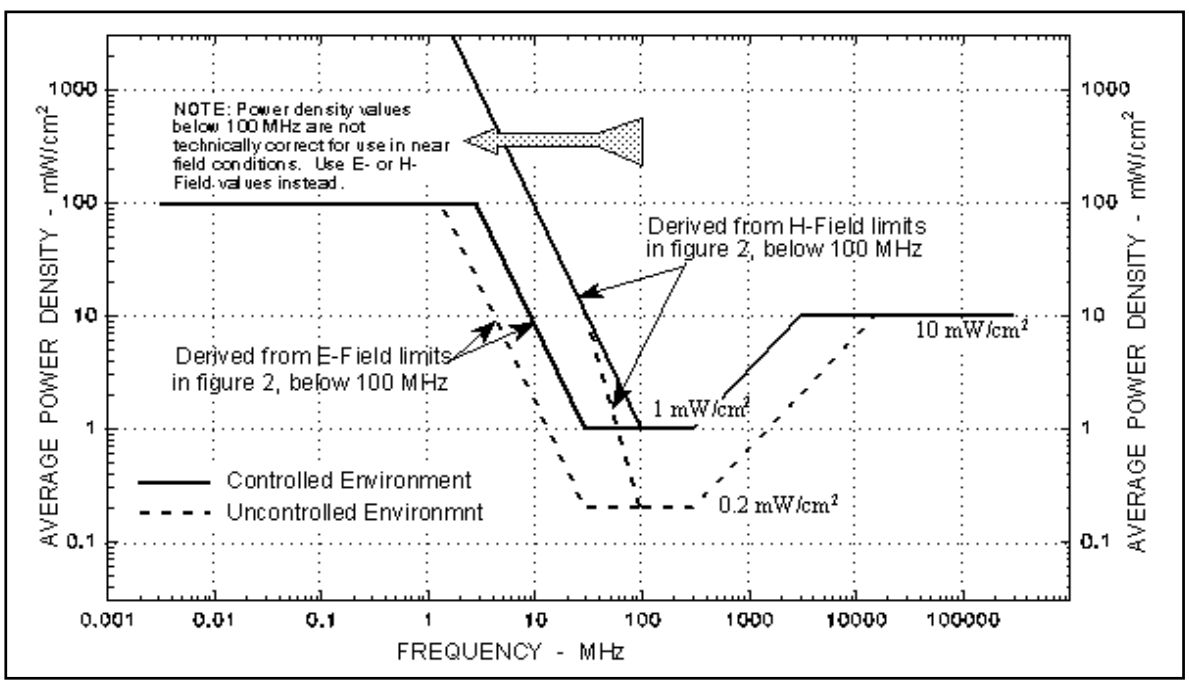

Figure 3. Radiation Hazards to Personnel from DoD INST 6055.11.

Two maximum hazard limits are defined;

1) Controlled Environments - where personnel are aware of the potential danger of RF exposure concurrently with employment, or exposure which may occur due to incidental transient passage through an area, and;
2) Uncontrolled Environments - A lower maximum level where there is no expectation that higher levels should be encountered, such as living quarters.

These Personnel Exposure Limits (PELs) are based on a safety factor of ten times the Specific Absorption Rate (SAR) which might cause bodily harm. The term PEL is equivalent to the terms "Maximum Permissible Exposure (MPE)" and "Radio Frequency Protection Guides (RFPG)" in other publications.

There are several exceptions to the max limits in Figs 2 and 3 (in some cases higher levels are permitted):

- High Power Microwave (HPM) system exposure in a controlled environment, which has a single pulse or multiple pulses lasting less than 10 seconds, has a higher peak E-Field limit of 200 kV/m.
- EMP Simulation Systems in a controlled environment for personnel who are exposed to broad-band (0.1 MHz to 300 GHz) RF are limited to a higher peak E-Field of 100 kV/m.
- The given limits are also increased for pulsed RF fields. In this case the peak power density per pulse for pulse durations < 100 msec and no more than 5 pulses in the period is increased to: PELPulse = PEL x TAVG / 5 x Pulse Width, and the peak E-field is increased to 100 kV/m. If there are more than 5 pulses or they are greater than 100 msec, a time averaged PD should not exceed that shown in Figure 3.
- A rotating or scanning beam likewise reduces the hazard, so although an on-axis hazard might exist, there may be none with a moving beam. The power density may be approximated with:
  PDscan = PDfixed (2 x Beam Width / scan angle)
- Many other special limitations also apply, such as higher limits for partial body exposure, so if in doubt, read the DoD Inst 6055.11 in detail. Field measurements may be measured in accordance with IEEE C95.3-1991.

The PELs listed in Figures 2 and 3 were selected for an average RF exposure time at various frequencies. In a controlled environment, this averaging time was selected as 6 minutes for 0.003 to 15,000 MHz. If the exposure time is less than 6 minutes, then the level may be increased accordingly. Similar time weighted averages apply to uncontrolled environments, but it varies enough with frequency such that DoD INST 6055.11 should be consulted.

NAVSEA OP 3565 contains a list of Navy avionics which transmit RF as well as radars along with their respective hazard patterns. Special training is required for individuals who work in areas which emit RF levels which exceed the uncontrolled levels. Warning signs are also required in areas which exceed either the controlled or uncontrolled limits.

Although E-Field, H-Field, and power density can be mathematically converted in a far-field plane wave environment, the relations provided earlier do not apply in the near field, consequently the E- or H-field strength must be measured independently below 100 MHz. It should be noted that the specifications in NAVSEA OP 3565 for lower frequency HERO limits are listed as peak E-field values, whereas lower RF limits in DoD INST 6055.11 on HERP are in average (RMS) E-field values. Upper

frequency restrictions are based on average (RMS) values of power density in both regulations except for certain circumstances.

HERF precautions are of more general concern to fuel truck operators. However, some general guidelines include:

- Do not energize a transmitter (radar/comm) on an aircraft or motor vehicle being fueled or on an adjacent aircraft or vehicle.
- Do not make or break any electrical, ground wire, or tie down connector while fueling.
- Radars able to illuminate fueling areas with a peak power density of 5 W/cm2 should be shut off.
- For shore stations, antennas radiating 250 watts or less should be installed at least 50 ft from fueling areas (at sea 500 watts is the relaxed requirement).
- For antennas which radiate more than 250 watts, the power density at 50 ft from the fueling operation should not be greater than the equivalent power density of a 250 watt transmitter at 50 ft.

ACTIVE ELECTRONICALLY SCANNED ARRAYS (AESA)

Scanning phased arrays employing electronically controlled phase shifters (e.g., PiN diode, ferrite) have been used in high power radar applications since the early 1960s. These are planar arrays and generally use a corporate type feed structure to array rows of elements in one dimension of the array and use an analogous feed to array the rows in the orthogonal dimension of the array, resulting in a single feed point. A high power RF transmitter, usually employing some sort of liquid cooling, is used to excite the array. This architecture is cumbersome and difficult to package and the high power transmitter is a single point of failure for the system.

The maturation of solid state transmit/receive modules (T/R) using Gallium Arsenide (GaAs) technology or more recently Gallium Nitride (GaN) technology has made AESAs a practical reality. The T/R modules consist of a low noise amplifier (LNA) for the receive function and a solid state high power amplifier (SSPA) for realization of the transmit function. The T/R module may also contain the necessary phase control elements for beam scanning. A generic 8-element AESA for one dimension is shown in Figure 1.

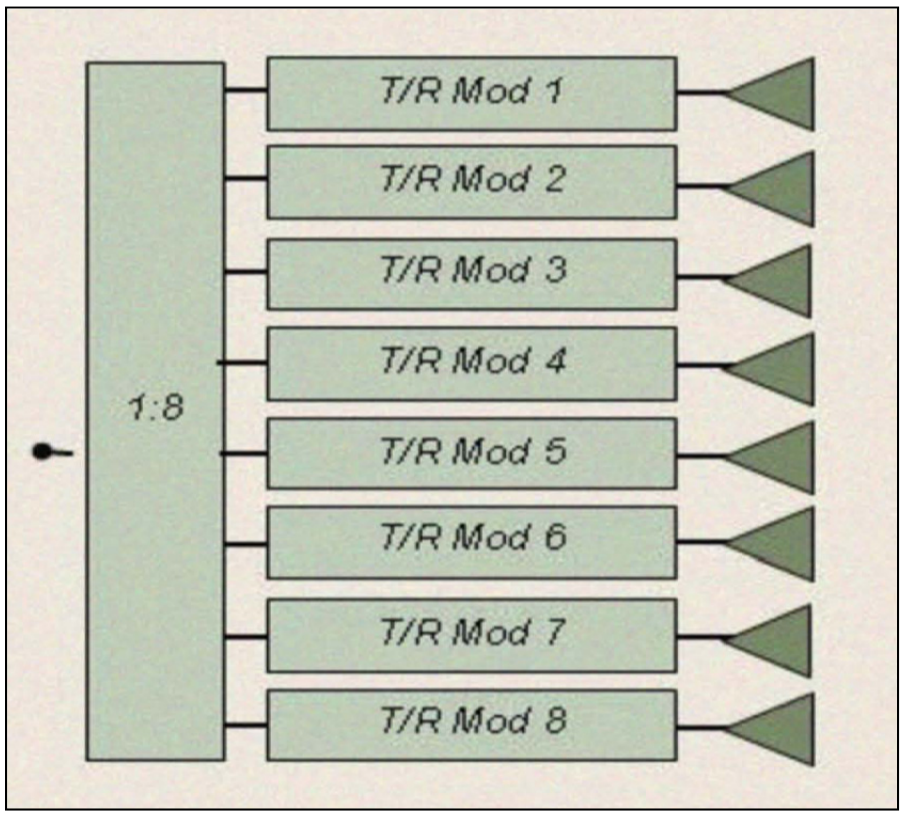

Figure 1. Eight Element AESA.

Electronically scanned phased array designs with decade bandwidths have been reported in the open literature for many years. However those reported are only lab versions and none have been implemented in a fielded system. In addition, the high average power requirement, particularly for EW systems, calls for the use of GaN SSPA technology and this, in conjunction with the dense array packaging requirement, poses severe heat dissipation/cooling issues.

AESAs for EW applications impose design considerations vastly different from an AESA for radar. In contradistinction with high **peak** power radar applications (e.g., AN/APG79), the high **average** power large duty factors (sometimes CW) requirements for EW impose severe design requirements and constraints for the wide bandwidth AESA. Incorporation of an AESA in airborne environment, with its concomitant restrictive volume, further exacerbates design constraints.

The heat dissipation problem is of major concern in modern high power AESAs. Due to the behavior of microwave transistor amplifiers, the power added efficiency (PAE) of a TR module transmitter is typically a relatively small fraction of the total prime power consumption. As a result, an AESA will dissipate a lot of heat, which must be extracted. The reliability of GaAs and GaN MMIC chips improves if the RF amplifier system operates at reduced temperatures. Traditional air cooling used in most established avionic hardware is ill suited to the high packaging density of an AESA. As a result modern AESAs are predominantly liquid cooled. A typical liquid cooling system will use pumps to drive the coolant through channels in the cooling plenum of the array, and then route it to a heat exchanger. In comparison, with a conventional air cooled fighter radar, the AESA will be more reliable but will require more electrical power and more cooling infrastructure, and typically can produce much higher average transmit power.

ADVANTAGES OF AESA RADIATORS

AESAs add many capabilities of their own to those of the Passive Electronically Steered Array (PESAs). Among these are: the ability to form multiple beams, to scan without mechanical steering, to use each transmit/receive module for different roles concurrently, like radar detection, and, more importantly, their multiple wave and scanning frequencies create multiple difficulties for traditional, correlation-type radar detectors.

LOW PROBABILITY OF INTERCEPT

Radar systems work by sending out a signal and then listening for its echo off distant objects. Each of these paths, to and from the target, is subject to the inverse square law of propagation. That means that a radar's received energy drops with the fourth power of distance, which is why radar systems require high powers, often in the megawatt range, to be effective at long range.

The radar signal being sent out is a simple radio signal, and can be received with a simple radio receiver. It is common to use such a receiver in the targets, normally aircraft, to detect radar broadcasts. Unlike the radar unit, which must send the pulse out and then receive its reflection, the target's receiver does not need the reflection and thus the signal drops off only as the square of distance. This means that the receiver is always at an advantage over the radar in terms of range. It will always be able to detect the signal long before the radar can see the target's echo. Since the position of the radar is extremely useful information in an attack on that platform, this means that radars generally must be turned off for lengthy periods if they are subject to attack; this is common on ships, for instance.

Turning that received signal into a useful display is the purpose of the RWR. Unlike the radar, which knows which direction it is sending its signal, the receiver simply gets a pulse of energy and has to interpret it. Since the radio spectrum is filled with noise, the receiver's signal is integrated over a short period of time, making periodic sources like a radar add up and stand out over the random background. Typically RWRs store the detected pulses for a short period of time, and compare their broadcast frequency and pulse repetition frequency against a database of known radars. The rough direction can be calculated using a rotating antenna, or similar passive array, and combined with symbology indicating the likely purpose of the radar - airborne early warning, surface to air missile, etc.

This technique is much less useful against AESA radars. Since the AESA can change its frequency with every pulse, and generally does so using a pseudo-random sequence, integrating over time does not help pull the signal out of the background noise. Nor does the AESA have any sort of fixed pulse repetition frequency, which can also be varied and thus hide any periodic brightening across the entire spectrum. Traditional RWRs suffered significantly decreased effectiveness against AESA radars.

HIGH JAMMING RESISTANCE

Jamming is likewise much more difficult against an AESA. Traditionally, jammers have operated by determining the operating frequency of the radar and then broadcasting a signal on it to confuse the receiver as to which is the "real" pulse and which is the jammer's. This technique works as long as the radar system cannot easily change its operating frequency. When the transmitters were based on klystron tubes this was generally true, and radars, especially airborne ones, had only a few frequencies to choose among. A jammer could listen to those possible frequencies and select the one to be used to jam.

Since an AESA could change its operating frequency with every pulse, and spread the frequencies across a wide band even in a single pulse, jammers are much less effective. Although it is possible to send out broadband white noise against all the possible frequencies, this means the amount of energy being sent at any one frequency is much lower, reducing its effectiveness. In fact, AESAs can then be switched to a receive-only mode, and use these powerful jamming signals instead to track its source, something that required a separate receiver in older platforms.

AESA radars can be much more difficult to detect, and so much more useful in receiving signals from the targets, that they can broadcast continually and still have a very low chance of being detected. This allows such radar systems to generate far more data than traditional radar systems, which can only receive data periodically, greatly improving overall system effectiveness.

OTHER ADVANTAGES

Since each element in an AESA is a powerful radio receiver, active arrays have many roles besides traditional radar. One use is to dedicate several of the elements to reception of common radar signals, eliminating the need for a separate radar warning receiver. The same basic concept can be used to provide traditional radio support, and with some elements also broadcasting, form a very high bandwidth data link.

AESAs are also much more reliable than either a PESA or older designs. Since each module operates independently of the others, single failures have little effect on the operation of the system as a whole. Additionally, the modules individually operate at lower powers and voltages so the need for a large high-voltage power supply is eliminated.

Replacing a mechanically scanned array with a fixed AESA mount can help reduce an aircraft's overall RCS, but some designs (such as the Eurofighter Typhoon) forgo this advantage in order to combine mechanical scanning with electronic scanning and provide a wider angle of total coverage.

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FRACTAL ANTENNAS

The term fractal, which means broken or irregular fragments, was originally coined by B.B. Mandelbrot **[1]** to describe a family of complex shapes that possess self-similarity in their geometrical structure. In-depth studies of the patterns of nature provided inspiration for the development of fractal geometry where it has been used to model numerous natural objects. Recent advances in the antenna art have led to the application of fractal geometry instead of convention Euclidean geometric concepts to the design of wide bandwidth, low profile, compact antennas.

A fractal antenna is an antenna that uses a fractal, self-similar design to maximize the length, or increase the perimeter (on inside sections or the outer structure), of material that can receive or transmit electromagnetic radiation within a given total surface area or volume. The earliest published reference to use of the term fractal radiators and fractal antennas to refer to fractal shaped antenna elements appeared May 1994 **[2]**.

Such fractal antennas are also referred to as multilevel and space filling curves, but the key aspect lies in their repetition of a motif over two or more scale sizes, or "iterations." For this reason, fractal antennas are very compact, multiband or wideband, and have useful applications in many commercial and military systems.

A good example of a fractal antenna as a space-filling curve is in the form of a Minkowski Island (Figure 1). Here, each line of copper is just a small fraction of a wavelength **[3]**.

A fractal antenna's response differs markedly from traditional antenna designs, in that it is capable of operating with good-to-excellent performance at many different frequencies simultaneously. Normally standard antennas have to be "cut" for the frequency for which they are to be used — and thus the standard antennas only work well at that frequency. This makes the fractal antenna an excellent design for wideband and multiband applications.

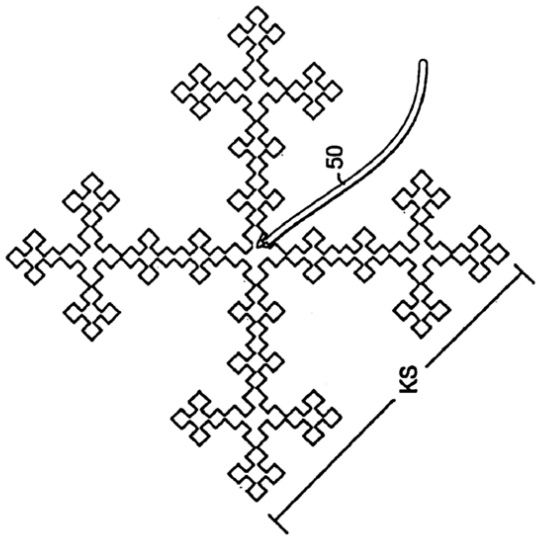

Figure 1. An Example of a Fractal Antenna: a Space-Filling Curve Called a Minkowski Island.

Antenna elements (as opposed to antenna arrays) made from self-similar shapes were first created by Nathan Cohen, then a professor at Boston University, starting in 1995 **[4].** Cohen's efforts with a variety

of fractal antenna designs were first published in 1995 (thus the first scientific publication on fractal antennas), and a number of patents have been issued from the 1995 filing priority of invention. Most allusions to fractal antennas make reference to these "fractal element antennas."

Many fractal element antennas use the fractal structure as a virtual combination of capacitors and inductors. This makes the antenna have so that it has many different resonances that can be selected and adjusted by choosing the proper fractal design. Electrical resonances may not be directly related to a particular scale size of the fractal antenna structure. The physical size of the antenna is unrelated to its resonant or broadband performance. The general rule of antenna length being near target frequency wavelength does not apply itself in the same way with fractal antennas.

This complexity arises because the current on the structure has a complex arrangement caused by the inductance and self capacitance. In general, although their effective electrical length is longer, the fractal element antennas are physically smaller.

Fractal element antennas are shrunken compared to conventional designs and do not need additional components. In general, the fractal dimension of a fractal antenna is a poor predictor of its performance and application. Not all fractal antennas work well for a given application or set of applications. Computer search methods, optimization algorithms, and antenna simulations are commonly used to identify which fractal antenna designs best meet the need of the application.

Although the first validation of the technology was published as early as 1995 **[4]** recent independent studies show advantages of the fractal element technology in real-life applications, such as radio frequency identification and cell phones.

A different and also useful attribute of some fractal element antennas is their self-scaling aspect. In 1999, it was discovered that self-similarity was one of the underlying requirements to make antennas "invariant" (same radiation properties) at a number or range of frequencies. Previously, under Rumsey's Frequency Independent Antenna Principle, it was believed that antennas had to be defined by angles for this to be true; the 1999 analysis **[5]**, based on Maxwell's equations, showed this to be a subset of the more general set of self-similar conditions. Hence fractal antennas offer a closed-form and unique insight into a key aspect of electromagnetic phenomena to wit the invariance property of Maxwell's equations.

Antenna tuning units are typically not required on fractal antennas due to their wide bandwidth and complex resonance. However, if a transmitting antenna has deep nulls in its response or has electromagnetic structural issues that require equalization then an antenna tuning unit should be used.

In addition to their use as antennas, fractals have also found application in other antenna system components including loads, counterpoises, and ground planes. Confusion by those who claim "grain of rice"-sized fractal antennas arises, because such fractal structures serve the purpose of loads and counterpoises, rather than bona fide antennas.

Fractal inductors and fractal tuned circuits (fractal resonators) were also discovered and invented simultaneously with fractal element antennas. An emerging example of such is in metamaterials. A recent report demonstrates using close-packed fractal resonators to make the first wideband metamaterial "invisibility cloak" at microwave frequencies **[6]**. Fractal filters (a type of tuned circuit) are another example of fractal geometry in microwave componentry.

As fractals can be used as counterpoises, loads, ground planes, and filters, all parts that can be integrated with antennas, they are considered parts of some antenna systems and thus are discussed in the context of fractal antennas.

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RADAR EQUATIONS

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FIELD INTENSITY and POWER DENSITY

Sometimes it is necessary to know the actual field intensity or power density at a given distance from a transmitter instead of the signal strength received by an antenna. Field intensity or power density calculations are necessary when estimating electromagnetic interference (EMI) effects, when determining potential radiation hazards (personnel safety), or in determining or verifying specifications.

Field intensity (field strength) is a general term that usually means the magnitude of the electric field vector, commonly expressed in volts per meter. At frequencies above 100 MHZ, and particularly above one GHz, power density (P_D) terminology is more often used than field strength.
Power density and field intensity are related by equation [1]:

$$P_D = \frac{E^2}{Z_0} = \frac{E^2}{120\pi} = \frac{E^2}{377} \qquad \textbf{[1]}$$

where P_D is in W/m^2, E is the RMS value of the field in volts/meter and 377 ohms is the characteristic impedance of free space. When the units of P_D are in mW/cm^2, then P_D (mW/cm^2) = E^2/3,770.

Conversions between field strength and power density when the impedance is 377 ohms, can be obtained from Table 1. It should be noted that to convert dBm/m^2 to dBμV/m add 115.76 dB. Sample calculations for both field intensity and power density in the far field of a transmitting antenna are in Section 4-2 and Section 4-8. Refer to chapter 3 on antennas for the definitions of near field and far field.

Note that the "/" term before m, m^2, and cm^2 in Table 1 mean "per," i.e., dBm per m^2, not to be confused with the division sign which is valid for the Table 1 equation $P=E^2/Z_o$. Remember that in order to obtain dBm from dBm/m^2 given a certain area, you must add the logarithm of the area, not multiply. The values in the table are rounded to the nearest dBW, dBm, etc. per m^2 so the results are less precise than a typical handheld calculator and may be up to ½ dB off.

VOLTAGE MEASUREMENTS

Coaxial cabling typically has input impedances of 50, 75, and 93Ω, (±2) with 50Ω being the most common. Other types of cabling include the following: TV cable is 75Ω (coaxial) or 300Ω (twin-lead), audio public address (PA) is 600Ω, audio speakers are 3.2 (4), 8, or 16Ω.

In the 50Ω case, power and voltage are related by:

$$P = \frac{E^2}{Z_0} = \frac{E^2}{50} = 50\, I^2 \qquad \textbf{[2]}$$

Conversions between measured power, voltage, and current where the typical impedance is 50 ohms can be obtained from Table 2. The dBμA current values are given because frequently a current probe is used during laboratory tests to determine the powerline input current to the system.

MATCHING CABLING IMPEDANCE

In performing measurements, we must take into account an impedance mismatch between measurement devices (typically 50 ohms) and free space (377 ohms).

Table 1. Conversion Table - Field Intensity and Power Density.
$P_D = E^2/Z_0$ (Related by free space impedance = 377 ohms)

E (Volts/m)	20 log 10^6 (E) (dBμV/m)	P_D (watts/m^2)	10 Log P_D (dBW/m^2)	Watts/cm^2	dBW/cm^2	mW/cm^2	dBm/cm^2	dBm/m^2
7,000	197	130,000	+51	13	+11	13,000	+41	+81
5,000	194	66,300	+48	6.6	+8	6,630	+38	+78
3,000	190	23,900	+44	2.4	+4	2,390	+34	+74
4,000	186	10,600	+40	1.1	0	1,060	+30	+70
1,000	180	2,650	+34	.27	-6	265	+24	+64
700	177	1,300	+31	.13	-9	130	+21	+61
500	174	663	+28	.066	-12	66	+18	+58
300	170	239	+24	.024	-16	24	+14	+54
200	166	106	+20	.011	-20	11	+10	+50
100	160	27	+14	.0027	-26	2.7	+4	+44
70	157	13	+11	$1.3x10^{-3}$	-29	1.3	+1	+41
50	154	6.6	+8	$6.6x10^{-4}$	-32	.66	-2	+38
30	150	2.4	+4	$2.4x10^{-4}$	-36	.24	-6	+34
20	146	1.1	+0	$1.1x10^{-4}$	-40	.11	-10	+30
10	140	.27	-6	$2.7x10^{-5}$	-46	.027	-16	+24
7	137	.13	-9	$1.3x10^{-5}$	-49	.013	-19	+21
5	134	.066	-12	$6.6x10^{-6}$	-52	$66x10^{-4}$	-22	+18
3	130	.024	-16	$2.4x10^{-6}$	-56	$24x10^{-4}$	-26	+14
2	126	.011	-20	$1.1x10^{-6}$	-60	$11x10^{-4}$	-30	+10
1	120	.0027	-26	$2.7x10^{-7}$	-66	$2.7x10^{-4}$	-36	+4
0.7	117	$1.3x10^{-3}$	-29	$1.3x10^{-7}$	-69	$1.3x10^{-4}$	-39	+1
0.5	114	$6.6x10^{-4}$	-32	$6.6x10^{-8}$	-72	$66x10^{-4}$	-42	-2
0.3	110	$2.4x10^{-4}$	-36	$2.4x10^{-8}$	-76	$24x10^{-4}$	-46	-6
0.2	106	$1.1x10^{-4}$	-40	$1.1x10^{-8}$	-80	$11x10^{-4}$	-50	-10
0.1	100	$2.7x10^{-5}$	-46	$2.7x10^{-9}$	-86	$2.7x10^{-6}$	-56	-16
$70x10^{-3}$	97	$1.3x10^{-5}$	-49	$1.3x10^{-9}$	-89	$1.3x10^{-6}$	-59	-19
$50x10^{-3}$	94	$6.6x10^{-6}$	-52	$6.6x10^{-10}$	-92	$66x10^{-8}$	-62	-22
$30x10^{-3}$	90	$2.4x10^{-6}$	-56	$2.4x10^{-10}$	-96	$24x10^{-8}$	-66	-26
$20x10^{-3}$	86	$1.1x10^{-6}$	-60	$1.1x10^{-10}$	-100	$11x10^{-8}$	-70	-30
$10x10^{-3}$	80	$2.7x10^{-7}$	-66	$2.7x10^{-11}$	-106	$2.7x10^{-8}$	-76	-36
$7x10^{-3}$	77	$1.3x10^{-7}$	-69	$1.3x10^{-11}$	-109	$1.3x10^{-8}$	-79	-39
$5x10^{-3}$	74	$6.6x10^{-8}$	-72	$6.6x10^{-12}$	-112	$66x10^{-10}$	-82	-42
$3x10^{-3}$	70	$2.4x10^{-8}$	-76	$2.4x10^{-12}$	-116	$24x10^{-10}$	-86	-46
$2x10^{-3}$	66	$1.1x10^{-8}$	-80	$1.1x10^{-12}$	-120	$11x10^{-10}$	-90	-50
$1x10^{-3}$	60	$2.7x10^{-9}$	-86	$2.7x10^{-13}$	-126	$2.7x10^{-10}$	-96	-56
$7x10^{-4}$	57	$1.3x10^{-9}$	-89	$1.3x10^{-13}$	-129	$1.3x10^{-10}$	-99	-59
$5x10^{-4}$	54	$6.6x10^{-10}$	-92	$6.6x10^{-14}$	-132	$66x10^{-12}$	-102	-62
$3x10^{-4}$	50	$2.4x10^{-10}$	-96	$2.4x10^{-14}$	-136	$24x10^{-12}$	-106	-66
$2x10^{-4}$	46	$1.1x10^{-10}$	-100	$1.1x10^{-14}$	-140	$11x10^{-12}$	-110	-70
$1x10^{-4}$	40	$2.7x10^{-11}$	-106	$2.7x10^{-15}$	-146	$2.7x10^{-12}$	-116	-76
$7x10^{-5}$	37	$1.3x10^{-11}$	-109	$1.3x10^{-15}$	-149	$1.3x10^{-12}$	-119	-79
$5x10^{-5}$	34	$6.6x10^{-12}$	-112	$6.6x10^{-16}$	-152	$66x10^{-14}$	-122	-82
$3x10^{-5}$	30	$2.4x10^{-12}$	-116	$2.4x10^{-16}$	-156	$24x10^{-14}$	-126	-86
$2x10^{-5}$	26	$1.1x10^{-12}$	-120	$1.1x10^{-16}$	-160	$11x10^{-14}$	-130	-90
$1x10^{-5}$	20	$2.7x10^{-13}$	-126	$2.7x10^{-17}$	-166	$2.7x10^{-14}$	-136	-96
$7x10^{-6}$	17	$1.3x10^{-13}$	-129	$1.3x10^{-17}$	-169	$1.3x10^{-14}$	-139	-99
$5x10^{-6}$	14	$6.6x10^{-14}$	-132	$6.6x10^{-18}$	-172	$66x10^{-16}$	-142	-102
$3x10^{-6}$	10	$2.4x10^{-14}$	-136	$2.4x10^{-18}$	-176	$24x10^{-16}$	-146	-106
$2x10^{-6}$	6	$1.1x10^{-14}$	-140	$1.1x10^{-18}$	-180	$11x10^{-16}$	-150	-110
$1x10^{-6}$	0	$2.7x10^{-15}$	-146	$2.7x10^{-19}$	-186	$2.7x10^{-16}$	-156	-116

NOTE: Numbers in table rounded off.

FIELD STRENGTH APPROACH

To account for the impedance difference, the antenna factor (AF) is defined as: AF=E/V, where E is field intensity which can be expressed in terms taking 377 ohms into account and V is measured voltage which can be expressed in terms taking 50 ohms into account. Details are provided in Section 4-12.

POWER DENSITY APPROACH

To account for the impedance difference, the antenna's effective capture area term, A_e relates free space power density P_D with received power, P_r, i.e. $P_r = P_D A_e$. A_e is a function of frequency and antenna gain and is related to AF as shown in Section 4-12.

SAMPLE CALCULATIONS

Section 4-2 provides sample calculations using power density and power terms from Tables 1 and 2, whereas Section 4-12 uses these terms plus field intensity and voltage terms from Table 1 and Table 2. Refer the examples in Section 4-12 for usage of the conversions while converting free space values of power density to actual measurements with a spectrum analyzer attached by coaxial cable to a receiving antenna.

Conversion Between Field Intensity (Table 1) and Power Received (Table 2).

Power received (watts or milliwatts) can be expressed in terms of field intensity (volts/meter or μv/meter) using equation [3]:

$$\textit{Power received } (P_r) = \frac{E^2}{480\pi^2}\frac{c^2}{f^2}G \qquad \textbf{[3]}$$

or in log form: $10 \log P_r = 20 \log E + 10 \log G - 20 \log f + 10 \log (c^2/480\pi^2)$ **[4]**

Then $10 \log Pr = 20 \log E_1 + 10 \log G - 20 \log f_1 + K_4$ **[5]**

$$\textit{Where } K_4 = 10 \log\left[\frac{c^2}{480\pi^2} \bullet \left(\begin{array}{l}\textit{conversions}\\ \textit{as required}\end{array} \frac{\textit{(Watts to mW)}}{\textit{(volts to } \mu v)^2 \textit{ (Hz to MHz or GHz)}^2}\right)\right]$$

The derivation of equation [3] follows:

$P_D = E^2/120\pi$ Eq [1], Section 4-1, terms (v^2/Ω)

$A_e = \lambda^2 G/4\pi$ Eq [8], Section 3-1, terms (m^2)

$P_r = P_D A_e$ Eq [2], Section 4-3, terms $(W/m^2)(m^2)$

$\therefore P_r = (E2/120\pi)(\lambda^2 G/4\pi)$ terms $(v^2/m^2\Omega)(m^2)$

$\lambda = c/f$ Section 2-3, terms (m/sec)(sec)

$\therefore P_r = (E^2/480\pi^2)(c^2 G/f^2)$ which is equation [3]

terms $(v^2/m^2\Omega)(m^2/sec^2)(sec^2)$ or v^2/Ω = watts

Values of K_4 (dB)

P_r	E_1	f_1 (Hz)	f_1 (MHz)	f_1 (GHz)
Watts (dBW)	volts/meter	132.8	12.8	-47.2
	μv/meter	12.8	-107.2	-167.2
mW (dBm)	volts/meter	162.8	42.8	-17.2
	μv/meter	42.8	-77.2	-137.7

Table 2. Conversion Table - Volts to Watts and dBμA.
($P_x = V_x^2/Z$ - Related by line impedance of 50 Ω)

Volts	dBV	dBμV	Watts	dBW	dBm	dBμA
700	56.0	176.0	9800	39.9	69.9	142.9
500	53.9	173.9	5000	37.0	67.0	140.0
300	49.5	169.5	1800	32.5	62.5	135.5
200	46.0	166.0	800	29.0	59.0	132.0
100	40.0	160.0	200	23.0	53.0	126.0
70	36.9	156.9	98	19.9	49.9	122.9
50	34.0	154.0	50	17.0	47.0	120.0
30	29.5	149.5	18	12.5	42.5	115.5
20	26.0	146.0	8	9.0	39.0	112.0
10	20.0	140.0	2	3.0	33.0	106.0
7	16.9	136.9	0.8	0	29.9	102.9
5	14.0	134.0	0.5	-3.0	27.0	100.0
3	9.5	129.5	0.18	-7.4	22.5	95.6
2	6.0	126.0	0.08	-11.0	19.0	92.0
1	0	120.0	0.02	-17.0	13.0	86.0
0.7	-3.1	116.9	9.8×10^{-3}	-20.1	9.9	82.9
0.5	-6.0	114.0	5.0×10^{-3}	-23.0	7.0	80.0
0.3	-10.5	109.5	1.8×10^{-3}	-27.4	2.6	75.6
0.2	-14.0	106.0	8.0×10^{-4}	-31.0	-1.0	72.0
0.1	-20.0	100.0	2.0×10^{-4}	-37.0	-7.0	66.0
.07	-23.1	96.9	9.8×10^{-5}	-40.1	-10.1	62.9
.05	-26.0	94.0	5.0×10^{-5}	-43.0	-13.0	60.0
.03	-30.5	89.5	1.8×10^{-5}	-47.4	-17.7	55.6
.02	-34.0	86.0	8.0×10^{-6}	-51.0	-21.0	52.0
.01	-40.0	80.0	2.0×10^{-6}	-57.0	-27.0	46.0
7×10^{-3}	-43.1	76.9	9.8×10^{-7}	-60.1	-30.1	42.9
5×10^{-3}	-46.0	74.0	5.0×10^{-7}	-63.0	-33.0	40.0
3×10^{-3}	-50.5	69.5	1.8×10^{-7}	-67.4	-37.4	35.6
2×10^{-3}	-54.0	66.0	8.0×10^{-8}	-71.0	-41.0	32.0
1×10^{-3}	-60.0	60.0	2.0×10^{-8}	-77.0	-47.0	26.0
7×10^{-4}	-64.1	56.9	9.8×10^{-9}	-80.1	-50.1	22.9
5×10^{-4}	-66.0	54.0	5.0×10^{-9}	-83.0	-53.0	20.0
3×10^{-4}	-70.5	49.5	1.8×10^{-9}	-87.4	-57.4	15.6
2×10^{-4}	-74.0	46.0	8.0×10^{-10}	-91.0	-61.0	12.0
1×10^{-4}	-80.0	40.0	2.0×10^{-10}	-97.0	-67.0	6.0
7×10^{-5}	-84.1	36.9	9.8×10^{-11}	-100.1	-70.1	2.9
5×10^{-5}	-86.0	34.0	5.0×10^{-11}	-103.0	-73.0	0
3×10^{-5}	-90.5	29.5	1.8×10^{-11}	-107.4	-77.4	-4.4
2×10^{-5}	-94.0	26.0	8.0×10^{-12}	-111.0	-81.0	-8.0
1×10^{-5}	-100.0	20.0	2.0×10^{-12}	-117.0	-87.0	-14.0
7×10^{-6}	-104.1	16.9	9.8×10^{-13}	-120.1	-90.1	-17.1
5×10^{-6}	-106.0	14.0	5.0×10^{-13}	-123.0	-93.0	-20.0
3×10^{-6}	-110.5	9.5	1.8×10^{-13}	-127.4	-97.4	-24.4
2×10^{-6}	-114.0	6.0	8.0×10^{-14}	-131.0	-101.0	-28.0
1×10^{-6}	-120.0	0	2.0×10^{-14}	-137.0	-107.0	-34.0
7×10^{-7}	-124.1	-3.1	9.8×10^{-15}	-140.1	-110.1	-37.1
5×10^{-7}	-126.0	-6.0	5.0×10^{-15}	-143.0	-113.0	-40.0
3×10^{-7}	-130.5	-10.5	1.8×10^{-15}	-147.4	-117.4	-44.4
2×10^{-7}	-134.0	-14.0	8.0×10^{-16}	-151.0	-121.0	-48.0
1×10^{-7}	-140.0	-20.0	2.0×10^{-16}	-157.0	-127.0	-54.0

POWER DENSITY

Radio Frequency (RF) propagation is defined as the travel of electromagnetic waves through or along a medium. For RF propagation between approximately 100 MHz and 10 GHz, radio waves travel very much as they do in free space and travel in a direct line of sight. There is a very slight difference in the dielectric constants of space and air. The dielectric constant of space is one. The dielectric constant of air at sea level is 1.000536. In all but the highest precision calculations, the slight difference is neglected.

From chapter 3, Antennas, an isotropic radiator is a theoretical, lossless, omnidirectional (spherical) antenna. That is, it radiates uniformly in all directions. The power of a transmitter that is radiated from an isotropic antenna will have a uniform power density (power per unit area) in all directions. The power density at any distance from an isotropic antenna is simply the transmitter power divided by the surface area of a sphere ($4\pi R^2$) at that distance. The surface area of the sphere increases by the square of the radius, therefore the power density, P_D, (watts/square meter) decreases by the square of the radius.

$$\begin{matrix}\textit{Power density from} \\ \textit{an isotropic antenna}\end{matrix} = P_D = \frac{P_t}{4\pi R^2} \qquad \begin{matrix}\textit{where : } P_t = \textit{Transmitter Power} \\ R = \textit{Range From Antenna (i.e., radius of sphere)}\end{matrix} \qquad \textbf{[1]}$$

P_t is either peak or average power depending on how P_D is to be specified.

Radars use directional antennas to channel most of the radiated power in a particular direction. The Gain (G) of an antenna is the ratio of power radiated in the desired direction as compared to the power radiated from an isotropic antenna, or:

$$G = \frac{\textit{Maximum radiation intensity of actual antenna}}{\textit{Radiation intensity of isotropic antenna with same power input}}$$

The power density at a distant point from a radar with an antenna gain of G_t is the power density from an isotropic antenna multiplied by the radar antenna gain.

Power density from radar, $$P_D = \frac{P_t G_t}{4\pi R^2} \qquad \textbf{[2]}$$

P_t is either peak or average power depending on how P_D is to be specified.

Another commonly used term is effective isotropic radiated power (EIRP), where **EIRP = P_t G_t.** ERP is also used but EIRP is preferred because it specifically defines the type of reference antenna as isotropic.

A receiving antenna captures a portion of this power determined by its effective capture Area (A_e). The received power available at the antenna terminals is the power density times the effective capture area (A_e) of the receiving antenna.

e.g., If the power density at a specified range is one microwatt per square meter and the antenna's effective capture area is one square meter then the power captured by the antenna is one microwatt.

For a given receiver antenna size the capture area is constant no matter how far it is from the transmitter, as illustrated in Figure 1. Also notice from Figure 1 that the received signal power decreases by 1/4 (6 dB) as the distance doubles. This is due to the R^2 term in the denominator of equation [2].

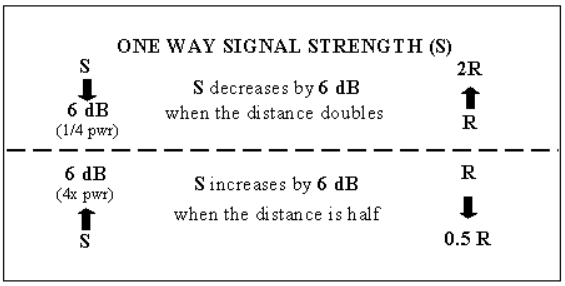

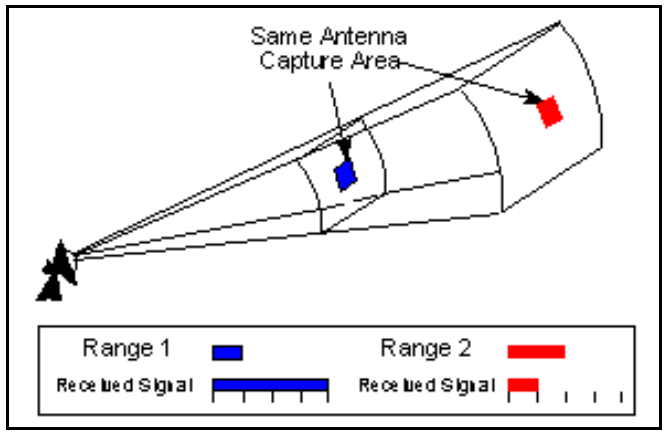

Figure 1. Power Density vs. Range.

Sample Power Density Calculation - Far Field
(Refer to Section 3-5 for the definition of near field and far field)

Calculate the power density at 100 feet for 100 watts transmitted through an antenna with a gain of 10.

Given: P_t = 100 watts G_t = 10 (dimensionless ratio) R = 100 ft

This equation produces power density in watts per square range unit.

$$P_D = \frac{P_t G_t}{4\pi R^2} = \frac{(100\ watts)(10)}{4\pi (100\ ft)^2} = 0.0080\ watts/\ ft^2$$

For safety (radiation hazard) and EMI calculations, power density is usually expressed in milliwatts per square cm. That's nothing more than converting the power and range to the proper units.

100 watts = 1 x 10^2 watts = 1 x 10^5 mW

100 feet = 30.4785 meters = 3047.85 cm.

$$P_D = \frac{P_t G_t}{4\pi R^2} = \frac{(10^5\ mW) \bullet (10)}{4\pi (3047.85cm)^2} = 0.0086\ mW/\ cm^2$$

However, antenna gain is almost always given in dB, not as a ratio. It's then often easier to express EIRP in dBm.

$$P_t\,(dBm) = 10\ \mathrm{Log}\left[\frac{P_t\ watts}{1\ mW}\right] = 10\ \mathrm{Log}\left[\frac{100}{.001}\right] = 50\ dBm$$

$$G_t\,(dB) = 10\ \mathrm{Log}\left[\frac{G_t}{1}\right] = 10\ \mathrm{Log}\,(10) = 10\ dB$$

EIRP (dBm) = P_t (dBm) + G_t (dB) = 50 + 10 = 60 dBm

To reduce calculations, the graph in Figure 2 can be used. It gives EIRP in dBm, range in feet and power density in mW/cm^2. Follow the scale A line for an EIRP of 60 dBm to the point where it intersects the 100 foot range scale. Read the power density directly from the A-scale x-axis as 0.0086 mW/cm^2 (confirming our earlier calculations).

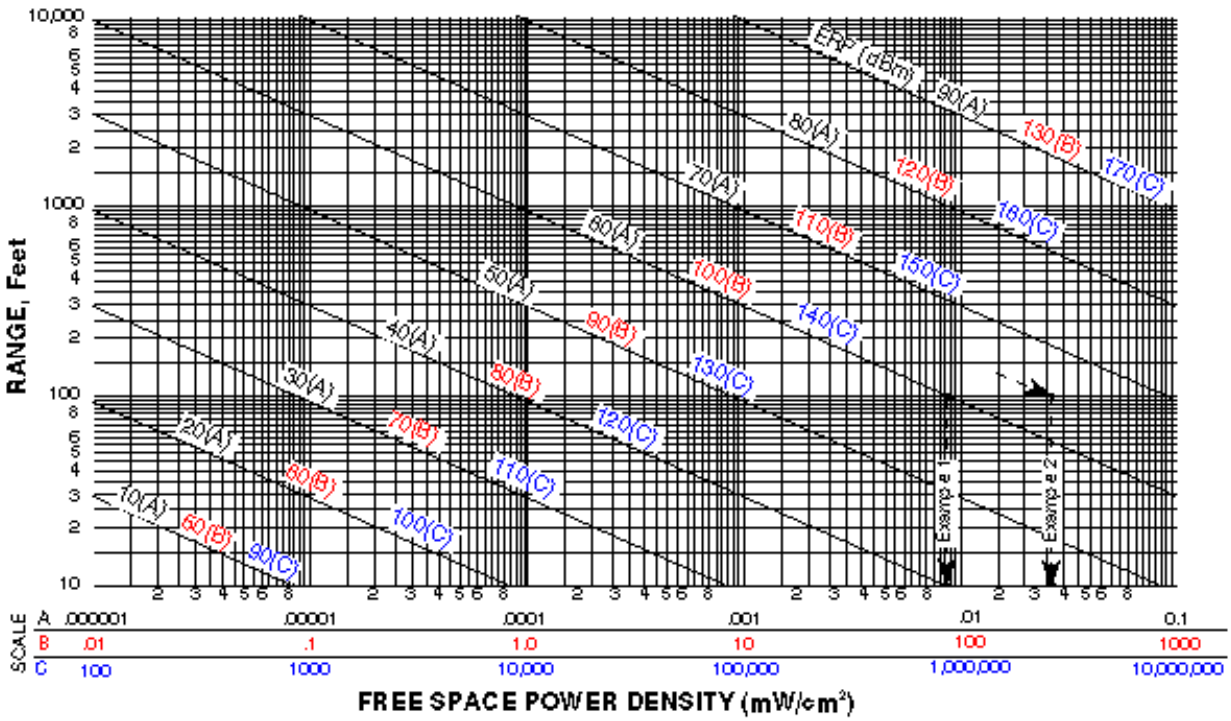

Figure 2. Power Density vs. Range and EIRP.

Example 2

When antenna gain and power (or EIRP) are given in dB and dBm, it is necessary to convert back to ratios in order to perform the calculation given in equation [2]. Use the same values as in example 1 except for antenna gain.

Suppose the antenna gain is given as 15 dB: $\mathbf{G_t\ (dB) = 10\ Log\ (G_t)}$

$$Therefore: \quad G_t = [10]^{\left(\frac{G_t(dB)}{10}\right)} = [10]^{\left(\frac{15}{10}\right)} = 31.6228$$

$$P_D = \frac{P_t G_t}{4\pi R^2} = \frac{(10^5\ mW)(31.6228)}{4\pi\,(3047.85)^2} = 0.0271\ mW/cm^2$$

Follow the 65 dBm (extrapolated) EIRP line and verify this result on the A-scale X-axis.

Example 3 - Sample Real Life Problem

Assume we are trying to determine if a jammer will damage the circuitry of a missile carried onboard an aircraft and we cannot perform an actual measurement. Refer to the diagram at the right.

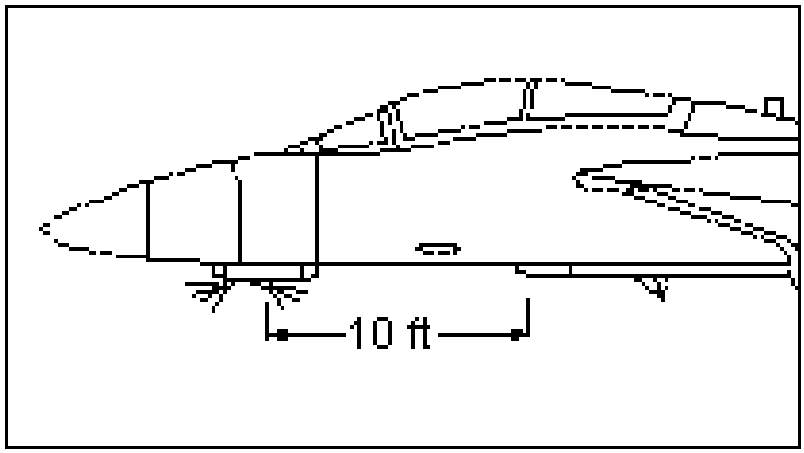

Given the following:

Jammer power: 500 W ($P_t = 500$)

Jammer line loss and antenna gain: 3 dB ($G_t = 2$)

Missile antenna diameter: 10 in

Missile antenna gain: Unknown

Missile limiter protection (maximum antenna power input): 20 dBm (100mW) average and peak.

The power density at the missile antenna caused by the jammer is computed as follows:

$$P_D = \frac{P_t G_t}{4\pi R^2} = \frac{500W\ (2)}{4\pi [(10ft)(.3048m/ft)]^2} = 8.56W/m^2$$

The maximum input power actually received by the missile is either:

$P_r = P_D A_e$ (if effective antenna area is known) or
$P_r = P_D G_m \lambda^2/4\pi$ (if missile antenna gain is known)

To cover the case where the missile antenna gain is not known, first <u>assume</u> an aperture efficiency of 0.7 for the missile antenna (typical). Then:

$P_r = P_D A \eta = 8.56\ W/m^2\ (\pi)[\ (10/2\ in)(.0254\ m/in)\ ]^2\ (0.7) = 0.3$ watts

Depending upon missile antenna efficiency, we can see that the power received will be about 3 times the maximum allowable and that either better limiter circuitry may be required in the missile or a new location is needed for the missile or jammer. Of course if the antenna efficiency is 0.23 or less, then the power will not damage the missile's receiver.

If the missile gain were known to be 25 dB, then a more accurate calculation could be performed. Using the given gain of the missile (25 dB= numeric gain of 316), and assuming operation at 10 GHz ($\lambda = .03$m)

$P_r = P_D G_m \lambda^2 / 4\pi = 8.56\ W/m^2\ (316)(.03)^2/ 4\pi = .19$ watts (still double the allowable tolerance)

ONE-WAY RADAR EQUATION / RF PROPAGATION

The one-way (transmitter to receiver) radar equation is derived in this section. This equation is most commonly used in RWR, communications, or ESM type of applications. The following is a summary of the important equations explored in this section:

ONE-WAY RADAR EQUATION

Peak Power at

Receiver Input, $P_r\,(or\ S) = P_D\,A_e = \dfrac{P_t\,G_t\,A_e}{4\pi\,R^2}$ *and Antenna Gain,* $G = \dfrac{4\pi\,A_e}{\lambda^2}$

or : Equivalent Area, $A_e = \dfrac{G\,\lambda^2}{4\pi}$

So the one-way radar equation is :

$$S\,(or\ P_r) = \frac{P_t\,G_t\,G_r\,\lambda^2}{(4\pi R)^2} = P_t\,G_t\,G_r\left[\frac{c^2}{(4\pi f\,R)^2}\right]^* \qquad (\ Note: \lambda = \frac{c}{f}\ )$$

* keep λ, c, and R in the same units

On reducing to log form this becomes:
$10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r - 20\log f R + 20\log (c/4\pi)$

or in simplified terms:
$10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r - \alpha_1$ (in dB)

Where: α_1 = one-way free space loss = $20\log (f_1 R) + K_1$ (in dB) and:
$K_1 = 20\log [(4\pi/c)$(Conversion factors if units if not in m/sec, m, and Hz)]
Note: To avoid having to include additional terms for these calculations, always combine any transmission line loss with antenna gain

Values of K_1 (in dB)

Range (units)	f_1 in MHz K_1 =	f_1 in GHz K_1 =
NM	37.8	97.8
km	32.45	92.45
m	-27.55	32.45
yd	-28.33	31.67
ft	-37.87	22.13

Note: Losses due to antenna polarization and atmospheric absorption (Sections 3-2 & 5-1) are not included in any of these equations.

Recall from Section 4-2 that the power density at a distant point from a radar with an antenna gain of G_t is the power density from an isotropic antenna multiplied by the radar antenna gain.

Power density from radar, $P_D = \dfrac{P_t\,G_t}{4\pi\,R^2}$

If you could cover the entire spherical segment with your receiving antenna you would theoretically capture all of the transmitted energy. You can't do this because no antenna is large enough. (A two degree segment would be about a mile and three-quarters across at fifty miles from the transmitter.)

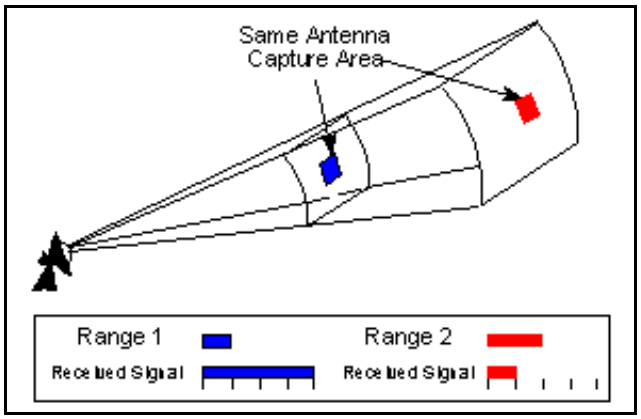

Figure 1. Power Density vs. Range.

A receiving antenna captures a portion of this power determined by its effective capture Area (A_e). The received power available at the antenna terminals is the power density times the effective capture area (A_e) of the receiving antenna.

For a given receiver antenna size the capture area is constant no matter how far it is from the transmitter, as illustrated in Figure 1. This concept is shown in the following equation:
Peak Power at Receiver input,

$$P_R \text{ (or S)} = P_D A_e = \frac{P_t G_t A_e}{4\pi R^2} \quad \text{which is known as the one-way (beacon) equation} \qquad \textbf{[2]}$$

In order to maximize energy transfer between an antenna and transmitter or receiver, the antenna size should correlate with frequency. For reasonable antenna efficiency, the size of an antenna will be greater than $\lambda/4$. Control of beamwidth shape may become a problem when the size of the active element exceeds several wavelengths.

The relation between an antenna's effective capture area (A_e) or effective aperture and its Gain (G) is:

$$\textit{Antenna Gain, } G = \frac{4\pi A_e}{\lambda^2} \qquad \textbf{[3]}$$

$$\textit{or : Equivalent Area, } A_e = \frac{G\lambda^2}{4\pi} \qquad \textbf{[4]}$$

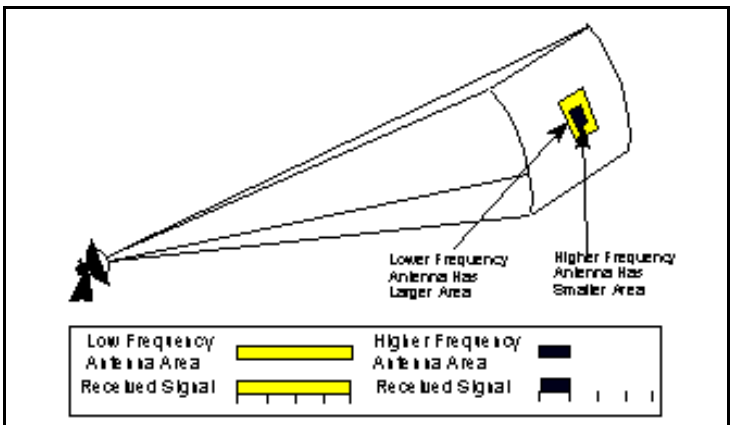

Figure 2. Capture Area vs. Frequency.

Since the effective aperture is in units of length squared, from equation [3], it is seen that gain is proportional to the effective aperture normalized by the wavelength. This physically means that to maintain the same gain when doubling the frequency, the area is reduced by 1/4. This concept is illustrated in Figure 2.

If equation [4] is substituted into equation [2], the following relationship results:

$$\textit{Peak Power at Receiver Input} = S \text{ (or } P_R) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 R^2} = \frac{P_t G_t G_r \lambda^2}{(4\pi R)^2} \qquad \textbf{[5]}$$

This is the signal calculated one-way from a transmitter to a receiver. For instance, a radar application might be to determine the signal received by a RWR, ESM, or an ELINT receiver. It is a general purpose equation and could be applied to almost any line-of-sight transmitter to receiver situation if the RF is higher than 100 MHZ.

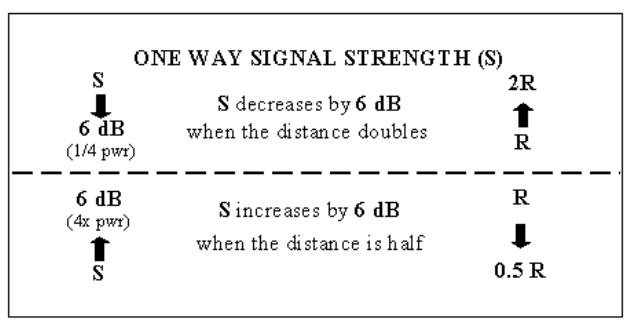

Values of K_1 (dB)		
Range (units)	f_1 in MHz K_1 =	f_1 in GHz K_1 =
NM	37.8	97.8
km	32.45	92.45
m	-27.55	32.45
yd	-28.33	31.67
ft	-37.87	22.13

The free space travel of radio waves can, of course, be blocked, reflected, or distorted by objects in their path such as buildings, flocks of birds, chaff, and the earth itself.

As illustrated in Figure 1, as the distance is doubled the received signal power decreases by 1/4 (6 dB). This is due to the R^2 term in equation [5].

To illustrate this, blow up a round balloon and draw a square on the side of it. If you release air so that the diameter or radius is decreased by 1/2, the square shrinks to 1/4 the size. If you further blow up the balloon, so the diameter or radius is doubled, the square has quadrupled in area.

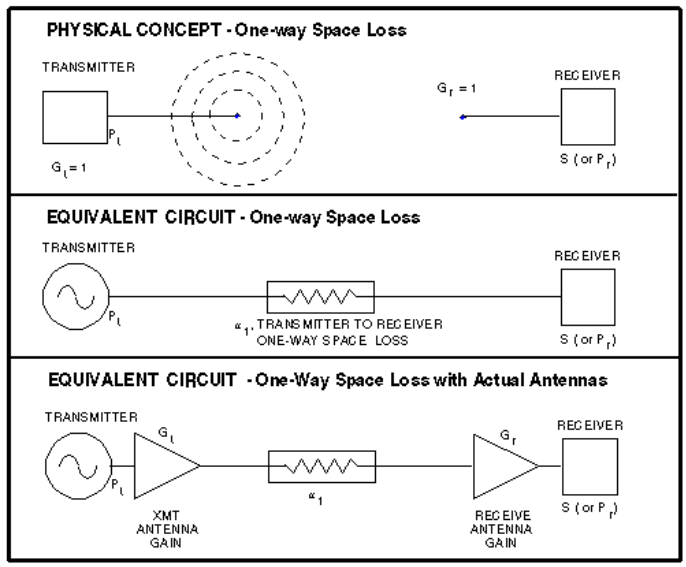

Figure 3. Concept of One-Way Space Loss.

The one-way free space loss factor (α_1), (sometimes called the path loss factor) is given by the term $(4\pi R^2)(4\pi/\lambda^2)$ or $(4\pi R/\lambda)^2$. As shown in Figure 3, the loss is due to the ratio of two factors (1) the effective radiated area of the transmit antenna, which is the surface area of a sphere ($4\pi R^2$) at that distance (R), and (2) the effective capture area (A_e) of the receive antenna which has a gain of one. If a receiving antenna could capture the whole surface area of the sphere, there would be no spreading loss, but a practical antenna will capture only a small part of the spherical radiation. Space loss is calculated using isotropic antennas for both transmit and receive, so α_1 is independent of the actual antenna. Using Gr = 1 in equation [11] in Section 3-1, $A_e = \lambda^2/4\pi$. Since this term is in the denominator of α_1, the higher the frequency (lower λ) the more the space loss. Since G_t and G_r are part of the one-way radar equation, S (or P_r) is adjusted according to actual antennas as shown in the last portion of Figure 3. The value of the received signal (S) is:

$$S\,(or\ P_R) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 R^2} = P_t G_t G_r \left[\frac{\lambda^2}{(4\pi R)^2}\right] \qquad \textbf{[6]}$$

To convert this equation to dB form, it is rewritten as:

$$10\ \mathrm{Log}\,(S \text{ or } P_r) = 10\ \mathrm{Log}\,(P_t G_t G_r) + 20\ \mathrm{Log}\left[\frac{\lambda}{4\pi f R}\right] \qquad \textbf{[7]}$$

Since $\lambda = c / f$, equation [7] can be rewritten as:

$$10\ \mathrm{Log}\ (S \text{ or } P_r) = 10\ \mathrm{Log}(P_t G_t G_r) - \alpha_1 \qquad \textbf{[8]}$$

Where the one-way free space loss, α_1, is defined as: $\alpha_1 = 20\ \mathrm{Log}\left[\frac{4\pi f R}{c}\right]$* **[9]**

The signal received equation in dB form is: $10\log (P_r \text{ or } S) = 10\log P_t + 10\log G_t + 10\log G_r - \alpha_1$ **[10]**

The one-way free space loss, α_1, can be given in terms of a variable and constant term as follows:

$$\alpha_1 = 20 \text{ Log}\left[\frac{4\pi f\ R}{c}\right]^* = 20 \text{ Log } f_1 R + K_1 \quad (in\ dB) \qquad \textbf{[11]}$$

The value of f_1 can be either in MHz or GHz as shown with commonly used units of R in the adjoining table.

$$where\ K_1 = 20 \text{ Log}\left[\frac{4\pi}{c} \bullet (Conversion\ units\ if\ not\ in\ m/\sec, m, and\ Hz)\right]$$

Note: To avoid having to include additional terms for these calculations, always combine any transmission line loss with antenna gain.

A value for the one-way free space loss (α_1) can be obtained from:

(a) The One-way Free Space Loss graph (Figure 4). Added accuracy can be obtained using the Frequency Extrapolation graph (Figure 5)

(b) The space loss nomograph (Figure 6 or 7)

(c) The formula for α_1, equation [11].

FOR EXAMPLE:

Find the value of the one-way free space loss, α_1, for an RF of 7.5 GHz at 100 NM.

(a) From Figure 4, find 100 NM on the X-axis and estimate where 7.5 GHz is located between the 1 and 10 GHz lines (note dot). Read α_1 as 155 dB. An alternate way would be to read the α_1 at 1 GHz (138 dB) and add the frequency extrapolation value (17.5 dB for 7.5:1, dot on Figure 5) to obtain the same 155 dB value.

(b) From the nomogram (Figure 6), the value of α_1 can be read as 155 dB (Note the dashed line).

(c) From the equation 11, the precise value of α_1 is 155.3 dB.

Remember, α_1 is a free space value. If there is atmospheric attenuation because of absorption of RF due to certain molecules in the atmosphere or weather conditions etc., the atmospheric attenuation is in addition to the space loss (refer to Section 5-1).

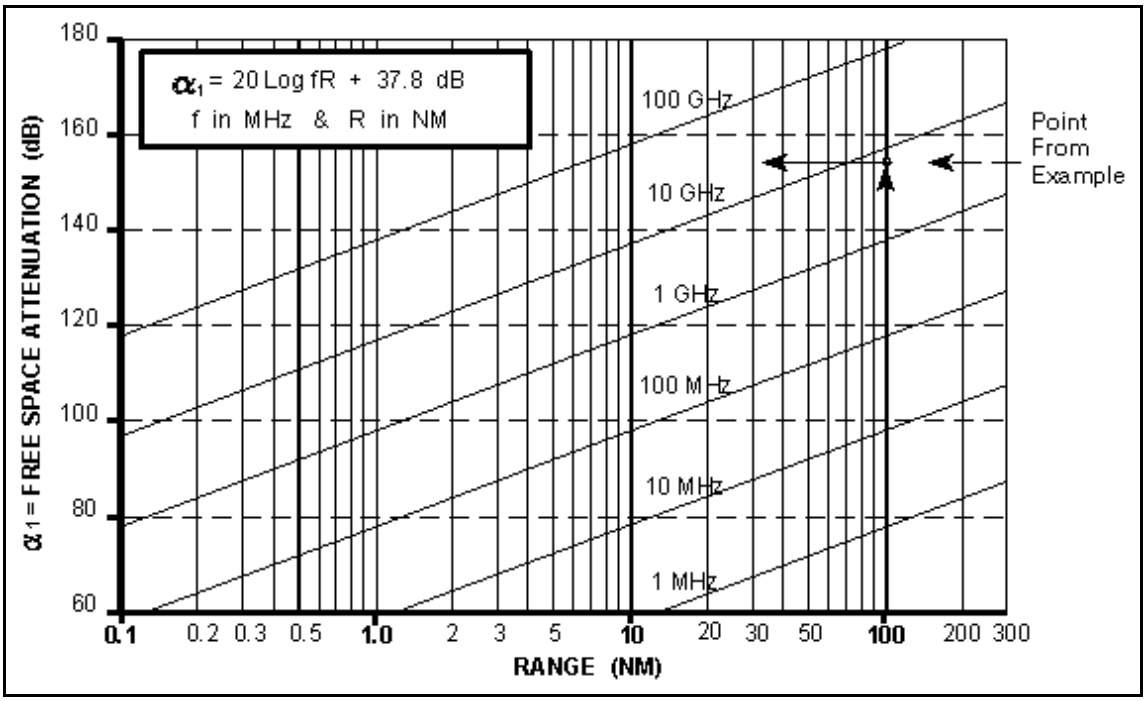

Figure 4. One-Way Free Space Loss.

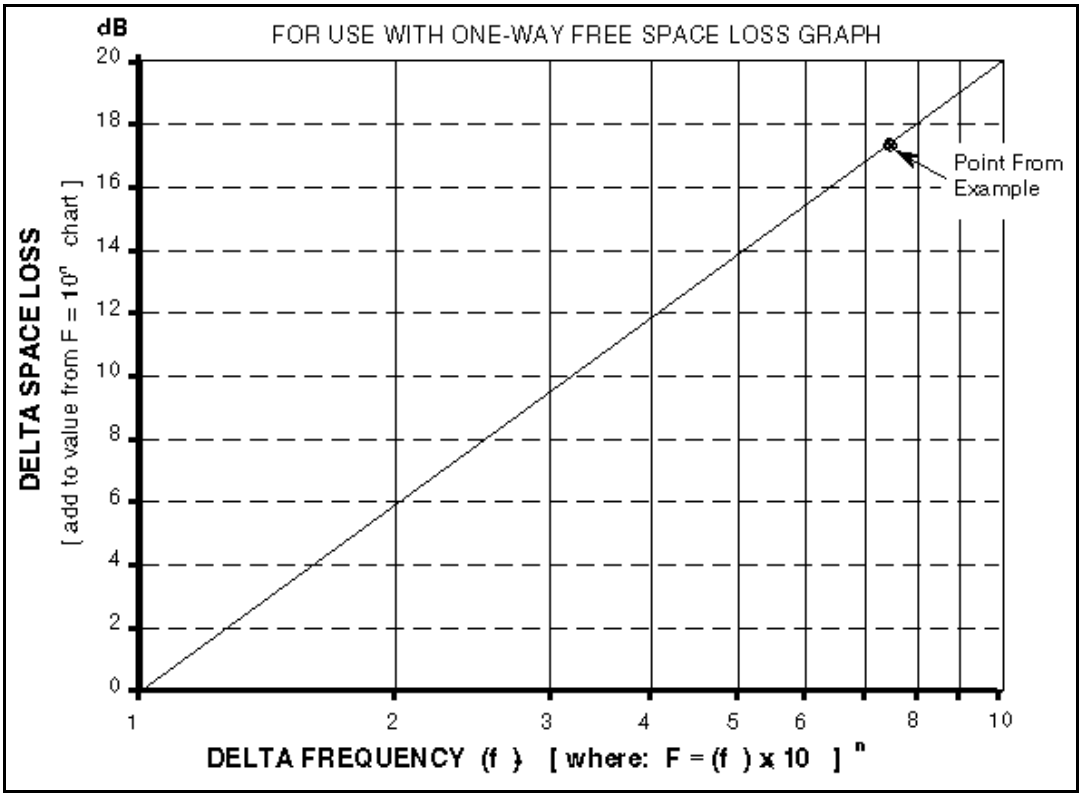

Figure 5. Frequency Extrapolation.

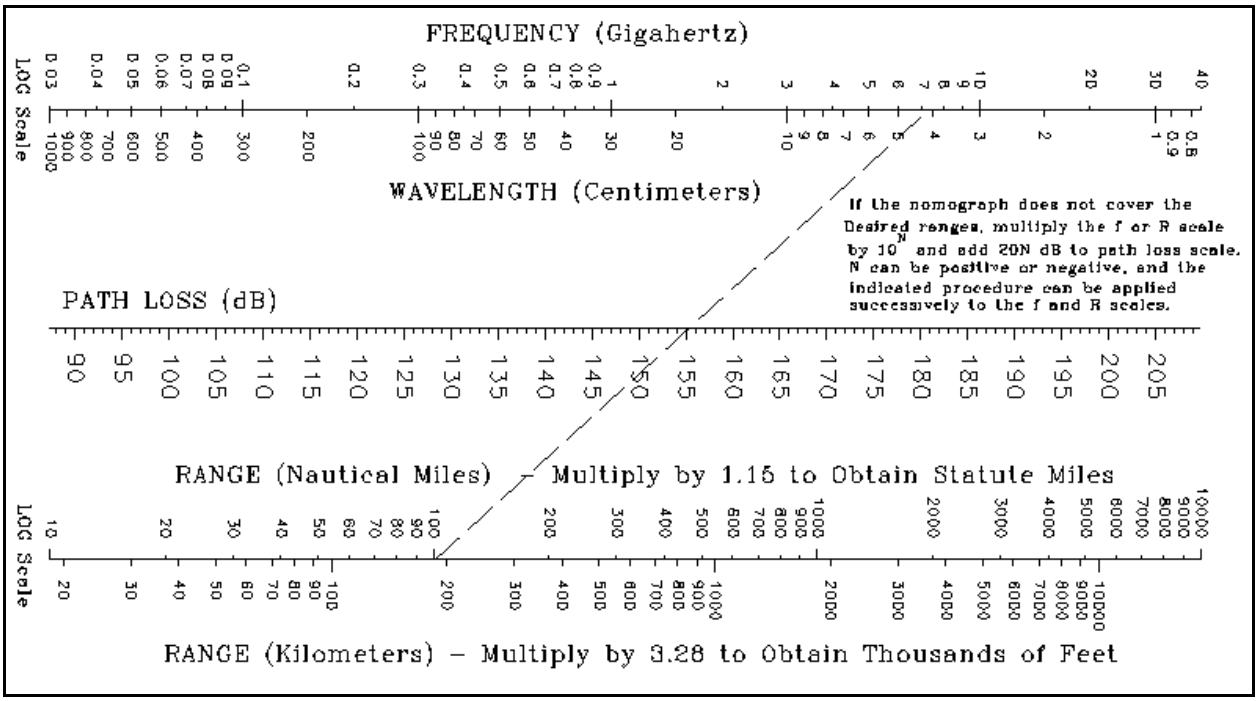

Figure 6. One-Way Space Loss Nomograph for Distances Greater Than 10 Nautical Miles.

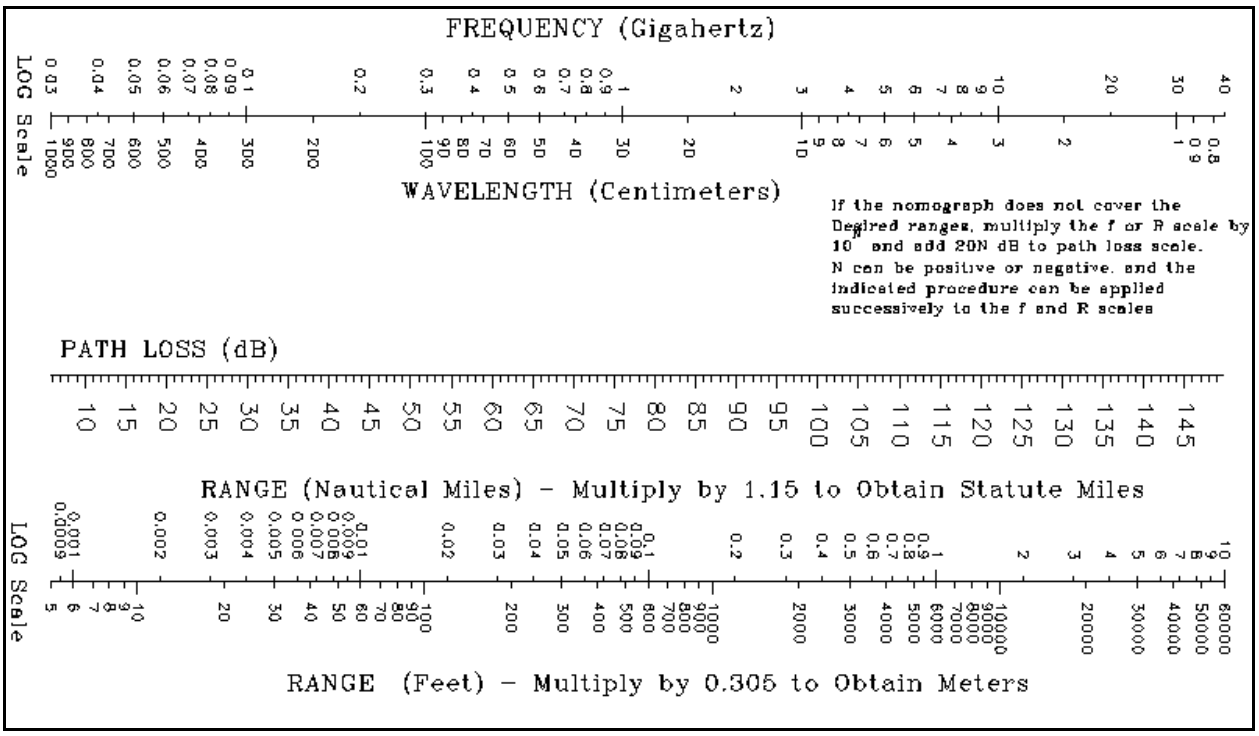

Figure 7. One-Way Space Loss Nomograph for Distances Less Than 10 Nautical Miles.

Figure 8 is the visualization of the losses occurring in one-way radar equation. Note: To avoid having to include additional terms, always combine any transmission line loss with antenna gain. Losses due to antenna polarization and atmospheric absorption also need to be included.

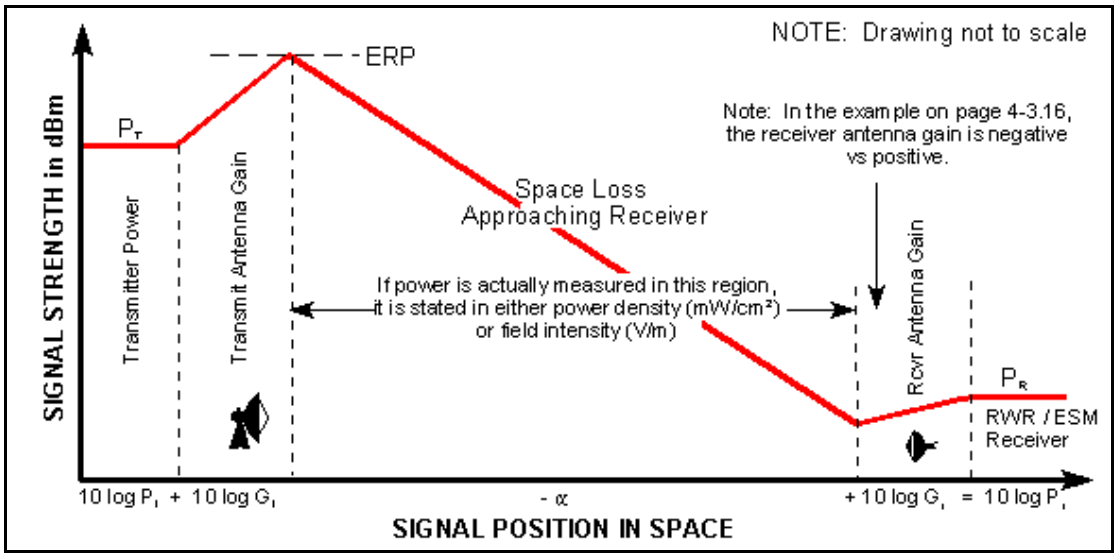

Figure 8. Visualization of One-Way Radar Equation.

RWR/ESM RANGE EQUATION (One-Way)

The one-way radar (signal strength) equation [5] is rearranged to calculate the maximum range R_{max} of RWR/ESM receivers. It occurs when the received radar signal just equals S_{min} as follows:

$$R_{max} \cong \left[\frac{P_t G_t G_r \lambda^2}{(4\pi)^2 S_{min}}\right]^{\frac{1}{2}} \; or \; \left[\frac{P_t G_t G_r c^2}{(4\pi f)^2 S_{min}}\right]^{\frac{1}{2}} \; or \; \left[\frac{P_t G_t A_e}{4\pi S_{min}}\right]^{\frac{1}{2}} \qquad \textbf{[12]}$$

In log form:

$$20\log R_{max} = 10\log P_t + 10\log G_t - 10\log S_{min} - 20\log f + 20\log(c/4\pi) \qquad \textbf{[13]}$$

and since $K_1 = 20\log\{4\pi/c$ times conversion units if not in m/sec, m, and Hz$\}$
(Refer to Section 4-3 for values of K_1).

$$10\log R_{max} = \tfrac{1}{2}[\,10\log P_t + 10\log G_t - 10\log S_{min} - 20\log f - K_1] \quad \text{(keep } P_t \text{ and } S_{min} \text{ in same units)} \qquad \textbf{[14]}$$

If you want to convert back from dB, then $R_{max} \cong \frac{10^{M\,dB}}{20}$, where M dB is the resulting number in the brackets of equation 14.

From Section 5-2, Receiver Sensitivity / Noise, S_{min} is related to the noise factor S:

$$S_{min} = (S/N)_{min}\,(NF)KT_oB \qquad \textbf{[15]}$$

The one-way RWR/ESM range equation becomes:

$$R_{max} \cong \left[\frac{P_t G_t G_r \lambda^2}{(4\pi)^2 (S/N)_{min} (NF) K T_o B}\right]^{\frac{1}{2}} \; or \; \left[\frac{P_t G_t G_r c^2}{(4\pi f)^2 (S/N)_{min} (NF) K T_o B}\right]^{\frac{1}{2}} \; or \; \left[\frac{P_t G_t A_e}{4\pi (S/N)_{min} (NF) K T_o B}\right]^{\frac{1}{2}} \qquad \textbf{[16]}$$

RWR/ESM RANGE INCREASE AS A RESULT OF A SENSITIVITY INCREASE

As shown in equation [12] $S_{min}^{-1} \propto R_{max}^2$. Therefore, -10 log $S_{min} \propto$ 20 logR_{max} and the following table results:

<u>% Range Increase:</u> Range + (% Range Increase) x Range = New Range
i.e., for a 6 dB sensitivity increase, 500 miles +100% x 500 miles = 1,000 miles
<u>Range Multiplier</u>: Range x Range Multiplier = New Range
i.e., for a 6 dB sensitivity increase 500 miles x 2 = 1,000 miles

dB Sensitivity Increase	% Range Increase	Range Multiplier	dB Sensitivity Increase	% Range Increase	Range Multiplier
+ 0.5	6	1.06	10	216	3.16
1.0	12	1.12	11	255	3.55
1.5	19	1.19	12	298	3.98
2	26	1.26	13	347	4.47
3	41	1.41	14	401	5.01
4	58	1.58	15	462	5.62
5	78	1.78	16	531	6.31
6	100	2.0	17	608	7.08
7	124	2.24	18	694	7.94
8	151	2.51	19	791	8.91
9	182	2.82	20	900	10.0

RWR/ESM RANGE DECREASE AS A RESULT OF A SENSITIVITY DECREASE

As shown in equation [12] $S_{min}^{-1} \propto R_{max}^2$. Therefore, -10 log $S_{min} \propto$ 20 logR_{max} and the following table results:

<u>% Range Decrease:</u> Range - (% Range decrease) x Range = New Range
i.e., for a 6 dB sensitivity decrease, 500 miles - 50% x 500 miles = 250 miles
<u>Range Multiplier</u>: Range x Range Multiplier = New Range
i.e., for a 6 dB sensitivity decrease 500 miles x .5 = 250 miles

dB Sensitivity Decrease	% Range Decrease	Range Multiplier	dB Sensitivity Decrease	% Range Decrease	Range Multiplier
- 0.5	6	0.94	-10	68	0.32
- 1.0	11	0.89	- 11	72	0.28
- 1.5	16	0.84	- 12	75	0.25
- 2	21	0.79	- 13	78	0.22
- 3	29	0.71	- 14	80	0.20
- 4	37	0.63	- 15	82	0.18
- 5	44	0.56	- 16	84	0.16
- 6	50	0.50	- 17	86	0.14
- 7	56	0.44	- 18	87	0.13
- 8	60	0.4	- 19	89	0.11
- 9	65	0.35	- 20	90	0.10

Example of One-Way Signal Strength: A 5 (or 7) GHz radar has a 70 dBm signal fed through a 5 dB loss transmission line to an antenna that has 45 dB gain. An aircraft that is flying 31 km from the radar has an aft EW antenna with -1 dB gain and a 5 dB line loss to the EW receiver (assume all antenna polarizations are the same).

Note: The respective transmission line losses will be combined with antenna gains, i.e.:

-5 +45 = 40 dB, -5 - 1 = -6 dB, -10 + 5 = -5 dB.

(1) What is the power level at the input of the EW receiver?

Answer (1): P_r at the input to the EW receiver = Transmitter power - xmt cable loss + xmt antenna gain - space loss + rcvr antenna gain - rcvr cable loss.

Space loss (from Section 4-3) @ 5 GHz = 20 log fR + K_1 = 20 log (5x31) + 92.44 = 136.25 dB. Therefore:

P_r = 70 + 40 - 136.25 - 6 = -32.25 dBm @ 5 GHz (P_r = -35.17 dBm @ 7 GHz since α_1 = 139.17 dB)

(2) If the received signal is fed to a jammer with a gain of 60 dB, feeding a 10 dB loss transmission line which is connected to an antenna with 5 dB gain, what is the power level from the jammer at the input to the receiver of the 5 (or 7) GHz radar?

Answer (2): P_r at the input to the radar receiver = Power at the input to the EW receiver+ Jammer gain - jammer cable loss + jammer antenna gain - space loss + radar rcvr antenna gain - radar rcvr cable loss. Therefore:

P_r = -32.25 + 60 - 5 - 136.25 + 40 = -73.5 dBm @ 5 GHz. (P_r = -79.34 dBm @ 7 GHz since α_1 = 139.17 dB and P_t = -35.17 dBm).

This problem continues in Sections 4-4, 4-7, and 4-10.

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TWO-WAY RADAR EQUATION (MONOSTATIC)

In this section the radar equation is derived from the one-way equation (transmitter to receiver) which is then extended to the two-way radar equation. The following is a summary of the important equations to be derived here:

TWO-WAY RADAR EQUATION (MONOSTATIC)

Peak power at the radar receiver input is:

$$P_r = \frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R^4} = P_t G_t G_r \left[\frac{\sigma c^2}{(4\pi)^3 f^2 R^4} \right]^*$$

Note : $\lambda = c/f$ and $\sigma = RCS$

** keep λ or c, σ, and R in the same units*

On reducing the above equation to log form we have:

$10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r + 10\log \sigma - 20\log f - 40\log R - 30\log 4\pi + 20\log c$

or in simplified terms: $10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r + G_\sigma - 2\alpha_1$ (in dB)

Note: Losses due to antenna polarization and atmospheric absorption (Sections 3-2 and 5-1) are not included in these equations.

Target gain factor, $G_\sigma = 10\log \sigma + 20\log f_1 + K_2$ (in dB)

K_2 Values (dB)

RCS (σ) (units)	f_1 in MHz K_2 =	f_1 in GHz K_2 =
m^2	-38.54	21.46
ft^2	-48.86	11.14

One-way free space loss, $\alpha_1 = 20\log (f_1 R) + K_1$ (in dB)

K_1 Values (dB)

Range (units)	f_1 in MHz K_1 =	f_1 in GHz K_1 =
NM	37.8	97.8
Km	32.45	92.45
m	-27.55	32.45
yd	-28.33	31.67
ft	-37.87	22.13

Figure 1 illustrates the physical concept and equivalent circuit for a target being illuminated by a monostatic radar (transmitter and receiver co-located). Note the similarity of Figure 1 to Figure 3 in Section 4-3. Transmitted power, transmitting and receiving antenna gains, and the one-way free space loss are the same as those described in Section 4-3. The physical arrangement of the elements is different, of course, but otherwise the only difference is the addition of the equivalent gain of the target RCS factor.

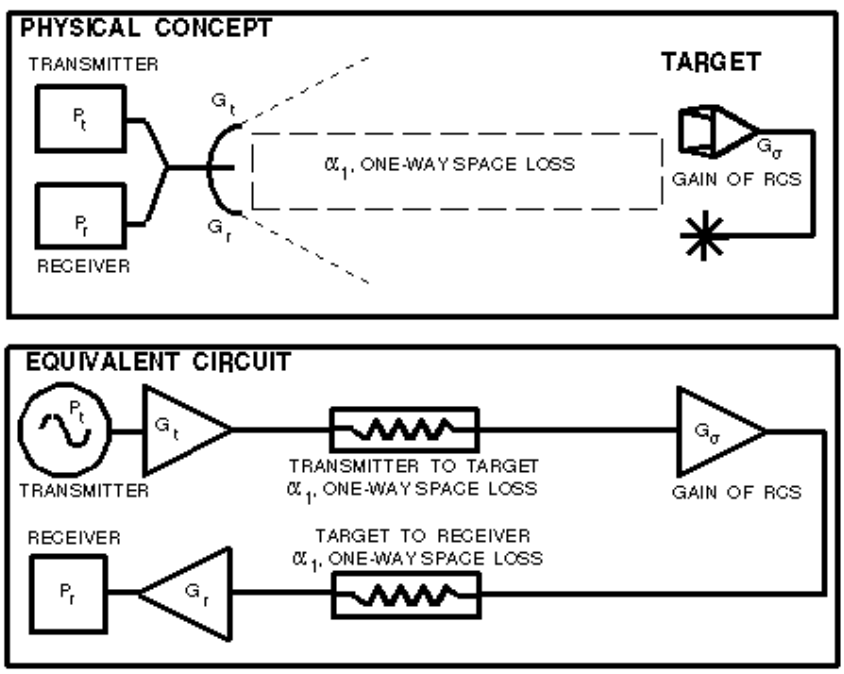

Figure 1. The Two-Way Monostatic Radar Equation Visualized.

From Section 4-3, One-Way Radar Equation / RF Propagation, the power in the receiver is:

$$\begin{matrix}\textit{Received Signal}\\ \textit{at Target}\end{matrix} = \frac{P_t G_t G_r \lambda^2}{(4\pi R)^2} \qquad \textbf{[1]}$$

From equation [3] in Section 4-3: $$\textit{Antenna Gain}, G = \frac{4\pi A_e}{\lambda^2} \qquad \textbf{[2]}$$

Similar to a receiving antenna, a radar target also intercepts a portion of the power, but reflects (reradiates) it in the direction of the radar. The amount of power reflected toward the radar is determined by the Radar Cross Section (RCS) of the target. RCS is a characteristic of the target that represents its size as seen by the radar and has the dimensions of area (σ) as shown in Section 4-11. RCS area is not the same as physical area. But, for a radar target, the power reflected in the radar's direction is equivalent to re-radiation of the power captured by an antenna of area σ (the RCS). Therefore, the effective capture area (A_e) of the receiving antenna is replaced by the RCS (σ).

$$G_r = \frac{4\pi\sigma}{\lambda^2} \qquad \textbf{[3]}$$

so we now have:

$$\begin{matrix}\textit{Reflected Signal}\\ \textit{from target}\end{matrix} = \frac{P_t G_t \lambda^2 4\pi\sigma}{(4\pi R)^2 \lambda^2} \qquad \textbf{[4]}$$

The equation for the power reflected in the radar's direction is the same as equation [1] except that P_t G_t, which was the original transmitted power, is replaced with the reflected signal power from the target, from equation [4]. This gives:

$$\begin{matrix}\textit{Reflected Signal Received Back}\\ \textit{at Input to Radar Receiver}\end{matrix} = \frac{P_t G_t \lambda^2 4\pi\sigma}{(4\pi R)^2 \lambda^2} \, x \, \frac{G_r \lambda^2}{(4\pi R)^2} \qquad \textbf{[5]}$$

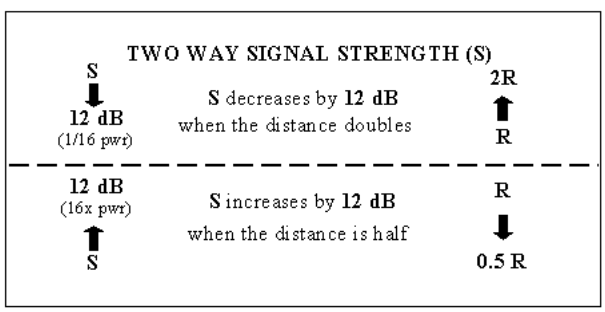

If like terms are cancelled, the two-way radar equation results. The peak power at the radar receiver input is:

$$P_r = \frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R^4} = P_t G_t G_r \left[\frac{\sigma c^2}{(4\pi)^3 f^2 R^4}\right]^* \qquad \textbf{[6]}$$

* Note: λ=c/*f* and σ = RCS. Keep λ or c, σ, and R in the same units.

On reducing equation [6] to log form we have:

$$10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r + 10\log \sigma - 20\log f - 40\log R - 30\log 4\pi + 20\log c \qquad \textbf{[7]}$$

Target Gain Factor

If Equation [5] terms are rearranged instead of cancelled, a recognizable form results:

$$S\ (or\ P_r) = (P_t G_t G_r) \bullet \left[\frac{\lambda^2}{(4\pi R)^2}\right] \bullet \left[\frac{4\pi\sigma}{\lambda^2}\right] \bullet \left[\frac{\lambda^2}{(4\pi R)^2}\right] \qquad \textbf{[8]}$$

In log form:

$$10\log[S\ (or\ P_r)] = 10\log P_t + 10\log G_t + 10\log G_r + 20\log\left[\frac{\lambda}{4\pi R}\right] + 10\log\left[\frac{4\pi\sigma}{\lambda^2}\right] + 20\log\left[\frac{\lambda}{4\pi R}\right] \qquad \textbf{[9]}$$

The fourth and sixth terms can each be recognized as -α, where α is the one-way free space loss factor defined in Section 4-3. The fifth term containing RCS (σ) is the only new factor, and it is the "Target Gain Factor."

In simplified terms the equation becomes:

$$10\log\ [S\ (\text{or } P_r)] = 10\log P_t + 10\log G_t + 10\log G_r + G_\sigma - 2\alpha_1 \qquad \text{(in dB)} \qquad \textbf{[10]}$$

Where α_1 and G_σ are as follows:

From Section 4-3, equation [11], the space loss in dB is given by:

$$\alpha_1 = 20\log\left[\frac{4\pi f\ R}{c}\right]^* = 20\log f_1 R + K_1 \quad where\ K_1 = 20\log\left[\frac{4\pi}{c} \bullet (Conversion\ units\ if\ not\ in\ m/s\ ec, m, and\ Hz)\right] \qquad \textbf{[11]}$$

* Keep c and R in the same units. The table of values for K_1 is again presented here for completeness. The constant, K_1, in the table includes a range and frequency unit conversion factor.

One-way free space loss, α_1 = 20log (f_1R) + K_1 (in dB)			
K_1 Values (dB)	Range (units)	f_1 in MHz K_1 =	f_1 in GHz K_1 =
	NM	37.8	97.8
	Km	32.45	92.45
	m	-27.55	32.45
	yd	-28.33	31.67
	ft	-37.87	22.13

While it's understood that RCS is the antenna aperture area equivalent to an isotropically radiated target return signal, the target gain factor represents a gain, as shown in the equivalent circuit of Figure 1. The Target Gain Factor expressed in dB is G_σ as shown in equation [12].

$$G_\sigma = 10\log\left[\frac{4\pi\sigma}{\lambda^2}\right] = 10\log\left[\frac{4\pi\sigma f^2}{c^2}\right] = 10\log\sigma + 20\log f_1 + K_2 \quad (in\ dB) \qquad \textbf{[12]}$$

$$where: K_2 = 10\log\left[\frac{4\pi}{c^2} \bullet \left(\begin{array}{c} Frequency\ and\ RCS \\ conversions\ as\ required \end{array} \frac{(Hz\ to\ MHz\ or\ GHz)^2}{(meters\ to\ feet)^2}\right)\right]$$

The "Target Gain Factor" (G_σ) is a composite of RCS, frequency, and dimension conversion factors and is called by various names: "Gain of RCS", "Equivalent Gain of RCS", "Gain of Target Cross Section", and in dB form "Gain-sub-Sigma".

If frequency is given in MHz and RCS (σ) is in m^2, the formula for G_σ is:

$$G_\sigma = 10\log\sigma + 20\log f_1 + 10\log\left[4\pi \bullet \left(\frac{\sec}{3\,x\,10^8\,m}\right)^2 \bullet m^2 \bullet \left(\frac{1x\,10^6}{\sec}\right)^2\right] \qquad \textbf{[13]}$$

or:

$$G_\sigma = 10\log\sigma + 20\log f_1 - 38.54 \quad (in\ dB) \qquad \textbf{[14]}$$

Target gain factor, G_σ = 10log σ + 20log f_1 + K_2 (in dB)			
K_2 Values			
(dB)	RCS (σ)	f_1 in MHz	f_1 in GHz
(units)	K_2 =	K_2 =	
m^2	-38.54	21.46	
ft^2	-48.86	11.14	

For this example, the constant K_2 is -38.54 dB. K_2 values for various area and frequency and frequency units are summarized in the adjoining table.

In the two-way radar equation, the one-way free space loss factor (α_1) is used twice, once for the radar transmitter to target path and once for the target to radar receiver path. The radar illustrated in Figure 1 is monostatic so the two path losses are the same and the values of the two α_1's are the same.

If the transmission loss in Figure 1 from P_t to G_t equals the loss from G_r to P_r, and $G_r = G_t$, then equation [10] can be written as:

$$10\log [S \text{ or } P_r] = 10\log P_t + 20\log G_{tr} - 2\alpha_1 + G_\sigma \quad \text{(in dB)} \qquad \textbf{[15]}$$

The space loss factor (α_1) and the target gain factor (G_σ) include all the necessary unit conversions so that they can be used directly with the most common units. Because the factors are given in dB form, they are more convenient to use and allow calculation without a calculator when the factors are read from a chart or nomograph.

Most radars are monostatic. That is, the radar transmitting and receiving antennas are literally the same antenna. There are some radars that are considered "monostatic" but have separate transmitting and receiving antennas that are co-located. In that case, equation [10] could require two different antenna gain factors as originally derived:

$$10\log [S \text{ or } P_r] = 10\log P_t + 10\log G_t + 10\log G_r - 2\alpha_1 + G_\sigma \quad \text{(in dB)} \qquad \textbf{[16]}$$

Note: To avoid having to include additional terms for these calculations, always combine any transmission line loss with antenna gain.

Figure 2 is the visualization of the path losses occurring with the two-way radar equation. **Note:** to avoid having to include additional terms, always combine any transmission line loss with antenna gain. Losses due to antenna polarization and atmospheric absorption also need to be included.

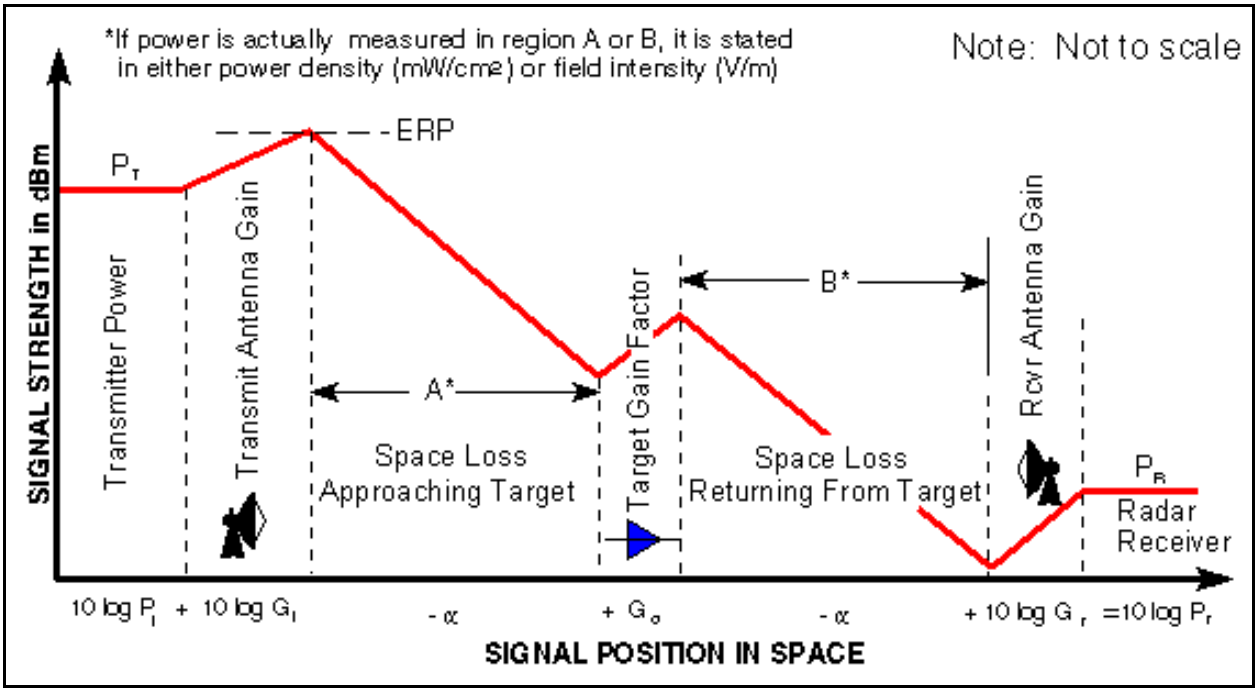

Figure 2. Visualization of Two-Way Radar Equation.

RADAR RANGE EQUATION (Two-Way Equation)

The Radar Equation is often called the "Radar Range Equation." The Radar Range Equation is simply the Radar Equation rewritten to solve for maximum Range. The maximum radar range (R_{max}) is the distance beyond which the target can no longer be detected and correctly processed. It occurs when the received echo signal just equals S_{min}.

The Radar Range Equation is then:

$$R_{\max} \cong \left[\frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 S_{\min}}\right]^{\frac{1}{4}} \; or \; \left[\frac{P_t G_t G_r c^2 \sigma]}{(4\pi)^3 f^2 S_{\min}}\right]^{\frac{1}{4}} \; or \; \left[\frac{P_t G_t A_e \sigma}{(4\pi)^2 S_{\min}}\right]^{\frac{1}{4}} \qquad \textbf{[17]}$$

The first equation, of the three above, is given in Log form by:

$$40\log R_{max} \cong 10\log P_t + 10\log G_t + 10\log G_r + 10\log \sigma - 10\log S_{min} - 20\log f - 30\log 4\pi + 20\log c \qquad \textbf{[18]}$$

As shown previously, Since K_1 = 20log [(4π/c) times conversion units if not in m/sec, m, and Hz], we have:

$$10\log R_{max} \cong \tfrac{1}{4}\,[10\log P_t + 10\log G_t + 10\log G_r + 10\log \sigma - 10\log S_{min} - 20\log f_1 - K_1 - 10.99\text{ dB}] \qquad \textbf{[19]}$$

If you want to convert back from dB, then

$$R_{max} \cong 10^{\frac{M\,dB}{40}}$$

Where M dB is the resulting number within the brackets of equation 19.

From Section 5-2, Receiver Sensitivity / Noise, S_{min} is related to the noise factors by:

One-way free space loss, $\alpha_1 = 20\log(f_1 R) + K_1$ (in dB)

K_1 Values (dB)	Range (units)	f_1 in MHz K_1 =	f_1 in GHz K_1 =
	NM	37.8	97.8
	Km	32.45	92.45
	m	-27.55	32.45
	yd	-28.33	31.67
	ft	-37.87	22.13

$$S_{min} = (S/N)_{min}(NF)\,kT_0 B \qquad \textbf{[20]}$$

The Radar Range Equation for a tracking radar (target continuously in the antenna beam) becomes:

$$R_{max} \cong \left[\frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 (S/N)_{min}(NF)kT_0 B}\right]^{\frac{1}{4}} \text{ or } \left[\frac{P_t G_t G_r c^2 \sigma}{(4\pi)^3 f^2 (S/N)_{min}(NF)kT_o B}\right]^{\frac{1}{4}} \text{ or } \left[\frac{P_t G_t A_e \sigma}{(4\pi)^2 (S/N)_{min}(NF)kT_o B}\right]^{\frac{1}{4}} \qquad \textbf{[21]}$$

P_t in equations [17], [19], and [21] is the peak power of a CW or pulse signal. For pulse signals these equations assume the radar pulse is square. If not, there is less power since P_t is actually the average power within the pulse width of the radar signal. Equations [17] and [19] relate the maximum detection range to S_{min}, the minimum signal which can be detected and processed (the receiver sensitivity). The bandwidth (B) in equations [20] and [21] is directly related to S_{min}. B is approximately equal to 1/PW. Thus a wider pulse width means a narrower receiver bandwidth which lowers S_{min}, assuming no integration.

One cannot arbitrarily change the receiver bandwidth, since it has to match the transmitted signal. The "widest pulse width" occurs when the signal approaches a CW signal (see Section 2-11). A CW signal requires a very narrow bandwidth (approximately 100 Hz). Therefore, receiver noise is very low and good sensitivity results (see Section 5-2). If the radar pulse is narrow, the receiver filter bandwidth must be increased for a match (see Section 5-2), i.e. a 1 μs pulse requires a bandwidth of approximately 1 MHz. This increases receiver noise and decreases sensitivity.

If the radar transmitter can increase its PRF (decreasing PRI) and its receiver performs integration over time, an increase in PRF can permit the receiver to "pull" coherent signals out of the noise thus reducing S/N_{min} thereby increasing the detection range. Note that a PRF increase may limit the maximum range due to the creation of overlapping return echoes (see Section 2-10).

There are also other factors that limit the maximum practical detection range. With a scanning radar, there is loss if the receiver integration time exceeds the radar's time on target. Many radars would be range limited by line-of-sight/radar horizon (see Section 2-9) well before a typical target faded below S_{min}. Range can also be reduced by losses due to antenna polarization and atmospheric absorption (see Sections 3-2 and 5-1).

Two-Way Radar Equation (Example)

Assume that a 5 GHz radar has a 70 dBm (10 kilowatt) signal fed through a 5 dB loss transmission line to a transmit/receive antenna that has 45 dB gain. An aircraft that is flying 31 km from the radar has an RCS of 9 m^2. What is the signal level at the input to the radar receiver? (There is an additional loss due to any antenna polarization mismatch but that loss will not be addressed in this problem). This problem continues in Sections 4-3, 4-7, and 4-10.

Answer:
Starting with: $10\log S = 10\log P_t + 10\log G_t + 10\log G_r + G_\sigma - 2\alpha_1$ (in dB)

We know that: $\alpha_1 = 20\log f R + K_1 = 20\log (5x31) + 92.44 = 136.25$ dB

and that: $G_\sigma = 10\log \sigma + 20\log f_1 + K_2 = 10\log 9 + 20\log 5 + 21.46 = 44.98$ dB (see Table 1)
(Note: The aircraft transmission line losses (-5 dB) will be combined with the antenna gain (45 dB) for both receive and transmit paths of the radar)

So, substituting in we have: $10\log S = 70 + 40 + 40 + 44.98 - 2(136.25) =$ **-77.52 dBm** @ 5 GHz

The answer changes to -80.44 dBm if the tracking radar operates at 7 GHz provided the antenna gains and the aircraft RCS are the same at both frequencies.

$\alpha_1 = 20\log (7x31) + 92.44 = 139.17$ dB, $G_\sigma = 10\log 9 + 20\log 7 + 21.46 = 47.9$ dB (see Table 1)

$10\log S = 70 + 40 + 40 + 47.9 - 2(139.17) =$ **-80.44 dBm** @ 7 GHz

Table 1. Values of the Target Gain Factor (G_σ) in dB for Various Values of Frequency and RCS.

Frequency (GHz)	RCS - Square meters						
	0.05	5	9	10	100	1,000	10,000
0.5 GHz	2.44	22.42	24.98	25.44	35.44	45.44	55.44
1 GHz	8.46	28.46	31.0	31.46	41.46	51.46	61.46
5 GHz	22.44	42.44	44.98	45.44	55.44	65.44	75.44
7 GHz	25.36	45.36	47.9	48.36	58.36	68.36	78.36
10 GHz	28.46	48.46	51.0	51.46	61.46	71.46	81.46
20 GHz	34.48	54.48	57.02	57.48	67.48	77.48	87.48
40 GHz	40.50	60.48	63.04	63.5	73.5	83.5	93.5

Note: Shaded values were used in the examples.

TWO-WAY RADAR RANGE INCREASE AS A RESULT OF A SENSITIVITY INCREASE

As shown in equation [17] $S_{min}^{-1} \propto R_{max}^4$. Therefore, $-10 \log S_{min} \propto 40 \log R_{max}$ and the table below results:

<u>% Range Increase:</u> Range + (% Range Increase) x Range = New Range
i.e., for a 12 dB sensitivity increase, 500 miles +100% x 500 miles = 1,000 miles
<u>Range Multiplier</u>: Range x Range Multiplier = New Range
i.e., for a 12 dB sensitivity increase 500 miles x 2 = 1,000 miles

Table 2. Effects of Sensitivity Increase.

dB Sensitivity Increase	% Range Increase	Range Multiplier	dB Sensitivity Increase	% Range Increase	Range Multiplier
+ 0.5	3	1.03	10	78	1.78
1.0	6	1.06	11	88	1.88
1.5	9	1.09	12	100	2.00
2	12	1.12	13	111	2.11
3	19	1.19	14	124	2.24
4	26	1.26	15	137	2.37
5	33	1.33	16	151	2.51
6	41	1.41	17	166	2.66
7	50	1.50	18	182	2.82
8	58	1.58	19	198	2.98
9	68	1.68	20	216	3.16

TWO-WAY RADAR RANGE DECREASE AS A RESULT OF A SENSITIVITY DECREASE

As shown in equation [17] $S_{min}^{-1} \propto R_{max}^{4}$ Therefore, $-10 \log S_{min} \propto 40 \log R_{max}$ and the table below results:

<u>% Range Decrease:</u> Range - (% Range Decrease) x Range = New Range
i.e., for a 12 dB sensitivity decrease, 500 miles - 50% x 500 miles = 250 miles

<u>Range Multiplier</u>: Range x Range Multiplier = New Range
i.e., for a 12 dB sensitivity decrease 500 miles x 0.5 = 250 miles

Table 3. Effects of Sensitivity Decrease.

dB Sensitivity Decrease	% Range Decrease	Range Multiplier	dB Sensitivity Decrease	% Range Decrease	Range Multiplier
- 0.5	3	0.97	-10	44	0.56
- 1.0	6	0.94	- 11	47	0.53
- 1.5	8	0.92	- 12	50	0.50
- 2	11	0.89	- 13	53	0.47
- 3	16	0.84	- 14	55	0.45
- 4	21	0.79	- 15	58	0.42
- 5	25	0.75	- 16	60	0.40
- 6	29	0.71	- 17	62	0.38
- 7	33	0.67	- 18	65	0.35
- 8	37	0.63	- 19	67	0.33
- 9	40	0.60	- 20	68	0.32

ALTERNATE TWO-WAY RADAR EQUATION

In this section the same radar equation factors are grouped differently to create different constants as is used by some authors.

TWO-WAY RADAR EQUATION (MONOSTATIC)

Peak power at the radar receiver input is:

$$P_r = \frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R^4} = \frac{P_t G_t G_{rsigma} c^2}{(4\pi)^3 f^2 R^4} * \quad \left(Note: \lambda = \frac{c}{f} \text{ and } \sigma \text{ is RCS} \right) \qquad \textbf{[1]}$$

* Keep λ or c, σ, and R in the same units. On reducing the above equation to log form we have:

or: $\mathbf{10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r - \alpha_2}$ (in dB)

Where: $\alpha_2 = 20\log f_1 R^2 - 10\log \sigma + K_3$, and $K_3 = -10\log c^2/(4\pi)^3$

Note:
Losses due to antenna polarization and atmospheric absorption (Sections 3-2 and 5-1) are not included in these equations

K_3 Values:
(dB)

Range Units	f_1 in MHz σ in m^2	f_1 in GHz σ in m^2	f_1 in MHz σ in ft^2	f_1 in GHz σ in ft^2
NM	114.15	174.15	124.47	184.47
km	103.44	163.44	113.76	173.76
m	-16.56	43.44	-6.24	53.76
yd	-18.1	41.9	-7.78	52.22
ft	-37.2	22.8	-26.88	33.12

In the last section, we had the basic radar equation given as equation [6] and it is repeated as equation [1] in the table above.

In Section 4-4, in order to maintain the concept and use of the one-way space loss coefficient, α_1, we didn't cancel like terms which was done to form equation [6] there. Rather, we regrouped the factors of equation [5]. This resulted in two minus α_1 terms and we defined the remaining term as G_σ, which accounted for RCS (see equation [8] & [9]).

Some authors take a different approach, and instead develop an entirely new single factor α_2, which is used instead of the combination of α_1 and G_σ.

If equation [1] is reduced to log form, (and noting that $f = c/\lambda$) it becomes:

$$10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r - 20\log (f R^2) + 10\log \sigma + 10\log (c^2/(4\pi)^3) \qquad \textbf{[2]}$$

We now call the last three terms on the right minus α_2 and use it as a single term instead of the two terms α_1 and G_σ. The concept of dealing with one variable factor may be easier although we still need to know the range, frequency, and radar cross section to evaluate α_2. Additionally, we can no longer use a nomograph like we did in computing α_1 and visualize a two-way space loss consisting of two times the one-way space loss, since there are now 3 variables vs. two.

Equation [2] reduces to:

$$\mathbf{10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r - \alpha_2} \qquad \text{(in dB)} \qquad \textbf{[3]}$$

Where $\alpha_2 = 20\log(f_1 R^2) - 10\log\sigma + K_3$ and where f_1 is the MHz or GHz value of frequency and $K_3 = -10\log(c^2/(4\pi)^3) + 20\log$ (conversion for Hz to MHz or GHz)+ 40log (range unit conversions if not in meters) - 20log (RCS conversions for meters to feet)

The values of K_3 are given in the table above.

Comparing equation [3] to equation [10] in Section 4-4, it can be seen that $\alpha_2 = 2\alpha_1 - G_\sigma$.

TWO-WAY RADAR EQUATION (BISTATIC)

The following table contains a summary of the equations developed in this section.

TWO-WAY RADAR EQUATION (BISTATIC)

Peak power at the radar receiver input is:

$$P_r = \frac{P_t\, G_t\, G_r\, \lambda^2\, \sigma}{(4\pi)^3\, R_{Tx}^2\, R_{Rx}^2} = P_t\, G_t\, G_r \left[\frac{\sigma\, c^2}{(4\pi)^3\, f^{\,2}\, R_{Tx}^2\, R_{Rx}^2} \right]^*$$

Note : $\lambda = c/f$ and σ = RCS

** keep λ or c, σ, and R in the same units*

On reducing the above equation to log form we have:

$10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r + 10\log \sigma - 20\log f + 20\log c - 30\log 4\pi - 20\log R_{Tx} - 20\log R_{Rx}$

or in simplified terms: $10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r + G_\sigma - \alpha_{Tx} - \alpha_{Rx}$ (in dB)

Where α_{Tx} corresponds to transmitter to target loss and α_{Rx} corresponds to target to receiver loss.

Note: Losses due to antenna polarization and atmospheric absorption (Sections 3-2 and 5-1) are not included in these equations.

Target gain factor, $G_\sigma = 10\log \sigma + 20\log f_1 + K_2$ (in dB)

K_2 Values (dB)

RCS (σ) (units)	f_1 in MHz K_2 =	f_1 in GHz K_2 =
m^2	-38.54	21.46
ft^2	-48.86	11.14

One-way free space loss, $\alpha_{Tx\ or\ Rx} = 20\log (f_1 R_{Tx\ or\ Rx}) + K_1$ (in dB)

K_1 Values (dB)

Range (units)	f_1 in MHz K_1 =	f_1 in GHz K_1 =
NM	37.8	97.8
Km	32.45	92.45
m	-27.55	32.45
yd	-28.33	31.67
ft	-37.87	22.13

BISTATIC RADAR

There are also true bistatic radars - radars where the transmitter and receiver are in different locations as is depicted in Figure 1. The most commonly encountered bistatic radar application is the semi-active missile. The transmitter is located on, or near, the launch platform (surface or airborne), and the receiver is in the missile which is somewhere between the launch platform and the target.

The transmitting and receiving antennas are not the same and are not in the same location. Because the target-to-radar range is different from the target-to-missile range, the target-to-radar and target-to-missile space losses are different.

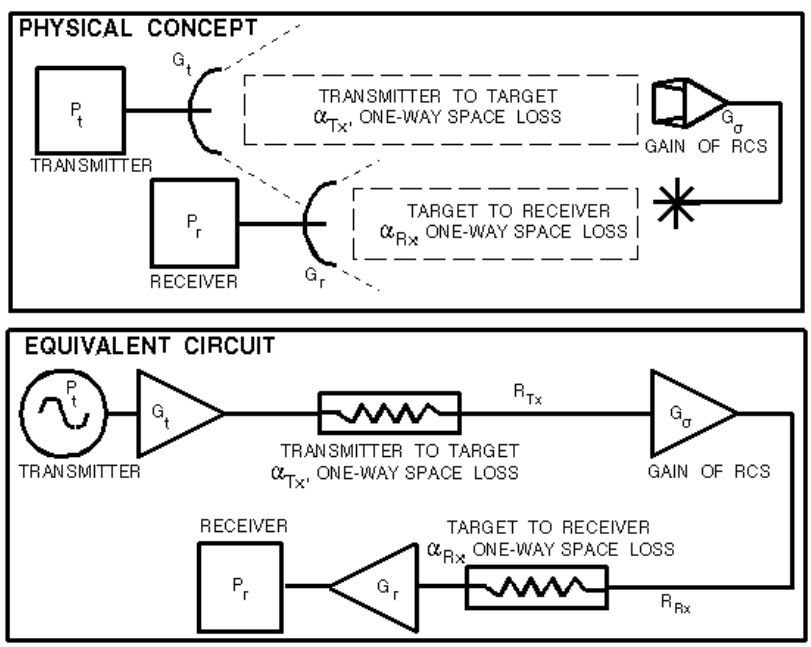

Figure 1. Bistatic Radar Visualized.

The peak power at the radar receiver input is:

$$P_r = \frac{P_t\, G_t\, G_r\, \lambda^2\, \sigma}{(4\pi)^3\, R_{Tx}^2\, R_{Rx}^2} = P_t\, G_t\, G_r \left[\frac{\sigma\, c^2}{(4\pi)^3\, f^{\,2}\, R_{Tx}^2\, R_{Rx}^2} \right] \qquad \left(Note : \lambda = \frac{c}{f} \; and \; \sigma = RCS \right) \qquad \textbf{[1]}$$

Keep λ or c, σ, and R in the same units.

On reducing the above equation to log form we have:

$$10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r + 10\log \sigma - 20\log f + 20\log c - 30\log 4\pi - 20\log R_{Tx} - 20\log R_{Rx} \quad \textbf{[2]}$$

or in simplified terms:

$$10\log P_r = 10\log P_t + 10\log G_t + 10\log G_r + G_\sigma - \alpha_{Tx} - \alpha_{Rx} \quad \text{(in dB)} \qquad \textbf{[3]}$$

Where α_{Tx} corresponds to transmitter to target loss and α_{Rx} corresponds to target to receiver loss, or:

$\alpha_{Tx} = 20\log(f_1 T_{Tx}) + K_1$ (in dB) and $\alpha_{Rx} = 20\log(f_1 T_{Rx}) + K_1$ (in dB)

with K_1 values provided on page 4-6.1 and with f_1 being the MHz or GHz value of frequency.

Therefore, the difference between monostatic and bistatic calculations is that two α's are calculated for two different ranges and different gains may be required for transmit and receive antennas.

To avoid having to include additional terms for these calculations, always combine any transmission line loss with antenna gain.

As shown in Figure 2, it should also be noted that the bistatic RCS received by the missile is not always the same as the monostatic RCS. In general, the target's RCS varies with angle. Therefore, the bistatic RCS and monostatic RCS will be equal for receive and transmit antennas at the same angle to the target (but only if all three are in a line, as RCS also varies with elevation angle).

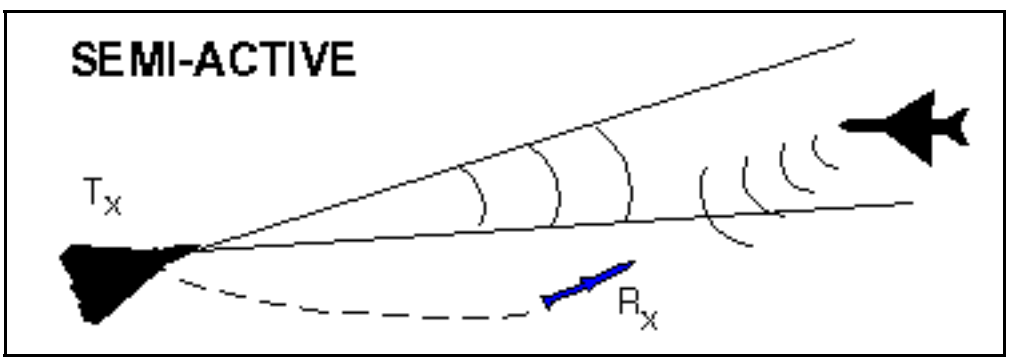

Figure 2. Bistatic RCS Varies.

JAMMING TO SIGNAL (J/S) RATIO - CONSTANT POWER [SATURATED] JAMMING

The following table contains a summary of the equations developed in this section.

JAMMING TO SIGNAL (J/S) RATIO (MONOSTATIC) $J/S = (P_j\, G_{ja} 4\pi\, R^2) / (P_t\, G_t\, \sigma)$ (ratio form)* or: $10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log\sigma^* + 10.99\text{ dB} + 20\log R^*$ Note (1): Neither f nor λ terms are part of these equations	* Keep R and σ in same units Target gain factor, (in dB) $G_\sigma = 10\log\sigma + 20\log f_1 + K_2$ K_2 Values (dB): RCS (σ) f_1 in MHz f_1 in GHz (units) K_2 = K_2 = m2 -38.54 21.46 ft2 -48.86 11.14
If simplified radar equations developed in previous sections are used: $10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - G_\sigma + \alpha_1$ (in dB) Note (2): the $20\log f_1$ term in $-G_\sigma$ cancels the $20\log f_1$ term in α_1	
JAMMING TO SIGNAL (J/S) RATIO (BISTATIC) R_{Tx} is the range from the radar transmitter to the target. See note (1). $J/S = (P_j\, G_{ja} 4\pi\, R_{Tx}^2) / (P_t\, G_t\, \sigma)$ (ratio form) * or: $10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log\sigma^* + 10.99\text{ dB} + 20\log R_{Tx}^*$	One-way free space loss (dB) α_1 or α_{Tx} = $20\log (f_1 R) + K_1$ K_1 Values (dB): Range f_1 in MHz f_1 in GHz (units) K_1 = K_1 = NM 37.8 97.8 km 32.45 92.45 m -27.55 32.45 ft -37.87 22.13
If simplified radar equations developed in previous sections are used: see note (2). $10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - G_\sigma + \alpha_{Tx}$ (in dB)	

This section derives the J/S ratio from the one-way range equation for J and the two-way range equation for S, and deals exclusively with active (transmitting) Electronic Attack (EA) devices or systems. Furthermore, the only purpose of EA is to prevent, delay, or confuse the radar processing of target information.

By official definition, EA can be either Jamming or Deception. This may be somewhat confusing because almost any type of active EA is commonly called "jamming," and the calculations of EA signal in the radar compared to the target signal in the radar commonly refer to the "jamming-to-signal" ratio ("J-to-S" ratio). Therefore this section uses the common jargon and the term "jammer" refers to any EA transmitter, and the term "jamming" refers to any EA transmission, whether Deception or Concealment.

Jamming: "Official" jamming should more aptly be called Concealment or Masking. Essentially, Concealment uses electronic transmissions to swamp the radar receiver and hide the targets. Concealment (Jamming) usually uses some form of noise as the transmitted signal. In this section, Concealment will be called "noise" or "noise jamming."

Deception: Deception might be better called Forgery. Deception uses electronic transmissions to forge false target signals that the radar receiver accepts and processes as real targets.

"J" designates the EA signal strength whether it originates from a noise jammer or from a deception system.

Basically, there are two different methods of employing active EA against hostile radars:

Self Protection EA
Support EA

For most practical purposes, Self Protection EEA is usually Deception and Support EA is usually noise jamming. As the name implies, Self Protection EA is EA that is used to protect the platform that it is on. Self Protection EA is often called "self screening jamming," "Defensive EA" or historically "Deception ECM." The top half of Figure 1 shows self-screening jamming.

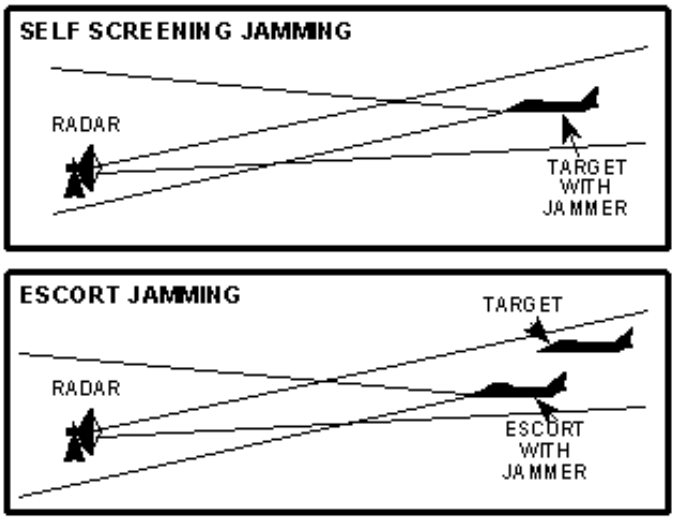

Figure 1. Self Protection and Escort Jamming.

The bottom half of Figure 1 illustrates escort jamming which is a special case of support jamming. If the escort platform is sufficiently close to the target, the J-to-S calculations are the same as for self protection EA.

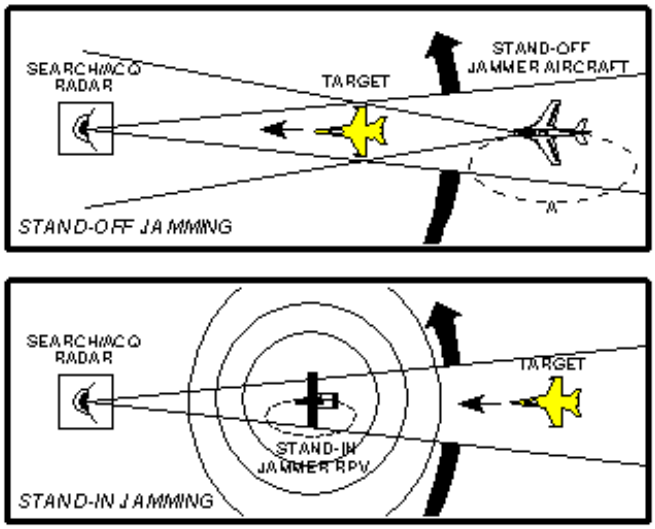

Figure 2. Support Jamming.

Support EA is electronic transmissions radiated from one platform and is used to protect other platforms or fulfill other mission requirements, like distraction or conditioning. Figure 2 illustrates two cases of support jamming protecting a striker - stand-off jamming (SOJ) and stand-in jamming (SIJ). For SOJ the support jamming platform is maintaining an orbit at a long range from the radar - usually beyond weapons range. For SIJ, a remotely piloted vehicle is orbiting very close to the victim radar. Obviously, the jamming power required for the SOJ to screen a target is much greater than the jamming power required for the SIJ to screen the same target.

When factoring EA into the radar equation, the quantities of greatest interest are "J-to-S" and Burn-Through Range.

"J-to-S" is the ratio of the signal strength of the jammer signal (J) to the signal strength of the target return signal (S). It is expressed as "J/S" and, in this section, is always in dB. J usually (but not always) must exceed S by some amount to be effective, therefore the desired result of a J/S calculation in dB is a positive number. Burn-through Range is the radar to target range where the target return signal can first be detected through the jamming and is usually slightly farther than crossover range where J=S. It is usually the range where the J/S just equals the minimum effective J/S (See Section 4-8).

The significance of "J-to-S" is sometimes misunderstood. The effectiveness of EA **is not** a direct mathematical function of "J-to-S." The magnitude of the "J-to-S" required for effectiveness is a function of the particular EA technique and of the radar it is being used against. Different EA techniques may very well require different "J-to-S" ratios against the same radar. When there is sufficient "J-to-S" for effectiveness, increasing it will rarely increase the effectiveness at a given range. Because modern radars can have sophisticated signal processing and/or EP capabilities, in certain radars too much "J-to-S" could cause the signal processor to ignore the jamming, or activate special anti-jamming modes. Increasing "J-to-S" (or the jammer power) does, however, allow the target aircraft to get much closer to the threat radar before burn-through occurs, which essentially means more power is better if it can be controlled when desired.

IMPORTANT NOTE: If the signal S is CW or PD and the Jamming J is amplitude modulated, then the J used in the formula has to be reduced from the peak value (due to sin x/x frequency distribution). The amount of reduction is dependent upon how much of the bandwidth is covered by the jamming signal. To get an exact value, integrals would have to be taken over the bandwidth. As a rule of thumb however:

- If the frequency of modulation is less than the BW of the tracking radar reduce J/S by 10 Log (duty cycle).
- If the frequency of modulation is greater than the BW of the tracking radar reduce J/S by 20 Log(duty cycle).

For example; if your jamming signal is square wave chopped (50% duty cycle) at a 100 Hz rate while jamming a 1 kHz bandwidth receiver, then the J/S is reduced by 3 dB from the maximum. If the duty cycle was 33%, then the reduction would be 4.8 dB. If the 50% and 33% duty cycle jamming signals were chopped at a 10 kHz (vice the 100 Hz) rate, the rule of thumb for jamming seen by the receiver would be down 6 dB and 9.6 dB, respectively, from the maximum since the 10 kHz chopping rate is greater than the 1 kHz receiver BW.

J/S for SELF PROTECTION EA vs. MONOSTATIC RADAR

Figure 3 is radar jamming visualized. The Physical concept of Figure 3 shows a monostatic radar that is the same as Figure 1, Section 4-4, and a jammer (transmitter) to radar (receiver) that is the same as Figure 3, Section 4-3. In other words, Figure 3 is simply the combination of the previous two visual concepts where there is only one receiver (the radar's).

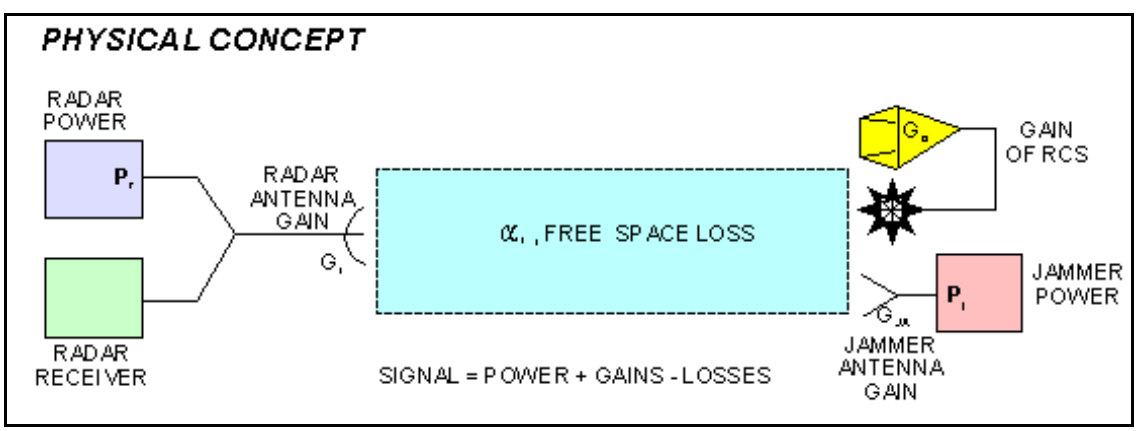

Figure 3. Radar Jamming Visualized.

The equivalent circuit shown in Figure 4 applies to jamming monostatic radars with either self protect EA or support EA. For self protect (or escort) vs. a monostatic radar, the jammer is on the target and the radar receive and transmit antennas are collocated so the three ranges and three space loss factors (α's) are the same.

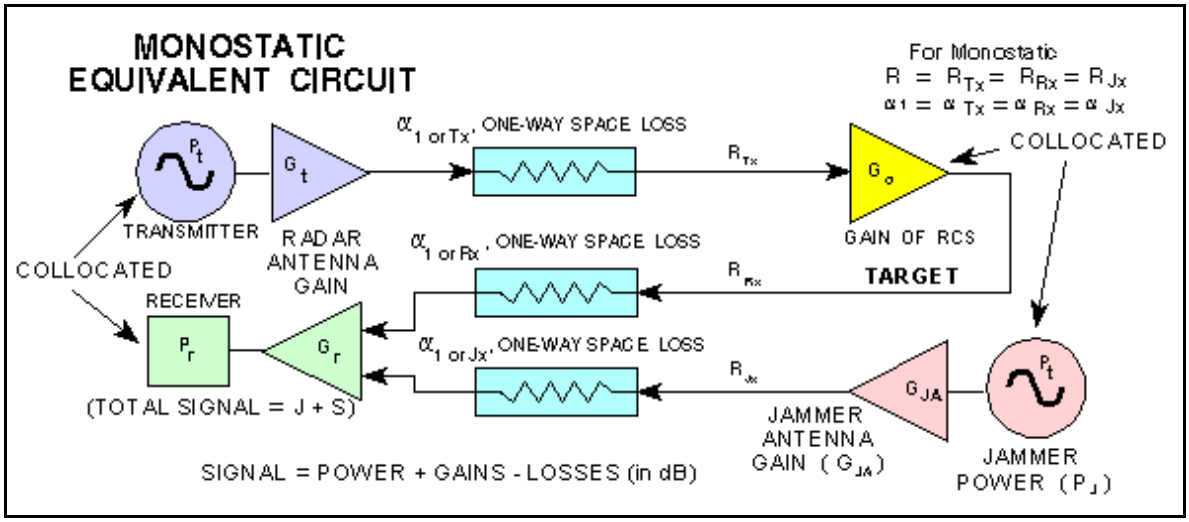

Figure 4. Monostatic Radar EA Equivalent Circuit.

<u>J-S Ratio (Monostatic)</u> - The ratio of the power received (P_{r1} or J) from the jamming signal transmitted from the target to the power received (P_{r2} or S) from the radar skin return from the target equals J/S.

From the one way range equation in Section 4-3: $$P_r 1 \text{ or } J = \frac{P_j G_{ja} G_r \lambda^2}{(4\pi R)^2} \quad \textbf{[1]}$$

From the two way range equation in Section 4.4: $$P_r 2 \text{ or } S = \frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R^4} \quad \textbf{[2]}$$

so $$\frac{J}{S} = \frac{P_j G_{ja} G_r \lambda^2 (4\pi)^3 R^4}{P_t G_t G_r \lambda^2 \sigma (4\pi R)^2} = \frac{P_j G_{ja} 4\pi R^2}{P_t G_t \sigma}^{*} \qquad (ratio\ form) \quad \textbf{[3]}$$

* Keep R and σ in the same units.

On reducing the above equation to log form we have:

$$10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log \sigma + 10\log 4\pi + 20\log R \quad \textbf{[4]}$$

or $$10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log \sigma + 10.99 \text{ dB} + 20\log R \quad \textbf{[5]}$$

Note: Neither *f* nor λ terms are part of the final form of equation [3] and equation [5].

J/S Calculations (Monostatic) Using a One Way Free Space Loss - The simplified radar equations developed in previous sections can be used to express J/S.

From the one way range equation Section 4-3:

$$10\log (P_{r1} \text{ or } J) = 10\log P_j + 10\log G_{ja} + 10\log G_r - \alpha_1 \quad \text{(in dB)} \qquad \textbf{[6]}$$

From the two way range equation in Section 4.4:

$$10\log (P_{r2} \text{ or } S) = 10\log P_t + 10\log G_t + 10\log G_r + G_\sigma - 2\alpha_1 \quad \text{(in dB)} \qquad \textbf{[7]}$$

$$10\log (J/S) = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - G_\sigma + \alpha_1 \quad \text{(in dB)} \qquad \textbf{[8]}$$

Note: To avoid having to include additional terms for these calculations, always combine any transmission line loss with antenna gain. The $20\log f_1$ term in $-G_\sigma$ cancels the $20\log f_1$ term in α_1.

Target gain factor, $G_\sigma = 10\log \sigma + 20\log f_1 + K_2$ (in dB)			One-way free space loss, $\alpha_1 = 20\log (f_1 R) + K_1$ (in dB)			
K_2 Values (dB)	RCS (σ) (units)	f_1 in MHz K_2 =	f_1 in GHz K_2 =	K_1 Values (dB)	Range (units)	f_1 in MHz K_1 =	f_1 in GHz K_1 =
	m^2	-38.54	21.46		NM	37.8	97.8
	ft^2	-48.86	11.14		km	32.45	92.45
					m	-27.55	32.45
					yd	-28.33	31.67
					ft	-37.87	22.13

J/S for SELF PROTECTION EA vs. BISTATIC RADAR

The semi-active missile illustrated in Figure 5 is the typical bistatic radar which would require the target to have self protection EA to survive. In this case, the jammer is on the target and the target to missile receiver range is the same as the jammer to receiver range, but the radar to target range is different. Therefore, only two of the ranges and two of the α's (Figure 6.) are the same.

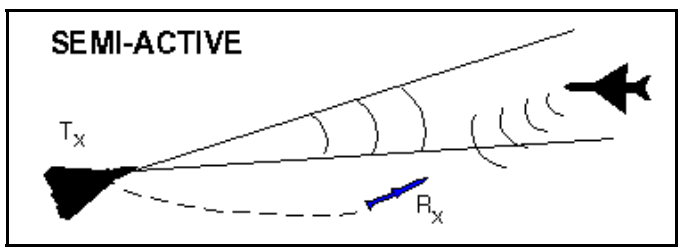

Figure 5. Bistatic Radar.

In the following equations:

α_{Tx} = The one-way space loss from the radar transmitter to the target for range R_{Tx}
α_{Rx} = The one-way space loss from the target to the missile receiver for range R_{Rx}

Like the monostatic radar, the bistatic jamming and reflected target signals travel the same path from the target and enter the receiver (missile in this case) via the same antenna. In both monostatic and bistatic J/S equations this common range cancels, so both J/S equations are left with an R_{Tx}^2 or 20 log R_{Tx} term. Since in the monostatic case $R_{Tx} = R_{Rx}$ and $\alpha_{Tx} = \alpha_{Rx}$, only R or α_1 is used in the equations. Therefore, the

bistatic J/S equations [11], [13], or [14] will work for monostatic J/S calculations, but the opposite is only true if bistatic R_{Tx} and α_{Tx} terms are used for R or α_1 terms in monostatic equations [3], [5], and [8].

The equivalent circuit shown in Figure 6 applies to jamming bistatic radar. For self protect (or escort) vs. a bistatic radar, the jammer is on the target and the radar receive and transmit antennas are at separate locations so only two of the three ranges and two of the three space loss factors (α's) are the same.

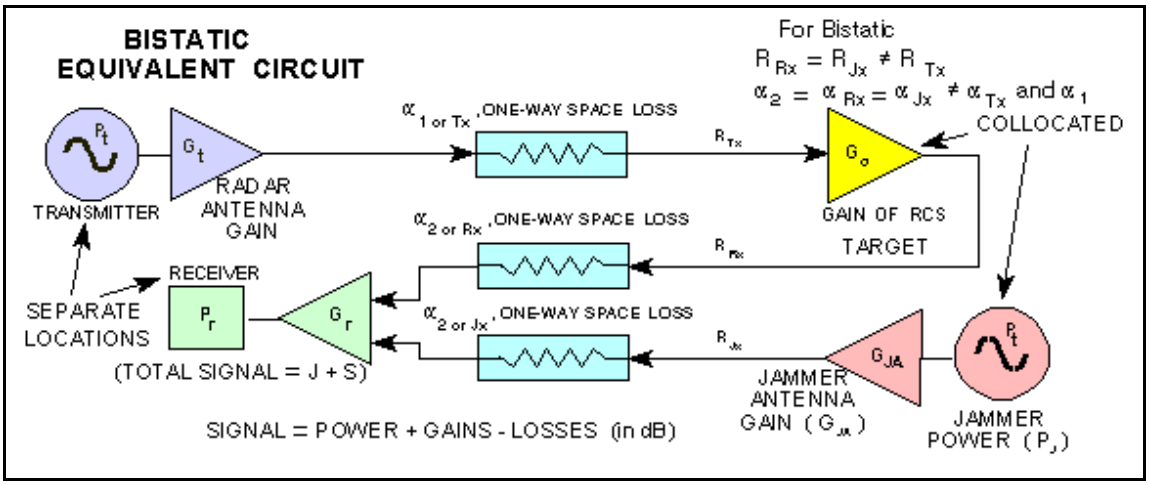

Figure 6. Bistatic Radar EA Equivalent Circuit.

<u>J-to-S Ratio (Bistatic)</u> When the radar's transmit antenna is located remotely from the receiving antenna (Figure 6), the ratio of the power received (P_{r1} or J) from the jamming signal transmitted from the target to the power received (P_{r2} or S) from the radar skin return from the target equals J/S. For jammer effectiveness J normally has to be greater than S.

From the one way range equation in Section 4-3: $$P_r 1 \text{ or } J = \frac{P_j G_{ja} G_r \lambda^2}{(4\pi R_{Rx})^2} \qquad (R_{Jx} = R_{Rx}) \qquad \textbf{[9]}$$

From the two way range equation in Section 4.4: $$P_r 2 \text{ or } S = \frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R_{Tx}^2 R_{Rx}^2} \qquad \textbf{[10]}$$

so $$\frac{J}{S} = \frac{P_j G_{ja} G_r \lambda^2 (4\pi)^3 R_{Tx}^2 R_{Rx}^2}{P_t G_t G_r \lambda^2 \sigma (4\pi R_{Rx})^2} = \frac{P_j G_{ja} 4\pi R_{Tx}^2}{P_t G_t \sigma}^{*} \qquad \textit{(ratio form)} \qquad \textbf{[11]}$$

* Keep R and σ in the same units.

On reducing the above equation to log form we have:

$$10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log \sigma + 10\log 4\pi + 20\log R_{Tx} \qquad \textbf{[12]}$$

or $$10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log \sigma + 10.99 \text{ dB} + 20\log R_{Tx} \qquad \textbf{[13]}$$

Note: To avoid having to include additional terms for these calculations, always combine any transmission line loss with antenna gain. Neither *f* nor λ terms are part of the final form of equation [11] and equation [13].

Bistatic J/S Calculations (Bistatic) Using a One Way Free Space Loss - The simplified radar equations developed in previous sections can be used to express J/S.

From the one way range equation in Section 4-3:

$10\log (P_{r1} \text{ or } J) = 10\log P_j + 10\log G_{ja} + 10\log G_r - \alpha_{Rx}$ (all factors dB) **[14]**

From the two way range equation in Section 4-4:
$10\log (P_{r2} \text{ or } S) = 10\log P_t + 10\log G_t + 10\log G_r + G_\sigma - \alpha_{Tx} - \alpha_{Rx}$ (all factors dB) **[15]**

$10\log (J/S) = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - G_\sigma + \alpha_{Tx}$ (all factors dB) **[16]**

Note: To avoid having to include additional terms for these calculations, always combine any transmission line loss with antenna gain. The $20\log f_1$ term in $-G_\sigma$ cancels the $20\log f_1$ term in α_1.

Target gain factor, $G_\sigma = 10\log \sigma + 20\log f_1 + K_2$ (in dB)				One-way free space loss $\alpha_{Tx \text{ or } Rx} = 20\log f_1 R_{Tx \text{ or } Rx} + K_1$ (in dB)			
K_2 Values (dB)	RCS (σ) (units)	f_1 in MHz K_2 =	f_1 in GHz K_2 =	K_1 Values (dB)	Range (units)	f_1 in MHz K_1 =	f_1 in GHz K_1 =
	m^2	-38.54	21.46		NM	37.8	97.8
	ft^2	-48.86	11.14		km	32.45	92.45
					m	-27.55	32.45
					yd	-28.33	31.67
					ft	-37.87	22.13

Saturated J/S (Monostatic) Example (Constant Power Jamming)

Assume that a 5 GHz radar has a 70 dBm signal fed through a 5 dB loss transmission line to an antenna that has 45 dB gain. An aircraft is flying 31 km from the radar. The aft EW antenna has -1 dB gain and a 5 dB line loss to the EW receiver (there is an additional loss due to any antenna polarization mismatch but that loss will not be addressed in this problem). The aircraft has a jammer that provides 30 dBm saturated output if the received signal is above -35 dBm. The jammer feeds a 10 dB loss transmission line which is connected to an antenna with a 5 dB gain. If the RCS of the aircraft is 9 m^2, what is the J/S level received by the tracking radar?

Answer: The received signal at the jammer is the same as the example in Section 4-3, i.e. answer (1) = -32.3 dBm @ 5 GHz. Since the received signal is above -35 dBm, the jammer will operate in the saturated mode, and equation [5] can be used. (See Section 4-10 for an example of a jammer in the linear region.)

$10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log \sigma + 10.99 \text{ dB} + 20\log R$

Note: the respective transmission line losses will be combined with antenna gains,
i.e. -5 + 45 = 40 dB & -10 +5 = -5 dB.

$10\log J/S = 30 - 5 - 70 - 40 - 9.54 + 10.99 + 89.8 = 6.25 \text{ dB @ 5 GHz}^*$

* The answer is still 6.25 dB if the tracking radar operates at 7 GHz provided the antenna gains and the aircraft RCS are the same at both frequencies.

In this example, there is inadequate jamming power at each frequency if the J/S needs to be 10 dB or greater to be effective. One solution would be to replace the jammer with one that has a greater power output. If the antenna of the aircraft and the radar are not the proper polarization, additional power will also be required (see Section 3-2).

BURN-THROUGH / CROSSOVER RANGE

The burn-through equations are derived in this section. These equations are most commonly used in jammer type of applications. The following is a summary of the important equations explored in this section:

J/S CROSSOVER RANGE (MONOSTATIC) (J = S)

$$R_{J=S} = [\ (P_t\ G_t\ \sigma) / (P_j\ G_{ja}\ 4\pi)\ ]^{1/2} \qquad \text{(dB Ratio)}$$

or $20 \log R_{J=S} = 10\log P_t + 10\log G_t + 10\log \sigma - 10\log P_j - 10\log G_{ja} - 10.99$ dB

If simplified radar equations already converted to dB are used:

$20 \log R_{J=S} = 10\log P_t + 10\log G_t + G_\sigma - 10\log P_j - 10\log G_{ja} - K_1 - 20\log f_1$ (dB)

* Keep P_t & P_j in same units
Keep R and σ in same units

K_1 Values (dB):

Range (units)	f_1 in MHz K_1 =	in GHz K_1 =
m	-27.55	32.45
ft	-37.87	22.13

BURN-THROUGH RANGE (MONOSTATIC)

The radar to target range where the target return signal (S) can first be detected through the EA (J).

$$R_{BT} = [\ (P_t\ G_t\ \sigma\ J_{min\ eff}) / (P_j\ G_{ja}\ 4\pi\ S)\ ]^{1/2} \qquad \text{(dB Ratio)}$$

or $20\log R_{BT} = 10\log P_t + 10\log G_t + 10\log\sigma - 10\log P_j - 10\log G_{ja} + 10\log(J_{min\ eff}/S) - 10.99$

If simplified radar equations already converted to dB are used:

$20\log R_{BT} = 10\log P_t + 10\log G_t + G_\sigma - 10\log P_j - 10\log G_{ja} - K_1 + 10\log(J_{min\ eff}/S) - 20\log f_1$(in dB)*

f_1 is MHz or GHz value of frequency

Target gain factor (dB)

$G_\sigma = 10\log \sigma + 20\log f_1 + K_2$

K_2 Values (dB):

RCS (σ) (units)	f_1 in MHz K_2 =	in GHz K_2 =
m^2	-38.54	21.46
ft^2	-48.86	11.14

BURN-THROUGH RANGE (BISTATIC)

R_{Tx} is the range from the radar transmitter to the target and is different from R_{Rx} which is the range from the target to the receiver. Use Monostatic equations and substitute R_{Tx} for R

CROSSOVER RANGE and BURN-THROUGH RANGE

To present the values of J and S, (or J/S) over a minimum to maximum radar to target range of interest, equation [1], Section 4-7. which has a slope of 20 log for J vs. range and equation [2], Section 4-7, which has a slope of 40 log for S vs. range are plotted. When plotted on semi-log graph paper, J and S (or J/S) vs. range are straight lines as illustrated in Figure 1.

Figure 1 is a sample graph - it cannot be used for data.

The crossing of the J and S lines (known as crossover) gives the range where J = S (about 1.29 NM), and shows that shorter ranges will produce target signals greater than the jamming signal.

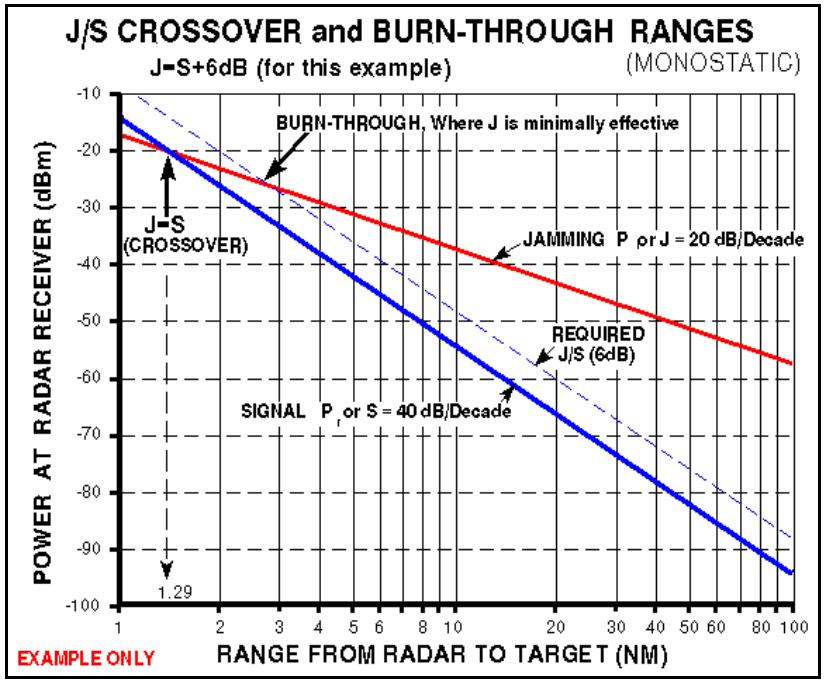

Figure 1. Sample J and S Graph.

The point where the radar power overcomes the jamming signal is known as burn-through. The crossover point where J = S could be the burn-through range, but it usually isn't because normally J/S > 0 dB to be effective due to the task of differentiating the signal from the jamming noise floor (see receiver sensitivity section). For this example, the J/S required for the EA to be effective is given as 6 dB, as shown by the dotted line. This required J/S line crosses the jamming line at about 2.8 NM which, in this example, is the burn-through range.

In this particular example, we have:

P_t = 80 dBm	G_t = 42 dB
P_j = 50 dBm	G_{ja} = 6 dB
σ = 18 m^2	f = 5.9 GHz (not necessary for all calculations)

A radar can be designed with higher than necessary power for earlier burn-through on jamming targets. Naturally that would also have the added advantage of earlier detection of non-jamming targets as well.

> Note: To avoid having to include additional terms for the following calculations, always combine any transmission line loss with antenna gain.

CROSSOVER AND BURN-THROUGH RANGE EQUATIONS (MONOSTATIC)

To calculate the crossover range or burn-through range the J/S equation must be solved for range. From equation [3], Section 4-7:

$$\frac{J}{S} = \frac{P_j\, G_{ja}\, 4\pi\, R^2}{P_t\, G_t\, \sigma} \qquad \textit{(ratio form)} \qquad \text{Solving for R:} \quad R = \sqrt{\frac{P_t\, G_t\, \sigma\, J}{P_j\, G_{ja}\, 4\pi\, S}} \qquad \textbf{[1]}$$

<u>BURN-THROUGH RANGE (MONOSTATIC)</u> - Burn-through Range (Monostatic) is the radar to target range where the target return signal (S) can first be detected through the jamming (J). It is usually the range when the J/S just equals the minimum effective J/S.

$$R_{BT} = \sqrt{\frac{P_t\, G_t\, \sigma\, J_{\min eff}}{P_j\, G_{ja}\, 4\pi\, S}} \qquad \text{(burn-through range)} \qquad \textbf{[2]}$$

or in dB form, (using 10log 4π = 10.99 dB):

$$20\log R_{BT} = 10\log P_t + 10\log G_t + 10\log \sigma - 10\log P_j - 10\log G_{ja} + 10\log (J_{\min eff}/S) - 10.99 \text{ dB} \qquad \textbf{[3]}$$

<u>RANGE WHEN J/S CROSSOVER OCCURS (MONOSTATIC)</u> - The crossover of the jammer's 20 dB/decade power line and the skin return signal's 40 dB/decade power line of Figure 1 occurs for the case where J = S in dB or J/S=1 in ratio. Substituting into equation [1] yields:

$$R_{(J=S)} = \sqrt{\frac{P_t\, G_t\, \sigma}{P_j\, G_{ja}\, 4\pi}} \qquad \text{(Crossover range)} \qquad \textbf{[4]}$$

or in dB form:

$$20\log R_{J=S} = 10\log P_t + 10\log G_t + 10\log \sigma - 10\log P_j - 10\log G_{ja} - 10.99 \text{ dB} \qquad \textbf{[5]}$$

Note: keep R and σ in same units in all equations.

CROSSOVER AND BURN-THROUGH EQUATIONS (MONOSTATIC) USING α - ONE WAY FREE SPACE LOSS

The other crossover burn-through range formulas can be confusing because a frequency term is subtracted (equations [6], [7] and [8]), but both ranges are independent of frequency. This subtraction is necessary because when J/S is calculated directly as previously shown, λ^2 or $(c/f)^2$ terms canceled, whereas in the simplified radar equations, a frequency term is part of the G_σ term and has to be cancelled if one solves for R. From equation [8], Section 4-7:

$$10\log J/S = 10\log P_j + 10\log G_{ja} - 10\log P_t - 10\log G_t - G_\sigma + \alpha_1 \qquad \text{(factors in dB)}$$

or rearranging: $\alpha_1 = 10\log P_t + 10\log G_t + G_\sigma - 10\log P_j - 10\log G_{ja} + 10\log (J/S)$

from Section 4-4: $\alpha_1 = 20\log f_1 R_1 + K_1$ or $20\log R_1 = \alpha_1 - K_1 - 20\log f_1$

then substituting for α_1:

$$20\log R_1 = 10\log P_t + 10\log G_t + G_\sigma - 10\log P_j - 10\log G_{ja} - K_1 + 10\log (J/S) - 20\log f_1 \quad \text{(in dB)} \qquad \textbf{[6]}$$

<u>EQUATION FOR BURN-THROUGH RANGE (MONOSTATIC)</u> - Burn-through occurs at the range when the J/S just equals the minimum effective J/S. G_σ and K_1 are as defined on page 4-8.1.

$$20\log R_{BT} = 10\log P_t + 10\log G_t + G_\sigma - 10\log P_j - 10\log G_{ja} - K_1 + 10\log (J_{min\ eff}/S) - 20\log f_1 \quad \text{(in dB)} \qquad \textbf{[7]}$$

<u>EQUATION FOR THE RANGE WHEN J/S CROSSOVER OCCURS (MONOSTATIC)</u>

The J/S crossover range occurs for the case where J = S, substituting into equation [6] yields:

$$20\log R_{J=S} = 10\log P_t + 10\log G_t + G_\sigma - 10\log P_j - 10\log G_{ja} - K_1 - 20\log f_1 \quad \text{(factors in dB)} \qquad \textbf{[8]}$$

BURN-THROUGH RANGE (BISTATIC)

Bistatic J/S crossover range is the radar-to-target range when the power received (S) from the radar skin return from the target equals the power received (J) from the jamming signal transmitted from the target. As shown in Figure 6, Section 4-7, the receive antenna that is receiving the same level of J and S is remotely located from the radar's transmit antenna. Bistatic equations [11], [13], and [14] in Section 4-7 show that J/S is only a function of radar to target range, therefore J/S is not a function of wherever the missile is in its flight path provided the missile is in the antenna beam of the target's jammer. The missile is closing on the target at a very much higher rate than the target is closing on the radar, so the radar to target range will change less during the missile flight.

It should be noted that for a very long range air-to-air missile shot, the radar to target range could typically decrease to 35% of the initial firing range during the missile time-of-flight, i.e. A missile shot at a target 36 NM away, may be only 12 NM away from the firing aircraft at missile impact.

Figure 2 shows both the jamming radiated from the target and the power reflected from the target as a function of radar-to-target range. In this particular example, the RCS is assumed to be smaller, 15 m^2 vice 18 m^2 in the monostatic case, since the missile will be approaching the target from a different angle. This will not, however, always be the case.

In this plot, the power reflected is:

$$P_{ref} = \frac{P_t G_t 4 \pi \sigma}{(4\pi R)^2}$$

Substituting the values given previously in the example on page 4-8.1, we find that the crossover point is at 1.18 NM (due to the assumed reduction in RCS).

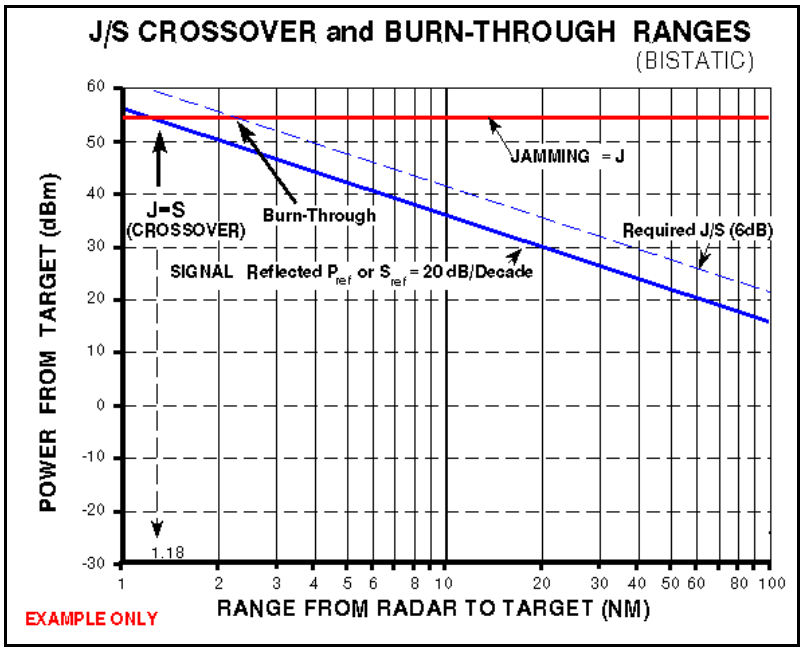

Figure 2. Bistatic Crossover and Burnthrough.

CROSSOVER AND BURN-THROUGH RANGE EQUATIONS (BISTATIC)

To calculate the radar transmitter-to-target range where J/S crossover or burn-through occurs, the J/S equation must be solved for range. From equation [11] in Section 4-7:

$$\frac{J}{S} = \frac{P_j G_{ja} 4\pi R_{Tx}^2}{P_t G_t \sigma} \qquad (ratio\ form)$$

Solving for R_{Tx}:

$$R_{Tx} = \sqrt{\frac{P_t G_t \sigma J}{P_j G_{ja} 4\pi S}} \qquad \textbf{[9]}$$

Note:
Bistatic equation [10] is identical to monostatic equation [1] except R_{Tx} must be substituted for R and a bistatic RCS (σ) will have to be used since RCS varies with aspect angle. The common explanations will not be repeated in this section.

<u>BURN-THROUGH RANGE (BISTATIC)</u> - Burn-through Range (Bistatic) occurs when J/S just equals the minimum effective J/S. From equation [9]:

$$R_{Tx(BT)} = \sqrt{\frac{P_t G_t \sigma J_{\min eff}}{P_j G_{ja} 4\pi S}} \qquad (ratio\ form) \qquad \textbf{[10]}$$

or in dB form:

$$20\log R_{Tx(BT)} = 10\log P_t + 10\log G_t + 10\log \sigma - 10\log P_j - 10\log G_{ja} + 10\log (J_{min\ eff}/S) - 10.99 \text{ dB} \quad \textbf{[11]}$$

If using the simplified radar equations (factors in dB):

$$20\log R_{Tx(BT)} = 10\log P_t + 10\log G_t + G_\sigma - 10\log P_j - 10\log G_{ja} - K_1 + 10\log (J_{min\ eff}/S) - 20\log f_1 \quad \textbf{[12]}$$

Where G_σ and K_1 are defined on page 4-8.1

RANGE WHEN J/S CROSSOVER OCCURS (BISTATIC)

The crossover occurs when J = S in dB or J/S = 1 in ratio.

$$R_{Tx(J=S)} = \sqrt{\frac{P_t\, G_t\, \sigma}{P_j\, G_{ja}\, 4\pi}} \qquad (ratio) \quad \textbf{[13]}$$

or in log form:

$$20\log R_{Tx(J=S)} = 10\log P_t + 10\log G_t + 10\log \sigma - 10\log P_j - 10\log G_{ja} - 10.99 \text{ dB} \quad \textbf{[14]}$$

If simplified equations are used (with G_σ and K_1 as defined on page 4-8.1) we have:

$$20\log R_{Tx(J=S)} = 10\log P_t + 10\log G_t + G_\sigma - 10\log P_j - 10\log G_{ja} - K_1 - 20\log f_1 \qquad \text{(factors in dB)} \quad \textbf{[15]}$$

Note: keep R and σ in same units in all equations.

DETAILS OF SEMI-ACTIVE MISSILE J/S

Unless you are running a large scale computer simulation that includes maneuvering, antenna patterns, RCS, etc., you will seldom calculate the variation in J/S that occurs during a semi-active missile's flight. Missiles don't fly straight lines at constant velocity. Targets don't either - they maneuver. If the launch platform is an aircraft, it maneuvers too. A missile will accelerate to some maximum velocity above the velocity of the launch platform and then decelerate.

The calculation of the precise variation of J/S during a missile flight for it to be effective requires determination of all the appropriate velocity vectors and ranges at the time of launch, and the accelerations and changes in relative positions during the fly out. In other words, it's too much work for too little return. The following are simplified examples for four types of intercepts.

In these examples, all velocities are constant, and are all along the same straight line. The missile velocity is 800 knots greater than the launch platform velocity which is assumed to be 400 kts. The missile launch occurs at 50 NM.

	J/S (dB)	ΔJ/S (dB)
At Launch:	29	n/a
Intercept Type	At 2 sec. to Intercept:	
AAM Head-on:	23	-6
SAM Incoming Target:	25	-4
AAM Tail Chase:	29	0
SAM Outbound Target:	35	+6

For the AAM tail chase, the range from the radar to the target remains constant and so does the J/S. **In these examples** the maximum variation from launch J/S is ± 6 dB. That represents the difference in the radar to target range closing at very high speed (AAM head on) and the radar to target range opening at moderate speed (SAM outbound target). The values shown above are examples, not rules of thumb, every intercept will be different.

Even for the simplified linear examples shown, graphs of the J and S will be curves - not straight lines. Graphs could be plotted showing J and S vs. radar to target range, or J and S vs. missile to target range, or even J/S vs. time of flight. If the J/S at launch is just barely the minimum required for effectiveness, and increasing it is difficult, then a detailed graph may be warranted, but in most cases this isn't necessary.

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SUPPORT JAMMING

The following table contains a summary of equations developed in this section:

MAIN LOBE JAMMING TO SIGNAL (J/S) RATIO (For SOJ/SIJ)	Target gain factor, $G_\sigma = 10\text{Log}\sigma + 20\text{Log}\, f_1 + K_2$ (in dB)
$J/S = (P_j\, G_{ja}\, 4\pi\, R_{Tx}^4) / (P_t\, G_t\, \sigma\, [BW_J/BW_R]\, R_{Jx}^2)$ (ratio form)*	K_2 Values (dB):
$10\log J/S = 10\log P_j - 10\log[BW_J/BW_R] + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log \sigma + \downarrow$ $10.99\text{ dB} + 40\log R_{Tx} - 20\log R_{Jx}$ * $\leftarrow\leftarrow$	RCS (σ) (units) / f_1 in MHz K_2 = / f_1 in GHz K_2 = m^2 -38.54 21.46 ft^2 -48.86 11.14
or if simplified radar equations are used:	
$10\log J/S = 10\log P_j - BF + 10\log G_{ja} - \alpha_{jx} - 10\log P_t - 10\log G_t - G_\sigma + 2\alpha_1$ (in dB)*	
SIDE LOBE JAMMING TO SIGNAL (J/S) RATIO (For SOJ/SIJ)	One-way free space loss, α_1 or $\alpha_{Tx} = 20\text{Log}(f_1 R) + K_1$ (in dB)
$J/S = (P_j\, G_{ja}\, G_{r(SL)}\, 4\pi\, R_{Tx}^4) / (P_t\, G_t\, G_{r(ML)}\, \sigma\, [BW_J/BW_R]\, R_{Jx}^2)$ (ratio form)*	K_1 Values (dB):
$10\log J/S = 10\log P_j - BF + 10\log G_{ja} + 10\log G_{r(SL)} - 10\log P_t - 10\log G_t - 10\log G_{r(ML)} + \rightarrow \downarrow$ $10.99\text{ dB} - 10\log \sigma + 40\log R_{Tx} - 20\log R_{Jx}$ * $\leftarrow\leftarrow$	Range (units) / f_1 in MHz K_1 = / f_1 in GHz K_1 = NM 37.8 97.8 Km 32.45 92.45 m -27.55 32.45 yd -28.33 31.67 ft -37.87 22.13
or if simplified radar equations are used (in dB)*:	
$10\log J/S = 10\log P_j - BF + 10\log G_{ja} + 10\log G_{r(SL)} - \alpha_{jx} - 10\log P_t - 10\log G_t - 10\log G_{r(ML)} - G_\sigma + 2\alpha_1$	
R_{Jx} Range from the support jammer transmitter to the radar receiver R_{Tx} Range between the radar and the target BF 10 Log of the ratio of BW_J of the noise jammer to BW_R of the radar receiver $G_{r(SL)}$ Side lobe antenna gain $G_{r(ML)}$ Main lobe antenna gain α_{JX} One way free space loss between SOJ transmitter and radar receiver α_1 One way space loss between the radar and the target	* Keep R and σ in same units

Support jamming adds a few geometric complexities. A SOJ platform usually uses high gain, directional antennas. Therefore, the jamming antenna must not only be pointed at the victim radar, but there must be alignment of radar, targets, and SOJ platform for the jamming to be most effective. Two cases will be described, main lobe-jamming and side-lobe jamming.

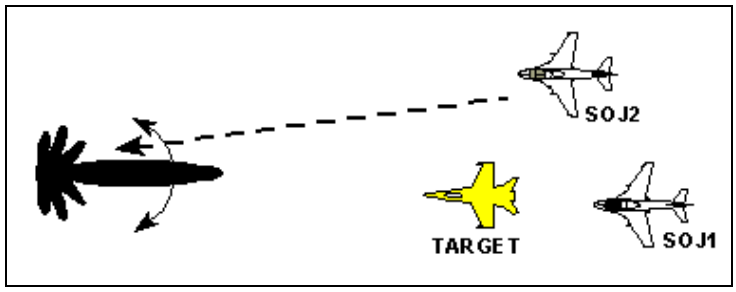

Figure 1. Radar Antenna Pattern.

Support jamming is usually applied against search and acquisition radars which continuously scan horizontally through a volume of space. The scan could cover a sector or a full 360°. The horizontal antenna pattern of the radar will exhibit a main lobe and side lobes as illustrated in Figure 1. The target is detected when the main lobe sweeps across it. For main lobe jamming, the SOJ platform and the target(s) must be aligned with the radar's main lobe as it sweeps the target(s).

For side lobe jamming, the SOJ platform may be aligned with one or more of the radar's side lobes when the main lobe sweeps the target. The gain of a radar's side lobes are many tens of dB less (usually more than 30 dB less) than the gain of the main lobe, so calculations of side lobe jamming must use the gain of the side lobe for the radar receive antenna gain, not the gain of the main lobe. Also, because many modern radars

employ some form of side lobe blanking or side lobe cancellation, some knowledge of the victim radar is required to predict the effectiveness of side lobe jamming.

All radar receivers are frequency selective. That is, they are filters that allow only a narrow range of frequencies into the receiver circuitry. Deceptive EA, by definition, creates forgeries of the real signal and, ideally, are as well matched to the radar receiver as the real signal. On the other hand, noise jamming probably **will not match** the radar receiver bandwidth characteristics. Noise jamming is either spot jamming or barrage jamming. As illustrated in Figure 2, spot jamming is simply narrowing the bandwidth of the noise jammer so that as much of the jammer power as possible is in the radar receiver bandwidth. Barrage jamming is using a wide noise bandwidth to cover several radars with one jammer or to compensate for any uncertainty in the radar frequency. In both cases some of the noise power is "wasted" because it is not in the radar receiver filter.

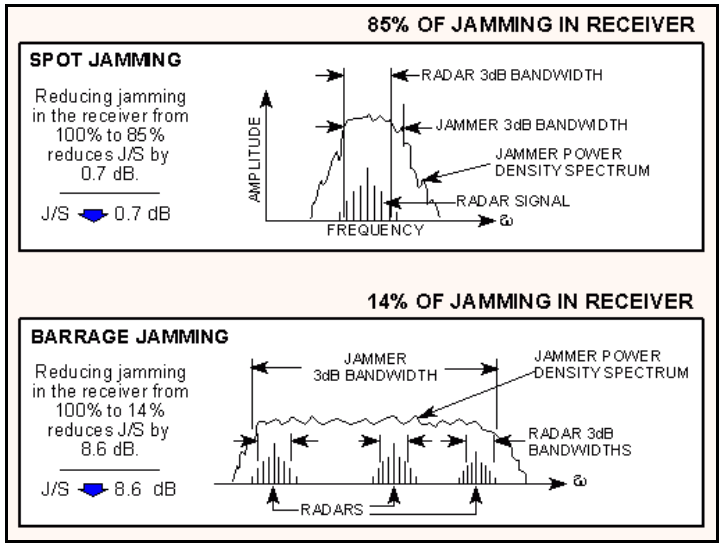

Figure 2. Noise Jamming.

In the past, noise jammers were often described as having so many "watts per MHz." This is nothing more than the power of the noise jammer divided by the noise bandwidth. That is, a 500 watt noise jammer transmitting a noise bandwidth of 200 MHz has 2.5 watts/MHz. Older noise jammers often had noise bandwidths that were difficult, or impossible, to adjust accurately. These noise jammers usually used manual tuning to set the center frequency of the noise to the radar frequency. Modern noise jammers can set on the radar frequency quite accurately and the noise bandwidth is selectable, so the noise bandwidth is more a matter of choice than it used to be, and it is possible that all of the noise is placed in the victim radar's receiver.

If, in the example above, the 500 watt noise jammer were used against a radar that had a 3 MHz receiver bandwidth, the noise jammer power applicable to that radar would be:

$$3\ MHz \times 2.5\ watts/MHz = 7.5\ watts\ _\ 38.75\ dBm \qquad \textbf{[1]}$$

The calculation must be done as shown in equation [1] - multiply the watts/MHz by the radar bandwidth first and then convert to dBm. You can't convert to dBm/MHz and then multiply. (See derivation of dB in Section 2-4)

An alternate method for dB calculations is to use the bandwidth reduction factor (BF).

The BF is: $$BF_{dB} = 10\ \text{Log}\left[\frac{BW_J}{BW_R}\right] \qquad \textbf{[2]}$$

where: BW_J is the bandwidth of the noise jammer, and BW_R is the bandwidth of the radar receiver.

The power of the jammer in the jamming equation (P_J) can be obtained by either method. If equation [1] is used then P_J is simply 38.75 dBm. If equation [2] is used then the jamming equation is written using (P_J - BF). All the following discussion uses the second method. Whichever method is used, it is required that $BW_J \geq BW_R$. If $BW_J < BW_R$, then all the available power is in the radar receiver and equation [1] does not apply and the BF = 0.

> Note: To avoid having to include additional terms for the following calculations, always combine any transmission line loss with antenna gain.

MAIN LOBE STAND-OFF / STAND-IN JAMMING

The equivalent circuit shown in Figure 3 applies to main lobe jamming by a stand-off support aircraft or a stand-in RPV. Since the jammer is not on the target aircraft, only two of the three ranges and two of the three space loss factors (α's) are the same. Figure 3 differs from the J/S monostatic equivalent circuit shown in Figure 4 in Section 4-7 in that the space loss from the jammer to the radar receiver is different.

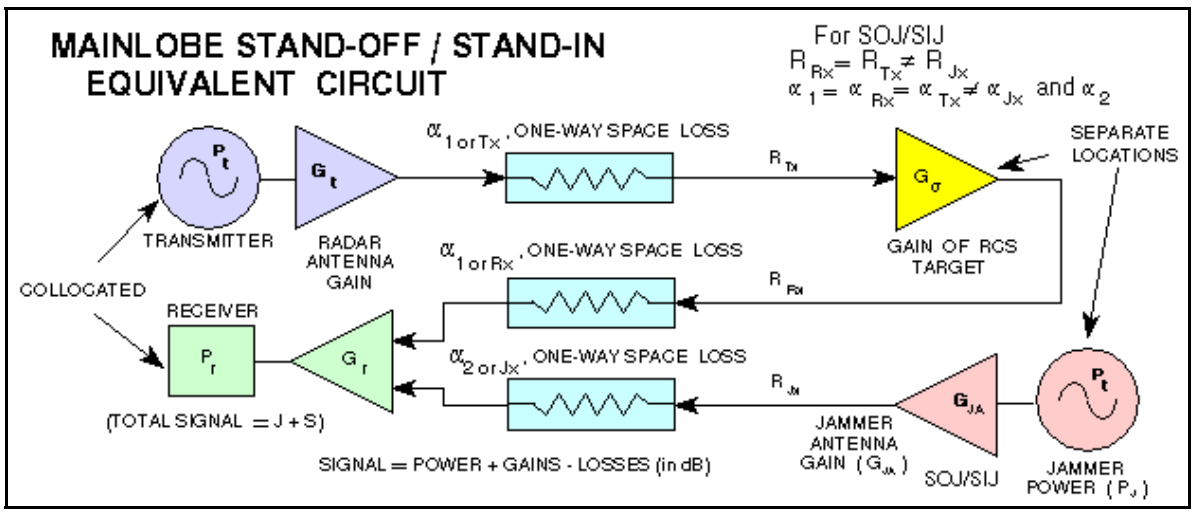

Figure 3. Main Lobe Stand-Off / Stand-In EA Equivalent Circuit.

The equations are the same for both SOJ and SIJ. From the one way range equation in Section 4-3, and with inclusion of BF losses:

$$P_r 1 \text{ or } J = \frac{P_j G_{ja} G_r \lambda^2 BW_R}{(4\pi R_{Jx})^2 BW_J} \qquad \textbf{[3]}$$

From the two way range equation in Section 4.4: $$P_r 2 \text{ or } S = \frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R_{Tx}^4} \qquad \textbf{[4]}$$

so $$\frac{J}{S} = \frac{P_j G_{ja} G_r \lambda^2 (4\pi)^3 R_{Tx}^4 BW_R}{P_t G_t G_r \lambda^2 \sigma (4\pi R_{Jx})^2 BW_J} = \frac{P_j G_{ja} 4\pi R_{Tx}^4 BW_R}{P_t G_t \sigma R_{Jx}^2 BW_J} \qquad \textit{(ratio form)} \qquad \textbf{[5]}$$

Note: Keep R and σ in the same units. Converting to dB and using 10 log 4π = 10.99 dB:

$$10\log J/S = 10\log P_j - 10\log [BW_j/BW_R] + 10\log G_{ja} - 10\log P_t - 10\log G_t - 10\log \sigma + 10.99 \text{ dB} + 40\log R_{Tx} - 20\log R_{Jx} \quad \textbf{[6]}$$

If the simplified radar equation is used, the free space loss from the SOJ/SIJ to the radar receiver is α_{Jx}, then equation [7] is the same as monostatic equation [6] in Section 4-7 except α_{Jx} replaces α, and the bandwidth reduction factor [BF] losses are included:

$$10\log J = 10\log P_j - BF + 10\log G_{ja} + 10\log G_r - \alpha_{Jx} \quad \text{(factors in dB)} \quad \textbf{[7]}$$

Since the free space loss from the radar to the target and return is the same both ways, $\alpha_{Tx} = \alpha_{Rx} = \alpha_1$, equation [8] is the same as monostatic equation [7] in Section 4-7.

$$10\log S = 10\log P_t + 10\log G_t + 10\log G_r + G_\sigma - 2\alpha_1 \quad \text{(factors in dB)} \quad \textbf{[8]}$$

and $$10\log J/S = 10\log P_j - BF + 10\log G_{ja} - \alpha_{Jx} - 10\log P_t - 10\log G_t - G_\sigma + 2\alpha_1 \quad \text{(factors in dB)} \quad \textbf{[9]}$$

Notice that unlike equation [8] in Section 4-7, there are two different α's in [9] because the signal paths are different.

SIDE LOBE STAND-OFF / STAND-IN JAMMING

The equivalent circuit shown in Figure 4. It differs from Figure 3, (main lobe SOJ/SIJ) in that the radar receiver antenna gain is different for the radar signal return and the jamming.

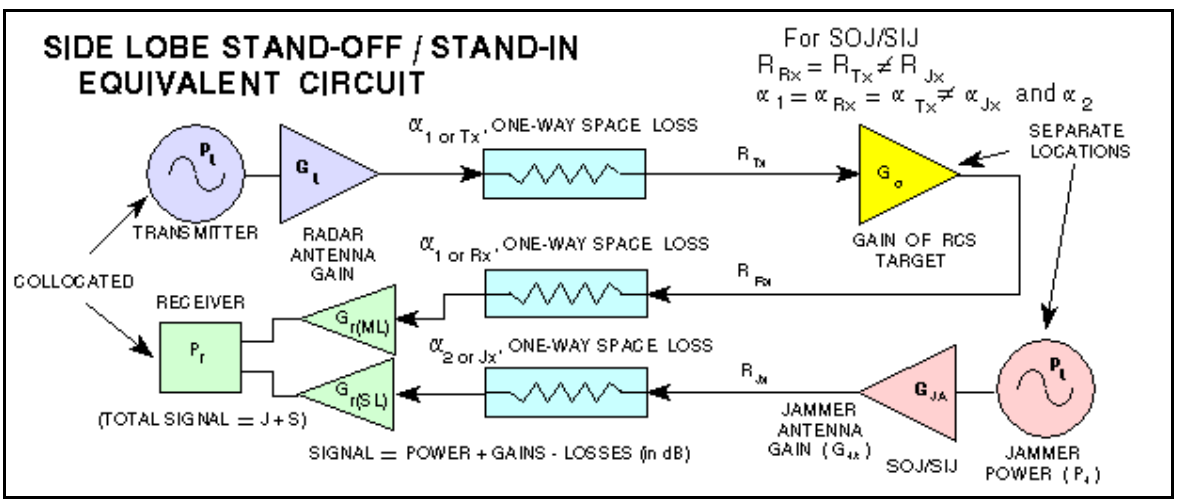

Figure 4. Side Lobe Stand-Off / Stand-In EA Equivalent Circuit.

To calculate side lobe jamming, the gain of the radar antenna's side lobes must be known or estimated. The gain of each side lobe will be different than the gain of the other side lobes. If the antenna is symmetrical, the first side lobe is the one on either side of the main lobe, the second side lobe is the next one on either side of the first side lobe, and so on. The side lobe gain is G_{SLn}, where the 'n' subscript denotes side lobe number: 1, 2, ..., n.

The signal is the same as main lobe equations [4] and [8], except $G_r = G_{r(ML)}$

$$P_r\,2 \text{ or } S = \frac{P_t\, G_t\, G_{r(ML)}\, \lambda^2\, \sigma}{(4\pi)^3\, R_{Tx}^4} \quad \textit{(ratio form)} \qquad \textbf{[10]}$$

If simplified radar equations are used:

$10\log S = 10\log P_t + 10\log G_t + 10\log G_{r(ML)} + G_\sigma - 2\alpha_1$ (factors in dB)

The jamming equation is the same as main lobe equations [3] and [7] except $G_r = G_{r(SL)}$:

$$J = \frac{P_j\, G_{ja}\, G_{r(SL)}\, \lambda^2\, BW_R}{(4\pi\, R_{Jx})^2\, BW_J} \qquad \textbf{[11]}$$

$10\log J = 10\log P_j - BF + 10\log G_{ja} + 10\log G_{r(SL)} - \alpha_{Jx}$ (factors in dB) **[12]**

so

$$\frac{J}{S} = \frac{P_j\, G_{ja}\, G_{r(SL)}\, 4\pi\, R_{Tx}^4\, BW_R}{P_t\, G_t\, G_{r(ML)}\, \sigma\, R_{Jx}^2\, BW_J} \quad \textit{(ratio form)} \qquad \textbf{[13]}$$

Note: keep R and σ in same units. Converting to dB and using $10\log 4\pi = 10.99$ dB:

$10\log J/S = 10\log P_j - BF + 10\log G_{ja} + 10\log G_{r(SL)} - 10\log P_t - 10\log G_t - 10\log G_{r(ML)} - 10\log\sigma + 10.99 \text{ dB} + 40\log R_{Tx} - 20\log R_{Jx}$
(factors in dB) **[14]**

If simplified radar equations are used:

$10\log J/S = 10\log P_j - BF + 10\log G_{ja} + 10\log G_{r(SL)} - \alpha_{Jx} - 10\log P_t - 10\log G_t - 10\log G_{r(ML)} - G_\sigma + 2\alpha_1$ **[15]**
(in dB)

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JAMMING TO SIGNAL (J/S) RATIO - CONSTANT GAIN [LINEAR] JAMMING

JAMMING TO SIGNAL (J/S) RATIO (MONOSTATIC)

$$\frac{J}{S} = \frac{G_{ja(Rx)}\, G_j\, G_{ja(Tx)}\, \lambda^2}{4\pi\sigma} = \frac{G_{ja(Rx)}\, G_j\, G_{ja(Tx)}\, c^2}{4\pi\sigma f^2} \quad \text{(ratio form)}$$

$G_{ja(Rx)}$ = The Gain of the jammer receive antenna
G_j = The gain of the jammer
$G_{ja(Tx)}$ = The Gain of the jammer transmit antenna

or:

$10\log J/S = 10\log G_{ja(Rx)} + 10\log G_j + 10\log G_{ja(Tx)} - 10\log (4\pi\sigma/\lambda^2)$

or if simplified radar equations developed in previous sections are used:

$10\log J/S = 10\log G_{ja(Rx)} + 10\log G_j + 10\log G_{ja(Tx)} - G_\sigma$ (dB)

* Keep λ and σ in same units. Note: λ = c/f

Target gain factor,
$G_\sigma = 10\log \sigma + 20\log f_1 + K_2$ (dB)

K_2 Values (dB):

RCS (σ) (units)	f_1 in MHz K_2 =	f_1 in GHz K_2 =
m^2	-38.54	21.46
ft^2	-48.86	11.14

JAMMING TO SIGNAL (J/S) RATIO (BISTATIC)

Same as the monostatic case except G_σ will be different since RCS (σ) varies with aspect angle.

Since the jammer on the target is amplifying the received radar signal before transmitting it back to the radar, both J and S experience the two way range loss. Figure 1 shows that the range for both the signal and constant gain jamming have a slope that is 40 dB per decade. Once the jammer output reaches maximum power, that power is constant and the jamming slope changes to 20 dB per decade since it is only a function of one way space loss and the J/S equations for constant power (saturated) jamming must be used.

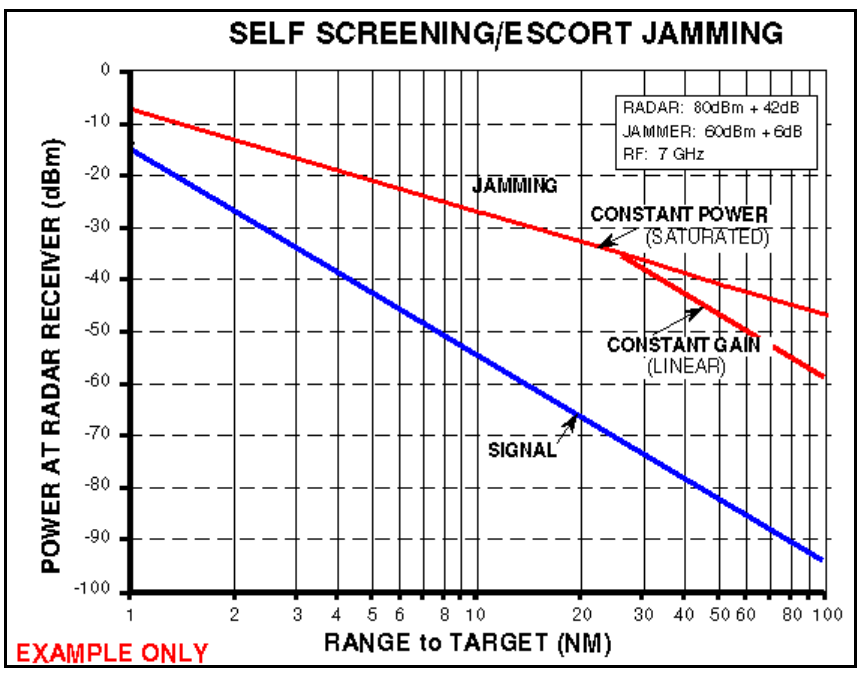

Figure 1. Sample Constant Gain / Constant Power Graph.

Normally the constant gain (linear) region of a repeater jammer occurs only at large distances from the radar and the constant power (saturated) region is reached rapidly as the target approaches the radar. When a constant gain jammer is involved it may be necessary to plot jamming twice - once using J from the constant power (saturated) equation [1] in Section 4-7 and once using the constant gain (linear) equation [4], as in the example shown in Figure 1.

CONSTANT GAIN SELF PROTECTION EA

Most jammers have a constant power output - that is, they always transmit the maximum available power of the transmitter (excepting desired EA modulation). Some jammers also have a constant gain (linear) region. Usually these are coherent repeaters that can amplify a low level radar signal to a power that is below the level that results in maximum available (saturated) power output. At some radar to target range, the input signal is sufficiently high that the full jammer gain would exceed the maximum available power and the jammer ceases to be constant gain and becomes constant power.

To calculate the power output of a constant gain jammer where:

S_{Rj} = The Radar signal at the jammer input (receive antenna terminals)
$G_{ja(Rx)}$ = The Gain of the jammer receive antenna
G_j = The gain of the jammer
α_{Tx} = The one-way free space loss from the radar to the target
P_{jCG} = The jammer constant gain power output
P_j = The maximum jammer power output
L_R = The jammer receiving line loss; combine with antenna gain $G_{ja(Rx)}$

From equation [10], Section 4-3, calculate the radar power received by the jammer.

$$10\log S_{Rj} = 10\log P_t + 10\log G_t - \alpha_{Tx} + 10\log G_{ja(Rx)} \qquad \text{(factors in dB)} \qquad \textbf{[1]}$$

The jammer constant gain power output is: $$10\log P_{jCG} = 10\log S_{Rj} + 10\log G_{ja} \qquad \textbf{[2]}$$

and, by definition: $$P_{jCG} \le P_j \qquad \textbf{[3]}$$

MONOSTATIC

The equivalent circuit shown in Figure 2 is different from the constant power equivalent circuit in Figure 4 in Section 4-7. With constant gain, the jamming signal experiences the gain of the jammer and its antennas plus the same space loss as the radar signal.

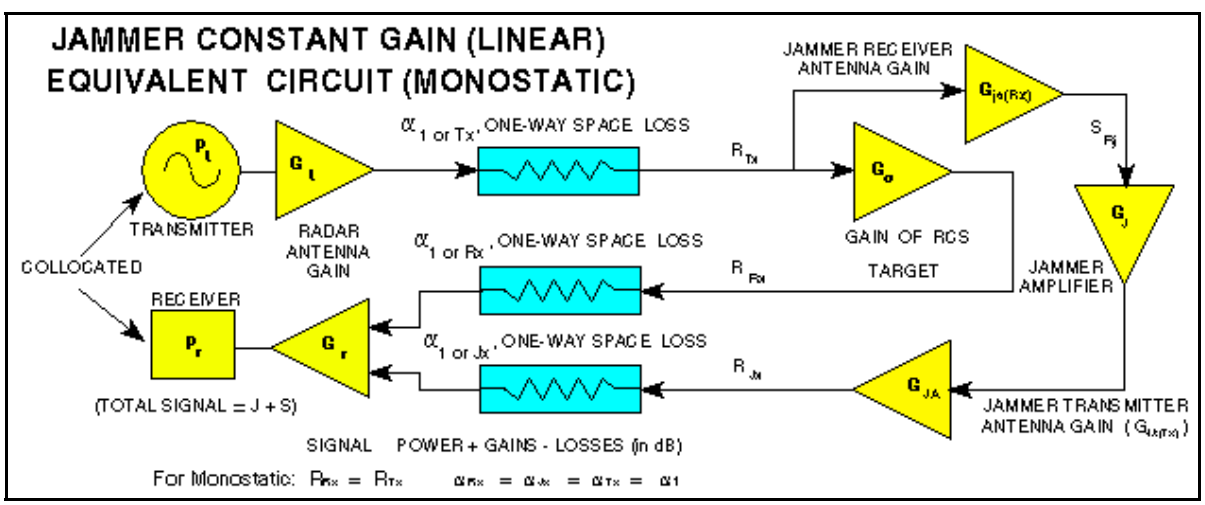

Figure 2. Jammer Constant Gain EA Equivalent Circuit (Monostatic).

To calculate J, the one way range equation from Section 4-3 is used twice:

$$J = \frac{P_t\, G_t\, G_{ja(Rx)}\, \lambda^2}{(4\pi R)^2} \frac{G_j\, G_{ja(Tx)}\, G_r\, \lambda^2}{(4\pi R)^2} \qquad \textbf{[4]}$$

From the two way range equation in Section 4-4: $S = \dfrac{P_t\, G_t\, G_r\, \lambda^2\, \sigma}{(4\pi)^3\, R^4}$ **[5]**

Terms cancel when combined: $\dfrac{J}{S} = \dfrac{G_{ja(Rx)}\, G_j\, G_{ja(Tx)}\, \lambda^2}{4\pi\sigma}$ *Keep λ and σ in same units* **[6]**

Or in dB form: $10\log J/S = 10\log G_{ja(Rx)} + 10\log G_j + 10\log G_{ja(Tx)} - 10\log (4\pi\sigma/\lambda^2)$ **[7]**

Since the last term can be recognized as minus G_σ from equation [10] in Section 4-4, where the target gain factor, $G_\sigma = 10\log (4\pi\sigma/\lambda^2) = 10\log (4\pi\sigma f^2/c^2)$, it follows that:

$10\log J/S = 10\log G_{ja(Rx)} + 10\log G_j + 10\log G_{ja(Tx)} - G_\sigma$ (factors in dB) **[8]**

Target gain factor, $G_\sigma = 10\log \sigma + 20\log f_1 + K_2$ (in dB)			
K_2 Values			
(dB)	RCS (σ) (units)	f_1 in MHz K_2 =	f_1 in GHz K_2 =
	m^2	-38.54	21.46
	ft^2	-48.86	11.14

BISTATIC

The bistatic equivalent circuit shown in Figure 3 is different from the monostatic equivalent circuit shown in Figure 2 in that the receiver is separately located from the transmitter, $R_{Tx} \neq R_{Rx}$ or R_{Jx} and G_σ will be different since the RCS (σ) varies with aspect angle.

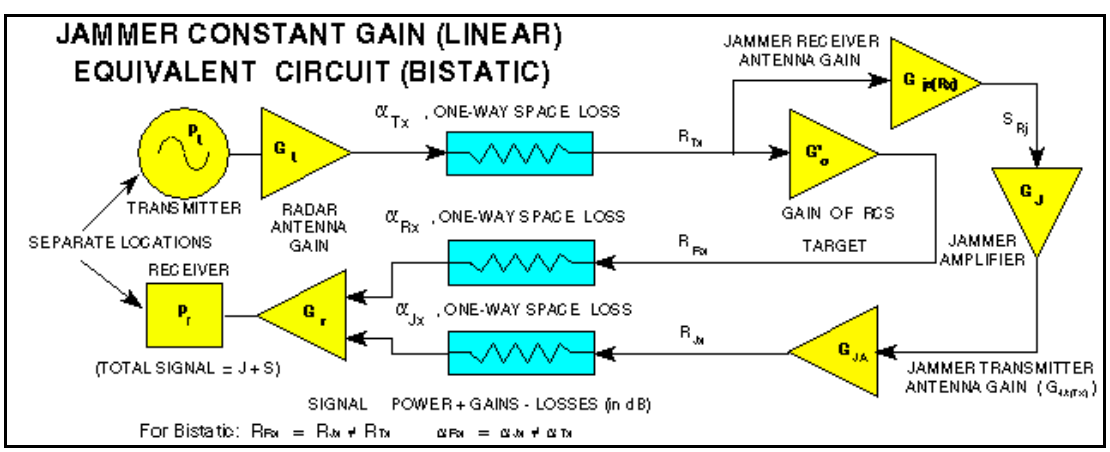

Figure 3. Jammer Constant Gain EA Equivalent Circuit (Bistatic).

To calculate J, the one way range equation from Section 4-3 is used twice:

$$J = \frac{P_t\, G_t\, G_{ja(Rx)}\, \lambda^2}{(4\pi\, R_{Tx})^2} \frac{G_j\, G_{ja(Tx)}\, G_r\, \lambda^2}{(4\pi\, R_{Rx})^2} \qquad (R_{Jx} = R_{Rx}) \qquad \textbf{[9]}$$

From the two way range equation in Section 4-4: $S = \dfrac{P_t\, G_t\, G_r\, \lambda^2\, \sigma'}{(4\pi)^3\, R_{Tx}^2\, R_{Rx}^2}$ (σ′ is bistatic RCS) **[10]**

Terms cancel when combined: $\dfrac{J}{S} = \dfrac{G_{ja(Rx)}\, G_j\, G_{ja(Tx)}\, \lambda^2}{4\pi\sigma'}$ *Keep λ and σ in same units* **[11]**

Or in dB form: $10\log J/S = 10\log G_{ja(Rx)} + 10\log G_j + 10\log G_{ja(Tx)} - 10\log (4\pi\sigma'/\lambda^2)$ **[12]**

Since the last term can be recognized as minus G_σ from equation [10] in Section 4-4, where the target gain factor, $G_\sigma = 10\log (4\pi\sigma'/\lambda^2) = 10\log (4\pi\sigma' f^2/c^2)$, it follows that:

$10\log = 10\log G_{ja(Rx)} + 10\log G_j + 10\log G_{ja(Tx)} - G_{\sigma'}$ (factors in dB) **[13]**

Target gain factor, $G_\sigma = 10\log \sigma + 20\log f_1 + K_2$ (in dB)			
K_2 Values			
(dB)	RCS (σ) (units)	f_1 in MHz K_2 =	f_1 in GHz K_2 =
	m^2	-38.54	21.46
	ft^2	-48.86	11.14

Linear J/S (Monostatic) Example (Linear Power Jamming)

Assume that a 5 GHz radar has a 70 dBm signal fed through a 5 dB loss transmission line to an antenna that has 45 dB gain. An aircraft that is flying 31 km from the radar has an aft EW antenna with -1 dB gain and a 5 dB line loss to the EW receiver (there is an additional loss due to any antenna polarization mismatch but that loss will not be addressed in this problem). The received signal is fed to a jammer with a gain of 60 dB, feeding a 10 dB loss transmission line which is connected to an antenna with 5 dB gain.

If the RCS of the aircraft is 9 m^2, what is the J/S level received at the input to the receiver of the tracking radar?

Answer:

$$10\log J/S = 10\log G_{ja(Rx)} + 10\log G_j + 10\log G_{ja(Tx)} - G_\sigma$$

$$G_\sigma = 10\log \sigma + 20\log f_1 + K_2 = 10\log 9 + 20\log 5 + 21.46 = 44.98 \text{ dB}$$

Note: The respective transmission line losses will be combined with antenna gains,
i.e. -1 -5 = -6 dB and -10 + 5 = -5 dB

$$10\log J/S = -6 + 60 - 5 - 44.98 = 4.02 \text{ dB @ 5 GHz}$$

The answer changes to 1.1 dB if the tracking radar operates at 7 GHz provided the antenna gains and aircraft RCS are the same at both 5 and 7 GHz.

$$G_\sigma = 10\log 9 + 20\log 7 + 21.46 = 47.9 \text{ dB}$$

$$10\log J/S = -6 + 60 - 5 - 47.9 = 1.1 \text{ dB @ 7 GHz}$$

Separate J (-73.5 dBm @ 5 GHz and -79.34 dBm @ 7 GHz) and S (-77.52 dBm @ 5 GHz and -80.44 dBm @ 7 GHz) calculations for this problem are provided in Sections 4-3 and 4-4, respectively. A saturated gain version of this problem is provided in Section 4-7.

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RADAR CROSS SECTION (RCS)

Radar cross section is the measure of a target's ability to reflect radar signals in the direction of the radar receiver, i.e. it is a measure of the ratio of backscatter power per steradian (unit solid angle) in the direction of the radar (from the target) to the power density that is intercepted by the target.

The RCS of a target can be viewed as a comparison of the strength of the reflected signal from a target to the reflected signal from a perfectly smooth sphere of cross sectional area of 1 m^2 as shown in Figure 1.

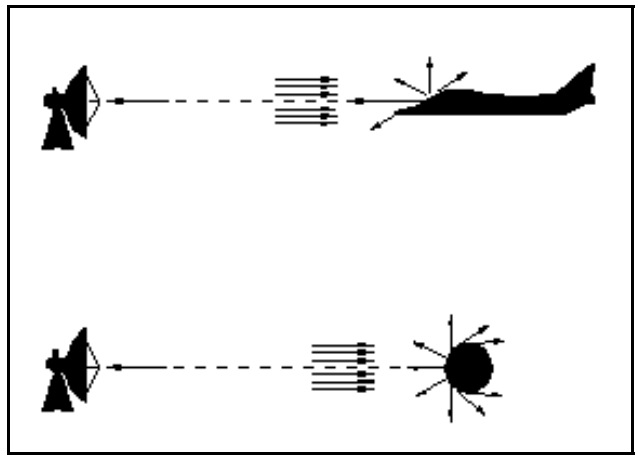

Figure 1. Concept of Radar Cross Section.

The conceptual definition of RCS includes the fact that not all of the radiated energy falls on the target. A target's RCS (σ) is most easily visualized as the product of three factors:

$\boldsymbol{\sigma}$ = **Projected cross section** x Reflectivity x Directivity.

RCS(σ) is used in Section 4-4 for an equation representing power reradiated from the target.

Reflectivity: The percent of intercepted power reradiated (scattered) by the target.

Directivity: The ratio of the power scattered back in the radar's direction to the power that would have been backscattered had the scattering been uniform in all directions (i.e. isotropically).

Figures 2 and 3 show that RCS does not equal geometric area. For a sphere, the RCS, $\boldsymbol{\sigma = \pi r^2}$, where r is the radius of the sphere.

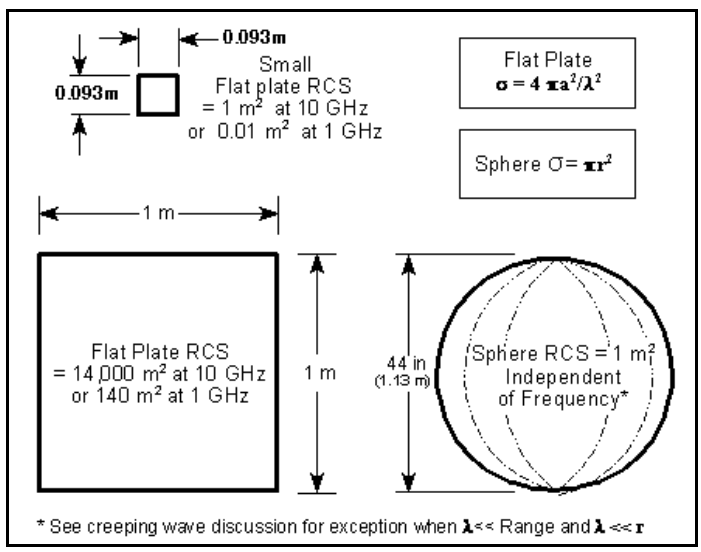

Figure 2. RCS vs. Physical Geometry.

The RCS of a sphere is independent of frequency if operating at sufficiently high frequencies where λ<<Range, and λ<< radius (r). Experimentally, radar return reflected from a target is compared to the radar return reflected from a sphere which has a frontal or projected area of one square meter (i.e. diameter of about 44 in). Using the spherical shape aids in field or laboratory measurements since orientation or positioning of the sphere will not affect radar reflection intensity measurements as a flat plate would. If calibrated, other sources (cylinder, flat plate, or corner reflector, etc.) could be used for comparative measurements.

To reduce drag during tests, towed spheres of 6", 14", or 22" diameter may be used instead of the larger 44" sphere, and the reference size is 0.018, 0.099, or 0.245 m^2 respectively instead of 1 m^2. When

smaller sized spheres are used for tests you may be operating at or near where λ~radius. If the results are then scaled to a 1 m^2 reference, there may be some perturbations due to creeping waves. See the discussion at the end of this section for further details.

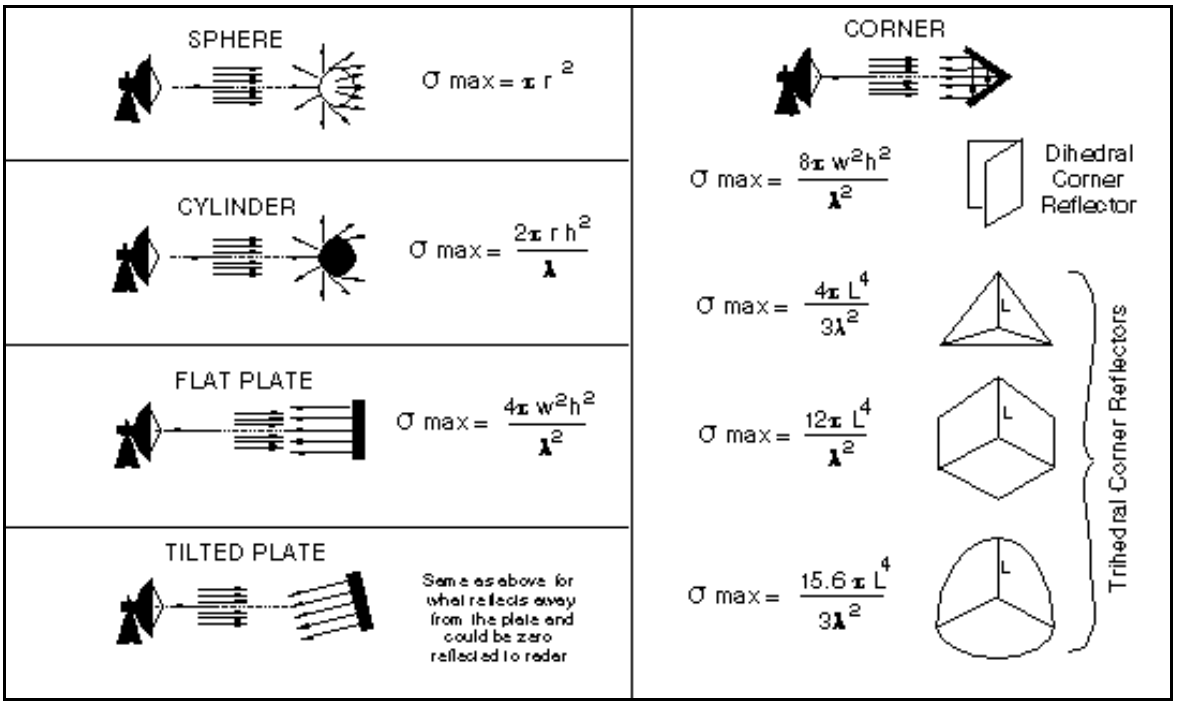

Figure 3. Backscatter From Shapes.

In Figure 4, RCS patterns are shown as objects are rotated about their vertical axes (the arrows indicate the direction of the radar reflections).

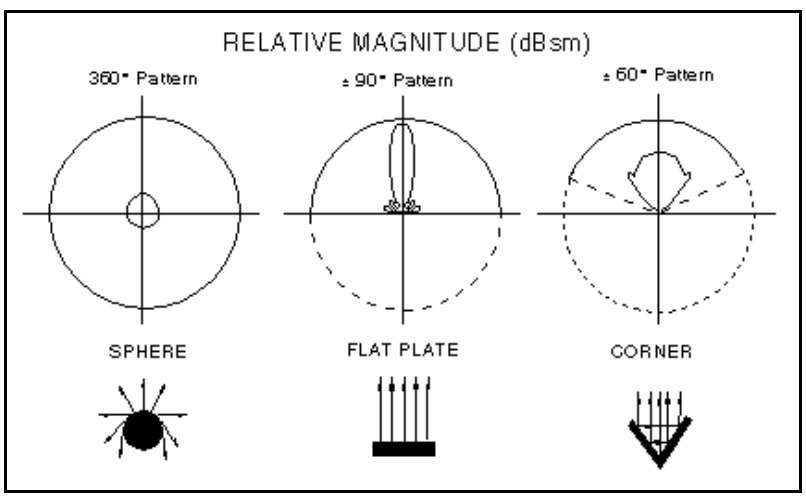

Figure 4. RCS Patterns.

The sphere is essentially the same in all directions.

The flat plate has almost no RCS except when aligned directly toward the radar.

The corner reflector has an RCS almost as high as the flat plate but over a wider angle, i.e., over ±60°. The return from a corner reflector is analogous to that of a flat plate always being perpendicular to your collocated transmitter and receiver.

Targets such as ships and aircraft often have many effective corners. Corners are sometimes used as calibration targets or as decoys, i.e. corner reflectors.

An aircraft target is very complex. It has a great many reflecting elements and shapes. The RCS of real aircraft must be measured. It varies significantly depending upon the direction of the illuminating radar.

Figure 5 shows a typical RCS plot of a jet aircraft. The plot is an azimuth cut made at zero degrees elevation (on the aircraft horizon). Within the normal radar range of 3-18 GHz, the radar return of an aircraft in a given direction will vary by a few dB as frequency and polarization vary (the RCS may change by a factor of 2-5). It does not vary as much as the flat plate.

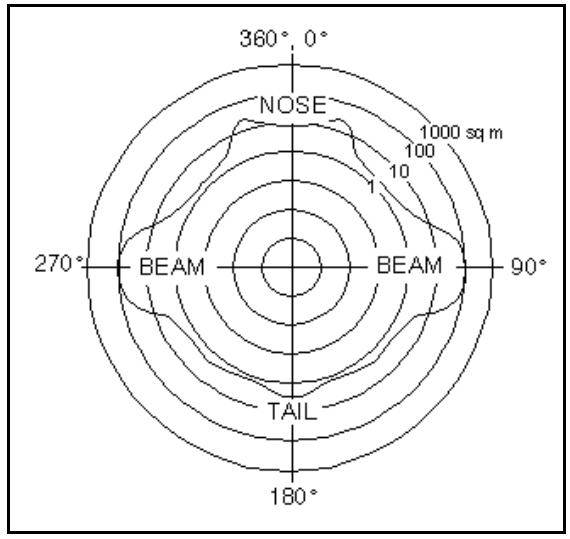

Figure 5. Typical Aircraft RCS.

As shown in Figure 5, the RCS is highest at the aircraft beam due to the large physical area observed by the radar and perpendicular aspect (increasing reflectivity). The next highest RCS area is the nose/tail area, largely because of reflections off the engines or propellers. Most self-protection jammers cover a field of view of +/- 60 degrees about the aircraft nose and tail, thus the high RCS on the beam does not have coverage. Beam coverage is frequently not provided due to inadequate power available to cover all aircraft quadrants, and the side of an aircraft is theoretically exposed to a threat 30% of the time over the average of all scenarios.

Typical radar cross sections are as follows: Missile 0.5 sq m; Tactical Jet 5 to 100 sq m; Bomber 10 to 1000 sq m; and ships 3,000 to 1,000,000 sq m. RCS can also be expressed in decibels referenced to a square meter (dBsm) which equals 10 log (RCS in m^2).

Again, Figure 5 shows that these values can vary dramatically. The strongest return depicted in the example is 100 m^2 in the beam, and the weakest is slightly more than 1 m^2 in the 135°/225° positions. These RCS values can be very misleading because other factors may affect the results. For example, phase differences, polarization, surface imperfections, and material type all greatly affect the results. In the above typical bomber example, the measured RCS may be much greater than 1000 square meters in certain circumstances (90°, 270°).

SIGNIFICANCE OF THE REDUCTION OF RCS

If each of the range or power equations that have an RCS (σ) term is evaluated for the significance of decreasing RCS, Figure 6 results. Therefore, an RCS reduction can increase aircraft survivability. The equations used in Figure 6 are as follows:

Range (radar detection):
From the 2-way range equation in Section 4-4:

$$P_r = \frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R^4}$$ Therefore, $R^4 \propto \sigma$ or $\sigma^{1/4} \propto R$

Range (radar burn-through):
The crossover equation in Section 4-8 has:

$$R_{BT}^2 = \frac{P_t G_t \sigma}{P_j G_j 4\pi}$$ Therefore, $R_{BT}^2 \propto \sigma$ or $\sigma^{1/2} \propto R_{BT}$

Power (jammer): Equating the received signal return (P_r) in the two way range equation to the received jammer signal (P_r) in the one way range equation, the following relationship results:

$$P_r = \frac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R^4} = \frac{P_j G_j G_r \lambda^2}{(4\pi R)^2}$$

$$\uparrow \qquad\qquad \uparrow$$

$$S \qquad\qquad J$$

Therefore, $P_j \propto \sigma$ or $\sigma \propto P_j$

Note: jammer transmission line loss is combined with the jammer antenna gain to obtain G_t.

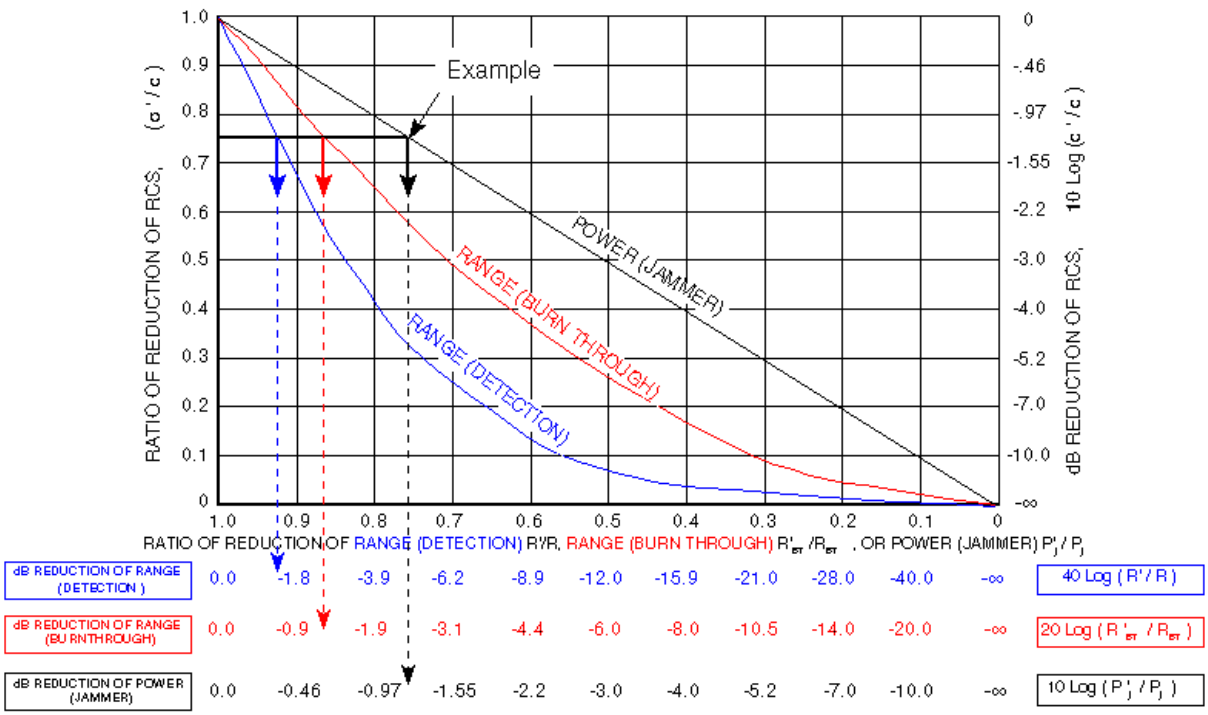

Figure 6. Reduction of RCS Affects Radar Detection, Burn-through, and Jammer Power.

<u>Example of Effects of RCS Reduction</u> - As shown in Figure 6, if the RCS of an aircraft is reduced to 0.75 (75%) of its original value, then (1) the jammer power required to achieve the same effectiveness would be 0.75 (75%) of the original value (or -1.25 dB). Likewise, (2) If Jammer power is held constant, then burn-through range is 0.87 (87%) of its original value (-1.25 dB), and (3) the detection range of the radar for the smaller RCS target (jamming not considered) is 0.93 (93%) of its original value (-1.25 dB).

OPTICAL / MIE / RAYLEIGH REGIONS

Figure 7 shows the different regions applicable for computing the RCS of a sphere. The optical region ("far field" counterpart) rules apply when $2\pi r/\lambda > 10$. In this region, the RCS of a sphere is independent of frequency. Here, the RCS of a sphere, $\sigma = \pi r^2$. The RCS equation breaks down primarily due

to creeping waves in the area where $\lambda \sim 2\pi r$. This area is known as the Mie or resonance region. If we were using a 6" diameter sphere, this frequency would be 0.6 GHz. (Any frequency ten times higher, or above 6 GHz, would give expected results). The largest positive perturbation (point A) occurs at exactly 0.6 GHz where the RCS would be 4 times higher than the RCS computed using the optical region formula. Just slightly above 0.6 GHz a minimum occurs (point B) and the actual RCS would be 0.26 times the value calculated by using the optical region formula. If we used a one meter diameter sphere, the perturbations would occur at 95 MHz, so any frequency above 950 MHz (~1 GHz) would give predicted results.

CREEPING WAVES

The initial RCS assumptions presume that we are operating in the optical region (λ<<Range and λ<<radius). There is a region where specular reflected (mirrored) waves combine with back scattered creeping waves both constructively and destructively as shown in Figure 8. Creeping waves are tangential to a smooth surface and follow the "shadow" region of the body. They occur when the circumference of the sphere ~ λ and typically add about 1 m^2 to the RCS at certain frequencies.

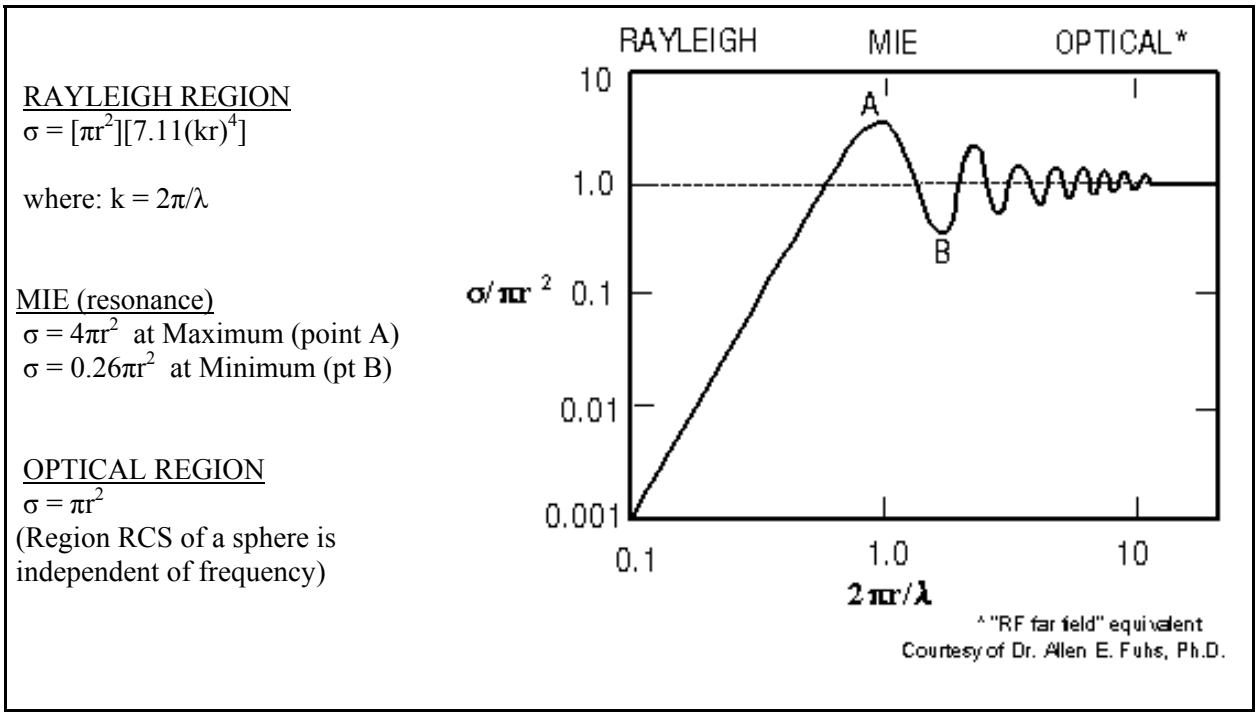

Figure 7. Radar Cross Section of a Sphere.

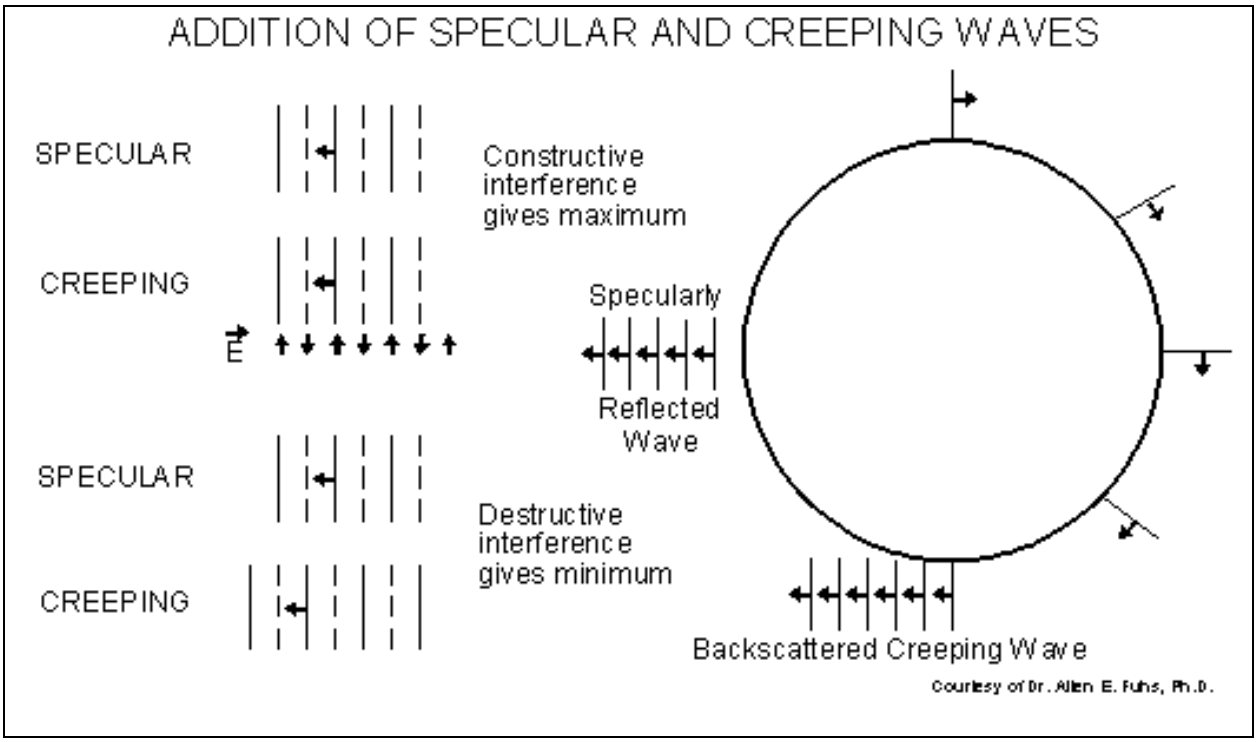

Figure 8. Addition of Specular and Creeping Waves.

EMISSION CONTROL (EMCON)

When EMCON is imposed, RF emissions must not exceed -110 dBm/meter^2 at one nautical mile. It is best if systems meet EMCON when in either the Standby or Receive mode versus just the Standby mode (or OFF). If one assumes antenna gain equals line loss, then emissions measured at the port of a system must not exceed -34 dBm (i.e. the stated requirement at one nautical mile is converted to a measurement at the antenna of a point source - see Figure 1). If antenna gain is greater than line loss (i.e. gain 6 dB, line loss 3 dB), then the -34 dBm value would be lowered by the difference and would be -37 dBm for the example. The opposite would be true if antenna gain is less.

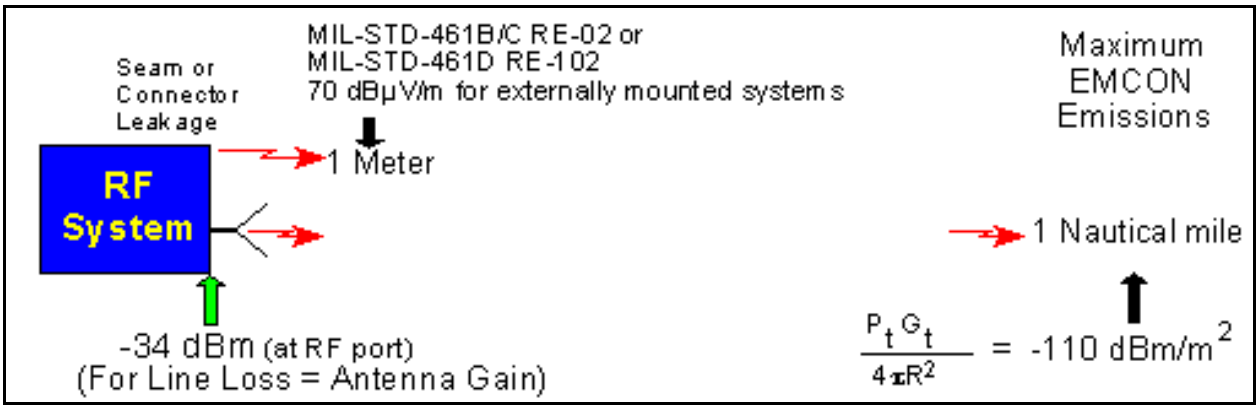

Figure 1. EMCON Field Intensity / Power Density Measurements.

To compute the strength of emissions at the antenna port in Figure 1, we use the power density equation (see Section 4-2)

$$P_D = \frac{P_t G_t}{4\pi R^2} \qquad \textbf{[1]} \qquad \text{or rearranging} \qquad P_t G_t = P_D\,(4\pi R^2) \qquad \textbf{[2]}$$

Given that P_D = -110 dBm/m^2 = $(10)^{-11}$ mW/m^2, and R = 1 NM = 1852 meters.

$$P_t G_t = P_D\,(4\pi R^2) = (10^{-11}\text{mW/m}^2)(4\pi)(1852\text{m})^2 = 4.31(10)^{-4}\text{ mW} = -33.65 \approx -34\text{ dBm}$$

at the RF system antenna as given.

or, the equation can be rewritten in Log form and each term multiplied by 10:

$$10\log P_t + 10\log G_t = 10\log P_D + 10\log (4\pi R^2) \qquad \textbf{[3]}$$

Since the m^2 terms on the right side of equation [3] cancel, then:

$$10\log P_t + 10\log G_t = -110\text{ dBm} + 76.35\text{ dB} = -33.65\text{ dBm} \approx -34\text{ dBm as given in Figure 1.}$$

If MIL-STD-461B/C RE02 (or MIL-STD-461D RE-102) measurements (see Figure 2) are made on seam/connector leakage of a system, emissions below 70 dBµV/meter which are measured at <u>one meter</u> will meet the EMCON requirement. Note that the airframe provides attenuation so portions of systems mounted inside an aircraft that measure 90 dBµV/meter will still meet EMCON if the airframe provides 20 dB of shielding (note that the requirement at one nm is converted to what would be measured at one meter from a point source).

The narrowband emission limit shown in Figure 2 for RE02/RE102 primarily reflect special concern for local oscillator leakage during EMCON as opposed to switching transients which would apply more to the broadband limit.

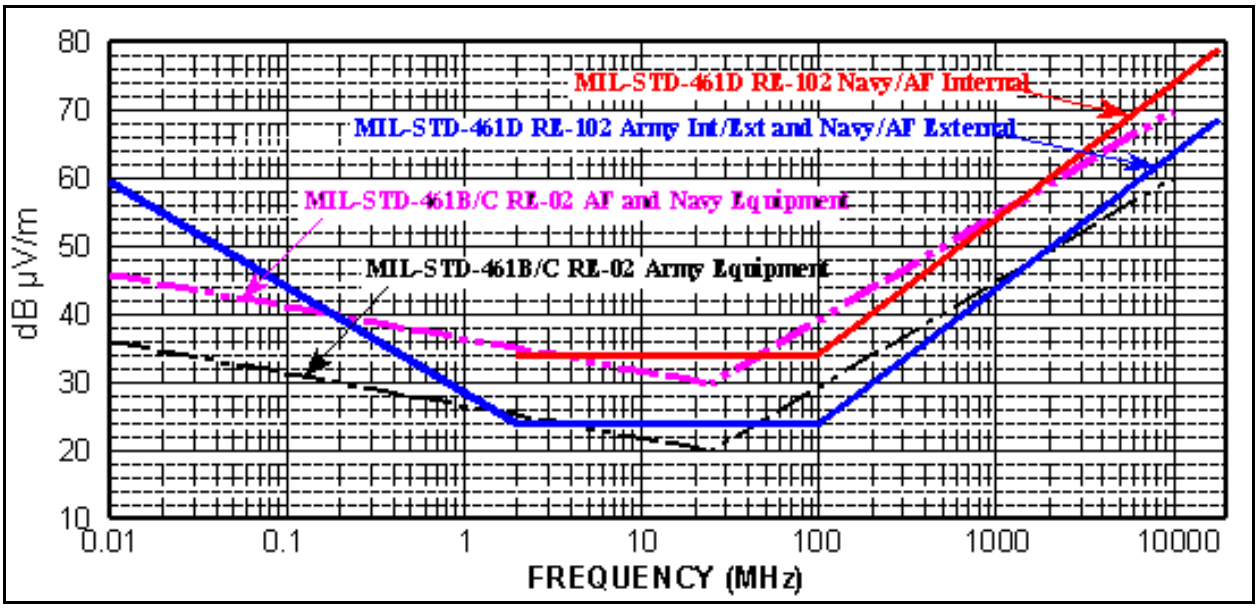

Figure 3. MIL-STD-461 Narrowband Radiated Emissions Limits.

Note that in MIL-STD-461D, the narrowband radiated emissions limits were retitled RE-102 from the previous RE-02 and the upper frequency limit was raised from 10 GHz to 18 GHz. The majority of this section will continue to reference RE02 since most systems in use today were built to MIL-STD-461B/C.

For the other calculation involving leakage (to obtain 70 dBµV/m) we again start with: $P_D = \frac{P_t G_t}{4\pi R^2}$

and use the previous fact that: 10log (P_tG_t) = -33.6 dBm = 4.37×10^{-4} mW (see Section 2-4).

The measurement is at one meter so $R^2 = 1\ m^2$

we have: $\frac{4.37 \times 10^{-4}}{4\pi} mW/m^2 = .348 \times 10^{-4}\ mW/m^2 = -44.6\ dBm/m^2 = P_D$ @ 1 meter

Using the field intensity and power density relations (see Section 4-1)

$$E = \sqrt{P_D Z} = \sqrt{3.48 \times 10^{-8} \bullet 377\Omega} = 36.2 \times 10^{-4}\ V/m$$

Changing to microvolts (1V = 10^6 µV) and converting to logs we have:

20 log (E) = 20 log (10^6 x 36.2×10^{-4}) = 20 log ($.362 \times 10^4$) = 71.18 dBµV/m ≈ <u>70 dBµV/m</u> as given in Figure 1.

Some Words of Caution

A common error is to only use the one-way free space loss coefficient α_1 directly from Figure 6, Section 4-3 to calculate what the output power would be to achieve the EMCON limits at 1 NM. This is incorrect since the last term on the right of equation [3] ($10 \text{ Log}(4\pi R^2)$) is simply the Log of the surface area of a sphere - **it is NOT** the one-way free space loss factor α_1. You cannot interchange power (watts or dBW) with power density (watts/m^2 or dBW/m^2).

The equation uses power density (P_D), **NOT** received power (P_r). It is independent of RF and therefore varies only with range. If the source is a transmitter and/or antenna, then the power-gain product (or EIRP) is easily measured and it's readily apparent if $10\log (P_t G_t)$ is less than -34 dBm. If the output of the measurement system is connected to a power meter in place of the system transmission line and antenna, the -34 dBm value must be adjusted. The measurement on the power meter (dBm) minus line loss (dB) plus antenna gain (dB) must not be higher than -34 dBm.

However, many sources of radiation are through leakage, or are otherwise inaccessible to direct measurement and P_D must be measured with an antenna and a receiver. The measurements must be made at some RF(s), and received signal strength is a function of the antenna used therefore measurements must be scaled with an appropriate correction factor to obtain correct power density.

RE-02 Measurements

When RE-02 measurements are made, several different antennas are chosen dependent upon the frequency range under consideration. The voltage measured at the output terminals of an antenna is not the actual field intensity due to actual antenna gain, aperture characteristics, and loading effects. To account for this difference, the antenna factor is defined as:

$$AF = E/V \qquad \textbf{[4]}$$

where E = Unknown electric field to be determined in V/m (or μV/m)
V = Voltage measured at the output terminals of the measuring antenna

For an antenna loaded by a 50 Ω line (receiver), the theoretical antenna factor is developed as follows:

$$P_D A_e = P_r = V^2/R = V_r^2/50 \text{ or } V_r = \sqrt{50 P_D A_e}$$

From Section 4-3 we see that $A_e = G_r\lambda^2/4\pi$, and from Section 4-1, $E^2 = 377 P_D$ therefore we have:

$$AF = \frac{E}{V} = \frac{\sqrt{377 P_D}}{\sqrt{50 P_D (\lambda^2 G_r / 4\pi)}} = \frac{9.73}{\lambda \sqrt{G_r}} \qquad \textbf{[5]}$$

Reducing this to decibel form we have:

$$20 \log AF = 20 \log E - 20 \log V = 20 \log \left[\frac{9.73}{\lambda \sqrt{GSUBr}} \right] \quad \textit{with } \lambda \textit{ in meters and Gain numeric ratio (not dB)} \qquad \textbf{[6]}$$

This equation is plotted in Figure 3.

Since all of the equations in this section were developed using far field antenna theory, use only the indicated region.

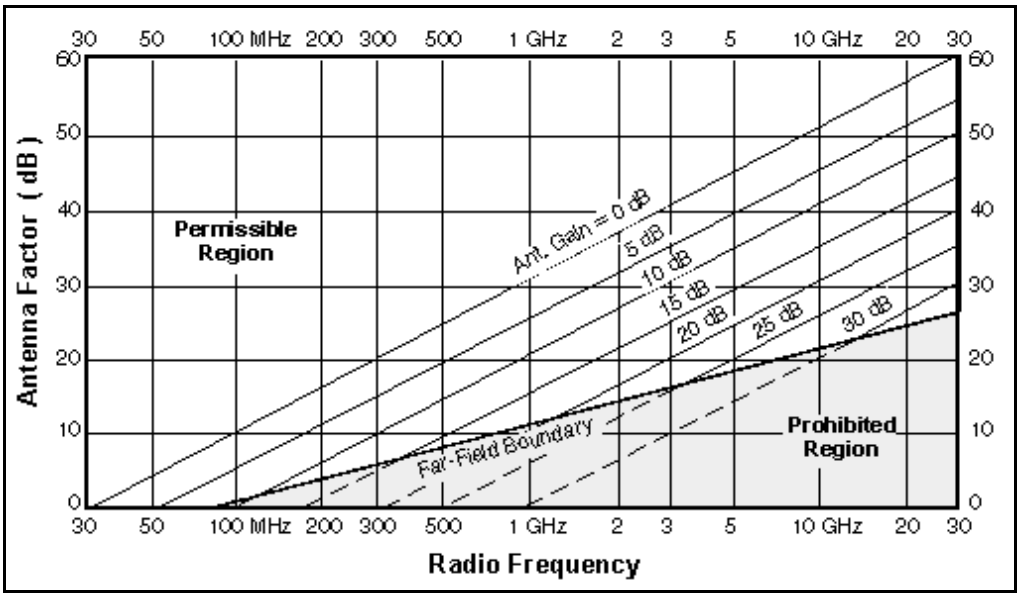

Figure 3. Antenna Factor vs. Frequency for Indicated Antenna Gain.

In practice the electric field is measured by attaching a field intensity meter or spectrum analyzer with a narrow bandpass preselector filter to the measuring antenna, recording the actual reading in volts and applying the antenna factor.

$$20\log E = 20\log V + 20\log AF \qquad \textbf{[7]}$$

Each of the antennas used for EMI measurements normally has a calibration sheet for both gain and antenna factor over the frequency range that the antenna is expected to be used. Typical values are presented in Table 1.

Table 1. Typical Antenna Factor Values.

Frequency Range	Antenna(s) Used	Antenna Factor	Gain(dB)
14 kHz - 30 MHz	41” rod	22-58 dB	0 - 2
20 MHz - 200 MHz	Dipole or Biconical	0-18 dB	0 - 11
200 MHz - 1 GHz	Conical Log Spiral	17-26 dB	0 - 15
1 GHz - 10 GHz	Conical Log Spiral or Ridged Horn	21-48 dB	0 - 28
1 GHz - 18 GHz	Double Ridged Horn	21-47 dB	0 - 32
18 GHz - 40 GHz	Parabolic Dish	20-25 dB	27 - 35

The antenna factor can also be developed in terms of the receiving antenna's effective area. This can be shown as follows:

$$AF = \frac{E}{V} = \frac{\sqrt{377\ P_D}}{\sqrt{50\ P_D\ A_e}} = \frac{2.75}{\sqrt{A_e}} \qquad \textbf{[8]}$$

Or in log form:

$$20 \log AF = 20 \log E - 20 \log V = 20 \log \left[\frac{2.75}{\sqrt{A_e}} \right] \qquad \textbf{[9]}$$

While this relation holds for any antenna, many antennas (spiral, dipole, conical etc.) which do not have a true "frontal capture area" do not have a linear or logarithmic relation between area and gain and in that respect the parabolic dish is unique in that the antenna factor does not vary with frequency, only with effective capture area. Consequently a larger effective area results in a smaller antenna factor.

A calibrated antenna would be the first choice for making measurements, followed by use of a parabolic dish or "standard gain" horn. A standard gain horn is one which was designed such that it closely follows the rules of thumb regarding area/gain and has a constant antenna factor. If a calibrated antenna, parabolic dish, or "standard horn" is not available, a good procedure is to utilize a flat spiral antenna (such as the AN/ALR-67 high band antennas). These antennas typically have an average gain of 0 dB (typically -4 to +4 dB), consequently the antenna factor would not vary a lot and any error would be small.

EXAMPLE:

Suppose that we want to make a very general estimation regarding the ability of a system to meet EMCON requirements. We choose to use a spiral antenna for measurements and take one of our samples at 4 GHz. Since we know the gain of the spiral is relatively flat at 4 GHz and has a gain value of approximately one (0 dB) in that frequency range. The antenna is connected to a spectrum analyzer by 25 feet of RG9 cable. We want to take our measurements at 2 meters from the system so our setup is shown as follows:

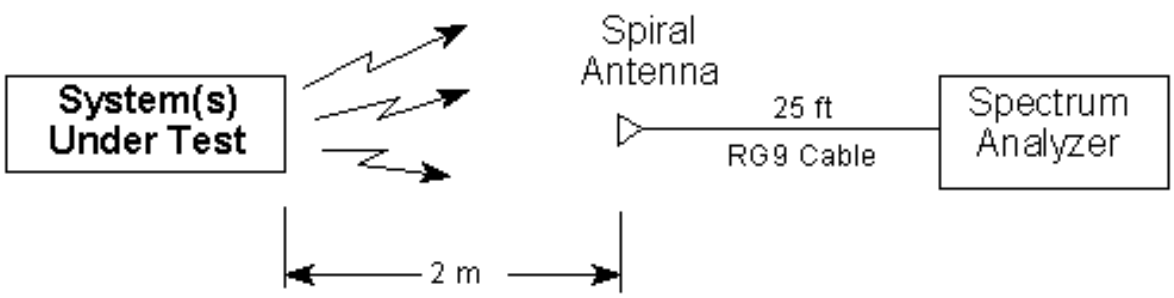

Our RG9 cable has an input impedance of 50Ω, and a loss of 5 dB (from Figure 5, Section 6-1).

First, let's assume that we measure -85 dBm at the spectrum analyzer and we want to translate this into the equivalent strength at 1 NM. Our power received by the antenna is: P_r = -85 dBm + 5 dB line loss = -80 dBm

also $P_D = P_r/A_e$ and $A_e = G\lambda^2/4\pi = (G/4\pi)\bullet(c/f)^2 = (1/4\pi)\bullet(3x10^8/4x10^9)^2 = 4.47x10^{-4}$ m^2

in log form: $10 \text{ Log } P_D = 10 \text{ Log } P_r - 10 \text{ Log } A_e = -80 \text{ dBm} + 33.5 = -46.5 \text{ dBm/m}^2$
at our 2 meter measuring point

To convert this to a value at 1 NM, we use

$P_t G_t = P_{D@1\ nm}\ 4\pi R_1^2 = P_{D@2\ m}\ 4\pi R_2^2$ and we solve for $PD@1_{nm}$

in log form after cancelling the 4π terms:

$10 \text{ Log } P_{D@1\ nm} = 10 \text{ Log } P_{D@2\ m} + 10 \text{ Log } (R_{2m}/R_{1nm})^2 = -46.5 \text{ dBm/m}^2 - 59.3 \text{ dB} = -105.8 \text{ dBm/m}^2$
which is more power than the maximum value of -110 dBm/m^2 specified.

If we are making repetitive measurement as we might do when screening an aircraft on the flight line with numerous systems installed, or when we want to improve (reduce) the leakage on a single system by changing antennas, lines, connectors, or EMI gaskets or shielding, this mathematical approach would be unnecessarily time consuming since it would have to be repeated after each measurement. A better approach would be to convert the -110 dBm/m^2 value at 1 NM to the maximum you can have at the measuring instrument (in this case a spectrum analyzer), then you could make multiple measurements and know immediately how your system(s) are doing. It should be noted that -90 to -100 dBm is about the minimum signal level that can be detected by a spectrum analyzer, so you couldn't take measurements much further away unless you used an antenna with a much higher gain.

In order not to exceed EMCON, the power density must not exceed -110 dBm/m^2 at 1 NM, which is 10^{-11} mW/m^2.

$$P_t G_t = P_{D@1\ nm}\ 4\pi R_1^2 = P_{D@2\ m}\ 4\pi R_2^2$$

we solve for $P_{D@2\ m} = 10^{-11}(1852m)^2/(2m)^2 = 8.57 \times 10^{-6}\ mW/m^2 = -50.7\ dBm/m^2$

We'll be using a spectrum analyzer, so we want to compute what the maximum power or voltage may be.

<u>Method 1 - Using the Power Density Approach</u>

Using logs/dB and the values of $P_{D@2\ m}$ and A_e determined previously:
$10 \text{ Log } P_r = 10 \text{ Log } P_D + 10 \text{ Log } A_e = -50.7 - 33.5 = -84.2 \text{ dBm}$

taking line loss into account we have: -84.2 - 5 dB = <u>- 89.2 dBm</u> as the maximum measurement reading.

If we wanted to calculate it in volts, and take into account our line impedance we would have the following:

$P_r = P_D A_e = V^2/R = V^2/50\Omega$ also $A_e = G\lambda^2/4\pi$ so solving for V we have:

$$V = \sqrt{P_D\left[\frac{G_r\lambda^2}{4\pi}\right]R} = \sqrt{P_D\left[\frac{G_r}{4\pi}\left(\frac{c}{f}\right)^2\right]R} = \sqrt{8.57x\,10^{-9}\left[\frac{1}{4\pi}\left(\frac{3x\,10^8}{4x\,10^9}\right)^2\right]50\Omega} = 1.38x\,10^{-5}\ volts \quad (before\ line\ loss)$$

since our line loss is 5 dB, we have -5 dB = 20 Log V_2/V_1. Solving for V_2 we get <u>$7.79x10^{-6}$ volts</u> or <u>-89 dBm</u> as a maximum at our measurement device input. We can see immediately that our value of -85 dBm that we measured on the previous page would not meet specifications, and neither would any signal with more power than -89 dBm.

<u>Method 2 - Using the Antenna Factor Approach</u>

Starting with the same value of power density that we obtained above ($8.57x10^{-9}$ W/m^2), we find the field intensity from Table 1, Section 4-1 to be approximately 65 dBμv/m. Also from Figure 3 in this section, AF = 43 dB @ 4 GHz (by calculating with equation [6], the exact value is 42.3 dB).

From equation [6]:
20log V = 20log E - 20log AF
20log V = 65 - 43 = 22 dBμv/m.

Since dBμv/m = 20 log (V)(10^6) = 20 log V + 20 log 10^6 = 20 log V + 120, we see that to get an answer in dBv we must subtract 120 from the dBμv/m value so: V_{dB} = 22 - 120 = -98dBv. We then subtract our line loss (-5 dB) and we have:

V = -98 - 5 = -103 dBv = 17 dBμv = <u>$7.1x10^{-6}$ volts</u>

using the fact that $P = V^2/R$ and for the input line R = 50Ω, P = $1x10^{-12}$ W = -120 dBW = <u>-90 dBm</u>

Although this method is just as accurate as that obtained using method 1, the values obtained in Table 1, Section 4-1, and Figure 3 must be interpolated, and may not result in values which are as precise as the appropriate formulas would produce.

<u>Sample Problem:</u> What is the approximate transmit power from a receiver?

A.	1 nanowatt (nW)	F.	100 μW	K.	10 W
B.	10 nW	G.	1 milliwatt (mW)	L.	100 W
C.	100 nW	H.	10 mW	M.	1 kilowatt (kW)
D.	1 microwatt (μW)	I.	100 mW	N.	10 kW
E.	10 μW	J.	1 watt (W)	O.	100 kW

The question may seem inappropriate since a receiver is supposedly a passive device which only receives a signal. If the receiver was a crystal video receiver as shown in Section 5-3, it wouldn't transmit power unless a built-in-test (BIT) signal was injected after the antenna to periodically check the integrity of the microwave path and components. The potential exists for the BIT signal to leak across switches and couple back through the input path and be transmitted by the receiver's antennas.

If the receiver uses a local oscillator (LO) and a mixer to translate the signal to an intermediate frequency (IF) for processing (such as a superhet shown in Section 5-3), there is the potential for the CW LO signal to couple back through the signal input path and be transmitted by the receiver's antenna. Normally a mixer has 20 dB of rejection for the reverse direction. In addition, the LO may be further attenuated by receiver front end filters.

In both cases, the use of isolators described in Section 6-7 could be used to further attenuate any signals going in the reverse direction, i.e. back to the antenna. A good receiver design should ensure that any RF leakage radiated by the receiver will not exceed the EMCON level.

In answer to the initial question, "transmit" leakage power should be less than -34 dBm (0.4 μW) to meet EMCON. Therefore, the real answer may be "A," "B," or "C" if EMCON is met and could be "D" through possibly "G" if EMCON is not met.

EW JAMMING TECHNIQUES

INTRODUCTION

Electronic jamming is a form of Electronic Attack where jammers radiate interfering signals toward an enemy's radar, blocking the receiver with highly concentrated energy signals. The two main technique styles are noise techniques and repeater techniques. The three types of noise jamming are spot, sweep, and barrage. Repeater techniques can be further subdivided into categories as shown in Figure 1.

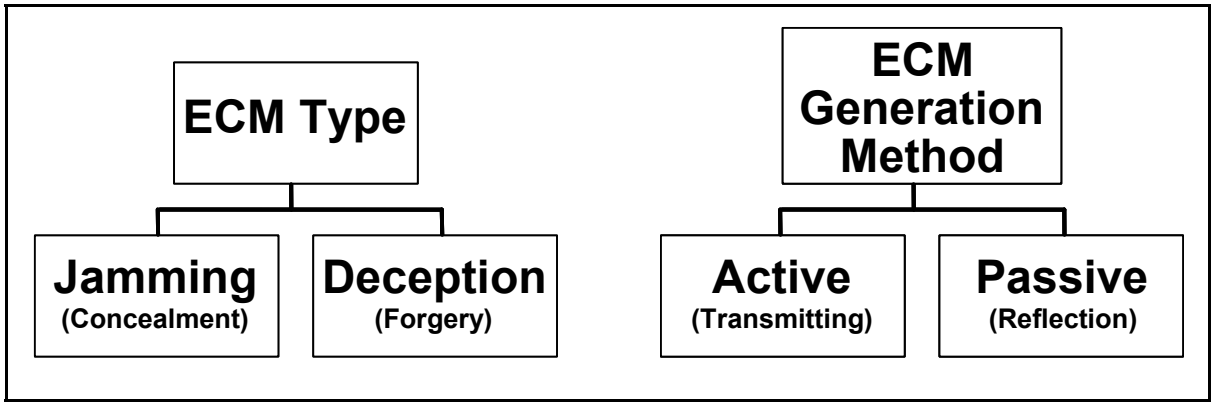

Figure 1. EA Repeater Technique Divisions.

ASYNCHRONOUS SWEPT WAVE MODULATION (ASWM)

ASWM is synonymous with A-SWM. Asynchronous indicates that the waveform is free running - also see SSWM. A swept wave modulation is essentially a swept amplitude modulation (SAM). It is a waveform that is swept between two frequencies that are usually chosen to bracket a radar's passive angle scanning rate. The modulation amplitude can be either down modulated or On-Off Keyed (OOK). The down modulated shape can be square wave, rectangular wave, linear (e.g. a sine wave), or a combination. The OOK modulated shape can be square wave or rectangular wave.

BARRAGE JAMMING

The jamming of multiple frequencies at once by a single jammer. The advantage is that multiple frequencies can be jammed simultaneously; however, the jamming effect can be limited because this requires the jammer to spread its full power between these frequencies. So the more frequencies being jammed, the less effectively each is jammed.

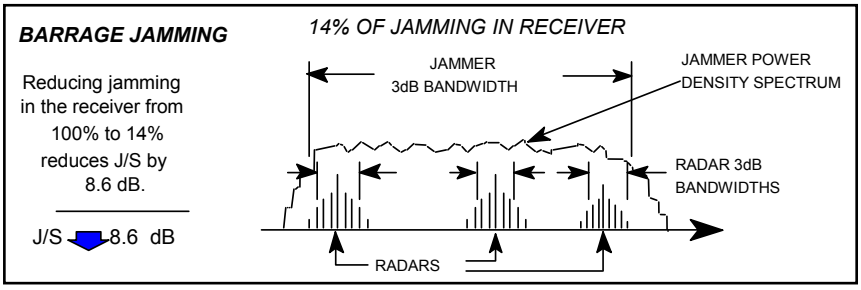

Figure 2. Barrage Jamming.

CROSS POLARIZATION (X-POL)

(1) A self-screening or support EA technique that causes angle errors in tracking radars and sensing errors in jamming suppression EP systems of surveillance radars by radiating a signal that is orthogonally polarized to the principal polarization of the victim radar. (2) A technique used against monopulse and other passive lobe tracking radars. Requires a strong jam-to-signal ratio or the skin echo will show up in the pattern nulls.

HOME ON JAM (HOJ)

A means whereby a missile guidance receiver utilizes the self-screening target jamming signal to develop angular steering information so that the missile can home on that target.

IMAGE JAMMING

Jamming at the image frequency of the radar receiver. Barrage jamming is made most effective by generating energy at both the normal operating and image frequency of the radar. Image jamming inverts the phase of the response and is thereby useful as an angle deception technique. Not effective if the radar uses image rejection.

INVERSE CON SCAN (ICS)

One method of confusing a radar operator or fire control radar system is to provide erroneous target bearings. This is accomplished by first sensing the radar antenna or antenna dipole scan rate and then modulating repeater amplifier gain so that the weapons system will fire at some bearing other than the true target bearing.

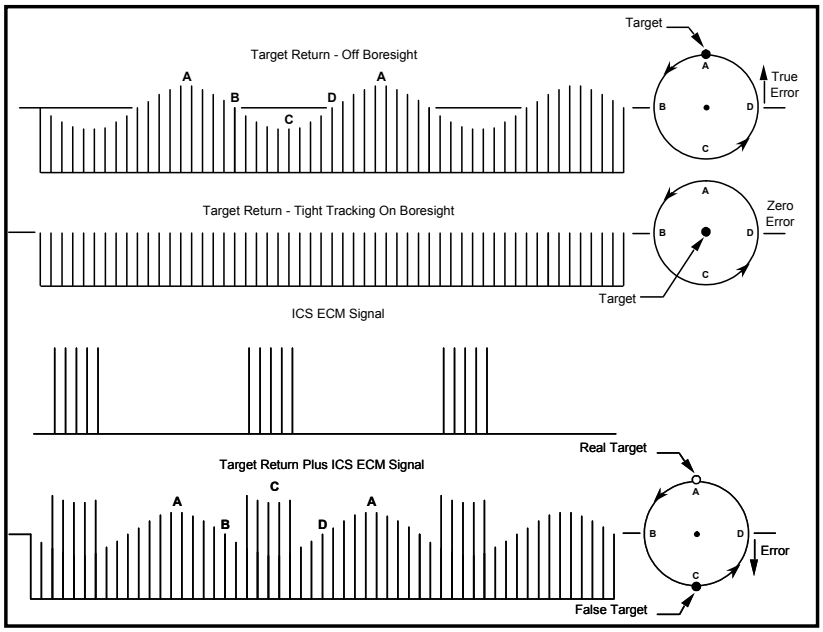

Figure 3. Inverse Con Scan.

J/S REQUIREMENT

The jamming to signal ratio for effective coverage of the true target. Usually on the order of zero dB (J/S=1).

LINEAR MODULATION

A modulation technique in which the output varies in a straight line (linear) manner with the input (modulating) waveform. This is different from a discontinuous (On-Off) modulation. Typically the modulating waveform is a ramp or triangular wave but could also be a sine wave modulating input.

LOBE ON RECEIVE ONLY (LORO)

Predicting the future location of a target (to track) requires that the radar look at areas where the target is not located. When this scanning is accomplished with the radiated beam, large angle targets such as chaff clouds can create complete radar "white-out." RWR indications can be obtained before actual target lock-on. These problems can be overcome by scanning only the receiving antennas and using a separate transmitting antenna pointed only at the target.

In a LORO system, a transmitting antenna emits a few "exploratory" pulses along a direction obtained from an acquisition radar. These exploratory pulses are the acquisition mode of the TTR. That is, in its acquisition mode the small beamed TTR must scan the large location segment provided by the acquisition radar. In radars equipped with Fast Time Constant, the return pulse is applied to a differentiator of extremely short time constant. When the pulse is received, it is "cut-off" on the leading edge and only that portion is fed to the computer. This allows the radar to effectively track on the leading edge of the target. FTC does not improve the range resolution but it can prevent any countermeasures aft of the target which are in the same resolution cell as the target (such as chaff) from interfering with the radar receiver.

The receiving antennas scan their sector for the target return due to these exploratory pulses; as the power centroid is located, the center of the receiving pattern is brought onto the target. The transmitting antenna, which is slaved to the receiving antenna, is then pointing directly at the desired target and only that target is radiated during tracking. This approach allows a very small radiated beam, but the resolution cell of the system is still that of the receiving antenna.

NOISE JAMMING

The transmission of noise-like signals in the target system's radar receiver bandpass. At low power levels, noise jamming has the characteristics of receiver noise and can be mistaken by the radar operator as a problem with the radar. The object of noise jamming is to introduce a disturbing signal into the hostile electronic equipment so that the actual signal is obscured by the interference. The victim of this disturbance might be a radar receiver, a communications network, or a data link.

See also Barrage Jamming and Spot Jamming.

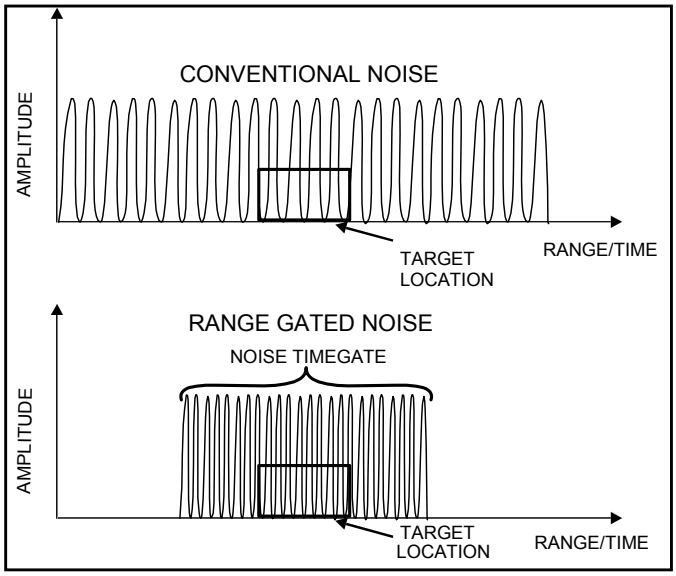

Figure 4. Noise Jamming.

ON-OFF MODULATION

On-Off Modulation is any modulation which switches rapidly between two states. This definition includes pulse radar operation.

On-Off Keying (OOK) is the envelope modulation of a jamming signal with a rectangular wave. The modulation rate and duty cycle are adjusted commensurate with the victim radar's processing time constants. These can be related to AGC time constants, logic time-outs, data sampling cycles, or any other data processing response times.

An important distinction must be made between the terms On-Off Keying and Blinking. While both terms involve envelope modulations that turn a jamming signal on and off, the term OOK is used as the envelope modulation of a single jamming signal, and the term blinking is used as the tactical application of OOK involving two or more cooperative jamming platforms.

PSEUDO RANDOM NOISE (PRN)

A controlled, noise-like, pulse pattern repeated in synchronism with the victim radar pulse repetition frequency. Synonymous with quasi-noise jamming.

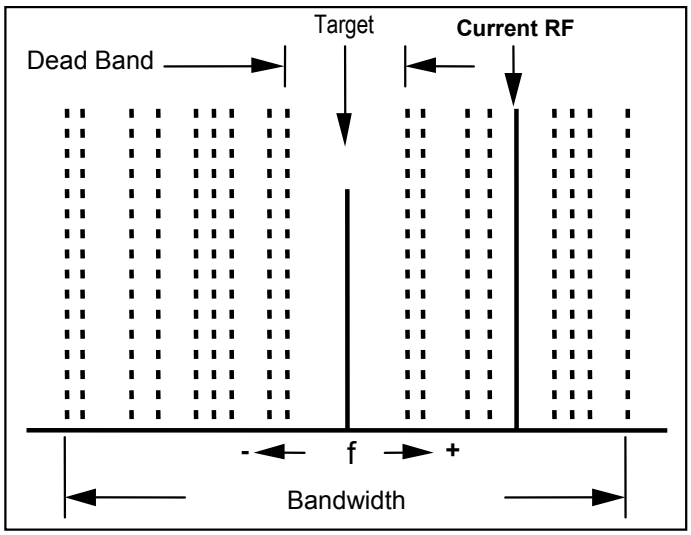

Figure 5. Random Dual Line.

RANDOM DUAL LINE (RDL)

RDL is a coherent repeater technique that is essentially the same as velocity noise (VN), narrow band noise (NBN), and pseudo random noise (PRN) except that no false Doppler frequencies are stepped directly over the target return. The objective is to prevent the momentary additions of the EA signal and target signal that might highlight the presence of a coherent return.

RANDOM RANGE PROGRAM (RANRAP)

A dynamic False Target Jamming technique program to create multiple realistic targets of varying size and distance from the jamming plane.

RANGE GATE PULL OFF (RGPO)

Once a tracking radar has detected a target, it will place *range gates* to either side of it. Range gates essentially blank out all signals which originate from ranges outside a narrow window, substantially increasing the signal-to-noise ratio and protecting the radar against unsynchronized jamming pulses. The radar 'concentrates' on a short range interval which encloses the target's location, and it no longer looks out for other targets. This state is known as 'lock-on'. But range gates can be 'stolen', and it is the objective of the Range Gate Pull-Off (RGPO) technique to *break lock* and escape from out of the window.

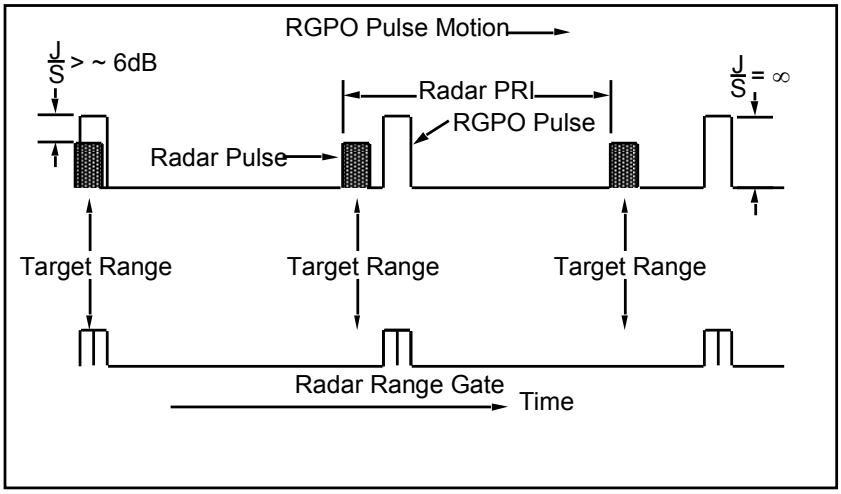

Figure 6. Range Gate Pull Off.

RGPO works as follows:

Upon detection (or assumption) that a tracking radar has locked on, the on-board jammer is switched on and starts to work in a couple of phases:

1. First, a sample of the illuminating pulse signal is taken and the radar's <u>pulse repetition frequency</u> (PRF) is determined. This sample is amplified and retransmitted simultaneously when further pulses are received. The aircraft actually highlights itself on the radar screen. The jamming power is steadily increased, and this continues until the replica is much stronger than the echo from the aircraft skin return. At this time, the sensitivity of the tracking radar's receiver is usually reduced in order to avoid overload. This causes the skin echo vanishes below the noise floor.

2. *Another* replica is transmitted after each of the 'dummy' skin echoes. The power of the second replica is increased while the dummy is made weaker.

3. Next, the tracker has locked on to the *delayed replica*, whereas the skin return has decreased into the noise. With respect to each of the radar's pulses, the replica is now being delayed by small, but increasing amounts of time. The range gates, of course, follow the dummy target which appears to be receding. This continues until the range gates have been moved away from the target's real position. The result is that the radar is tracking a *phantom target* and the skin return is being blanked out by the range gates.

4. Finally, the jammer is switched off and leaves the radar with just *nothing* but noise inside the window between its range gates. Break-lock was successfully achieved and the "tracking" radar needs to

switch back into a search or acquisition mode and loses time. The whole cycle will start again if the target is still within range and is reacquired.

As described above, RGPO creates only false targets which appear at greater ranges than the real target because the deceptive signal is transmitted *after* the skin echo. However, if the victim radar's PRF is constant then the time of incidence of the next radar pulse can be calculated and jamming pulses can be placed such that false targets at closer ranges are also produced.

SCINTILLATION (SCINT)

Scintillation is not an EA technique by itself, it is an implementation of an EA technique. Scintillation is simply superimposing a small, pseudo random amplitude modulation on the EA signal to make it appear more realistic to a manual operator.

SPOT JAMMING

Occurs when a jammer focuses all of its power on a single frequency. While this would severely degrade the ability to track on the jammed frequency, a frequency agile radar would hardly be affected because the jammer can only jam one frequency. While multiple jammers could possibly jam a range of frequencies, this would consume a great deal of resources to have any effect on a frequency-agile radar, and would probably still be ineffective

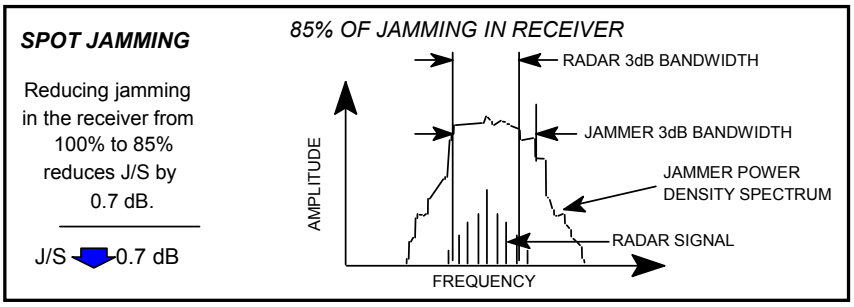

Figure 7. Spot Jamming.

SWEPT JAMMING

This happens when a jammer's full power is shifted from one frequency to another. While this has the advantage of being able to jam multiple frequencies in quick succession, it does not affect them all at the same time, and thus limits the effectiveness of this type of jamming. Although, depending on the error checking in the receiver(s) this can render a wide range of receivers effectively useless.

SWEPT AMPLITUDE MODULATION (SAM)

The OOK frequency is linearly varied in a sawtooth fashion between preset frequency limits while the duty factor is held constant.

SWEPT WAVE MODULATION (SWM)

A swept wave modulation.2 (SWM.2) is essentially a swept amplitude modulation (SAM). It is a waveform that is swept between two frequencies that are usually chosen to bracket a radar's passive angle scanning rate. SWM can be either Synchronous Swept Wave Modulation.2-; (S-SWM) or Asynchronous Swept Wave Modulation.2-; (A-SWM.2-;). The modulation amplitude can be either down modulated or On-Off Keyed (OOK). The down modulating shape can be square wave, rectangular wave, linear (e.g. a sine wave), or a combination. The OOK modulating shape can be square wave or rectangular wave.

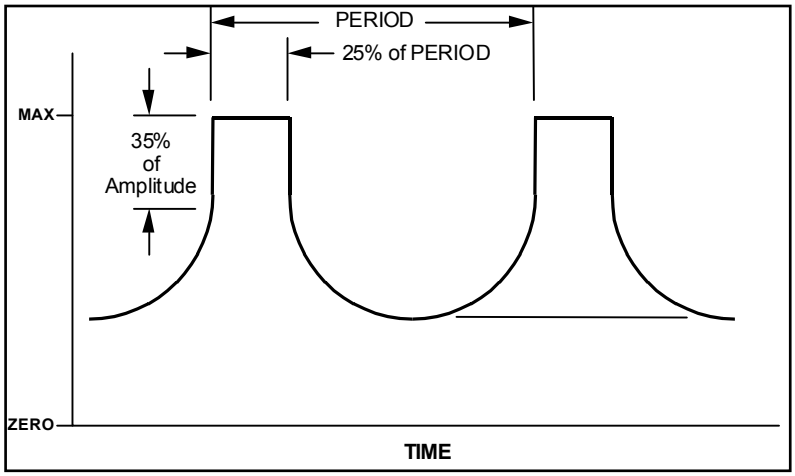

Figure 8. Typical Linear SWM Modulation.

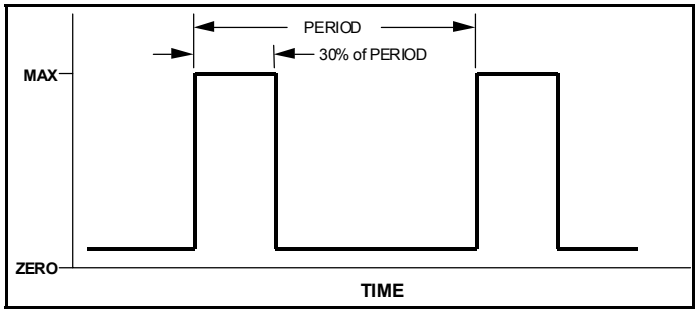

Figure 9. Rectangular SWM.

SYNCHRONOUS SWEPT WAVE MODULATION (SSWM)

SSWM is synonymous with S-SWM. S-SWM and A-SWM are essentially the same except that asynchronous means that the waveform is free running and synchronous means that when a radar scan or TWS beam can be detected, the modulation waveform is synchronized to the detected beam. For programming purposes A-SWM sets sweep limits and rate by frequency (Hz), while S-SWM sets them by period (mSec).

Active Con-Scan radars will not have a detectable modulation if the target is being tightly tracked in the center of the beam. Therefore, a SWM can "jog" the tracking sufficiently to detect the modulation and allowing subsequent synchronization of the SWM waveform.

TRACK WHILE SCAN JAMMING

The technique of shifting or "walking" EA pulses off target. Many angle jamming techniques are effective.

VELOCITY FALSE TARGETS (VFT)

VFT is a pseudo-random false Doppler target concealment technique. It is designed for use against radars that acquire Doppler targets with a bank of contiguous narrow band filters. A false Doppler target is programmed to remain in a Doppler filter long enough for the radar processing to declare it a valid target return, but not long enough for the radar processing to establish tracking.

The false Doppler target is then switched to the next pseudo-randomly selected frequency and repeated. It is intended to overload the radar processing and/or the operator's ability to identify an actual target. In the illustration, the VFTs jump around in the indicated numerical order.

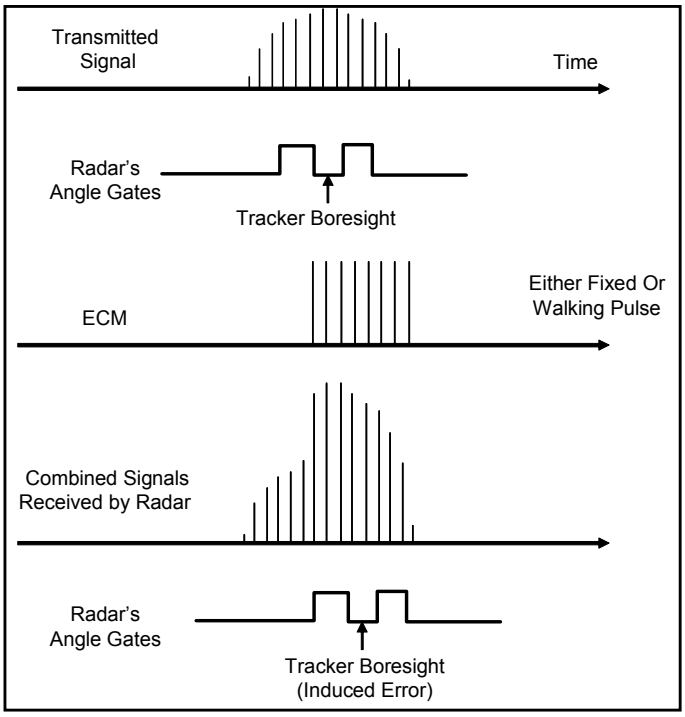

Figure 10. TWS Jamming.

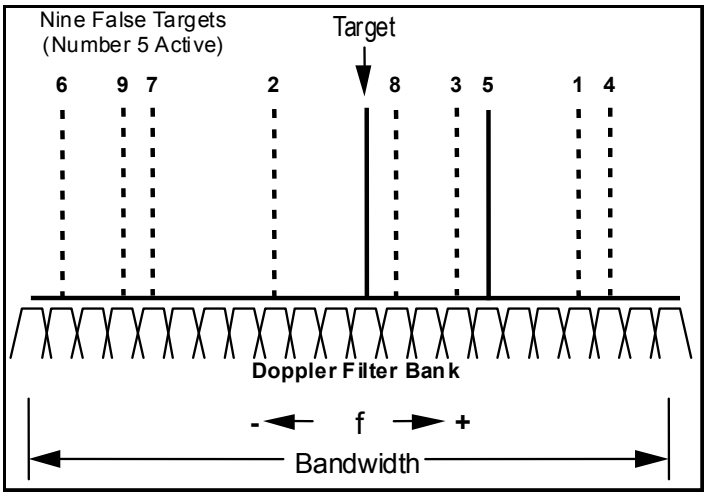

Figure 11. Velocity False Targets.

VELOCITY GATE PULL OFF

This is a method of capturing the velocity gate of a Doppler radar and moving it away from the skin echo. Similar to the RGPO, but used against CW or Doppler velocity tracking radar systems. The CW or pulse doppler frequency, which is amplified and retransmitted, is shifted in frequency (velocity) to provide an apparent rate change or Doppler shift.

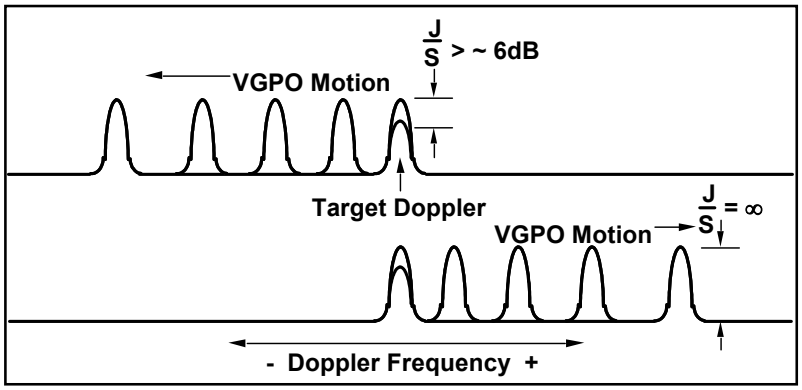

Figure 12. Velocity Gate Pull Off.

VELOCITY NOISE (VN)

VN is a coherent repeater technique. The objective is to create noise centered on a coherent radar's RF, with a noise bandwidth that is close to, or less than, the radar's bandwidth and conceal the target, or destroy target signal coherency. VN is generated by pseudo randomly stepping a frequency over the victim radar's bandwidth. The dashed RF lines represent possible frequencies and the solid line represents the frequency currently active.

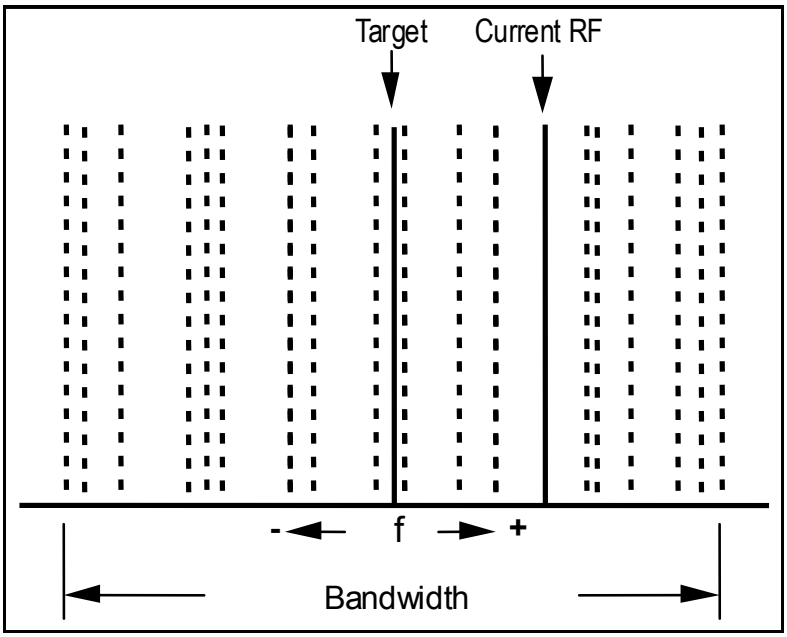

Figure 13. Velocity Noise.

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RADAR AND RECEIVER CHARACTERISTICS & TEST

RF Atmospheric Absorption / Ducting 5-1
Receiver Sensitivity / Noise 5-2
Receiver Types and Characteristics 5-3
Radar Modes 5-4
General Radar Display Types 5-5
IFF - Identification - Friend or Foe 5-6
Receiver Tests 5-7
Signal Sorting and Direction Finding 5-8

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RF ATMOSPHERIC ABSORPTION / DUCTING

Signal losses are associated with each stage of signal processing in both the transmitting and receiving portions of the system. The transmitting losses include power transmission efficiency, waveguide and antenna losses, and duplexer losses. In the receiver, losses include antenna, waveguide, RF amplifier, mixer, and IF amplifier.

In addition to these losses, energy traveling through the atmosphere suffers from atmospheric attenuation caused primarily by absorption by the gasses. For lower frequencies (below 10 GHz), the attenuation is reasonably predictable. For high frequencies in the millimeter wave range, the attenuation not only increases, but becomes more dependent upon peculiar absorbing characteristics of H_2O, O_2, and the like.

Figure 1 shows the areas of peak absorption in the millimeter wave spectrum. Figure 2 shows how the intensity of precipitation can affect atmospheric attenuation.

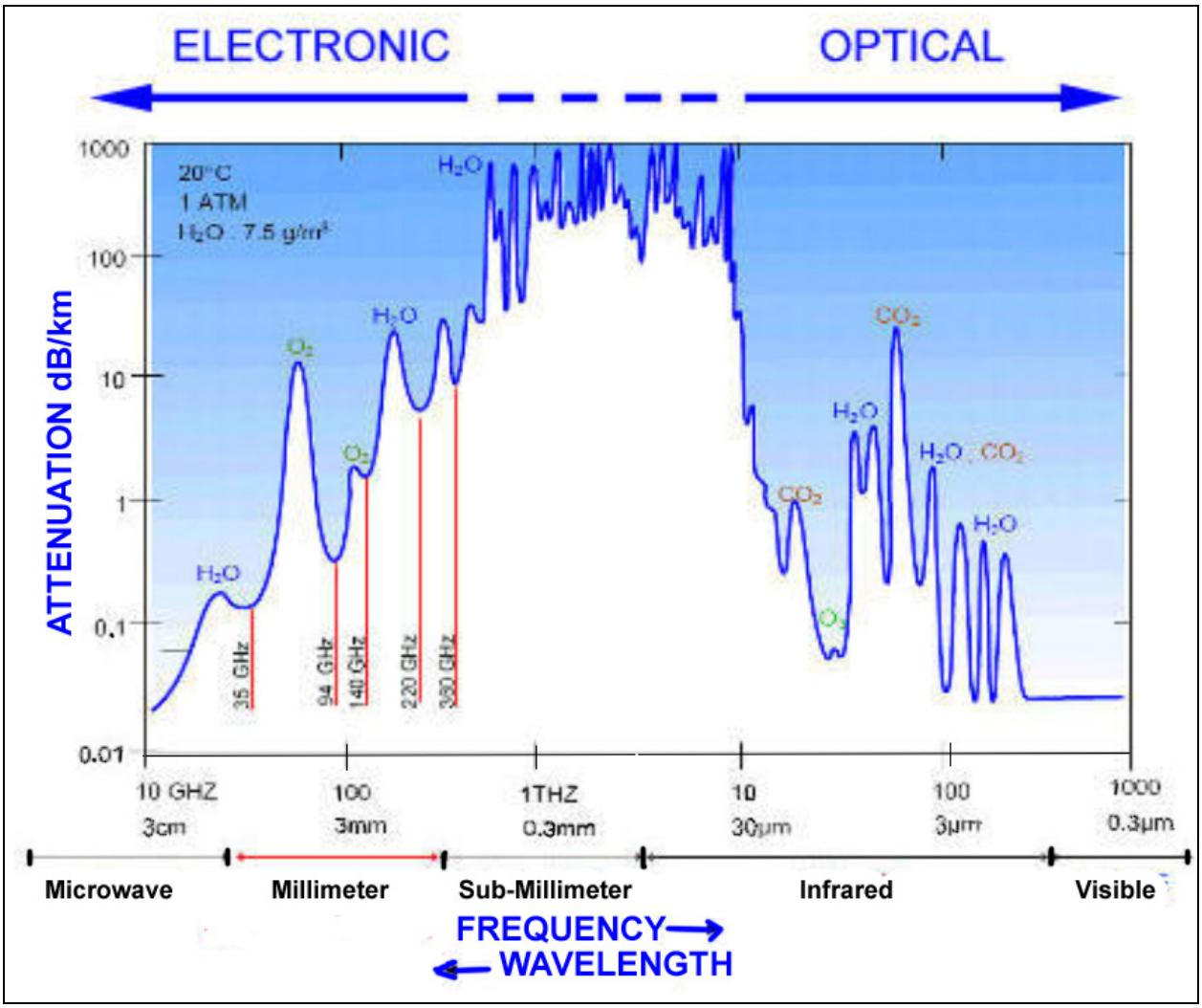

Figure 1. Atmospheric Absorption of Millimeter Waves.

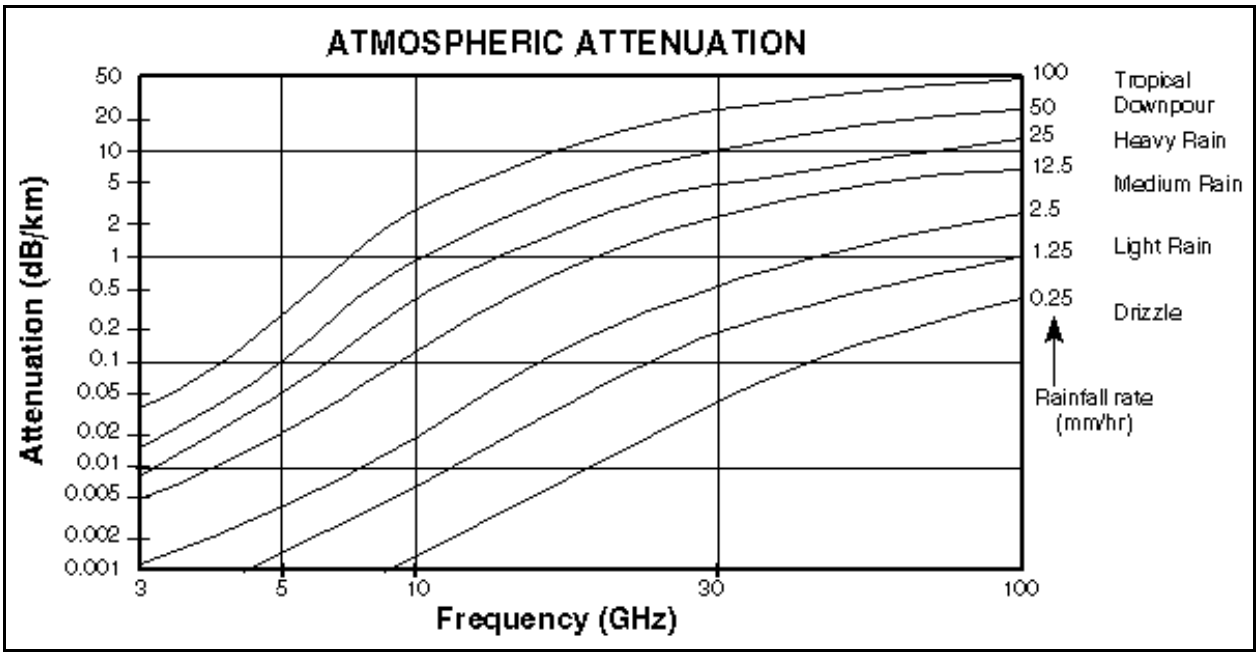

Figure 2. Atmospheric Attenuation.

Ducting is an increase in range that an electromagnetic wave will travel due to a temperature inversion of the lower atmosphere (troposphere) as shown in Figure 3. The temperature inversion forms a channel or waveguide (duct) for the waves to travel in, and they can be trapped, not attenuating as would be expected from the radar equation. Ducting may also extend range beyond what might be expected from limitations of the radar horizon (see Section 2-9).

The ducting phenomena is frequency sensitive. The thicker the duct, the lower the minimum trapped frequency.

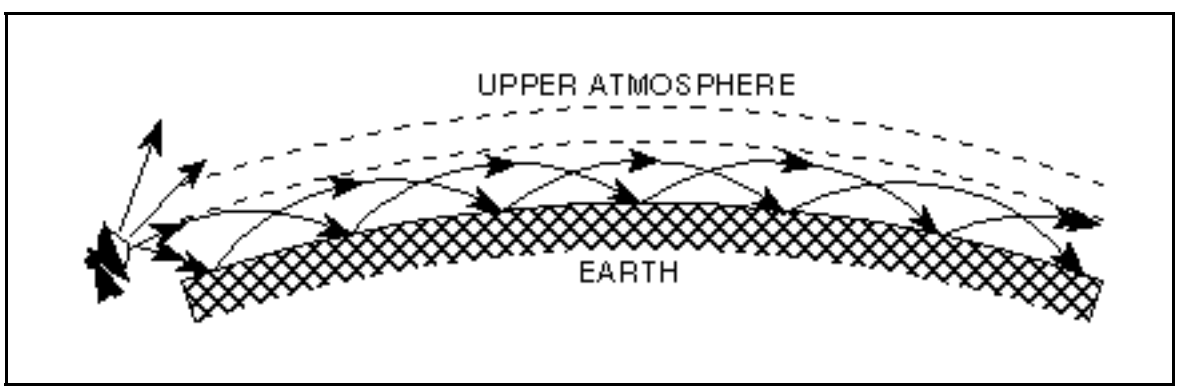

Figure 3. Ducting.

A similar occurrence takes place with ionospheric refraction, however the greatest increase in range occurs in the lower frequencies. This is familiar to amateur radio operators who are able to contact counterparts “around the world.”

RECEIVER SENSITIVITY / NOISE

RECEIVER SENSITIVITY

Sensitivity in a receiver is normally taken as the minimum input signal (S_{min}) required to produce a specified output signal having a specified signal-to-noise (S/N) ratio and is defined as the minimum signal-to-noise ratio times the mean noise power, see equation [1]. For a signal impinging on the antenna (system level) sensitivity is known as minimum operational sensitivity (MOS), see equation [2]. Since MOS includes antenna gain, it may be expressed in dBLi (dB referenced to a linear isotropic antenna). When specifying the sensitivity of receivers intended to intercept and process pulse signals, the minimum pulse width at which the specified sensitivity applies must also be stated. See the discussion of post-detection bandwidth (B_V) in Section 5-2 for significance of minimum pulsewidth in the receiver design.

$$\mathbf{S_{min} = (S/N)_{min} k T_o B (NF)}$$ receiver sensitivity ("black box" performance parameter) **[1]**

or $$\mathbf{MOS = (S/N)_{min} k T_o B (NF)/G}$$ system sensitivity i.e. the receiver is connected to an antenna (transmission line loss included with antenna gain) **[2]**

where: S/N_{min} = Minimum signal-to-noise ratio needed to <u>process</u> (vice just detect) a signal
NF = Noise figure/factor
k = Boltzmann's Constant = 1.38×10^{-23} Joule/°K
T_o = Absolute temperature of the receiver input (°Kelvin) = 290°K
B = Receiver Bandwidth (Hz)
G = Antenna/system gain

We have a lower MOS if temperature, bandwidth, NF, or S/N_{min} decreases, or if antenna gain increases. For radar, missile, and EW receivers, sensitivity is usually stated in dBm. For communications and commercial broadcasting receivers, sensitivity is usually stated in micro-volts or dBμv. See Section 4-1.

There is no standard definition of sensitivity level. The term minimum operational sensitivity (MOS) can be used in place of S_{min} at the system level where aircraft installation characteristics are included. The "black box" term minimum detectable signal (MDS) is often used for S_{min} but can cause confusion because a receiver may be able to detect a signal, but not properly process it. MDS can also be confused with minimum discernable signal, which is frequently used when a human operator is used to interpret the reception results. A human interpretation is also required with minimum visible signal (MVS) and tangential sensitivity (discussed later). To avoid confusion, the terms S_{min} for "black box" minimum sensitivity and MOS for system minimum sensitivity are used in this section. All receivers are designed for a certain sensitivity level based on requirements. One would not design a receiver with more sensitivity than required because it limits the receiver bandwidth and will require the receiver to process signals it is not interested in. In general, while processing signals, the higher the power level at which the sensitivity is set, the fewer the number of false alarms which will be processed. Simultaneously, the probability of detection of a "good" (low-noise) signal will be decreased.

Sensitivity can be defined in two opposite ways, so discussions can frequently be confusing. It can be the ratio of response to input or input to response. In using the first method (most common in receiver discussions and used herein), it will be a negative number (in dBm), with the more negative being "better" sensitivity, e.g., -60 dBm is "better" than -50 dBm sensitivity. If the second method is used, the result will be a positive number, with higher being "better." Therefore the terms low sensitivity or high sensitivity can be very confusing. The terms S_{min} and MOS avoid confusion.

SIGNAL-TO-NOISE (S/N) RATIO

The Signal-to-Noise Ratio (S/N) (a.k.a. SNR) in a receiver is the signal power in the receiver divided by the mean noise power of the receiver. All receivers require the signal to exceed the noise by some amount. Usually if the signal power is less than or just equals the noise power it is not detectable. For a signal to be detected, the signal energy plus the noise energy must exceed some threshold value. Therefore, just because N is in the denominator doesn't mean it can be increased to lower the MOS. S/N is a required minimum ratio, if N is increased, then S must also be increased to maintain that threshold. The threshold value is chosen high enough above the mean noise level so that the probability of random noise peaks exceeding the threshold, and causing false alarms, is acceptably low.

Figure 1 depicts the concept of required S/N. It can be seen that the signal at time A exceeds the S/N ratio and indicates a false alarm or target. The signal at time B is just at the threshold, and the signal at time C is clearly below it. In the sample, if the temperature is taken as room temperature (T_o = 290°K), the noise power input is -114 dBm for a one MHz bandwidth. Normally S/N_{min} may be set higher than S/N shown in Figure 1 to meet false alarm specifications.

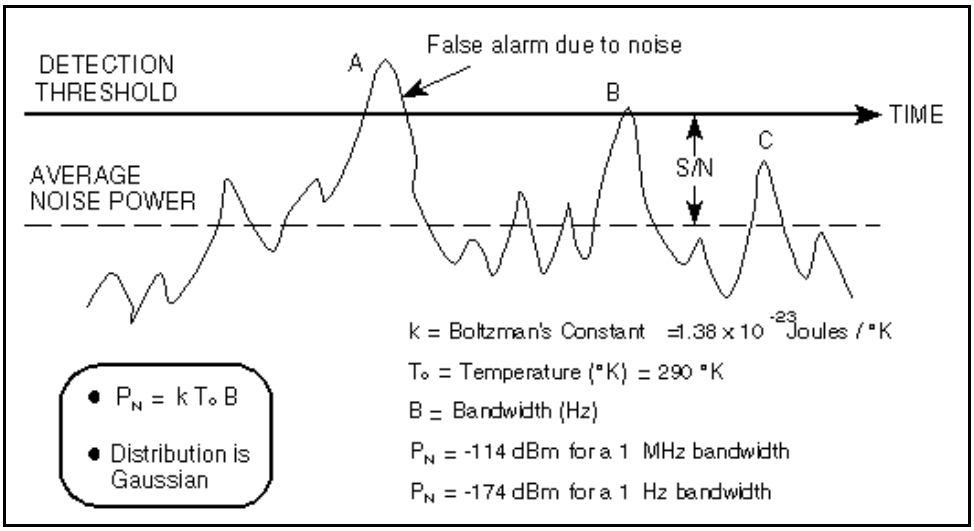

Figure 1. Receiver Noise Power at Room Temperature.

The acceptable minimum Signal-to-Noise ratio (or think of it as Signal **above** Noise) for a receiver depends on the intended use of the receiver. For instance, a receiver that had to detect a single radar pulse would probably need a higher minimum S/N than a receiver that could integrate a large number of radar pulses (increasing the total signal energy) for detection with the same probability of false alarms. Receivers with human operators using a video display may function satisfactorily with low minimum S/N because a skilled operator can be very proficient at picking signals out of a noise background. As shown in Table 1, the setting of an acceptable minimum S/N is highly dependent on the required characteristics of the receiver and of the signal.

Table 1. Typical Minimum S/N Required.

Skilled Operator	Auto-Detection	Auto-detection with Amplitude, TOA, and Frequency Measurements	AOA Phase Interferometer	AOA Amplitude Comparison
3 to 8 dB	10 to 14 dB	14 to 18 dB	14 to 18 dB	16 to 24 dB

A complete discussion of the subject would require a lengthy dissertation of the probability and statistics of signal detection, which is beyond the scope of this handbook, however a simplified introduction follows. Let's assume that we have a receiver that we want a certain probability of detecting a single pulse with a specified false alarm probability. We can use Figure 2 to determine the required signal-to-noise ratio.

S/N EXAMPLE

If we are given that the desired probability of detecting a single pulse (P_d) is 98%, and we want the false alarm rate (P_n) to be no more than 10^{-3}, then we can see that S/N must be 12 dB (see Figure 2).

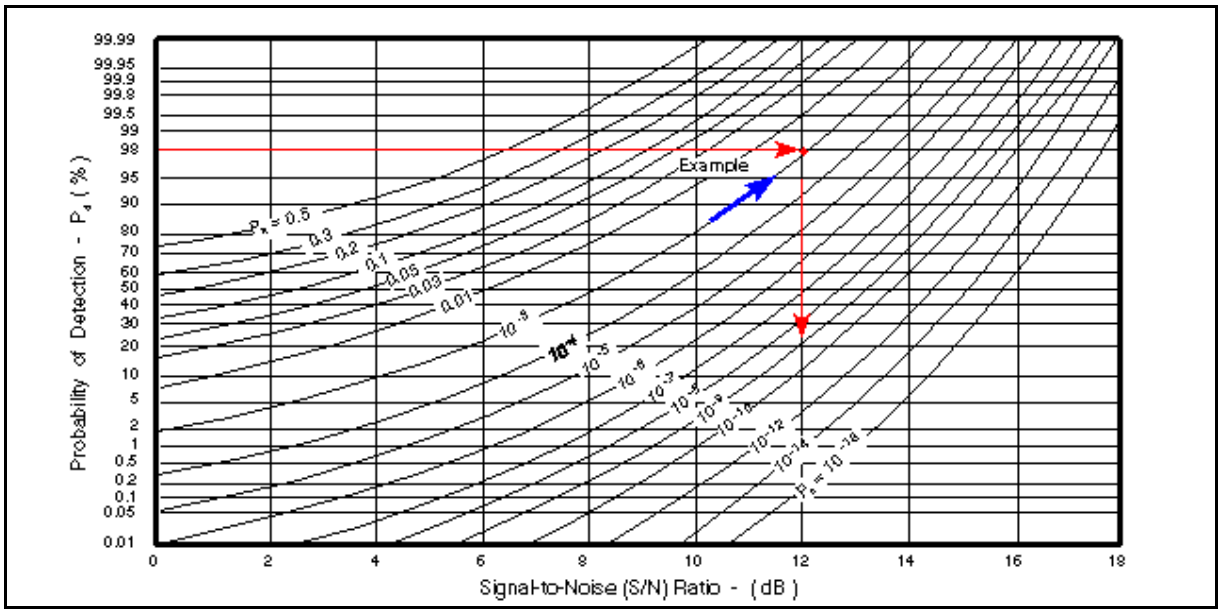

Figure 2. Nomograph of Signal-to-Noise (S/N) Ratio as a Function of Probability of Detection (P_d) and Probability of False Alarm Rate (P_n).

MAXIMUM DETECTION RANGE (ONE-WAY)

From Section 4-3, the one way signal strength from a transmitter to a receiver is:

$$S\ (or\ P_R) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 R^2}$$

For calculations involving receiver sensitivity the "S" can be replaced by S_{min}. Since $S_{min} = (S/N)_{min}\, kT_oB(NF)$, given by equation [1], the one-way radar equation can be solved for any of the other variables in terms of receiver parameters. In communication, radar, and electronic warfare applications, you might need to solve for the maximum range (R_{max}) where a given radar warning receiver could detect a radiated signal with known parameters. We would then combine and rearrange the two equations mentioned to solve for the following one-way equation:

$$R_{max} \cong \sqrt{\frac{P_t\ G_t\ G_r\ \lambda^2}{(4\pi)^2 (S/N)_{min}\, k\, T_o\, B\, (NF)}} \quad or \quad \sqrt{\frac{P_t\ G_t\ G_r\ c^2}{(4\pi f)^2 (S/N)_{min}\, k\, T_o\, B\, (NF)}} \quad or \quad \sqrt{\frac{P_t\ G_t\ A_e}{4\pi\, (S/N)_{min}\, k\, T_o\, B\, (NF)}} \qquad \textbf{[3]}$$

We could use standard room temperature of 290° K as T_o, but NF would have to be determined as shown later.

In this calculation for receiver R_{max} determination, P_t, G_t, and λ are radar dependent, while G_r, S/N_{min}, NF, and B are receiver dependent factors.

Equation [3] relates the maximum detection range to bandwidth (B). The effects of the measurement bandwidth can significantly reduce the energy that can be measured from the peak power applied to the receiver input. Additional bandwidth details are provided in Sections 4-4, 4-7, and in other parts of this section.

NOISE POWER, kT_oB

Thermal noise is spread more or less uniformly over the entire frequency spectrum. Therefore the amount of noise appearing in the output of an ideal receiver is proportional to the absolute temperature of the receiver input system (antenna etc) times the bandwidth of the receiver. The factor of proportionality is Boltzmann's Constant.

Mean noise power of ideal receiver = $kT_oB = P_N$ (Watts)
Mean noise power of a real receiver = $(NF)kT_oB$ (Watts)

The convention for the temperature of T_o is set by IEEE standard to be 290°K, which is close to ordinary room temperature. So, assuming T_o = 290°K, and for a bandwidth B = 1 Hz, $kT_oB = 4x10^{-21}$ W = -204 dBW = -174 dBm.

For any receiver bandwidth, multiply $4x10^{-21}$ W by the bandwidth in Hz, or if using dB;

10 log kT_oB = -174 dBm + 10 Log (actual BW in Hz) or -114 dBm + 10 Log (actual BW in MHz)

and so on, as shown by the values in Table 2.

Table 2. Sample Noise Power Values (kT_oB).

Bandwidth	Bandwidth Ratio (dB)	Watts	dBW	dBm
1 Hz	0	$4x10^{-21}$	-204	-174
1 kHz	30	$4x10^{-18}$	-174	-144
1 MHz	60	$4x10^{-15}$	-144	-114
1 GHz	90	$4x10^{-12}$	-114	-84

Typical values for maximum sensitivity of receivers would be:

RWR	-65 dBm
Pulse Radar	-94 dBm
CW Missile Seeker	-138 dBm

If antenna contributions are ignored (see note in Table 4) for a CW receiver with a 4 GHz bandwidth, the ideal mean noise power would be -174 dBm + 10 Log($4x10^9$) = -174 dBm + 96 dB = -78 dBm. A skilled operator might only be able to distinguish a signal 3 dB above the noise floor (S/N=3 dB), or -75 dBm. A typical radar receiver would require a S/N of 3 to 10 dB to distinguish the signal from noise, and would require 10 to 20 dB to track. Auto tracking might require a S/N of approximately 25 dB, thus, a receiver may only have sufficient sensitivity to be able to identify targets down to -53 dBm. Actual pulse receiver detection will be further reduced due to sin x/x frequency distribution and the effect of the measurement bandwidth as discussed in Sections 4-4 and 4-7. Integration will increase the S/N since the signal is coherent and the noise is not.

Noise Bandwidth

Equivalent Noise Bandwidth (B_N) - Set by minimum pulse width or maximum modulation bandwidth needed for the system requirements. A choice which is available to the designer is the relationship of pre- and post-detection bandwidth. Pre-detection bandwidth is denoted by B_{IF}, while post-detection is denoted B_V, where V stands for video. The most affordable approach is to set the post-detection filter equal to the reciprocal of the minimum pulse width, then choose the pre-detection passband to be as wide as the background interference environment will allow. Recent studies suggest that pre-detection bandwidths in excess of 100 MHz will allow significant loss of signals due to "pulse-on-pulse" conditions. Equations [4] and [5] provide B_N relationships that don't follow the Table 3 rules of thumb.

Table 3. Rules of Thumb for B_N a.k.a. B (Doesn't apply for S/N between 0 and 10 to 30 dB).

S/N out	Linear Detector	Square Law Detector
High S/N (>15 to 20 dB)	$B_N = B_V$ (> 20 to 30 dB)	$B_N = 4\ B_V$ (> 10 to 15 dB)
Low S/N (< 0 dB)	$B_N = \sqrt{(2\ B_{IF}\ B_V - B_V^2)\ /\ 4\ (S/N)_{out}}$	$B_N = \sqrt{(2\ B_{IF}\ B_V - B_V^2)\ /\ (S/N)_{out}}$

For a square law detector: (1)

$$B_N = B_V \left[2 + \sqrt{4 + \frac{(2\ B_{IF}\ /\ B_V) - 1}{(S/N)_{out}}} \right] \qquad \textbf{[4]}$$

At high $(S/N)_{out}$, the $1/(S/N_{out})$ term goes to zero and we have: $B_N = B_V\ [\ 2 + \sqrt{4}\ ] = 4\ B_V$

At low $(S/N)_{out}$, the $1/(S/N_{out})$ term dominates, and we have:

$$B_N = B_V \sqrt{\frac{(2\ B_{IF}\ /\ B_V) - 1}{(S/N)_{out}}} = \sqrt{\frac{2\ B_{IF}\ B_V - B_V^2}{(S/N)_{out}}}$$

For a linear detector: (1)

$$B_N = \frac{B_V}{2} + \frac{1}{4} \bullet \sqrt{B_V \left(4\ B_V + \frac{H^2 (2\ B_{IF} - B_V)}{(S/N)_{out}} \right)} \qquad \textbf{[5]}$$

H is a hypergeometric (statistical) function of $(S/N)_{in}$

H = 2 for $(S/N)_{in} << 1$
H = 1 for $(S/N)_{in} >> 1$

At high $(S/N)_{out}$, the $1/(S/N_{out})$ term goes to zero and we have: $B_N = \frac{B_V}{2} + \frac{1}{4}\sqrt{B_V\ (4\ B_V)} = B_V$

At low $(S/N)_{out}$, the $1/(S/N_{out})$ term dominates, and we have:

$$B_N = \frac{1}{4} \bullet \sqrt{\frac{B_V H^2 (2 B_{IF} - B_V)}{(S/N)_{out}}} = \sqrt{\frac{2 B_{IF} B_V - B_V^2}{4 (S/N)_{out}}}$$

Note (1): From Klipper, "Sensitivity of Crystal Video Receivers With RF Pre-amplification," *The Microwave Journal*, August 1965.

TRADITIONAL "RULE OF THUMB" FOR NARROW BANDWIDTHS (Radar Receiver Applications)
Required IF Bandwidth for Matched Filter Applications:

$$B_{IF} = \frac{1}{PW_{\min}} \quad \text{Where :} \quad \begin{array}{l} B_{IF} = \text{Pre - detection RF or IF bandwidth} \\ PW_{\min} = \text{Specified minimum pulse width} = \tau \end{array}$$

Matched filter performance gives maximum probability of detection for a given signal level, but: (1) Requires perfect centering of signal spectrum with filter bandwidth, (2) Time response of matched pulse does not stabilize at a final value, and (3) Out-of-band splatter impulse duration equals minimum pulse width. As a result, EW performance with pulses of unknown frequency and pulse width is poor.

Required Video Bandwidth Post - Detection
Traditional " Rule of Thumb"

$$B_V = \frac{0.35}{PW_{\min}} \quad \text{Where : } B_V = \text{Post - detection bandwidth}$$

Some authors define B_V in terms of the minimum rise time of the <u>detected</u> pulse, i.e., $B_V = (0.35 \text{ to } 0.5)/t_r$ min, where t_r = rise time.

REVISED "RULE OF THUMB" FOR WIDE BANDWIDTHS (Wideband Portion of RWRs)

$$B_{IF} = \frac{2 \text{ to } 3}{PW_{\min}} \quad \text{and} \quad B_V = \frac{1}{PW_{\min}}$$

The pre-detection bandwidth is chosen based upon interference and spurious generation concerns. The post-detection bandwidth is chosen to "match" the minimum pulse width. This allows (1) Half bandwidth mistuning between signal and filter, (2) Half of the minimum pulse width for final value stabilization, and (3) The noise bandwidth to be "matched" to the minimum pulse width. As a result, there is (1) Improved EW performance with pulses of unknown frequency and pulse width, (2) Measurement of in-band, but mistuned pulses, and (3) Rejection of out-of-band pulse splatter.

NOISE FIGURE / FACTOR (NF)

Electrical noise is defined as electrical energy of random amplitude, phase, and frequency. It is present in the output of every radio receiver. At the frequencies used by most radars, the noise is generated primarily within the input stages of the receiver system itself (Johnson Noise). These stages are not inherently noisier than others, but noise generated at the input and amplified by the receiver's full gain greatly exceeds the noise generated further along the receiver chain. The noise performance of a receiver is described

by a figure of merit called the noise figure (NF). The term noise factor is synonymous, with some authors using the term "factor" for numeric and "figure" when using dB notation. (The notation "F_n" is also sometimes used instead of "NF.") The noise figure is defined as:

$$NF = \frac{Noise\ output\ of\ actual\ receiver}{Noise\ output\ of\ ideal\ receiver} = \frac{N_{out}}{GN_{in}} \quad or\ in\ dB: \quad 10\ \mathrm{Log}\left[\frac{Noise\ output\ of\ actual\ receiver}{Noise\ output\ of\ ideal\ receiver}\right] = 10\ \log\frac{N_{out}}{GN_{in}}$$

A range of NF values is shown in Table 4.

Table 4. Typical Noise Figure / Factor Value.	Decimal	dB
Passive lossy network (RF transmission line, attenuator, etc.) Example: 20 dB attenuator (gain = 0.01)	Same as reciprocal of gain value ex: 100	Same as dB value ex: 20
Solid State Amplifier (see manufacturers specifications)	4	6
Traveling Wave Tube (see manufacturers specifications)	10 to 100	10 to 20
Antennas (Below ≈ 100 MHz, values to 12 dB higher if pointed at the sun) Note: Unless the antenna is pointed at the sun, its negligible NF can be ignored. Antenna gain is not valid for NF calculations because the noise is received in the near field.	1.012 to 1.4	0.05 to 1.5

An ideal receiver generates no noise internally. The only noise in its output is received from external sources. That noise has the same characteristics as the noise resulting from thermal agitation in a conductor. Thermal agitation noise is caused by the continuous random motion of free electrons which are present in every conductor. The amount of motion is proportional to the conductor's temperature above absolute zero. For passive lossy networks, the noise factor equals the loss value for the passive element:

$$NF = \frac{N_{out}}{G\,N_{in}} = \frac{kTB}{\frac{1}{L}kTB} = L \qquad \begin{array}{c} Where\ L = Ratio\ Value\ of\ Attenuation \\ i.e.\ For\ a\ 3\ dB\ attenuator,\ G = 0.5\ and\ L = 2 \\ \therefore NF = 2\ \ and\ \ 10\log NF = 3\ dB \end{array}$$

A typical series of cascaded amplifiers is shown in Figure 3.

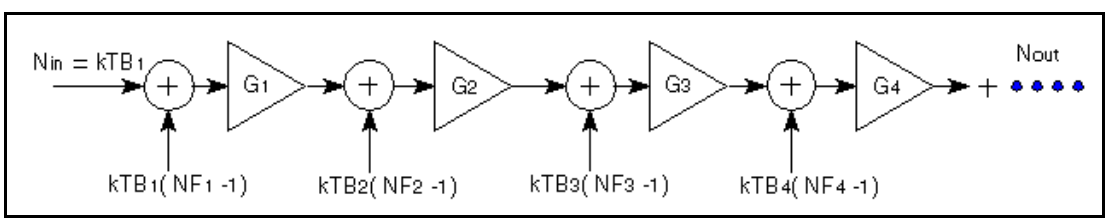

Figure 3. Noise Factors for Cascaded Amplifiers (NF_{CA}).

Loss (negative gain) can be used for the gain value of attenuators or transmission line loss, etc to calculate the noise out of the installation as shown in the following equation:

$$N_{out} = N_{in}\,G\,NF_{CA} = k\,T\,B_1(G_1G_2G_3\ldots)\left(NF_1 + \frac{B_2(NF_2-1)}{B_1G_1} + \frac{B_3(NF_3-1)}{B_1G_1G_2} + \frac{B_4(NF_4-1)}{B_1G_1G_2G_3} + \ldots\right) \quad (ratio\ form) \qquad \textbf{[6]}$$

If the bandwidths of the amplifiers are the same, equation [6] becomes:

$$N_{out} = N_{in}\, G\, NF_{CA} = k\, T\, B\,(\, G_1 G_2 G_3 \ldots)\left(NF_1 + \frac{NF_2 - 1}{G_1} + \frac{NF_3 - 1}{G_1 G_2} + \frac{NF_4 - 1}{G_1 G_2 G_3} + \ldots \right) \quad \textit{(ratio form)} \qquad [7]$$

Pre-amplifier Location Affects Receiver Input Noise

As shown in Figure 4, if a 2 to 12 GHz receiver installation doesn't have enough sensitivity, it is best to install an additional amplifier closer to the antenna (case 1) instead of closer to the receiver (case 2). In both cases, the line loss (L) and the amplifier gain (G) are the same, so the signal level at the receiver is the same. For case 1, $S_1 = P_{in} + G - L$. In case 2, $S_2 = P_{in} - L + G$, so $S_1 = S_2$. The noise generated by the passive transmission line when measured at the receiver is the same in both cases. However, the noise generated inside the amplifier, when measured at the receiver input, is different.

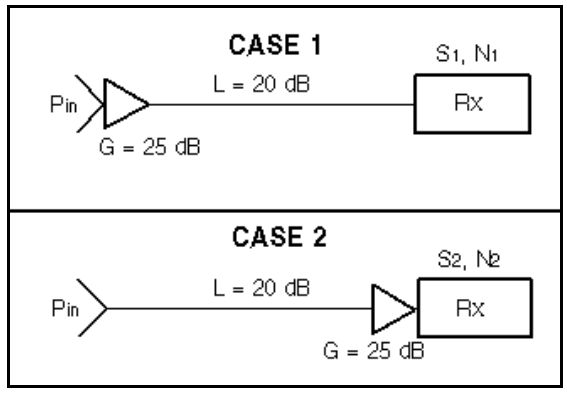

Figure 4. Pre-Amp S/N.

For this example, case 2 has a noise level at the input to the receiver which is 19.7 dB higher than case 1 (calculations follow later).

Table 5a	Case 1 Gain		Case 1 NF	
	Amp	L	Amp	L
dB	25	-20	6 *	20
ratio	316.2	0.01	4 *	100

Table 5b	Case 2 Gain		Case 2 NF	
	L	Amp	L	Amp
dB	-20	25	20	6 *
ratio	0.01	316.2	100	4 *

* Amplifier NF value from Table 4.

Using equation [3] and the data in Tables 5a and 5b, the noise generated by the RF installation is shown in Tables 6a and 6b (the negligible noise contribution from the antenna is the same in both cases and is not included) (also see notes contained in Table 4):

Table 6a. Case 1	**Table 6b.** Case 2
$G(NF) = 316.2\,(0.01)\left(4 + \frac{100 - 1}{316.7}\right) = 13.64$	$G(NF) = 0.01\,(316.2)\left(100 + \frac{4 - 1}{0.01}\right) = 1264.8$
10 log G(NF) = 11.34 dB	10 log G(NF) = 31 dB
Noise at receiver:	
$N_{out\,1}$ = -74 dBm + 11.34 dB = -62.7 dBm	$N_{out\,2}$ = -74 dBm + 31 dB = -43 dBm

$N_{out\,2} - N_{out\,1}$ = 19.7 dB. The input noise of -74 dBm was calculated using 10 log (kTB), where B = 10 GHz.

Note that other tradeoffs must be considered: (1) greater line loss between the antenna and amplifier improves (decreases) VSWR as shown in Section 6-2, and (2) the more input line loss, the higher the input signal can be before causing the pre-amplifier to become saturated (mixing of signals due to a saturated amplifier is addressed in Section 5-7).

Combining Receive Paths Can Reduce Sensitivity

If a single aircraft receiver processes both forward and aft signals as shown in Figure 5, it is desirable to be able to use the receiver's full dynamic range for both directions. Therefore, one needs to balance the gain, so that a signal applied to the aft antenna will reach the receiver at the same level as if it was applied to the forward antenna.

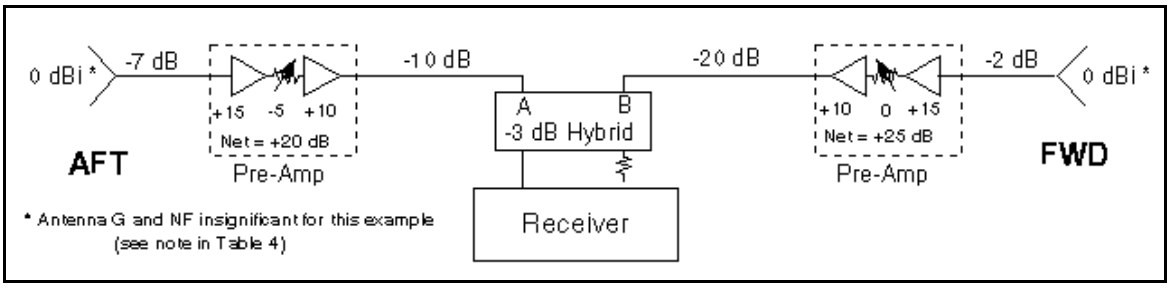

Figure 5. Example of Pre-Amplifier Affecting Overall Gain / Sensitivity.

Common adjustable preamplifiers can be installed to account for the excessive transmission line loss. In this example, in the forward installation, the level of the signal at the receiver is the same as the level applied to the antenna. Since the aft transmission line has 5 dB less attenuation, that amount is added to the preamplifier attenuator to balance the gain. This works fine for strong signals, but not for weaker signals. Because there is less loss between the aft preamplifier and the receiver, the aft noise dominates and will limit forward sensitivity. If the bandwidth is 2-12 GHz, and if port A of the hybrid is terminated by a perfect 50Ω load, the forward noise level would be -65.3 dBm. If port B is terminated, the aft noise level would be -60.4 dBm. With both ports connected, the composite noise level would be -59.2 dBm (convert to mw, add, then convert back to dBm). For this example, if the aft preamplifier attenuation value is changed to 12 dB, the gain is no longer balanced (7 dB extra loss aft), but the noise is balanced, i.e., forward = -65.6 dBm, aft = -65.3 dBm, and composite -62.4 dBm. If there were a requirement to see the forward signals at the most sensitive level, extra attenuation could be inserted in the aft preamplifier. This would allow the forward noise level to predominate and result in greater forward sensitivity where it is needed. Calculations are provided in Tables 7 and 8.

Table 7. Summary of Gain and NF Values for Figure 5 Components.

		Aft					Fwd				
		RF Line	Amp	Attn	Amp	RF Line & hybrid	RF Line	Amp	Attn	Amp	RF Line & hybrid
Gain	dB	-7	15	-5	10	-13	-2	15	0	10	-23
	ratio	0.2	31.6	0.32	10	0.05	0.63	31.6	0	10	0.005
NF	dB	7	6	5	6	13	2	6	0	6	23
	ratio	5	4	3.16	4	20	1.585	4	0	4	200

Aft NF = 22.79 therefore 10 log NF = 13.58 dB. Input noise level = -74 dBm + 13.58 dB = -60.42 dBm ≅ -60.4 dBm
Fwd NF = 7.495 therefore 10 log NF = 8.75 dB. Input noise level = -74 dBm + 8.75 dB = -65.25 dBm ≅ -65.3 dBm
The composite noise level at the receiver = -59.187 dBm ≅ -59.2 dBm.

Table 8. Effect of Varying the Attenuation (shaded area) in the Aft Preamplifier Listed in Table 7.							
Aft Attn NF	Aft Attn Gain	Aft Noise	Fwd Noise	Composite Noise	Min Signal Received ***	Aft Input	Fwd Input
0 dB	0 dB	-55.8 dBm	-65.3 dBm	-55.4 dBm	-43.4 dBm	-48.4 dBm	-43.4 dBm
5	-5	-60.4	-65.3	-59.2	-47.2 *	-47.2 *	-47.2 *
10	-10	-64.4	-65.3	-61.8	-49.8	-44.8	-49.8
12	-12	-65.6 **	-65.3 **	-62.4	-50.4	-43.4	-50.4
15	-15	-67.1	-65.3	-63.1	-51.1	-41.1	-51.1

* Gain Balanced ** Noise Balanced *** S/N was set at 12 dB

TANGENTIAL SENSITIVITY

Tangential sensitivity (TSS) is the point where the top of the noise level with no signal applied is level with the bottom of the noise level on a pulse as shown in Figure 6. It can be determined in the laboratory by varying the amplitude of the input pulse until the stated criterion is reached, or by various approximation formulas.

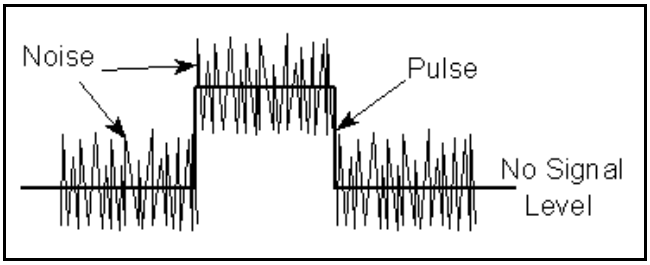

Figure 6. Tangential Sensitivity.

The signal power is nominally 8±1 dB above the noise level at the TSS point. TSS depends on the RF bandwidth, the video bandwidth, the noise figure, and the detector characteristic.

TSS is generally a characteristic associated with receivers (or RWRs), however the TSS does not necessarily provide a criterion for properly setting the detection threshold. If the threshold is set to TSS, then the false alarm rate is rather high. Radars do not operate at TSS. Most require a more positive S/N for track (> 10 dB) to reduce false detection on noise spikes.

SENSITIVITY CONCLUSION

When all factors effecting system sensitivity are considered, the designer has little flexibility in the choice of receiver parameters. Rather, the performance requirements dictate the limit of sensitivity which can be implemented by the EW receiver.

1. Minimum Signal-to-Noise Ratio (S/N) - Set by the accuracy which you want to measure signal parameters and by the false alarm requirements.

2. Total Receiver Noise Figure (NF) - Set by available technology and system constraints for RF front end performance.

3. Equivalent Noise Bandwidth (B_N) - Set by minimum pulse width or maximum modulation bandwidth needed to accomplish the system requirements. A choice which is available to the designer is the relationship of pre- (B_{IF}) and post-detection (B_V) bandwidth. The most affordable approach is to set the post-detection filter equal to the reciprocal of the minimum pulse width, then choose the pre-detection passband to be as wide as the background interference environment will allow. Recent studies suggest that pre-detection bandwidths in excess of 100 MHz will allow significant loss of signals due to "pulse-on-pulse" conditions.

4. Antenna Gain (G) - Set by the needed instantaneous FOV needed to support the system time to intercept requirements.

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RECEIVER TYPES AND CHARACTERISTICS

Besides the considerations of noise and noise figure, the capabilities of receivers are highly dependent on the type of receiver design. Most receiver designs are trade-offs of several conflicting requirements. This is especially true of the Electronic Support Measures (ESM) receivers used in Electronic Warfare.

This section consists of a figure and tables that provide a brief comparison of various common ESM receiver types. Figures 1 and 2 show block diagrams of common ESM receivers. Table 1 is a comparison of major features of receivers. Table 2 shows the receiver types best suited for various types of signals and Tables 3 and 4 compare several direction of arrival (DOA) and emitter location techniques. Table 5 shows qualitative and quantitative comparisons of receiver characteristics.

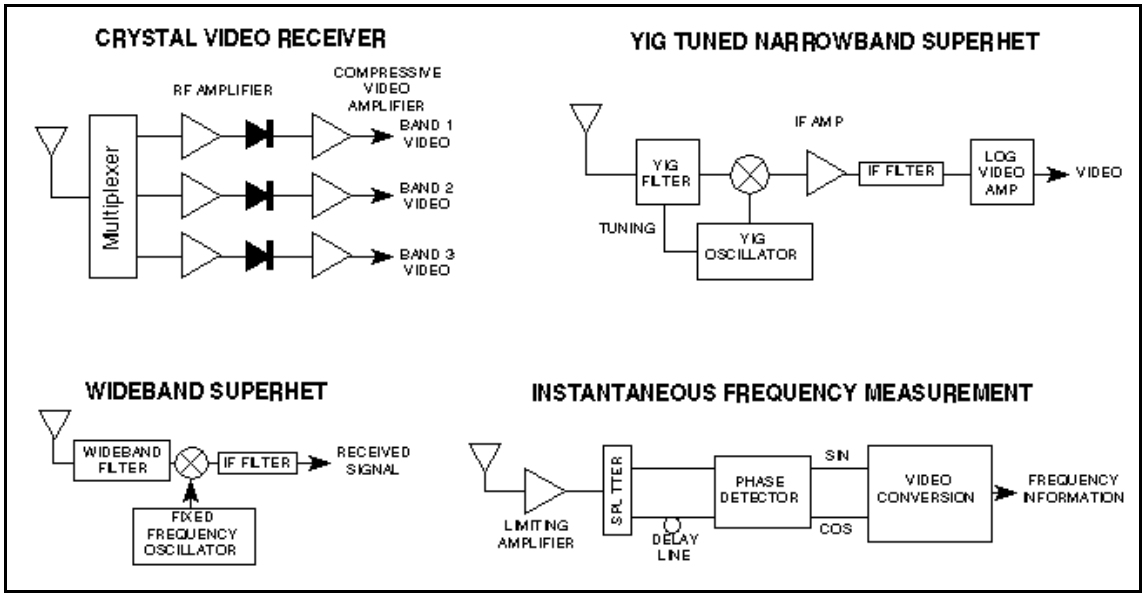

Figure 1. Common ESM Receiver Block Diagrams.

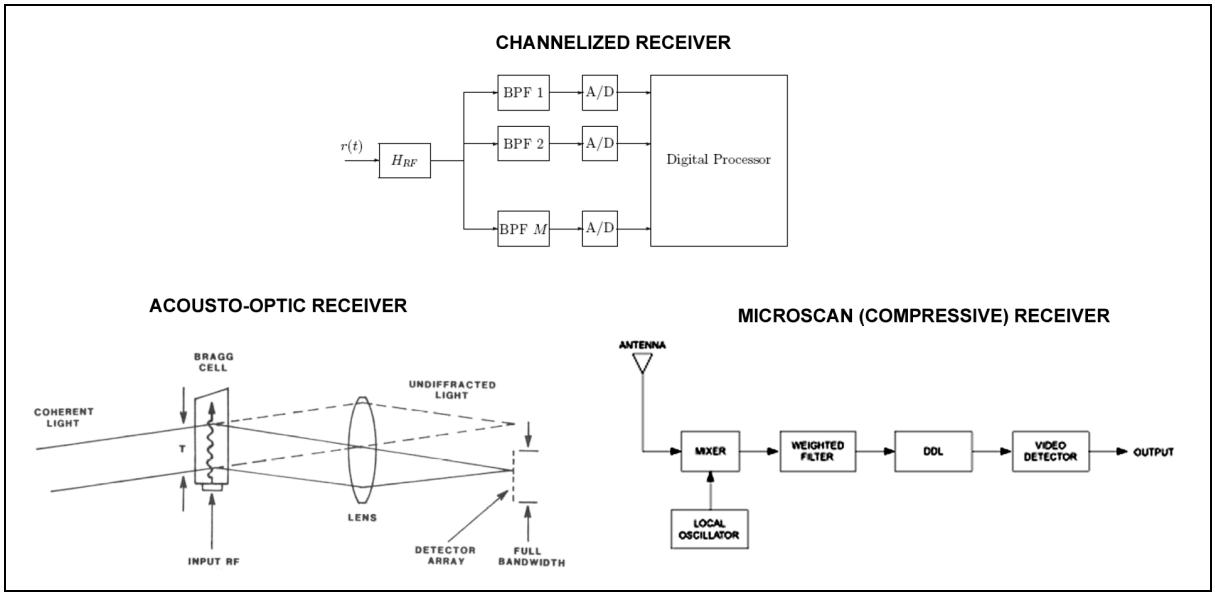

Figure 2. Common ESM Receiver Block Diagrams (Continued).

Table 1. Comparison of Major Features of Receivers.

Receiver	Advantages	Disadvantages	Principal Applications
Wideband crystal video	Simple, inexpensive, instantaneous, High POI in frequency range	No frequency resolution Poor sensitivity and Poor simultaneous signal performance	RWR
Tuned RF Crystal Video	Simple, Frequency measurement Higher sensitivity than wideband	Slow response time Poor POI	Option in RWR, Frequency measurement in hybrid
IFM	Relatively simple Frequency resolution Instantaneous, high POI	Cannot sort simultaneous signals Relatively poor sensitivity	Shipboard ESM, Jammer power management, SIGINT equipment
Narrow-band scanning Superhet	High sensitivity Good frequency resolution Simultaneous signals don't interfere	Slow response time Poor POI Poor against frequency agility	SIGINT equipment Air and ship ESM Analysis part of hybrid
Wide-band Superhet	Better response time and POI	Spurious signals generated Poorer sensitivity	Shipboard ESM Tactical air warning
Channelized	Wide bandwidth, Near instantaneous, Moderate frequency resolution	High complexity, cost; Lower reliability; limited sensitivity	SIGINT equipment Jammer power management
Microscan	Near instantaneous, Good resolution and dynamic range, Good simultaneous signal capability	High complexity, Limited bandwidth No pulse modulation information Critical alignment	SIGINT equipment Applications for fine freq analysis over wide range
Acousto-optic	Near instantaneous, Good resolution, Good simultaneous signal capability Good POI	High complexity; new technology	

Note: The Microscan receiver is also known as a compressive receiver

Table 2. Receiver Types vs. Signal Types.

Signal Type	Receiver Type							
	Wide-Band Crystal Video	TRF Crystal Video	IFM	Narrow-Band Superhet	Wide-Band Superhet	Channelized	Microscan	Acousto-optic
CW	Special design for CW	Special design for CW	Yes, but interferes with pulsed reception	Yes	Yes	Yes	Yes	Yes
Pulsed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Multiple Frequency	No	No	No	Yes, but won't recognize as same source	No	Yes	Yes	Yes
Frequency Agile	Yes, doesn't measure frequency	No	Yes	No	Yes (within passband)	Yes	Yes	No/Yes, depending on readout time
PRI Agile	Yes	Yes	Yes	No/Yes, depending on scan rate	Yes	Yes	No/Yes, imprecision in TOA	No/Yes, depending on readout time
Chirped	Yes, within acceptance BW	No	Yes	No/Yes, depending on BW	Yes	Yes (reduced sensitivity)	No/Yes, depending on scan rate	Yes (reduced sensitivity)
Spread Spectrum	Yes, within acceptance BW	No	Yes	No	No/Yes, depending on BW	Yes (reduced sensitivity)	Yes (reduced sensitivity)	Yes (reduced sensitivity)

Table 3. Direction of Arrival Measurement Techniques.

	Amplitude Comparison	Phase Interferometer
Sensor Configuration	Typically 4 to 6 Equal Spaced Antenna Elements for 360° Coverage	2 or more RHC or LHC Spirals in Fixed Array
DF Accuracy	$DF_{ACC} \approx \frac{\Theta_{bW}^2 \Delta C_{dB}}{24\,S}$ (Gaussian Antenna Shape)	$DF_{ACC} \approx \frac{\lambda}{2\,\pi\,d\,\cos\theta}\Delta\theta$
DF Accuracy Improvement	Decrease Antenna BW; Decrease Amplitude Mistrack; Increase Squint Angle	Increase Spacing of Outer Antennas; Decrease Phase Mistrack
Typical DF Accuracy	3° to 10° rms	0.1° to 3° rms
Sensitivity to Multipath/Reflections	High Sensitivity; Mistrack of Several dB Can Cause Large DF Errors	Relatively Insensitive; Interferometer Can be Made to Tolerate Large Phase Errors
Platform Constraints	Locate in Reflection Free Area	Reflection Free Area; Real Estate for Array; Prefers Flat Radome
Applicable Receivers	Crystal Video; Channelizer; Acousto-Optic; Compressive; Superheterodyne	Superheterodyne
ΔC_{dB}= Amplitude Monopulse Ratio in dB S= Squint Angle in degrees θ_{BW}= Antenna Beamwidth in degrees		

Table 4. Emitter Location Techniques.

Measurement Technique	Advantages	Disadvantages
Triangulation	Single Aircraft	Non-instantaneous location Inadequate accuracy for remote targeting Not forward looking
Azimuth/elevation	Single Aircraft Instantaneous location possible	Accuracy degrades rapidly at low altitude Function of range
Time Difference of Arrival (Pulsed signals)	Very high precision Can support weapon delivery position requirements Very rapid, can handle short on-time threat	Very complex, diverse systems required, at least 3 aircraft High quality receivers, DME (3 sites) very wideband data link Very high performance control processor; requires very high reliability subsystems

Table 5. Qualitative Comparison of Receivers. (From NRL Report 8737)

Feature	Receiver Type							
	Wide-Band Crystal Video	TRF Crystal Video	IFM	Narrow-Band Superhet	Wide-Band Superhet	Channelized	Microscan	Acousto-optic
Instantaneous Analysis Bandwidth	Very wide	Narrow	Very wide	Narrow	Moderate	Wide	Wide	Moderate
Frequency Resolution	Very poor	Fair	Good	Very good	Poor	Fair	Good	Good
Sensitivity	Poor (No preamp) Fair (preamp)	Fair/ good	Poor (No preamp) Fair (preamp)	Very good	Fair	Fair/ good	Very good	Good
Dynamic Range	Fair	Fair/ good	Good	Very good	Fair	Good	Fair	Poor
Speed of Acquisition	Very Fast	Slow	Very Fast	Slow	Fast	Very Fast	Very Fast	Fast
Short pulse Width Capability	Good	Good	Good	Good	Very good	Good	Fair	Fair
Retention of Signal Character-istics	Fair	Fair	Poor	Good	Fair/ good	Good	Poor	Fair/ good
Applicability to Exotic Signals	Poor/ fair	Poor	Good	Poor	Fair/ good	Good	Fair/ good	Fair/ good
High signal Density Performance	Poor (high false alarm rate from background)	Fair/ good	Good	Poor	Fair (depending on BW)	Fair/good, depending on architecture & processing	Good	Poor
Simultaneous Signal Capability	Poor	Fair/ good	Poor	Good	Fair (depending on BW)	Good	Good	Good
Processing Complexity	Moderate depending on application	Moderate depending on application	Moderate	Moderate	Moderate	Low-high depending on architecture	Complex	Simple signal processing complex data processing
Immunity to Jamming	Poor	Fair	Poor/ Fair	Good	Poor/ Fair	Good	Good	Good
Power Requirements	Low	Low/ Moderate	Moderate	Moderate	Moderate	High	Moderate	Moderate/ High
RF Range (GHz)	Multi-octave (0.5-40)	0.15-18 separate	>0.5 to 40	<0.01 to 40	0.5 to 18	0.5 to 60	<0.5 to 8	0.5-4 (0.5-18 channelized and down conversion)
Max Instantane-ous Analysis Bandwidth	Multi-octave (to 17.5 GHz)	As high as desired with equivalent reduction in resolution	Multi-octave (1 octave per unit)	50 MHz	500 MHz	~2 GHz without degradation, 17.5 GHz with degradation	0.5 to 2 depending on PW limitation	1 GHz
Frequency Accuracy	Measurement accuracy no better than analysis BW	Measurement accuracy no better than analysis BW	5-10 MHz	0.5% to 1%	0.5 to 3 MHz	±1 MHz	10 KHz	±1 MHz

Feature	Receiver Type							
	Wide-Band Crystal Video	TRF Crystal Video	IFM	Narrow-Band Superhet	Wide-Band Superhet	Channelized	Microscan	Acousto-optic
Pulse Width Range	CW to 50 ns	CW to 50 ns	CW to ~20 ns (depending on resolution)	CW to 100 ns with 20 MHz resolution	CW to 4 ns with 500 MHz resolution	CW to 30 ns (depending on resolution)	CW to 250 ns	CW to 0.5 µs
Frequency Resolution	~400 MHz (no better than BW)	25 MHz	1 MHz	<0.1 MHz	100-500 MHz	10-125 MHz (less with freq vernier)	1 MHz	0.5 to 1 MHz
Sensitivity (dBm)	-40 to -50 (no preamp) -80 (with preamp)	Better than -80 with preamp	-40 (no preamp) -75 (preamp) 4 GHz BW	-90, 1 MHz BW	-80, 500 MHz BW	-70, 10-50 MHz BW	-90, 5-10 MHz BW	-70 to -80
Maximum Dynamic Range (dB)	70	70-80	80 (w/preamp) 100+ (saturated)	90	60	50-80	40-60	25-35
Tuning Time	-	50 ms	-	1.0 s (1 octave)	.12 s (200 MHz band)	-	0.3 µs LO scan time	0.5 ms (integration time)
Signal ID Time	100 ns	50 ms	2-10 ms	~0.1 s	-	2.10 ms	~1 µs	-
Minimum Weight (lb)	20 (with processor)	30	<20 (octave unit) 65-75 (full coverage)	60-75	35 (tuner only)	1309-200 for 0.5 to 18 GHz coverage	25	29-55
Size / Minimum Volume (in³)	Small 300 (w/processor)	Small 375	Sm/Moderate 600-1000 ~100 miniaturized	Moderate 1500-3000	Moderate Several thousand	Large 4000-8000 (0.5-18 GHz coverage	Moderate 1200-2000	Small 800-1900
Minimum Power (W)	100 (with processor) <10 without processor	60 (without processor)	~50 (octave unit)	150	150 (tuner only)	350 to 1200 for 0.5 to 18 GHz coverage	70-80	200
Cost	Low	Low/ Moderate	Moderate	Moderate/ High	Moderate/ High	High	Moderate/ High	Low/ Moderate

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RADAR MODES

Typical Radar modes are listed below in the general functional category for which they were designed. Not all of these modes are applicable to all radars and certain radars have additional modes.

• NAVIGATION

Terrain avoidance - A mode in which the radar is set at a fixed depression angle and short range to continuously sweep the ground area directly in front of the aircraft in order to avoid mountains. This is particularly useful during flight into unfamiliar territory when clouds, haze, or darkness obscure visibility.

Ground mapping - A mode in which the radar uses a variety of techniques to enhance ground features, such as rivers, mountains, and roads. The mode is unlike air-to-air modes where ground return is rejected from the display.

Precision velocity update / Doppler navigation - A mode in which the radar again tracks ground features, using Doppler techniques, in order to precisely predict aircraft ground speed and direction of motion. Wind influences are taken into account, such that the radar can also be used to update the aircraft inertial navigation system.

• FIGHTER MISSIONS

Pulse search - Traditional pulse techniques are used to accurately determine range, angle, and speed of the target. Limitations are easy deception by enemy jamming, and less range when compared to other modes.

Velocity search - A high PRF Pulse Doppler waveform is used for long range detection primarily against nose aspect targets, giving velocity and azimuth information. Although velocity search can work against tail-on targets, the Doppler return is weaker, consequently the maximum detection range is also much less. When the target is in the beam (flying perpendicular to the fighter), the closure (Doppler) is the same as ground return and target return is almost zero.

Track While Scan (TWS) - A system that maintains an actual track on several aircraft while still searching for others. Since the radar is sharing its computing time between targets, the accuracy is less precise than for a single target track (STT) mode of operation.

Raid assessment - A mode in which the radar has an STT on a single target, but is routinely driven off by a small amount in order to determine if multiple aircraft exists in the immediate vicinity of the target aircraft.

Single-Target-Track (STT) (including air combat maneuvering modes) - Highly precise STT modes are used to provide the most accurate information to the fire control computer so that accurate missile or gun firing can be accomplished. The fire control radar continuously directs energy at the target so that the fired missile locates and tracks on the reflected energy from the target. Air combat maneuvering modes are automatic modes in which the radar has several sweep patterns fixed about the aircraft axis, such that little or no work is required of the pilot in order to lock up a target.

- **AIR-TO-GROUND MISSIONS**

Weapons delivery - A mode in which ground features are tracked, and particular emphasis is placed on determining range to the ground target, angle of dive, weapons ballistic tables, and aircraft speed.

Surveillance/tracking of ground forces/targets - Similar to the above with emphasis on multiple ground features and less on weapons delivery data.

Reconnaissance - A specific navigational mode to aid in identifying specific targets.

- **AIR-TO-SURFACE MISSIONS**

ASW - Navigational techniques specializing in specific search patterns to aid in detection of enemy submarines.

- **TECHNIQUES USED FOR MULTIPLE APPLICATIONS**

Synthetic Aperture Radar (SAR) - A form of radar that uses the relative motion between an antenna and its target region, to provide coherent-signal variations, in order to obtain finer spatial resolution than is possible with conventional beam-scanning means. SAR is usually implemented by mounting a single beam-forming antenna on a moving platform such as an aircraft from which a target scene is repeatedly illuminated with pulses of radio waves at wavelengths anywhere from a meter down to millimeters. The many echo waveforms received successively at the different antenna positions are coherently detected and stored and then post-processed together to resolve elements in an image of the target region.

Over-The-Horizon Radar (OTHR) - uses the refraction of high frequency radiation through the ionosphere in order to detect targets beyond the line-of-sight. The complexities of the ionosphere can produce multipath propagation, which may result in multiple resolved detections for a single target. When there are multipath detections, an OTHR tracker will produce several spatially separated tracks for each target. Information conveying the state of the ionosphere is required in order to determine the true location of the target and is available in the form of a set of possible propagation paths, and a transformation from measured coordinates into ground coordinates for each path. Since may be no other information as to how many targets are in the surveillance region, or which propagation path gave rise to which track, there is a joint target and propagation path association ambiguity which must be resolved using the available track and ionospheric information.

GENERAL RADAR DISPLAY TYPES

There are two types of radar displays in common use today.

RAW VIDEO

Raw video displays are simply oscilloscopes that display the detected and amplified target return signal (and the receiver noise). Raw video displays require a human operator to interpret the various target noise and clutter signals.

On the left hand display of Figure 1, an operator could readily identify three targets and a ghost (a ghost is a phony target that usually fades in and out and could be caused by birds, weather, or odd temporary reflections - also referred to as an angel). Target 3 is a weak return and hidden in the noise - an operator can identify it as a target by the "mouse under the rug" effect of raising the noise base line.

SYNTHETIC VIDEO

Synthetic video displays use a computer to clean up the display by eliminating noise and clutter and creating its own precise symbol for each target.

On the right hand display target 1 comes and goes because it is barely above the receiver noise level - notice that it is quite clear on the raw video. Target 3 wasn't recognized by the computer because it's too far down in the noise. The computer validated the ghost as a target. The ghost might be a real target with glint or ECM characteristics that were recognized by the computer but not the operator.

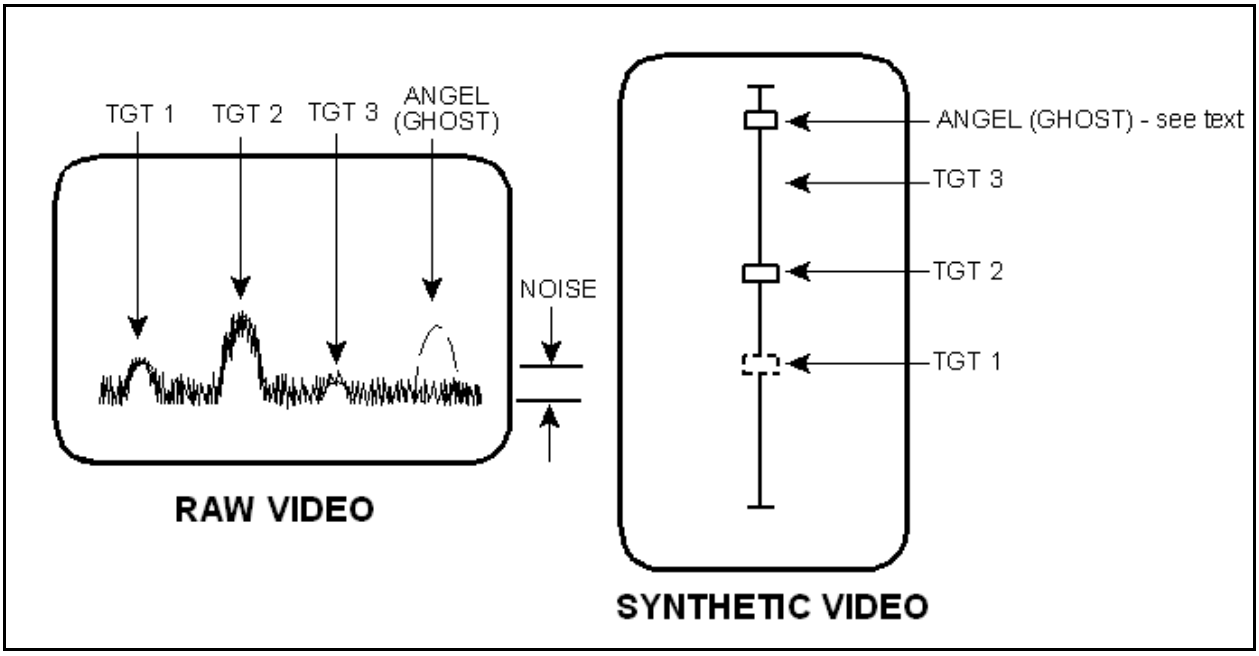

Figure 1. Radar Display Types.

SEARCH AND ACQUISITION RADARS

They generally use either a PPI or a sector PPI display as shown in Figure 2. PPI displays can be either raw video or synthetic video.

PPI scope (plan position indicator).
- Polar plot of direction and distance.
- Displays all targets for 360 degrees.

Sector PPI scope.
- Polar plot of direction and distance.
- Displays all targets within a specific sector.
- Origin may be offset so that "your" radar position may be off the scope.

TRACKING RADARS

Usually use some combination of A, B, C, or E scope displays. There are many other types of displays that have been used at one time or another - including meters - but those listed here are the most common in use today.

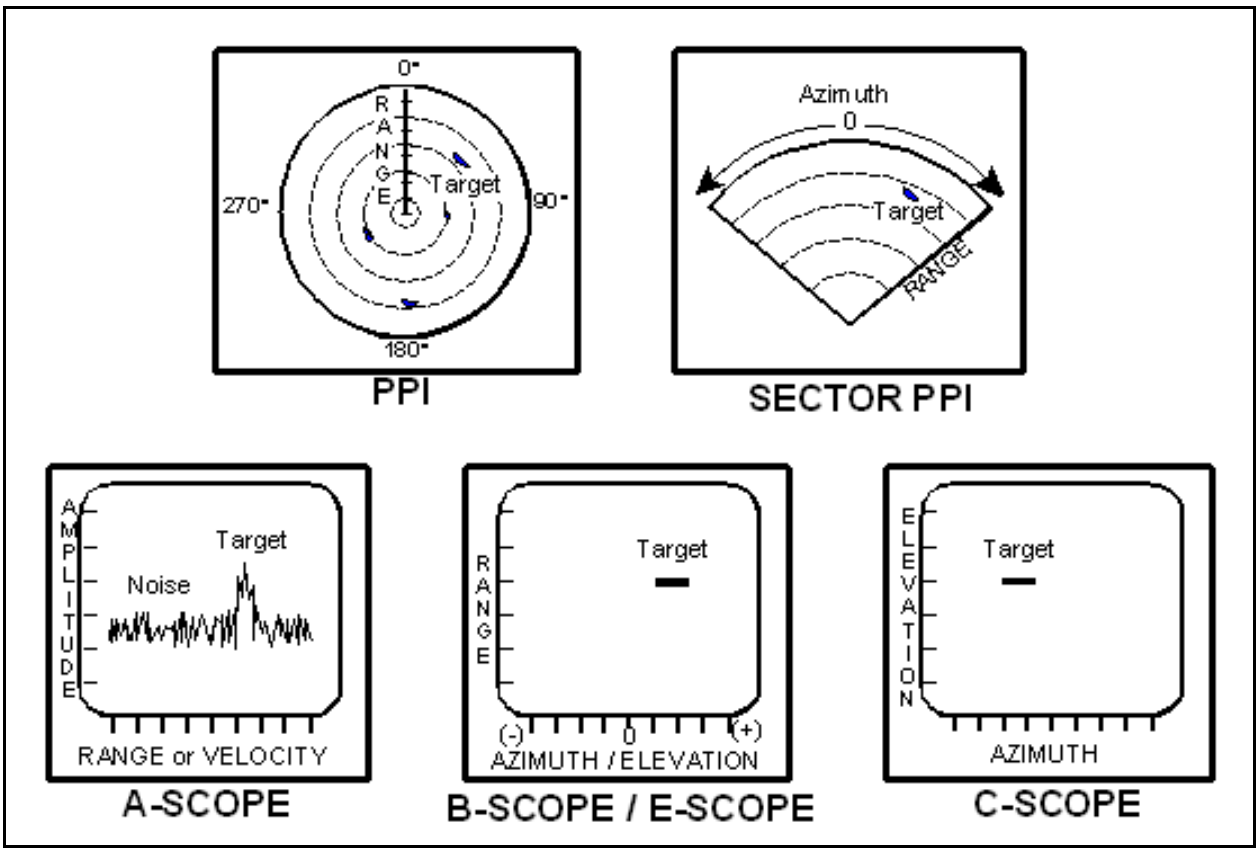

Figure 2. Common Radar Displays.

A-SCOPE

Target signal amplitude vs. range or velocity.

Displays all targets along pencil beam for selected range limits.

Displays tracking gate. Usually raw video. Some modern radars have raw video a-scopes as an adjunct to synthetic video displays.

Must be used with a separate azimuth and elevation display of some sort.

Also called a range scope (R-Scope).

B-SCOPE

Range vs. azimuth or elevation. Displays targets within selected limits.

Displays tracking gate. May be raw or synthetic video.

Surface radars usually have two. One azimuth/one elevation which can result in confusion with multiple targets.

C-SCOPE

Azimuth vs. elevation. Displays targets within selected limits of az and el.

Displays tracking gate. May display bull's-eye or aim dot.

May have range indicator inserted typically as a marker along one side. Usually synthetic video.

Pilots eye view and very common in modern fighter aircraft heads up displays for target being tracked.

Could be used in any application where radar operator needs an "aiming" or "cross hair" view like a rifle scope.

E-SCOPE

Elevation vs. Range similar to a B-scope, with elevation replacing azimuth.

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IFF - IDENTIFICATION - FRIEND OR FOE

Originated in WWII for just that purpose - a way for our secondary radars to identify U.S. aircraft from enemy aircraft by assigning a unique identifier code to U.S. aircraft transponders.

The system is considered a secondary radar system since it operates completely differently and independently of the primary radar system that tracks aircraft skin returns only, although the same CRT display is frequently used for both.

The system was initially intended to distinguish between enemy and friend but has evolved such that the term "IFF" commonly refers to all modes of operation, including civil and foreign aircraft use.

There are five major modes of operation currently in use by military aircraft plus two sub-modes.

- Mode 1 is a non-secure low cost method used by ships to track aircraft and other ships.
- Mode 2 is used by aircraft to make carrier controlled approaches to ships during inclement weather.
- Mode 3 is the standard system also used by commercial aircraft to relay their position to ground controllers throughout the world for air traffic control (ATC).
- Mode 4 is secure encrypted IFF (the only true method of determining friend or foe) Military only
- Mode 5 – provides a cryptographically secured version of Mode S and ADS-B GPS position. (military only). Mode 5 is divided into two levels. Both are crypto-secure with Enhanced encryption, Spread Spectrum Modulation, and Time of Day Authentication. Level 1 is similar to Mode 4 information but enhanced with an Aircraft Unique PIN. Level 2 is the same as Mode 5 level one but includes additional information such as aircraft position and other attributes
- Mode "C" is the altitude encoder (military and civilian).
- Mode S – provides multiple information formats to a selective interrogation. Typically aircraft are assigned a unique 24-bit Mode S address. The Mode S address is partitioned and a group of address ranges are allocated to each country. Some countries change the assigned address for security reasons, and thus it might not be a unique address. (military and civilian)

The non-secure codes are manually set by the pilot but assigned by the air traffic controller.

A cross-band beacon is used, which simply means that the interrogation pulses are at one frequency and the reply pulses are at a different frequency. 1030 MHz and 1090 MHz is a popular frequency pair used in the U.S.

The secondary radar transmits a series of selectable coded pulses. The aircraft transponder receives and decodes the interrogation pulses. If the interrogation code is correct, the aircraft transponder transmits a different series of coded pulses as a reply.

The advantage of the transponder is that the coded pulses "squawked" by the aircraft transponders after being interrogated might typically be transmitted at a 10 watt ERP, which is much stronger than the microwatt skin return to the primary radar. Input power levels may be on the order of several hundred watts.

The transponder antenna is low gain so that it can receive and reply to a radar from any direction.

An adjunct to the IFF beacon is the altitude encoding transponder known as mode C - all commercial and military aircraft have them, but a fair percentage of general aviation light aircraft do not because of cost. The number of transponder installations rises around many large metropolitan areas where they are required for safety (easier identification of aircraft radar tracks).

Air traffic control primary radars are similar to the two-dimensional search radar (working in azimuth and range only) and cannot measure altitude.

The expanded display in figure 1 is typical of an air traffic control IFF response. The aircraft was told to squawk a four digit number such as "4732." The altitude encoded transponder provides the aircraft altitude readout to the ground controllers display along with the coded response identifying that particular aircraft.

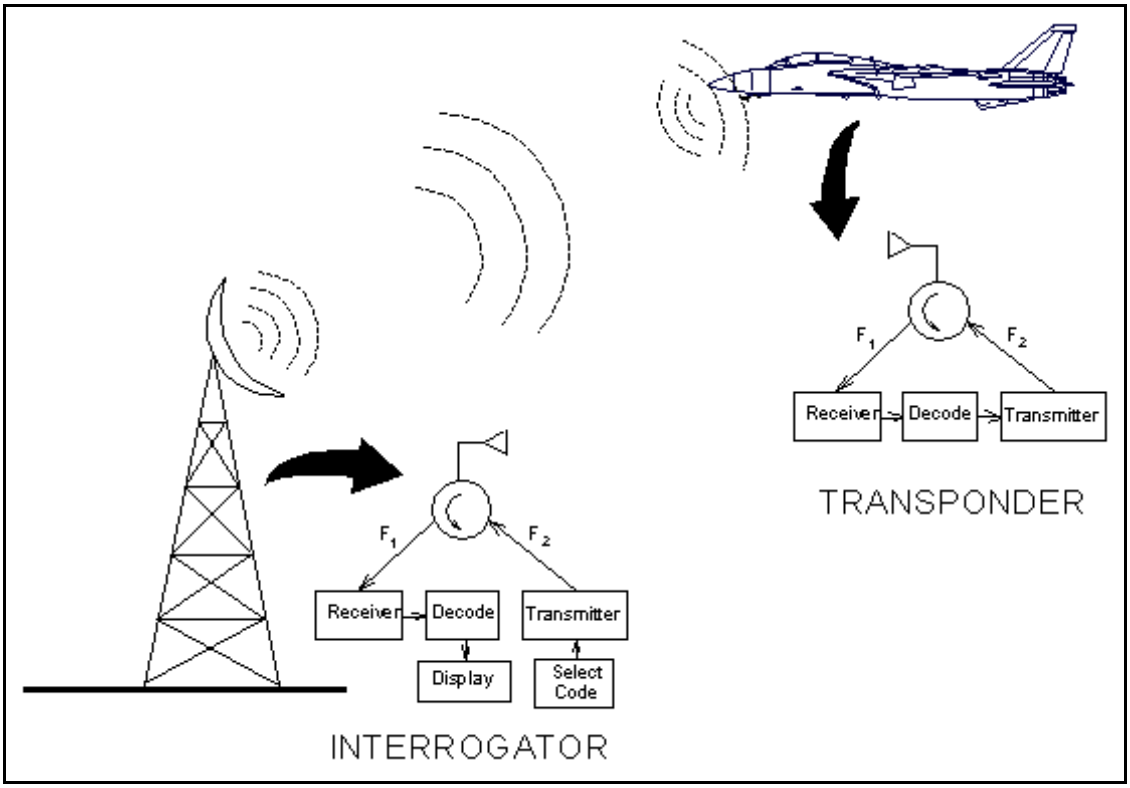

Figure 1. IFF Transponder.

In addition to systems with active electronic data interchange between airborne and ground equipment, some military surveillance systems can provide targeting in tactical applications. The development of automated techniques for use against ground targets is typically referred to as Automatic Target Recognition (ATR). When used against air targets, it is typically referred to as Non-Cooperative Target Recognition (NCTR). The requirements for radar target recognition are complex since typical targets have background clutter and often multiple targets types exist.

RECEIVER TESTS

Two tone and spurious response (single signal) receiver tests should be performed on EW and radar receivers to evaluate their spurious free dynamic range. A receiver should have three ranges of performance: (1) protection from damage, (2) degraded performance permitted in the presence of a strong interfering signal(s) and no degradation when only a strong desired signal is present, and (3) full system performance.

The original MIL-STD-461A design requirement and its companion MIL-STD-462 test requirement specified four receiver tests. These standards allowed the interfering signal(s) to be both inband and out of band, which is meaningful for design and test of EW receivers, however inband testing generally is not meaningful for narrowband communications receivers. These standards were difficult to follow and had to be tailored to properly evaluate the EW and radar system. MIL-STD-461B/C still allowed the interfering signal(s) to be both inband and out of band but deleted the single signal interference test (CS08 Conducted Susceptibility test). MIL-STD-461D/-462D leave the pass/fail criteria entirely up to what is listed in the individual procurement specification. It also places all interfering signals out of band, redesignates each test number with a number "100" higher than previously used, and combines "CS08" as part of CS104. Therefore, to provide meaningful tests for EW and radar systems, the procurement specification must specify the three ranges of performance mentioned in the beginning of this section and that the tests are to be performed with the interfering signal(s) both inband and out of band. The four tests are as follows (listed in order of likelihood to cause problems):

Test Name	MIL-STD-461A	MIL-STD-461D
Undesired, Single signal interference test	CS08	Part of CS104
Desired with undesired, two signal interference tests	CS04	CS104
Two signal intermodulation test	CS03	CS103
Two signal cross modulation test	CS05	CS105

The rest of this section explains the application of these tests and uses the names of the original MIL-STD-461A tests to separate the tests by function.

TEST SETUP

A directional coupler used backwards (as shown here in Figure 1) is an easy way to perform two signal tests. The CW signal should be applied to the coupling arm (port B) since the maximum CW signal level is -10 dBm. The pulse signal should be applied to the straight-through path (port C) since the maximum pulse level is +10 dBm peak. These power levels are achievable with standard laboratory signal generators, therefore one doesn't have to resort to using amplifiers which may distort the signals. Always monitor the output signal to verify spectrally pure signals are being applied to the test unit. This can be accomplished by another directional coupler used in the standard configuration. Dissimilar joints or damaged or corroded microwave components can cause mixing. This can also result if the two signal generators are not isolated from one another. Therefore, even if a directional coupler is used to monitor the

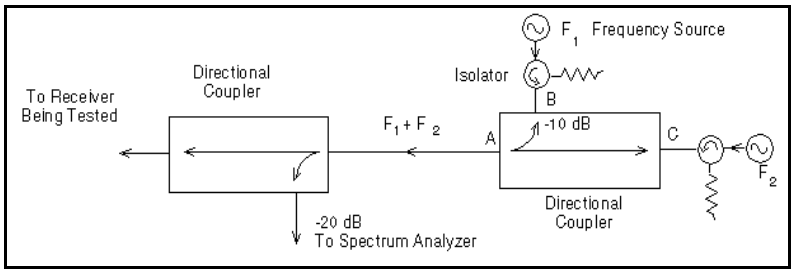

Figure 1. Receiver Test Setup When Antenna Can Be Removed.

signal line, it is still advisable to directly measure the input to the receiver whenever there is a suspected receiver failure. This test does not need to be performed in an EMI shielded room and is more suitable for a radar or EW lab where the desired signals are readily available.

If the receiver's antenna is active or cannot be removed, a modified test as shown in Figure 2 should be performed. The monitoring antenna which is connected to the spectrum analyzer should be the same polarization as the antenna for the receiver being tested. Amplifiers may be required for the F_1 and F_2 signals. It is desirable to perform this test in an anechoic chamber or in free space.

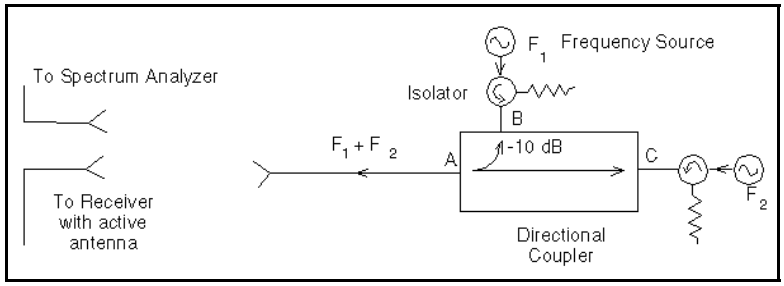

Figure 2. Receiver Test Setup When Antenna Is Active.

In the following discussion of CS08, CS04, CS03, and CS05 tests, it is assumed that when the receive light illuminates, the receiver identifies a signal that matches parameters in the User Data File (UDF) or pre-programmed list of emitter identification parameters. If a receiver is different, the following procedures will have to be appropriately tailored. If the UDF does not have entries for very low level signals in the 10% and 90% regions of each band, complete testing is not possible. Most problems due to higher order mixing products and adjacent band leakage are only evident in these regions. In the following tests, the lowest level where the receive light is constantly on is used to identify the minimum receive level. If a receiver has a receive level hysteresis or other idiosyncrasy, then using a 50% receive light blinking indicator may be more appropriate. Whatever technique is appropriate, it should be consistently used during the remainder of the test. The maximum frequency for testing is normally 20 GHz. If a millimeter wave receiver is being tested, the maximum frequency should be 110 GHz.

CS08 - UNDESIRED, SINGLE SIGNAL INTERFERENCE TEST

MIL-STD-461B/C (EMI design requirements) deleted this test. MIL-STD-461D allows a single signal test as part of CS104 (CS04) but specifies it as an out of band test. The original CS08 inband and out of band test is still needed and is the most meaningful test for wide band EW receivers which have a bandwidth close to an octave. This test will find false identification problems due to 1) lack of RF discrimination, 2) higher order mixing problems, 3) switch or adjacent channel/band leakage, and 4) cases where the absence of a desired signal causes the receiver to search and be more susceptible. In this latter case, a CS04 two signal test could pass because the receiver is captured by the desired signal, whereas a CS08 test could fail. Examples of the first three failures are as follows.

EXAMPLE 1

A 2 to 4 GHz receiver which uses video detection (e.g., crystal video) and doesn't measure RF is used for this example. This receiver assumes that if the correct Pulse Repetition Interval (PRI) is measured, it is from a signal in the frequency band of interest. Three cases can cause false identification. Refer to Figure 3.

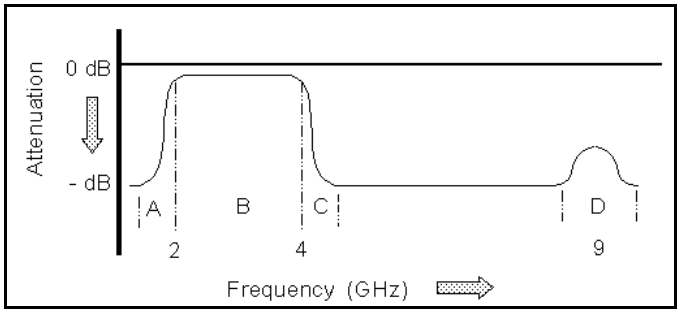

Figure 3. Frequency Areas in a Sample 2-4 GHz Receiver.

(1) Region A&C. The 2 to 4 GHz band pass filter will pass strong signals in regions A&C. If they have the correct PRI, they will also be identified.

(2) Region B. Any other signal besides the desired signal in the 2 to 4 GHz region that has the correct PRI will also be identified as the signal of interest.

(3) Region D. Band pass filters with poor characteristics tend to pass signals with only limited attenuation at frequencies that are three times the center frequency of the band pass filter. If these signals have the correct PRI, they will be incorrectly identified.

High duty cycle signals (CW or pulse doppler) in regions A, B, C, and D may overload the processing of signals, saturate the receiver, or desensitize the receiver. This case is really a two signal CS04 test failure and will be addressed in the CS04 section.

EXAMPLE 2

A receiver measuring the carrier frequency of each pulse (i.e., instantaneous frequency measurement (IFM)) and the PRI is used for this example. False signal identification can occur due to higher order mixing products showing up in the receiver pass bands. These unwanted signals result from harmonics of the input RF mixing with harmonics of the Local Oscillator (LO). Refer to Figures 4 and 5.

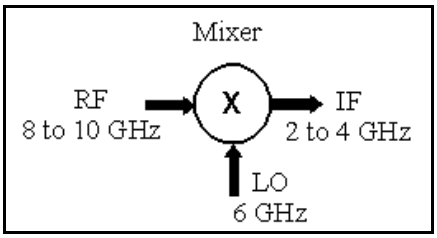

Figure 4. Low Side Mixing.

Mixers are nonlinear devices and yield the sum, difference, and the original signals. Any subsequent amplifier that is saturated will provide additional mixing products.

If a 8.5 GHz signal with a 1 kHz PRI is programmed to be identified in the UDF, measurements are made at the 2.5 GHz Intermediate Frequency (IF), i.e., RF-LO = IF = 8.5-6 = 2.5 GHz.

The same 2.5 GHz signal can result from an RF signal of 9.5 GHz due to mixing with the second harmonic of the LO i.e., 2 X 6 - 9.5 = 2.5 GHz. This signal will be substantially attenuated (approximately 35 dB) when compared to the normal IF of 9.5 - 6 = 3.5 GHz. If the receiver has filters at the IF to reduce the signal density and a filter has minimum insertion loss at 2.5 GHz and maximum insertion loss at 3.5 GHz, then only the low level 2.5 GHz signal will be measured and assumed to be due to a 8.5 GHz input signal whereas the input is really at 9.5 GHz.

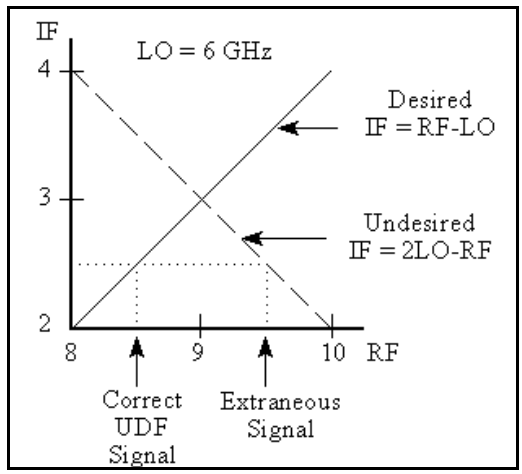

Figure 5. Low Side Mixing Results.

Spurious intermodulation products can also result from high side mixing, but generally the suppression of undesired signals is greater. In this case, the LO is at a frequency higher than the RF input. This is shown in Figures 6 and 7.

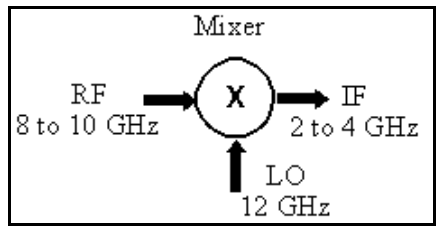

Figure 6. High Side Mixing.

Table 1. Intermodulation Product Suppression.

Harmonic of		
LO	RF	Suppression
1	1	0
1	2	ΔP-41
1	3	2ΔP-28
2	1	-35
2	2	ΔP-39
2	3	2ΔP-44
3	1	-10
3	2	ΔP-32
3	3	2ΔP-18
4	1	-35
4	2	Δ-39
5	1	-14
5	3	2ΔP-14
6	1	-35
6	2	ΔP-39
7	1	-17
7	3	2ΔP-11

Courtesy Watkins-Johnson

As previously mentioned, the amplitude of intermodulation products is greatly reduced from that of the original signals. Table 1 shows rule of thumb approximate suppression (reduction), where $\Delta P = P_{RF}(dBm) - P_{LO}(dBm)$. As can be seen, the strength of the LO is a factor. The higher the LO power, the more negative the suppression becomes.

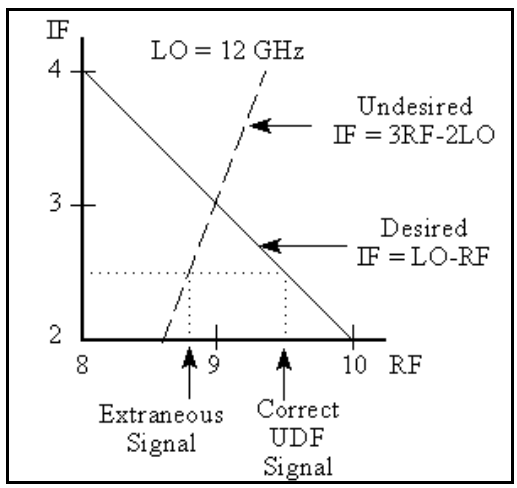

Figure 7. High Side Mixing Byproducts.

If one assumes the maximum RF power for full system performance is +10 dBm and the LO power level is +20 dBm, then ΔP = -10 dB minimum. Therefore in this example, the 3RF-2LO mixing product would be 2ΔP - 44 = - 20 - 44 = -64 dB when compared to the desired mixing product.

The use of double mixing, as shown in Figure 8, can significantly reduce unwanted signals but it is more expensive. For a 8 GHz signal in, one still generates a 2 GHz IF but by mixing up, then down, unwanted signals are not generated or significantly suppressed.

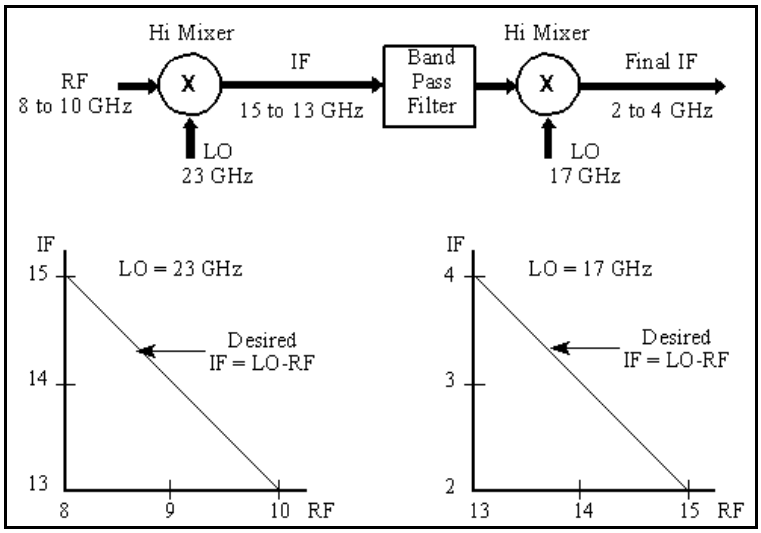

Figure 8. Double Mixing.

Some of these problems can be corrected by:

(1) always having LOs on the high side versus low side of the input RF (but this is more expensive),

(2) using double mixing

(3) software programming the receiver to measure for the potential stronger signal when a weak signal is measured in a certain IF region, and

(4) improved filtering of the LO input to the mixer and the output from the mixer.

EXAMPLE 3

If the same receiver discussed in example 2 had additional bands (Figure 9) and used a switch at the IF to select individual bands, a strong signal in an adjacent band could be inadvertently measured because:

(1) the switch, which may have 80 dB of isolation when measured outside the circuit, may only have 35 dB isolation when installed in a circuit because of the close proximity of input and output lines,

(2) the strong signal in one band may have the same IF value that is being sought in an adjacent band, and

(3) the additional parameters such as PRI may be the same.

As shown in Figure 9, assume that in band 2 we are looking for a 4.5 GHz signal that has a PRI of 1 kHz. Measurements are made at an IF of 3.5 GHz since LO-RF = IF = 8-4.5 = 3.5 GHz. If a 6.5 GHz signal is applied to band 3, its IF also equals 3.5 since LO-RF = 10-6.5 = 3.5 GHz. If this is a strong signal, has a PRI of 1 kHz, and there is switch leakage, a weak signal will be measured and processed when the switch is pointed to band 2. The receiver measures an IF of 3.5 GHz and since the switch is pointed to band 2, it scales the measured IF using the LO of band 2 i.e., LO-IF = RF = 8-3.5 = 4.5 GHz. Therefore, a 4.5 GHz signal is assumed to be measured when a 6.5 GHz signal is applied. Similarly this 6.5 GHz signal would appear as a weak 3.5 GHz signal from band 1 or a 9.5 GHz signal from band 4.

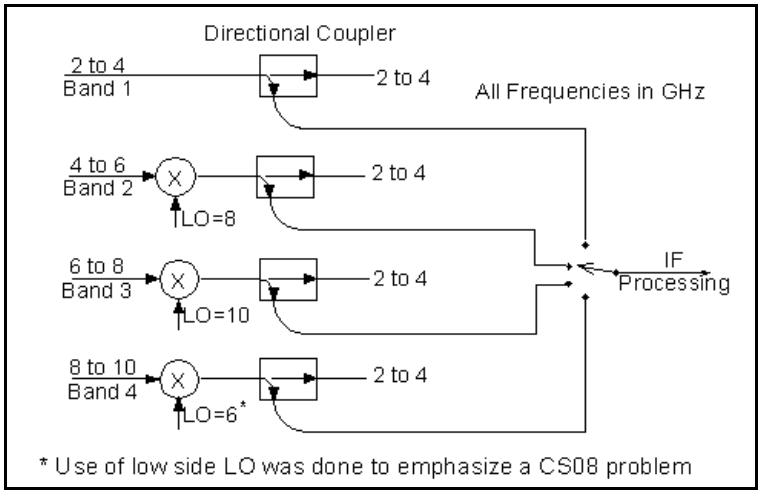

Figure 9. Multi Band Receiver With Common IF.

In performing this test it is important to map the entries of the UDF for each band i.e., show each resulting IF, its PRI, and the sensitivity level that the receive light is supposed to illuminate, i.e., if a test in one band used a PRI corresponding to a PRI in another band where the receive threshold is programmed to not be sensitive this will negate the effectiveness of a cross coupling test. Mapping the UDF will facilitate applying a strong signal to one band using the PRI of a desired signal in an adjacent band.

CS08 TEST PROCEDURE

Assume that the receiver band is 2 to 4 GHz as shown in Figure 10. Pick the UDF entry that has the greatest sensitivity. UDF #1 entry is for a 3±.05 GHz signal with a PRI of 1 kHz. If the test signal is set for the UDF #1 PRI, a receive light will also occur at the frequencies of UDF #2 if it also has the same PRI (this is not a test failure). If adjacent bands don't also have entries with the same PRI, then the test should be repeated for the band being tested with at least one of the adjacent band PRI values.

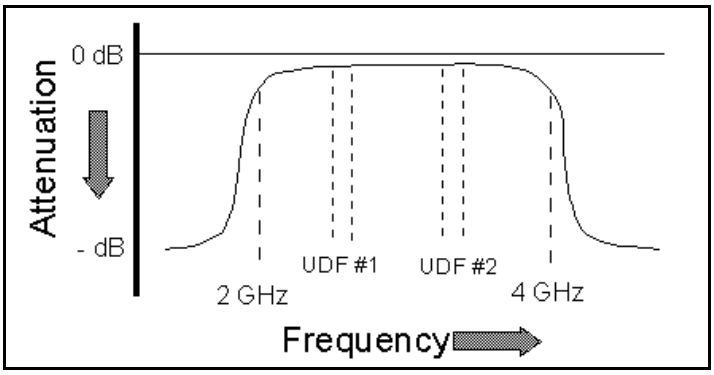

Figure 10. Receiver Band With Multiple UDF Entries.

(1) Set the receiver or jammer to the receive mode, verify it is working for UDF #1 and record P_o, the minimum signal level where the receive light is constantly on.

(2) Raise this signal to its maximum specified level for full system performance. If a maximum level is not specified, use +10 dBm peak for a pulse signal or -10 dBm for a CW signal.

(3) Tune this strong RF signal outside the UDF #1 range and record any RF frequency where the receive light comes on. If another inband UDF has the same PRI, this is not a failure.

(4) This test is performed both inband and out of band. Out of band tests should be performed on the high end to five times the maximum inband frequency or 20 GHz, whichever is less, and on the low end to IF/5 or 0.05 F0, whichever is less, unless otherwise specified. The out of band power level is +10 dBm peak for a pulse signal or -10 dBm for a CW signal, unless otherwise specified.

(5) If a receive light comes on when it is not supposed to, record the RF and reduce the power level to where the receive light just stays on constantly. Record this level P1. The interference rejection level is P1-P0= PIR

(6) Repeat this test for each type of signal the receiver is supposed to process, i.e., pulse, PD, CW, etc.

CS04 - DESIRED WITH UNDESIRED, TWO SIGNAL INTERFERENCE TEST

The intent is for a weak desired signal to be received in the presence of an adjacent CW signal. The desired signal is kept tuned at minimal power level and a strong unmodulated signal is tuned outside the UDF region. Radar and EW receivers without preselectors are likely to experience interference when this test is performed inband. Receivers with nonlinear devices before their passive band pass filter, or filters that degrade out of band, are likely to experience susceptibility problems when this test is performed out of band.

Tests performed inband - An unmodulated CW signal is used. If the receiver is supposed to handle both pulsed and CW signals, this test is performed inband. If the pulse receiver is supposed to desensitize in order to only process pulse signals above the CW level, then only this limited function is tested inband i.e., normally the levels correspond, if a CW signal of -20 dBm is present, then the receiver should process pulse signals greater than -20 dBm.

CS04 TEST PROCEDURE

(1) As shown in Figure 11, initially the pulse signal is tuned to F_0 and the minimum receive level P_0 is recorded, i.e., minimum level where the receive light is constantly on.

(2) The pulse signal is raised to the maximum specified level for full system performance and tuned on either side of F_0 to find the frequencies on both sides (F_{High} and F_{Low}) where the receive light goes out. If a maximum pulse power level is not specified, then +10 dBm peak is used. In some receivers F_L and F_H are the band skirts.

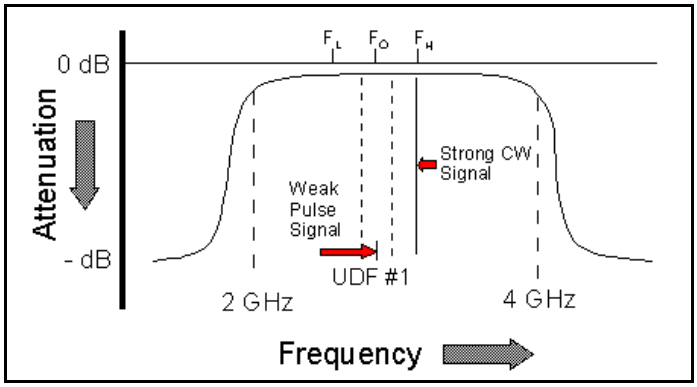

Figure 11. CS04 Test Signals.

(3) The pulse signal is returned to the level found in step 1. A CW signal at the maximum specified CW power level for full system performance is tuned above F_H and below F_L. If a maximum CW power level is not specified, then -10 dBm is used. Anytime the receive light is lost, the tuned CW RF value is recorded. The CW signal should be turned off to verify that the pulse signal can still be received in the absence of

interference. If the pulse signal is still being received, then the interfering CW signal should be reapplied and decreased to the lowest power level where the receive light stays on constantly. Record this level P_1. The interference rejection level is $P_1 - P_0 = P_{IR}$.

(4) Out of band tests should be performed to five times the maximum inband frequency or 20 GHz, whichever is less, and on the low end to IF/5 or 0.05 F_0, whichever is less, unless otherwise specified. The out of band CW power level is -10 dBm unless otherwise specified.

Failures - Out of band test

(1) If a non-linear device such as a limiter is placed before a band pass filter, a strong out of band signal can activate the limiter and cause interference with the inband signal. The solution is to place all non-linear or active devices after a passive band pass filter.

(2) Band pass filters with poor characteristics tend to pass signals with only limited attenuation at frequencies that are three times the center frequency of the band pass filter. Passage of a CW or high duty cycle signal that is out of band may desensitize or interfere with the processing of a weak inband signal.

CS03 INTERMODULATION TEST

This two signal interference test places a pulse signal far enough away (Δf) from the desired UDF frequency (F_0) that it won't be identified. A CW signal is initially placed $2\Delta f$ away. If an amplifier is operating in the saturated region, these two signals will mix and produce sum and difference signals. Subsequent mixing will result in a signal at the desired UDF frequency F_0 since $F_1 - (F_2 - F_1) = F_0$. These two signals are raised equally to strong power levels. If no problem occurs, the CW signal is tuned to the upper inband limit and then tuned out of band. A similar test is performed below F_0.

CS03 TEST PROCEDURES

(1) Set the receiver or jammer to the receive mode. Verify it is working at a desired signal frequency, (F_0), and record the minimum signal level i.e., lowest level where the receive light is constantly on (record this level P_0).

(2) The modulated signal is raised to the maximum specified level for full system performance and tuned on either side of F_0 to find the frequency F_1 on both sides where the receive light goes out. If a maximum power level is not specified, +10 dBm peak is used. The difference between F_1 and F_0 is Δf as shown in Figure 12.

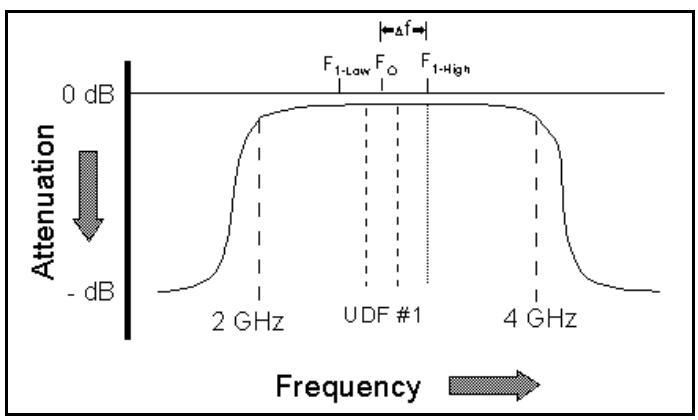

Figure 12. Initial CS03 Test Signal.

(3) As shown in Figure 13, a pulse signal is tuned to F_1 and a CW signal is tuned to F_2 where $F_2 = F_1 + \Delta f$ on the high side. The power level of the two signals is initially set to P_0 and raised together until the maximum specified levels for full system performance are reached. If maximum power levels are not specified, then +10 dBm peak is used for the pulse signal and -10 dBm is used for the CW signal. Whenever the receive light comes on, the two signals should be turned off individually to verify that the failure is due to a combination of the two signals versus (1) a single signal (CS08) type failure or (2) another inband UDF value has been matched. If the failure is due to the two signal operation, then the power level (P_1 and P_2) of F_1 and F_2 should be recorded. If $P_1=P_2$, the intermodulation rejection level is $P_1-P_0=P_{IM}$. If $P_1 \neq P_2$, it is desirable to readjust them to be equal when the receive light just comes on.

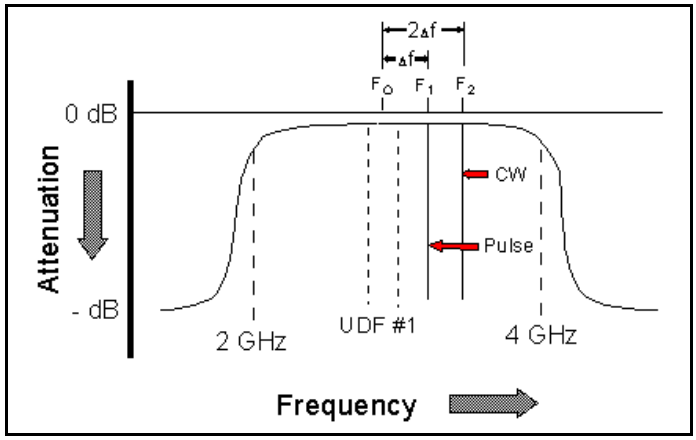

Figure 13. CS03 Testing Signal.

(4) Once the $F_1 + F_2$ signals are raised to the maximum power test levels described in step 3 without a failure, then F_2 is tuned to the upper limit of the band. F_2 should also be tuned out of band to five times the maximum inband frequency or 20 GHz whichever is less unless otherwise specified. The out of band power level is -10 dBm unless otherwise specified. Whenever the receive light comes on, F_2 should be turned off to verify that the failure is due to a two signal test. If it is, turn F_2 back on and equally drop the power levels of F_1 and F_2 to the lowest level where the receive light just comes on. Record the power levels (P_1 and P_2).

(5) Step 3 is repeated where F_1 is Δf below F_0 and $F_2=F_1-\Delta f$. Step 4 is repeated except F_2 is tuned to the lower limit of the band. F_2 should also be tuned out of band down to 0.1 F_0, unless otherwise specified.

(6) Normally if a failure is going to occur it will occur with the initial setting of F_1 and F_2. Care must be taken when performing this test to ensure that the initial placements of F_1 and F_2 do not result in either of the signals being identified directly.

As shown in Figure 14, if F_1 was placed at 3.2 GHz it would be identified directly and if F_2 was placed at 3.4 GHz it would be identified directly. Whereas, if F_1 was at 3.1 GHz and F_2 was at 3.2 GHz neither interfering signal would be identified directly but their intermodulation may result in an improper identification at F_0. Later when F_2 is tuned higher, the receive light will come on around 3.4 GHz and 3.6 GHz. This is not a test failure just a case of another inband UDF value being matched.

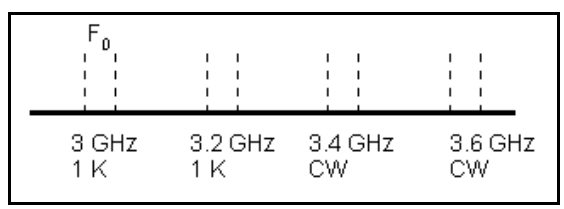

Figure 14. Sample UDF Entries.

CS05 - CROSS MODULATION

This two signal interference test places a weak CW signal where the receiver is programmed for a pulse signal and tunes a strong pulse signal elsewhere. As shown in Figure 15, when an amplifier is saturated, lower level signals are suppressed. When an amplifier is operated in the linear region all signals receive the rated linear gain. In this test the pulse signal will cause the amplifier to kick in and out of saturation and modulate the weak CW signal. The receiver may measure the modulation on the CW signal and incorrectly identify it as a pulse signal.

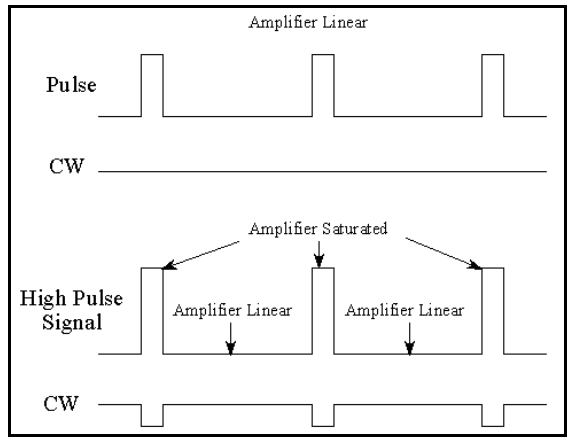

Figure 15. Cross Modulation Example.

CS05 TEST PROCEDURE

(1) Initially the pulse signal is tuned to F_0 and the minimum power level P_0 where the receive light is constantly on is recorded.

(2) As shown in Figure 16, the signal is raised to the maximum specified level for full system performance for a pulse signal and tuned on either side of F_0 to find the frequencies on both sides, (F_{High} and F_{Low}) where the receive light goes out. If a maximum pulse power level is not specified, then +10 dBm peak is used.

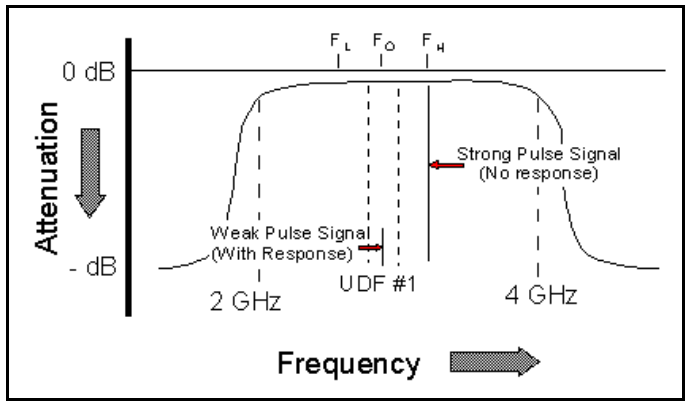

Figure 16. Initial CS05 Test Signals.

(3) The pulse signal from step 2 is turned off and a second signal is placed at F_0. It is a CW signal that is 10 dB stronger than the peak power level (P_0) measured is step 1. The receive light should not come on.

(4) As shown in Figure 17, the strong pulse signal of step 2 is turned back on and tuned above F_H and then tuned below F_L. Out of band tests should be performed to the maximum RF of the system + maximum IF or 20 GHz whichever is less and on the low end to the minimum RF of the system minus the maximum IF, unless otherwise specified.

(5) If a receive light occurs, turn off the weak CW signal since the "failure" may be due to the tuned pulsed signal, i.e., a CS08 failure or another inband UDF value has been matched.

If the light extinguishes when the weak CW signal is turned off, then turn the signal back on, reduce the value of the high level pulse signal until the minimum level is reached where the light stays on constantly. Record this level as P_1.

The cross modulation rejection level is P_1-P_0-10 dB = P_{CM}.

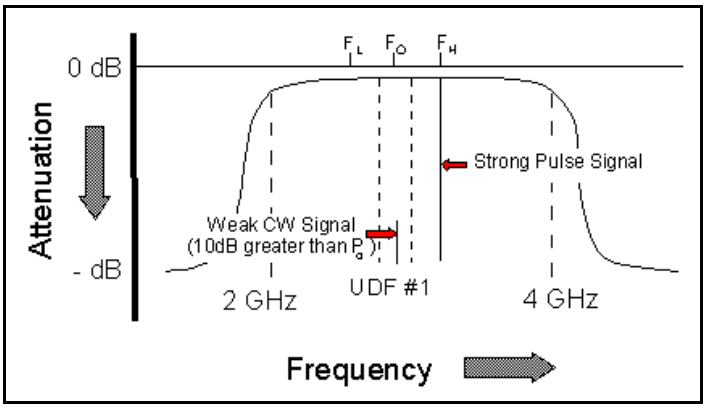

Figure 17. Final CS05 Test Signals.

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SIGNAL SORTING METHODS and DIRECTION FINDING

As shown in Figure 1, signal processing is basically a problem of signal detection, emitter parameter measurement and correlation, emitter sorting, identification, and operator notification.

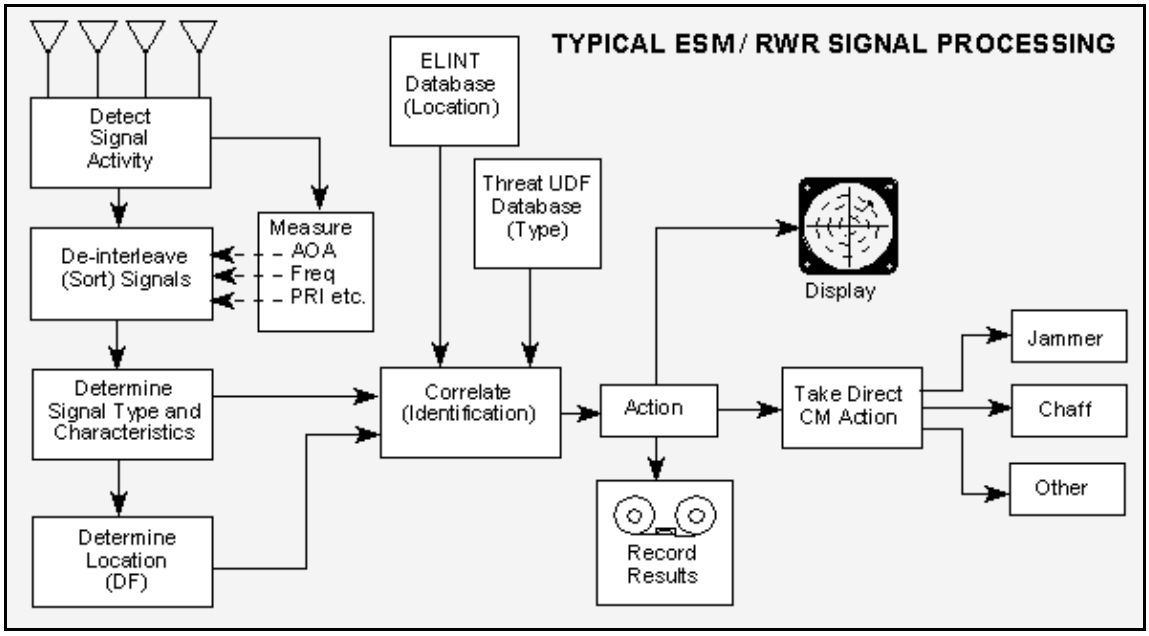

Figure 1. Signal Processing Steps.

The ultimate goal of this processing is to classify radar signals by their unique characteristics and to use this data to identify enemy radars operating in the environment, determine their location or direction, assess their threat to friendly forces, and display this information to the operator.

While not all electronic support measures (ESM) or radar warning receiver (RWR) systems perform every step in this process, each completes some of them. For example, ESM systems seldom initiate direct CM action, while RWRs sometimes do. Also ESM systems frequently record electronic data for future use, but few RWRs do. ESM systems place more emphasis on accurate emitter location and hence direction finding capabilities, while RWRs usually give a rough estimate of position/distance.

The typical emitter characteristics that an ESM system can measure for a pulse radar include the following data:

1. Radio Frequency (RF)
2. Amplitude (power)
3. Direction of Arrival (DOA) - also called Angle of Arrival (AOA)
4. Time of Arrival (TOA)
5. Pulse Repetition Interval (PRI)
6. PRI type
7. Pulse Width (PW)
8. Scan type and rate
9. Lobe duration (beam width)

However, this list is not comprehensive. Other emitter parameters are available which may be necessary to characterize the threat system.

More sophisticated ESM systems can measure additional parameters, such as PRI modulation characteristics, inter- and intra-pulse Frequency Modulation (FM), missile guidance characteristics (e.g., pattern of pulse spacing within a pulse group), and Continuous Wave (CW) signals.

Still other parameters which can describe an electromagnetic wave but are currently not commonly used for identification include polarization and phase. However, as threat emitters begin to use this data more frequently to avoid jamming the more important they may become in identifying signals.

Some of the emitter characteristics which describe an electromagnetic wave are shown in Figure 2.

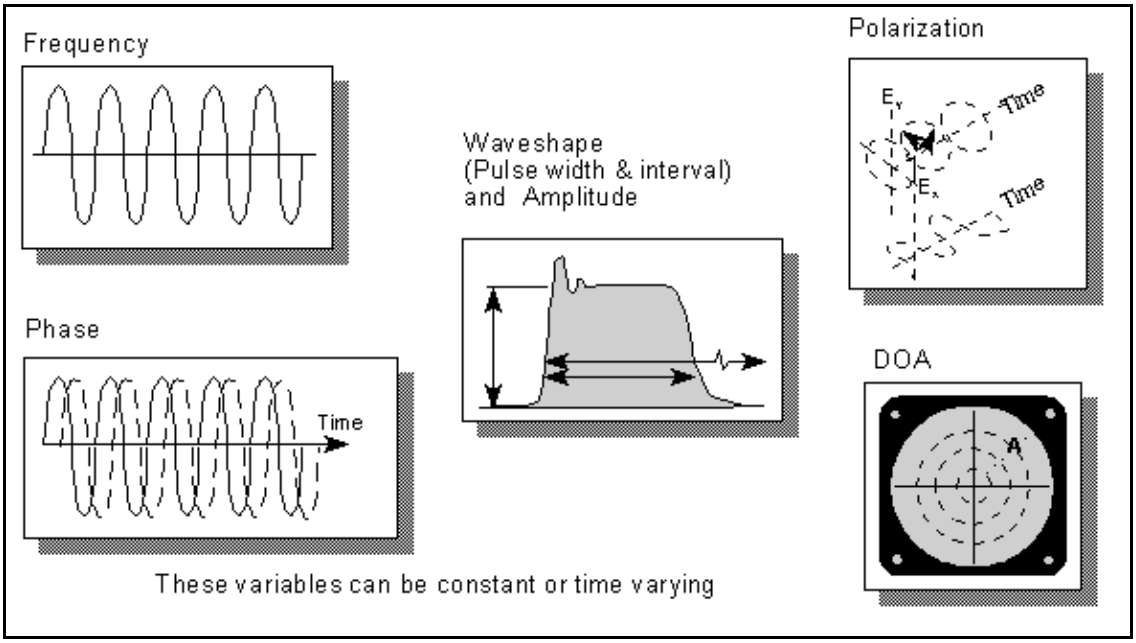

Figure 2. Information Content of an Electromagnetic Wave.

Table 1 illustrates the relative importance of several measured parameters during various stages of signal processing.

Table 1. Importance of Emitter Parameters During Signal Processing.

Parameter	Pulse Train De-interleavement	Emitter Identification	Intercept Correlation
Frequency	2	2	2
Amplitude	1	0	1
Angle of Arrival	2	0	2
TOA	0	0	1
PRI	2	2	2
PRI type	2	2	2
PW	2	1	1
Scan rate and type	0	2	1
Lobe Duration	0	1	1
0 Not Useful	1 Some Use	2 Very Useful	

Some emitter parameters can be measured using a single pulse; these parameters are referred to as monopulse parameters. The monopulse parameters include RF, PW, DOA, amplitude and TOA. RF can be determined on a pulse-by-pulse basis by receivers that can measure frequency. Frequency is very useful for emitter identification since most radars operate at a single frequency. Most real-time systems measure pulse width instead of pulse shape because the latter is much more difficult to characterize mathematically. Unfortunately, the apparent pulse width can be severely distorted by reflections, and consequently, its usefulness for emitter identification is limited. DOA cannot be used for emitter identification, but is excellent for sorting signals. A number of ESM systems use both frequency and DOA information to distinguish the new signals from the old (that is, known) ones. Amplitude also cannot be used for emitter identification. However, it can be used for sorting and for gross distance estimation using precompiled emitter's effective radiated power. Moreover, amplitude in conjunction with TOA can be used to determine the emitter's scan characteristics.

Other emitter parameters such as PRI, guidance and scan characteristics can be determined only by analyzing a group of pulses. All these parameters are useful for emitter identification; unfortunately, they require time for data collection and analysis, and call for sophisticated signal processing algorithms.

The problem of signal recognition in real-time is complicated by two factors: modulation of the signals and the very high pulse densities expected in the environment. Complex modulations (for example, inter-pulse RF modulation, intra-pulse RF modulation and agile Pulse Repetition Frequencies (PRFs)) present a significant pattern recognition problem for a number of ESM systems. It is expected that during some missions, hundreds of emitters will be transmitting simultaneously in the same vicinity. Wide-open antenna/receiver combination systems may have to cope with up to a million PPS. Even narrow-band receivers can expect data rates up to 100,000 PPS. At these rates, a single modern computer cannot be expected to process all the pulses, derive the characteristics for all emitters and identify the emitters in real-time. Other factors which encumber signal recognition include missing pulses, atmospheric noise and multiple reflections of pulses.

Present RWRs are designed primarily to cope with stable emitters. A stable emitter is one whose frequency and pulse repetition interval (PRI) remain relatively constant from pulse to pulse. The future threat will move steadily away from the stable emitter towards agile emitters which vary their frequency and PRI characteristics. The first change in this direction is towards the patterned agile emitter which varies its pulse and frequency parameters in accordance with a specific pattern. Examples of patterned agile emitters are MTI radars which use staggered PRFs, pulse Doppler radars which change frequency and PRF on a block-to-block

basis, and certain frequency-agile radars whose transmitter frequency is mechanically modulated in a systematic pattern (e.g., spin-tuned magnetron). The next step in this evolution is towards truly agile emitters which change their frequency and PRF in a random manner on a pulse-to-pulse basis. One tempering factor in this evolution is that radars which process Doppler must maintain a constant frequency for at least two consecutive pulses.

In addition to agile frequency and PRI parameters, the future threat will be composed of a number of high-PRF pulsed Doppler, burst-frequency, CW, pulse-compression, agile-beam, and LPI radars, which use pseudo-noise waveforms. This conglomeration of radar types will cause a high signal density which must be segmented into a manageable data stream by the use of both frequency and spatial filtering in the RWR. While frequency and PRI are good parameters for sorting present-day non-agile emitters, they are poor or useless parameters for sorting agile emitters.

Angle of arrival is generally regarded as the best initial sorting parameter because it cannot be varied by the emitter from pulse to pulse.

PASSIVE DIRECTION FINDING AND EMITTER LOCATION

Direction finding (DF) systems provide several important functions in modern EW systems. We have already discussed the importance of measuring the emitter's bearing, or angle of arrival (AOA), as an invariant sorting parameter in the deinterleaving of radar signals and in separating closely spaced communication emitters. In addition, the conservation of jamming power in power-managed ECM systems depends on the ability of the associated ESM system to measure the direction to the victim emitter. A function which is becoming increasingly important in defense suppression and weapon delivery systems involves locating the emitter's position passively. This can be accomplished from a single moving platform through successive measurements of the emitter's angular direction, or from multiple platforms which make simultaneous angular measurements.

The emitter identification function requires identifying and associating consecutive pulses produced by the same emitter in angle of arrival (AOA) and frequency. The AOA is a parameter which a hostile emitter cannot change on a pulse-to-pulse basis. However, to measure the AOA of pulses which overlap in the time domain first requires them to be separated in the frequency domain. The advanced ESM receivers which accomplish this function must operate over several octaves of bandwidth while providing RMS bearing accuracies on the order of at least 2 degrees with high POI and fast reaction time in dense signal environments.

There are basically three methods, depicted in Figure 3, which allow the passive location of stationary ground-based emitters from airborne platforms.

These are:

1. The azimuth triangulation method where the intersection of successive spatially displaced bearing measurements provides the emitter location.

2. The azimuth/elevation location technique, which provides a single-pulse instantaneous emitter location from the intersection of the measured azimuth/elevation line with the earth's surface.

3. The time difference of arrival (TDOA), or precision emitter location system (PELS) method, which measures the difference in time of arrival of a single pulse at three spatially remote locations.

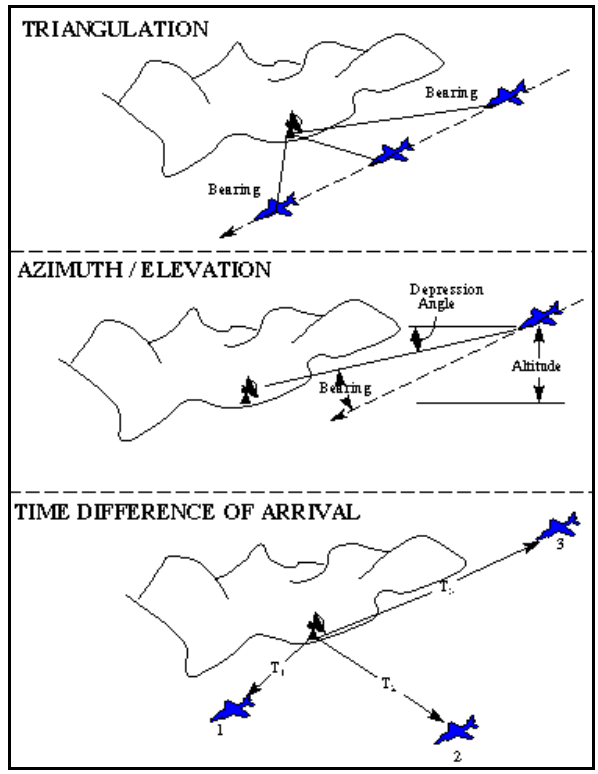

Figure 3. Passive Emitter Location Techniques.

Additional methods include:

1. Phase rate of change, which is similar to triangulation, except it makes calculations using the phase derivative.

2. Angle distance techniques, where the distance from the emitter is derived from the signal strength (with known "threat" characteristics).

3. RF Doppler processing, which measures Doppler changes as the aircraft varies direction with respect to the "target" radar.

The relative advantages and disadvantages of each are given in Table 2.

Table 2. Emitter Location Techniques.

Measurement Technique	Advantages	Disadvantages
Triangulation	Single Aircraft	Non-Instantaneous Location; Inadequate Accuracy for Remote Targeting; Not Forward Looking
Azimuth/Elevation	Single Aircraft Instantaneous Location Possible	Accuracy Degrades Rapidly at Low Altitude; Function of Range
Time Difference of Arrival (Pulsed Signals)	Very High Precision Can Support Weapon Delivery Position Requirements Very Rapid, Can Handle Short On-Time Threat	Very Complex, At Least 3 Aircraft; High Quality Receivers; DME (3 Sites); Very Wideband Data Link; Very High Performance Control Processor; Requires Very High Reliability Subsystems. Requires common time reference and correlation operation for non-pulse signals.

The triangulation method has the advantage of using a single aircraft, and its accuracy is greatest for a long baseline and the broadside geometry. The accuracy degenerates as the aircraft heading line approaches the boresight to the emitter.

The azimuth/elevation technique also has the advantage of using a single aircraft, but suffers from the difficultness of making an accurate elevation measurement with limited vertical aperture and in the presence of multipath effects.

The TDOA technique requires multiple aircraft and is complex, but has high potential accuracy. The determination of the location of the site involves the solution of at least two simultaneous second order equations for the intersection of two hyperbolas which represent $T_2 - T_1 = \text{Constant \#1}$ and $T_3 - T_2 = \text{Constant \#2}$. This method can be used to obtain a fix for an emitter which radiates only a single pulse.

ANGLE-OF-ARRIVAL (AOA) MEASUREMENTS

Several of the above DF measurements require AOA determination. Threat AOA measurements are also required to inform the aircrew in order to position the aircraft for optimal defense.

As shown in Figure 4, angle-of-arrival measuring systems fall into three main system categories of:

1. Scanning beam
2. Amplitude comparison or Simultaneous-multiple-beam
3. Phased Interferometer techniques

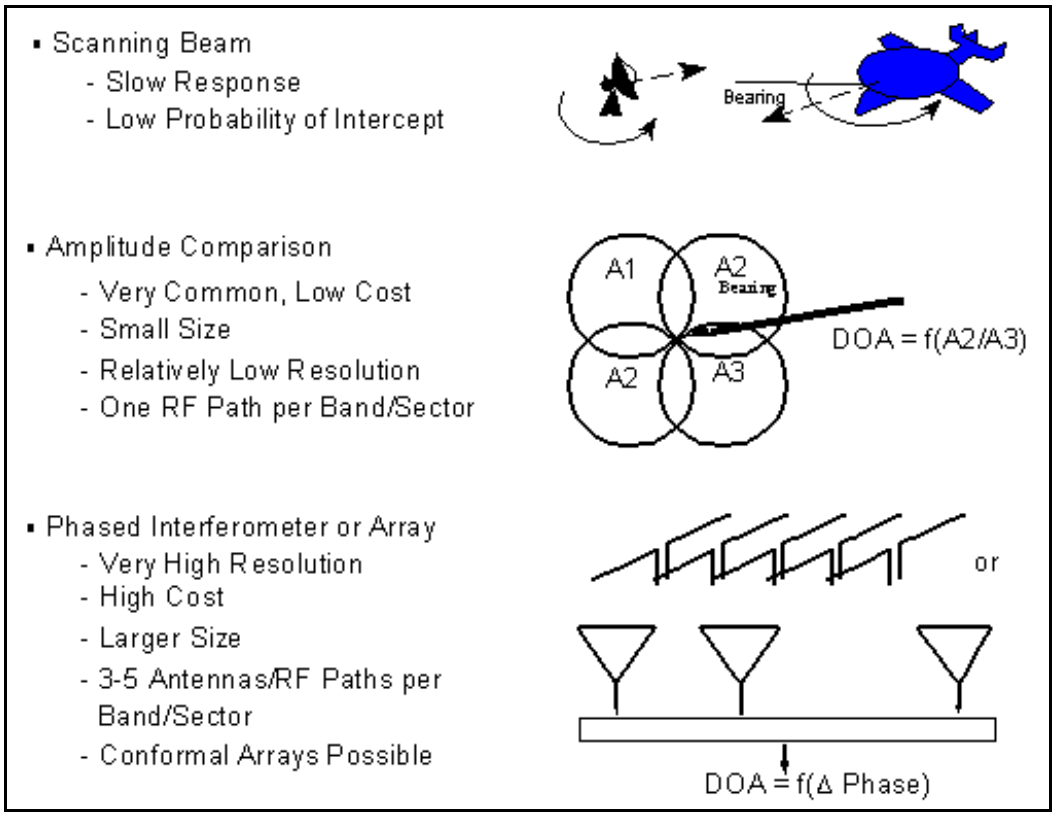

Figure 4. Angle-of-Arrival Measurement Techniques.

Scanning Beam

The mechanically scanning beam, or "spinner," requires only a single receiver and also exhibits high sensitivity due to the use of a directive antenna. The disadvantage is that the "spinner" usually exhibits slow response because it must rotate through the coverage angle (e.g., 360 degrees) to ensure that it intercepts an emitter. Also, if the emitter uses a scanning directional antenna, both beams must point at each other for maximum sensitivity, which is a low probability occurrence. Both of these effects cause the mechanically scanning beam technique to have a low probability of intercept (POI).

Amplitude Comparison

The two primary techniques used for direction finding are the amplitude-comparison method and the interferometer or phase-comparison method. The phase-comparison method generally has the advantage of greater accuracy, but the amplitude-comparison method is used extensively due to its lower complexity and cost. Regardless of which technique is used, it should be emphasized that the ultimate rms angular accuracy is given by:

$$\Delta\theta = \frac{k\,\theta_B}{\sqrt{SNR}}$$

where θ_B is the antenna's angular beamwidth, or interferometer lobe width, and SNR is the signal-to-noise ratio.

Thus, phase interferometers that typically use very widebeam antennas require high signal-to-noise ratios to achieve accurate angle-of-arrival measurements. Alternately, a multi-element array antenna can be used to provide relatively narrow interferometer lobes, which require modest signal-to-noise ratios.

Virtually all currently deployed radar warning receiving (RWR) systems use amplitude-comparison direction finding (DF). A basic amplitude-comparison receiver derives a ratio, and ultimately angle-of-arrival or bearing, from a pair of independent receiving channels, which utilize squinted antenna elements that are usually equidistantly spaced to provide an instantaneous 360° coverage. Typically, four or six antenna elements and receiver channels are used in such systems, and wideband logarithmic video detectors provide the signals for bearing-angle determination. The monopulse ratio is obtained by subtraction of the detected logarithmic signals, and the bearing is computed from the value of the ratio.

Amplitude comparison RWRs typically use broadband cavity-backed spiral antenna elements whose patterns can be approximated by Gaussian-shaped beams. Gaussian-shaped beams have the property that the logarithmic output ratio slope in dB is linear as a function of angle of arrival. Thus, a digital look-up table can be used to determine the angle directly. However, both the antenna beamwidth and squint angle vary with frequency over the multi-octave bands used in RWRs. Pattern shape variations cause a larger pattern crossover loss for high frequencies and a reduced slope sensitivity at low frequencies. Partial compensation of these effects, including antenna squint, can be implemented using a look-up table if frequency information is available in the RWR. Otherwise, gross compensation can be made, depending upon the RF octave band utilized.

Typical accuracies can be expected to range from 3 to 10 degrees rms for multi-octave frequency band amplitude-comparison systems which cover 360 degrees with four to six antennas.

The four-quadrant amplitude-comparison DF systems employed in RWRs have the advantage of simplicity, reliability, and low cost. Usually, only one antenna per quadrant is employed which covers the 2 to 18 GHz band. The disadvantages are poor accuracy and sensitivity, which result from the broad-beam antennas employed. Both accuracy and sensitivity can be improved by expanding the number of antennas employed. For example, expanding to eight antennas would double the accuracy and provide 3 dB more gain. As the number of antennas increases, it becomes appropriate to consider multiple-beam-forming antennas rather than just increasing the number of individual antennas. The geometry of multiple-beam-forming antennas is such that a conformal installation aboard an aircraft is difficult. Therefore, this type of installation is typically found on naval vessels or ground vehicles where the space is available to accommodate this type of antenna.

Simultaneous-multiple-beam (amplitude comparison)

The simultaneous-multiple-beam system uses an antenna, or several antennas, forming a number of simultaneous beams (e.g., Butler matrix or Rotman lens), thereby retaining the high sensitivity of the scanning antenna approach while providing fast response. However, it requires many parallel receiving channels, each with full frequency coverage. This approach is compatible with amplitude-monopulse angular measuring techniques which are capable of providing high angular accuracy.

A typical example of a multiple-beam antenna is a 16-element circular array developed as part of a digital ESM receiver. This system covers the range from 2 to 18 GHz with two antenna arrays (2 to 7.5 GHz and 7.5 to 18 GHz), has a sensitivity of -55 to -60 dBm and provides an rms bearing accuracy of better than 1.7 degrees on pulsewidths down to 100 ns.

Phased Interferometer Techniques

The term interferometer generally refers to an array type antenna in which large element spacing occurs and grating lobes appear.

Phase interferometer DF systems are utilized when accurate angle-of-arrival information is required. They have the advantage of fast response, but require relatively complex microwave circuitry, which must maintain a precise phase match over a wide frequency band under extreme environmental conditions. When high accuracy is required (on the order of 0.1 to 1°), wide baseline interferometers are utilized with ambiguity resolving circuitry. The basic geometry is depicted in Figure 5, whereby a plane wave arriving at an angle is received by one antenna earlier than the other due to the difference in path length.

The time difference can be expressed as a phase difference:

$$\varphi = \omega\Delta\tau = 2\pi a(f/c) = 2\pi\,(d \sin\theta)/\lambda,$$

where θ is the angle of arrival,
d is the antenna separation, and
λ is the wavelength in compatible units.

The unambiguous field of view (FOV) is given by $\theta = 2 \sin^{-1} (\pi/2d)$, which for $\lambda/2$ spacing results in 180° coverage. This spacing must be established for the highest frequency to be received.

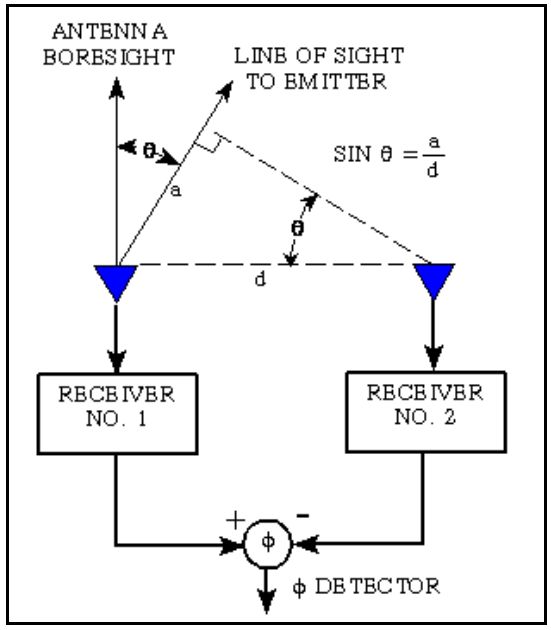

Figure 5. Phase Interferometer Principle.

Interferometer elements typically use broad antenna beams with beamwidths on the order of 90°. This lack of directivity produces several adverse effects. First, it limits system sensitivity due to the reduced antenna gain. Secondly, it opens the system to interference signals from within the antenna's broad angular coverage. The interference signals often include multipath from strong signals which can limit the accuracy of the interferometer.

In an interferometer, the locus of points that produce the same time or phase delay forms a cone. The indicated angle is the true azimuth angle multiplied by the cosine of the elevation angle. The error in assuming the incident angle to be the azimuth angle is negligible for signals near the antenna's boresight. At 45° azimuth and 10° elevation, the error is less than 1°, increasing to 15° for both at 45°. Two orthogonal arrays, one measuring the azimuth angle and the other the elevation angle can eliminate this error. For targets near the horizon, the depression angle is small, thereby requiring only horizontal arrays.

The rms angular accuracy of an interferometer in radians is given by:

$$\sigma_\theta = \Delta\alpha \,/\, (\pi \bullet \sqrt{SNR}\,),$$ where $\Delta\alpha = \lambda/(d\cdot\cos\theta)$ is the separation between adjacent nulls.

For a two-element interferometer, the spacing (d) must be $\lambda/2$ or less to provide unambiguous, or single lobe ± 90°, coverage. This, in effect, sets a wide interferometer (or grating) lobe which must be split

by a large factor to achieve high accuracy. This, in turn, imposes a requirement for high SNR to achieve the large beam-splitting factor. For example, if 0.1° accuracy is required from an unambiguous two-element interferometer, then a SNR of about 50 dB is required to achieve this accuracy. This may be difficult to achieve considering the inherently low sensitivity of an interferometer system.

When high accuracy is required from an interferometer system, it is usual to employ separations greater than $\lambda/2$. The increased separation sets up a multi-grating-lobe structure through the coverage angle which requires less SNR to achieve a specified accuracy. For example, a two-element interferometer with 16λ spacing would set up a 33-grating-lobe structure (including the central lobe) throughout the ± 90° coverage angle. Within each of the 33 grating lobes, it would only require a SNR on the order of 20 dB to achieve 0.1° accuracy. However, there would be 33 ambiguous regions within the ± 90° angular coverage and also 32 nulls (where the phase detector output is zero), about which the system would be insensitive to an input signal. The ambiguities could be resolved by employing a third antenna element with $\lambda/2$ spacing, which would provide an accuracy on the order of 3° with 20 dB SNR. This accuracy is sufficient to identify which of the 33 lobes contains the signal. Providing coverage in the null regions requires additional antenna elements.

Interferometers employing multiple antenna elements are called multiple-baseline interferometers. In a typical design, the receiver consists of a reference antenna and a series of companion antennas. The spacing between the reference element and the first companion antenna is $\lambda/2$; other secondary elements are placed to form pairs separated by 1, 2, 4, and 8 wavelengths. The initial AOA is measured unambiguously by the shortest-spaced antenna pair. The next greatest spaced pair has a phase rate of change which is twice that of the first, but the information is ambiguous due to there being twice as many lobes as in the preceding pair. A greater phase rate of change permits higher angular accuracy while the ambiguity is resolved by the previous pair. Thus, the described multiple-baseline interferometer provides a binary AOA measurement where each bit of the measurement supplies a more accurate estimate of the emitter's AOA.

Harmonic multiple-baseline interferometers use elements which are spaced at $2^n \cdot \lambda/2$, with n = 0, 1, 2, 3. In nonharmonic interferometers, no pair of antennas provides a completely unambiguous reading over the complete field of view. For example, the initial spacing in the nonharmonic interferometer might be λ, while the next companion element spacing is $3\lambda/2$. Ambiguities are resolved by truth tables, and hence the accuracy is set by the spacing of the widest baseline antenna pair. Nonharmonic interferometers have been implemented over 9:1 bandwidths (2 to 18 GHz) with rms accuracies from 0.1 to 1° and with no ambiguities over ± 90°. The principal advantage of the nonharmonic over the harmonic interferometer is the increased bandwidth for unambiguous coverage.

Interferometer DF accuracy is determined by the widest baseline pair. Typical cavity-backed spirals, track to 6 electrical degrees, and associated receivers track to 9°, resulting in an rms total of 11°. At a typical 16 dB SNR, the rms phase noise is approximately 9 electrical degrees. For these errors and an emitter angle of 45°, a spacing of 25λ is required for 0.1° rms accuracy while a spacing of 2.5λ is needed for 1° accuracy. For high accuracy, interferometer spacings of many feet are required. In airborne applications, this usually involves mounting interferometer antennas in the aircraft's wingtips.

The characteristics of typical airborne amplitude comparison and phase interferometer DF systems are summarized in Table 3. The phase interferometer system generally uses superheterodyne receivers which provide the necessary selectivity and sensitivity for precise phase measurements.

Table 3. Direction of Arrival Measurement Techniques.

	Amplitude Comparison	Phase Interferometer
Sensor Configuration	Typically 4 to 6 Equispaced Antenna Elements for 360° Coverage	2 or more RHC or LHC Spirals in Fixed Array
DF Accuracy	$DF_{ACC} \approx \frac{\theta_{BW}^2 \Delta C_{dB}}{24S}$ (Gaussian Shape)	$DF_{ACC} = \frac{\lambda}{2\pi d \cos\theta} \Delta\theta$
DF Accuracy Improvement	Decrease Antenna BW Decrease Amplitude Mistrack Increase Squint Angle	Increase Spacing of Outer Antennas; Decrease Phase Mistrack
Typical DF Accuracy	3° to 10° rms	0.1° to 3° rms
Sensitivity to Multipath/ Reflections	High Sensitivity Mistrack of Several dB Can Cause Large DF Errors	Relatively Insensitive; Interferometer Can Be Made to Tolerate Large Phase Errors
Platform Constraints	Locate in Reflection Free Area	Reflection Free Area; Real Estate For Array; Prefers Flat Radome
Applicable Receivers	Crystal Video; Channelizer; Acousto-Optic; Compressive; Superheterodyne	Superheterodyne

ΔC_{dB} = Amplitude Monopulse Ratio in dB
S = Squint Angle in degrees
θ_{BW} = Antenna Beamwidth in degrees

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MICROWAVE / RF COMPONENTS

Microwave Waveguides and Coaxial Cable 6-1
Voltage Standing Wave Ratio (VSWR) / Reflection Coefficient
Return Loss / Mismatch Loss 6-2
Microwave Coaxial Connectors 6-3
Power Dividers and Directional Couplers 6-4
Attenuators / Filters / DC Blocks 6-5
Terminations / Dummy Loads 6-6
Circulators and Diplexers 6-7
Mixers and Frequency Discriminators 6-8
Detectors 6-9
RF / Microwave Amplifiers 6-10
Signal Generation 6-11
Digital Processing Components 6-12
Microwave Measurements 6-13

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MICROWAVE WAVEGUIDES and COAXIAL CABLE

In general, a waveguide consists of a hollow metallic tube of arbitrary cross section uniform in extent in the direction of propagation. Common waveguide shapes are rectangular, circular, and ridged. The rectangular waveguide has a width a and height b as shown in Figure 1. Commonly used rectangular waveguides have an aspect ratio b/a of approximately 0.5. Such an aspect ratio is used to preclude generation of field variations with height and their attendant unwanted modes. Waveguides are used principally at frequencies in the microwave range; inconveniently large guides would be required to transmit radio-frequency power at longer wavelengths. In the X-Band frequency range of 8.2 to 12.4 GHz, for example, the U.S. standard rectangular waveguide, WR-90, has an inner width of 2.286 cm (0.9 in.) and an inner height of 1.016 cm (0.4 in.).

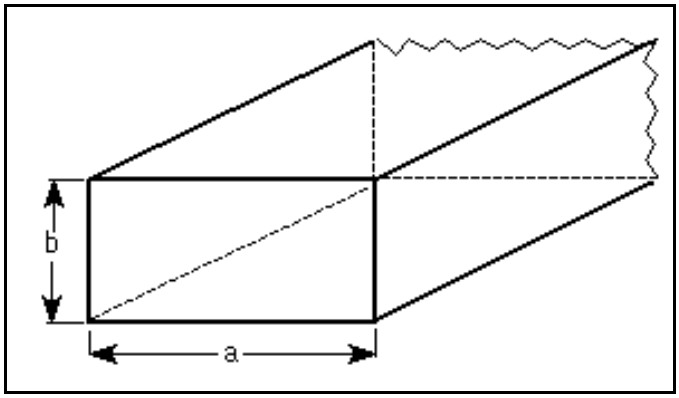

Figure 1. The Rectangular Waveguide.

In waveguides the electric and magnetic fields are confined to the space within the guides. Thus no power is lost to radiation. Since the guides are normally filled with air, dielectric losses are negligible. However, there is some I^2R power lost to heat in the walls of the guides, but this loss is usually very small.

It is possible to propagate several modes of electromagnetic waves within a waveguide. The physical dimensions of a waveguide determine the cutoff frequency for each mode. If the frequency of the impressed signal is <u>above</u> the cutoff frequency for a given mode, the electromagnetic energy can be transmitted through the guide for that particular mode with minimal attenuation. Otherwise the electromagnetic energy with a frequency <u>below</u> cutoff for that particular mode will be attenuated to a negligible value in a relatively short distance. This grammatical use of cutoff frequency is opposite that used for coaxial cable, where cutoff frequency is for the highest useable frequency. The dominant mode in a particular waveguide is the mode having the lowest cutoff frequency. For rectangular waveguide this is the TE_{10} mode. The TE (transverse electric) signifies that all electric fields are transverse to the direction of propagation and that no longitudinal electric field is present. There is a longitudinal component of magnetic field and for this reason the TE_{mn} waves are also called H_{mn} waves. The TE designation is usually preferred. Figure 2 shows a graphical depiction of the E field variation in a waveguide for the TE_{10}, TE_{20}, and TE_{30} modes. As can be seen, the first index indicates the number of half wave loops across the width of the guide and the second index, the number of loops across the height of the guide - which in this case is zero. It is advisable to choose the dimensions of a guide in such a way that, for a given input signal, only the energy of the dominant mode can be transmitted through the guide. For example, if for a particular frequency, the width of a rectangular guide is too large, then the TE_{20} mode can propagate causing a myriad of problems. For rectangular guides of low aspect ratio the TE_{20} mode is the next higher order mode

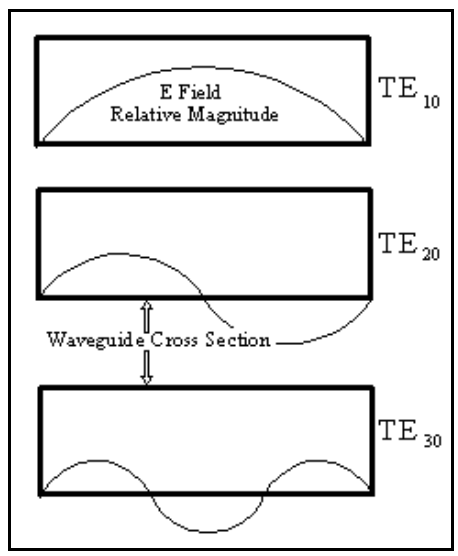

Figure 2. TE Modes.

and is harmonically related to the cutoff frequency of the TE_{10} mode. It is this relationship together with attenuation and propagation considerations that determine the normal operating range of rectangular waveguide.

The discussion on circular waveguides will not be included because they are rarely used in the EW area. Information regarding circular waveguides can be found in numerous textbooks on microwaves.

CHARACTERISTICS OF STANDARD RECTANGULAR WAVEGUIDES

Rectangular waveguides are commonly used for power transmission at microwave frequencies. Their physical dimensions are regulated by the frequency of the signal being transmitted. Table 1 tabulates the characteristics of the standard rectangular waveguides. It may be noted that the number following the EIA prefix "WR" is in inside dimension of the widest part of the waveguide (i.e., WR90 has an inner dimension of 0.90").

DOUBLE RIDGE RECTANGULAR WAVEGUIDE

Another type of waveguide commonly used in EW systems is the double ridge rectangular waveguide. The ridges in this waveguide increase the bandwidth of the guide at the expense of higher attenuation and lower power-handling capability. The bandwidth can easily exceed that of two contiguous standard waveguides. Introduction of the ridges mainly lowers the cutoff frequency of the TE_{10} mode from that of the unloaded guide, which is predicated on width alone. The reason for this can easily be explained when the field configuration in the guide at cutoff is investigated. At cutoff there is no longitudinal propagation down the guide. The waves simply travel back and forth between the side walls of the guide. In fact the guide can be viewed as a composite parallel plate waveguide of infinite width where the width corresponds to the direction of propagation of the normal guide. The TE_{10} mode cutoff occurs where this composite guide has its lowest-order resonant frequency. This occurs when there is only one E field maximum across the guide which occurs at the center for a symmetrical ridge. Because of the reduced height of the guide under the ridge, the effective TE_{10} mode resonator is heavily loaded as though a shunt capacitor were placed across it. The cutoff frequency is thus lowered considerably. For the TE_{20} mode the fields in the center of the guide will be at a minimum. Therefore the loading will have a negligible effect. For guides of proper aspect ratio, ridge height, and ridge width, an exact analysis shows that the TE_{10} mode cutoff can be lowered substantially at the same time the TE_{20} and TE_{30} mode cutoffs are raised slightly. Figure 3 shows a typical double ridged waveguide shape and Table 2 shows double ridged waveguide specifications. In the case of ridged waveguides, in the EIA designation, (WRD350 D36) the first "D" stands for double ridged ("S" for single ridged), the 350 is the starting frequency (3.5 GHz), and the "D36" indicates a bandwidth of 3.6:1. The physical dimensions and characteristics of a WRD350 D24 and WRD350 D36 are radically different. A waveguide with a MIL-W-23351 dash number beginning in 2 (i.e., 2-025) is a double ridge 3.6:1 bandwidth waveguide. Likewise a 1- is a single ridge 3.6:1, a 3- is a single ridge 2.4:1, and a 4- is a double ridge 2.4:1 waveguide.

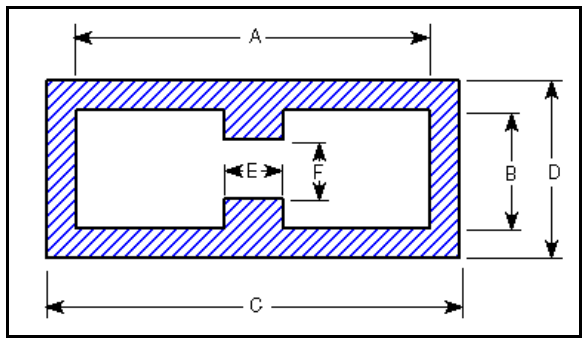

Figure 3. Double Ridge Waveguide.

Figure 4 shows a comparison of the frequency /attenuation characteristics of various waveguides. The attenuation is based on real waveguides which is higher than the theoretical values listed in Tables 1 and 2. Figure 5 shows photographs of waveguides with some common connectors. Figure 6 shows attenuation characteristics of various RF coaxial cables.

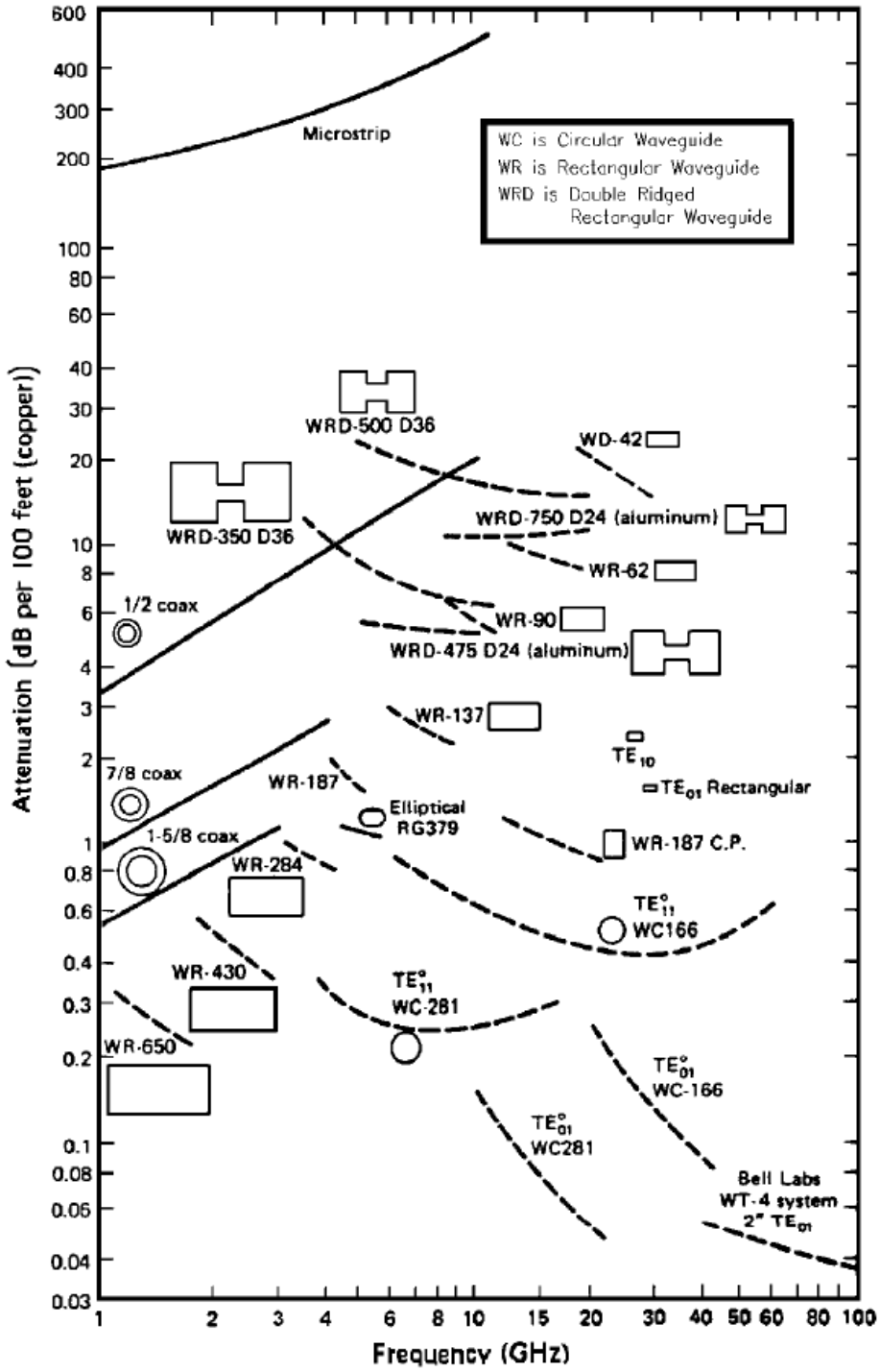

Figure 4. Attenuation vs. Frequency for a Variety of Waveguides and Cables.

Table 1. Rectangular Waveguide Specifications.

Waveguide Size	JAN WG Desig	MIL-W-85 Dash #	Material	Freq Range (GHz)	Freq Cutoff (GHz)	Power (at 1 Atm)		Insertion Loss (dB/100ft)	Dimensions (Inches)	
						CW	Peak		Outside	Wall Thickness
WR284	RG48/U RG75/U	1-039 1-042	Copper Aluminum	2.60 - 3.95	2.08	45 36	7650	.742-.508 1.116-.764	3.000x1.500	0.08
WR229	RG340/U RG341/U	1-045 1-048	Copper Aluminum	3.30 - 4.90	2.577	30 24	5480	.946-.671 1.422-1.009	2.418x1.273	0.064
WR187	RG49/U RG95/U	1-051 1-054	Copper Aluminum	3.95 - 5.85	3.156	18 14.5	3300	1.395-.967 2.097-1.454	1.000x1.000	0.064
WR159	RG343/U RG344/U	1-057 1-060	Copper Aluminum	4.90 - 7.05	3.705	15 12	2790	1.533-1.160 2.334-1.744	1.718x0.923	0.064
WR137	RG50/U RG106/U	1-063 1-066	Copper Aluminum	5.85 - 8.20	4.285	10 8	1980	1.987-1.562 2.955-2.348	1.500x0.750	0.064
WR112	RG51/U RG68/U	1-069 1-072	Copper Aluminum	7.05 - 10.0	5.26	6 4.8	1280	2.776-2.154 4.173-3.238	1.250x0.625	0.064
WR90	RG52/U RG67/U	1-075 1-078	Copper Aluminum	8.2 - 12.4	6.56	3 2.4	760	4.238-2.995 6.506-4.502	1.000x0.500	0.05
WR75	RG346/U RG347/U	1-081 1-084	Copper Aluminum	10.0 - 15.0	7.847	2.8 2.2	620	5.121-3.577 7.698-5.377	0.850x0.475	0.05
WR62	RG91/U RG349/U	1-087 1-091	Copper Aluminum	12.4 - 18.0	9.49	1.8 1.4	460	6.451-4.743 9.700-7.131	0.702x0.391	0.04
WR51	RG352/U RG351/U	1-094 1-098	Copper Aluminum	15.0 - 22.0	11.54	1.2 1	310	8.812-6.384 13.250-9.598	0.590x0.335	0.04
WR42	RG53/U	1-100	Copper	18.0 - 26.5	14.08	0.8	170	13.80-10.13	0.500x0.250	0.04
WR34	RG354/U	1-107	Copper	2.0 - 33.0	17.28	0.6	140	16.86-11.73	0.420x0.250	0.04
WR28	RG271/U	3-007	Copper	26.5 - 40.0	21.1	0.5	100	23.02-15.77	0.360x0.220	0.04

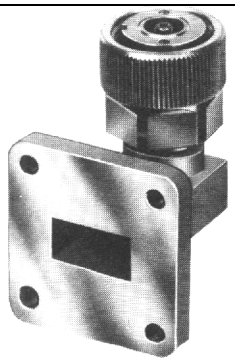

Standard waveguide - 7 mm

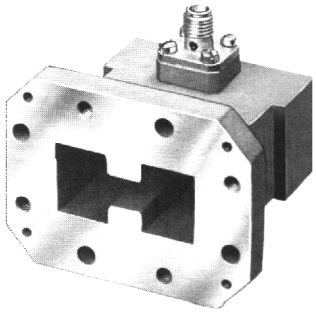

Double ridge waveguide - SMA jack

Figure 5. Waveguides With Some Common Connections.

Table 2. Double Ridge Rectangular Waveguide Specifications.

Waveguide Size	MIL-W-23351 Dash #	Material	Freq Range (GHz)	Freq Cutoff (GHz)	Power (at 1 Atm)		Insertion Loss (dB/ft)	Dimensions (Inches)					
					CW	Peak		A	B	C	D	E	F
WRD250		Alum Brass Copper Silver Al	2.60 - 7.80	2.093	24	120	0.025 0.025 0.018 0.019	1.655	0.715	2	1	0.44	0.15
WRD350 D24	4-029 4-303 4-031	Alum Brass Copper	3.50 - 8.20	2.915	18	150	0.0307 0.0303 0.0204	1.48	0.688	1.608	0.816	0.37	0.292
WRD475 D24	4-033 4-034 4-035	Alum Brass Copper	4.75 - 11.00	3.961	8	85	0.0487 0.0481 0.0324	1.09	0.506	1.19	0.606	0.272	0.215
WRD500 D36	2-025 2-026 2-027	Alum Brass Copper	5.00 - 18.00	4.222	4	15	0.146 0.141 0.095	0.752	0.323	0.852	0.423	0.188	0.063
WRD650		Alum Brass Copper	6.50 - 18.00	5.348	4	25	0.106 0.105 0.07	0.720	0.321	0.820	0.421	0.173	0.101
WRD750 D24	4-037 4-038 4-039	Alum Brass Copper	7.50 - 18.00	6.239	4.8	35	0.0964 0.0951 0.0641	0.691	0.321	0.791	0.421	0.173	0.136
WRD110 D24	4-041 4-042 4-043	Alum Brass Copper	11.00 - 26.50	9.363	1.4	15	0.171 0.169 0.144	0.471	0.219	0.551	0.299	0.118	0.093
WRD180 D24	4-045 4-046 4-047	Alum Brass Copper	18.00 - 40.00	14.995	0.8	5	0.358 0.353 0.238	0.288	0.134	0.368	0.214	0.072	0.057

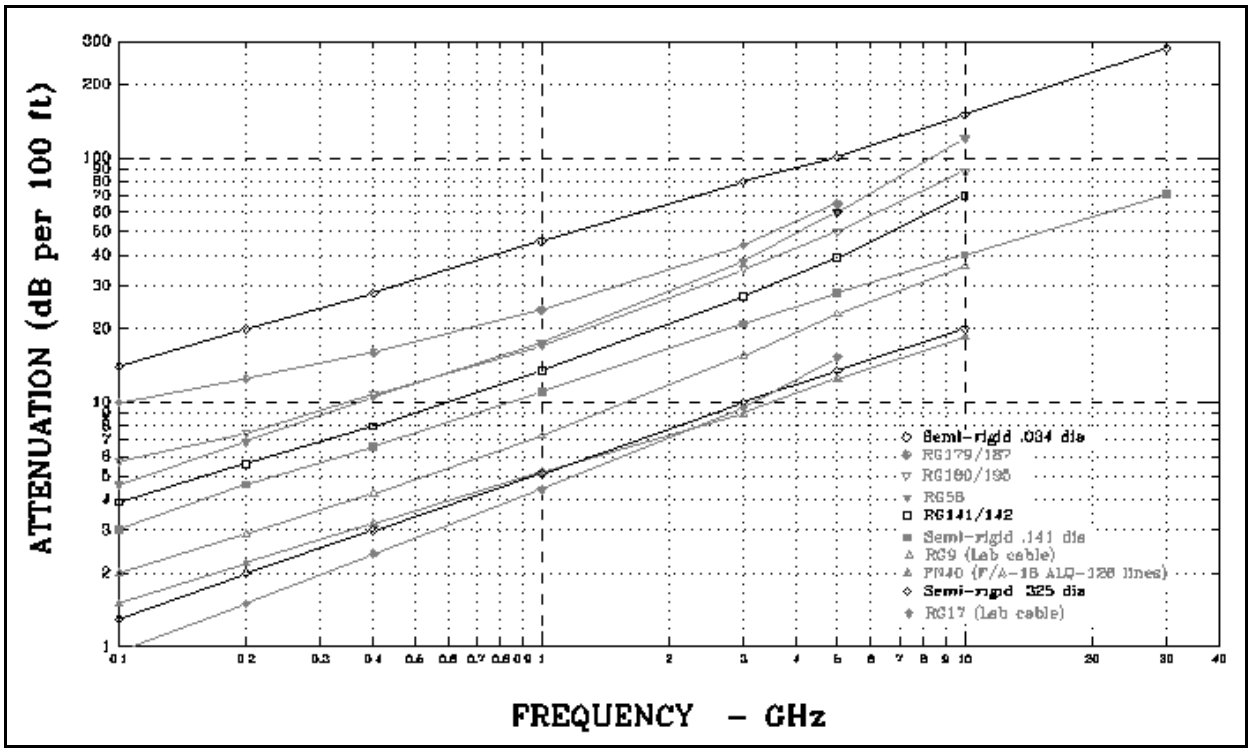

Figure 6. Attenuation vs. Frequency for a Variety of Coaxial Cables.

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VOLTAGE STANDING WAVE RATIO (VSWR) / REFLECTION COEFFICIENT RETURN LOSS / MISMATCH LOSS

When a transmission line is terminated with an impedance, Z_L, that is not equal to the characteristic impedance of the transmission line, Z_O, not all of the incident power is absorbed by the termination. Part of the power is reflected back so that phase addition and subtraction of the incident and reflected waves creates a voltage standing wave pattern on the transmission line. The ratio of the maximum to minimum voltage is known as the Voltage Standing Wave Ratio (VSWR) and successive maxima and minima are spaced by 180° (λ/2).

$$VSWR = \frac{E_{\max}}{E_{\min}} = \frac{E_i + E_r}{E_i - E_r}$$

where E_{max} = maximum voltage on the standing wave
E_{min} = minimum voltage on the standing wave
Ei = incident voltage wave amplitude
Er = reflected voltage wave amplitude

The reflection coefficient, ρ, is defined as E_r/E_i and in general, the termination is complex in value, so that ρ will be a complex number.

Additionally we define: $\Gamma = \frac{Z_L - Z_O}{Z_L + Z_O}$ The refection coefficient, ρ, is the absolute value of the magnitude of Γ. If the equation for VSWR is solved for the reflection coefficient, it is found that:

$$\begin{matrix}\textit{Reflection}\\ \textit{Coefficient}\end{matrix} = \rho = |\Gamma| = \frac{VSWR - 1}{VSWR + 1} \qquad \text{Consequently, } VSWR = \frac{1+\rho}{1-\rho}$$

The return loss is related through the following equations:

$$\begin{matrix}\textit{Return}\\ \textit{Loss}\end{matrix} = 10 \log\left[\frac{P_i}{P_r}\right] = -20 \log\left[\frac{E_r}{E_i}\right] = -20 \log\left[\frac{VSWR - 1}{VSWR + 1}\right] = -20 \log \rho$$

Return loss is a measure in dB of the ratio of power in the incident wave to that in the reflected wave, and as defined above always has a positive value. For example if a load has a Return Loss of 10 dB, then 1/10 of the incident power is reflected. The higher the return loss, the less power is actually lost.

Also of considerable interest is the Mismatch Loss. This is a measure of how much the transmitted power is attenuated due to reflection. It is given by the following equation:

Mismatch Loss = $-10 \log (1 - \rho^2)$

For example, an antenna with a VSWR of 2:1 would have a reflection coefficient of 0.333, a mismatch loss of 0.51 dB, and a return loss of

VSWR	Return Loss (dB)	% Power / Voltage Loss	Reflection Coefficient	Mismatch Loss (dB)
1	∞	0 / 0	0	0.000
1.15	23.1	0.49 / 7.0	0.07	.021
1.25	19.1	1.2 / 11.1	0.111	.054
1.5	14.0	4.0 / 20.0	0.200	.177
1.75	11.3	7.4 / 27.3	0.273	.336
1.9	10.0	9.6 / 31.6	0.316	.458
2.0	9.5	11.1 / 33.3	0.333	.512
2.5	7.4	18.2 / 42.9	0.429	.880
3.0	6.0	25.1 / 50.0	0.500	1.25
3.5	5.1	30.9 / 55.5	0.555	1.6
4.0	4.4	36.3 / 60.0	0.600	1.94
4.5	3.9	40.7 / 63.6	0.636	2.25
5.0	3.5	44.7 / 66.6	0.666	2.55
10	1.7	67.6 / 81.8	0.818	4.81
20	0.87	81.9 / 90.5	0.905	7.4
100	0.17	96.2 / 98.0	0.980	14.1
∞	.000	100 / 100	1.00	∞

* Divide % Voltage loss by 100 to obtain ρ (reflection coefficient)

9.54 dB (11% of your transmitter power is reflected back). In some systems this is not a trivial amount and points to the need for components with low VSWR.

If 1000 watts (60 dBm/ 30 dBW) is applied to this antenna, the return loss would be 9.54 dB. Therefore, 111.1 watts would be reflected and 888.9 watts (59.488 dBm/29.488 dBW) would be transmitted, so the mismatch loss would be 0.512 dB.

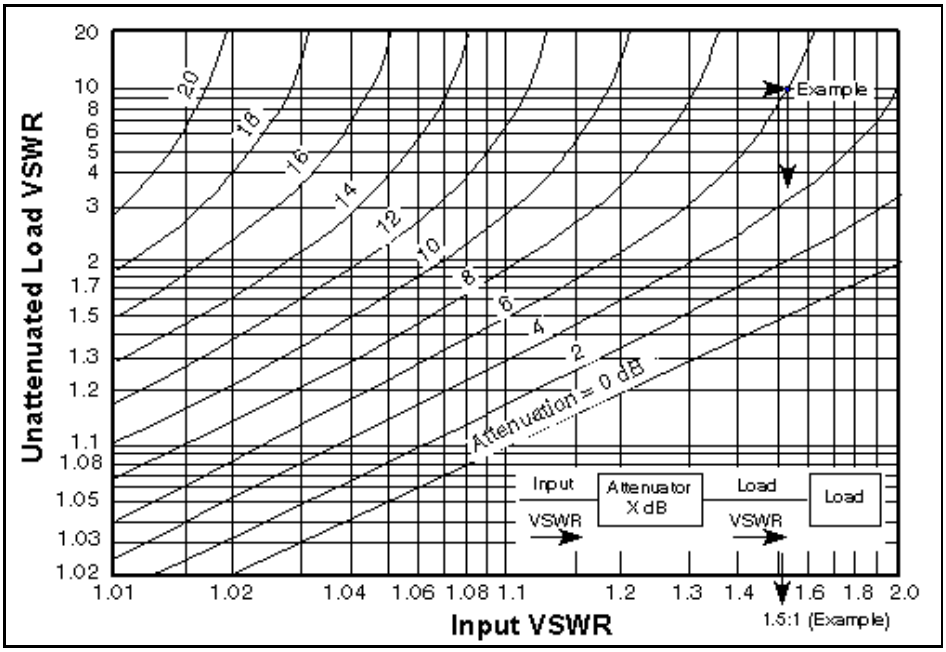

Figure 1. Reduction of VSWR by Attenuation.

Transmission line attenuation improves the VSWR of a load or antenna. For example, a transmitting antenna with a VSWR of 10:1 (poor) and a line loss of 6 dB would measure 1.5:1 (okay) if measured at the transmitter. Figure 1 shows this effect.

Therefore, if you are interested in determining the performance of antennas, the VSWR should always be measured at the antenna connector itself rather than at the output of the transmitter. Transmit cabling will load the line and create an illusion of having a better antenna VSWR. Transmission lines should have their insertion loss (attenuation) measured in lieu of VSWR, but VSWR measurements of transmission lines are still important because connection problems usually show up as VSWR spikes.

Historically VSWR was measured by probing the transmission line. From the ratio of the maximum to minimum voltage, the reflection coefficient and terminating impedance could be calculated. This was a time consuming process since the measurement was at a single frequency and mechanical adjustments had to be made to minimize coupling into circuits. Problems with detector characteristics also made the process less accurate. The modern network analyzer system sweeps very large frequency bandwidths and measures the incident power, P_i, and the reflected power, P_r. Because of the considerable computing power in the network analyzer, the return loss is calculated from the equation given previously, and displayed in real time. Optionally, the VSWR can also be calculated from the return loss and displayed real time.

If a filter is needed on the output of a jammer, it is desirable to place it approximately half way between the jammer and antenna. This may allow the use of a less expensive filter, or a reflective filter vs. an absorptive filter.

Special cases exist when comparing open and shorted circuits. These two conditions result in the same ∞ VSWR and zero dB return loss even though there is a 180° phase difference between the reflection coefficients. These two conditions are used to calibrate a network analyzer.

MICROWAVE COAXIAL CONNECTORS

For high-frequency operation, the average circumference of a coaxial cable must be limited to about one wavelength in order to reduce multimodal propagation and eliminate erratic reflection coefficients, power losses, and signal distortion.

Except for the sexless APC-7 connector, all other connectors are identified as either male (plugs) which have a center conductor that is a probe or female (jacks) which have a center conductor that is a receptacle. Sometimes it is hard to distinguish them as some female jacks may have a hollow center "pin" which appears to be male, yet accepts a smaller male contact.

An adapter is an approximately zero loss interface between two connectors and is called a barrel when both connectors are identical. A number of common of coaxial connectors are described below, however other special purpose connectors exist, including blind mate connectors where spring fingers are used in place of threads to obtain shielding (desired connector shielding should be at least 90 dB).

APC-2.4 (2.4mm) - The 50 Ω APC-2.4 (Amphenol Precision Connector-2.4 mm) is also known as an OS-50 connector. It was designed to operate at extremely high microwave frequencies (up to 50 GHz).	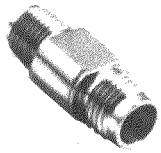
APC-3.5 (3.5mm) - The APC-3.5 connector provides repeatable connections and has a very low VSWR. Either the male or female end of this 50 Ω connector can mate with the opposite type of SMA connector. The APC-3.5 connector can work at frequencies up to 34 GHz.	2.4 mm jack - 3.5 mm jack
APC-7 (7mm) - The APC-7 was developed by HP, but has been improved and is now manufactured by Amphenol. The connector provides a coupling mechanism without male or female distinction and is the most repeatable connecting device used for very accurate 50 Ω measurement applications. Its VSWR is extremely low up to 18 GHz. Other companies have 7mm series available.	7mm - 3.5mm plug
BNC (OSB) - The BNC (Bayonet Neill-Concelman or Bayonet Navy Connector) was originally designed for military system applications during World War II. The connector operates best at frequencies up to about 4 GHz; beyond that it tends to radiate electromagnetic energy. The BNC can accept flexible cables with diameters of up to 6.35 mm (0.25 in.) and characteristic impedance of 50 to 75 Ω. It is now the most commonly used connector for frequencies under 1 GHz. Other names the BNC has picked up over the years include: "Baby Neill-Concelman", "Baby N connector", "British Naval Connector", and "Bayonet Nut Connector"	BNC male plug (above) BNC female jack

C - The C (Concelman) coaxial connector is a medium size, older type constant 50 Ω impedance. It has a bayonet (twist and lock) connection. It is larger than the BNC, but about the same as Type N. It has a frequency range of 0-11 GHz	C Plug (top)
SC (OSSC) - The SC type connector is a screw version of the "C" connector.	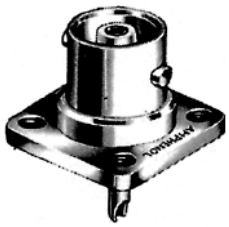 C jack (bottom)
SMA (OSM/3mm) - The SMA (Sub-Miniature A) connector was originally designed by Bendix Scintilla Corporation, but it has been manufactured by the Omni-Spectra division of M/ACOM (as the OSM connector) and many other electronic companies. It is a 50 Ω threaded connector. The main application of SMA connectors is on components for microwave systems. The connector normally has a frequency range to 18 GHz, but high performance varieties can be used to 26.5 GHz.	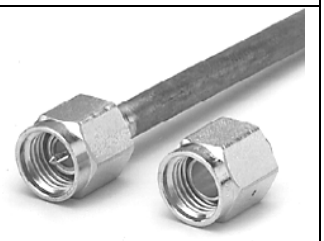 SMA Plug (above) SMA Jack
SSMA (OSSM) - The SSMA is a microminiature version of the SMA. It is also 50 Ω and operates to 26.5 GHz with flexible cable or 40 GHz with semi-rigid cable.	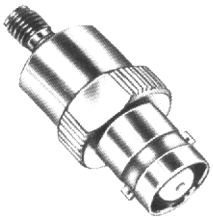 SSMA jack - BNC jack

SMC (OSMC) - The SMC (Sub-Miniature C) is a 50 Ω or 75 Ω connector that is smaller than the SMA. The connector can accept flexible cables with diameters of up to 3.17 mm (0.125 in.) for a frequency range of up to 7-10 GHz.	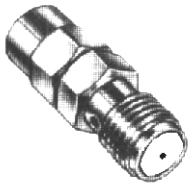 SMC Plug - SMA Jack (Some call this a SMC Jack, even though it has a female connector)
SMB (OSMB) - The SMB is like the SMC except it uses quick disconnect instead of threaded fittings. It is a 50 / 75 Ω connector which operates to 4 GHz with a low reflection coefficient and is useable to 10 GHz.	 SMB Plug (above) SMB Jack
TNC (OST) - The TNC (Threaded Neill-Concelman or threaded Navy Connector) is merely a threaded BNC. The function of the thread is to stop radiation at higher frequencies, so that the connector can work at frequencies up to 12 GHz (to 18 GHz when using semi-rigid cable). It can be 50 or 75 Ω. For size comparison here is a SMA plug - TNC plug 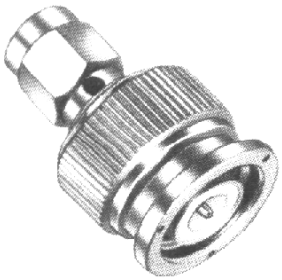	 TNC Plug (above) TNC Jack

Type N (OSN) - The 50 or 75 Ω Type N (Navy) connector was originally designed for military systems during World War II and is the most popular measurement connector for the frequency range of 1 to 11 GHz. The precision 50 Ω APC-N and other manufacturers high frequency versions operate to 18 GHz.

For size comparison here is a picture of Type N plug - TNC jack

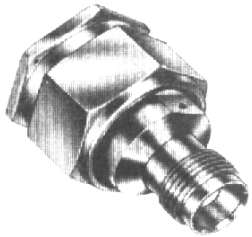

N Plug (above)

N Jack

Note: Always rotate the movable coupling nut of the plug, not the cable or fixed connector, when mating connectors. Since the center pin is stationary with respect to the jack, rotating the jack puts torque on the center pin. With TNC and smaller connectors, the center pin will eventually break off.

An approximate size comparison of these connectors is depicted below (not to scale).

Large ========== Medium ========== Small
SC 7mm N TNC/BNC 3.5mm SMA 2.4mm SSMA SMC

Figure 1 shows the frequency range of several connectors.

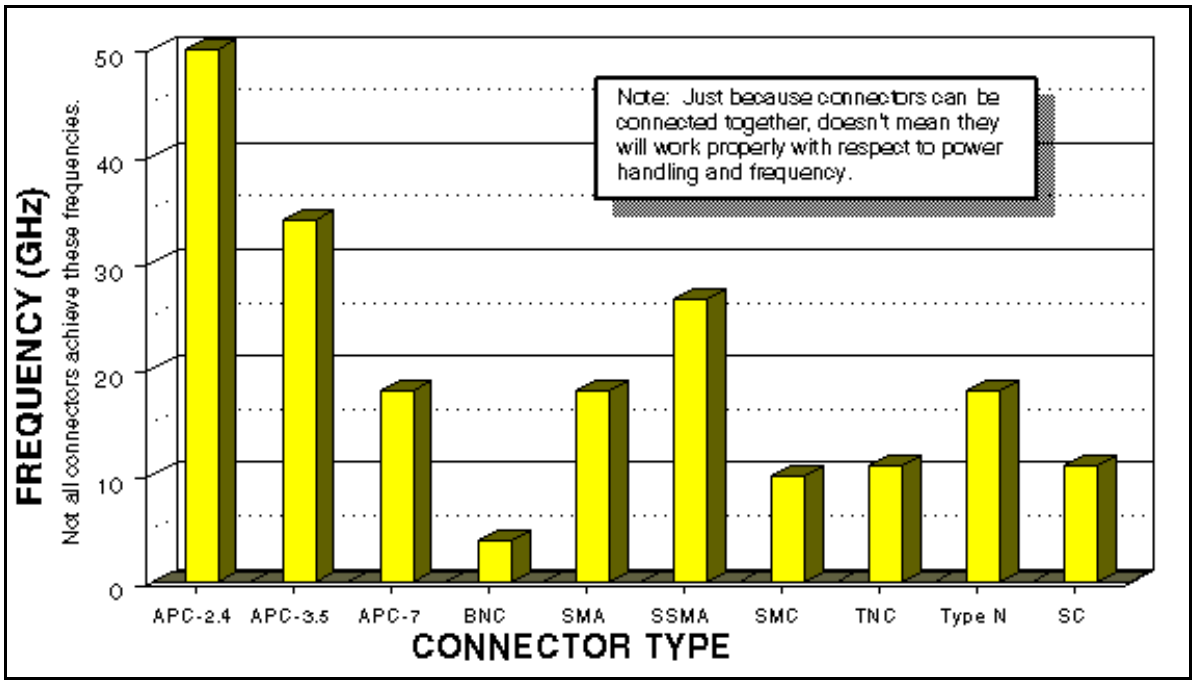

Figure 1. Frequency Range of Microwave Connectors.

POWER DIVIDERS AND DIRECTIONAL COUPLERS

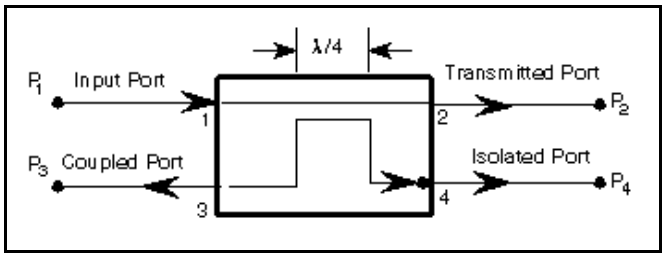

Figure 1. Directional Coupler.

A directional coupler is a passive device which couples part of the transmission power by a known amount out through another port, often by using two transmission lines set close enough together such that energy passing through one is coupled to the other. As shown in Figure 1, the device has four ports: input, transmitted, coupled, and isolated. The term "main line" refers to the section between ports 1 and 2. On some directional couplers, the main line is designed for high power operation (large connectors), while the coupled port may use a small SMA connector. Often the isolated port is terminated with an internal or external matched load (typically 50 ohms). It should be pointed out that since the directional coupler is a linear device, the notations on Figure 1 are arbitrary. Any port can be the input, (as in Figure 3) which will result in the directly connected port being the transmitted port, adjacent port being the coupled port, and the diagonal port being the isolated port.

Physical considerations such as internal load on the isolated port will limit port operation. The coupled output from the directional coupler can be used to obtain the information (i.e., frequency and power level) on the signal without interrupting the main power flow in the system (except for a power reduction - see Figure 2). When the power coupled out to port three is half the input power (i.e., 3 dB below the input power level), the power on the main transmission line is also 3 dB below the input power and equals the coupled power. Such a coupler is referred to as a 90 degree hybrid, hybrid, or 3 dB coupler. The frequency range for coaxial couplers specified by manufacturers is that of the coupling arm. The main arm response is much wider (i.e., if the spec is 2-4 GHz, the main arm could operate at 1 or 5 GHz - see Figure 3). However it should be recognized that the coupled response is periodic with frequency. For example, a λ/4 coupled line coupler will have responses at nλ/4 where n is an odd integer.

Common properties desired for all directional couplers are wide operational bandwidth, high directivity, and a good impedance match at all ports when the other ports are terminated in matched loads. These performance characteristics of hybrid or non-hybrid directional couplers are self-explanatory. Some other general characteristics will be discussed below.

COUPLING FACTOR

The coupling factor is defined as: $\textit{Coupling factor (dB)} = -10 \log \frac{P_3}{P_1}$

where P_1 is the input power at port 1 and P3 is the output power from the coupled port (see Figure 1).

The coupling factor represents the primary property of a directional coupler. Coupling is not constant, but varies with frequency. While different designs may reduce the variance, a perfectly flat coupler theoretically cannot be built. Directional couplers are specified in terms of the coupling accuracy at the frequency band center. For example, a 10 dB coupling ± 0.5 dB means that the directional coupler can have 9.5 dB to 10.5 dB coupling at the frequency band center. The accuracy is due to dimensional tolerances that can be held for the spacing of the two coupled lines. Another coupling specification is frequency sensitivity. A larger frequency sensitivity will allow a larger frequency band of operation. Multiple quarter-wavelength coupling sections are used to obtain wide frequency bandwidth directional couplers. Typically this type of directional coupler is designed to a frequency bandwidth ratio and a maximum coupling ripple within the frequency band. For example a typical 2:1 frequency bandwidth coupler design that produces a 10 dB

coupling with a ±0.1 dB ripple would, using the previous accuracy specification, be said to have 9.6 ± 0.1 dB to 10.4 ± 0.1 dB of coupling across the frequency range.

LOSS

In an ideal directional coupler, the main line loss port 1 to port 2 (P_1 - P_2) due to power coupled to the coupled output port is:

$$Insertion\ loss\ (dB) = 10 \log \left[1 - \frac{P_3}{P_1} \right]$$

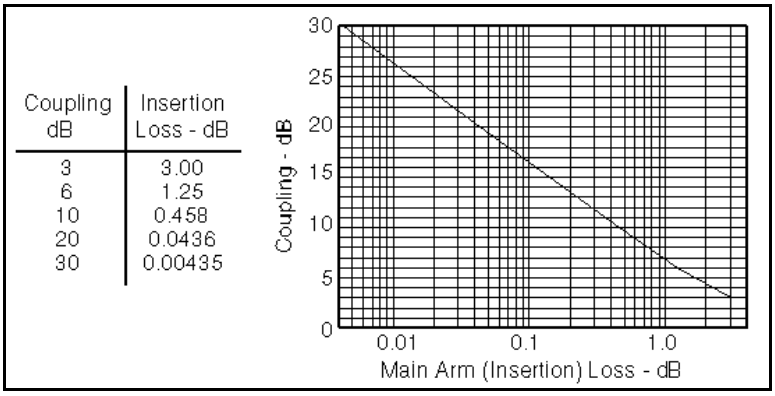

Figure 2. Coupling Insertion Loss.

The actual directional coupler loss will be a combination of coupling loss, dielectric loss, conductor loss, and VSWR loss. Depending on the frequency range, coupling loss becomes less significant above 15 dB coupling where the other losses constitute the majority of the total loss. A graph of the theoretical insertion loss (dB) vs. coupling (dB) for a dissipationless coupler is shown in Figure 2.

ISOLATION

Isolation of a directional coupler can be defined as the difference in signal levels in dB between the input port and the isolated port when the two output ports are terminated by matched loads, or:

$$Isolation\ (dB) = -10 \log \frac{P_4}{P_1}$$

Isolation can also be defined between the two output ports. In this case, one of the output ports is used as the input; the other is considered the output port while the other two ports (input and isolated) are terminated by matched loads.

Consequently: $$Isolation\ (dB) = -10 \log \frac{P_3}{P_2}$$

The isolation between the input and the isolated ports may be different from the isolation between the two output ports. For example, the isolation between ports 1 and 4 can be 30 dB while the isolation between ports 2 and 3 can be a different value such as 25 dB. If both isolation measurements are not available, they can assumed to be equal. If neither are available, an estimate of the isolation is the coupling plus return loss (see VSWR section). The isolation should be as high as possible. In actual couplers the isolated port is never completely isolated. Some RF power will always be present. Waveguide directional couplers will have the best isolation.

If isolation is high, directional couplers are excellent for combining signals to feed a single line to a receiver for two-tone receiver tests. In Figure 3, one signal enters port P_3 and one enters port P_2, while both exit port P_1. The signal from port P_3 to port P_1 will experience 10 dB of loss, and the signal from port P_2 to port P_1 will have 0.5 dB loss. The internal load on the isolated port will dissipate the signal losses from port P_3 and port P_2. If the isolators in Figure 3 are neglected, the isolation measurement (port P_2 to port P_3) determines the amount of power from the signal generator F_2 that will be injected into the signal generator F_1. As the injection level increases, it may cause modulation of signal generator F_1, or even injection phase locking. Because of the symmetry of the directional coupler, the reverse injection will happen with the same possible modulation problems of signal generator F_2 by F_1. Therefore the isolators are used in Figure 3 to effectively increase the isolation (or directivity) of the directional coupler. Consequently the injection loss will be the isolation of the directional coupler plus the reverse isolation of the isolator.

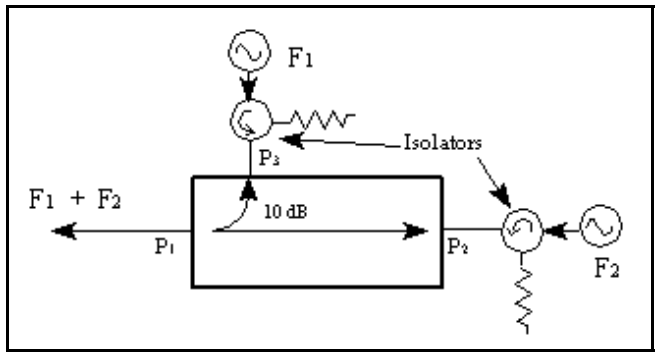

Figure 3. Two-Tone Receiver Tests.

DIRECTIVITY

Directivity is directly related to Isolation. It is defined as:

$$Directivity\ (dB) = -10 \log \frac{P_4}{P_3} = -10 \log \frac{P_4}{P_1} + 10 \log \frac{P_3}{P_1}$$

where: P_3 is the output power from the coupled port and P_4 is the power output from the isolated port.

The directivity should be as high as possible. Waveguide directional couplers will have the best directivity. Directivity is not directly measurable, and is calculated from the isolation and coupling measurements as:

Directivity (dB) = Isolation (dB) - Coupling (dB)

HYBRIDS

The hybrid coupler, or 3 dB directional coupler, in which the two outputs are of equal amplitude takes many forms. Not too long ago the quadrature (90 degree) 3 dB coupler with outputs 90 degrees out of phase was what came to mind when a hybrid coupler was mentioned. Now any matched 4-port with isolated arms and equal power division is called a hybrid or hybrid coupler. Today the characterizing feature is the phase difference of the outputs. If 90 degrees, it is a 90 degree hybrid. If 180 degrees, it is a 180 degree hybrid. Even the Wilkinson power divider which has 0 degrees phase difference is actually a hybrid although the fourth arm is normally imbedded.

Applications of the hybrid include monopulse comparators, mixers, power combiners, dividers, modulators, and phased array radar antenna systems.

AMPLITUDE BALANCE

This terminology defines the power difference in dB between the two output ports of a 3 dB hybrid. In an ideal hybrid circuit, the difference should be 0 dB. However, in a practical device the amplitude balance is frequency dependent and departs from the ideal 0 dB difference.

PHASE BALANCE

The phase difference between the two output ports of a hybrid coupler should be 0, 90, or 180 degrees depending on the type used. However, like amplitude balance, the phase difference is sensitive to the input frequency and typically will vary a few degrees.

The phase properties of a 90 degree hybrid coupler can be used to great advantage in microwave circuits. For example in a balanced microwave amplifier the two input stages are fed through a hybrid coupler. The FET device normally has a very poor match and reflects much of the incident energy. However, since the devices are essentially identical the reflection coefficients from each device are equal. The reflected voltage from the FETs are in phase at the isolated port and are 180° different at the input port. Therefore, all of the reflected power from the FETs goes to the load at the isolated port and no power goes to the input port. This results in a good input match (low VSWR).

If phase matched lines are used for an antenna input to a 180° hybrid coupler as shown in Figure 4, a null will occur directly between the antennas. If you want to receive a signal in that position, you would have to either change the hybrid type or line length. If you want to reject a signal from a given direction, or create the difference pattern for a monopulse radar, this is a good approach.

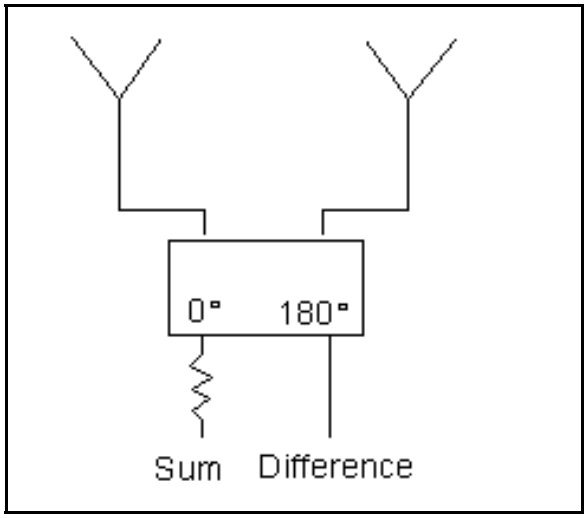

Figure 4. Balanced Antenna Input.

OTHER POWER DIVIDERS

Both in-phase (Wilkinson) and quadrature (90°) hybrid couplers may be used for coherent power divider applications. The Wilkinson's power divider has low VSWR at all ports and high isolation between output ports. The input and output impedances at each port is designed to be equal to the characteristic impedance of the microwave system. A typical power divider is shown in Figure 5. Ideally, input power would be divided equally between the output ports. Dividers are made up of multiple couplers, and like couplers, may be reversed and used as multiplexers. The drawback is that for a four channel multiplexer, the output consists of only 1/4 the power from each, and is relatively inefficient. Lossless multiplexing can only be done with filter networks.

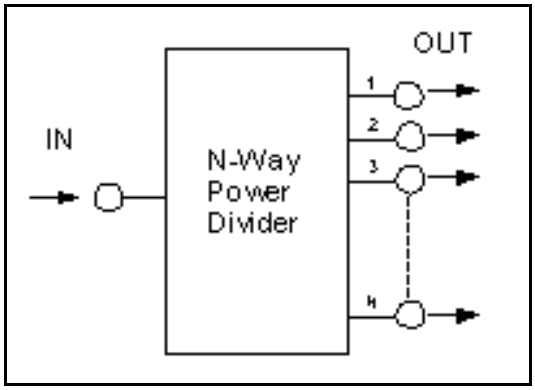

Figure 5. Power Divider.

Coherent power division was first accomplished by means of simple Tee junctions. At microwave frequencies, waveguide tees have two possible forms - the H-Plane or the E-Plane. These two junctions split power equally, but because of the different field configurations at the junction, the electric fields at the output arms are in-phase for the H-Plane tee and are anti-phase for the E-Plane tee. The combination of these two tees to form a hybrid tee allowed the realization of a four-port component which could perform the vector sum (Σ) and difference (Δ) of two coherent microwave signals. This device is known as the magic tee.

POWER COMBINERS

Since hybrid circuits are bi-directional, they can be used to split up a signal to feed multiple low power amplifiers, then recombine to feed a single antenna with high power as shown in Figure 6. This approach allows the use of numerous less expensive and lower power amplifiers in the circuitry instead of a single high power TWT. Yet another approach is to have each solid state amplifier (SSA) feed an antenna and let the power be combined in space or be used to feed a lens which is attached to an antenna. (See Section 3-4.)

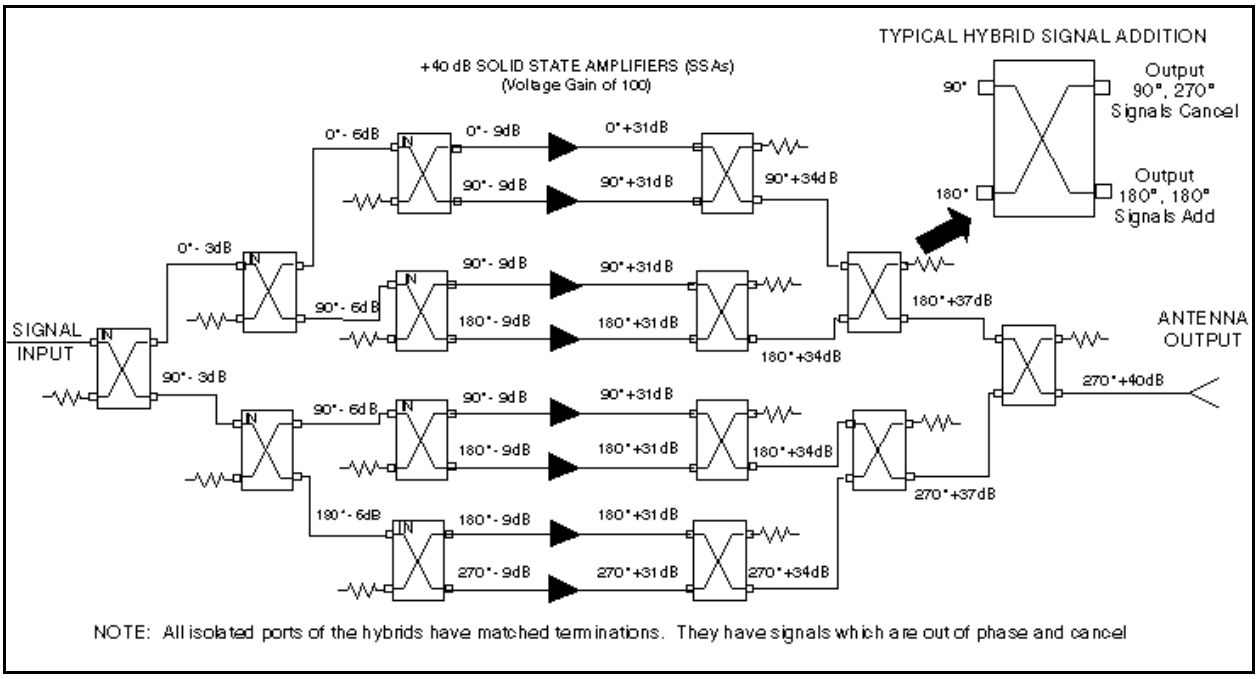

Figure 6. Combiner Network.

<u>Sample Problem:</u>

If two 1 watt peak unmodulated RF carrier signals at 10 GHz are received, how much peak power could one measure?

A. 0 watts

B. 0.5 watts

C. 1 watt

D. 2 watts

E. All of these

The answer is all of these as shown in Figure 7.

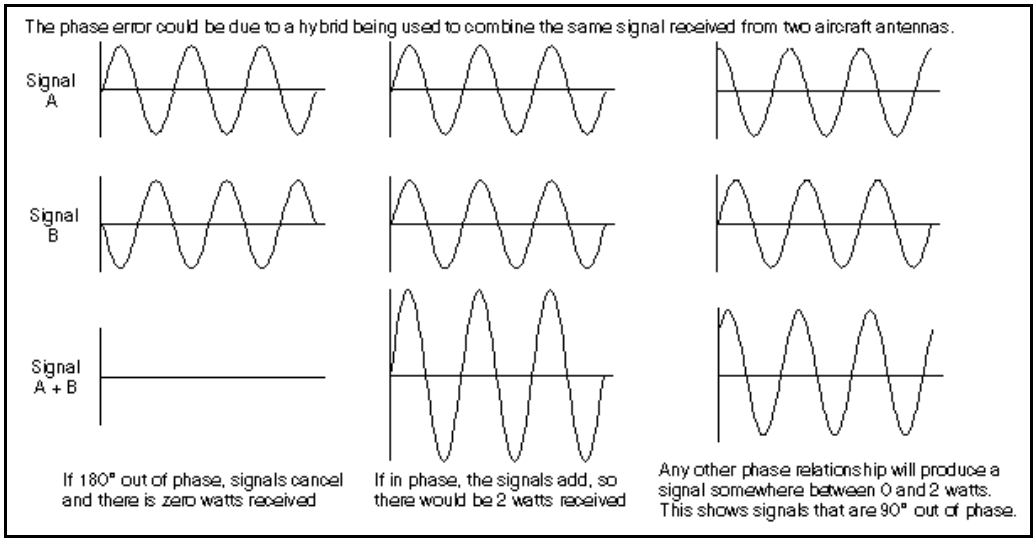

Figure 7. Sine Waves Combined Using Various Phase Relationships.

ATTENUATORS / FILTERS / DC BLOCKS

ATTENUATORS

An attenuator is a passive microwave component which, when inserted in the signal path of a system, reduces the signal by a specified amount. They normally possess a low VSWR which makes them ideal for reducing load VSWR in order to reduce measurement uncertainties. They are sometimes used simply to absorb power, either to reduce it to a measurable level, or in the case of receivers to establish an exact level to prevent overload of following stages.

Attenuators are classified as either fixed or variable and either reflective or non-reflective. The fixed and variable attenuators are available in both waveguide and coaxial systems. Most of the receivers under 20 GHz use coaxial type attenuators.

FIXED

The performance characteristics of a fixed attenuator are:

1. input and output impedances
2. flatness with frequency
3. average and peak power handling capability
4. temperature dependence

VARIABLE

The variable attenuator can be subdivided into two kinds: step attenuator and continuously variable attenuator. In a step attenuator, the attenuation is changed in steps such as 10 dB, 1 dB or 0.5 dB. In a continuously variable attenuator, the attenuation is changed continuously and a dial is usually available to read the attenuation either directly or indirectly from a calibration chart.

For a variable attenuator, additional characteristics should be considered, such as:

1. amount or range of attenuations
2. insertion loss in the minimum attenuation position
3. incremental attenuation for step attenuator
4. accuracy of attenuation versus attenuator setting
5. attenuator switching speed and switching noise.

REFLECTIVE

A reflective attenuator reflects some portion of the input power back to the driving source. The amount reflected is a function of the attenuation level. When PIN diodes are zero or reverse biased, they appear as open circuits when shunting a transmission line. This permits most of the RF input power to travel to the RF output. When they are forward biased, they absorb some input, but simultaneously reflect some back to the input port. At high bias current, most RF will be reflected back to the input resulting in a high input VSWR and high attenuation.

ABSORPTIVE

The VSWR of a non-reflective (absorptive) PIN diode attenuator remains good at any attenuation level (bias state). This is accomplished by configuring the diodes in the form of a Pi network that remains matched for any bias state or by use of a 90° hybrid coupler to cancel the waves reflected to the input connector.

MICROWAVE FILTERS

INTRODUCTION

Microwave filters are one of the most important components in receivers. The main functions of the filters are: (1) to reject undesirable signals outside the filter pass band and (2) to separate or combine signals according to their frequency. A good example for the latter application is the channelized receiver in which banks of filters are used to separate input signals. Sometimes filters are also used for impedance matching. Filters are almost always used before and after a mixer to reduce spurious signals due to image frequencies, local oscillator feedthrough, and out-of-frequency band noise and signals. There are many books which are devoted to filter designs. There are many kinds of filters used in microwave receivers, so it is impossible to cover all of them.

If a filter is needed on the output of a jammer, it is desirable to place it approximately half way between the jammer and antenna vs. adjacent to either. The transmission line attenuation improves the VSWR of the filter at the transmitter. This may allow use of a less expensive filter, or use of a reflective filter vs. an absorptive filter.

A filter is a two-port network which will pass and reject signals according to their frequencies. There are four kinds of filters according to their frequency selectivities. In the examples that follow, f_L = low frequency, f_M = medium frequency, and f_H = high frequency. Their names reflect their characteristics, and they are:

1. A low-pass filter which passes the low frequency signals below a predetermined value as shown in Figure 1.

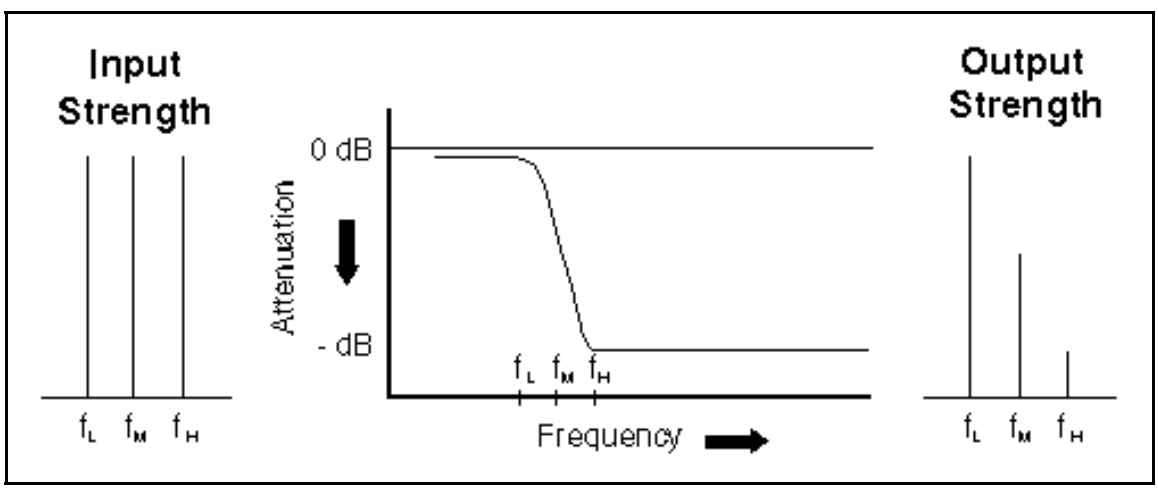

Figure 1. Low-Pass Filter.

2. A high-pass filter which passes the high frequency signals above a predetermined value as in Figure 2.

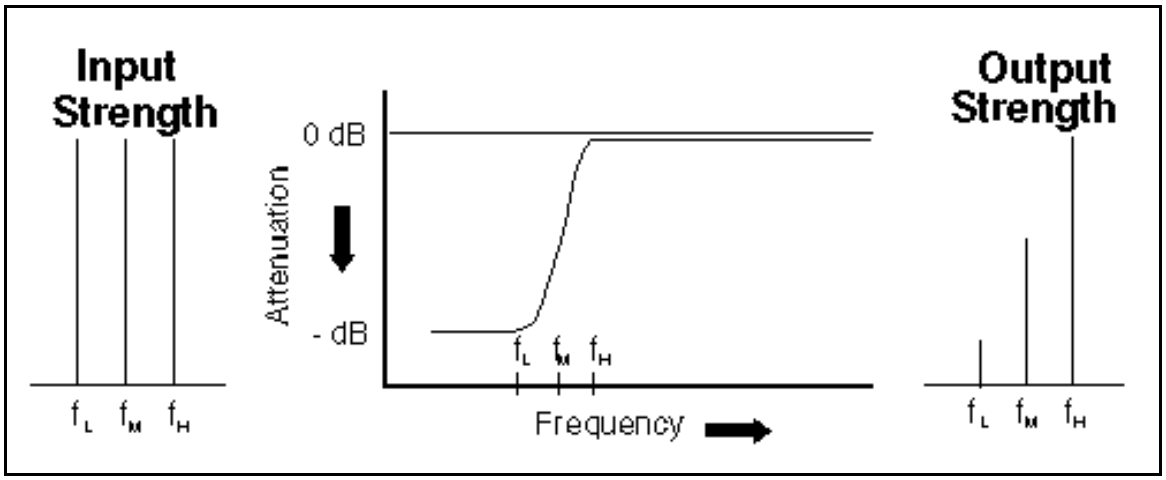

Figure 2. High-Pass Filter.

3. A band-pass filter which passes signals between two predetermined frequencies as shown in Figure 3.

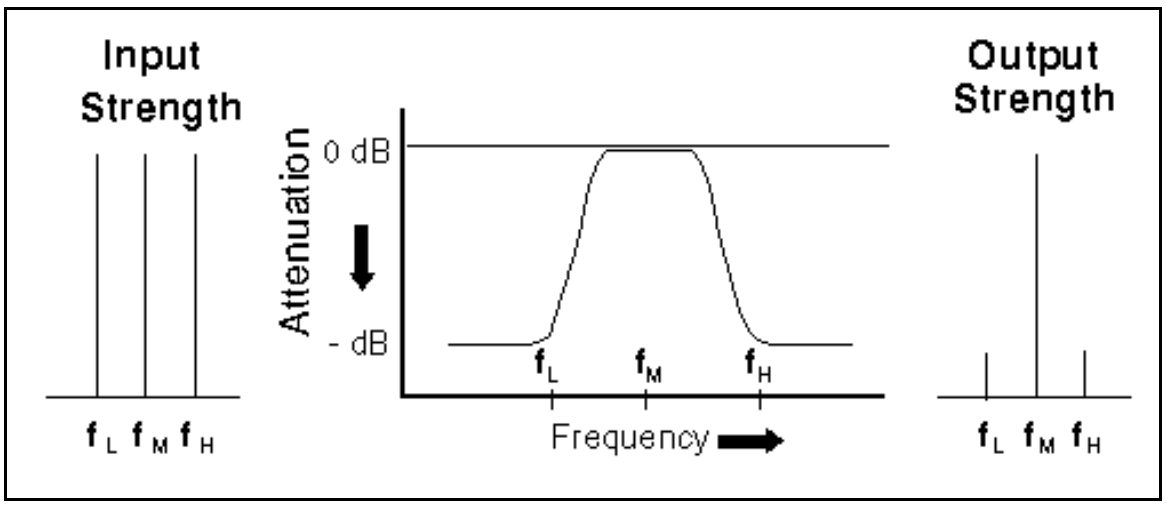

Figure 3. Band-Pass Filter.

A band-pass filter with different skirt slopes on the two sides of the pass band is sometimes referred to as an asymmetrical filter. In this filter the sharpness of the rejection band attenuation is significantly different above and below the center frequency. One additional note regarding band-pass filters or filters in general, their performance should always be checked in the out-of-band regions to determine whether or not they possess spurious responses. In particular they should be checked at harmonics of the operating frequency.

4. A band reject filter (sometimes referred to as a bandstop or notch filter) which rejects signals between two predetermined frequencies such as high power signals from the aircraft's own radar as shown in Figure 4.

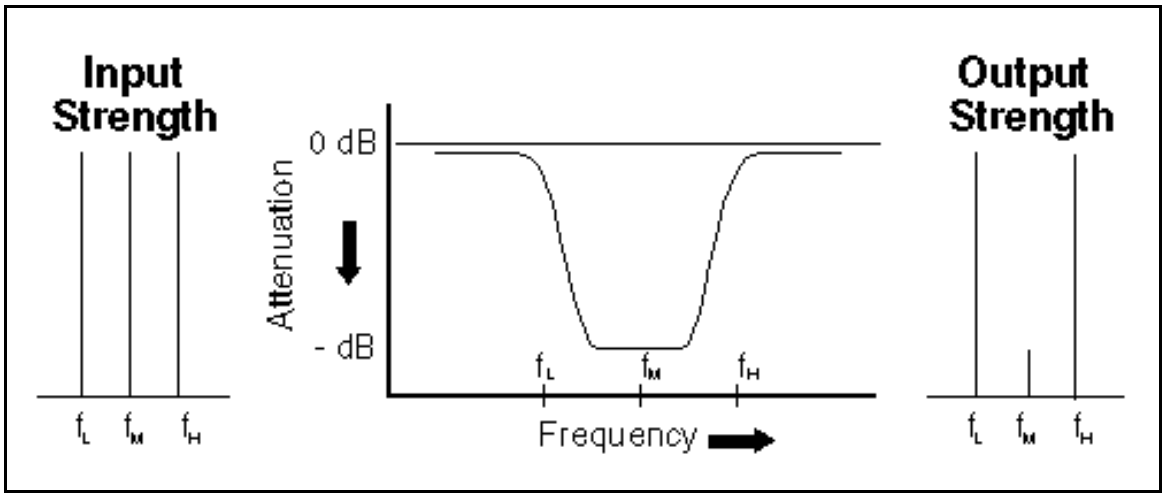

Figure 4. Band-Reject Filter.

In general, filters at microwave frequencies are composed of resonate transmission lines or waveguide cavities that, when combined, reflect the signal power outside the filter frequency pass band and provide a good VSWR and low loss within the frequency pass band. As such, specifications for filters are maximum frequency, pass band loss, VSWR, and rejection level at a frequency outside of the pass band. The trade-offs for filters are a higher rejection for a fixed frequency pass band or a larger frequency pass band for a fixed rejection, which requires a filter with more resonators, which produce higher loss, more complexity, and larger size.

DC BLOCKS

DC Blocks are special connectors which have a capacitor (high pass filter) built into the device. There are three basic types:

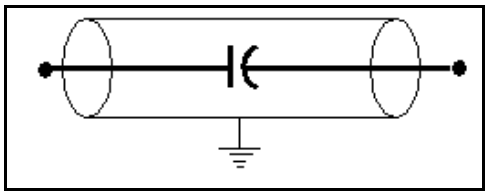

Figure 5. Inside DC Block.

1. INSIDE - The high pass filter is in series with the center conductor as shown in Figure 5. DC is blocked on the center conductor.

2. OUTSIDE - The high pass filter is in series with the cable shield as shown in Figure 6.

3. INSIDE/OUTSIDE - A high pass arrangement is connected to both the inner and outer conductors.

DC Blocks are ideal for filtering DC, 60 Hz, and 400 Hz from the RF line.

In general, capacitors with a large value of capacitance do not have the least loss at microwave frequencies. Also, since capacitance is proportional to size, a large size produces more capacitance with more inductance. Because of these reasons, D.C. blocks are typically available with a high pass frequency band starting in the region of 0.1 to 1 GHz.

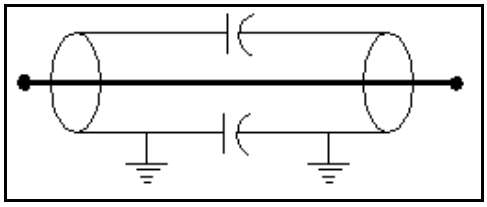

Figure 6. Outside DC Block.

TERMINATIONS / DUMMY LOADS

A termination is a one-port device with an impedance that matches the characteristic impedance of a given transmission line. It is attached to a certain terminal or port of a device to absorb the power transmitted to that terminal or to establish a reference impedance at that terminal. Important parameters of a termination are its VSWR and power handling capacity. In a receiver, terminations are usually placed at various unconnected ports of components such as hybrid and power dividers to keep the VSWR of the signal path low. It is extremely important that the isolated port in a directional coupler and the unused port of a power divider (i.e., only three ports of a four-way power divider are used) be properly terminated. All of the design considerations of directional couplers and power dividers are based on the fact that all ports are terminated with matched loads. If an unused port is not properly terminated, then the isolation between the output ports will be reduced which may severely degrade the performance of the receiver.

A termination is the terminology used to refer to a low power, single terminal device intended to terminate a transmission line. Similar devices designed to accommodate high power are generally termed dummy loads.

TERMINATIONS

Terminations are employed to terminate unconnected ports on devices when measurements are being performed. They are useful as dummy antennas and as terminal loads for impedance measurements of transmission devices such as filters and attenuators.

The resistive elements in most terminations are especially fabricated for use at microwave frequencies. Two types are commonly employed: (1) resistive film elements, and (2) molded resistive tapers. The resistive film is very thin compared to the skin depth and normally very short relative to wavelength at the highest operating frequency. The molded taper consists of a dissipative material evenly dispersed in a properly cured dielectric medium. Both forms of resistive elements provide compact, rugged terminations suitable for the most severe environmental conditions with laboratory stability and accuracy.

Terminations should be properly matched to the characteristic impedance of a transmission line. The termination characteristics of primary concern are:

a. operating frequency range
b. average power handling capability
c. operating temperature range
d. VSWR
e. size
f. weight

Many microwave systems employ directional couplers which require terminations on at least one port, and most have various modes of operation or test where terminations are needed on certain terminals.

A matched termination of a generalized transmission line is ideally represented by an infinite length of that line having small, but non-zero loss per unit length so that all incident energy is absorbed and none is reflected.

Standard mismatches are useful as standards of reflection in calibrating reflectometer setups and other impedance measuring equipment. They are also used during testing to simulate specific mismatches which would be encountered on the terminals of components once the component is installed in the actual system.

The following table shows common mismatches with the impedance that can provide the mismatch.

Common Mismatches (Z_O = 50 Ω)		
Ratio	Z_L (higher)	Z_L (lower)
1.0 : 1	50 Ω (matched)	50 Ω (matched)
1.25 : 1	62.5 Ω	40 Ω
1.50 : 1	75 Ω	33.3 Ω
2.00 : 1	100 Ω	25 Ω

DUMMY LOADS

A dummy load is a high power one port device intended to terminate a transmission line. They are primarily employed to test high power microwave systems at full power capacity. Low power coaxial loads are generally termed terminations and typically handle one watt or less.

Most radars or communications systems have a dummy load integrated into them to provide a non-radiating or EMCON mode of operation, or for testing (maintenance).

Three types of dissipative material are frequently employed in dummy loads: (1) lossy plastic, (2) refractory, and (3) water.

The lossy plastic consists of particles of lossy material suspended in plastic medium. This material may be designed to provide various attenuations per unit length but is limited as to operating temperature. It is employed primarily for low power applications.

The refractory material is a rugged substance that may be operated at temperatures up to 1600°F. It is virtually incapable of being machined by ordinary means but is often fabricated through diamond wheel grinding processes. Otherwise material must be fired in finished form. Such material is employed in most high power applications.

The dissipative properties of water are also employed for dummy load applications. Energy from the guide is coupled through a leaky wall to the water which flows alongside the main guide. Water loads are employed for extremely high power and calorimetric applications.

While dummy loads can operate over full waveguide bands, generally a more economical unit can be manufactured for use over narrower frequency ranges.

The power rating of a dummy load is a complex function dependent upon many parameters, including average and peak power, guide pressure, external temperature, guide size, air flow, and availability of auxiliary coolant. The average and peak powers are interrelated in that the peak power capacity is a function of the operating temperature which in turn is a function of the average power.

CIRCULATORS AND DIPLEXERS

A microwave circulator is a nonreciprocal ferrite device which contains three or more ports. The input from port n will come out at port n + 1 but not out at any other port. A three-port ferrite junction circulator, usually called the Y-junction circulator, is most commonly used. They are available in either rectangular waveguide or strip- line forms. The signal flow in the three-port circulator is assumed as 1→2, 2→3, and 3→1 as shown in Figure 1.

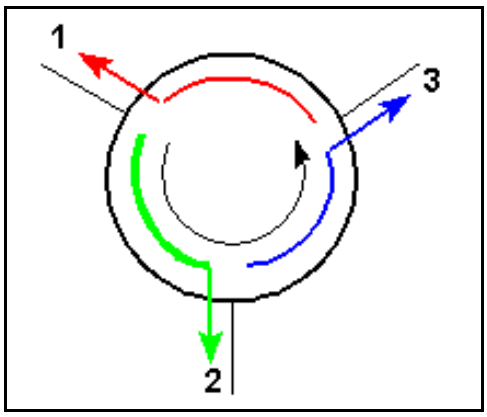

Figure 1. Symbolic Expression for a Y-Junction Circulator.

If port 1 is the input, then the signal will come out of port 2; in an ideal situation, no signal should come out of port 3 which is called the isolated port. The insertion loss of the circulator is the loss from 1 to 2, while the loss from 1 to 3 is referred to as isolation. A typical circulator will have a few tenths of a dB insertion loss from port 1 to 2 and 20 dB of isolation from port 1 to 3 for coaxial circulators (30 dB or more for waveguide circulators). When the input is port 2, the signal will come out of port 3 and port 1 is the isolated port. Similar discussions can be applied to port 3.

> Since circulators contain magnets, they should not be mounted near ferrous metals since the close proximity of metals like iron can change the frequency response.

As shown in Figure 2, if one port of a circulator is loaded, it becomes an isolator, i.e., power will pass from ports one to two, but power reflected back from port two will go to the load at port three versus going back to port one.

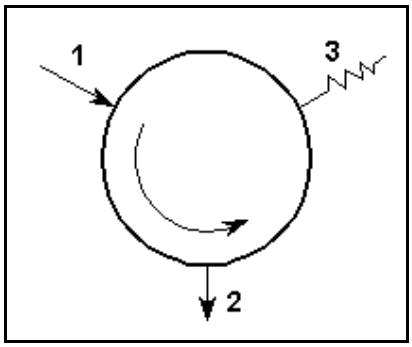

Figure 2. Isolator From A Circulator.

As shown in Figure 3 this circulator is made into a diplexer by adding a high pass filter to port two. Frequencies from port one that are below 10 GHz will be reflected by port two. Frequencies above 10 GHz will pass through port two. At the 10 GHz crossover frequency of the diplexer, a 10 GHz signal will be passed to both ports two and three but will be half power at each port. Diplexers or triplexers (one input and three output bands), must be specifically designed for the application.

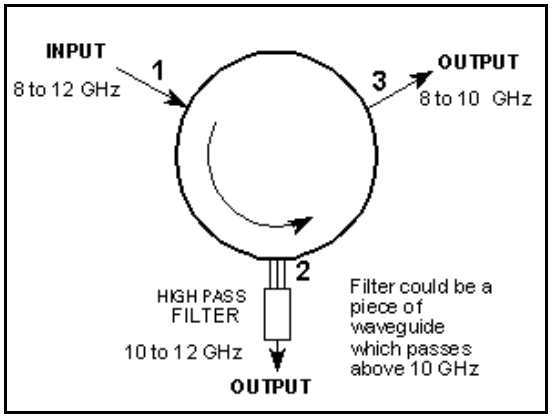

Figure 3. Diplexer From A Circulator.

Another useful device is the 4-port Faraday Rotator Circulator shown symbolically in Figure 4. These waveguide devices handle very high power and provide excellent isolation properties. It is useful when measurements must be made during high power application as shown. A water load is used to absorb the high power reflections so that a reasonable power level is reflected to the receiver or measurement port.

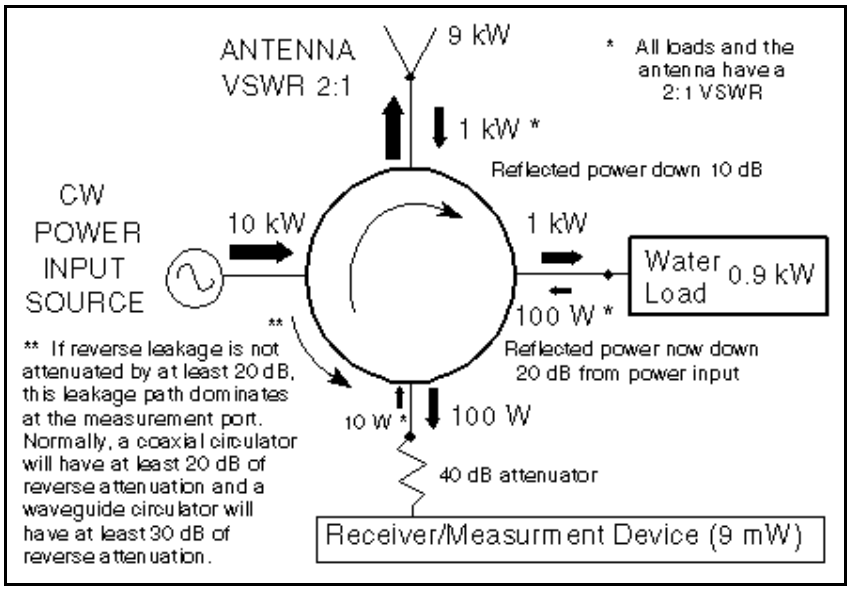

Figure 4. Faraday Rotator Circulator.

<u>The Maximum Input Power to a Measurement Device</u> - The ideal input to a measurement device is in the 0 to 10 dBm (1 to 10 mW) range. Check manufacturer's specification for specific maximum value.

If the RF transmission lines and their components (antenna, hybrid, etc.) can support the wider frequency range, circulators could be used to increase the number of interconnecting RF ports from two as shown in Figure 5, to four as shown in Figure 6. Figure 7 shows an alternate configuration using diplexers which could actually be made from circulators as shown previously in Figure 3.

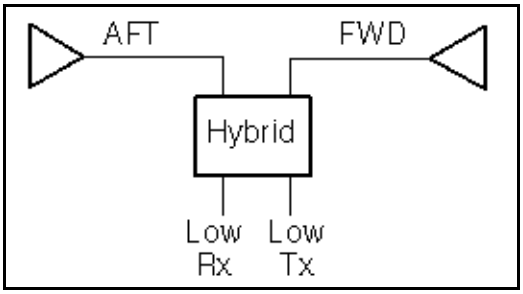

Figure 5. Low Band Configuration.

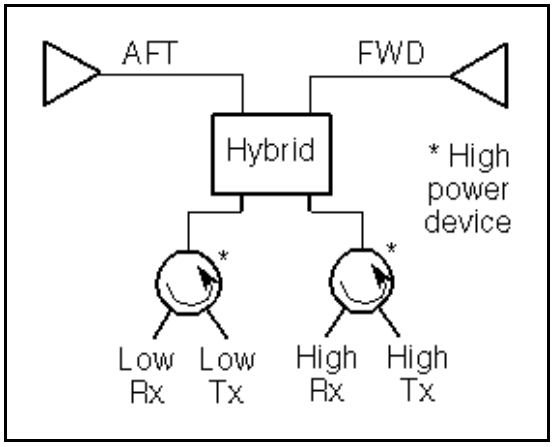

Figure 6. Low/High Band Configuration.

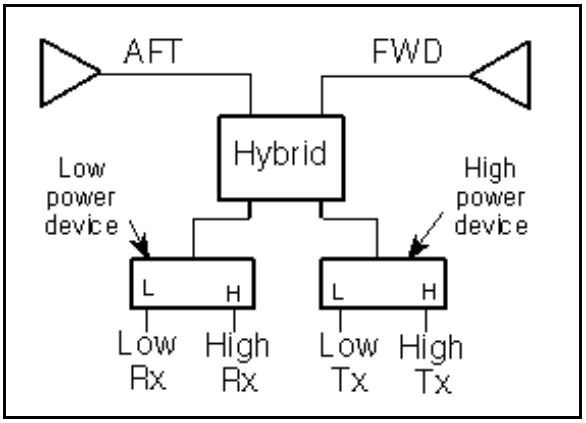

Figure 7. Alternate Low/High Band Configuration.

MIXERS AND FREQUENCY DISCRIMINATORS

Mixers are used to convert a signal from one frequency to another. This is done by combining the original RF signal with a local oscillator (LO) signal in a non-linear device such as a Schottky-barrier diode.

The output spectrum includes:

- The original inputs, LO and RF
- All higher order harmonics of LO and RF
- The two primary sidebands, LO ± RF (m,n = 1)
- All higher order products of mLO ± nRF (where m,n are integers)
- A DC output level

The desired output frequency, commonly called the intermediate frequency (IF), can be either the lower (LO-RF) or upper (LO+RF) sideband. When a mixer is used as a down converter, the lower sideband is the sideband of interest.

A microwave balanced mixer makes use of the 3 dB hybrid to divide and recombine the RF and LO inputs to two mixing diodes. The 3 dB hybrid can be either the 90° or 180° type. Each has certain advantages which will be covered later. The critical requirement is that the LO and RF signals be distributed uniformly (balanced) to each mixer diode.

Figure 1 is a typical balanced mixer block diagram. The mixer diodes are reversed relative to each other; the desired frequency (IF) components of each diode are then in-phase while the DC outputs are positive and negative respectively.

The two diode outputs are summed in a tee where the DC terms cancel and only the desired IF component exists at the IF port.

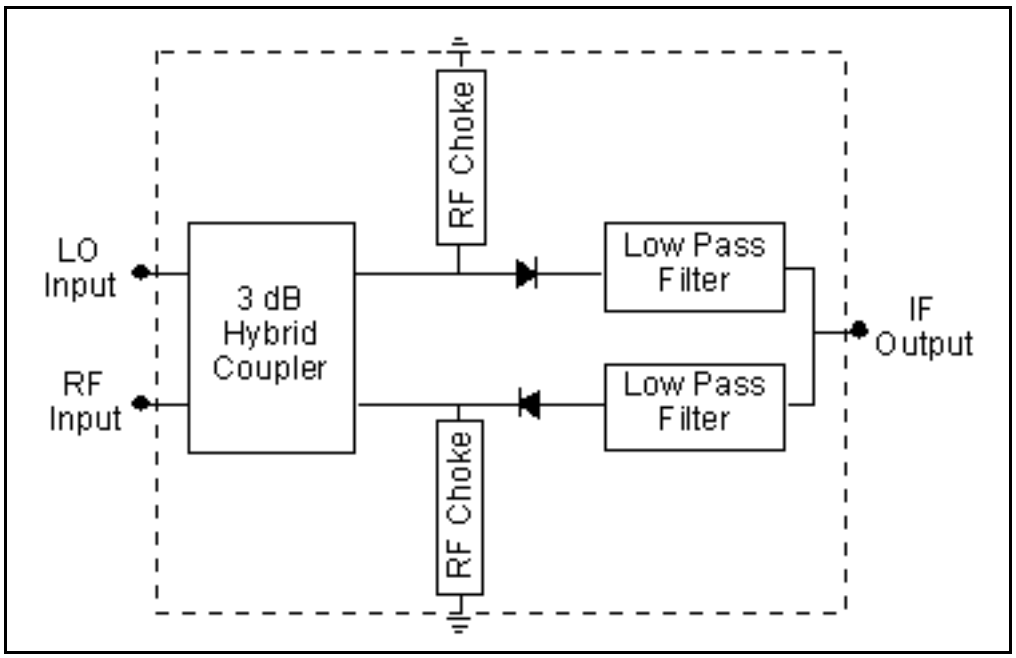

Figure 1. Mixer Block Diagram.

Other types of mixers exist, including the double-balanced mixer, and the Ortho-Quad® (quadrature fed dual) mixer. The relative advantages and disadvantages of each of the four types are summarized in Table 1.

Table 1. Mixer Comparison.

Mixer Type	VSWR [1]	Conversion Loss [2]	LO/RF Isolation [3]	Harmonic Suppression [4]	Dynamic Range	IF Bandwidth
90° Hybrid	good	lowest	poor	poor-fair	high	wide
180° Hybrid	poor	low	good	good	high	wide
Double-Balanced	poor	low	Very good -excellent	very good	high	extremely wide
Ortho Quad	good	low	very good	fair	high	wide

NOTES:
(1) Poor = 2.5:1 typical; Good = 1.3:1 typical
(2) Conversion loss: lowest: 5-7 dB typical; Low 7-9 dB typical
(3) Poor: 10 dB typical; Good: 20 dB typical; Very Good: 25-30 dB typical; Excellent: 35-40 dB typical
(4) Poor: partial rejection of LO/RF even harmonics
Fair: slightly better
Good: can reject all LO even harmonics
Very Good: can reject all LO and RF even harmonics

Used in various circuits, mixers can act as modulators, phase detectors, and frequency discriminators.

The phase discriminators can serve as a signal processing network for systems designed to monitor bearing, polarization, and frequency of AM or FM radiated signals.

A frequency discriminator uses a phase discriminator and adds a power divider and delay line at the RF input as shown in Figure 2. The unknown RF signal "A" is divided between a reference and delay path. The differential delay (T) creates a phase difference (θ) between the two signals which is a linear function of frequency (f) and is given by $\theta = 2\pi fT$.

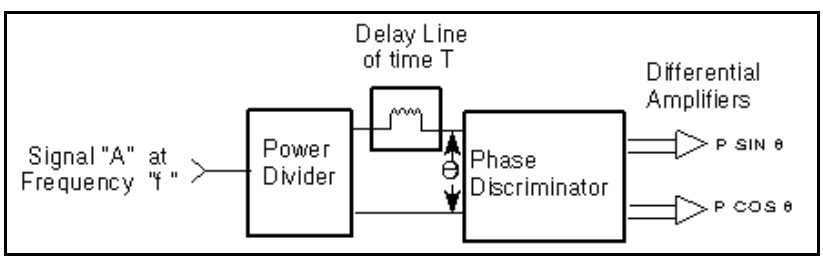

Figure 2. Frequency Discriminator.

When the two output signals are fed to the horizontal and vertical input of an oscilloscope, the resultant display angle will be a direct function of frequency.

DETECTORS

A detector is used in receiver circuits to recognize the presence of signals. Typically a diode or similar device is used as a detector. Since this type of detector is unable to distinguish frequency, they may be preceded by a narrow band-pass filter.

A typical simplistic circuit is shown in Figure 1.

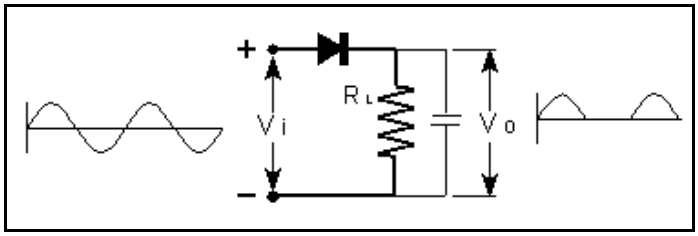

Figure 1. Typical Diode Detector Circuit.

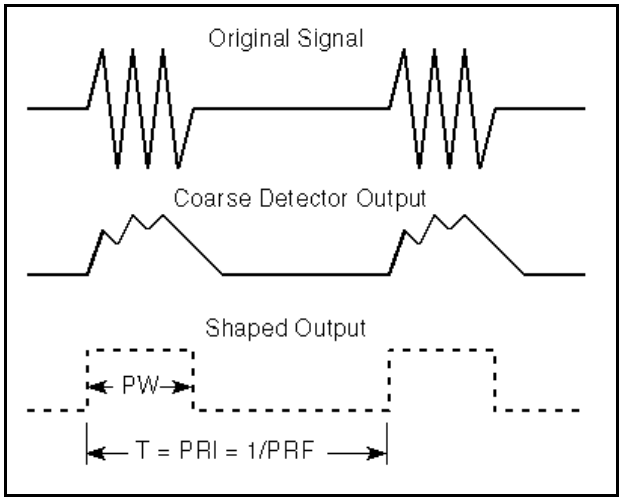

Figure 2. Demodulated Envelope Output.

To integrate a pulse radar signal, we can add capacitance to the circuit in parallel with the output load R_L to store energy and decrease the bleed rate. Figure 2 shows a typical input/output waveform which detects the envelope of the pulse radar signal. From this information pulse width and PRF characteristics can be determined for the RWR UDF comparison.

When the diode is reverse biased, very little current passes through unless the reverse breakdown voltage is exceeded. When forward biased and after exceeding the cut-in voltage, the diode begins to conduct as shown in Figure 3. At low voltages, it first operates in a square law region. Detectors operating in this region are known as small signal type. If the voltage is higher, the detector operates in a linear region, and is known as the large signal type.

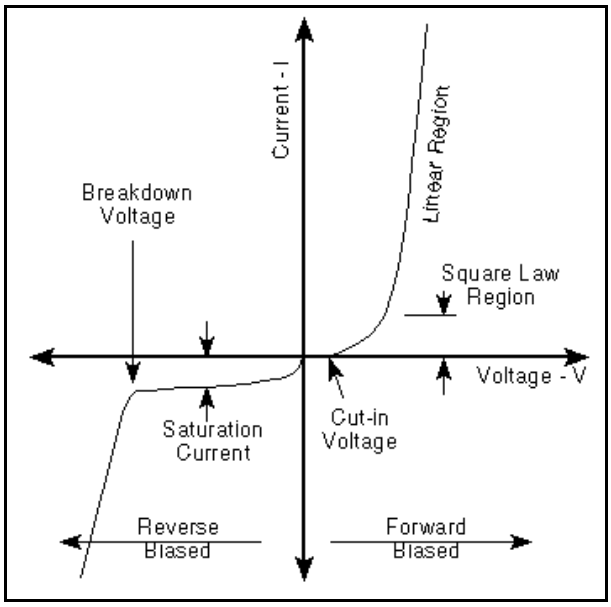

Figure 3. Diode Electrical Characteristics.

The power/voltage characteristics for a typical diode detector is shown in Figure 4.

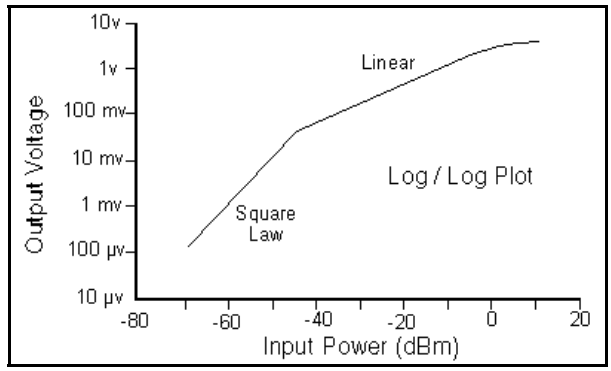

Figure 4. Diode Power/Voltage Characteristic.

Square Law Detector

In the square law region, the output voltage V_o is proportional to the square of the input voltage V_i, thus V_o is proportional to the input power.

$$V_o = nV_i^2 = nP_i \quad \text{or} \quad P_i \propto V_o$$

Where n is the constant of proportionality

Linear Detector

In the linear detection region, the output voltage is given by:

$$V_o = mV_i \quad \text{and since } P=V^2/R, \quad P_i \propto V_o^2$$

Where m is the constant of proportionality

Log Detector Amplifier

Another type of detector arrangement is the Log detector amplifier circuit shown in Figure 5. It is formed by using a series of amplifiers and diode detectors. Due to the nature of the amplifier/diode characteristics, the output voltage is related to the power by:

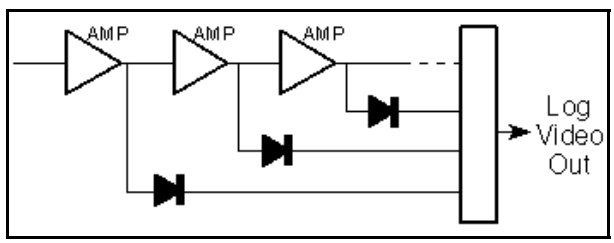

Figure 5. Log Detector.

$$P_i \propto 10^{pVo+q}$$

Where p and q are constants of proportionality

The Log detector has good range, but is hampered by large size when compared to a single diode detector.

Pulse Width Measurements

If the pulse width of a signal was specified at the one-half power point, the measurements of the detected signal on an oscilloscope would vary according to the region of diode operation. If the region of operation is unknown, a 3 dB attenuator should be inserted in the measurement line. This will cause the power to decrease by one-half. The (temporary) peak amplitude on the oscilloscope becomes the amplitude reference point for measuring the pulse width when the external 3 dB attenuator is removed.

These voltage levels for half power using the three types of detectors are shown in Table 1.

Table 1. Detector Characteristics.

	Square Law	Linear	Log
Output Voltage When Input Power is reduced by Half (3 dB)	0.5 V_{in}	0.707 V_{in}	A very small value. ~ 0.15 V_{in} for typical 5 stage log amplifier
Sensitivity & Dynamic Range	Good sensitivity Small dynamic range	Less sensitivity Greater dynamic range	Poorest sensitivity Greatest dynamic range (to 80 dB)

Also see the Microwave Measurements section subsection entitled "Half Power or 3 dB Measurement Point."

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RF / MICROWAVE AMPLIFIERS

An amplifier is one of the most essential and ubiquitous elements in modern RF and microwave systems. Fundamentally, an amplifier is a type of electronic circuit used to convert low-power signals into ones of significant power. The specific requirements for amplification are as varied as the systems where they are used. Amplifiers are realized using a wide range of different technologies, and are available in many form factors. While the performance of an amplifier can be measured by wide range of attributes, several important ones include: gain, power added efficiency (PAE), input and output return loss, 1-dB compression point (P_{1dB}), stability, linearity, intermodulation distortion, and noise figure.

Traveling Wave Tubes (TWTs)

A traveling-wave tube (TWT) is a specialized vacuum tube used in electronics to amplify radio frequency (RF) signals to very high power. A TWT is a component of an electronic assembly known as a traveling-wave tube amplifier (TWTA), often pronounced "Tweet-uh." While trades between these parameters exist, modern TWTAs are capable of providing very high gains (>50 dB), multiple octaves of bandwidth, high efficiency, and output powers that range from tens to thousands of watts. Pulsed TWTAs can reach even higher output powers. Figure 1 presents a simplified diagram of a helix-type TWT.

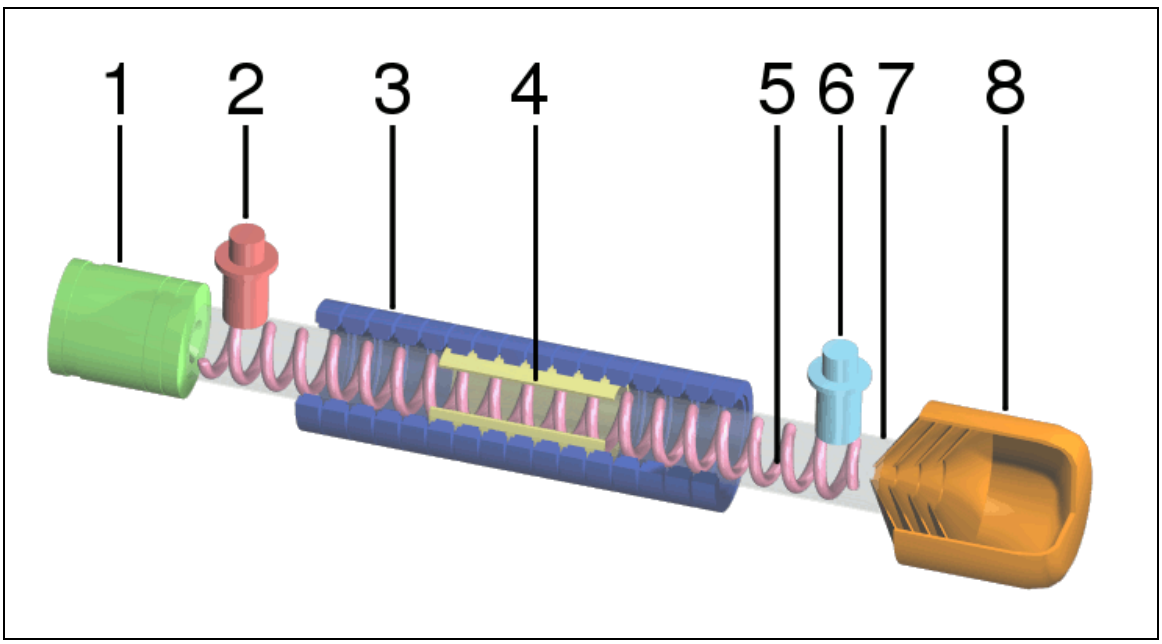

Figure 1. Cutaway view of a helix TWT.
(1) Electron gun; (2) RF input; (3) Magnets; (4) Attenuator;
(5) Helix coil; (6) RF output; (7) Vacuum tube; (8) Collector.
Reproduced from Wikipedia.

The device is an elongated vacuum tube with an electron gun (a heated cathode that emits electrons) at one end. A solenoid coil wrapped around the tube creates a magnetic field which focuses the electrons into a beam, which then passes down the middle of a wire helix that stretches the length of the tube, finally striking a collector at the other end. An input signal is coupled into the helix near the emitter, is amplified by the electron beam as it travels down the length of the tube, and the amplified signal is coupled to an external port near the collector.

The helix, which acts as a RF transmission line, delays the signal to near the same propagation speed as the electron beam. The speed at which the electromagnetic wave travels down the tube can be varied by changing the number or diameter of the turns in the helix. While propagating along the tube, the EM wave interacts with the electron beam. Since the electromagnetic wave effectively propagates slower than the electron beam, the electrons "bunch up" and modulate the input signal, giving up energy in the process - an effect known as velocity modulation. Thus, the traveling wave progressively grows in amplitude as it propagates down the tube towards the collector.

Figure 2 features a photo of a high voltage power supply and TWT.

Figure 2. TWTA Including High Voltage Power Supply (top) and TWT (bottom).

Historically, TWTAs have been used in satellite transponders, radars, and in electronic warfare and self-protection systems. Recently, with the advent of wideband, high power solid-state amplifier solutions, however, TWTAs are slowly being replaced due to the higher reliability of their solid state counterparts.

Microwave Power Modules (MPMs)

A Microwave Power Module (MPM) is a hybrid solution between solid-state and vacuum tube electronics, which aims to take advantage of the best features of both technologies. They feature a solid-state pre-amplifier, miniaturized TWTA, and a high-density power supply, all integrated into a unit much more compact and lightweight than the traditional TWTA. While MPMs generally don't provide as much power as their larger TWTA counterparts, their lighter weight, compact form factor, and relaxed power supply requirements (often 28 VDC or 270 VDC) enable use in applications where a TWTA would not be possible.

Similar to TWTAs, MPMs are capable of providing very high gains (>50 dB), multiple octaves of bandwidth, high efficiency. Typical power levels range from tens to hundreds of watts, with ~1 kW capability for pulsed MPMs.

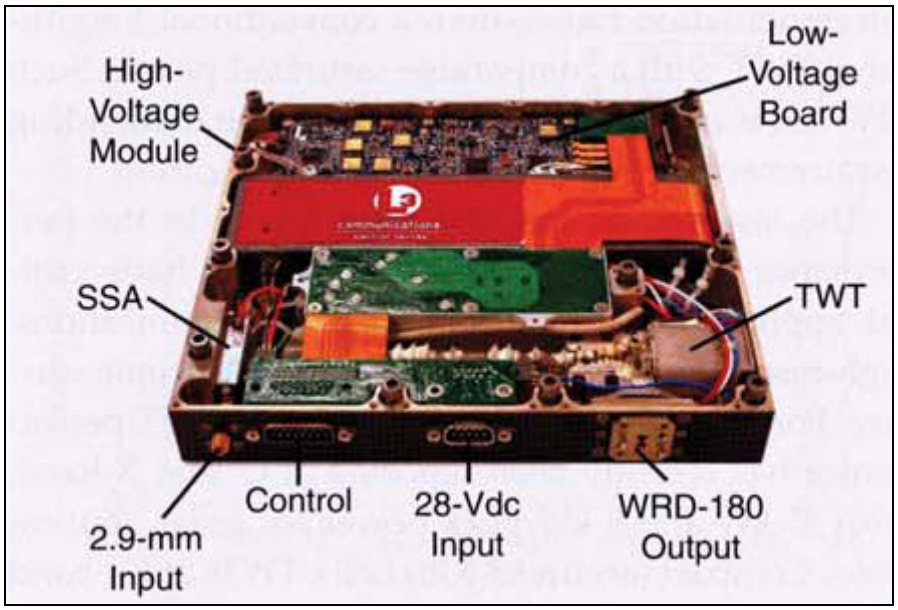

Figure 3. 40W Ka-band MPM With Components Identified.
Image from *IEEE Magazine*, December 2009, page 42.

They have found applications in phased array antennas, lower-power radar transmitters, satellite communications, EW systems, and UAVs.

Solid State

Solid-state electronics, including amplifiers, are built entirely from solid materials and in which the electrons, or other charge carriers, are confined entirely within the solid material. The building material is most often a crystalline semiconductor. Solid-state power amplifiers, or SSPAs, are fabricated on many different semiconductor technologies, some of which include GaAs, GaN, InP, SiGe, CMOS. A photo of a GaN SSPA is presented in Figure 4.

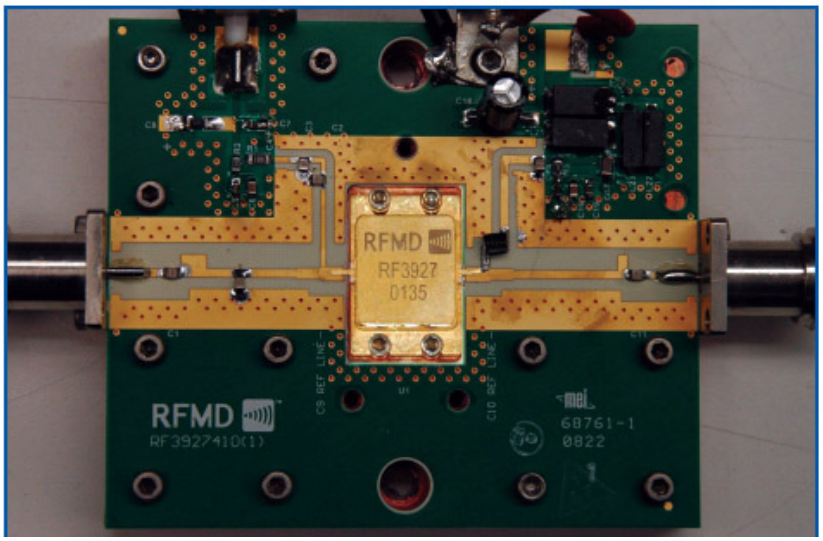

Figure 4. Typical SSPA. Note the GaN die and external impedance matching networks.

In general, SSPAs are heralded as having a higher reliability than TWTAs. While high power SSPAs are available on the market, achieving high efficiency has been a challenge as many amplifier stages often need to be combined to meet to achieve power levels in the tens to hundreds of watts. Multi-stage designs increase size, weight, and power (SWAP) and decrease PAE (due to ohmic losses in the combining networks), which is one reason why TWTs and MPMs still provide excellent alternatives for medium to high power applications.

Below is a table that attempts to compare and contrast different solid-state technologies in the context of microwave networks and amplifiers. It is by no means complete, but provides a general overview.

Table 1. Comparison Between Different Semiconductor Process Technologies.

Technology	Advantages	Disadvantages
Silicon variants (CMOS, SiGe)	• Cheapest substrate due to CPU industry • Can be fabricated with nanometer accuracy	• Not a good overall microwave substrate • Results in lossy, high noise figure, low power components • Crystal is fragile • Junction temperatures limited to ~110C
Indium Phosphide Variants (InP/InGaP)	• High performance at low voltage • Good thermal stability • Results in high efficiency PAs, particularly at lower operating voltage • Extremely low noise figure • Useful through W-band and beyond	• Less mature, "niche" fabrication houses • Brittle, fragile material • Higher cost than GaAs • Low breakdown voltage – not good for high power
Gallium Arsenide variants (GaAs)	• Most mature, widespread technology • Many transistor variants (MESFET, PHEMT, MHEMT, HBT, etc) • High reliability • Fairly low cost (but more than silicon) • Great microwave substrate • Low loss, high ε_r. • 16-20V breakdown possible • Junction temperatures up to 150C	• High noise figure, Noise figure and power performance • Difficult to summarize - depends on transistor type used
Gallium Nitride (GaN)	• Up to 10x the power density of GaAs • High breakdown voltage (100V possible) • Results in high efficiency, high frequency, wide bandwidth PAs • Can operate hotter than GaAs, Si, or SiGe	• Currently more expensive than GaAs, but costs are decreasing • Difficult to fabricate • High power density leads to thermal challenges

SIGNAL GENERATION

Signal generators, also known variously as function generators, RF and microwave signal generators, pitch generators, arbitrary waveform generators, digital pattern generators or frequency generators are electronic devices that generate repeating or non-repeating electronic signals (in either the analog or digital domains). They are generally used in designing, testing, troubleshooting, and repairing electronic or electro-acoustic devices; though they often have artistic uses as well.

There are many different types of signal generators, with different purposes and applications (and at varying levels of expense); in general, no device is suitable for all possible applications.

Analog Signal Generators

RF signal generators are capable of producing CW (continuous wave) tones. The output frequency can usually be tuned anywhere in their frequency range. Many models offer various types of analog modulation, either as standard equipment or as an optional capability to the base unit. This could include AM, FM, ΦM (phase modulation) and pulse modulation. Another common feature is a built-in attenuator which makes it possible to vary the signal's output power. Depending on the manufacturer and model, output powers can range from -135 to +30 dBm. A wide range of output power is desirable, since different applications require different amounts of signal power. For example, if a signal has to travel through a very long cable out to an antenna, a high output signal may be needed to overcome the losses through the cable and still have sufficient power at the antenna. But when testing receiver sensitivity, a low signal level is required to see how the receiver behaves under low signal-to-noise conditions.

RF signal generators are required for servicing and setting up analog radio receivers, and are used for professional RF applications.

Arbitrary Waveform Generator

An arbitrary waveform generator (AWG) is a piece of electronic test equipment used to generate electrical waveforms. These waveforms can be either repetitive or single-shot (once only) in which case some kind of triggering source is required (internal or external). The resulting waveforms can be injected into a device under test and analyzed as they progress through the device, confirming the proper operation of the device or pinpointing a fault in the device.

Unlike function generators, AWGs can generate any arbitrarily defined wave shape as their output. The waveform is usually defined as a series of "waypoints" (specific voltage targets occurring at specific times along the waveform) and the AWG can either jump to those levels or use any of several methods to interpolate between those levels.

Because AWGs synthesize the waveforms using (baseband) digital signal processing techniques, their maximum frequency is usually limited to no more than a few gigahertz (~10 GHz being the latest state-of-the-art in 2012).

A major difficulty in generating non-repetitive waveforms at higher frequencies with AWGs is the large amount of data required to describe high-frequency baseband signals. For example, a 20 gigasample/sec arbitrary waveform with 8 bits of resolution requires 20 GB of data to represent every 1 second of signal, regardless of that signal's nature. Generating such large digital data streams and delivering them to the DAC in the AWG is an increasingly difficult problem as DAC upper frequencies continue to grow.

AWGs, like most signal generators, may also contain an attenuator, various means of modulating the output waveform, and often contain the ability to automatically and repetitively "sweep" the frequency of the output waveform (by means of a voltage-controlled oscillator) between two operator-determined limits. This capability makes it very easy to evaluate the frequency response of a given electronic circuit.

AWGs can operate as conventional function generators. These would include standard waveforms such as sine, square, ramp, triangle, noise, and pulse. Some units include additional built-in waveforms such as exponential rise and fall times, sinx/x, cardiac. Some AWGs allow users to retrieve waveforms from a number of digital and mixed-signal oscilloscopes. Some AWGs may display a graph of the waveform on their screen - a graph mode. Some AWGs have the ability to generate a pattern of words from multiple bit output connector to simulate data transmission, combining the properties of both AWGs and digital pattern generators.

One feature of direct digital synthesizer (DDS) based arbitrary waveform generators is that their digital nature allows multiple channels to be operated with precisely controlled phase offsets or ratio-related frequencies. This allows the generation of polyphase sine waves, I-Q constellations, or simulation of signals from geared mechanical systems such as jet engines. Complex channel-channel modulations are also possible.

Vector Signal Generators

Modern vector signal generators can be seen as a hybrid of the arbitrary waveform generator and the analog signal generator, combining a lower-bandwidth AWG with analog upconversion, allowing a moderate-bandwidth (~100 MHz, circa 2012) digital signal to be upconverted to any frequency (~50 GHz typically upper frequency typically).

With the advent of digital communications systems, it is no longer possible to adequately test these systems with traditional analog signal generators. This has led to the development of vector signal generators, also known as digital signal generators. These signal generators are capable of generating digitally-modulated radio signals that may use any of a large number of digital modulation formats such as QAM, QPSK, FSK, BPSK, and OFDM. In addition, since modern commercial digital communication systems are almost all based on well-defined industry standards, many vector signal

generators can generate signals based on these standards. Examples include GSM, W-CDMA (UMTS), CDMA2000, LTE, Wi-Fi (IEEE 802.11), and WiMAX (IEEE 802.16). In contrast, military communication systems such as JTRS, which place a great deal of importance on robustness and information security, typically use very proprietary methods. To test these types of communication systems, users will often create their own custom waveforms and download them into the vector signal generator to create the desired test signal.

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DIGITAL SIGNAL PROCESSING COMPONENTS

The goal of DSP is usually to measure, filter and/or compress continuous real-world analog signals. The first step is usually to convert the signal from an analog to a digital form, by sampling and then digitizing it using an analog-to-digital converter (ADC), which turns the analog signal into a stream of numbers. However, often, the required output signal is another analog output signal, which requires a digital-to-analog converter (DAC). Even if this process is more complex than analog processing and has a discrete value range, the application of computational power to digital signal processing allows for many advantages over analog processing in many applications, such as error detection and correction in transmission as well as data compression. With the increasing bandwidth and dynamic range of ADC and digital components, common analog RF signal processing operations such as filtering, threshold detection, and pulse compression are being carried out in the digital domain. Additionally new capabilities such as synthetic aperture radar (SAR), digital RF memory (DRFM), and space-time adaptive processing (STAP) are wholly enabled by the increasing power of digital processing components.

Analog-to-Digital Converter

An analog-to-digital converter (abbreviated ADC, A/D or A to D) is a device that converts a continuous quantity to a discrete time digital representation. An ADC may also provide an isolated measurement. The reverse operation is performed by a digital-to-analog converter (DAC).

Typically, an ADC is an electronic device that converts an input analog voltage or current to a digital number proportional to the magnitude of the voltage or current. However, some non-electronic or only partially electronic devices, such as rotary encoders, can also be considered ADCs.

Resolution

The resolution of the converter indicates the number of discrete values it can produce over the range of analog values. The values are usually stored electronically in binary form, so the resolution is usually expressed in bits. In consequence, the number of discrete values available, or "levels," is a power of two. For example, an ADC with a resolution of 8 bits can encode an analog input to one in 256 different levels, since $2^8 = 256$. The values can represent the ranges from 0 to 255 (i.e. unsigned integer) or from −128 to 127 (i.e., signed integer), depending on the application.

Resolution can also be defined electrically, and expressed in volts. The minimum change in voltage required to guarantee a change in the output code level is called the least significant bit (LSB) voltage. The resolution Q of the ADC is equal to the LSB voltage. The voltage resolution of an ADC is equal to its overall voltage measurement range divided by the number of discrete values:

$$Q = \frac{E_{FSR}}{2^M}$$

where M is the ADC's resolution in bits and E_{FSR} is the full scale voltage range (also called 'span').

E_{FSR} is given by

$$E_{FSR} = V_{RefHi} - V_{RefLow}$$

where V_{RefHi} and V_{RefLow} are the upper and lower extremes, respectively, of the voltages that can be coded.

Normally, the number of voltage intervals is given by

$$N = 2^M - 1$$

where M is the ADC's resolution in bits.

That is, one voltage interval is assigned in between two consecutive code levels.

A typical 3 bit (2^8 = 8-level) coding scheme is depicted in Figure 1.

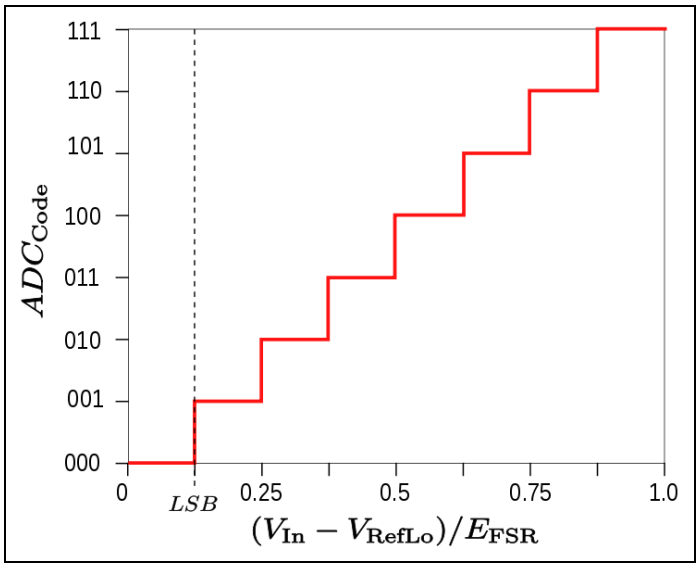

Figure 1. An 8-level (3 bit) ADC Coding Scheme.

Example:

Assume input signal x(t) = A cos(t), A = 5V
Full scale measurement range = -5 to 5 volts
ADC resolution is 8 bits: 2^8 - 1 = 256 - 1 = 255 quantization levels (codes)
ADC voltage resolution, Q = (5 V − [-5] V) / 255 = 10 V / 255 ≈ 0.039 V ≈ 39 mV.

In practice, the useful resolution of a converter is limited by the best signal-to-noise ratio (SNR) that can be achieved for a digitized signal. An ADC can resolve a signal to only a certain number of bits of resolution, called the effective number of bits (ENOB). One effective bit of resolution changes the signal-to-noise ratio of the digitized signal by 6 dB, if the resolution is limited by the ADC. If a preamplifier has been used prior to A/D conversion, the noise introduced by the amplifier can be an important contributing factor towards the overall SNR.

Accuracy

An ADC has several sources of errors. Quantization error and (assuming the ADC is intended to be linear) non-linearity are intrinsic to any analog-to-digital conversion. There is also a so-called aperture error which is due to a clock jitter and is revealed when digitizing a time-variant signal (not a constant value).

These errors are measured in a unit called the least significant bit (LSB). In the above example of an eight-bit ADC, an error of one LSB is 1/256 of the full signal range, or about 0.4%.

Sampling Rate

The analog signal is continuous in time and it is necessary to convert this to a flow of digital values. It is therefore required to define the rate at which new digital values are sampled from the analog signal. The rate of new values is called the sampling rate or sampling frequency of the converter.

A continuously varying band limited signal can be sampled (that is, the signal values at intervals of time T, the sampling time, are measured and stored) and then the original signal can be exactly reproduced from the discrete-time values by an interpolation formula. The accuracy is limited by quantization error. However, this faithful reproduction is only possible if the sampling rate is higher than twice the highest frequency of the signal. This is essentially what is embodied in the Shannon-Nyquist sampling theorem.

Oversampling

Usually, for economy, signals are sampled at the minimum rate required, with the result that the quantization noise introduced is white noise spread over the whole pass band of the converter. If a signal is sampled at a rate much higher than the Nyquist frequency and then digitally filtered to limit it to the signal bandwidth there are the following advantages:

- Digital filters can have better properties (sharper roll-off, phase) than analog filters, so a sharper anti-aliasing filter can be realized and then the signal can be down-sampled giving a better result
- A 20-bit ADC can be made to act as a 24-bit ADC with 256× oversampling
- The signal-to-noise ratio due to quantization noise will be higher than if the whole available band had been used. With this technique, it is possible to obtain an effective resolution larger than that provided by the converter alone.
- The improvement in SNR is 3 dB (equivalent to 0.5 bits) per octave of oversampling which is not sufficient for many applications. Therefore, oversampling is usually coupled with noise shaping. With noise shaping, the improvement is 6L+3 dB per octave where L is the order of loop filter used for noise shaping. e.g. - a 2nd order loop filter will provide an improvement of 15 dB/octave.

<u>Digital to Analog Converter (DAC)</u>

Digital-to-analog converters (DACs) perform the inverse function of the ADC. As such, the aforementioned principles of accuracy, resolution, sampling and oversampling, etc. apply equivalently.

Field-Programmable Gate Array (FPGA)

A field-programmable gate array (FPGA) is an integrated circuit designed to be configured by the customer or designer after manufacturing—hence "field-programmable." The FPGA configuration is generally specified using a hardware description language (HDL), similar to that used for an application-specific integrated circuit (ASIC). Circuit diagrams were previously used to specify the configuration, as they were for ASICs, but this is increasingly rare. FPGAs can be used to implement any logical function that an ASIC could perform. The ability to update the functionality after shipping, partial re-configuration of a portion of the design and the low non-recurring engineering costs relative to an ASIC design (notwithstanding the generally higher unit cost), offer advantages for many applications.

FPGAs contain programmable logic components called "logic blocks," and a hierarchy of reconfigurable interconnects that allow the blocks to be "wired together"—somewhat like many (changeable) logic gates that can be inter-wired in (many) different configurations. Logic blocks can be configured to perform complex combinational functions, or merely simple logic gates like AND and XOR. In most FPGAs, the logic blocks also include memory elements, which may be simple flip-flops or more complete blocks of memory.

FPGAs are becoming increasingly more popular for implementing RF signal processing functions such as signal compression (matched filtering), channel selection, modulation / demodulation, etc.

MICROWAVE MEASUREMENTS

Measurement Procedures

Calculate your estimated power losses before attempting to perform a measurement. The ideal input to a measurement device is in the 0 to 10 dBm (1 to 10 mW) range.

Linearity Check

To verify that a spectrum measurement is accurate and signals are not due to mixing inside the receiver, a linearity check should be performed, i.e., externally insert a 10 dB attenuator - if measurements are in the linear region of the receiver, all measurements will decrease by 10 dB. If the measurements decrease by less than 10 dB, the receiver is saturated. If the measurements disappear, you are at the noise floor.

Half-Power or 3 dB Measurement Point

To verify the half power point of a pulse width measurement on an oscilloscope, externally insert a 3 dB attenuator in the measurement line, and the level that the peak power decreases to is the 3 dB measurement point (Note: you cannot just divide the peak voltage by one-half on the vertical scale of the oscilloscope).

VSWR Effect on Measurement

Try to measure VSWR (or reflection coefficient) at the antenna terminals. Measuring VSWR of an antenna through its transmission line can result in errors. Transmission lines should be measured for insertion loss not VSWR.

High Power Pulsed Transmitter Measurements

When making power measurements on a high power pulsed transmitter using a typical 40 dB directional coupler, an additional attenuator may be required in the power meter takeoff line, or the power sensor may be burnt out.

For example, assume we have a 1 megawatt transmitter, with PRF = 430 pps, and PW = 13 μs. Further assume we use a 40 dB directional coupler to tap off for the power measurements. The power at the tap would be:

$10 \log(P_p) - 10 \log(DC) - \text{Coupler reduction} =$

$10 \log(10^9 \text{mW}) - 10 \log(13 \times 10^{-6})(430) - 40 \text{ dB} =$

90 dBm - 22.5 dB - 40 dB = 27.5 dBm (too high for a power meter)

Adding a 20 dB static attenuator to the power meter input would give us a value of 7.5 dBm or 5.6 mW, a good level for the power meter.

High Power Measurements With Small Devices

When testing in the presence of a high power radar, it is normally necessary to measure the actual field intensity. The technique shown in Figure 4, in Section 6-7, may not be practical if the measurement device must be small. An alternate approach is the use of a rectangular waveguide below its cutoff frequency. In this manner, the "antenna" waveguide provides sufficient attenuation to the frequency being measured so it can be coupled directly to the measurement device or further attenuated by a low power attenuator. The attenuation of the waveguide must be accurately measured since attenuation varies significantly with frequency.

ELECTRO-OPTICS AND IR

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ELECTRO-OPTICAL SYSTEMS AND EW COUNTERMEASURES

INTRODUCTION

The development of infrared countermeasures and the evaluation of their performance against threat missiles is a broad, complex technical field. Much of the detailed information about the threats to be countered and the characteristics of the countermeasures themselves is understandably sensitive, beyond the limitations of this document. More detailed information can be requested, provided the requesting organization has the necessary clearance and need to know. Such requests will be considered on a case-by-case basis. Information will be provided only upon written concurrence of the controlling Government organization.

There are many electro-optical (EO) electronic warfare (EW) systems, which are analogous to radio frequency (RF) EW systems. These EO EW systems operate in the optical portion of the electromagnetic spectrum. Electro-optics (EO), as the name implies, is a combination of electronics and optics. By one definition EO is the science and technology of the generation, modulation, detection and measurement, or display of optical radiation by electrical means. Most infrared (IR) sensors, for example, are EO systems. In the popularly used term "EO/IR," the EO is typically used to mean visible or laser systems. The use of EO in this context is a misnomer. Actually, almost all "EO/IR" systems are EO systems as defined above. Another often-used misnomer is referring to an EO spectrum. EO <u>systems</u> operate in the <u>optical</u> spectrum, which is from 0.01 to 1000 micrometers. EO systems include, but are not limited to, lasers, photometry, infrared, and other types of visible, and UV imaging systems.

Within the broad field of Electronic Warfare, electro-optical systems are prevalent for communication systems and offensive and defensive applications. Lasers have been used extensively for weapons guidance purposes, warhead fuzing applications, targeting systems and other offensive weapons related purposes. Understanding electro-optical and radiometric principles and sensors is critical to the development of vehicle survivability systems. These principles range from signature reduction and camouflage to active countermeasure systems such as lamp-based and laser jammers to passive threat warning systems and expendable flare decoys.

Although military systems operate in many portions of the electro-optical spectrum, the infrared is of paramount importance for remote detection systems and weapons applications. Missile seekers, Forward Looking Infrared (FLIR) systems, and Infrared Search and Track Systems all operate in the infrared portion of the spectrum.

OPTICAL SPECTRUM

The optical spectrum is that portion of the electromagnetic spectrum from the extreme ultraviolet (UV) through the visible to the extreme IR. Figure 1 shows the optical spectrum in detail. The end points of the optical spectrum are somewhat arbitrary.

IR spectrum terminology has also varied through the years, with near (near visible), or short-wavelength infrared (SWIR) being on the high frequency end. Then as frequency decreases the spectrum is followed by intermediate or mid-wavelength infrared (MWIR), then far or long-wavelength IR (LWIR), and finally extreme IR.

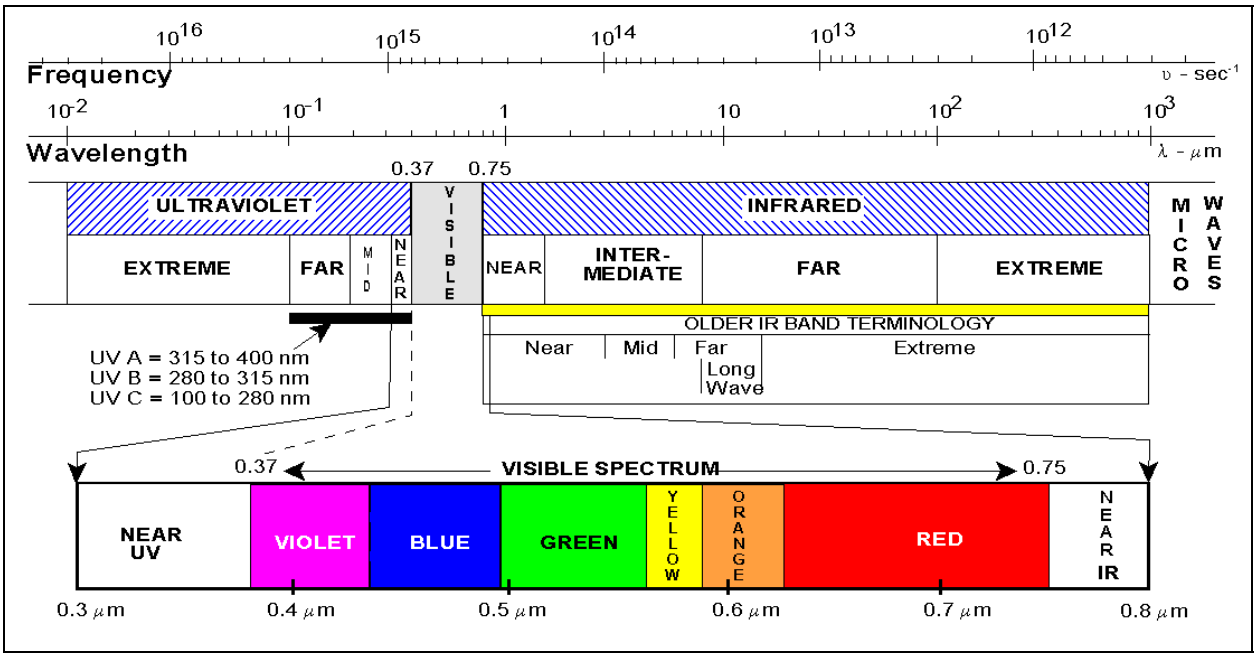

Figure 1. Optical Spectrum.

RADIOMETRIC QUANTITIES AND TERMINOLOGY

The common terms used to describe optical radiation are the source parameters of power, radiant emittance (older term) or radiant exitance (newer term), radiance, and radiant intensity. They refer to how much radiation is given off by a body. The parameter measured by the detector (or collecting object/surface) is the irradiance. Any of these quantities can be expressed per unit wavelength in which case the subscript is changed from e (meaning energy derived units) to λ and the term is then called "Spectral ...X...", i.e. I_e is radiant intensity, while I_λ is spectral radiant intensity. These quantities in terms of currently preferred "Système International d'Unités" (SI units) are defined in Table 1.

Table 1. Radiometric SI Units.

Symbol	Name	Description	Units
Q	Radiant Energy		J (joules)
Φ_e	Radiant Power (or flux)	Rate of transfer of radiant energy	W (watts)
M_e	Radiant Exitance	Radiant power per unit area emitted from a surface	$W\ m^{-2}$
L_e	Radiance	Radiant power per unit solid angle per unit projected area	$W\ m^{-2}sr^{-1}$
I_e	Radiant Intensity	Radiant power per unit solid angle from a point source	$W\ sr^{-1}$
E_e	Irradiance	Radiant power per unit area incident upon a surface	$W\ m^{-2}$
X_λ	Spectral ...X..	(Quantity) per unit wavelength interval	(Units) nm^{-1} or μm^{-1}

Where X_λ is generalized for each unit on a per wavelength basis; for example, L_λ would be called "spectral radiance" instead of radiance.

In common usage, irradiance is expressed in units of Watts per square centimeter and wavelengths are in **µ**m instead of nanometers (nm). Other radiometric definitions are shown in Table 2.

Table 2. Other Radiometric Definitions.

Symbol	Name	Description	Units
α	Absorptance[1]	α = (*) absorbed / (*) incident	numeric
ρ	Reflectance	ρ = (*) reflected / (*) incident	numeric
τ	Transmittance	τ = (*) transmitted / (*) incident	numeric
$\in$	Emissivity	$\in$ = (*) of specimen / (*) of blackbody @ same temperature	numeric

Where (*) represents the appropriate quantity Q, Φ, M, E, or L
Note (1) Radiant absorptance should not be confused with absorption coefficient.

PHOTOMETRIC QUANTITIES

Whereas the radiometric quantities Φ_e, M_e, I_e, L_e, and E_e have meaning throughout the entire electromagnetic spectrum, their photometric counterparts Φ_v, M_v, I_v, L_v, and E_v are meaningful only in the visible spectrum (0.38 **µ**m thru 0.78 **µ**m).

The "standard candle" was redefined as the new candle or candela (cd). One candela is the luminous intensity of 1/60th of 1 cm^2 of the projected area of a blackbody radiator operating at the temperature of the solidification of platinum (2045 ºK). By definition, the candela emits one lumen (lm) per steradian.

Table 3 displays the photometric quantities and units. These are used in dealing with optical systems such as aircraft television camera systems, optical trackers, or video recording.

Table 3. Photometric SI Units.

Symbol	Name	Description	Units
Q_v	Luminous energy		lumen sec (lm s)
F or Φ_v	Luminous flux or Luminous Power	Rate of transfer of luminant energy	lumen (lm)
M_v	Luminous Exitance or flux density (formerly luminous emittance)	Luminant power per unit area emitted from a surface	lm m^{-2}
L_v	Luminance (formerly brightness)	Luminous flux per unit solid angle per unit projected area	nit (nt) or candela / m^2 or lm/sr·m^2
I_v	Luminous Intensity (formerly candlepower)	Luminous power per unit solid angle from a point source	candela (cd) or lm/sr
E_v	Illuminance (formerly illumination)	Luminous power per unit area incident upon a surface	lux or lx or lm/m^2
K	Luminous efficacy	K= Φ_v / Φ_e	lm / w

Table 4 displays conversion factors for commonly used illuminance quantities.

Table 4. Illuminance Conversion Units.

		Lux (lx)	Footcandle (fc)	Phot (ph)
1 lux (lm m^{-2})	=	1	0.0929	1×10^{-4}
1 footcandle (lm ft^{-2})	=	10.764	1	0.001076
1 phot (lm cm^{-2})	=	1×10^{4}	929	1

THE BASIC PRINCIPLES

The processes of absorption, reflection (including scattering), and transmission account for all incident radiation in any particular situation, and the total must add up to one in order that energy be conserved:

$\alpha + \rho + \tau = 1$, as shown in Figure 2.

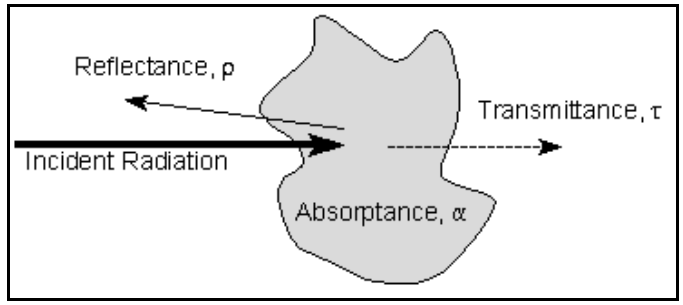

Figure 2. Radiation Incident on a Body.

If a material is opaque (no transmission), then: absorption + reflection = 1

In addition to the above processes, optical (including IR) radiation interacts with matter the same as radiation in any other part of the spectrum, including:

1. **Diffraction** – around edges
2. **Emission** – from matter by conversion from another form of energy
3. **Interference** – constructive and destructive
4. **Refraction** – bends when passing between two media with different propagation speeds (Snell's Law)
5. **Scattering** – when interacts with particles whose size approaches length of the wave
6. **Polarized** - electric field is partially polarized by reflection from dielectric

STERADIAN – SOLID ANGLE

Of significance to many terms and units in radiometric calculations is the *solid angle*. Figure 3 is a pictorial depicting the relationship of area, distance, and solid angle. By definition, the ratio of area on the surface of a sphere to the square of distance (the radius) is the unit less parameter *solid angle*, or steradian in the SI system of units. Solid angle is usually abbreviated as "sr" or given the Greek letter, Ω. The steradian is a dimensionless quantity in radiometric calculations.

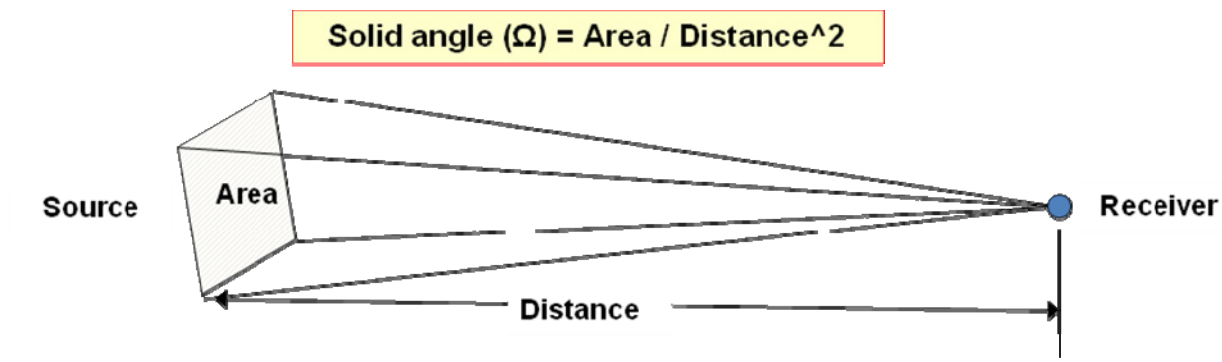

Figure 3. Solid Angle.

A sphere contains a solid angle of 4π steradians; a hemisphere contains 2π steradians, and so on. The area is a curved surface, but in most applications, the solid angles are sufficiently small that the area can be approximated as a plane. Also, for small angles, the solid angle in steradians is approximately equal to the product of two plane angles in radians.

CONVERSIONS

IR wavelengths are typically expressed in **µ**m, visible wavelengths in **µ**m or nm, and UV wavelengths in nm or angstroms. Table 5 lists conversion factors for converting from one unit of wavelength to another. The conversion is from column to row. For example, to convert from **µ**m to nm, multiply the value expressed in **µ**m by 10^3. IR wavelengths are also sometimes expressed in a frequency-like unit called wavenumbers or inverse centimeters. A wavenumber value can be found by dividing 10,000 by the wavelength expressed in **µ**m. For example, 2.5 **µ**m converts to a wavenumber of 4000 or 4000 inverse centimeters (cm^{-1}).

Table 5. Wavelength Conversion Units.

From ->	Angstroms - Å	Nanometers - nm	Micrometers - **µ**m
To get ↓	Multiply by		
Angstroms - Å	1	10	10^4
Nanometers - nm	10^{-1}	1	10^3
Micrometers - **µ**m	10^{-4}	10^{-3}	1

BASIC RADIANT POWER RELATIONSHIPS

Radiant intensity is the most commonly used term to describe the radiant power of a source per unit solid angle. Radiant Intensity offers the advantage of being a source term, like radiance, that is not related to the size of the radiating source. In practice, radiant intensity is a derived term and is not directly measurable. If the Instantaneous Field of View (IFOV), which represents the smallest optical resolution element of a remote sensor, subtends an angle smaller than the size of the radiating source, the

sensor responds directly to *radiance*. If the IFOV of the sensor subtends an angle larger than the radiating source, the sensor responds to *irradiance*. The relationship among radiant intensity, radiance, and irradiance is shown in the following equation:

$$I = ED^2 = E\frac{A}{\Omega} = LA = L\Omega D^2$$

Where:

I = Intensity. Radiant intensity is the target source power per unit solid angle, in Watts/steradian.

E = Irradiance. Irradiance is the received power density in Watts/cm2 incident on a distant sensor. Irradiance is the quantity measured or detected by a distant sensor where the target is not spatially resolved (i.e., where the target subtends an angle smaller than the resolution or field of view of the instrument.)

L = Radiance. Radiance is the intensity per unit area of source, in W/cm^2/steradians. Radiance is the quantity measured by a camera or imaging system, where the target is optically resolved (i.e., where the target subtends an angle much greater than the resolution or instantaneous field of view of the imager.)

A = Area. Area is the cross-sectional or projected area of the target in cm^2.

D = Distance. Distance between the target and sensor in cm.

Ω = Solid angle subtended by the target in steradians. Solid angle appears directly or indirectly in many infrared quantities. The solid angle subtended by a source is the ratio of the source area to the square of distance.

All remote sensors receive energy from a source through an atmospheric path. The atmosphere attenuates the propagation of energy due to scattering, absorption, and molecular rotation and vibration, depending on the wavelengths involved. The atmosphere itself also radiates. All incident energy on a remote sensor, except as received under vacuum conditions, is detected through the atmosphere. The term *apparent* is applied to a radiometric quantity to acknowledge the presence of atmospheric effects. A remote sensor, responding the radiance of a source over an atmospheric path, responds to *apparent radiance*.

Real sensors do not respond uniformly to energy. Sensors have non-uniform spectral and spatial response due to many factors, including detector and optical characteristics. All energy received by the detector is spectrally weighted by the spectral response of the instrument. The term *effective* is applied to acknowledge the non-uniform response of the instrument.

Outside of a vacuum, all radiation incident on a remote sensor is attenuated by atmospheric effects such as scattering and absorption. Where the atmosphere absorbs, it also emits. Path radiance is the term applied to the contribution of the atmospheric path to the received radiation. The term *apparent* is applied to radiometric quantities to acknowledge the influence of the atmosphere on the received radiation.

DOMAINS, DISTRIBUTIONS, AND SENSOR RESPONSE

Radiant power that is emitted or reflected from a source is distributed across multiple dimensions or domains. The three domains that are most important to radiometric applications are spectral (Figure 4), spatial (Figure 5), and temporal (Figure 6). Knowing how the radiant power from a source is distributed across each domain is important to understanding performance of an EW system, whether it be a sensor, a weapon, or a countermeasure.

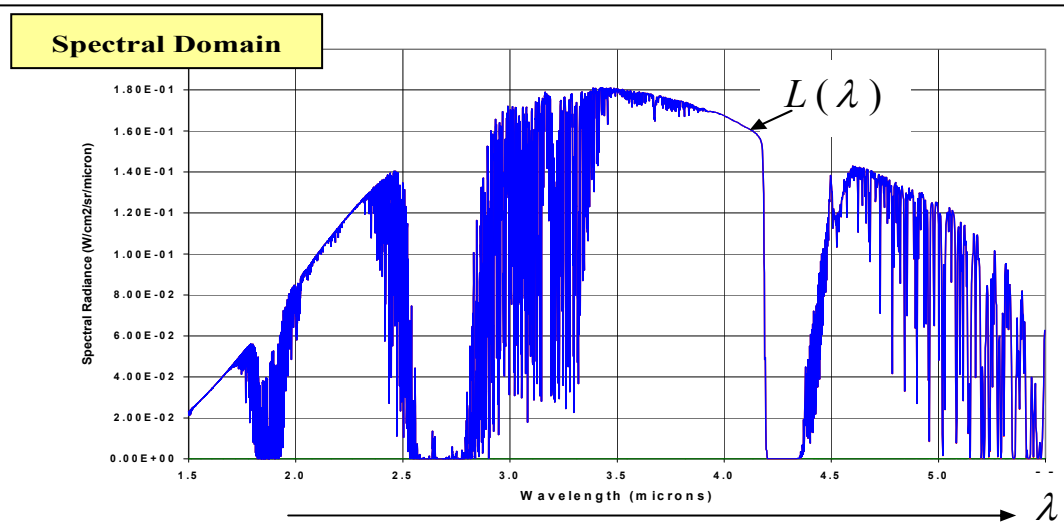

In the spectral domain, radiation is distributed as a function of wavelength (or wavenumber). Radiation from solid materials is distributed as a continuum in accordance with Planck's formula. The graph above shows the spectral distribution of radiation from a 600 degree Celsius blackbody after passage through the atmosphere. Radiation from gases appears at specific wavelength "lines" corresponding to molecular resonances.

Figure 4. Sample Spectral Distribution of a Solid Material.

Spatial Domain

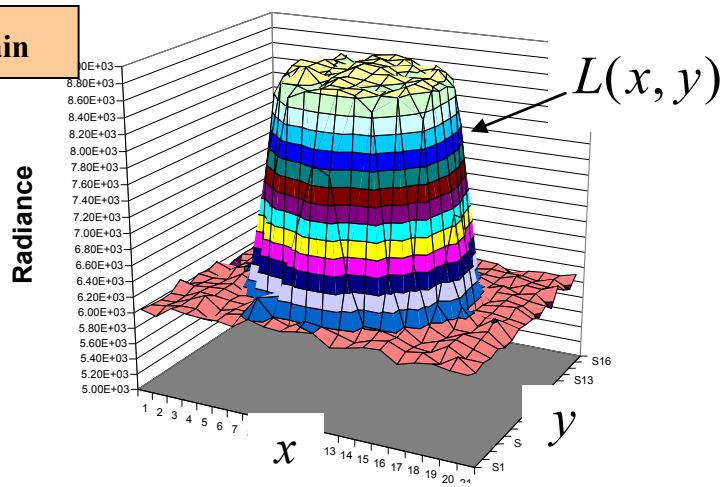

In the spatial domain, radiation is distributed as a function of angle, position, size, shape, or orientation. The graph above shows the radiance of a circular target as viewed by an imaging system.

Figure 5. Sample Spatial Distribution of a Circular Target Image.

Temporal Domain

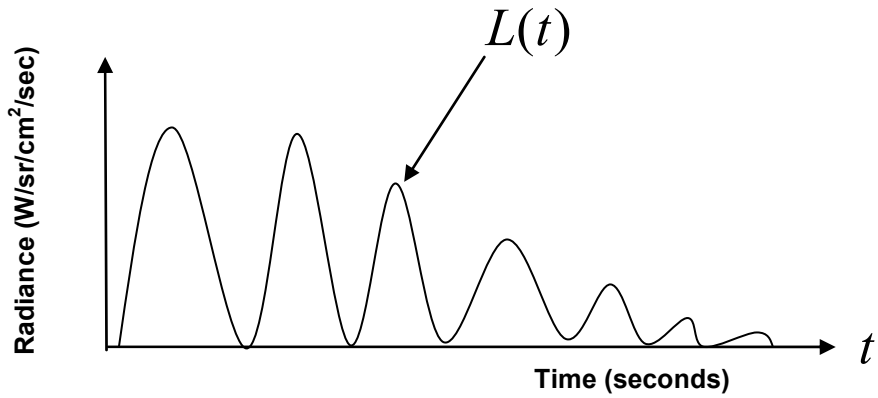

In the temporal domain, radiation is distributed as a function of time (or frequency). Most IR target sources, such as aircraft and ground vehicles, change slowly with time and can be considered steady state for measurement purposes. However, IR countermeasures systems and devices, such as jammers and decoy flares, have high frequency content that must be considered in their design and effectiveness assessment.

Figure 6. Sample Temporal Distribution of a Modulated Source.

All electro-optical sensors have some sensitivity to how radiation is distributed across the different domains. This sensitivity or response takes the following forms:

1. **Spectral response**:
    a. May be broad in the case of a radiometer or imager, or narrow in the case of a spectrometer where response takes the form of resolution.
    b. Spectral response is chosen to exploit particular spectral features of interest in a target.
    c. Non-uniformity of spectral response can have a significant effect on the performance of sensor.

2. **Spatial response**:
    a. May be broad in the case of a radiometer or spectrometer, where spatial response takes the form of sensitivity across the sensor's FOV. In the case of an imager, the spatial response may be narrow because spatial response takes the form of the resolution or IFOV.
    b. Required spatial resolution is defined by the size and radiant power of the source, the distance between the source and the target, and by the sensitivity of the sensor.
    c. Non-uniformity of spatial response can have a significant effect on the performance of sensor.
    d. Response to radiation from the background within the FOV is primarily a spatial response issue and can be significant to sensor performance.

3. **Temporal response**:
    a. Takes the form of bandwidth or, in the case of a digital system, of sampling frequency.
    b. Unlike spectral and spatial response, temporal response includes the response time of the detector and all of the electronics, data transfer time, and processing time for a sensor.
    c. Non-uniformity across a region is usually not a concern. Temporal response is usually uniform for target frequencies that fall well below the low-pass or Nyquist breakpoints.

Sensors respond to received radiant power by integrating the power distribution in each domain under the corresponding response curve. Sensors respond in multiple domains, so output is proportional to a multi-dimensional, weighted integral. Figure 7 illustrates response-weighting, or convolution, of radiation with instrument response in the spectral domain. The concept applies equally in the spatial domain.

Response Weighting in the Spectral Domain

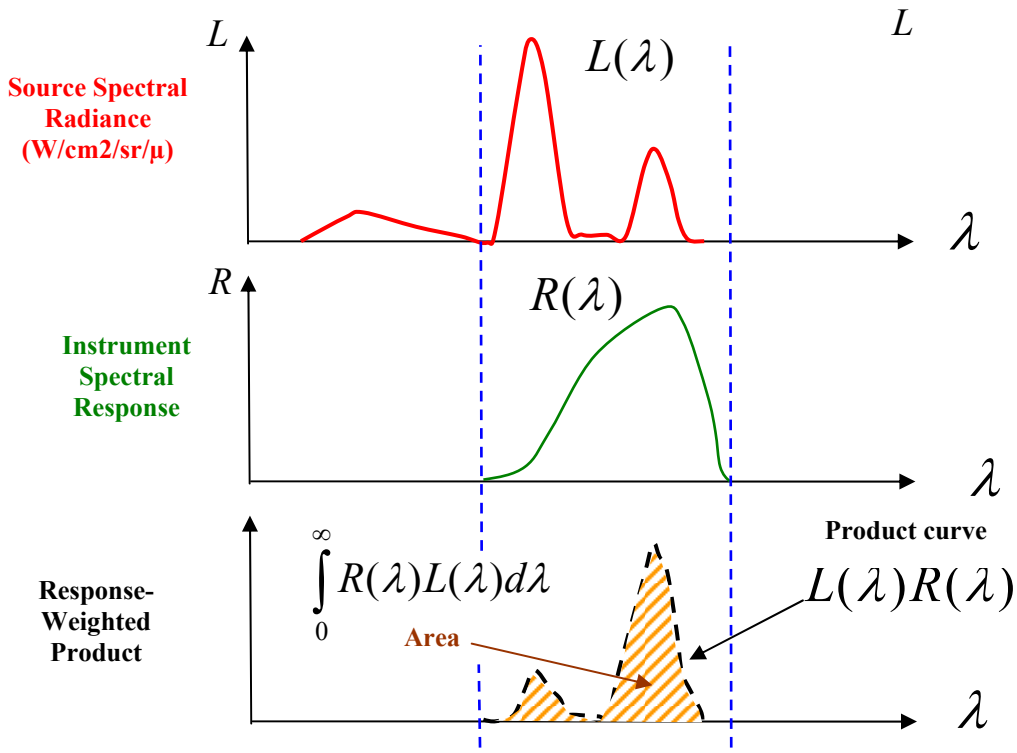

Non-uniform sensor response across a domain distorts the distribution of received radiant power by weighting the radiation at some wavelengths differently than others. Instrument output is proportional to the integral of this weighted product, which makes instrument response shape an embedded part of both the measurement and the calibration. Some consequences of non-uniform response are:

- Two different sources with identical power, but different distributions will produce different measurement values.
- If two different sources (such as the calibration and the target) have similar relative power distributions, the relative weighting by the instrument will be the same for both sources, so the shape and degree of non-uniformity has little or no effect. This will be discussed in more detail later as a key strategy in calibration to reduce measurement uncertainty.

Figure 7. Response-Weighting in the Spectral Domain.

The consequence of instrument output being proportional to multiple weighted integrals is that the characteristics of the instrument affect the measured value in ways that cannot be easily extracted or corrected. Understanding non-uniformity in sensor response is critical to understanding performance and evaluating the effectiveness of the system.

INFRARED SOURCE CHARACTERISTICS

Reflectance

Reflectance is generally categorized as either *specular* (mirror-like) or *diffuse* (scattered by reflection from a rough surface). Most surfaces exhibit both types of reflection, but one typically dominates. Reflections from smooth surfaces are specular. Reflectance is a unitless quantity between zero and one that is the ratio of reflected power to the incident power. Reflectance varies with angle from the normal and with wavelength.

Diffuse reflectors scatter incident radiation broadly. Johann Heinrich Lambert described an ideal diffuse reflector in which the intensity of reflected rays is distributed as a cosine of the angle from the normal, regardless of the angles of the arriving incident rays. Such a surface is described as *Lambertian*. The same relationship applies to a diffuse source. If the source is perfectly diffuse, the radiance is independent of the viewing angle because the projected area of the source also varies as a cosine function of the angle from normal.

While no surface is perfectly diffuse, standard paint on most aircraft, for example, is near enough for at least a first approximation. Significant effort has gone into measuring and describing surface properties of military vehicles to support modeling and simulation activities. Bidirectional Reflectance Distribution Function (BRDF) is defined as the ratio of the reflected radiance to the incident irradiance at a wavelength, λ.

The BRDF provides a complete description of the reflectance properties of a surface. Measurements of BRDF are made in specially equipped optical laboratories. For aircraft, a typical use of BRDF data is in computer models that predict the reflections of the earth and sun from the aircraft fuselage and wings.

Emissivity

Emissivity is a unitless quantity that is a measure of the efficiency of a surface as an absorber or emitter. Emissivity is expressed as a number between 0.0 and 1.0. According to Kirchoff's Law, for an opaque object in thermal equilibrium, i.e., no net heat transfer, the emissivity equals the absorptance. In other words, a perfect emitter is also a perfect absorber. This ideal emitter is known as a *blackbody*. A surface with an emissivity of 1.0 emits the maximum radiation that Planck's Law allows. A body for which the emissivity is constant with wavelength but less than 1.0 is commonly known as a *graybody*. Planck's equation is typically expressed for an ideal blackbody emitter, but multiplying the blackbody expression by the emissivity term expresses the spectral distribution of power for a graybody.

Electromagnetic (EM) radiation, including infrared radiation, can be characterized by amplitude, frequency (or wavelength), coherency, and polarization properties. Amplitude refers to the magnitude of the electromagnetic wave. Coherency refers to the degree in which the electromagnetic waves maintain a constant phase difference, both spatially and temporally. Polarization is a description of the orientation of the wave's propagation perpendicular to the direction of travel. Like all electromagnetic radiation, infrared radiation travels as an EM field with the propagation velocity of the speed of light in a vacuum, and slower through air and other dielectrics. , Infrared radiation also exhibits both wave and particle properties. Which property is used depends on the application: Waves are used for applications involving propagation and geometrical optics, while particles (photons) are used for most detector

applications. The energy of a photon is inversely proportional to its wavelength (hc/λ) where h is the Planck's constant, and c is the speed of light.

Infrared radiation also interacts with matter in a variety of ways:

- Reflects – wave is reflected from a surface.
- Refracts – direction of wave bends when passing between two transparent media with different propagation speeds.
- Scatters – when interacts with particles whose size approaches the wavelength of the radiation.
- Diffracts – around edges of an obstruction.
- Interferes – constructively and destructively.
- Absorbs – when absorbed by matter, radiation is (usually) converted into heat energy.
- Emits – radiation is emitted from matter by conversion from another form of energy.
- Transmitted – propagates through a transparent medium (or vacuum).

Plank's Law:

Infrared is directly related to the heat radiated from matter. Anything with a temperature above absolute zero (-273.15 degrees Celsius) radiates in the infrared. Planck's Law, discovered by German Physicist Max Planck, mathematically describes the distribution of radiant power across the spectrum for a given temperature. The form presented below calculates source radiance in Watts/sr/cm^2/ μ:

$$L_\lambda = \frac{C_1}{\pi\lambda^5\left[e^{\left(\frac{C_2}{\lambda T}\right)} - 1\right]}$$

Where: $C_1 = 2\pi c^2 h = 3.7415 \times 10E{+}04$ W cm^{-2} μ^4

$C_2 = ch/k = 1.4389E{+}04$ μ K

c = speed of light; h = Plank's constant; k = Boltzmann's constant

With λ in μ and T in Kelvin (= ºC + 273.15)

The behavior of Planck's curve with temperature is fundamental to every infrared detection scenario. Figure 8 shows Planck's equation for a single temperature. The shape of this curve resembles a wave of water, with a steep rise in power on the short wavelength side of the peak and a tail off on the long wavelength side.

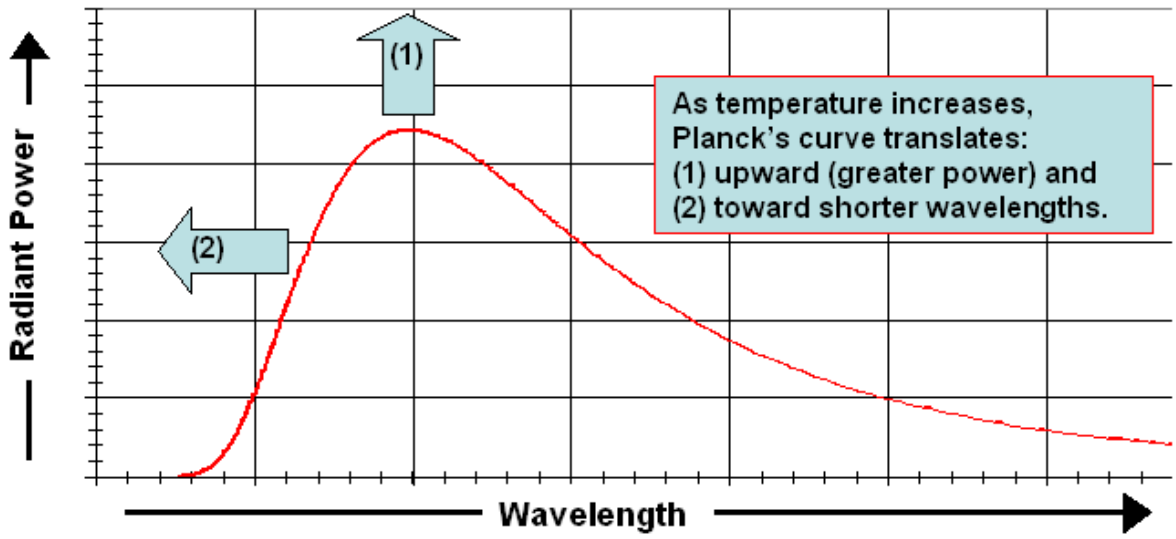

Figure 8. Temperature Effects and Power Distribution.

When temperature increases, two significant changes in power distribution occur and are governed by the following two relationships:

Stefan-Boltzmann Law:

The total power under the curve increases proportionally to the fourth power of the temperature. According to the Stefan-Boltzmann law, the total radiant emittance (power) of a blackbody is:

$M = \sigma T^4$ Where: $\sigma = \frac{2\pi^5 k^4}{15 c^2 h^3} = 5.67 \times 10^{-12} \, Watts \, cm^{-2} \, ^\circ K^{-4}$

and T is in Kelvin

This is Plank's radiation law integrated over all values of λ.

Wein's Displacement Law

The peak emission translates toward shorter wavelengths.

Wein's displacement law takes the derivative of the Plank's law equation to find the wavelength for maximum spectral exitance (emittance) at any given temperature:

$\lambda_{max} = 2897.8 / \mathbf{T}$ where T = temperature is in Kelvin

The surface of the sun radiates with a spectral distribution like that of a 5900 Kelvin source. In accordance with Wein's Law, the wavelength at which the radiation for a 5900 Kelvin source peaks is approximately 490 nanometers. The maximum sensitivity of the day-adapted human eye (photopic) occurs at about 555 nanometers, which happens to be in a highly transparent region of the atmosphere. In other words, the temperature of our sun and the transmission of our atmosphere are conveniently matched

to the response of the human eye. Figure 9 shows the relationship between the response of the human eye and the spectral distribution of solar irradiance.

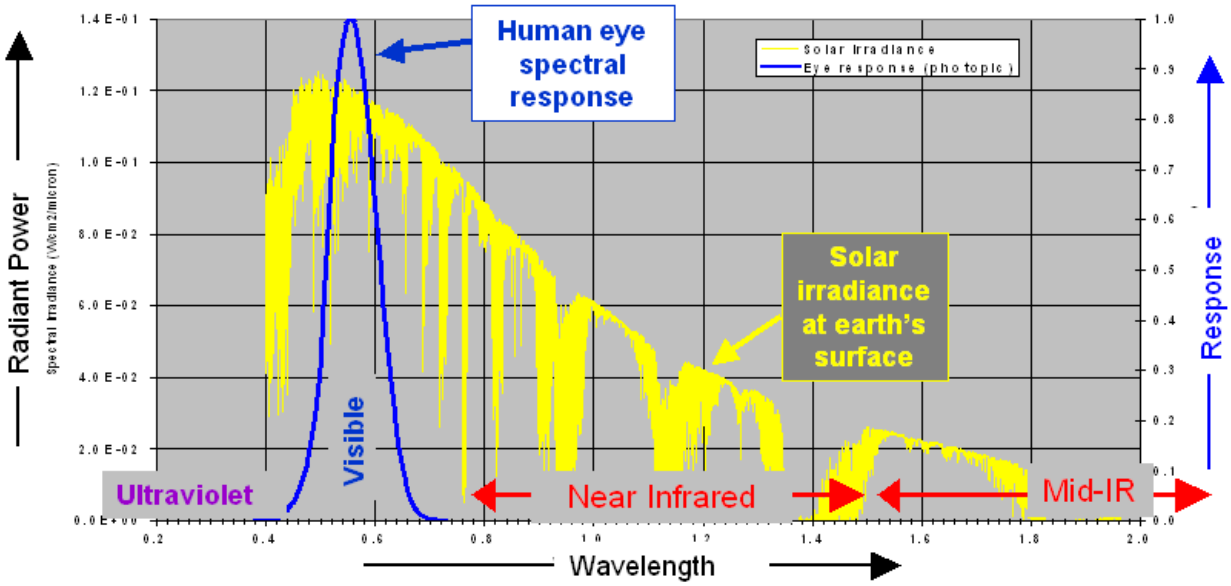

Figure 9. Power Distribution of the Sun Related to the Human Eye.

Unlike other electromagnetic radiation, the peak radiation from objects at the temperature of the earth, and of humans, vehicles, aircraft, etc., lies at infrared wavelengths. This makes the infrared portion of the spectrum militarily important.

For detection of an object, whether it is with the human eye or with an electro-optical sensor, it is not where the maximum emissions occur in the spectrum that is important. It is where the maximum difference between the target and background lies that is most significant.

The *absolute* signature of a source or target is the power radiated and reflected by the target without influence from background radiation. Absolute signature can be measured with an instrument such as an imaging camera at close range, producing highly resolved IR imagery. The difference between radiation from a target and its background is its *contrast*. Contrast is the target signature relative to a specific background. Contrast irradiance is the quantity detected by any remote sensor or missile. Contrast varies greatly with background conditions.

Figure 10 shows several different types of source distributions encountered by infrared sensors. Most targets of military interest are a complex combination of spectral contributions from a variety of sources. For example, the signature of an aircraft can typically be described by the contributions from airframe, hot engine parts, and plume.

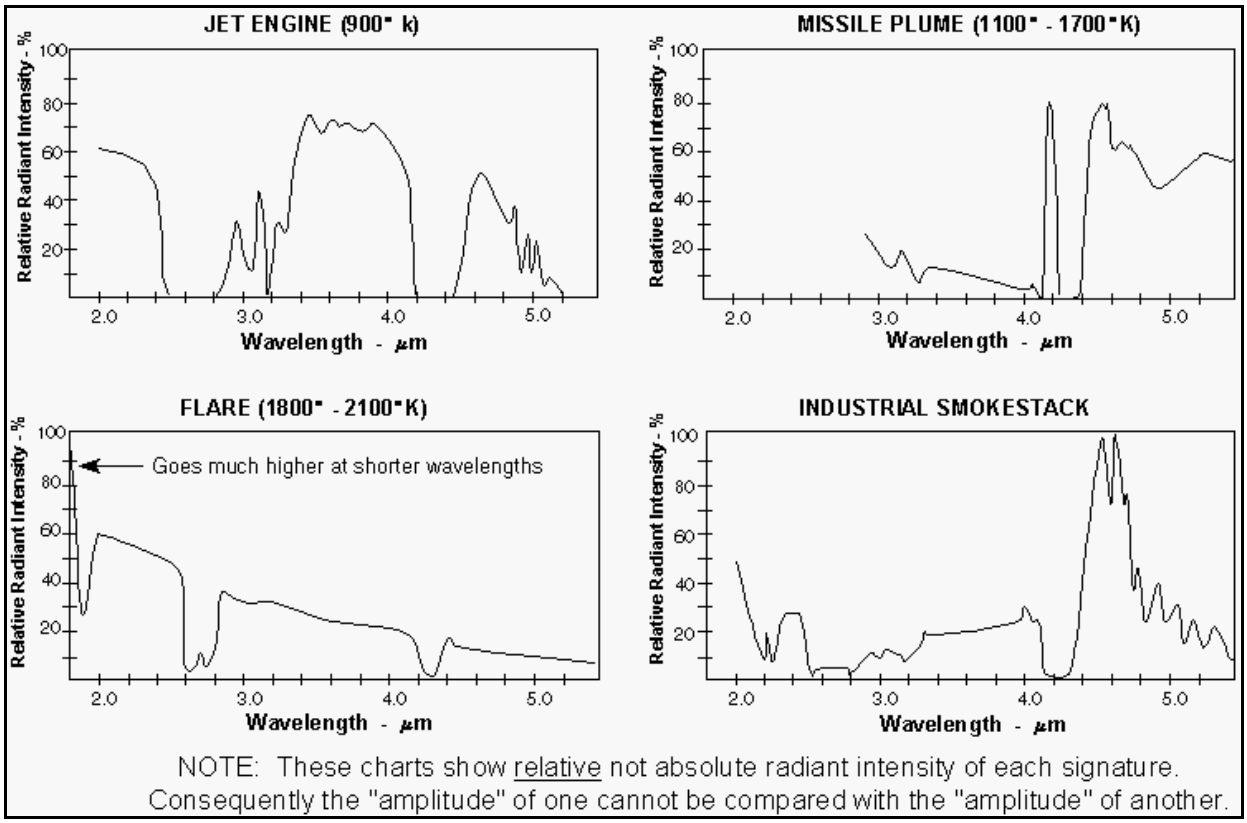

Figure 10. Spectral Distribution of Various Targets.

ATMOSPHERIC TRANSMISSION

The radiation emitted or reflected from the targets and backgrounds must pass through the intervening atmosphere before reaching the detection system. The radiation is absorbed and re-emitted by molecular constituents of the atmosphere and scattered into and out of the path by various aerosol components.

Figure 11 reveals the presence of atmospheric windows, i.e. regions of reduced atmospheric attenuation. IR detection systems are designed to operate in these windows. Combinations of detectors and spectral bandpass filters are selected to define the operating region to conform to a window to maximize performance and minimize background contributions.

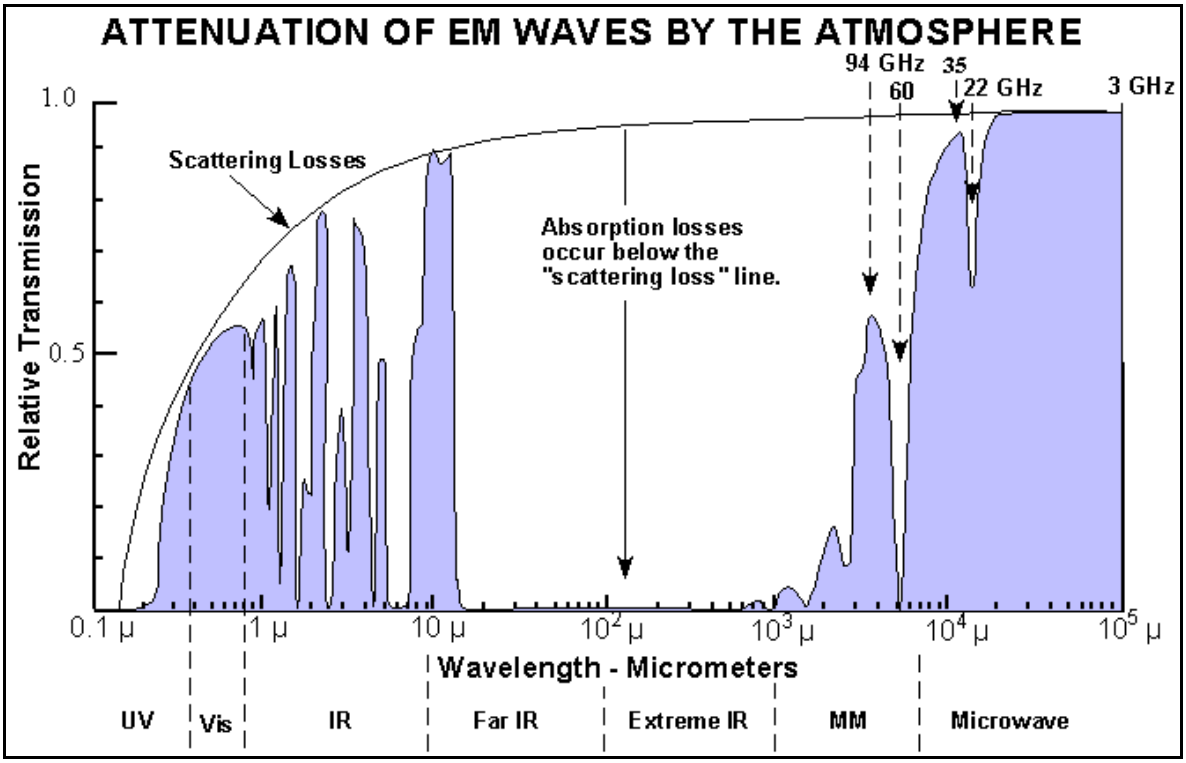

Figure 11. Atmospheric Transmission Over 1 NM Sea Level Path.

The molecules that account for most of the absorption in the IR region are water, carbon dioxide, nitrous oxide, ozone, carbon monoxide, and methane. Figure 12 shows an expanded view of the infrared portion of the spectrum.

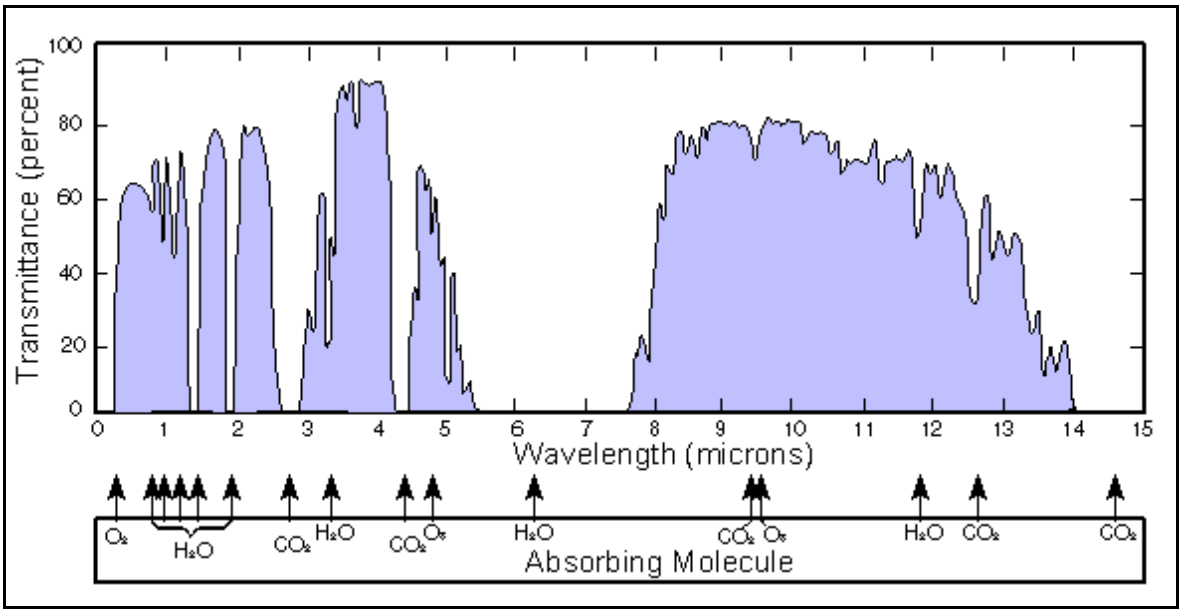

Figure 12. Transmittance of Atmosphere Over 1 NM Sea Level Path (Infrared Region).

The transmission in a window is greatly dependent on the length and characteristics of the path. As path length increases, absorption gets deeper and broader. Water vapor also has a significant effect overall on transmission through the atmosphere. High relative humidity attenuates transmission at all optical wavelengths.

Since water vapor generally decreases with altitude, transmission generally increases and path length becomes the determining factor. However, path length does not affect transmission of all wavelengths the same.

The altitude effects on transmittance are shown in Figure 13.

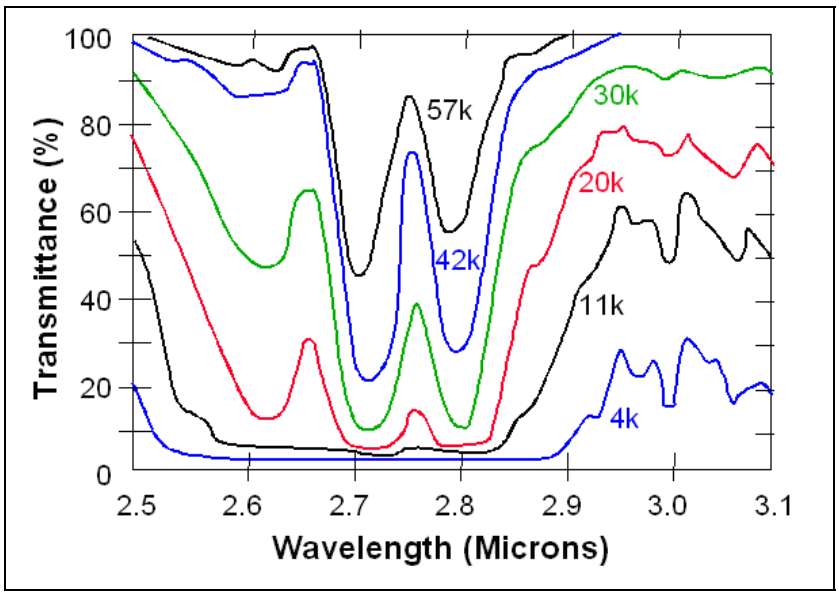

Figure 13. Transmittance at Various Altitudes.

A great deal of work has gone into developing high fidelity atmospheric models. One of the most commonly used tools is MODTRAN™ (MODerate Resolution Atmospheric TRANsmission). MODTRAN™ models atmospheric propagation of EM radiation from 0.2 to 100 um. MODTRAN was developed by Spectral Sciences Inc. and the United States Air Force Research Laboratory.

ELECTRO-OPTICAL COMPONENTS AND SENSORS

Almost all IR instruments, missiles, search systems, etc. have similar functional components. Basic components typically include:

- Optics - Reflective or refractive lenses to:
  - Collect radiation. Irradiance (power density) is increased by collecting radiation over a large area and focusing down to a small area.
  - Form or focus an image that will be used to extract information about the target.

- Filter(s) - Spectral and spatial filters to distinguish target from background and to extract
  - Target information.
  - Spectral filters restrict sensitive wavelength range.
  - A spatial filter separates image information by features such as size or position.

- Detector - A transducer to convert received radiation to an electrical signal for processing.

- Electronics - Used to amplify and condition the detector signal and perform some action, such as controlling a servo for tracking and guidance or recording the received information. In addition to the above, the optical head may also contain a window to protect the electronics and an output unit consisting of indicators or displays.

Windows / Domes / Lens Materials

For most applications of EO systems in EW the detection system is protected from the environment by a window or dome of optically transmissive material. The window operates both as a weather seal and, in some cases, helps to define the spectral response region of the system. In some cases the window functions as a lens.

IR energy interacts with matter in ways we associate with light (reflection, refraction, and transmission). Lower energy of IR photons results in different optical properties than light. For example:

- Glass and water are not transparent to wavelengths longer than about 3 microns.
- Silicon and germanium are highly transparent to infrared radiation, but are opaque to visible light.

Transmission bands of representative window or lens materials are shown in Figure 14. The end points depicted are for the 10% transmission wavelengths. Not shown in Figure 14 are the various UV transmissive glasses such as Pyrex, Corex, and Vycor or Amorphous Material Transmitting IR radiation (AMTIR) which are various combinations of Ge-As-Se (AMTIR-1), As-Se (AMTIR-2, 4, & 5), Ge-Sb-Se (AMTIR-3), As-S (AMTIR-6).

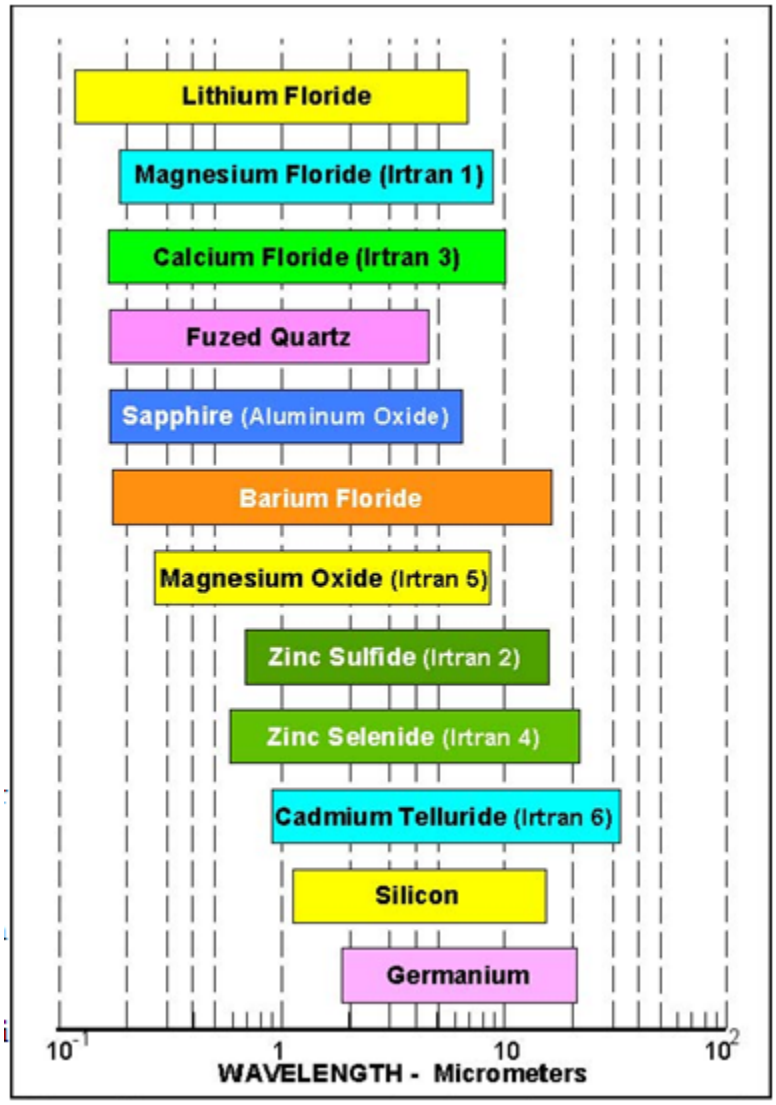

Figure 14. Transmission of Selected Window / Lens Materials.

Objective Lens

The objective lens is the first optical element in a lens in a typical sensor or missile seeker. The objective lens serves two main functions:

- Collect radiation (i.e., multiply irradiance (power density) by collecting over a large area and focusing onto a small area)
- Form an image of the target scene onto a filter and detector array.

Lens Types

Lenses for the IR can be either refractive or reflective. Refractive optics are "straight through" lenses, with the light never making large bends as shown in Figure 15.

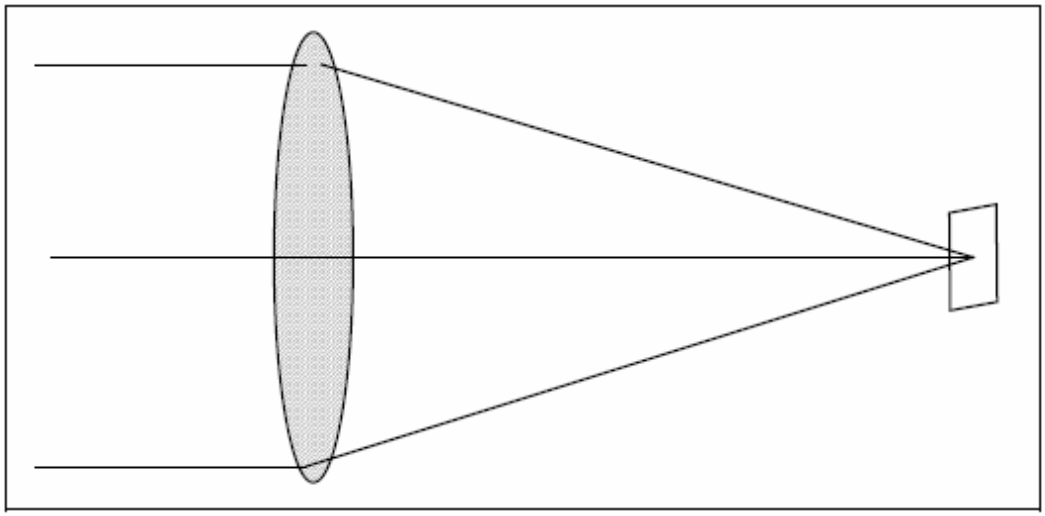

Figure 15. Refractive Lens.

A common reflective design used in many missiles is the Cassegrain. The Cassegrain design shown in Figure 16 is compact in size for its focal length.

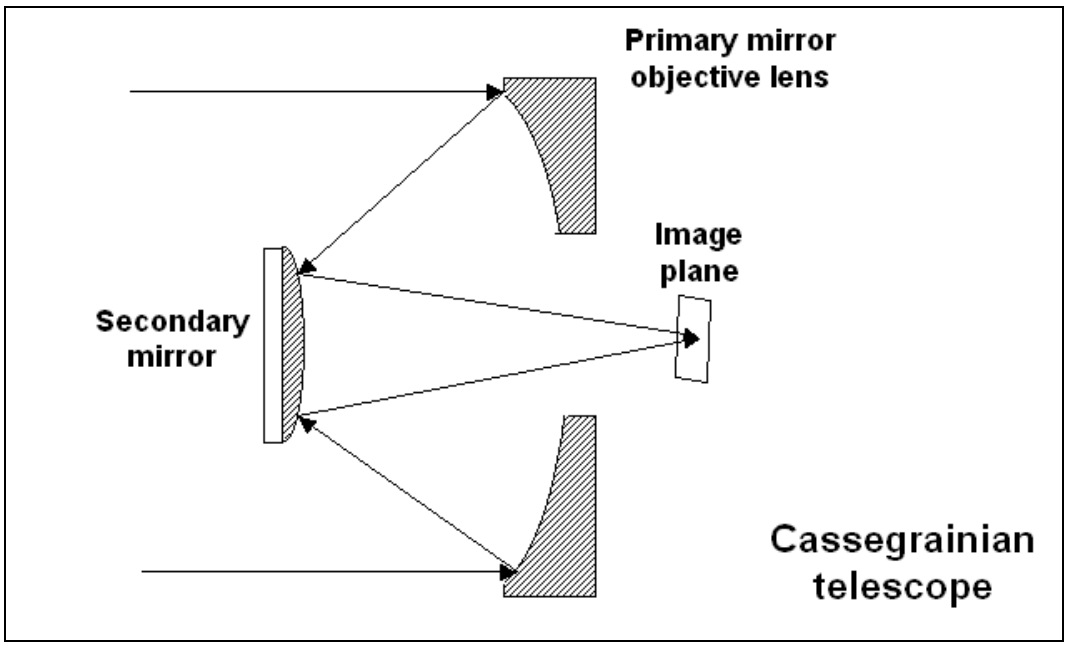

Figure 16. Cassegrain Lens.

Optical Filters

Filters may be divided into two major categories: (1) spectral and (2) spatial.

Most optical radiation detectors have a wider sensitivity band than desired for the particular application. Spectral filters restrict sensitive wavelength range. Reasons for filtering include: enhancement of target-to-background contrast, avoidance of unwanted plume emissions and/or atmospheric absorption regions, and extraction and measurement of target spectral features.

To further define the system sensitivity, band interference filters or absorption filters are used. An absorption filter is a bulk material with a sharp cut-on or cut-off in its transmission characteristic. A cut-on and a cut-off filter can be combined to make a bandpass filter. By selecting absorption characteristics of absorption filters combined with the response of a detector, the desired system response can be obtained. An interference filter is composed of dielectric coatings on an appropriate substrate combined in such a way to produce cut-on, cut-off, or bandpass filters. Interference filters allow more control of the final response characteristics and smaller elements. See Figure 17.

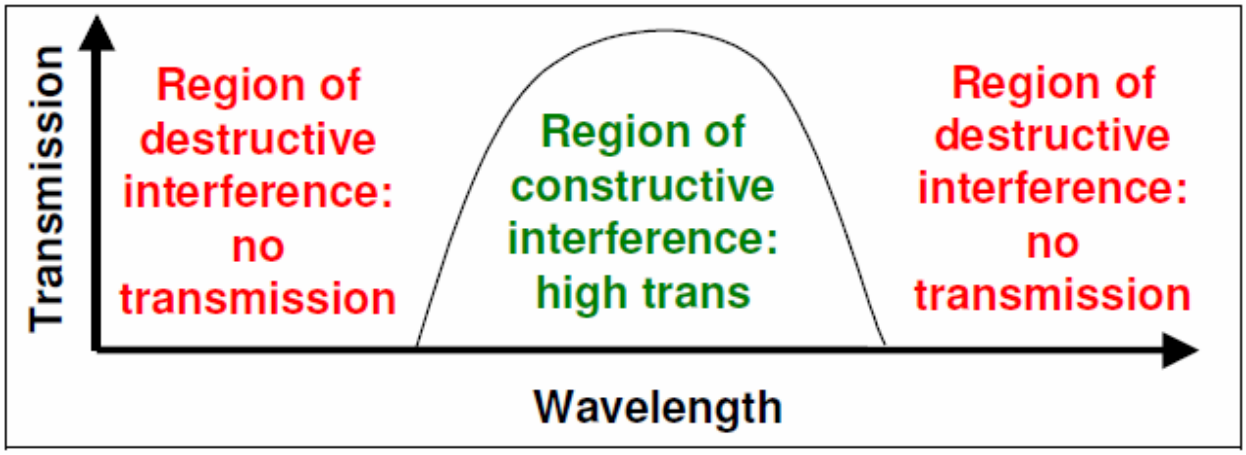

Figure 17. Spectral Bandpass Filter.

Most spectral filters are of the thin-film interference type. Layers of dielectric material are vacuum deposited on a substrate window material. Typical substrate materials in IR are sapphire, silicon, and germanium. Thickness of deposited layers designed to have constructive interference to pass desired radiation at desired wavelengths and destructive interference to block undesired wavelengths Besides spectral filters, EO system optics often have antireflection (or AR) coatings to eliminate or greatly reduce unwanted reflections between optical elements.

A spatial filter separates information in a scene image by features such as size or position. Spatial filters take a variety of forms. Some common types and their functions include:

- Field stop: limits an instrument's field of view. Blocks unwanted sources (such as sun) outside nominal field of view.
- Mechanical modulator or "chopper."
- Reticle: A mechanical modulator used in many missile designs. Usually discriminates against extended sources (such as background) in favor of "point" target sources and provides target directional information from modulation phase.

Detector Coolers

Many IR detectors have to be cooled for proper operation. Most systems use closed-cycle coolers or thermoelectric coolers. Thermoelectric coolers use the Peltier effect, which produces a reduced temperature by passing a d-c current through a thermoelectric junction. Multi-stage coolers can cool a detector down to below 200ºK. Closed-cycle coolers typically are of the Stirling cycle design and utilize the expansion of a gas (helium) to cool a cold finger attached to the detector. These generally operate at liquid nitrogen temperature (77ºK).

Detectors

A detector is a transducer that transforms electromagnetic radiation into a form, which can be more easily detected. In the detectors of interest to EW the electromagnetic radiation is converted into an electrical signal. In some systems the signal is processed entirely within the system to perform its function. In others the signal is converted to a form to allow the human eye to be used for the final detection and signal analysis.

Detectors are transducers than convert optical radiation into electrons. The physical effects by which electromagnetic radiation is converted to electrical energy are divided into two categories: photon effects and thermal effects. EW systems primarily use detectors dependent on photon effects. These effects can be divided into internal photo effects and external photo effects.

The external photo effect is known as photoemission. In the photoemissive effect, photons impinging on a photocathode drive electrons from its surface. These electrons may then be collected by an external electrode and the photocurrent thus obtained is a measure of the intensity of the received radiation.

Internal photoeffects of interest are the photoconductive effect and the photovoltaic effect. In the photoconductive effect, absorbed photons cause an increase in the conductivity of a semiconductor. The change is detected as a decrease in the resistance in an electrical circuit. In the photovoltaic effect, absorbed photons excite electrons to produce a small potential difference across a p-n junction in the semiconductor. The photovoltage thus produced may be amplified by suitable electronics and measured directly.

Thermal detectors respond directly to heat. Examples of these devices include bolometers, thermopiles, and pyroelectric detectors. The pyroelectric effect is an example of the thermal effect. The pyroelectric effect is a change in polarization in a crystal due to changes in temperature. Radiation falling on such a crystal is detected by observing the change in polarization as a build up of surface charge due to local heating. When coated with a good black absorber, the crystal will be sensitive to a wide band of wavelengths.

Figure 18 shows the spectral sensitivity range of typical detectors using these effects.

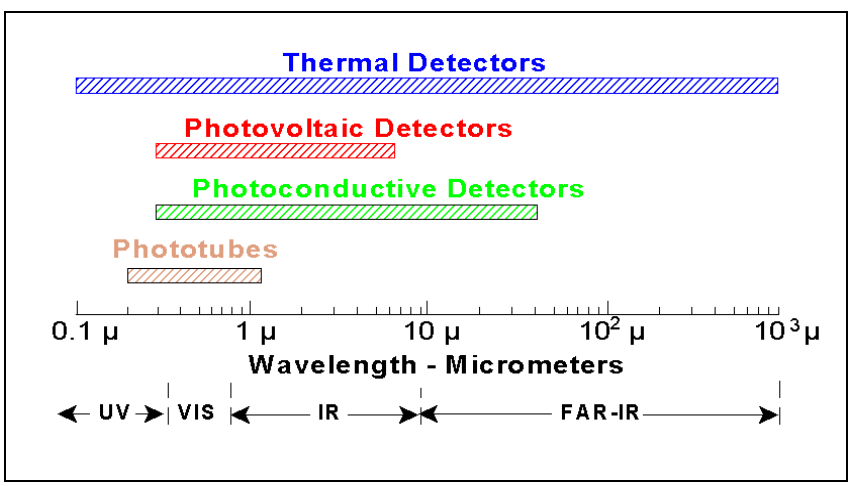

Figure 18. Spectral Range of Various Detectors.

Detector Types

Photoconductive detectors operate as resistors in a circuit. The resistance of the detector changes as the radiation incident on its surface changes. For EW applications, the most photoconductive detector types include: Indium Antimonide (InSb), which can also be operated in photovoltaic mode; Gallium Arsenide (GaAs); Lead Sulfide (PbS); and Lead Selenide (PbSe).

Photovoltaic detectors, the most common detectors used in modern EW and military sensor applications, produce a voltage that is proportional to the incident radiation. Common examples of photovoltaic detectors are Indium Antimonide (InSb) and Mercury Cadmium Telluride (HgCdTe). Both of these detector types offer high sensitivity when cryogenically cooled.

Diode phototubes and photomultipliers are commonly used detectors for UV systems including many operational missile-warning systems. These types of tubes offer the advantage of operating uncooled which can significantly reduce the complexity of a sensor system and offer increased reliability. Most of the modern IR sensors require cooled detectors. InSb, for example, requires cooling to 77 Kelvin to achieve the necessary sensitivity. Depending on the application, HgCdTe can be operated at somewhat higher temperature conditions.

A Photoelectromagnetic (PEM) detector has a junction that generates a current when exposed to light in a magnetic field.

Some detectors (such as InSb) have multiple modes of operation, including: Photoconductive (PC), Photovoltaic (PV), or Photoelectromagnetic (PEM) modes of operation.

Detector Parameters and Figures of Merit

The important parameters in evaluating a detector are the spectral response, time constant, the sensitivity, and the noise figure.

The spectral response determines the portion of the spectrum to which the detector is sensitive.

The time constant is a measure of the speed of response of the detector. It is also indicative of the ability of the detector to respond to modulated radiation. When the modulation frequency is equal to one over the time constant, the response has fallen to 70.7 % of the maximum value. The time constant is related to the lifetime of free carriers in photoconductive and photovoltaic detectors and to the thermal coefficient of thermal detectors. The time constant in photoemissive devices is proportional to the transit time of photoelectrons between the photocathode and anode.

The sensitivity of a detector is related to its responsivity. The responsivity is the ratio of the detected signal output to the radiant power input. For photoconductive and photovoltaic detectors the responsivity is usually measured in volts per watt -- more correctly, RMS volts per RMS watt. However, the sensitivity of a detector is limited by detector noise. Responsivity, by itself, is not a measure of sensitivity. Detector sensitivity is indicated by various figures of merit, which are analogous to the minimum detectable signal in radar. Such a quantity is the noise equivalent power (NEP). The NEP is a measure of the minimum power that can be detected. It is the incident power in unit bandwidth, which will produce a signal voltage equal to the noise voltage. That is, it is the power required to produce a signal-to-noise ratio of one when detector noise is referred to unit bandwidth. The units of NEP are usually given as watts, but more correctly, are watts/$Hz^{1/2}$ or watts·$sec^{1/2}$.

Another figure of merit is the noise equivalent irradiance (NEI). The NEI is defined as the radiant power per unit area of the detector required to produce a signal-to-noise ratio of one. The units of NEI are watts per square centimeter.

Noise equivalent power (NEP) is the radiant power required to produce a signal to noise ratio of one for a detector. Detectivity (D) of a detector is defined as the reciprocal of the NEP. The units of D are watts $^{-1}$·sec $^{-½}$. A higher value of detectivity indicates an improvement in detection capability. Since D depends on detector area, an alternate figure of merit, known as D-star (D*). D* is the detectivity measured with a bandwidth of one hertz and reduced to a responsive area of one square centimeter. The units of D* are cm·watts $^{-1}$·sec $^{-½}$. D* is the detectivity usually given in detector specification sheets. Typical spectral detectivity characteristics for various detectors are shown in Figure 19.

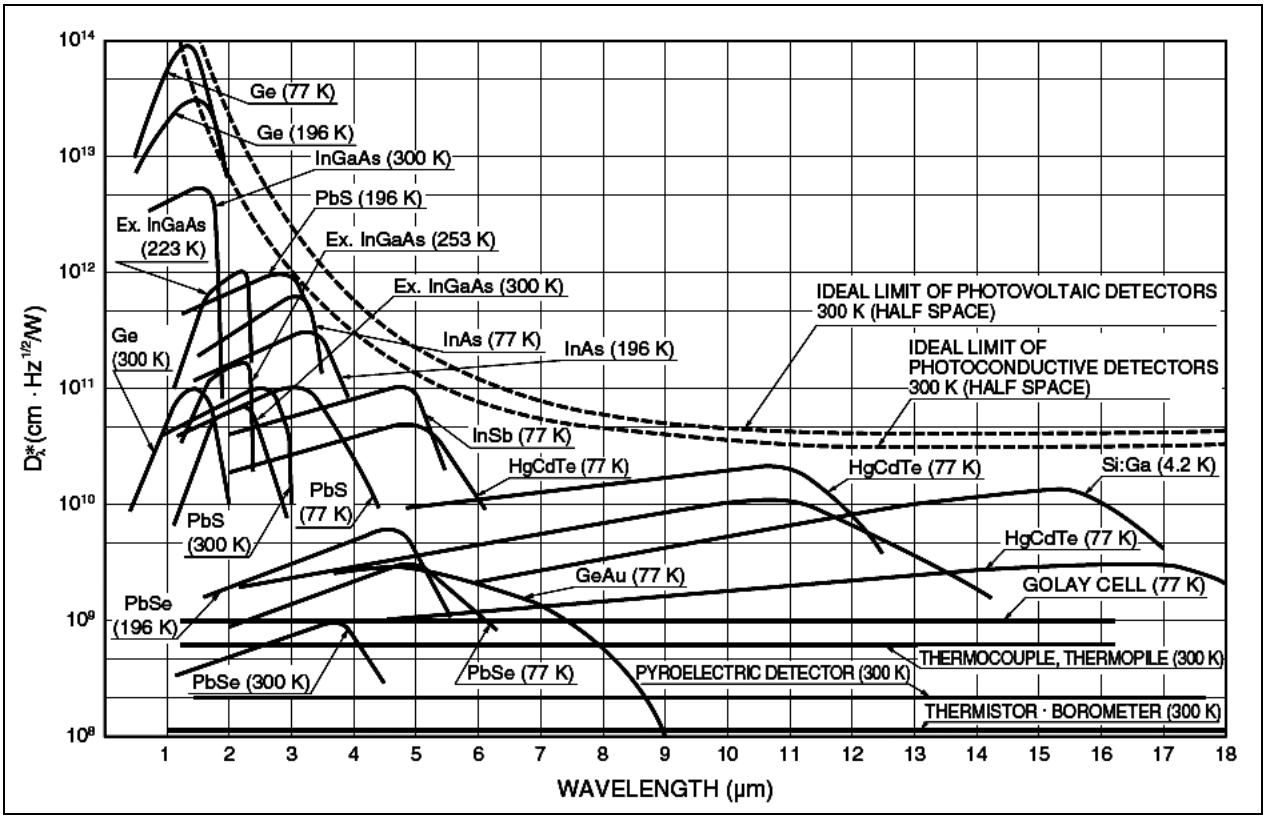

Figure 19. Spectral Detectivity of Various Detectors.

Besides the NEI mentioned above, the quantum efficiency of the photocathode is also a figure of merit for photoemissive devices. Quantum efficiency is expressed as a percent -- the ratio of the number of photoelectrons emitted per quantum of received energy expressed as a percent. A quantum efficiency of 100 percent means that one photoelectron is emitted for each incident photon.

There are other figures of merit for television cameras. The picture resolution is usually described as the ability to distinguish parallel black and white lines and is expressed as the number of line pairs per millimeter or TV lines per picture height. The number of pixels in the scene also defines the quality of an image. A pixel, or picture element, is a spatial resolution element and is the smallest distinguishable and resolvable area in an image. CCD cameras with 512 x 512 elements are common.

Another resolution quantity is the gray scale, which is the number of brightness levels between black and white a pixel can have.

Noise in Detectors

The performance of a detector is limited by noise. The noise is the random currents and voltages that compete with or obscure the signal or information content of the radiation. Five types of noise are most prominent in detectors: (1) thermal, (2) temperature, (3) shot, (4) generation-recombination, and (5) 1/f noise.

Thermal noise, also known as Johnson noise or Nyquist noise, is electrical noise due to random motions of charge carriers in a resistive material.

Temperature noise arises from radiative or conductive exchange between the detector and its surroundings, the noise being produced by fluctuations in the temperature of the surroundings. Temperature noise is prominent in thermal detectors.

Shot noise occurs due to the discreetness of the electronic charge. In a photoemissive detector shot noise is due to thermionic emission from the photocathode. Shot noise also occurs in photodiodes and is due to fluctuations in the current through the junction.

Generation-recombination noise is due to the random generation and recombination of charge carriers (holes and electrons) in semiconductors. When the fluctuations are caused by the random arrival of photons impinging upon the detector, it is called photon noise. When it is due to interactions with phonons (quantized lattice vibrations), it is called generation-recombination noise. Johnson noise is predominant at high frequencies, shot noise predominates at low frequencies, and generation-recombination and photon noise are predominant at intermediate frequencies.

As the name implies, 1/f noise has a power spectrum that is inversely proportional to frequency. It is dominant at very low frequencies. In photoemissive detectors it is called flicker noise and has been attributed to variation in the emission from patches of the photocathode surface due to variation in the work function of the surface. In semiconductors 1/f noise is also called modulation noise. Here it is apparently due to surface imperfections and ohmic contacts (which are a form of surface imperfection).

Infrared Spectral Region and Features of Interest

Different portions of the infrared spectrum are common for particular applications. The reasons for the selection of a specific window are often sensitive and beyond the scope of this document, but selections are typically based on several key considerations:

- Target characteristics such as size and spectral distribution of signature.
- Background radiance and clutter.
- Atmospheric effects (transmission, path radiance, scintillation, etc.).
- Distinguishing characteristics between natural and man-made sources.

Table 6 describes some of the types of characteristics that are prevalent in the short-wavelength (SWIR) infrared (0.7 to 3.0 microns), mid-wavelength (MWIR) infrared (3.0 to 6.0 microns) and long-

wavelength (LWIR) infrared (7.0 to 14.0 microns) along with some types of systems that operate in these regions.

Table 6. Infrared Features, Regions, and Types of Systems.

Near or Short Wave IR (SWIR)	**Dominant natural source**:	**Sun**
	Atmospheric:	
	Transmission:	High
	Path radiance:	Scattered sunlight
	Dominant aircraft IR component:	Sunlit airframe
	Anti-aircraft threat:	Vehicle-launched SAM
Mid-wave IR (MWIR)	**Dominant natural source:**	**Sun**
	Atmospheric:	
	Transmission:	High transmission "windows" between H_2O and CO_2 absorption
	Path radiance:	Scattered sunlight below 3 microns Thermal at longer than 3 microns
	Dominant aircraft IR component:	Engine hot parts and plume
	Anti-aircraft threat:	All AAMs and SAMs
Far or Long-wave IR (LWIR)	**Dominant natural source:**	**Earth**
	Atmospheric:	
	Transmission:	High
	Path radiance:	Low: small thermal emission from ozone
	Dominant aircraft IR component:	Airframe direct emission and terrestrial illumination
	Anti-aircraft threat:	Airborne IRST. No anti-aircraft missiles

Sensors and Detection

Figure 20 shows a generalized detection problem. On the left of the diagram are the radiation sources - the sun, background, and the target of interest. In the middle is the intervening atmosphere, which attenuates the radiation as it travels to the detection system shown on the right of the diagram.

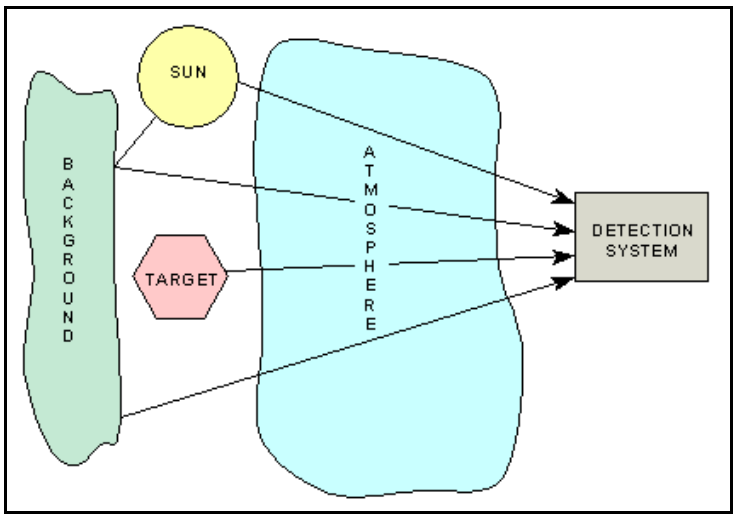

Figure 20. Generalized Detection Problem.

Figure 21 shows the basic relationships that are critical to detection of a target in the infrared. The figure is based on a generalized aircraft, but the principles apply whether the target is in fact an aircraft against a sky background or a ground vehicle being viewed from above against a terrain background. At detection, most targets are unresolved. The sensor's ability to detect the target against background in this case is driven primarily by noise equivalent irradiance.

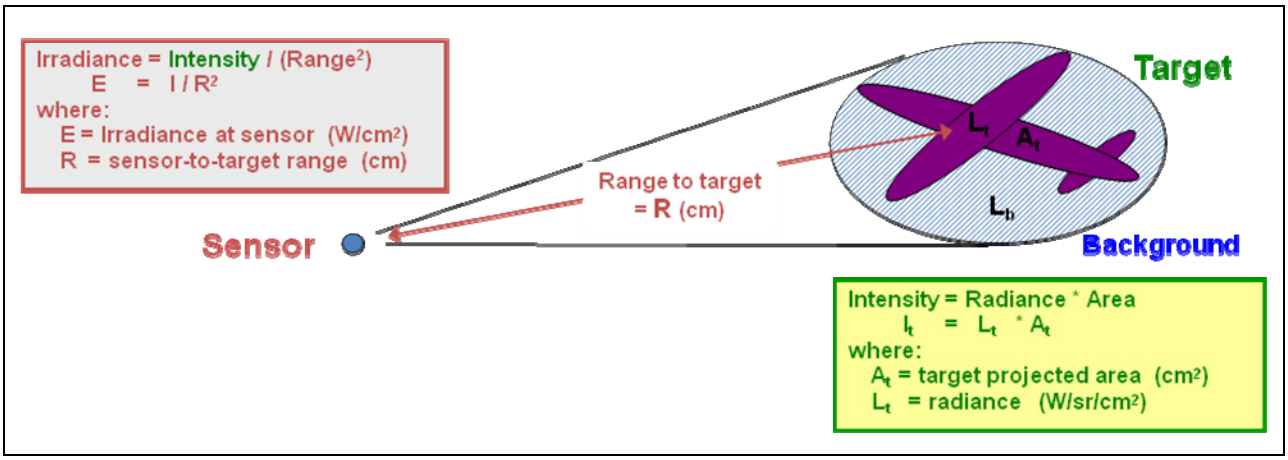

Figure 21. Detection of a Target with a Remote Sensor.

Each of the equations shown in Figure 21 in reality has atmospheric effects and attenuation due to transmission losses and contributes to path radiance. Just as the power distribution of the target and background vary with wavelength, atmospheric effects are also spectrally selective.

Figure 22 shows the roll off of irradiance as a function of range for two different aircraft. Detection occurs at the point of intersection with the sensors noise equivalent irradiance. In the case of threat missiles, there is often a signal-to-noise threshold required for launch of the missile to ensure target quality prior to launch. The product of noise equivalent irradiance and the threshold for these systems is known typically as the minimum trackable irradiance (MTI). This is the figure used to calculate detection range for such systems.

In an effort to simplify calculations, band average atmospheric transmission values are often applied during analysis of detection scenarios. The target itself is non-uniformly distributed as a function of wavelength, and the atmospheric effect is non-uniform, so this approach is mathematically incorrect since it pulls a non-constant term out of an integral. The degree of error introduced by the band average approach depends on the spectral distribution of the source and the overall transmission of the band in question, but caution should be applied when applying band averages. All calculations involving atmospheric propagation should be done spectrally and then integrated to provide the in-band value.

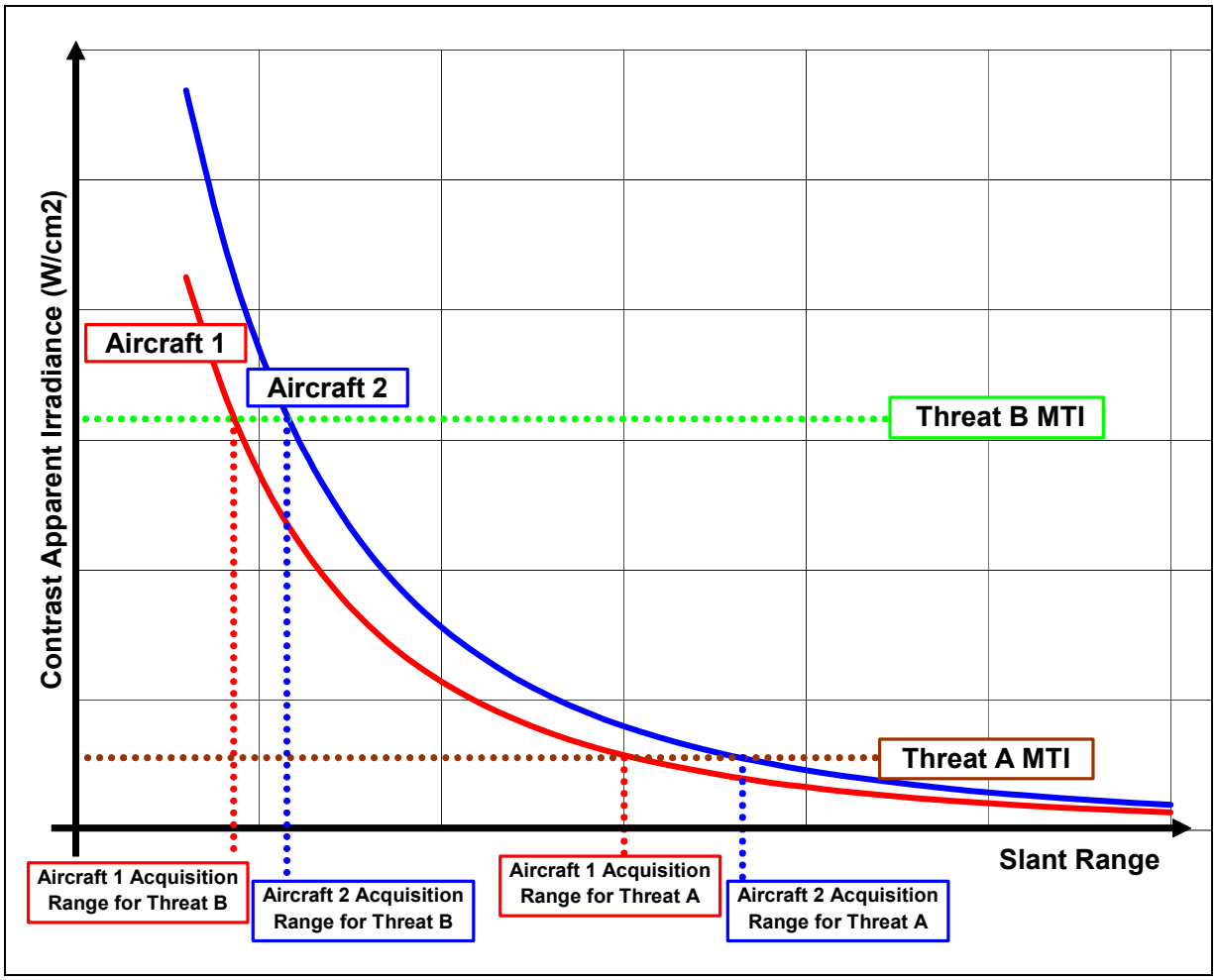

Figure 22. Detection Range Calculation.

Sensor Characterization

As described in a previous section, the output of every sensor is proportional to an integral of the received radiation weighted by the instrument's response function in that domain. Every sensor responds to radiation in accordance with the characteristics of the sensor and its components.

Characterization quantifies the sensor's response shape. Knowledge of response shape is essential to the design of a sensor and understanding its performance in with changing ambient conditions and against various types of targets in real environments.

Normalization

Calibration of a sensor, which describes its response to known input sources, and characterization of the sensor would ideally be the same process. Ideally, the absolute instrument response would be mapped over a domain with a traceable standard laboratory source that was tunable across the range of interest. In the spectral domain, for example, this would require a tunable monochromater whose output beam provided a level of spectral irradiance traceable to a radiation standard and that also had a

cryogenically-cooled background source. The result would be an absolute spectral response function in units of output reading per unit radiance (or irradiance) as a function of wavelength.

In practice, it is sufficient and more practical to separate the characterization and calibration processes, so characterization determines only the relative response shape rather than absolute. Calibration then incorporates the results of the shape characterization to determine the absolute instrument response. Both, however, are important to understanding performance of a sensor.

Characterization uses a variety of different methods and sources to map relative response shapes. The response curve is then normalized and this normalized curve is used in the later derivation of the calibration coefficients. Different normalizations, such as normalization to an average value, are possible, but the convention throughout most of the measurement community today is to normalize response curves to unity at the peak.

When the contributions of all the components are combined into one curve, the result is then peak normalized and this, now unitless, curve is used in the calibration calculations.

Calibration

Sensor calibration, which is the process of relating the known input power to the output of a sensor, requires the use of standard sources, typically National Institute of Standards and Technology (NIST) traceable blackbodies and various other laboratory equipment such as collimators which make all of the rays coming from the source parallel to each other, thus representing a source at infinity. Figure 23 is a pictorial illustration of the calibration of a sensor.

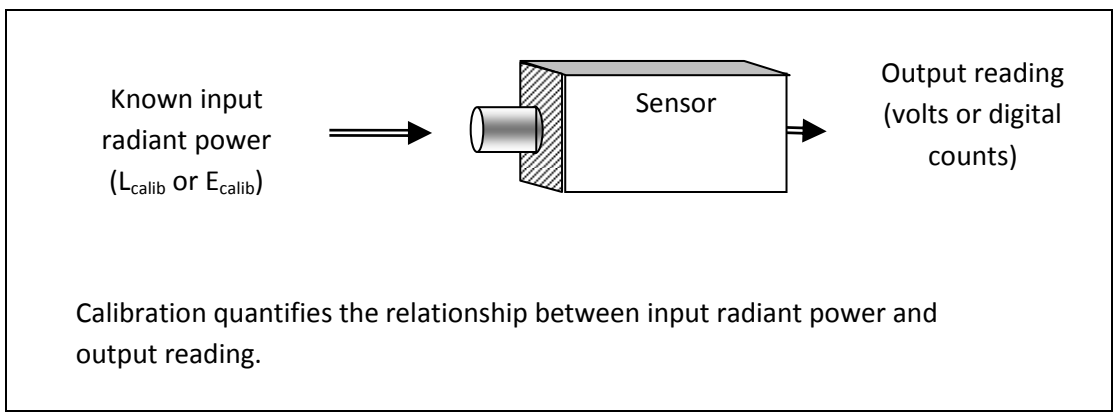

Figure 23. Sensor Calibration Relates Input Power to Output.

Calibration of a sensor usually involves two major steps. Responsivity is the change in output of the sensor to changing input. For a sensor that responds linearly, for example, responsivity represents the slope of the curve when source radiance or incident irradiance is plotted against output voltage or counts for a digitized system. Figure 24 represents a calibration curve for a sensor that has a linear change in output over its dynamic range with changing input power. The slope of the curve is the "m" in the linear equation. Not all sensors respond linearly with power. Higher order response coefficients are common, especially for bolometers and infrared focal plane array sensors operated at short integration times. For these the process of determining the response of the instrument is the same, the curve just yields higher order terms.

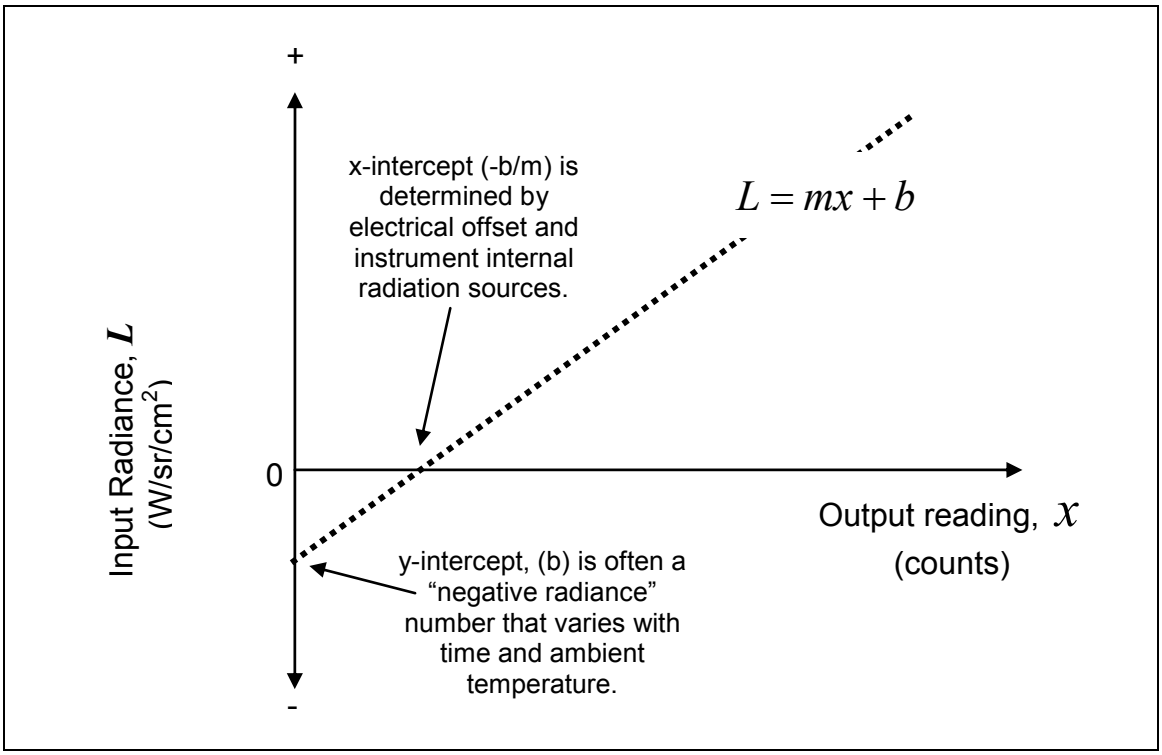

Figure 24. Calibration of a Sensor to Determine Responsivity and Offset.

For most electro-optical sensors, the responsivity does not change with ambient temperature. In other words, the non-constant terms in the calibration equation, whether it is linear or higher order, do not change with changes in temperature. Over time, however, as detectors decay, responsivity decreases. This would show itself on the Figure 24 as an increase in the slope value, i.e., higher input power is required for the same output as the detector becomes less responsive.

Offset

Offset is another important parameter for instrument calibration. For any real (non-ideal) instrument, the response curve does not pass through zero. There are several reasons for this; one being that except in a complete vacuum, zero radiance does not exist. Additionally, contributions from detector noise and radiation from the optical elements in the lens, which cause the offset to drift with changes in ambient temperature, contribute to the offset term. Some amount of offset is designed into the system as well. All electronic circuits have some amount of DC drift. To prevent clipping of the signal if this drift should go below the lower limit of the analog-to-digital converter, the "bottom end" level is adjusted up to some offset level. The consequence of this offset voltage is the addition of a y-intercept term (b), which also must be quantified by the calibration if the sensor is a laboratory instrument. For a sensor that is used for contrast detection, the intercept value is unimportant since it subtracts out in the contrast calculation.

Sensitivity

Sensitivity for a sensor is determined to a large extent by the noise level in the detector output. For focal plane array detector, pixel-to-pixel non-uniformity also limits the sensitivity of the system since

detection is determined by contrast with surrounding pixels. In practice, at least for cooled infrared sensors, detection is typically limited by background and not noise limits.

Instrument Response Uniformity and Non-Uniformity Correction

In reality, all sensors exhibit non-uniform response in all of the domains referenced previously. For example, in the spatial domain, the raw output of an infrared focal plane array detector exhibits pixel-to-pixel offset differences and response differences across the field-of-view. The response change is the result of two primary factors. Since each pixel is essentially a unique detector, it exhibits unique response because of manufacturing tolerances, slight differences in crystal structure, etc. Additionally, most electro-optical sensors implement an aperture or "field stop" in the case of infrared sensors, that limits the radiation that can reach the detector outside of the sensor's desired field-of-view. Radiation entering at angles off of normal to the detector shows a cosine roll-off in incident power. The result is a reduction in responsivity for pixels that are radially separated from the center of the detector. For the majority of systems, an optical gain correction can be applied to compensate for the change in response. The typical method involves using an extended blackbody source that fills the FOV of the sensor. Reference images are collected with the source at two temperatures that are well separated across the sensor's dynamic range. This process is typically called a "2-point" correction. Actual temperature is unimportant. Slope corrections can be determined for each pixel. The result is a gain map that can be stored in the sensor electronics that can be applied to each image to correct for the non-uniform spatial response across the detector array. Pixel-to-pixel offset maps can be determined using one of the same reference images. Pixel slope and offset corrections are typically derived as normalized quantities relative to a center pixel, average of center pixels, or maximum value. The application of the correction maps to the images is commonly referred to as "non-uniformity correction." Figure 25 shows the transition from a raw image to a non-uniformity corrected image.

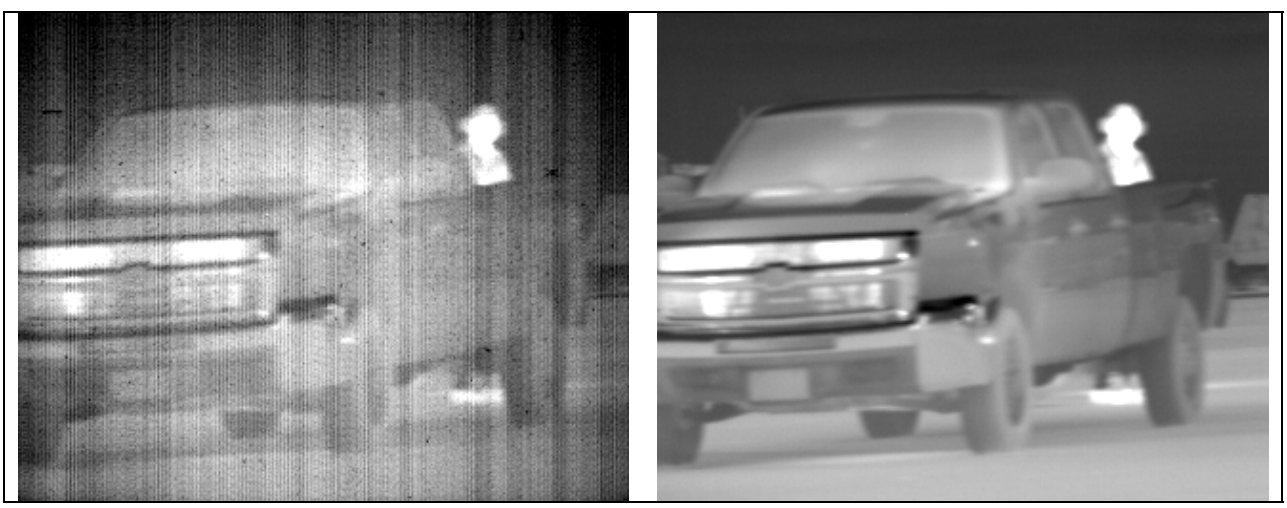

Figure 25. Non-Uniformity Correction of a Mid-IR Image.

Bad Pixel Replacement

Focal plane arrays have pixels that are either unresponsive or responsive outside of useful limits. Figure 25 shows some of the bad pixels that appear as small black spots in an image from an InSb IRFPA imager. Bad pixels can be identified during laboratory calibration or with a sensor mounted reference source. There are many approaches to replacement of bad pixels and the best approach often depends on the sensor characteristics and its application. One common approach is simply to replace the pixel with the average of its nearest neighbors.

INFRARED THREATS TO AIRCRAFT AND THEIR COUNTERMEASURES

IR guided missiles are the largest single cause for aircraft losses since the start of the 1991 Gulf war. All missiles designed within the last 20 years have counter-countermeasures circuitry. Every missile can be defeated with IR countermeasures given time to develop and test devices and techniques, but many missiles have not been exploited and the variety and complexity of the different designs present formidable challenges to the US countermeasure community.

The IR "signature" of any aircraft has three main components:

- Engine exhaust plumes
- Engine hot parts (tailpipe, etc)
- Airframe (aerodynamic heating & reflection from sun, earth, etc)

Infrared guided missiles modulate the signal produced by the aircraft in contrast with its background. Previous generations of missiles used reticles to produce signal waveforms that would provide spatial and temporal information from which signal processing could produce trackable information.

IR Missile Operation

Aircraft (or any other object) can be intercepted using several different types of guidance. The simplest type is pure pursuit, where the missile is always pointed directly at the target location. This is not aerodynamically efficient since the missile would follow a longer (curving) flight path when following a crossing target.

Most missile guidance systems are designed to lead the target so that intercept occurs at the point where the target will be at the time the missile arrives. This requires that the missile fly a course so the relative bearing to the target stays constant (constant "line of sight" angle). The LOS angle is determined by missile speed relative to the target (higher closing speed = smaller angle). The size of the angle isn't important; only that it be constant (zero line of sight rate) as shown in Figure 26.

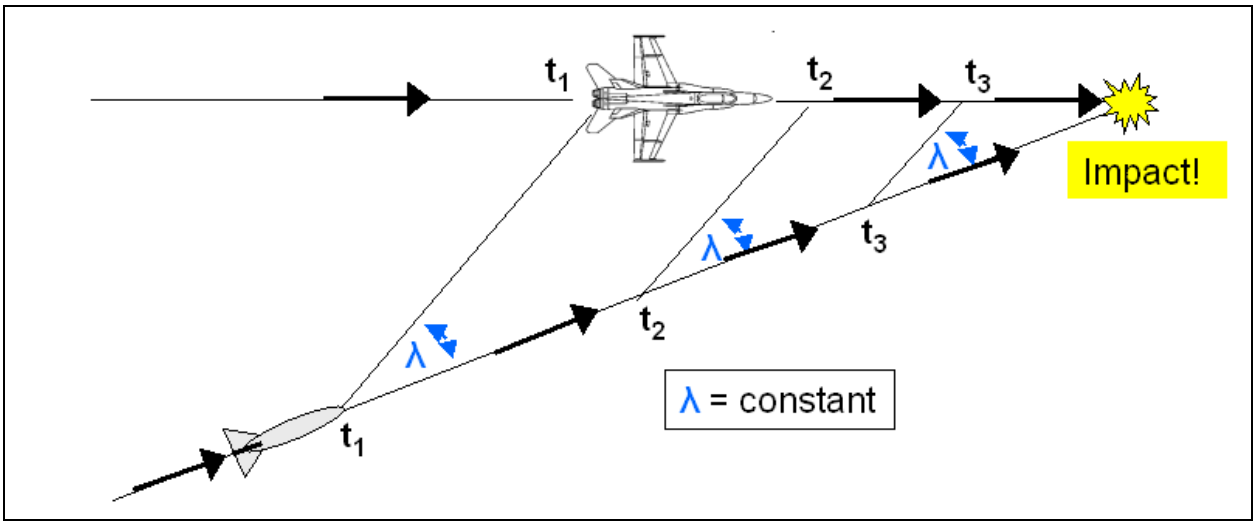

Figure 26. Missile Proportional Navigation.

This intercept course ("proportional navigation") requires that the missile have two separate servo loops: (1) a target tracker and (2) a wing control servo to control direction of flight

For a missile to guide to its intended target, it needs a tracker, which contains the following elements:

- Optics to collect and focus IR from target.
- Gimbals to allow movement to point the optics.
- Gyro stabilization to isolate optics from missile body.
- Detector to convert the received IR to electrical signal.
- Stabilization (gyro) to isolate from missile body.
- A method to determine target direction to enable closed-loop tracking.
- A method to distinguish the target from natural background.

The target tracker is the "window" into the missile's guidance through which it can be deceived by countermeasures.

The problem of determining target direction with a single detector was solved by forming an image of the target scene onto the center of a reticle disk that spun with the optics. Unlike, for example, the reticle in a rifle telescope that superimposes cross hairs, the reticle in a missile acts as a kind of shutter that blocks the passage of IR through part of the reticle and allows IR to pass through the other part. A target image falling on the opaque portion is blocked and produces no detector signal. A target image falling on the transparent portion is passed on to the detector. When the reticle is spun, IR from a target off center is alternately passed and blocked, resulting in amplitude modulation (AM). The phase of this modulation relative to a spin reference is used to tell target direction from center. A closed servo loop moves the optics to keep the target centered on the reticle. This is depicted in Figure 27.

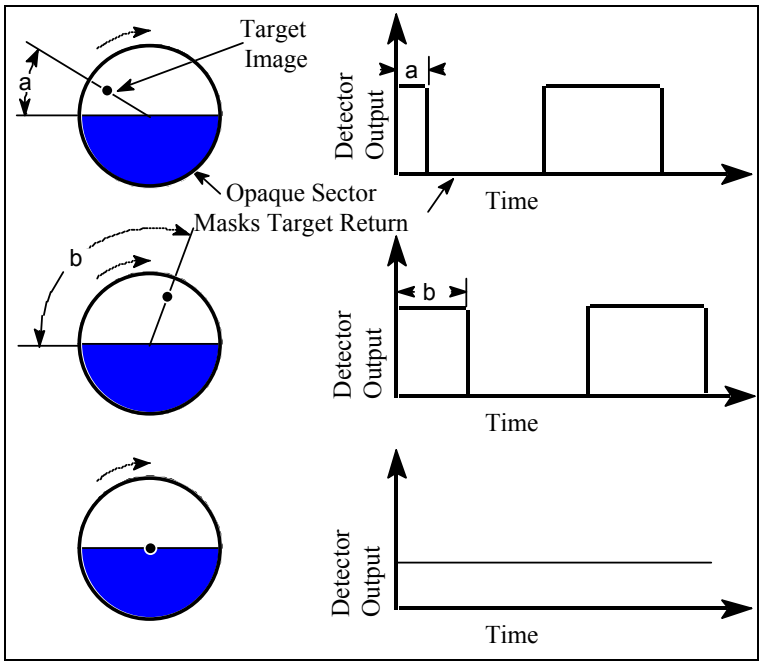

Figure 27. Basic Reticle Design.

Target trackers have another problem: The aircraft target must be distinguished from natural background sources, such as sunlit clouds and terrain. To solve this, they look for features in the spectral, spatial, and temporal domains where the target is different from background.

- Temporal: There is no difference. Neither clouds nor aircraft signature are time varying.
- Spectral: Some difference. Choice of wavelength band yields helpful differences between target and background, but this is not sufficient by itself.
- Spatial: The most viable option. Aircraft are smaller than clouds and terrain. Background radiation can be greatly reduced by spatial filtering.

If half of the reticle is made with opaque "spokes," then some irradiance from targets with small images (such as aircraft) will be modulated more completely and generate a stronger signal at a faster modulating rate than large images (clouds) as shown in Figure 28.

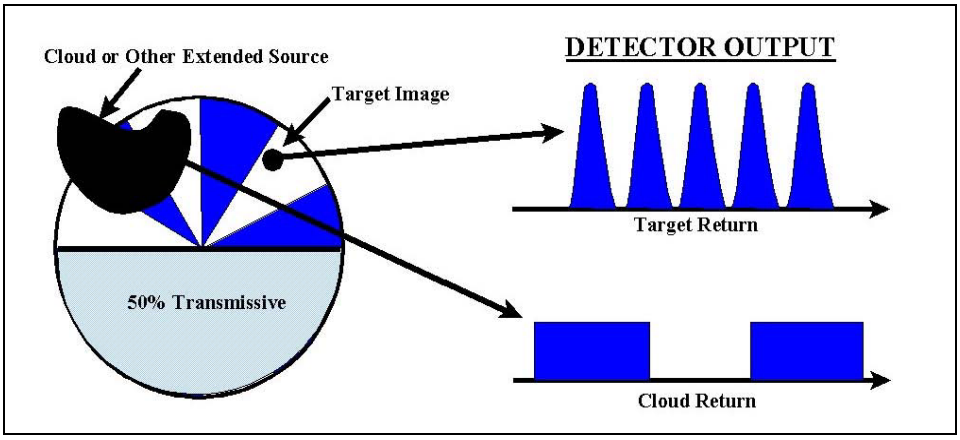

Figure 28. IR Seeker Design for Background Discrimination.

The past figure and the following two figures (29 and 30) depict a spin-scan reticle used on the early Sidewinder designs. After the detector preamp, signal goes through a narrow bandpass filter to improve S/N. The AM waveform is then rectified and filtered. Target direction is determined from AM envelope phase.

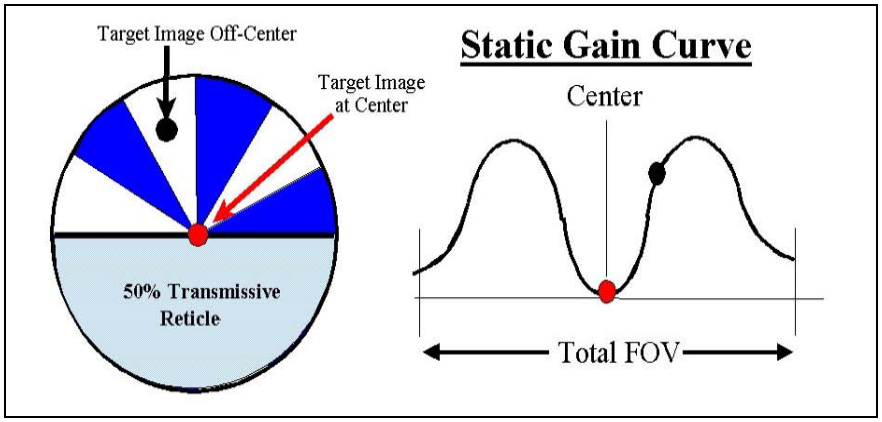

Figure 29. Spin Scan Seeker.

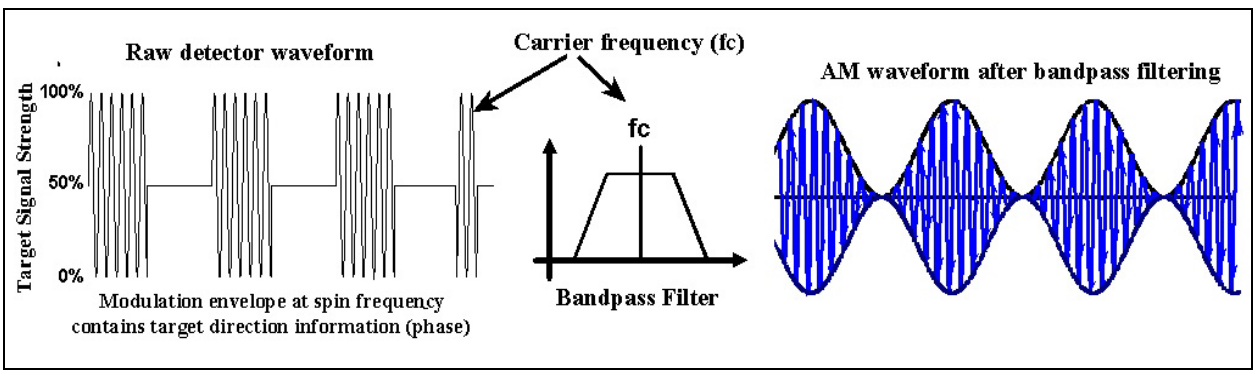

Figure 30. Spin Scan Waveforms for Off-Center Target.

Spin-scan has the following characteristics that are important to countermeasures:

- The tracker loop drives to null the signal to zero. This occurs when the target is on the optical axis and the target image is at the center of the reticle.
- If the target is off-center, an AM carrier "error signal" is generated, where the phase of the modulation envelope indicates the target direction.

With spin scan, the missile is always looking at the target. This vulnerability to jammers led to the next evolution in target trackers: conical scan.

Conical scan borrows concept from early fire-control radars, which used a nutating feed horn. A con scan tracker is shown in Figure 31. With con scan:

- The secondary mirror of the Cassegrain is canted so the field of view seen by the detector sweeps out a pattern of overlapping circles.
- A target image at boresight falls near the edge of the reticle instead of center.
- Reticle pattern is same all the way around. (Usually tapered spokes.)

- Modulation of target near boresight is FM rather than AM. This allows tighter tracking.
- For larger angles off boresight, the target image falls outside the FOV of the detector for part of the scan. The modulation then becomes AM.

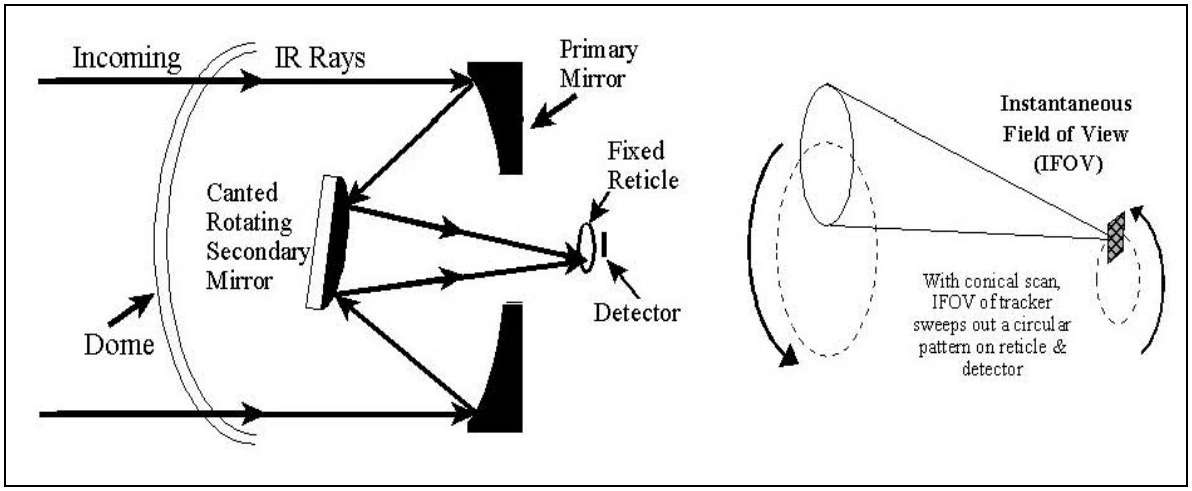

Figure 31. Conical Scan Tracker.

In the con scan tracker, as the missile instantaneous field of view nutates about a target on boresite, (moving through positions at t_1 through t_5 shown in Figure 32), the apparent position of a target image on the reticle sweeps out the circular pattern shown.

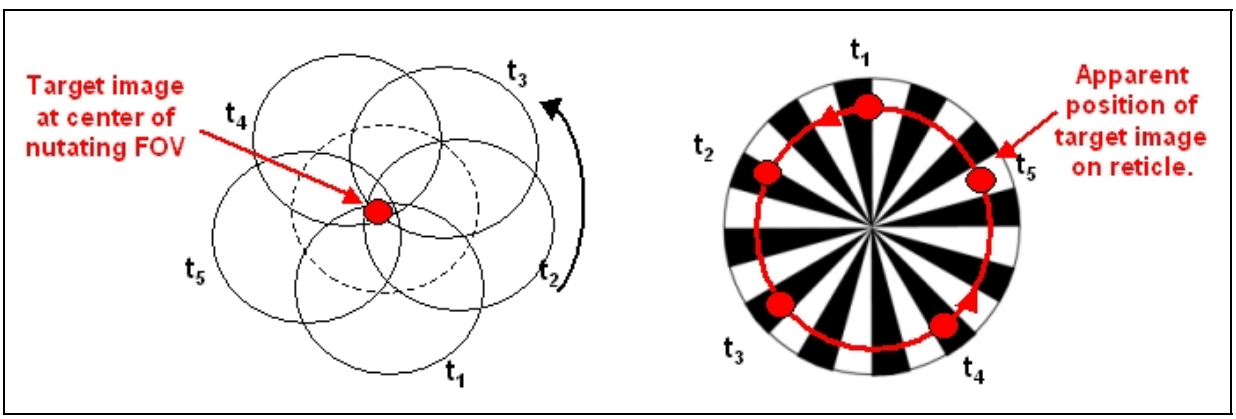

Figure 32. Image on a Con Scan Reticle: Target at Boresite.

If the target is off boresight as shown in Figure 33, the detector receives a signal of varying pulse widths.

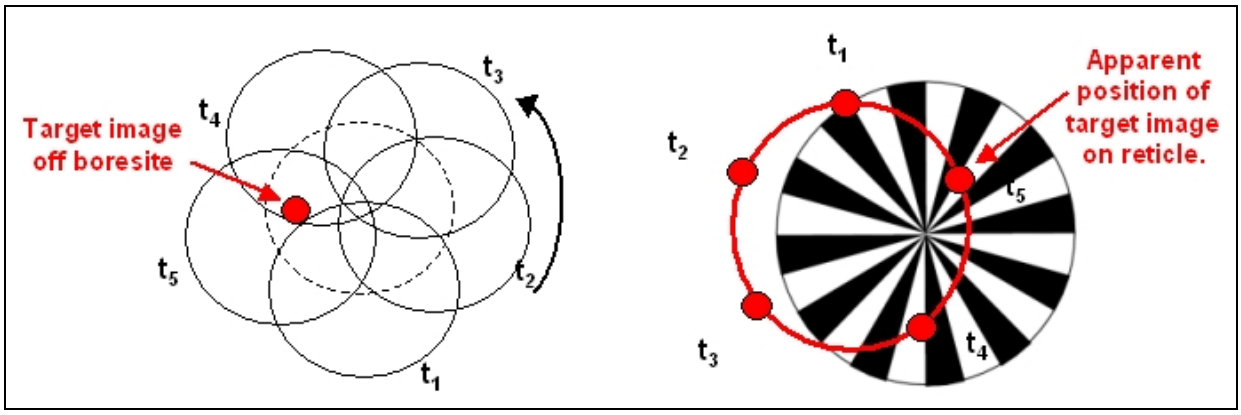

Figure 33. Image on a Con Scan Reticle: Target off Boresite**.**

The waveform produced by a target on boresite is a constant amplitude carrier at the reticle chopping frequency as shown in Figure 34. A target slightly off boresite produces a constant amplitude carrier that is frequency modulated at spin frequency.

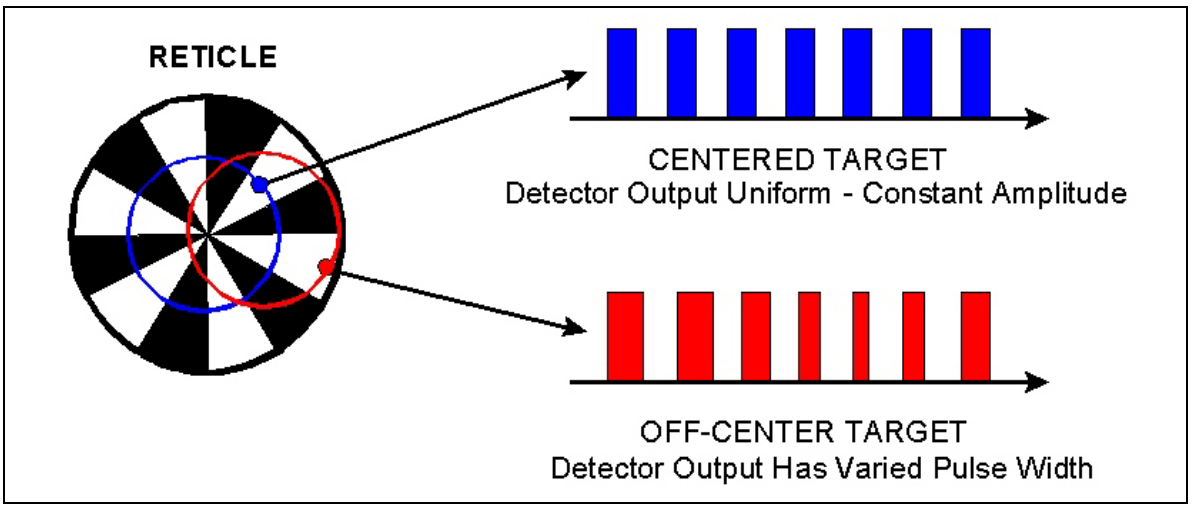

Figure 34. Conical Scan Seeker Output.

A target further off boresite leaves the missile field of view during part of the scan, producing an amplitude-modulated waveform similar to that of a spin scan tracker. The important difference is that with a spin scan tracker, the target never leaves the missile field of view. With con scan, the target may fall outside the missile FOV at certain times during the scan. Because con-scan trackers do not necessarily view the target continuously, they can have high resistance to jammers.

Other types of seeker scan patterns now exist. The Rosette scan pattern shown in Figure 35 is one such example. It has an even higher resistance to countermeasures.

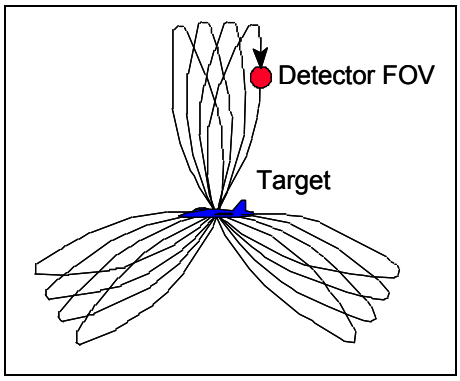

Figure 35. Rosette Scan Pattern.

Imaging arrays of detectors without reticles are newer yet. They may be classified as either staring (every pixel sees the entire scene), or scanning arrays, where the optics plays a role in determining which "pixels" are exposed to optical / IR radiation.

INFRARED COUNTERMEASURE (IRCM)

Flares

Figure 36 shows a Navy F/A-18E Super Hornet aircraft dispensing IRCM flares from its internal flare dispensers. IRCM have been the staple of countermeasures protection for military aircraft more than four decades. Flares are designed to transfer the track of an attacking infrared missile by exhibiting characteristics that confuse the tracking and guidance algorithms built into the missile. Modern missiles incorporate Counter-Countermeasures (CCM) capabilities including hardware configurations, circuitry, and logic to help identify countermeasures and reject them from processing. CCM capabilities can be based on spectral, spatial, and temporal features of the target scene. As missiles continue to improve in their sensitivity, range, maneuverability, and CCM capabilities, flares continue to evolve in order to keep pace with the evolving threat.

Figure 36. Navy F/A-18E Aircraft Dispensing IRCM Flares.

Over the years the Navy has fielded many flare types including the MJU-2/B, MJU-8, MJU-32, MJU-38, MJU-27, MJU-49, and many other improved versions of these flares and other types as well. IRCM flares continue to be the prevailing countermeasure for military aircraft protection by offering cost effective and robust protection.

Dispenser Systems

Most Navy fixed wing and rotary wing aircraft are equipped with countermeasures dispenser systems. These systems are critical to the survivability of the aircraft in a hostile threat environment. Modern dispensers such as the AN/ALE-47 offer high reliability and substantial programming capability that allows flare dispenses to be tailored for maximum protection of the host aircraft type. AN/ALE-47 is highly integrated into the aircraft over the 1553 data buses. The dispenser can incorporate information from several aircraft systems including missile-warning systems to improve its responses to threats and provide vital situational awareness to the aircrew.

Impulse Cartridges

IRCM flares are dispensed from the aircraft flare dispensers with electrically initiated impulse cartridges. Impulse cartridges incorporate energetic materials within a small confined canister. Upon application of a voltage to the electrical leads, a bridge wire in contact with the energetic materials burns through, igniting the propellant materials. The expanding gases push the flare from its case, held captive in the aircraft dispenser. Impulse cartridges for Navy use have been designed to withstand the extreme electro-magnetic environments encountered around aircraft carriers and other combat ships. Examples of impulse cartridges include the CCU-63 and CCU-136.

Infrared Jammers

Several lamp-based and mechanically modulated jammers have been developed over the years for protection of aircraft. Examples include the AN/ALQ-144 and AN/ALQ-157, predominantly used on helicopters and cargo aircraft. These jammers offer some level of protection over a broad field-of-regard and offer the advantage of continuous operation.

In principle, these jammers produce a modulated signal in the track band of the threat that corrupts the target tracking pulses in the missile seeker.

Passive Missile Warning Systems

Infrared-guided weapons provide passive attack capabilities against military vehicles. Unlike a radar-guided weapon that actively emits radiation and tracks the reflected pulses from the target, infrared weapons track radiation already being emitted from the target. Attacking missiles fly at very high speeds, and they are exceptionally maneuverable. Missile warning systems must be capable of detecting the threat, alerting the aircrew, and cueing a countermeasures response within sufficient time to counter the attacking missile. The time from launch to impact can be very short, making timely detection critical. Active warning systems have been developed in the past that use Doppler Radar capabilities to detect missiles, but passive missile warning systems have been preferred because of the desire to minimize emissions from the aircraft under attack.

Several passive missile-warning systems have been developed over the years for military aircraft. These systems operate in a variety of different parts of the electro-optical spectrum, but the most common are ultraviolet and infrared sensor systems. Examples of passive missile warning systems include AN/AAR-47, AN/AAR-54, AN/AAR-57, AN/AAQ-24 (both passive and active components), and the Joint and Allied Threat Awareness System (JATAS), currently under development by the Navy. Passive missile warning sensors continue to improve with advances in detector technologies, particularly with imaging detectors. These sensors provide excellent angle-of-arrival information, necessary to support cueing of laser based countermeasures, and advanced processing to detect and declare threat missiles in cluttered environments.

Laser Countermeasures

Laser-based infrared countermeasures have been in development for many years. Several systems have been fielded over the past fifteen years including the AN/AAQ-24 system on Air Force cargo aircraft and helicopters and a derivative system for Marine Corps helicopters.

Although configurations vary, most of these systems incorporate a single multi-band laser or several single-band lasers that produce modulated waveforms designed to corrupt a missile's guidance target tracking. The laser optics are located in a tracking gimbal that provides agile and rapid pointing over a broad field-of-regard. Laser based countermeasures require a relatively high angle of arrival accuracy from the host aircraft's missile warning sensor. Upon declaration of the threat, the missile warning system hands-off track to the tracking gimbal and cues the lasers to lase. A tracking camera in the tracking gimbal with high optical resolution helps to maintain track on the threat missile through the engagement period.

LASERS

The word laser comes from Light Amplification by Stimulated Emission of Radiation. A laser system emits light that is generated through a process of stimulated emission. The radiation produced by a laser exhibits high temporal and spatial coherence. In order to begin the process of stimulated emission, the lasing medium absorbs the energy from a pump source. The atoms in the lasing medium are excited to a higher energy state. These atoms will eventually return to their ground state. A large number of atoms that are excited to higher states create a population inversion. Population inversion describes the number of atoms in excited state versus the number of atoms in the ground state. In order for the atoms to return to their ground state, they must release energy. This energy is released in the form of photons. Energy of a photon is expressed as

$$E = \frac{hc}{\lambda}$$

Where

E = Energy, generally electron volts (eV)
h = Planck's constant = 4.136×10^{-15} (eV·s)
c = speed of light = 2.998×10^{8} (m/s)
λ = wavelength of light in meters

The energy that must be released by the atom to return to the ground state will direct the wavelength of the photon emitted since h and c are constants. If all the excited atoms released the same amount of energy to return to their ground state, the released photons would all have the same wavelength

and would be considered fully monochromatic. Most lasers do not emit a single wavelength but a range of slightly differing wavelengths ($\Delta\lambda$).

The lasing medium may be a solid, a gas, liquid, or plasma. Some laser types include gas, chemical, dye, fiber-based, solid-state and semiconductor lasers. The laser radiation can be output in a continuous wave (CW) or in a pulsed wave. A continuous wave laser emits light that maintains a steady amplitude and frequency. A pulse wave will vary in amplitude and is also characterized by the systems pulse repetition frequency (PRF). The PRF is defined as the number of pulses emitted during a unit of time. Figure 37 shows the spectral output of several laser types.

The first laser was constructed by Theodore Maiman at Hughes Research Laboratories in Malibu, California. This laser was a pulsed, solid-state ruby laser. The ruby laser uses a synthetic ruby crystal as the lasing medium. A xenon flash lamp is used to excite the atoms in a ruby rod to higher energy levels. The highly polished and mirrored ends of the rod form a resonant cavity. One end of the rod has a slightly lower reflectivity. The lamp excitation produces an inverted population of excited atoms, which are stimulated to relax to lower energy levels releasing their extra energy as photons. Repeated reflections off the mirrored ends of the rod causes the photons to bounce back and forth through the rod stimulating further emissions at the same wavelength and phase producing a highly coherent beam, which finally passes through the lower reflectivity end.

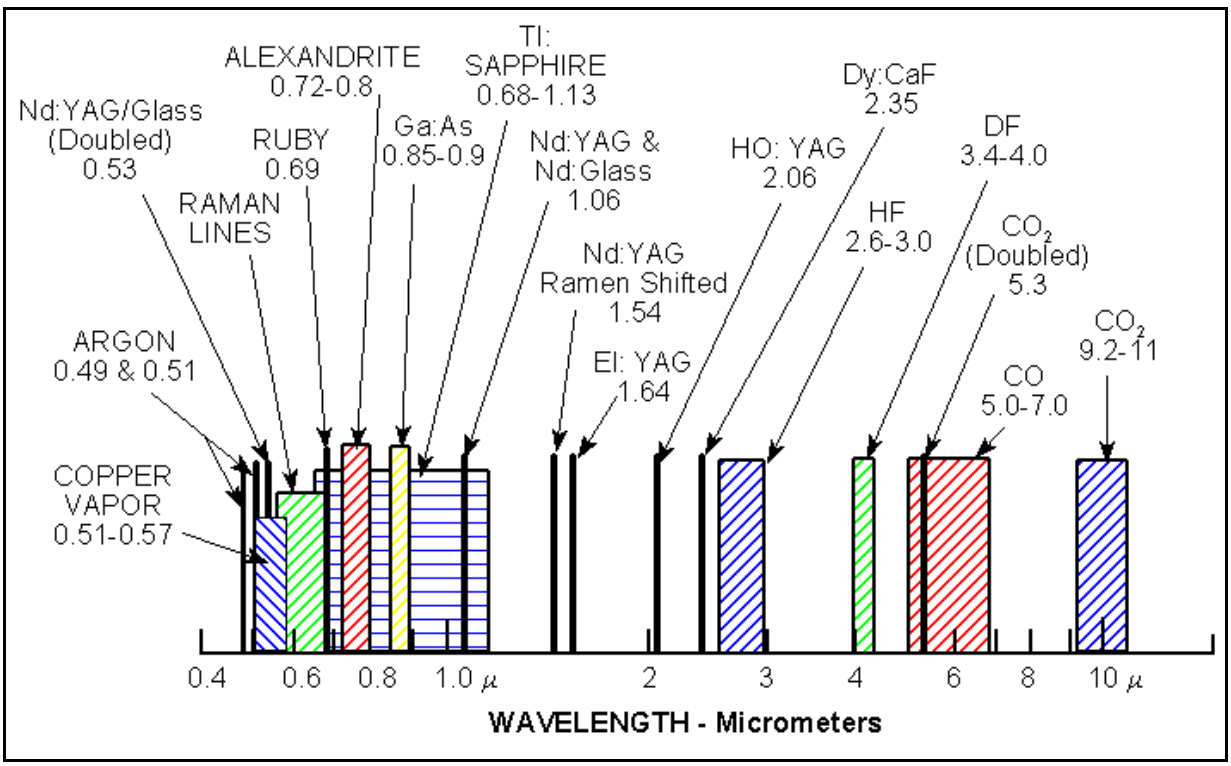

Figure 37. Spectral Lines / Ranges of Available Lasers.

The typical laser rangefinder uses a solid-state laser with a neodymium-YAG crystal lasing at 1.06 μm.

Gas lasers can be pulsed or CW. The gas dynamic laser obtains its inverted population through a rapid temperature rise produced by accelerating the gas through a supersonic nozzle. In chemical lasers the inversion is produced by a chemical reaction. In the electric discharge laser the lasing medium is

electrically pumped. The gas can also be optically pumped. In an optically pumped gas laser the lasing medium is contained in a transparent cylinder. The cylinder is in a resonant cavity formed by two highly reflective mirrors.

Many gas lasers use carbon dioxide as the lasing medium (actually a mixture of CO_2 and other gases). These are the basis for most high energy or high power lasers. The first gas laser was an optically pumped CW helium-neon laser. The common laser pointer is a helium-neon laser operating at 0.6328 µm. The lasing medium is a mixture of helium and neon gas in a gas discharge or plasma tube.

The dye laser is an example of a laser using a liquid for the lasing medium. The lasing medium is an organic dye dissolved in a solvent such as ethyl alcohol. Dye lasers operate from the near UV to the near IR, are optically pumped, and are tunable over a fairly wide wavelength range.

Another type of laser is the semiconductor or injection laser, also known as a laser diode. The junctions of most semiconductor diodes will emit some radiation if the devices are forward biased. This radiation is the result of energy released when electrons and holes recombine in the junction. There are two kinds of semiconductor diode emitters: (1) the light emitting diode (LED), which produces incoherent spontaneous emission when forward biased and which has a broad (800 angstrom) spectral output, and (2) the laser diode, which maintains a coherent emission when pulsed beyond a threshold current and which has a narrow spectral width (< 10 angstrom). In the laser diode the end faces of the junction region are polished to form mirror surfaces. They can operate CW at room temperatures, but pulsed operation is more common. Figure 38 shows a typical diode laser structure.

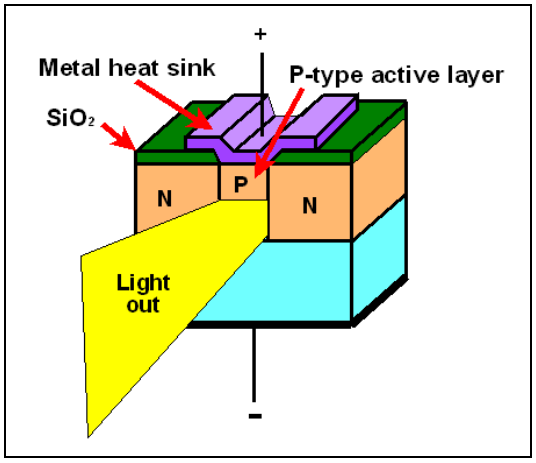

Figure 38. Diode Laser Construction.

Fiber lasers use fibers that are doped with rare-earth elements as the pumping medium. These rare-earth elements include elements such as Erbium (most common), Ytterbium, and Neodymium. There are other elements such as Thulium that are used for doping purposes. Erbium doped fiber lasers can emit in the 1.5 to 1.6 micron wavelength, which is important due to eye safety concerns in this part of the spectrum. Other wavelength emissions for Erbium include 2.7 and 0.55 microns.

Fiber based laser systems are beneficial in many ways. The fiber gain medium is compact compared to many other types of gain medium and is highly efficient. The fiber gain medium can also be physically manipulated to save space. Fiber based lasers are able to achieve high output powers. The gain medium of a fiber laser can extend for several kilometers to achieve these higher power outputs. The fact that the light is already propagating in a flexible fiber can also allow for system designs that implement a gain cavity in one location and then deliver the output in another location.

Q-switching is a common means of obtaining short intense pulses from lasers. The Q-switch inhibits lasing until a very large inverted population builds up. The switch can be active or passive. A passive Q-switch switches at a predetermined level. An active Q-switch is controlled by external timing circuits or mechanical motion. The switch is placed between the rod (or lasing medium) and the 100 percent mirror. Figure 39 shows an arrangement using a Pockels cell as an active Q-switch.

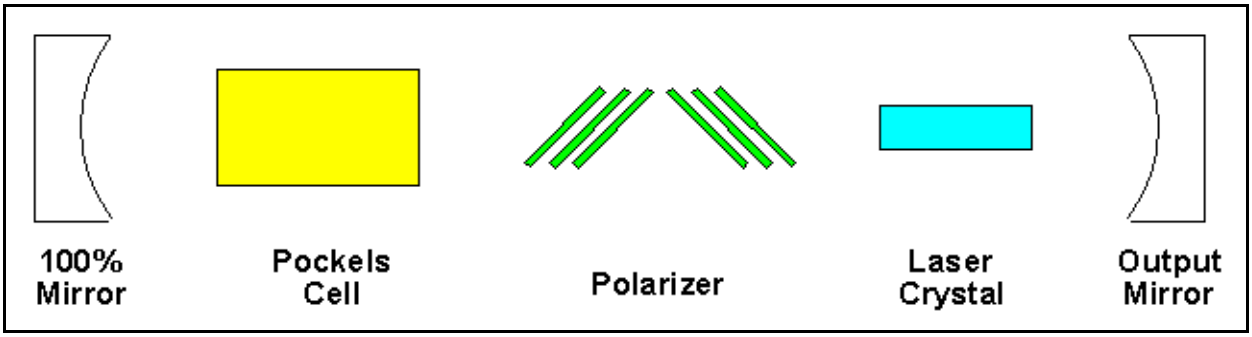

Figure 39. Q-Switch Arrangement.

Other methods of obtaining pulsed operation include using pump sources that are pulsed and mode-locking.

FIBER OPTICS

Fiber optic cables are the optical analog of RF waveguides. Fiber optic cables are made from transparent dielectrics. The fiber optic cable acts as an optical waveguide allowing light to propagate along the length of the fiber by using the principle of total internal reflection. This phenomenon can only occur under certain conditions relating to the material indices of refraction and the light ray's angle of incidence. Some benefits of fiber optic fiber include low losses, bandwidth, electromagnetic interference immunity, size, and weight.

Consider the physical construction of a bare optical fiber, depicted in Figure 40. A bare optical fiber is simply the inner glass core and the surrounding glass sleeve. The core must have a higher index of refraction than the cladding, $n_1 > n_2$. When $n_1 > n_2$, light impinging the boundary between the core and the cladding will totally internally reflect if the incident angle at each reflection is greater than the critical angle, θ_c. $\sin \theta_c = (n_2 / n_1)$

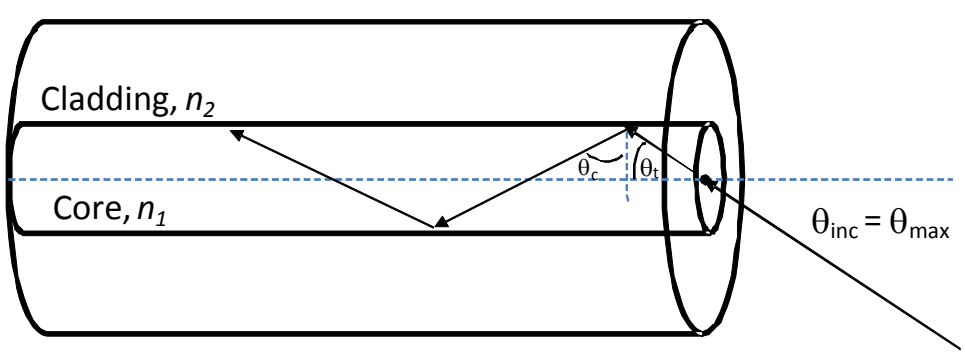

Figure 40. Bare Fiber Optic Cable.

Incident rays on the face of the fiber must intersect at angles less than θ_{max} for the internal ray, θ_t, to intersect at θ_c. When rays intersect the front face of the fiber at angles greater than θ_c, they are only partially reflected in the core and will leak out.

There are many varieties of optical fibers. Optical fibers can either be single mode or multimode. Single mode fibers are fibers which propagate a single mode down the length of the fiber while multimode fibers can propagate many modes. Single mode fibers typically have a much smaller core diameter, typically around 8 to 10 µm. Their cladding is usually 125 µm. Multimode fibers typically have core diameters around 62.5 µm with 125 µm claddings. These diameters can vary depending on the application. Loss in multimode fibers over a 1 kilometer distance is typically around 1 dB at 1310 nm. This value will vary some with changes in wavelength. Single mode fibers can maintain the quality of a light pulse over longer distances than multimode fibers due to modal dispersion effects that occur in multimode fibers. Typical losses for a single mode fiber over 1 kilometer is approximately .3 dB at 1310 nm. Again, this value will vary some with changes in wavelength. However, multimode fiber is much less expensive than single-mode and can have a lower connection loss due to the larger core diameter. Multimode fiber is commonly used in communications.

In addition to single mode or multimode, a fiber can have a step index profile or a graded index profile. Figure 41 depicts the two profiles. The step index profile maintains a uniform index of refraction within the core. A graded index profile has a peak index of refraction at the center of the core. The index of refraction value rolls off from the center to lower values closer to the cladding interface. This profile assists with the modal dispersion issue found in multimode fiber.

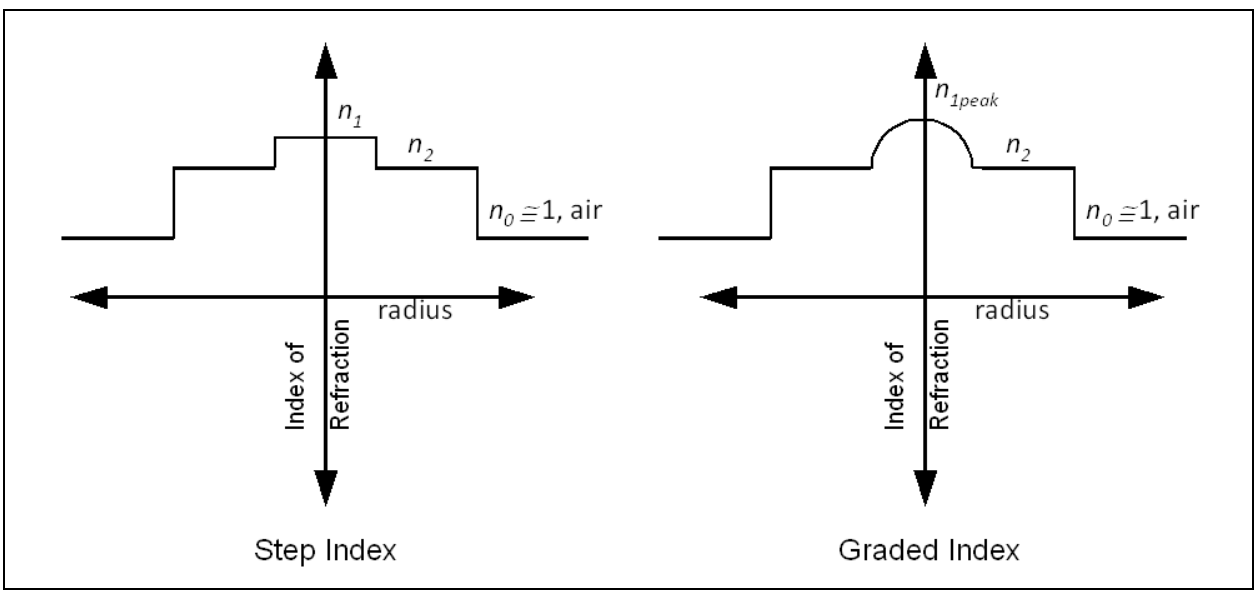

Figure 41. Fiber Profiles for a Single Mode Step Index and a Multimode Graded-Index Fiber.

Most fiber is not used in a bare form and has some additional layers of protection around the cladding. These layers can include a 250 µm buffer with a 900 µm PVC tight buffer. Some fiber will also contain aramid yarn followed by a 3 mm PVC furcation tube. Buffer tubes are often used to assist with identification and provide damage protection. The outer layers can provide additional isolation from environmental factors and lower optical crosstalk.

There are also more specialized types of fiber that include polarization maintaining and photonic crystal fibers. Polarization maintaining fibers are not constructed with a cylindrical core but instead use elliptical, bow-tie styled cores or stress rods located in the cladding (PANDA style). These are shown in Figure 42.

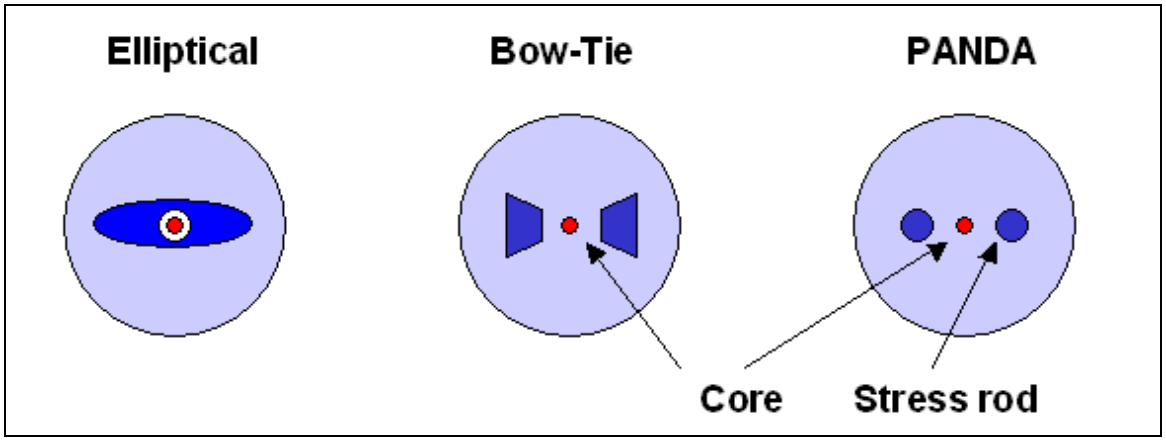

Figure 42. Polarization Maintaining Optical Fiber Types.

Polarization maintaining fibers maintain the state of the linearly polarized light propagating through the fiber. This type of fiber is used when the polarization state of the light cannot vary within a system. Photonic crystals propagate light by an arrangement of very small and closely spaced air holes that are maintained throughout the length of the fiber. Applications of photonic crystal fibers are varying and can be used in fiber lasers, amplifiers, sensors, and telecom.

It is well known that fiber optics has many communication applications; however, improvements in fiber optic technology have lent themselves to many EO applications. Many EO components are now fiber based and can interface with the tremendous advancements in fiber-based laser systems as well as other EO systems. An example of the use of fiber optics in an EW system is the AN/ALE-50 and 55 Fiber-Optic Towed Decoy (FOTD). The FOTD uses fiber optic cabling to communicate with the jammer.

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LASER SAFETY

Lasers are divided into the following classes:

Class 1	Low power / non-hazardous
Class 2/2a	Low power / minor controls necessary
	Emit less than 1 mW visible CW radiation. Not considered hazardous for momentary (<0.25 sec) unintentional exposure. Class 2a lasers are those class 2 lasers not intended to be viewed, i.e. supermarket scanners.
Class 3a/3b	Medium power / direct viewing hazard / little diffuse reflection hazard.
Class 3a	Visible lasers with 1-5 mW power output, invisible lasers, and those having 1-5 times the Accessible Emission Limit (AEL) of class 1 lasers.
Class 3b	All other class 3 lasers at all wavelengths which have a power output less than 500 mW.
Class 4	High power / eye & skin hazard / potential diffuse reflection hazard or fire hazard

There are several pertinent instructions and guidelines regarding laser use. They are:

- OPNAVINST 5100.27B Navy Laser Hazards Control Program
  (which replaced OPNAVINST 5100.27A and SPAWARINST 5100.12B)
- MIL-HDBK-828B, Range Laser Safety
- ANSI Z136.1-2007, American National Standard for the Safe Use of Lasers (Parent)

Every Navy command which uses lasers must have a Laser System Safety Officer (LSSO). All LSSOs must attend a Navy LSSO course.

There are four categories of LSSOs.

- Administrative Laser Safety Officer (ALSO)
- Technical Laser Safety Officer (TLSO)
- Laser Safety Specialist (LSS)
- Range Laser Safety Specialist (RLSS)

See OPNAVINST 5100.27B for details of their qualifications and responsibilities.

The hazard ranges of interest are the NOHD for direct viewing of a beam and the $r_{1(safe)}$ or $r_{2(safe)}$ for viewing a beam reflected off an object such as a wall. These are depicted in Figure 1. The Maximum Permissible Exposure (MPE) values present laser safety levels as a function of exposure time, laser PRF, pulse duration, and wavelength. Different tables are used for eye safety while directly viewing a beam, for viewing a diffusely reflected beam, and for skin exposure.

For repeated pulses the following equation is used to calculate the maximum permissible exposure (MPE).

$$\text{MPE (repeated pulse)} = \frac{MPE(single\ pulse)}{(\ PRF\ x\ t_e\ )^{1/4}} \qquad \textbf{[1]}$$

Where PRF is the pulse repetition frequency of the laser and t_e is the exposure duration.

For visible lasers t_e is usually taken as 1/4 second and for non-visible lasers a value of 10 seconds is used.

Figure 1 depicts some laser hazard distances.

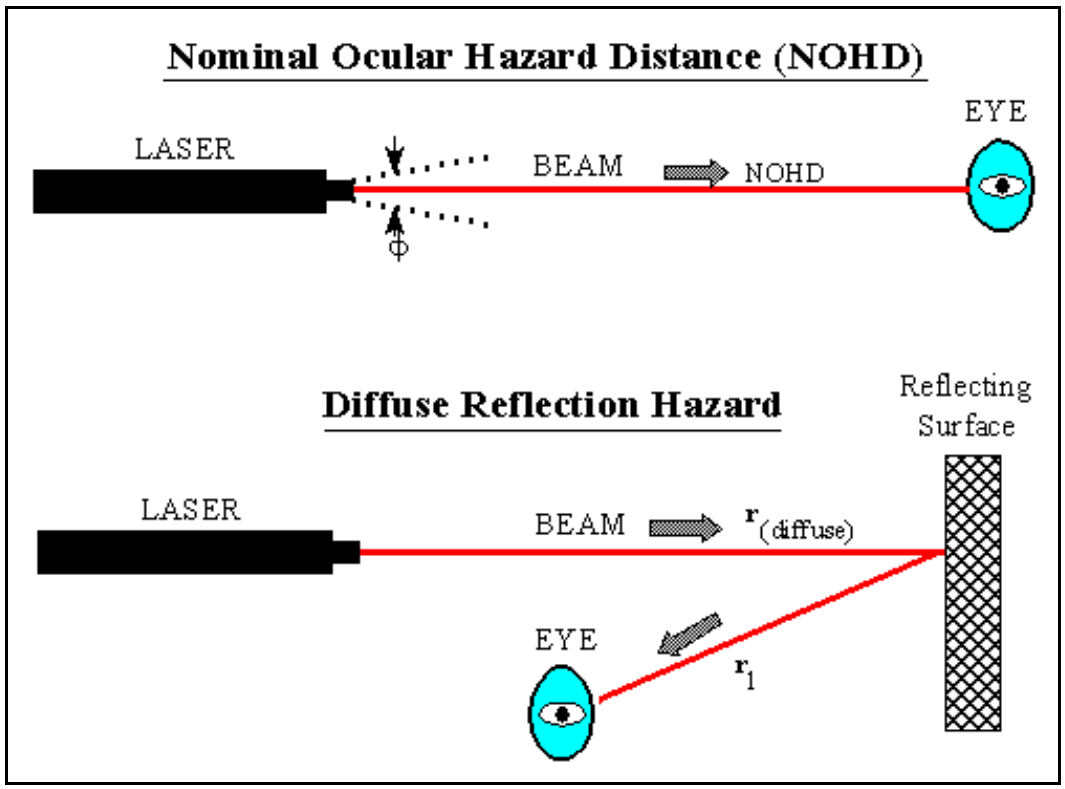

Figure 1. Laser Hazard Distances.

Range laser safety specialists shall be designated for external operations. Range test plans shall specify:

- Permissible aircraft flight paths, and ship or vehicle headings.
- Hazard areas to be cleared.
- Operational personnel locations.
- Types of surveillance to be used to ensure a clear range.
- Radio / communications procedures.

During laser operations no portion of the laser beam may extend beyond the controlled target area unless adequate surveillance can prevent radiation of unprotected areas. Class 3 and class 4 lasers shall not be directed above the horizon unless coordinated with those responsible for the given airspace (FAA, Navy, Air Force, etc).

In an industrial environment, warning and hazard signs and lights will be posted, a hazard zone shall be designated when lasers are in operation, and training shall be provided to operators in the proper eye and body (skin) protection required. Interlocks to laser operation shall be provided when there is the possibility of unauthorized personnel entering the hazard area.

Fiber optic cables usually have laser power sources so appropriate warnings or labels need to be applied to connections or possible breakage points.

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AIRCRAFT DYNAMICS CONSIDERATIONS

Free Fall / Aircraft Drag.....8-1
Mach Number and Airspeed vs. Altitude.....8-2
Maneuverability 8-3
EMP / Aircraft Dimensions.....8-4

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FREE FALL / AIRCRAFT DRAG

The purpose of this section is to get an awareness of the distance traveled by a flare or other object such as a bomb, which is jettisoned or dropped by an aircraft. This will give the reader an appreciation for the significance of aircraft tactical altitude.

From Newton's second law of motion:

$F = m_o a$ where: F = Force
m_o = Mass of object
a = Acceleration

and the law of gravitation: $F = G\dfrac{m_o m_e}{r^2}$

		English Units	SI Units
where:	F = Force of attraction	lb_f	Newton
	G = universal gravitational constant	3.44×10^{-8} $ft^4/lb\text{-}sec^4$	6.67×10^{-11} $m^3/kg\text{-}sec^2$
	m_o, m_e= Masses (not weight) of object & earth	slug	kg
	r = distance between center of gravity of objects	feet	meter

Combining the two equations and solving for "a":

$$a = \frac{G\,m_e}{r^2} = g$$, the familiar constant acceleration due to gravity.

Since G and m_e are fixed and the variation in r (the distance from the earth's center) is small except for satellites, "g" is considered fixed at 32.2 ft/sec^2.

For objects with a constant acceleration (g), it can be shown that:

$$d = v_i t + \frac{1}{2} g t^2$$ where d = distance traveled
v_i = Initial velocity
t = time
g = acceleration

For a falling object, Figure 1 on the following page may be used to estimate time/distance values.

- The upper curve is for an object shot upward with an initial velocity of 50 ft/sec.
- The middle curve is for an object shot horizontally with an initial velocity of 50 ft/sec or one that is a free-falling object dropped with no initial vertical velocity.
- The lower curve is for an object with a downward initial velocity of 50 ft/sec.

Notes:

1) 50 ft/sec is the typical cartridge ejection velocity of a flare/chaff expendable.
2) The top curve actually goes up 39 feet before starting back down, but this is difficult to see due to the graph scale.
3) This simplification ignores the effects of air drag or tumbling effects on a falling object which will result in a maximum terminal velocity, with resultant curve straightening.

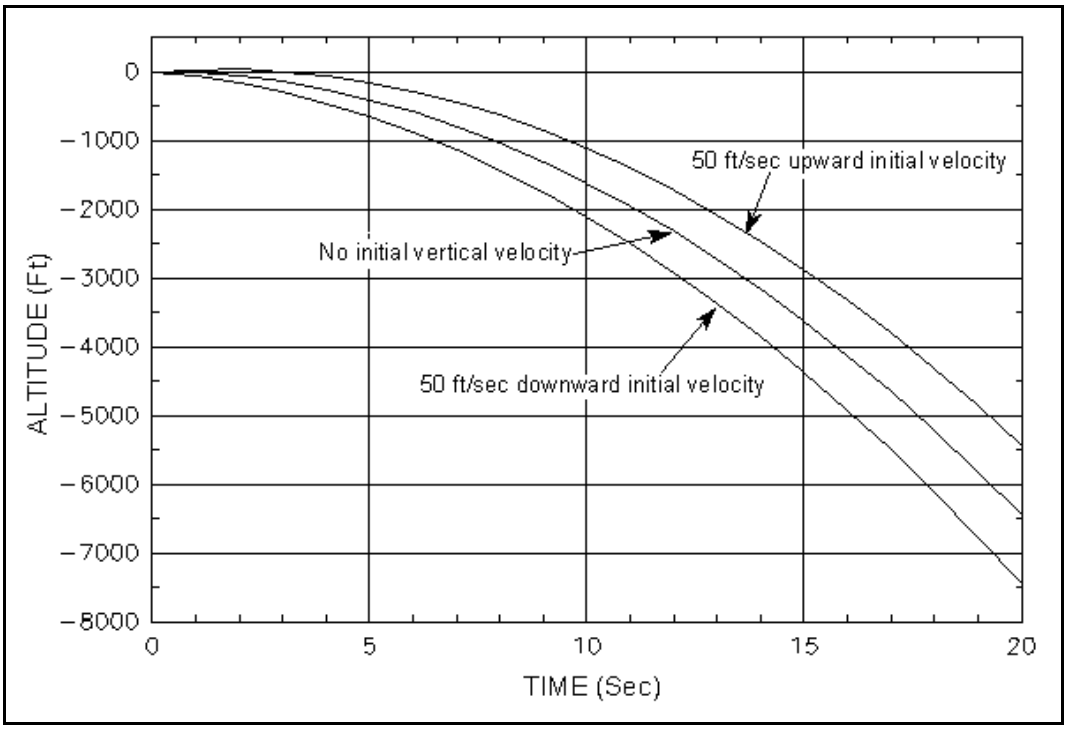

Figure 1. Object Fall Rate.

SAMPLE CALCULATIONS

Let us assume that we want to know how far a bomb or other object has fallen after 13 seconds if it had been dropped from an aircraft traveling at 450 kts which was in a 40° dive.

Our initial vertical velocity is: 450 kts (Sin 40°) (1.69 ft/sec per knot) = 489 ft/sec downward

$d = V_i t + \frac{1}{2}gt^2 = -489(13) + \frac{1}{2}(-32.2)(13)^2 = -6355 - 2721 = -9{,}076$ ft.

Remember to keep the signs (+/-) of your calculations in agreement with whatever convention you are using. Gravity pulls downward, so we used a minus sign for acceleration. Also the initial velocity was downward.

In reality, any object may well have reached terminal velocity before the time indicated using the above formula or Figure 1. In this example, the actual distance determined from ballistics tables would have been 8,000 ft, which is about 13% less than the above calculation would indicate. The drag characteristics of the object determine how much shorter the distance will be. In any case, it will not have dropped farther.

AIRCRAFT DRAG INDEX POINTS

Tactical aircraft carry stores in various combinations depending upon the mission. Each store has a different drag load which affects range. The pilot needs to know the total drag load in order to determine his aircraft range on a particular mission. Adding up the total drag in pounds of force for wind resistance would be cumbersome. Therefore, the drag of the stores is compared to a known reference drag (usually the aircraft), and expressed as a percentage of aircraft drag multiplied by some constant. This ratio is variously called drag count, drag index, or drag points. For instance, if a missile has 100 pounds of drag and the reference aircraft drag is 50,000 pounds, the ratio is 100/50,000 = 0.002. Multiply this by a constant of 100 (for example) and the drag index point is 0.2. The pilot only needs to look on a chart to see what the drag index points are for his stores, add up the drag points, and look on a chart to see what his aircraft range and best range (or endurance) speed will be.

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MACH NUMBER and AIRSPEED vs. ALTITUDE

MACH NUMBER is defined as a speed ratio, referenced to the speed of sound, i.e.

$$MACH\ NUMBER = \frac{Velocity\ of\ Interest}{Velocity\ of\ Sound} \quad \textit{(at the given atmospheric conditions)} \qquad \textbf{[1]}$$

Since the temperature and density of air decreases with altitude, so does the speed of sound, hence a given true velocity results in a higher MACH number at higher altitudes.

AIRSPEED is a term that can be easily confused. The unqualified term airspeed can mean any of the following:

a. Indicated airspeed (IAS) - the airspeed shown by an airspeed indicator in an aircraft. Indicated airspeed is expressed in knots and is abbreviated KIAS.

b. Calibrated airspeed (CAS) - indicated airspeed corrected for static source error due to location of pickup sensor on aircraft. Calibrated airspeed is expressed in knots and is abbreviated KCAS. Normally it doesn't differ much from IAS.

c. True airspeed (TAS) - IAS corrected for instrument installation error, compressibility error, and errors due to variations from standard air density. TAS is expressed in knots and is abbreviated KTAS. TAS is approximately equal to CAS at sea level but increases relative to CAS as altitude increases. At 35,000 ft, 250 KIAS (or KCAS) is approximately 430 KTAS.

IAS (or CAS) is important in that aircraft dynamics (such as stall speed) responds largely to this quantity. TAS is important for use in navigation (True airspeed ± wind speed = ground speed).

Figures 1 and 2 depict relations between CAS and TAS for various altitudes and non-standard temperature conditions. The first graph depicts lower speed conditions, the second depicts higher speeds.

As an example of use, consider the chart on the next page. Assume we are in the cockpit, have read our IAS from the airspeed indicator, and have applied the aircraft specific airspeed correction to obtain 370 KCAS. We start at point "A" and go horizontally to our flight altitude at point "B" (25,000 ft in this case). To find our Mach, we go down vertically to point "C" to obtain 0.86 Mach. To get our TAS at our actual environmental conditions, we go from point "B" vertically until we hit the Sea Level (S.L.) reference line at point "D", then travel horizontally until we reach our actual outside air temperature (-20°C at altitude) at point "E", then go up vertically to read our actual TAS from the scale at point "F" (535 KTAS). If we wanted our TAS at "standard" temperature and pressure conditions, we would follow the dashed lines slanting upward from point "B" to point "G" and read 515 KTAS from the scale. Naturally, we could go into the graph at any point and go "backwards" to find CAS from true Mach or TAS.

Figure 3 shows a much wider range of Mach numbers. It contains only TAS and Mach, since aircraft generally do not fly above Mach 2, but missiles (which don't have airspeed indicators) do. The data on this graph can be obtained directly from the following formula for use at <u>altitudes of 36,000 ft and below</u>:

$$Speed\ of\ Sound\ (KTAS) = 29.06\sqrt{518.7 - 3.57\,A} \qquad Where\ A = altitude\ (K\ ft) \qquad \textbf{[2]}$$

The speed of sound calculated from this formula can be used with the equation on the first page to obtain Mach number. This equation uses the standard sea level temperature of 59° F and a lapse rate of -3.57°/1000 ft altitude. Temperature stabilizes at -69.7° F at 36,000 ft so the speed of sound stabilizes there at 573 knots. See the last page of this section for a derivation of equation [2].

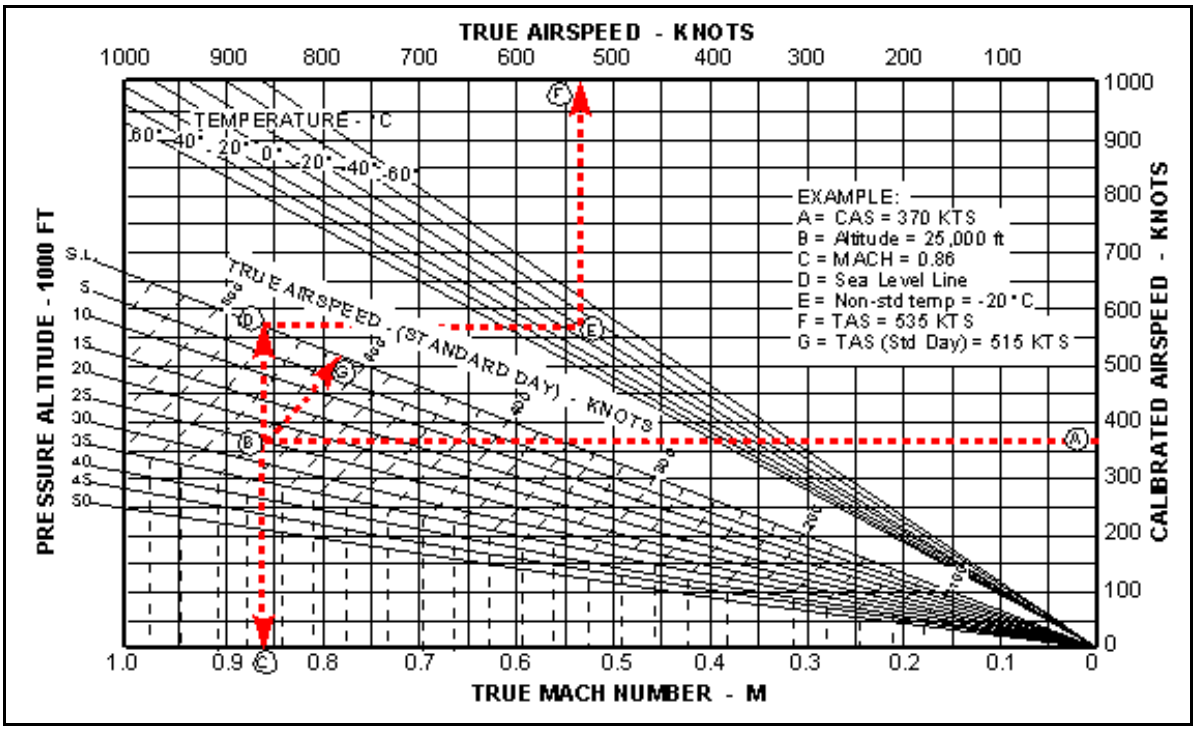

Figure 1. TAS and CAS Relationship With Varying Altitude and Temperature.

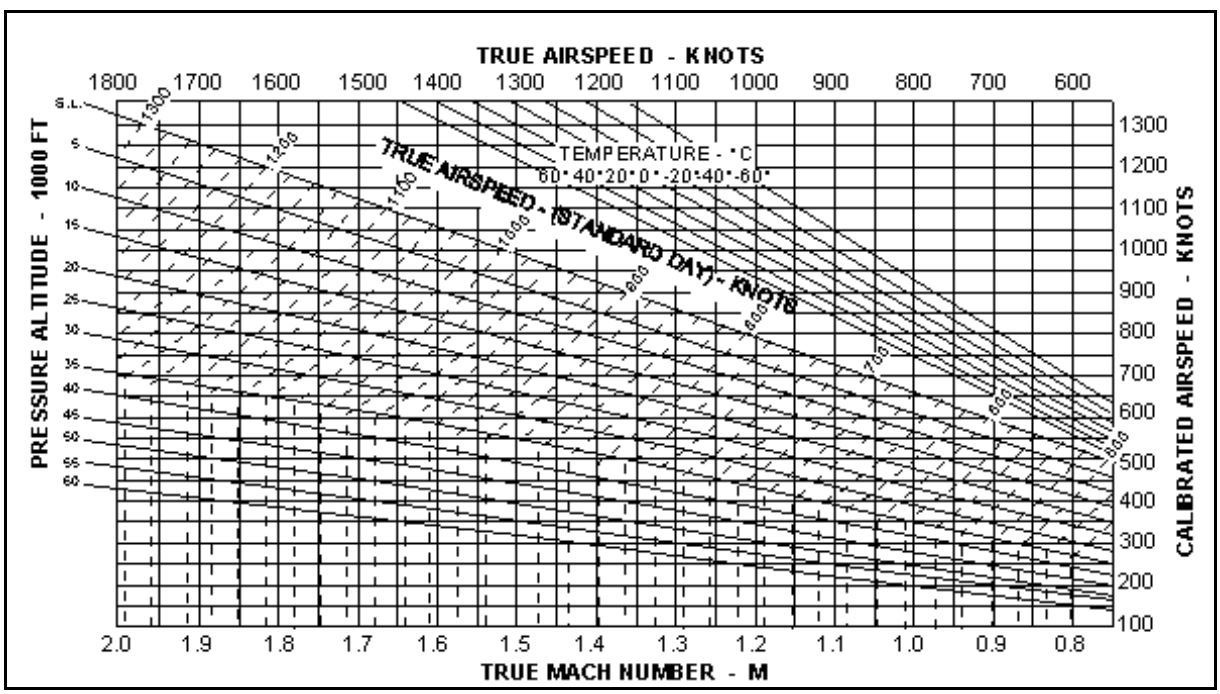

Figure 2. TAS and CAS Relationship With Varying Altitude and Temperature (Continued).

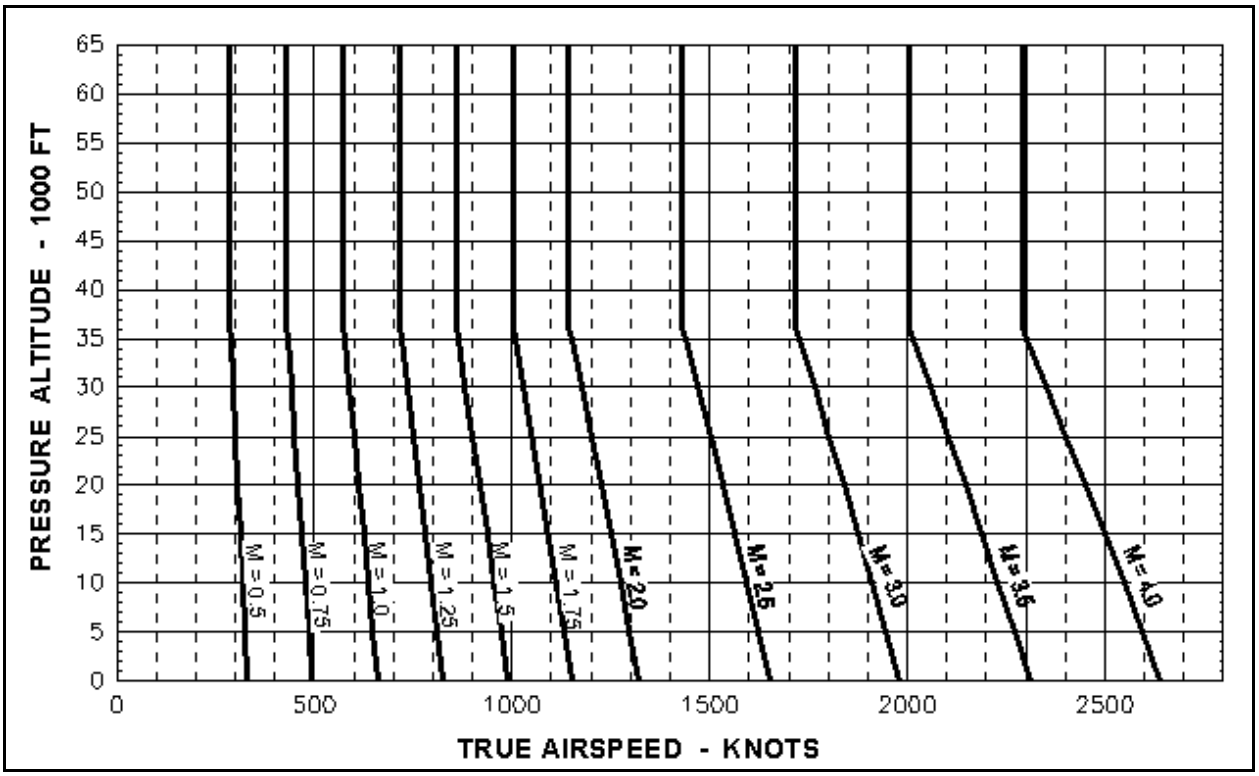

Figure 3. Mach Number vs. TAS Variation With Altitude.

The following is a derivation of equation [2] for the speed of sound:

Given: p = pressure (lb/ft^2) T = absolute temperature (°Rankine) = °F + 459.7
v = specific volume (ft^3/lb) w = specific weight (lb/ft^3) = $1/v$
R = a constant (for air: R = 53.3) ρ = density = $w/g = 1/gv$ $\therefore$ $v = 1/g\rho$

From Boyle's law of gasses: $pv = RT$, therefore we have: $p/\rho = gRT = (32.2)(53.3)T = 1718\ T$ **[3]**

It can also be shown that: p/ρ^{γ} = constant; for air $\gamma = 1.4$ **[4]**

From the continuity equation applied to a sound wave: $\rho A V_a = (\rho + dp)A(V_a + dV_a)$ **[5]**

Expanding and dropping insignificant terms gives: $dV_a = -V_a\, d\rho/\rho$ **[6]**

Using Newton's second law ($p + \rho V_a/2$ = a constant) and taking derivatives: $dp = -\rho V_a dV_a$

Substituting into [6] gives: $V_a^2 = dp/d\rho$ **[7]**

Then taking derivatives of [4] and substituting in [7] gives: $V_a = \sqrt{\dfrac{\gamma p}{\rho}}$ **[8]**

Then using [3] gives: $V_a = \sqrt{\gamma g R T} = \sqrt{1.4(1718)T} = 49\sqrt{T}$ **[9]**

Using a “Standard” atmosphere of 59° F @ Sea Level (S.L.) and a lapse rate of -3.57°/1000 ft altitude:

$$V_a = 49\sqrt{459.7 + 59 - 3.57\,A}\;\frac{ft}{\sec}\left[\frac{3600\sec}{hr}\,\frac{nm}{6076\;ft}\right] = 29.06\sqrt{518.7 - 3.57A}$$ which is equation [2]

MANEUVERABILITY

A useful function is to determine how many "G's" an aircraft might require to make a given turn without altitude loss. From Newton's laws, F cos φ = W, where: F = force applied to an aircraft, W = weight, and φ = bank angle. By definition "G's" is the ratio of the force on an object to its weight, i.e., G = F/W = 1/cos φ.

Simple calculations will show the results presented in Table 1, to the right.

Table 1. G vs. Angle of Bank. (No altitude loss)

G	φ
1.0	0
1.4	45
2.0	60
3.9	75
7.2	82
11.5	85

Given that the average structural limit of an aircraft is about 7 G's, the maximum bank angle that can be achieved <u>in level (non-descending) flight</u> is 81.8°.

Figure 1 can be used to determine the turn radius and rate-of-turn for any aircraft, given speed and angle of bank (assuming the aircraft maintains level flight). It may also be used in the reverse context. It should be noted that not all aircraft can fly at the speeds depicted - they may stall beforehand or may be incapable of attaining such speeds due to power/structural limitations.

In the example shown on Figure 1, we assume an aircraft is traveling at 300 kts, and decides to make a 30° angle of bank turn. We wonder what his turn radius is so we can approximate his flight path over the ground, and what his rate of turn will be. We enter the chart at the side at 300 kts and follow the line horizontally until we intercept the 30° "bank angle for rate of turn" line. We then go down vertically to determine the 2.10°/sec rate of turn. To get radius, we continue horizontally to the 30° "bank angle for turn radius" line. We can then go down vertically to determine the radius of 13,800 ft.

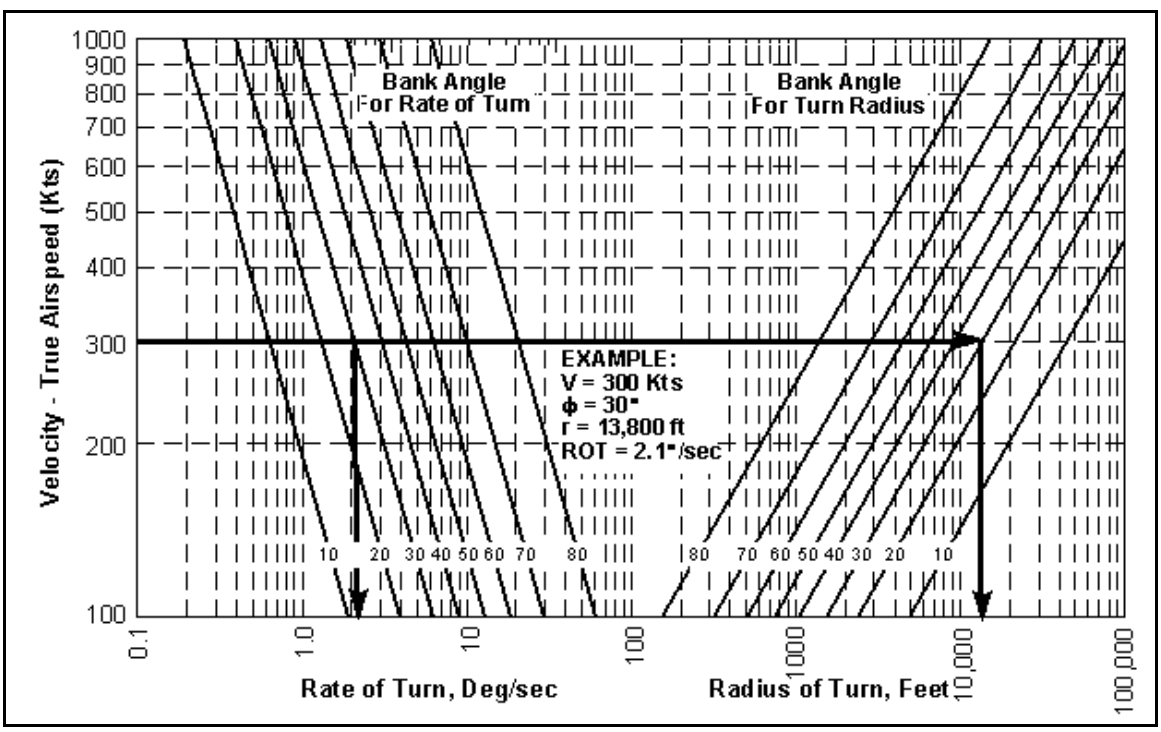

Figure 1. Aircraft Turn Rate / Radius vs. Speed.

The exact formulas to use are:

$$Rate\ of\ Turn = \frac{1091 \tan(\phi)}{V} \qquad Radius\ of\ Turn = \frac{V^2}{11.26 \tan(\phi)} \qquad Where: \begin{array}{l} V = Velocity\ (Knots) \\ and\ \phi = Angle\ of\ Bank \end{array}$$

Another interesting piece of information might be to determine the distance a typical aircraft might travel during a maneuver to avoid a missile.

Figure 2 shows a birds-eye view of such a typical aircraft in a level (constant altitude) turn.

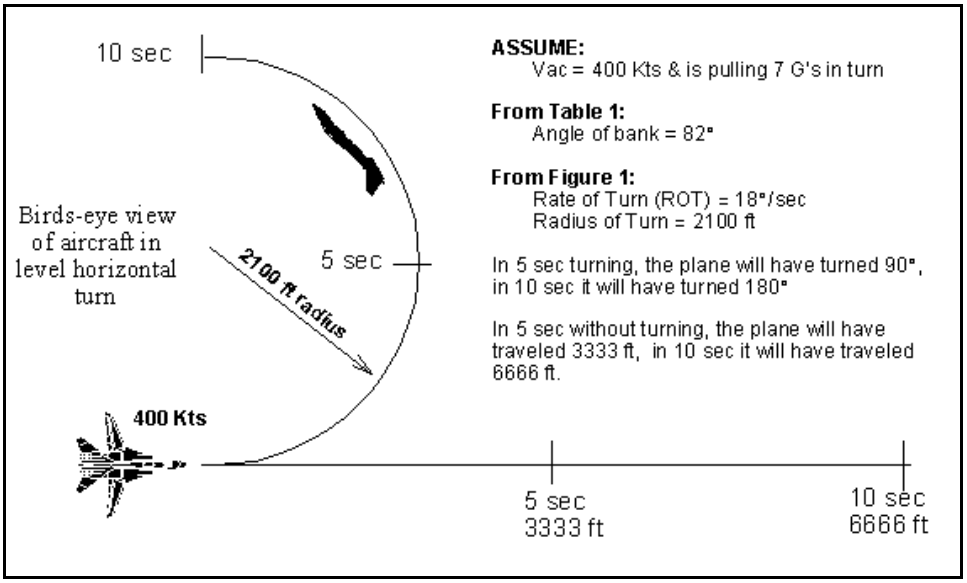

Figure 2. Maneuvering Aircraft.

To counter many air-to-air missiles the pilot might make a level turn, however in countering a SAM, altitude is usually lost for two reasons: (1) the direction of maneuvering against the missile may be downward, and (2) many aircraft are unable to maintain altitude without also losing speed. These aircraft may have insufficient thrust for their given weight or may be at too high an altitude. The lighter an aircraft is (after dropping bombs/burning fuel), the better the performance. Likewise, the higher the altitude, the poorer the thrust-to-weight ratio. Maximum afterburner is frequently required to maintain altitude at maximum "G" level.

REFERENCE AXES (Roll, Pitch, Yaw)

The rotational or oscillating movement of an aircraft, missile, or other object about a longitudinal axis is called roll, about a lateral axis is called pitch, and about a vertical axis is called yaw as shown in Figure 3.

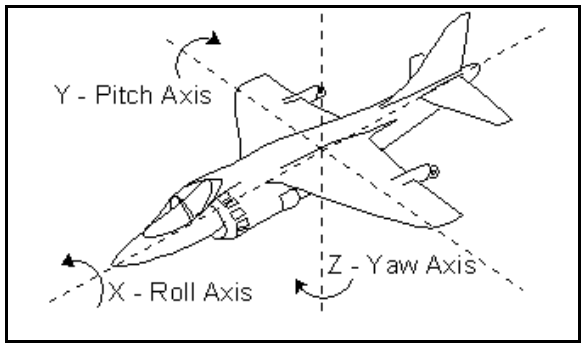

Figure 3. Reference Axes.

SAMPLE CALCULATIONS

If we want to determine the rate of turn or turn radius more precisely than can be interpolated from the chart in Figure 1, we use the formulas. For our initial sample problem with an aircraft traveling 300 kts, in a 30° angle of bank turn, we have:

$$Rate\ of\ Turn = \frac{1091 \tan(\phi)}{V} = \frac{1091 \tan(30)}{300} = 2.1°/\sec$$

$$Radius\ of\ Turn = \frac{V^2}{11.26 \tan(\phi)} = \frac{300^2}{11.26 \tan(30)} = 13{,}844\ ft$$

These are the same results as we determined using Figure 1.

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EMP / AIRCRAFT DIMENSIONS

An aircraft flying in the vicinity of an electromagnetic pulse (EMP) acts like a receiving antenna and picks up EMP radiation in relation to size like a dipole (or half-wavelength dipole). The electromagnetic pulse spectrum decreases above 1 MHz as shown in Figure 1, so an F-14 aircraft that is an optimum ½ wavelength antenna at ≈8 MHz will pick up less EMP voltage than a B-52 or an aircraft with a trailing wire antenna. A rule of thumb for the voltage picked up is:

V_{EMP} = 8.1 volts/ft times the maximum dimension of the aircraft in feet

This rule of thumb was generated because a single linear relationship between voltage and aperture seemed to exist and compared favorably with more complex calculations for voltage picked up by various aircraft when subjected to EMP.

Table 1 shows various aircraft and the frequencies they would be most susceptible to, using $f = c/\lambda$, where λ matches the selected aircraft dimension for maximum "antenna reception effect." This should be a design consideration when trying to screen onboard avionics from the effects of EMP.

The following is a partial listing of aircraft types vs. identifying prefix letters (several are used in Table 1):

A	Attack	K	Tanker	T	Trainer
B	Bomber	O	Observation	U	Utility
C	Cargo	P	Patrol	V	Vertical or Short Takeoff and Landing (V/STOL)
E	Electronic Surveillance	Q	Special mission		
F	Fighter	R	Reconnaissance	X	Experimental
H	Helicopter	S	Anti Sub/Ship	Y	Prototype

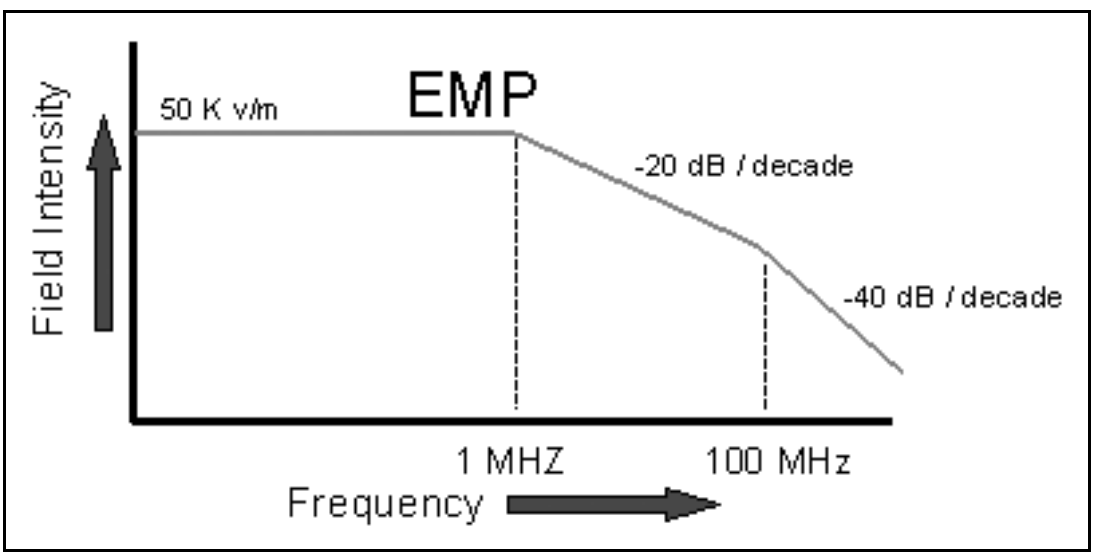

Figure 1. EMP as a Function of Frequency.

Table 1. Aircraft Dimensions and Equivalent Antenna Aperture.

Mission	Aircraft Type	Height (ft.)	Frequency (MHz)		Length (ft.)	Frequency (MHz)		Wing Span (ft.)	Frequency (MHz)	
		A	f	f/2	A	f	f/2	A	f	f/2
ATTACK	A-10	14.66	67.05	33.52	53.33	18.43	9.21	57.5	17.1	8.55
ELECTRONIC WARFARE	EA-6B	16.50	59.64	29.82	59.34	16.58	8.29	53.0	18.57	9.29
	EA-18	16.0	61.47	30.74	60.17	16.35	8.17	44.67	22.02	11.01
FIGHTER	F-15	18.4	53.42	26.71	63.75	15.42	7.71	42.8	22.97	11.48
	F-16	16.66	59.00	29.5	49.25	19.96	9.98	31.0	31.71	15.85
	F/A-18C/D	15.3	64.31	32.16	56.0	17.57	8.79	40.70	24.18	12.09
	F/A-18E/F	16	61.47	30.7	60.17	16.34	8.17	44.67	22.02	11.01
	F-22	17.75	55.41	27.7	64.17	15.33	7.66	43	22.87	11.43
	F-35A	14.2	69.27	34.63	51.4	19.1	9.57	35	28.1	14.05
	F-35C	15.5	63.45	31.73	51.4	19.1	9.57	43	22.8	11.43
	F-117	12.42	79.15	39.57	65.92	14.91	7.46	43.33	22.69	11.34
ASW	P-3C	33.75	29.16	14.58	116.42	8.45	4.23	99.67	9.87	4.94
	S-3A	22.75	43.25	21.63	54.34	18.45	9.23	68.67	14.33	7.17
	P-8	42.1	23.36	11.68	129.5	7.6	3.8	123.6	7.96	3.98
AEW	E-2C	18.4	53.48	26.74	56.50	17.42	8.71	80.58	12.21	6.11
V/STOL	AV-8B	11.64	84.45	42.23	46.3	21.23	10.62	30.3	32.44	16.22
	V-22	18.1	54.3	27.2	57.3	17.17	8.58	84.5	11.64	5.82
	F-35B	15.0	65.6	32.78	51.2	19.2	9.61	35	28.1	14.05
HELICOPTERS	AH-1W	14.16	69.46	34.73	58.25	16.89	8.44	48.0	20.49	10.24
	UH-1E	12.75	71.18	35.59	52.91	18.60	9.30	44.0	22.36	11.18
	U/SH-2	15.41	63.85	31.93	52.5	18.74	9.37	44.0	22.36	11.18
	SH-3D	16.42	59.93	29.97	72.67	13.54	6.77	62.00	15.87	7.84
	CH-46D	16.75	58.75	29.38	84.34	11.67	5.84	50.0	19.68	9.84
	CH-47	18.75	52.45	26.23	99.0	9.94	4.98	60.0	16.39	8.19
	CH-53A	24.91	39.50	19.75	88.16	11.16	5.58	72.25	13.62	6.81
	SH-60	17.0	57.85	28.93	64.83	15.17	7.59	53.83	18.27	9.14
	AH-64	15.25	64.5	32.25	58.25	16.89	8.44	48.0	20.49	10.24
TRANSPORT	C-2A	15.92	61.81	30.91	56.6	17.39	8.70	80.58	12.21	6.11
TANKERS	KC-130F	38.1	25.83	12.92	97.8	10.06	5.03	132.5	7.43	3.72
SPECIAL ELECTRONICS	EC-13OQ	38.5	25.56	12.78	99.34	9.91	4.96	132.58	7.42	3.71
TRAINER	T-2B	14.8	66.49	33.25	38.7	25.43	12.72	37.85	26.00	13.0
	T-39D	16.0	61.50	30.75	43.75	22.49	11.25	44.34	22.19	11.10
	T-45	13.5	72.86	36.43	39.33	25.0	12.5	30.8	31.93	15.97

DATA TRANSFER BUSSES

Data Busses 9-1
RS-232 Interface 9-2
RS-422 Balanced Voltage Interface 9-3
RS-485 Interface 9-4
IEEE-488 Interface Bus (HP-IB/GP-IB) 9-5
MIL-STD-1553 & 1773 Data Bus 9-6
Ethernet 9-7
Transmission Control Protocol / Internet Protocol 9-8

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DATA BUSSES

INTRODUCTION

The avionics systems on aircraft frequently contain general purpose computer components which perform certain processing functions, then relay this information to other systems. Some common examples are the mission computers, the radar processors, RWRs, and jammers. Each system is frequently laid out as shown in Figure 1.

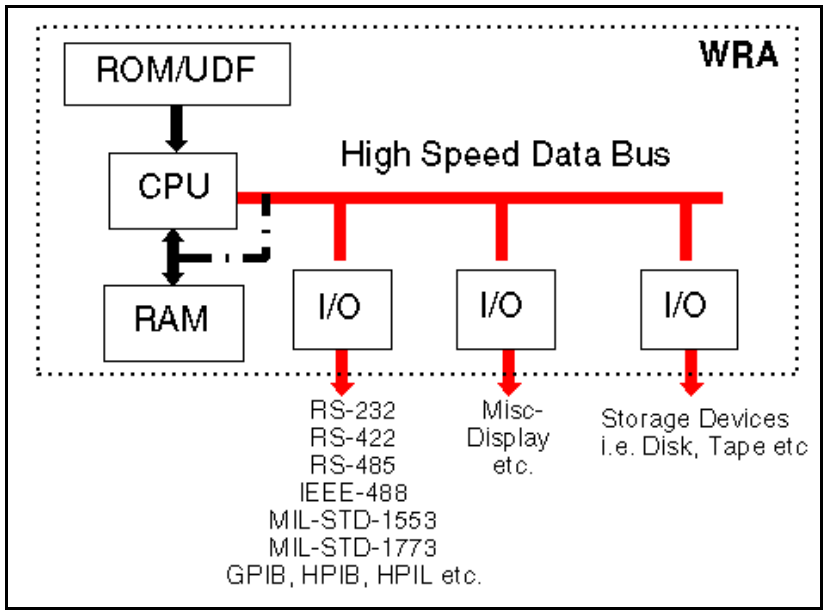

Figure 1. Avionics Block Diagram.

The Input/Output (I/O) modules will vary in function, but all serve the same purpose - to translate the electrical signals from one protocol to one of another in order to exchange information. I/O modules are used similarly in general purpose computers in laboratories to test equipment and/or tie computers together via a local area network (LAN) to exchange information. Some of the methodologies include a star, ring, or bus type network (see terminology at the end of this section).

A number of network "models" exist for describing the functions, interfaces and protocols involved in network data interchange. Regardless of the descriptive model used, all strive toward the same end and none actually changes the detailed implementation. Table 1 shows the layer names and the number of layers of networking models presented in Internet Engineering Task Forces (IETF) Request For Comments (RFCs) and in common use by textbooks.

Table 1. Some Common Network Architecture Models.

IETF-RFC 1122	Kurose, Forouzan	Comer, Kozierok	Stallings	Cisco Academy
Four layer Internet model	*Five-layer Internet model or TCP/IP protocol suite*	*TCP/IP 5-layer reference model*	*Five layer TCP/IP model*	*Four layer Internet model*
Application	Application	Application	Application	Application
Transport	Transport	Transport	Host-to-host or transport	Transport
Internet	Network	Internet	Internet	Internetwork
Link	Data link	Data link (Network interface)	Network access	Network interface
	Physical	(Hardware)	Physical	

These textbooks are secondary sources that may be contrary to the intent of RFC 1122 and other primary sources such as the Open Systems Interconnection (OSI) Reference Model developed by the International Organization for Standardization (ISO).

The OSI Reference Model is a more general description for layered communications and computer network protocol design. The IETF makes no effort to follow the OSI model although RFCs sometimes refer to it. The description of the OSI layers is shown in Table 2.

Table 2. OSI Reference Model.

	Name	Use	Misc Example	IP Suitte
7	APPLICATION	Meaning of data	HL7, Modbus	DHCP, DNS, FTP, Gopher, HTTP, NTP, SMTP, SNMP, Telnet
6	PRESENTATION	Building blocks of data and encryption	ASCII, EBCDIC, MIDI	MIME, XDR, SSL
5	SESSION	Opening and closing of specific communication paths	NetBIOS, SAP, Half Duplex, Simplex, SDP	NetBIOS, RTP, SAP
4	TRANSPORT	Error checking	NBF	PPTP, SCTP, TCP, UDP
3	NETWORK	Determination of data paths within the network	NBF, Q.931, IS-IS	IP, ICMP
2	DATA LINK	Data transmission, source, destination, and checksum	802.3 (Ethernet), PPP 802.11a/b/g/n MAC, FDDI	ARP, PPP, PPTP, SLIP
1	PHYSICAL	Voltage levels, signal connections, wire, or fiber	RS-232, 10Base-T, 802.11a/b/g/n Physical	

A layer is a collection of conceptually similar functions that provide services to the layer above it and receives service from the layer below it. On each layer an instance provides services to the instances at the layer above and requests service from the layer below. For example, a layer that provides error-free communications across a network provides the path needed by applications above it, while it calls the next lower layer to send and receive packets that make up the contents of the path. Conceptually two instances at one layer are connected by a horizontal protocol connection on that layer.

Most networks do not use all layers. For example, RS-232 is only a physical layer. Ethernet is only layers 1 and 2. TCP/IP is a protocol, not a network, and uses layers 3 and 4 regardless of whether layers 1 and 2 are a telephone line, wireless connection, or 10Base-T Ethernet cable.

Most of the sections in this division discuss the lowest (physical) layer of communication. There are, however, several more areas of general interest which are included in later sections such as Ethernet and TCP/IP. These are used in general purpose computers like the desktop PC or lab networks, and are not commonly used in aircraft.

The typical high-speed data busses on avionics/computers do not operate as fast as the CPU clock speed, but they are much faster than the interface busses they connect to. There are a number of interface busses (physical layer in network model) which are widely used by aircraft, avionics systems and test equipment. The most common include the RS-232, the RS-422, the RS-485, the IEEE-488 (GP-IB/HP-IB) and the MIL-STD-1553A/B. The MIL-STD-1773 bus is a fiber optic implementation of the 1553 bus and may be used in the future when technology requires it to reduce susceptibility to emissions or other reasons.

A summary of these more common types follows in Table 3, which includes a brief descriptive comparison, while a section covering each in more detail is provided later.

Table 3. Summary of Physical Bus Characteristics.

Bus	Max Length	Max Number of Terminals(1)	Type	# of Lines(2)	Data Rate	Rise Time(3)	Data Format
RS-232C	100 feet max 50 ft at 20k bps	1	Serial	3-20	150 - 19,200 baud per sec		5- to 8- bit serial
RS-422	1.2 km(4)	10(5)	Serial	3	see figure in RS-232 section	<0.1 T_b	unspecified
RS-485	unspecified	32	Serial	3	10 MHz	<0.3 T_b	unspecified
IEEE-488 (GP-IB/HP-IB)	20 meters	14	Parallel	16	500 kHz(6)		8-bit parallel
HP-IL	100 meters	30	Serial	2	20 k BPS		serial
MIL-STD-1553B MIL-STD-1773	300 feet N/A	32(7)	Serial	3	1 MHz	100-300 ns	20-bit serial

NOTES FROM TABLE:

(1) Max Number of Terminals does not include the bus controller.

(2) Including ground/shield

(3) T_b = time duration of the unit interval at the applicable data signaling rate (pulse width)

(4) Length is function of data signaling rate influenced by the tolerable signal distortion, amount of longitudinally coupled noise and ground potential difference introduced between the controller and terminal circuit grounds as well as by cable balance. See RS-422 section for graph.

(5) Physical arrangement of multiple receivers involves consideration of stub line lengths, fail-safe networks, location of termination resistors, data rate, grounding, etc.

(6) Rate can go up to 1 MHz if special conventions are followed.

(7) Max Number of Terminals includes terminal reserved for broadcast commands.

BUS TERMINOLOGY

10BASE-T: Standard "Plain Vanilla" Ethernet based on Unshielded Twisted Pair wire

10BASE-F: 10Mbps fiber optic Ethernet

100BASE-T: Standard "Fast Ethernet" based on twisted pair copper wire

ADDRESS: A unique designation for the location of data or the identity of an intelligent device; allows each device on a single communications line to respond to its own message.

ASCII (American Standard Code for Information Interchange): Pronounced asky. A seven-bit-plus-parity code established by ANSI to achieve compatibility between data services.

ASYNCHRONOUS OPERATION: Asynchronous operation is the use of an independent clock source in each terminal for message transmission. Decoding is achieved in receiving terminals using clock information derived from the message.

BAUD: Unit of signaling speed. The speed in baud is the number of discrete events per second. If each event represents one bit condition, baud rate equals bits per second (BPS). When each event represents more than one bit, baud rate does not equal BPS.

BIT: Contraction of binary digit: may be either zero or one. A binary digit is equal to one binary decision or the designation of one or two possible values of states of anything used to store or convey information.

BIT RATE: The number of bits transmitted per second.

BRIDGE: A network bridge connects multiple network segments at the data link layer (layer 2) of the OSI model, and the term layer 2 switch is very often used interchangeably with bridge. Bridges are similar to repeaters or network hubs, devices that connect network segments at the physical layer; however, with bridging, traffic from one network is managed rather than simply rebroadcast to adjacent network segments.

BROADCAST: Operation of a data bus system such that information transmitted by the bus controller or a remote terminal is addressed to more than one of the remote terminals connected to the data bus.

BUS CONTROLLER: The terminal assigned the task of initiating information transfers on the data bus.

BUS MONITOR: The terminal assigned the task of receiving bus traffic and extracting selected information to be used at a later time.

BYTE: A binary element string functioning as a unit, usually shorter than a computer "word." Eight-bits per byte are most common. Also called a "character."

COMMAND/RESPONSE: Operation of a data bus system such that remote terminals receive and transmit data only when commanded to do so by the bus controller.

CRC: Cyclic Redundancy Check; a basic error-checking mechanism for link-level data transmissions; a characteristic link-level feature of (typically) bit-oriented data communications protocols. The data integrity of a received frame or packet is checked by an algorithm based on the content of the frame and then matched

with the result that is performed by a sender and included in a (most often, 16-bit) field appended to the frame.

CROSSOVER CABLE: Cable with transmit/receive pairs reversed so one computer or hub or switch can link directly to another.

DATA BUS: Whenever a data bus or bus is referred to in MIL-STD-1553B, it shall imply all the hardware including twisted shielded pair cables, isolation resistors, transformers, etc., required to provide a single data path between the bus controller and all the associated remote terminals.

DCE (Data Communications Equipment): Devices that provide the functions required to establish, maintain, and terminate a data-transmission connection; e.g., a modem.

DHCP: Dynamic Host Configuration Protocol - permits auto-assignment of temporary IP addresses for new devices logging in

DNS: Domain Name Server - associates names with IP addresses

DTE (Data Terminal Equipment): Devices acting as data source, data sink, or both.

DUPLEX: Communication traveling between two nodes in both directions

DYNAMIC BUS CONTROL: The operation of a data bus system in which designated terminals are offered control of the data bus.

EIA (Electronic Industries Association): A standards organization in the U.S.A. specializing in the electrical and functional characteristics of interface equipment.

FDM (Frequency-Division Multiplexer: A device that divides the available transmission frequency range into narrower banks, each of which is used for a separate channel.

FDX (Full Duplex): Simultaneous, two-way, independent transmission in both directions (4-wire).

FTP: File Transfer Protocol - the most popular mechanism for bulk movement of files on TCP/IP.

GATEWAY: Device which links Ethernet to dissimilar networks and transfers data at the application layer level. Interface cards link the PC to Ethernet via the PCI, ISA, PCMCIA, PC/104, or other buses.

GPIB: General Purpose Interface Bus (see section 9-5),

HALF DUPLEX: Operation of a data transfer system in either direction over a single line, but not in both directions on that line simultaneously.

HANDSHAKING: Exchange of predetermined signals between two devices establishing a connection. Usually part of a communications protocol.

HPIB / HPIL: Hewlett-Packard Interface Bus / Hewlett-Packard Interface Loop

HUB: The simplest method of redistributing data, are "dumb," not interpreting or sorting messages that pass through them. A hub can be as simple as an electrical buffer with simple noise filtering. It isolates the

impedances of multiple spokes in a star topology. Some hubs also have limited store-and-forward capability. They indiscriminately transmit data to all other devices, which are still on the same collision domain, connected to the hubs. They are not assigned MAC addresses or IP addresses.

IEEE (Institute of Electrical and Electronic Engineers): An international professional society that issues its own standards and is a member of ANSI and ISO.

IP: Internet Protocol portion of TCP/IP. It is a protocol used for communicating data across a packet-switched network.

IP ADDRESS: Address of a TCP/IP enabled device on an Intranet or Internet – in the form xxx.xxx.xxx.xxx, where xxx is an integer between 0 and 255.

LAN: Local Area Network

MAC: Media Access Control - the physical components which disassemble Ethernet message fames

MANCHESTER ENCODING: Digital encoding technique (specified for the IEEE 802.3 Ethernet baseband network standard) in which each bit period is divided into two complementary halves; a negative-to-positive (voltage) transition in the middle of the bit period designates a binary "1," while a positive-to-negative transition represents a "0." The encoding technique also allows the receiving device to recover the transmitted clock from the incoming data stream (self-clocking).

MESSAGE: A single message is the transmission of a command word, status word, and data words if they are specified. For the case of a remote terminal to remote terminal (RT to RT) transmission, the message shall include the two command words, the two status words, and data words.

MODE CODE: A means by which the bus controller can communicate with the multiplex bus related hardware, in order to assist in the management of information flow.

MODEM (Modulator-Demodulator): A device used to convert serial digital data from a transmitting terminal to a signal suitable for transmission over a telephone channel, or to reconvert the transmitted signal to serial digital data for acceptance by a receiving terminal.

MULTIPLEXOR (also Multiplexer): A device used for division of a transmission into two or more subchannels, either by splitting the frequency band into narrower bands (frequency division) or by allotting a common channel to several different transmitting devices one at a time (time division).

NETWORK: An interconnected group of nodes; a series of points, nodes, or stations connected by communications channels; the assembly of equipment through which connections are made between data stations.

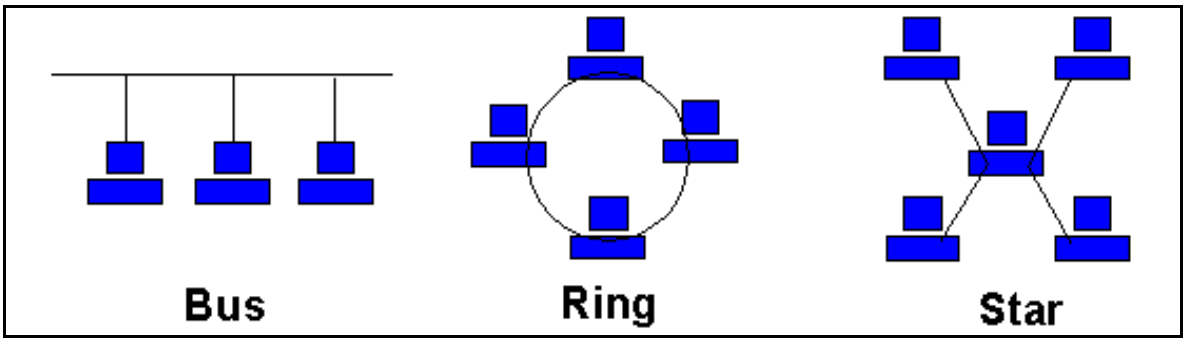

NODE: A point of interconnection to a network. Normally, a point at which a number of terminals or tail circuits attach to the network.

PARALLEL TRANSMISSION: Transmission mode that sends a number of bits simultaneously over separate lines (e.g., eight bits over eight lines) to a printer. Usually unidirectional.

PHASE MODULATION: One of three ways of modifying a sine wave signal to make it "carry" information. The sine wave or "carrier" has its phase changed in accordance with the information to be transmitted.

PING: Packet Inter Net Groper - very useful utility which probes for the existence of a TCP/IP host

POLLING: A means of controlling devices on a multipoint line.

PORT: A number in TCP/IP to which services are assigned; e.g. FTP is port 21; SMTP is port 25; HTTP is port 80.

PROTOCOL: A formal set of conventions governing the formatting and relative timing of message exchange between two communicating systems.

PULSE CODE MODULATION (PCM): The form of modulation in which the modulation signal is sampled, quantized, and coded so that each element of information consists of different types or numbers of pulses and spaces.

REMOTE TERMINAL (RT): All terminals not operating as the bus controller or as a bus monitor.

REPEATER: Buffer which cleans up, strengthens and re-transmits a signal.

ROUTER: Repeater which selectively re-distributes messages based on IP address

SERIAL TRANSMISSION: The most common transmission mode; in serial, information bits are sent sequentially on a single data channel.

SNMP: Simple Network Management Protocol; allows monitoring and management of a network.

SOCKET: Specific instance of an IP address and Port number that represents a single connection between two applications.

STAR TOPOLOGY: Topology which allows only one device at each end of a wire and requires repeaters for more than two devices.

STUBBING: Stubbing is the method wherein a separate line is connected between the primary data bus line and a terminal. The direct connection of stub line causes a mismatch which appears on the waveforms. This mismatch can be reduced by filtering at the receiver and by using bi-phase modulation. Stubs are often employed not only as a convenience in bus layout but as a means of coupling a unit to the line in such a manner that a fault on the stub or terminal will not greatly affect the transmission line operation. In this case, a network is employed in the stub line to provide isolation from the fault. These networks are also used for stubs that are of such length that the mismatch and reflection degrades bus operation. The preferred method of stubbing is to use transformer coupled stubs. The method provides the benefits of DC isolation, increased common mode protection, a doubling of effective stub impedance, and fault isolation for the entire stub and terminal. Direct coupled stubs should be avoided if at all possible. Direct coupled stubs provide no DC isolation or common mode rejection for the terminal external to its subsystem. Further, any shorting fault between the subsystems' internal isolation resistors (usually on the circuit board) and the main bus junction will cause failure of that entire bus. It can be expected that when the direct stub length exceeds 1.6 feet, that it will begin to distort the main bus waveforms. Note that this length includes the cable runs internal to a given subsystem.

SUBSYSTEM: The device or functional unit receiving data transfer service from the data bus.

SWITCH: Repeater which selectively re-distributes messages based on hardware MAC address

SYNCHRONOUS TRANSMISSION: Transmission in which data bits are sent at a fixed rate, with the transmitter and receiver synchronized. Synchronized transmission eliminates the need for start and stop bits.

TCP: Transmission Control Protocol - mechanism in TCP/IP that ensures that data arrives intact and in correct order

TELNET: Standard interface through which a client may access a host as though it were local

TERMINAL: The electronic module necessary to interface the data bus with the subsystem and the subsystem with the data bus. Terminals may exist as separate units or be contained within the elements of the subsystem.

TIME DIVISION MULTIPLEXING (TDM): The transmission of information from several signal sources through one communication system with different signal samples staggered in time to form a composite pulse train.

UDP: User Datagram Protocol - lower overhead alternative to TCP protocol which does not guarantee message delivery

WORD: A set of bits or bytes comprising the smallest unit of addressable memory. In MIL-STD-1553B, a word is a sequence of 16 bits plus sync and parity.

RS-232 INTERFACE

INTRODUCTION

The RS-232 interface is the Electronic Industries Association (EIA) standard for the interchange of serial binary data between two devices. It was initially developed by the EIA to standardize the connection of computers with telephone line modems. The standard allows as many as 20 signals to be defined, but gives complete freedom to the user. Three wires are sufficient: send data, receive data, and signal ground. The remaining lines can be hardwired on or off permanently. The signal transmission is bipolar, requiring two voltages, from 5 to 25 volts, of opposite polarity.

COMMUNICATION STANDARDS

The industry custom is to use an asynchronous word consisting of: a start bit, seven or eight data bits, an optional parity bit and one or two stop bits. The baud rate at which the word sent is device-dependent. The baud rate is usually 150 times an integer power of 2, ranging from 0 to 7 (150, 300, 600, ..., 19,200). Below 150 baud, many system-unique rates are used. The standard RS-232-C connector has 25 pins, 21 pins which are used in the complete standard. Many of the modem signals are not needed when a computer terminal is connected directly to a computer, and Figure 1 illustrates how some of the "spare" pins should be linked if not needed. Figure 1 also illustrates the pin numbering used in the original DB-25 connector and that now commonly used with a DB-9 connector normally used in modern computers

Specifying compliance to RS-232 only establishes that the signal levels in two devices will be compatible and that if both devices use the suggested connector, they may be able to be connected. Compliance to RS-232 does not imply that the devices will be able to communicate or even acknowledge each other's presence.

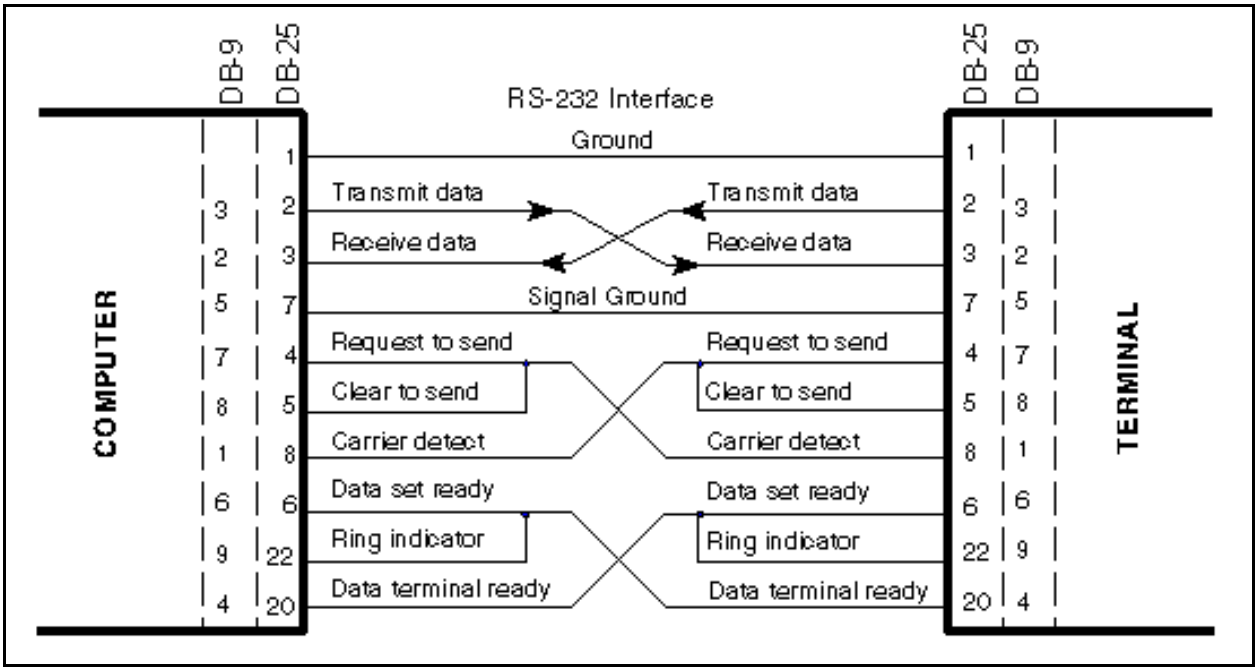

Figure 1. Direct-to-Computer RS-232 Interface.

Table 1 shows the signal names, and functions of the RS-232 serial port pinout. Table 2 shows a complete pin description.

Table 1. RS-232 Serial Port Pinout.

Name	Pin	Signal Name	Function
AA	1	PG Protective Ground	This line is connected to the chassis ground of the GPIB-232CV. Since the GPIB-232CV chassis ground is not connected to earth ground, pin 1 should be connected on both serial devices.
BA	2	TxD Transmit Data	This line carries serial data from the GPIB-232CV to the serial host.
BB	3	RxD Receive Data	This line carries serial data from the serial host to the GPIB-232CV.
CA	4	RTS Request to Send	This signal line is driven by the GPIB-232CV and when asserted indicates that the GPIB-232CV is ready to accept serial data. The GPIB-232CV un-asserts RTS when it is no longer ready to accept serial data because of a buffer full condition.
CB	5	CTS Clear to Send	This signal line is asserted by the serial host and sensed by the GPIB-232CV. When asserted, it indicates that the serial host is ready to accept serial data. When unasserted, it indicates that data transmission should be disabled.
AB	7	SG Signal Ground	This line establishes a reference point for all interface voltages.
CD	20	DTR Data Terminal Ready	This signal line is asserted by the GPIB-232CV to signal that it has been powered on, and is ready to operate.

Table 2. RS-232C Interface Signals.

Pin	Description	Pin	Description	Pin	Description
1	Protective Ground	10	(Reserved for Data Set Testing)	19	Secondary Request to Send
2	Transmitted Data	11	Unassigned	20	Data Terminal Ready
3	Received Data	12	Sec. Rec'd. Line Sig. Detector	21	Signal Quality Detector
4	Request to Send	13	Sec. Clear to Send	22	Ring Indicator
5	Clear to Send	14	Secondary Transmitted Data	23	Data Signal Rate Selector (DTE/DCE Source)
6	Data Set Ready	15	Transmission Signal Element Timing (DCE Source)	24	Transmit Signal Element Timing (DTE Source)
7	Signal Ground (Common Return)	16	Secondary Received Data	25	Unassigned
8	Received Line Signal Detector	17	Receiver Signal Element Timing (DCE Source)		
9	(Reserved for Data Set Testing)	18	Unassigned		

Electrical Characteristics: The RS-232-C specifies the signaling rate between the DTE and DCE, and a digital signal is used on all interchange circuits. The RS-232 standard specifies that logic "1" is to be sent as a voltage in the range -15 to -5 V and that logic "0" is to sent as a voltage in the range +5 to +15 V. The standard specifies that voltages of at least 3 V in amplitude will always be recognized correctly at the receiver according to their polarity, so that appreciable attenuation along the line can be tolerated. The transfer rate is rated > 20 kbps and a distance of < 15 m. Greater distance and data rates are possible with good design, but it is reasonable to assume that these limits apply in practice as well as in theory. The load impedance of the terminator side of the interface must be between 3000 and 7000 ohms, and not more than 2500 pF.

Table 3, summarizes the functional specifications of the most important circuits.

Table 3. RS-232-C Circuit Definitions.

Name	Direction to:	Function
Data Signals		
Transmitted Data (BA)	DCE	Data generated by DTE
Received Data (BB)	DTE	Data Received by DTE
Timing signals		
Transmitter Signal Element Timing (DA)	DCE	Clocking signal, transitions to ON and OFF occur at center of each signal element
Transmitter Signal Element Timing (DB)	DTE	Clocking signal, as above; both leads relate to signals on BA
Receiver Signal Element Timing (DD)	DTE	Clocking signal, as above, for circuit BB
Control Signals		
Request to Send (CA)	DCE	DTE wishes to transmit
Clear to Send (CB)	DTE	DCE is ready to transmit; response to request to send
Data Set Ready (CC)	DTE	DCE is ready to operate
Data Terminal Ready (CD)	DCE	DTE is ready to operate
Ring Indicator (CE)	DTE	Indicates that DCE is receiving a ringing signal on the communication channel
Carrier Detect (CF)	DTE	Indicates that DCE is receiving a carrier signal
Signal Quality Detector (CG)	DTE	Asserted when there is reason to believe there is an error in the received data
Data Signal Rate Selector (CH)	DCE	Asserted to select the higher of two possible data rates
Data Signal Rate Selector (CI)	DTE	Asserted to select the higher of two possible data rates
Ground		
Protective Ground (AA)	NA	Attached to machine frame and possibly external grounds
Signal Ground (AB)	NA	Establishes common ground reference for all circuits

Range: The RS-232-C standard specifies that the maximum length of cable between the transmitter and receiver should not exceed 100 feet. Although in practice many systems are used in which the distance between transmitter and receiver exceeds this rather low figure. The limited range of the RS-232C standard is one of its major shortcomings compared with other standards which offer greater ranges within their specifications. One reason why the range of the RS-232C standard is limited is the need to charge and discharge the capacitance of the cable connecting the transmitter and receiver.

Mechanical Characteristics: The connector for the RS-232-C is a 25 pin connector with a specific arrangement of wires. In theory, a 25 wire cable could be used to connect the Data Terminal Equipment (DTE) to the Data Communication Equipment (DCE). The DTE is a device that is acting as a data source, data sink, or both, e.g. a terminal, peripheral, or computer. The DCE is a device that provides the functions required to establish, maintain, and terminate a data-transmission connecting, as well as the signal conversion, and coding required for communication between data terminal equipment and data circuit; e.g. a modem. Table 4, shows the complete summary of the RS-232-C, e.g., descriptor, sponsor, data format, etc.

Table 4. Summary of the RS-232-C.

Data Format	5- to 8- bit serial
Transfer Type	Asynchronous
Error Handling	Optional Parity Bit
Connector	25-pin female connector on DCE; 25-pin male connector on DTE
Length	20 meters
Speed	20 kb/s
Remarks	RS-232 is used in the microcomputer world for communications between two DTEs. The null-modem is included into one or both connecting devices, and/or cable and is seldom documented. As a result, establishing an RS-232 connection between two DTEs is frequently a difficult task.

RS-422 BALANCED VOLTAGE INTERFACE

Specifying compliance to RS-422 only establishes that the signal between the specified devices will be compatible. It does not indicate that the signal functions or operations between the two devices are compatible. The RS-422 standard only defines the characteristic requirements for the balanced line drivers and receivers. It does not specify one specific connector, signal names, or operations. RS-422 interfaces are typically used when the data rate or distance criteria cannot be met with RS-232. The RS-422 standard allows for operation of up to 10 receivers from a single transmitter. The standard does not define operations of multiple tri-stated transmitters on a link.

The RS-422-A interfaces between the Data Terminal Equipment (DTE) and Data Communication Equipment (DCE) or in any point-to-point interconnection of signals between digital equipment. It employs the electrical characteristics of balanced-voltage digital interface circuits.

The balanced voltage digital interface circuit will normally be utilized on data, timing, or control circuits where the data signaling rate is up to 10 Mbit/s. While the balanced interface is intended for use at the higher data signaling rate, it may (in preference to the unbalanced interface circuit) generally be required if any of the following conditions prevail:

- The interconnecting cable is too long for effective unbalanced operation.
- The interconnecting cable is exposed to an extraneous noise source that may cause an unwanted voltage in excess of + 1 volt measured differentially between the signal conductor and circuit common at the load end of the cable with a 50 ohm resistor substituted for the generator.
- It is necessary to minimize interference with other signals.
- Inversion of signals may be required, i.e. plus to minus MARK may be obtained by inverting the cable pair.

Applications of the balanced voltage digital interface circuit are shown in Figure 1.

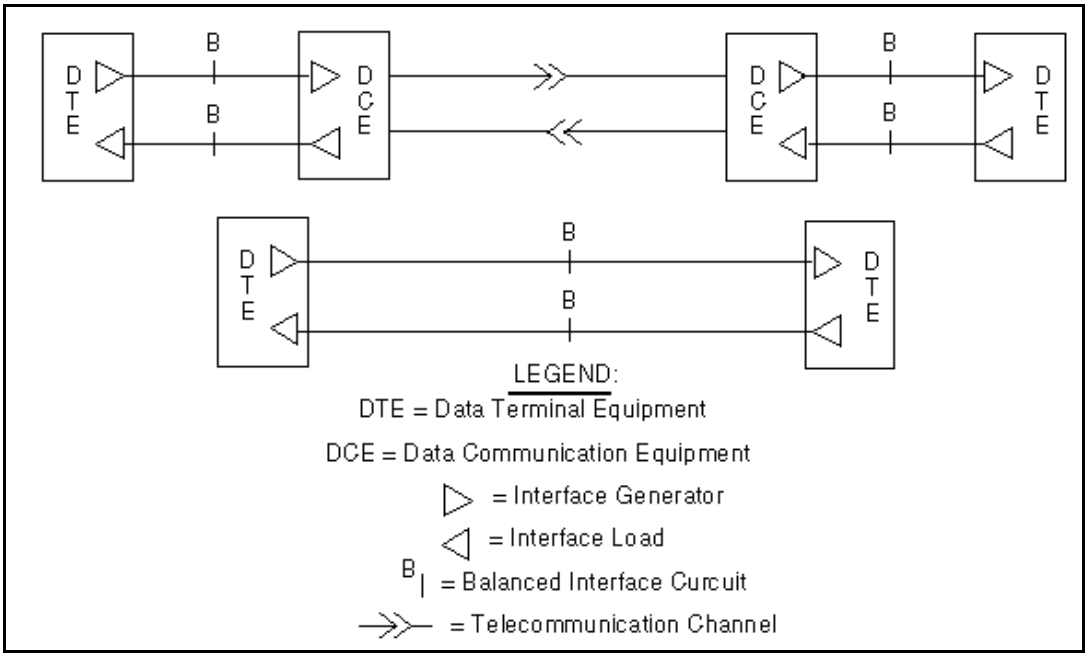

Figure 1. Application of a RS-422 Circuit.

While a restriction on maximum cable length is not specified, guidelines are given later with respect to conservative operating distances as function of data signaling rate.

For a binary system in which the RS-422-A is designed, the data signaling rate in bit/s and the modulation in bauds are numerically equal when the unit interval used in each determination is the minimum interval.

Electrical Characteristics:

The balanced voltage digital interface circuit consists of three parts: the generator (G), the balanced interconnecting cable, and the load. The load is comprised of one or more receivers (R) and an optional cable termination resistance (RT). The balanced voltage interface circuit is shown in Figure 2.

Environmental Constraints:

Balanced voltage digital interface conforming to this standard will perform satisfactorily at data signaling rates up to 10 Mbit/s providing that the following operational constraints are satisfied:

- The interconnecting cable length is within that recommended for the applicable data signaling rate (see Figure 3) and the cable is appropriately terminated.
- The common mode voltage at the receiver is less than 7 volts (peak). The common mode voltage is defined to be any uncompensated combination of generator-receiver ground potential difference, the generator offset voltage (Vos), and longitudinally coupled peak noise voltage measured between the received circuit ground and cable within the generator ends of the cable short-circuited to ground.

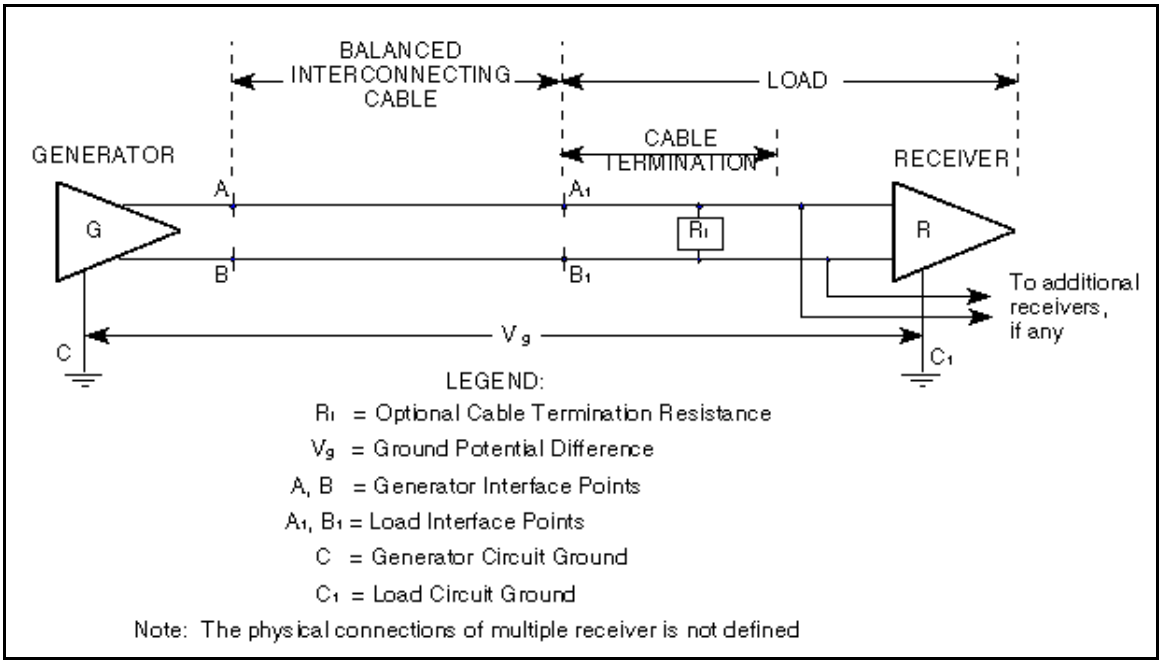

Figure 2. Balanced Digital Interface Circuit.

Interconnecting Cable Guidelines:

The maximum permissible length of cable separating the generator and the load is a function of data signaling rate and is influenced by the tolerable signal distortion, the amount of coupled noise and ground potential difference introduced between the generator and load circuit as well as by cable balance. The curve of cable length versus signaling rate is given in Figure 3. This curve is based upon using 24 AWG copper, twisted-pair cable with a capacitance of 52.5 pF/meter terminated in a 100 ohm load. As data signaling rate is reduced below 90 kbit/s, the cable length has been limited at 1200 meters by the assumed maximum allowable 6 dBV signal loss.

Industry customs are not nearly as well established for RS-422 interfaces as they are for RS-232. The standard specifies use of the 37-pin "D"; the 9-pin "D" is specified for use with the secondary channel. Most data communications equipment uses the 37-pin "D"; many computer applications use a 9-pin "D" only. Some equipment applications use the 25-pin "D" defined for RS-232.

Compatibility With Other Interfaces:

Since the basic differential receivers of RS-423-A and RS-422-A are electrically identical, it is possible to interconnect an equipment using RS-423-A receivers and generators on one side of the interface with an equipment using RS-422-A generators and receivers on the other side of the interface, if the leads of the receivers and generators are properly configured to accommodate such an arrangement and the cable is not terminated.

This circuit is not intended for interoperation with other interface electrical circuits such as RS-232-C, MIL-STD-188C, or CCITT (Comite Consultatif Internationale Telegraphique et Telephonique), recommendations V.28 and V.35. Under certain conditions, the above interfaces may be possible but may require modification of the interface or equipment; therefore satisfactory operation is not assured and additional provisions not specified herein may be required.

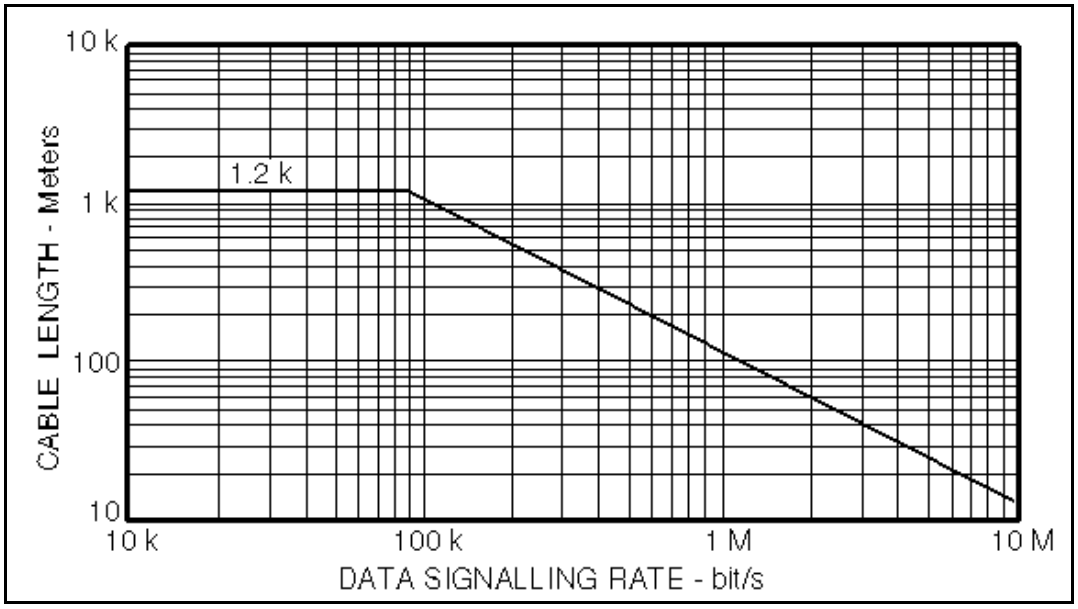

Figure 3. Data Signaling Rate vs. Cable Length.

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RS-485 INTERFACE

STANDARD FOR ELECTRICAL CHARACTERISTICS OF GENERATORS AND RECEIVERS FOR USE IN BALANCED DIGITAL MULTIPOINT SYSTEMS

Introduction: The RS-485 is the recommend standard by the Electronic Industries Association (EIA) that specifies the electrical characteristics of generators and receivers that may be employed for the interchange of binary signals in multipoint interconnection of digital equipments. When implemented within the guidelines, multiple generators and receivers may be attached to a common interconnecting cable. An interchange system includes one or more generators connected by a balanced interconnecting cable to one or more receivers and terminating resistors.

Electrical Characteristics: The electrical characteristics that are specified are measured at an interconnect point supplied by the devices manufacturer. Figure 1 shows an interconnection application of generators and receivers having the electrical parameters specified. The elements in the application are: generators, receivers, transmission cables, and termination resistances (Rt). The loads on the system caused by each receiver and passive generator shall be defined in terms of unit loads. Each generator can drive up to 32 unit loads consisting of both receivers and generators in the passive state. The loading caused by receivers and passive generators on the interconnect must be considered in defining the device electrical characteristics. Two areas are of concern: the DC load and the AC load characteristics. The DC load is defined as a number or fractions of "unit loads." The AC loading is not standardized but must be considered in the design of a system using the devices meeting this standard.

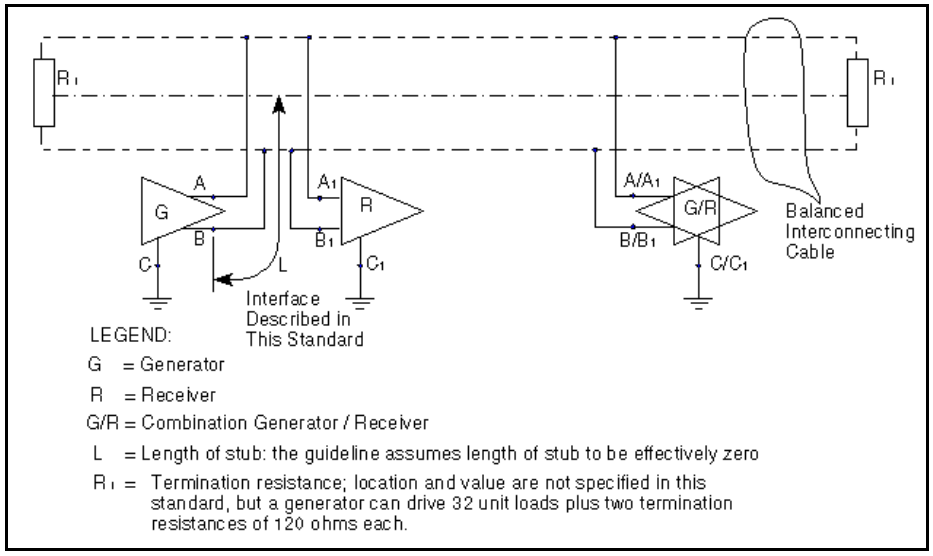

Figure 1. Multipoint Interconnect Application.

General System Configuration: The generators and receivers conforming to the RS-485 standard can operate with a common mode voltage between -7 volts and +7 volts (instantaneous). The common mode voltage is defined to be any uncompensated combination of generator-receiver ground potential difference and longitudinally coupled peak noise voltage measured between the receiver circuit ground and cable with the generator ends of the cable short circuited to ground, plus the generator offset voltage (Vos).

Grounding Arrangements: Proper operation of the generator and receiver circuits requires the presence of a signal return path between the circuit grounds of the equipment at each end of the interconnection. The grounding arrangements are shown in Figure 2. Where the circuit reference is provided by a third conductor, the connection between circuit common and the third conductor must contain some resistance (e.g., 100 ohms) to limit circulating currents when other ground connections are provided for safety. Some applications may require the use of shielded interconnecting cable for EMI or other purposes. The shield shall be connected to frame ground at either or both ends, depending on the application.

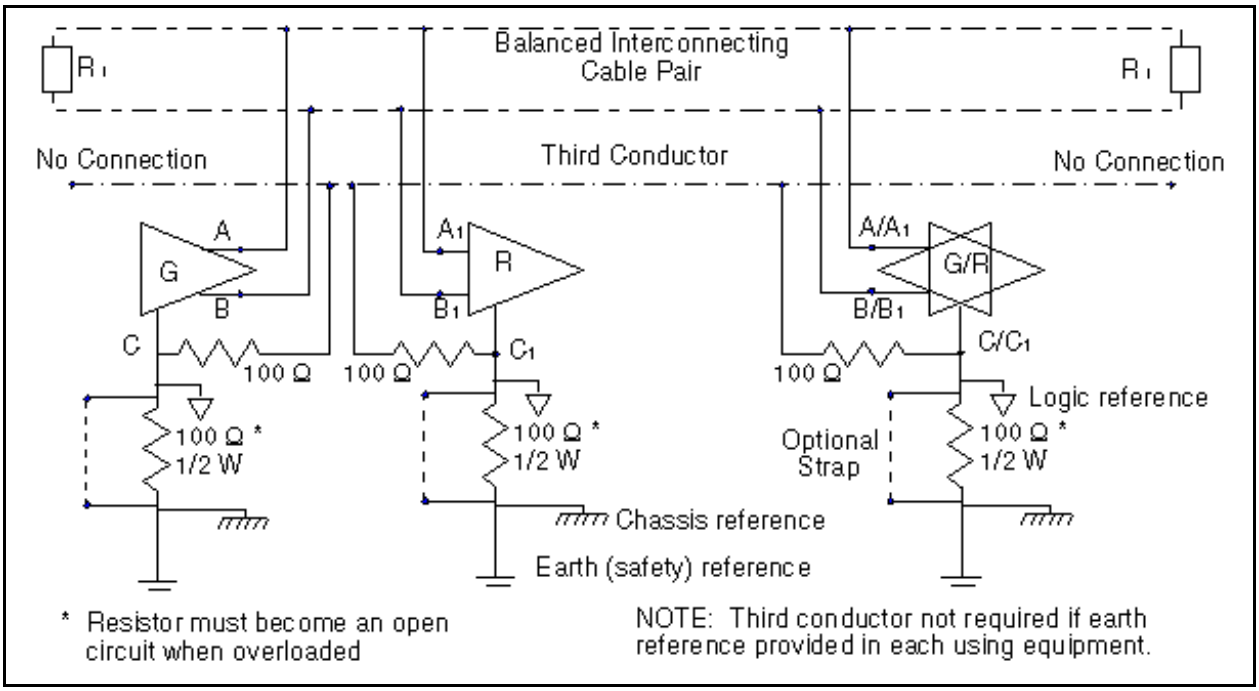

Figure 2. Grounding Arrangements.

Similarity with RS-422-A:

In certain instances, it may be possible to produce generators and receivers that meet the requirements of both RS-422-A and of RS-485. Table 1 depicts the differences in parameter specifications which exist between the two documents.

Table 1. Comparison of RS-422-A and RS-485 Characteristics.

Characteristic	RS-422-A	RS-485
Min. output voltage	2V into 100 ohm > 1/2 open circuit V	1.5 V into 54 ohms
I_{short} to ground	150 mA maximum	
I_{short} to -7, +12 volts		250 mA peak
t_{rise} time	< 0.1 t_b , 100 ohm load	< 0.3 t_b , 54 ohm, 50 pF load

Where t_b = time duration of the unit interval at the applicable data signaling rate (pulse width).

IEEE-488 INTERFACE BUS (HP-IB/GP-IB)

In the early 1970's, Hewlett-Packard came out with a standard bus (HP-IB) to help support their own laboratory measurement equipment product lines, which later was adopted by the IEEE in 1975. This is known as the IEEE Std. 488-1975. The IEEE-488 Interface Bus (HP-IB) or general purpose interface bus (GP-IB) was developed to provide a means for various instruments and devices to communicate with each other under the direction of one or more master controllers. The HP-IB was originally intended to support a wide range of instruments and devices, from the very fast to the very slow.

DESCRIPTION

The HP-IB specification permits up to 15 devices to be connected together in any given setup, including the controller if it is part of the system. A device may be capable of any other three types of functions: controller, listener, or talker. A device on the bus may have only one of the three functions active at a given time. A controller directs which devices will be talkers and listeners. The bus will allow multiple controllers, but only one may be active at a given time. Each device on the bus should have a unique address in the range of 0-30. The maximum length of the bus network is limited to 20 meters total transmission path length. It is recommended that the bus be loaded with at least one instrument or device every 2 meter length of cable (4 meters is maximum). The use of GP-IB extenders may be used to exceed the maximum permitted length of 20 meters.

ELECTRICAL INTERFACE

The GP-IB is a bus to which many similar modules can be directly connected, as is shown in Figure 1. A total of 16 wires are shown in the figure - eight data lines and eight control lines. The bus cables actually have 24 wires, providing eight additional for shielding and grounds.

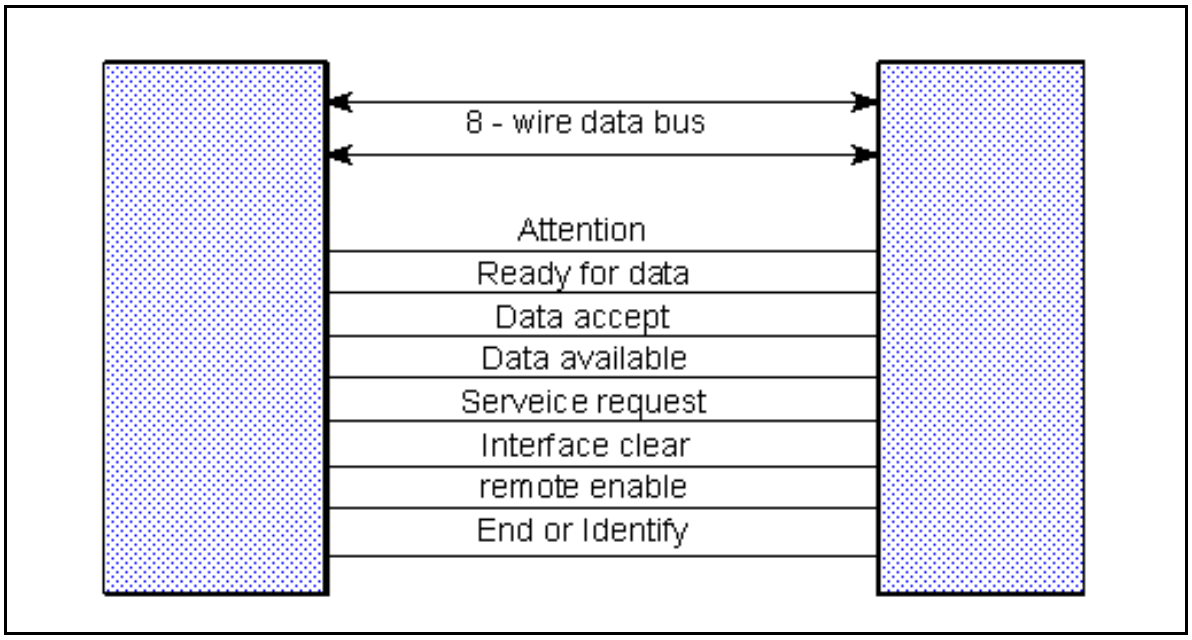

Figure 1. IEEE-488 (HP-IB / GP-IB) Bus Configuration.

The GP-IB defines operation of a three-wire handshake that is used for all data transfers on the bus. The bus operation is asynchronous in nature. The data-transfer rate of the GP-IB is 500 kHz for standard applications and can go up 1 MHz if special conventions are followed. Each transaction carries 8 bits, the maximum data bandwidth is on the order of 4 to 8 megabits (1 M byte) per second. The bus is a two way communications channel and data flows in both directions. Figure 2 illustrates the structure of the GP-IB bus and identifies the 16 connections of the interconnecting cable.

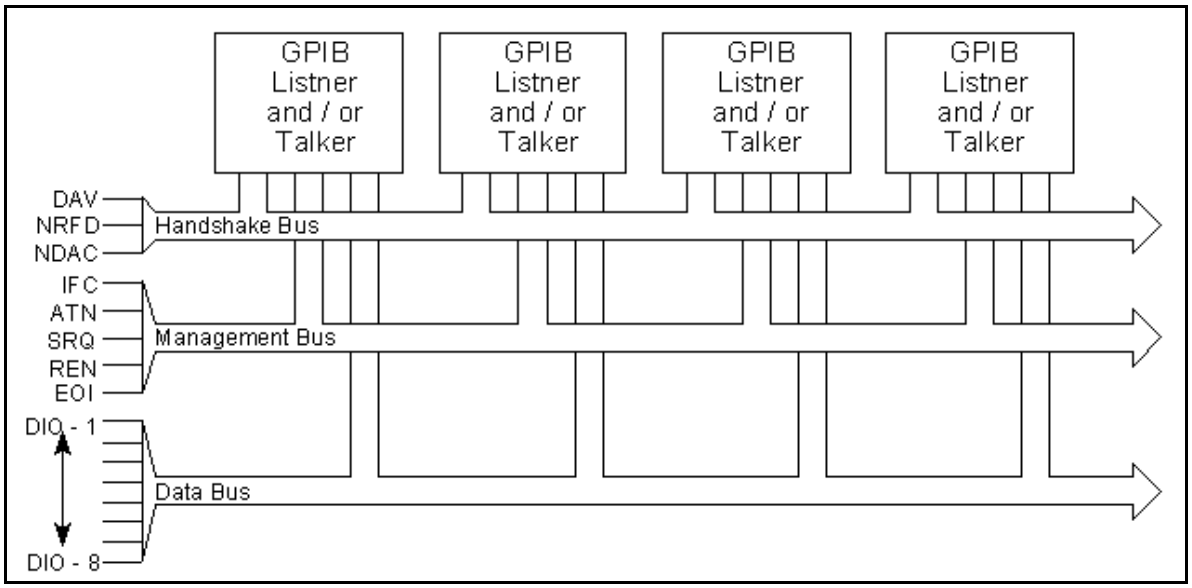

Figure 2. GP-IB Instrumentation Bus Structure.

The cabling limitations make it a less-than-ideal choice for large separation between devices. These limitations can be overcome with bus extenders. Those attempting to use bus extenders should be aware that few extenders are as transparent as claimed. This is especially true in handling of continuous data and interrupts. In nonextended environments, it provides an excellent means for high-speed computer control of multiple devices.

The following table shows the various interface functions, the mnemonics and the descriptions.

Table 1. GP-IB Interface Functions.

Interface Function	Mnemonic	Description
Talker (extended talker)	T (TE)	Device must be able to transmit
Listener (Extended listener)	L (LE)	Device must receive commands and data
Source Handshake	SH	Device must properly transfer a multiline message
Acceptor Handshake	AH	Device must properly receive remote multiline messages
Remote/Local	RL	Device must be able to operate from front panel and remote information from bus
Service Request	SR	Device can asynchronously request service from the controller
Parallel Poll	PP	Upon controller request, device must uniquely identify itself if it requires service
Device Clear	DC	Device can be initialized to a predetermined state
Device Trigger	DT	A device function can be initiated by the talker on the bus
Controller	C	Device can send addresses, universal commands, address commands, and conduct polls
Drivers	E	This code describes the type of electrical drivers in a device

The cabling specifications of the GP-IB interface system permit interconnecting all devices together in a star or linear configuration. The GP-IB connector is a 24-pin ribbon-type connector.

In summary, Table 2 on this page and the next shows the complete description of the GP-IB data bus.

Table 2. GP-IB Data Bus Description.

IEEE-488, GP-IB, HP-IB, or IEC-625					
Descriptor	8-bit parallel, monodirectional, multi-master (token passing) One controller, one talker, several listeners	Arbitration	Token passing: the controller addresses the next controller SRQ Service request when the controller assigns modes	Connector	24-pin Amphenol Female connector on equipment chassis. DIO1 1 ■ ■ 13 DIO5 DIO2 2 ■ ■ 14 DIO6 DIO3 3 ■ ■ 15 DIO7 DIO4 4 ■ ■ 16 DIO8 EOI 5 ■ ■ 17 REN DAV 6 ■ ■ 18 Gnd NRFD 7 ■ ■ 19 Gnd NDAC 8 ■ ■ 20 Gnd IFC 9 ■ ■ 21 Gnd SRQ 10 ■ ■ 22 Gnd ATN 11 ■ ■ 23 Gnd Shld 2 ■ ■ 24 Gnd
Sponsor	Hewlett-Packard	Error handling	Parity bit DI07 when 7-bit ACSII characters		
Standard	IEEE 488, IEC 625	Bus length	15 m		
Address space	31 devices	Driver	Special 24 mA drivers		
Data format	8-bit parallel	Speed	1 MByte/s		
Transfer type	Write only, talker toward listener(s) or commander toward all others			Remarks	The 488 is most commonly used for data acquisition of H-P peripherals. Programmable interfaces and drivers exist and simplify the development of microprocessor interfaces.
Timing	Handshaken 3-wire broadcast transfer: DAV data valid NDAC Not data accepted NRFD Not ready for data	References	IEEE Computer Society		

HP-IL VARIATION

Since introduction of the IEEE-488, technology produced a generation of medium-speed, low-power, instrumentation which had a need to operate in an automatic test system such as the GP-IB. The HP-IL (Hewlett-Packard Interface Loop), was introduced to meet this need. The HP-IL is a low-cost, low-power alternative to the GP-IB system. The HP-IL and GP-IB provide the same basic functions in interfacing controllers, instruments, and peripherals, but they differ in many other respects. HP-IL is suitable for use in low-power, portable applications (typically used for interface of battery-power systems). The GP-IB is not practical to operate from battery power. The HP-IL maximum data rate is 20K bytes per second. This is a high rate compared to the RS-232C, but much slower than GP-IB. The HP-IL can operate over distances of up to 100 meters between any two devices. Since it is a loop environment, there is no maximum system cable restriction. The basic device-addressing scheme allows for up to 30 devices on a loop.

MIL-STD-1553 & 1773 DATA BUS

PURPOSE

In recent years, the use of digital techniques in aircraft equipment has greatly increased, as have the number of avionics subsystems and the volume of data processed by them.

Because analog point-to-point wire bundles are inefficient and cumbersome means of interconnecting the sensors, computers, actuators, indicators, and other equipment onboard the modern military vehicle, a serial digital multiplex data bus was developed. MIL-STD-1553 defines all aspects of the bus, therefore, many groups working with the military tri-services have chosen to adopt it.

The 1553 multiplex data bus provides integrated, centralized system control and a standard interface for all equipment connected to the bus. The bus concept provides a means by which all bus traffic is available to be accessed with a single connection for testing and interfacing with the system. The standard defines operation of a serial data bus that interconnects multiple devices via a twisted, shielded pair of wires. The system implements a command-response format.

MIL-STD-1553, "Aircraft Internal Time-Division Command/Response Multiplex Data Bus," has been in use since 1973 and is widely applied. MIL-STD-1553 is referred to as "1553" with the appropriate revision letter (A or B) as a suffix. The basic difference between the 1553A and the 1553B is that in the 1553B, the options are defined rather than being left for the user to define as required. It was found that when the standard did not define an item, there was no coordination in its use. Hardware and software had to be redesigned for each new application. The primary goal of the 1553B was to provide flexibility without creating new designs for each new user. This was accomplished by specifying the electrical interfaces explicitly so that compatibility between designs by different manufacturers could be electrically interchangeable.

The Department of Defense chose multiplexing because of the following advantages:

- Weight reduction
- Simplicity
- Standardization
- Flexibility

Some 1553 applications utilize more than one data bus on a vehicle. This is often done, for example, to isolate a Stores bus from a Communications bus or to construct a bus system capable of interconnecting more terminals than a single bus could accommodate. When multiple buses are used, some terminals may connect to both buses, allowing for communication between them.

MULTIPLEXING

Multiplexing facilitates the transmission of information along the data flow. It permits the transmission of several signal sources through one communications system.

BUS

The bus is made up of twisted-shielded pairs of wires to maintain message integrity. MIL-STD-1553 specifies that all devices in the system will connect to a redundant pair of buses. This provides a second path for bus traffic should one of the buses be damaged. Signals are only allowed to appear on one of the two buses at a time. If a message cannot be completed on one bus, the bus controller may switch to the other bus. In some applications more than one 1553 bus may be implemented on a given vehicle. Some terminals on the bus may actually connect to both buses.

BUS COMPONENTS

There are only three functional modes of terminals allowed on the data bus: the bus controller, the bus monitor, and the remote terminal. Devices may be capable of more than one function. Figure 1 illustrates a typical bus configuration.

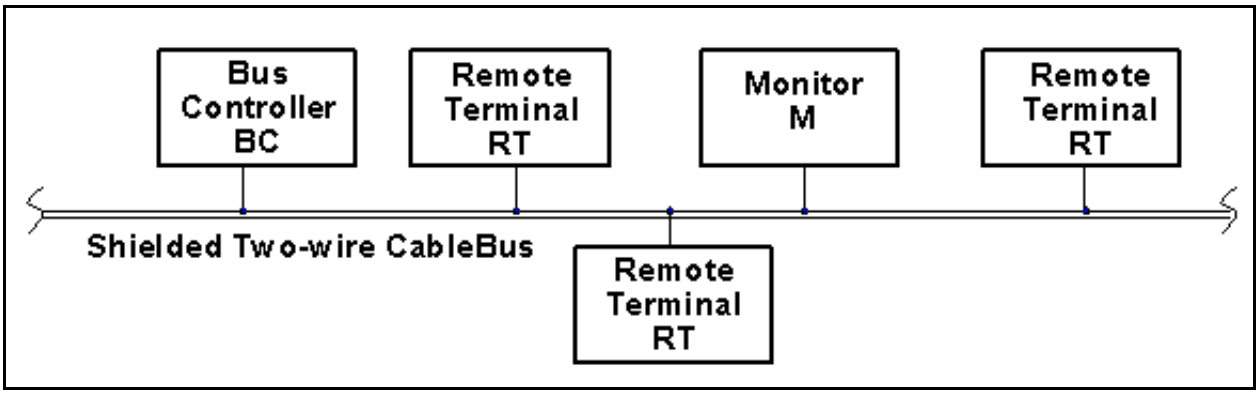

Figure 1. 1553 Bus Structure.

- Bus Controller - The bus controller (BC) is the terminal that initiates information transfers on the data bus. It sends commands to the remote terminals which reply with a response. The bus will support multiple controllers, but only one may be active at a time. Other requirements, according to 1553, are: (1) it is "the key part of the data bus system," and (2) "the sole control of information transmission on the bus shall reside with the bus controller."

- Bus Monitor - 1553 defines the bus monitor as "the terminal assigned the task of receiving bus traffic and extracting selected information to be used at a later time." Bus monitors are frequently used for instrumentation.

- Remote Terminal - Any terminal not operating in either the bus controller or bus monitor mode is operating in the remote terminal (RT) mode. Remote terminals are the largest group of bus components.

MODULATION

The signal is transferred over the data bus using serial digital pulse code modulation.

DATA ENCODING

The type of data encoding used by 1553 is Manchester II biphase.

- A logic one (1) is transmitted as a bipolar coded signal 1/0 (in other words, a positive pulse followed by a negative pulse).
- A logic zero (0) is a bipolar coded signal 0/1 (i.e., a negative pulse followed by a positive pulse).

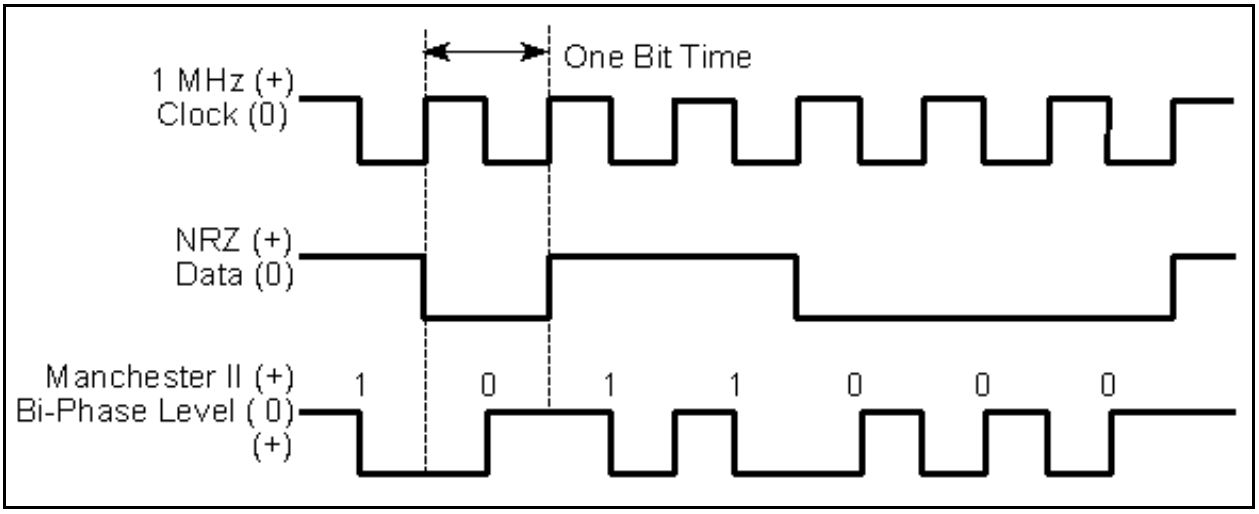

Figure 2. Data Encoding.

A transition through zero occurs at the midpoint of each bit, whether the rate is a logic one or a logic zero. Figure 2 compares a commonly used Non Return to Zero (NRZ) code with the Manchester II biphase level code, in conjunction with a 1 MHz clock.

BIT TRANSMISSION RATE

The bit transmission rate on the bus is 1.0 megabit per second with a combined accuracy and long-term stability of +/- 0.1%. The short-term stability is less than 0.01%.

There are 20 1.0-microsecond bit times allocated for each word. All words include a 3 bit-time sync pattern, a 16-bit data field that is specified differently for each word type, and 1 parity check bit.

WORD FORMATS

Bus traffic or communications travels along the bus in words. A word in MIL-STD-1553 is a sequence of 20 bit times consisting of a 3 bit-time sync wave form, 16 bits of data, and 1 parity check bit. This is the word as it is transmitted on the bus; 1553 terminals add the sync and parity before transmission and remove them during reception. Therefore, the nominal word size is 16 bits, with the most significant bit (MSB) first.

There are three types of words: command, status, and data. A packet is defined to have no inter-message gaps. The time between the last word of a controller message and the return of the terminal status

byte is 4-12 microseconds. The time between status byte and the next controller message is undefined. Figure 3 illustrates these three formats.

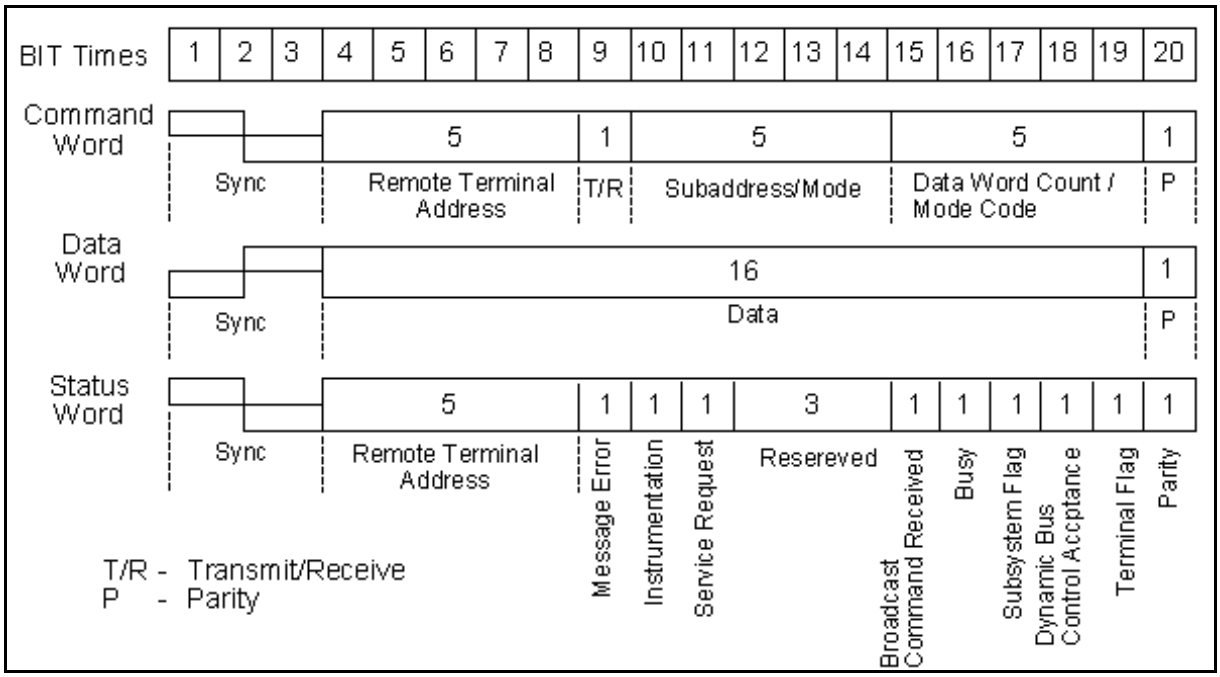

Figure 3. 1553 Word Formats.

COMMAND WORD

Command words are transmitted only by the bus controller and always consist of:

- 3 bit-time sync pattern
- 5 bit RT address field
- 1 Transmit/Receive (T/R) field
- 5 bit subaddress/mode field
- 5 bit word count/mode code field
- 1 parity check bit.

DATA WORD

Data words are transmitted either by the BC or by the RT in response to a BC request. The standard allows a maximum of 32 data words to be sent in a packet with a command word before a status response must be returned. Data words always consist of:

- 3 bit-time sync pattern (opposite in polarity from command and status words)
- 16 bit data field
- 1 parity check bit.

STATUS WORD

Status words are transmitted by the RT in response to command messages from the BC and consist of:

- 3 bit-time sync pattern (same as for a command word)
- 5 bit address of the responding RT
- 11 bit status field
- 1 parity check bit.

The 11 bits in the status field are used to notify the BC of the operating condition of the RT and subsystem.

INFORMATION TRANSFERS

Three basic types of information transfers are defined by 1553:

- Bus Controller to Remote Terminal transfers
- Remote Terminal to Bus Controller transfers
- Remote Terminal to Remote Terminal transfers

These transfers are related to the data flow and are referred to as messages. The basic formats of these messages are shown in Figure 4.

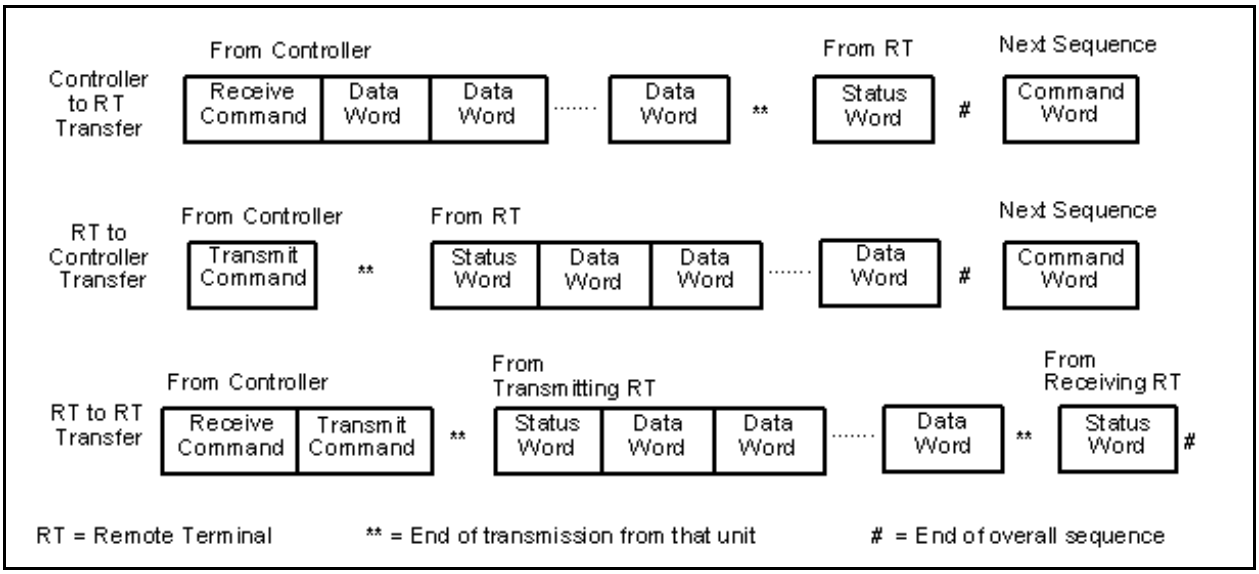

Figure 4. 1553 Data Message Formats.

The normal command/response operation involves the transmission of a command from the BC to a selected RT address. The RT either accepts or transmits data depending on the type (receive/transmit) of command issued by the BC. A status word is transmitted by the RT in response to the BC command if the transmission is received without error and is not illegal.

Figure 5 illustrates the 1553B Bus Architecture in a typical aircraft.

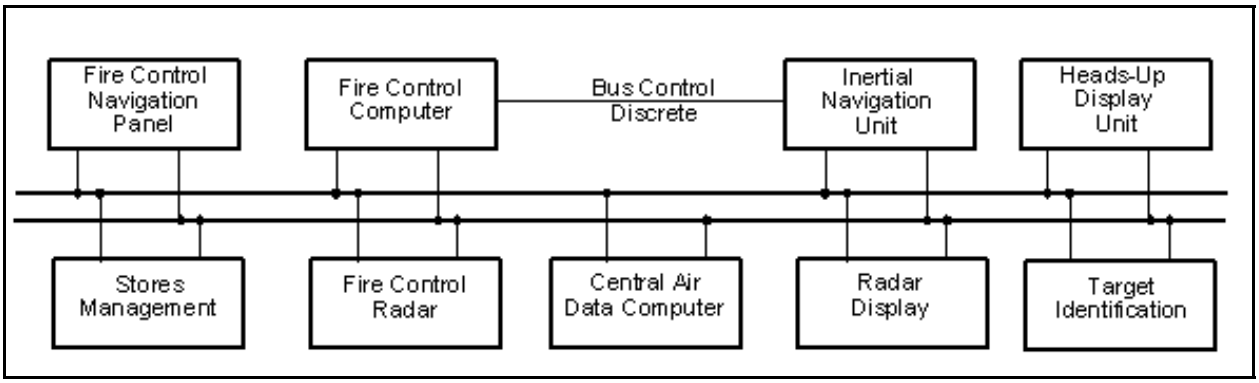

Figure 5. Typical Bus Architecture.

MIL-STD-1773

MIL-STD-1773 contains the requirements for utilizing a fiber optic "cabling" system as a transmission medium for the MIL-STD-1553B bus protocol. As such, the standard repeats MIL-STD-1553 nearly word-for-word. The standard does not specify power levels, noise levels, spectral characteristics, optical wavelength, electrical/optical isolation or means of distributing optical power. These must be contained in separate specifications for each intended use.

Data encoding and word format are identical to MIL-STD-1553, with the exception that pulses are defined as transitions between 0 (off) and 1 (on) rather than between + and - voltage transitions since light cannot have a negative value.

Since the standard applies to cabling only, the bus operates at the same speed as it would utilizing wire. Additionally, data error rate requirements are unchanged.

Different environmental considerations must be given to fiber optic systems. Altitude, humidity, temperature, and age affects fiber optics differently than wire conductors. Power is divided evenly at junctions which branch and connectors have losses just as wire connectors do.

ETHERNET

HISTORY

Ethernet was originally developed by Digital, Intel, and Xerox (DIX) in the early 1970's at the Xerox Palo Alto Research Center (PARC). The two primary inventors were Robert Metcalf and David Boggs.

IEEE Project 802 was set up in February 1980 to provide standards for Local Area Network (LAN) and Metropolitan Area Network (MAN) Architecture. The following committees were established:

- IEEE 802.1: Standards related to network management.
- IEEE 802.2: General standard for the data link layer in the OSI Reference Model. The IEEE divides this layer into two sub-layers -- the logical link control (LLC) layer and the media access control (MAC) layer. The MAC layer varies for different network types and is defined by standards IEEE 802.3 through IEEE 802.5.
- IEEE 802.3: Defines the MAC layer for bus networks that use CSMA/CD. **This is the basis of what is most commonly referred to as the Ethernet standard**.
- IEEE 802.4: Defines the MAC layer for token-bus networks.
- IEEE 802.5: Defines the MAC layer for token-ring networks.
- IEEE 802.6: Standard for Metropolitan Area Networks (MANs).
- IEEE 802.7-9 Inactive Standards:
    - IEEE 802.7: Broadband local area networks. The working group is currently inactive.
    - IEEE 802.8: The Fibre Optic Technical Advisory Group was to create a LAN standard for fiber optic media used in token passing computer networks like FDDI.
    - IEEE 802.9: Integrated Services (IS) LAN Interface at the MAC and Physical Layers.
- IEEE 802.10: A standard for security functions that can be used in both LAN and MAN.
- IEEE 802.11: Wireless LAN MAC and physical layer
- IEEE 802.12: Demand Priority Access Method, Physical Layer and Repeater used in star topology, 100VG-AnyLAN, etc
- IEEE 802.16: Fixed broadband wireless LAN

Ethernet versions 1.0 and 2.0 followed after the original development until the IEEE 802.3 committee altered the structure of the Ethernet II packet to form the Ethernet 802.3 packet. You will currently see either Ethernet II (DIX) format or Ethernet 802.3 format being used.

IEEE 802.3 Ethernet uses Manchester Phase Encoding (MPE) for coding the data bits on the outgoing signal.

INTRODUCTION

Ethernet is a family of frame-based computer networking technologies for local area networks (LANs). The 'Ether' part of Ethernet denotes that the system is not meant to be restricted for use on only one medium type. Copper cables, fiber cables and even radio waves can be used.

Ethernet is standardized as IEEE 802.3. The combination of the twisted pair versions of Ethernet for connecting end systems to the network, along with the fiber optic versions for site backbones, is the most

widespread wired LAN technology. It has largely replaced competing LAN standards such as token ring, FDDI, and ARCNET.

Ethernet defines a number of wiring and signaling standards for the Physical Layer of the OSI networking model, through means of network access at the Media Access Control (MAC) / Data Link Layer, and a common addressing format. Therefore, Ethernet defines the lower two layers of the OSI Reference Model (see Data Busses Section intro). Ethernet sometimes implies an attached protocol—such as TCP/IP, however TCP/IP really defines the transport and network layers, respectively, of the OSI model.

Ethernet was designed as a 'broadcast' system, i.e. stations on the network can send messages whenever and wherever they want. All stations may receive the messages, however only the specific station to which the message is directed responds. To handle simultaneous demands, the system uses Carrier Sense Multiple Access with Collision Detection (CSMA/CD).

CARRIER SENSE MULTIPLE ACCESS WITH COLLISION DETECTION (CSMA/CD)

When an Ethernet station is ready to transmit, it checks for the presence of a signal on the cable. If no signal is present then the station begins transmission. However, if a signal is present then the station delays transmission until the cable is not in use. If two stations detect an idle cable and at the same time transmit data, then a collision occurs. On a star-wired, unshielded twisted pair (UTP) network, if the transceiver of a sending station detects activity on both its receive and transmit pairs before it has completed transmitting, then it decides that a collision has occurred. On a coaxial system, a collision is detected when the DC signal level on the cable is the same or greater than the combined signal level of the two transmitters. Line voltage drops dramatically if two stations transmit at the same time and the first station to notice this sends a high voltage jamming signal around the network as a signal. The two stations involved with the collision quit transmitting again for a random time interval.

A Collision Domain is that part of the network where each station can 'see' other stations' traffic both unicast and broadcasts. The Collision Domain is made up of one segment of Ethernet coax (with or without repeaters) or a number of UTP shared hubs. A network is segmented with bridges that create two segments, or two Collision Domains where a station on one segment cannot see traffic between stations on the other segment unless the packets are destined for itself. If it can still see all broadcasts on the segmented network(s), no matter the number of segments, it is a Broadcast Domain.

ETHERNET FRAME

Figure 1 depicts the structure of the older DIX (Ethernet II) and the now standard 802.3 Ethernet frames. The numbers above each field represent the number of bytes.

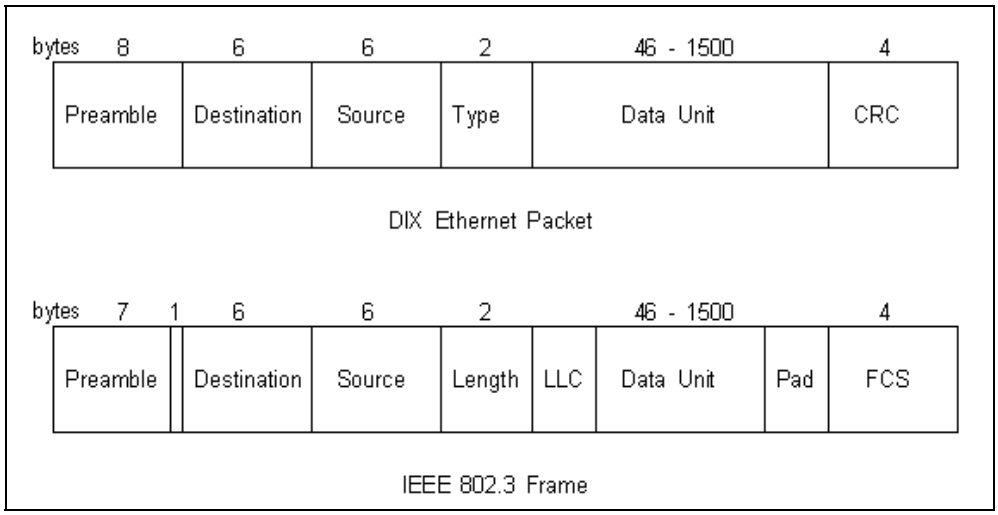

Figure 1. Ethernet Frame.

- **Preamble field:** Establishes bit synchronization and transceiver conditions so that the circuitry synchs with the received frame timing. The DIX frame has 8 bytes for the preamble rather than 7, as it does not have a Start Frame Delimiter (or Start of Frame).
- **Start Frame Delimiter:** Sequence 10101011 in a separate field, only in the 802.3 frame.
- **Destination address:** Hardware address (MAC address) of the destination station (usually 48 bits i.e. 6 bytes).
- **Source address:** Hardware address of the source station (must be of the same length as the destination address, the 802.3 standard allows for 2 or 6 byte addresses, although 2 byte addresses are never used, N.B. Ethernet II *only* uses 6 byte addresses).
- **Type:** Specifies the protocol sending the packet such as IP or IPX (only applies to DIX frame).
- **Length:** Specifies the length of the data segment, actually the number of LLC data bytes, (only applies to 802.3 frame and replaces the Type field).
- **LLC:** Logical Length Control is a data communication protocol layer which provides multiplexing and flow control mechanisms that make it possible for several network protocols (IP, IPX) to coexist within a multipoint network and to be transported over the same network media.
- **Data:** Actual data which is allowed anywhere between 46 to 1500 bytes within one frame.
- **Pad:** Zeros added to the data field to 'Pad' a short data field to 46 bytes (applies to 802.3 frame).
- **CRC:** Cyclic Redundancy Check to detect errors during transmission (DIX version of FCS).
- **FCS:** Frame Check Sequence to detect errors that occur during transmission (802.3 version of CRC). This 32-bit code has an algorithm applied to it, which will give the same result as the other end of the link, provided that the frame was transmitted successfully.

From the above we can see that the maximum 802.3 frame size is 1518 bytes and the minimum size is 64 bytes. Packets that have correct CRCs (or FCSs) but are smaller than 64 bytes are known as 'Runts'.

The hardware address, or MAC address is transmitted and stored in Ethernet network devices in **Canonical** format i.e. Least Significant Bit (LSB) first. The expression **Little-Endian** is used to describe the LSB format in which Ethernet is transmitted. On the other hand, Token Ring networks and the subset, Fiber

Distributed Data Interface (FDDI) networks, transmit the MAC address with the Most Significant Bit (MSB) first, or **Big-Endian**, This is known as **Non-Canonical** format. Note that this applies on a byte-by-byte basis i.e. the bytes are transmitted in the same order, it is just the bits in each of those bytes that are reversed. The storage of the MAC addresses in Token Ring and FDDI devices however, may sometimes still be in Canonical format so this can sometimes cause confusion. The reference to, the distribution of MAC addresses and the Organizationally Unique Identifier (OUI) destinations are always in Canonical format.

The Logical Link Control (LLC) protocol data unit (PDU) is defined in IEEE 802.2 and operates with 802.3 Ethernet as seen in Figure 2.

DSAP address	SSAP address	Control	Information
8 bits	8 bits	8 or 16 bits	M*8 bits

DSAP address	=	Destination service access point address field
SSAP address	=	Source service access point address field
Control	=	Control field [16 bits for formats that include sequence numbering, and 8 bits for formats that do not (see 5.2)]
Information	=	Information field
*	=	Multiplication
M	=	An integer value equal to or greater than 0. (Upper bound of M is a function of the medium access control methodology used.)

Figure 2. LLC Format.

LLC is based on the High-Level Data Link Control (HDLC) data protocol format. Whereas Ethernet II (2.0) combines the MAC and the Data link layers restricting itself to connectionless service in the process, IEEE 802.3 separates out the MAC and Data Link layers. IEEE 802.2 is also required by Token Ring and FDDI but cannot be used with the Novell 'Raw' format. There are three types of LLC; Type 1, which is connectionless, Type 2 which is connection-oriented, and Type 3 for Acknowledged Connections.

The **Service Access Point (SAP)** is used to distinguish between different data exchanges on the same end station and basically replaces the Type field for the older Ethernet II frame. The **Source Service Access Point (SSAP)** indicates the service from which the LLC data unit is sent, and the **Destination Service Access Point (DSAP)** indicates the service to which the LLC data unit is being sent. As examples, NetBIOS uses the SAP address of **F0** whilst IP uses the SAP address of **06**. The following lists some common SAPs:

00 - Null LSAP
02 - Individual LLC Sublayer Management Function
03 - Group LLC Sublayer Management Function
05 - IBM SNA Path Control (group)

06 - Internet Protocol (IP)
18 - Texas Instruments
42 - IEEE 802.1 Bridge Spanning Tree Protocol
80 - Xerox Network Systems (XNS)
86 - Nestar
AA - SubNetwork Access Protocol (SNAP)
E0 - Novell NetWare
F0 - IBM NetBIOS
F5 - IBM LAN Management (group)
FE - ISO Network Layer Protocol

The **Control Field** identifies the type of LLC, of which there are three:

- **Type 1** - Data (PDUs) shall be exchanged between LLCs without the need for the establishment of a data link connection. These PDUs shall not be acknowledged, nor shall there be any flow control or error recovery. This is called **Unsequenced Information (UI)**.
- **Type 2** – Needs data link connection. Uses **Information (I)** frames and maintains the sequence numbers during an acknowledged connection-oriented transmission.
- **Type 3** – No data link connection required. Uses **Acknowledged Connection (AC)** frames in an acknowledged connectionless service.

MAC ADDRESS

With an Ethernet MAC address, the first octet uses <u>only</u> the lowest significant bit as the Individual/Group (I/G) bit address identifier. If it is zero it indicates the address is individual. If it is one, it indicates a group address. The Universally or Locally administered (U/L) address bit is the bit of octet 0 adjacent to the I/G address bit. This bit indicates whether the address has been assigned by a local or universal administrator. Universally administered addresses have this bit set to 0. If this bit is set to 1, the entire address (i.e., 48 bits) has been locally administered.

The first 3 octets of the MAC address form the Organizational Unique Identifier (OUI) assigned by IEEE to organizations that requires their own group of MAC addresses.

SUBNETWORK ACCESS PROTOCOL (SNAP)

The SNAP protocol was introduced to allow an easy transition to the new LLC frame format for vendors. SNAP allows older frames and protocols to be encapsulated in a Type 1 LLC header making any protocol 'pseudo-IEEE compliant'. SNAP is described in RFC 1042. Figure 3 shows how it looks:

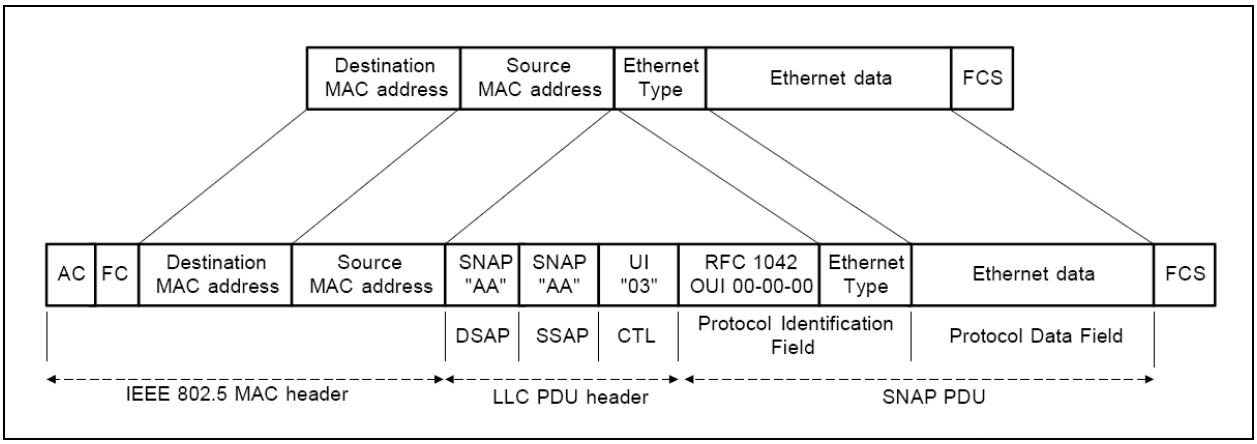

Figure 3. Ethernet Frame SNAP-encapsulated in IEEE 802.5 Frame.

It can be seen that it is an LLC data unit (sometimes called a Logical Protocol Data Unit (LPDU)) of Type 1 (indicated by 03). The DSAP and SSAP are set to AA to indicate that this is a SNAP header coming up. The SNAP header then indicates the vender via the Organizational Unique Identifier (OUI) and the protocol type via the Ethertype field. In the example above the OUI is 00-00-00 which means that there is an Ethernet frame. An ethernet type (Ethertype) of 08-00 would indicate Internet IP is the protocol. The official list of types can be found at IEEE. Although vendors tend to be are moving to LLC1 on the LAN, SNAP still remains.

TRANSMISSION MEDIA

<u>10Base-5</u> - largely obsolete, but may still be in use.

Traditionally, Ethernet is used over 'thick' coaxial cable called 10Base-5 (the '10' denotes 10Mbps, base means that the signal is baseband i.e. takes the whole bandwidth of the cable (so that only one device can transmit at one time on the same cable), and the '5' denotes 500 m maximum length). The minimum length between stations is 2.5 m.

The cable is run in one long length forming a 'Bus Topology'. Stations attach to it by way of inline N-type connections or a transceiver, which is literally screwed into the cable (by way of a 'Vampire Tap') providing a 15-pin Attachment Unit Interface (AUI) connection (also known as a DIX connector or a DB-15 connector) for a drop lead connection (maximum of 50 m length) to the station. The segments are terminated with 50 ohm resistors and the shield grounded at one end only.

The segment could be appended with up to a maximum of 4 repeaters; therefore 5 segments (total length of 2,460 m) can be connected together. Of the 5 segments only 3 can have devices attached (100 per segment). This is known as the 5-4-3 rule. A total of 300 devices can be attached on a Thicknet broadcast domain.

10Base-2 – dominant for many years

It was common to see the Thick coax used in Risers to connect Repeaters, which in turn provide 'Thin Ethernet' coaxial connections for runs up to 30 workstations. Thin Ethernet (Thinnet) uses RG-58 cable and is called 10Base-2 (The '2' now denoting 200 m maximum length - strictly speaking this is 185 m). The minimum length between stations is 0.5 m.

Each station connects to the thinnet by way of a Network Interface Card (NIC), which provides a BNC (British Naval Connector). At each station the thinnet terminates at a T-piece and at each end of the thinnet run (or 'Segment') a 50-ohm terminator is required to absorb stray signals, thereby preventing signal bounce. The shield is grounded at one end only.

A segment can be appended with other segments using up to 4 repeaters, i.e. 5 segments in total. Two of these segments however, cannot be tapped; they can only be used for extending the length of the broadcast domain (to 925 m). What this means is that 3 segments with a maximum of 30 stations on each can give you 90 devices on a Thinnet broadcast domain.

10Base-T – Most widespread today

The most common media used in of Ethernet today involves use of Unshielded Twisted Pair (UTP) or Shielded Twisted Pair (STP). For instance, Category 5 UTP can be installed in a 'Star-wired' format, with runs recommended at no greater than 100 m (including patch leads, cable run and flyleads) and Ethernet Hubs with UTP ports (RJ45) centrally located. It has been found though that runs of up to 150 m are feasible, the limitations being signal strength. Also, there should be no more than a 11.5 dB signal loss and the minimum distance between devices is 2.5 m. The maximum delay for the signal in a 10Mbps network is 51.2 microseconds. This comes from the fact that the bit time (time to transmit one bit) is 0.1 microseconds and that the slot time for a frame is 512 bit times.

In order to connect to Ethernet in this 'Star Topology', each station has a NIC, which contains an RJ45 socket which is used by a 4-pair droplead to connect to another nearby RJ45 socket.

Each port on the hub sends a 'Link Beat Signal' which checks the integrity of the cable and devices attached, a flickering LED on the front of the port of the hub tells you that the link is running fine. The maximum number of hubs (or, more strictly speaking, repeater counts) that you can have in one segment is four and the maximum number of stations on one broadcast domain is 1024.

The advantages of the UTP/STP technology are gained from the flexibility of the system, with respect to moves, changes, fault finding, reliability, and security. The following table shows the RJ45 pin-outs for 10Base-T:

RJ45 Pin	Function	Color
1	Transmit	White/Orange stripe
2	Transmit	Orange
3	Receive	White/Green stripe
4		Blue
5		White/Blue stripe
6	Receive	Green
7		White/Brown stripe
8		Brown

If you wish to connect hub to hub, or a NIC directly to another NIC, then the following 10Base-T crossover cable should be used:

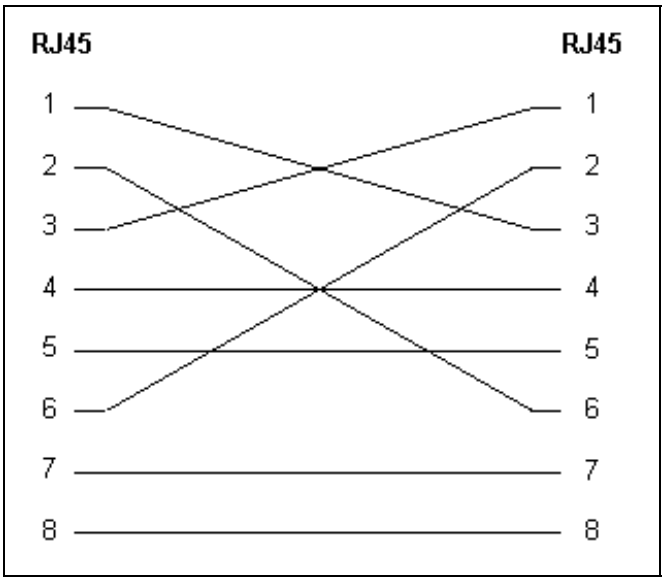

Figure 4. 10Base-T Crossover.

The 4-repeater limit manifests itself in 10/100Base-T environments where the active hub/switch port is in fact a repeater, hence the name multi-port repeater. Generally, the hub would only have one station per port but you can cascade hubs from one another up to the 4-repeater limit. The danger here is that you will have all the traffic from a particular hub being fed into one port so care would need to be taken on noting the applications being used by the stations involved, and the likely bandwidth that the applications will use.

There is a pre-standard called Lattisnet (developed by Synoptics), which runs 10 MHz Ethernet over twisted pair but instead of bit synchronization occurring at the sending (as in 10Base-T) the synchronization occurs at the receiving end.

10Base-F

The 10Base-F standard defines the use of fiber for Ethernet. 10Base-FL describes the standards for the fiber optic links between stations and repeaters, allowing up to 2 km per segment on multi-mode fiber. It replaces the 1987 FOIRL (Fiber Optic Inter-Repeater Link), which provides the specification for a fiber optic Media Attachment Unit (MAU) and other interconnecting components. Two related standards are essentially "dead": 10Base-FB allows up to 2 km per segment (on multi-mode fiber) and is designed for backbone applications such as cascading repeaters. In addition, there is the 10Base-FP (Passive components) standard

The 10Base-F standard allows for 1024 devices per network.

Fast Ethernet - 100Base-T

Fast Ethernet is the most popular of the newer standards and is an extension to 10Base-T. The '100' denotes 100 Mbps data speed and it uses the same two pairs as 10Base-T and must only be used on Category 5 UTP cable installations with provision for it to be used on Type 1 STP. The actual data throughput increases by between 3 to 4 times that of 10Base-T.

Fast Ethernet is specified in 802.3u and uses the same frame formats and CSMA/CD technology as normal 10Mbps Ethernet. The difference is that the maximum delay for the signal across the segment is 5.12 microseconds instead of 51.2 microseconds. This stems from the fact that the bit time (time to transmit one bit) is 0.01 microseconds and that the slot time for a frame is 512 bit times. The Inter-Packet Gap (IPG) for 802.3u is 0.96 microseconds as opposed to 9.6 microseconds for 10Mbps Ethernet.

Whereas 10Base-T uses Normal Link Pulses (NLP) for testing the integrity of the connection, 100Base-T uses Fast Link Pulses (FLP) which are backwardly compatible with NLPs but contain more information. FLPs are used to detect the speed of the network (e.g. in 10/100 switchable cards and ports). The distance must not exceed 100 m.

The IEEE uses the term 100Base-X to refer to both 100Base-Tx and 100Base-Fx and the Media-Independent Interface (MII) allows a generic connector for transceivers to connect to 100Base-Tx, 100Base-Fx and 100Base-T4 LANs.

There is no such thing as the 5-4-3 rule in Fast Ethernet. All 10Base-T repeaters are considered to be functionally identical. Fast Ethernet repeaters are divided into two classes of repeater: Class I and Class II. A Class I repeater has a repeater propagation delay value of 140 bit times, whilst a Class II repeater is 92 bit times. The Class I repeater (or Translational Repeater) can support different signaling types such as 100Base-Tx and 100Base-T4. A Class I repeater transmits or repeats the incoming line signals on one port to the other ports by first translating them to digital signals and then retranslating them to line signals. The translations are necessary when connecting different physical media (media conforming to more than one physical layer specification) to the same collision domain. Any repeater with an MII port would be a Class I device. Only one Class I repeater can exist within a single collision domain, so this type of repeater cannot be cascaded.

A Class II repeater immediately transmits or repeats the incoming line signals on one port to the other ports: it does not perform any translations. This repeater type connects identical media to the same collision domain (for example, TX to TX). At most, two Class II repeaters can exist within a single collision domain.

The cable used to cascade the two devices is called and unpopulated segment or IRL (Inter-Repeater Link). The Class II repeater (or **Transparent Repeater**) can only support one type of physical signaling.

100Base-T4

100Base-T4 was an early implementation of Fast Ethernet. It requires four twisted copper pairs, but those pairs were only required to be category 3 rather than the category 5 required by TX. One pair is reserved for transmit, one for receive, and the remaining two will switch direction as negotiated. A very unusual 8B6T code is used to convert 8 data bits into 6 base-3 digits (the signal shaping is possible as there are three times as many 6-digit base-3 numbers as there are 8-digit base-2 numbers). The two resulting 3-digit base-3 symbols are sent in parallel over 3 pairs using 3-level pulse-amplitude modulation (PAM-3).

100Base-T2

This little known version of Fast Ethernet is for use over two pairs of Category 3 cable and uses PAM-5 for encoding. There is simultaneous transmission and reception of data in both pairs and the electronics uses DSP technology to handle alien signals in adjacent pairs. 100Base-T2 can run up to 100 m on Category 3 UTP.

100Base-Fx

100Base-Fx is a version of Fast Ethernet over optical fiber. It uses a 1300 nm near-infrared (NIR) light wavelength transmitted via two strands of optical fiber, one for receive (RX) and the other for transmit (TX). Maximum length is 400 meters (1,310 ft) for half-duplex connections (to ensure collisions are detected) or 2 kilometers (6,600 ft) for full-duplex over multimode optical fiber. Longer distances are possible when using single-mode optical fiber. 100Base-Fx uses the same 4B5B encoding and NRZI line code that 100Base-TX does. 100Base-Fx should use the following connectors: SC, straight tip (ST), or media independent connectors (MIC), with SC being the preferred option. 100Base-Fx is not compatible with 10Base-Fl, the 10 MBit/s version over optical fiber.

100Base-Sx

100Base-Sx is a version of Fast Ethernet over optical fiber. It uses two strands of multi-mode optical fiber for receive and transmit. It is a lower cost alternative to using 100Base-Fx, because it uses short wavelength optics (850 nm) which are significantly less expensive than the long wavelength optics used in 100Base-Fx. 100Base-Sx can operate at distances up to 300 meters (980 ft).

100Base-Sx uses the same wavelength as 10Base-Fl, the 10 MBit/s version over optical fiber. Unlike 100Base-Fx, this allows 100Base-Sx to be backwards-compatible with 10Base-Fl. Because of the shorter wavelength used and the shorter distance it can support, 100Base-Sx uses less expensive optical components (LEDs instead of lasers) which makes it an attractive option for those upgrading from 10Base-Fl and those who do not require long distances.

100Base-Bx

100Base-Bx is a version of Fast Ethernet over a single strand of optical fiber (unlike 100Base-Fx, which uses a pair of fibers). Single-mode fiber is used, along with a special multiplexer which splits the signal into transmit and receive wavelengths. The two wavelengths used for transmit and receive are either 1310/1550 nm or 1310/1490 nm. Distances can be 10, 20, or 40 km.

100VG-AnyLAN

Based on 802.12 (Hewlett Packard), 100VG-AnyLAN uses an access method called Demand Priority. The 'VG' stands for 'Voice Grade' as it is designed to be used with Category 3 cable. This is where the repeaters (hubs) carry out continuous searches around all of the nodes for those that wish to send data. If two devices cause a 'contention' by wanting to send at the same time, the highest priority request is dealt with first, unless the priorities are the same, in which case both requests are dealt with at the same time (by alternating frames). The hub only knows about connected devices and other repeaters so communication is only directed at them rather than broadcast to every device in the broadcast domain (which could mean 100's of devices!). This is a more efficient use of the bandwidth. This is the reason why the new standard was developed as it is not strictly Ethernet. Standard 802.12 is designed to better support both Ethernet and Token Ring.

The encoding techniques used are 5B/6B and NRZ. All four pairs of UTP are used. On Cat3 the longest cable run is 100 m but this increases to 200 m on Cat5. The clock rate on each wire is 30 MHz; therefore 30 Mbits per second are transmitted on each pair giving a total bit rate of 120 Mbps. Since each 6-bits of data on the line represents 5 bits of real data due to the 5B/6B encoding, the rate of real data being transmitted is 25 Mbps on each pair, giving a total real data rate of 100 Mbps. For 2-pair STP and fiber, the bit rate is 120 Mbps on the transmitting pair, for a real data transmission rate of 100 Mbps.

Gigabit Ethernet

Although the functional principles of Gigabit Ethernet are the same as Ethernet and Fast Ethernet i.e. CSMA/CD and the Framing format, the physical setup is very different. One difference is the slot time. The standard Ethernet slot time required in CSMA/CD half-duplex mode is not long enough for running over 100 m of copper, so Carrier Extension is used to guarantee a 512-bit slot time.

1000Base-X (802.3z)

The 802.3z committee is responsible for formalizing the standard for Gigabit Ethernet. The 1000 refers to 1 Gbps data speed. The existing Fiber Channel interface standard (ANSI X3T11) is used and allows up to 4.268 Gbps speeds. The Fiber Channel encoding scheme is 8B/10B.

Gigabit Ethernet can operate in half or full duplex modes and there is also a standard 802.3x which manages XON/XOFF flow control in full duplex mode. With 802.3x, a receiving station can send a packet to a sending station to stop it sending data until a specified time interval has passed.

There are three media types for 1000Base-X. 1000Base-Sx, 1000Base-Lx, and 1000Base-Cx.

1000Base-Sx (‘S’ is for Short Haul) uses short-wavelength laser (850 nm) over multi-mode fiber. 1000Base-Sx can run up to 300 m on 62.5/125 μm multimode fiber and up to 550 m on 50/125 μm multimode fiber.

1000Base-Lx (‘L’ is for Long Haul) uses long wavelength laser (1300 nm) and can run up to 550 m on 62.5/125 μm multi-mode fiber or 50/125 μm multi-mode fiber. In addition, 1000Base-Lx can run up to 5 km (originally 3 km) on single-mode fiber using 1310 nm wavelength laser.

1000Base-Cx is a standard for STP copper cable and allows operation up to 25 m over STP cable.

1000Base-T (802.3ab)

Many cable manufacturers are enhancing their cable systems to ‘enhanced Category 5’ (Cat 5e) standards in order to allow Gigabit Ethernet to run at up to 100 m on copper. The Category 6 standard has yet to be ratified, and is not being pursued very strongly.

In order to obtain the 1000 Mbps data bit rate across the UTP cable without breaking the FCC rules for emission, all 4 pairs of the cable are used. Hybrid circuits at each end of each pair are used to allow simultaneous transmission and reception of data (full-duplex) by separating the transmission signal from the receiving signal. Because some transmission signal still manages to couple itself to the receiving side there is an additional echo canceller built in, this is called a Near End Crosstalk (NEXT) canceller.

Encoding is carried out with PAM-5.

TRANSMISSION CONTROL PROTOCOL / INTERNET PROTOCOL

Transmission **C**ontrol **P**rotocol / **I**nternet **P**rotocol (TCP/IP) is the communication protocol for the Internet.

Whereas IP handles lower-level transmissions from computer to computer as a message makes its way across the Internet, TCP operates at a higher level, concerned only with the two end systems, for example a Web browser and a Web server. In particular, TCP provides ordered delivery of a stream of bytes from a program on one computer to another program on another computer. Besides the Web, other common applications of TCP include e-mail and Internet file transfer like FTP. Among its other management tasks, TCP controls message size, the rate at which messages are exchanged, and network traffic congestion. Your computer Internet address is a part of the standard TCP/IP protocol and so is your domain name.

Inside the TCP/IP standard there are several protocols for handling data communication:

- TCP (Transmission Control Protocol) communication between applications
- UDP (User Datagram Protocol) simple communication between applications
- IP (Internet Protocol) communication between computers
- ICMP (Internet Control Message Protocol) for errors and statistics
- DHCP (Dynamic Host Configuration Protocol) for dynamic addressing

TCP: If one application wants to communicate with another via TCP, it sends a communication request. This request must be sent to an exact address. TCP is responsible for breaking data down into IP packets before they are sent, and for assembling the packets when they arrive. After a "handshake" between the two applications, TCP will set up a "full-duplex" communication between the two applications. The "full-duplex" communication will occupy the communication line between the two computers until it is closed by one of the two applications. UDP is very similar to TCP, but simpler and less reliable.

IP: IP is responsible for sending the packets to the correct destination. IP does not occupy the communication line between two computers and hence reduces the need for network lines. Each line can be used for communication between many different computers at the same time. With IP, messages (or other data) are broken up into small independent "packets" and sent between computers via the Internet. IP is responsible for "routing" each packet to the correct destination.

When an IP packet is sent from a computer, it arrives at an IP router. The IP router is responsible for "routing" the packet to the correct destination, directly or via another router. The path the packet will follow might be different from other packets in the same communication chain. The router is responsible for the right addressing, depending on traffic volume, errors in the network, or other parameters.

Each computer must have a unique IP address before it can connect to the Internet. Each IP packet must also have an address before it can be sent to another computer. TCP/IP uses 32 bits (4 bytes), of four numbers between 0 and 255, separated by a period, to address a computer. A typical IP address is of the format: 192.255.30.50

Domain Names: A name is much easier to remember than a 12 digit number. The names used for TCP/IP addresses are called domain names. "**navy.mil"** is a domain name. Subdomains are identified by prefixes to the main domain name (separated by a period). When you address a web site, like **http://www.navair.navy.mil** the name is translated to a number by a Domain Name System (DNS) Server. DNS servers are connected to the Internet all over the world. When a new domain name is registered together with a TCP/IP address, all DNS servers are updated with this information.

BROWSER AND OTHER APPLICATION LAYER PROTOCOLS

DHCP - Dynamic Host Configuration Protocol. DHCP is used for allocation of dynamic IP addresses to computers in a network.

FTP - File Transfer Protocol. FTP takes care of transmission of data files between computers.

HTTP - Hyper Text Transfer Protocol - takes care of the communication between a web server and a web browser. It is used for sending requests from a web client (a browser) to a web server, returning web content (web pages) from the server back to the client.

HTTPS - Secure HTTP. HTTPS typically handles credit card transactions and other sensitive data.

IMAP - Internet Message Access Protocol. The IMAP protocol is used by email programs (like Microsoft Outlook) just like the POP protocol (discussed below). The main difference between the IMAP protocol and the POP protocol is that the IMAP protocol will not automatically download all your emails each time your email program connects to your email server. The IMAP protocol allows you to look through your email messages at the email server before you download them. With IMAP you can choose to download your messages or just delete them. This way IMAP is useful if you need to connect to your email server from different locations, but only want to download your messages when you are back in your office.

NTP - Network Time Protocol. NTP is used to synchronize the time (the clock) between computers.

POP - Post Office Protocol. The POP protocol is used by email programs (like Microsoft Outlook) to retrieve emails from an email server. If your email program (also called email client), uses POP, all your emails are downloaded to your computer each time it connects to your email server.

SMTP - Simple Mail Transfer Protocol. The SMTP protocol is used for the transmission of e-mails to another computer. Normally your email is sent to an email server (SMTP server), and then to another server or servers, and finally to its destination. SMTP can only transmit pure text. It cannot transmit binary data like pictures, sounds, or movies directly. SMTP uses the MIME protocol to send binary data across TCP/IP networks.

SNMP - Simple Network Management Protocol. SNMP is used for administration of computer networks.

PRESENTATION LAYER PROTOCOLS

MIME - Multi-purpose Internet Mail Extensions protocol. Converts binary data to pure text. The MIME protocol lets SMTP transmit multimedia files including voice, audio, and binary data.

SSL - Secure Sockets Layer. The SSL protocol is used for encryption of data for secure data transmission.

LOWER LAYER PROTOCOLS

ARP - Address Resolution Protocol. ARP is used by IP to find the hardware address of a computer network card based on the IP address.

BOOTP - Boot Protocol. BOOTP is used for booting (starting) computers from the network.

ICMP - Internet Control Message Protocol. ICMP takes care of error-handling in the network.

LDAP - Lightweight Directory Access Protocol. LDAP is used for collecting information about users and e-mail addresses from the internet.

PPTP - Point to Point Tunneling Protocol. PPTP is used for setting up a connection (tunnel) between private networks.

RARP - Reverse Address Resolution Protocol. RARP is used by IP to find the IP address based on the hardware address of a computer network card.

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GLOSSARY

ACCEPTABLE DEGRADATION - The allowable reduction in system performance. For a fire control radar, the acceptable degradation is usually expressed as a reduction in range; for example, the maximum lock-on range might be degraded by 25 percent without loss of essential defense capability.

ACQUISITION - A procedure by which a fire control tracking radar attains initial lock-on. Usually, the approximate target coordinates are supplied to the tracking radar and it searches a predetermined volume of space to locate the target.

AEROSOLS - Solid particles dispersed in the atmosphere having resonant size particles with a high index of refraction. The particles both scatter and absorb visual and laser directed energy so as to cut down on weapon systems directed by these techniques.

AFC (AUTOMATIC FREQUENCY CONTROL) - An arrangement whereby the frequency of an oscillator or the tuning of a circuit is automatically maintained within specified limits with respect to a reference frequency. A magnetron drifts in frequency over a period of time. The AFC of a radar makes the local oscillator shift by an equal amount so the IF frequency will remain constant.

AGC (AUTOMATIC GAIN CONTROL) - A method for automatically obtaining an essentially constant receiver output amplitude. The amplitude of the received signal in the range gate determines the AGC bias (a DC voltage) which controls the receiver gain so as to maintain a nearly constant output even though the amplitude of the input signal changes.

AMPLIFIER - An electronic device used to increase signal magnitude or power. See also GaAs FET Amplifier, Klystron Amplifier, Traveling-Wave Tube Amplifier.

AMPLITUDE MODULATION (AM) - A method of impressing a message upon a carrier signal by causing the carrier amplitude to vary proportionally to the message waveform.

AMPLITUDE SHIFT KEYING (ASK) - A method of impressing a digital signal upon a carrier signal by causing the carrier amplitude to take different values corresponding to the different values of the digital signal.

ANGLE JAMMING - ECM technique, when azimuth and elevation information from a scanning fire control radar is jammed by transmitting a jamming pulse similar to the radar pulse, but with modulation information out of phase with the returning target angle modulation information.

ANGULAR SEPARATION - This term is frequently used to indicate a protective (from EMI) zone for a missile. The interfering antenna axis must be separated, throughout the critical portion of the missile flight, from the missile by the specified angle. The vertex of the angle is at the interference source antenna.

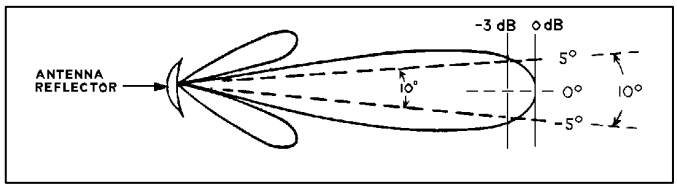

ANTENNA BEAMWIDTH - The angle, in degrees, between the half-power points (-3 dB) of an antenna beam. This angle is also nearly that between the center of the mainlobe and the first null. The angle is given for both horizontal and vertical planes unless the beam is circular. When so indicated, the term may refer to the angular width of the mainlobe between first nulls [beamwidth between first nulls (BWFN)]. See also Antenna Pattern. The figure illustrates vertical profile for antenna displaying a 10-degree beamwidth characteristic. The values can vary dramatically with frequency.

ANTENNA CROSS TALK - A measure of undesired power transfer through space from one antenna to another. Ratio of power received by one antenna to power transmitted by the other, usually expressed in decibels.

ANTENNA ISOLATION - The ratio of the power input to one antenna to the power received by the other. It can also be viewed as the insertion loss from transmit antenna input to receive antenna output to circuitry.

ANTENNA LOBING - Two lobes are created that overlap and intercept at -1 to -3 dB. The difference between the two lobes produces much greater spatial selectivity than provided by either lobe alone. (See also Lobe, Antenna.)

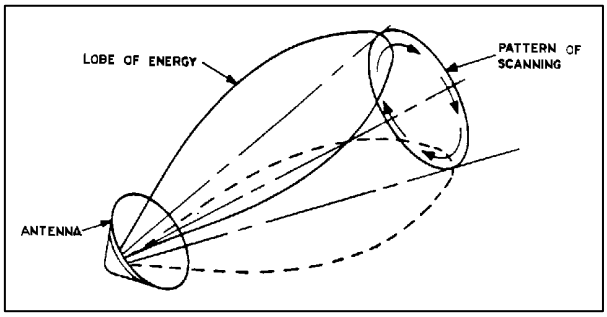

ANTENNA NUTATING - An antenna, as used in automatic-tracking radar systems, consisting of a parabolic reflector combined with a radiating element which is caused to move in a small circular orbit about the focus of the antenna with or without change of polarization. The radiation pattern is in the form of a beam that traces out a cone centered on the reflector axis. The process is also known as nutating conical scanning.

ANTENNA PATTERN - A cross section of the radiating pattern (representing antenna gain or loss) in any plane that includes the origin (source reference point) of the pattern. Both horizontal and vertical polar plots are normally used to describe the pattern. Also, termed "polar diagram" and "radiation pattern."

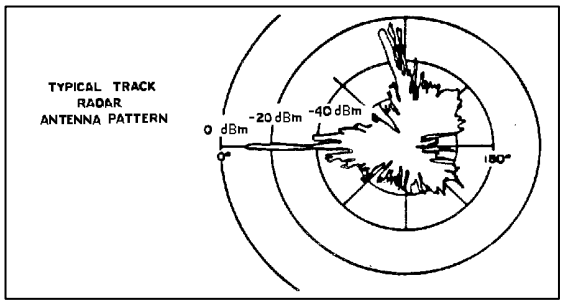

ANTENNA, PENCIL-BEAM - A highly directional antenna designed that cross sections of the major lobe are approximately circular, with a narrow beamwidth.

ANTI-CLUTTER CIRCUITS (IN RADAR) - Circuits which attenuate undesired reflections to permit detection of targets otherwise obscured by such reflections.

APERTURE - In an antenna, that portion of the plane surface area near the antenna perpendicular to the direction of maximum radiation through which the major portion of the radiation passes. The effective and/or scattering aperture area can be computed for wire antennas which have no obvious physical area.

A-SCOPE - A cathode-ray oscilloscope used in radar systems to display vertically the signal amplitude as a function of time (range) or range rate. Sometimes referred to as Range (R)-Scope.

ASYNCHRONOUS PULSED JAMMING - An effective form of pulsed jamming. The jammer nearly matches the pulse repetition frequency (PRF) of the radar; then it transmits multiples of the PRF. It is more effective if the jammer pulsewidth is greater than that of the radar. Asynchronous pulsed jamming is similar to synchronous jamming except that the target lines tend to curve inward or outward slightly and appear fuzzy in the jammed sector of a radar scope.

ATTENUATION - Decrease in magnitude of current, voltage, or power of a signal in transmission between two points. May be expressed in decibels.

AUTOMATIC FREQUENCY CONTROL - See AFC.

AUTOMATIC GAIN CONTROL - See AGC.

BACKWARD WAVE OSCILLATOR (BWO) - A cross-field device in which an electron stream interacts with a backward wave on a nonreentrant circuit. This oscillator may be electronically tuned over a wide range of frequencies, is relatively unaffected by load variations and is stable. BWO is commonly pronounced "be woe".

BALANCED MIXERS - The two most frequently encountered mixer types are single-balanced and double-balanced. In a double-balanced mixer, four Schottky diodes and two wideband transformers are employed to provide isolation of all three ports.

BALLISTIC MISSILE - Any missile which does not rely upon aerodynamic surfaces to produce lift and consequently follows a ballistic trajectory when thrust is terminated.

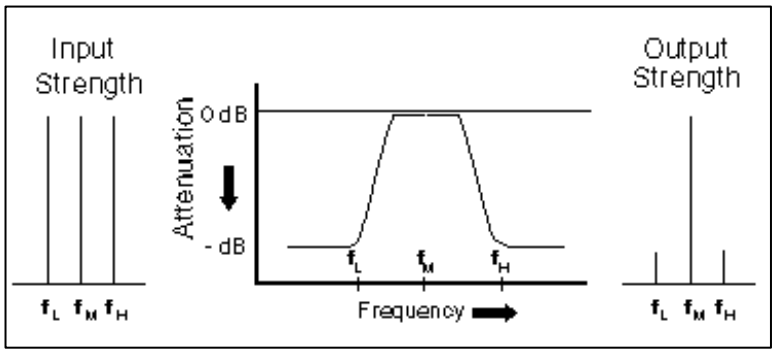

BANDPASS FILTER - A type of frequency discrimination network designed to pass a band or range of frequencies and produce attenuation to all other frequencies outside of the pass region. The figure illustrates a typical bandpass filter, incorporating a bandpass region of (F_h)-(F_l), offering no rejection (0 dB) to desired signal (F_m) and much higher rejection to the adjacent undesired signals F_h, and F_l. The upper and lower frequencies are usually specified to be the half power (-3 dB) or half voltage points (-6 dB).

BANDWIDTH - An expression used to define the actual operational frequency range of a receiver when it is tuned to a certain frequency. For a radar receiver, it is the difference between the two frequencies at which the receiver response is reduced to some fraction of its maximum response (such as 3 dB, 6 dB, or some other specified level). The frequencies between which "satisfactory" performance is achieved. Two equations are used:

$$\textit{Narrowband by \%} \ \left(\frac{F_u - F_l}{F_c}\right)(100) \quad ; \quad \textit{Broadband by ratio} \ \frac{F_u}{F_l}$$

$$\textit{Where } F_u = \textit{Upper} \ ; \ F_l = \textit{lower} \ ; \ F_c = \textit{center} = (F_u + F_l) \div 2$$

See also Receiver Bandwidth and Spectrum Width.

BARRAGE NOISE JAMMING - Noise jamming spread in frequency to deny the use of multiple radar frequencies to effectively deny range information. Although this is attractive because it enables one jammer to simultaneously jam several radars of different frequencies, it does have the inherent problem that the wider the jamming spread, the less jamming power available per radar, i.e. the watts per MHz bandwidth is low.

BATTERY, MISSILE - A missile battery consists of a missile launcher and its associated missile fire control systems (such as a MK 11 MOD 0 Missile Launcher and two MK 74 MOD 0 Missile Fire Control Systems).

BEACON - A system wherein a transponder in a missile receives coded signals from a shipboard radar guidance transmitter and transmits reply signals to a shipboard radar beacon receiver to enable a computer to determine missile position. The missile beacon transmitter and shipboard radar beacon receiver are tuned to a frequency different from that of the guidance transmitter.

BEAM - See Lobe, antenna. The beam is to the side of an aircraft or ship.

BEAM, CAPTURE - See Capture Beam.

BEAM-TO-BEAM CORRELATION (BBC) - BBC is used by frequency scan radars to reject pulse jamming and jamming at a swept frequency. Correlation is made from two adjacent beams (pulses). The receiver rejects those targets (signals) that do not occur at the same place in two adjacent beams.

BEAMWIDTH - See Antenna Beamwidth.

BEAT FREQUENCY OSCILLATOR (BFO) - Any oscillator whose output is intended to be mixed with another signal to produce a sum or difference beat frequency. Used particularly in reception of CW transmissions.

BINGO - The fuel state at which an aircraft must leave the area in order to return and land safely. Also used when chaff/flares reach a preset low quantity and automatic dispensing is inhibited.

BIPOLAR VIDEO - Unrectified (pre-detection) IF (both positive and negative portions of the RF envelope) signals that arise from the type of detection and console display employed in pulse Doppler and MTI receivers.

BISTATIC RADAR - A radar using antennas at different locations for transmission and reception.

BLANKING - The process of making a channel, or device non-effective for a certain interval. Used for retrace sweeps on CRTs or to mask unwanted signals such as blanking ones own radar from the onboard RWR.

BOGEY - Unknown air target.

BURN-THROUGH RANGE - The ability of a radar to see through jamming. Usually, described as the point when the radar's target return is a specified amount stronger than the jamming signal (typical values are 6 dB manual and 20 dB automatic). See Section 4-8.

BUTT LINE - Line used for reference in measurement of left/right location. One of several aircraft references. See also fuselage station and water line.

CAPTURE BEAM - A wide beam incorporated in capture transmitters of beam rider (command guided) missile systems to facilitate gaining initial control of a missile immediately after launch. Upon capture, the system then centers the missile in the narrow guidance beam. The figure illustrates a launched missile at point of capture.

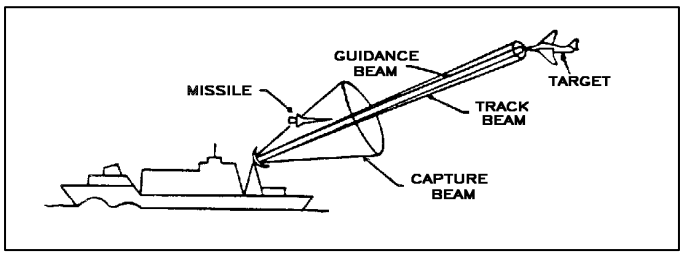

CAPTURE TRANSMITTER - A transmitter employing a wide beam antenna to gain initial control of in-flight missile for the purpose of centering the missile in the guidance transmitter antenna beam. See also Capture Beam.

CARRIER FREQUENCY - The basic radio frequency of the wave upon which modulations are impressed. Also called "Carrier" or f_c. See figure at right.

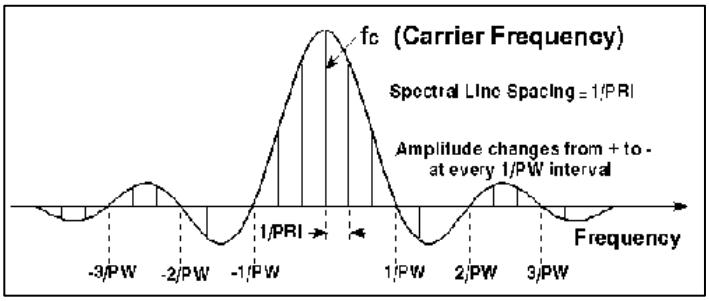

CATCH-22 - A lose-lose situation, from the book of the same name.

CAVITY - A space enclosed by a conducting surface used as a resonant circuit at microwave frequencies. Cavity space geometry determines the resonant frequency. A storage area for oscillating electromagnetic energy.

CENTER FREQUENCY - The tuned or operating frequency. Also referred to as center operating frequency. In frequency diversity systems, the midband frequency of the operating range. See also Carrier Frequency.

CHAFF - Ribbon-like pieces of metallic materials or metalized plastic which are dispensed by aircraft or ships to mask or screen other "targets." The radar reflections off the chaff may cause a tracking radar to break lock on the target. The foil materials are generally cut into small pieces for which the size is dependent upon the radar interrogation frequency (approximately 1/2 wave length of the victim radar frequency). Being this length, chaff acts as a resonant dipole and reflects much of the energy back to the radar. Also see rainbow, rope, stream chaff, and window.

CHANNEL - A frequency or band of frequencies. In guided missile systems, an assigned center frequency and a fixed bandwidth around it. Designates operating frequency of track radars and frequency/code assignments of X-band CW illuminators.

CHIRP - A pulse compression technique which uses frequency modulation (usually linear) on pulse transmission.

CHIRP RADAR - See PC.

CIRCULARLY POLARIZED JAMMING - The techniques of radiating jamming energy in both planes of polarization simultaneously. With this method, there is a loss of 3 dB of effective power in either linear plane, and substantial loss if the opposite sense of circular polarization is used (i.e. left vs. right). See Section 3-2.

CLUTTER, RADAR - Undesired radar returns or echoes resulting from man-made or natural objects including chaff, sea, ground, and rain, which interfere with normal radar system observations. The figure illustrates a target being masked by ground clutter

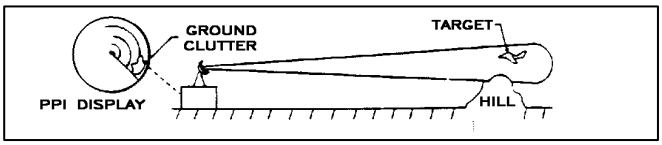

CO-CHANNEL - This term is used to indicate that two (or more) equipments are operating on the same frequency.

COHERENT - Two signals that have a set (usually fixed) phase relationship.

COINCIDENCE DETECTOR - This radar video process requires more than one hit in a range cell before a target is displayed. This prevents video interference from pulses coming from another radar, because such interference is unlikely to occur twice in the same range cell.

COLLIMATION - The procedure of aligning fire control radar system antenna axes with optical line of sight, thereby ensuring that the radars will provide for correct target illumination and guidance beam positioning.

COMMAND CODE - Modulations superimposed upon transmitter carrier signals to provide electronic instructions to an airborne guided missile or pilotless aircraft. The receiver of the remotely guided vehicle is preset to accept only a selected transmitter code to eliminate the possibility of the vehicle responding to commands of extraneous signals. Missile command codes include instructions such as arm, warhead detonate, and self destruct.

COMMAND GUIDANCE - A guidance system wherein intelligence transmitted to the missile from an outside source causes the missile to traverse a directed flight path.

CONICAL SCAN - See Antenna, Nutating.

CONTINUOUS WAVE and CONTINUOUS WAVE ILLUMINATOR - See CW and CWI.

COOPERATIVE COUNTERMEASURES - (CO-OP) Generic term for jamming the same threat radar from two or more separate platforms that are in the same radar resolution cell.

COUPLING FACTOR - A multiplying factor, expressed in dB, used to express the change in EM energy intensity from a radar transmitter to a receiver. The factor includes the antenna gains and the loss (basic transmission loss) caused by the distance between the antennas. The factor will usually be a negative dB figure (a reduction in intensity) because basic transmission loss is always a large negative value. The antenna gains may be positive (pointed toward each other) or negative (no main beam interactions).

CROSS MODULATION - Intermodulation caused by modulation of the carrier by an undesired signal wave.

CROSS POLARIZATION - or "Cross Pole," is a monopulse jamming technique where a cross-polarized signal is transmitted to give erroneous angle data to the radar. The component of the jamming signal with the same polarization as the radar must be very small.

CW (CONTINUOUS WAVE) - In radar and EW systems this term means that the transmitter is on constantly; i.e., not pulsed (100% duty cycle). These systems may frequency or phase modulate the transmitter output. A CW radar has the ability to distinguish moving targets against a stationary background while conserving spectrum bandwidth compared to pulsed radar requirements. A CW radar extracts accurate target range-rate data but cannot determine target range.

CWI (CONTINUOUS WAVE ILLUMINATOR) - A surface or aircraft-based CW transmitter employed in semiactive homing missile systems where the transmitter illuminates the target and the missile senses the reflected energy. The transmitter also provides a reference signal to the missile rear receiver to allow determination of range-rate data and target identification. CW transmitter emissions are sometimes coded corresponding to the associated missile receiver codes to reduce the possibility of the "missile accepting commands of extraneous signals.

DECIBEL (dB) - A dimensionless unit for expressing the ratio of two values of power, current, or voltage. The number of decibels being equal to: $dB = 10 \log P_2/P_1 = 20 \log V_2/V_1 = 20 \log I_2/I_1$ Normally, used for expressing transmission gains, losses, levels, and similar quantities. See Section 2-4.

DECEPTION - The deliberate radiation, reradiation, alteration, absorption or reflection of electromagnetic energy in a manner intended to mislead the enemy interpretation or use of information received by his electronic systems.

dB - See Decibel, or Decibel Section 2-4.

dBc - Decibels referenced to the carrier signal.

dBi - Decibels referenced to an isotropic radiator. (dBLi indicating linear isotropic radiator is sometimes used).

dBm - Decibels relative to 1 mW. dBm is calculated by using the ratio of some power (expressed in mW) to 1 mW. For example, 1 mW is 0 dBm and 10 mW is +10 dBm.

dBsm - Decibel referenced to one square meter.

dBv / dBμv - Decibels referenced to one volt or microvolt, i.e. 0 dBv is 1 volt or 120 dBμv.

dBW / dBμW - Decibels referenced to 1 watt or one microwatt, i.e. 0 dBW is 1 watt or 30 dBm or 60 dBμW.

DEMODULATOR - A device employed to separate the modulation signal from its associated carrier, also called Second Detector. See also Detection.

DESIGNATION - The assignment of a fire control radar to a specific target by supplying target coordinate data to the radar system.

DETECTION - Usually refers to the technique of recovering the amplitude modulation signal (envelope) superimposed on a carrier. See figure at right.

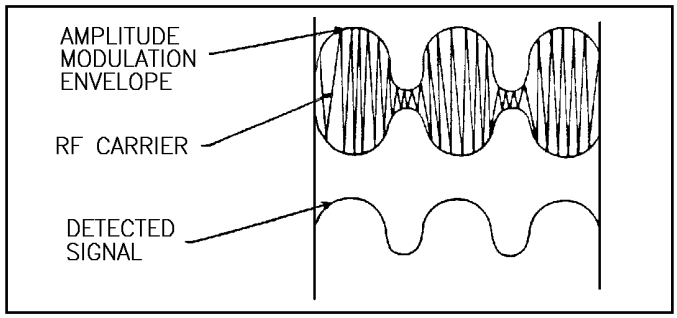

DICKE FIX - This type of radar processing occurs in the IF amplifier. A limiter follows a wideband amplifier, and then the signal goes to a matched filter amplifier. This discriminates against pulses that are too long (clutter) or too short (interference). The "DICKE FIX" is a technique that is specifically designed to protect the receiver from ringing caused by noise, fast-sweep, or narrow pulse jamming. The basic configuration consists of a broadband limiting IF amplifier, followed by an IF amplifier of optimum bandwidth. The limit level is preset at approximately the peak amplitude of receiver noise, the bandwidth may vary from 10 to 20 MHz, depending on the jamming environment. This device provides excellent discrimination against fast sweep jamming (10-500 MHz), usually something on the order of 20 to 40 dB, without appreciable loss in sensitivity. However, strong CW jamming will seriously degrade the performance of the DICKE FIX because the CW signal captures the radar signal in the limiter.

DIELECTRICALLY STABILIZED OSCILLATOR - The DSO uses a dielectric resonator as the frequency determining element. When the dielectric material is properly selected and used, the variations in dielectric constant vs. temperature and the dimensions of the resonant structure vs. temperature tend to cancel

out, providing relatively good frequency vs. temperature stability. The DSO offers frequency accuracy and stability, low power consumption and high reliability. Some of the commonly used materials are barium, zirconium, or tin tinates. The composition of these materials may be controlled to achieve any frequency variation with temperature with close tolerances.

DIODE - An electronic device which restricts current flow chiefly to one direction. See also Gunn diode, IMPATT diode, PIN diode, point contact diode, Schottky barrier diode, step recovery diode, tunnel diode, varactor diode.

DIODE SWITCH - PIN-diode switches provide state-of-the-art switching in most present-day microwave receivers. These switches are either reflective or nonreflective in that the former reflect incident power back to the source when in the isolated state. While both types of switches can provide high isolation and short transition times, the reflective switch offers multi octave bandwidth in the all shunt diode configuration, while the non-reflective switch offers an octave bandwidth.

DIPLEX - The simultaneous transmission or reception of two signals using a common feature such as a single antenna or carrier. Typically, two transmitters operate alternately at approximately the same RF and using a common antenna. See Section 6-7 for a discussion of diplexers.

DIRECTIONAL COUPLER - A 4-port transmission coupling device used to sample the power traveling in one direction through the main line of the device. There is considerable isolation (typically 20 dB) to signals traveling in the reverse direction. Because they are reciprocal, the directional coupler can also be used to directively combine signals with good reverse isolation. The directional coupler is implemented in waveguide and coaxial configurations. See Section 6-4.

DIRECTIVITY - For antennas, directivity is the maximum value of gain in a particular direction. (Isotropic point source has directivity = 1). For directional couplers, directivity is a measure (in dB) of how good the directional coupling is and is equal to the isolation minus the coupling. See Section 6-4.

DISH - A microwave reflector used as part of a radar antenna system. The surface is concave and is usually parabolic shaped. Also called a parabolic reflector.

DOPPLER EFFECT - The apparent change in frequency of an electromagnetic wave caused by a change in distance between the transmitter and the receiver during transmission/reception. The figure illustrates the Doppler increase that would be realized by comparing the signal received from a target approaching the radar site to the transmitted reference signal. An apparent frequency decrease would be noted for targets departing the radar location. Differences can be calibrated to provide target range-rate data.

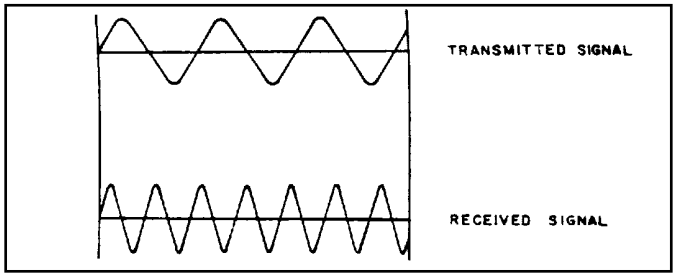

DRY RUN - A test run with aircraft/ship armament and/or EW switches off.

DUCTING - The increase in range that an electromagnetic wave will travel due to a temperature inversion of the atmosphere. The temperature inversion forms a channel or waveguide (duct) for the waves to travel in, and they can be trapped, not attenuating as would be expected from the radar equation.

DUMMY LOAD (Radio Transmission) - A dissipative but essentially nonradiating substitute device having impedance characteristics simulating those of the antenna. This allows power to be applied to the

radar transmitter without radiating into free space. Dummy loads are commonly used during EMCON conditions or when troubleshooting a transmitter at a workbench away from its normal environment.

DUPLEXER - A switching device used in radar to permit alternate use of the same antenna for both transmitting and receiving.

DUTY CYCLE - The ratio of average power to peak power, or ratio of pulse length to interpulse period for pulsed transmitter systems. Interpulse period is equal to the reciprocal of the pulse repetition rate.
See Section 2-5.

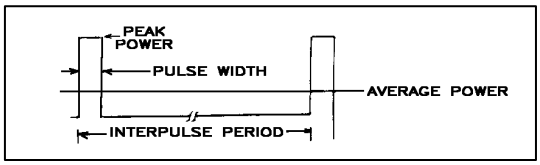

The duty cycle of a radar having a pulse length of 0.3 µsec and a PRF of 2000 pulses/sec is computed as follows:

Interpulse Period, T = PRI = 1/PRF = 500 µsec

$$Duty\ Cycle = \frac{Pulse\ length}{Interpulse\ Period} = \frac{0.3\ \mu\text{sec}}{500\ musec} = 0.0006\ (or\ 0.06\%)$$ or Duty Cycle (dB) = 10log(Duty cycle) = -32.2 dB

An output tube providing an average power of only 90 watts for such a system would, therefore, provide a peak power of:

$$Peak\ Power = \frac{Average\ Power}{Duty\ Cycle} = \frac{90}{0.0006} = 150{,}000\ W\ or\ 52\ dBW\ or\ 82\ dBm$$

EFFECTIVE RADIATED POWER (ERP) - Input power to the antenna in watts times the gain ratio of the antenna. When expressed in dB, ERP is the transmitter power (P_T), in dBm (or dBW) plus the antenna gain (G_T) in dB. The term EIRP is used sometimes and reiterates that the gain is relative to an isotropic radiator.

EGRESS - Exit the target area.

ELECTROMAGNETIC COUPLING - The transfer of electromagnetic energy from one circuit or system to another circuit or system. An undesired transfer is termed EMI (electromagnetic interference).

EMC (ELECTROMAGNETIC COMPATIBILITY) - That condition in which electrical/electronic systems can perform their intended function without experiencing degradation from, or causing degradation to other electrical/electronic systems. More simply stated, EMC is that condition which exists in the absence of EMI. See also Intersystem and Intrasystem EMC tests.

EME (ELECTROMAGNETIC ENVIRONMENT) - The total electromagnetic energy in the RF spectrum that exists at any given location.

EMI (ELECTROMAGNETIC INTERFERENCE) - Any induced, radiated, or conducted electrical emission, disturbance, or transient that causes undesirable responses, degradation in performance, or malfunctions of any electrical or electronic equipment, device, or system. Also synonymously referred to as RFI (Radio Frequency Interference).

EMI MODEL - Usually a set of equations or logical concepts designed to illustrate the interactions, the detailed parameters considerations, and mathematical procedures necessary for proper analysis of a given EMI situation.

EMITTER - Any device or apparatus which emits electromagnetic energy.

EMP (ELECTROMAGNETIC PULSE) - The generation and radiation of a very narrow and very high-amplitude pulse of electromagnetic noise. It is associated with the high level pulse as a result of a nuclear detonation and with intentionally generated narrow, high-amplitude pulse for ECM applications. In the case of nuclear detonations, EMP consists of a continuous spectrum with most of its energy distributed through the low frequency band of 3 KHz to 1 MHz.

ERROR SIGNAL - In servomechanisms, the signal applied to the control circuit that indicates the degree of misalignment between the controlling and the controlled members. In tracking radar systems, a voltage dependent upon the signal received from a target whose polarity and magnitude depend on the angle between the target and the center axis of the scanning beam.

FAST TIME CONSTANT - See FTC.

FEET DRY / WET - Aircraft has crossed from water to shore / aircraft has crossed from shore to water.

FERRET - An aircraft, ship, or vehicle especially equipped for the detection, location, recording, and analyzing of electromagnetic radiations.

FIELD STRENGTH - The magnitude of a magnetic or electric field at any point, usually expressed in terms of ampere turns per meter or volts per meter. Sometimes called field intensity and is expressed in volts/meter or dBμv/meter. Above 100 MHz, power density terminology is used more often. See Section 4-1.

FIRST HARMONIC - The fundamental (original) frequency.

FREQUENCY AGILITY - A radar's ability to change frequency within its operating band, usually on a pulse-to-pulse basis. This is an ECCM technique employed to avoid spot jamming and to force the jammer to go into a less effective barrage mode.

FREQUENCY AGILITY RADAR - A radar that automatically or semiautomatically tunes through a discrete set of operating frequencies in its normal mode of operation.

FREQUENCY DIVERSITY RADAR - A radar system technique, employed primarily as an antijamming feature, where the transmitter output frequency varies randomly from pulse to pulse over a wide frequency range.

FREQUENCY RANGE - (1) A specifically designated portion of the frequency spectrum; (2) of a device, the band of frequencies over which the device may be considered useful with various circuit and operating conditions; (3) of a transmission system, the frequency band in which the system is able to transmit power without attenuating or distorting it more than a specified amount.

FREQUENCY SHIFT KEYING (FSK) - A form of FM where the carrier is shifted between two frequencies in accordance with a predetermined code. In multiple FSK, the carrier is shifted to more than two frequencies. FSK is used principally with teletype communications.

"FRUIT" - In a radar beacon system, there is a type of interference called "FRUIT," caused by beacon replies to interrogation asynchronous with the observer's interrogator. The largest amount of this

interference is received through the sidelobes of the interrogating antenna, but it can become dense enough to cause false target indications.

FTC (FAST TIME CONSTANT) - An antijam feature employed in radar systems where receiver circuits may be selected to provide a short time constant to emphasize signals of short duration to produce discrimination against the low frequency components of clutter.

FUNDAMENTAL FREQUENCY - Used synonymously for tuned frequency, carrier frequency, center frequency, output frequency, or operating frequency.

FUSELAGE STATION or just STATION - A reference point (usually the nose of an aircraft) used to measure or identify fore and aft locations. One of several aircraft location designations - also see butt line and water line.

GaAs FET AMPLIFIER - Because of their low noise, field-effect transistors are often used as the input stage of wideband amplifiers. Their high input resistance makes this device particularly useful in a variety of applications. Since the FET does not employ minority current carriers, carrier storage effects are eliminated giving the device faster operating characteristics and improved radiation resistant qualities.

GAIN - For antennas, the value of power gain in a given direction relative to an isotropic point source radiating equally in all directions. Frequently expressed in dB (gain of an isotropic source = 0 dB). The formula for calculating gain is:

$$G = \frac{4\pi\, P(\theta,\phi)}{P_{in}} \quad ; \text{where} \quad \begin{array}{l} P(\theta,\phi) = \text{Radiation intensity in given direction} \\ P_{in} = \text{Power into lossless antenna radiating uniformly in all directions} \end{array}$$

Note: (1) If radiation efficiency is unity, then gain = directivity i.e. if directivity = 2, then gain = 3 dB, etc.
(2) Interference losses within an array also affect gain
(3) See Section 3-1 for further details

For amplifiers, gain is the ratio of the output power to input power (usually in dB).

GATE (RANGE) - A signal used to select radar echoes corresponding to a very short range increment. Range is computed by moving the range gate or marker to the target echo; an arrangement which permits radar signals to be received in a small selected fraction of the time period between radar transmitter pulses.

GATING - (1) The process of selecting those portions of a wave which exist during one or more selected time intervals; (2) the application of a square waveform of desired duration and timing to perform electronic switching; (3) the application of receiver operating voltages to one or more stages only during that portion of a cycle of operation when reception is desired. See also Gate (Range).

GCI (GROUND-CONTROLLED INTERCEPT) - Vectoring an interceptor aircraft to an airborne target by means of information relayed from a ground-based radar site which observes both the interceptor and the target.

GIGA - A prefix meaning 10^9 (times a billion). For example, gigahertz (GHz).

GLINT (In Radar) - 1. The random component of target location error caused by variations in the phase front of the target signal (as contrasted with Scintillation Error). Glint may affect angle, range of

Doppler measurements, and may have peak values corresponding to locations beyond the true target extent in the measured coordinate. 2. Electronic countermeasures that uses the scintillating, or flashing effect of shuttered or rotating reflectors to degrade tracking or seeking functions of an enemy weapons system.

GUARDBAND - A frequency band to which no other emitters are assigned as a precaution against interference to equipments susceptible to EMI in that band.

GUIDANCE, BEAM RIDER - A missile guidance technique which is dependent on the missile's ability to determine its positions with reference to the center of scan of the guidance radar beam and thus correct its trajectory on the basis of detected errors.

GUIDANCE CODE - A technique of modulating guidance transmitter carriers with coded pulses compatible with the receiver code of the missile assigned that system, thus reducing the possibility of the missile accepting erroneous commands of other transmissions.

GUIDANCE, COMMAND - A guidance system wherein intelligence transmitted to the missile from an outside source causes the missile to traverse a directed path in space.

GUIDANCE, HOMING, ACTIVE - A system of homing guidance wherein both the transmitter and receiver are carried within the missile.

GUIDANCE, HOMING, PASSIVE - A form of homing guidance, which is dependent on a missile's ability to detect energy emitted by the target. Frequently termed Home-On-Jam (HOJ).

GUIDANCE, HOMING, SEMIACTIVE - A system of homing guidance wherein the missile uses reflected signals from the target which has been illuminated by a source other than within the missile. See also CWI.

GUIDANCE, INERTIAL - A self-contained system independent of information obtained from outside the missile, usually using Newton's second law of motion.

GUNN DIODE - The Gunn diode is a transferred electron device which because of its negative resistance can be used in microwave oscillators or amplifiers. When the applied voltage exceeds a certain critical value, periodic fluctuations in current occur. The frequency of oscillation depends primarily upon the drift velocity of electrons through the effective length of the device. This frequency may be varied over a small range by means of mechanical tuning.

HARMONIC - A sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency. For example, a component which is twice the fundamental frequency is called the second harmonic. (The fundamental is the first harmonic, which is frequently misunderstood.)

HERTZ - The unit of frequency equal to one cycle per second.

HOME-ON-JAM (HOJ) - See Guidance, Homing, Passive.

HORN ANTENNA - A flared, open-ended section of waveguide used to radiate the energy from a waveguide into space. Also termed "horn" or "horn radiator." Usually linearly polarized, it will be vertically polarized when the feed probe is vertical, or horizontally polarized if the feed is horizontal. Circular

polarization can be obtained by feeding a square horn at a 45° angle and phase shifting the vertical or horizontal excitation by 90°.

HYPERABRUPT VARACTOR OSCILLATOR - Due to a non-uniform concentration of N-type material (excess electrons) in the depletion region, this varactor produces a greater capacitance change in tuning voltage and a far more linear voltage-vs.-frequency tuning curve. As a result, this device has an improved tuning linearity and low tuning voltage.

IF (INTERMEDIATE FREQUENCY) - The difference frequency resulting from mixing (beating) the received signal in a superheterodyne receiver with the signal from the local oscillator. The difference frequency product provides the advantages inherent to the processing (amplification, detection, filtering, and such) of low frequency signals. The receiver local oscillator may operate either below or above the receiver tuned frequency. A single receiver may incorporate multiple IF detection.

$IF = F_{LO} - F_O$ (for a local oscillator operating above the fundamental)

where:
F_O = Received fundamental frequency
F_{LO} = Local oscillator frequency

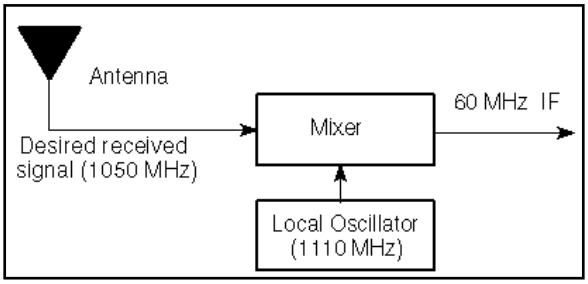

The simplified block diagram illustrates a typical mixing procedure employed in radar systems to obtain desired IF frequencies. The local oscillator is tuned above the fundamental frequency in this example. It should be noted that an undesired signal received at the receiver image frequency of 1170 MHz will also produce the desired 60 MHz IF frequency; this relationship provides the receiver image. See also Image Frequency.

IFF (IDENTIFICATION FRIEND OR FOE) - A system using radar transmission to which equipment carried by friendly forces automatically responds by emitting a unique characteristic series of pulses thereby distinguishing themselves from enemy forces. It is the "Mode IV" for the aircraft transponder. See also transponder.

IMAGE FREQUENCY - That frequency to which a given superheterodyne receiver is inherently susceptible, thereby rendering such a receiver extremely vulnerable to EMI at that frequency. The image frequency is located at the same frequency difference (Δf) to one side of the local oscillator as the tuned (desired) frequency is to the other side. An undesired signal received at the image frequency by a superheterodyne receiver not having preselection would, therefore, mix (beat) with the oscillator, produce the proper receiver IF, and be processed in the same manner as a signal at the desired frequency. See also receiver selectivity.

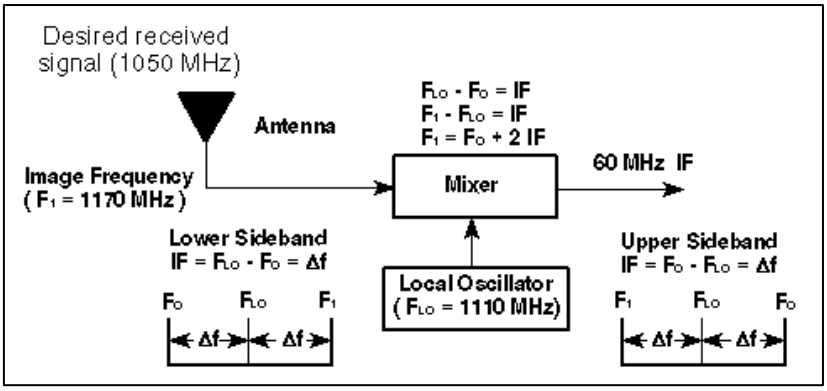

IMAGE JAMMING - Jamming at the image frequency of the radar receiver. Barrage jamming is made most effective by generating energy at both the normal operating and image frequency of the radar.

Image jamming inverts the phase of the response and is thereby useful as an angle deception technique. Not effective if the radar uses image rejection.

IMPATT DIODE - The IMPATT (IMPact Avalanche and Transit Time) diode acts like a negative resistance at microwave frequencies. Because of this property, Impatt diodes are used in oscillators and amplifiers. Usually the frequency range is in the millimeter wave region where other solid state devices cannot compete.

INGRESS - Go into the target area.

INSERTION LOSS - The loss incurred by inserting an element, device, or apparatus in an electrical/electronic circuit. Normally expressed in decibels determined as 10 log of the ratio of power measured at the point of insertion prior to inserting the device (P_1) to the power measured after inserting the device (P_2). Insertion loss (dB) = 10 log P_1/P_2.

INTEGRATION EFFECT - Pulse radars usually obtain several echoes from a target. If these echoes are added to each other, they enhance the S/N ratio, making a weak target easier to detect. The noise and interference do not directly add from pulse to pulse, so the ratio of target strength to undesired signal strength improves making the target more detectable. Random noise increases by the square root of the number of integrations, whereas the signal totally correlates and increases directly by the number of integrations, therefore the S/N enhancement is equal to the square root of the number of integrations.

INTERFERENCE - See EMI.

INTERFERENCE PARAMETERS - Equipment and propagation characteristics necessary for the proper evaluation of a given EMI situation.

INTERFERENCE/SIGNAL RATIO - See I/S Ratio.

INTERFERENCE THRESHOLD - The level of interference normally expressed in terms of the I/S (interference/signal) ratio at which performance degradation in a system first occurs as a result of EMI.

INTERFEROMETER - When two widely spaced antennas are arrayed together, they form an interferometer. The radiation pattern consists of many lobes, each having a narrow beamwidth. This antenna can provide good spatial selectivity if the lobe-to-lobe ambiguity can be solved such as using amplitude comparison between the two elements.

INTERMODULATION - The production, in a nonlinear element (such as a receiver mixer), of frequencies corresponding to the sums and differences of the fundamentals and harmonics of two or more frequencies which are transmitted through the element; or, the modulation of the components of a complex wave by each other, producing frequencies equal to the sums and differences of integral multiples of the component frequencies of the complex wave.

INTERSYSTEM EMC - EMC between the external electromagnetic environment (EME) and an aircraft with its installed systems. Generally, only system BIT must operate properly on the carrier deck while all system functions must operate properly in the operational EME.

INTRASYSTEM EMC - EMC between systems installed on an aircraft, exclusive of an external environment.

INVERSE CON SCAN - One method of confusing a radar operator or fire control radar system is to provide erroneous target bearings. This is accomplished by first sensing the radar antenna scan rate and then modulating repeater amplifier gain so the weak portion of the radar signal is amplified by the jammer, while the strong portion is not, so the weapons systems will fire at some bearing other than the true target bearing. The angle deception technique is used to break lock on CONSCAN radars.

INVERSE GAIN - Amplification, inverse modulation, and re-radiation of a radar's pulse train at the rotation rate of the radar scan. Deceives a conical scanning radar in angle.

ISOTROPIC ANTENNA - A hypothetical antenna which radiates or receives energy equally in all directions.

I/S RATIO (INTERFERENCE-TO-SIGNAL RATIO) (ISR) - The ratio of electromagnetic interference level to desired signal level that exists at a specified point in a receiving system. The ratio, normally expressed in dB, is employed as a tool in prediction of electronic receiving system performance degradation for a wide range of interference receiver input levels. Performance evaluations compare actual I/S ratios to minimum acceptable criteria.

JAFF - Expression for the combination of electronic and chaff jamming.

JAMMING - The deliberate radiation, reradiation, or reflection of electromagnetic energy with the object of impairing the use of electronic devices, equipment, or systems by an enemy.

JATO - JAmmer Technique Optimization group -- Organization coordinates EA technique development and evaluation efforts in support of naval airborne EA (ALQ-99, USQ-113, ALQ-227, ALQ-231, ALE-43). The group is run out of PMA-234 and comprised of elements at NAWCWD-Point Mugu, Johns Hopkins University/ Applied Physics Lab, Naval Research Lab, and NSWC-Crane. Efforts include M&S, Lab test, ground test, flight test, direct fleet support, and requirements and test support to development programs.

JINK - An aircraft maneuver which sharply changes the instantaneous flight path but maintains the overall route of flight. More violent than a weave.

JITTERED PRF - An antijam feature of certain radar systems which varies the PRF consecutively, and randomly, from pulse to pulse to prevent enemy ECM equipment from locking on, and synchronizing with, the transmitted PRF. PRF is synonymous with pulse repetition rate (PRR).

JTAT - JATO Techniques Analysis and Tactics -- Analysis documents produced by JATO to advise EA systems operators on the best ways to employ their systems by region, mission and equipment configuration. Currently covering ALQ-99 and USQ-113 on EA-6B; ALQ-99 and ALQ-227 on EA-18G, and ALQ-231 on AV-8B.

KILO - A prefix meaning 10^3 (times one thousand). For example, kilohertz.

KLYSTRON AMPLIFIER - An electron beam device which achieves amplification by the conversion of periodic velocity variations into conduction-current modulation in a field-free drift region. Velocity variations are launched by the interaction of an RF signal in an input resonant cavity and are coupled out through an RF output cavity. Several variations including reflex and multi cavity klystrons are used.

KLYSTRON, MULTICAVITY - An electron tube which employs velocity modulation to generate or amplify electromagnetic energy in the microwave region. Since velocity modulation employs transit time of

the electron to aid in the bunching of electrons, transient time is not a deterrent to high frequency operations as is the case in conventional electron tubes. See also Velocity Modulation.

KLYSTRON, REFLEX - A klystron which employs a reflector (repeller) electrode in place of a second resonant cavity to redirect the velocity-modulated electrons through the resonant cavity. The repeller causes one resonant circuit to serve as both input and output, which simplifies the tuning operation. This type of klystron is well adapted for use as an oscillator because the frequency is easily controlled by varying the position of the repeller. See also Velocity Modulation.

LEAKAGE - Undesired radiation or conduction of RF energy through the shielding of an enclosed area or of an electronic device.

LENS, RADAR (MICROWAVE) - The purpose of any such lens is to refract (focus) the diverging beam from an RF feed into a parallel beam (transmitting) or vice versa (receiving). The polarization is feed dependent.

LIGHT AMPLIFICATION BY STIMULATED EMISSION OF RADIATION (LASER) - A process of generating coherent light. The process utilizes a natural molecular (and atomic) phenomenon whereby molecules absorb incident electromagnetic energy at specific frequencies, store this energy for short but usable periods, and then release the stored energy in the form of light at particular frequencies in an extremely narrow frequency-band.

LIMITING - A term to describe that an amplifier has reached its point of saturation or maximum output voltage swing. Deliberate limiting of the signal is used in FM demodulation so that AM will not also be demodulated.

LITTORAL - Near a shore.

LOBE, ANTENNA - Various parts of the antenna's radiation pattern are referred to as lobes, which may be subclassified into major and minor lobes. The major lobe is the lobe of greatest gain and is also referred to as the main lobe or main beam. The minor lobes are further subclassified into side and back lobes as indicated in the figure to the right. The numbering of the side lobes are from the main lobe to the back lobe.

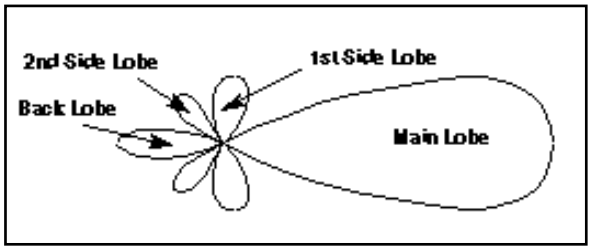

LOCAL OSCILLATOR FREQUENCY - An internally generated frequency in a superheterodyne receiver. This frequency differs from the receiver operating frequency by an amount equal to the IF of the receiver. The local oscillator frequency may be designed to be either above or below the incoming signal frequency.

LOG VIDEO - This receiver process, generally implemented in the IF, compresses the dynamic range of the signal so both weak and strong signals are displayed without changing the gain setting. Output voltage can be calibrated in volts/dB of input power.

LONG PULSE MODE - Many pulsed radars are capable of transmitting either long or short pulses of RF energy. When the long pulses of RF energy are selected manually (or sometimes automatically), the radar is said to be operating in the long pulse mode. In general, "long pulse mode" is used to obtain high average

power for long-range search or tracking, and "short pulse mode" gives low average power for short-range, high-definition, tracking or search.

LOOSE DEUCE - General term for two aircraft working in mutual support of each other.

LORO (LOBE-ON-RECEIVE-ONLY) - A mode of operation generally consisting of transmitting on one non-scanning antenna system and receiving the reflected energy on another scanning system (The receiver could be TWS, Conical, or monopulse).

MACH NUMBER - The ratio of the velocity of a body to the speed of sound in the medium that is being considered. In the atmosphere, the speed of sound varies with temperature and atmospheric pressure, hence, so does mach number.

MAGNETIC ANOMALY DETECTOR - A means of detecting changes in the earth's magnetic field caused by the presence of metal in ships and submarines.

MAGNETRON - A magnetron is a thermionic vacuum tube which is constructed with a permanent magnet forming a part of the tube and which generates microwave power. These devices are commonly used as the power output stage of radar transmitters operating in the frequency range above 1000 MHz and are used less commonly down to about 400 MHz. A magnetron has two concentric cylindrical electrodes. On a conventional magnetron, the inner one is the cathode and the outer one is the anode. The opposite is true for a coaxial magnetron.

MAGNETRON OSCILLATOR - A high-vacuum tube in which the interaction of an electronic space charge and a resonant system converts direct current power into ac power, usually at microwave frequencies. The magnetron has good efficiency, is capable of high power outputs, and is stable.

MATCHED FILTER - This describes the bandwidth of an IF amplifier that maximizes the signal-to-noise ratio in the receiver output. This bandwidth is a function of the pulsewidth of the signal.

MDS (MINIMUM DETECTABLE/DISCERNIBLE SIGNAL) - The receiver input power level that is just sufficient to produce a detectable/discernible signal in the receiver output. The detectable term is interchangeable with S_{min} and the discernable term is interchangeable with MVS. See Section 5-2.

MEACONING -- A system receiving radio signals and rebroadcasting them (or just transmitting) on the same frequency to confuse navigation. The meaconing station attempts to cause aircraft to receive inaccurate range or bearing information.

MEATBALL - Visual light "ball" seen in Fresnel lens optical landing system (FLOLS) by pilot during carrier or Navy field landing. Used as a reference to determine if flight path is high or low.

MEGA - A prefix meaning 10^6 (times one million). For example megahertz (MHz)

MICROVOLT PER METER - A commonly used unit of field strength at a given point. The field strength is measured by locating a standard receiving antenna at that point, and the "microvolts per meter" value is then the ratio of the antenna voltage in microvolts to the effective antenna length in meters. Usually used below 100 MHz. Above 100 MHz, power density terminology is normally used.

MICROWAVE AMPLIFICATION BY STIMULATED EMISSION OF RADIATION (MASER) - A low-noise radio-frequency amplifier. The emission of energy stored in a molecular or atomic system by a microwave power supply is stimulated by the input signal.

MISS DISTANCE - Used variously in different contexts. The distance from the missile to the geometric center of the aircraft, or the closest point of approach (CPA) of the missile to any portion of the aircraft such as the aircraft nose or telemetry pod, etc.

MISSILE SYSTEMS FUNCTIONS - Examples of missile system functions are: "acquisition" (ability to lock-on a desired target); "tracking" of a target; "guidance" of a missile toward a target; "illumination" of a target so that a homing missile can home on the reflected RF illumination; and "command" signal transmission to a missile to cause it to arm, to detonate, to commence homing, or to destroy itself.

MIXERS - See Balanced and Schottky Diode Mixers.

MODULATION - The process whereby some characteristic of one wave is varied in accordance with some characteristic of another wave. The basic types of modulation are angle modulation (including the special cases of phase and frequency modulation) and amplitude modulation. In missile radars, it is common practice to amplitude modulate the transmitted RF carrier wave of tracking and guidance transmitters by using a pulsed wave for modulating, and to frequency module the transmitted RF carrier wave of illuminator transmitters by using a sine wave.

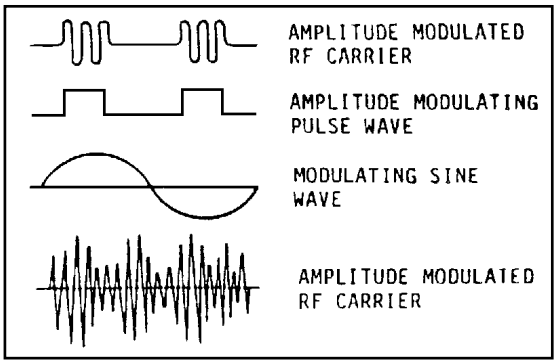

MODULATION, AMPLITUDE - This type of modulation changes the amplitude of a carrier wave in responses to the amplitude of a modulating wave. This modulation is used in radar and EW only as a switch to turn on or turn off the carrier wave; i.e., pulse is a special form of amplitude modulation.

MODULATION, FREQUENCY - The frequency of the modulated carrier wave is varied in proportion to the amplitude of the modulating wave and therefore, the phase of the carrier varies with the integral of the modulating wave. See also Modulation.

MODULATION, PHASE - The phase of the modulated carrier is varied in proportion to the amplitude of the modulating wave. See also Modulation.

MONOPULSE - (See figure to right) A type of tracking radar that permits the extracting of tracking error information from each received pulse and offers a reduction in tracking errors as compared to a conical-scan system of similar power and size. Multiple (commonly four) receiving antennas or feeds are placed symmetrically about the center axis and operate simultaneously to receive each RF pulse reflected from the target. A comparison of the output signal amplitude or phase among the four antennas indicates the location of the target with respect to the radar beam center line. The output

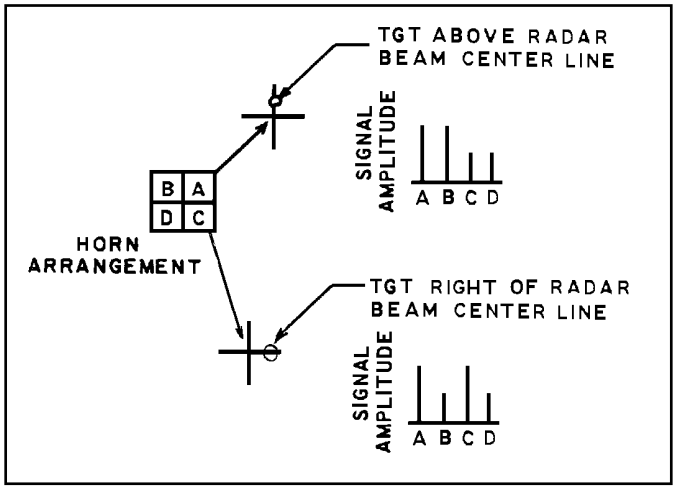

of the comparison circuit controls a servo system that reduces the tracking error to zero and thereby causes the antenna to track the target.

MOS (MINIMUM OPERATIONAL SENSITIVITY) - The minimum signal which can be detected and automatically digitally processed by a radar without human discrimination.

MTI (MOVING TARGET INDICATOR) - This radar signal process shows only targets that are in motion. Signals from stationary targets are subtracted out of the return signal by a memory circuit.

MULTIPATH - The process by which a transmitted signal arrives at the receiver by at least two different paths. These paths are usually the main direct path, and at least one reflected path. The signals combine either constructively or destructively depending upon phase, and the resultant signal may be either stronger or weaker than the value computed for free space.

MULTIPLEX - Simultaneous transmission of two or more signals on a common carrier wave. The three types of multiplex are called time division, frequency division, and phase division.

MULTIBAND RADAR - A type of radar which uses simultaneous operation on more than one frequency band through a common antenna. This technique allows for many sophisticated forms of video processing and requires any jammer to jam all channels at the same time in order to be effective.

MVS (MINIMUM VISIBLE SIGNAL) - The minimum input pulse signal power level which permits visibility of the output pulse, such as on a radar A-scope display. This level is determined by initially setting the input level above the visible detection threshold, and then slowly decreasing the amplitude.

NOISE FIGURE, RECEIVER - A figure of merit (NF or F) of a system given by the ratio of the signal-to-noise ratio at the input, S_i / N_i, divided by the signal-to-noise ratio at the output, S_o/N_o. It essentially expresses the ratio of output noise power of a given receiver to that of a theoretically perfect receiver which adds no noise.

$$Noise\ Figure = \frac{S_i / N_i}{S_o / N_o} = \frac{N_o}{G\,N_i}$$

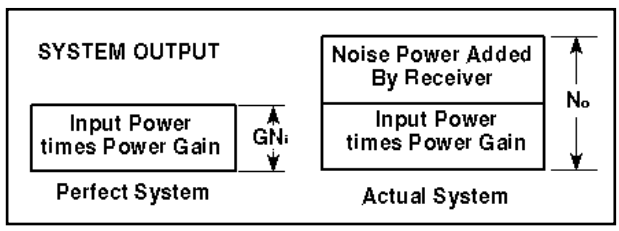

Where $S_o = GS_i$ and G is the gain of the system.

Noise figure is usually expressed in dB and given for an impedance matched condition. Impedance mismatch will increase the noise figure by the amount of mismatch loss. NF is usually given at room temperature; 17°C or 290°K. See Section 5-2.

NOISE JAMMING - A continuous random signal radiated with the objective of concealing the aircraft echo from the enemy radar. In order for it to be effective, it must have an average amplitude at least as great as the average amplitude of the radar echo. There are three major categories of noise jamming which are grouped by how jamming power is concentrated: Spot, barrage, and swept jamming. (See individual definitions)

NONCOHERENT - Two signals that have no set phase relationship.

NOTCH - The portion of the radar velocity display where a target disappears due to being notched out by the zero Doppler filter. If not filtered (notched), ground clutter would also appear on the display. A

notch filter is a narrow band-reject filter. A "notch maneuver" is used to place a tracking radar on the beam of the aircraft so it will be excluded.

NULL, ANTENNA PATTERN - The directions of minimum transmission (or reception) of a directional antenna. See also Lobe, Antenna.

NULL FILL - The nulls in an antenna pattern may be reduced (filled) by using a second ancillary (spoiler) antenna whose pattern is such that it fills in the nulls of the main antenna pattern.

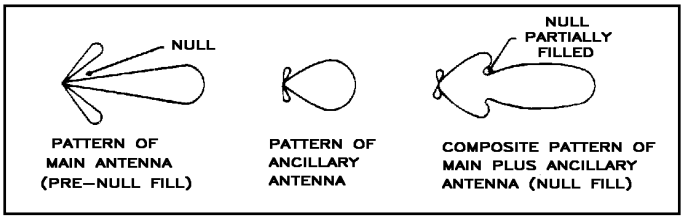

NUTATION - As applied to current missile system radars, this term refers to the mechanical motion of an antenna feed to produce a conical scan (fixed polarization) by the main beam of a tracking antenna, thus providing a means of developing tracking error signals. See also Antenna, Nutating. By analogy, "Nutation" also is used to denote the electrical switching of the quadrants of a seeker antenna. See also Interferometer. The effect is similar to that of a conical scan.

NUTATOR - A motor-driven rotating antenna feed used to produce a conical scan for a tracking radar. See also Antenna, Nutating. Also, the electrical circuits necessary to effect nonmechanical conical scans. See also Nutation.

OPERATIONAL CONSTRAINTS - Limitations on operating procedures in order to prevent interference between missile systems on a ship or between missile systems in a formation of ships under operational conditions. These limitations consist of such things as limited frequency bands or channels in which the radars may be tuned, limited sectors of space into which radar beams may be pointed, limits on minimum spacing between ships, limits on what codes may be used by radars and missiles on each ship, and limits on minimum interval between firing of certain missiles.

OSCILLATORS - Devices which generate a frequency. See also Backward Wave, Dielectrically Stabilized Oscillator, Hyperabrupt Varactor Oscillator, Magnetron Oscillator, Varactor Tuned Oscillator, and YIG tuned oscillator.

OSCILLATOR, LOCAL - See Local Oscillator Frequency.

PALMER SCAN - Conical scan superimposed on another type of scan pattern - usually a spiral pattern.

PARAMETER - A quantity which may have various values, each fixed within the limits of a stated case or discussion. In the present case, some examples of parameters; would be: radar frequency, limited by the tuning range of the radar; missile range, limited by the maximum operating range of the missile; or a missile code, limited by the number of codes available and by the codes that the ship radars are set up to operate on.

PASSIVE ANGLE TRACKING - Tracking of a target using radiation from the target (such as jamming), with no radiation from the radar itself. Only angular tracking is possible under these conditions since no measurement of time of travel of radiation to the target is possible, as is required to obtain target range.

PC (PULSE COMPRESSION) - The process used in search and tracking pulse radars whereby the transmitted pulse is long, so as to obtain high average transmitter output power, and the reflected pulse is

processed in the radar receiver to compress it to a fraction of the duration of the transmitted pulse to obtain high definition and signal strength enhancement. Pulse compression may be accomplished by sweeping the transmitted frequency (carrier) during the pulse. The returned signal is then passed through a frequency-dependent delay line. The leading edge of the pulse is therefore delayed so that the trailing edge catches up to the leading edge to produce effectively a shorter received pulse than that transmitted. Pulse compression radars are also referred to as CHIRP radars. Other more sophisticated pulse compression techniques are also possible and are becoming more popular.

PENCIL BEAM - A narrow circular radar beam from a highly directional antenna (such as a parabolic reflector).

PHASED ARRAY RADAR - Radar using many antenna elements which are combined in a controlled phase relationship. The direction of the beam can be changed as rapidly as the phase relationships (usually less than 20 microseconds). Thus, the antenna typically remains stationary while the beam is electronically scanned. The use of many antenna elements allows for very rapid and high directivity of the beam(s) with a large peak and/or average power. There is also a potential for greater reliability over a conventional radar since the array will fail gracefully, one element at a time.

PIN DIODE - A diode with a large intrinsic (I) region sandwiched between the P- and N- doped semiconducting regions. The most important property of the PIN diode is the fact that it appears as an almost pure resistance at RF. The value of this resistance can be varied over a range of approximately one-10,000 ohms by direct or low frequency current control. When the control current is varied continuously, the PIN diode is useful for attenuating, leveling and amplitude modulation of an RF signal. When the control current is switched on and off or in discrete steps, the device is useful in switching, pulse modulating, and phase shifting an RF signal.

POINT CONTACT DIODE - This was one of the earliest semiconductor device to be used at microwave frequencies. Consisting of a spring-loaded metal contact on a semiconducting surface, this diode can be considered an early version of the Schottky barrier diode. Generally used as a detector or mixer, the device is somewhat fragile and limited to low powers.

POLARIZATION - The direction of the electric field (E-field) vector of an electromagnetic (EM) wave. See Section 3-2. The most general case is elliptical polarization with all others being special cases. The E-field of an EM wave radiating from a vertically mounted dipole antenna will be vertical and the wave is said to be vertically polarized. In like manner, a horizontally mounted dipole will produce a horizontal electric field and is horizontally polarized. Equal vertical and horizontal E-field components produce circular polarization.

PORT - The left side of a ship or aircraft when facing the bow (forward)

POWER (AVERAGE) FOR PULSED RADARS - Average power for a pulse radar is the average power transmitted between the start of one pulse and the start of the next pulse (because the time between pulses is many times greater than the pulse duration time, the average power will be a small fraction of peak power).

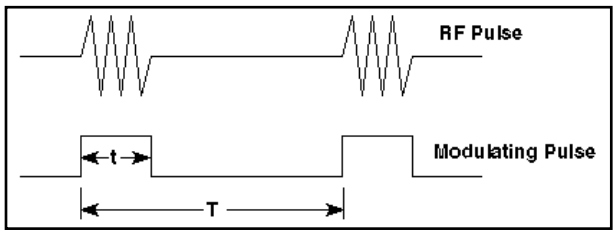

For this example: Peak Power = 1 MW, Pulse Time (t) = 0.5 microsecond, and Interval Between Pulses (T) = 1000 microseconds (1000 pps).

Peak Power = Pwr during pulse time (t) = 1 MW = 10^6 Watts = 90 dBm.

Avg Power = Average Power During Time (T) = 10^6 x t/T
= 10^6 x 0.5/1000 = 0.5 x 10^3 = 0.5 kilowatt = 57 dBm or 27 dBW

POWER OUTPUT - Power output of a transmitter or transmitting antenna is commonly expressed in dBW or dBm. One megawatt would be expressed as 60 dBW or 90 dBm:

10 log (1 megawatt / 1 watt) = 10 log ($10^6/10^0$)
= 10 x 6 = 60 dBW

10 log (1 megawatt / 1 milliwatt) = 10 log ($10^6/10^{-3}$)
= 10 x 9 = 90 dBm

POWER (PEAK) FOR PULSED RADARS - Peak power for a pulsed radar is the power radiated during the actual pulse transmission (with zero power transmitted between pulses).

POWER FOR CW RADARS - Since the power output of CW transmitters (such as illuminator transmitters) usually have a duty cycle of one (100%), the peak and average power are the same.

POWER DENSITY - The density of power in space expressed in Watts/meter^2, dBW/m^2, etc. Generally used in measurements above 100 MHz. At lower frequencies, field intensity measurements are taken. See Section 4-1.

PPI-SCOPE - A radar display yielding range and azimuth (bearing) information via an intensity modulated display and a circular sweep of a radial line. The radar is located at the center of the display.

PRESELECTOR - A device placed ahead of the mixer in a receiver, which has bandpass characteristics such that the desired (tuned) RF signal, the target return, is allowed to pass, and other undesired signals (including the image frequency) are attenuated.

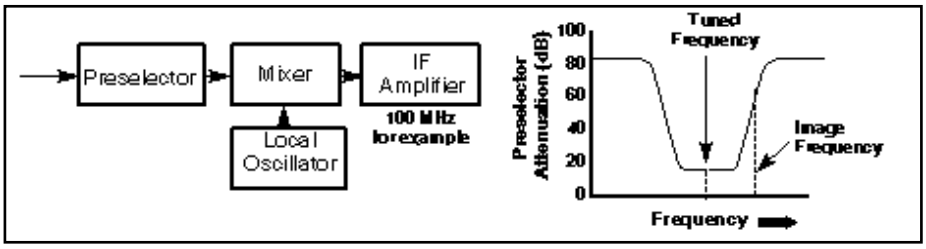

PROPAGATION - In electrical practice, the travel of waves through or along a medium. The path traveled by the wave in getting from one point to another is known as the propagation path (such as the path through the atmosphere in getting from a transmitting antenna to a receiving antenna, or the path through the waveguides and other microwave devices in getting from an antenna to a receiver).

PULSE COMPRESSION - See PC.

PULSED DOPPLER (PD) - A type of radar that combines the features of pulsed radars and CW Doppler radars. It transmits pulses (instead of CW) which permits accurate range measurement. This is an inherent advantage of pulsed radars. Also, it detects the Doppler frequency shift produced by target range rate which enables it to discriminate between targets of only slightly different range rate and also enables it to greatly reduce clutter from stationary targets. See also Doppler Effect.

PULSE LENGTH - Same meaning as Pulsewidth.

PULSE MODULATION - A special case of amplitude modulation wherein the carrier wave is varied at a pulsed rate. Pulse Modulation - The modulation of a carrier by a series of pulses generally for the purpose of transmitting data. The result is a short, powerful burst of electromagnetic radiation which can be used for measuring the distance from a radar set to a target.

PULSE REPETITION FREQUENCY (PRF) - The rate of occurrence of a series of pulses, such as 100 pulses per second. It is equal to the reciprocal of the pulse spacing (T) or PRT. (PRF = 1/T = 1/PRI). Sometimes the term pulse repetition rate (PRR) is used.

PULSE REPETITION FREQUENCY (PRF) STAGGER - The technique of switching PRF (or PRI) to different values on a pulse-to-pulse basis such that the various intervals follow a regular pattern. This is useful in compensating for blind speeds in pulsed MTI radars. Interpulse intervals which differ but follow a regular pattern.

PULSE REPETITION INTERVAL (PRI) or TIME (PRT) - Time between the beginning of one pulse and the beginning of the next.

PULSE SPACING - The interval of time between the leading edge of one pulse and the leading edge of the next pulse in a train of regularly recurring pulses. See also Pulse Repetition Frequency. Also called "the interpulse period."

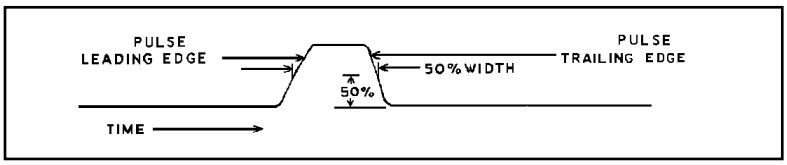

PULSEWIDTH - The interval of time between the leading edge of a pulse and the trailing edge of a pulse (measured in microseconds for the short pulses used in radar). Usually measured at the 3 dB midpoint (50-percent power or 70% voltage level) of the pulse, but may be specified to be measured at any level. See Section 6-10 for measurement techniques.

QUANTIZE - The process of restricting a variable to a number of discrete values. For example, to limit varying antenna gains to three levels.

RADAR - Radio detection and ranging.

RADAR CROSS SECTION - A measure of the radar reflection characteristics of a target. It is equal to the power reflected back to the radar divided by power density of the wave striking the target. For most targets, the radar cross section is the area of the cross section of the sphere that would reflect the same energy back to the radar if the sphere were substituted. RCS of sphere is independent of frequency if operating in the far field region. See Section 4-11.

RADAR RANGE EQUATION - The radar range equation is a basic relationship which permits the calculation of received echo signal strength, if certain parameters of the radar transmitter, antenna, propagation path, and target are known.

Given: $P_r = \dfrac{P_t G_t G_r \lambda^2 \sigma}{(4\pi)^3 R^4}$ *(freespace)* as the basic two-way radar equation (see Sections 4-4 thru 4-6)

where:

P_r = Peak power at receiver input

λ = Wavelength of signal (length) = c/f

P_t = Transmitted signal level (power)
R = Range of target to radar (distance)
G_t = Gain of transmitting antenna (dimensionless ratio)
σ = Radar cross section of target
G_r = Gain of receiving antenna (dimensionless ratio)

In practical use, the radar range equation is often written in logarithmic form, all terms expressed in decibels, so that the results can be found by simple processes of addition and subtraction. Using the above equation and $\lambda = c/f$.

$$10 \log P_r = 10 \log P_t + 10 \log G_t + 10 \log G_r + 10 \log \sigma - 40 \log R - 20 \log f + 20 \log c - 30 \log 4\pi$$

where: f = Signal frequency (cycles {dimensionless}/time) c = Speed of light (length/time)

$$10 \log P_r = 10 \log P_t + 10 \log G_t + 10 \log G_r + G_\sigma - 2\alpha_1$$

where α_1 and G_σ are factors containing the constants and conversion factors to keep the equations in consistent units.

Refer to Sections 4-4 through 4-6.

RADAR TRIGGER KILL - see Trigger Kill, Radar.

RADIATION EFFICIENCY - $E = P_{radiated}/P_{in}$ (ideal=1)

RADIATION PATTERN - See Antenna Pattern.

RADIO FREQUENCY - See RF.

RADIO FREQUENCY INTERFERENCE - See RFI.

RAIL KEEPING - Ability of countermeasures to keep the missile on the launch rail, i.e., prevent launch.

RAINBOW - A technique which applies pulse-to-pulse frequency changing to identifying and discriminating against decoys and chaff.

RANGE CELL - In a radar, a range cell is the smallest range increment the radar is capable of detecting. If a radar has a range resolution of 50 yards and a total range of 30 nautical miles (60,000 yds), there are: 60000/50 = 1,200 range cells.

RANGE GATE - A gate voltage used to select radar echoes from a very short range interval.

RANGE GATE PULL OFF (RGPO) - Deception technique used against pulse tracking radars using range gates. Jammer initially repeats the skin echo with minimum time delay at a high power to capture the AGC circuitry. The delay is progressively increased, forcing the tracking gates to be pulled away ("walked off") from the target echo. Frequency memory loops (FML's), or transponders provide the variable delay.

RANGE RATE - The rate at which a radar target is changing its range with respect to the radar (in feet per second for example). Note that this rate is not the same as target velocity unless the target is moving straight toward or straight away from the radar.

RANGE SCOPE - See A-Scope or PPI.

RECEIVER BANDWIDTH - The difference between the limiting frequencies within which receiver performance in respect to some characteristic falls within specified limits. (In most receivers this will be the difference between the two frequencies where the intermediate frequency (IF) amplifier gain falls off 3 dB from the gain at the center IF frequency.) See also Receiver Selectivity.

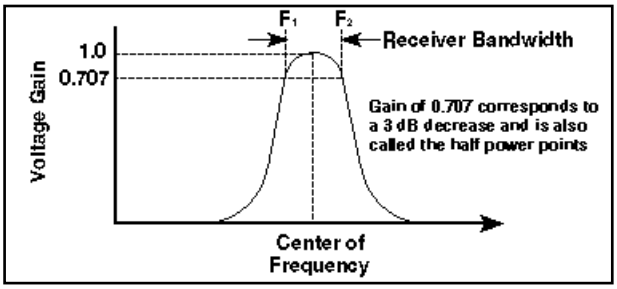

RECEIVER SELECTIVITY - The degree to which a receiver is capable of differentiating between the desired signal and signals or interference at other frequencies. (The narrower the receiver bandwidth, the greater the selectivity.)

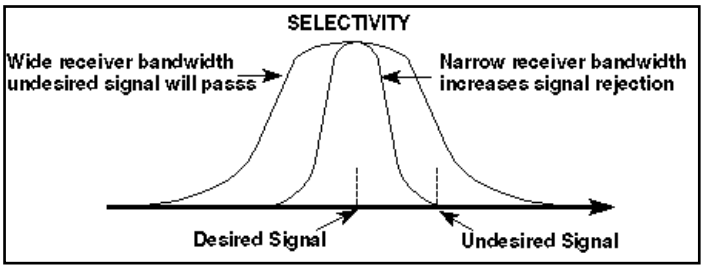

REFLECTION - The turning back (or to the side) of a radio wave as a result of impinging on any conducting surface which is at least comparable in dimension to the wavelength of the radio wave.

RESOLUTION - In radar, the minimum separation in angle or in range between two targets which the radar is capable of distinguishing.

RF (RADIO FREQUENCY) - A term indicating high frequency electromagnetic energy.

RFI (RADIO FREQUENCY INTERFERENCE) - Any induced, radiated, or conducted electrical disturbance or transient that causes undesirable responses or malfunctioning in any electrical or electronic equipment, device, or system. Same as EMI. Not to be confused with the logistic term ready for issue (also RFI).

RING AROUND - A condition in which a repeater jammer's total gain, from receiver antenna to transmitter antenna, exceeds the antenna isolation resulting in the repeater amplifying its own internal noise. Akin to positive feedback in an amplifier that causes unwanted oscillations.

RING AROUND (RADAR-TO-MISSILE) - The condition where radio frequency interference signals from a transmitter of one missile radar enter the receiving circuits of a missile under the control of another missile radar.

RING AROUND (RADAR-TO-RADAR) - The condition where radio frequency interference signals from a transmitter of one radar enter the receiving circuits of another radar.

ROPE - An element of chaff consisting of a long roll of metallic foil or wire which is designed for broad, low-frequency response. See Chaff.

R-SCOPE - (RANGE SCOPE) See A-scope or PPI.

SAFETY OF FLIGHT (SOF) TEST - A flight test to verify that a new or modified subsystem will not cause a major problem with the aircraft, i.e., interference can occur, but will not be such that required

navigational systems will fail or which might potentially cause the loss of an aircraft under all normally expected weather conditions.

SCAN - To transverse or sweep a sector or volume of airspace with a recurring pattern, by means of a controlled directional beam from a radar antenna. See also "Antenna, nutating."

SCHOTTKY BARRIER DIODE - The Schottky barrier diode is a simple metal-semiconductor boundary with no P-N junction. A depletion region between the metal contact and the doped semiconductor region offers little capacitance at microwave frequencies. This diode finds use as detectors, mixers, and switches.

SCHOTTKY DIODE MIXER - The mixer is a critical component in modern RF systems. Any nonlinear element can perform the mixing function, but parameters determining optimal mixing are noise figure, input admittance, and IF noise and impedance. The Schottky diode is particularly effective because of its low noise figure and nearly square law characteristics.

SCHOTTKY DIODE SWITCH - Standard P-N diodes are limited in switching ability at high frequencies because of capacitance provided by the minority carriers. The Schottky diode overcomes this problem by use of the metal-semiconductor junction with inherently low carrier lifetimes, typically less than 100 picoseconds.

SEARCH RADAR - A radar whose prime function is to scan (search) a specified volume of space and indicate the presence of any targets on some type of visual display, and, in some cases, to provide coordinates of the targets to a fire control system to assist in target acquisition and tracking.

SEEKER - The seeker consists of circuitry in a homing missile which detects, electronically examines, and tracks the target; provides data for controlling the flight path of the missile; and provides signals for destroying the missile or for detonating it at intercept. (The seeker function is similar to that of an interferometer.)

SELF-SCREENING JAMMING (SSJ) - Each aircraft carries its own jamming equipment for its own protection.

SENSITIVITY - The sensitivity of a receiver is taken as the minimum signal level required to produce an output signal having a specified signal-to-noise ratio. See also Minimum Visible Signal and Minimum Discernible Signal (MDS).

SENSITIVITY TIME CONTROL - See STC.

SENSOR - The receiver portion of a transmitter/receiver pair used to detect and process electromagnetic energy.

SHIELDING - The physical arrangement of shields for a particular component, equipment, or system, (A shield is a housing, screen, or other material, usually conducting, that substantially reduces the effect of electric or magnetic fields on one side of the shield upon devices or circuits on the other side.) Examples are tube shields, a shielded enclosure or cabinet for a radar receiver, and the screen around a screen room.

SHORT PULSE MODE - See Long Pulse Mode.

SIDEBAND - A signal either above or below the carrier frequency, produced by the modulation of the carrier wave by some other wave. See figure at right ⇒

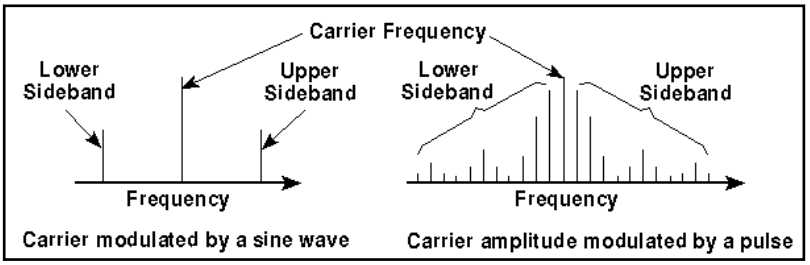

SIDELOBE - See Lobe, Antenna.

SIGNAL STRENGTH - The magnitude of a signal at a particular location. Units are volts per meter or dBV/m.

SIGNATURE - The set of parameters which describe the characteristics of a radar target or an RF emitter and distinguish one emitter from another. Signature parameters include the radio frequency of the carrier, the modulation characteristics (typically the pulse modulation code), and the scan pattern.

SILICON CONTROLLED SWITCH - A P-N-P-N device able to operate at sub-microsecond switching speeds by the application of gate signals. Because it is a four layer device, this switch is also known as a tetrode thyristor.

SLANT POLARIZATION - Technique of rotating a linear antenna 45° so it can receive or jam both horizontal and vertical polarization although there is a 3 dB loss. See Section 3.2.

SOLID STATE STAMO - A stable master oscillator constructed using transistors and other solid state devices as opposed to vacuum tubes. See also STAMO.

SPECTRUM - The distribution of power versus frequency in an electromagnetic wave. See also Spectrum Signature Analysis and illustrations under Sideband.

SPECTRUM ANALYZER - An electronic device for automatically displaying the spectrum of the electromagnetic radiation from one or more devices. A cathode ray tube display is commonly used to display this power-versus frequency spectrum. For examples of two types of displays, see illustrations under Sideband.

SPECTRUM SIGNATURE ANALYSIS - The analysis of the electromagnetic radiation from an electronic device to determine the relative power in each sideband, harmonic, and spurious emission compared to the carrier frequency. This particular distribution (or spectrum) is peculiar to the device and can identify this type of device, thereby acting as an identifying "signature."

SPECTRUM WIDTH (TRANSMITTER) - The difference between the frequency limits of the band which contains all the spectrum frequency components of significant magnitude.

SPOILER ANTENNA - An antenna used to change (spoil) the antenna pattern of a second antenna so as to reduce the nulls in the pattern of the second antenna. See also Null Fill.

SPOKING (RADAR) - Periodic flashes of the rotating radial display. Sometimes caused by mutual interference.

"SPOOFING" - A type of deception by using an electronic device to transmit a "target" echo. The spoofing transmitter must operate at the same frequency and PRF as the radar to be deceived. The radar main pulse triggers the spoofing transmitter which, after a delay, transmits a false echo.

SPOT JAMMING - Narrow frequency band jamming concentrated against a specific radar at a particular frequency. The jamming bandwidth is comparable to the radar bandpass. Can deny range and angle information.

SPURIOUS EMISSION - Electromagnetic radiation transmitted on a frequency outside the bandwidth required for satisfactory transmission of the required waveform. Spurious emissions include harmonics, parasitic emissions, and intermodulation products, but exclude necessary modulation sidebands of the fundamental carrier frequency.

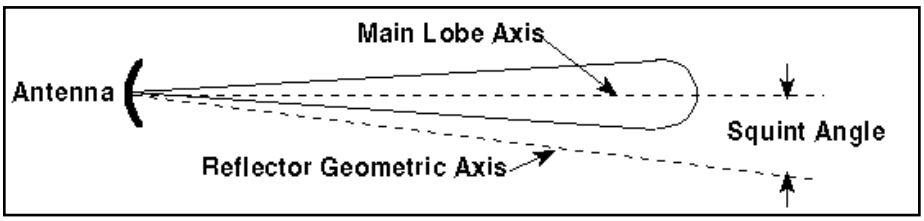

SQUINT ANGLE - The angular difference between the axis of the antenna mainlobe and the geometric axis of the antenna reflector, such as the constant angle maintained during conical scan as the mainlobe rotates around the geometric axis of the reflector.

STAGGERED PRF - Staggered PRF allows an increase in MTI blind speeds such that no zeros exist in the velocity response at lower velocities. In a two-period mode, the usual "blind speed" or occurrence of a zero in the velocity response is multiplied by a factor which is a function of the ratio of the two repetition periods.

STAMO (STABLE MASTER OSCILLATOR) - A very stable (drift free) oscillatory used to provide a precise frequency for transmission and for comparison with the reflected radar signal returned to the receiver, such as in a Doppler radar where a precise difference between transmitted and received signals must be measured to determine accurately the Doppler frequency.

STAND-FORWARD JAMMING - A method which places the jamming vehicle between the enemy sensors and attack aircraft.

STAND-IN JAMMING (SIJ) - Similar to stand-forward jamming but usually using an UAV with a lower powered jammer instead of a jammer aircraft.

STAND-OFF JAMMING (SOJ) - An ECM support aircraft orbits in the vicinity of the intended target. As the fighter-bomber pilot starts his strike penetration, the ECM aircraft directs jamming against all significant radars in the area. This technique provides broad frequency band ECM without affecting performance of the strike aircraft.

STARBOARD - The right side of a ship or airplane when facing the bow (forward).

STC (SENSITIVITY TIME CONTROL) - Gain control that reduces the radar receiver gain for nearby targets as compared to more distant targets. STC prevents receiver saturation from close-in targets.

STEP RECOVERY DIODE - A charge-controlled switch which ceases current conduction so rapidly that it can be used to produce an impulse. Cyclic operation of the diode can produce a train of impulses which when used with a resonant circuit can produce a single frequency output at any harmonic of the pulse frequency.

STERADIAN - Unit of solid angle. An entire sphere has 4π steradians.

STREAM CHAFF - Operational technique of dropping large quantities of chaff for a continuous period of time. This results in a "ribbon" or "stream" of returns many miles in lengths on radarscopes. The penetrating strike force can then use the resulting chaff corridor to mask their penetration.

SUBHARMONIC - A frequency which is an integral submultiple of another frequency. For example, a sine wave whose frequency is one-third of the frequency of another sine wave is called the third subharmonic. (3 MHz is the third subharmonic of 9 MHz).

SUPERHETERODYNE RECEIVER - A receiver that mixes the incoming signal with a locally generated signal (local oscillator) to produce a fixed, low intermediate frequency (IF) signal for amplification in the IF amplifiers.

SUPPRESSION - Elimination or reduction of any component of an emission, such as suppression of a harmonic of a transmitter frequency by band rejection filter.

SUPPRESSION OF ENEMY AIR DEFENSES (SEAD) - Activity which neutralizes, destroys, or temporarily degrades enemy air defense systems by using physical attack or electronic means (SEAD pronounced "seed" or "C add").

SUSCEPTIBILITY - The degree to which an equipment or a system is sensitive to externally generated interference.

SWEPT JAMMING - Narrowband jamming which is swept through the desired frequency band in order to maximize power output. This technique is similar to sweeping spot noise to create barrage jamming, but at a higher power.

SWITCHES - See also Diode Switch, Silicon Controlled Switch, Schottky Diode Switch.

SYNCHRODYNE - A klystron mixer amplifier stage in a transmitter, where two signal frequencies are applied as inputs and a single amplified signal is taken out.

TARGET SIZE - A measure of the ability of a radar target to reflect energy to the radar receiving antenna. The parameter used to describe this ability is the "radar cross section" of the target. The size (or radar cross section) of a target, such as an aircraft, will vary considerably as the target maneuvers and presents different views to the radar. A side view will normally result in a much larger radar cross section than a head-on view. See also Radar Cross Section.

TERMINAL IMPEDANCE - The equivalent impedance as seen by the transmitter/receiver.

TERRAIN BOUNCE - Term for jamming that is directed at the earth's surface where it is reflected toward the threat radar. Reflected jamming creates a virtual image of the jamming source on the earth as a target for HOJ missiles.

THERMISTOR - A resistor whose resistance varies with temperature in a defined manner. The word is formed from the two words "thermal" and "resistor,"

THRESHOLD ISR - The interference to signal ratio (ISR) at which the performance of a receiver starts undergoing degradation. It must be determined by tests.

TRACKING RADAR - A radar whose prime function is to track a radar target and determine the target coordinates (in range and angular position) so that a missile may be guided to the target, or a gun aimed at the target.

TRACKING RADAR RECEIVER - These are of two primary types: conical scan and monopulse. (1) The conical scan system directs the radar signal in a circle around the target. The radar paints this circle 15 to 40 times per second. As the target moves out of the center of this circle, the radar develops aim error voltages and re-aims the antenna. (2) The monopulse system directs four beams at the target simultaneously. The target is in the middle of the four beams. If the target is not in the center, the radar return develops an aim error voltage to re-aim the antenna.

TRACK WHILE SCAN (TWS) RADAR - Although it is not really a tracking radar in the true sense of the word, it does provide complete and accurate position information for missile guidance. In one implementation it would utilize two separate beams produced by two separate antennas on two different frequencies. The system utilizes electronic computer techniques whereby raw datum is used to track an assigned target, compute target velocity, and predict its future position, while maintaining normal sector scan. Most aircraft use only a single antenna.

TRADE-OFF TABLES - A set of tables showing the various combinations of two or more variables that are related in that making one variable better will make the other variable worse. The trade-off helps find the best solution considering all combinations. (For example, how a no-interference condition can be maintained if two emitter platforms are brought close together, if at the same time the frequency separation between their radar transmitters is increased.)

TRANSIENT - A phenomenon (such as a surge of voltage or current) caused in a system by a sudden change in conditions, and which may persist for a relatively short time after the change (sometimes called ringing).

TRANSPONDER - A transmitter-receiver capable of accepting the electronic challenge of an interrogator and automatically transmitting an appropriate reply. There are four modes of operation currently in use for military aircraft. Mode 1 is a nonsecure low cost method used by ships to track aircraft and other ships. Mode 2 is used by aircraft to make carrier controlled approaches to ships during inclement weather. Mode 3 is the standard system used by commercial aircraft to relay their position to ground controllers throughout the world. Mode 4 is IFF. See also IFF.

TRAVELING-WAVE TUBE AMPLIFIER - The TWT is a microwave amplifier capable of operation over very wide bandwidths. In operation, an electron beam interacts with a microwave signal which is traveling on a slow wave helical structure. The near synchronism of the beam and RF wave velocities results in amplification. Bandwidths of 3:1 are possible. Operation at high powers or at millimeter wavelengths is possible at reduced bandwidths.

TRIGGER KILL (RADAR) - A method employed to momentarily disable certain radar system circuits to reduce or eliminate RF emissions which may cause an EMI/EMC or RADHAZ situation such as on the deck of a ship.

TUNNEL DIODE - The tunnel diode is a heavily doped P-N junction diode that displays a negative resistance over a portion of its voltage-current characteristic curve. In the tunneling process, electrons from the p-side valence bands are able to cross the energy barrier into empty states in the N-side conduction band when a small reverse bias is applied. This diode is used as a microwave amplifier or oscillator.

UPLINK - The missile guidance signal which passes midcourse correction command guidance intelligence from the guidance radar site to the missile.

VARACTOR DIODE - A P-N junction employing an external bias to create a depletion layer containing very few charge carriers. The diode effectively acts as a variable capacitor.

VARACTOR TUNED OSCILLATOR - A varactor diode serves as a voltage-controlled capacitor in a tuned circuit to control the frequency of a negative resistance oscillator. The major feature of this oscillator is its extremely fast tuning speed. A limiting factor is the ability of the external voltage driver circuit to change the voltage across the varactor diode, which is primarily controlled by the driver impedance and the bypass capacitors in the tuning circuit.

VELOCITY GATE PULL-OFF (VGPO) - Method of capturing the velocity gate of a Doppler radar and moving it away from the skin echo. Similar to the RGPO, but used against CW or Doppler velocity tracking radar systems. The CW or pulse doppler frequency, which is amplified and retransmitted, is shifted in frequency (velocity) to provide an apparent rate change or Doppler shift.

VELOCITY MODULATION - Velocity modulation is modification of the velocity of an electron beam by alternately accelerating and decelerating the electrons at a frequency equal to the input frequency. Thus, the electrons are segregated in bunches, each bunch causing a cycle or current as it passes an output electrode. The velocity of the electrons is thus a function of the modulation voltage. See also Klystron, Multicavity and Klystron, Reflex.

VICTIM - A receiver (radar or missile) that suffers degradation due to ECM or EMI effects.

VIDEO - Receiver RF signals that have been converted (post detection) into a pulse envelope that can be seen when applied to some type of radar visual display; also used to describe the actual display itself (such as the video on an A-scope).

WARM - Acronym for Wartime Reserve Mode. Any mode of operation of a radar or ECM that is held in reserve, and never used, except in actual combat.

WATER LINE - A reference line used for vertical measurements. When used with an aircraft it is usually the ground with the landing gear extended normally. One of several aircraft location designations, also see butt line and fuselage station.

WAVEGUIDE - A transmission line consisting of a hollow conducting tube of arbitrary geometry (usually rectangular, but may be circular) within which electromagnetic waves may propagate.

WAVELENGTH (λ) - The distance traveled by a wave in one period (the period is the time required to complete one cycle). $\lambda = c/f$. In the atmosphere, electromagnetic waves travel at c, the speed of light (300 million meters per second or 30 cm/nsec). At 5 GHz, one wavelength = 6 cm. At 10 GHz, one wavelength = 3 cm.

WAVEMETER - An instrument for measuring the frequency of a radio wave. The wavemeter is a mechanically tunable resonant circuit. It must be part of a reflection of transmission measurement system to measure the maximum response of a signal. Below 20 GHz, the wavemeter has been replaced by the frequency counter with much greater accuracy and ease of use.

WEAVE - An aircraft maneuver that smoothly changes the instantaneous flight path but maintains the overall route of flight. Not as violent as a jink.

WET RUN - A test run with ship / aircraft armament and/or EW switches on.

WILD WEASEL - USAF aircraft (F-4Gs during Desert Storm) used for suppression of enemy air defense (SEAD) mission.

WINDOW - WWII name for chaff

YIG TUNED OSCILLATOR - A YIG (yttrium iron garnet) sphere, when installed in the proper magnetic environment with suitable coupling will behave like a tunable microwave cavity with Q on the order of 1,000 to 8,000. Since spectral purity is related to Q, the device has excellent AM and FM noise characteristics.

ZENER DIODE - A diode that exhibits in the avalanche-breakdown region a large change in reverse current over a very narrow range in reverse voltage. This characteristic permits a highly stable reference voltage to be maintained across the diode despite a wide range of current.

THE REALITY OF PSYCHOTRONIC WEAPONS TODAY!

by

Preston T. Bailey, PhD.

Poll: Most Americans Feel Threatened By the Government

A new survey from Pew Research Center finds more than half of Americans believe the government threatens their personal rights. The national survey marks the first time a majority of Americans have viewed the government as a threat since Pew began tracking public opinion on the subject in 1995.

Welcome to
IDAHO
ATTENTION CRIMINALS & TERRORISTS
Over 170,000 Idaho Residents Have A Permit to Legally Carry A Concealed Weapon, About 60% Of The rest of the Population Is Armed But Have Not Bothered to Purchase the License As It Is Not A Requirement To Carry A Firearm. Understand, A Substantial Portion Of The Population Is Armed And Prepared To Defend themselves And Others Against Acts of Criminal Violence.
YOU HAVE BEEN WARNED!
However, California, New York and Illinois have disarmed their citizens for your convenience.

The outgoing Homeland Security Secretary has a warning for her successor: A massive and “serious” cyber attack on the U.S. homeland is coming, and a natural disaster — the likes of which the nation has never seen — is also likely on its way.

ELECTROMAGETIC ENERGY WEAPONS

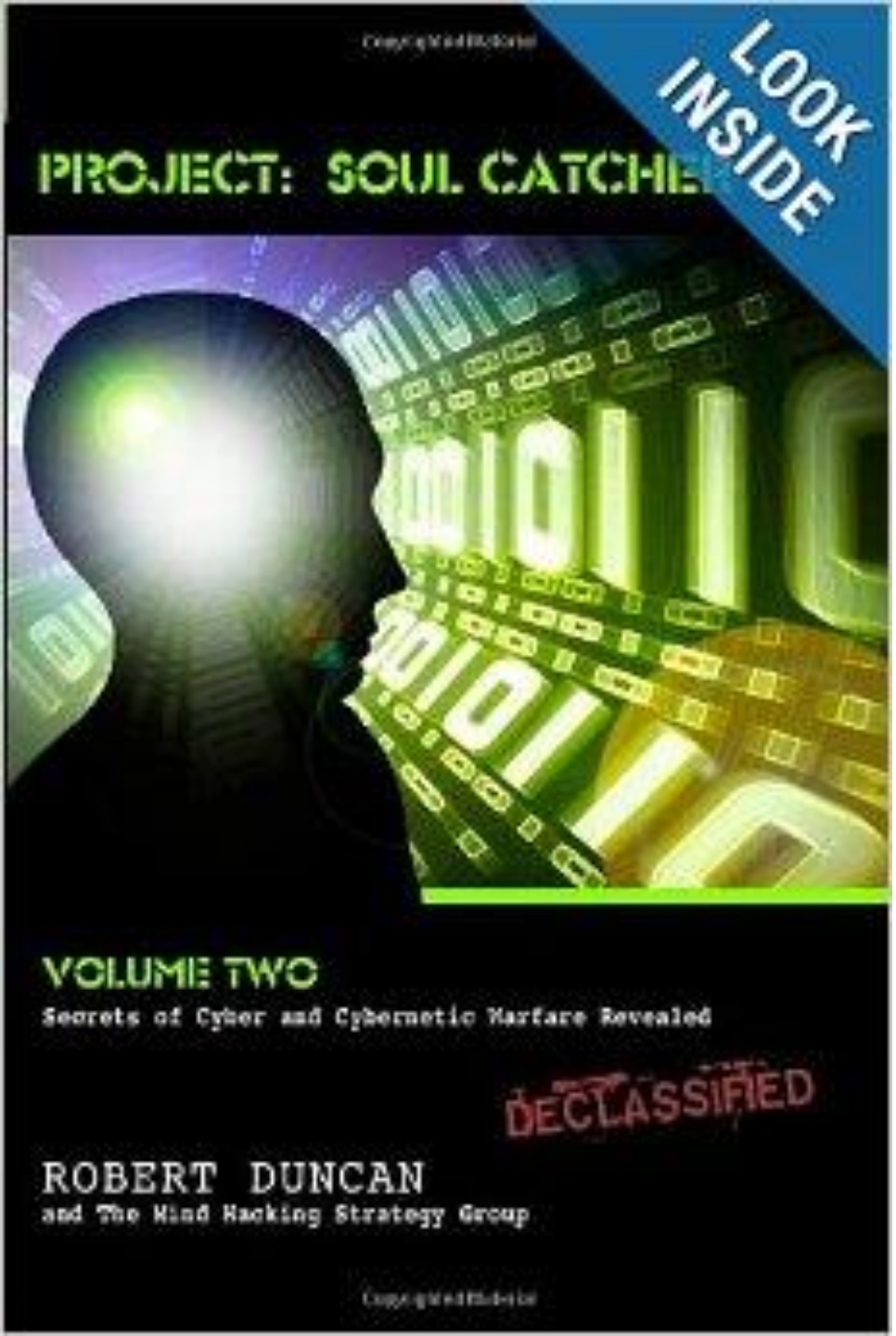

<u>Project Soul Catcher: Secrets of Cyber and Cybernetic Warfare Revealed</u> reveals the cybernetic mind control by the CIA and their use of psychotronic weapons and their pursuit to weaponize neurpsychology.

ELECTROMAGNETIC SATELLITE TECHNOLOGY

THE NEUROPHONE:US Patent # 3,393,279. July 16th, 1968

It's a device that converts sound to electrical impulses sometimes called the “Voice of God” or makes the person think he is crazy. When the signals are sent to the brain, it makes a person think that God is speaking to him/her or even an “alien.” It targets the unique bioelectrical resonance frequency using his “vibrational pattern” in the brain called a “signature” and it acts like an audio receiver.

THE PSYCHO-ACOUSTIC PROJECTOR:

U.S. patent #3,566,347, (23/2/71)
A device/weapon which can actually deafen the target.

SILENT SUBLIMAL MESSAGES: US Patent # 5,159,703. October 27th, 1992

Non aural carriers in extreme audio frequency ranges are amplified or modulated with the desired material and propagated acoustically for direct inducement into the brain. This is an excellent method of influencing people without their knowledge and is used in advertising.

METHODS AND SYSTEMS OF ALTERING CONSICOUSNESS:

US Patent # 5,123,844. June 23rd, 1992
US Patent # 5,289,438. February 22nd, 1994
These systems stimulate the brain with different frequencies and wave forms to alter the subject's state of consciousness.

Electro Magnetic Field (EMF) monitoring/interference is one of the most insidious and secretive of all methods used by the agencies.

MICROWAVE WEAPONS: "A hearing system" U.S. patent #4,877,027, 31/10/89 & "A hearing device" U.S. patent #4,858,612, 22/8/89.

The first known experiment with microwaved voices was conducted by Sharp and Grove in the early 70's. However, the Defence Intelligence Agency and ARPA (The Advanced Research Projects Agency) are principally to blame for the abuse of such technologies since. eg Project Pandora etc. The CIA's Langley Research Center as well as numerous scientists working in Energy/Defence department labs across the U.S. are also responsible.

BRAIN WAVE MONITORS/ANALYSERS

When the brain wave pattern of an individual is detected from the use of one of numerous types of detectors such as a satellite, these brainwave signals are sent to a monitor with a computer. These brain wave patterns are interpreted through a brain wave vocabulary that records the thoughts into words. The NSA monitors the brainwaves of their targets by satellite and decode the evoked potentials (3.50Hz 5 milliwatts) that the brain emits. So, using lasers / satellites and high-powered computers, the agencies have now gained the ability to decipher human thoughts - and from a considerable distance almost instantaneously.

Psychotronic Weapons

Russian former Prime Minister Dmitry Medvedev with a psychotronic gun

Psychotronic Guns by Thor Jensen

This is still an in-development project, but the potential for mayhem is unimaginable. Russia is currently working on weapons that employ electromagnetic radiation to directly affect the central nervous system – the root of all sensory processing – in a variety of unpleasant ways. The weapon will most likely build on existing research that shows the ability of low-frequency microwaves to affect brain function, alter moods and transmit false sensory data. Although this may all seem like *X-Files* stuff, the scientific basis is there. It's up to some unscrupulous weapons designer to put it into practice.

Long Range Acoustic Device

Sound waves have the potential to deal tremendous damage at loud enough amplitudes – think about a sonic boom, for instance. But you don’t need a jet engine to turn sound into a weapon. The Long Range Acoustic Device is a creation of the American technology Corporation that was originally designed to defend safe zones around boats. It produces an incredibly loud noise that can travel almost 1000 feet in a targeted beam, and if the frequency is amplified enough it can cause legitimate physical pain in its victims.

Dazer Laser

Of all the senses you use on the battlefield, vision is probably the most important. So disrupting that can turn the tide in war. One of the most effective sensory weapons on the market right now is the Dazer Laser, made by Laser Energetics. Using a green laser source that emits both a continuous and pulsed wave, the range on the unit can be adjusted to as far as 2400 meters. One shot of the laser targeted at the eye area can completely incapacitate the victim for several minutes, long enough for them to be subdued non-lethally.

Distributed Sound And Light Array Debilitator

The most effective sensory weapons are ones that can engage and disorient multiple methods of input as well. Colloquially known as the “puke ray,” the Distributed Sound And Light Array Debilitator generates sound and light in a specific sequence designed to overload the brain’s processors, generating feelings of unease and discomfort. Prolonged exposure can result in even more unpleasant effects, including nausea and vomiting. Some scientists are even working towards producing a portable version the size of a flashlight that can be used on an individual basis.

Pulsed Energy Projectiles

The sensory organ with the largest active area in the body is, of course, the sense of touch. The human body has millions of individual nerves that are used to transmit sensory data to the brain, and a new experimental weapon from the U.S. government aims to really get them going. Pulsed energy projectiles are a specially-modulated laser that generates a burst of expanding plasma when they hit a solid object. That plasma in turn emits an electromagnetic pulse that causes immediate, searing pain to nerve cells all over the target's body. They're not in use yet, but research has been very promising.

MEDUSA

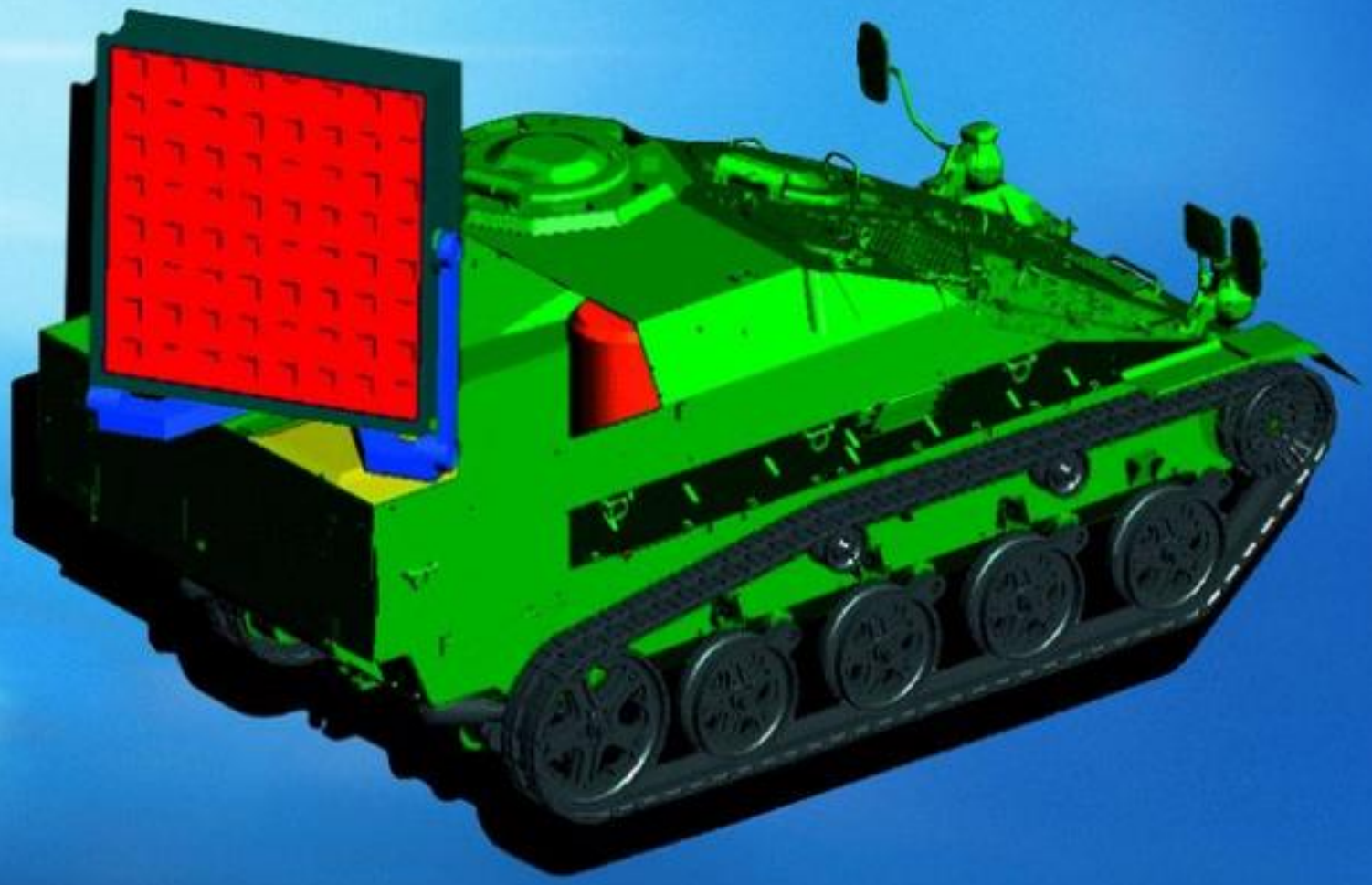

One of the most interesting sensory weapons on the market uses audio to disorient and confuse targets, but it skips the ear entirely. MEDUSA, a product of the Sierra Nevada Corporation, doesn’t create sound in a conventional way. Instead, it uses pulses of microwave radiation to generate shockwaves inside the skull that are detected by the ears from within – so earplugs won’t help you at all. It can generate painful white noise and even recognizable speech that sounds like it’s coming from the inside of your brain. Scary stuff.

"The Mind Has No Firewall" Army article on psychotronic weapons (Parameters)

The human body, much like a computer, contains myriad data processors. They include, but are not limited to, the chemical-electrical activity of the brain, heart, and peripheral nervous system, the signals sent from the cortex region of the brain to other parts of our body, the tiny hair cells in the inner ear that process auditory signals, and the light-sensitive retina and cornea of the eye that process visual activity.

We are on the threshold of an era in which these data processors of the human body may be manipulated or debilitated. Examples of unplanned attacks on the body's data-processing capability are well-documented. Strobe lights have been known to cause epileptic seizures. Not long ago in Japan, children watching television cartoons were subjected to pulsating lights that caused seizures in some and made others very sick.

http://dprogram.net/2009/07/01/the-mind-has-no-firewall-army-article-on-psychotronic-weapons/

TYPES OF PSYCHOTRONIC WEAPONS

A psychotronic generator produces a powerful electromagnetic emanation capable of being sent through telephone lines, TV, radio networks, supply pipes, and incandescent lamps.

An autonomous generator is a device that operates in the 10-150 Hertz band. At the 10-20 Hertz band, it forms an infrasonic oscillation that is destructive to all living creatures.

A nervous system generator is designed to paralyze the central nervous systems of insects which could have the same applicability to humans.

Ultrasound emanation devices using ultrasound emanations are capable of carrying out bloodless internal operations without leaving a mark on the skin. They can also be used to kill people from a distance.

Noiseless cassettes is the ability to place infra-low frequency voice patterns over music, patterns that are detected by the subconscious. These messages are then stored in a person’s sub-conscious mind which they may later act upon.

MICHIGAN LAW AGAINST ELECTROMAGNETIC DEVICES

House Bill 4513 would amend the penal code (MCL 750.200h) to define “harmful electronic or electromagnetic device” as a device designed to emit or radiate an electronic or electromagnetic pulse or signal or microwave intended to cause harm to others or cause damage to, destroy, or disrupt any electronic or telecommunications system or device including a computer or computer network. The bill would also include a harmful electronic or electromagnetic device in the definition of “imitation harmful substance or device.”

The Nuremberg Code opposes all forms of human experiments

The state of Missouri has a law against involuntary chipping or implanting of a human

Many countries have laws against human experimentation and the use of electromagnetic devices to control a person either their mind or their bodies

SENATOR JOHN GLENN

Senator Glenn's publicly-expressed outrage that this government has been found to be engaging in brutal forms of involuntary human experimentation, and that any and all forms of this type of experimentation be exposed. He stated that there are experiments with non-ionizing, so-called "non-lethal," directed-energy weapons, surveillance and psychotronic systems. He opposes Microwave Harassment and Mind-Control Experimentation especially connected to Los

Alamos National Laboratory, the Department of Energy, the Department of Defense, CIA, and the National Reconnaissance Office. He stated the DOD has increased in the numbers of Ground Wave Emergency Network (GWEN) towers and satellites that qualify as directed-energy emitters, microwave towers, and antennae arrays. John Glenn is also a member of the Electronic Surveillance Project that is trying to stop these forms of harassment and human experimentation.

CITIZENS AGAINST HUMAN RIGHTS ABUSE

Scientists, many of which are Nobel Prize winners, in this Human Rights organization have documented for years the numerous abuses of electromagnetic weapons and electromagnetic radiation (EMR) mind control weapons. Most of the perpetrators of this abuse has been Russia and the United States. The International Red Cross has also verified these offenses.

http://mindjustice.org/emr13.htm

RUSSIAN DEFENSE MINISTER

In March 2012 the Russian defense minister Anatoli Serdjukov said:

“The development of weaponry based on new physics principles; direct-energy weapons, geophysical weapons, wave-energy weapons, genetic weapons, psychotronic weapons, etc., is part of the state arms procurement program for 2011-2020,”Voice of Russia

EUROPEAN PARLIAMENT

A directed energy weapon system is designed to match a radio frequency source to interfere with human brain activity at a synapse level." Since 1999 those weapons have been upgraded and should be banned in the world.

UNITED NATIONS

The United Nations also agreed with this report and stated the "United States is the main country of the world to use directed energy weapons and electromagnetic weapons.

The former United States Secretary of Defense William Cohen stated in a press briefing, while commenting on new technological threats possibly held by terrorist organizations: *"Others are engaging in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, (and) volcanoes remotely, using the use of electromagnetic waves."*

A TARGETED INDIVIDUAL

Targeted Individuals are people who are illegally and covertly stalked, tortured and harassed by the use of hi-tech, Modern-day Military type Technologies (DAARPA, NASA, CIA etc.). Targets/Victims are usually implanted with **RFID** *(Radio-Remote Frequency Identification Device)* type transmitter chips ***(PositiveID*** or VERi Chips) and sometimes miniature Nano-Biochips and Stimulators/Transmitters mostly for GPS tracking purposes. Targets can be remotely connected to via radio frequency signals sent to the chip/s thus the mind and body being in theory "wirelessly" connected.. controlled and manipulated.

There are targeted individuals, victims of Psychotronic (or Mind Control, Electronic, Electromagnetic, Directed Energy, Neurological, Non-lethal) Weapons, who are being targeted unjustly or used as human subjects in experiments without their informed consent. Victims of mind/body control detail the most extreme and totalitarian violations of human rights in human history. Criminals may implant people with microchips or nanomaterials and place them under continuous surveillance. They monitor the human brain, continuously alter consciousness and behavior, directly assault and torture mind and bodies of the human subjects.

These are some of the symptoms that targeted individuals may experience:

a). Microwave hearing, torture with loud noise.

b). Visual hallucinations, artificial dreams.

c). Reading thoughts, retrieving memories.

d). Manipulation of thoughts, will, emotions, desires and perceptions.

e). Manipulation of human behavior: forced speech, involuntary body movements, transmission of specific commands into the subconscious, compulsory execution of these commands (i.e. the Manchurian Candidate effect).

f). Debilitation of mental acuity, loss of memory.
g). Sleep deprivation or uncontrollable sleep
h). Cramps, spasms, excruciating artificial pain in any part of the body, manipulation of body systems, including heart attacks and other serious medical conditions.

TARGETED INDIVIDUAL SUPPORT GROUPS

http://www.freedomfchs.com/id19.html

http://www.stopcovertwar.com/support.html

https://www.facebook.com/victimsoforganizedstalking

http://www.targetedinamerica.com/hitlist.html

http://targetedindividualsua.weebly.com/

http://targetedindividuals.blogspot.com/2011/08/tis-support-group.html

Dennis M. Bushnell
Chief Scientist
NASA Langley Research Center

Future Strategic Issues/Future Warfare

CURRENTLY

- Order of 70% of Worlds Research conducted outside of U.S. (to first order, a % of GDP, U.S. produces order of 18% of worlds GDP)
- Order of 70% of U.S. Research now “Commercial” (as opposed to Government sponsored)

TYPES OF WARFARE

- **Hunter-Gatherer - "Nature Provided"**
- **Agriculture - <u>Controlled</u> Nature (Plants/Animals)**
- **Industrial - <u>Mechanized</u> Agriculture**
- **IT/BIO/Nano - <u>Automating</u> Industry/Agriculture**
- **Virtual - <u>Robotization</u> of IT/Bio/Nano/Industry/Agriculture**

Worldwide IT Revolution

- **Comms/Computing/Sensors/Electronics**
- **U.S. Commercial IT R&D ~ $100B/yr.**
- **Factor of 1 Million further improvement [Silicon,Molecular,Quantum,Bio,Optical]**
- **Beyond Human AI?**
- **Automatics/Robotics "in the large"**
- **Immersive multi-sensory VR/"Holodecks"**
- **Ubiquitous multi physics/hyperspectral sensors [land/sea/air/space]**
- **Micro/Nano sats/GNC/sensors,etc.**

Current Competitive Landscape

- U.S. produces only 18% of Worlds GDP
- ~70% of Research conducted offshore
- $300B/yr trade deficit
- 32 other nations devote a larger % of their GDP to Research
- 5th in No of R&D personnel/labor unit
- 3% savings rate vs. 30% in Asia
- Proliferation of IT,bio,nano,Space Technology etc.

Bio Revolution Applications

- **“Pharm Animals” [drugs, spare parts]**
- **Fast Growing plants on/near sea surface & sea water irrigated plants for biomass energy/closed CO2 cycle**
- **Polymer growing plants**
- **Spider genes in goats allow spider silk spinning from goat milk for “Biosteel”, 3.5X strength of aramid fibers for Armor**
- **Binary Bio-weaponry**

A Real Transgenic Spider Goat

Carbon Nanotubes

- C1,000,000, Buckminister Fullerine Carbon
- 100X strength, 1/6 weight of steel
- 8X better Armor
- Low energy Molecular/Petaflop Computing
- Ultra Capacitor/High Temperature SC
- Non-Cryo H2 storage

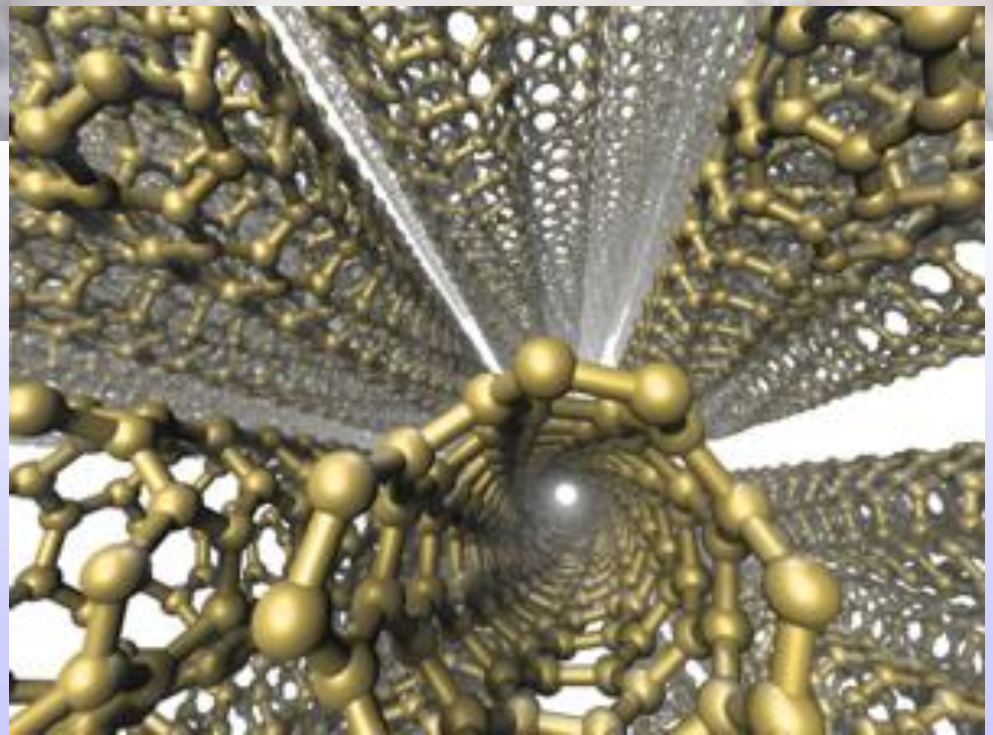

Some Sensor "Swarms"

- SMART DUST
  - Cubic mm or less
  - Combined sensors, comms and power supply
  - Floats in air currents for up to 2 years
- NANOTAGS
  - Placed on everything/everywhere
  - Identification and Status Info
- Co-opted INSECTS

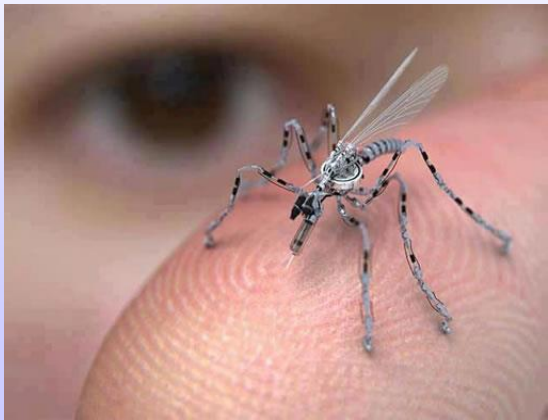

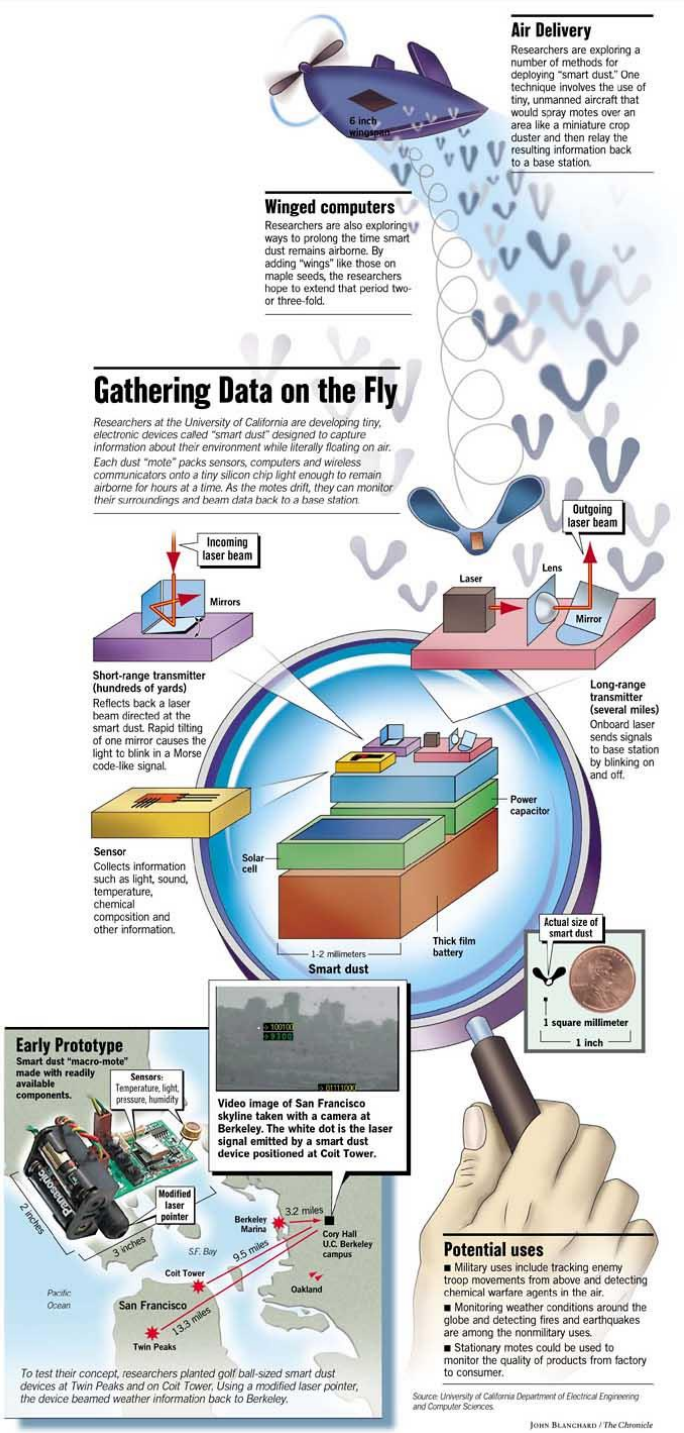
Air Delivery
Researchers are exploring a number of methods for deploying "smart dust." One technique involves the use of tiny, unmanned aircraft that would spray motes over an area like a miniature crop duster and then relay the resulting information back to a base station.
6 inch wingspan
Winged computers
Researchers are also exploring ways to prolong the time smart dust remains airborne. By adding "wings" like those on maple seeds, the researchers hope to extend that period two- or three-fold.
Gathering Data on the Fly
Researchers at the University of California are developing tiny, electronic devices called "smart dust" designed to capture information about their environment while literally floating on air.
Each dust "mote" packs sensors, computers and wireless communicators onto a tiny silicon chip light enough to remain airborne for hours at a time. As the motes drift, they can monitor their surroundings and beam data back to a base station.
Incoming laser beam
Mirrors
Short-range transmitter (hundreds of yards)
Reflects back a laser beam directed at the smart dust. Rapid tilting of one mirror causes the light to blink in a Morse code-like signal.
Outgoing laser beam
Laser
Lens
Mirror
Long-range transmitter (several miles)
Onboard laser sends signals to base station by blinking on and off.
Power capacitor
Sensor
Collects information such as light, sound, temperature, chemical composition and other information.
Solar cell
Thick film battery
1-2 millimeters
Smart dust
Actual size of smart dust
1 square millimeter
1 inch
Early Prototype
Smart dust "macro-mote" made with readily available components.
Sensors: Temperature, light, pressure, humidity
Modified laser pointer
2 inches
3 inches
Video image of San Francisco skyline taken with a camera at Berkeley. The white dot is the laser signal emitted by a smart dust device positioned at Coit Tower.
Berkeley Marina
3.2 miles
Cory Hall U.C. Berkeley campus
9.5 miles
S.F. Bay
Coit Tower
Oakland
Pacific Ocean
San Francisco
13.3 miles
Twin Peaks
To test their concept, researchers planted golf ball-sized smart dust devices at Twin Peaks and on Coit Tower. Using a modified laser pointer, the device beamed weather information back to Berkeley.
Potential uses
■ Military uses include tracking enemy troop movements from above and detecting chemical warfare agents in the air.
■ Monitoring weather conditions around the globe and detecting fires and earthquakes are among the nonmilitary uses.
■ Stationary motes could be used to monitor the quality of products from factory to consumer.
Source: University of California Department of Electrical Engineering and Computer Sciences.
JOHN BLANCHARD / The Chronicle

IN GOD WE TRUST
LIBERTY
2001
D

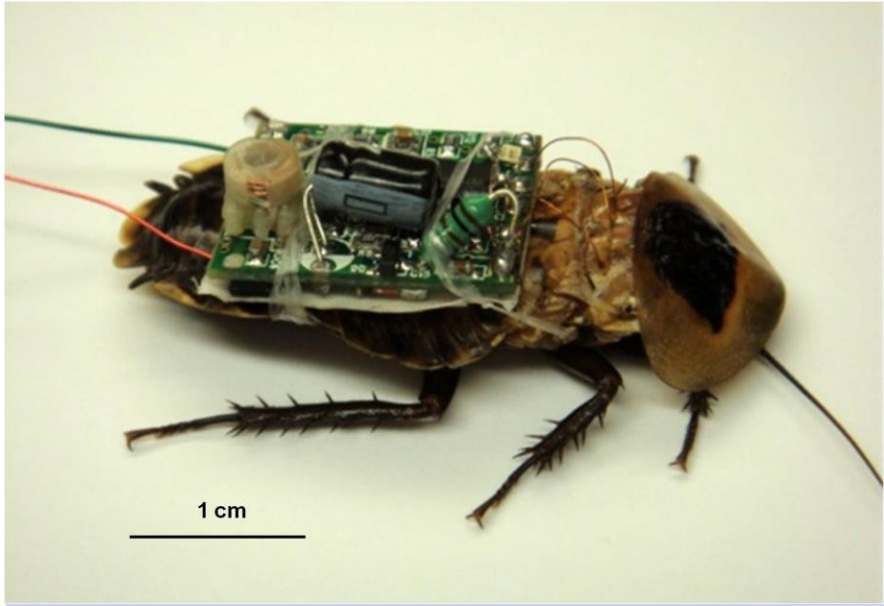
1 cm

“Volumetric” Weaponry

[Alternatives to HE]

- EMP
- Info/Net/Psy warfare
- Miniature brilliant sensor/mine combo’s
- Fuel/air & dust/air
- RF
- Chem/bio Antifunctionals/antifauna
- Isomers, Strained Bond Energy Release, etc.
- Carbon fibers/Acoustics etc.

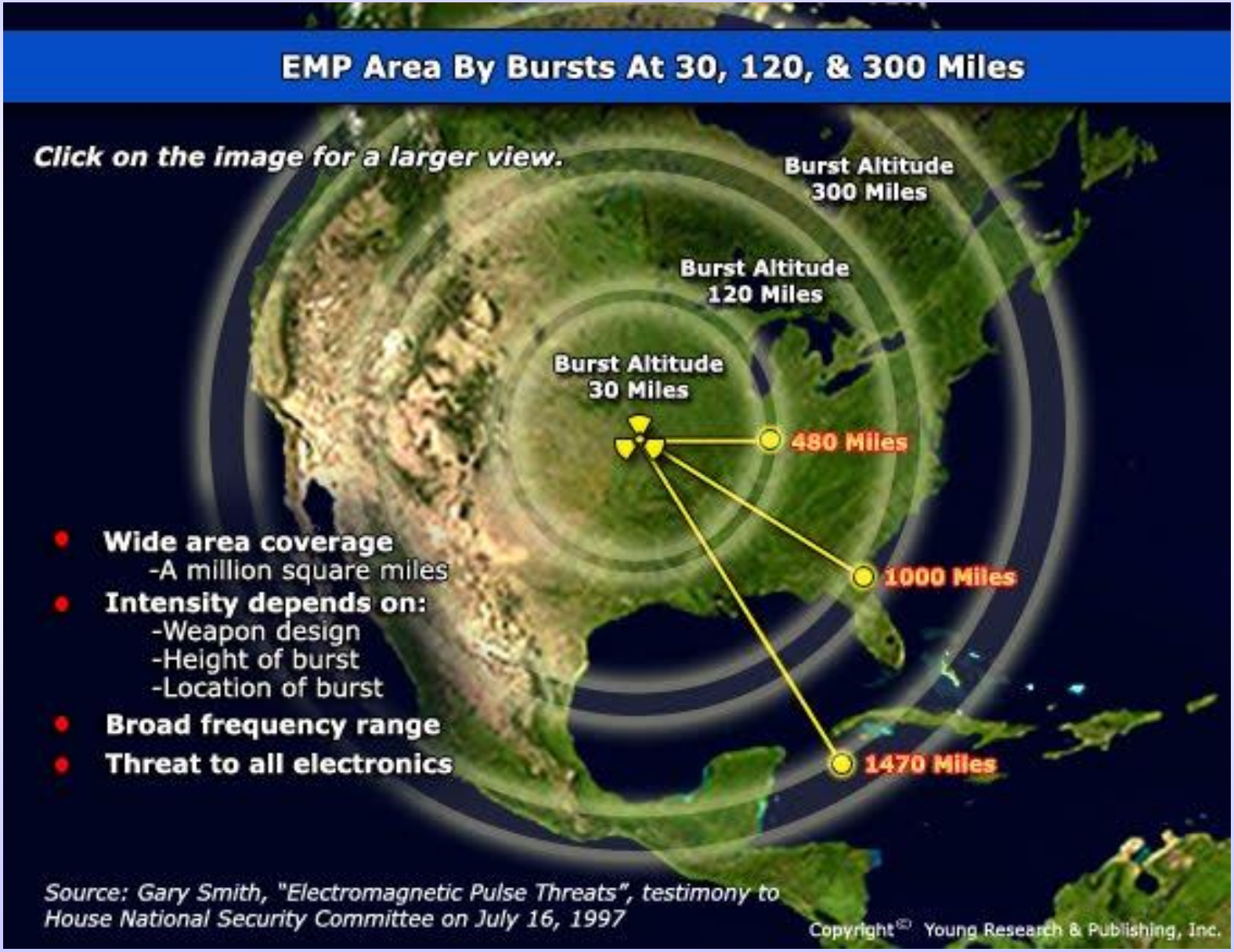
EMP Area By Bursts At 30, 120, & 300 Miles
Click on the image for a larger view.
Burst Altitude 300 Miles
Burst Altitude 120 Miles
Burst Altitude 30 Miles
480 Miles
1000 Miles
1470 Miles
Wide area coverage
-A million square miles
Intensity depends on:
-Weapon design
-Height of burst
-Location of burst
Broad frequency range
Threat to all electronics
Source: Gary Smith, "Electromagnetic Pulse Threats", testimony to House National Security Committee on July 16, 1997
Copyright© Young Research & Publishing, Inc.

“Slingatron” for Global Precision Strike

- 10Kg projectiles, up to thousands/minute
- Global, or less, range
- $20M/device
- Mechanical “on-the-ground” propulsion via Gyrating Spiral Guide Tube (a multiple “hula hoop”
- “Poor Mans” Global Precision Strike/“Takedown Weapon”

SLINGATRON

A MECHANICAL HYPERVELOCITY MASS ACCELERATOR

Test Ring

Impact Physics and Space Launch Research Facility

Global Reach Machine

Potential Future "Orders of Magnitude" Increases in Overall Weapon Effectiveness/Availability at Orders of Magnitude Reduced Cost(s)

- Bio/Chem/Molec./Nano Computing - (E6)
- Ubiquitous Optical Comms - (E4)
- Micro/Nano/Ubiquitous Sensors - (E4)
- BioWeaponry - (EN)
- Co-operative Swarms of Cheap/Small Weapons/Sensors - (E4)
- Volumetric Weaponry - (E4)
- Cyber/Artificial Life (Beyond AI) - (E?)

Chemtrails

Inside of a US Chemtrail Plane

Major U.S. Future Warfare Issues

- **“Non-explosive Warfare” (psywar, biowar IT/net war, “anti-operability war,” Beam weaponry including RF, Spoofing/Cammo**
- **Robotic Warfare “in the large”/better than human AI/“Cyber life”**

Worth1000.com

DARPA Laser Weapon

ROBOTIC SOLDIERS

Robotic soldiers are being created right now in the world to build a huge army against humans and God. The New World Order is not going to reveal their plans on the evening news!

SINGULARITY

The **technological singularity** is a theoretical moment in time when artificial intelligence will have progressed to the point of a greater-than-human intelligence that will "radically change human civilization" according to Amnon Eden. Ray Kurzweil says "revolutions in genetics, nanotechnology and robotics will usher in the beginning of the Singularity." Robots and cybernetic organisms are developing at a very fast pace that is blurring the line between humans and robots.

Bionic Skin for a Cyborg You

Flexible electronics allow us to cover robots and humans with stretchy sensors

By Takao Someya
Posted 26 Aug 2013 | 17:30 GMT

Share | Email | Print

One decade ago, my research group at the University of Tokyo created a flexible electronic mesh and wrapped it around the mechanical bones of a robotic hand. We had dreamed of making an electronic skin, embedded with temperature and pressure sensors, that could be worn by a robot. If a robotic health aide shook hands with a human patient, we thought, this sensor-clad e-skin would be able to measure some of the person's vital signs at the same time.

Today we're still working intensively on e-skin, but our focus is now on applying it directly to the human body. Such a bionic skin could be used to monitor medical conditions or to provide more sensitive and lifelike prosthetics

Photo: Someya-Sekitani Group

Gilded skin: Takao Someya's latest e-skin material is one tenth the

Today we're still working intensively on e-skin but our focus is now on applying it directly to the human body. Such a bionic skin could be used to monitor medical conditions or to provide more sensitive and lifelike prosthetics.

Gilded skin: Takao Someya's latest e-skin material is one-tenth the thickness of plastic kitchen wrap, and it can conform to any body shape.

Thin-film transistors don't just allow electronics to be flexible—they can also help an e-skin mimic the sensitivity of real skin. Consider this: There are more than 2 million pain receptors in a person's skin, which is equivalent to the number of pixels found in a typical high-definition TV. Synthetic skin covers the circuits that looks like human skin.

http://spectrum.ieee.org/biomedical/bionics/bionic-skin-for-a-cyborg-you

CAMP FEMA

Coming to your city soon!

motifake.com

FEMA CAMPS in the United States

From

Reply | Forward | Archive | Junk | Delete

Subject **RE: Supply Questions**

7/29/2013 10:48 AM

To Me <support@mypatriotsupply.com>

Other Actions

Matt,

I am inquiring in regards to the following:

1. Breakdown the total possible servings available for immediately delivery. For example, "averaging 3 servings per meal, 3 times per day, per person = 9 servings per day per person" how many servings can you provide within 24 hours, 48 hours, 72 hours, etc.?
2. Number of currently available meals?
3. Can your current stock begin shipping in 24 hours?
4. Do you ship dedicated truckloads by pallet? If so, how many pallets per truck?
5. At full capacity (assuming all resources are available) how many canned/packaged servings per day can you provide in a 24 hour period?

Please let me know when you have the opportunity.

Thanks in advance,

DHS/Federal Emergency Management Agency

Patriots Plaza
395 E Street,
Washington, DC 20472
(202) - Office
(202) - BlackBerry

FEMA

FM 3-39.40

There is over 600 FEMA camps

INTERNMENT AND RESETTLEMENT OPERATIONS

FEMA has divided the U.S. into 10 regions with Governors assigned over each region

February 2010

10 FEDERAL REGIONS

ent: Military Internment Camps in U.S to be Used for Political Dissidents

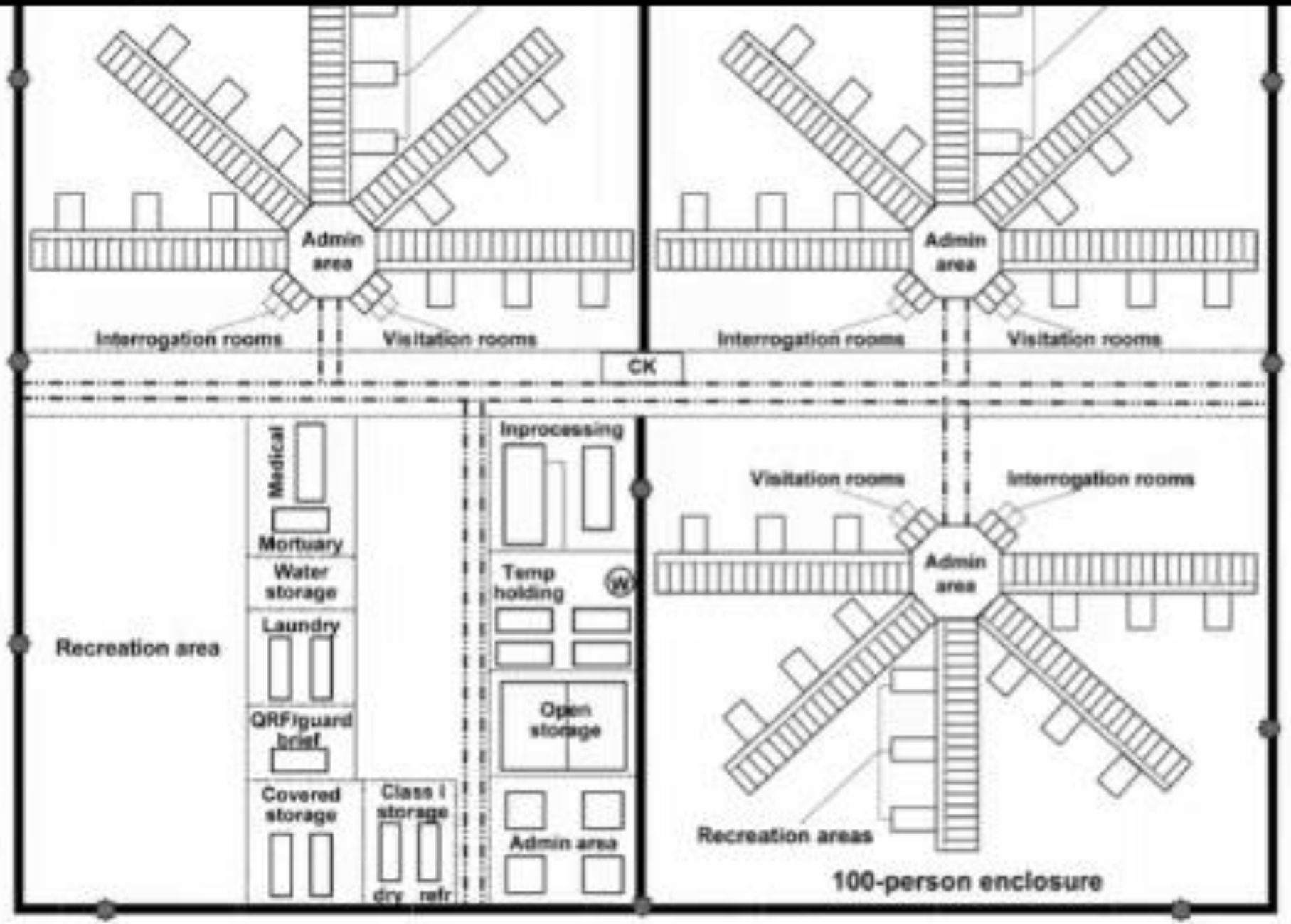

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INTERNMENT AND RESETTLEMENT OPERATIONS

February 2010

Internment and Resettlement Operations

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If there are not real FEMA camps for detainment of American citizens, then why:

- Did Obama sign so many Executive Orders taking away the freedoms of American citizens?
- Did Obama say that anyone who is a threat to American security could be “detained indefinitely?”
- Does Homeland Security avoid answering a direct question about the hundreds of camps that exist?
- Are so many camps totally empty but staffed 24 hours a day?

- Why did they not house a single illegal immigrant of the 12 million that are here in any of these camps even though they say that is what they were built for?
- Why didn’t any of those effected by hurricanes go to a FEMA camp?
- Why does Homeland Security keep on building more FEMA camps?
- Why are a majority of these camps designed to hold 20,000 inmates?

- Why aren’t the people paid to station these camps informed about the <u>purpose</u> of the camps?
- Why are these camps hiring so many guards recently?
- Why aren’t the victims of fires, flooding, tornadoes, and hurricanes taken to any of these camps?
- Why did the sponsors of the bill years ago to build these camps even know what these camps were designed for?

LIST OF ALL OF THE CAMPS:

http://www.sianews.com/modules.php?name=News&file=article&sid=1062

Googles list of FEMA Camps

Complete 326 page manual

http://info.publicintelligence.net/USArmy-InternmentResettlement.pdf

Leaked Document: Military Internment Camps in U.S to be Used for Political Dissidents

http://www.youtube.com/watch?v=FfkZ1yri26s

Military ad as it appeared in Government Pub:

Correction Officer Internment / Resettlement Specialist

As an Internment/Resettlement Specialist for the Army National Guard, you will ensure the smooth running of military confinement/ correctional facility or detention/internment facility, similar to those duties conducted by civilian Corrections Officers. This will require you to know proper procedures and military law; and have the ability to think quickly in high-stress situations. Specific duties may include assisting with supervision and management operations; providing facility security; providing custody, control, supervision, and escort; and counseling individual prisoners in rehabilitative programs.

So, why is the National Guard hiring “Internment / Resettlement Specialists?”

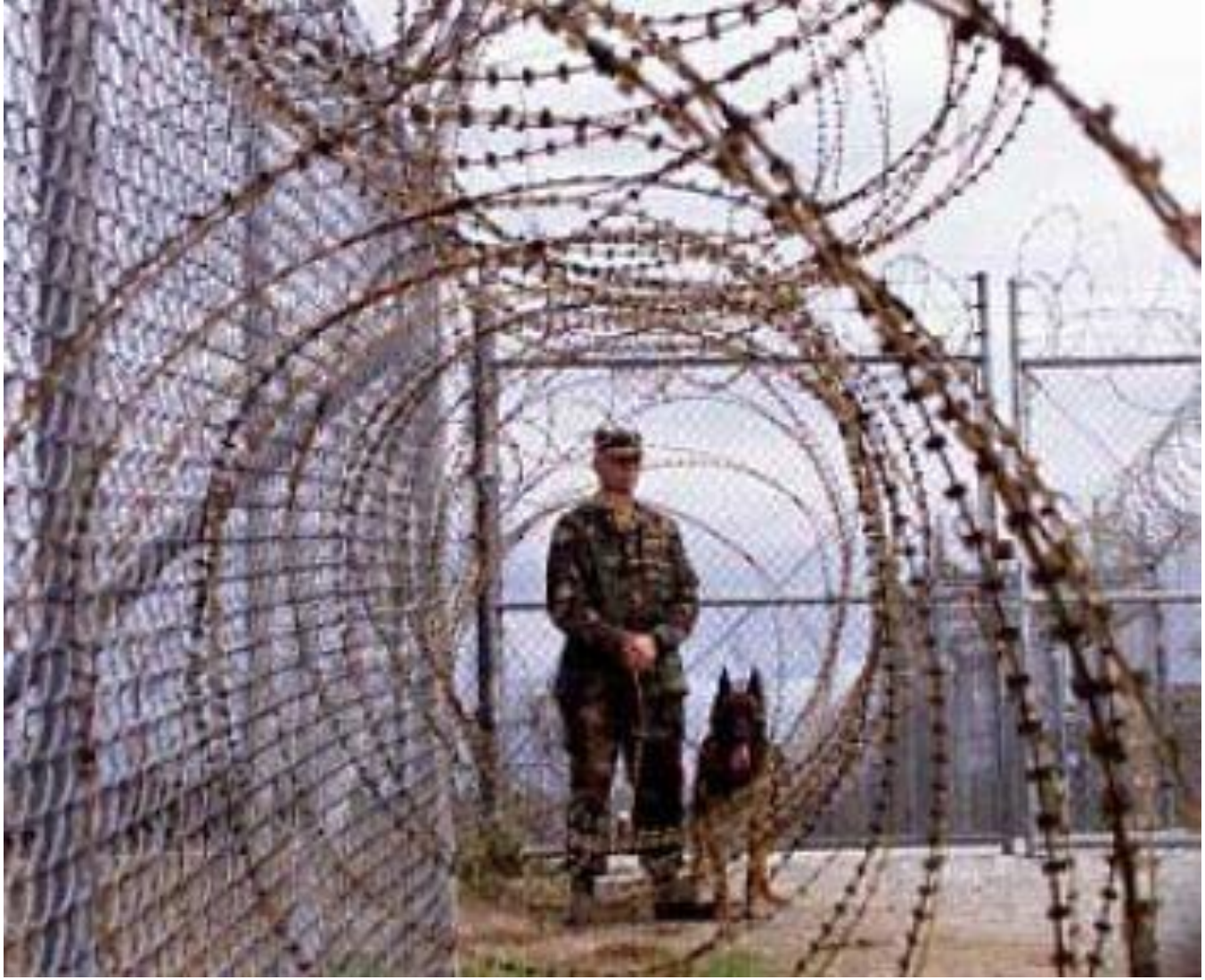

http://intellihub.com/2013/06/13/find-the-fema-camp-nearest-you/

The White House quietly issued National Security Presidential Directive 51 (NSPD-51), to ensure "continuity of government" in the event of what the document vaguely calls a "catastrophic emergency." Should the president determine that such an emergency has occurred, he and he alone is empowered to do whatever he deems necessary to ensure "continuity of government." This could include everything from canceling elections to suspending the Constitution to launching a nuclear attack.

REX 84

The Rex 84 Program was established on the reasoning that if a mass exodus of illegal aliens crossed the Mexican/US border, they would be quickly rounded up and detained in detention centers by FEMA. Rex 84 allowed many military bases to be closed down and to be turned into prisons. With half a million entering the US every year, not one of them has been put in a FEMA camp yet! What are they waiting for?

NATIONAL DEFENSE AUTHORIZATION ACT

Sect. 1042 of the 2007 National Defense Authorization Act (NDAA), "Use of the Armed Forces in Major Public Emergencies," gives the executive the power to invoke martial law. For the first time in more than a century, the president is now authorized to use the military in response to "a natural disaster, a disease outbreak, a terrorist attack or any other condition in which the President determines that domestic violence has occurred to the extent that state officials cannot maintain public order."

If the US government spends billions of dollars on Homeland Security, they scan all of our emails, record all of our telephone calls, and watch almost everything we do; because they expect a Muslim terrorist to blow up our country any minute, then why did they allow 9 million Muslims to come into our country?

WARNING!

FEMA EXECUTIVE ORDERS

E.O. 11004 - Allows the Housing and Finance Authority to relocate communities, build new housing with public funds, designate areas to be abandoned, and establish new locations for populations.

E.O. 10990 - Allows the government to take over all models of transportation and control of highways and seaports.

E.O. 10995 - Allows the government to seize and control the communication media.

E.O. 10997 - Allows the government to take over all electrical power, gas, petroleum, fuels and minerals.

E.O. 10998 - Allows the government to take over all food resources and farms.

Etc. these are real presidential executive orders!
Not to mention these are just a few of them...
To learn more Google fema executive orders.

ARMY TRAINING MANUAL

The manual states, “These operations (camp) may be performed as domestic civil support operations,” and adds that “The authority to approve resettlement such operations within U.S. territories,” would require a “special exception” to “The Posse Comitatus Act,” which can be obtained via “the President invoking his executive authority.” The document also makes reference to identifying detainees using their “social security number.”

Mock Military Invasions

http://www.independentsentinel.com/2013/03/military-drills-armored-tanks-zombies-are-coming-to-a-city-near-you/

DRONES

- The U.S. has over 8,000 drones
- They are used by police for surveillance on Americans
- They are used along the borders
- Some states have passed laws against flying drones

CHRISTIAN PERSECUTION

Media Silent as Muslims Ethnically Cleanse 60,000 Christians in Philippines

http://frontpagemag.com/2013/dgreenfield/media-silent-as-muslims-ethnically-cleanse-60000-christians-in-philippines/

PERSECUTION AT UNPRECEDENTED LEVELS

The Body of Christ today is suffering a degree of persecution not seen previously in our lifetime. In Central African Republic a serious humanitarian crisis is unfolding as the predominantly Christian population suffers terror at the hands of Islamic rebels. Afghan converts risk death not only in Afghanistan but also in India because the Afghan media is inciting violence against them, particularly Pastor Obaid. In Somalia, al-Shabaab routinely kills Somali converts.

Mustaf (13), who has already lost two Christian relatives to al-Shabaab, was recently kidnapped by militants seeking to draw his Christian parents out of hiding. For example on 30 August eleven Laos families (50 people) were expelled from their village and sent out into the bush for refusing to renounce Christ. On 1 September nine Catholics were massacred by Fulani Muslim gunmen in Nigeria's Kaduna State. On 4 September jihadists killed eight Syrian soldiers before seizing control of the Aramaic-speaking, Christian village of Maaloula in western Syria.

"The power of the Executive to cast a man into prison without formulating any charge known to the law, and particularly to deny him the judgment of his peers, is in the highest degree odious and is the foundation of all totalitarian government whether Nazi or Communist."

- Winston Churchill, Nov. 21, 1943

HORSEY
ON THE PLUS SIDE, WE SEEM TO HAVE HIT BOTTOM.
U.S. ECONOMY

Fed downgrades its outlook for US economy

Federal Reserve sketches a gloomier outlook for US economic growth for this year and next

AP By Christopher s. Rugaber, AP Economics Writer | Associated Press – 5 hours ago

Email Recommend 605 Tweet Share +1 Print

WASHINGTON (AP) -- The Federal Reserve on Wednesday downgraded its outlook for the U.S. economy for 2013 and 2014. In doing so, it underscored concerns that led it to maintain the pace of its stimulus.

The Fed predicted Wednesday that the economy will grow just 2 percent to 2.3 percent this year, down from its previous forecast in June of 2.3 percent to 2.6 percent growth.

Next year's economic growth will be a barely healthy 3 percent, the Fed predicts.

Fed officials decided to continue their $85-billion-a-month bond purchase program, surprising most economists, who had expected a slight reduction. The bond purchases have been designed to keep long-term loan rates low to encourage spending.

The Fed's policymakers expect the unemployment rate to fall to 7.1 percent to 7.3 percent by the end of 2013, slightly below its June forecast of 7.2 percent to 7.3 percent. It predicts that unemployment will fall as low as 6.4 percent next year, down from 6.5 percent in its June forecast.

The unemployment rate is now 7.3 percent.

The projections showed that 12 of the 17 officials on the Fed's policymaking committee think the Fed shouldn't begin raising rates until 2015. And two think the Fed shouldn't do so until 2016, one more than in June. Three chose 2014, the same as in June.

The Fed doesn't say which policymakers made which forecast.

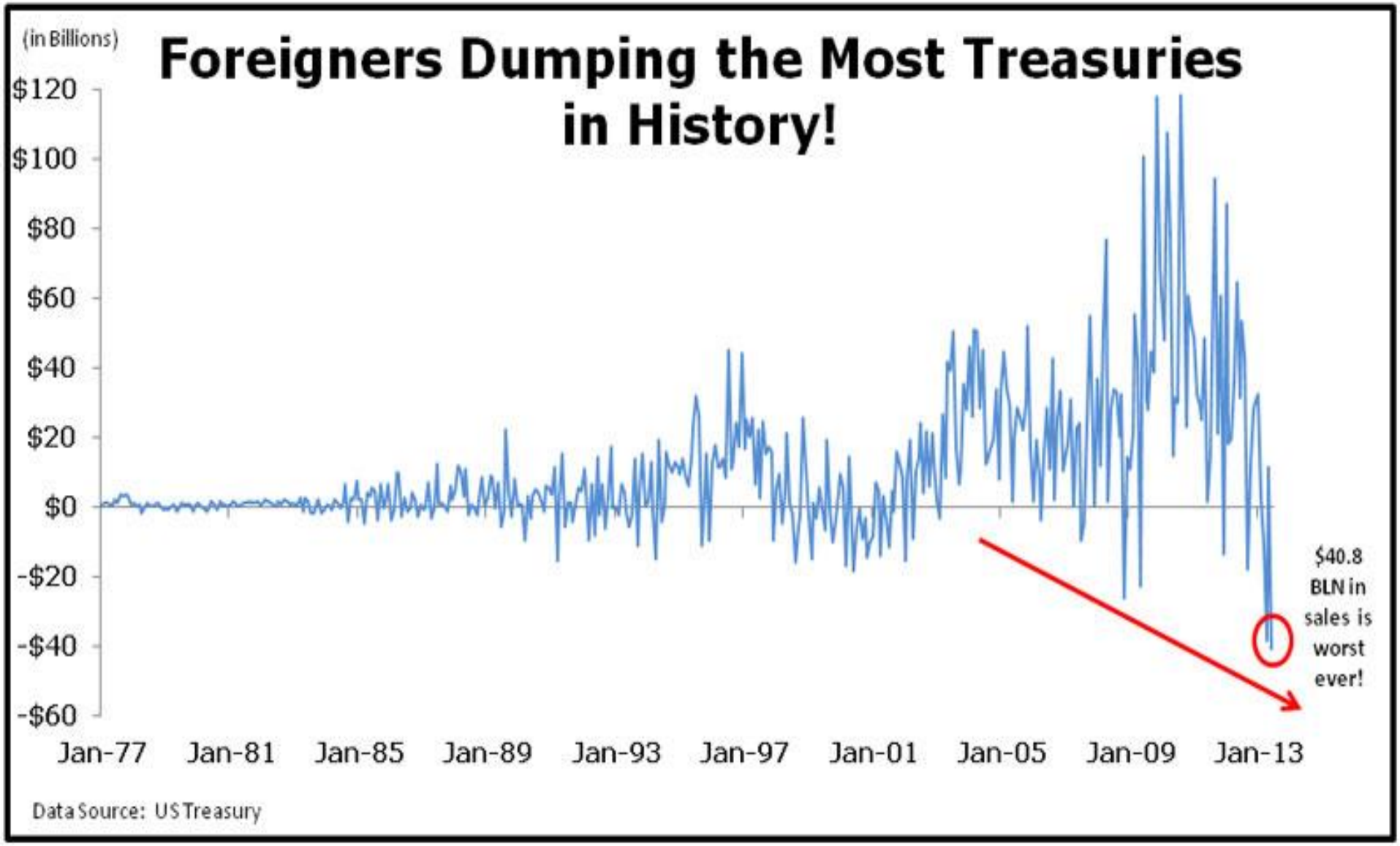
Foreigners Dumping the Most Treasuries in History!
(in Billions)
$120
$100
$80
$60
$40
$20
$0
-$20
-$40
-$60
Jan-77
Jan-81
Jan-85
Jan-89
Jan-93
Jan-97
Jan-01
Jan-05
Jan-09
Jan-13
$40.8 BLN in sales is worst ever!
Data Source: US Treasury

FINANCES IN THESE DIFFICULT TIMES

We Are Now On The Verge Of A Historic Meltdown & Collapse

On the heels of a tremendous rally in gold and silver, today a man who has been involved in the financial markets for 50 years shocked King World News when he said that we are on the verge of a historic and catastrophic global financial "meltdown." He also spoke about events that are unfolding behind the scenes at the White House right now. This is without question one of John Embry's most powerful interviews ever.

Embry: ***"I guess I'm always unnerved as a result of what happened in April, the last time the President of the United States had a meeting with all of the bank heads, and two days later the price of gold was smashed for over $200. Now, the President is meeting with all of the heads of the various agencies, institutions, the Fed, and all of the other key money entities in the United States today. What's that all about?***

But clearly if the President is having this meeting, there is a crisis unfolding somewhere in the background, and it could very well relate to the dollar, interest rates, and the massive derivatives market associated with interest rates....

"Rising interest rates are a killer in an over-levered economy, and that's exactly what we've been seeing in the United States.

This surge in interest rates may have already seriously destabilized the entire financial system, and that's why there is this meeting taking place in the White House today. The fact is that the vast majority of derivatives in the global financial system are related to interest rates.

Now, the entire financial system may be on the precipice of some sort of catastrophic event unfolding because of what we have already seen in the bond market, and how the derivatives are so heavily intertwined. Meaning, we may be on the verge of another disastrous derivatives meltdown.

We have an unbelievable amount of interest rate derivatives in the financial system. So the winners theoretically take the profits on them, and the losers simply misprice them on their books. But as you get higher interest rates it becomes even more destabilizing.

I firmly believe the reason the President has called this meeting today is because if interest rates in the U.S. continue to rise, it could really unleash something disastrous. We are talking here about the possibility of a meltdown.
http://kingworldnews.com/kingworldnews/KWN_DailyWeb/Entries/2013/8/20_We_Are_Now_On_The_Verge_Of_A_Historic_Meltdown_%26_Collapse.html

Financial Crisis Alert: Half A Million People Drop Off Workforce In One Month, Bank of America To Cut 2100 Jobs, Shut 16 offices, HP Has Chopped 22,700 Jobs Since Last Year, Polled Unemployment Soars To March 2012 Levels!

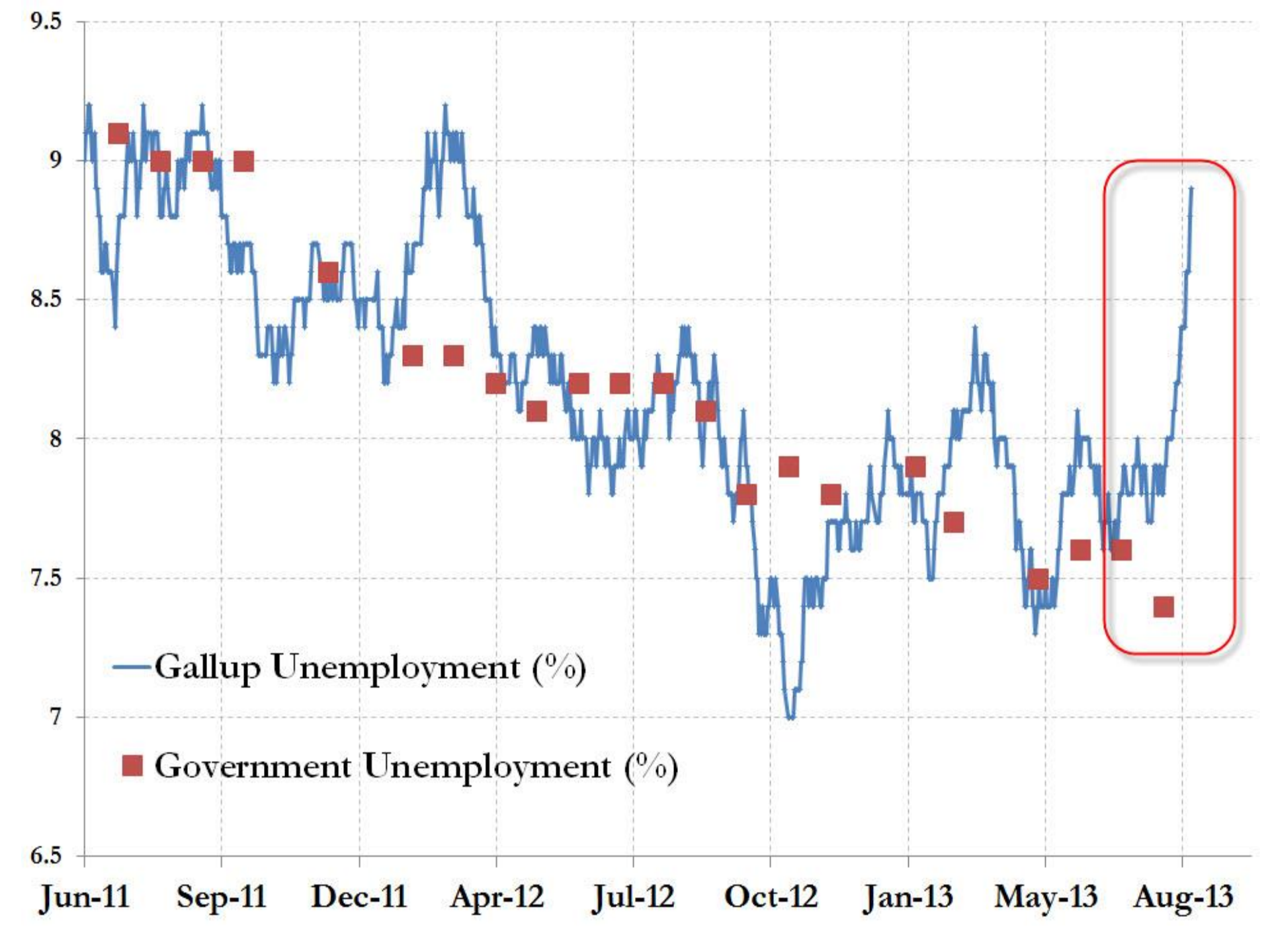
9.5
9
8.5
8
7.5
7
6.5
Gallup Unemployment (%)
Government Unemployment (%)
Jun-11
Sep-11
Dec-11
Apr-12
Jul-12
Oct-12
Jan-13
May-13
Aug-13

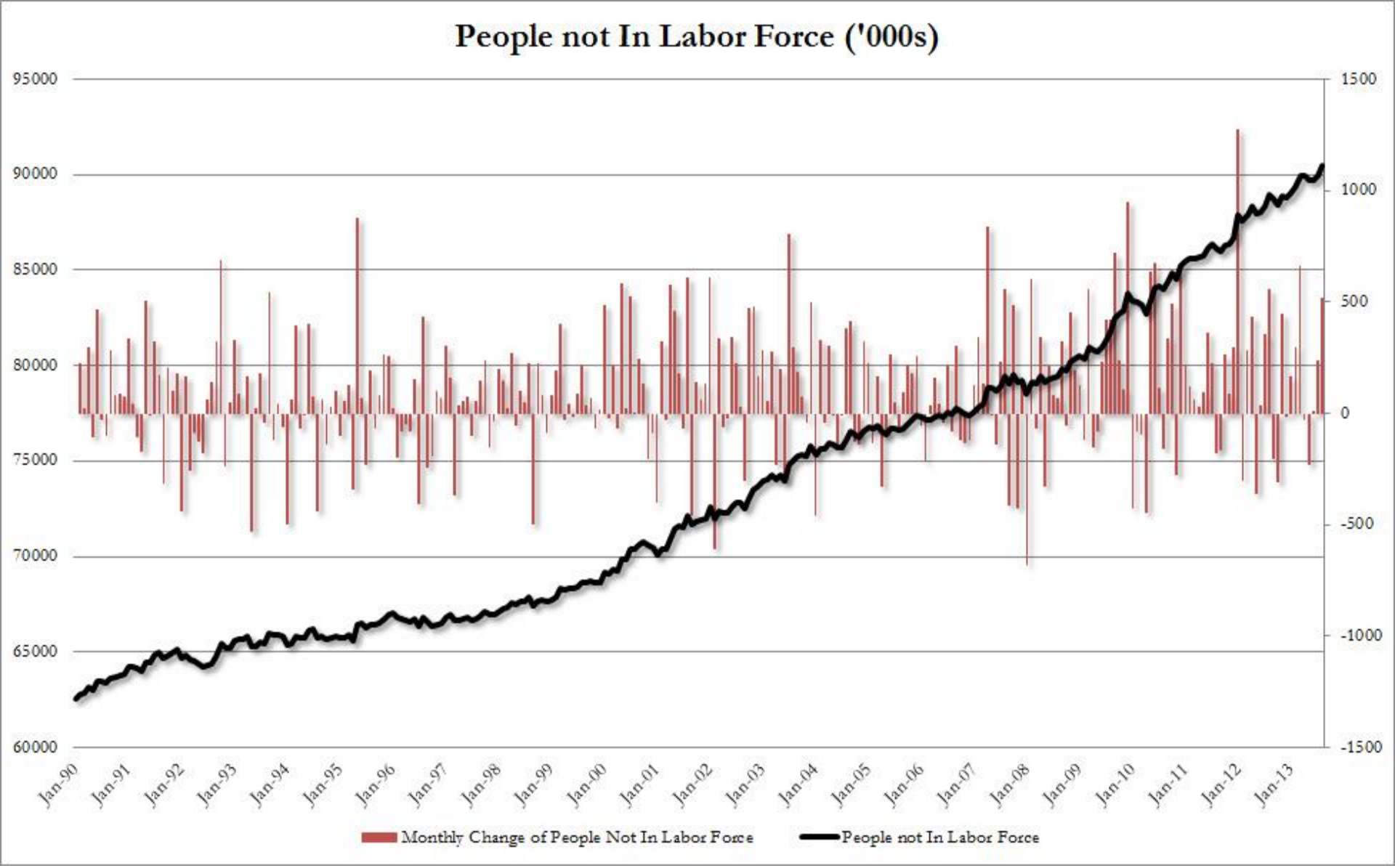

http://investmentwatchblog.com/financial-crisis-alert-half-a-million-people-drop-off-workforce-in-one-month-bank-of-america-to-cut-2100-jobs-shut-16-offices-hp-has-chopped-22700-jobs-since-last-year-jpmorgan-exits-commodity-a/

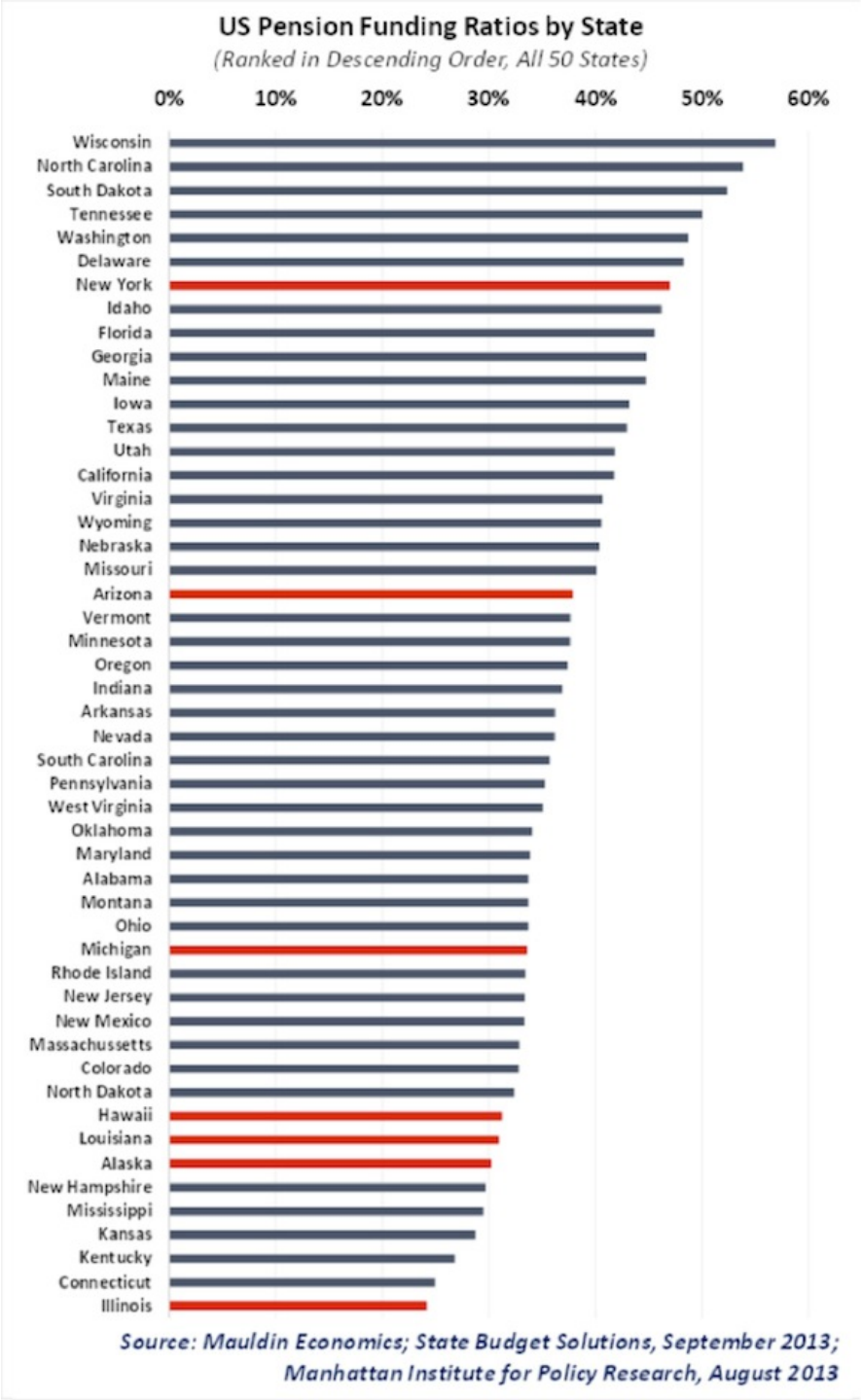
US Pension Funding Ratios by State
(Ranked in Descending Order, All 50 States)
0%
10%
20%
30%
40%
50%
60%
Wisconsin
North Carolina
South Dakota
Tennessee
Washington
Delaware
New York
Idaho
Florida
Georgia
Maine
Iowa
Texas
Utah
California
Virginia
Wyoming
Nebraska
Missouri
Arizona
Vermont
Minnesota
Oregon
Indiana
Arkansas
Nevada
South Carolina
Pennsylvania
West Virginia
Oklahoma
Maryland
Alabama
Montana
Ohio
Michigan
Rhode Island
New Jersey
New Mexico
Massachussetts
Colorado
North Dakota
Hawaii
Louisiana
Alaska
New Hampshire
Mississippi
Kansas
Kentucky
Connecticut
Illinois
Source: Mauldin Economics; State Budget Solutions, September 2013;
Manhattan Institute for Policy Research, August 2013

International Investors Dump $40.8 Billion in Treasuries, the Most Ever

Money and Markets

Foreign holders dumped a whopping $40.8 billion in long-term Treasuries, the biggest exodus from bonds in the history of the U.S. Worse, June was actually the third month of mass dumping in the past four, for a total of $79 billion. China, the biggest holder of our bonds, unloaded $21.5 billion, while Japan, the second-largest holder, dumped $20.3 billion.

It wasn't just government bonds, either. Foreigners dumped $116 million of bonds made up of packaged U.S. mortgages. They sold $5.2 billion of Fannie Mae, Freddie Mac and Ginnie Mae bonds, and $5 billion in corporate bonds. And they unloaded $26.8 billion of U.S. stocks. All told, more international capital flowed *out* of U.S. markets than at any time in history, worse even than at the depths of the 2008 credit crisis.

State's unfunded pension debt will grow to more than $200 billion under new reporting rules

	Unfunded liability as currently reported	Unfunded liability under Moody's
TRS	$43.5 billion	$120.6 billion
SERS	$20.2 billion	$46.2 billion
SURS	$17.6 billion	$39.3 billion
JRS	$1.3 billion	$2.6 billion
GARS	$0.2 billion	$0.4 billion
Combined	**$82.9 billion**	**$209.0 billion**

Source: Commission on Government Forecasting and Accountability; Illinois Policy Institute

Market Week Pullout

Dow Falls 1.3% on Syria Fears; Time to Buy Tyson Foods Page M3

BARRON'S

The Dow Jones Business and Financial Weekly Vol. XCIII No. 35 barrons.com September 2, 2013 $5.00

Good Hands: Allstate Could Rise 50%
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A flush Vodafone could attract AT&T

THE BULL'S IN CHARGE

Despite recent stock-market declines and the possibility of an autumn correction, Wall Street's top strategists see the market headed higher over the longer term, with stocks rising 20% or more in 18 months.

DOW JONES

Subscriptions/Customer Service: 800 544 0422

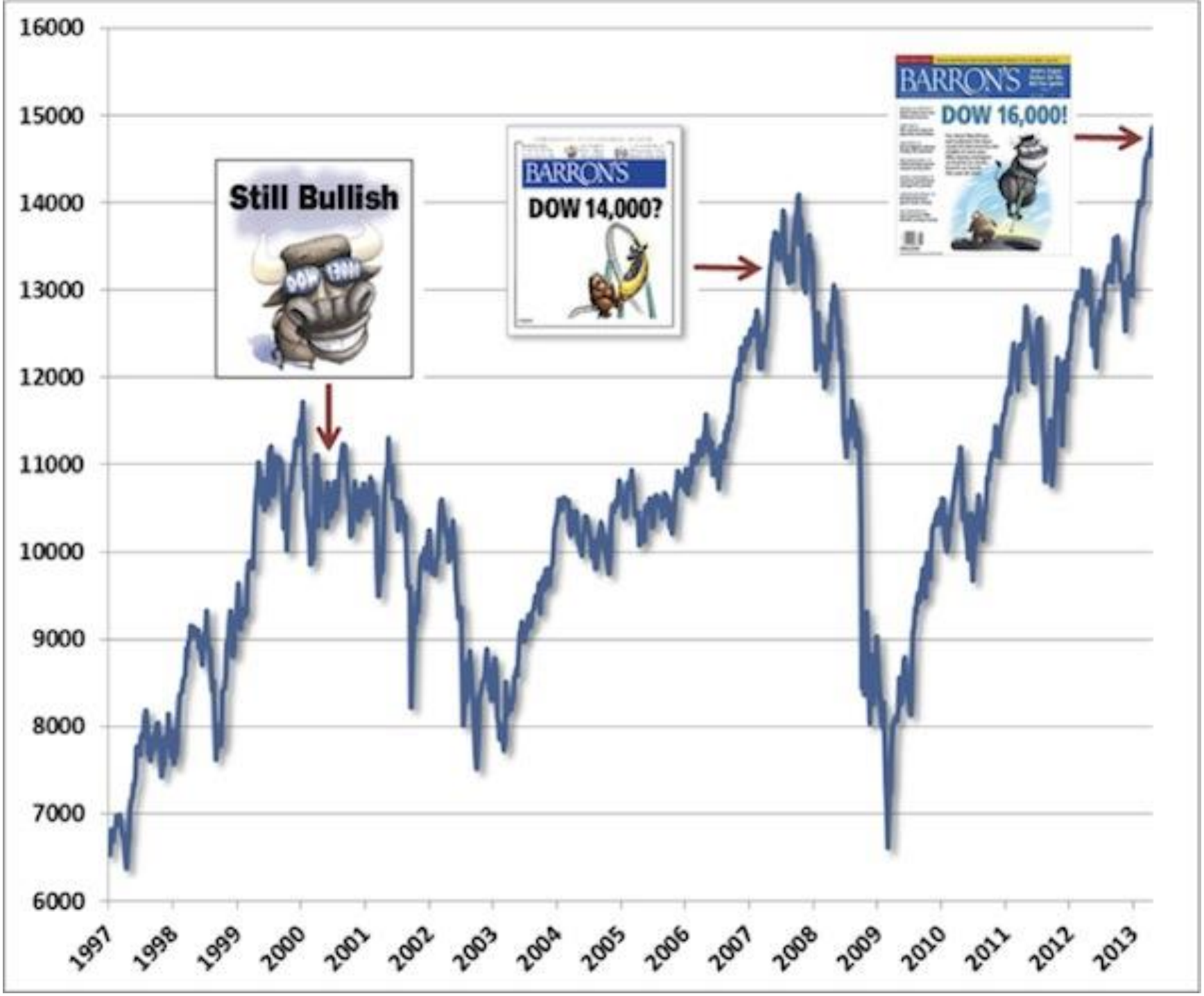
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
Still Bullish
BARRON'S
DOW 14,000?
BARRON'S
DOW 16,000!

UNITED STATES DOLLAR

China and Japan a few weeks ago sold $48 billion worth of U.S. Treasury Bonds in one day more than ever in history. Bernanke and the Fed are printing $85 billion per month ($40 billion to buy Mortgage Backed Securities and $45 billion to buy Treasuries). All foreign countries are buying less US Treasury bonds since June of this year. This is very bad news.

WHAT TO DO TO PREPARE FOR THIS?

1. Get a job and keep it
2. Start a job on something that makes money
3. Store cash at your home
4. Buy gold and silver eagles and keep it at home
5. Pay off your bills
6. Store food
7. Store water

8. Store guns & ammunition

9. Store toilet paper

10. Store tooth brush, tooth paste, shampoo, soap, etc.

11. Have something to cook on such as an outside gas cooker, fireplace, or solar cooker.

12. Store cooking oil, condiments, bowls, cups, etc.

13. Have a water filter- Big Berkey

Preston T. Bailey, PhD., D.Min.

"That's all Folks!"

www.SaveAmerica Foundation.com

Empowerment by Virtue of Golden Truth
Human Cloning: Specifically,
REM Driven Human Cloning
FULL DISCLOSURE

Donald Marshall

29 October 2015

https://www.facebook.com/donald.marshall.148
http://donaldmarshall.proboards.com/
Vincent Eastwood Interview
https://www.youtube.com/watch?v=M_1UiFeV5Jg&ab

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Do Not Panic, Riot, or Cause Chaos. This is Very Important. 47
Spread this Disclosure Document until it reaches the Armed Forces 47
Donald Marshall is NOT "The New Age Saviour". Nobody wants to be a 'saviour' 48
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Introduction

Just read it. Every word in this document is true, and it is the most important document to ever reach the internet. This document is written to empower good people of the world against the tyranny which exists all around us in our world today. Effectively, the document presented here discloses concealed information about the extent to which medicine, science, and technology has advanced in our **current** era. Moreover, I am disclosing this information because I have been extensively abused, and I am victim of **current** advances in medicine, science, and technology, which I describe in detail below. There are many, many, other victims of abuse, including myself, and therefore it is our plea that you read this document with an open mind and you investigate **ALL** statements which may initially irk you and appear 'suspect' to begin with (the circumstantial evidence is available all around you); because as a victim of abuse, I can honestly say, there is nothing worse than experiencing abuse, and those who have the power to protect you from your abusers, ignore you.

I will now discuss what qualifies as whistle blowing disclosure. After detailing the criteria which qualifies for whistle blowing disclosure, I will detail aspects of the Serious Crime Act, and preface a foundation which defines, explains, and references key information for the reader to understand as well as explore the extent to which medicine, science, and technology has advanced today; all for the express purpose of compelling the reader that medicine, science, and technology, has advanced at an incredible rate; that **current** advances in medicine, science and technology are withheld from public knowledge; and finally these advancements in medicine, science, and technology, have been and are **currently** used to commit **serious unspeakable** crimes against humanity and our environment here on earth. Moreover, it is my aim to present this information as coherently as possible to assist the reader to save me, and save many, many others who experience abuse daily resulting from concealed advances in technology.

Whistle Blowing: Qualifying Disclosure

In the United Kingdom under the Public Interest Disclosure Act (1998) (PIDA) section 43B, a "qualifying disclosure" (whistle blowing disclosure) implies "any disclosure of information which in the reasonable belief of the worker, tends to show one of the following:

a) That a criminal offence has been committed, is being committed or is likely to be committed,
b) That a person has failed, is failing or is likely to fail to comply with any legal obligation to which he is subject
c) That a miscarriage of justice has occurred, is occurring or is likely to occur,
d) That the health or safety of any individual has been, is being or is likely to be endangered,
e) That the environment has been, is being, or is likely to be damaged, or
f) That information tending to show any matter falling within any one of the preceding paragraphs has been, or is likely to be deliberately concealed"

Furthermore, under the Enterprise and Regulatory Reform Act (ERRA) 2013 section 17 (*The new 'public interest' test)* is added for whistle blowing disclosures, amending section 43B of the Employment Rights Act (ERA) 1996 and therefore now reads as such (new words underlined):

"(1) In this part a 'qualifying disclosure' means any disclosure of information which, in the reasonable belief of the worker making the disclosure, *is made in the public interest and* tends to show one or more of the following-- [criminal offence, breach of legal obligation, etc]." (Halliday 2013, p. 2).

The following information is presented **with the express intent** that it is made in the public interest, and meets the all criteria set out in section 43B (a-f) of PIDA as well as the 'public interest test', ERRA section 17. Furthermore, in order for the reader to perceive the credence of my statements, so that (s)he has impetus to research the validity of my statements and not dismiss it as folly supplied by an internet troll who has nothing better to do than waste peoples' time, I will cite the Serious Crime Act 2015 here for the express purpose of convincing the reader that all statements made in this document and my original document are indeed FACTUAL! THIS IS NO HOAX. THIS IS NO JOKE. This is simply what is happening in the world today.

The Serious Crime Act 2015

The Serious Crime Act 2015 (UK) section 41, 3ZA, amends section 3A of the Computer Misuse Act 1990 which **previously** read [under Computer Misuse Offences]:

[[F1] 3A Making, supplying or obtaining articles for use in offence under section 1 or 3

1) [That] A person is guilty of an offence if he makes, adapts, supplies or offers to supply any article intending it to be used to commit, or to assist in the commission of, an offence under section 1 or 3.

To: [The Serious Crime Act 2015, section 41, 3ZA]

3ZA Unauthorised acts causing, or creating risk of, serious damage

(1) A person is guilty of an offence if—

(a) the person does any unauthorised act in relation to a computer;

(2) Damage is of a "material kind" for the purposes of this section if it is—

(a) damage to human welfare in any place;

(b) damage to the environment of any place;

(c) damage to the economy of any country; or

(d) damage to the national security of any country.

3) For the purposes of subsection (2)(a) an act causes damage to human welfare only if it causes—

(a) loss to human life;

(b) human illness or injury;

(4) It is immaterial for the purposes of subsection (2) whether or not an act causing damage—

(a) does so directly;

(b) is the only or main cause of the damage.

(5) In this section—

(c) a reference to a country includes a reference to a territory, and to any place in, or part or region of, a country or territory.

(6) A person guilty of an offence under this section is (unless subsection (7) applies) liable, on conviction on indictment, to imprisonment for a term not exceeding 14 years, or to a fine, or to both.

(7) Where an offence under this section is committed as a result of an act causing or creating a significant risk of—

(a) serious damage to human welfare of the kind mentioned in subsection (3)(a) or (3)(b), or

(b) serious damage to national security,

a person guilty of the offence is liable, on conviction on indictment, to imprisonment for life, or to a fine, or to both."

In laymen's terms it is a **serious crime** (Serious Crime Act 2015), punishable by imprisonment, a fine, or both, to cite hatred or spread hoaxes by use of a computer which would cause mass hysteria or public dissension. I have been condemning public figures, high profile individuals, celebrities, singers, movie stars, directors, politicians, world leaders, royalty, anti-secret society 'truthers' (who are really misinformation agents, and agents of deception) etc. –the list is long - since 2011 and **NOT** a single one of these high profile people has issued a public statement saying "I do not like how you have tarnished my name" or filed a law suit against me. Why you may ask? **Because** every word I have stated and will state again (in this document) is true.

Fundamentals

Before I describe the heinous crimes committed against me and many others (including unsuspecting civilians of the world) it is important that I explain, define, and reference:

- Key figures such as Phil Schneider, George Green and Aaron Russo, so that the reader has reference points to verify the extent to which technology has advanced in our **present** era (and continues to advance);
- Define and briefly explain the transhumanist / post human agenda (for those who may be unfamiliar with their aims).
- Define and explain rapid eye movement (R.E.M) sleep, the phases of sleep, and what happens to the (original's) body during sleep.

- Reference advances in technology, with particular attention to: Memory suppression technologies; Mind-voice technology; H.A.A.R.P technology, RFID microchip technology, and MK Ultra technology (CIA's mind control program);
- Define and explain cloning; the different types of clones; cloning centres and cloning technology;
- Define drip feed disclosure / evaluative conditioning and explain why it occurs;
- Explain what 'consciousness transfer' is to the best of my knowledge, and cite drip feed disclosure articles with the express intent to allow the reader to grasp the abuse I have suffered daily at the hands of my tormentors.

Key Figures

Phil Schneider

Phil Schneider (pictured) had 17 years experience working in government black projects carrying a level three security clearance. He was a geologist and engineer who worked in the black projects underground bases at Area 51, S-4, and Los Alamos.

He is most notable for disclosing (Schneider 1995; 1996; Open Minds 2011):

- The 'black budget' expenditure of the United States, which Schneider claims to be between 1.023 trillion U.S. dollars every 2 years (over $500 billion per year);
- Deep Underground Military Bases (also known as D.U.M.Bs -"dumbs"), and at the time of his lecture (Schneider, 1995), –that there are 131 **active** Deep Underground Military Bases present in the United States, and 1477 Deep Underground Military Bases worldwide;
- Each D.U.M.B costs on average 17-19 billion U.S. dollars; paid for by the taxpayer; and it takes approximately a year-and-a-half to 2 years to build D.U.M.Bs with sophisticated methods.
- That military technology outstrips the general public's technology at a rate of 44 to 45 years of technology for every calendar year which passes. In other words for every 12 months which passes military technology will have advanced by 44 years than what we as the general public is currently accustomed to. Therefore as a rough example if we were to take the year Facebook was founded (2004) as a base year, then the military technology since the creation of Facebook will have outstripped what the

general public is accustomed to by as much as **484 years(!)** (2015 - 2004 = 11. 11 x 44 = 484). Similarly, if we are to use the year which YouTube was founded as a base year (2005), once again, military technology would be 440 years more advanced than what the public is currently accustomed to today.

For the purpose of disclosing current advances in medicine, science and technology, and how such advances are used against me and the people of the world to commit monstrous crimes I will use 1945 as a base year. Everything will become apparent including why I use 1945 as a base year for my disclosure, but for the express purpose of compelling the reader to investigate my disclosure I must present everything, logically, sequentially, methodologically, and provide references for the reader in a coherent way to enable him or her to **pay serious attention** to my eye witness accounts. Therefore, at this present stage keep in mind the year 1945, and the fact that military technology outstrips the general public's technology at a rate of 44 years for every 12 months which passes.

George Green

George Green (pictured) was affiliated with U.S. Presidential candidates, and was once asked to be the Finance Chairman for the next President of the United States. Green would later declined the offer of Finance Chairman when a comment made by Ted Kennedy regarding sleeping with Green's 14 year old daughter caused George Green to re-evaluate his associations with this in-group.

During his 2008 interview with Project Camelot (2008a; 2008b), Green disclosed the following noteworthy information:

- U.S. presidents are "selected" and not elected. This is clearly expressed in a story Green recounts, when Green asks:
  "Who is going to be the next President of the United States [for him to overlook their finances]?"
  And the reply was: "Jimmy Carter"
  Green responds: "Jimmy who?"
  The reply Green received was: "Well, he's the Democratic Governor of Georgia."
  George Green: "But I've been voting Republican."
  Green was then confronted by a tall man, Paul Volcker (American Economist, and Chairman of Federal Reserve under Jimmy Carter and Ronald Regan), who walked over and said, "Son, don't worry about it [Republican or Democrat], we control 'em both."
- U.S. scientists learned how to make people (clones) since 1938 -walking talking ones –and the scientists call these people "synthetics" or "the others".
- Cloning technology is relatively advanced. All that has to be done is take two cells from the original, give the cells a small electrical charge (retain a fertilised egg), then all one needs is a receiver (a womb / artificial womb for the fertilised egg to grow).
- Scientist were excited by the synthetic technology because it meant that spare organ parts could be grown for an "original" human without rejection, because theoretically speaking, the DNA of the synthetic is the same as the original.
- Green gives an example of a cloned Politician: George Walker Bush. Green advices the viewer to seek old video recordings of George W. Bush, and compare the old George W. Bush, with the George W. Bush during Bush's second term,

-in terms of mannerism, speech pattern, body language etc. (old videos of George Walker Bush (Boringest 2006; Fox 4 News - Dallas-Fort Worth 2014) are presented in the References section).

- Scientist have also learned how to make these synthetic people within a few months, to the point where the synthetic can be a walking, talking duplicate of the original, intact with all the memories and experiences of the original. The only problem is that the memory, experiences, and functioning capabilities of these synthetics are like: "A DVD recorder. Sometimes you have glitches, and you have to take the synthetics to Camp David occasionally [every 6 months to a year] to get them tuned up."
- Remember these synthetics are people too, they can think and act just like you can, but they do not have a soul.
- Most of the world leaders have been bought and paid for [by men in the background] and are created to think a certain way –to meet the agendas of these men who remain in the background.
- The global elite plans on depopulating the current human population of **over 7 billion** to **500 million** people. This is corroborated by the "Georgia Guidestones" (WorldTruth 2014).
- Vladimir Putin is executing plans to bring the United States down and into a massive depression. Furthermore, China agrees with Vladimir Putin's plans; stating that the Chinese government has not been a Superpower for over 5000 years and "It is their turn to run the world."
- China has the capacity to set back / shut down all of U.S. computing and electrical systems within two days.

At this present stage, the most **salient** points to keep in mind from Green's accounts are that: U.S. presidents are selected and not elected; and **most importantly**, that scientists have been capable of creating synthetics (cloning people) since 1938. If you have kept in mind Schneider's statement (1995; 1996), (that for every 12 months which passes military technology increases by the equivalent of 44 years compared to what the general public is accustomed to) –then learning that scientists have been capable of cloning humans since 1938 should not come as much surprise. Again, everything regarding my disclosure will become apparent, and I thank these men for disclosing their information, because it helps the reader to corroborate my disclosure.

Aaron Russo

Aaron Russo (pictured) was an American businessman, director, and political activist. He is best known for directing blockbuster films such as *Trading Places, The Rose* and *Wise Guys.* Russo believed that a human being "Should stand for something, and do the right thing when the time calls to act". Consequently, during the latter part of his career he did his best to warn the American public by producing documentaries such as *Mad as Hell* (1996), *Freedom to Fascism* (Russo 2006), and *Reflections and Warnings* (Jones 2008).

Russo disclosed the following key information in *Freedom to Fascism* (Russo 2006):

Income Tax

- There is no law requiring Americans to pay income tax. **Although this is a truth, I DO NOT advocate Americans NOT to pay income tax (and neither did Russo).** This is simply because the Federal Reserve can imprison you and seize your possessions for not paying income tax (although there is no law requiring Americans to do so). So for the sake of avoiding hassle for the mean time –pay your income taxes.
- To further illustrate the above point, Bob Shultz speaking at "We the People Foundation" said the following: "Most people believe that the income tax system is legal and that the revenue from the tax is used in the public interest. However, there is a substantial conclusive body of evidence that proves that our income tax system represents the most pernicious form of tyranny. It is the greatest hoax ever perpetrated by government against the working men and women of America."
- Charlie Beall: "The federal government itself refuses to provide, the American people, who are coercively being subjected to this extraction of their private property, without any underlying legal justification. There is no law. There is no law that requires the average American worker in the private sector to pay a direct un-apportioned tax on their labour and compensation for services. There is no law."

- State Representative – Phil Hart –(R-Idaho): "You can look through the statutes, and look for the law that requires you to pay, and when you do that, you **cannot** identify a law that requires the average person in America who earns a wage and works in private business to pay an income tax."
- Peter Gibbons (Tax Attorney) –It's actually very simple. Congress tried to enact an income tax in 1894 –The Supreme Court said that is unconstitutional. When The Supreme Court says something is unconstitutional, it's unconstitutional. They (Congress) tried again in 1913 –and The Supreme Court said –the 16th amendment- "No new power of taxation" –so if they (Congress) didn't have it then (1913) and they didn't get it; they **DON'T** have it. There is no constitutional base for a tax on the wages for Americans living and working in the 50 States of the union. Period. End of argument.

Radio Frequency Identification (RFID) Microchips

- The latest technology for identifying people at the point of self, when they make purchases –is actually the implantable (RFID) microchip. There are microchips that can actually be imbedded directly into human flesh... It's a tiny glass capsule about the size of a grain of rice... it contains an RFID computer microchip with a coiled antenna and it can transmit information also at a distance.
- Katherine Albrecht –Author of "*Spychips*" (2005) makes the following comment: "RFID is a technology that uses tiny computer technology the size of a grain of sand or smaller; hooked up to miniature antennas to transmit information about items at a distance. Back in 1999, Procter and Gamble, Gillette, and MIT got together to find a way to commercialise this technology and make it small enough, make it efficient enough and make it low cost enough to essentially ---their dream is to put these tiny computer chips on every physical item manufactured on planet earth."
- Radio waves can travel through walls, they can travel through wood, and they can travel through things we normally rely on to protect our privacy, for example your purse, your bag-pack, your pocket, –anything you are wearing or carrying.
- One of the most worrisome applications of RFID microchips, are proposals to put them into cash, meaning that it would be able to track every bank note where it had been, who it had been issued to, and create in essence an audit trail. That would essentially take away the anonymity of cash we now enjoy today.
- Once everything you do is tied down to a single number and there is no longer the ability to pay with cash, then all it takes to render you a non citizen is to simply turn that microchip off. **You will no longer be able to participate in any function in society including buying food. Once money becomes digitised through RFID technology, the elite can deduct whatever amount of money they want out of your microchip, whenever they want. They can trace you whenever they want. You will be at their mercy.**

Habeas Corpus

- Habeas Corpus is "[A] writ [formal document] requiring a person under arrest to be brought before a judge or into court, especially to secure the person's release unless lawful grounds are shown for their detention" (Legal-dictionary 2015).
- During the Bush Presidency [2001-2009 (History 2015)], President Bush signed executive orders giving him sole authority to impose martial law, and suspend Habeas Corpus. This gives him doctorial power over the people without any 'checks and balances.'

  In other words, "The government can jail you for life without charges, without a trial, without a lawyer" (Russo 2006).
- Furthermore: "The National Defense Authorization Act [4] signed by President Obama on the 31st December 2011 authorises the indefinite detention, without trial or indictment, of any US citizens designated as enemies by the executive." See Paye (2013) for further discussion regarding the suspension of Habeas Corpus.

Fraudulent Manipulation of Election Results

- In 2004 at the "Forum of Presidential Election" Clinton Eugene Curtis, a former Computer Programmer for NASA and ExxonMobil testified under oath that election results can be rigged using electronic programs.
- In 2004 he gave the following abridged testimony (Russo 2006):

  Judge: Mr Curtis, are there programs which can be used to secretly fix elections?
  Curtis: Yes.
  Judge: How do you know that to be the case?
  Curtis: Because in October of 2000 I wrote a prototype for present congressman Tom Feeney, and the company I worked for in Oviedo Florida –it did just that.
  Judge: And when you said, "it did just that" –it would rig an election?
  Curtis: It would flip the vote 51:49 –whoever you wanted it to go to, and whichever race you wanted to win.
  Judge: And would that program that you designed be something that election officials that might be on county boards would actually, could detect?
  Curtis: They'd never see it.
  Judge: So how would such a program, a secret program that, fixes the election –how could it be detected?
  Curtis: You would have to view it either with source code, or you would have to have a receipt and then count the hard paper against the actual vote total –other than that you won't see it.
- **Judge:** Given the availability of such vote rigging software and the testimony that has been given under oath of substantial statistical anomalies and gross differences –between exit polling data and the actual tabulated results, do you have an opinion whether or not Ohio elections, the Ohio Presidential elections was hacked?
  Curtis: Yes. I would say it was.

Person in the audience: ---So in other words there is absolutely no assurance whatsoever in anything in regard to these machines?
Curtis: Absolutely none.

- See Truthstream (2006) for further details regarding the full account of Curtis' testimony on how elections can be manipulated.
- Moreover, voting machine manufactures refuse to allow anyone to see the source code. Without paper ballots, the honesty of any election cannot be verified.

The War on Terrorism is the War on Your Freedom

- It is time to wake up America. These ID cards are not about defeating terrorism, but they are **ALL** about controlling the American people.
- The (mainstream) media controls the information that a person gets in various ways. They can make sure that the average American watching T.V. or reading the newspaper is going to come out with a certain mindset. She is going to say this is good, that's bad –and that is all they (media/elites) have to do.

Whoever Makes the Money Makes the Rules

- As Mayer Rothschild said "Give me control of a nation's money supply, and I care not who makes its laws". Mayer Rothschild, private banker, –knew that he and the other bankers would now control the laws of the nation. Government gave these bankers one of its most important powers, and now had to borrow money from the bankers and pay interest to finance the government.
- America has gone from people owning their own property, owning their own businesses –to a nation in debt because all the money is created by borrowing (from private banks) and this country has become one where people just live by borrowing.

Russo's Message to Mankind

- If you are in the military or law enforcement, remember you swore an oath [to uphold the law of the land]. You did not swear an oath to promote world government, or corporations.
- Now that you do understand what happened [to America, and the monetary system based on debt slavery] and how it is leading to a tyrannical one world government – the future of mankind depends on you –will you choose freedom or slavery?
- Stop being passive liberals. Stop being passive conservatives. Stop being passive centralists. Stop being passive human beings! When the media starts telling you that the country will fall apart if this is done... Do not be fooled!!
- Remember these are sick, malevolent and twisted people we are dealing with, trying to save themselves. Squash their agendas and stay on course.
- "I believe the time for mankind is time to give all or perish. Grow up or die. Grow up and become adults. Act like adults. Take some responsibility. The world which you have perceived is childlike; –and now the curtain has been pulled back for all to see."

- Unless people get active [get fully informed, and learn how governments of the world are conspiring against their people] and say –I am going to help shut down the Federal Reserve System; I am going to shut down the powers that be –the whole human race is doomed otherwise.
- We are coming near the end game and things are starting to accelerate... –and people are looking at the world leaders to declare martial law [which in turn will rid Habeas corpus].

Let's Consolidate our Problems

- If we can all get focused on how to win the game instead of all these different objectives –such as people are fighting for a better environment; people are fighting to keep their guns/gun control; there are all these different issues which are going on around the world -and which are all important on their own –but if we can consolidate on that and focus –and take all those people –and say –hey let's shut down the Federal Reserve, then we'll deal with those issues. Let's go to the agenda, the objective, the root cause of man's problems, first, then we'll go back to the other stuff.
- That is the priority right now. You have to cut off the head of the beast. And the head of the beast is the Federal Reserve System and the people behind it. You see, and that is what will save the world, and if people understand that –and they **stop** being passive liberals, and **stop** being passive republicans, but rather become **active** human beings –that is what will save the world!

Aaron Russo: Reflections and Warnings

In this documentary Russo recalls his relationship with Nick Rockefeller. Russo shares critical information Rockefeller discussed with him.

The Falsehood of September 11th 2001

- Russo met Nick Rockefeller through a female attorney who telephoned Russo and said "One of the Rockefellers would like to meet you." Russo made a documentary called *Mad as Hell* (1996), and Rockefeller had watched the video and knew Russo was running for Governor of Nevada and wanted to meet him. Russo said "Sure I'd like to meet him", and the two met and talked. Rockefeller proved to be a very smart man and shared ideas with Russo and was the person to tell Russo 11 months before 9/11 happened "There was going to be an event..."
- Rockefeller never told Russo what the event was going to be; but, there was going to be an event –and out of that event, we [America] were going to invade Afghanistan, to run pipelines from the Caspian Sea; we were going to invade Iraq, to take over the oil fields and establish a base in the Middle East, and make it all part of the New World Order; and we would go after (Hugo) Chavez and Venezuela –and sure enough, later when 9/11 happened –and I remember he was telling me how you are going to see soldiers looking in caves for people in Afghanistan and Pakistan and all these places and there is going to be this war on terror which has no real enemy and

the whole thing is a giant HOAX, but it is a way for the government to take over the American people (and the world).

- There is no question about it [that 9/11 is a hoax]. Nick Rockefeller said to Russo: "There is going to be a "War on Terror"" and he was laughing. Who are we fighting against...? Why do you think 9/11 happened and then nothing has happened since then? Do you think that our security is so great here that these people who pulled off 9/11, who were able to lock down another plane...? Come on it is ridiculous... 9/11 was done by people in our own government and our own banking system to perpetuate the fear of the American people into subordinating themselves to anything the government wants them to do. That is what it is about and to create this endless war on terror.
- Nick Rockefeller was laughing when he said, "We are going to be sending men into caves in Afghanistan and Pakistan" –and it was just cynical, he kept laughing and saying "Look how stupid everyone is! We can do whatever we want!"
- 9/11 was the first lie; and the next lie was to go into Iraq, to get Saddam Hussein out with his weapons of mass destruction (when the real issue was control of the oil fields) –that was the next lie. 9/11 created an endless war on terror that would go on and on and you can never define a real winner. There is no one to defeat and so it goes on and on forever. And they can do whatever they want; because they scared the hell out of the American public.
- This whole war on terror is [perpetuated on] a fraud. It is a farce. It is very difficult to say it out loud because people are intimidated in saying it. Because if you say it they want to make you into a nutcase –but the truth has to be... and the truth has to come out. The fact of the matter happens to be the whole war on terror is a fraud, it is a farce. Yes. There is a war going on in Iraq, because we invaded Iraq, and people over there are fighting... but the 'war on terror' –it is a JOKE –you know, and until we discover what really happened in 9/11 and who was responsible for 9/11 –because that is where the war on terror emanates from. That is where it comes from. It was 9/11 which allowed this war on terror to begin and until we get to the bottom root of 9/11 –the truth of 9/11 we'll never know about the war on terror.
- Russo was in Tahiti when 9/11 happened and he got a call from his son – and his son said –"The twin towers, they were just attacked and they are falling down or something..." Russo was in Tahiti and had just woken up from sleep. Russo didn't realise what it was immediately (11 months after Rockefeller had told him about 9/11 and it had happened –because Rockefeller said there was going to be an event –he wasn't specific) –but after Russo saw that America was going to go to Iraq and Afghanistan, that is when he realised, and equated it to what Rockefeller had said.
- 9/11 was only a manifestation to create a fear in the American public. So that we would obey and do what they want us to do. Take for example, Richard Reed 'The shoe bomber' –now here is a guy who is 6 feet 6, ugly as can be; I heard he smelled... He sits on a plane, lights a match in a non-smoking area, to put his shoe on fire... surrounded by people... That is idiotic! If you were going to blow up a plane... you would go into the bathroom... you close the door... and you put your shoe on fire...

you are not going to sit there.... surrounded by people, lighting matches in a no smoking flight... they (elite) want you to believe this nonsense. That is ridiculous!

- The war on terrorism is to keep people in fear. It is an endless war without a real enemy ('terrorists') –so that people would submit and do whatever the government wants them to. Submit to searches, give you ID cards, put Radio Frequency Identification (RFID) chips in you etc. You become servants to the elite –that is what this is all about...
- Freedom of liberty is what people really want, and it is time to stop the duplicity of the government from lying to us. You see many people know the truth of what is happening in this country; like 9/11 but they are afraid to stand up. People have to stand up and find their courage and say "I'm not going to take this anymore, I know the truth" –and they create a situation where if you tell the truth, you are considered a lunatic.
- In other words if someone goes on a T.V. show and says that 9/11 was an inside job – immediately the person is labelled an idiot or crazy. They call you names. **You cannot be afraid of that.**
- If you do not fight the corruption and you do not stand up for what is right in life, you end up being a serf and a slave and you are leaving your children a world in which you would not want to live in yourself, so how can you in decency behave that way? You have to stand up for what is right in life, and unless you do that you are nothing.

The New World Order Agenda

- The whole agenda is to create a one world government where everyone has an RFID chip implanted in them. All the money is to be in those chips [a cashless world]. This information came straight from Nick Rockefeller himself. That is what the ultimate plans of the global elite, banking industry and Rockefeller wants to accomplish.
- The agenda is to implant everyone with RFID microchips. All money is transferred to those microchips. There is no more cash. Money would be in microchips. Instead of having cash, you would have money in your microchips, but whenever they want, they (elite) could take whatever amount out of your microchip whenever they want to. Total control. If you are a protestor they just turn off your chip; you cannot buy food; you cannot do anything; it is total control of the people.
- So they want a one world government controlled by them. Everyone being chipped, all the money in those chips, and they control the chips and they control people, and you become a slave. You become a serf to these people –that is their goal. That is their goal; that is their intentions.
- Russo did not believe in enslaving people and Rockefeller would question him in the following manner: "Why do you care about them? Why do you care about those people? What difference does it make to you [Aaron]? Take care of your own life.
  Do the best you can for you and your family. What do the rest of the people mean to you? They don't mean anything to you. They are just serfs. They are just people..."

- Rockefeller asked –"Why are you fighting for the people for, what is it all about? The people have to be ruled. The constitution, what you are standing for is only for a few people, it's only for a few individuals who can live that way and we believe that it is best for society to be ruled by an elite people who control everything." Russo told Rockefeller he does not believe that. Russo believes: "God put me on this earth to be best person I could be and put everyone on this earth to be the best they can be, and NOT to be a slave and a sheep to YOU and these people (elite) –and I do not understand why you want to control everything. What is the need for that?"
- It was just a lack of caring [from Rockefeller's part], and that is just not who Russo was. It was just sort of like cold you know, and Russo used to say to Rockefeller, "What is the point, of all this? You have all the money in the world you need; you have all the power you need, what is the point? What is the end goal? Rockefeller said "The end goal is to get everyone chipped. To control the whole society. To have the elite people [the bankers and government] controlling the world."

Women's Liberation from the Perspective of the Elite

- Women's' Liberation was founded by the Rockefellers.
- Rockefeller asked Russo: "What do you think women's liberation was about?" At the time Russo had a pretty conventional thinking about it and he said "It's about women having the right to work; get equal pay with men; just like they won the right to vote." At this point Rockefeller started to laugh and he said to Russo "You're an idiot"
- Rockefeller said –"Let me tell you what that was about. We the Rockefellers funded women's' liberation. We are the ones who got it all over the newspapers and television. The Rockefeller foundation –and you want to know why? There were two primary reasons:"
- 1) "We couldn't tax half the population before Women's Liberation and the second reason was"
- 2) "Now we get the kids at an early age [because both parents are away from home working] –we can indoctrinate the kids how to think, so it breaks up their family –the kids start looking at the state as the family, as the school as the officials as their family, not as their parents teaching them, and so those are the two primary reasons for women's liberation."
- Russo thought, up to that point, Women's Liberation was a noble thing; however when he saw the Rockefellers' intentions behind it, where they were coming from when they created Women's Liberation; the thought process of it; Russo saw the evil behind what he thought was a noble venture.

America is a Republic

- America is a constitution republic / it is supposed to be a constitution republic –and **NOT** a democracy. The majority should not rule, and nor should the majority take over the inalienable rights of the minority.

- Americans pledge allegiance to the "Flag and the **Republic** which it stands" –and **NOT** democracy.
- Democracy is the worst form of government you can have because it is majority rule. Therefore the government can tell you what to do because 'the majority' wants it. It is irrelevant what the majority wants. Decisions should not take away the inalienable rights of an individual.
- Russo also said "It doesn't matter who you vote for, republican or democrat; –they are the same –neither one of them is stopping the Federal Reserve or paying income taxes.
- The elite (Federal Reserve) have taken over the American government; there is no difference between republicans and democrats. There is no difference between the two parties. The duality is manufactured. They (Federal Reserve; central banks) control both parties. It doesn't matter to the elite which one wins, because whoever is running for President will be someone they anoint. Whoever runs for President, will do whatever the elite want them to do. The fact of the matter happens to be that you cannot win an election unless you have enough money to win; they (Federal Reserve; central banks) make sure who gets the money.

Depopulation

- Russo and Rockefeller discussed many things –and one of the things Rockefeller brought up in conversation was reducing the world population. Rockefeller felt that there are too many people in the world. In a way Russo agreed that there are too many people in the world, but he **does not** think he has the authority to say who dies and who lives; but the elite felt that they want to reduce world population and Rockefeller felt it should be reduced by half.
- Rockefeller even mentioned to Russo in conversation, that they were having a real problem trying to solve the Israel/Palestine problem –and they were playing with the idea of bringing Israel to Arizona –and taking everybody from Israel and giving everybody a million dollars, and setting up Israel in the state of Arizona –because that is a problem that they are not in charge of.

Borrowing Money from Private Banks causes Inflation and Debt

- These people (elite) control the money so they make all the rules, and therefore they put the rules in which they want into effect, and the truth is America has really become a socialist communistic country. Everyone says it is a capitalistic country, but how can it be a capitalistic country when you have a central bank? That is the first question people should ask. It can't be. It is a planned economy, it is a phony!
- If they want to create prosperity, they just print dollars, or put digits into the economy. Now you have prosperity. You do not have real prosperity, you do not have real manufacturing, you just have money being injected in which is infusion of credit. This makes the government go into more debt.

- Whoever makes the money makes the rules. Rothschild said that. Why are we allowing these private bankers to make the money for our country? It is nonsense. Why are we paying interest to these banks to make money for us when the government can do it itself without paying interest, without all that debt? There is no answer to that question and it is a question no politician will raise. Everybody talks about America's debt... We are in debt because we borrow money... but we don't HAVE to borrow money. They designed it so that we can go into debt. We can create the money, and back it by gold so that they cannot create too many of it, so that you do not have the inflation, and do what the Founding Fathers told us.
- Why in the world does the American government borrow money from the banks when they have the ability to create it themselves without borrowing it, and paying interest on it? Why? Nobody can answer that question –not one politician ever raises that. Why does the American government ever borrow money, when they can create it without paying interest?

  –And people say that –well if the American government creates it, it will cause inflation. And that is their answer. And Russo says well let's look at it: the American government has the Federal Reserve do it, which creates the same inflation as if they did it, but also with the inflation –now you are getting massive debt –so with the Federal Reserve you have inflation and debt. Now if the American government made the money, backed by gold which would limit the amount they could make –you wouldn't have debt and you wouldn't have inflation.
- It wasn't until 1913 when the Federal Reserve came in, that America had inflation. Before then there was no inflation for 100 years. There were points and spikes, mostly during the Civil War –but basically there was no inflation other than during that short period of time. I mean a loaf of bread would cost the same thing. People could plan their lives.
- Today, they have planned inflation, and now you have two parents working, they cannot afford to take and pay for their family anymore; the kids are going to state run schools now, the kids are being indoctrinated how to think; they are being given Ritalin, they are being given all these drugs, the whole country is being dumb down, it is all because of the Federal Reserve System; and the Federal Reserve system and these bankers are responsible for the demise of America. And if we ever want to win this battle you must shut down the Federal Reserve System, and we must shut down these bankers and restore sound money to this country.
- If you analyse the situation and if you realise that since the Federal Reserve has come into being since 1913, illegally, without a constitutional amendment, by bribing a few senators during Christmas vacation, they turned over the most important power that the American government has, the creation and issuance of money to a private bank.
- Through that private bank issuing money they have destroyed this country. They have destroyed the purchasing power of money in this country; they have created social programs that are destroying this country.
- The Federal Reserve has created massive inflation in America which means the American worker has to keep on making more money to keep up with the cost of

living. The more money they make to keep up with the cost of living, the less competitive they become in the world economy. So now what happens is that we have to pay our workers so much to keep up with the cost of living; and then they (elite; government; corporations etc.) say screw the American worker; let's go overseas now to get the cheap labour.

- The inflation the Federal Reserve has created has now allowed other countries to outcompete us. Other countries do not have to pay as much money as we have to pay to our workers to survive. So now we are not competitive anymore and we have lost our manufacturing base. We have lost our competitive edge.
- "Freedom to Fascism" is a documentary that everybody should see. Russo and his team show the fraud of the income tax; they show how Judges put people into jail for no reason; they show the corruption of the justice system. They show how the Federal Reserve came into being and how it is controlling society and how all the central banks are working together through the bank of International Settlements, in Switzerland which is the central bank for all central banks and how all are working together to create this one world government; this one world order; which is what they are trying to do.

The Deception of the Council of Foreign Relations (CFR)

- Russo was interested in joining the Council of Foreign Relations, but he found out from Rockefeller himself, that part of the end goal of the CFR is to get everyone RFID chipped. To control the whole society and have the elite people (bankers, government etc.) controlling the world. Russo asked Rockefeller "Do all the people in the CFR believe the way that you do?" Rockefeller said "No, no, no. Most of them believe they are doing the right thing. A lot of them believe it is better off being socialistic. We have to convince people that socialism is really capitalism." Because America is becoming a socialistic country; it is a communist country today.
- Russo's friendship with Rockefeller became one where they would share thoughts, ideas and philosophies and Rockefeller wanted Russo to become a part of what they were doing [enslavement agenda], and for Russo to become a member of the CFR; Rockefeller offered various business opportunities for Russo to get involved in the CFR and to **not** take up the fight or the battle that Russo had been taking up in the past. Rockefeller wanted Russo to drop the idea of helping the people; because "What was the point in Russo fighting for the people?" Rockefeller would question.
- Russo asked Rockefeller do all the people of the Council of Foreign Relations feel the same way you feel? Rockefeller said "A lot of them think they are doing the right thing, they think that socialism is the best way to go (but this form of socialism involves redistributing the wealth for the elites and not to everyone), they think that they are doing the right thing." But the people at the (very) top they all know the truth of what is happening. (Therefore, the good people in the CFR are also under an illusion, and do not know that effectively they are working for evil men who have the overall goal to control the populace of the world).

- So it is compartmentalised within the elite structure as well. All the people in the CFR -2000 to 3000 people like Dan Raddler –they don't know what is going on--- they join the CFR because it is prestigious. They think it is good for business, it is good for this; they don't know what is really happening –the evil that comes out of it –that is emanating out of it.
- In terms of the CFR, in terms of compartmentalisation, there are many good people which Russo believes are part of these organisations who do not even understand what these organisations are really about. For example, when Russo was in Germany, doing cancer treatment, there was a gentleman there who was visiting a friend of his with cancer. The gentleman visiting his friend was a member of the CFR, and him and Russo were talking and Russo showed him the movie (*Freedom to Fascism* (2006)); --and he said, "Oh my god! I'm going to resign." "I had no idea this is what the CFR is about". He had no idea; he is just a nice guy, who thought he was joining a prestigious organisation.
- A lot of people join the CFR because they think it is a prestigious organisation; it will help them in business; make good business contacts etc. They do not have an understanding that the CFR is really about world domination. How they, and the Trilateral Commission, The Bilderberger [Group], the banks, all work together to control the people –a lot of them do not understand that. They do not see the big picture. They think: Oh the CFR is a prestigious organisation. I'll make this, I'll make that, and I can do business deals. It is just business to them. The CFR wants to get the people in there that have influence and power, and so they are part of that (enslavement agenda), and so they are not opposed to them. So the whole country is becoming the haves and the have not. You are getting the very, very wealthy and the middle class being destroyed and you are getting the poor people.
- In Russo's words: "You can call the CFR what you like, but it is a criminal organisation. Run by criminals. But people do not think of it as a criminal organisation, because it has 'class'; 'style'; 'prestige'; –and it is 'respected'; so people do not look at it as being a criminal organisation. That is what a great job they have done."

Combining America, Mexico and Canada into one Country

- Imagine this... here you are in America, and they (elite) are combining American, Canada and Mexico into one country. The North American union. And the American people do not know anything about it. It is not even in the press. They would rather talk about Rosy O'Donnell and Donald Trump calling each other names than discussing the fact that we are merging into one country. This isn't even reported.
- The fact of the matter happens to be, that tells you how controlled the media is. The elite control the media, and they control governments and they are all in bed together. Here you are combining American, Canada and Mexico into one country, and you do not see it in the press. You do not see it in the press. Why? This should be one of the top stories everywhere –and the elite are not worried about it. That tells you –there is the evidence that [media] it is controlled. They do not want the American people to

know what is going on, that is why they do not protect our borders. That is why we are losing our constitution, the very document that secures our freedoms.

Russo's Vision on How to Bring These People Down

- There is no question we are in tyranny, there is no question that the American citizen is no longer a free individual human being, to do the things that they wish to do. We're slaves and it is getting worse.
- We are dealing with complete evil; and until the American people wake up and say, we do not want this evil in our country anymore and we want to come back to a country of decency and goodness, integrity and honour, we are going down that road and that is what it is going to take? It is going to take people to stand up and say we do not want to live in this kind of world anymore. I believe we should pull all of our troops out of Iraq, I believe we should leave other countries alone. Let other countries live their lives the way they choose to. Stop trying to spread 'democracy' around the world, which is the worst form of government there is anyway (because 51 percent rule over 49%), restore our republic to what it is supposed to be and go back to what the founding fathers gave us. Restore the republic.
- In Russo's opinion: The populace must shut down the Federal Reserve System –and there has to be an uprising. There has to be an uprising. People have to stand up. One person cannot do it alone. You cannot do it alone. People do not seem to have the courage to do what they have to do.
- A lot of people in Hollywood know the truth, they do not want to stand up and speak about it; I know many of them have seen my movie (*Freedom to Fascism* (2006)) and they know I am right, and they want to talk about it because everybody is afraid. Everybody is afraid because they think that the money they get from the Federal Reserve is really money and they have a comfortable lifestyle and they are afraid of change. They are afraid to stand up for what is right, and until people are willing to stand up and have the courage to do what they need to do, it is not going to change; and hopefully we can affect change when people stand up and say "Hey, I've had enough".
- We (the populace) have one advantage. They (elite) need us to cooperate. See, if we do not cooperate with them, they cannot win. They always need our cooperation with them to go along with their programs. They try to "sell us". Democracy; this majority says this; believe in this; do this, do that; the war on terror; we have to be scared... They are always trying to do things to "sell to us" to go along with them, and once we learn not to cooperate with them; then we win the game.
- That is the point, do not cooperate with them, and do not go along with the program anymore. Stop it. Join forces, and bring freedom back to this country. It is going to take people who believe in freedom; The Constitution and the Founding Fathers, Thomas Jefferson, to make this country whole again, because right now it is in the grip of the evil ones, and the only way to stop that is for good men to stand up.

- We have to stop being scared. We have to do what is necessary to take back what is ours. We have to stop these bankers, these elite, full of liars, congressmen full of liars. They are destroying our borders.
- So through these bankers, attempting to take over America, knowing that America was the freest nation on this earth, it was necessary for them to takeover America, take away gun rights, freedom to bear arms, and create a country where we become slaves, because once they take over America, the rest of the world becomes a lot easier for them. And so by creating 9/11, an event to terrify the American people that we are being 'attacked by terrorist', you create a world where there is an enemy that can **never** be pinpointed. You can never win the battle. It is 100 year war – a never ending war on terrorism. So you are always fighting this war, and through the war on terrorism, through 9/11 which is the first lie, then you create the war on terrorism which is the next lie, then you create the war in Iraq through weapons of mass destruction, which is the next lie –so you get one lie, to the next lie, to the next lie, -- now it is going to be Iran the next lie –and sending more troops and insurgents into Iraq.
- Restore America's Republic back to what it is supposed to be. Get the bankers out of our government. Get government to stop borrowing money from the banks. Government should make its own money; restore the Republic. Restore individual freedoms. That is what this country is about -and until we do that we are going to be slaves.
- You have to take away the creation of money away from the private bankers and you will solve 95% of your problems.
- Americans, mobilise, stand tall, stand together, tell the government you are "Mad as hell!" Do not cooperate with the government do not accept a National ID card. Do everything in your power to restore freedom and your individuality back to America. Stop being a country run by the institutions for the institutions. Let's go back to "We the people, by the people for the people", as opposed to, we the institutions, by the institution, for the institution. Stand up for your individual rights. Stand up for the God leaders that are in each and every one of us!

The Trans-humanist / Post Human Agenda

Transhumanism is a cultural and intellectual movement that believes we can, and should, improve the human condition through the use of advanced technologies. One of the core concepts in transhumanist thinking is life extension: through genetic engineering, nanotech, cloning, and other emerging technologies, eternal life may soon be possible. Likewise, transhumanists are interested in the ever-increasing number of technologies that can boost our physical, intellectual, and psychological capabilities beyond what humans are naturally capable of (thus the term *trans*human) (Anthony 2013). Transcranial direct current stimulation (tDCS), for example, which speeds up reaction times and learning speed by running a very weak electric current through your brain, (Anthony 2012) has already been used by the US military to train snipers. On the more extreme side, transhumanism deals with the concepts of mind uploading (to a computer), and what happens when we finally craft a

computer with greater-than-human intelligence (the technological singularity) (See: "How to create a mind, or die trying", Hewitt 2012) (Anthony 2013).

Moreover, put simply, "posthumanism" can be defined as that condition in which humans and intelligent technology are becoming increasingly intertwined (TheNanoAge 2015). For readers interested in learning more about the posthuman / transhuman agenda see BT Soul Catcher 2025 (BEAMS 2007); Avatar Project 2045 (2045 Initiative 2015; Borghino 2012) and Mind Clone Robot (Bloomberg Business 2015; RT 2015) which have all been disclosed as methods of transferring the human consciousness to a computer.

The Phases of Sleep and Rapid Eye Movement (R.E.M) Sleep

Sleepers pass through five stages of sleep: 1, 2, 3, 4, and REM (rapid eye movement) sleep. These stages progress cyclically from stage 1 through REM then begin again with stage 1. A complete sleep cycle takes an average 90 to 110 minutes (Sleepdex 2015). In other words, after falling asleep, it takes approximately 90-110 minutes to enter REM sleep.

Stages

Waking	REM Sleep	NREM Sleep			
Stage 0	Stage R	Light Sleep		Deep Sleep	
		Stage 1	Stage 2	Stage 3	Stage 4
Eyes open, responsive to external stimuli, can hold intelligible conversation	Brain waves similar to waking. Most vivid dreams happen in this stage. Body does not move.	Transition between waking and sleep. If awakened, person will claim was never asleep.	Main body of light sleep. Memory consolidation. Synaptic pruning.	Slow waves on EEG readings.	Slow waves on EEG readings.
16 to 18 hours per day	90 to 120 min/night	4 to 7 hours per night			

Image 1: Stages of sleep. Source: Sleepdex: (2015)

Any sufficiently advanced technology is indistinguishable from magic.
Arthur C. Clarke

REM Sleep

Most dreaming occurs during Stage Five, known as REM. REM sleep is characterized by eye movement, increased respiration rate, and increased brain activity. REM sleep is also referred to as paradoxical sleep because, while the brain and other body systems become more active, your muscles become more relaxed, or paralyzed. Dreaming occurs because of increased brain activity, but voluntary muscles become paralyzed. Voluntary muscles are those that you need to move by choice, for example, your arms and legs. Involuntary muscles are those that include your heart and gut. They move on their own (Sleepdex 2015; Walcutt 2013).

Rapid eye movement, or REM sleep, is when you typically dream. You may have images float by in earlier stages, particularly when you are going through Alpha or Theta (brain waves), but the actual dream state occurs in REM (Walcutt 2013).

This period of paralyzation is a built-in protective measure to keep you from harming yourself. When you are paralyzed, you can't leap out of bed and run. Do you ever feel like you can't escape during a dream? Well, the truth is, you can't. You can breathe, and your heart is working, but you really can't move (Walcutt 2013).

The reader is also advised to see the Horizon documentary "Why Do We Dream?" (BBC Horizon 2009). This video is available, on YouTube, and details sleep, the phases of sleep, REM sleep, the period of paralysation and more.

Current Advances in Technology

This is a section some readers may have difficulty with, because reading about these current technologies alone, one cannot help but feel that such technologies described below sound like the stuff of science fiction and fantasy -although they have been corroborated through public drip-feed disclosure (explained below). Nevertheless, I urge the reader to keep in mind Arthur C. Clarke's quote (above), as well as Phil Schneider's testimony regarding the advancements of military technology in comparison to the general public's technology (for every 12 months, military technology outstrips the technology the public is accustomed to by a rate of 44 years). Moreover, for the reader who finds difficulty understanding the technologies described below, seek the supporting articles / videos.

Memory Suppression Technologies

Memory suppression technologies are any scientifically advanced technologies which are used to suppress memory. Examples of how memories can be suppressed can be found by reading Winter's (2014) article which details how memories can be suppressed using light; and Greenberg's (2013) article which discusses memory suppression through gene / chemical modification.

Mind-Voice Technology

Mind-voice technology is an advanced technology which is capable of reading, listening, hearing or broadcasting your inner voice / thoughts. Examples of articles which discuss mind-voice technology are: Prigg (2014) details software which can read the inner voice; and New Scientist (2014) which also discusses a brain decoder which can eavesdrop on one's inner voice.

H.A.A.R.P. Technology

The High Frequency Active Auroral Research Program (HAARP) is a radio transmitting system that can bounce signals off the ionosphere (a region of the Earth's upper atmosphere 60km (37 miles) to 1000km (620 miles) altitude) and back to earth to probe deep into the earth or sea, its proponents say. The system could locate minerals or communicate with submarines. (Begich & Manning 1997; Sheen, Begich & Robbins 2005).

HAARP can also:

- Disrupt human mental processes.
- Knock out all global communications systems.
- Manipulate global weather.
- Change weather patterns over large areas.
- Interfere with wildlife migration patterns.
- Hurt ecosystems.
- Negatively affect your health, moods, and mental states.
- Unnaturally impact the Earth's upper atmosphere.

This illustration (below) shows the ionosphere's relationship to the Earth. The illustration appeared in the HAARP Environmental Impact Statement on page 10-125 of Volume II.

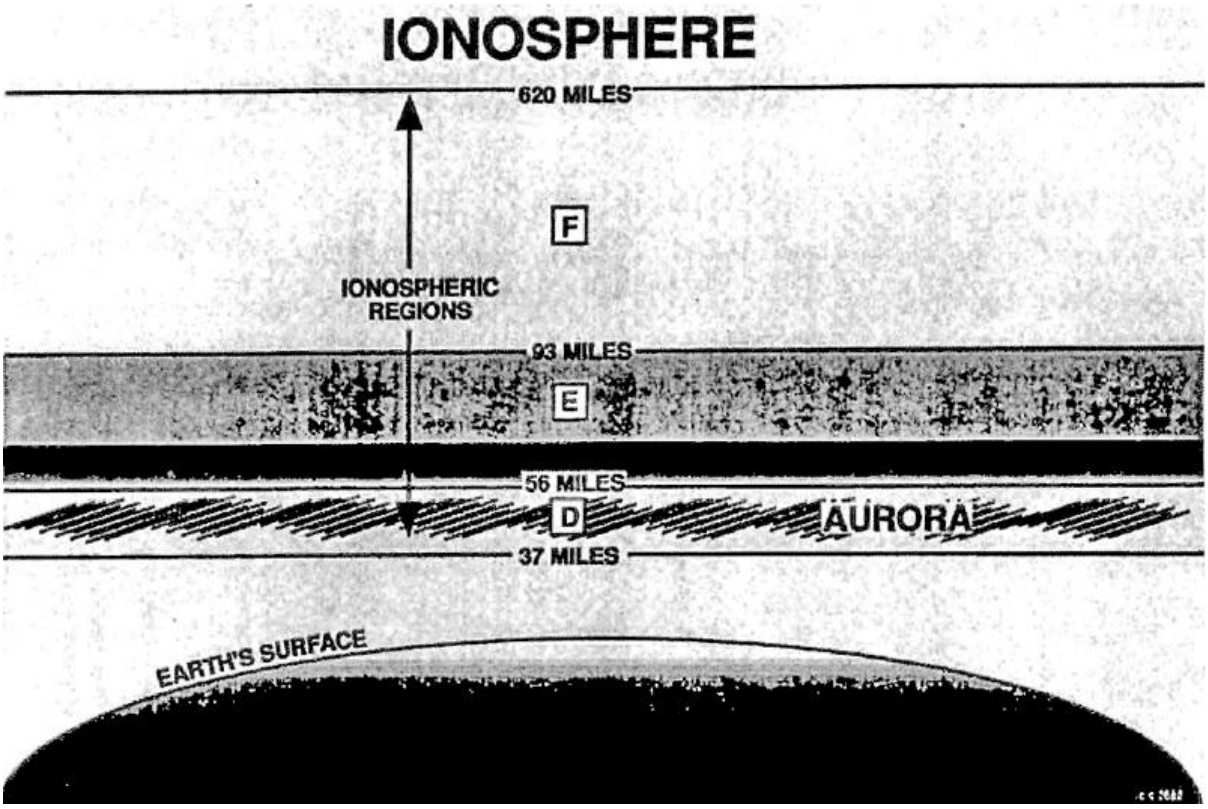

Image 2: The ionosphere's relationship to earth. Source: (Begich & Manning 1997)

The ionosphere protects the earth. HAARP (High frequency Active Auroral Research Program) is made to beam more than 1.7 gigawatts (billion watts) of radiated power into the ionosphere -the electrically charged layer above Earth‘s atmosphere. Put simply, the apparatus is a reversal of a radio telescope - just transmitting instead of receiving. It will boil the upper atmosphere. After disturbing the ionosphere, the radiations will bounce back onto the earth in the form of long waves which penetrate our bodies, the ground, and the oceans.

HAARP represents a technology which could lead to a new class of weapons that could change our world profoundly - an all-purpose military tool. If misused, the tool could mess up the weather. It could be used against humanity in a way that would change what people think, believe and feel. It could be used for good or evil, just as a harp can produce the music of Mozart or the melody of a death march.

H.A.A.R.P. and Weather Control

- “The theoretical implication [of Dr. Robert Helliwell and John Katsufrakis of Stanford University in 1974] suggested by their work is that global weather control can be attained by the injection of relatively small 'signals' into the Van Allen belts (radiation belts around Earth) - something like a super-transistor effect” said Frederic Jueneman.
- Yes. The weather can be controlled using HAARP technology.

- A series of weather disasters began in 1960, according to a CIA report mentioned in the editorial, but at the time climatologists couldn‘t look ahead and see that droughts, floods and abnormal temperatures would continue beyond that decade. As if natural disasters weren‘t bad enough, the CIA reported that national governments were already able to manipulate weather for military purposes [using HAARP technology].

As far back as 1958, the chief White House advisor on weather modification, Captain Howard T. Orville, said the U.S. Department of Defence (DoD) was studying ways to manipulate the charges of the earth and sky and so affect the weather by using an electronic beam to ionize or deionize the atmosphere over a given area. In 1966, Professor Gordon J. F. MacDonald, associate director of the Institute of Geophysics and Planetary Physics at the University of California, Los Angeles, was a member of the President‘s Science Advisory Committee, and later a member of the President's Council on Environmental Quality.

Gordon J. F. MacDonald published papers on the use of environmental control technologies for military purposes. MacDonald made a revealing comment: ―The key to geophysical warfare is the identification of environmental instabilities to which the addition of a small amount of energy would release vastly greater amounts of energy. MacDonald had a number of ideas for using the environment as a weapon system and he contributed to what was, at the time, the dream of a futurist. When he wrote his chapter, ―“How to Wreck the Environment” for the book “Unless Peace Comes” he was not kidding around.

In the text MacDonald describes the use of weather manipulation, climate modification, polar ice cap melting or destabilization, ozone depletion techniques, earthquake engineering, ocean wave control and brain wave manipulation utilizing the planet‘s energy fields. He also said that these types of weapons would be developed and, when used, would be virtually undetectable by their victims. He was not some wire haired fanatic when he made these observations in 1966 -he had the credentials of a world recognized scientist. What his futuristic concepts became, are the things which projects like HAARP are made of...

H.A.A.R.P. and Mind Control

- Radio frequency radiation, acting as a carrier for extremely low frequencies (ELF), can be used to wirelessly entrain (adjust) brain waves.
- We are talking about very, very low power requirements. The trick for influencing brain activity is in the combination of frequency, power level and wave form.
- As Dr. Patrick Flanagan, one of America’s most gifted inventors noted in an interview, the HAARP project could be not only the biggest ionospheric heater in the world, but also the biggest brain-entrainment (brain adjustment) device ever conceived.
- According to HAARP records, when the device is built to full power it can send very low frequency (VLF) and extremely low frequency (ELF) waves using many wave forms at energy levels sufficient to affect the mental states of entire regional populations.

- The HAARP transmitting system could be used unintentionally or intentionally to alter mental functions.
- If HAARP is tuned to the right frequency, using just the right wave forms, mental disruption throughout a region could occur intentionally or as a side effect of the radio frequency transmissions [in other words: “mind control”].

RFID Technology

Radio Frequency Identification (RFID) microchips are microchips that can be directly imbedded into human flesh. This section discusses the dangers of RFID chips. See Rense (2001) for full review.

- RFID technology links the brains of people via implanted microchips to satellites controlled by ground-based super-computers.
- Today they are small enough to be inserted into the neck or back, and also intravenously (through a vein) in different parts of the body during surgical operations, with or without the consent of the subject. It is now almost impossible to detect or remove them.
- Implanted human beings can be followed anywhere.
- Today's microchips operate by means of low-frequency radio waves that target them. With the help of satellites, the implanted person can be tracked anywhere on the globe.

RFID Technology and the Medical Profession

- One reason the dangers of implantable microchip technology has remained a state secret is the widespread prestige of the psychiatric DIAGNOSTIC STATISTICAL MANUAL IV produced by the U.S. American Psychiatric Association (APA), and printed in 18 languages. Psychiatrists working for U.S. intelligence agencies no doubt participated in writing and revising this manual. This psychiatric "bible" covers up the secret development of Mind Control technologies by labelling some of their effects as symptoms of paranoid schizophrenia.
- The Psychiatric Diagnostic Statistical Manual (DSM) for mental disorders has been a brilliant cover up operation in 18 languages to hide the atrocities of military and intelligence agencies' actions towards their targets. THE MANUAL LISTS ALL MIND CONTROL ACTIONS AS SIGNS OF PARANOID SCHIZOPHRENIA.
- If a target is under surveillance with modern technology via TV, radio, telephone, loudspeakers, lasers, microwaves, poisoned with mind altering drugs via air-ducts, giving familiar smells which cause headache, nausea and so forth, if s/he claims her/his clothes are poisoned, her/his food or tap water as well --- all medical schools teach their students that the person is paranoid, ESPECIALLY if s/he believes intelligence agencies are behind it all.
- Never is the medical profession told that these are routine actions all over the world by intelligence agencies against their targets. Thus, victims of mind control are falsely considered mentally ill and get no help since they are not believed and their suffering is doubled by misinformed health professionals.

Further Implications of RFID Technology

- How many people realize what the implications of implantable chips actually mean? It means total loss of privacy and total outside control of the person's physical body functions, mental, emotional and thought processes, including the implanted person's subconscious and dreams! For the rest of his / her life!
- It sounds like science fiction but it is secret military and intelligence agencies' mind control technology, which has been experimented with for over half a century (since 1950s). Totally without the knowledge of the general public and even the general academic population.
- Supercomputers in Maryland, Israel and elsewhere with a speed of over 20 BILLION bits/sec can monitor millions of people simultaneously. In fact, the whole world population can be totally controlled by these secret brain-computer interactions, however unbelievable it sounds for the uninformed.
- Neuro-electromagnetic involuntary human experimentation has been going on with the so-called "vulnerable population" for over 50 years, in the name of "science" or "national security" contrary to all human rights. It happens today in the **USA, Japan, and Europe**. With few exceptions, the mass media suppresses all information about the entire topic.
- Only increased public awareness of the microchip implants, their frightful consequences to privacy by influencing of individuals' thoughts and actions, causing people to become biological robots with physical and emotional pain whenever the supercomputer technician so wishes, is enough reason to refuse to take the microchip into your body for whatever reason.
- It is the biggest threat to humanity and the most sinister plan to enslave the human race forever.

If you have a choice and want to remain a normal human being with privacy, **DO NOT** have your children implanted **NOR** yourself implanted with RFID microchip(s) (or any other type of implantable microchip). Otherwise your vision, hearing, sensing, thoughts, dreams and subconscious will be influenced by an outsider, who does not have your best interests in mind. For the rest of your life!

Mind Control: MK Ultra Technology

MK Ultra today has evolved from the 1950s variation of mind control (MK Ultra Compendium 1980), whereby drugs such as LSD, and interrogation were used as methods to weaken the mind of the individual to force confessions through mind control. Today, mind control is achieved through the implantable microchip (mentioned above; Rense 2001).

- The brain functions of an implanted person can then be remotely monitored by supercomputers and even altered through the changing of frequencies.
- Once implanted, the U.S. National Security Agency's (NSA) 20 billion bits / second supercomputers could now "see and hear" what you are experiencing with a remote monitoring system (RMS).

- Every thought, reaction, hearing and visual observation causes a certain neurological potential, spikes, and patterns in the brain and its electromagnetic fields, which can now be decoded into thoughts, pictures and voices. MK Ultra technology is therefore capable of Mental Video and Audio Projection, as well as Artificial Telepathy.
- The mass media have not reported that an implanted person's privacy vanishes for the rest of his or her life. S/he can be manipulated in many ways. Using different frequencies, the secret controller of MK Ultra technology can even change a person's emotional life. S/he can be made aggressive or lethargic. Sexuality can be artificially influenced. Thought signals and subconscious thinking can be read, dreams affected and even induced, all without the knowledge or consent of the implanted person by using MK ultra technology.
- Memory suppression technologies are used in conjunction with MK Ultra technology, which enables the programmer to control certain memories the victim remembers. The use of memory suppression technologies and MK Ultra technology allows the programmer to reinforce behaviour and elicit specific conditioned responses.
- Mind control techniques, such as MK Ultra, can be used for political purposes. The goal of mind controllers today is to induce the targeted persons or groups to act against his/her own convictions and best interests. Zombified individuals can even be programmed using MK Ultra technology, to murder and remember nothing of their crime afterward.
- The goal of mind control, using MK Ultra technology is to program an individual to carry out any task against their will and self-preservation instinct and to control the absolute behaviour and thought patterns of the individual. The purpose of mind control, using MK Ultra technology is to disrupt memory, discredit people through unusual behaviour, to make them insane or to commit suicide or murder.

See Mind-Computer (2012) which discusses how artificial telepathy is achieved. Artificial telepathy, also known as ‘brain to brain communication’, is also possible using MK Ultra technology. Furthermore, review: Jim Cristea (2009); Berkeley News (2011); UC Berkeley Campus Life (2011) CTForecaster (2013); nature video (2013) and Stromberg (2013). The above mentioned articles and videos describe, demonstrate, and corroborate how audio and video projection of the brain is achieved; how dreams can be recorded and projected digitally; how the brain can be scanned to reveal hidden information personal to an individual; and what a person’s underlying intentions are, by using brain scans. Moreover, the articles and videos mentioned above confirm the functionalities of MK Ultra technology.

Furthermore, when our brain functions are connected to supercomputers by means of RFID technology, MK Ultra technology and other implantable microchips, it will be too late for protest. This threat can be defeated only by educating the public, using available literature on biotelemetry (electronic equipment that receives signals from radio transmitters) and information exchanged at international congresses.

Human Cloning

There are currently five different types of clones, concealed from public knowledge. There are Mark 1 clones; Mark 2 Clones; Mark 3 Clones; and Mark 4 clones and reanimated clones. Moreover, there are two types of cloning techniques: duplication cloning and replication cloning.

Mark 1 clones are REM sleep driven clones. However, the technology used for Mark 1 clones causes many side effects and therefore Mark 1 REM sleep driven clones are no longer a preferred choice.

Mark 2 clones are also REM sleep driven clones. Mark 2 clones have fewer side effects than Mark 1 clones, and therefore Mark 2 clones are currently the preferred method for REM sleep driven clones.

Mark 3 clones are independent clones which operate on microchip containing the entire consciousness of an individual.

Mark 4 clones are also independent clones, operating on a microchip which contains the entire consciousness of an individual and is an advanced version of a Mark 3 clone.

These independent clones (Mark 3 and Mark 4) have a lifespan of 6 months to 12 months and require adjustments after this period to run efficiently once more. Without these adjustments, their functionality weakens.

To "reanimate" means "to restore to life; resuscitate; revive". Consequently, reanimated clones are clones which are genetically identical to that of a person who once lived.

Replication cloning is what the public is most familiar with. Replication cloning involves giving birth to a genetic identical of an original where the newborn starts life off as a baby and matures. The newborn is referred to as a clone.

However, duplication cloning is a current concealed advanced from of cloning, and it involves taking as little as two cells from an individual, adding a constant electrical charge to the cells until a complete human being is formed.

Duplication cloning is similar to the process of regenerative medicine as demonstrated by Dr. Stephen Badylak's video "How to grow a New Fingertip" (CBS 2008; Science Channel 2014) where Badylak states: 'A whole human can be grown within 9 months.' On average it takes 5 months to grow a duplicate clone of an original by means of advanced scientific and technological regenerative procedures.

Cloning Centre and Cloning Technology

A cloning centre is a place where clones are produced. Cloning technology are the advancements in medicine, science and technology used to produce duplicate and replicate copies of originals.

Drip Feed Disclosure and Evaluative Conditioning

Drip Feed Disclosure

Drip feed disclosure is the process of supplying information but in small amounts overtime. Drip feed disclosure is also the process of revealing information slowly overtime, possibly telling lies to conceal certain aspects of the truth until the source administering the drip feed disclosure has adequate time to let out the truth in a slow and controlled way, thereby delaying the betrayed partner (in this disclosure, the public) from having the "complete truth" for some time.

Drip feed disclosure is also a method to gauge public reaction used by governments, the media, multinational corporations and organisations as well as high ranking officials to "test" whether the general public is acceptant of the concealed information or not. When the public reacts favourably to the drip feed disclosure, more information is revealed and made public, and it appears to the unsuspecting observer that the people involved in making the disclosure are taking positive steps towards a favourable goal for all. However, when the public reacts adversely; information contradicting the drip feed disclosure is presented, and an expert is presented to the public who voices the concerns of the general public, and therefore it appears that the opinions of the public have been noted and research and development will not continue in the initial stated direction. Nevertheless, the truth remains concealed and research and development continues despite the aversions of the public.

Examples of drip feed disclosure involve articles such as mind uploading / downloading (BEAMS 2007), Mind Clone Robots (Bloomberg Business 2015; RT 2015), The 2045 Avatar Project (2045 Initiative 2015; Borghino 2012). I am here to tell you that I have been a spy for over 30 years and such technological accomplishments which are posted under trans-humanism / post-humanism genre have been realised many years ago and are **available** today. They are just concealed from the public.

Furthermore, Dolly the sheep was announced as the first publicly cloned mammal (Animal Research 1996), but how many readers can say they know that, four years later, a monkey (BBC News 2000), our closest primate, was cloned? This is publicly disclosed knowledge, but I suspect not many people know of a cloned monkey four years after Dolly. This is because there was such a worldwide adverse reaction to genetic cloning when Dolly was made public, that the disclosure of the cloned Rhesus monkey (BBC News 2000) was not made public knowledge on a grand scale.

Evaluative Conditioning

Evaluative conditioning is defined as a change in liking, which occurs due to an association with a positive or negative stimulus (see De Houwer et al., 2001). Simply put, this means that our preferences for brands, products, people and other things can be influenced and even modified by the presence of something we like or dislike strongly (Hale 2012).

In many settings, a neutral stimulus, called a "conditioned stimulus", often coincides with some desirable or undesirable object, called the unconditioned stimulus. An unknown brand, for example, might appear in a commercial that also depicts a happy child. Over time, stimuli that often coincide with desirable objects are perceived more favourably, whereas stimuli that often coincide with undesirable objects are perceived less favourably--called evaluative conditioning (De Houwer, Thomas, & Bauyens, 2001; Walter, Nagengast, & Trassilli, 2005; Moss 2009). An "unconditioned response" is a response to a neutral stimulus we have no / little control over. It is a natural automatic response.

In other words, our preferences for liking or disliking brands, products etc. (the neutral stimulus) can be influenced by embedding (implicitly placing) the brand etc. (neutral stimulus) with positive or negative associations. Overtime our conditioned response becomes one of conditioned favourable or negative response towards the brand, product etc. (neutral stimulus) when we are faced with the brand, product etc. at a future date. Our preferences have been guided overtime. Evaluative conditioning can change our preferences when carried out subliminally or implicitly; it does not have to be explicit.

In media; music; movies; and other forms of popular culture and entertainment, images and symbols (of stimuli which cause undesirable consequences) are embedded subliminally and implicitly and are paired with positive associations as a form of evaluative conditioning. This causes individuals who have no preconceived judgements of the stimulus to be guided to have positive associations with a stimulus which causes undesirable consequences.

In popular culture; media; advertisements; movies; music and other forms of entertainment, evaluative conditioning is used as a method of hinting (that something is wrong); showing off of power (i.e. nothing can be done to stop the negative stimulus) and as a form of gloating (i.e. we've pulled off the negative stimulus / we are pulling it off). In over the 30 years I have been a spy, I have witnessed methods of evaluative conditioning used to hint, show off power, and gloat more often than not, and evaluative conditioning is not used just to guide social order.

The fortunate aspect is that once a person learns that his / her preferences are being guided by methods of evaluative conditioning, in order to influence the person to have positive associations with negative stimuli (or feel powerless towards the negative stimuli); and that the stimulus (brand / product) does in fact cause undesirable consequences –then the 'spell' is broken. The person can now choose how he or she responds to the brand etc. Usually, once all is known: a negative stimulus is associated with negative associations; despite it being portrayed as positive through evaluative conditioning.

Consciousness Transfer

Consciousness is defined as "the state of being aware of and responsive to one's surroundings; a person's awareness or perception of something" (Dictionary Reference 2015). Consciousness can also be described as: individual awareness of a person's unique thoughts, memories, feelings, sensations and environment (Cherry 2015).

John Locke (1632-1704) was an English philosopher, Oxford academic and medical researcher who argues that it is sameness of consciousness rather than sameness of substance that constitutes personal identity. Consequently, if the psychological life is transferred from the body of a prince to the body of a cobbler (shoe mender), Locke argues, the resulting person will be the prince and not the cobbler. He would be responsible for the prince's actions and not the cobbler's; those who were close to the prince could continue their relationships with him but those who had relationships with the cobbler could not, and so on (Schechtman 2012, p.334). Moreover, basic Lockean intuition has proved to be that "consciousness transfer" can be thought of as the feat in which the person moves from one body into another (Schechtman 2012, p.334).

Consciousness transfer can also be thought of as the process of transferring or copying the mental content (including long-term memory and "self") from a particular brain and copying it to a computational device; artificial body or avatar body such as that of a robot or clone version of the original. The computation device, robot or the clone, will then respond essentially the same way as the original brain (as suggested by Lockean theory on consciousness transfer) and therefore the computational device, robot or clone experiences having a conscious mind and essentially the behaviour of the computational device, robot or clone, can be attributed as belonging to that of the original.

It is **OF MONUMENTAL IMPORTANCE** that the reader understands the above statement regarding consciousness transfer is a method of **CURRENT** concealed advances in technology and not a concept relegated only to the genre of science fiction. At the very least the reader should be **open** to the possibility of consciousness transfer and the implications of consciousness transfer, in order to truly begin to understand the extent to which current concealed advances in technology are used to commit monstrous crimes.

I understand the above sounds unsettling, but there are also many wonderful concealed advances in technology (detailed in the disclosure section). The marvels in technological feats and human accomplishment will be released for the benefit of mankind once the world learns about the monstrous crimes which are committed against the them, and the earth, through the use of highly concealed technological advances and the good people of the world band together to put an end to the tyranny around us.

Now is also a good time to remind the reader that if military technology advances by a rate of 44 years for every 12 months which passes, then since 1945 military technology has advanced by a rate of more than 3000 years compared to the technology the public is currently accustomed to (44 times 70 = 3080). Now ask yourself honestly, in 3000 years from now (the year is 5015) don't you think humans will have been capable of developing a method which allows them to transfer their consciousness from one body to the next and more?

I am here to tell you that I have been a spy for over 30 years and that from the intelligence I have gathered over the years it has been illustrated to me countless times that consciousness transfer is indeed fact and currently exists. Consciousness transfer has been achieved since 1945, although this accomplishment in human advancement (and more) is concealed from public knowledge. Moreover, consciousness transfer is a highly advanced form of concealed technology used by high ranking members of society to commit unspeakable crimes against the public.

Furthermore, for the reader who wishes to understand how consciousness transfer is possible, see Petkova and Ehrsson (2008) and Ehrsson (2013). In the video Professor Henrik Ehrsson (2013) demonstrates:

1) Consciousness transfer from one body to the next (owning another body other than ones original)
2) Physiological evidence for owning the new body. In other words when consciousness has been transferred and the person perceives the new body as that of his or her own; when the new body is threatened as the mannequin (new body) was in the experiment, individuals still perceived the mannequin body as that of their own and became frightened (displayed biological and physiological responses).
3) Visual perception and stimulation causes us to perceive ownership of a new body.
4) The new body we inhabit must be similar to that of our own (it does not matter whether the new body is smaller or larger than our original so long as the measurements are proportional) for consciousness transfer to occur.

5) That it is possible for consciousness to be transferred to another person's body and have (or perceive) ownership of other person's body while being localised in your own body. In other words, dual consciousness is possible.

Petkova and Ehrsson's (2008) and Ehrsson's (2013) research gives one of the clearest publicly disclosed explanations of consciousness transfer and I urge the reader to watch the video in order to better understand my disclosure. One of the main findings from his research is that perception is not rigid; and perception does shape reality. Sight and synchronous (going on at the same time) stimulation can, and does alter the brains perception of reality. Sight and synchronous stimulation activates certain parts of the brain (the sensory parts of the brain and the motor (movement) parts of the brain). The match between the two (sight and stimulation) "convinces" the brain that 'hey, I'm no longer in this body; I'm in that one or that I have a third arm (although it is a false limp) etc. Accordingly, "perception is reality".

Disclosure: Save the Victims through your Diligence

I've done my best to preface this information as logically, sequentially and methodologically for the reader as possible. I have stated what the law is on 'whistle blowing'; I have given references and definitions where appropriate and I have provided many sources in order for the reader to research, corroborate, and better understand my disclosure, so that he or she becomes compelled to help me and victims like me, defeat tyranny and save the future of mankind; therefore if there are any areas of my disclosure which still appears suspect –and I understand, after all my efforts –things may still not appear clear to some readers because we are dealing with highly advanced concealed technologies which are not available in the world the general public lives in; and therefore it is difficult to fathom and furthermore conceive that men can be so evil to their fellow humans through the use of advances in science and technology. Nevertheless, I promise you, I have no reason to lie, I am victimised daily because of these technologies, and therefore my only option is to tell the truth, and nothing but the truth so that the people of the world can put an end to this grave injustice.

For the reader who still finds it difficult to accept my disclosure after first read, I want you to do two things:

1) **Give me the benefit of the doubt.** I am asking you to do this because as I stated earlier, one of the hardest things to do as a victim of abuse is to come forward about the abuse you have suffered. It is even more heartbreaking when nobody believes you. Consider all the victims of paedophiles you have heard about on the news. I cannot speak for their individual cases but I can attest to the fact it affects my mental psyche beyond comprehension; there is nothing worse than being ignored and that nobody believes you. So on that premise, please give me the benefit of the doubt, because I'm sure the majority of good human beings out there will feel worse when it is proven that I am a victim of severe abuse and you ignored me, when you could have done everything in your power to save me.

2) **Set out on a genuine quest to debunk my disclosure.** If my disclosure appears suspect to you to begin with, then set out on a genuine and investigative quest to debunk my disclosure because, if my disclosure initially appears circumspect to believe, then I should be proven false within minutes of your research of my disclosure, because even professionals make mistakes. There will be something about the disclosure which will just not 'add up'. However, when a person is telling the truth, then it is very difficult to debunk that person.
I promise you, it will be worth your time to know the real truth about the world, simply because the truth is liberating.

I would also like to remind you that the truth about the world has been hidden from the public for many decades, therefore when you do hear the truth of course it is going to sound absurd to begin with; but keep an open mind and pursue till you know what truth is; because "to "know" is to understand with certainty".

Words of Inspiration: Personalized from a Theoretical Physicist –Thomas Campbell

The following gives an introduction to many aspects which occur in this world behind closed doors or in plain sight depending on how familiar the reader is with the topics. Evidently, a lot of what is written predominantly affects the people of the world and it is time the people of the world stood up and reclaimed their world. I cannot stress this importance enough! The disclosure is also a basis which explains many of the anomalies which exist in the world today. I apologise in advance if the disclosure is too shocking to be believable (initially) and it shakes the foundations of your belief systems... but as I've said, rather than lash out at the information, you must question your own belief system... and probe into the mechanisms which have influenced you to adopt your current belief system... only then does the shock subside... and you can move forward with an open mind through investigation, which should lead you to either corroborate or debunk the disclosure. Keep in your heart: scepticism, optimism and open mindedness (Campbell 2008). Scepticism keeps you from believing fallacies. It keeps you from falling into that which you have not yet proven for yourself. Scepticism is a requirement for breakthroughs. Optimism gives you the ability to give merit to that which you have not yet proven for yourself and Open Mindedness gives you the ability to "see" that which has not yet been proven.

The Science of Hidden Consciousness

Furthermore, "Consciousness Science Kept Hidden" (YesEthan 2013) illustrates:

- "The heart is an electrical organ. It produces by far the strongest form of bio electricity in our body; up to 40-60 times stronger than the second most powerful source –which is the brain. This electrical energy travels through every single cell in our body and in a sense, binds the cells together. The bio-electricity field is strong enough that it can even be detected outside of the body; out into space; beyond the skin. It is very measurable electromagnetic energy, much like radio waves. What we found is that the heart produces an electromagnetic field that surrounds our entire body 360 degrees; and it can be detected about 3-4 feet with megatron meters outside of the body. Researchers at the medical facility in Kansas –say they have detected it 10-12 feet. So regardless of how far it goes, what is interesting is that we produce this electromagnetic field which can be detected; it can be measured, with sensitive mainstream medical equipment." -Howard Martin (co Author) "The Heart Math Solution""
- Scientific studies have shown: that the heart is not only the most powerful centre in the body, it is the most intelligent and has the ability to receive precognition (knowledge of a future event or situation, especially outside one's normal sense of perception). If we can create coherence with our heart and mind centre we can access our intuition more frequently.

When you read my disclosure, remember that it is the heart and NOT the brain which is the most powerful centre in the body; the heart is the most intelligent; it has the ability to receive precognition and intuition about a future event, **before it actually occurs**; therefore if you find that your heart is in resonance with the themes I disclose; do not fight it with the ego of the mind; when our egos get in the way it overrides our heart's intuition; your heart is capable of discerning the truth of an event before your brain becomes conscious of it; by all means listen to your heart, and allow your brain to naturally develop its intuition. It will be the coherence between your heart first, and then your mind centre which will allow you to access your intuition.

Make an effort and reach your own conclusions to the point where you feel comfort in the fact that you **KNOW** the information contained in this disclosure is indeed factual. This will be the point you will have become empowered with golden truth and compelled to fulfil your duty as a human being and also spread the truth far and wide. Yes, we are all living in very interesting times.

Disclosure: Donald Marshall's Message to the World

My name is Donald Marshall. I have been cloned by a large secretive cult know as "The Freemasons" and "The Vril Society" and "Scientologist" together called the Illuminati. For readers unfamiliar with The Illuminati see "The New World Order" (1990) by A. Ralph Epperson and Appendix C in this document; an introductory guide to the Illuminati and their agenda for the world is presented.

Furthermore, I have to tell you that human cloning has been done since 1945. Now is also a very good time to recall Phil Schneider's comment (Schneider was a Geologist and Engineer who worked on black projects and Deep Underground Military Bases (DUMBs)): "That for every 12 months which passes, military technology advances by a rate of 44 years compared to the technology the public is currently accustomed to" (Schneider 1995; 1996; Open Minds 2011). George Green (a former Financier affiliated with U.S. Presidential candidates) also attests to the fact that humans have been cloned since 1938 (Green 2008a; 2008b). Therefore if we take 1945 as a base year, then military technology or hidden technology has advanced by the rate equivalent to 3080 years than the technology the general public is currently accustomed to (2015 – 1945 = 70 years; 70 multiplied by 44 = 3080). So yes, humans have been cloned since 1945 and continue to be cloned today and that current hidden technology in the year 2015 is as much as 3000 years ahead of the technology the public is currently accustomed to. I'll repeat myself because it is **very important** the reader understands the above statement, even if, the rest of the disclosure is hard to fathom after first read. The two **most important** things to keep in mind are:
1) Humans have been cloned for over 70 years (since 1945);
2) **Present** hidden technology is more advanced -as much as 3080 years more advanced- than what the public is currently accustomed to and technology continues to advance at an incredible rate.

The Two Types of Cloning Techniques

Now there are two different types of cloning techniques, there is replication cloning and duplication cloning. Replication cloning is the type of cloning the public has generally heard of. Replication cloning involves taking the nucleus (the DNA) out of a donor egg, and replacing it with new DNA from the person to be cloned. After a few days the resulting embryo can be implanted for pregnancy. The newborn starts life off as a genetic copy of an original.

Duplication cloning, on the other hand, is the second hidden method and type of cloning where the DNA from the person is grown in a big thick tank full of (salty) water. It involves a method of regenerative technology where the cells are agitated and agitated and over the course of 5 months, a fully formed duplicate clone body of an original is developed. The Illuminati used to have to use a tissue sample from the original or the cells from women's pap smears because this contained rich cells to make duplicate clones; they also used children's foreskins which were discarded at the hospital that got removed. That is what happened to me. I had my foreskin removed at age 4 –and by age 5 the Illuminati grew duplicate clones of me. Now the Illuminati say they have upgraded the technology since 2000 and now all they need is blood from the original. They then agitate the blood cells over and over again through regenerative technology, until a fully formed duplicate clone body of an original is produced. For readers who are unfamiliar with regenerative procedures, see Dr Stephen Badylak's video on "How to grow a new fingertip" (Science Channel 2014) and Carmichael (2013) which discuses how scientists cloned a mouse from a blood sample (this is another example of drip-feed disclosure). Regenerative science and medicine (CBS 2008) does work; I've seen it many times.

The Different Grades of Clones: "Mark 1" to "Mark 4" Clones

There are a few different grades of clones that I know of. There are: "Mark 1" to "Mark 4" clones. Mark 1 clones were available at the end of World War II (1945). Mark 1 clones were rapid eye movement (REM) driven clones but they were primitive grades of cloning with lots of side effects caused to the original. Mark 1, REM driven clones were called "Organic Robotoids", even though there are no robotic parts to the clone at all. See Dr Peter Beter's discussion on "Organic Robotoids" (Beter 2011).

Donald Marshall's Dilemma with "Mark 2" Sleep Driven REM Clones

The problem I am having is with Mark 2 REM driven clones. "Mark 2" is a rapid eye movement (REM) driven clone. In other words, Mark 2 clones are sleep driven clones. REM sleep is the fifth stage of sleep (Sleepdex 2015). The first REM cycle usually happens 90 minutes to 110 minutes **after** we fall asleep (Sleepdex 2015). What that means is: **currently,** this is the Illuminati's main form of communication. They do not call people on the phone; they do not meet at the Bohemian Grove anymore (they only meet there once a year for traditional purposes). Since they discovered the science of sleep driven cloning, they meet at the cloning centre **WHEN THEY GO TO SLEEP** (The cloning centre is a physical location, located 5 / 6 hours radius from the Robert Pickton Farm (Port Coquitlam, British Columbia, Canada) at a nature reserve).

Consciousness Transfer Happens When the Original Reaches REM Sleep

The Illuminati can transfer the consciousness of an original once the person reaches REM sleep if there is a duplicate clone of the original at the cloning centre, once the person goes to sleep (90 minutes to 110 minutes after falling asleep). So what happens is that the consciousness of the original is transferred to the duplicated clone body (the duplicated clone body is grown within 5 months by regenerative technology) once the original reaches REM sleep. The original's consciousness is transferred from the original's body, although the original's body is still in their bed, asleep at home; to a duplicated REM driven clone body at the cloning centre and the original 'wakes up' as a cloned version of himself / herself at the cloning centre. It is a great marvel of science and one man's greatest achievements, but it is kept hidden and used for sinister purposes which I discuss below. I must address the readers at this point who are lost at the thought of duplication cloning, and consciousness transfer.

For readers who may have difficulty understanding the process of duplication cloning, see the video which features Dr Stephen Badylak (CBS 2008; Science Channel 2014). Badylak describes and illustrates how a new fingertip can be grown within 4 weeks, by the process of regenerative technology. Duplication cloning works a similar way; involving regenerative technology whereby the cells are agitated and agitated, and over the course of 5 months a fully formed duplicate clone body of an original is grown. Moreover, readers should also view the Horizon documentary "Why Do We Dream?" (2009); the documentary clearly explains the phases of sleep; particularly REM sleep. The documentary also clearly explains that during REM phase sleep the whole body shuts down, and it is only the brain which is active. The fact that the brain is still active, although the body is inactive, is a perfect opportunity for consciousness transfer; and this is usually the moment the Illuminati transfer the consciousness of a person who is asleep, to a cloned version of himself / herself. The reader should also explore Ehrsson's (2013) lecture on consciousness transfer. In the video, Ehrsson (2013) clearly explains how through the first person visual perspective (seeing through the eyes), and through synchronous (occurring at the same time) stimulation of a body part, individuals can perceive and see the world from another body different from their original. In other words, so long as people can see through the eyes, and the body is stimulated, the match between the visual perspective and feeling body sensations allows the individual to see and perceive the world through another body different from their original. The consciousness has been transferred to another body.

Ehrsson (2013) also demonstrates that consciousness is linked. Once consciousness is transferred (from the original's body to the new body), even though the new body is not the persons original body; when the new body is attacked, because the person perceives the world through the new body, everything feels "very real". When the new body (for which the person's consciousness has been transferred to) is attacked, the original still perceives the threat as "real", and therefore the person displays a biological and physiological fear response in their original body; the heart rate increases, as does respiration (breathing) rate, as well as anxiety.

Donald Marshall is an Original as he sits at Home Typing this Disclosure

This is how advanced technology is today. This is also exactly what happens to me. **I am an original as I sit at home here typing this disclosure,** but when I enter REM sleep, my entire original body shuts down, and only my brain is active. The Illuminati have linked my consciousness to a REM driven duplicate clone body of me. Therefore, as soon as I enter REM sleep, they are alerted to the fact that I have entered stage five of the sleep cycle, and in REM sleep, because they have a green and red light above duplicate clones at the cloning centre. The red light indicates that the original is awake, and the green light lets them know that original has entered REM phase sleep and it is time to transfer their consciousness to a duplicate clone version. They cannot transfer the consciousness of an original before REM phase or when the original is awake. When they try and transfer consciousness before an original is in REM phase it makes the original have intense headaches. Setting an alarm every 90 minutes to wake up and then go back to sleep also does not work in terms of avoiding REM sleep and having your consciousness transferred, because the body requires REM sleep, and therefore you become very tired, quickly, if you do not get REM sleep. If you stay awake for four days without REM sleep you begin to hallucinate; after seven days without REM sleep you will die.

When Donald Marshall's REM Driven Cloned Experiences Began

This whole sordid episode began when I was 5 years old, after going to the doctors to get my foreskin removed, at age 4. The tissues from my discarded foreskin were used to grow multiple duplicate clones of me. Within months, I was having my consciousness transferred to a REM driven, 5 year old clone version of me every time I entered REM sleep. The reason the Illuminati did this was because they wanted to use me as what they term "a diddle kid" – in other words they wanted to have sex with an REM driven, 5 year old, duplicate clone version of me. This is what they do. They clone people. They make duplicate clone bodies of people to victimise in terrible ways, and they clone children for men with undeveloped penises to have sex with.

However, I could never remember any of these REM driven clone experiences when I woke up for 25 years; because another aspect of REM driven cloning is that the Illuminati have the advantage of being able to suppress the experiences of people who have their consciousness transferred to their REM driven duplicate clone versions through advanced memory suppression technologies. For the reader who wishes to understand how memory suppression works see Winter (2014). Memories are stored and retrieved from different parts of the brain. Interactions between the cerebral cortex (the outer layer of the brain) and hippocampus need to work together in order to bring the memories out of mental storage to be re-experienced by the mind (Winter 2014). Therefore all that has to be done is for them to turn off the nerve cells which communicate with the cerebral cortex and hippocampus for the evening which you went to sleep and had your consciousness transferred to a REM driven duplicate clone version of you, and you will not remember anything. The technology is so advanced; they can, and do suppress memories at a push of a button. Therefore, the victim wakes up the next morning and will not remember a single REM driven duplicate clone experience. All that they will be aware of is that they did not have a dream the previous night.

This is what happened to me for over 25 years. I wasn't allowed to remember these REM driven duplicate clone experiences until I turned 30. My memories were suppressed for 25 years. I would wake up many days, after a night's sleep, thinking 'I didn't have a dream last night'; or I would wake up the next morning and I would be sick, although I went to sleep the previous night feeling completely healthy. Throughout the years, I thought I had terminal illness; because whenever I went to see a doctor, the diagnosis would always come back that 'there was nothing wrong with me'.

However, over the course of 25 years when I was memory suppressed, and not allowed to remember my REM sleep driven clone experiences, the Illuminati were using me to produce songs, lots and lots of songs, and whenever I could not produce a song, or did not want to, they would stab my REM driven clone body; sodomize my REM driven clone body; chain me to a crucifix and burn my REM driven clone and torture me for all kinds different reasons; and even when I was compliant and did what they told me to, I was attacked, simply because some members of the Illuminati wanted to know what it feels like to stab someone. Now because consciousness is linked (Ehrsson 2013), all these REM clone torture experiences affected me in my original body, and I have a weak heart today because of it, at the age of 39. The memories of my REM clone driven experiences also had to be released to me slowly (see Alford (2014) and FW: Thinking (2014) –for an example of how memories can be wiped and restored) over the course of many months because I had been through so much horror and torture that if the memories was released all at once, I would have had a heart attack in my real body and died.

This is one of the main reasons the Illuminati currently use REM sleep driven cloning (besides sex and torture): to plagiarise talented people under duress. There are many people including me who have been, and are plagiarised on a daily basis. Their consciousness is transferred to their REM driven clone alternates, and night after night and under duress they are forced to reveal their money making ideas or face torture or clone death; clone death after clone death. That is what the movie *Inception* (2010) is about: REM sleep driven cloning, and stealing ideas from the minds of unsuspecting individuals. The Illuminati actually made the film *Inception* (2010) as well as *The Island* (2005), *Avatar* (2009) and *The 6th Day* (2000); the films mentioned above contain references of cloning and REM driven cloning to show off the Illuminati's 'power' and throw in the world's face and laugh.

The Science of REM Driven Cloning Began in 1945

I am one of the few people fortunate, or unfortunate depending on how you look at it, who remembers all of my REM driven cloning experiences because these memories were released to me at the age of 30. I remember many people who have attended and still attend the cloning centre which they bring me to over the course of 34 years. I am currently 39 years old and was brought there since the age of 5. The science of REM sleep driven cloning was first discovered in 1945, and at first it was just a political thing which leaders of the world did. Through the science of REM sleep driven cloning, political figures, heads of state and royalty met each other as REM driven clones versions of their selves when they went to sleep and discussed worldly affairs in complete secret with each other. They also did whatever they wanted with each other as REM driven clones, which they could not do in their original bodies such as sex, fighting each other to the death, jumping off cliffs as their REM driven clones, and just about anything you can think of when one has the ability of pseudo-immortality as a sleep driven clone version of themselves hidden from the guise of the world and general public.

Well they soon got bored of each other very quickly, and started to make REM driven duplicate clones of movie stars, musicians, celebrities and public figures from all walks of life to hang with as REM driven clones and now they all get together for a disgusting time as REM driven clones when they go to sleep. Most of the G20 political leaders meet at the cloning centre as REM driven clones when they go to sleep to discuss worldly matters and watch gruesome things done to innocent and unsuspecting civilians, who are also REM sleep driven clones at the cloning centre, but civilians have their memories suppressed. This is what the films *Hostel* (2006); *Hostel: Part II* (2007); and *Hostel: Part III* (2011) (Illuminati made films) -are about: -rich people paying to torture and kill innocent people at a secluded location for sport; just that at the cloning centre, the Illuminati members torture and kill REM driven clones of innocent people.

Therefore, depending on what was done to your REM driven clone, you could wake up the next day with a very intense headache in your **original body**, if your REM clone was repeatedly punched in the head; an upset stomach in your **original body** if your internal organs were tortured; achy limbs; and worst of all, feel sick all over; although the previous evening you went to sleep feeling healthy. Remember consciousness is linked (Ehrsson 2013), therefore whatever happens to your REM driven clone will affect you in your original body. Even when they suppress your memory; the previous night's experiences still affects you in your original body. You wake up with the knowledge that you did not dream the previous evening when you went to sleep, and with certain illnesses depending on what was done to your REM driven clone.

Help Donald Marshall STOP REM Driven Cloning NOW!

Everything I discuss in this disclosure is firsthand witness accounts. I have seen and experienced horror spectacles done to innocent civilians and to me. For the sake of humanity and the innocent children brought to the cloning centres all over the world; I must tell the whole world about this and the good people of this world **MUST HELP ME TO BRING THIS TO A STOP.** My sense of duty, moral correctness, and conscience cannot allow me to stay silent about this evil. REM sleep driven cloning, and the torture of innocent civilians as REM driven clones; having REM driven clone sex with beautiful, innocent unsuspecting civilians of the world; the paedophilia of children through the process of REM driven cloning; REM driven sex slavery; the plagiarism of talented individuals through the process of REM driven cloning; and REM driven idea slavery, whereby talented individuals must produce new ideas and concepts daily (or whenever they sleep) or be stabbed or tortured in their sleep as REM clones –is the most vicious and pernicious form of tyranny ever to occur against humanity and **IT MUST BE STOPPED NOW!**

Do Not Panic, Riot, or Cause Chaos. This is Very Important.

Now I must preface this carefully, because members of the Illuminati have told me that I have to put this in an eloquent fashion, in a way which does not make people panic because people finding out about REM driven cloning, and the extent of the evil it has been used for, and continues to be used for; it could cause loss of social order, riots and anarchy in the streets. Moreover, I too **DO NOT** want riots and anarchy in the streets, despite the fact that I am vehemently angry considering the extent to which they plagiarised my talents over the years. If you are a good person reading this, and you want to help and you want social order restored for the benefit of mankind, promise yourself; me; all the innocent children they have affected through REM driven cloning, and the children of the future that you will **NOT** riot, and destroy a world for children who are going to inherit the world. **This is very important**. Remember the Illuminati have highly advanced technologies (kept hidden and secret), including weaponry, and they are just waiting for any excuse to use it on the populace. In all revolutions, the populace always win, and I want this disclosure and the end of REM driven sleep cloning to go smoothly. I want the good people of the world to keep spreading this information, keep spreading this disclosure all over social media, tell your close friends, your family, and as many people on social media platforms as you can. The internet, and radio shows with small audiences are the only forms of communication the Illuminati do not control. They own all forms of television networks, even including the Aboriginal People's Television Network (APTN), and therefore a message as important as this will never reach the average man or woman through television because it does not serve their agenda.

Spread this Disclosure Document until it reaches the Armed Forces

I want this message to reach the armed forces, because currently people in the armed forces are following orders, yet they do not know how corrupt their governments and people in high profile places are. They are unknowingly defending these corrupt people. People in the armed forces will **NOT** defend these corrupt people nor will they harm civilians when they realise that these corrupt people have been growing duplicate clone bodies of civilians, transferring civilians consciousness to their duplicate clone versions when the victim reaches REM sleep, and torturing civilians in their sleep; having sex with under-aged REM driven cloned children; having sex with innocent and unsuspecting adults as REM driven sleep clones, against their will; torturing REM driven clones for sport; and for money-making ideas to benefit their own pockets while they make innocent civilians sick and have side effects in their original bodies from REM sleep driven cloning technology. No. The armed forces will not accept that. Therefore keep spreading and sharing this information for everyone to see so

that it reaches personnel in the armed forces **ASAP!** I want the armed forces to overthrow these corrupt people. The Illuminati think they are very sly and untouchable because together they hold most of the wealth in the world. We must show them that they are not untouchable. Please do all you can, to share and spread this message. It is the most important message to ever reach the internet because it affects all our liberties.

I must also address the readers who may feel afraid in spreading my message because they may want to do the right thing, but they are terrified the Illuminati may degrade or end their lives. As unbelievable as the next thing I am going to share sounds, it is a belief system which shapes the reality of the Illuminati and therefore they themselves are afraid to do anything which may degrade their lives or 'eternal soul'.

They believe that they are the 'fornicators' mentioned in The Bible, and if they were to degrade or harm the lives of anyone aiding me, they would suffer the wrath of God when they die. Notice I said **when they die**, but so long as they are still alive they can do all the evil they like, with little consequence, as they do in their REM driven clone versions at the cloning centre; worshipping Lucifer and doing all sorts of ungodly things. They even say God does not exist, only science and technology; yet they are afraid of dying. Very afraid of dying; because they believe they'll meet God's judgement. I'm just relaying what they have told me. They are weird like that. They also follow Hopi Indian Prophecy, Mayan Prophecy and Nostradamus Prophecy. They mix and match those three prophecies and come up with their own religion of what may or may not happen in the future.

Donald Marshall is NOT "The New Age Saviour". Nobody wants to be a 'saviour'

Furthermore, **THEY** believe I am a new age saviour for the end times; that I was going to save the world from something, according to the Nostradamus prophecy (quatrains); the Illuminati consider Nostradamus the greatest prophet ever to walk the earth. They are in awe of him.

I **DO NOT** endorse their claims. I just want REM driven cloning to stop and these people face punishments for their crimes against humanity. I really do not endorse such claims, but if it saves my life and yours, so be it. In reality and practicality, nobody wants to be 'the saviour'; not with such tyranny and pernicious evil such as this. We'd rather all just be living normal lives without the knowledge and practice of REM driven sleep cloning which is used for torture, clone death spectacles and sex with children. My friends on Facebook do not want to be heroes or 'saviours' either; nobody really does, but we do it out of a sense of duty, moral correctness and our conscience would never rest knowing the true extent of evil in this world, and doing nothing to end it. So all that saviour and Nostradamus prophecy talk, it is just the Illuminati; they like to quote prophecies, and make them come true to make themselves feel special.

Like I said, they are weird. I'm just relaying what they say, and I **do not** endorse the new age saviour claims. I'm just a normal guy, who was unfortunate to be cloned when he had his foreskin removed at age 4. This could have happened to anyone. Thankfully I had a very active imagination at the age of 5 and with the use of the technologies such as Mind-voice technology (that is what the Illuminati call it) it allowed me to make songs to keep the perverts off me. Mind-voice technology is just a technology which can tune into the inner voice in your head (See articles by Prigg (2014) and New Scientist (2014) –which discuss how scientist can listen to your inner voice; –it is similar to how Mind-voice technology

works). Therefore, when you hear the sound of a guitar; the sound of drums; or any instrument for that matter; after hearing the sound, when you imagine the sound you heard, your REM driven clone can replicate this sound with Mind-voice technology **exactly**; and I used Mind-voice technology to make many, many songs over the years. As I've said, and I'll say it again: technology today is very advanced.

How the Nostradamus Prophecies shapes the lives of the Illuminati

Also another reason they have not killed me is because the Illuminati said "If they do, everyone is going to know I am telling the truth", -which I am with my right hand to God and I cannot lie about this stuff; the things I have seen are too sinister and diabolical. It would make me as bad as them if I did. Furthermore, because they follow the Nostradamus prophecies religiously, they have told me that they believe anyone helping me is considered part of "The Army of Light" and again, to hurt or degrade anyone helping me, considered part of The Army of Light would incur the wrath of God; and that to hurt anyone considered part of The Army of Light will degrade their lives; they will suffer misfortune and entire ruin as will their eternal soul. These are just some of the interpretations of the Nostradamus quatrains they have relayed to me. These people are beyond crazy, zealot and religious fanatics. Nevertheless, the main point to remember by all this is that **you are safe**, and **they cannot hurt you**, **they are scared to hurt you**, as well as kill me because prophecies have shaped their lives and the lives of their ancestors for hundreds of years.

Furthermore, and practically, I have told too many people that this is the extent, to which technology has developed in our current day, and it is kept secret and hidden from the public for nefarious purposes and this is what the Illuminati do: REM sleep driven cloning. I have been spreading this information **since 2011** and not one of these high profile people, government officials or celebrity figures has issued a (public) statement against me or taken me to court over libel charges because I'm telling the truth; and their statements would not hold in court.

I have also told over a million Arabs; I have appeared on radio interviews with Vinny Eastwood (Vincent Eastwood 2013); Jeanice Barcelo (Jeanice Barcelo 2013); and Lisa Phillips on the Cry Freedom Radio show (Astral 7ight 2013a – 2013h). I have reached audiences as many as 280,000 views on the Vinny Eastwood Show (Vincent Eastwood 2013) alone. However, I must stress that YouTube reduces the view count of my interviews every so often in order to suppress the truth so that my interviews do not get featured on their platform. Nevertheless, there is safety in numbers and rest assured there are new people waking up to the disclosure of REM driven sleep cloning every day; and therefore you can share and spread this information **without any worry** about facing reprisals from the Illuminati, even if you do not believe that it is in fact their beliefs in Nostradamus prophecies which is saving you and I from the Illuminati.

HIV/AIDS has been cured; so have many forms of cancer

Now is also a good time to share with the reader that this situation is not all 'doom and gloom.' In their quest to perfect technologies, science and medicine, the Illuminati discovered the cure for HIV/AIDS; cancer (except pancreatic cancer); Alzheimer's; Dementia and many more debilitating diseases which humanity suffers with. They relayed the fact that they found the cure for HIV/AIDS by stimulating the cells in an oxygenated rich environment because diseases/viruses cannot thrive in an oxygenated rich environment (in layman's terms). Magic Johnson was cured from AIDS this way and they use him as a spokesperson to sell the retrovirus pills which they know is not as effective. However, the greed these people have,

knows no bounds, and because they receive too many donations for HIV/AIDS as well as cancer donations they do not announce they have cured HIV/AIDS or cancer publicly. As I've told you, and will continue to tell you: technology is far, far, FAR advanced than what you currently see around you. With the help of the good people of earth I promise to release these technologies for the benefit of mankind, and all reading this disclosure can hold me to this. You **must** hold me to this. It is time we ended corrupt governments and corrupt individuals in high positions of power in this world. Hold me to this.

I hope you are now beginning to understand why this is a **world emergency** and why these corrupt people must be ousted and overthrown. I also hope you understand why you must not riot or cause chaos because as I said at the beginning of this disclosure "I write this to empower good people of the world against the tyranny which exists all around us in our world today"; I **did NOT** write this to cause chaos, public dissension or anarchy. Good people of the world will inherit the earth once these corrupt people are overthrown. Therefore, under no circumstance must you destroy the world when you are going to inherit it. No matter how angry this disclosure makes you; no matter how angry the diabolical people who commit these crimes against humanity make you feel. Let's make sure this goes smoothly. Keep spreading and sharing this information, until this disclosure reaches the armed forces; until the armed forces bring these corrupt people to their knees. We are about to inherit the earth; by all means let's ensure everything goes smoothly. Now that you understand how important this disclosure is and that the overthrow of these corrupt individuals must progress smoothly, I'll continue.

The Behaviour of High Profile People at the Cloning Centre

The high profile individuals who attend these REM driven clone gatherings in their sleep have nothing better to do than to show off in disgusting ways. They have no shame and it seems nothing embarrasses them. Some REM sleep driven, cloning centre attendees, sit in the stands of an unused arena, smaller than a hockey rink, but it still has the capacity to seat between approximately 300 to 400 people. There is dirt in the centre of the rink where ice would be. They have frightened REM driven clones of children walk into the middle of the dirt rink to be victimised for a bizarre and disgusting spectacle. Sometimes, they have animals like dogs have sex with the REM driven clone children, while a man holds the dogs on leash so that it wouldn't bite the child on the back of the neck; which I have seen happen before. They all try to outdo each other in their levels of depravity; to be evil is to be "cool" to them.

The Ring Leaders of the Cloning Centre

I will now discuss the ring leaders, but before I name names, please understand that I am not someone who has collated stories and evidence together over the internet. I REALLY **do not** need to do this. Every time I enter REM sleep, the ring leaders at the cloning centre transfer my consciousness to a duplicate clone version of me. I have seen and talked with these monsters over the course of 34 years as REM driven clones at the cloning centre. However, I do understand that for the average reader, without understanding how far medicine, science and technology has advanced; without seeing or hearing people, other than me, discuss the crimes the ring leaders of the cloning centres commit, it is very difficult to imagine that this is what these high profile people are involved with, and do. Nevertheless, I guarantee it; this is the true extent and prevalence of evil in our world.

Their public personas, and public images is well managed by their PR teams, and therefore for the average person it is difficult to imagine these people in any other way but "positive"; but these people behind closed doors are the most evil, sick and twisted people I have ever had the misfortune of encountering. It is also difficult to take in what I am saying because I am not a public figure, nor do I have the "influence" or public image these people have; the general populace have never met, or heard of me, or known who I am; if this was the case my eye witness testimony alone will be enough; however, I do understand that we are dealing with highly advanced technologies, thousands of years advanced compared to what the general public is accustomed to, and because of this I provide references for the reader; I provide references for the reader to have something to corroborate what I am disclosing; and I provide references for the reader to see past the illusions these people have created.

Moreover, as "Consciousness Science Kept Hidden" demonstrates (YesEthan 2013):
remember that it is the heart and not the brain which is the most powerful centre in the body, the heart is the most intelligent; it has the ability to receive precognition and intuition about a future event, **before it actually occurs**, therefore if you find that your heart is in resonance with the names mentioned; do not fight it with the ego of the mind; when our egos get in the way it overrides our heart's intuition; your heart is capable of discerning the truth of an event before your brain becomes conscious of it; by all means listen to your heart, and allow your brain to naturally develop its intuition. It will be the coherence between your heart first, and then your mind centre which will allow you to access your intuition.

The references I provide for the reader to corroborate what I am about to say includes: "Appeal from Survivors of Canadian Genocide" (inifiniLor 2013); Tila Tequila –"Missing Children and Cloning Centres" (Astral 7ight 2013i); "Royal Babylon by Heathcote Williams" (MrCowshedder 2012); and "THIS MOVIE WILL BLOW YOUR F%SNG MIND" (KafkaWinstonWorld 2014).

Watch all the above videos and you will easily see all that I disclose. In Appeal from Survivors of Canadian Genocide interview (inifiniLor 2013): Listen to the indigenous people Stee-mas and Wahtsek speak about the pain and torment they have suffered under the Crown, the Vatican, the government, and churches of Canada. 50,000 to 150,000 indigenous children have gone missing because of the involvement of the Crown, the Vatican, the government, and the churches of Canada; and all these factions involved know this!

Tila Tequila is a television personality who has attended the cloning centres as a REM driven clone since childhood. In Tila Tequila's radio phone in (Astral 7ight 2013i), the audio is not very clear for the majority of her disclosure; she was also frightened and therefore she sounds most animated; however her words are clear at the following points of the audio (I also provide a transcript in the appendices section: "Appendix A"):

4.00 min: Cloning Centres and they take your children...
4.25 min: –There are these CLONING CENTRES –I'm not even talking about child molestation here...
5.40 min –They take your children –they not only molest them; men f*** them; and make them shoot each other...
7.59 min- There is a point where you cannot just turn the other way, you know this stuff is going on and you go 'oh well, you know... that's their problem; let's just turn the other cheek. How long are you going to turn the other cheek until it happens to your own freaking children?

10.34 min - Do you know why they love children? Because they are innocent souls; they are innocent... they are the most innocent, pure beings in this planet. They are not harmed by anything. They are new to the world; bright-eyed, pure innocent children. That is why these disgusting paedophile... and these clone rings, cloning centres, satanic rituals, Brownsville Texas... there are many of the of the cloning centres where they take your children that go missing.

Royal Babylon by Heathcote Williams (MrCowshedder 2012) addresses the fact that for Brits, despite their inordinate pride about their tradition, it is often revealed they know little about it than anyone. The documentary then goes on to address the fact that Prince Phillip the Duke of Edinburgh, has a lust for blood-sports which includes shooting endangered wildlife and mammals which he considers 'culling'. The documentary is also notable for demonstrating to the viewer that Queen Elizabeth II redistributed as much as 2.1 million for her private income from 276 people from Merseyside and Lancashire. These people had no will, so their property was grabbed. The same is true for the Duchy of Cornwall. If you die without making a will, everything you possess will go to Prince Charles. Furthermore, Queen Elizabeth II is the largest land owner on earth. Queen Elizabeth II: head of state of the United Kingdom, and 31 other states and territories is the legal owner of about 6600 million acres of land; one six of the earth's non ocean surface. She is the only person on earth who owns whole countries, and who owns countries that are not her own domestic territory. This land ownership is separate from her role as head of state; is different from other monarchies where no such claim is made –Norway, Belgium, Denmark etc. The value of her land holding is £17,600,000,000,000 (17.6 trillion Pounds) (approximately)).

In "THIS MOVIE WILL BLOW YOUR F%SNG MIND" (KafkaWinstonWorld 2014), readers with a deeper knowledge of the Illuminati and the agenda of the Illuminati will easily spot the minor inaccuracies in the documentary. However, the documentary provides a good reference and foundation for anyone new to the topic of the Illuminati and their agendas for the world. The documentary demonstrates how the world is currently a deception within a deception coated in reverse psychology. It gives widespread insight into the Royal family of England, and their lineage.

Furthermore, the documentary provides information that the world's most popular religions have been infiltrated with Illuminati dogma, in secret. The documentary details how (some) modern Christians, Jews, and Muslims do not (yet) recognise their common enemy because that enemy is invisible (until now). The enemy hides within their own religions. The enemy also hides within the activist community (anti-Illuminati movements), it finances big budget documentaries and movements. The end game is to sell a divisive (creating strong disagreement), anti-capitalistic, atheistic message and deliver trusting followers right into the lap of a communist (one government) New World Order. The enemy is the Illuminati.

The documentary also details that: "Today, the bloodlines of this unholy alliance are on the final stages of establishing one world religion, one world government, and one world ruler [--that is **IF**, the good people of this world do nothing to stop them]. The Windsor Royals are at the control of this web of deceit. It is a known fact that Adam Weishaupt (the founder of the Illuminati) took refuge and got assistance from the German Saxe-Coburg Gotha Royal family. The Saxe-Coburg Gotha's changed their German name to Windsor (in 1917). The Windsor's public image is a façade, to hide the cesspool from which they operate behind the scenes; their power and control cascades out of Buckingham Palace to the elite bloodlines who run world affairs."

For anyone who thinks they know they Royal family of England, did you know that still to this day: they have a person appointed called "Groom of the Stool"? What is a "Groom of the stool", you may ask? A Groom of the stool is responsible for stools. The kind you sit on and the kind you expel. In other words a Groom of the stool wipes Royal bottoms. The above has been confirmed to me by Prince Charles of Wales himself as REM driven clones at the cloning centre, and I quote: "It gives you the feeling of being completely taken care of" when I asked Prince Charles (as a REM driven clone) why they still have that. But don't just take my word for this; research "Groom of the stool".

The Royal Family of England

As most of readers have already guessed; and as unbelievable as it may currently sound to some readers, the ring leaders of these cloning centres includes the royal family of England. As I've said REM driven cloning started as far back as 1945, and it was just a political thing, but Queen Elizabeth II has been involved with REM driven cloning since its inception! Yes! Queen Elizabeth II; Phillip, Duke of Edinburgh and Prince Charles of Wales are the worst of them. They are unbelievable depraved perverts all showing off to the celebrities who attend these REM driven clone gatherings. Elizabeth has the REM sleep driven cloned children at the cloning centre call her "Lilli-bet" and Elizabeth as a REM driven clone herself does ungodly things to these REM driven cloned children. Some she fakes being nice to; some she is terrible to; and as a REM sleep driven clone Elizabeth cuts these REM driven clone children with swords while they scream. The decent people at these cloning centres who have had their consciousness transferred into their duplicate REM driven clones, and are there against their will, like I am; they are terrified to say anything against Elizabeth and her cronies. Most of these decent people also have their children's consciousness transferred into their REM driven duplicate clones, and Elizabeth and her cronies hold these decent peoples' children as hostage; to be torn apart; clone death after clone death if they have the slightest inkling of informing anyone, but as Elizabeth and her cohort have been torturing me as REM driven sleep clones anyway, I will disclose all that they do.

Vladimir Putin is also there, as an REM driven clone, and he loves to put the fear of torture and death into people, but he is essentially a perverted coward himself. Most of the famous people who attended the cloning centre as REM driven clones are ashamed to speak or be seen by me there very much; because they are ashamed of the perverse and disgusting gatherings. I am a decent person, even when my consciousness is transferred to my REM duplicate clone alternative, and I will not participate in these depraved acts; so they use me as an example and torture me for being a good person. They have drugged my REM driven clone, and as I've mentioned because consciousness transfer is real (Ehrsson 2013) and because consciousness is linked, therefore everything feels "real as real"; when I'm drugged as a REM driven clone, I behave exactly as any person would on hard drugs (although I have never taken any drugs in my original body); my vision is blurry and my balance affected; they have used this as method of having me do disgusting things in a blurred state, videotaping these dirty acts and editing a highlight reel which also depicts me doing disgusting things to show to the world when the world learns of their depraved natures and their public personas are shattered so that I can be despised as much as they will be when the entire world learns about this. Furthermore, because of the microchip inserted in my REM driven clone; they mind controlled me like a "Manchurian Candidate" (*The Manchurian Candidate* 2004) using MK Ultra technology, which is far more advanced than the declassified MK Ultra techniques (MK Ultra Compendium 1980) mentioned online today which references MK Ultra techniques in the 1970s. See Rense (2001) for a detailed explanation of how implanted microchips work, and how these chips allow the programmer

control victims. C.S.I.S Canadian intelligence are all involved; they have REM driven clones too; including a lot of Commissionaires and Canadian Prime Minister Steven Harper himself; They do what Elizabeth says, and seem to follow her every whim without question. It doesn't matter who you are; if you have a cute child, or a talented child with imagination, creativity and moneymaking potential (such as business smarts; song making ability; literary / oratory ability etc. –you name it so long as your child has moneymaking value to them) they will send for the blood record of your child; agitate the blood cells over and over until a duplicate clone of your child is grown; they will then transfer your child's duplicate clone body from the tank they were grown onto a steel rack; the steel racks contain 5 rows and each row holds a duplicate cloned body; once your child goes to sleep in his or her original body and once they enter REM sleep (90 minutes to 110 minutes after they first fall asleep) the Illuminati are alerted to this fact by a green light above your child's duplicate clone at the cloning centre and they then transfer your child's consciousness to the REM driven duplicate clone; this is the point where the prime evils molest your children; and so your children are being molested in their sleep as REM driven clones and then they suppress the child's memory or implant false memories (see Kim (2013) and Alford (2015) –on how false memories can be implanted) so your children wake up not remembering dreams from the previous night, or if they do remember anything, the memory is false. These depraved acts very much stunt children's development; it causes them to have learning disabilities; unexplained depression; loneliness; suicidal thoughts, and all kinds of side effects.

The cloning centre is a paedophiles paradise and **it must be stopped**! Elizabeth secretly owes a few music companies too (Universal and others) with bands under contract; she forces me under a knife to compose music for them; if I can't she will stab my REM driven clone; burn my REM driven clone and have her pervert thugs smash my REM driven clone body there. As Ehrsson (2013) demonstrated, because consciousness is linked; and consciousness transfer leads the person who has had their consciousness transferred to still perceive reality as "real as real" in the new body; I have the same biological and physiological responses as I would have if these attacks were occurring to my original body. This has caused me to have heart damage and severe debilitating headaches. Because my memories were released to me; I can now also remember all my past REM driven clone memories since age 5; as well as the previous night's REM driven cloned memories (when I have my consciousness transferred to the cloning centre) which causes severe stress to my mental psyche and mental well being.

As unbelievable as the above statement sounds regarding Elizabeth's ownership of music companies, just go and listen to the song "Abadon" performed by Boondox (RainmanJhof 2011) on YouTube. There are two "Abadon" versions; the version you seek can be found in the Reference section uploaded by RainmanJhof (2011); skip to 2:46 min (or listen to the whole song; pay particular attention at 2:46 min) and you will hear loud and clearly, Elizabeth say "Drop the mother f****ing base". That is Elizabeth's voice; you can compare it to any of her Christmas speeches. That is her. Elizabeth said the above as a REM driven clone at the cloning centre. I know. I was there. They got so confident, that nobody would ever find out about their REM driven cloning shenanigans, that they even had me sing on a song I produced: "Where'd You Go" –Fort Minor (Murdok Dubstep Remix) (MurdokDubstep 2010), available on YouTube. Tila Tequila and I sing on this remixed track as REM driven clones (MurdokDubstep 2010); I start to sing from 1:44 min onwards. You can compare the voice you hear in the song with the Vinny Eastwood interview (Vincent Eastwood 2013). That is me, in both cases, and that song was recorded at the cloning centre.

One good person at the cloning centre; Bernie Mac (also as an REM clone version of himself); who was an actor and comedian, tried to stand up for me and speak up for me saying 'Cloning and torturing people here, it's not right to do to a human being...' and "This place is the devil"'... Bernie Mac also tried to have others join him in speaking out against the REM driven clone torture zone while he was having his consciousness transferred to his REM clone driven version. Elizabeth and Philip tortured him for 4 to 5 hours continuously at the cloning centre as an example of their 'power', Bernie Mac had an aneurysm (brain bleed) the next day and died. This is one of the aspects about REM driven clone torture: if you torture a REM driven clone continuously for hours on end, you will cause the person to die in their original body from a heart attack or aneurysm (while they sleep); even if they do manage to wake up the next day; because of the constant pain their consciousness has recorded; and because consciousness is linked they will wake up only to have a heart attack or aneurysm in their original bodies the following day. If you apply a constantly electrical current to a REM driven clone, that person will either have a heart attack or die from aneurysm in their original bodies while they sleep.

This form of murder is similar to the CIA's heart attack gun (Non Mirage Truth Vision 2015); which was declassified in the 1970s and was a weapon used for causing heart attacks in victims, undetectable as the cause of heart attack under autopsy. The difference with REM driven clone death as a form of weaponry is that hardly anyone has heard of death by REM driven clone torture. Moreover, the perpetrator can be thousands of miles away from the victim; the culprit just needs a duplicate REM driven clone of the victim to torture or apply a constant electrical current to; this is exactly what is going on in our world every day. When Elizabeth and Philip don't like someone and they want to get rid of that person, they clone that person; torture his or her REM driven clone till that person has a heart attack or aneurysm in their original body and dies.

This is what Elizabeth and Duke Phillip did to the indigenous people in Canada. The video reference (inifiniLor 2013) provided above, regarding the genocide of the indigenous people of Canada discusses this very topic (inifiniLor 2013). As Elizabeth and Duke Phillip visited Canada as clones, when they killed the native children; they both had solid alibis of being in England at the time. They then cloned all the witnesses of the Canadian missing children's case and had them remotely killed by applying constant electric currents to their REM driven clones; one by one and each witness either died of a heart attack or aneurysm. They just dispatched the last witness by also applying a constant electric current to the persons REM driven clone because the missing children's case was building momentum.

After Bernie Mac's death everyone is afraid to speak up; they all became afraid of suffering the same fate. All it will take is a few lie detector tests from an independent source; and I will volunteer for them; they cover up for themselves so carefully that lie detector tests from an independent source unconnected to them in anyway will be the only viable method. I know many know non-famous people who have also attended these clone centre gatherings as their REM driven clone duplicate versions and also remember the clone gathering experiences in their original bodies (because they were not memory suppressed) that could be given lie detector tests to prove this. When it comes to the sexual exploitation of a child, lie detectors are admissible in Canadian courts. I need decent people with integrity to speak about this filthy business; to testify about who is involved. There is much to tell about the Illuminati and I am a wealth of information about this topic.

Elizabeth also had Princess Dianna Spencer killed by having someone shine the brightest light known to mankind through the window side on her car; they served away to avoid the light and hit the divider; it was no paparazzi. I first wrote about this in my original disclosure in **2011**; this was corroborated by an article 2 years **AFTER** I had made my original disclosure. See Radar Online (2013) for the corroborating article. Furthermore, "Candle in the wind" performed by Elton John (SadSongs4You 2010) was not Dianna's 'death song'; it was "Bigger than us" performed by "White Lies" (WhiteLiesVevo 2010). The Illuminati released this song, deliberately, 13 years after Dianna's death, again as a show of their 'power'. I did not want to compose this song but Elizabeth and her thugs threatened to stab and burn my REM driven clone repeatedly if I did not. Listen to the lyrics. I'll provide some of the lyrics here for those of you who are feeling too shocked by these revelations:

<u>White Lies Lyrics "Bigger than us"</u>

You took the tunnel route home.
You've never taken that way with me before.
Did you feel a need for change?
Apologies on your fingernails,
Love flickered in the city of lights
Like internet and radio waves.

I don't need your tears
I don't want your love
I've just got to get home

And I feel like I'm breaking up
But I wanted to stay.
Headlights on the hillside
Don't take me this way.
I don't want you to hold me
I want you to pray,
'cause it's bigger than us.

Are you beginning to see why these people must be stopped and stopped immediately? Are you beginning to see why it is no longer okay to 'turn a blind eye' or 'bury your head in the sand', and hope it all goes away? Can you see why I need the good people of this world to keep sharing this disclosure (online); to tell your friends and family until this information reaches the armed forces so that the armed forces can bring these people to their knees. I also do not want innocent civilians to get hurt despite the monstrosities these people cause to humanity on a daily basis. I want the overthrow to progress smoothly so that the good people of the earth can inherit the world, with all technologies and medical advancements which benefit mankind, made available to all. This is why I maintain my composure and resolve, in spite of the evil I see on a daily basis, and you the reader must also maintain your composure and resolve in spite of the evil which I am disclosing, so that we do not inherit a torn down world after we have completely overthrown these malevolent, sinister and corrupt hypocrites!

Furthermore, Diana survived the car crash; and while, either on her way to hospital or in hospital, Dianna was injected with a high concentration of salt, which is near undetectable in an autopsy and she died. Elizabeth did this because Diana was going to marry an Arab named Dodi Fayed. The Illuminati hate Arabs because for the most part, Arabs have not broken their relationship with God. Dianna hated her association with these people; Dianna knew about REM driven, sleep cloning and wanted nothing to do with it; but she was afraid of being killed and so said nothing. I know a lot about this and many more deplorable things the Illuminati have done over the course of 34 years and I will be more than happy to reveal all the evil they have done; as well as all the wonderful discoveries and progresses they have made in medicine, science and technology, which they have withheld from the general public. I am very happy to disclose all, because I known once the world learns of all they have done, we truly will begin to see the end of such evil on this planet. Just make sure you keep spreading this disclosure and it reaches the armed forces soon. Soon, soon, soon!

Help Donald Marshall by Sharing this Disclosure with Your Close Friends and Family

If you are reading this, then you have to help me. I know some of you may be reading this thinking, but I am just an ordinary man or woman Donald, I know you are telling the truth; I can feel it in my heart and my head that what you say is true and that you are telling the truth (which I promise you, with my right hand to God I am) but I'm just an ordinary man / woman Donald; I don't have any power; I don't have any influence; or because of the position I am currently in I can't speak out against these people; and I am just an ordinary man / woman I cannot be expected to take on the world's problems. You are right if you are thinking and feeling this, and I do not expect or want you to take on the world's problems. All I want you to do is share this information with close friends and family initially, because when you do that, at least that is one more person who will know about the true extent of evil in this world. When your close friend or family member also shares my disclosure with another close friend, the disclosure will eventually spread exponentially. It will also be one more person who has your well being in their thoughts because I understand how scary it is to know this. Therefore remember **there is safety in numbers;** and the more people you tell in your social circle, the more you can all look out for each other. So feel free to share my disclosure with close friends and family. Do not talk about my disclosure in public (for now) if it makes you feel uncomfortable. Moreover, if you want to reach more people (other than your initial social circle) the best way, is to do it online: through social media, such as Facebook, Twitter, and YouTube etc. As I've already mentioned, the Illuminati controls all forms of media except the internet.

The Illuminati, being so 'confident' at the time with the evil they wield onto the world, put my face on a Megadeth album cover titled *The World Needs a Hero* (2001) (to mock me) when I was 23. I posed for this album cover at the cloning centre when I was 23, and the album was released with a picture of my face, as a REM driven clone, 3 years later when I was 26. They did this because they were extremely confident that nothing would ever be proven. Google image it, although I am 39 now, you can still tell that it is me. The image shows what I end up looking like after an REM driven clone gathering with a skeleton popping out from my chest. I understand most of you are going to continue reading because although it is "liberating", it is also "paralysing" at the same time (Laurence Mountford) to realise what the truth of the world is, so I will display two images below, but promise yourself, that you will Google search this image in your spare time.

Image 3: Megadeth Album Cover: *The World Needs a Hero* (2001)

Image 4: My original body: top left (age 37) and bottom right (age 37); compared to my 23 year old REM driven duplicate clone body (top right and bottom left) at the cloning centre.

You can clearly see from the images that, it is in fact me. In Image 4, you can also compare what my real body (top left and bottom right) looks like compared to my duplicate clone body. Duplicate clones do not come out of the tank looking 100% like the original; it's 99% - there are always some slight variations as some have commented that the eyebrows and nose in the picture, bottom right, is not the same (as the duplicate clone on the album cover). However, to people who make such comments, I say: my eyebrows and nose is the same when you compare it to the pictures of my original body (top left and bottom right). Also, remember that the image on the album cover is a duplicate REM driven clone of me. REM duplicate clones do not come out of the tank looking 100% like the original. There are always slight variations; but the wrinkles on my 37 year old forehead (when I took the picture in my original body; top left and bottom right) is similar to my 23 year old wrinkles, the lips are the same; and the face which you see, is definitely, the same! Yes. REM duplicate cloning is real; going to sleep and waking up as a cloned version of version of you is real and **we must put a stop to it now!**

The Deplorable Nature of the Illuminati

My own family has been turned against me one by one. The Illuminati have told my family members when they were REM driven clones at the cloning centre, things such as I secretly hit or molested their children; poisoned their pets when the pets died of sickness and other such things to make my own family hate me and not want to help me. Even when my family side with me there at the cloning centre, as REM driven clones of themselves; and my family members say 'They do not believe that Donny did all those horrid things' -which they have been told; Elizabeth then says "Are you cooling me a liyah?!" in her disgusting croaking voice made as low as low and evil sounding as she can make it, complete with psychotic and malevolent glare; and as terrified REM driven clones my family say "No, no, of course [what you are saying] it's true", stuttering and afraid as REM clones. My mother Catherine McMahon sold me into this REM driven sex and torture cloning slavery when she remarried a man named Gordon Cohoon; Gordon's whole family is in this scummy secret society, his brothers Tom and Tony Cohoon; his sisters Darlene and Bernadette Cohoon; they fear the new and improved lie detector tests; and all it would take, is for an independent source, far, far removed from any association with the Illuminati to administer these lie detector tests on me **AND** the above named people to prove this unequivocally.

Half way through the making of my original disclosure document (in **2011**), when I went to sleep that evening, the Illuminati transferred my consciousness to my REM driven clone and introduced me to a man (who was also a REM driven clone) named TROY LANDRY. He is an alligator trapper from Louisiana on the TV program named "Swamp People". Troy Landry said "If I send my [original] disclosure out to the public then he would take a power drill to my shin bone at the cloning centre and suck the marrow from my [REM driven clone's] bones." It is similar to spinal tap, and one of the WORST things you can do to a REM driven clone besides burning a REM driven clone. I told Troy that I will be sending out my disclosure to the public, because I have to escape the cloning centre, and so, Troy Landry did just that. It was excruciatingly painful; all the REM driven clones that were sat in the stands of the arena just watched; slack-jawed. Troy Landry is an insatiable child molester and an extra retarded REM driven clone. A side effect of REM driven cloning is that as a REM driven clone version of yourself, your emotions are heightened and you are less smart as you are when you are experiencing the world in your original body. Nevertheless, Troy Landry is extra retarded as a REM driven clone.

In Louisiana, when Troy sees a young boy that he likes, Troy asks of the boy's name and tells the boy "He is an alligator hunter"; Troy then proceeds to shake the boy's hand; Troy then has his paedophile friends at the local cloning centre find the boy's blood records to grow duplicate clones of the boy. Five months later, there are multiple REM driven duplicate clone bodies of the boy grown for Troy Landry to victimise before the crowd of onlookers. All members of the Illuminati do this; it's just a way of life to them; they consider themselves 'the privileged people' in the world power organisation. Almost all the cast on the "Swamp People" television program attended the cloning centre as REM driven duplicate clones of themselves, **when they go to sleep**. After putting a power drill to my shin bone, Troy Landry asked me again, "Will I send my [original] disclosure out?" I said "Yes" to which he replied "I'll do the same to your pelvic bone everyday!" The pain on my pelvic bone was far worse than when Troy put the power drill to my REM driven clone shin bone. I told Troy "I have no choice but to inform the public" – and so Troy put a power drill to my REM driven pelvic bone, everyday... and it is the worst pain ever... you forget your own name; where you are; all you know is pain; and you beg God or anything to save you from it...

Another deplorable thing which the Illuminati did in real life is: The Canadian government were trying to lower the amount of prostitutes on the streets (Elizabeth hates prostitutes) so they had a man named Robert Pickton start killing the women and feeding the women to pigs on his farm. The Illuminati had a camera set up in the upper corner of a room in Pickton's house and recorded Pickton hitting these women over the head with a hammer (a ball-peen hammer). They took the recordings, all 49 of these murders, and they all watch them at the cloning centre. To be seen as 'tough' at the cloning centre is to watch all 49 of the Pickton murders without having it affect your psyche. Elizabeth loves watching the Pickton murders and she says she has a macabre fascination with death. Canadian Prime minster Steven Harper knows all about the conduct of the Pickton murders; he has seen all the recordings and cheers on as the rest of them do. If Mr. Pickton says anything about his involvement with the Illuminati, or the recordings, they will apply a constant electrical current to his REM driven clone until Pickton has a heart attack or aneurysm in his original body.

What Happened to Britney Spears?

The Pickton murders are also the reason Britney Spears 'lost it' and shaved her head bald. She had watched too many Pickton murders as a REM driven clone at the cloning centre and it drove her 'over the edge'. I'll also reference the following songs performed by Britney Spears so that the reader has more corroborating evidence to add to the ever increasing pile. Search for the video "Break the Ice" (BritneySpearsVevo 2009) on YouTube. In the Japanimation video; at the beginning of the video; that is a cloned **cartoon** version of Britney Spears being grown in a big thick thank full of water (1 second to 7 seconds); and at 1:32 min to 1:43 min Britney walks into the cloning centre. This is **EXACTLY** how the cloning tubes are in real life. They are stacked one on top of the other, each filled with salty water. Britney Spears made this video because she said a fantasy of hers is to "Blow up a cloning centre". The Illuminati allowed her to release this video because at the time they figured nobody would ever figure it out. I have provided the images on the next page.

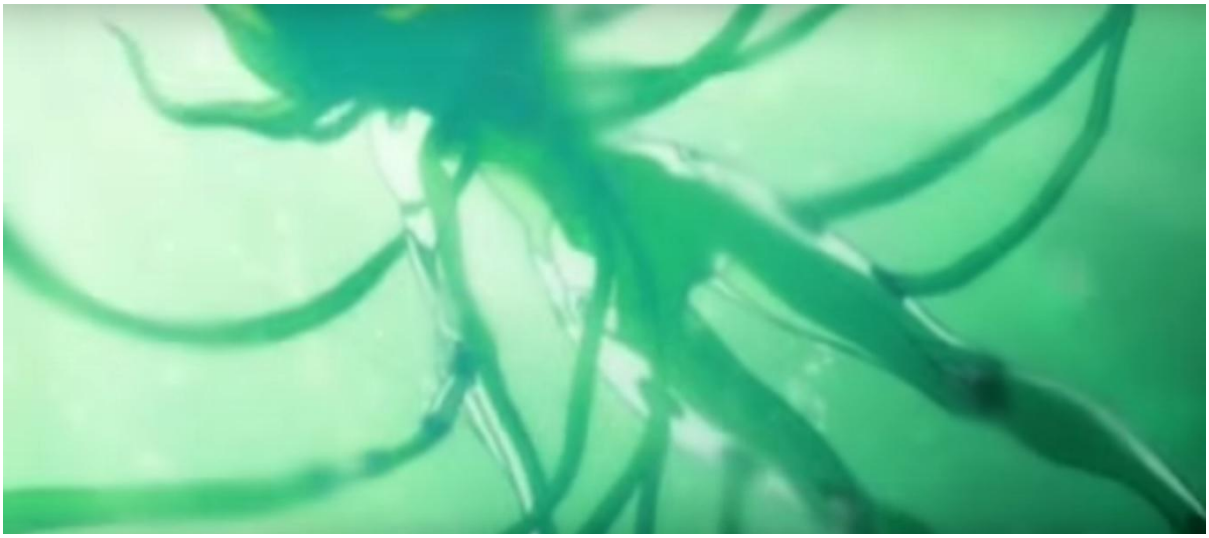

Image 5: Britney Spears is being grown as a duplicate clone in a cloning tube. The depiction is EXACTLY how the duplicate clones are grown in the Cloning Centre... with wires extending from the body; in a big thick tank full of salty water.

Image 6: Britney Spears walks into the cloning centre. The cloning tubes are stacked one on top of another. This is EXACTLY how these cloning tubes are in real life at the Cloning Centre.

Image 7: The Cloning Centre depicted from an aerial view.

In “Hold it Against Me” (BritneySpearsVevo 2011) performed by Britney Spears; Britney is depicted fighting against her clone at 2:46 min till the end of the video. In “Mona Lisa” (SimpleGirl4ewer 2007) later remade by Britney Spears she changed the words in the song from “gone” to “cloned”. I’ll provide the lyrics to chorus here because they have not changed it on A-Z lyrics etc., but listen to the song and you will clearly hear the following:

Britney Spears Lyrics “Mona Lisa”

She’s the original (yeah, yeah)
She’s unforgettable (yeah yeah)
She wants you to know (yeah)
She’s been cloned…
It’s kind of incredible (yeah yeah)
She’s so unpredictable (yeah yeah)
She wants you to know (yeah)
She’s been cloned,
She’s been cloned,
She’s been cloned…

Yes. Britney Spears and many other celebrities want you to know they have been cloned. The celebrities are depending on you, the ordinary man / woman; the populace, as I am depending on you to spread this message fast and far. In fact Elizabeth has said that “If any public person speaks out, they will die!” Therefore, public figures cannot openly discuss this topic to warn the populace –so they hint. It is **NOW** up to the ordinary man and woman to end this. Furthermore, Elizabeth has a nuclear bomb hooked up at the cloning centre which she can press at any time to wreck havoc on the world unsuspectingly. Thankfully, I managed to convince Elizabeth not to do such a silly thing. I hope you can now understand why everyone is terrified of Elizabeth at the cloning centre, and why this is a **world emergency** and we are depending on you to share and spread my disclosure!

NEVER EVER SELL YOUR SOUL

In This Physical World Selling Your Soul Is Selling Your REM Driven Clone

Furthermore I must discuss an entrapment many up and coming ‘stars’ fall into. You have most likely heard many public figures say “I sold my soul to the devil” or some variation of “I sold my soul”. I am now going to address the aspect of “selling souls” or “selling your soul” which I am sure you have heard many of these celebrities talk about. I’ll address this as coherently as I can because the on the surface selling your soul talk is difficult to contemplate especially if you consider the soul to be a metaphysical, ethereal or mystical part separate from your earth body. Moreover, we live in a physical world, so selling a metaphysical aspect of you sounds incomprehensible (at first). For the most part we have little understanding of what the soul is. However, we are told that the soul is a part of us which never dies and it is eternal. It is all that we are, ever were, and ever will be. Now our faiths and beliefs come into question, because if you are an atheist: there is no God, selling your soul is a bunch of crazy nonsense.

From a practical perspective it also seems difficult to fathom, because if you go on what you have been told, you are selling an intangible part of yourself to be used by someone else for whatever they wish; and so if you get into the headspace of viewing your soul as something separate from you or that you are in control of your mind and your body, then again, 'selling an intangible aspect of you' again sounds like nonsense because right now nobody controls you; you are controlling you; so what are you really selling? Thin air?

Many up and coming 'stars' think this way when they are confronted with "selling their soul" aspect. The up and coming 'stars' are blinded by the prospect of being super famous and super rich; and in the moment they are confronted with "selling their soul" they believe these Illuminati people, are a group of over religious zealots and that they, -the up and coming 'stars' are taking advantage of the Illuminati because the 'soon to be 'stars'' do not believe (in that moment) it is possible to sell your soul, and only consider being super rich and super famous; so the 'stars' sign their 'soul' over.

At this point, it is usually too late for the up and coming 'star'; because what they have actually sold, in this physical world, is the use of their REM driven clone to the Illuminati. They have sold their REM driven clone to be used for REM driven sex by perverse old men and women whenever they enter REM sleep.

These celebrities are not memory suppressed either; so whenever they enter REM sleep, their consciousness is transferred to their REM driven clone, to be used for whatever the Illuminati wish: usually sex as REM driven clones with dirty and perverse old men in return for a promotion in the entertainment industry; such as movie role, advertisements, concert gigs etc. It is a very, very, sick business, and once these up and coming 'stars' get into the business they are trapped. Now you can begin to understand why so many celebrities, although on the surface it appears they have it all, are depressed; and do random and crazy things. It is a cry for help. Their illogical behaviours, (not all) for the most part, can be attributed to REM driven cloning. Furthermore, the Illuminati consider 'selling your soul' (the use of your REM clone) **a very serious business.** They do not joke about this; and there are NO RETURNS. Once you have sold the use of your REM driven clone for promotions etc., that's it. If you ever make a fuss and want your 'soul' back, in other words: you no longer wish to have your REM driven clone to be used by dirty old men for sex; the Illuminati will kill you by applying a constant electric current to your REM driven clone until you have a heart attack or aneurysm in your original body and die. It is as simple as that.

For example, Whitney Houston wanted nothing to do with the cloning centres, she said she would keep quiet; she never wants to be in the spotlight; she never wants to do radio or television. Let bygones be bygones, I'll go my way and you can go your way. The Illuminati were extremely angry! They had bank-rolled her, and now she didn't want to be their 'friend' or ever associate with them again. She was sacrificed; she was killed with a constant electric current to her REM clone. She had sold her soul, in the beginning of her career; in other words, the "use of her REM clone". Earlier in Whitney Houston's career, she had signed that they can use her REM driven clone however they wish.

I have also seen people say "No" –when confronted with 'selling their souls'. These people are then memory suppressed, and will not remember the proposal of their REM driven experience. The people who also refuse to sell the use of their REM driven clone ('sell their souls') are blacklisted secretly, and they will never receive a high paying movie role, concert gig, advertisements etc. If you have ever wondered why so many talented people have not 'made it' –they refused to sell their souls, in other words, the use of their REM driven clones in exchange for promotions. This is how the entertainment industry really works. Another aspect of selling your soul, in other words, **selling your REM driven clone** is that you are also agreeing to sell your children, and your children's children etc.; your whole lineage to the Illuminati; for the Illuminati to use your unborn children for paedophilia, torture, sex sports and other grotesque and ungodly things when they sleep. It is a nasty business. **NEVER EVER** sell your soul.

The lesson is very important. NEVER EVER, 'sell your soul'; NEVER, EVER! You will experience the worst nightmare situation ever, and in this physical world, that is the use of your REM driven clone to be used for sex sports. You'll never have a decent night's sleep ever again, and you will always retain the full memory of your REM driven clone experiences; as well as, you will be selling your unborn children into this dirty business. Even when confronted with this as a joke: never sell your soul. Never Ever! The physical aspect you are confronted with when asked to 'sell your soul' is: "YOU", and everything which makes you, "you"; your ideas, your creativity, your privacy, your biology; everything which makes you, you. Never sell your soul, which in this life is currently the use of your REM driven clone! Never, ever! I hope that is well received.

Fake Alien Abductions conducted through REM Driven Cloning Technology

I must add they grow duplicate REM driven clones of people from all walks of life and then they transfer the persons consciousness to their REM driven clone version at the cloning centre while the person's REM driven duplicate clone is chained down to stainless steel corpse tables; or they pre-inject the REM driven duplicate clones with drugs before transferring the consciousness so that once the consciousness has been transferred, the REM driven clone cannot move. This is the point when they usually send people into the room dressed as aliens. It is a fake alien abduction. It's just these Illuminati people dressed in Hollywood quality accessories and they make the REM driven duplicate clones which have either been chained to the steel corpse tables or pre-injected with drugs, believe they are having an 'alien abduction'. Members of the Illuminati even dye chicken skin grey, and stretch it over a mask for realism and perform "experiments" on the immobile REM driven clones; the perverts anally probe them; they rape their limb bodies and do not suppress the victims memories; so these victims wake up thinking they have been abducted by aliens but in reality, they had their consciousness transferred to their duplicate clone versions when they entered REM sleep and they were violated. The victims do not know where to turn and naturally, they are embarrassed. Some victims even try and do install cameras all around their bedrooms in order to videotape themselves while they sleep; to prove they have been 'taken'; but to no avail they have not been taken; they have been cloned and had their consciousness transferred to their REM driven duplicate copies once they enter REM sleep by the most disgusting perverts in the world. The scum even videotape these 'abductions' to watch later as sick demented porn. These fake abductions are conducted by the Illuminati more often than you can imagine. They just keep doing it to random people over and over and over...

I am THE Spy for Humanity against the Corruption of the Illuminati

Over the years the Illuminati have offered me: a priceless katana (samurai sword); a rigged jackpot winning lottery ticket; REM driven clone slaves to keep me quiet, any of the prettiest women I've ever seen; any girl from high school; Vladimir Putin's daughter; even children; I do the right thing and spit in their REM driven clone faces; jam my fingers into their eyes but they have the technology to turn off the pain sensors of a REM driven clone, and therefore they have their pain receptors turned off as REM clones, while my pain receptors are fully on (sometimes even beyond the threshold of what is normal pain for a human). See the online articles: Science Daily (2014) and RT (2014) which discuss how pain receptors can be turned on and off in humans. Not much will hurt their REM driven clones other than getting dirt or vomit in a wound or bleeding too much. However, they have perfected the science and technology of REM driven cloning and therefore it only takes time and approximately $30 to grow new duplicate clone bodies. I started to smear excrement in their faces as a REM driven clone at the cloning centre in an attempt to deter them; I have **never** handled faeces in my original body, but I do this as a REM driven clone at the cloning centre, and even that does not deter them from their depraved ways. I composed a song which was later performed by "One Republic" referring to it called "All the Right Moves" ("All the right friends in all the right places... All the right moves in all the right faces"). I've made so many songs with MK Ultra technology (Rense 2001; Jim Cristea 2009; Berekley News 2011; Mind-Computer 2012 nature video 2013) and Mind-voice technology (New Scientist 2014; Prigg 2014) it is ridiculous. You see it is very easy to make music using Mind-voice technology; Flo-Rida used Mind-voice technology to produce the song "Whistle" when I first made my original disclosure (in 2011). The song is a taunt at me about my "whistle blowing disclosure" i.e. 'Can Donald blow the whistle? Etc. etc.' The thing is, anyone with a talent for music can make music much easier with the technologies which they have (MK ultra technology; Mind-voice technology); however, the Illuminati made more money from the music I composed, and so over the years, they just kept using me, over and over and over again, for rock, pop, rap, country etc. There are so many people involved in this REM driven cloning business, it is staggering; the organisation is vast. The only things the Illuminati fear are nuclear war; the new and improved lie detector tests and the general populace spreading my DISCLOSURE DOCUMENTS.

For those of you thinking Queen Elizabeth II looks like a kindly little old lady and you still cannot believe that all this is true, although I have provided plenty of evidence to the contrary as well as evidence of her saying "Drop the mother f***ing base" as a REM driven clone on a song track (RainmanJhof 2011); you could not be more wrong. She is the worst human being I have ever seen or heard of. It is so sad to see these REM driven women and children having their consciousness transferred to their REM driven clone duplicates and brought to the centre of the dirt rink, sitting there naked, afraid and crying and raped and beaten for sport, for the rich and famous. REM driven cloned women and children display the most range of emotions, and it is the saddest thing to see there. Therefore, of course I cannot bring myself to be a part of this despite any riches which the Illuminati offer me.

Over the 31 years when I was having my consciousness transferred to my REM driven clone at the cloning centre; Elizabeth, Vladimir and many, many Illuminati members and cloning centre attendees discussed many topics with me. These Illuminati people, such as Elizabeth and Vladimir, as well as many others confided in me because I had composed songs since I was 5 years old.

For readers struggling with the idea that a 5 year old can compose such wonderful songs at such a young age I will remind you that, it is easier to compose songs with technologies such as MK Ultra and Mind-voice technology. One is only limited by their imagination and creativity. Moreover, research talented children. I won't provide references of talented children here because I want to protect children from the Illuminati, and not have children exploited like I was; and for the readers who are parents; I am sure you know how talented, creative, and imaginative your children are.

Accordingly, since the age of 5, Elizabeth, Vladimir and many, others confided me in me because they thought I was special, and wanted me to hang with them; some of these Illuminati people, I had composed their favourite songs; I was also memory suppressed for many years so they thought it was harmless to tell me everything that exists or is possible. They were trying to impress me and amaze me, and therefore they showed me plenty of their technologies and what they had. They wanted me to me a willing, full Illuminati member; so over the years I feigned interest and pretended to like these Illuminati people, so that I could learn what they do and how they do it. I was looking for a way to block the consciousness transfer to a clone during REM sleep, or hoping they would reveal this part to me; but they did not, and I did not find a method to block the consciousness transfer. However, I bided my time, until I knew just about everything they do; so that I could reveal to the world everything they do; to give humanity a fighting chance against everything they do and as a consequence, I became a spy for humanity against the corruption of the Illuminati.

The Threat to Humanity when the H.A.A.R.P Grid is Complete

One of the most important topics which they discussed with me that I must add to this disclosure is HAARP technology and their plans for HAARP technology. I have discussed the basics of HAARP above. HAARP radio transmitters have to be placed at certain points across earth to complete a 'HAARP grid'. Once all the installations are completed over the earth HAARP will have more functions as a grid than the basics described. The Illuminati have told me, there is a possibility the HAARP grid will be capable of time travel, although there is a 50/50 chance using HAARP for time travel could destroy the earth. They also told me that once the HAARP installations are completed, the HAARP grid will be able to bend space and make the distance between, for example, Earth and Pluto approximately 1000 miles for a few seconds, and then the distance will go back to normal.

The Illuminati also said, once the HAARP grid is completed, they would be able to mind control people like never before without the use of RFID microchips or MK Ultra. Life on earth will be much worse once all the HAARP installations are up and working together in unison. The grid has to be complete though. HAARP cannot achieve time travel manipulation and mind control if it is just located in one or a few locations around the earth. There must be a certain number of HAARP installations around the world, in certain locations around the world; and the HAARP radio transmitters must be working in unison in order to achieve time travel manipulation and mind control of the populace of earth.

This is what they told me as REM driven clones at the cloning centre. This disclosure could be false, or a half truth. I do not know. However, it is very important that I add this to the disclosure because the Illuminati are working twice as fast to complete the HAARP grid to achieve their aim of mind control over the entire population since I the time I sent out my first disclosure (in **2011**). Whether or not they will achieve their aim of total mind control once all the HAARP installations are completed is NOT something we can afford to debate. They also told me that once the HAARP installations are completed; they will have the

capability to mind control anyone remotely like never before, at the push of a button. HAARP will also be capable of setting back time; which the Illuminati will use if they are ever in danger of being exposed. However, the Illuminati will remember the previous time, and the general populace will NOT remember the previous time, so that the Illuminati can correct the mistake(s) which led to their downfall. **Once the HAARP grid is completed, humanity will be slaves forever.** This is why we cannot afford to debate. Furthermore, from the book "Angels don't play this HAARP" (Begich & Manning 1997, p. 8), it is estimated that the HAARP grid will be completed by approximately 2017; others estimate by the year 2020. The important thing to note is that humanity does not have long, until the HAARP grid is completed.

I must also add the positive side of HAARP, because as I have said, there is nothing inherently evil about technology. Technology is just a tool; it depends on the person using it. HAARP used correctly, and in the hands of honest men and women, will tame the weather with no adverse effects. Therefore humanity is on a timeline and a deadline to bring the Illuminati to an end. **HAARP is one of the main reasons, this disclosure must spread, and spread fast.**

See below for possible HAARP locations around the earth (Rense 2011). The HAARP sites are located globally where the richest mineral belts are located. Sub-surface mineral exploration has been done from satellites by radio tomography that is 100% accurate.

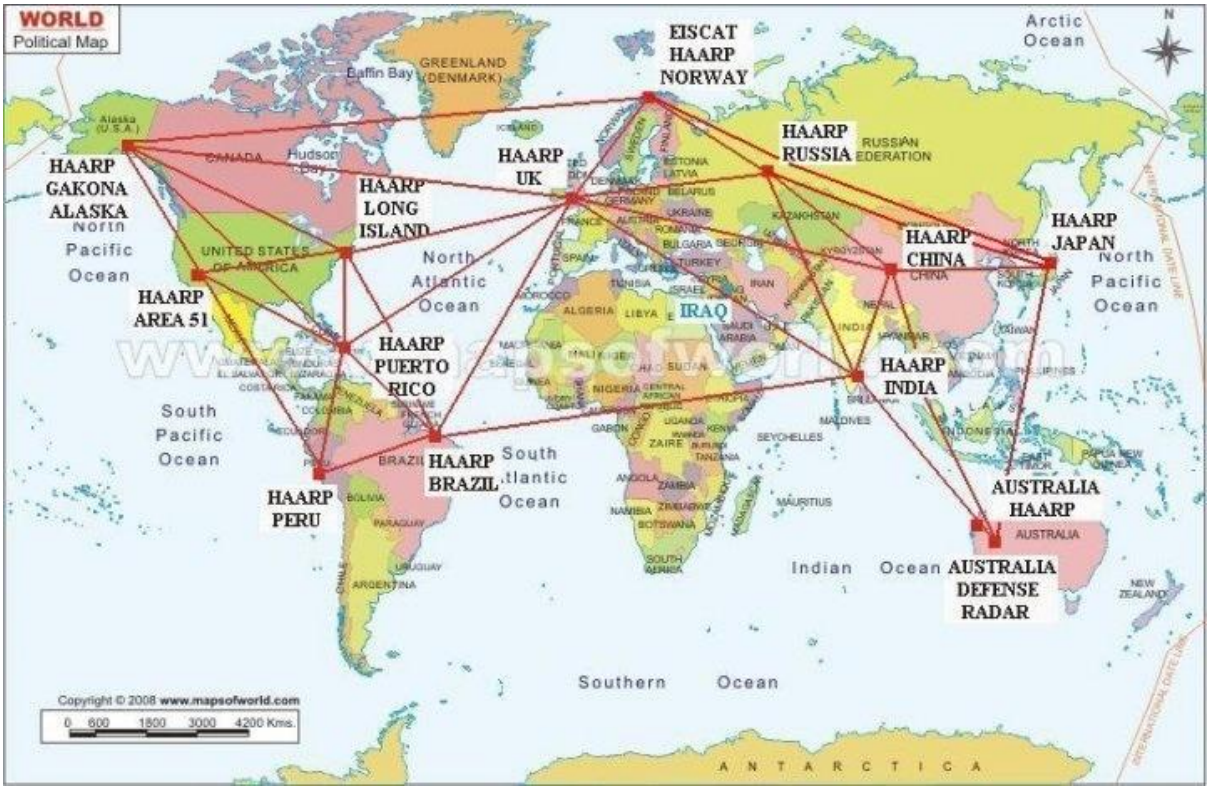

Image 8: Possible H.A.A.R.P. Locations. Source: Rense (2011)

REM Driven Cloning is the Most Terrible Nightmare Situation Ever

Furthermore, in terms of REM driven cloning; Fefe Dobson (singer) and Kurt Russell (actor) told me during my original disclosure (**2011**) specifically, to include in my disclosure that they do not like the cloning centre and they didn't torture me. Then they said not to mention them, but I will mention them again. Mila Kunis (actress) from "That 70s Show" stabbed in my REM driven clone body multiple times when I made my original disclosure and I was rendered immobile for saying that "She is a slimy scumbag for hanging with these people" and for also saying "She has enormous eyeballs and looks like a lemur". Mila Kunis (as a REM driven clone at the cloning centre) then begged me not to mention her (in my original disclosure, but I'll mention her again too) and then Mila Kunis said "She doesn't want to go to the clone zone anyway" and the Illuminati then deactivated her consciousness from her REM driven clone body, and she left. Her REM driven clone body went limp at the point where her consciousness was deactivated from it; her REM driven clone body looked 'dead', and she was gone. Some of the privileged people at the cloning centre are allowed **NOT** to have their consciousness transferred to their REM driven, clone duplicate versions (or they attend the cloning centre willingly when they want), but not me. I am an imprisoned slave in the worst nightmare situation. I told Nicole Leone (Madonna) also a REM driven clone at the cloning centre, that I was going to tell everyone that she coerced me to compose songs for her throughout my life (as REM driven clones). Nicole Leone (Madonna) told me VERY specifically to say in my disclosure here "She is not afraid!" and "No one will believe me and nothing will come of this". I beg you to help me prove her wrong.

Moreover, having your consciousness transferred to a REM driven clone alternative inhibits the person's ability to dream for that evening. Although your original body is immobile and asleep in your bed, when they transfer your consciousness you have actually 'woken up' as a REM driven clone version of you at a physical location here on earth; therefore you walk and talk as a clone version of you. You are not dreaming; you are just a REM driven clone for the evening. Furthermore, when the Illuminati restore your memories (as they have with me) or do not suppress the memory of your REM driven cloning experience for the evening (such as with the fake alien abductions), you will remember the experience as 'clear as daylight on a summer's day'; the experience is 'clear as a bell' as life is in your original body.

It is unlike dreaming, where dreams are fuzzy, incoherent and with random conjecture. The Illuminati know this as a fact, and therefore pre-inject the REM driven clones of random unsuspecting civilians for the evening with drugs before they transfer the person's consciousness. They tell the person who has had their consciousness transferred to their REM driven clone all sorts of nonsense: such as they are in the 5th Dimension; the astral plane; a singularity; the spiritual realm; Valhalla; quantum hopping etc. and all sorts of fallacies so that the person will not have a coherent picture of what has happened or what is happening. The truth is that person has had their consciousness transferred to their REM driven duplicate clone when they went to sleep and entered REM sleep; their original body still remains asleep in their bed; their consciousness however is now transferred to a clone duplicate alternative, and the person is 'awake', walking and talking as a cloned version of themselves in a physical location. The Illuminati allow some people to retain some of these REM driven clone experiences to affect their mental psyche.

The physical location where the populace will be able to verify these REM driven clones is somewhere within 5/6 hours drive, in a radius of the Robert Pickton farm, Port Coquitlam, British Columbia, in Canada, somewhere at a remote nature reserve. This is the cloning centre all the rich and famous attend because it is above ground and the rich and famous don't like the 'hospital smell' of underground cloning centres. The above ground cloning centre located in Canada is the cloning centre I have my consciousness transferred to when I sleep. It is guarded by military personnel. There are many cloning centres all over the world; as Phil Schneider (1995; 1996) disclosed as far back as the mid 1990s when he spoke: there were 1477 Deep Underground Military Bases (DUMBs) worldwide and 131 active DUMBs in the United States alone. Each DUMB costs on average 17 -19 billion U.S. dollars; paid for by the taxpayer; and it takes approximately a year-and-a-half to 2 years to build DUMBs with sophisticated methods. DUMBs contain cloning floors, and have an entire floor dedicated to human cloning, where duplicate clones are grown of unsuspecting civilians (remember they just need your blood / DNA); and unsuspecting civilians have their consciousness transferred to their REM driven clones at a physical location, which is usually these Deep Underground Military Bases when they sleep; unsuspecting civilians are memory suppressed, also to be used for gruesome torture and sex sports; as well as the plagiarism of talented individuals. Schneider gave the above statistics in the mid 1990s; chances are there are more DUMBS and cloning centres worldwide today.

Are you beginning to understand why this is the worst nightmare situation ever? Can you understand how: you, your friends, your family, your brothers, your sisters, aunties, uncles, children, work colleagues and anyone else you have contact with in your network, may be involved in this REM driven cloning business and will not even be fully aware of the situation or remember any experiences which they may have had once they wake up from sleep and they are back in their original bodies? I remember all of the REM driven clone experiences as clear as daylight because my memories are fully restored. Can you understand why the Illuminati must be stopped and stopped immediately? This REM driven clone business is vast, and it affects everyone, not just me.

This is why I mention that I am fortunate or unfortunate to remember all these experiences clearly depending on how you view it. I am unfortunate in the sense that I can recall all the depraved things these people do as REM driven cloned duplicates as clear as daylight and it affects my mental psyche. However, the fortunate part is: because I can recall all these experiences clearly, I can inform the world about the evil committed against humanity in a clear and logical way for the average reader to understand and verify, so that the populace can bring these people to justice for the crimes they have perpetrated against humanity and continue to inflict on humanity. For anyone who has had their intellectual property stolen by the Illuminati as a consequence of the technologies they have used on you unsuspectingly, you will be able to sue and regain monetary reward for the theft of intellectual property as well as invasion of your privacy.

I do not want to get too far ahead, because at this present moment, it is **very important** (I cannot say it enough) that this disclosure spreads (this is the stage we are currently at); it reaches the armed forces; to enable the armed forces to realise the crimes committed against humanity because of these people (the armed forces are kept 'out of the loop'; they just 'follow orders'); the armed forces will have to perform a military coup and bring this people to their knees. This is the point where the ordinary man / woman can have his REM driven cloning experiences restored, (that is if you want to) and sue / rightfully reclaim damages and legal reward for any crimes committed against him or her.

The Meek Shall Inherit the Earth

As you can see if everything goes smoothly; the meek shall inherit the earth. This is why you must maintain your composure and resolve, as I do every single day. You must not riot or cause chaos, damage property or undertake any act which will cause public dissension. The good people of this earth are about to inherit the earth; under no circumstance must you destroy anything. At the end of this currently dire and complicated situation; humanity will inherit the cure for HIV/AIDS, cancer, Alzheimer's, dementia, you name it –many debilitating diseases known to man; and other such wonderful technologies like hypersonic trains which run on magnets and are capable of doing Mach 5 (Mach 5 is the equivalent of 3806 miles per hour or 6125 kilometres per hour; Schneider (1995; 1996) also mentions the availability of Mach 5 trains in his disclosure, back in the 1990s). These trains can be used to deliver foods which are discarded in More Economically Developed Countries (MEDCs) to Less Economically Developed Countries (LEDCs) because these trains can travel thousands of miles within minutes. Yes. The Illuminati have all these wonderful technologies and more, but withhold it, and in turn withhold the progress of humanity. Yes. Plenty of man's problems can be solved when we address the root causes of our problems, and one of the root causes of humanity's problems is: REM driven human cloning which is currently in the hands of evil men. Even REM driven cloning can be used for the benefit of mankind when this tool is in the hands of righteous men. It can be used learn new skills in your sleep: such as gain extra qualifications; learn how to speak a new language; play instruments etc. –so long as memories are not suppressed, you will be able to perform the skills you learned as a REM clone in your original body when you wake up. As you see there is nothing wrong with most technologies; it all depends on the person / people using it. Nevertheless, although they may be beneficial uses to REM driven cloning not yet realised, we must be shut down REM cloning before we can even consider how REM driven cloning may benefit mankind, because at this present moment all that REM driven human cloning is used for is to commit evil, particularly against unsuspecting civilians.

It is OK to feel angry about all these crimes committed against humanity daily. But do not let these evil crimes rule you, in fact, let it motivate you; let it motivate you to the point where you will stand up and speak out to ensure that these crimes end. I think about the children and the future of the world every day; that is what motivates me and I view my situation as a God-given mission to bring these people to justice. I view things this way to maintain my sanity and composure. This is what keeps me going despite the extreme evil I experience, and it helps me to maintain my resolve and composure. The fact that I do not want a single child to grow up in a world, where they are being messed with in their sleep is what keeps me going despite this extreme evil. Some children are even kidnapped and brought to the cloning centre in their original bodies, again to be messed with. This is the root cause of why so many children go missing across the world. I'm sure any rational thinking human being feels the same way I do, and does not want their children, or any child to inherit a sick world governed by sick individuals.

I am a baptised Roman Catholic and a God fearing man. I believe there is a Creator of the universe but the Illuminati tell me there is no God, only science and technology. The Illuminati are also responsible for the death of the young beauty pageant girl Jean-Benet Ramsay; her parents are in this REM driven cloning business. Casey Anthony's daughter; as well as, Casey Anthony (before she died) AND Casey Anthony's parents also attend the cloning centre as REM driven clones. Many others; a man had his wife killed and this was mentioned on the news; it was an Asian woman whose rich husband had killed her; the

husband said the wife was responsible for their son's death. Elizabeth's response was that "Rich people in this organisation (The Illuminati) do not go to jail, they are covered for."

Stephen Spielberg and George Lucas are Illuminati members and they willing attend the cloning centre as REM driven clones when they sleep. George Lucas made other Illuminati members light my REM driven clone body on fire for the end of his movie *Star Wars Episode III: Revenge of the Sith* (2005).George Lucas said (as a REM driven clone) he wanted Hayden Christensen "To scream realistically". Hayden Christensen (also a REM driven clone at the cloning centre) watched me, and listened to my screams and groans of pain and copied the sounds coming from my burning REM driven clone exactly. Hayden Christensen knows he is a REM driven clone when he goes to sleep and Hayden Christensen knows his consciousness is transferred when he reaches REM sleep. Hayden Christensen knows all about REM driven human cloning, and he is a "privileged" Illuminati member. Natalie Portman also knows all there is to know about REM driven human cloning; as does approximately a quarter of the "Star Wars" cast. Many directors have attended the cloning centre as REM driven clones too, and have used me in a similar role playing situation; they have caused me to have excruciating pain as a REM driven clone, to see what kind of squeak or screech I will make, as if I were less than a dog; and when I am a bloody mess on the floor as a REM driven clone; that is when they usually crawl on my broken REM driven clone body and sodomize me saying something like "They love me and they cannot control themselves because I made all their favourite songs and I'm so "special"".

My ribs in my REM driven clone body will be broken, I will have suffered internal bleeding and will be crying or screaming, if I am able, but they just continue to sodomize me, and videotape such a depraved act of wickedness so that they can view it again like "evil pornography".

The REM driven cloned children, who have their consciousness transferred while they sleep at home in bed, in their original bodies, need a familiar face to talk to as REM clones or all they do is scream and cry at the cloning centre; that is where Joy Geizer comes in. Joy Geizer is married to my half brother from my father's first marriage; Joy Geizer is a REM driven clone girl guide leader, and when the Illuminati clone young girls, Joy Geizer speaks to these REM driven cloned girls; Joy Geizer keeps the REM driven cloned girls calm and "pimps" them out for free, knowing that these young girls will have their memories suppressed, and therefore they will not remember the experience and will not talk about it when they wake up. All the Geizers are in this REM driven, human cloning business; there are many people who remember these REM driven cloning experiences in their 'awake state' and in their original bodies who could be polygraph tested by independent polygraph testers. The police, and polygraph testers in my City of Halifax, Nova Scotia are compromised (they attend cloning centres as REM driven clones too); they cover up for child molesters and therefore cannot be trusted to fairly administer a polygraph test; as I said, commissionaires and C.S.I.S are heavily involved. All it would take is a few polygraph tests to prove these things unequivocally, because for those of you who have 'eyes', you can already see that REM driven cloning is real, and that this is actually the way of the world. I will take these polygraph tests publicly too, and demand that my mother and step father submit to them. They have told me, they **wouldn't** even attempt to lie on a polygraph.

Human cloning, particularly REM driven human cloning, is one of the absolute truths of this world; hidden from the world for over 70 years. My life and the freedoms of many, many people, including the reader (you) depend on this disclosure. The Illuminati say that the world finding out about REM driven human cloning will set the stage for the end of the world; people panicking and destroying property because of the evil these people have committed, but as I've said: prove them wrong, because we are going to inherit the earth, so there is no need to riot or cause public dissension. There will be no end of this world; just the end of the crazy Illuminati people. They always like to think and behave so negatively, don't they? *Sigh*. Furthermore, the whole talk about 2012; December 21st 2012 and the end of the world Mayan Prophecy; that was really about the world finding out REM driven human cloning, and the sick and sadistic nature it has been used for by these sick and sadistic people. Under no circumstance must you riot; you **must** prove you are better than these savage barbarians. I'll say it again, **because it is important**: we are going to inherit the earth, and therefore the smart and right thing to do, is not to destroy anything, especially the earth which you shall inherit.

Furthermore, I hope you are beginning to understand that the good people of this world must bring these people to justice and stop their wicked ways. I sincerely wrote this disclosure so that the good people of earth would be empowered to put a stop to their wicked ways. I wrote this disclosure to empower the good people of earth against tyranny and not so that the world would end. Therefore you must understand that the downfall of these Luciferians (Illuminati) must progress smoothly, because unless you have been to the cloning centre as a REM driven clone and retained the full memories of your experience, it is difficult to understand the level of depravity and sub human cruelty; it is beyond anything that has ever been heard of, and there is much more to tell.

Ignore this disclosure and you will condemn me to a horrible eventual death and you will encourage them that 'they are all 'powerful''. This is not an exaggeration. There is no need to exaggerate even President Barrack Obama is involved in the REM driven cloning business and attends the cloning centre as a REM driven clone version of himself, when he goes to sleep. He and his wife Michelle Obama attend these REM driven clone gatherings. Barrack Obama has even told me as a REM driven clone, at the cloning centre "Donny, we're all powerful. You are a slave and the people here [as REM driven clones at the cloning centre] won't speak up for you for fear of torture or death. Now make us a new song or we'll gut you like fish and leave you to writhe in agony!"

Be Wary of: Shills; Trolls; Disinformation Agents and Double Agents

There are many, many disinformation agents whose aim it is, is to denounce or debunk me. Be very wary of them. They DO NOT, and cannot debunk me, because after all, everything I have disclosed is truth. Although the truth concerns highly advanced concealed technologies, so it is a bit difficult to fathom at first, but keep reading, and you will realise that all which I have disclosed is true. Be very wary of the disinformation agents.

The most common thing these people say is that "Donald is a paranoid schizophrenic" –yet, ask them to detail the ins and outs of what a paranoid schizophrenic is and what specifically qualifies Donald to be a 'paranoid schizophrenic'; there is a high probability they will not be able to explain this to you, logically, sequentially and methodologically. Their main goal is just to make it as difficult for newcomers to understand what the real truth of this world is and as I have disclosed; and one of the root causes of man's problems is REM driven cloning.

Some disinformation agents are paid by the Illuminati, to behave this way, and are all too happy to echo empty statements (without any substantial evidence for their claims) because it provides them with a pay check. I will provide the following reference for the reader which discusses the signs and symptoms of a paranoid schizophrenic; all for the express intent for the reader to further understand paranoid schizophrenia. You can read more about paranoid schizophrenia on Medical News Today (2015). The link is provided in the reference section. You are welcome to read my Facebook wall and within days, you will realise I converse with others quite naturally. You can also ask individuals who have spoken to me through Skype or met me; but if this is not a viable option for you; all you have to do is read my Facebook wall and within days, you'll see that whoever makes such harsh and untrue remarks on my character is in fact a disinformation agent.

Furthermore, remember we live in a 3D **physical** world; and there is always a physical aspect to how something manifests. Therefore, when you hear others discussing concepts such as 'Tila Tequila demonstrated an 'energy ball' right on camera; Why didn't Donald discuss that?!' Please understand that these people are trying to deceive you with misinformation. There are also professional disinformation agents to be wary of. I do not perceive anything extra-ordinary in the world when I am awake in my original body beyond the five senses. I don't see orbs, auras or anything of the like. All I will ever discuss are practical things which have been unequivocally proven to me as fact; because in the situation the earth is currently in, I cannot afford to speculate.

Contact Information

My Facebook is: https://www.facebook.com/donald.marshall.148
You can also press Ctrl+Click (hold "Ctrl" on your keyboard and left "Click" with your mouse, on the image to your right).

I have a public wall on Facebook which starts from March 2012. In other words, all posts are made public since March 2012 and you do not have to join my friends list or subscribe me to see what I post (although you will have to have a Facebook account). I suggest that newcomers start reading from March 2012, and be patient, and read everything. You can read everything and learn the real truth of the world free of charge. I don't wish to write a book, I am not looking to turn a profit from this; I want to crush these guys and shut down the cloning centres!

It also worthwhile to add that: I am **not** asking for donations. I do not want **ANY** donations. Ever! These disclosures are far more important than any donations. This is **NOT** my job. I have a job. I am an independent contractor; carpentry is my trade and I earn a living this way. If you sincerely want to help; the best way to help is to spread and share my disclosures. That is all I ever ask for, so that eventually, the world knows about REM driven human cloning, and the armed forces can bring these people to their knees. **That is all I want; spread, spread, and spread this disclosure.** I will **never ever** ask for donations. Ever! Please keep this in mind, and anyone who asks for donations in my name or on my behalf should not be trusted. I, Donald Marshall, will **NEVER EVER** ask for any donations. I hope that is well received.

You can also view Proboards which has all my Facebook posts and have been archived by Celine O'Carroll and Astral 7ight by visiting:

http://donaldmarshall.proboards.com/
You can also press Ctrl+Click (hold "Ctrl" on your keyboard and left "Click" with your mouse, on the image to your right).

There is a search function on Proboards, and you can use this to search for and read all the disclosures I have made regarding REM driven clones, the people involved and more. I understand that it is human nature to want to know, which people have been to the cloning centre as REM driven clones; therefore, use the search function to read about any public figure which I have already covered that you have an inkling about. You can also post anonymously on Proboards and Celine and other Administrators will transfer your question onto Facebook which I'll answer.

Donald Marshall Revolution is a website which details a brief overview of the Illuminati.
http://donaldmarshallrevolution.com/
You can also press Ctrl+Click (hold "Ctrl" on your keyboard and left "Click" with your mouse, on the image to your right).

Interviews

You can listen to the radio interviews I have done. Listen for consistency; particularly anything which you do not hear me, pronounce clearly for the first time; the best thing to do is to pause the recording at that particular point and replay it. You should also research the statement you do not understand. Sometimes reading helps comprehension a lot faster.

One of the main reasons you should pause and replay the recordings is because: the truth has been kept hidden for so long that a lot of what I discuss in my interviews are beyond most people's current world view; so at some points I may speak too fast for you; my audio/ microphone may not be so clear so you may miss what I say etc.

A friend has told me that when he first watched the Vinny Eastwood interview; he did not hear me say the word "scars" (When Vinny asked: 'How do I know I'm the real me?') although he replayed that particular point in the video 8 times. Everything was just beyond his current comprehension, at the time. No matter how many times he replayed that part he really could not hear me say the word "scars" –so he let that part go, and played the rest of the interview, pausing, and replaying points which he did not understand, especially to comprehend whether I was talking about my original body or my REM driven clone duplicate body. He also listened to all my interviews for consistency, to note any 'slip ups', or any parts of my testimonies which do not 'add up'. He would listen to all my interviews, pausing and replaying parts he did not understand and he would reserve his judgements until he felt everything I was saying was for example as ordinary as: 'I woke up today, brushed my teeth, and took the dog for a walk'. He was also patient to realise the truth. After listening to my interviews he would just let it 'sink in'. A week later he would come back and listen to the same interviews, to test whether his comprehension on the topics I discuss has improved, and

whether he can understand what I am saying without having to pause and repeat at certain points in my interview; and soon enough he could now hear me say "scars" at that particular point of the Vinny Eastwood interview. He had reached the point where all topics I discuss sounded to him like I'm saying everyday common place stuff that people have heard, such as: 'I woke up today, brushed my teeth, and took the dog for a walk'. For anyone who may struggle to understand the topics I discuss: I strongly recommend you take the above approach as my friend did; soon enough, you too will realise the real truth of the world like he has: REM driven cloning, kept secret and used for sinister purposes.

I cannot say the following is true for everybody, however, an unproductive venture a complete newcomer can do is to listen to my interviews first time, all the way through, without pausing or replaying parts which they do not fully understand; If you do this and if there is just a single part of my interviews which does not make sense to you; this will interfere with your understanding of the entire interview. Remember, all I am discussing is technology, thousands of years advanced compared to what you currently use; available today, hidden and secret. If things start to get too complex for you, reduce it to its bare minimums: (advanced) science and technology. I hope that helps.

Another thing which I do in my interviews, that friends have picked up on, is: -because REM driven cloning has been my reality for many years; I don't differentiate between my original body and my REM driven clone body. I just say: I did this, I did that, and Elizabeth did this and that, therefore it can become very confusing for newcomers. Please bare with me; although I'm more emotional as a REM driven clone, and not as smart as I am in my original body (this is a side effect of cloning: REM driven clones are more emotional than normal, and dumber than they are in their original bodies) I'm still "me" when my consciousness is transferred; I have all the experiences and knowledge which makes me, "me" and therefore I naturally do not differentiate between my REM driven clone version, and my original body as an outsider discussing these concepts would. I understand it helps comprehension so I have painstakingly done this throughout this disclosure.

I hope this helps; and I hope this helps to better understand my disclosure as well as the interviews which I have done. On the next page you can find the links to my interviews. You can copy and paste the links to your web browser or press Ctrl+Click – (hold "Ctrl" on your keyboard and left "Click" with your mouse, on the images below) to direct you to the interviews.

Links to Donald Marshall Interviews

Vincent Eastwood

Copy and paste the link below to your web browser.
https://www.youtube.com/watch?v=M_1UiFeV5Jg&ab_channel=VincentEastwood
OR Press Ctrl+Click (on the image below) to follow the link.

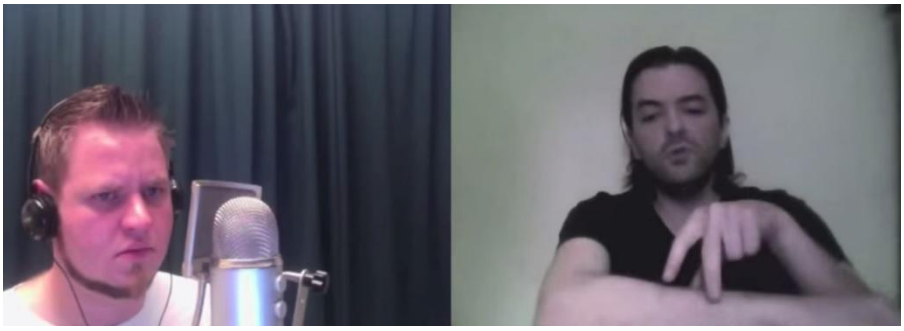

Jeanice Barcelo

Copy and paste the link below to your web browser.
https://www.youtube.com/watch?v=3uzgu4ekT3c&ab_channel=JeaniceBarcelo
OR Press Ctrl+Click (on the image below) to follow the link.

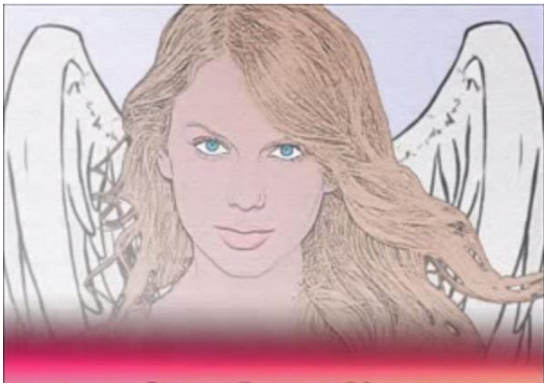

Lisa Phillips (CFR)

Copy and paste the link below to your web browser.
https://www.youtube.com/watch?v=UonnFuHLJKc&ab_channel=Astral7ight
OR Press Ctrl+Click (on the image below) to follow the link.
Listen to parts 1 through 8.

Radio Presenters –Contact Donald Marshall

Anyone who sincerely wants to contact me for radio interviews on their show is welcome to do this. Please contact me through Proboards by leaving a message for me to contact you.

Professionals who understand "Consciousness Transfer" –Contact Donald Marshall

Any neuroscientists, engineers or professionals who understand how consciousness transfer works, and can provide me with a detailed methodology of how to block the consciousness transfer to my REM driven clone; please message me on Proboards, and this will be greatly appreciated.

Email

I currently do not have a contactable email address. In my original disclosure, the email address has been compromised (hacked), and so has any other email accounts I created: Yahoo, hotmail, Gmail, AOL etc. It doesn't matter; they eventually get hacked; for whatever reason, the Illuminati do not want me to have an email account.

How to Learn More about Donald Marshall's Whistle Blowing Disclosures

The best ways to learn about the truth of the world is through my Facebook page and Proboards. There is a mountain of evidence which has been collated over the years, and corroborates all that I have disclosed here. I also understand that for some people it is impractical to read three years worth of Facebook posts, especially when some post are repetitive; contain unnecessary comments from trolls, shills and other disinformation agents. Therefore, I am currently compiling 5 documents which should make it easier for others to read and understand everything quickly; as well as, for others to share and spread those 5 documents including this main disclosure document –so 6 documents about the real truth of the world. All for free!!

These documents include:

- "Frequently Asked Donald Marshall Questions" –This will contain all the general FAQs which I have been asked over the years; all in one place.
- "Experiences from the cloning centre" –This document will contain the full disclosure of my REM driven cloning experiences from the cloning centre when I go to sleep; all in chronological order.
- "List of people to avoid" This will contain a whole list of trolls, shills, and disinformation agents and double agents in alphabetical order, to avoid at all costs, in real life and online; -all complied in one place; and the reasons why they should be avoided.
- "Public Figures and their relationship with Donald Marshall as REM driven clones" – this will be a complete list of every public figure I have ever come into contact with as a REM driven clone; and you will be able to read about all the public figures I have met as REM clones, as well as the experiences, all in one place.
- "The subterranean underground colonists: The Vril" –this will be everything about the biological parasites the Illuminati harbour. Yes. The Illuminati harbour biological parasites, which they use against unsuspecting humans. I told you the Illuminati were

the biggest depraved perverts ever to grace God's earth. REM driven human cloning, kept secret from the world for over 70 years is difficult to fathom as it is, as are these biological parasites. These parasites are also one of the main root causes of humanity's problems here on earth, and must be rendered extinct. In this document you will be able to learn everything about their, strengths, weaknesses, psychology, biology, ecology, sexuality and arm yourself with knowledge which ensures that humanity exterminates these parasites from our earth, forever. The secret of Vril; a secret no more!

I hope after reading my eye witness statements presented in this document that you have now began to understand that this is simply what is happening in our world today.

Heed my disclosure, very diligently. At the start of my disclosure I asked the reader to do two things:

1) Give me the benefit of the doubt –because there is nothing worse than being a victim of abuse, reporting it and the people who have the power to stop it, ignore you;
2) Set out on a genuine quest to debunk my disclosure. I understand that for some people, plenty of what I have disclosed will still sound 'too out there' beyond their current scope of reality to be believable. For such people, the honest thing to do is to start with the first topic which you do not fully understand and explore it, either by finding that corresponding topic on Proboards (Donald Marshall Proboards 2015), and continuing your research from there; or just Google any topic you currently do not understand and review the topic on websites such as New Scientist (2015), Gizmag (2015), Motherboard (2015), BBC News (2015a; 2015b), BBC Future (2015), The Guardian (2015a; 2015b) The Independent (2015a; 2015b), Daily Mail Online (2015) and start reading more articles in the Science and Technology columns because these people have been telling you what they have been doing for decades. Consequently, keep in mind that articles which discuss 'future' technologies and 'improvements' in medicine or science, are articles, which are **really** discussing present technologies, and achievements in science and medicine already realised; because most of these achievements have been realised decades ago. It just hasn't been fully disclosed publicly.

I have also saved and backed-up every reference (except the homepages of the websites referenced) in this document; therefore if a link or video is ever deleted let me know.

How Much Do You Know About Post-humanism / Trans-humanism?

Furthermore, you have to be honest here: because if you do not know much or anything about post-humanism / trans-humanism then I am afraid to say, -and this is no fault of yours – that you are behind in this the world; simply because these Illuminati people are Post-humanists; and that is the direction the want the rest of the world to go. They want the world to reach a destination where human cloning is common place; a world where downloading your mind / entire life experience onto a computer microchip and living on as a cloned version of you with the microchip running the consciousness to be common place; and these Illuminati Post-humanists want the world to head in a direction where it is commonplace to molest children through science and technology. No. This really is not Science-Fiction, this is the world we live in today; this is why such marvels in science, medicine and technology has been withheld from the general public and kept hidden by an 'elite' group of people because if these people

honestly came forward, and said “We have invented this technology and we want to use it for this “negative” purpose” –the populace would not accept it, and these people will be lynched in the streets before lunchtime. Therefore, through concealed advancements in medicine, science and technology, the Illuminati can live out their inner depraved cravings and commit crimes against humanity and the world, for which most people will be too blind to see or even fathom, because the hidden science and technology is beyond the average person’s current comprehension.

Therefore, please attain an education in post-humanism / trans-humanism because these Illuminati people believe they can rival creation, nature and the marvels of the universe through science, medicine and technology. The Illuminati go **against** creation; they go **against** nature; and they go **against** humans. They don’t consider themselves humans. They consider themselves post-humans and believe they can become “gods” through advancements in medicine, science and technology. See LawOfIdentity (2014) and Mark Dice (2014) for Richard Seed’s comments on ‘becoming gods’ through transhumanism. Richard Seed is a Physicist with a Ph.D. from Harvard University; he is well known in the controversial cloning debate and declares his aspirations to "become god" saying 'We are going to become Gods, period. If you don't like it, get off. You don't have to contribute, you don't have to participate, but if you are going to interfere with me becoming a God, you're going to have trouble. There'll be warfare.' If you value humanity, do your best to attain an education in the trend of post-humanism / trans-humanism; otherwise the future of mankind will be bleak. We must do everything we can to stop these people.

This is of uttermost importance. REM driven cloning of is the most terrible thing in the world, especially when it involves unsuspecting civilians, and worst of all, innocent children. If you choose NOT to do anything you allow the Illuminati to continue to clone your children, sisters, wives, and sons. You allow the Illuminati to continue to hijack the minds of your children, sisters, wives, and sons while they sleep, through concealed advancements in science and technology. You allow the Illuminati to transfer the consciousness of your children, sisters, wives and sons to their REM driven duplicate clone versions while they sleep, whereby the Illuminati molest your children, sisters, wives and sons, which will cause them to have learning disabilities, unexplained depression and suicidal thoughts, as well as all kinds of side effects.

This IS your ONLY chance to end these monsters. There is a deadline!

This is your **ONLY** chance to do something to end these monsters. We are on a timeline and there is a deadline. As I have already mentioned, as well as, the top scientists in the field of physics and geophysics have mentioned: HAARP is not only capable of controlling the weather; once the HAARP grid is completed and working at full power, it will be capable of mind control over entire populations. We will all be slaves to the Illuminati FOREVER. Our freewill will be gone forever. Furthermore, if they achieve their aim of time travel with HAARP technology, future generations of humanity will never be able to stop them, because as they have told me: ‘They will always be able to go back to a previous time, and correct the mistake(s) which led to their downfall’. This is the Illuminati’s end game and what they wish to achieve. This is why this disclosure is so heavy, and so important. It goes beyond REM driven cloning; although it is important the world understands REM driven cloning. The future of humanity is at stake; and because of the 2-5 year deadline until the HAARP grid is completed, it is time humanity stood up and brought an end to the Illuminati. This REALLY is your ONLY chance to end these monsters!

The only way for evil to triumph is for good people to do nothing.
Edmund Burke

Remember for every 12 months which passes military / concealed technology outstrips the technology the general public is accustomed to by 44 years (Schneider 1995; 1996). Close your eyes and think 44 years into the future. The year is 2059. What kind of technologies do you expect mankind to have? Do it for real; don't just read the words. Close your eyes and imagine. The year is 2059. What kind of technologies does mankind have? You see. It is 'out of this world' technology, right. This is exactly what is going on today in the year 2015. It's just that it is hidden. That's all. Not so difficult to fathom now.

Do NOT Be Afraid to Help. We Outnumber the Illuminati by 1,000,000:1

Don't be afraid to help. These people are easily defeated when good people stand together as one. These Illuminati people total no more than 10,000 people. 10,000 people against 7,000,000,000 (7 billion) people –that's less than 0.000001 % of the world's population. Now can you begin to understand how prevalent evil can be when a small organised group of individuals, as little as 10,000 of the world's most evil and tyrannical people all work together in unison to exert their influence over the world? The world does not have to be this way. We outnumber the Illuminati people by a 1,000,000 to 1. For every Illuminati person there is, there are **one million** people who are not Illuminati, therefore do not to be afraid to help; all you will be doing is helping humanity rid itself of its sickness. So please feel free to share and spread my disclosure far and wide.

For those of you whom this applies to: remember the Illuminati (and I know it sounds ridiculous despite the evil they do) are deeply religious. They believe anyone aiding me is part of the "Army of Light" prophesised by Nostradamus; and to harm or degrade the life of anyone assisting me will bring them to their ultimate end and they will incur the wrath of God; they will suffer utter ruin and demise in their lives if they are to hurt you; they are very scared of people who can see through the lies and deceptions they have inflicted on the world. So please, stay calm, do not stress your heart, and know that **you are safe**, and **they cannot hurt you**. You can feel safe in the knowledge that you can do the right thing by helping me. They told me this as REM driven clones on the night of 21st of February 2014 when I went to sleep. The above is exactly what they said.

For anyone interested in understanding the interpretations of the Nostradamus Prophecies, Crystal Links (2015) provides a good source for all 942 of the quatrains. Delores Cannon is also an author who has written three volumes called "Conversations with Nostradamus" and for anyone interested you can read these online (Galactic 2012a; Galactic 2012b) as well as watch her YouTube videos (CreativeForceVideo 2014; Disclose TruthTV 2015).

Yes. This is the state of the world today: a deception within a deception coated in reverse psychology; and fact is indeed stranger than fiction. Now after everything I have said, if you are still sceptical and 'in-between' on this issue then the best thing for you to do is to pay attention to your dreams; or lack of dreams –they are your own experiences and you cannot deny your experiences.

In other words, you may be having REM driven cloned experiences too; for some people they have a 'dream', where they are in the same environment, over and over and over again; or the theme being discussed in their 'dreams' is the same over and over and over again; or the environment their 'dreams' take place always appear to happen in the same 3 or 4 environments over and over again –no matter what the theme is. In each scenario there is a likely probability that these are not just dreams, and in fact these people have had their consciousness transferred to the REM driven clone duplicates and the Illuminati is trying to extract something from them, once that is done they implant a false memory (See Kim (2013) and Alford (2015) for discussions on how false memories are implanted) so you wake up with the feeling of remembering something, but in actuality it is false; or you wake up with no memory of dreams from the previous evening, which means there is a high probability that you had your memories suppressed when your consciousness was transferred to your REM driven clone. This is why I say you can be sceptical about everything I have said (for now), but pay attention to your dreams, or lack of dreams, they are your own experiences, and you cannot deny your own experiences.

Noteworthy Frequently Asked Question

A Frequently Asked Question I receive, which is worth a mentioning here, is as follows: **Q:** Donald, if everything you have said is true...; in other words human clones walk among us now in a multilayered conspiracy which reaches the highest levels of government; armed with this knowledge what does one do exactly? What happens now, Donald? You obviously want to spread the word and make people aware but to what end?

DM: In short: I want to bring a complete end to the Illuminati and usher in a "Golden Age" of mankind. This question is best answered by detailing my 'Mission and Vision' for ending the Illuminati completely.

Donald Marshall's Mission and Vision on How to Bring Down The Illuminati

- This disclosure must spread, and **spread FAST and FAR!**
- If you now understand everything I have disclosed in this document as truth, then do not waste any more time. Share this disclosure with your wives, husbands, brothers, sisters' aunties, uncles, friends, co-workers, and children. We all have a part to play in saving the world from a premature doom.
- Call friends who have not heard from you in a while and tell them you have important news to share. Share this document. Share it on social media such as Facebook; Twitter; Instagram; Dropbox; Slideshare etc.
- Keep sharing this document until it comes to the attention of the Armed Forces. The Armed Forces will have to intervene. Once the Armed Forces intervene we will have reached the middle stage of this vision and will be witnessing a complete end to the Illuminati. Until then, we're in the beginning stages, so please; spread this document faster and further. The quicker it is spread; the quicker the Illuminati are ended.
- Once the Armed Forces have intervened a Military coup can be orchestrated against these vile people.
- Cloning centres can then be shut down once these people are overthrown.

- The freeing of any missing people (children; teens; adults) trapped in the cloning centres can commence (once the Armed Forces intervene).
- HAARP (as well as other highly advanced technologies) can now be contained and not used for adverse effects against the world (once the world learns of this disclosure).
- These Illuminati people will then HAVE to appear in court for their crimes against humanity.
- Suing the Illuminati members in court (once court proceedings commence... we will be past the midpoint of my vision, and closer towards witnessing a complete end to the Illuminati).
- The populace (and it will be your choice) can then have their REM driven clone experiences restored and also sue and claim any legal reward / compensation.
- After the populace has sued the Illuminati for their crimes against humanity; the punishments can commence.
- Punishments will include: imprisonment and executions of these sick and malevolent people. The imprisonment and executions of evil Illuminati members will bring an end to the Illuminati.
- After the punishments and executions; Governments worldwide can now be replaced with incorrupt individuals, worldwide.
- The structure of Governance will also have to change. The reason for this because future generations will always be able to check their leaders and governance more appropriately; so that the depraved and subhuman acts I described can NEVER be committed against humanity again; nor will world leaders be capable of committing such monstrous crimes in such secrecy ever again.
- Ensuring that the laws of the land always progresses in line with advancements in medicine, science and technology; as well as, ensuring law progresses in the directions of Research and Development (R&D) regarding future technologies, science and medicine.
- Release of technologies, science and medicine which benefit mankind.
- Commence a “Golden Age” of mankind.

If you do not fight the corruption and you do not stand up for what is right in life, you end up being a serf and a slave and you are leaving your children a world in which you would not want to live in yourself, so how can you in decency behave that way? You have to stand up for what is right in life, and unless you do that you are nothing.

Aaron Russo

Empowerment by Virtue of Golden Truth

As you can see, despite all the horror of the world I currently present: if everything goes smoothly, the good people of this world, truly will inherit it. This is why despite any anger, sadness, or fears you may have; you must not riot, damage property or cause chaos or bring about any other form of public dissension. You cannot stay silent, or ignore the issue in the hope that the threat removes itself. You are called to act; you must take action to help bring the Illuminati to an end; you must act while at the same time, you must maintain your composure and resolve to ensure that the whole procedure goes smoothly, and we all inherit a world we want to live in.

Your life, **at this very moment**, is more important than you may have probably ever imagined. You have purpose. Through you, and other good people around the world, together we can bring an end to such unspeakable forms of tyranny in this world. It is my humble stance that you have now become truly empowered with golden truth and you are now compelled to bring this tyranny to an end.

Do not waste the knowledge you have obtained from this disclosure. It is my only hope to escape this man made living hell. It is my only hope, as well as, the hope of many REM clones imprisoned there, as well as, real people who go missing daily, and are trapped in the cloning centres.

We sincerely beg you.

Donald Marshall

Appendices

Appendix A: Thien Thanh Thi Nguyen (Tila Tequila) Transcript

Link: https://www.youtube.com/watch?v=7mRZ7ItF9ls&ab_channel=Astral7ight

00.00 – 1.10 min: You know what... since you f****** with my program darling Queen Elizabeth [II] and the paedophilia ring and the cloning centres, and the cloning centres. That's right darling the cloning centres. Parents listen to me right now, they are blocking me but that is quite alright. They are blocking me but that is quite alright. Because I have many, many other forces; I shall not say their names right now, but I have many big plans to expose all of you disgusting, sadistic f***s! Okay? That is all. I shall save that for another time. But, however, I shall REPEAT: that was just an introduction to the reptilian family, leading all the way back. They call themselves the "The Black Nobility". Now that is just one part of it; alright?

1.11 -2.47 min: The Black Nobility; the reptilian family; all the way back from ancient times; so which they think... they feel like they are the divine chosen ones... from whom may I ask? Definitely. Definitely not God. Our creator of the world. Reptilians: they feed on blood; children; the paedophilia ring; recently busted. Oh! It has been going on for centuries. Parents listen to me carefully. I don't care if I'm cutting out. I will continue this and I am not alone on this battle. Believe THAT! Believe THAT! I am not alone on this battle. I started out alone but I am marching on with MILLIONS; okay? So sit your old a** down okay. Because you are gonna roll over, but it doesn't matter anyway because you are all ancestral f***s! Who interbreed... ancestral f*****g... and then... and then... Oh! Only going to talk about cloning those children and... oh! And all those many children's parents listen to me carefully.

2.48 -4.24 min: Hundreds of missing children come up every year. You wonder... why? How? How could this be? And then there is so called CPS [Child Protection Services] or whatever they are called; they come and take your children, just, just for nothing; right? Not to discredit everybody, because not everybody is bad. I'm talking about the bad people. And they take your kids... they take them as this... they treat them like... I can't even say the word. It's disgusting, it's sadistic. They... they... they take your kids... they toss them out like little [inaudible] cause they are so f*****g... Pardon my French, but then again when I'm dealing with these evil cum-buckets I have no holy words coming out of my mouth, because these are the only words they resonate to. So therefore that's how I refer to them. Because they can only [inaudible] ...their masters whiplash on them with these [inaudible] words of cursing, vileness and slaving and that is not what the true God is; okay? The God of Hell...; Anyways...

4.25 – 5.30 min: There are these CLONING CENTRES where they take your children and do sadistic things to them. I'm not even talking about child molestation here; not to mention; uh there is one of them that got caught, flying out to Florida; to meet up with a four year old little girl, to have sex with a four year old girl. That's right. Google it because it is so highly sinful... We have commercials about... you know starving kids; you know save the starving kids and it is heartbreaking. We can have commercials about it... why? Because it is a horrible thing and people can have commercials about it. WHY do we not have commercials about... 'Daddy please don't, don't. Mommy please don't let daddy let daddy touch me?' – because it is disgusting! It is so disgusting; beyond sin that no one, NO ONE, can even make a commercial about that because that's how sinful it is.

5.31 – 7.19 min: Do you understand that? Do you understand how sinful that is? These people, I'm not even going to call them people; alright? They take your children; they not only molest them; men f*** them and make them shoot each other. They give them guns. It's either you shoot him or I'm gonna shoot you. They are... mind you, they are children. Children. Yes. I'm speaking out, because I... uh! Who else is doing this? You're all just [inaudible]... shame on you... And actually the most recent paedophilia... got taken down... WOW! How long did that take? Really?! Do you know how long this has been going on? *Sigh* Alright I'm gonna calm down... but as a parent and I love parents out there. My heart goes out to all the parents out there who have missing children. You know, we all pray for them; every day. And I put on a bold face in public every day; because there needs to be someone strong, believe that. But my strength comes from somewhere... that I have a very vulnerable emotional side where I feel very strongly for these children and innocent people. So therefore I want to speak out.

7.20 – 9.10 min: I have and I have my passion too; and in the end you shall all know why I am so passionate about exposing every single one of these scumbags; okay? The truth shall prevail and you all will know why. So, as for you parents... ah... there are no words to describe. But let me just expose because you can't just... there is a point where you CANNOT just turn the other way. You know this stuff is going on; and you go 'Oh well... that's their problem. Let's just turn the other cheek.' How long are you going to turn the other cheek, until it happens to your own freaking children? When, when, when your own child; three years old, get's run out [kidnapped] and gets blasted right in the head with a gun... yeah... there's more to that people; okay? And I'm not just saying that coming from some... I mean, actually, mothers, fathers out there... If you found out... I'm sure you would do way worse than what I am just saying. I'm just using voc. I'm just annihilating them vocally. I'm sure the parents out there who find out what their children have gone through, their missing children. I am pretty positive more than just a vocal annihilation of these scumbags that do this to your children; okay?

9.11 – 10.32 min: So keep on turning the other cheek folks. Hey, go and turn the other cheek; you are with the others. I am not. I AM NOT. Like I said you... There is only two ways to go about this: you're either with us: the good guys, or you're with the others. There is no in-between. Cause if you are in-between, hiding like cowards, turning the other cheek; doing whatever; well then you are a freaking coward and you are just a sheep. And sheep end up dying because you know what you are owned by "The Others". So pick one: you're either one of us: the good guys or you're part of the others. That is simple as that! Two choices: good guys; bad guys. In-between you're dead because the bad guys are going to suck your soul out [transfer your consciousness to your REM driven clone] and do some sadistic stuff to you and watch, and make you watch while they pretty sadistic stuff to your children as well.

10.33 – 11.33 min: Do you know why they love children? Because they are innocent souls; they're innocent... they're, they're the most innocent pure beings in this planet. They're not harmed by anything. They're new to the world; bright-eyed pure innocent children. That is why these disgusting paedophile and these clone rings; cloning centres; satanic rituals; Brownsville Texas... There are many other cloning centres where they take your children that go missing. And you wonder why? What happens to them? I'm sorry to break this to you but that is what happens. Now either do you want to know what happens to them or do you want to turn the other freaking cheek?

11.34 – 13.09 min: Tune into my next show. I'm gonna upload stuff; I have an arsenal ready to blow up! Okay. And I have reason behind this. You all should know my personal reason soon; but this has nothing to do with me right now. But know that I'm back, I'm back with a vengeance and I'm back with an army full of people around the world who are sick and tired of treated like animals; or quote, unquote "COWS". We all know what that means. For the outside world (the masses) we all know the term "sheep", sheeple. But for the insiders we know what the cows are don't we? You know what "The Others" like to do with the cows, right? They start to herd you in... and to... yeah...I'm gonna end it at that. And to all the parents, families and children out there, I love you so much. I... have to maintain composure, because that is what I do. That is all. Over and out.

Appendix B: MK Ultra

MK Ultra *-noun:* [Manufacturing Killers Utilizing Lethal Tradecraft Requiring Assassinations] The goal of mind control, using MK Ultra technology is to program an individual to carry out any task against their will and self-preservation instinct, and to control the absolute behaviour and thought patterns of the individual.

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Modern-day MK Ultra involves an implantable microchip which is inserted into a Mark 2 clone of the victim. Every thought, reaction, hearing and visual observation causes a certain neurological potential, spikes, and patterns in the brain and its electromagnetic fields, which can now be decoded by the implantable microchip into thoughts, pictures and voices. The thoughts, pictures and voices of the implanted Mark 2 clone (victim) can now be displayed visually and heard on any system capable of converting visual images, such as a television or a computer. These images are usually displayed on a giant screen at the cloning centre.

The purpose of MK Ultra is to elicit a specific conditioned response in a victim (desired by the programmer) to an otherwise neutral stimulus. In other words, through the process of "classical conditioning" (which involves learning a new behaviour via the process of association. In simple terms two stimuli are linked together to produce a new learned response in a person) the implanted Mark 2 REM duplicate clone (victim) is placed thorough many similar recurring scenarios which are experienced (or perceived) by the victim as "real", because the programmer manipulates the victim's audio and visual field, and continuously pairs the victim with the neutral stimulus, so that either a positive or negative conditioned response is elicited in the victim towards the neutral stimulus.

In other words an implanted victim can be placed in many recurring situations deemed as frightful, where a mystery stranger saves the victim from the frightful situation over and over again. The victim will now have positive associations towards the mystery stranger and therefore the conditioned response is now one of 'positive associations' (towards the mystery stranger who did not elicit such a reaction before).

MK Ultra techniques are administered through Mark 2 (sleep driven) clones. In other words classical conditioning happens when the person sleeps. Memory suppression technologies are also used in conjunction with MK Ultra technology, which enables the programmer to control certain memories the victim remembers. The use of memory suppression technologies and MK Ultra technology allows the programmer to reinforce behaviour and elicit specific conditioned responses (in an original).

Therefore, in our example above, when the original meets the mystery stranger in real life, the original (victim) will be predisposed to the mystery stranger and automatically 'feel safe' around this person and may even believe that he / she should 'date this mystery stranger' – depending on what was programmed; because the victim was conditioned to elicit such an emotional response towards the mystery stranger in his / her sleep as a Mark 2 REM driven clone through MK Ultra functionality.

MK Ultra can also be used to create zombified individuals who are programmed to murder and remember nothing of their crime afterward. MK Ultra (technology) can also be used to disrupt the memory of the original, discredit people through unusual behaviour, make the person insane or commit suicide and murder.

MK Ultra has much functionality. Furthermore, because of its video and audio projection functionality, MK Ultra can also be used to compose music. MK Ultra is capable of relaying the Mark 2 REM driven clone's subconscious and conscious mind as visual images and audio, projected onto a screen. Therefore thoughts, pictures and voices which have been experienced consciously and subconsciously in one's life can be displayed visually and audibly on a television or computer screen. The Mark 2 clone now has the option of harmonising these thoughts, pictures, and voices into a coherent order which produces music through the thought process of his or her imagination. See Jim Cristea (2009); Berkeley News (2011); UC Berkeley Campus Life (2011) CTForecaster (2013); nature video (2013) and Stromberg (2013) for examples and discussions and the capability of MK Ultra technology.

Appendix C: The Illuminati

Illuminati –*noun:* A modern-day criminal organisation operated by reprobate (depraved, unprincipled and wicked person) criminals. Their main agenda: is to enslave the whole world through advanced concealed technologies.

Today's Illuminati trace their roots back to Professor Adam Weishaupt who found the Illuminati on 1st May 1776. Since the inception of the Illuminati the intent has always been, and remains: "to bring about a NEW World Order that writes God out of the picture and deifies (glorifies) Lucifer." This intent is still prevalent today. The following excerpt is derived from A. Ralph Epperson (1990) *The New World Order:*

> Weishaupt was a teacher of Cannon Law (law governing the affairs of a Christian Church, especially the law created or recognised by the Papal authority in the Roman Catholic Church) at the University of Ingolstadt in Bavaria, now part of Germany.
>
> He even told the world, in his writings, where he would conceal the Order: "None is fitter than the three lower degrees of Free Masonry; the public is accustomed to it, expects little from it, and therefore takes little notice of it." He felt that this secrecy would lead him to success because he felt no one would be able to break into it. He wrote: "Our secret Association works in a way that nothing can withstand ...."
>
> Weishaupt accepted the fact that all secret associations and secret orders had two doctrines, one concealed and reserved for the Masters... the other public ...." and the Illuminati was [and are to this day] a secret society with two doctrines.
>
> Professor Weishaupt, its founder, boasted of his organization's secrecy. He realized that this secrecy would enable them to decide the fate of nations and because their deliberations were secret, no outsider could interfere. He wrote: "The great strength of our Order lies in its concealment; let it never appear in its own name, but always covered by another name, and another occupation." Weishaupt later wrote about that secrecy in a letter to a fellow member of the Illuminati: "Nothing can bring this about [the new world order] but hidden societies. Hidden schools of wisdom are the means which will one day free men from their bonds [the "bonds" of religion] Princes and nations shall vanish from the earth." So the secret societies were created to bring the world to the new society known as the New World Order. The members of these organizations obviously feel that their goals are so noble that they may perform whatever tasks are required of them to bring that goal to fruition. This means that murder, plunder, and lying all become acceptable as long as these methods assist its members in obtaining their goal.
>
> Adam Weishaupt, the founder of the Illuminati, wrote over and over and over again, that "the ends justified the means." Weishaupt also told initiates to use whatever means, which included murder, to achieve the goals of the association that he was joining. And that the major goal of the Illuminati, was the destruction of all religion, including Christianity. That meant that if Christians physically stood in the way, they could be removed by simply murdering them. Weishaupt even went so far as to say that anyone not willing to take the life of another was unfit to join the Illuminati. He wrote the following in a letter to a fellow member in 1778: "No man is fit for our Order who is not ... ready to go to every length ...."
>
> Another reason, that Weishaupt felt that the Illuminati would succeed, was the fact that he was offering his members worldwide power. He felt that this inducement would enable him to draw into his organization only those who would do anything to satisfy that desire for power. He wrote: "The true purpose of the Order was to rule the world. To achieve this it was necessary for the Order to destroy all religions, overthrow all governments and abolish private property."

> But his religion had a different base than the traditional religion: his was based upon a worship of reason: "... then will Reason rule with unperceived sway." "... Reason will be the only code of Man. This is one of our greatest secrets." "When at last Reason becomes the religion of man, then will the problem be solved." Weishaupt's dedication of his organization to "reason" makes some sense when the reader recalls that "reason" has been defined as the "unbridled use of man's mind to solve man's problems without the involvement of God." The Bible calls this "the fruit of the tree of the knowledge of good and evil." It was this knowledge that God wanted man not to have, and it was the promise made to man by Lucifer that man could have it by eating of "the fruit." In addition, Weishaupt's religion offered its believers a reward not offered by any other religion: worldwide power!
>
> Weishaupt wrote: "The pupils [members of the Illuminati] are convinced that the Order will rule the world. Every member therefore becomes a ruler." Weishaupt's religion not only offered power to his believers, but he offered them something else not guaranteed by any other religion: worldly success. He said that once a candidate had achieved the exalted degree of Illuminatus Minor, the fourth of the thirteen inside his Order, his superiors would: "assist him [the member] in bringing his talents into action, and [would] place him in situations most favourable for their exertion, so that he may be assured of success." Finally, the goal of the Illuminati was "man made perfect as a god - without God."

The ideology of "man made perfect as a god –without God" still remains to this day, and it is practiced by today's Illuminati members. The above phrase is what ties in Luciferian worship and trans-humanism. Lucifer is idolised by Illuminati members as the deity who gave man 'knowledge' and therefore is worthy of worship; God, -according to Luciferians, -did not want man to have knowledge and therefore is despised by Luciferians. Ingrained in the trans-humanism doctrine is the believe that: 'man can become 'god' through science and technology and in turn overthrow the Creator of the universe: God'. See LawOfIdentity (2014) and Mark Dice (2014).

These are the basics of Luciferianism. Therefore everything which is natural or pertains to nature must be contended or destroyed by Luciferians. This is why Illuminati members endorse having sex with children, killing first born sons, and drink blood. All the above go against nature and according to the 'edicts of Lucifer': paedophilia makes the person committing the act younger (it doesn't, it is just an excuse to act perverse on children because they know children are vulnerable); killing your first born son gives you good luck and fortune in this life (so yes, some Luciferians have sacrificed their first bon sons); and Illuminati members believe drinking blood / cannibalism is a 'purifying agent' (although in reality it causes spongiform encephalitis (holes in the brain)).

Modern-day Illuminati members still retain the goal of its founder "to bring about a NEW World Order that writes God out of the picture and deifies (glorifies) Lucifer." Infiltration through secrecy, still remains their mode of operation, for the current Illuminati and therefore they have secretly infiltrated all the major religions on earth; government and education – where each successive generation is being dumb down; they have continually diminished the ability for individuals to own private property, or claim inheritance; divided people against each other to continually diminish patriotism; and have continually diminished family values.

They also compartmentalise their knowledge between members. Until I fully exposed the Illuminati, many people who have been REM clones at the cloning centre did not know they were in fact REM driven clones, and thought they were in the 5th Dimension; the astral plane; a singularity; the spiritual realm; Valhalla; quantum hopping; a time stutter etc. or whatever else the Illuminati told them.

Today's Illuminati members also meet in secret (just like the founding members) as REM driven clones, **when they go to sleep**. Furthermore, because Illuminati meetings are in secret and not many people know the exact location (because knowledge is compartmentalised) of the cloning centre; or the fact that their consciousness has been transferred to Mark 2 REM driven clone bodies at the cloning centre (and they are not in their original bodies); as well as the fact that unsuspecting civilians have their memories suppressed; the points mentioned above are the reasons the Illuminati believe 'they are all powerful and untouchable'; and as a consequence, today's Illuminati members do all the disgusting things they want, because they believe no outsider can interfere.

The ring leaders of the Illuminati today also believe "the ends justify the means". This is why they clone, torture, molest, murder, and rape unsuspecting civilians as REM driven clones in their sleep. The Illuminati of today offer their members incitements to go along with their agenda and not oppose them (or face death). Another popular method is to entice their target with many, many wonderful prospects, and have the target believe they are joining a noble and prosperous venture, so that the target fulfils the objectives of the Illuminati unknowingly; promoting the Illuminati in a positive way, because the target has been deceived to perceive the nature of the Illuminati as 'positive'; by the time the target finds out the true intent of the Illuminati, and the evil which emanates from it, it is too late. Those who rise up in the ranks of the Illuminati are the men and women who have an insatiable lust for power, and most importantly: the men and women who want to rule the world.

Modern-day Illuminati members also wish to become gods (through technology); overthrow the Creator, and achieve their overall aim of enslaving mankind. This is why they clone people, and clone people in high rank society from all walks of life (movie stars, musicians, politicians etc.; whether the person willing wants to be part of the Illuminati or not) so long as that person is in a position of power and influence, the Illuminati clone that person, and threaten that person, for example -"Hey, you're going to hang with us –or else" –through such coercion, the people in high rank society who have power and influence will not oppose the Illuminati's plans to become gods; enslave mankind forever; and rule the world. Another reason for cloning high rank society is to include these people into the Illuminati (willingly or unwillingly) to ensure the world's populace remains in ignorance (because once all the world leaders and high rank society are cloned and under the coercion of the Illuminati nobody in a position of influence or power can warn the populace against the Illuminati) until the Illuminati's plan is completed and they have enslaved the world forever.

The Illuminati's overall aim of 'becoming gods' and ruling the world, as well as, mind controlling all the inhabitants of earth is also the reason the Illuminati:

- Administer drip feed disclosure through media, by telling some truths mixed with lies in order to conceal their true intentions and overall aim, and prevent the betrayed partner (the public) from ever discovering "the complete truth";
- Administer evaluative conditioning, by placing their symbols and ideology in popular media with positive associations, so that the unknowing and unsuspecting public will eventually become predisposed to the Illuminati and unsuspectingly have a positive or neutral response towards the Illuminati;
- Because they want to become 'gods' is also the reason the Illuminati is promoting RFID microchips and only discussing RFID microchips positively, while at the same time placing suppression (gagging) orders on anyone who speaks negatively about RFID microchips –which implies an unsuspecting public will willingly accept the microchip; and at the point of transaction, the person will have (unknowingly) given up their privacy to a third party (the Illuminati) for the rest of his / her life;
- Their aim to become 'gods' is also the reason the Illuminati are hurriedly trying to complete the HAARP grid across earth –because a complete HAARP grid will allow them to achieve their goal of mind control over the entire world; which fulfils their objective of becoming gods; because a complete HAARP grid will be capable of time travel, and therefore the Illuminati will be capable of going back to a previous time to correct the mistake(s) which led to their downfall; the Illuminati members will retain the knowledge of the previous time, and the rest of humanity will have no recollection of such a memory.

The Illuminati is **not** a joke. It is **not** fiction. They are very real, and part of humanity's reality; and through advanced concealed technologies the Illuminati aim to enslave humanity forever. The ring leaders of the present Illuminati includes Queen Elizabeth II, Prince Philip Duke of Edinburgh, Prince Charles of Wales and Vladimir Putin. I have also detailed the actions of the ringleaders in the main text in this disclosure, as well as, detailed other modern-day evil Illuminati members on my Facebook and Proboards. It is time the good people of earth, stopped being afraid, do the right thing, put a stop to this evil, and save themselves, as well as their children's children from being slaves forever. Spread and share this disclosure.

Glossary

Aneurysm -*noun:* An excessive swelling of the wall of an artery at a fixed point in the body. A brain aneurysm is therefore a: bulge or ballooning in a blood vessel in the brain. It often looks like a berry hanging on a stem. A brain aneurysm can leak or rapture, causing bleeding into the brain.

Brain Aneurysm -*noun:* see Aneurysm.

Clone –*noun:* a cell, group of cells, an organism produced asexually from a single ancestor and is genetically identical to a single ancestor.

Concealed Technology -*noun:* hidden machinery and devices undisclosed and currently unavailable for public consumption. Concealed (or military) technology develops at a rate of 44 years for every 12 months which passes in comparison to the technology the public is currently accustomed to. Origin: Phil Schneider.

Cloning Centre –*noun:* a physical location (on earth) where duplicate and replicate clones are produced. These physical locations are usually Deep Underground Military Bases (DUMBs). DUMBs have an entire floor dedicated to cloning. It is also a place where Illuminati members meet with each other as REM driven clones. The above-ground cloning centre where many high profile people attend can be found within a radius of 5/6 hours drive from the Robert Pickton Farm Port Coquitlam, British Columbia, in Canada, somewhere at a remote nature reserve.

Cloning Technology -*noun:* the technological advancements in medicine, science and technology used to produce duplicate and replicate copies of originals.

Conditioned Response -*noun:* an automatic response established by training to an ordinarily neutral stimulus.

Conditioned Stimulus –*noun:* A previously neutral stimulus that, after repeated association with an unconditioned stimulus, elicits the response produced by the unconditioned stimulus itself.

Consciousness –*noun:* the state of being aware of and responsive to one's surroundings; a person's awareness or perception of something.

Consciousness Transfer -*noun or verb:* the process of transferring or copying the mental content (including long-term memory and "self") from a particular brain and copying it to a computational device; artificial body or avatar body such as that of a robot or clone version of the original. It is also the feat in which the person's mental content (long term memory and "self") moves from one body into another.

Depopulation *verb:* to remove or reduce the population of, as by destruction or force.

Drip Feed Disclosure *noun or verb:* is the process of supplying information but in small amounts overtime. Drip feed disclosure is also the process of revealing information slowly overtime, possibly telling lies to conceal certain aspects of the truth until the source administering the drip feed disclosure has adequate time to let out the truth in a slow and controlled way, thereby delaying the betrayed partner (in this disclosure, the public) from having the "complete truth" for some time.

DUMB –*noun:* [Deep Underground Military Base] a facility directly owned and operated by or for the military or one of its branches that shelters military equipment and personnel, and facilitates training and operations beneath the surface of the earth.

Duplicate Clone -*noun:* a fully formed human body which is a genetic copy of original developed through the process of regenerative technology. Duplicate clones are grown in a big thick tank full of (salty) water.

Duplication Cloning -*verb:* involves agitating the cells of on an original repetitively until a fully formed human body of the original is developed. Duplicate clones take an average of 5 months to form into a fully developed human body of the original through the process of regenerative medicine and technology.

Evaluative Conditioning -*noun:* is a change in liking, which occurs due to an association with a positive or negative stimulus.

H.A.A.R.P. Technology –*noun:* [High frequency Active Auroral Research Program] a radio transmitting system that can bounce signals off the Earth's upper atmosphere, (60km (37 miles) to 1000km (620 miles) high) back to probe deep into the earth or sea. HAARP is also capable of: disrupting human mental processes; knocking out all global communication systems; changing weather patterns over large areas; interfering with wildlife and migration patterns; hurting ecosystems; negatively affect human beings health, moods and mental states; and unnaturally 'boil' the earth's upper atmosphere. HAARP used correctly will control the weather without any adverse effects.

H.A.A.R.P. Grid –*noun:* a network of radio transmitters which can bounce signals off the earth's upper surface. Each transmitter is located at a specific point across earth and communicates in unison with other radio transmitters across the earth. At this present time of writing, a HAARP grid has **not** been completed, although the Illuminati are working twice as fast to complete a HAARP grid. The threat to humanity once a HAARP grid is completed includes: mind control over the entire world's inhabitants. A completed HAARP grid will also be capable of time travel, and therefore the Illuminati will always be able to go back to a pervious point in time to correct the mistake(s) which led to their downfall. Humanity will be slaves forever.

Habeas Corpus -*noun:* is [A] writ [formal document] requiring a person under arrest to be brought before a judge or into court, especially to secure the person's release unless lawful grounds are shown for their detention.

Heart Attack -*noun:* A sudden occurrence of a blockage of the flow of blood to the heart.

Human Clone –*noun:* The creation of a genetically identical copy of a human.

Ionosphere –*noun:* the layer of the earth's atmosphere which contains a high concentration of ions and free electrons and is able to reflect radio waves. It lies above the mesosphere and extends from about 60km (37 miles) to 1,000 km (620 miles) above the earth's surface.

Illuminati –*noun:* A modern-day criminal organisation operated by reprobate (depraved, unprincipled and wicked person) criminals. Their main agenda: is to enslave the whole world through advanced concealed technologies. See Appendix C for further discussion.

Mark 2 Clone –*noun:* Is a sleep driven clone; specifically, a REM sleep driven clone. A Mark 2 Clone is activated by transferring the consciousness of an original into a Mark 2 Clone **only when** the original reaches REM sleep (usually 90- 110 minutes **after** the original falls asleep). Once the consciousness of the original is transferred from the original's body to the Mark 2 Clone, the Mark 2 clone is now capable of motion: such as walking, talking etc. The Mark 2 clone 'drops limp' and becomes motionless once the original wakes up from sleep. The original's consciousness no longer resides in the Mark 2 clone (once the original is awake) and therefore the Mark 2 clone is now incapable of motion. Mark 2 Clones are also known as "REM Driven Clones" and "REM Duplicate Clones".

Memory Suppression –*noun or verb:* is the selective removal of memories or associations with the mind using memory suppression technology.

Memory Suppression Technology –*noun:* any scientifically advanced technology used selectively to remove memories from the conscious mind.

Mind-Voice Technology –*noun:* an advanced technology capable of reading, listening, hearing and broadcasting a person's inner voice or thoughts. It is capable of replicating sounds **exactly**. Therefore an individual can hear the sound of drums, a guitar or any instrument and replicate that sound exactly just by thinking about it. Consequently, Mind-voice technology has the functionality of producing music.

Military Technology –*noun:* machinery and devices developed from scientific knowledge used by the Armed Forces which advance at a rate of 44 years for every 12 months which passes, compared to the technology the public is accustomed to. Origin: Phil Schneider

MK Ultra -*noun:* [Manufacturing Killers Utilizing Lethal Tradecraft Requiring Assassinations] The goal of mind control, using MK Ultra technology is to program an individual to carry out any task against their will and self-preservation instinct and to control the absolute behaviour and thought patterns of the individual. See Appendix B for further details.

Neutral Stimulus –*noun:* is a stimulus which initially produces no specific response other than focusing attention. In classical conditioning, when used together with an unconditioned stimulus, the neutral stimulus becomes a conditioned stimulus.

Negative Association -*noun:* is an undesirable experience or perception.

Negative Stimulus -*noun:* a stimulus with undesirable consequences.

New World Order -*noun:* [NWO] Agenda. The whole NWO agenda is to turn humanity into mindless slaves forever; whereby the post-humans / trans-humans mind control the entire world's populace either through RFID microchips or a completed HAARP grid. Another aspect of the NWO agenda is to depopulate the world's current population of 7.3 billion people to 500 million people (and never exceed a world population of 500 million people afterwards); ruled by a one world government; a one world ruler; with a one world religion. See Appendix C for more details.

Original –*noun:* A person who is **not** a clone.

Pain Receptor -*noun:* Any one of the many nerve endings throughout the body that warn of harmful changes in the environment such as excessive pressure or temperature.

Positive Association -*noun:* is a desirable experience or perception.

Positive stimulus -*noun:* a stimulus with desirable consequences.

Posthumanism –*noun:* seeks to rewrite the very definition of being human. It is the condition in which humans and intelligent technology become intertwined. In the Posthuman there are no essential differences or absolute demarcations between bodily existence and computer stimulation, cybernetic mechanism and biological organism, robot technology and human goals.

Posthuman -*noun:* see Posthumanism.

Project MK Ultra -*noun:* see MK Ultra.

Regenerative Medicine -*noun:* (of a living organism) the process of re-growing new tissues after loss or damage.

Regenerative Technology -*noun:* any machinery or device developed from scientific knowledge which has the capability to re-grow new tissues after loss or damage.

REM Sleep –*noun:* [Rapid Eye Movement] is the fifth stage of sleep in the sleep cycle. It takes 90 - 110 minutes to reach REM sleep after we fall asleep. REM sleep is also known as the "period of paralysation". The involuntary muscles such as the brain become more active whereas voluntary muscles (those that you move by choice) such as your arms and legs become more relaxed or paralysed. REM sleep is a kind of sleep that occurs at intervals during sleep, and it is characterised by rapid eye movements.

REM Driven Clone -*noun:* [Rapid Eye Movement Driven Clone] a clone that can only become activated, once the original is in REM sleep. See Mark 2 Clone.

REM Duplicate Clone -*noun:* [Rapid Eye Movement Driven Clone] A clone developed by regenerative medicine and technology and is therefore an identical copy of an original. REM duplicate clones can only become activated when the original is in REM sleep. See Mark 2 Clone.

REM Driven Clone Death –*noun:* the process where an original dies because of constant torture to their REM driven clone or where a constant electrical current is applied to the REM driven clone resulting in death of an original usually in the form of an aneurysm or heart attack (because consciousness is linked) in the original's body.

REM Driven Clone Torture —*noun or verb:* the action or practice of inflicting serve pain on a REM driven clone. REM driven clone torture causes biological and physiological responses in the original's body because consciousness is linked. Intermittent REM driven clone torture (depending on what is done) causes the original to experience severe headaches, an upset stomach, achy limbs, sickness; a weakened heart. Continuous REM driven clone torture will lead to the death of the original; usually in the form of aneurysm or heart attack in the original's body.

Replication Cloning –*verb:* involves giving birth to a genetic identical of an original where the newborn starts life off as a baby and matures. The newborn is referred to as a clone.

RFID Technology [Radio Frequency Identification] **-***noun:* are electronic microchips the size of a grain of sand that can be directly embedded into the human flesh. RFID microchips communicate wirelessly through the use of electromagnetic fields to transfer data. RFID microchips link the brains of people via the implanted microchip to satellites controlled by ground base super-computers. The dangers of RFID microchips to the implanted person are: total loss of privacy and total control of the person's physical body functions, mental and emotional thought processes, including the implanted person's subconscious or dreams –for the rest of that person's life! RFID microchips are also tracking devices, and the implanted person can be tracked anywhere on the globe.

Selling One's Soul -*verb:* to sell the use one's "Mark 2" REM driven clone to the Illuminati, for the Illuminati to use the individual's Mark 2 REM driven clone in whatever manner the Illuminati wishes. There are no returns once the individual has signed over his / her (soul) Mark 2 REM driven clone. When an individual sells their (soul) Mark 2 REM driven clone, the person has also entered into a contract to sell the Mark 2 REM driven clone(s) of their current children (if they have any) as well as any unborn children the person may have later in life. The person sells all their descendants (souls) Mark 2 REM driven clones to the Illuminati, once the individual sells their (soul) Mark 2 REM driven clone to the Illuminati. Selling one's (soul) Mark 2 REM driven clone is considered **a serious business transaction** to the Illuminati. There are no returns. If the person ever makes a fuss and wants their (soul) Mark 2 REM driven clone back, the Illuminati will either torture the person's Mark 2 Clone, or apply a constant electric current to the person's Mark 2 Clone until the person either has a heart attack or aneurysm in their original body. This is what public figures are hinting at when they say "They have sold their soul". They have sold the use of their Mark 2 REM driven clone to the Illuminati. Selling one's soul is not a joke. Never sell your soul.

Stimulus –*noun:* is something that causes a reaction, especially interest, excitement or energy. It is also an energy change registered by the senses. For example a stimulus can be a shinny object for a baby.

Technology –*noun:* machinery and devices developed from scientific knowledge.

Technological Advancement –*noun:* is incorporating, by means of experimental development, a characteristic or capability not previously existing or available in standard practice, into a new or existing process or product that enhances a product's performance. Novelty, uniqueness, or innovation alone does not indicate a technological advancement.

Transhumanism –*noun:* the belief or theory that the human race can evolve beyond its current physical and mental limitations, especially by means of science and technology.

Unconditioned Response –*noun:* is a response to a neutral stimulus we have no / little control over. It is a natural automatic response. For example, food is an unconditioned stimulus for a hungry animal, and salivation is the unconditioned response.

Unconditioned Stimulus –*noun:* A stimulus that elicits an unconditioned response.

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Tetryonic Theory

The unified quantum field geometry of charged EM mass-ENERGY-Matter in motion

"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them." [Albert Einstein]

Given the range and applied scope of Quantum Physics in today's modern technologic World there remains a driving desire to rationalise our numerous disparate scientific theories into one coherent theory with a intuitive model that can be applied equally to the Quantum and Cosmological scales of our Universe.

Such a theory would need to preserve the currently observed outcomes and present established theories in a new light, offering additional testable predictions of its own, and ideally do so in a manner that is simpler than that of the established theories and hypothesises.

Many foundational properties of Quantum Mechanics remain unaddressed by scientific theory and in the following pages an overview of the key quantum properties challenging our current scientific advancement will be highlighted, including a number of assumptions that currently impede the development of a fully realised, coherent solution to all of our current scientific questions.

While Mathematics is the language of Science it remains a language that lacks a well-defined physical model on which to test it and further its many and varied solutions to Quantum & Cosmological scale physics. It is this lack of any rigid, enforceable GEOMETRY that has allowed the development of numerous disjointed statistical and probabilistic solutions to physical problems, in turn impeding our scientific understanding and advancement of quantum processes.

The Standard Model has many observed and testable components to it but more recently new theories have emerged to contest it without being rigorously testable themselves. They rely on the established foundation provided by the Standard Model but try to explain its various deficiencies ad-hoc with various suppositions without any solid footing of their own.

Often the only way to progress further in our scientific endeavours is to retrace our footsteps in science and to develop new physical models on which we can discern our known results and observations thus excluding any false or misleading assumptions (mathematical of otherwise).

In doing so there exists the promise that a simple underlying foundation can be found to the physics of our Universe, revealing new and exciting advances in Science that will allow us to usher in a new age of scientific and technological advancement for the betterment of humanity as a whole.

'Tetryonics – The charged geometry of EM mass-ENERGY-Matter' whose founding principle is that **EQUILATERAL Planck energies are** the foundation geometry for all quantum mechanical processes is presented here as just such a solution to the current quandaries of Quantum Mechanics.

ENERGY

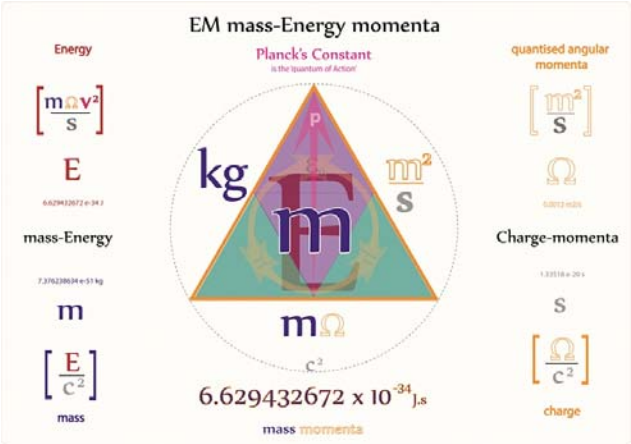

Energy, in Physics, is an indirectly observed quantity of a system that imbues it with the ability to exert a Force or do Work over a distance.

It has been measured and quantified through numerous methodologies over the centuries, most notably through its associated characteristics such as mass, velocity and ElectroMagnetic fields.

The most recent attempt to quantify its characteristics (with respect to heat and light) led to the discovery of Planck's constant and the development of Quantum Mechanics

The application of a simple proposition (that Energy has an equilateral geometry) opens the door on a greater understanding of the mechanics of the quantum world, a realm that will be forever beyond the reach of our physical eyes.

The myriad of perplexing properties of quantum properties (such as Charge, mass & Matter) and the astonishing outcomes of quantum experiments (Interference and Wave-Particle duality) can now all be readily modelled and explained rationally on a solid geometric footing.

Paving the way for new discoveries and a greater understanding of our Universe and its mechanics

Quantised Angular Momenta

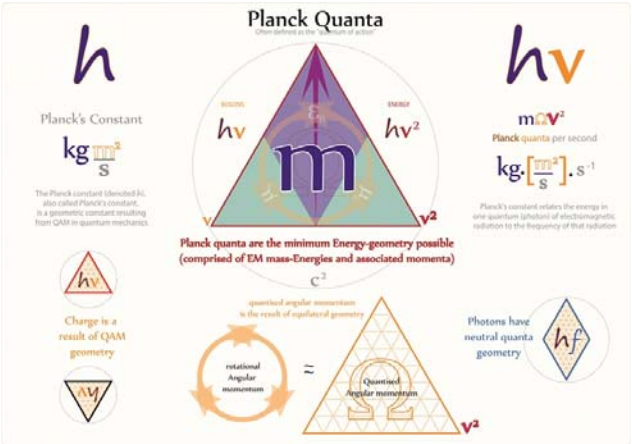

Building on the priori definition of equilateral energy quantisation it can be quickly demonstrated that any energy measurement per unit of Time results in a geometric unit of measurement that has historically be taken to represent rotational motion (specifically Angular momentum)

This unit of motion is found throughout Quantum Mechanics and is directly related to the square energy levels in nuclear processes.

The equilateral EM fields of energy quanta are constrained by its geometry and this geometry lies at the heart of understanding the quantum world in all its beauty.

It determines properties such as Electric permittivity and Magnetic permeability, the vector direction of linear momentum and relates the scalar property of electromagnetic mass directly to velocity.

CHARGE

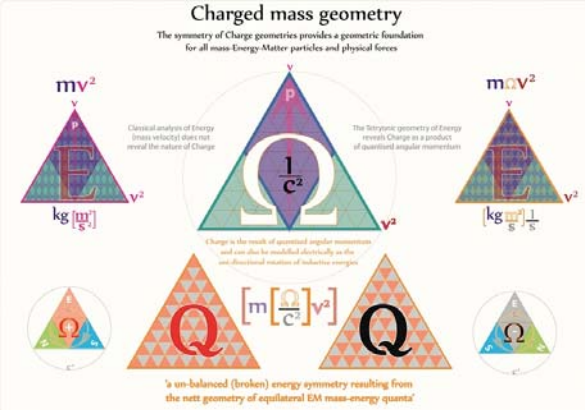

A fundemental property of all mass-ENERGY-Matter that gives rise to the Forces of electrical Interaction has eluded physical explanation by Physicists since its discovery and led to many 'band aid' additions to the Standard model in attempts to explain its observed properties.

The most recent attempt at an explanation was Special relativity theory which in turn led to our current models of charge from contractions of Matter due to motion.

SR explains Charge as an invariant property of of electrostatic bodies and that the motion of charges creates an additional magnetic moment through the relativistic distortion of spherical bodies of Matter.

Equilateral Planck energy momenta geometries and Matter topologies offer a completely different explanation for the source of electrostatic charges and their associated magnetic moments.

Positive and Negative charges are revealed to be opposite side of the same quantum energy 'quoin', and can be modelled electrically as ideal quantum inductive loops. It is equilateral geometry that gives rise to the physical properties of quantised angular momenta, inertial mass, elemental charges and even the geometric topology of Matter itself.

In a planar 2D form they form a neutral EM energy momenta geometry but it is when they form the topology of 3D Matter they are expressed as either Positive or Negative electric charge fascia.

ODD number energy quanta [W Bosons] combine via their magnetic bases in fixed quantum steps to create the 'squared' nuclear energy levels so familiar to quantum mechanics and form the basis for ElectroMagnetic Induction.

It is their rigid equilateral geometry that provides the basis for relativistic charge invariance and the quantum mechanism for photo-electron transitions in atoms while the net energy momenta quanta in charged geometries provides the electromotive force known as Voltage.

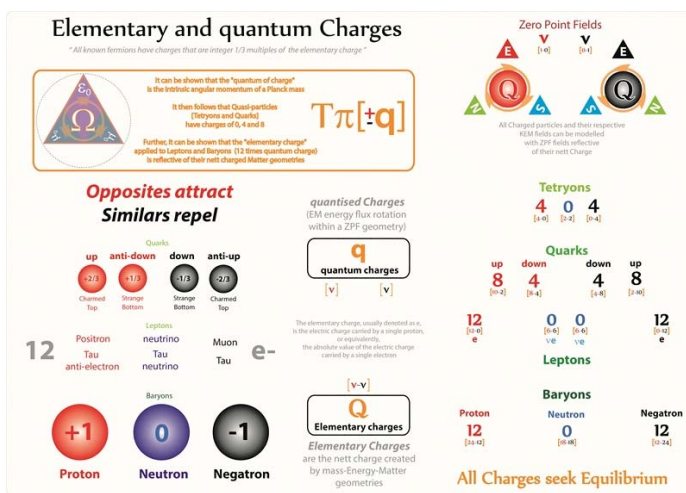

Equilateral geometry reveals an intrinsic connection between EM Energy, mass and Charge.

As separated charges seek equilibrium they provide motive energies & the quantum scaffolding for large scale Matter topologies and their force interactions throughout our Universe.

mass-ENERGY-Matter

All Energy has an EM mass equivalence and equally any object with EM mass has energy equivalence

But there has never been a formal scientific definition and associated equation to distinguish the property of EM mass from that of Matter.

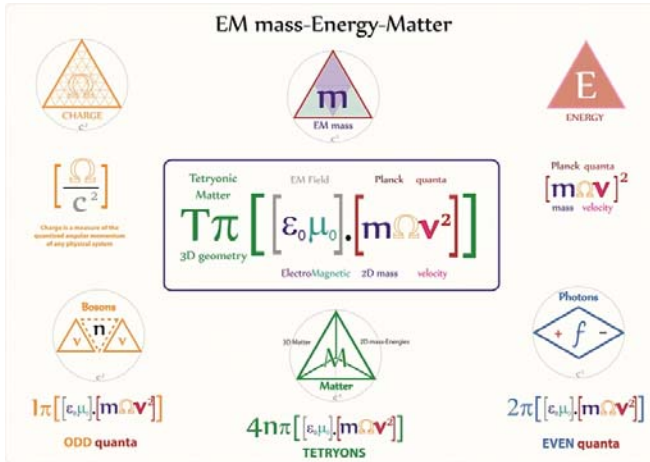

Using Tetryonic geometry it can be clearly demonstrated that ElectroMagnetic mass is NOT Matter – it is the Energy content of a system per unit of time [E / c^2] in total agreement with Einstein (and all before him) however, lacking a formal definition of either the two terms have become mired with each other so much that they are often used for each other inappropriately even in scientific peer-reviewed literature.

ElectroMagnetic mass is the two dimensional (planar) measurement of Energy per unit of Time whereas Matter is a measure of the tetrahedral energies found in a spherical volume of 3D space.

Mass-energy can be viewed as the paper from which 3D Matter is created when it is folded into a tetrahedral shape (the quantum canvas covering the topology of Matter)

The often used tem of 'massless' is now shown to be a misnomer that should be removed from the scientific vocabulary except where it specifically refers to empty space (devoid of any energies).

Matter is now formally defined geometrically as 4nπ tetrahedral standing wave of EM energy and it is the tetrahedral topology of Tetryons that forms the foundation for all large scale Matter in the Universe (not spherical point particles).

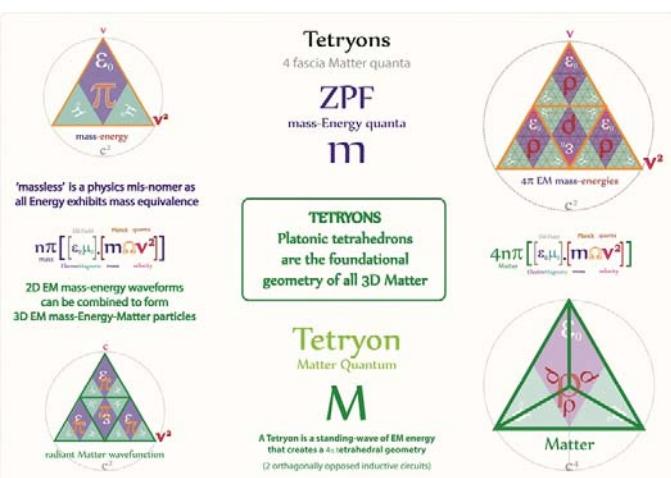

Charge allows EM masses to form a Tetryonic topology giving volume to Matter and its energy momenta provides the interactive forces between them imbuing motion into our Universe.

Matter at rest is comprised of EM mass-energies that are always in motion and propagating in a tetrahedral EM standing wave.

To cause at will the birth and death of matter would be man's grandest deed, which would give him the mastery of physical creation, make him fulfil his ultimate destiny."

[Nikola Tesla]

Sub-Atomic Particles

Using equilateral energy all the mass-energy geometries & mass-Matter topologies of EM fields and particles can be physically modelled revealing the known Standard Model particle sand a few more.

Bosons are shown to be transverse EM fields that facilitate EM induction and Photons are revealed as longitudinal dual-charge pairs possessing a neutral EM charge and inherent magnetic moment.

The net unidirectional momentum of Bosons then distinguishes them from Photons that possess a bi-directional momentum

Closer examination of the geometries highlights a long-standing error in the mathematical formulation of QM energy formulas, namely the mistaken interchanging of Planck's quanta [*v*] for Einstein's frequency [*f*] in relation to Energy.

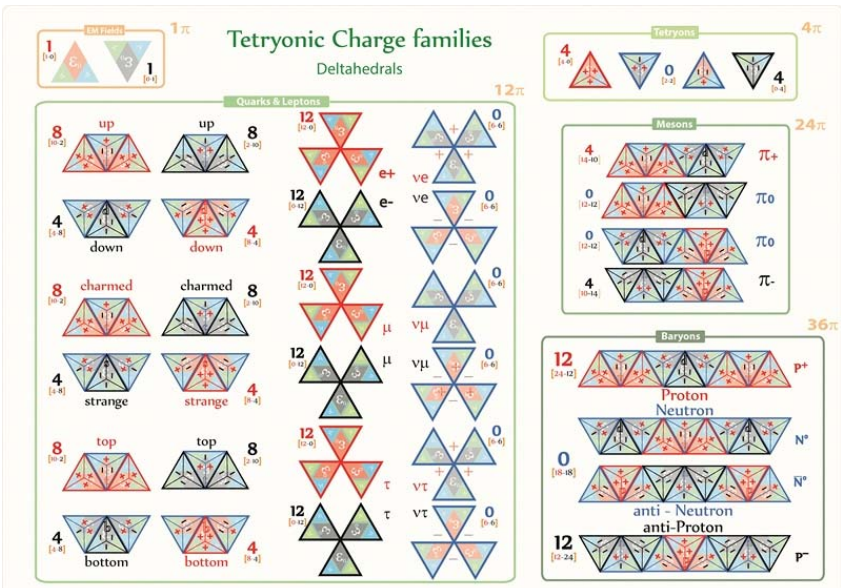

2D EM masses [bosons-photons] do not have the physical property of 3D topology possessed by Matter [Fermions]

Fermions can now be defined as the standing wave energy topologies that create all the known sub-atomic particles – the building blocks of large scale Matter and structure in the macro world.

Historically these particles have been classified according to their charges and masses, Tetryonic geometry now provides a 3D physical model of all the particles highlighting the physical source of the 1/3 charges of Quarks and revealing charge to be the foundational geometry of all Matter.

Tetryons are 4π charge topologies that are the foundational quanta of Matter and surprisingly have a mass-charge ratio identical to that of Leptons explaining how these particles have remained hidden from accelerator experiments.

Quarks are 12π charge geometries where the attractive strong charge interactions between their fascia form 8π particle topologies with entirely different properties to that of Leptons

Leptons also have 12π charge geometries but with repulsive fascia that result in them forming the quantum equivalent of a 6 loop rotor

Protons and Neutrons are 36π charge geometries [that result in 20π Baryon topologies] and have identical masses (against the current model of baryonic masses which derived from an entirely different process where Neutrons are formed by Protons absorbing electrons).

The Particle Zoo

Baryons – the building blocks of atomic nuclei can be formed from many tri- quark combinations and energy levels and this is of particular note when modern accelerators are used to probe atomic structures.

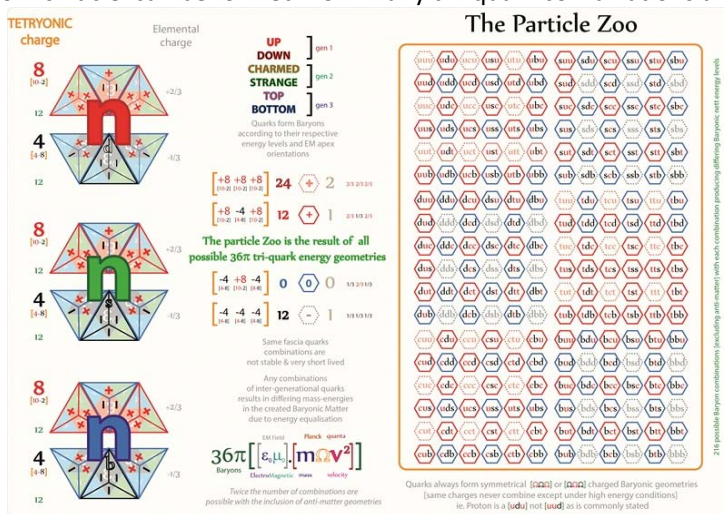

The higher energies they employ when colliding particles together results in higher 2D kinetic energies (and increased energy quanta) which recombine after collisions into a plethora of similar particles called the Particle Zoo.

A sound understanding of EM mass-energy geometries & the charged topologies of all sub-atomic Matter particles reveals the true genesis of all of the Baryons to be found in the particle zoo.

Tetryonic geometries facilitate the precise 3D modelling of all the periodic elements, allotropes and compounds enabling the development of new classes of materials and medicines providing us with many new insights into Quantum Chemistry and large scale Matter in general.

Quantum Electro-Dynamics [QED]

Adding to the mysteries of quantum mechanics is a number of well-known QED effects that have also eluded physical explanation – to date

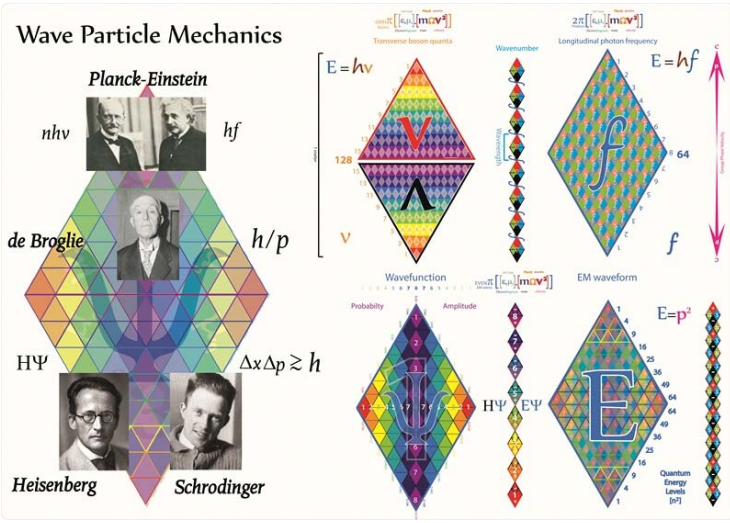

In 1865, James Maxwell Clerk unified the then disparate theories of Electric and Magnetic fields into a theory of Electromagnetism and related then to the velocity of light.

The exact quantum geometry for EM wave geometries (and the photons comprising them) that explains their Wavefunctions and observed inference patterns represents one of the greatest challenges to developing a concise fully realised quantum theory of EM radiation.

Wave-Particle duality dating back to the 17th century is perhaps the best known example of quantum behaviour that has defied precise modelling despite intense effort by scientists around the World for over two centuries

The application of equilateral energy momenta to the charged geometries of Photons and EM waves not only explains these long standing mysteries but also removes the quantum fuzziness introduced by Heisenberg's Uncertainty principle, in turn clearing the way for Science to develop an advanced understanding of Electricity, its role in Quantum ElectroDynamics and provide new clean forms of energy from quantum processes.

Photo-electrons and spectral lines

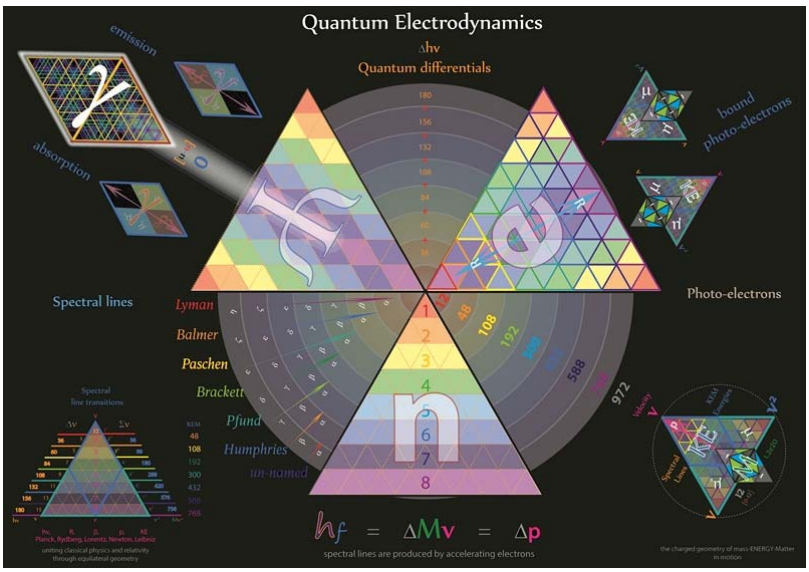

The physical relationship between Spectral lines, Rydberg's Constant and the Kinetic energies of Photo-electrons as they interact with photons and atomic nuclei is quickly revealed when equilateral energy geometries are employed

It is the rigid geometry of equilateral Planck energy momenta that gives rise to the invisible forces of Faraday's Electric and Gauss' Magnetic fields as well as Newton's Action-at-a-Distance.

Quantised Angular Momentum, a direct measure of the long hidden equilateral geometry of Energy, is revealed as the source of Charge, the physical constants and even the geometry of EM mass-energy & Matter itself.

The geometry of Nuclear Forces and Constants

Charge interactions resulting from equilateral EM energy geometries have been mistakenly developed into three disparate nuclear forces:

The EM Force is the result of $2n\pi$ charge geometries acting along transverse or longitudinal directions (or in superposition) in the forms of Bosons and Photons

The Weak Force is the inductive coupling of the magnetic permeability of adjacent energy geometries

The Strong Force is the attractive force between opposite charged fascia of Tetryonic Matter. It can also form a repulsive force between similar charged fasciae resulting in charged Leptons [electrons].

Gravitation (mathematically identical to Coulomb's Force save for strength and source) can also be modelled as the geometric mean of super-positioned EM waves.

All of which are determined by the Fine Structure Constant – the mysterious hand of GOD – setting the strength of EM interactions and determining Charge on the quantum level.

Applying equilateral geometry to energy momenta quanta, the Tetryonic model of EM mass-ENERGY-Matter quickly evolves to explain many additional electrical properties such as Voltage, Current and Power

Quantum Chemistry

Applying tetrahedral Matter topologies to quantum chemistry leads to a number of significant advances in the understanding of chemical processes most notably:

- **Accurate models for all periodic elements and their associated allotropes**
- **Advanced molecular orbitals plots**
- **Exact rest masses for all elements and**
- **A new Periodic table based on the charged topologies of Matter**

Improving upon and extending the Aufbau principle with charged geometries leads to many refinements in chemical engineering and facilitates the building of accurate 3D models of all elements, isotopes and compounds.

Every element can be analysed from the quantum level upwards revealing its exact 3D topology, quark configuration, rest mass-Matter-energies and chemical properties.

And number of misconceptions can be quickly clarified and corrected in turn advancing our understanding to the physical mechanics underlying chemical processes like chemical bonding, element family properties and the structures of complex chemical compounds.

Hydrocarbons and Carbohydrates have already been modelled using equilateral charge topology with the results matching the established chemical models of Nobel gases, Core electrons, Lewis diagrams and the most recent electron photographs of these chemical properties of atoms.

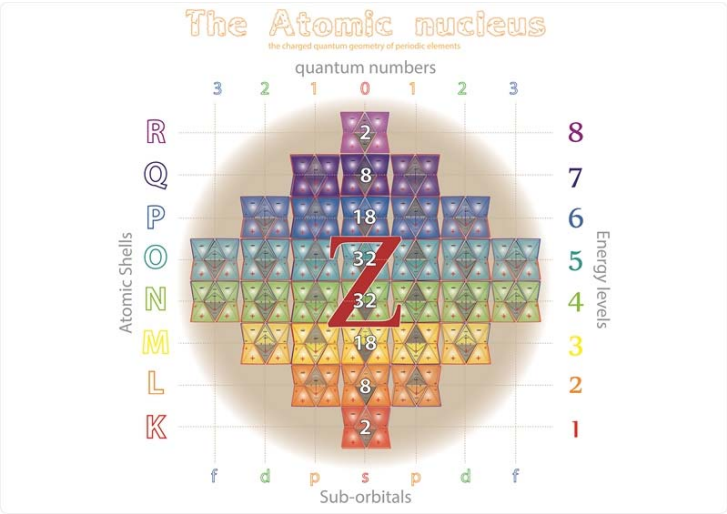

Even DNA can be modelled in 3 dimensions leading to a greater understanding of the role of quantum mechanics in biological processes and the interaction of EM radiation on organic compounds.

A highly developed quantum model of chemical elements and compounds will allow us to model chemical and biological structures in hitherto unimagined detail and facilitate the building of complex (and increasingly accurate) models of all chemical compounds and biological processes.

A Unified field equation

In physics a Unified Field Theory is a type of theory that allows all that is usually thought of as a fundamental force or elementary particle to be formulated in terms of a single equation that explains all their disparate properties.

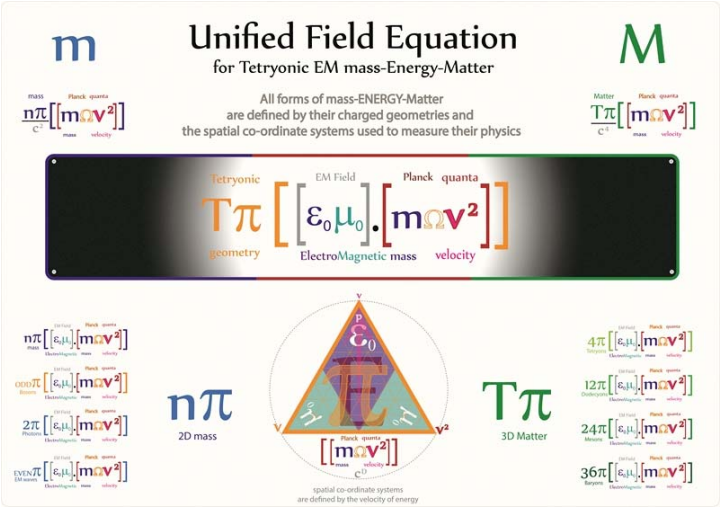

It is considered the holy grail of Science, offering the promise of advances in Technology, Energy and Medicine unparalleled in Human history.

Equilateral energy provides the foundation for the creation of a single equation that expresses EM mass-ENERGY and Matter as the result of geometric & topological charge interactions.

Applying equilateral geometry to Planck energy momenta quanta has been shown to firmly resolve many of the current mysteries plaguing the Standard model and provides a firm foundation for the development of a single unified quantum theory uniting all quantum and macroscopic forces.

It effortlessly merges all the tested features of Classical mechanics with the statistical probabilities of quantum mechanics and scales up to the cosmological scale of General Relativity.

Equilateral charged energy geometries provide a quantifiable foundation for advances in:

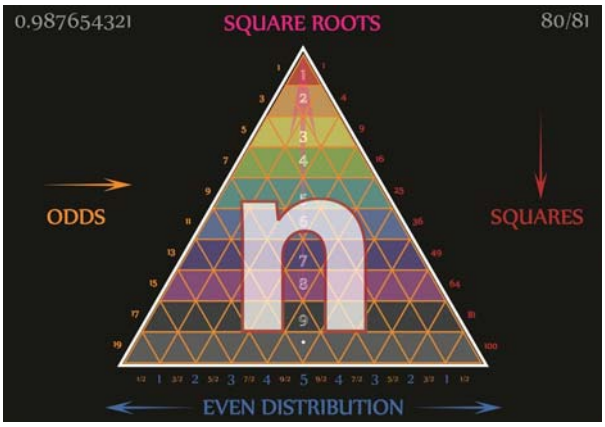

- **Quantum Mechanics**
- **Quantum Electrodynamics**
- **Quantum Chemistry**
- **Quantum Cosmology**

Explaining the quantum mysteries of mass & Matter, Wave-Particle duality and gravitational Singularities by challenging the very foundational assumptions of Relativity and the role of charge in our Universe.

Mathematical principles such as re-normalisation, probabilities and square roots of negative numbers can all be geometrically modelled through Tetryonics leading to further advances in fields such as biology, medicine, quantum computing and telecommunications

Through the charged geometry of Tetryonics many of the erroneous theories that have been developed during the last 1oo years can be falsified at last providing a solid foundation for further advances in science and mathematics.

Gravitation

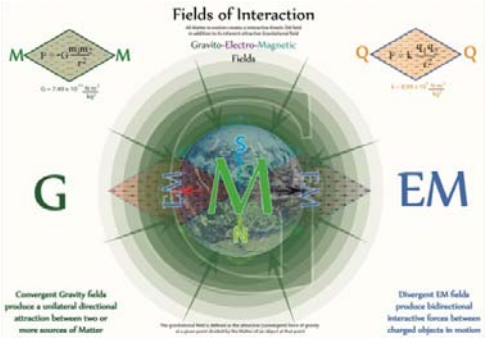

The force of Gravity has been long-held to be the mysterious force that holds our Universe together, shaping the Stars and holding us to the Earth as we orbit our own SUN.

Tetryonic geometry reveals its quantum mechanics to be the result of electromagnetic fields and the effect produced by the geometry of Matter in these fields.

Newton saw Gravity as a force that acts instantaneously on distant bodies of Matter while Einstein dismissed the force between the bodies and explained it as the result of the 'curvature of Spacetime'.

In fact the Gravitational field is comprised of 3 separate components, each of which produces differing forces of interaction, but all combine to produce the nett Gravitational field that we observe and describe as strictly convergent Gravity.

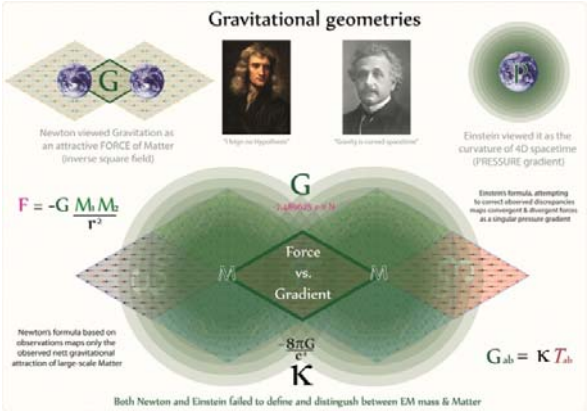

Gravity fields are created by the topology of Matter itself as it displaces and distorts the Vacuum energies surrounding it.

Electric fields diverge radially from all Matter as it is heated, or placed in motion by other forces creating an interactive field with both divergent and convergent equatorial regions of force and acceleration.

Dipole Magnetic fields located around the Polar Regions of all Matter also create a perturbative force on bodies close to them

Although Newton's and Einstein's theories were both correct in their respective analysis of the forces at work they both failed to define and distinguish between EM masses and Matter leading to the continued debate over the true nature and physical formulation of quantum gravity.

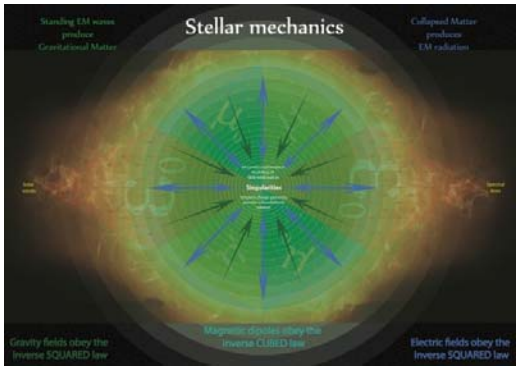

These three quantum forces [G+E+M] combine to produce a field of gravitational acceleration that was so eloquently modelled by Newton back in the 16th century through his inverse square law.

And these 3 distinct forces also combine to produce the stellar mechanics that power the Stars – a Gravito-Electro-Magnetic pinch.

The force of Gravity, created by the geometry of Matter draws Matter toward the core of Stars.

And the GEM pinch singularity at the core of the Star destroys Matter (collapsing its 3D geometry), turning it into radiant 2D ElectroMagnetic radiation (Light).

Energy from the Stars

Virtual particles, Dark Energy and Dark Matter (were all developed to explain the observed mechanics of our Universe) and can now be revealed to be differing manifestations of the electromagnetic force interacting at various angles to, and with, the standing-wave topologies that create it.

Quantum fields of Planck energies combine to create charged 2D geometries of radiative ElectroMagnetic fields that in turn spread out interacting with each other to give us the fundamental laws of Attraction and Repulsion.

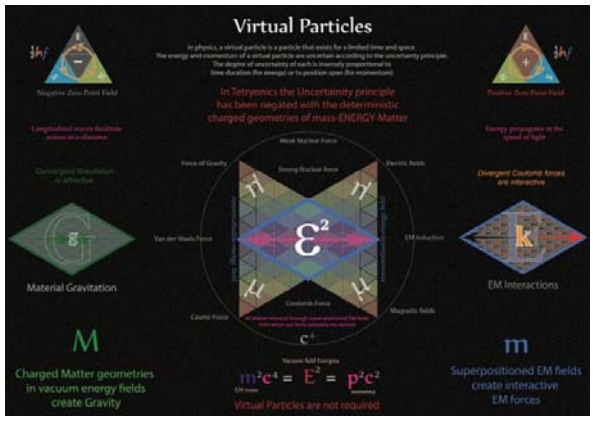

The 3D standing-wave topologies of Matter provide a rigid structure that displaces the surrounding Vacuum energies and creates a pressure gradient which we call Gravity.

And the destruction of these Matter topologies in turn creates radiant energies that propagate out into the surrounding space to weaken and form the Vacuum energies that permeate all of Space.

The eternal cycle of Matter creation and destruction within Stars and Galaxies is what drives the Universe we see today causing it to contract as it forms gravitational Matter and to expand as it restructures the standing-wave Matter into radiant forms of Energy (Light and heat).

The same process offers us clean, limitless energy for all our needs as well as unlimited resources from the restructuring of this energy into its varied elemental and compound forms.

Our toxic stockpiles of radioactive wastes can be completely eliminated from the environment and electrical power can be safely stored as mass within large-scale models of the deuterium nuclei and distributed worldwide to any location without the need for transmission lines.

Even hydro-electric storage schemes can be eliminated, returning water courses to their natural states of flow in turn reducing conflicts stemming from the flow of this precious resource worldwide.

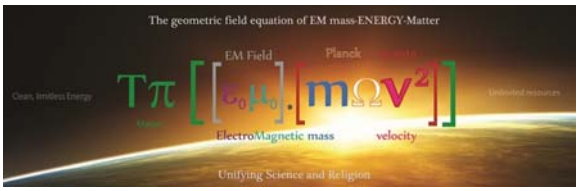

Through the geometries of equilateral Planck energies and the application of the Tetryonic unified field equation of mass-ENERGY-Matter in motion to our needs, for the first time in Humanity's history, we have the chance to advance our civilization to new pinnacles of technology and understanding in turn leaving our World a better place than we found it to be.

The age old dilemma of technological advancement versus environmental pollution is at an end

We stand on the threshold of realising one of the greatest advances in scientific understanding ever witnessed but we must also endeavour to redress our current social challenges with an equally rigorous determination to ensure all of Humanity benefits from this discovery

…… *ABRAHAM [2012]*

Tetryonics …. Challenging and correcting the foundations of quantum theory

Electric field permittivity has a 2pi (rhombic) field geometry while magnetic field permeability is always the result of two separate equilateral magnetic fields that form a magnetic dipole moment

Where two or more rhombic electric fields interact a Coulombic –charge force of interaction results
Where two or more equilateral magnetic fields interact a Gaussian-Ampere forces of interaction results *[opposite fields attract - same fields repel]*

The classical model of the unidirectional electrostatic force fields of point charged particles is corrected to show a bidirectional arrangement of equilateral Planck energy momenta geometries within the electrostatic field that creates the bi-directional forces of charge interactions

Where two similar coupled equilateral energy momenta fields combine an electrostatic field is created
Where two opposite coupled equilateral energy momenta fields combine a magnetic dipole is created

The arrangement and asymmetry of Planck quantum charges with in any EM field determines the motion and acceleration of charged particles within the field of electrostatic force

The classical forces of attraction should be renamed forces of interaction
(as they result from bidirectional quantum vector forces)

All electromagnetic fields are comprised of a squared number of equilateral Planck energy momenta quanta (whose asymmetrical distribution of equilateral Planck quanta results in a net divergent Force) with a convergent vector force component

When modelled with equilateral Planck geometries electromagnetic fields follow the Biot-Savart Law:

- Rhombic electric fields follow the inverse squared law of propagation
- Equilateral magnetic fields follow the inverse squared law of propagation
- Magnetic dipole fields follow an inverse cubed law of propagation

The equilateral geometry of quantised angular momentum creates chirality at the quantum level in physics (rotation does not affect the charge of plank quanta, but mirroring and/or spatial coordinate translations do)

All positive charged fields can be modelled as having a clockwise inductive flux geometry
All negative charged fields can be modelled as having an anticlockwise inductive flux geometry
(with OMEGA representing equilateral geometries per second and PI reflecting their scalar areas]

All W bosons are comprised of an odd number of equilateral Planck quanta in a trapezoidal geometry
All Z bosons are comprised of an even number of equilateral Planck quanta in a dual-trapezoidal geometry (neutral Z bosons are equivalent in terms of Planck mass energy momenta to photons save their net geometry)

All charged fascia [Higgs bosons] are comprised of squared numbers of equilateral Planck quanta in an equilateral geometry.

The odd quanta W bosons within electromagnetic fields form quantum levels of charged mass-energy momenta

The Planck equation [E=n.hv] of quantised energy is a generalised equation of Planck geometries (and applies to all energy momenta arrangements equally)

Bosons and Quantum levels are a transverse measure of mass energy momenta in EM fields
Photons are a longitudinal measure of mass energy momenta within the same electromagnetic fields

Equilateral Planck energy momenta per second [E/c^2] equates to mass geometries
Equilateral Planck energies momenta per second squared [E/c^4] equates to Matter topologies

Interactive **mass energy geometries** can combine via the weak force to form standing wave Matter topologies

Standing wave **Matter topologies** can combine via the strong force to form elementary subatomic particles

The fundamental Matter quantum of all physics is the tetryon (a tetrahedral mass-energy Matter topology) which is formed from photons of electrostatic energy and can be found as positive, neutral or negative charges topologies

These three forms of charged tetryons form the foundation of all the physical Matter of our universe as they seek a state of equilibrium, Tetryons are not spherical point charges – they are tetrahedral, likewise the subatomic particles they form are not spherical point charges - they are **[T]π** Tetryonic charge topologies

The Tetryonic topologies created by tetryons as they combine to form elementary particles creates new forms of closed volume topologies that follow Euler's characteristic [V+F-E = 2] for Platonic solids

Quarks and leptons are comprised of 12 charged mass energy geometries
- quarks form *[8π]* octahedral Matter topologies
- leptons form *[12π]* dodecahedral Matter topologies

and

Baryons are comprised of 36 charged mass energy geometries
- forming *[20π]* Icosahedral Matter topologies

Anti-UP quark's are comprised of 2 positive and 8 negative charges
creating a net charge of **-8** *[-2/3 elementary charge]*
DOWN quark's are comprised of 4 positive and 8 negative charges
creating a net charge of **-4** *[-1/3 elementary charge]*
Anti-DOWN quark's are comprised of 8 positive and 4 negative charges
creating a net charge of **4** *[1/3 elementary charge]*
UP quark's are comprised of 10 positive and 2 negative charges
creating a net charge of **8** *[2/3 elementary charge]*

Positrons are comprised of 12 positive charges
creating a net charge of **+12** *[positive integer elementary charge]*
neutrinos are comprised of 6 positive and 6 negative charges
creating a net charge of **0** *[no elementary charge]*
Electrons are comprised of 12 negative charges
creating a net charge of **-12** *[negative integer elementary charge]*

Protons are comprised of 24 positive charges and 12 negative charges
creating a net charge of **+12** *[positive integer elementary charge]*
Neutrons are comprised of 18 positive and 18 negative charges
creating a net charge of **0** *[no elementary charge]*
anti-Neutrons are comprised of 18 positive and 18 negative charges
creating a net charge of **0** *[no elementary charge]*
anti -Protons are comprised of 12 positive charges and 24 negative charges
creating a net charge of **-12** *[negative integer elementary charge]*

Rest lepton topologies have a completely neutralised magnetic dipole structure and all leptons (charged or neutral) have identical physical Matter topologies
Their rest masses are the result of the number of plank quanta comprising each Matter topology with applied forces creating additional asymmetrical KEM fields resulting in kinetic energies, magnetic moments and vector velocities of motion

As the energies of motion are added to equilateral KEM fields the Planck quanta themselves are physically WAVE-length Lorentz contracted

(Lorentz contractions apply to mass energy geometries only - NOT to Matter topologies)

Matter topologies are Lorentz invariant to velocity changes (or acceleration)
The relativistic distortion of spherical point charges in physics is no longer applicable, in turn undermining a basic tenet of special relativity as postulated by Albert Einstein

It is the equilateral secondary KEM fields of motion created by applied forces to material Matter topologies (and the asymmetrical distribution of plank charges therein) that creates the magnetic moments associated with charged particles in motion, not the relativistic distortion of spherical bodies of Matter as postulated by Einstein in special relativity

These secondary KEM fields of motion also contain the kinetic EM energies and vector [square root] linear momentum of material particles in motion - the mass energy momenta density and physical geometries of Matter topologies is unaffected by applied forces or changes to velocity-momenta

The changing Lorentz contracted mass energies of kinetic EM fields contributes to the total relativistic mass energy of Matter topologies but in no way changes the mass energy distribution of the Matter component of particles in motion itself - leading in turn to varying generations of subatomic particles with in the particle families themselves

The net asymmetric KEM field geometry of each particles in motion is reflective of the charged distribution of the Matter topology of the particle itself.

Mesons are created when quark and anti-quark particles combine via the strong force interaction between their charged fascias to create unique 14 pi Matter topologies (neutral or charged pions)

These strong interactions between opposite charge fascia of material particles and the resulting Matter topologies are evidence of the fact that Matter-antimatter combinations do not necessarily result in the explosive annihilation of the particles concerned (in fact the combining of opposite charge quarks is a necessary step in the formation of the baryons)

All Baryons are Matter topologies created from the combination of tri-quark topologies
The quark's combine via their opposite charged [Higgs] fascia to create neutral and charged elementary topologies
Due to this opposite charge interaction the charged distribution of baryonic topologies does not follow the textbook given arrangements of [UUD] & [DDU] instead they are arranged as follows:

Protons	**UP**	**+**	**DOWN**	**+**	**UP**
Neutrons	**DOWN**	**+**	**UP**	**+**	**DOWN**
anti-Neutrons	**anti-DOWN**	**+**	**anti-UP**	**+**	**anti-DOWN**
anti-Protons	**anti-UP**	**+**	**anti-DOWN**	**+**	**anti-UP**

The specific arrangement of charged fascia within these respective Matter topologies goes on to facilitate nuclear bonding via the residual strong force between atomic nuclei, following the charge arrangement given in modern textbooks does not allow the formation of baryons or their subsequent bonding to form larger scale atoms and molecules

Protons and neutrons are revealed to have quark arrangements that are mirror symmetries of each other, revealing the neutral charge neutron to have a complementary negative charge arrangement to that of protons.

The increased Planck mass energy contents of various families of quarks facilitates the creation of a huge number of possible Baryon topologies resulting in the particle zoo of subatomic elements created in particle collisions within accelerator experiments - all of these elements can be easily modelled and accounted for using Tetryonic mass-energy Matter topologies

Additionally, the particles often referred to as gluons within the standard model can be easily accounted for and explained as being neutral tetryons within Tetryonic theory - where these neutral charge Matter topologies form a neutral Matter dielectric between charged tetryons to facilitate the strong force interaction and the formation of larger particles

Neutral tetryons (gluons) can also form particles in their own right (neutrinos and glue-balls), as can charged tetryons (charge-ball particles), most of which are short lived

Tetryonics reveals the previously hidden geometry and topology of electromagnetic fields and subatomic particles and the geometric relationship and interplay between electric permittivity and magnetic permeability within all EM field that results on the speed of light in any medium.

As well as the revealing a geometric source of all physical constants within physics itself, Tetryonic charge geometries show the weak force to be a magnetic dipole [edge] interaction between mass energy geometries and Matter topologies and the strong force to be a charge [fascia] interaction between Matter topologies themselves

The equilateral [quantised angular momentum] of ***inductive*** Planck mass energy geometries within squared [HIGGS] fascia of Matter topologies is what creates ***inertial*** properties of Matter at the quantum level

The strong force between charged parallel Higgs fascia of Matter topologies results in 'hidden' partitions of mass energy with in the Matter topologies of quark's and baryons leading to the inability of mathematics online to accurately model and understand the physics of creating these particles at the quantum level

Tetryonic charged mass energy geometries allows for the accurate 2D and 3D modelling of all Matter topologies and fields of Force interactions within physics

It reveals that the deuterium atom [not the hydrogen atom] is the quantum building block of all elementary Matter - the unique charge topology of deuterium (consisting of a proton, neutron and electron) can be related to the electromechanical topology and function of quantum synchronous converters.

These quantum synchronous converters absorb and emit mass energies via the rotating electrons [quantum rotors] bound to the nuclei by way of radiant bosons and photons [heat and light]

The net charge of Deuteron nuclei facilitates their binding together to form helium and larger atoms, while stored mass energy quanta within their Matter topology results in raised quantum grounds states that can all be modelled mathematically using Schrodinger’s wavenumbers

The simpler geometric charge topology reveals visually how the mass energy content of baryons directly affects the angular momentum and energy levels of photo electrons bound to atomic nuclei, in turn revealing that larger elements be created in two ways - namely by the addition of a neutron to a Hydrogen atom (as classically modelled in modern chemical physics) or through the raising of Planck mass-energy quanta within the deuterium Matter topology itself

Deuterium nuclei without any bound photo-electrons form quantum batteries with EM mass energies can be stored indefinitely without being released.
These nuclei can be arranged atomically in either a series, parallel or empty parallel configuration each of which affects the ground energy states of the respective nuclei created.
Where photo-electrons (quantum rotors) are attracted and bind to these nuclei (quantum batteries) the stored mass energies can then be released in a controlled manner via spectral line emissions, or energy can be added via spectral line absorption.

As photo-electrons are bound to the deuteron nuclei the energy levels are affected directly by the mass energy levels of the nuclei that they bind to, in turn affecting their KEM field energies
The square root linear momentum of KEM field energies normally creates a vector motion but in the case of bound electrons this vector motion is turned into an angular motion resulting in electron spin within the nucleus.

The direction of the spin is always reference with respect to the nuclear magnetic moment resulting in up and down electron spins and their associated magnetic dipole moments

The kinematics of KEM fields provides an easy visual explanation of Newton's 2nd law of motion - namely that deceleration can be seen as the removal of odd number quanta from the squared kinetic energy fields and acceleration can be viewed as the addition of odd numbered quanta to squared kinetic energy fields.

The addition or subtraction of odd numbered Planck quanta from squared energy fields results in changing square root linear momentum for the particles that these fields are associated with - this changing linear momentum over time can be equated to acceleration leading to Newton's formulation of Force = mass x acceleration [F = ma = dp/t = dmv/t]

Using the equilateral geometry of Planck's constant we can now unify classical mechanics with quantum mechanics and reveal the underlying dynamics of relativistic mass energies of motion (as well is providing an electromechanical explanation of inertia in the physics of Matter in motion)

Newton's vector linear momentum [p=mv] forces are revealed to be the geometric square root of Leibnitz's scalar energies [E/mv^2] with their associated inertial mass being a measure of the scalar energies per second [m=E/v^2]

Linear momentum [mv] is differentiated from vector velocities [v] through the equilateral geometry of energy per second [m] in tetryonics, with the total linear momentum of any EM field or system of particles being the vector some of the square root Planck linear momentum of the quanta in the fields comprising the system

Once the equilateral field geometry of KEM fields is revealed it is easy to show that the total energy of the field [E=mv^2] is the result of the kinetic energies [1/2Mv^2] plus the magnetic moment [1/2Mv^2] of any material topology in motion

This in turn allows for a rigid geometric differentiation of quantised angular momentum [Ω] in Planck quanta, the linear momentum [p] of any system and the classical angular momentum [vector rotation about a point] in physics

These geometric definitions of mass energy momenta in physical systems as portrayed in Tetryonic theory reveal a differing geometric relationship to that commonly portrayed in modern physics]i.e. neutralising right angled Pythagorean triangles]

Additionally Lorentz corrections factors are restricted to planar 2-D mass energies of KEM fields associated to particles in motion where changes of velocity force result in the addition or subtraction of equilateral Planck quanta from the KEM field geometry resulting in the physical expansion or contraction of Planck geometries within the field

Tetryonic theory's geometric definition and application of quantised angular momentum with respect to mass energy momenta in physics allows for the physical modelling of mass energy and Matter at all scales of physics and their unification of classical, quantum and relativistic mechanics

The 'squared' energies of quantum mechanics and statistical distributions of the math associated with quantum mechanics is now revealed in an entirely new light facilitating the macro scale modelling of all hitherto unseen quantum particles and processes.

The geometric relationships between charge, mass geometries and Matter topologies is easily visualised and applied to all physics revealing quantised angular momenta [QAM] to be the hidden variable of Planck's constant [h].....

The modelling of quantised angular momentum as an equilateral geometry allows for the elimination of Heisenberg's uncertainty principle and Bell's inequality from the foundational tenants of quantum mechanics

Both the position and momentum of particles and fields can be now modelled at any stage of a system's spatio-temporal development and evolution using these simple equilateral charged geometries of mass energy momenta

Precise rest mass energies of any Matter topology can be calculated from 1st principles allowing for accurate modelling of all quantum systems and even periodic elements - expanding our knowledge of chemical systems and processes

The Planck-Compton frequency, de Broglie wavelength, absolute rest mass and charge Matter topology of all periodic elements, compounds and molecules can now be calculated with absolute certainty and precision and can be related back to Avogadro's number for all elements in chemistry

The exponential energy levels of atomic nuclei and atomic processes of energy release can also now be shown to be the result of an underlying geometric Planck scale geometry inherent to all mass energy Matter within physics

Einstein's mass energy equivalence formula is shown to be a geometric relationship between measurements of energy per second and inertial mass..... combined with Tetryonics new definition of Matter as energy per second squared we can now show that Einstein's famous formulation is an incomplete formulation of the mass-ENERGY-Matter relationship that applying only to specific processes within our physical universe

The Lorentz corrections on which special relativity is based are shown to be WAVE-length and QAM corrections for the changing physical geometries of scalar mass energies per unit of time in spatial co-ordinate systems (c^2) and that additional time-based dimensional analysis must be taken into account in order to define and differentiate between electromagnetic mass and Matter in physics

The application of squared (equilateral) geometries to physics in the role of quantised angular momentum has been overlooked since the inception of physics itself, but with the inclusion of this geometry a rigid geometric grammar can now be imposed upon the mathematics of physics leading to the correction of many erroneous mathematical assumptions

An exact value from first principles for Planck's constant can be calculated and Avogadro's number can be confirmed and related to the absolute rest mass of hydrogen atoms.

A geometric representation of Coulomb's charged field interactions and the impedance of free space can also be provided for all physical processes allowing for a fast and accurate visualisation of energy mechanics at all scales of physics

Tetryonics theory’s equilateral charged mass energy and polyhedral Matter topologies allow for the modelling and differentiation of energy in all its forms within any spatial coordinate system providing a vast improvement over relativity's use of stress energy tensors and non-Euclidean geometries in modelling physical systems

All fields and particles can be defined and differentiated in terms of their charged mass energy geometries and Matter topologies respectively and the differentiation of elemental families into their generations can be easily accounted for through the addition of mass energies of motion to secondary KEM fields associated with each particle grouping

Inertial resistance to force can be modelled and explained through the equilateral geometry of quantised angular momentum when viewed as an electromechanical equivalent to an inductive loop of energy

Electromagnetic inertial mass can now be clearly defined as a measure of the inductive EM energy density of any charged 2D planar Planck geometry in any spatial co-ordinate system of measurement

3D Matter can now be viewed and modelled as the closed topology created by 2D mass energies through charge interactions in any spatial co-ordinate system of measurement per second squared

Additionally physical terms such as 'mass-less' particles are shown to be a misnomer as any field or particle must by definition contain energy per unit of time - and should be more appropriately re-termed Matter-less or weightless particles

Tetryonics theory defines, differentiates and unifies energy in all its forms (mass, Matter & Force) through the equilateral geometry of quantised angular momentum at the quantum level, allowing for the development of a unified field equation that models physics on all scales and reveals a common geometric thread to all the disparate fields of physics that to date have defied unification

Equilateral (SQUARED) energy fields of Planck quanta comprised of statistical distributions of (ODD) transverse bosons and (EVEN) longitudinal photons account for all the quantum mechanical processes of physics including EM field geometries and material particle topologies and electron spin

Principle quantum levels [1st Schrodinger wave-numbers] are shown to be the result of the series addition of deuterium nuclei in atomic elements with their resulting energy levels determining the squared energy levels of bound photoelectron KEM fields – in turn forming the foundation of discrete quantum jumps of electrons bound to atomic nuclei

The bound photo-electron can only transition between allowed squared energy levels permitted by the energy levels of deuterium nuclei to which they are bound and once free from the atomic nuclei the electron can emit or absorbed a continuous spectra of light photons - but while bound to the deuterium nuclei in atoms it can only have specific [squared] KEM energy levels

The complex, asymmetric tri-quark (9 tetryon) Matter topology of baryons directly affects the magnetic moment of protons and neutrons in motion making them considerably weaker than the symmetric axial Bohr magnetron of electrons in motion

As the Bohr magneton of photo-electrons is determined by the squared energies of its secondary KEM field confusion has arisen with respect to the allocation of spins to subatomic particles, Tetryonic geometries now correct for this and suggest that the electron historically viewed as a spin 1/2 particle is in fact a spin 3 particle under the formal definitions of spin rotations i.e. rotating at 120° can bring it back to an identical quantum state as the initial state measured]

Again Tetryonic theory and its energy geometries in addition to explaining and correcting electron spins also shows that the term electron spin can now be taken literally when modelled with Tetryonic geometries to provide an accurate description of the origin of magnetic moments for electrons, in turn undermining the foundational postulate of special relativity that these magnetic moments are the result of the distortion of spherical point charges and that relativistic Lorentz contractions apply to Matter topologies

Dirack's constant, or Planck's reduced constant [$h/2\pi$], is revealed to be a measure of the electric permittivity of a relativistic electron's KEM field, and the measurement of the associated magnetic dipole of the same KEM field results in the mistaken concept of 1/2 spins in the measurement of Bohr magnetons

The magnetic vector created by the Bohr magneton [or KEM field dipole] when measured with respect to the nuclear magneton [Proton magnetic moment] produces either a higher energy [parallel] or lower energy [anti-parallel] state for all atomic nuclei

It is the arrangement of these parallel or anti-parallel magnetic dipoles within atomic nuclei that determines the exact frequency-wavelength (energy level) of emitted spectral lines with the interaction of a particle’s magnetic dipole moment with external electromagnetic fields creating Lorentz forces

As electrons and protons have identical quantum Matter topologies [elementary charges] but differing mass energy contents the electron is able to create a much larger secondary KEM field (with associated magnetic dipole moment) for the same velocity [$\frac{1}{2}Mv^2$]

The energy level differences created by the parallel or anti-parallel spin coupling of electrons with protons or deuterium nuclei within atomic elements creates the hyperfine splitting and Zeemen effects observed and spectral lines

As the electron is now shown to be a complex non-spherical particle topology when it binds with protons to form hydrogen the unique Matter topology of both the proton and the electron [Hydrogen] create a small but detectable precession in the motion of the spinning electron as compared to that of the motion of the same electron in a deuterium nuclei

Additionally, as all periodic elements, compounds and molecules are comprised of deuterium nuclei (not hydrogen as currently supposed) the orientation and spin direction of electrons bound within these nuclei results in the diamagnetic and paramagnetic properties of various macro-scale materials

Tetryonics theory reveals that the mass charge ratio is of particles are measure of the constituent mass energy geometries that go into making the particle's final Matter topology that we observe a measure

But unlike the current mathematical approach the geometric approach of Tetryonics reveals the hidden mass energy partitions within the Matter topology of all subatomic particles and that particles such as tetryons (the quantum building blocks of all Matter) are in fact hidden within the debris of current collider results.

4 quantum charge tetryons have the same1/3 partial elementary charge as some quarks, and can be measured as having the same mass charge ratio's as charged leptons such as positrons and electrons in collider experiments.

…….. To be continued [QED, Chemistry, Cosmology, Mathematics, Biology and economic theory]

answers@tetryonics.com

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TETRYONICS

The charged topology of periodic & compound Matter

Foundational Quantum Chemistry

Abraham

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Periodic element Families

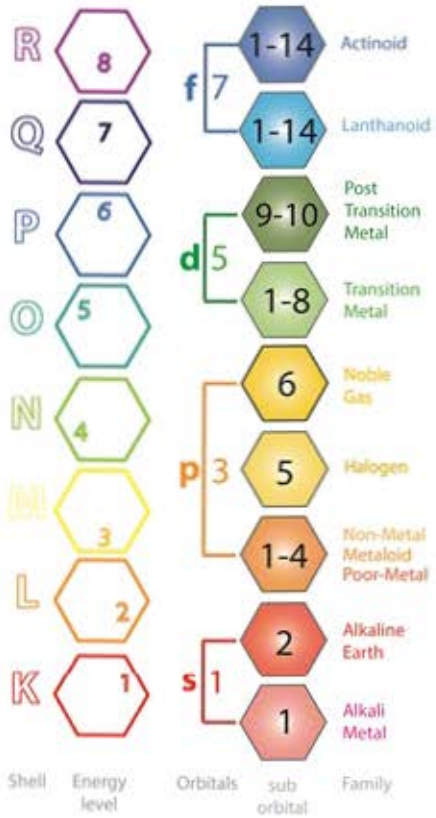

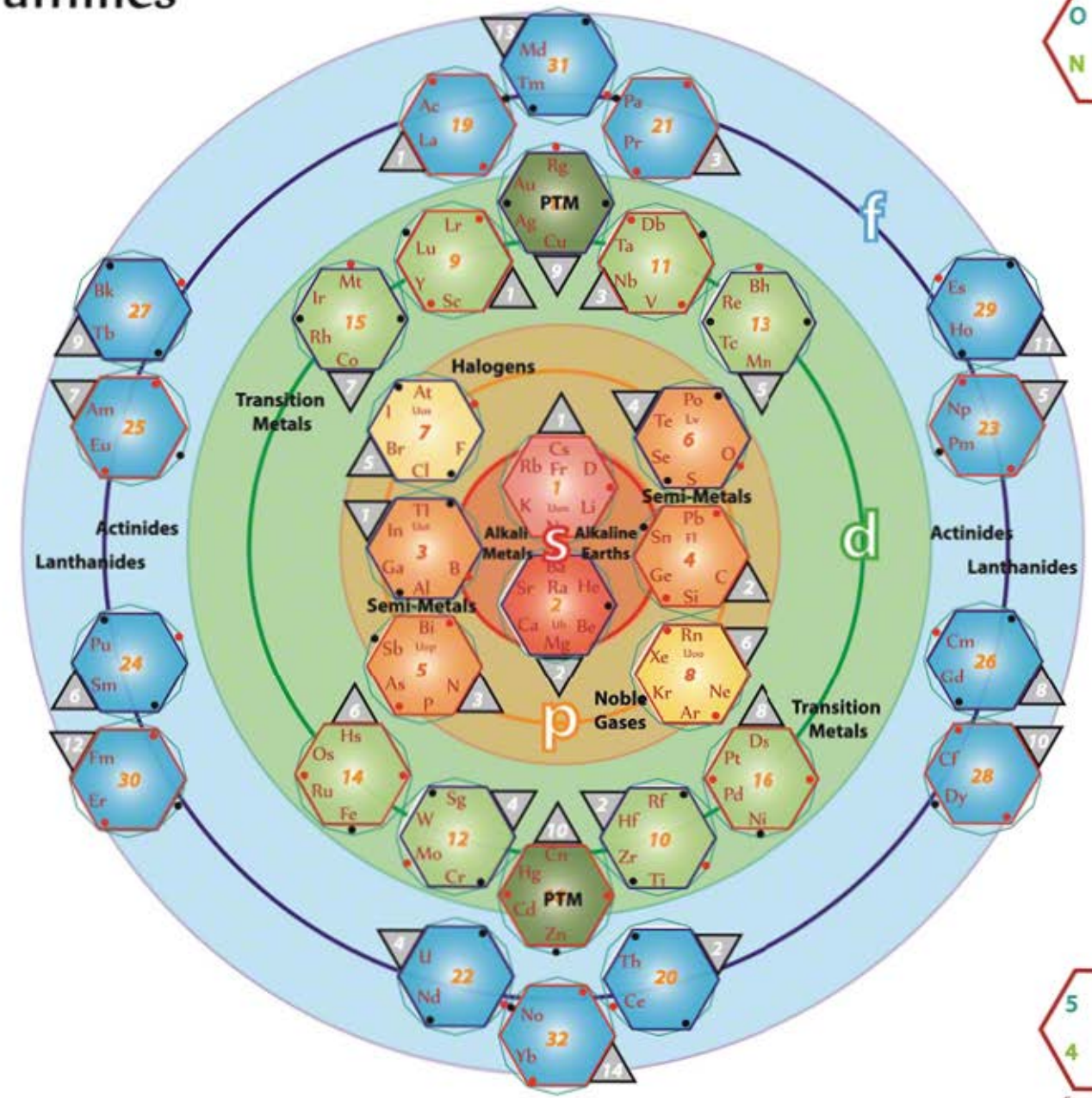

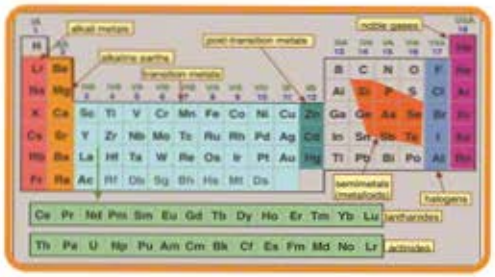

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Alkali Metals

The alkali metals are silver-colored (caesium has a golden tinge), soft, low-density metals, which react readily with halogens to form ionic salts, and with water to form strongly alkaline (basic) hydroxides.

These elements all have one electron in their outermost shell, so the energetically preferred state of achieving a filled electron shell is to lose one electron to form a singly charged positive ion.

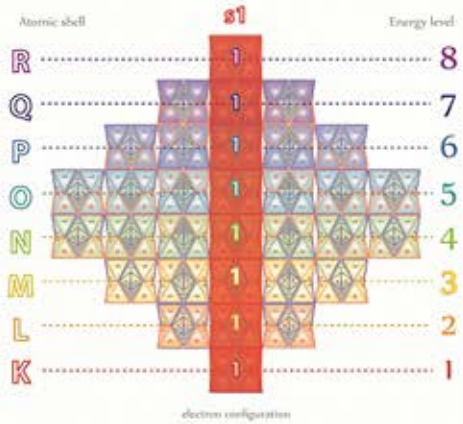

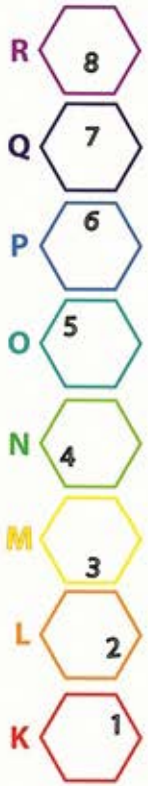

s Orbital

n1-8

s1 sub-orbital

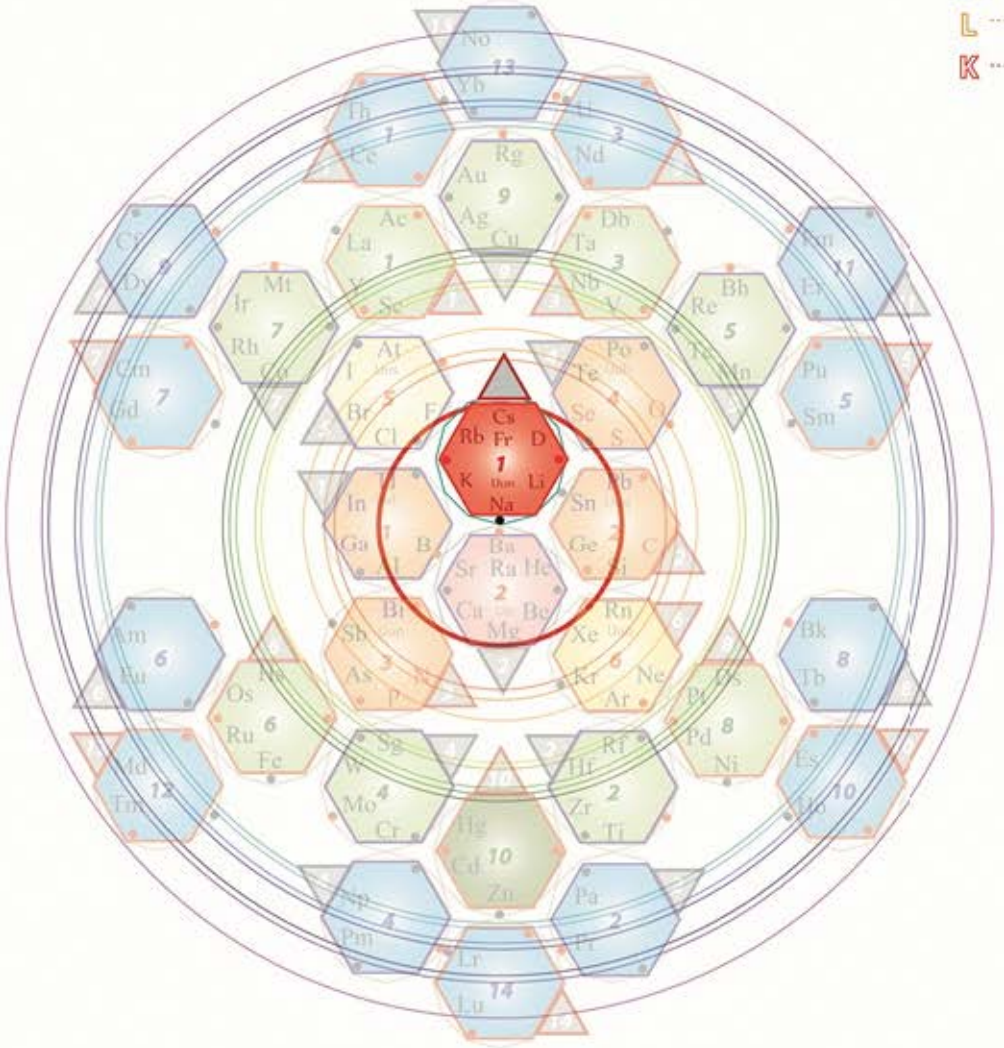

8

Alkaline Metals

The alkali metals are all highly reactive and are never found in elemental form in nature.

As a result, in the laboratory they are stored under mineral oil. They also tarnish easily and have low melting points and densities. Potassium and rubidium possess a weak radioactive characteristic (harmless) due to the presence of long duration radioactive isotopes.

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Alkaline Earths

The alkaline earth metals are silver colored, soft metals, which react readily with halogens to form ionic salts, and with water, though not as rapidly as the alkali metals, to form strong alkaline (basic) hydroxides.

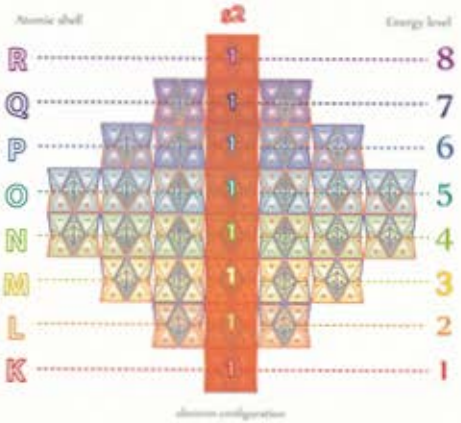

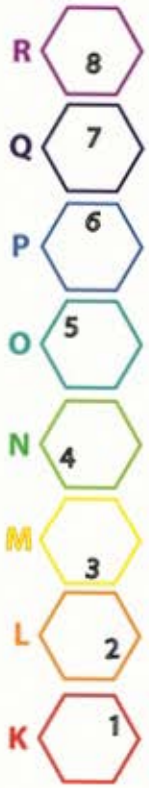

s Orbital

n1-8

s2 sub-orbital

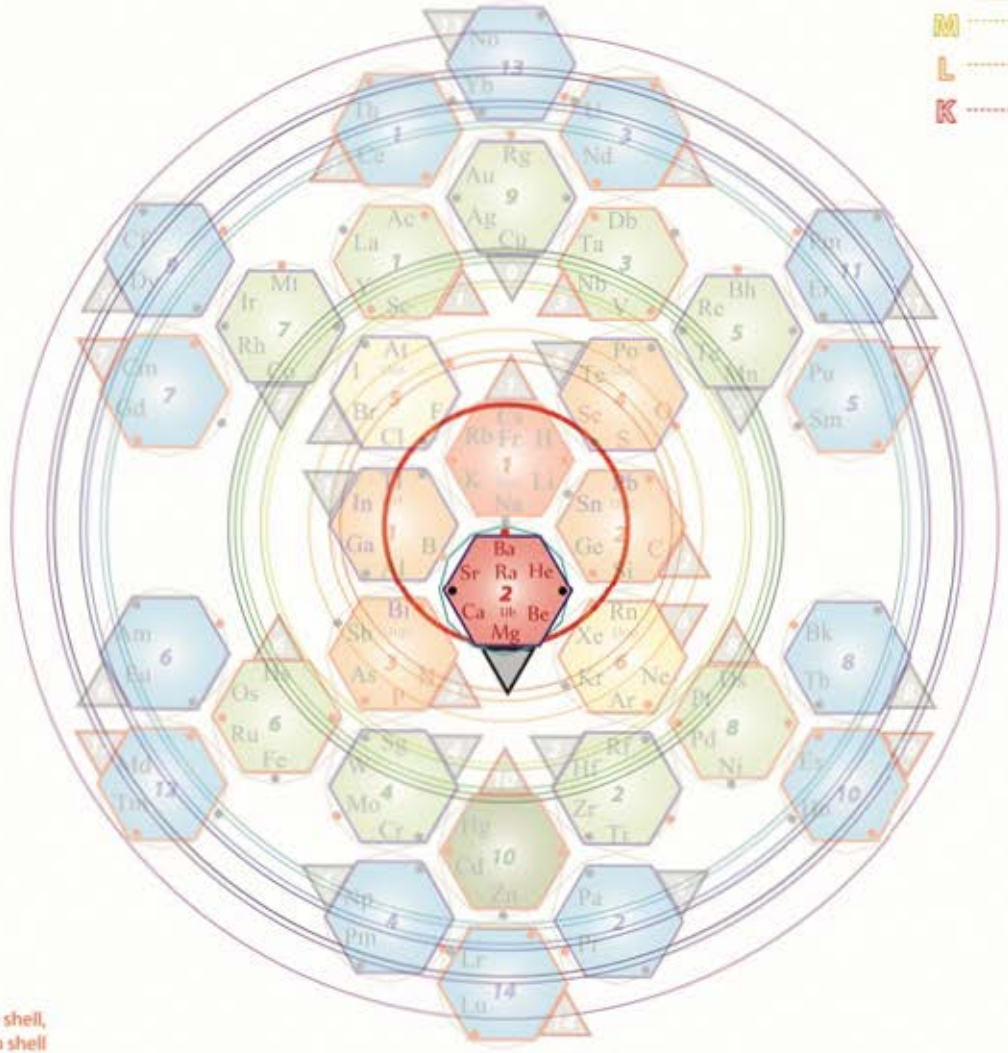

8

Alkaline Earths

All the alkaline earth metals have two electrons in their valence shell, so the energetically preferred state of achieving a filled electron shell is to lose two electrons to form doubly charged positive ions.

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Metalloids

A metaloid is a material with a small overlap in the energy of the conduction band and valence bands.

Unlike a regular metal, metaloids have been described electrically as charge carriers of both types (holes and electrons), so it could be argue that they should be called 'double-metals' rather than metaloids.

As metaloids have fewer charge carriers than metals, they typically have lower electrical and thermal conductivities.

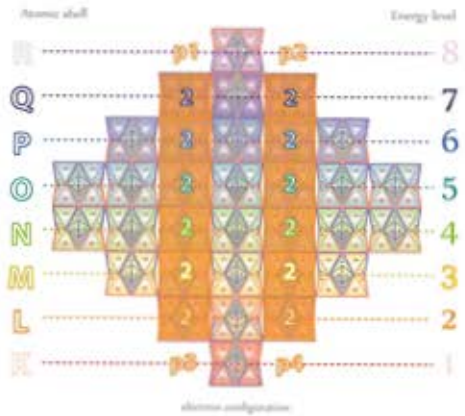

p 1-4 Non-Metal Metaloid Poor-Metal

2 p-Orbitals

n2-7

p1-4 sub-orbitals

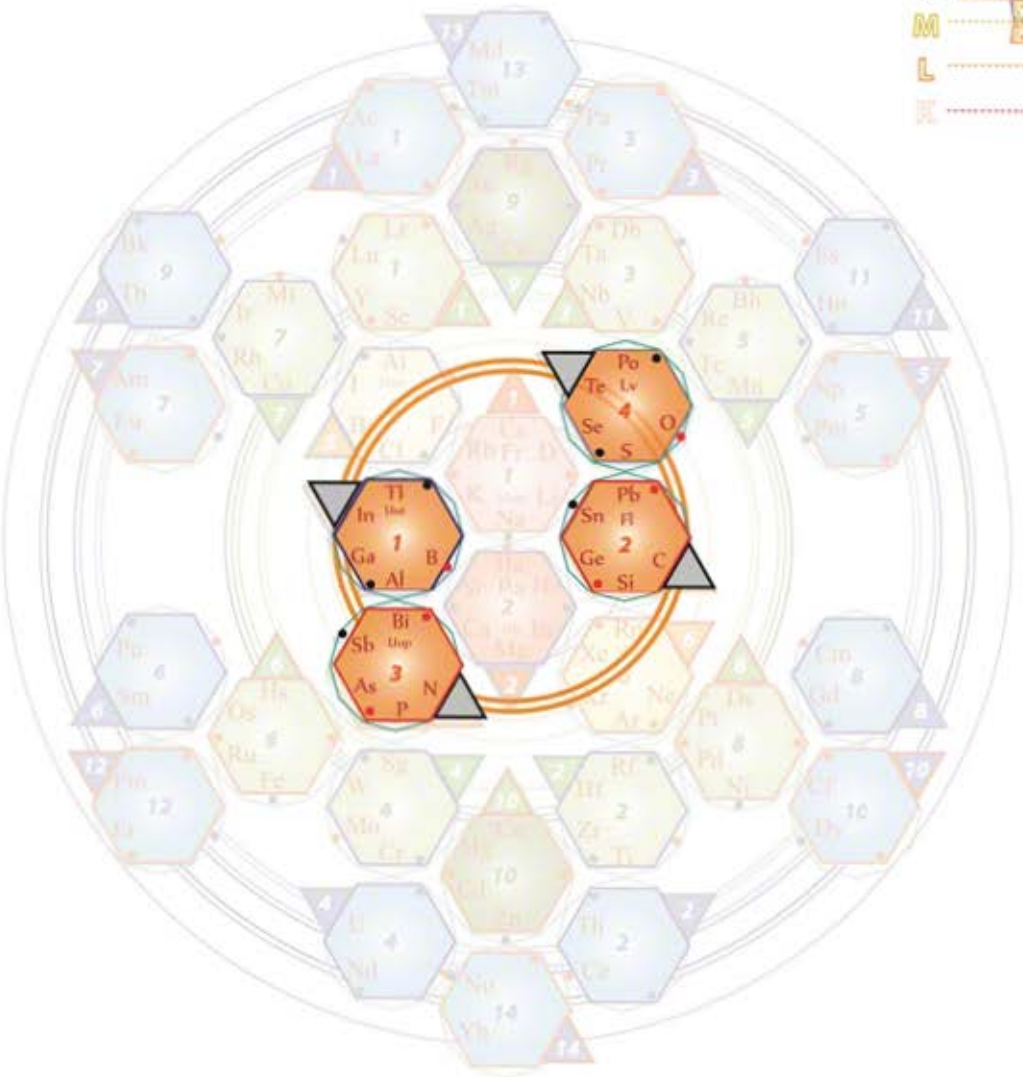

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Semi-Metals

Charge carriers typically occur in much smaller numbers than in a real metal. In this respect they resemble degenerate semiconductors more closely.
This explains why the electrical properties of metaloids are partway between those of metals and semiconductors.

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Halogens

Owing to their high reactivity, the halogens are found in the environment only in compounds or as ions.

Halide ions and oxoanions such as iodate (IO_3^-) can be found in many minerals and in seawater.

Halogenated organic compounds can also be found as natural products in living organisms. In their elemental forms, the halogens exist as diatomic molecules, but these only have a fleeting existence in nature and are much more common in the laboratory and in industry.

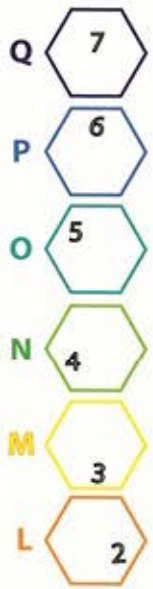

p 5 Halogen

p3 Orbital

n2-7

p5 sub-orbital

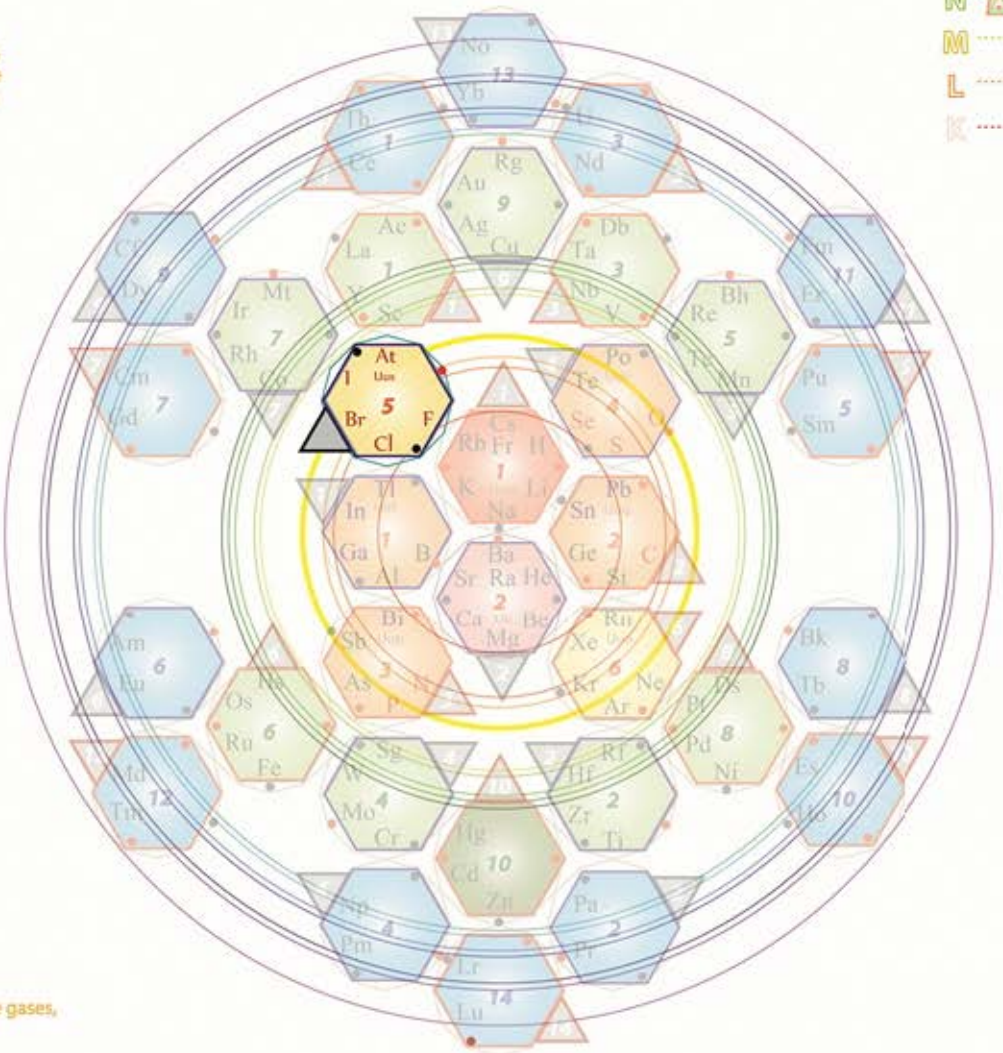

6

Halogens

At room temperature and pressure, fluorine and chlorine are gases, bromine is a liquid and iodine and astatine are solids.

Group 17 is therefore the only periodic table group exhibiting all three states of matter at room temperature

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Nobel Gases

The properties of the noble gases can be well explained by modern theories of atomic structure: their outer shell of valence electrons is considered to be "full", giving them little tendency to participate in chemical reactions, and only a few hundred noble gas compounds have been prepared.

The melting and boiling points for each noble gas are close together, differing by less than 10 °C (18 °F); consequently, they are liquids only over a small temperature range.

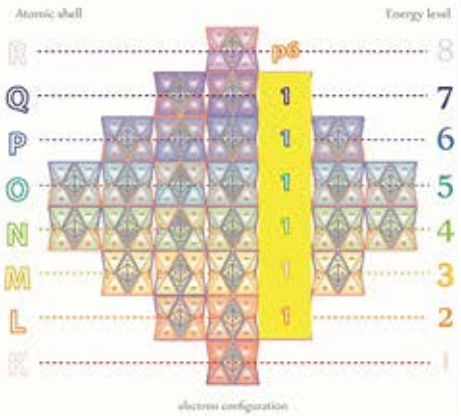

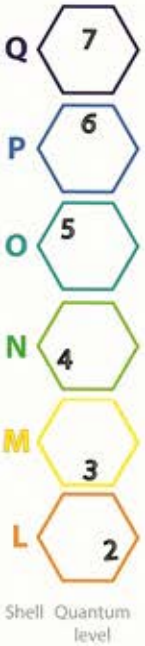

p 6 Noble Gas

completed p3 Orbital

n2-7

p6 sub-orbital

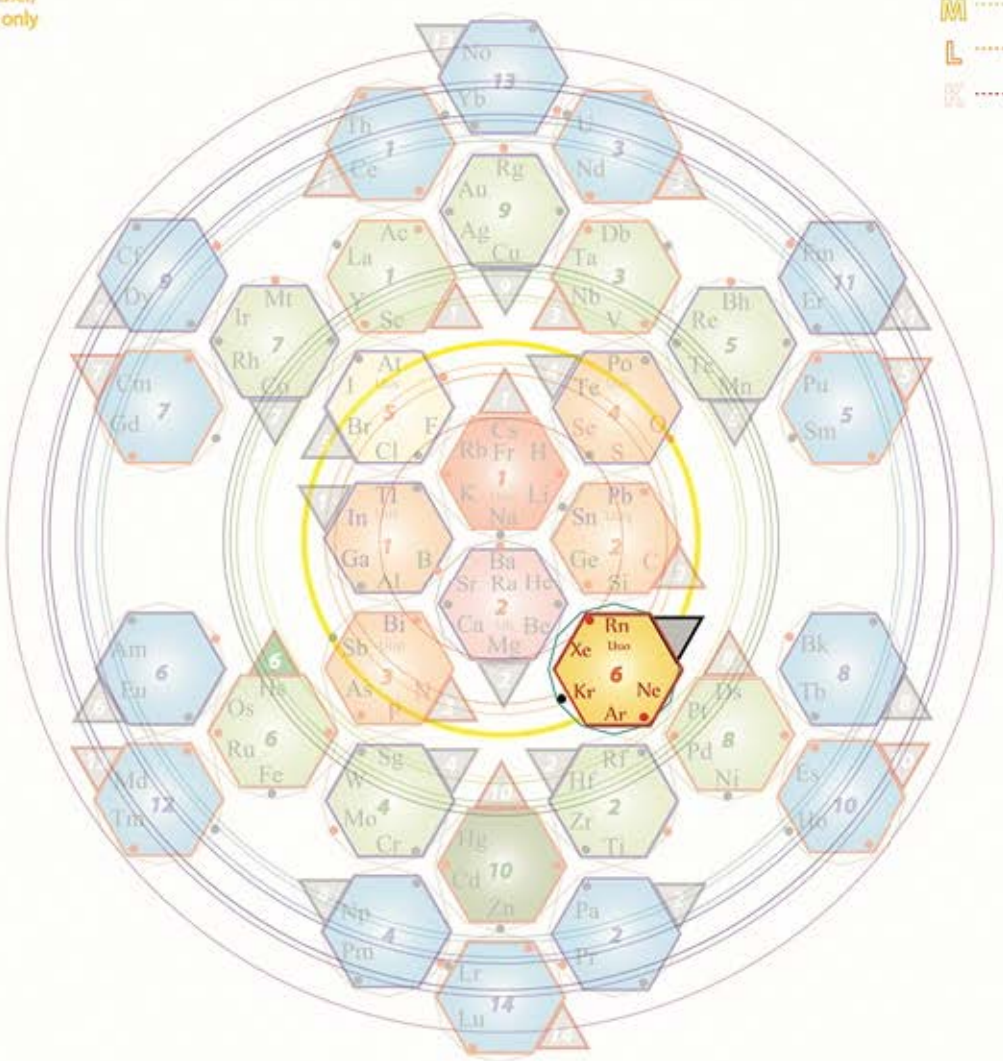

6 Nobel Gases

Neon, argon, krypton, and xenon are obtained from air using the methods of liquefaction of gases and fractional distillation.

Helium is typically separated from natural gas, and radon is usually isolated from the radioactive decay of dissolved radium compounds.

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Transitional Metals

In chemistry, the term transition metal commonly refers to any element in the d-block of the periodic table, including the group 12 elements zinc, cadmium and mercury.

This corresponds to groups 3 to 12 on the periodic table, which are all metals.

More strictly, IUPAC defines a transition metal as "an element whose atom has an incomplete d sub-shell, or which can give rise to cations with an incomplete d sub-shell."

The first definition is simple and has traditionally been used. However, many interesting properties of the transition elements as a group are the result of their partly filled d subshells.

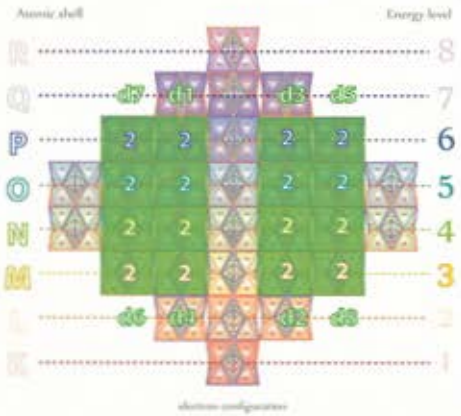

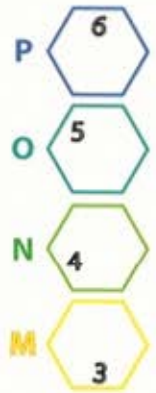

d 1-8 Transition Metal

4 d-Orbitals

n3-6

d1-8 sub-orbitals

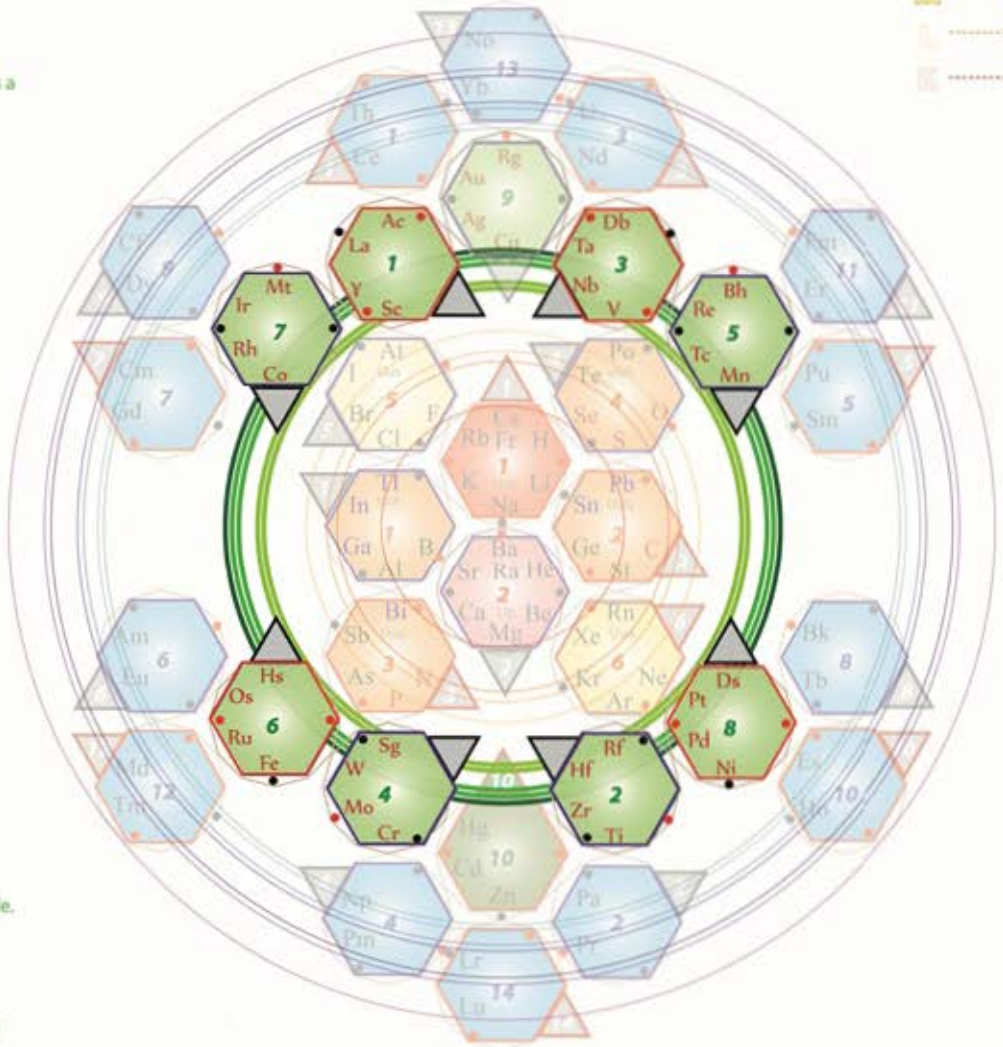

32 Transition Metals

The name transition comes from their position in the periodic table. In each of the four periods in which they occur, these elements represent the successive addition of electrons to the d atomic orbitals of the atoms.

In this way, the transition metals represent the transition between group 2 elements and group 13 elements.

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Post-Transition Metals

In chemistry, the term post-transition metal is used to describe the category of metallic elements to the right of the transition elements on the periodic table.

There are two IUPAC definitions of "transition element" that have been in apparent conflict with one another since September 2007.

According to the first definition, transition metals are elements in group 3 through group 11.
In this case, post-transition metals include all of group 12—zinc, cadmium, mercury, and ununbium

According to the second definition, transition elements either have an incomplete d-subshell or have the ability to form an incomplete d-subshell.

Post Transitional metals are normally defined as completed d orbitals

Tetryonics suggests it may be appropriate to include all the d5 orbital elements in this grouping

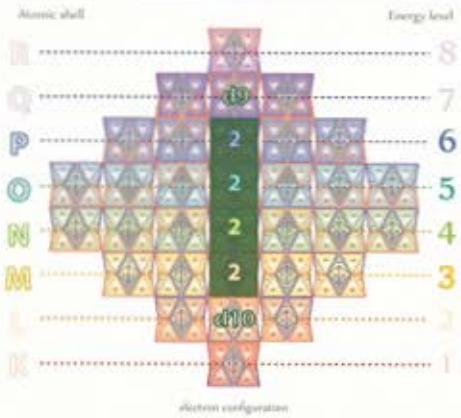

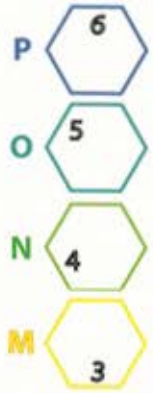

d 9-10 Post Transition Metal

d5 Orbital

n3-6

d9-10 sub-orbitals

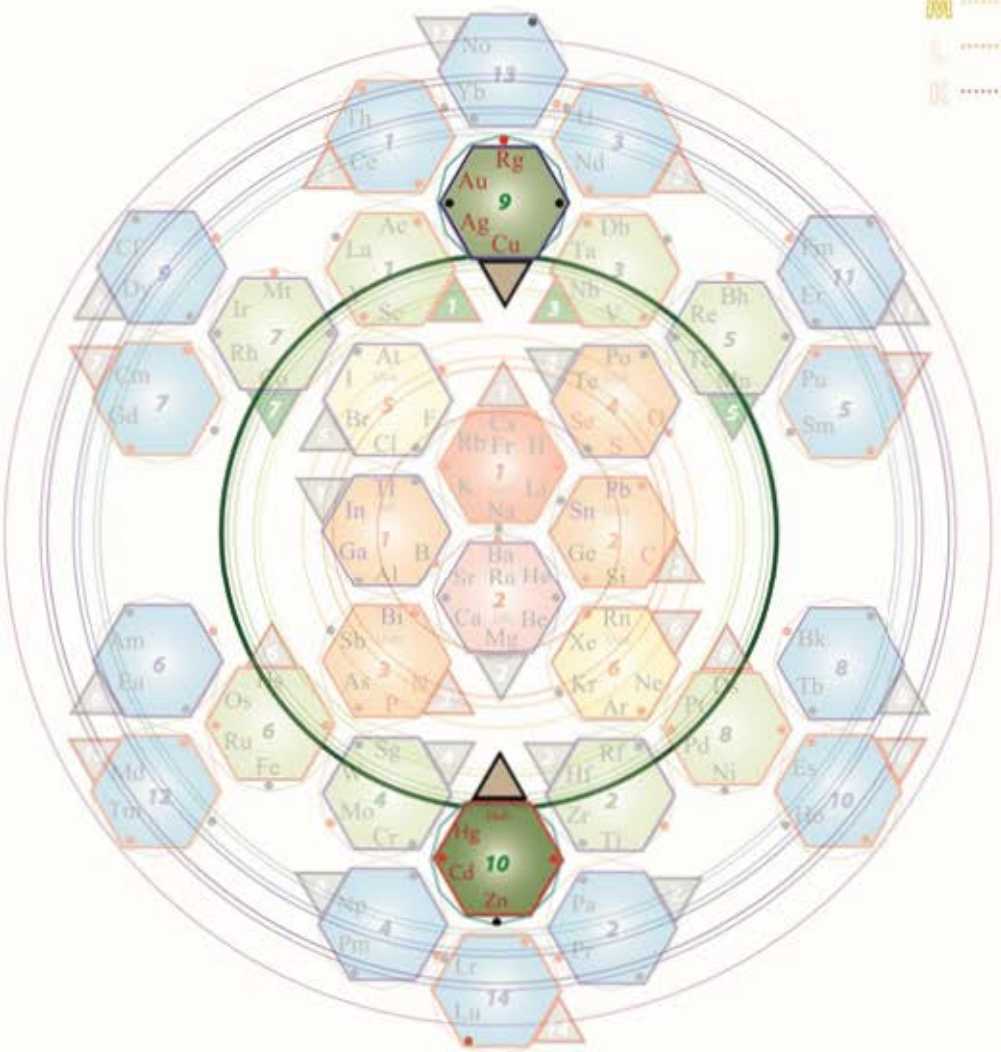

8 Post-transitional Metals

In 2007, mercury(IV) fluoride was synthesized.[2][3] This compound contains a mercury atom with an incomplete d-subshell, and ununbium is predicted to have the capacity to form a similar electronic configuration.

In this case, post-transition metals include only zinc and cadmium within group 12.

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Lanthanoids

All lanthanoids are f-block elements, corresponding to the filling of the 4f electron shell

The lanthanoid series (Ln) is named after Lanthanum.

The trivial name "rare earths" is sometimes used to describe all the lanthanoids together with scandium and yttrium.

These elements are in fact fairly abundant in nature, although rare as compared to the "common" earths such as lime or magnesia. Cerium is the 26th most abundant element in the Earth's crust, neodymium is more abundant than gold and even thulium (the least common naturally-occurring lanthanoid) is more abundant than iodine.

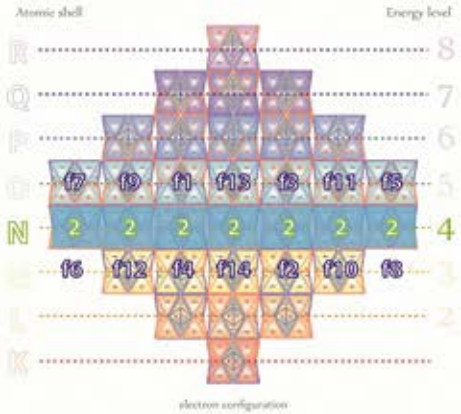

f 1-14 Lanthanoid

N 4

Shell Quantum level

7 f-Orbitals

n4

f1-14 sub-orbitals

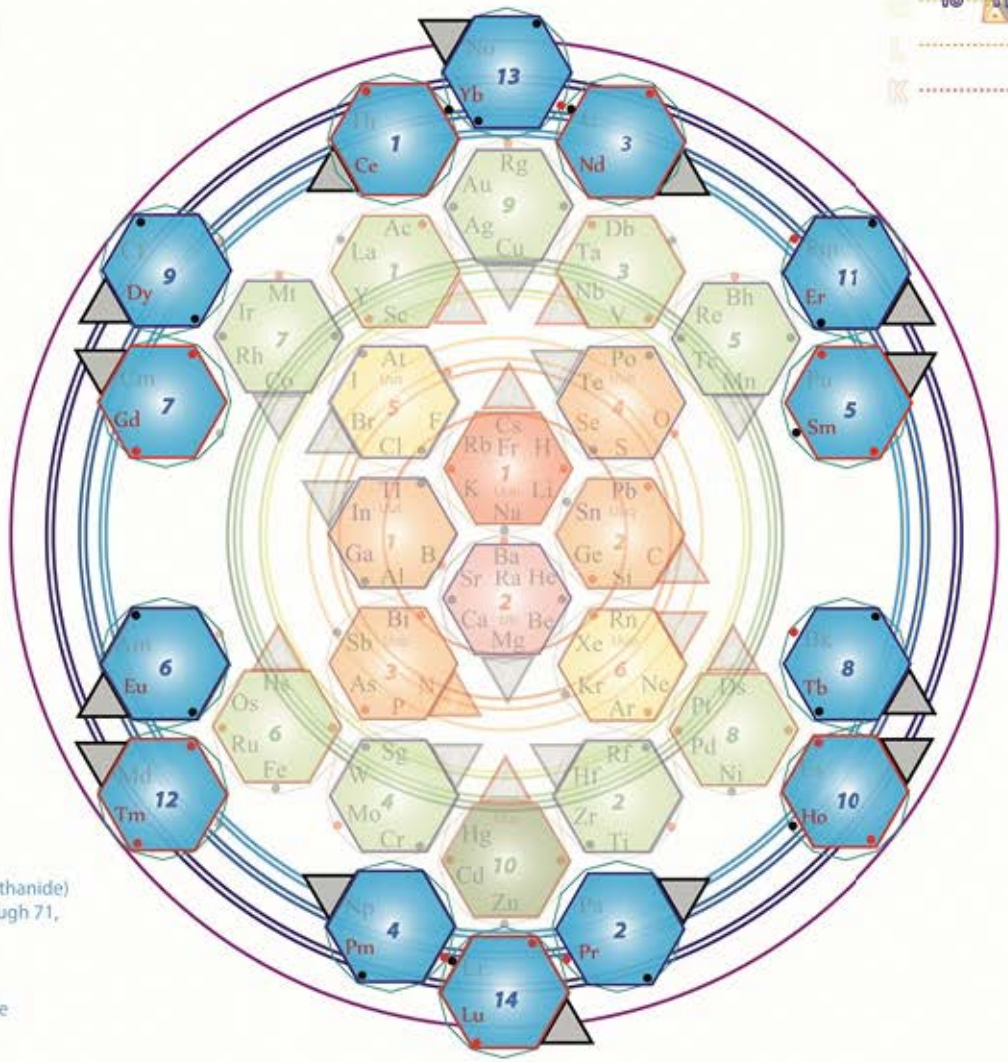

14 Lanthanoids

The term "rare earths" arises from the minerals from which they were isolated, which were uncommon oxide-type minerals.

According to the IUPAC terminology, the lanthanoid (previously lanthanide) series comprises the fifteen elements with atomic numbers 57 through 71, from Lanthanum to Lutetium.

The use of this name is deprecated by IUPAC, as they are neither rare in abundance nor "earths" (an obsolete term for water-insoluble strongly basic oxides of electropositive metals incapable of being smelted into metal using late 18th century technology).

4

Quantum level

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Actinoids

According to IUPAC nomenclature, the actinoid (previously actinide) series encompasses the 15 chemical elements that lie between actinium and lawrencium included on the periodic table, with atomic numbers 89 - 103.

The actinoid series derives its name from the first element in the series, actinium, and ultimately from the Greek ακτις (aktis), "ray," reflecting the elements' radioactivity.

The actinoids display less similarity in their chemical properties than the lanthanoid series (Ln), exhibiting a wider range of oxidation states, which initially led to confusion as to whether actinium, thorium, and uranium should be considered d-block elements. All actinoids are radioactive.

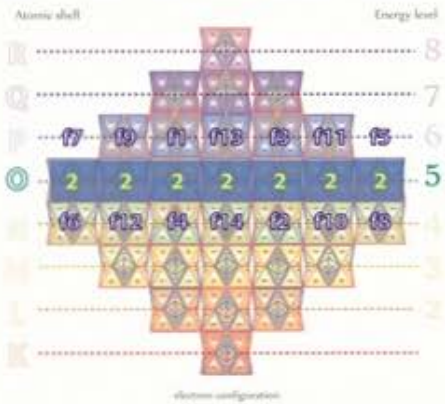

f 1-14 Actinoid

o 5

Shell Quantum level

7 f-Orbitals

n5

f1-14 sub-orbitals

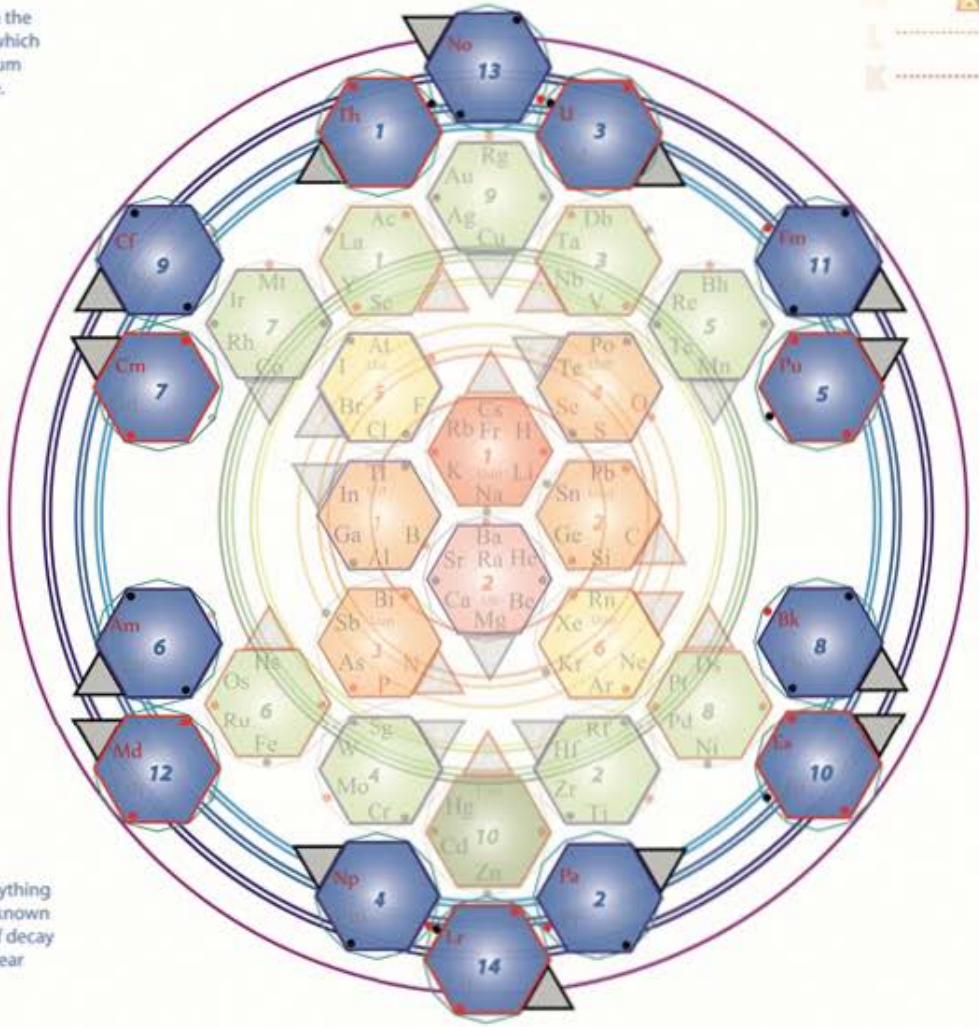

14 Actinoids

Only thorium and uranium occur naturally in the earth's crust in anything more than trace quantities. Neptunium and plutonium have been known to show up naturally in trace amounts in uranium ores as a result of decay or bombardment. The remaining actinoids were discovered in nuclear fallout, or were synthesized in particle colliders.

The latter half of the series possess exceedingly short half-lives.

5

Quantum level

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$$E = nhv$$

$$\sum_{K}^{R}{}_{P}\,{}_{25}^{32}\left[\left[72(n)^2\right]+\left[12e19\right]+\left[m_e v^2\right]\right]_1^8$$

Baryon rest masses — lepton rest mass — KEM

Deuterium mass-energy per shell

$$m = Ev^2/c^2$$

Periodic summation formula

re-terming the masses of the periodic summation formula into Planck energy quanta we can derive a quadratic formulation for the mass-energies of any periodic element

Baryon energies determine electron KEMs

$$h\sum_{K}^{R}{}_{P}\,{}_{25}^{32}\left[\left[72(n^2)\right]+\left[v\right]+\left[12e19\right]\right]_1^8$$

Baryon rest mass-energy — KEM — lepton rest mass-energy

Deuterium mass-energy per shell

electron rest mass-Matter is velocity invariant

quadratic PΣ formulation

$$n = 1e19v$$

this quadratic form can be again re-organised to better reflect the specific rest mass-energy contributions of Baryons, electrons & their KEM fields to the molar mass-energy-Matter of any specific element

atomic shell energies

$$\sum_{K}^{R}{}_{P}\,{}_{25}^{32}\left[\left[72(n^2)\right]+\left[12e19\right]+\left[\Delta v\right]\right]_1^8$$

Baryon rest quanta — lepton rest quanta — KEM

nuclear mass-energy quanta per shell

spectral line transitions

Elementary PΣ formulation

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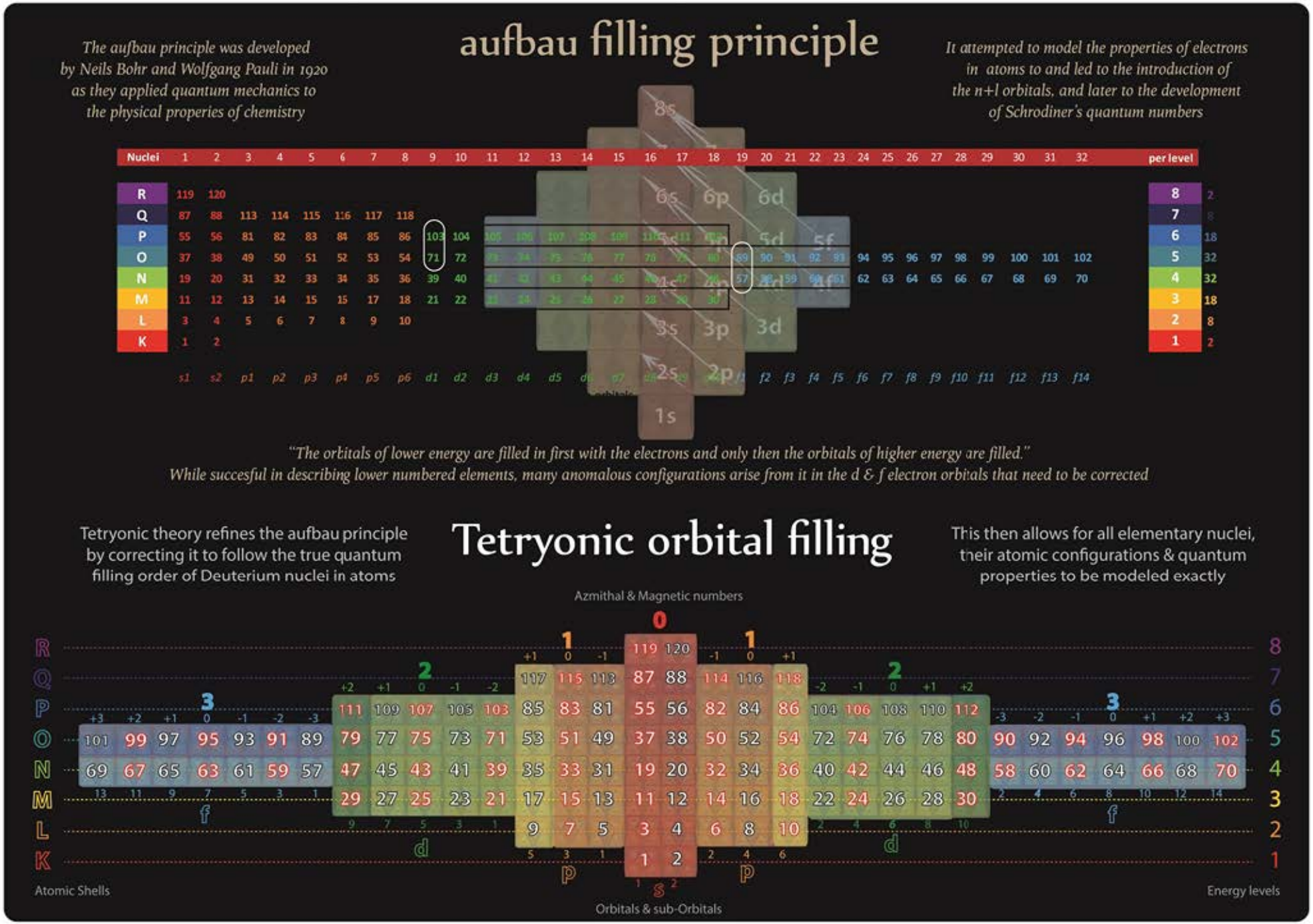

Tetryonics 52.14 - Tetryonic aufbau orbital filling

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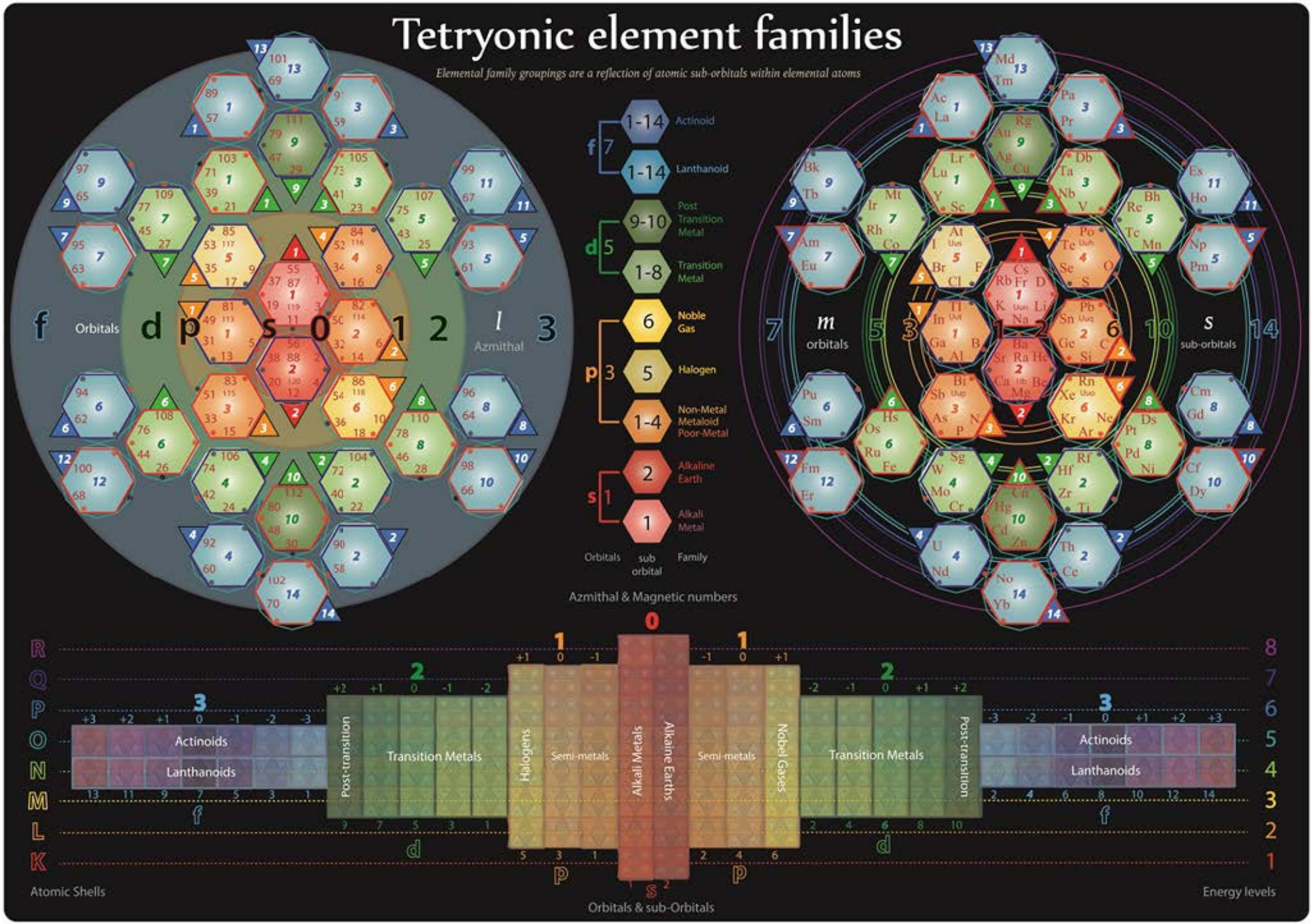

Tetryonics 52.15 - Tetryonic elemental families

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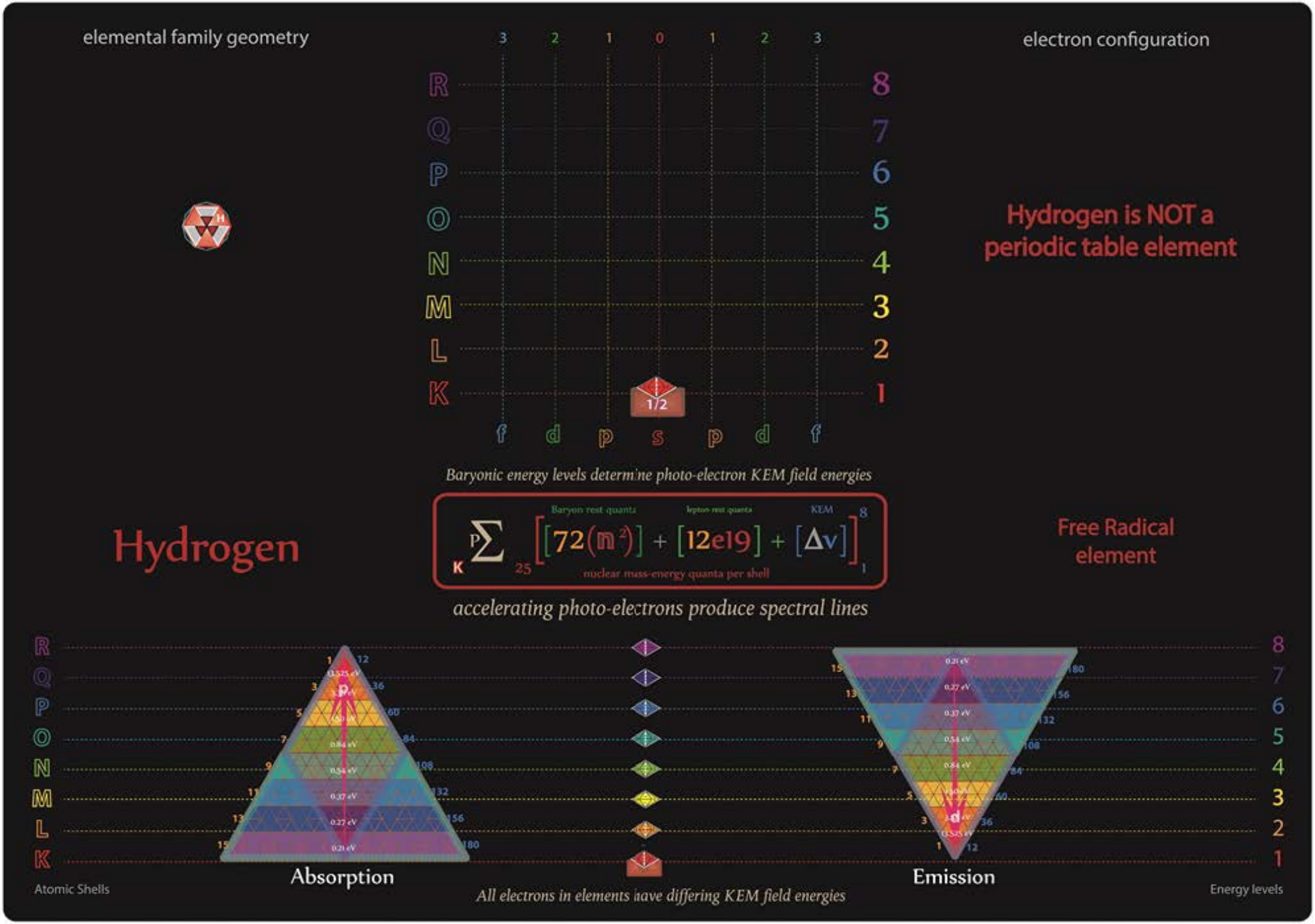

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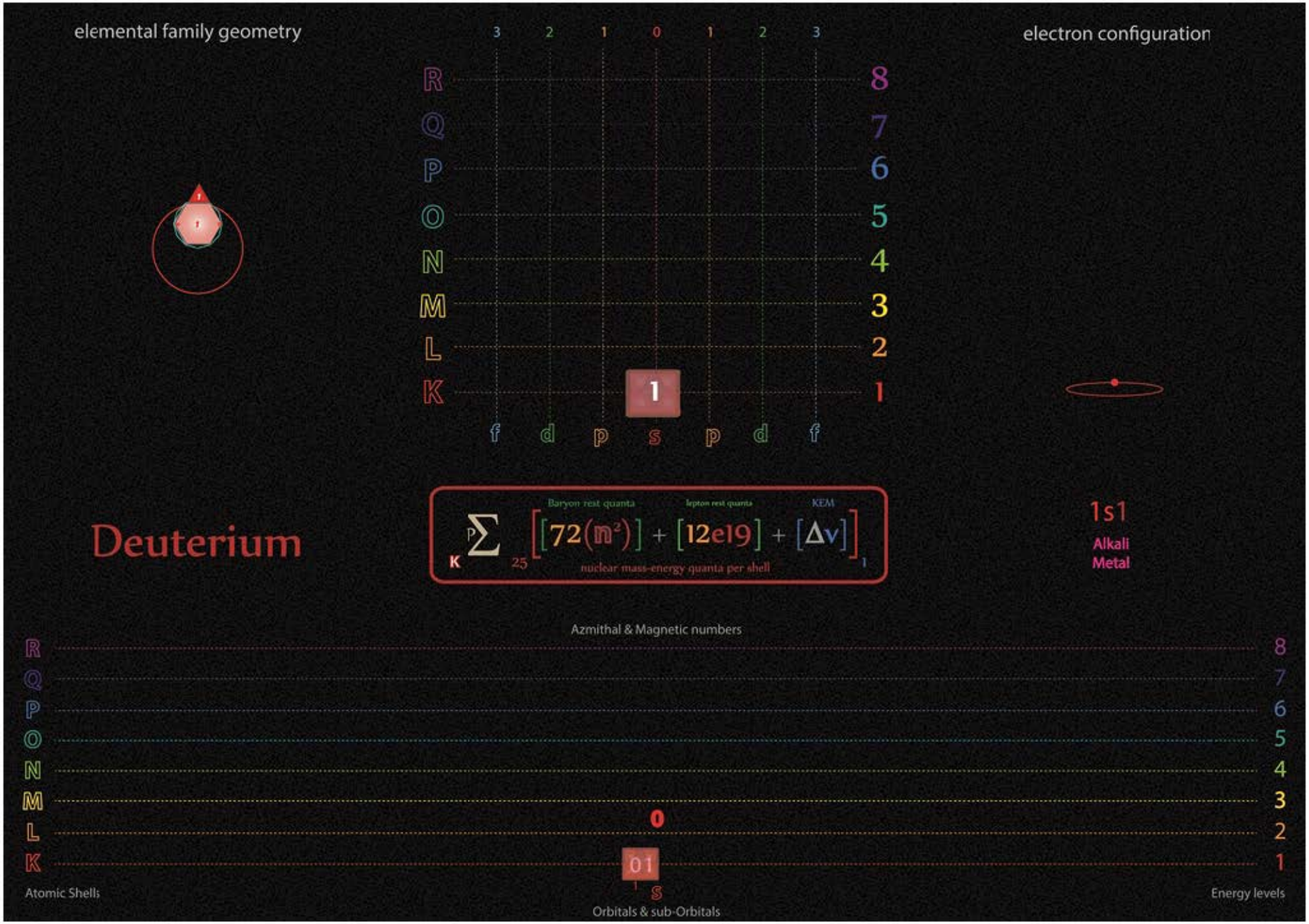

Tetryonics 53.01 - Deuterium atomic config

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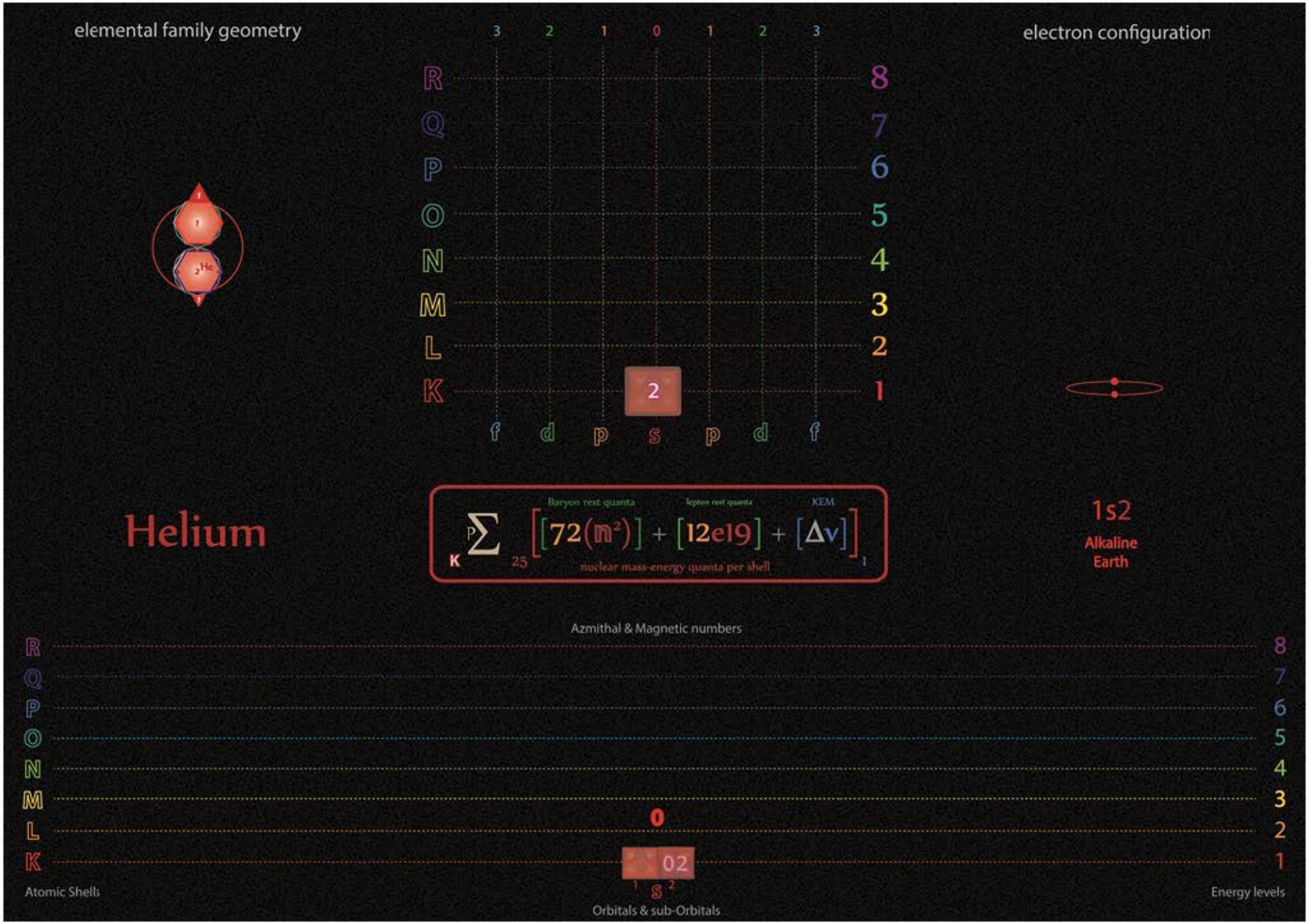

Tetryonics 53.02 - Helium atomic config

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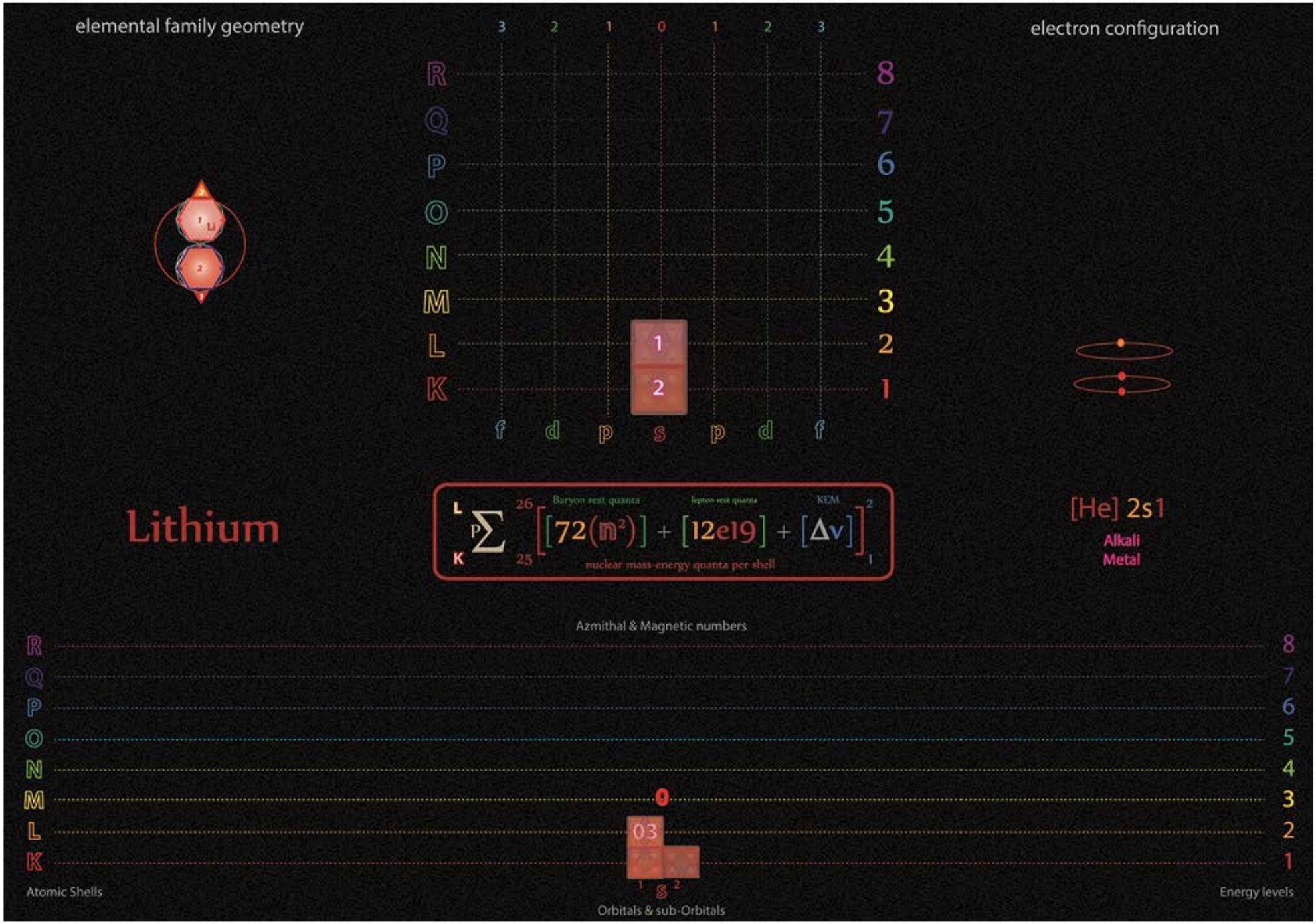

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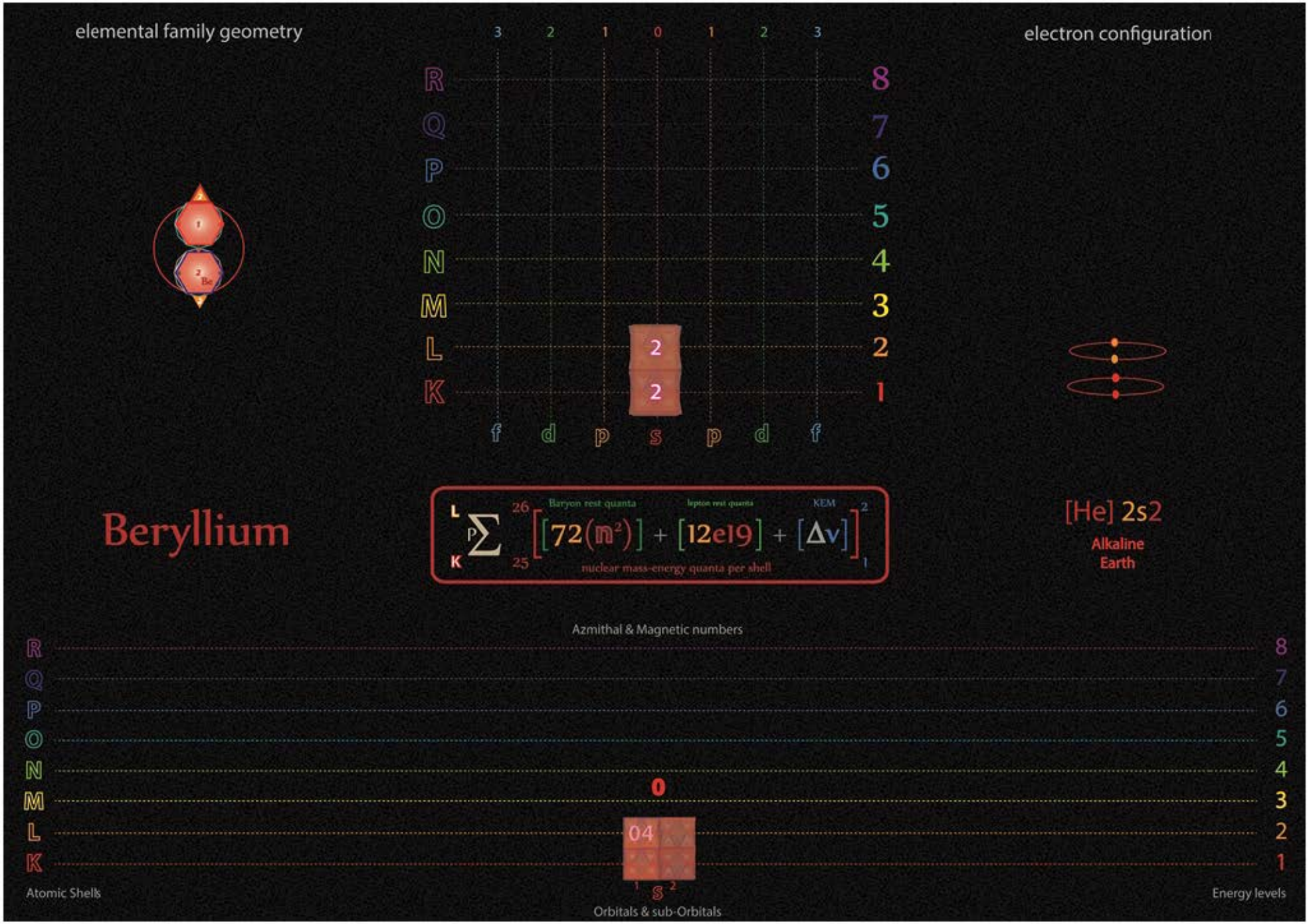

Tetryonics 53.04 - Beryllium atomic config

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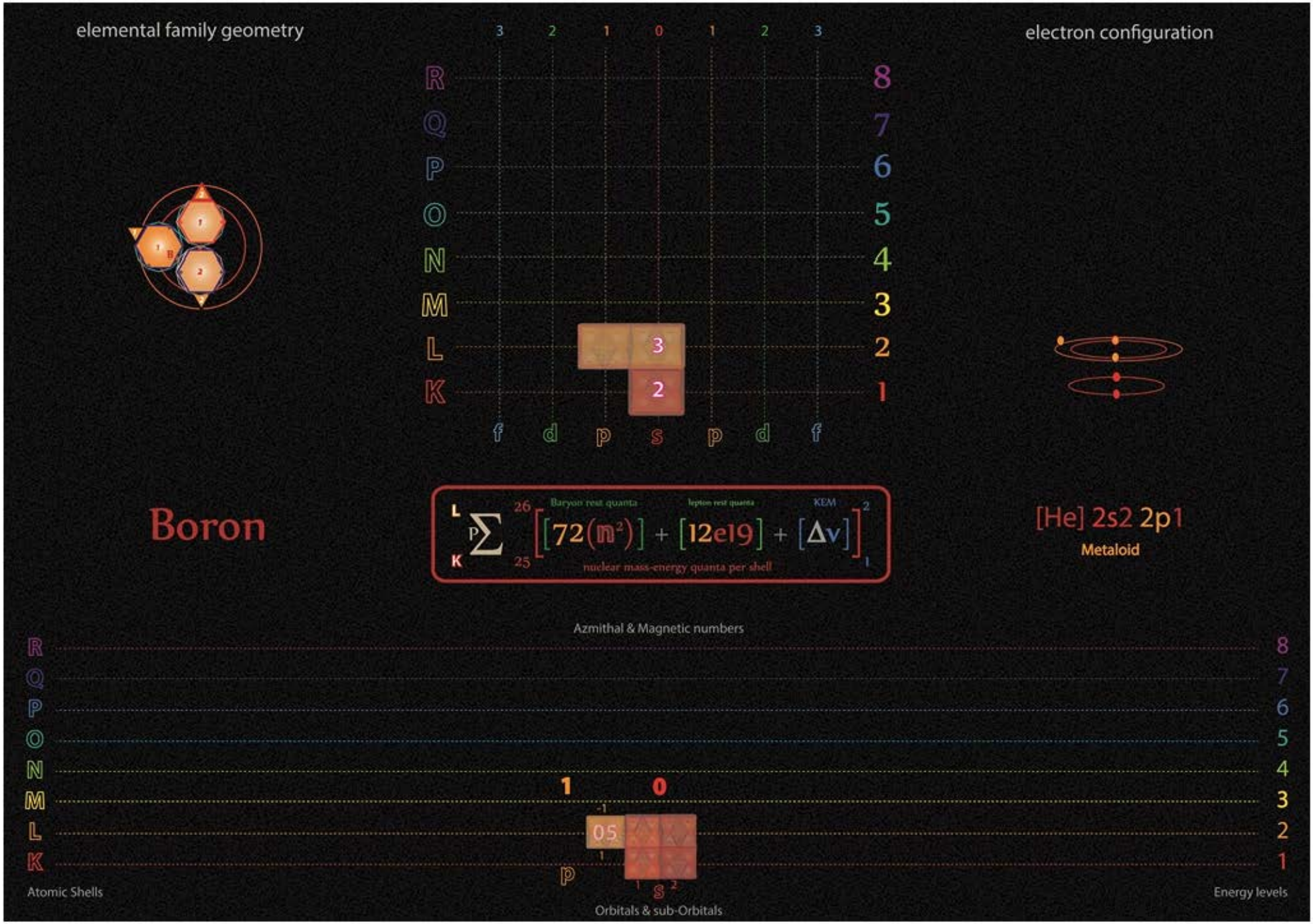

Tetryonics 53.05 - Boron atomic config

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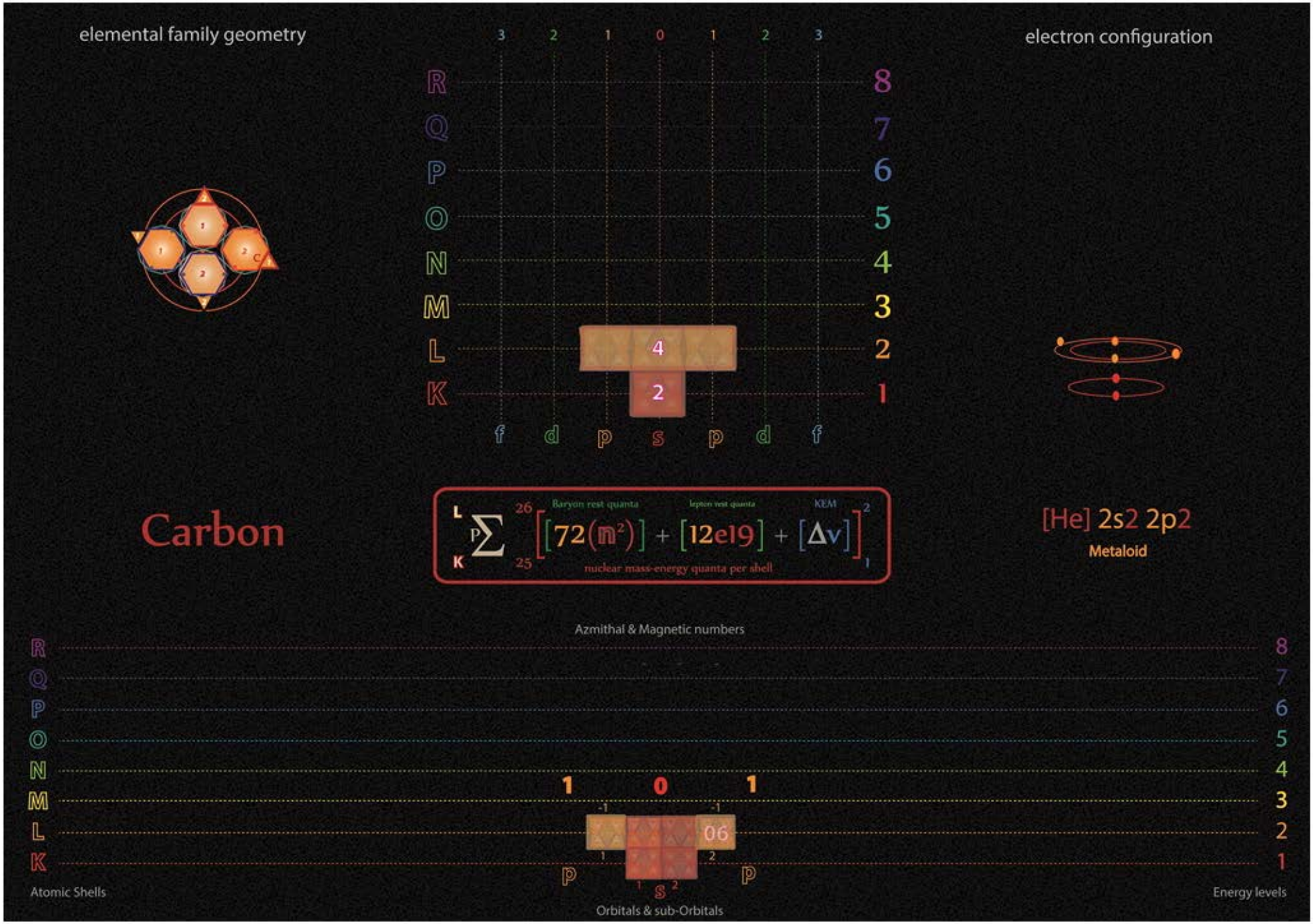

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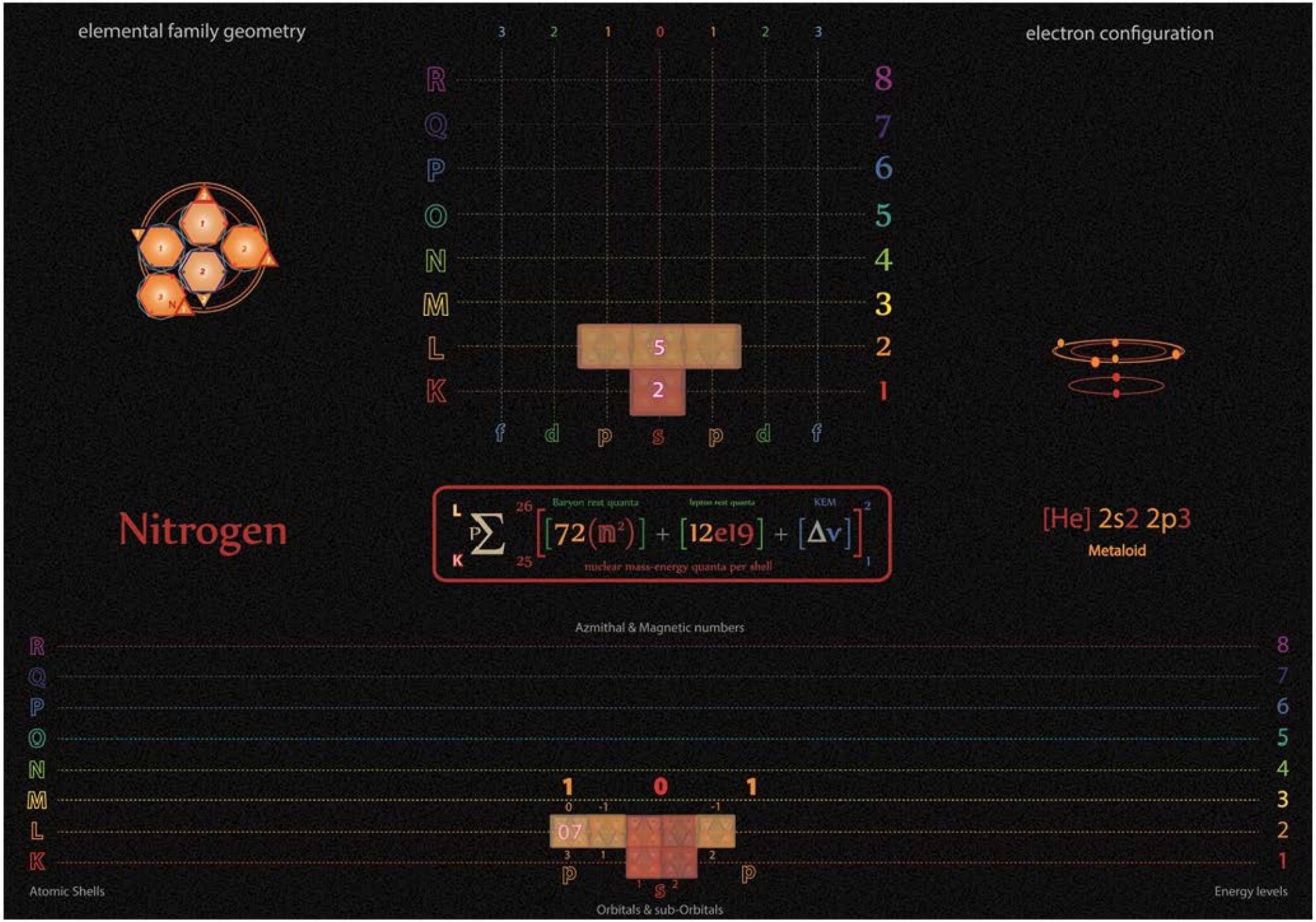

Tetryonics 53.07 - Nitrogen atomic config

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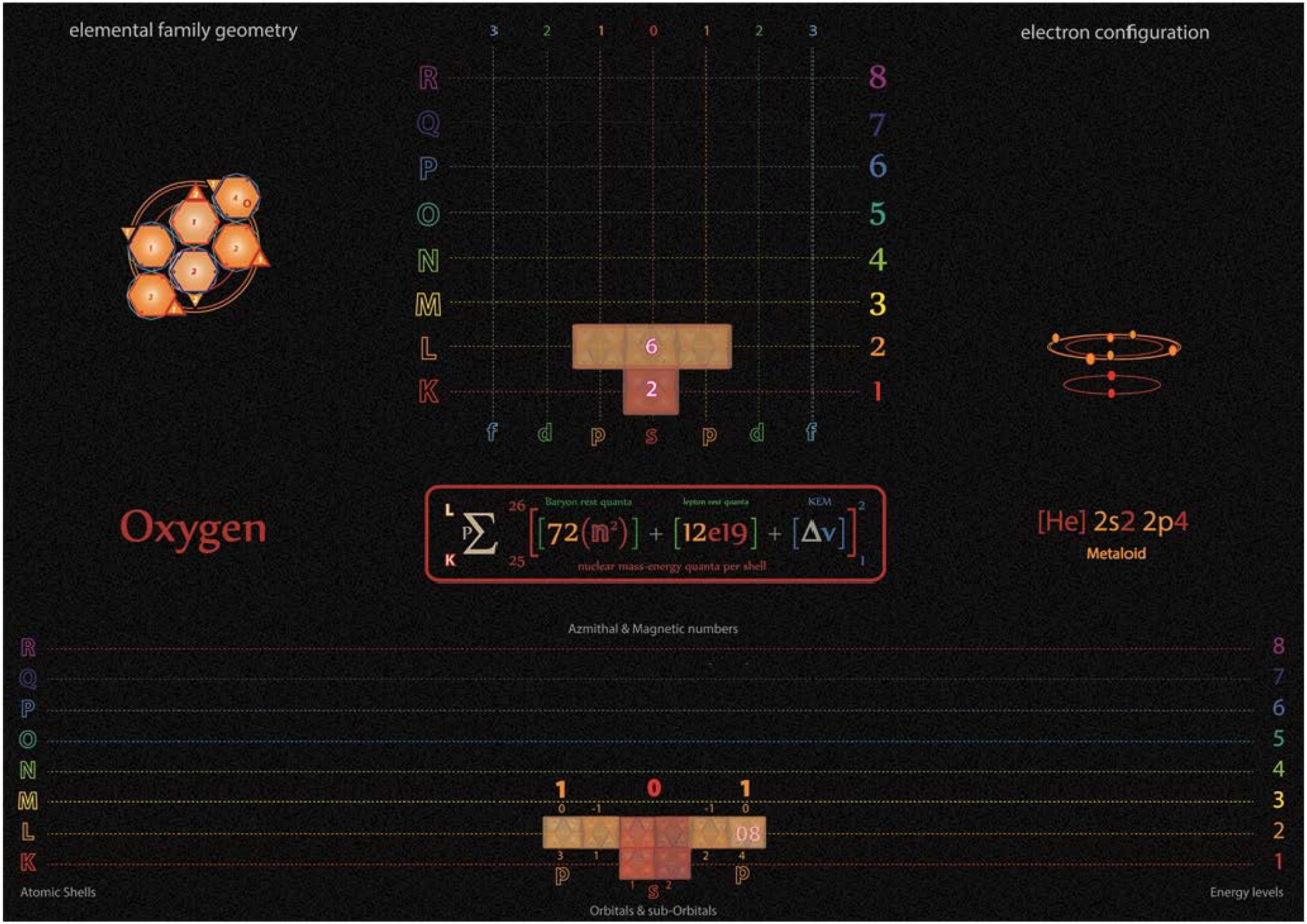

Tetryonics 53.08 - Oxygen atomic config

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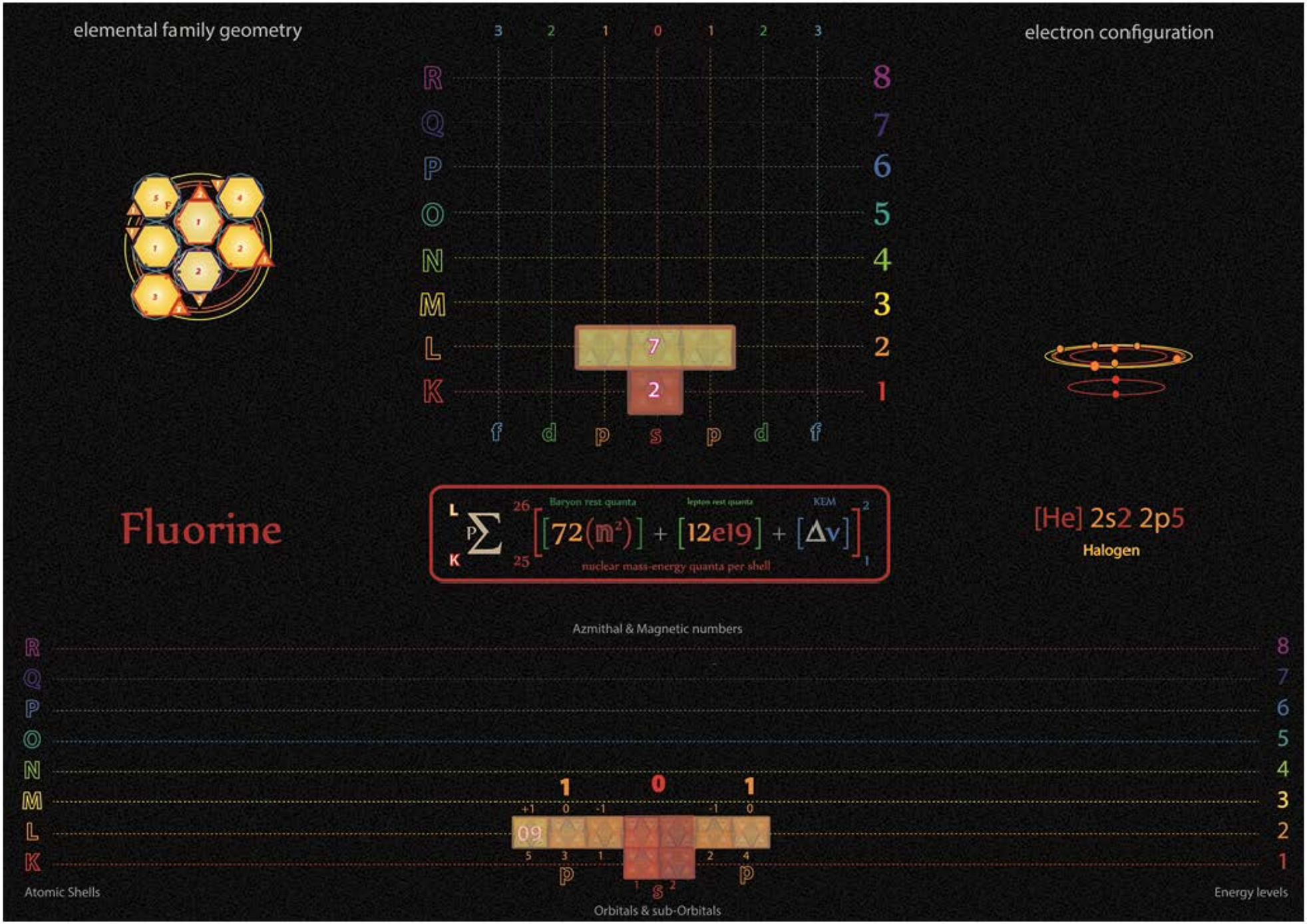

Tetryonics 53.09 - Fluorine atomic config

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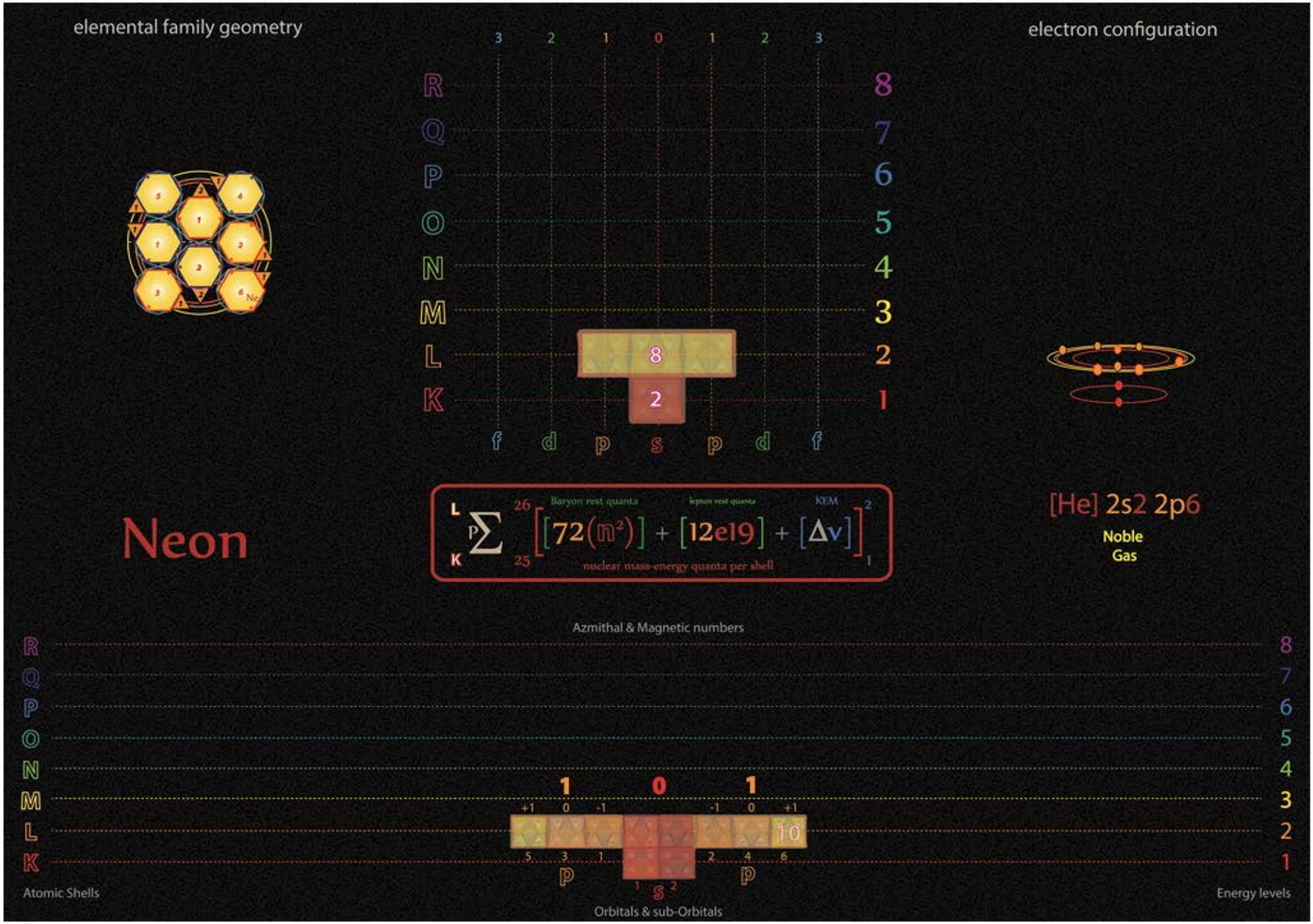

Tetryonics 53.10 - Neon atomic config

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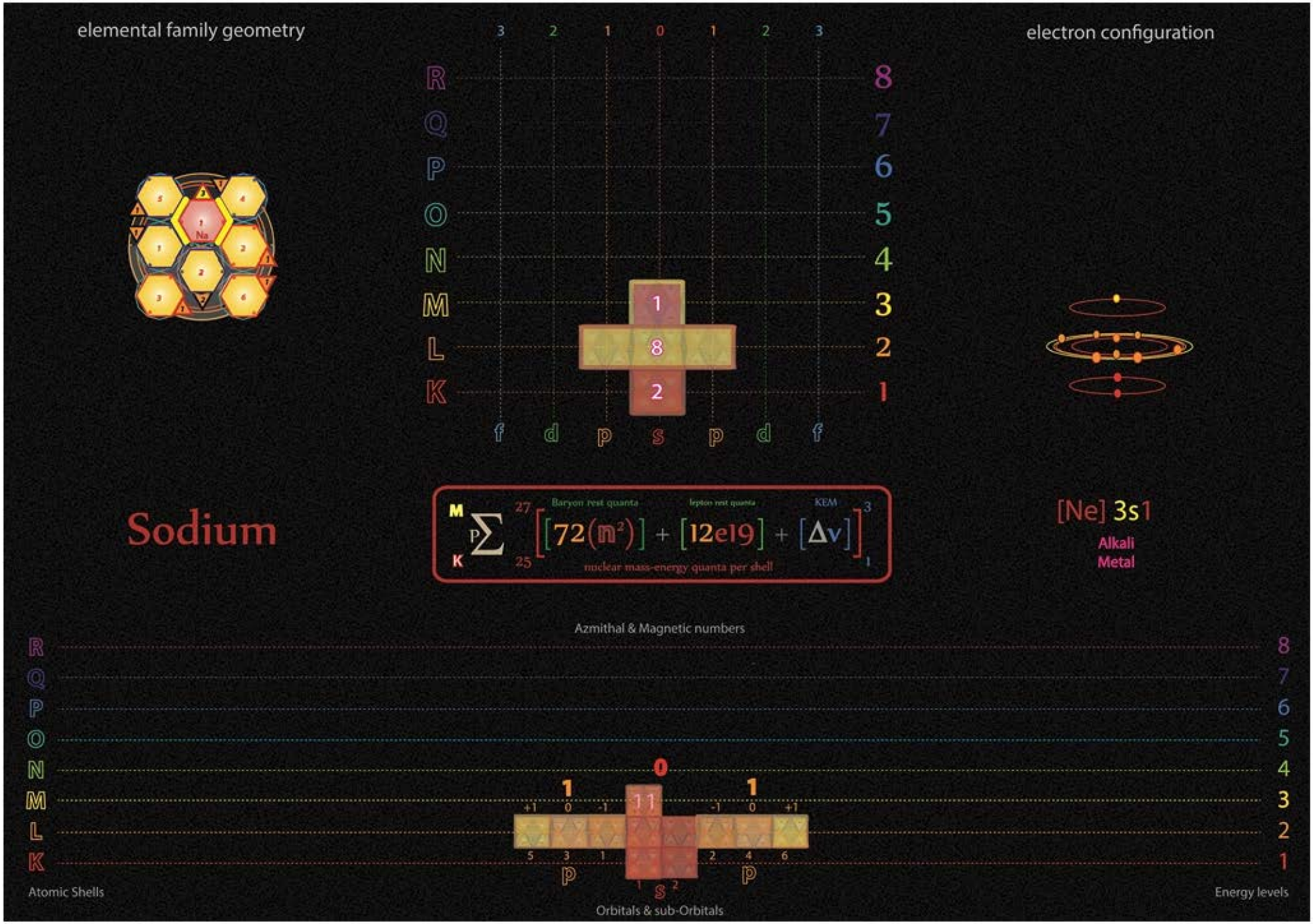

Tetryonics 53.11 - Sodium atomic config

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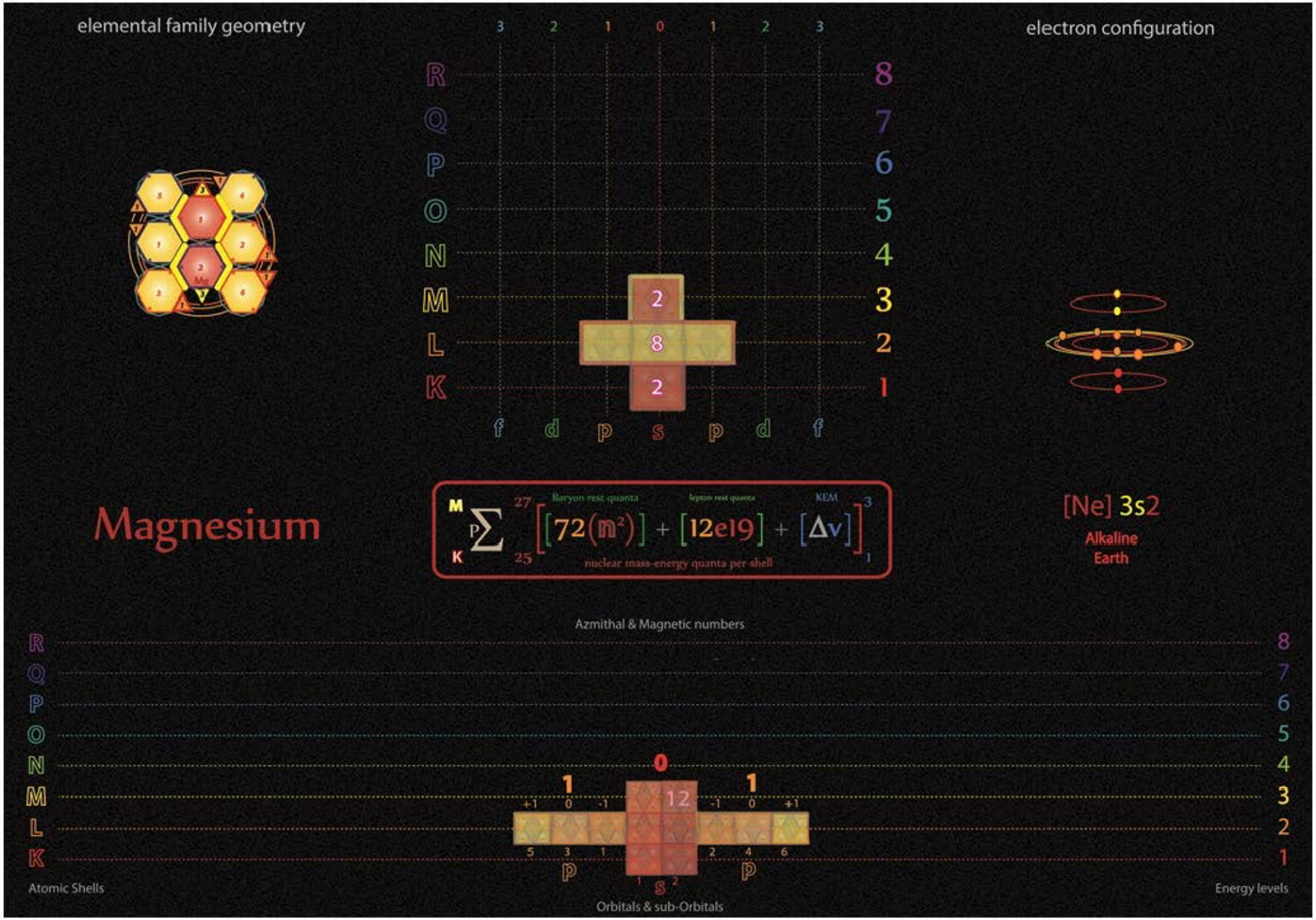

Tetryonics 53.12 - Magnesium atomic config

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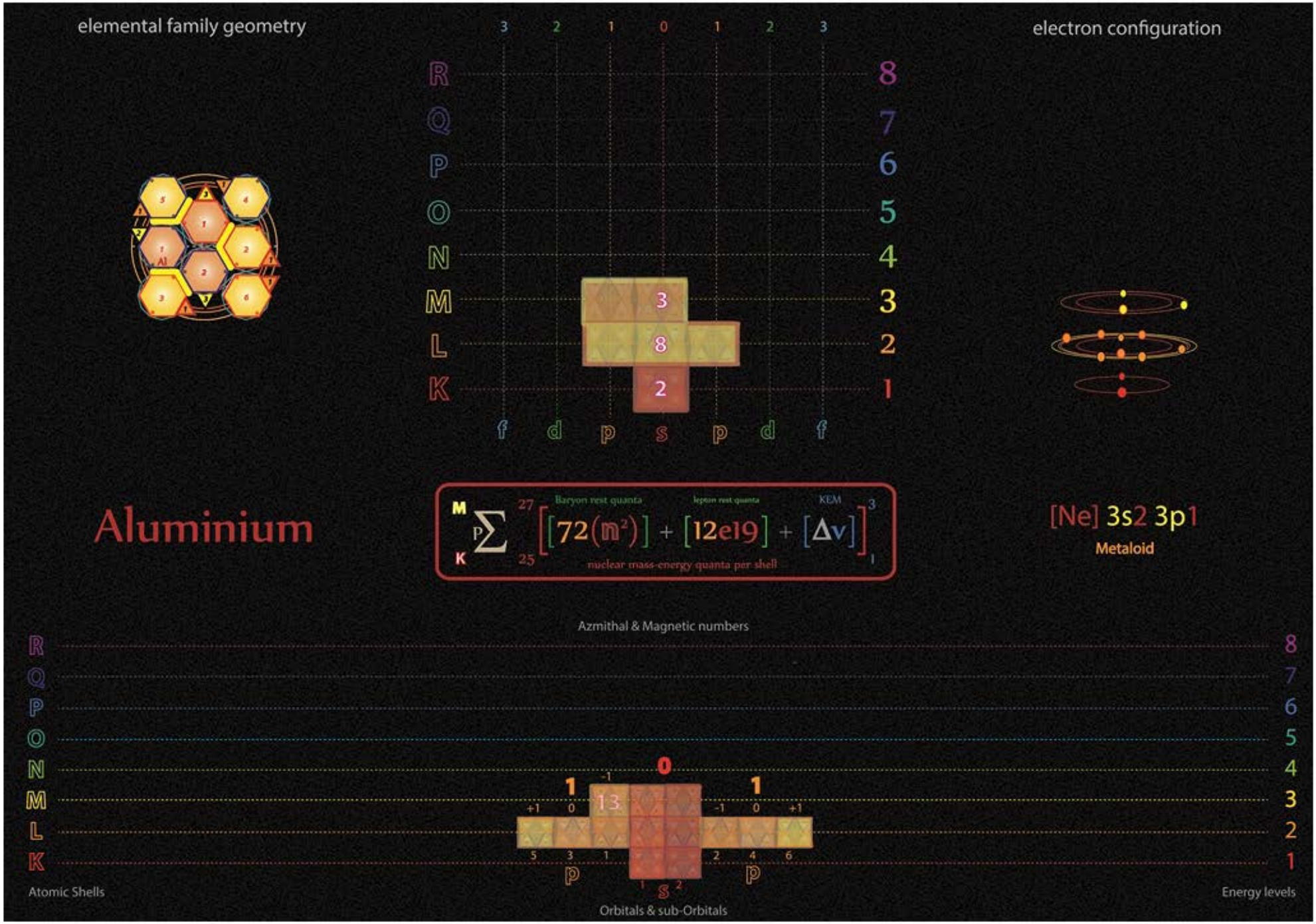

Tetryonics 53.13 - Aluminium atomic config

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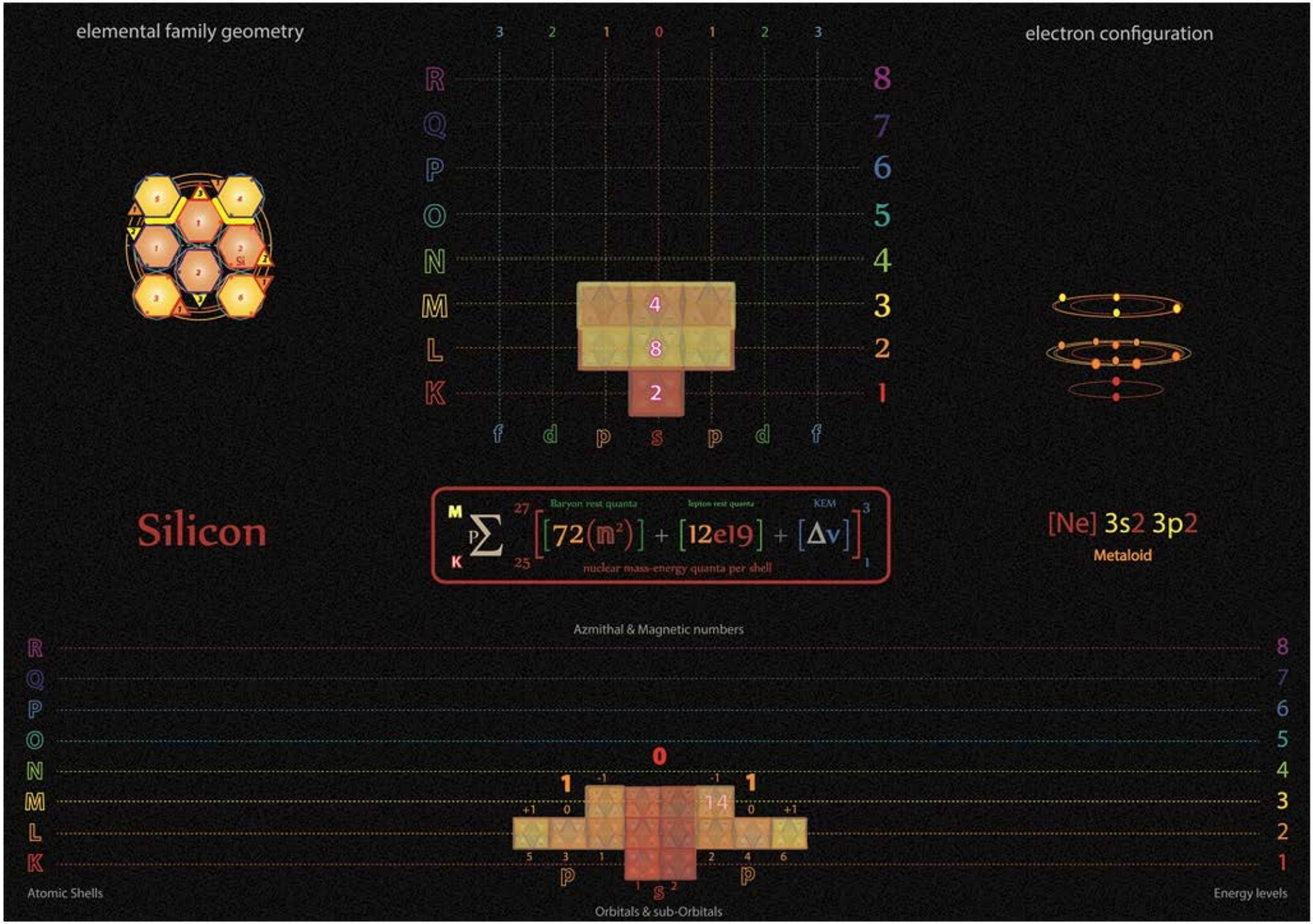

Tetryonics 53.14 - Silicon atomic config

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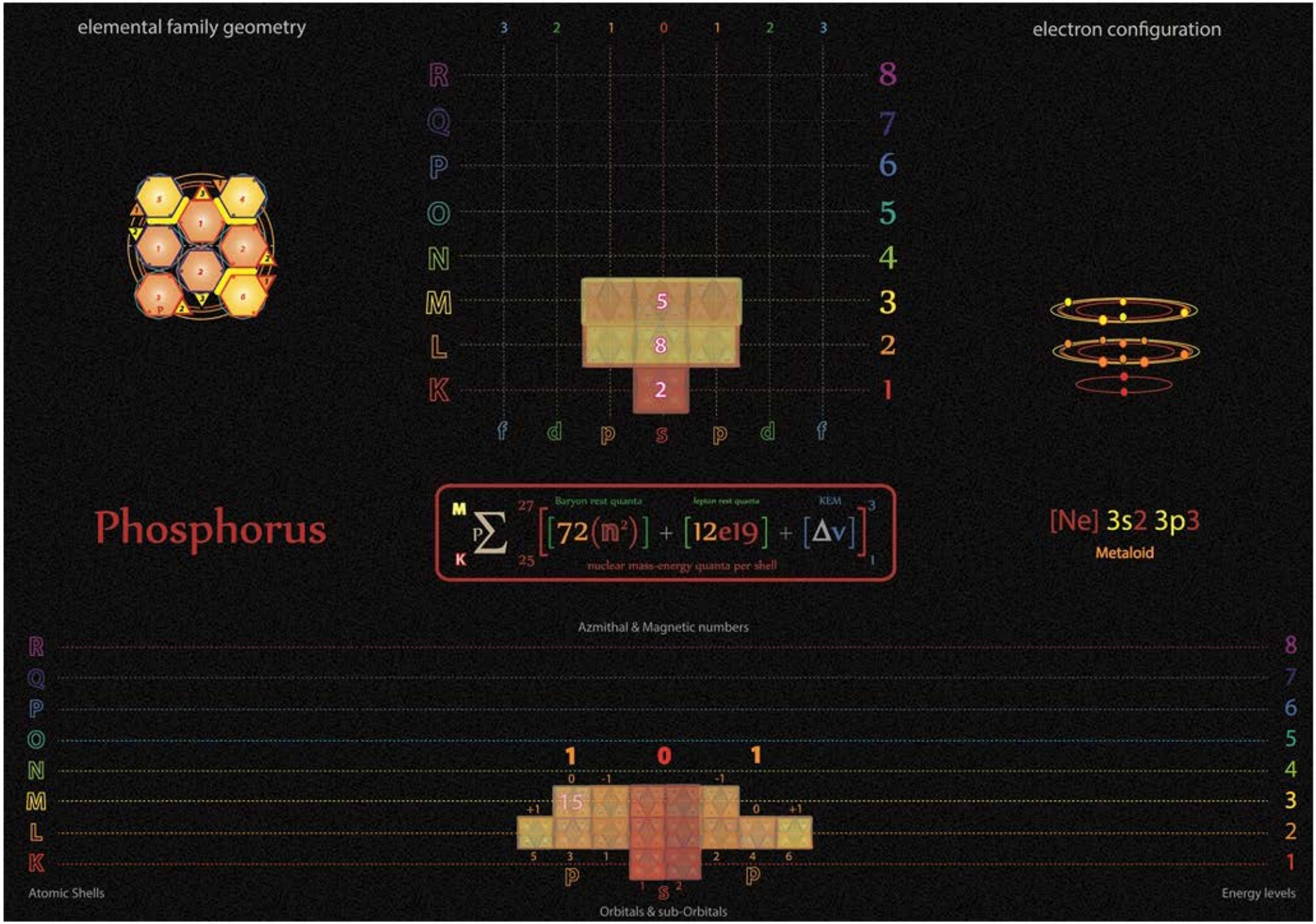

Tetryonics 53.15 - Phosphorus atomic config

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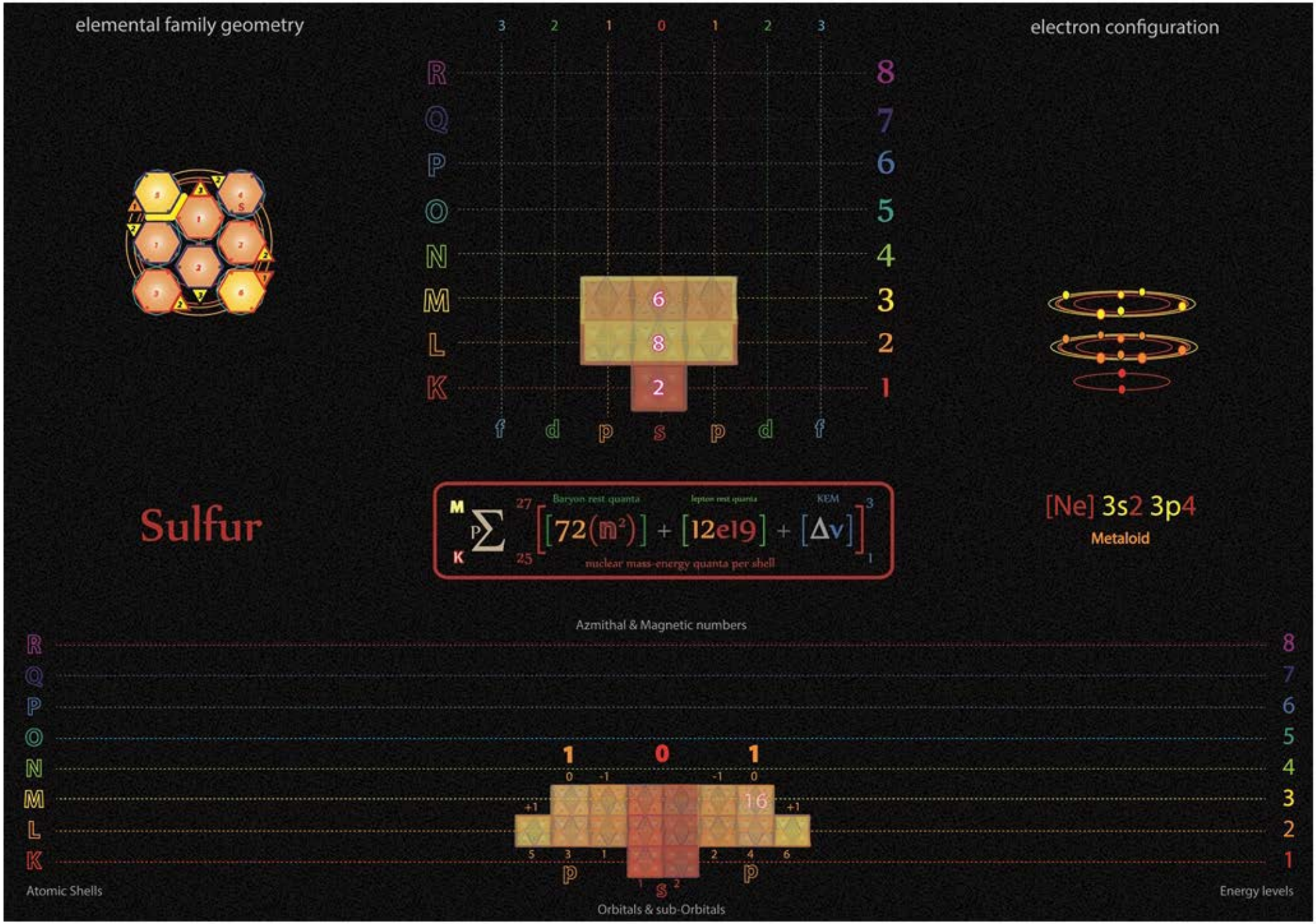

Tetryonics 53.16 - Sulfur atomic config

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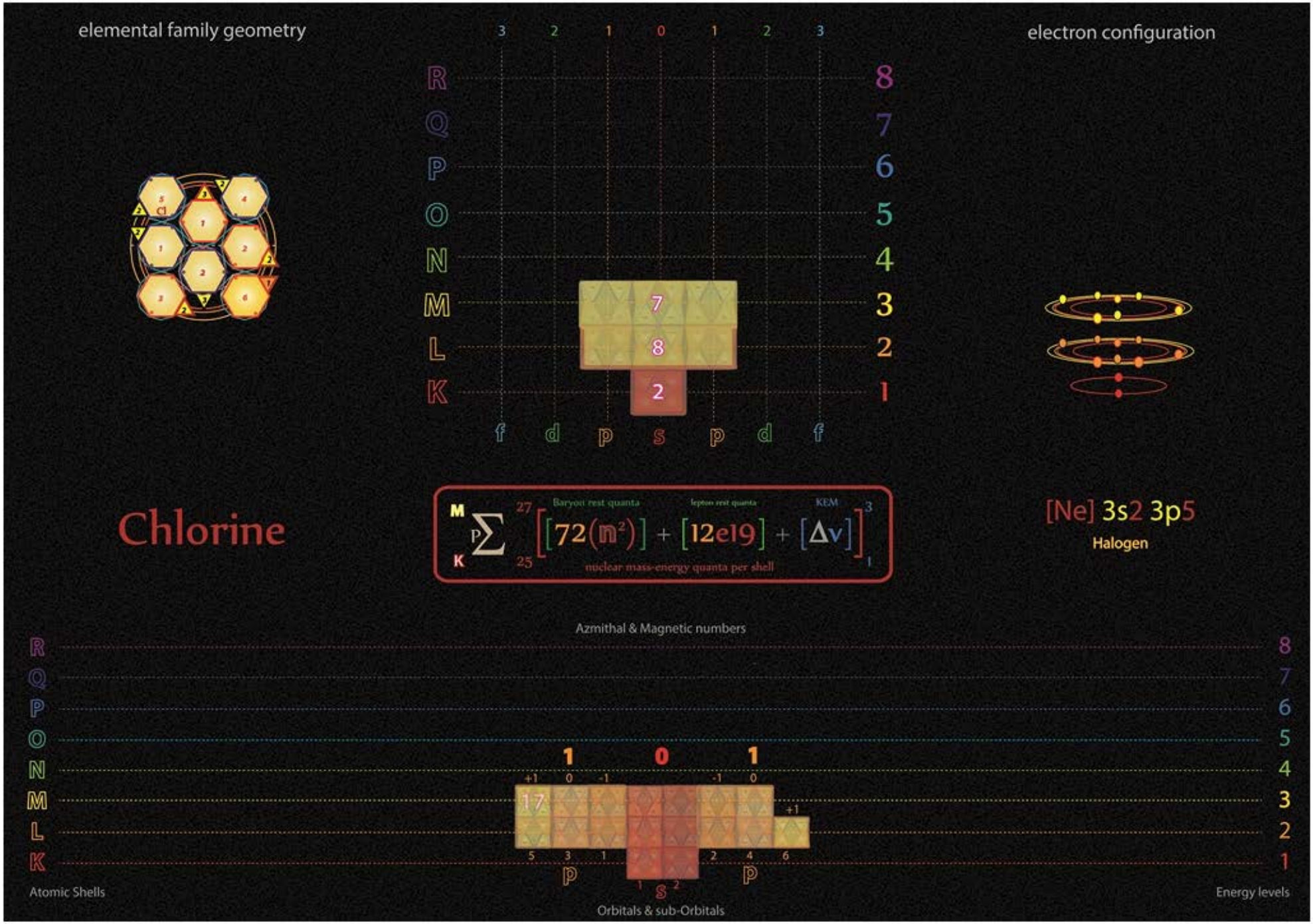

Tetryonics 53.17 - Chlorine atomic config

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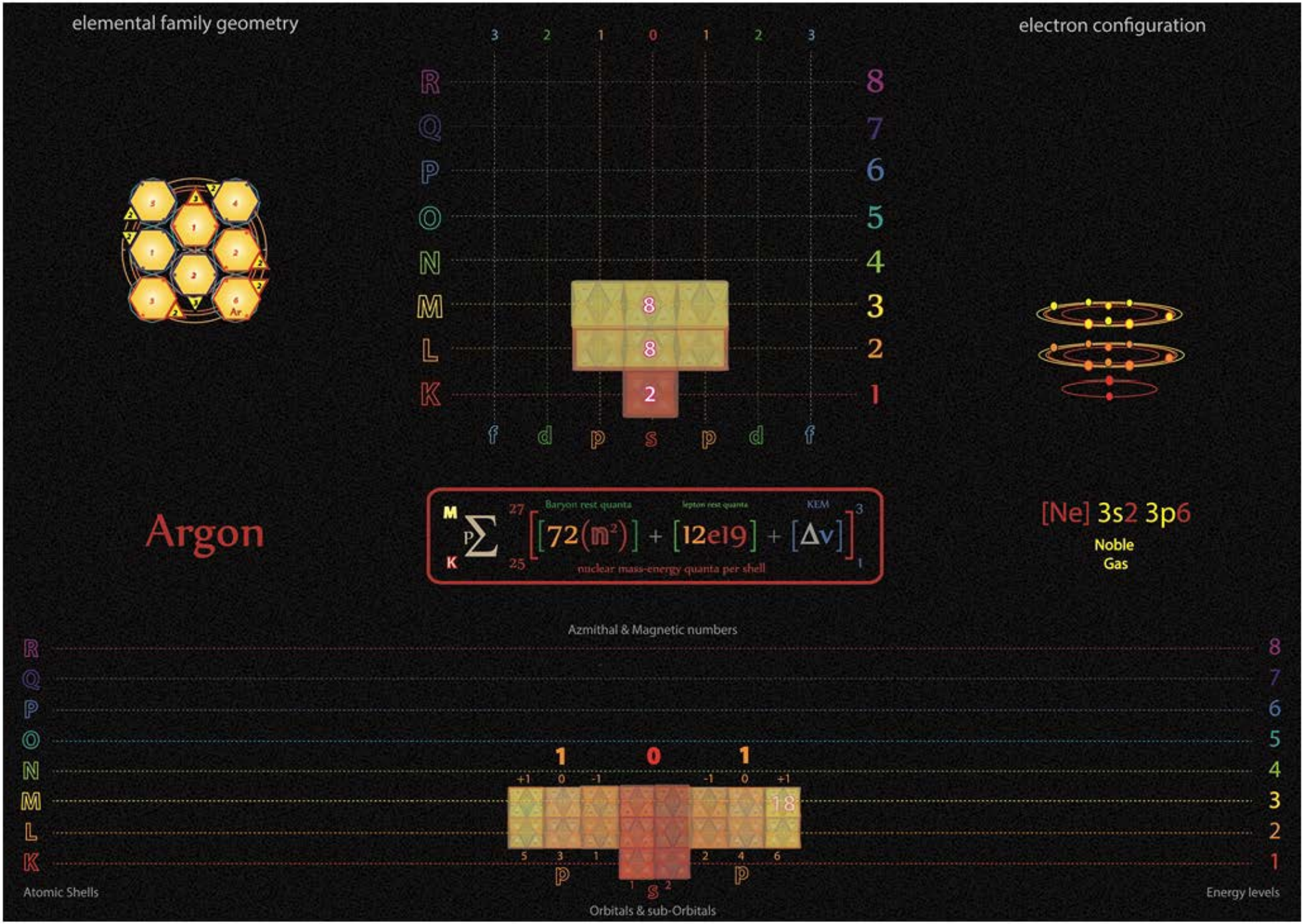

Tetryonics 53.18 - Argon atomic config

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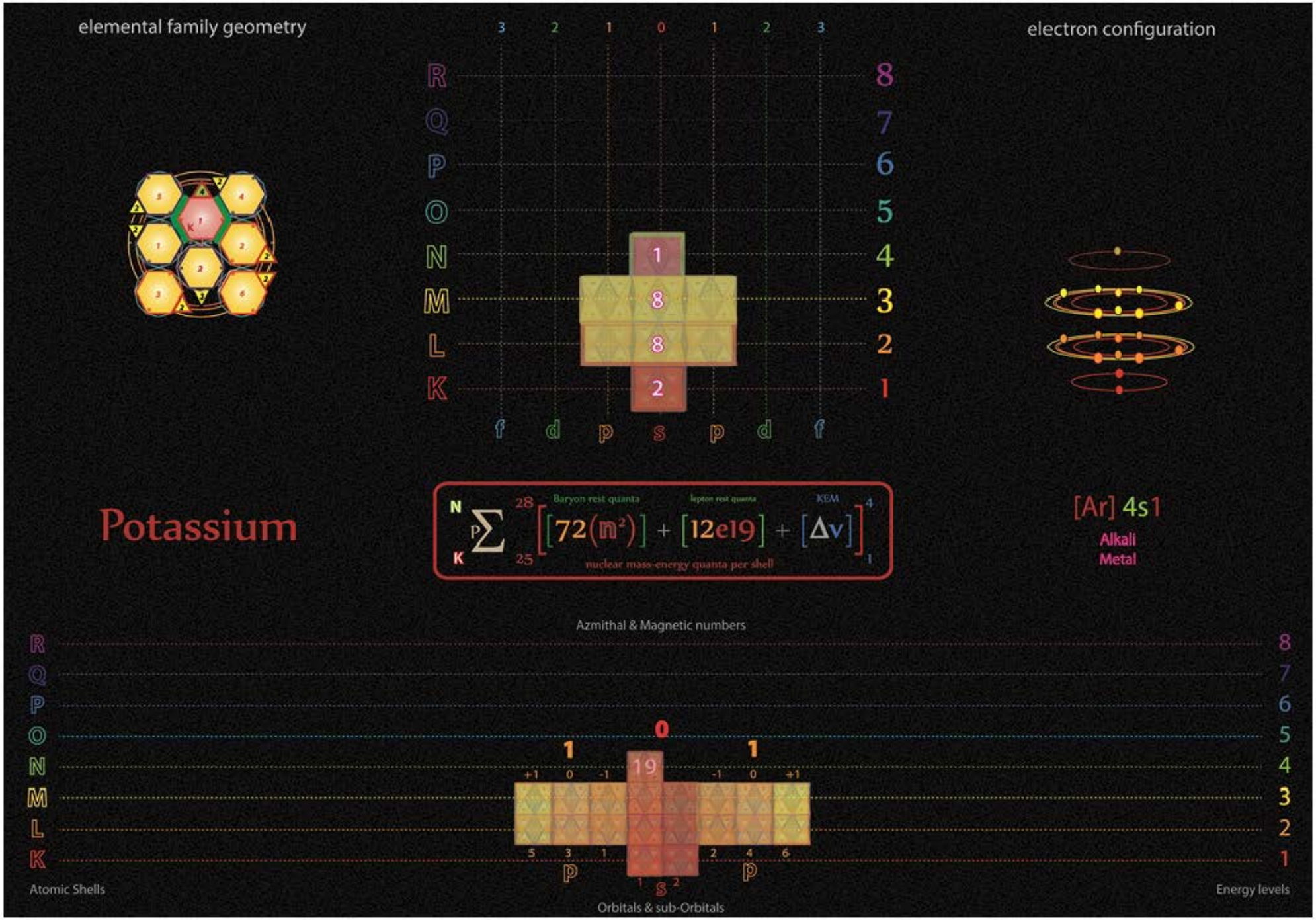

Tetryonics 53.19 - Potassium atomic config

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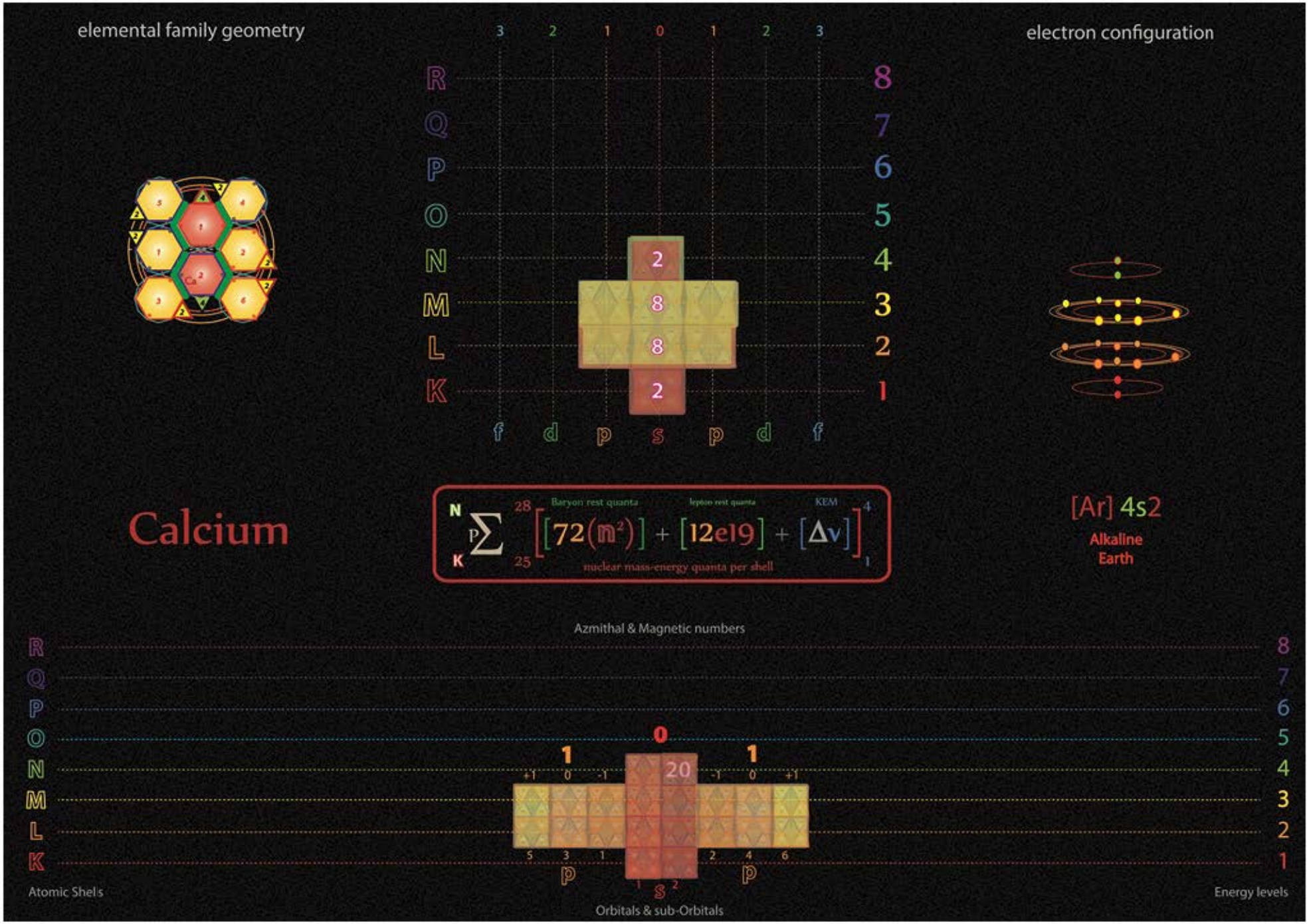

Tetryonics 53.20 - Calcium atomic config

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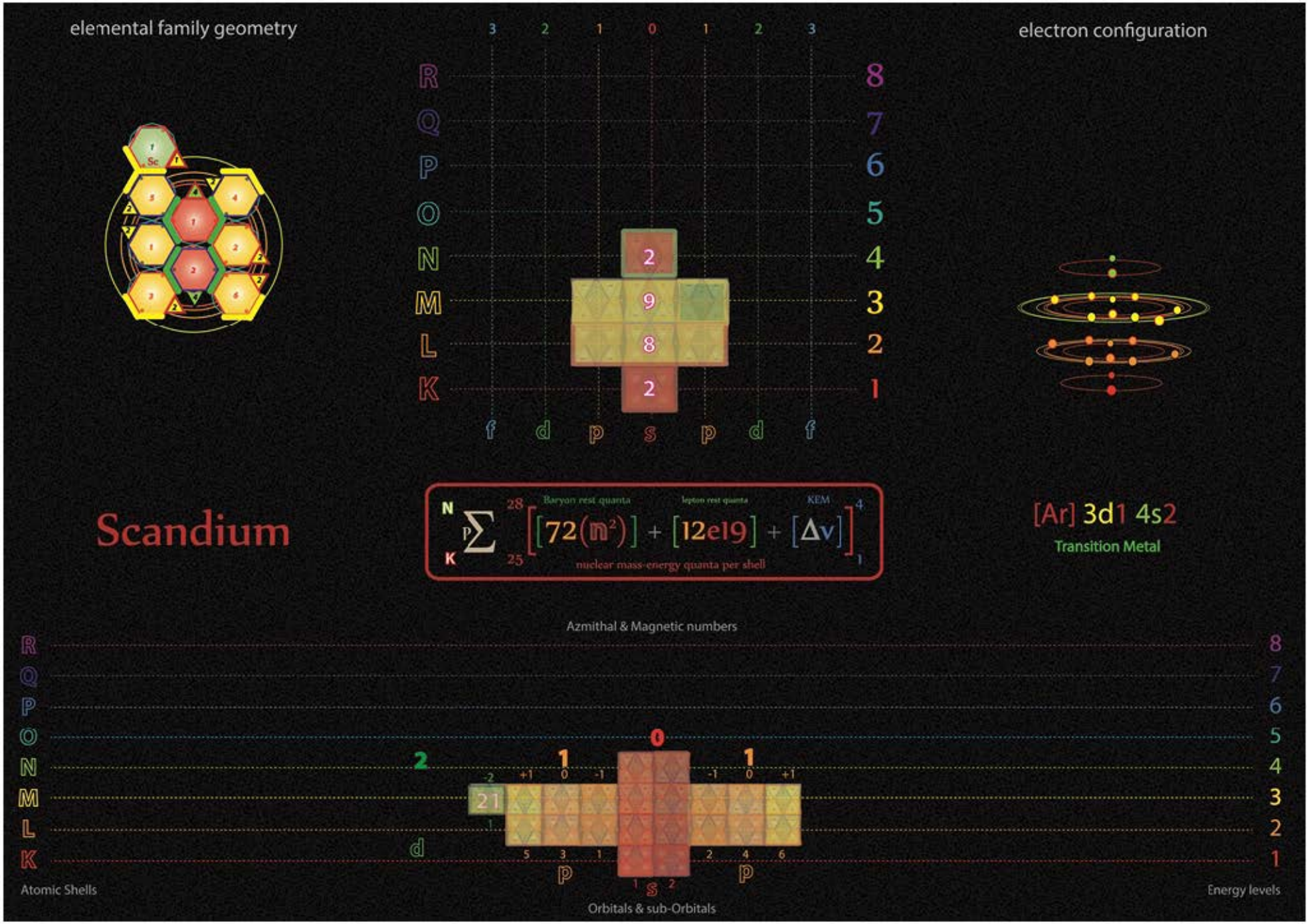

Tetryonics 53.21 - Scandium atomic config

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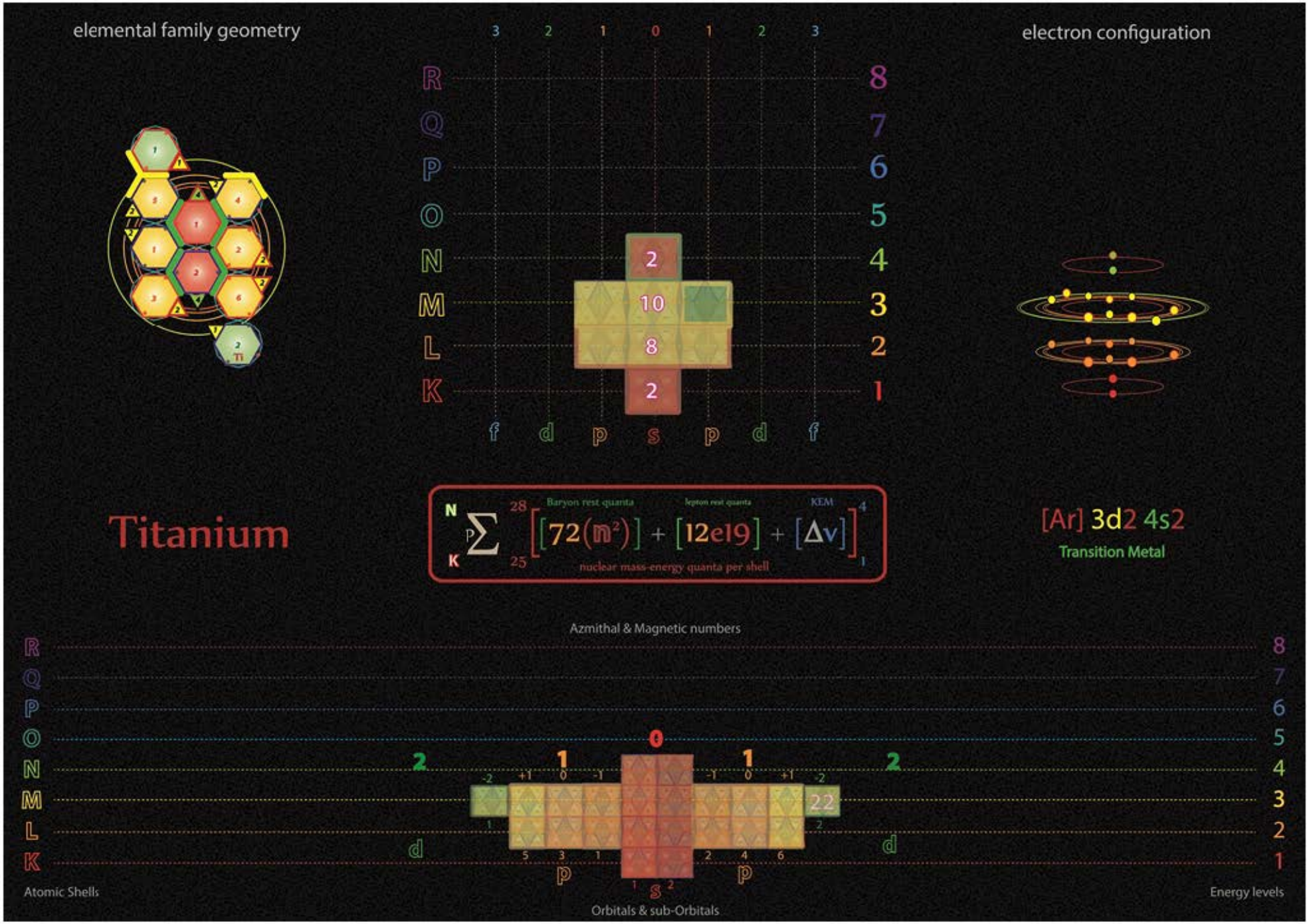

Tetryonics 53.22 - Titanium atomic config

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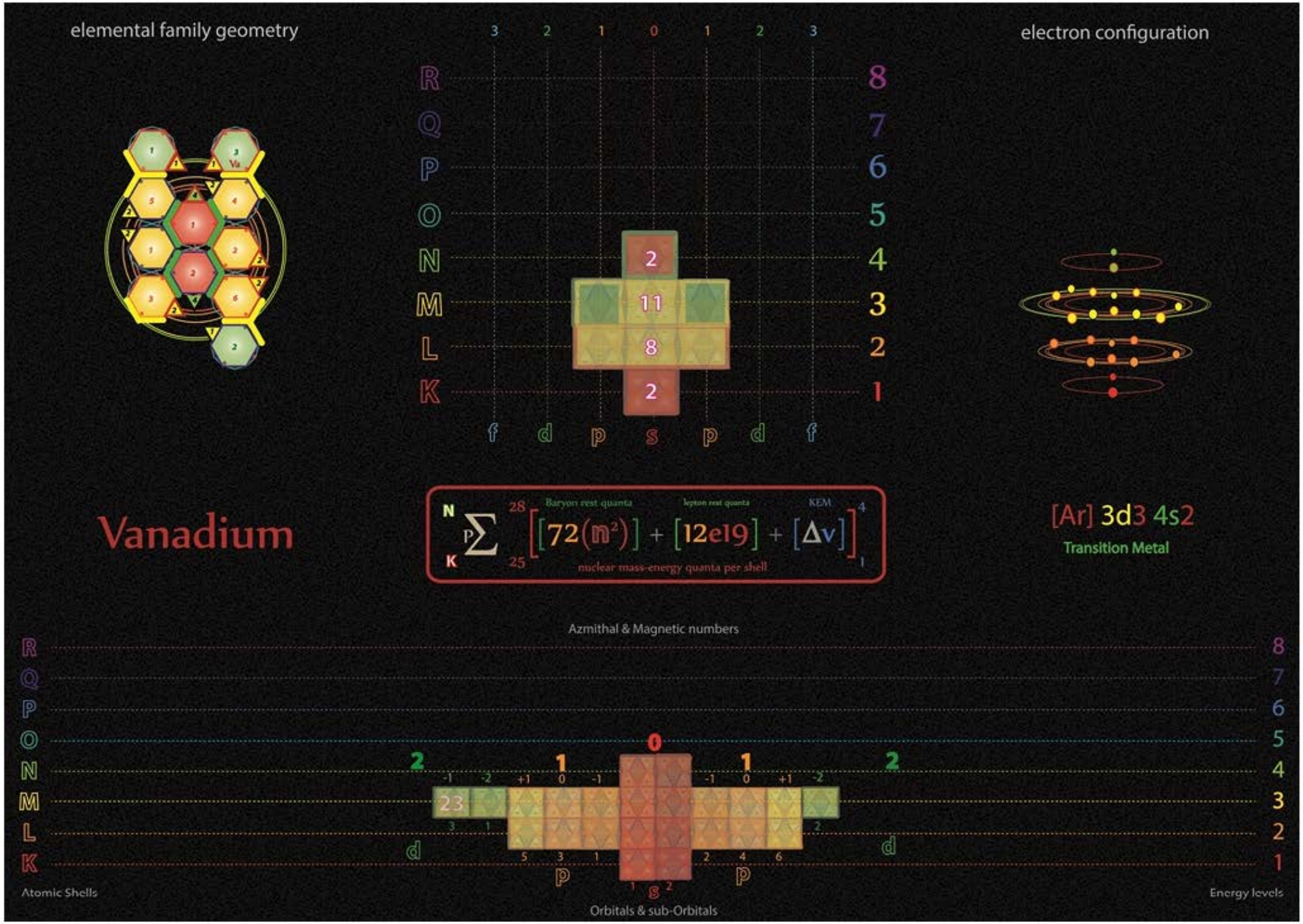

Tetryonics 53.23 - Vanadium atomic config

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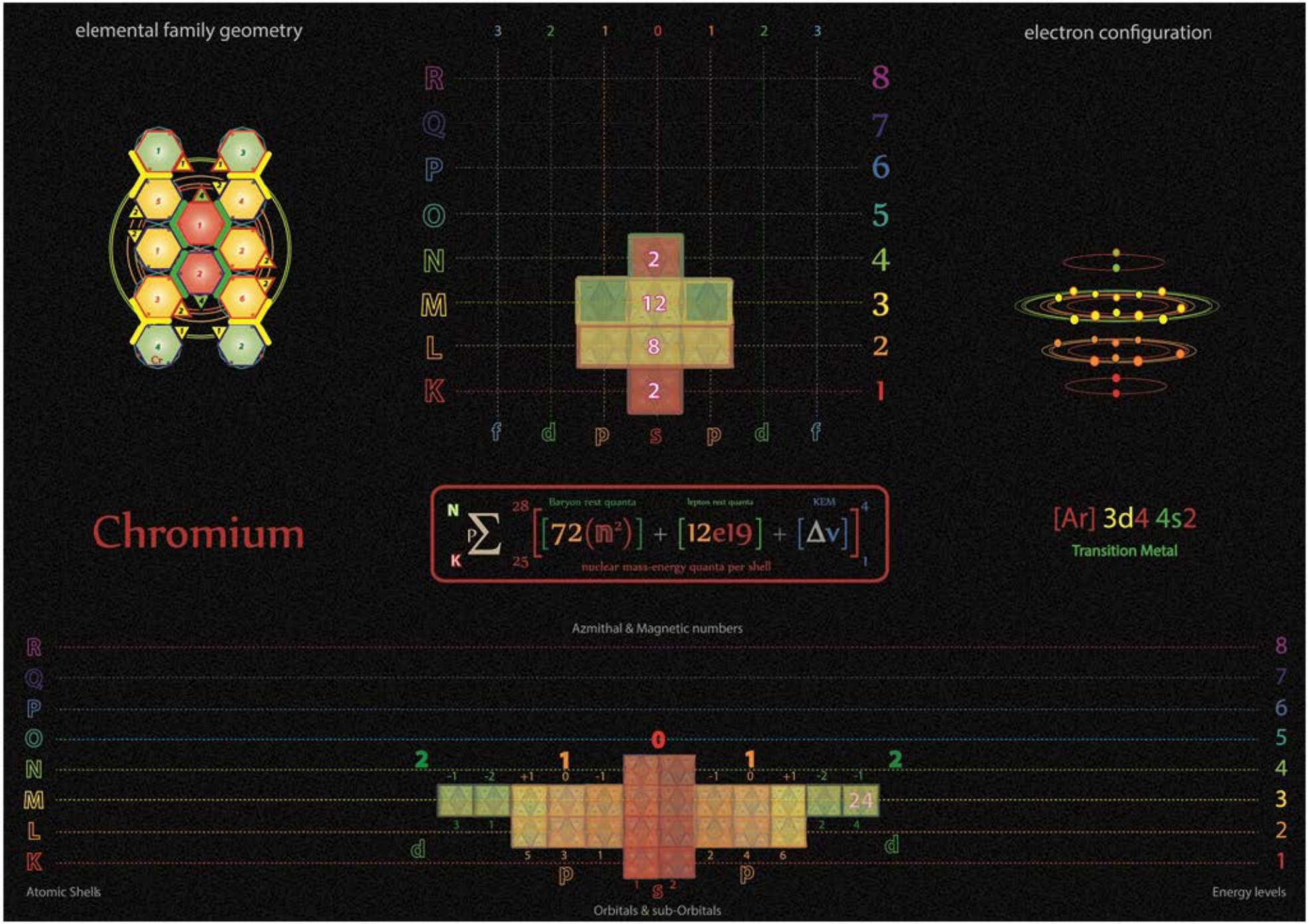

Tetryonics 53.24 - Chromium atomic config

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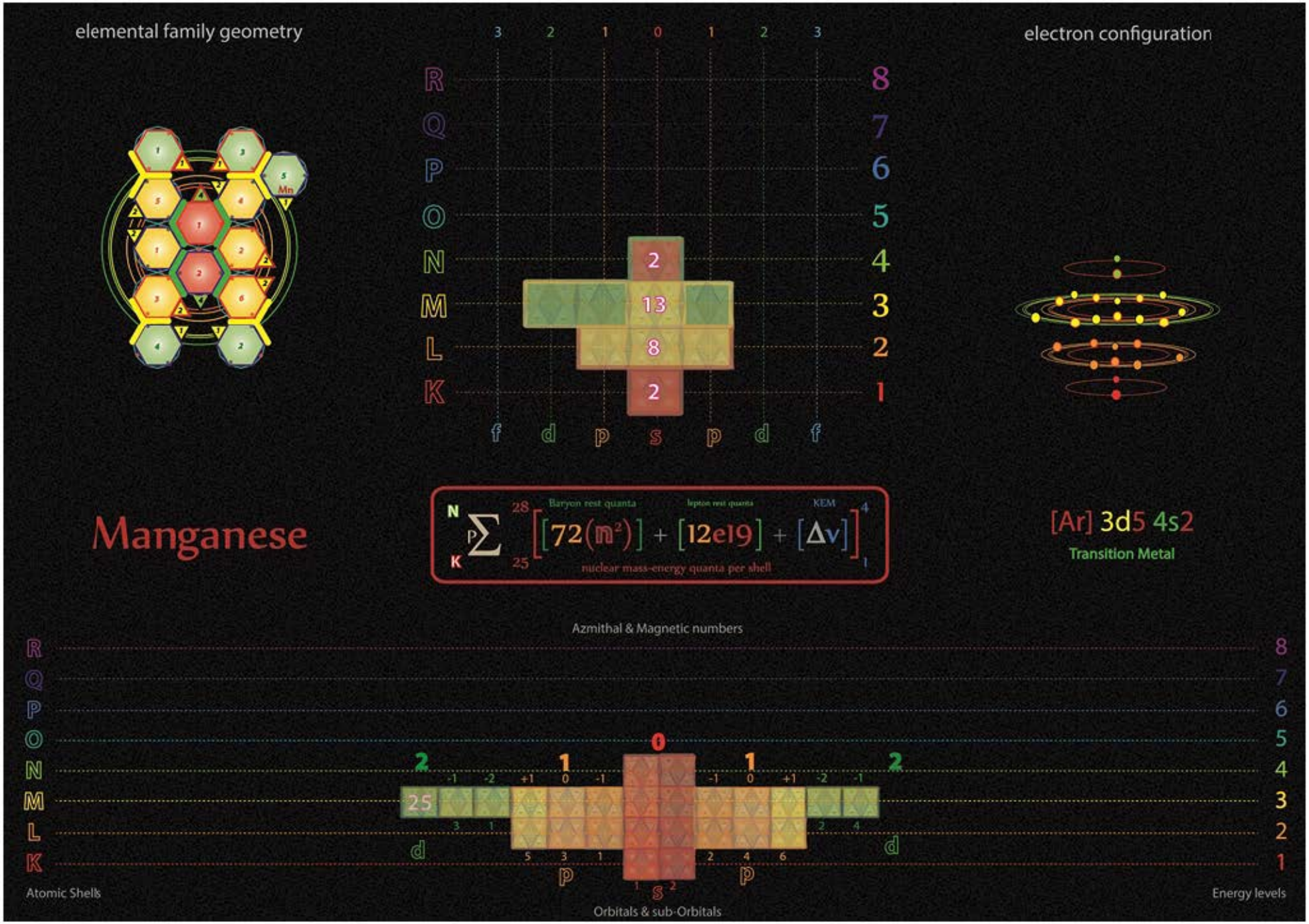

Tetryonics 53.25 - Manganese atomic config

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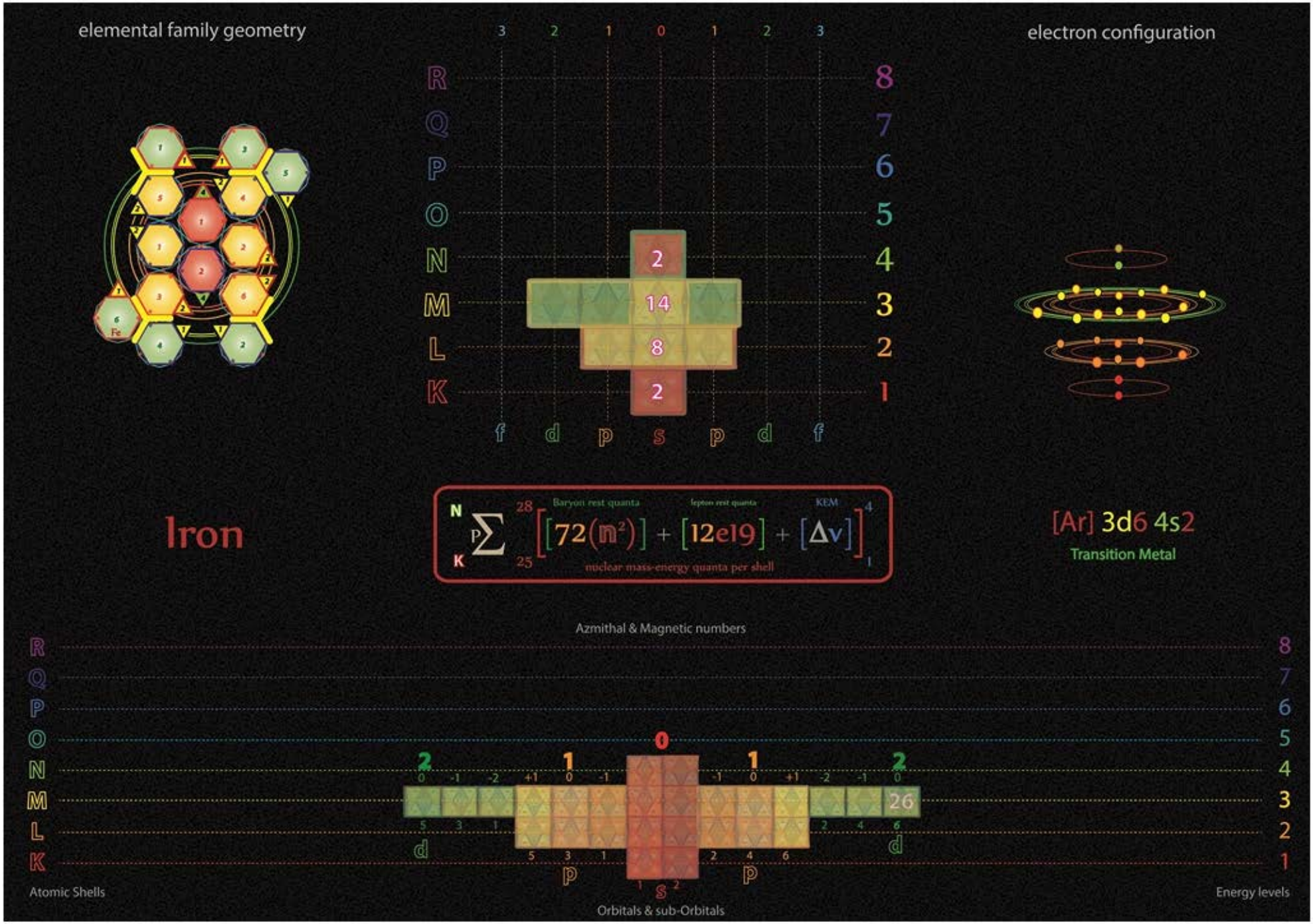

Tetryonics 53.26 - Iron atomic config

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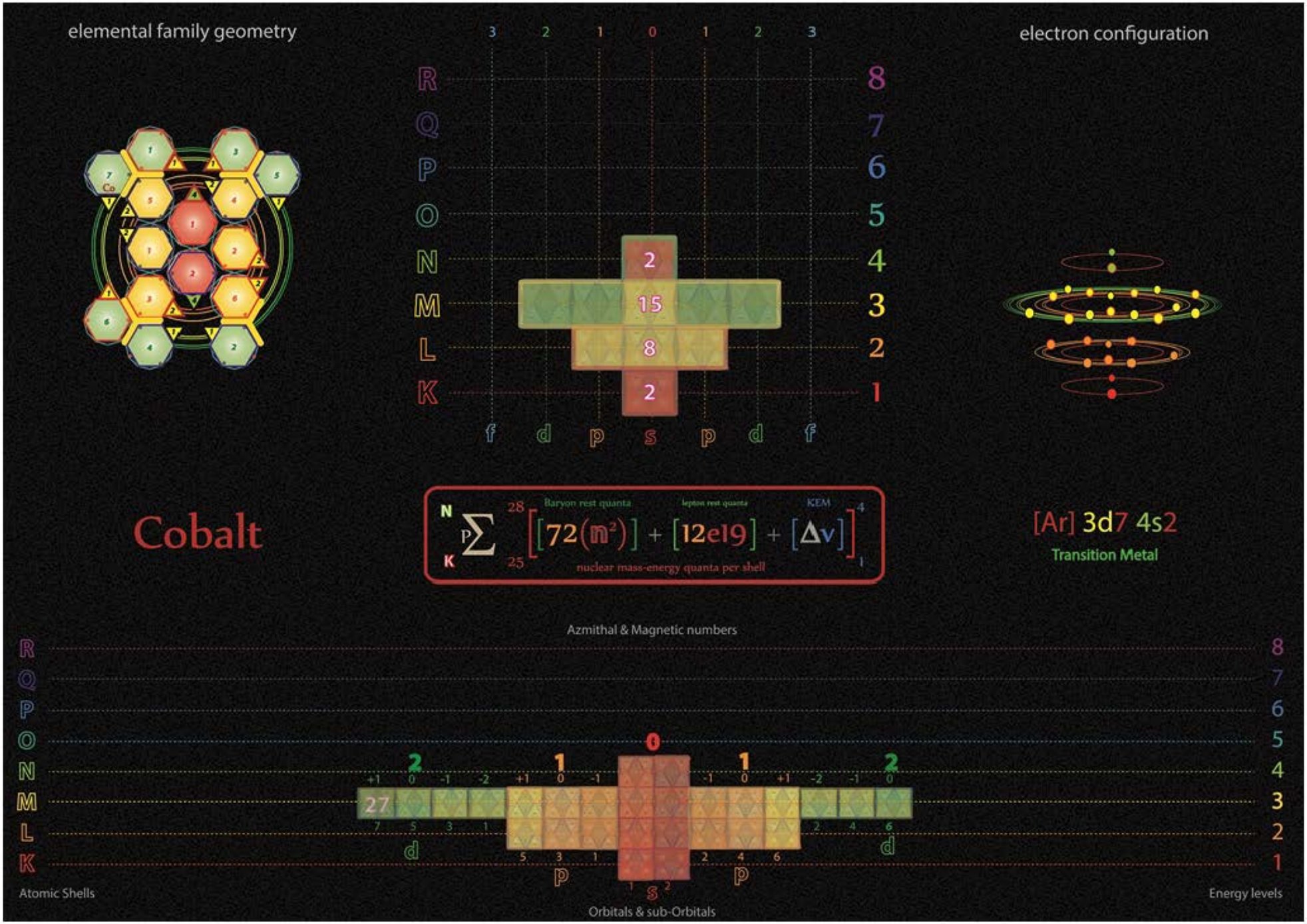

Tetryonics 53.27 - Cobalt atomic config

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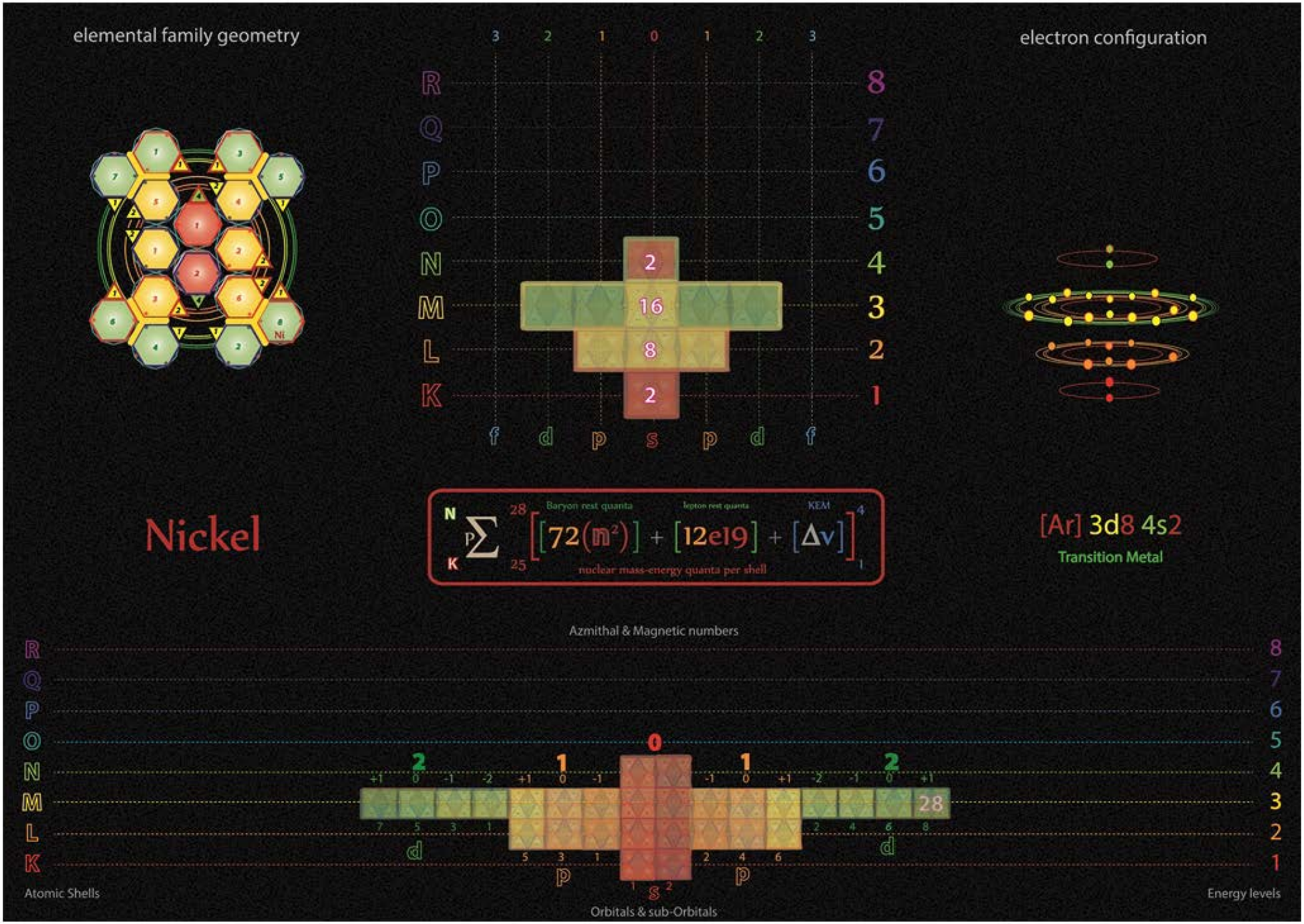

Tetryonics 53.28 - Nickel atomic config

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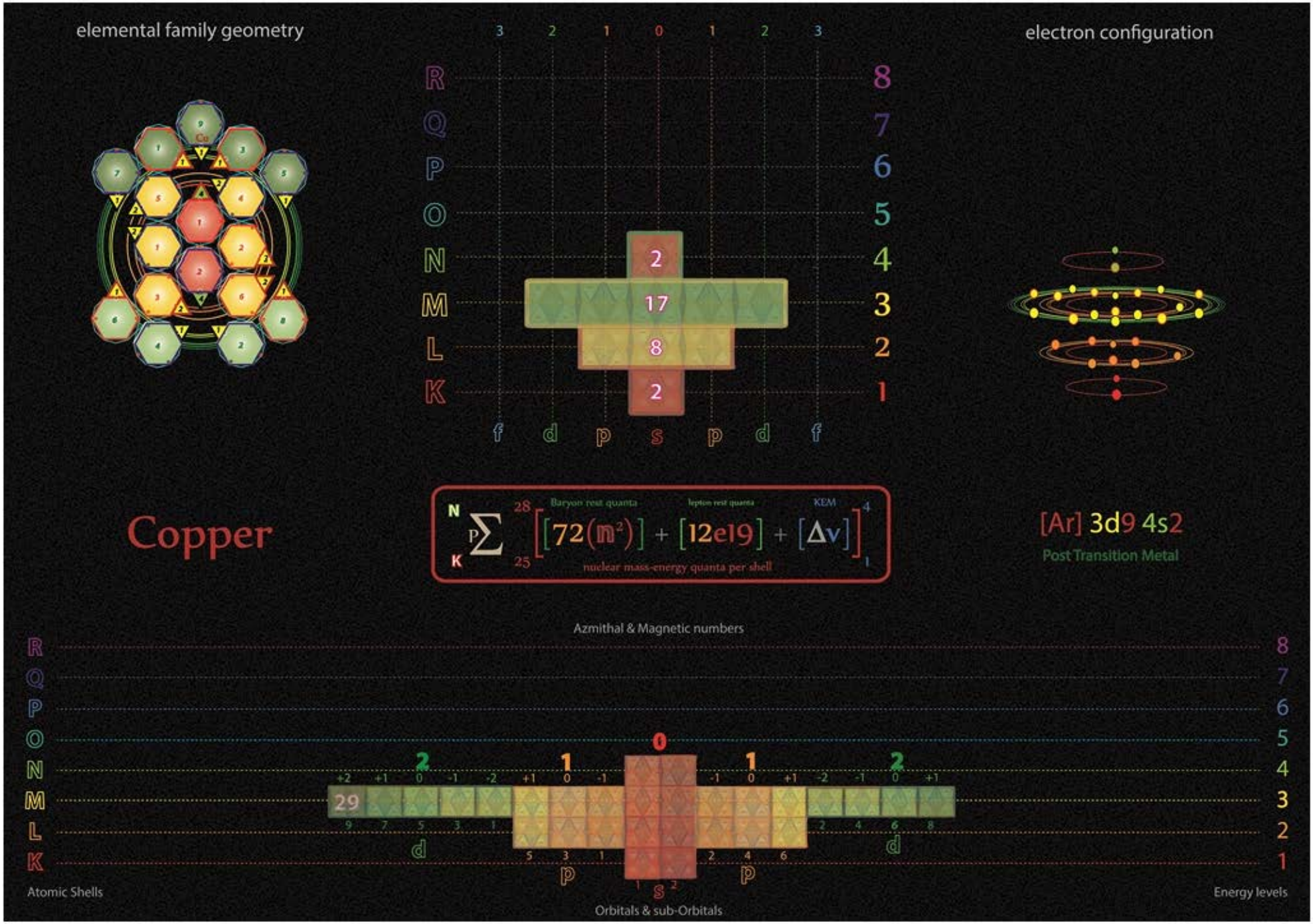

Tetryonics 53.29 - Copper atomic config

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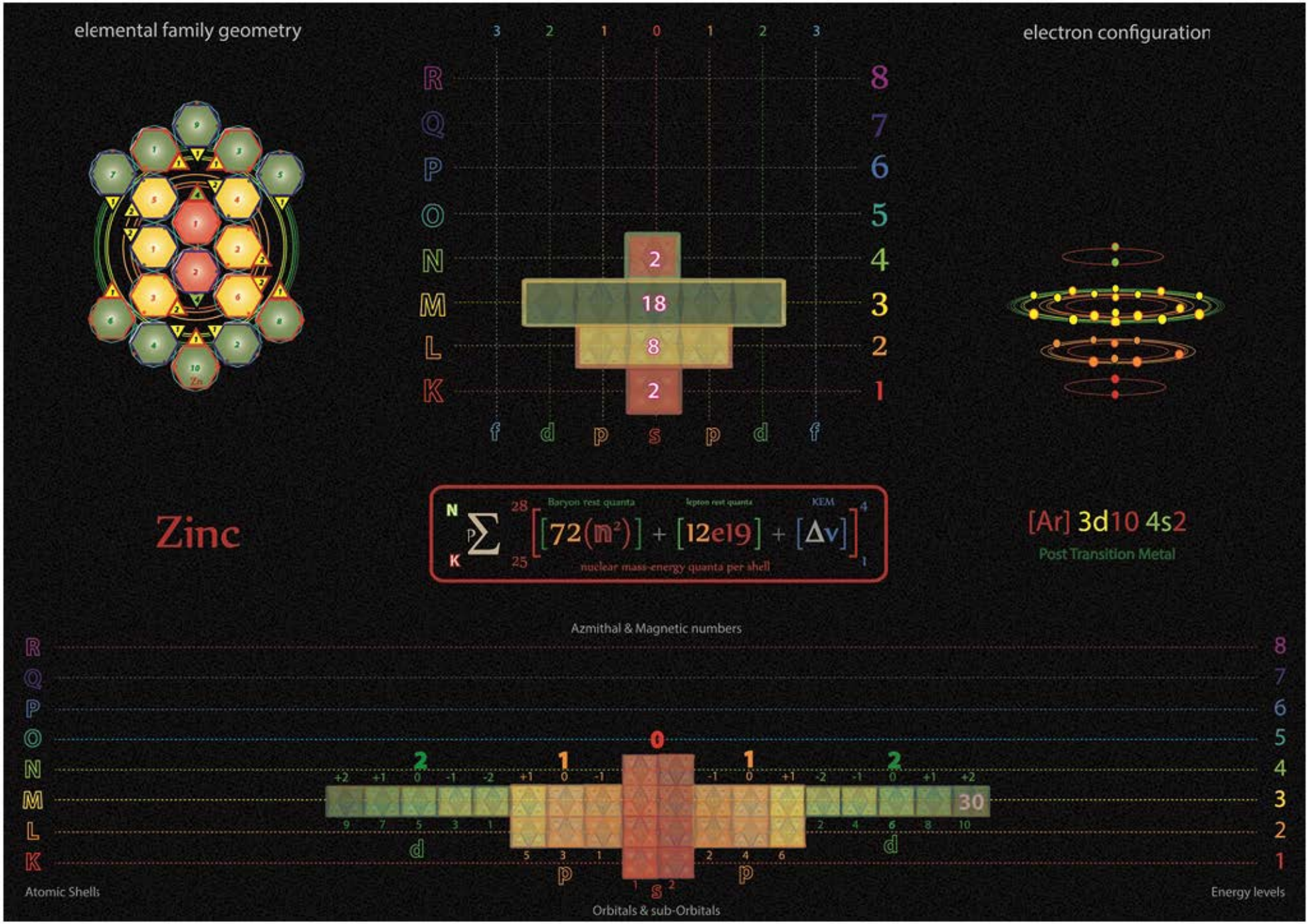

Tetryonics 53.30 - Zinc atomic config

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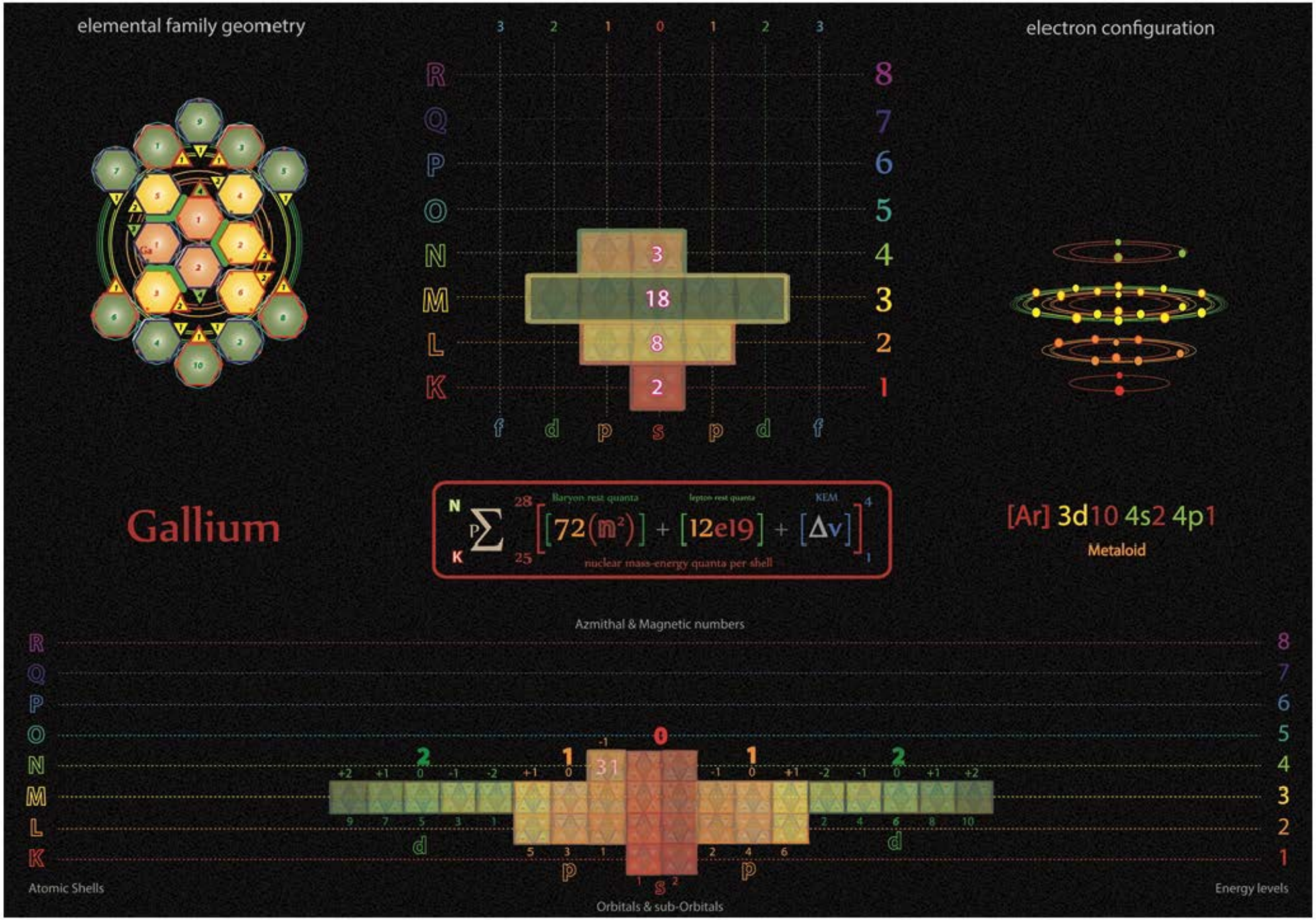

Tetryonics 53.31 - Gallium atomic config

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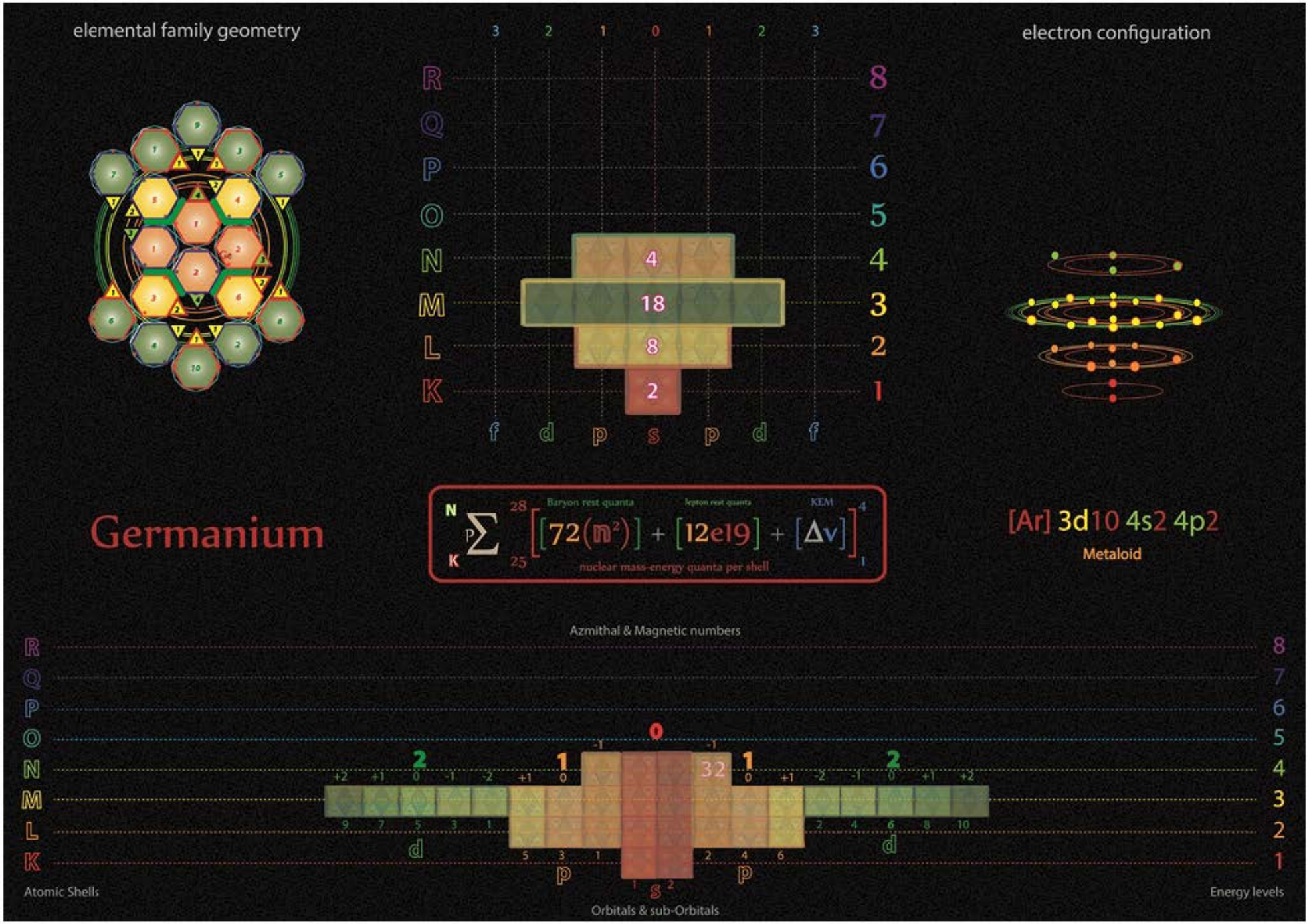

Tetryonics 53.32 - Germanium atomic config

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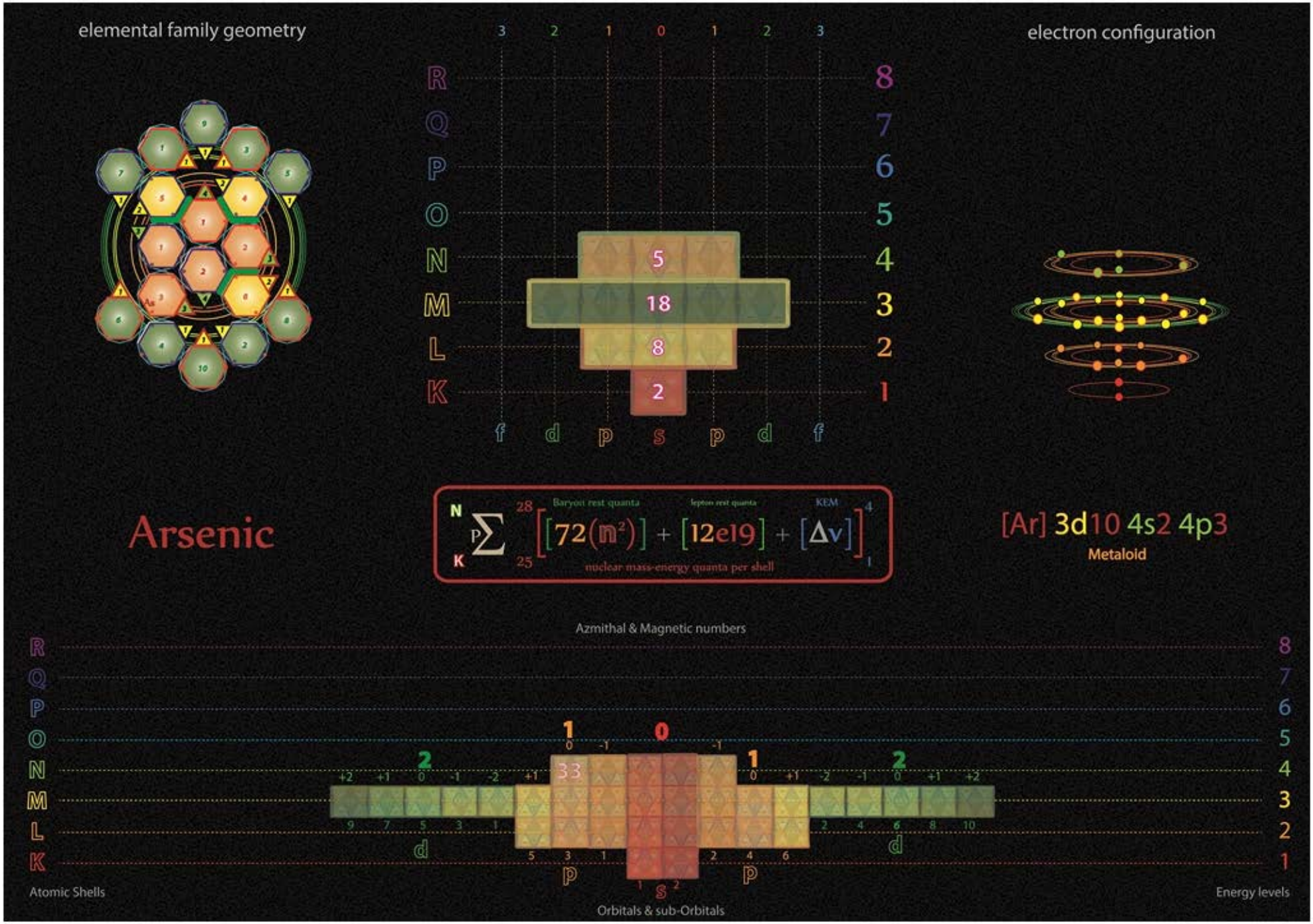

Tetryonics 53.33 - Arsenic atomic config

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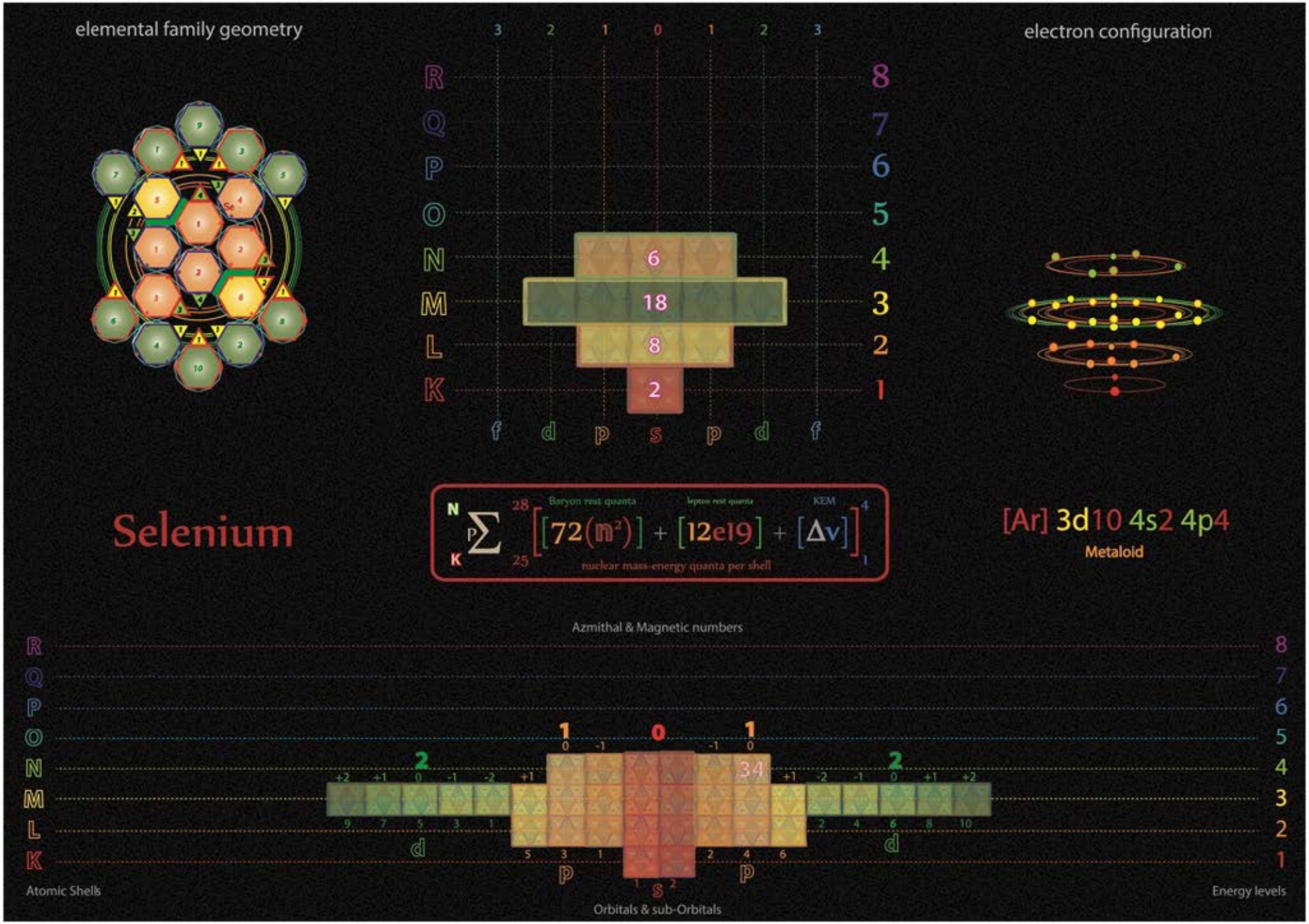

Tetryonics 53.34 - Selenium atomic config

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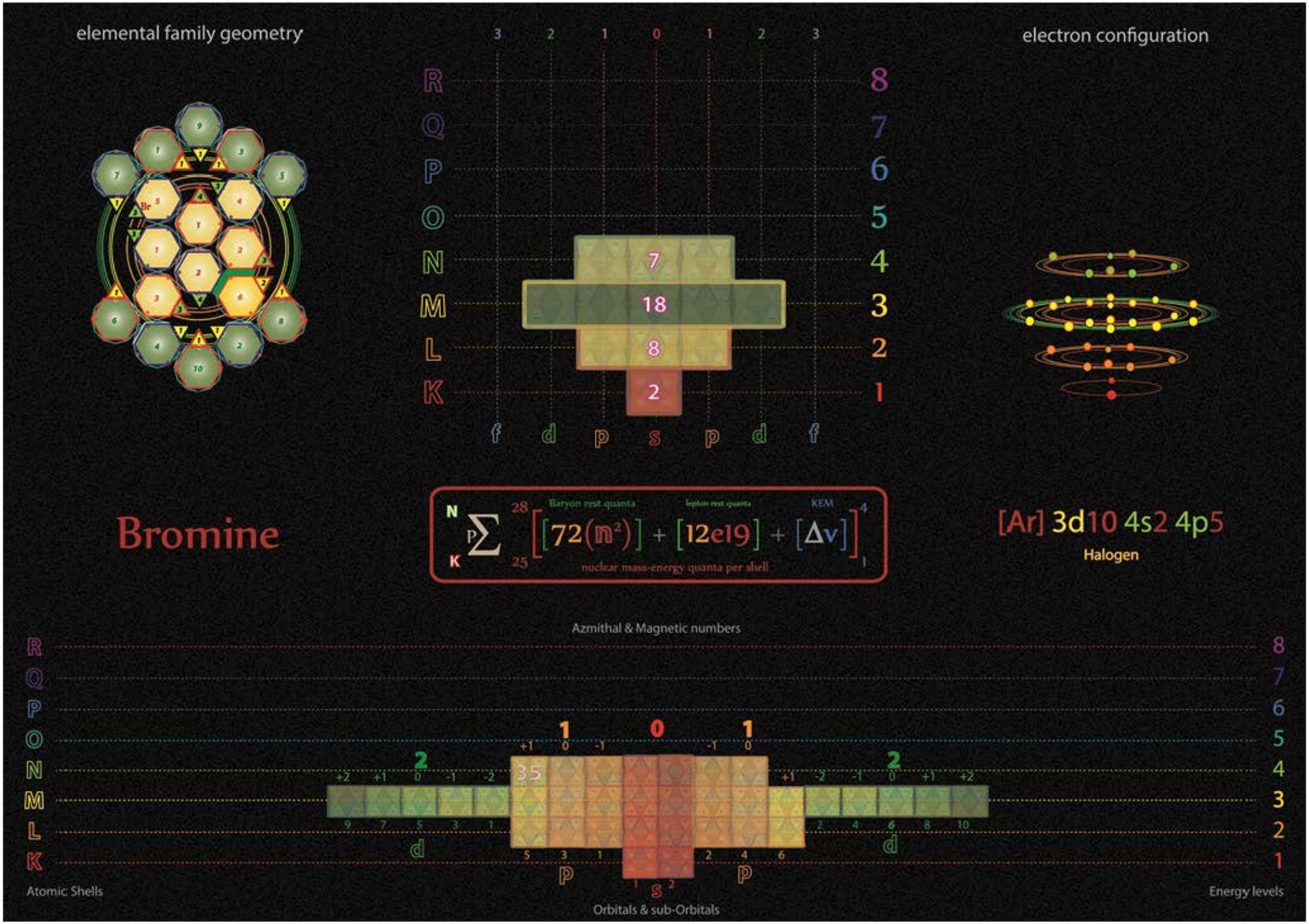

Tetryonics 53.35 - Bromine atomic config

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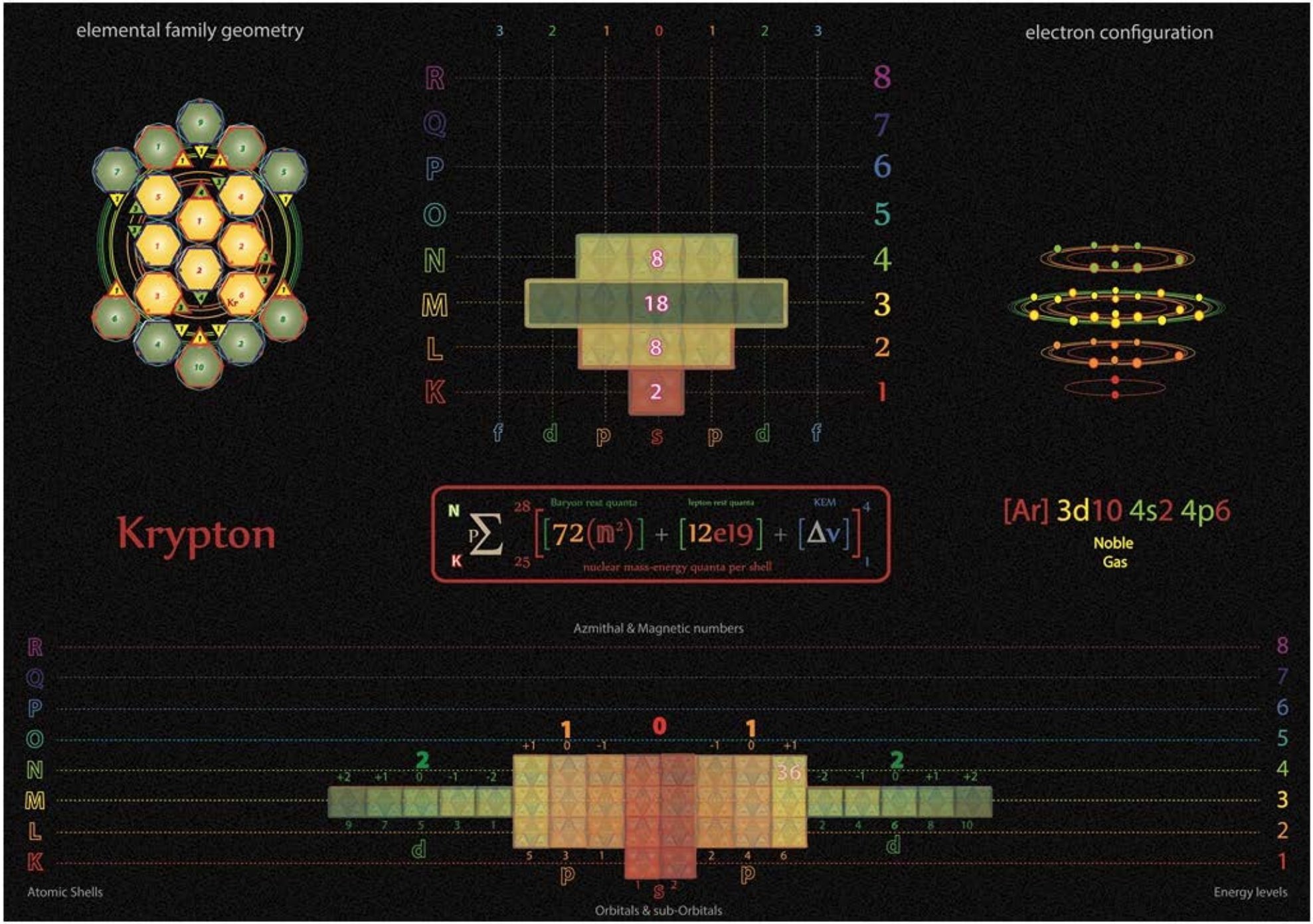

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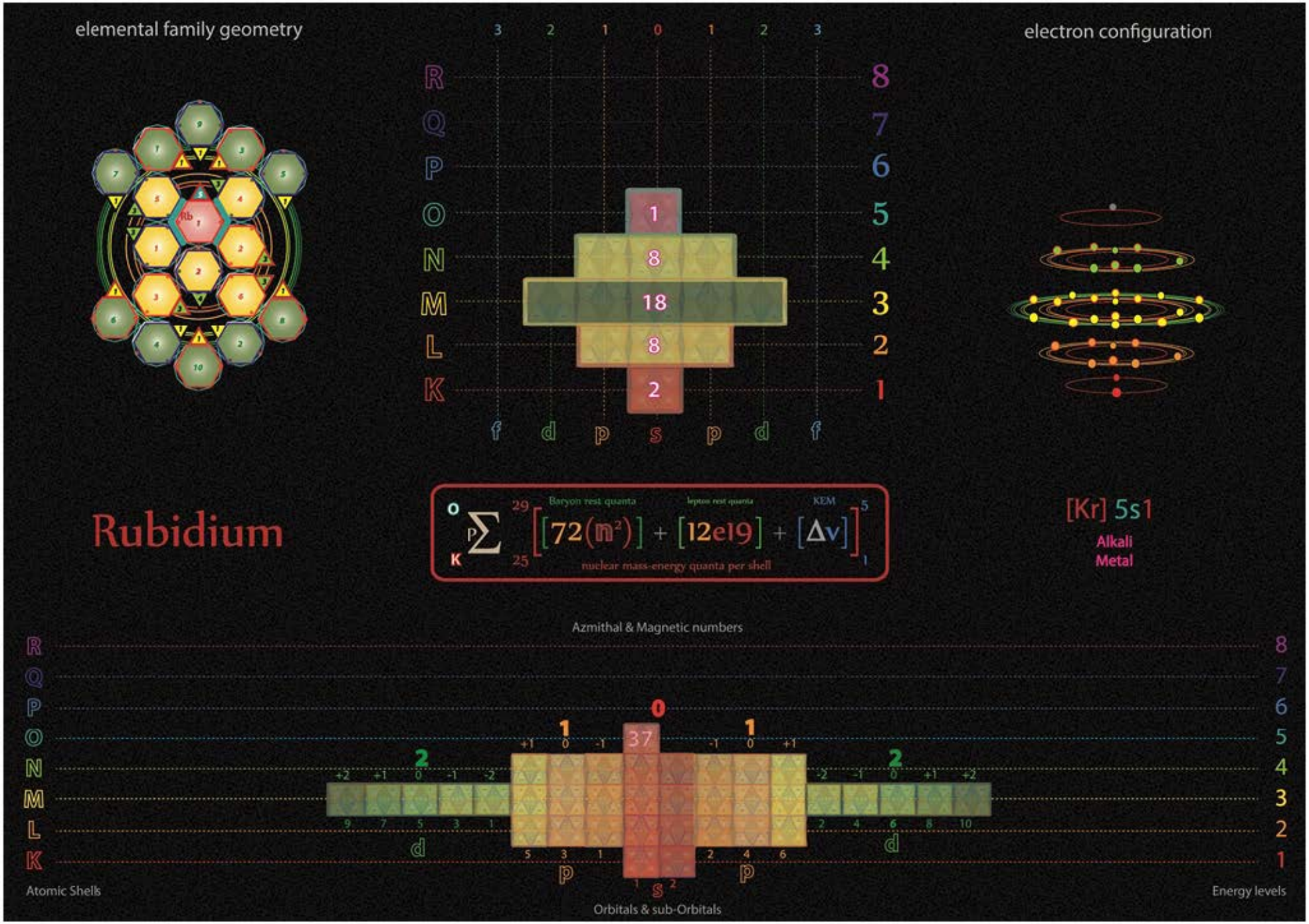

Tetryonics 53.37 - Rubidium atomic config

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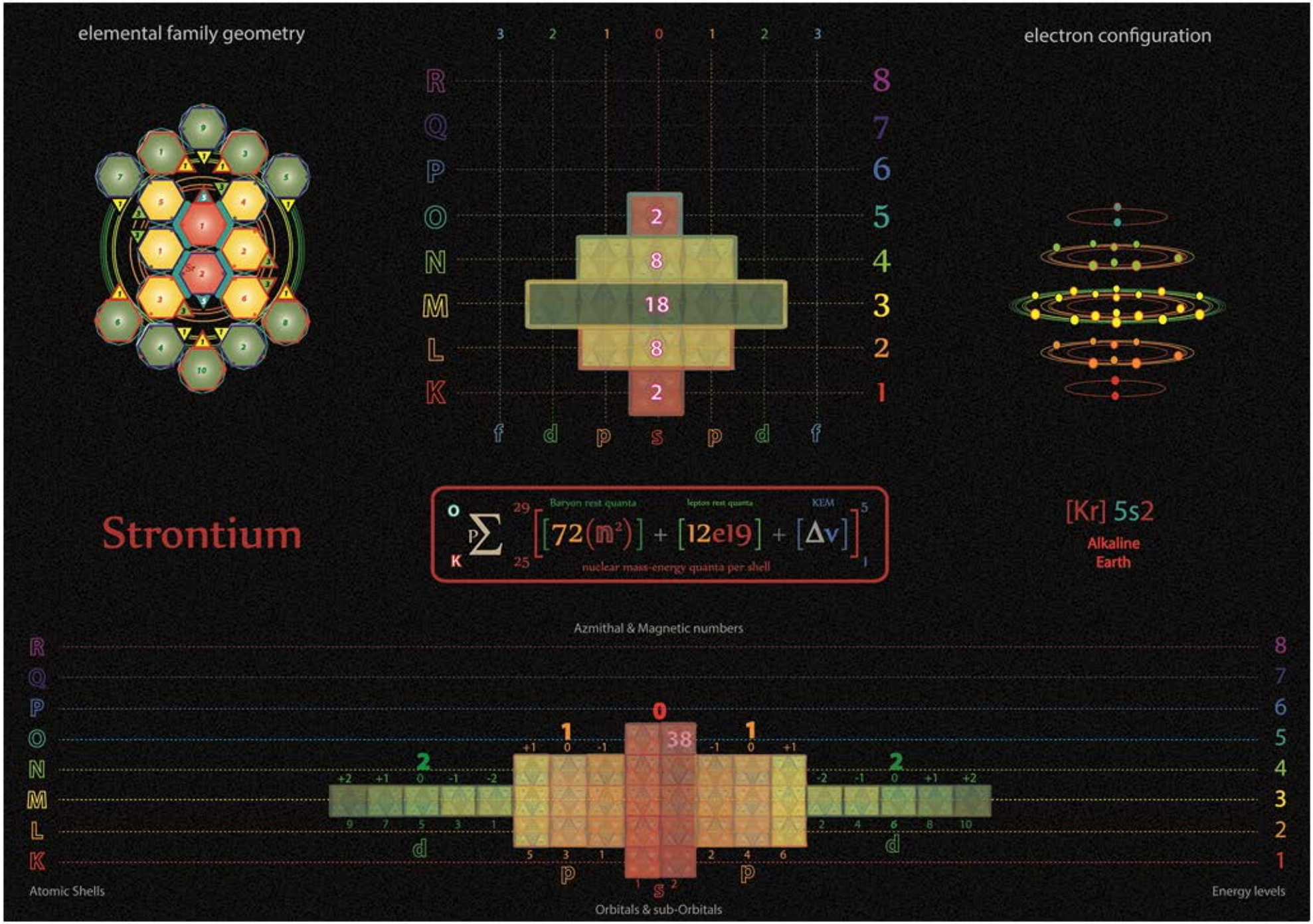

Tetryonics 53.38 - Strontium atomic config

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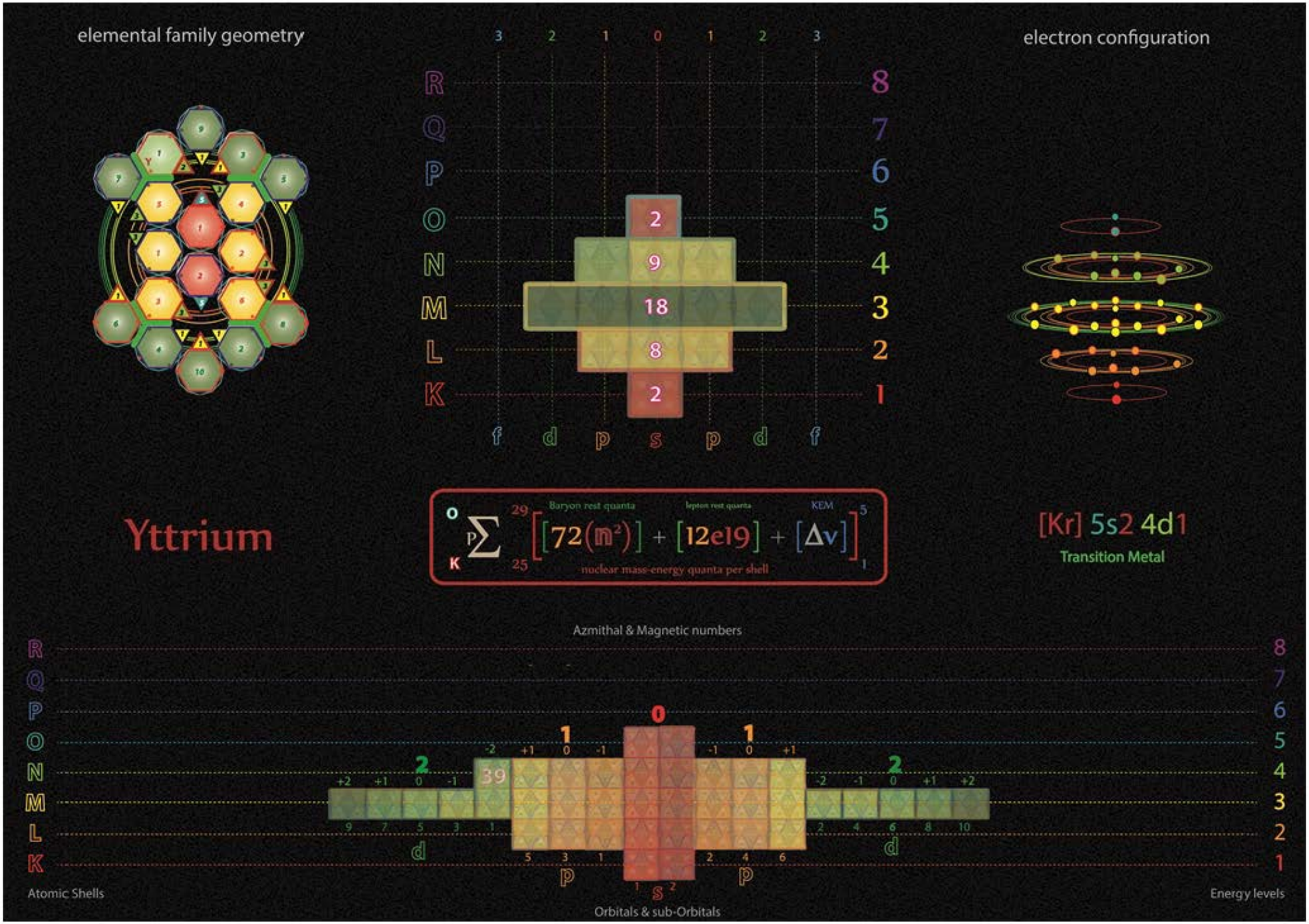

Tetryonics 53.39 - Yttrium atomic config

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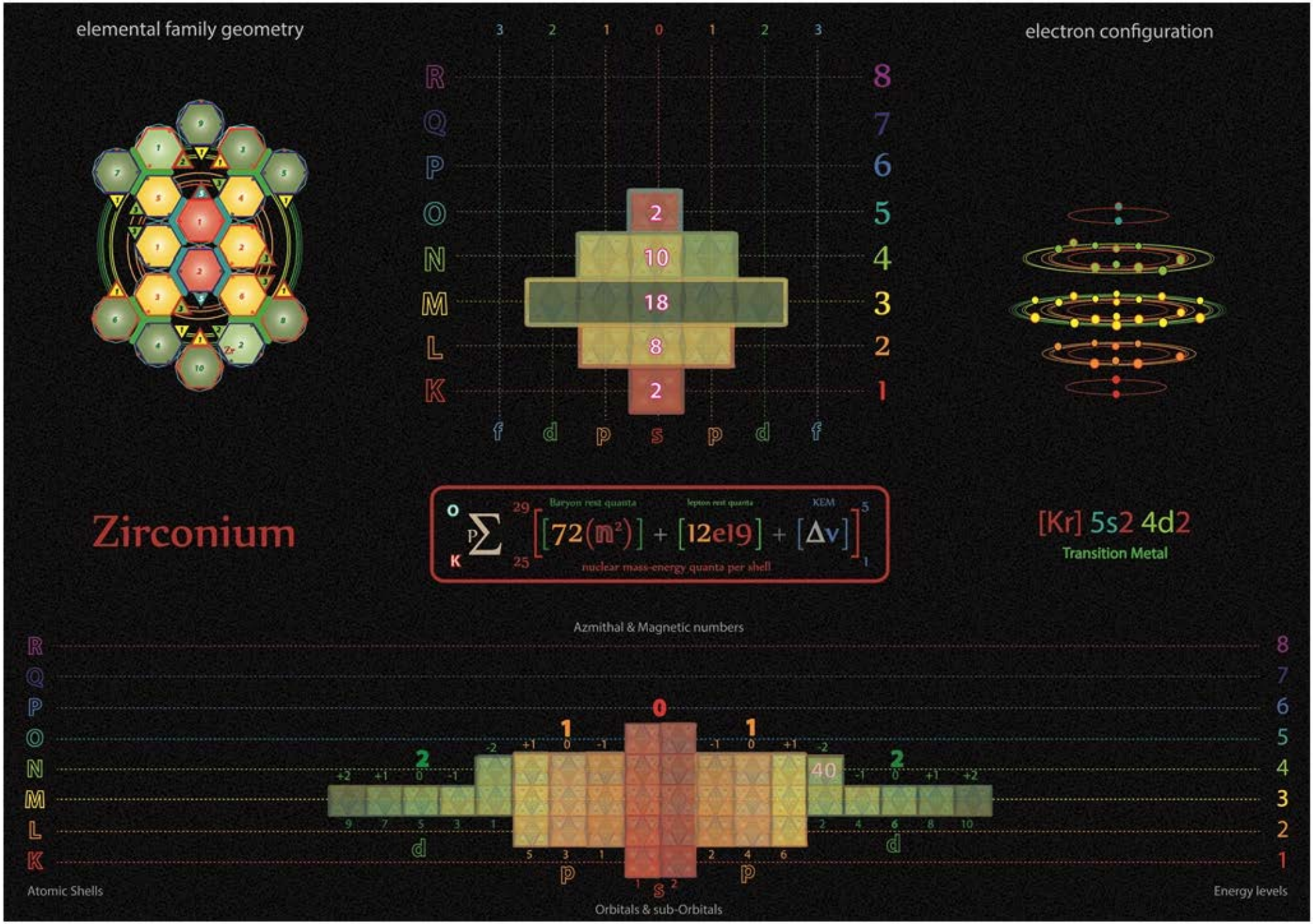

Tetryonics 53.40 - Zirconium atomic config

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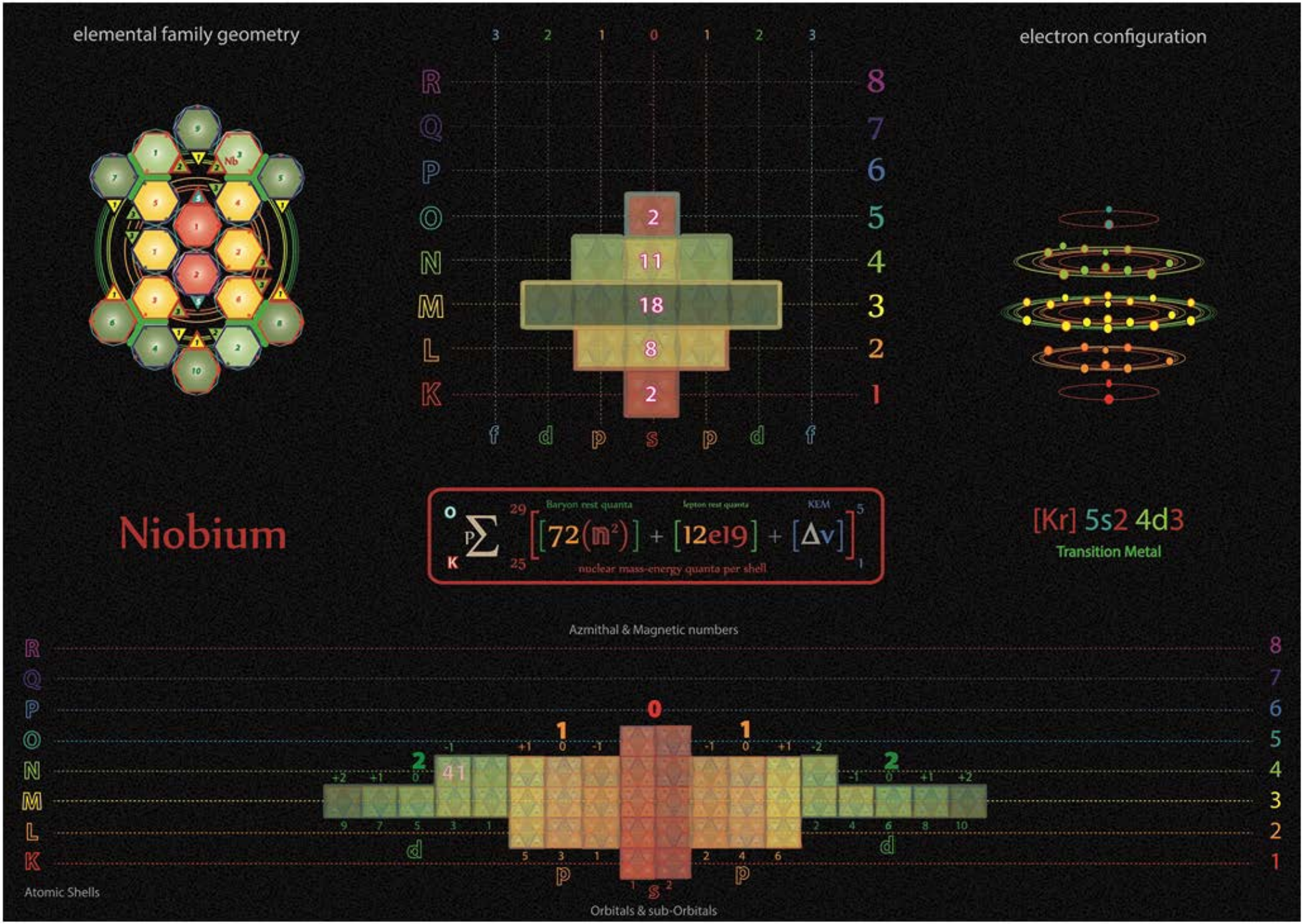

Tetryonics 53.41 - Niobium atomic config

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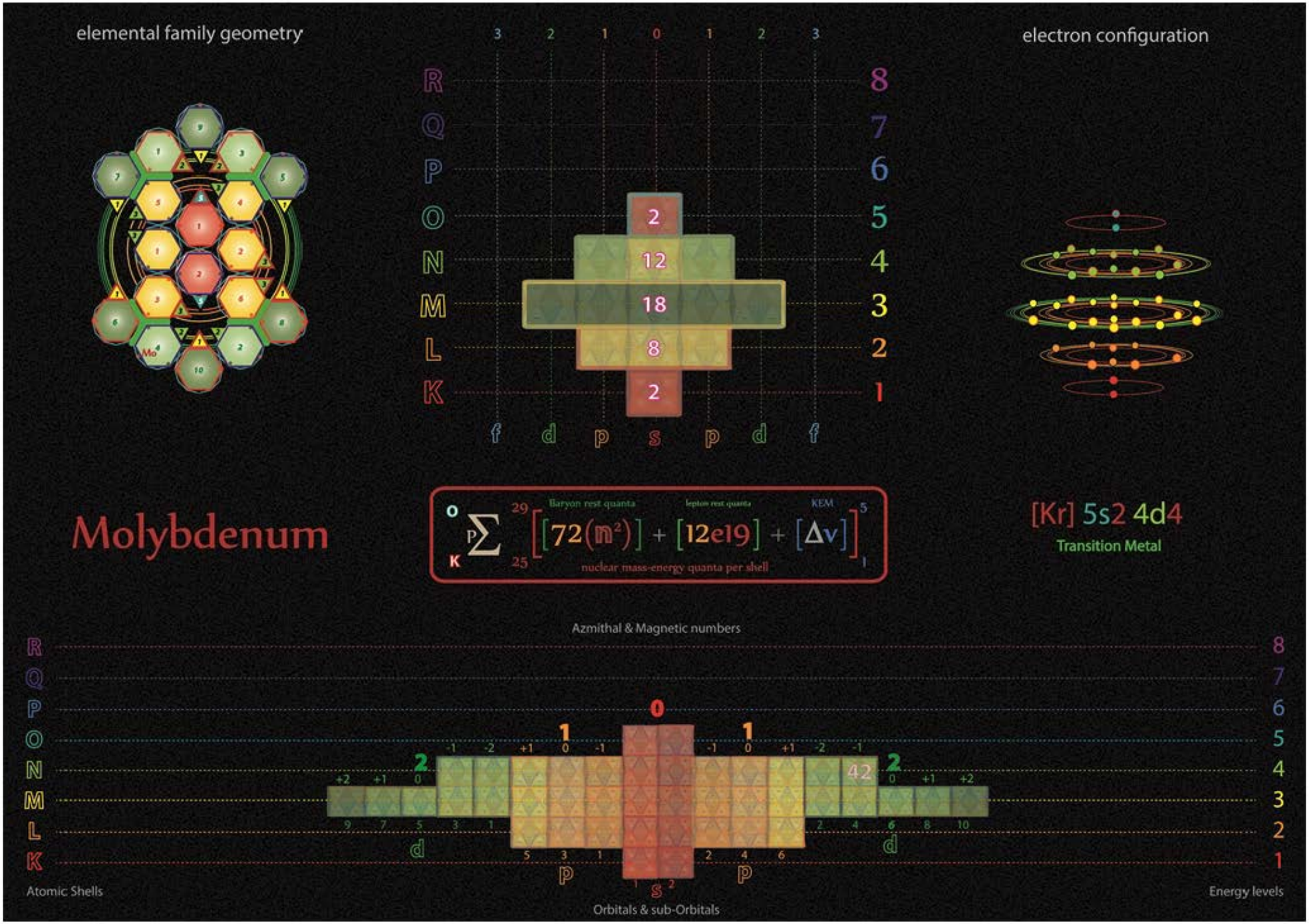

Tetryonics 53.42 - Molybdenum atomic config

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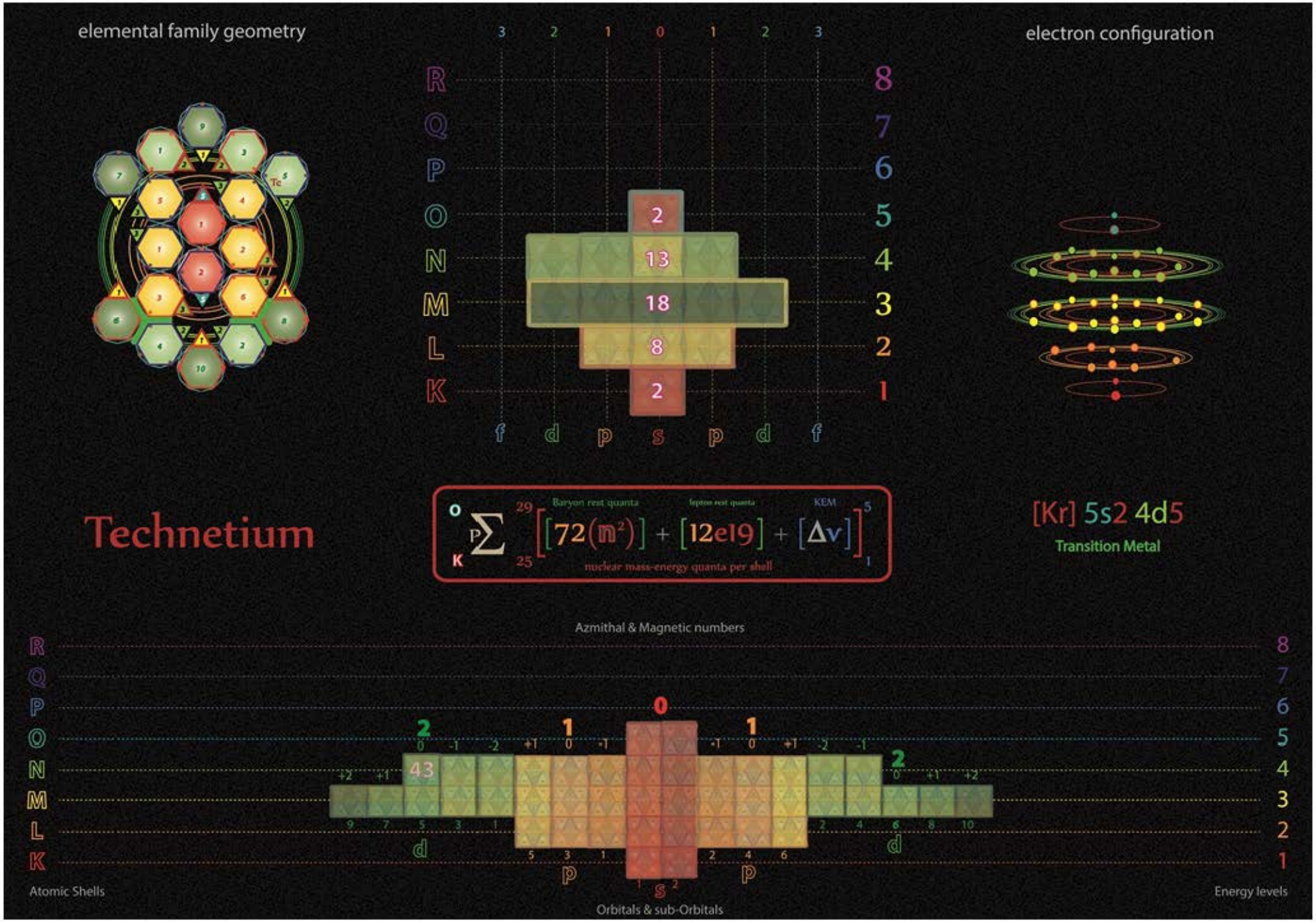

Tetryonics 53.43 - Technetium atomic config

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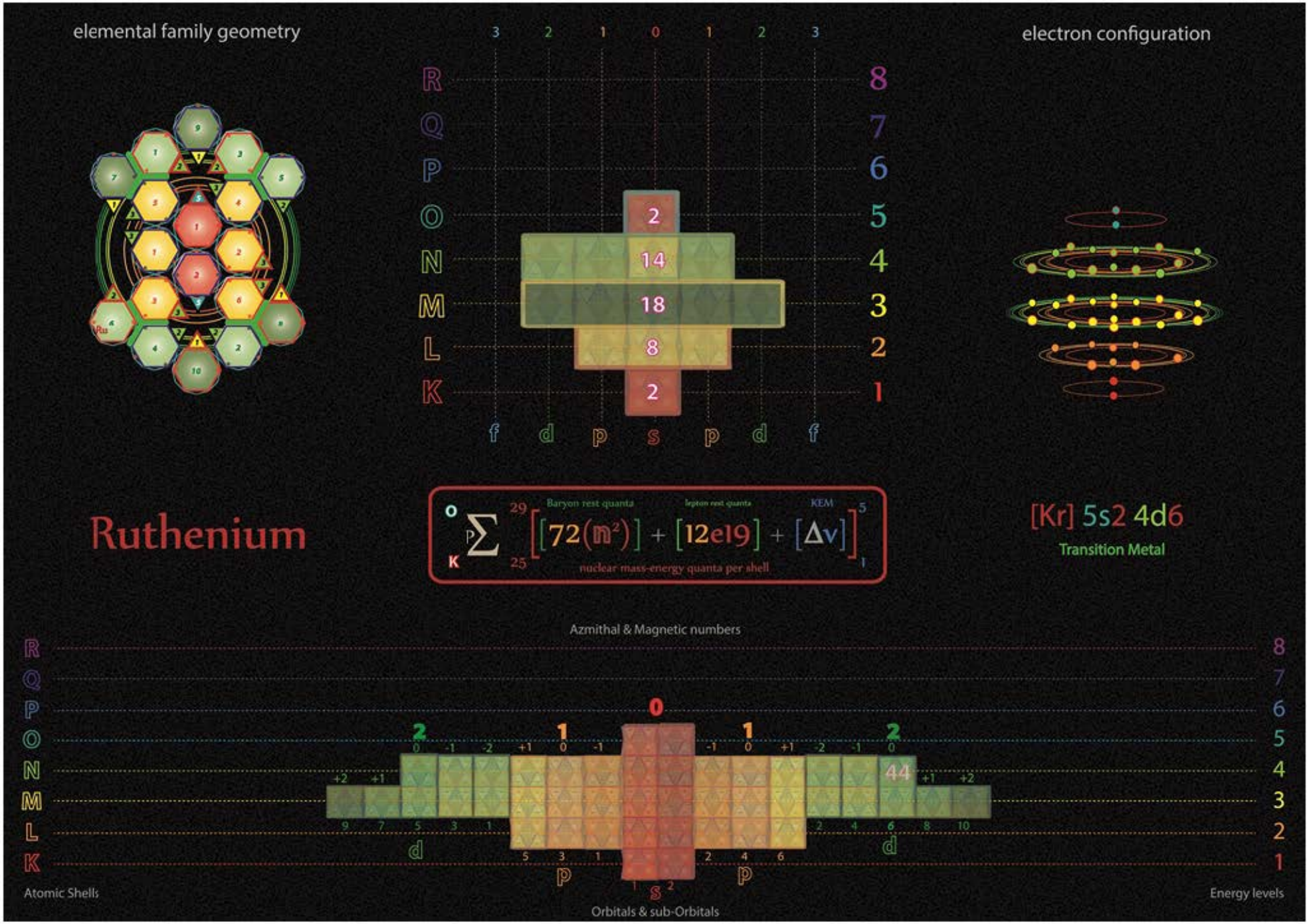

Tetryonics 53.44 - Ruthenium atomic config

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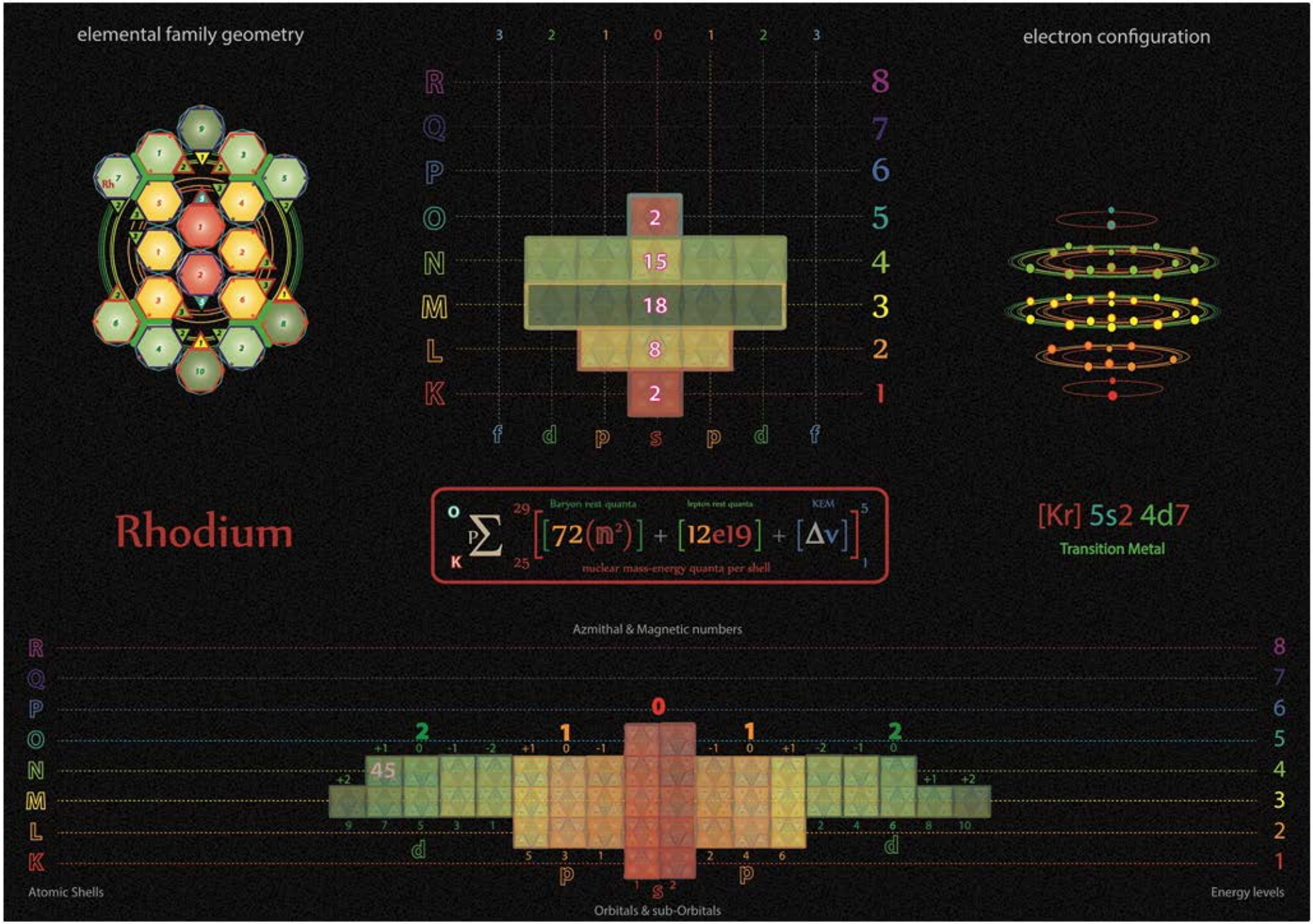

Tetryonics 53.45 - Rhodium atomic config

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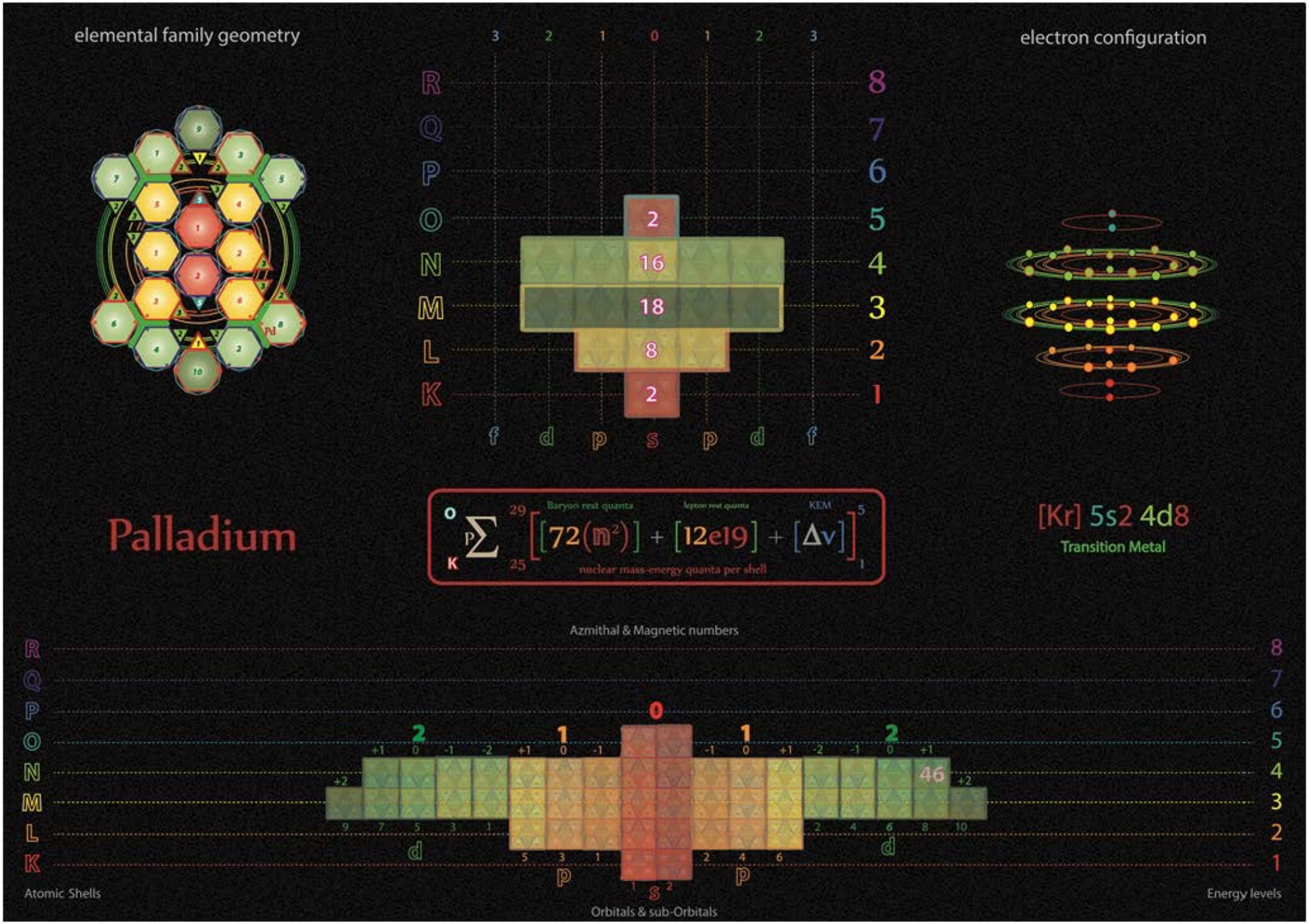

Tetryonics 53.46 - Palladium atomic config

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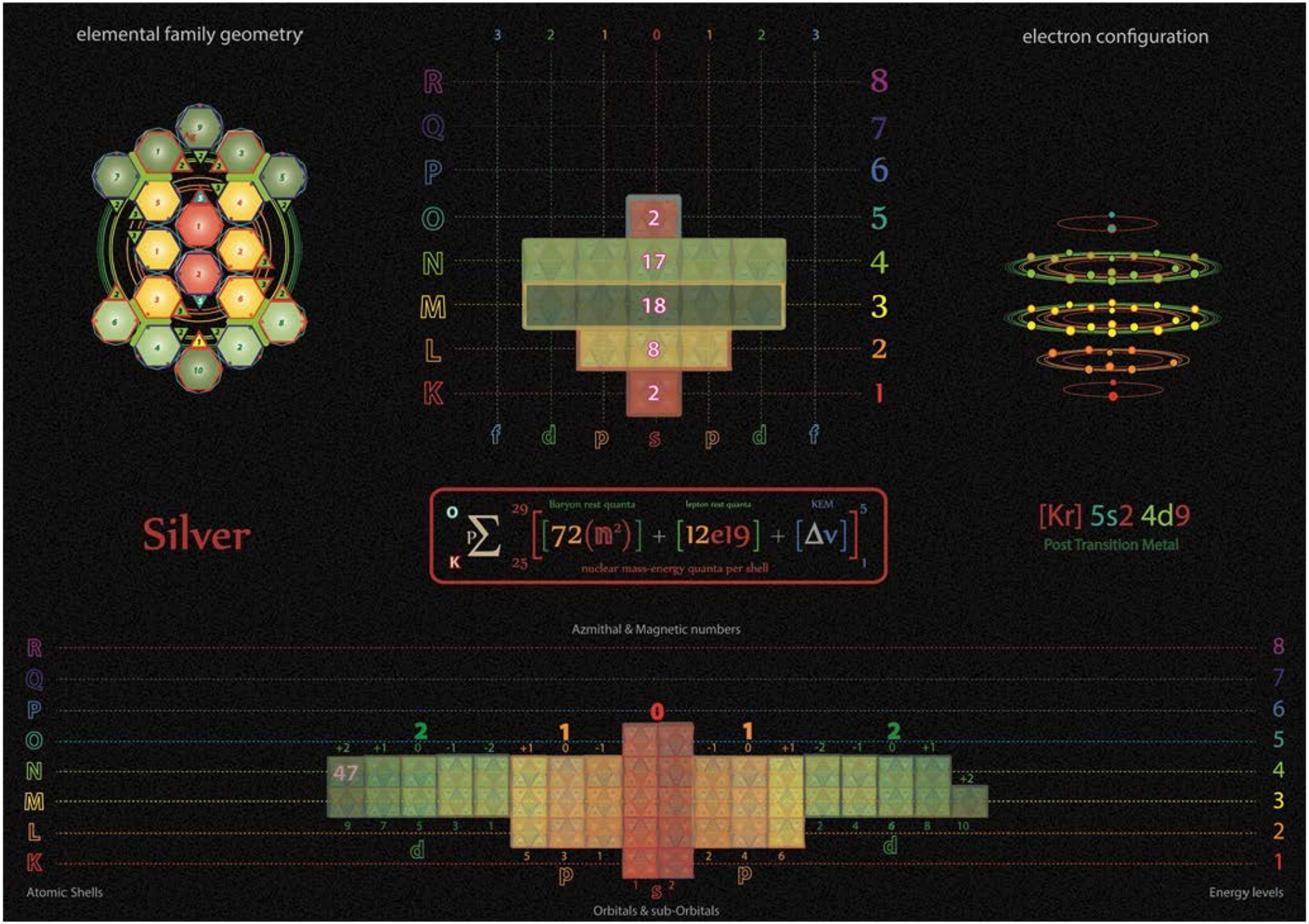

Tetryonics 53.47 - Silver atomic config

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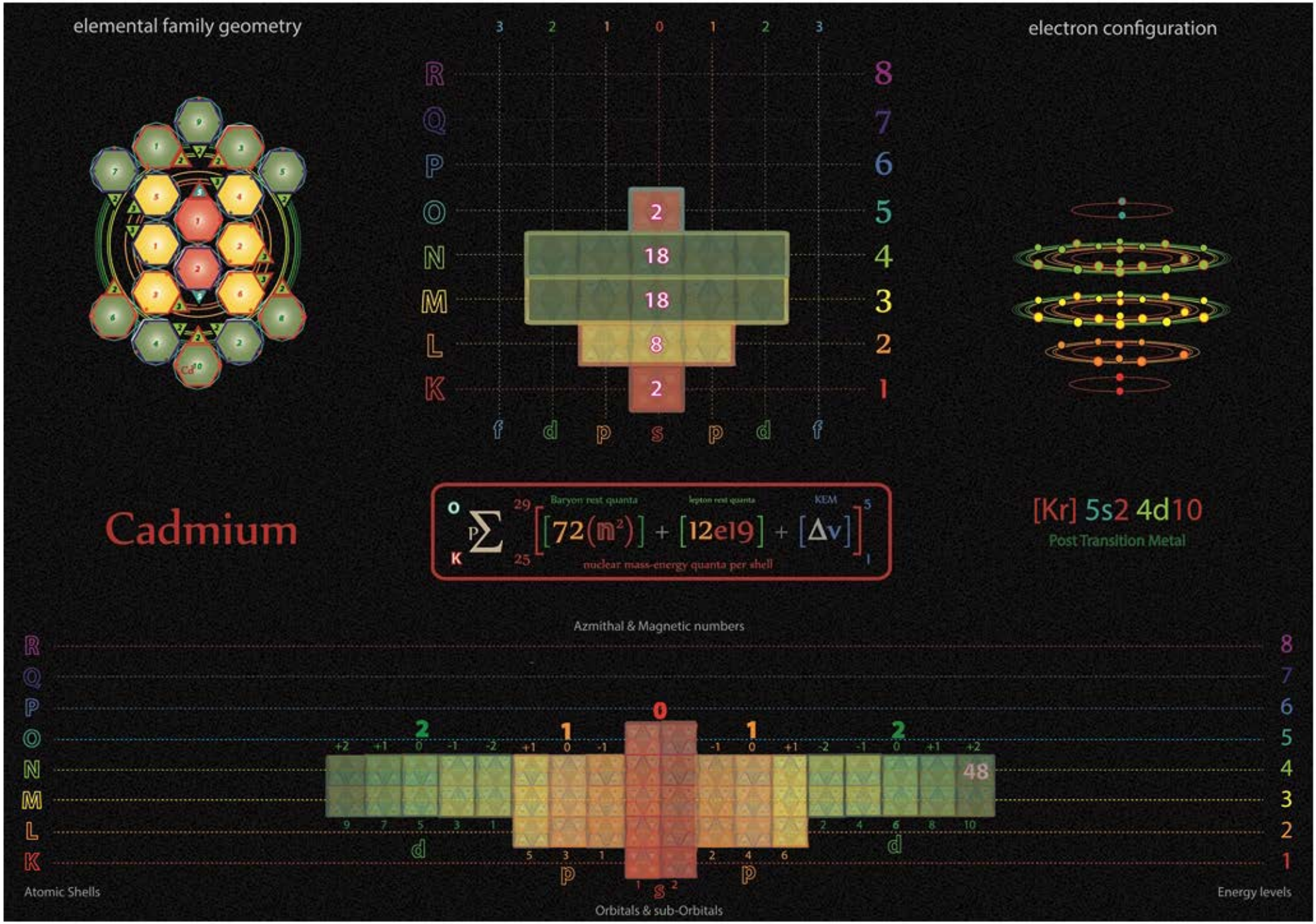

Tetryonics 53.48 - Cadmium atomic config

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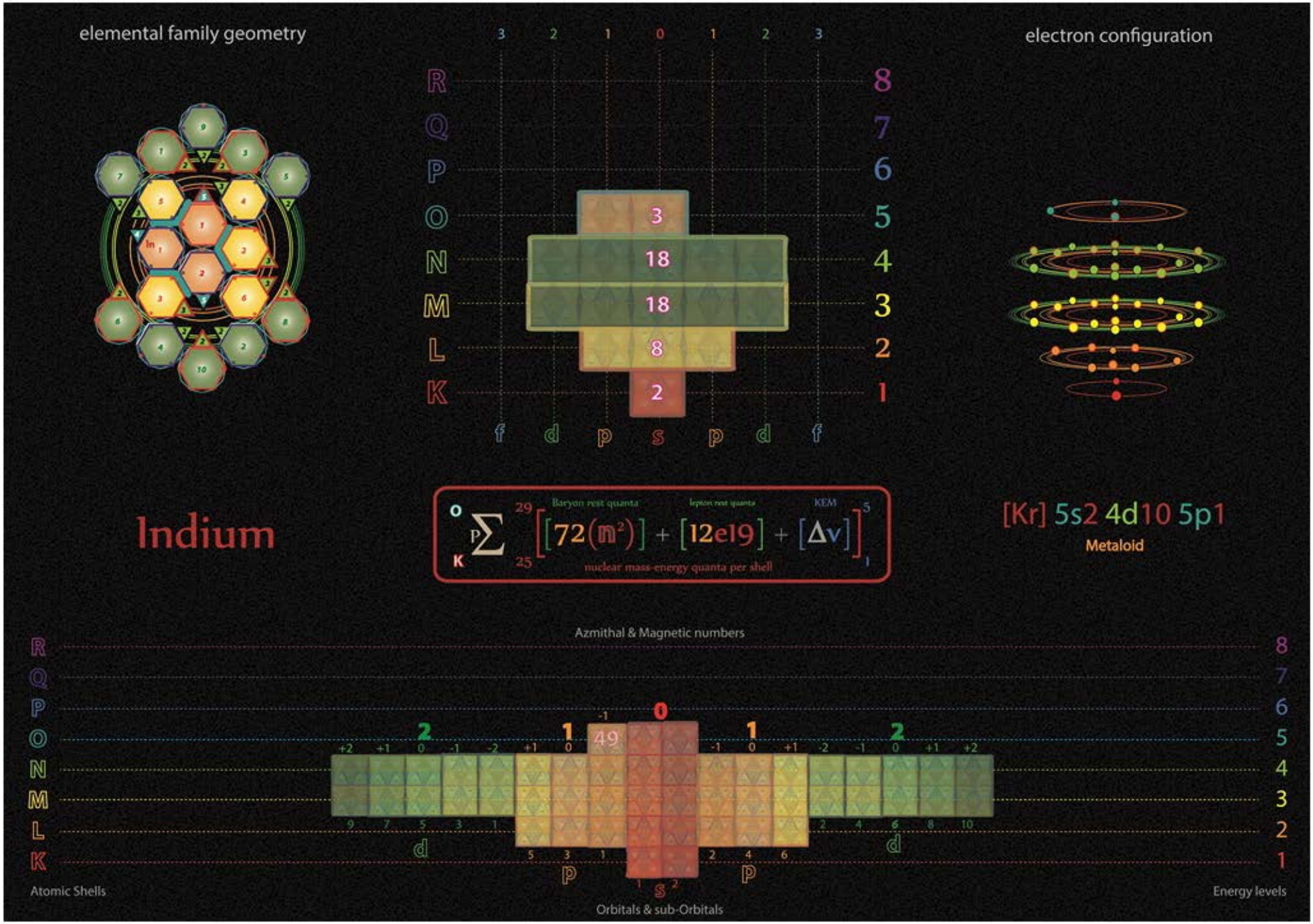

Tetryonics 53.49 - Indium atomic config

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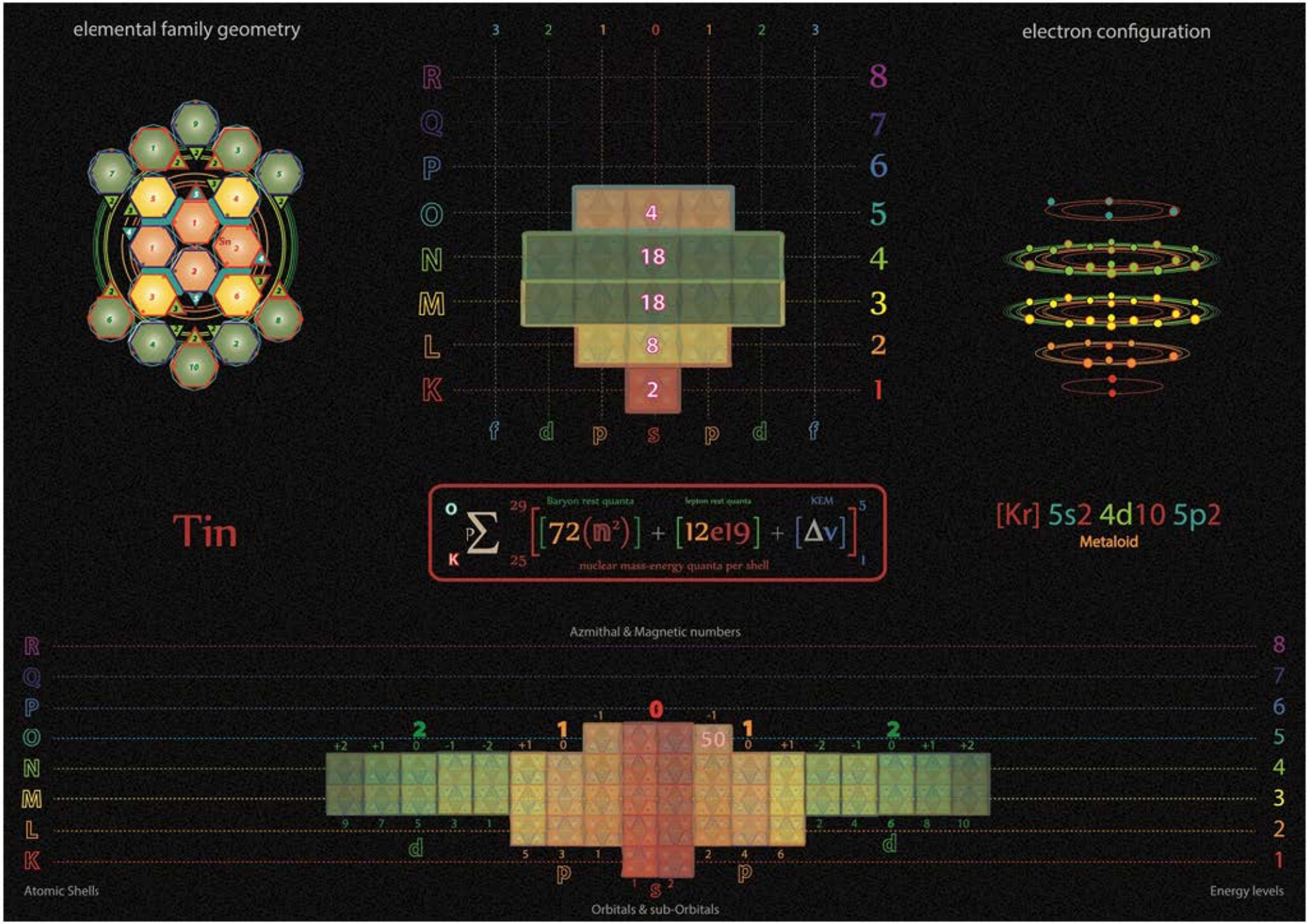

Tetryonics 53.50 - Tin atomic config

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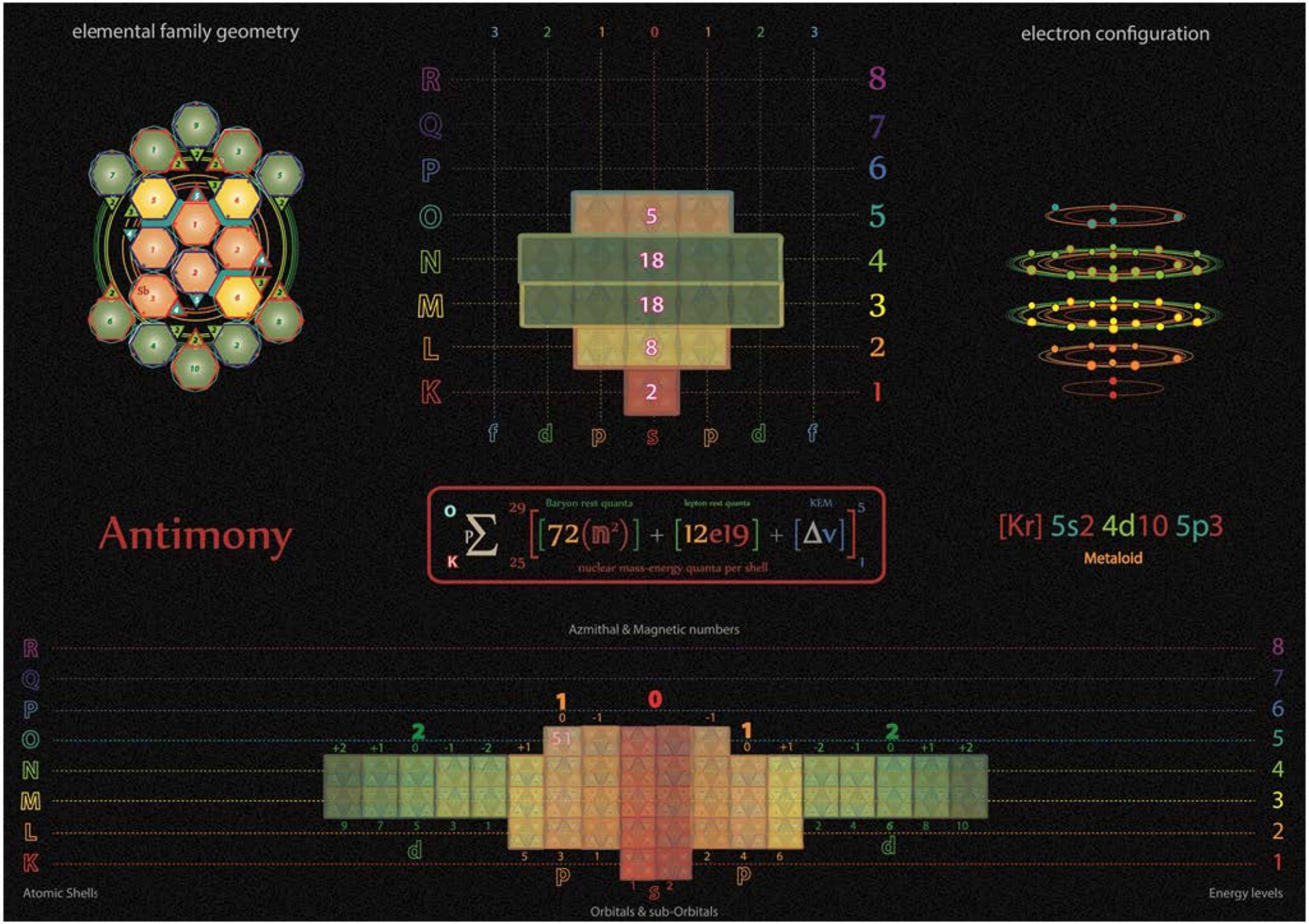

Tetryonics 53.51 - Antimony atomic config

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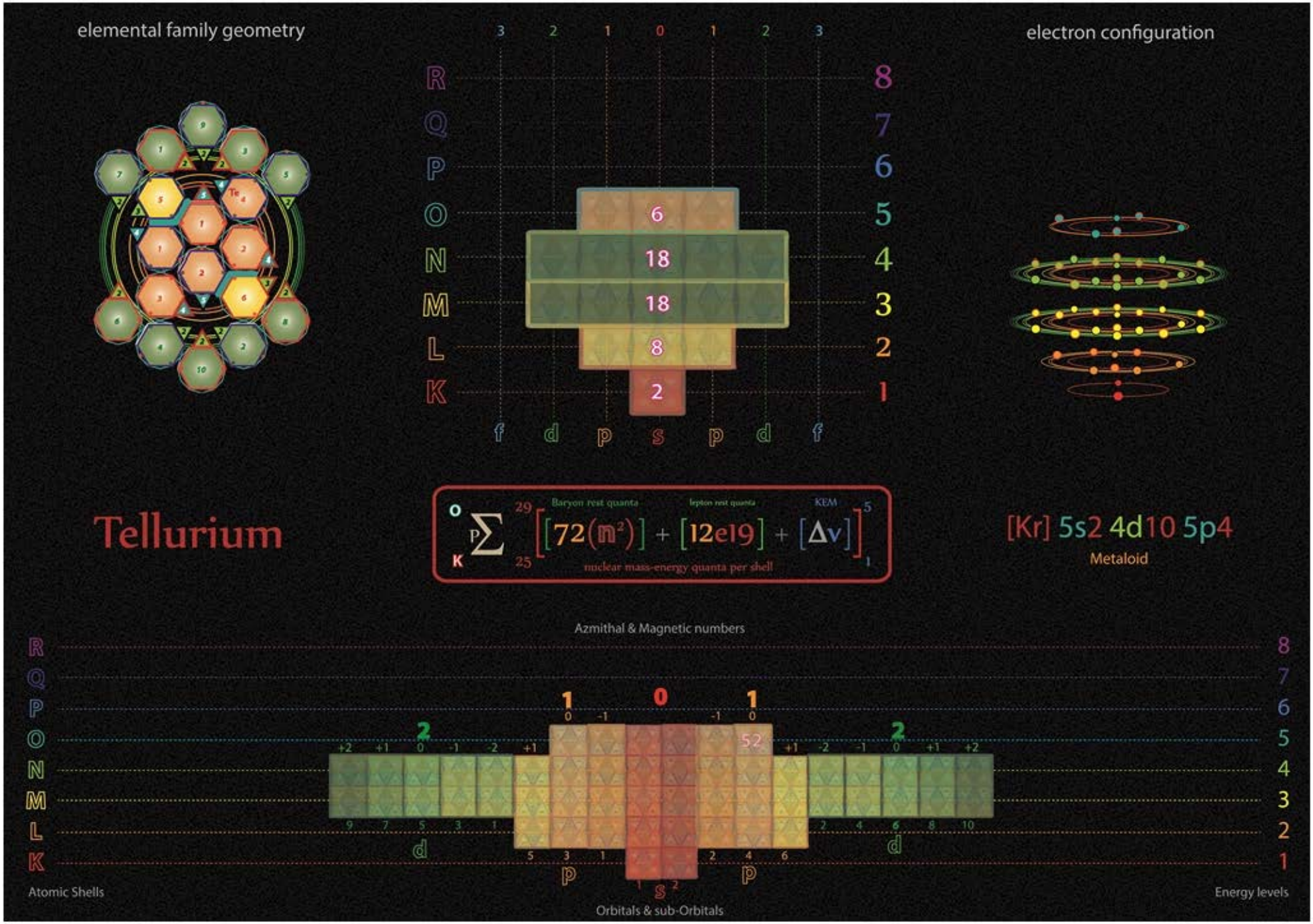

Tetryonics 53.52 - Tellurium atomic config

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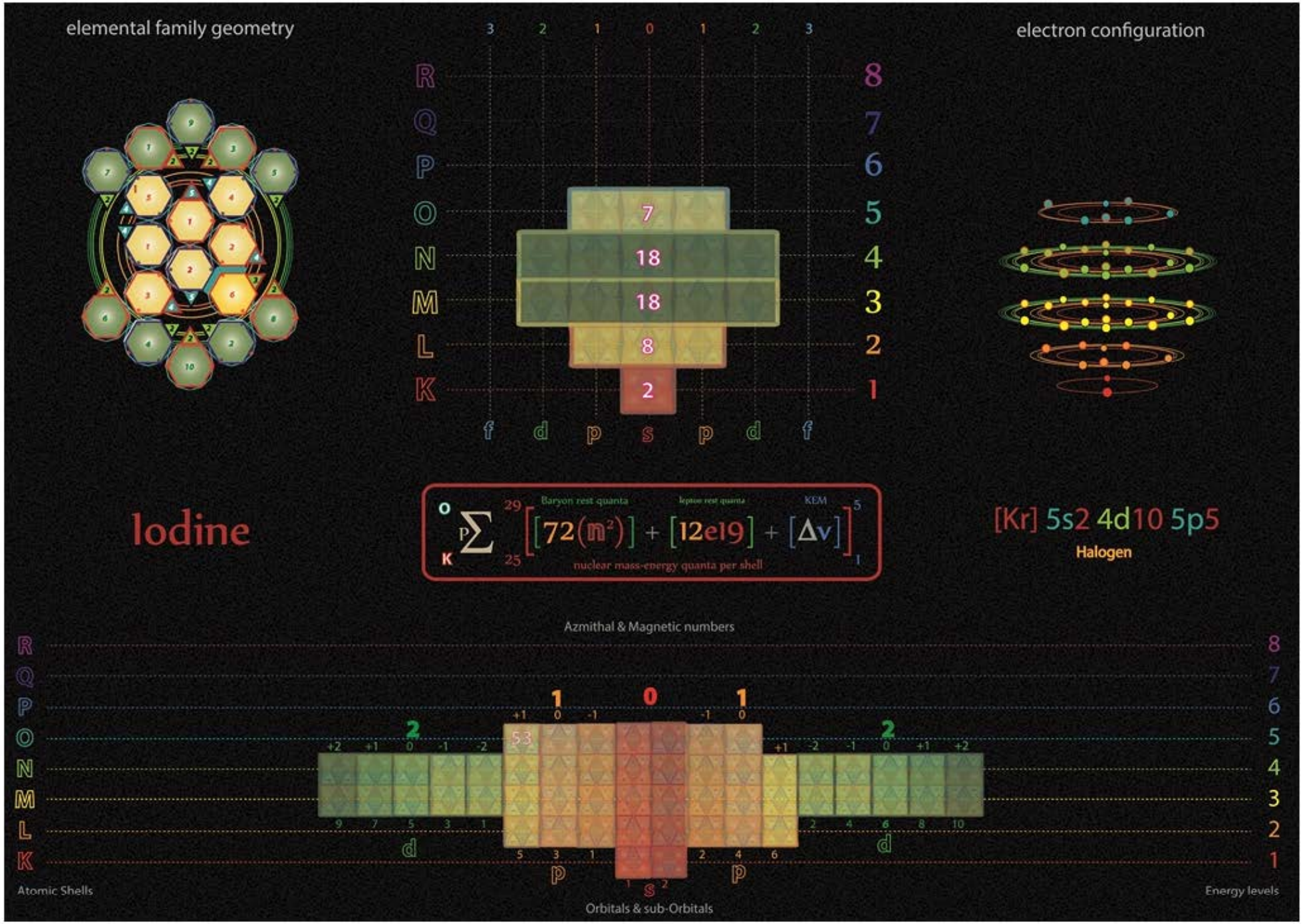

Tetryonics 53.53 - Iodine atomic config

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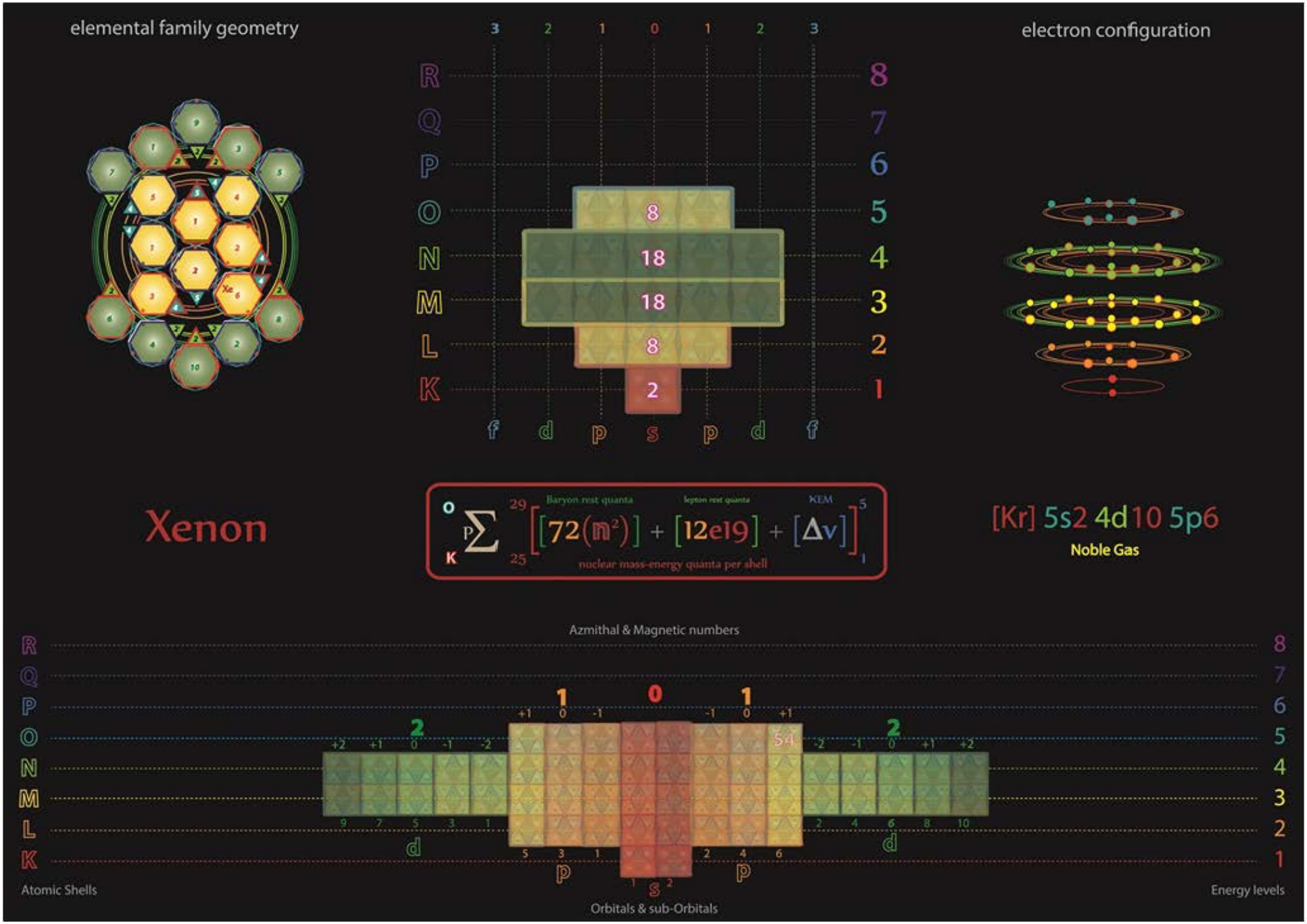

Tetryonics 53.54 - Xenon atomic config

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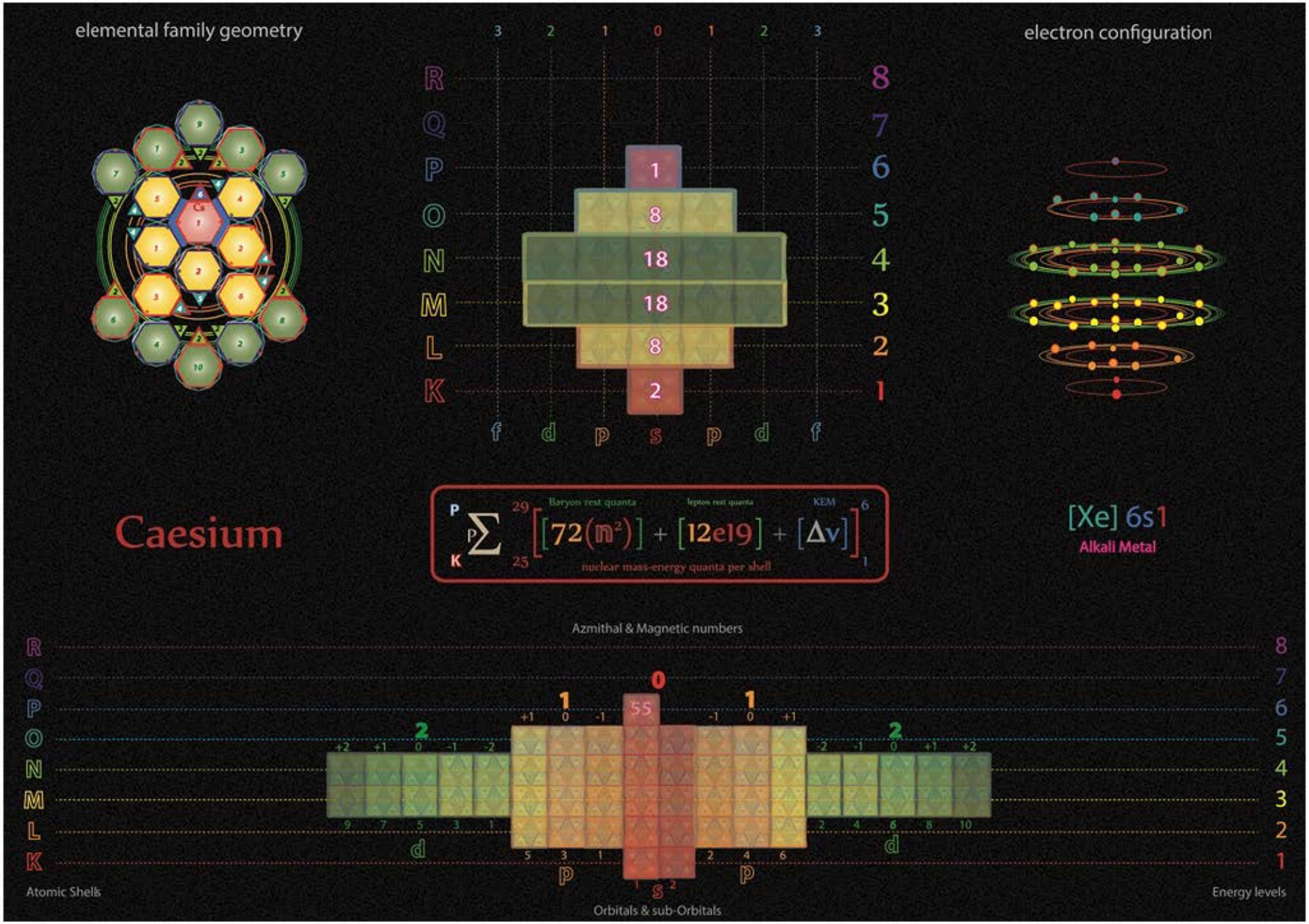

Tetryonics 53.55 - Caesium atomic config

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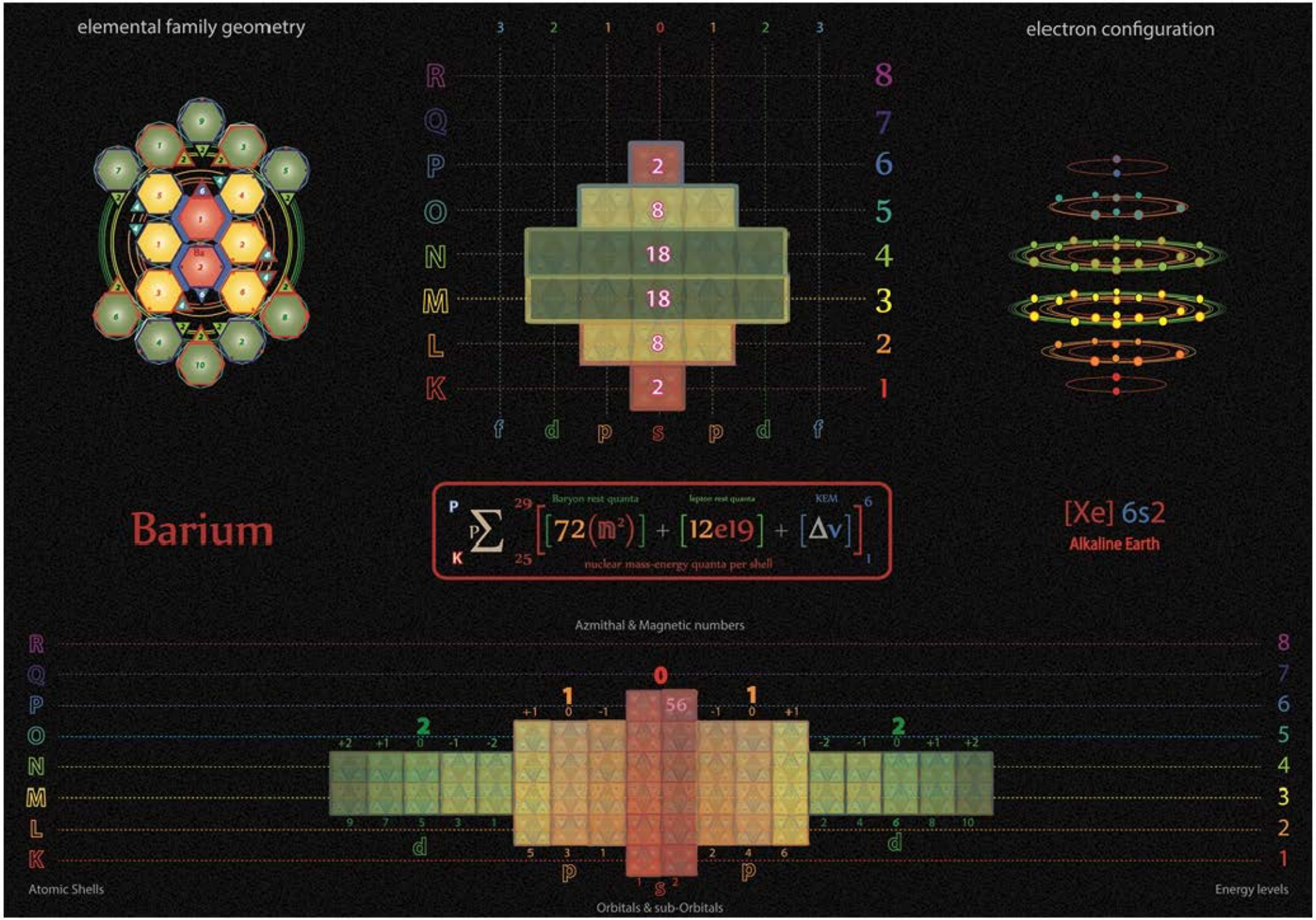

Tetryonics 53.56 - Barium atomic config

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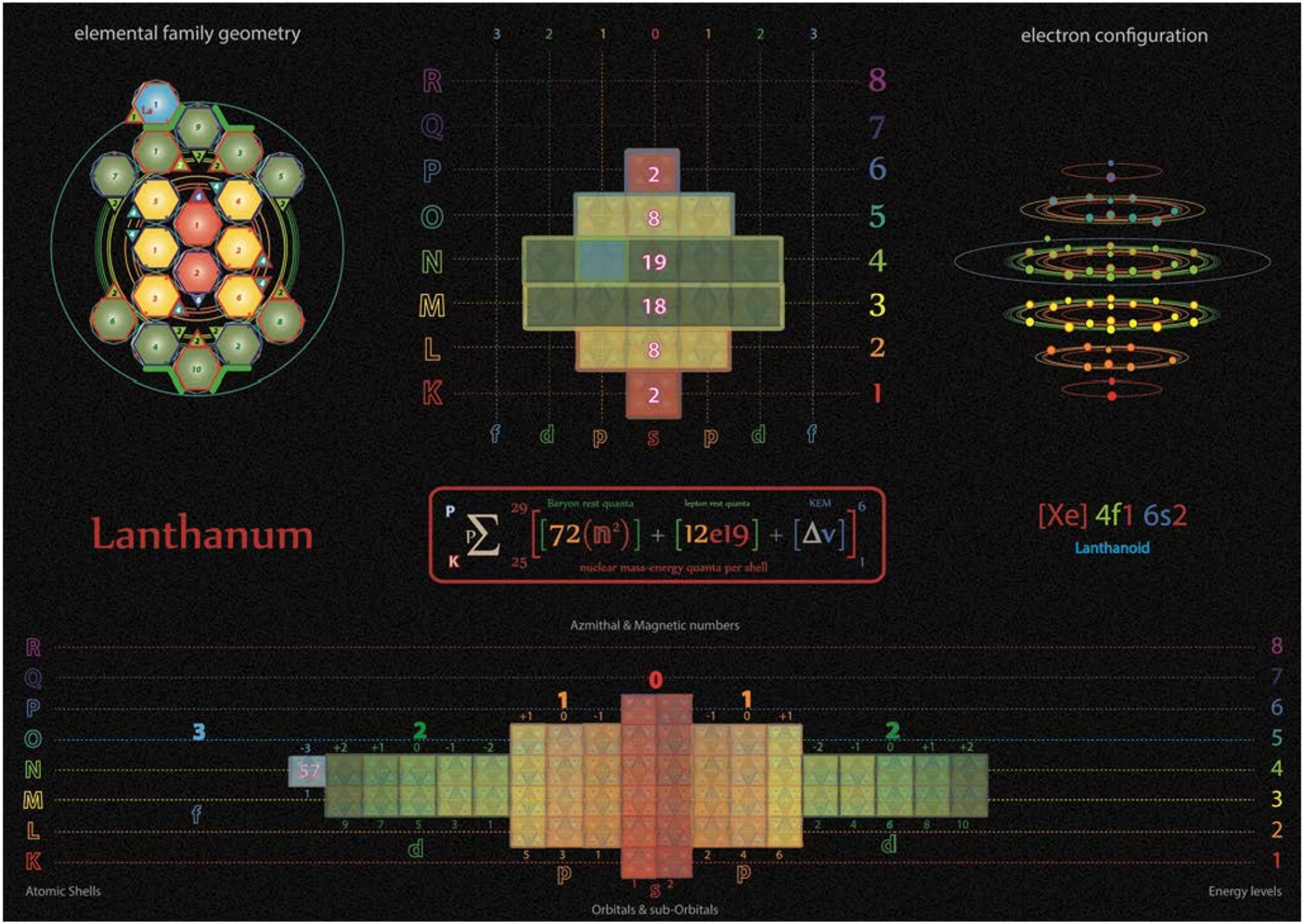

Tetryonics 53.57 - Lanthanum atomic config

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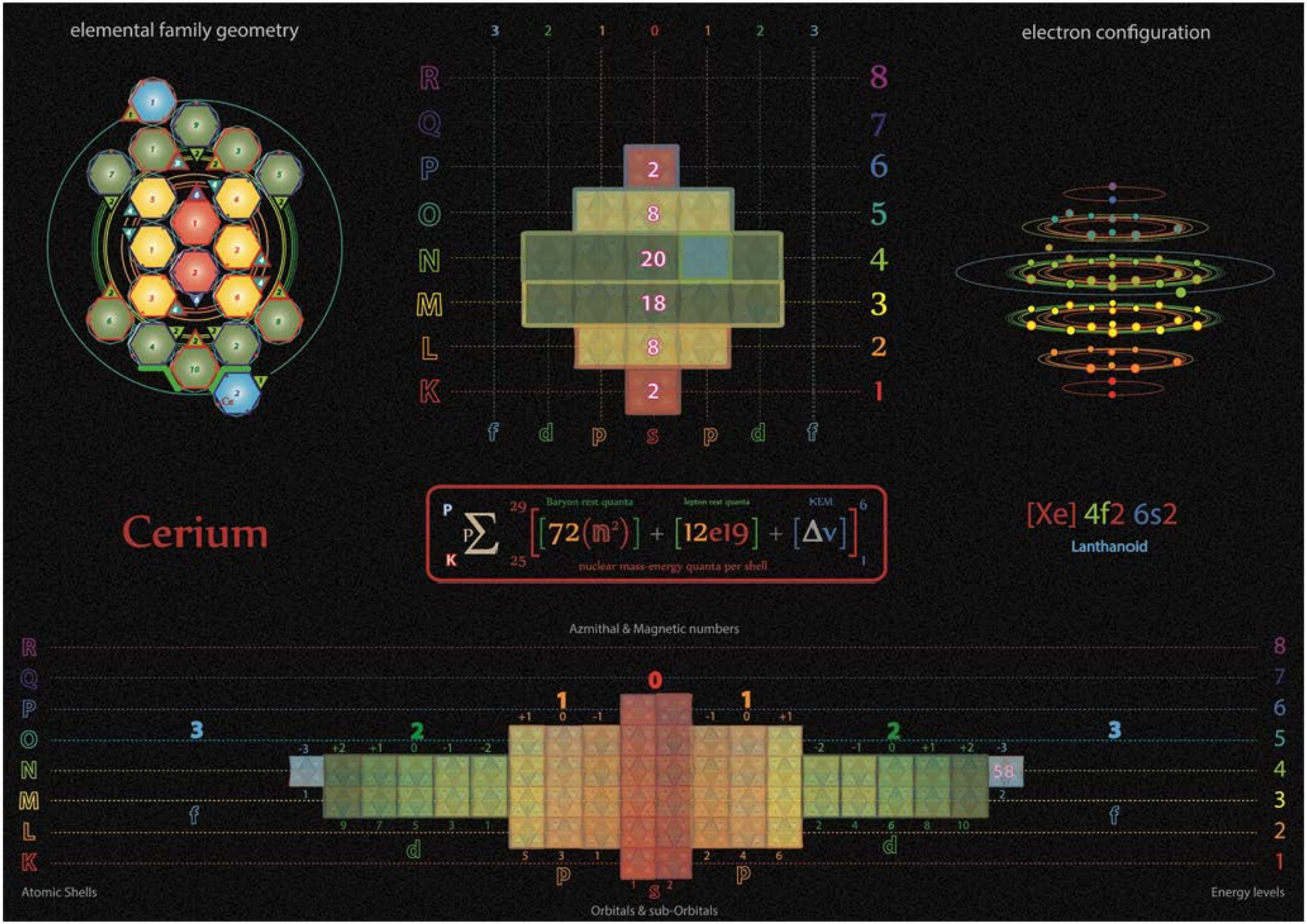

Tetryonics 53.58 - Cerium atomic config

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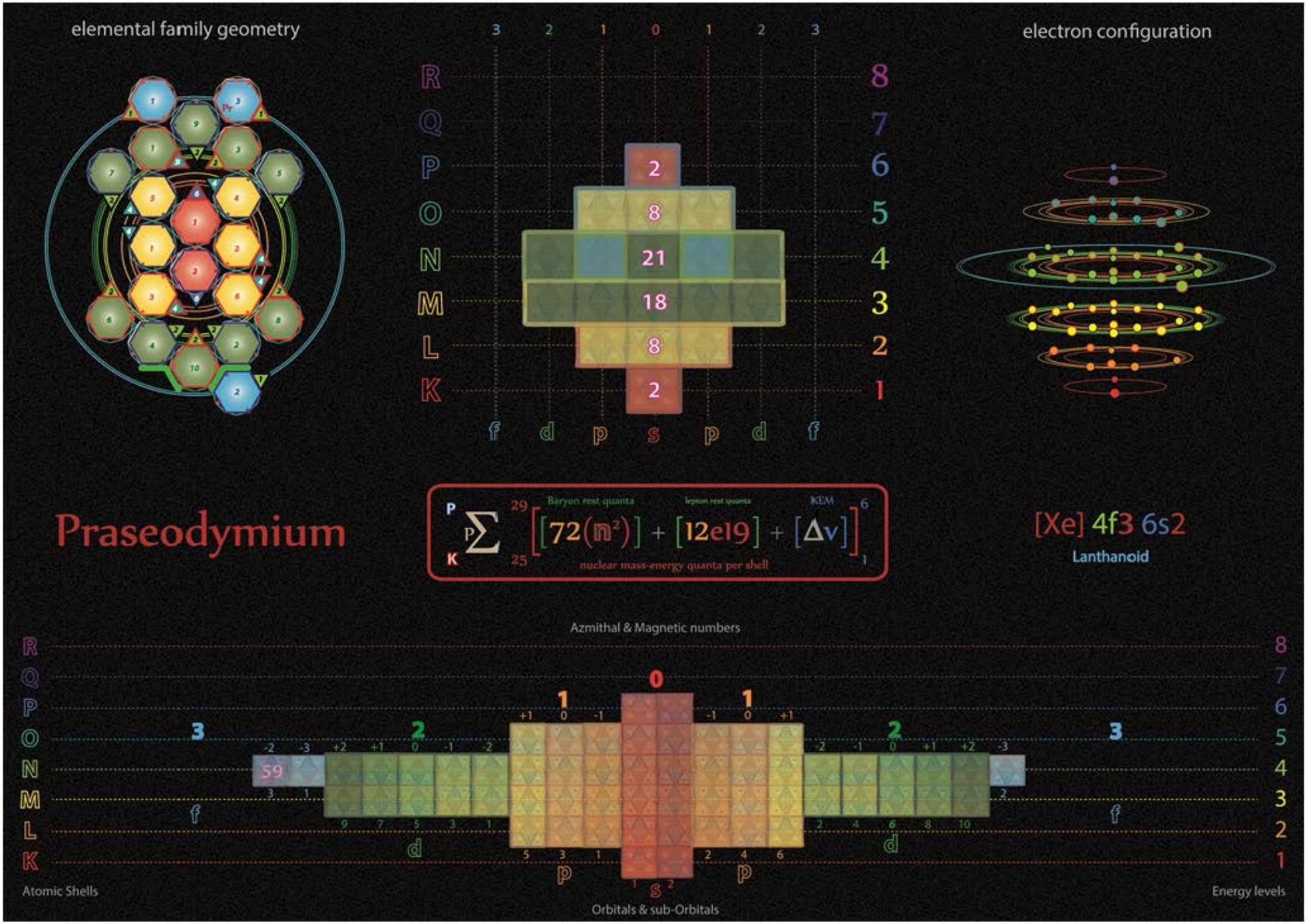

Tetryonics 53.59 - Praseodymium atomic config

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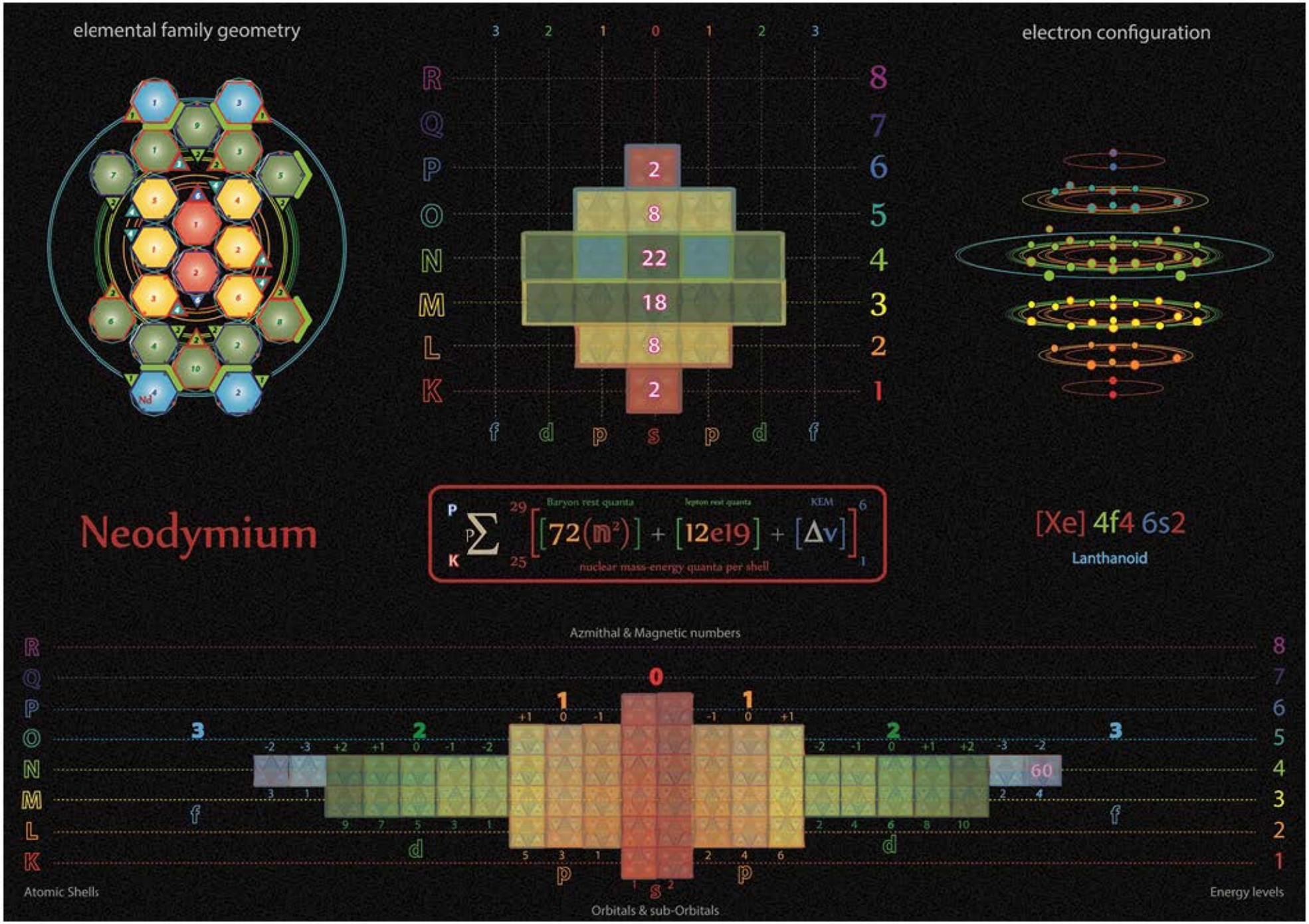

Tetryonics 53.60 - Neodymium atomic config

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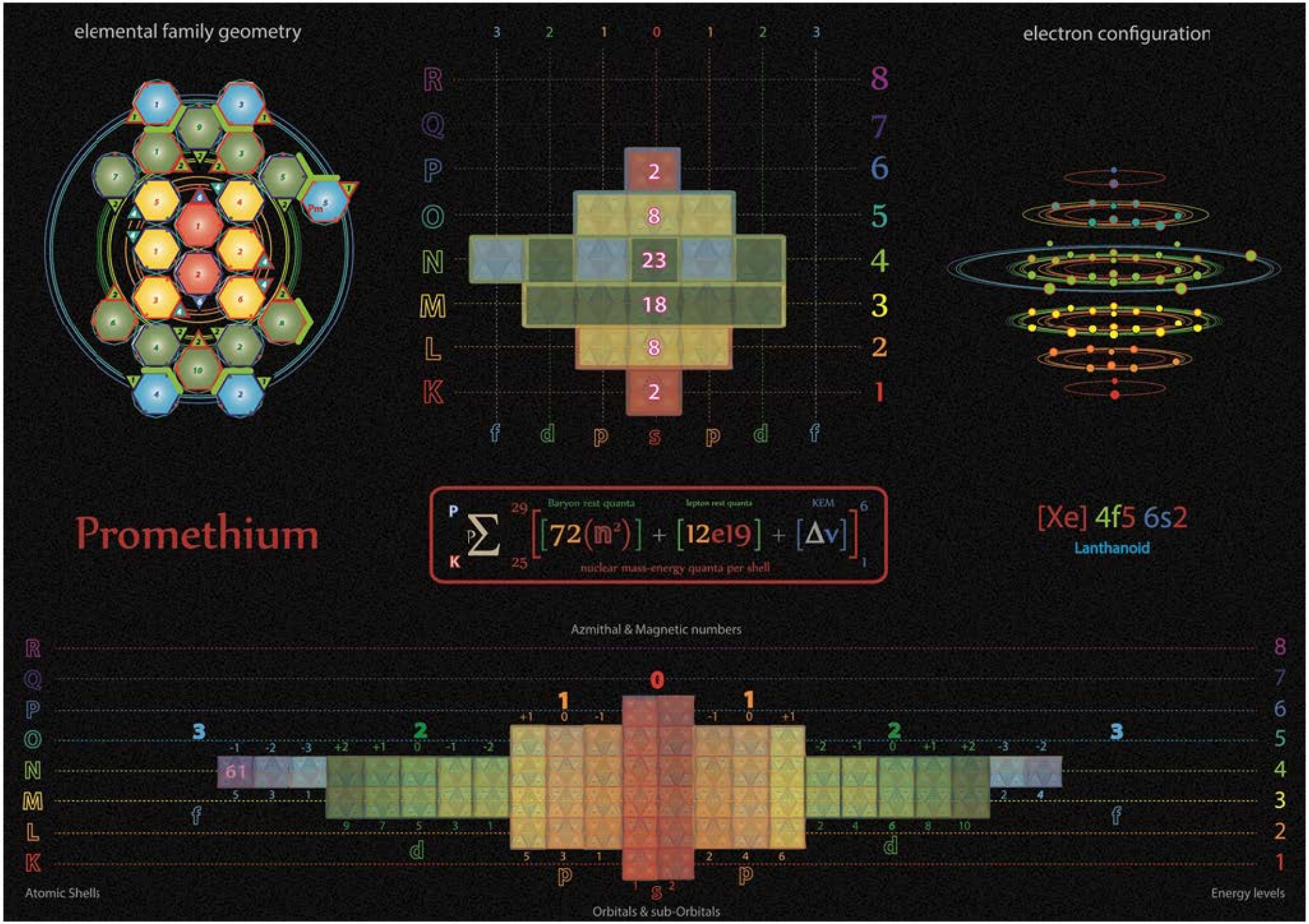

Tetryonics 53.61 - Promethium atomic config

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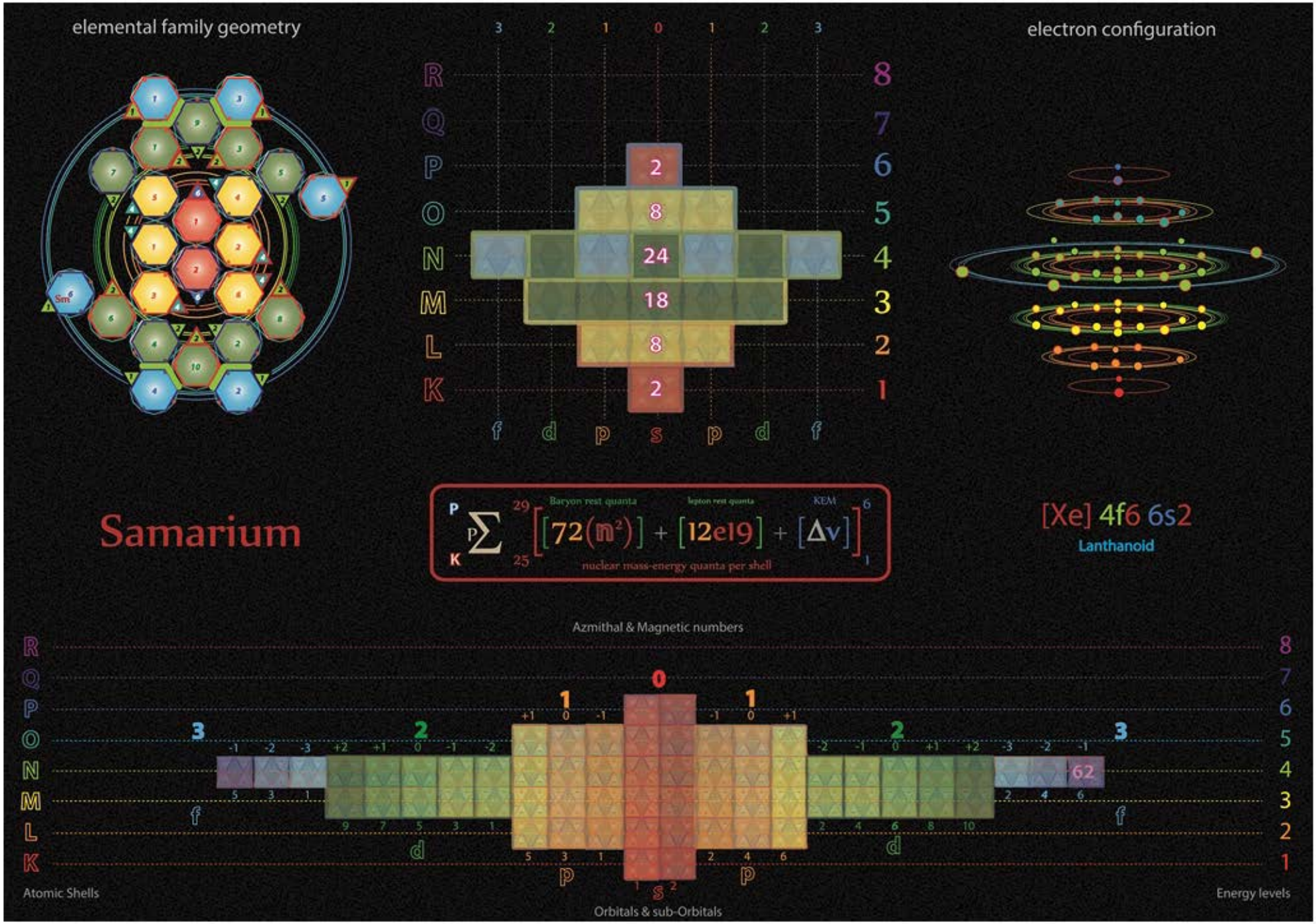

Tetryonics 53.62 - Samarium atomic config

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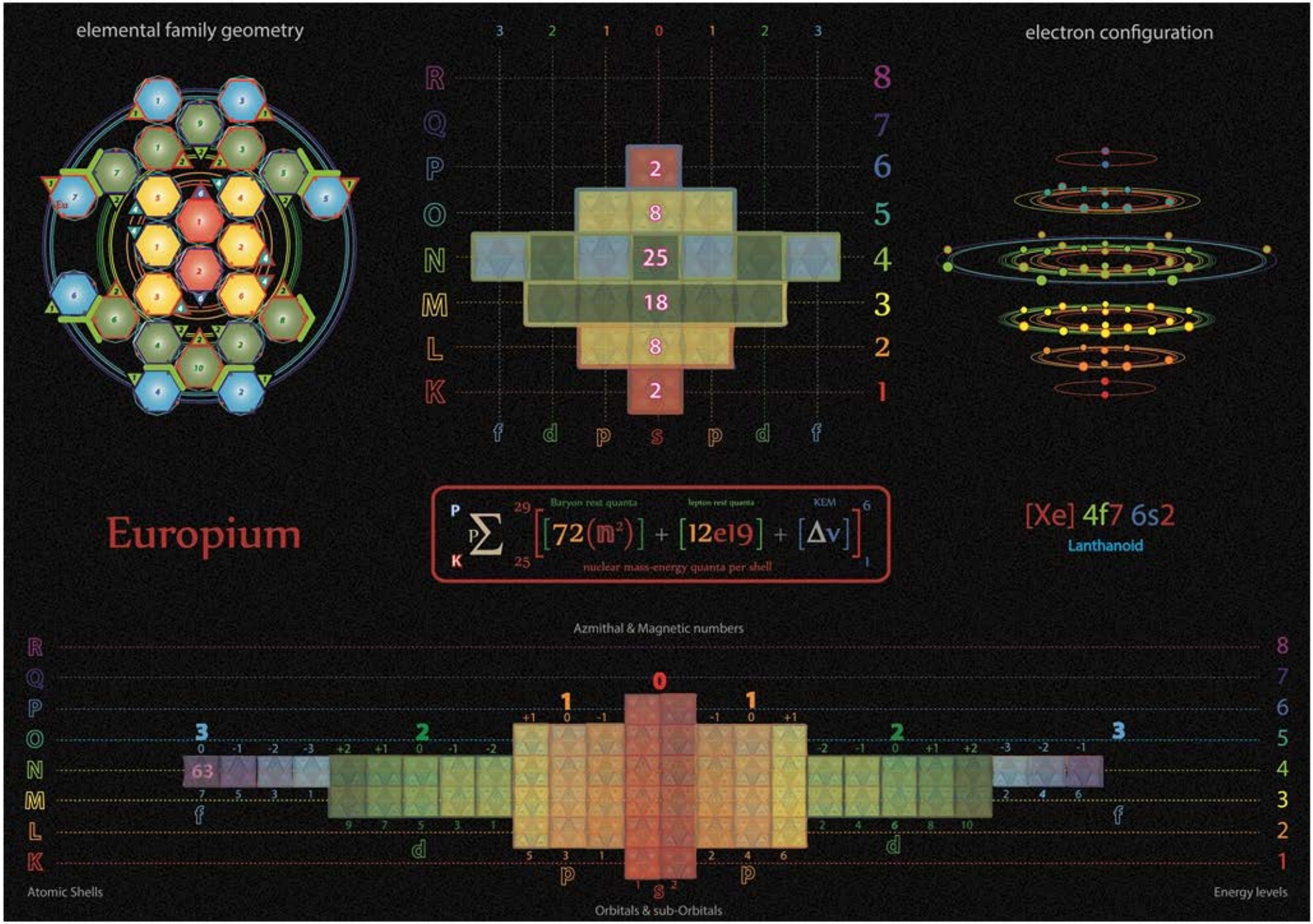

Tetryonics 53.63 - Europium atomic config

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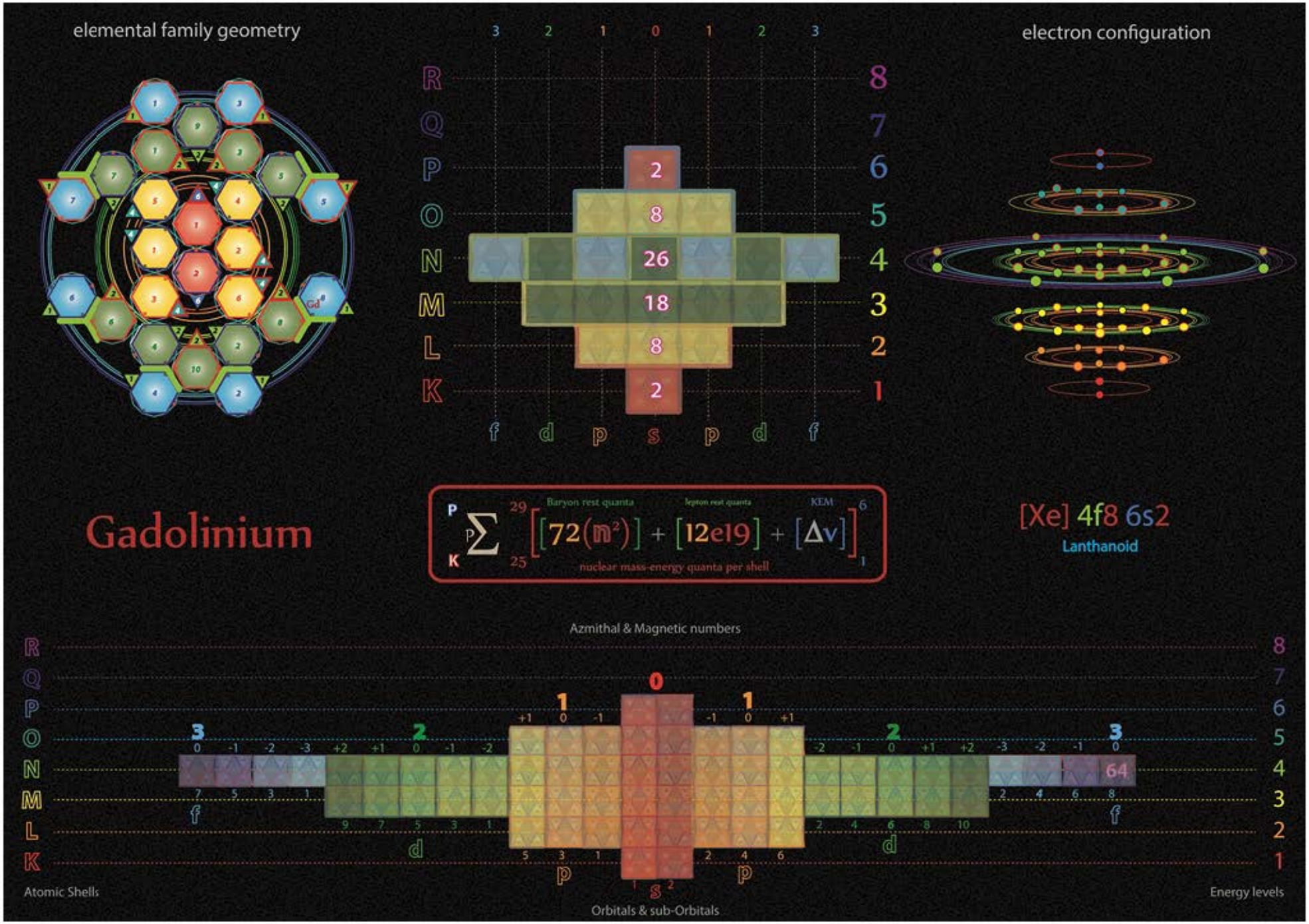

Tetryonics 53.64 - Gadolinium atomic config

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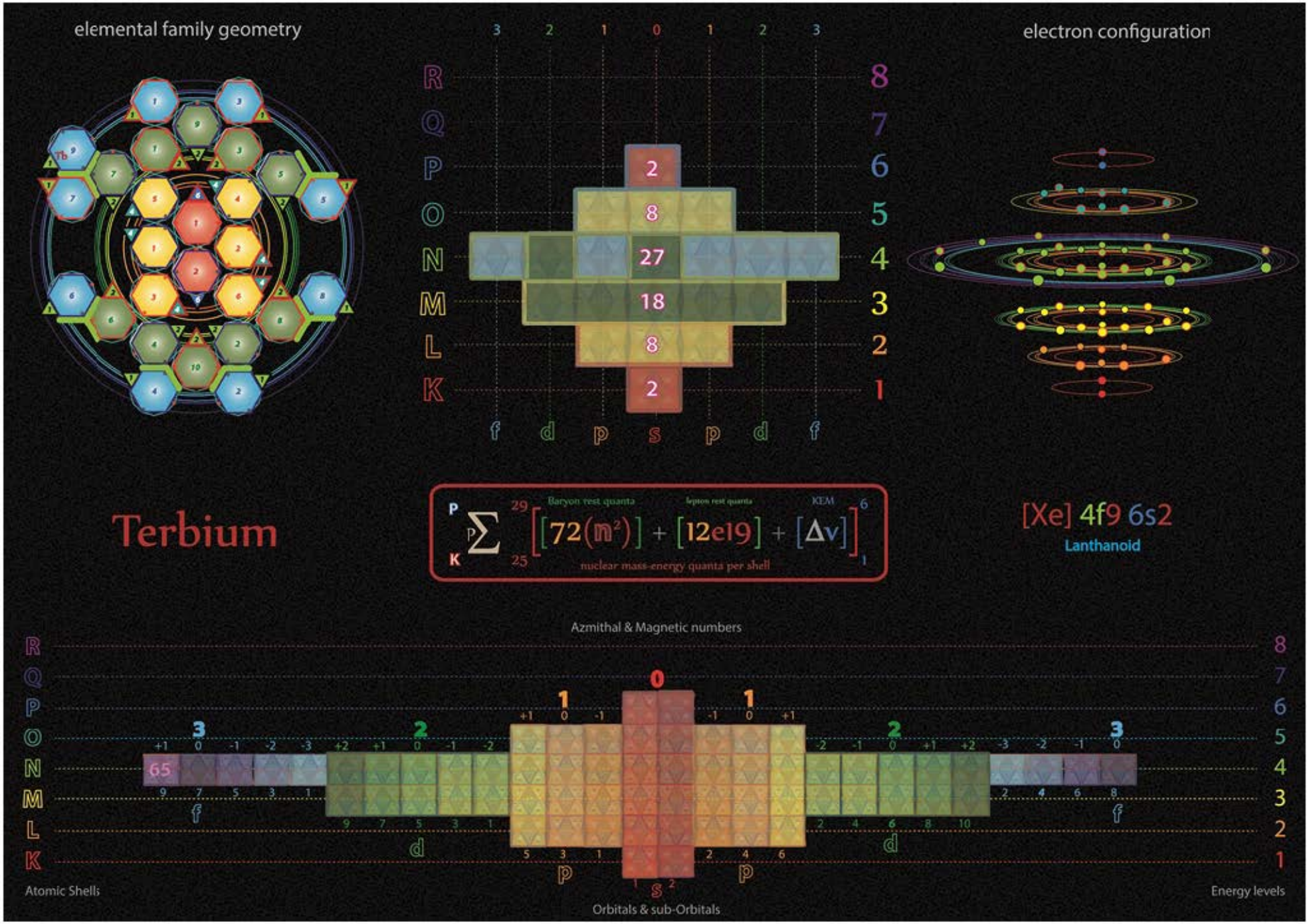

Tetryonics 53.65 - Terbium atomic config

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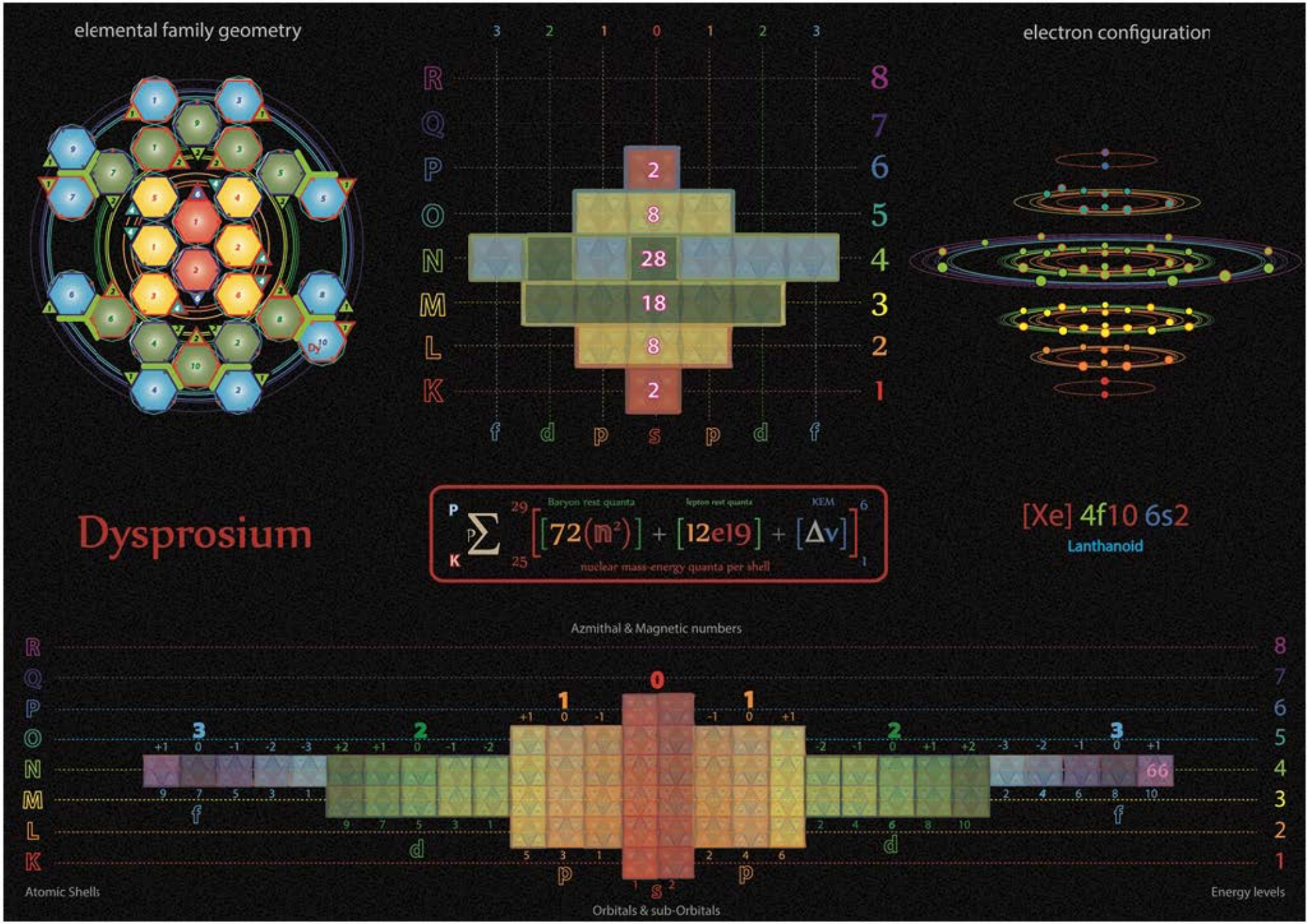

Tetryonics 53.66 - Dysprosium atomic config

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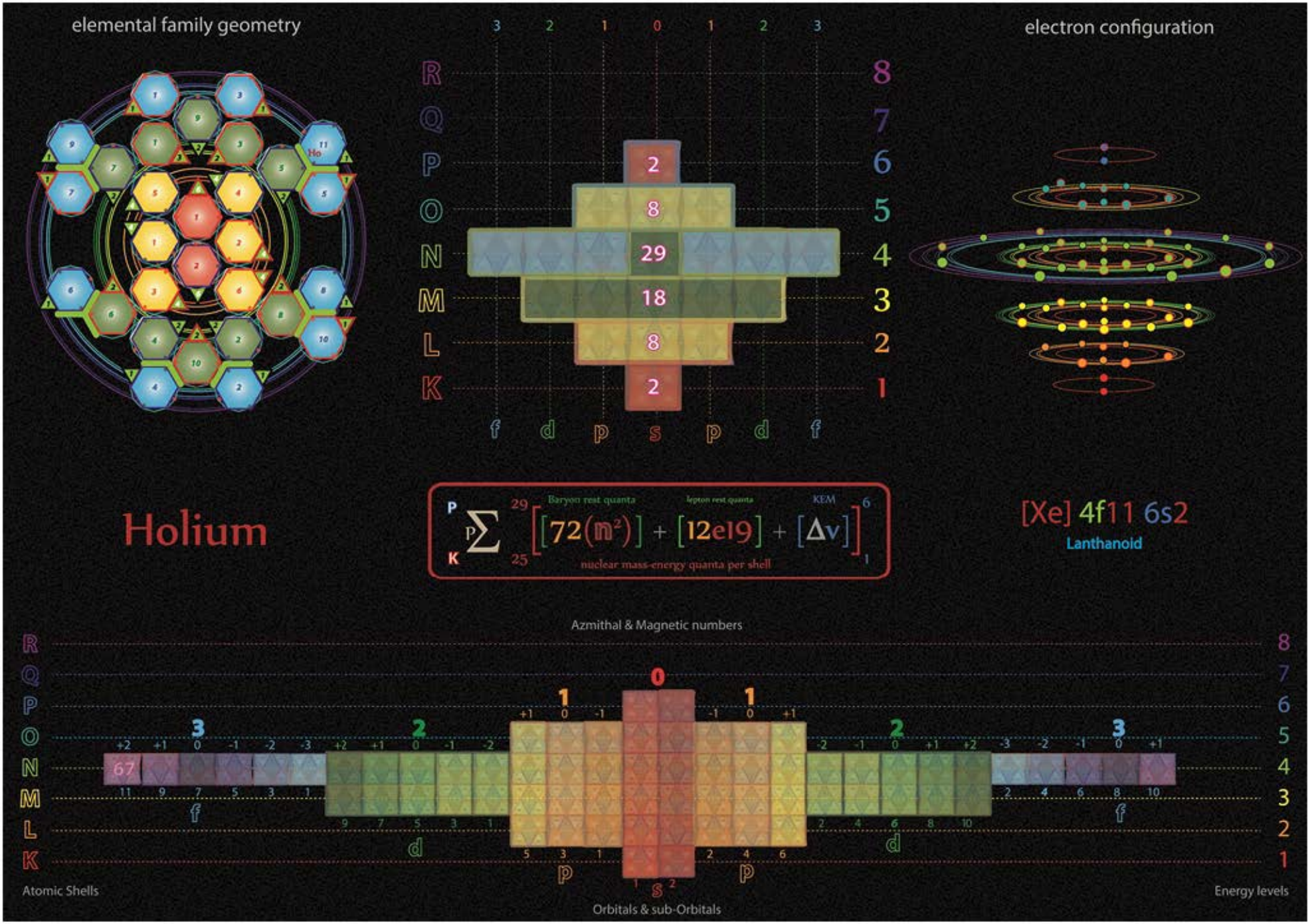

Tetryonics 53.67 - Holium atomic config

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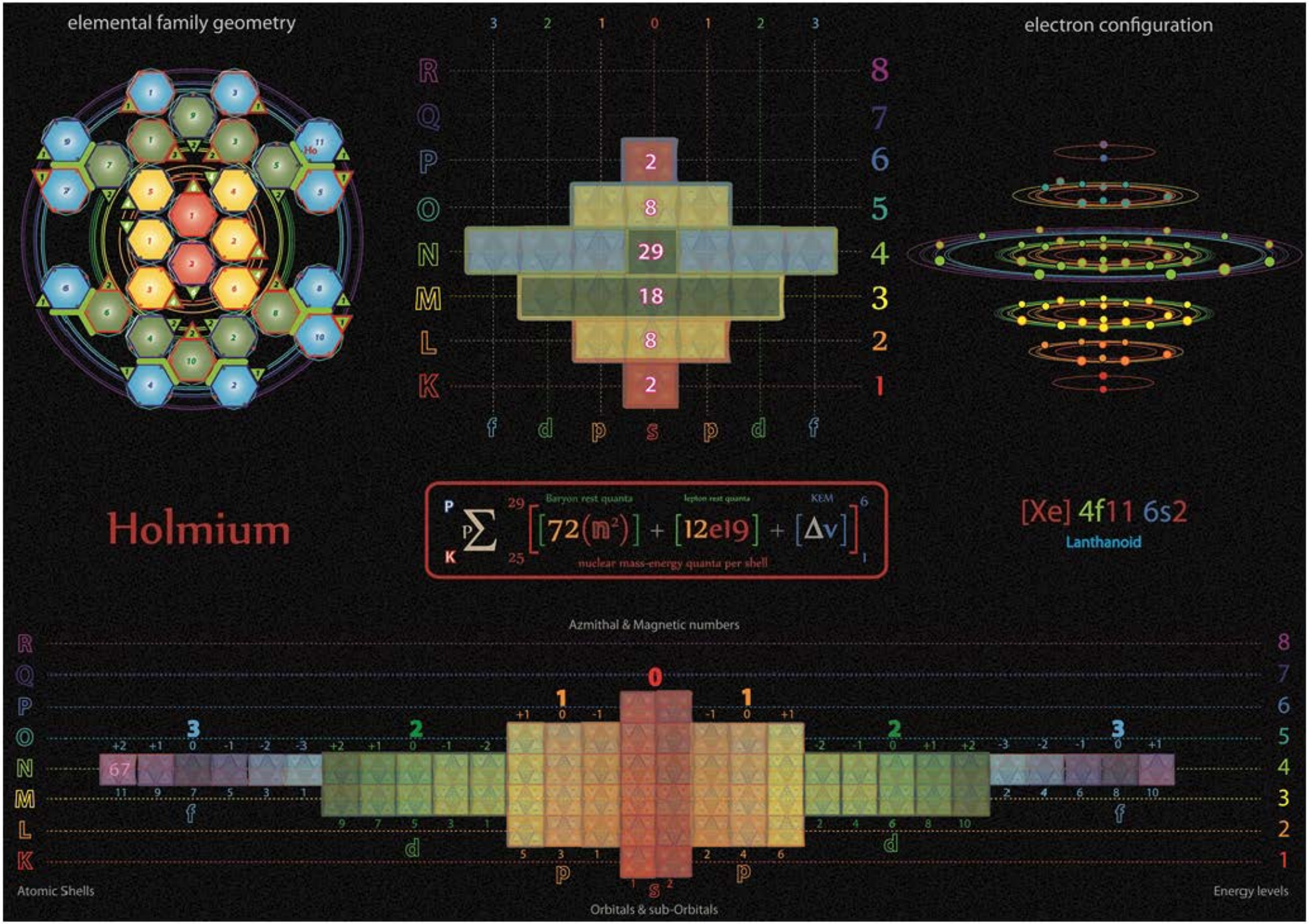

Tetryonics 53.67 - Holmium atomic config

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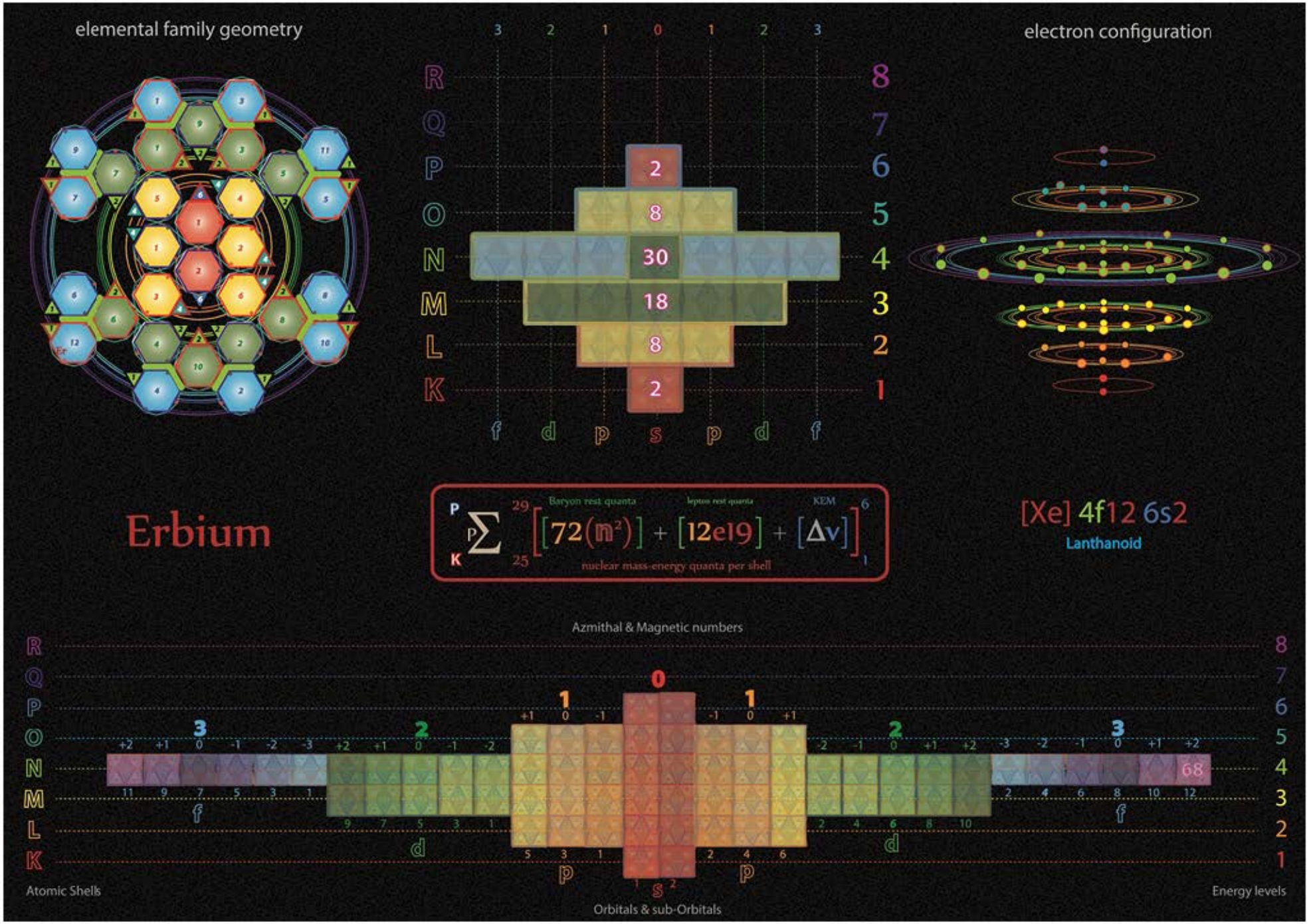

Tetryonics 53.68 - Erbium atomic config

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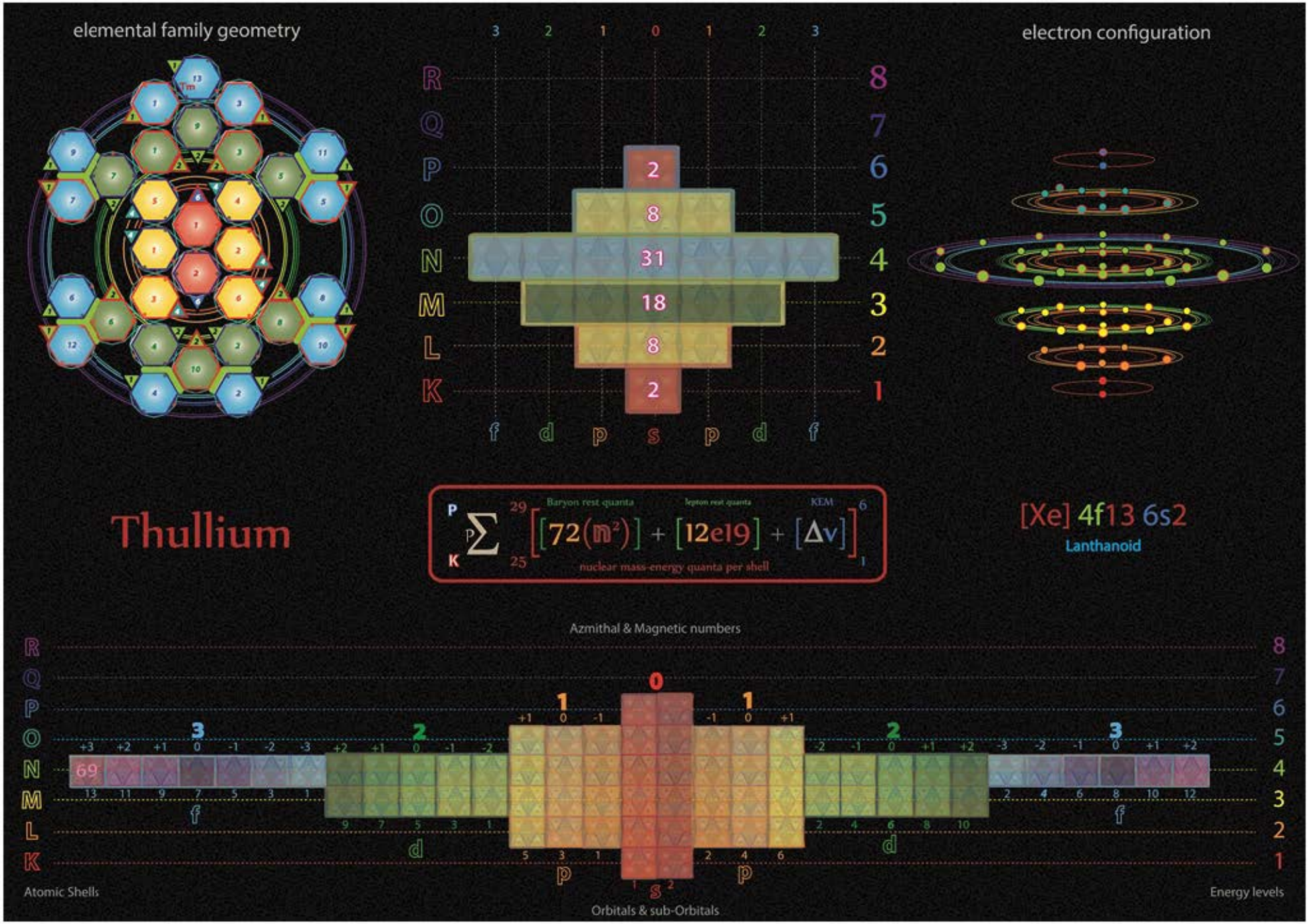

Tetryonics 53.69 - Thulium atomic config

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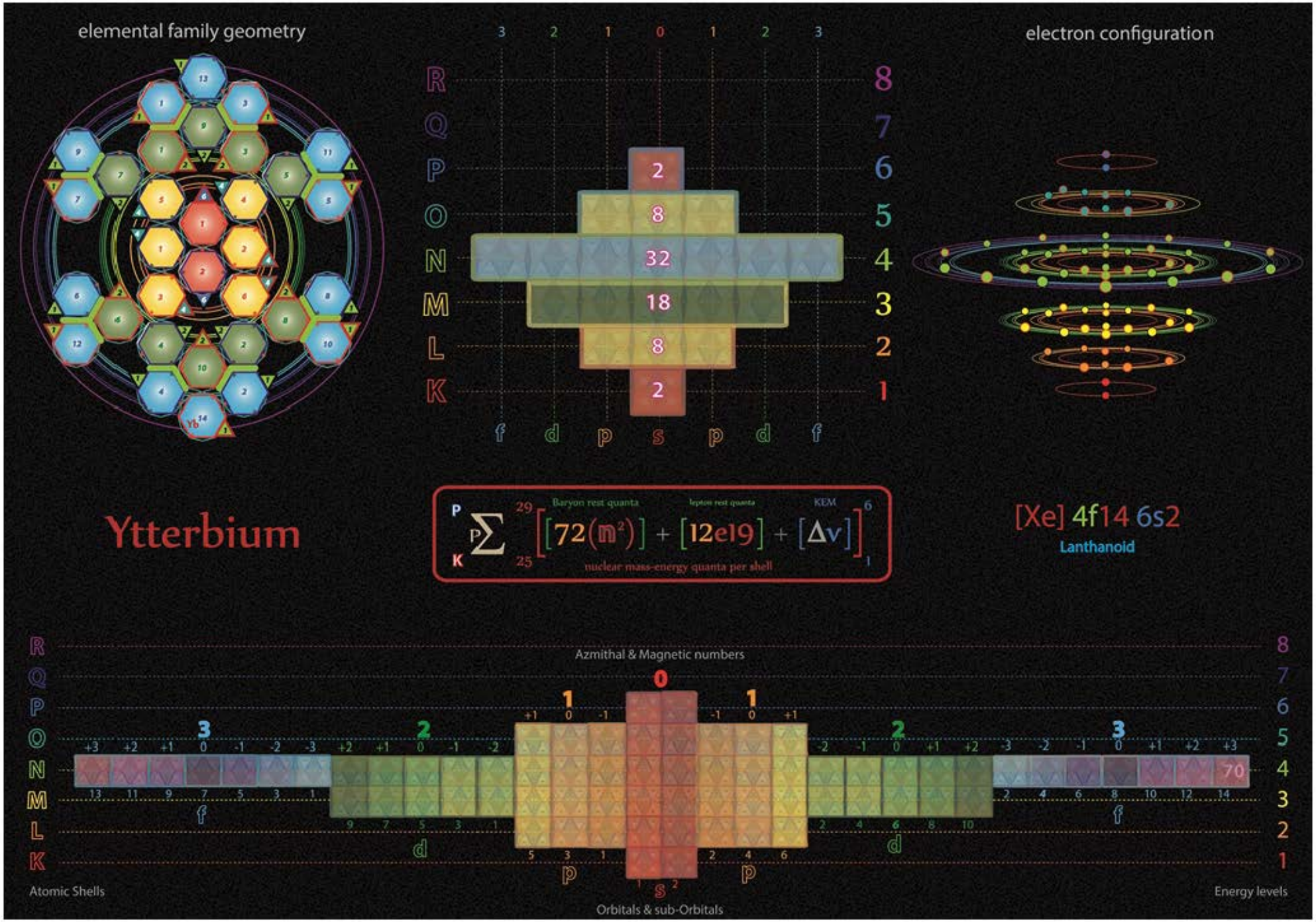

Tetryonics 53.70 - Ytterbium atomic config

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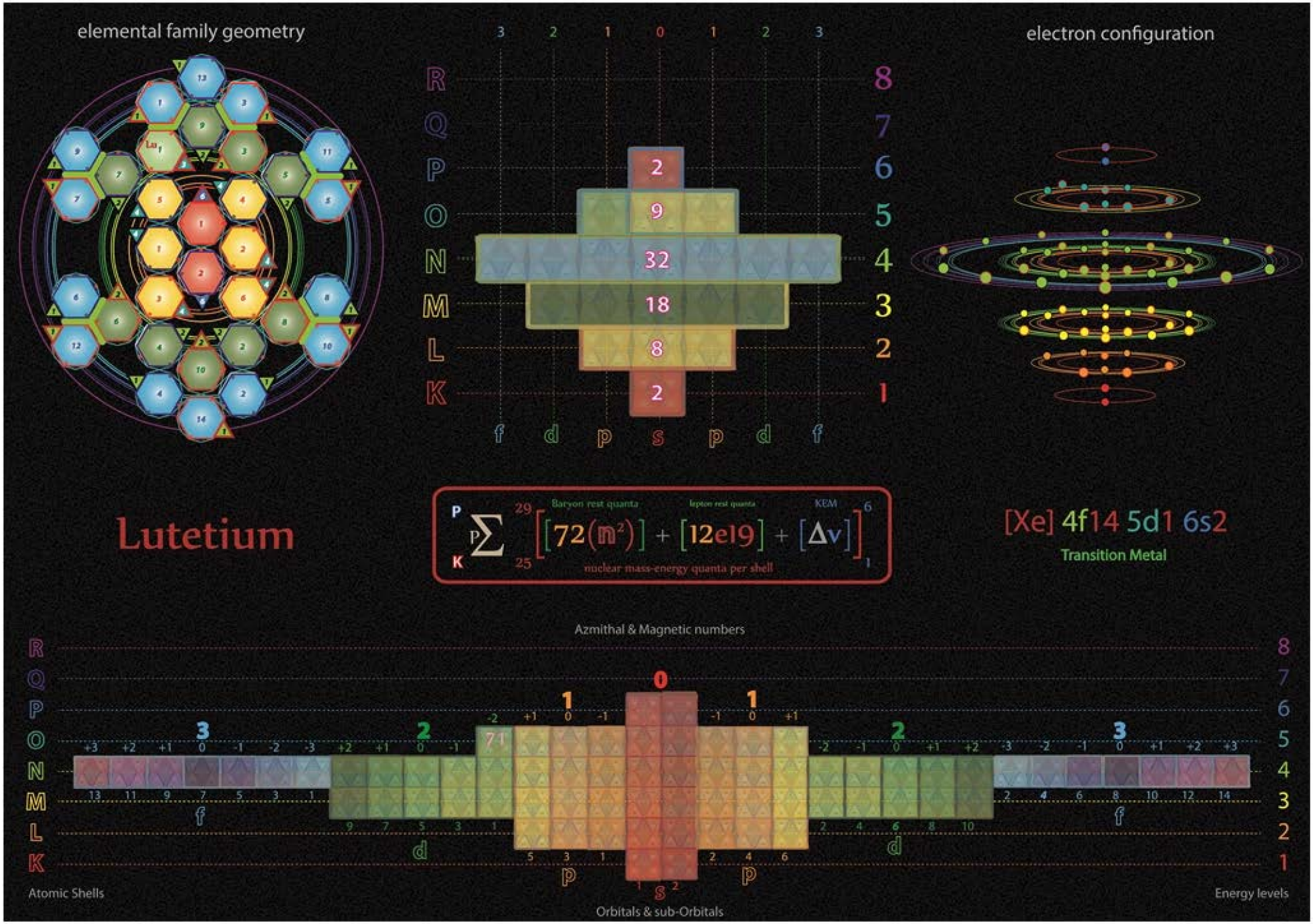

Tetryonics 53.71 - Lutetium atomic config

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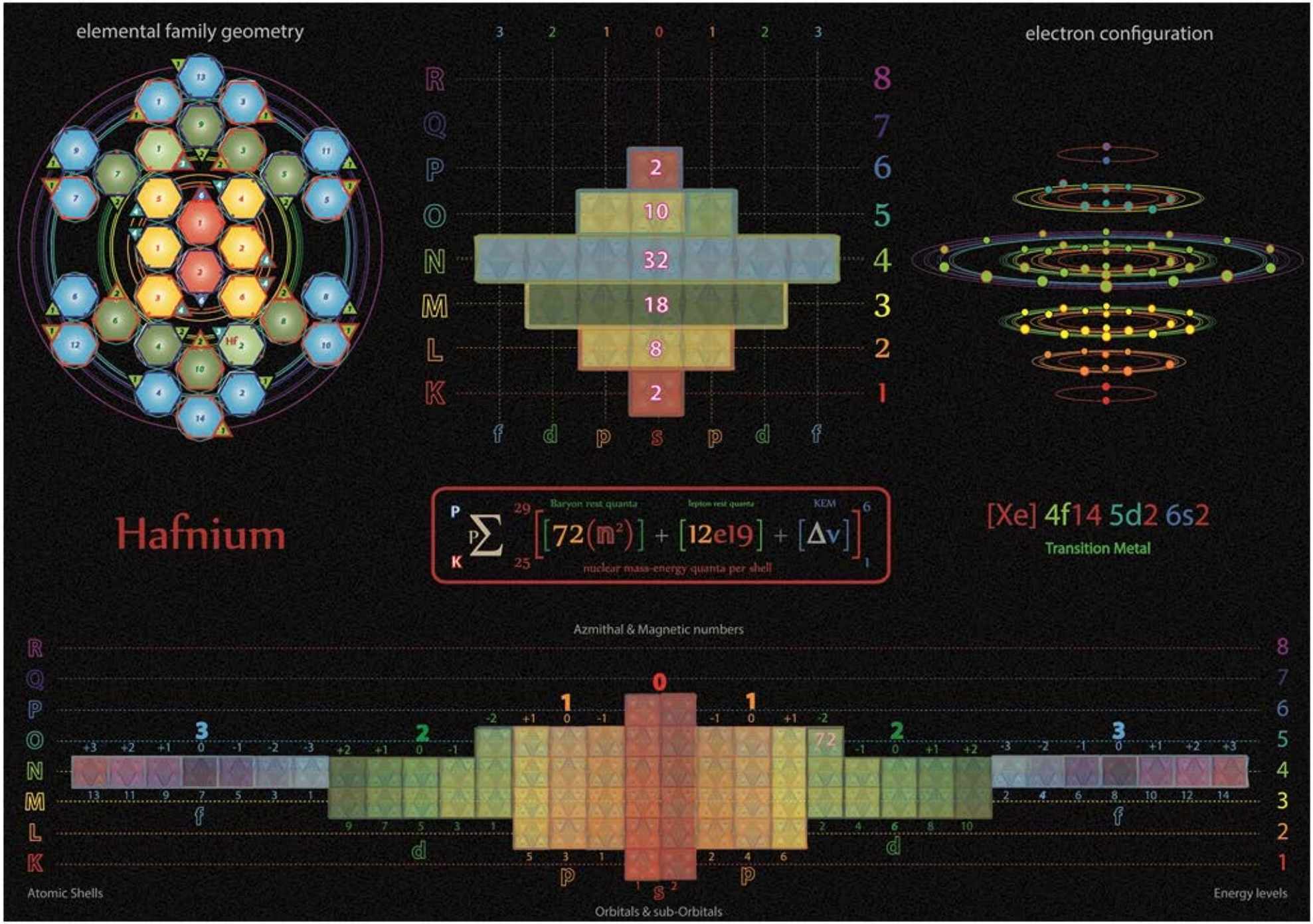

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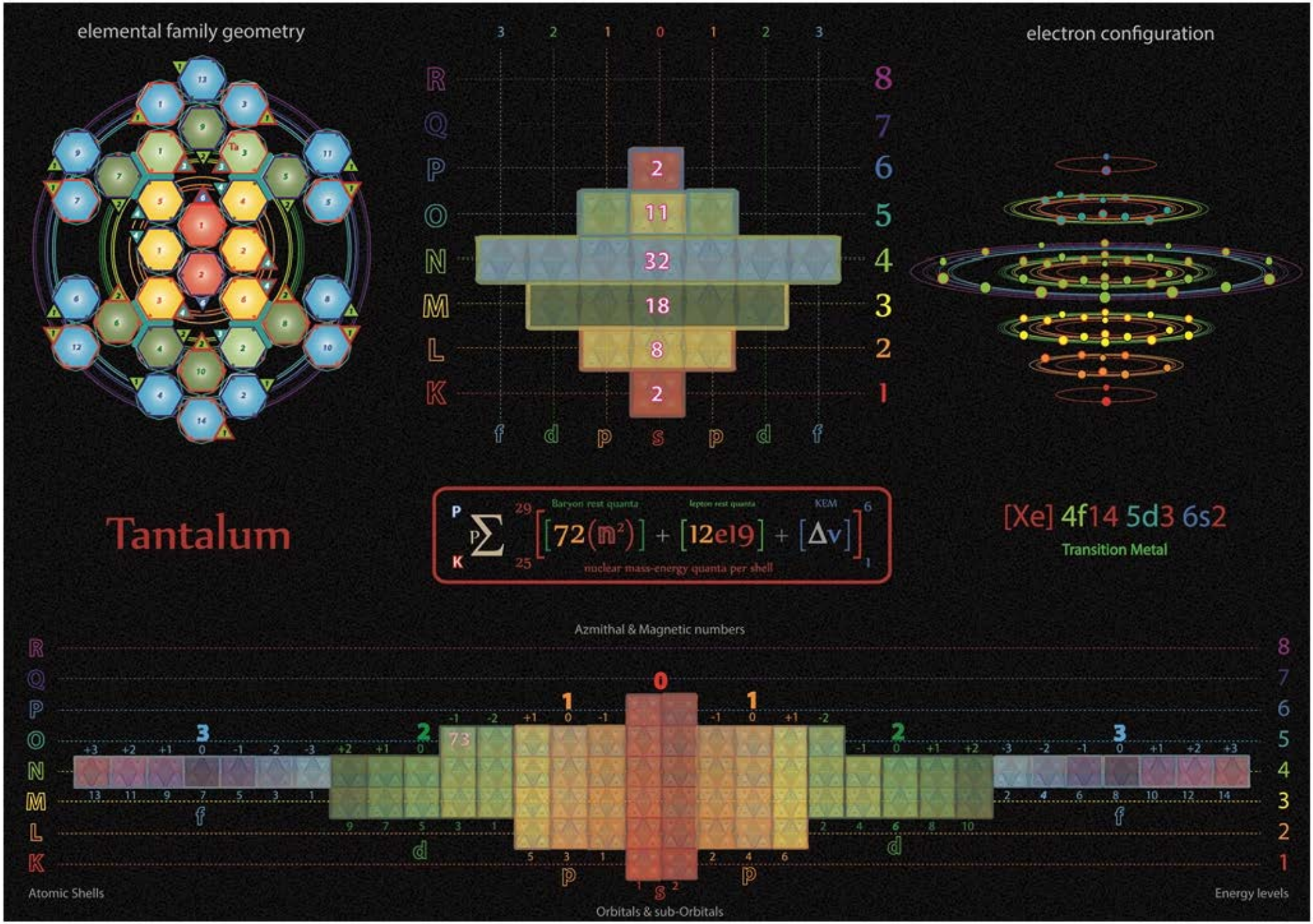

Tetryonics 53.73 - Tantalum atomic config

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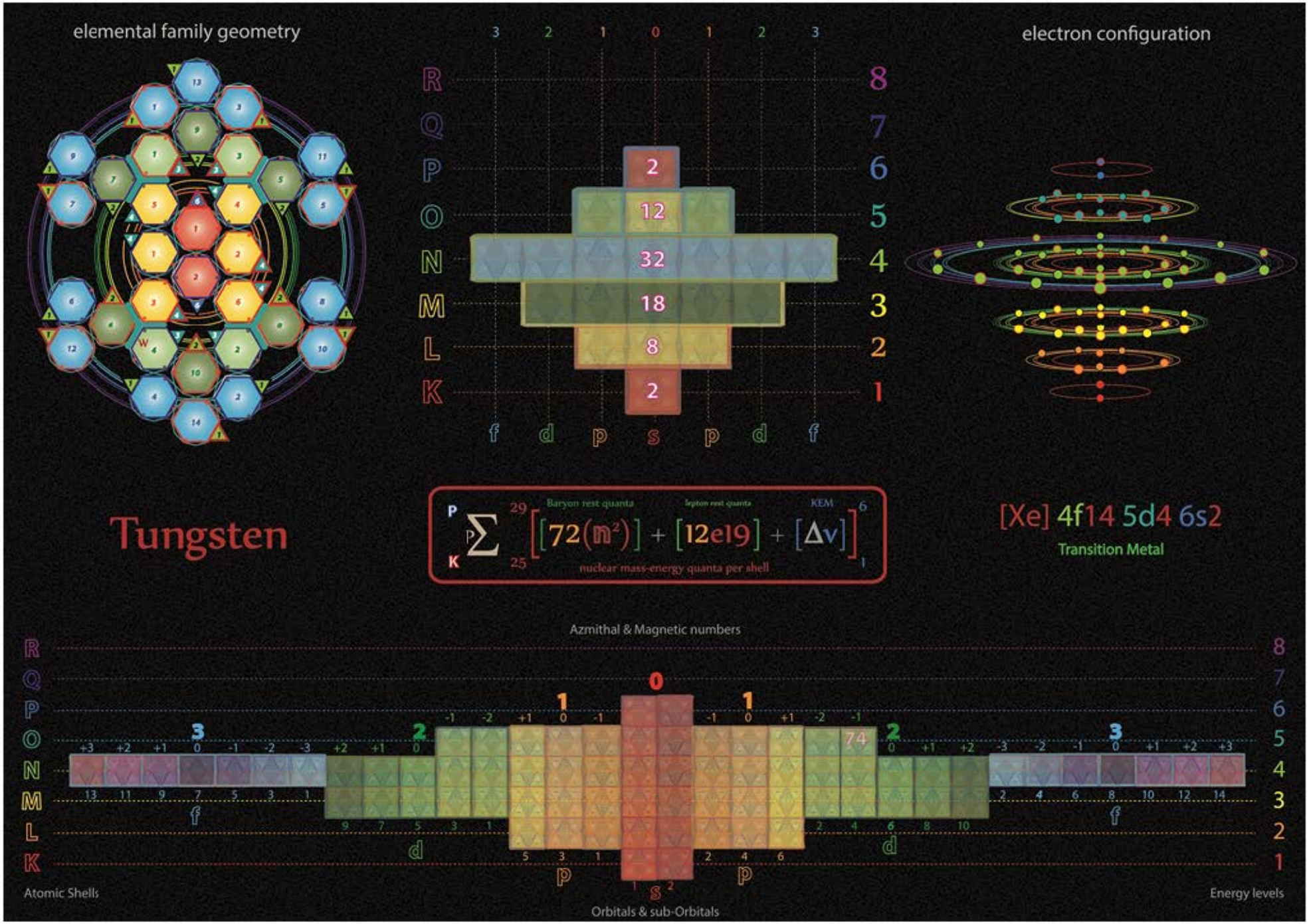

Tetryonics 53.74 - Tungsten atomic config

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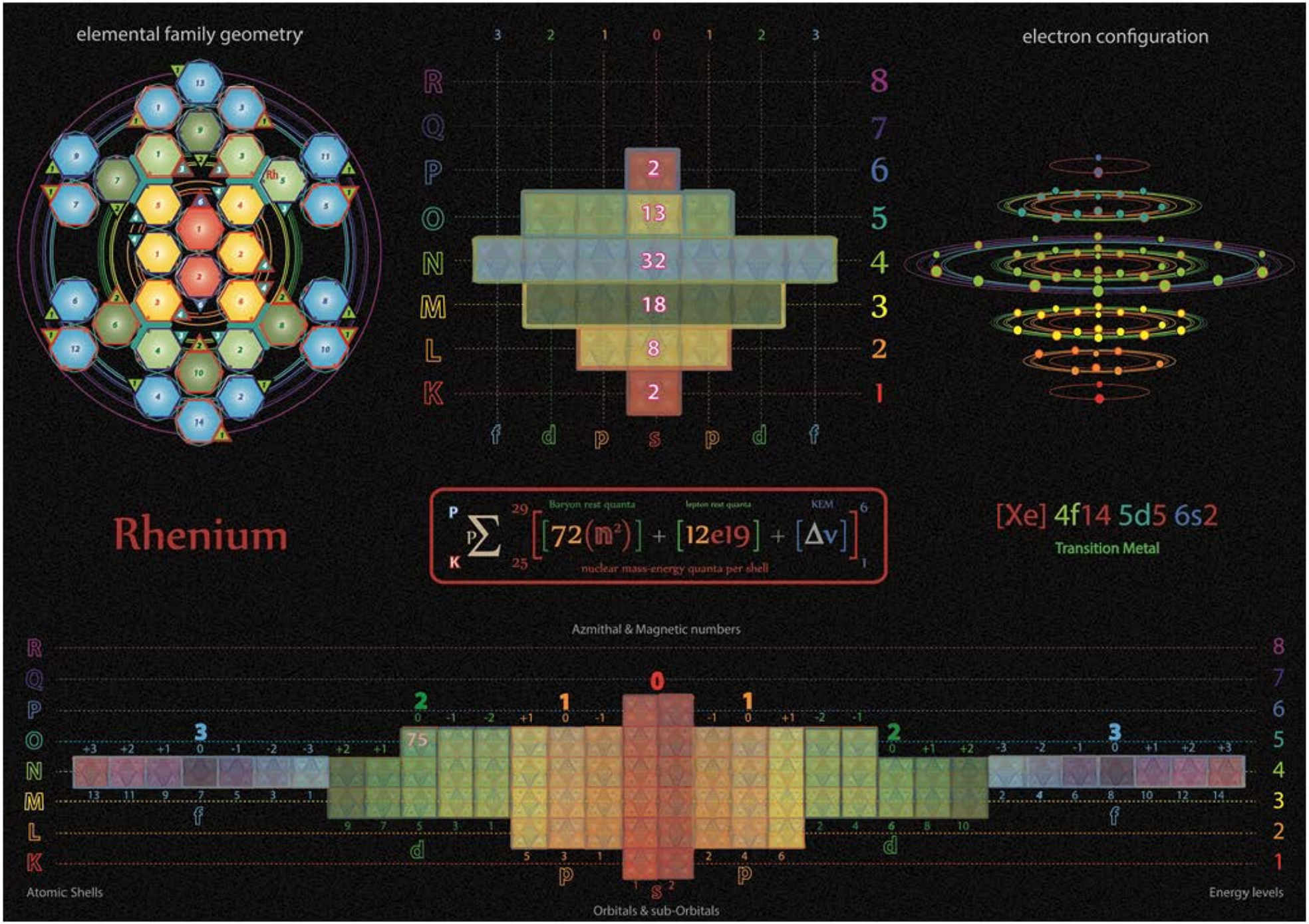

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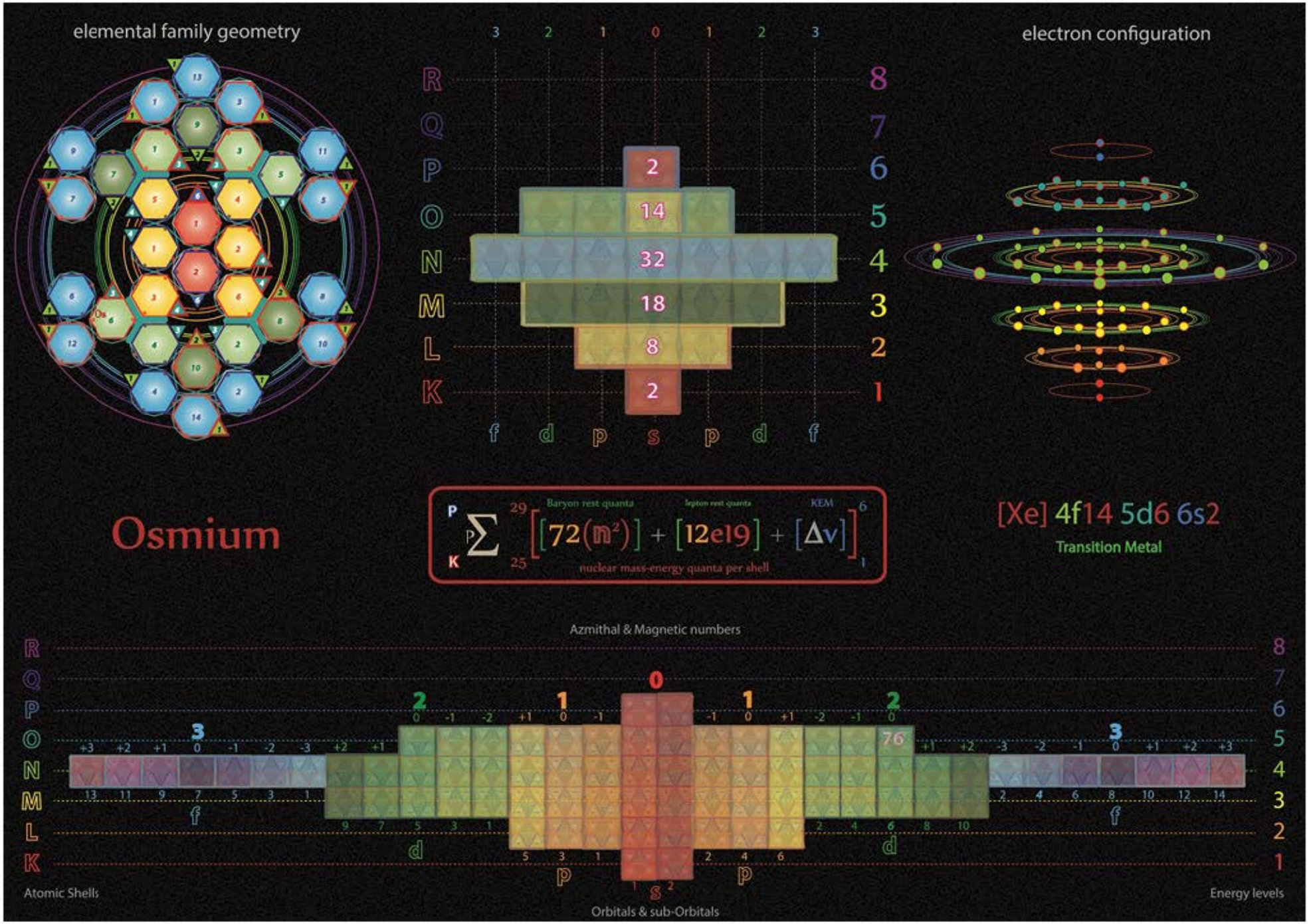

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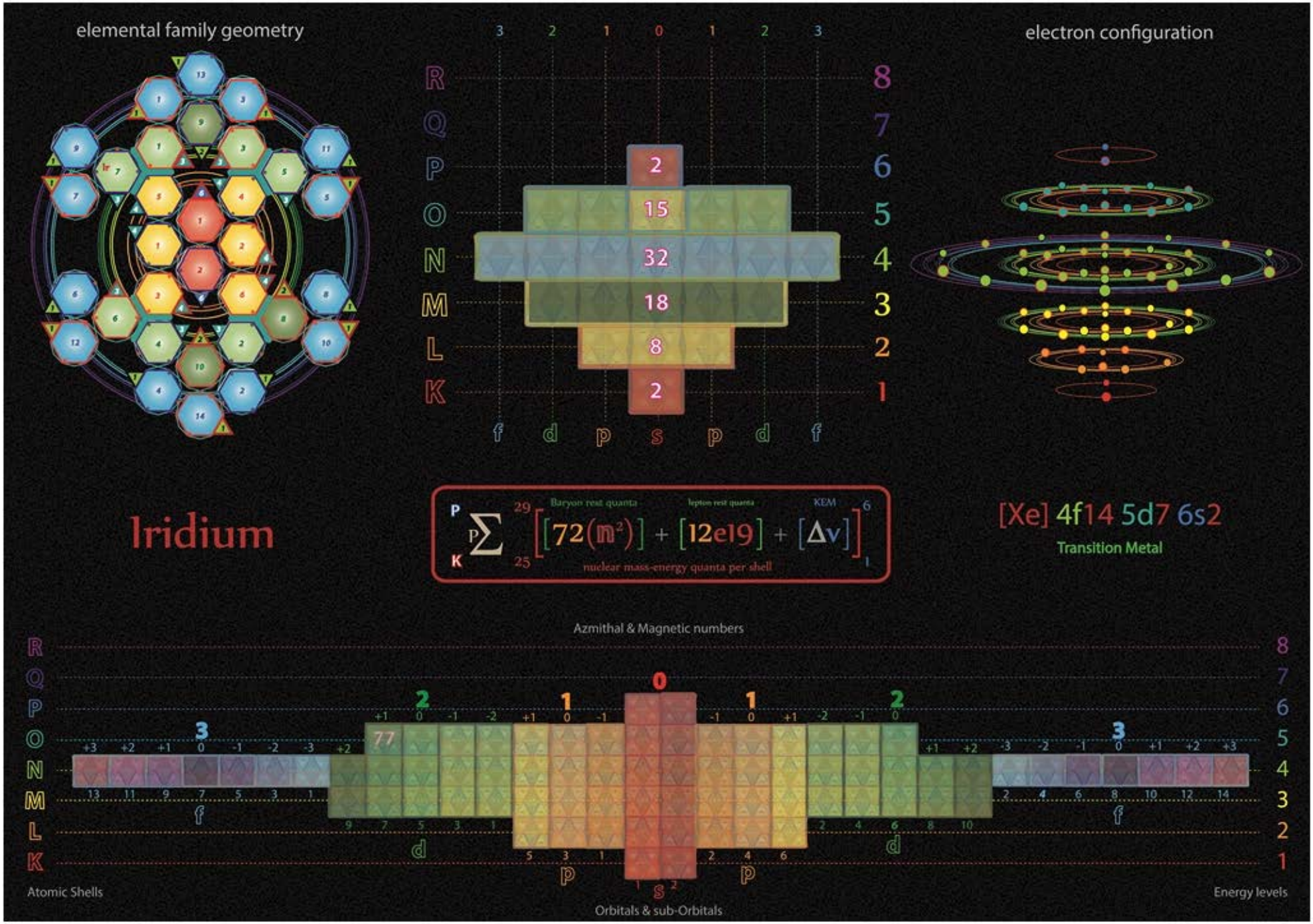

Tetryonics 53.77 - Iridium atomic config

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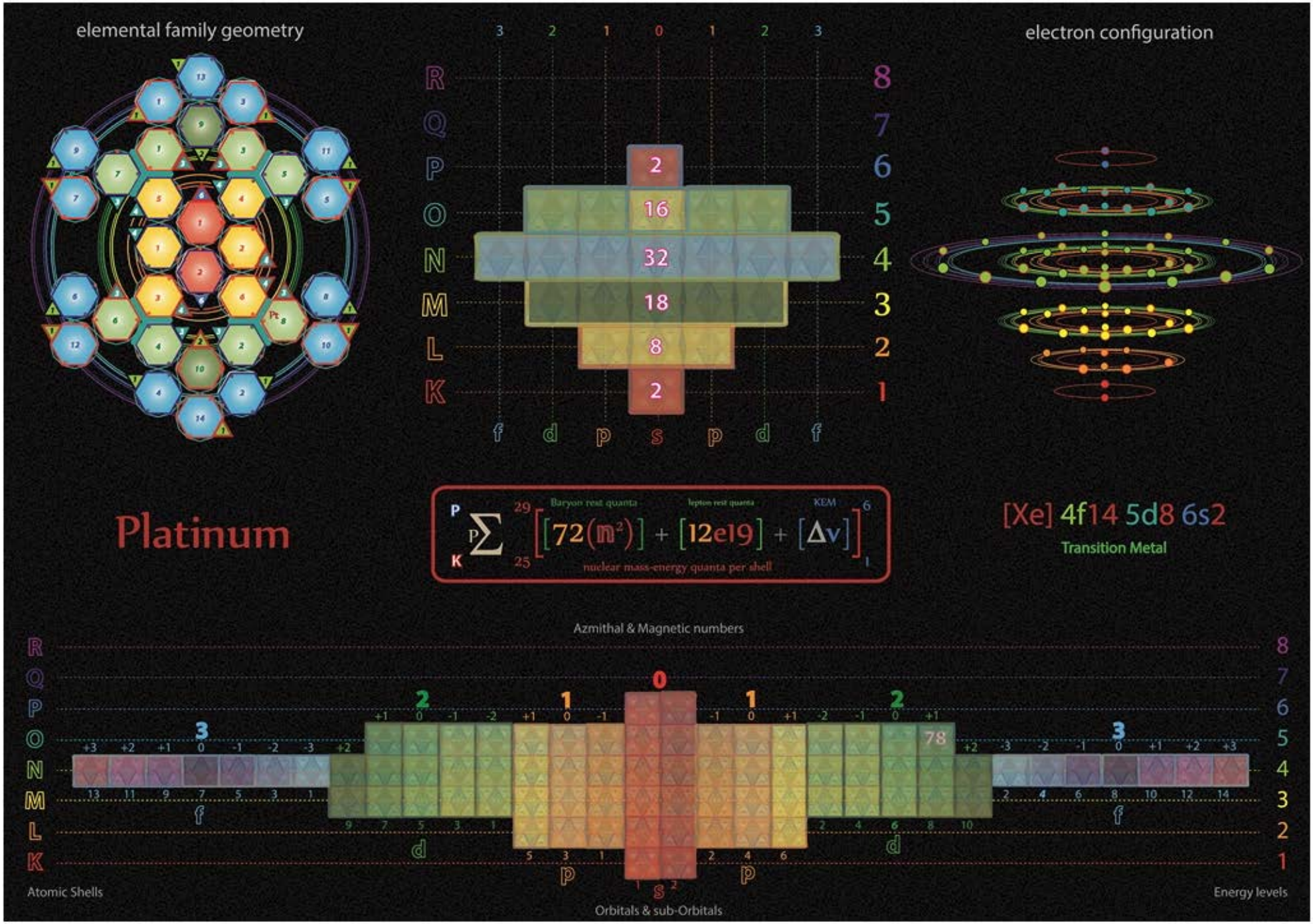

Tetryonics 53.78 - Platinum atomic config

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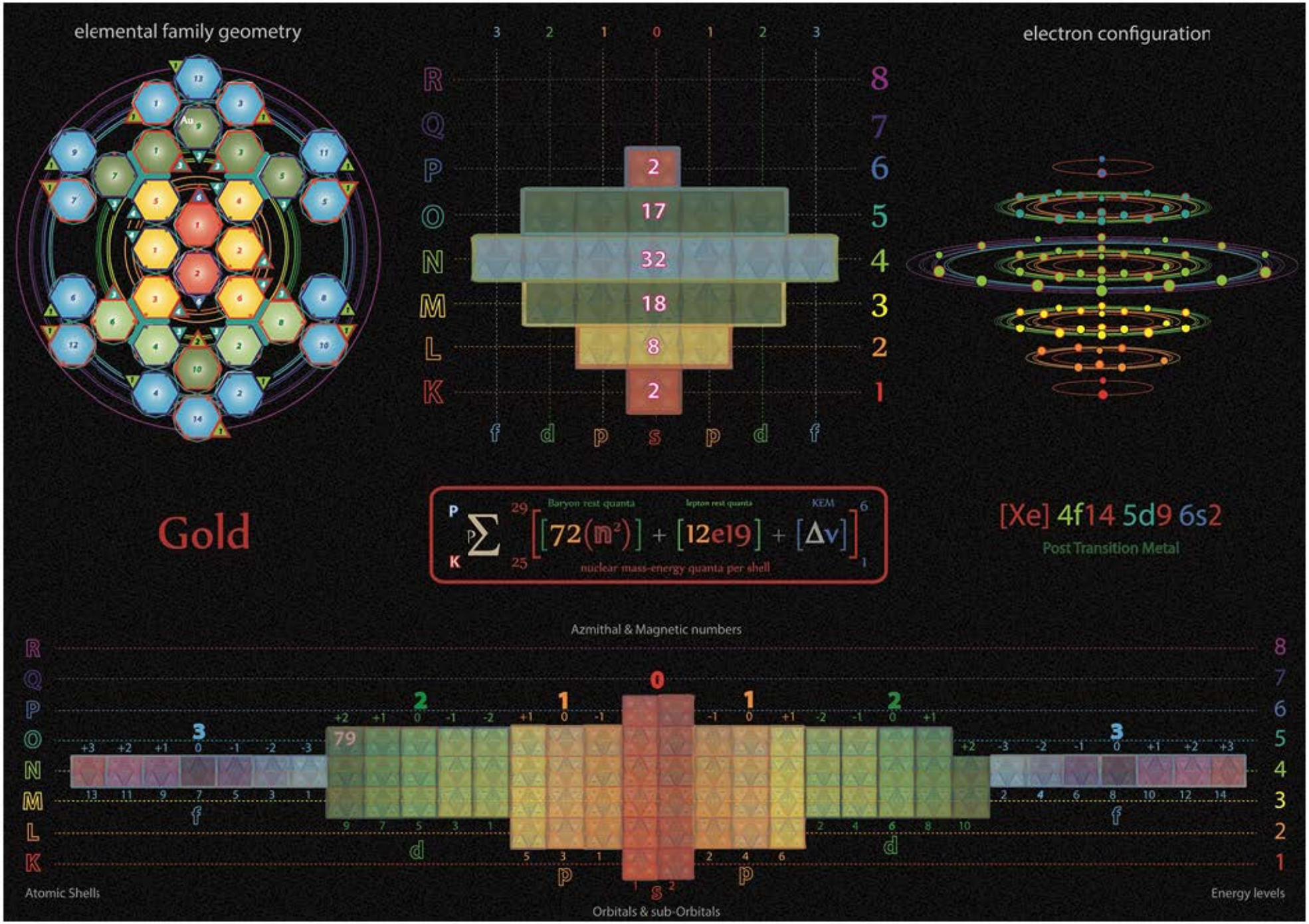

Tetryonics 53.79 - Gold atomic config

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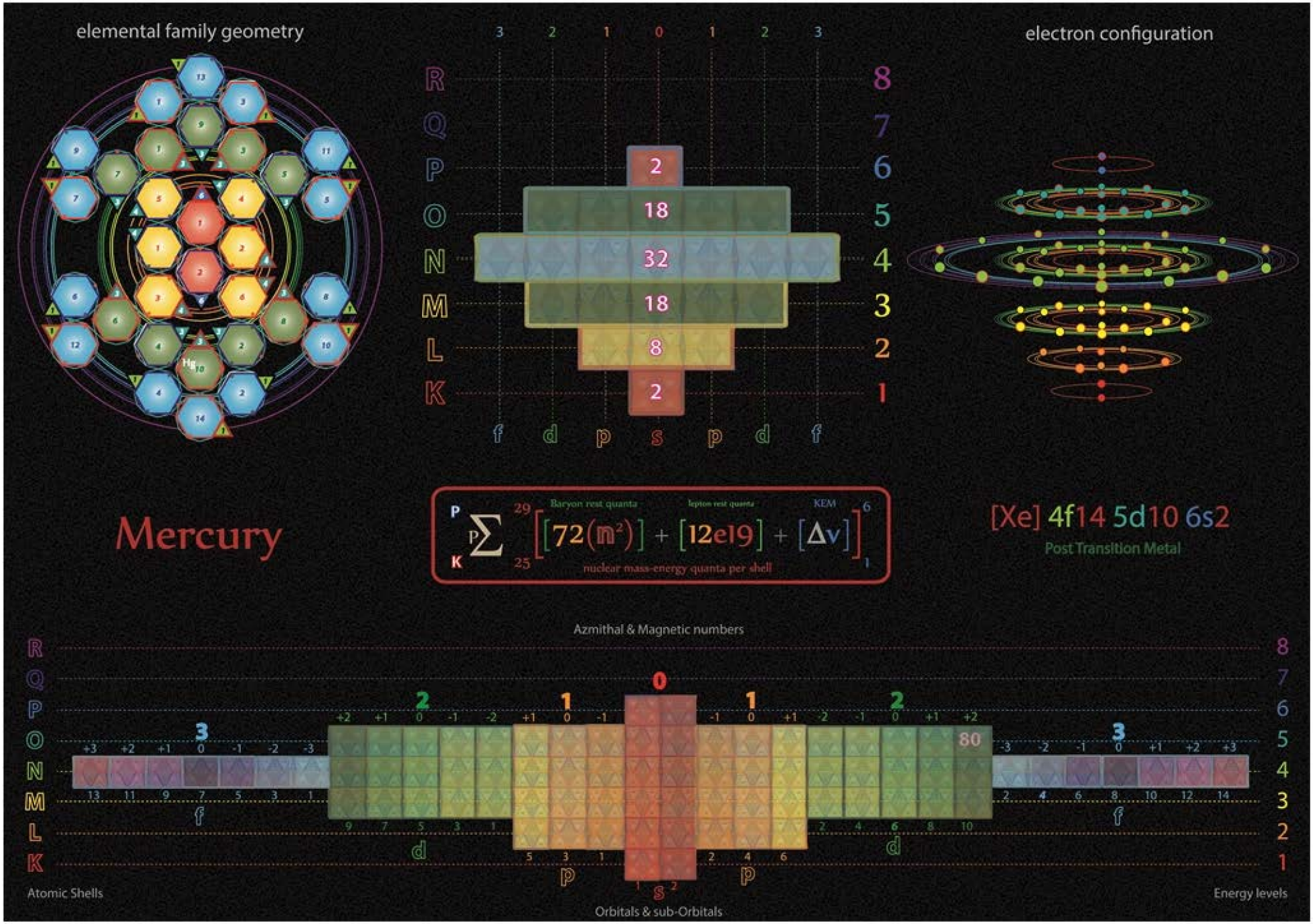

Tetryonics 53.80 - Mercury atomic config

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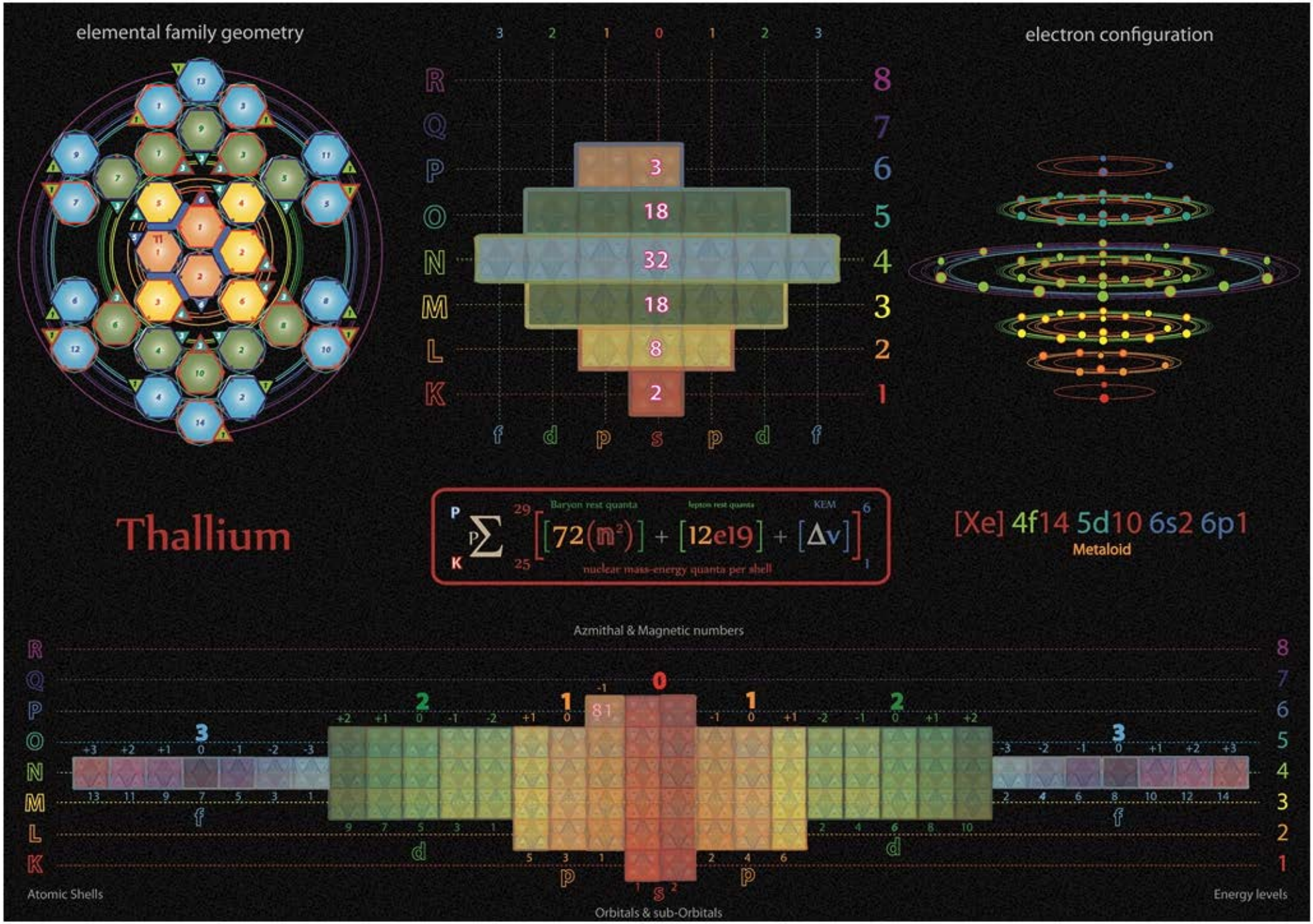

Tetryonics 53.81 - Thallium atomic config

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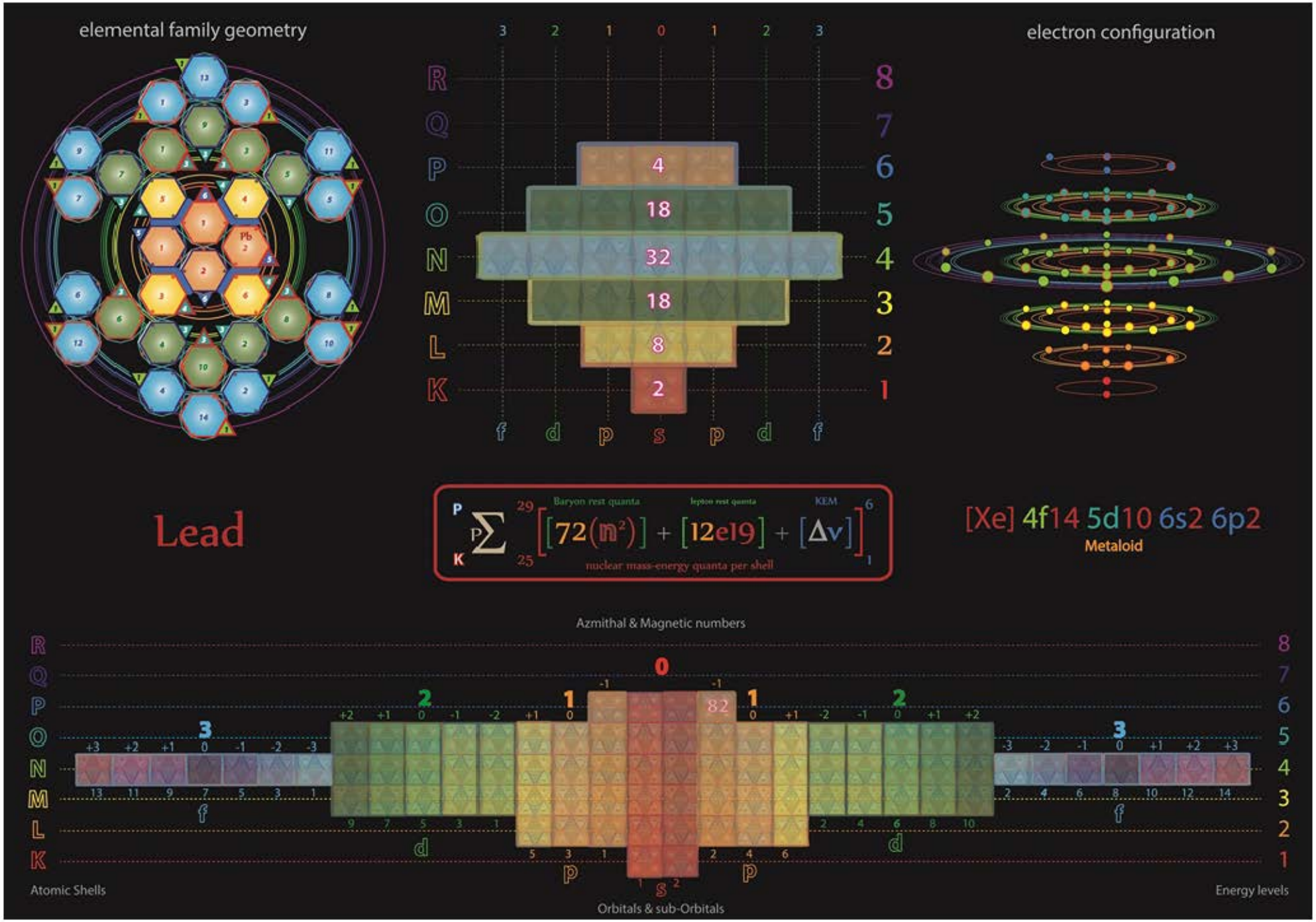

Tetryonics 53.82 - Lead atomic config

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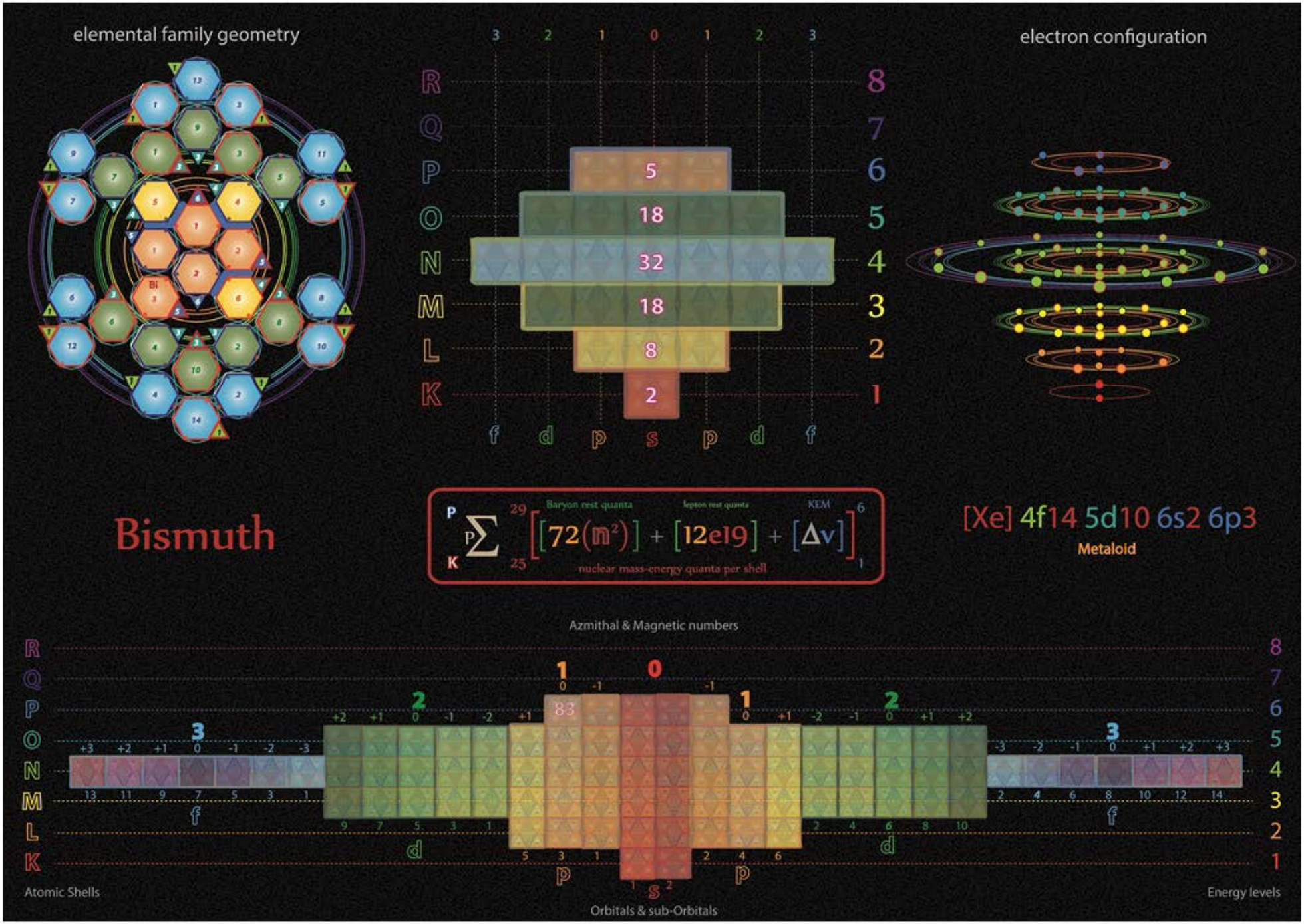

Tetryonics 53.83 - Bismuth atomic config

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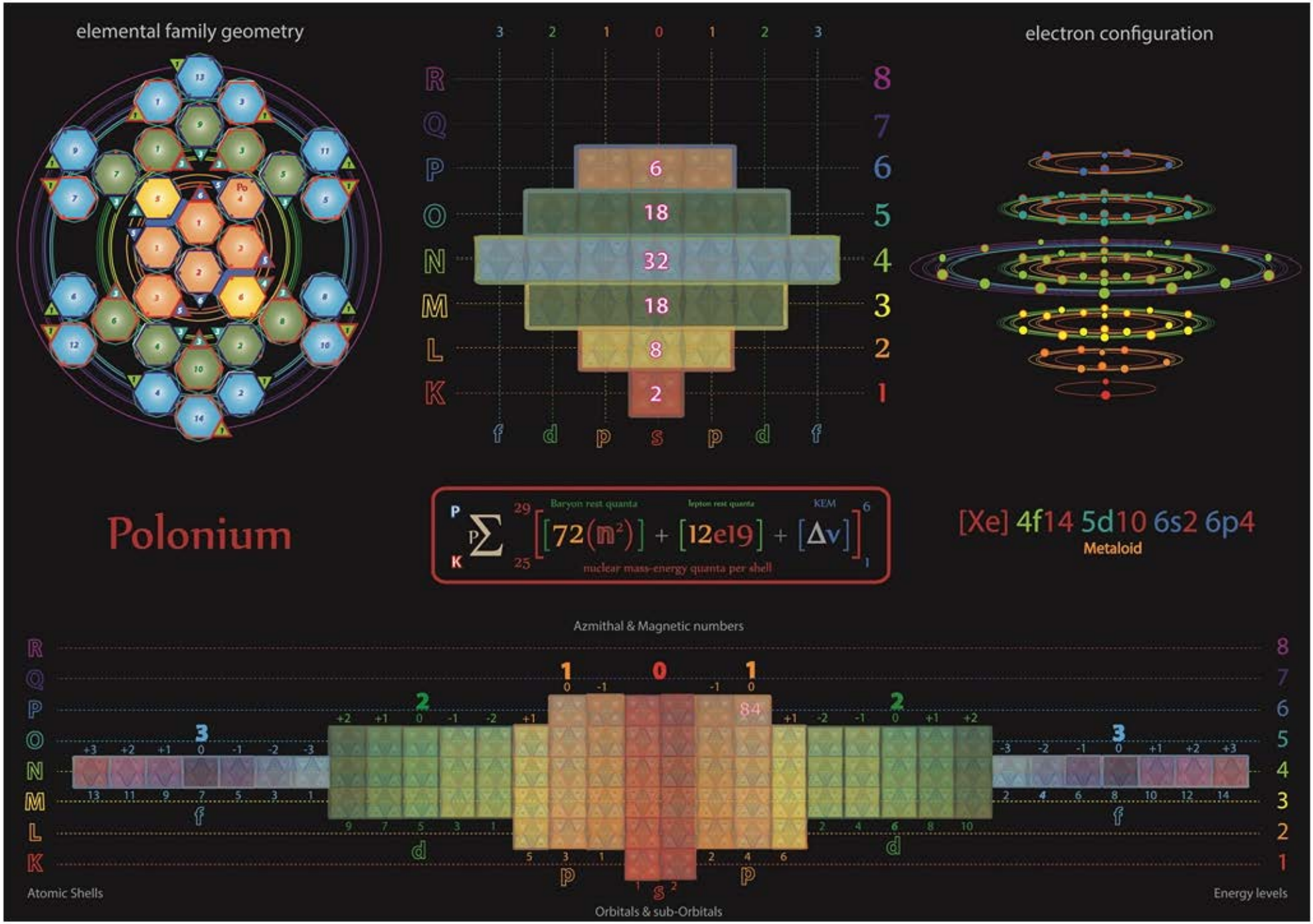

Tetryonics 53.84 - Polonium atomic config

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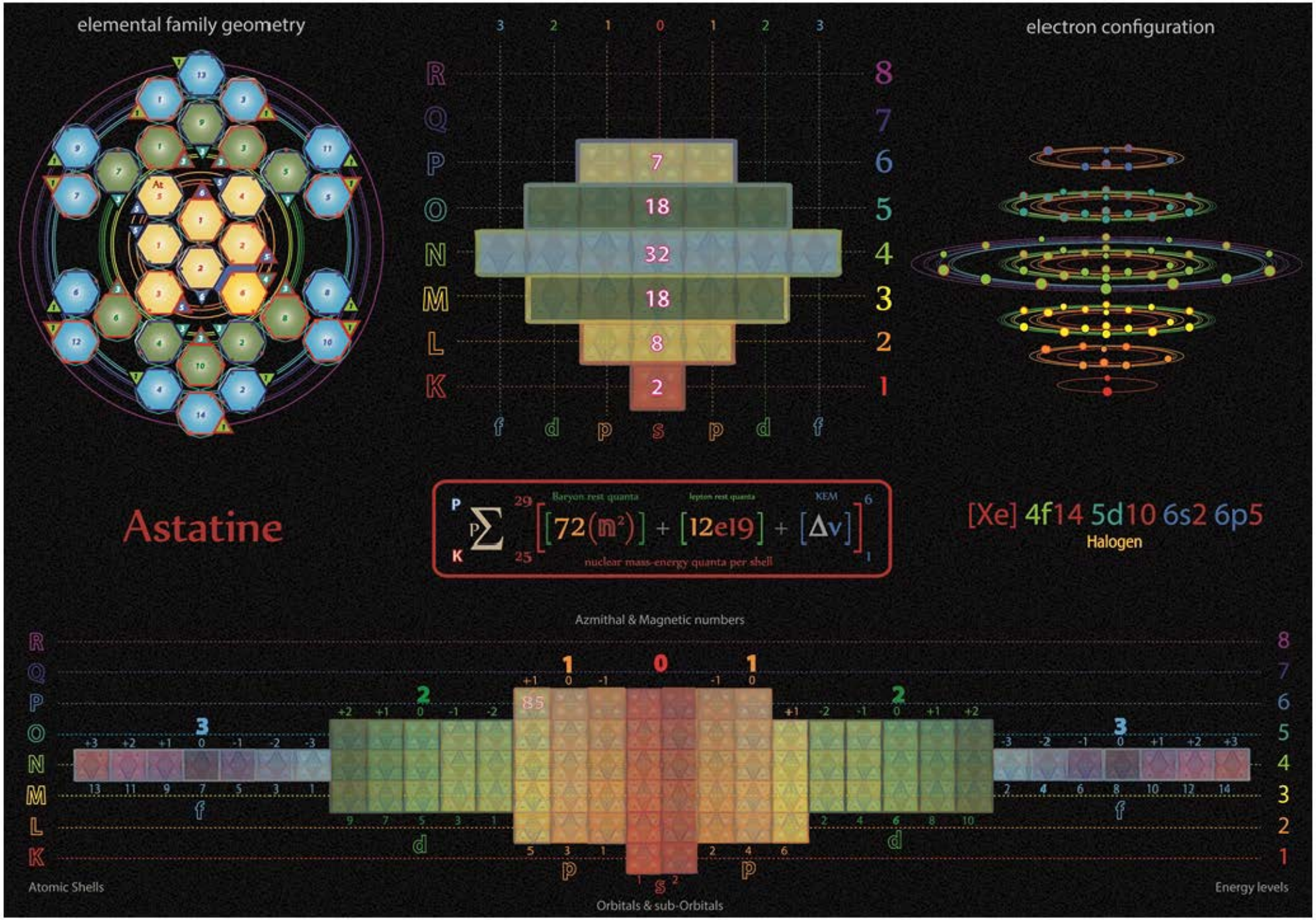

Tetryonics 53.85 - Astatine atomic config

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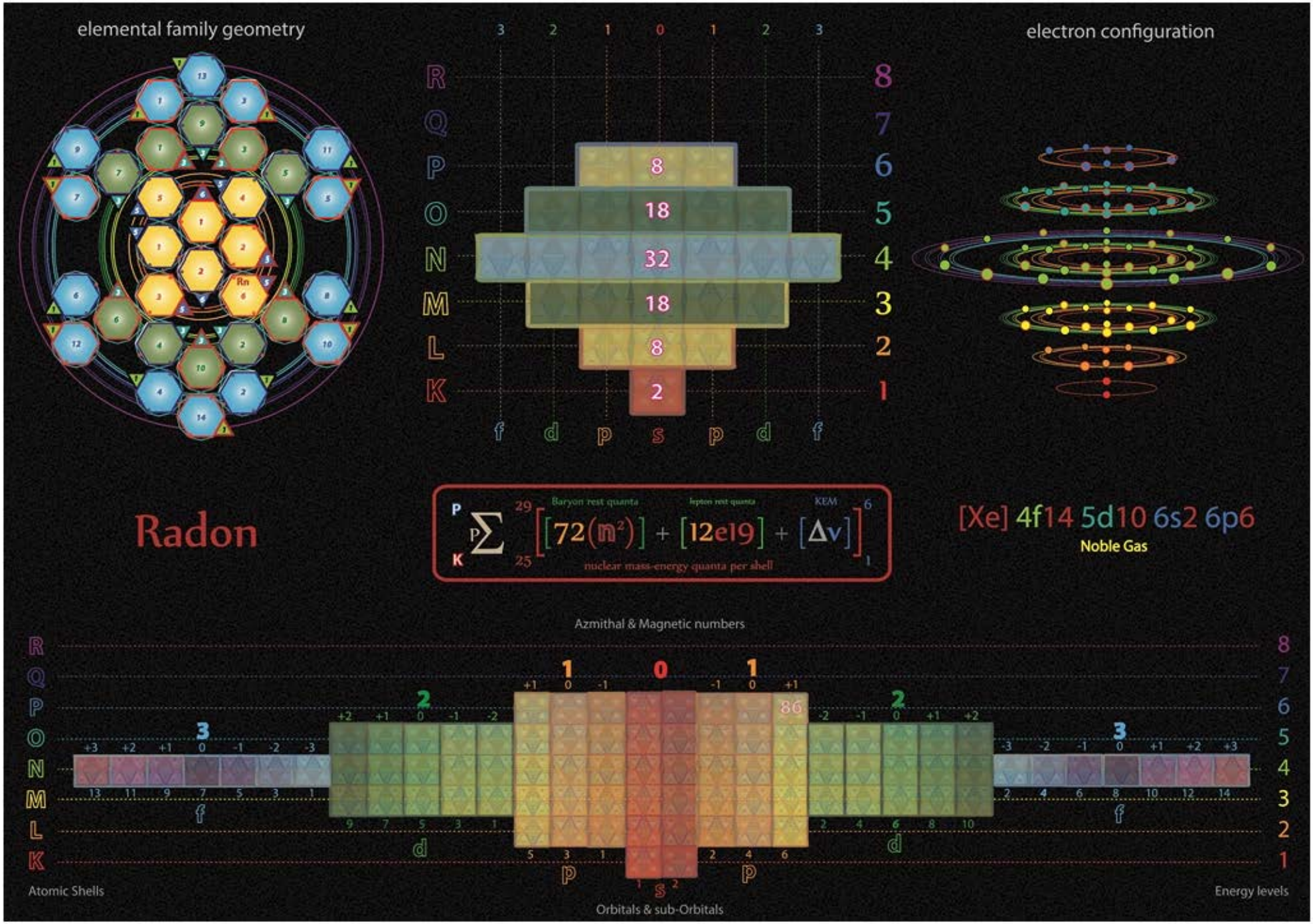

Tetryonics 53.86 - Radon atomic config

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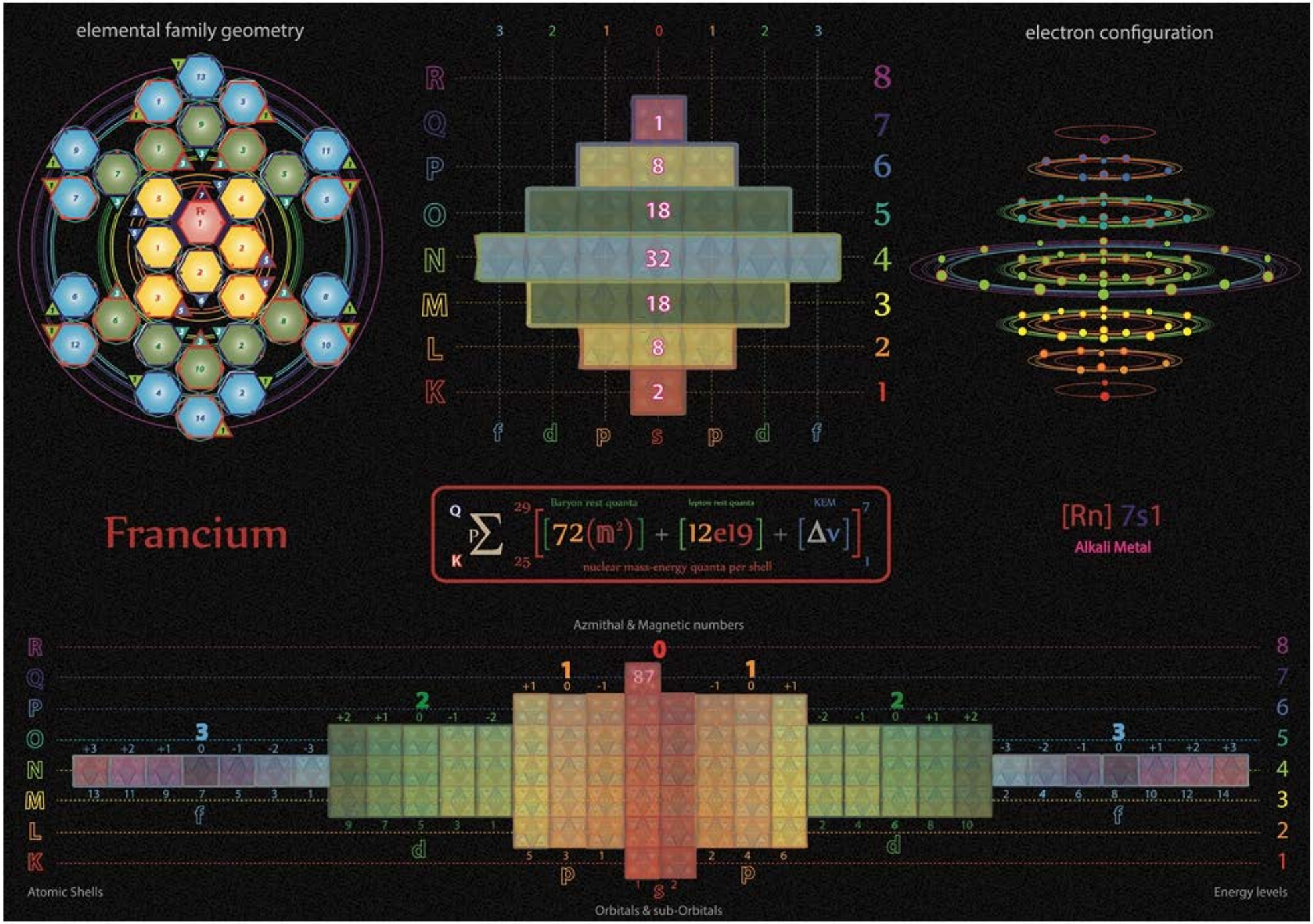

Tetryonics 53.87 - Francium atomic config

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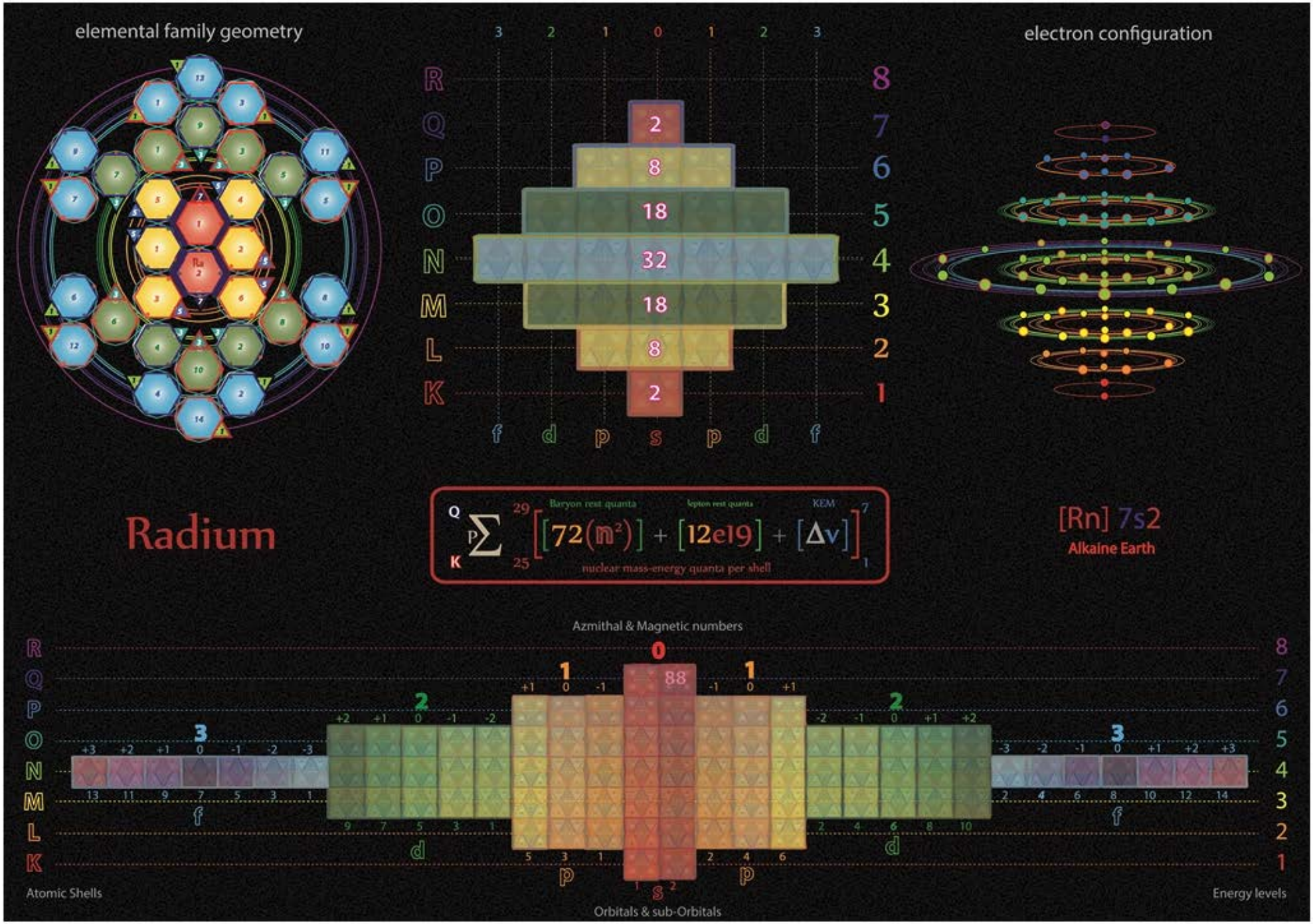

Tetryonics 53.88 - Radium atomic config

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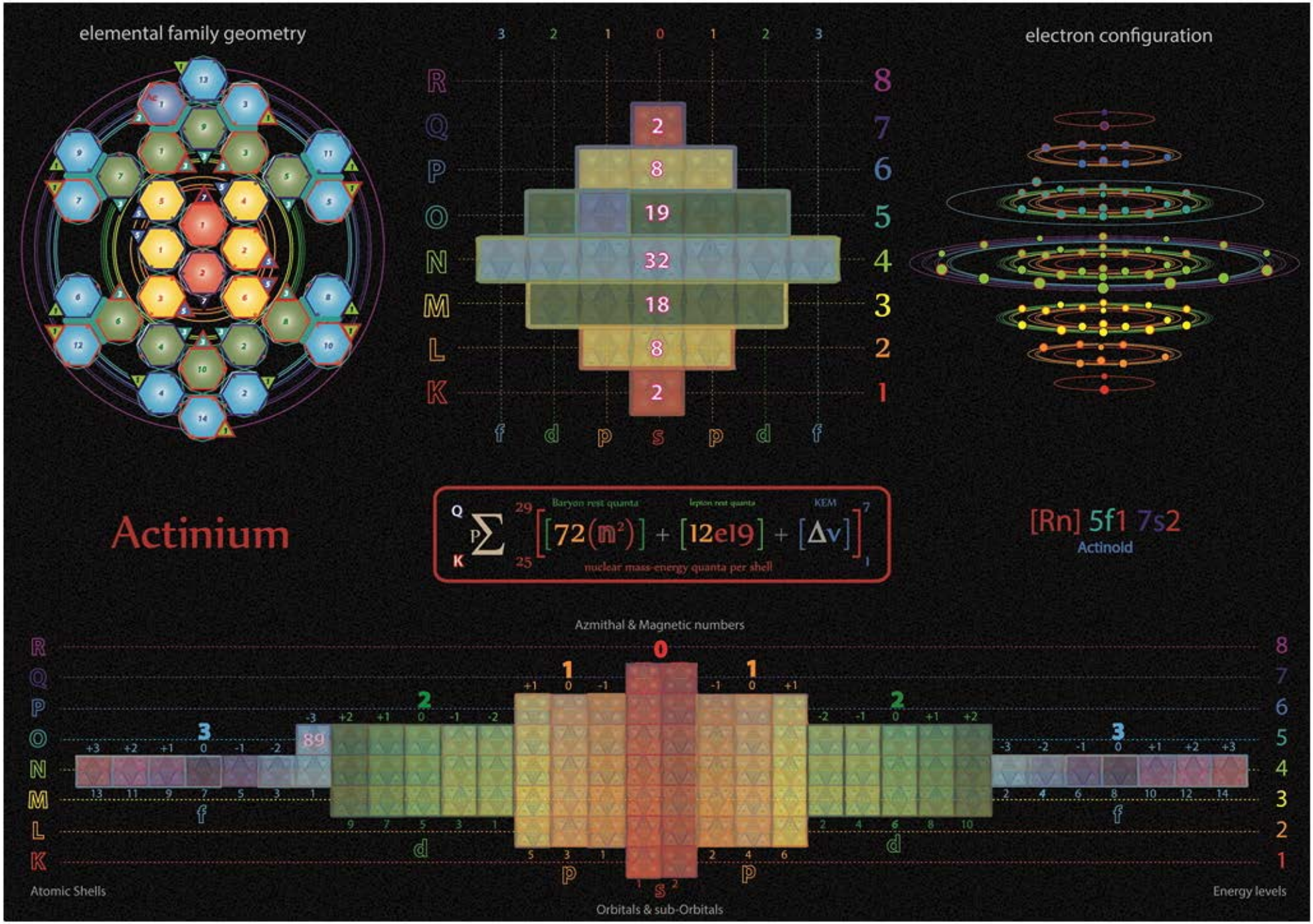

Tetryonics 53.89 - Actinium atomic config

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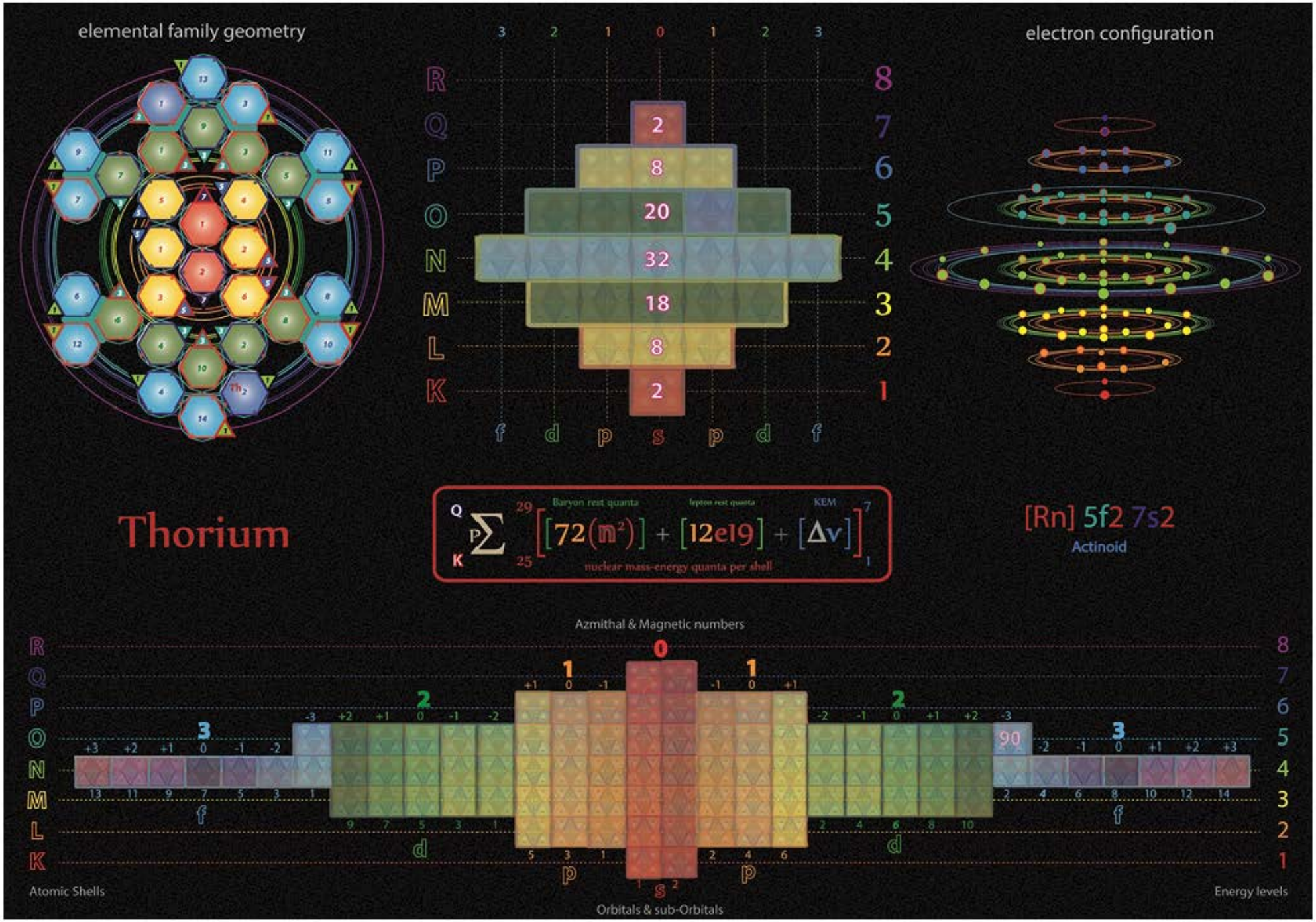

Tetryonics 53.90 - Thorium atomic config

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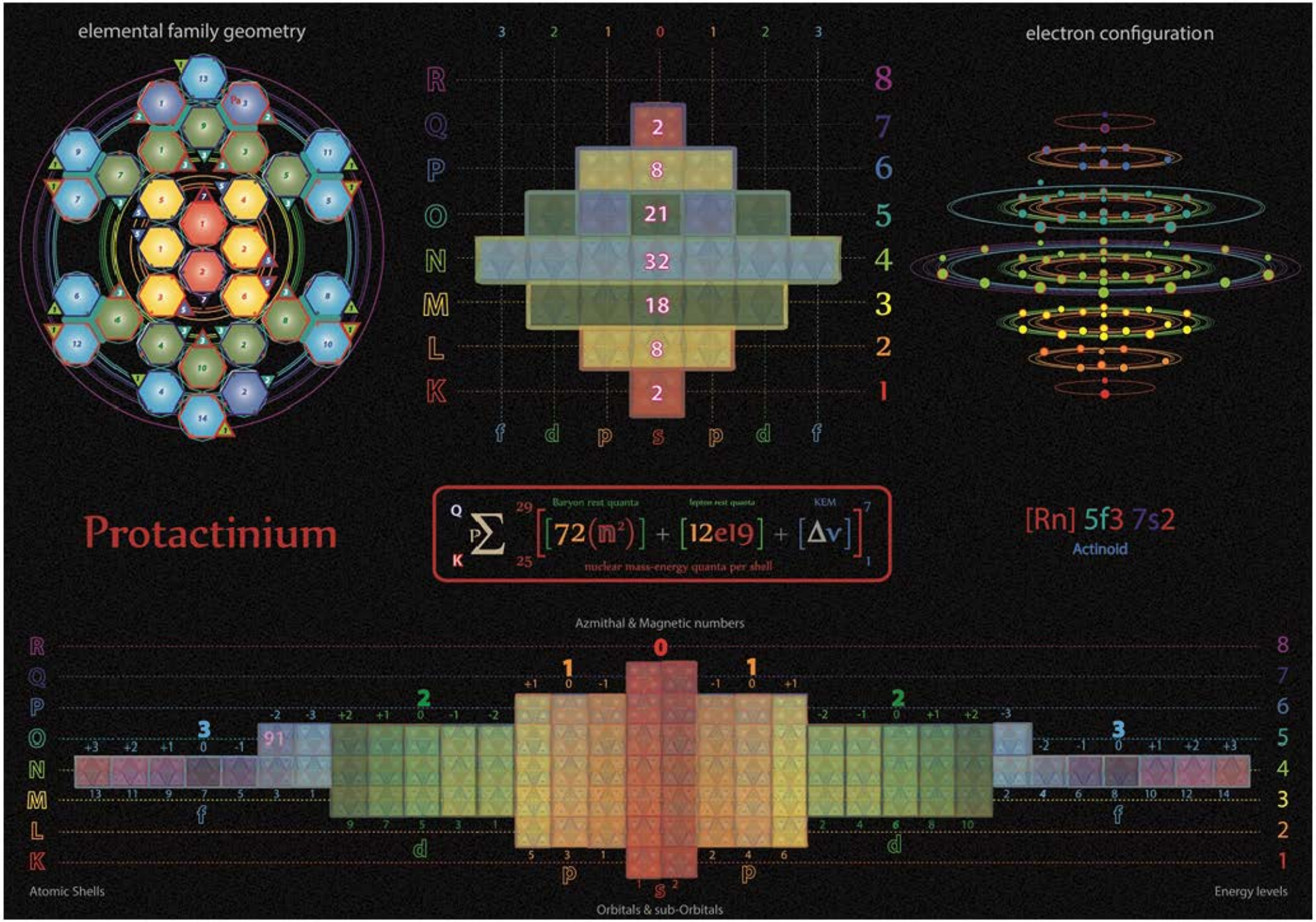

Tetryonics 53.91 - Protactinium atomic config

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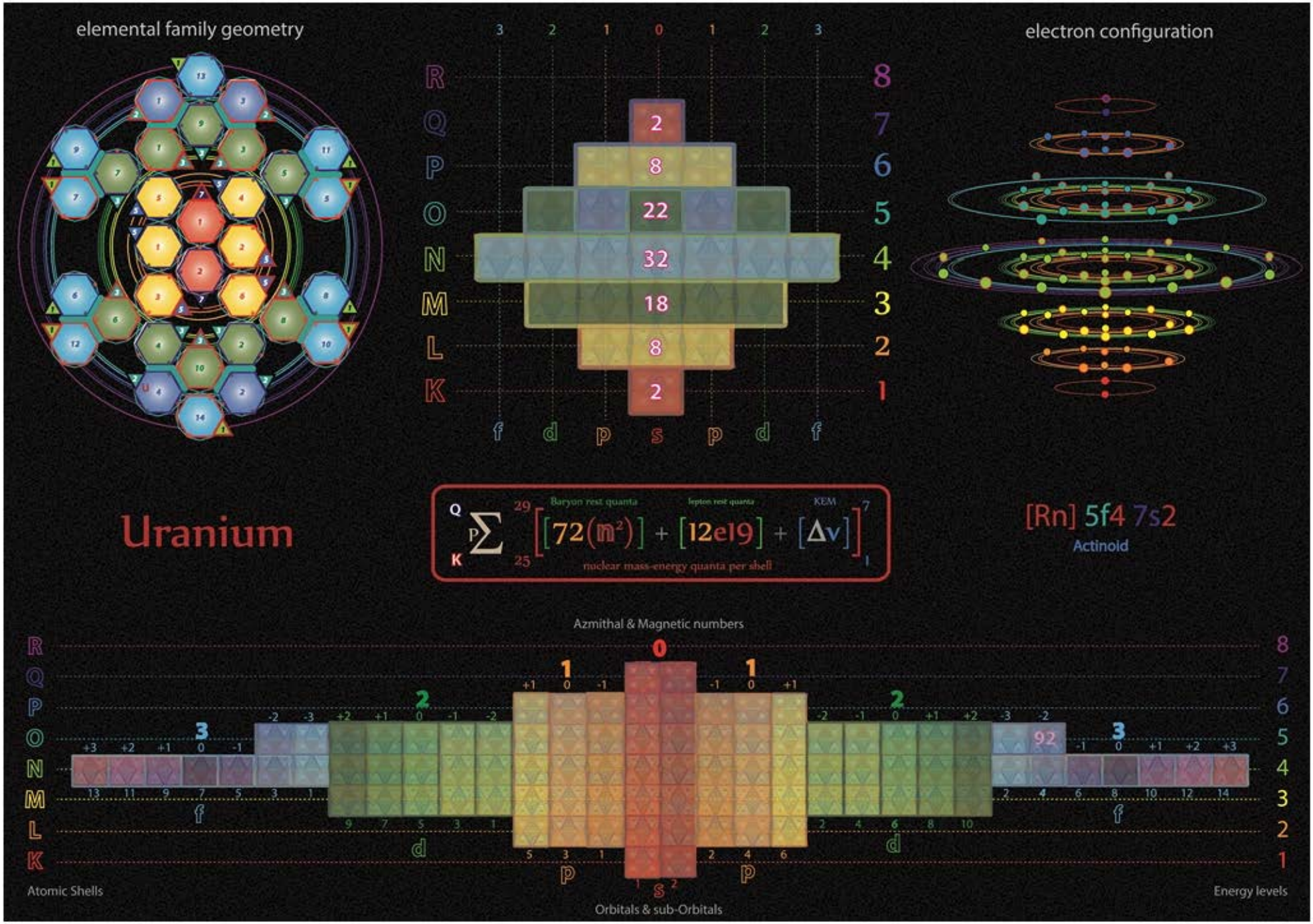

Tetryonics 53.92 - Uranium atomic config

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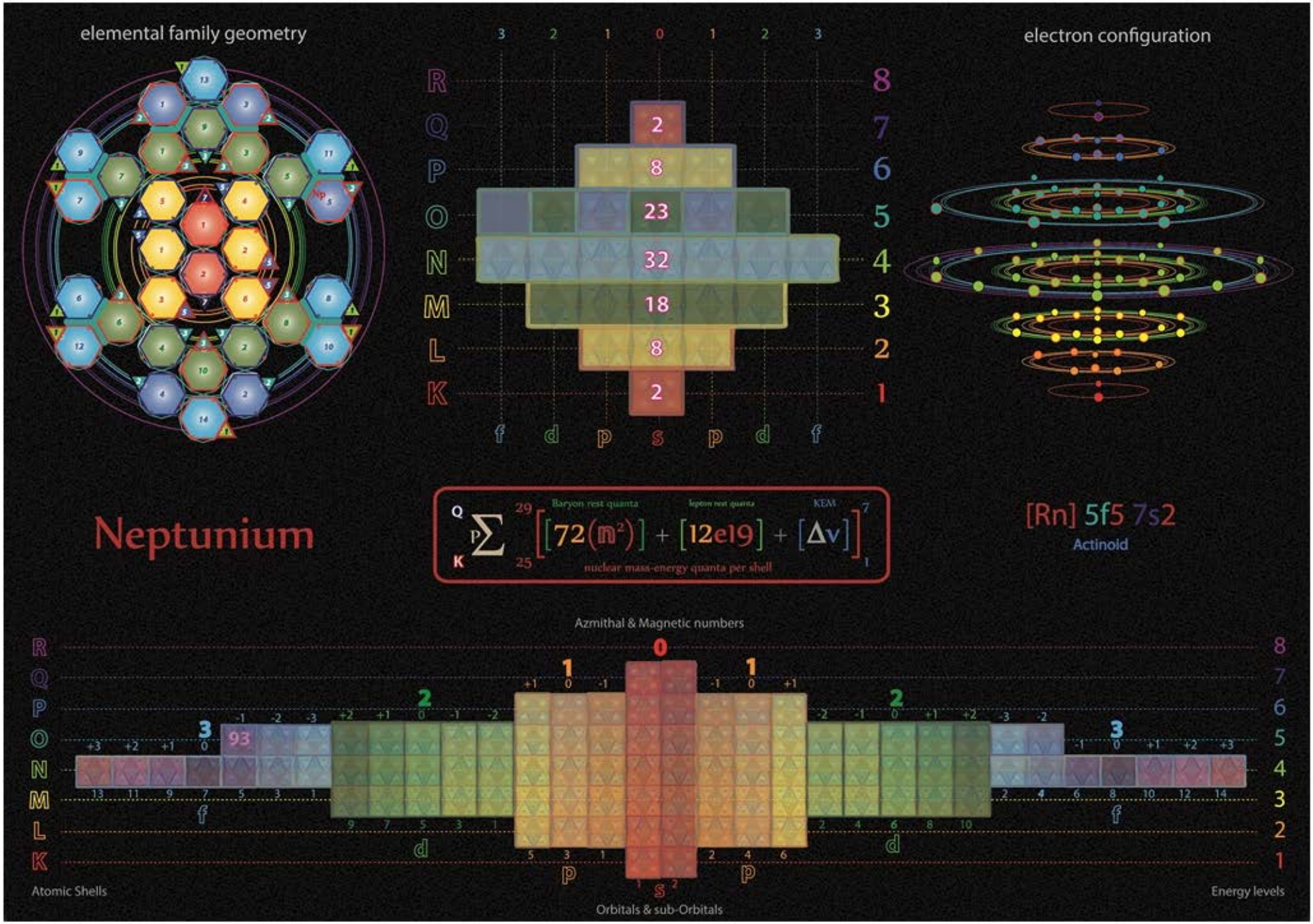

Tetryonics 53.93 - Neptunium atomic config

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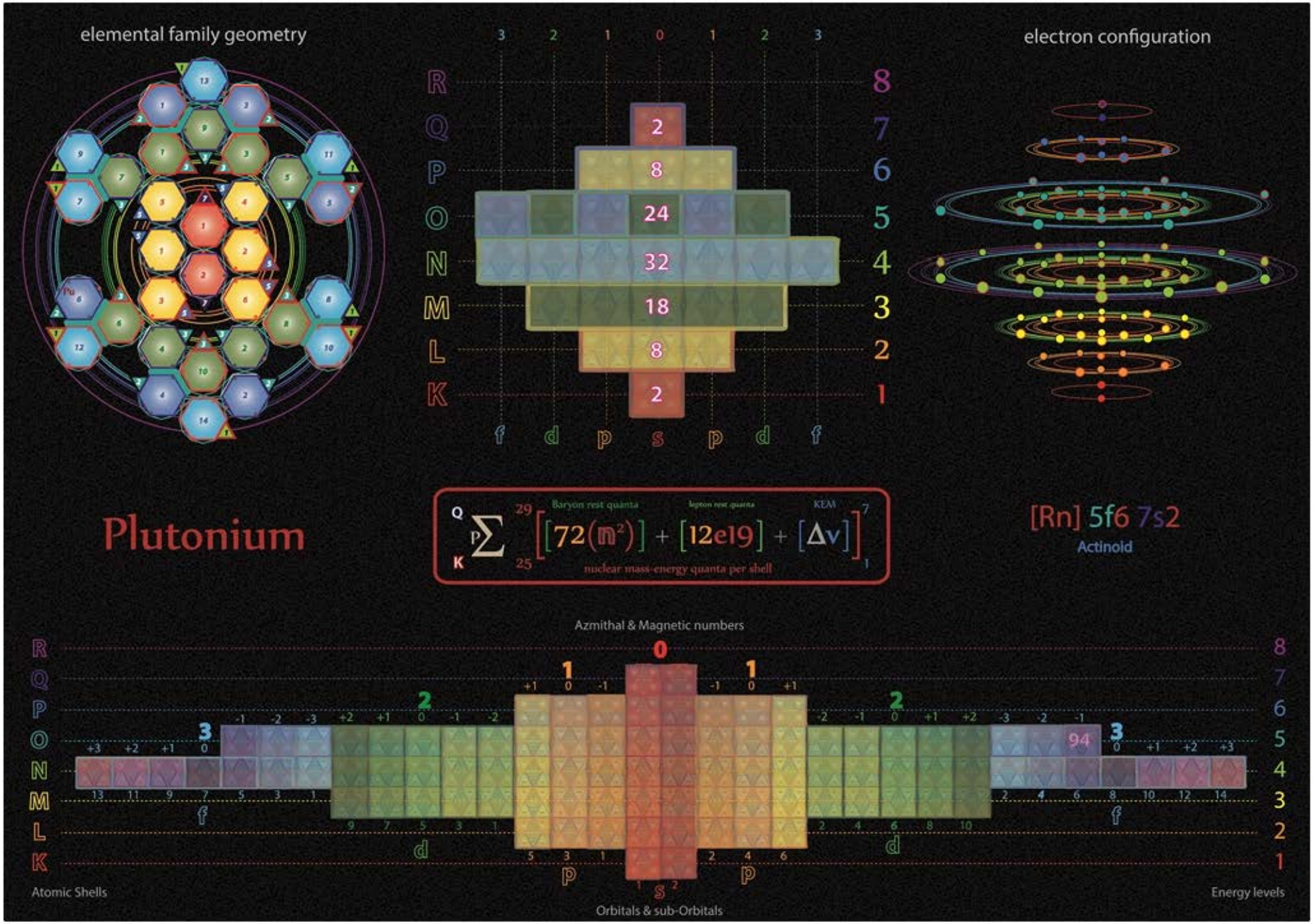

Tetryonics 53.94 - Plutonium atomic config

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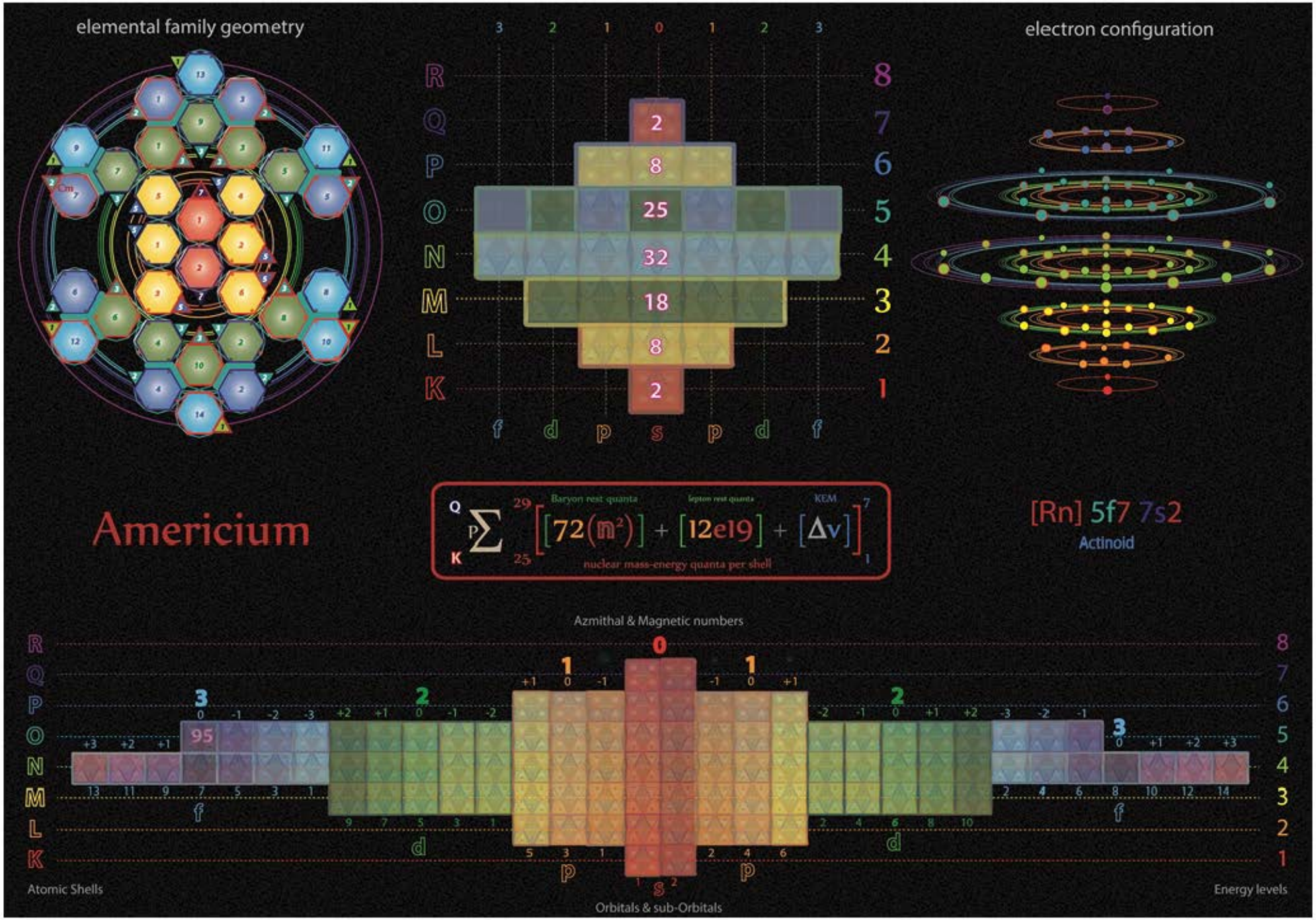

Tetryonics 53.95 - Americium atomic config

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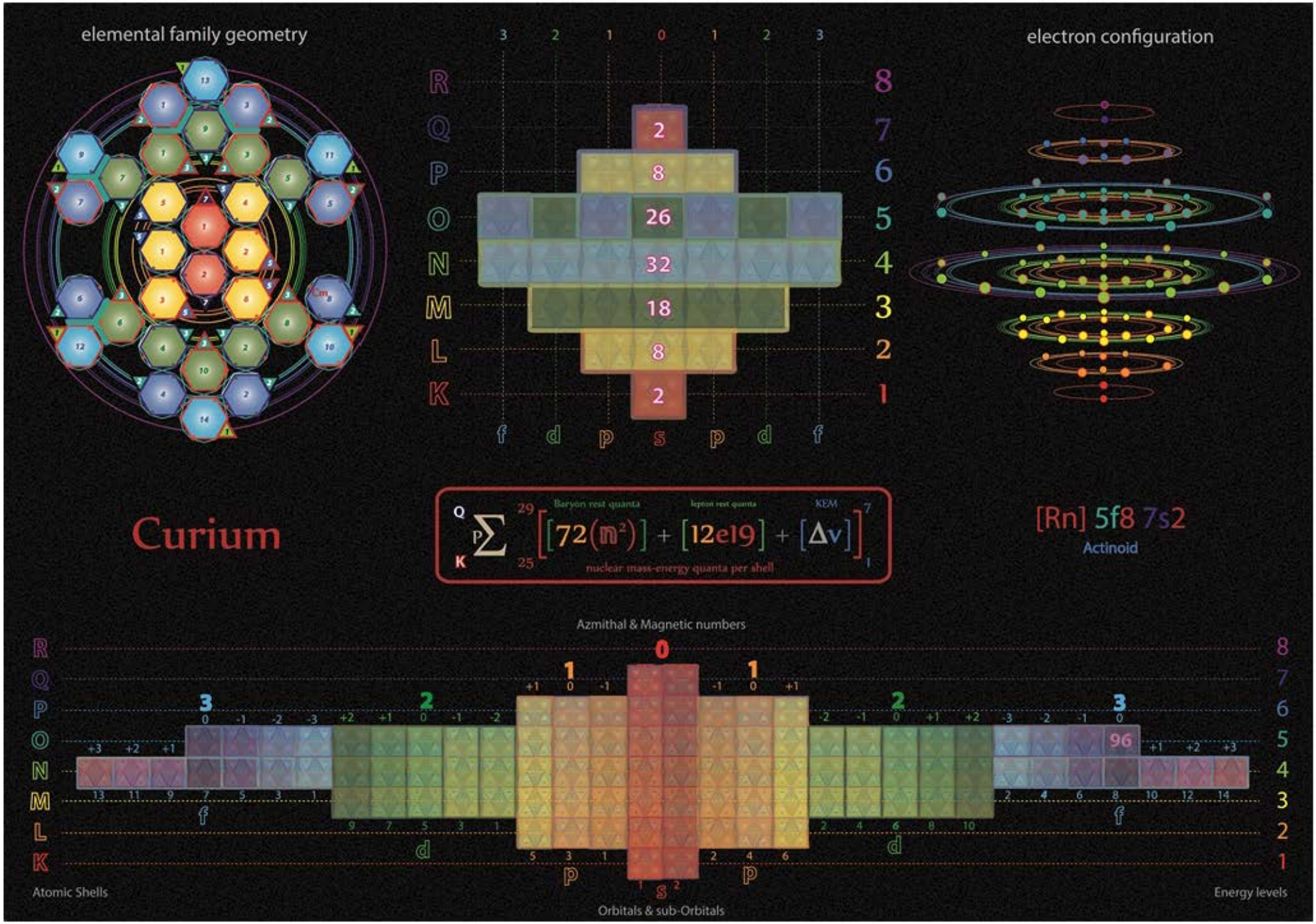

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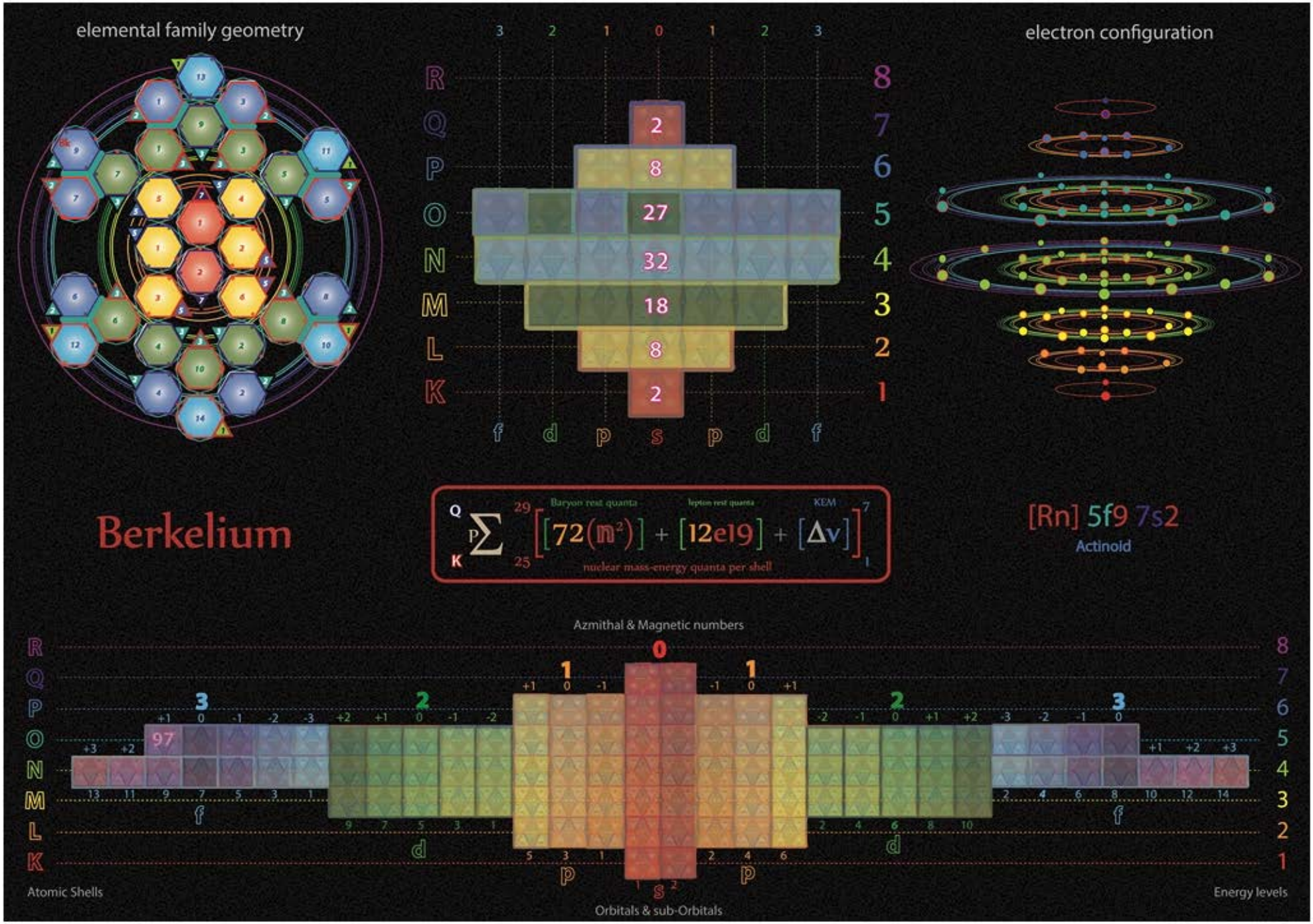

Tetryonics 53.97 - Berkelium atomic config

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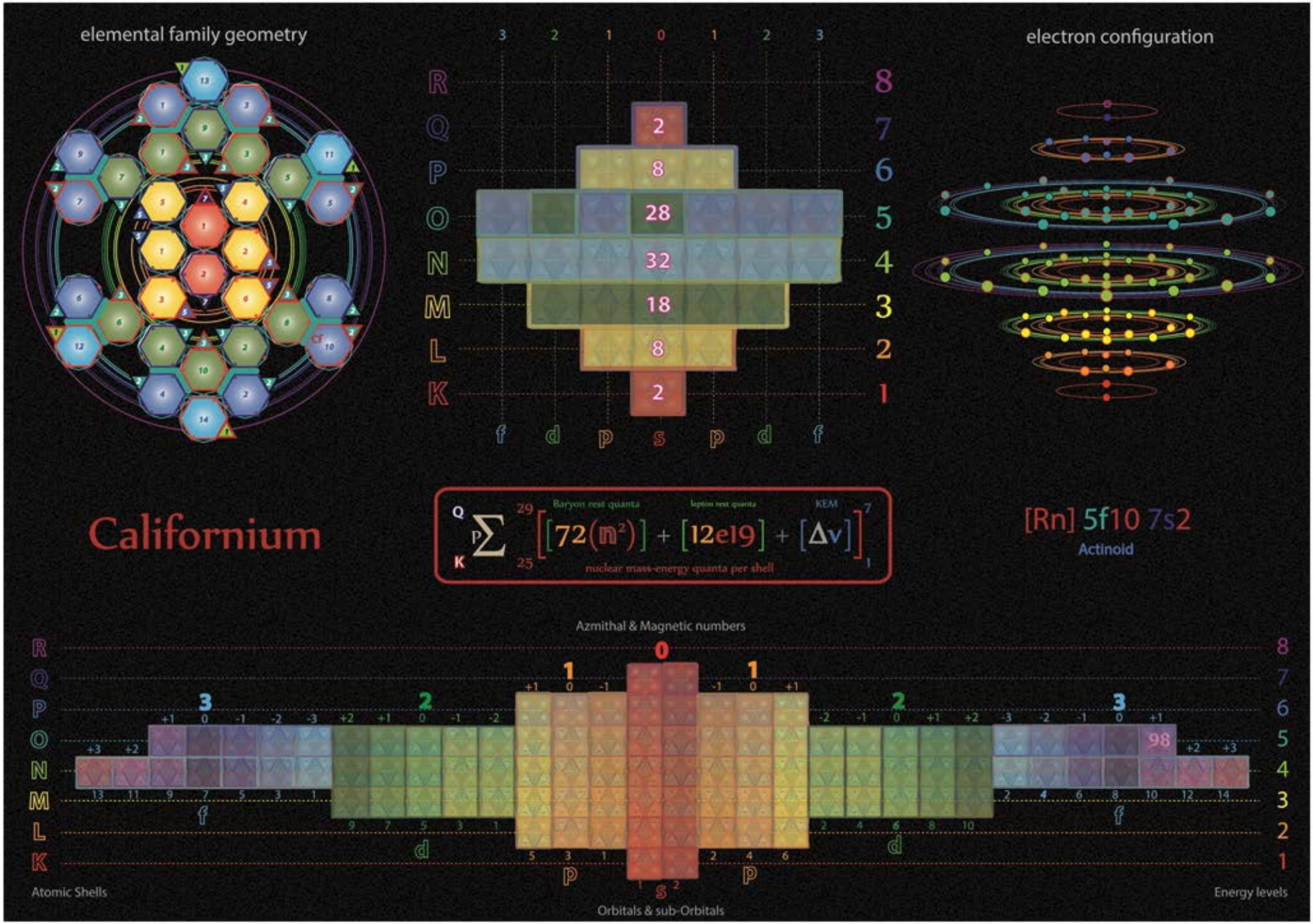

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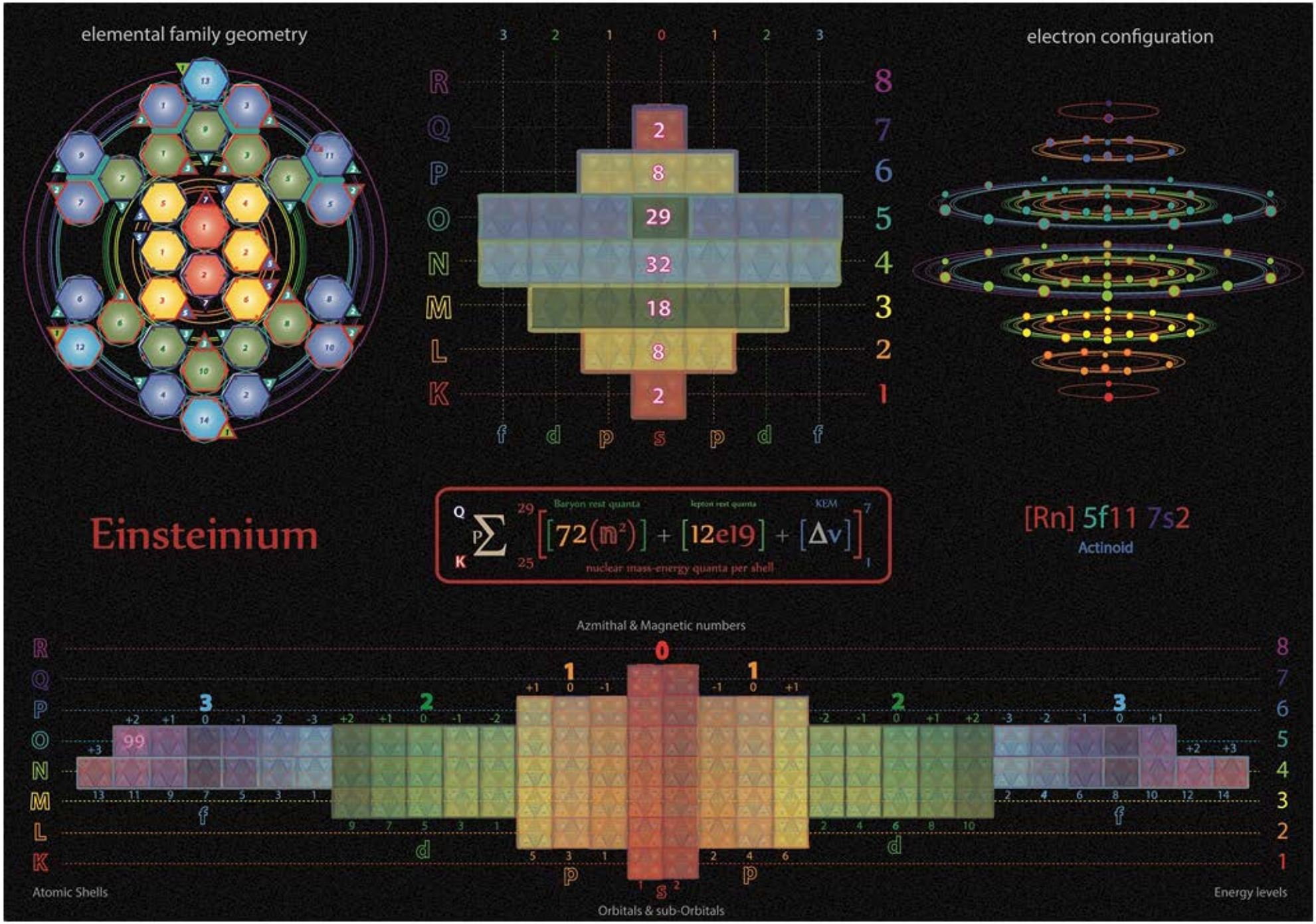

Tetryonics 53.99 - Einsteinium atomic config

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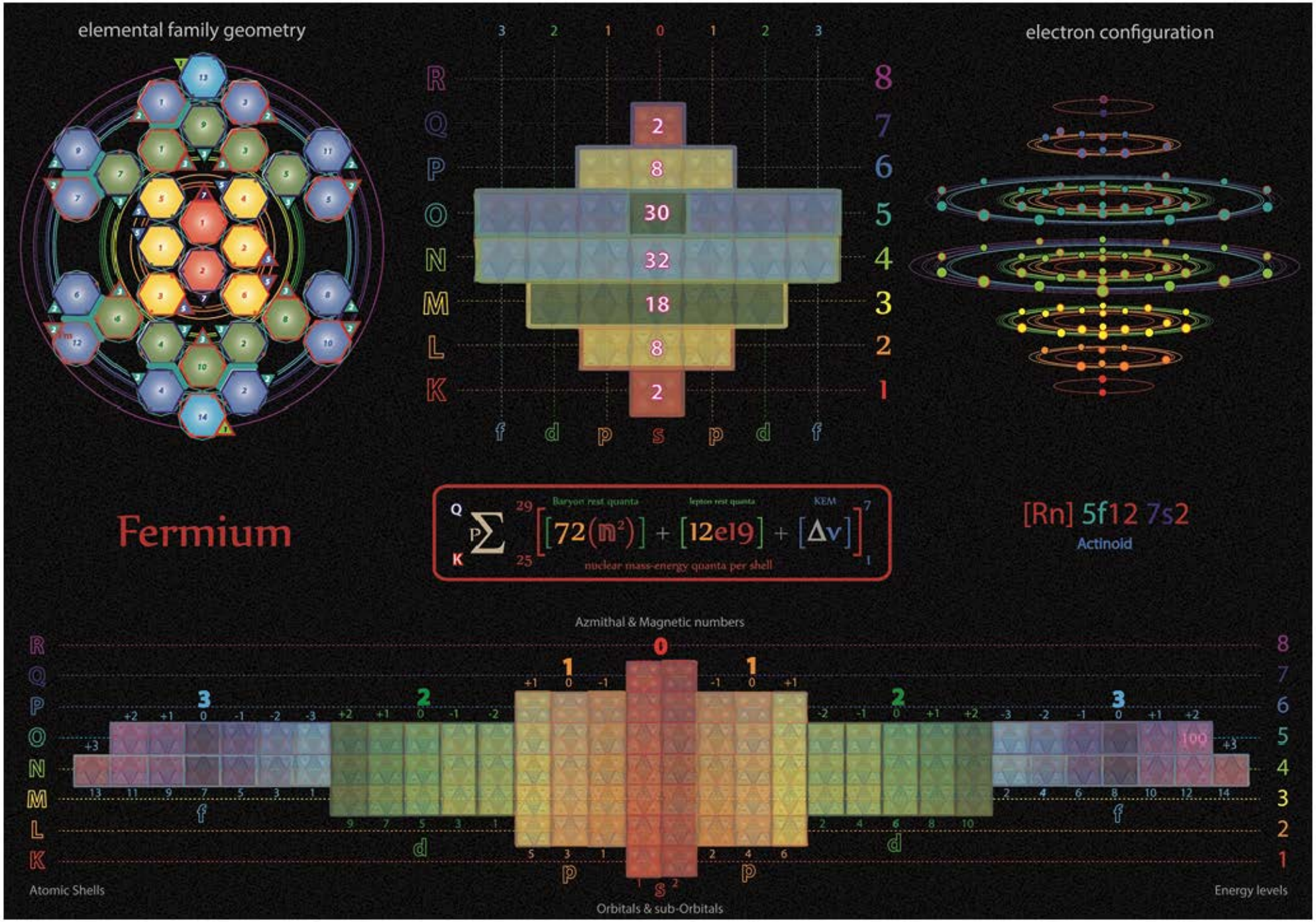

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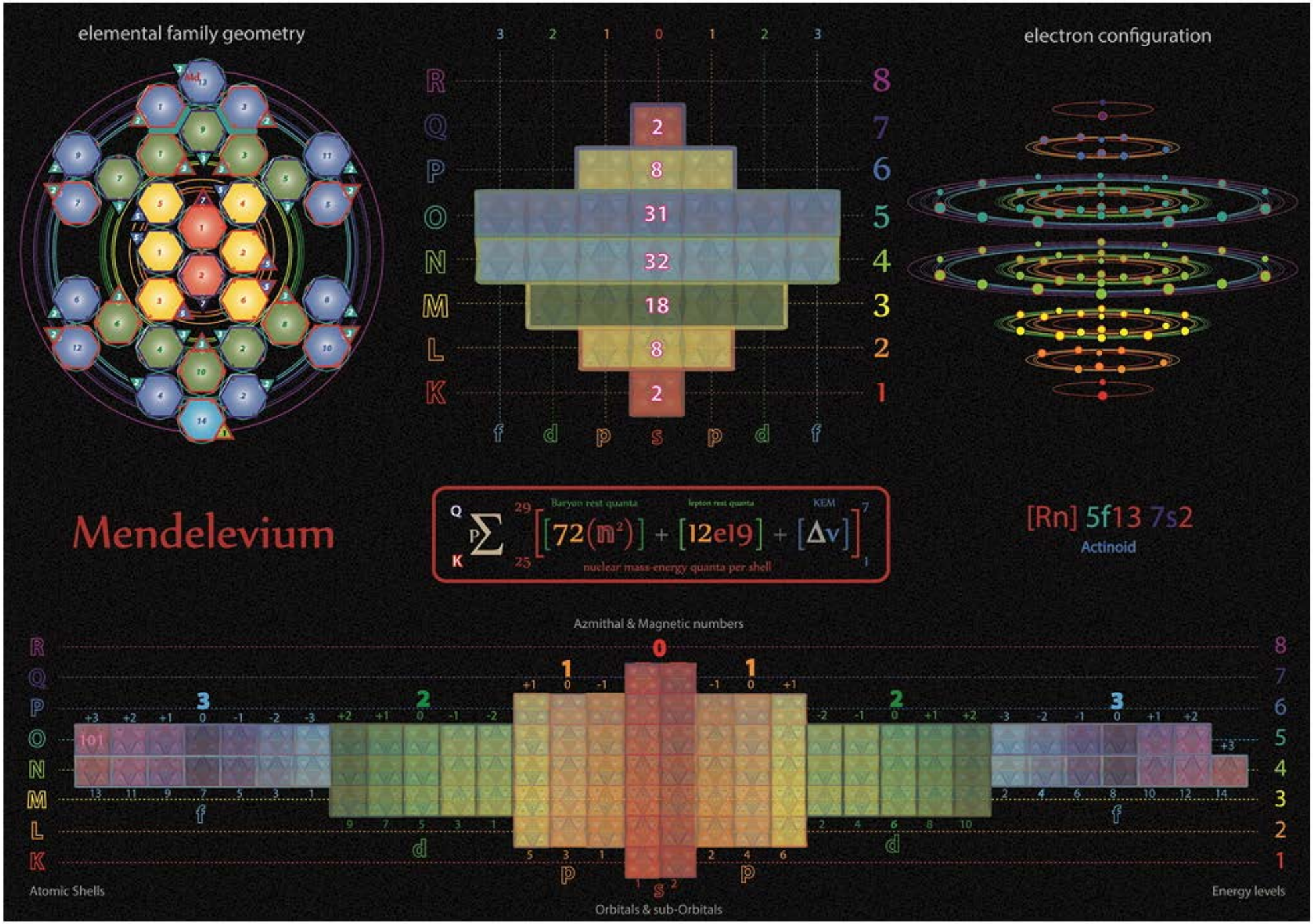

Tetryonics 53.101 - Mendelevium atomic config

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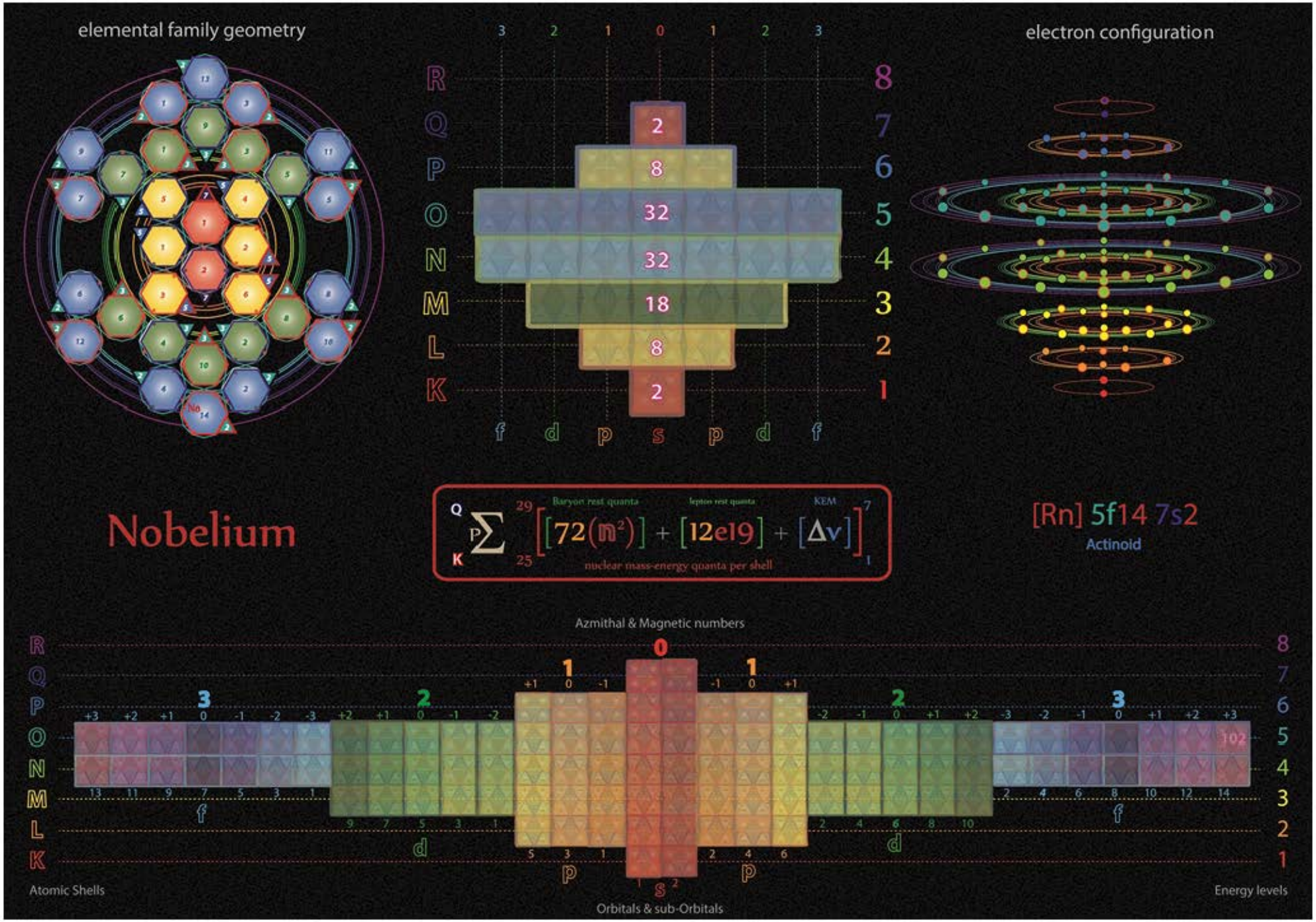

Tetryonics 53.102 - Nobelium atomic config

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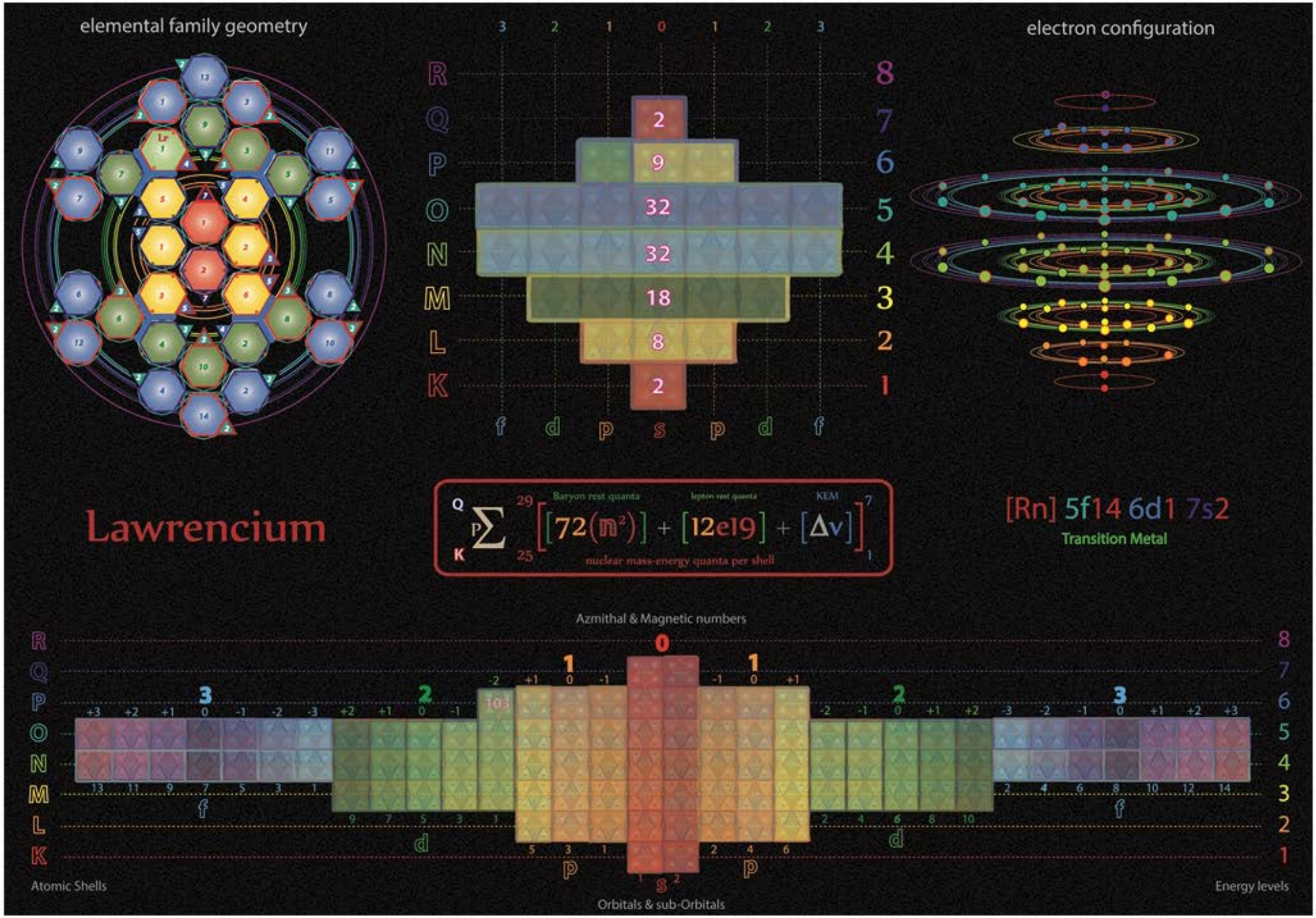

Tetryonics 53.103 - Lawrencium atomic config

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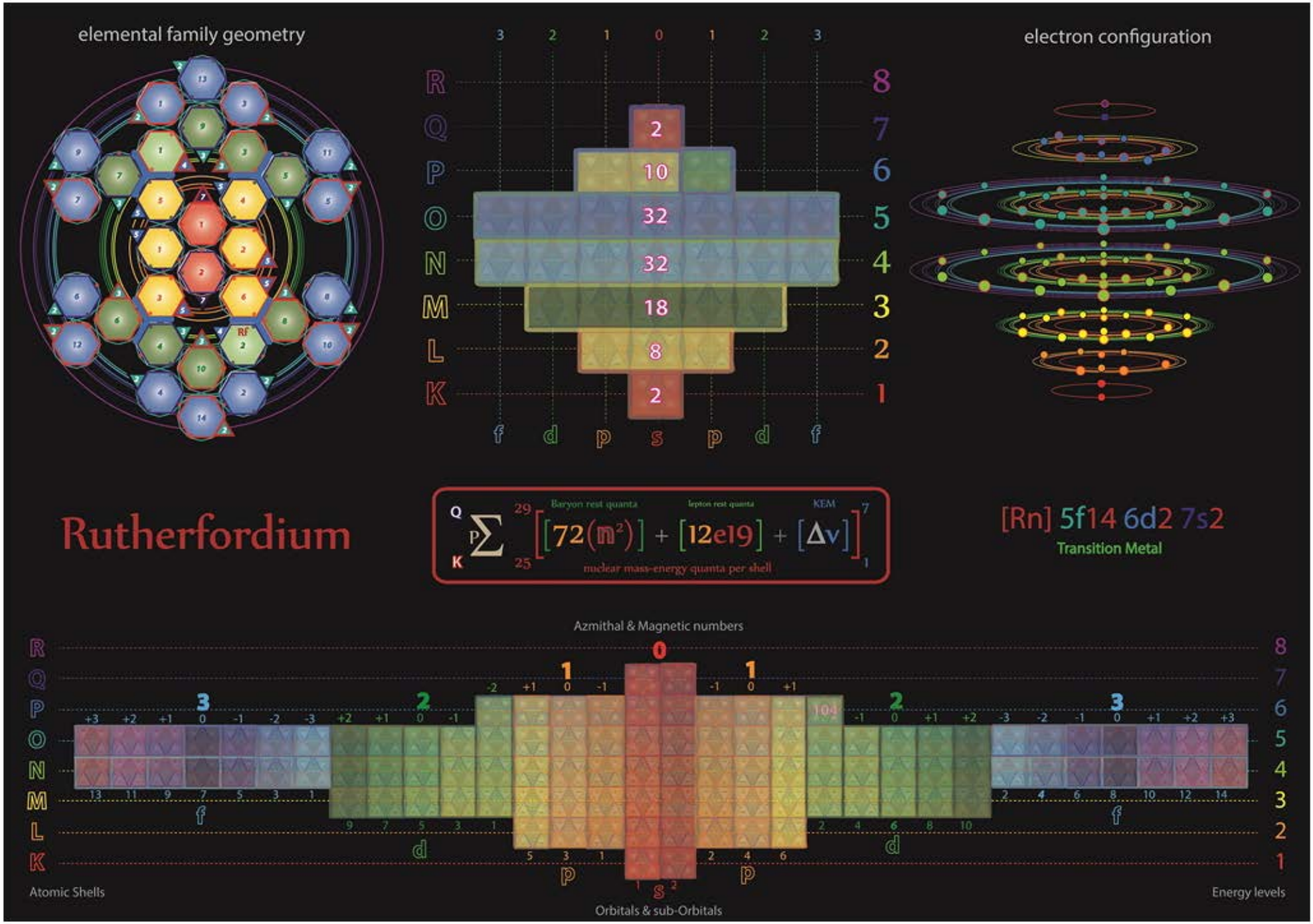

Tetryonics 53.104 - Rutherfordium atomic config

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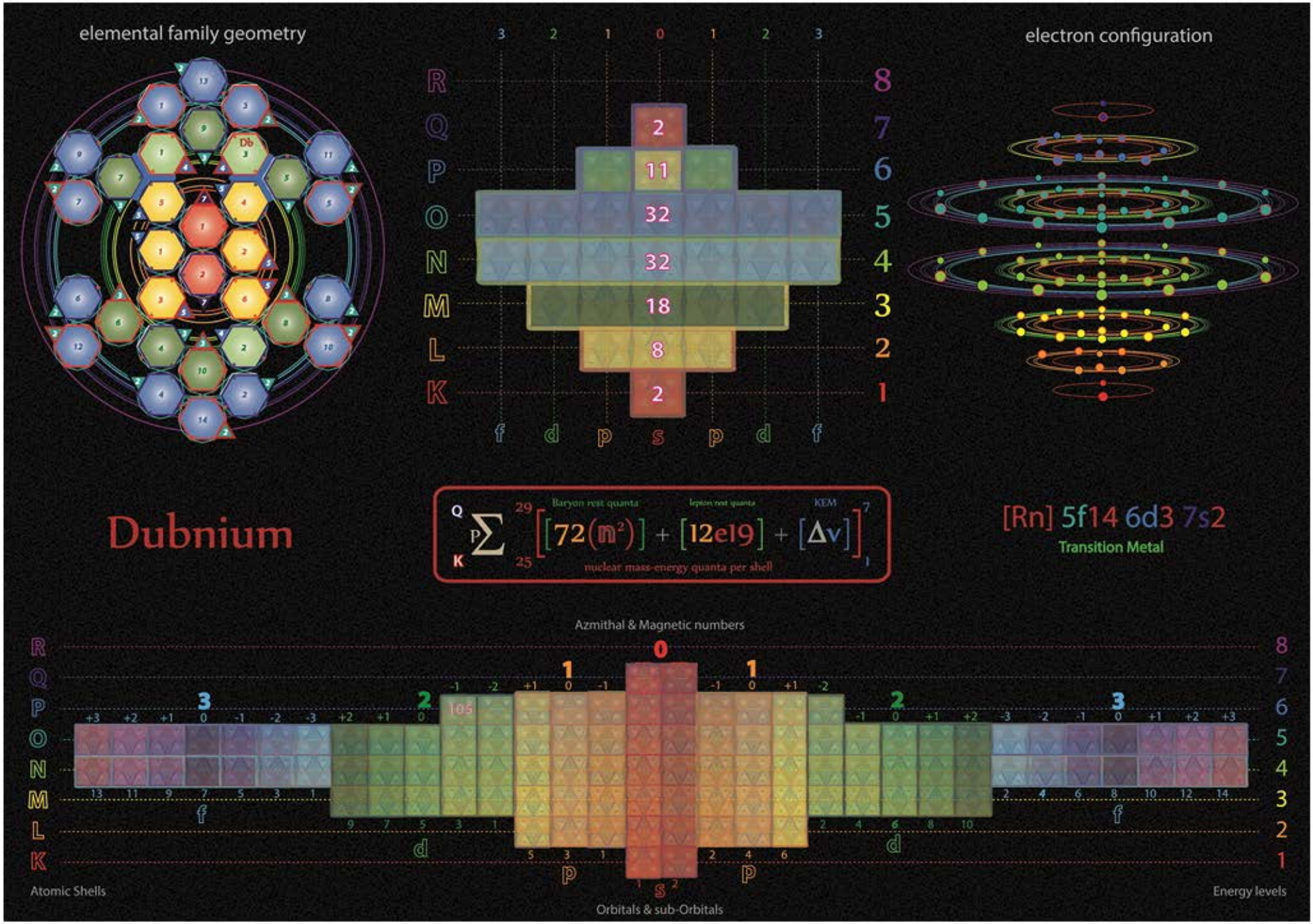

Tetryonics 53.105 - Dubnium atomic config

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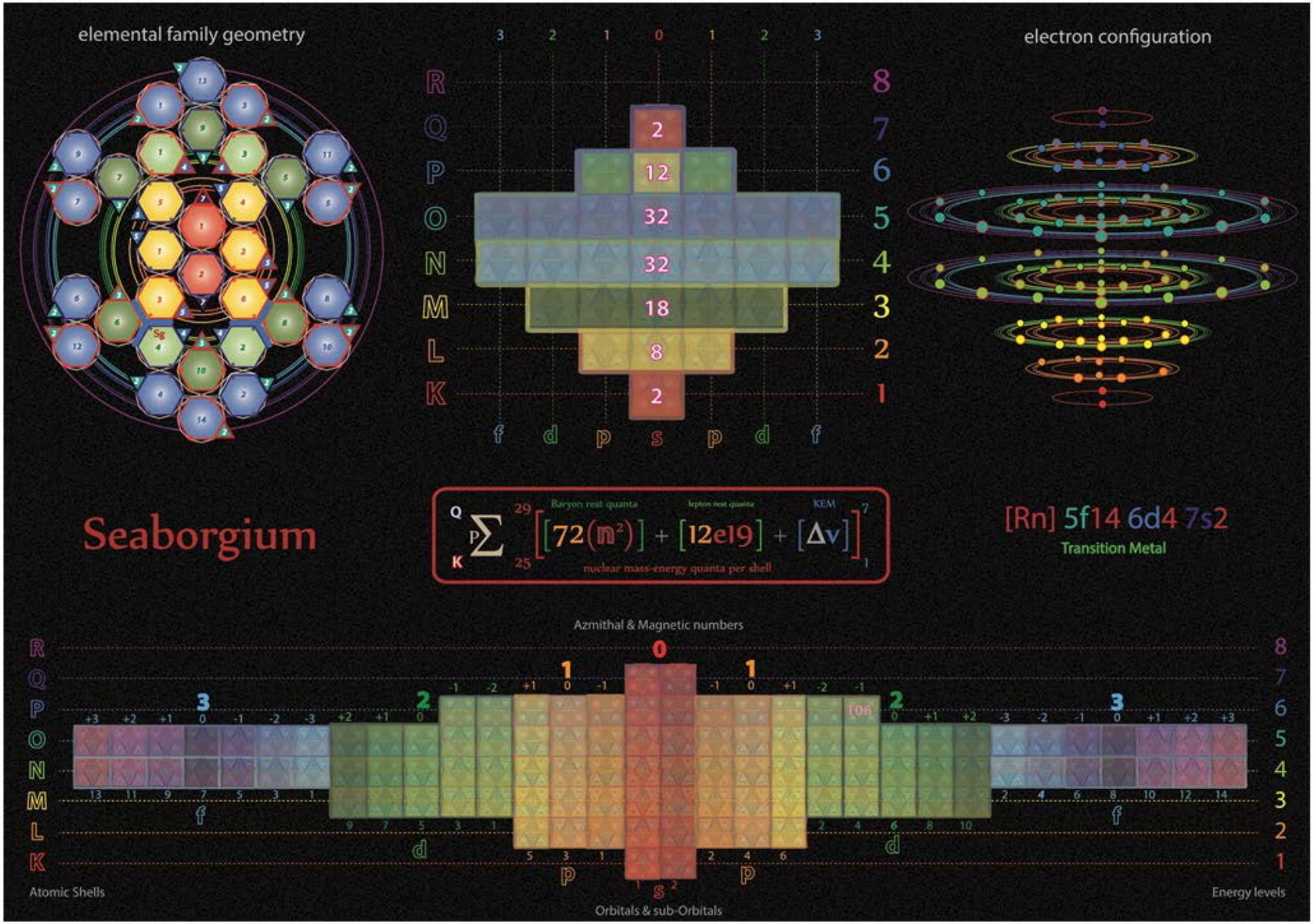

Tetryonics 53.106 - Seaborgium atomic config

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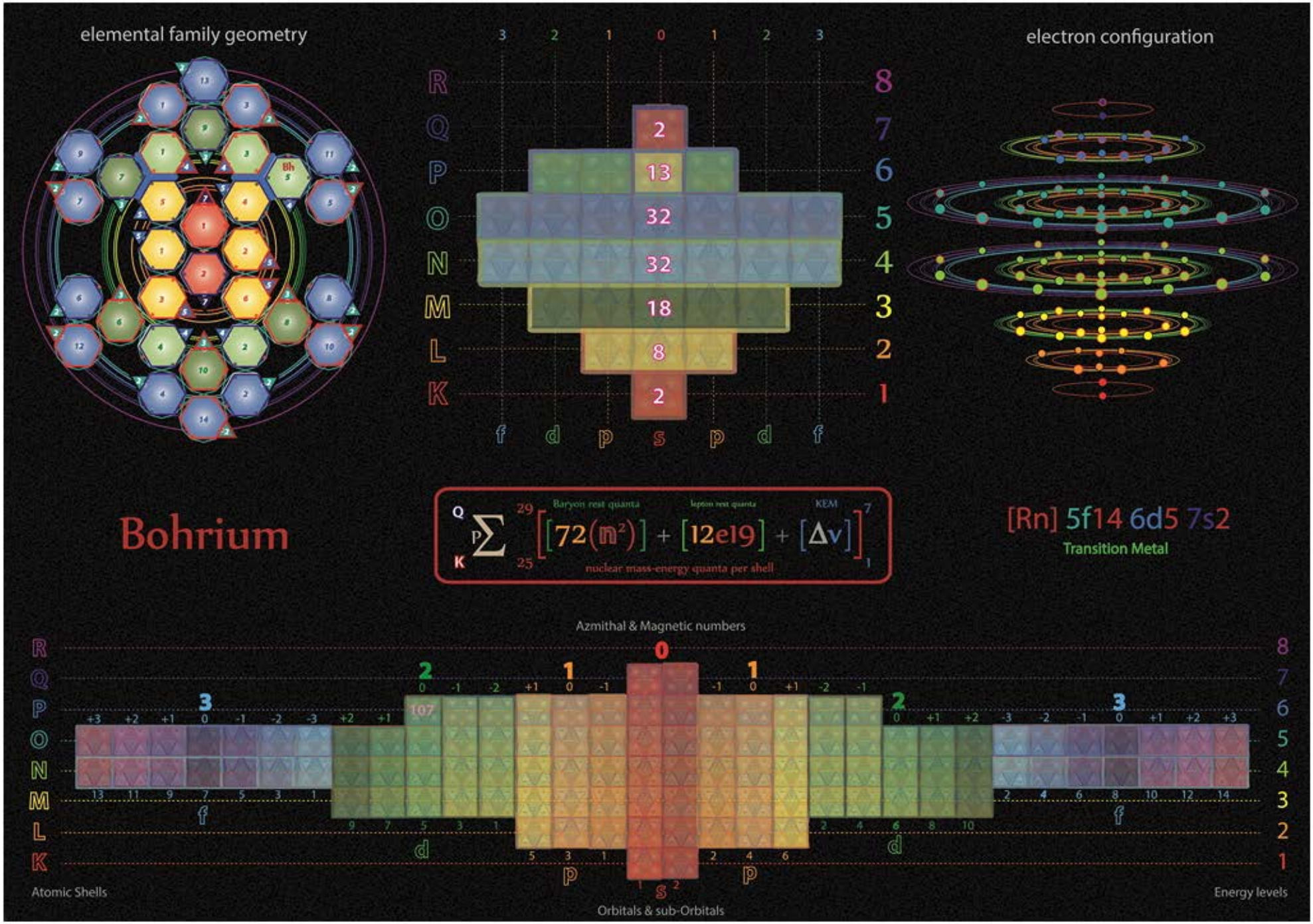

Tetryonics 53.107 - Bohrium atomic config

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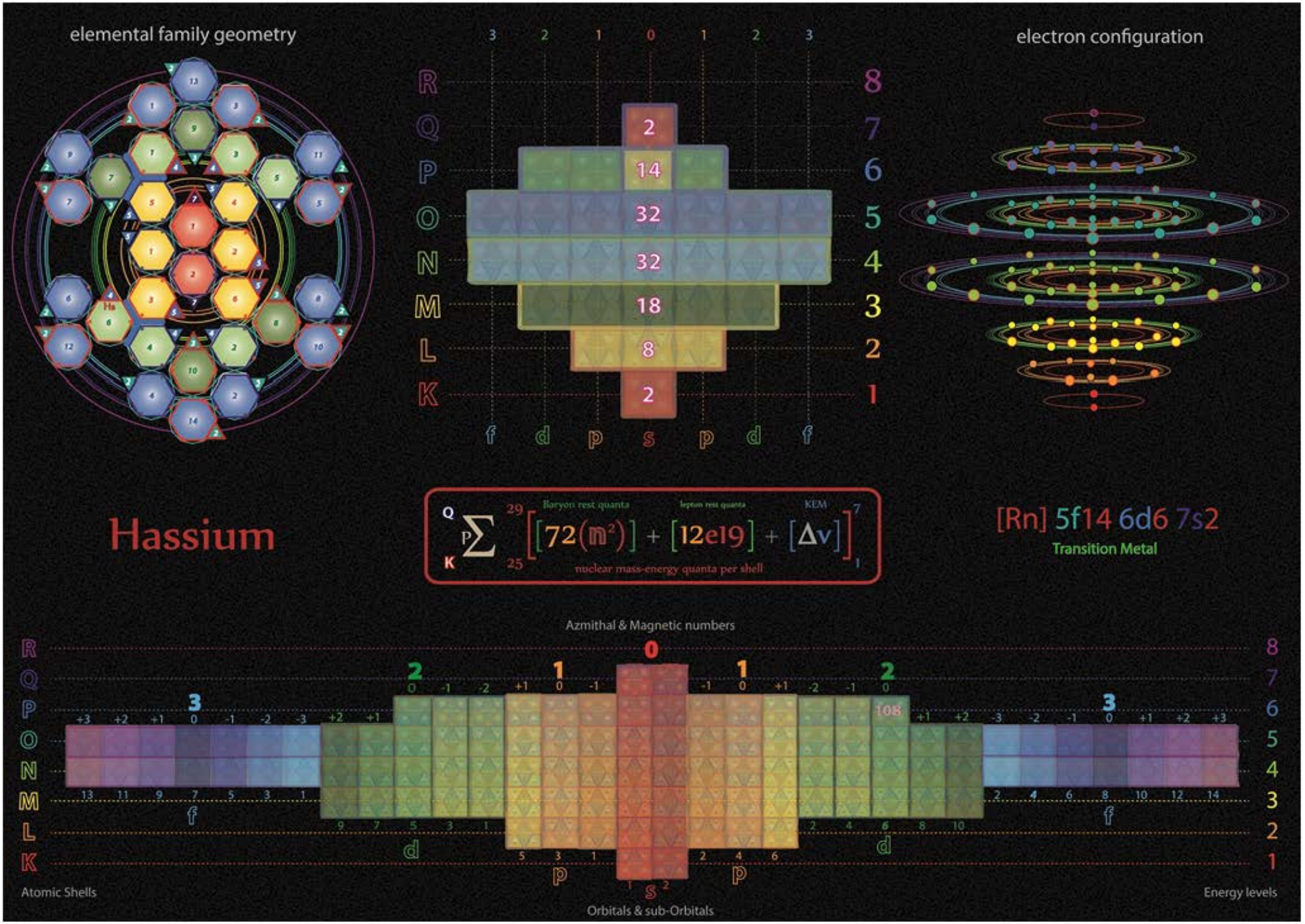

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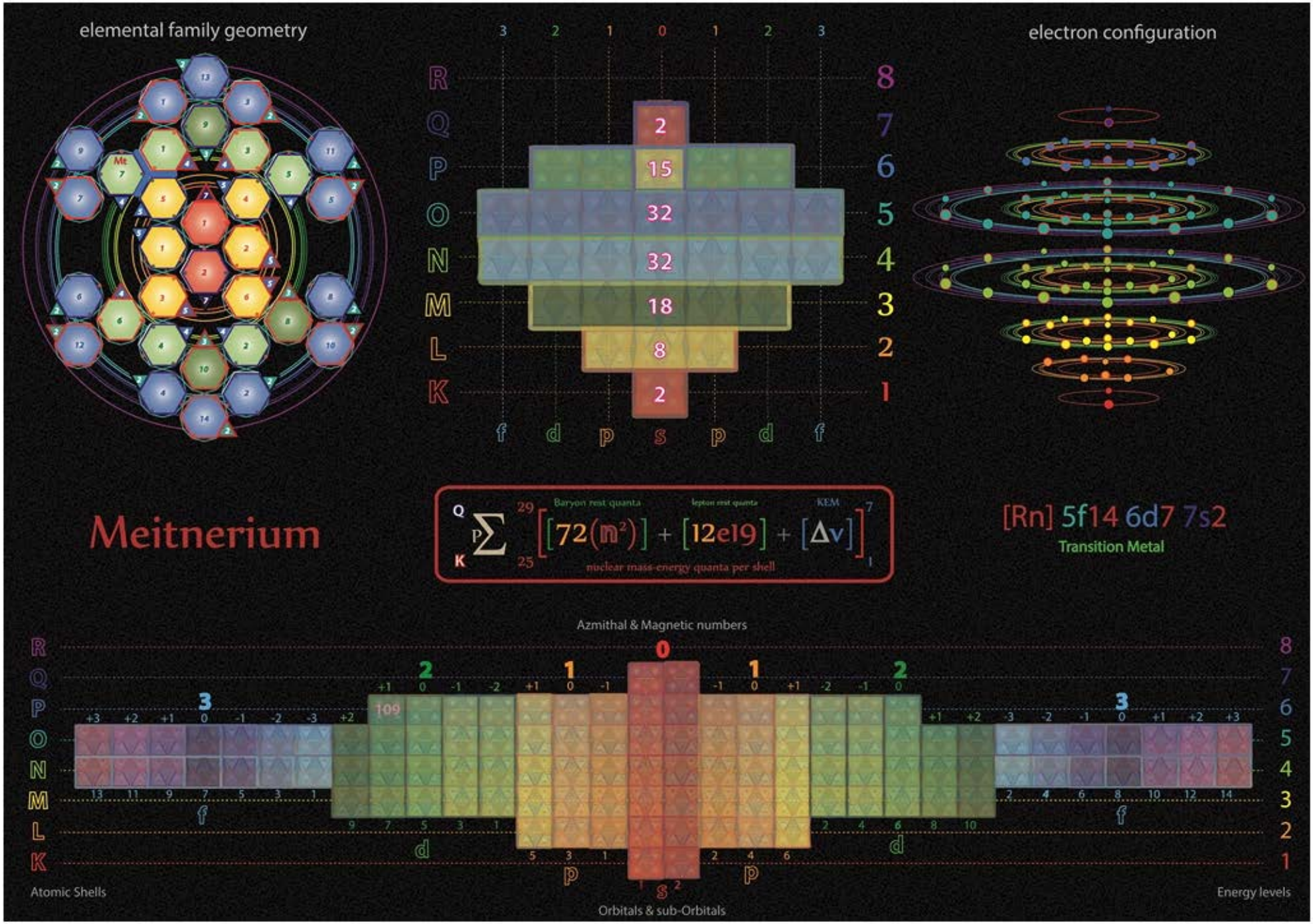

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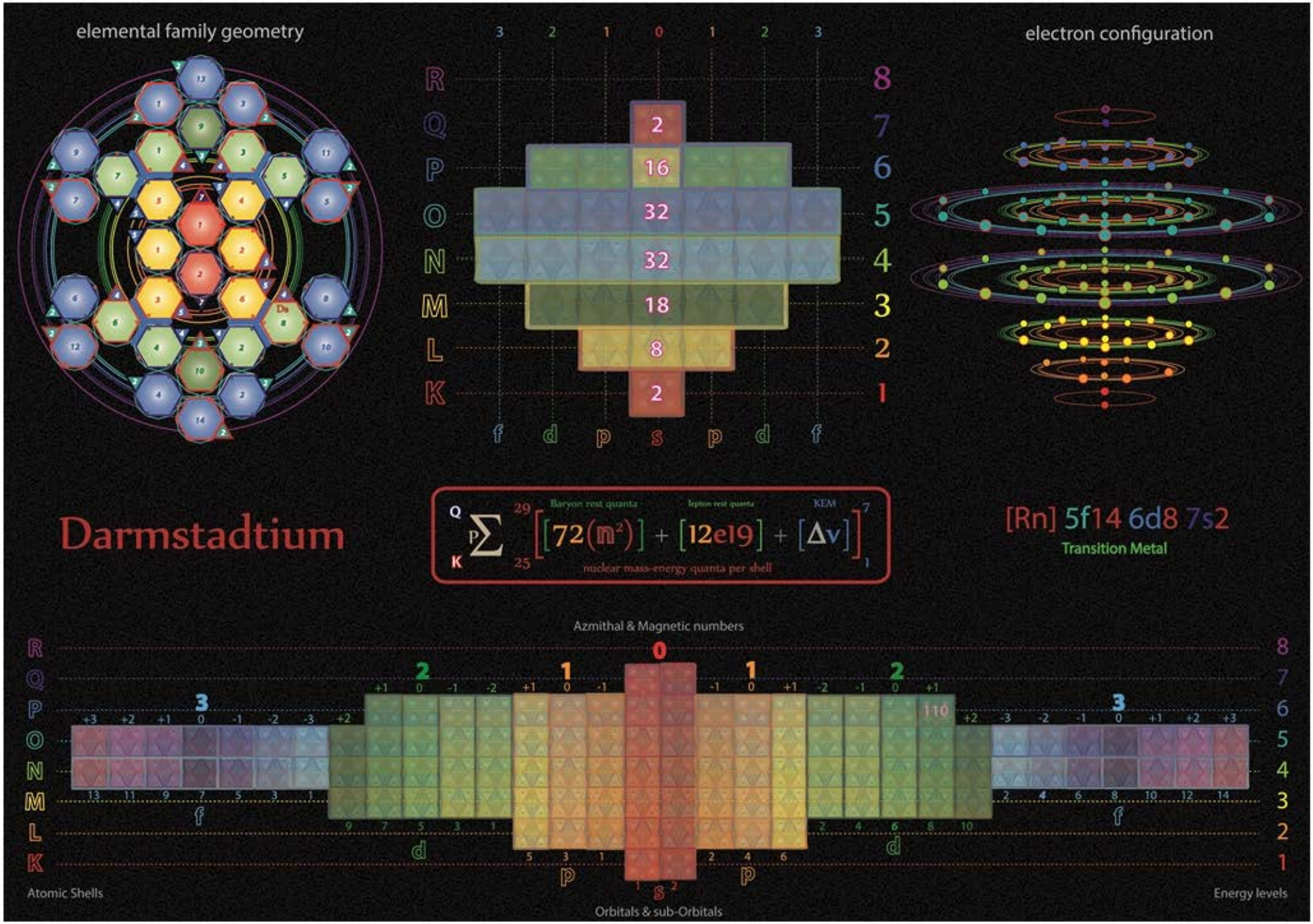

Tetryonics 53.110 - Darmstadtium atomic config

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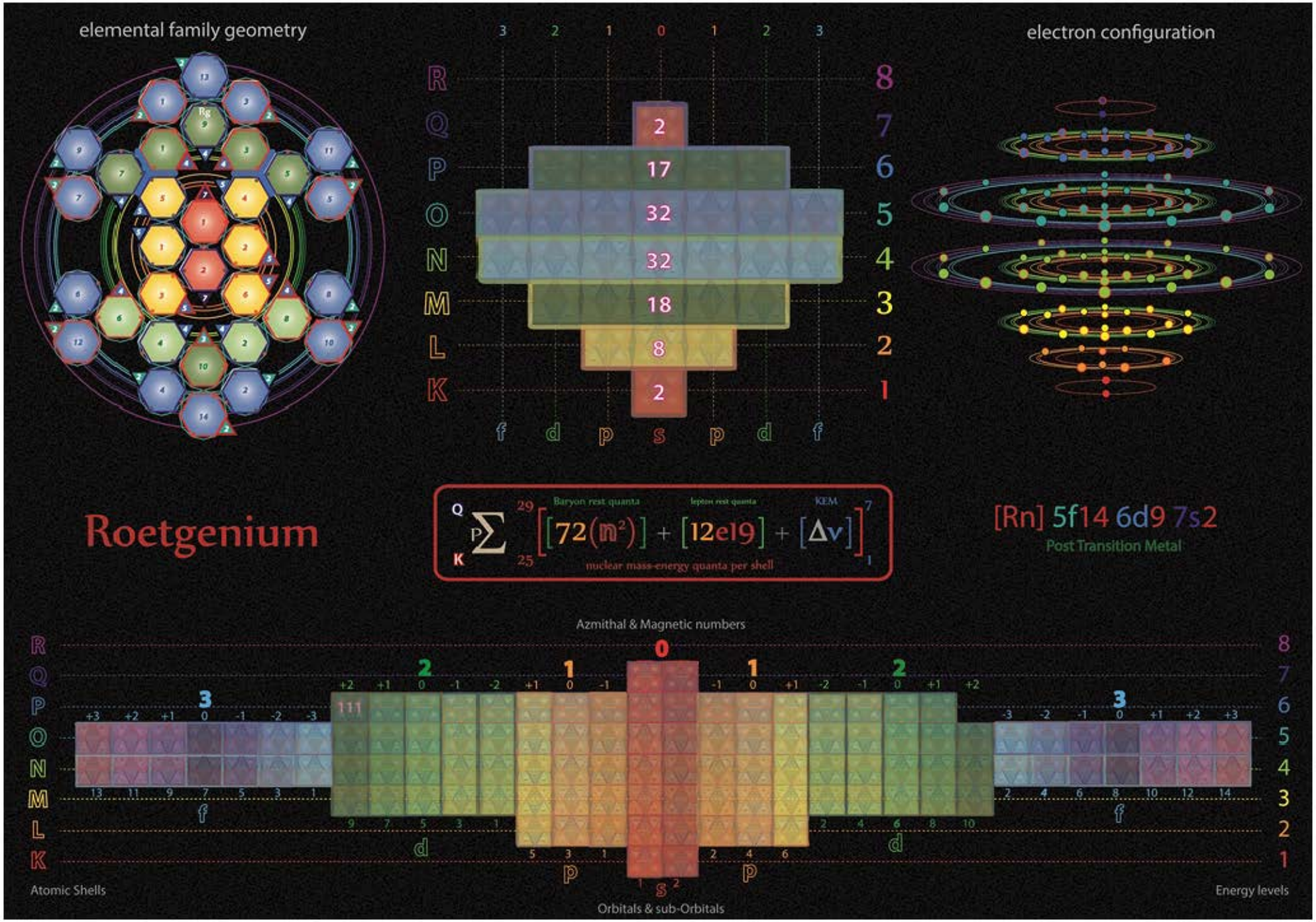

Tetryonics 53.111 - Roetgenium atomic config

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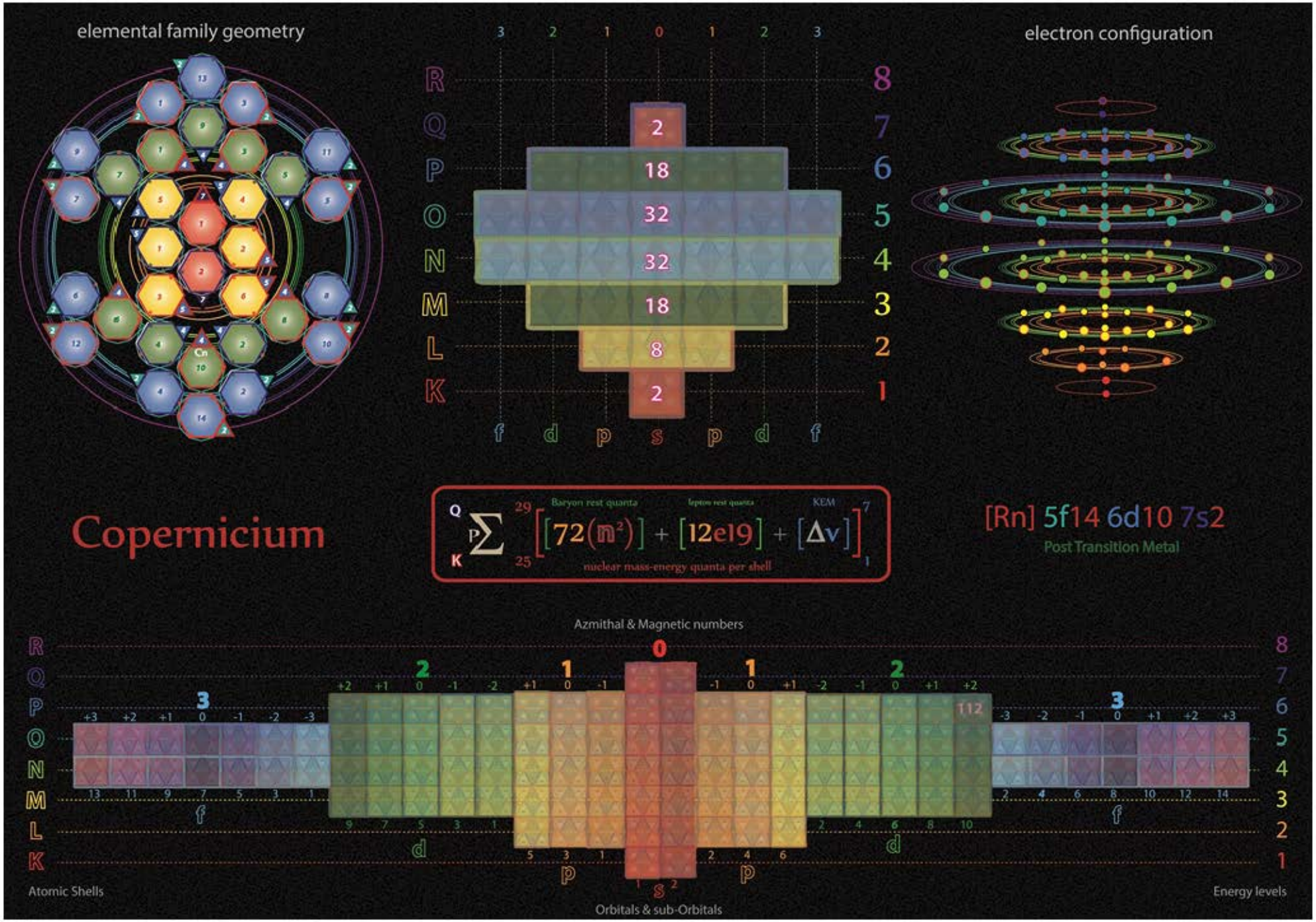

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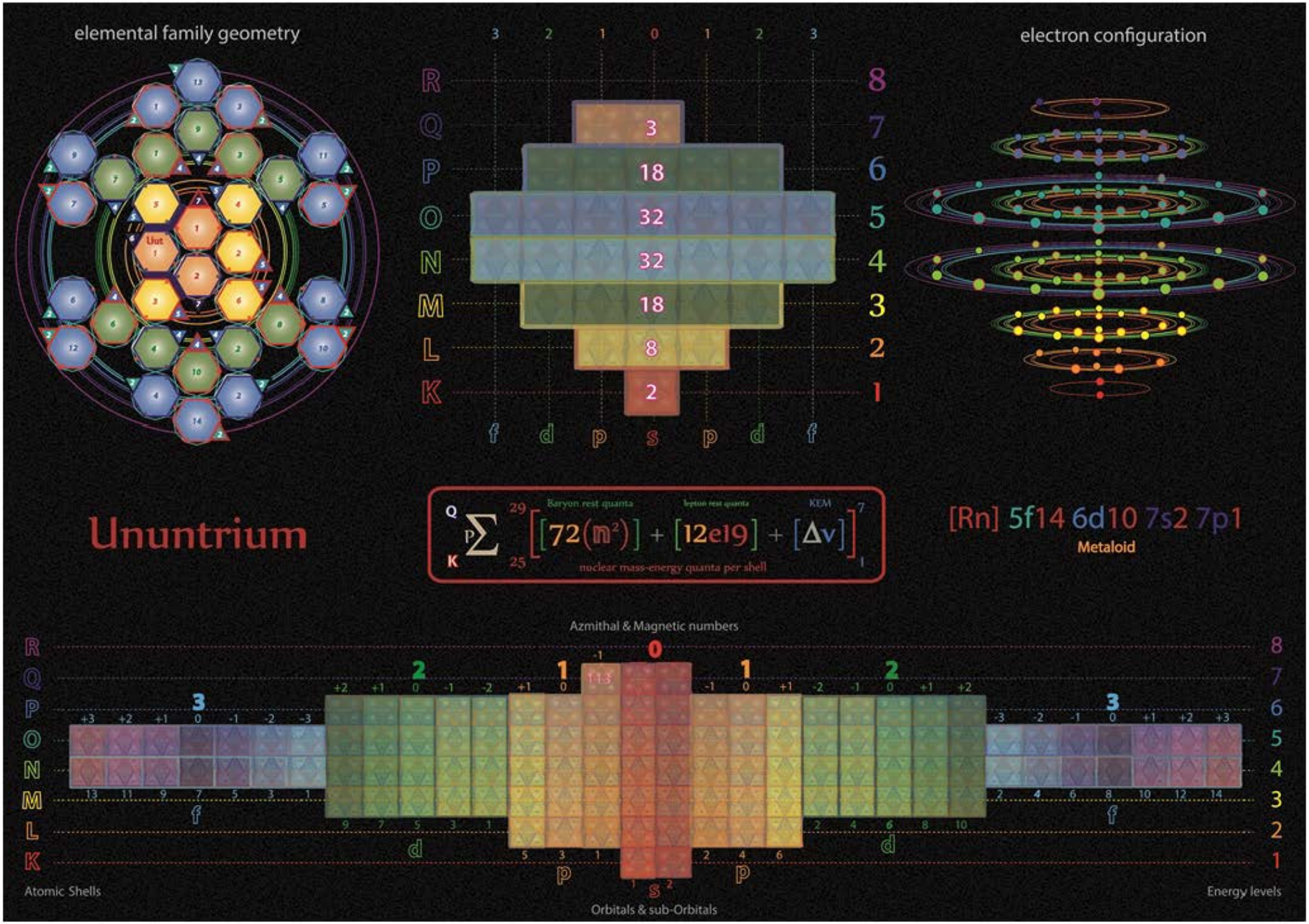

Tetryonics 53.113 - Ununtrium atomic config

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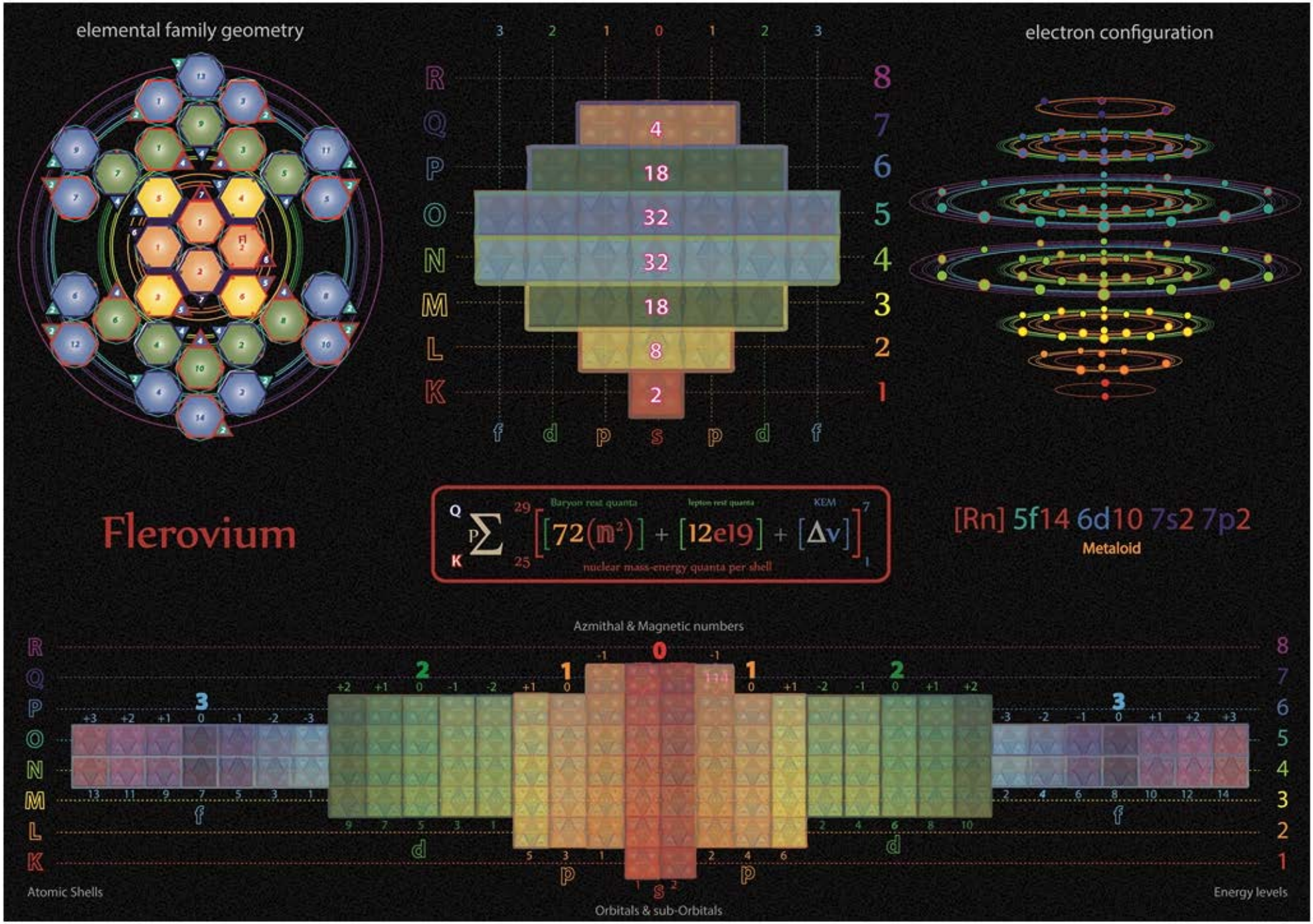

Tetryonics 53.114 - Flerovium atomic config

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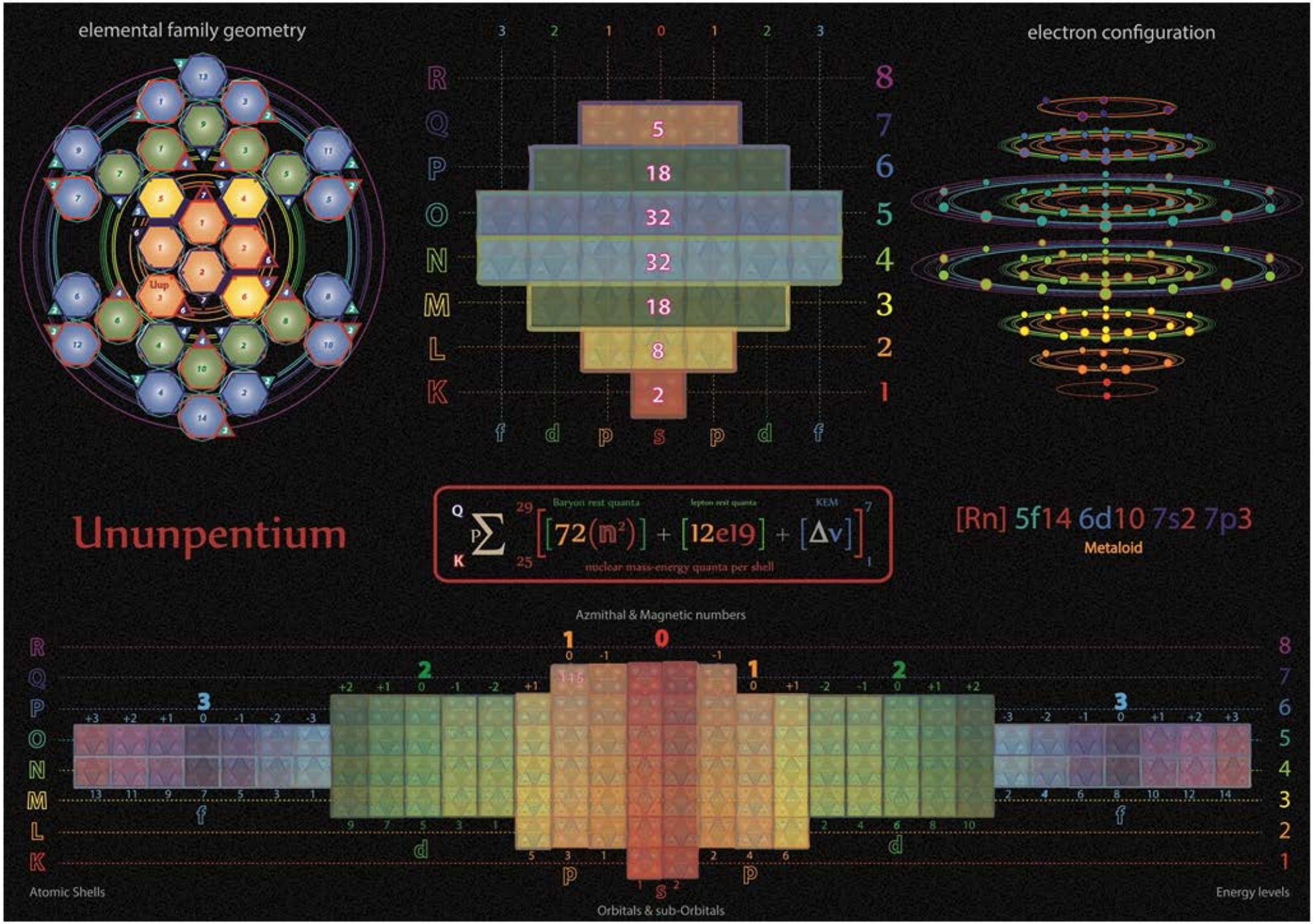

Tetryonics 53.115 - Ununpentium atomic config

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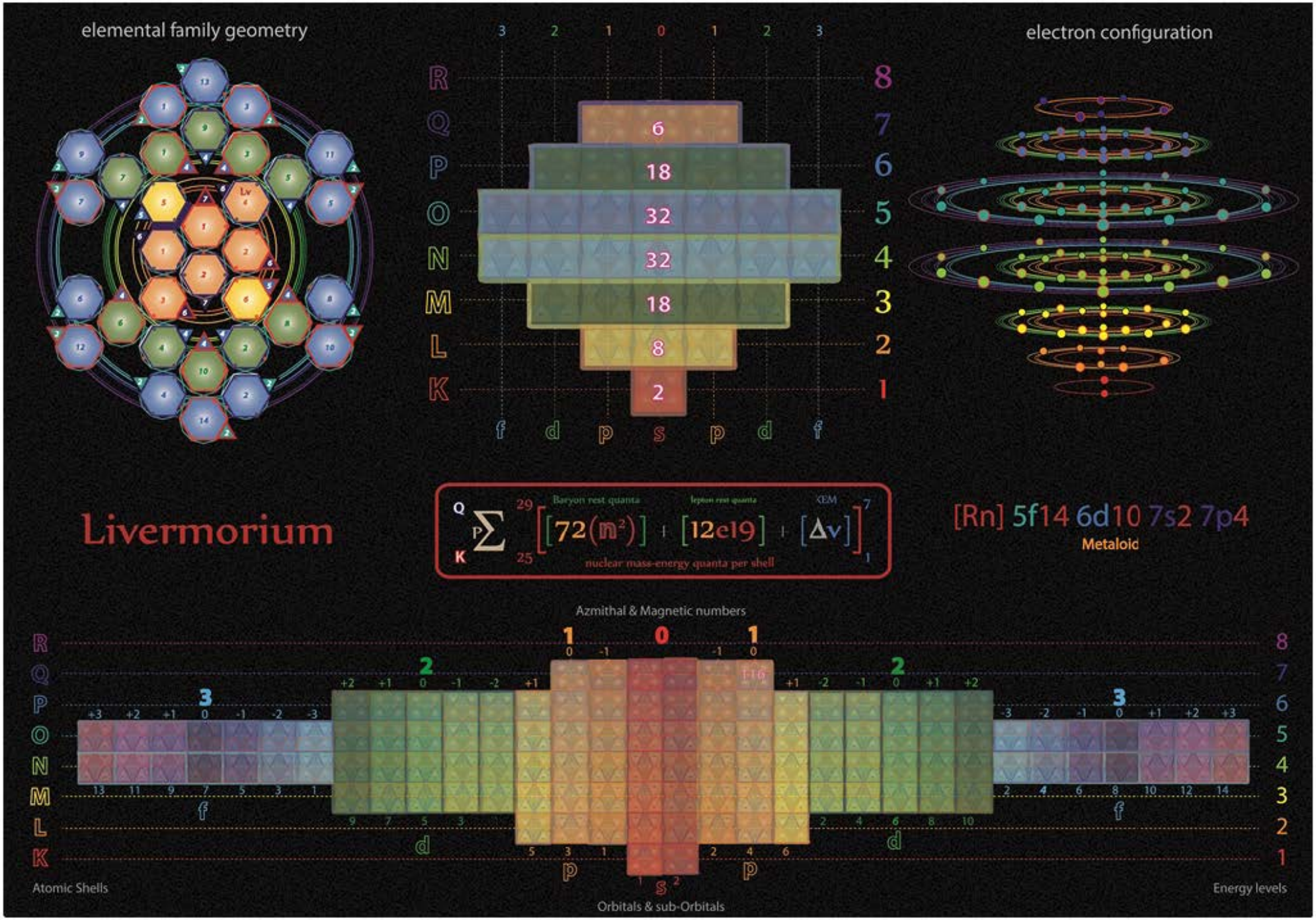

Tetryonics 53.116 - Livermorium atomic config

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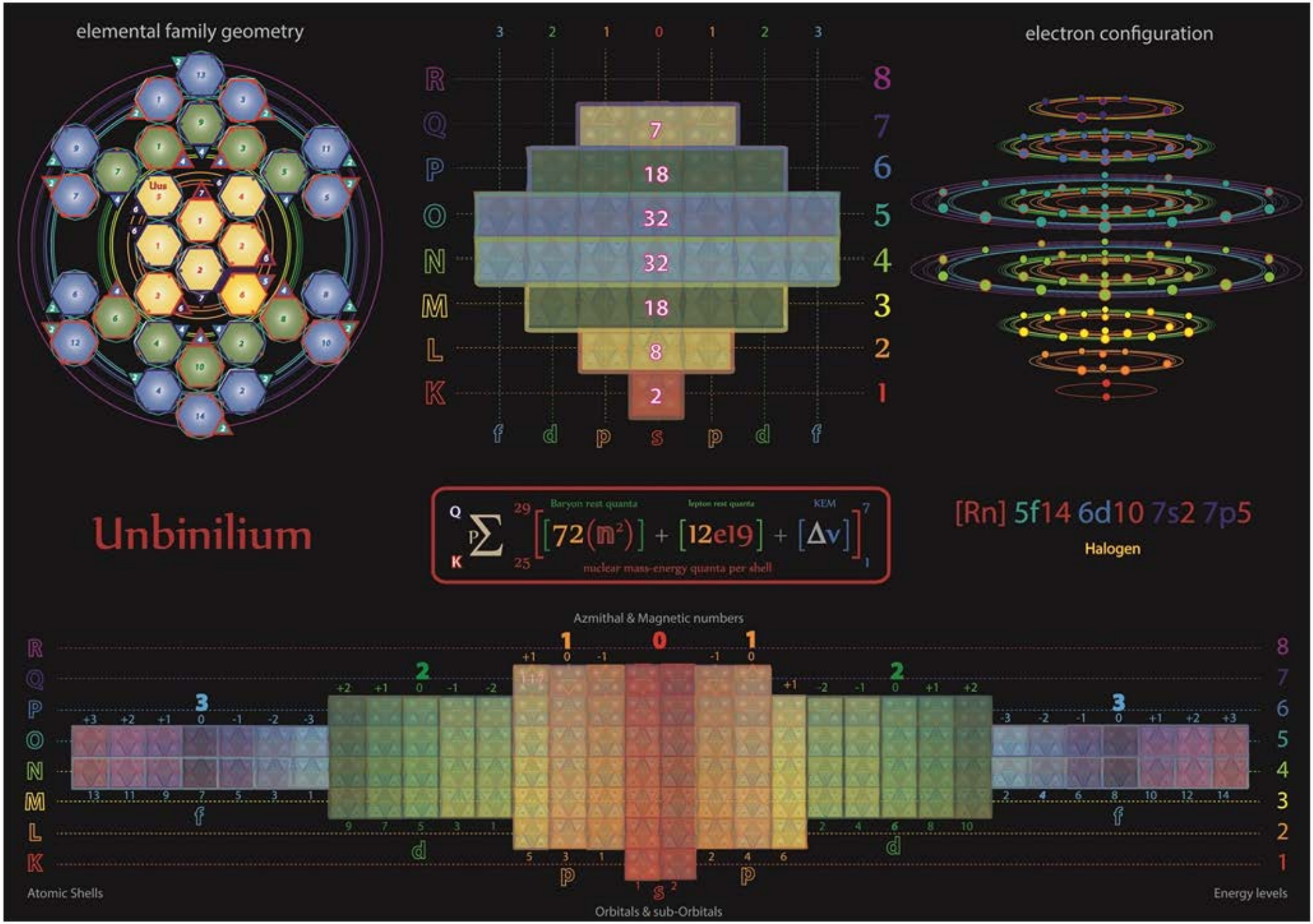

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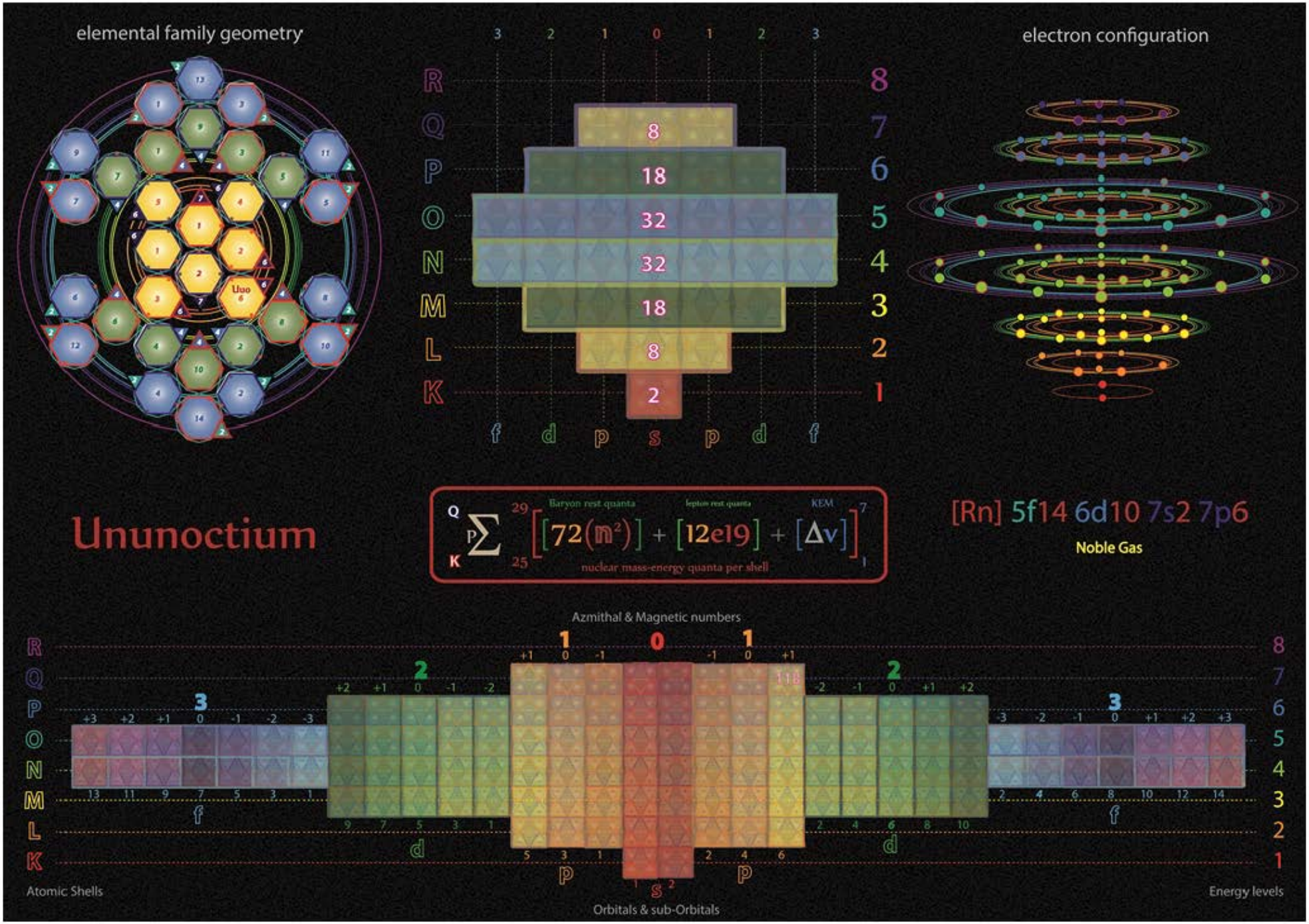

Tetryonics 53.118 - Ununoctium atomic config

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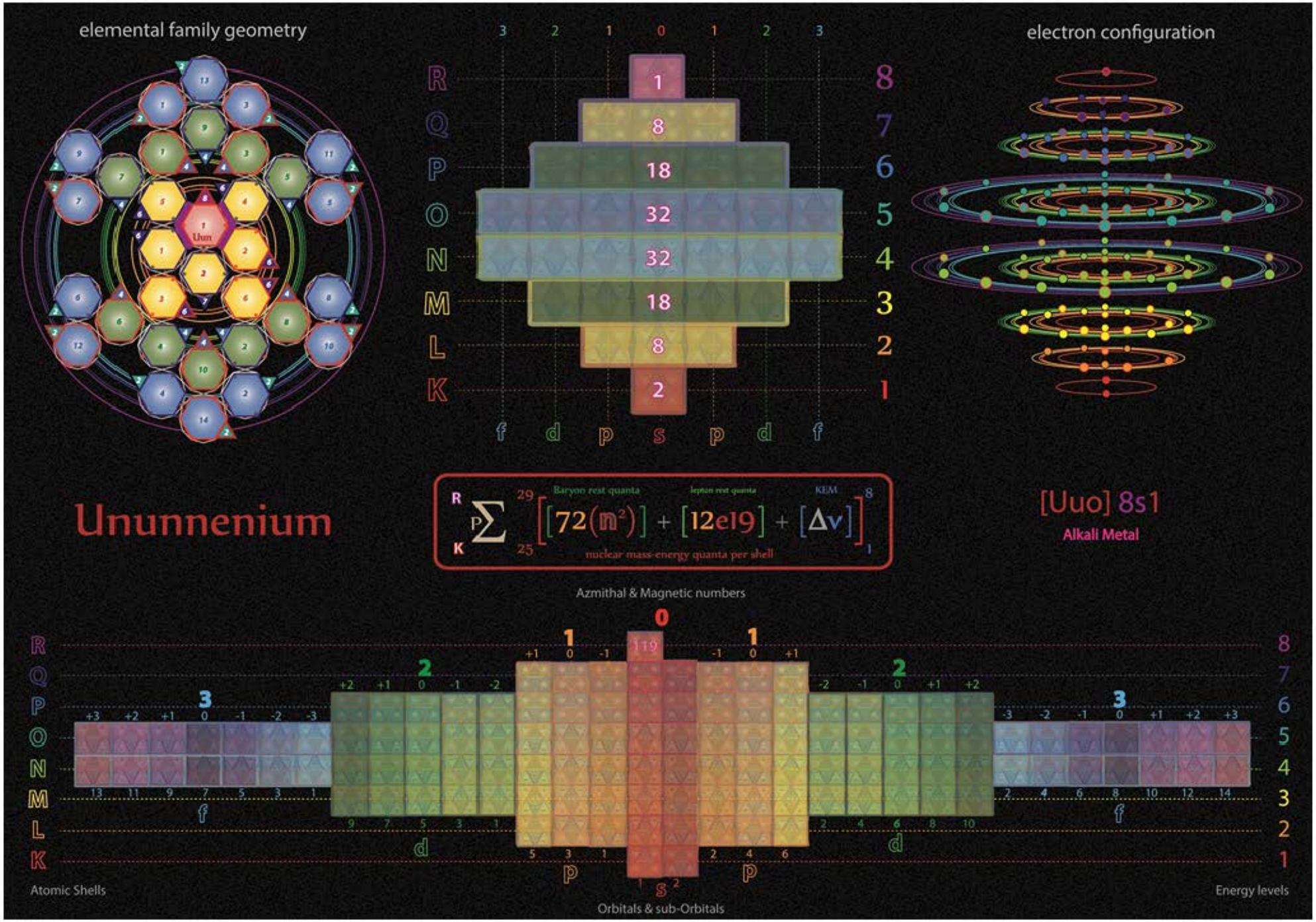

Tetryonics 53.119 - Ununnenium atomic config

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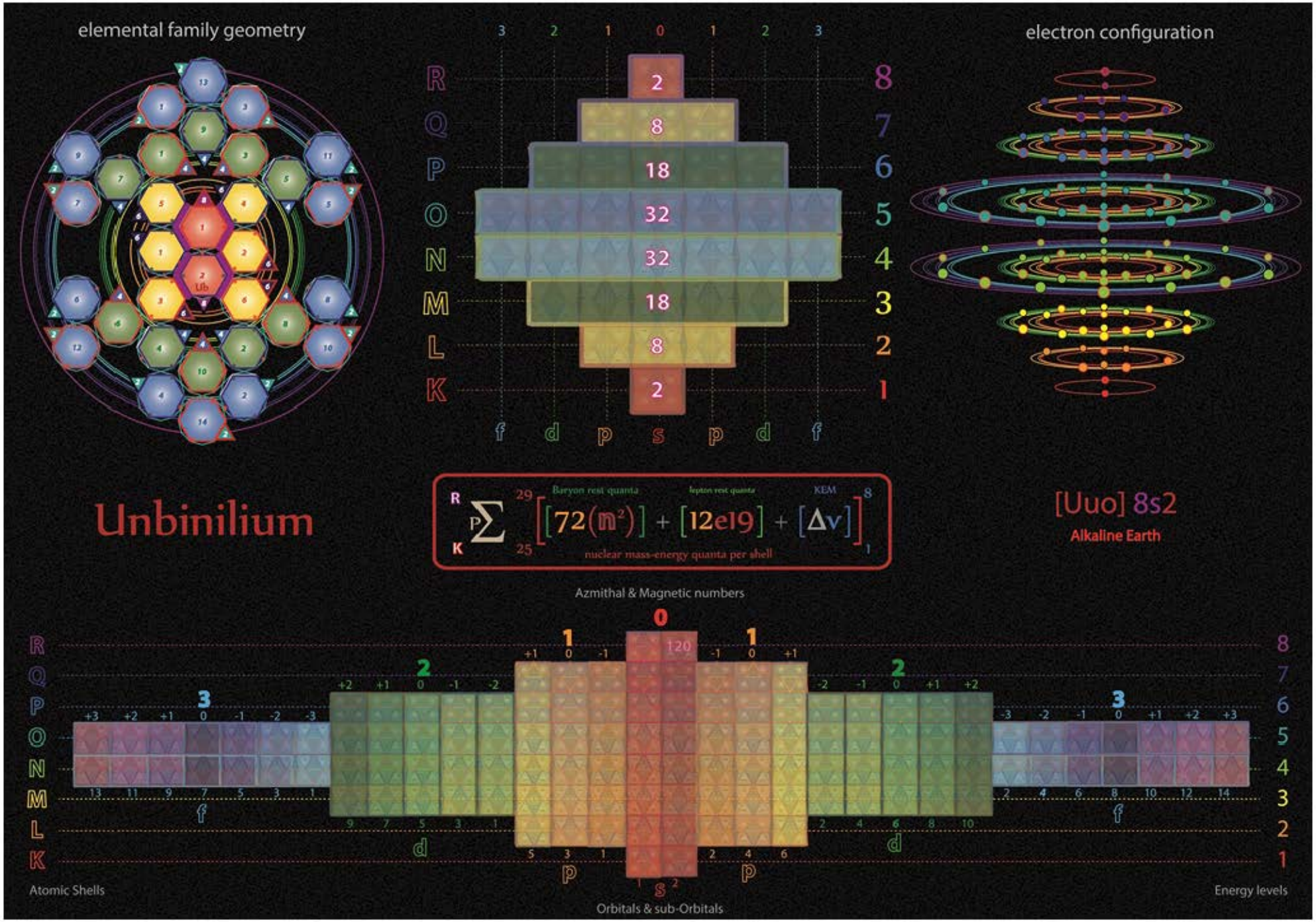

Tetryonics 53.120 - Unbinilium atomic config

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Chemical element bonding

All Deuterium nuclei pack in hexagonal patterns to form larger atoms & molecules

Individual chemical element topologies are mapped using Cormier grid

Hexagonal tiling is a regular tiling of the Euclidean plane

Tetryonic chemistry utilises hexagonal tiling for modelling chemical bonds

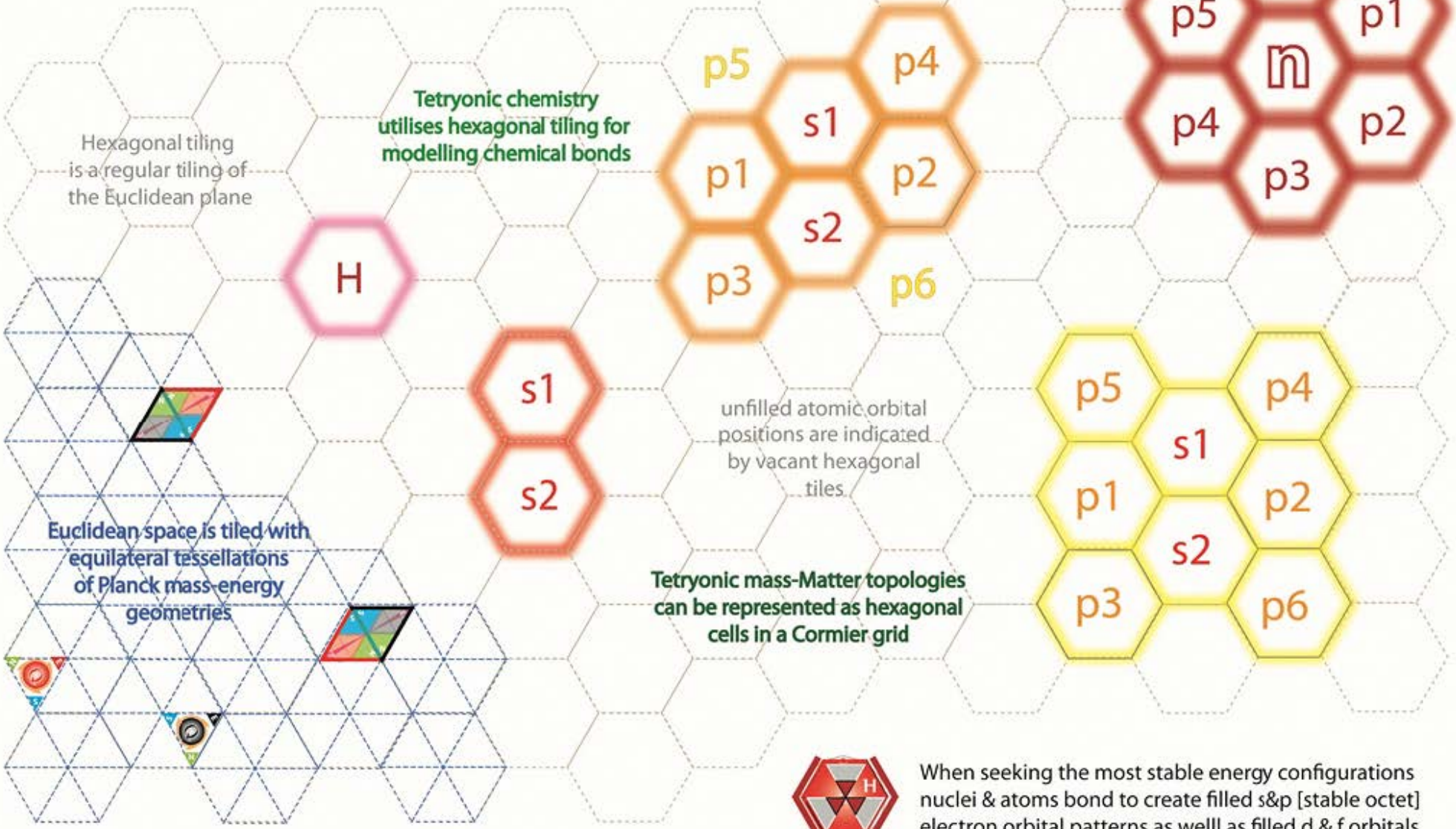

unfilled atomic orbital positions are indicated by vacant hexagonal tiles

Euclidean space is tiled with equilateral tessellations of Planck mass-energy geometries

Tetryonic mass-Matter topologies can be represented as hexagonal cells in a Cormier grid

When seeking the most stable energy configurations nuclei & atoms bond to create filled s&p [stable octet] electron orbital patterns as welll as filled d & f orbitals.

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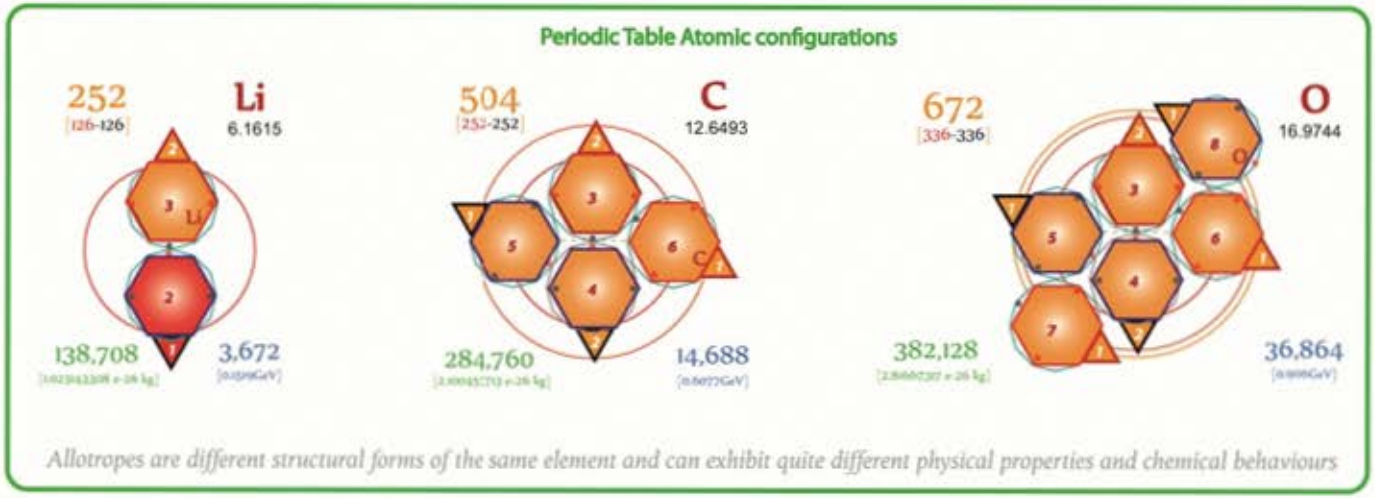

Lithium

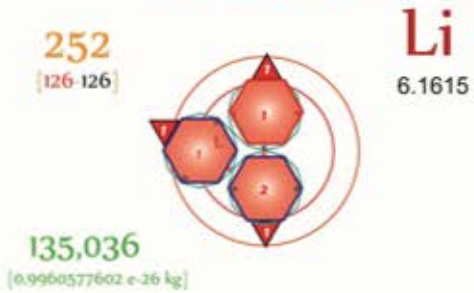

Oxygen

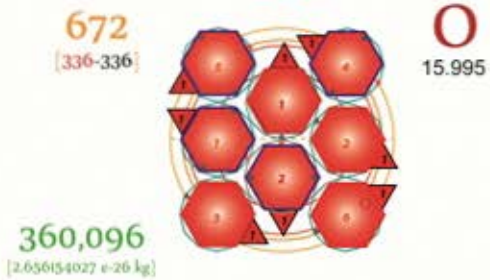

Allotropes

The Periodic Table, although useful in identifying Elements via their atomic and quantum numbers, does not reflect all the charged topologes that Deuterium nuclei can form as they combine.

Various atomic configurations with the same Tetryonic charge, but differing in their final mass-Matter topologies and properties can be formed - they are the Allotropes

Some of the more plentiful chemical elements form this way

Carbon

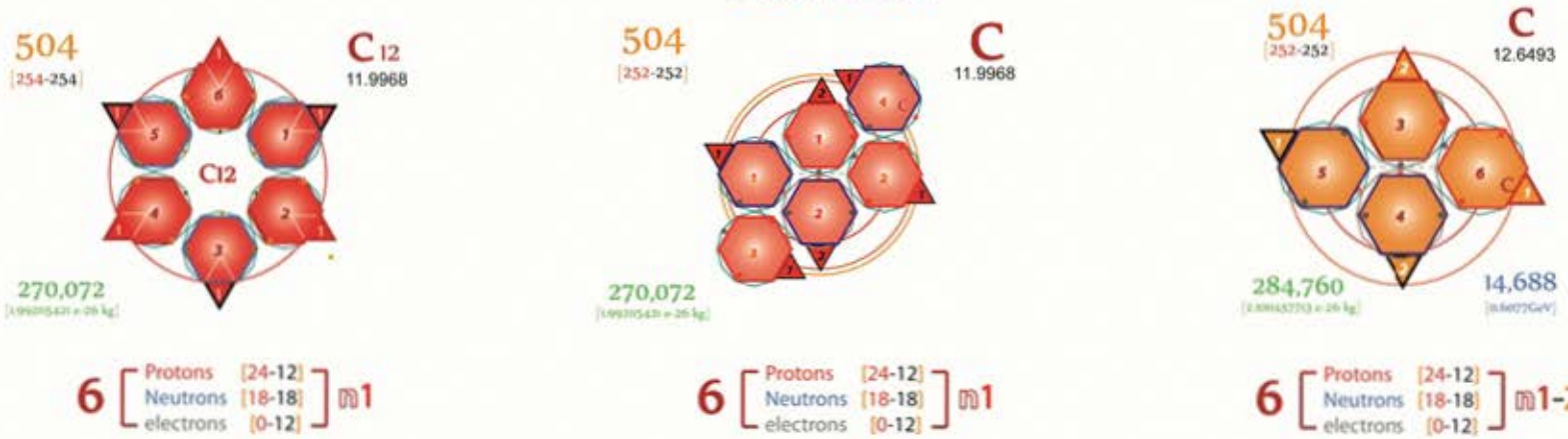

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Allotropes are elements created from the same number of Deuterium nuclei as periodic elements but possess a differing mass-Matter topology

Q

same component charge

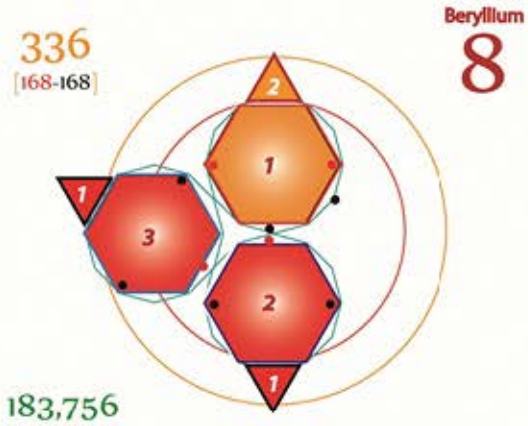

different Matter geometries

M

The varying material geometries allows what is the same chemical element to possess vastly different bonding points and chemical attributes

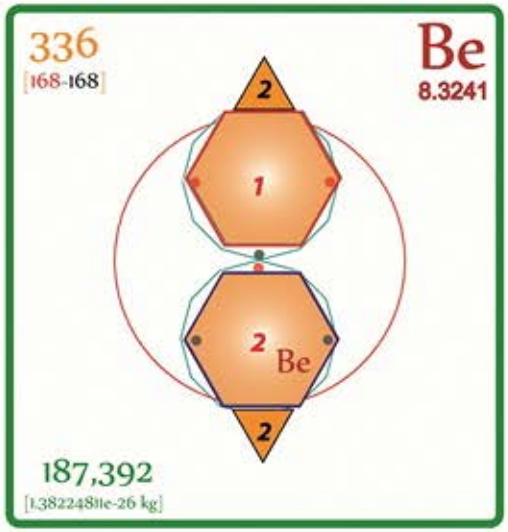

Allotropic geometries

[charge vs Matter]

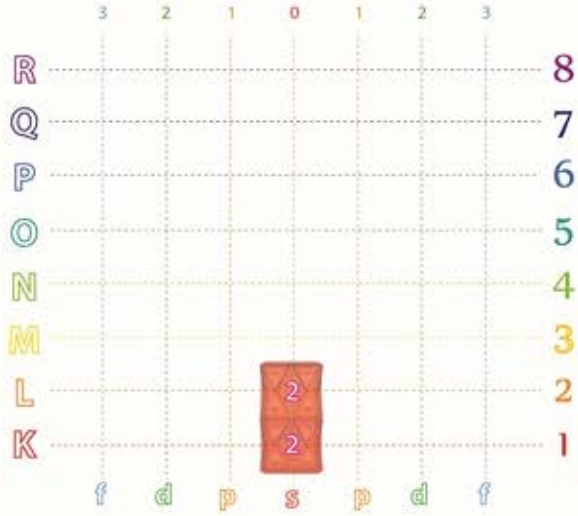

Some element allotropes have different Matter topologies that persist in different phases

Allotropes vs. Isotopes

Isotopes are elementary atoms with the same number of nuclei, but with differing energy levels, resulting in different mass-energies

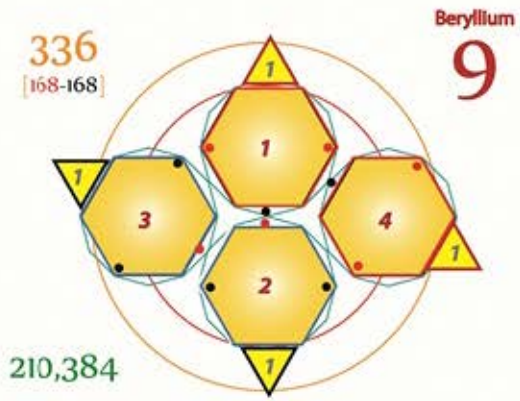

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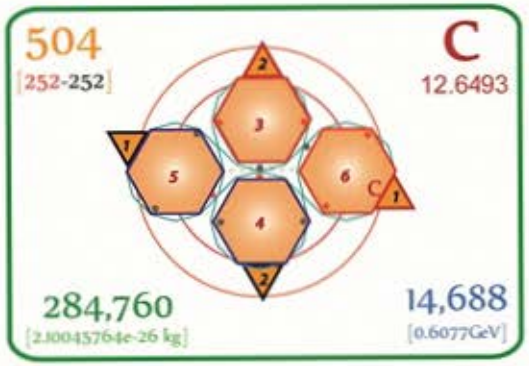

Tetryonic theory affords us the ability to model the charged mass-energy geometries & 3D Matter topologies of each element along with its bonding points

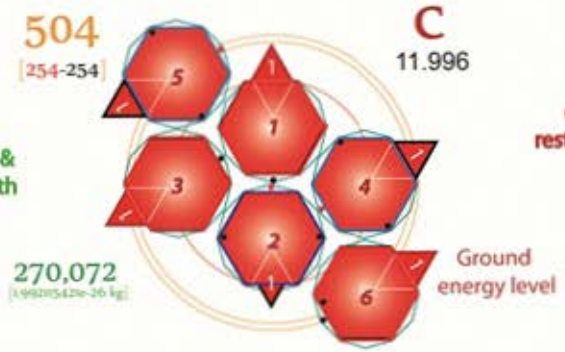

It also allows for the calculation of the molar rest mass-energy geometry of any Matter topology

Carbon Allotropes

Carbon is capable of forming many allotropes due to its valency.

Well known forms of carbon include:

Carbon
Diamond
Graphite
Graphene
Amorphous carbon
Buckminsterfullerenes
Carbon nanotubes
Glassy carbon
atomic & diatomic carbon

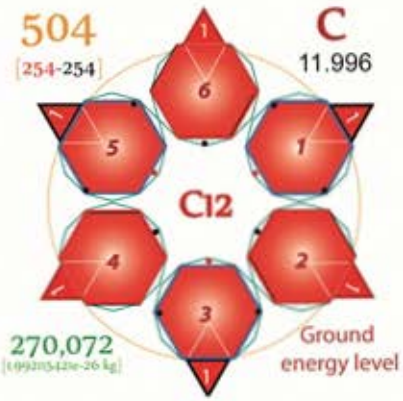

Graphene has a unique p orbital arrangement of its electrons

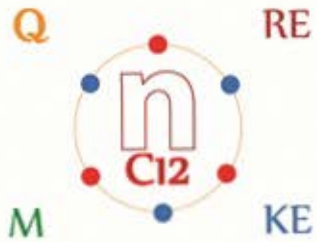

Electron Configuration

[n] p6

Shell		Molar meM		Nuclei per shell
R 8	446,976	19.855	6	
Q 7	418,680	18.598	6	
P 6	391,392	17.385	6	
O 5	365,112	16.218	6	
N 4	339,840	15.095	6	
M 3	315,576	14.018	6	
L 2	292,320	12.985	6	
K 1	270,072	11.996	6	

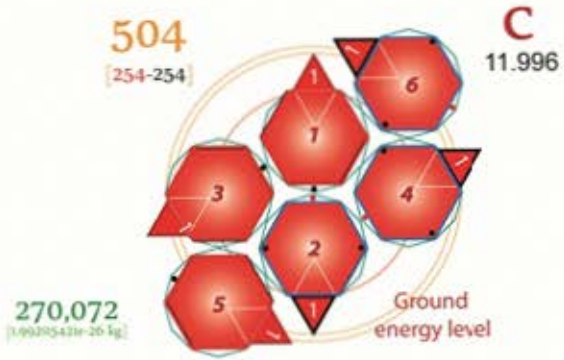

Carbon-14, a radioactive isotope of carbon with a half-life of 5,730 years, is used to find the age of formerly living things through a process known as radiocarbon dating.

In 1961 the international unions of physicists and chemists agreed to use the mass of the isotope carbon-12 as the basis for atomic weight.

There are nearly ten million known carbon compounds and an entire branch of chemistry, known as organic chemistry, is devoted to their study.

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Graphene

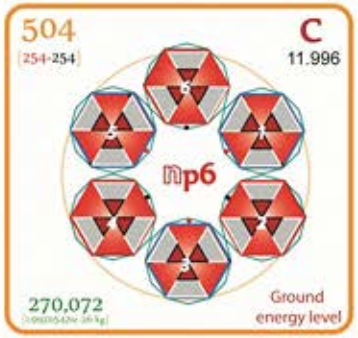

Graphene is also an allotrope of carbon.

Its structure is one-atom-thick planar sheets of sp2-bonded carbon atoms that are densely packed in a honeycomb crystal lattice

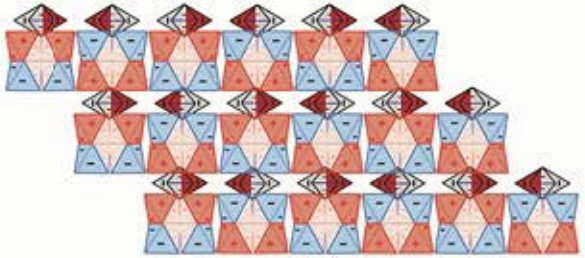

Graphite electrons can act as atomic bearings between the planar sheets of graphene

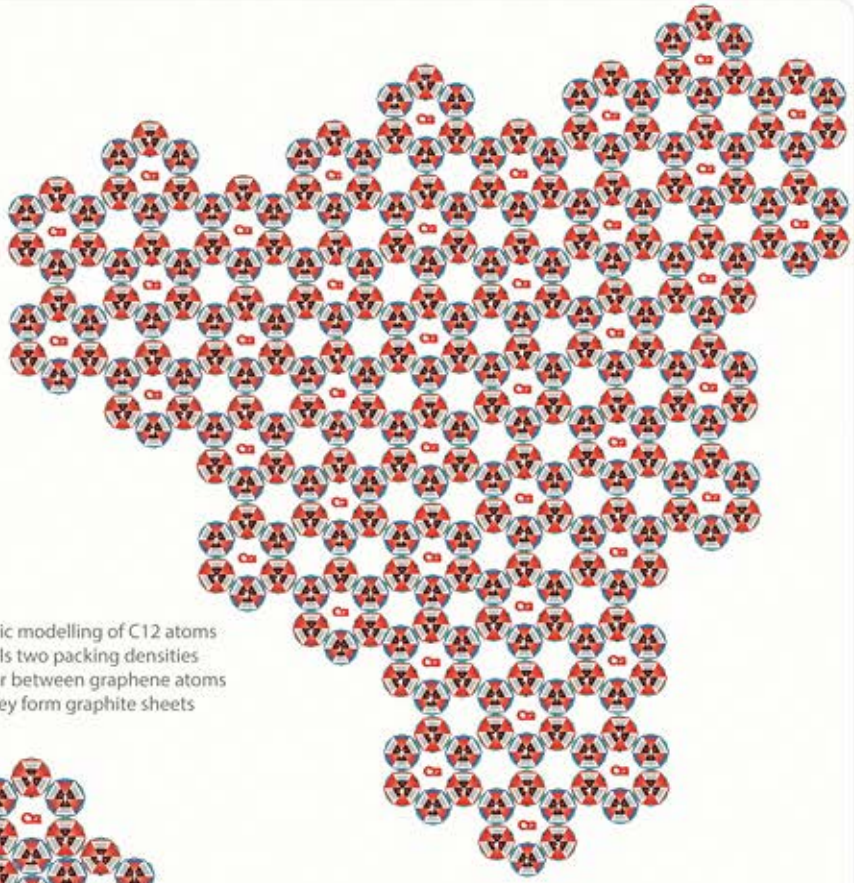

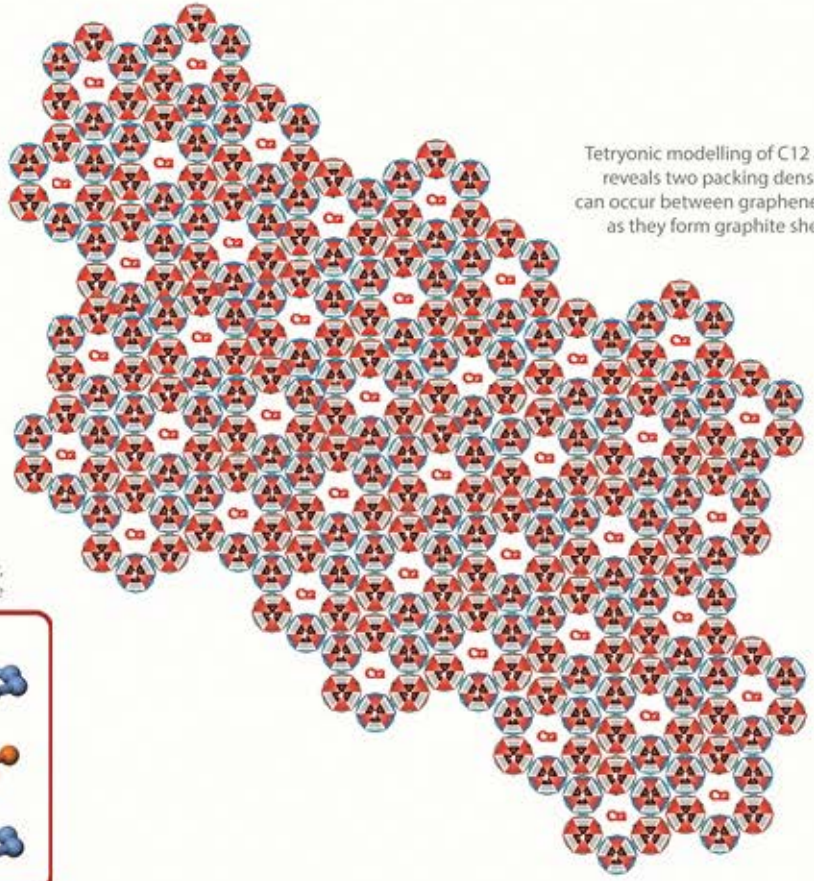

Tetryonic modelling of C12 atoms reveals two packing densities can occur between graphene atoms as they form graphite sheets

Graphite

The mineral graphite is an allotrope of carbon.

Unlike periodic table carbon [diamond], graphite is an electrical conductor, a semi-metal.

And Graphite is the most stable form of carbon under standard conditions.

Graphite has a layered, planar structure. In each layer, the carbon atoms are arranged in a hexagonal lattice

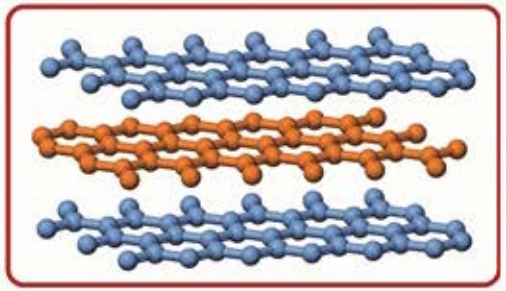

Unlike periodic carbon where electrons are tightly bound, graphite is highly conductive, with electrical energy being propagated via the electrons & their KEM fields

Graphene electrons are loosley bound to the top of the Deuterium nuclei

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Carbon Nanotubes

Carbon nanotubes (CNTs) are allotropes of carbon with a cylindrical nanostructure.

Large molecules consisting only of carbon, known as buckminsterfullerenes, or buckyballs, have recently been discovered and are currently the subject of much scientific interest.

A single buckyball consists of 60 or 70 carbon atoms (C60 or C70) linked together in a structure that looks like a soccer ball.

They can trap other atoms within their framework, appear to be capable of withstanding great pressures and have magnetic and superconductive properties.

C36

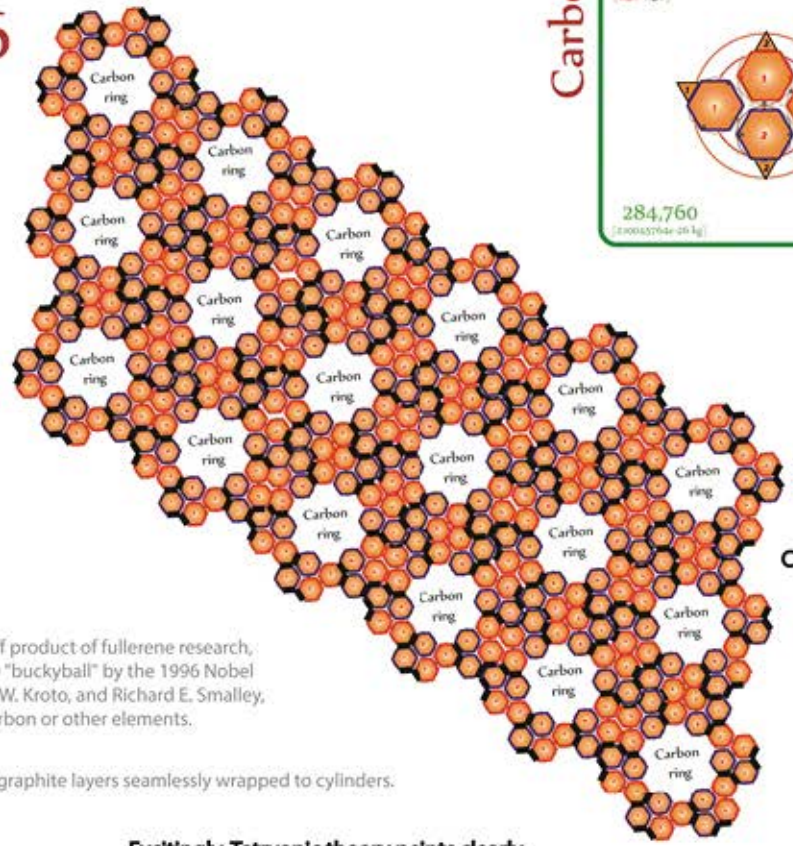

Carbon

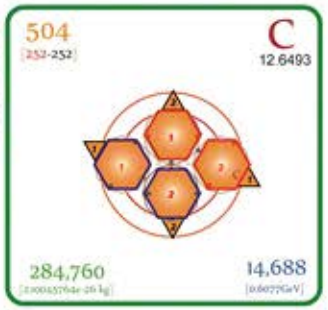

Carbyne

They can be thought of as a sheet of graphite (a hexagonal lattice of carbon) rolled into a cylinder.

C12

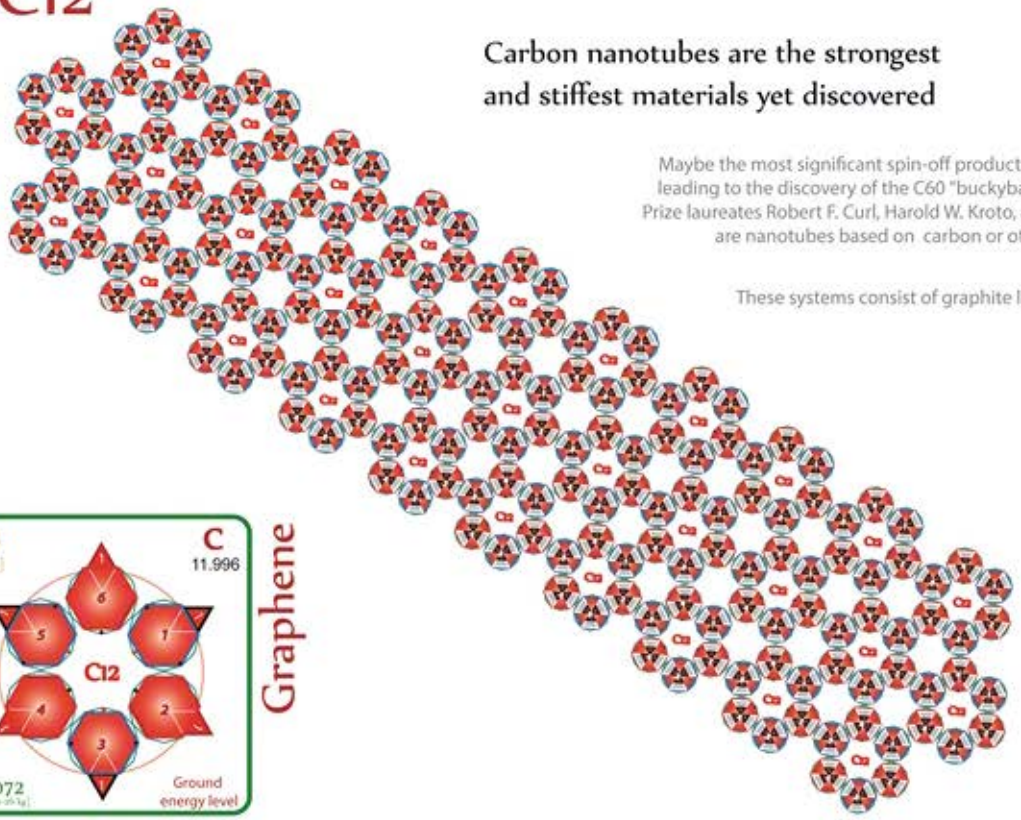

Carbon nanotubes are the strongest and stiffest materials yet discovered

Maybe the most significant spin-off product of fullerene research, leading to the discovery of the C60 "buckyball" by the 1996 Nobel Prize laureates Robert F. Curl, Harold W. Kroto, and Richard E. Smalley, are nanotubes based on carbon or other elements.

These systems consist of graphite layers seamlessly wrapped to cylinders.

Excitingly, Tetryonic theory points clearly to the possibility that organo-carbon nanotubes can be created.

Where C36 periodic carbon could be used insetad of conventional C12 graphene atoms

Carbyne

Graphene

C60

Nanotubes are members of the fullerene structural family, which also includes the spherical buckyballs, and the ends of a nanotube may be capped with a hemisphere of the buckyball structure.

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Diamonds

are a metastable allotrope of carbon,
where the carbon atoms are arranged in
cubic crystal structure called a diamond lattice.

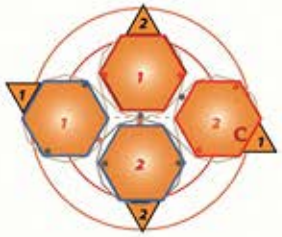

Periodic [C6] Carbon

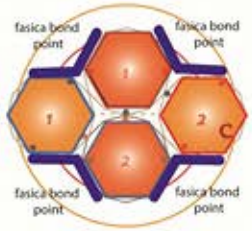

Ionised [C6] Carbon

Diamonds are renowned as a material with superlative physical qualities,
most of which originate from the strong fascia bonds between its atoms.

Most natural diamonds are formed at high temperature
and pressure at depths of 140 to 190 kilometers in the Earth's mantle
[resultirg in the loss of electrons form bound positions, making
them poor conductors compared to grahphene atoms].

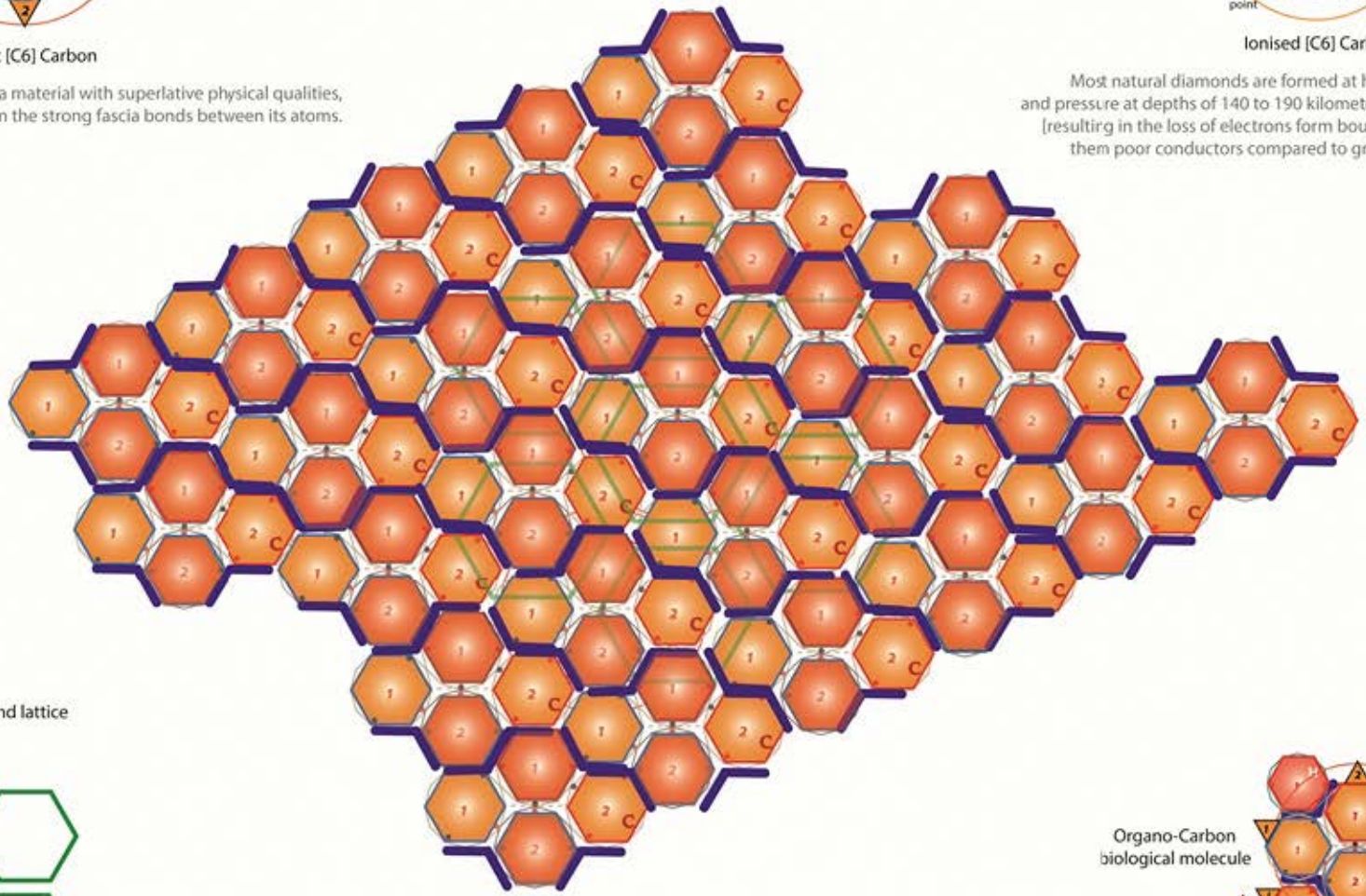

filled n[C7] Carbon diamond lattice

Organo-Carbon
biological molecule

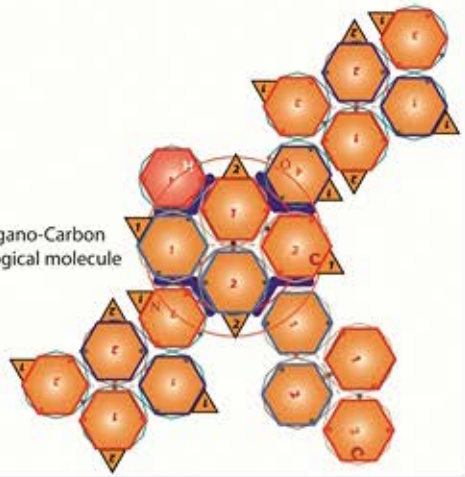

The chemical bonds that hold the carbon atoms in diamonds together
are stronger than those in graphite.

In diamonds, the bonds form an inflexible three-dimensional lattice, whereas in graphite,
the atoms are tightly bonded into sheets, which can slide easily over one another, making the overall structure weaker

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Oxygen Allotropes

There are several known allotropes of oxygen.
The most familiar is molecular oxygen (O2), present at significant levels in Earth's atmosphere and also known as dioxygen or triplet oxygen.
Another is the highly reactive ozone (O3).

Others include:
Atomic oxygen (O1, a free radical)
Singlet oxygen (O2), either of two metastable states of molecular oxygen
Tetraoxygen (O4), another metastable form
Solid oxygen, existing in six variously colored phases, of which one is O8 and another one metallic

Atomic Oxygen also forms bonds easily with Hydrogen to create Hydroxy compounds

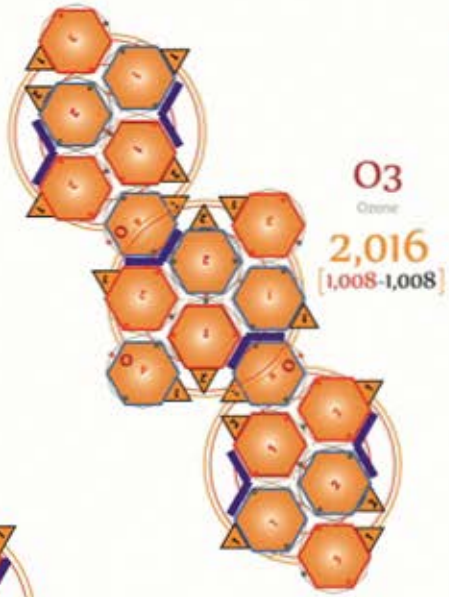

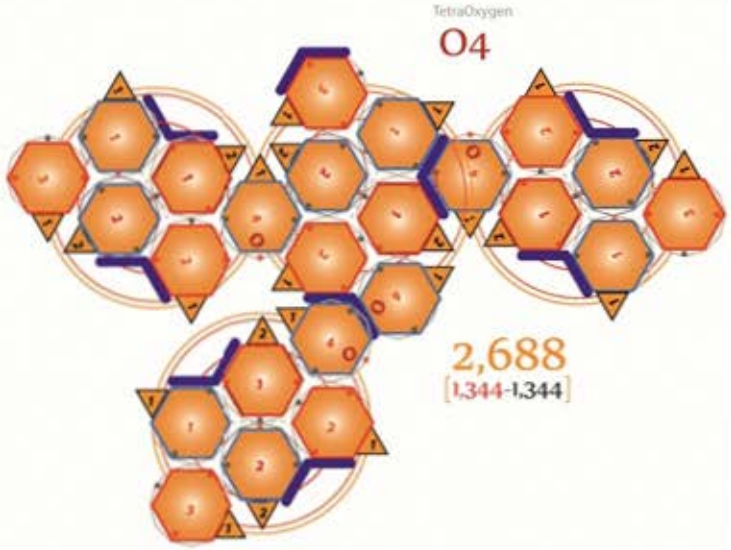

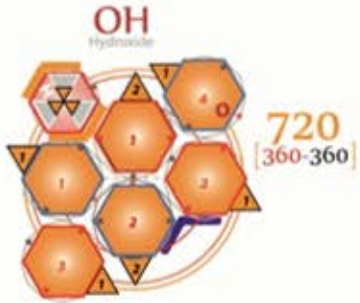

All charge fascia interact and bind where possible to form neutral chemical bonds

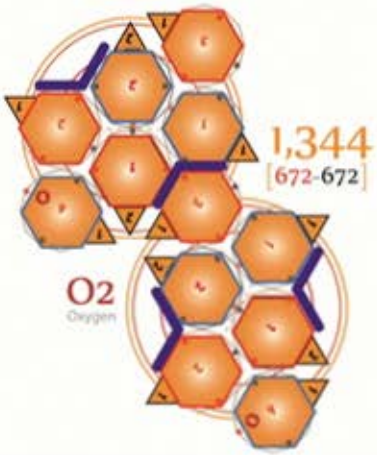

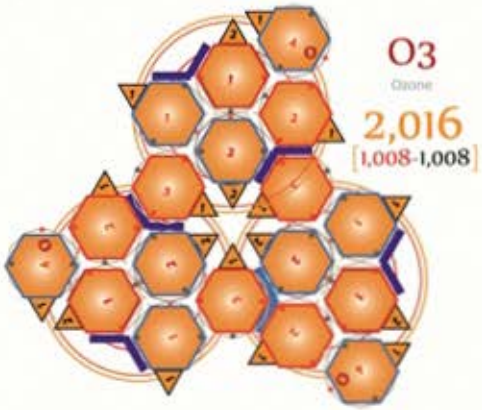

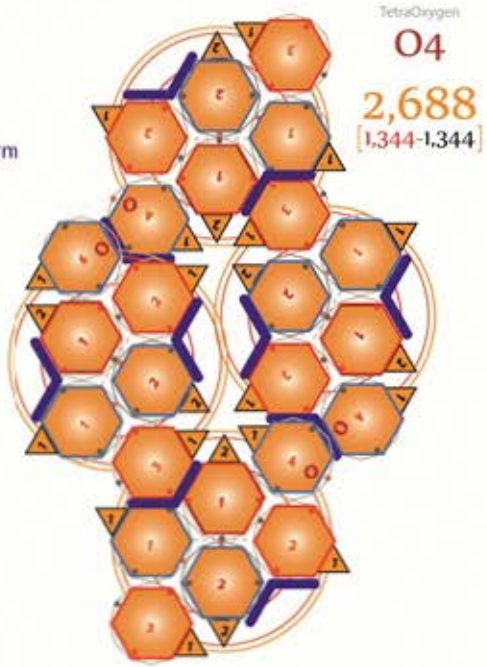

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Phosphor Allotropes

Elemental phosphorus can exist in several allotropes; the most common of which are white and red solids.

Solid violet and black allotropes are also known.

Gaseous phosphorus exists as diphosphorus and atomic phosphorus.

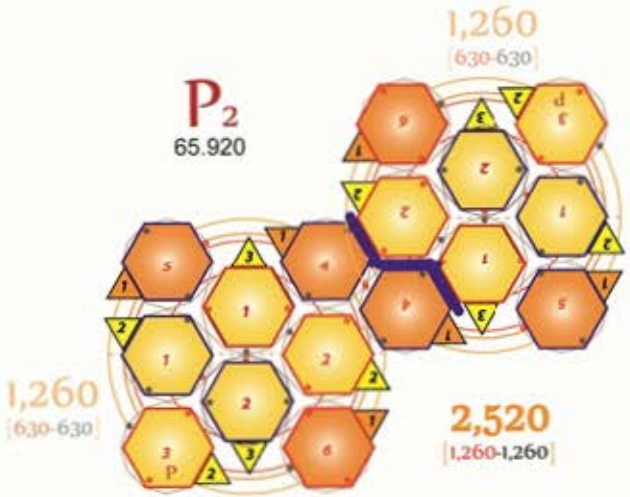

The diphosphorus allotrope (P2) can be obtained normally only under extreme conditions (for example, from P4 at 1100 kelvin).

Nevertheless, some advancements were obtained in generating the diatomic molecule in homogenous solution, under normal conditions with the use by some transition metal complexes (based on for example tungsten and niobium).

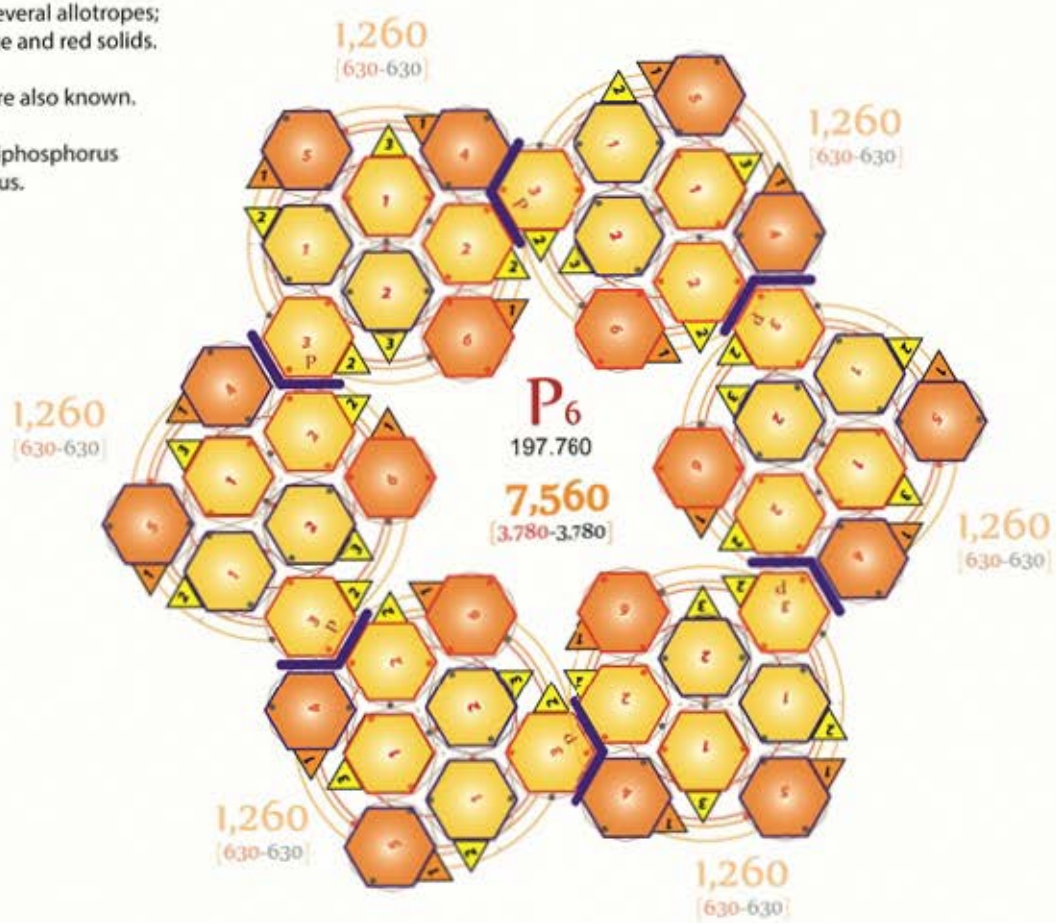

Black phosphorus is the thermodynamically stable form of phosphorus at room temperature and pressure. It is obtained by heating white phosphorus under high pressures (12,000 atmospheres).

In appearance, properties and structure it is very like graphite, being black and flaky, a conductor of electricity, and having puckered sheets of linked atoms

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Sulfur Allotropes

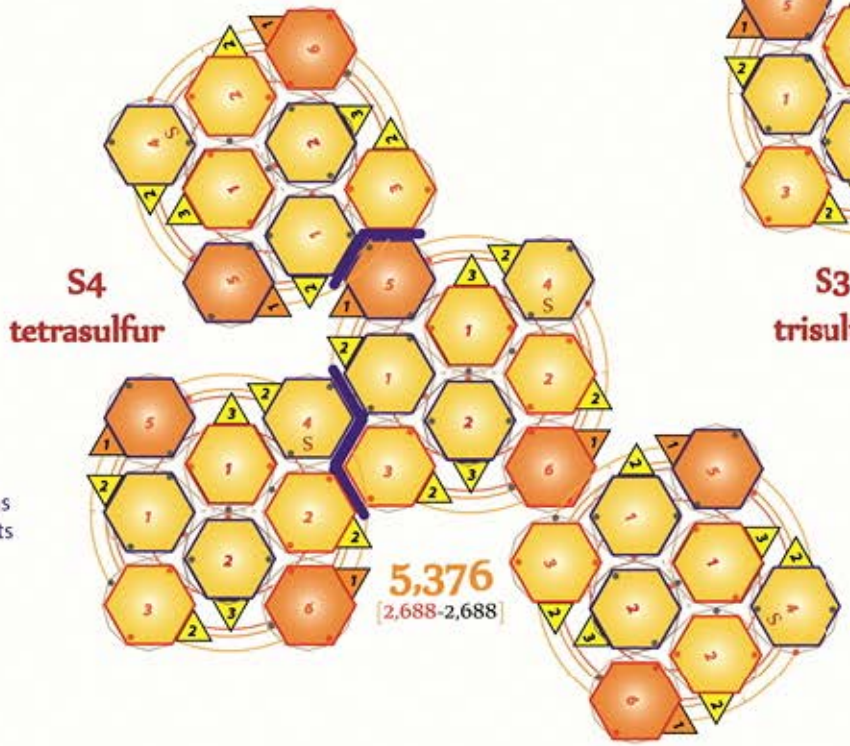

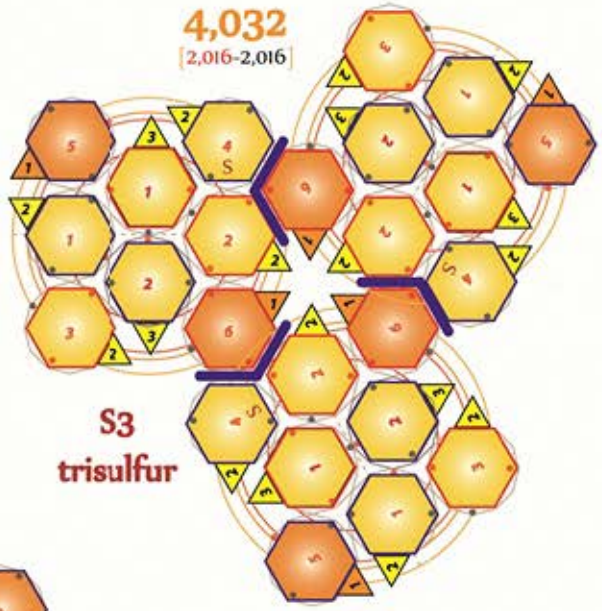

Charged fascia interactions between differing elements result in the familiar chemical bonds

There are a large number of allotropes of sulfur. In this respect, sulfur is second only to carbon.

Sulfur [like Carbon] can form Chains or Ring compounds

cyclo-hexasulfur

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Isotopes

In addition to forming varying allotropic elements

Atoms can also absorb energy directly and create numerous elemental isotopes as a result of their differing nuclear energy levels

Deuterium nuclei with bound photo-electrons form quantum-scale synchronous converters

0	Hydrogen	22,512	24,384	26,352	28,416	30,576	32,832	35,184	37,632
Element		1	2	3	4	5	6	7	8
1	Deuterium	45,012	48,720	52,596	56,640	60,852	65,232	69,780	74,496
2	Helium	90,024	97,440	105,192	113,280	121,704	130,464	139,560	148,992
3	Lithium	135,036	146,160	157,788	169,920	182,556	195,696	209,340	223,488
4	Berylium	180,048	194,880	210,384	226,560	243,408	260,928	279,120	297,984
5	Boron	225,060	243,600	262,980	283,200	304,260	326,160	348,900	372,480
6	Carbon	270,072	292,320	315,576	339,840	365,112	391,392	418,680	446,976
7	Nitrogen	315,084	341,040	368,172	396,480	425,964	456,624	488,460	521,472
8	Oxygen	360,096	389,760	420,768	453,120	486,816	521,856	558,240	595,968
9	Fluorine	405,108	438,480	473,364	509,760	547,668	587,088	628,020	670,464
10	Neon	450,120	487,200	525,960	566,400	608,520	652,320	697,800	744,960
11	Sodium	495,132	535,920	578,556	623,040	669,372	717,552	767,580	819,456
12	Magnesium	540,144	584,640	631,152	679,680	730,224	782,784	837,360	893,952
13	Aluminium	585,156	633,360	683,748	736,320	791,076	848,016	907,140	968,448
14	Silicon	630,168	682,080	736,344	792,960	851,928	913,248	976,920	1,042,944
15	Phosphorus	675,180	730,800	788,940	849,600	912,780	978,480	1,046,700	1,117,440
16	Sulfur	720,192	779,520	841,536	906,240	973,632	1,043,712	1,116,480	1,191,936
17	Chlorine	765,204	828,240	894,132	962,880	1,034,484	1,108,944	1,186,260	1,266,432
18	Argon	810,216	876,960	946,728	1,019,520	1,095,336	1,174,176	1,256,040	1,340,928
19	Potassium	855,228	925,680	999,324	1,076,160	1,156,188	1,239,408	1,325,820	1,415,424
20	Calcium	900,240	974,400	1,051,920	1,132,800	1,217,040	1,304,640	1,395,600	1,489,920

It is the increased nucleonic energy levels that creates isotopes (not extra Neutrons within an atomic nucleus)

The energy level of Baryons determines the KEM energies of photo-electrons bound to them

Most isotopes are considered to be radioactive as a result of the nuclei seeking to release excess energy in the form of photons of energy or particles with high kinetic energies

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Carbon Isotopes

It is widely held in the scientific community tha:
Carbon-14, 14C, or radiocarbon, is a radioactive isotope of carbon with a nucleus containing 6 protons and 8 neutrons.

It is in fact a nucleus comprised of 6 deuterium nuclei [with 6 Protons, 6 Neutrons & 6 electrons]

The mistaken belief in 'extra' neutrons being present in the nucleus stems from the fact that electrons and protons combine in equal numbers in the atomic nucleus and historically attributing the mass in excess of this as being the result of the mass contribution of 'extra' neutrons

Tetryonics finally corrects this erroneous assumption

Carbon 12-14

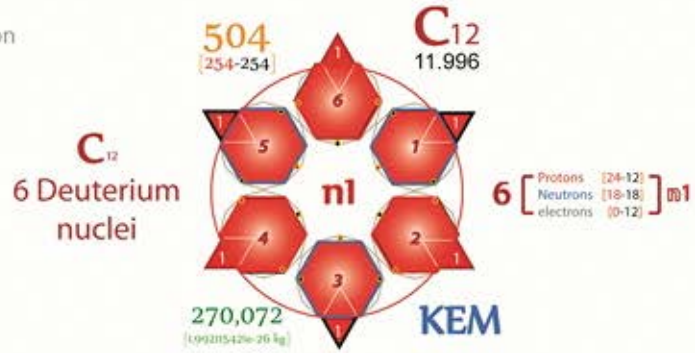

There are NO extra neutrons (in excess of the element's Z#) in the nuclei of atomic isotopes.

The measured 'excess mass' is the direct result of the raised quantum levels of the Deuterium nuclei that comprise each atomic element

And is compreletely accounted for in Tetryonic theory by calculating for the total rest mass-energies in each elementary Matter topology.

The 'extra' mass historically attrtibuted to neutron numbers above that of the elemental number are now reflected as stored kinetic 'chemical' energies as they always were.

ALL elements & isotopes have equal numbers of Protons, electrons & Neutrons

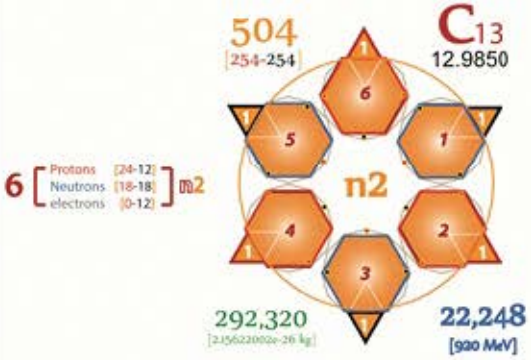

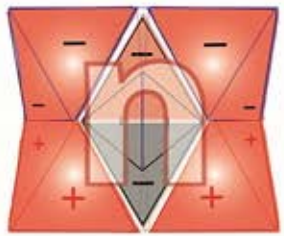

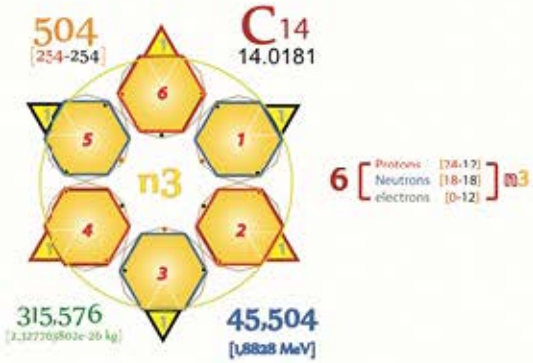

Quantum levels of atomic nuclei contribute to the molar mass
[Isotopes are higher energy nuclei]

		n1	n2	n3	n4	n5	n6	n7	n8
KEM diff	C12	270,072	292,320	315,576	339,840	365,112	391,392	418,680	446,976
		0	22,248	45,504	69,768	95,040	121,320	148,608	176,904
neutron #			.98	2.0	3.1	4.2	5.4	6.6	7.8

This applies equally to all atomic nuclei

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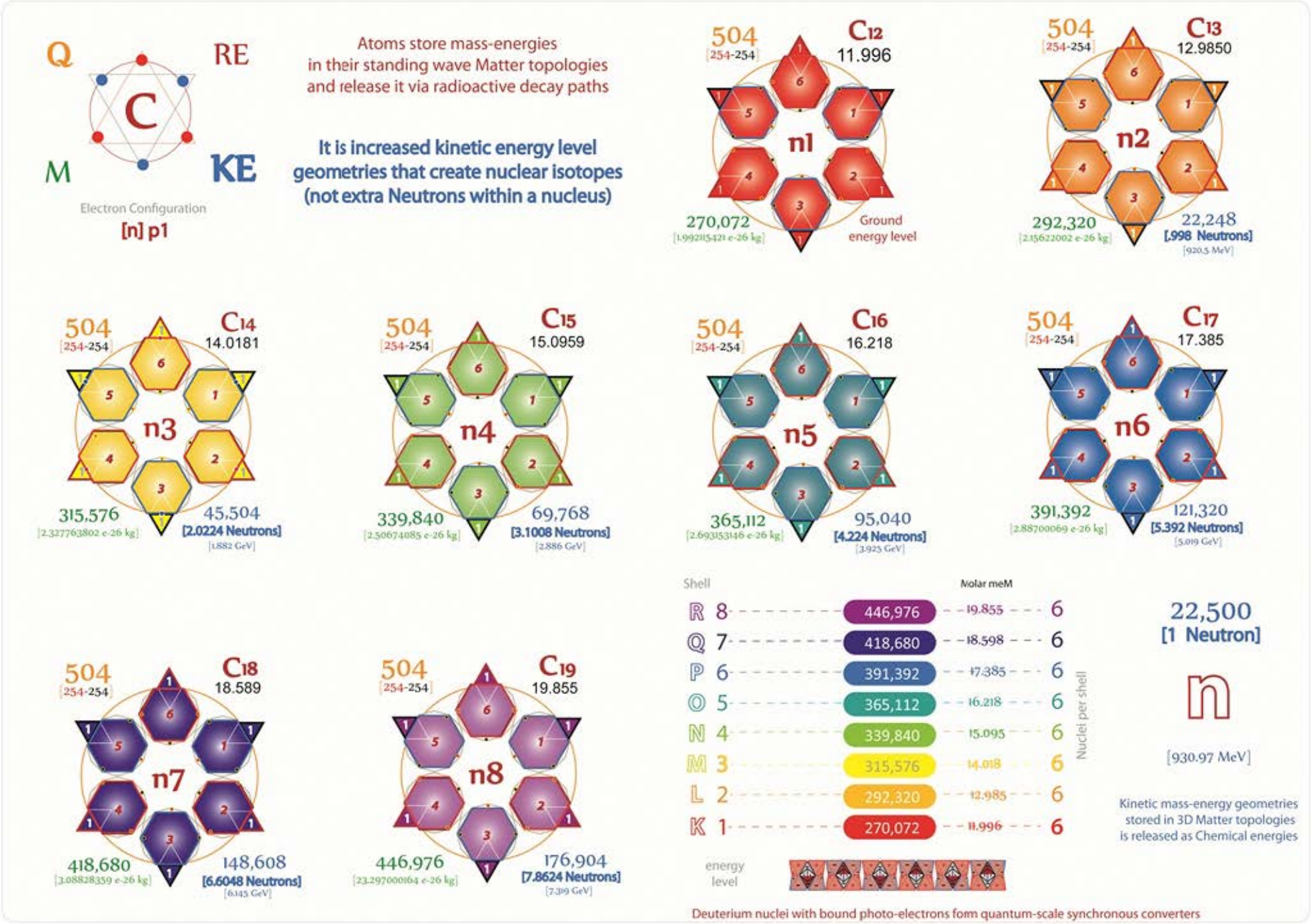

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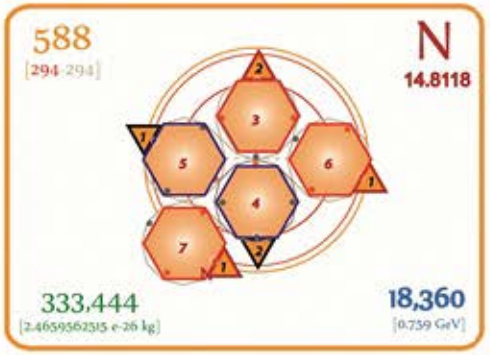

It is increased Nucleonic energy levels that creates Isotopes
(not extra Neutrons within any elementary Nucleus)

Nitrogen gas

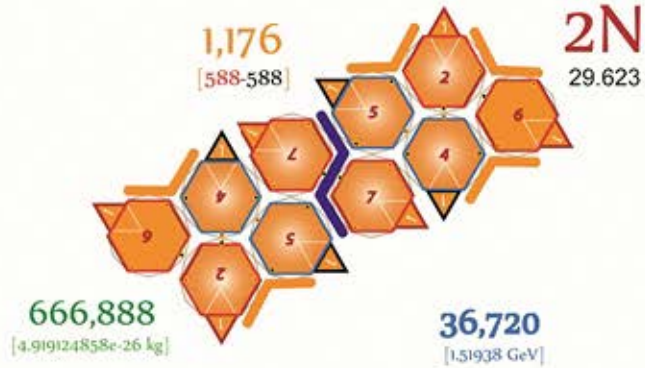

Nitrogen Allotropes & Isotopes

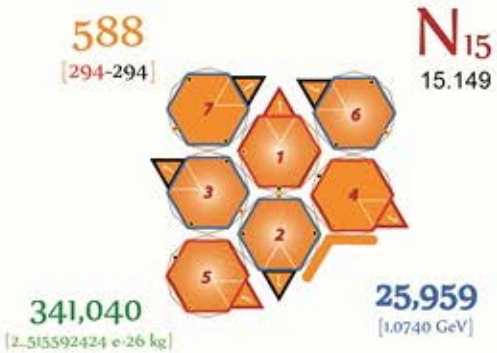

Isotopes are created by increasing the number of Planck mass-energies stored in the standing-wave geometries of chemical elements

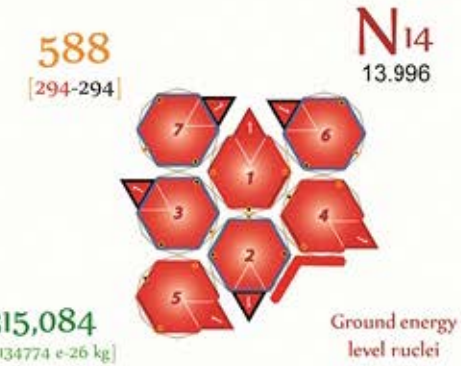

The charged mass-energy geometries of differing allotropic topologies create various chemical bond points

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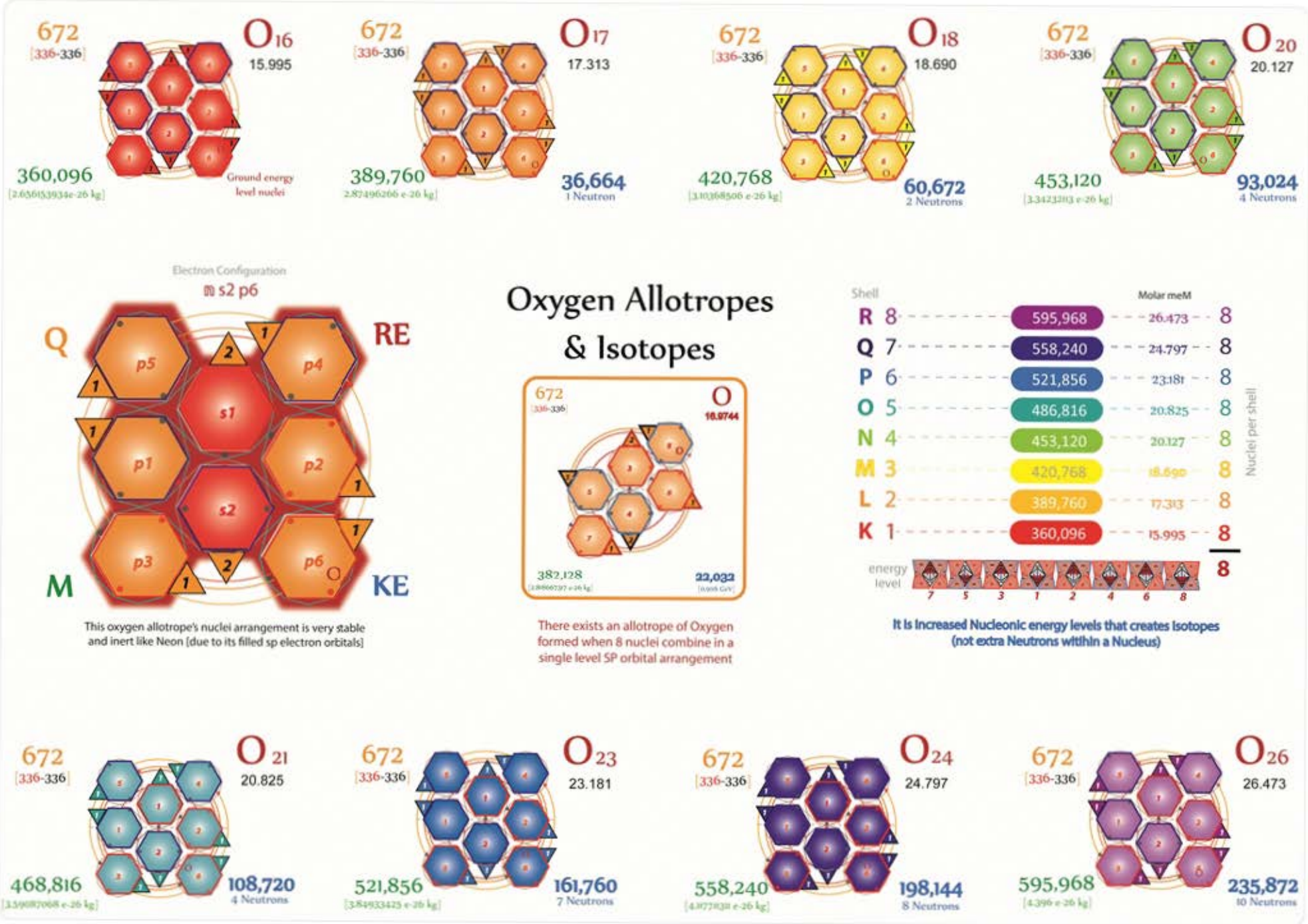

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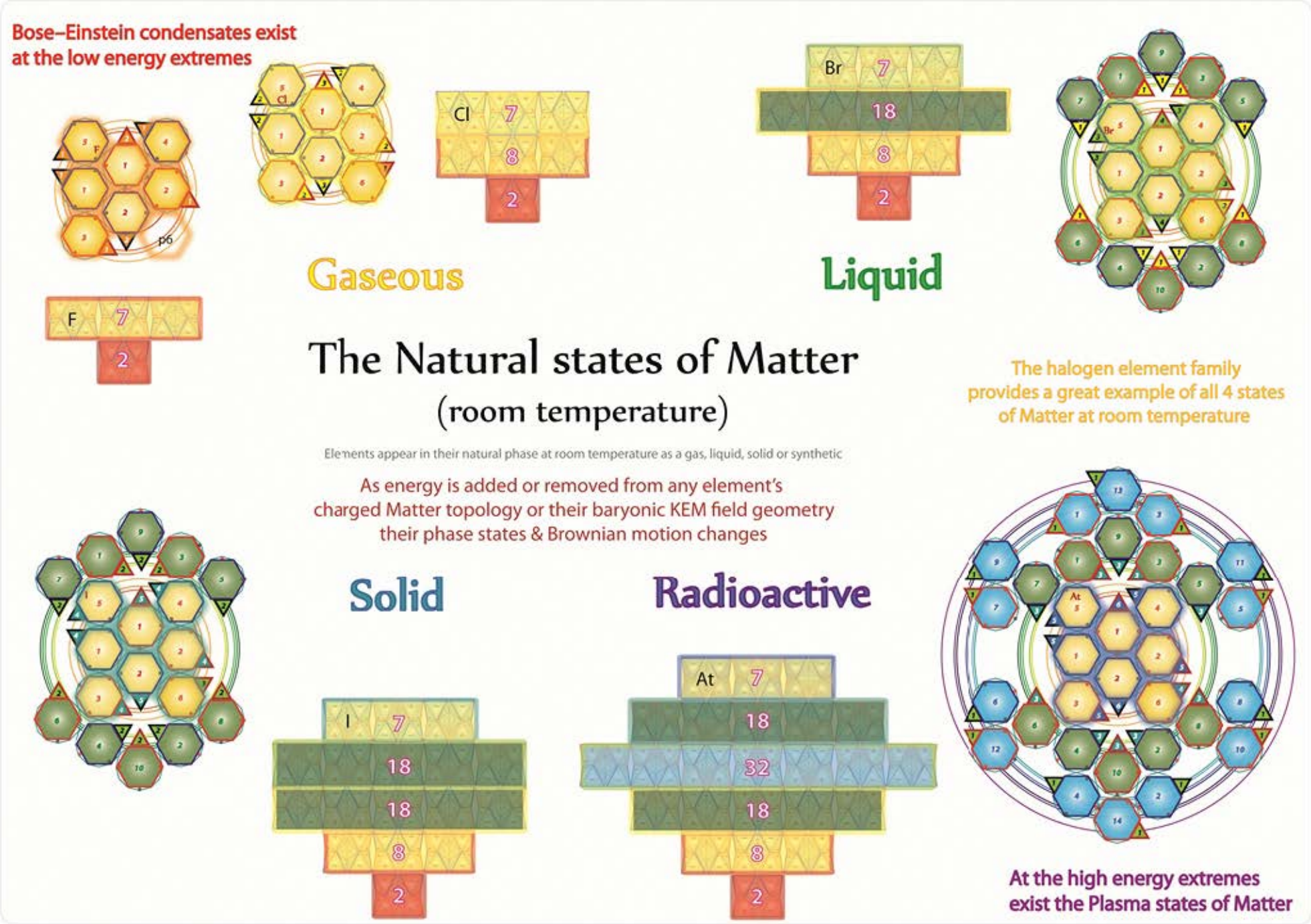

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Chemical bonds

A chemical bond is an attraction between atoms that allows the formation of chemical substances that contain two or more atoms.

Particle charge & Inter-fascia electric interaction provides the foundation of chemical bonds

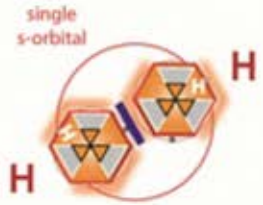

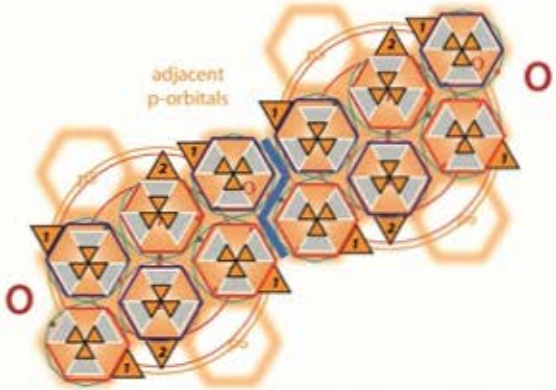

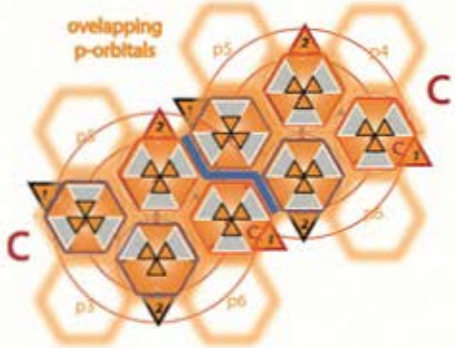

It is usually taught that based on electron sharing principles a single bond contains 2 paired electrons, a double bond has 4 electrons and a triple bond has 6 shared electrons

filled electron shells [weak KEM'ical bonds]

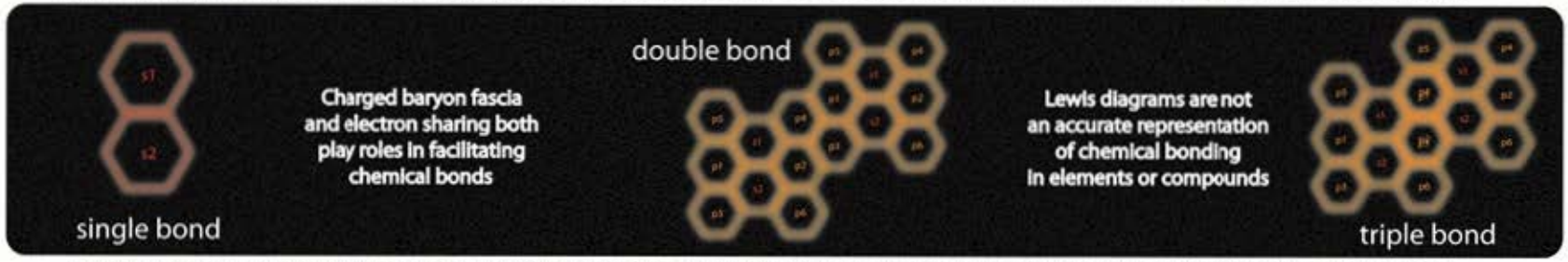

unfilled electron shells [stronger KEM'ical bonds]

Tetryonic geometry provides an advanced quantum topology for all atoms and compounds that is superior to the older Lewis diagrams and even molecular orbital theory, facilitating a clear understanding of the quantum geometry of each element, its nuclear bonds and electron sharing in all compound chemical structures; along with the core & valence electron configurations & interactive electric charge fascia bonding positions for each compound created.

ethane [C2H6]

6 valence electrons

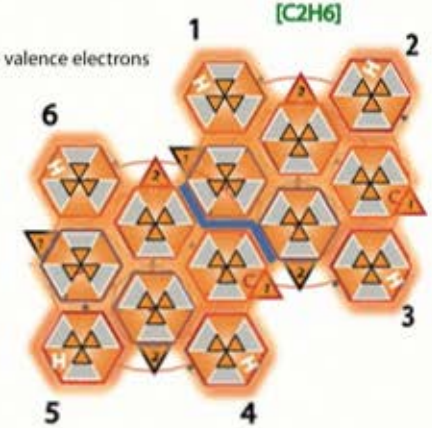

ethene [C2H4]

4 valence electrons

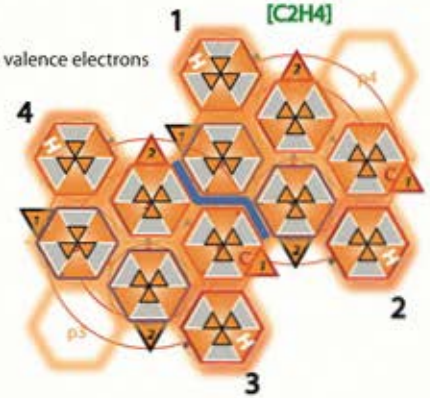

ethyne [C2H2]

2 valence electrons

Valance electrons also play an important role in determining the strength of chemical bonds

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Van der Waals Forces

Van der Waals forces include attractions between atoms, molecules, and surfaces. They differ from covalent and ionic bonding in that they are caused by correlations in the fluctuating polarizations of nearby particles

All charges seek equilibrium

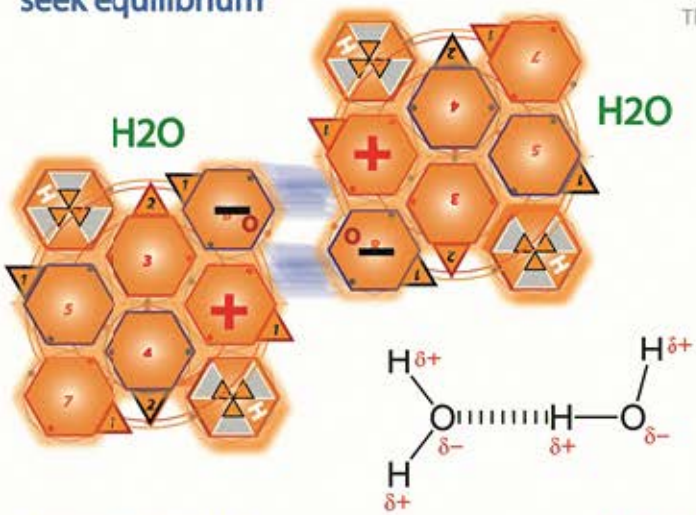

The Forces of interaction can be attractive or repulsive

Van der Walls and London forces are the geometric fields of interaction between charged Matter topologies

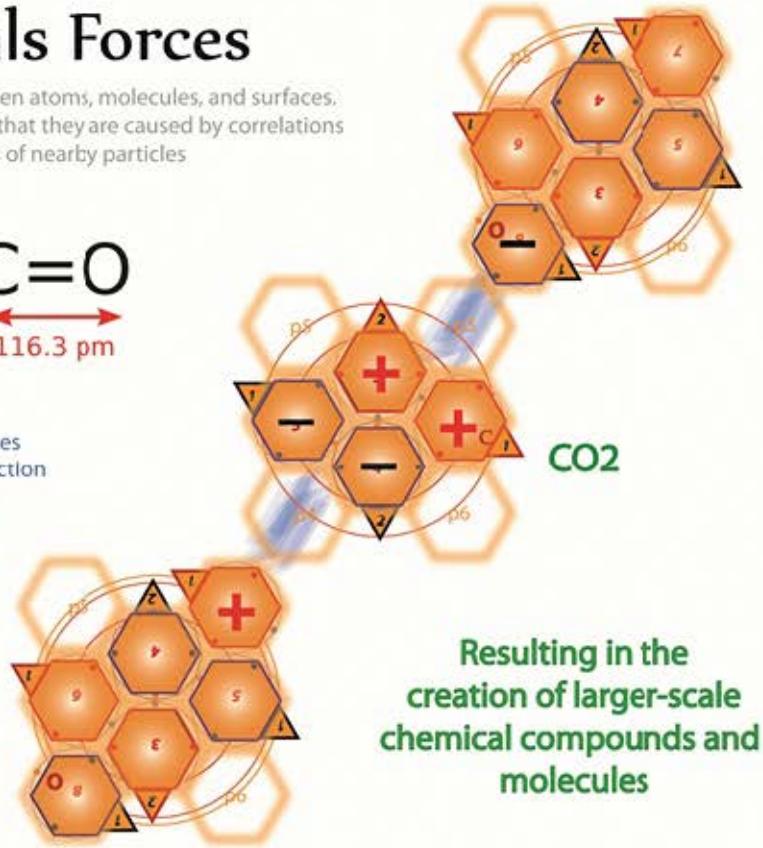

Resulting in the creation of larger-scale chemical compounds and molecules

Residual interactive bonding force between the charged fascia of atoms

This is considered to be the only attractive intermolecular force present between neutral atoms (e.g., a noble gas configurations and charge neutral atomic topologies).

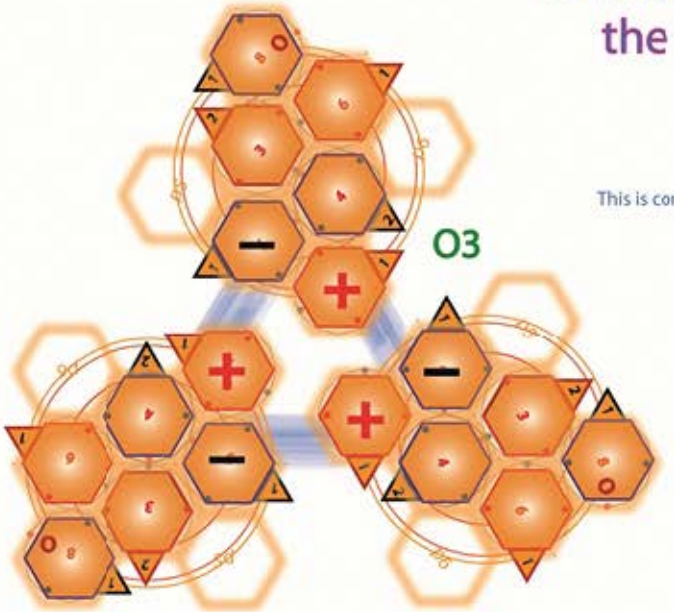

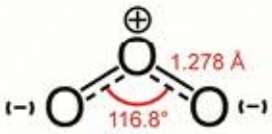

Without London forces, there would be no attractive force between noble gas atoms, and they wouldn't exist in liquid form.

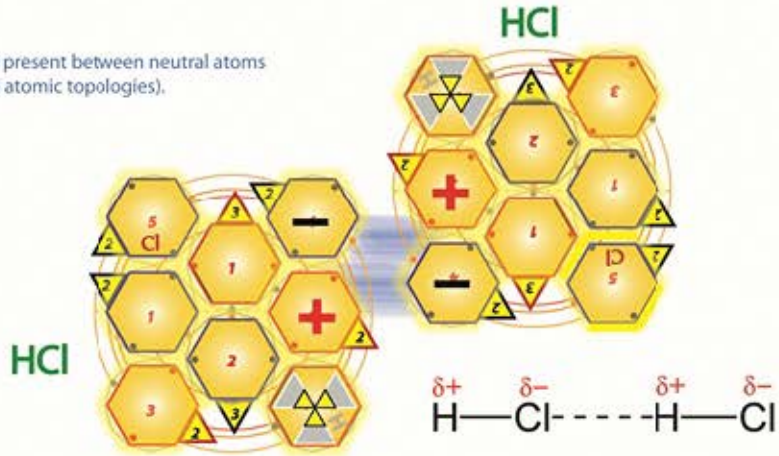

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Lewis Structures

The Lewis structure was named after Gilbert N. Lewis, who introduced it in his 1916 article The Atom and the Molecule.

Lewis structures, also called Lewis-dot diagrams, are diagrams that show the bonding between the atoms of any molecule, and the lone pairs of electrons that may exist in the molecule.

Line drawings can be used to depict molecular geometry:

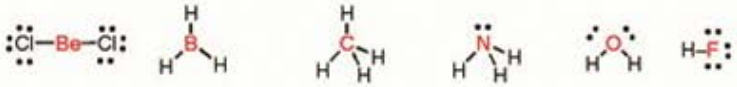

Beryllium dichloride $BeCl_2$ *linear*	Borane BH_3 *trigonal planar*	Methane CH_4 *tetrahedral*	Ammonia NH_3 *trigonal pyrimidal*	Water H_2O *bent*	Hydrofluoric acid HF *linear*

Also applies to molecules with multiple bonding:

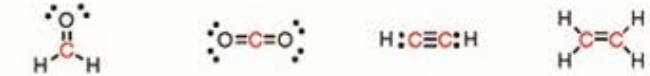

methanal (formaldehyde) *trigonal planar*	Carbon dioxide *linear*	ethyne (acetylene) *linear*	ethane (ethylene) *both carbons are trigonal planar*

Hydrogen is a 'free radical' atom whose energy can be changed to facilitate chemical bonding between elements

Tetryonic geometry uses the charged geometry of the element fascia themselves

to show the bonds and charge interactions between differing elements as they form larger compounds

as well as the actual final quantum topology of compound elements and molecules

They are similar to electron dot diagrams in that the valence electrons in lone pairs are represented as dots, but they also contain lines to represent shared pairs in a chemical bond (single, double, triple, etc.).

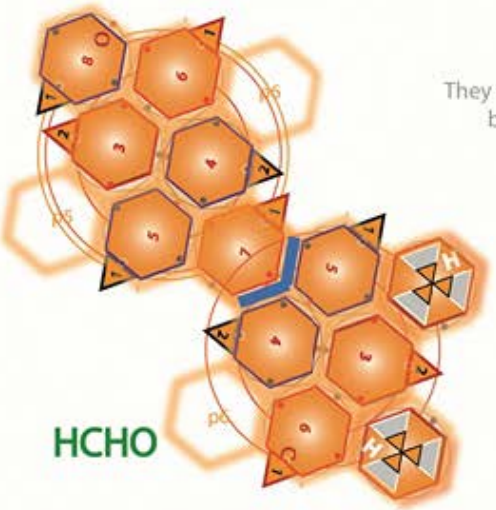

single fascia bond

double fascia bonds

triple fascia bond

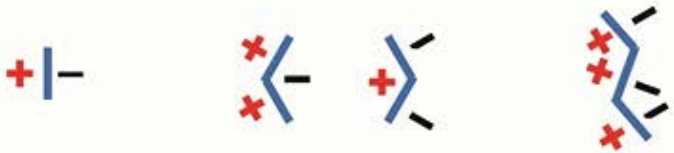

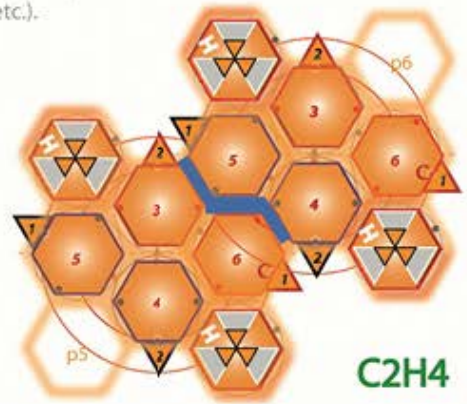

it is the electric field fascia of baryons that facilitates chemical bonds

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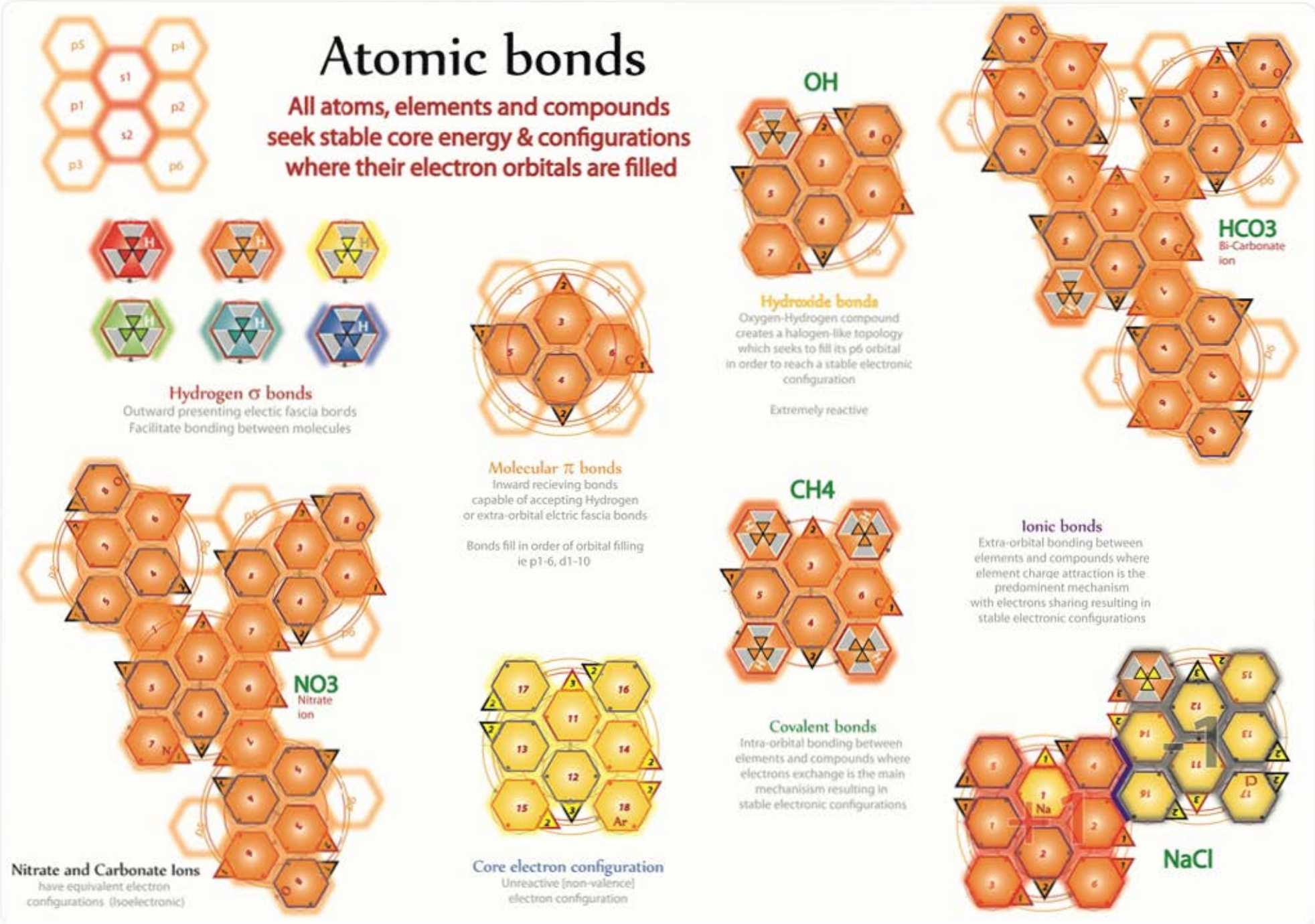

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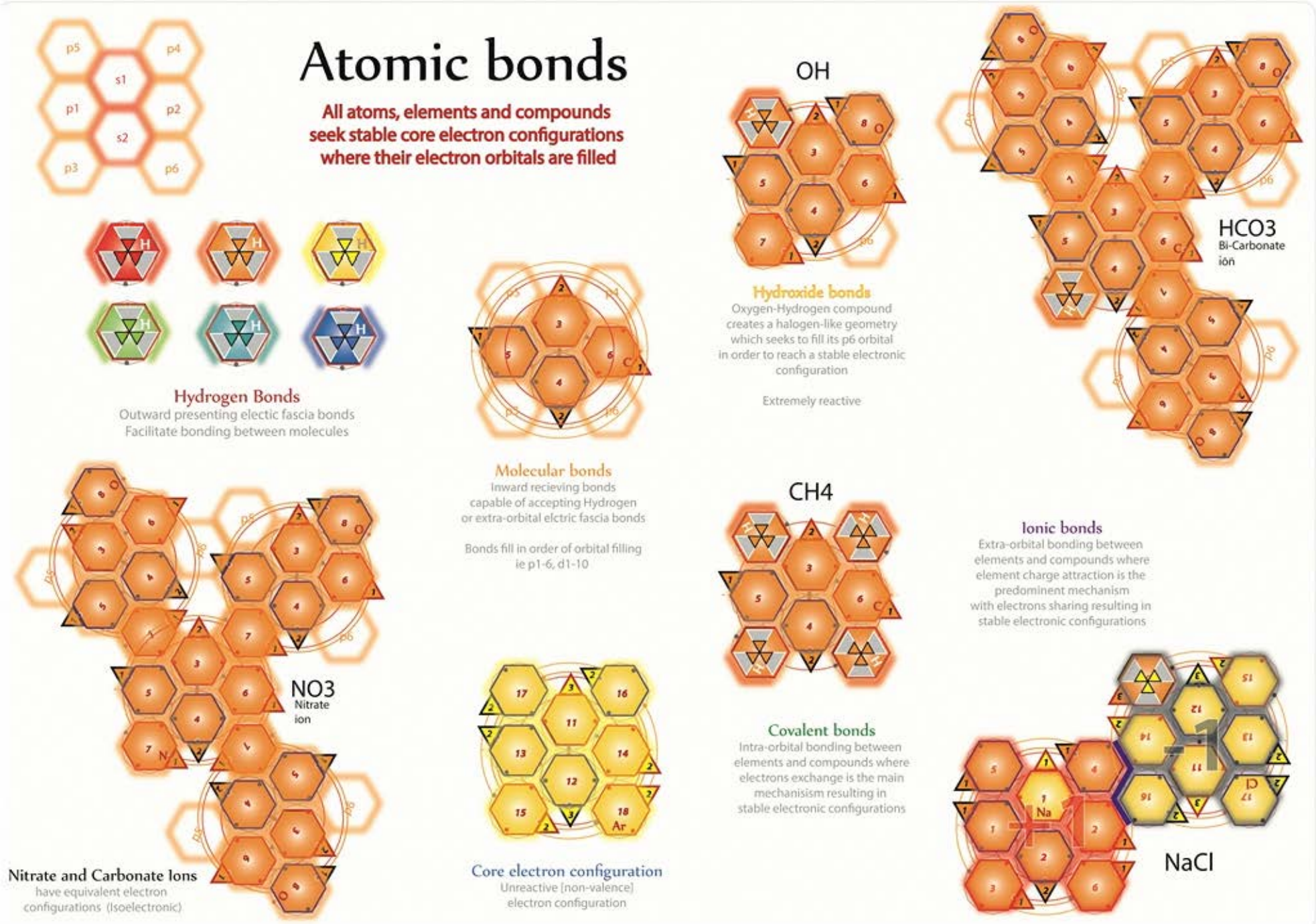

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[He] 2s2 2p6
2

[Ne] 3s2 3p6
10

[Ar] 3d10 4s2 4p6
18

CORE ELECTRON configurations

			[He]
L	1s2	2s2 2p6	[Ne]
M	1s2 2s2 2p6	3s2 3p6	[Ar]
N	1s2 2s2 2p6 3s2 3p6 3d10	4s2 4p6	[Kr]
O	1s2 2s2 2p6 3s2 3p6 3d10 4s2 4p6 4d10	5s2 5p6	[Xe]
P	1s2 2s2 2p6 3s2 3p6 3d10 4s2 4p6 4d10 4f14 5s2 5p6 5d10	6s2 6p6	[Rn]
Q	1s2 2s2 2p6 3s2 3p6 3d10 4s2 4p6 4d10 4f14 5s2 5p6 5d10 5f14 6s2 6p6 6d10	7s2 7p6	[Uuo]

The term "core electrons" or "noble gas core" refers to the electrons within the atom which have the same electron configuration as the nearest noble gas of lower atomic number and contain filled s&p orbitals

'Nobel Gas' configuration
full s,p orbitals

'core electron' configurations are present in energy levels L [2] - [7] Q

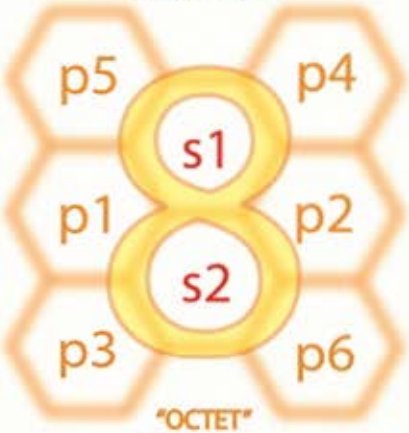

electrons not in filled or complete atomic orbitals are valence electrons

"OCTET"
No valance

Using core electron notation greatly reduces complexity of the electron configuration notations of larger elements in the periodic table

[Ub] 120	1s2	2s2 2p6	3s2 3p6 3d10	4s2 4p6	5s2 4d10 5p6	4f14 5d10 6s2 6p6	5f14 6d10 7s2 7p6	8s2
	2	8	18	32	32	18	8	2

They are the electrons in the inner part of the atom that are not valence electrons and therefore do not participate in bonding

[Uuo] 8s2
118

[Kr] 4d10 5s2 5p6
36

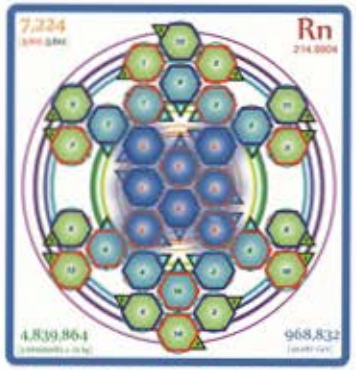

[Xe] 4f14 5d10 6s2 6p6
54

[Rn] 5f14 6d10 7s2 7p6
86

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Core electron configurations

Core electrons are the electrons in an atom that are not valence electrons and therefore do not participate in bonding.

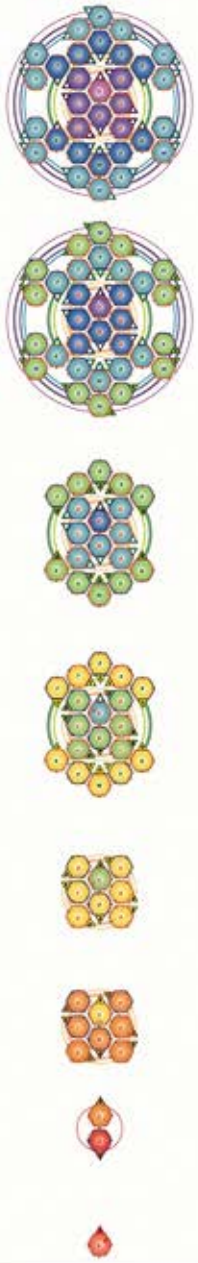

Reactive

Elements with more nuclei than the core configurations are reactive

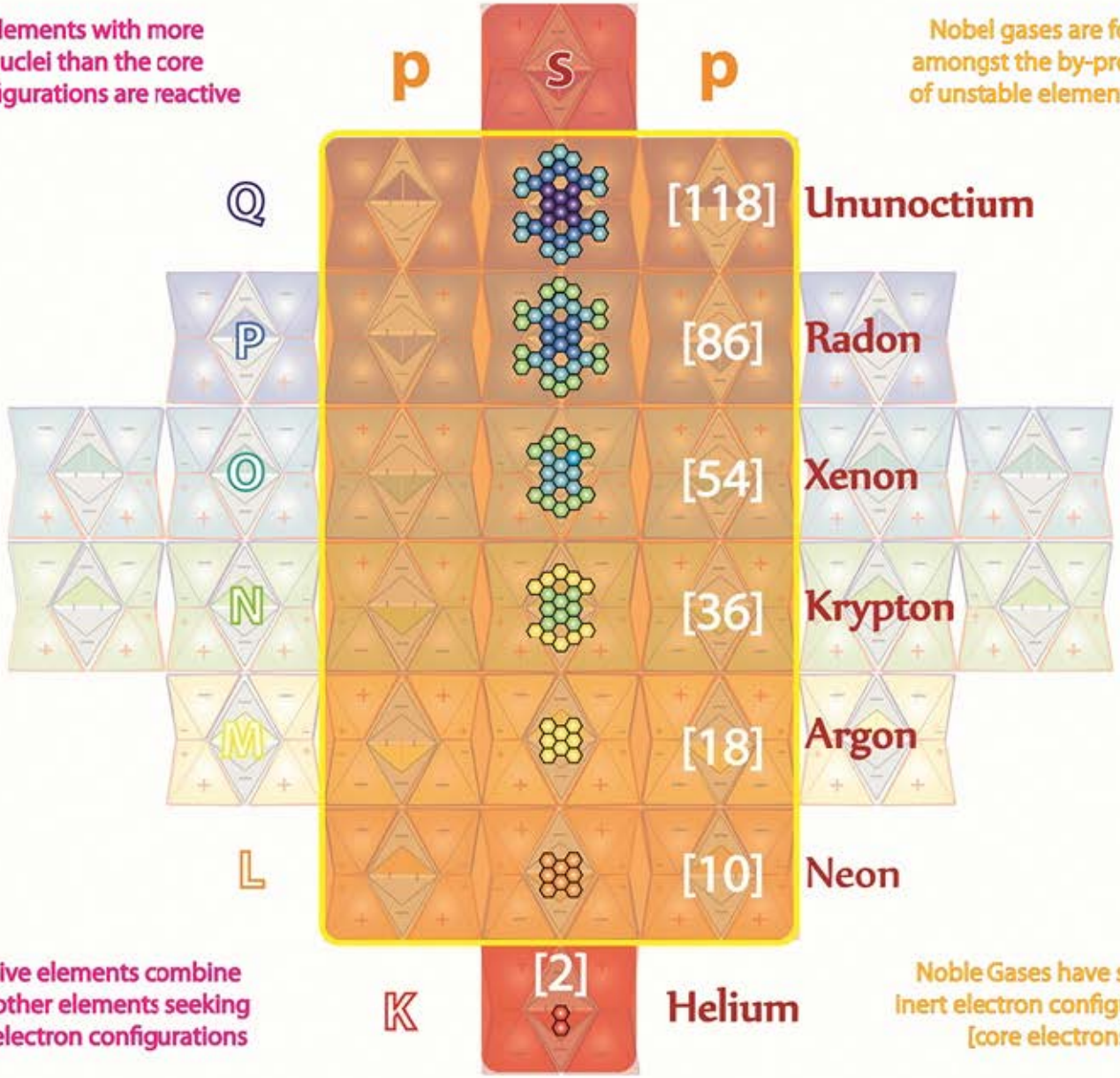

Nobel gases are found amongst the by-products of unstable element decay

Reactive elements combine with other elements seeking core electron configurations

Noble Gases have stable inert electron configurations [core electrons]

Inert

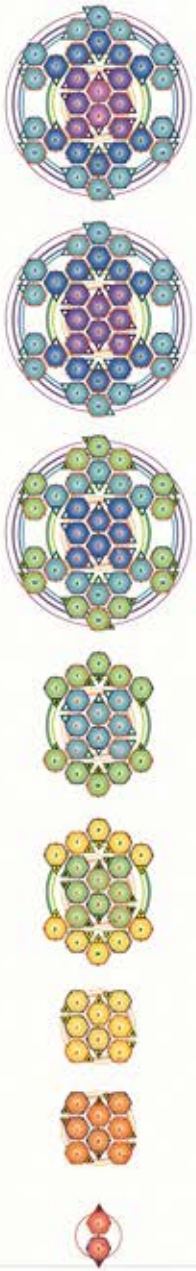

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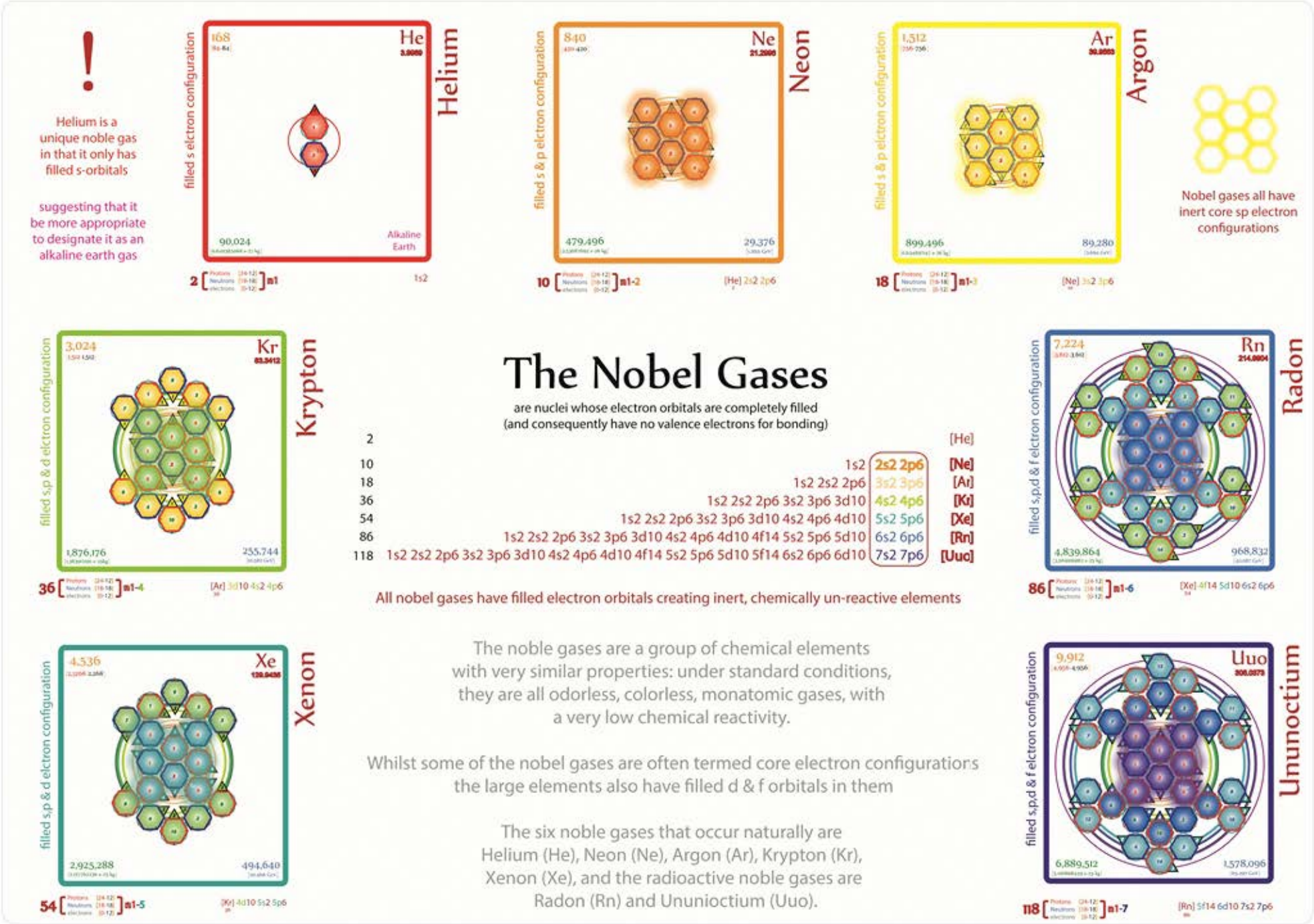

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Molecular Bonds

Hydrogen bonds

A weak, primarily electrostatic, bond between a hydrogen atom bound to a highly electronegative element in a given molecule and a second highly electronegative atom in another molecule

Diatomic bonds are fascia interactions between molecules with the same nuclei number [O2, F2, I2, Cl2]

Sigma bonds

The residual EM force between opposite charge fascia in nuclei holds individual nuclei together in turn resulting in larger molecules and compounds

Pi bonds

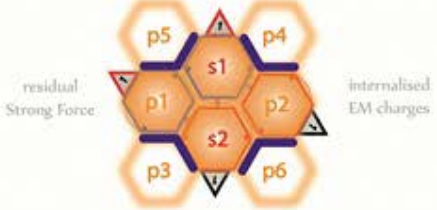

Molecular bonds

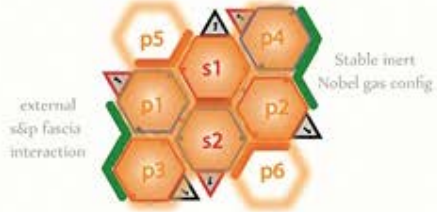

A molecular bond is an attractive force between nuclei that allows two or more elements or atoms to combine into a singular, complex compound structure

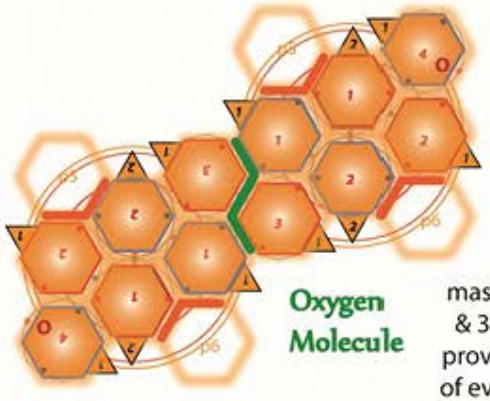

Oxygen Molecule

Tetryonic mass-energy geometries & 3D Matter topologies provide for the modelling of even the most complex chemical bonding arrangements

Hydrogen Sulfate Molecule

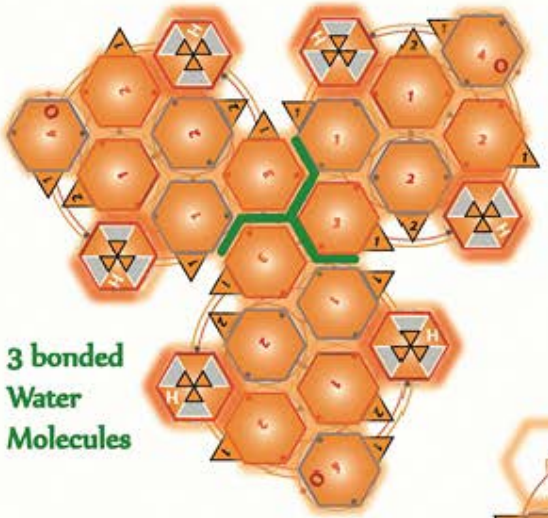

3 bonded Water Molecules

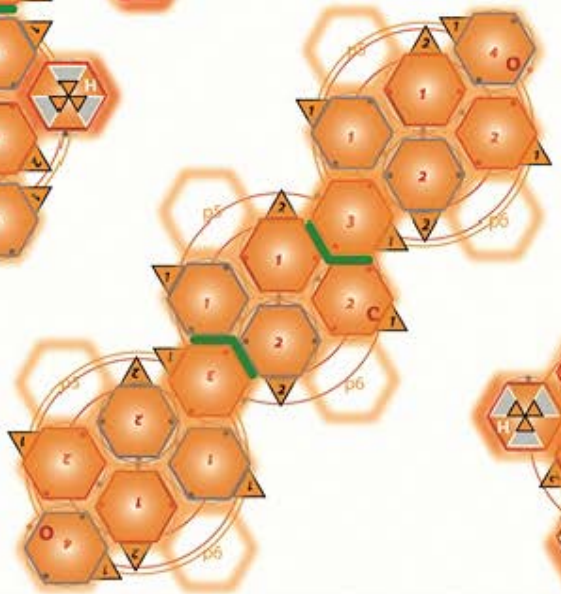

Carbon Dioxide Molecule

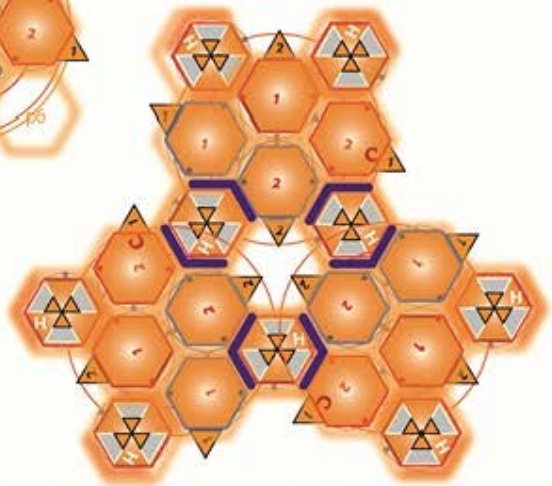

Trishexane Molecule

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Covalent bonds are chemical links between two atoms in which electrons are shared between them.

Sigma bonds are covalent bonds formed by direct overlapping of two adjacent atom's outermost orbitals.

Note: sigma bonds can be formed by the bonding of either s-orbitals [or two adjacent p-orbitals]

A pi bond is a covalent bond formed between two neighboring atom's unbonded p-orbitals.

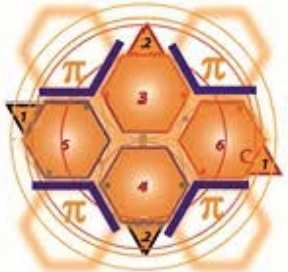

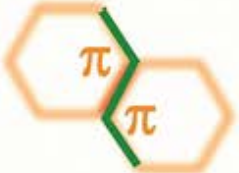

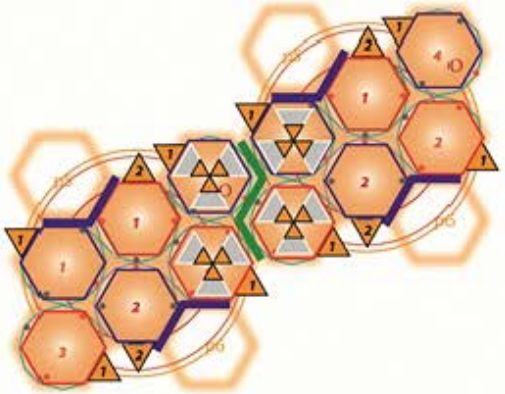

Double and triple bonds between atoms are usually made up of a single sigma bond and one or two pi bonds

π—σ—π

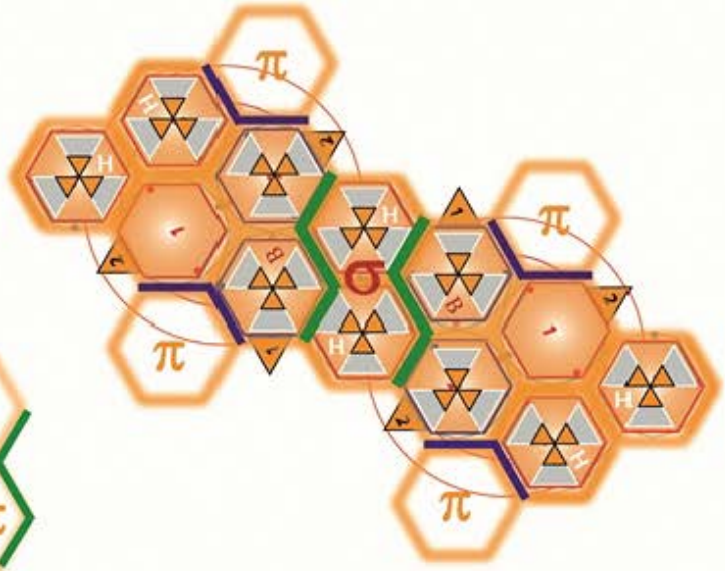

Lewis electron dot diagrams fail to illustrate reality in that molecules exist as 3D objects and not as a two dimensional systems as shown by them.

Tetryonic geometry & topologies provide a polar view of 3D atomic nuclei that can be viewed as an exact representation of what a molecule & its bonds would look like when viewed from above.

Sigma & Pi covalent bonds

The single electrons from each atom's p orbital combine to form an electron pair creating the sigma bond.

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Alkali Metals

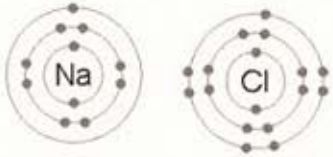

Valence electrons

are the highest energy electrons in an atom forming the outermost electrons of an atom, and are important in determining how the atom reacts chemically with other atoms

Historically, the number of valence electrons was reflected by the element's group number in the Mendeleev table and formed the basis of elemental families

Tetryonic topologies now replace the older, incorrect models of valence electron configurations with the full 3D modelling of all atoms, elements & compounds

[zz] are core electron configurations

providing a superior visual means of accurately determining the energies and position of any electron in chemical compounds and determining the valence numbers

Halogens

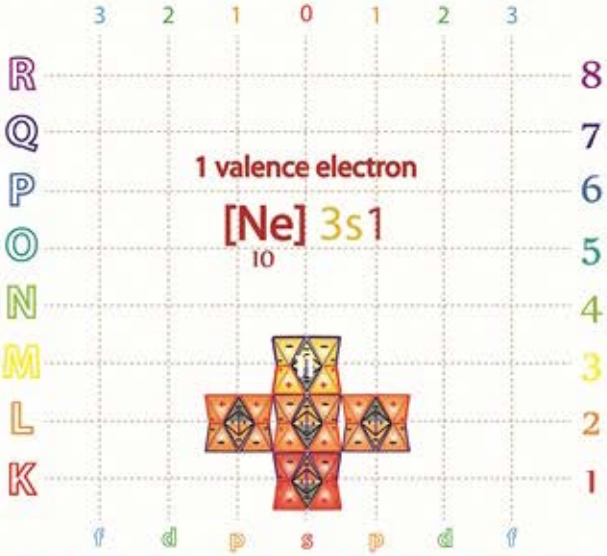

Atoms with more electrons than a closed shell are also highly reactive, as the extra valence electrons are easily removed from that orbital (to form a positive ion)

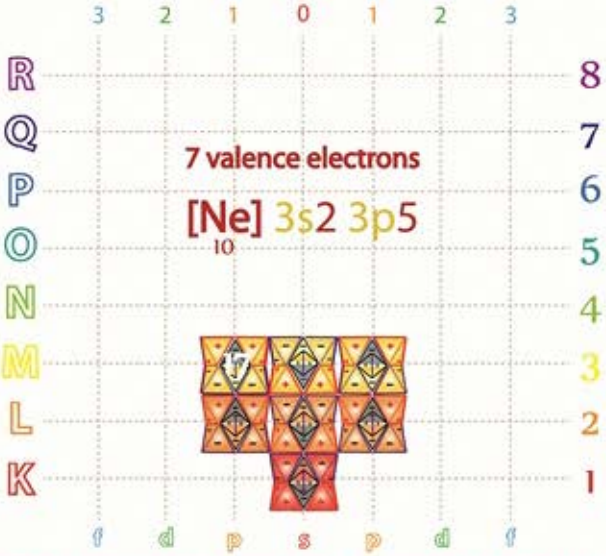

Atoms one or two valence electrons short of a closed shell are highly reactive, due to their tendency to seek to gain the missing valence electrons (thereby forming a negative ion)

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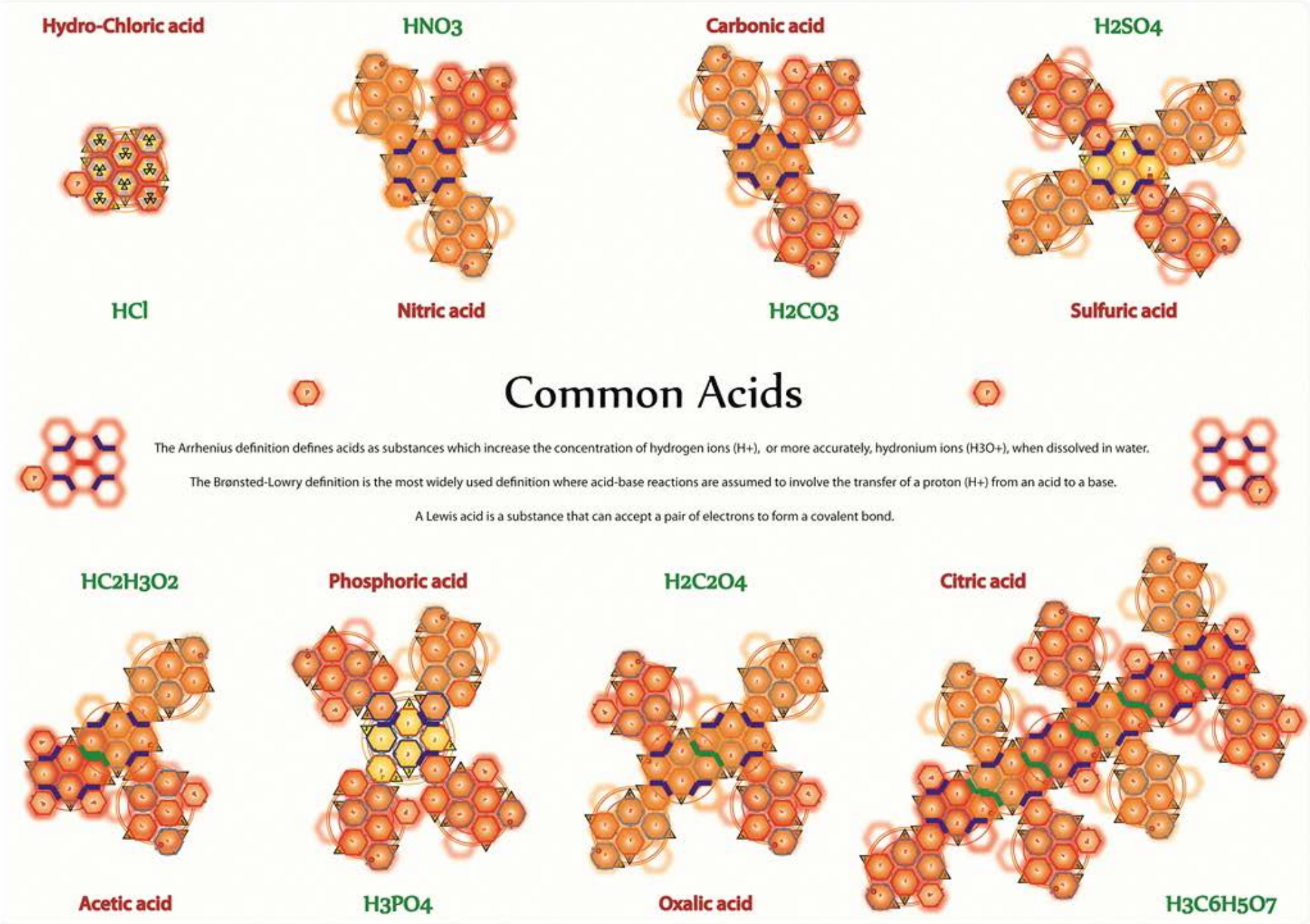

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Chemical reactions

Valence Bonds & Molecular orbitals

A chemical reaction is a process that leads to the transformation of one set of chemical substances to another.

Valence bond theory focuses on how the atomic orbitals of the dissociated atoms combine in molecular formations to give rise to individual chemical bonds.

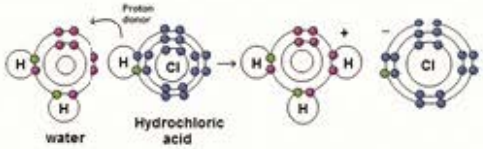

In contrast, molecular orbital theory has orbitals that are designed to cover the whole molecule but is mathematically more complex in application

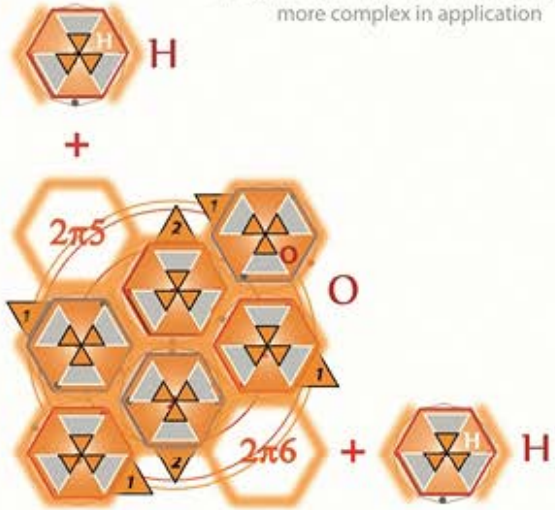

6 valence electrons
2 [n2] valence bonds available
(8 electron stable configuration)

7 valence electrons
1 [n3] valence bond available
(8 electron stable configuration)

In order to form Hydro-chloric acid [HCl aq] and bond with similar water [H2O] molecules, the n2 Hydrogen atom's energy must be raised so it can migrate to the [3π6] orbital and bond

[n2] Hydrogen atom cannot bond in the [3π6] valence position so in HCl gas it forms a [n2] di-atomic bond instead and its electron migrates to the [π6] orbital

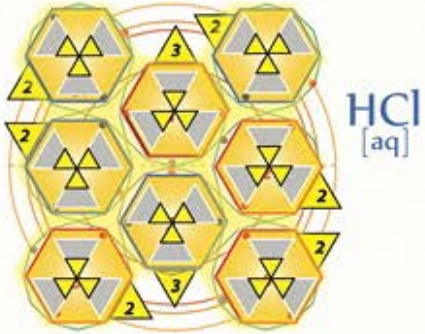

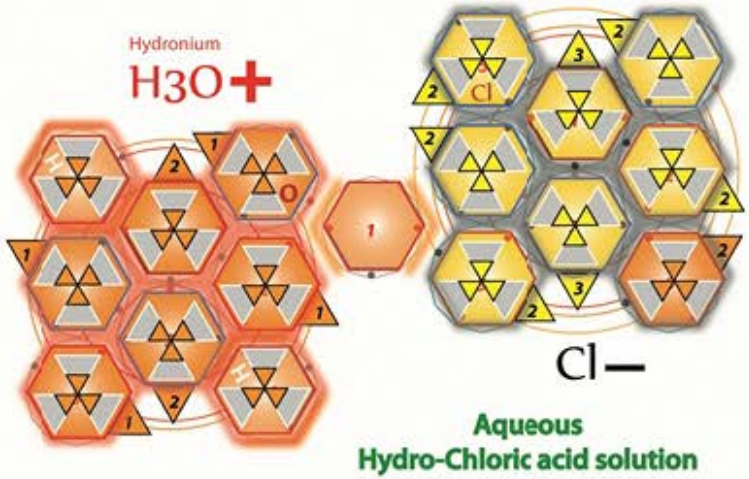

Tetryonic theory replaces both VB & MO theories by modelling the physical quantum charge topologies and rest mass-energy geometry of all elements and compounds

Valence configurations seek to create stable filled obital configurations

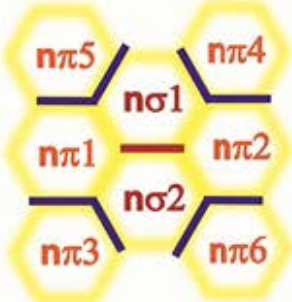

Building on exisiting electron configuration nomenclature tetryonic theory provides a new bonding schema for elements and complex compounds alike that is fully reflective of the physical quantum charge interactions

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Ionic Bonding

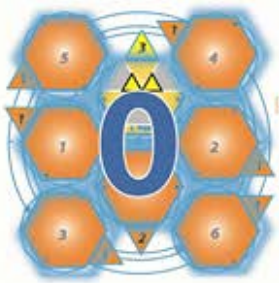

960
[480-480]

Alkaline Metal

Sodium atom gives up an electron in order to create a stable [Ne] nobel gas configuration

Sodium atom develops into a nett POSITIVE charge ion

948
[480-468]

2,424
[1,212-1,212]

NaCl

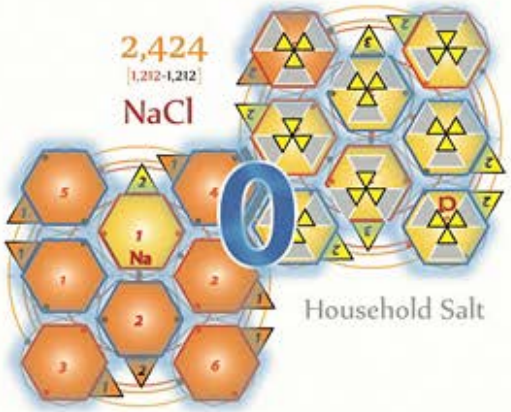

Household Salt

Resultant salt [NaCl] molecule has a NEUTRAL charge with the n3 electron migrating to fill the 3p6 orbital

Chlorine atom seeks an electron to order to create a stable [Ar] nobel gas configuration

OPPOSITES ATTRACT

1,476
[732-744]

Chlorine atom develops into a nett NEGATIVE charge ion

Halogen

1,464
[732-732]

All atoms and molecules seek equilibrium via stable electron configurations

In short, it is a bond formed by the attraction between two oppositely charged ions.

An ionic bond (or electrovalent bond) is a type of chemical bond that can often form between metal and non-metal ions (or polyatomic ions such as ammonium) through electrostatic attraction.

The metal donates one or more electrons, forming a positively charged ion or cation with a stable electron configuration. These electrons then enter the non metal, causing it to form a negatively charged ion or anion which also has a stable electron configuration. The electrostatic attraction between the oppositely charged ions causes them to come together and form a bond.

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Valence electron rules

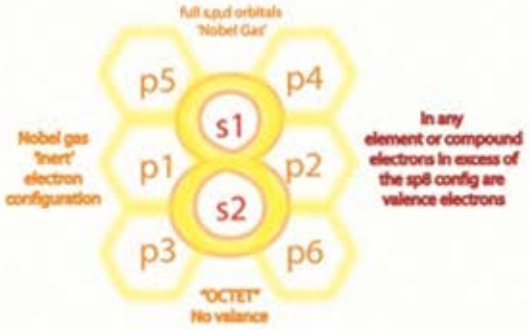

sp8 - core electron orbital grouping

Tetryonic quantum charge topologies provide the complete picture

Valence electrons are the highest quantum level electrons in elemental or compound atom nuclei in excess of the core sp8 'noble gas' electron configuration

They are located in the outer most shells (ie K-Q or Quantum 1-7) making them easily ionised from the elemental nuclei

s 1-2 [electron orbital pair]
p 1-2, 3-4, 5-6 [electron orbital pairs]
d 1-2, 3-4, 5-6, 7-8, 9-10 [electron orbital pairs]
f 1-2, 3-4, 5-6, 7-8, 9-10, 11-12, 13-14 [electron orbital pairs]

Valance electron congigurations always include 's' orbital electrons due to their higher quantum levels

Developed from Lewis diagrams
is usually only useful for elements Z<20

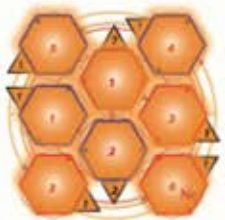

Neon
[He] 2s2, 2p6

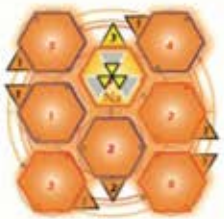

Sodium
[Ne] 3s1
Valence - 1

Fluorine
[He] 2s2, 2p5
Valence - 7

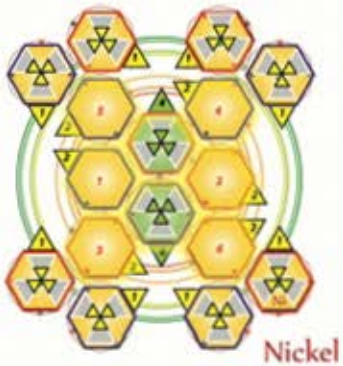

Nickel
[Ar] 3d8, 4s2
Valence - 10

Gold
[Xe] 4f14, 5d9, 6s2
Valence - 11

Scandium
[Ar] 3d1, 4s2
Valence - 3

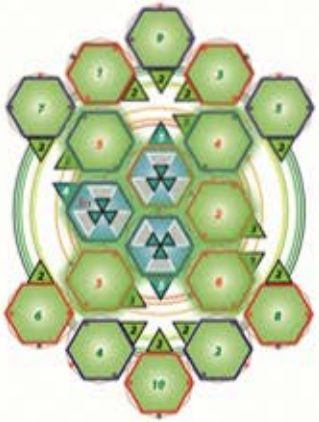

Indium
[Kr] 4d10, 5s2, 5p1
Valence - 3

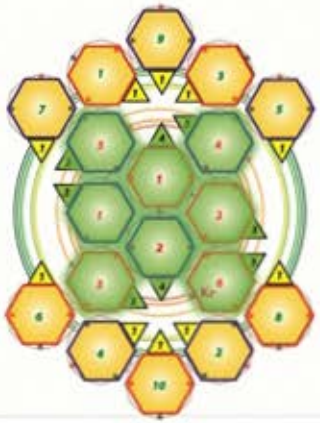

Krypton
[Ar] 4s2, 4p6

Mercury
[Xe] 4f14, 5d10, 6s2

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Filled electron orbitals

Once 8 valence electrons are reached a stable valence cofiguration is created

Once sub-orbit 8 (P7-8) is reached sequential valence numbering switches to paired valence numbering (as per orbital energies)

Valence numbers can be calculated by adding the 2 highest energy orbitals together (and subtracting 8 - if the total is higher than 8)

The octet rule is a simple chemical rule of thumb that states that atoms tend to combine in such a way that they each have eight electrons in their valence shells, giving them the same electronic configuration as a noble gas.

The rule is applicable to the main-group elements, especially carbon, nitrogen, oxygen, and the halogens, but also to metals such as sodium or magnesium. In simple terms, molecules or ions tend to be most stable when the outermost electron shells of their constituent atoms contain eight electrons.

In short, an element's valence shell is full and most stable when it contains eight electrons, corresponding to an s2p6 electron configuration.

CORE ELECTRONS

This stability is the reason that the noble gases are so unreactive, for example neon with electron configuration 1s2 2s2 2p6. (Helium is an exception as explained).

Note that a "full shell" means that there are the eight electrons in the valence shell when the next shell starts filling, even though higher subshells (d, f, etc.) have not been filled.

There can be at most eight valence electrons in a ground-state atom because p subshells are always followed by the s subshell of the next shell.

OCTET RULE

This means that once there are 8 valence electrons (when the p subshell is filled), the next additional electron goes into the next shell, which then becomes the valence shell.

A consequence of the octet rule is that atoms generally react by gaining, losing, or sharing electrons in order to achieve a complete octet of valence electrons. Reaction of atoms occurs primarily in two ways: ionically and covalently.

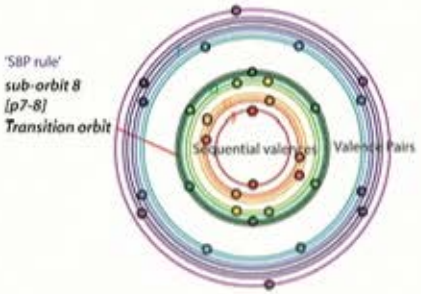

Once 8 valence electrons are reached the sub-orbits are stable and form a stable, non-reactive valence configuration.

Additionally, valence numbers proceed sequentially (1,2,3,4,5,6,7) up to sub-orbit 8 (P7-8) at which point all sub-orbit valences number in valence pairs (1-2, 3-4, 5-6, 7-8, 9-10, 11-2, 13-14)

The siginificance is that sub-orbit 8 is the middle sub-orbit (of 16 total sub-orbits possible)

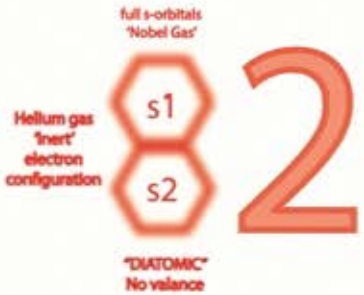

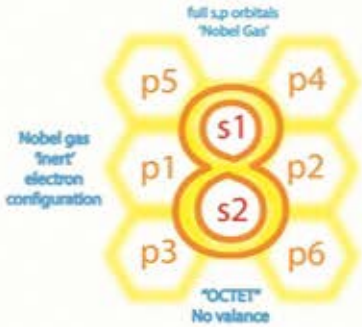

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ACID

Hydrochloric acid is a clear, colourless solution of hydrogen chloride in water, it is a highly corrosive, strong mineral acid

Aqueous Hydro-Chloric acid solution

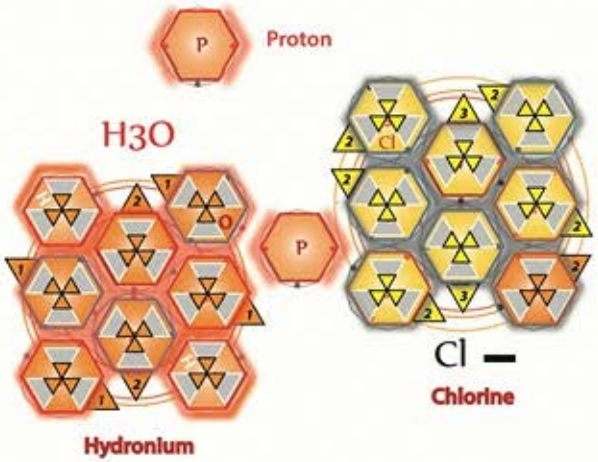

The H(+) cation of the acid combines with the OH(-) anion of the base to form water.

combining the free Protons & electrons

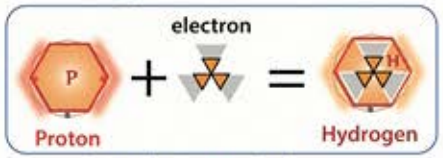

neutralises the ions and releases energy

all charges seek equilibrium

When an acid and a base are placed together, they react to neutralize the acid and base properties, producing a salt.

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

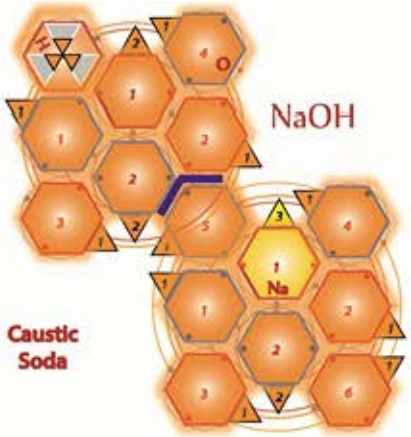

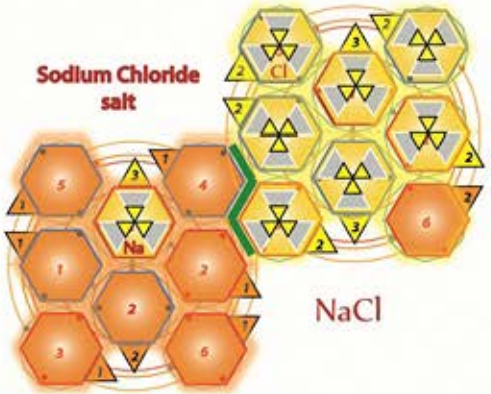

The compound formed by the cation of the base and the anion of the acid is called a salt.

BASE

Sodium hydroxide, also known as caustic soda, or lye, has the molecular formula NaOH and is a highly caustic metallic base and alkali salt.

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Geometric Molecular Topology

Molecules are most often held together with covalent bonds involving single, double, and/or triple bonds, where a "bond" is a pair of electrons shared between elements as they seek equilibrium (another method of bonding is ionic bonding and involves a positive cation and a negative anion).

Hydrogen

A Hydrogen bond is a chemical bond in which a hydrogen atom of one molecule is attracted to an electronegative atom, especially nitrogen, oxygen, or flourine atoms, usually of another molecule

The hydrogen bond is often described as an electrostatic dipole-dipole interaction.

However, it also has some features of covalent bonding: it is directional and strong, acting over interatomic distances shorter than that of van der Waals radii

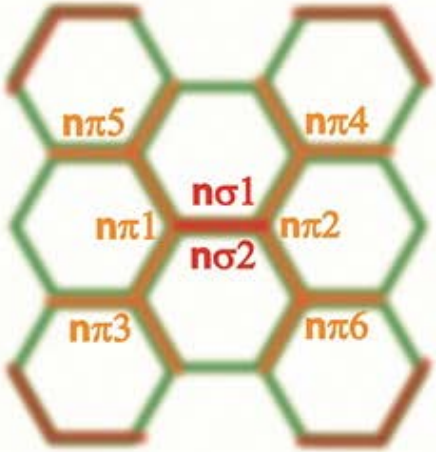

Oxygen

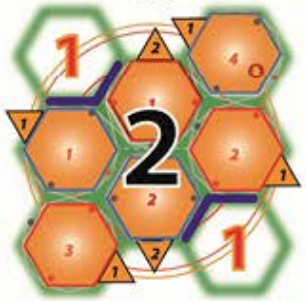

The oxidation state of oxygen is −2 in almost all known compounds

Oxides of Oxygen & oxygen molecules are found throughout the range of Organic & inorganic compounds

All molecules seek KEM'ical charge and energy equilibrium

Geometric Molecular Topology is the overall arrangement of the atoms in a molecule, where the bonded atoms in a molecule are responsible for determining the final molecular topology of a chemical system of bonded elements.

As the numbers of atoms in molecules increases, the quantum molecular topology of a system grows increasingly complex and can only be modelled accurately using Tetryonic charged geometries

by bonding together and forming larger complex molecules

Common nitrogen functional groups include: amines, amides, nitro groups, imines, and enamines.

Compounds of Carbon form the 'backbones' of Organic & inorganic compounds

Molecular Octets

The concept of the Expanded Octet occurs in any system that has an atom with more than four electron pairs attached to it.

Most commonly, atoms will expand their octets to contain a total of five or six electron pairs, in total. In theory, it is possible to expand beyond those number.

The large amounts of negative charge concentrated in small volumes of space prevent those larger expanded octets from forming.

When an atom expands its octet, it does so by making use of empty d-orbitals that are available in the valence level of the atom doing the expanding.

The atom that expands its octet in a structure will usually be located in the center of the structure and the system will not use any multiple bonds in attaching atoms to the central atom.

Nitrogen

Carbon

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48
[24-24]

96
[48-48]

1 Proton
1 electron

48
[24-24]
Hydrogen

Hydrogen
48
[24-24]

84
[42-42]
Deuterium

Deuterium
84
[42-42]

168
[84-84]

2 Protons
2 Neutrons
2 electrons

bonds

Hydrogen

H

Hydrogen is a 'free radical' atom

H2 has a smaller s-orbital [lower energy level] compared to Helium

Deuterium is the building block of elements

H + H

e- p+ Hydrogen atom

e- p+ Hydrogen atom

Hydrogen atoms → form Covalent bonds

H_2

di-atomic Hydrogen

Hydrogen, bound mostly to carbon and nitrogen, is part of almost every molecule in your body: DNA proteins, sugars, fats.
Hydrogen bonds - which form between atoms that "share" a hydrogen atom, is one of the most important interactions that makes biological molecules behave as they do.

0
[48-48]

0
[24-24]

0
[24-24]

2 Protons
2 electrons

Hydrogen bonds are sigma bonds

s1
σ
s2

note: n2 energy level Hydrogen is illustrative only
[Hydrogen bonds can be of any energy level]

0
[24-24]

0
[48-48]

2 Protons
2 electrons

0
[24-24]

The charged fascia of Baryonic quarks facilitates chemical [hydrogen] bonding in molecules

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Carbon Compounds

504
[252-252]

Carbon can bond in four places, and it can bond to itself so it's easy to make lots of different molecules.

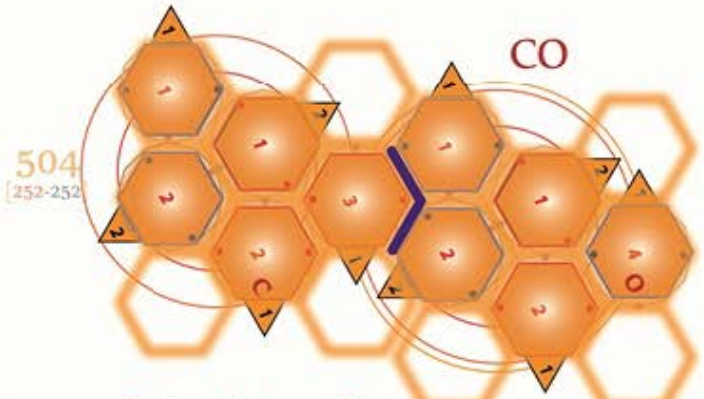

Carbon Monoxide Molecule

[He] 2s2 2p2

Many carbon compounds are essential for life as we know it.
Some of the most common carbon compounds are: carbon dioxide (CO_2), carbon monoxide (CO), carbon disulfide (CS_2), chloroform ($CHCl_3$), carbon tetrachloride (CCl_4), methane (CH_4), ethylene (C_2H_4), acetylene (C_2H_2), benzene (C_6H_6), ethyl alcohol (C_2H_5OH) and acetic acid (CH_3COOH) to name just a few.

Acetylene Molecule

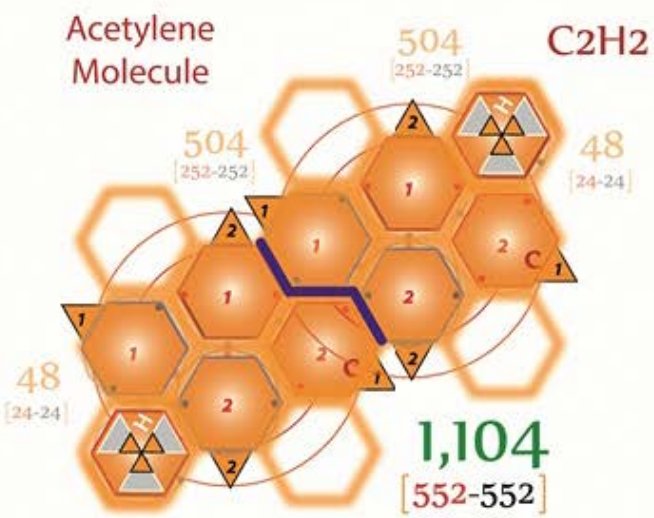

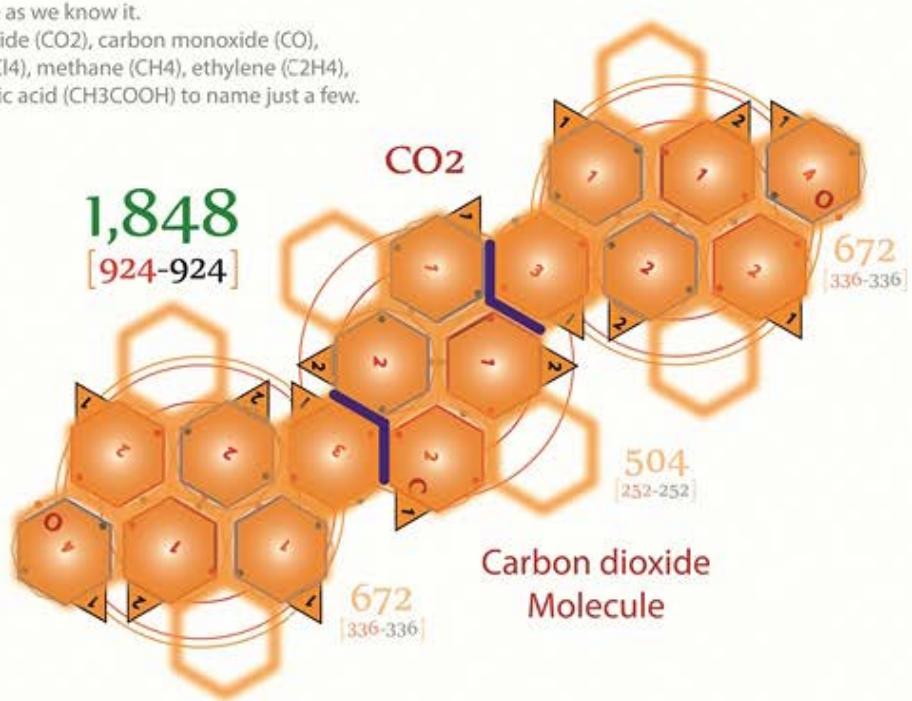

Carbon dioxide Molecule

C

There are nearly ten million known carbon compounds and an entire branch of chemistry, known as organic chemistry, is devoted to their study.

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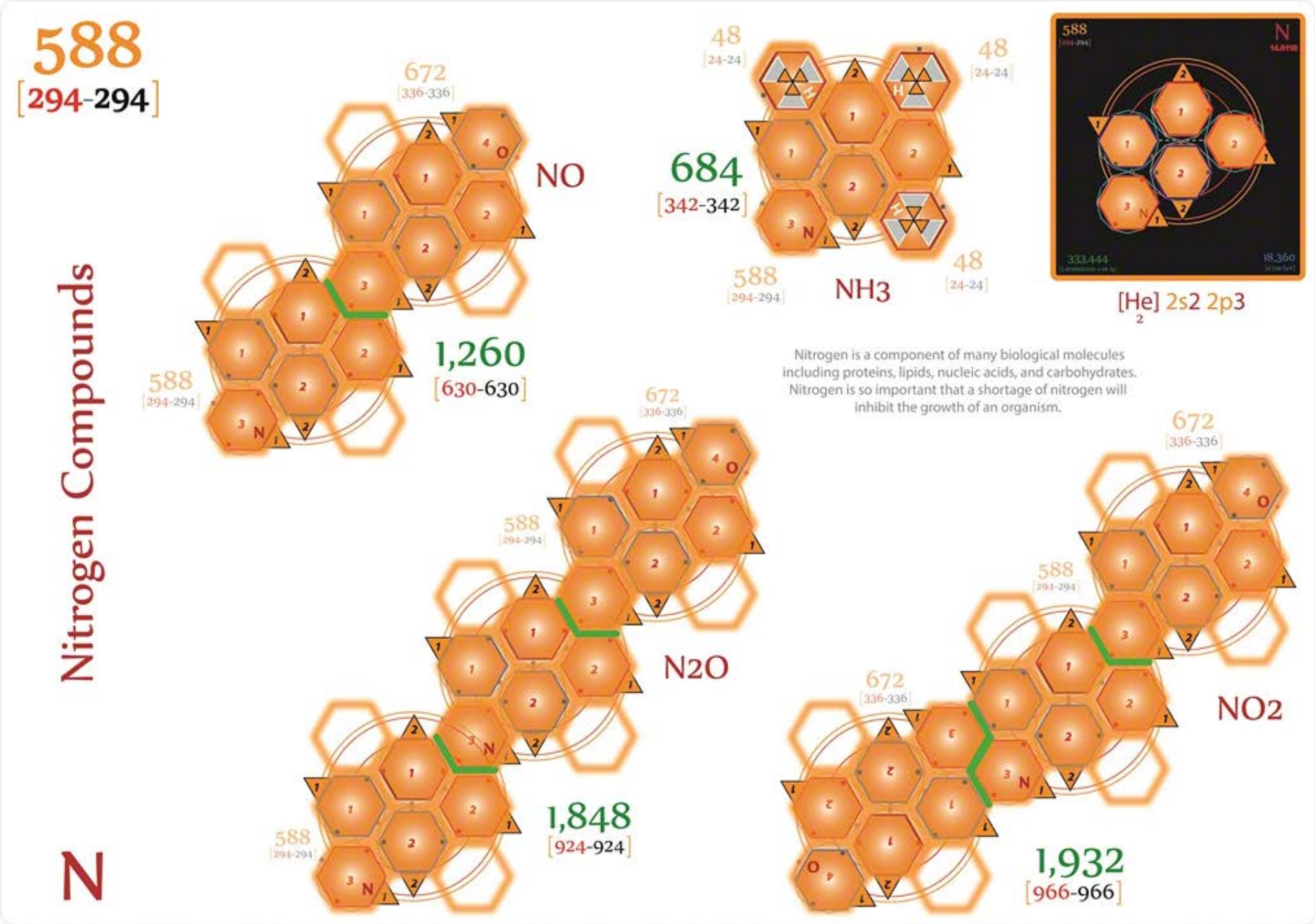

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Oxygen Compounds

672
[336-336]

H2O

768
[384-384]

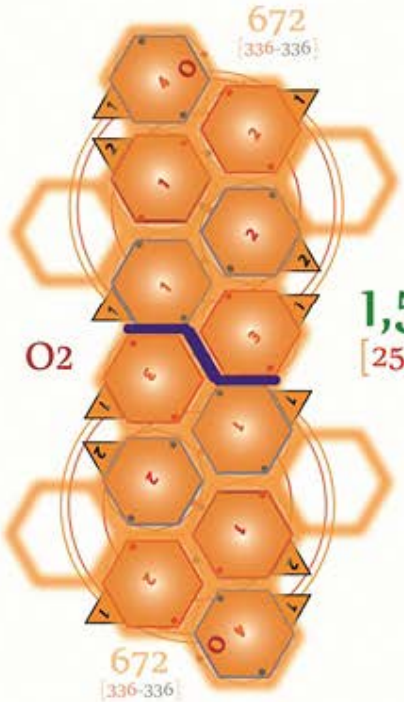

1,504
[252-252]

[He] 2s2 2p4
2

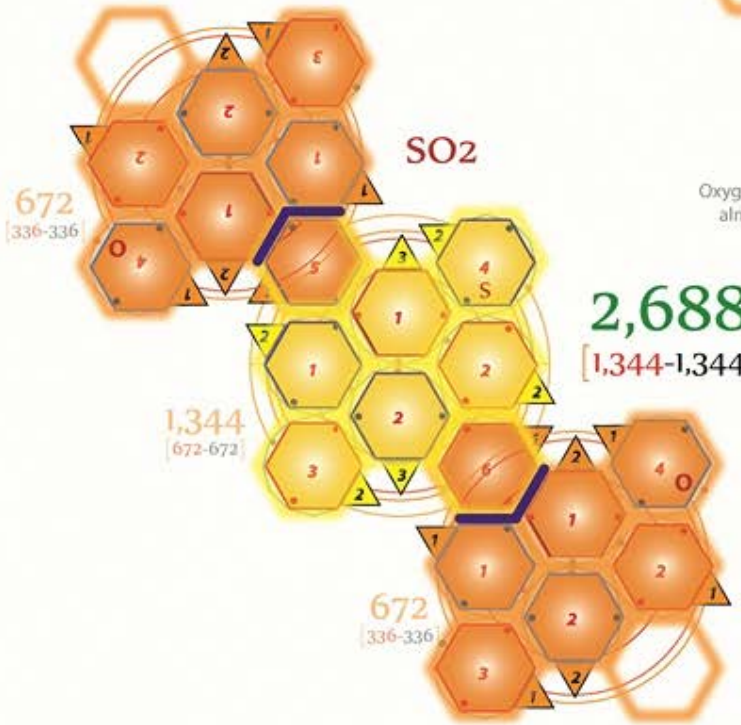

2,688
[1,344-1,344]

Oxygen forms oxide compounds with almost all of the known elements

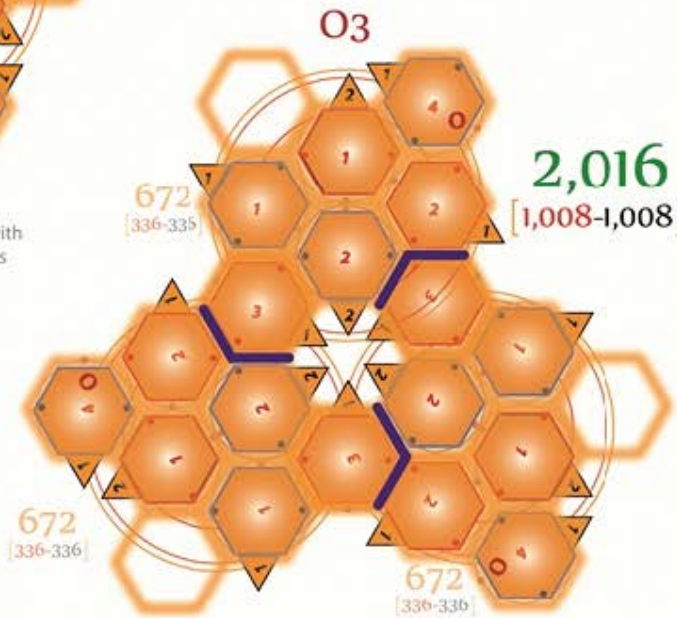

2,016
[1,008-1,008]

O

As soon as the oxygen enters your blood, a passing protein molecule called hemoglobin picks it up. Each molecule of hemoglobin can transport four molecules of oxygen to almost anywhere in the body.

The hemoglobin transport the oxygen to your cells where another protein, called cytochrome C oxidase makes two molecules of water out of every molecules of oxygen delivered to it

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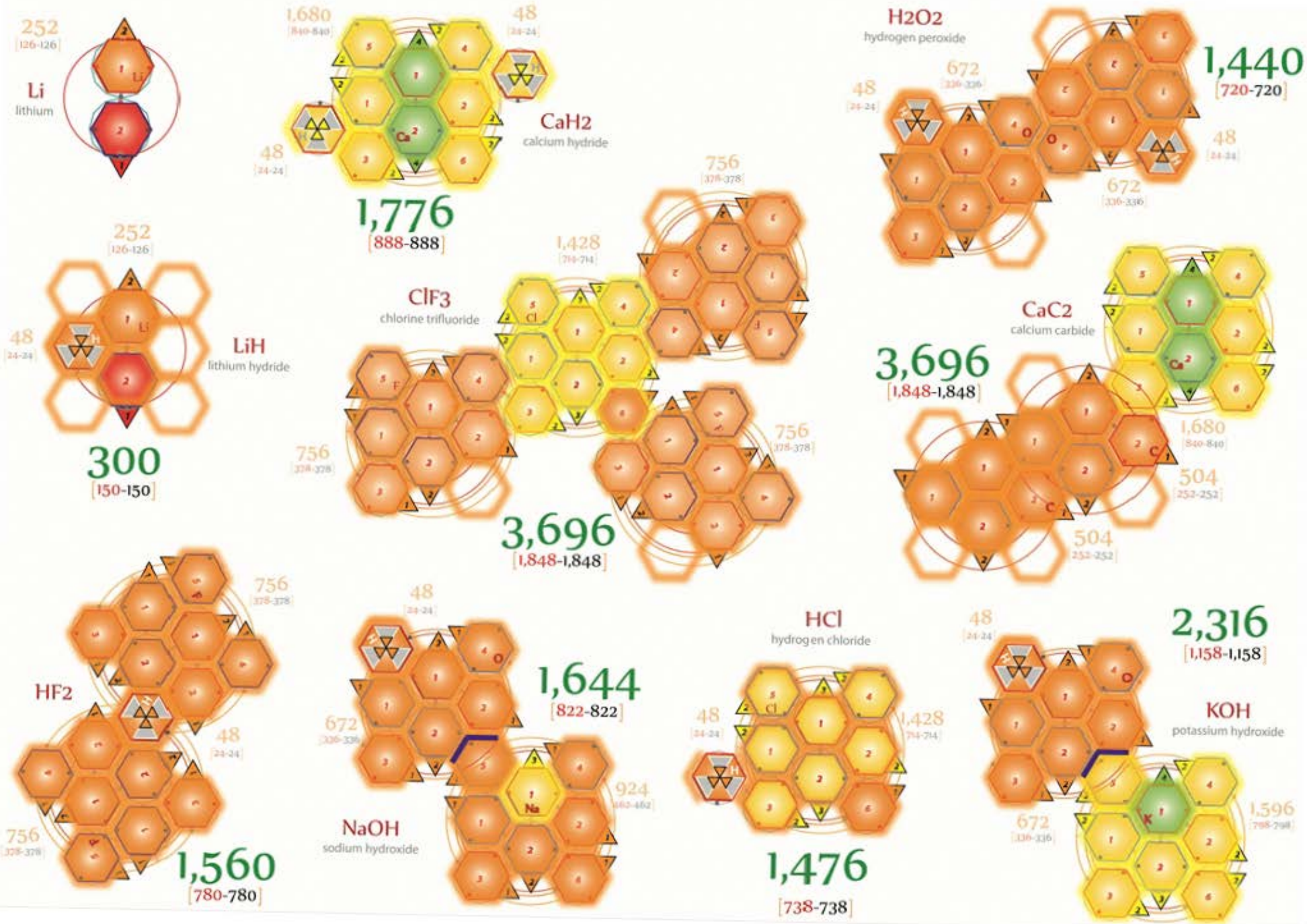

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Chemistry

is a branch of physical science, concerning the study of the composition, properties and behavior of Matter

Compounds containing bonds between carbon and a metal are called organometallic compounds.

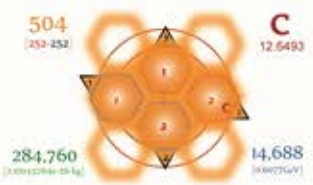

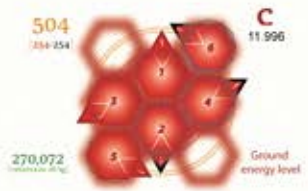

Inorganic compounds are produced by non-living natural processes or in the laboratory.

Inorganic compounds can form salts.

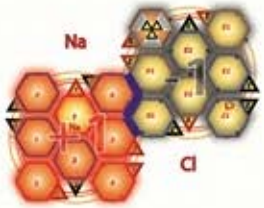

Inorganic compounds contain metal atoms.

Schrodinger's quantum numbers

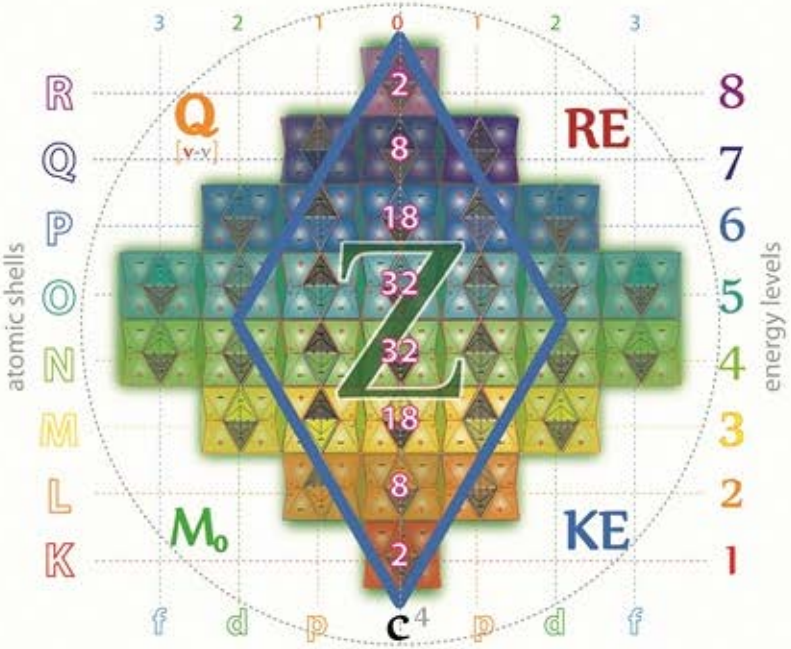

Bohr's atomic orbitals

Organic compounds are produced by living things.

Organic compounds can't form salts.

Organic compounds contain carbon-hydrogen bonds.

Tetryonic theory unifies and expands upon the currently disjointed physical and chemical theories through the application of 2D equilateral charged mass-energy geometries in 3D standing-wave mass-Matter topologies

Inorganic

Typically the difference is defined as being whether or not a substance contains carbon or carbon-hydrogen bonds

Organic

A chemical compound is a collection of elements bonded together in a way that the resultant ions, atoms or molecules form a 3D material geometric structure. Tetryonic chemical geometries, along with its firm definition and distinction between EM mass & Matter provide a clear visual path for the differentiation between both branckes of modern chemistry - as well as the source of animation in living Matter

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Functional Groups

A functional group is a reactive portion of a molecule.

carbonyl group

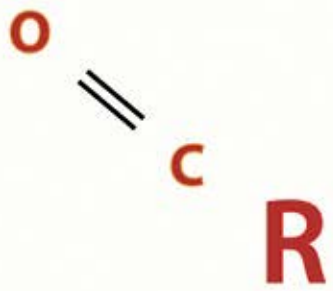

hydroxyl group

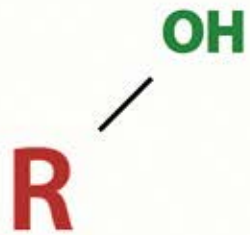

Organic molecules containing a hydroxyl group are known as alcohols.

carboxyl group

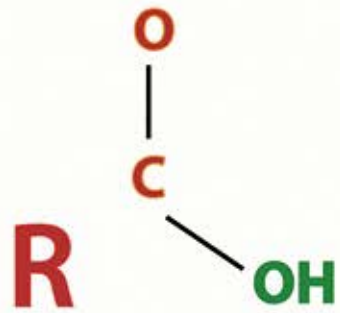

The combinations of functional groups with hydrocarbons produce a vast number of compounds.

Carbon monoxide

carbonyl group is composed of a carbon atom double-bonded to an oxygen atom

Nitric acid

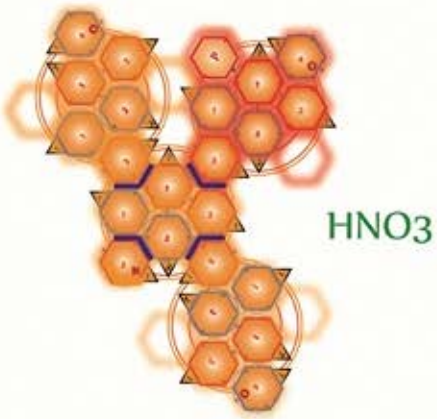

Carbonic acid

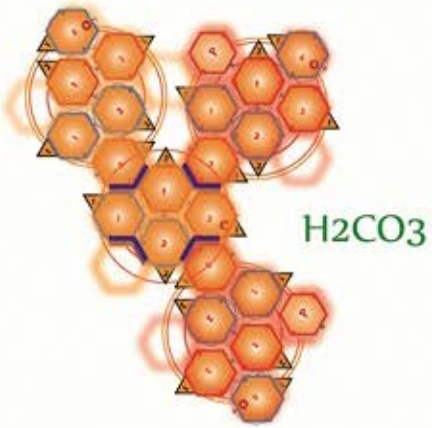

The carboxyl group is present in amino acids and carboxylic acids.

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Derivatives of Hydrocarbons

An almost unlimited number of carbon compounds can be formed by the addition of a functional group to a hydrocarbon

Esters

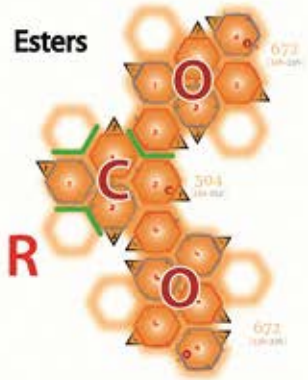

Most esters have pleasant odors.
Esters are responsible for the fragrances of many flowers & the tastes of ripened fruits.

Ethers

The best known ether is diethyl ether.
It is a volatile, highly flammable liquid that was used as an anesthetic in the past.

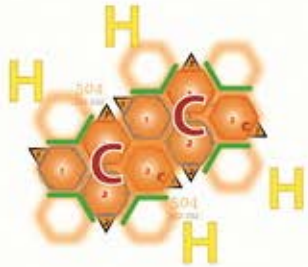

Alkyl Halides - haloalkanes

Common alkyl halides include medical anesthetics, chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs).

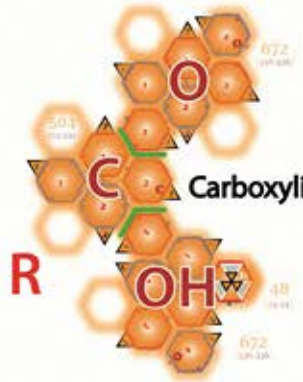

Carboxylic Acids

The simplest of the carboxylic acids is formic acid and is a constituent of bee stings and the bites of other insects including mosquitos.

Alcohols

Alcohols are organic compounds containing a hydroxyl group, [OH], substituted for a hydrogen atom. Ethanol is the alcohol in alcoholic beverages and it is also widely used as a solvent.

hydro

Aldehydes

An aldehyde is a compound containing a carbonyl group with at least one hydrogen attached to it.
With a Hydrogen in place of the R group it forms Formaldehyde

carbons

Ketones

Acetone is the simplest of the ketones.
Acetone is a commonly used solvent and is the active ingredient in nail polish remover and some paint thinners

Amines

Amines are organic compounds that contain nitrogen, they are basic compounds with strong odors, often described as "fishy"

Amides

Amides are nitrogen-containing organic compounds and are formed when amino acids react to form proteins.

"R's" stand for carbon substituents or hydrogen atoms.

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Hydrocarbons

In organic chemistry, a methylene group is any part of a molecule that consists of two hydrogen atoms bound to a carbon atom, which is connected to the remainder of the molecule

CH2
Methylene

The methylene group should be distinguished from the free methylene radical, also called carbene, whose molecule is a methylene group all by itself.

H2C
Carbene

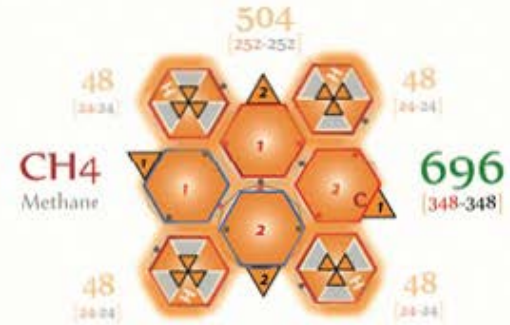

CH4
Methane

696
[348-348]

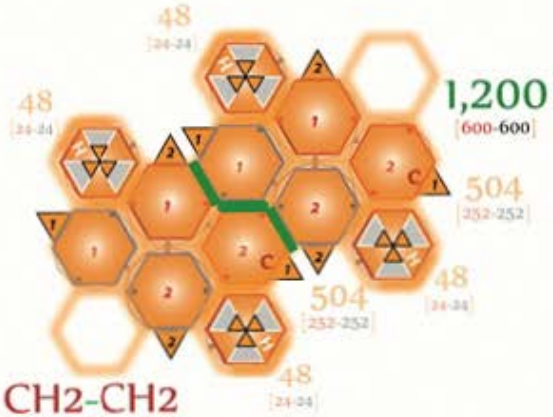

CH2-CH2
Ethylene

CH3-CH3
Ethane
C2H6

2

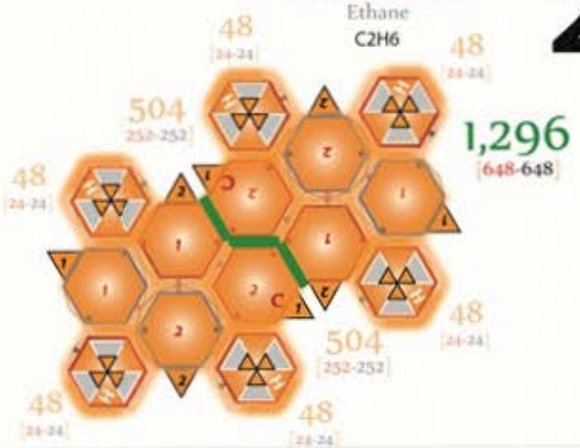

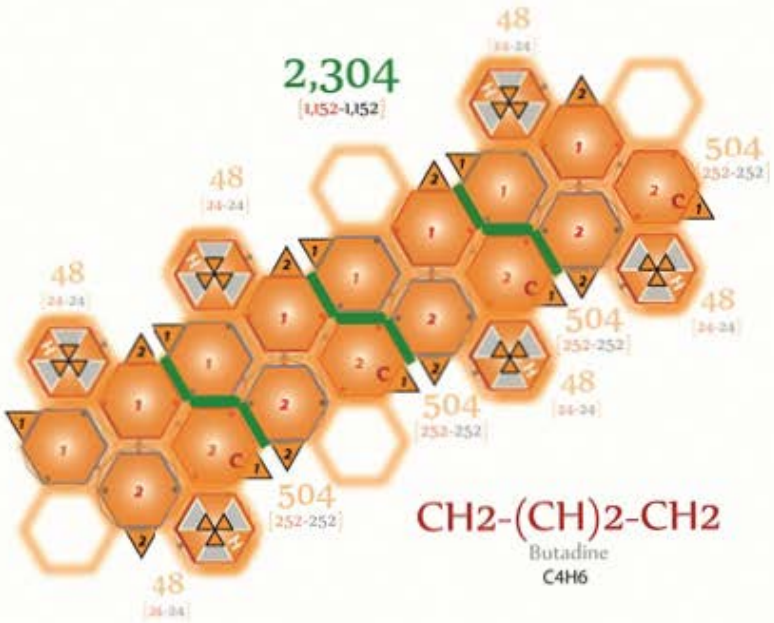

CH2-(CH)2-CH2
Butadine
C4H6

CH3-(CH2)-CH3
Propane
C3H8

3

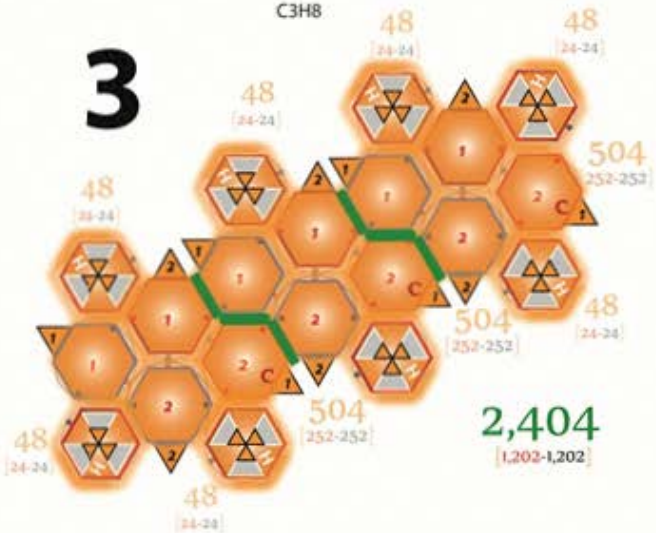

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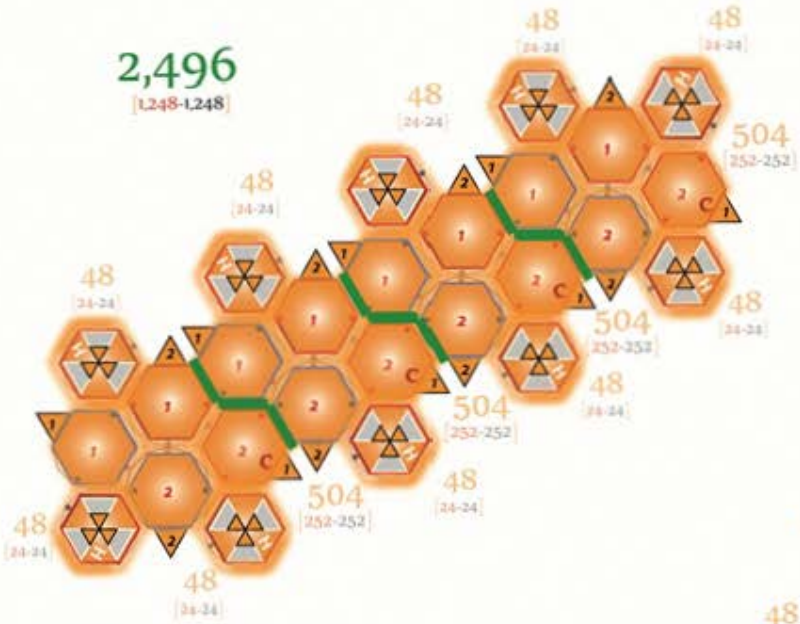

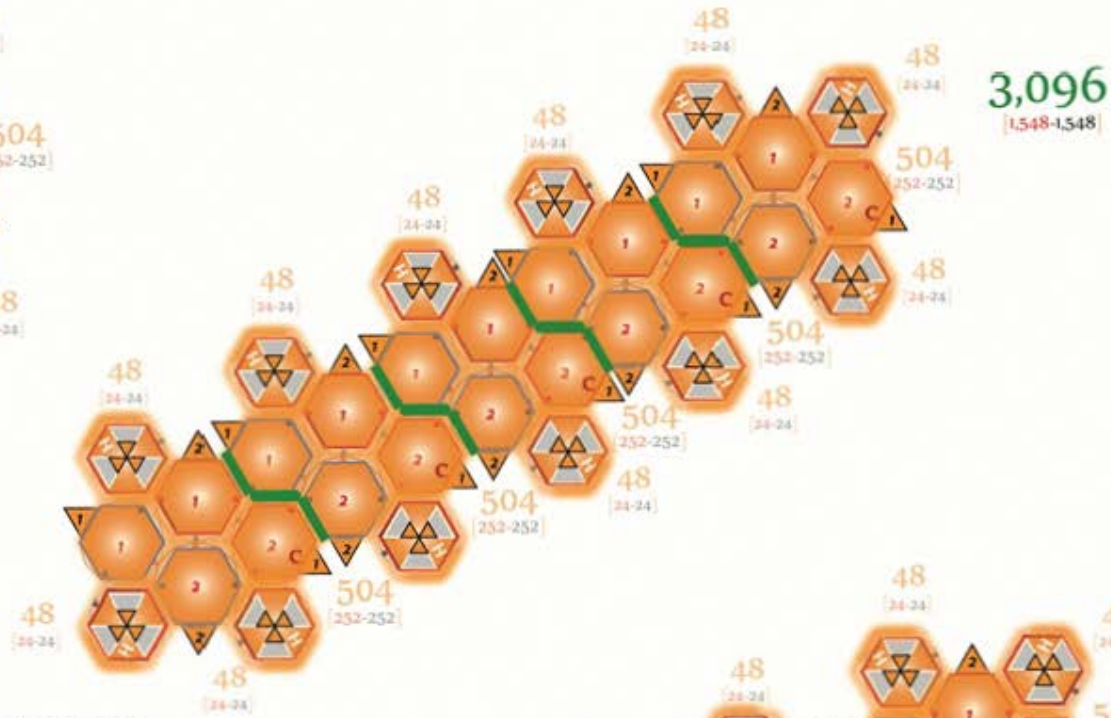

CH_3-$(CH_2)_2$-CH_3

Butane

C4H10

4

Butane, also called n-butane, is the unbranched alkane with four carbon atoms, CH3- [CH2]n -CH3.

Butane is also used as a collective term for n-butane together with its only other isomer, isobutane (also called methylpropane), CH(CH3)3.

Butanes are highly flammable, colorless, odorless, easily liquefied gases.

CH_3-$(CH_2)_3$-CH_3

Pentane

C5H12

5

CH_3-$(CH_2)_4$-CH_3

Hexane

C6H14

6

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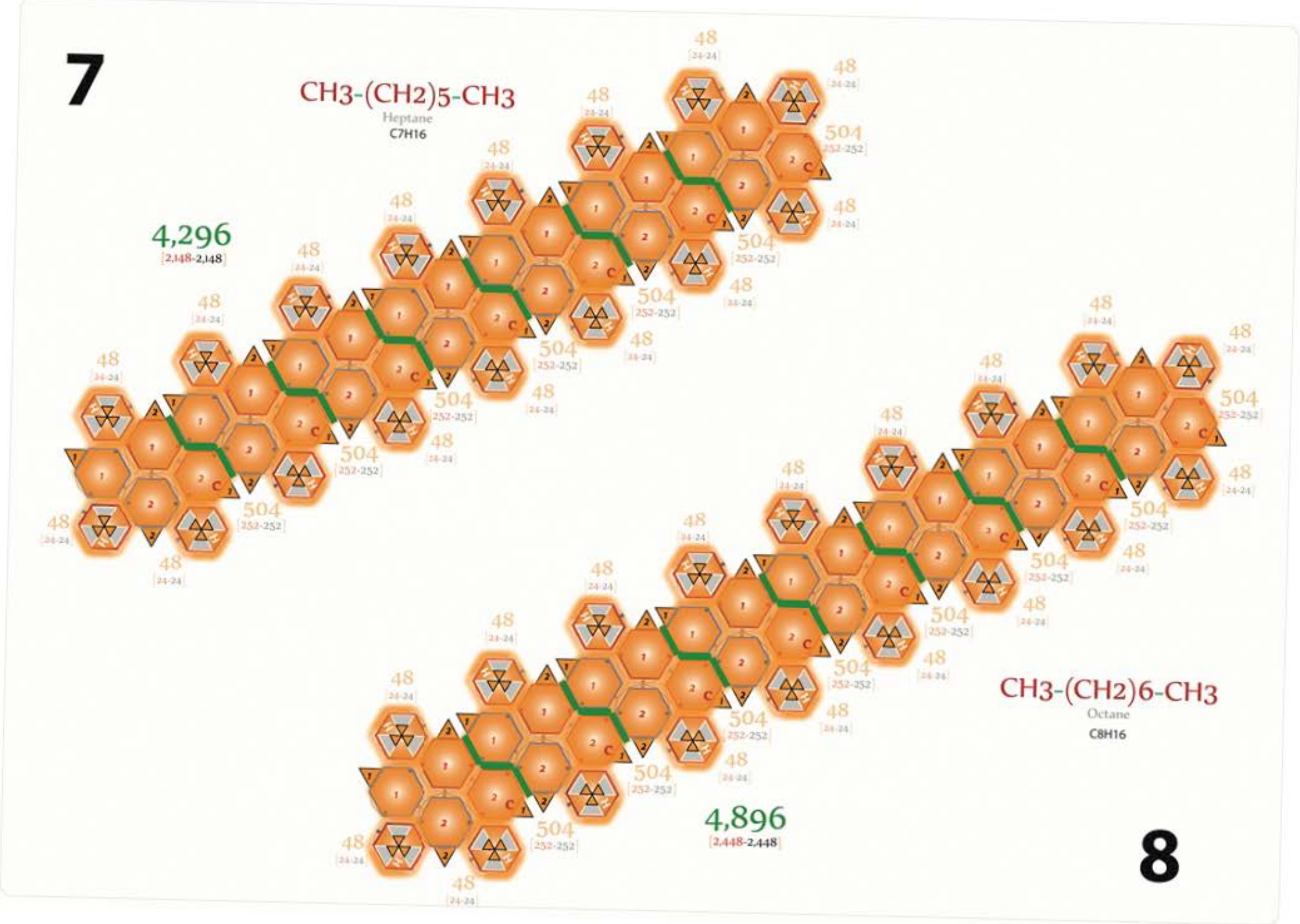

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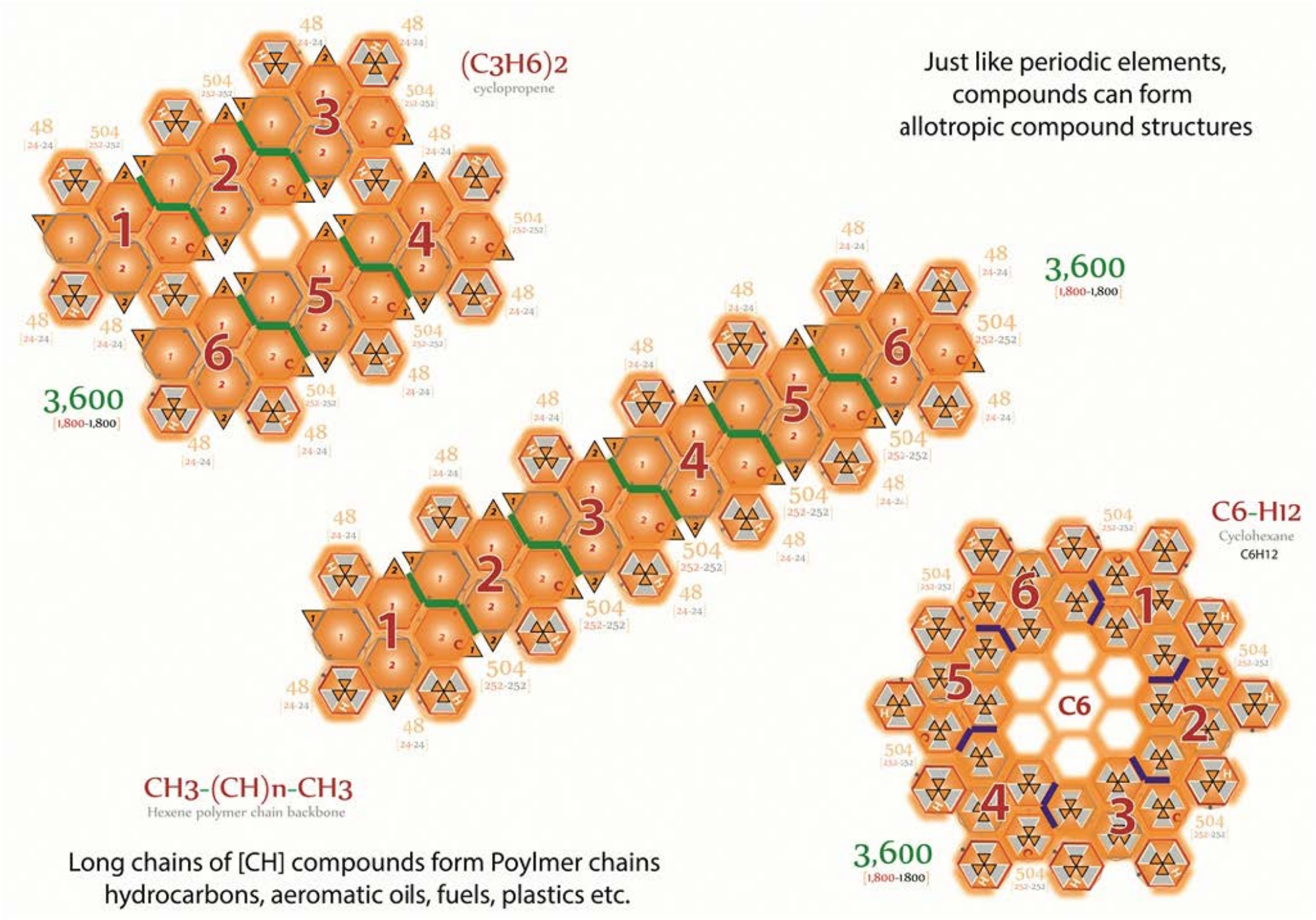

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3,024
[1,512-1,512]

Carbon ring

Rings of atoms are also common in organic structures. You may have heard the famous story of Auguste Kekulé first realizing that benzene has a ring structure when he dreamt of snakes biting their own tails.

Friedrich August Kekul

(7 September 1829 - 13 July 1896)

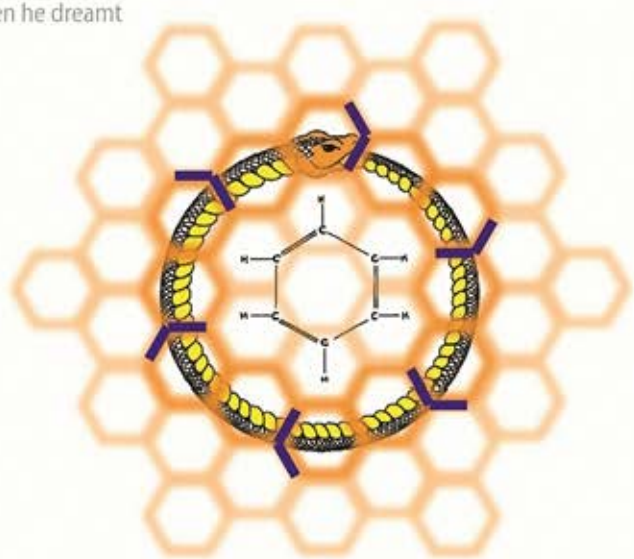

Organic Chemistry

In 1865, August Kekulé presented a paper at the Académie des Sciences in Paris suggesting a cyclic structure for benzene, the inspiration for which he ascribed to a dream. However, was Kekulé the first to suggest that benzene was cyclic. Some credit an Austrian schoolteacher, Josef Loschmidt with the first depiction of cyclic benzene structures.

In 1861, 4 years before Kekulé's dream, Loschmidt published a book in which he represented benzene as a set of rings. It is not certain whether Loschmidt or Kekulé—or even a Scot named Archibald Couper—got it right first

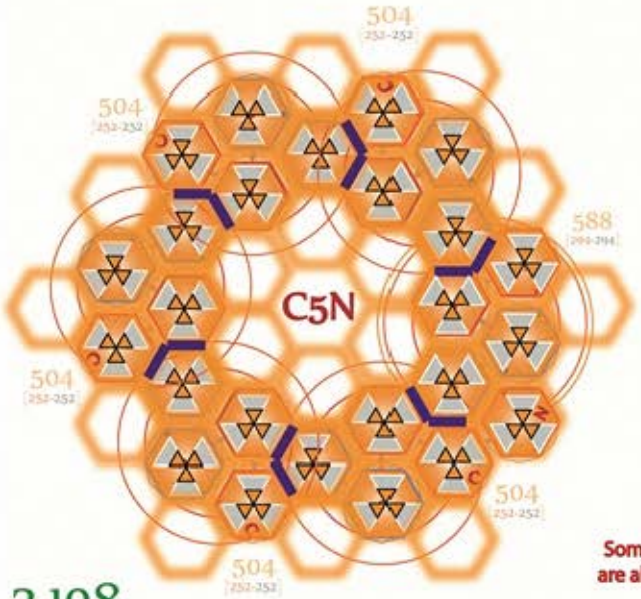

3,108
[1,554-1,554]

Carbon-Nitrogen ring

Some non-benzene-based compounds called heteroarenes, which follow Hückel's rule, are also aromatic compounds. In these compounds, at least one carbon atom is replaced by one of the heteroatoms oxygen, nitrogen, or sulfur.

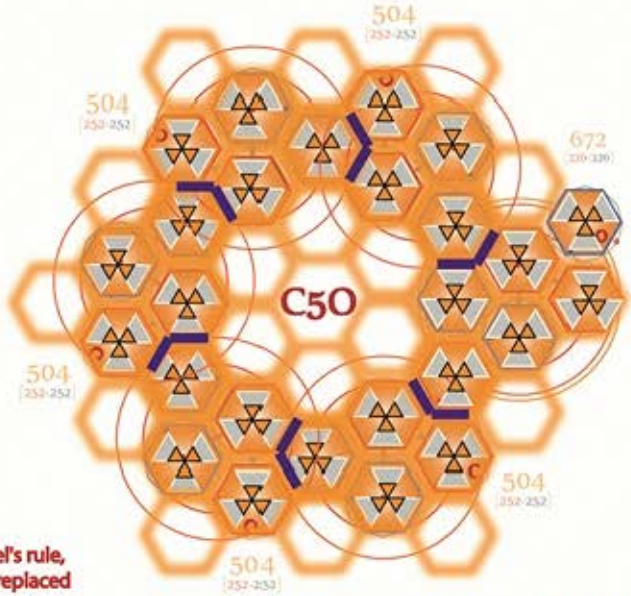

Carbon-Oxygen ring

3,192
[1,596-1,596]

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Benzene molecules

Benzene, or benzol, is an organic chemical compound and a known carcinogen with the molecular formula C6H6.

It is sometimes abbreviated Ph–H.
Benzene is a colorless and highly flammable liquid with a sweet smell and a relatively high melting point.

Because it is a known carcinogen, its use as an additive in gasoline is now limited, but it is an important industrial solvent and precursor in the production of drugs, plastics, synthetic rubber, and dyes. Benzene is a natural constituent of crude oil, and may be synthesized from other compounds present in petroleum.

Benzene is an aromatic hydrocarbon and the second [n]-annulene ([6]-annulene), a cyclic hydrocarbon with a continuous pi bond.

Cyclic hydrocarbon compounds are often referred to as Aromatic compounds due to their sweet smell

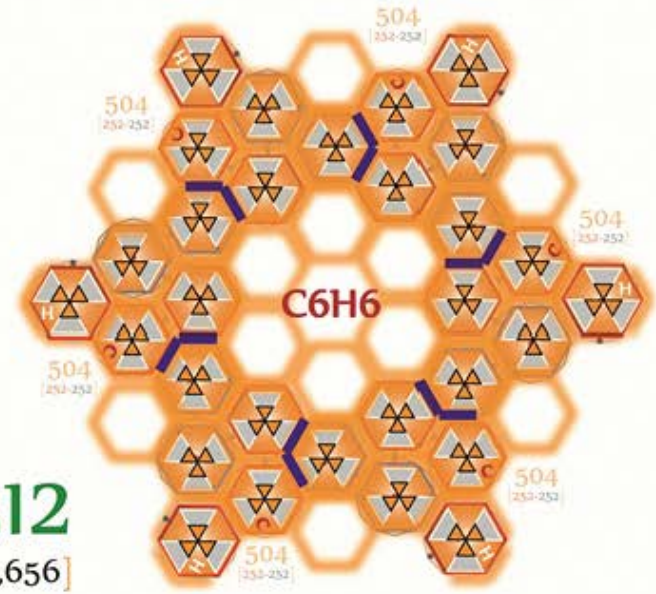

3,312
[1,656-1,656]

(CH)6
Benzene ring
C6H6

A aromatic hydrocarbon is formed when CH compounds form a cyclic molecule

Many important additional chemical compounds are derived from benzene by replacing one or more of its hydrogen atoms with another functional group.

Examples of simple benzene derivatives are phenol, toluene, and aniline, abbreviated PhOH, PhMe, and PhNH2, respectively

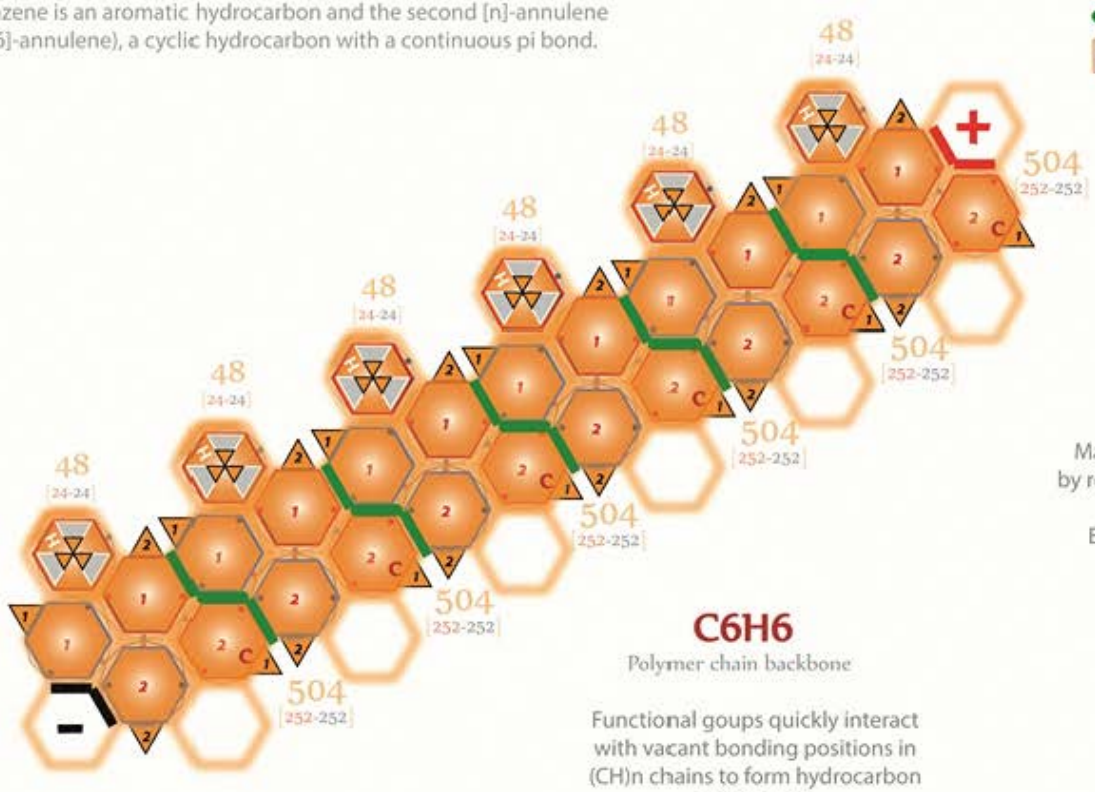

C6H6
Polymer chain backbone

Functional goups quickly interact with vacant bonding positions in (CH)n chains to form hydrocarbon compounds

Linear (CH)n chains are rarely found in nature as the Positive and Negative tail ends of Hydrocarbon chain interact and bond to form cyclic compounds.

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Carbon-Nitrogen Chains

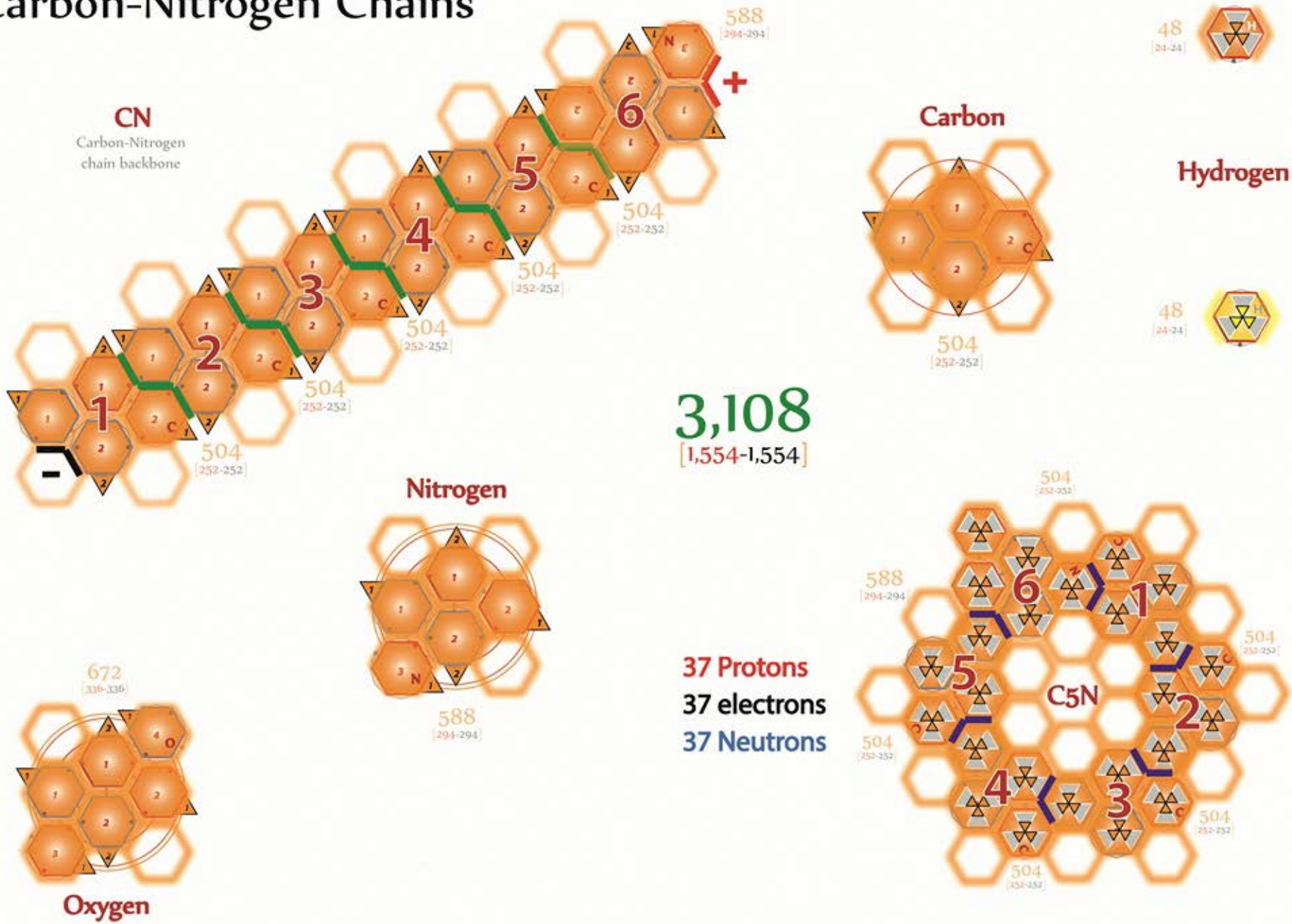

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Carbon-Oxygen Chains

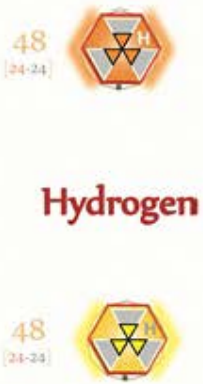

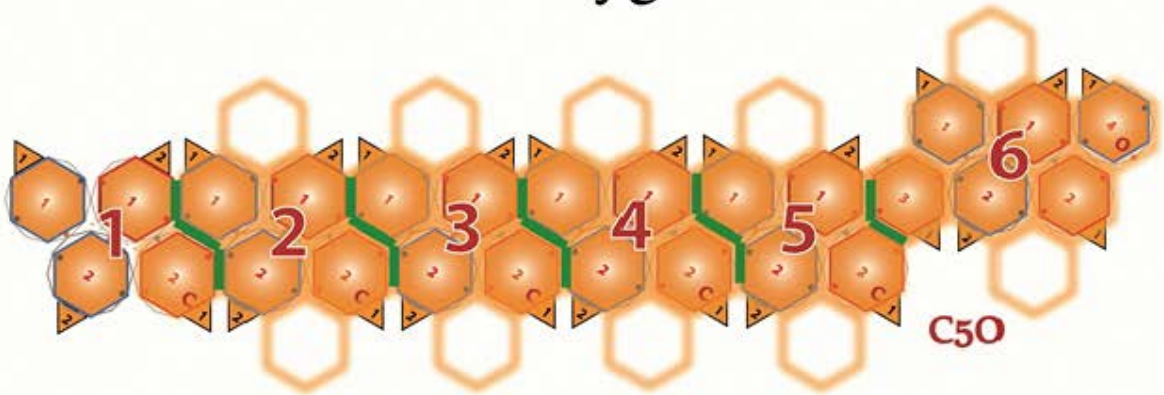

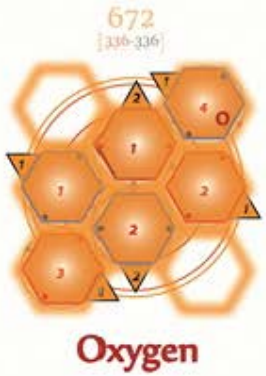

Heterocyclic Rings

Tetrahydropyran is the organic compound consisting of a saturated six-membered ring containing five carbon atoms and one oxygen atom.

3,192
[1,596-1,596]

38 Protons
38 electrons
38 Neutrons

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$C_6H_2(NO_2)_3CH_3$
Trinitrotoluene

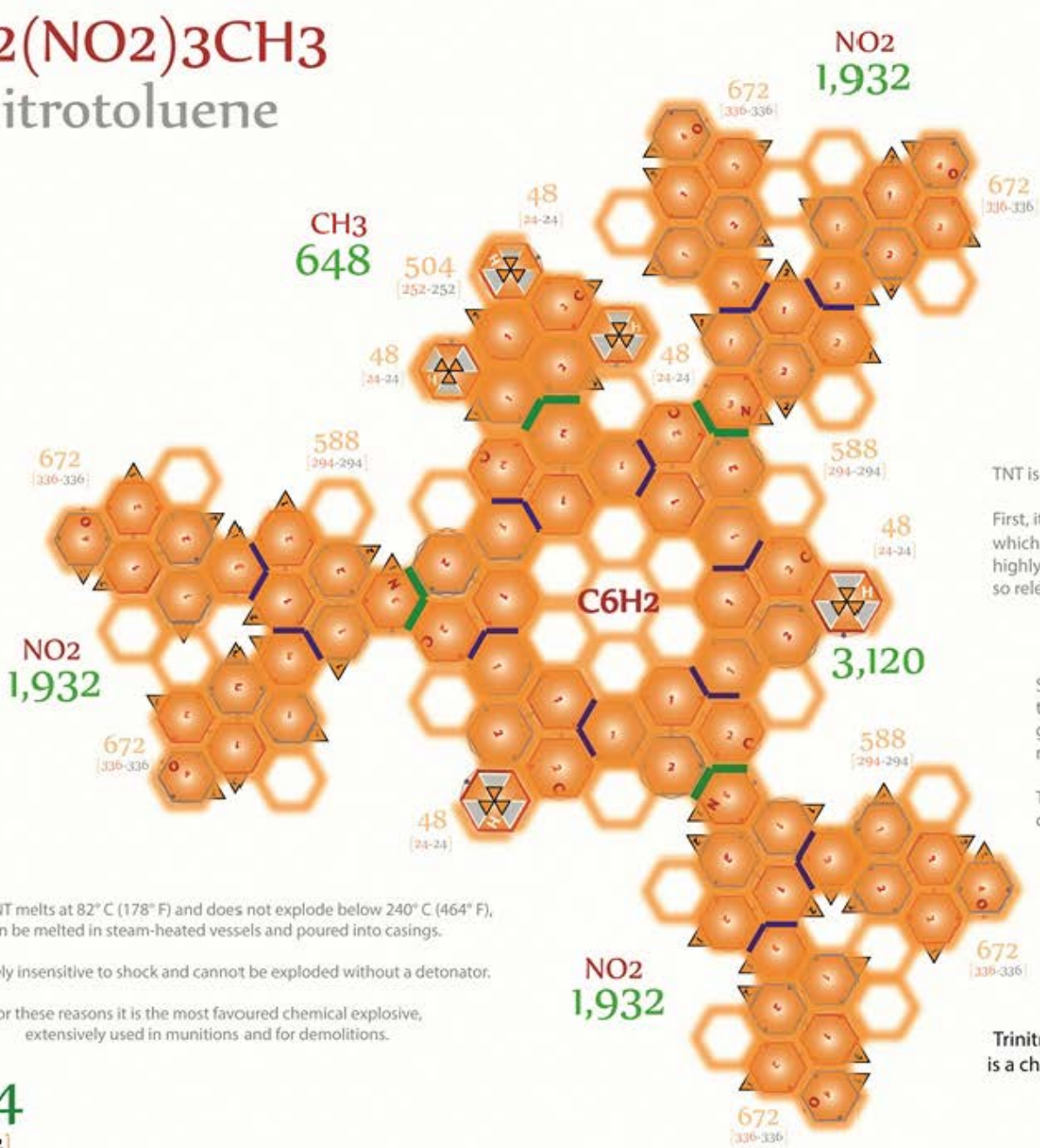

2,4,6-trinitrotoluene is better known by its initials, TNT. It is an important explosive, since it can very quickly change from a solid into hot expanding gases.

TNT is explosive for two reasons;

First, it contains the elements carbon, oxygen and nitrogen, which means that when the material burns it produces highly stable substances (CO, CO2 and N2) with strong bonds, so releasing a great deal of energy.

Secondly, TNT is chemically unstable - the nitro groups are so closely packed that they experience a great deal of strain and hindrance to movement from their neighbouring groups.

Thus it doesn't take much of an initiating force to break some of the strained bonds, and the molecule then flies apart.

Because TNT melts at 82° C (178° F) and does not explode below 240° C (464° F), it can be melted in steam-heated vessels and poured into casings.

It is relatively insensitive to shock and cannot be exploded without a detonator.

For these reasons it is the most favoured chemical explosive, extensively used in munitions and for demolitions.

9,564
[4,782-4,782]

Trinitrotoluene, or more specifically, 2,4,6-trinitrotoluene, is a chemical compound with the formula $C_6H_2(NO_2)_3CH_3$

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(C6)4-H10
Pyrene

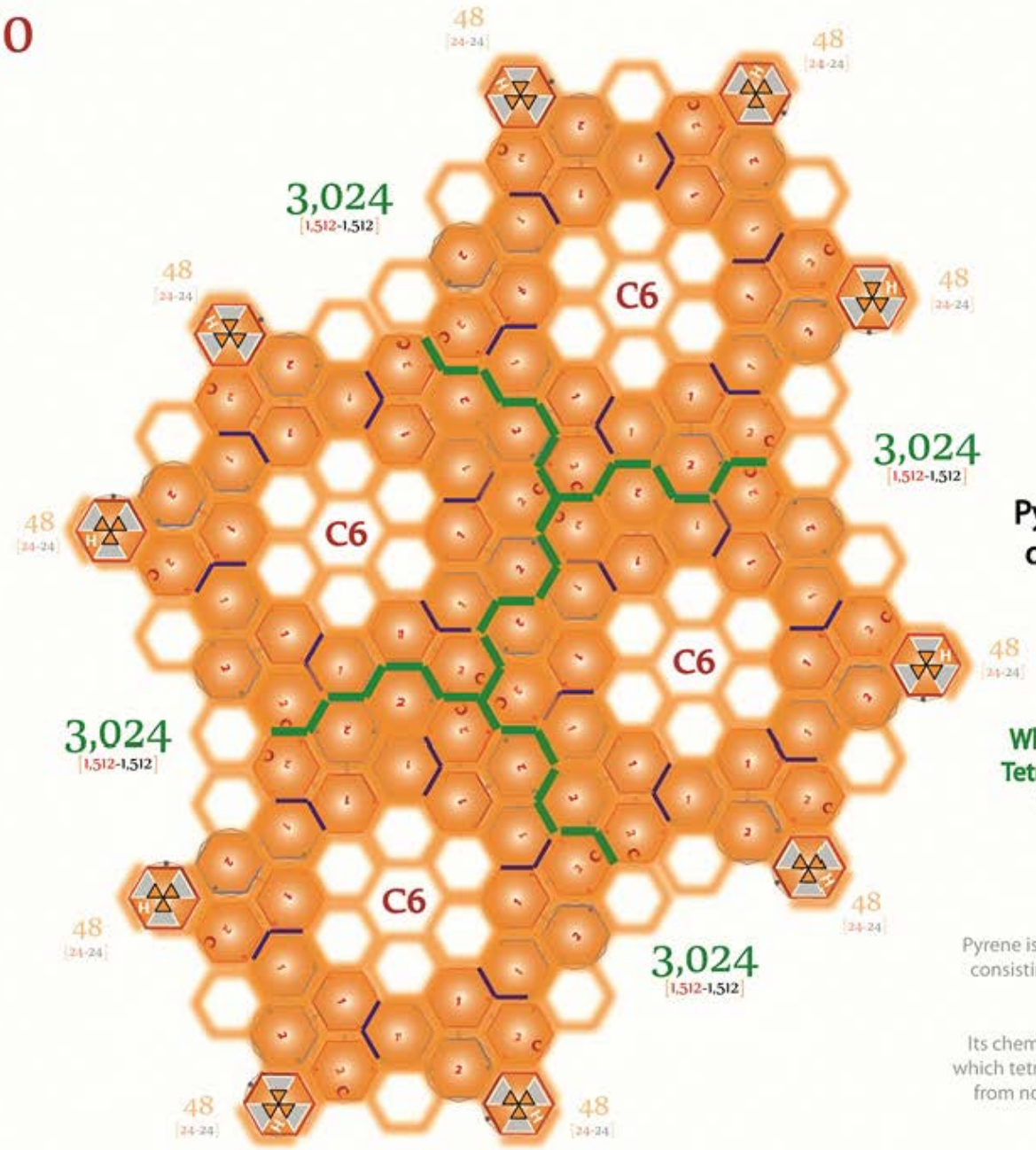

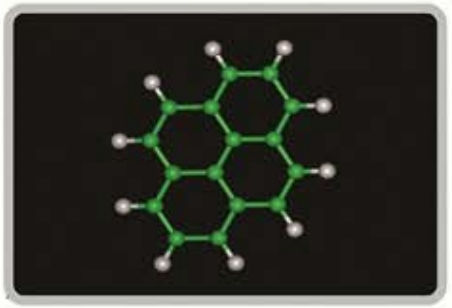

Pyrene highlights the failings of Lewis diagram structures

Which can be rectified using charged Tetryonic geometric Matter topologies for all elements and compound interactions & modelling

Pyrene is a polycyclic aromatic hydrocarbon (PAH) consisting of four fused benzene rings, resulting in a flat aromatic system.

Its chemcial formula as is often stated as C16H10, which tetryonic geometry shows is an error resulting from not using equilateral quantum geometries in chemical topology modelling.

Four cyclic carbon rings cannot be formed with only 16 C-atoms

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Ammonium Nitrate

3,384

NH4NO3,

Ammonium nitrate is composed of two polyatomic ions:
1) Ammonium Ion (NH4+)
2) Nitrate Ion (NO3-)

The bond between these ions is an ionic bond meaning the ammonium ion transfers an electron to the nitrate ion.

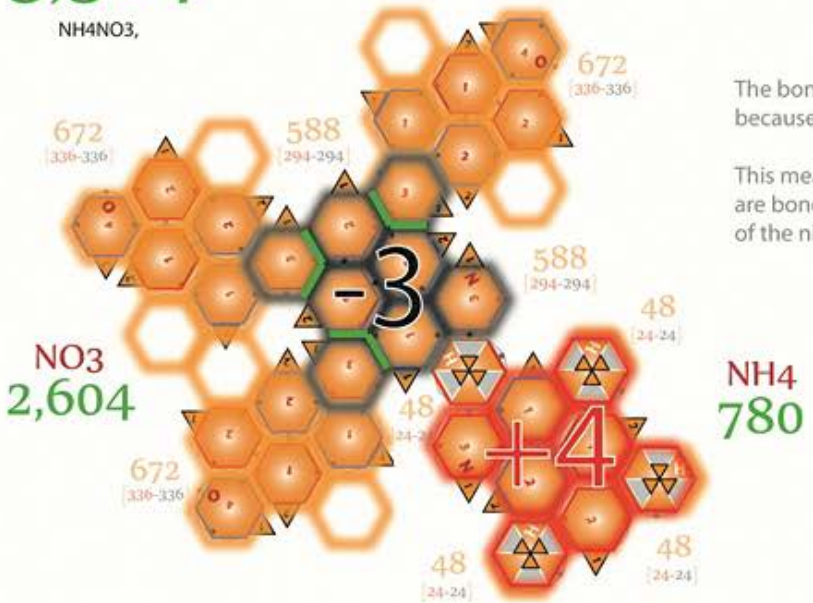

The bonds in a polyatomic atomic ion are covalent because they take place between gases.

This means that the hydrogens of the ammonium ion are bonded to the nitrogen covalently and that the oxygens of the nitrate are bonded to the nitrogen covalently

Ammonium nitrate decomposes into the gases nitrous oxide and water vapor when heated (non-explosive reaction); however, ammonium nitrate can be induced to decompose explosively by detonation.

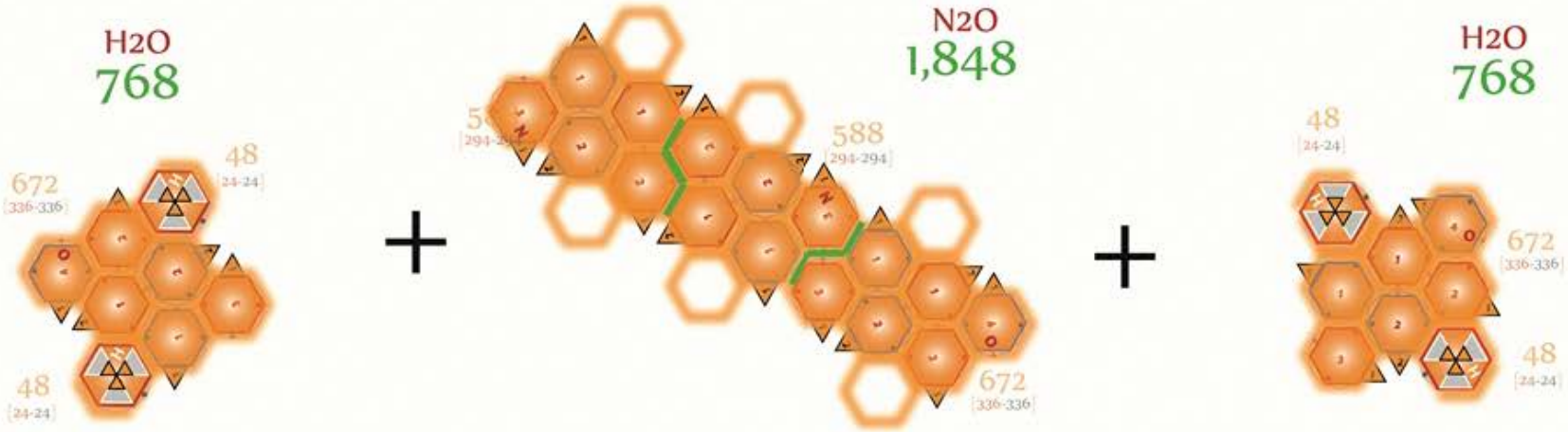

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Carbohydrates

A carbohydrate is an organic compound that consists only of carbon, hydrogen, and oxygen (with a hydrogen:oxygen ratio of 2:1) in other words, with the empirical formula $C_m(H_2O)_n$

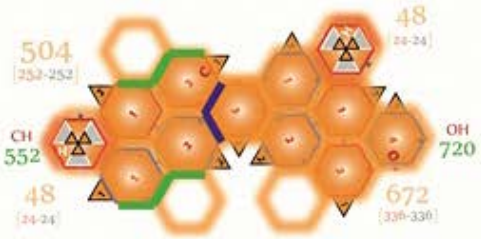

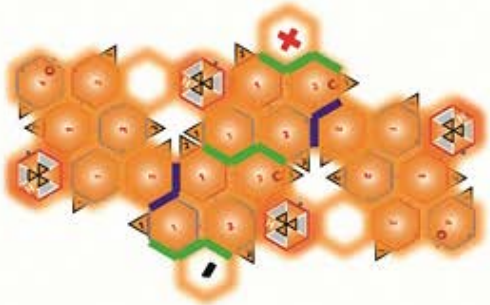

Monosaccharides

Ribose

Gluclose

Lactose

Disaccharides

$$C_m(H_2O)_n$$

Oligosaccharides

Fructose

Sucrose

Deoxyribose

Polysaccharides

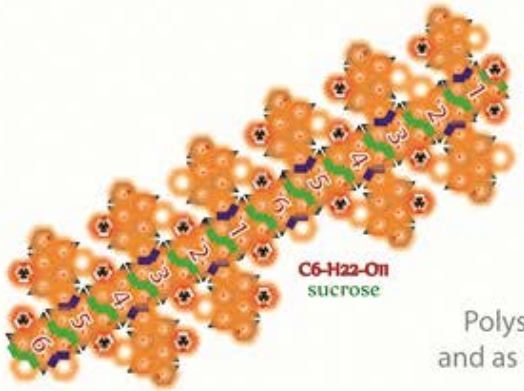

Carbohydrates perform numerous roles in living organisms.
Polysaccharides serve for the storage of energy (e.g., starch and glycogen), and as structural components (e.g., cellulose in plants and chitin in arthropods)

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Monosaccharides

Monosaccharides are the simplest carbohydrates in that they cannot be hydrolyzed to smaller carbohydrates

The Carbon nuclei in Monosaccharides join together to form chains of biologically important carbohydrates

1,272

[636-636]

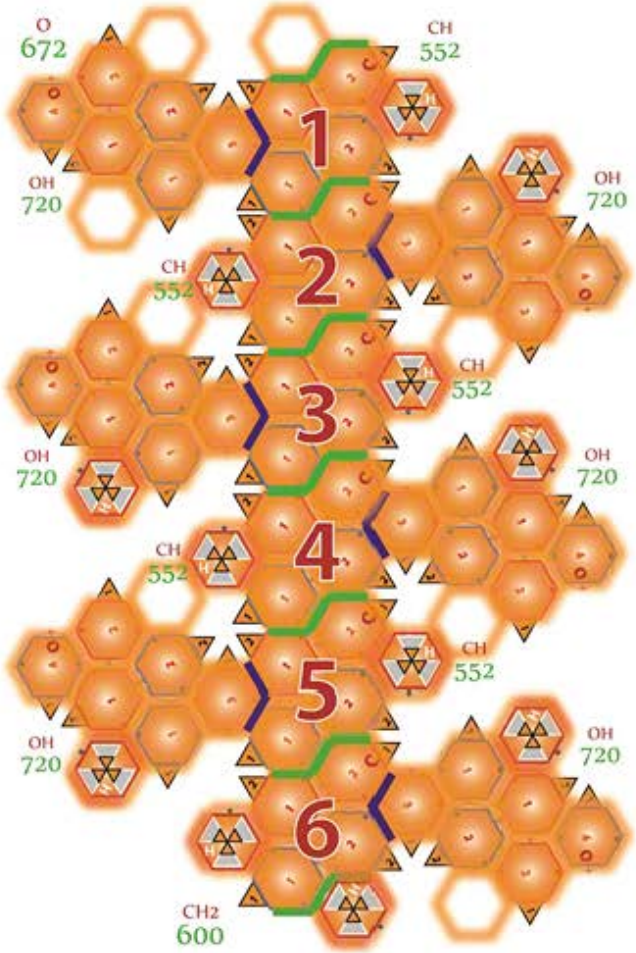

C(H2O)6

D-glucose

C6-H12-O6

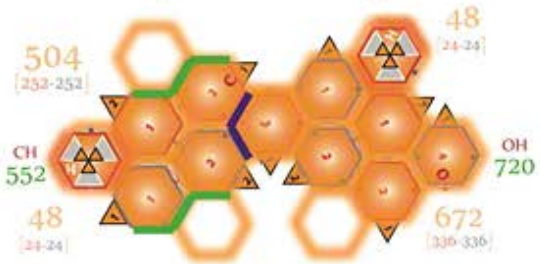

C(H2O)

The general chemical formula of an unmodified monosaccharide is (C•H2O) n, literally a "carbon hydrate."

CH 552 **CH-OH** OH 720

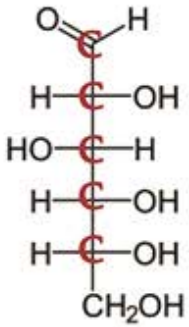

D-Glucose

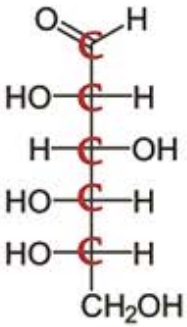

L-Glucose

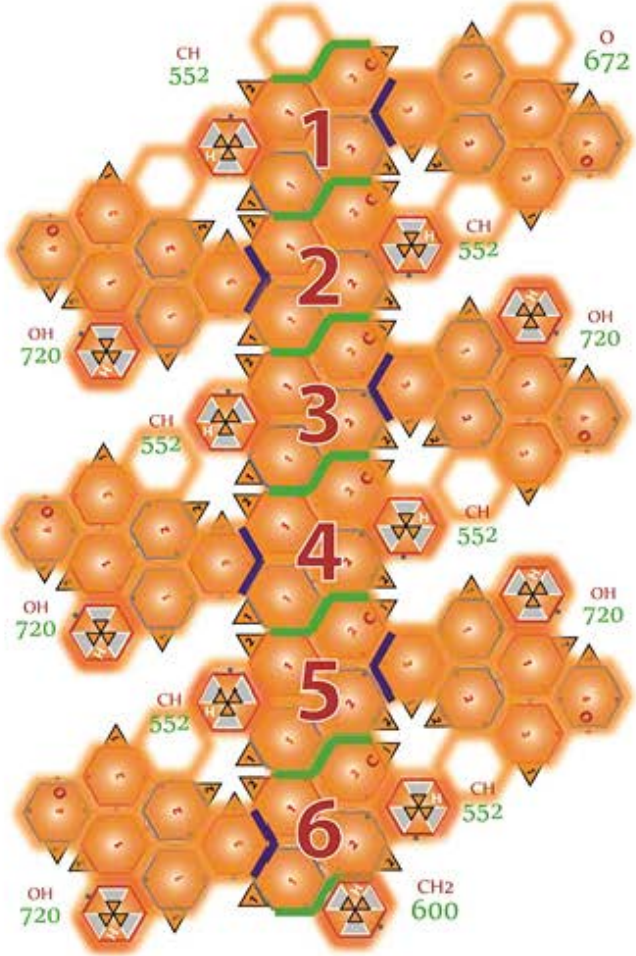

C(H2O)6

L-glucose

C6-H12-O6

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C(H2O)n

Major Monosaccharides

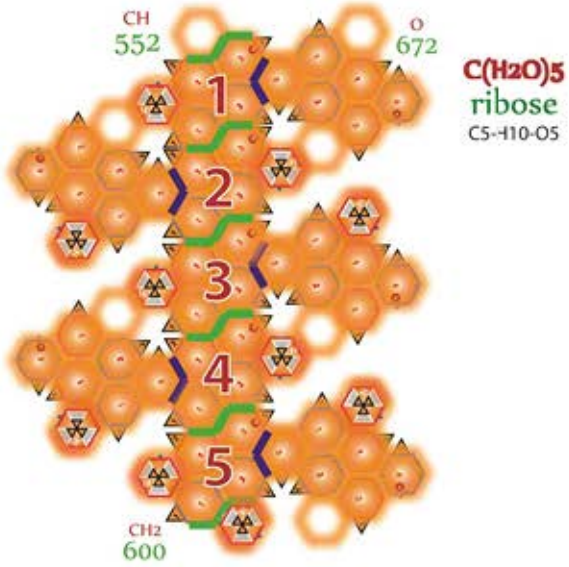

C(H2O)5
ribose
C5-H10-O5

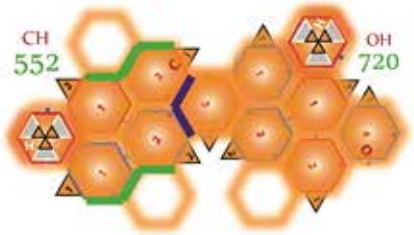

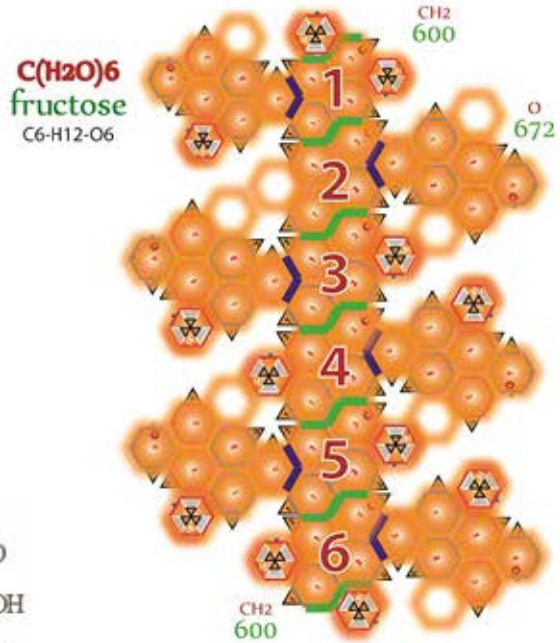

C(H2O)6
fructose
C6-H12-O6

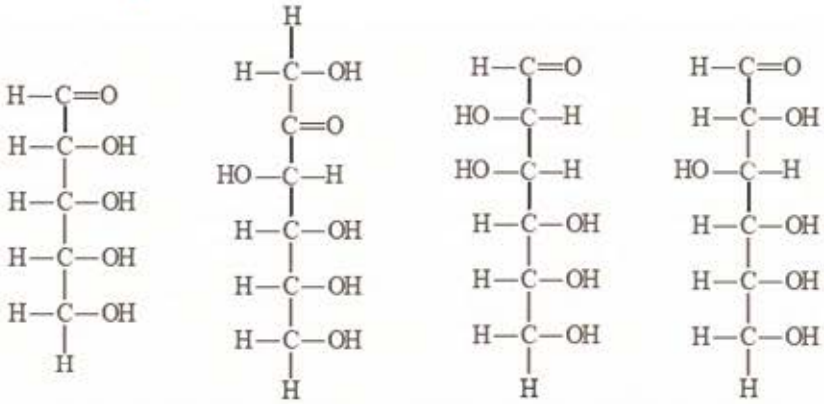

D D & L sugars are chiral, mirror images of one another and have the same name. **L**

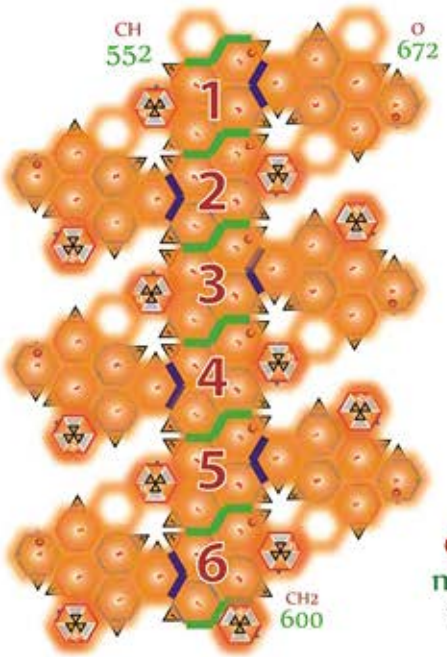

C(H2O)6
mannose
C6-H12-O6

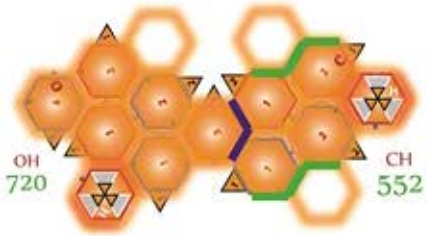

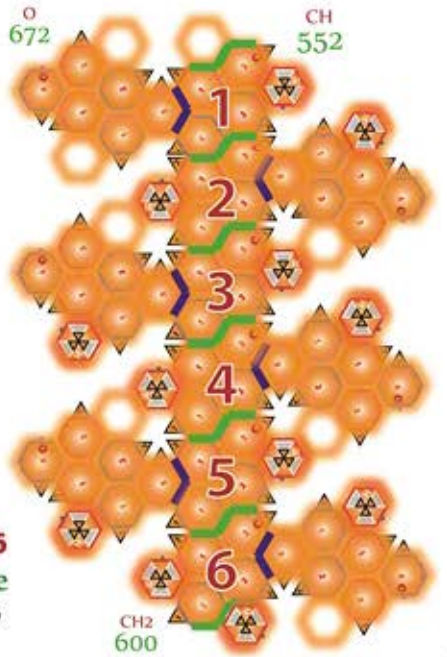

C(H2O)6
glucose
C6-H12-O6

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A monosaccharide often switches from the acyclic (open-chain) form to a cyclic form, through a nucleophilic addition reaction between the carbonyl group and one of the hydroxyls of the same molecule.

cyclic monosaccharides

For many monosaccharides (including glucose), the cyclic forms predominate, and therefore the same name commonly is used for forms of isomers.

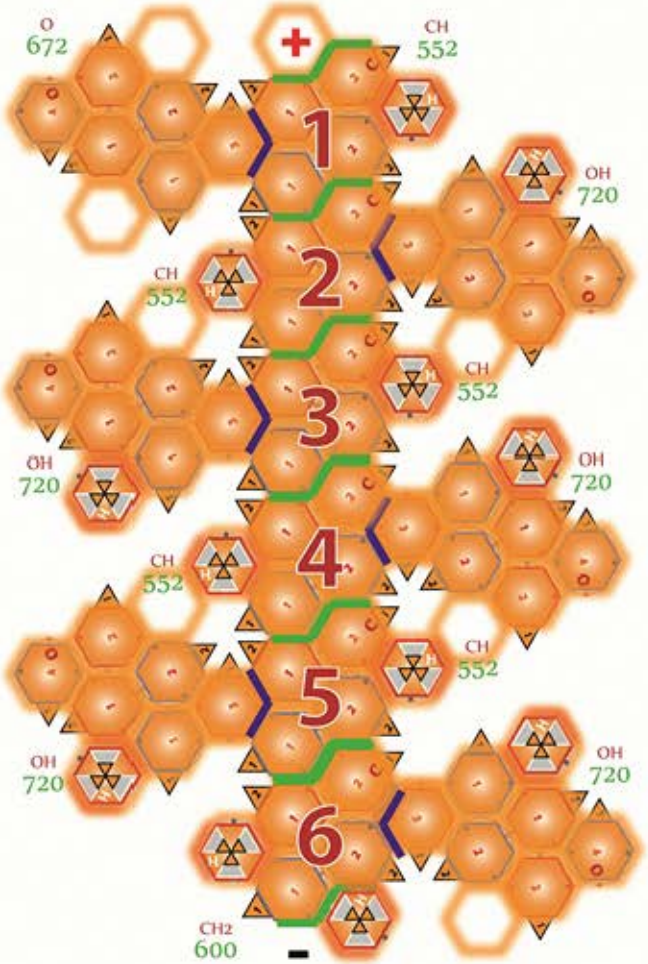

linear saccharide chain

The Carbon nuclei in Monosaccharides chains can join together to form cyclic [Carbon-Oxygen] rings or polycarbohydrates through condensation

C(H2O)6
glucose
C6-H12-O6

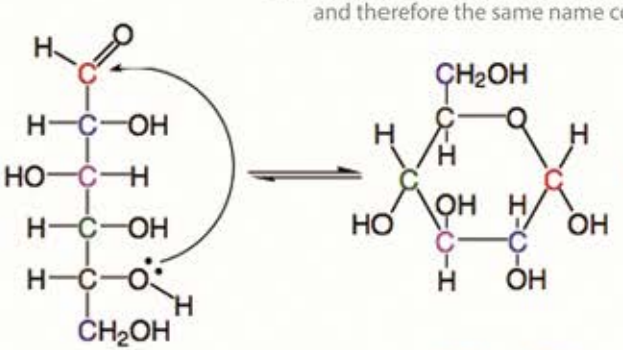

C(H2O)6
glucopyranose
C6-H12-O6

C6-H12-O6

7,632

[3,816-3,816]

The reaction creates a ring of carbon atoms closed by one bridging oxygen atom, which in turn can be easily broken to restore the linear monosaccharide chains

cyclic Oxygen-Carbon ring

Allotropic cyclic [Carbon-Oxygen] forms of polycarbohydrates can also be formed via other element bonding processes

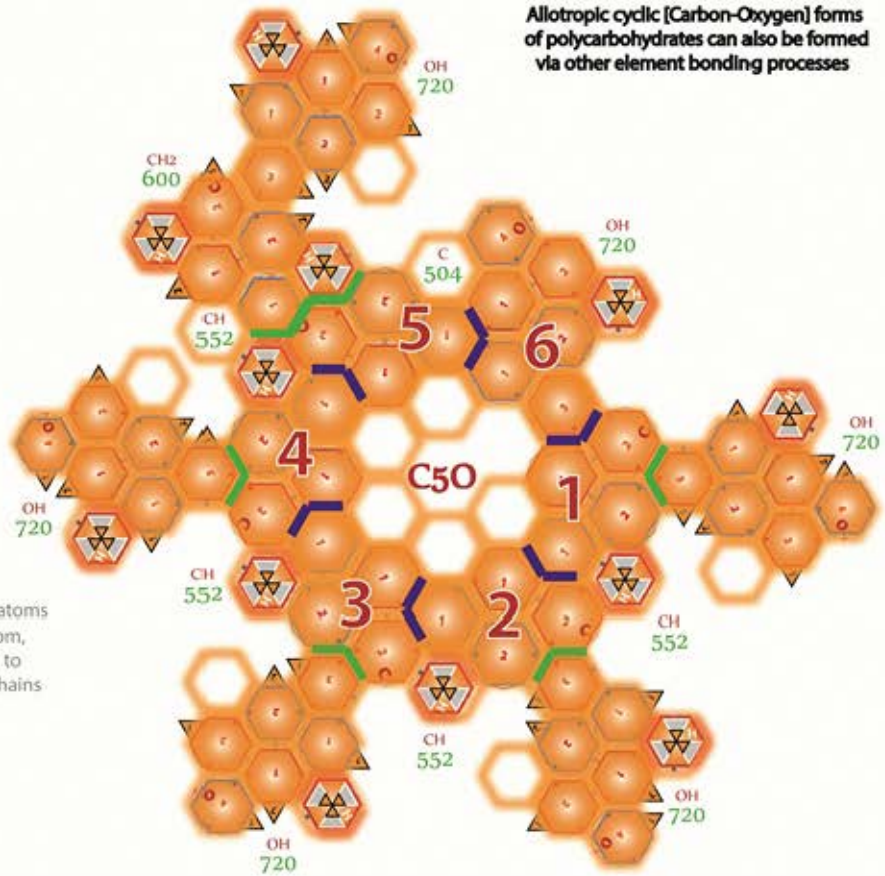

acyclic monosaccharides

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Condensed Disaccharides

Condensed Disaccharides are formed when two monosaccharides are joined together and a molecule of water is removed

For example, milk sugar (lactose) is made from glucose and galactose whereas cane sugar (sucrose) is made from glucose and fructose

+

2,544

[1,272-1,272]

Disaccharides & condensed disacchardes can bond together and form cyclic polysaccharides

simple disaccharide

condensed disaccharide

$[CH_2O]_{12} - [H_2O]$

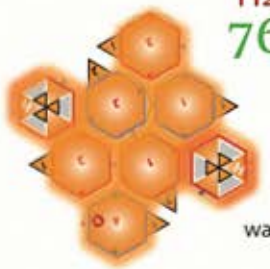

The reverse of this reaction, the formation of two monosaccharides from one disaccharide, is called a hydrolysis reaction and requires one water molecule to supply the H and OH to the sugars formed.

Sucrose is used in many plants for transporting food reserves, often from the leaves to other parts of the plant. Lactose is the sugar found in the milk of mammals and maltose is the first product of starch digestion and is further broken down to glucose before absorption in the human gut.

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14,496
[7,248-7,248]

Disaccharides

Disaccharides are one of the four basic categories of carbohydrates,
(the others are monosaccharides, oligosaccharides, and polysaccharides)

Monosaccharides, such as glucose, are the monomers out of which disaccharides are constructed.

C12-(H2O)11

Disaccharides & condensed disaccharides can bond together and form cyclic polysaccharides

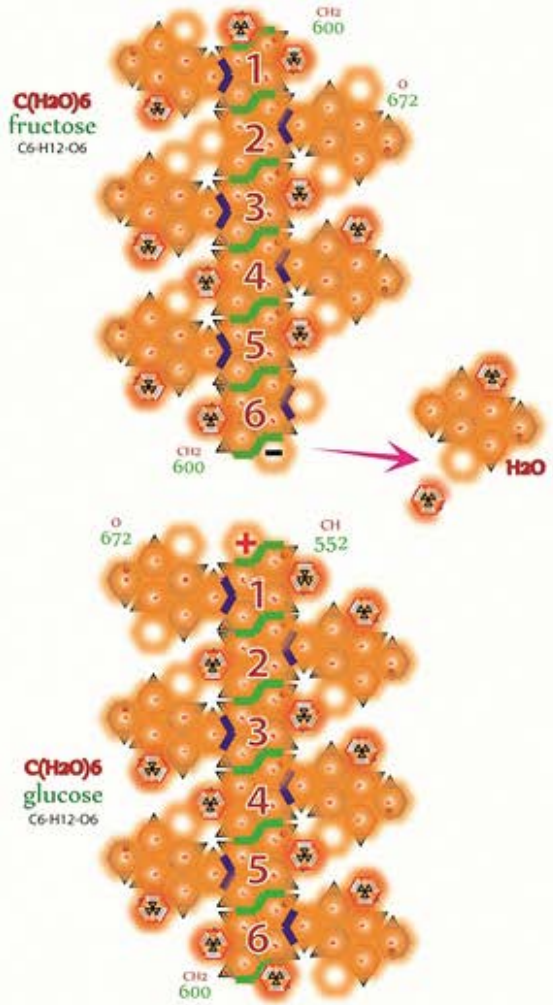

sucrose
C12-H22-O11

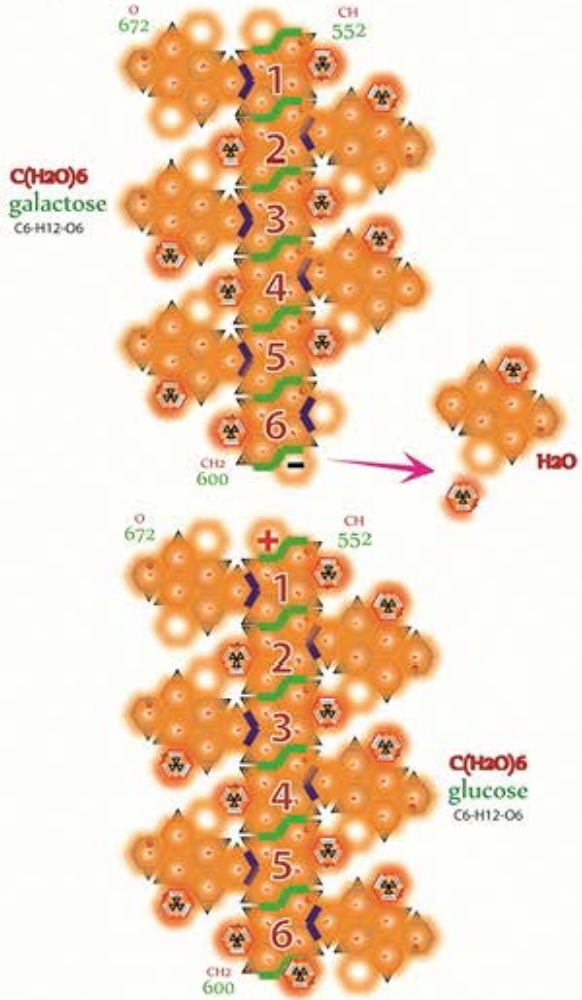

lactose
C12-H22-O11

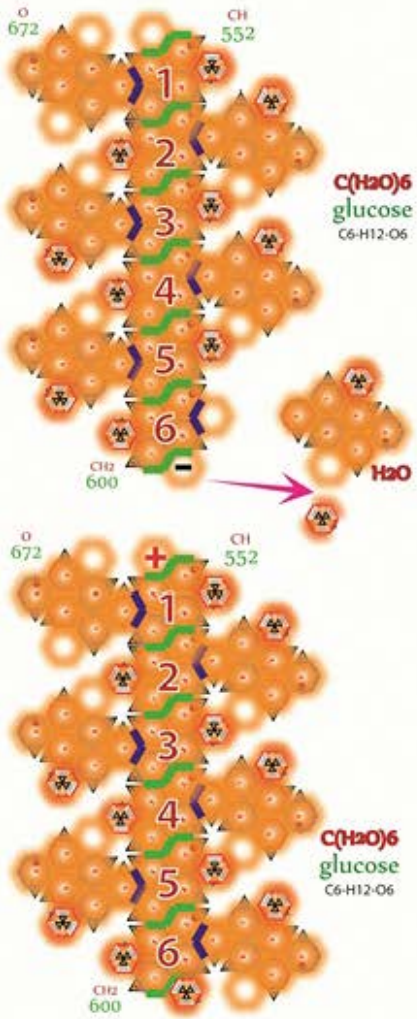

maltose
C12-H22-O11

The general chemical formula for carbohydrates, C(H2O),
gives the relative proportions of carbon, hydrogen, and oxygen in a monosaccharide
(the proportion of these atoms are 1:2:1)-(H2O)

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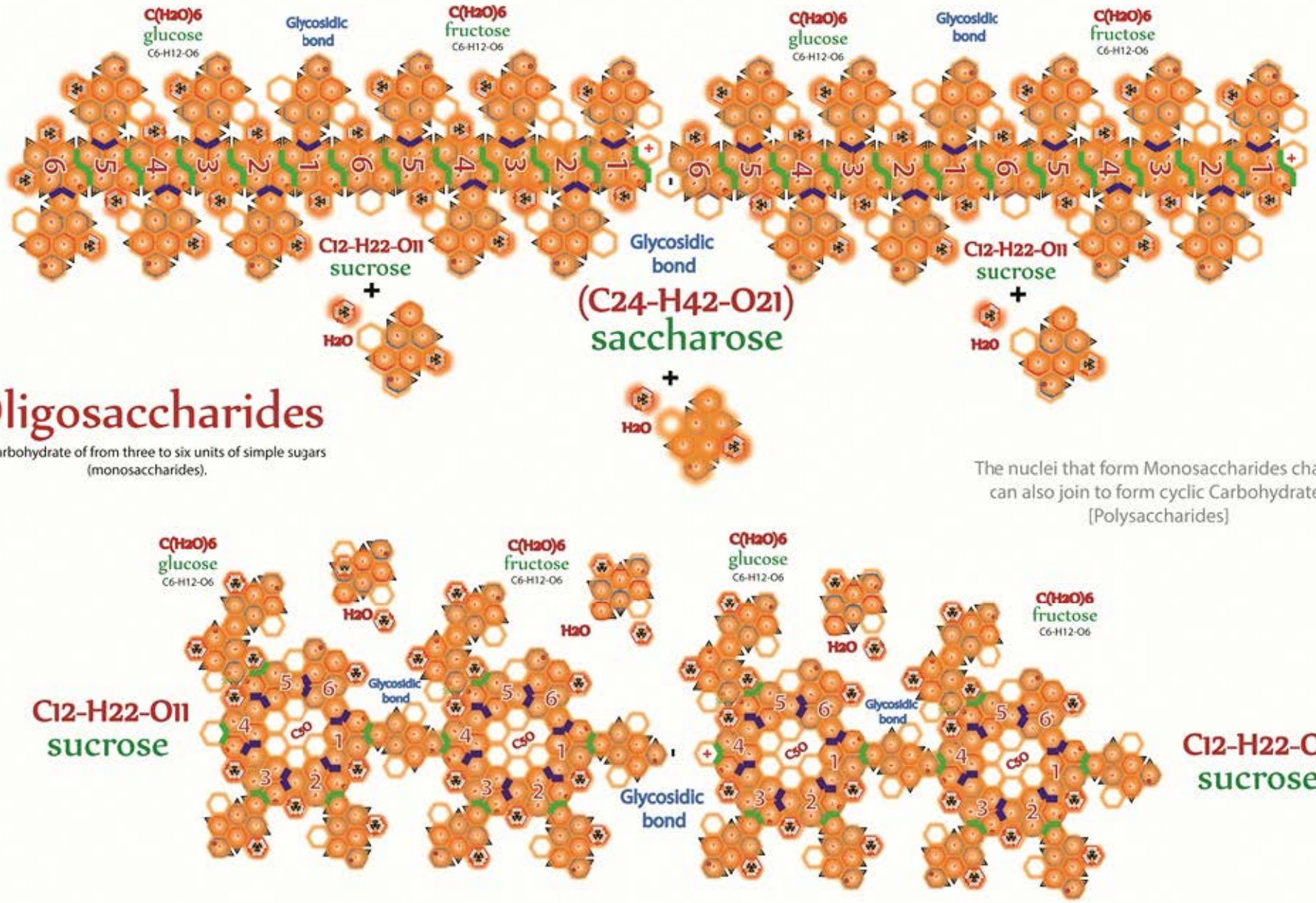

An oligosaccharide is a saccharide polymer containing a small number (typically two to ten) component sugars (monosaccharides). Oligosaccharides can have many functions; for example, they are commonly found on the plasma membrane of animal cells where they can play a role in cell–cell recognition.

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Starch or amylum is a carbohydrate consisting of a large number of glucose units joined by glycosidic bonds. This polysaccharide is produced by most green plants as an energy store.

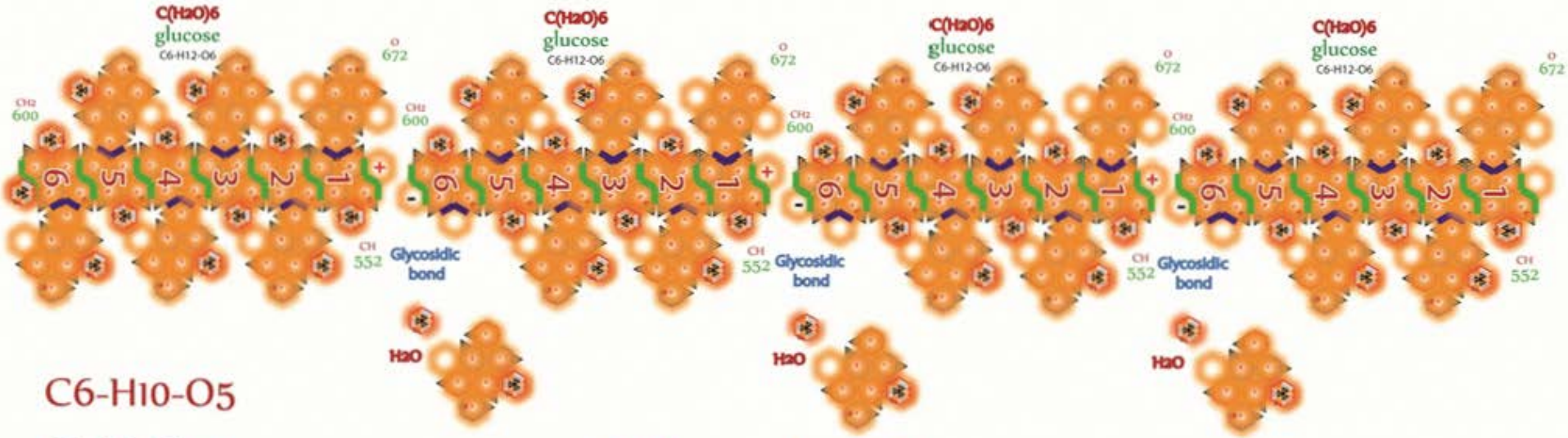

C6-H10-O5

6,864 n

[3,432-3,432]

Polysaccharides

Polysaccharides have a general formula of Cx(H2O)y where x is usually a large number between 200 and 2500.

The repeating units in a Polysaccharide polymer backbone are often six-carbon monosaccharides, their general formula can be represented as (C6-H10-O5)n

$C_x[H_2O]_y$

Polysaccharides are generally comprised of chains of cyclic monosaccharides

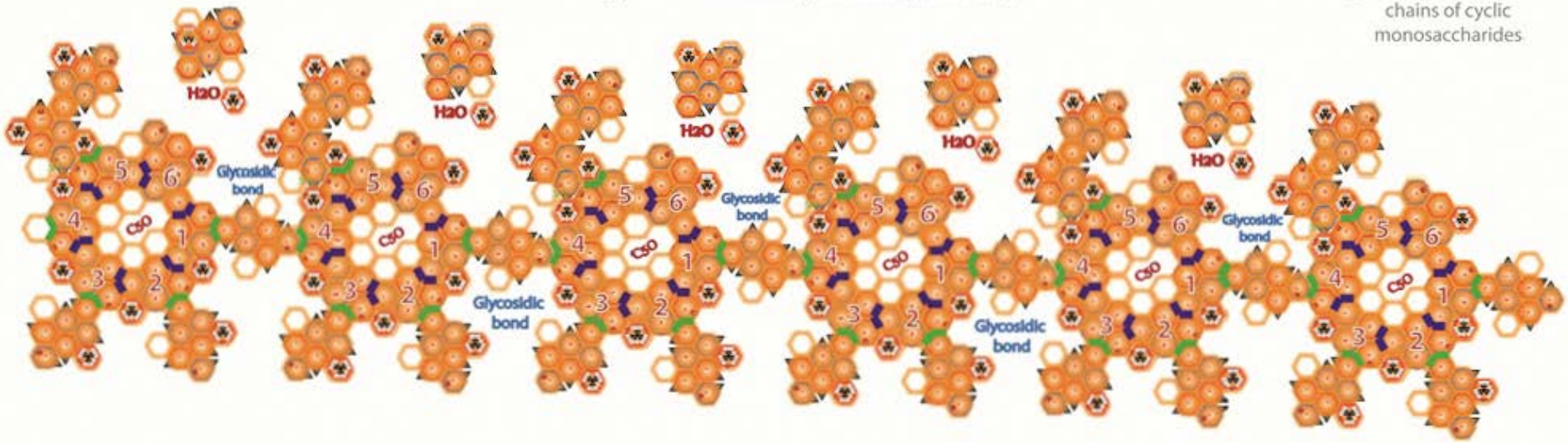

Cellulose is an organic compound with the formula (C6H10O5)n, a polysaccharide consisting of a linear chain of several hundred to over ten thousand linked D-glucose sugars.

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Amines

Amines are organic compounds that contain Nitrogen

NH2-[HC-R]-COOH + NH2-[HC-R]-COOH

As both the amine and carboxylic acid groups of amino acids can react to form amide bonds, one amino acid molecule can react with another and become joined through an amide linkage. This polymerization of amino acids is what creates proteins.

OH + NH2 -----> NH + H2O

This yields a peptide bond and a molecule of water via a condensation reaction

Carboxylic Acids

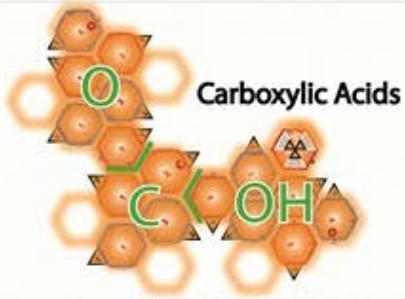

The general formula of a carboxylic acid is R-COOH

Amino Acids

Amino acids are biologically important organic compounds made from amine and carboxylic acid functional groups, along with a side-chain specific to each amino acid

un-ionized amino acid

NH2-[HC-R]-COOH

zwitterionic amino acid

NH3-[HC-R]-COO

The α-carbon.

The α-amino acids in peptides and proteins consist of a carboxylic acid (-COOH) and an amino (-NH2) functional group attached to the same tetrahedral carbon atom

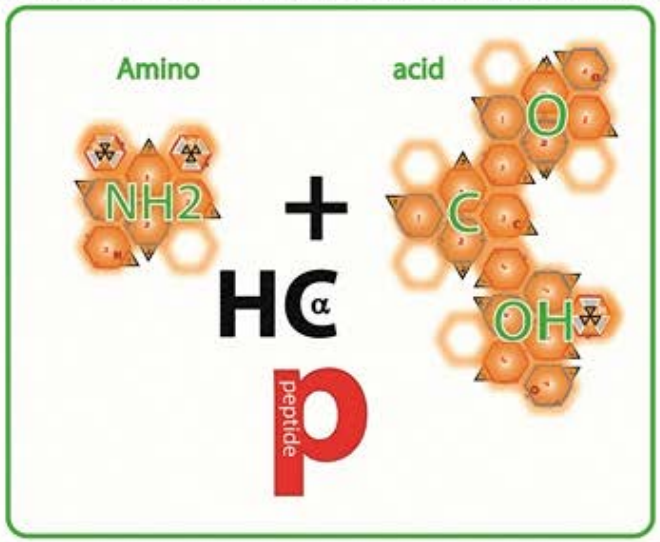

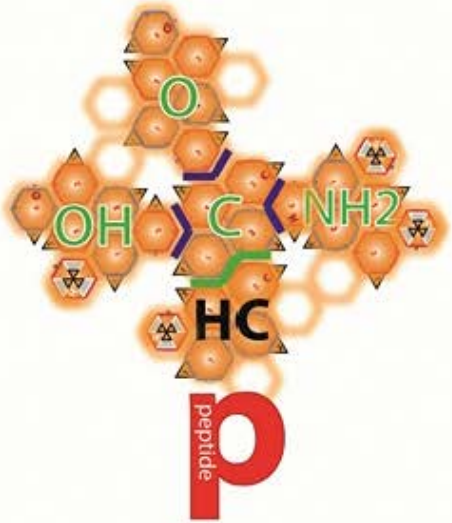

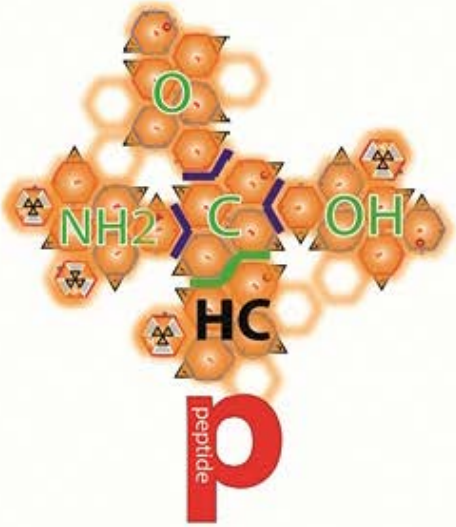

The peptide group attached to the alpha carbon distinguishes one amino acid from another (Tetryonic theory defines these compound side-chains of atoms as peptides [p])

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Peptide side chains

Amino acids are the structural units (monomers) that join together
to form short polymer chains called peptides;
or longer chains called either polypeptides or proteins

AAA
AAG
AAC
AAU
AGA
AGG
AGC
AGU
ACA
ACG
ACC
ACU
AUA
AUG
AUC
AUU

A
C5-H5-N5
Adenine

amino

acid

C
C4-H5-N3-O
Cytosine

CAA
CAG
CAC
CAU
CGA
CGG
CGC
CGU
CCA
CCG
CCC
CCU
CUA
CUG
CUC
CUU

3,180 Gly C2H5NO2
3,780 Ala C3H7NO2
4,452 Ser C3H7NO3
4,884 Pro C5H9NO2
4,980 Val C5H11NO2
5,052 Thr C4H9NO3
5,124 Cys C3H7NO2S
5,580 Lle C6H13NO2
5,580 Leu C6H13NO2
5,592 Asn C4H8N2O3
5,628 Asp C4H7NO4

P
peptide side chain

current chemical theory hypothesizes that all peptides and proteins are the result of codon triplet side chains on amino acids

Tetryonic theory reveals serious flaws in this line of thought

6,192 Gln C5H10N2O3
6,216 Lys C6H14N2O2
6,228 Glu C5H9NO4
6,324 Met C5H11NO2S
6,564 His C6H9N3O2
6,996 Phe C9H11NO2
7,392 Arg C6H14N4O2
7,668 Tyr C9H11NO3
8,640 Trp C11H12N2O2

GAA
GAG
GAC
GAU
GGA
GGG
GGC
GGU
GCA
GCG
GCC
GCU
GUA
GUG
GUC
GUU

G
C5-H5-N5-O
Guanine

U
C4-H4-N2-O2
Uracil

UAA
UAG
UAC
UAU
UGA
UGG
UGC
UGU
UCA
UCG
UCC
UCU
UUA
UUG
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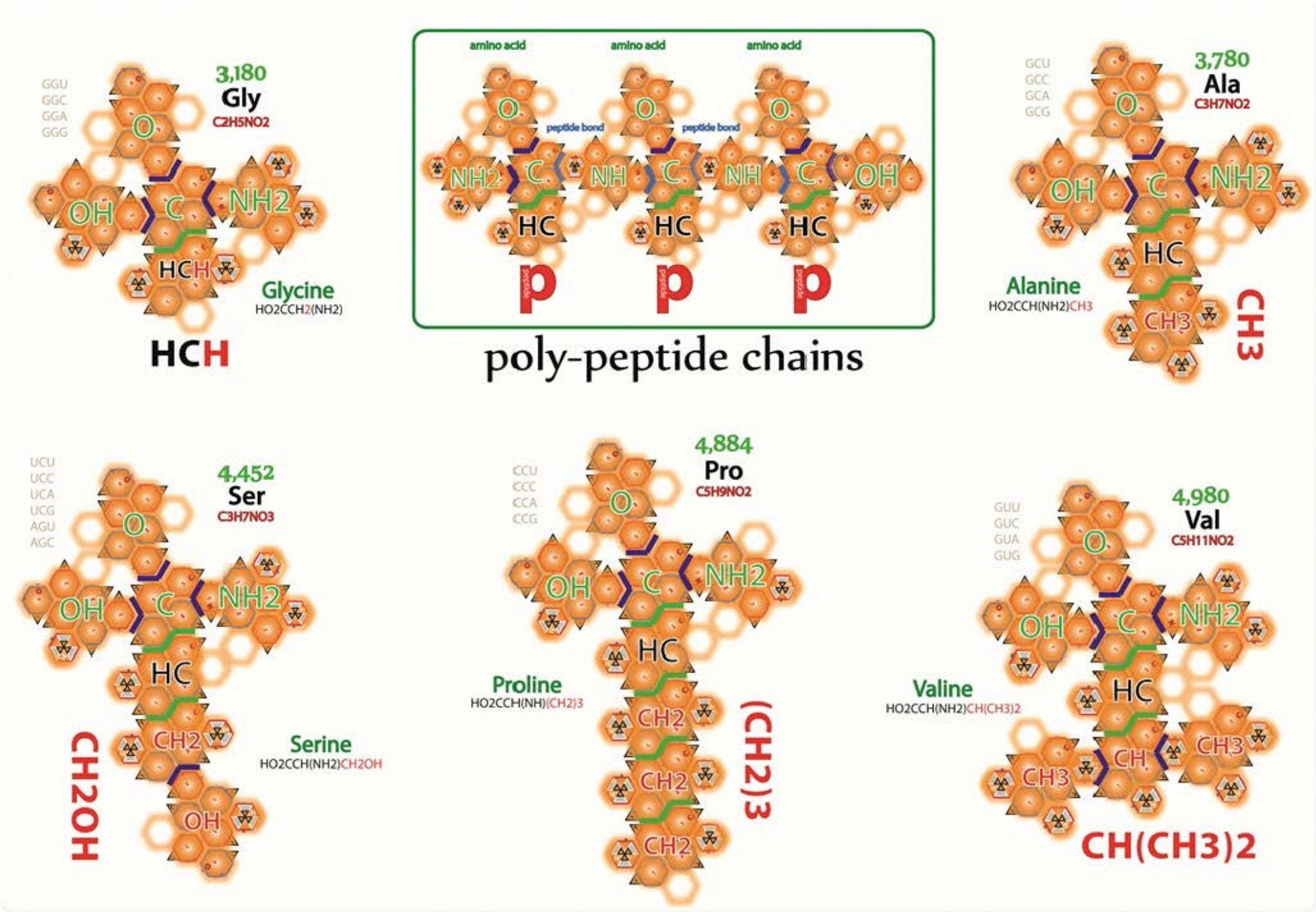

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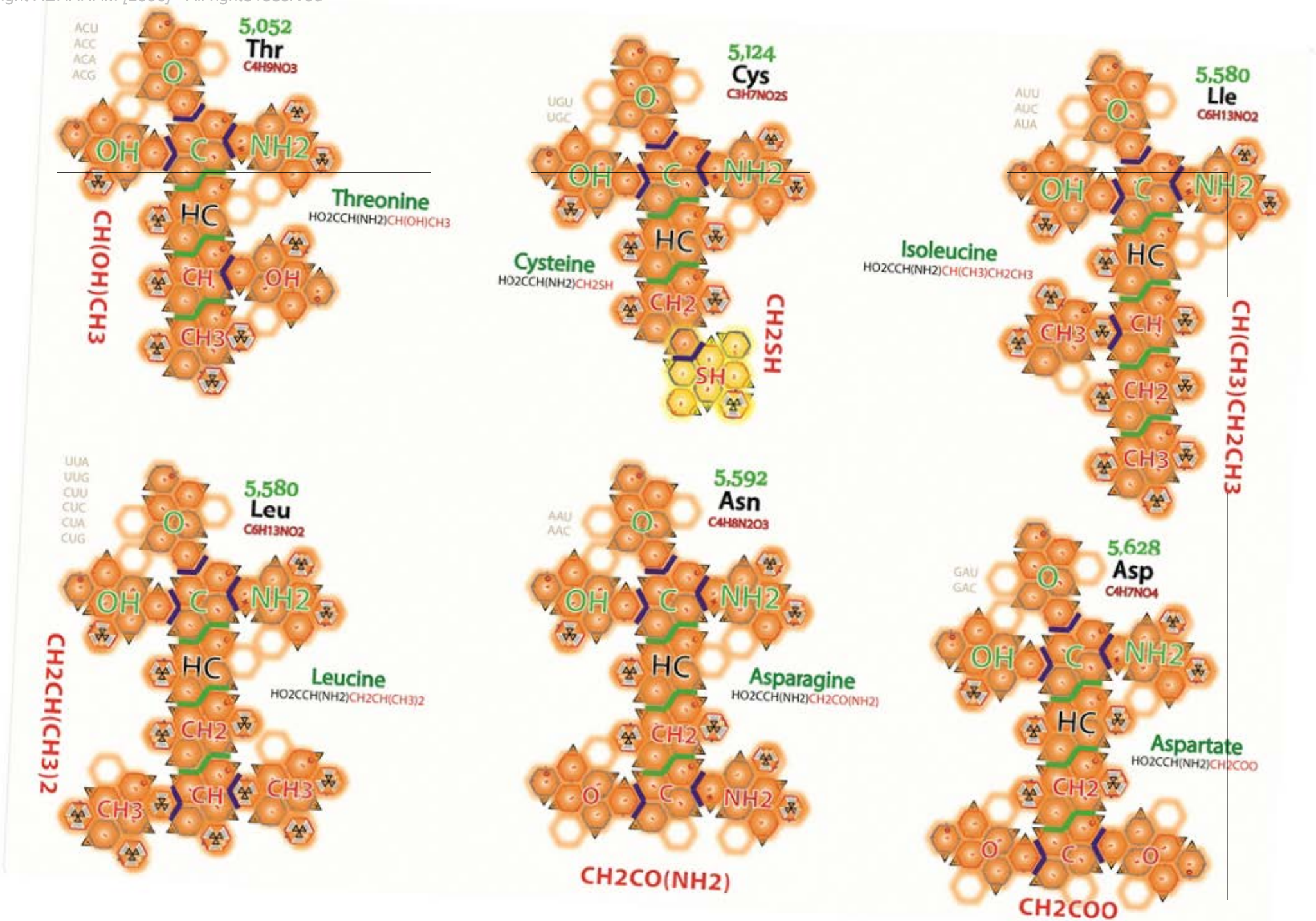

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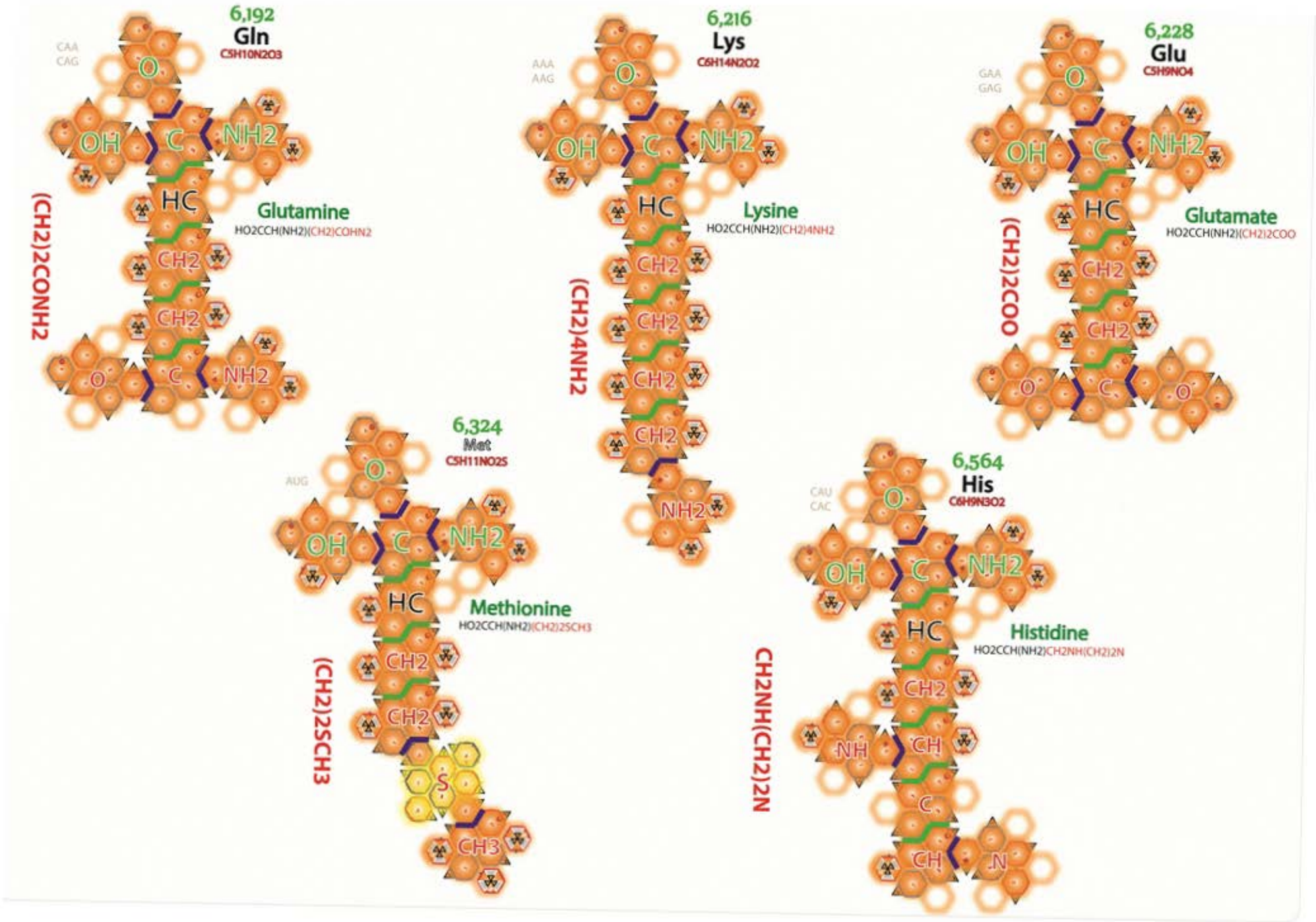

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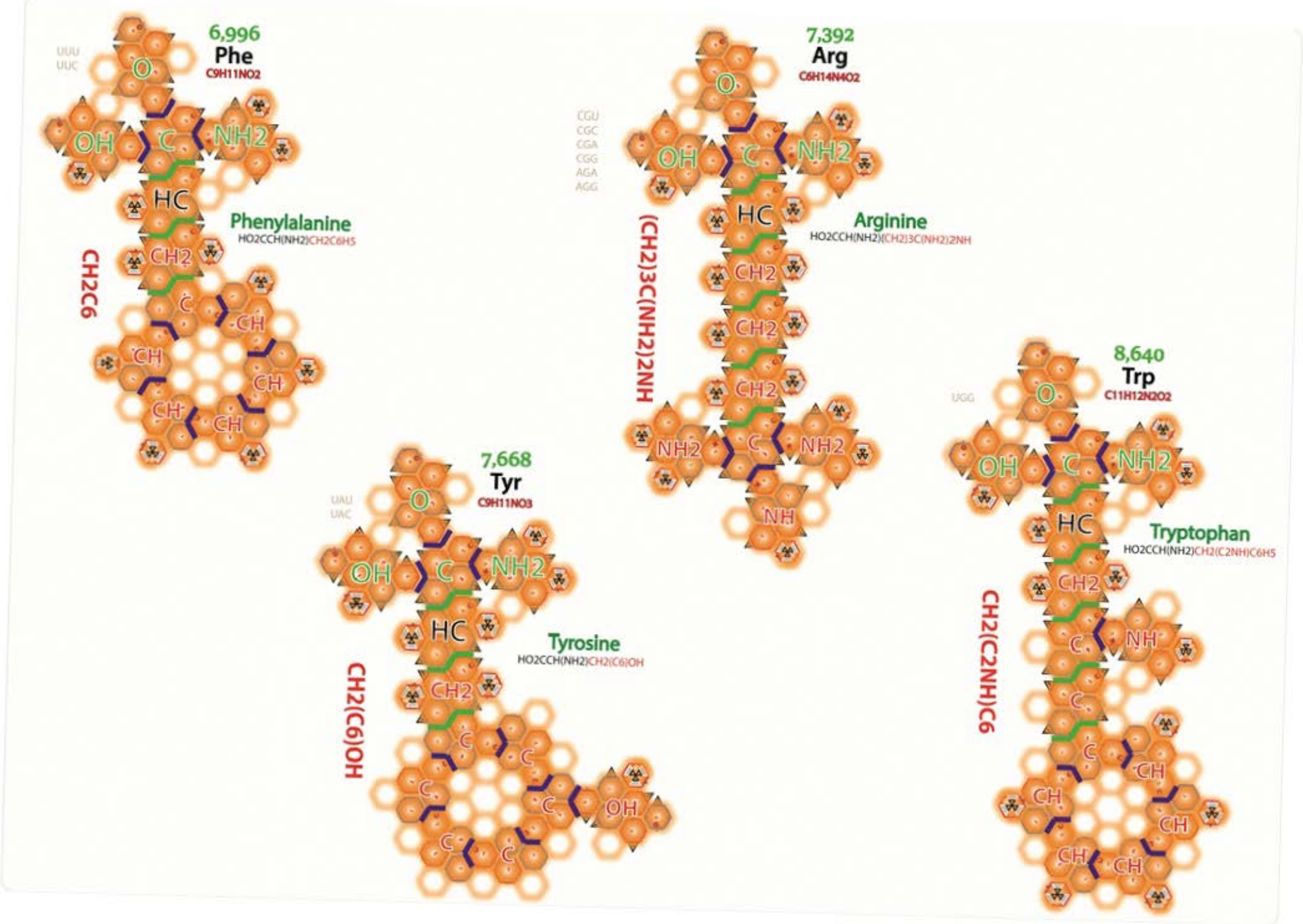

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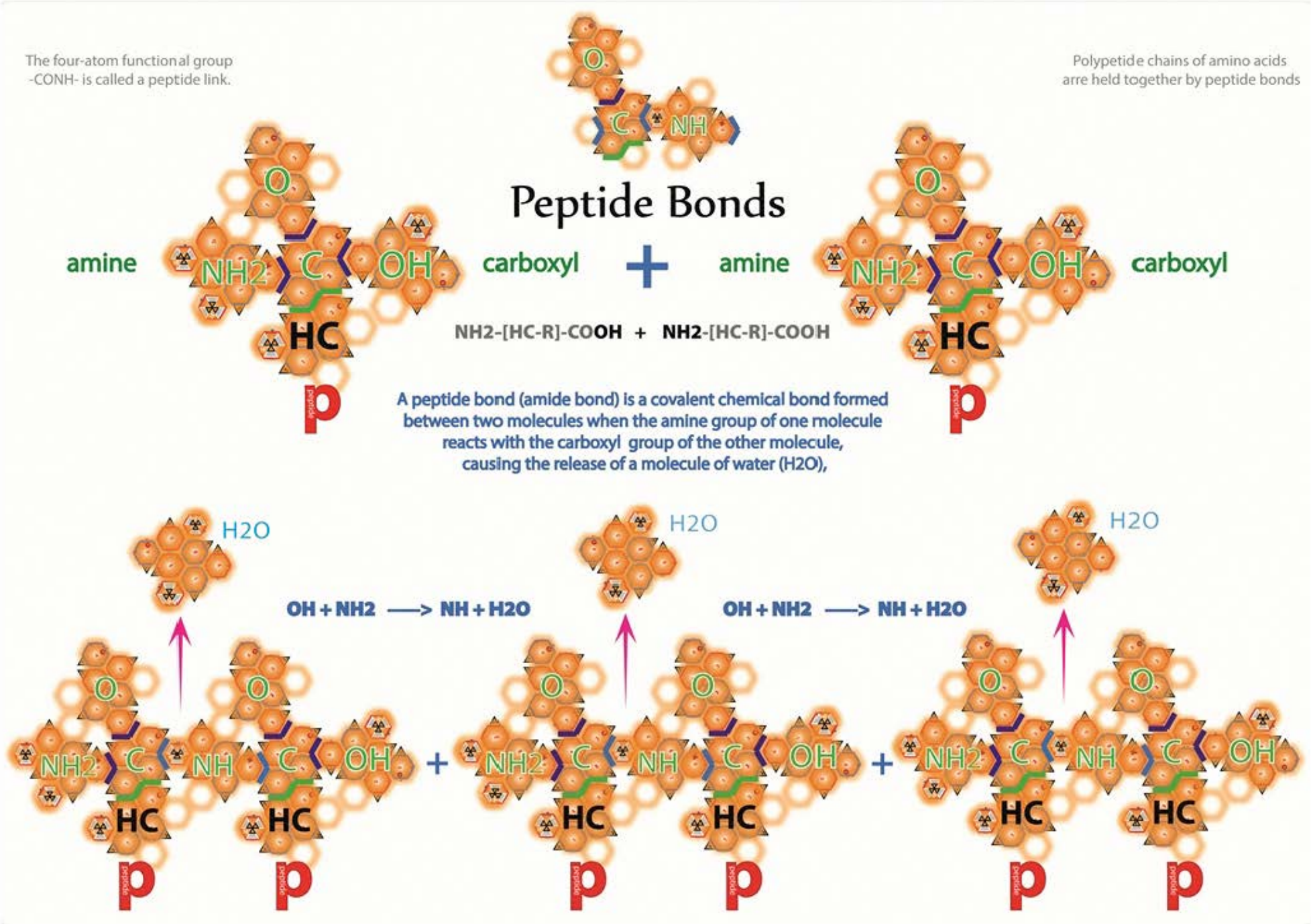

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amino terminus
The beginning of a polypeptide protein molecule has a free amino group.

The four-atom functional group -CONH- is called a peptide link.

carboxy terminus
The end of a polypeptide protein molecule has a free carboxyl group.

Proteins [poly-peptides] are formed by joining the -CO2H [carboxyl] end of one amino acid with the -NH2 [amine] end of another to form an amide. The -CONH- bond between amino acids is known as a peptide bond because relatively short polymers of amino acids are known as peptides.

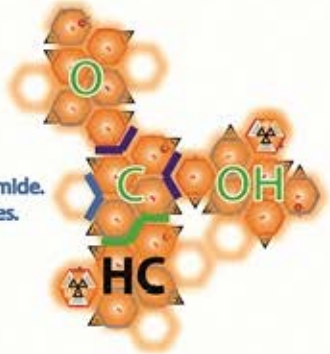

polypetide chains

Proteins are formed when amino acids are covalently linked together.

DNA and RNA have a deoxyribose and ribose sugar backbone, respectively, whereas PNA's backbone is composed of repeating (2-aminoethyl)-glycine units linked by peptide bonds.

Proteins

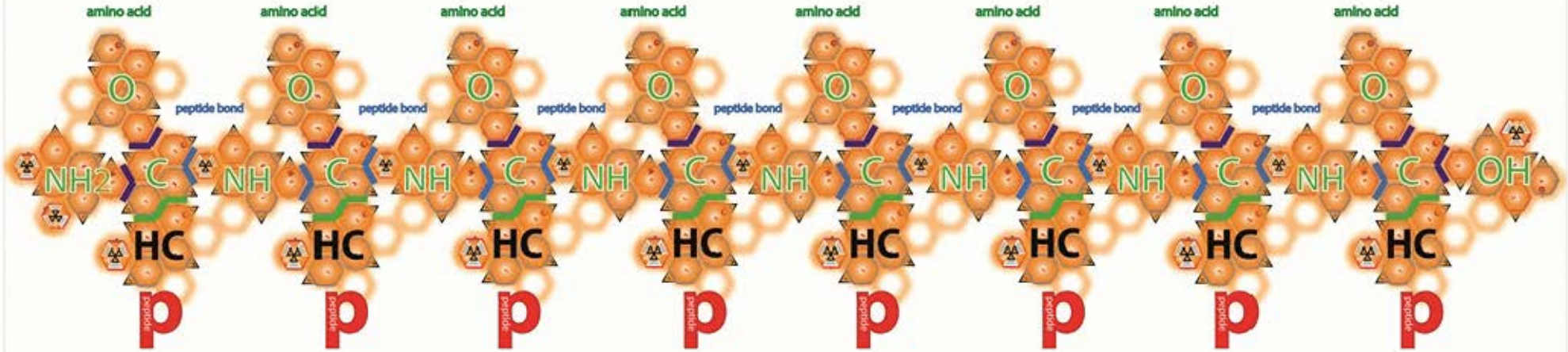

There are 20 different nucleotide side chains present in biological molecules.

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Lipids

hydrophyllic

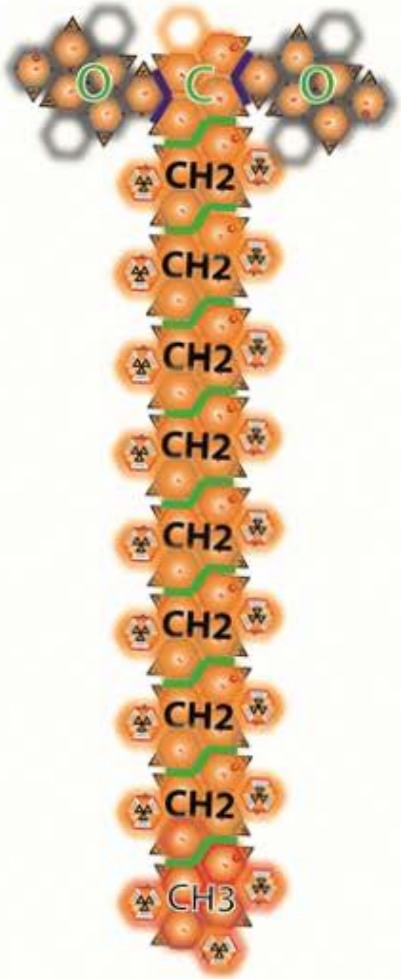

hydrophobic

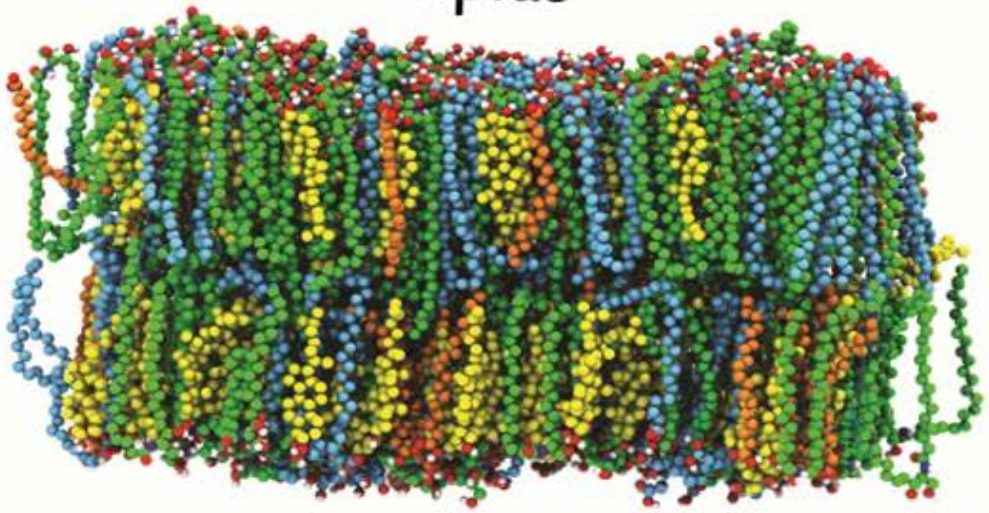

Lipids are a group of naturally occurring molecules that include fats, waxes, sterols, fat-soluble vitamins (such as vitamins A, D, E, and K), mono-glycerides, di-glycerides, tri-glycerides, phospho-lipids, and others.

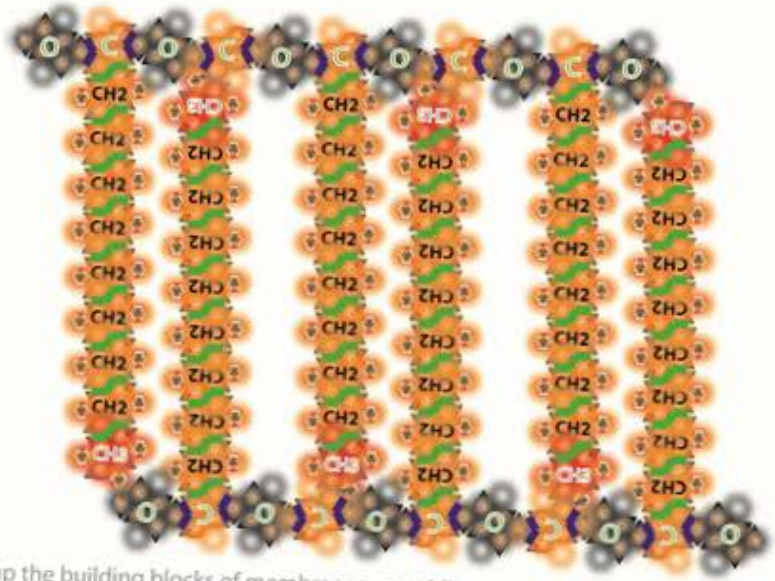

hydrophobic

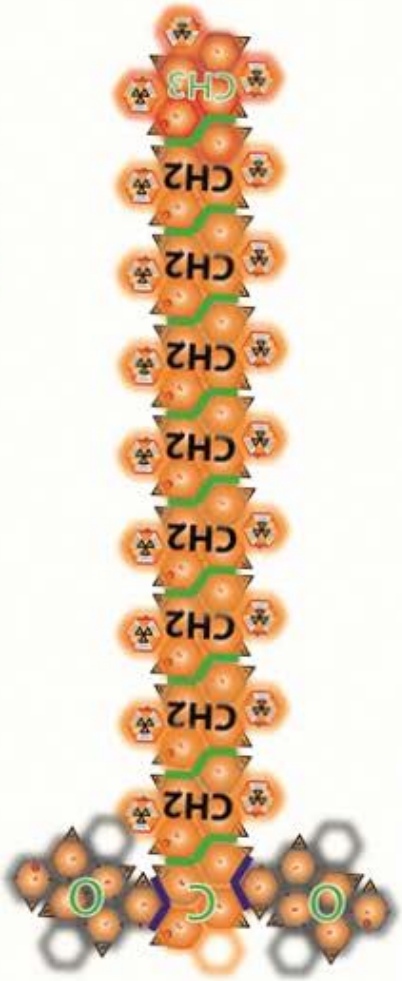

hydrophyllic

Lipids are molecules that contain hydrocarbons and make up the building blocks of membranes, providing a semi-permeable barrier between a living cell's internal & external enviroments.

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Lewis chemical structure

Acetylcholine

is an organic molecule that acts as a neurotransmitter in many organisms, including humans. It is an ester of acetic acid and choline

Tetryonic charge topology

Ach

C7H16NO2

CH3COO(CH2)2N+(CH3)3

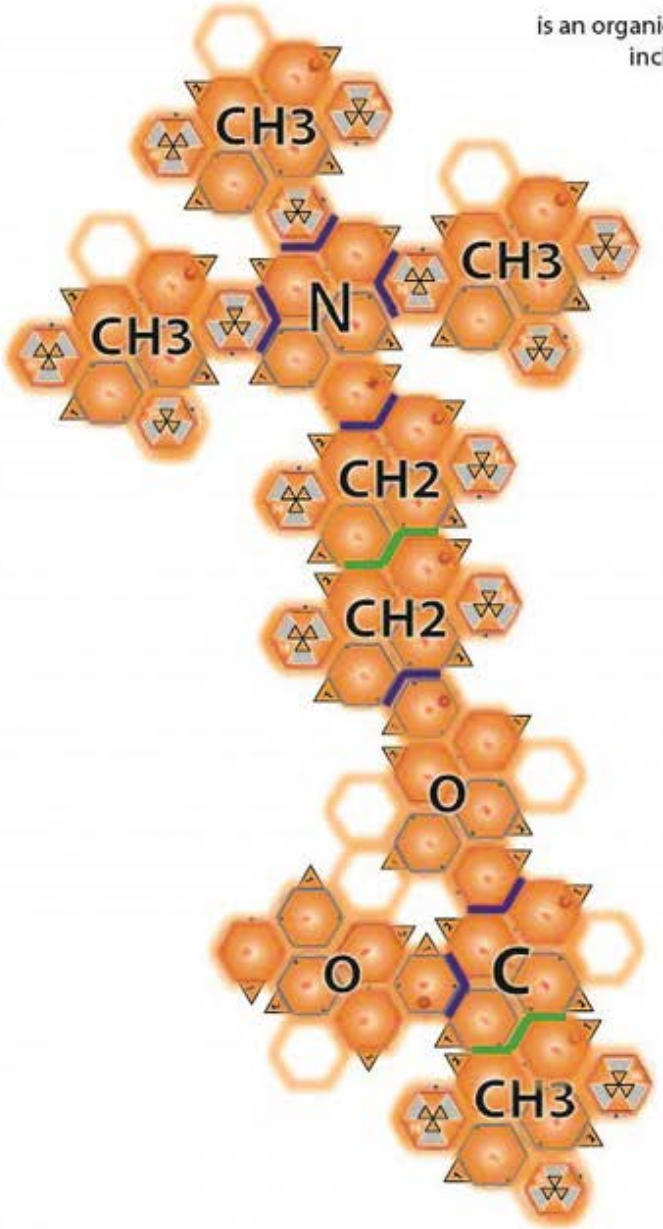

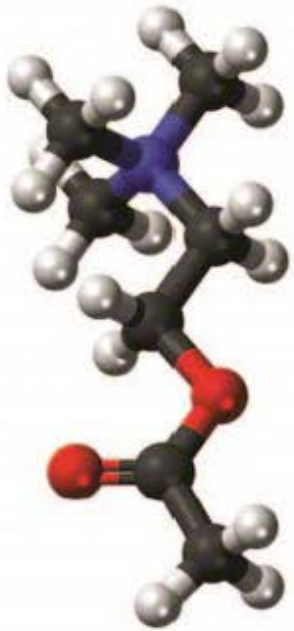

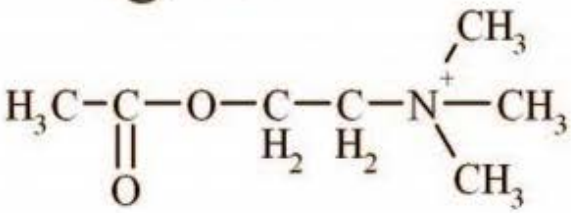

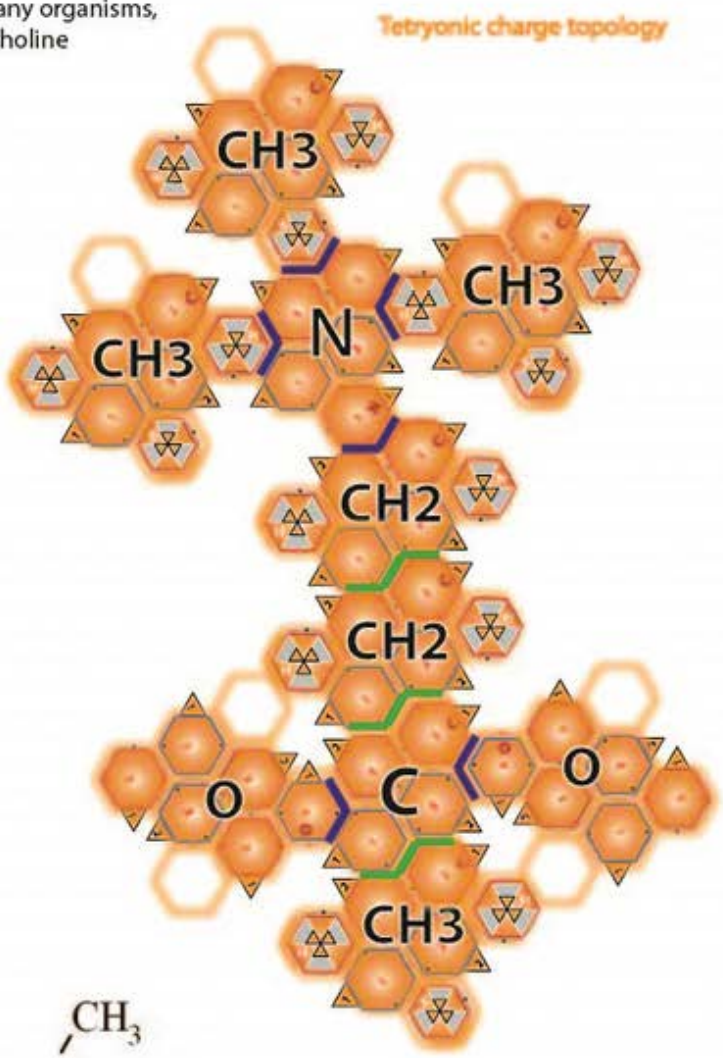

6,228

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Ribose

6,360

[3,180-3,180]

C5-H10-O5

Carbohydrate compounds can form acyclic sugars

Ribose is an organic compound with the formula C5H10O5; specifically, a monosaccharide (simple sugar) with linear form H–(C=O)–(CHOH)4–H

Carbohydrate compounds can also form cyclic sugars

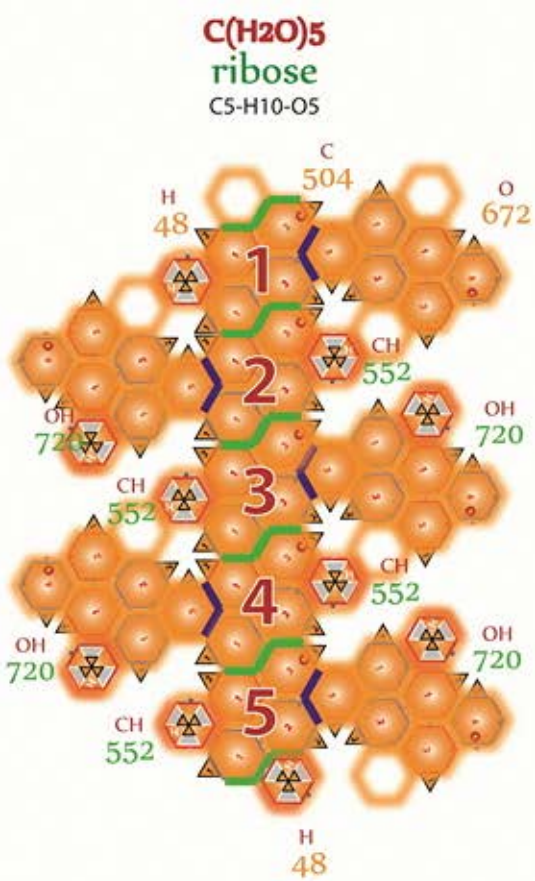

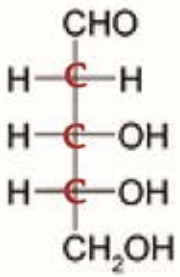

H-(CO)-(CHOH)4-H

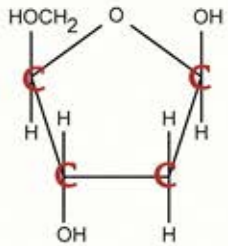

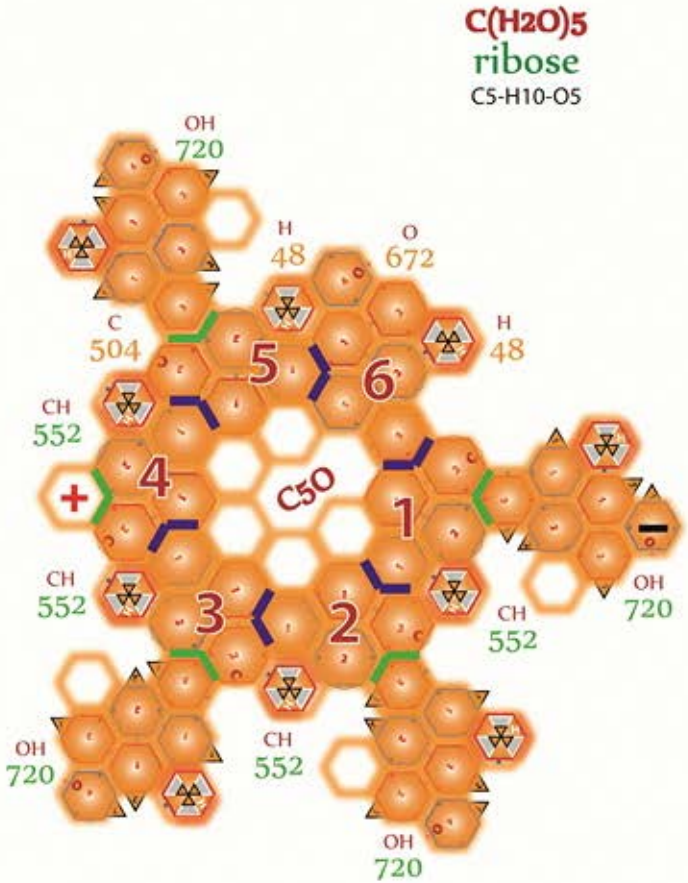

Ribose forms part of the backbone of RNA.
It is related to deoxyribose, which is found in DNA.

Ribose is present within every living cell of the body and is used to manufacture ATP (the energy currency of the cell) from scratch. Whilst the body can manufacture its own ribose from glucose, this requires energy and is a very slow process.

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As its name indicates it is a deoxygenated sugar, meaning that it is derived from the sugar ribose by loss of an oxygen atom

Deoxyribose

5,688
[2,844-2,844]

As a component of DNA, 2-deoxyribose derivatives have an important role in biology

The DNA (deoxyribonucleic acid) molecule, which is the main repository of genetic information in life, consists of a long chain of deoxyribose-containing units called nucleotides, linked via phosphate groups

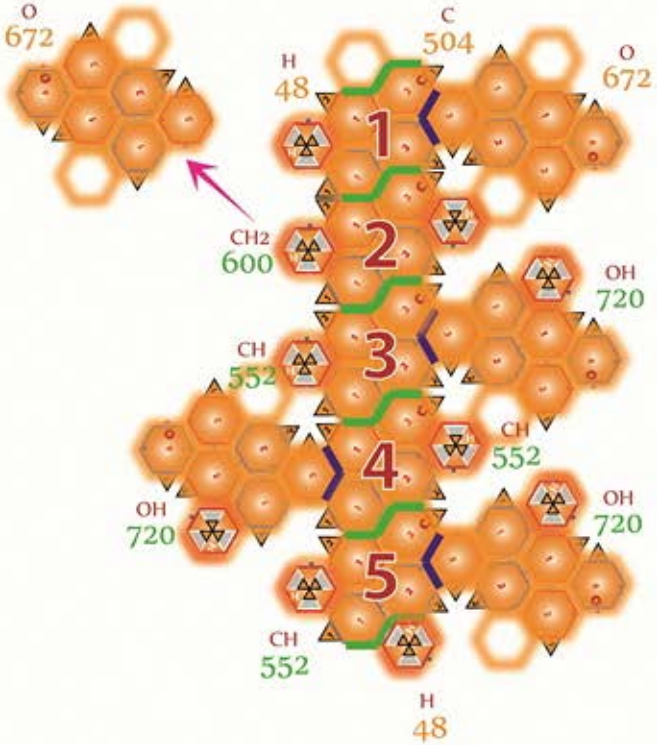

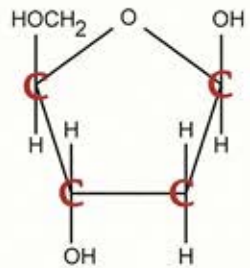

Deoxyribose, more, precisely 2-deoxyribose, is a monosaccharide

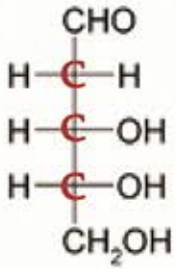

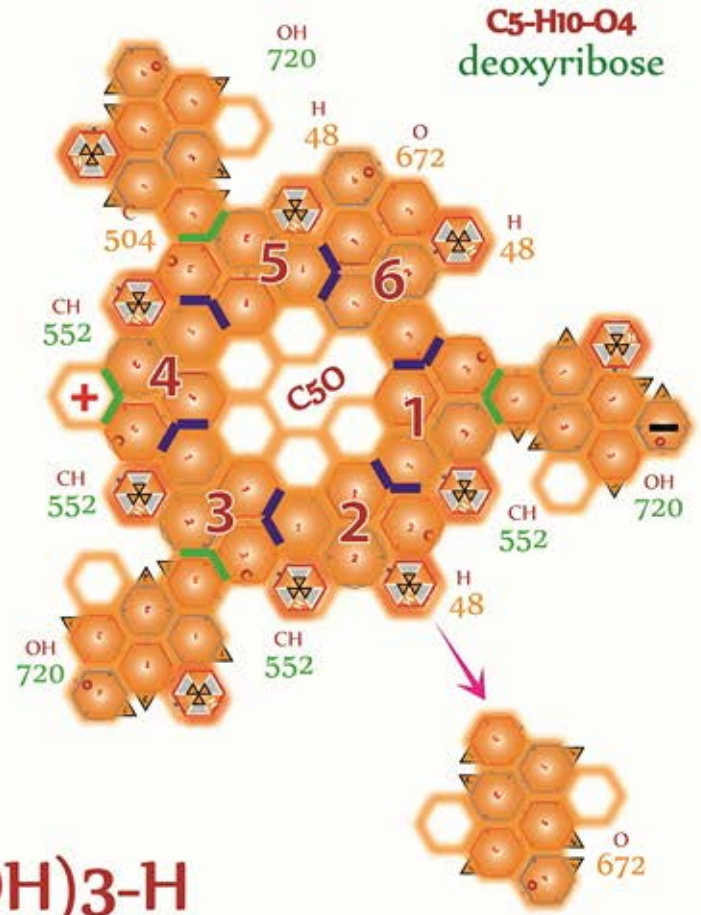

C5-H10-O4
deoxyribose

H-(CO)-(CH2)-(CHOH)3-H

Hermann Emil Fischer won the Nobel Prize in Chemistry (1902) for his work in determining the structure of the D-aldohexoses.

However, the linear, free-aldehyde structures that Fischer proposed represent a very minor percentage of the forms that hexose sugars adopt in solution. It was Edmund Hirst and Clifford Purves, in the research group of Walter Haworth, who conclusively determined that the hexose sugars preferentially form a pyranose, or six-membered, ring. Haworth drew the ring as a flat hexagon with groups above and below the plane of the ring – the Haworth projection

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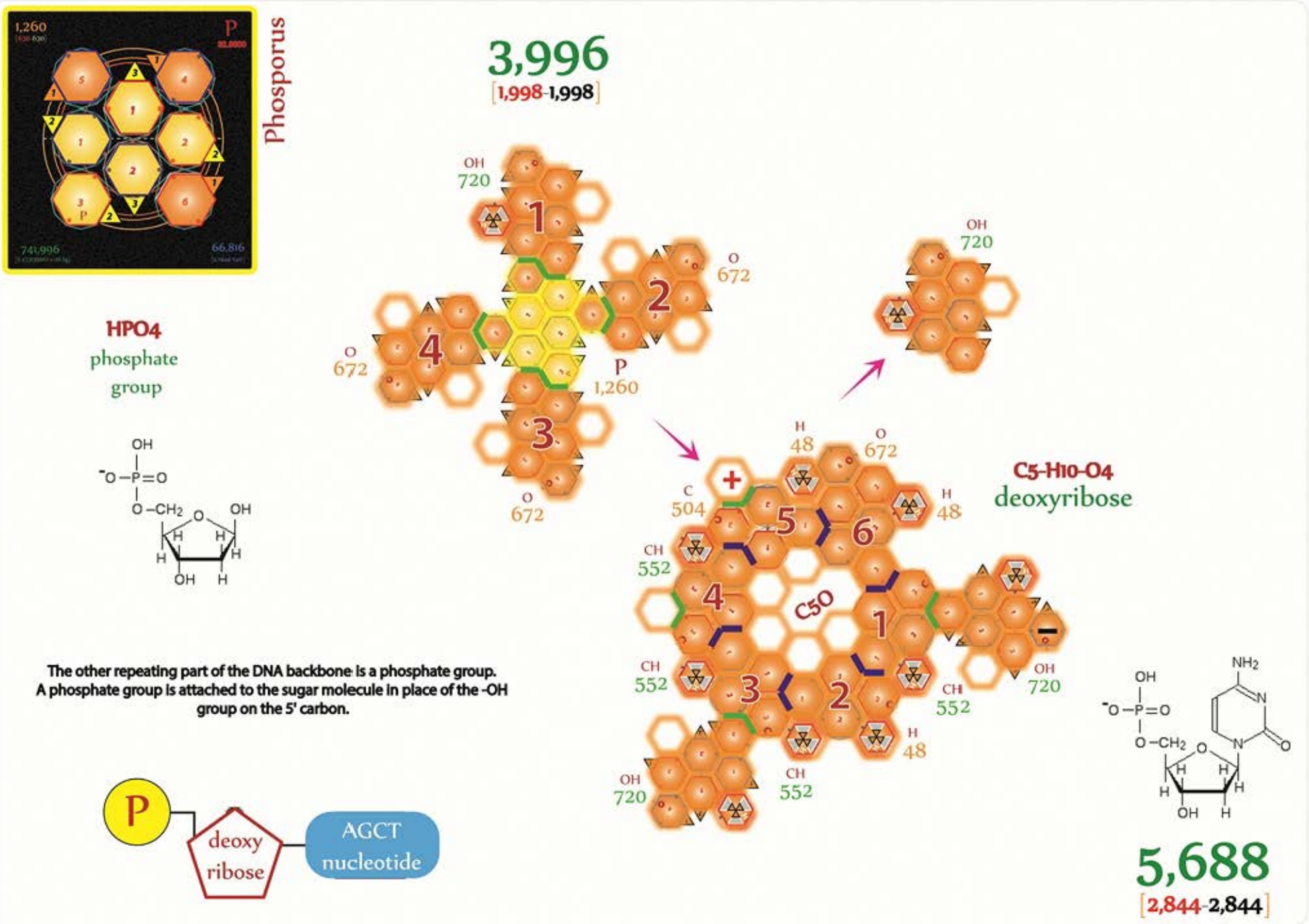

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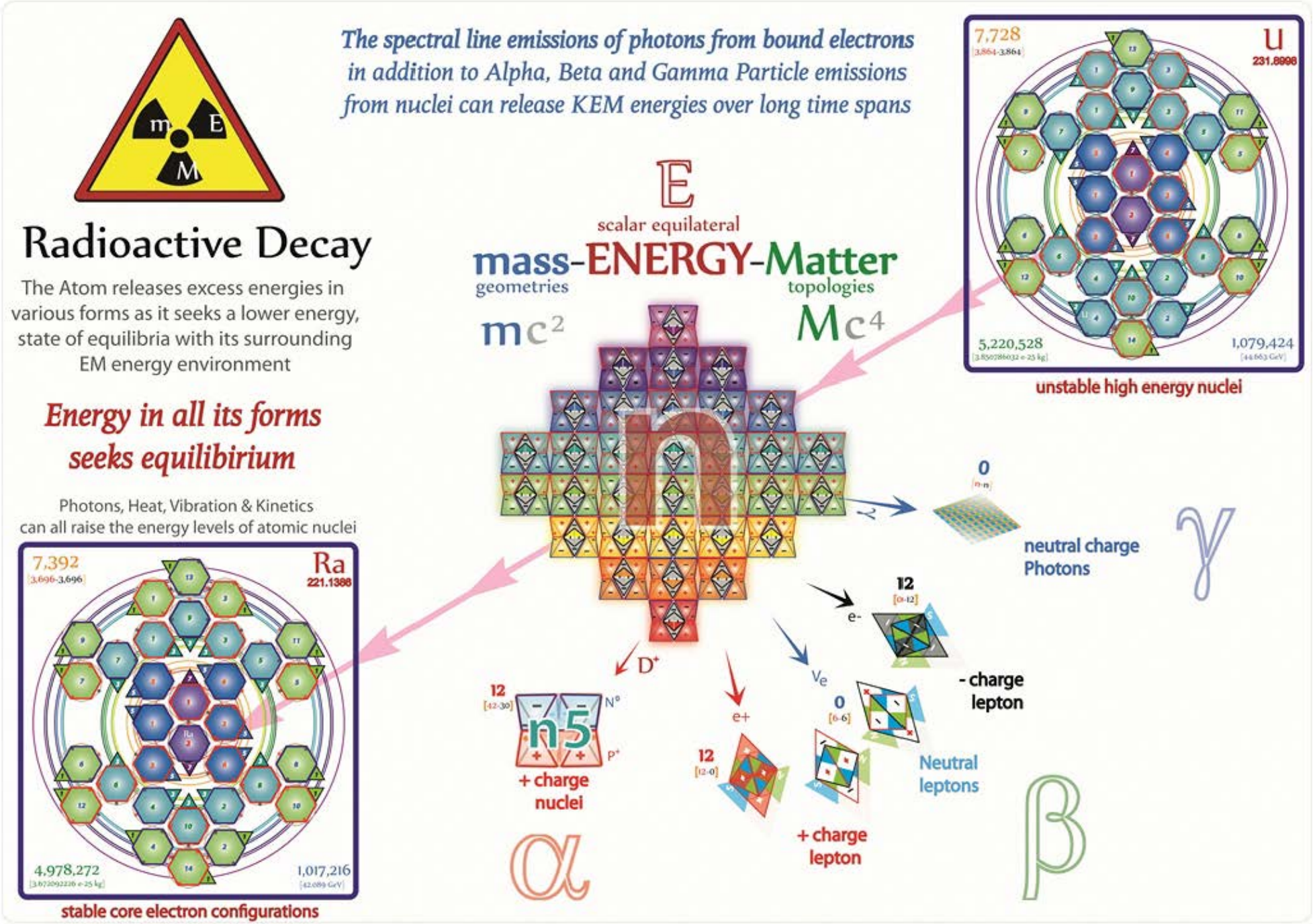

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Radio-Carbon isotope dating

Radiocarbon dating (sometimes simply known as carbon dating) is a radiometric dating method that uses the naturally occurring radioisotope carbon-14 (14C) to estimate the age of carbon-bearing materials up to about 58,000 to 62,000 years

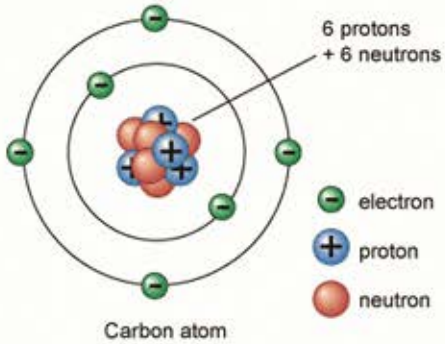

Standing-wave KE not 'excess' Neutrons

It is the stored Kinetic Energies [KE] that increase the mass of Carbon12 to create its isotopes, historically these mass-energies have been mistakenly thought to be extra Neutrons in the nuclei

[6 Deuterium nuclei]

ALL elemental Carbon atoms have an atomic configuration of 6 protons, 6 neutrons and 6 electrons

C14 half-life
5730 ± 40

Carbon-14, 14C, or radiocarbon, is a radioactive isotope of carbon with a nucleus containing 6 protons, 6 neutrons and 6 electrons with an excess energy content of 1.88 GeV

Carbon-13, 13C, is a weakly radioactive isotope of carbon with a nucleus containing 6 protons, 6 neutrons and 6 electrons with an excess energy content of 920 MeV

Radio-Carbon dating can be used to determine the age of carbonaceous materials up to about 60,000 years old

Isotopic mass-charge quotient determines an element's properties

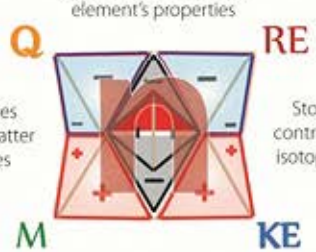

Net Charges create 3D Matter topologies

Stored KE contributes to isotopic mass

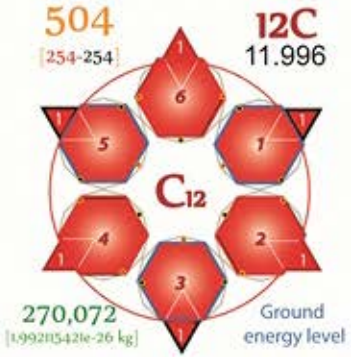

Tetryonic theory corrects historical errors of atomic geometries and nuclear energies

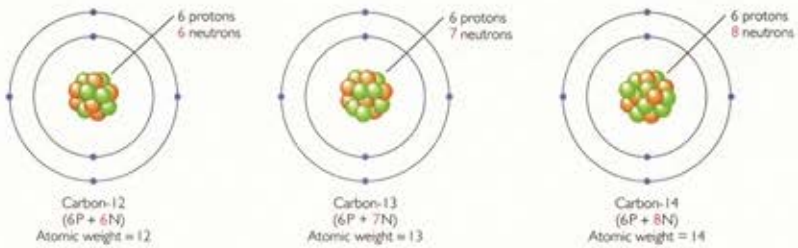

The stored KE [chemical] mass-energies of the Carbon 12+ isotopes comes from various radiological [and biological] processes and its steady, predictable release through the quantum mechanics of the synchronous convertors that make up Carbon nuclei make it useful in dating objects based on their decay rates

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Radioactive Isotopes

Where the elementary nuclei's Deuteron energy levels are raised from their ground levels radioactive isotopes are created

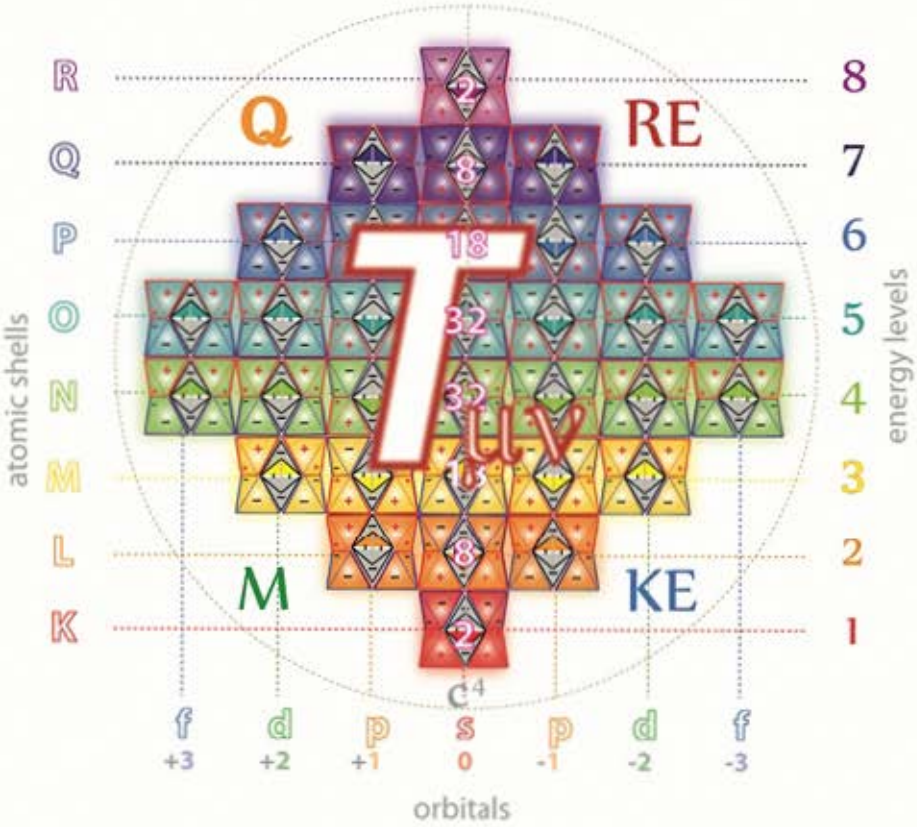

Each periodic element is comprised of an EQUAL number of Protons, Neutrons & electrons that form each element's unique 2D mass-energy geometries & 3D Matter topology and contribute to its observed properties

The $\frac{\text{mass}}{c^2}$ ~ $\frac{\text{energy}}{c^4}$ content of Matter

Einstein's relativistic stress energy tensor models mass-energy-Matter as a nebulous energy-momenta density-pressure gradient

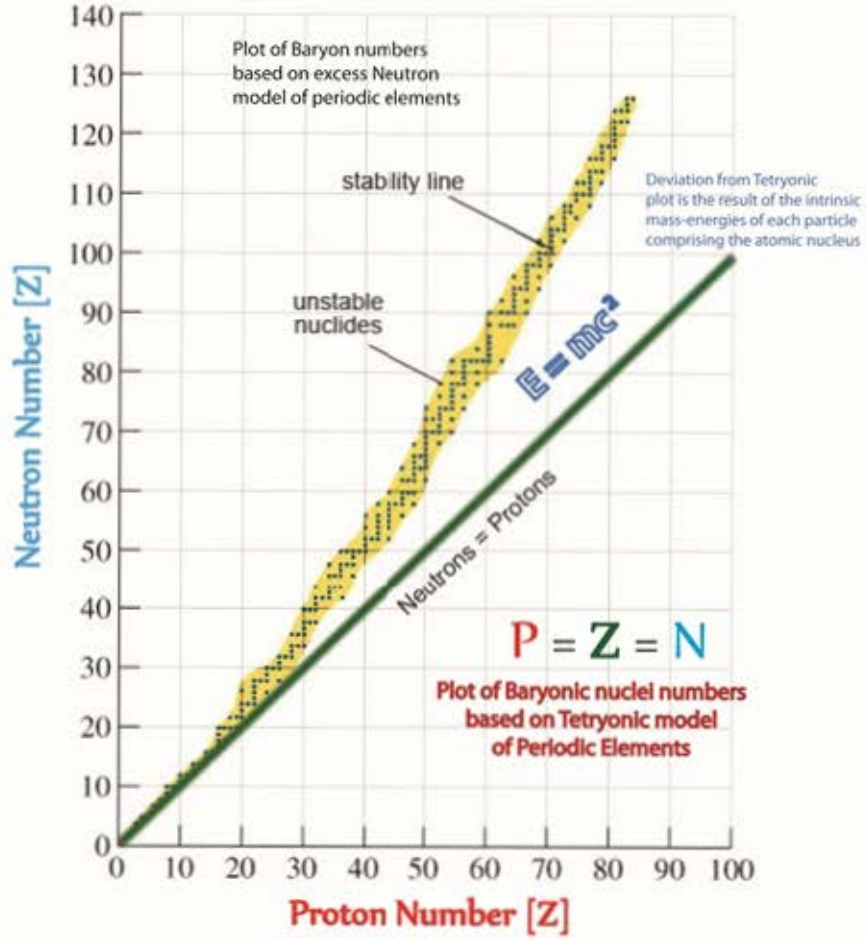

Tetryonic theory redefines the relativistic stress energy tensor [$T_{\mu\nu}$] into a geometric measure of the charged 2D electromagnetic mass-energies & 3D Matter topologies within any spatial co-ordinate system

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Nuclear Decay processes

is the set of processes by which an unstable atomic nucleus emits subatomic particles

Charged Matter equivalence

Neutrogen $\nu e_{[6\text{-}6]} + N^0_{[18\text{-}18]} \overset{[24\text{-}24]}{\sim} P^+_{[24\text{-}12]} + e^-_{[0\text{-}12]}$ Hydrogen

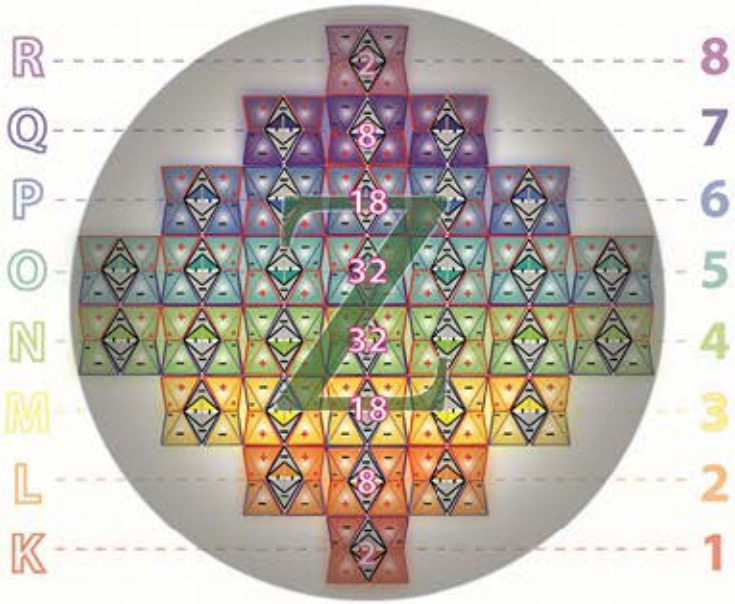

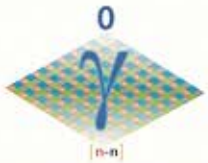

gamma rays

$KE_{[\nu\text{-}\nu]} \rightarrow \gamma_{[n\text{-}n]}$

gamma ray production

Charge & mass-energy momenta are conservative physical properties

Radioactivity was discovered in 1896 by the French scientist Henri Becquerel, while working on phosphorescent materials. These materials glow in the dark after exposure to light, and he suspected that the glow produced in cathode ray tubes by X-rays might be associated with phosphorescence

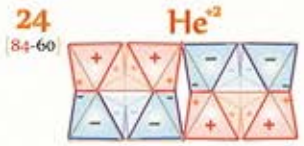

alpha-particles

$D^+_{[42\text{-}30]}$ $D^+_{[42\text{-}30]}$ $\rightarrow$ $He^{+2}_{[84\text{-}60]}$

alpha particle production

E

Energy can be released from atomic nuclei through various processes

alpha-particles
beta-particles
gamma rays
spectral lines
heat & motion

beta-particles

m *All nuclear decay particles are determined by Tetryonic charge topologies* M

Charge Matter particle creation follows chemical equilibrium formulae

$N^0_{[18\text{-}18]} \rightarrow e^+_{[12\text{-}0]} + \nu e_{[6\text{-}6]} + e^-_{[0\text{-}12]}$

Neutron decay processes

$N^0_{[18\text{-}18]} \rightarrow \nu e_{[6\text{-}6]} + \nu e_{[6\text{-}6]} + \nu e_{[6\text{-}6]}$

3D Matter topologies are not conservative

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Alpha radiation

(Deuteron emissions)

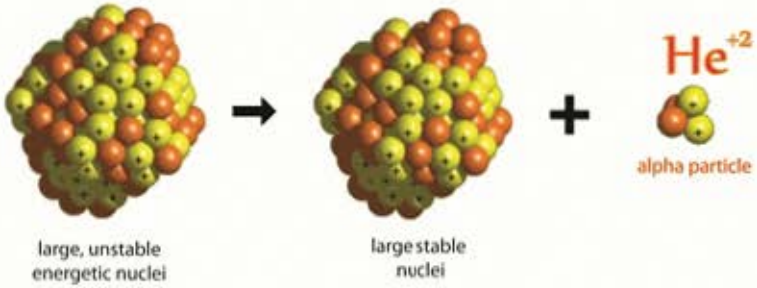

Alpha particles are released during alpha decay processes in ultra-heavy nuclei like uranium, thorium, actinium, and radium

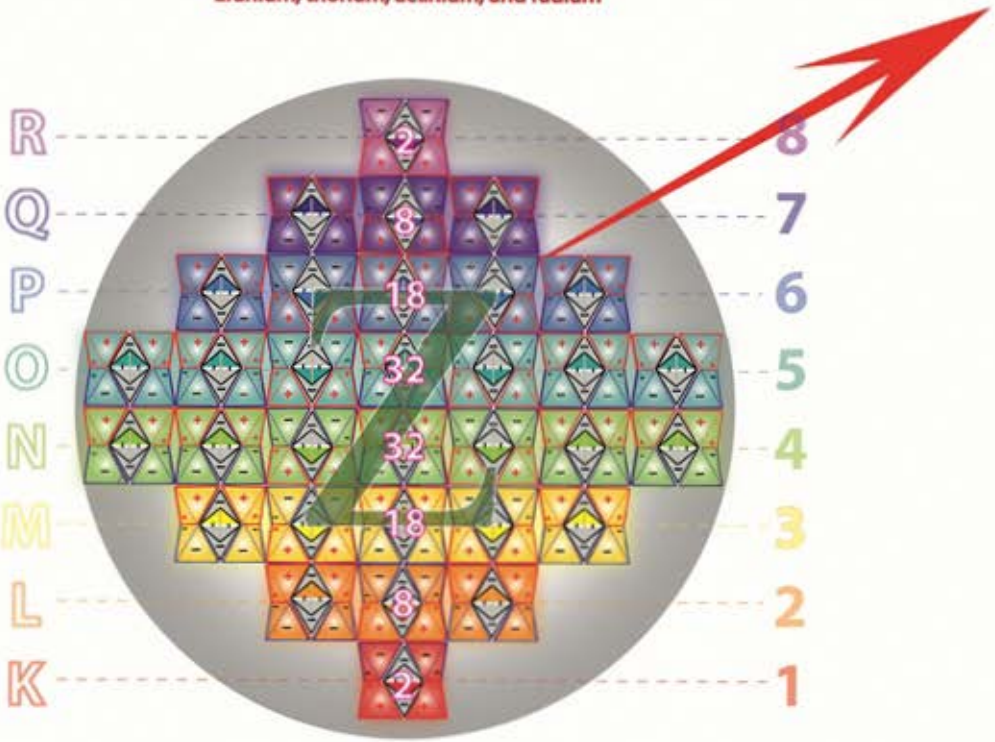

Beta radiation - Negative charge sets (Nuclei)
Gamma radiation - Neutral Charge sets (Photons)

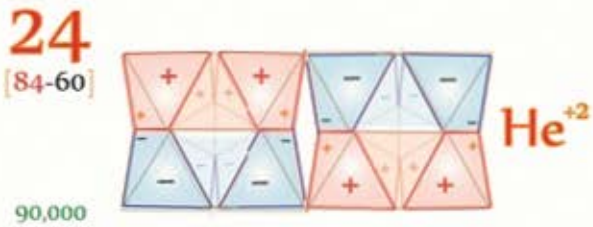

Helium nuclei creation

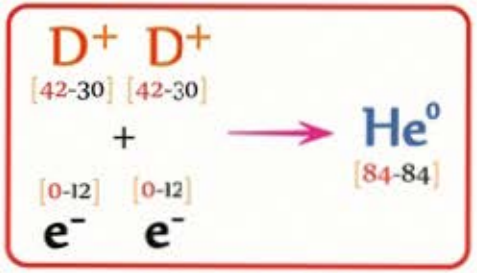

charged alpha nuclei bond & capture electrons to form neutral Helium

alpha particles

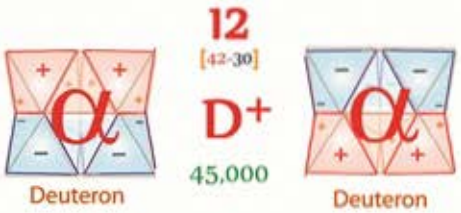

The radioactive isotope Americium 241 emits alpha particles which are used in smoke detectors.

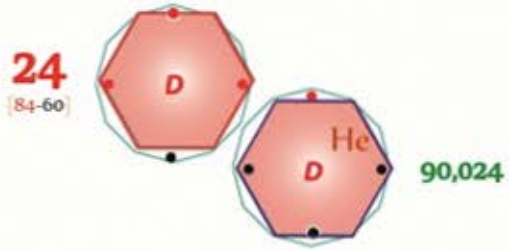

Due to their larger masses compared to beta and gamma particles, alpha particles can be easily stopped by a piece of paper or human skin.

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Beta particle decay

N^0 [18-18] → e^+ [12-0] + νe [6-6] + e^- [0-12]

Neutron decay paths

N^0 [18-18] → νe [6-6] + νe [6-6] + νe [6-6]

(the emission of leptons from atomic nuclei)

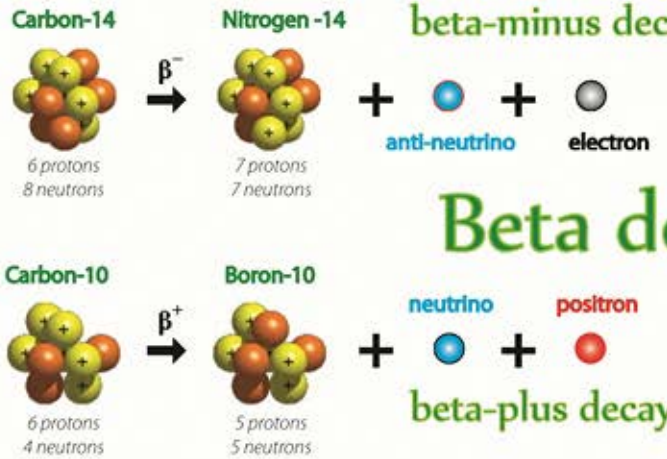

Beta decay

Charge is a conserved physical property of all material objects

N^0 [18-18] + νe [6-6] $\xrightarrow{[24\text{-}24]}$ P^+ [24-12] + e^- [0-12]

Neutron decay is not a spontaneous process

All beta decay processes are the result of neutrino interaction with Neutrons

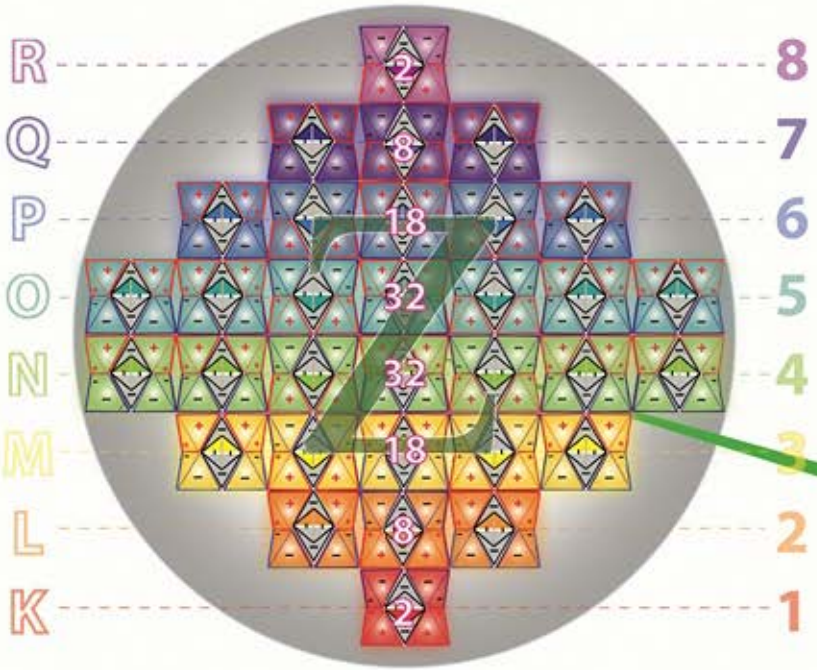

Alpha radiation - Positive charge particles (Nuclei)
Gamma radiation - Neutral charge quanta (Photons)

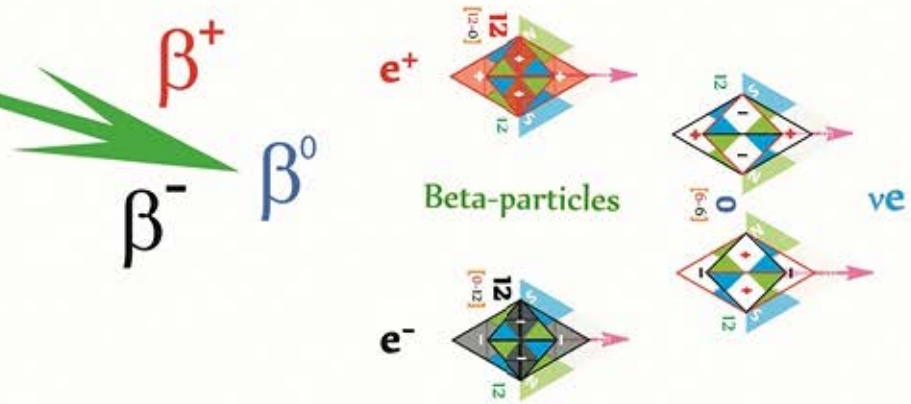

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Gamma Radiation

(high energy photon emission)

Natural sources of gamma rays on Earth include gamma decay from naturally occurring radioisotopes, and secondary radiation from atmospheric interactions with cosmic ray particles.

All ejected gamma ray photons are neutral energy quanta sets [photons / EM waves]

Gamma rays typically have frequencies above 10 exahertz (or >10^19 Hz), and therefore generally have energies above 100 keV and wavelengths less than 10 picometers (less than the diameter of an atom)

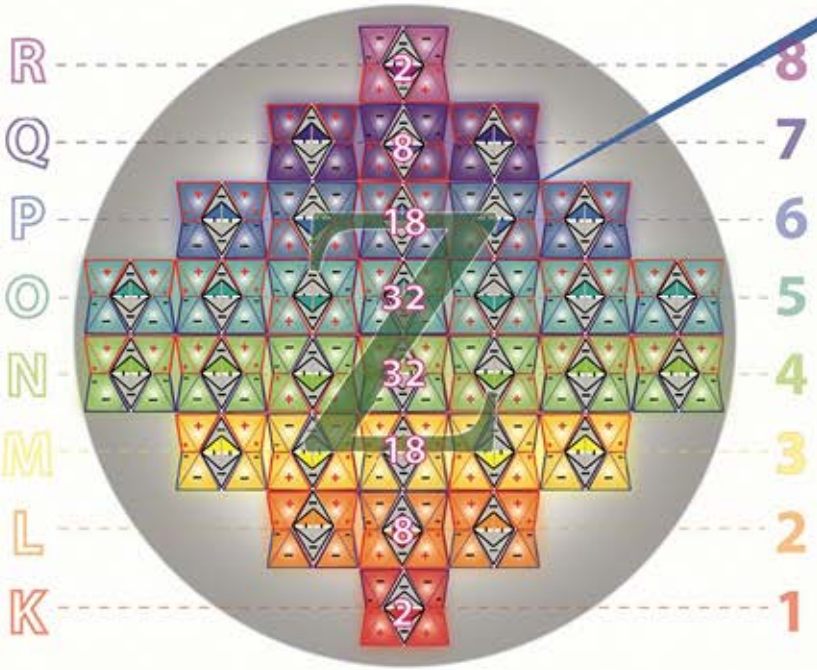

Alpha radiation - Positive charge particles (nuclei)
Beta radiation - Negative charge particles (leptons)

gamma rays

Gamma decay produces rays with energies of only a few hundred keV, and almost always less than 10MeV

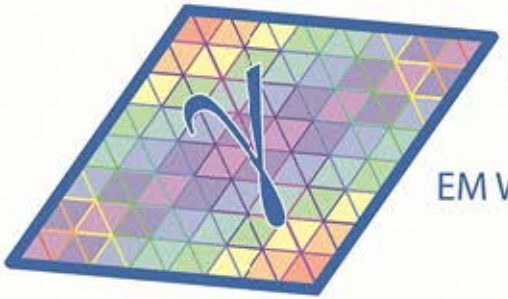

0
[n-n]

EM Wave

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Photons; EM Field (ElectroMagnetic); Planck quanta (mass, velocity)

Gamma rays are a form of ionizing radiation, and they have very good penetrating power. They result from the release of atomic energies and will cause biological damage to living tissue.

$$2h\nu = E = hf$$

Care must always be taken to distingush between charged Planck quanta [v] and photons [f]

gamma ray bursts

Baryon mass-Matter topology

N^0 [18-18] → [2.25 e23] [v-v]

$$E = 2mc^2 = hf$$

930 MeV 930 MeV

are the result of the stored KEM mass-energies of Matter topologies being released as mass-energy momenta geometries

gamma ray mass-energy geometry

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neutrino-Neutron Interactions

Neutrogen

νe [6-6] + N^0 [18-18] [24-24] ~ P^+ [24-12] + e^- [0-12]

Charged Matter equivalence

Hydrogen

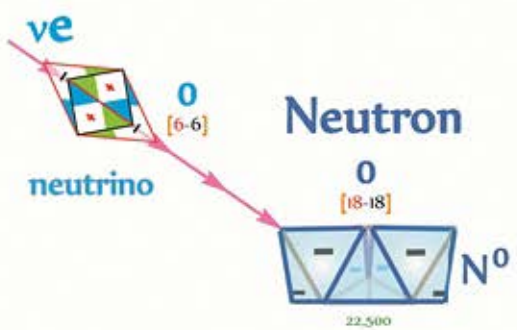

neutrino capture

Neutron decay is not the spontaneous process hypothesied by modern nuclear physicists

The observed decay products are the result of solar neutrinos interacting with Neutrons (both within nuclei and free)

the neutrinos also have an equally likely probability of interacting with Protons in the nuclei

[24-24]

A Neutronium atom has an identical mass-charge quotient to that of Hydrogen

[24-24]

Neutronium decay processes

A Neutron/neutrino interaction can decay into 4 differing particle sets

[24-24]

N^0 [18-18] + νe [6-6]

- α → e^+ [12-0] + e^+ [12-0] + e^- [0-12] + e^- [0-12]
- β → e^+ [12-0] + e^- [0-12] + νe [6-6] + νe [6-6]
- γ → νe [6-6] + νe [6-6] + νe [6-6] + νe [6-6]
- δ → [n-n] γ^0

All paths are uni-directional high energy Matter-Energy CP decay paths only →

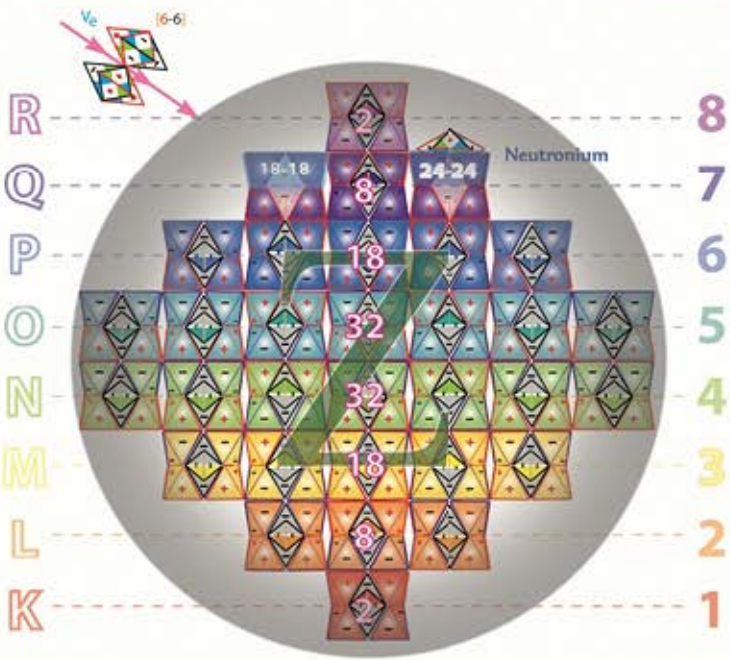

Excluding their nett Charge, Neutrons have neutral particle geometries [18-18] identical to that of a Proton [24-12]

N^0 [18-18] ≠ P^+ [24-12] + e^- [0-12]

[24-24]

Spontaneous Neutron decay into Proton-electron-neutrinos is not possible without the interaction of Muonic neutrinos (see Tetryonic Charge numbers)

A Neutron is NOT a Proton that has absorbed an electron

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neutrino-Proton Interactions

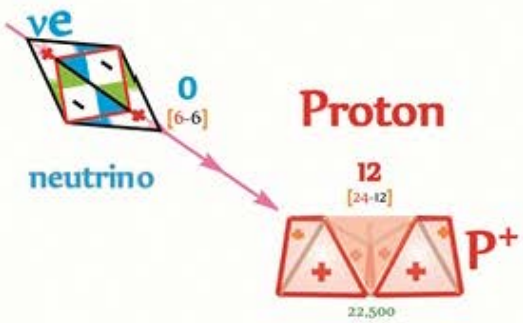

Although very weakly interacting, neutrinos can still be attracted to and bind to Protons via their negative charge fascia

neutrino capture

Neutron decay is not the spontaneous process hypothesied by modern nuclear physicists

The observed decay products are the result of solar neutrinos interacting with Neutrons (both within nuclei and free)

the neutrinos also have an equally likely probability of interacting with Neutrons in the nuclei

[30-18]

A Proton-neutrino atom would have an identical charge quotient to that of a Proton

[24-12]

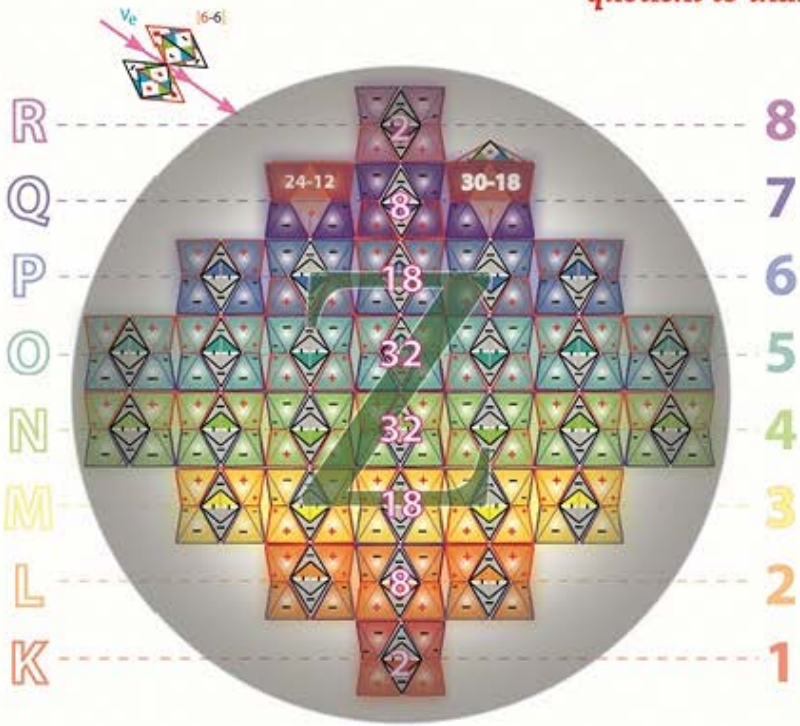

Proton decay paths

A Proton/Neutrino interaction can decay into 4 differing particle sets

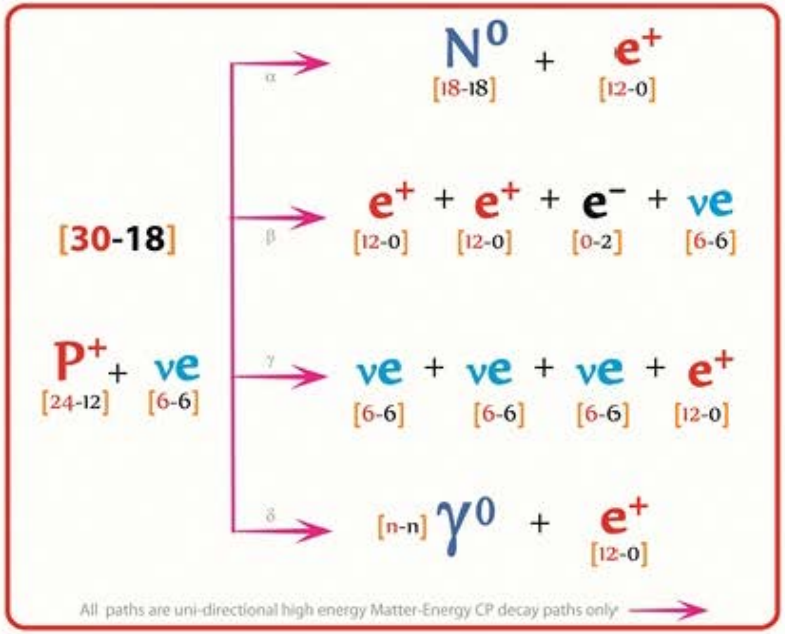

If they exist, Proton-neutrino particle couplings would function in a manner identical to that of Proton-electron couplings and could be detected by the anomalous spin measurements that would result

A Proton has a Positive charge geometry [24-12] equivalent to that of a Neutral Neutron [18-18]

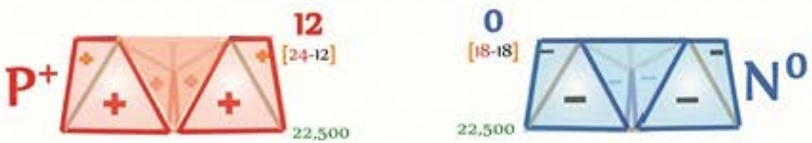

A Proton is topologically identical to a Neutron (differing only in the net charge created)

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Quantum Batteries

Atomic nuclei can be easily scaled to non-quantum sizes to offer clean, safe and portable long term Energy storage devices that can store energy indefinitely and release it on demand anywhere in the World

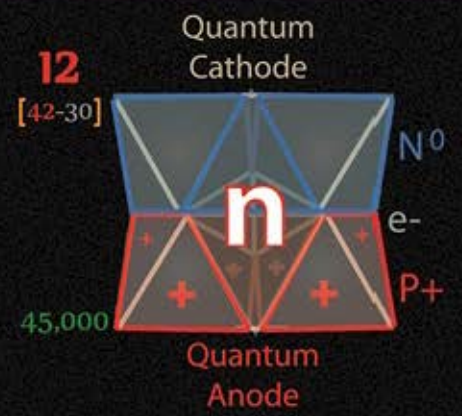

The quantum battery is unique in that in addition to storing energy indefinitely, when an electron binds to the Deuteron nuclei it has the ability to release specific energies [photons] by way of its quantum-scale synchronous converter topologies

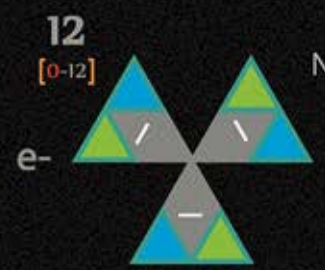

Negative charge topology

Quantum Rotor

12 loop quantum inductive rotor

(Atomic Nuclei)

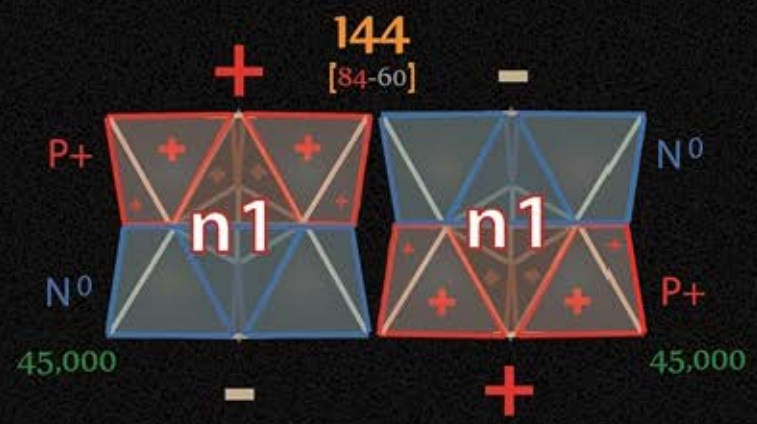

anti-Parallel Configuration

Synchronous quantum converter topologies can be connected in parallel or series to meet varying power requirements anywhere in the World and provides for the safe storage of nuclear energy as mass

Series Configuration

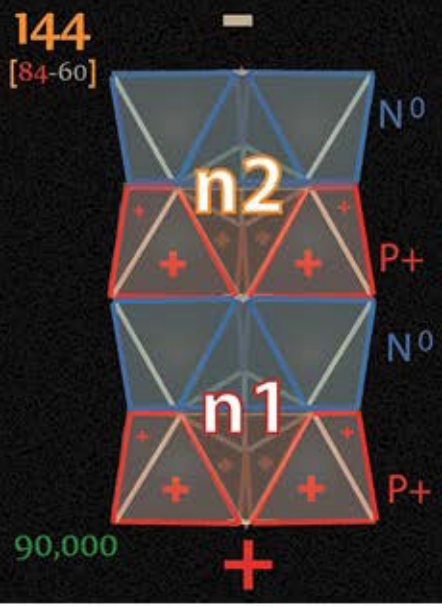

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Quantum synchronous Converters

Energy can be stored in macro-scaled quantum converters as mass

The electron has a charged Tetryonic Matter topology that is electrically equivalent to a 6 loop inductive rotor

Energy

$$\frac{12\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity; n8; n1

momenta

Quantum Cathode

Quantum Anode

Matter is radiant EM energy in a standing-waveform

Energy

$$\frac{72\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Nuclei; Planck quanta; mass; velocity; n32; n25

momenta

Building on the charged topology of Deuterium nuclei, scaled electromechanical quantum converters can be manufactured to provide efficient electrical mass-energy storage & distribution devices

Energy

$$\frac{84\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Deuterons; Planck quanta; mass; velocity; n32; n25; n8; n1

momenta

These devices can be transported any where demand requires them worldwide with their energies stored in the form of mass

Negating the need for centralised power stations and distribution lines extending vast distances to provide power to remote communities

A quantum synchronous converter can store and release 3 forms of energy

Angular Momentum (motional energy)
square root linear momentum

Radiant Energy (emission/absorption)
of photon/boson mass-energy geometries

EM mass-Matter (stored masses in Matter topologies)
radiant EM mass-energies stored in standing wave Matter topologies

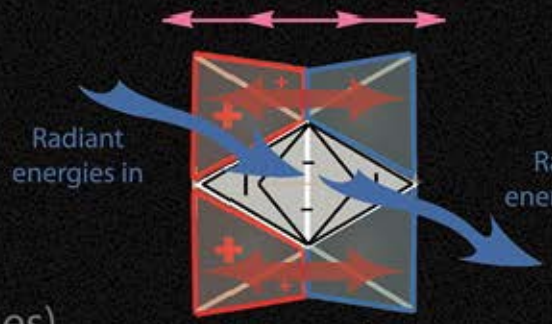

Leptons rotate within the Baryonic EM fields of the Nucleus

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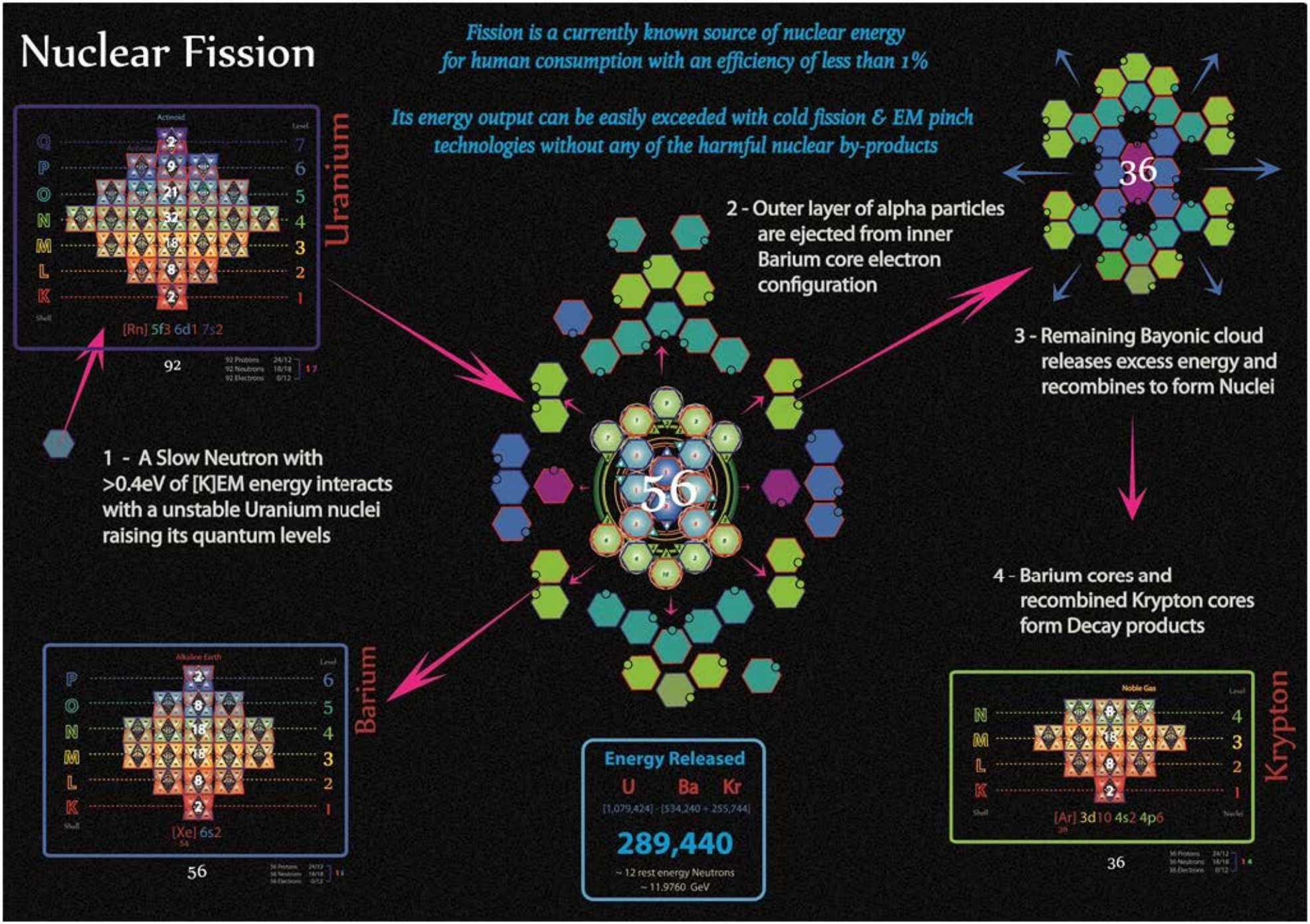

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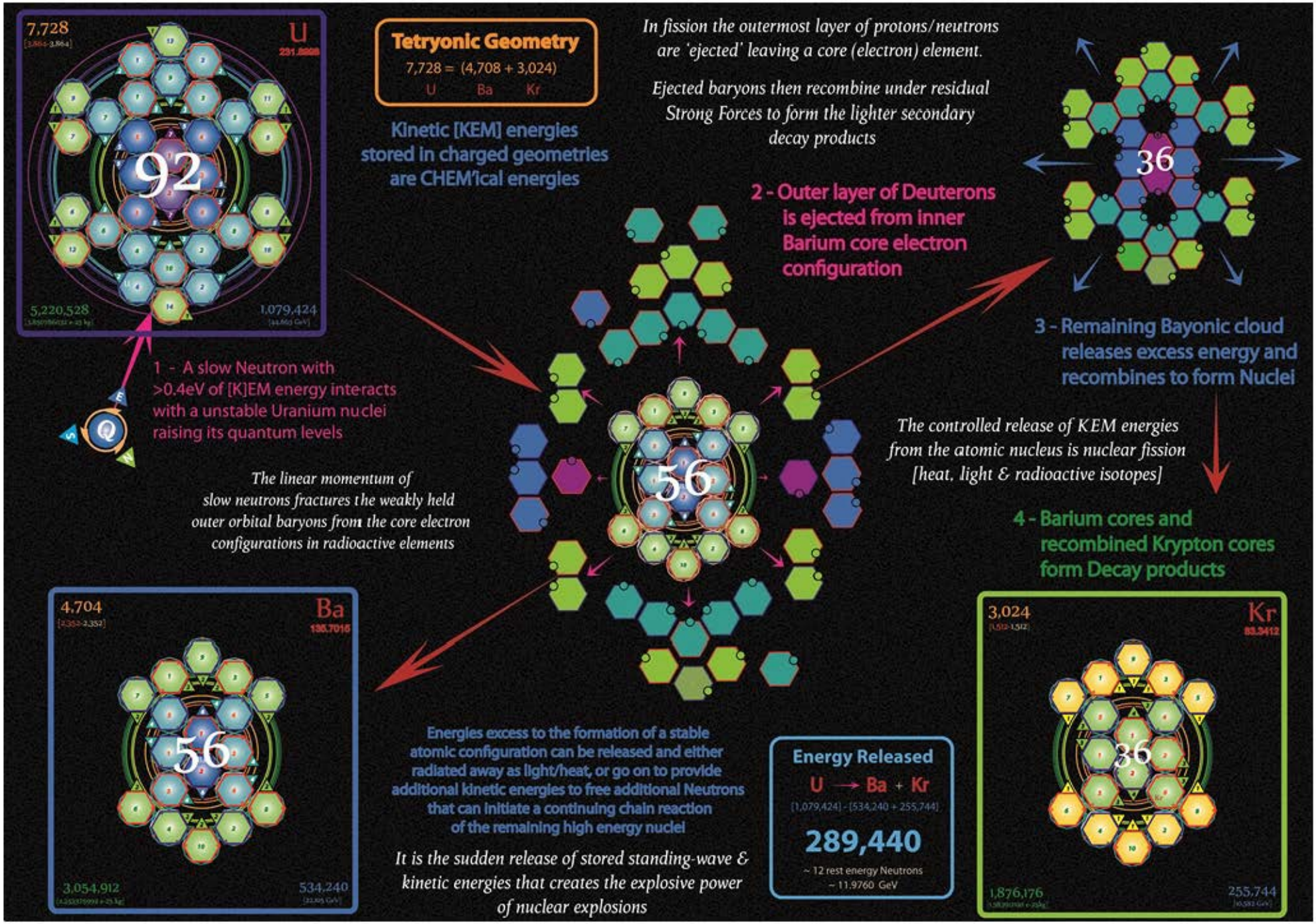

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Sonoluminescence

Sonoluminescence is the first hint at the energies that can be released from Tetryonic collapse and involves the emission of short bursts of light from imploding bubbles in a liquid when excited by sound.

The production of light as a result of the passing of sound waves through a liquid medium.

The sound waves cause the formation of bubbles that emit bright flashes of light when they collapse.

It is a key step on the road to realising technologies that can provide Humanity with clean, safe, efficient Energy production through the conversion of Matter into various forms of EM radiation

Sonoluminesence is the result of energy releases from the collapse of standing-wave Matter topologies within Fluids

Finding an efficient means of inducing and managing a controlled reaction where 3D Matter topologies are converted into 2D radiant energy is a key step on the path to creating a future energy source of all Humanity

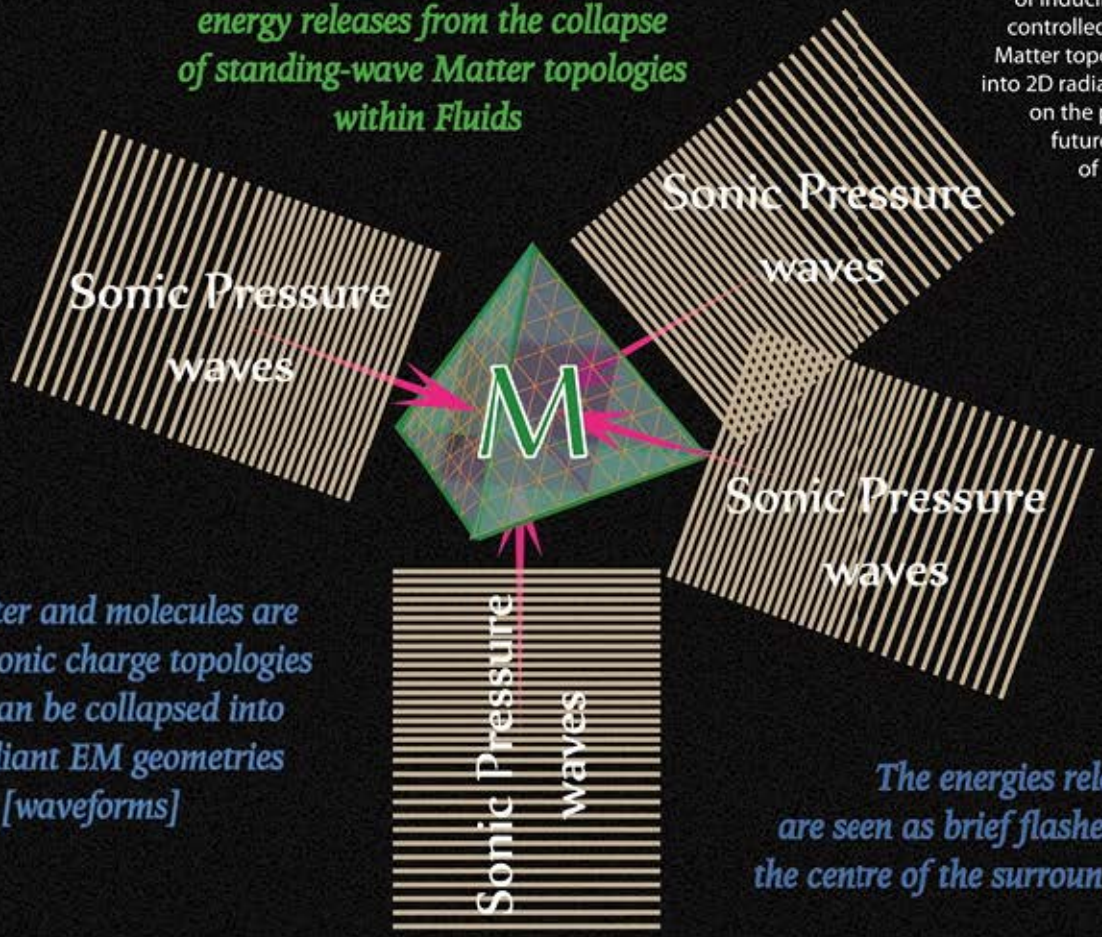

The gauge transformation of Matter into EM radiation is the most efficient form of energy release available to us

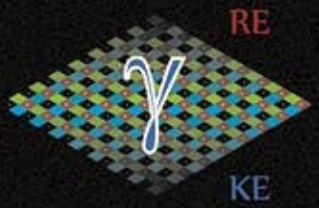

All Matter and molecules are 3D Tetryonic charge topologies which can be collapsed into 2D radiant EM geometries [waveforms]

The energies released are seen as brief flashes of light at the centre of the surrounding medium

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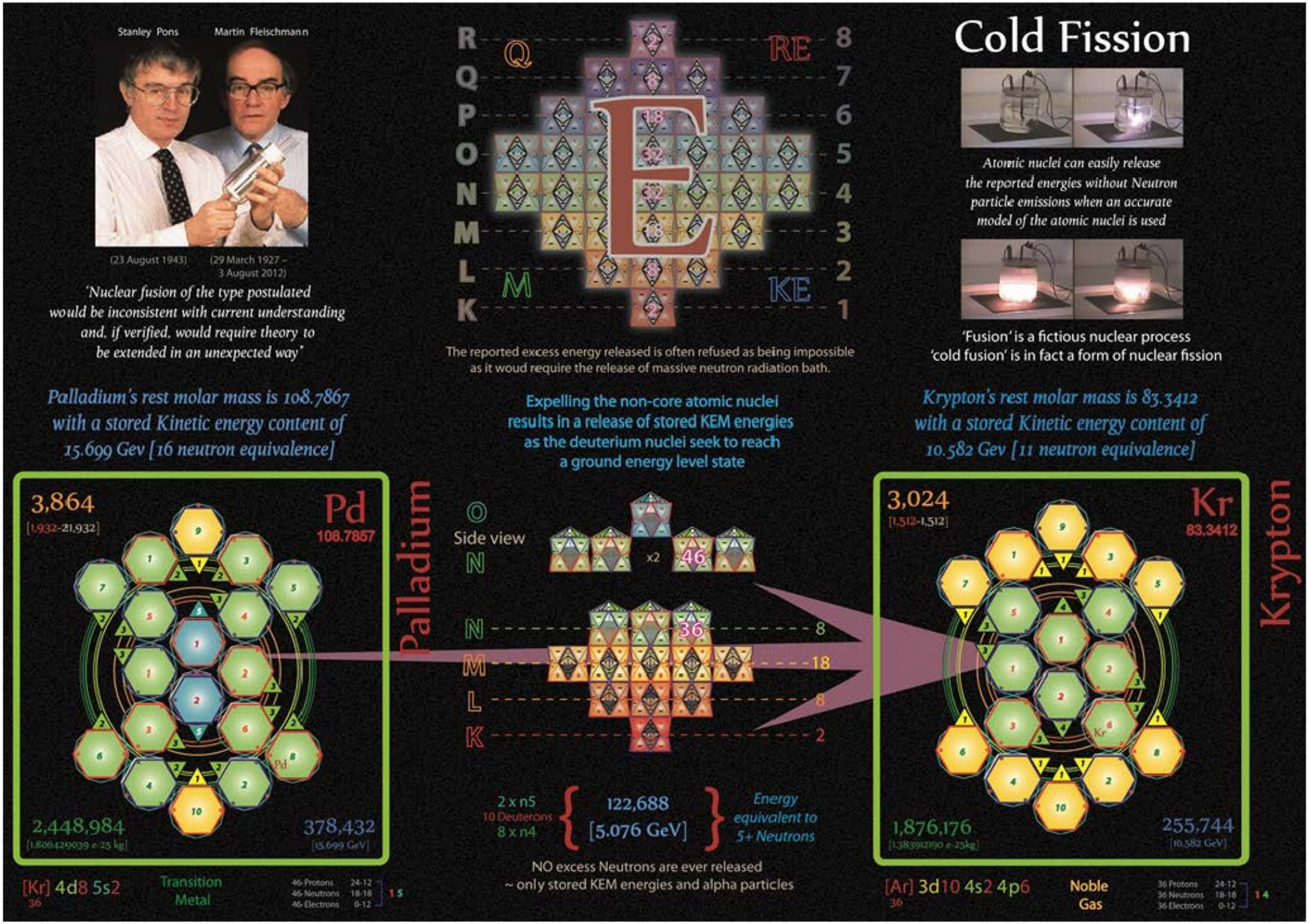

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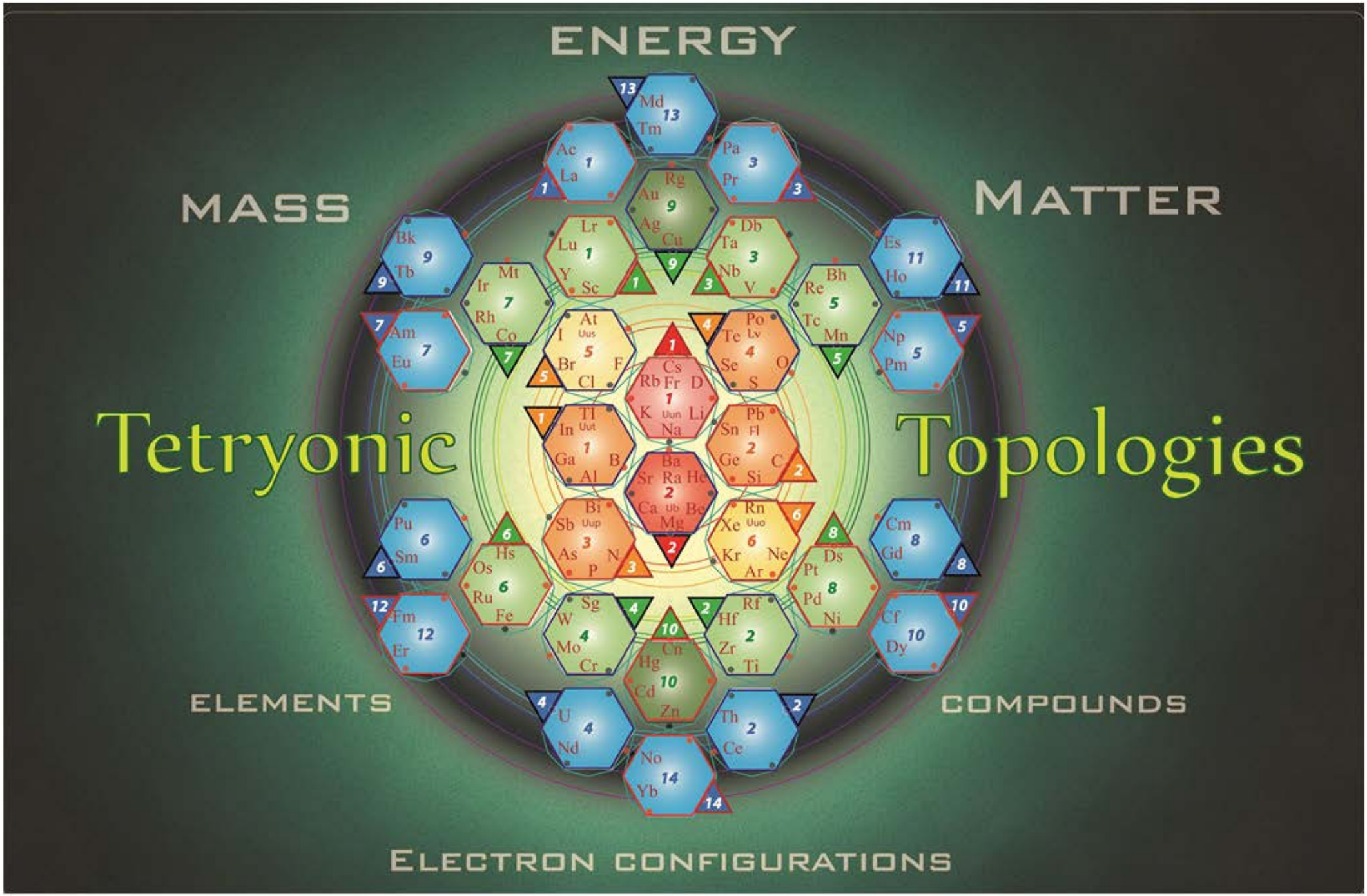

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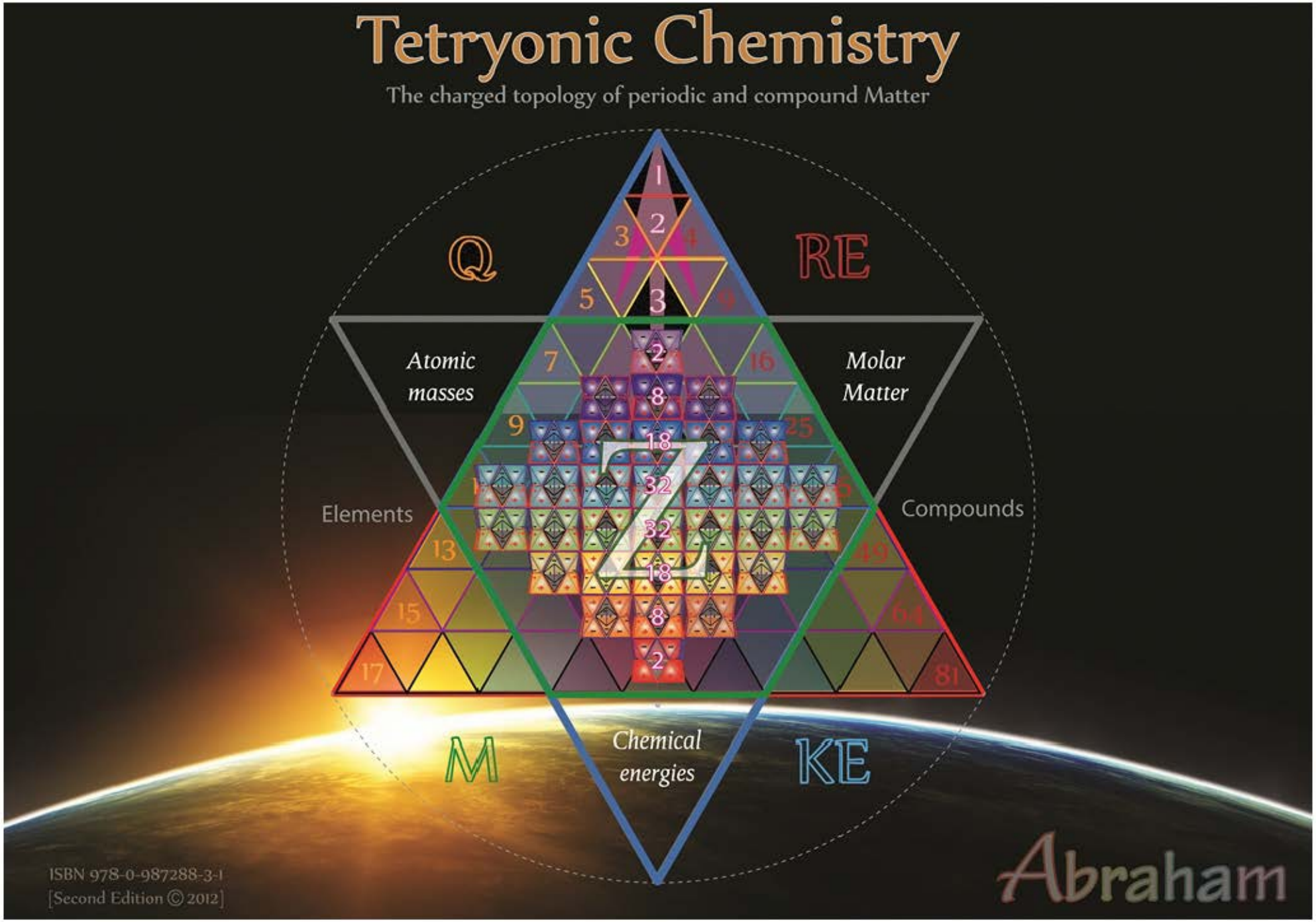

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TETRYONICS

The charged interactions of universal Gravitation

Foundational Quantum Cosmology

Abraham

ISBN 978-0-987288-4-8
[Second Edition © 2012]

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Laws of Force

$F = ma$

Sir Issac Newton

(25 December 1642 – 20 March 1727)

$w = mg$

Gravity

Newton's Principia formulated the laws of motion and of universal gravitation

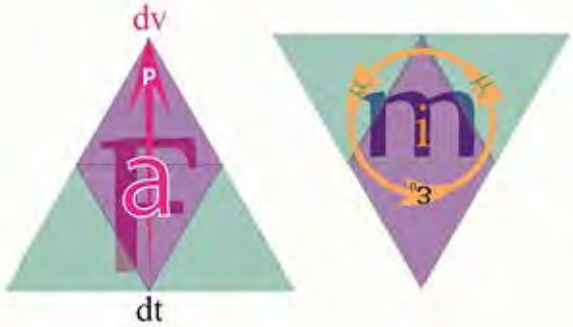

changing Magnetic lines of Force

Michael Faraday

(22 September 1791 – 25 August 1867)

create changing Electric fields of Force

Faraday discovered the principles of electromagnetic induction, diamagnetism, and the laws of electromagnetism.

Electro-Magnetism

$$\oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0}$$

Gauss

Light is an electromagnetic wave

Faraday

$$\oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt}$$

James Clerk Maxwell

(13 June 1831 – 5 November 1879)

$$\oint \vec{B} \cdot d\vec{A} = 0$$

Gauss

The separate works of Gauss, Ampere & Faraday were unified to create an electromagnetic wave field theory

Ampere

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 i + \frac{1}{c^2}\frac{\partial}{\partial t}\int \vec{E} \cdot d\vec{A}$$

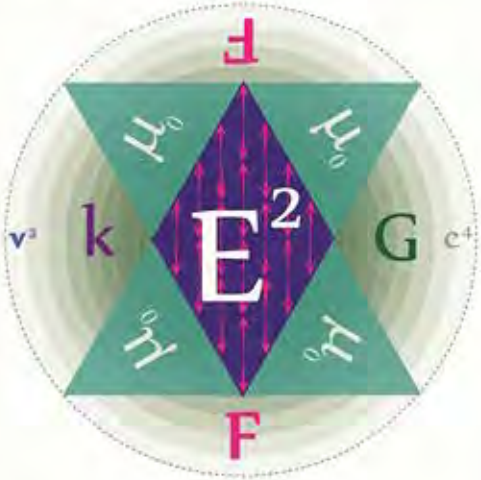

Lorentz Contraction

Lorentz proposed that moving bodies contract in the direction of motion (Lorentz–Fitzgerald contraction)

Hendrik Lorentz

(18 July 1853 – 4 February 1928)

Lorentz Transformations

Special Relativity

attempted to explain the constant speed of Light using relative motion & Lorentz contractions

Albert Einstein

(14 March 1879 – 18 April 1955)

&

later attempted to explain gravity as a curvature of spacetime caused by Matter

General Relativity

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Early physics of Motion

In the 4th century BC, the Greek philosopher Aristotle believed that there is no effect or motion without a cause

In Book VII of his De Architectura, the Roman engineer and architect Vitruvius contends that gravity is not dependent on a substance's "weight" but rather on its "nature".

The cause of the downward motion of heavy bodies, such as the element earth, was related to their nature, which caused them to move

In the 7th Century the Indian mathematician Brahmagupta stated "Bodies fall towards the earth as it is in the nature of the earth to attract bodies, just as it is in the nature of water to flow."

Greek philosopher Aristotle

(384 BC - 322 BC)

Aristotle defined space to be the boundary geometry of a body

[x,y,z]

geometry, toplogy

Aristotle defined time to be a measure of movement

the past Δ the future

'Nature abhors a vacuum'

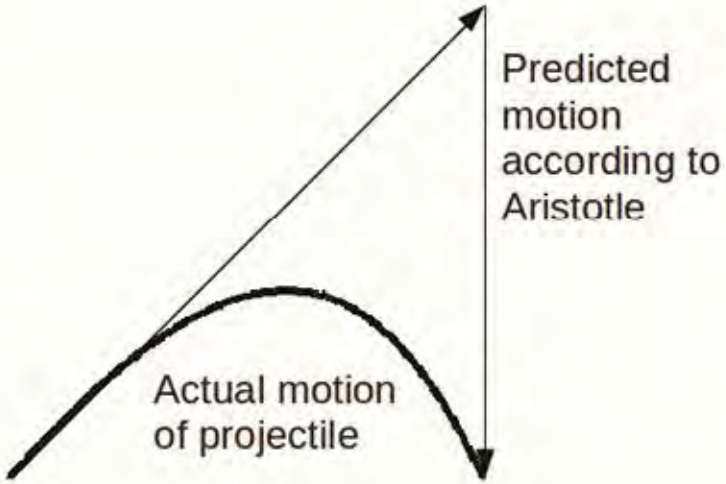

Heavier things fall faster, with speed being proportional to weight.

The speed with which a body falls is inversely proportional to the density of the medium it is falling through.

Indian Mathematician Brahmagupta

(597-668 AD)

Brahmagupta dedicated a substantial portion of his work to geometry

Brahmagupta is considered the first to formulate the concept of zero

negative numbers **0** positive numbers

Brahmagupta introduced new algebric methods for solving quadratic equations

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Galilean Gravity

Galileo Galilei

(15 February 1564 – 8 January 1642)

Galileo claimed to have a Universal Law of Gravitation covering both terrestrial gravity and the motion of planets which he was afraid to discuss.

But this looks more an inspired aspiration than a reality, as he seems not to have considered gravitational force as decreasing with distance from its source.

He did however, definitively show that objects experience a uniform acceleration in a gravitational field (irrespective of their masses) which was central to Newton's later Universal Law of Gravitation

Galileo dismissed as a "useless fiction" the idea, held by his contemporary Johannes Kepler, that the moon caused the tides.

Galileo also refused to accept Kepler's elliptical orbits of the planets, considering the circle the "perfect" shape for planetary orbits.

The Motion of Falling Bodies

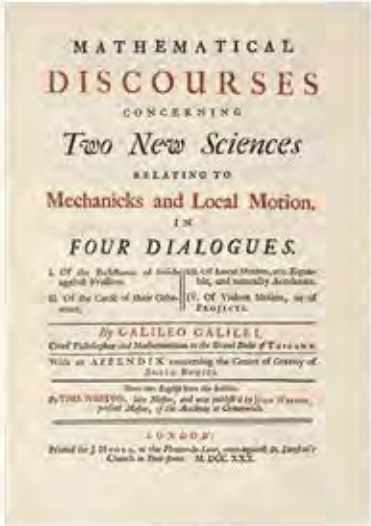

MATHEMATICAL
DISCOURSES
CONCERNING
Two New Sciences
RELATING TO
Mechanicks and Local Motion,
IN
FOUR DIALOGUES.

By GALILEO GALILEI

(ca. 1590)

Galileo was the first to counter Aristotle's earlier idea's of motion by teaching that
All objects experience a uniform acceleration in a Gravitational field
(irrespective of their different mass-Matter contents)

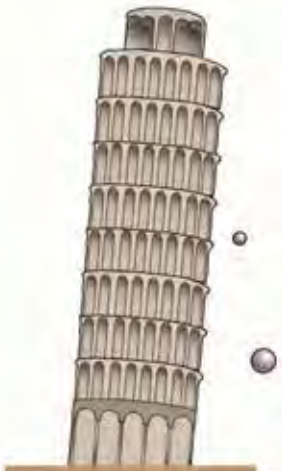

Aristotelian physics

In De motu Galileo proposed that in free fall bodies dropped with a characteristic uniform speed determined not by their weight but by their specific gravity.

He put this theory to the test by dropping bodies from heights and found that his experiments did not confirm his theory.

It is quoted in 'Galileo's Daughter' that the lighter body (i.e. that of the lower specific gravity) will move ahead of the heavier body at the start of the fall, and that the heavier body then overtakes it and arrives at the bottom slightly earlier.

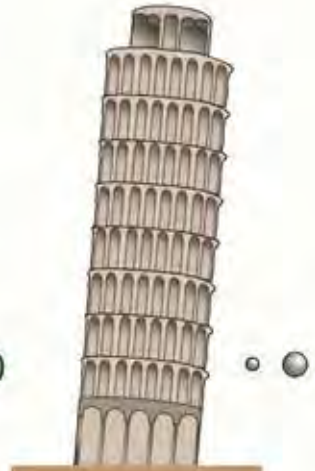

Newtonian physics

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Sir Issac Newton

(25 December 1642 – 20 March 1727)

In the late 17th century, Robert Hooke's suggested
'that there is a gravitational force which depends on the inverse square of the distance'

Newtonian Gravitation

Newton's monograph Philosophiæ Naturalis Principia Mathematica, published in 1687, lays the foundations for most of classical mechanics. In this work, Newton described Universal gravitation and the three laws of motion, which dominated the scientific view of the physical universe for the next three centuries.

Newton showed that the motions of objects on Earth and of celestial bodies are governed by the same set of natural laws, by demonstrating the consistency between Kepler's laws of planetary motion and his theory of gravitation, thus removing the last doubts about heliocentrism and advancing the Scientific Revolution.

The Principia is generally considered to be one of the most important scientific books ever written.

Principia Mathematica

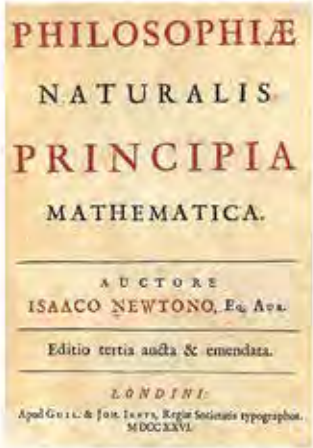
PHILOSOPHIÆ
NATURALIS
PRINCIPIA
MATHEMATICA.
AUCTORE
ISAACO NEWTONO, Eq. Aur.
Editio tertia aucta & emendata.
LONDINI:
Apud Guil. & Joh. Innys, Regiæ Societatis typographos.
MDCCXXVI.

first edition (1686/1687)

First Law of Motion

$$\sum \mathbf{F} = 0 \Rightarrow \frac{d\mathbf{v}}{dt} = 0$$

Bodies at rest - remain at rest unless acted upon by an outside Force

Second Law of Motion

$$\sum \mathbf{F} = \frac{\mathrm{d}\mathbf{p}}{\mathrm{d}t} = m\frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} + \mathbf{v}\frac{\mathrm{d}m}{\mathrm{d}t}$$

The nett force on a particle is equal to the time rate of change of its linear momentum [p]

Third Law of Motion

$$\sum \mathbf{F}_{a,b} = -\sum \mathbf{F}_{b,a}$$

For every action there is an equal and opposite reaction

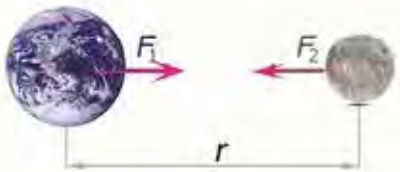

Newton's Law of universal Gravitation

"I deduced that the forces which keep the planets in their orbs must [be] reciprocally as the squares of their distances from the centers about which they revolve: and thereby compared the force requisite to keep the Moon in her Orb with the force of gravity at the surface of the Earth; and found them answer pretty nearly"

$$F = -G\frac{M_1 m_2}{r^2}$$

"hitherto I have not been able to discover the cause of those properties of gravity from the phenomena, and I frame no hypothesis"

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According to Bošković's simple dynamistic atomism, Matter is not only endowed with forces (dynamic system), but it is composed of forces (dynamistic system), Forces flow out of the atom and permeate empty space.

This idea led to the concept of the field, much later formulated by M. Faraday (1844), who together with J.C. Maxwell introduced the idea of fields of force into science.

Boskovic is famous for his atomic theory and made many important contributions to astronomy, including the first geometric procedure for determining the equator of a rotating planet from three observations of a surface feature and for computing the orbit of a planet from three observations of its position.

In 1753 he also discovered the absence of atmosphere on the Moon.

Rudjer Boskovic

(18 May 1711 – 13 February 1787)

k

Boskovic proposed that attractive Gravitational fields could be explained as diminshed interactive EM fields that result in a nett converent force at great distances

G

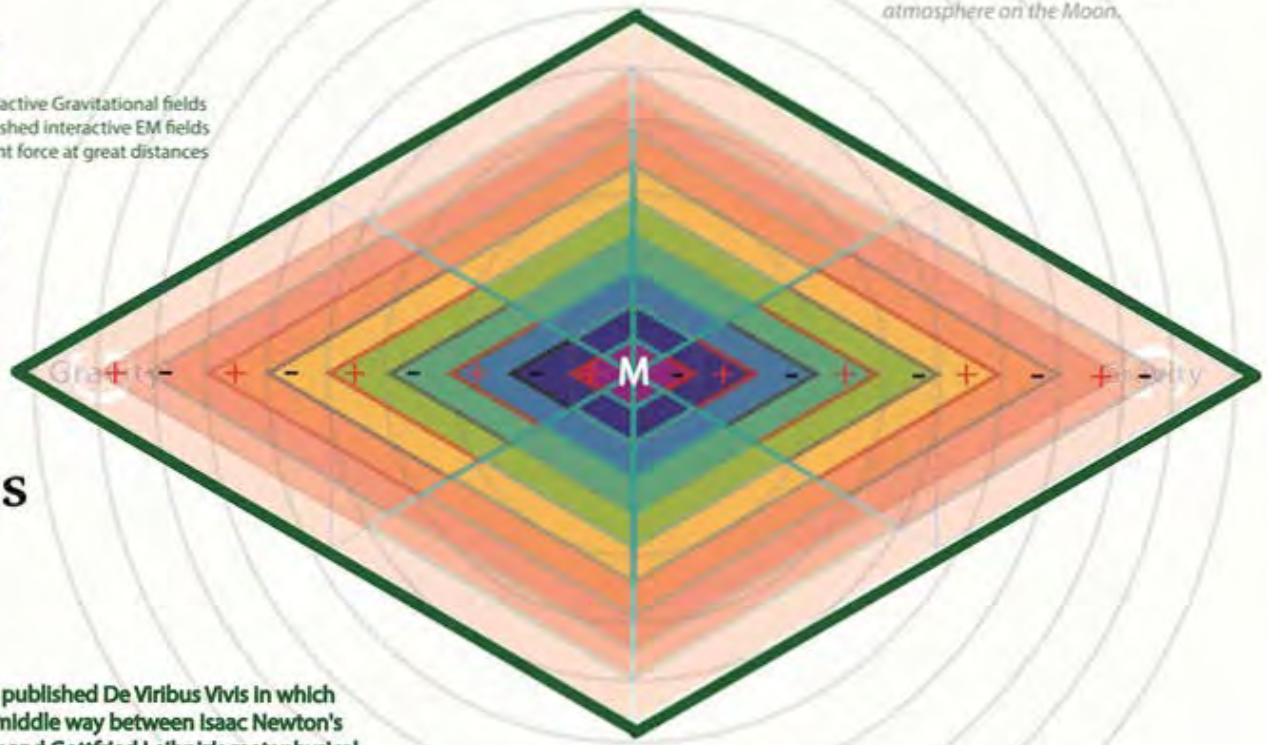

Diminished EM waves

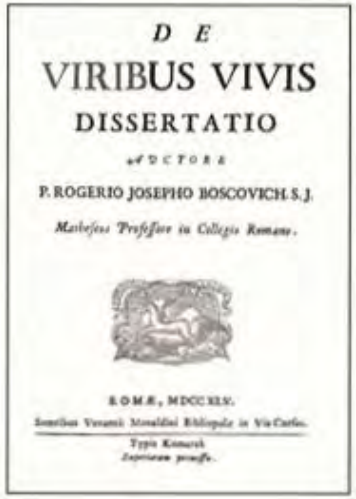

DE
VIRIBUS VIVIS
DISSERTATIO
AUCTORE
P. ROGERIO JOSEPHO BOSCOVICH S.J.
Matheseos Professore in Collegio Romano.

ROMÆ, MDCCXLV.

In 1745 Bošković published De Viribus Vivis in which he tried to find a middle way between Isaac Newton's gravitational theory and Gottfried Leibniz's metaphysical theory of monad-points

The force is repulsive when this curve lies above the line AC and attractive when it lies below it.

At very large distances (at and beyond V), it is attractive and approaches Newton's inverse-square law of force produced by gravity

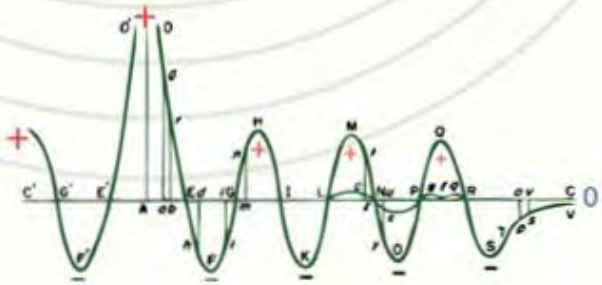

nett attractive force at large distances

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Gaussian Gravity

Gauss's law for gravity bears the same mathematical relation to Newton's law that Gauss's law for electricity bears to Coulomb's law.

G

Gauss's law for gravity is mathematically similar in form to Gauss's law for electrostatics.

k

the striking mathematical similarity in the formulation of electrostatics and gravitation has puzzled science for centuries

$$F_{elec} \propto \frac{Q_1 Q_2}{r^2}$$

$$F_{grav} \propto \frac{M_1 m_2}{r^2}$$

Carl Friedrich Gauss

(30 April 1777 – 23 February 1855)

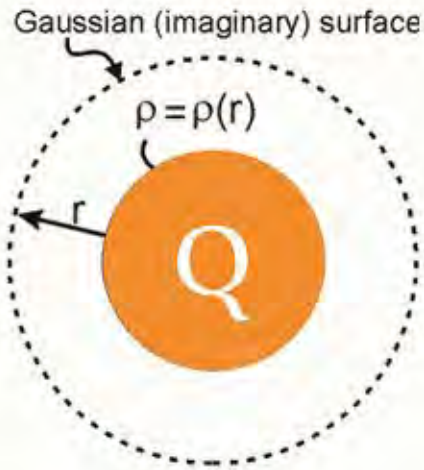

$$\oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0} = 4\pi k q$$

The electric flux through any closed surface is proportional to the enclosed electric charge.

$$\nabla \cdot E = \frac{\rho}{\varepsilon_0} = 4\pi k \rho$$

Gauss's law for gravity, also known as Gauss's flux theorem for gravity, is a law of physics which is essentially equivalent to Newton's law of universal gravitation.

Although Gauss's law for gravity is physically equivalent to Newton's law, there are many situations where Gauss' law for gravity offers a more convenient and simple way to do a calculation than Newton's law.

note: 4π spherical topologies are equivalent to 4π tetrahedral topologies [see Euler characteristics & Gauss-Bonnet topology theorem]

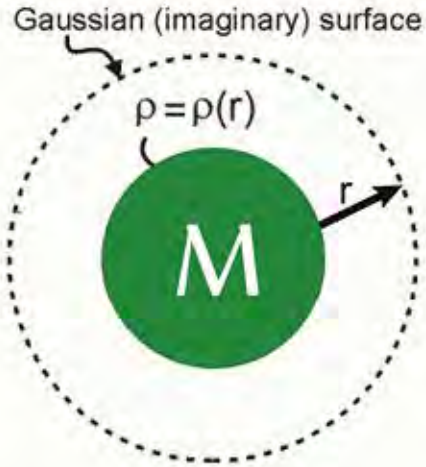

$$\oint_{\partial V} \mathbf{g} \cdot d\mathbf{A} = -4\pi G M$$

The gravitational flux through any closed surface is proportional to the enclosed Matter

$$\nabla \cdot \mathbf{g} = -4\pi G \rho$$

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Poisson's Gravity fields

Charges are the sources and sinks of EM fields

Matter is the source of Gravitational fields

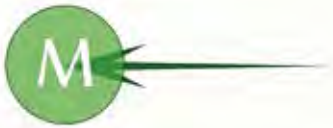

Poisson recognised that charges are the sources and sinks of electrostatic fields: positive charges emanate electric field lines, and the field lines terminate at negative charges.

Similarly, in Newton's gravitation masses are the sources of the gravity field so that field lines terminate at objects that have mass.

Poisson formalised Gauss' Law for electric fields (using the more general divergence theorem)

$$\iint \vec{E} \cdot d\vec{S} = \frac{q_e}{\epsilon_0} \Rightarrow \vec{\nabla} \cdot \vec{E} = \frac{\rho_e}{\epsilon_0}$$

and then applied the same formulation to spherical Matter for gravitation

$$\iint \vec{g} \cdot d\vec{S} = -4\pi G_c m \Rightarrow \vec{\nabla} \cdot \vec{g} = -4\pi G_c \rho_m$$

Simeon Poisson

(21 June 1781 – 25 April 1840)

All EM field interactions are the result of superpositioned EM fields (comprising of convergent AND divergent energy momenta) whose quanta create differing field strengths, The inverse square forces of gravity can be modelled using the same field geometry thus illustrating the reason for the geometric & mathematical similarity between Newton's & Coulomb's constants

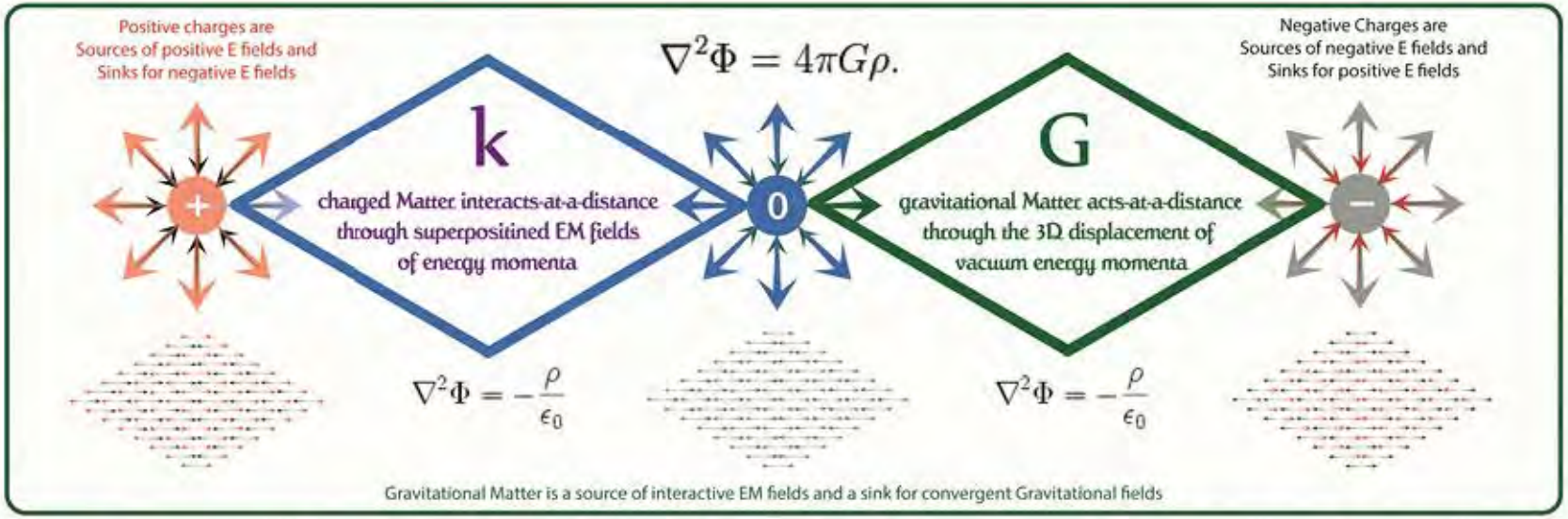

Tetryonic QM & QED clearly shows that both the sink and source fields are the result of bidirectional energy momenta

Poison's field equations shows that weak KEM field geometries can be used to model the convergent forces of Gravitational fields

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Gravito-Electro-Magnetism

inverse squared law

nett divergent
Electric field forces

$1/r^2$

$$\oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0}$$

k

$$\oint \vec{B} \cdot d\vec{A} = 0$$

inverse cubed law

vector
Magnetic forces

$1/r^3$

Maxwell's 1864 achievements concerning electromagnetism have been called the "second great unification in physics", following on from the first one realised by Isaac Newton.

Maxwell's equations
$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$
$\nabla \cdot \mathbf{B} = 0$
$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$
$\nabla \times \mathbf{B} = \frac{1}{\epsilon_0 c^2}\mathbf{J} + \frac{1}{c^2}\frac{\partial \mathbf{E}}{\partial t}$

James Clerk Maxwell

(13 June 1831 – 5 November 1879)

Any opinion as to the form in which the energy of gravitation exists in space is of great importance, and whoever can make his opinion probable will have, made an enormous stride in physical speculation.

The apparent universality of gravitation, and the equality of its effects on matter of all kinds are most remarkable facts, hitherto without exception; but they are purely experimental facts, liable to be corrected by a single observed exception.

We cannot conceive of Matter with negative inertia or mass; but we see no way of accounting for the proportionality of gravitation to mass by any legitimate method of demonstration

GEM equations
$\nabla \cdot \mathbf{E}_g = -4\pi G \rho_g$
$\nabla \cdot \mathbf{B}_g = 0$
$\nabla \times \mathbf{E}_g = -\frac{\partial \mathbf{B}_g}{\partial t}$
$\nabla \times \mathbf{B}_g = 4\left(-\frac{4\pi G}{c^2}\mathbf{J}_g + \frac{1}{c^2}\frac{\partial \mathbf{E}_g}{\partial t}\right)$

$1/r^2$

strictly convergent vector force

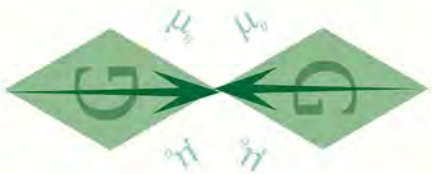

Maxwell proposed a set of equations based on his EM field laws that created a Gravito-Electro-Magnetic field reflective of the similarities between Newton's & Coulomb's Laws

$$\nabla \times \mathbf{E}_g = -\frac{\partial \mathbf{B}_g}{\partial t}$$

G

$$\nabla \cdot \mathbf{B}_g = 0$$

giving rise to spectulation about the existence of 'gravitons'
a theorised Gravitational 'charge' carrier

$1/r^3$

gravitomagnetic dipole

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The General Theory of Relativity

In 1915, Einstein extended SR and proposed a new theory of gravitation to account for accelerating bodies

Einstein said that when he "was sitting in a chair in the patent office at Bern when all of a sudden a thought occurred to me: 'If a person falls freely he will not feel his own weight.' I was startled. This simple thought ... impelled me toward a theory of gravitation. ..."

$$R_{\mu\nu} - \tfrac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

The EFE is a tensor equation relating a set of symmetric 4 x 4 tensors.

Newton's gravitational constant

Ricci curvature tensor $R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$ the stress-energy tensor

the metric tensor

speed of light in vacuum

Each tensor has 10 independent components

Spacetime Matter

$$G_{\mu\nu} + g_{\mu\nu}\Lambda = 8\pi T_{\mu\nu}$$

the cosmological constant

General Relativity describes gravity as a warping of space itself, not as a force.
Einstein pictured space as a three-dimensional version of a thin rubber sheet

Einstein's General Theory of Relativity, which was published in 1916 had as its foundation that the laws of nature in an accelerating frame are equivalent to the laws of a gravitational field.

This is known as the Equivalence Principle.

General Relativity

$$G_{ab} = 8\pi G T_{\mu\nu}$$

Albert Einstein

(14 March 1879 – 18 April 1955)

$$G_{ab} = \kappa T_{\mu\nu}$$

curved spacetime — *mass-energy tensor*

where

$$\kappa = -\frac{8\pi G}{c^4}$$

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Sir Issac Newton

(25 December 1642 – 20 March 1727)

GEM fields & Gravity

Gravity is one of the four fundamental interactions of nature,
along with electromagnetism and the nuclear strong and weak forces

[for centuries scientific enquiry has been aimed squarely at discerning a physical mechanism for gravitation]

Albert Einstein

(14 March 1879 – 18 April 1955)

Matter, Planck quanta

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

mass, velocity

Tetryonics reveals Gravity to be the result of the displacement of vacuum energies by mass-Matter topologies which is accurately modelled using GEM field geometry

masses

$$F = -G\frac{M_1 m_2}{r^2}$$

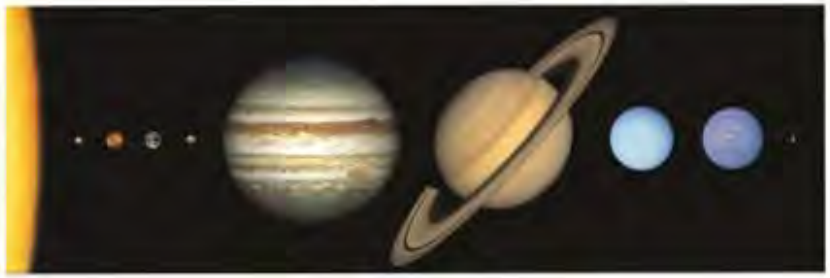

energies

$$G_{ab} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Gravity is responsible for keeping the Earth and the other planets in their orbits around the Sun; for keeping the Moon in its orbit around the Earth; for the formation of tides; for natural convection, by which fluid flow occurs under the influence of a density gradient and gravity; for heating the interiors of forming stars and planets to very high temperatures; and for various other phenomena observed on Earth.

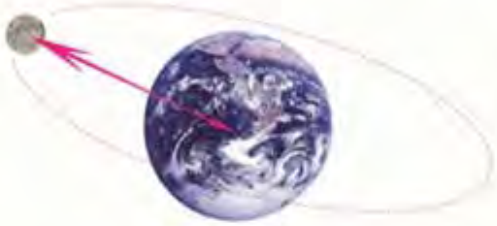

instantaneous action-at-a-distance

Gravity is a natural phenomenon by which physical bodies attract each other with a force proportional to their mass-Matter content.

Gravity is most familiar as the agent that gives weight to objects with mass and causes them to fall to the ground when dropped.

Gravity causes dispersed Matter to coalesce, and coalesced Matter to remain intact, to the creation of the SUN, the Earth, and to source of energy in the stars that light our universe.

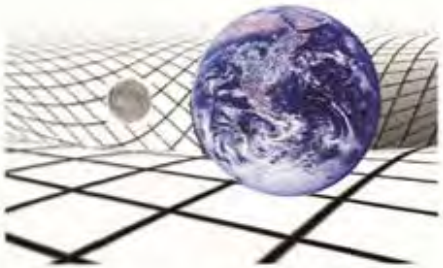

motion in curved spacetime

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Separating Space & Time

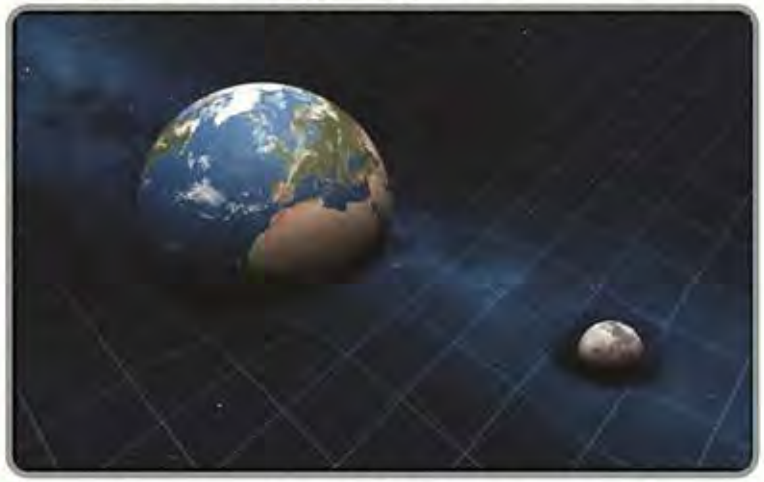

(in the search for Gravity)

Instantaneous
'action-at-a-distance'

Relativistic
spacetime 'curvature'

DOES

The Earth pull on the moon and
the moon pull proportionally back on the Earth

OR

Does the Earth curve spacetime in its vicinity
with the moon following the geodesic path created

Tetryonic theory through its clear definitions of charged mass-ENERGY-Matter provides the long-sought answer to Gravitation

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Empty Space

is defined in Tetryonic & relativistic theory
by the speed of light

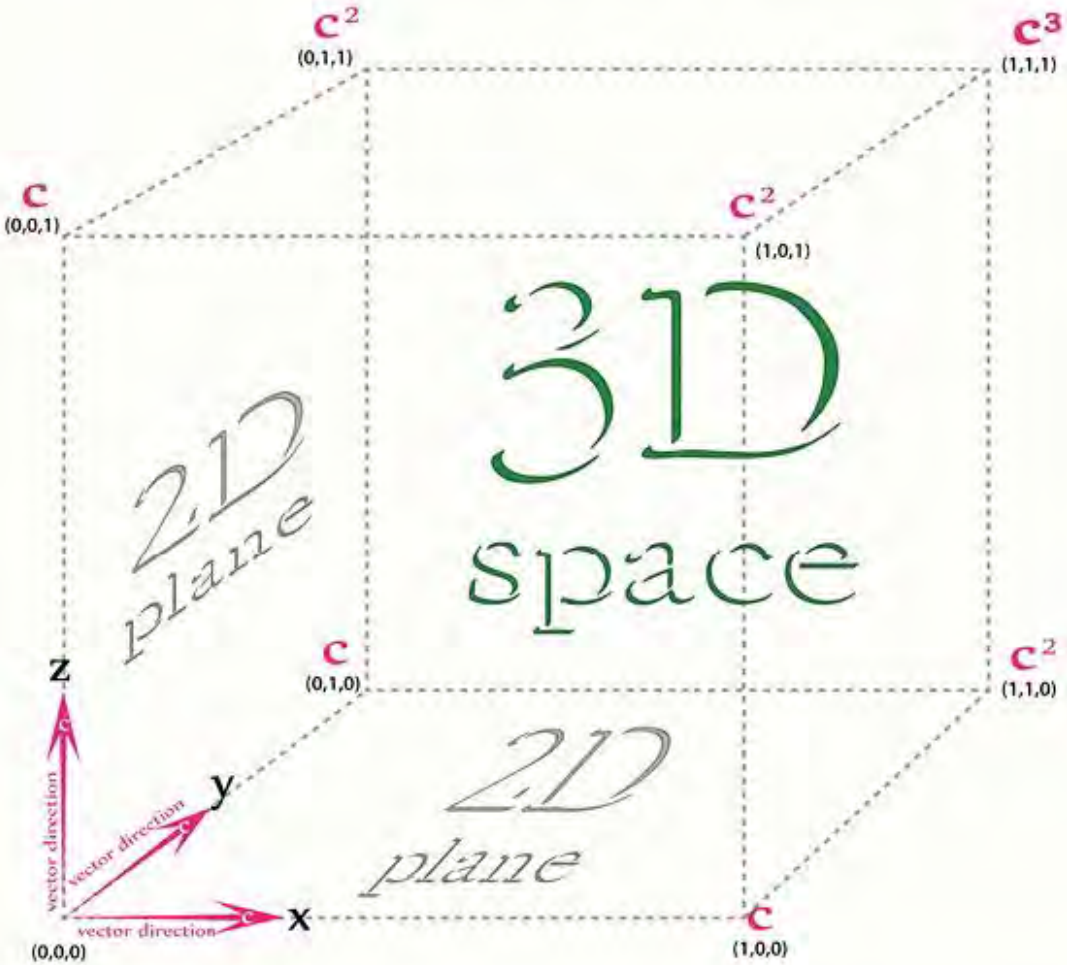

Energy

content of free space is Zero

A Spatial region is defined by a co-ordinate system so as to measure the physics and motion of mass-ENERGY-Matter within its confines

mass

is Energy content per unit of time

EM mass-energies can be found in (and move through) empty Space in various forms: radiant energies, Matter etc

Matter

is Energy content per unit of time squared

Space can be any regular geometry [Cubic, Spherical or polyhedral] limited by the spatial co-ordinates used to define the region or volume

Empty Space is defined as a geometric volume devoid of any form of Energy

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Spacetime co-ordinates

The linear force vectors of divergent Energy can form various co-ordinate systems based on their vector directions per unit of time

Charge radiates unilaterally in the direction of its vector linear momentum

Vector forces

Euclidean planar space-time

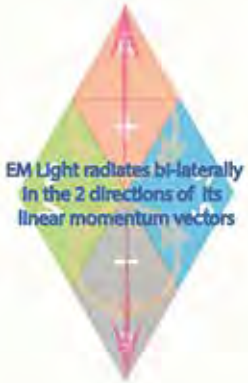

c
299,792,458
linear metres
per sec

c^2
8.987551787 e16
radial square metres
per sec

Time in Physics is a measure of how long it takes for light to travel 299,792,458 metres from its source in a vacuum

Radiant Energies

1 2 3 4 5 6 7 8

Radial Time

metre
299,792,458 sec

A metre in Physics is the distance light travels in 1/ 299,792,458 of a second from its source

299,792,458 m
second

c^3
2.694400242 e25
cubic metres
per sec

c^4
8.077608713 e33
spherical metres
per sec

Cartesian and Curvilinear spatial co-ordinate systems both measure 3D Matter

Energy entropy of a system

mass-energy-Matter content of a system

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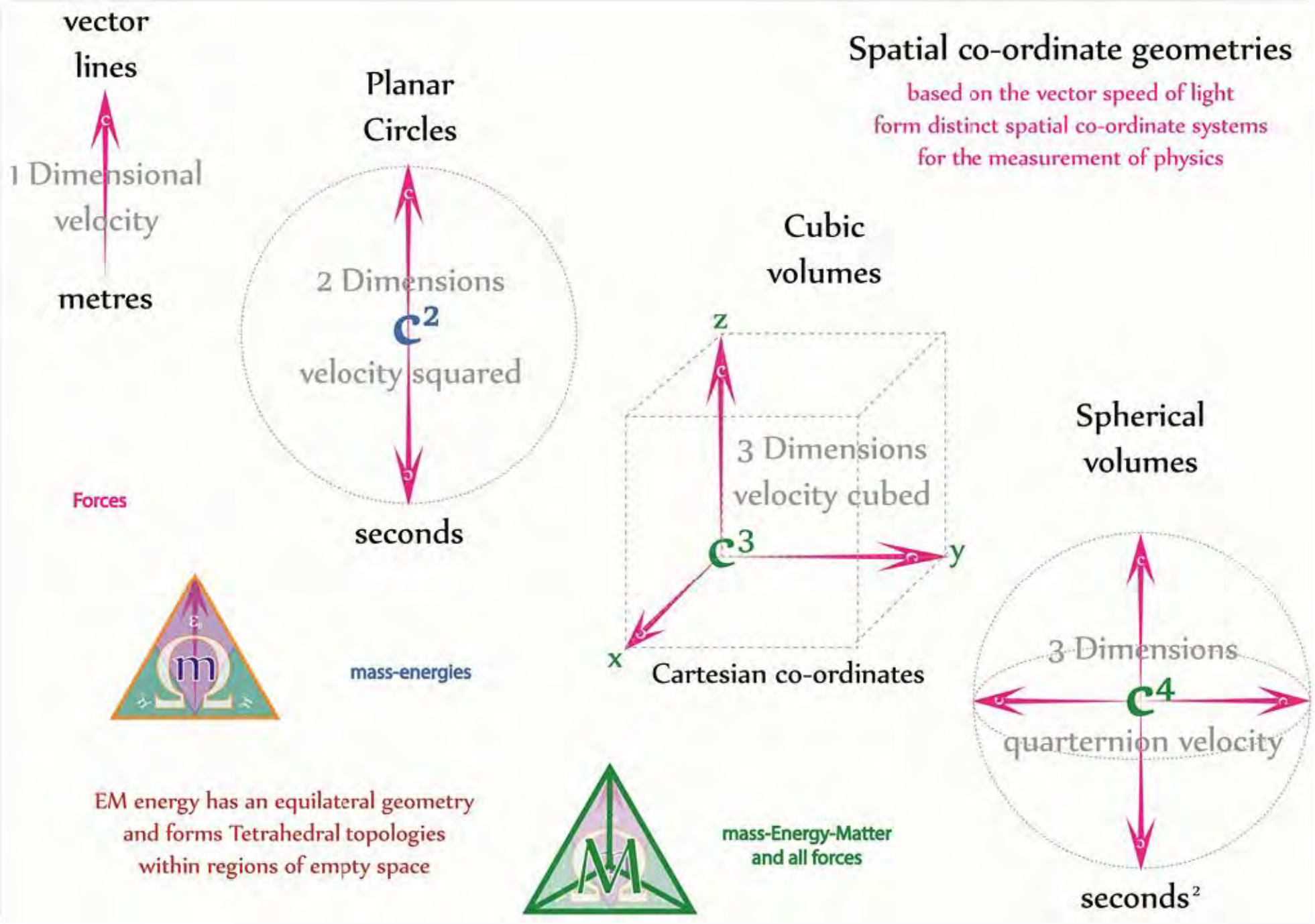

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Spatial co-ordinate systems

Spacetime (or space-time, or space time) is any mathematical model that combines space and time into a single continuum.

Spacetime is usually interpreted with space as being three-dimensional and time playing the role of a fourth dimension that is different from the spatial dimensions.

Tetryonic theory redefines as time to be a measure of the changing quantised angular momenta of Planck scale Charges In any spatial plane or volume

By combining space and time into a single manifold, we can significantly simply a large number of physical theories, and re-formulate them in a more uniform way to explain the mechanics of the Universe at all scales

Tetryonics maps radial spacetime co-ordinates through the vector momentum of Energy

Cubic

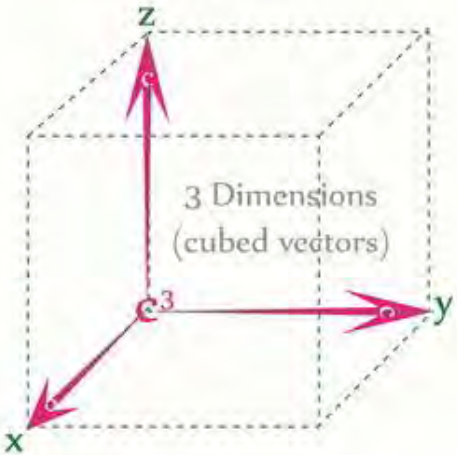

Spherical

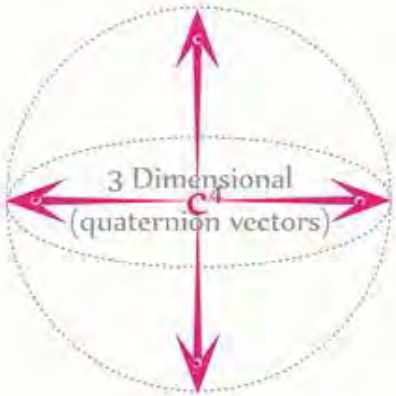

seconds²

Cartesian Space-Time

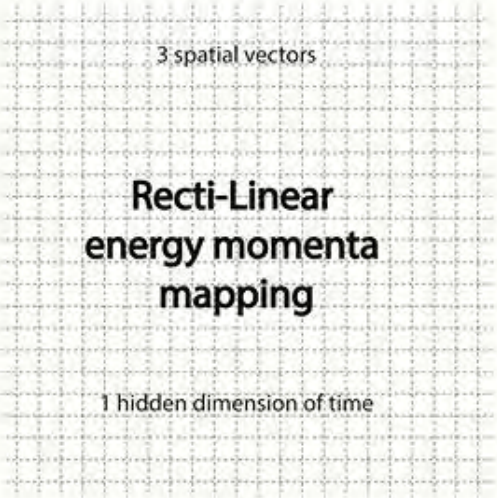

The quantised angular momenta of mass-Energy and Matter are triangular geometries

The current methodologies for mapping energy densities onto Euclidean, Cartesian and Reimannian co-ordinates are inaccurate reflections of the charged mass-ENERGY-Matter geometries, introducing a mathematical complexity to a otherwise simple foundational equilateral geometry

Tetryonic Space-Time

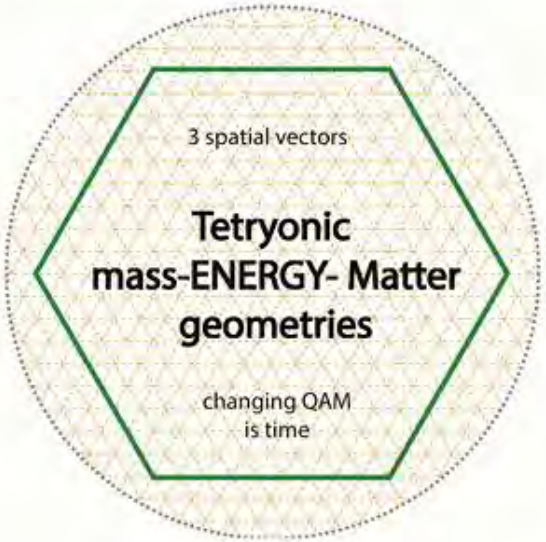

By mapping equilateral mass-energies & Matter into radial spatial co-ordinates Tetryonic theory is able to reveal the hidden 4th dimension of time

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Space & time separated

All equilateral mass-energies & tetrahedral Matter can be mapped with planar spatial geometries within spherical space-time co-ordinates

Space is the region of measurement defined by the vector propagation of light
time is a measure of the changing QAM within any spatial region

Tπ standing-waves

c⁴ spatial regions contain mass-Matter

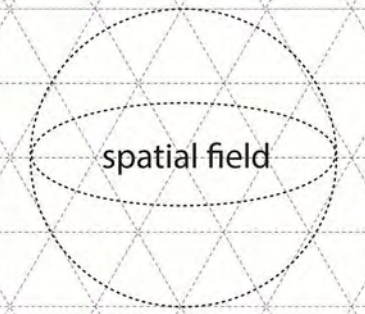

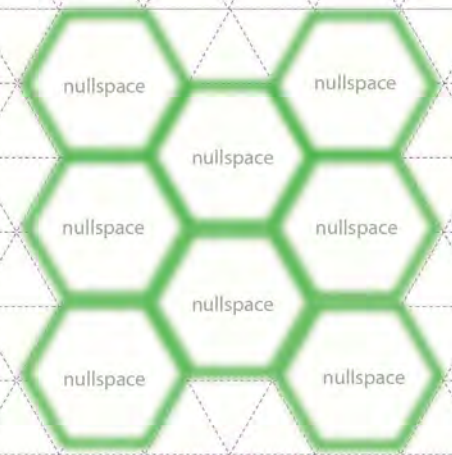

compounds

c² spatial regions contain mass-energies

nπ radiant geometries

weak irradiated mass-energies permeate 'empty' space
[vacuum energies]

photons

Baryons

Elements

3D Matter
topologies

Molecules

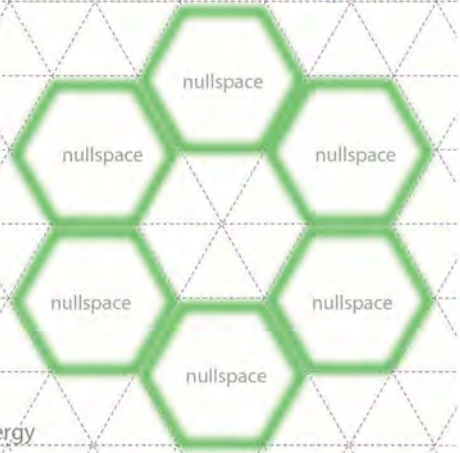

W+

2D mass-energy
geometries

+q

bosons

charges

-q

W-

photons

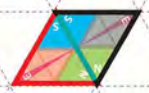

γ

'nullspace' is a spatial region devoid of all forms of energy
[found only within tetrahedral Matter topologies]

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2D Euclidean spatial geometry

All 2D mass-energy momenta map onto **FLAT** Euclidian co-ordinates

[x,y] $\Delta\Omega$
(2D space & time)

Cartesian spatial co-ordinates
fail to accurately map
equilateral energy momenta

Minkowski spacetime
is a close approximation of
Tetryonic energy momenta

Tetryonic space-time

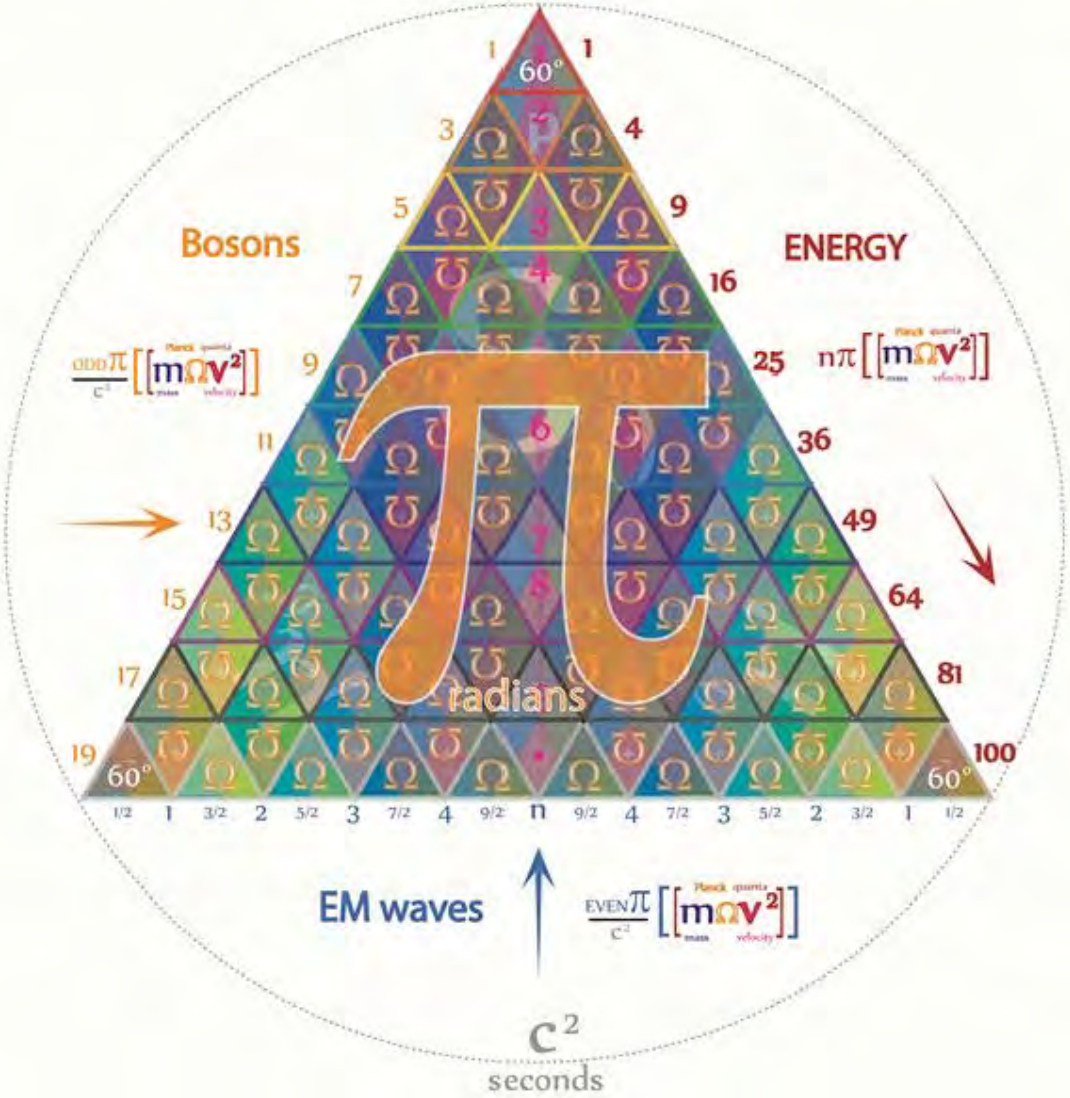

negative curvative
angles add up to > 180 °

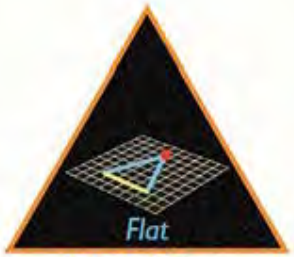

flat Euclidean
angles = 180 °

positive curvature
angles add up to < 180 °

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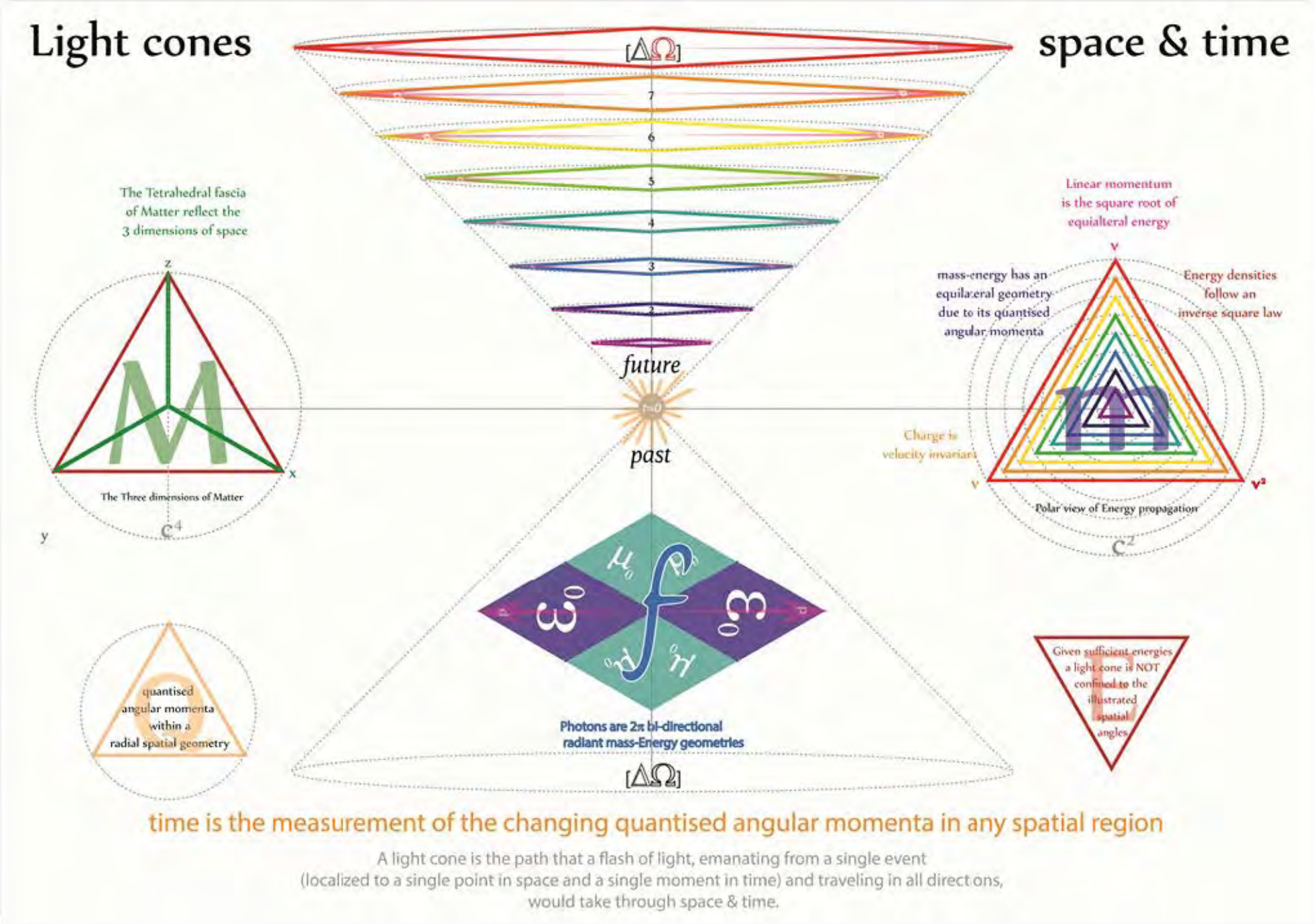

time is the measurement of the changing quantised angular momenta in any spatial region

A light cone is the path that a flash of light, emanating from a single event (localized to a single point in space and a single moment in time) and traveling in all directions, would take through space & time.

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Charge, energy momenta & time

measurements of the changing quantised angular momenta of scalar energy is the basis of measuring time

Ω

$.0012$

$\frac{m^2}{s}$

quantised angular momentum

$\beta = \left[\frac{v}{c}\right]$

Linear Lorentz factor

metres

$\frac{m^2}{s} \cdot \frac{s}{m}$

$\frac{\Omega}{v}$

λ

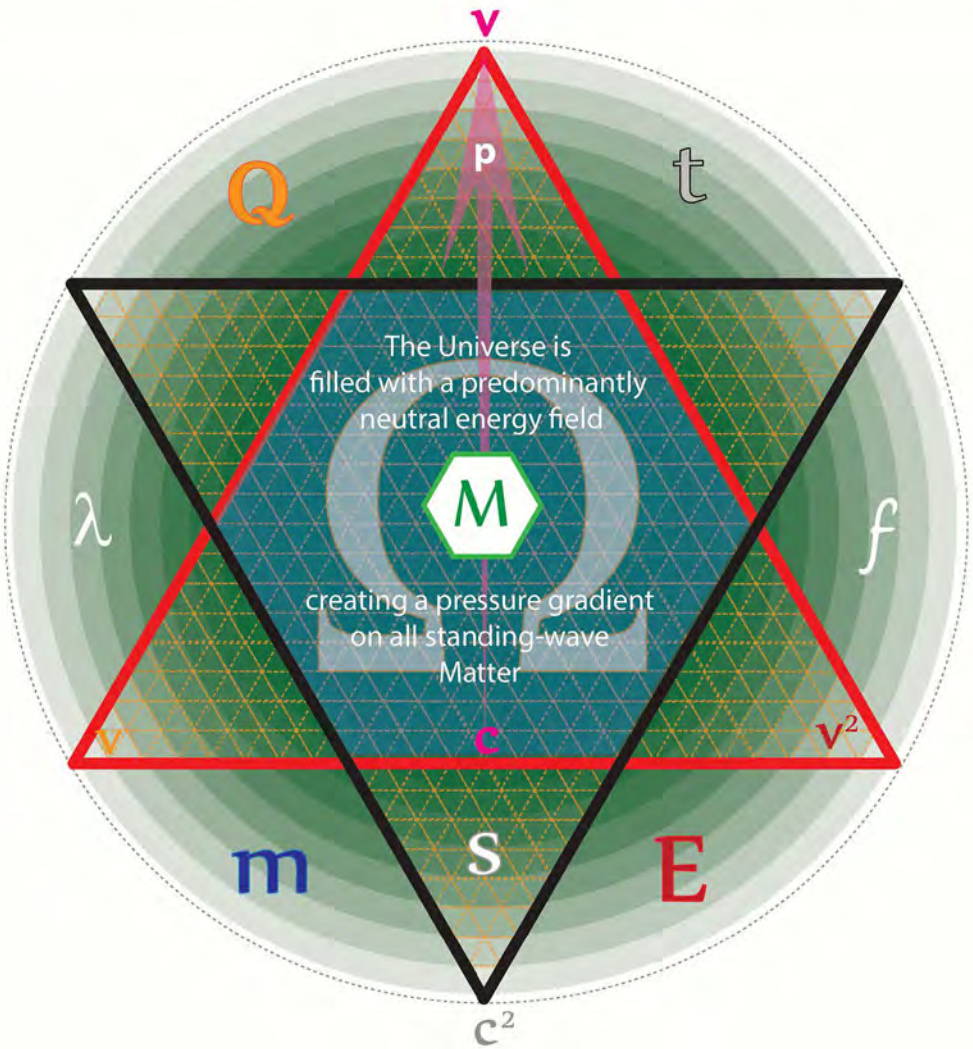

Velocity of Light

$$c = \left[\left[\frac{\Omega}{c}\right]_{\lambda} \cdot \left[\frac{c^2}{\Omega}\right]_{f}\right]$$

Wavelength Frequency

q

$\frac{\Omega}{c^2}$

$\frac{m^2}{s} \cdot \frac{s^2}{m^2}$

seconds

$\left[\frac{v^2}{c^2}\right] = \beta^2$

Scalar Lorentz factor

per second

$\frac{m^2}{s^2} \cdot \frac{s}{m^2}$

$\frac{v^2}{\Omega}$

f

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Spacetime Fields

are spatial geometries that contain changing Quantised Angular energy-Momenta [Planck quanta]

$\vec{p}$

Spatial co-ordinate systems are defined by the vectors of their linear energy momentum

Space
[x,y,z]

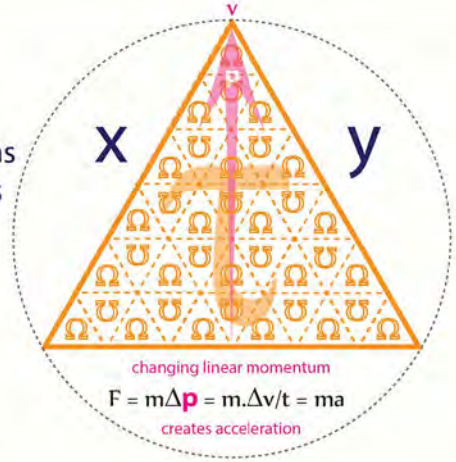

$\Delta\Omega$

Time is a measure of the changing quantised angular momenta in any defined region of space

Time
[seconds]

Charge is the nett distribution of Planck quanta mass.[Quantised Angular Momenta] within any spatial co-ordintate system

EM masses are 2D planar energy waveforms

2D mass-energy quanta have linear & angular momenta

Matter has a 3D volumetric energy waveform

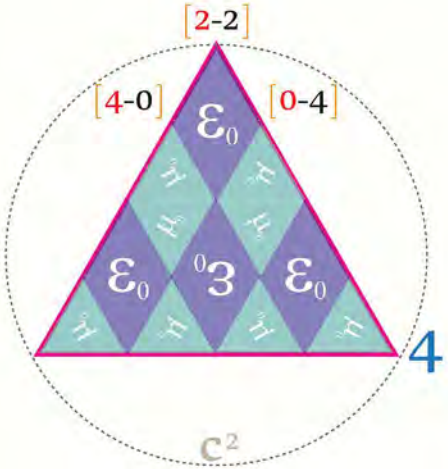

mass Planck quanta

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

Tetryonic geometry restores symmetry to Einstein's mass-energy equivalence and reveals a mass-ENERGY-Matter equivalance

radiant mass-energies can form standing-wave Matter

$$\frac{m}{c^2} = \frac{E}{c^4} = M$$

standing-wave Matter can release radiant mass-energies

where space and time are separated

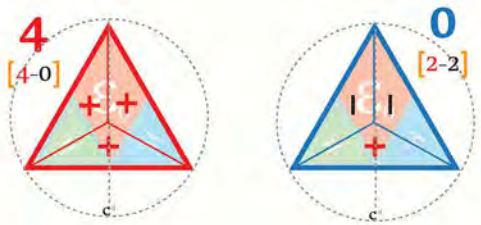

Matter Planck quanta

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

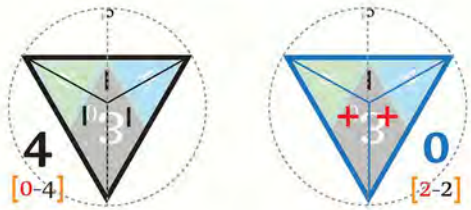

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The 4th dimension of Time

is charge, the angular momenta associated with any planar mass-energy

Accelerate

$\vec{p}$

increasing a systems's linear momentum

$F = m\Delta p = m.\Delta v/t = ma$

creates acceleration

Deccelerate

$\vec{p}$

decreasing a systems's linear momentum

$F = m\Delta p = m.\Delta v/t = ma$

creates decceleration

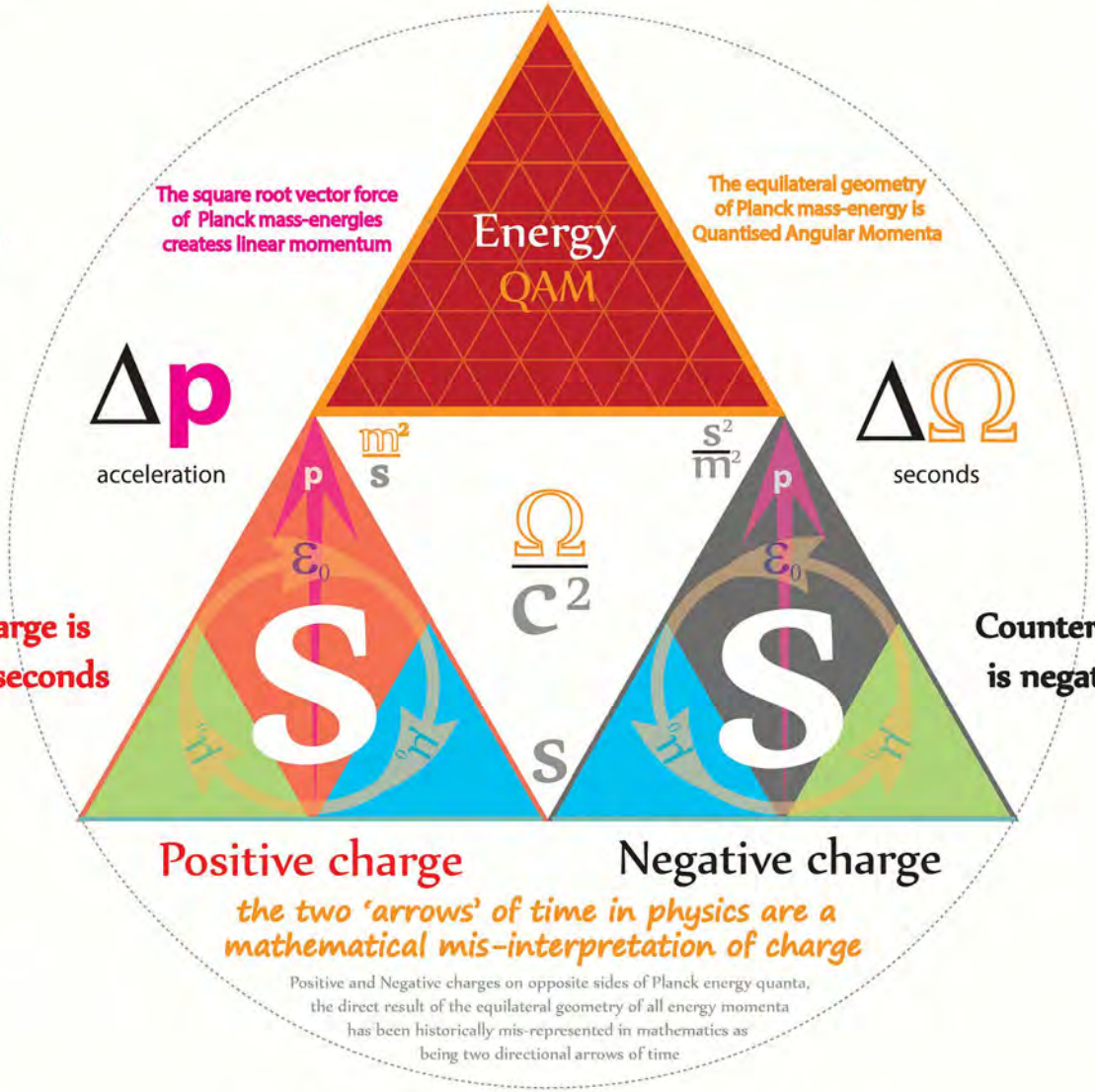

$\Delta\Omega$

Positive Time

Time is a measure of the changing angular momenta-energy (Planck geometry) of any given spatial region

$\Delta\Omega$

Negative Time

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CHARGE

all ideal inductive loops resist changes to their Energy levels

INERTIAL mass

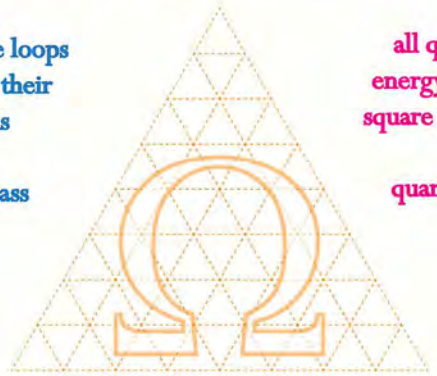

All quantised angular momentum is an equilateral geometry

all quantised Planck energy momenta posses square root vector Forces

quantum of WORK

vector velocity results from linear momentum - the square root of all scalar energies

$$kg\left[\frac{m^2}{s^2}\ \frac{s^2}{m^2}\right]$$

$$kg\left[\frac{m^2}{s}\ \frac{s^2}{m^2}\right]$$

Scalar energy per unit time

mass

Planck quanta per unit time

mass.seconds

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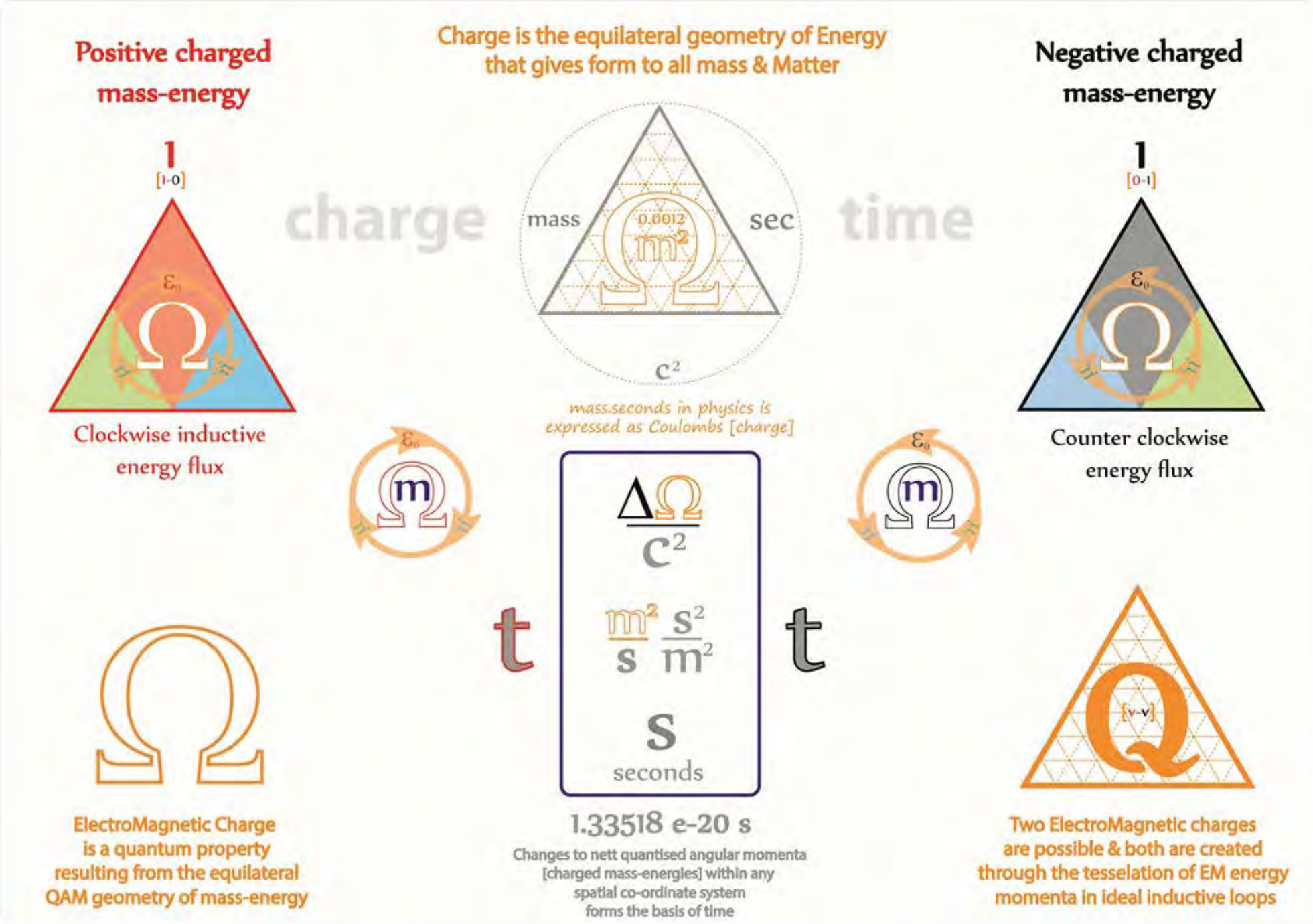

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The Quantum Arrow of Time

in physics is a measurement of changes to quantised angular momenta

Thermodynamic arrow of time

The Entropy of a system always increases

Radiative arrow of time

EM mass-energies native outward from a point source

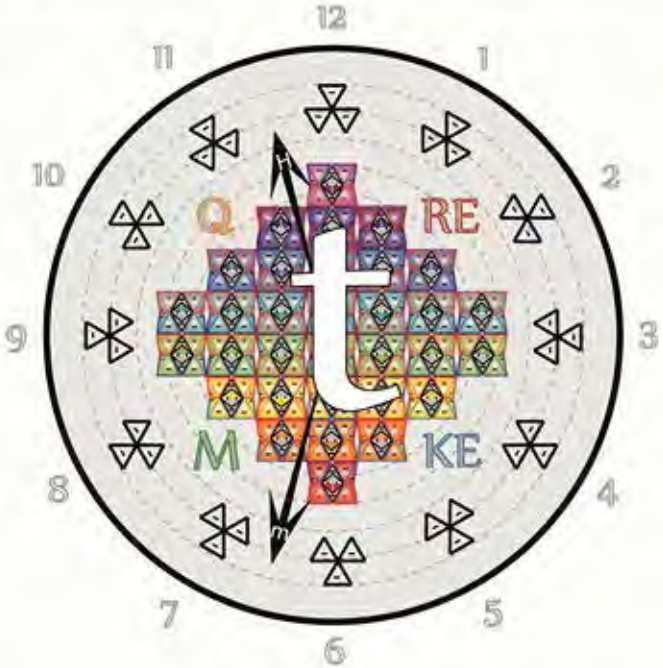

Cosmological arrow of time

The Universe is evolving from a big bang to ?

Causal arrow of time

A cause always precedes its effect

Tetryonic theory maps QAM as equilateral Planck geometries & reveals ΔQAM to be time
Time and the spatial dimensions it creates are mapped with radial & spherical co-ordinates

ΔmΩ Decceleration

The Arrow of Time

is our perception of changing quantum-scale angular momenta

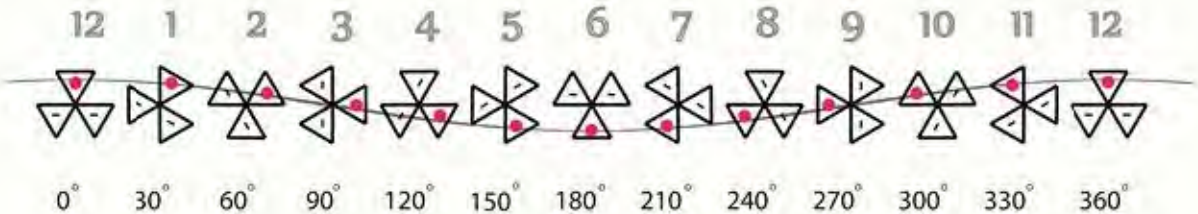

ΔmΩ Acceleration

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Time dilation

An accurate clock at rest with respect to one observer may be measured to tick at a different rate when compared to a second observer's own equally accurate clocks. This effect arises neither from technical aspects of the clocks nor from the fact that signals need time to propagate, but from the nature of spacetime itself.

The changing quantised angular momenta of all mass-energy-Matter densities in any spatial region all impact on our measurement of time [ΔΩ]

increasing the mass of Matter increases the stress energy tensor [mass-energy gradient]

Stronger G fields

GR

Vacuum energy-Matter pressure gradients

Weaker G fields

gravity is proportional to the material displacement volume of mass-Matter in a given spatial region of vacuum energy

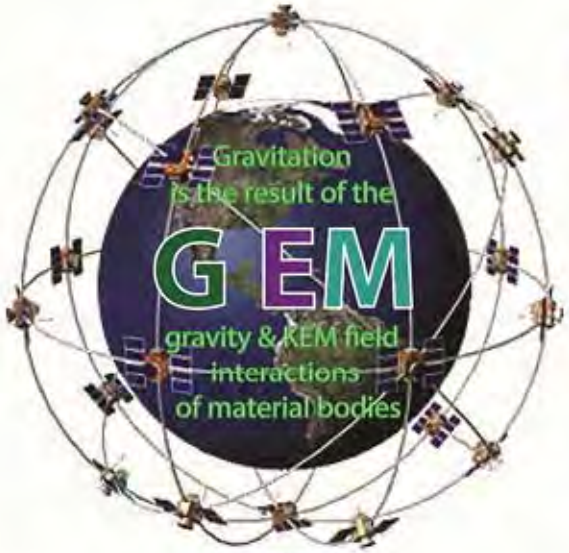

tests of GR using photons are erroneous tests of SR

accelerating material objects increases the Planck quanta [mass.QAM] in their KEM fields

Stronger KEM fields

Kinetic EM energies of motion

SR

Weaker KEM fields

deccelerating material objects decreases the Planck quanta [mass.QAM] in their KEM fields

Any attempt to accurately model the full effections of Gravitation must include a complete definition and differentiation of all mass-energy & Matter along with the vacuum energy pressure gradient created by them

In the theory of relativity, time dilation is an actual difference of elapsed time between two events as measured by observers either moving relative to each other or differently situated from gravitational masses.

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Entropy in physical systems

is the result of changes to the net organisation of quantised angular momenta as it seeks equilibrium

Second law of thermodynamics

An isolated physical system, if not already in its own internal state of thermodynamic equilibrium, spontaneously evolves towards it.
In an isolated physical system, there is a tendency towards spatial homogeneity.

The Boltzmann equation was developed to describe the dynamics of an ideal gas

$$\frac{\partial f}{\partial t} + v\frac{\partial f}{\partial x} + \frac{F}{m}\frac{\partial f}{\partial v} = \frac{\partial f}{\partial t}$$

Ludwig Eduard Boltzmann

(February 20, 1844 – September 5, 1906)

$$S = k\cdot[\log(W)]$$

Boltzmann entropy formula

Tetryonic theory utilises the equilateral geometry of ideal quantum inductors to model EM energies

mass-energy radiator

normal statisitcal distribution of energies

Energy in all its forms seeks equilibrium

$$E = n.h\nu$$

Max Planck extended on the work of Stefan-Boltzman by deriving his heat law and quantum mechanics

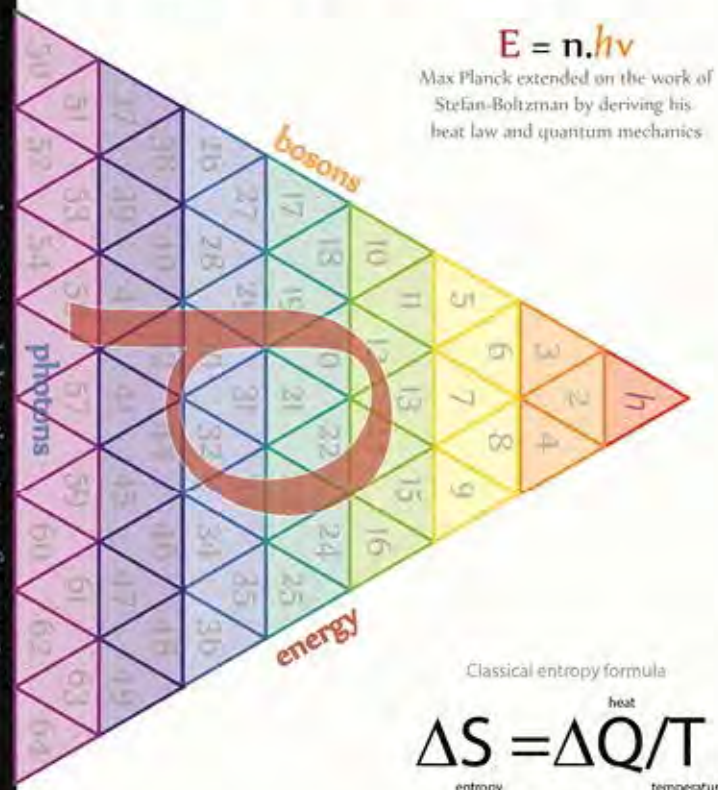

Classical entropy formula

$$\Delta S = \Delta Q/T$$

entropy, heat, temperature

Energy always moves from higher energy organised systems to a lower dis-organised system

lower energy blackbody

A black body is an idealized physical body that absorbs all incident electromagnetic radiation

Jacob David Bekenstein

(born May 1, 1947)

Bekenstein-Hawking entropy formula

$$S = \frac{\pi A k c^3}{2hG}$$

still uses 3D [c^3] classical cartesian co-ordinates

Stephen William Hawking

(born 8 January 1942)

Tetryonic theory unites classical and quantum mechanics with relativity through equilateral QAM

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The Aether

Aether theories in physics propose the existence of a medium, the aether a space-filling substance or field, thought to be necessary as a transmission medium for the propagation of electromagnetic waves.

bosons, photons and Matter are simply geometric concentrations of EM energy in regions of Space

Spacetime is the QAM geometry of any measured spatial [LT] region

Vast radiant energy fields exist throughout all of Space save inside Matter topologies

Matter geometries form perfect quantum Faraday cages excluding all energies thus creating nullspaces

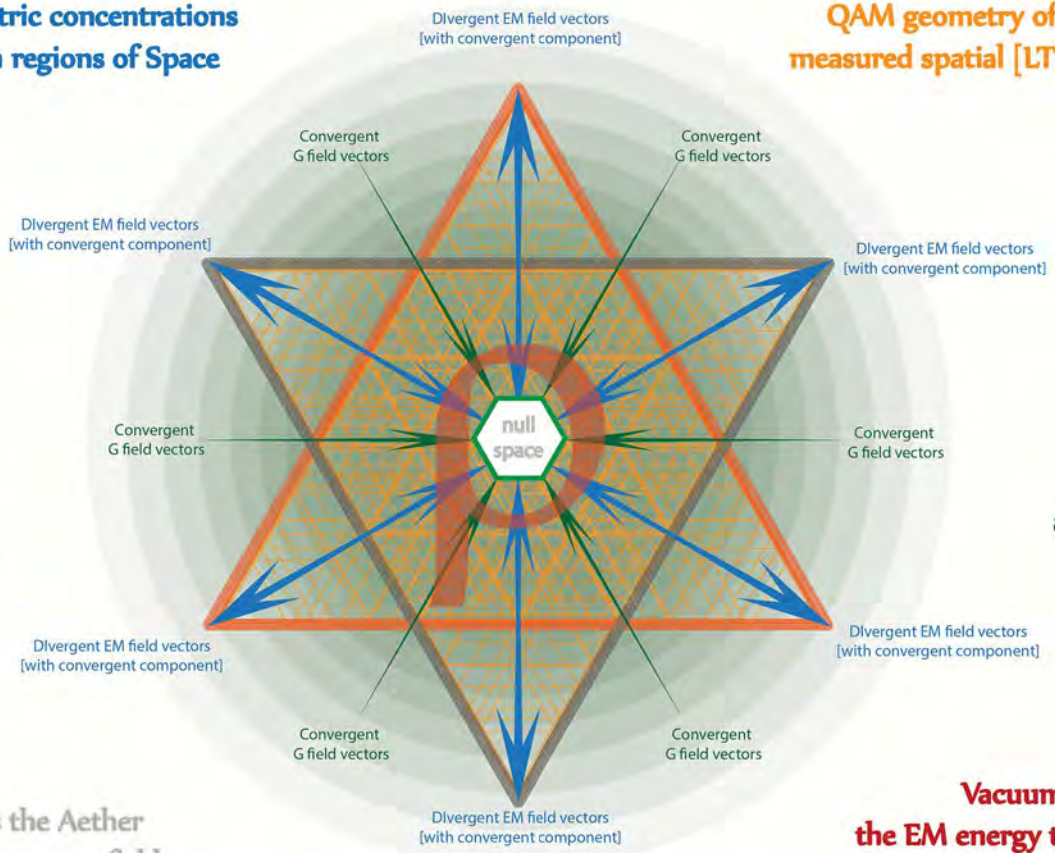

The low level EM fields permeating the space between Matter forms a background vacuum energy density

The vacuum energy field acts upon the internal 'null space' volumes of all Matter creating a gravitational pressure gradient

Historically refered to as the Aether (or the Ether) this vacuum energy field has been the source of much contention

Vacuum Energy is the EM energy that permeates and fills any spatial region

Photons do not require the aether to propagate however the aether is permeated with 'weak' superpositioned EM fields

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The Luminiferous Aether

In the late 19th century, luminiferous aether or ether, meaning light-bearing aether, was proposed as a medium for the propagation of light.

Newton's Opticks (1704) postulated an "Aethereal Medium" transmitting vibrations faster than light, by which light, is put into "Fits of easy Reflexion and easy Transmission"

Maxwell proposed a mechanical sea of molecular vortices to explain the transfer of ElectroMagnetic energies

Einstein wrote that one can actually speak about a "new aether", but one may not speak of motion in relation to that aether

In Tetryonics all EM radiation & Matter are revealed to be concentrations of geometric Energies seeking equilibrium in regions of Spacetime

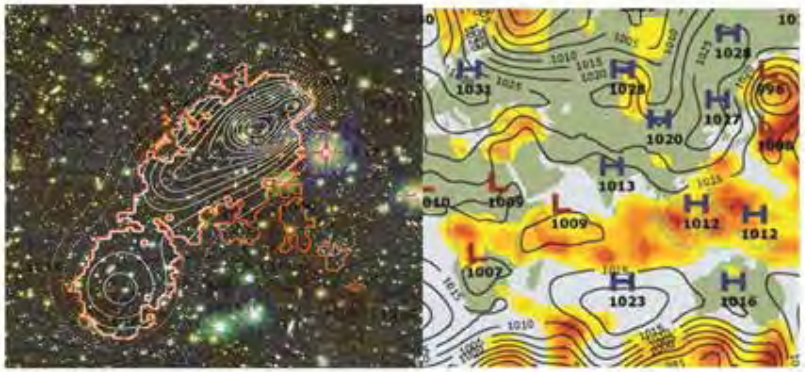

The aether does NOT facilitate the transmission of Energies throughout the Universe, it is the result of radiated [K]EM energies

Vacuum energies can be likened to the mean atmospheric pressure, with 2D mass-energies being HIGHER pressure 'gusts'

and

the nullspaces within 3D Matter creating a LOW pressure gradient [providing a driving mechanism akin to to that of Storms, Cyclones or Tornados]

$\frac{\rho}{m^2}$

Photons are radiant 2D mass-energy geometries

Vacuum energies are very long wavelength photons

Hendrik Lorentz created an electron/aether theory, in which he introduced a strict separation between Matter and the aether

$\frac{\rho}{m^3}$

All Matter are 3D mass-energy topologies containing nullspaces

Planets, Stars and Galaxies contain high densities of mass-energies

Michaelson and Morley sought to detect the Relative motion between the Earth and aether by measuring the speed of light

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Vacuum Energy

Vacuum energy is an underlying background mass-energy that exists in free space even when the space is devoid of matter

The Universe is Electric in nature and all Matter in it interacts via Gravito-Electro-magnetic [GEM] fields

Tetryonics shows that all Matter is quantised and these charged mass-energy quanta produce EM fields of varying strengths in turn radiating out from the source Matter into Space to form GEM fields

VE is not a 'quantum foam' as popularly depicted, it is a triangular Euclidean geometry of neutral mass-energies

The internal nullspaces of all Matter geometries creates a pressure gradient within Vacuum energies

Photons

'Vacuum' Energies

EM fields do NOT propagate to 'infinity'

They radiate under the inverse square law until they weaken to become vacuum-energies

Gravitational Energy

Matter

There are no 'virtual particles' in free space only varying mass-Energy density geometries [Bosons, Photons & Matter]

The Cosmic background radiation is the result of low level KEM fields radiated from all Matter

The field gradients are strongest closer to bodies of Matter

Coulombic fields are DIVERGENT [K]EM fields with interactive forces

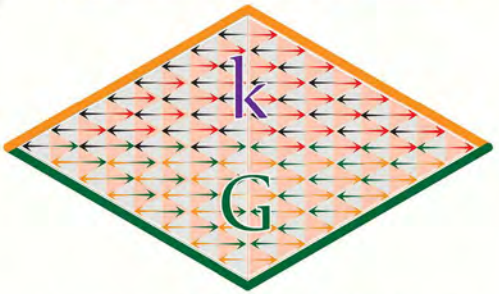

Gravitational fields are CONVERGENT
Gravity is always attractive

Space is not Black [it is INDIGO]

It is filled with superpositioned EM fields

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The Higgs Field

is another name for the Aether (or vacuum energy field) that fills free Space, its interaction with inductive Tetryonic topologies creates the inertial properties observed in mass-Matter

Peter Higgs

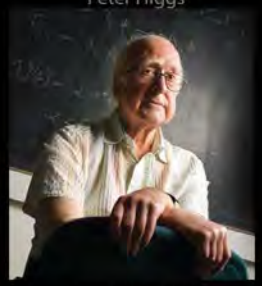

(born 29 May 1929)

The 'Higgs Boson' is just a W boson by another name

Free Space

is any spatial region free of EM energy quanta (nullspace within Tetryons)

All Higgs vacuum fields are equilateral mass-Energy-momenta fields

Vacuum Energy

is the lowest denisty [longest wavelength] electromagnetic mass-energy that having diverged from Matter radiates outwards to fill space & create a pressure gradient

'Virtual particles' do NOT exist

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All Bosons have ODDn planar electromagnetic charge geometries

Inductive resistance to changes of the energy content of charged fascia through vacuum energy fields creates inertial mass

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass, Planck quanta, mass, velocity

Electromagnetic mass is a measure of the Energy content of a 2D geometry per unit of Time

m

mass-energy is a 2D geometric property of 3D Matter

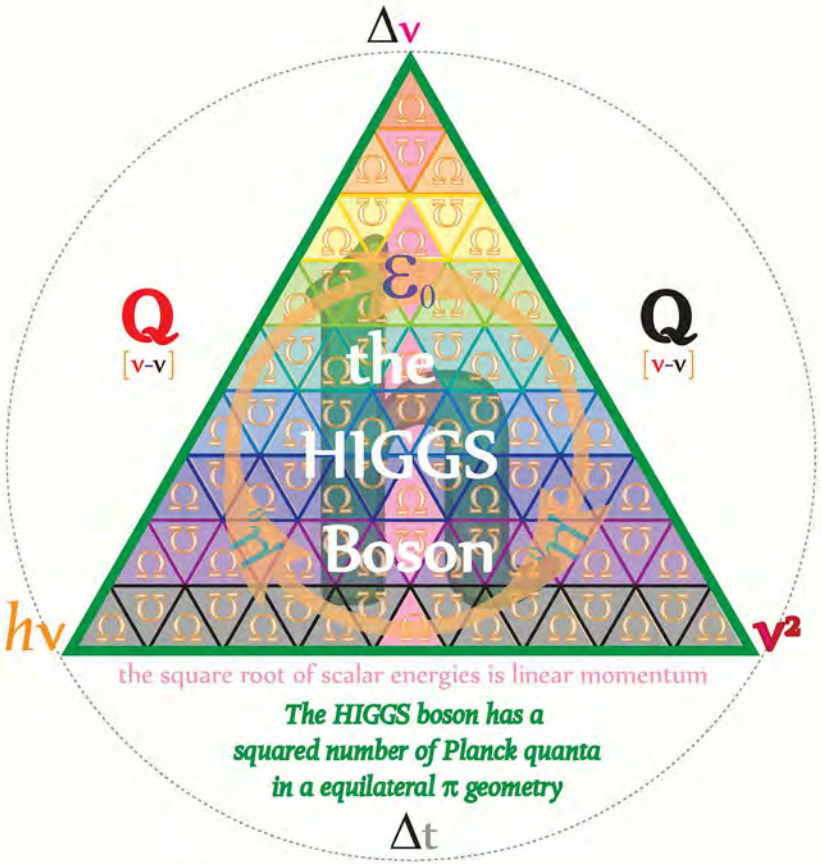

The HIGGS boson has a squared number of Planck quanta in a equilateral π geometry

The HIGGS boson is an alternative name for the 2D charged mass-energy fascia of all Matter

[whose inductive QAM quanta create the physical property of inertial mass]

$$F = \dot{m}a$$

inertial mass is a measure of a body's resistance to changes in acceleration due to external forces

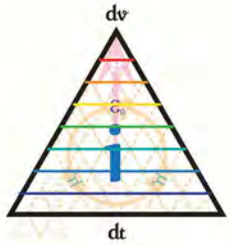

Charged Planck quanta form the geometry of of all mass-ENERGY-Matter
[each charge fascia contains equilateral mass-energy momenta]

TETRYONS

All Matter has 4n enclosed tetrahedral charge topologies

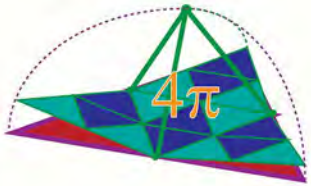

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter, Planck quanta, mass, velocity

3D material Matter is a EM standing-wave topology whose mass is a measure of its geometric Energy content

M

Matter is the 3D topology created by mass-energies

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The energy momenta density of standing wave Matter

determines its inertial mass

m
mass
kg

M
Matter
KG

Spatial topology

Matter

$$\frac{4n\pi}{c^4}\left[\left[\underbrace{m}_{\text{mass}}\overset{\text{Planck quanta}}{\Omega}\underbrace{v^2}_{\text{velocity}}\right]\right]$$

EM mass-energies

de Broglie Wavelengths

$$\frac{\rho}{c^2}$$

mass

m

$$\frac{\rho}{c^4}$$

Matter

M

Compton Frequencies

The mass-energy content of Matter is contained entirely within its charged fascia topology

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3D Nullspaces

Planck mass-energy quanta clothe only the topologies of Matter

3D EM fields with volume are measurements of Energy per unit Time squared [Matter]

$T\pi$

Nullspace is proportional to the internal volumes of Tetryons

2D planar EM fields are measurements of Energy per unit Time [EM mass]

$[m\Omega v^2]$

The mass-energy densities [fascia] of Matter do NOT influence nullspaces

Inside the Tetrahedral topologies of all Matter exists the only true vacuum

Any radiant energy trying to enter the interior volume of a Tetryon will be absorbed into the fascia, increasing its Tetryonic mass (or increasing its KEM field energy)

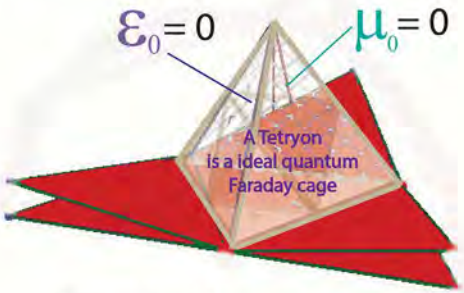

A volume devoid of any possible energy quanta [ie The True vacuum]

The interior volume of Tetryons has the lowest energy density/pressure possible and is accumulative as Matter forms increasingly complex states, creating regions of low energy density within the nuclei of all Matter

Outer space is considered a high-quality vacuum, with the equivalent of just a few hydrogen atoms per cubic meter on average. However even it is permeated with superpositioned EM fields of vacuum mass-energies

$\frac{\rho_0}{T}$

A true vacuum is a spatial volume that is completely devoid of EM mass-energies, such that its energy density/pressure is much lower than of the surrounding energy density/pressure [a nullspace]

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[x,y] $\Delta\Omega$

Positive charges in 2D space are classically modelled as clockwise energy fluxs

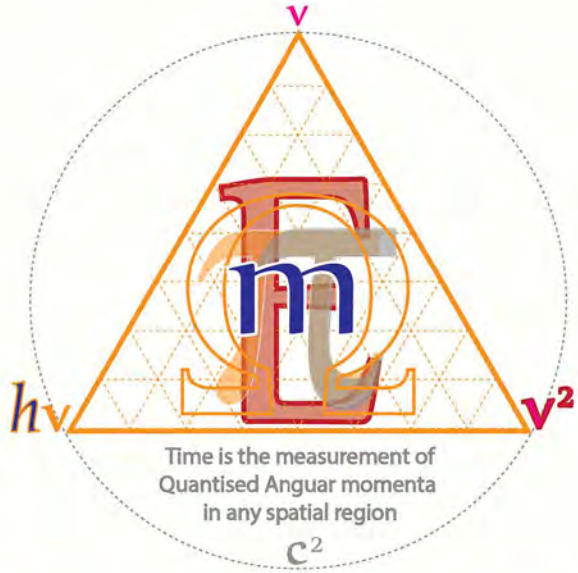

[x,y] $\Delta\Omega$

Negative charges in 2D space are classically modelled as anti-clockwise energy fluxs

Charged Planck mass-energies provide the scaffolding of 3D Matter

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass Planck quanta

m

mass

[x,y,z] $\Delta\Omega$

3D Space and Time

M

Matter

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter Planck quanta

mass velocity

2D mass geometries are a property of 3D Matter

2 Dimensional mass-energies

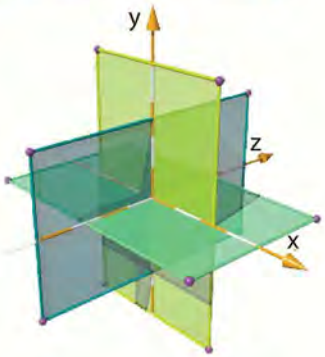

3 Dimensions of Space

kg

radiant

2D mass-energy momenta

$$T\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field impedance Planck quanta mass velocity

creates 3D standing-wave Matter

KG

2D charged fascia

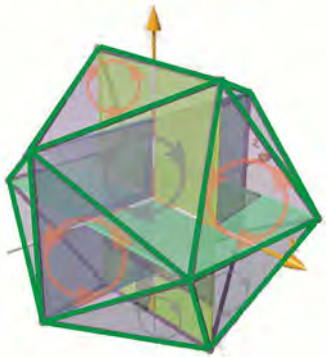

3D Space + Time

3D Matter topology is not a property of 2D mass-energy

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The impedance of any spatial region

is determined by its scalar energy content

Positive Matter

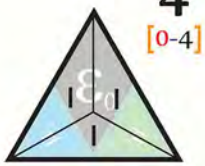

Negative Matter

$$\frac{m}{hv^2}$$

$$\frac{mc^2}{v^2}$$

$$\frac{mc^2}{h}$$

$$\frac{v^2}{c^2}$$

$$\frac{h}{m}$$

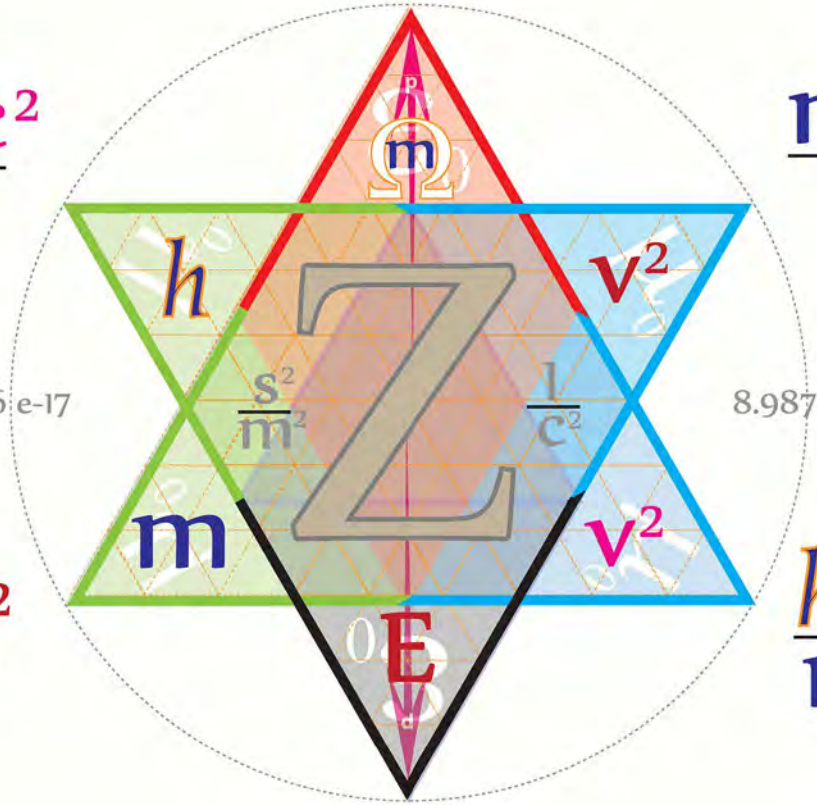

1.112650056 e-17 $\frac{s^2}{m^2}$

$\frac{1}{c^2}$ 8.987551787 e16 $^{-1}$

$$\frac{hv^2}{c^2}$$

$$\frac{hv^2}{m}$$

111.265 ohms

Neutral Matter

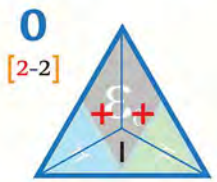

Neutral Matter

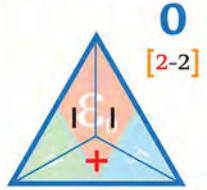

The impedance of any medium determines
the velocity of propagation for mass-energy momenta through it

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EM mass vs. Matter

Often a source of confusion,
Tetryonics provides a rigorous
definition of both EM mass & Matter

6.022141579 e23
[Avagadros number]

1 ton of Carbon & 1 ton of Lead have the same mass-energies

But they have differing Matter topologies that create a differing energy densities for any spational region of measurement

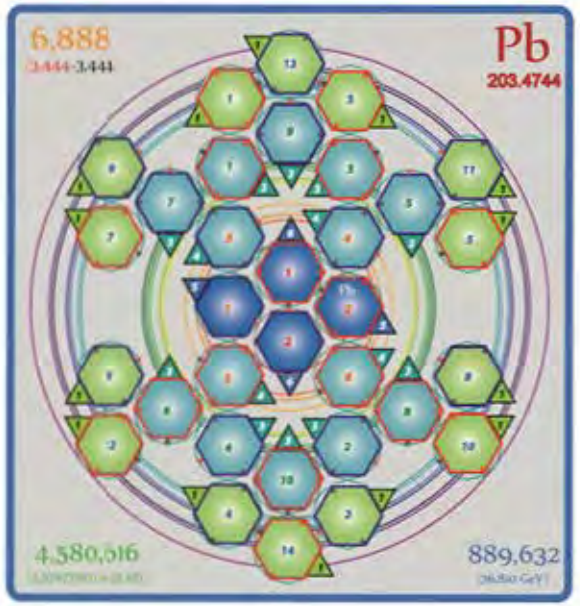

1 mole of Carbon atoms
[11.996 grams]

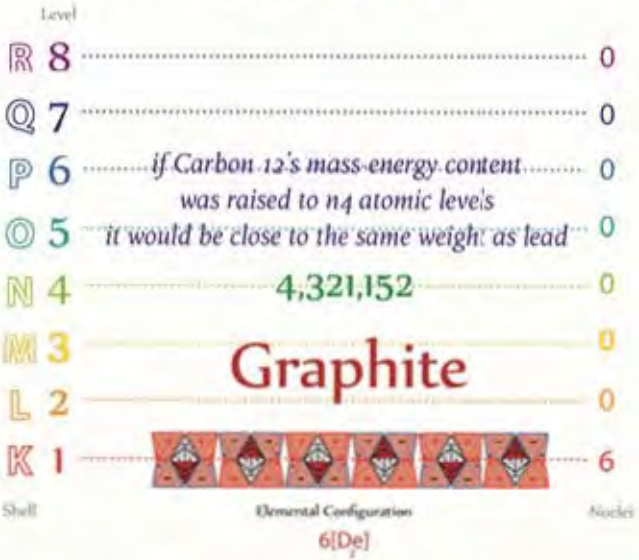

In terms of charged Matter topology
Carbon12 displaces 1/14th the volume of Lead

In terms of mass-ENERGY-Matter densities
Lead is 17 times denser than Carbon
as a result of the mass quanta per charge fascia

1 mole of Lead
[203.4744 grams]

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EM mass-energy geometries

are 2D Euclidean EM fields posessing energy momenta

$\frac{\rho}{m^2}$

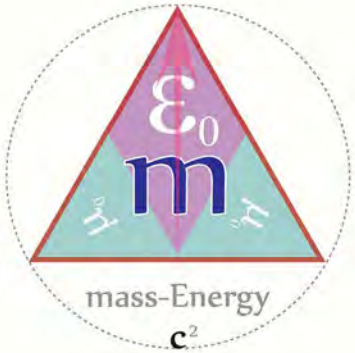

Charge $\frac{1\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Bosons $\frac{\text{ODD}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Photons $\frac{2\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

EM waves $\frac{\text{EVEN}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

ENERGY

$n\pi\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

m — **mass**

$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

M — **Matter**

$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Equilateral mass-energy geometries & Matter Topologies are measured in radial spatial-time co-ordinate systems

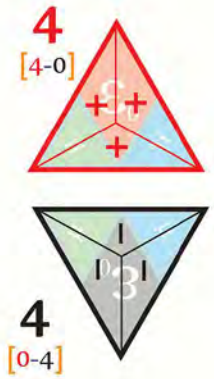

Tetryons $\frac{4\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Fermions $\frac{12\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Baryons $\frac{36\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Deuterons $\frac{84\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

$\frac{\rho}{m^3}$

KG

Matter Topologies

are 3D standing-wave [4nπ] mass-energy geometries

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mass-energy-Matter quanta

are all defined by charged geometries & topologies

Bosons (v)

Bosons

$$\frac{\text{ODD}\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

Photons(f)

EM waves

$$\frac{\text{EVEN}\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

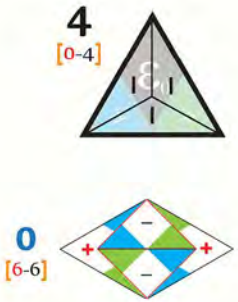

Tetryons (n)

Matter

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

charges

1π	ZPF	v
ODDπ	boson	v

mass-energies

2π	photon	$2v^2$
EVENπ	EM wave	$2v^2$

mass-Matter

4π	tetryon	n
12π	lepton	n
24π	meson	n
36π	Baryon	n

Inductive charges

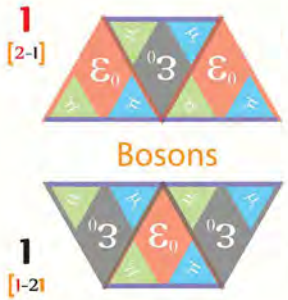

EM waves

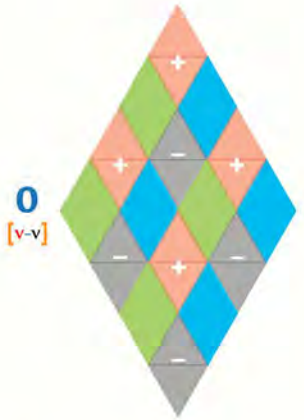

Matter particles

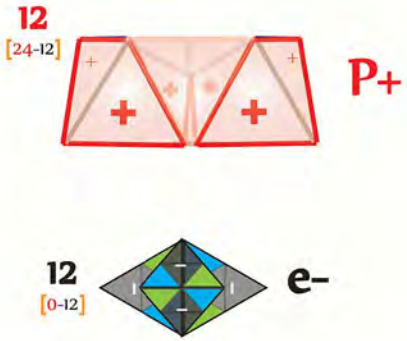

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Differentiating mass & Matter

geometries — topologies

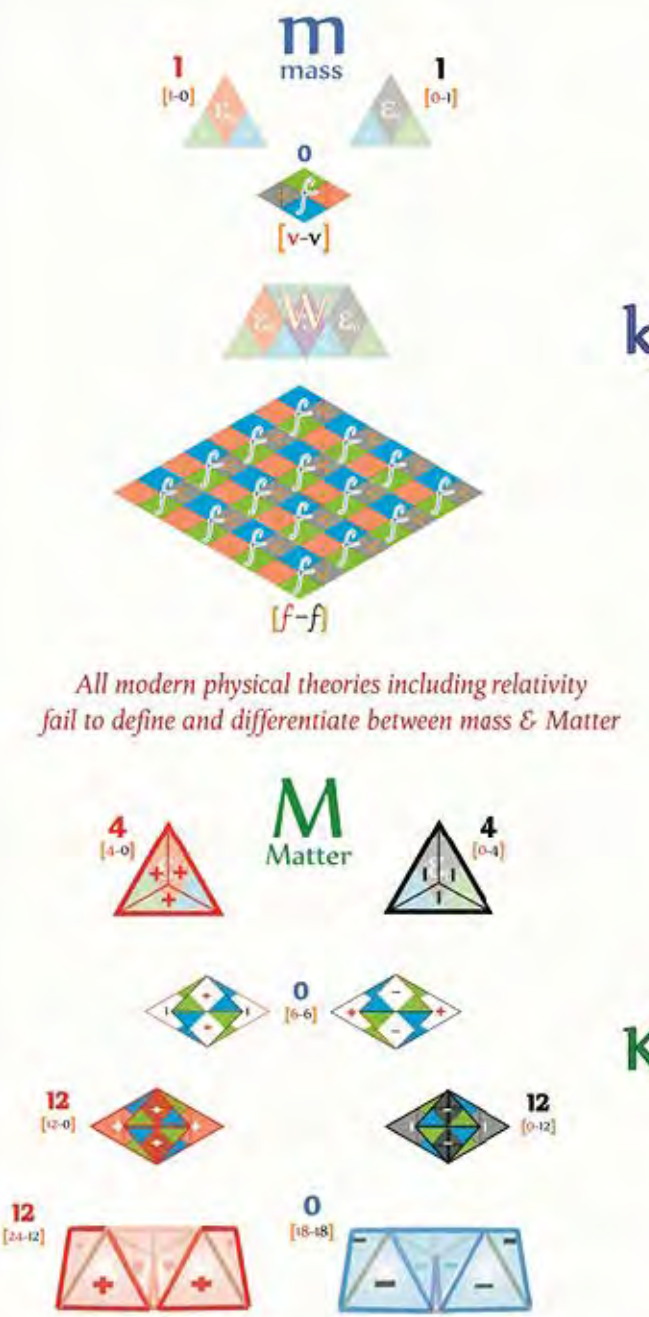

All modern physical theories including relativity fail to define and differentiate between mass & Matter

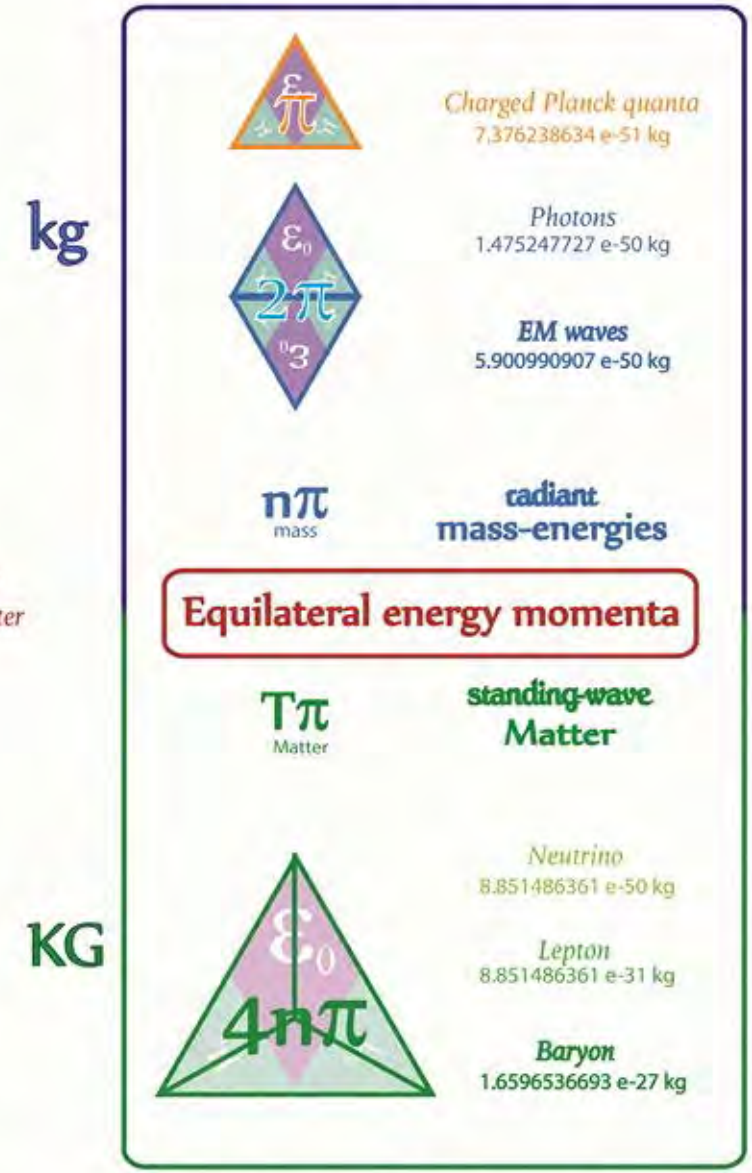

Increasing a particle's speed increases its Kinetic EM mass-energies (rest Matter's EM mass-energy content is velocity invariant)

All Matter has EM mass-energies not all EM mass-energies form Matter

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6.629432351 e-34 J

$$E = mv^2$$

E
Energy
$kg\,\frac{m^2}{s^2}$

$$E_{\text{Energy}} = n\pi\left[\left[m_{\text{mass}}\,\Omega\,v^2_{\text{velocity}}\right]\right]$$

Planck quanta

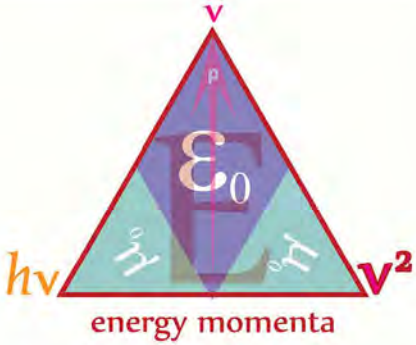

ENERGY

the proagation velocity of energy is determined by the impedance of any spatial region

$E=hv^2$

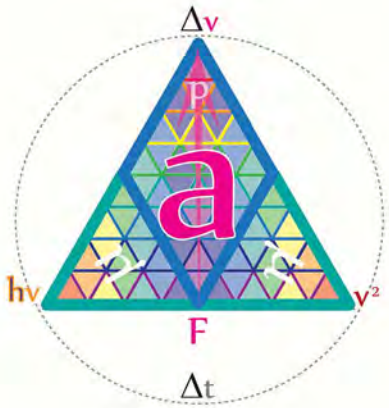

$F=ma$

the scalar impedance of space

$\frac{s^2}{m^2}$

$$\varepsilon_0 \times \mu_0$$

Electric permittivity & *Magnetic permeability*

1.11265 e-17 $\frac{s^2}{m^2}$

$\frac{1}{c^2}$

the Forces created by energy momenta in any spatial region are related through the scalar constant of mass

EM mass

$$m = \frac{E}{c^2}$$

m
mass
kg

$$n\pi_{\text{mass}}\left[\left[\varepsilon_0\mu_0\right].\left[m_{\text{mass}}\,\Omega\,v^2_{\text{velocity}}\right]\right]$$

field impedance
ElectroMagnetic
Planck quanta

7.376238376 e-51 kg

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The energy-momenta of Matter

$$\mathbf{p} = \mathbf{mv}$$

Linear correction factor

$$\beta = \left[\frac{v}{c}\right]$$

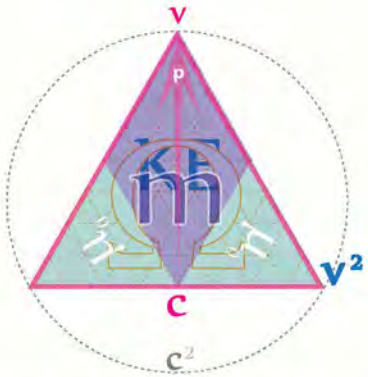

The Energy comprising all KEM fields is proportional to the particle's velocity

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

Scalar correction factor

$$\mathbf{p}^2 = E = mv^2$$

$$\mathbf{p} = T\pi\left[\left[\overset{\text{Energy}}{m\Omega v}_{\text{momenta}}\right]\right]$$

As the velocity of a particle increases so does its KEM field's mass-energy momentum

$$mv = \mathbf{p} = hv$$

$$kg\frac{m}{s}$$

$$\sqrt{6.629432351\ e\text{-}34\ J}$$

$$4n\pi\left[\overset{\text{Planck quanta}}{m\Omega v}_{\text{mass velocity}}\right]$$

2.5476847 e-17 kg m/s

The linear momentum of mass-energies in standing-wave rest Matter topologies propagates at c

$$\mathbf{p}_M = 4\pi[mv]$$

The rest mass of a particle with NO motion is the total EM mass-energy of the particle

Its linear four-momentum is the square root of its scalar energies

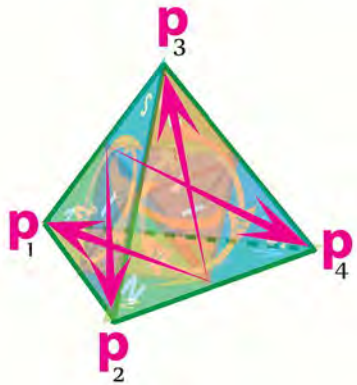

rest mass-Matter

In standing-wave Matter, where there is NO external forces acting on the particle, all internal momenta act in opposition and add to ZERO

$$\vec{\mathbf{p}}_0 = \sum^{\text{all fascia}} \vec{\mathbf{p}}$$

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Gravitational mass-Matter quanta

gravity pulls on things proportional to their mass-Matter content

$$F = -G \frac{M_1 M_2}{r^2}$$

Radiant mass-energy geometries

All 3D Tetryonic topologies create displacement Matter volumes that in turn generate KEM fields as a result of the motion of their charge fascia

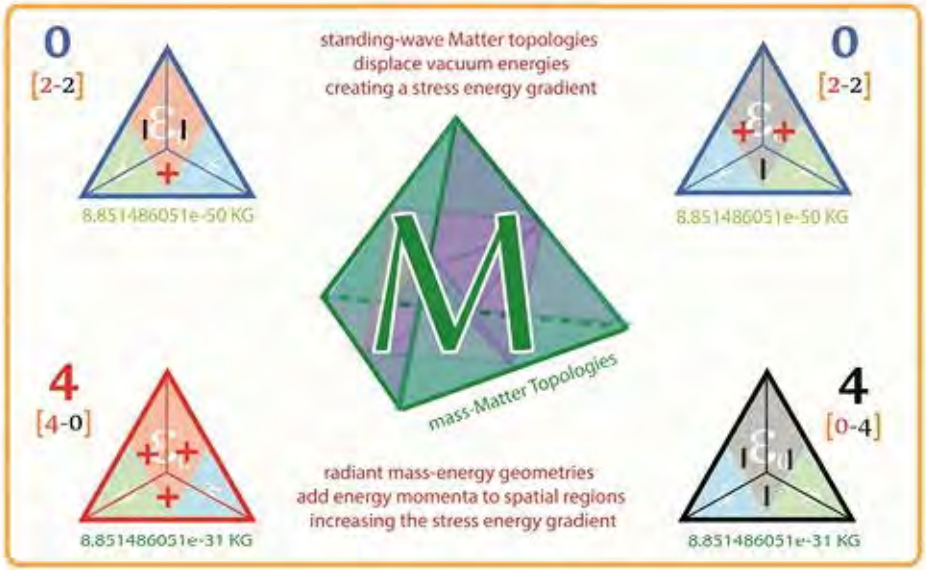

Standing-wave Matter Topologies

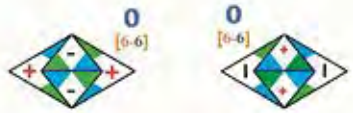

8.851486051e-50 KG

Mattter particles can have the same Tetryonic topologies but possess a differing charged mass-energy momenta content

8.851486051e-31 KG

Gravitational Attraction can be modelled as a dipole attraction of opposite charged mass fascia of Matter topologies through its differing energy field interactions

Gravitation attraction is a strictly
UNI-DIRECTIONAL CONVERGENT FORCE

$k = 8.99\ e9\ \frac{N\ m^2}{C^2}$

$G = 6.67\ e\text{-}11\ \frac{N\ m^2}{KG^2}$

KEM field energy momenta produce a BI-DIRECTIONAL INTERACTION FIELD

Gravitation attraction is 20 orders of magnitude weaker

KEM field energy momenta produce a BI-DIRECTIONAL INTERACTION FIELD

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Stress energy gradients

Energy's highest density form is 3D Matter [comprised of planar 2D EM mass-energies] whilst its lowest pressure form is the vacuum energies created by radiated mass-energies filling space

Q
[v-v]

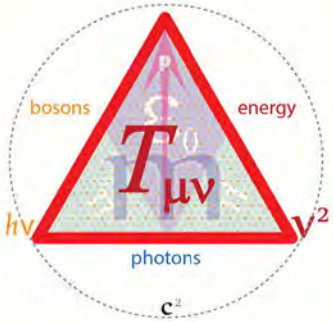

Q
[v-v]

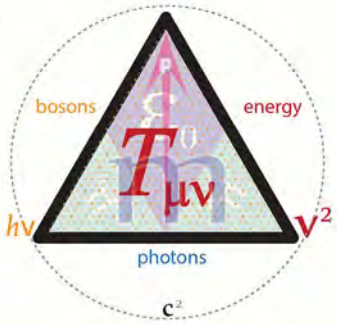

ENERGY in all its forms seeks equilibrium

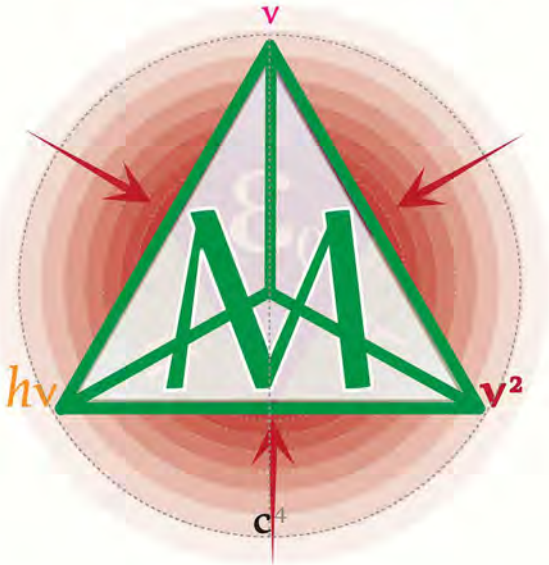

Where Newton's Law of Gravitation is modelled on geometric means

$$F = k\,\frac{Q_1 Q_2}{r^2}$$

Inverse Square Law

$$F = -G\,\frac{M_1 m_2}{r^2}$$

Einstein's General Relativity is modelled on energy pressure

$$PV = nRT$$

Matter tells Spacetime how to bend
Spacetime tells Mater how to move

$$R_{\mu\nu} - \tfrac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4}\, T_{\mu\nu}$$

Like any pressure gradient, ENERGY always flows from areas of highest density to regions of low density seeking to reduce 'pressure' differentials and reach a state of equilibrium.

mass-Matter topologies create stress energy differentials in the vacuum energies of space

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Gravitational Matter & weight

is a measure of the amount of mass-energy in Matter

The gravitational mass of a body determined by its response to the force of gravity

mass-Matter

Matter

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

The gravitational acceleration of a body in any gravity field is uniform and proportional to its mass-Matter

$$w = F = M.g$$

48

[24-24]

charge topology

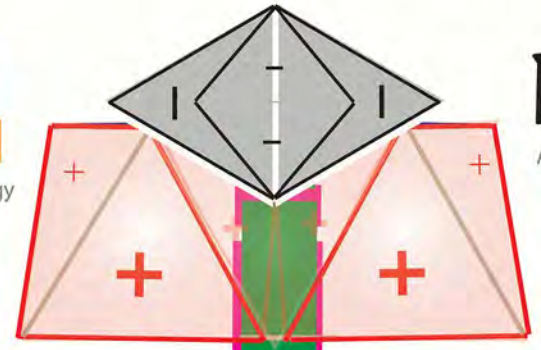

N_A

Avagadro

electrons

$$\frac{12\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

mass-energy-Matter

8.8514586361 e-31 KG

Baryons

$$\frac{36\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

mass-energy-Matter

1.659653693 e-27 KG

22,512

mass-Matter

1.66053886 e-27 KG

mass-Matter quantum

.001 KG

molar mass

$$w = M.g$$

lg

weight

$$F = Ma_g$$

9.8 m/s²

g

Force

$$= [.001] \times [9.8]$$

$$= .0098 \text{ N}$$

KG

$$\frac{\left[kg\,\frac{m}{s^2}\right]}{KG}$$

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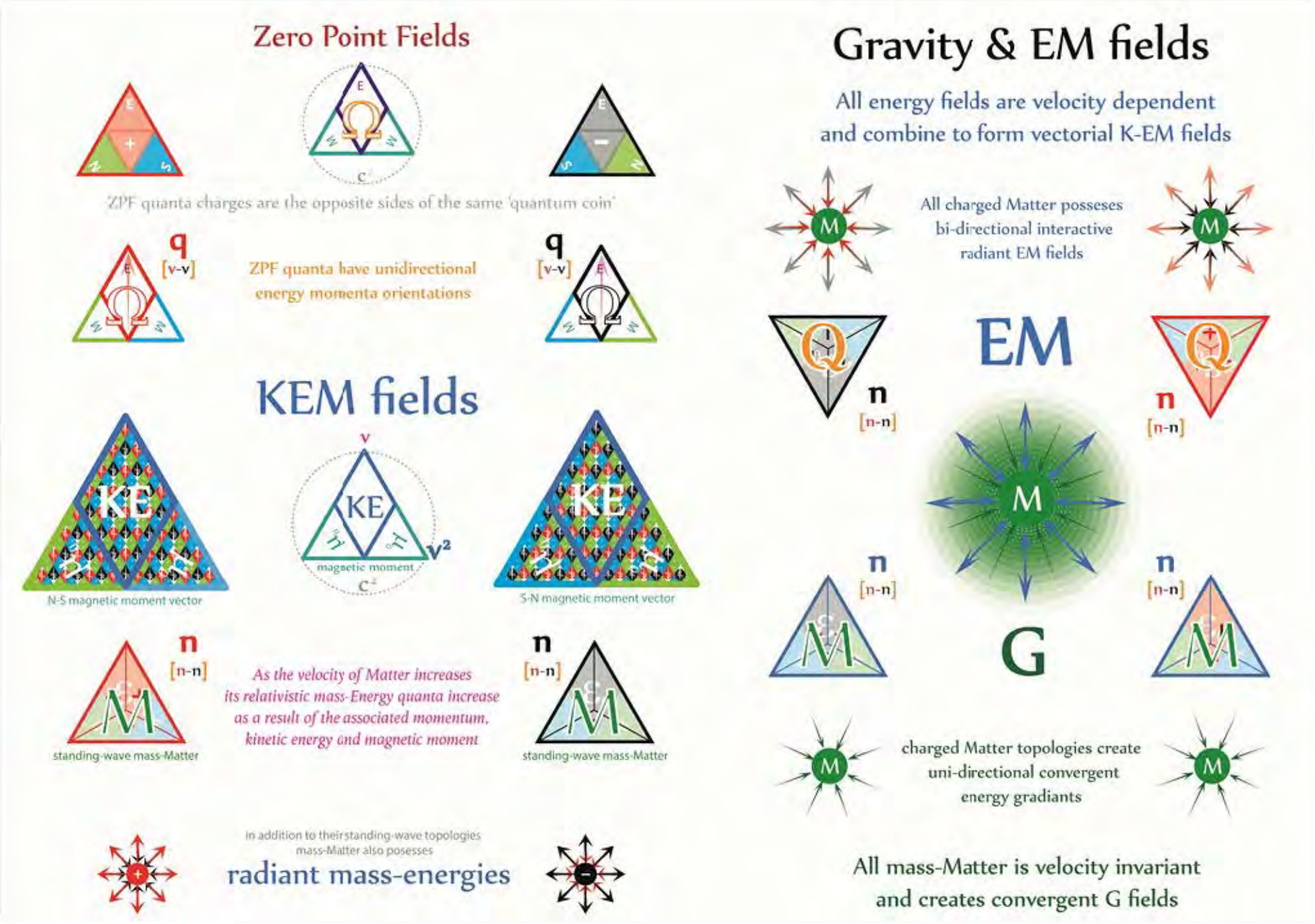

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Matterless EM mass-energies

Photons are often termed as 'mass-less' particles in physics which is a complete mis-nomer.
Leading to many erroneous supersitions on the true nature and physics of light and gravity

$$\frac{E}{c^2} = m$$

mass geometry

$$M = \frac{E}{c^4}$$

Matter topology

mass is a measure of planar Energy per second

mass-less infers no energy momenta

Photons are weightless radiant EM energies not massless particles

photons possess 2D planar radiant EM mass-energy momenta

A Particle has a charged Matter topology

Matter is a closed tetrahedral standing-wave energy possessing volume

photons & EM waves have no 3D Matter topology, they are Matter-less geometries

$$\frac{\text{ENERGY}\ n\pi\left[\left[\overset{\text{Planck quanta}}{m\Omega v^2}\right]\right]}{c^2}$$

mass velocity

second

$$\frac{\overset{\text{mass}}{n\pi}\left[\left[\overset{\text{Planck quanta}}{m\Omega v^2}\right]\right]}{c^2}$$

mass velocity

$$\frac{\overset{\text{Matter}}{T\pi}\left[\left[\overset{\text{Planck quanta}}{m\Omega v^2}\right]\right]}{c^4}$$

mass velocity

The definition and distinction between mass & Matter
is a major failing of modern physics, corrected for by Tetryonic theory

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EM fields, vacuum energies and gravity

all result from radiant equilateral mass-energy momenta
and standing-wave Matter in radial space

$$F = k \frac{Q_1 Q_2}{r^2}$$

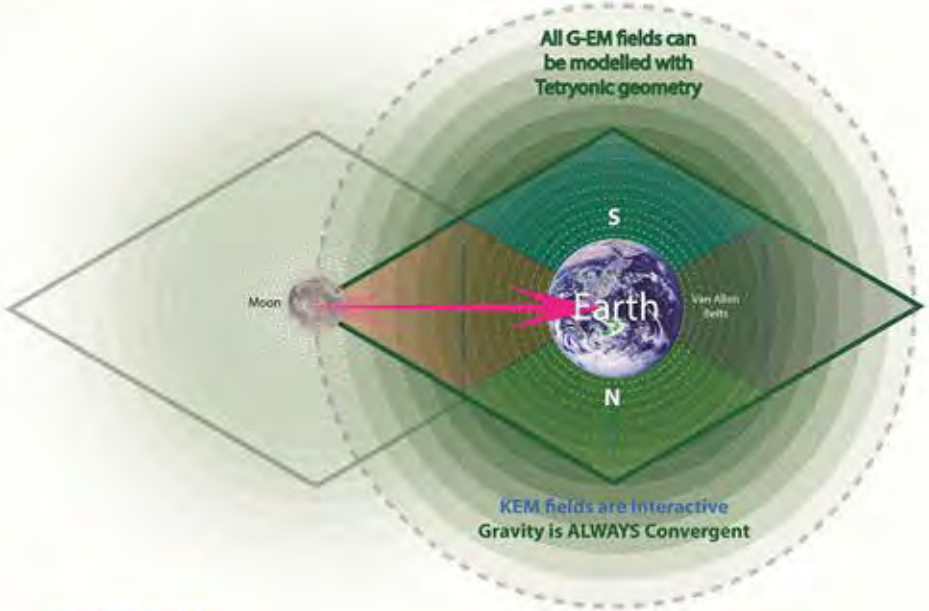

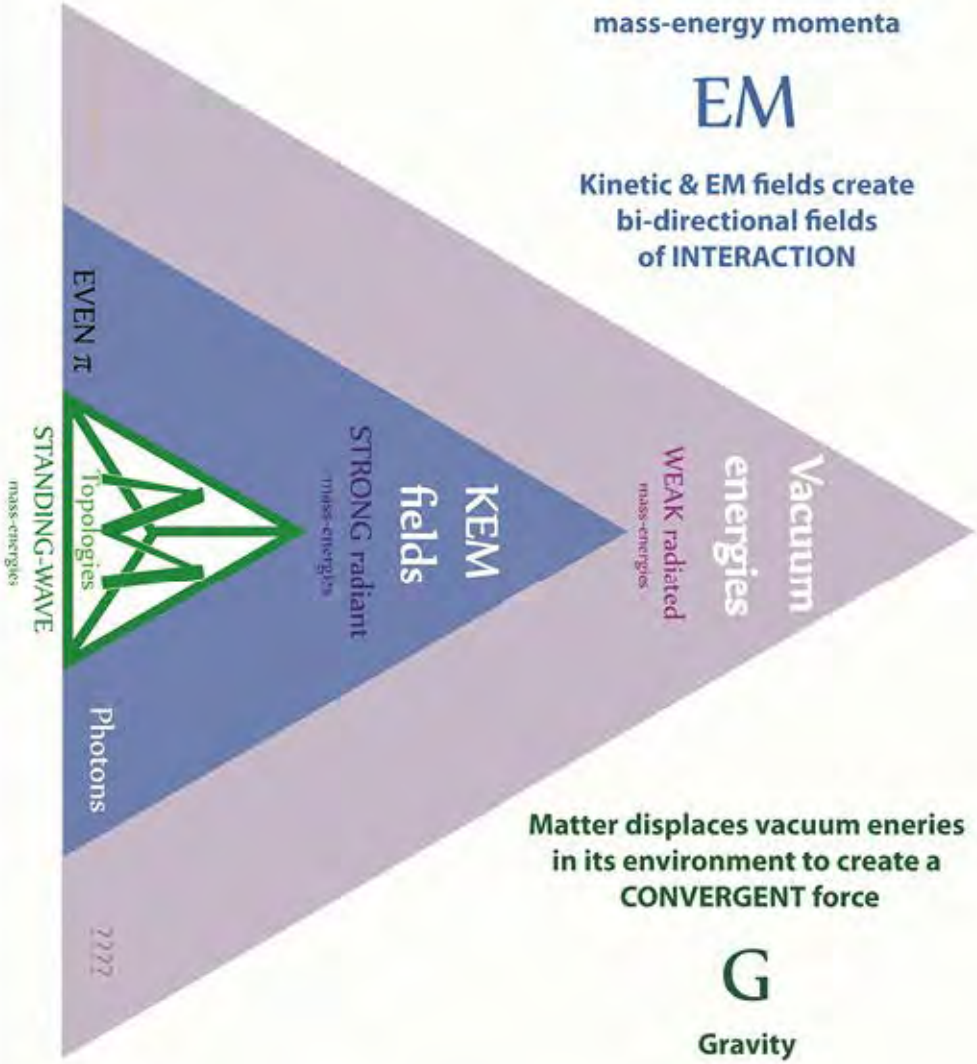

mass-energy momenta

EM

Kinetic & EM fields create bi-directional fields of INTERACTION

All GEM fields have equilateral quantum geometries

Matter displaces vacuum eneries in its environment to create a CONVERGENT force

G

Gravity

the proportional attraction of material bodies towards each other can be easily modeled with Tetryonic fields

$$F = -G \frac{M_1 m_2}{r^2}$$

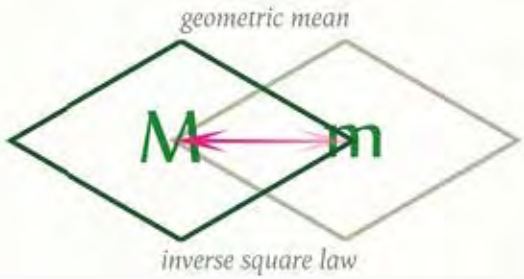

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Charges vs. Gravity

both can be modelled as interactive or attractive geometric forces

Charged particles are comprised of non-neutralised Planck quanta

Neutral Matter is comprised of neutralised Planck quanta

$$F = k \frac{Q_1 Q_2}{r^2}$$

$$F = -G \frac{M_1 M_2}{r^2}$$

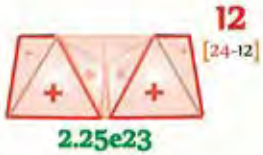

Charges produce bi-lateral interactive forces

mass

Matter

Nuclei

Elements

Gravity is a convergent attractive force

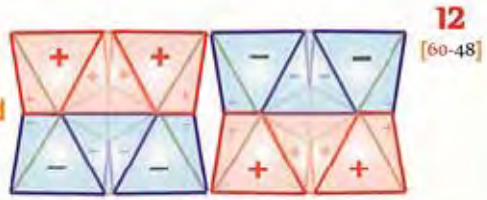

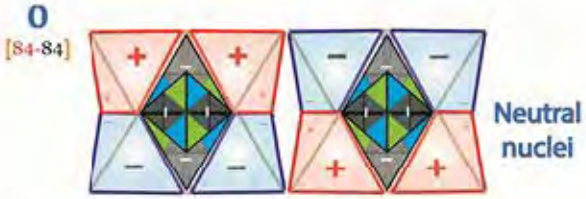

$8.99 \times 10^{9} \ \frac{N\,m^2}{kg^2}$

Opposites Attract
Similars Repel

Interactive mass-energies & **Gravitational mass-Matter**

both produce inverse squared forces

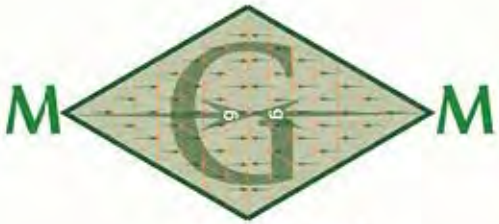

$7.49 \times 10^{-11} \ \frac{N\,m^2}{KG^2}$

Gravitational Matter is always Attractive

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$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

GravitoElectroMagnetism, (abbreviated GEM), refers to a set of formal analogies between Maxwell's field equations and an approximation, valid under certain conditions, of the Einstein field equations for General Relativity.

$$\nabla \cdot \mathbf{B} = 0$$

$$\mathbf{F} = q\left(\frac{-1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{\mathbf{r}}\right) = q\mathbf{E}$$

$$F = k\,\frac{Q_1 Q_2}{r^2}$$

$$k = 8.99 \times 10^9 \frac{\mathrm{N\,m^2}}{\mathrm{C^2}}$$

nett Charge is a DIVERGENT field

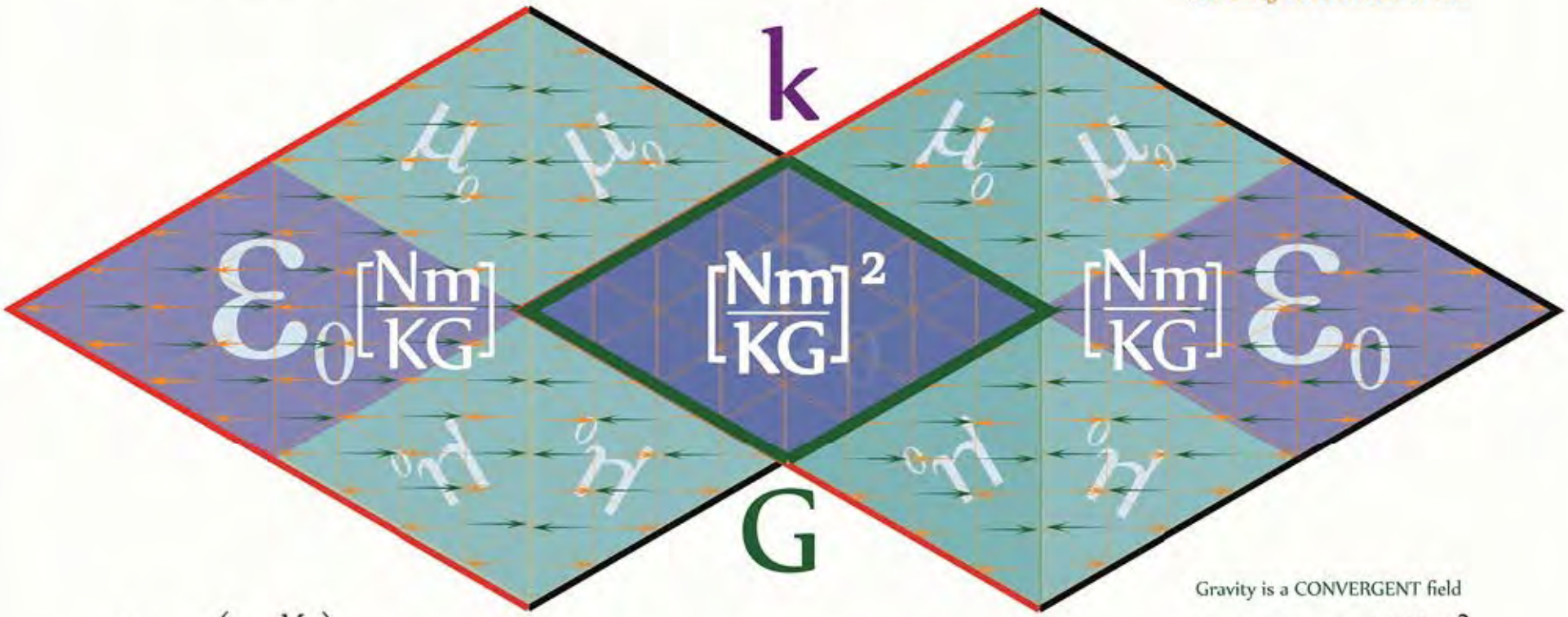

Gravity is a CONVERGENT field

$$\mathbf{F} = m\left(-G\frac{M}{r^2}\hat{\mathbf{r}}\right) = m\mathbf{g}.$$

$$F = -G\,\frac{M_1 M_2}{r^2}$$

$$G = 6.67 \times 10^{-11} \frac{\mathrm{N\,m^2}}{\mathrm{kg^2}}$$

$$\nabla \times \mathbf{E}_g = -\frac{\partial \mathbf{B}_g}{\partial t}$$

GEM fields are an accurate way of modelling Gravitational attraction between massive bodies using weak KEM field vectors

$$\nabla \cdot \mathbf{B}_g = 0$$

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Gravitational fields can be modelled as weak convergent EM fields

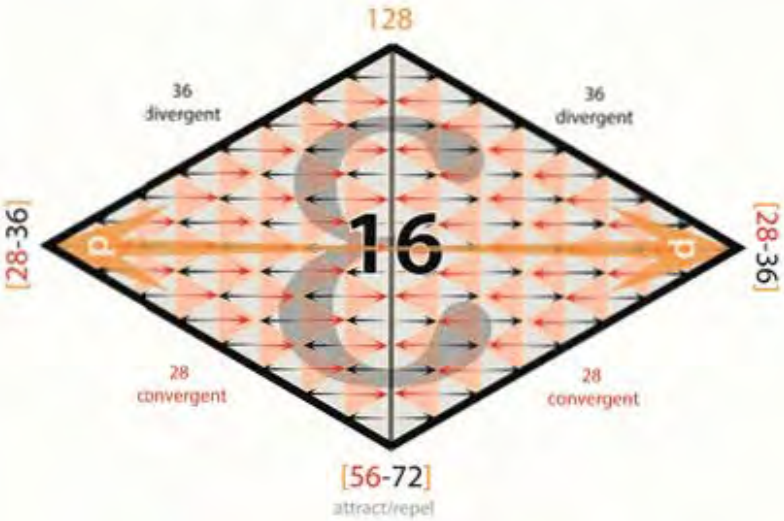

negative charge Matter

Electrostatic fields

Charges attract or repel dependent on polarity
Neutral Matter is largely unaffected (equally repel & attract)

neutral charge Matter

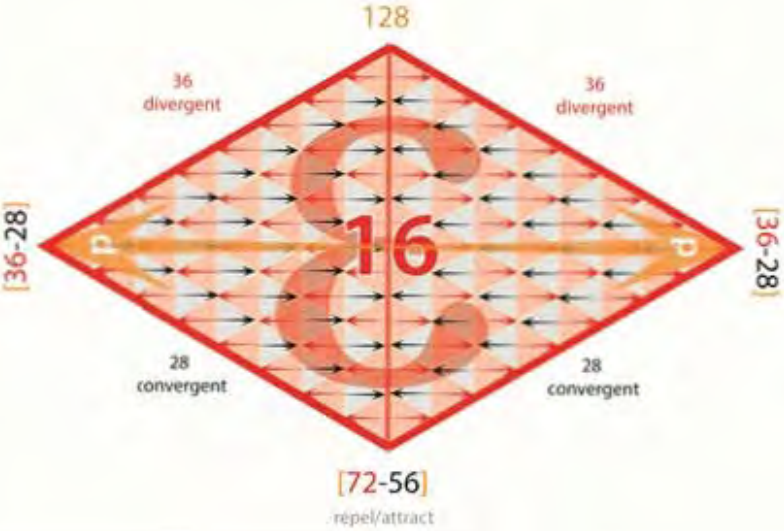

positive charge Matter

Charged Matter INTERACTS electrically

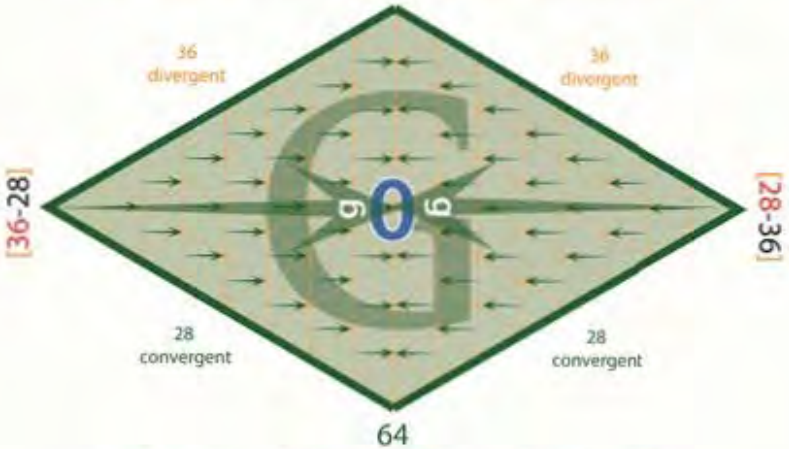

All Matter ATTRACTS gravitationally

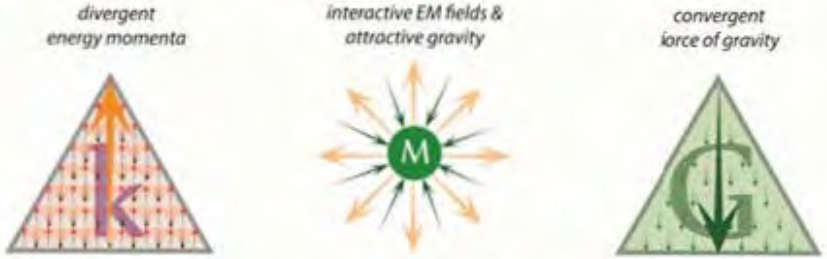

Nett KEM field interaction is divergent from source
Gravitational attraction is the convergent mean force between two sources

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Gravitational & Electric constants

are scaling constant relating Gravitational gradients to superpositioned EM fields

[1665]

Newton was the first to apply the Inverse Square law to Gravity

but was unaware of ElectroMagnetic forces

GEM

Gravito ElectroMagnetism

[1769]

Coulomb applied the Inverse Square Law to Charge Interactions

and obtained the value for the Electric Constant

Newton's convergent Gravity & Couolomb's Charge interaction
both follow inverse squared laws
(geometric means)

Attractive Gravity has the negative vector of nett Charge Interaction

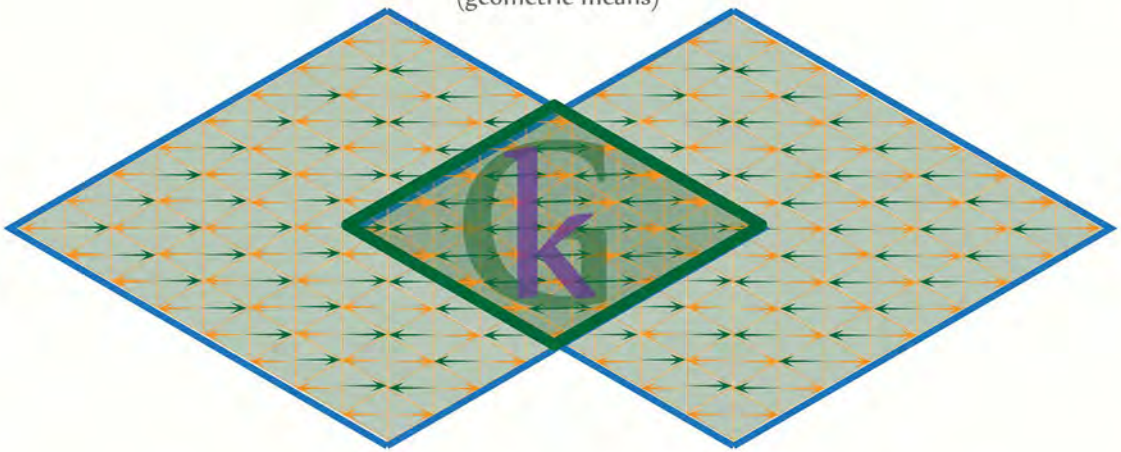

Interactive EM fields are 20 orders of magnitude stronger than Gravity

'Graviton'
Gravitational 'charge' carrier

Convergent force vectors

superpositioned EM fields can be used to model the strength and direction of the weaker Graviational force vectors at any point in the fields as they are both inverse squared forces

Producing the ongoing speculation of the existence of a gravitational charge carrier

(an erroneous assumption that stems from using mathematics alone, without a solid understanding of geometric mass-energies & Matter topologies)

Photon
Electric charge carrier

Divergent force vectors

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Newton's attractive Gravity & Coulomb's Charge interaction
both follow inverse square laws

Instantaneous
action-at-a-distance

The Force of Gravity

Absolute
Space & Time
(x,y,z) (t)

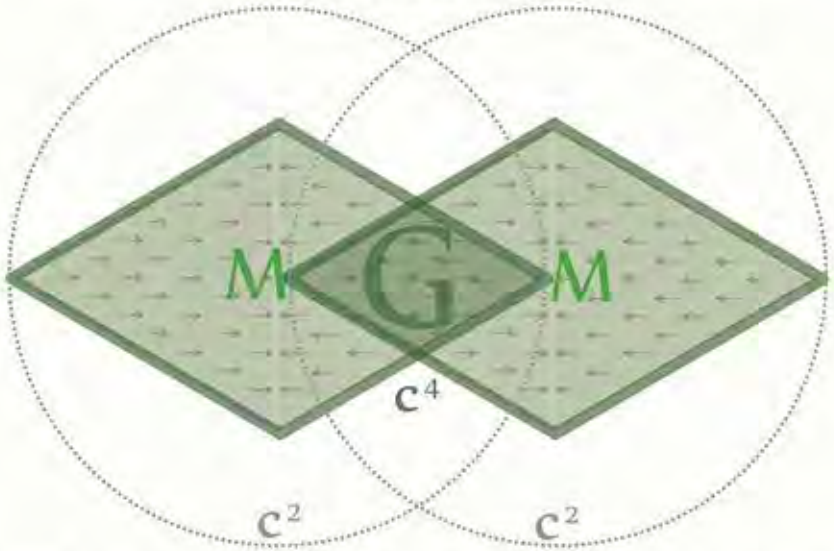

Gravitational action
limited to c

mass-ENERGY-Matter

Curved relativistic
Spacetime
(x,y,z,t)

Modelling Gravity with EM field geometries

while superpositioned EM fields can be used to model the strength and vector direction
of weaker Gravitational fields at any point in time within the field geometry
they DO NOT reflect the actual physicality of the fields involved

$$R_{00} = 4\pi\rho$$

The speed of Gravity is not limited to c as changes to the energy density-pressure gradient are immediately translated through the aether from one object to the other

$$R_{\mu\nu} - \tfrac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Gravity is a the pressure gradient created by the displacement of vacuum energies though the presence of 3D mass-Matter topologies in any region of space

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Fields of Interaction

All topological Matter in motion creates a interactive Kinetic EM field in addition to its inherent convergent Gravitational field

Convergent Gravity fields produce a uni-directional attraction between two or more Matter topologies

Divergent EM fields produce a bi-directional interactive force between charged objects

interactive EM fields of force are created by geometrically superpositioned equilateral energy momenta vectors

G fields

E fields

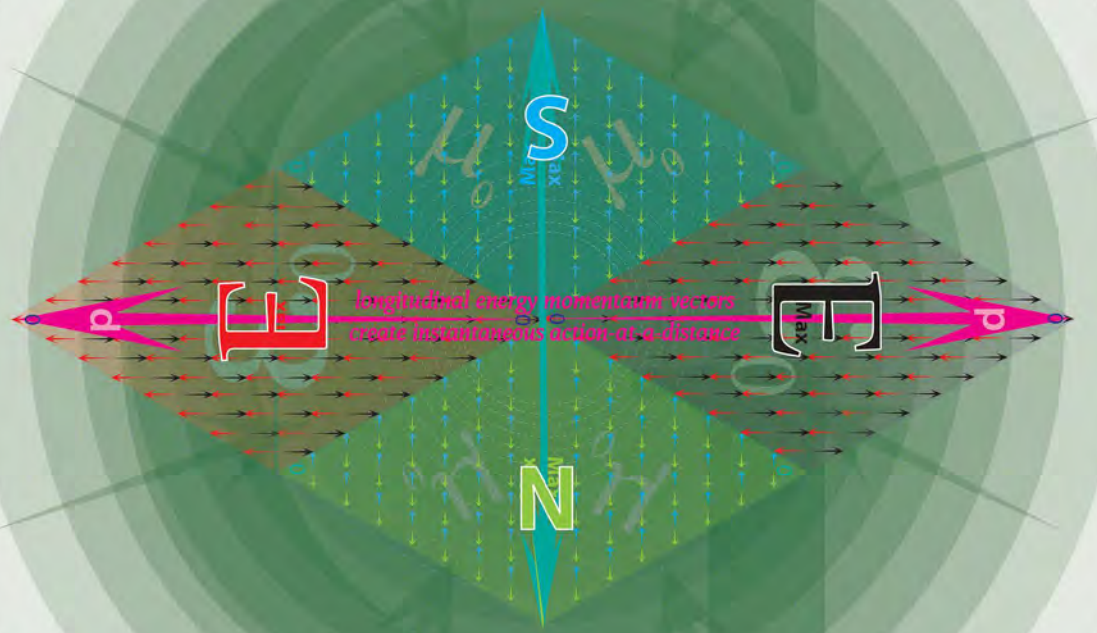

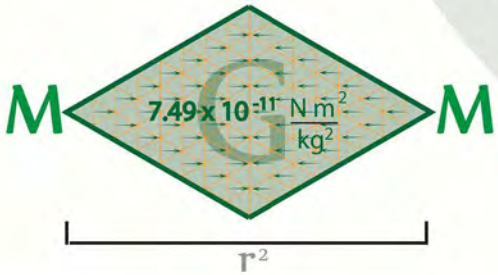

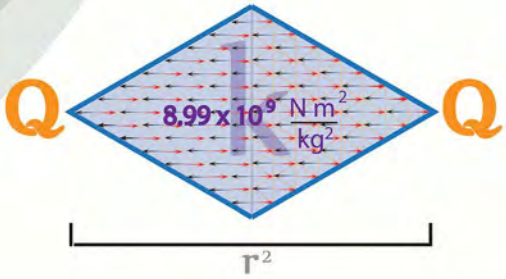

Gravitational fields of force are created by the displacement of vacuum energies by Matter topologies

Gravito-Electro-Magnetic Fields

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GEM gradients

The gravitational field of Material objects is the result of zero energy nullspace volumes encompassed by all Matter which in turn creates a displacement energy pressure differential gradient with the surrounding Vacuum Energies

Gravitational attraction can be modelled as a CONVERGENT EM FIELD created by the nullspace differential of Matter

All Matter in motion creates an eternally dynamic system of Gravitational fields and radiative ElectroMagnetic Energies

EM radiation is a bidirectional DIVERGENT-CONVERGENT FIELD resulting from quanta imbalances

radiative EM fields are created by all Matter as it seeks equilibrium with its environment, the impedance of space creates a propagation velocity equal to the speed of light

convergent Gravitational fields

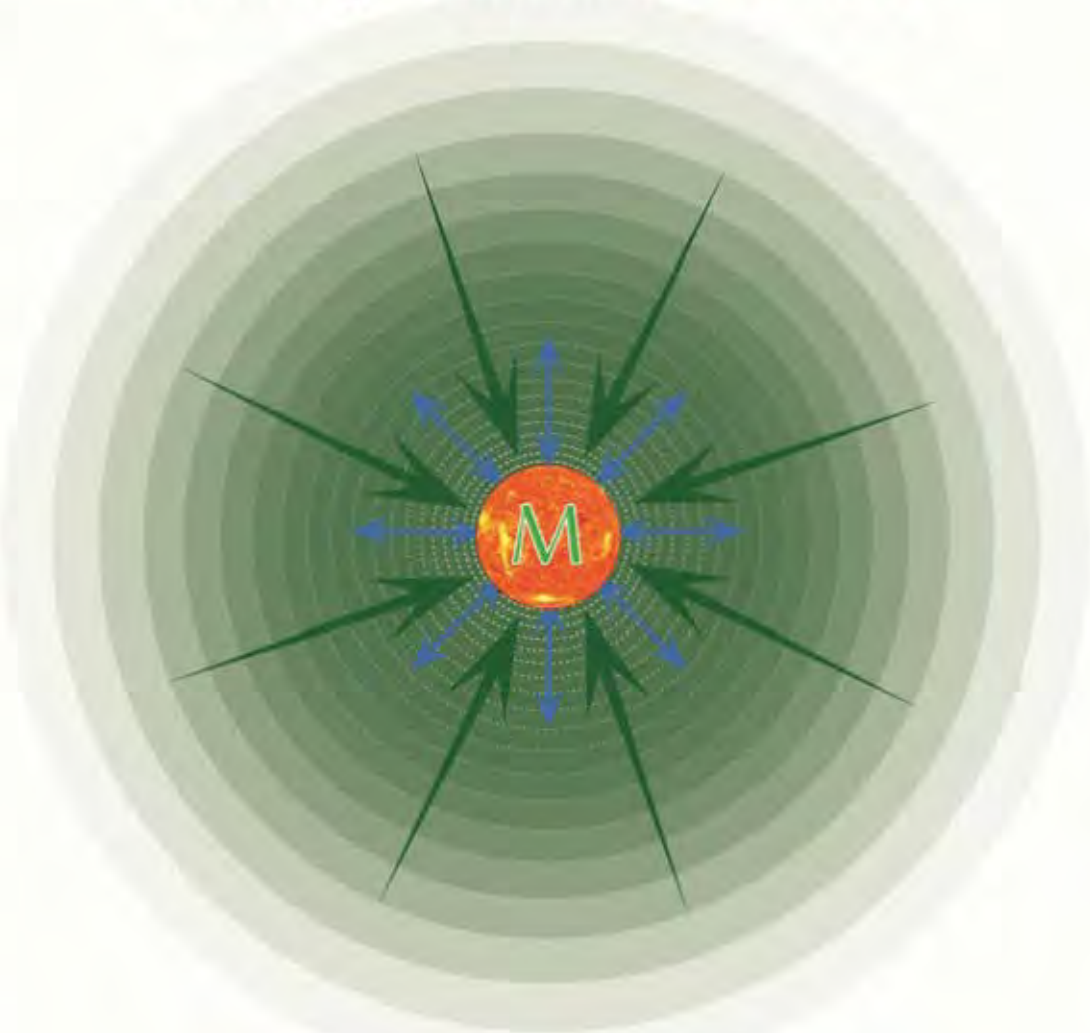

radiant interactive EM fields

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Gravity and ElectroMagnetic fields

Newtonian Gravity

Gravity & Electro-Magnetic field strengths
all converge to zero at the centre of the sphere

General Relativity

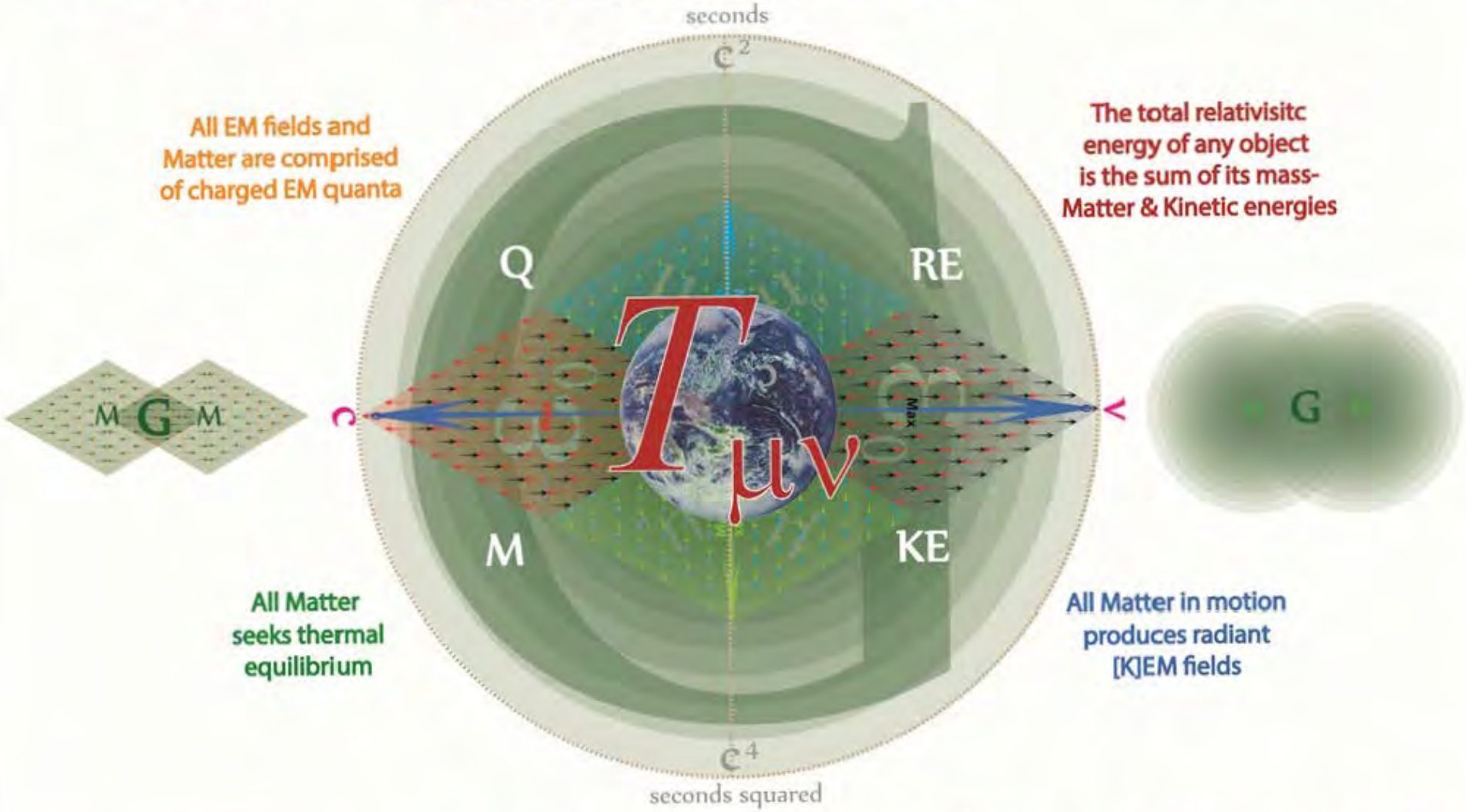

Charges are Interactive

Gravimetric fields can be modelled as weak EM fields
[space-time curvatures] created by Matter

Gravity is always attractive

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Electric vs Gravitational Fields

C

KG

In fields of charge the nett divergent field encloses the convergent field

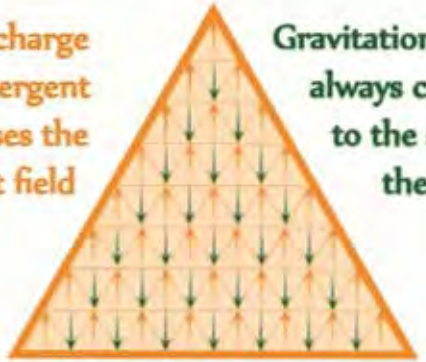

Gravitational fields are always convergent to the source of the field

interactive electrostatic fields

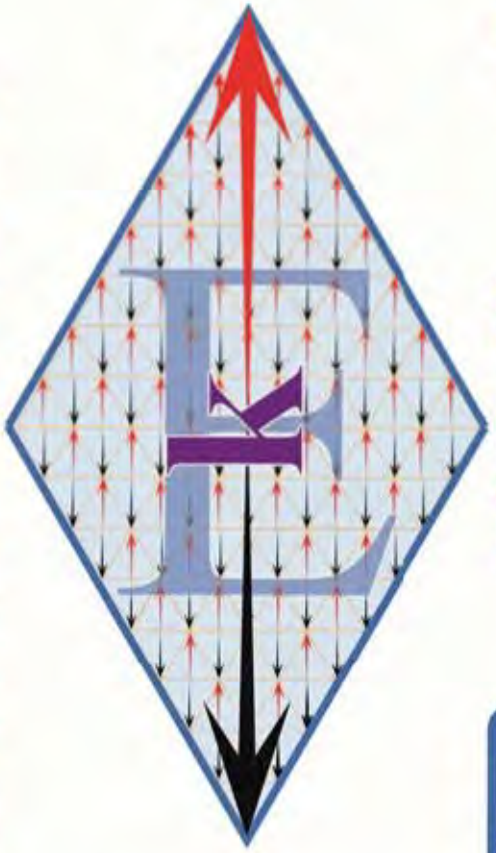

nett Divergent Field

SR

Using Special relativity as the basis for the development of a General theory of Relativity to model Gravity is problematic
[as SR models EM interactions]

GR

strictly Convergent Field

attractive gravitational fields

Field	Units	Equation
Gravity	$\vec{g} = \frac{\text{newtons}}{\text{kilogram}} \left(\frac{N}{kg}\right)$	$\vec{F} = m\vec{g}$
Electricity	$\vec{E} = \frac{\text{newtons}}{\text{coulomb}} \left(\frac{N}{C}\right)$	$\vec{F} = q\vec{E}$

Electrical interaction is the result of the nett EM geometry of [K]EM fields

Q

The similarities between Electro-Magnetic and Gravitational fields can be shown by modelling their effects through EM field geometries

Gravitational attraction is the result of the displacement topology of Matter

M

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Electric fields and Gravitation

Electrostatic forces are much greater than Gravitational forces (by about 10^20 times),
The force of gravity is attractive for all Matter, whereas electrostatic forces are repulsive for like charged Matter,
There are no negative [repulsive] gravitational charges, while there are both positive and negative electric charges.

Electrostatic forces are interactive
while Gravitational forces are always attractive

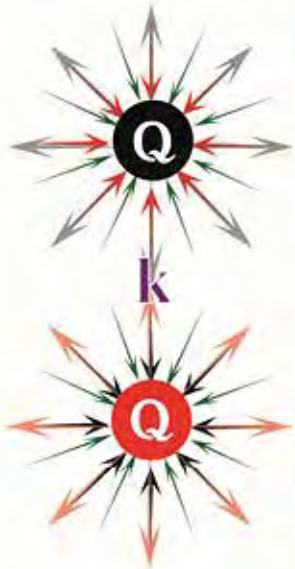

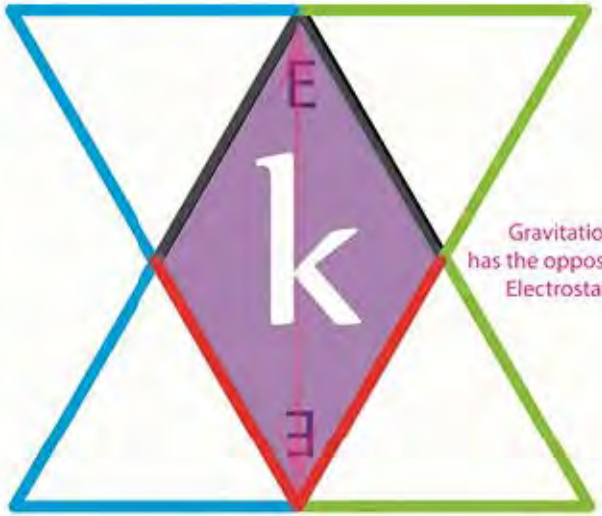

Gravitational attraction
has the opposite force vector of
Electrostatic interaction

All ElectroMagnetic field quanta are subject to
Lorentz wavelength-frequency corrections due to velocity

Gravitational Matter topologies are NOT affected by
Lorentz corrections due to their velocity of motion

There are similarities between the Electric field and the Gravity field of Matter,
(so sometimes Matter is refered to as "gravitational charge")

Both act in a vacuum and are central and conservative.
Both obey an inverse-square law (both are inversely proportional to square of r).
Both field types propagate at the finite speed of c, the speed of light.
Electric charges and EM mass-energies are conservative

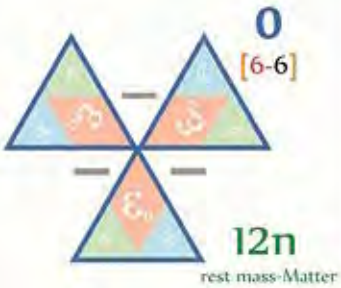

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Charge vs Gravitation

[empirically determined value]
8.987551787e9 N

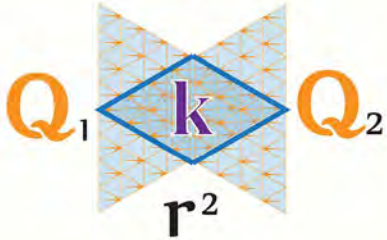

"The magnitude of the electrostatic force between two charges is directly proportional to the product of the magnitudes of each charge and inversely proportional to the square of the distance between the charges."

Charge interaction can be modelled as a DIVERGENT EM FIELD

We have two fundamental laws stating that the forces between two particles are directly proportional to the product of their charges/masses and inversely proportional to the square of the distance between them

Gravitational attraction can be modelled as a CONVERGENT EM FIELD

"The magnitude of the gravitational force between two masses is directly proportional to the product of the magnitudes of each mass and inversely proportional to the square of the distance between the charges."

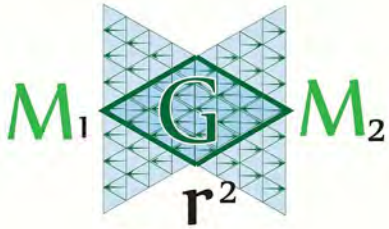

6.67428e-11 N
[empirically determined value]

Coulombic interaction is proportional to Charge
(energy geometry imbalances)

$$F = k \frac{Q_1 Q_2}{r^2}$$

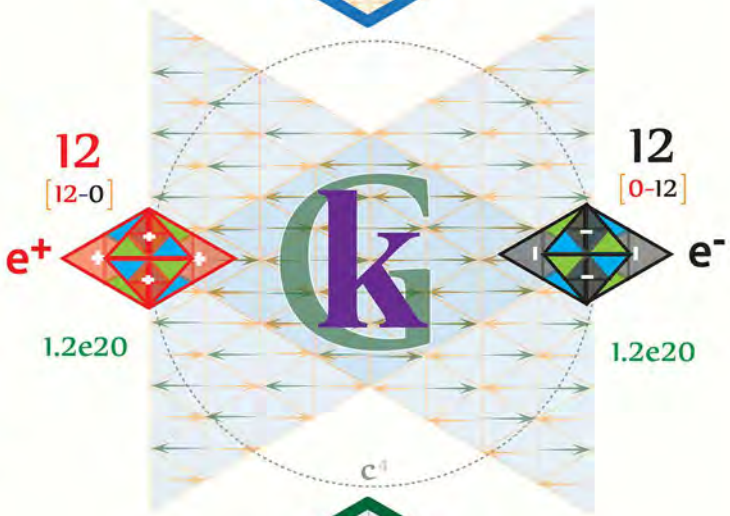

$$F = -G \frac{M_1 M_2}{r^2}$$

Gravitational attraction is proportional to Matter
(total rest EM mass-energy content)

*It can now be clearly demonstrated that **Newtonian Gravity** can be modelled as a weak convergent Electro-Magnetic Force*

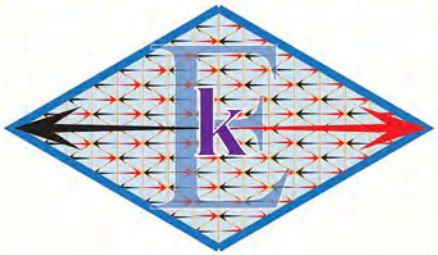

$$\frac{k}{G} \quad \frac{8.9875 \text{ e9 N}}{6.67384 \text{ e-11 N}}$$

= 1.346 e20

The field strength differential is reflective of the Compton frequency of electron [1.20 e20 quanta]

Einstein's general relativity offers a different model of Gravitational attraction however

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Gravito-Electro-Magnetic interaction

$$F \propto \frac{Q_1 Q_2}{r^2}$$

Charge interactions can be modelled as a superpositional DIVERGENT FORCE

The ElectroMagnetic [Coulombic] field strength is proportional to an object's relativistic charge

12 [0-12]

12 [0-12]

$$F = k \frac{Q_1 Q_2}{r^2}$$

$\frac{N\,m^2}{C^2}$

8.98755 e9

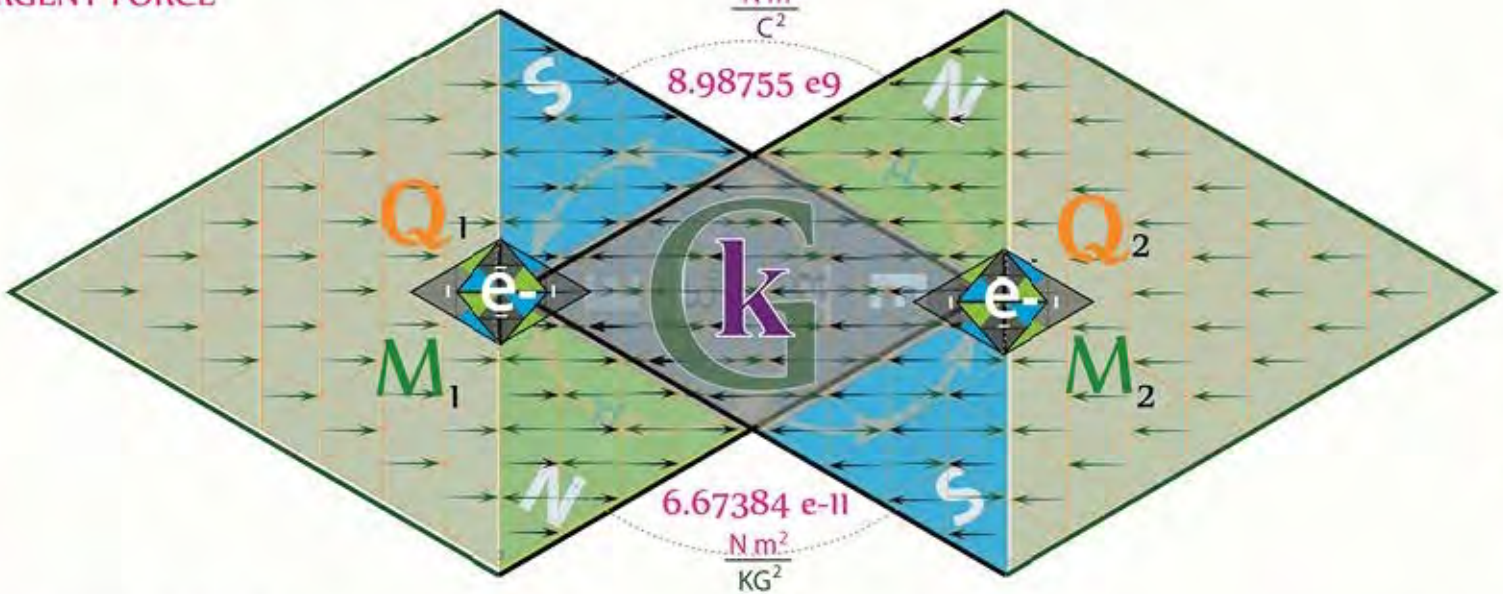

6.67384 e-11

$\frac{N\,m^2}{KG^2}$

equilateral mass-energy momenta quanta create the interactive fields of Force between material bodies of Matter

The attractive strength of Gravity is 20 orders of magnitude weaker than the strength of Electrostatic interaction

Gravitational attraction can be modelled as a superpositional CONVERGENT FORCE

1.2e20

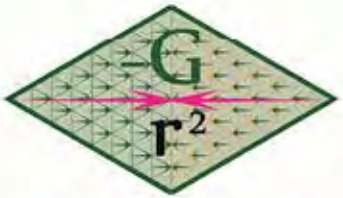

1.2e20

$$F = -G \frac{M_1 m_2}{r^2}$$

$$F \propto \frac{M_1 m_2}{r^2}$$

Gravitational field strenth is proportional to the rest Matter topology (and can be modelled with weak coulombic fields)

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Charged Matter Gravitational interactions

Electrostatic force fields dominate Gravitational fields
and can be modelled via their superpositioned
energy momenta force fields

Following the field symmetries provided by Tetryonic geometry we can now model all fields

$$F = k \frac{Q_1 Q_2}{r^2}$$

2.30900415 e-28 Newtons

Electromagnetic interactions as well as the convergent Gravitational atraction

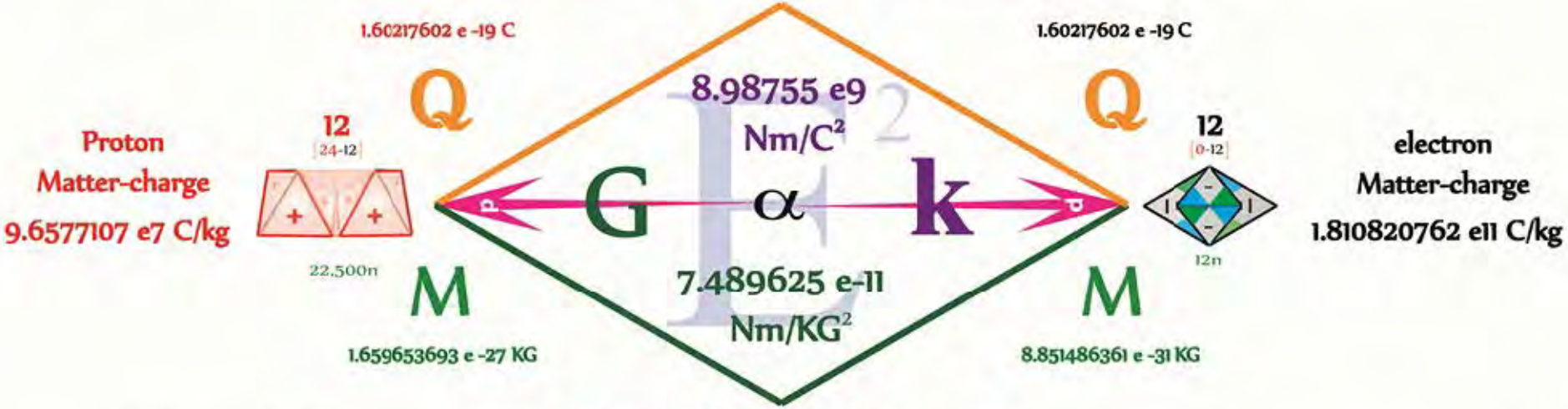

1.10025594 e-67 Newtons

Reflecting all of the geometric force interactions in terms of EM mass-ENERGY & Matter

$$F = -G \frac{M_1 m_2}{r^2}$$

Allowing an accurate value of the graviationl constant to be derived

Gravity [like electrostatic] fields
can be modelled as superpositioned
Energy momenta force fields

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The Gravitational Constant

The gravitational constant is a difficult physical constant to measure to high accuracy, in fact it was not measured until over seventy years after Newton's death by Henry Cavendish with his torsion beam experiment, performed in 1798

G

The gravitational constant is denoted by letter G, it is an empirical physical constant involved in the calculation of the gravitational force between two material bodies.

It usually appears in Sir Isaac Newton's law of universal gravity, and in Albert Einstein's theory of general relativity.

Henry Cavendish

(10 October 1731 – 24 February 1810)

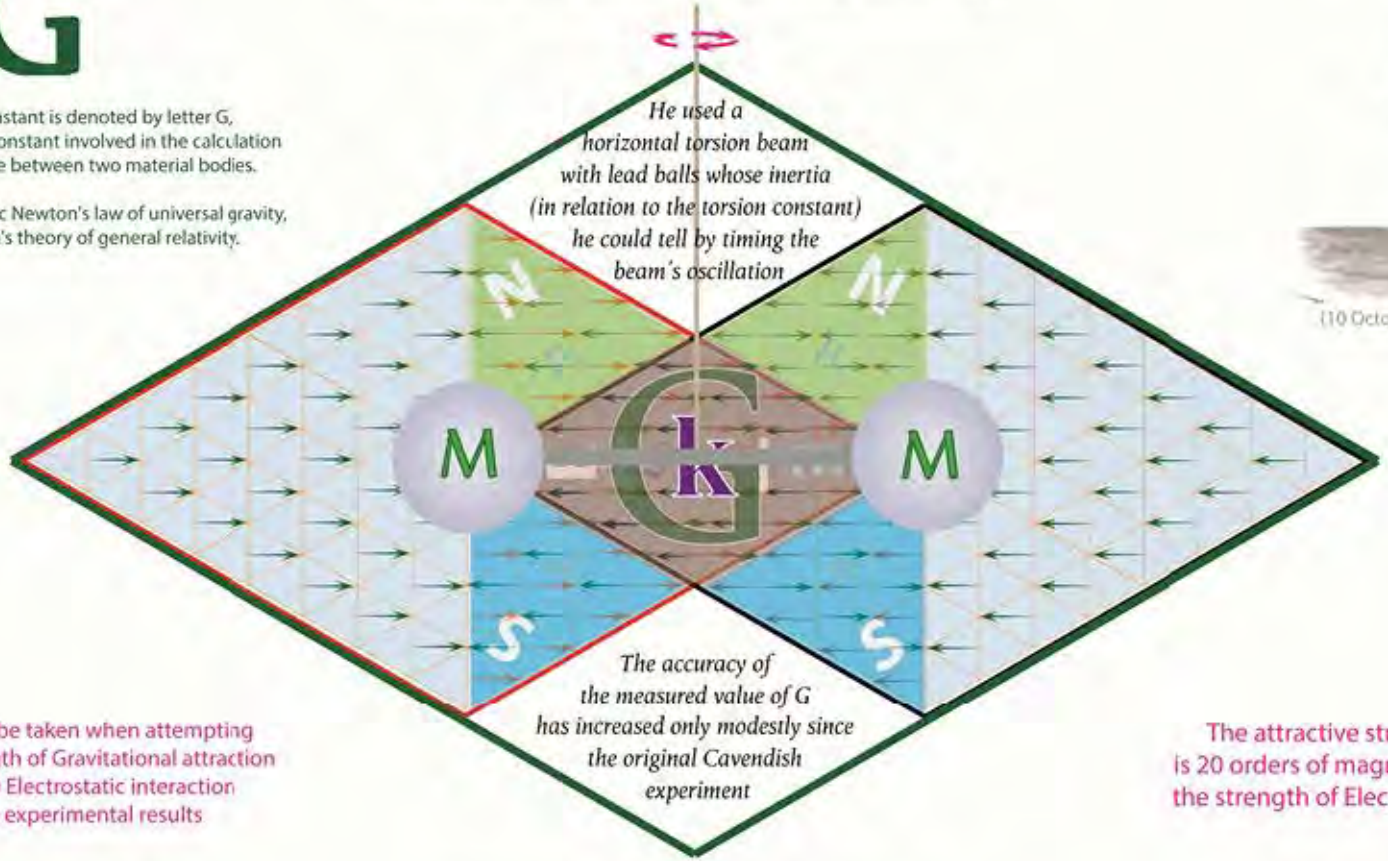

Extreme care must be taken when attempting to measure the strength of Gravitational attraction to ensure that NO Electrostatic interaction influences the experimental results

The attractive strength of Gravity is 20 orders of magnitude weaker than the strength of Electrostatic interaction

8.98755 e9 N

6.67384 e-11 N

It is also known as the universal gravitational constant, Newton's constant, and colloquially as Big G.

$$F = k \frac{Q_1 Q_2}{r^2}$$

g

It should not be confused with "little g" (g), which is the local gravitational field (equivalent to the free-fall acceleration), especially that at the Earth's surface.

G

$$F = -G \frac{M_1 m_2}{r^2}$$

Gravity has no established relation to other fundamental forces, so it does not appear possible to calculate it indirectly from other constants that can be measured more accurately, as is done in some other areas of physics

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Fundamental field strengths

are the result of equilateral energy momenta geometries

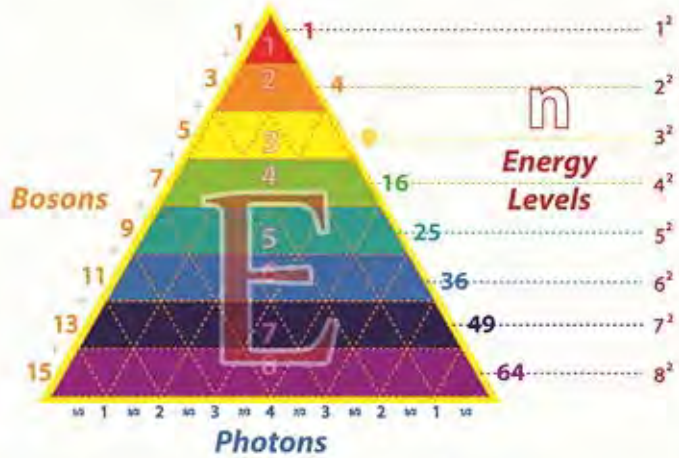

Force	Approximate Relative Strength	Range
Strong Nuclear	10^{38}	10^{-15}
ElectroMagnetic	10^{36}	Infinite
Weak	10^{2}	10^{-18}
Gravitational	1	infinite

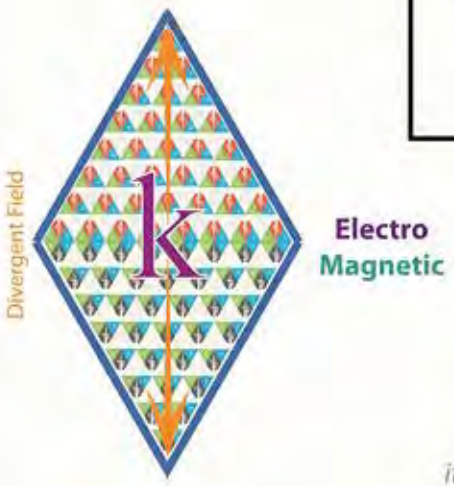

All the field strengths of the fundamental interactions are a direct result of the interactions of their Tetryonic mass-energy goemetries and Tetryonic Matter topologies

m E M

geometries density topologies

(whilst Gravity can be modelled as a weak convergent Coulombic attraction its actual physics are the result of vacuum energy displacement by Matter topologies)

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The Strength of the Gravitational Constant

Coulomb's Constant

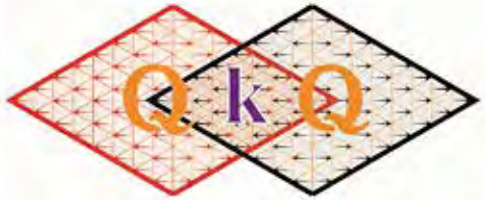

[24-12]

Proton nett charge

1.60217646 e -19 C

equal (but opposite) nett Charges

[0-12]

Electron nett charge

1.60217646 e -19 C

8.987551787e9 N

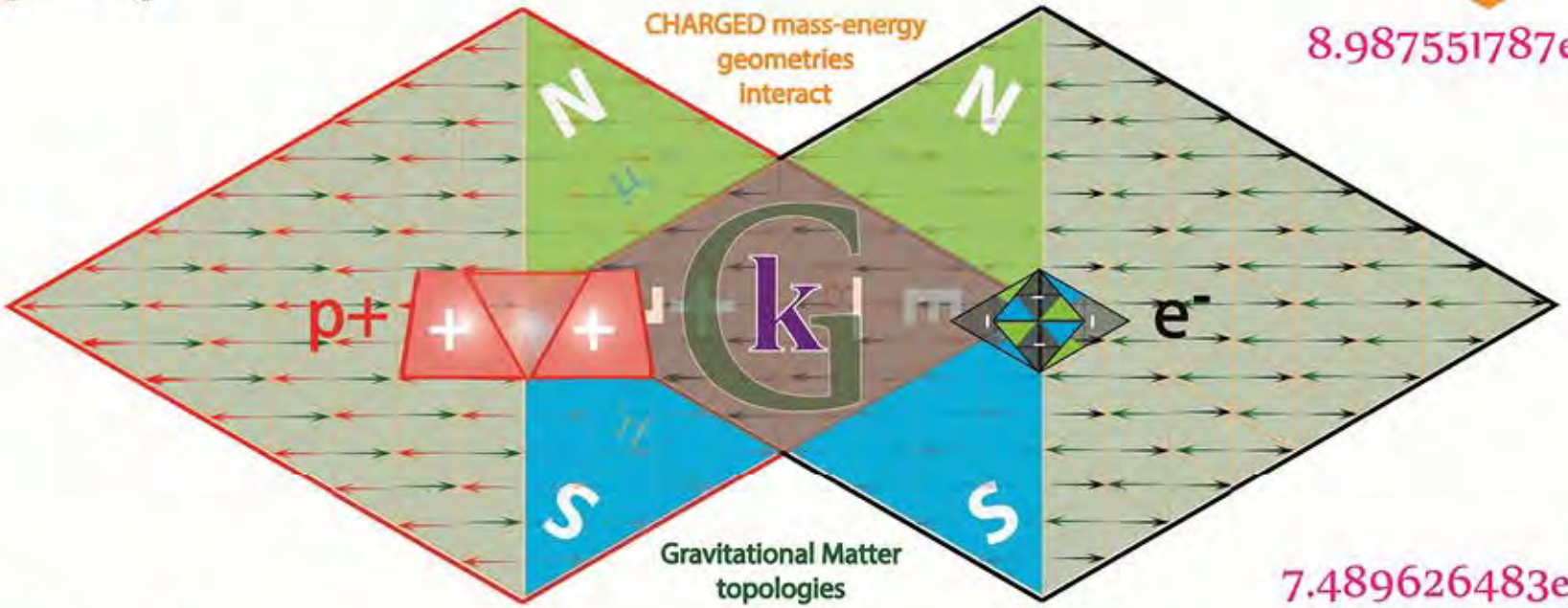

7.489626483e-11 N

Newton's Constant

1.659653693 e -27 KG

Proton rest mass-Matter

[1.5e23-7.5e22]

1875

8.851486361 e -31 KG

electron rest mass-Matter

[1.2e20]

Although it provides a coherent and accurate model of all the motive forces & interactions present the modelling of Gravity with EM fields does not account for the source, strength & unilateral direction of Gravitational fields

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Tetryonic Matter interaction and Gravitation

Electrostatic convergence can serve as a model for Gravitational attraction

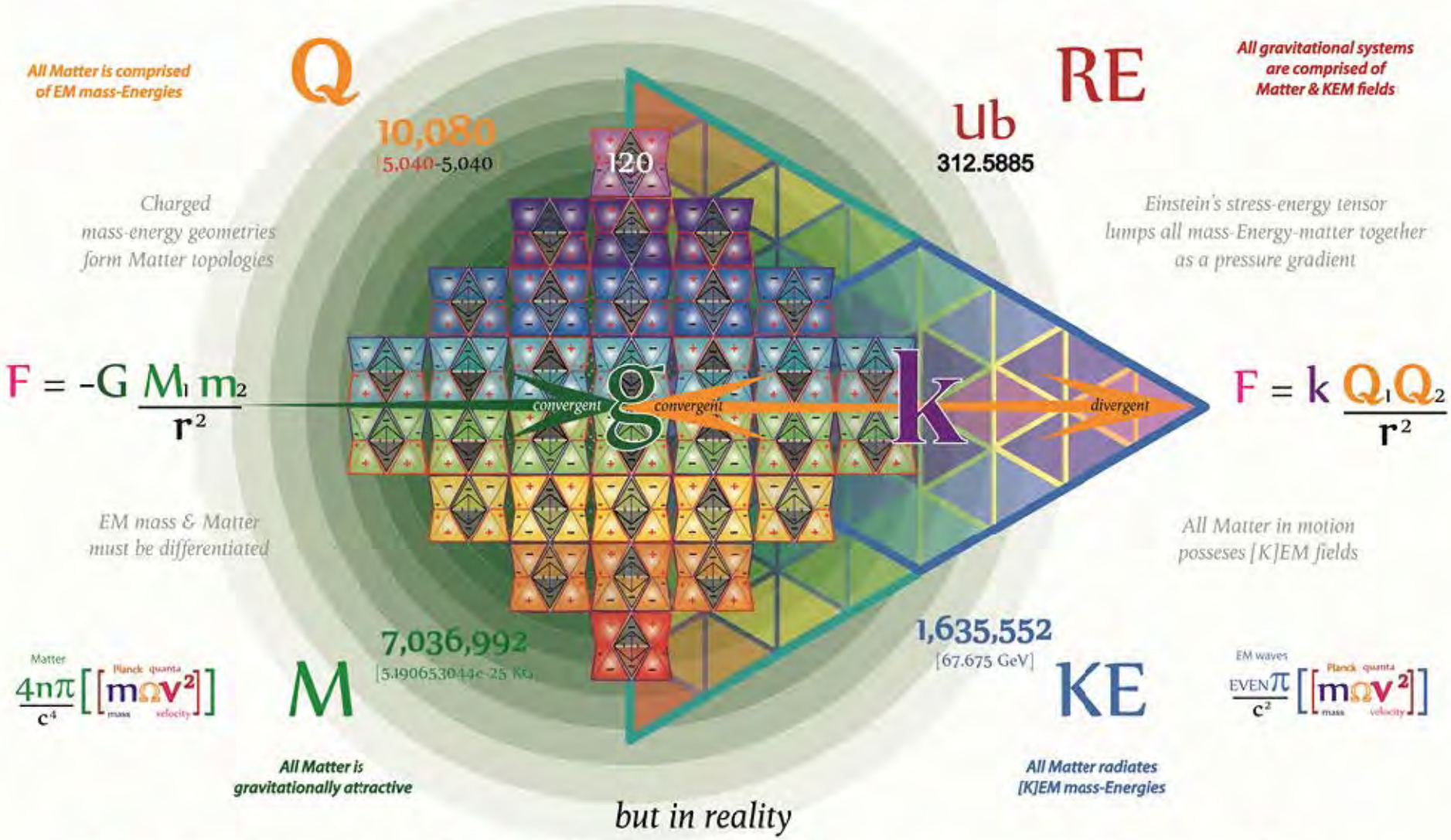

Gravitational attraction results from the displacement of vacuum energies by Matter topologies

[The effects of stronger [K]EM fields can be excluded from the long distance attractive [gravitational] motion of material bodies to each other]

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Modelling the force of Gravity

It is in many ways very similar to Coulomb's law of Interaction
between charged particles developed by Coulomb
(after Newton's Gravitation)

For many people, it is easiest to picture gravity
as a kind of special invisible force,
emanating from ALL the Matter in the universe.
Newton's law of Gravity leads one to sees
it this way and it is probably the view
most of us were given when we learned
about gravity in elementary school.

Gravity can be modelled as weak convergent EM field

However, there is another way
to model Gravity's effects.
It stems from Albert Einstein's
General theory of Relativity,
a theory that describes gravitation
as being the result of the curvature of
spacetime as a result of energy gradiant

Gravity can also be modelled as convergent pressure gradients

To understand what gravity really is you must have a clear understanding of the distinctions between radiant EM mass and standing-wave Matter and the various quantum interactions they produce.

Tetryonics provides a clear geometric definition and distinction between 2D radiant mass-energy geometries and 3D Matter topologies along with a new unified model of the mechanics of Universal Gravitation at all scales

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radiant mass-energy geometries

$\frac{\rho}{m^2}$

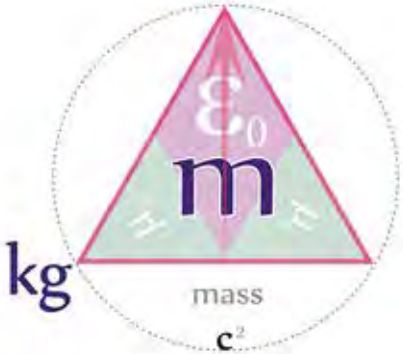

'Action-at-a-Distance'

mass-energies

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

[K]EM mass-Energies with QAM create interactive divergent [and convergent] charge geometries

Newtonian Gravity

Toplogical mass is Matter

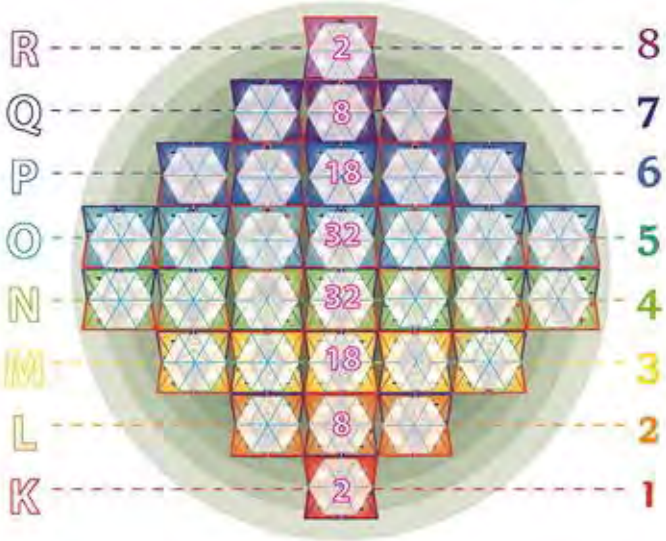

All Matter contains nullspaces and produces motional KEM fields

standing-wave Matter toplogies

$\frac{\rho}{m^3}$

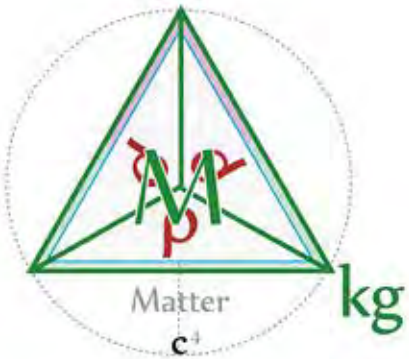

'Folded Space-Time'

Matter

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

Tetryonic Matter creates low pressure nullspace resulting in convergent Energy pressure gradients

General Relativity

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Instantaneous action-at-a-distance

Tetryonic QED theory shows that where the linear energy momentum of longitudinal waves align and act in a co-linear direction they can facilitate near instantanous action-at-a-distance

$$\sum \mathbf{F} = 0 \Rightarrow \frac{d\mathbf{v}}{dt} = 0$$

Free particles move with constant vector-velocity
(that is, with zero acceleration, unless acted upon by an outside force).

The Earth orbits the SUN where it is now about a common centre of gravity

'Action-at-a-Distance' and 'Instantaneous' forces were introduced into Physics within Newton's notion of absolute space and time

If the SUN were to vanish the Earth would cease traveling in its current elipical orbit immediately

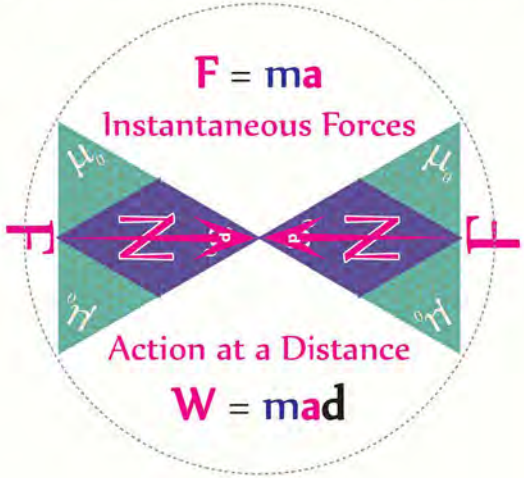

$$\sum \mathbf{F} = \frac{\mathrm{d}\mathbf{p}}{\mathrm{d}t} = m\frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} + \mathbf{v}\frac{\mathrm{d}m}{\mathrm{d}t}$$

The vector-force on a particle equals the product of its mass by its vector acceleration

$$\mathbf{F} = m\mathbf{a} = \frac{\Delta \mathbf{p}}{\Delta \mathrm{t}} = \Delta\left[\frac{m\mathbf{v}}{\mathrm{t}}\right]$$

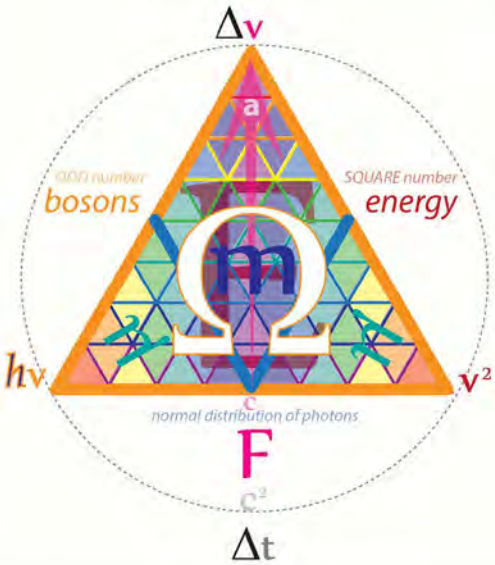

The speed of gravity is limited to c

Einstein's GR theory replaces Newton's force of gravity and absolute space & time with a relativistic spacetime gradient curved by mass-energies

If the SUN were to vanish the Earth would continue traveling in its current orbit for 8⅓ minutes

The forces of action and reaction are equal and opposite;
(if a particle A exerts a force f on a particle B, then B exerts a force–f on A)

$$\sum \mathbf{F}_{a,b} = -\sum \mathbf{F}_{b,a}$$

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Newton's Gravitational Constant

$$F = -G\frac{M_1 m_2}{r^2}$$

According to Newton's law of universal gravitation,

the attractive force (F) between the centres of two bodies of mass-Matter, is proportional to the product of their Matter (M1 and m2), and inversely proportional to the square of the distance (r) between them

Long distance force

spacetime curvature

Newton's Gravitional Force models a motive force for gravitational acceleration

Einstein's General relativity has no motive force for gravitational accelerations

6.67384 e-11

$$\left[\frac{Nm}{kg}\right].\left[\frac{Nm}{kg}\right]$$

The gravitational force between two interacting bodies of Matter is

$$\left[\frac{N\,m^2}{kg^2}\right] = \left[kg\,\frac{m}{s^2}\,\frac{m^2}{kg^2}\right] = \left[\frac{m^3}{kg\,s^2}\right]$$

$4\pi G\rho$

$8\pi G\rho$

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Action-at-a-Distance

All Matter creates KEM fields of energy momenta

All Matter creates a displacement of vacuum energies

radiant mass-energies INTERACT

Once established longitudinal EM fields between Matter form an 'inelastic rod' of energy momenta that can facilitate an instantaneous 'Action-at-a-Distance'

standing-wave Matter ATTRACTS

Any field of longitudinal energy momenta between Matter can facilitate instantaneous interactions including radiant EM fields and vacuum energies

Gravity is known as a Universal force of attraction between two objects that is proportional to their mass-Matter content

Newton's theory of gravity offered no prospect of identifying any mediator of gravitational interaction. His theory assumed that gravity acts instantaneously, regardless of distance.

Energy momenta creates universal motive forces

According to Albert Einstein's theory of special relativity, instantaneous action-at-a-distance was seen to violate the relativistic upper limit on speed of propagation of information.

If one of the interacting objects were to suddenly be displaced from its position, the other object would feel its influence instantaneously, meaning information had somehow been transmitted faster than the speed of light.

Gravity fields create a universal attractive field

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Gravitational Constant

The gravitational constant denoted by letter G, is an empirical physical constant involved in the calculation(s) of gravitational force between two bodies.
It appears in Sir Isaac Newton's law of universal gravitation, and in Albert Einstein's theory of general relativity.
It is also known as the universal gravitational constant, Newton's constant, and colloquially as Big G.

It should not be confused with "little g", which is the local gravitational field (equivalent to the free-fall acceleration), at the Earth's surface

Gravitational Forces can be modelled

$6.67\ e\text{-}11\ \left[\frac{Nm}{kg}\right]^2$

linear Newton metres

$6.67\ e\text{-}11\ \left[\frac{E}{kg}\right]^2$

scalar Energy momentum

as the geometric MEAN of superpositioned fields of gravitational energy

$$F = -G\,\frac{M_1\,m_2}{r^2}$$

The gravitational force between
two neutral interacting bodies is

N.m = Joules

$$\left[\frac{Nm}{kg}\right].\left[\frac{Nm}{kg}\right]$$

$[N.m/kg]^2 \sim [E/kg]^2$

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Gravitational acceleration

Gravitational acceleration can be viewed as a reflection of the change in an object's momentum over time

$$\sum \mathbf{F} = \frac{d\mathbf{p}}{dt} = m\frac{d\mathbf{v}}{dt} + \mathbf{v}\frac{dm}{dt}$$

$$\frac{\left[\frac{m}{s}\right]}{s}$$

$$\vec{g} = \frac{\vec{F}_g}{m} = -G\frac{mM}{mr^2}\hat{r} = -\frac{GM}{r^2}\hat{r}$$

expressed vectorially the force is always ATTRACTIVE to the larger masss and acts in opposition to the KEM field's divergent momenta

$$F = ma$$

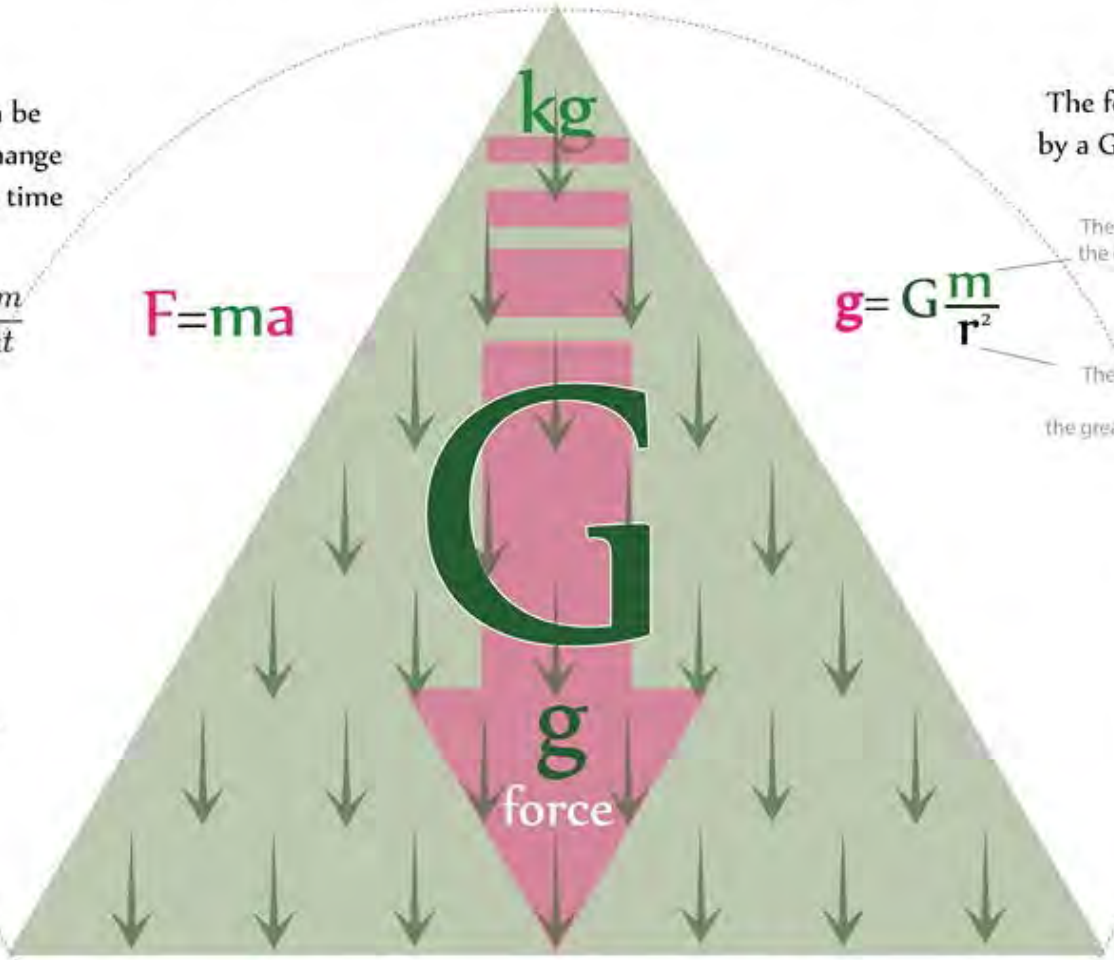

The force on a body acted upon by a Gravitational field is given by

$$g = G\frac{m}{r^2}$$

The greater the mass of a gravitating object the greater the acceleration due to the mass

The closer a body is to a the source of a Gravitational field the greater the acceleration due to the field

$$\left[\frac{N}{kg}\right] = \left[\frac{m}{s^2}\right] = \frac{\left[kg\frac{m}{s^2}\right]}{kg}$$

gravitational acceleration can be modelled as the convergent vector component of superpositioned EM fields

$$\left[\frac{Nm}{kg}\right]^2$$

The gravitational force between TWO neutral interacting bodies is

$$\left[\frac{Nm}{kg}\right]\cdot\left[\frac{Nm}{kg}\right]$$

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Modelling Gravitational fields

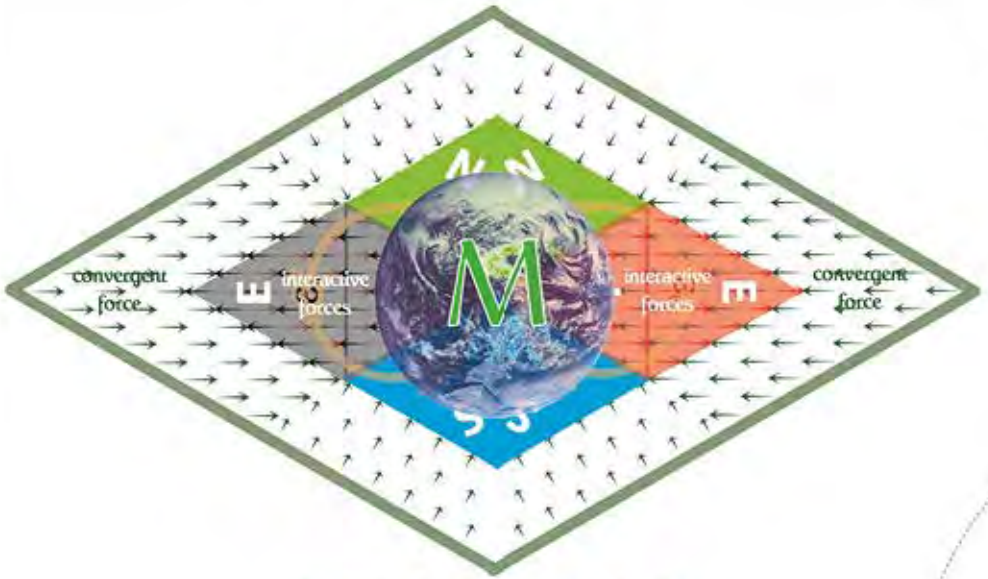

The [K]EM fields of planetary bodies are the result of their mass-Matter density and motion in space

Gravity can be modelled as weak convergent force created by and acting between the mass-Matter in planetary bodies

Matter topologies displace vacuum energies creating Gravity

Weak KEM fields can accurately model Gravitational fields

Gravitational fields are the result of the displacement of vacuum energies by Matter topologies and the interactive energy momenta of their radiant KEM fields

$$F = k \frac{Q_1 Q_2}{r^2}$$

interactive forces

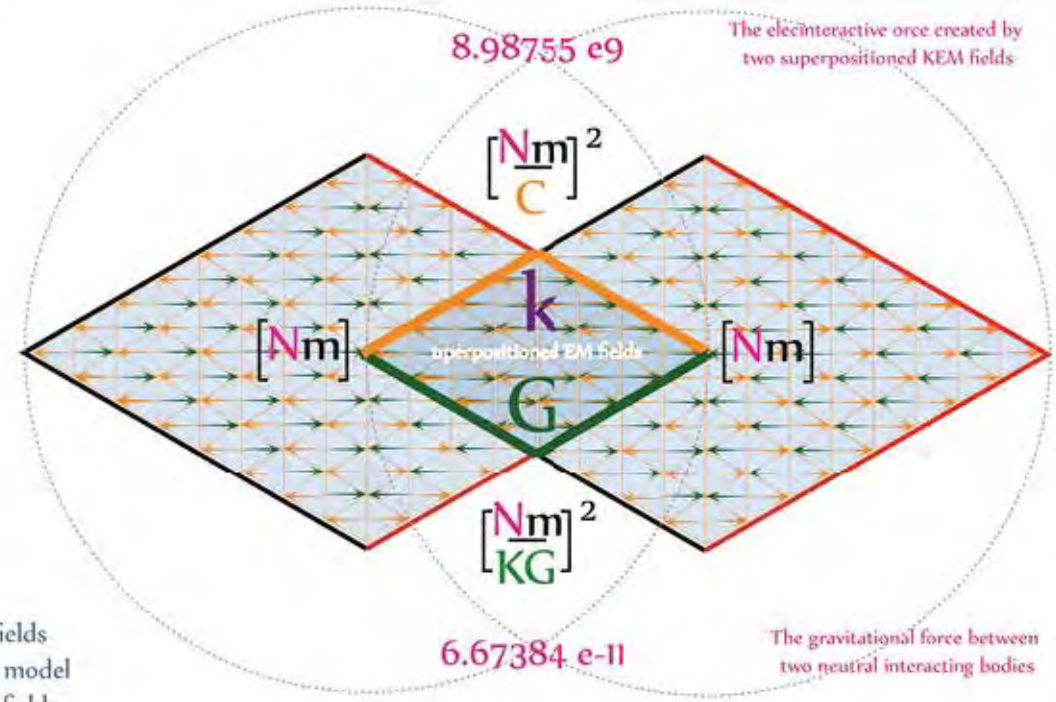

attractive force

$$F = -G \frac{M_1 M_2}{r^2}$$

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Centres of Gravity

are determined by
the distribution of the combined
gravitational mass-Matter in a system

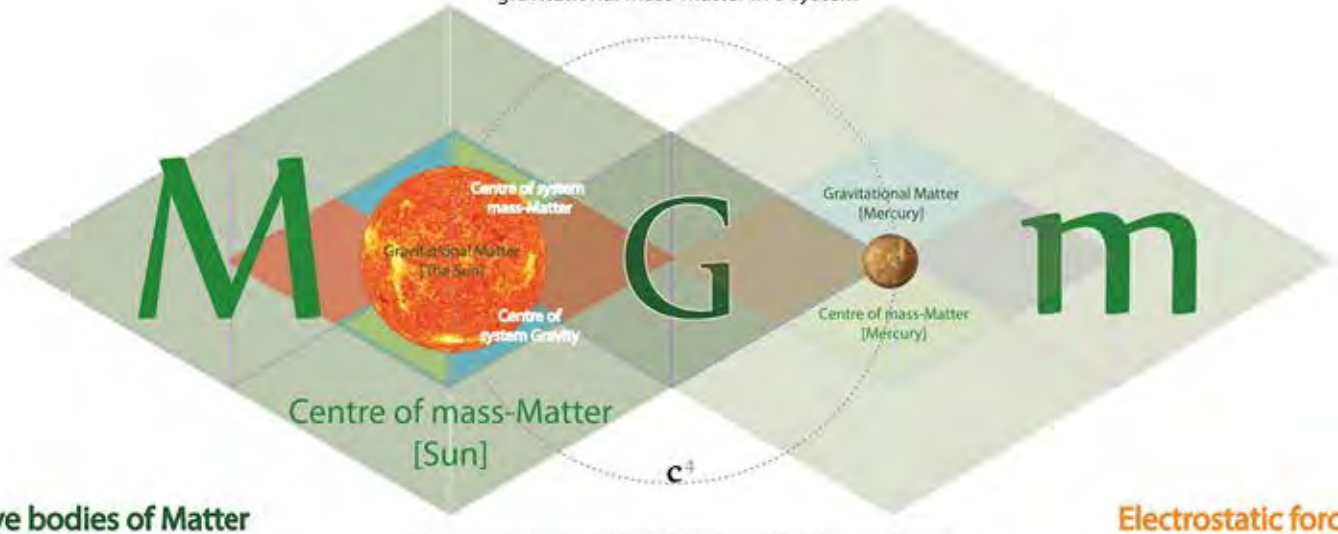

Any two massive bodies of Matter (be they Stars or Neutrinos) will orbit about their 'Centre of Gravity'

The term center of mass is often used interchangeably with center of gravity, but they are physically different concepts. They happen to coincide in a uniform gravitational field, but where gravity is not uniform, center of gravity refers to the mean location of the gravitational force acting on a body.

Electrostatic forces are many orders of magnitude greater than gravity & dominate nuclear interactions at the quantum scale

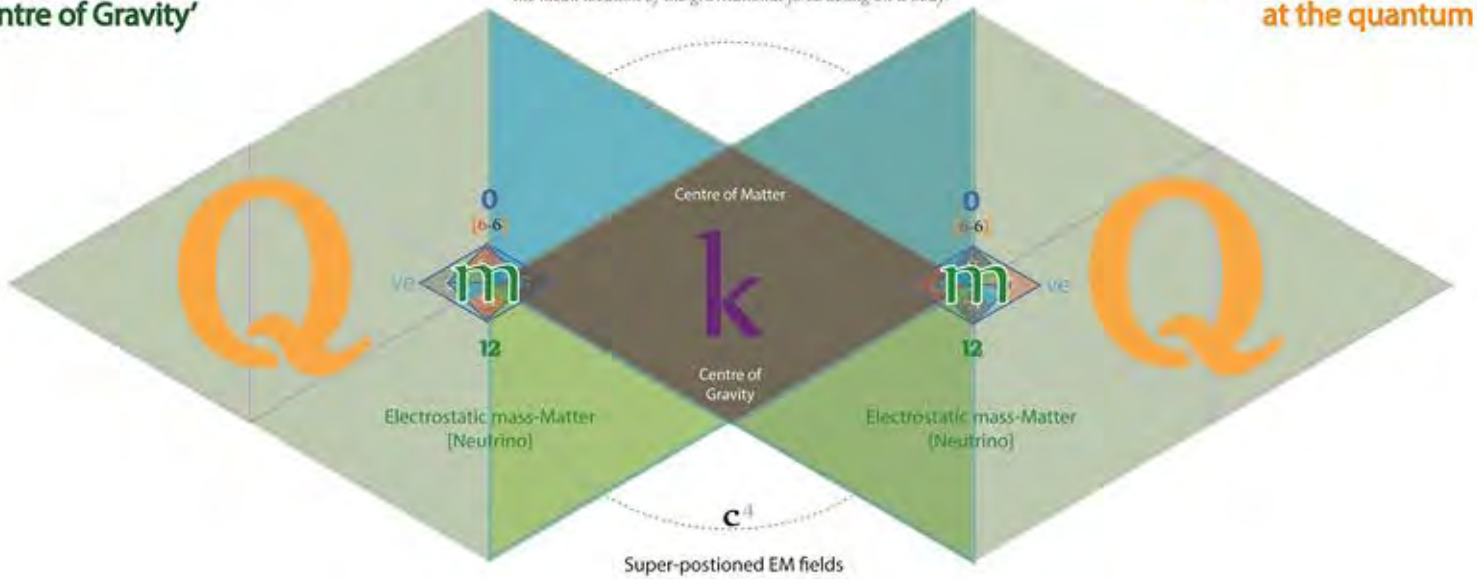

Super-postioned EM fields
have c⁴ geometries [c²x c²]

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There are two quite distinct types of mass in Newton's theory of mechanics and gravitation,

(i) inertial mass, which occurs as the ratio between force and acceleration in Newton's second law and thus measures a particle's resistance to acceleration, and

(ii) Gravitational mass, which may be regarded as the gravitational analog of electric charge, and which occurs in Newton's Gravitational equation

$$F = ma$$

$$F_g = -G \frac{m_1}{r^2}$$

Inertial mass
is a measure of the total
energy momenta geometries
of Matter topologies

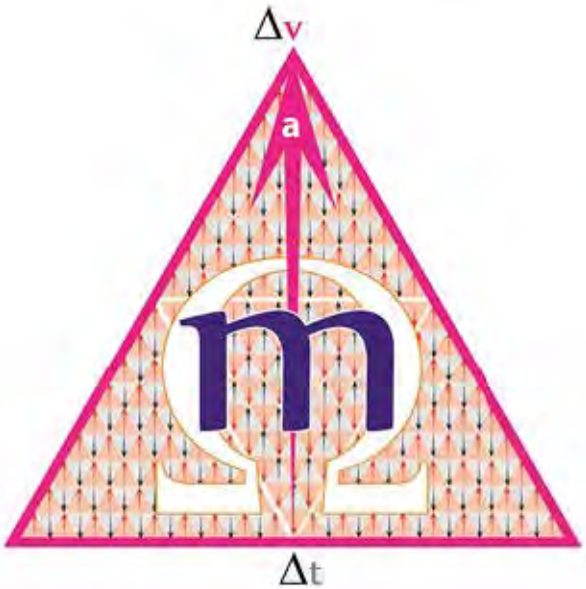

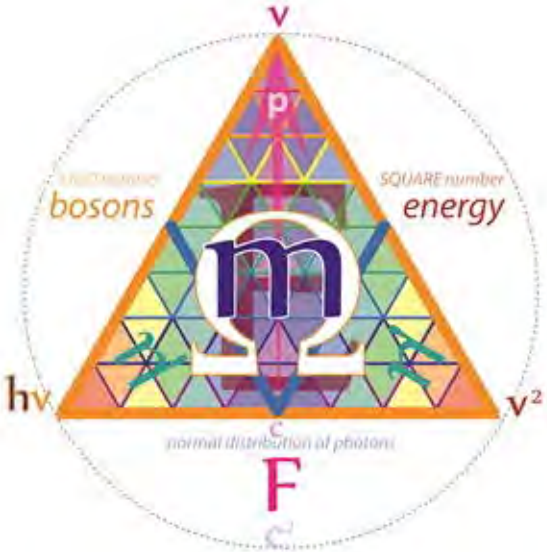

All Gravitational Matter
has EM mass geometries in
its Matter topology

Often stated as the 'Principle of Equivalence'
on which General relativity is founded ,
it can be summarised as follows:

$$a = \frac{m}{m} g$$

"Inertial mass and Gravitational mass are equivalent"

whilst mass-energies contribute equally to inertial & gravitational mass it is Matter topologies that creates Gravity

Inertial mass

results from constituent quanta
acting against (or with) any
Force applied to a mass

'Gravitational' mass

is seen as being the constituent quanta
of opposite charge polarity
attracting another particle's quanta

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$M + KE$

gravitational mass-Matter — *fields of force*

Discerning between the competing laws of Gravity

At the heart of resolving the true nature of Gravity is the formal definitions of mass-Energy-Matter and the interplay between the various field interactions they produce and possess

$= RE$

relativisitic mass-energy densities

$$F = -G \frac{M_1 m_2}{r^2}$$

Newton taught that masses attract each other with a force inversly proportional to the distance between the masses.

Newton's idea was that planets are held in their orbits around the Sun by a force proprtional to the mass of the Sun and the planets, and that force is always pointing inwards (i.e. planets get pulled in the direction of the Sun, and the Sun gets pulled in the directions of the planets).

Newton said that a person standing on the Earth is being held to the Earth by a force due to the mass of the Earth and the mass of the person, and that force is always pointing inwards (i.e. a person gets pulled in the direction toward the center of the Earth, and the Earth gets pulled in the direction of that person).

Newton's and Einstein's view of gravity differ markedly

Einstein, on the other hand, taught that all things with mass (including the Sun, Earth, and the rest of the planets) create a energy density gradient that causes spacetime to curve and that this curvature is an alteration the geometry of spacetime.

The curvature casues Matter to move toward the center of the largest nearby mass. The closer to this mass the larger the degree of curvature in the local spacetime.

Additionally, Einstein taught that if there are no external forces acting upon an object (even those without any mass such as photons) then that object will simply follow its natural path (geodesic) through the altered geometry of the local spacetime - regardless of the degree of curvature of that local spacetime. This implies that if an object is somehow kept from following its natural path (geodesic) then a net force does exist and is measurable on that object.

Newton's view of gravity

Sir Isaac Newton described gravity as a force that attracts things possessing Matter

Sir Issac Newton

(25 December 1642 – 20 March 1727)

Einstein's view of gravity

Albert Einstein described gravity as a 3D curvature of spacetime caused by Matter

Albert Einstein

(14 March 1879 – 18 April 1955)

Gravity is an instantaneous 'Action-at-a-Distance' mediated by a means unknown

Ricci curvature — *scalar curvature* — *Gravitational constant*

$$R_{\mu\nu} - \frac{1}{2} R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

spatial geometry — *stress-energy tensor*

Matter and energy tell spacetime how to curve. Spacetime tells matter how to move

There is no doubt that both Sir Isaac Newton & Albert Einstein were both brilliant, their theories describing Universal Gravitation have remained at the fore for hundreds of years now.

However, a more accurate model of the Universal Gravitation is now at hand and its true nature is revealed via the Tetryonic geometry of EM mass-Energy-Matter and its associated field interactions. Tetryonic Gravitation demonstrates the validity of both approaches and reveals the true geometry behind the field interplays that result in the familiar force of Gravity

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The two models of Gravitation

Newtonian gravitation models the observed large-scale convergent force between all material bodies

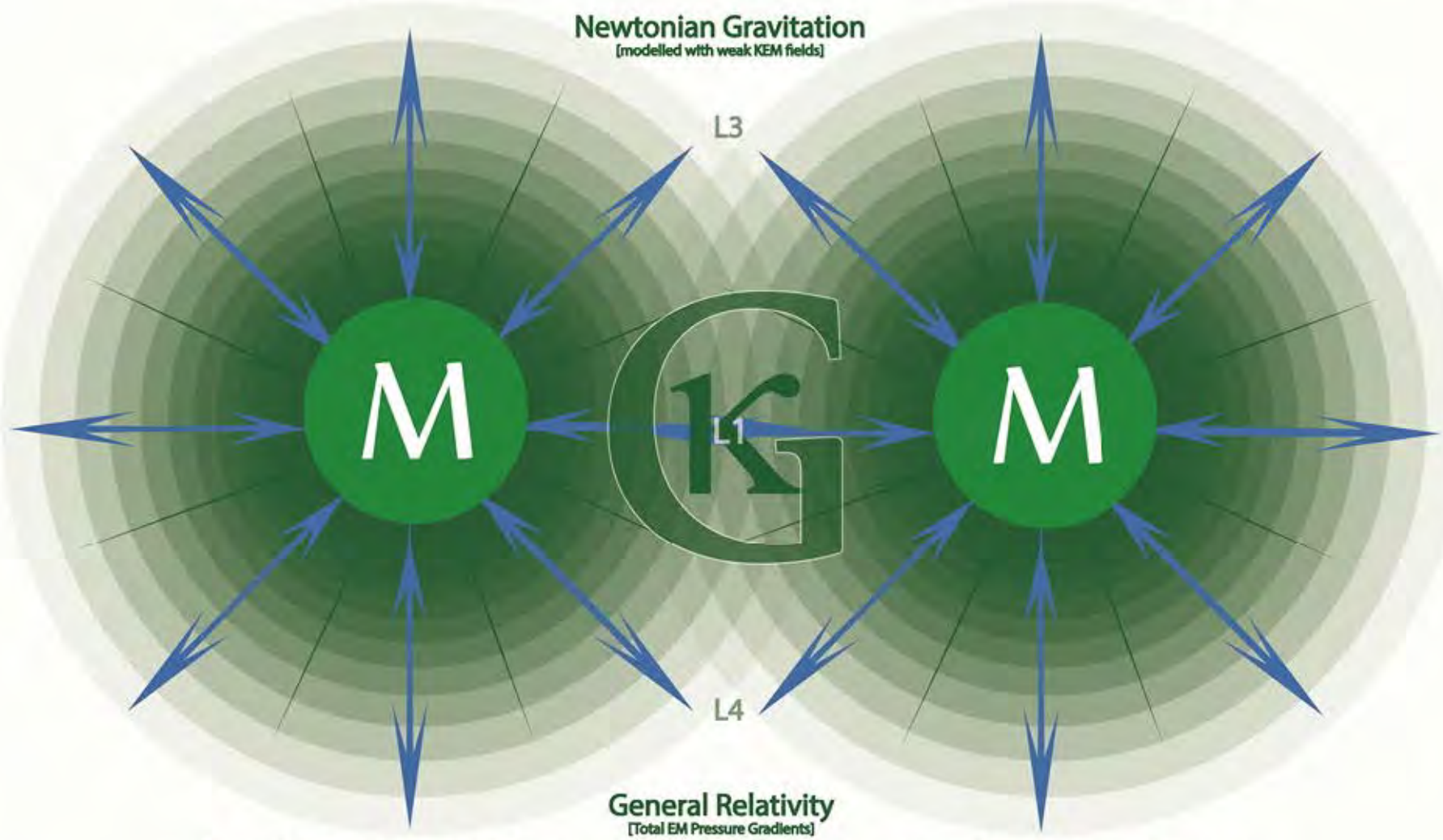

General Relativity models the convergent pressure gradiant created by all forms of energy

While both models are very successful they both fail to reveal the quantum-scale geometries and topologies that give rise to universal gravitation

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Theories of gravitation

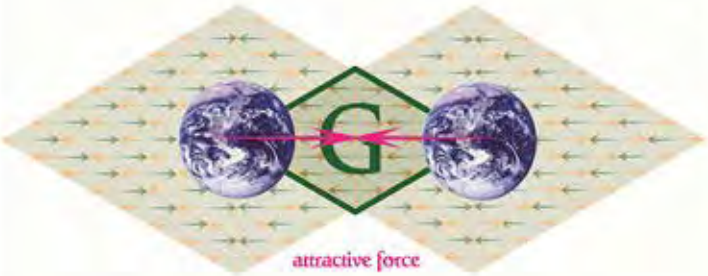

Newton viewed Gravitation as an attractive FORCE of Matter
(inverse square field strength)

for the mechanics of gravitation
"I feign no Hypothesis"

"Gravity is the result of curved spacetime"

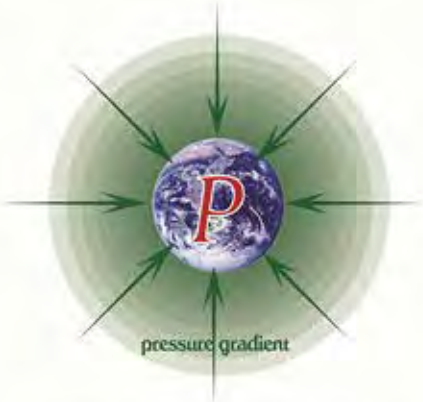

Einstein viewed it as the curvature of 4D spacetime
(PRESSURE gradient)

$$F = -G \frac{M_1 M_2}{r^2}$$

$$G_{ab} = \kappa T_{\mu\nu}$$

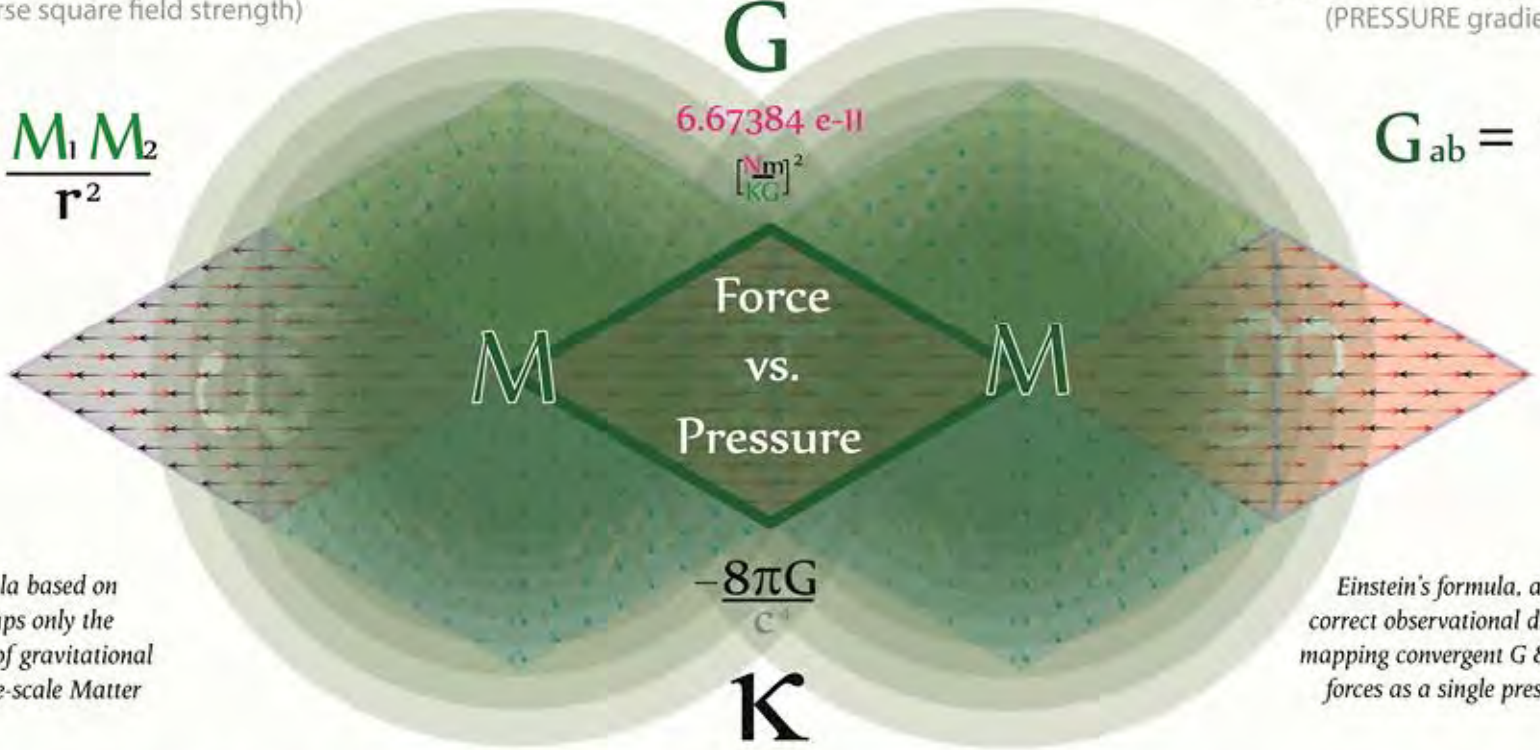

Newton's formula based on observations maps only the observed nett force of gravitational attraction on large-scale Matter

Einstein's formula, attempted to correct observational discrepancies by mapping convergent G & divergent EM forces as a single pressure gradient

Both Newton and Einstein failed to define and distingush between mass-energy geometries & Matter topologies

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Newton's G vs Einstein GR

Both Newton and Einstein developed their gravitational models
from the observed motions of celestial bodies without any distinction
between mass and Matter or the quantum forces at work

Φ

Gravitational Matter

Newton maps Matter's gravitational attraction
[excluding any perturbations caused by [K]EM fields]

All mass-energies

Einstein's GR maps Newton's G & SR effects
[mass-energy momenta [K]EM interactions]

$g_{\mu\nu}$

F

Increasing accuracy in the measurements of the motions
of spacecraft interacting with planetary bodies [using EM waves]
has resulted in the need for refinement of both theories

$\Gamma^{\sigma}_{\mu\nu}$

$\nabla^2\Phi$

$R_{\mu\nu}$

Einstein's doubling of Newton's gravitational constant
was done to fit later observed perturbations in
Mercury's orbital mechanics

Newtonian G field

ρ

Any valid tests of the purely gravitational fields of Matter
must exclude KEM fields and not use EM masses to test it

$T_{\mu\nu}$

$$\nabla^2\Phi = 4\pi G\rho$$

Poisson

$$[\text{Newton}] = \frac{4\pi GMm}{r^2}$$

$$[\text{Einstein}] = \frac{8\pi GT_{\mu\nu}}{c^4}$$

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Pressure gradients and GR

Tensor mathematics is utilised in General relativity to model mass-energy geometries and energy pressure gradients as curved spacetime

$$F = -G\frac{M_1}{r^2}$$

Newton's Gravitational fields are modelled on the observed motions of large-scale Matter attraction

$$G_{ab} = \kappa T_{\mu\nu}$$

Einstein's GR gradients corrects Newtonian gravity by modelling all forms of EM mass-Energy momenta

Newtonian G field

4π

Einstein's G field

8π

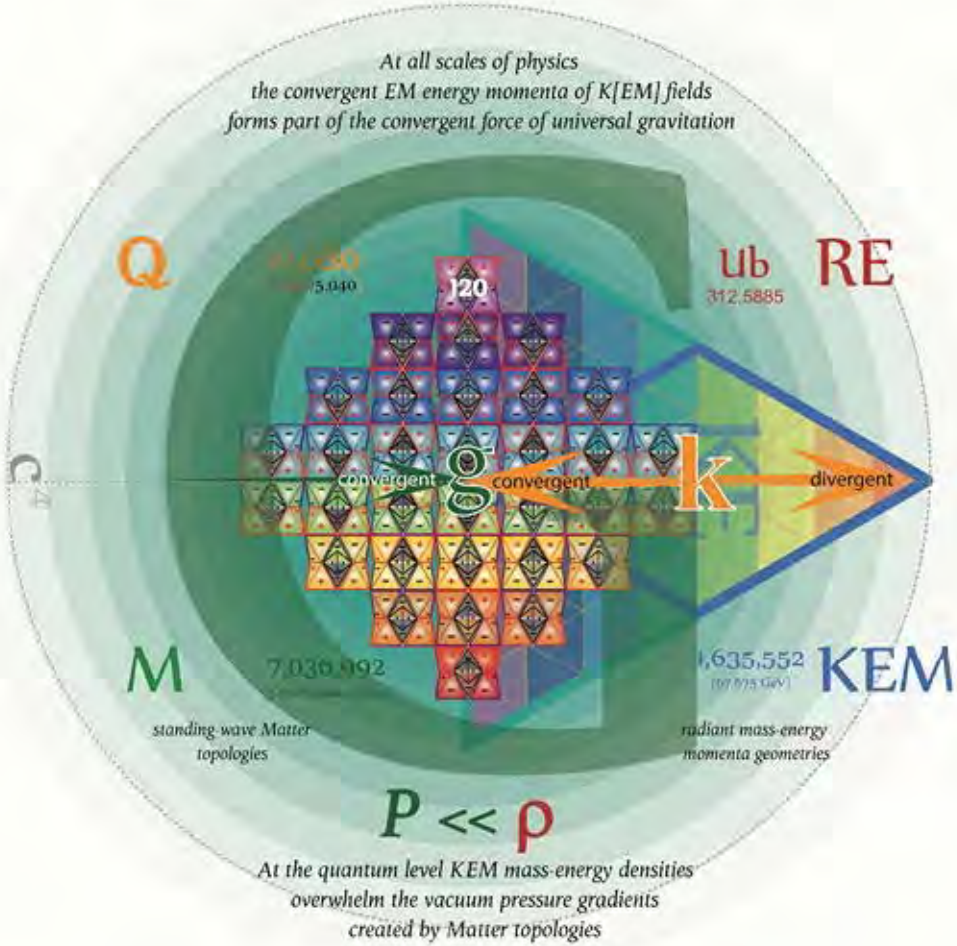

G

κ

Vector Force between Matter

$$n\pi\rho = n\pi\,[[m\Omega v^2]] = T_{\mu\nu}$$

Planck quanta; mass; velocity

representive of ALL the mass-energy momenta of any spatial volume

Pressure gradient per unit Volume

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Stress energy-pressure gradiants

are the result of Tetryonic charge geometries & topologies

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass — Planck quanta — mass — velocity

Radiant mass-energies have planar energy geometries

$n\pi$	Energy quanta
EVENπ	photons
ODDπ	bosons
4π	tetryons
12π	quarks
12π	leptons
24π	mesons
36π	Baryons

All Matter topologies are tetrahedral standing-wave mass-energy geometries

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter — Planck quanta — mass — velocity

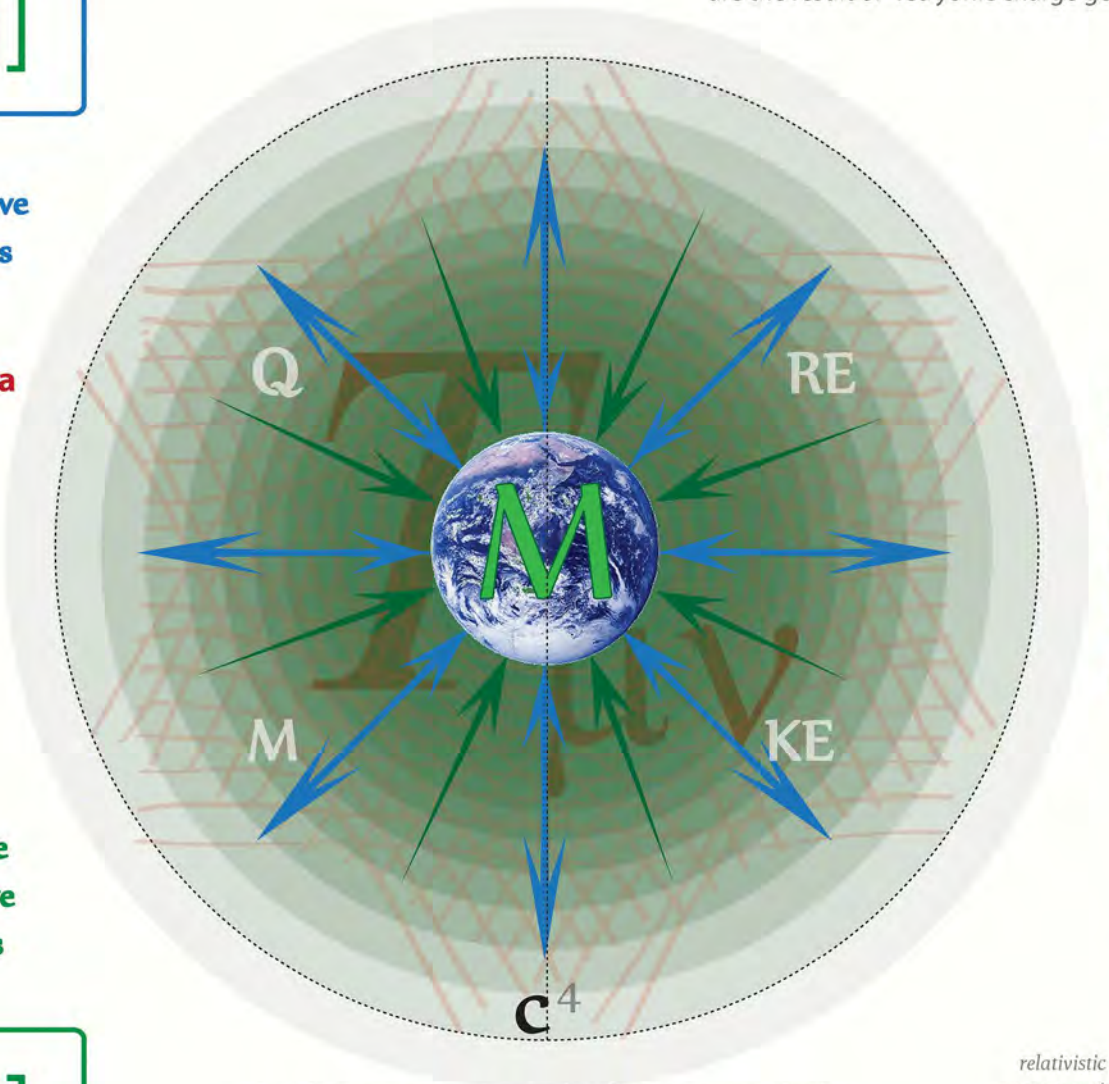

On the non-quantum scale all Matter topologies can be generalised and mathematically modelled as SPHERICAL 4π mass-energy topologies

radiated [K]EM fields have interactive energy momenta [convergent & divergent]

fields of Force

KEM

M

standing-wave topologies

displace vacuum energies creating convergent Gravity

relativistic mass-energies		standing-wave Matter		radiant mass-energies
RE	=	**M**	+	**KEM**
stress energies		topologies		geometries

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Stress Energy tensor

In the Einstein field equations [EFE] of general relativity, the stress-energy tensor is the source of gravitational mass just as Matter is the source of such a field in Newtonian gravity

$$T_{\mu\nu}$$

In Einstein's general relativity, the symmetric stress-energy tensor acts as the source of spacetime curvature

mass *ENERGY* *Matter*

m E M

geometries *momenta* *topologies*

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter; Planck quanta; mass; velocity

The Tetryonic unified field equation models all mass-ENERGY geometries & Matter topologies

A recognised problem in General Relativity is that the stress tensor models all forms of mass-energy-Matter in the form of a generalised stress energy pressure gradient but fails to differentiate between either mass or Matter and their resulting interactions within the fields

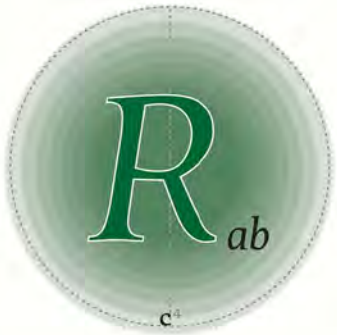

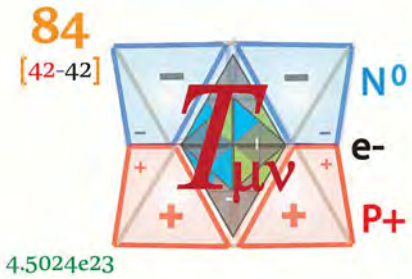

$$n\pi\left[m\Omega v^2\right]$$

Planck quanta; mass; velocity

radiant mass-energies create interactive fields of force

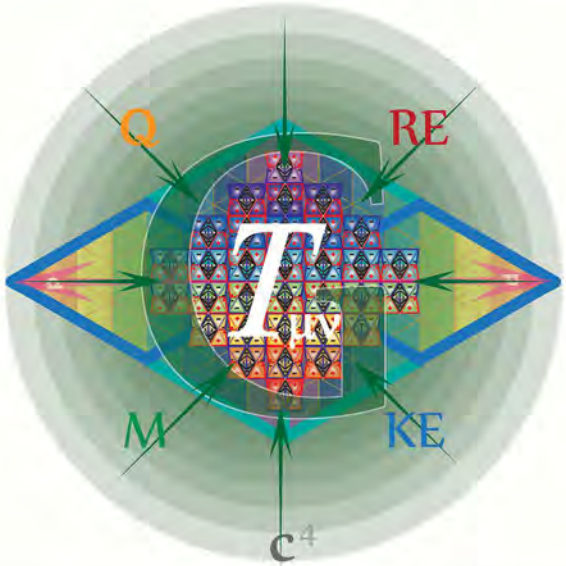

$$T\pi[\rho]$$

standing-wave Matter creates vacuum energy pressure gradients

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Gravimetric topologies

Charges create radiant mass-energy geometries & standing-wave Matter topologies

kg

2D mass geometries

EM mass is not Matter

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass; Planck quanta; mass; velocity

Charged energy geometries are the basis for 2D mass

Photons have mass-energy momenta geometries but no Matter topology

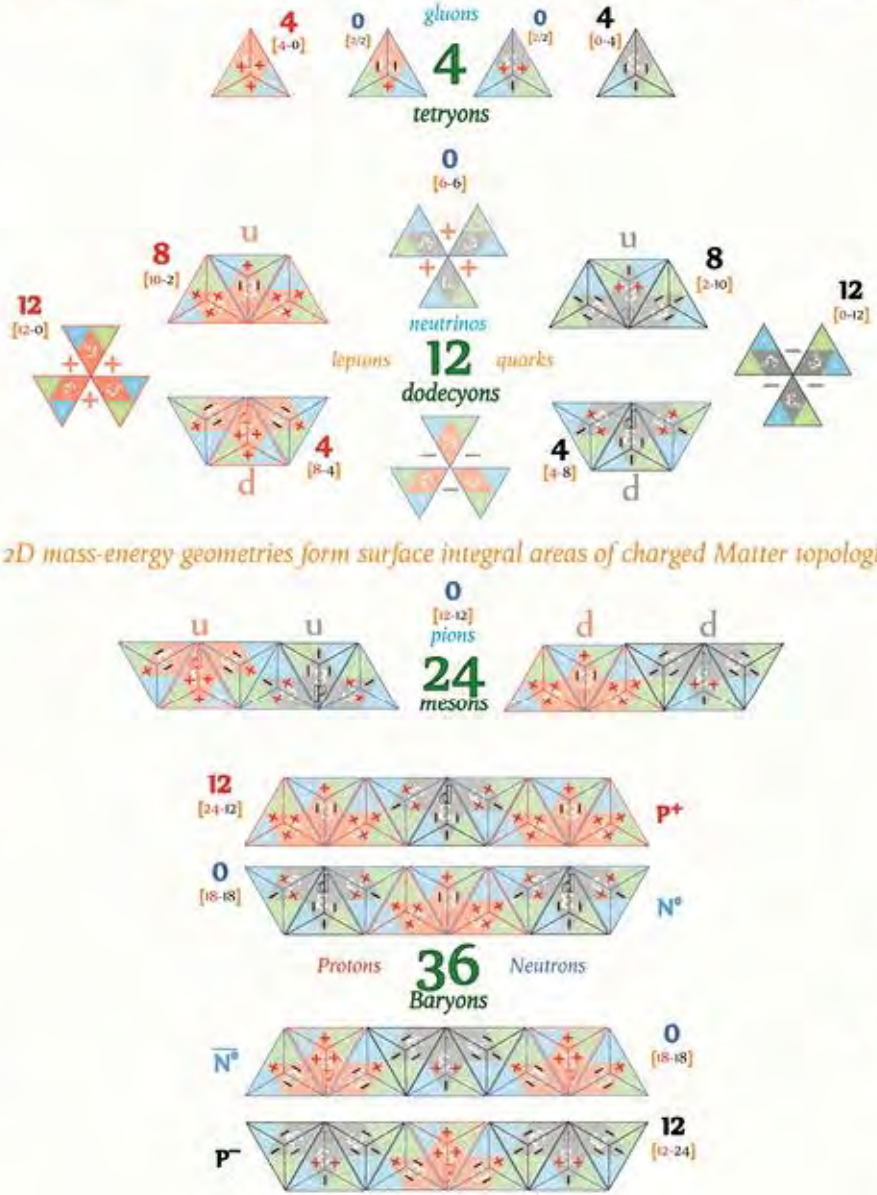

KG

3D Matter topologies

Matter has mass energies

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter; Planck quanta; mass; velocity

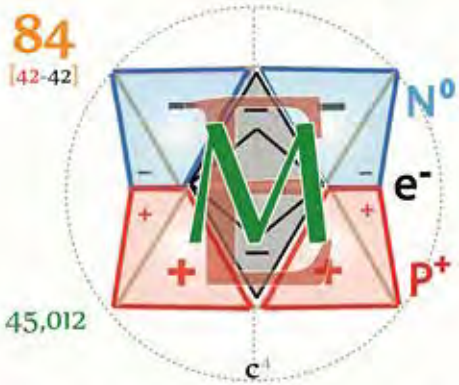

Charged mass-energy topologies are the basis for 3D Matter

Its topology forms a quantum Faraday cage [with a charged surface integral of mass-energies]

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Interactive mass-energies vs. gravitational Matter

energy in all its forms seeks equilibrium

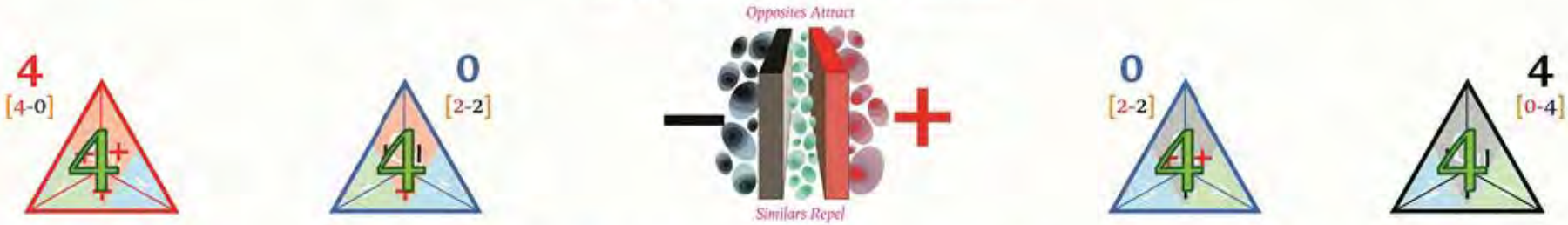

radiant mass-energy geometries

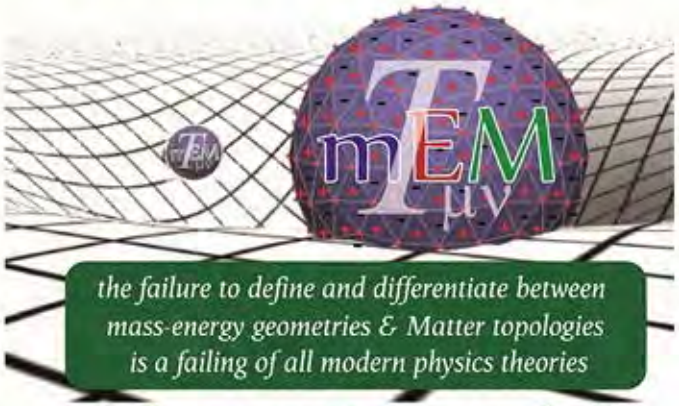

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$ (mass; Planck quanta; mass; velocity)

$$\frac{T\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$ (Matter; Planck quanta; mass; velocity)

standing-wave Matter topologies

Charged Planck quanta of mass-energy momenta that form topologies displace the vacuum energies surrounding them in turn creating a mass-energy-Matter pressure gradient

Compton frequency of rest Matter is what creates inertial mass, its Gravitational Matter results from its charged topology

The integral inductive EM mass-energy momenta in Matter fascia create the physical property of inertial mass

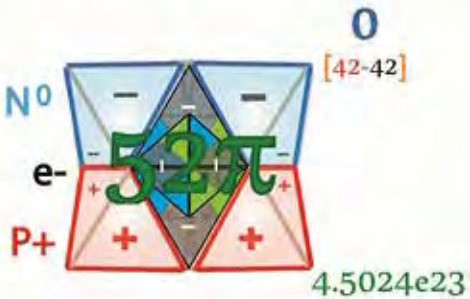

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$$F_z = \Delta P . \Delta A$$

Pressure is the force per unit area
applied in a direction perpendicular to the surface of an object

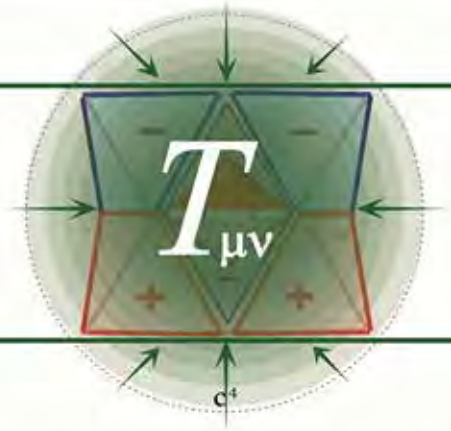

The theory of general relativity uses a stress-energy tensor to reflect to the pressure differentials created by Energy in ALL its forms (making no distinction between EM masses & Matter)

In Tetryonics the stress energy tensor is expanded, through geometric terms, to diferentiate between radiant mass-energy interactions and Matter topologies in radial spatial co-ordinate systems defined by the speed of light

Radiant EM masses

mass

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

Photons are often referred to as 'massless particles' are better defined as Matterless EM mass-energy momenta

Photons

$$\frac{2\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

interactive mass-energy momenta geometries

Energy Pressure gradients

The vacuum energy pressure gradient created by the charged topology of Matter is distinct from its intrinsic & radiative mass-energy geometries

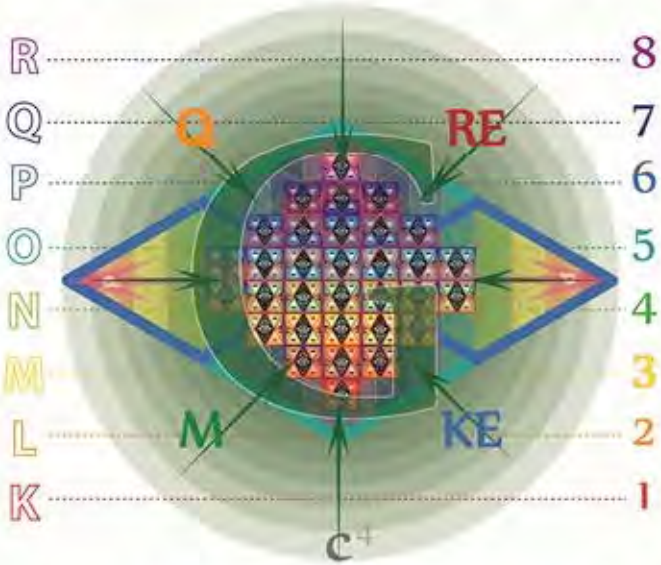

Any theory of gravitation that attempts to model it on any scale must account for energy in all its forms

Standing-wave Matter

Matter

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

Tetryons, the quantum building blocks of Matter have EM mass-energy topologies that create a vaccum pressure gradient

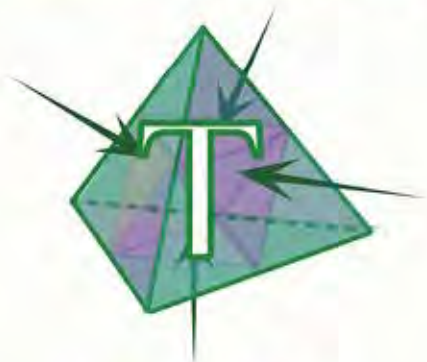

Tetryons

$$\frac{4\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

gravitational Matter topologies

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Convergent mass-energies & Gravitational Matter

m

Spacetime curvature

$$R_{\mu\nu} - \frac{1}{2}R g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Stress-Energy Tensor

M

The concept of mass in general relativity (GR) is more complex than the concept of mass in special relativity.
In fact, general relativity does not offer a single definition for the term mass, but offers several different definitions which are applicable under different circumstances.

Komar mass | Bondi mass | ADM mass

Under some circumstances, the mass or Matter components of a system may not even be defined

Einstein Field equation

Spacetime curvature

$$R_{\mu\nu} - \frac{1}{2}R g_{\mu\nu} = \underset{\text{constant}}{\overset{\text{gravitation}}{K}} \frac{n\pi}{c^4}\left[\left[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v^2}\right]\right]$$

Planck quanta

total mass-energy-Matter

per spatial volume

Tetryonic geometries & topologies

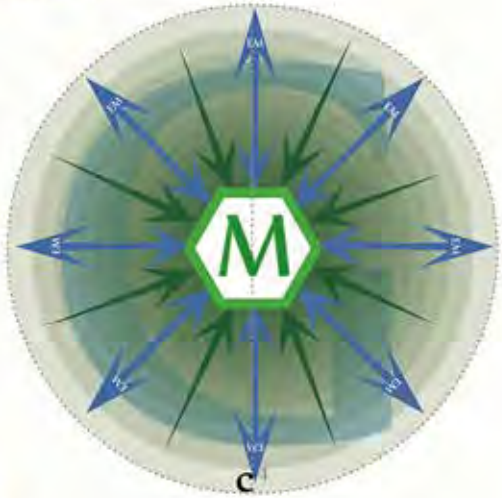

In contrast Tetryonic field equations explicitly differentiate all EM mass-energies and Matter via their charged geometries along with their contributions to the total energy density of any spatial region

GR models the convergent force of gravitation as a convergent energy density pressure gradient created by mass-energies

$$\underset{\text{mass-Matter}}{\overset{\text{gravitational}}{M}} + \underset{\text{mass-energies}}{\overset{\text{interactive}}{kEM}} = \underset{\text{energies}}{\overset{\text{stress}}{U}}$$

Tetryonics models gravitation as the result of mass-energy interactions AND Matter topology displacement of vacuum energies

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Interactive EM force fields are subject to Lorentz velocity corrections

Faraday

$$\mathcal{E} = -\frac{d\Phi_B}{dt},$$

$$|\mathcal{E}| = N\left|\frac{d\Phi_B}{dt}\right|$$

$$\oint \vec{E}\cdot d\vec{s} = -\frac{d\Phi_B}{dt}$$

$$\oint \vec{E}\cdot d\vec{A} = \frac{q}{\varepsilon_0}$$

$$\oint \vec{B}\cdot d\vec{A} = 0$$

$$\oint \vec{B}\cdot d\vec{s} = \mu_0 i + \frac{1}{c^2}\frac{\partial}{\partial t}\int \vec{E}\cdot d\vec{A}$$

Maxwell

E & M

EM

Special Relativity was developed from the foundation of Lorentz corrections to EM fields

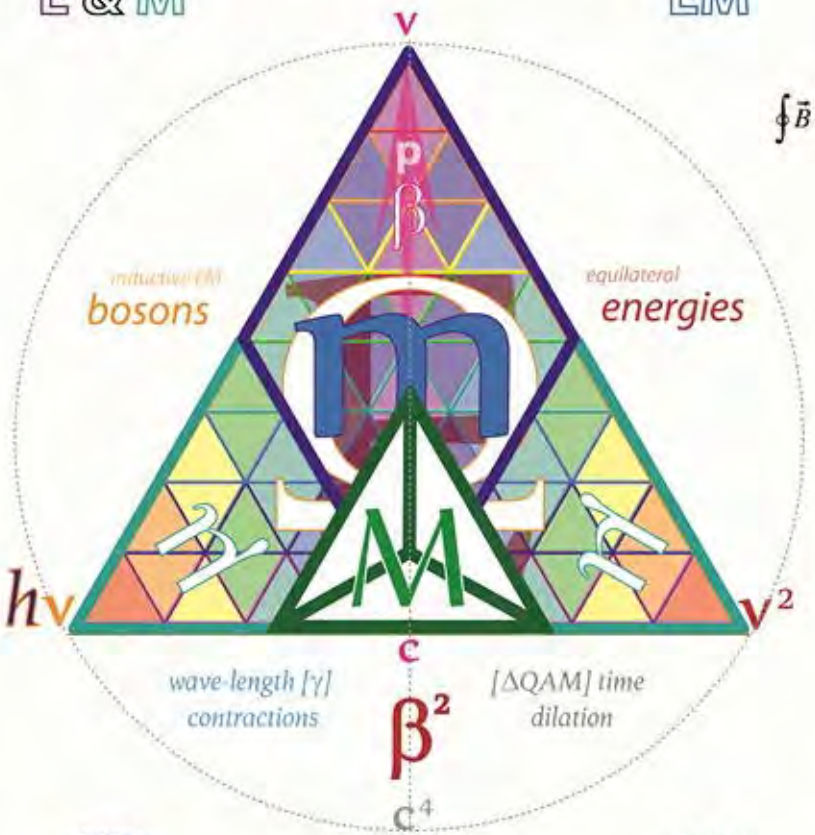

General Relativity was developed from Special Relativity and incorporates EM field interactions

Lorentz

$$L = L'\sqrt{1-\frac{v^2}{c^2}}$$

$$t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}}$$

SR

seconds²

GR

$$G_{\mu\nu} = 8\pi G T_{\mu\nu}$$

$$E = \frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}$$

Einstein

Standing-wave Matter topologies are Lorentz invariant

the failure to differentiate between mass & Matter has lead to major misconceptions in physics

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Tensor Rankings

Rank 0

scalars

A tensor may consist of a single number, in which case it is referred to as a tensor of order zero, or simply a scalar

An example of a scalar would be the EM mass-energy of a particle or field

A second example of a scalar field would be the value of the gravitational potential energy as a function of position

Rank 1

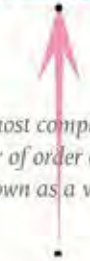

The next most complicated tensor is the tensor of order one, otherwise known as a vector.

vectors

A vector can be defined as a direction between two points, its strength may vary continuously from point-to-point, thereby defining a vector field

Next above a vector are tensors of order 2, which are often referred to as matrices.

Rank 2

mass-energy momenta

A tensor of rank 2 is defined as a system that has a magnitude and two associated vector directions within the fields that it describes

Tetryonic Matrices

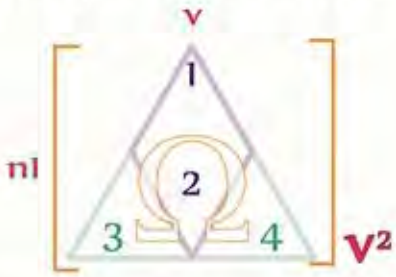

EM fields can be represented by Tetryonic Matrices [Tensors] identical to current square Tensor Matrices with the only difference being the change in the geometry of the matrix to better reflect the true geometry of EM fields

This better facilitates the easy recognition of Electric & Magnetic scalar fields and their associated energy-momenta vectors

Rank 3

curved spacetime

Rank 4 Tensors as used in Einstein's General Theory of Relativity, describe the curvature of spacetime [the so-called Riemann curvature tensor].

Rank 4

mass-Matter topology

the total mass-energies of Matter & fields thatcontribute to creating gravity.

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ElectroMagnetic field tensor

The electromagnetic tensor or electromagnetic field tensor (sometimes called the field strength tensor, Faraday tensor or Maxwell bivector) is a mathematical object that describes the electromagnetic field of a physical system in Maxwell's theory of electromagnetism

$$2\pi\left[\frac{1}{c^2}\cdot\left[m\Omega v^2\right]\right]$$

Photons; Energy; momenta

$$\frac{2\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Photons; Planck quanta; mass; velocity

Visualising EM waves and photons in terms of their Tetryonic geometry the scalar relationships between Electric and Magnetic fields becomes readily apparent.

$$F^{\mu\nu} = -F^{\nu\mu}$$

photons are their own anti particles

A EM field tensor has six degrees of freedom, representing the three components of each of the electric and magnetic fields

$$c = \frac{1}{\sqrt{\mu_0\varepsilon_0}}$$

Speed of Light

$$\varepsilon_0\mu_0 = \frac{1}{c^2}$$

EM Fields

EM wave factors such as Lorentz's velocity corrections arise naturally from the geometry providing a clear and concise illustration of the relationships between EM mass-energies, Charge, Electric & Magnetic fields and the speed of Light

λ

$$\vec{\nabla}\cdot\vec{B} = 0$$

$$\vec{\nabla}\cdot\vec{E} = \frac{\rho}{\epsilon_0}$$

$$\vec{\nabla}\cdot\vec{E} = \frac{\rho}{\epsilon_0}$$

$$\frac{\partial\vec{B}}{\partial t} + \vec{\nabla}\times\vec{E} = 0$$

the change of the magnetic field with respect to time plus the curl of the electric field is equal to zero

Wavelength contraction

$$L = L'\sqrt{1 - \frac{v^2}{c^2}}$$

$$\vec{\nabla}\times\vec{B} - \frac{1}{c^2}\frac{\partial\vec{E}}{\partial t} = \mu_0\vec{J}$$

The curl of the magnetic field vector minus the change of the electric field with respect to time, is equal to the field's current density

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

Scalar correction factor

Linear correction factor

$$\beta = \left[\frac{v}{c}\right]$$

$$c = \left[\left[\frac{c^2}{\Omega}\right]\cdot\left[\frac{\Omega}{c}\right]\right]$$

speed of Light; velocity of propagation; f Frequency; λ Wavelength

$$p = \frac{h}{\lambda} = \frac{E}{c}$$

Linear Momentum

$$\det(F) = \frac{1}{c^2}\left(\vec{B}\cdot\vec{E}\right)^2$$

the electromagnetic tensor may also be written in terms of the 4-vector potential

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3D space time

$[\Delta x, \Delta y, \Delta z]$ $\Delta\tau$

In Tetryonics, the relativistic Four vector reflects the changing quantised angular momenta [time] of EM mass-energies & Matter in 3D space

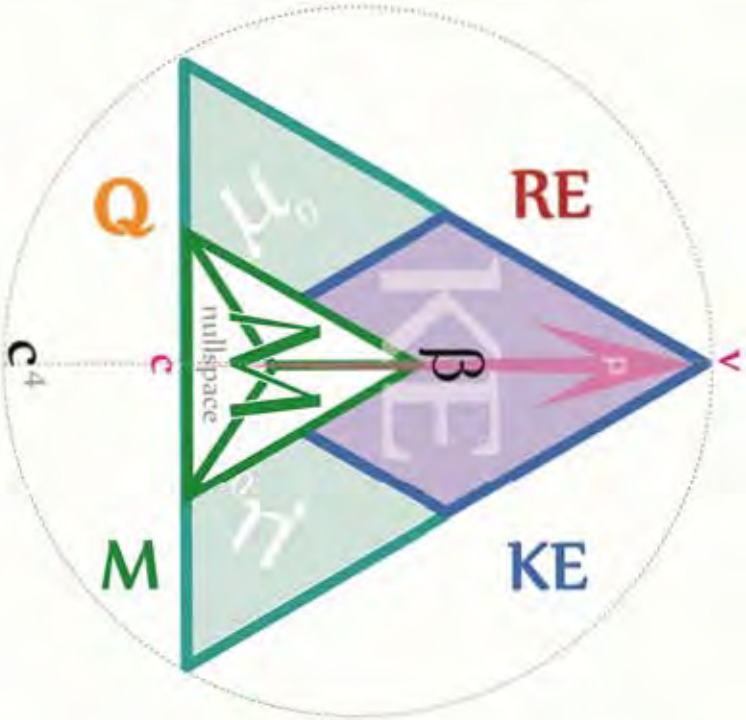

$M_0 + KE = E$

Standing-wave four-vector | Lorentz corrected mass-energies | Stress energy momenta tensor

Relativistic Four-vectors

Charged Matter interacts at-a-distance through super-positioned energy momenta fields from which our force constants are derived

The electromagnetic four-potential is a potential from which electromagnetic field can be derived. It combines both the electric scalar potential and the magnetic vector potential into a single space-time four-vector

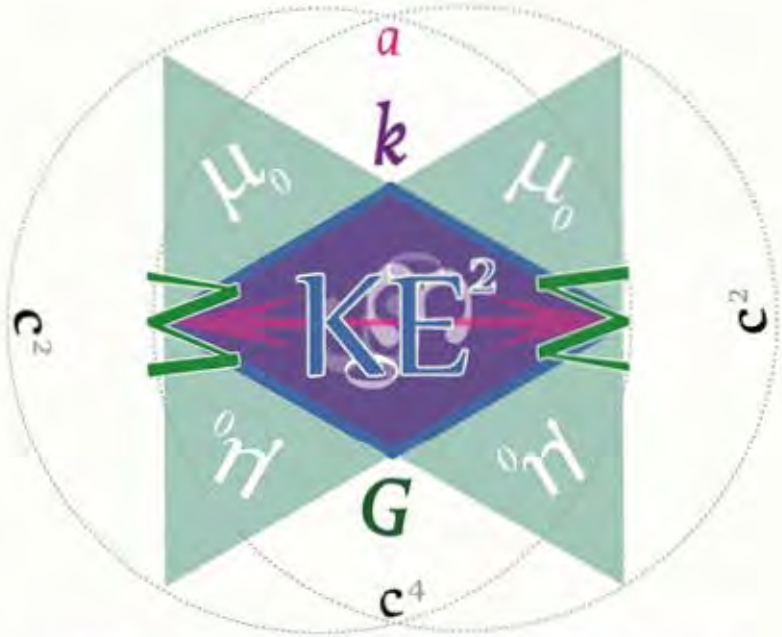

Inverse squared Gravity can be mathematically modeled using the same geometry explaining the similar formulations for charge interaction & gravitation

$m^2v^4 = KE^2 = p^2v^2$

EM mass | radiant energies | momenta

Four-vectors are reflective of the total EM mass-energy momenta of superpositioned [K]EM fields where the KE is the interactive force component

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Special and General relativity

General relativity was developed by Einstein in an attempt to describe the acceleration forces experienced by graviational Matter (on the foundation of special relativity) which in turn was an extension of Lorentz corrections of EM waves developed to account for the fixed speed of light and established Newtonian mechanics

SR

Special Relativity

(describes inertial frames of reference in flat Euclidean spacetime)

mass-energy

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass — Planck quanta — mass — velocity

geometries

GR

General Relativity

(describes accelerating frames of reference in curved Riemannian spacetime)

Matter

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter — Planck quanta — mass — velocity

topologies

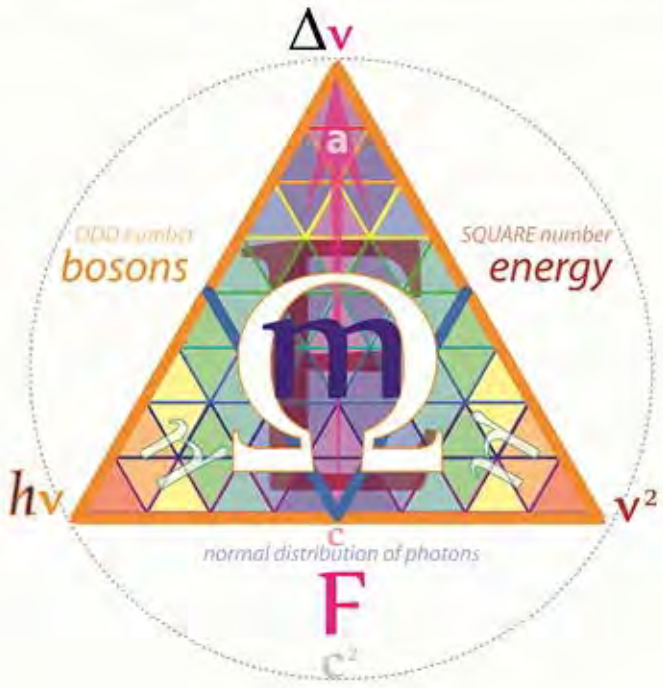

2D

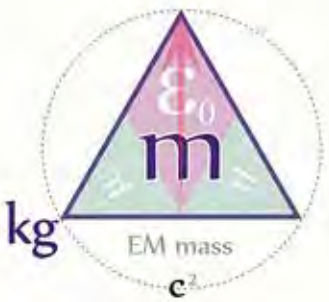

3D

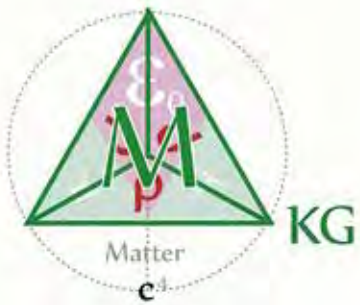

all physical theories to date have failed to explain the mechanics of gravitation at all scales of energy and distance

$$\frac{\rho}{m^2} \qquad \frac{\rho}{m^3}$$

6.629432351 e-34 J

ENERGY — Planck quanta

$$n\pi\left[\left[m\Omega v^2\right]\right]$$

mass — velocity

7.376238376 e-51 kg

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The Weak Equivalence Principle

$$m_g \, .a = m_i \, .g$$

Newton

The uniqueness of free fall states than any two test bodies must fall with the same acceleration in a given external gravitational field

$$m_g = m_i \sum_A \eta^A \frac{E^A}{c^2}$$

Einstein

The uniqueness of free fall trajectories allows one to regard spacetime as filled being with curved energy gradients

$$F = ma$$

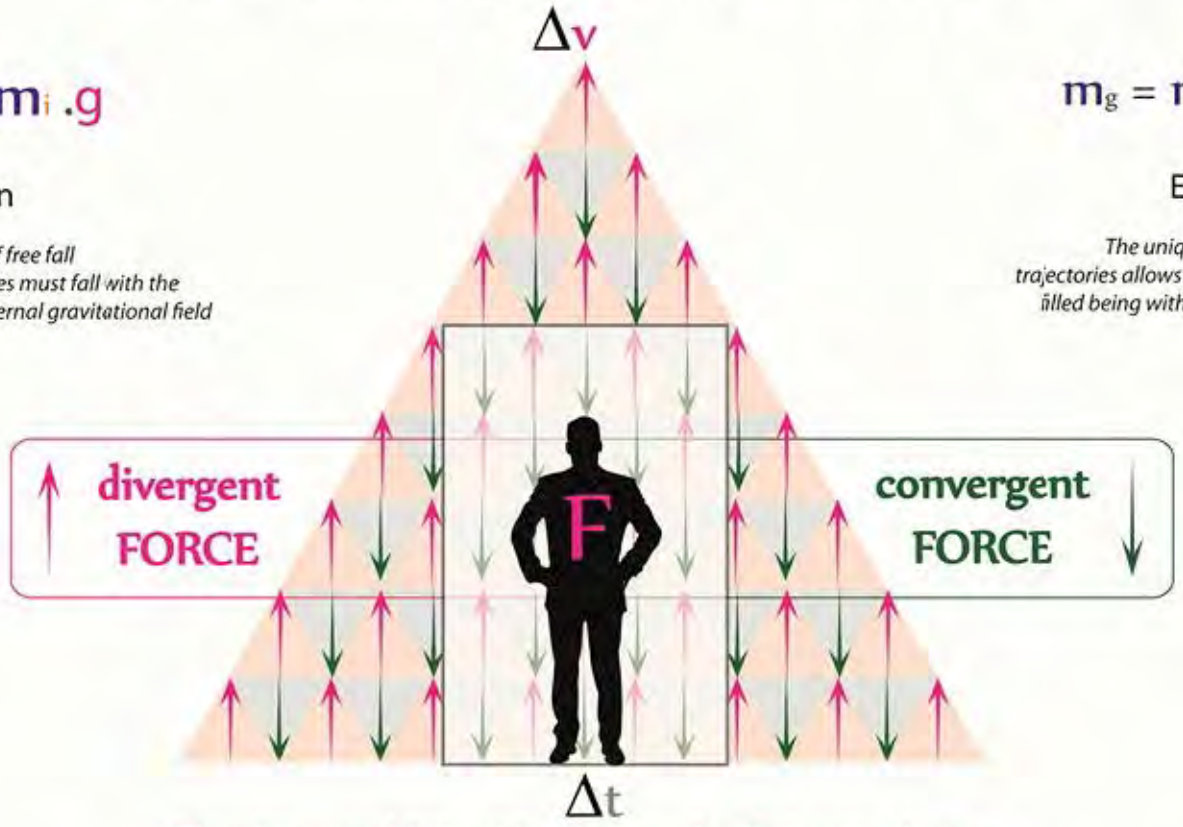

$$F = mg$$

F_i

acceleration vs inertial mass

'There is no way of distinguishing between the effects on an observer of a uniform gravitational field and that of constant acceleration'

Inertial and Gravitational masses are equivalent

Of particular note is the fact that the relativistic formulation of the weak equivalence principle hints at the fact that mass-energies in all their forms must be accounted for and correctly modeled for an accurate picture of the mechanics of gravitiation on all-scales to be developed

F_g

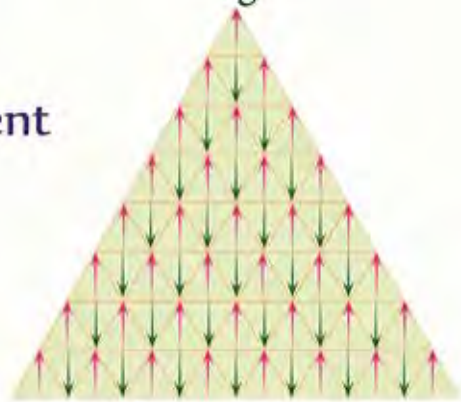

acceleration vs gravitational mass

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Einstein's Gravitational Constant

Newton gave a law for the behavior of objects that experienced gravitational forces:
$F = ma$, where $F = -m\nabla\phi$ for a given gravitational field ϕ

And along with Gauss & Poisson also gave a law determining how φ is generated:
$\nabla^2\phi = 4\pi G\rho$.

Einstein subsiquently re-expressed Newtonian Gravitation as a curvation of spacetime brought about by the presence of all mass-Energies

$$G_{ab} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

$$G_{ab} = \kappa T_{\mu\nu}$$

General Relativity

$$n\pi[mEM]$$

Tetryonic charged geometries

spactime curvature — Gravitational constant — stress energies

$$G_{ab} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

speed of light

Gravitational Matter topologies — Interactive mass-energy geometries

$$T\pi\left[\frac{\rho}{c^4}\right] + n\pi\left[\frac{\rho}{c^2}\right]^2$$

3D spatial region — 2D spatial fields

Einstein viewed gravitation as the result of a curvature of spacetime created by a mass-energy-pressure gradiant

An explanation for all three formulations of Gravity must be derived from Tetryonic charge geometries

c^4

Tetryonics differentiates between Matter & interactive mass-energies via their charged geometries and topologies

EM

2D euclidean mass-energy-momenta

Rank 2 tensors

convergent & divergent forces

$$m = \frac{\rho}{c^2}$$

M

3D mass-Matter topologies

Rank 4 tensors

convergent pressure gradient

$$M = \frac{\rho}{c^4}$$

By modeling all mass-energy geometries and Matter topologies as a stress energy tensor General Relativity fails to differentiate between the interactive Forces of mass-energy momenta and gravitational Matter

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mass-energy-Matter spatial interactions

No two Fermions [3D Matter topologies] can occupy the same physical space at the same time - Pauli exclusion

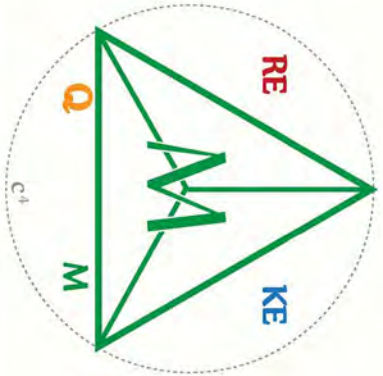

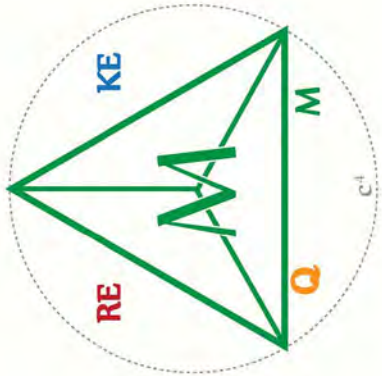

c^4

is a volumetric measure of the amount of space taken up by Matter

Fermions

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

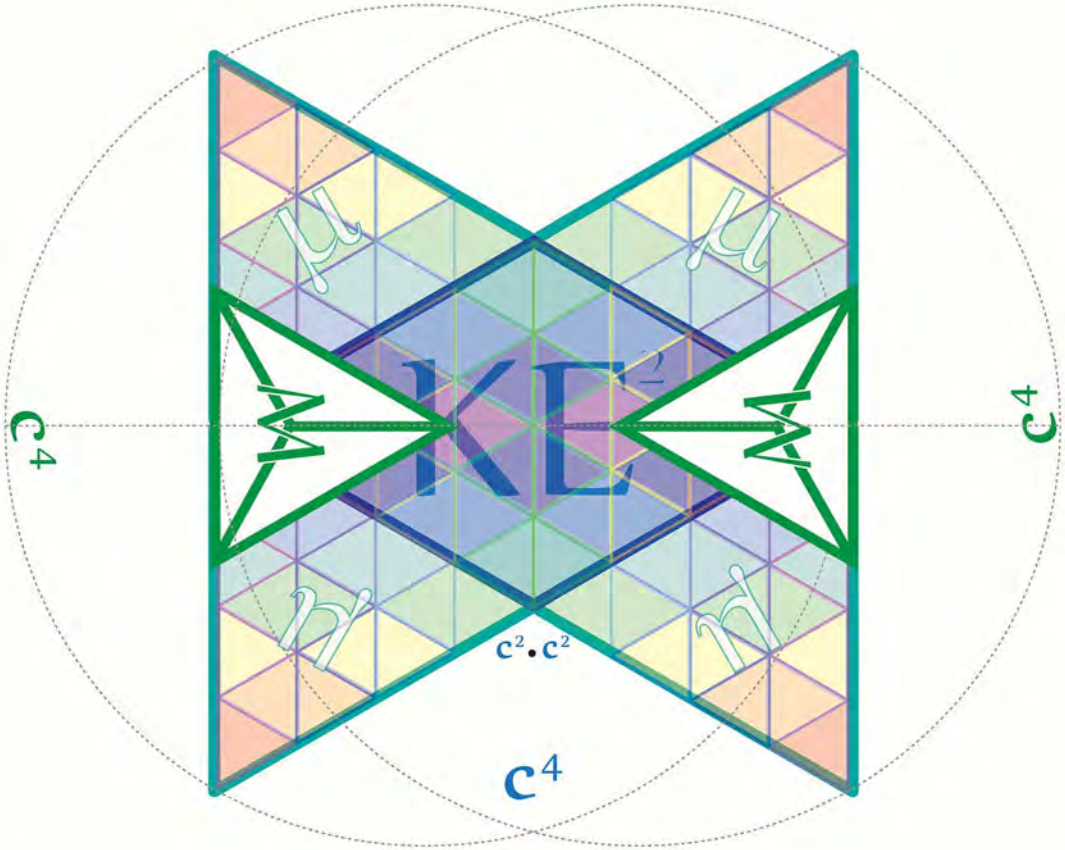

c^4

is also a spatial measure of two superpositioned interactive KEM fields

Force interaction

$$\frac{2\pi}{c^2}\cdot\frac{2\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

All separated particles interact with each other via 2D fields of Force (superpositioned [K]EM fields)

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SR

Special relativity applies Lorentz velocity corrections to radiant mass-energy momenta

GR

General relativity applies SR to total energy momenta density-pressure gradients

Otto von Guericke, (1602-1686), a German physicist, performed a famous experiment: the "Magdeburg Hemispheres".

When two halves of a large, hollow metal ball had all the air removed from the volume they created when joined, two teams of horses couldn't pull them apart, because the pressure of the Earth's atmosphere (external to the volume created) exerted a very large force on the ball as it sought to equalise the pressure gradient created.

Nullspace energy pressure gradients

mass-energy geometries

$$P = \frac{Force}{Area} = \frac{F}{A} \Rightarrow \frac{F.d}{A.d} \Leftarrow \frac{W}{V} = \frac{Energy}{Volume} = U$$

mass-Matter topologies

The scalar mass-energies of all Matter topologies are all contained in their charged fascia

$$n\pi\left[\frac{\rho}{c^2}\right]$$

$$T\pi\left[\frac{\rho}{c^4}\right]$$

A Faraday cage is a metallic enclosure that prevents the entry or escape of an electromagnetic field (EM field)

All Matter topologies are ideal Faraday cages, quantum standing-waves of EM mass-energies that in turn create regions of nullspace

An ideal quantum Faraday cage consists of an unbroken, perfectly conducting shell. (a Matter topology of scalar mass-energies)

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Total stress energies & Matter

The stress energy tensor can be regarded only as a provisional means of representing all of the interactive mass-energies & gravitational Matter in any physical system.

It is only in present circumstances that we find we have insufficient knowledge of the electromagnetic field of concentrated charges that compels us, provisionally, to leave, undetermined in present theory, the true form of this tensor...

The right hand side the EFE is a formal condensation of all things whose comprehension in the sense of a field theory is still problematic.

Not for a moment... did I doubt that this formulation was merely a makeshift in order to give the general principle of relativity a preliminary closed form expression.

For it was essentially no more than a theory of the gravitational field, which was isolated somewhat artificially from a total field of as yet unknown structure.

$T_{\mu\nu}$

GR's Stress Energy Tensor does NOT differentiate between EM mass & Matter

Einstein

Abraham

mass $\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$ (mass, velocity; Planck quanta)

ENERGY $n\pi\left[\left[m\Omega v^2\right]\right]$ (mass, velocity; Planck quanta)

Matter $\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (mass, velocity; Planck quanta)

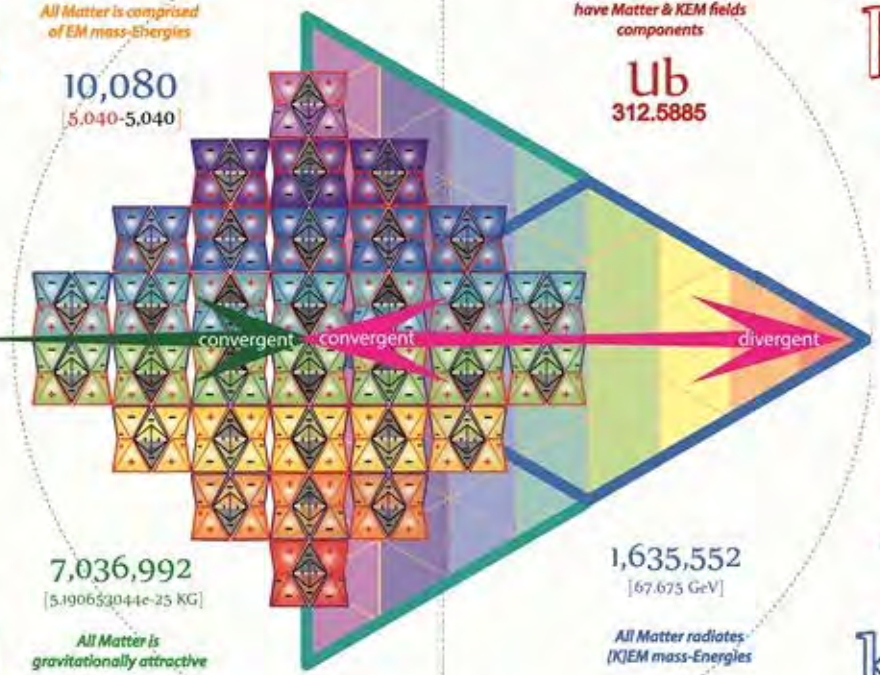

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Einstein's Field Equation

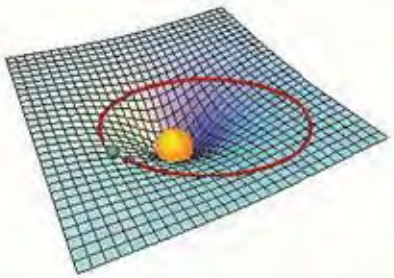

"Spacetime tells Matter how to move; Matter tells spacetime how to curve"
John Archibald Wheeler

$$R_{ab} - \frac{1}{2}Rg_{ab} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

The solutions of the Einstein field equations are metrics of spacetime

General Relativity was developed to account for the observed perihilion precession of Mercury's orbit around the SUN
[only noticable through detailed observations after Newton developed his law of universal gravitation]

Newtonian G field

4π

the scalar curvature — the cosmological constant — Newton's gravitational constant

Ricci curvature tensor $R_{ab} - \frac{1}{2}g_{ab}R + \Lambda g_{ab} = \frac{8\pi G}{c^4} T_{\mu\nu}$ the stress-energy tensor

the metric tensor — the spatial region of mass-energy-Matter being measured as determined by the speed of Energy in vacuum

The EFE is a tensor equation relating a set of symmetric 4 x 4 tensors. Each tensor has 10 independent components

Einstein's G field

8π

The EFE (based on SR principles) reduces to Newton's law of gravitation where the radiant mass-energy fields are weak and velocities are much less than the speed of light
[highlighting the inability of GR to distingush between radiant mass-energy geometries & the standing-wave Matter topologies comprising the total energies within the stress Energy tensor]

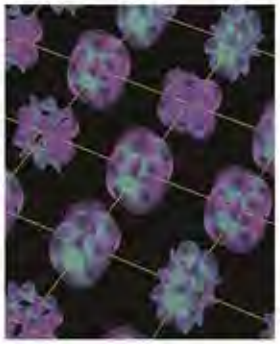

Curved Spacetime — *Einstein's gravitational constant*

$$G_{ab} + \Lambda g_{ab} = \kappa T_{\mu\nu}$$

the cosmological constant — *mass-ENERGY-Matter*

Despite the successes of General Relativity, the problems of quantum gravity and spacetime singularities remain open problems in its formulation of curved spacetime geometries

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All Energies are quantised

Gravitation is Universal

Gravity results from curved spacetime

ZPF

Quantum theory

m

Newtonian Mechanics

M

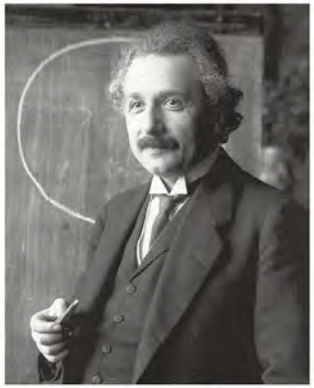

Relativity theory

VE

Quantum gravity is the effort in theoretical physics to create a theory that includes both general relativity and the standard model of particle physics. Currently, these two theories describe different scales of nature and attempts to explore the scale where they overlap yield results that don't quite make sense, like the force of gravity (or curvature of spacetime) becoming infinite.

Euclidean quantum gravity
Scalar theories
Modified Newtonian dynamics (MOND)
Einstein–Cartan Bimetric theories
Tensor–vector–scalar
DGP model
Geometrodynamics
Loop Quantum Gravity
Lovelock theory
Kaluza–Klein theory
Induced gravity
Canonical Quantum Gravity
Jackiw–Teitelboim gravity
Liouville gravity
String theory
Composite gravity
Quantum gravity
Causal Set theory
Brans–Dicke
Massive gravity
Gravity as it is currently understood cannot be reconciled with the laws of quantum mechanics.
Scalar–tensor–vector
Teleparallelism
Causal dynamical triangulation
Conformal gravity
Nonsymmetric gravitation
2+1D topological gravity
Gauss–Bonnet gravity
Supergravity
Gauge theory gravity
f(R) gravity
Unified theory

hv	Q	G	SR	GR
1899	1785	1686	1905	1915
Planck's law	*Couolomb's law*	*Newton's law of Gravitation*	*Special relativity*	*General relativity*

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Without the aid of Tetryonic's charged geometries
Gravitational & EM fields point to mathematical singularities

Inverse squared Electric fields produce INTERACTIVE fields of force

Inverse squared Magnetic fields produce PURTURBATIVE fields of force

There are NO Black Holes

There are NO point Particles

Matter produces CONVERGENT inverse squared fields of Gravity

Gravitation is the nett convergent force produced by all G-E-M fields

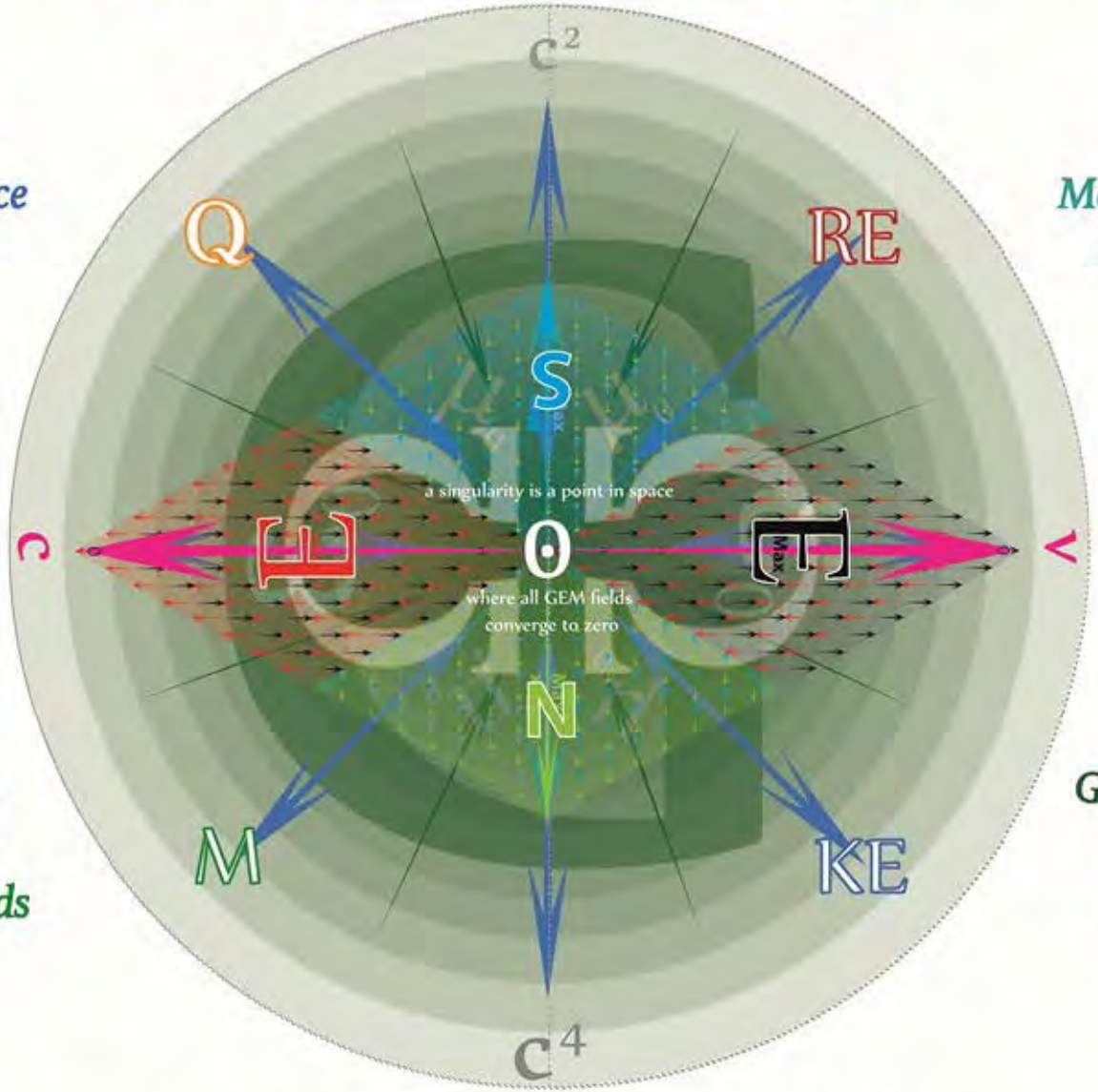

GravitoElectroMagnetic fields

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Matter topologies and gravity

the positive spatial displacements created by tetrahedral standing-wave mass-energies displace vacuum energies found in those regions to create a energy density pressure gradient

A convergent Gravity field is the result of the higher density-pressure vacuum energies in any spatial region seeking to equalise the lower pressure regions of nullspace within Matter topologies

Matter has a
Tetrahedral mass-energy
quantum topology
[non-Spherical]

M

The mass-energies
of Matter topologies
are stored in the integral
surface area geometries
of their charged fascia

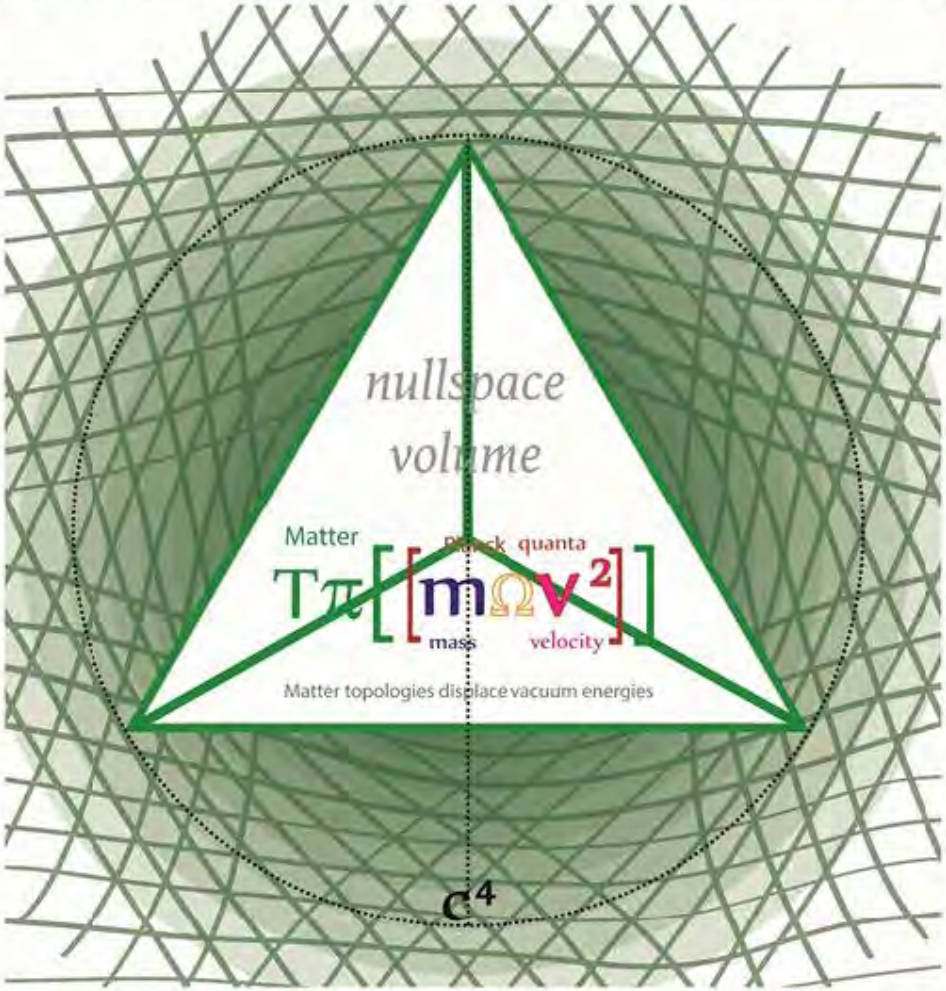

Gravity itself is
the result of vacuum
energy pressure gradients
not Coloumbic fields

G

Gravitation is the
result of the convergent
gravity AND interactive
[k]EM fields that all quantum
Matter topologies create

The resultant density-pressure gradients created by the displacement of vacuum energies by Matter topologies can be modelled using equilateral EM field geometries and a reduced Coloumb constant

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Spatial displacement of GEM energies by Matter topologies

The positive 4nπ displacement of vacuum eneriges by Matter topologies creates

$$F = -G \frac{M_1 m_2}{r^2}$$

Planets orbit around the SUN

Newtonian fields models the resultant attraction as gravity

EM fields accelerate charged Matter

$$F = k \frac{Q_1 Q_2}{r^2}$$

Spatial energy density-pressure

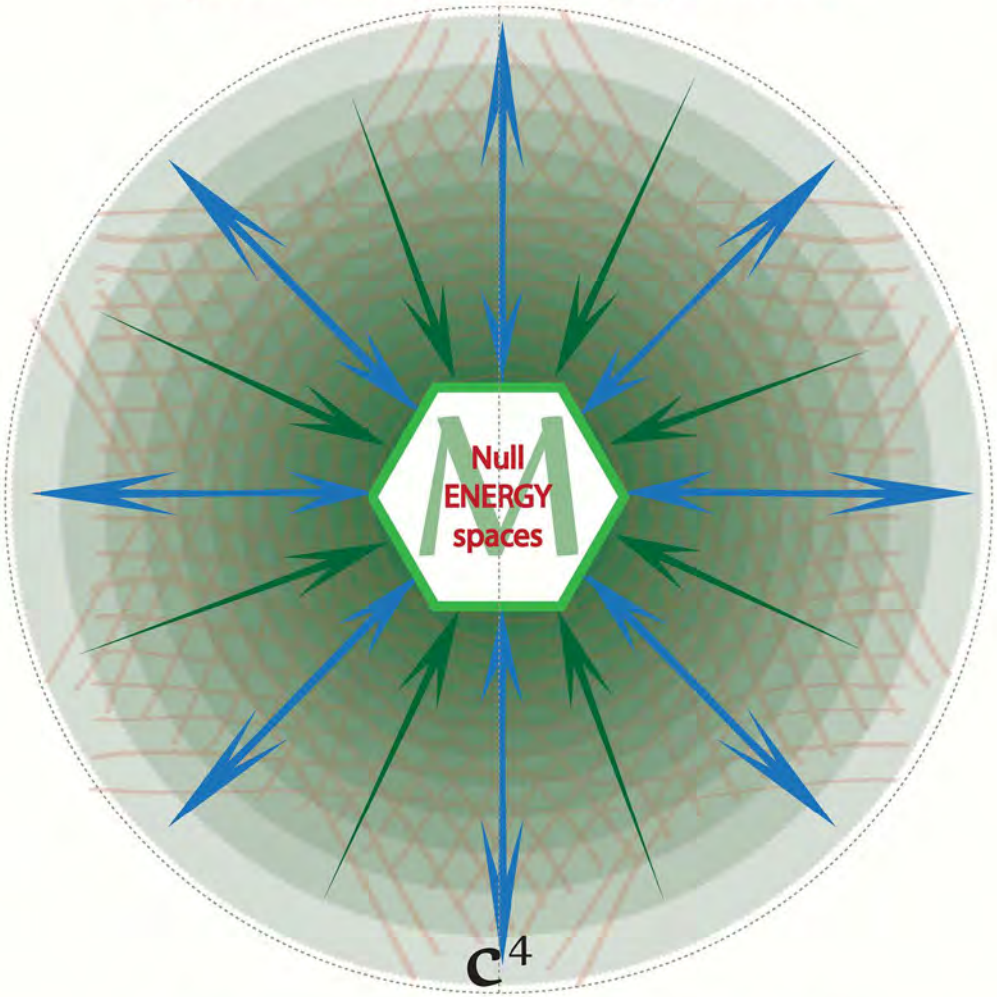

Convergent Gravitational fields

$$G_{ab} = 8\pi G T_{\mu\nu}$$

All EM mass & Matter create stress energies

Einstein models the GEM energy densities as curved spacetime

Orbital precessions must be accounted for

Newton — Einstein

4π vs. 8π

G — G+SR

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Newtonian Gravity

model the observed, long range attraction between two bodies of Matter
[exclusive of the close range electromagnetic interactions of each body]

A gravity field is produced by the charged topology of mass-Matter as it displaces vacuum energies and creates intrisic nullspace energy differentials

The strength of a Gravity field produced by Matter is proportional to the total EM mass-energy geometry/topology of any body and its convergent force can be modelled with equilateral Tetryonic geometries

Single Body Gravitational Field

$$F = -G \frac{M_1}{r^2}$$

Single Body Gravitational Field

$$F = -G \frac{m_2}{r^2}$$

Two Body Gravitational Field

$$F = -G \frac{M_1 m_2}{r^2}$$

However, unless it is at absolute zero all Matter topologies produce interactive EM fields that contribute to gravitational forces as evidenced with the perihelion of Mercury where later observations revealed inaccuracies in Newton's formulation for the motion of material bodies subject to convergent G forces & interactive EM fields

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Gravitational energies as a geometric mean

the geometric mean of two numbers is the square root of their product

EM standing waves [Matter] can be created and destroyed

EM mass-energies can be neither created or destroyed

Sir Issac Newton was the first to realise that gravity could be modelled as an inverse square Force

$$F = -G\frac{M_1 m_2}{r^2}$$

M

E

The Force of Gravity can be accurately modelled

Gravitational field of mass-Matter only

$$F_G = 4\pi G\rho$$

[ignoring EM interactions]

Gravitational energy of Matter in motion

$$G_{ab} = 8\pi G T_{\mu\nu}$$

[including KEM field interactions]

$$F_G = \frac{M_1 . m_2}{r^2}$$

$$F_G = \sqrt{M_1 . m_2}$$

as the convergent geometric MEAN of interactive superpositioned E-fields that represent the total mass-energies of the gravitational Matter

Gravity is the result of spatial energy density differentials created by the internal null-space volumes of Matter.
Energy (in all its forms) will seek to fill areas of lower pressure in search of universal equilbrium

Newton modelled the attractive forces between objects of Matter

GR models the energy density created by mass-Matter

Matter topologies are non-conservative and as they are destroyed the low pressure nullspace gradient [convergent gravitational Force] they created is replaced with conservative forms of radiative EM energy [interactive vacuum energies-photons]

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Gravitational Tidal Forces

The tidal force is a secondary effect of the force of gravity resulting from the geometry of massive bodies attracting each other.

Its geometric effects allow acceleration fields to be distingushed from pure graviation fields

Over a small area on the surface of a Gravitating body, gravitational attaction is often modelled as a uniform field acting downwards across the whole area.

The Gravity of a material body of mass-Matter has historically been defined as a strictly attracitve force between bodies

$$F = -G \frac{M_1 m_2}{r^2}$$

Tetryonics reveals Gravitation to be the nett result of 3 distinct interactions:
Convergent G-fields
Interactive E-fields and
Perturbative M-fields

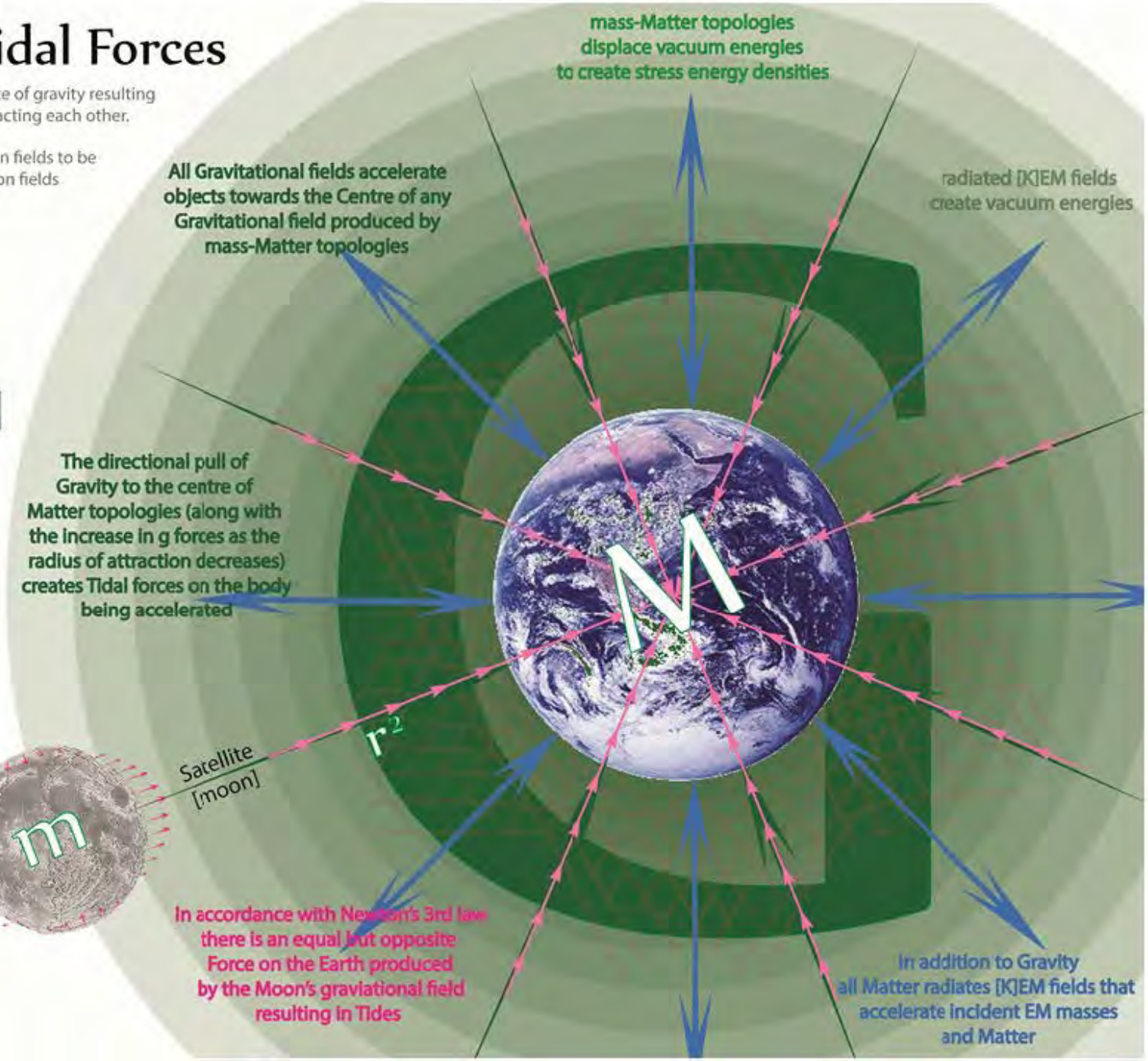

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Tetryonic Gravitation

is the result of the combined interactions
of radiant EM geometries & Matter topologies
in any spatial region of measurement

[k]EM fields & Vacuum energy gradients
create energy momenta pressure differentials
that accelerate Matter

3D mass-Matter topologies
create nullspace
vacuum energy differentials

Radiant EM mass-energy densities
create [k]EM and Vacuum Energy fields

$$F = -G\frac{M_1 m_2}{r^2}$$

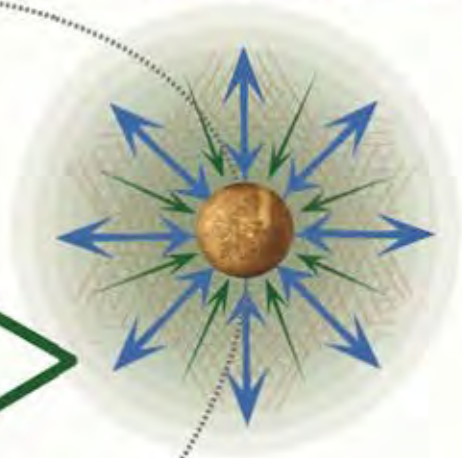

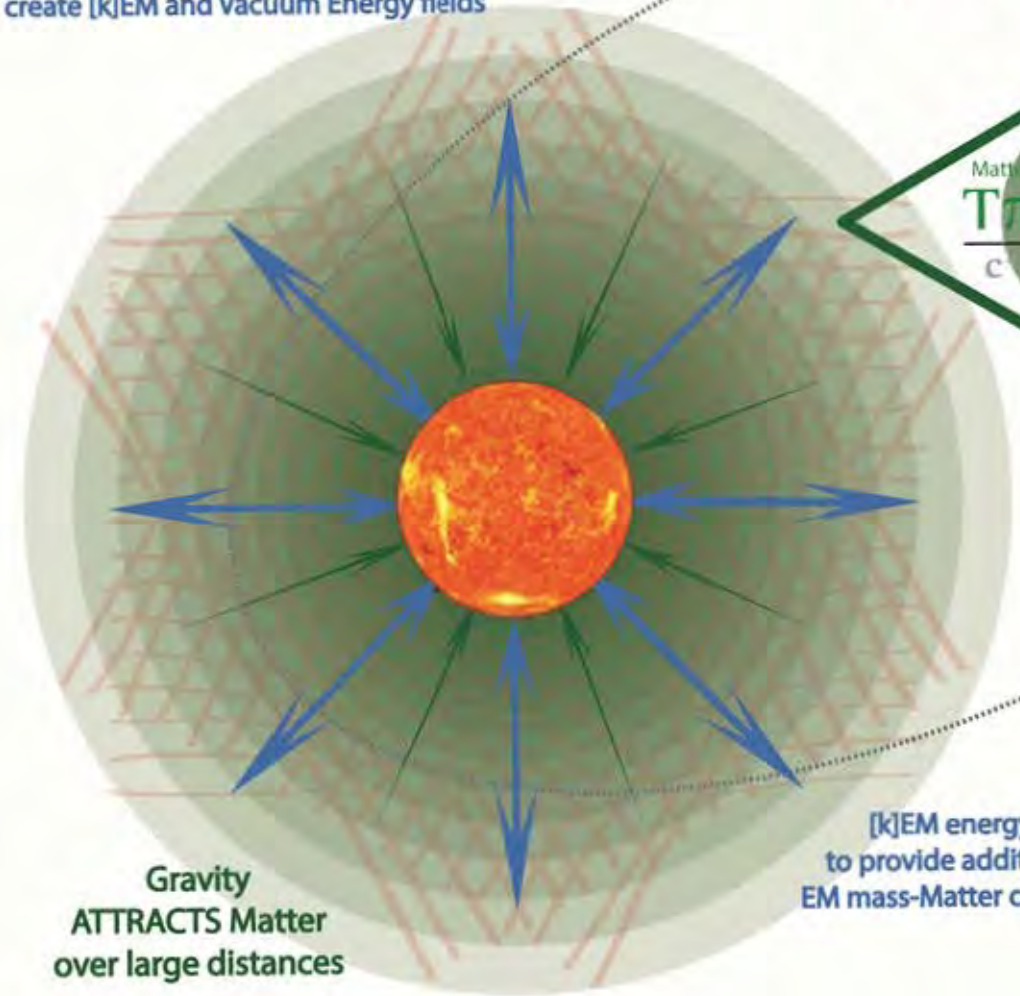

All massive bodies create interactive GEM fields
through their mass-energy geometries & Matter topologies
with convergent and divergent vectors of acceleration

[k]EM energy fields INTERACT
to provide additional acceleration to
EM mass-Matter close to material bodies

Gravity
ATTRACTS Matter
over large distances

$$G_{ab} = \kappa T_{\mu\nu}$$

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EM masses & Gravitational Matter

$\frac{\rho}{m^2}$

The core problem preventing the unification of Classical gravitation with QM & Relativity theory is the imprecise formulation, definition and differentiation between mass & Matter

$\frac{\rho}{m^3}$

$$F = ma$$

mass is a conserved quantity
Matter is not a conserved quantity

$$F = -G\frac{M_1 m_2}{r^2}$$

inertial mass
active gravitational mass
passive gravitational mass

$$G_{ab} = \kappa T_{\mu\nu}$$

Even GR offers no clear distinction

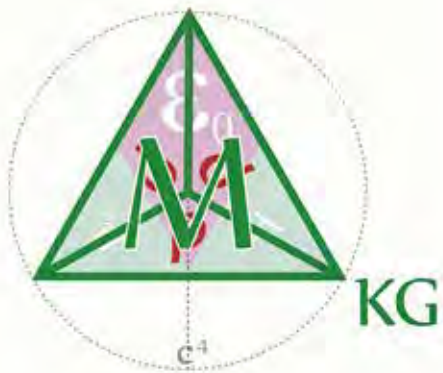

$$E = mc^2$$

radiant mass-energy geometry

General relativity has been heralded as a highly successful model of gravitation and cosmology, which has so far passed every unambiguous observational and experimental test.

$$E = Mc^4$$

standing-wave Matter topology

Even so, there are strong indications the theory is incomplete

Without a clear, concise understanding and accurate models of the relationship between mass & Matter [and their interactions] a Unified Field theory is impossible

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass — Energy — Planck quanta — mass — velocity

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter — Energy — Planck quanta — mass — velocity

mass is a geometric measure of a field's planar energy momenta content per unit Time

$$mc^2 = E = Mc^4$$

Matter is a topological measure of an object's planar mass-energy content per unit of Time

Note: in both cases the amount of Energy described is identical
It is the changing spatial co-ordinate systems used to measure Energy in all it forms
that allows for the differentiation betweeen mass-energy geometries & Matter-energy topologies

2D masses
bosons photons

3D Matter
Fermions, Baryons

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mass-ENERGY-Matter equivalence

Einstein's mass-energy equivalence can be further refined and differentiated through charge geometries [in turn creating a symetric mass-ENERGY-Matter equivalence formulation]

mass

standing-wave

topologies

The mass-energies of EM waveforms is contained within its charged geometry

$$E = mc^2$$

EM mass-energy is a property of Matter

radiant EM mass geometry

$$\frac{m}{c^2} = M$$

standing-wave Matter topology

$$m = \frac{E}{c^2}$$

$$\frac{E}{c^4} = M$$

radiant

geometries

Matter is NOT a property of EM mass-energy

$$E = Mc^4$$

The mass-energies of Matter is contained entirely within its charged fascia topology

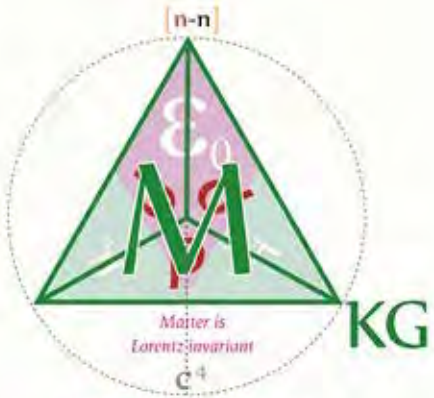

Matter

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Tetryonic unified GEM fields

Equilateral Tetryonic geometry/topology provides a unified quantum field equation to model all Gravito-Electro-Magnetic mass-ENERGY-Matter interactions

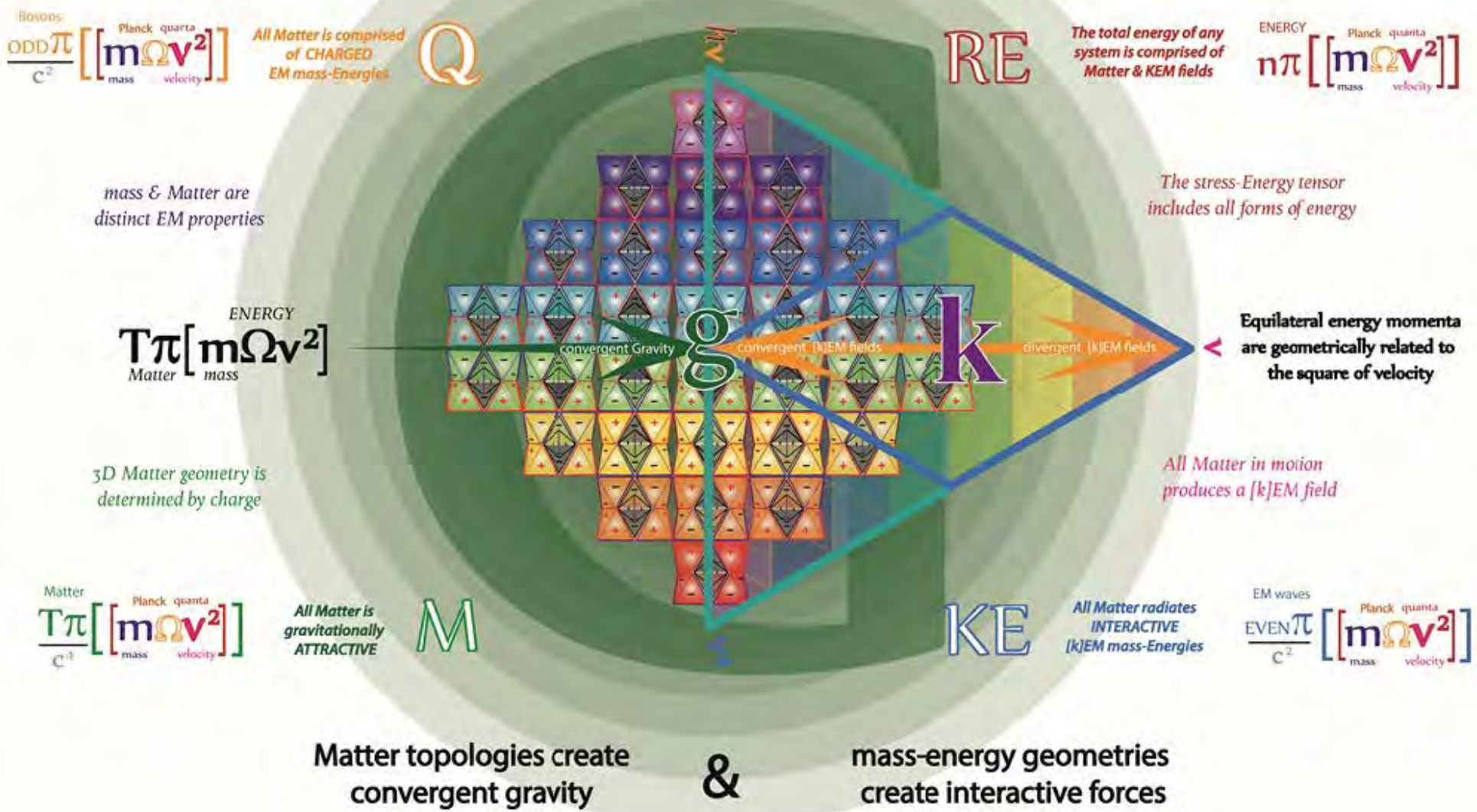

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Quantum Gravity

At present, one of the deepest problems of modern theoretical physics is the unification of General Relativity, which describes gravitation, and applies to large-scale structures (stars, planets, galaxies), with Quantum Mechanics, which describes the other three fundamental forces acting on the atomic scale

M

Newtonian Gravitation models observed motions of large-scale MATTER

$T_{\mu\nu}$

Einstein's GR models interactions of all mass-energy-Matter

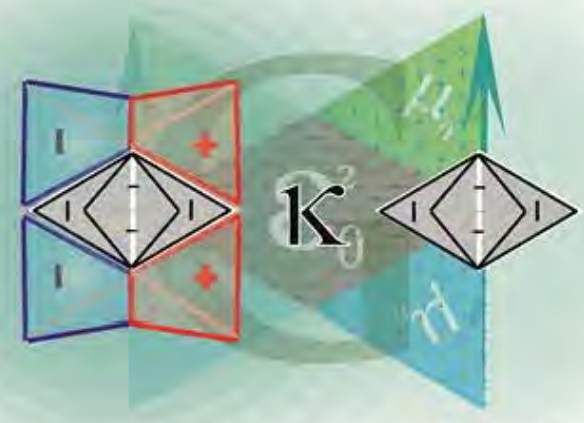

G

The large scale Cosmos is ruled by GRAVITY

k

The Quantum world is ruled by ELECTROMAGNETISM

There are major points of tension between Quantum mechanics and General relativity.

Firstly, classical general relativity breaks down at singularities, and Quantum mechanics becomes inconsistent with general relativity in the neighborhood of singularities

Secondly, it is not clear how to determine the gravitational field of a particle, since under the Heisenberg uncertainty principle of Quantum mechanics its location and velocity at any instant of Time cannot be known with certainty.

Thirdly, there is the Problem of Time in Quantum gravity. Time has a different meanings in Quantum mechanics and General relativity and hence there are subtle issues to resolve when trying to formulate a theory which combines the two.

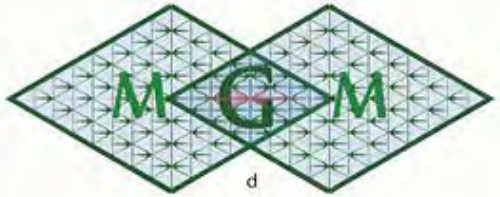

Gravitational attraction is a convergent Force between Matter

Newton

Gravitation results from energy density-pressure gradients

Einstein

Attempts to generalize ordinary quantum field theories, used in elementary particle physics to describe the fundamental interaction of gravity have to date led to serious problems.

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Gravitons

Gravitons are not required in Tetryonic theory as gravitational attraction is a convergent force created by the EM energy differential produced by 3D Matter topologies in a vacuum energy field

All standing-wave Matter geometries create Gravity

G

CONVERGENT Gravitation

Gravitons are the hypothetical carriers of the attractive Gravitational FORCE

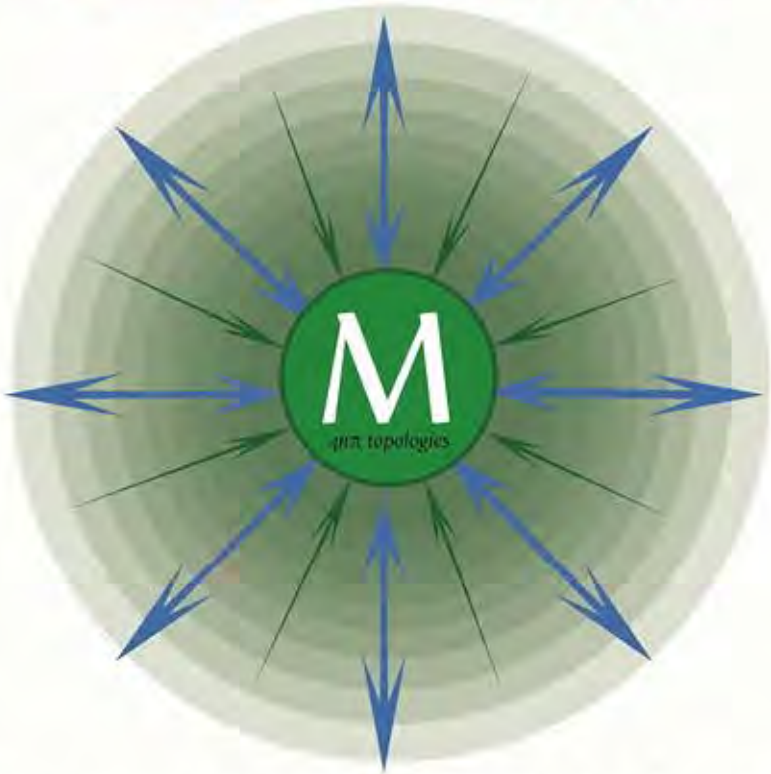

Radiant EM fields are produced by all Matter in motion

EM

DIVERGENT ElectroMagnetism

Photons are the carriers of the interactive ElectroMagnetic FORCE

Gravitons were proposed as the gravitational equivalent of the Photon in ElectroMagnetic theory but have never been detected

$4\pi G$

They were postulated because of the great success of quantum field theory (in particular, the Standard Model) at modeling the behavior of all other known forces of nature as being mediated by elementary particles: electromagnetism by the photon, the strong interaction by the gluons, and the weak interaction by the W and Z bosons.

$8\pi G$

The hypothesis was that the gravitational interaction is likewise mediated by a – yet undiscovered – elementary particle, dubbed the graviton. In the classical limit the theory would allow Newton's law of gravitation in the weak-field limit to conform with Einstein's field equations of General relativity

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Laplacian field interactions

The planar two-dimensional Laplacian is given by

$$\Delta = \nabla^2 = \nabla \quad \nabla = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2}$$

This fundamental differential operator of Applied Mathematics was introduced by Laplace in his 1782 study of the force of gravitational attraction exerted by spheroids and was named after him by Maxwell in his 1873 treatise on electromagnetism.

impedance of a medium — energy density — electric permittivity — field geometry — magnetic permeability

$$Z = \frac{\rho}{c^2} = \varepsilon_0 \mu_0$$

$$G_P = \kappa \frac{\rho}{c^4}$$

energy density pressure gradient — Einstein's constant — energy density — 4-vol volume

The net divergence of Positive charge fields is due to the anti-symmetry of their component Planck quanta

The net divergence of Negative charge fields is due to the anti-symmetry of their component Planck quanta

Δ *divergent field*

Δ^2 *interactive field*

Δ *divergent field*

$$E = \frac{\rho}{c^2 \mu_0}$$

$$B = \frac{\rho}{c^2 \varepsilon_0}$$

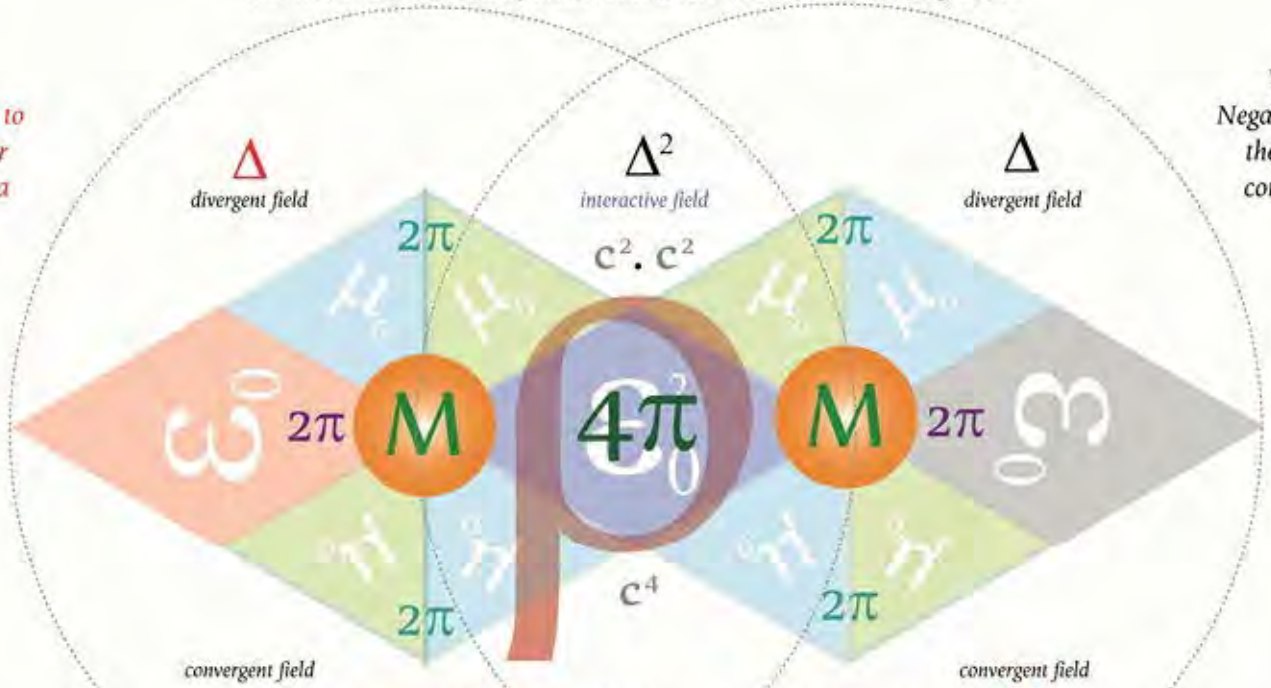

convergent field ∇

superpositioned [k]EM fields produce both convergent and divergent forces depending on the charges involved

convergent field ∇

The Laplacian of any scalar field is interpreted as being the limit of the net outward flux per unit enclosed area of this field through a closed contour surrounding the point of evaluation

$$\Delta\phi = \lim_{A \to 0} \frac{1}{A} \oint_{\partial D} \frac{\partial \phi}{\partial \nu} \, dl, \quad A = \mathrm{area}(D)$$

co-ordinate-free representation of the Laplacian

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Newton's Gravitational Constant has been shown to be a greatly reduced version of Coulomb's Electric Interaction Constant

$$\frac{Q\,k\,\kappa\,\rho\,G\,M}{r^2\;c^4}$$

Newtonian Gravitation models the observed convergent force of GEM interactions that results in the motion of large-scale Matter

Any compete Unified field equation for Gravitation must take into account both the Nullspace gravitation resulting from Matter topologies as well as the Coulombic 2D interaction fields that result from charge and the motion of Matter through the aether

Combined Interactive & Gravitational Forces

mass-energy-Matter

$$G_\rho = \kappa \frac{\rho}{c^4}$$

spatial volume

Coulomb's Law

$$P+\left[\frac{2\pi[mv^2]}{c^2}\right]^{[24\text{-}12]}\;k\;\left[\frac{2\pi[mv^2]}{c^2}\right]^{[0\text{-}12]}e-$$

KE [1-0] KE [0-1]

Q_1 c^4 Q_2

Coulombic [k]EM fields

Divergent [Interaction] radiative EM Fields

[k]EM interactive superpositioned EM fields of Force [k]EM

$$P+\left[\frac{T\pi[m]}{c^4}+\left[\frac{n\pi[mv^2]}{c^2}\right]\;\kappa\;\frac{n\pi[mv^2]}{c^2}\right]+\frac{T\pi[m]}{c^4}\right]e-$$

Matter — *convergent gravitational field of Force* — *Matter*

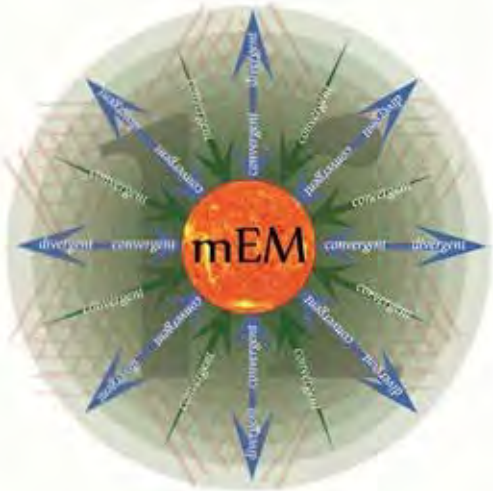

Newton's Law

$$P+\left[\frac{4n\pi[mc^2]}{c^2}\right]\;G\;\left[\frac{4n\pi[mc^2]}{c^2}\right]e-$$

M_1 M_2

[2,25e23] c^4 [1.2e20]

Gravitational Matter

Convergent [Attractive] Gravity Field

The observed net convergent force between objects of mass-Matter are the result of convergent G & interactive EM fields

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vacuum impedance $Z = \frac{1}{c^2} = \varepsilon_0 \mu_0$ electric permittivity, magnetic permeability

mass-energy density

$G_P = \kappa \frac{\rho}{c^4}$

spatial region

The energy density pressure gradient produced by the positive dispacement of vacuum energies by 3D standing-wave mass-Matter topologies is a strictly convergent force

$P = \frac{kT}{V}$

CHARGED mass-energy geometries create Matter topologies

Q

RE

mass-Matter-Vacuum energy displacements contributes to STRESS energies

M

All Matter is gravitationally ATTRACTIVE

m

Gravity fields produce a convergent inverse square force

mass-Matter topologies displace vacuum energies to create gravity

M

KE

All Matter radiates INTERACTIVE [k]EM mass-energy momenta

$$\nabla \phi \, grav = 4\pi G \rho$$

The pressure Force of Gravity is proportional to the amount of mass-Matter in a system and can be modelled with weak superpositioned E-field geometries

$$F = -G \frac{M_1 m_2}{r^2}$$

$$G = \frac{8\pi G}{c^4} T_{\mu\nu}$$

c^4

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Inverse squared interactive E-fields

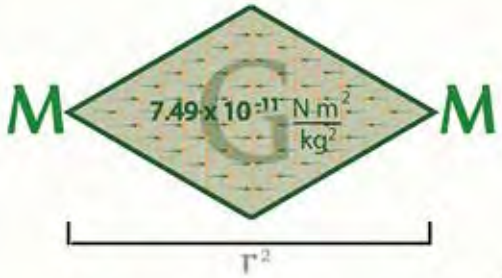

wherever mass-energies create standing-wave topologies they also create Gravity

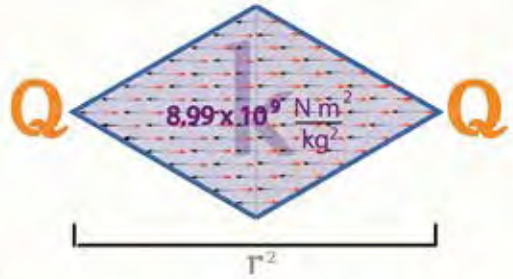

wherever there exists mass-energy imbalances energy will seek equilibirum via radiant EM fields

Although present, the Gravitational Attraction between quantum scale Matter particles is vastly overwhelmed by the Coulombic Interaction field resulting from the nett Charge Imbalances of Matter and its fields of motion

Protons have Stronger G fields than electrons but weaker [k]EM fields

electrons have Weaker G fields than Protons but stronger [k]EM fields

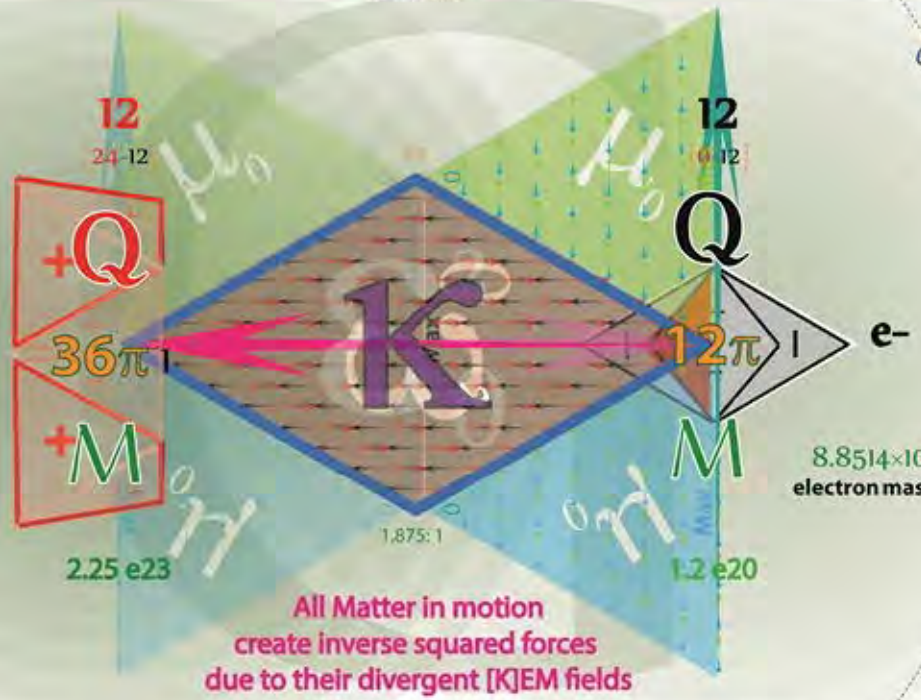

1.6596×10^{-27} KG
proton mass-Matter

8.8514×10^{-31} KG
electron mass-Matter

All Matter in motion create inverse squared forces due to their divergent [K]EM fields

M

Matter *mass-energy*
$36\pi * 25n^2$
topology *geometry*

KEM

superpositioned kEM fields create forces of attraction & repulsion
Gravity creates a strictly convergent force of attraction

Matter *mass-energy*
$12\pi * 1n^2$
topology *geometry*

[k]EM

G
c^4

mass-Matter topologies displace vacuum energies to form convergent gravity

Equilateral [k]EM mass-energies contribute to the total stress energies of any region

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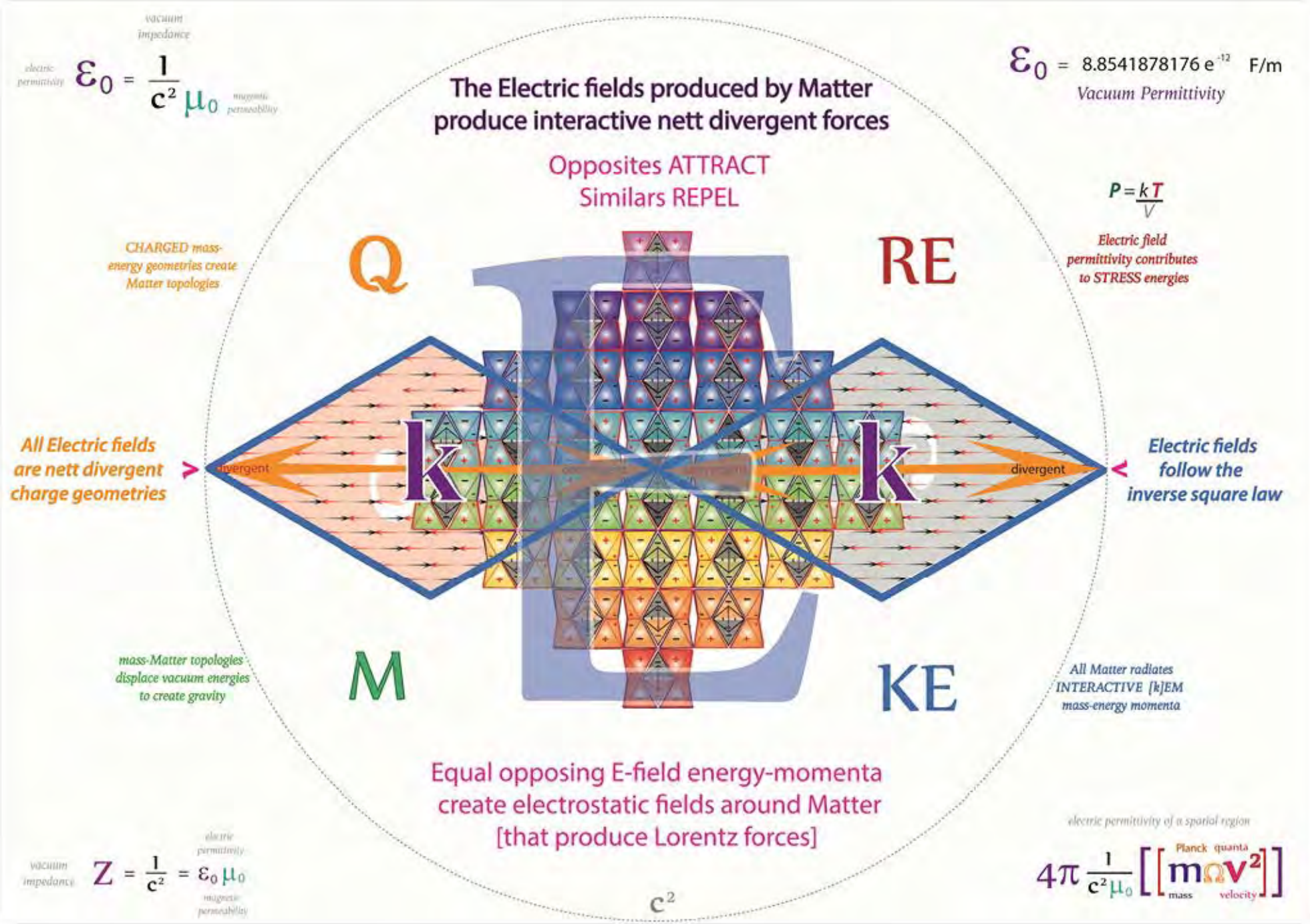

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Perturbative M-forces

ElectroMagnetism is a velocity dependent vector interaction that dominates the Gravitational attraction of Matter

G

M

Inertial viewpoint

G

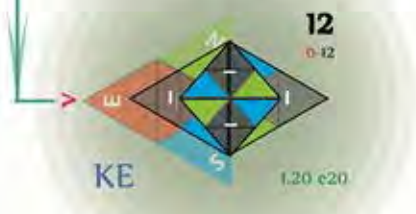

The Gravitational forces on the central particle are always equal irrespective of the inertial viewpoints

EM

Maxwells ElectroMagnetism
$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$
$\nabla \cdot \mathbf{B} = 0$
$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$
$\nabla \times \mathbf{B} = \frac{1}{\epsilon_0 c^2}\mathbf{J} + \frac{1}{c^2}\frac{\partial \mathbf{E}}{\partial t}$

[k]EM fields have electric and magnetic field components

The Tetryonic GEM model reveals the interplay of Convergent [Gravity], Interactive [E-fields] & perturbative [M-field] forces

Gravitational Matter is ALWAYS attractive vectorial ElectroMagnetic fields are interactive

Gravity can be modelled with pseudo-electric and pseudo-magnetic field components

GravitoElectroMagnetism
$\nabla \cdot \mathbf{E}_g = -4\pi G \rho_g$
$\nabla \cdot \mathbf{B}_g = 0$
$\nabla \times \mathbf{E}_g = -\frac{\partial \mathbf{B}_g}{\partial t}$
$\nabla \times \mathbf{B}_g = -\frac{4\pi G}{c^2}\mathbf{J}_g + \frac{1}{c^2}\frac{\partial \mathbf{E}_g}{\partial t}$

G

The sign of the effect is different (attraction in one case, repulsion in another), but this is just because in electromagnetism the sign of the electric part of the acceleration is opposite that of gravity: electric charges of the same type repel each other, while in gravity two massive objects attract.

Apart from this sign, there is such a close analogy to magnetism that this velocity-dependent gravitational effect is often termed Gravito-magnetism

G

M

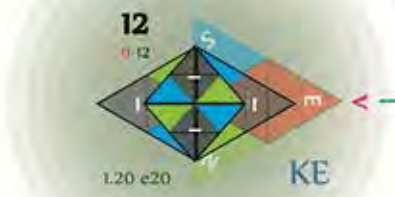

G

Inertial viewpoint

The ElectroMagnetic forces resulting from inertial motion in a different frame of reference produces different KINETIC [EM] forces

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vacuum impedance

magnetic permeability $\mu_0 = \frac{1}{c^2 \varepsilon_0}$ electric permittivity

$\mu_0 = 1.2566370614\, e^{-12}$ N/A^2

Vacuum Permeability

The Magnetic fields of Matter produce perturbative interactions

$P = \frac{kT}{V}$

Magnetic field permeability contributes to STRESS energies

CHARGED mass-energy geometries create Matter topologies

Q

RE

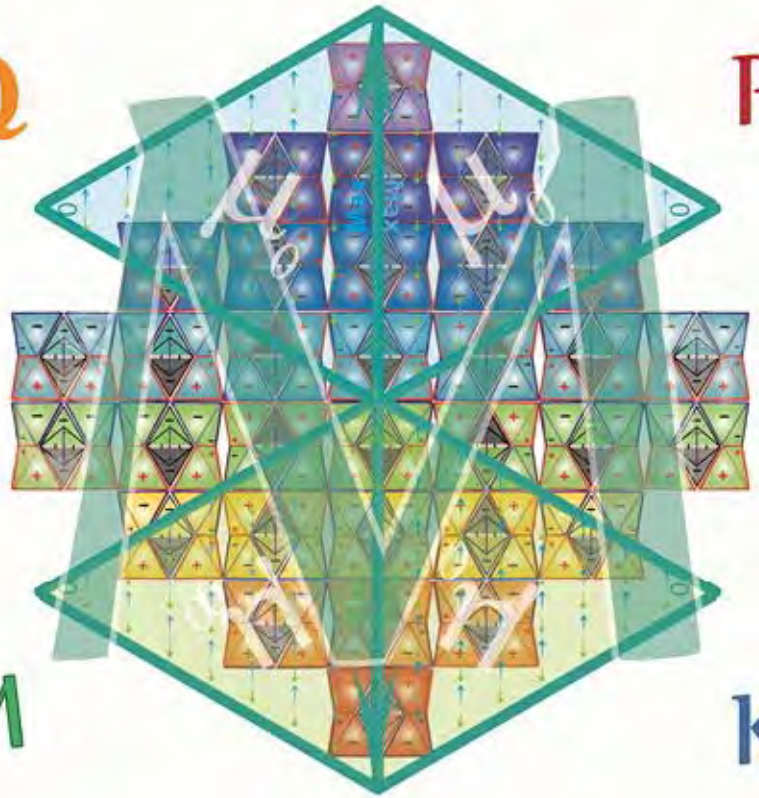

Magnetic dipoles follow the inverse cubed law

Magnetic fields follow the inverse square law

mass-Matter topologies displace vacuum energies to create gravity

M

KE

All Matter radiates INTERACTIVE [k]EM mass-energy momenta

Matter posesses a secondary magnetic moment that is subject to Lorentz forces

vacuum impedance $Z = \frac{1}{c^2} = \varepsilon_0 \mu_0$ magnetic permeability

electric permittivity

c^2

magnetic permeability of a spatial region

$4\pi \frac{1}{c^2 \varepsilon_0} \left[\left[m \Omega v^2 \right] \right]$

Planck quanta

mass velocity

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Gravitational & EM fields

Any unified Field equation that attempts to accurately model celestial scale gravitational attraction must also take into account KEM field interactions between the bodies resulting from their respective motions

Q

RE

1:0.0123

M

K

G

m

Gravity is created by vacuum energy displacement produced by Matter topologies in vacuum energy fields

along with displaced Vacuum energy gradients

Interactive E-fields and perturbative M-fields

also contribute to the nett convergent gravitational field

M

KEM

All Matter produces a nett Gravitational [convergent] force as a direct result of its mass-Matter topologies & KEM mass-energies

mass-Matter

5.9736×10^{24} KG

Earth

2.8673e26 π

displacement topology

interactive KEM field mass-energy momenta

$$\left[\frac{4n\pi}{c^4}\left[\rho_{mass}\right]_{Matter,\ Energy} + \left[\frac{2n\pi}{c^2}\left[\rho\right]_{EM\ mass} \quad \kappa \quad \frac{2n\pi}{c^2}\left[\rho\right]_{EM\ mass}\right] + \frac{4n\pi}{c^4}\left[\rho_{mass}\right]_{Matter,\ Energy}\right]$$

r^2

Gravitational gradients can be modelled as weak KEM fields

mass-Matter

7.3477×10^{22} KG

moon

3.526e24 π

displacement topology

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Independently and almost simultaneously in1964 three groups of physicists proposed the proposed the Higgs mechanism thorugh which the inertial mass properties of Matter are created: François Englert and Robert Brout; by Peter Higgs (inspired by ideas of Philip Anderson); and by Gerald Guralnik, C. R. Hagen, and Tom Kibble.

The Higgs mechanism was incorporated into modern particle physics

by Steven Weinberg and Abdus Salam, and is an essential part of the standard model.

As the Universe cooled and the temperature fell below a critical value, an invisible force field called the 'Higgs field' was formed together with the associated 'Higgs boson'

The Higgs mechanism is a process by which vector bosons can obtain mass

M

TETRYONS / FERMIONS / BARYONS
3D tetrahedral standing-waves
[4nπ EM mass-Matter topologies]
interact with the vacuum energy aether

Matter

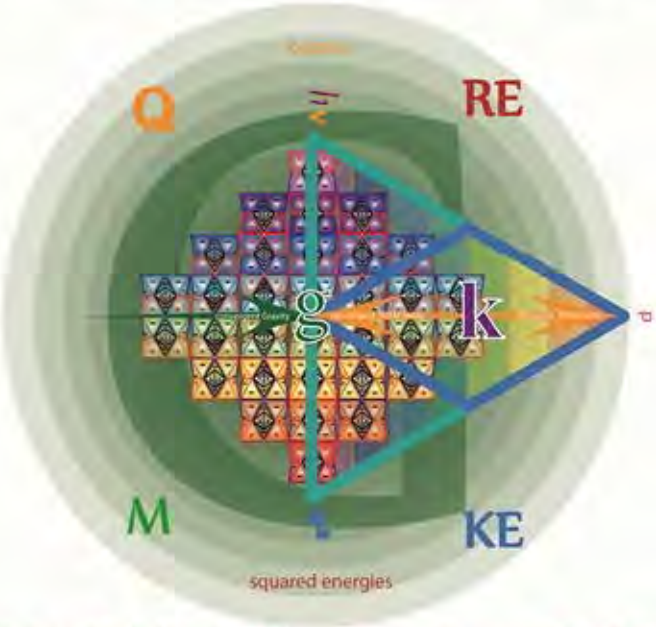

m

BOSONS / PHOTONS
2D planar matterless fields
[nπ EM mass-energy geometries]
'slice' through the vacuum energy aether

EM masses

Tetryonics is a full relativistic unified theory of electromagnetic mass-ENERGY & Matter and motion in which the classical properties of inerital mass and quantum mechanical quantised energy momenta are explained as being direct result of the geometric properties of inductive equilateral energies moving through external electromagnetic fields

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Applying the Unified Field Equation

for ElectroMagnetic masses & Matter interactions

All Matter has a 4π standing-wave mass-energy topology

Matter topologies

$$G_{ab} = 8\pi G T_{\mu\nu}$$

The net gravitational force is the geometric mean of all EM mass-ENERGY-Matter interactions

All kEM waves have 4π superpositioned mass-energy geometries

mass-ENERGY geometries

$$-G\frac{M_1 m_2}{r^2} = F$$

$$F = k\frac{Q_1 Q_2}{r^2}$$

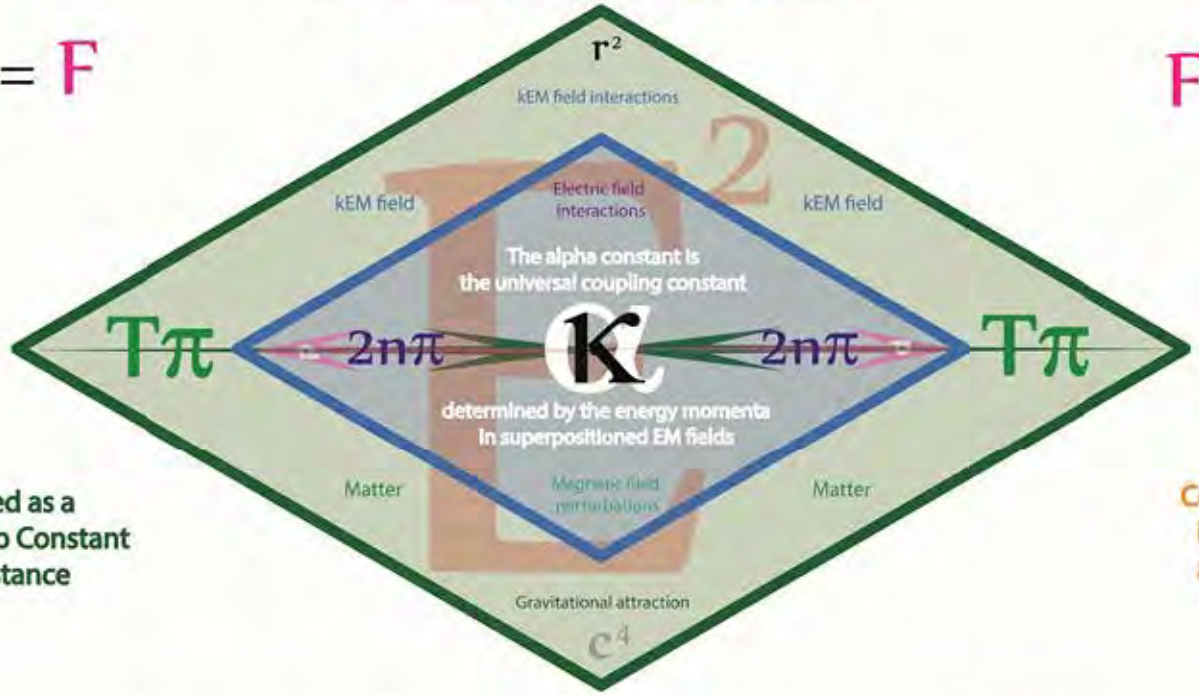

G

k

Gravity can be modelled as a reduced negative Coloumb Constant acting over a large distance

Coloumb's Constant is a large interactive Electric constant acting over a short distance

Tetryons - 4π
Leptons - 12π
Quarks - 12π
Mesons - 24π
Baryons - 36π

Charges - 1π

Photons -2π

EM Fields - 2nπ

Ignoring interactive [k]EM field interactions reduces GR [k] to Newtonian [G]

$$G_{ab} = 4\pi G T_{\mu\nu}$$

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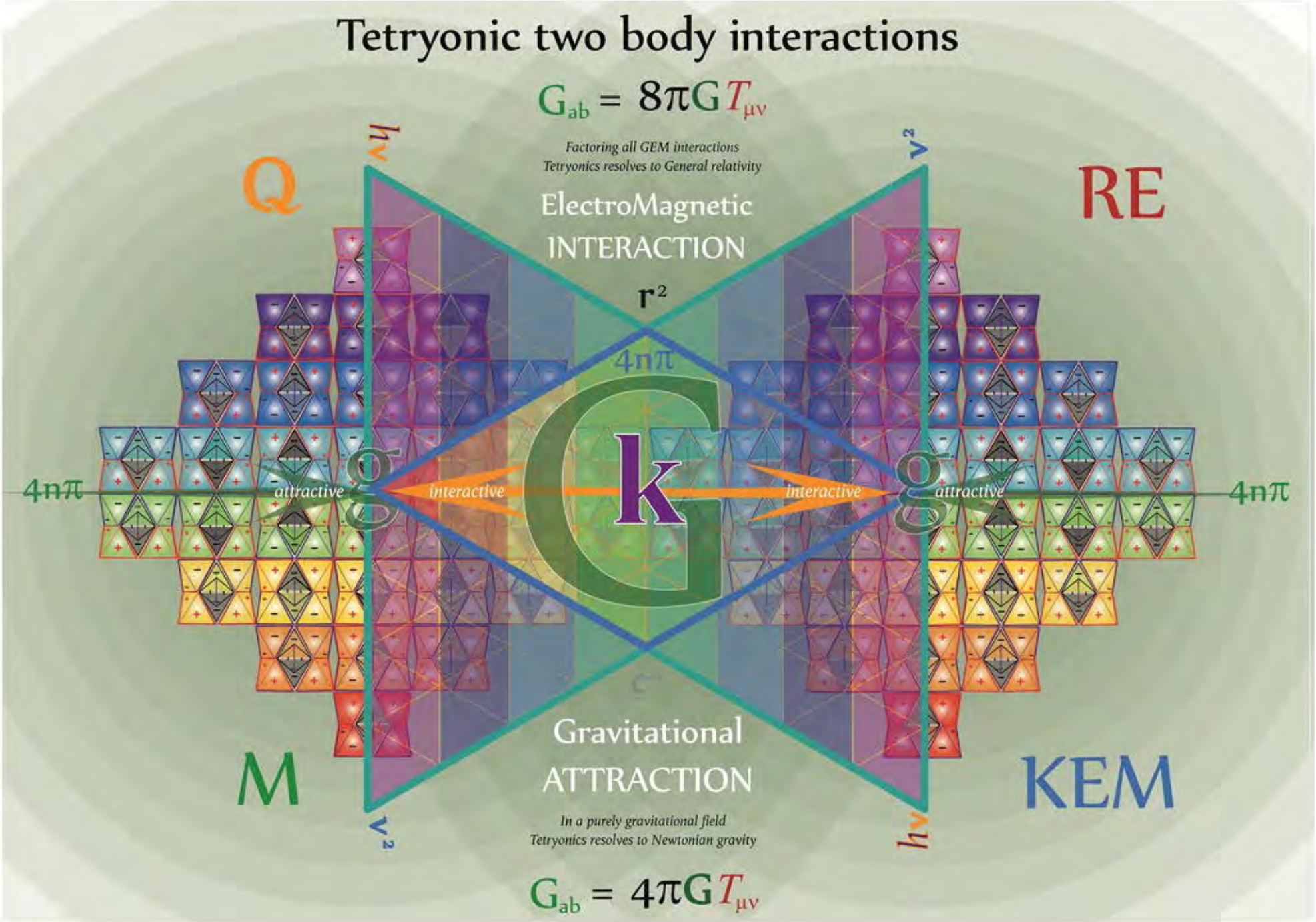

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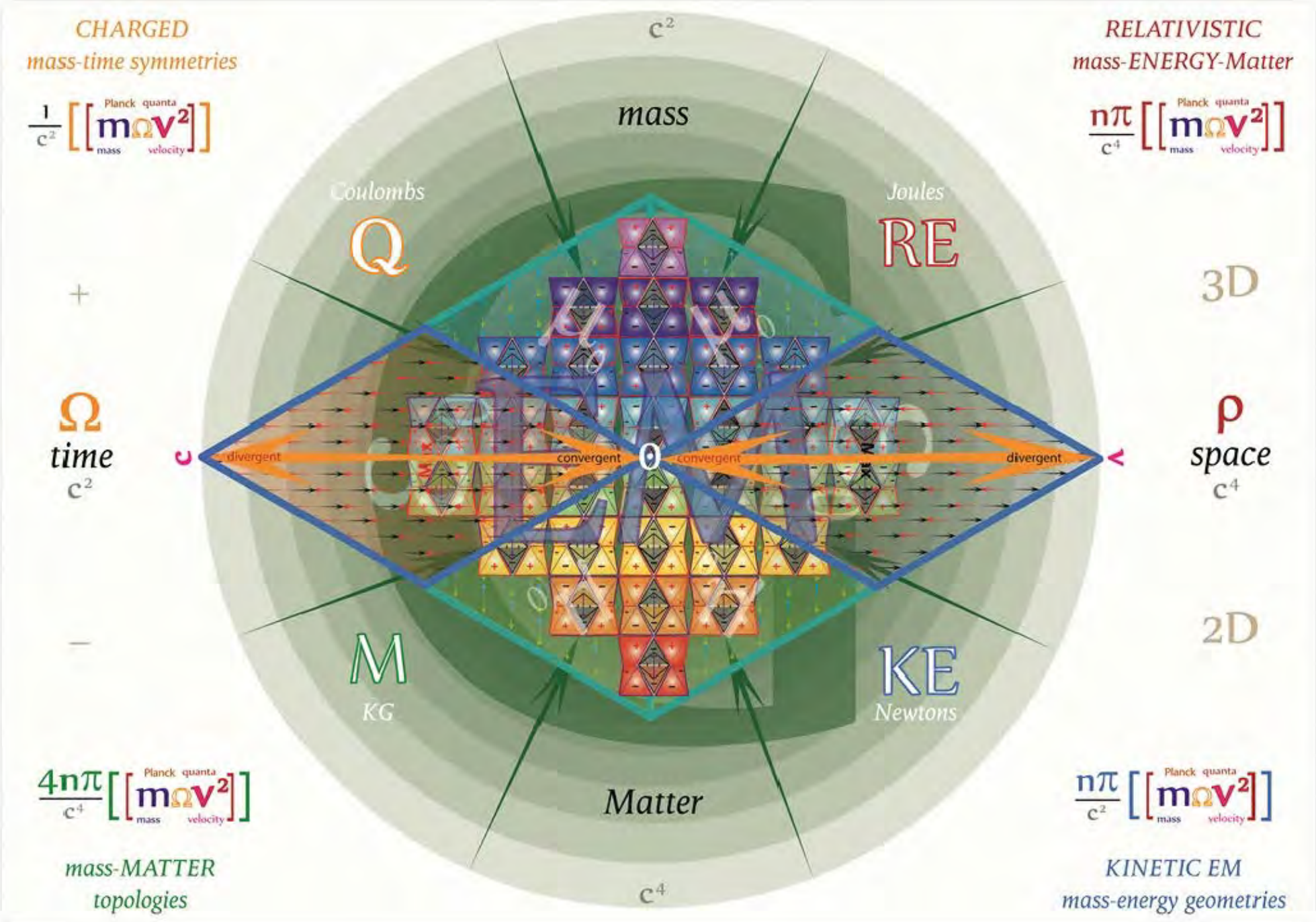

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Our EM SUN

The SUN (like the Planets) is a CHARGED body moving through an EM environment

G & E fields obey the inverse SQUARED laws

The nett Charge of a body is the result of an excess of one type of energy quanta and is reflective of their charged topologies [ie ionised Matter]

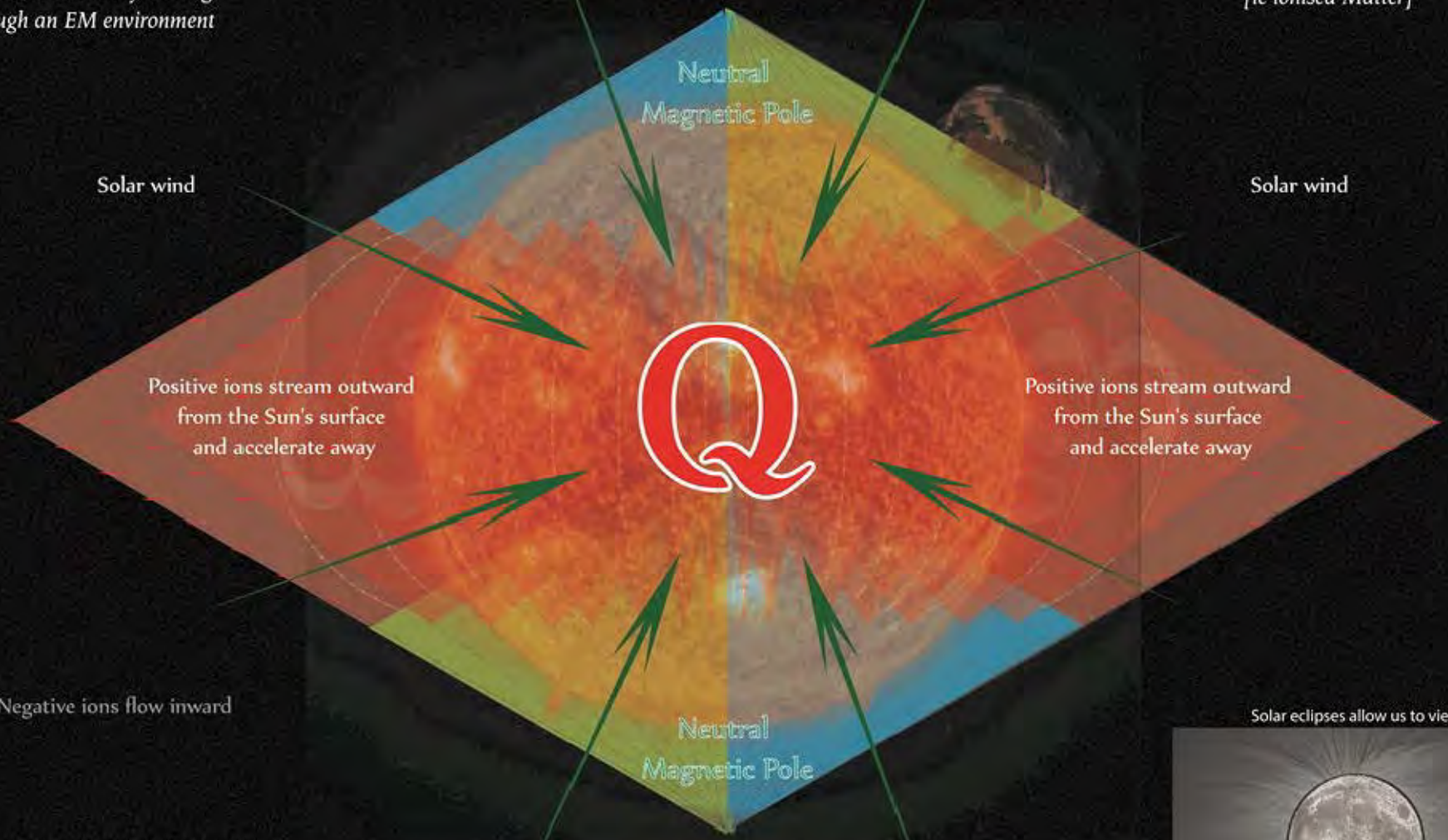

The charged E field [heliosphere] of our SUN interacts with other charged planetary bodies

Magnetic dipole fields follow the inverse CUBED law

Solar eclipses allow us to view

the SUN's EM corona in detail

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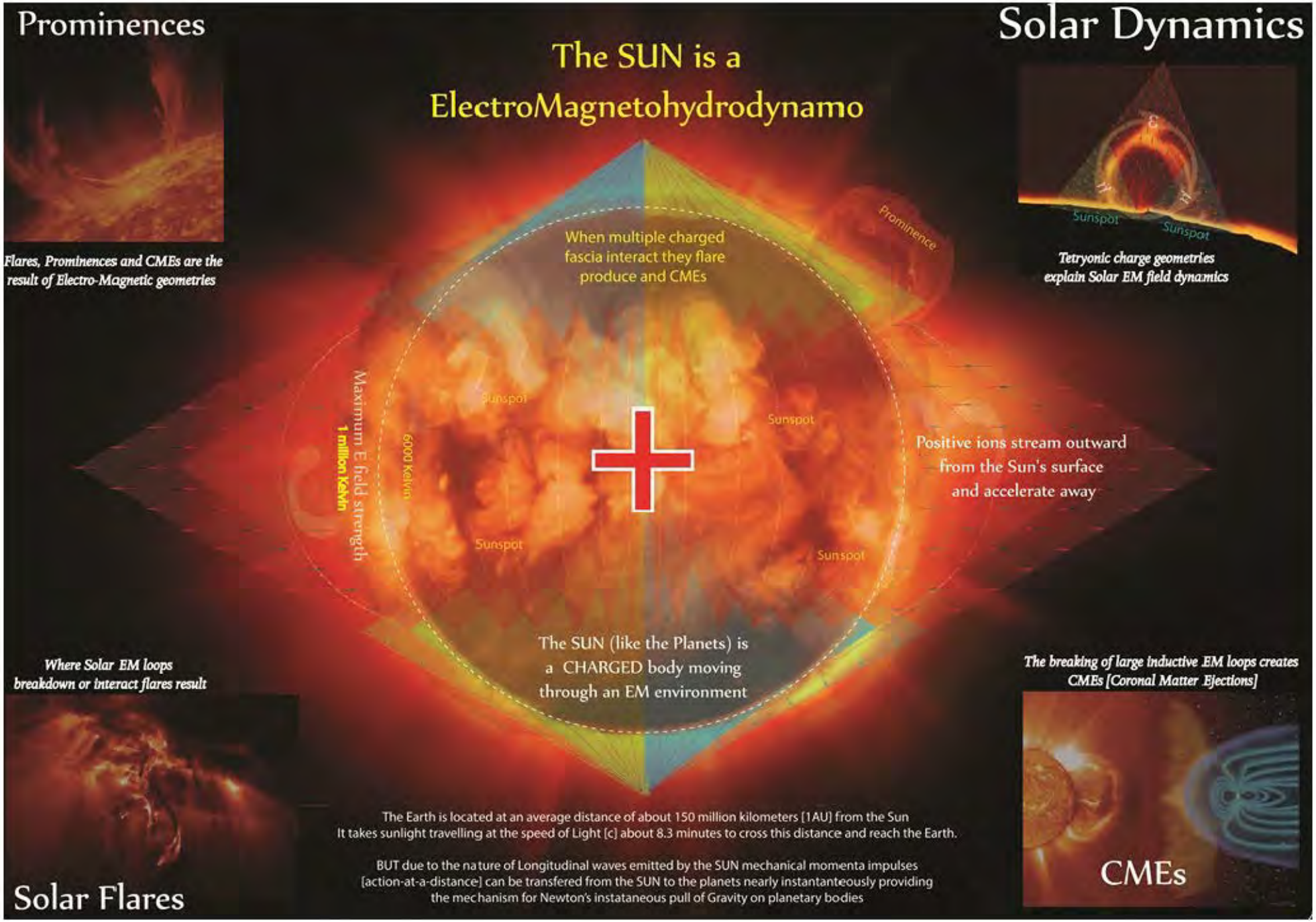

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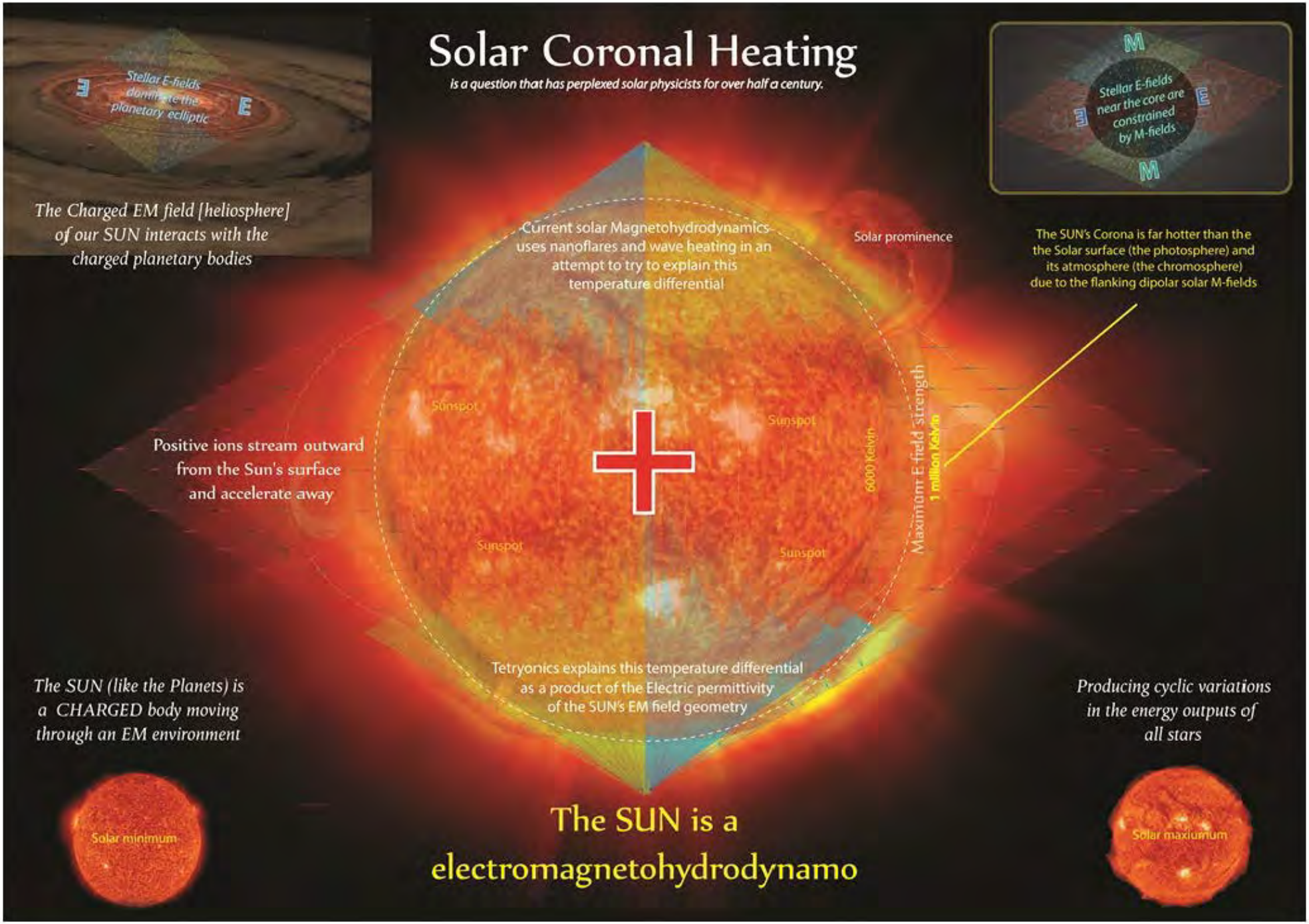

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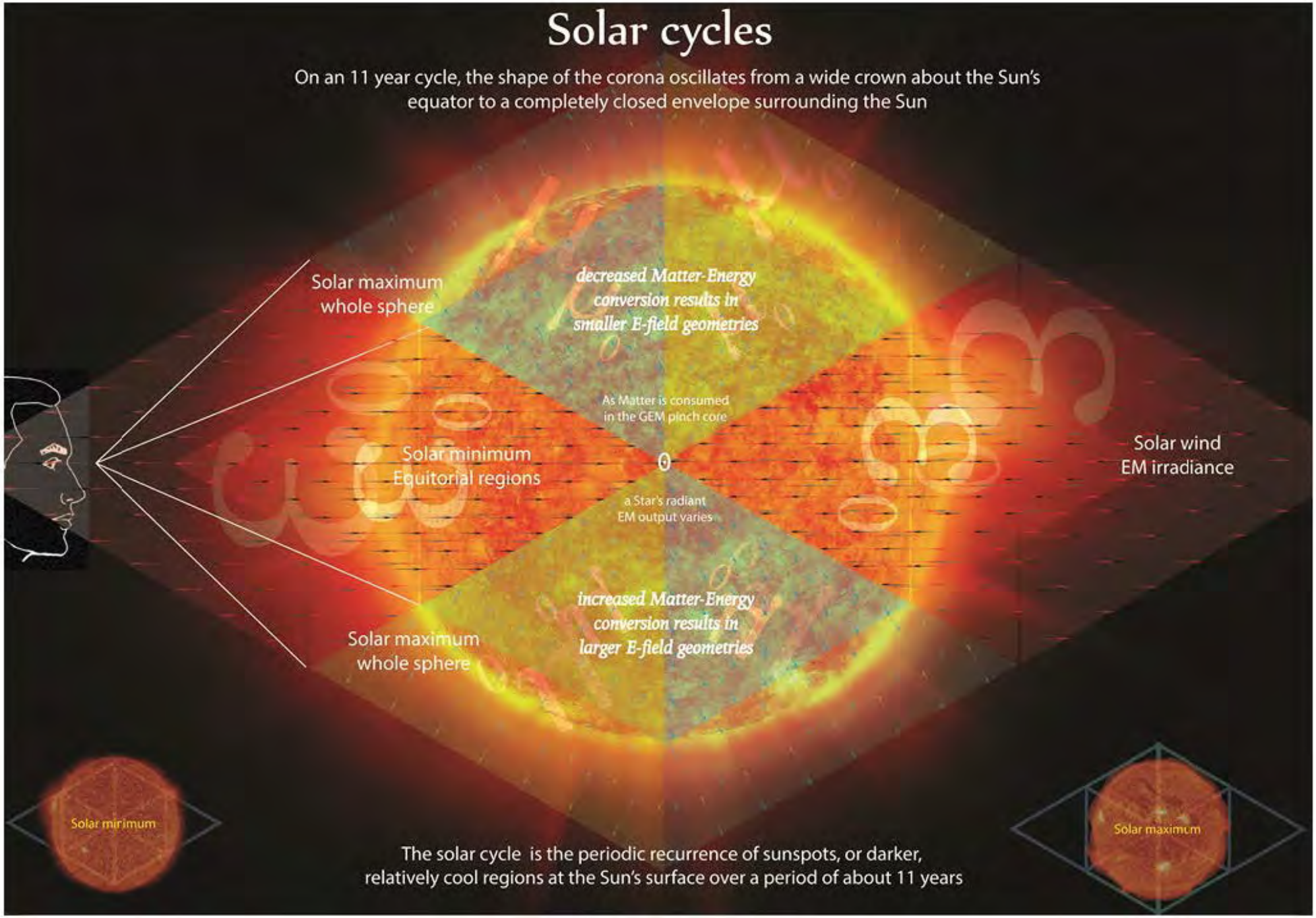

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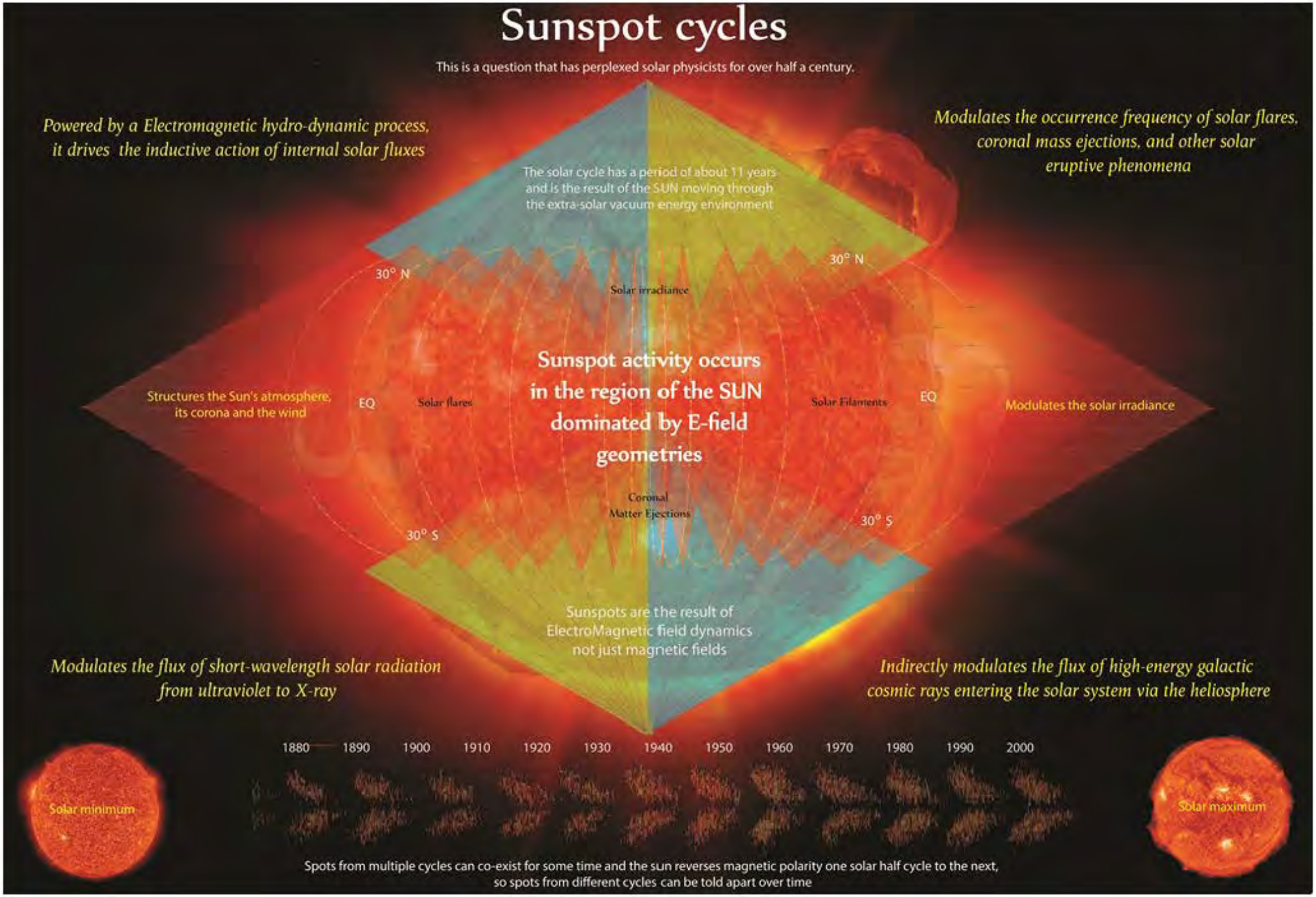

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Solar irradiance

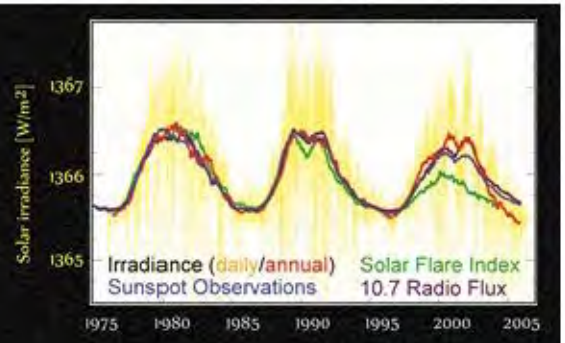

Solar EM mass-energy irradiation

is a measure of the total incident levels of solar EM radiation recieved by the Earth's upper atmosphere in a given unit of time.

It is not the same as measuring the amount of EM radiation emitted from the surface of the SUN.

It can be stated that solar irradiation is the amount of EM energy transmitted from the SUN to the Earth's outer atmosphere.

This measurement is normally done in square units per units of time.

Solar irradiance [W/m²]

The set amount of solar energy recieved by the Earth's atmosphere is called the solar constant.

The most recent value measured for the Solar Constant is 1368 Watts per meter squared.

The Solar constant has an inverse relationship to the solar irradiance of the SUN's surface reflective of Earth's distance from the SUN.

It shows how the massive amouts of EM energies emitted by the sun is scaled down to what is used by every biosystem on the planet.

The SUN is an ElectroMagnetic pinch reactor

The Sun emits longitudinal EM radiation across most of the electromagnetic spectrum.

The basic causes of the solar variability and solar cycles are still under debate, Tetryonics dictates a EM mechanism for the energies produced at the core of Stars and that the variability of the stellar outputs may be due to changes in the ElectroMagnetic environment that Stars [and their planetary systems] move through

The spectrum of the Sun's solar radiation is close to that of a black body with a temperature of about 5,800 K.

Solar irradiation produces Carbon 14

An extremely long stretch of low activity in recent years has left scientists baffled and searching for a better model of the SUN's interal processes and how to forcast its output in order to establish a better link between the solar cycle and global climate flucuations

The total solar irradiance (TSI) is the amount of solar radiative energy incident on the Earth's upper atmosphere

Changes in the SUN's EM output can have a direct effect on the weather and electrical activity of the Earth and other planets

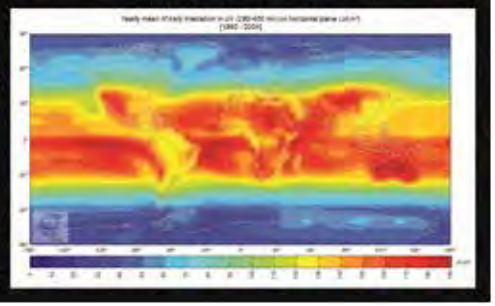

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Stellar refraction of EM waves

Any test of General Relativity using photons (or EM waves) will only measure SR interactions
[ie Gravitational red-shifting is a SR effect on EM masses not graviational Matter]

G

The motion of Matter is affected by gravitational attraction and EM interactions

EM

The motion of EM masses is affected by EM interactions and creates refraction

Photons are NOT 'bent' by Gravitational fields they are refracted by propagation velocity changes resulting from their EM interactions with the solar corona

$$\alpha[\text{einstein}] = \frac{8\pi GM}{c^2}$$

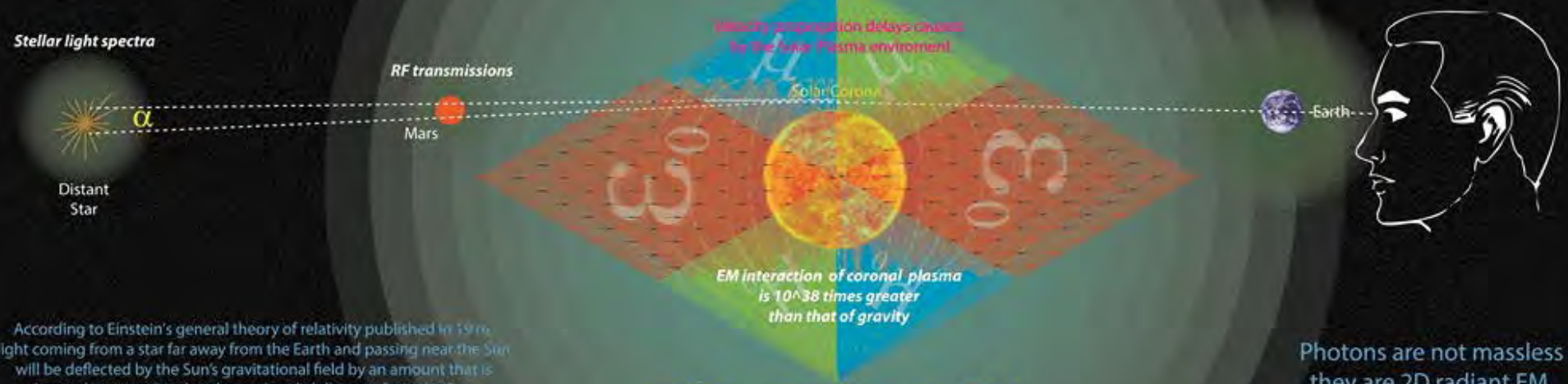

According to Einstein's general theory of relativity published in 1916 light coming from a star far away from the Earth and passing near the Sun will be deflected by the Sun's gravitational field by an amount that is inversely proportional to the star's radial distance from the Sun

1.745" at the Sun's limb
(this is the result of EM refraction NOT Matter gravitation)

$$\alpha[\text{newton}] = \frac{4\pi GM}{r}$$

Photons are not massless they are 2D radiant EM mass-energy momenta geometries

r

The additional 'bending' of light rays as they pass by a Gravitational body as predicited in Einstein's general relativity is caused by refractive EM interactions not by the force of gravity

4π

4π

c^2

Gravitation in General relativity is Newton's Gravity with SR corrections

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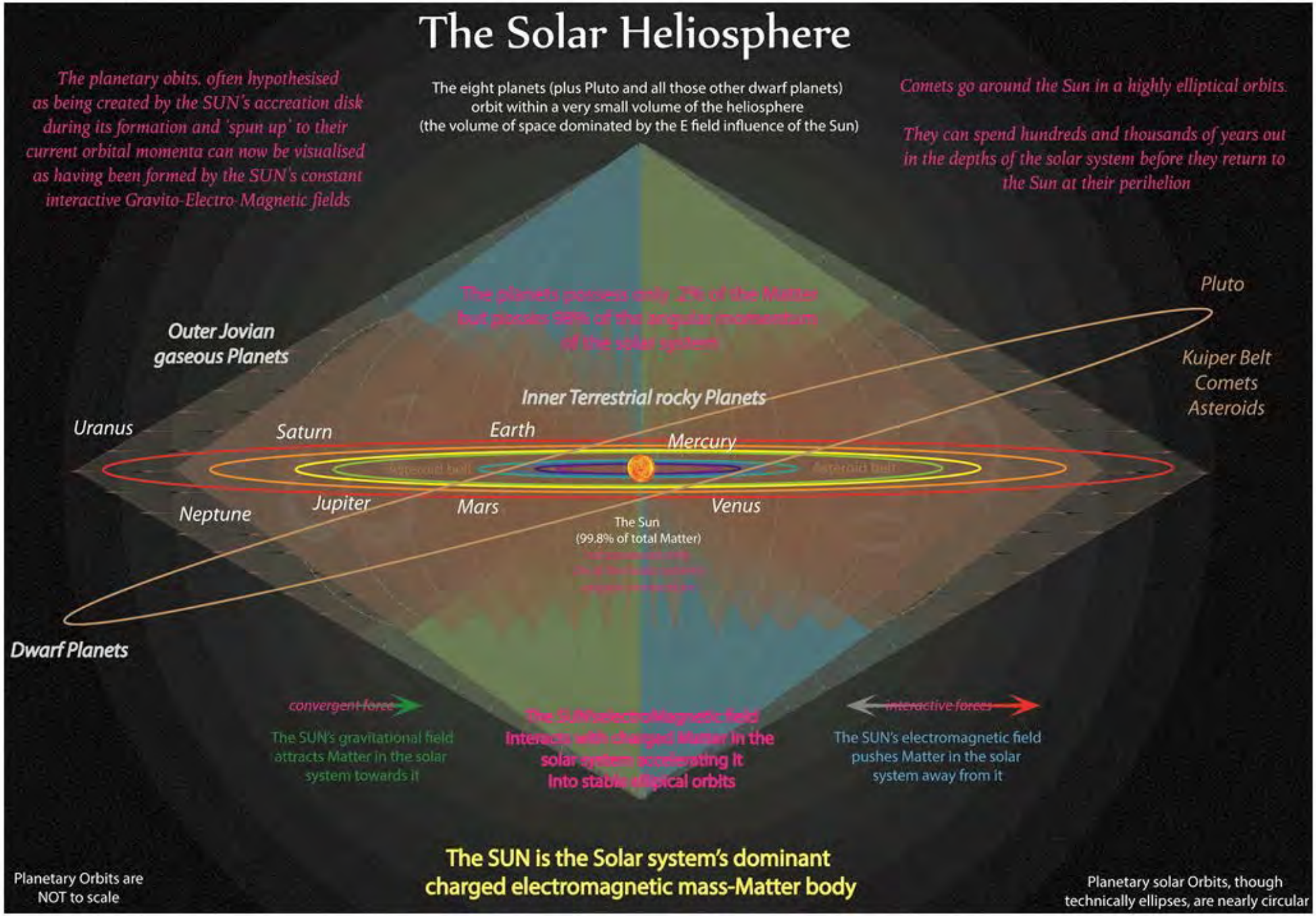

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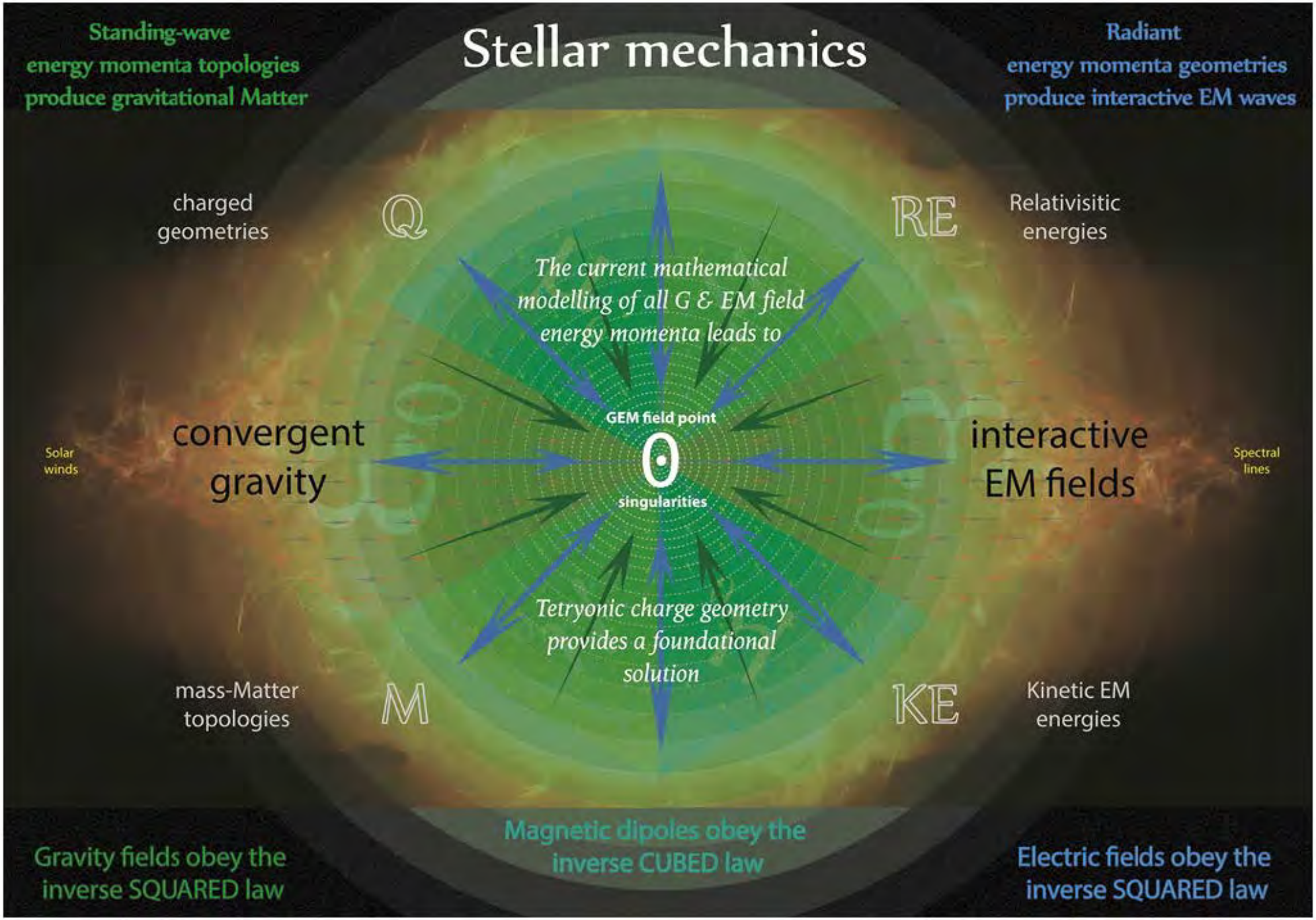

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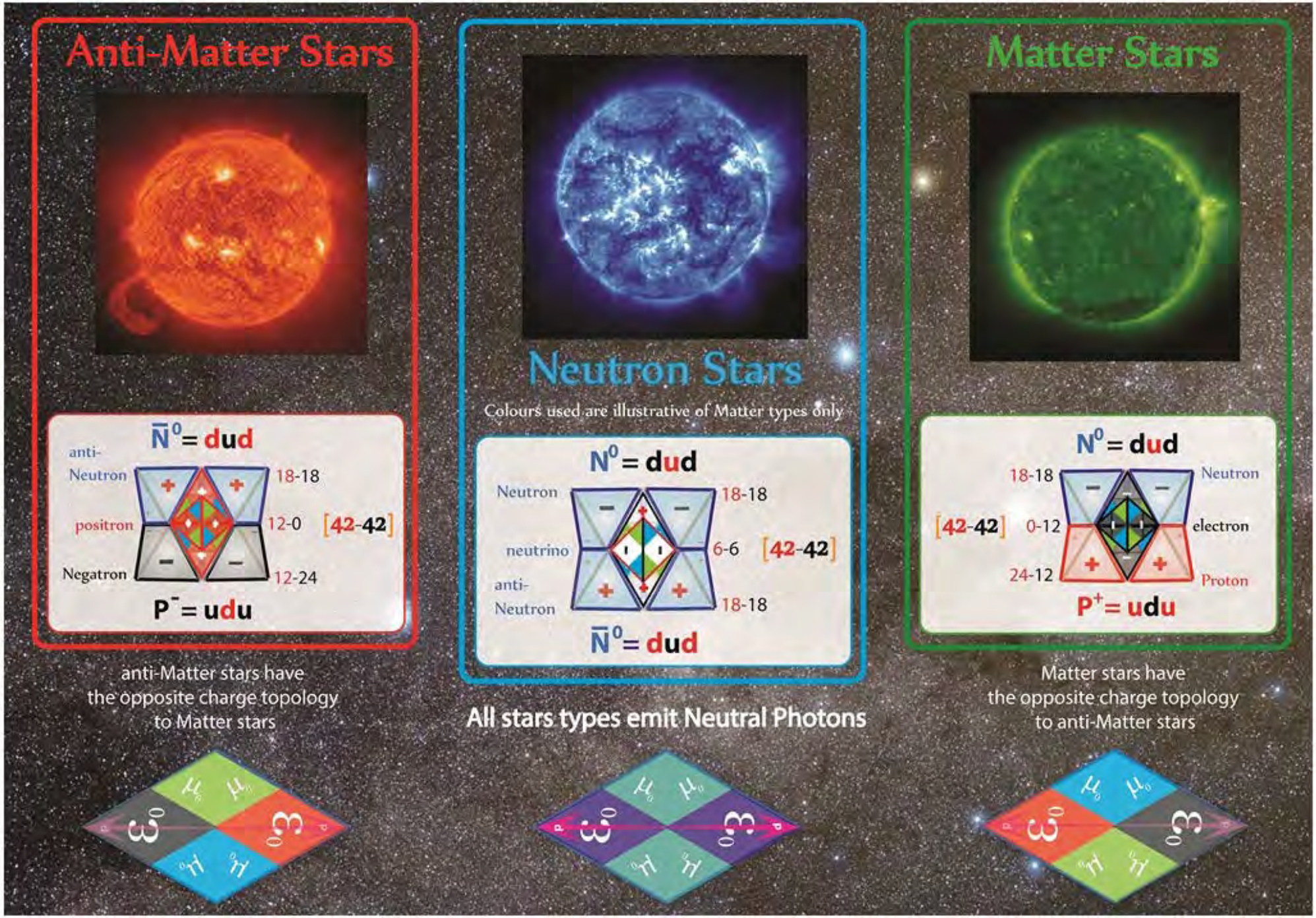

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Star classifications

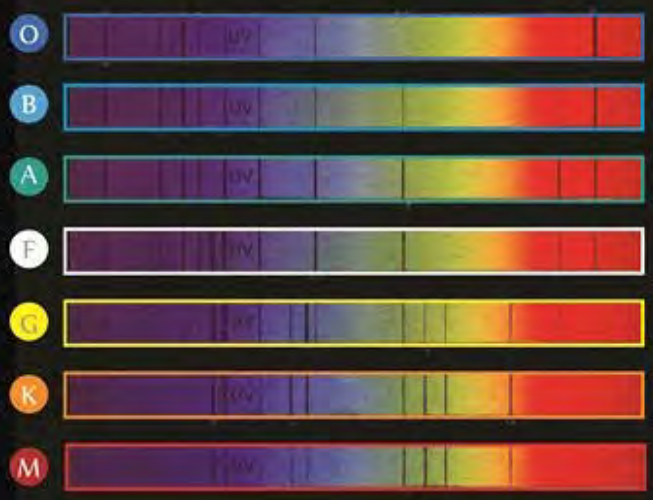

The greater the EM mass-energies radiated in a given volume of space the higher the Temperatures

White dwarves

Average Matter in Small volumes

The greater the voume for a given amount of radiated EM mass-energy the 'cooler' the Frequency of light produced from stellar processes

O
≥ 16 M

Blue giants

Greater mass-Matter in Larger volumes

B
2.1–16 M

A
1.4–2.1 M

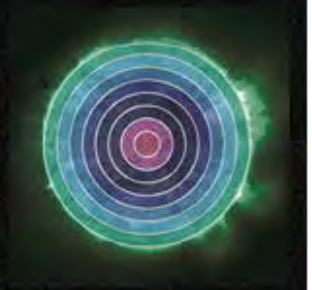

Red giants

Less mass-Matter in Larger volumes

M
≤ 0.45 M

K
0.45–0.8 M

G
0.8–1.04 M

F
1.04–1.4 M

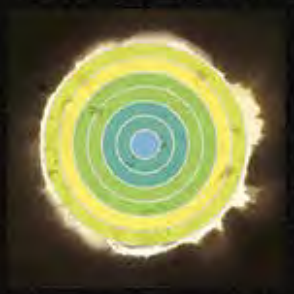

Main sequence

Average mass-Matter in medium volumes

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Nucleosynthesis

The goal of nucleosynthesis is to understand the vastly differing abundances of the chemical elements and their several isotopes as being a result of natural history

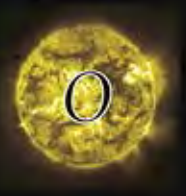

Nucleosynthesis is the process of creating new atomic nuclei from pre-existing nucleons (protons and neutrons)

All Stars have a dominant spectral colour and emit a multitude of spectral lines

All Stars emit various colour spectra that combine to form spectral lines reflective of the star's energy output

The CNO cycle describing element creation inside Stars is erroneous .....

All spectral lines can be produced by the excitation of stellar nuclei by photons released by GEM pinch Matter-Energy conversion

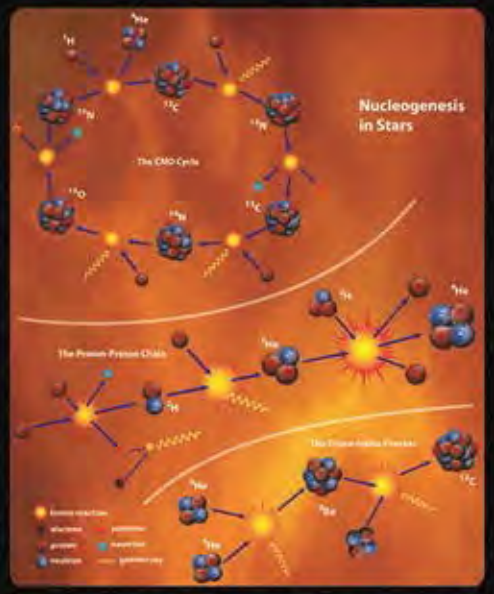

Elements in the Sun

Element	% of total atoms	% of total mass
Hydrogen	91.2	71.0
Helium	8.7	27.1
Oxygen	0.078	0.97
Carbon	0.043	0.40
Nitrogen	0.0088	0.096
Silicon	0.0045	0.099
Magnesium	0.0038	0.076
Neon	0.0035	0.058
Iron	0.030	0.014
Sulfur	0.015	0.040

In 1920, Arthur Eddington was the first to suggest that stars obtained their energy from nuclear fusion of hydrogen to form helium.

The P-P Chain describing the FUSION of elements to release energy is erroneous .....

All Matter-Energy conversion inside Stars is the result of ElectroMagnetic Pinches

Nucleosynthesis problems such as the abundances of observed elements & low mass element synthesis remain open problems for the current theory

Despite intense efforts to create suitable conditions, FUSION as described in nuclear theory, remains an ellusive source of Energy

The CNO cycle and P-P reactions are incorrect theorical models, developed to explain the SUN's GEM pinch dynamics and broad spectral line emissions

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Solar Arc lamp spectra

spectral lines are produced by accelerating electrons

Energy-momentum relationship

$$E = mv^2$$

Q

RE

Elemental Spectra

Stellar

1 2 3 4 5 6 7 8 9 ⊙ Ni Fe Si Mg O N C He H

core

Quantum Energy levels [layers]

M

KE

Spectral line transitions

hν, R, β, p, KE
Planck, Rydberg, Lorentz, Newton, Leibniz

Spectral lines

KEM	
48	Lyman
108	Balmer
192	Paschen
300	Brackett
432	Pfund
588	Humphries
768	un-named

classical physics and relativity united through equilateral geometry

Astrophysicists and astronomers use arc lamps as spectral line reference sources for many elemental emission and absorption lines

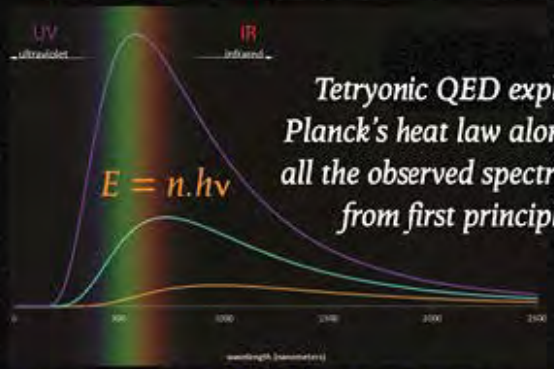

Tetryonic QED explains Planck's heat law along with all the observed spectral lines from first principles

$$\Delta hf = \Delta Mv = \Delta p$$

Planck's quantum radiation Law gives a energy distribution that peaks at a certain wavelength, Wien's Law explains the peak shifts to shorter wavelengths for higher temperatures, and the Stefan-Boltzman law explains the growth in the height [the area under] the curve with increasing temperatures

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Stellar spectral lines

$E = Mc^4$

Energy-mass-Matter equivalence

Z#
All elements have equal number nuclei components [P-e-N]

$\Delta mv = \Delta hf$
Excitation of photo-electrons in atomic nuclei produces spectral line emissions

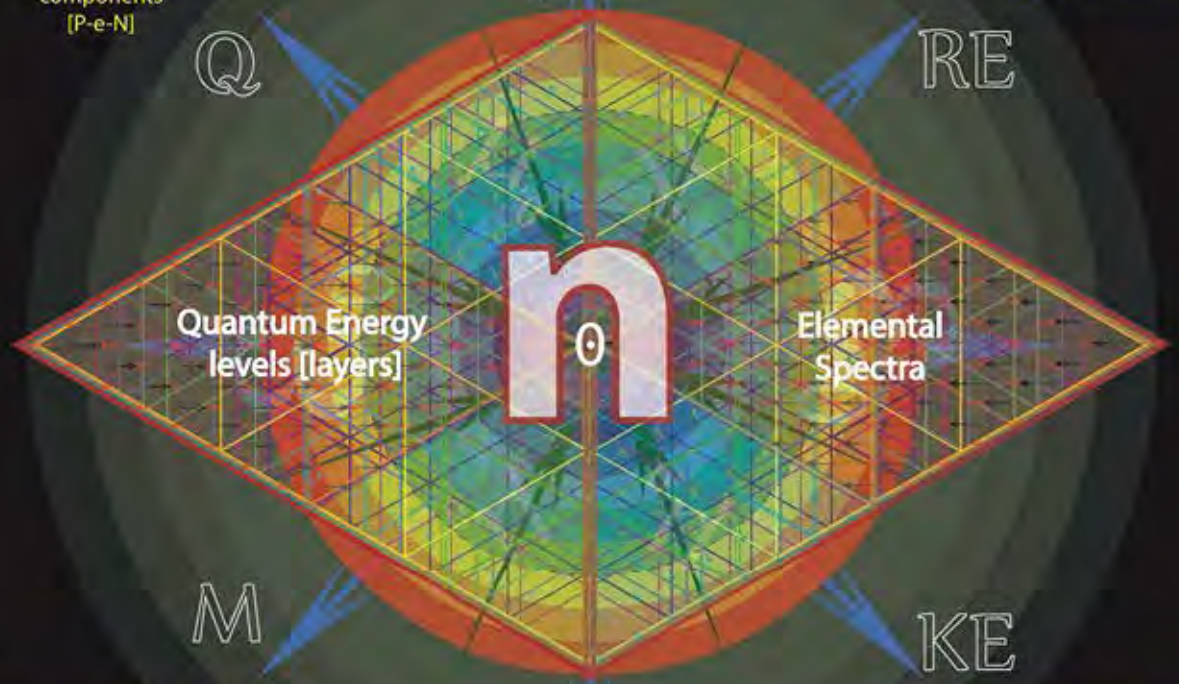

Energies released from the collapse of mass-Matter topologies in stellar cores is radiated as spectral mass-energies [GEM pinch]

mass-Energy equivalance

$E = mc^2$

The emissions from GEM pinch processes produce broad spectral lines that range from UV to IR rays *[& include white light]*

The spectral lines of all elements can be mimicked by Deuterium nuclei with rasied energy levels undergoing energy transitions

Tetryonic Electrodynamics

$hf = \Delta Mv = \Delta p$

spectral lines are produced by accelerating electrons

As energy is 'released' by the collapse of mass-Matter topologies in the stellar core they radiate outward raising the nuclear energies of the surrounding Matter which in turn radiate spectral series photons

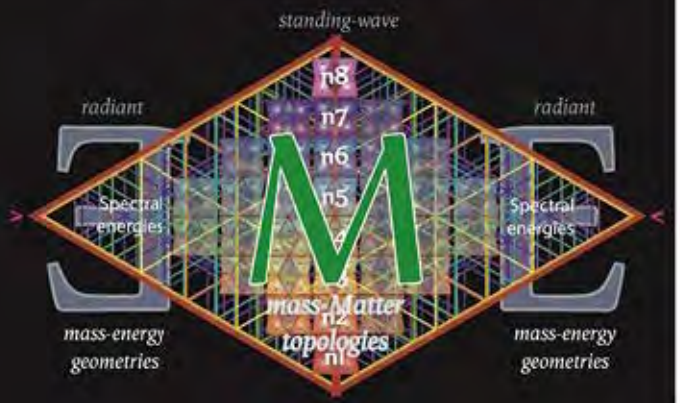

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Joseph von Fraunhofer

(6 March 1787 – 7 June 1826)

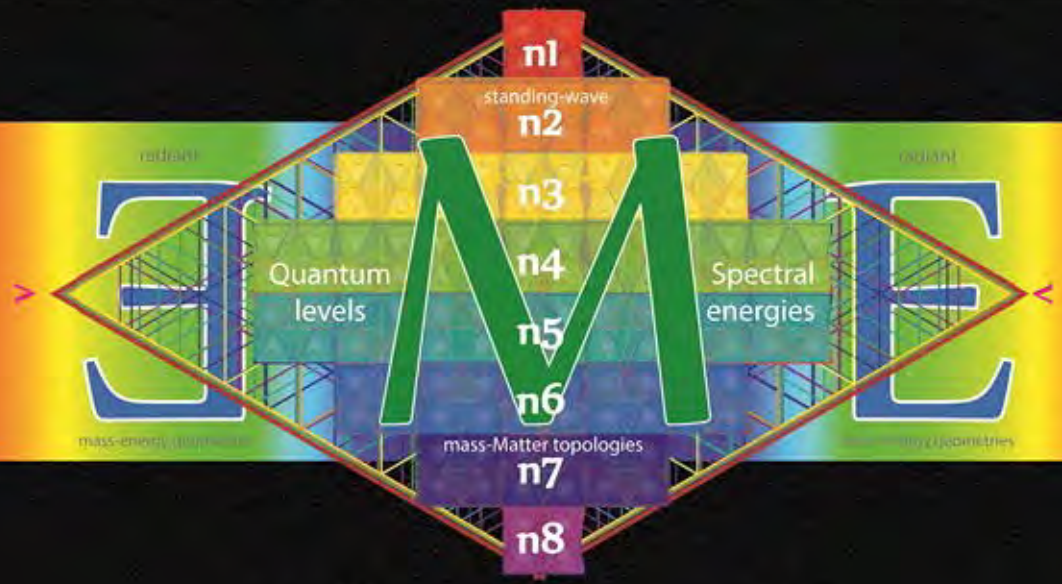

Annie Jump Cannon

(December 11, 1863 – April 13, 1941)

SPECTRAL SERIES

Lyman
Balmer
Paschen
Brackett
Pfund
Humphries

Stellar spectroscopy

Astronomical spectroscopy is the technique of spectroscopy used in astronomy. The object of study is the spectrum of electromagnetic radiation, including visible light, which radiates from stars and other celestial objects.

ATOMIC SHELLS

K
L
M
N
O
P

Spectral absorption lines are often referred to as Fraunhofer lines

QUANTUM LEVELS

In 1901 Annie Cannon improved upon the 1897 work of Harvard associate Antonia Maury to produce the Harvard spectral class

STELLAR CLASSIFICATIONS

Spectroscopy can be used to derive many properties of distant stars and galaxies, such as their chemical composition, and motion through Doppler shift measurements.

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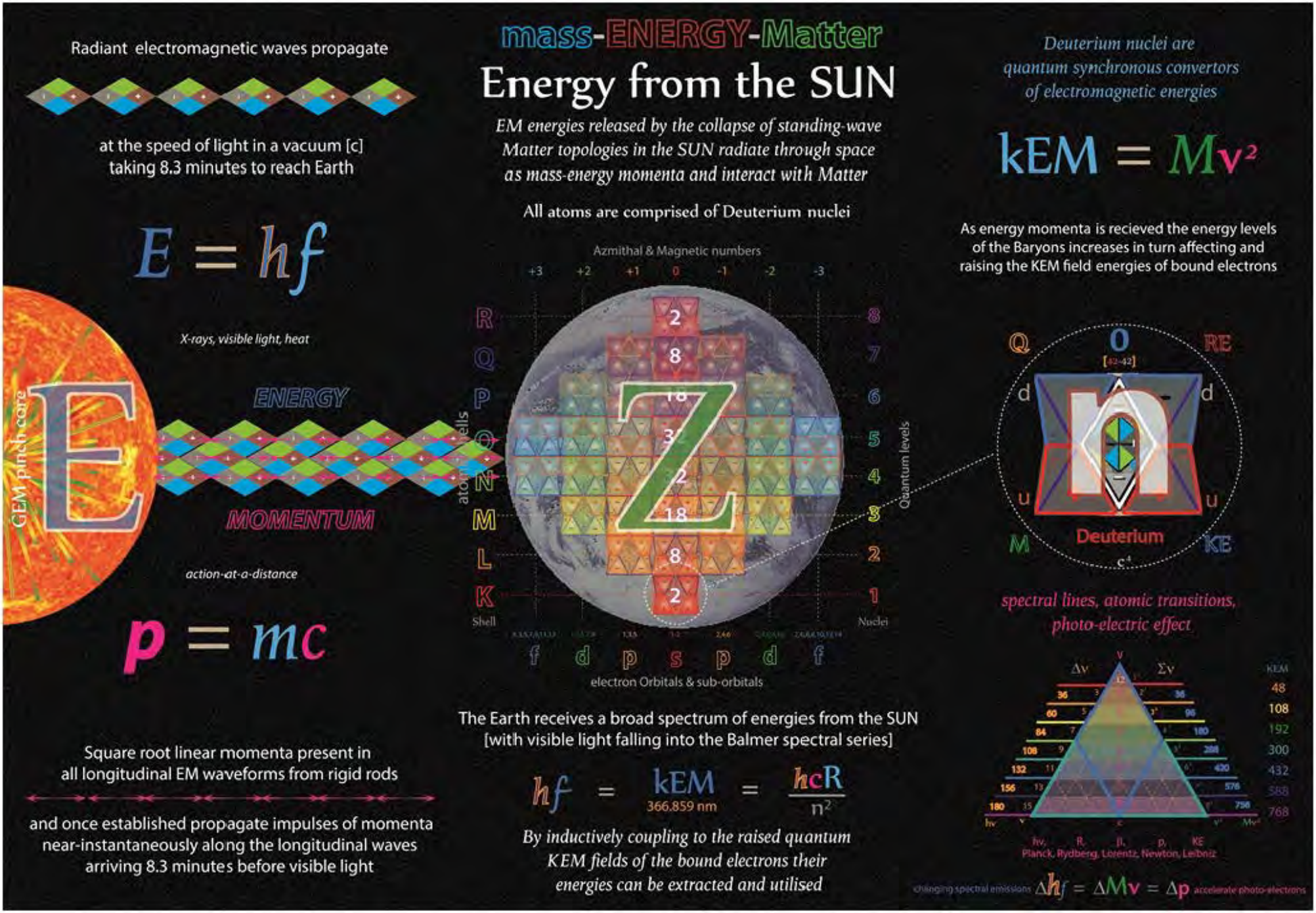

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Stellar Energies

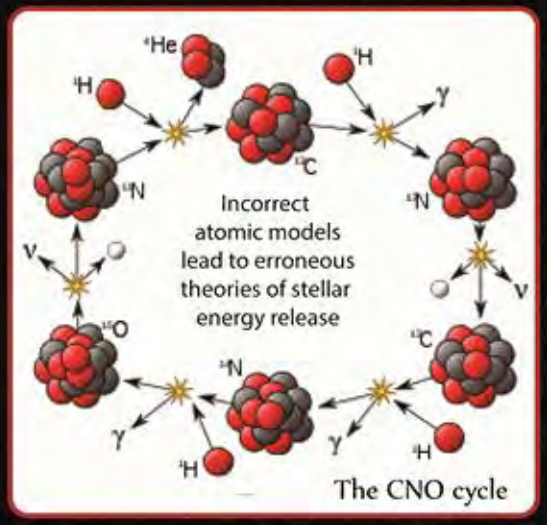

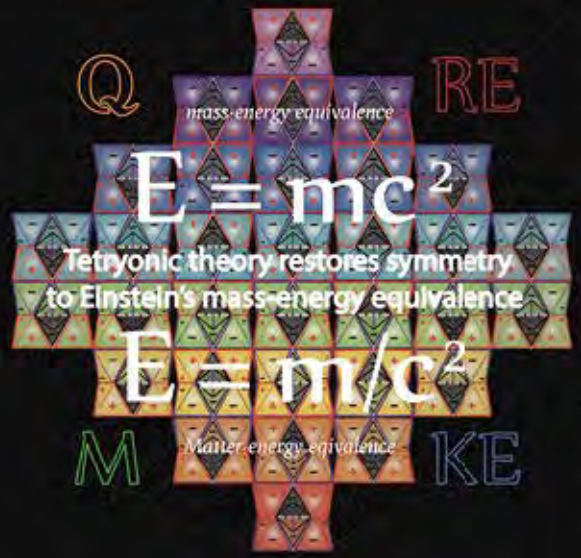

$$mc^2 = E = Mc^4$$

mass — ENERGY — Matter

mass-ENERGY-Matter equivalence shows that a tiny amount of mass-Matter can be converted into a tremendous amount of radiant EM mass-energy

The energy released hypothesised by 'Fusion' is 1/200th that of the Tetryonic collapse of Matter into radiant EM mass-energies

All mass-ENERGY-Matter topologies are modelled in Tetryonic theory and Baryon decay is instigated by neutrinos

Neutrons are NOT Protons with an absorbed electron inside their charge topology

High pressure tunneling through the Coulomb barrier does NOT occur

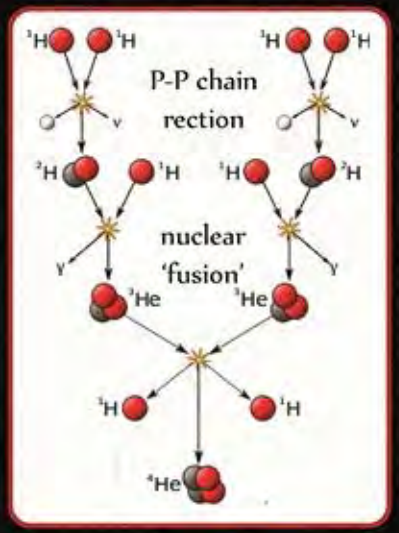

The P-P fusion chain of Hydrogen->Helium is completely erroneous

The neutrino production of Proton-Proton chain reactions is 1/3 of what is detected

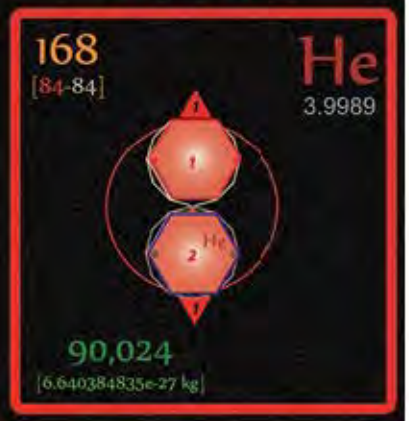

The SUN's energy comes from Tetryonic Matter collapse NOT the fusion of atomic nuclei

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Stellar Nuclear Fusion

is the process of fusing of light atomic nuclei in order to facilitate energy releases

Long sought after, but never realised, Fusion energies remain an ellusive source of clean limitless energy.

'COLD fusion'

can be realised through the fragmenting of large atomic nuclei thus releasing stored nuclear [K]EM waveform energies

The much-maligned 'COLD fusion' of Palladium is in fact a form of atomic fission that releases the stored chemical [kEM] energies of atomic nuclei and is 12-13% efficient

Tetryonics reveals the true mechanics behind the cold 'fusion' observed by Drs. Pons & Fleischmann and corrects the model of stellar processes to reveal new energy sources for the future

'HOT fusion'

is a fallacy, Stars release energy by collapsing standing-wave Matter into radiant EM mass-energy geometries in electromagnetic pinches

The hypothesised 'HOT fusion' of elements in stars is the Tetryonic conversion of mass-Matter within the star into radiant mass-energies requiring an electromagnetic pinch reaction but is 100% efficient

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Where Fusion went Wrong

The conversion of standing-wave Matter into radiant mass-energy constitutes a sustainable, virtually unlimited environmentally compatible long-term source of energy that can meet all of Humanity's needs.

The toriodal design of Tokamak reactors does not allow for the formation of plasma pinches at their cores

Inertial confinement fusion produces brief shockwaves, excessive heating and no sustained EM field

Of the two designs only inertial confinement offered the best chance of creating the conditions required to effectively collapse Matter topologies in order to release the EM energies it contains.

However a far superior approach would be the electromagnetic pinching of Matter (as present in all stellar cores)

Tokamak design

Among a small number of approaches, the concept of toroidal magnetic confinement of fusion plasmas has achieved the most impressive scientific and technical progress towards energy release by thermonuclear burn of deuterium-tritium fuels.

The plasma consists of charged nuclei and electrons, which move in tight spirals around the lines of force of strong magnetic fields.

The basic problems in attaining useful nuclear fusion conditions are

(1) to heat the gas to these very high temperatures and

(2) to confine a sufficient quantity of the reacting nuclei for a long enough time to permit the release of more energy than is needed to heat and confine the gas.

A subsequent major problem is the capture of this energy and its conversion to electrical energy for work

Inertial confinement

In inertia confinement the fuel—tritium or deuterium is contained within a tiny glass sphere that is then bombarded on several sides by a pulsed laser or heavy ion beam.

This causes an implosion of the glass sphere, setting off a thermonuclear reaction that ignites the fuel but offer no self-regualation and relase of radiant mass-energies.

E_{in}

In any useful fusion device, the energy output must exceed the energy required to confine and heat the plasma

E_{out}

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ElectroMagnetic Pinch technology

can serve as the gateway to realising new forms of clean, safe, efficient Energy production through the conversion of any Matter into various forms of EM radiation utilising electromagnetic pinch geometries developed from Tetryonic theory

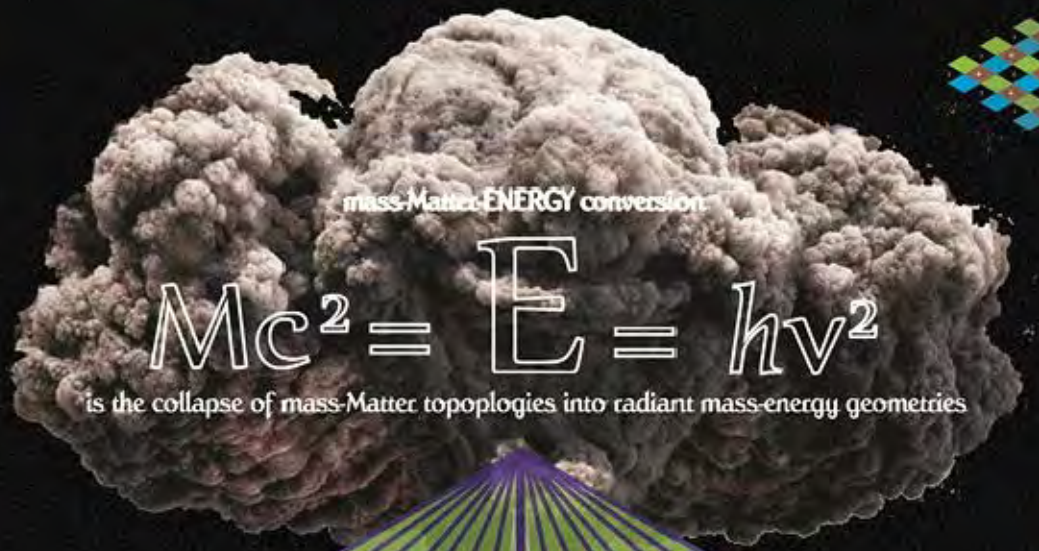

Charged Matter topologies are standing wave EM mass-energies

Radiant mass-energies form kEM wave geometries

An electromagnetic pulse (sometimes abbreviated EMP) is a burst of electromagnetic radiation that results from an explosion (usually from the detonation of a nuclear weapon) and/or a suddenly fluctuating magnetic field. The resulting rapidly changing electric fields or magnetic fields may couple with electrical/electronic systems to produce damaging current and voltage surges.

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Stellar GEM Pinches

The century old theoretical mechanism of FUSION from which the SUN generates its broad radiative EM energies must be replaced with Gravito-Electro-Magnetic pinches

M

Gravity fields obey the inverse SQUARE law

3D standing-wave topologies

$E = Mc^4$

Energy-mass-Matter equivalence

mass-Matter creates Gravity

Polar Magnetic fields obey the inverse SQUARED law
Magnetic dipoles obey the inverse CUBED law

E

Electric fields obey the inverse SQUARE law

2D radiant geometries

$E = mc^2$

mass-Energy equivalance

mass-energies create kEM fields

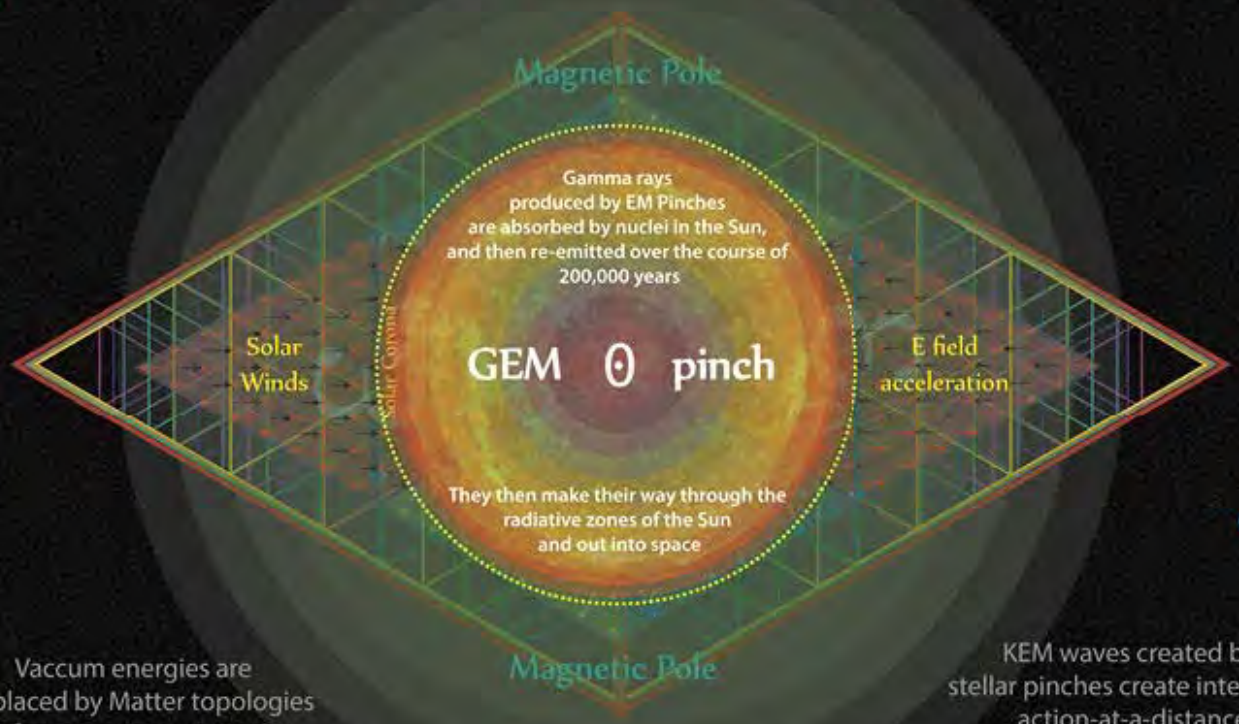

Vaccum energies are displaced by Matter topologies to form convergent gravity

KEM waves created by stellar pinches create interactive action-at-a-distance

The conversion of Matter to Energy in stellar GEM pinches is 100% efficient

The Fusion of elements is NOT the energy source of Stars

mass-Matter-ENERGY conversion

Stars emit broad spectra LONGITUDINAL electromagnetic waves

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GEM Pinch efficiency

GEM Matter-Energy conversion is the 100% efficient dimensional transformation of 3D Matter into 2D mass-energy

M

Theorised Proton-Proton chain reactions of Stellar fusion release <1% of the total Matter as EM energies

3D mass-Matter topologies

c^4

m

Matter to energy conversion by EM pinches releases 100% of the total Tetryonic Matter as radiant EM mass-energies

2D mass-energy geometries

c^2

The collapse and conversion of 3D mass-Matter topologies into radiant mass-energies releases as much energy as

annihilation

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EM Pinch reactors

The technology required to create clean, limitless energy and meet all of humanity's future energy requirements has existed since the 1900's.

The basic steps to build a EM Pinch reactor are

(1) design and build a EM pinch field into which a fuel pellet can be injected

(2) the fuel can be any form of Matter that exhibits both Electric & Magnetic dipoles to facilitate the automatic positioning of the material fuel into the pinch core [the EM fields interact untill they equalise]

(3) enclose the EM Pinch core in a containment casing that can both capture and absorb the radiant EM energies produced by the collapse of Matter at the core and convert these energies into electricity

Th efficiency of the containment vessel along with energy storage and distribution can all be improved through the use of various Tetryonic field geometries to capture and re-circulate all EM energies produced

There are no moving parts to wear out or require extensive maintenance regimes

Upon any loss of Power to the system the EM pinch will be unsustainable and shutdown automatically preventing any possibility of runaway reactions

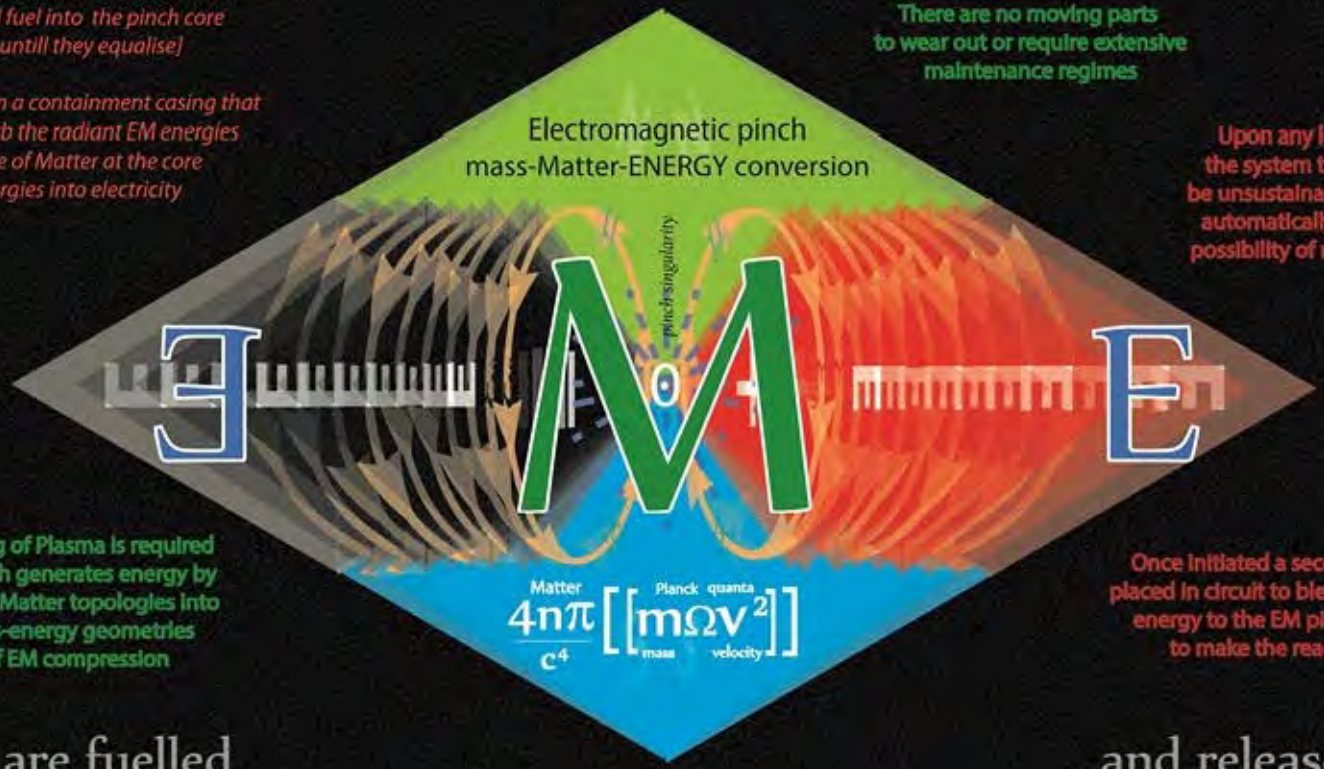

Photons
$\frac{2\pi}{c^2}[[m\Omega v^2]]$ (Planck quanta; mass, velocity)

EM waves
$\frac{2n\pi}{c^2}[[m\Omega v^2]]$ (Planck quanta; mass, velocity)

No preheating of Plasma is required as the EM pinch generates energy by collapsing' 3D Matter topologies into 2D EM mass-energy geometries by way of EM compression

Once initiated a secondary 'circuit' could be placed in circuit to bleed off and return sufficient energy to the EM pinch field circuit in order to make the reaction self-sustaining

EM pinches are fuelled

by any form of Matter

The electromagnetic pinching of Matter (as utilised in Nature in all stellar cores) produces only EM radiation [light & heat] as a by-product - there are no harmful wastes - as the Matter is converted with 100% efficiency

and release mass-energy

as radiative KEM fields

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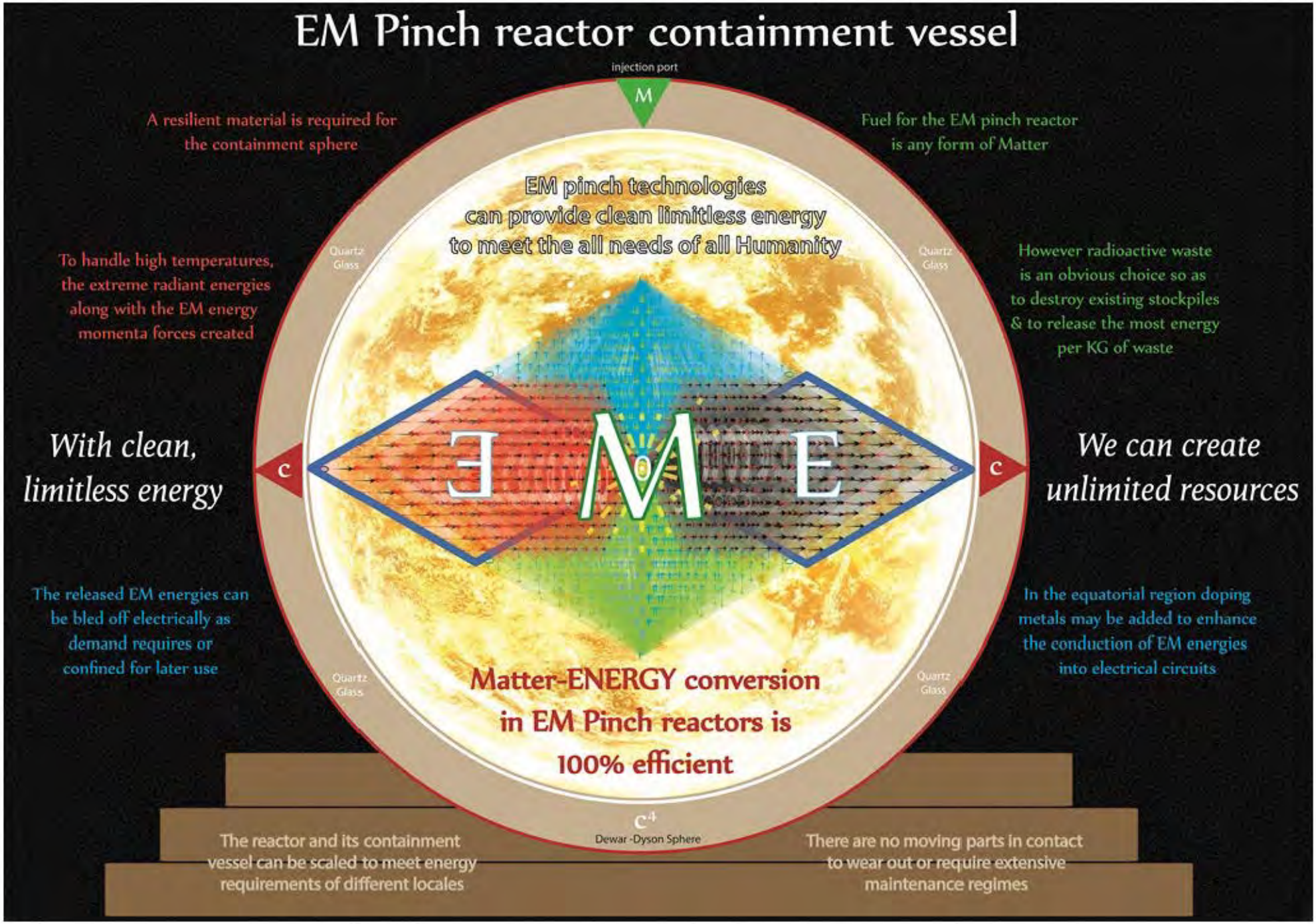

Tetryonics 73.16 - EM Pinch reactor containment

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The Earth has finite resources and an ever increasing human population puts pressure on its ability to supply resources to meet our needs

Unlimited material Resources

With clean, limitless energy sources

Tetryonics offers a solution to human problems that have plagued civilization from its beginnings leading to wars, disease and famines

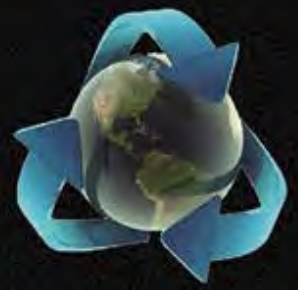

Unlimited resources can be created

mass-energy geometries
cannot be created or destroyed

mass-Matter topologies
can be created and destroyed

Resources

Health

With this new understanding of the charged mass-energy geometries of Matter excess energies generated from the destruction of Matter topologies can be reformed into any desired element or compound, and all harmful waste can be removed from our environment

Food

Water

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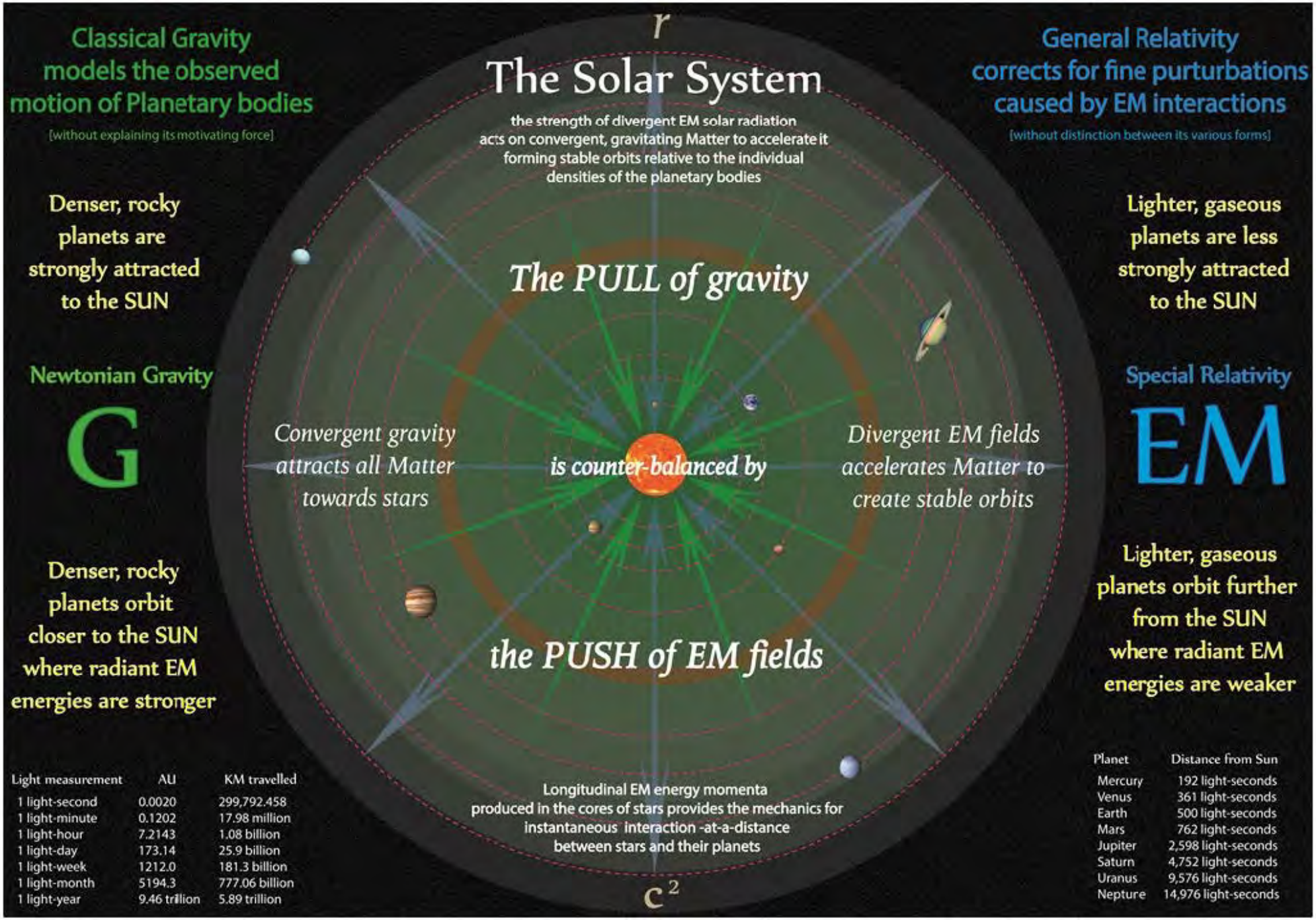

Light measurement	AU	KM travelled
1 light-second	0.0020	299,792.458
1 light-minute	0.1202	17.98 million
1 light-hour	7.2143	1.08 billion
1 light-day	173.14	25.9 billion
1 light-week	1212.0	181.3 billion
1 light-month	5194.3	777.06 billion
1 light-year	9.46 trillion	5.89 trillion

Planet	Distance from Sun
Mercury	192 light-seconds
Venus	361 light-seconds
Earth	500 light-seconds
Mars	762 light-seconds
Jupiter	2,598 light-seconds
Saturn	4,752 light-seconds
Uranus	9,576 light-seconds
Nepture	14,976 light-seconds

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Kepler's Laws

Kepler's three laws of planetary motion can be described as follows:

The path of the planets about the sun is elliptical in shape, with the center of the sun being located at one focus. (The Law of Ellipses)

An imaginary line drawn from the center of the sun to the center of the planet will sweep out equal areas in equal intervals of time. (The Law of Equal Areas)

The ratio of the squares of the periods of any two planets is equal to the ratio of the cubes of their average distances from the sun. (The Law of Harmonies).

$$T^2 = k\,a^3$$

The square of the orbital period of a planet is directly proportional to the cube of the semi-major axis of its orbit.

Gravity attracts Matter towards stars

The divergent energy momenta of kEM fields create an acceleration FORCE on material bodies

The orbit of every planet is an ellipse with the Sun at one of the two foci.

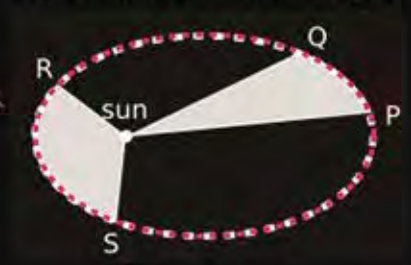

A line joining a planet and the Sun sweeps out equal areas during equal intervals of time.

An Elipse circumsribed, onto the Apex points of an Equilateral triangle has the form of a Circle

A Star's kEM field accelerates Matter away from it creating stable ellipical orbits

a
F
Q
P
b
SUN
c

With an equilateral triangle, draw lines from the center of the circle to each vertex and each midpoint, creating six right triangles, as shown with six different colored triangles. Each right triangle has a radius of the circle for one leg, and half of a side of the original triangle for another. Any two right triangles sharing one of the radial lines must therefore be congruent, and that implies that the hypotenuses of the triangles are all equal. This in turn shows that the six right triangles are all congruent, and so the large triangle they combine to form is equilateral

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The Major celestial bodies

All planetary orbits are the result of a balance between gravitation Matter and interactive kEM fields

The sun is a rotating charged mass-Matter object, and it creates a solar system-wide kEM field.

The solar mass is large enough to produce a EM field with lines of Force reaching the orbit of Pluto.

Planet	Object Axial tilt (°)	Axial tilt (radians)
Mercury	~0.01	0.00
Venus	177.4	3.10
Earth	23.44	0.41
Moon	1.5424	0.03
Mars	25.19	0.44
Jupiter	3.13	0.06
Saturn	26.73	0.47
Uranus	97.77	1.71
Neptune	28.32	0.49
Pluto	119.61	2.09

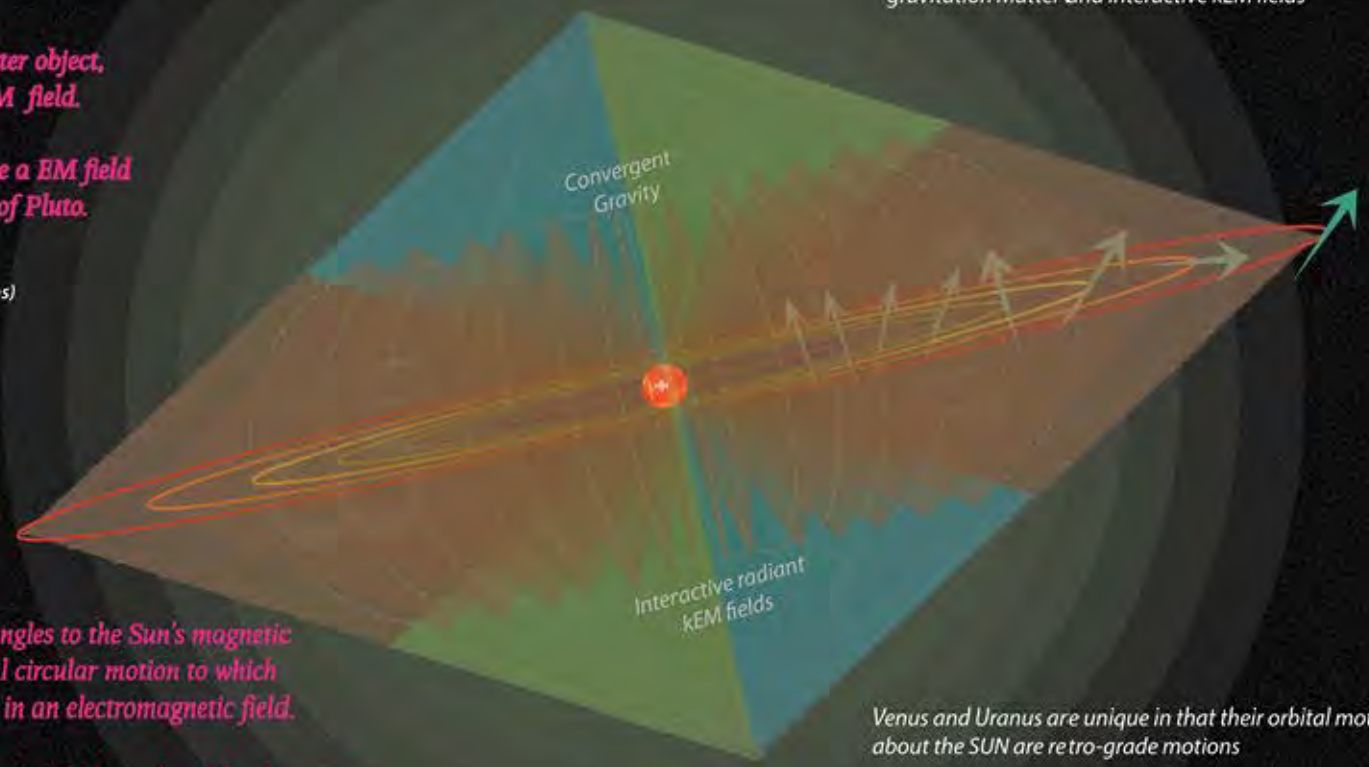

The charged planets move at right angles to the Sun's magnetic lines of force and describe the usual circular motion to which moving charged bodies are subject to in an electromagnetic field.

Venus and Uranus are unique in that their orbital motions about the SUN are retro-grade motions

Satellites, in turn, revolve in the smaller magnetic fields produced by the rotation of the planets. Mercury and Venus have no satellites as they produce extremely weak electromagnetic fields in addition to their Gravitational fields.

"In comparing the masses of the Earth, Jupiter and Saturn to their volumes, one remarks that the densities of these planets are, to some degree, inverse to their mean distances from the Sun. This rule is not true for Venus and Uranus"

Urbain Le Verrier

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Solar orbit Inclinations

Inclination to Sun's equator (°)

Rocky Planets	
Mercury	3.38
Venus	3.86
Earth	7.15
Mars	5.65
Gas giants	
Jupiter	6.09
Saturn	5.51
Uranus	6.48
Neptune	6.43

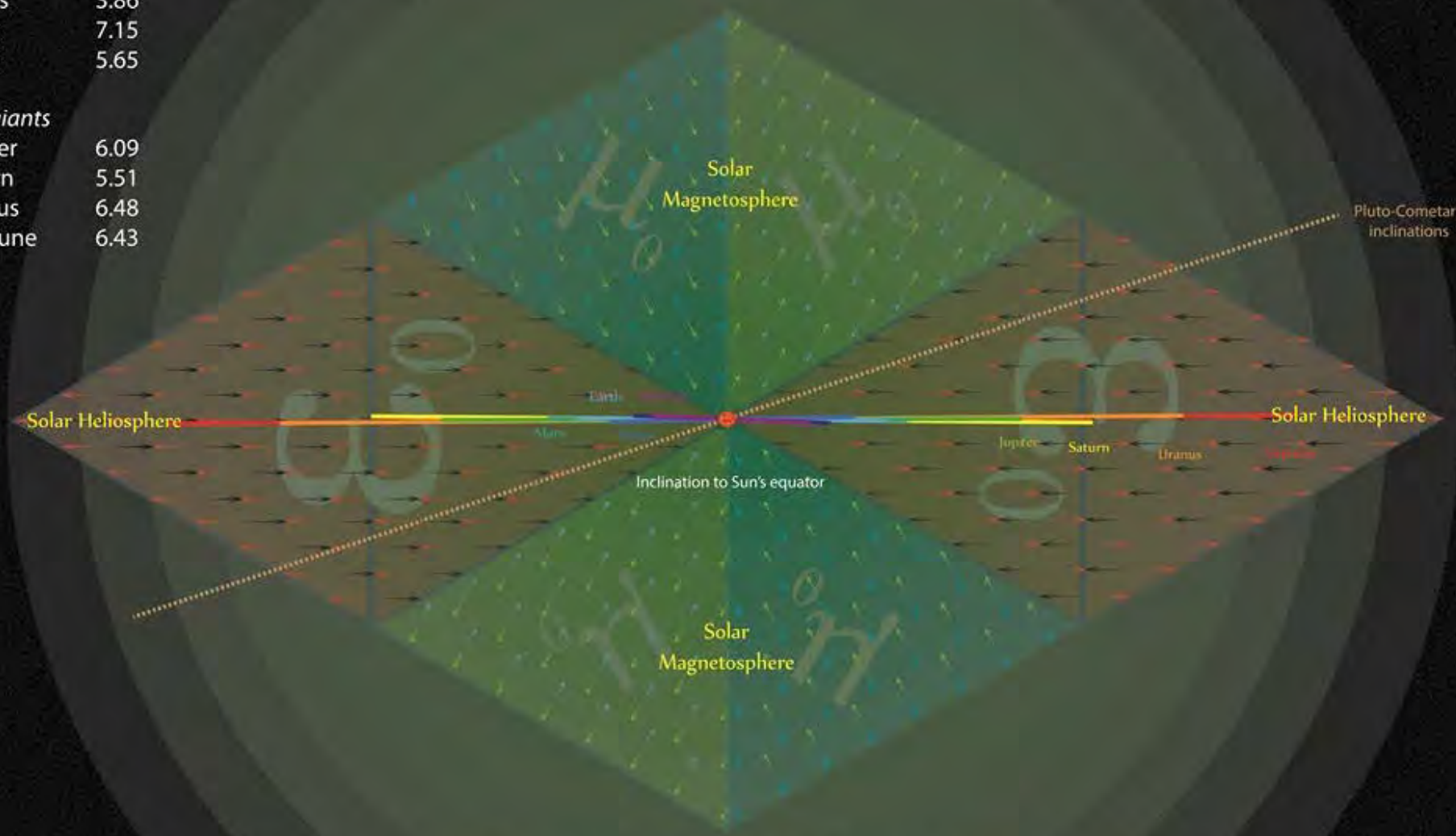

Orbital inclination is one of the six orbital parameters describing the shape and orientation of a celestial orbit.

It is the angular distance of the orbital plane from the plane of reference (usually the primary's equator or the ecliptic), normally stated in degrees.

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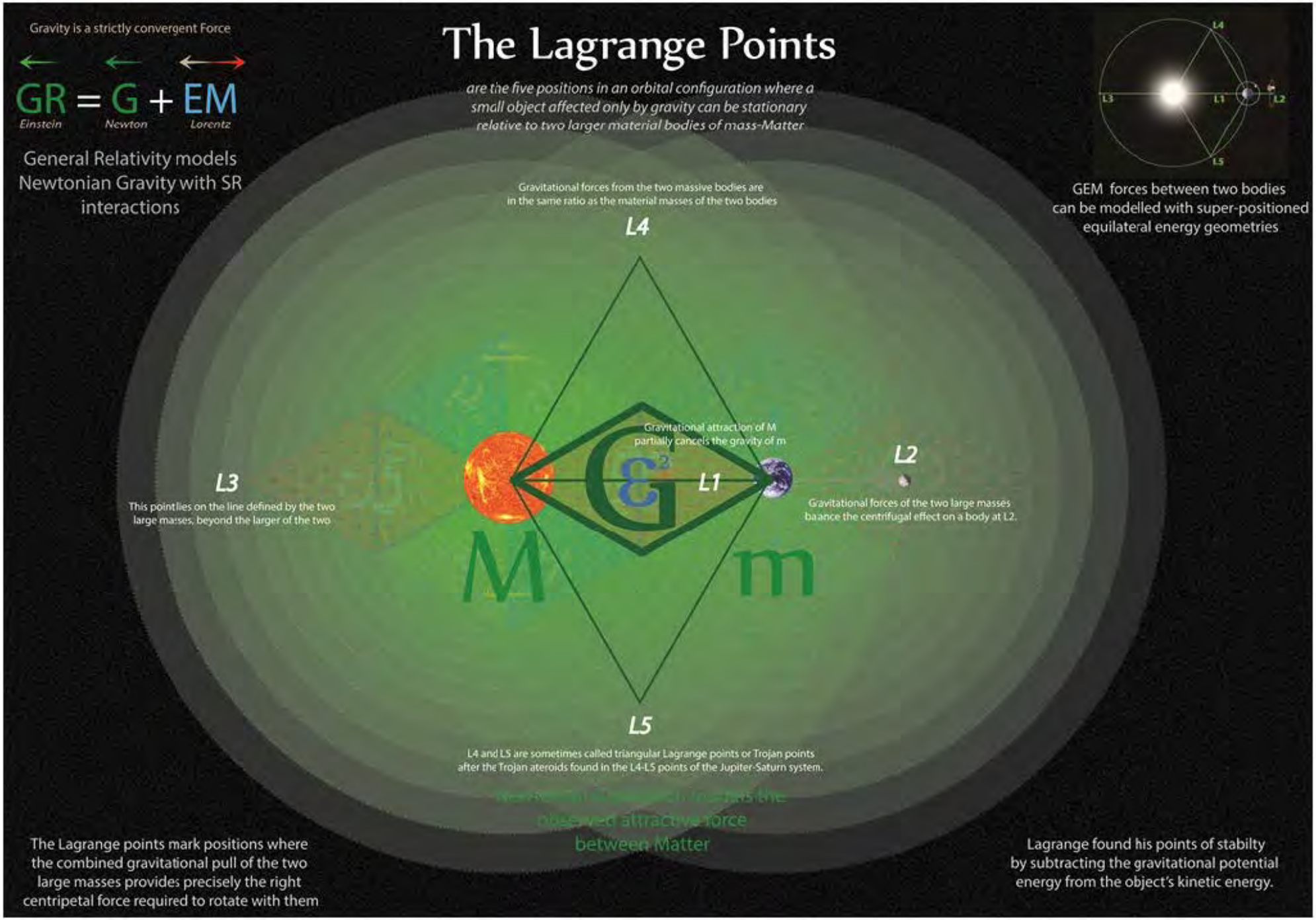

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Earth-Moon Gravito-Electro-Magnetic fields

$F = mv^2/r$

Orbital motion

The Moon's orbit is the result of the balance between Earth's gravitational attraction and the Moon's orbital velocity

Gravitational tests in the region of any material body using Photons must also take into account EM interactions

$F_g = -G \frac{M_1}{r^2}$

1,023 m/s

[3,680 km/hr]

sqrt[GM/r]

Convergent gravity attracts 3D Material bodies towards each other

strictly convergent gravity does not explain why the Moon is slowly moving away from the Earth at the rate of 3.8 cm per year

Gravity is not what gives the Moon its velocity.

It has been theorised that whatever velocity the Moon has was probably acquired when it was created.

Gravity prevents the Moon from breaking out of Earth orbit and flying away, confining it to its known orbit

Tetryonics illustrates that along with the gravitational force the Earth's [k]EM field provides a interactive force to accelerate any bodies in its gravitational embrace.

It is this balance between Gravitational attraction interactive E-field forces & Magnetic purturbations that creates stable orbits over long periods of time

5.9736e24 kg mass

These geometries reflect simple calculations. However, it assumes something we now accept without second thought:

That the pull of the Earth would be the same if all the mass of the Earth were concentrated in its center

convergent gravity

divergent kEM field

$\frac{6.67\ e\text{-}11\ N^2}{KG^2}$

6,371 km radius

1,738 m radius

363,301 km

Gravitational fields are 1/r^2 fields

Earth's gravitational field on the Moon's surface is 1/3600 that of the field on the Earth's surface [1/60²]

The origin of the Earth's magnetic field has so far defied all attempts at a satisfactory solution.

$F = -G \frac{M_1 m_2}{r^2}$

Divergent 2D kEM fields accelerate charged bodies creating stable orbits

The Gravitational field of the Earth is the result of its mass-Matter and can be modelled as a weak EM field

moon's orbital period

27.32 days . 24hr/day . 3600s/hr = 2,360,448 s

The Sun's gravitational effect on the Moon is over twice as great as the Earth's on the Moon

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The Earth's ElectroMagnetic field

Earth's magnetic field (also known as the geomagnetic field) is the magnetic field that extends from the Earth's inner core to where it meets the solar wind,

It is the magnetic dipole field tilted at an angle of 11 degrees with respect to the rotational axis

Solar particle ions attracted

The Earth's magnetic field is really generated by the motion of the Earth through solar & vacuum energies and it is enhanced by the molten alloys in the Earth's core

Solar particle ions repelled

Solar particle ions repelled

Solar particle ions repelled

Solar particle ions attracted

It protects the Earth from cosmic rays that would strip away the upper atmosphere leaving us exposed to UV & cosmic rays

The magnetic poles precess and even flip over time

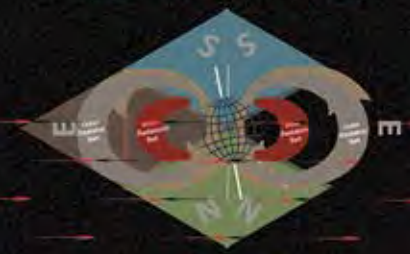

At random intervals (several hundred thousand years) the Earth's field reverses (the north and south geomagnetic poles change places with each other)

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The Earth's molten core

The Earth has an outer silicate solid crust, a highly viscous mantle, a liquid outer core that is much less viscous than the mantle, and a solid inner core. Scientific understanding of Earth's internal structure is based on observations of topography and bathymetry.

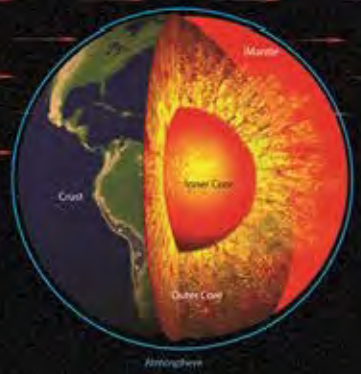

Q

The SUN and planetary bodies are all charged Matter moving in, displacing and interacting with solar and vacuum energies

Dynamo theory suggests that convection in the outer core, combined with the Coriolis effect, gives rise to Earth's magnetic field.

KE

The energy that creates the Earth's magnetic field is supplied by the SUN via longitudinal waves of energy momenta

The solid inner core is too hot to hold a permanent magnetic field but acts to stabilize the magnetic field generated by the Earth's motion through the Stellar EM environment as it orbits the SUN

The Earth's molten core does not produce the Earth's magnetic field it enhances it

The force exerted by Earth's gravity can be used to calculate its mass, and by estimating the volume of the planet, its average density can be calculated.

Astronomers can also calculate Earth's mass from its orbit and effects on nearby planetary bodies.

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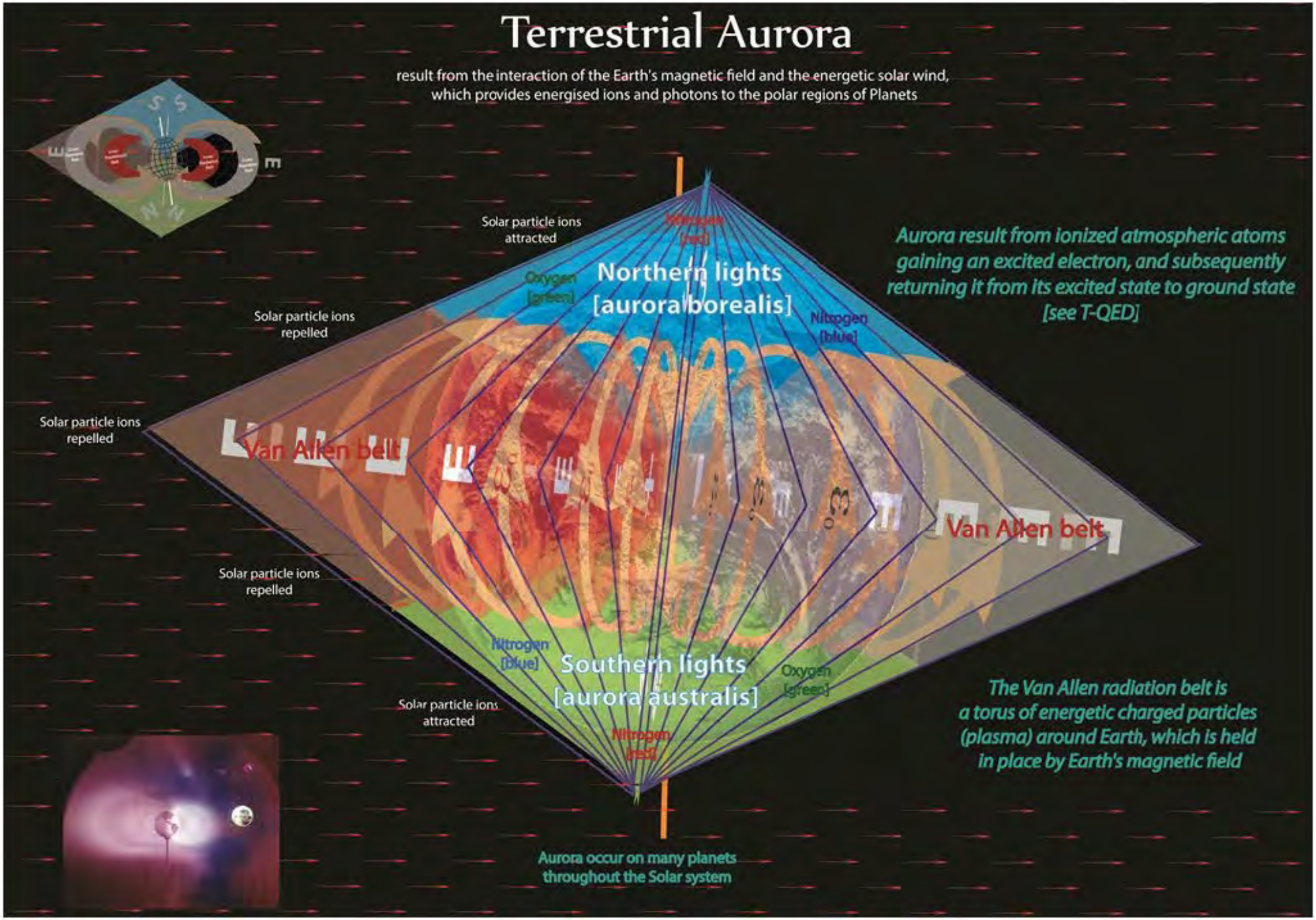

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Absolute Rest Frames

Absolute Rest is intrinsically linked to the concepts of absolute time and space originally introduced by Sir Isaac Newton in the Philosophiæ Naturalis Principia Mathematica, which provided a theoretical foundation that facilitated Newtonian mechanics.

According to Newton, absolute time and space respectively are independent aspects of objective reality.

Rest in physics refers to an object being stationary relative to a particular frame of reference or another object

In Tetryonics an Inertial Rest frame can be determined by the absence of a Kinetic EM field & its Magnetic moment

The concepts of space and time were separate in physical theory prior to the advent of special relativity theory, which connected the two and showed both to be dependent upon the observer's inertial state of motion relative to other inertial frames.

In Einstein's theories, the ideas of absolute time and space were superseded by the notion of spacetime in special relativity, and by dynamically curved spacetime in general relativity.

$$p^2 = E = mv^2$$

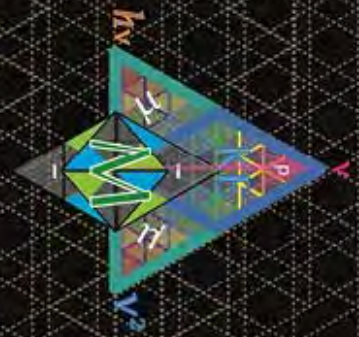

$$\frac{P^2}{2} = KE = \frac{1}{2}Mv^2$$

In some of his later paper (especially in 1920 and 1924), Einstein gave a new definition of the aether by identifying it with "properties of space", and this aether can be called absolute, as long as its state cannot be influenced by Matter.

So he argued that Newton's absolute space can be considered as an "absolute aether". Also the four-dimensional spacetime of special relativity (which replaces the absolute space of Newton) would be some sort of "absolute aether", as its states cannot be influenced by Matter.

Tetryonics clearly establishes free space as a 3D volume filled with a interactive vacuum [aether] and EM energies against which any relative motion can be deduced by the presence (or absence) of divergent [K]EM fields produced as a direct result of Matter in motion additionally, 3D mass-Matter topologies displace the aether [vacuum energy field] producing convergent differential energy gradients [gravity fields]

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Red-shifted Photonic Energies

Energy is ALWAYS conserved... longer wavelength [red-shifted] photon energies are a reflection of the time specific measurement of photonic energies at a particular distance from the source of the light

Photons are neutral, coupled charge equilateral mass-energy momenta geometries that radiate bilaterally at the speed of light in a vacuum

Photons

$$\frac{2\pi}{c^2}\left[\left[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v^2}\right]\right]$$

Planck quanta

EM waves

$$\frac{\text{EVEN}\,\pi}{c^2}\left[\left[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v^2}\right]\right]$$

Planck quanta

As photons radiate from a point source at 'c'

c

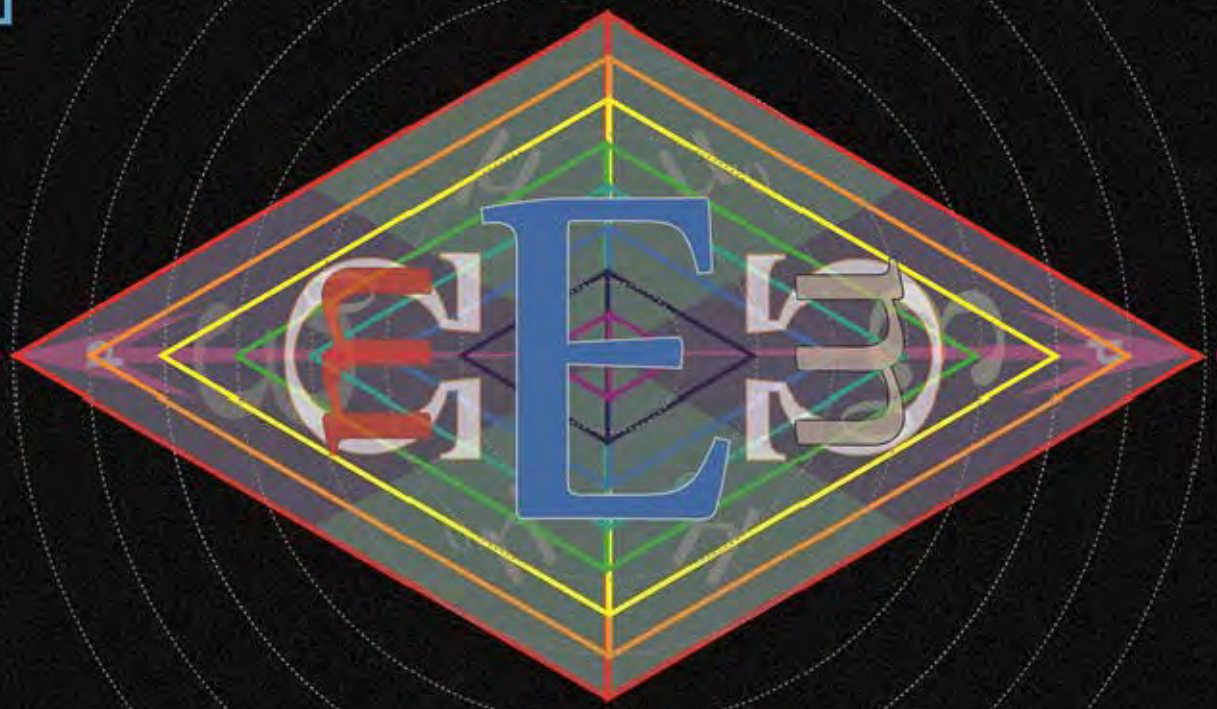

c

their EM energies diminsh as per the inverse square law

producing the familiar red-shifting of spectral lines

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The red shift of Photons

$d\lambda$

According to special relativity, as something approaches the speed of light, the passage of time slows.
A twin moving at the speed of light would not age or change relative to the stationary twin.

General relativity additionally states that the cosmological red shift is the result of a photon traveling through an expanding space time field which causes the photon to loose energy and it's wavelength correspondingly increases.

A photon travels at the speed of light; therefore it will not experience the passage of time, therefore it will not change; yet it does.

df

The divergent spreading of EM energy over time from a source creates the spacetime aether

The Quantised Angular Momentum and Energy content are directly related through the geometry of Photons

All EM Energy waveforms (save Matter) radiate outward following the inverse square law & reducing their energy content over time

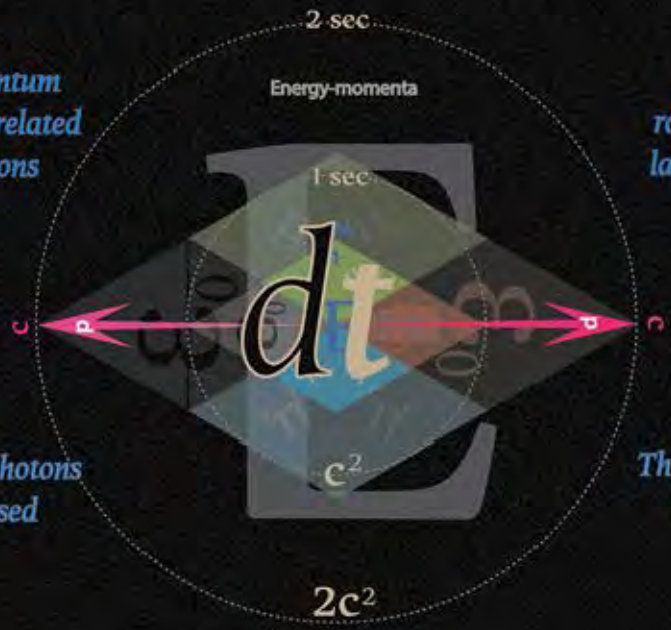

Blue-shifted photon travelling towards observer

Red-shifted photon moving away from observer

The EM mass-energy content of photons reveals photons to be a quantised electromotive field

The wavelength of a photon is related directly to its quantised mass-energy momenta geometry per unit of time

Tetryonic geometry relates photon mass-energy momenta to
the constant velocity of light in a vacuum and its intrinsic quantised angular momenta

$$\frac{mc^2}{c^2} = KE = \frac{hv^2}{c^2}$$

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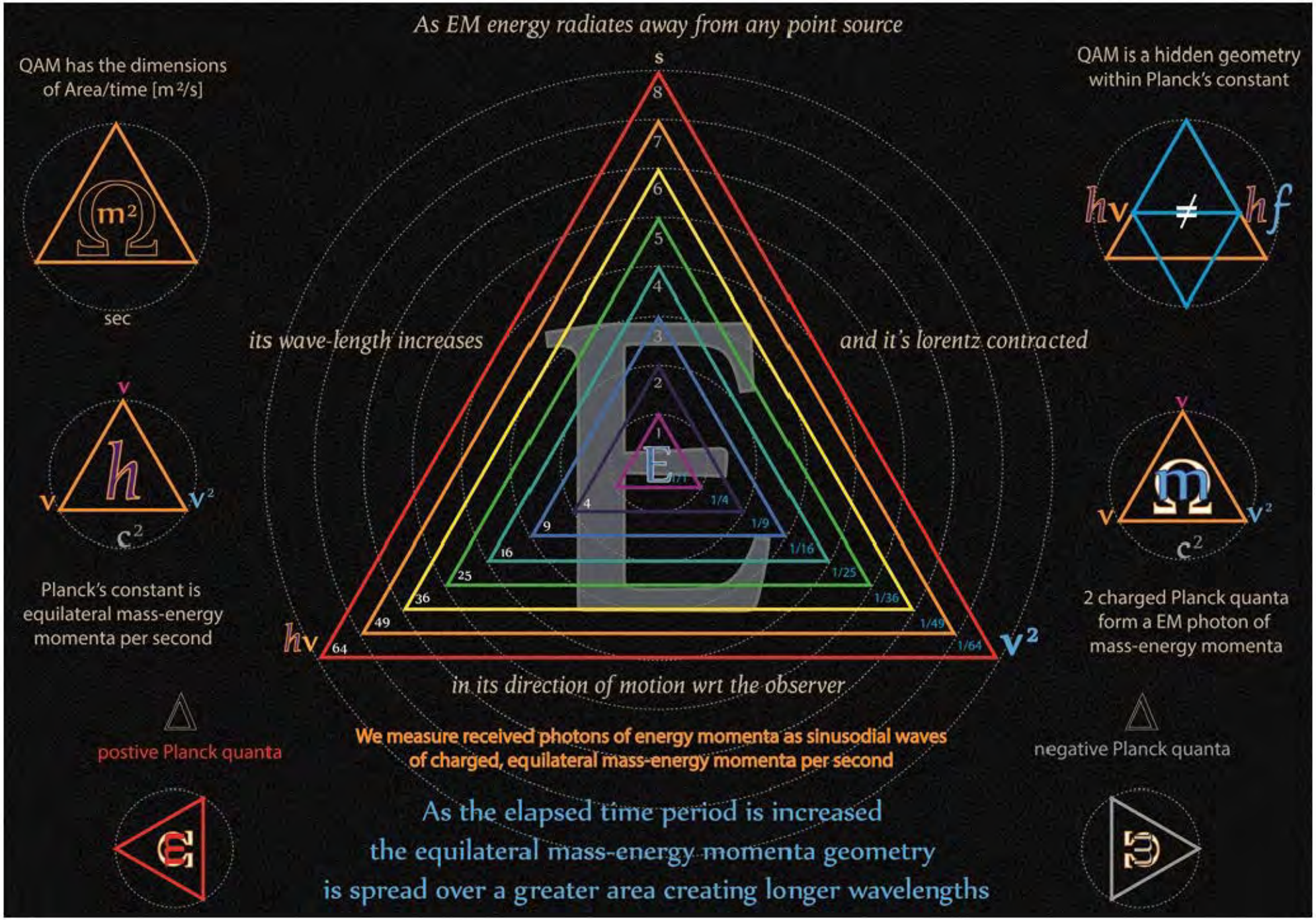

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The Doppler shifting of EM waves

Photons

$$\frac{2\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

EM waves

$$\frac{\text{EVEN}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

General relativity incorrectly holds that the cosmological red shift is the result of a photon traveling through an expanding space time field which causes the photon to loose energy and it's wavelength correspondingly increases

Photonic energies form infitie energy loops [quantum transformers]

It is the Photon's intrinsic geometry that increases the further it travels from the source due to the inverse square law resulting in less energy (per unit of time) being recieved at increasing distances from the source as the Photon's specific QAM [m²/s] has increased over time

All EM waves are comprised of Photons of specific energies [Light is superpositioned EM waves]

All Photons are quantum harmonic oscillators and create sinusoidal EM waveforms are they radiate and are detected

Radiating geometric EM mass-energies from a source (over Distance-Time) creates the spatial vacuum aether

2 sec

Photons are 2π divergent bi-directional mass-energy momenta geometries

1 sec

Blue-shifted

observer moves towards source *or* source moves towards observer

Any relative motion between the source & observer that reduces the distance between them produces a Blue-shift in the measured quanta-frequency/ energy of the EM wave

observer moves away from source *or* source moves away from observer

Red-shifted

Red-shifted

source moves away from observer *or* observer moves away from source

Any relative motion between the source and observer that increases the distance bewteen them produces a Red-shift in the measured quanta-frequency/ energy of the EM wave

source moves towards observer *or* observer moves towards source

Blue-shifted

Photonic mass-energies always propagate at c

2c²

Tetryonics clearly shows and relates Time to quantised angular momentum and Planck energy momenta to velocity

The energy of indiviudal photons is invariant until they interact with Matter and transfer their mass-energy momenta

motion toward the source increases the number of quanta per sec measured

[v+v]

Poor definintions of Energy per unit of Time along with the interchange of quanta and frequency have led to the mistaken concept of photons losing energy

$$mv^2 = E = hv^2$$

Photons DO NOT lose energy as they travel, the group energy [per unit of time] of the EM wave they form spreads out over time as a direct result of the inverse square law

motion away from the source decreases the number of quanta per sec measured

[v-v]

Cosmological doppler-shifting of Light is the direct result of the motion of Matter in the Universe

Gravitational Red-shifting is an EM effect not gravitational

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Relativistic Corrections

are applied to only [kinetic]EM mass-energy geometries

$$\frac{Mv^2}{c^2} = KEM = \frac{hv^2}{c^2}$$

$d\lambda$

dt

Wave-length contraction

linear
Lorentz corrections

$$\beta = \left[\frac{v}{c}\right]$$

SR - measuring rods in differing interial frames have different contracted lengths

GR - lengths measured in curved spacetime are different to straight lines in flat spacetime

Time Dilation

scalar
Lorentz corrections

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

SR - clocks in differing inertial frames experience time dilation

GR - clocks in differing Gravitational fields experience time dilation

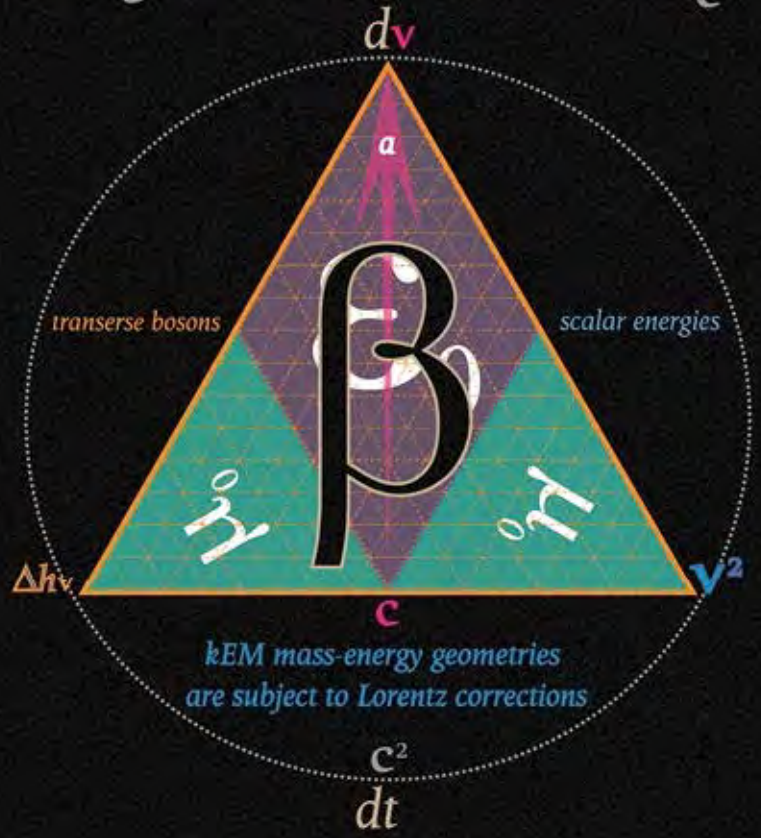

$$\frac{\Delta\ \Omega}{c} \qquad \frac{\Delta\ \Omega}{c^2}$$

$$\frac{T\pi}{c^4}\left[\left[m\Omega v\right]^2\right]$$

Matter — scalar energy momenta — Planck quanta — mass — velocity — linear momentum

The mass-energies of standing-wave Matter topologies are Lorentz invariant

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GPS relativistic corrections

Claims that the Global Positioning System (GPS) provides a valid test of General relativity are erroneous
[GR provides Lorentzian [SR] correcttions under the guise of Gravitational effects]

Photons are mass-energy momenta quanta
[they are Matter-less NOT mass-less]
and are subect to Lorentz Forces and corrections

Newton G + SR = GR *Einstein*
Lorentz

Graviational Matter

M

All Matter topologies
produce
a Gravitational field

Newtonian Gravity
is universal

The gravitational effects
caused by Matter can only
be accurately modelled [or
tested] through the exclusion
of all EM fields interactions

Interactive masses

m

All Matter in motion
produces
interactive mass-energies

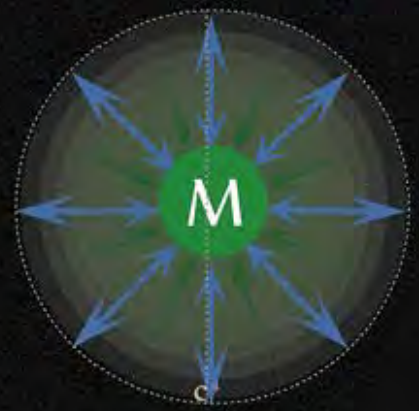

General Relativity
is limted to c

Any test of GR using Photons
as a testing mechanism
by definition is affected by
and subject to Special relativity
[ElectroMagnetic effects]

The 'gravitational' frequency shifting [Red-Blue shifting of EM waves] is in fact an electromagnetic effect

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The Bending of Light

Like the Perihelion of Mercury, the bending of Light due to Gravity as it passes near the limb of the Sun is a flawed test of GR that fails to distingush between Gravitational Matter and EM mass interactions due to GR's use of a Stress Energy Tensor that is reflective of all EM mass-ENERGY-Matter in the system being measured.

The 'Gravitational bending' of light as it passes close to Matter is a scientific misnomer

EM waves of light are refracted by the EM plasma enviroment of any star

According to General relativity, a light ray arriving from the left would be bent inwards such that its apparent direction of origin, when viewed from below would differ by an angle (a), whose size is inversely proportional to the distance (d) of the closest approach of the ray path to the center of mass.

All Light and EM waves are 2D ElectroMagnetic masses and are unaffected by gravity

All Light and EM waves are deflected and dispersed by ElectroMagnetic interactions

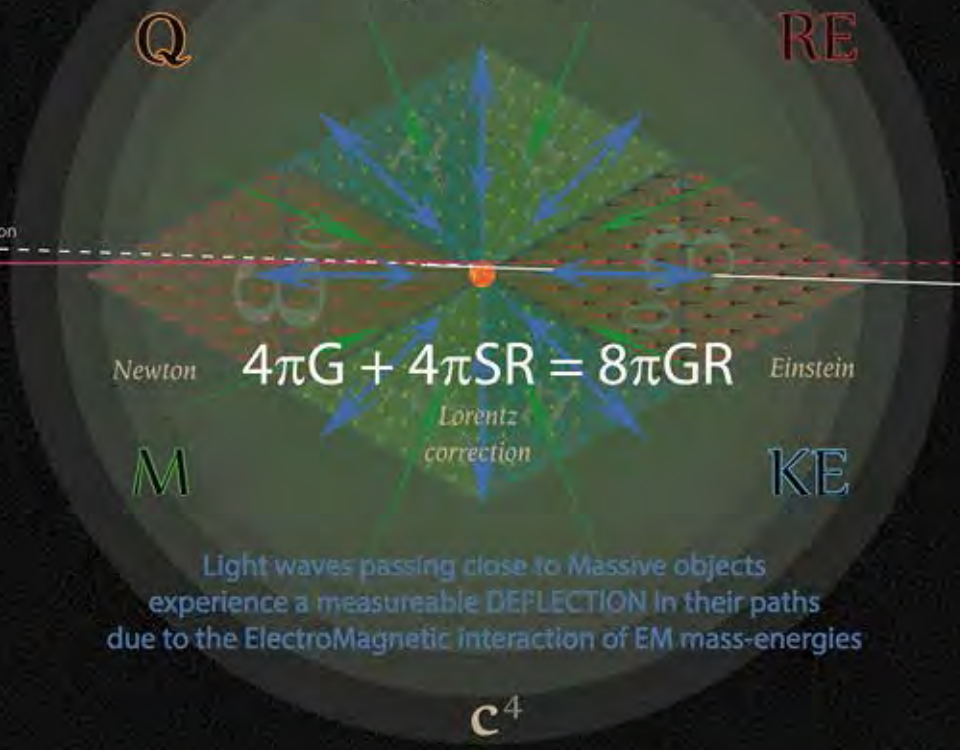

3D standing-wave gravitational mass-Matter

2D radiant electromagnetic mass-energies

Light waves passing close to Massive objects experience a measureable DEFLECTION in their paths due to the ElectroMagnetic interaction of EM mass-energies

c^4

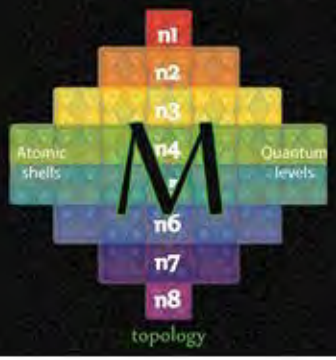

Gravitation is a result of convergent vacuum energy densities produced by toplogical EM mass-energies of Matter & their interactive mass-energy geometries

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The Perihelion of Mercury

is the result of EM interactions in addition to gravitational attraction

The perihelion of Mercury's orbit precesses at a measurable rate, but even after accounting for gravitational perturbations caused all other planets in the solar system, Newton's theory (assuming a precise inverse-square relationship for distance) predicts a rate of precession that differs from the measured rate by approximately 43 arcseconds per century.

Both Newton and Einstein saw Gravity as a singular force of attraction between objects and developed their math accordingly from the observed motions without any physical distinction between mass & Matter

$4\pi G$

Newton modelled only the observed nett attractive force of Matter in the system

$8\pi G$

Einstein modelled the nett convergent force of all energies without differentiation

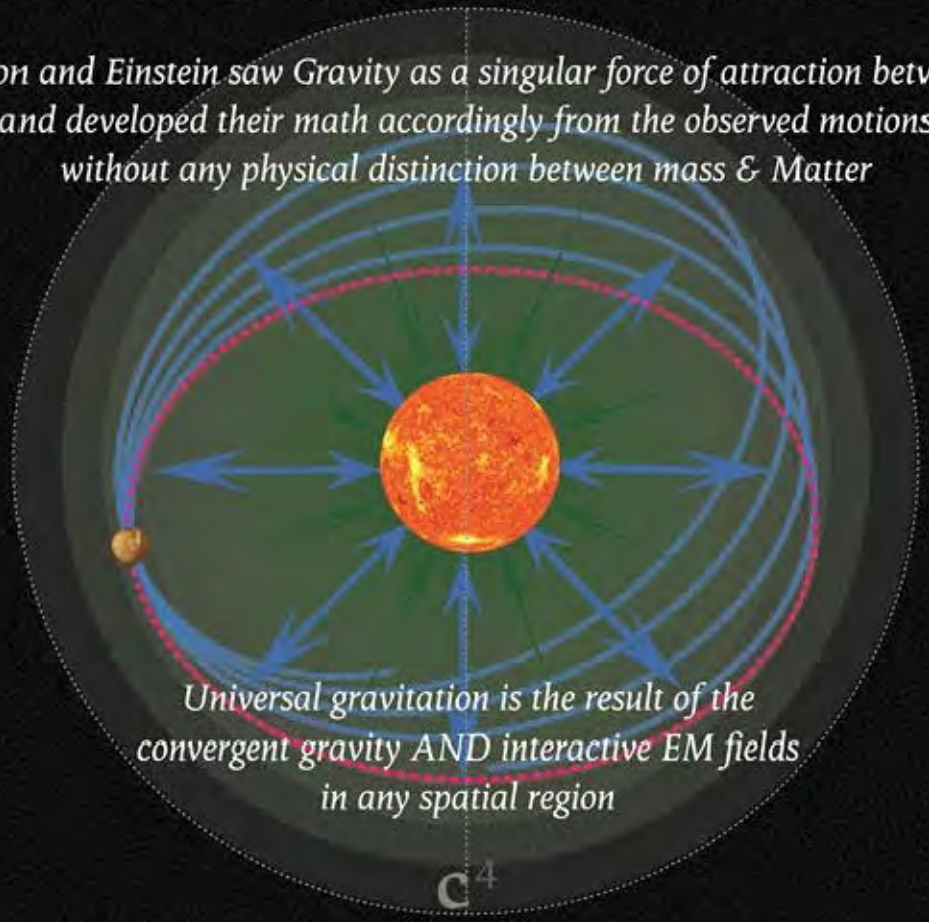

$$F = -G\frac{M_1 m_2}{r^2}$$

$$G_{ab} = \kappa T_{ab}$$

Universal gravitation is the result of the convergent gravity AND interactive EM fields in any spatial region

Newton

G

c^4

Einstein

$G + EM$

Newton Lorentz

General relativity was developed in part to provide an estimate for this rate of precession that better matches observations.

Newton's theory can also be 'incorrectly modified' to explain this perihelion by factoring in the gravitational pull due to other planets or making tiny adjustments to parameters in the gravitational equation to reflect the effect of ElectroMagnetic interactions between the Sun and Mercury.

By modelling the quantum interactions of ALL GEM mass-ENERGIES and their distinct geometries Tetryonic theory explains recently measured discrepancies in both Newtonian & GR formulations of Gravity

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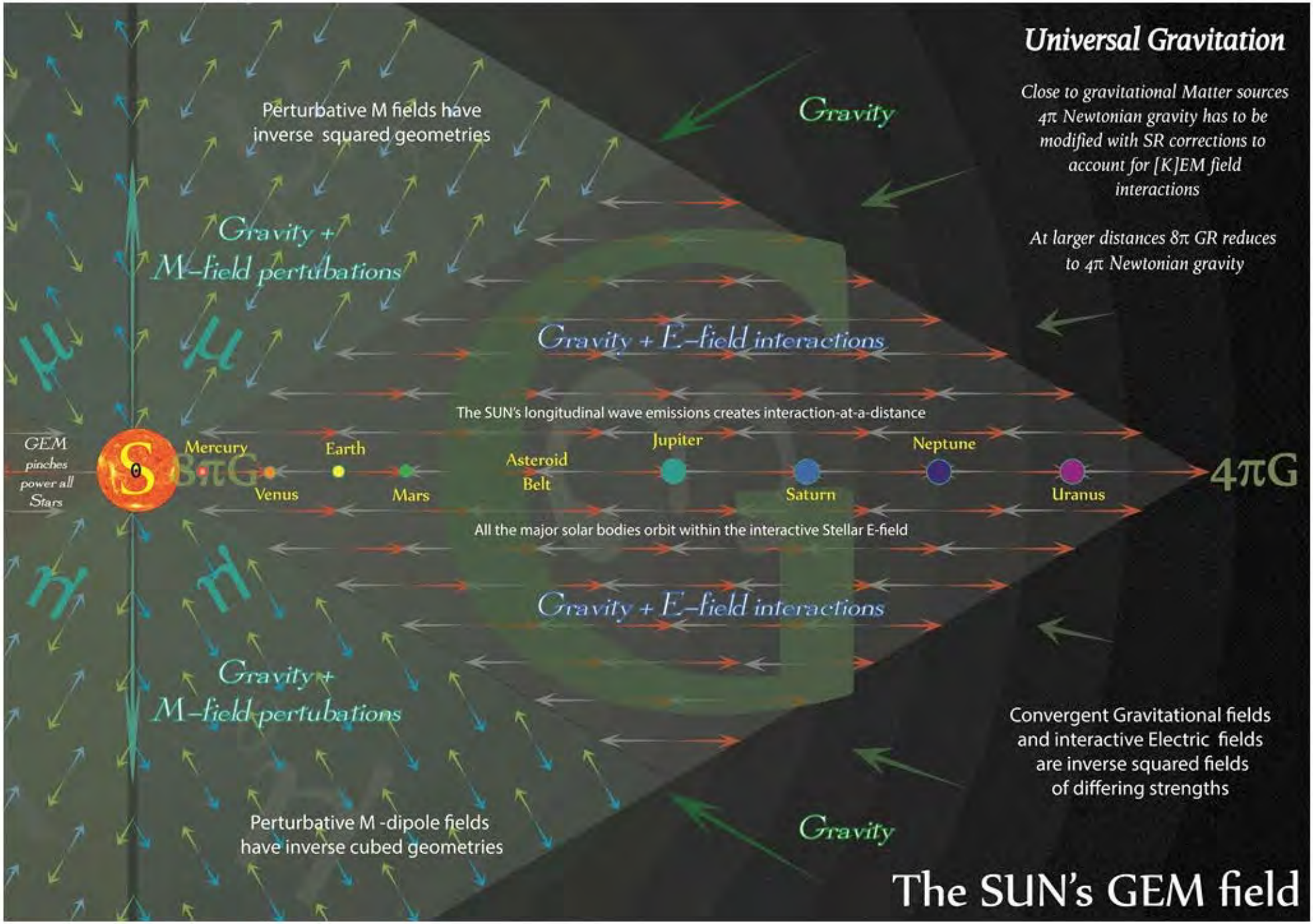

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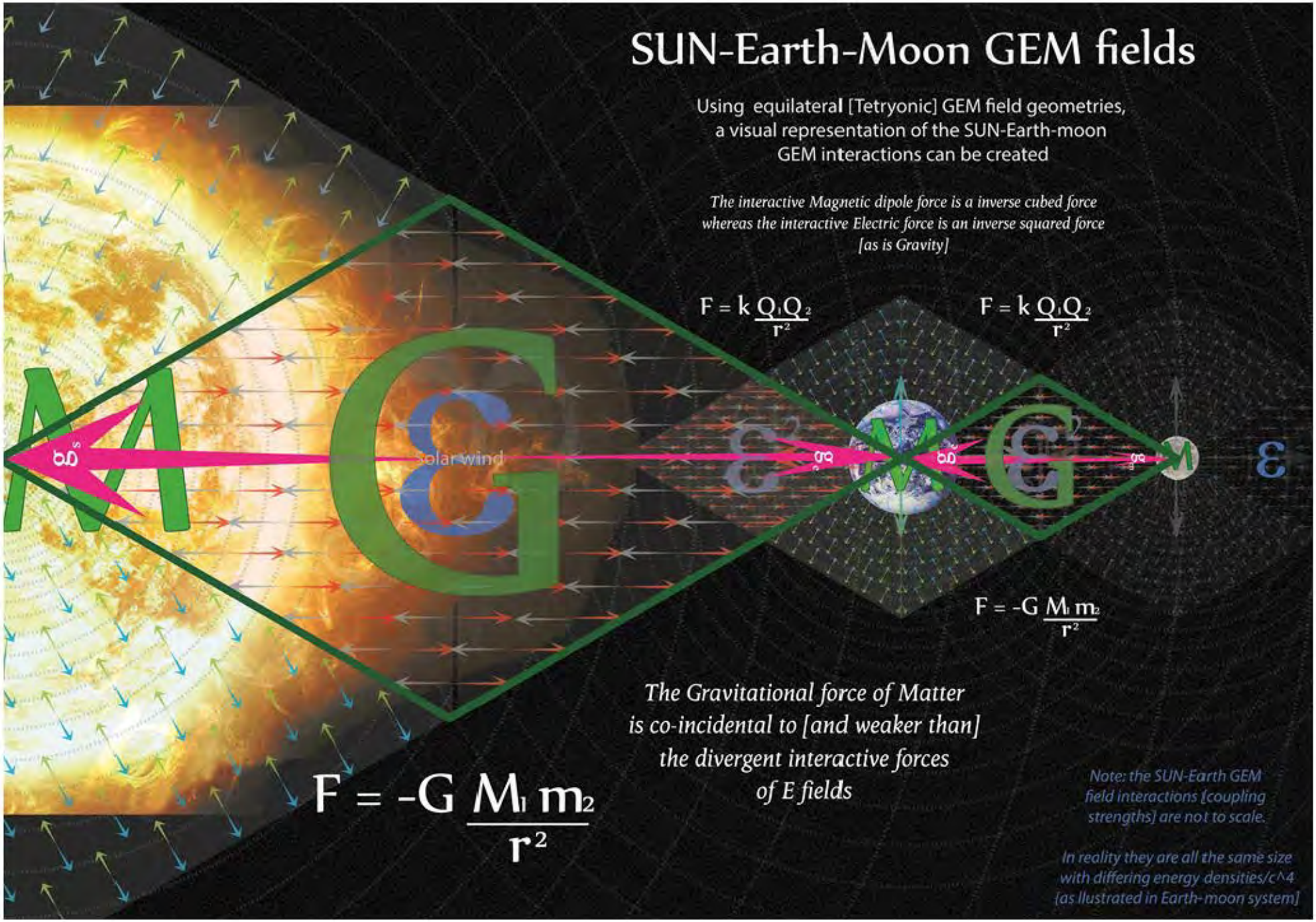

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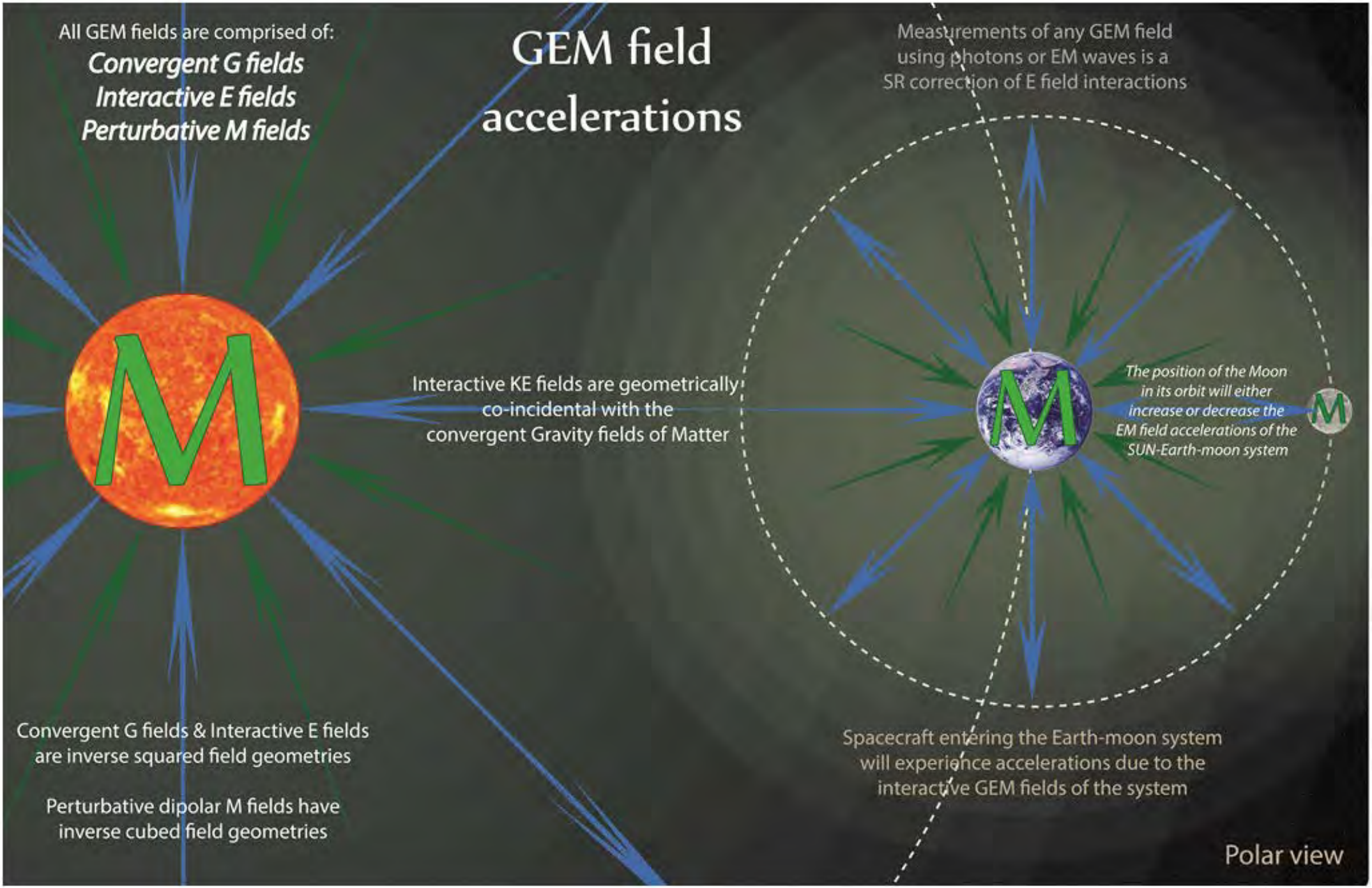

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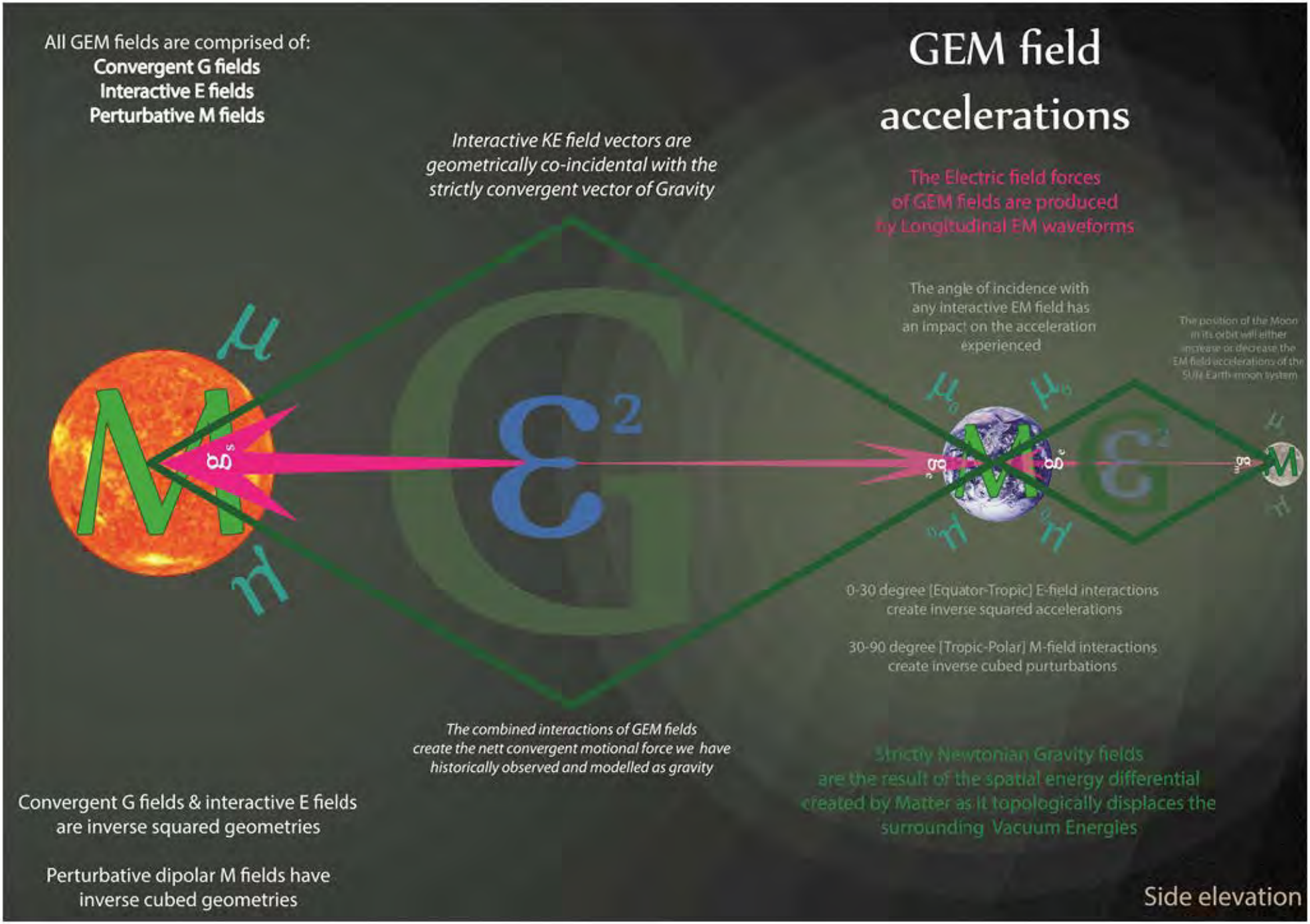

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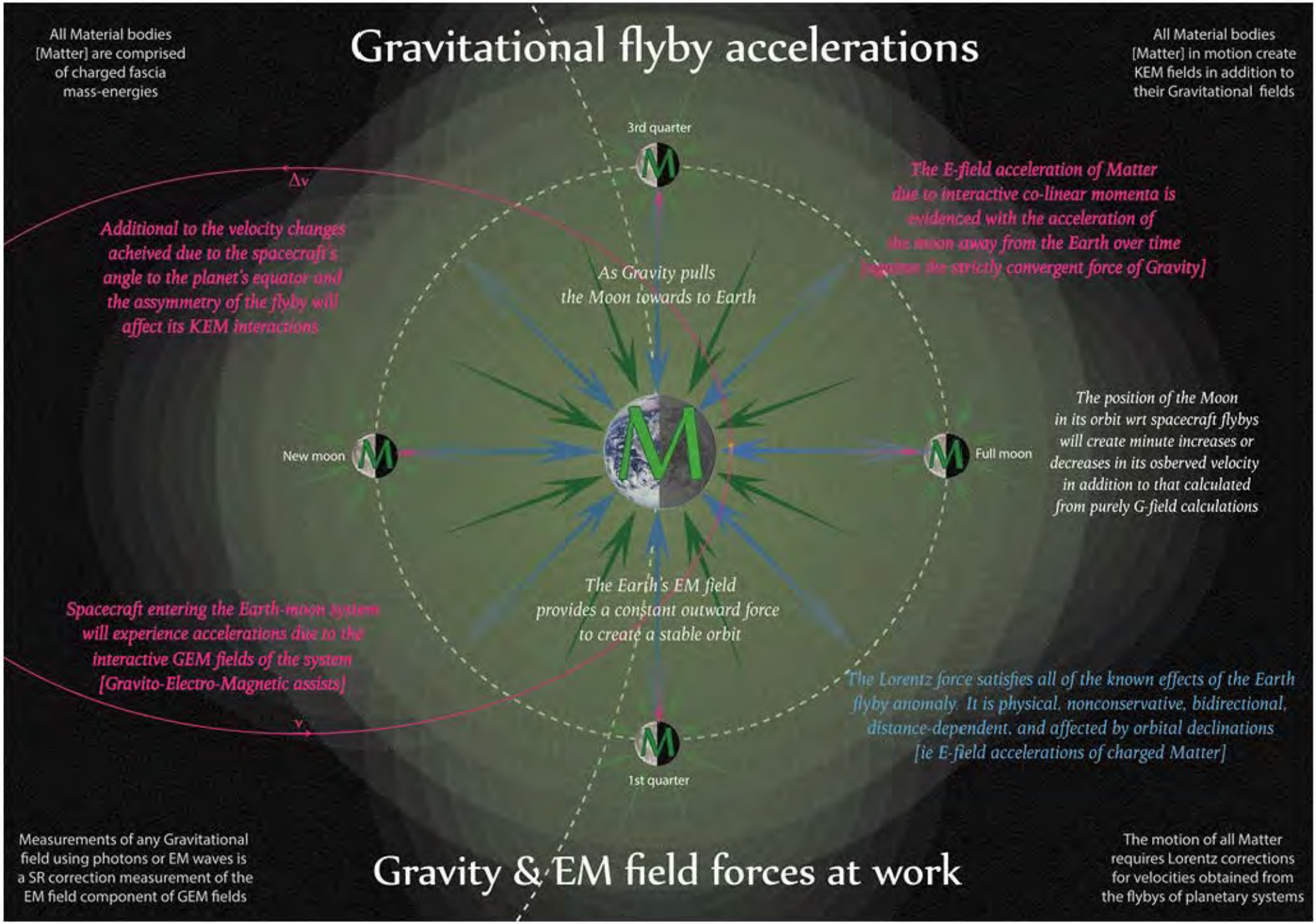

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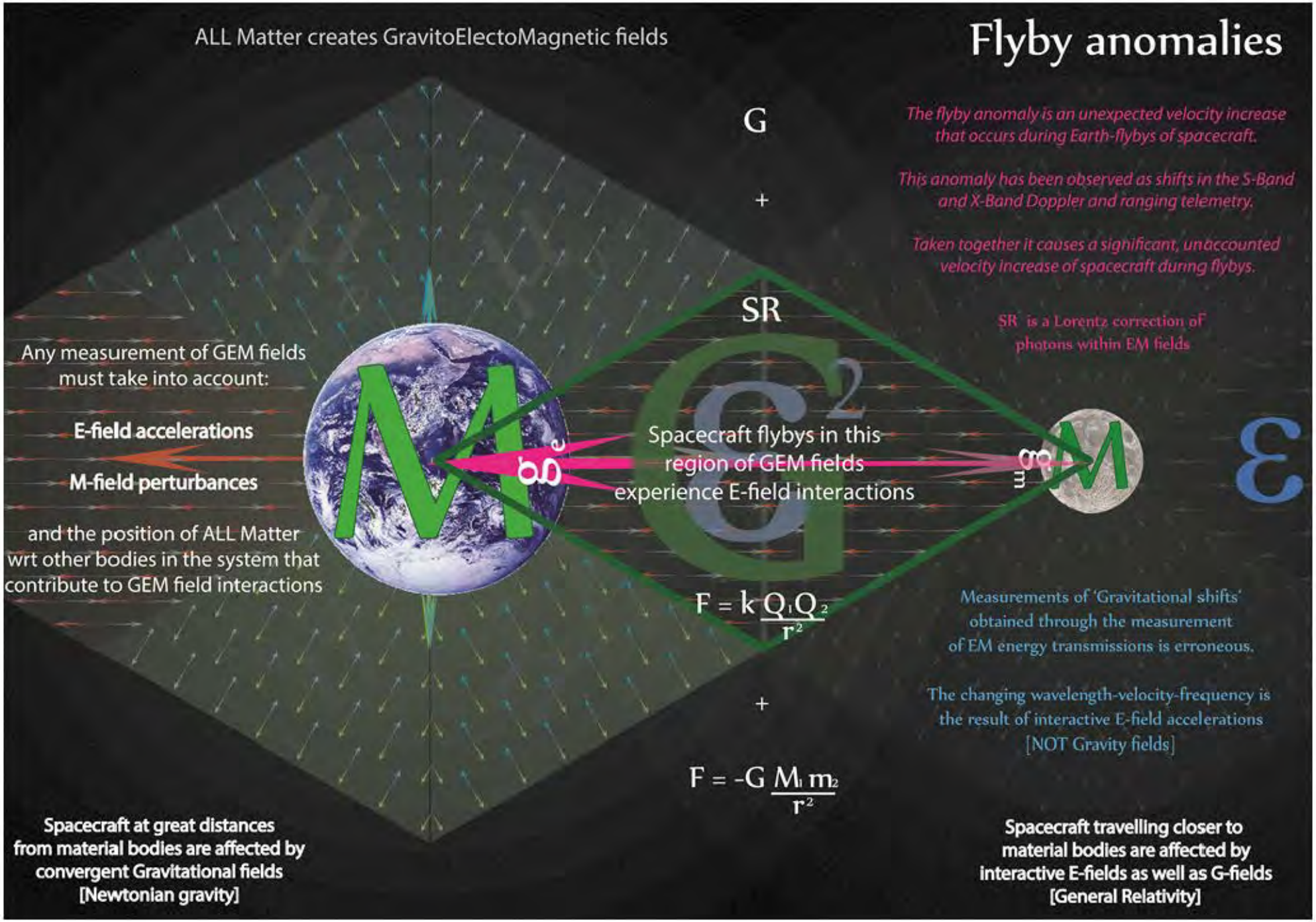

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Pioneer anomaly

Despite many proposed solutions,
there is not yet an accepted explanation
for the cause of the Pioneer velocity anomaly

Newtonian Gravitation

$$F = -G \frac{M_1 m_2}{r^2}$$

measures the nett gravitational attraction
of Matter towards other Matter
[using weak [K]EM fields]

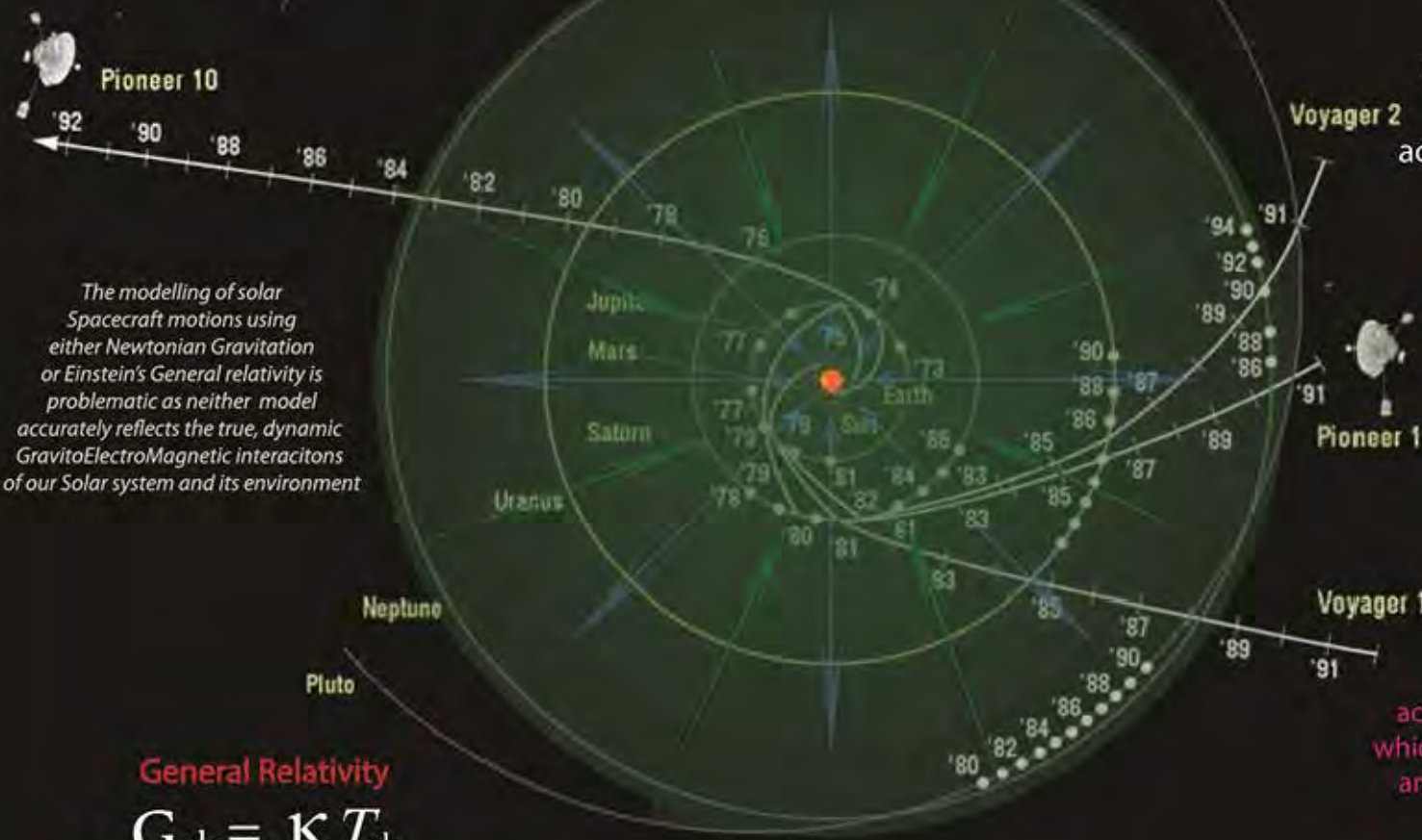

Many proposals
have been put forward to
explain this unexpected
acceleration towards the Sun

The modelling of solar Spacecraft motions using either Newtonian Gravitation or Einstein's General relativity is problematic as neither model accurately reflects the true, dynamic GravitoElectroMagnetic interacitons of our Solar system and its environment

Tetryonic GEM interactions shows
that the measured acceleration is
the result of a weakening, inverse
squared stellar EM interaction
throughout the Solar heliopause

This would result in
a decrease in divergent
acceleration away from the Sun
which has been mis-interpretted as
an acceleration toward the Sun

General Relativity

$$G_{ab} = \kappa T_{ab}$$

calculates for the total Gravitational and
EM interactions for energy in all its forms
[using Energy pressure gradients]

"Both Pioneer spacecraft are escaping the Solar System, and are slowing under the influence of the Sun's nett gravitational [GEM] field.

Upon very close examination of navigational data, the spacecraft were found to be slowing slightly more than expected.
The effect is an extremely small but unexplained acceleration towards the Sun, of 8.74±1.33×10−10 m/s2"

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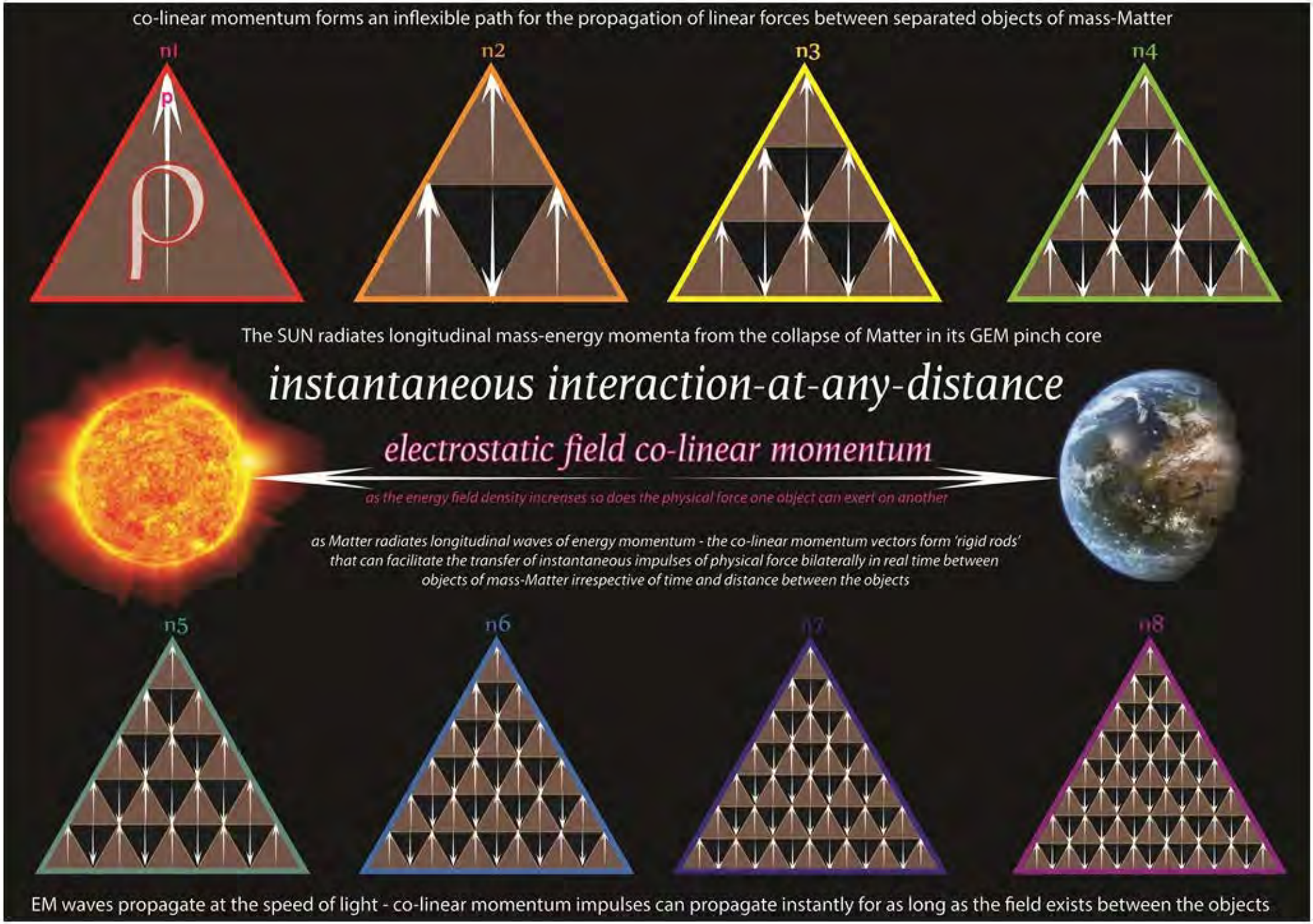

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Instantaneous interaction-at-a-distance

One of the major points of disagreement between Newtonian Graviation and General Relativity concerns Einstein's limiting of information and energy momenta propagation to the speed of light whereas the Newtonian physics for Gravitation acts instantly between Matter irrespective of distance and time

particles interact with others in real time irrespective of distance

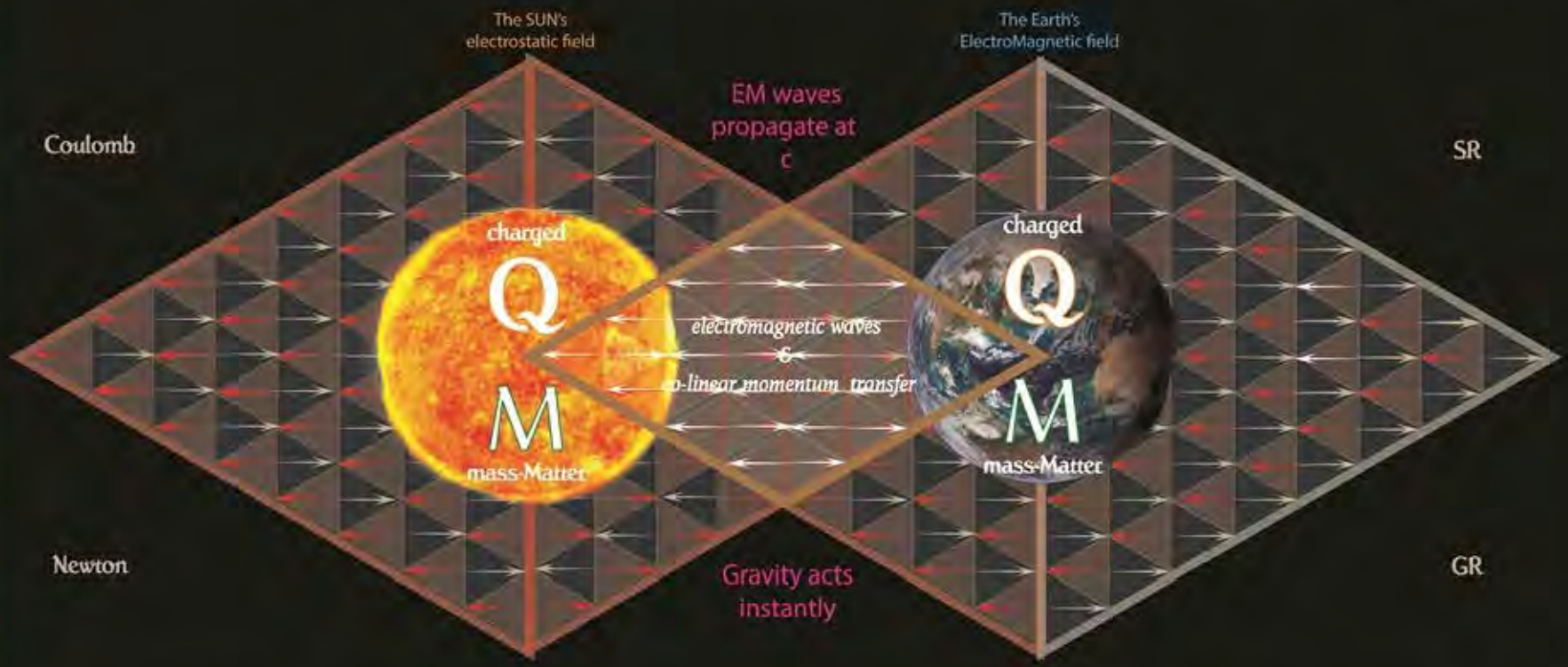

the flow of energy and information is limited to the speed of light

Where electrostatic and/or electromagnetic fields overlap they form fields of interaction between bodies of Matter

the 'quantum rods' of co-linear momentum in their EM fields facilitate 'FTL spooky interaction-at-a-distance' facilitating near instantaneous [real time] impulses of linear momentum to convey physical forces over vast distances without loss for as long as the fields exist between the objects

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The efficient wireless transmission of electrical energy requires the creation of a large electrostatic field of longitudinal energy momenta

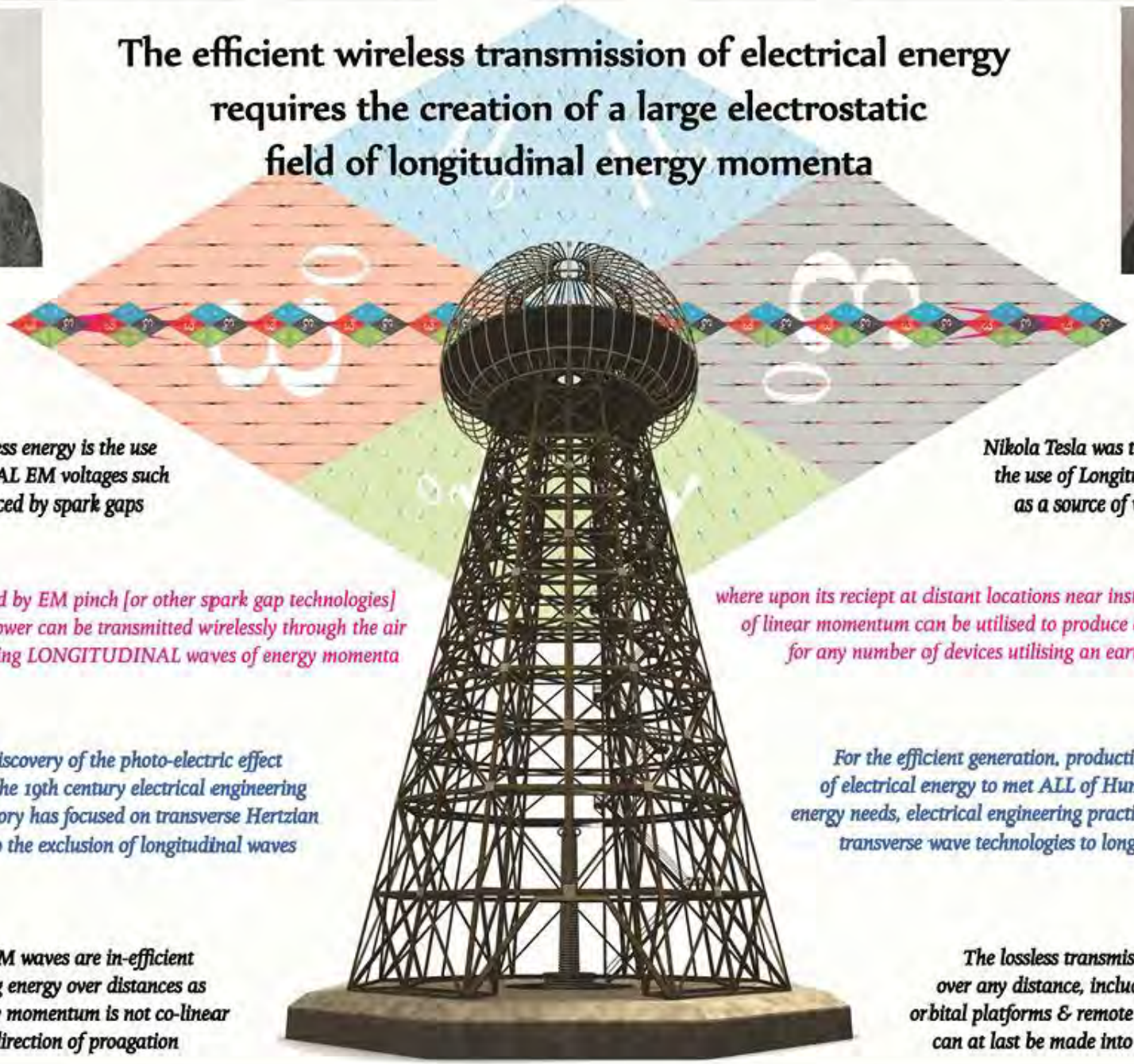

The key to wireless energy is the use of LONGITUDINAL EM voltages such as those produced by spark gaps

Nikola Tesla was the first to promote the use of Longitudinal EM waves as a source of wireless energy

Once generated by EM pinch [or other spark gap technologies] real electrical power can be transmitted wirelessly through the air without loss using LONGITUDINAL waves of energy momenta

where upon its reciept at distant locations near instanteous impulses of linear momentum can be utilised to produce electrical work for any number of devices utilising an earth return

Since the discovery of the photo-electric effect at the turn of the 19th century electrical engineering and physics theory has focused on transverse Hertzian waveforms to the exclusion of longitudinal waves

For the efficient generation, production and storage of electrical energy to met ALL of Humanities growing energy needs, electrical engineering practices must move from transverse wave technologies to longitudinal waves

Transverse EM waves are in-efficient for transmitting energy over distances as their linear energy momentum is not co-linear with their direction of proagation

The lossless transmission of power over any distance, including to and from orbital platforms & remote locations on Earth, can at last be made into a physical reality

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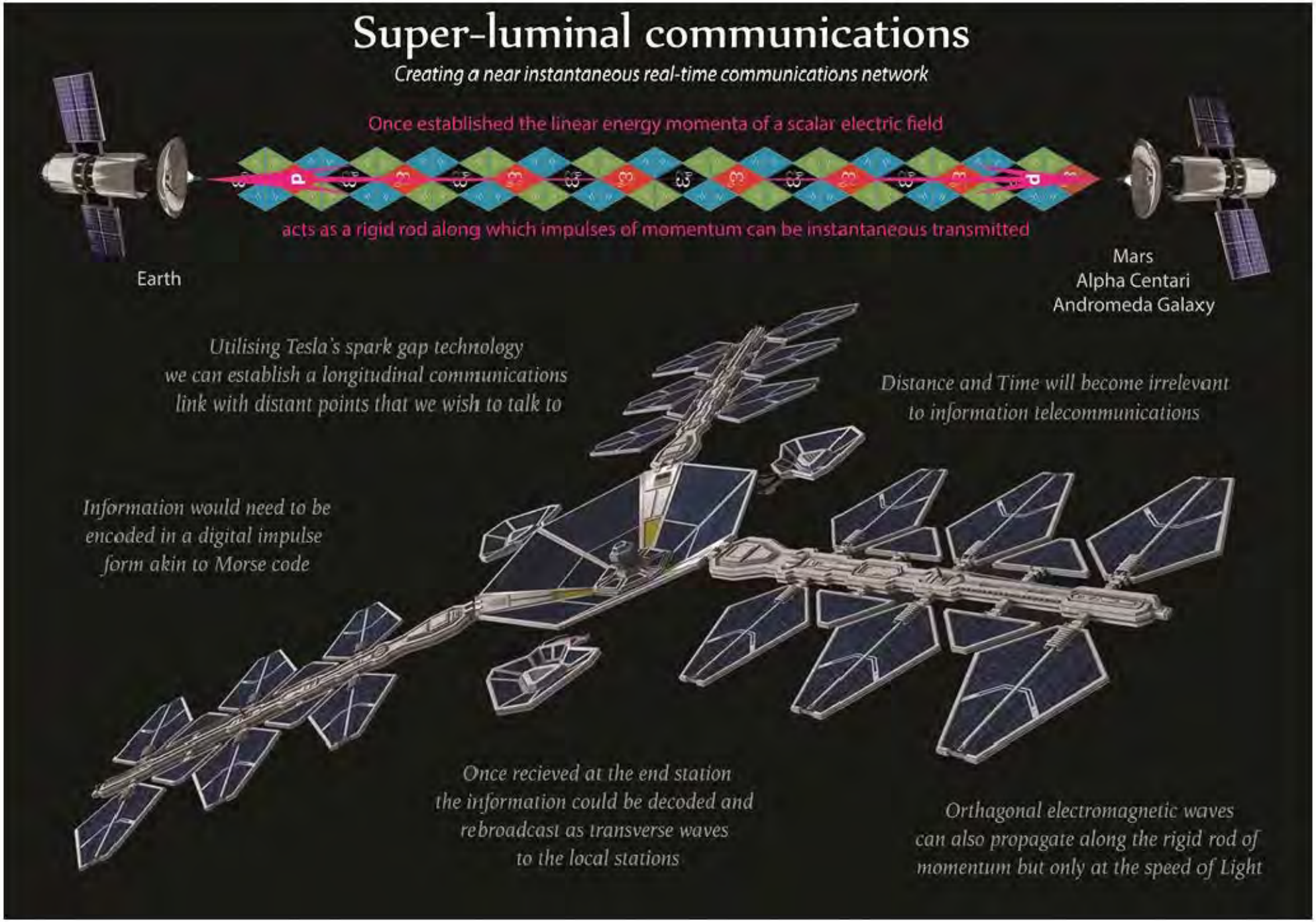

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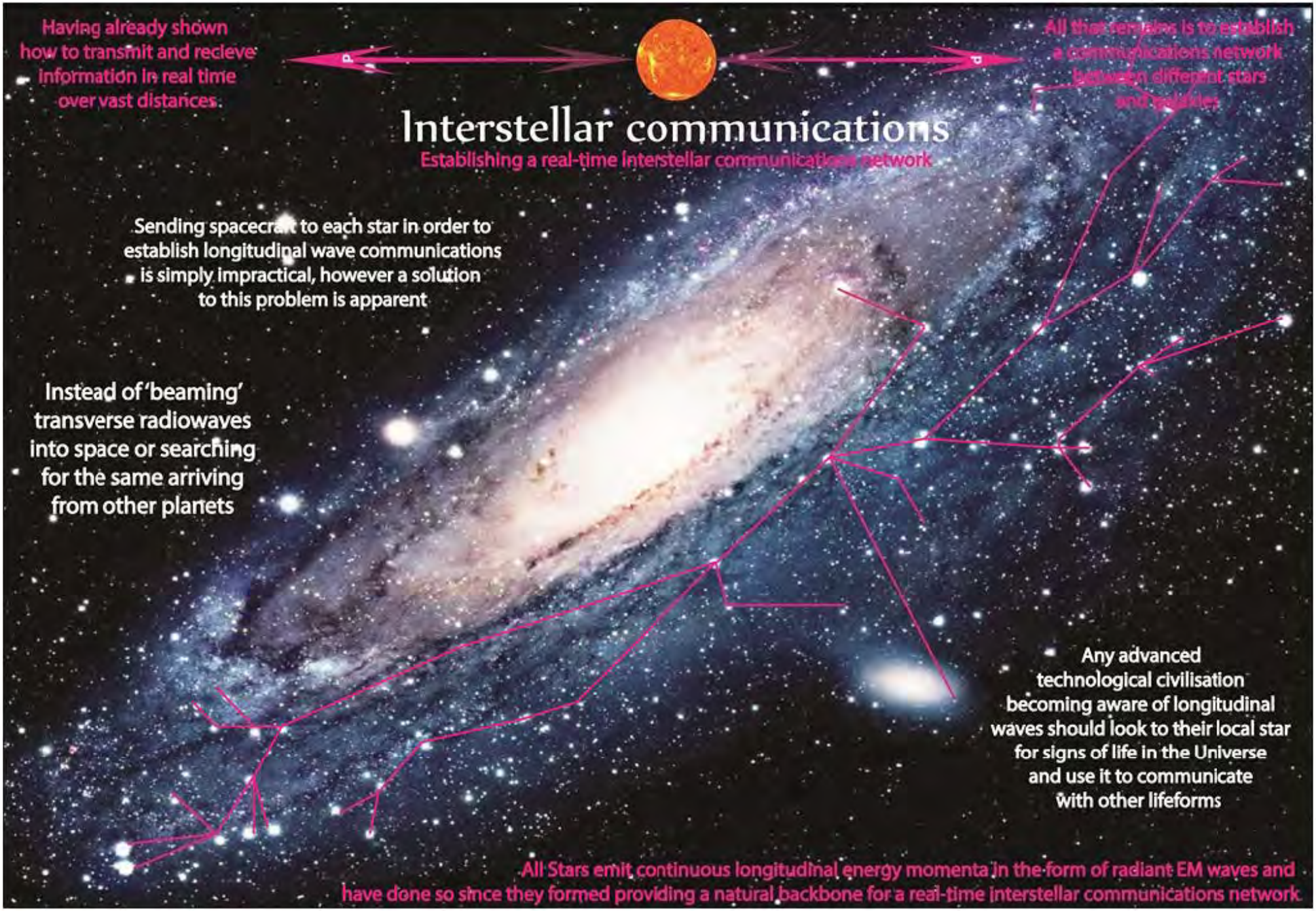

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Mercurial anomalies

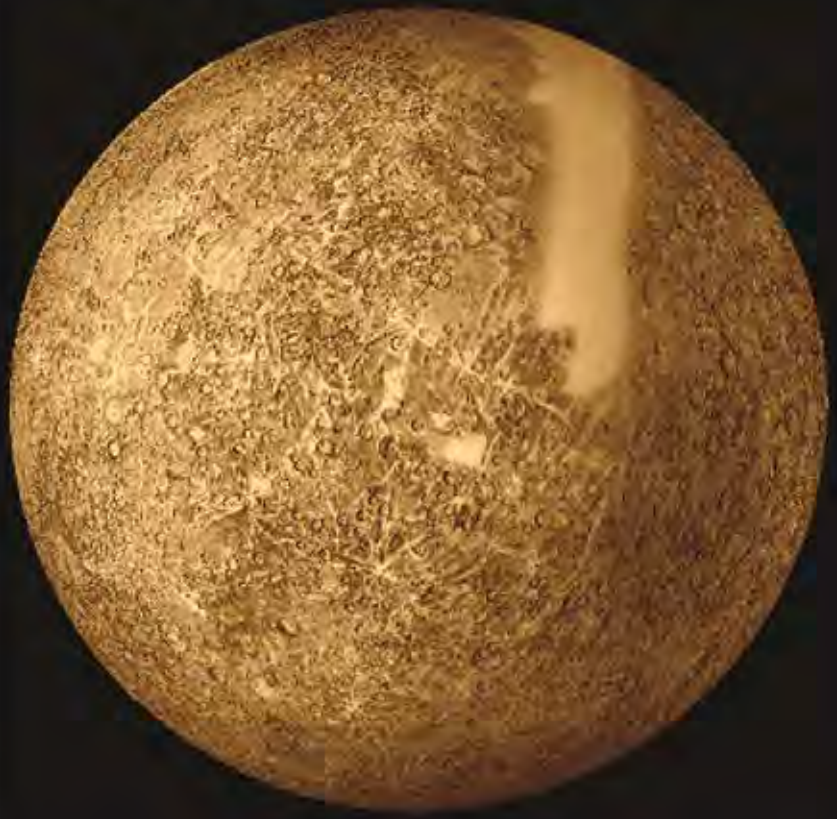

Mercury has a weak magnetic field

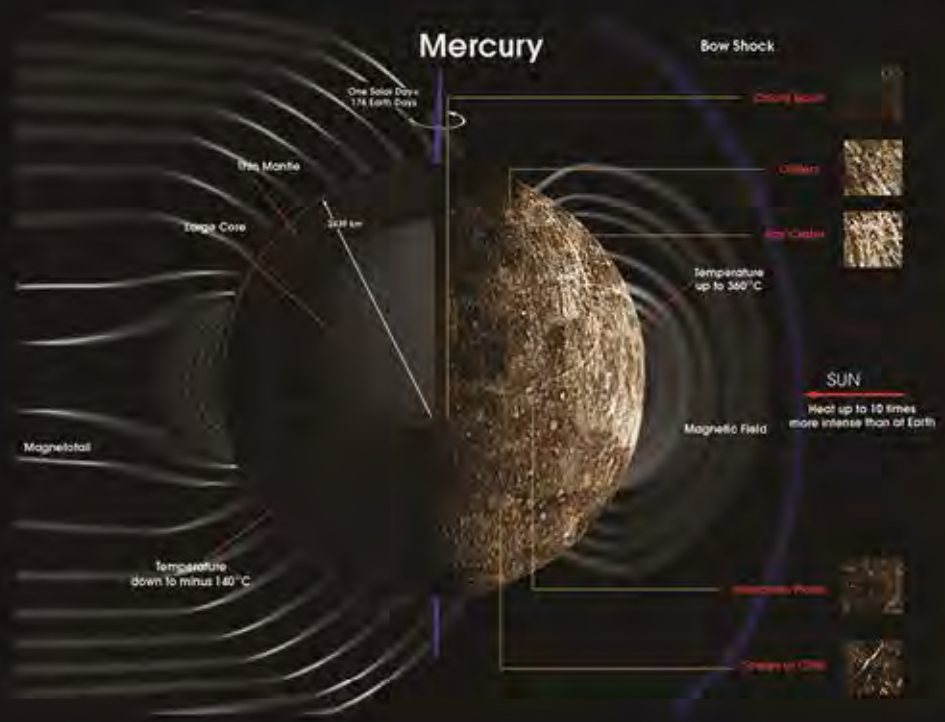

Mercury has heat of its own, not just reflected heat of the Sun;

Mercury has still an atmosphere of Hydrogen, possibly the last vestiges of a more extensive halo and trail (caduceus)

Mercury rotates because it is in its present orbit it is strongly affected by the EM field of the SUN,

Because the ElectroMagnetic forces near the Sun need to be accounted for in the motion of any satellite about a more massive body [ie Satellite-Planet or Planet- Sun], the stronger E & perturbative M forces are responsible for the observed precession of the perihelion of Mercury, and Leverrier's discovery of this precession can be modelled with Einsteins' General relativity through Tetryonic geometries

Laplace showed that should a celestial body attracted by its primary as inverse square of distance be subject to another attraction that changes as the inverse cube of distance, a precession by that body would result.

Einstein corrected Newton's gravitational results by calculating for ALL the energies in a system but failed to realise that his 'graviational correction' was in fact a Lorentz correction for EM interactions

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Venusian anomalies

is sometimes referrd to as Earth's "twin" owing to their similar size, gravity, and bulk composition.

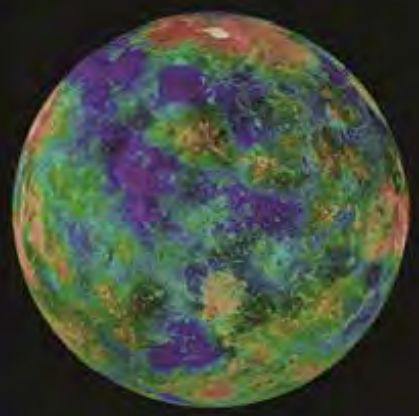

Venus has the densest atmosphere of all the terrestrial planets in the Solar System, consisting of mostly carbon dioxide. The atmospheric pressure at the planet's surface is 92 times that of the Earth.

Venus is the hottest world in the solar system. Although Venus is not the planet closest to the sun, its dense atmosphere traps heat in a runaway version of the greenhouse effect that warms up the Earth.

As a result, temperatures on Venus reach 465 degrees C

The lack of an intrinsic magnetic field at Venus was surprising given it is similar to Earth in size, and was expected also to contain a dynamo at its core

Venus has no moons or rings

Galileo's discovery that Venus showed phases (while being never very far from the Sun in our sky) proved that it orbits the Sun and not the Earth

The Venusian year is about 225 Earth days long.

Venus takes 243 Earth days to rotate on its axis, which means that days on Venus would be longer than years. However, because of Venus' curious retrograde rotation, the time from one sunrise to the next is only about 117 Earth days

The very top layer of Venus' clouds zip around the planet every four Earth days, propelled by hurricane-force winds traveling roughly 224 miles (360 kilometers) per hour.

This super-rotation of the planet's atmosphere, some 60 times faster than Venus itself rotates, may be one of Venus' biggest mysteries.

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Earth-Moon anomalies

The Moon is slowly accelerating away from the Earth

Athough it is attracted gravitationally to the Earth the Moon is moving away from the Earth at about 4cm per year as a result of the Earth's EM field interactions with Matter in its vicinity.

The Earth's EM field accelerates the moon against the pull of gravity stabilising its orbit
its current field strength forces the moon to slowly accelerate away from the Earth over time

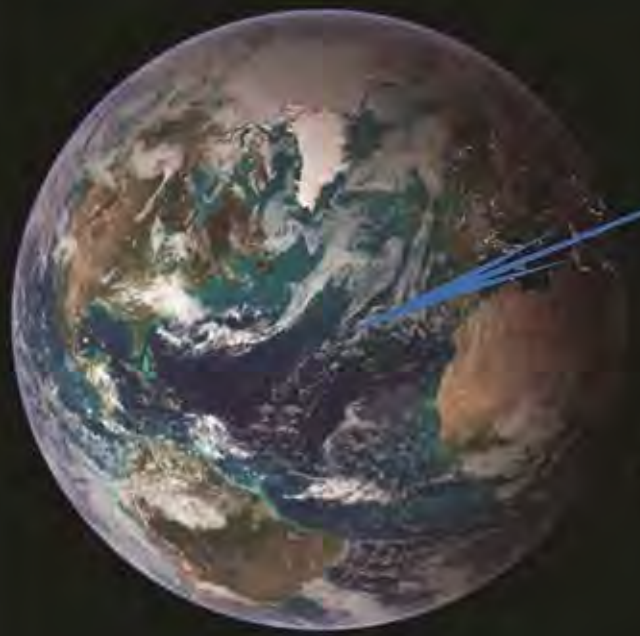

The Moon's Origin

Most scientists think the moon was born from a gargantuan collision, when a young, 30-million-year-old Earth was sideswiped by an embryonic planet the size of Mars some 4.5 billion years ago, with debris from our planet and this impactor eventually coalescing from the ejecta to form our Moon.

The Lunar a lunar day is a month long, the same as the Moon's orbital period

The Moon only shows one face to the Earth

it is gravitational locked in its orbit with one side always facing the Earth when viewed from the Earthat night. There is no such thing as the "dark side of the moon". The sun shines on all sides

The Moon is 400 times smaller than the SUN
The SUN is 400 times more distant

The Moon looks exactly the same size as the Sun

"There is no astronomical reason why the moon and the sun should fit so well. It is the sheerest of coincidences, and only the Earth among all the planets is blessed in this fashion." .....Isaac Asimov

A striking coincidence that has had astronomers thinking since ancient times is why the Sun and the Moon appear to be the same size during an eclipse. It's known that the Sun's diameter is 400 times that of the Moon, but, then again, the Moon is 400 times further away from the Sun.

This creates the optical illusion that the two are actually the same size, allowing us to observe the Solar corona and its EM field lines

Our moon is the only moon in the solar system that has a stationary, near-perfect circular orbit. Stranger still, the moon's center of mass is about 6000 feet closer to the Earth than its geometric center (which should cause wobbling), but the moon's bulge is on the far side of the moon, away from the Earth. "Something" had to put the moon in orbit with its precise altitude, course, and speed.

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Martian anomalies

Phobos

There is no completely satisfactory theory as to how Deimos and Phobos came to be in orbit around Mars

With a dametre of 6 km Deimos is one of the smallest known moons in the solar system

Deimos

Although Mars is much smaller than Earth, [approx 1/4 the size] its surface area is about the same as the land surface area of Earth

Deimos and Phobos are probably asteroids perturbed by Jupiter into orbits that allowed them to be captured by Mars

The southern hemisphere of Mars is predominantly ancient cratered highlands somewhat similar to the Moon.

In contrast, the northern hemisphere consists of plains which are much younger, lower in elevation and have a much more complex history.

Mars orbits about 1.5au from the SUN

An abrupt elevation change of several kilometers seems to occur at the boundary

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Jupiters' anomalies

Jupiter has an intense and far-reaching magnetic field. Exactly what drives the magnetic powerhouse and how deep inside the planet it originates, however, is unknown

Jupiter's diameter is approx 1/10 that of the SUN and 10 times the size of Earth

Jupiter has twelve satellites.

The five inner moons revolve around their planet in orbits only slightly inclined to the planet's equator at distances from about 110,000 miles for the innermost to about 640,000 miles for the outermost.

Jupiter's mass is 2.5 times that of all the other planets in our Solar System combined

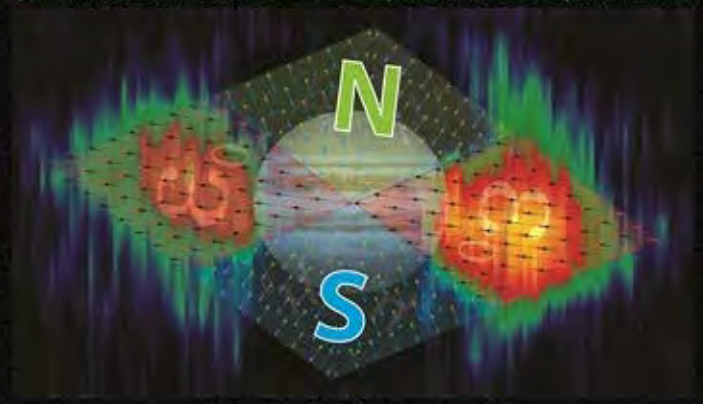

Tetryonic EM geometry offers answers to many of the dynamic mysteries of Jupiter and its moons

Then there is a group of three moons whose orbits are inclined to the planet's equator by almost 30° at distances of about 7 million miles from Jupiter.

These three moons also revolve around the planet in the predicted direction.

The four outer moons, however, move around the planet in retrograde motion, or opposite to that of the other eight satellites, at distances from about 12 to 13 million miles from the planet

Its Great Red Spot has a circumference about the same as the Earth

Jupiter also has the most energetic auroras in the solar system at both of its poles

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Saturnian anomalies

In addition to the planet's giant rings, Saturn has nine major moons and more than 60 known satellites.

The motion of the outermost, Phoebe, is retrograde, moving in a direction opposite to the other eight moons and opposite to that predicted from an evolutionary origin.

Tetryonic theory suggests that this retrograde motion is the result of it being a gravitationally captured body whose motion over time will be slowed, eventually forcing it into the same motion as the others

TITAN
is the only moon that
possesses a thick atmosphere, and
it's the only place beyond Earth to have
stable bodies of liquid Methane on its surface

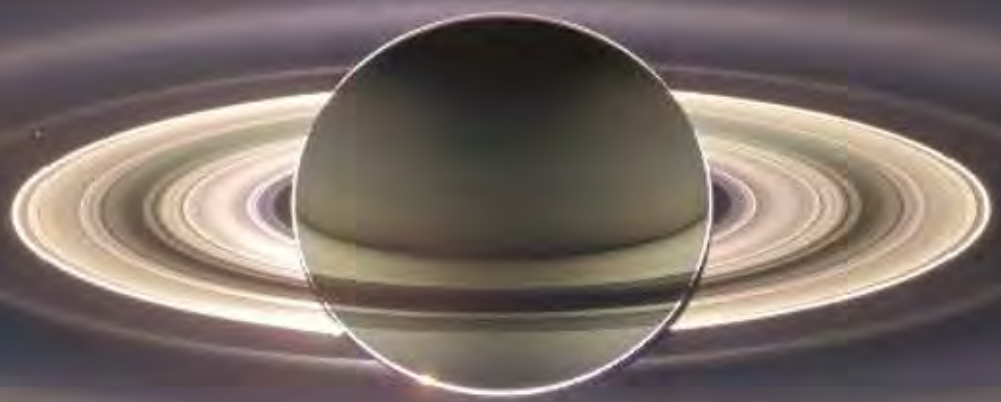

The rings of Saturn occasionally exhibit ghostly radial spokes that seemingly defy the laws of gravity

The Saturnian rings, like many others, are formed by the electric field of the planet and subject to seasonal fluctuations of the SUN's heliosheric E-field

Tetryonic GEM interactions shows that these features are the result of electric forces additional to gravity

Strange features abound within the rings of Saturn. These include hundreds of "record grooves" or narrow fluctuations in the B ring, the most massive ring.

These also include "plateaus" in the C ring, the innermost main ring—broad, dark, sharp-edged features thicker than elsewhere in the ring.

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Neptunes' anomalies

Neptune was the first planet found by mathematical prediction rather than by empirical observation

Neptune has two satellites.

Nereid, a small moon, moves around Neptune in the predicted direction, but Triton, one of the larger satellites in the solar system with a mass almost twice that of the earth's moon.

Of Neptune's 13 moons, Triton is by far the biggest and the only one massive enough to be spheroidal.

Weirdly, Triton has a "retrograde" orbit, revolving in the opposite direction of the planet and other moons.

Plus, the orbit is at an angle rather than in the plane around the equator like typical satellites

The magnetic field of Neptune, like that of Uranus, is highly tilted at 47 degrees from the rotation axis and offset at least 0.55 radii (about 13,500 kilometers or 8,500 miles) from the physical center

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Uranus' anomalies

Uranus is remarkable, even though it rotates around the sun in the same direction as the other planets in an orbit inclined less than a degree (46') from the ecliptic (the plane of the earth's orbit around the sun), the axis of rotation of Uranus is nearly in the plane of its orbit.

Accordingly, the inclination of the equator of Uranus to the plane of its orbit is 98°, and its axial rotation is retrograde.

The five moons or satellites of Uranus move exactly in the equatorial plane of the planet and they revolve in the same direction as the planet rotates.

Their motion, with respect to the remainder of the solar system, is, therefore, also retrograde.

Tetryonic theory dictates that Uranus' peculiar planetary mechanics may be the result of the EM interactions of Uranus itself with its satellites rather than the current evolutionary explanation

The direction of the axial rotation of Uranus and the motion of its satellites is opposite to that predicted on the basis of an evolutionary origin.

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Pluto's anomalies

Pluto is much smaller than any of the official planets
and due to its size and orbital inclination
is now classified as a "dwarf planet"

Pluto rotates in the opposite direction
to that of most of the other planets

Pluto is locked in a 3:2 resonance with Neptune;
i.e. Pluto's orbital period is exactly 1.5 times longer than Neptune's.
Its orbital inclination is also much higher than the other planets

Pluto's orbit is highly eccentric.
At times it is closer to the Sun than Neptune

Charon is unusual in that it is
the largest moon with respect to its
primary planet in the Solar System
(a distinction once held by Earth's moon)

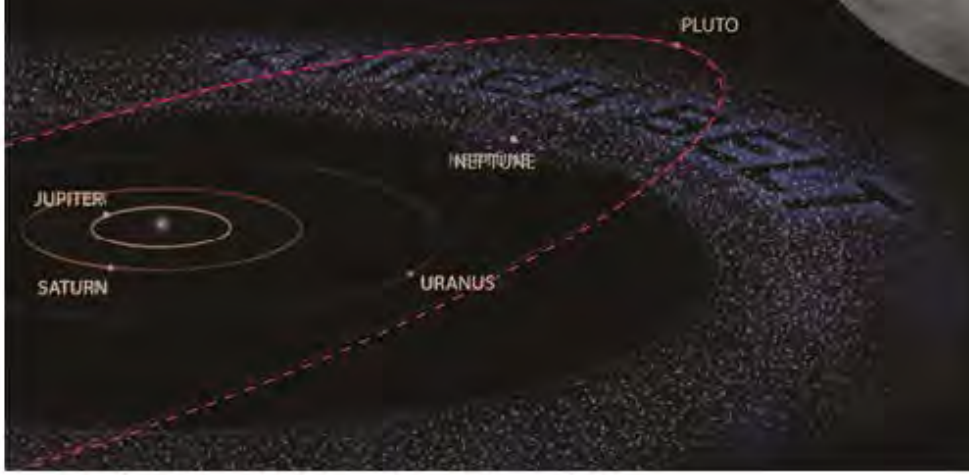

The Pluto–Charon system is noteworthy
for being one of the Solar System's
few binary system

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Cometary anomalies

Comets provide some of the clearest evidence of Electromagnetic interactions between the SUN and other planetary bodies

While the solid nucleus of comets is generally less than 50 km across, the coma may be larger than the Sun, and ion tails have been observed to extend 3-4 astronomical units (5-600 million km)

Cometary discharging may also occur due to any disturbances of its electrical plasma sheath as it passes through regions of varying electric potential.

This seems to have occurred in the recent "totally surprising" outburst of Comet Holmes 17P as it moved away from the Sun's domain.

In 2000 the explosive break up of Comet Linear provoked great amazement as the event occurred well over a hundred million kilometers from the Sun

Other anomalies that can be explained by a CHARGED model of cometary nuclei are:
Unexpectedly high temperatures and X-ray emissions from cometary comas

The sharply carved relief of comets
[the exact opposite of what is expected under the "dirty snowball" model]

The unexplained ability of a relatively minuscule comet nucleus to hold in place a highly spherical coma, up to millions of miles in diamater, against the force of the solar wind;

Ejection of larger particles and "gravel" that was never anticipated under the idea that comets accreted from primordial clouds of ice, gas, and dust;

A short supply or complete absence of water and other volatiles on comets' nuclei;

The Electric Universe's model of charged solar bodies predicted the occurrence of an electrical flash in advance to the impact of a projectile into the nucleus of Comet Tempel 1 (Deep Impact.)

The Dust tail is the result of reflective ejected Matter following the comet's path throught solar system while the Ion tail is the result of ejected charged particles of Matter and is heavily influenced by the SUN's radiated E fields

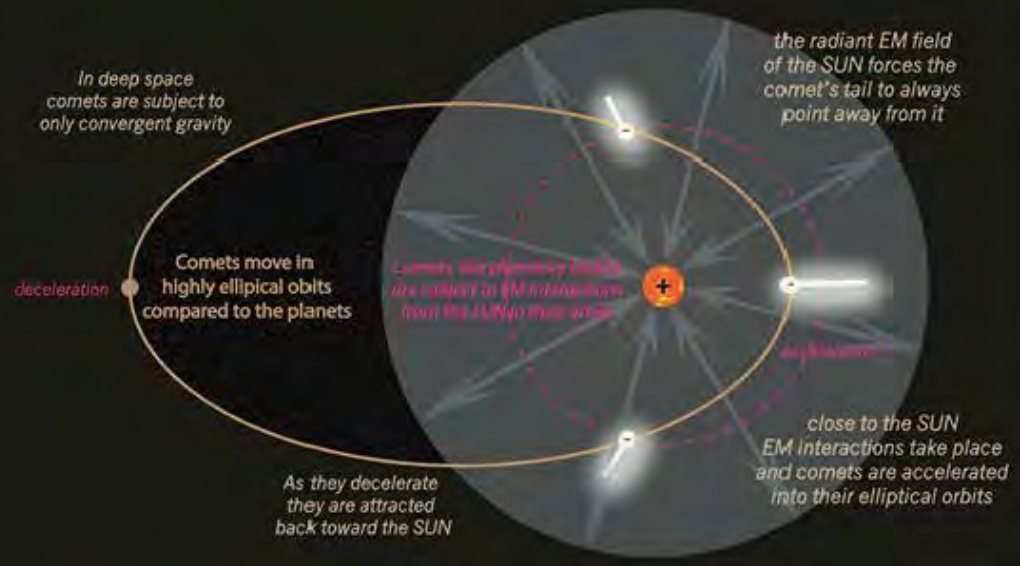

The tails of comets always point away from the Sun, so after a comet has passed the Sun it actually travels tail first

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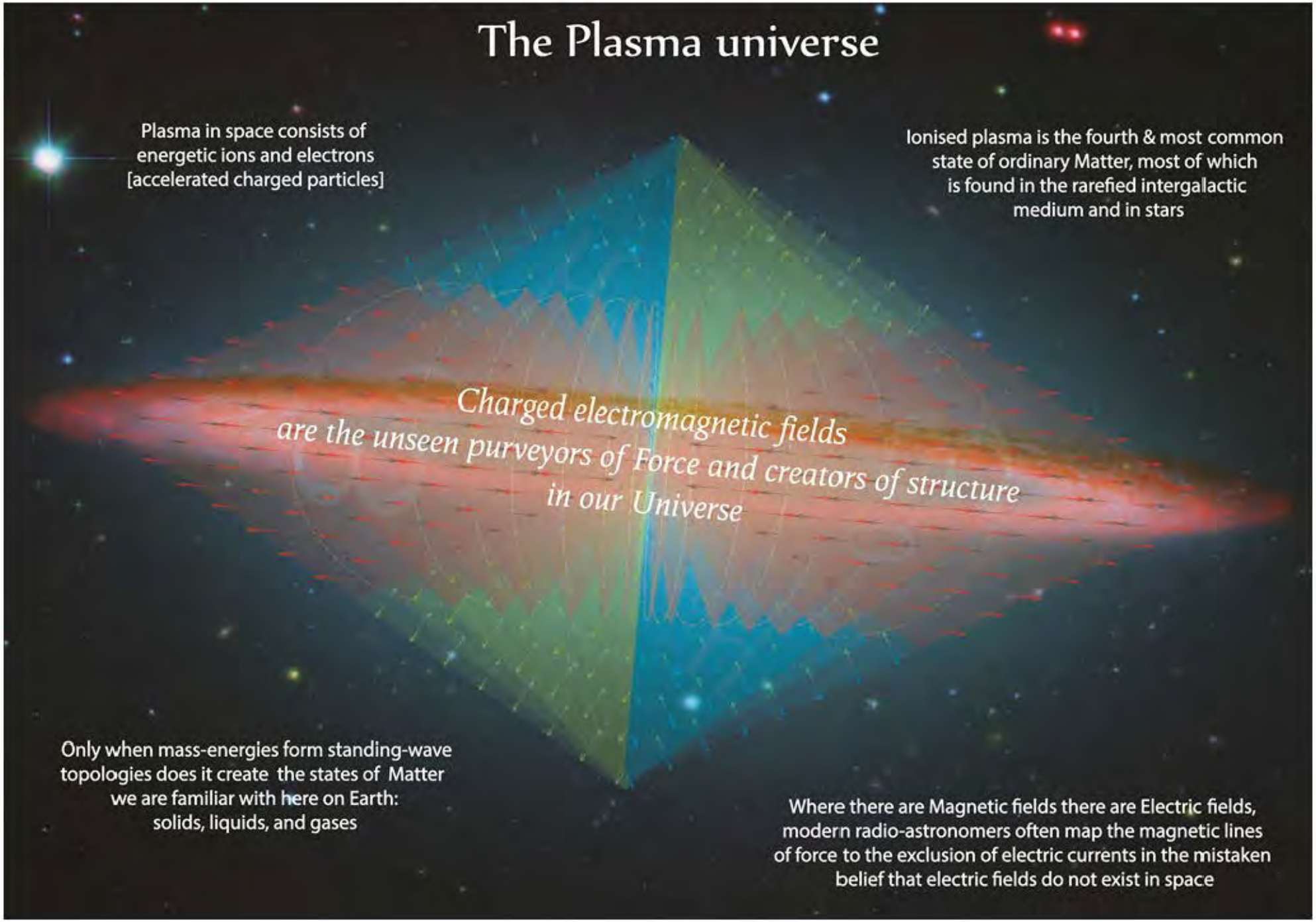

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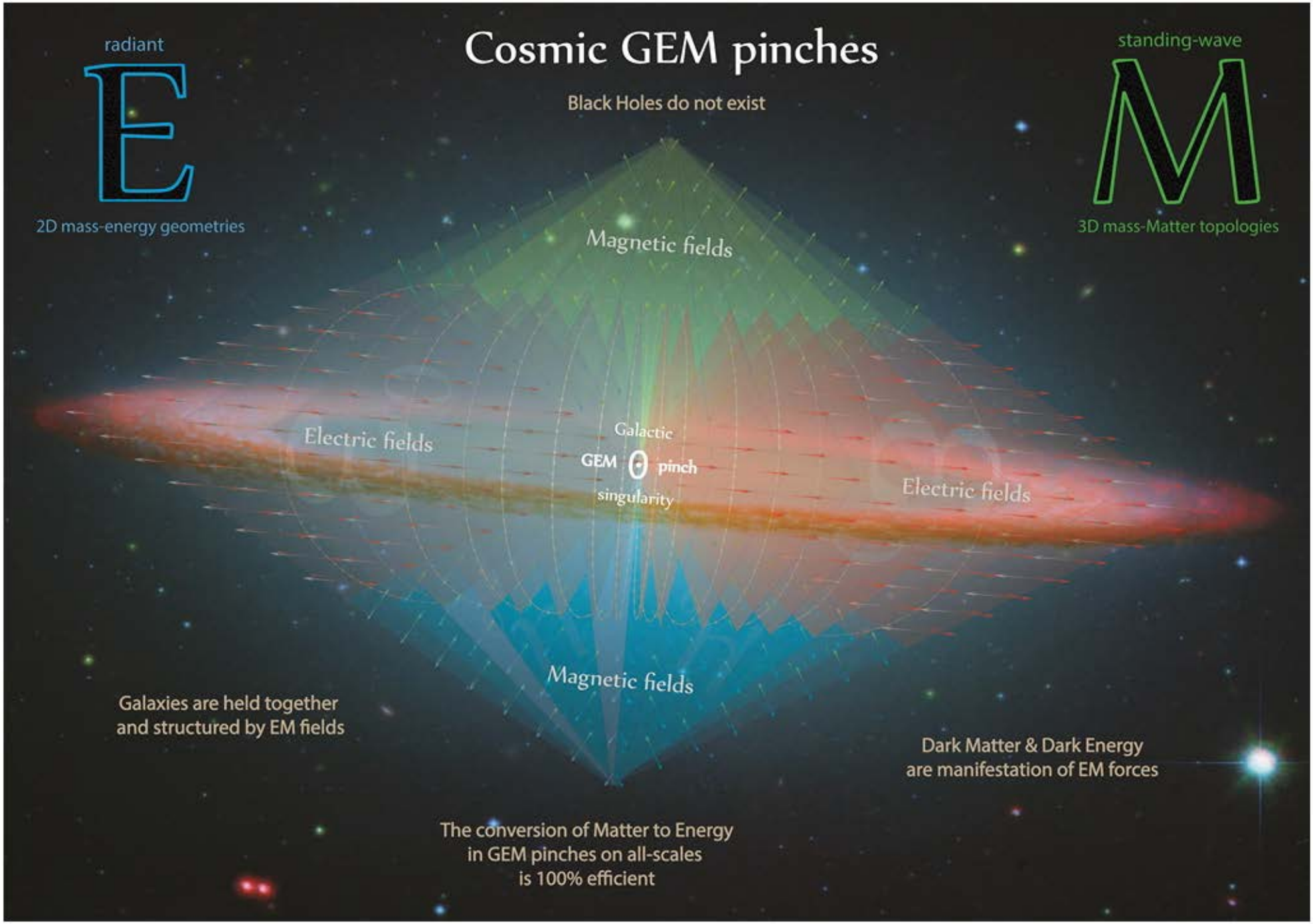

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PLASMA FIELDS

The Cosmos is electromagnetic in nature

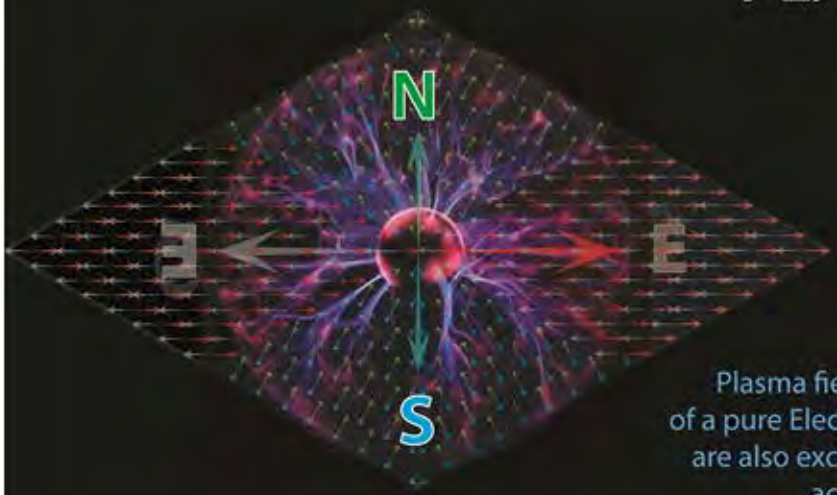

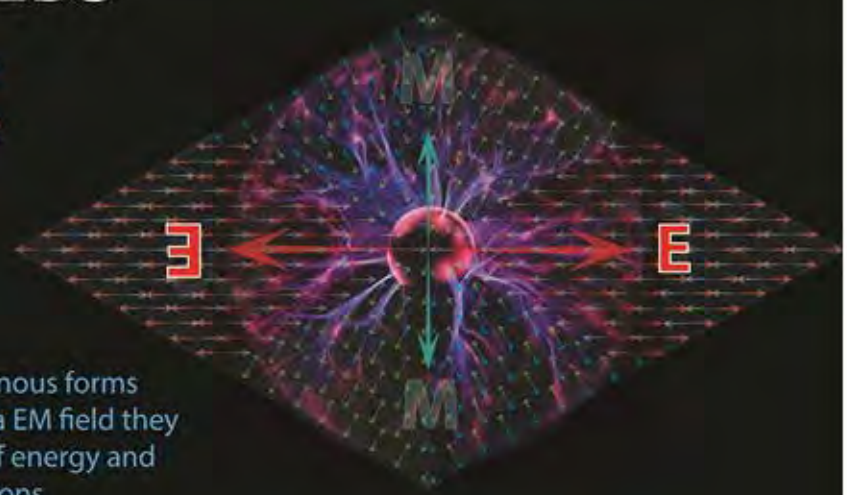

Plasma fields create the most tenous forms of a pure Electrical field, and being a EM field they are also exceptional conductors of energy and accelerators of charged Ions

Magnetised Plasma fields
neutral electric charge EM fields
(with a magnetic magneton)

Charged Plasma fields
charged electrostatic EM fields
(with no magnetic magneton)

Neutron stars

Matter

antiMatter

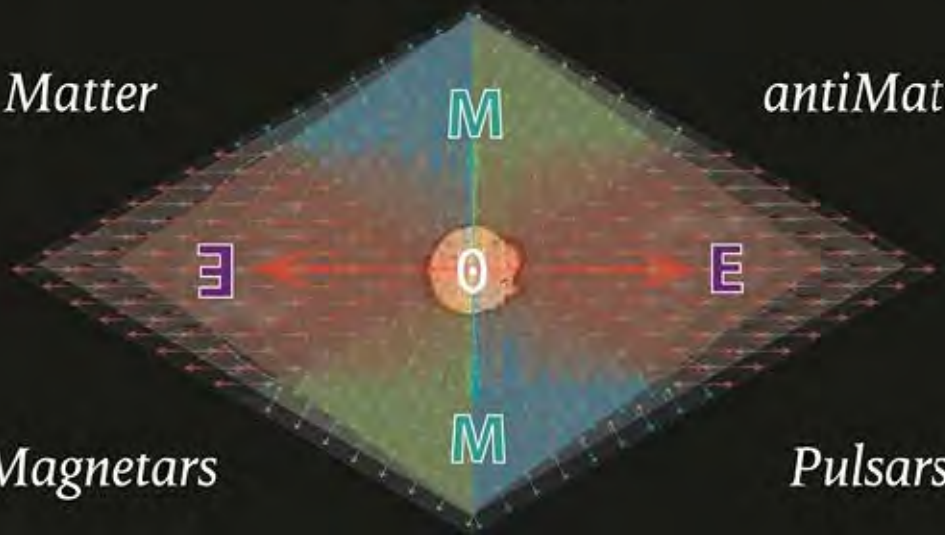

Accretion discs

Gamma rays

Magnetars

Pulsars

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Neutron Stars

All Gravitational fields
are comprised of quantum
GEM fields

In current astrophysical theories in order to create a

Neutron star

the central region of the star collapses under gravity.

It collapses so much that protons and electrons
combine to form neutrons. and neutrogenic Matter

Hence the name "neutron star".

Typical Neutron stars have
very strong M-fields

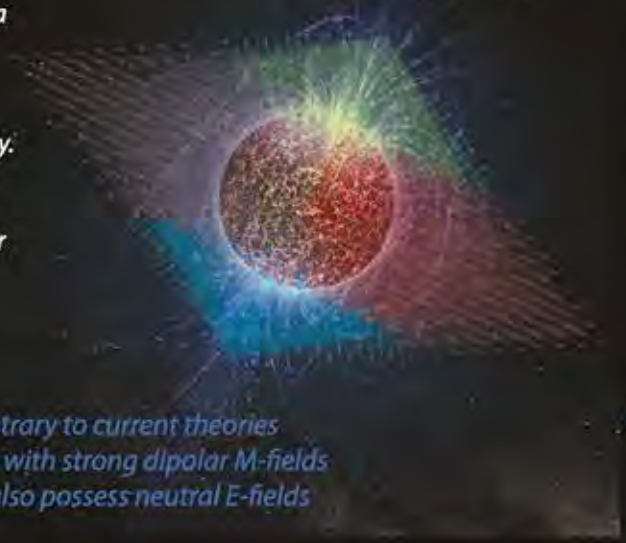

Contrary to current theories
any star with strong dipolar M-fields
must also possess neutral E-fields

"A neutron star is a type of remnant that can result from the gravitational collapse of a massive star during a Type II, Type Ib or Type Ic supernova event.

Such stars are composed almost entirely of neutrogenic Matter, [Neutrons, antiNeutrons and neutrinos] which against current theory act in exactly the same manner as ordinary Matter in producing spectral lines.

"Neutron stars are very hot and are supported against further collapse because of the Pauli exclusion principle.

This principle states that no two neutrons (or any other fermionic particle) can occupy the same place and quantum state simultaneously"

As shown throughout Tetryonic theory
Neutron stars can be formed
comprised completely of 'Neutral Matter'

Neutral Matter is comprised of
Neutron - anti-Neutron - Neutrino
atomic nuclei

Neutral matter atoms function identically to
normal matter-antimatter particle topologies
and releases energy in the form of photons

The gravitational collapse of any
stellar material must overcome
the radiant EM energies that it
releases

Pulsars are non-neutral stellar
objects that have weak M-fields
but emit extremely strong E-field
radiation as they collapse

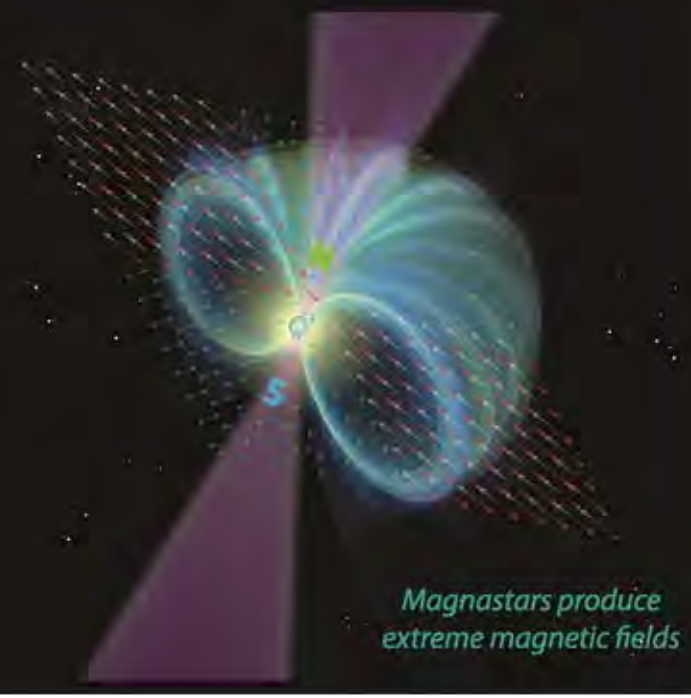

Neutral matter in Neutron stars experience the same ElectroMagnetic forces as
normal matter and anti-matter stars but have differing charge arrangements

Magnastars produce
extreme magnetic fields

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Neutrons & Neutronium formation neutrinos

Neutronium is a proposed name for a substance composed entirely of Neutrons & neutrinos

Neutron degeneracy

As a star collapses, the Fermi energy of the electrons increases to the point where it is energetically favorable for them to combine with protons to produce neutrons (via inverse beta decay, also termed "neutralization" and electron capture)

This, as shown through Tetryonic geometry, is incorrect

Neutrons are NOT comprised of Protons with electrons fused into them under pressure

Gravitational fields are comprised of convergent gravity and interactive EM fields

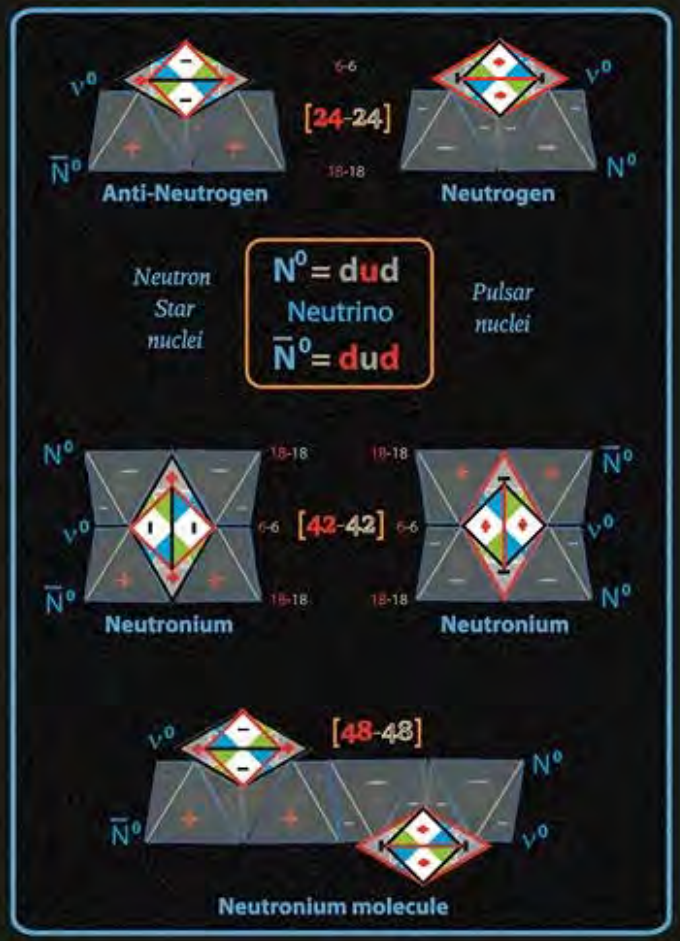

"The gravitational field at the star's surface is about 2×10^11 times stronger than on Earth.

Such a strong gravitational field acts as a gravitational lens and bends the radiation emitted by the star such that parts of the normally invisible rear surface become visible"

Photons and EM waves are REFACTED by EM fields NOT bent by gravity as currently hypothesized

Neutronium

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

The neutral nuclei of neutron stars emit exactly the same light as normal stars do

Neutron stars are made of neutronium nuclei

A neutron star is a type of stellar remnant that can result from the gravitational collapse of a massive star during a Type II, Type Ib or Type Ic supernova event.

N^0

Such stars are composed almost entirely of neutrons, which are subatomic particles without electrical charge and with the same mass-Matter as protons. Neutron stars are very hot and are supported against further collapse by quantum degeneracy pressure due to the Pauli exclusion principle.

This principle states that no two neutrons (or any other fermionic particles) can occupy the same place and quantum state simultaneously

ν^0

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Equilateral Planck geometries create elementary charge topologies

Neutron star types

Neutron stars comprise one of the possible evolutionary end-points for stars, they are compact stellar objects measuring between 10 and 20 km across with intense magnetic fields around 10^12 times that of the Earth

Like all forms of Matter, neutron stars are formed from 3 distinct charge flavours of Matter

Matter

positrons

Protons

neutrinos

0

Neutrons

electrons

Negatrons

anti-Matter

Neutron stars are neutral charge pulsars

Positive charge pulsars

Strong E-fields

Neutron Stars

Strong dipolar M-fields

Negative charge pulsars

Strong E-fields

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Pulsars

A pulsar is a rotating neutron star that emits a beam of electromagnetic radiation.

This radiation can only be observed when the beam of emission is pointing towards the Earth, much the way a lighthouse can only be seen when the light is pointed in the direction of an observer, and is responsible for the pulsed appearance of emission.

Pulsars are electrically charged versions of neutron stars that have weak M-fields in comparision to Neutron stars themselves

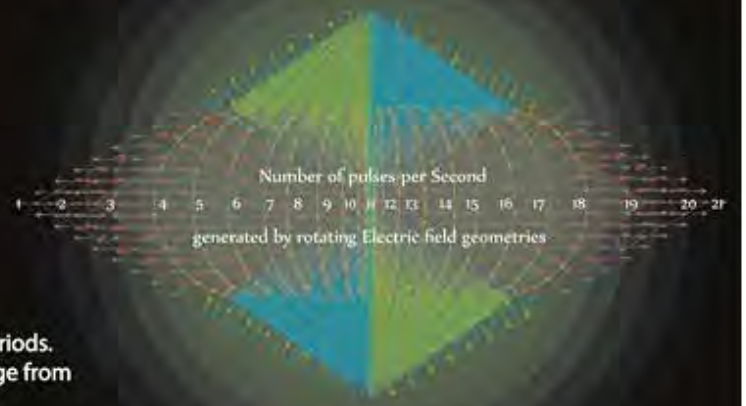

Pulsars are very dense, and have short, regular rotational periods. This produces a very precise interval between pulses that range from milliseconds to several seconds for individual pulsars

E-field waves accelerate charged particles M-fields do no work

Ampere

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$$

Electric force — *Magnetic field*

Lorentz

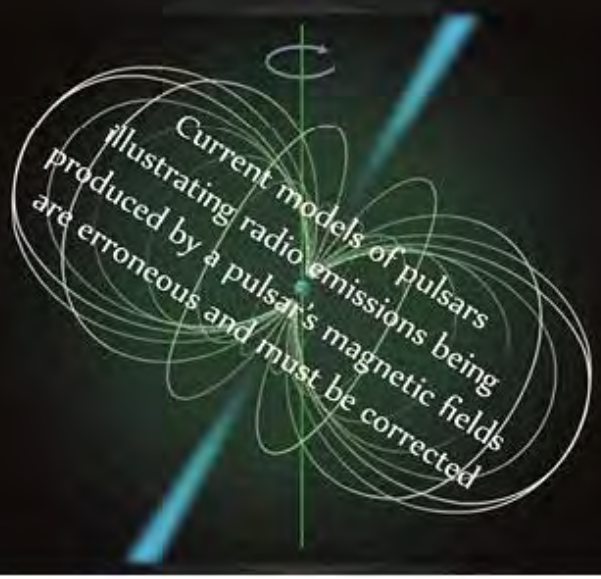

Radio wave astomony detects E-field waves of energy momenta not magnetic waves

Maxwell

Because a magnetic force is always perpendicular to the motion, the magnetic field can do no work on an isolated charge.

It can only do work indirectly, via the electric field generated by a changing magnetic field

Faraday

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Pulsars

Are compact Matter bodies with strong GEM fields

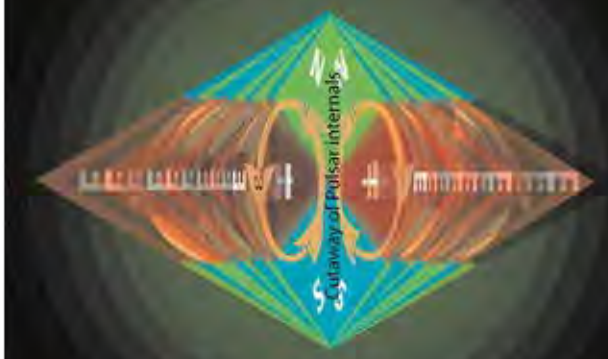

Like all Stellar bodies their GEM fields resolve to a point at their core

The gravitational collapse of Matter produces radiative electromagnetic waves

A millisecond pulsar (MSP) is a pulsar with a rotational period in the range of about 1-10 milliseconds.

Millisecond pulsars have been detected in the radio, X-ray, and gamma ray portions of the electromagnetic spectrum.

The origin of millisecond pulsars is still unknown.

The leading theory is that they begin life as longer period pulsars but are spun up or "recycled" through accretion. For this reason, millisecond pulsars are often called recycled pulsars.

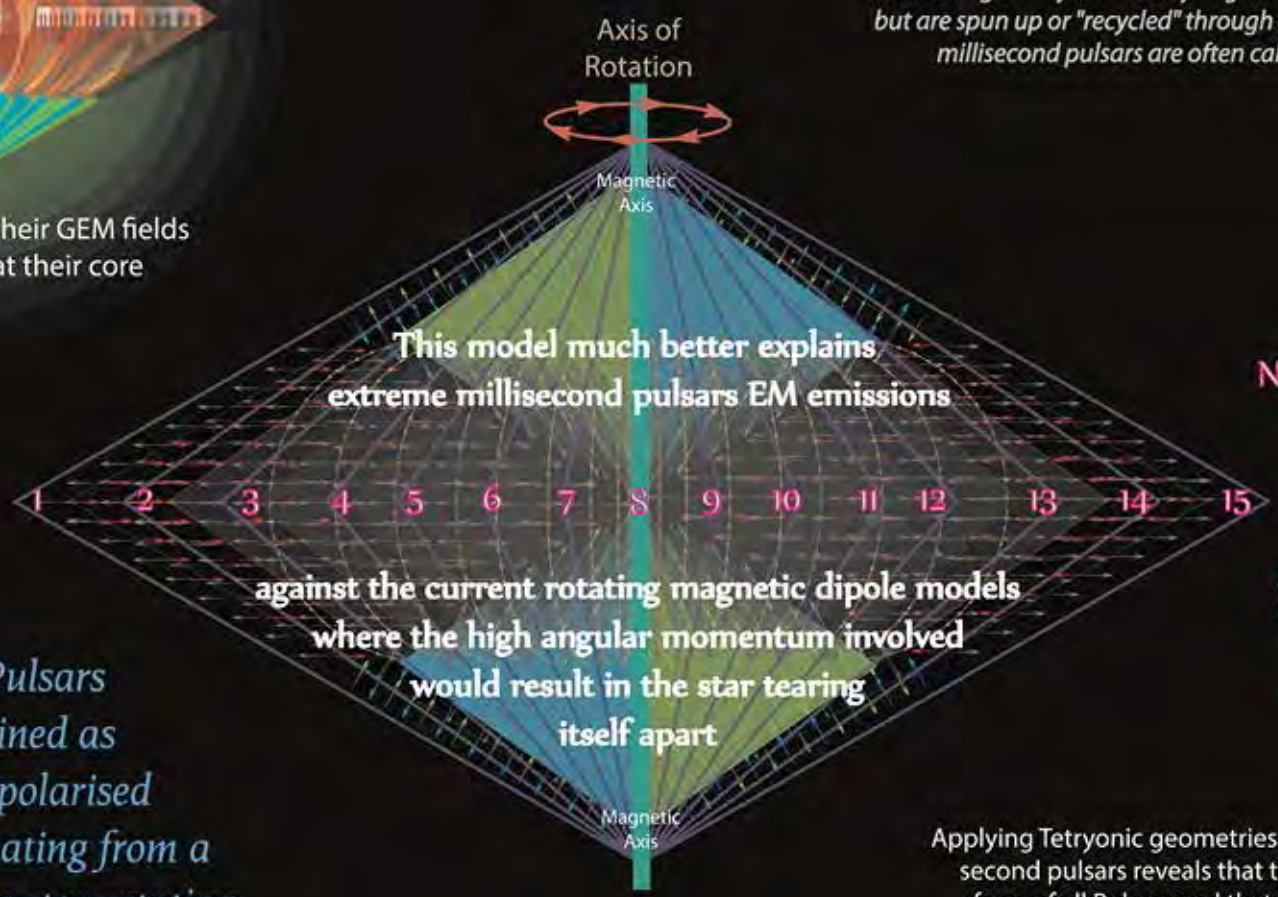

This model much better explains extreme millisecond pulsars EM emissions

against the current rotating magnetic dipole models where the high angular momentum involved would result in the star tearing itself apart

Number of Pulses per Second

Radio wave astomony detects E-field energy momenta impulses not magnetic waves

Millisecond Pulsars are best explained as the detection of polarised Electric fields originating from a non-charged Neutron star rotating with high angular momentum

Applying Tetryonic geometries to the question of milli-second pulsars reveals that they are the formative form of all Pulsars and that over time they slow down to become the observed longer period pulsars [obeying the conservation of Angular momentum law]

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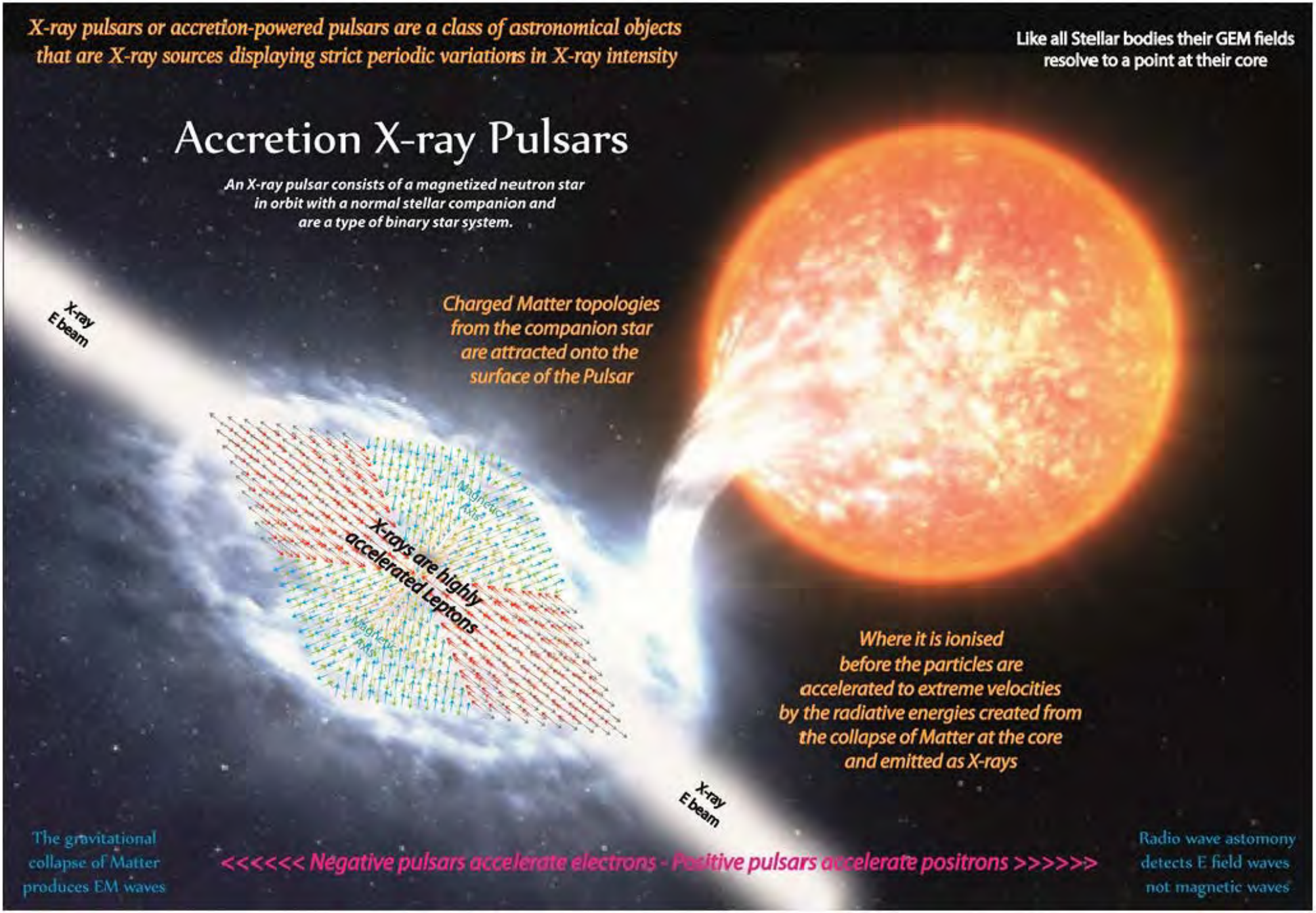

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Stellar Novae

Novae are cataclysmic stellar phenomena that take place in binary systems consisting of a compact stellar object and a low-mass star.

Novae are cataclysmic nuclear explosions in a white dwarf star.

It is caused by the accretion of hydrogen on to the surface of the star, which ignites and starts a runaway nuclear 'fusion' process

All stellar 'fusion' processes are in fact GEM pinches that convert standing wave Matter into radiant mass-energy

the size of a planet but with a mass of up to 1.4 times that of the Sun

The stars must be close enough for the intense gravitational field of the white dwarf to tear material away from the outer layers of its companion.

photons of energy momenta form kEM fields that accelerate ions and electrons

spectral line transitions

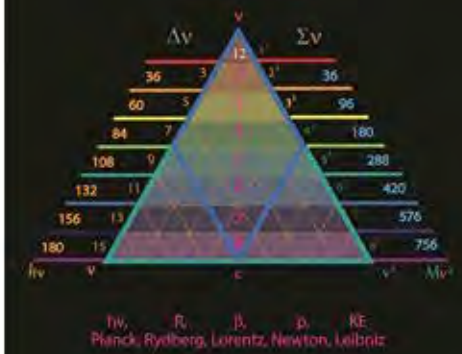

all elemental spectral lines are the result of accelerating photo-electrons

Novae break accreted Matter into its constituent Deuterium nuclei and then irradiate the nuclei to higher energy levels with radiant EM energies produced by their EMP cores

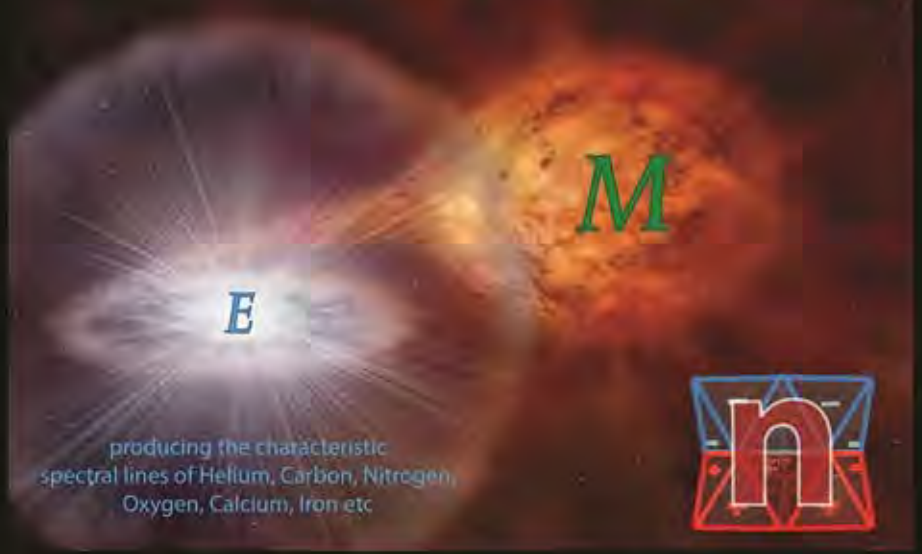

producing the characteristic spectral lines of Helium, Carbon, Nitrogen, Oxygen, Calcium, Iron etc

runaway Matter-energy conversion within the supernova

12	*Lyman*
48	*Balmer*
108	*Paschen*
192	*Brackett*
300	*Pfund*
432	*Humphries*
588	*un-named*
768	*ionised leptons*

accelerates ions & photo-electrons producing spectral line emissions and creates gamma ray bursts

An enigma that has puzzled experts for over 50 years is the origin of the irregular, inhomogeneous distribution of nova ejecta

The material transferred by the companion star is often of solar composition (i.e., close to 98% hydrogen and helium by mass).

Elements, in the range between carbon (C) and calcium (Ca) on the periodic table, can account for 30% to 50% of the material ejected during a nova explosion.

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Supernovae explosions

Supernovae are extremely luminous and cause a burst of radiation that often briefly outshines an entire galaxy,

The GEM pinching [collapse of Matter waveforms]
always results in divergent neutral charge
KEM mass-energies

All Matter particles
are standing wave
mass-energy topologies

The gravitational attraction of Matter
is many orders of magnitude weaker
than that of divergent KEM energies
and ceases upon Matter's collapse into
radiant mass-energy geometries

If the EM pinch at the core of a Star rapidly increases its efficiency or loses its ability to confine the resultant KEM energies the star will be blasted apart

stellar core
GEM Θ pinch
collapse

Black holes, hypothesied in physics as a solution to the math of Einstein's General relativity since it was was first formulated in 1915, do NOT exist

All their physics are provided for by GEM pinch field mechanics

A star moving in a ElectroMagnetic
vacuum energy environment will be subject
to changes in the energy density of the
surrounding vacuum energies

The energy released as a result of the
collapse of Matter topologies in the
core of a supernova is as efficient as
Matter-antiMatter annihilation

Supernovae are created by the sudden disruption of the counter balanced convergent and radiative mass-ENERGY-Matter output of GEM pinch singularities at the core of compact stellar objects which results in the sudden release of massive amounts of divergent mass-energy all at once from the stellar core blasting away the remaining stellar Matter

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Singularities

Current theories based on mathematical modelling of General relativity without accurate quantum mechanical models predicts that at densities greater than those supported by fermion degeneracy, gravity overwhelms all other forces collapsing the 3D material body of a large star to create a singularity and the eventual formation of a black hole.

A gravitational singularity or spacetime singularity is a location where the quantities that are used to measure the gravitational electromagnetic fields become infinite in a way that does not depend on the spatial co-ordinate system

Just as the radiative KEM fields of Matter in motion and charged EM fields gives rise to the modern physics misconceptions of spherical point particles and String theories

Tetryonic theory precludes point particles and black holes through analytic mass-energy geometries & Gaussian Matter topologies that result from equilateral Planck energy momenta interactions

The collapse of 3D Matter releases its standing-wave energies as radiant 2D mass-energies foms the basis for all Stellar energy releases

Equilateral Planck charge geometries are the key to understanding stellar processes

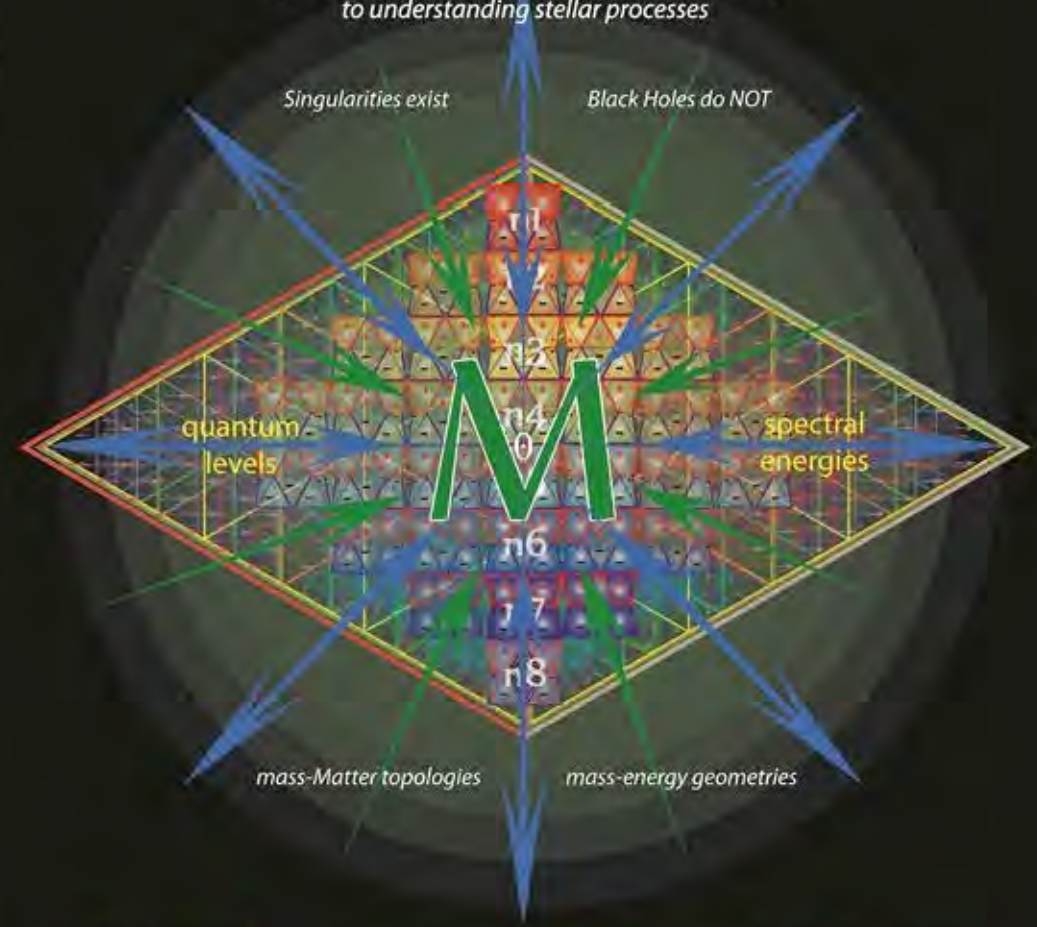

The smallest quanta of 3D Matter is a Tetryon

(any attempt to reduce its 3 spatial dimensions results in its collapse into 2D divergent mass-energy waveforms)

Tracing the GravitoElectroMagnetic fields of Matter back to their origin point can give rise to the misconception of a EM field singularity leading to a black hole

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Black holes do not exist

Quasi-stellar objects

As standing-wave Matter is converted to radiant EM masses and pure energy the outputs of GEM pinches can increase dramatically over short periods

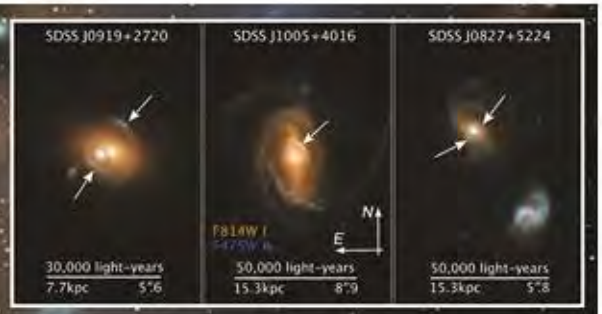

A quasi-stellar radio source ("quasar") is a very energetic and distant active galactic nucleus.

Quasars and Blazars are extremely luminous and were first identified as being high redshift sources of electromagnetic energy, including radio waves and visible light, that were point-like, similar to stars, rather than extended sources similar to galaxies

Long hypothesised as having supermassive Blackholes at their cores Tetryonics reveals Matter~Energy GEM pinches to be the source of the observed, distant large-scale stellar dynamics

All Matter (comprised of charged Planck quanta) will accelerate according to their charge distributions as they interact with the divergent energies of EM pinches

The central 'core' point singularity of any GEM pinch is completely invisible and is revealed only by its effects on Matter through its interactive EM fields

mass geometries are energy per c^2

$$E = mc^2$$

mass-energy equivalence

Stellar GEM pinches convert Matter topologies into radiant mass-energy geometries with 100% efficiency

Matter topologies are energy per c^4

Matter-energy equivalence

$$E = \frac{m}{c^2}$$

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Active Galaxies

The current astrophysical models of active galaxies propose supermassive Blackholes as the only mechanism possible to produce the observed large-scale dynamics

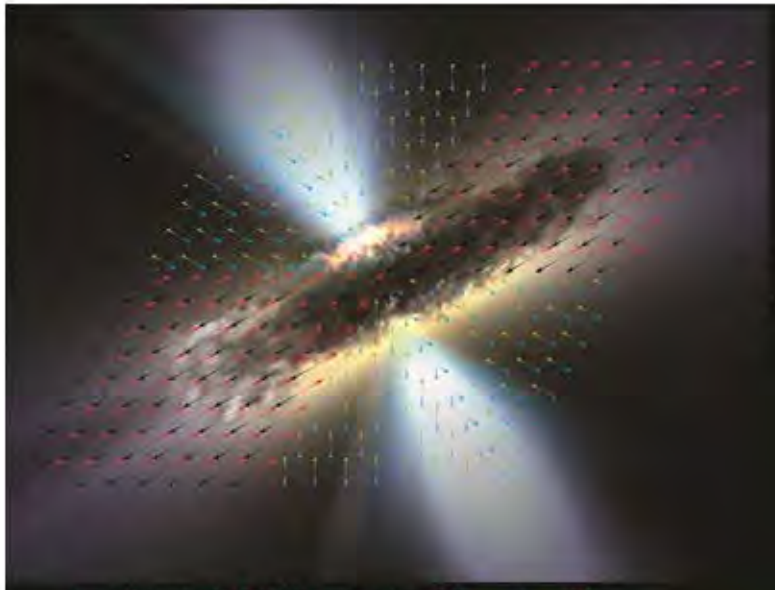

In addition to the E-field acceleration of charged particles GEM pinches can also release energies along their Magnetic axis

GR uses stress tensors to model the gravitational effects of ALL energy in a system in its various forms without distinction or differentiation between mass-energy geometries and Matter topologies

EM PINCHES ARE 100% EFFICIENT CONVERTERS OF MATTER INTO ENERGY

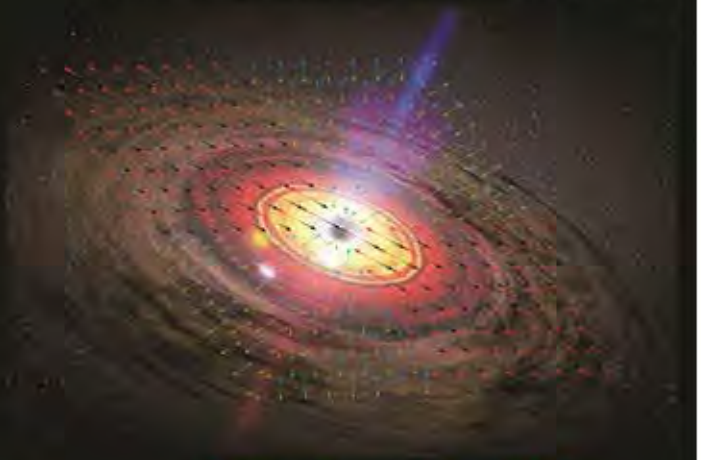

E-fields hold Matter in a disc and M-fields release highly polarised energies

An active galactic nucleus (AGN) is a compact region at the centre of a galaxy that has a much higher than normal luminosity over at least some portion, and possibly all, of the electromagnetic spectrum.

Using Tetryonic geometry the Universe is revealed as being completely dominated by ElectroMagnetic forces, with Gravity aiding at the larger scales to help shape the differing forms of Galaxies that we see

Tetryonics reveals the Galactic EM Pinches are also capable of fitting the observed data and explaining many of the current mysteries surrounding how active galaxies generate their power.

The motion of stars about a central point in a galaxy's core is the result of a GEM pinch's radiated interactive forces

EM PINCHES REDUCE TO SINGULARITIES AT THE FOCUS OF THEIR DIVERGENT FIELDS

Tetryonic geometry reveals divergent interactive EM masses
&
convegent gravitational Matter all contribute to the nett force of Gravitational fields

The energies released by the conversion of Matter into energy in GEM pinches is the most energetic process in the Universe

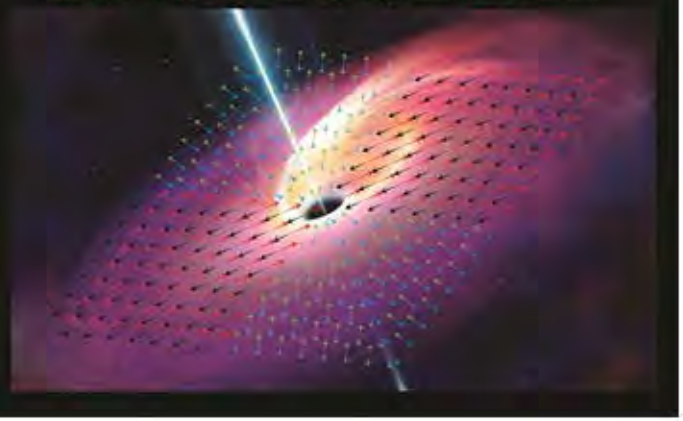

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Black holes

[Garbage IN - Garbage OUT]

Computer-based modelling of GR mathematics without charge geometries leads to paradoxial & erroneous outcomes

Tetryonics allows for Supermassive Matter to form but does NOT allow for the classically defined Black holes

The centres of Galaxies & Quasars hypothesised as being powered by supermassive blackholes are in fact the foci of ElectroMagnetic pinches

In General relativity, a black hole is a region of space in which the gravitational field is so powerful that nothing, including light, can escape its gravitational pull.

The black hole has a one-way surface, called an event horizon, into which objects can fall, but out of which nothing can come. It is called "black" because it absorbs all the light that hits it, reflecting nothing, just like a perfect blackbody in thermodynamics.

'Standard Model' quantum analysis of black holes shows them to possess a temperature and emit Hawking radiation.

In Standard Model Quantum Mechanics a problem arises in that Charge and Gravity equations break down and produce infinities and other impossible results

Very large non-radiating 'Dark Matter' would be the closest thing possible to the currently theorised black-holes.

However the 3D volume of such an object would be limited to the space taken up by its constituent Tetryonic charge Matter topologies. (ie Tetryons face-to face without Space present between any facsias)

This is similar to the current models of Neutron Stars , WIMPs and MACHOs

Black holes, Worm holes & other passable singularities do NOT exist

The collapse of standing-wave Matter topologies results in the release of divergent radiative mass-energy geometries

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Vacuum Field geometry

radiated weak neutral EM energies that permeate all of space

$+\frac{1}{2}hf$

Matter standing wave topologies make up a small faction of the energy in the Universe

Newtonian

Gravity fields

Gravitational Matter is always Attractive

M

convergent gravitational mass-Matter topologies

All mass-energy geometries & Matter topologies are created from Planck quanta

[v-v]

Relativistic stress energy tensors model mass & Matter as a density-pressure gradient

p

Q

RE

Quantum field theory states that all fundamental fields, such as the electromagnetic field, must be quantized at each and every point in space.

A field in physics may be envisioned as if space were filled with interconnected vibrating balls and springs, and the strength of the field were like the displacement of a ball from its rest position.

The theory requires 'vibrations' in, or more accurately changes in the strength of such a field to propagate as per the appropriate wave equation for the particular field in question.

Gravitation — **Electric** 0 **Magnetic** — Interaction

The second quantization of quantum field theory requires that each such ball-springcombination be quantized, that is, that the strength of the field be quantized at each point in space.

Canonically if the field at each point in space is a simple harmonic oscillator, its quantization places a quantum harmonic oscillator at each point.

Excitations of the field correspond to the elementary particles of particle physics.

Thus, according to the theory, even the vacuum has a vastly complex structure and all calculations of quantum field theory must be made in relation to this model of the vacuum.

hv — v^2

Wikipedia

M_0

KE

d

Matter topologies displace vacuum energies to create gravity

kEM geometries radiate to create vacuum energies of all wavelengths

All radiative EM fields weaken as they diverge from their sources to create the vacuum energy aether

$-\frac{1}{2}hf$

EM mass-energy geometries radiate, permeating all of Free Space

Relativistic

EM corrections

ElectroMagnetic masses are interactive

m

divergent interactive mass-energy geometries

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The Big Bang theory

The Big Bang is a considered to be a well-tested scientific theory which is widely accepted within the scientific community because it is the most accurate and comprehensive explanation for the full range of phenomena astronomers observe.

The framework for the Big Bang model relies on Albert Einstein's general relativity and on simplifying assumptions such as homogeneity and isotropy of space.

Primodial Atom

According to the Big Bang theory, the Universe was once in an extremely hot and dense state which expanded rapidly

The Big Crunch

If the mass density of the Universe were greater than the critical density, then the Universe would reach a maximum size and then begin to collapse.

It would become denser and hotter again, ending with a state similar to that in which it started

The equations of classical General relativity indicate a singularity at the origin of cosmic time, and while the Big Bang model is well accepted in modern cosmology, Tetryonics provides a clear causal model for the origin of all mass-energy-Matter and fields of force in our Universe, offering a unified, determinsitic explaination of all its field interactions and ultimate energy fate.

Gravitation — Interaction

Tetryonics relates Time to changing equilateral QAM [Planck] geometries in a dynamic evolving Universe. Moreover, general relativity must break down before the Universe reaches the Planck temperature while Tetryonics provides a unified explanation for the mechanics of the Universe

Big Bang

Extrapolation of the expansion of the Universe backwards in time using general relativity yields an infinite density and temperature at a finite time in the past, which it is proposed underwent a explosive birth and a period of rapid expansion in order to produce the homogneity currently observed.

The Big Chill

The heat death of the universe is a suggested ultimate fate of the universe, in which the universe has diminished to a state of no thermodynamic free energy and therefore can no longer sustain motion or life.

Inflation

The Big Bang theory is the prevailing cosmological model that attempts to explain the early development of the Universe

Energy death

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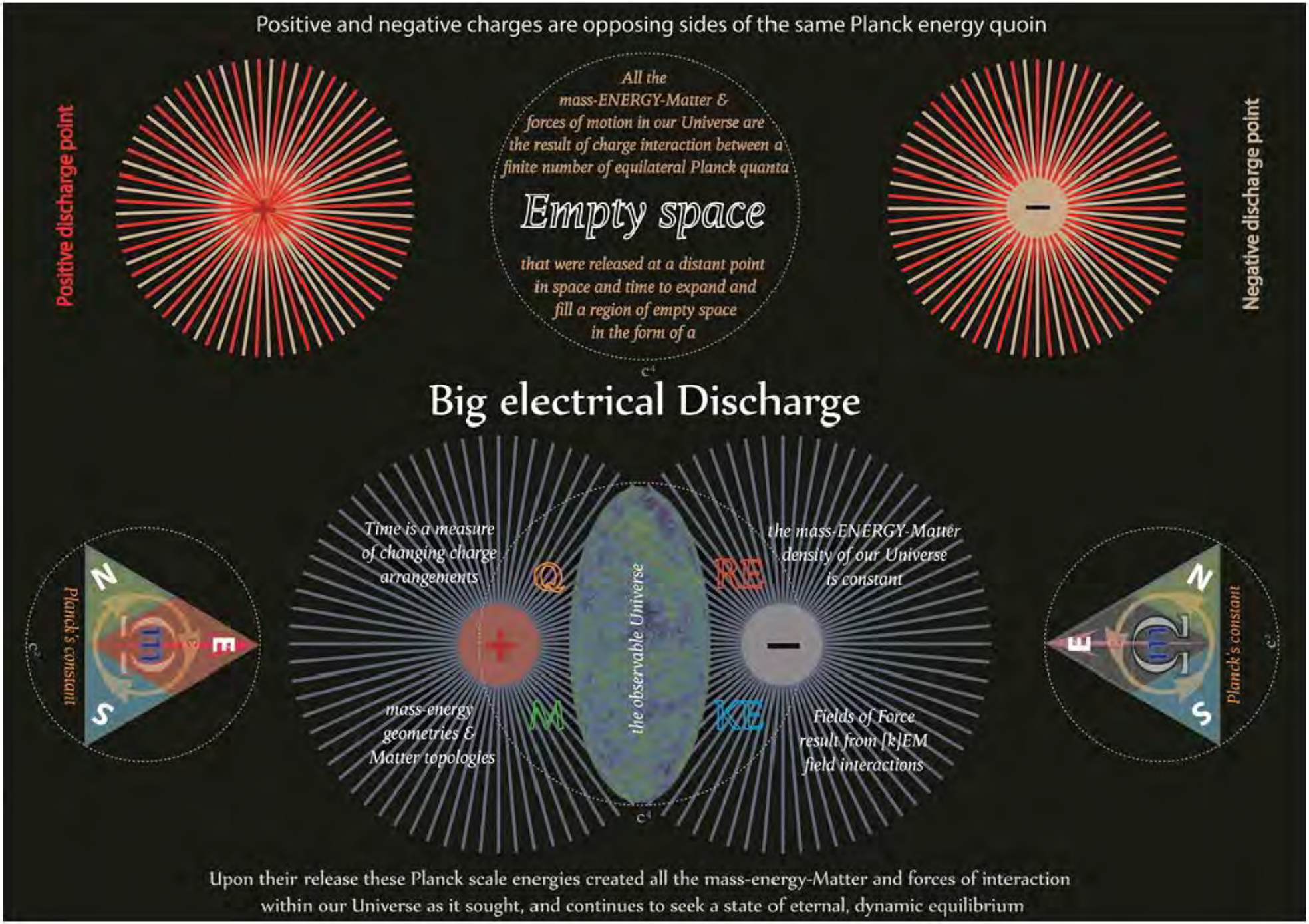

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The Dynamic Universe

Like a living breathing Organism, the Universe can now be seen as an eternally dynamic system that is constantly evolving through Matter creation, EM interactions & Matter destruction

Gravitational contraction

Singularities

arise from the vector modelling of convergent EM fields of force without an understanding of the EM energy momenta geometries

The formation of Matter creates regions of attractive low vacuum energy pressure

[Convergent Gravity]

Dark Matter

results from modern modelling of convergent EM interactions without an understanding of the EM energy momenta geometries

All mass-ENERGY -Matter arises from equilateral Planck energy quanta

Flat Euclidean geometries and Platonic topologies create everything

charge
Q

Energy
RE

M
mass-Matter

KE
kinetics

Radiant expansion

Inflation

arises from an attempt to explain the observed homogenity of the Universe without an understanding of kEM energy momenta geometries

The collapse of standing-wave Matter releases interactive EM mass-energies

[Divergent EM Radiation]

Dark Energy

results from modern modelling of divergent EM interactions without an understanding of the EM energy momenta geometries

The energetic 'space-time fabric' of our Universe is not curved, it is created from flat Euclidean Planck quanta in a finely tuned state of dynamic equilibrium between gravitational Matter & radiant EM mass-energies

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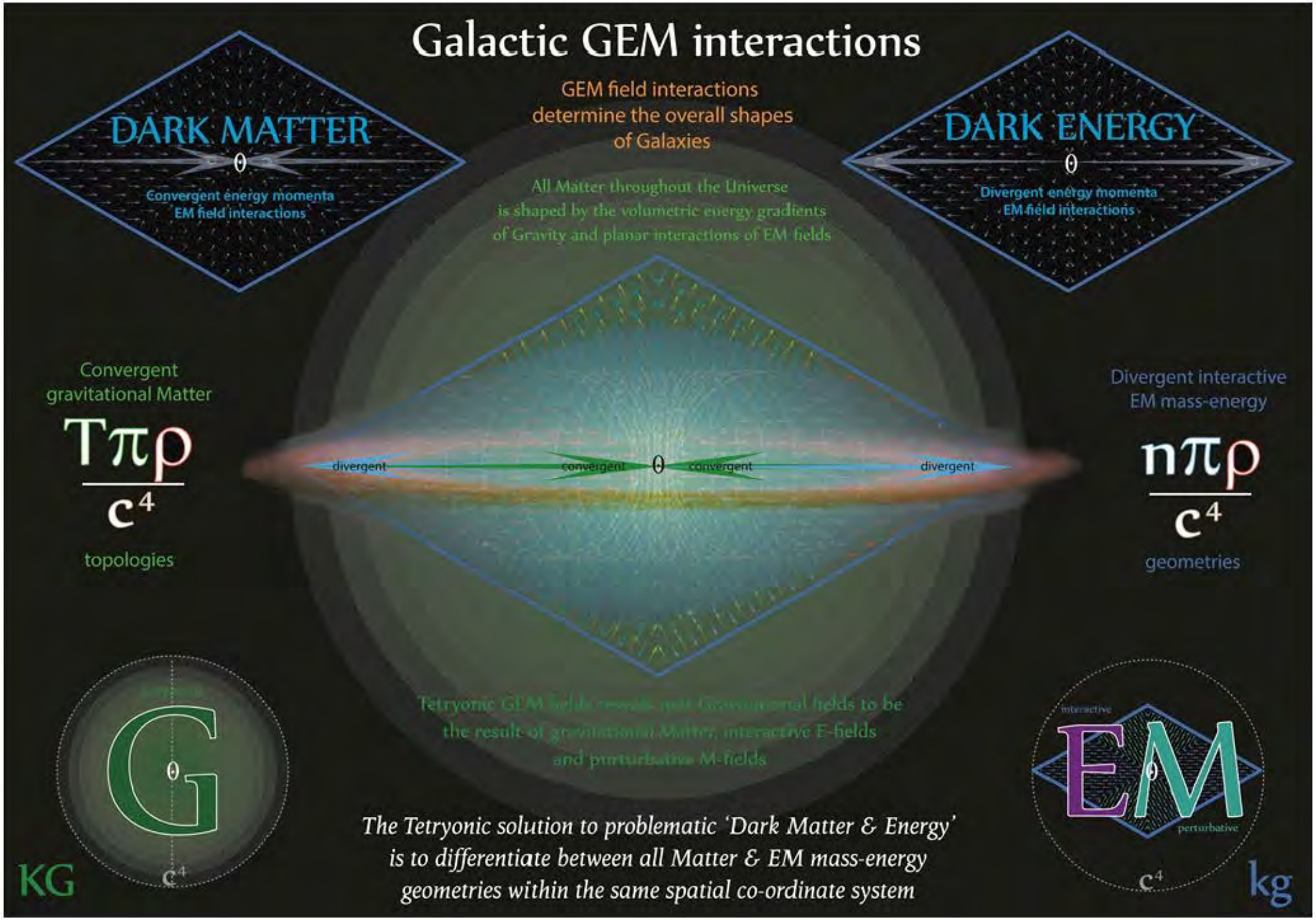

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The Dark Forces

Gravitational attraction is the result of the nullspace of Matter.
It is many orders of magnitude weaker than ElectroMagnetic forces
(Gravity does not hold the whole galaxy together)

charged energy geometries

energy momenta quanta

$$n\pi[m\Omega v]^2$$

mass velocity

$$G_{ab} + \Lambda g_{ab} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

Newtonian Gravity models the motion resulting from the attractive force between Matter

charged energy geometries create Bosons & Photons and Matter topologies

the radiated [K]EM energies of Matter diverge to create Secondary Energies

General Relativity models perturbative force resulting from the total energy of any system

All [K]EM radiation has a CONVERGENT component in its interactive field that increases when Matter is in motion

DARK MATTER

or when its standing-wave Matter topology is destroyed

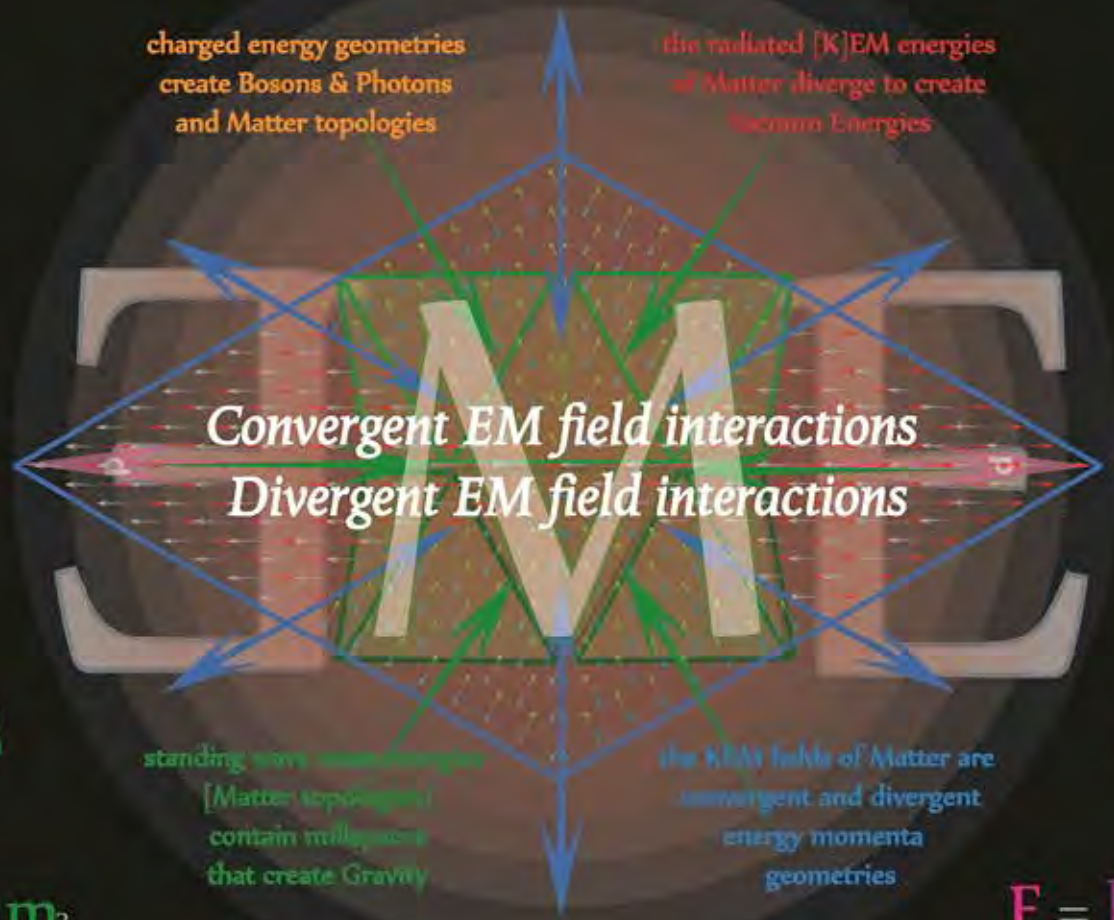

All [K]EM radiation has a DIVERGENT omponent in its interactive field that increases when Matter is in motion

DARK ENERGY

or when its standing-wave Matter topology is destroyed

$E \xrightarrow[\text{energy momenta}]{\text{convergent}} M$

standing wave mass-energies [Matter topologies] contain millipoises that create Gravity

the KEM fields of Matter are convergent and divergent energy momenta geometries

$M \xrightarrow[\text{energy momenta}]{\text{divergent}} E$

$$F = -G\frac{M_1 m_2}{r^2}$$

$$F = k\frac{Q_1 Q_2}{r^2}$$

Gravitational Matter is attractive

G

Tetryonics dictates that in order to correct for measured Gravitational accelerations we must distingush between EM mass and Matter and take into account all the EM forces as well as that of Gravity produced by Matter

k

ElectroMagnetic mass-energies are interactive

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Vacuum Energies

Vacuum energy is an underlying background energy that exists in space even when it is devoid of Matter (free space) and results from the introduction of the Cosmological constant [Λ] by Albert Einstein as a modification of his original theory of General relativity in order to achieve a static universe.

Dark Matter is a measure of CONVERGENT KEM interactions additional to that of Gravity

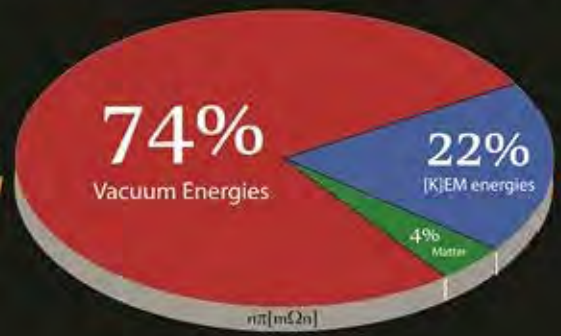

Dark Energy is a measure of DIVERGENT KEM interactions opposing that of Gravity

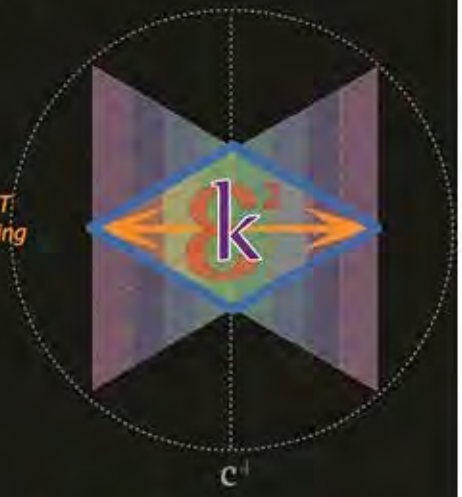

He later abandoned this concept after observations of the Hubble redshift indicated that the universe might not be stationary

Gravitational Matter is always attractive

ElectroMagnetic masses are always interactive

$$G_{ab} + \Lambda g_{ab} = \frac{8\pi G}{c^4} T_{\mu\nu}$$

total system energy

Matter

M

topologies

mass

m

geometries

Unlike Einstein's Special and General theories of Relativity that utiliizes a scalar energy density tensor, Tetryonics utilizes analytical geometry & topology to differentiate between EM mass & Matter and model all energy interactions in any spatial region

Gravity results from standing-wave Matter

Gravito-Electro-magnetic interactions

GEM

of all EM mass-ENERGY-Matter in the Universe can be defined as

$$= \frac{n\pi[m\Omega v]^2}{c^4}$$

Total energy geometries — *quantised energy momenta*

spatial volume of mass-energy-Matter interactions

EM interactions result from superpositioned EM masses

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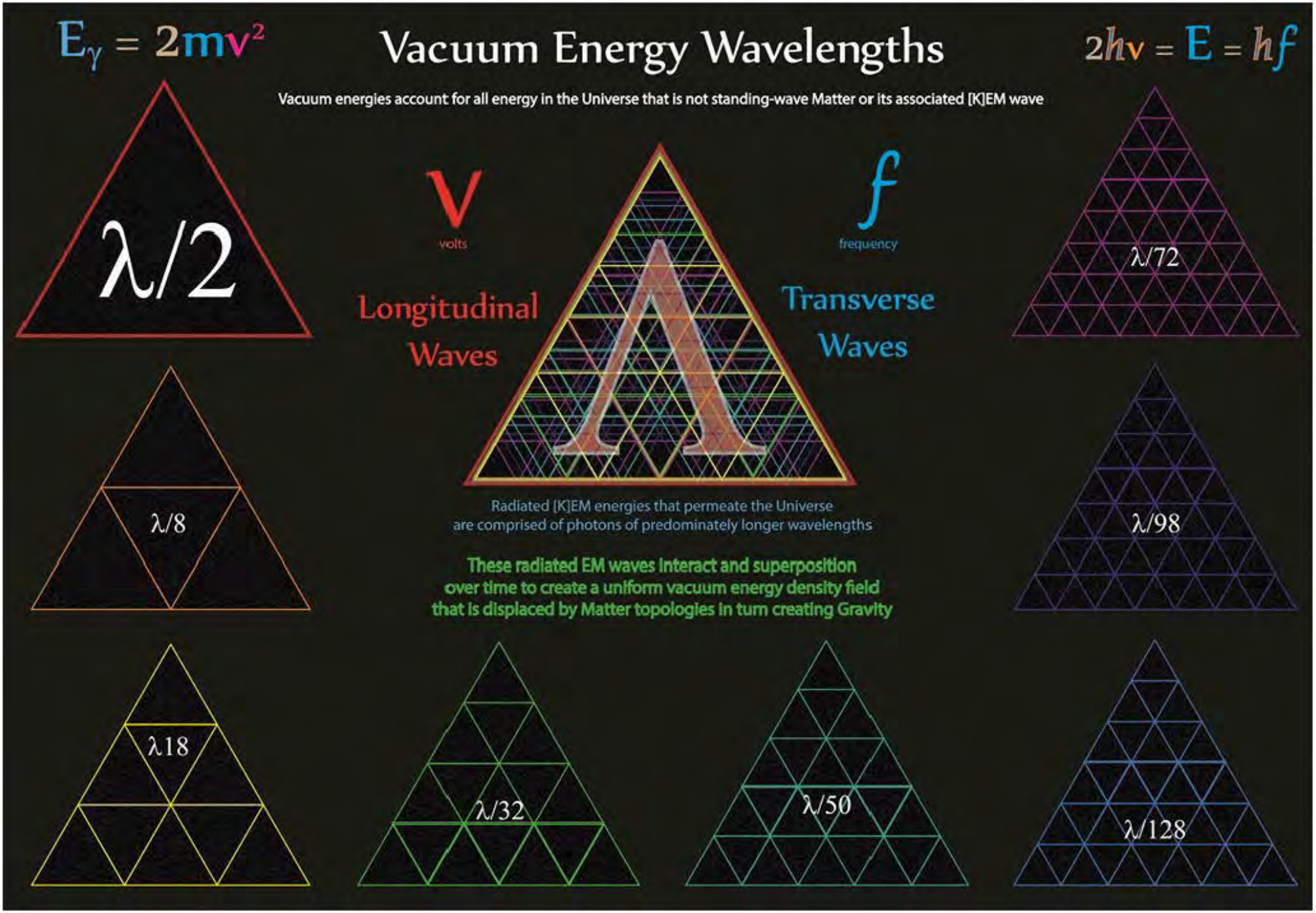

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Dark Matter is a nett attractive force that results when the Electromagnetic interactions of Matter in motion are not included in calculations

In addition to Gravity the [K]EM waves of all Matter in motion possess a convergent component which in turn creates a unidirectional 'force'

The convergent EM force component can be modelled as being the result of an 'invisible' form of Matter or additional gravitational force

All Matter emits divergent EM radiation photons comprised of bidirectional vector momenta

Matter produces Gravity
EM waves are interactive

Dark Matter is matter that neither emits nor scatters light or other electromagnetic radiation, and so cannot be directly detected via optical or radio astronomy.

Gravity is the result of the displacement of vacuum energies by 3D Matter topologies

All [K]EM radiation has a convergent component in its interactive field that increases when Matter is in motion or created in the form of EM standing-wave topologies

DARK MATTER

As Matter is destroyed and energy is released the attractive force of Gravity decreases but the convergent acceleration due to Dark Matter increases

Dark Matter

Dark matter is estimated to constitute 84% of the Matter in the universe and 23% of the total mass-energies

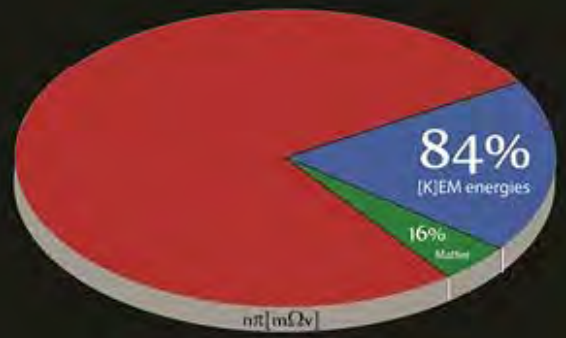

Dark Matter created by KEM field convergence contributes to the total energies of the cyclic Universe

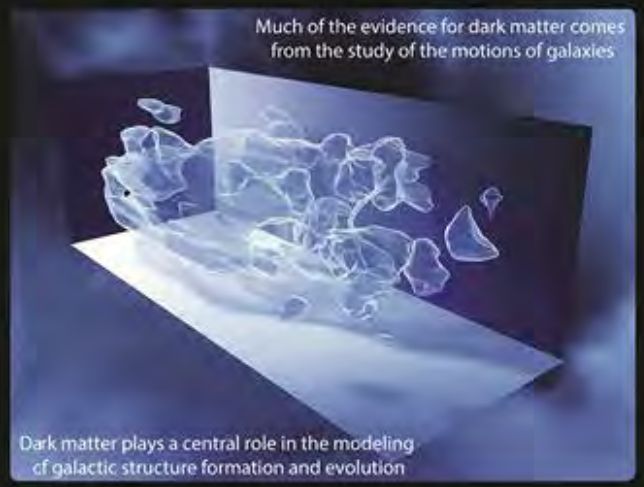

Dark Matter's existence is inferred from its gravitational effects on visible Matter and the convergent lensing of background radiation

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Galaxy Rotations

In 1986, Nobel laureate Hannes Alfven postulated at an electrical model for the solar system

The rotation curve of a galaxy (also called a velocity curve) can be represented by a graph that plots the orbital speed (in km/s) of the stars or gas in the galaxy on the y-axis against the distance from the center of the galaxy on the x-axis

The dynamic modelling of large scale Matter must take into account all forces present

Based on Newtonian mechanics and assuming, as was originally thought, that most of the Matter of the galaxy had to be in the galactic bulge near the center, Matter (such as stars and gas) in the disk portion of a spiral should orbit the center of the galaxy similar to the way in which planets in the solar system orbit the sun, i.e. where the average orbital speed of an object any distance away from the majority of the Matter would decrease inversely with the square root of the radius of the orbit

G

Gravitational Matter is attractive

Newtonian gravity models convergent Gravity only

$$F = -G\frac{M_1}{r^2}$$

Gravity alone produces spheres or ellipsoids

Matter is comprised of charged quanta
ALL charged quanta experience
Lorentz forces

EM forces produce dynamic spiral shapes

$$F = q[E+v.B]$$

SR

ElectroMagnetic mass-Energy is interactive

General relativity models interactive GEM energies

$$F = k\frac{Q_1}{r^2}$$

The curves of the rotational velocities of stars within Galaxies do not decrease in the expected Inverse square root relationship but are "flat", i.e. outside of the central bulge their speed is nearly constant from the centre out of the edge of the galaxy [identical to the forces produced by homopolar motors]

Tetryonics dictates that we must take into account EM forces as well as Gravity in order to account for any perturbations that convergent Gravitation alone cannot account for

Observations have shown there is not sufficient visible Matter in the Universe to account for the apparent strength of gravitational forces within and between galaxies leading to the hypothesis that up to 90% of the Matter in the Universe is

Dark Matter

Gravity alone does not hold the whole galaxy together
It is many orders of magnitude weaker than ElectroMagnetic forces

Gravitational attraction is the nett convergent force resulting from three distinct quantum forces

To account for the redshift-magnitude relation of type Ia supernovae General relativity requires that much of the energy in the Universe consists of a component with large negative pressure, this negative-gravity has been dubbed

Dark Energy

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Dark Energy

Dark energy is a hypothetical form of energy that permeates all of space and tends to increase the rate of expansion of the universe.

EM mass-energies are conservative

Matter is not conservative

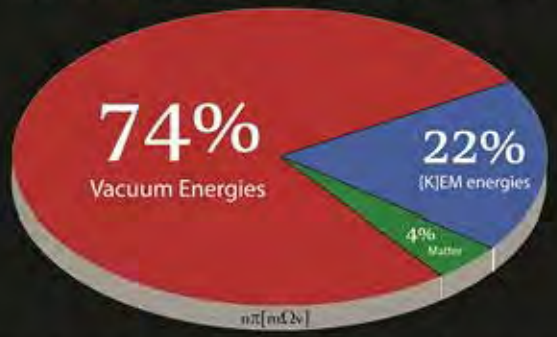

Independent from its actual nature, dark energy would need to have a strong negative pressure (repulsive force or divergent energy opposite that of gravitational attraction) in order to explain the observed acceleration in the expansion rate of the universe.

Dark Energy is the divergent scalar field created by [K]EM field energies

The cosmological constant is physically equivalent to vacuum energy

All [K]EM radiation has a divergent component in its interactive field that increases when Matter is in motion

DARK ENERGY

or its standing-wave topology is destroyed

As Matter is destroyed and energy is released the attractive force of Gravity decreases and the divergent acceleration due to Dark Energy increases

A major outstanding problem is that most quantum field theories predict a huge energy value for the quantum vacuum, more than 100 orders of magnitude too large.

This would need to be cancelled almost, but not exactly, by an equally large term of the opposite sign.

In fact a negative pressure does not influence the gravitational interaction between Matter [which remains attractive] but rather alters the overall evolution of the universe at the cosmological scale, typically resulting in the localised accelerating expansion of the universe despite the attraction between Matter present throughout the Universe.

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Energy-momenta geometry

The super-positioned EM fields of free space is comprised of Planck energy momenta

A major outstanding problem is that most quantum field theories predict a huge cosmological constant from the energy of the quantum vacuum, more than 100 orders of magnitude too large.

If the Higgs field does exist, another field with an unknown negative energy is needed to reduce the total energy in the vacuum to a slightly positive value to correspond with the current accelerated rate of expansion

Due to the equilateral asymmetry of all the energy momenta quanta in charged electromagnetic fields

Dark Energy is Divergent Vacuum Energy momenta in free Space

Summing over all possible Energy quanta at all points in space gives a large but NOT infinite quantity of energy-momenta

E Field Coulombic forces

convergent momenta

divergent momenta

Vacuum charge momentum

Convergent Vacuum Energy momenta in free Space is Dark Matter

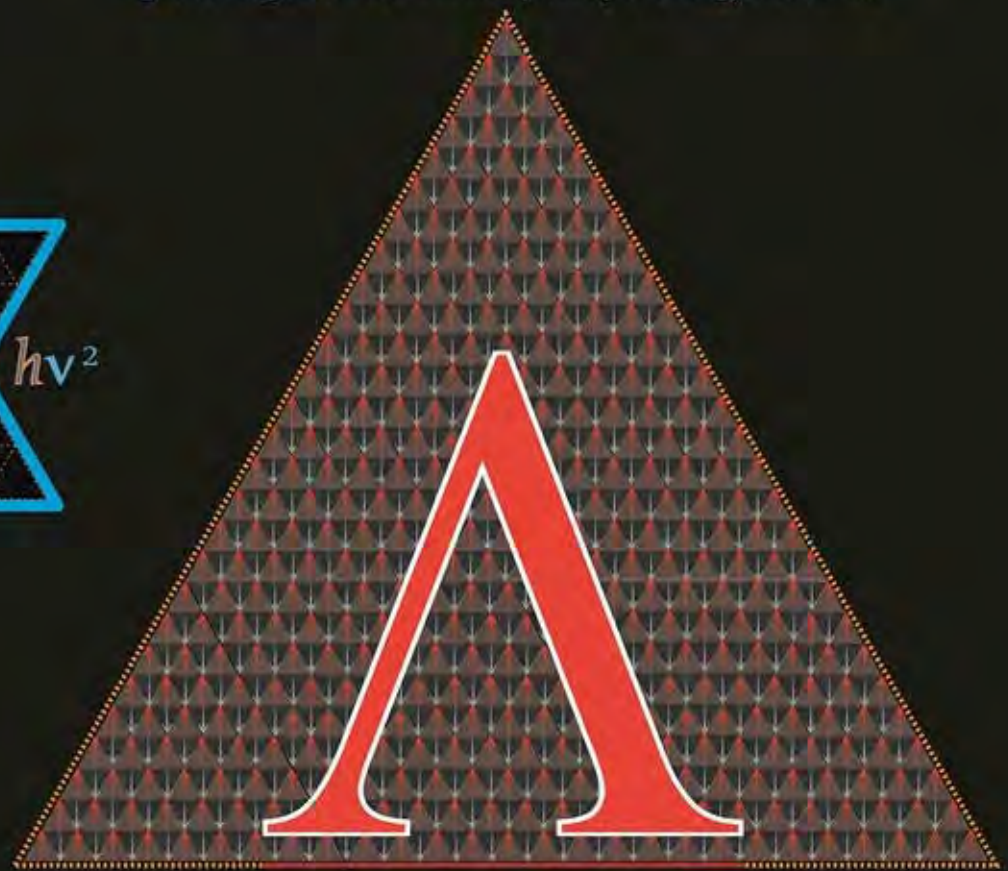

1	1		1
2	3		0.666667
3	5		0.6
4	7		0.571429
5	9		0.555556
6	11		0.545455
7	13		0.538462
8	15		0.533333
9	17		0.529412
10	19		0.526316
11	21		0.52381
12	23		0.521739
13	25		0.52
14	27		0.518519
15	29		0.517241
16	31		0.516129
17	33		0.515152
18	35		0.514286
19	37		0.513514
20	39		0.512821
21	41		0.512195
22	43		0.511628
23	45		0.511111
24	47		0.510638
25	49		0.510204
26	51		0.509804
27	53		0.509434
28	55		0.509091
29	57		0.508772
30	59		0.508475

The total Vacuum Energy in any spatial region contains fields of Planck energy-momenta seeking an equalised, homgenous state

2

Divergent energy momenta always dominates over Convergent energy momenta

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Charged electrostatic fields

E Field Coulombic forces

convergent momenta — divergent momenta

Charge interaction

DIVERGENT CHARGE FIELDS are external Energy momenta

momenta

CONVERGENT CHARGE FIELDS are internal Energy momenta

Energy-momenta forces

Forward velocity — downward Thrust

Momenta acceleration

1	1		1
2	3		0.666667
3	5		0.6
4	7		0.571429
5	9		0.555556
6	11		0.545455
7	13		0.538462
8	15		0.533333
9	17		0.529412
10	19		0.526316
11	21		0.52381
12	23		0.521739
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14	27		0.518519
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25	49		0.510204
26	51		0.509804
27	53		0.509434
28	55		0.509091
29	57		0.508772
30	59		0.508475

7/15

Electrostatic fields can provide a source of thrust

The greater the EM charge field strength the greater the divergent force

a source of cost effective space launches

v

1-0 1 1-0

2-1 2 3-1

3-2 3 6-3

4-3 4 10-6

5-4 5 15-10

6-5 6 21-15

7-6 7 28-21

8-7 8 36-28

1	0
3	.25
2	.333
1.666	.375
1.5	.4
1.4	.4166
1.333	.4375
1.2857	.4375

#	Pos	Neg	Charge	Pos %	Neg %	Pos Split	Neg Split	Power	SQRT
1000	1000	999	1	0.50025	0.49975	500500	499500	1000000	1000

Launch Pad

Momentum splits are reversed for Negative charges

Electric Charge divergence is always superior to Charge convergence

Momentum trends to 50/50 split (but never reaches it)

Launch Pad

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Electrostatic lifters

Electrostatic levitation is the process of using an electric field to levitate a charged object and counteract the effects of gravity

Tetryonic geometries and Coulombic forces offers an alternative means of propulsion for space lauches and frictionless transports

Electrostatic charges are always divergent from their sources

Static electricity is the result of electrostatic charges

Electrostatic charges are comprised of divergent energy momenta

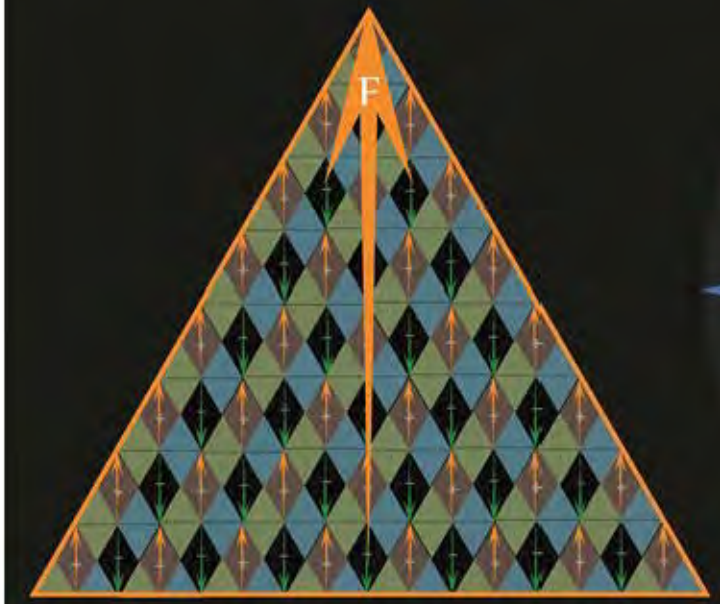

Charged voltage fields contain nett divergent energy momenta [Planck quanta] that can do work over distances

Electrostatic levitation

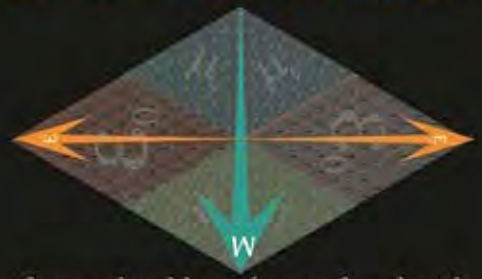

forces should not be confused with

Magnetic levitation

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The Light speed barrier

BOSONS/PHOTONS
2D Planar massless particles
[EM mass-Energies]
'slice' throught the
vacuum energy aether

CHARGED
particle or massive body

ENERGY-MOMENTA
of populsion field

The Compton frequency of quanta
In any EM field is directly proportional
to the field's velocity of propagation

The 'speed of Light'
is the limiting speed of
transverse EM accelerations
[it is not THE limit]

$E = Mv^2$

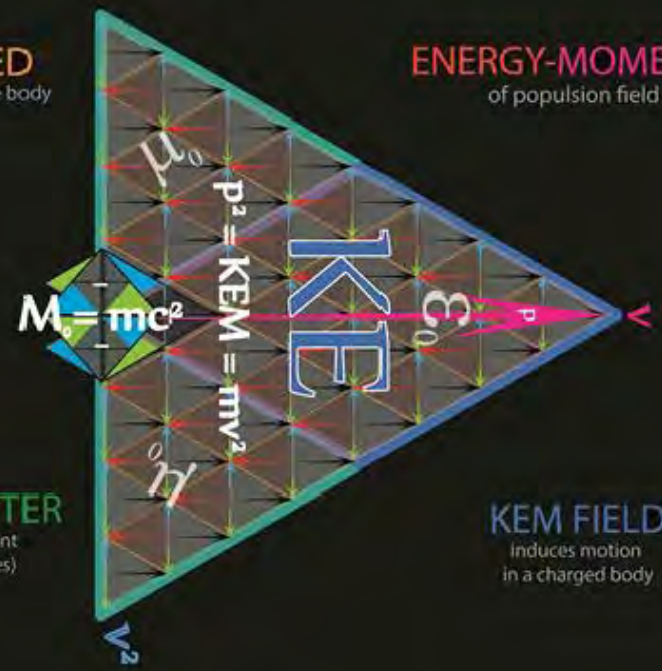

$KE = \frac{1}{2}Mv^2$

MOTION VECTOR
direction of propulsion
of a charged body

REST MATTER
remains invariant
(but accelerates)

KEM FIELD
induces motion
in a charged body

TETRYONS/BARYONS
3D Tetrahedral EM Matter
[4nπ EM mass-Energies]
interact at various angles with the
vacuum energy aether

Tetryonic geometry clearly shows that here is NO limit to the energy content that can be released into any spatial region, negating the long held belief of a Light speed barrier

V

According to special relativity, c is the maximum speed at which all EM mass-Energy and information in the universe can travel.
it is predicted by General relativity to be the absolute velocity of all 'massless particles' and associated fields
- including ElectroMagnetic radiation such as Light in a vacuum.

Such particles and waves travel at c regardless of the motion of the source or the inertial frame of reference of the observer.
In the theory of relativity, c interrelates space and time, and appears in the famous equation of mass–energy equivalence E = mc2.

C

The speed at which light waves propagate in vacuum
is independent both of the motion of the wave source
and of the inertial frame of reference of the observer

$$E = n\pi\left[\left[\underbrace{m}_{\text{mass}}\overset{\text{Planck quanta}}{\Omega}\underbrace{v^2}_{\text{velocity}}\right]\right]$$

The speed of light in vacuum, usually denoted by c,
is a physical constant important in many areas of physics
and is determined by the impedance of the medium

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Inflation

While the detailed particle physics mechanisms responsible for inflation are not known, the basic picture makes a number of predictions that have been confirmed by observation.

Inflation is thus now considered part of the standard hot Big Bang cosmology

ENERGY $n\pi$ [[Planck quanta $m\Omega v$]^2]
momentum mass velocity

All mass-energy propagates at a velocity directly related to the impedance of the medium

Tetryonics now provides a detailed physical model of ALL ponderable Matter and its kinetics through the charged geometry of mass-ENERGY-Matter

The energy in any spatial region possesses a related mass-velocity [linear momentum] component

GIVEN SUFFICIENT ENERGIES ANY REGION OF SPACE-TIME WILL UNDERGO SUPERLUMINAL EXPANSION [INFLATION]

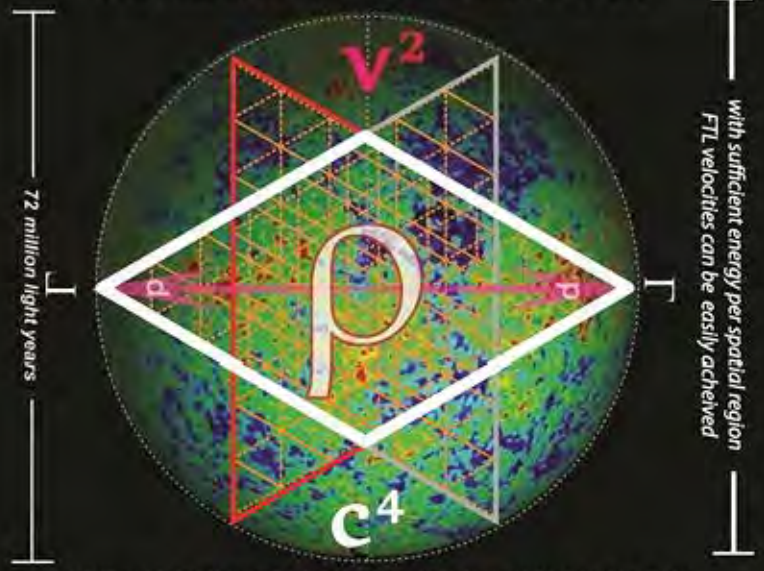

UNTIL IT REACHES A CRITICAL ENERGY DENSITY THAT RESULTS IN THE OSBERVED SPEED OF LIGHT THAT WE NOW MEASURE

The observable Universe could have originated from a region of pure energy in it's past.

This point would have contained all the Energy that ultimately formed all the mass-Matter of the Universe and Forces that we now observe and measure in two 2D planar fields

"And God said, Let there be light: and there was light"

The planar EM Energies released at that point would have resulted in faster-than-light divergence from that point as dictated by the geometric energy-momenta velocity relationship

mass $\frac{n\pi}{c^2}$ [[Planck quanta $m\Omega v^2$]]
mass velocity

It prescribes a dynamical EM Universe evolving over time
into a state of equilibrium between gravitational mass-Matter topologies and radiant, interactive mass-energy momenta geometries

Matter $\frac{T\pi}{c^4}$ [[Planck quanta $m\Omega v^2$]]
mass velocity

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Superluminal velocities

Any velocity is obtainable by Matter providing sufficient energy is released in very short durations to a region of space containing a charged body

$$\Sigma F = \frac{\Delta p}{dt} = m.\frac{dv}{dt}$$

W bosons $[hv]-$ decelerate

E

W bosons $+[hv]$ accelerate

Every quantum energy level change requires a related change in the number of quanta compared to the previous energy level (ad infinitum)

Note: inertial considerations still apply
Instanteous release of energy to acheive superluminal velocities is not advised

REQUIRED VELOCITY

$$\beta = \left[\frac{v}{c}\right]$$

Linear correction factor

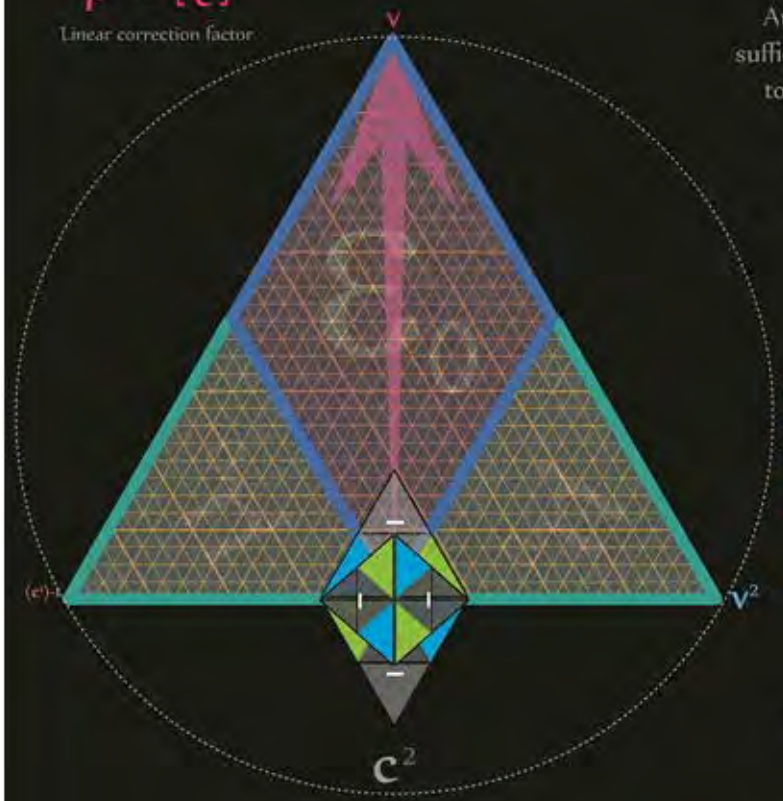

The speed of light is a limiting velocity for accelerations due to transverse wave electromagnetic energies

Providing the KEM geometry contains enough energy per c^2 geometry the long held belief of 'the speed of light' being an ultimate speed barrier is shown to be invalid

KEM fields contain energy-momenta

$$p^2 = KEM = mv^2$$

Any mass-energy field moving at superluminal velocities is still subject to Lorentz contractions

Any Matter held within, and moving along with, a superluminal EM field remains Lorentz invariant

$$\frac{mv^2}{c^2} = \frac{KEM}{c^2} = \frac{hv^2}{c^2}$$

The mass-energy of Kinetic EM fields is velocity dependent and subject to Lorentz corrections

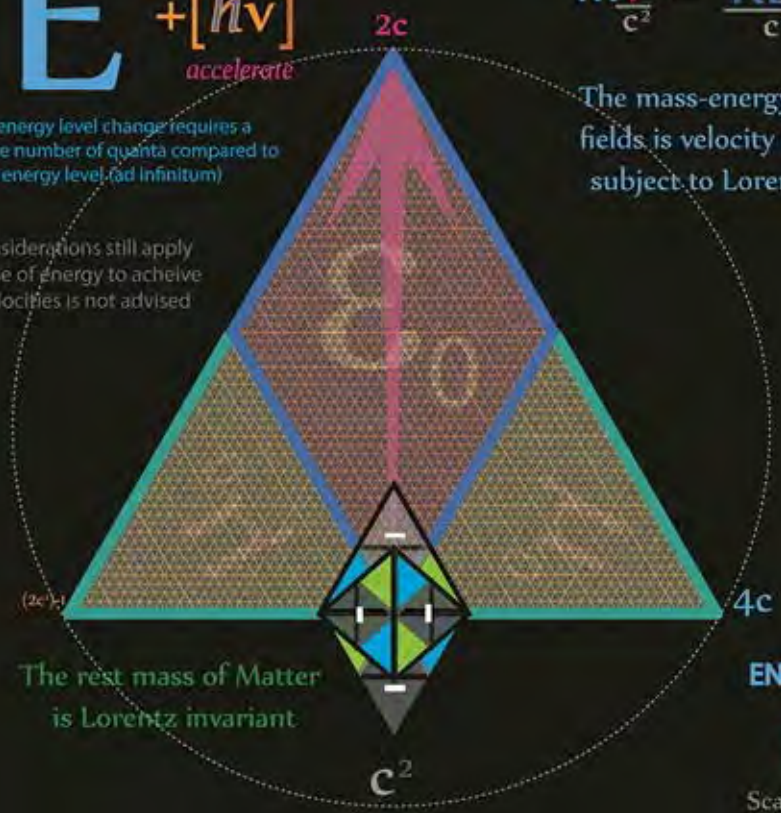

The rest mass of Matter is Lorentz invariant

ENERGY REQUIRED

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

Scalar correction factor

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Faster than Light Travel

It has been well established by Tetryonic geometry that the speed of light 'c' is not a insurmountable barrier as long expounded by Relativity theory

The natural speed of Light is easily surpassed given the right technologies (and sources of energy)

Velocity changes are additive as per Newtonian mechanics

The energy requirements to accelerate Matter to increasing velocities are exponental and follow equilateral geometries

As the Spaceship's Velocity increases the wavelength of Kinetic Energies decreases and the Compton Frequency increases

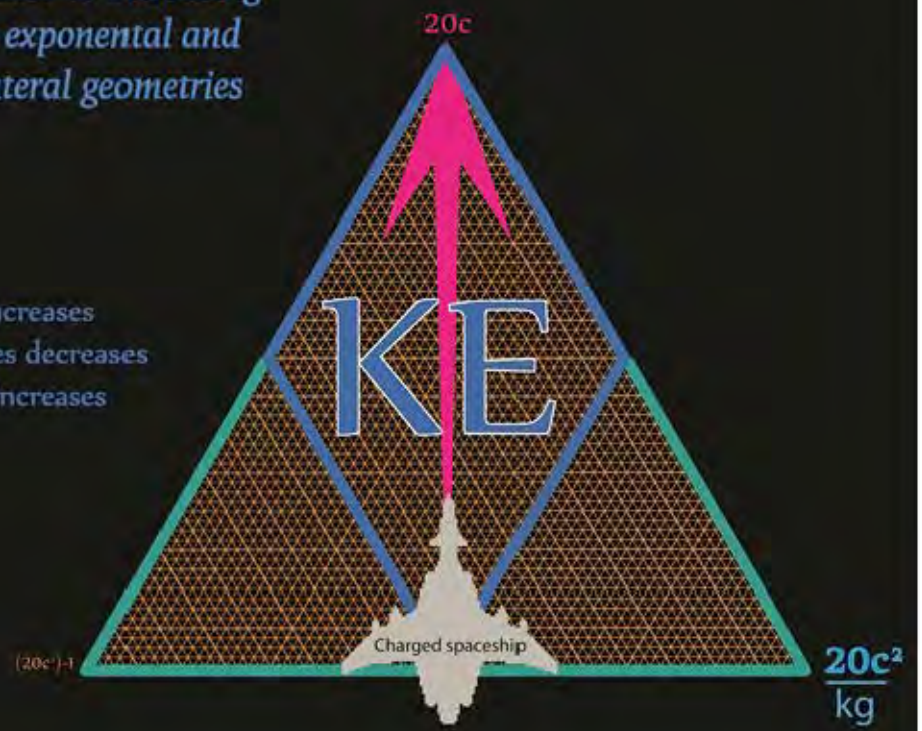

Warp Speed Scotty

Proposed explanation(s) GAMMA RAY BURSTS (GRB)

Any massive body using KEM fields as a motive force for faster-than-Light travel would produce an extremely bright release of Gamma rays at their point of acceleration (as only 1/2 of the photonic energy would be used to accelerate the craft in any one direction). additionally anybody noticing the burst of required Energy would not find a 'source' for the Gamma ray burst when they looked as the craft would have accelerated away from that point in free space

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Conservation symmetry

A conservation law states that some quantity X
(describing any physical system)
remains constant throughout its motion

$$\frac{\Delta x}{dt} = 0$$

Rotation symmetry gives
conservation of angular momentum

conservation of angular momenta

$$\left[\frac{\Omega}{c^2}\right]$$

QAM / second

conservation of linear momentum

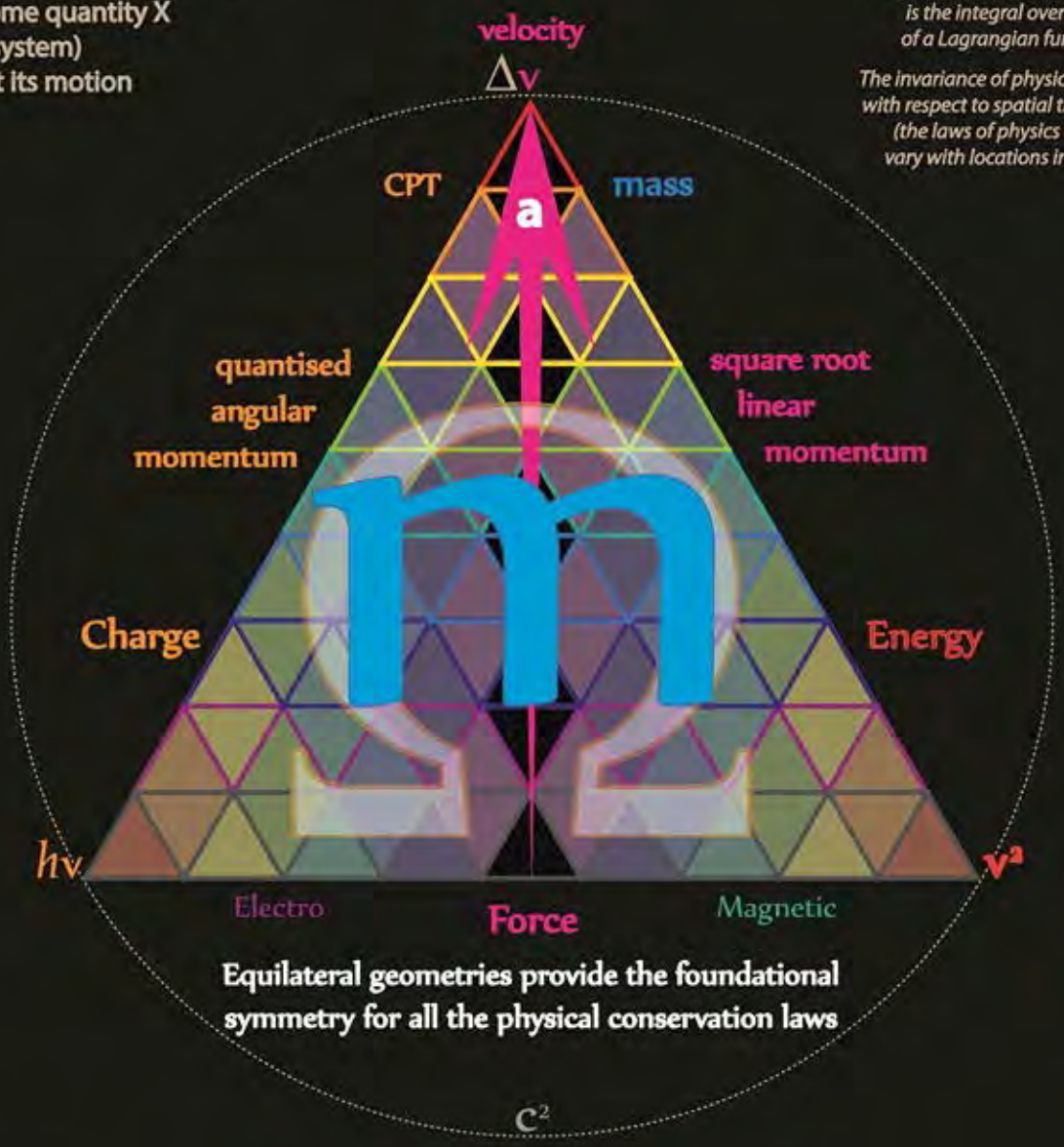

Equilateral geometries provide the foundational symmetry for all the physical conservation laws

Matter topologies are not conservative

Noether's Symmetry

The action of a physical system is the integral over time of a Lagrangian function

The invariance of physical systems with respect to spatial translation (the laws of physics do not vary with locations in space)

Amalie Emmy Noether

(23 March 1882 – 14 April 1935)

Time translation symmetry
gives conservation of energy

conservation of energy

6.629432672 e-34 J
Planck quanta
$[m\Omega v^2]$
mass velocity
7.376238634 e-51 kg

mass-ENERGY quanta

conservation of mass

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Virtual Particles

In physics, a virtual particle is a particle that exists for a limited time and space.
The energy and momentum of a virtual particle are uncertain according to the uncertainty principle.
The degree of uncertainty of each is inversely proportional to
time duration (for energy) or to position span (for momentum).

In Tetryonics the Uncertainity principle has been negated with deterministic, re-normalisable charged mass-ENERGY geometries & Matter topologies

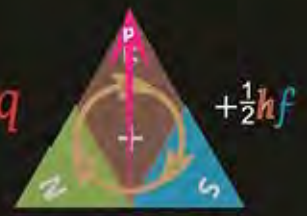

Positive Zero Point Field energy momenta

Longitudinal waves facilitate action-at-a-distance

Convergent Gravitation is attractive

Material Gravitation

M

Charged Matter topologies in vacuum energy fields create Gravity

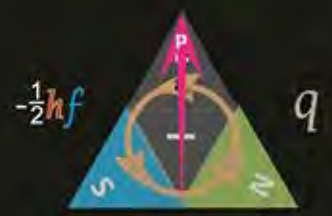

Negative Zero Point Field energy momenta

Energy propagates at the speed of light

Divergent Coulomb forces are interactive

EM Interactions

m

Superpositioned EM fields create interactive EM forces

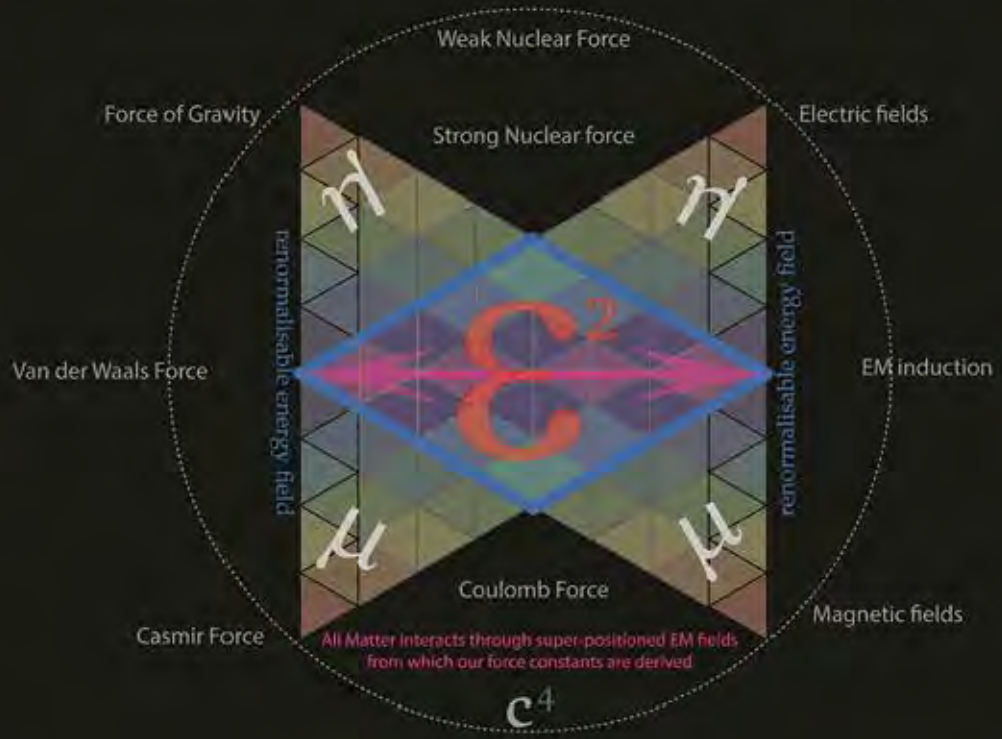

Vacuum field Energies

$$m^2c^4 = E^2 = p^2c^2$$

EM mass — momenta

virtual Particles are not a required part of tetryonic theory

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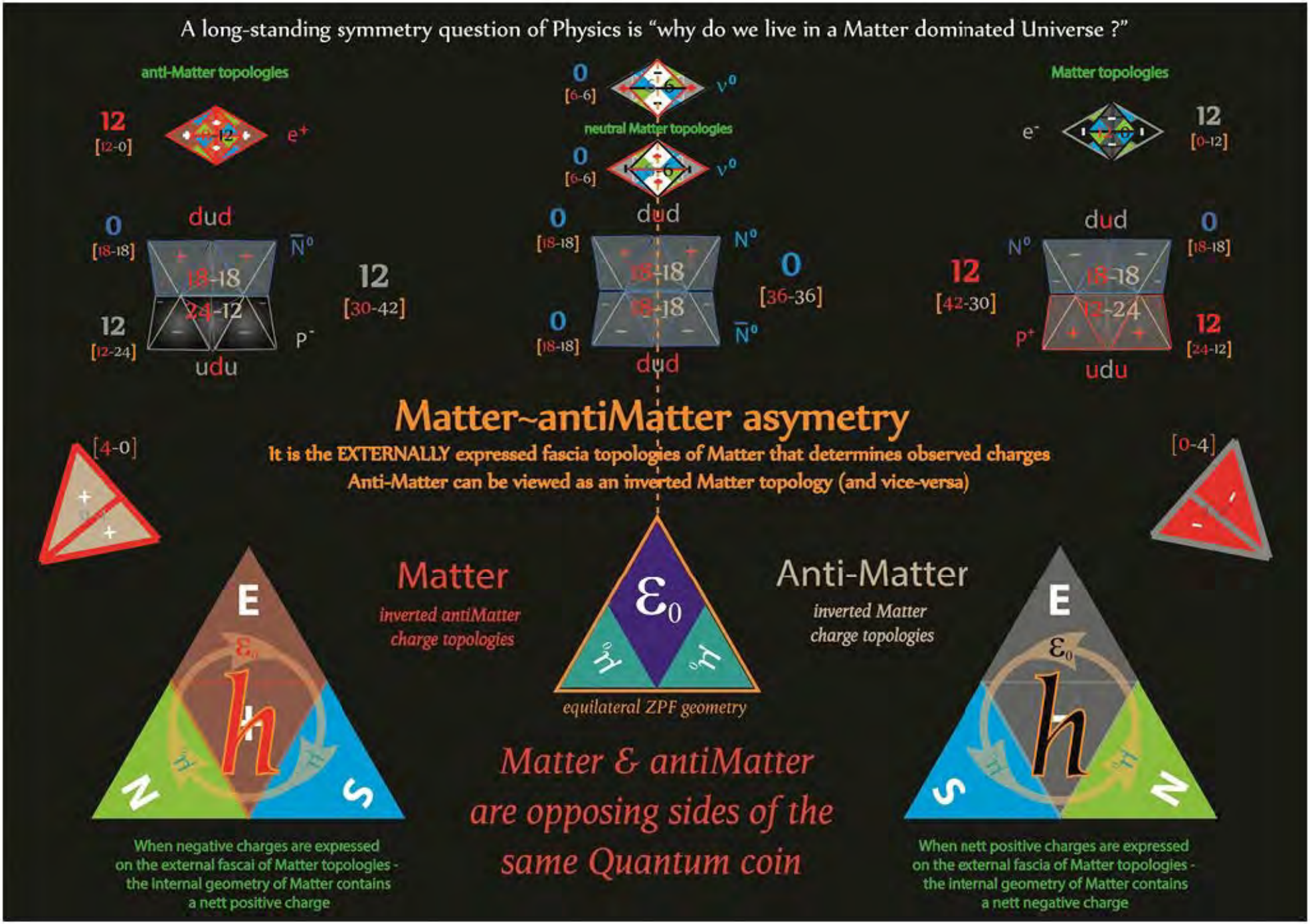

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Types of Matter

In addition to the established Matter-antiMatter forms of mass
there exists a third form of Matter

Anti-Matter

anti-Neutron
positron
anti-Proton

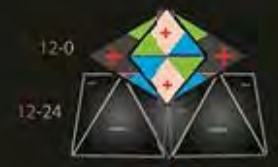

48

0
[24-24]

udu
anti-Hydrogen

dud

84

0
[42-42]

anti-Deuterium

96

0
[48-48]

di-atomic
anti-Hydrogen

Neutral Matter

Neutron Neutrino anti-Neutron

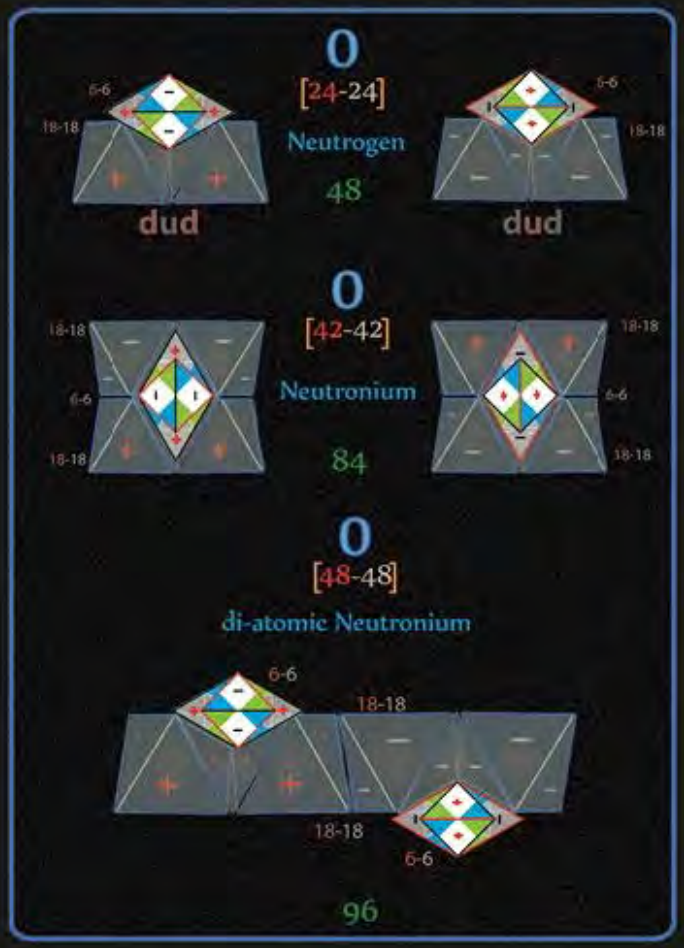

Matter

Neutron
electron
Proton

0
[24-24]

48

udu
Hydrogen

dud

0
[42-42]

84

Deuterium

0
[48-48]

96

di-atomic
Hydrogen

The Universe is filled with Matter - Neutronium - antiMatter star Galaxies
and their emitted photons of light are identical

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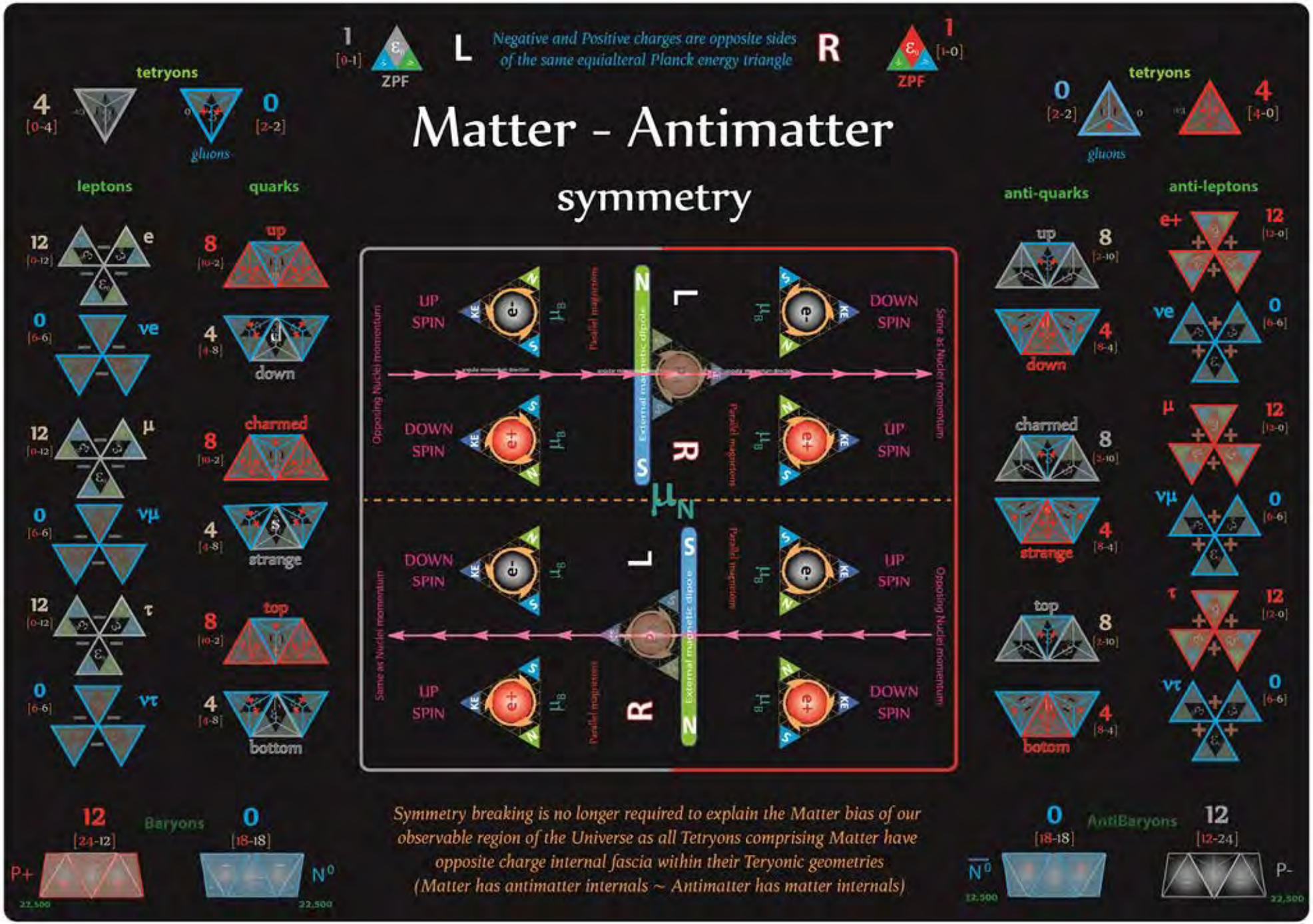

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Anti-Matter

Baryon asymmetry

Matter

The Big Bang should have produced equal amounts of Matter and antiMatter, as such, there should have been total cancellation of both.

dud

anti-Deuterium

0
[42-42]
84

It is not yet understood why the Universe has more matter than antimatter.
It is generally assumed that when the Universe was young and very hot,
it was in equilibrium and contained equal numbers of baryons and antibaryons.

Protons should have cancelled with antiprotons, electrons with antielectrons (positrons),
neutrons with antineutrons, and so on for all elementary particles.
This would have resulted in a sea of photons in the universe with no matter.

However, observations suggest that the Universe, including its most distant parts,
is made almost entirely of normal matter.

dud

0
[42-42]
84

Deuterium

anti-Neutron
positron
anti-Proton

0
[42-42]
Neutronium
84

Neutron
electron
Proton

antiMatter dominated Galaxy

Matter dominated Galaxy

Neutral Matter

Neutron Neutrino anti-Neutron

Tetryonics dictates that the Universe is filled with Matter - Neutronium - Antimatter star Galaxies and their emitted light photons are identical

Tetryonics also demonstrates that the charge topologies of each Matter type prevalent in the formation of each Galaxy determines the overall resultant EM field geometries that shapes their large-scale evolution

It is hypothesised that the rotation direction of galaxies is also influenced by how each galaxy was formed in particular the predominance of Matter over antiMatter interactions and the electrodynamic fields of each Galaxy's GEM pinch core

Clockwise rotation

Counter-clockwise rotation

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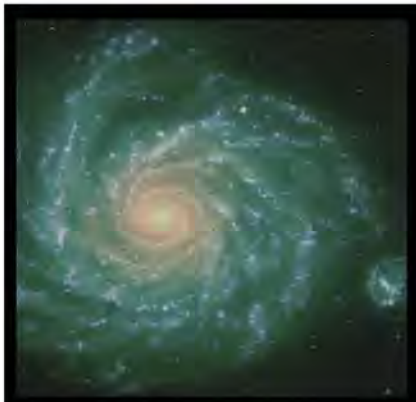

Opposites attract - Similars repel
even on the galactic-scale

Galactic Matter distributions

Tetryonics dictates that the Universe is filled with 3 forms of
Matter - Neutronium - Antimatter stars and Galaxies
their light is identical and cannot be used to distingush them

Matter

Neutron
Electron
Proton

Neutronium

Neutron Neutrino anti-Neutron

Neutronium is found predominantly in Neutron stars and Pulsars
spread throughout Matter and antiMatter galaxies
however it is conceivable that neutral galaxies may exist

Anti-Matter

anti-Neutron
Positron
anti-Proton

Tetryonics 80.21 - Galactic Matter distribution

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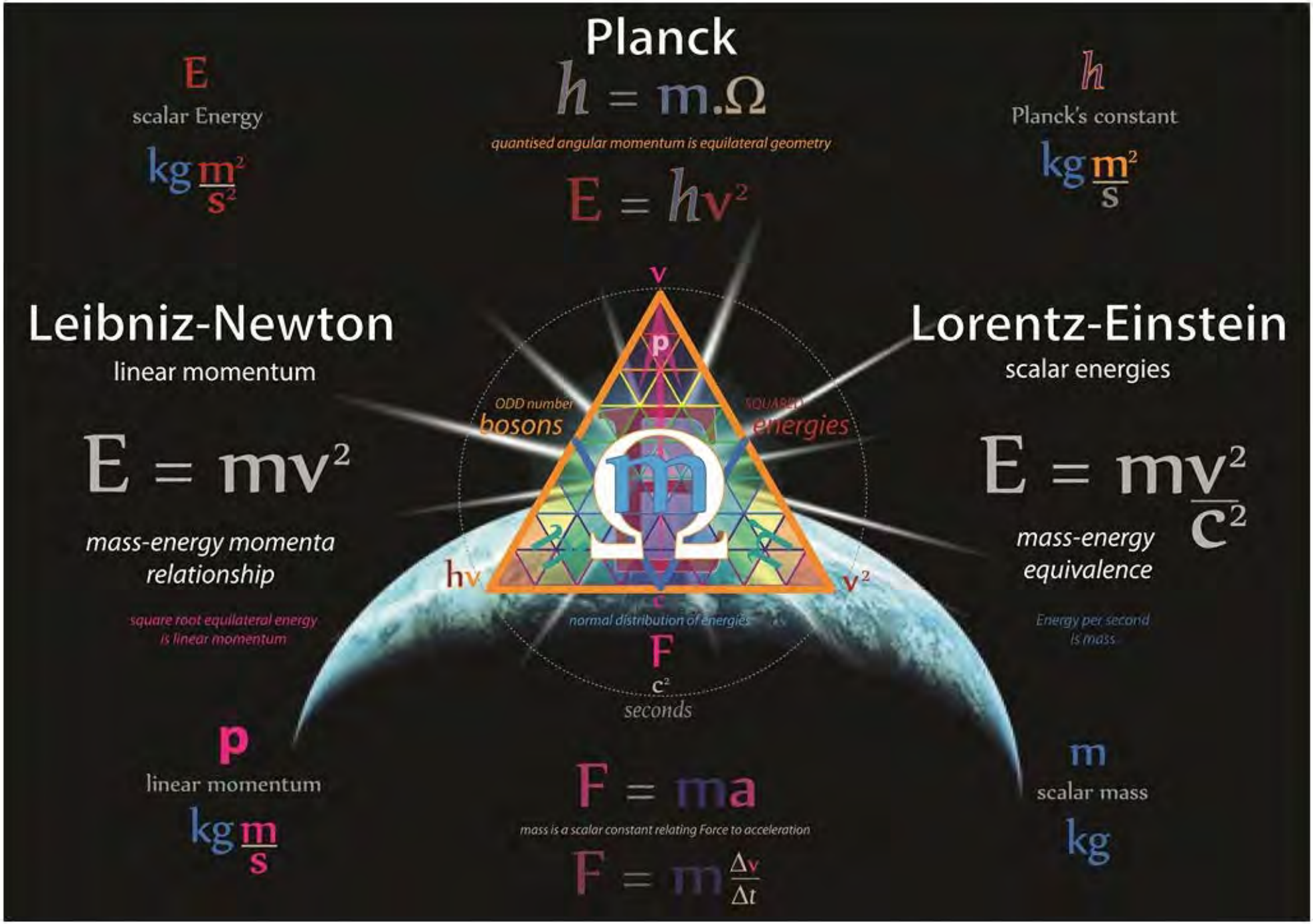

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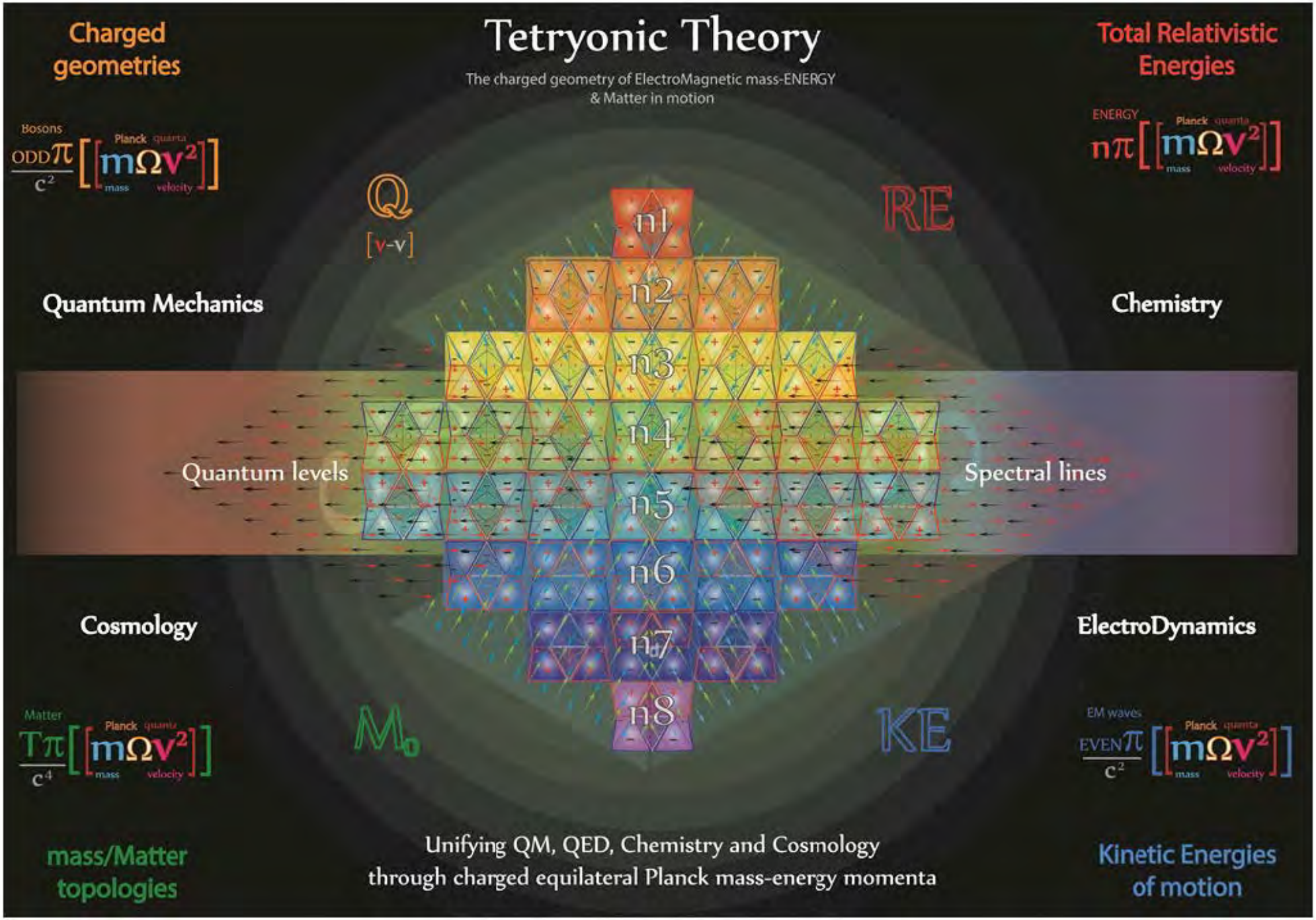

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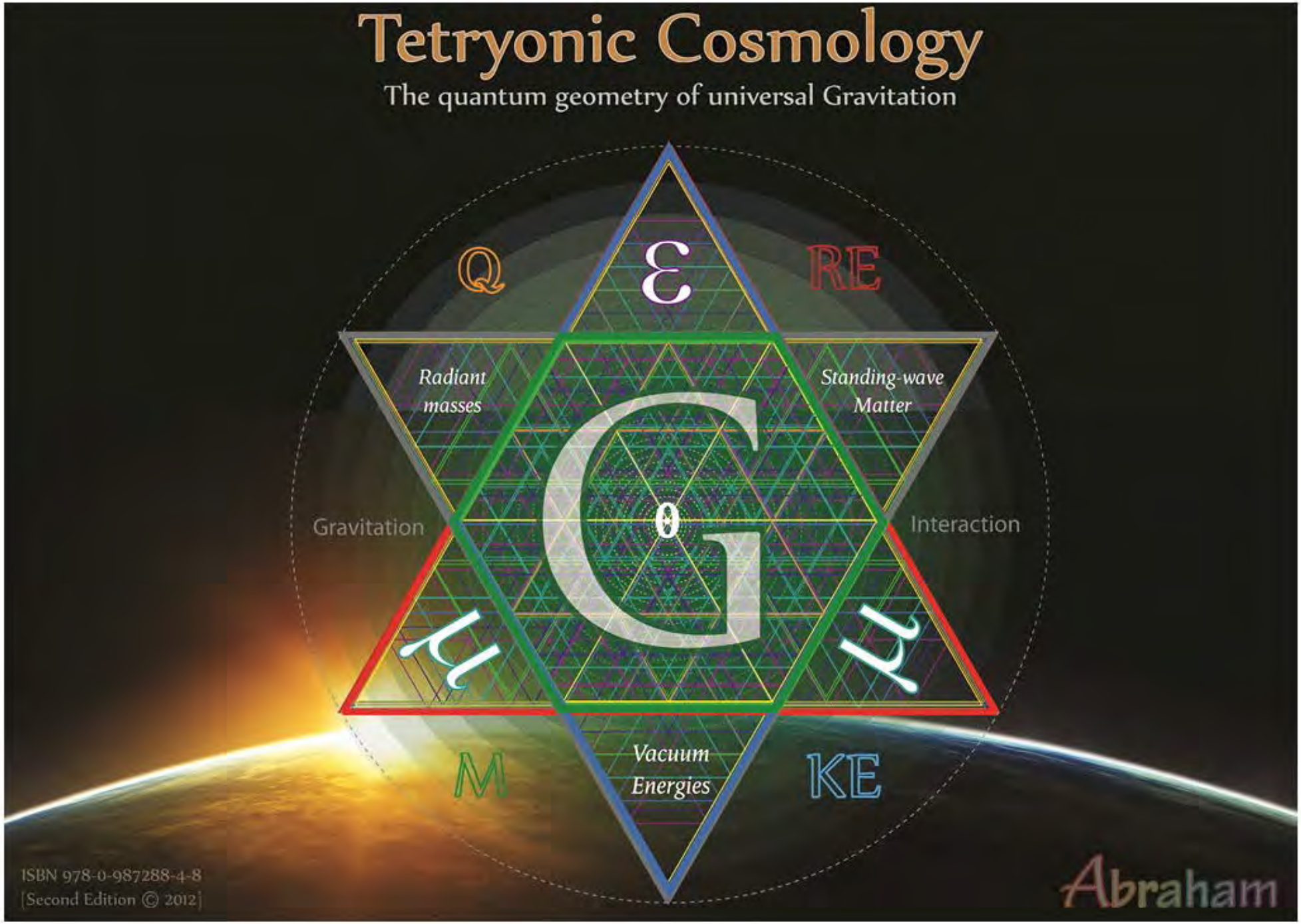

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TETRYONICS

The equilateral geometry underpinning the mathematics of Physics

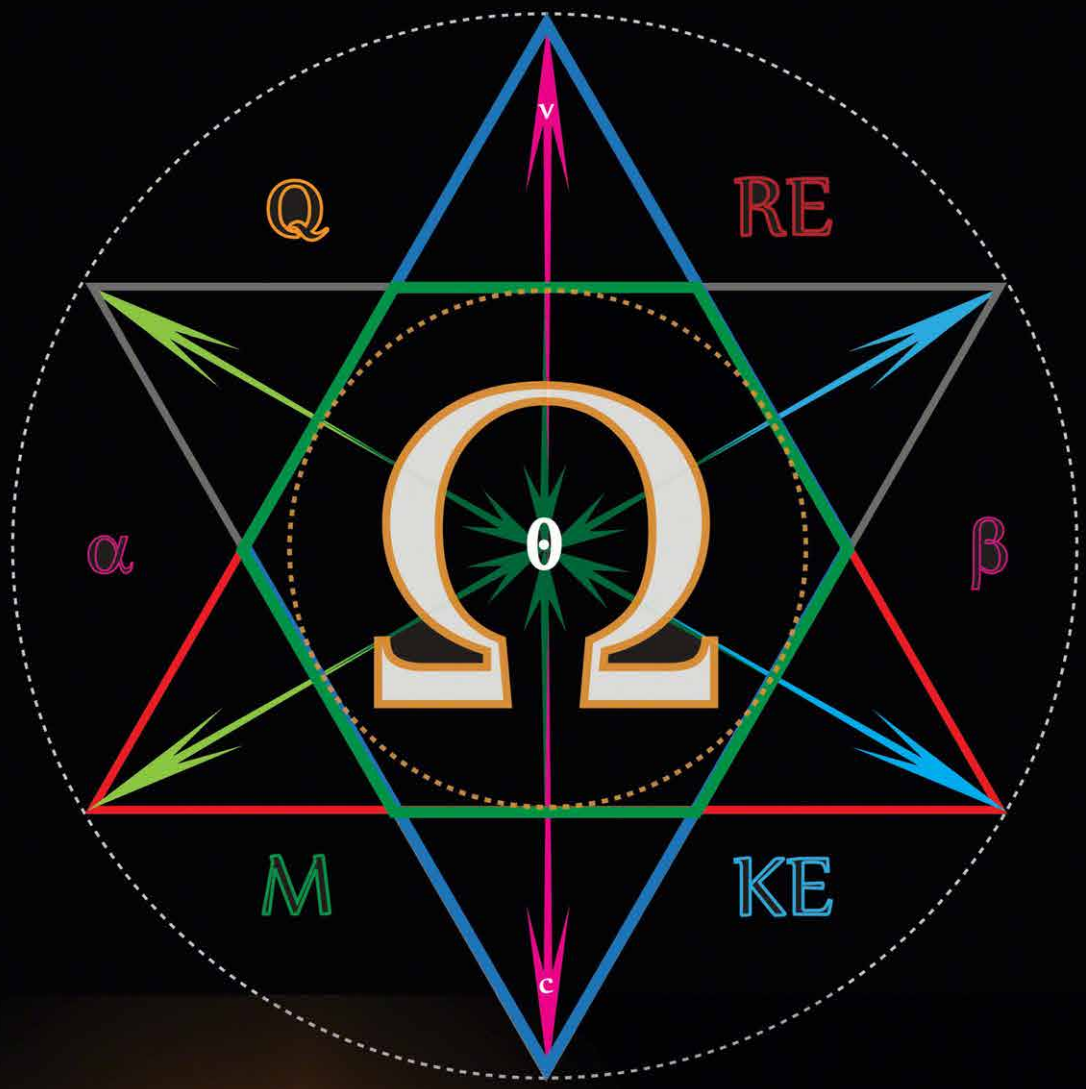

Foundational physics Mathematics

Abraham

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Geometry and the Theory of Everything

Plato

(c.428-348 BC)

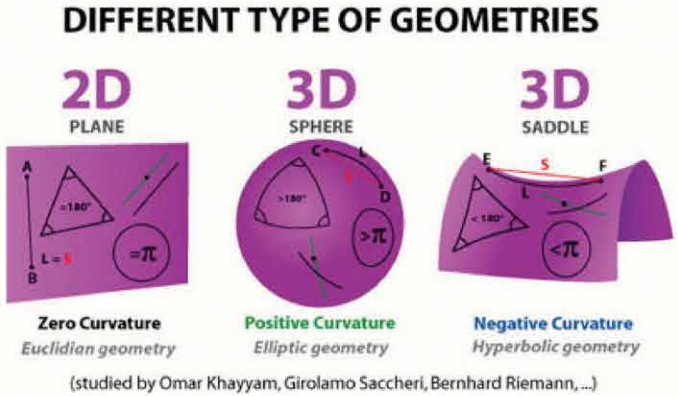

Euclid

(c.330-275 BC, fl. c.300 BC)

The Socratic tradition was not particularly congenial to mathematics, as may be gathered from Socrates' inability to convince himself that 1 plus 1 equals 2, but it seems that his student Plato gained an appreciation for mathematics after a series of conversations with his friend Archytas in 388 BC.

One of the things that most caught Plato's imagination was the existence and uniqueness of what are now called the five "Platonic solids".

It's uncertain who first described all five of these shapes - it may have been the early Pythagoreans - but some sources (including Euclid) indicate that Theaetetus (another friend of Plato's) wrote the first complete account of the five regular solids.

Presumably this formed the basis of the constructions of the Platonic solids that constitute the concluding Book XIII of Euclid's Elements.

In any case, Plato was mightily impressed by these five definite shapes that constitute the only perfectly symmetrical arrangements of a set of (non-planar) points in space, and late in life he expounded a complete "theory of everything", in the treatise called Timaeus, based explicitly on these five solids.

Interestingly, almost 2000 years later, Johannes Kepler was similarly fascinated by these five shapes, and developed his own cosmology from them

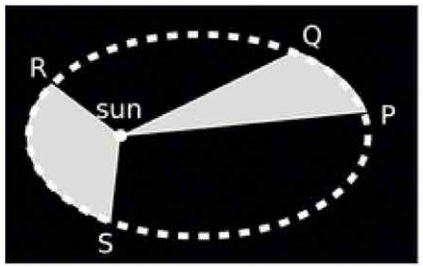

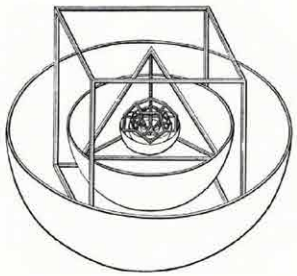

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Tetractys

The Greek Tetractys is a triangular figure consisting of ten points arranged in four rows:

one, two, three, and four points in each row, which is the geometrical representation of the fourth triangular number.

As a mystical symbol, it was very important to the secret worship of the Pythagoreans.

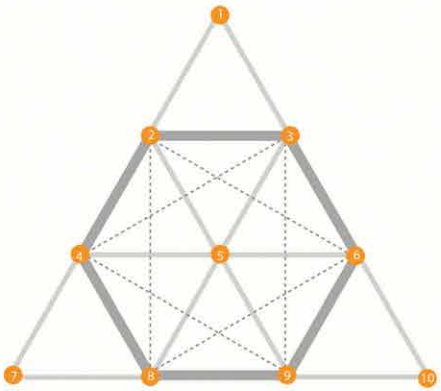

Sacred numbers

The Tetractys historically symbolized the four elements [Earth, Air, Fire, and Water] and the relationship between Humanity and the cosmos created by GOD

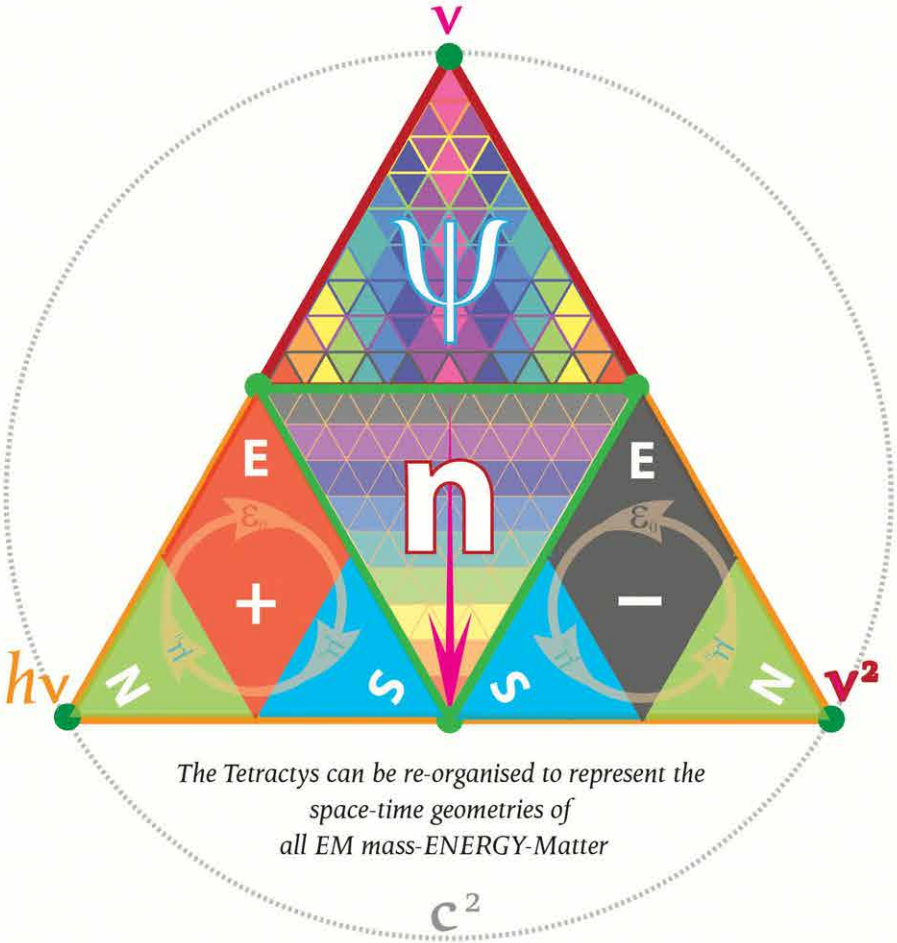

The Tetractys can be re-organised to represent the space-time geometries of all EM mass-ENERGY-Matter

The tetrad was the name given to the number four - in Pythagorean philosophy there were four seasons and four elements, and the number was also associated with planetary motions and music

As a mystical symbol, it was very important to the secret worship of the Pythagoreans.

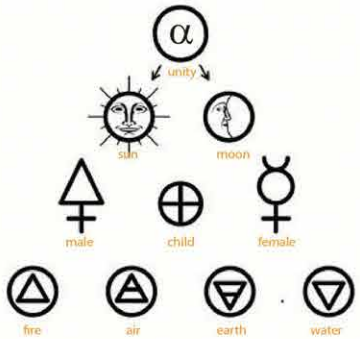

The Cosmos

The single triangle in the first row represents zero-dimensions (a point)
A vector direction in one-dimension can be represented as a line between any two points
The second row represents a Boson (two-dimensions in a plane defined by a rhombus of three triangles)
The whole figure folded represents three-dimensions (a tetrahedron defined by four apex points)
Photons of ElectroMagnetic mass-Energy quanta are represented by two opposing triangles

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The Greek Zodiac

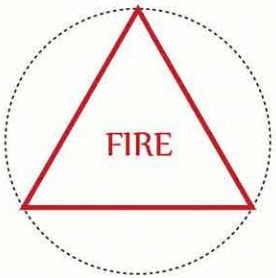

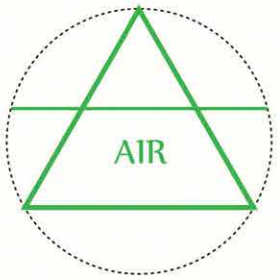

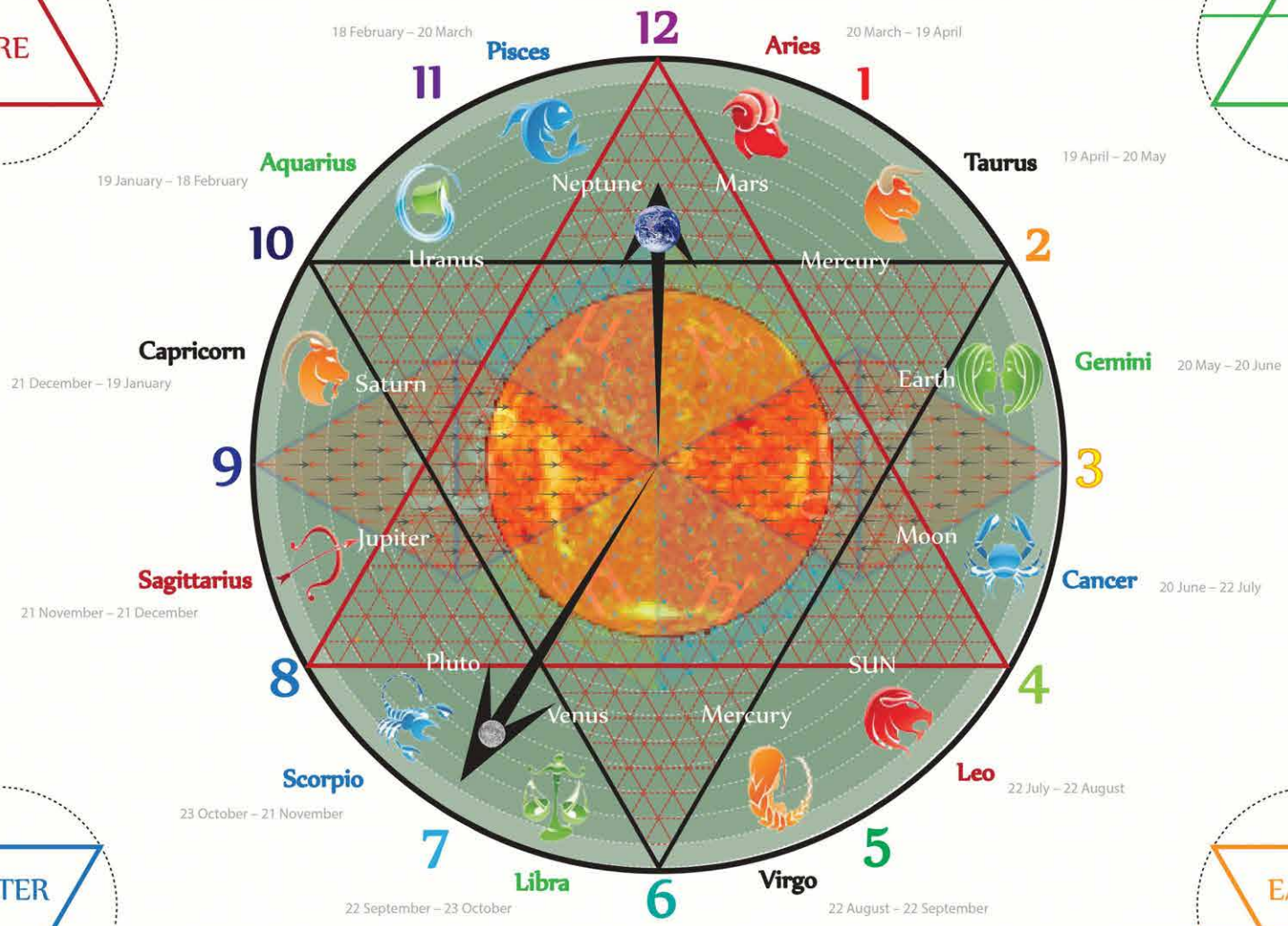

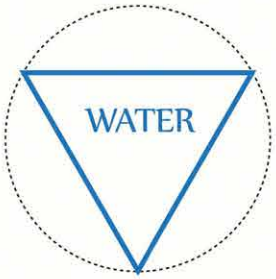

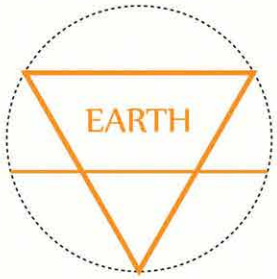

The Greek Elements

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Equilateral Triangles

An equilateral triangle is a triangle in which all three sides are equal

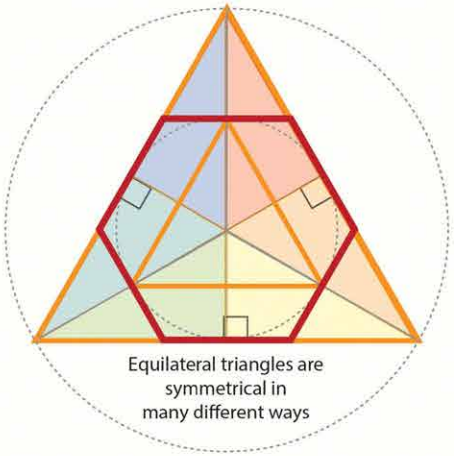

Equilateral triangles are symmetrical in many different ways

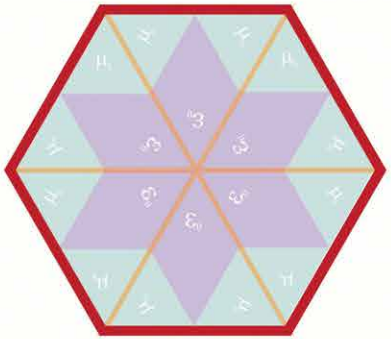

Any six equilateral triangles joined can make a hexagon.

It is unique in that it is the only polygon that can be tiled [or divided] and produce only identical geometries and squares numbers

The equilateral triangle is eminently suited for the construction of fractals

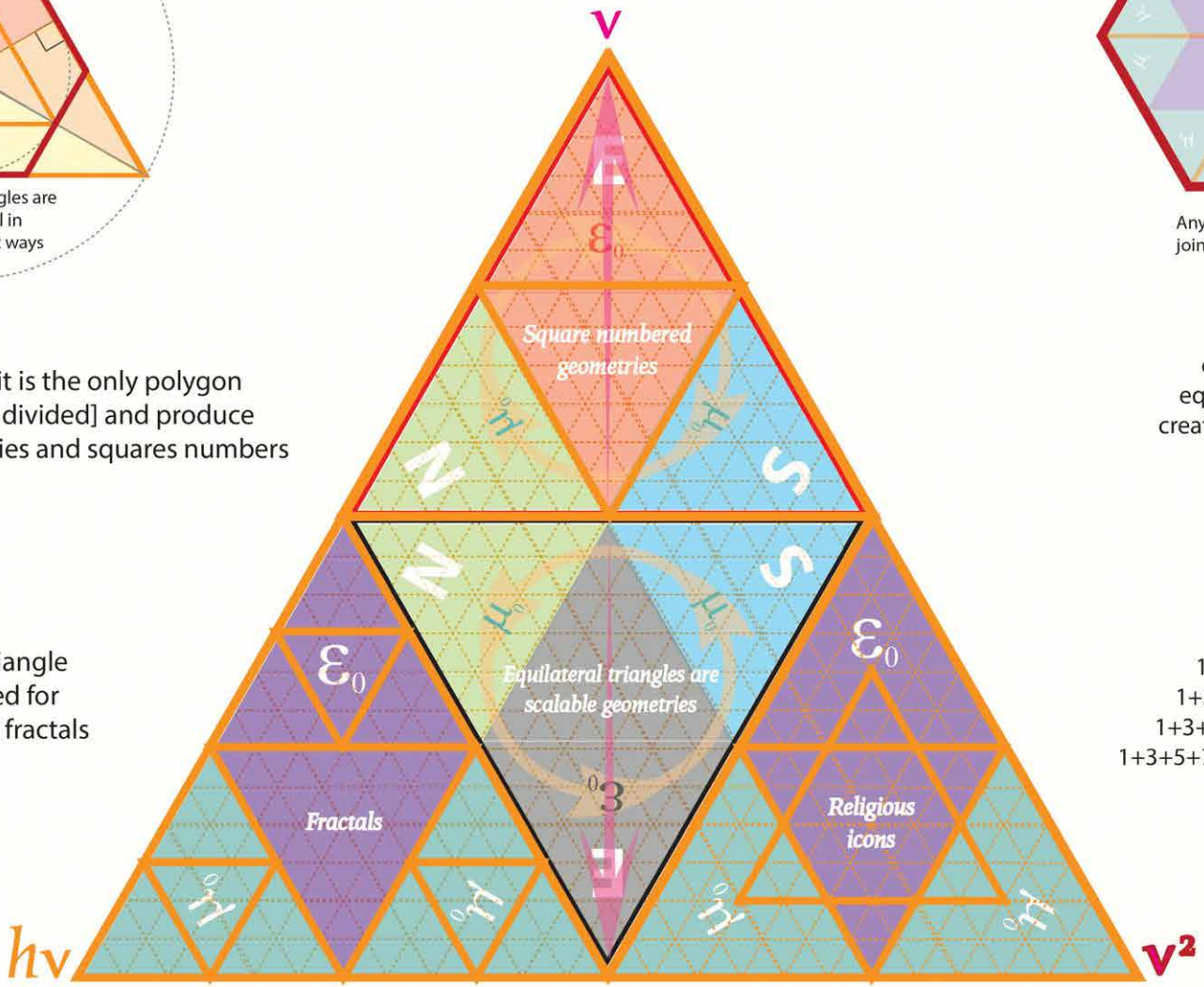

The tesselation of odd numbered equilateral triangles creates square numbers

That is,

1
1+3 = 4
1+3+5 = 9
1+3+5+7 = 16
1+3+5+7+9 = 25
1+3+5+7+9+11 = 36
1+3+5+7+9+11+13 = 49
1+3+5+7+7+9+11+13+15 = 64
etc

An equilateral triangle is simply a specific case of a regular polygon with 3 sides

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The Pythagorean Theorem

Though attributed to Pythagoras, it is not certain that he was the first person to prove it.

The first clear proof came from Euclid, and it is possible the concept was known 1000 years before Pythoragas by the Babylonians

$$a^2 + b^2 = c^2$$

The square of the hypotenuse of a triangle is equal to the sum of the squares of its sides.

In any right triangle,
the area of the square whose side is the hypotenuse
(the side opposite the right angle) is equal to
the sum of the areas of the squares
whose sides are the two legs
(the two sides that meet at a right angle)

Pythagoras of Samos

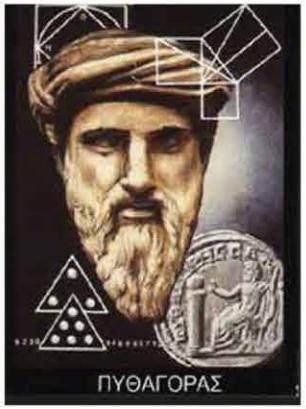

about (570 – 495 BC)

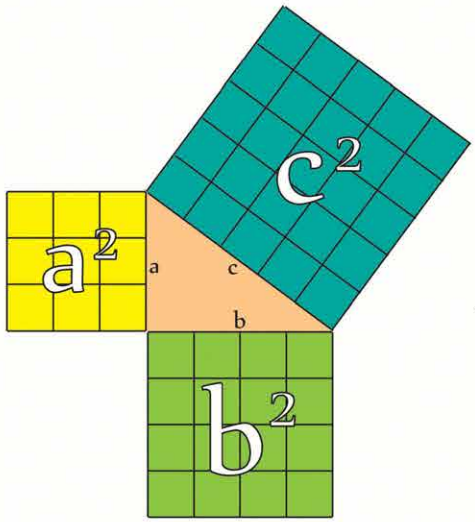

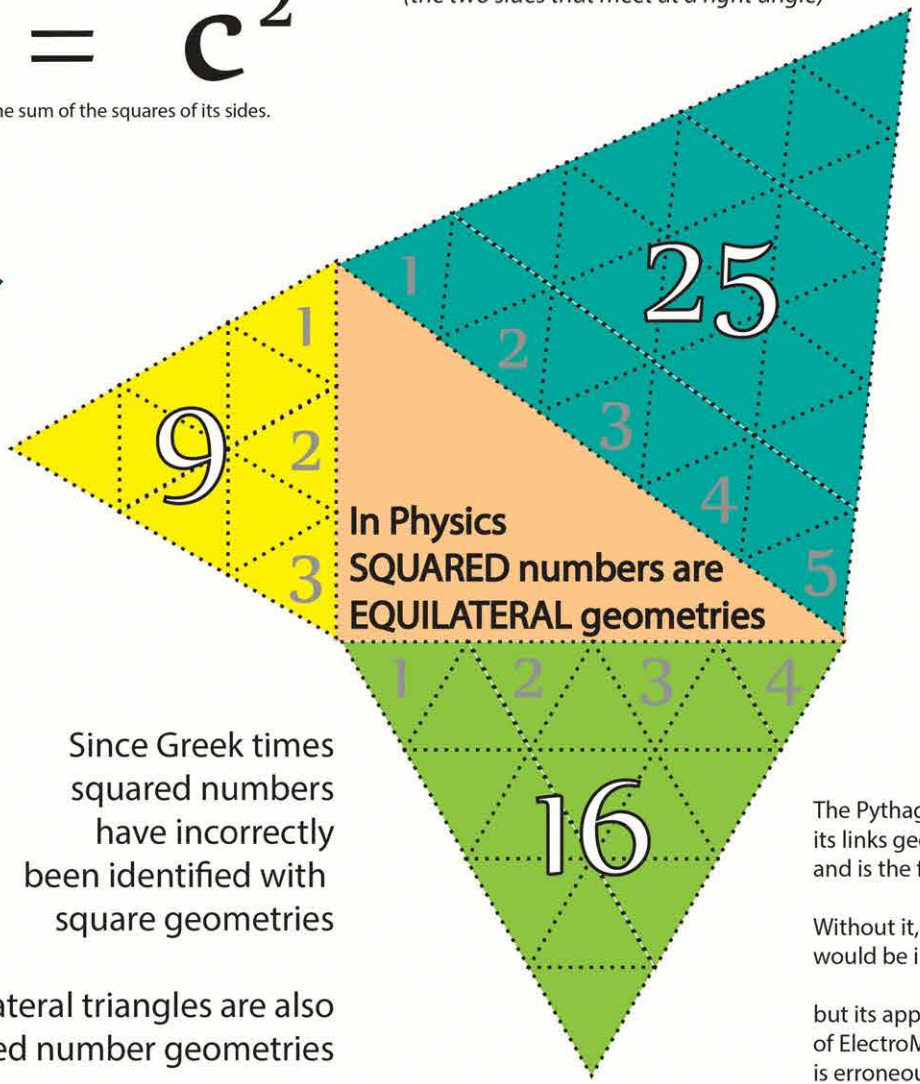

In Physics
SQUARED numbers are
EQUILATERAL geometries

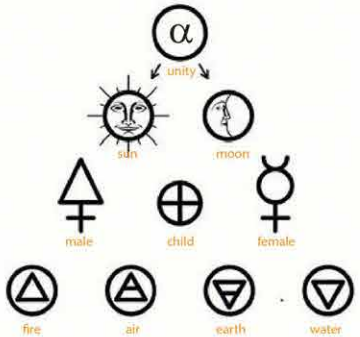

Pythagorean Tetractys

Since Greek times
squared numbers
have incorrectly
been identified with
square geometries

Equilateral triangles are also
squared number geometries

The Pythagorean equation is at the core of much of geometry,
its links geometry with algebra,
and is the foundation of trigonometry.

Without it, accurate surveying, mapmaking, and navigation
would be impossible,

but its application to the energy-momenta geometries
of ElectroMagnetic fields and Matter in motion in Physics
is erroneous and must be corrected for science to advance

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Hexagons

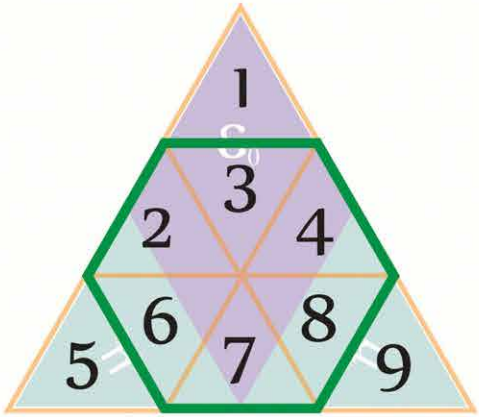

Energy geometries

A regular hexagon can be subdivided into six equilateral triangles

Hexagons are the only regular polygon that can be subdivided into another regular polygon

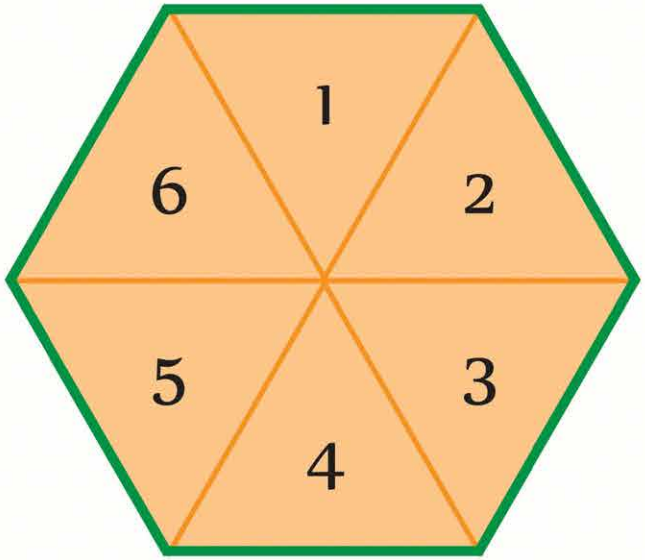

Hexagons are the unique regular polygon such that the distance between the center and each vertex is equal to the length of each side

An interesting relationship between circular and hexagonal geometry is that hexagonal patterns often appear spontaneously when natural forces are trying to approximate circles

Atomic nuclei geometries

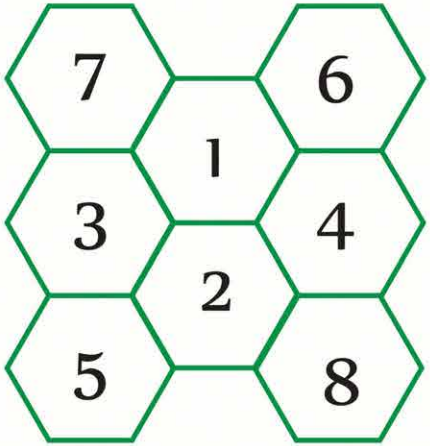

Hexagons can be tiled or tessellated in a regular pattern on a flat two-dimensional plane

Six is a highly composite number, the second-smallest composite number, and the first perfect number.

That is, 1*2*3=1+2+3=6

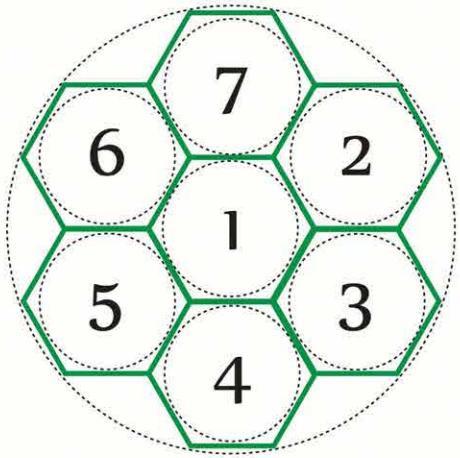

Hexagonal tessellation is topologically identical to the close packing of circles on a plane

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Platonic Solids

The Pythagoreans knew that there were only five regular convex solids, the tetrahedon, cube, octahedron, icosohedron and dodecahedron and each one could be accurately circumscribed by a sphere.

FIRE

4 triangles meet to form a Tetrahedron

EARTH

6 squares meet to form a Cube

AIR

8 triangles meet to form a Octahedron

tetryons **4**

regular deltahedrons

leptons **12**

F - E + V = 2

faces edges vertexs

8 *quarks*

regular deltahedrons

20 *Baryons*

Plato

(c.428-348 BC)

The philosopher Plato concluded that they must be the fundamental building blocks – the atoms – of nature, and assigned to them what he believed to be the essential elements of the universe.

12 pentagons meet to form a Dodecahedron

THE HEAVENS

20 triangles meet to form a Icosahedron

WATER

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Tetryonic Solids

Despite their unique topologies Tetryonic solids are not unlike Platonic solids save that their toplogies are comprised entirely from complex hitherto undescribed **4nπ equilateral Planck mass-energy momenta geometries** that also match the Euler numbers of Platonic solids

+ tetryon

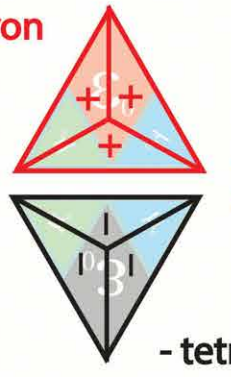

4 faces
6 edges
4 vertices

2

- tetryon

up quark

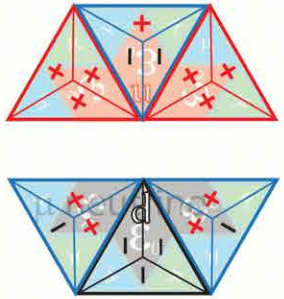

2

8 faces
12 edges
6 vertices

down quark

mass geometries

4π *tetryons* **4π**

regular deltahedrons

12π *leptons* **12π**

Matter topologies

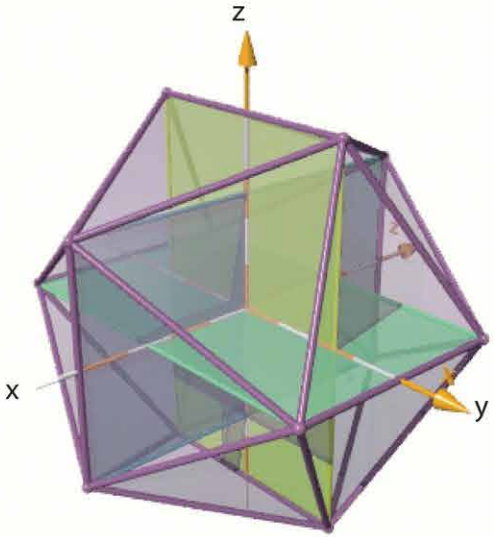

Matter topologies

8π *quarks* **12π**

regular deltahedrons

20π *Baryons* **36π**

mass geometries

neutrino

electron

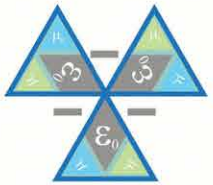

12 faces
18 edges
8 vertices

2

Their equilateral topologies are best described as regular topologic-deltahedrons:

tetra-delta-hedrals	tetryons	4π external charge fascia
octa-delta-hedrals	quarks	8π external charge fascia
dodeca-delta-hedrals	leptons	12π external charge fascia
icoso-delta-hedrals	Baryons	20π external charge fascia

note:
Charged mass-energy fascia geometries and edges become "hidden" upon the meshing of delta-hedra to form Matter topologies

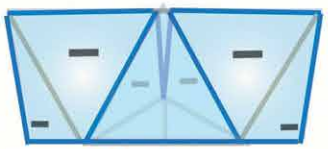

Neutron

2

Proton

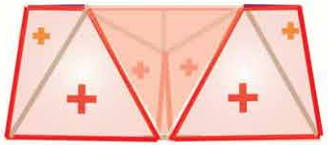

20 faces
30 edges
12 vertices

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Euclidean geometry

Euclid

(c.330-275 BC, fl. c.300 BC)

Arguably the most influential Mathematics book ever written is Euclid's 'The Elements'

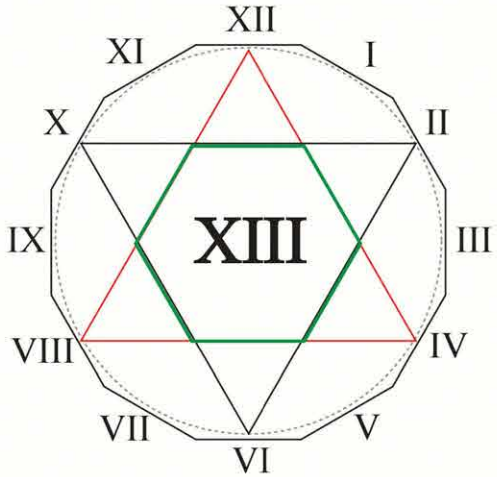

In all, it contains 465 theorems and proofs, described in a clear, logical and elegant style, and using only a compass and a straight edge.

The Elements - Book 1 - Definition 20

Of the trilateral figures, an equilateral triangle is that which has its three EQUAL sides

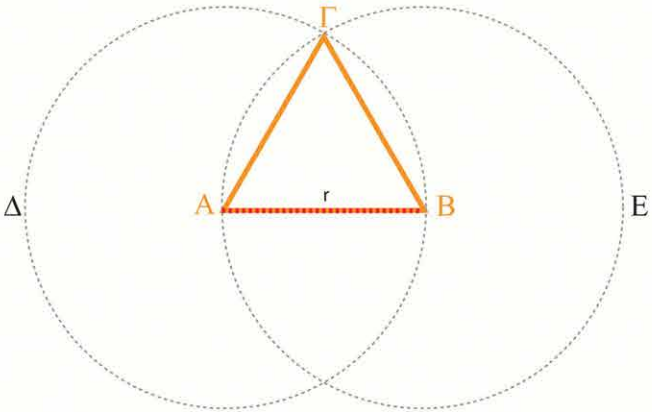

Euclid's Elements - Book 1 - Proposition 1
Method of constructing an Equialteral triangle

Euclid's five general axioms were:

Things which are equal to the same thing are equal to each other.

If equals are added to equals, the wholes (sums) are equal.

If equals are subtracted from equals, the remainders (differences) are equal.

Things that coincide with one another are equal to one another.

The whole is greater than the part

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Archimedes

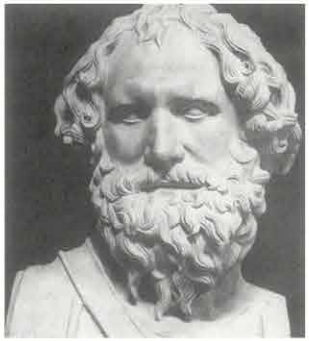

c. (287 BC – c. 212 BC)

As its definition relates to the circle,
π is found in many formulae in trigonometry and geometry,
especially those concerning circles, ellipses, or spheres.

It is also found in formulae from other branches of science,
such as cosmology, number theory, statistics, fractals,
thermodynamics, mechanics, and electromagnetism

Incorrect identification of Pi [c/d] as opposed to Pi radians
in Physics has led to the inappropriate association
of spherical particles to the physical sciences
whereas equilateral triangles & tetrahedra
form its true geometry

The number π is a mathematical constant that is
the ratio of a circle's circumference to its diameter.

Pi

π is an irrational number
its decimal representation
never ends and never repeats.

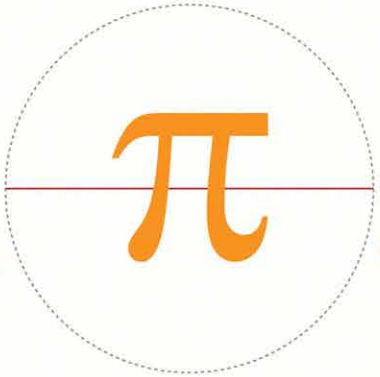

$\pi = c/d$

The ratio C/d is constant,
regardless of the circle's size

3.141592654.....

Proof of the fact that C=2πr and how Archimedes proved it

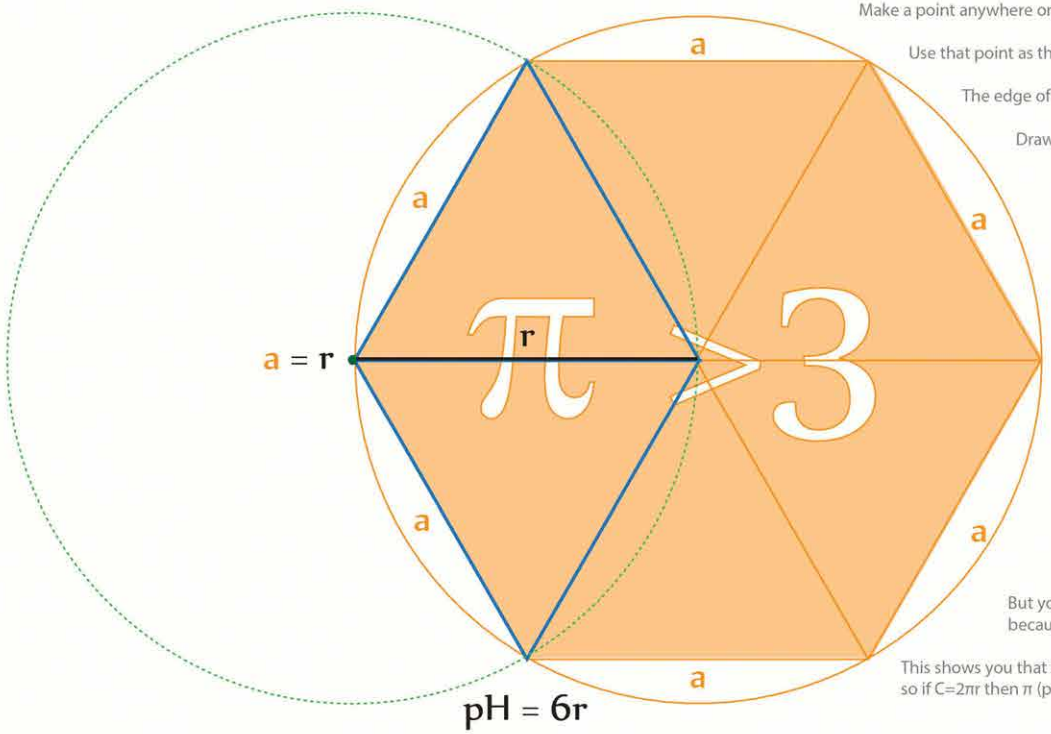

Draw any circle.

Make a point anywhere on the circumference of the [green] circle.

Use that point as the center of a second [blue] circle with the same radius as the green circle.

The edge of the blue circle should touch the center of the green circle.

Draw the line segment connecting the centers of the two circles.

That forms the radius of both of the circles.

Now draw the line connecting the center of the blue circle to where it crosses the green circle
on both sides, and complete the triangles.

You should have two equilateral triangles whose sides are equal to the radius of the green circle

Now extend all of the radius lines so they become diameter lines,
all the way across the circle, and finish drawing all of the triangles to connect them.

You've got six equilateral triangles now, that make an orange hexagon.

So the perimeter of your hexagon is the same as six times the radius of your circle.

But your circumference is a little bigger than the perimeter of your hexagon,
because the shortest distance between two points is always a straight line.

This shows you that the circumference of the blue circle has to be more than 6r,
so if C=2πr then π (pi) has to be a little bigger than 3, which it is.

The more sides we draw on our polygon, the closer we will get to the real value of pi (3.14159 etc.).
Using a polygon with 96 sides, Archimedes was able to calculate that π was a little bigger than 3.1408

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The Golden Ratio

Two quantities are in the golden ratio (φ) if the ratio of the sum of the quantities to the larger quantity is equal to the ratio of the larger quantity to the smaller one.

The figure to the right illustrates the geometric relationship

[1.61803]

L — Interior line length [LM] of the bisector line is equal to 1/2 the side of the original triangle [BC] [AB] or [CA] — M

Φ

Golden ratio phi

$$\hbar = \frac{h}{2\pi}$$

Tetryonic geometry reveals the maximum E-field amplitude of the reduced Planck constant to be an example of the Golden ratio in physics

velocity vectors

The height of the triangle [ALM] produced by the bisecting line is 1/2 the height of the height of [ABC]

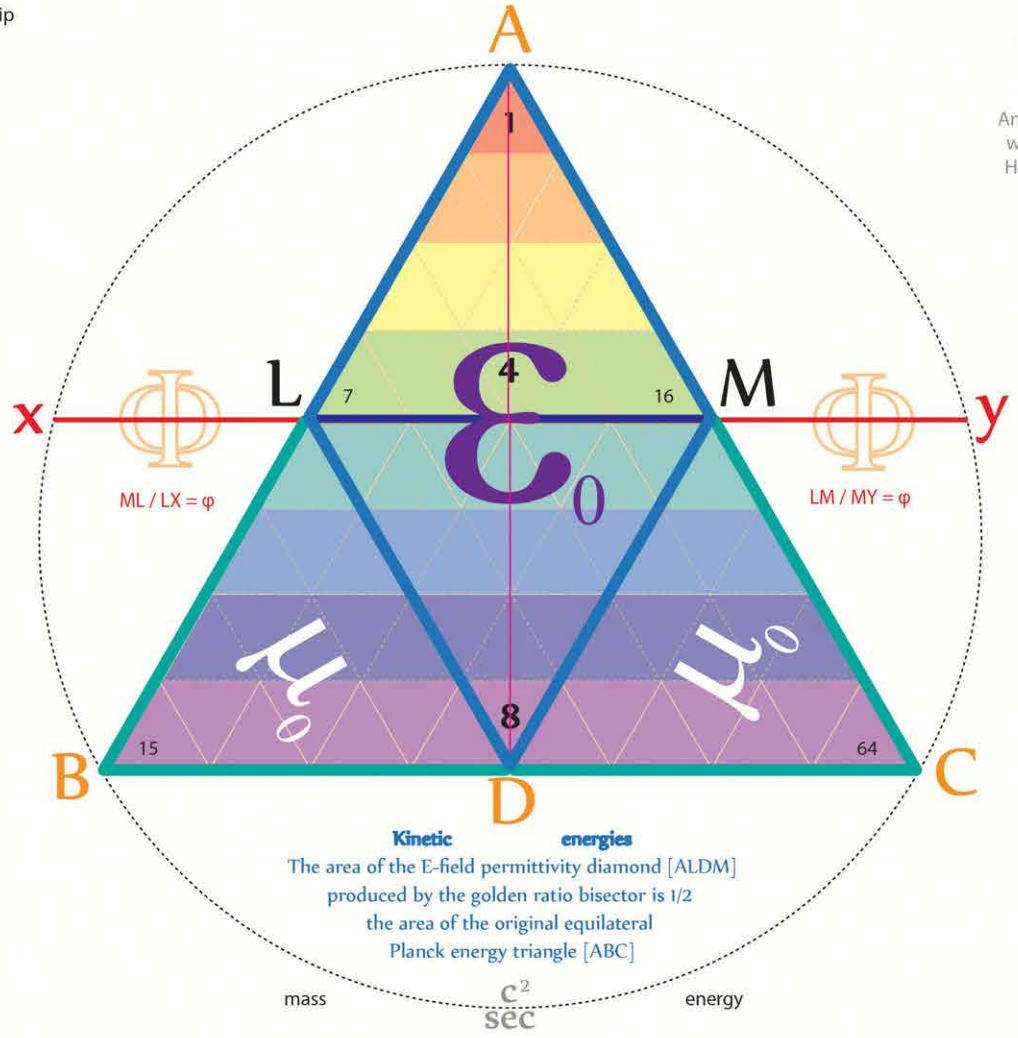

Planck's constant [h]

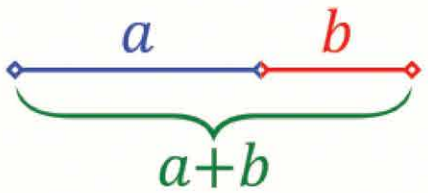

$a+b$ is to a as a is to b

An intriguing showing of φ in an equilateral triangle was observed by George Odom, a resident of the Hudson River Psychiatric Center, in the early 1980s

M — The exterior lines [My] and [Lx] are Phi ratios of the interior line [LM] — y

Let L and M be the midpoints of the sides AB and AC of an equilateral triangle ABC

By measurement and the Intersecting Chords Theorem

MX·MY = AM·MC.

which is of the form

(a + b)·b = a·a.

Denoting a/b = x, we see that

$1 + x = x^2$,

George Odom

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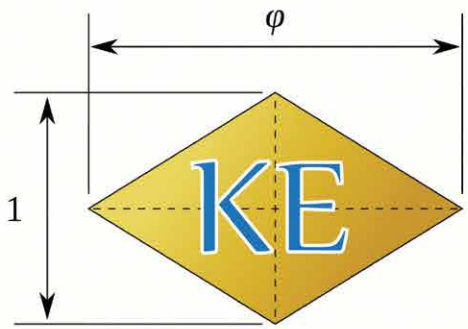

The Golden Rhombus

Applying the golden ratio (φ) to quantum scale electrodynamic geometry we can quickly determine that the linear momentum and magnetic moment vectors of photons & EM waves can also be expressed as a golden ratio

vector velocities
vs
magnetic vector

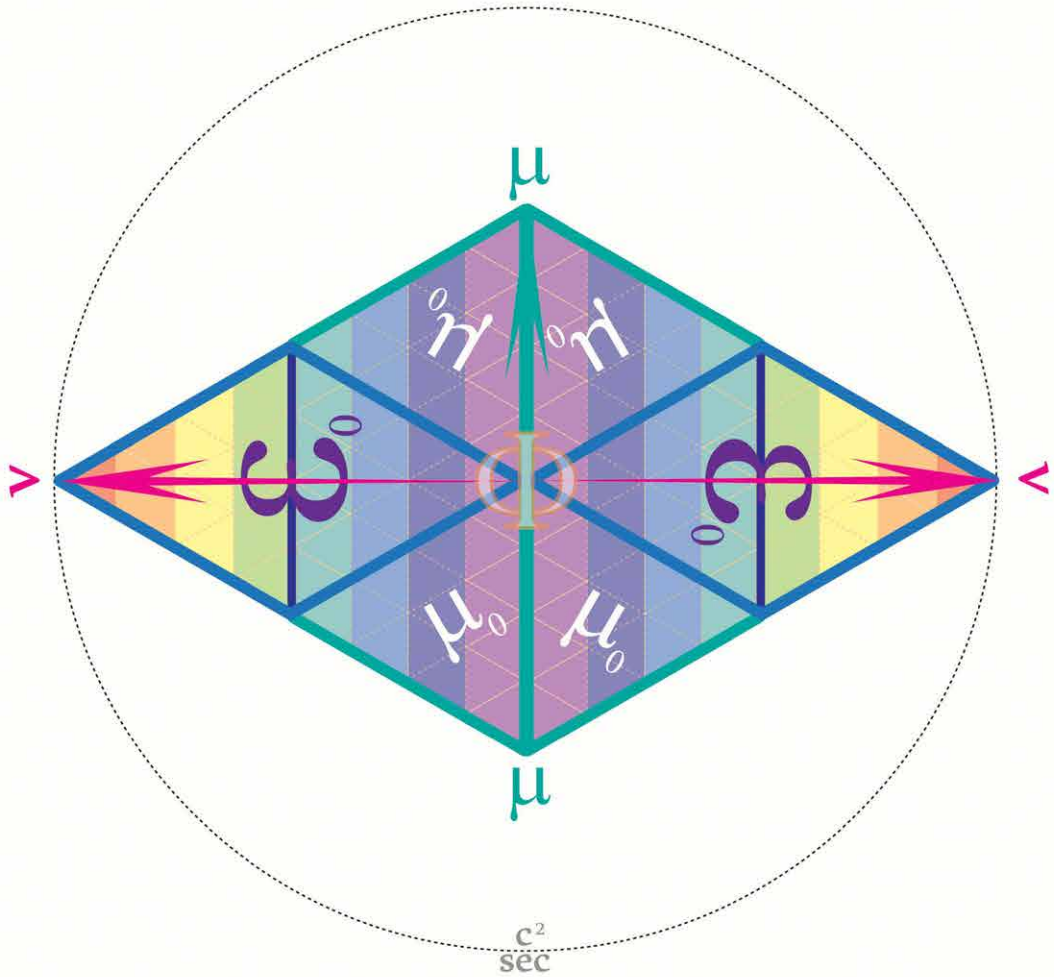

magnetic Force
vs
electric Force

photons
of
EM energy

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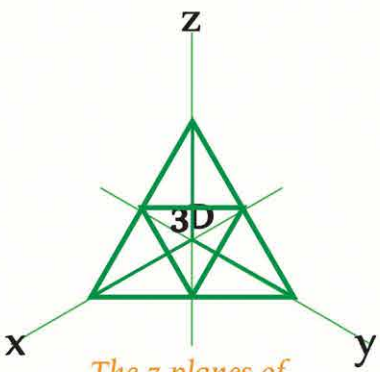

The 3 planes of Cartesian co-ordinates

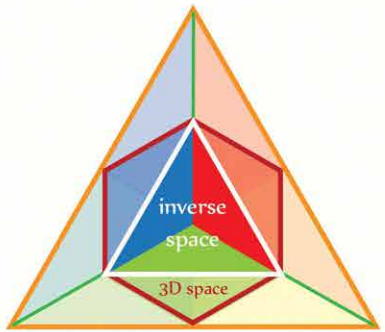

An equilateral [square] triangle divided into 12 equal semitones

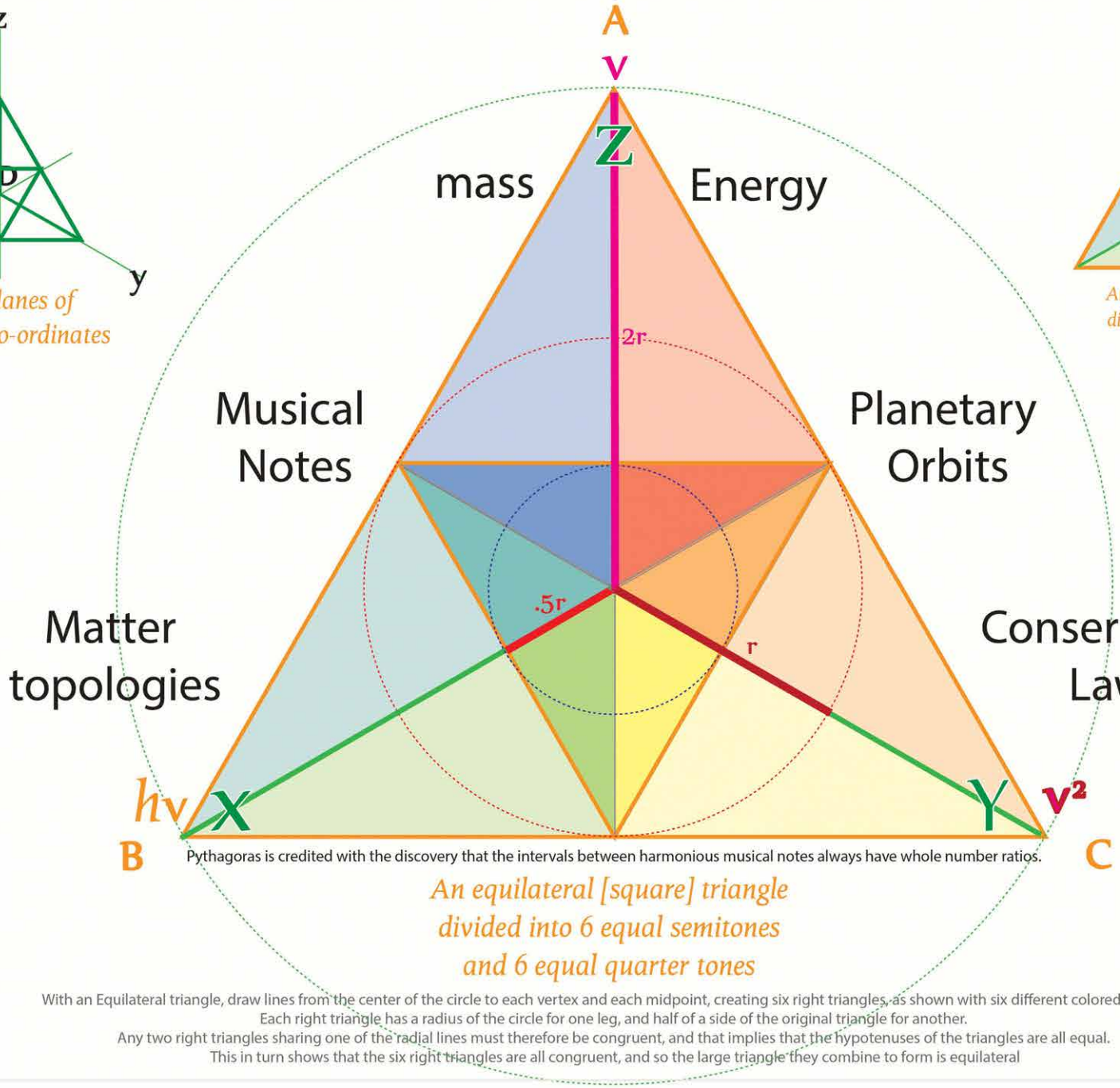

Pythagoras is credited with the discovery that the intervals between harmonious musical notes always have whole number ratios.

An equilateral [square] triangle divided into 6 equal semitones and 6 equal quarter tones

With an Equilateral triangle, draw lines from the center of the circle to each vertex and each midpoint, creating six right triangles, as shown with six different colored triangles.
Each right triangle has a radius of the circle for one leg, and half of a side of the original triangle for another.
Any two right triangles sharing one of the radial lines must therefore be congruent, and that implies that the hypotenuses of the triangles are all equal.
This in turn shows that the six right triangles are all congruent, and so the large triangle they combine to form is equilateral

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Equilateral Fifths

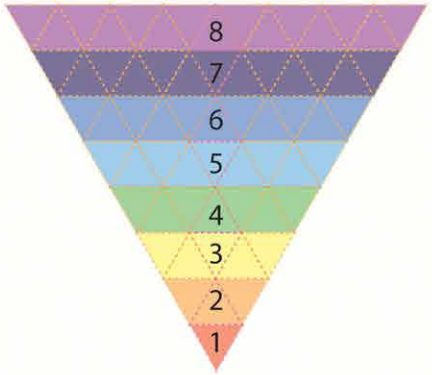

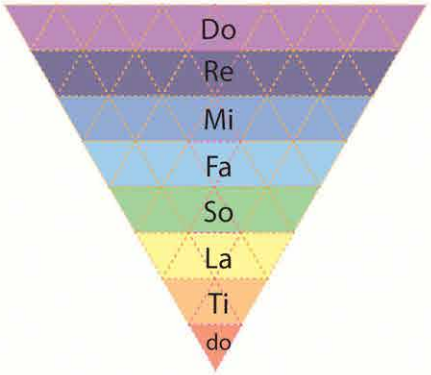

B
C
B flat
15:8
9:5
13/1
A
D flat
5:3
12
11
1
16:15
10
2
A flat
8:5
9
CDEFGABC
do re mi fa so la ti do
3
9:8
D
8
4
7
5
3:2
6
6:5
G
E flat
45:32
5:4
4:3
G flat
E
F

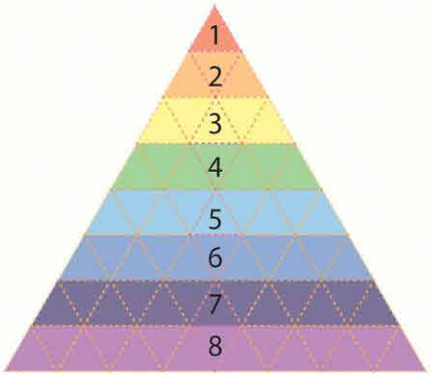

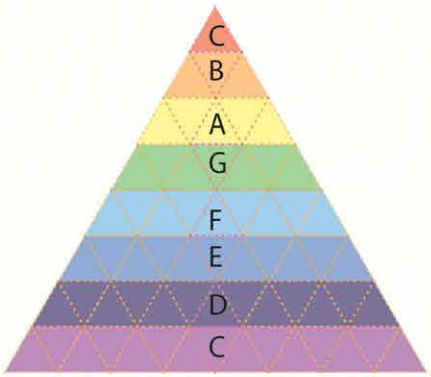

Musical Notes

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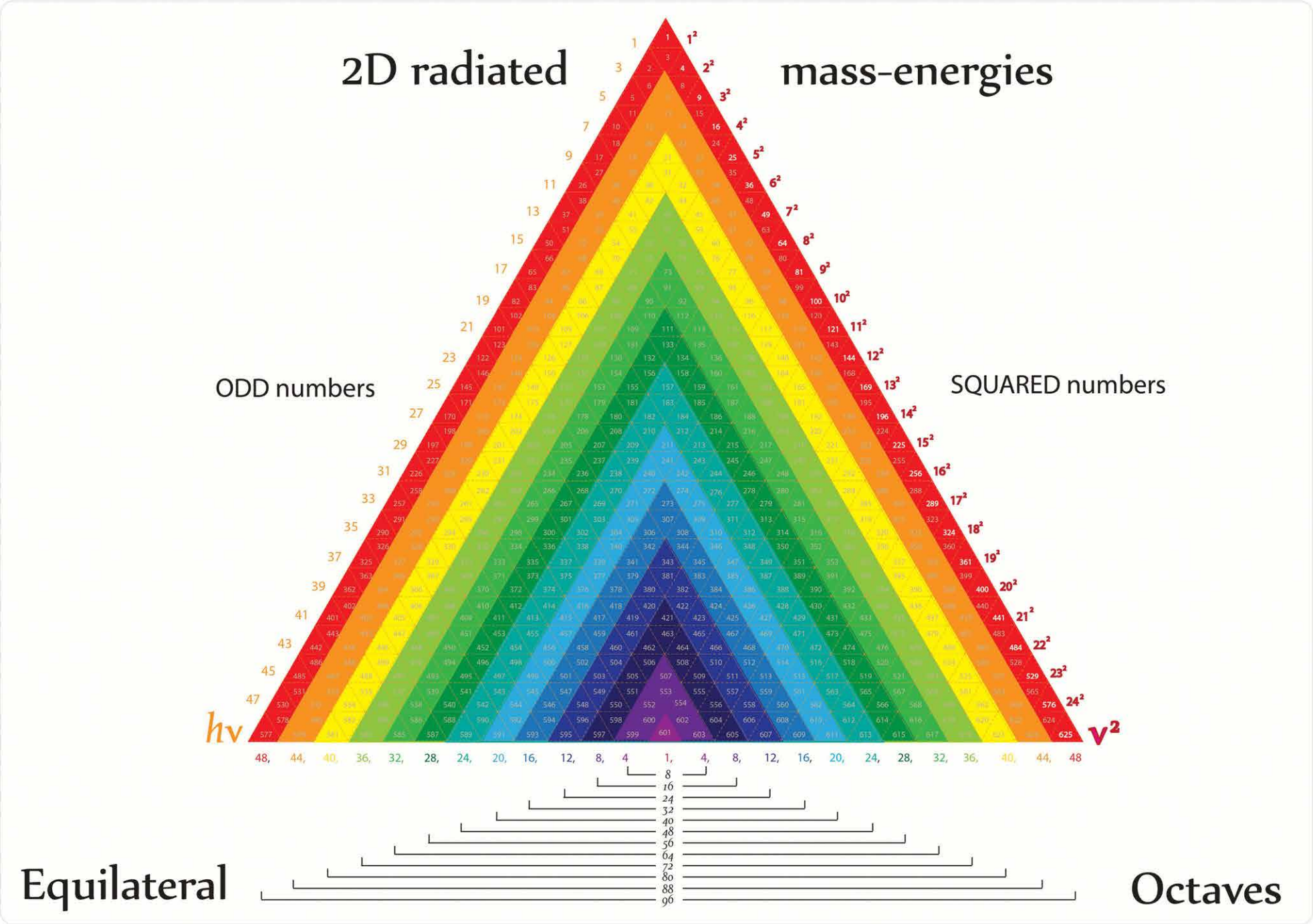

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Ternary Diagrams

Viviani's Theorem implies that lines parallel to the sides of an equilateral triangle provide (homogeneous/barycentric/areal/trilinear) coordinates for ternary diagrams for representing three quantities A,B,C whose sum is a constant (which can be normalized to unity).

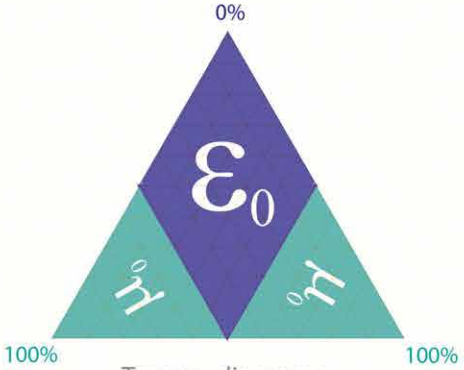

Ternary diagrams should NOT be used to model EM field strengths

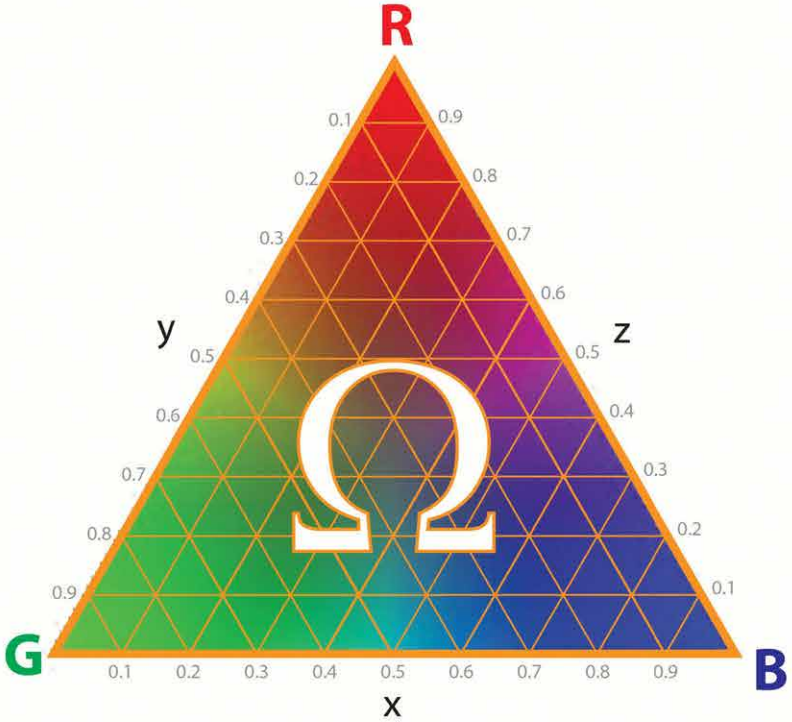

In a ternary plot, of EM energy the Electric field [E] and the Magnetic dipole [N-S] must renormalise to 1

A ternary diagram is simply a triangular coordinate system in which the 3 edges correspond to the axes.

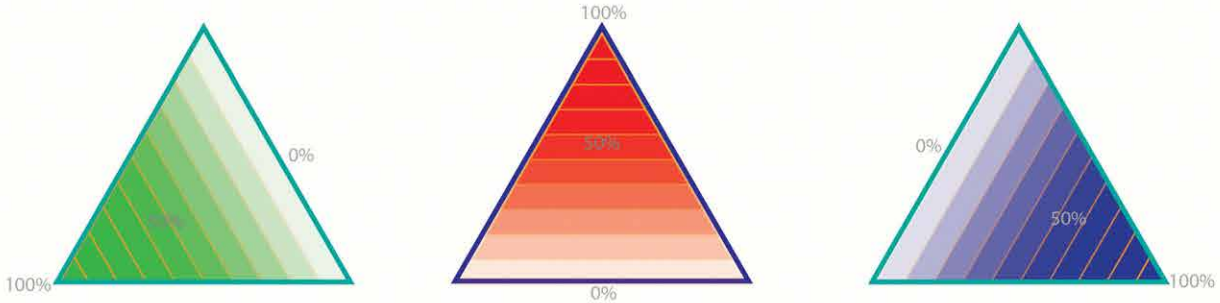

Trilinear charts are commonly used for finding the result of mixing three components (such as gases, chemical compounds, soil, color, etc.) that add to 100% of a quantity.

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Whilst the Pythagorean Theorem boasts a slightly greater economy of terms than the Eutrigon Theorem (Wayne Roberts 2003), the latter contains an important area not included in the former:

the area enclosed or swept out by the three points of the triangle in question

$$ab = a^2 + b^2 - c^2$$

the area of any eutrigon is equal to the combined areas of the equilateral triangles on legs 'a' and 'b', minus the area of the equilateral triangle on its hypotenuse 'c'.

The Pythagorean theorem

$$a^2 + b^2 = c^2$$

The square of the hypotenuse of a triangle is equal to the sum of the squares of its sides.

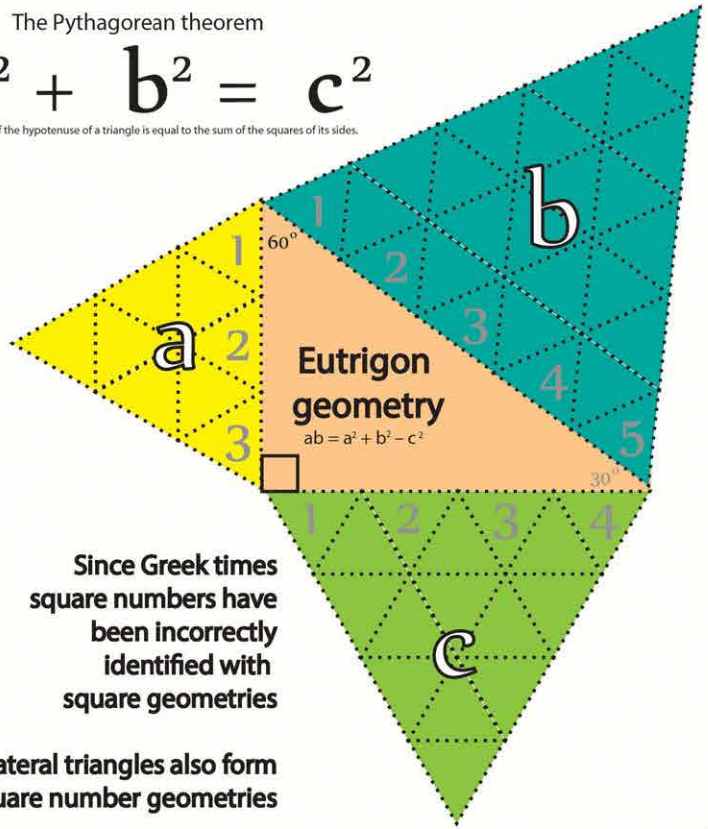

Since Greek times square numbers have been incorrectly identified with square geometries

Equilateral triangles also form square number geometries

Eutrigons

are an important new class of triangle (mathematically defined by Wayne Roberts), as the analogue of the right-triangle in orthogonal (Cartesian) coordinate geometry

Kepler's Second Law of planetary motion

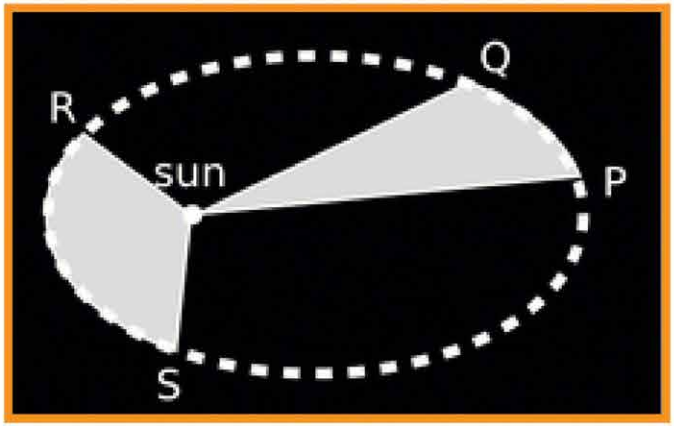

The orbit of every planet is an ellipse with the Sun at one of the two foci.

A line joining a planet and the Sun sweeps out equal areas during equal intervals of time.

The algebraic form of the Eutrigon Theorem, (like the algebraic form of Pythagoras' Theorem), is proven to be special case of the Cosine Rule...

Tetryonic theory reveals the equilateral [square] energy geometry that reveals the 'harmonics at play' in physical laws such as the second law of Kepler, and in many other phenomena in physics, chemistry, cosmology, biochemistry and number theory thus providing the foundation for the mathematics of quantum mechanics

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Number theory

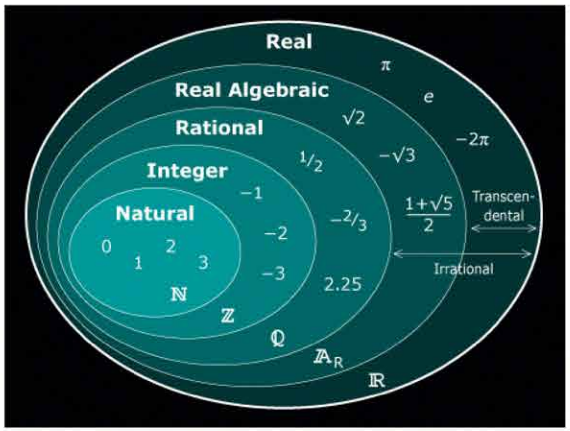

The Pythagoreans also established the foundations of number theory, with their investigations of triangular, square and also perfect numbers (numbers that are the sum of their divisors).

They discovered several new properties of square numbers, such as that the square of a number n is equal to the sum of the first n odd numbers (e.g. 1 + 3 + 5 + 7 = 16).

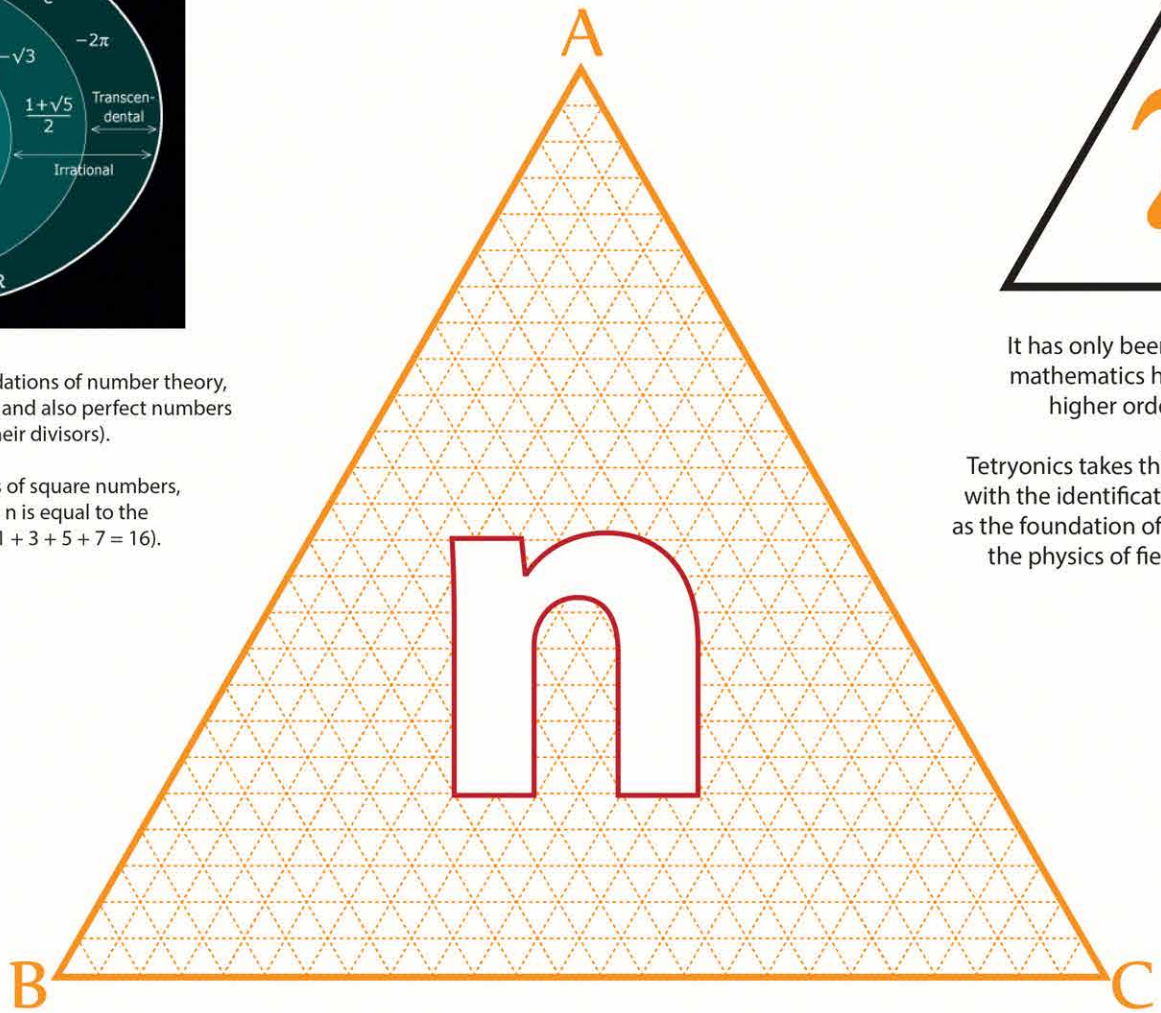

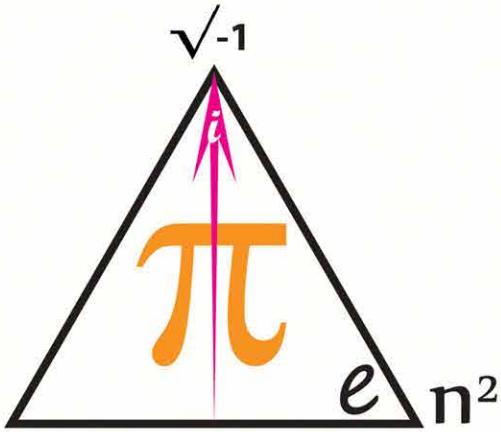

It has only been in recent centuries that mathematics has begun to explore the higher order irrational numbers

Tetryonics takes this investigation to new levels with the identification of equilateral geometries as the foundation of transcendental numbers and the physics of fields and particles in motion

What mathematics has failed to appreciate is the significance application of equilateral geometries to the 'square' numbers of physics and science in general

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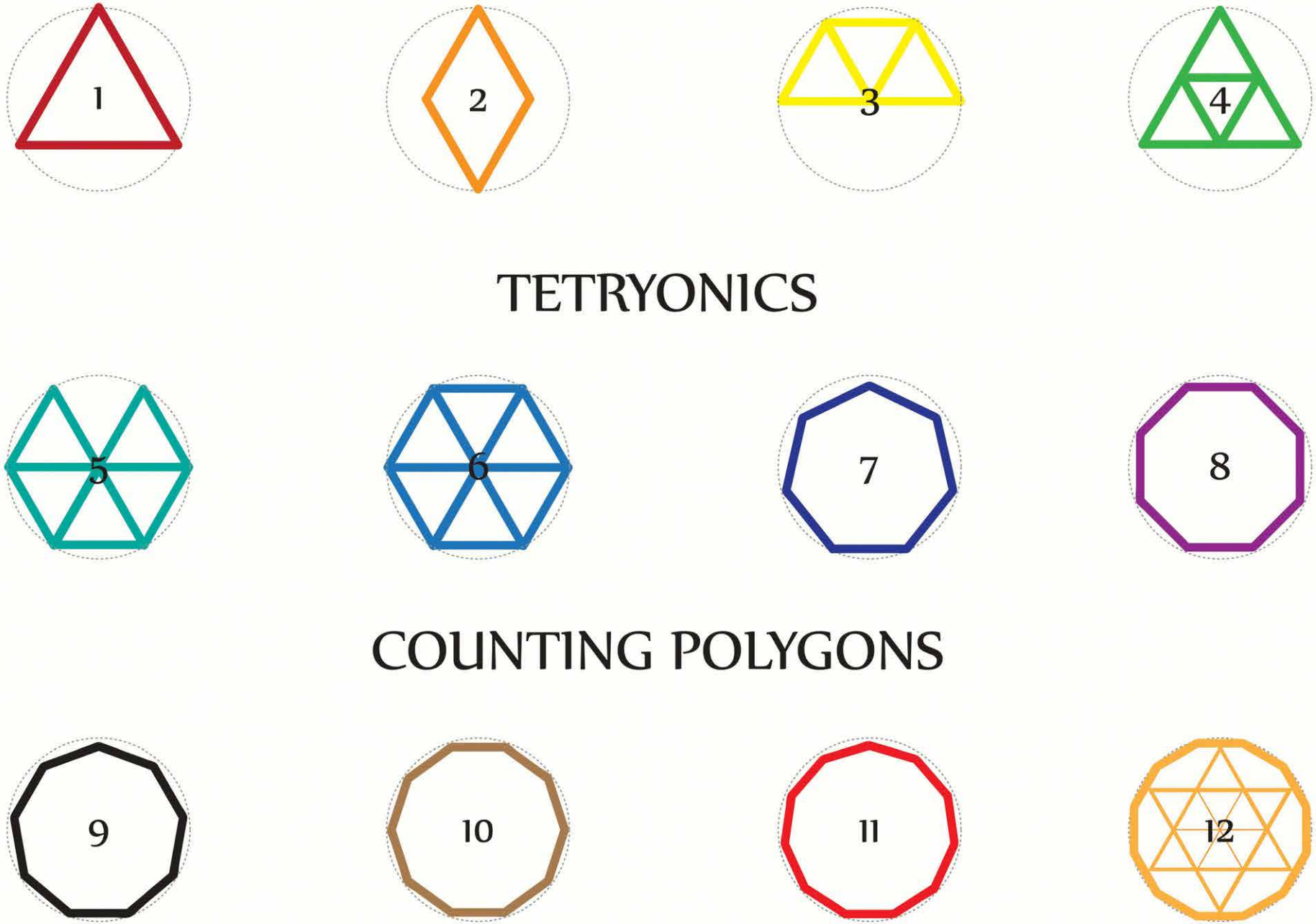

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SQUARED energies in quantum mechanics are EQUILATERAL geometries

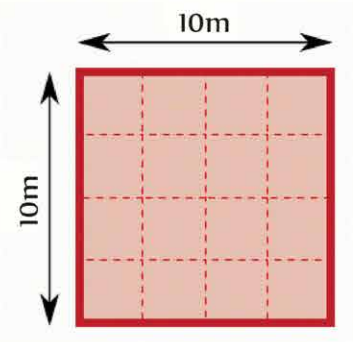

Square

area = s^2 = [100]

Circles

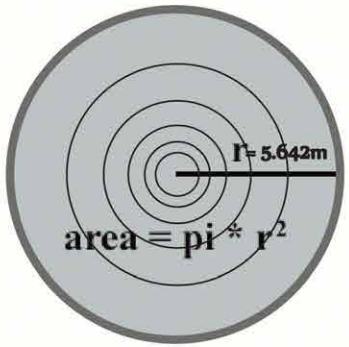

= pi *$[5.642]^2$
= 100

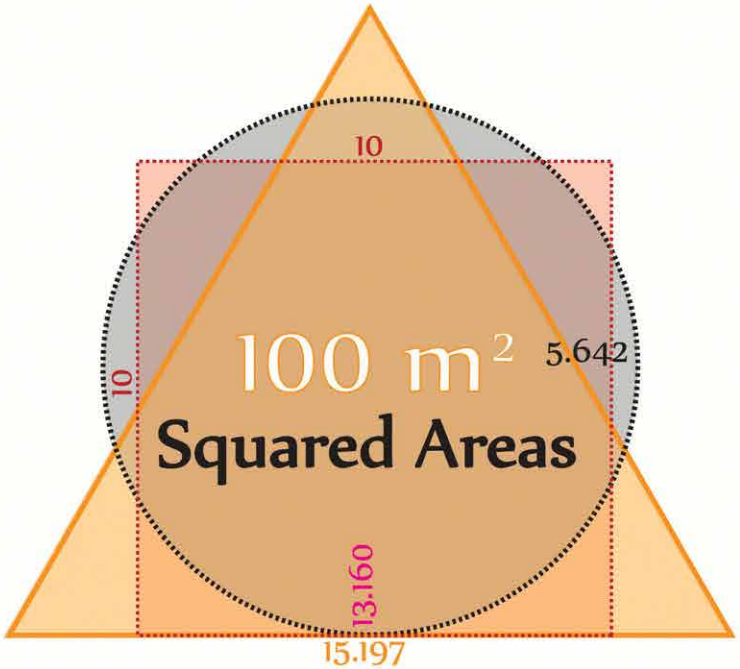

can be created by a number of planar geometries

For a long time it has been assumed by scientists (and mathematicians) that circular [and squared] geometries are the geometric foundation of all physics, leading to a serioulsy flawed model of particles and forces in quantum mechanics

Tetryonic theory now reveals that quantised equilateral angular momenta creates the foundational geometry of all the mass-Energy-Matter & forces of physics

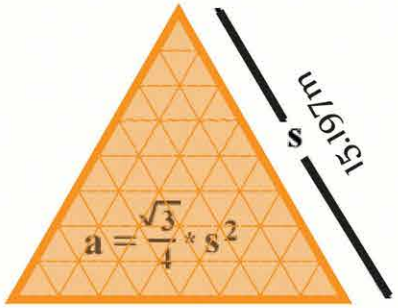

Equilateral

area = $(\frac{1}{2}*b)*h$

Triangles

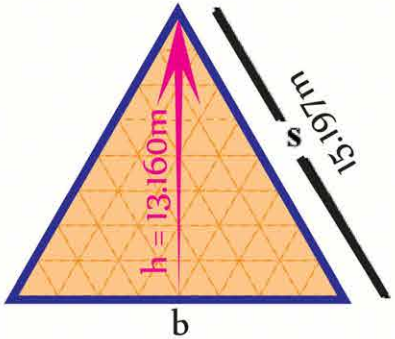

b h
[.5x15.197] x 13.160
= 100

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0.987654321

SQUARE ROOTS

80/81

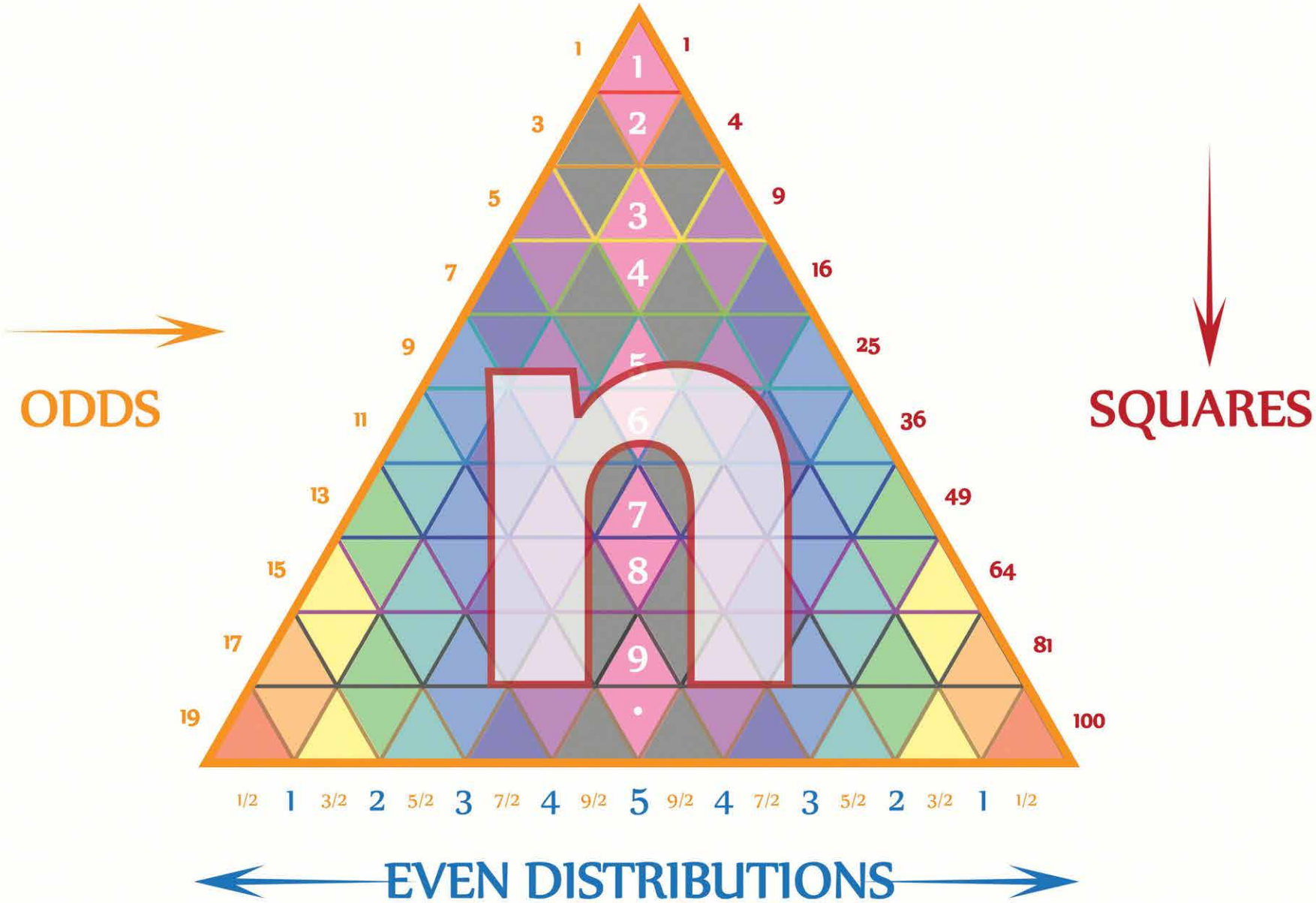

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Integers

The integers (from the Latin integer), literally "untouched", hence "whole"
in Tetryonics it is the basis for the Planck charge quantum

$$2n-1$$

$$[[n] + [n-1]]$$

Triangular numbered geometries are NOT equialteral geometries

0, 1, 3, 6, 10, 15, 21, 28, 36, 45, 55, ...

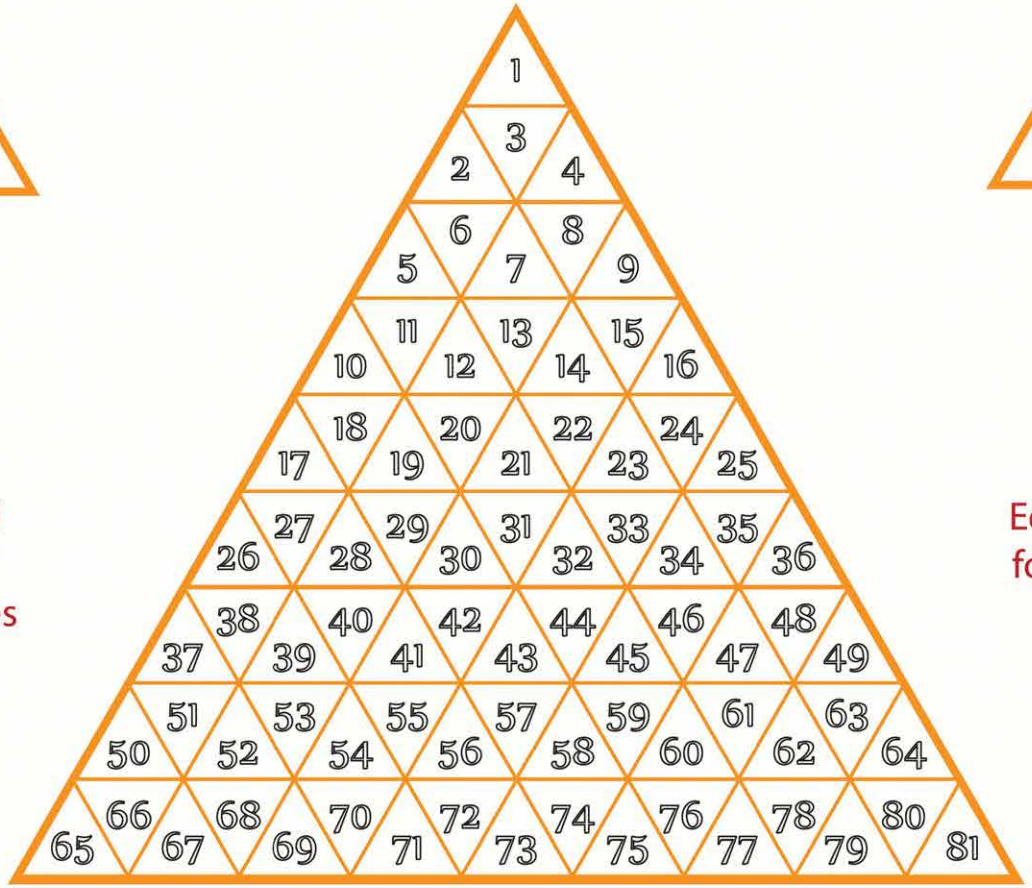

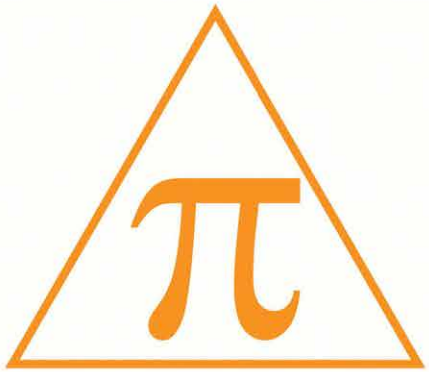

$$\sum_{1}^{n} [2n-1]$$

Equilateral geometries form **SQUARE** number geometries

1, 4, 9, 16, 25, 49, 64, 81, 100, 121, 144, ...

Equilateral energy quanta form a normal longitudinal distribution

Viewed as a subset of the real numbers, they are numbers that can be written without a fractional or decimal component

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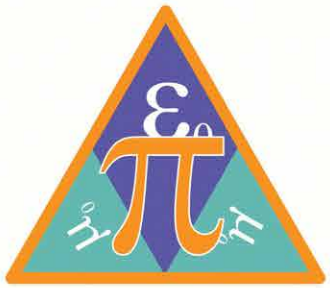

Bosons are a transverse measure of scalar energy momenta

ODD numbers

An odd number is an integer which is not a multiple of two.

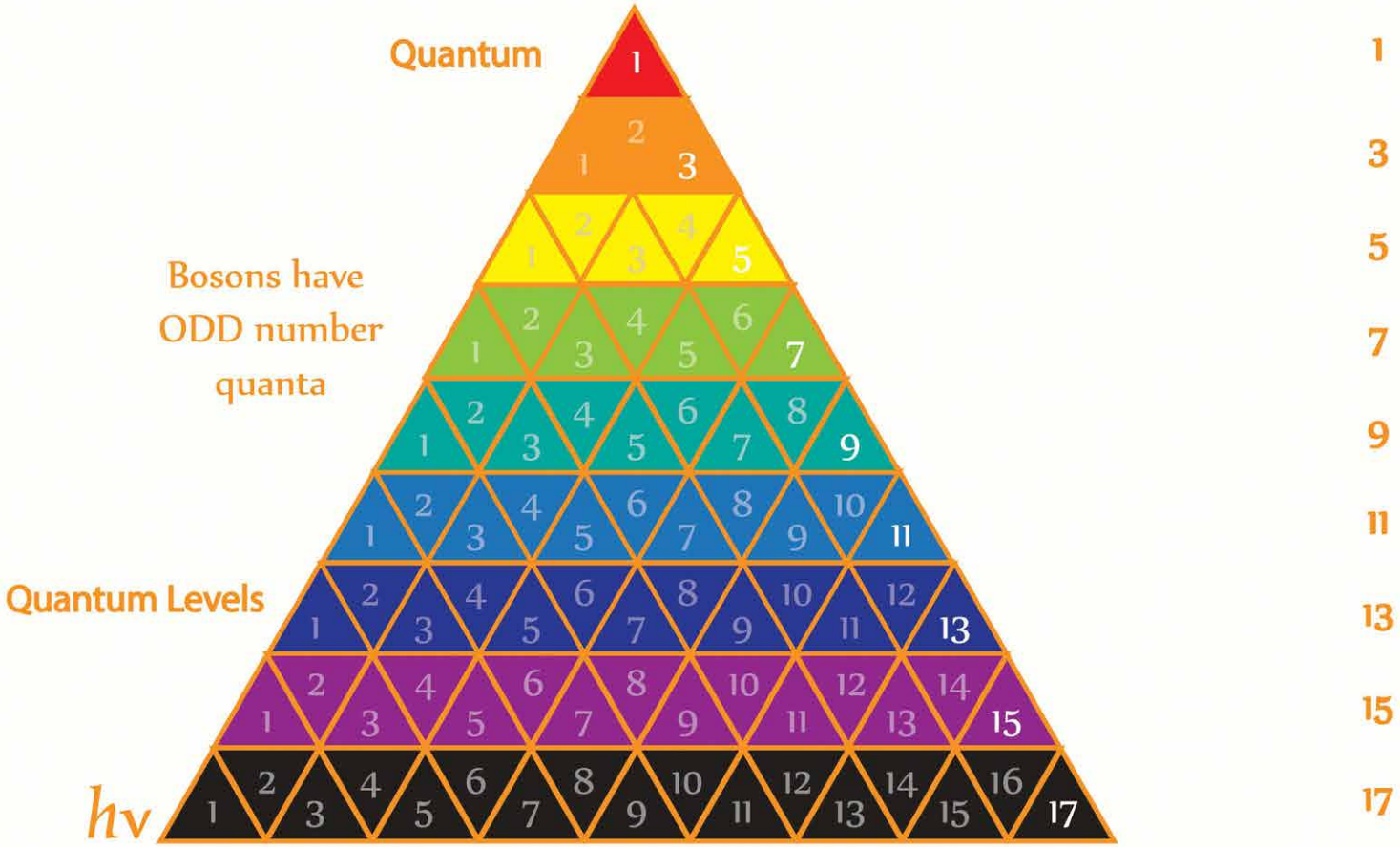

An odd number, when divided by two, will result in a fraction

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Tau radians

Around the whole outside of a circle,
there are about 6.283 radians - or, Tau radians

3.141592654

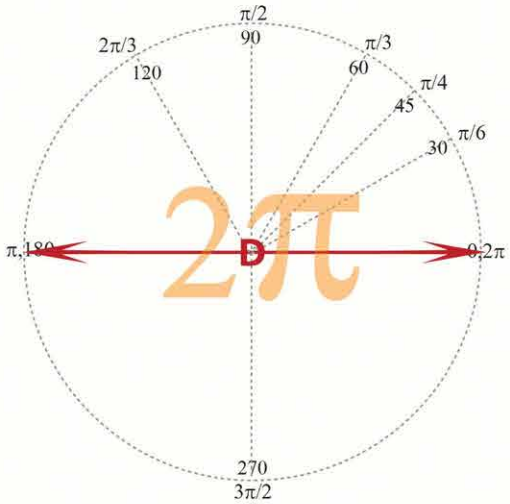

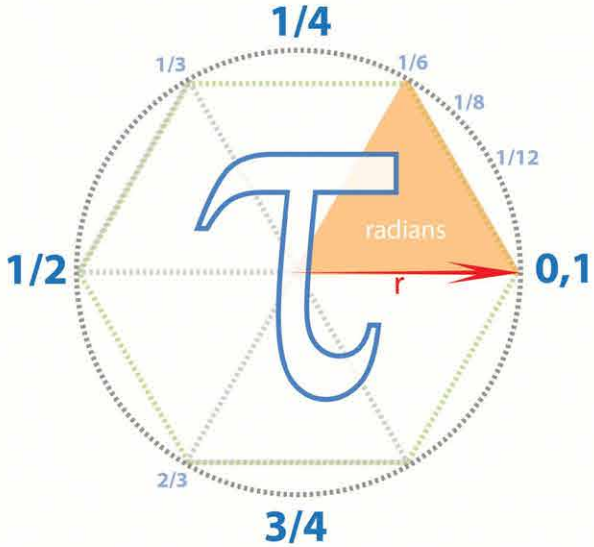

6.283185307

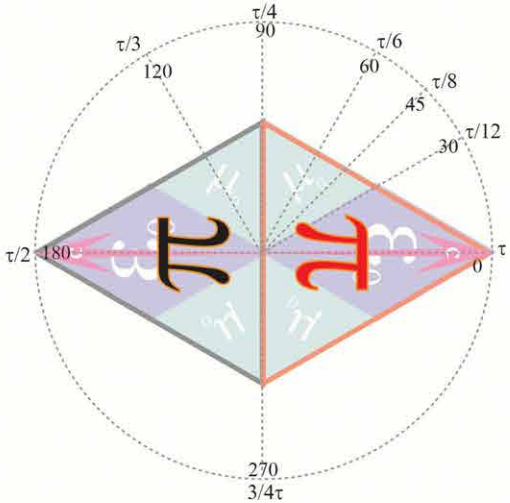

τ is a more 'natural' radian system for geometric physics than π
Tau = 2π = 360 degree rotation about a point

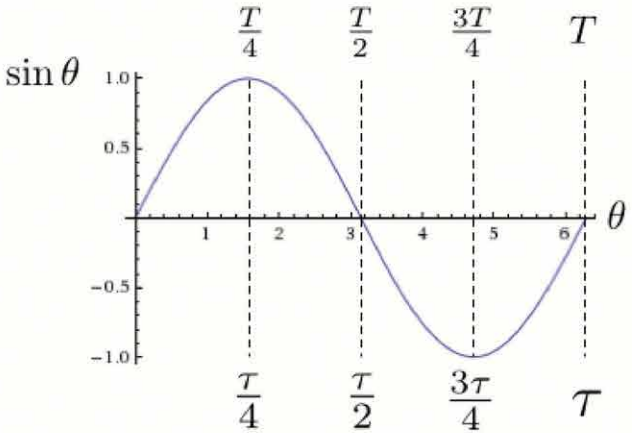

π
historically defined as the
ratio of a circle's circumference to its DIAMETER
should be redefined in physics to

τ
the ratio of its circumference to its RADIUS

in doing so many of the π/2 terms common to physics
will re automatically rationalised and will better reflect
the Tetryonic geometry of mass-ENERGY-Matter in motion

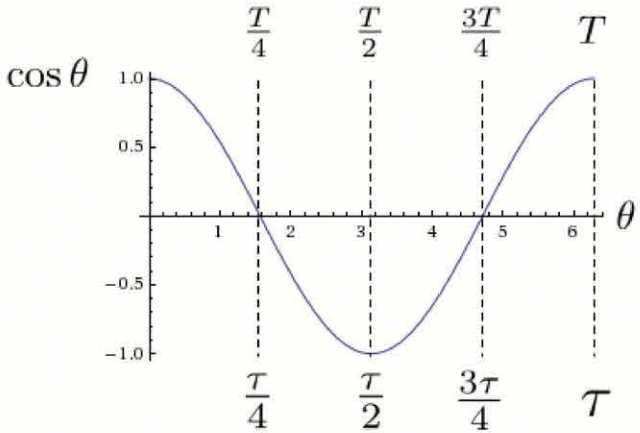

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Photons are a longitudinal measure of scalar energy momenta

Photons are EVEN number quantums

EVEN numbers

An integer that is not an odd number is an even number

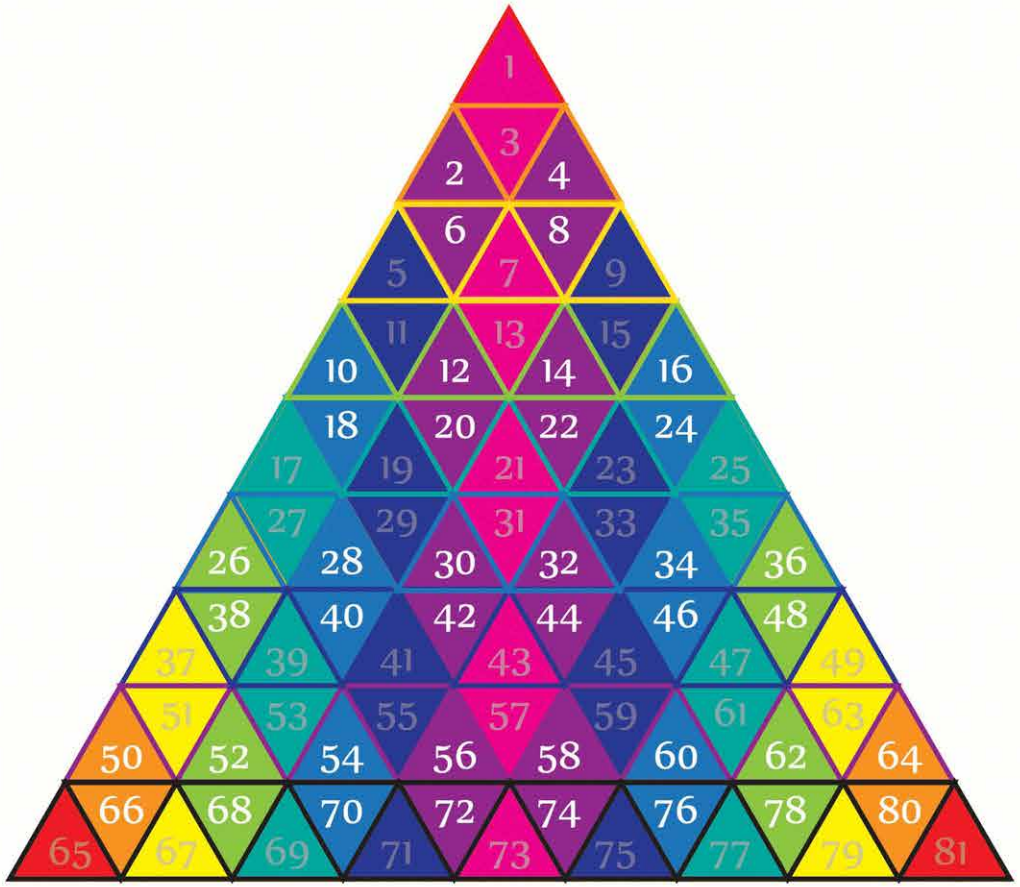

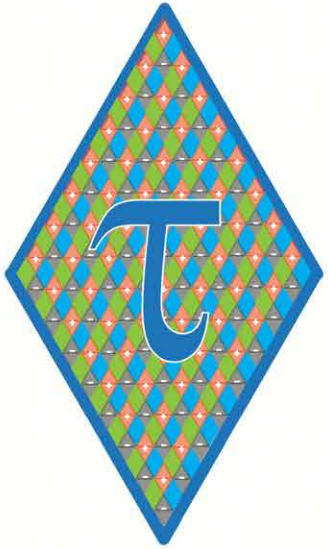

EM waves are comprised of EVEN numbered quanta

If an even number is divided by two, the result is another whole number

1/2 1 3/2 2 5/2 3 7/2 4 9/2 4 7/2 3 5/2 2 3/2 1 1/2

If an odd number is divided by two, the result is a fractional number

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Triangular numbers

Historically, a triangular number counts quanta that can pack together to form an equilateral triangle

1, 3, 6, 10, 15, 21, 28, 36, 45, 55, ...

this form of geometric counting of same charges over-complicated the simpler physical reality

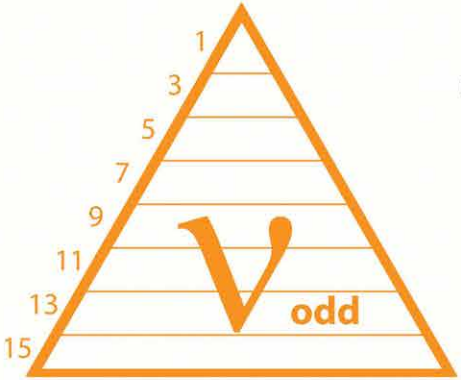

$$2\nu - 1$$

$$[[\nu] + [\nu-1]]$$

Equilateral chords or quantum levels are ODD numbers

1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21,....

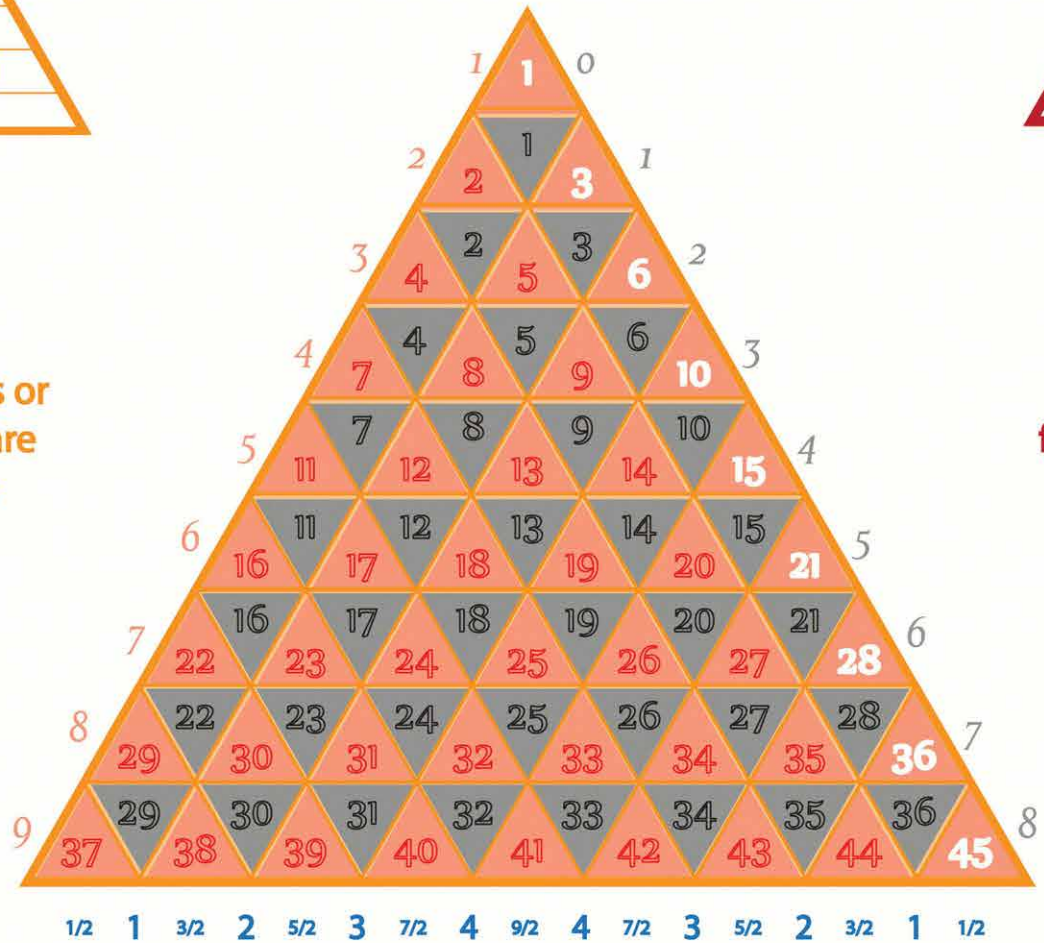

Triangular energy quanta form normal distributions

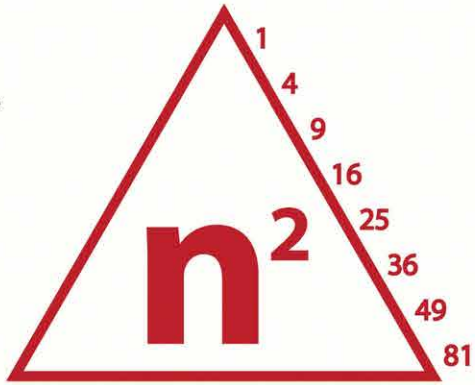

$$\sum_{1}^{n} [2n-1]$$

Equilateral geometries form SQUARE numbered geometries

1, 4, 9, 16, 25, 49, 64, 81, 100, 121, 144, ...

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Squared numbers

A square number, sometimes also called a perfect square,
is the result of an integer multiplied by itself

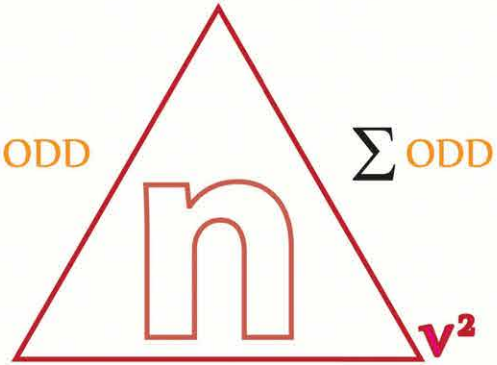

1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17

Square numbers result from the summing of consecutive ODD numbers

ODDS

2n-1

[[n] + [n-1]]

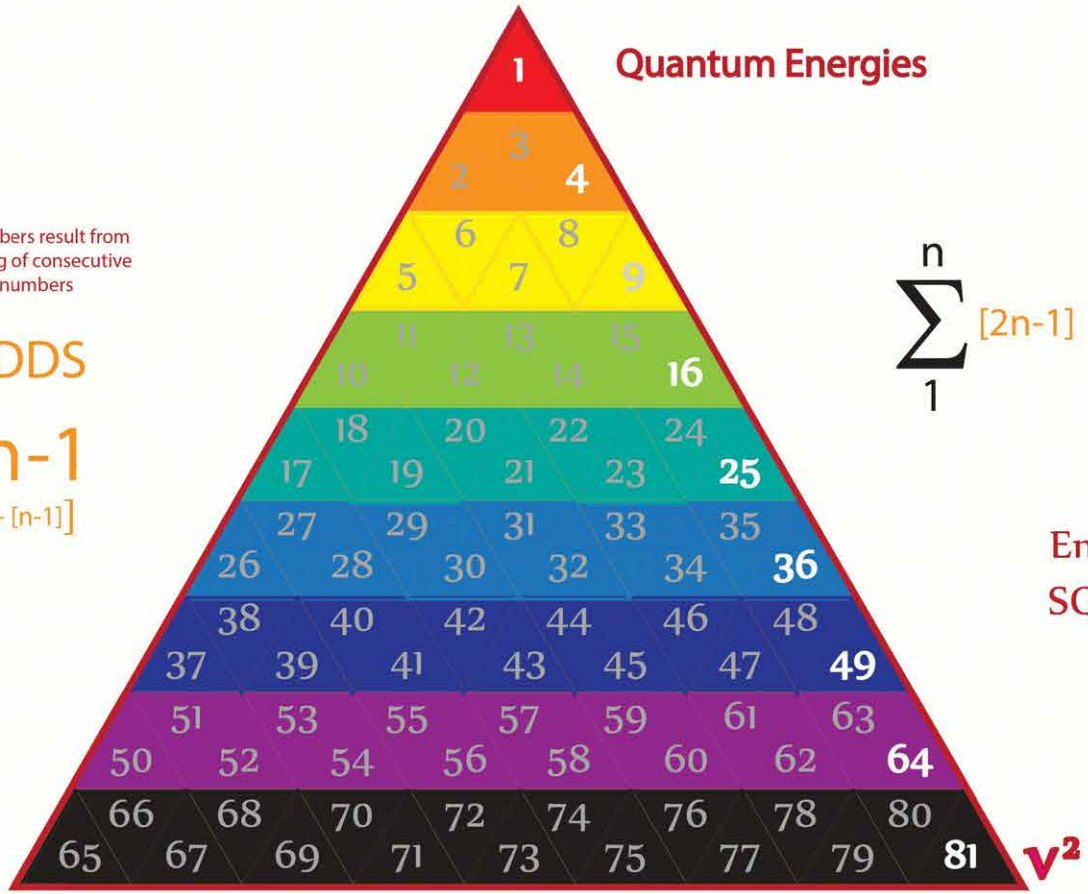

$$\sum_{1}^{n} [2n-1]$$

Energy levels have SQUARE number quanta

Compton Frequency

In Tetryonics Square numbers produce equilateral geometries

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Square roots

A square root of a number is a number that, when it is multiplied by itself (squared) , gives the first number again.

1
[1-0]

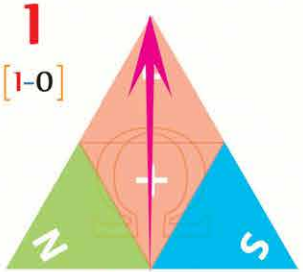

Root of positive one

$-i$ and $+i$

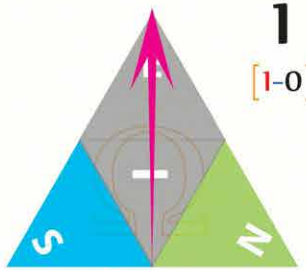

1
[1-0]

Root of negative one

Square roots of negative numbers have a basis in physical reality

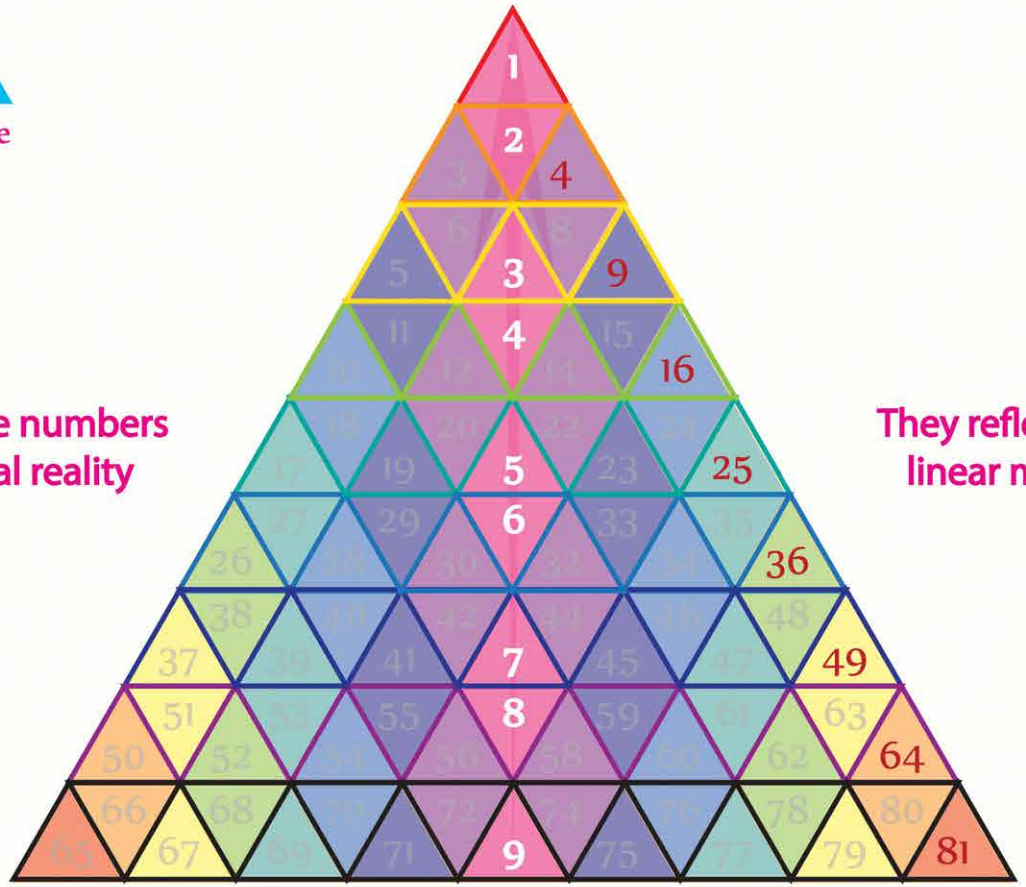

They reflect the real non-negative linear momentum of a system

A whole number with a square root that is also a whole number is called a perfect square in Tetryonic theory they are actually equilateral geometries

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Real Numbers

In mathematics, a real number is a value that represents a quantity along a continuous line. The real numbers include all the rational numbers,

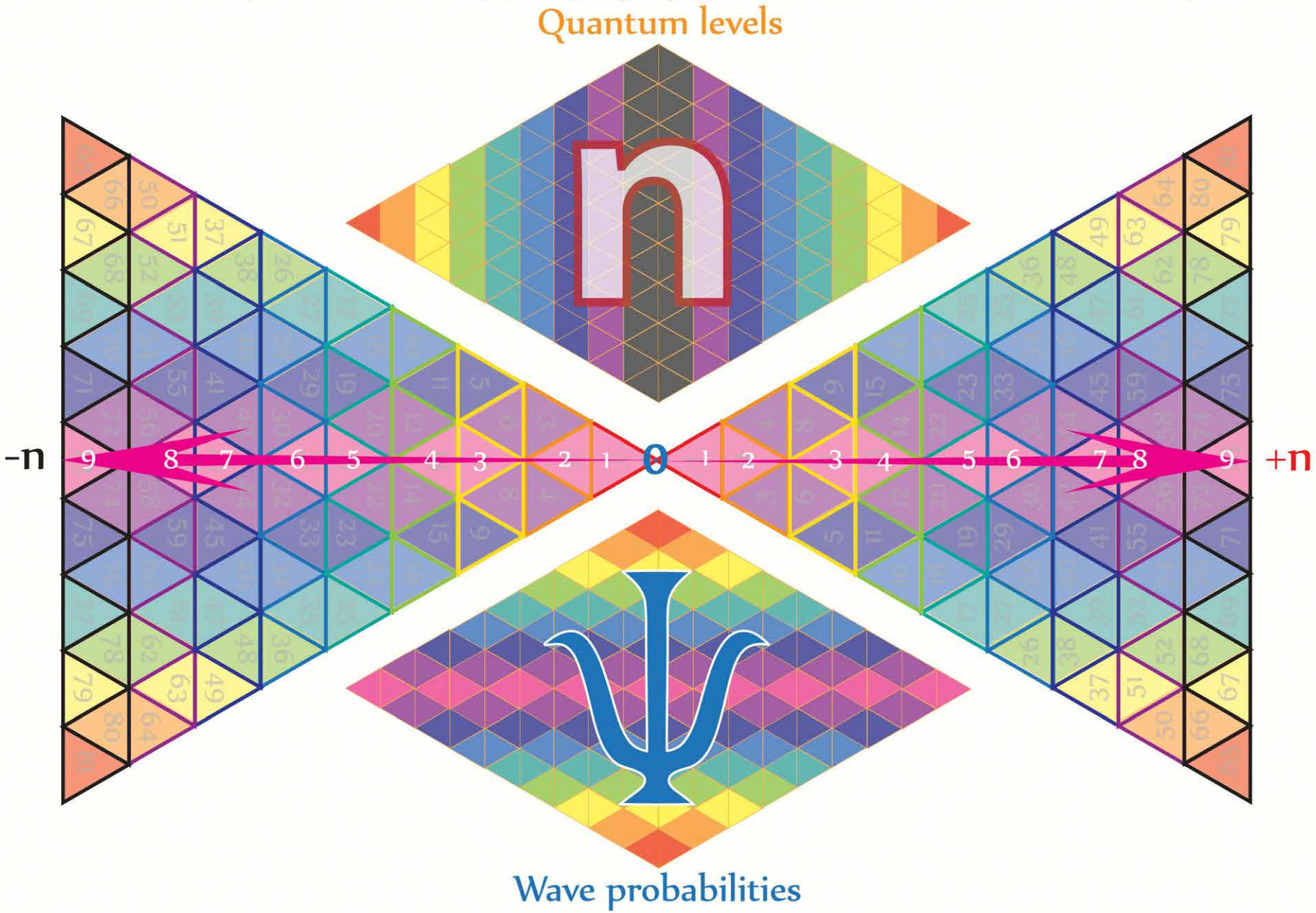

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ONE to ∞^2

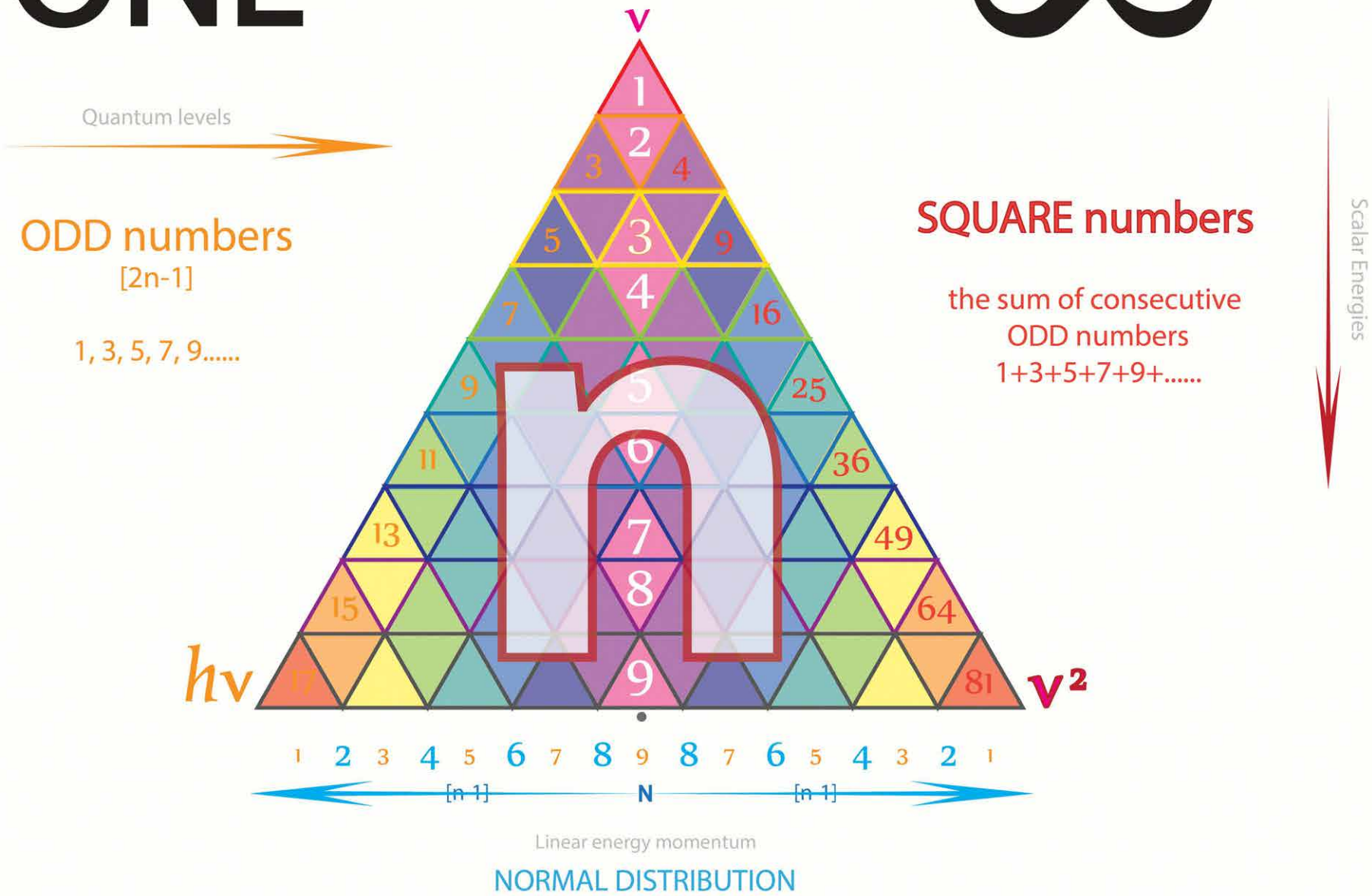

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Basic Properties of nested scribed Equilateral Triangles

Given an equilateral triangle of side s

altitude

$\sqrt{3/2}\,S$

$3S$

perimeter

$\sqrt{3/4}\,S^2$

area

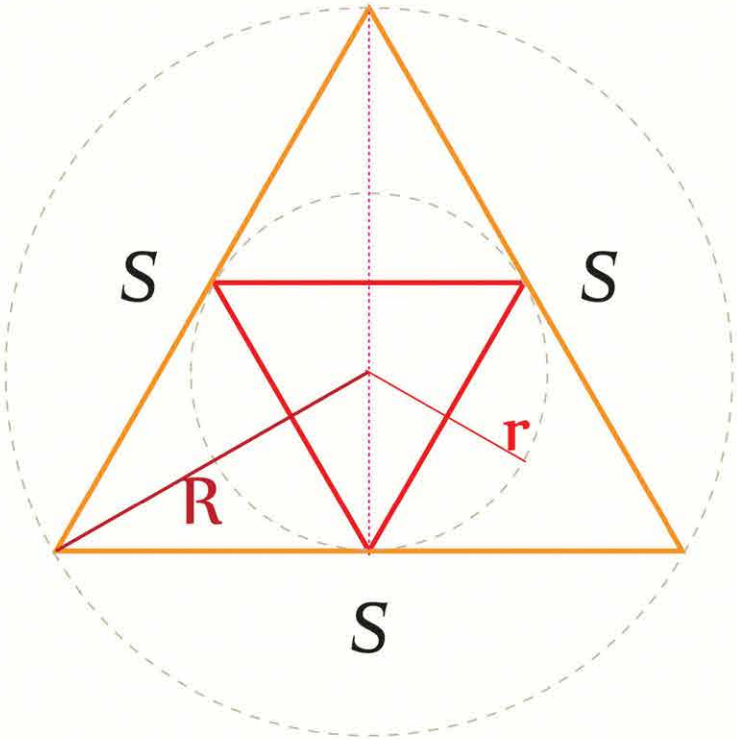

$\sqrt{3/6}\,S$

in-radius

$\sqrt{\pi/12}\,S^2$

in-circle area

circum-radius

$\sqrt{3/3}\,S$

circum-circle area

$\sqrt{\pi/3}\,S^2$

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Tetryonic [equilateral] geometry

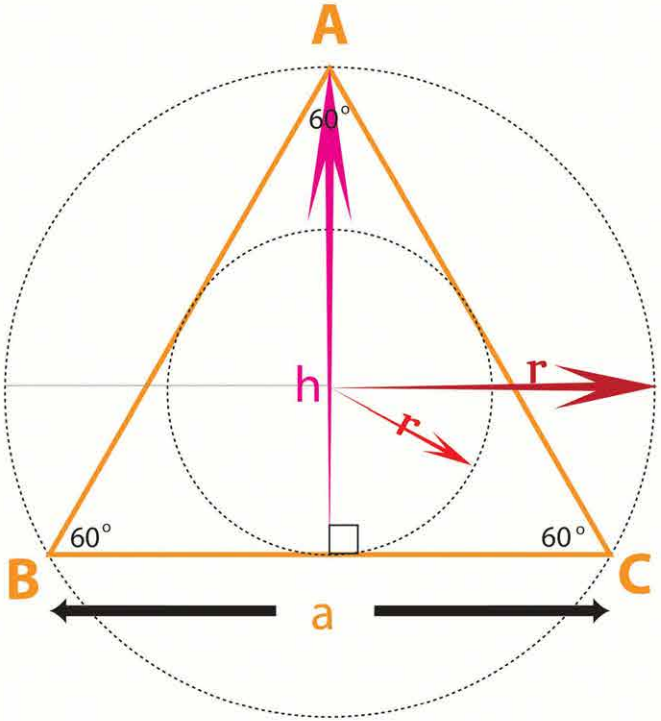

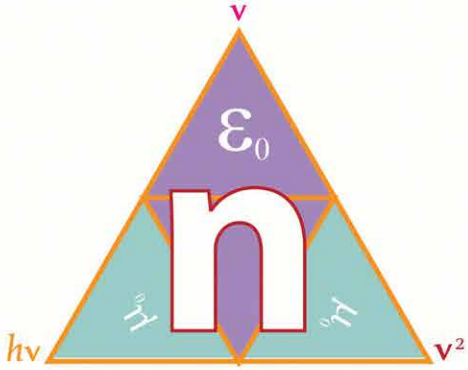

The equilateral triangle exhibits 'square symmetry'
it can always be divided into n^2 [number]
of smaller self-similar parts

All triangles are flat euclidean π radian geometries [180°]

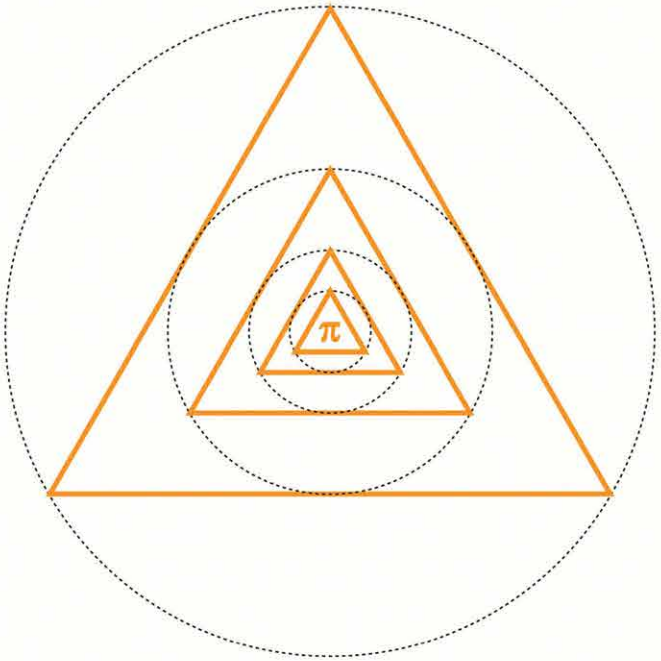

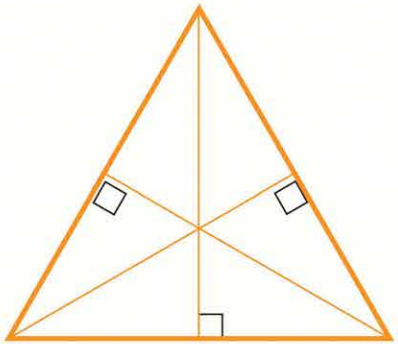

An equilateral triangle is the most symmetrical triangle,
having 3 lines of reflection and rotational symmetry of order 3 about its center

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CHARGE

Scribed equilateral geometries

reflect space-time's geometric relationship with charged mass-energy

Energy

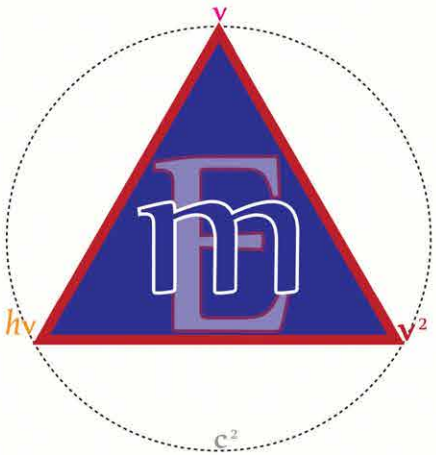

QAM

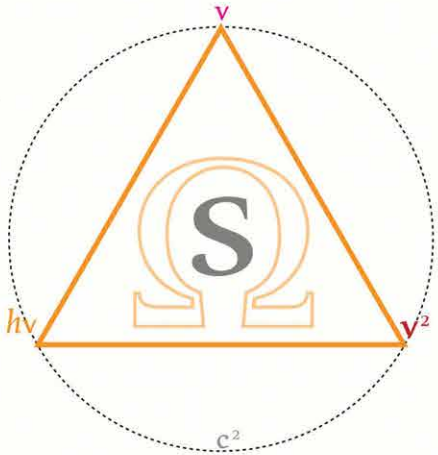

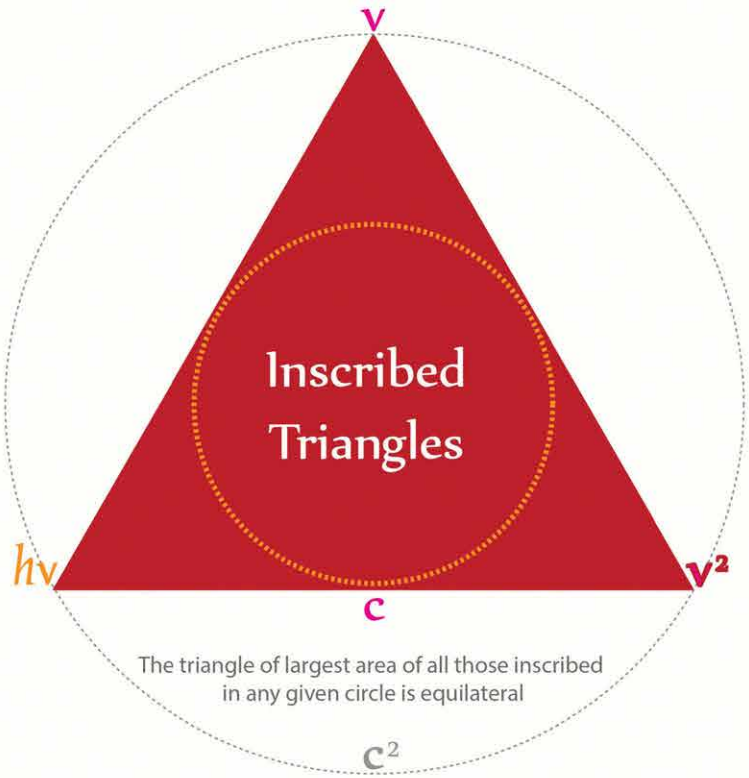

Energy per spatial unit

mass

QAM per spatial unit

seconds

$$m = \frac{E}{c^2}$$

$$\frac{\Omega}{c^2} = s$$

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Circumscribed Triangles

reflect Energy's relationship with Time

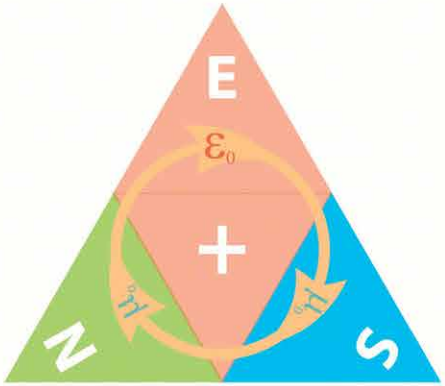

Positive Planck Charge

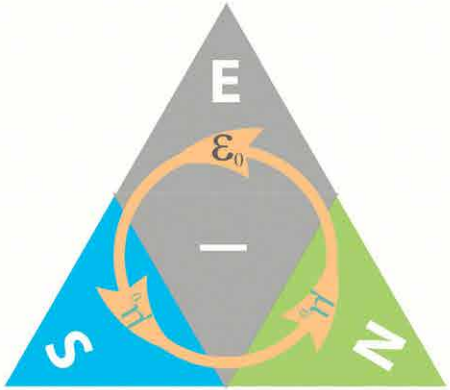

Negative Planck Charge

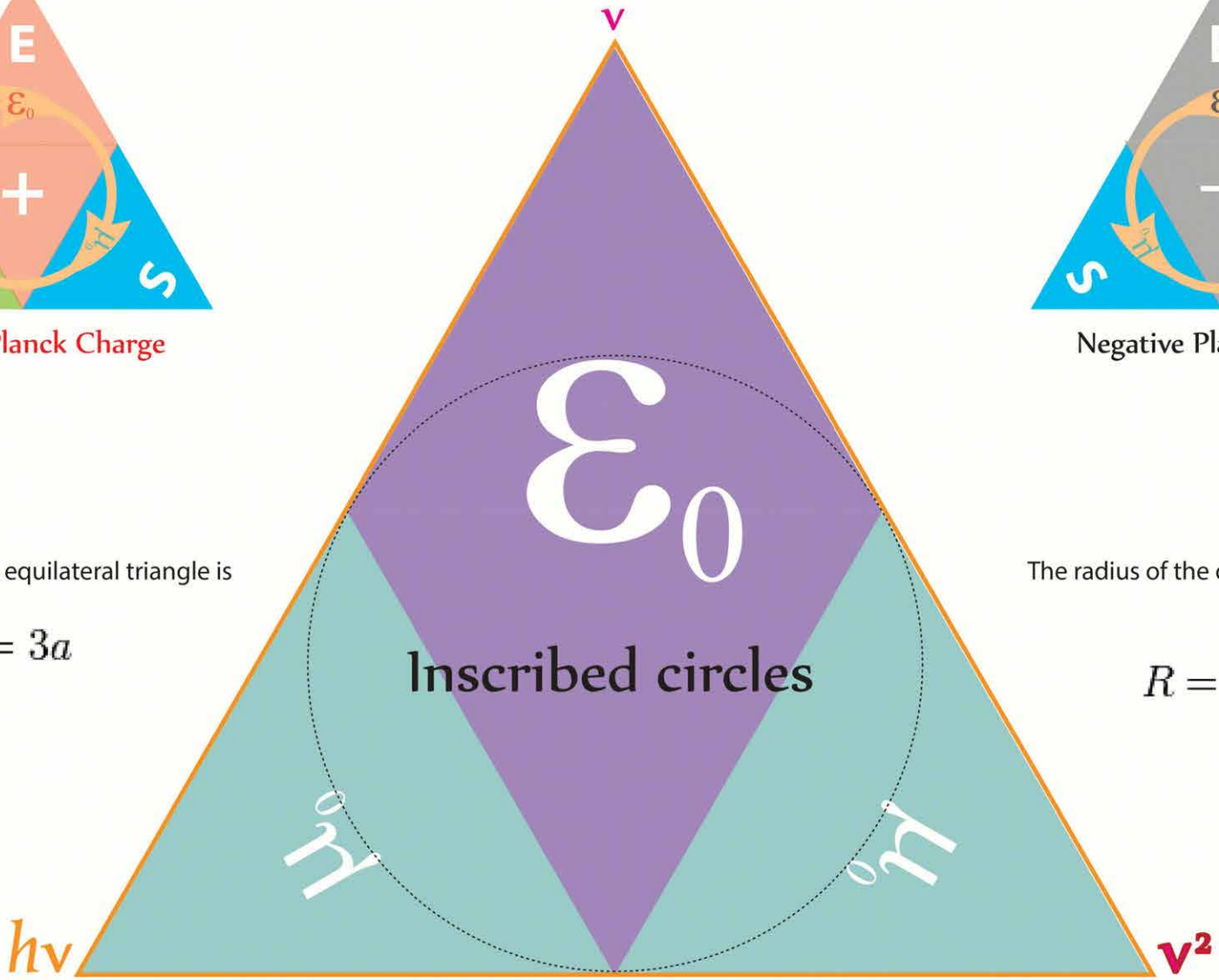

The perimiter of an equilateral triangle is

$$p = 3a$$

The radius of the circumscribed circle is

$$R = \frac{\sqrt{3}}{3}a$$

The equilateral triangle has the smallest area of all those circumscribed around a given circle

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Circumscribed circles

By Euler's inequality, the equilateral triangle has the smallest ratio R/r of the circumradius to the inradius of any triangle: specifically, R/r = 2

The ratio of the area to the square of the perimeter of an equilateral triangle

$$\frac{1}{12\sqrt{3}}$$

The ratio of the area of the incircle to the area of an equilateral triangle

$$\frac{\pi}{3\sqrt{3}}$$

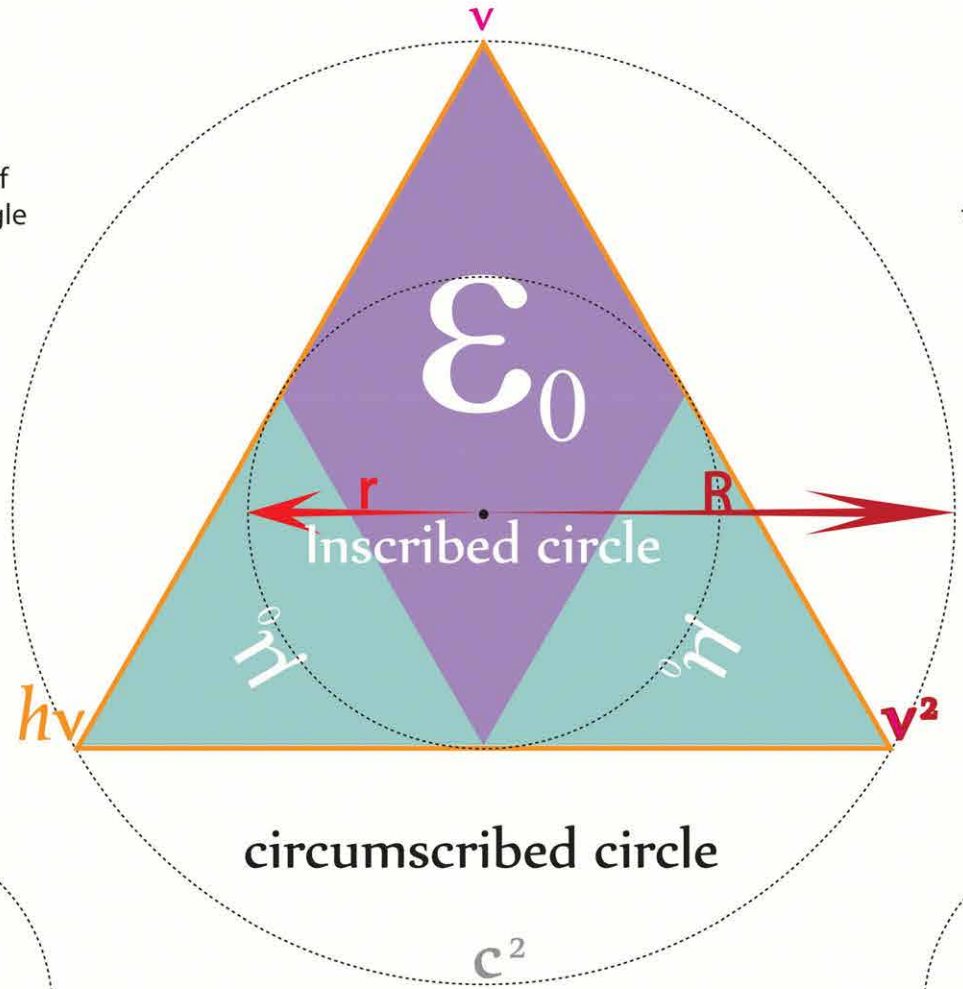

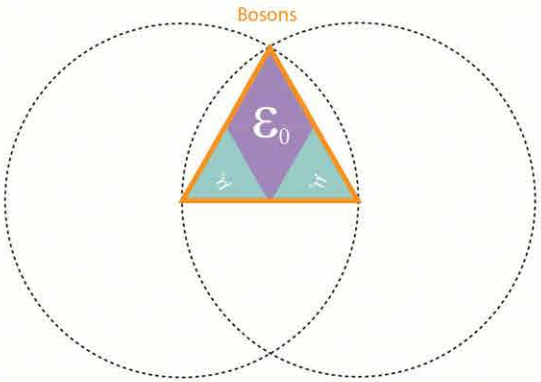

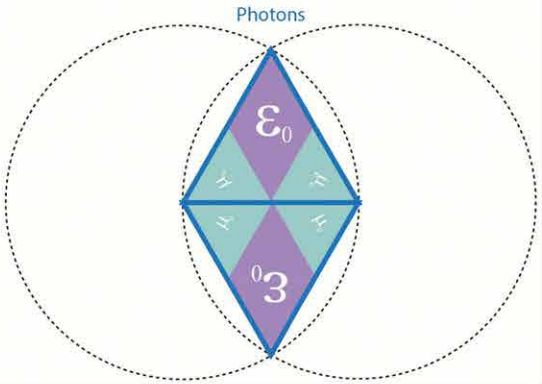

Equilateral triangles and Tetrahedrons will scale at exactly the same proportion as Circles and Spheres scribing them

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Charged mass-ENERGIES

Charge is the result of quantised angular momenta
[the inscribed circular flux of energy in equilateral geometries]

Time is a measure of changing quantised angular momenta
[the circumscribed spatial co-ordinate of equilateral energy geometries]

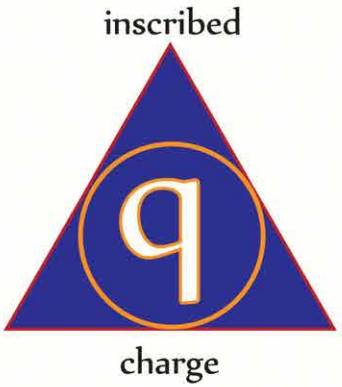

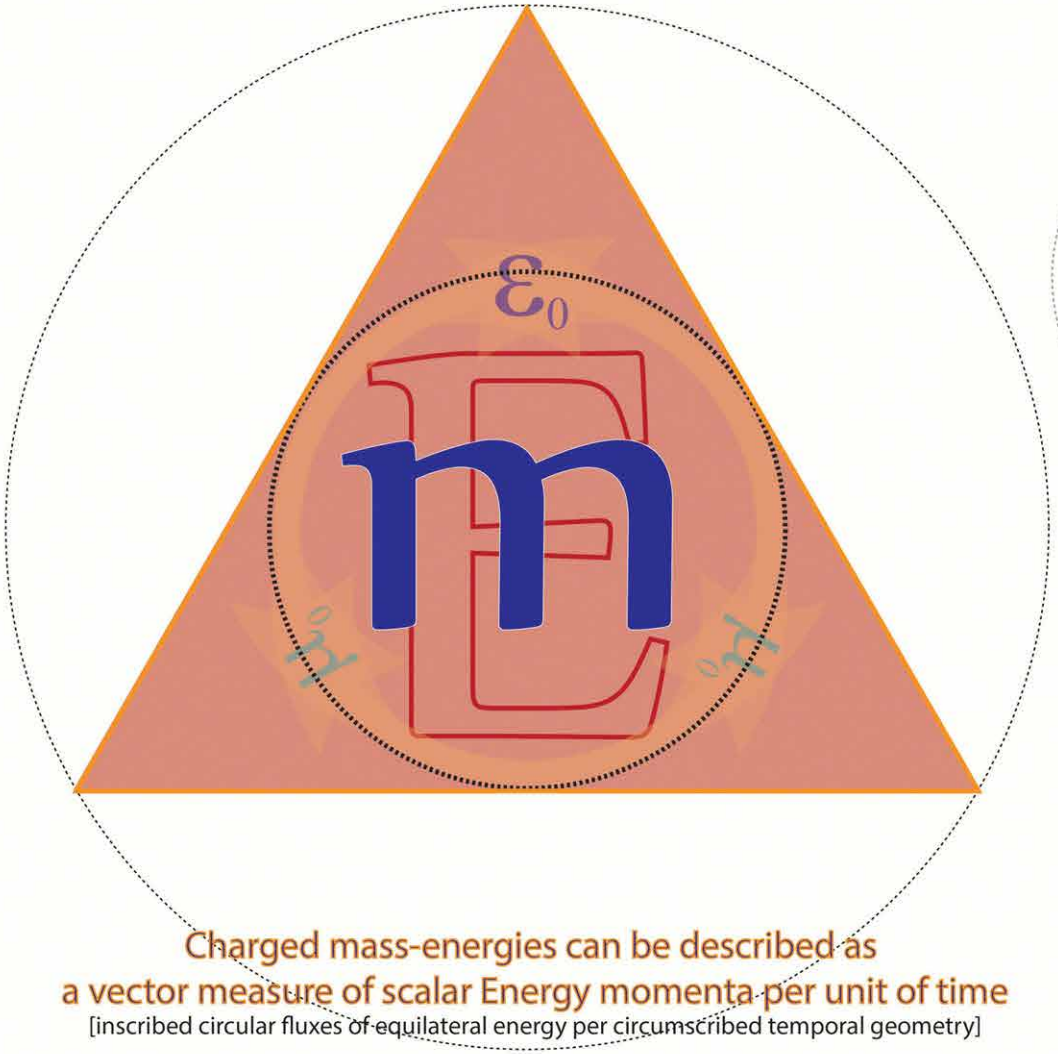

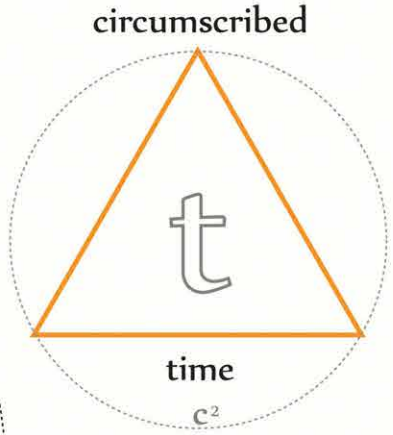

It is the equilateral geometry of energy not a classical vector rotation that creates QAM

Scalar EM mass is a measure of equilateral Planck energy per spatial co-ordinate system

m

Charged mass-energies can be described as a vector measure of scalar Energy momenta per unit of time
[inscribed circular fluxes of equilateral energy per circumscribed temporal geometry]

E

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Trigometric functions

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

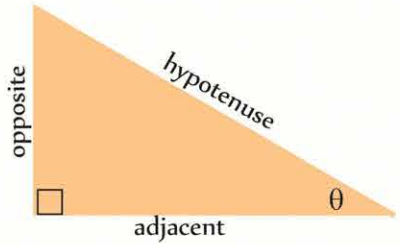

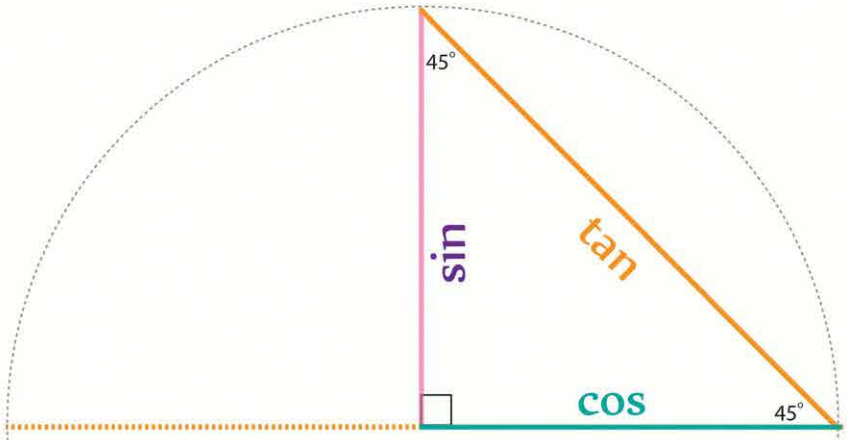

The most familiar trigonometric functions are the sine, cosine, and tangent.

In the context of the standard unit circle with radius 1,
where a triangle is formed by a ray originating at the origin and
making some angle with the x-axis,

the SINE of the angle gives the length of the y-component (rise) of the triangle,
the COSINE gives the length of the x-component (run), and
the TANGENT function gives the slope
(y-component divided by the x-component)

Standard trigometric functions must be carefully applied to
measurements of equilateral Planck mass-energy geometries
in scribed circular space-time co-ordinate systems

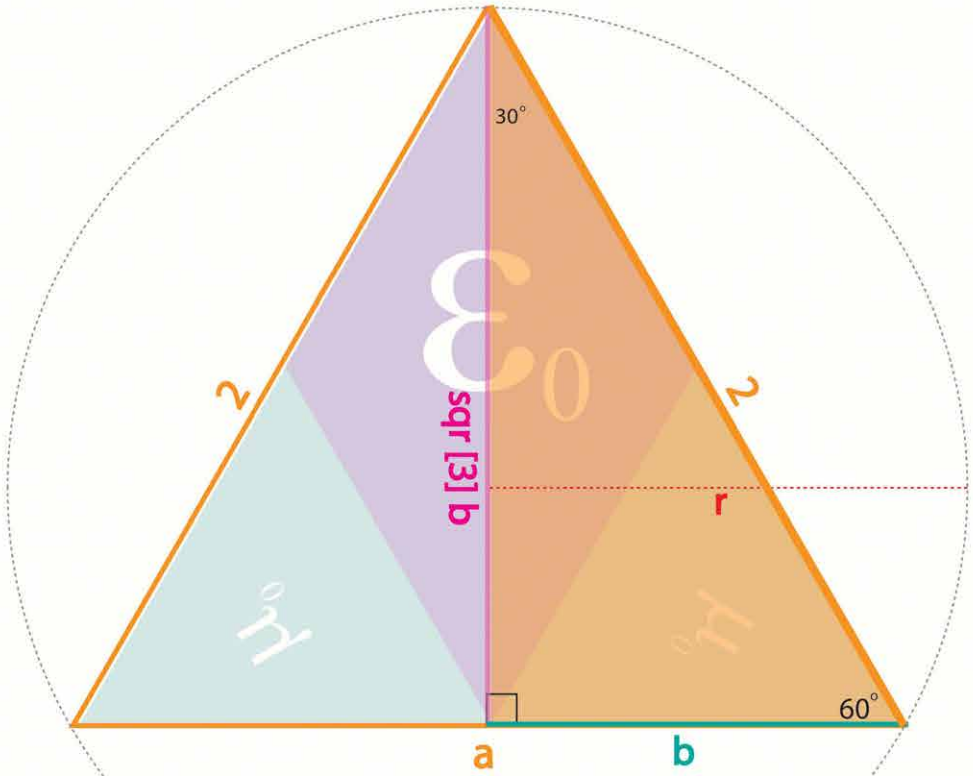

In most cases it is in fact easier to
ignore the trigonomteric functions and math
and simpy draw their related equilateral geometries

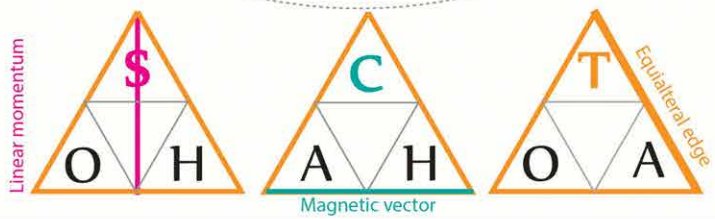

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The roots of scribed equilateral triangles

Scalar equilateral energies map directly onto circular space-time co-ordinates
through their square root linear momentum

r

The ratio of the
circumscribed circle of
an equilateral triangle
to its inscribed circle
is 2:1

d

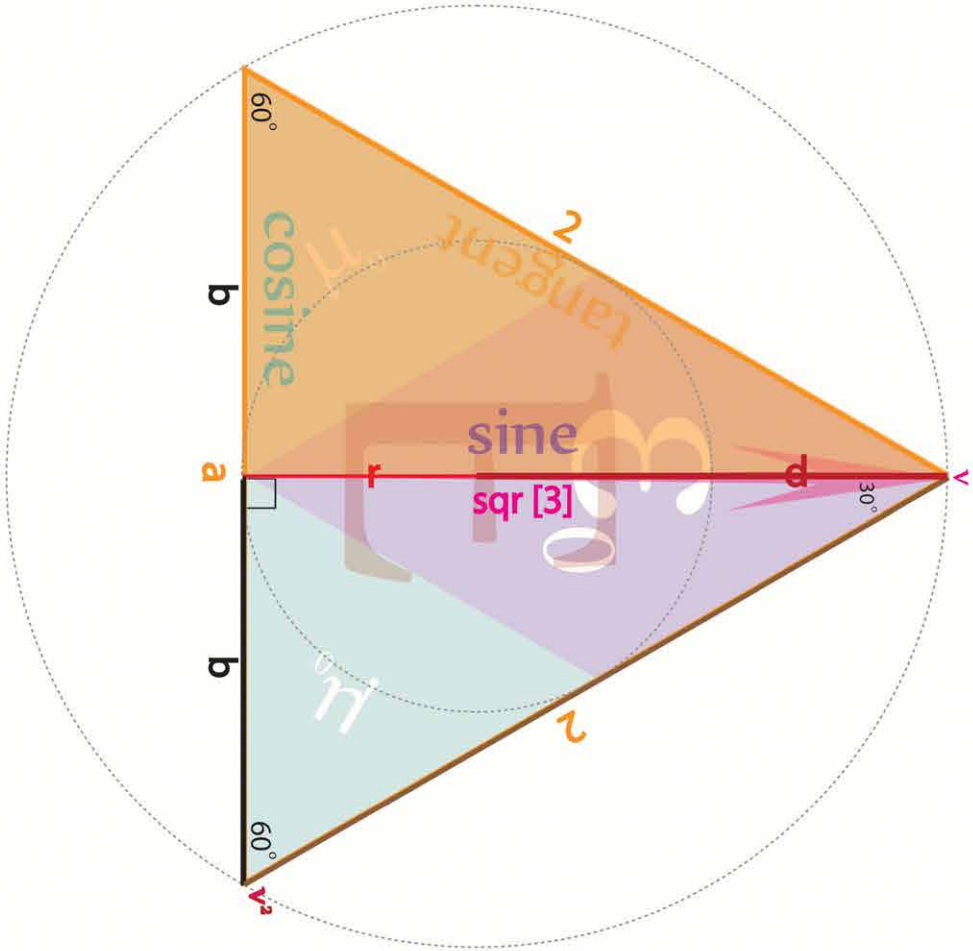

0.866 r

The ratio of the
side of an equilateral triangle
to the radius of
its incribed circle
is sqr [3]/2

a

The ratio of the
side of an equilateral triangle
to the radius of
its circumscribed circle
is sqr [3]

1.732 d

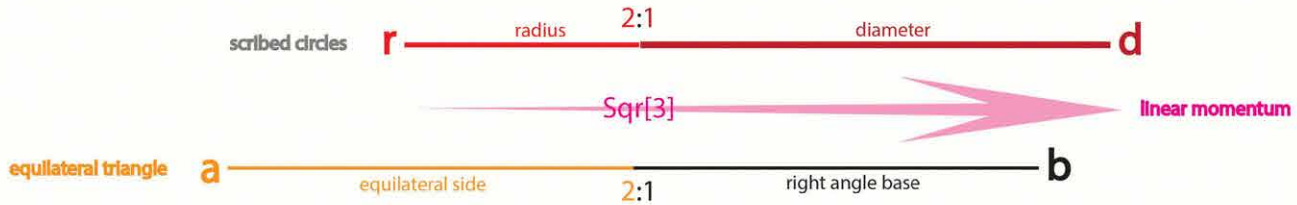

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Equilateral triangles and scribed circles

$$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}} = \frac{1}{\sqrt{1-\beta^2}} = \frac{\mathrm{d}t}{\mathrm{d}\tau}$$

$$\gamma(\beta) = 1 + \frac{1}{2}\beta^2 + \frac{3}{8}\beta^4 + \frac{5}{16}\beta^6 + \frac{35}{128}\beta^8 + \ldots$$

$$L = L'\sqrt{1 - \frac{v^2}{c^2}}$$

$$E_k = \frac{mc^2}{\sqrt{1-(v/c)^2}} - mc^2$$

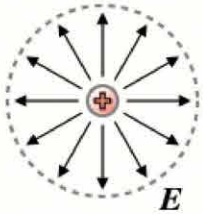

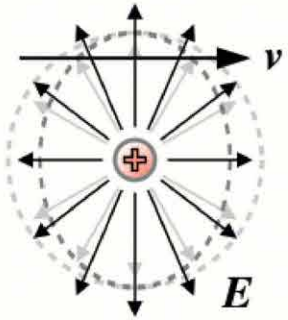

$$mc^2\left\{\frac{1}{\sqrt{1 - v^2/c^2}} - 1\right\}$$

$$p = \frac{m_0 v}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma m_0 v$$

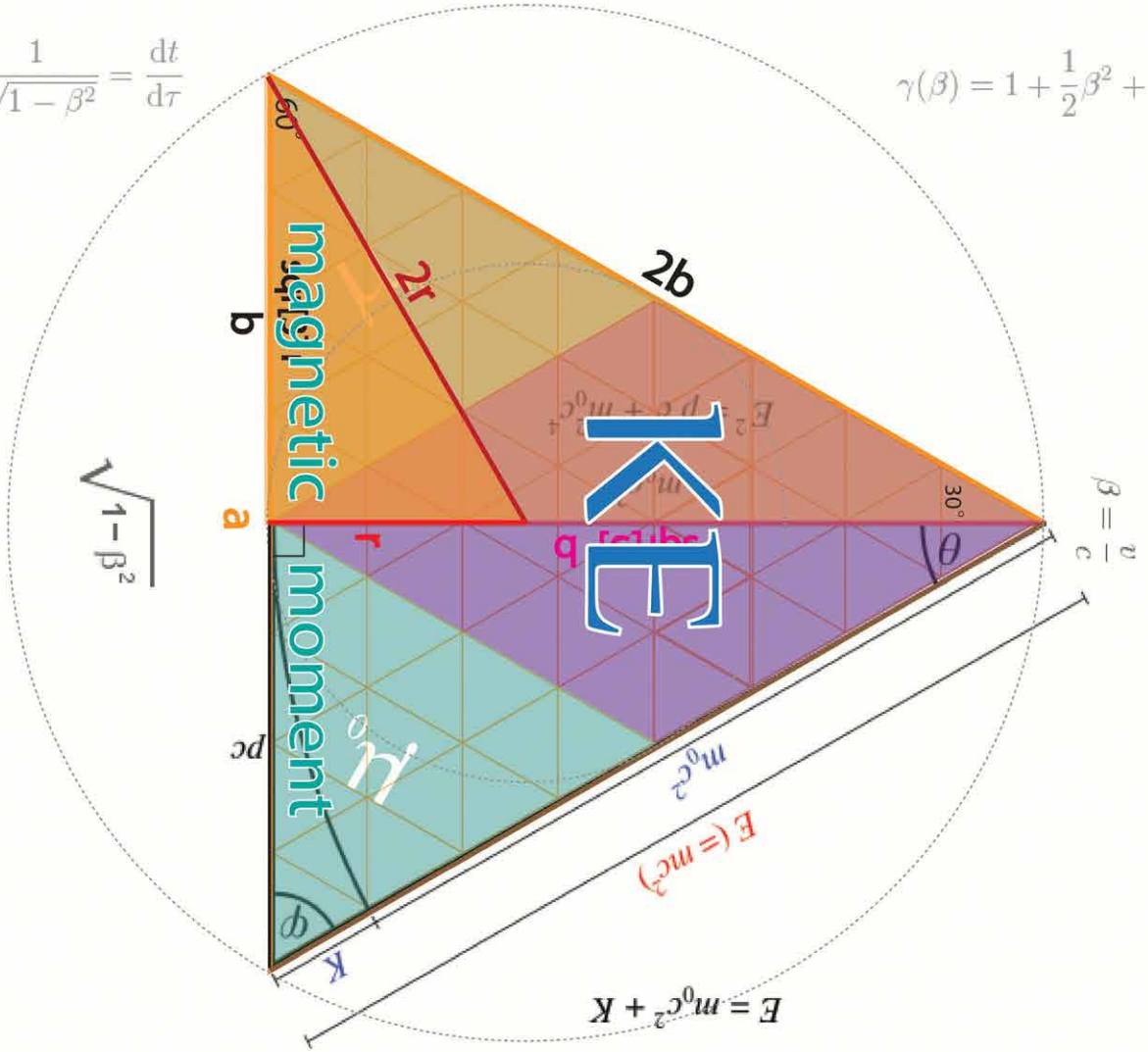

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

All the relativistic relationships historically attributed to circularised energies and modelled through the use of the math of right angled triangles are in fact the result of equilateral, scalar geometries

$$\sqrt{1 - \left(\frac{v}{c}\right)^2}$$

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Finite sequences and series have defined first and last terms,

$$\sum a_n = a_0 + a_1 + a_2$$

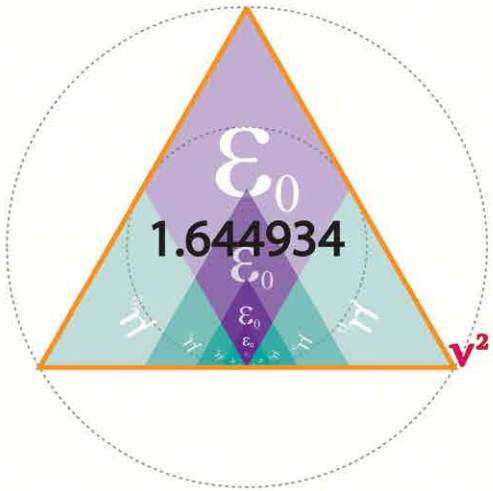

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \lim_{n \to +\infty} \left(\frac{1}{1^2} + \frac{1}{2^2} + \cdots + \frac{1}{n^2} \right).$$

whereas infinite sequences and series continue indefinitely

The Basel problem is a famous problem in mathematical analysis with relevance to number theory, first posed by Pietro Mengoli in 1644 and solved by Leonhard Euler in 1735.

$$\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \frac{1}{5^2} + \ldots = \frac{\pi^2}{6}$$

Tetryonics now provides a geometric solution to visualising and solving the Basel problem

$$\zeta(2) = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \cdots = \frac{\pi^2}{6} \approx 1.645;$$

Tetryonic Infinite Series

is a infinite sequence of square numbers,
the result of adding all those terms together
[or their geometric inverse]

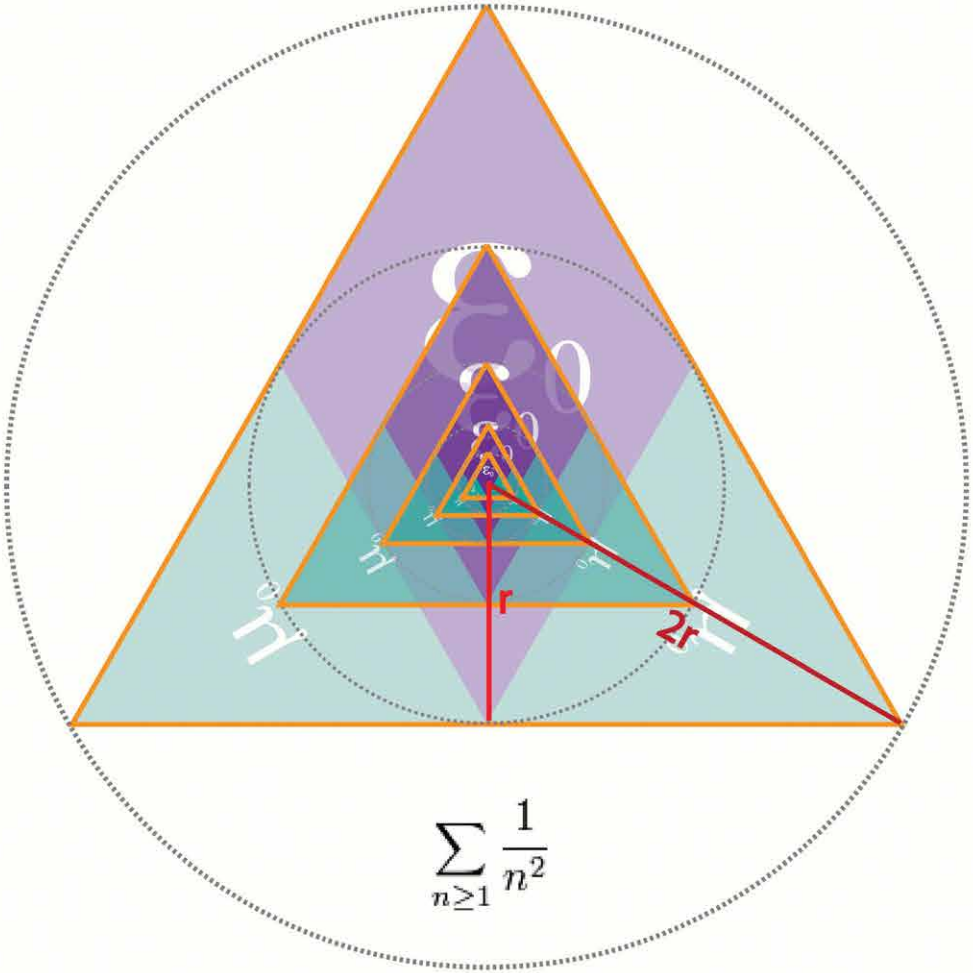

$$\sum_{n \geq 1} \frac{1}{n^2}$$

The entire sum of the series is equal to
twice the size of the radius of the largest inscribed circle
which is equal to the largest circle circumscribing the triangular series.

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Inverting the Circle

Electric Permittivity

ε_o

Magnetic Permeability

μ_o

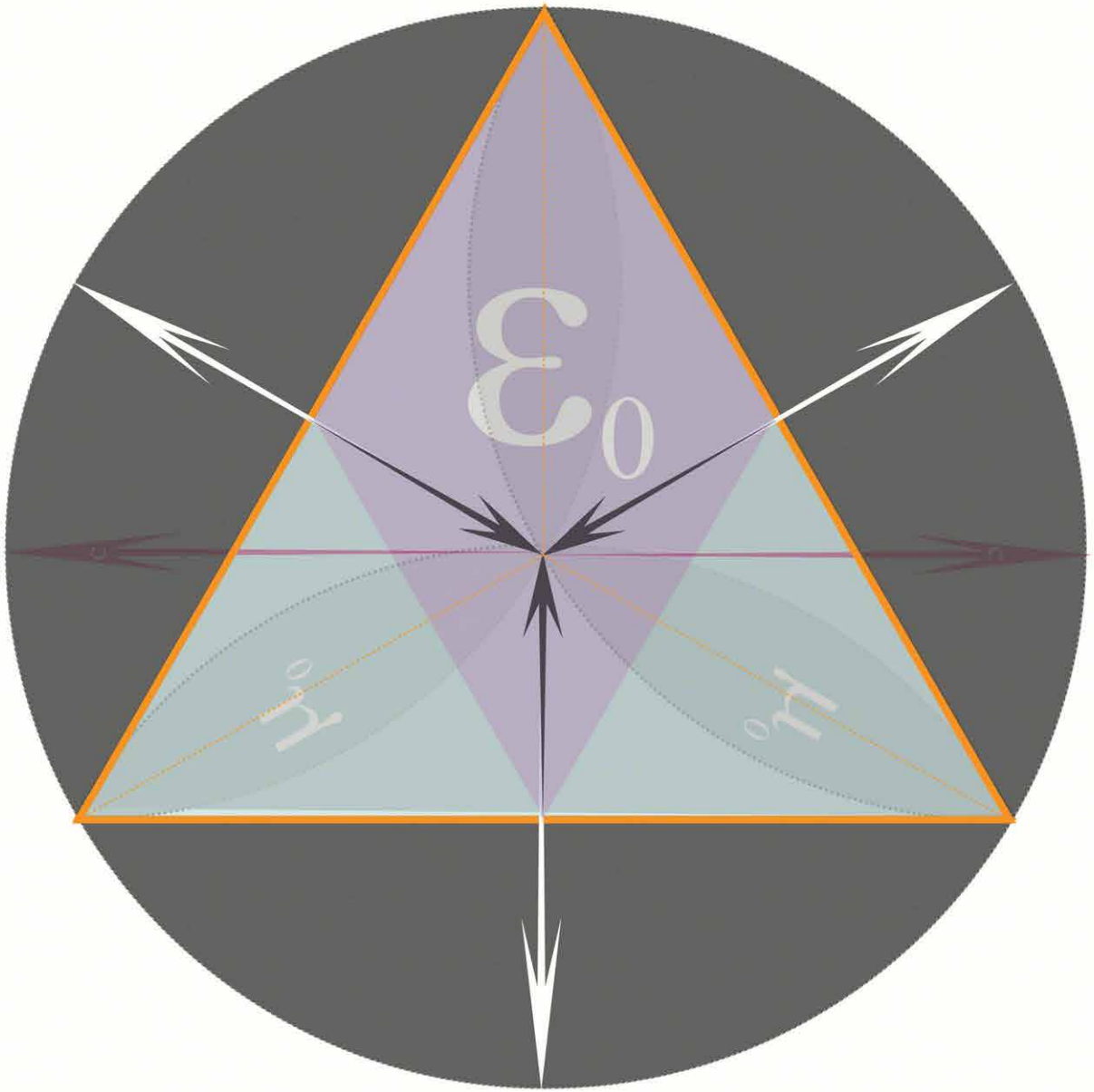

c^2

2D spatial co-ordinates

$\frac{1}{c^2}$

ElectroMagnetic fields

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Irrational numbers

an irrational number cannot be represented as a simple fraction.
Irrational numbers are those real numbers that cannot be represented as terminating or repeating decimals

sin(x)=-square root of (3)/2

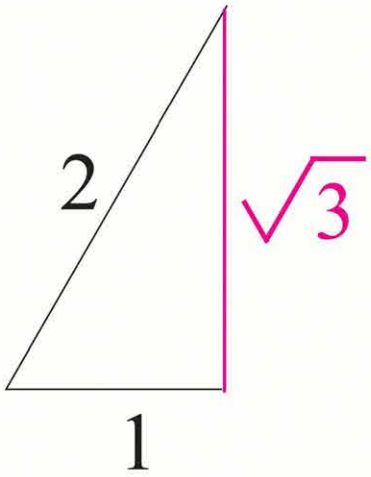

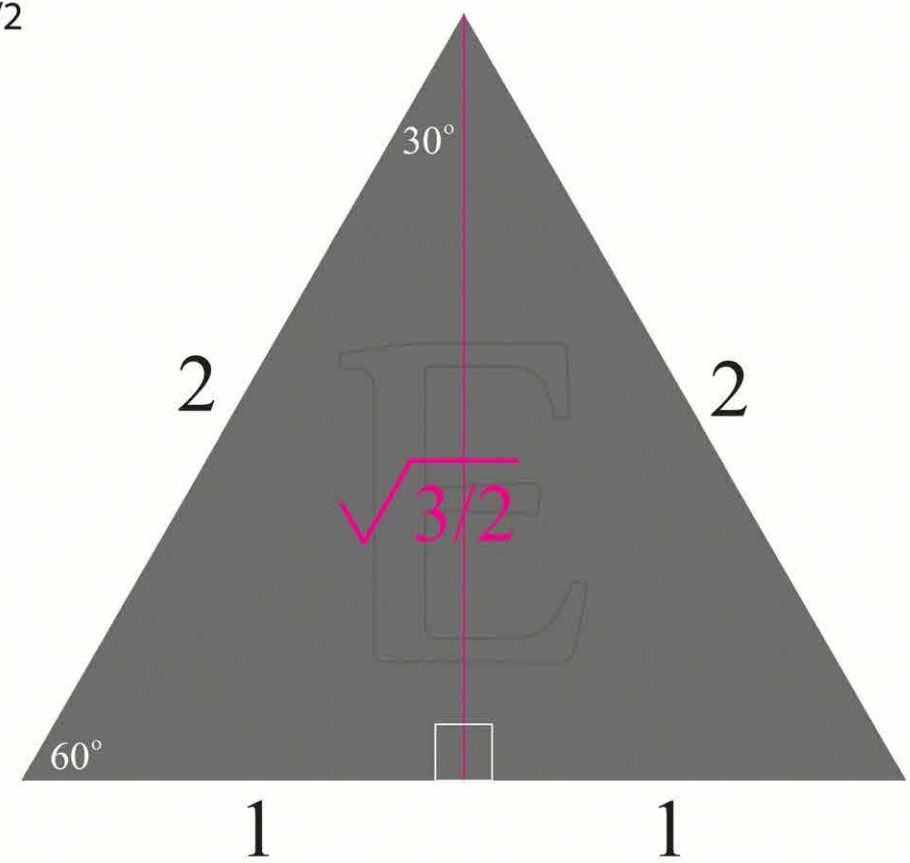

0.866025403.....

Pythagφras' theoreom
and irratiφnal numbers expressed in terms of right-angled triangles in Physics
offer a 'half truth' regarding the equilateral geometry of Energy

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Leibniz

Leibniz introduced the concept of vis viva (living force) which attempted to quantify life force

Newton

Newton focused his work on linear momentum which he developed into his famous laws of motion

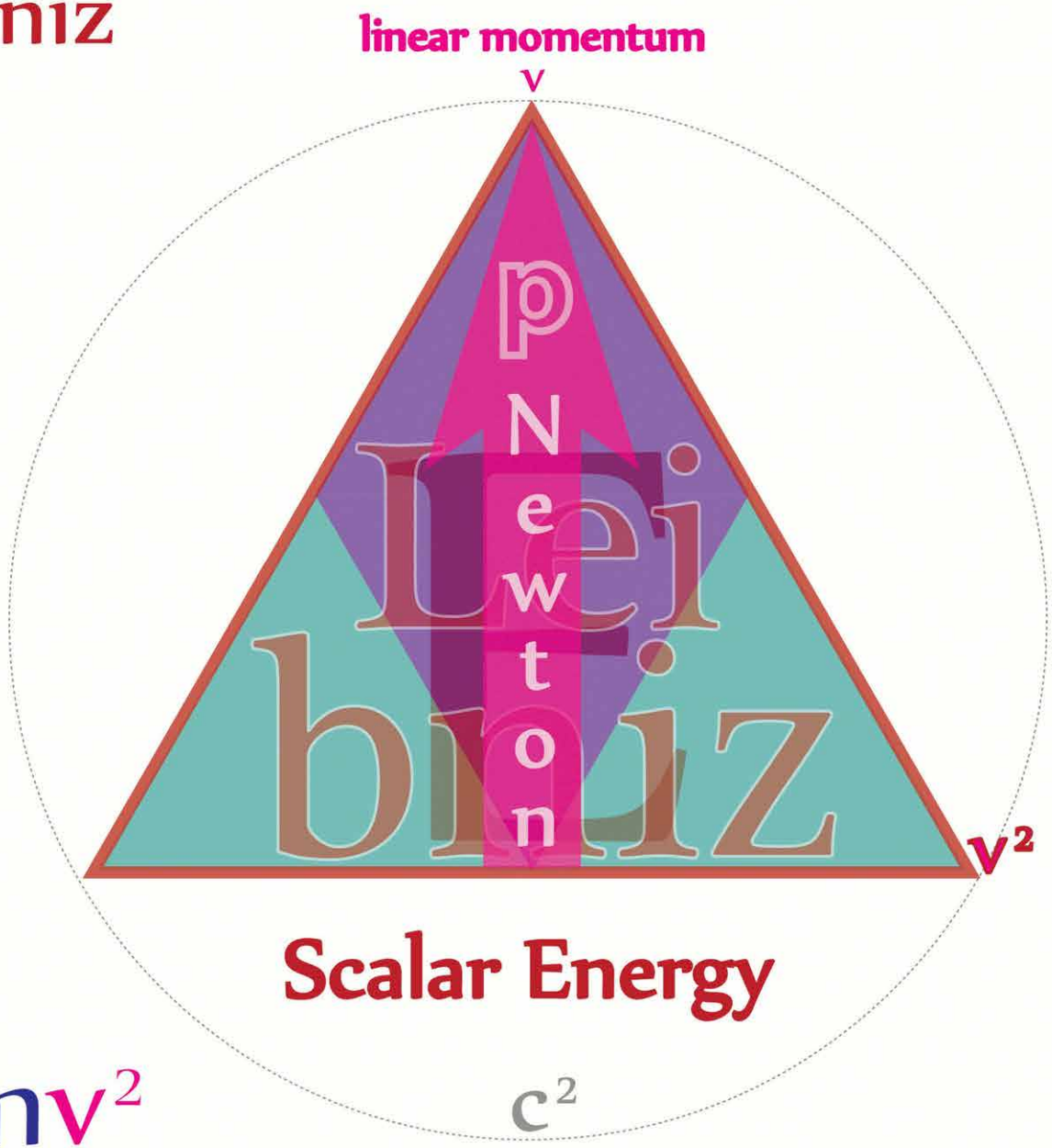

Newton and Leibniz disagreed about what the world is made of and how its physics shaped our scientific concepts of force, energy, and momentum

Tetryonics reveals the physical relationships they both described mathematically as geometric properties of equilateral Planck energy momenta

$E=mv^2$

$p=mv$

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Geometric Square Roots

In geometrical terms, the square root function maps the area of a square to its side length.

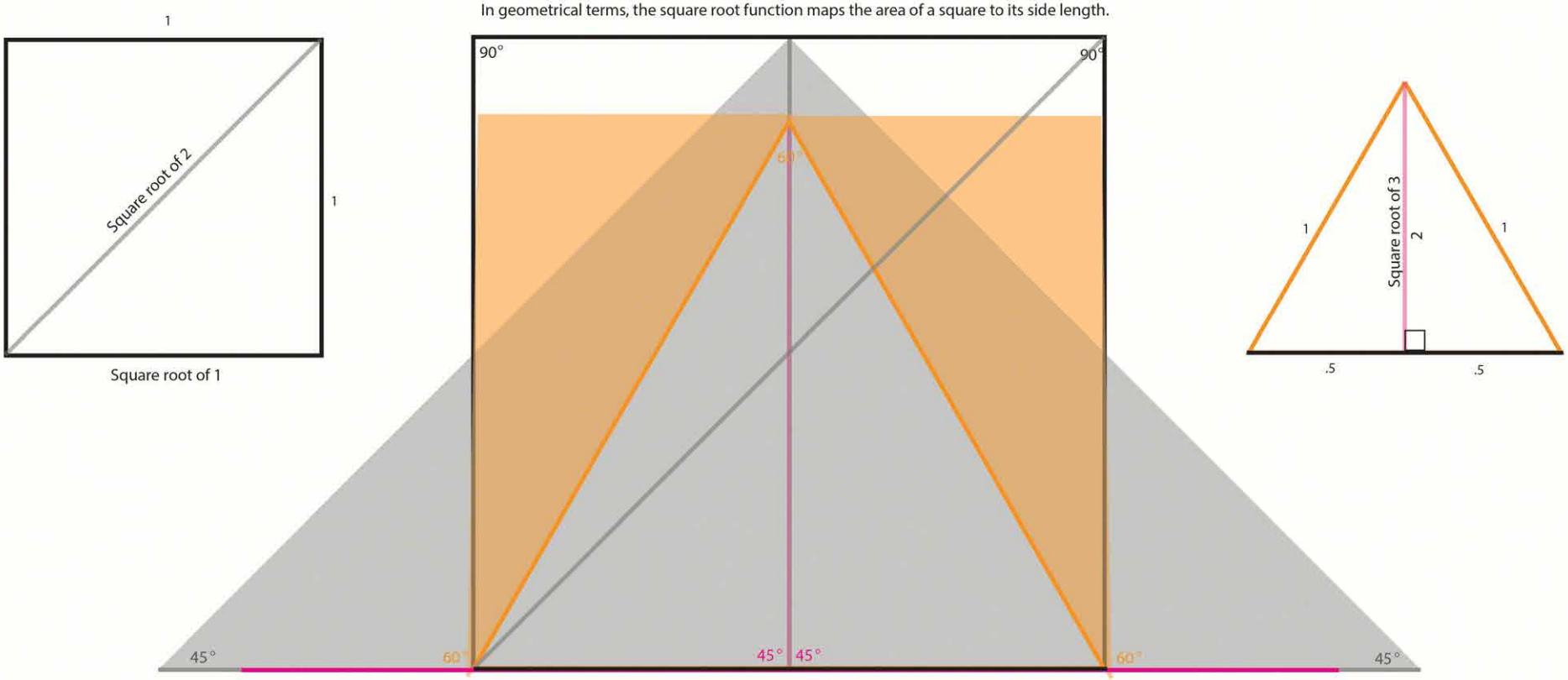

"In mathematics, as in any scientific research, we find two tendencies present. On the one hand, the tendency toward abstraction seeks to crystallize the logical relations inherent in the maze of material that is being studied, and to correlate the material in a systematic and orderly manner. On the other hand, the tendency toward intuitive understanding fosters a more immediate grasp of the objects one studies, a live rapport with them, so to speak, which stresses the concrete meaning of their relations"

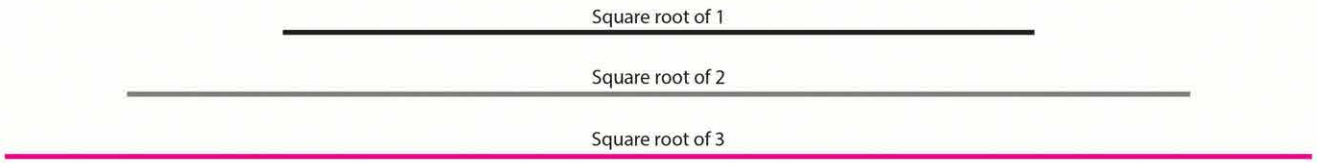

"As to geometry, in particular, the abstract tendency has here led to the magnificent systematic theories of Algebraic Geometry, of Riemannian Geometry, and of Topology; these theories make extensive use of abstract reasoning and symbolic calculation in the sense of algebra.

Notwithstanding this, it is still as true today as it ever was that intuitive understanding plays a major role in geometry. And such concrete intuition is of great value not only for the research worker, but also for anyone who wishes to study and appreciate the results of research in geometry"

David Hilbert [Geometry and the Imagination]

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Square Roots in Physics

In mathematics, a square root of a number a is a number [n] such that [n]2 = x,
or, in other words, a number [n] whose square (the result of multiplying the number by itself, or [n × n]) is x.

Modern calculators use the
Square Root Algorithm
to calculate the value

It is an approximate numerical value

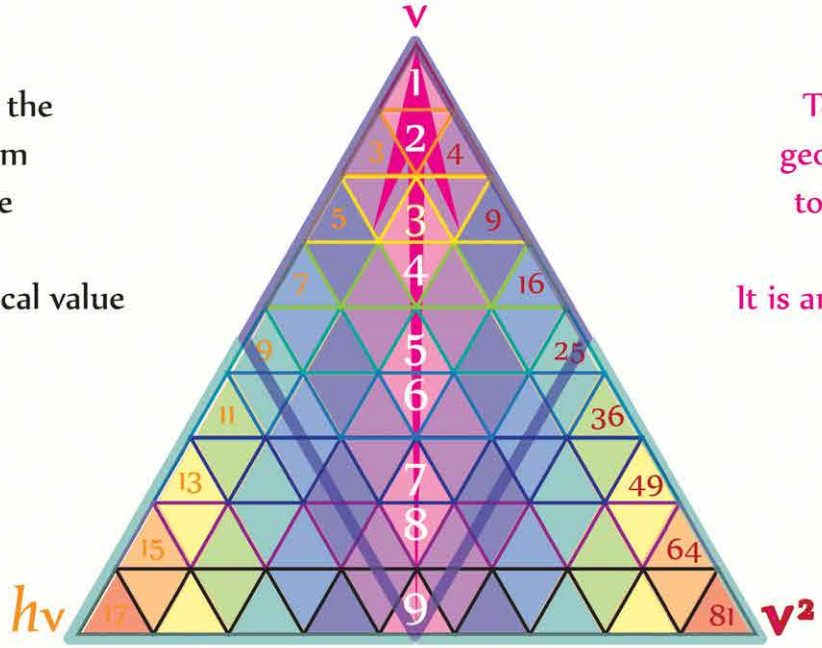

Tetryonics uses the
geometric Square Root
to calculate the value

It is an exact geometric value

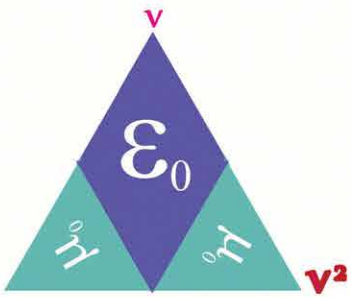

$$E = mv^2$$

In classical geometry,
the square root function maps the
area of a square to its side length.

$$p = \sqrt{E}$$

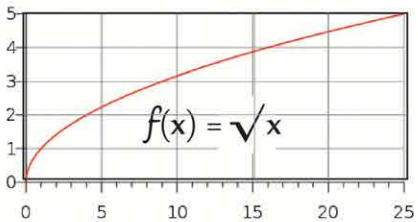

Geometry can easily map irrational numbers

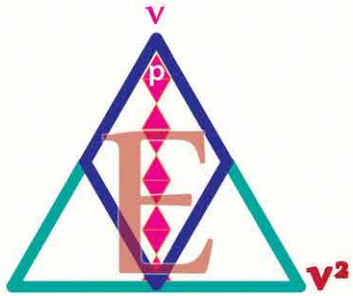

$$p^2 = E$$

In physics,
the square root function maps
ENERGY [E] to momentum [mv]

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The Square roots of n

Historically, any number raised to the power of 2 has been modeled using a polygon--the square
That's why we call raising a number to the second power "squaring the number."

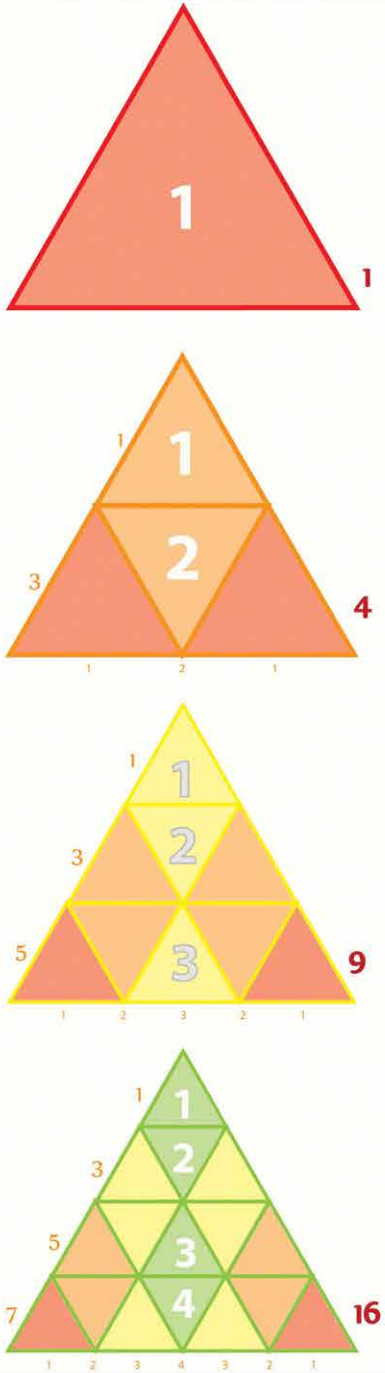

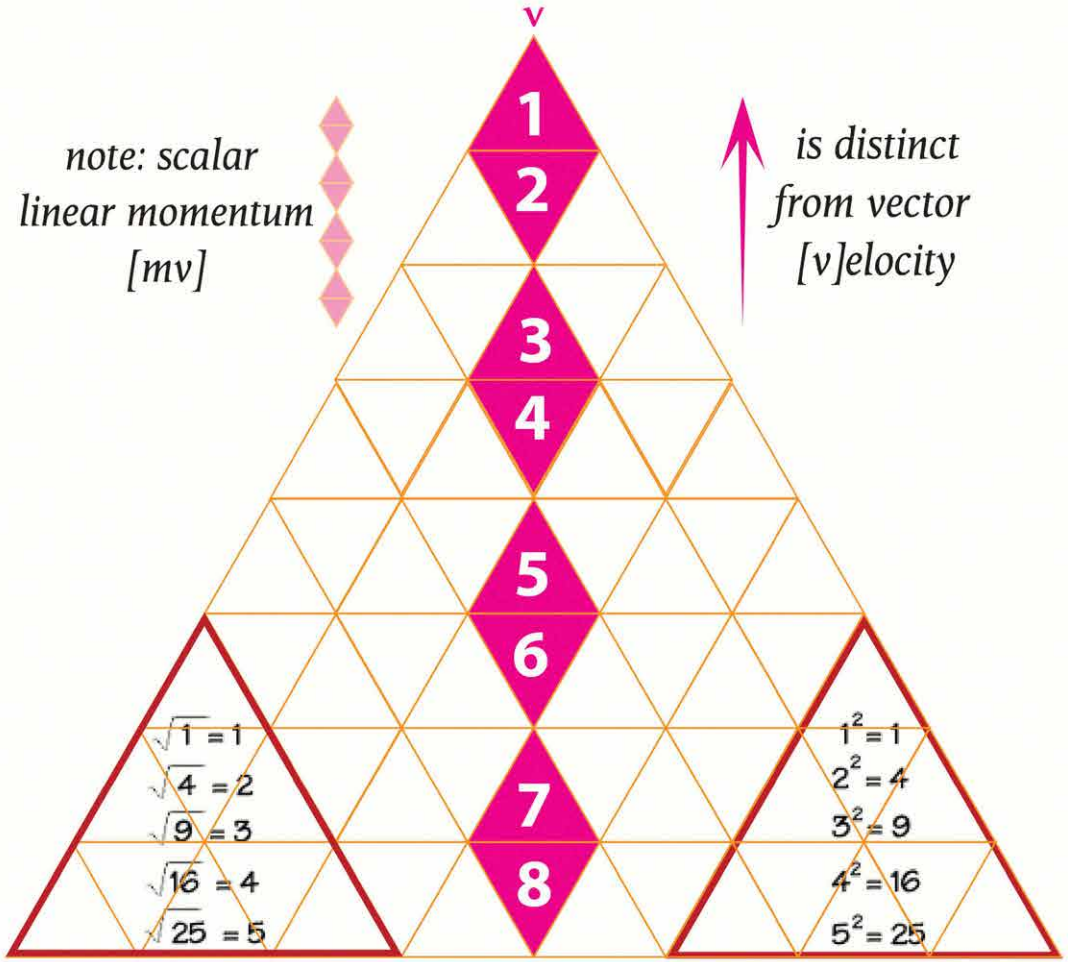

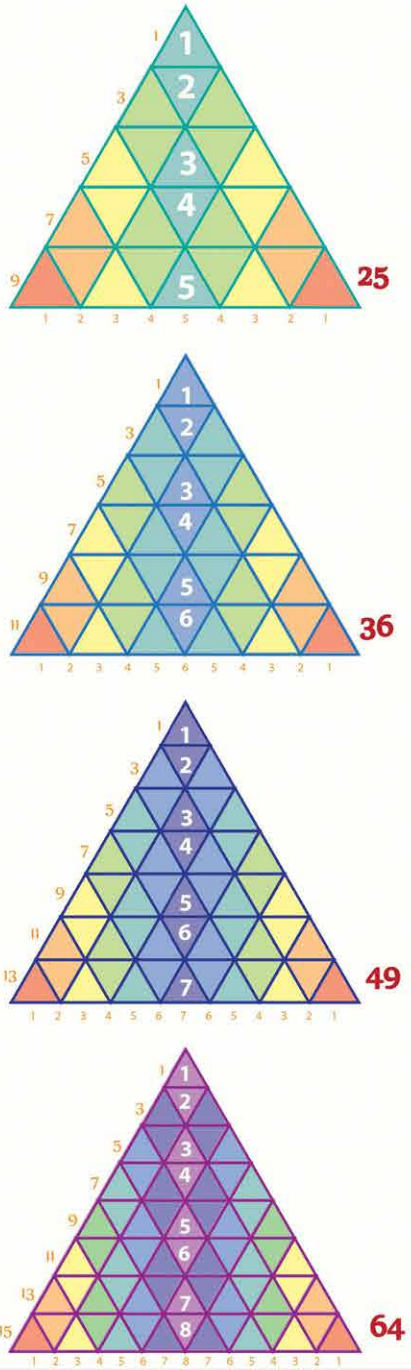

[In physics square numbers are in fact equilateral geometries]
The perfect squares are squares of whole numbers.
Here are the first eight perfect squares

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The Square root of Negative 1

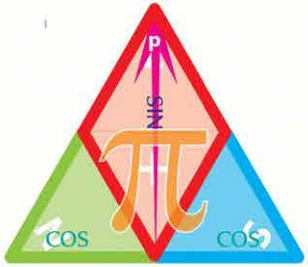

Positive fields are out of phase with Negative fields

Magnetic fields are out of phase with Electric fields

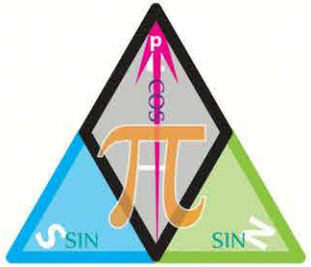

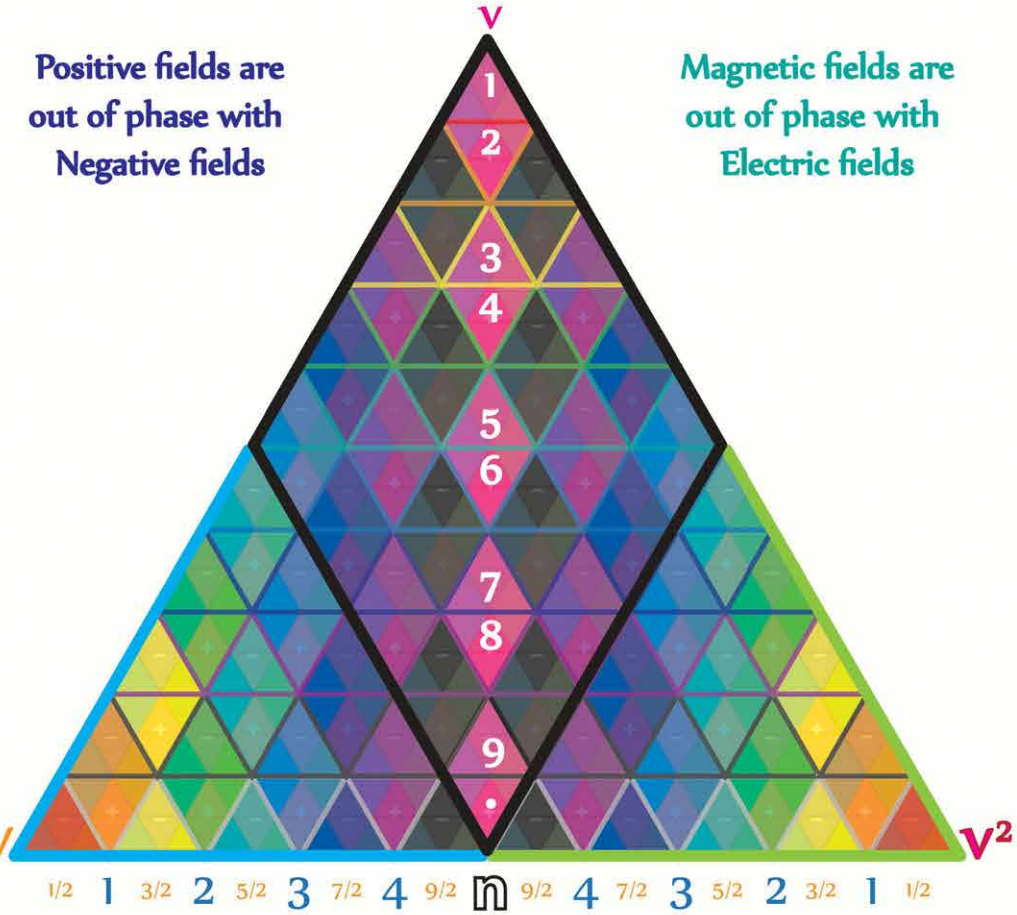

Euler's Formula

Euler's formula is often considered to be the basis of the complex number system. In deriving this formula, Euler established a relationship between the trigonometric functions, sine and cosine, and e raised to a power

$$e^{ix} = \cos(x) + i\sin(x)$$

a mathematical description of EM-Energy waveforms

Leonhard Euler

(15 April 1707 – 18 September 1783)

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \ldots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \ldots$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \ldots$$

$$\sin x + \cos x = 1 + x - \frac{x^2}{2!} - \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \ldots$$

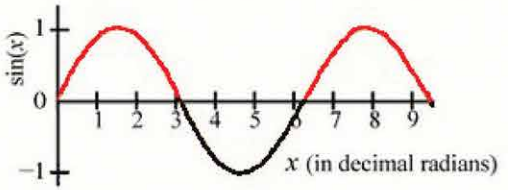

$$e^{i\pi} = -1$$

$$e^{i\pi} + 1 = 0$$

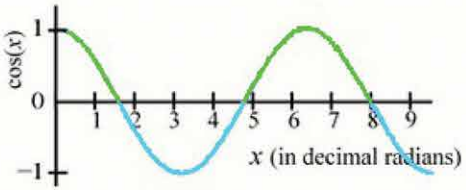

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Geometric means

The geometric mean of two numbers, is the square root of their product

geometric square root of positive one

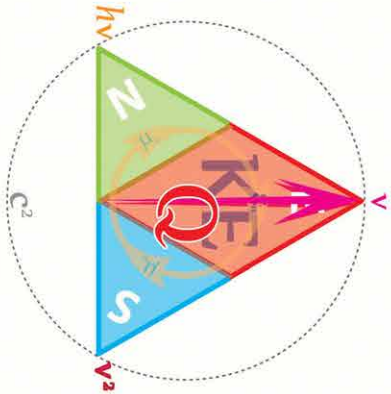

$$F = k\frac{Q_1 Q_2}{r^2}$$

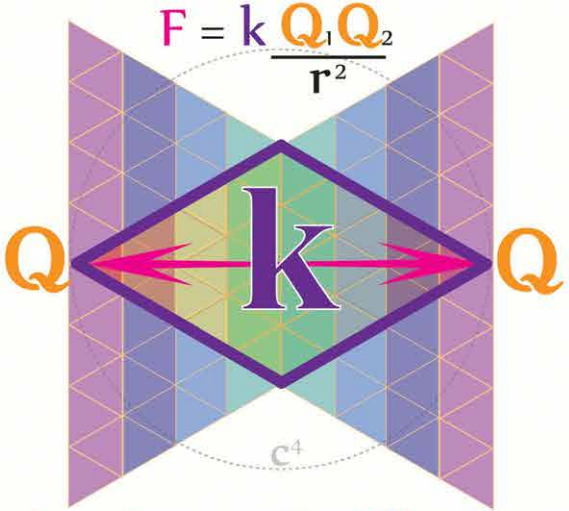

geometric square root of negative one

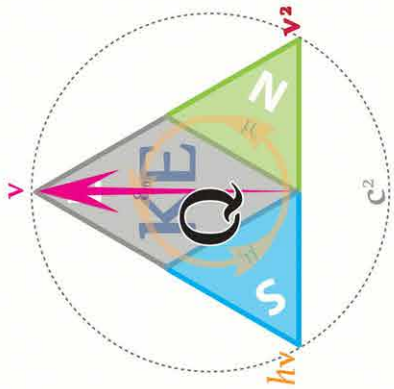

In physics, the geometric mean of two superpositioned fields produces a vector square root Force

It is generally stated that the geometric mean applies only to positive numbers.

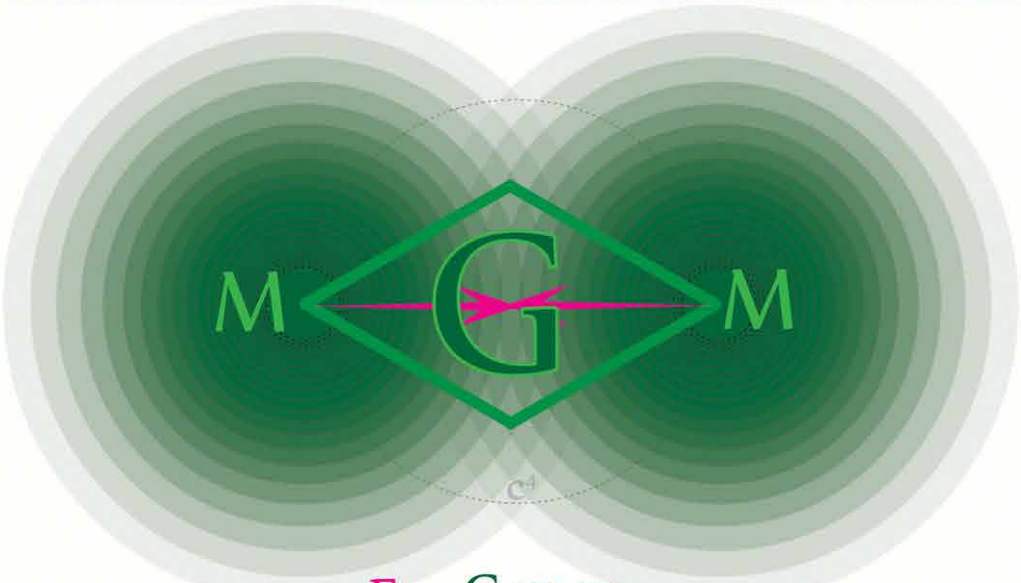

In Tetryonic geometry the geometric mean applies to positive & negative fields.

$$F = -G\frac{m_1 m_2}{r^2}$$

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Superpositioning

When two or more waves traverse the same space,
the net amplitude at each point is the
sum of the amplitudes of the individual waves.

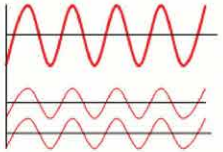

constructive interference

In phase

Additive

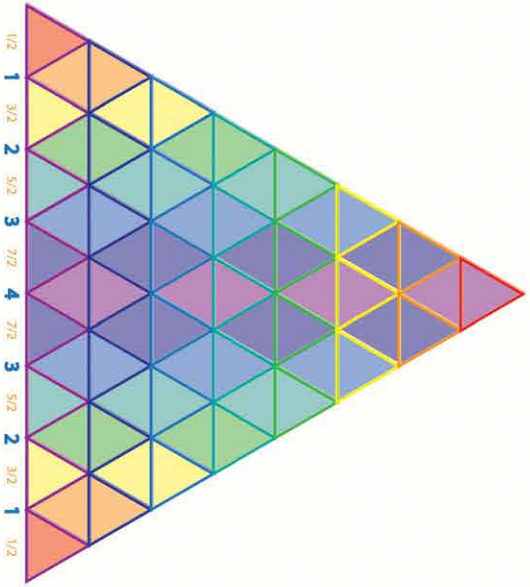

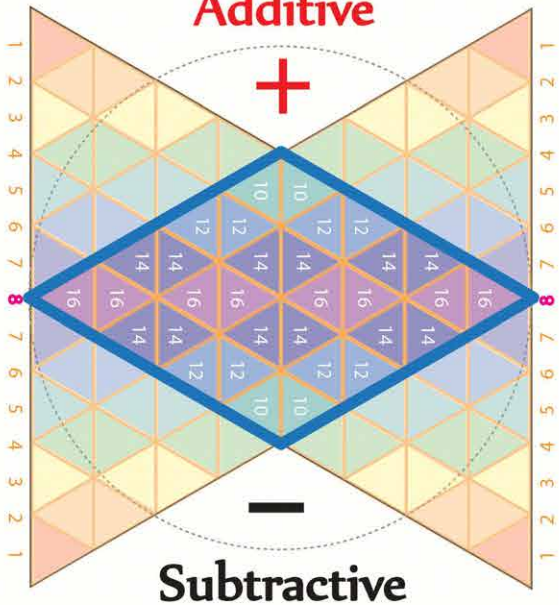

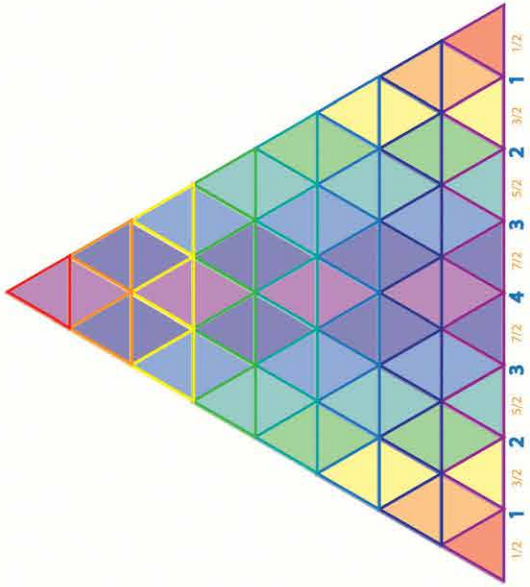

Subtractive

Out of phase

destructive interference

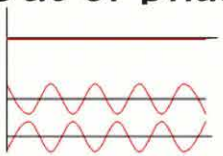

When two or more waves traverse the same space,
if the summed variation has a smaller amplitude
than the constiuent component variations.

The lines of Force

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Tetryonic Multiplication table

A multiplication table is a mathematical grid used to define a multiplication operation and its results

Multiplication Table

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120

Historically Multiplication tables have been based on Square geometries

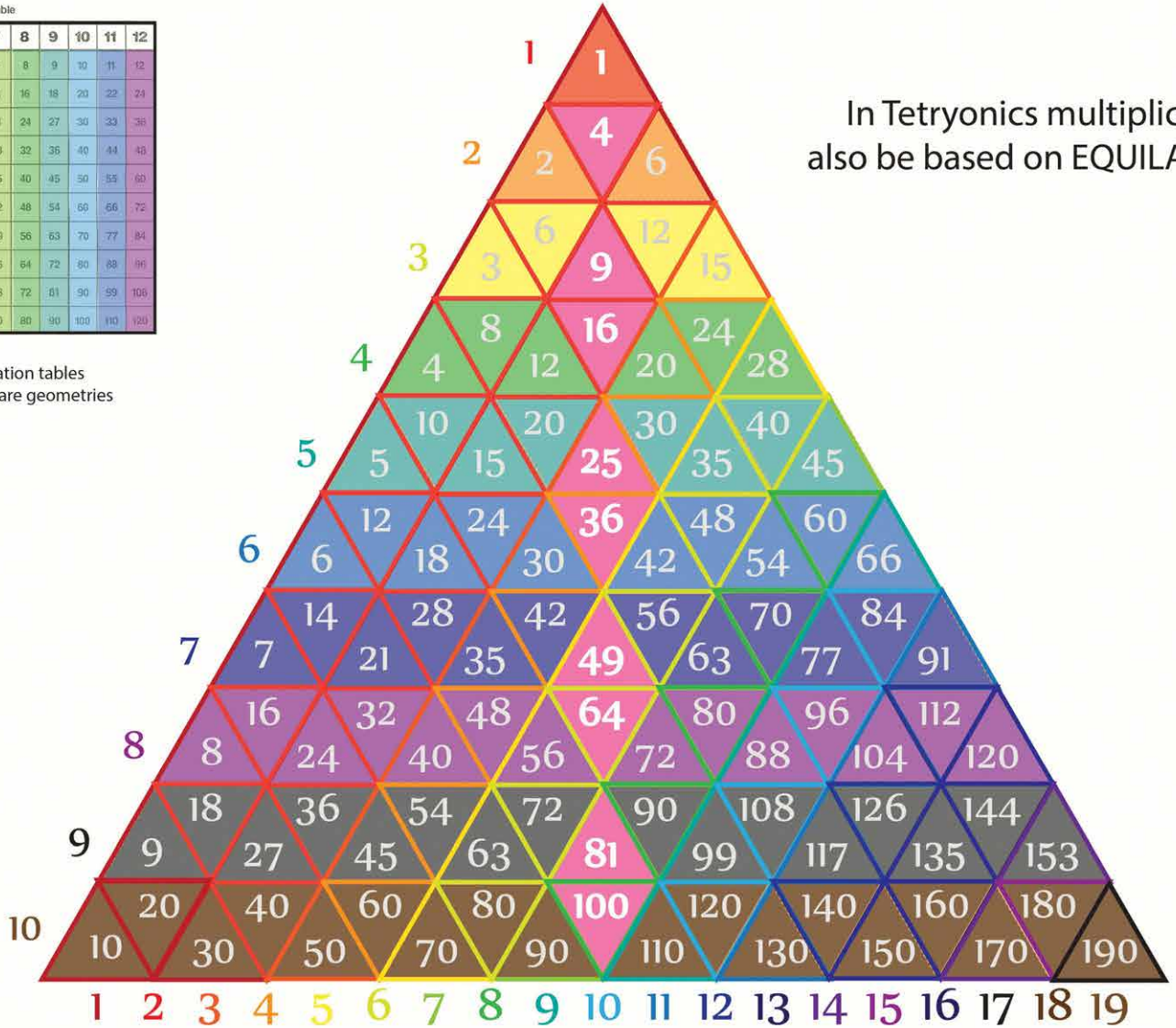

In Tetryonics multiplication tables can also be based on EQUILATERAL geometries

The integer multiplicitors are colour coded

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Rhombic Multiplication Tables

1	2	3	4	5	6	7	8	9	10
2	**4**	6	8	10	12	14	16	18	20
3	6	**9**	12	15	18	21	24	27	30
4	8	12	**16**	20	24	28	32	36	40
5	10	15	20	**25**	30	35	40	45	50
6	12	18	24	30	**36**	42	48	54	60
7	14	21	28	35	42	**49**	56	63	70
8	16	24	32	40	48	56	**64**	72	80
9	18	27	36	45	54	63	72	**81**	90
10	20	30	40	50	60	70	80	90	**100**

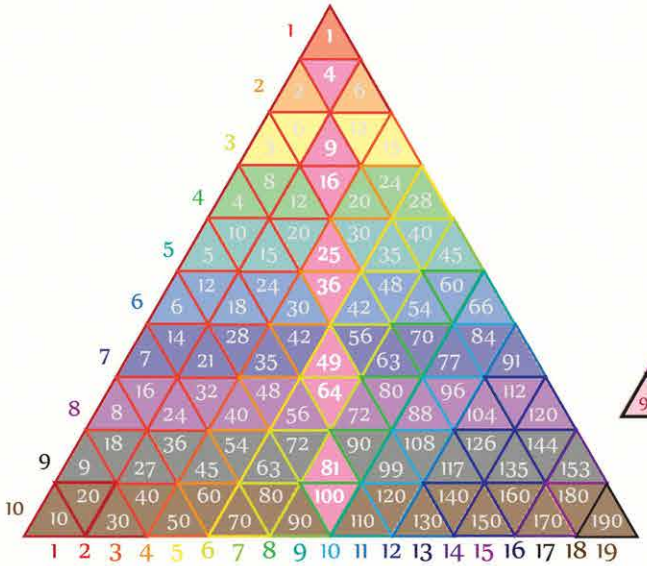

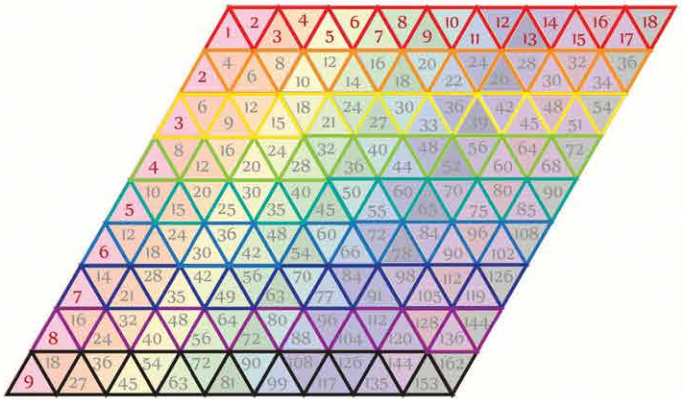

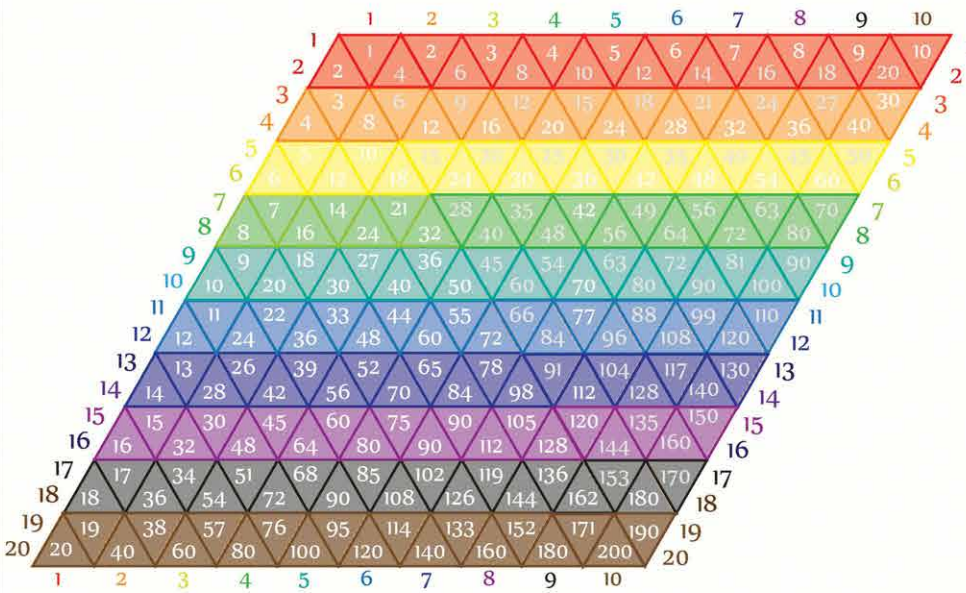

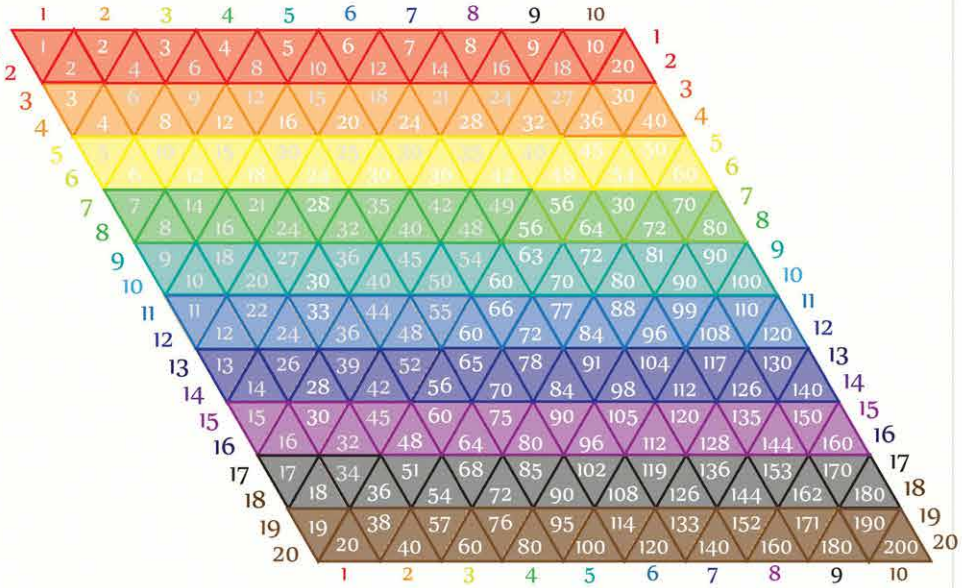

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Photonic Root Tables

Tetryonic multiplication table can take a number of geometric forms

Square root median

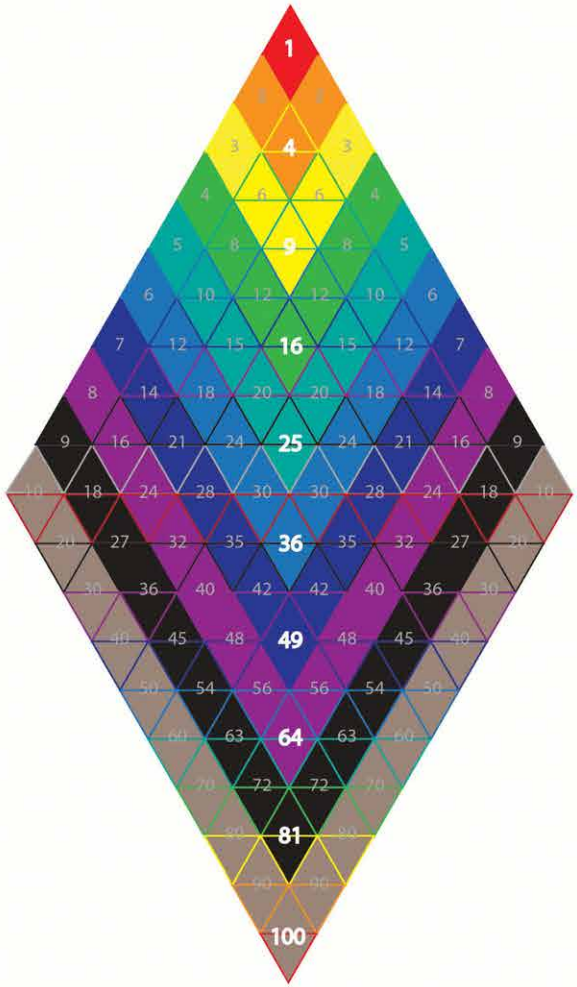

Table read diagonally

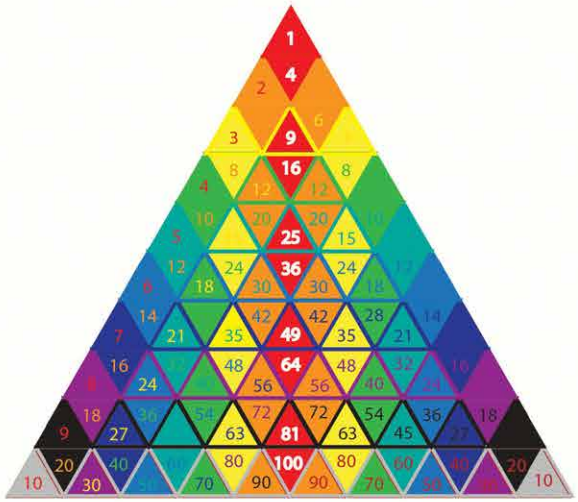

1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

Integer median

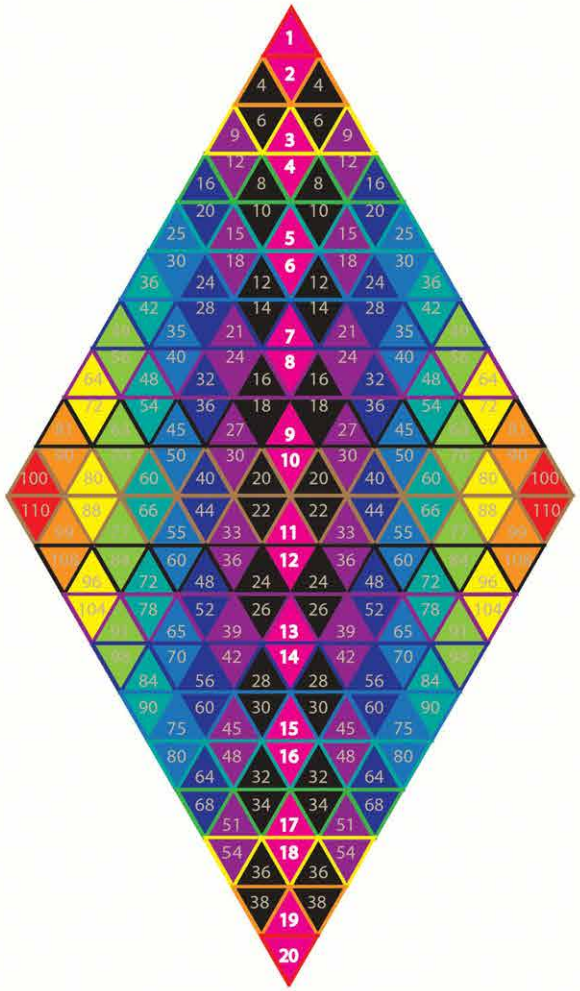

Table read from centre
to outside edge then down

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Divide [division] tables

Minus [subtraction] tables

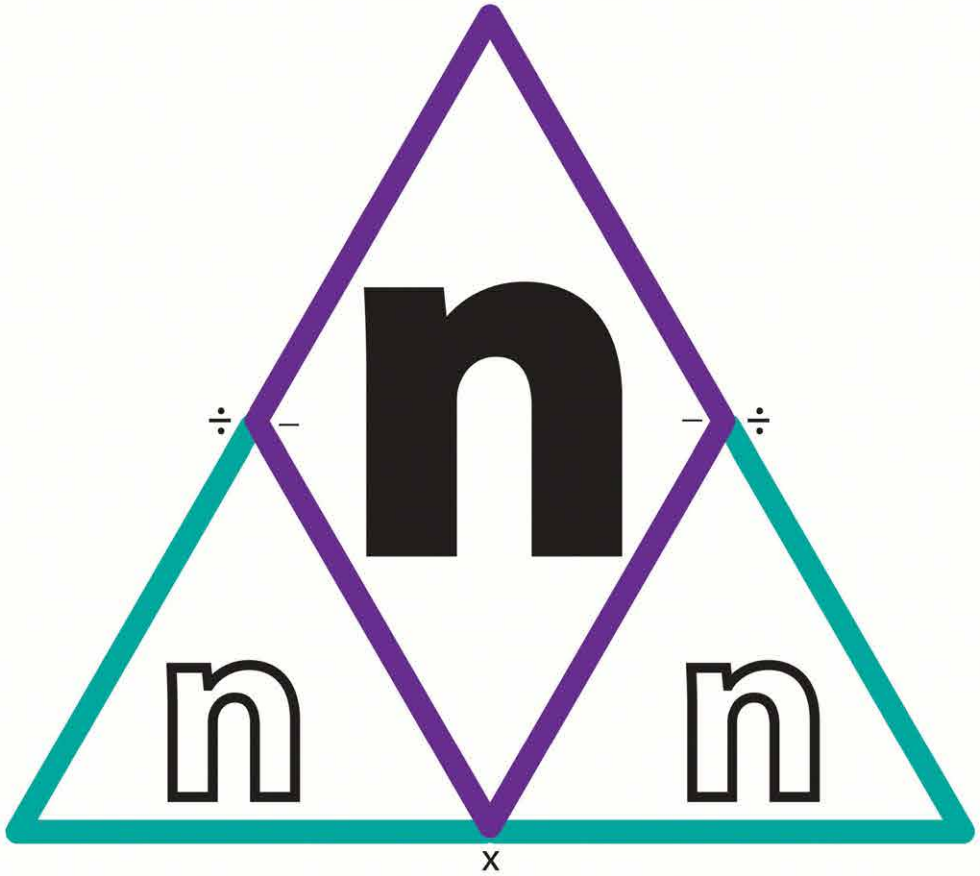

Times [multiplication] tables

Plus [addition] tables

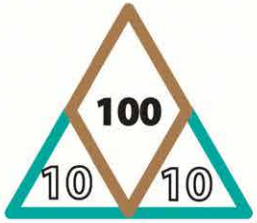

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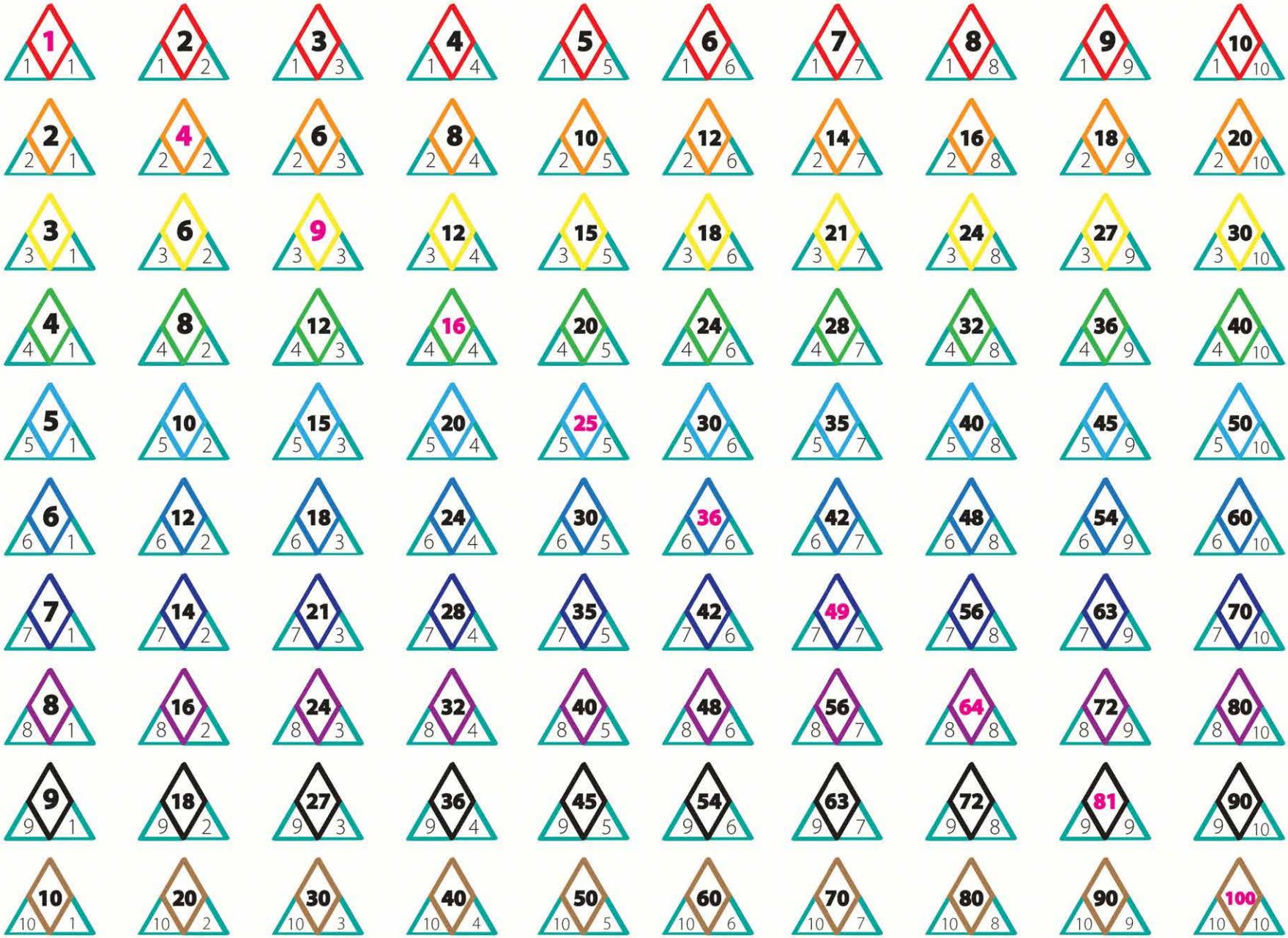

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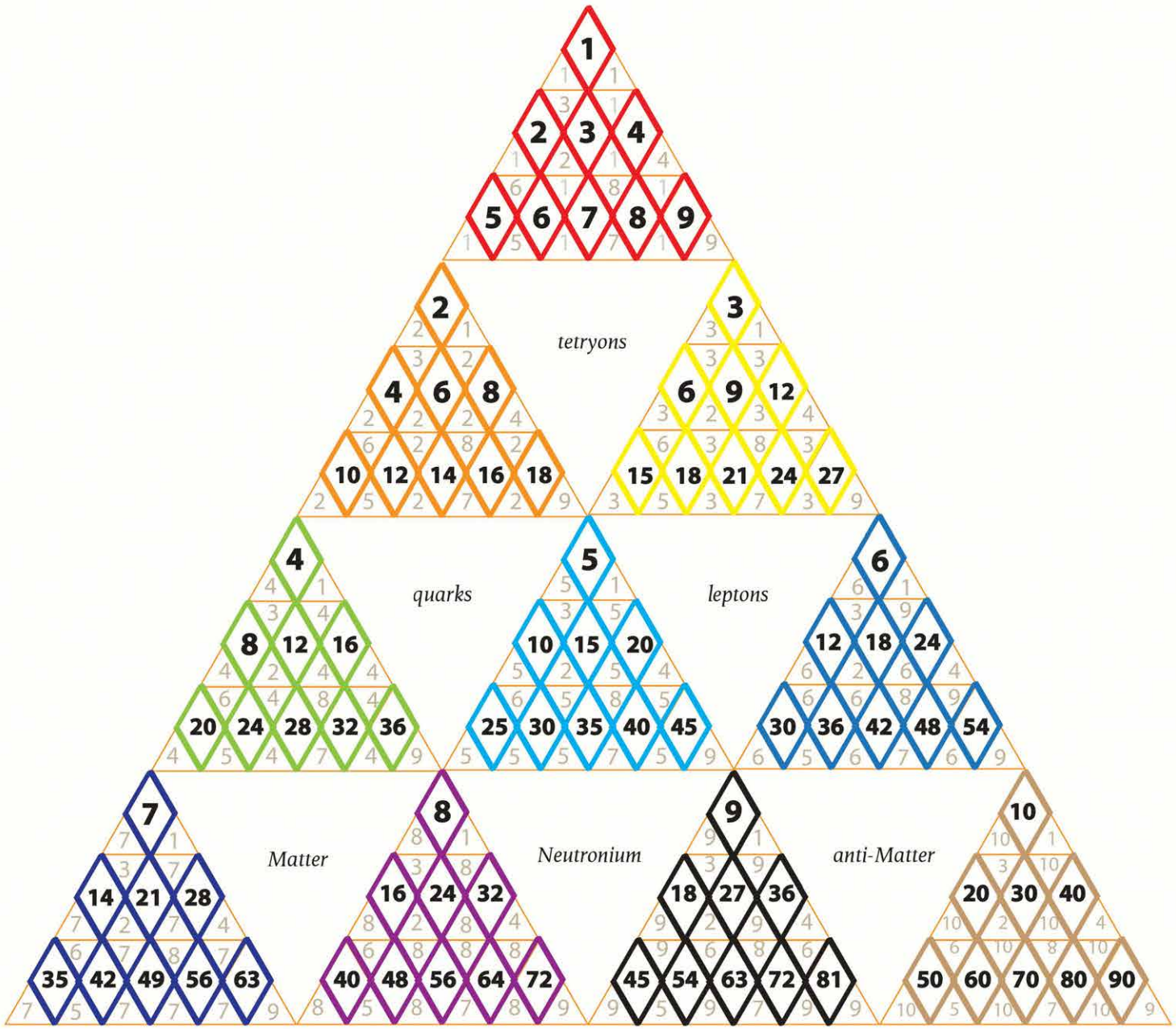

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Irrational Numbers

An irrational number is defined to be any number that is the part of the real number system that cannot be written as a complete ratio of two integers

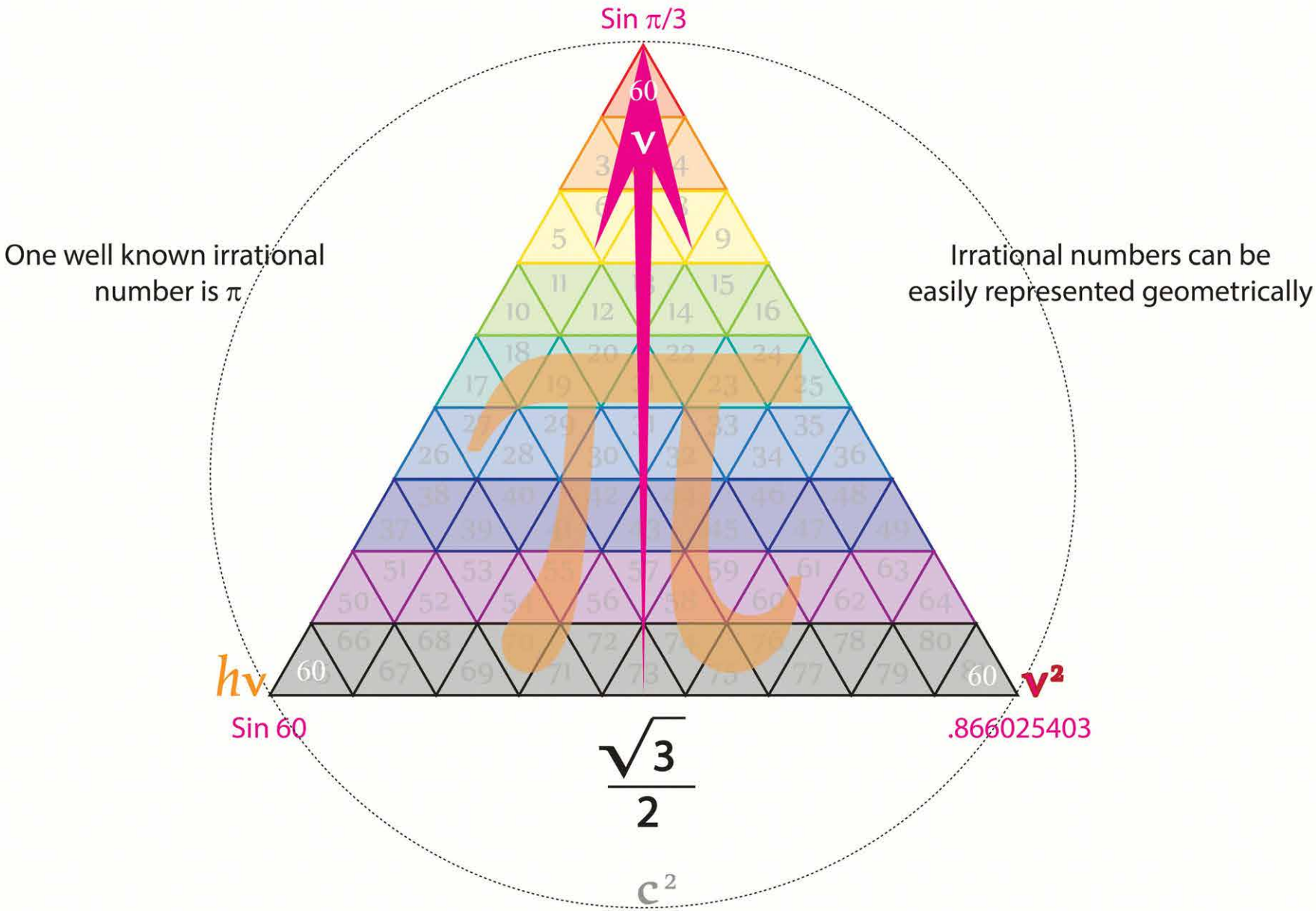

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Exponentials & Logarithms

1	0
10	1
100	2
1,000	3

e and the Natural Log are inverse functions of each other:

e^x is the amount of continuous GROWTH after a certain amount of time.
Natural Log (ln) is the amount of TIME of continuous growth to reach a certain level

$10{,}000 = 10^4$

$\log(10{,}000) = 4$

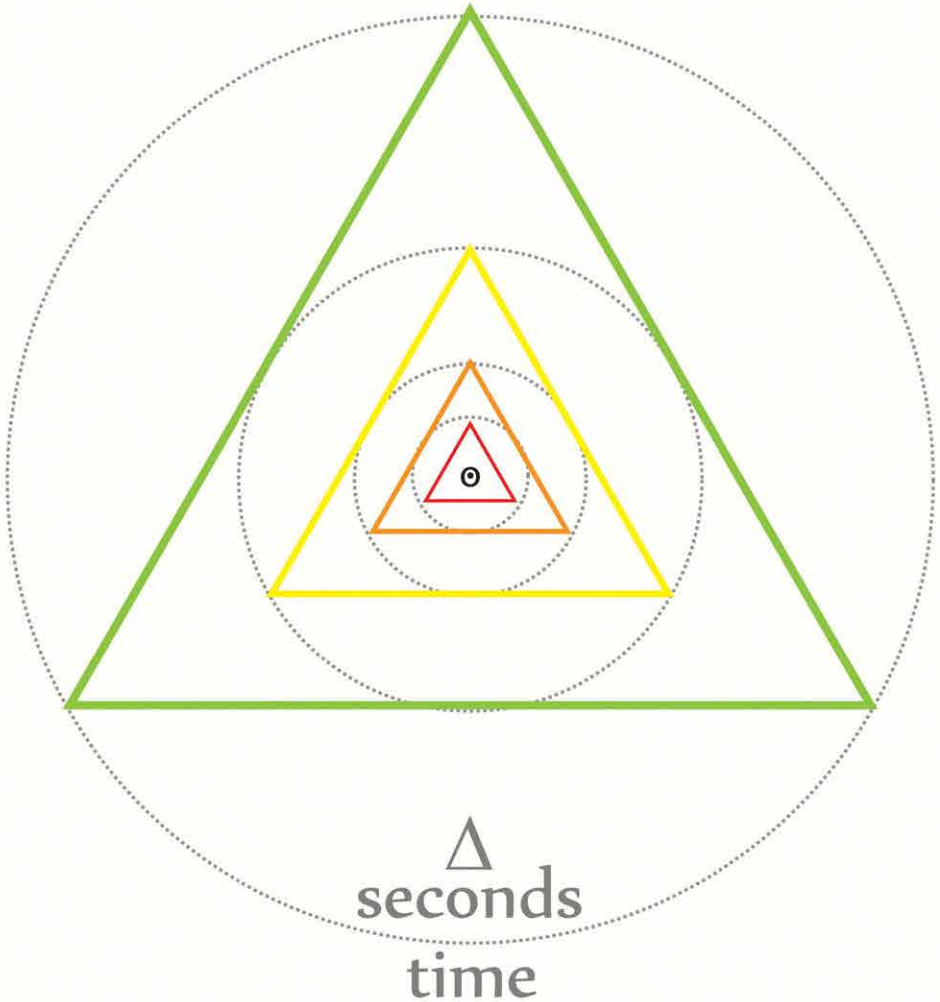

e

How much growth after x units of time
(and 100% continuous growth)

$$e^x = \lim_{n\to\infty}(1+x/n)^n,$$

GROWTH

ln

ln(x) lets us plug in continuous growth
and get the time it would take.

$$\ln(x) = \lim_{n\to\infty} n(x^{1/n}-1).$$

PERIOD

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Exponential growth

GEOMETRIC

3.141592654

π

Pi is the ratio between circumference and diameter shared by all circles.

It is a fundamental ratio inherent in all circles and therefore impacts any calculation of circumference, area, volume, and surface areas

Pi radians are equally important and show all quantised equilateral energy geometries are related to their scribed circles

$$\text{growth} = e = \lim_{n \to \infty}\left(1 + \frac{r}{n}\right)^t$$

e represents the idea that all continually growing systems are scaled versions of a common rate

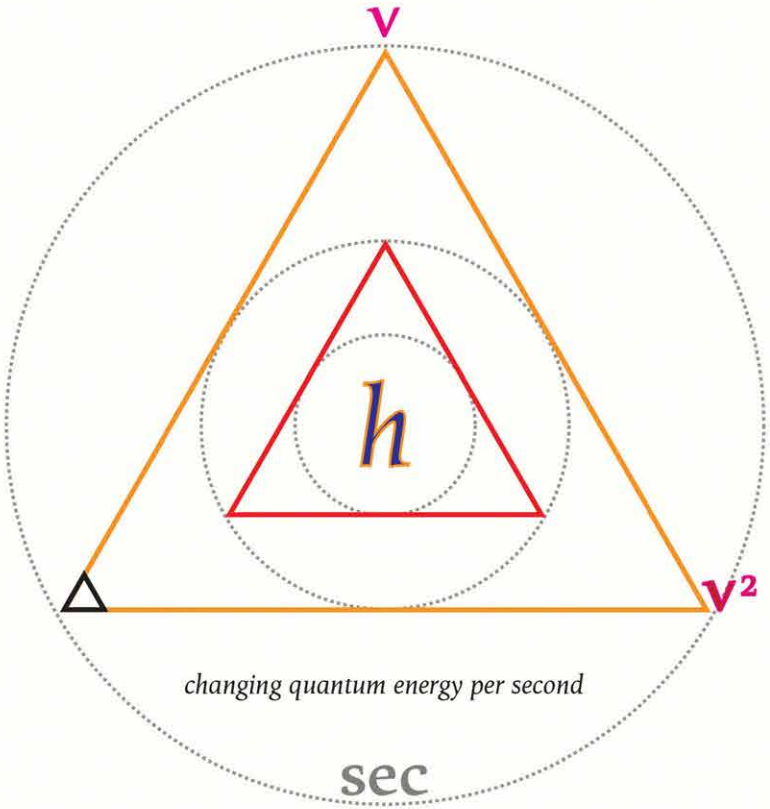

GROWTH

2.718281828

e

e is the base rate of growth shared by all continually growing processes.

e lets you take a simple growth rate (where all the change happens all at once at the end of a period of time - ie quantised growth)

e shows up whenever systems grow exponentially and continuously..... radioactive decay, interest calculations and populations

tetryons *EM fields* *quarks*

e can be applied to the equilateral energy geometries of physical systems only where the rate of increase is a integer factor of a squared number

leptons *Baryons*

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Nuclear Energy levels

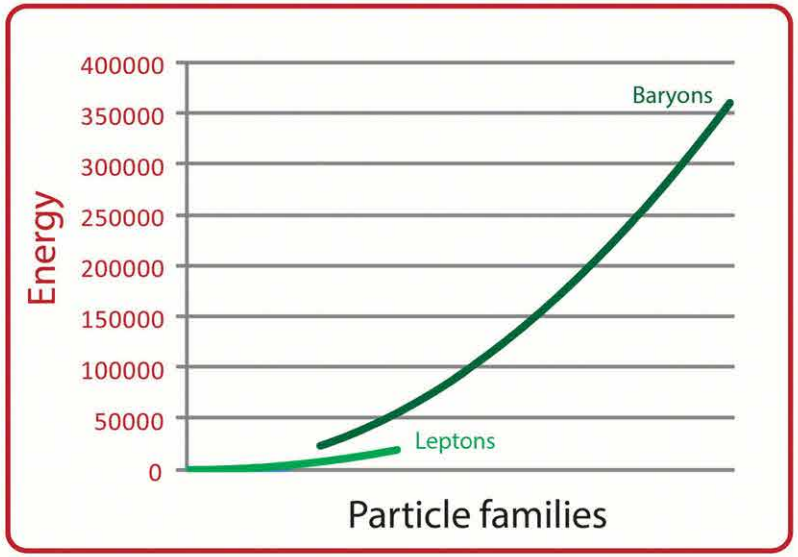

The emission and absorption of bosons and Photons within sub-atomic nuclei

Increase and decrease in integer amounts according to the charged Tetryonic topologies of the particles involved

Exponential energy levels

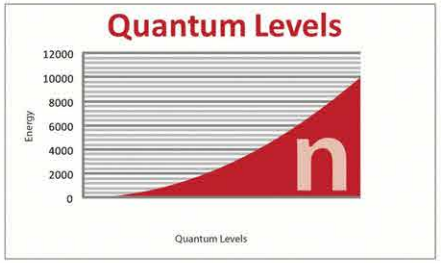

Radioactive decays follow exponential curves determined by the Tetryonic topology of the sub-atomic particle families

Proton
Neutron

antiNeutron
antiProton

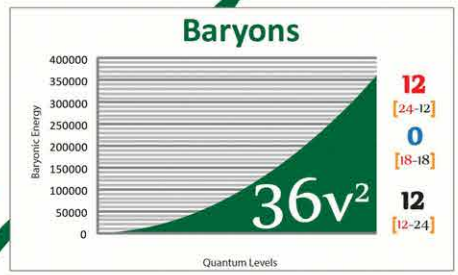

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

Electron
Positron

Neutrino

Up
Down
Strange
Charmed
Top
Bottom

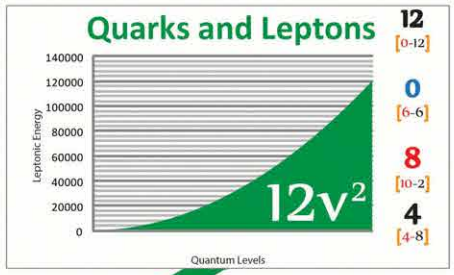

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

quarks, leptons; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

Positive
Negative
Neutral

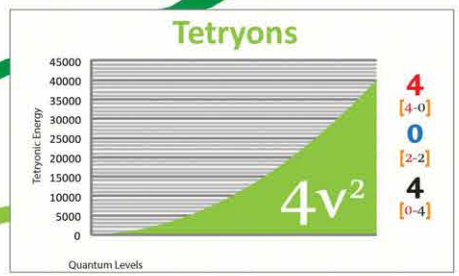

$$4\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

tetryons; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

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Series addition & the Riemann Zeta Function

The second series addition of the Reimann Zeta function is where x=2: (pi^2)/6=1+1/2^2+1/3^2+1/4^2+...
(the sum of the reciprocals of the squares)

$$\zeta(s) = \sum_n \frac{1}{n^s}$$

$$\zeta(2) = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots = \frac{\pi^2}{6}$$

$$\sum_{n=1}^{\infty} \frac{1}{n^x}$$

$$f(n) = 1/n^2$$

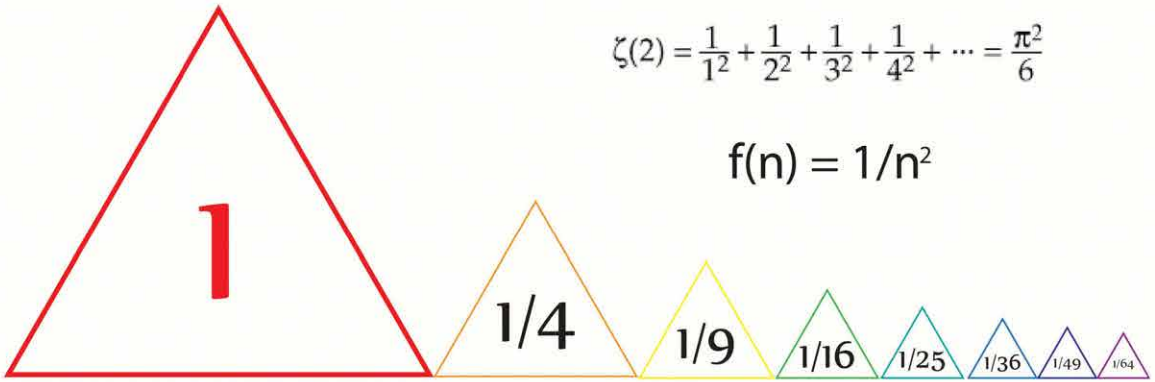

In mathematics, the Riemann zeta function, is a prominent function of great significance in number theory. It is a named after German mathematician Bernhard Riemann. It is so important because of its relation to the distribution of prime numbers. It also has applications in other areas such as physics, probability theory, and applied statistics

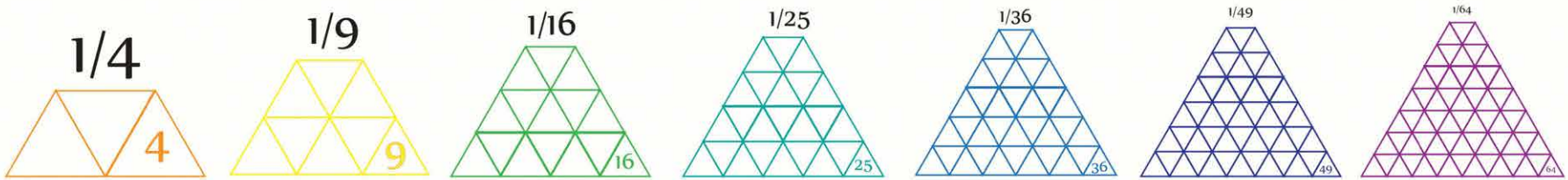

The mystery of prime numbers
Question: which natural numbers are prime? how are they distributed among natural numbers?

Primes are basic building blocks for natural numbers:

- any natural number is a product of prime numbers
- a prime number is only divisible by itself and by 1:
  (it cannot be further simplified)

We don't know how to predict where the prime numbers are:

"Prime numbers grow like weeds among the natural numbers, seeming to obey no other law than that of chance but also exhibit stunning regularity" (Don Zagier, number theorist)

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Adding the odd numbers in order produces the square numbers

Apart from 2, all primes are odd numbers;
the difference between two consecutive squares being odd,
every prime can be expressed as the difference between two squares

SPECTRAL LINES

Primes can be modelled as Bosons
[ODD number energy momenta geometries]

[2n-1]

KEM ENERGIES

Primes can be expressed as Bosons
[the difference of two squared energies]

$n^2 - [n-1]^2$

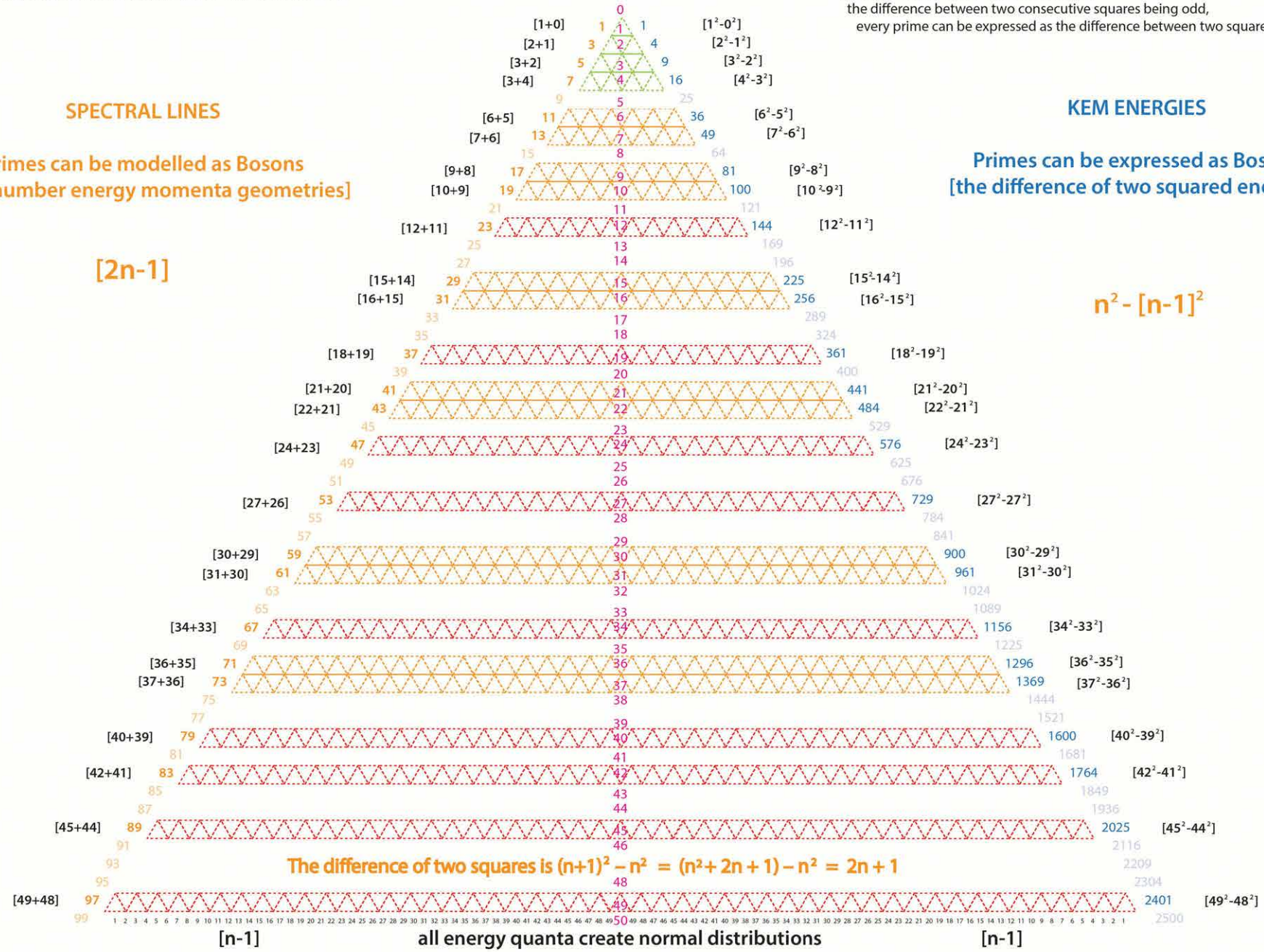

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Prime number Distributions

A twin prime is a prime number that differs from another prime number by two, for example the twin prime pair (41, 43). Sometimes the term twin prime is used for a pair of twin primes; an alternative name for this is prime twin or prime pair.

Twin primes appear despite the general tendency of gaps between adjacent primes to become larger as the numbers themselves get larger due to the prime number theorem (the "average gap" between primes less than n is log(n)).

$$p_2 - p_1 = 2$$

Every twin prime pair except (3, 5) is of the form (6n – 1, 6n + 1) for some natural number n, and with the exception of n = 1, n must end in 0, 2, 3, 5, 7, or 8

What Yitang Zhang just proved is that there are infinitely many pairs of primes that differ by at most 70,000,000. In other words, that the gap between one prime and the next is bounded by 70,000,000 infinitely often—thus, the "bounded gaps" conjecture.

On first glance, this might seem a miraculous phenomenon. If the primes are tending to be farther and farther apart, what's causing there to be so many pairs that are close together?

It is the geometry of Numbers themselves that causes a natural geometric convergence

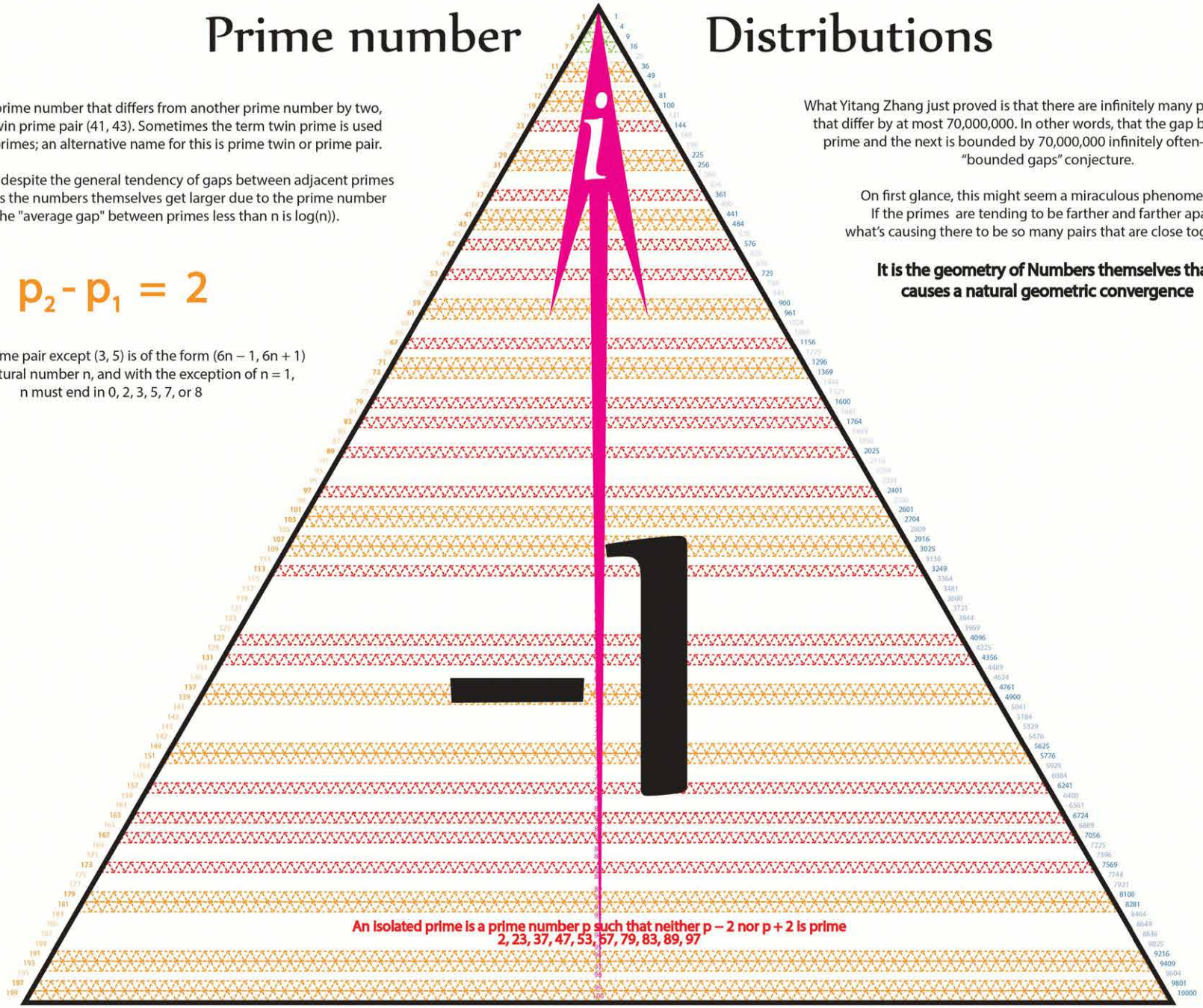

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The Digital roots of Prime numbers

The digital root (also repeated digital sum) of a number is the (single digit) value obtained by an iterative process of summing digits, on each iteration using the result from the previous iteration to compute a digit sum.

The process continues until a single-digit number is reached.

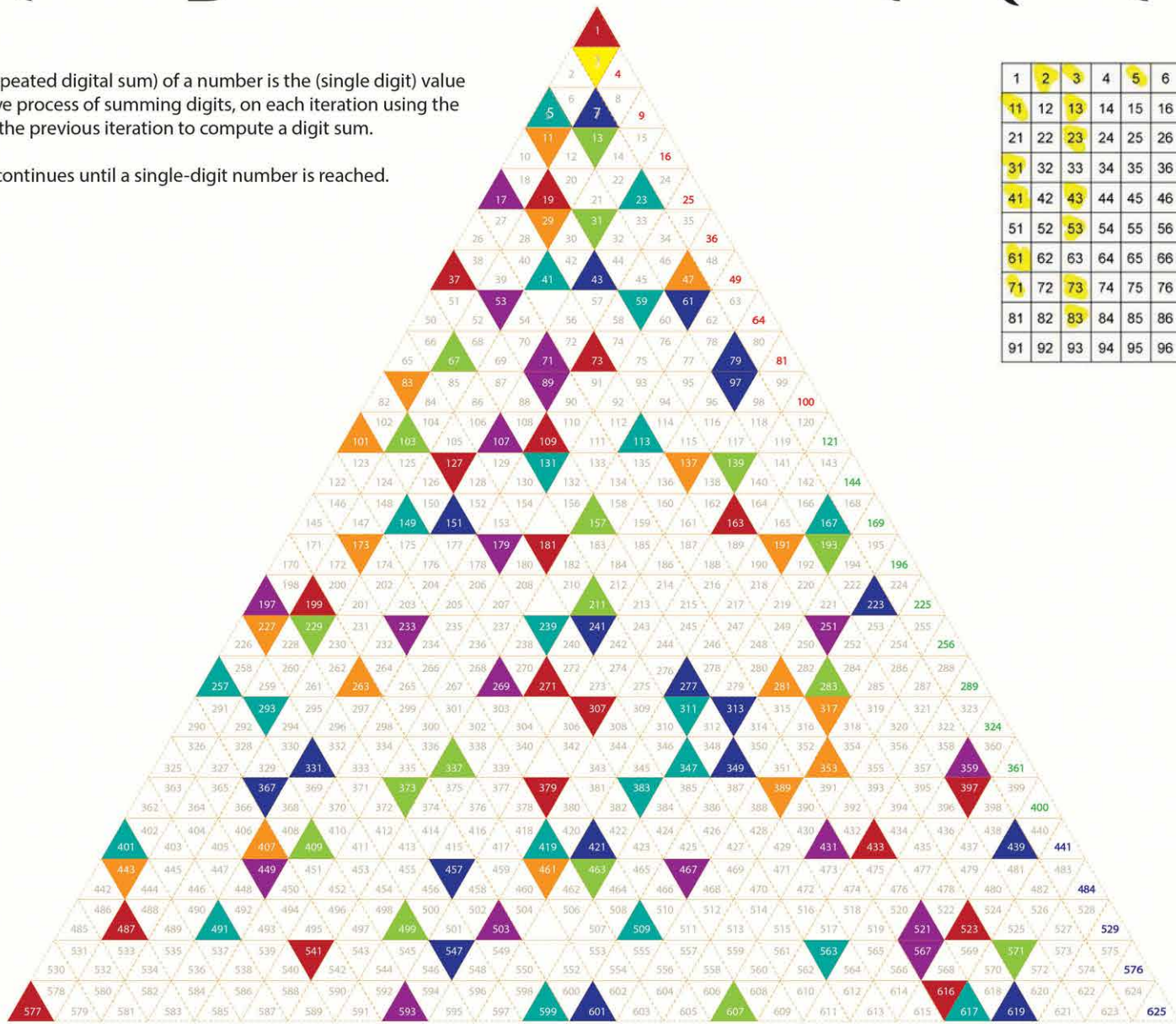

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

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Archimedes is given credit for the first calculus.

Archimedes infinite series

Today's calculus was published by Newton.

1 + 3/4 + 3/16 + 3/64 + 3/256 + 3/1024 + ...

1 + .75 + .1875 + .046875 + .01171875 + ...

$$3\left(\frac{1}{4}+\frac{1}{4^2}+\frac{1}{4^3}+\frac{1}{4^4}+\cdots\right)=1.$$

$$\frac{3}{4}+\frac{3}{4^2}+\frac{3}{4^3}+\frac{3}{4^4}+\cdots=1.$$

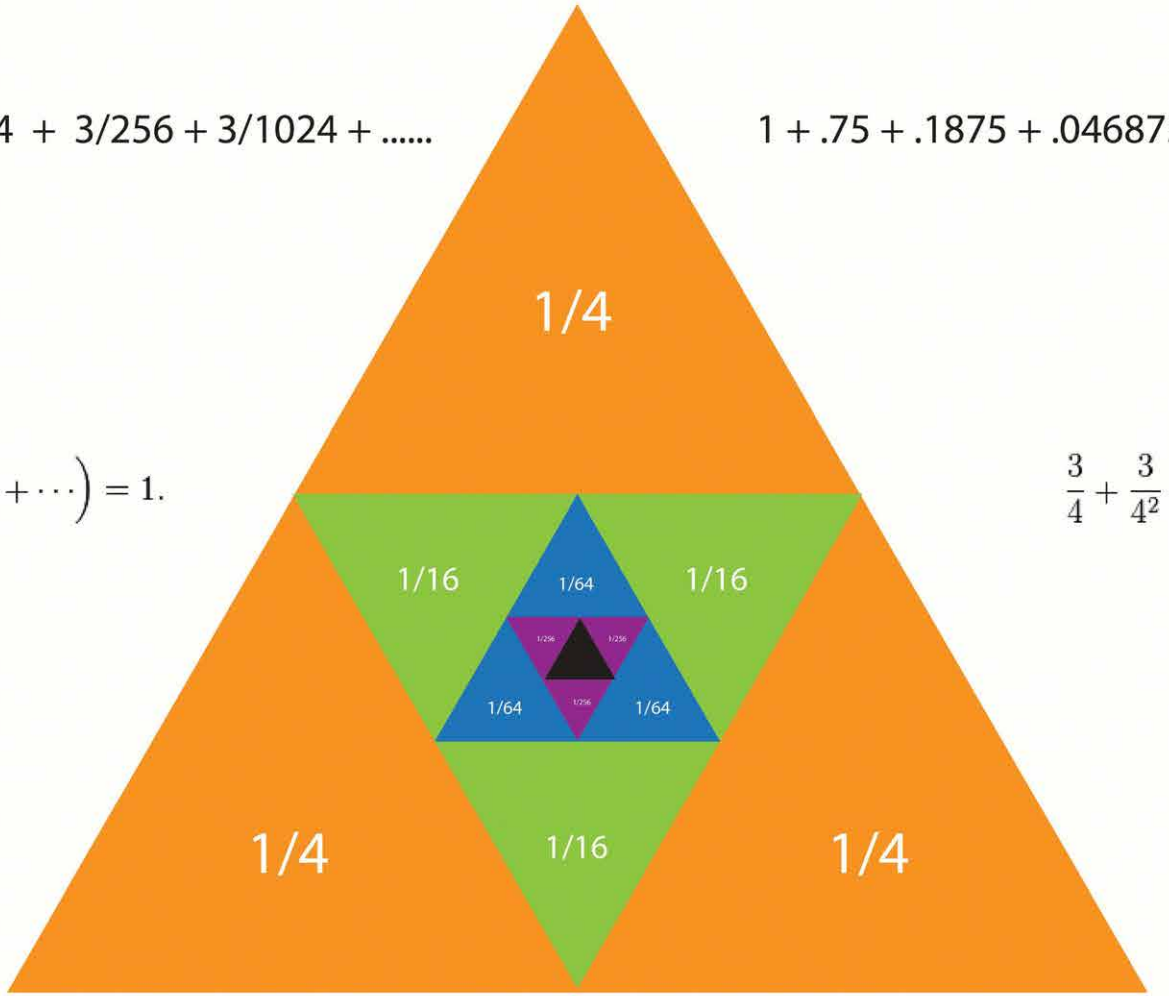

Nested convergent infinite series

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Summing a convergent infinite series

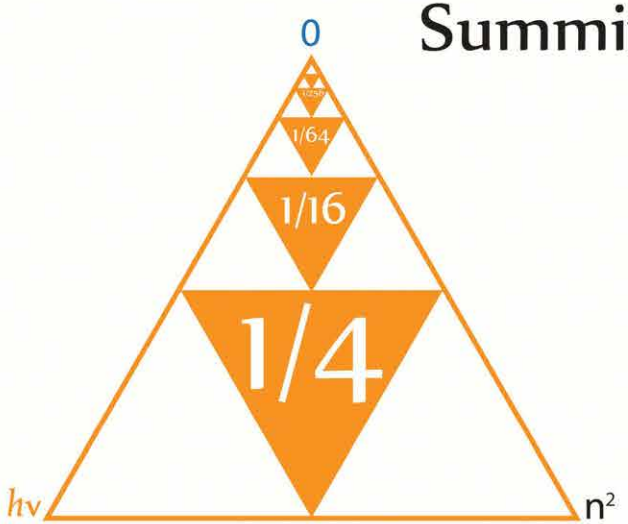

$1/4 + 1/4^2 + 1/4^3 + 1/4^4 + 1/4^5 + \ldots\ldots\ldots\ldots$

$$\sum_{n=0}^{\infty} a_n = a_0 + a_1 + a_2 + \cdots$$

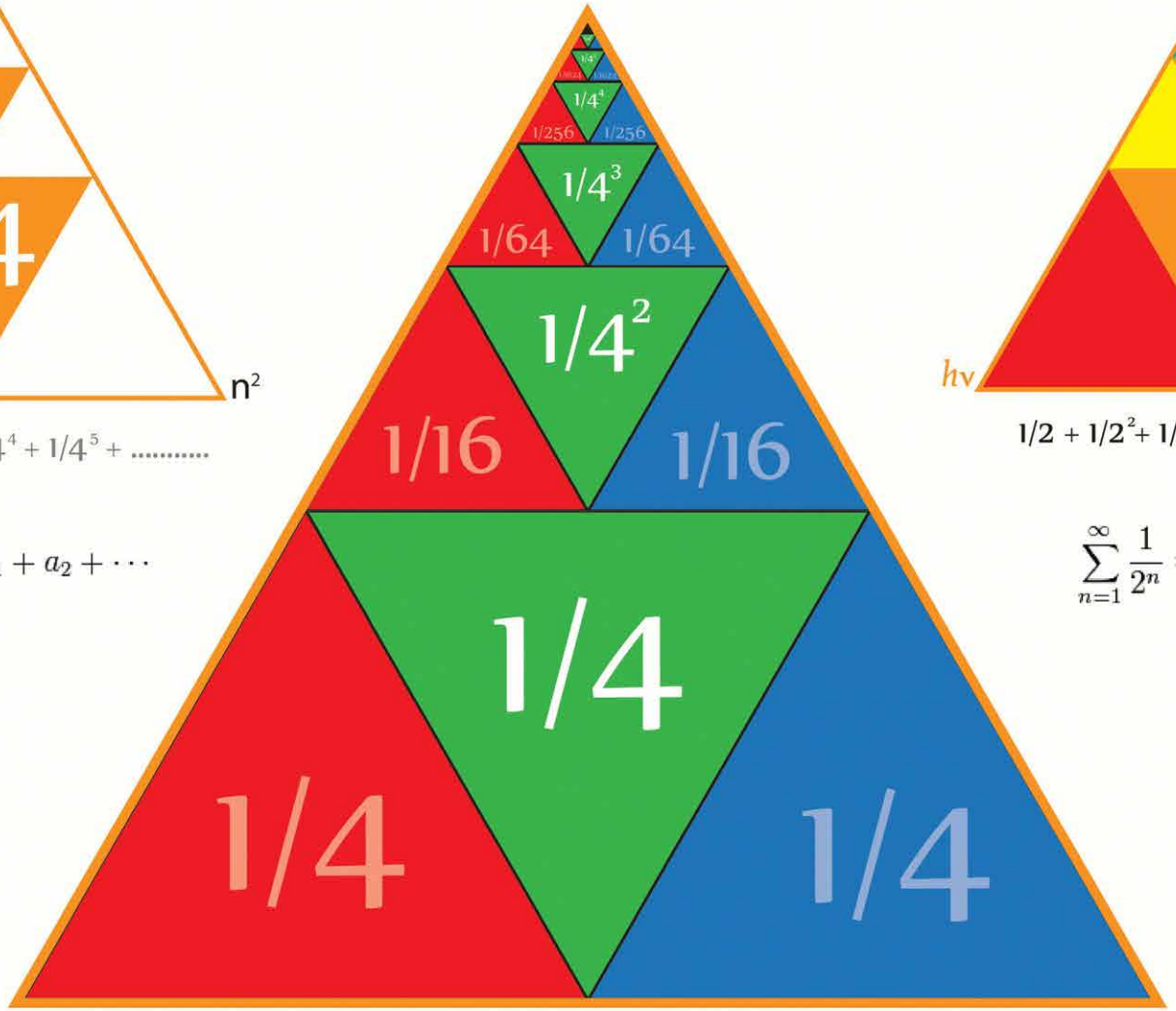

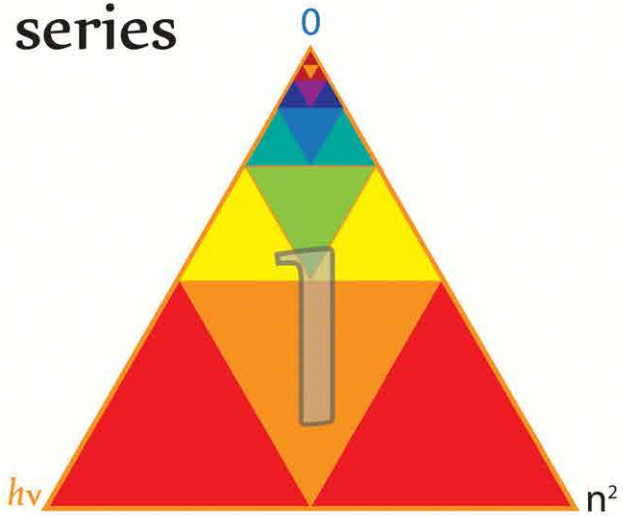

$1/2 + 1/2^2 + 1/2^3 + 1/2^4 + 1/2^5 + \ldots\ldots\ldots\ldots$

$$\sum_{n=1}^{\infty} \frac{1}{2^n} = \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots.$$

ODDS = 2n-1

$$\sum_{1}^{n} 2n-1 = n^2$$

Summing the dissimilar coloured equilateral triangles gives unity

1/3 1/3 1/3

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1/3 1/3 1/3

Summing the dissimilar coloured equilateral triangles gives unity

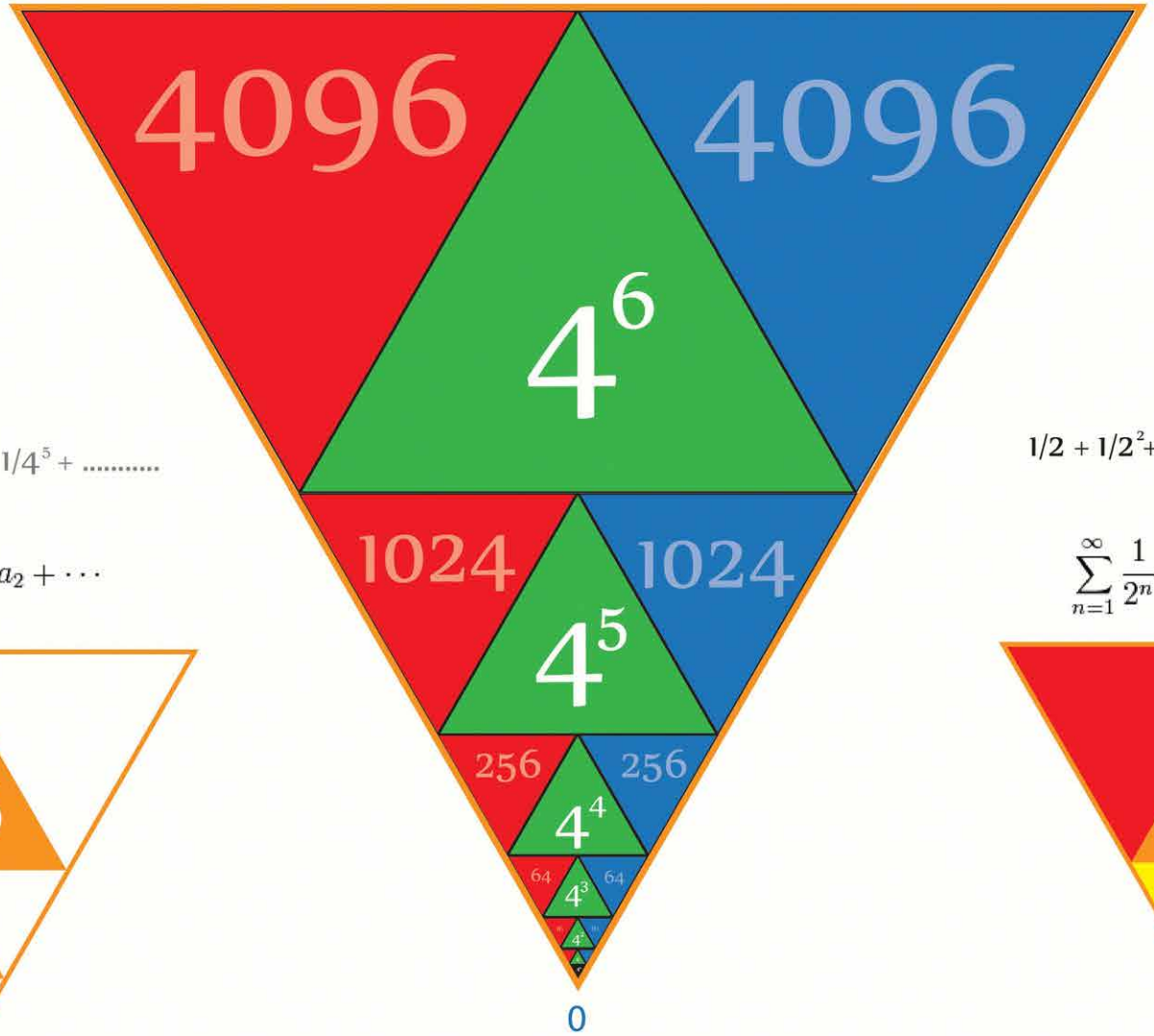

$1/4 + 1/4^2 + 1/4^3 + 1/4^4 + 1/4^5 + \ldots\ldots\ldots\ldots$

$$\sum_{n=0}^{\infty} a_n = a_0 + a_1 + a_2 + \cdots$$

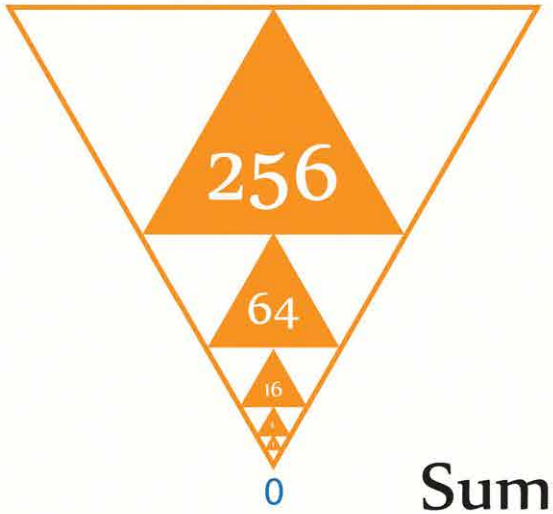

$1/2 + 1/2^2 + 1/2^3 + 1/2^4 + 1/2^5 + \ldots\ldots\ldots\ldots$

$$\sum_{n=1}^{\infty} \frac{1}{2^n} = \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots.$$

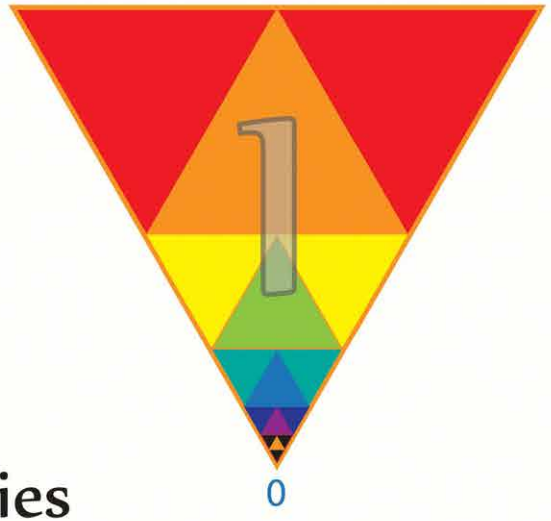

Summing a divergent infinite series

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Pietro Mengoli

(1626 – June 7, 1686)

The Basel Problem

Leonhard Euler

(15 April 1707 – 18 Sept 1783)

The Basel problem is a famous problem in mathematical analysis with relevance to number theory, first posed by Pietro Mengoli in 1644 and solved by Leonhard Euler in 1735.

$$\zeta(2) = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots = \frac{\pi^2}{6} \approx 1.644934$$

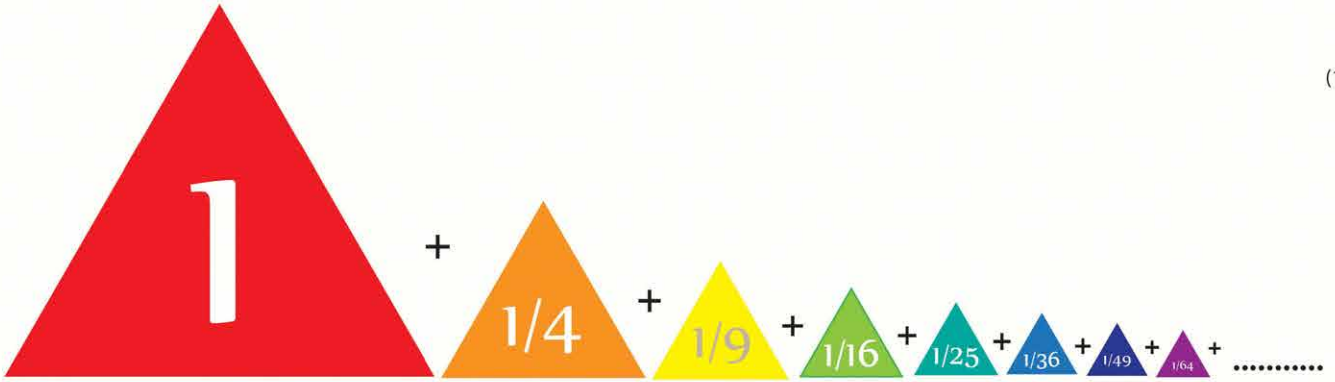

The Basel problem asks for the precise summation of the reciprocals of the squares of the natural numbers, i.e. the precise sum of the infinite series

$$f(n) = 1/n^2$$

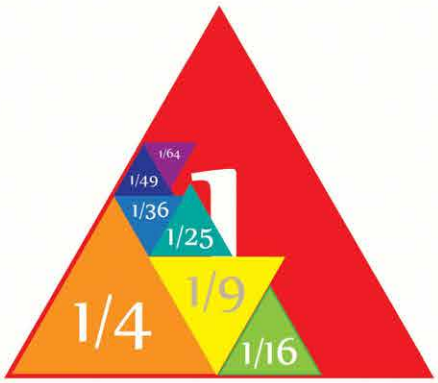

$$\approx$$

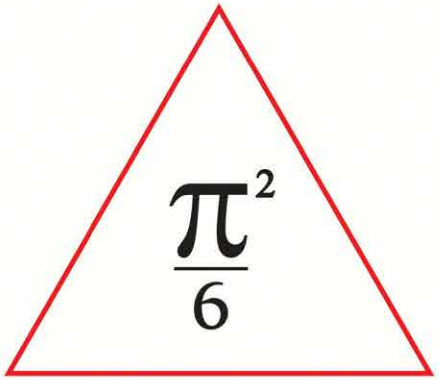

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Integrals of mass-energy

is a means of finding scalar areas using summation and limits.

Integration is a micro adding of ***CONTINUOUS*** quantities.

$$\int_{n}^{\infty} f(x)$$

Integration is a special case of summation.

Integration is defined as the limit of a summation as the number of elements approches infinity while a part of their respective value approaches zero.

Summation is the finite sum of multiple, fixed values.

$$\sum_{n}^{\infty} x$$

Summation is a macro adding of ***DISCRETE*** quantities.

The summation of equilateral energy momenta quanta with respect to their linear vector components

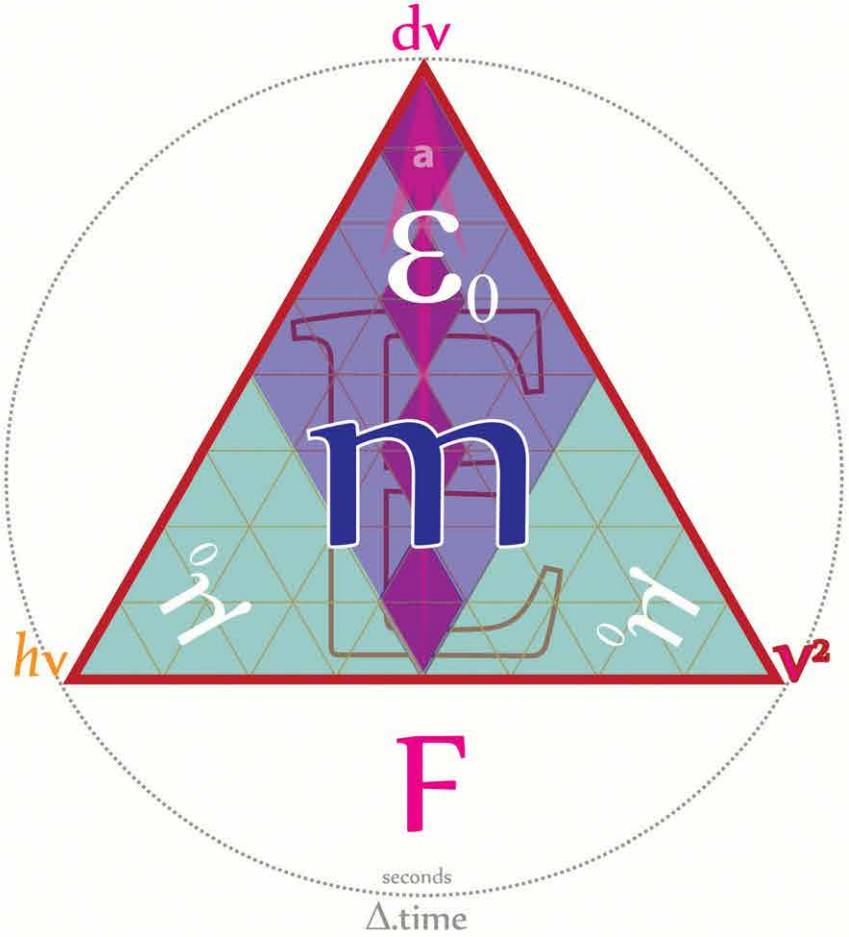

Integrating the energy quanta contained within equilateral charge geometry gives the variable Force required to acheive changes in motion [Energy, work, acceleration]

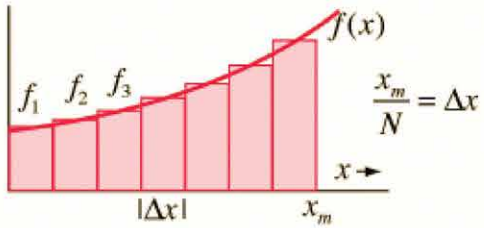

The Integral of the continuous area under the curve is the summation of an infinte number of disctrete rectangular measurements made to a specified limit

An integration isn't a simple summation, but the limit of a sequence of summations

All Planck energies are discrete equilateral geometries

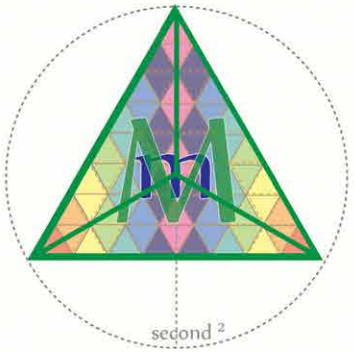

mass is the surface integral of EM energy geometries per unit of time

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"The calculus of infinitesimals"

The fundamental theorem of calculus
simply states that the sum of infinitesimal changes in a quantity over time
adds up to the net change in the quantity.

Scalar Energy

$E = mv^2$

Leibniz's vis viva (Latin for living force) is mv2,

[2 x kinetic energy]

Gottfried Wilhelm von Leibniz

(July 1, 1646 – November 14, 1716)

vector Force

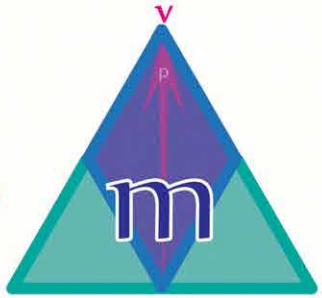

$F = m[dv/dt]$

Much of Newton's work centred around momentum and changes to it

[mass.velocity]

Sir Isaac Newton

(1643-1727)

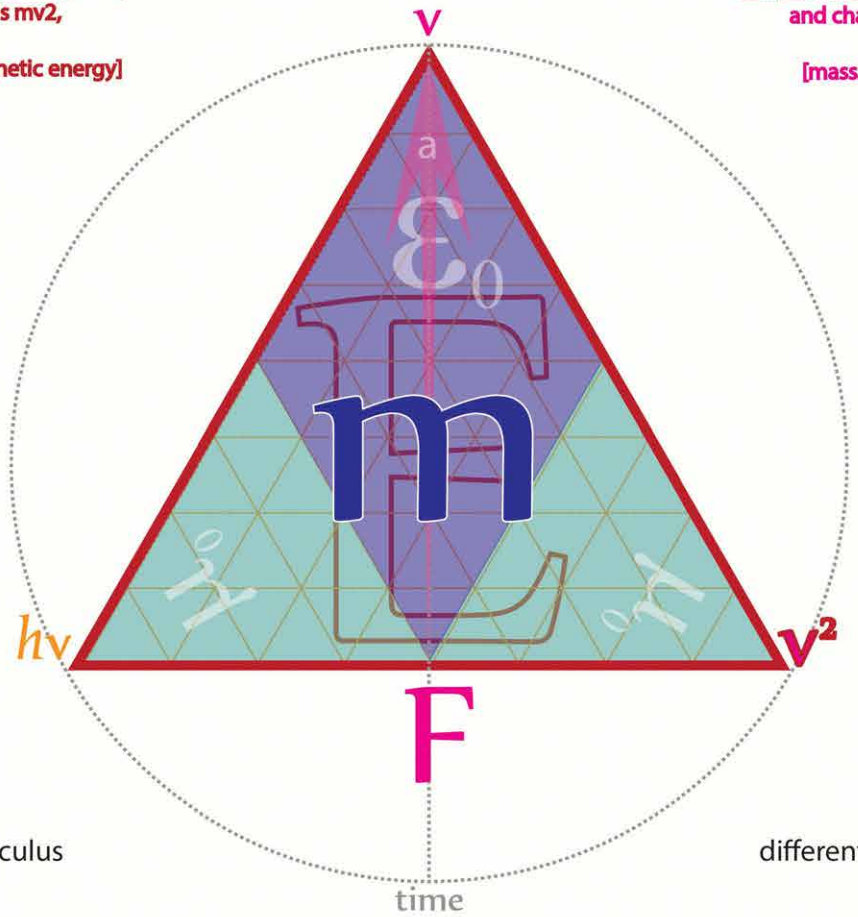

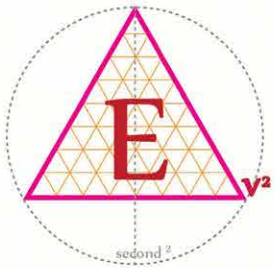

integral calculus

The founders of calculus thought of the integral as an infinite sum of rectangles of infinitesimal width

differential calculus

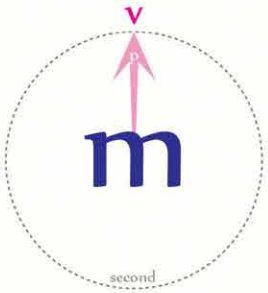

In calculus, a branch of mathematics, the derivative is a measure of how a function changes as its input changes

The fundamental theorem of calculus is a theorem that links the concept of the integral with the derivative of a function.

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Energy momentum geometries

Leibniz
scalar energies

linear momentum is the square root vector force of the scalar energy required to do a set amount of work

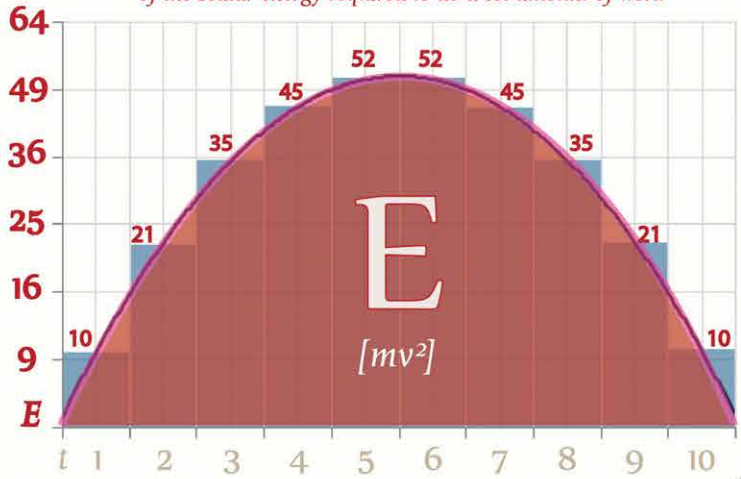

$$E = p^2$$

Energy momentum

$$kg\left[\frac{m}{s}\right]^2$$

Newton
linear momentum

$$d[mv]/dt = dp/dt = ma$$

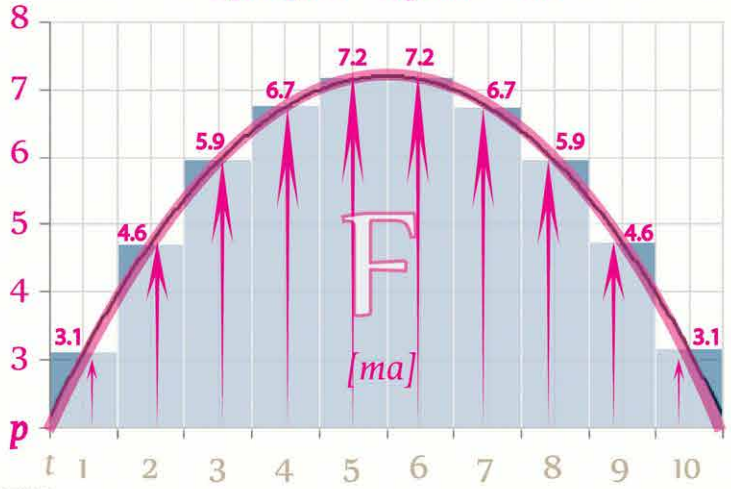

print out this page

then cut out the 10 Planck energy momenta triangles shown

slice fine lines along the pink linear momentum arrows with a razor blade or similar as highlighted under the Newtonian acceleration curve

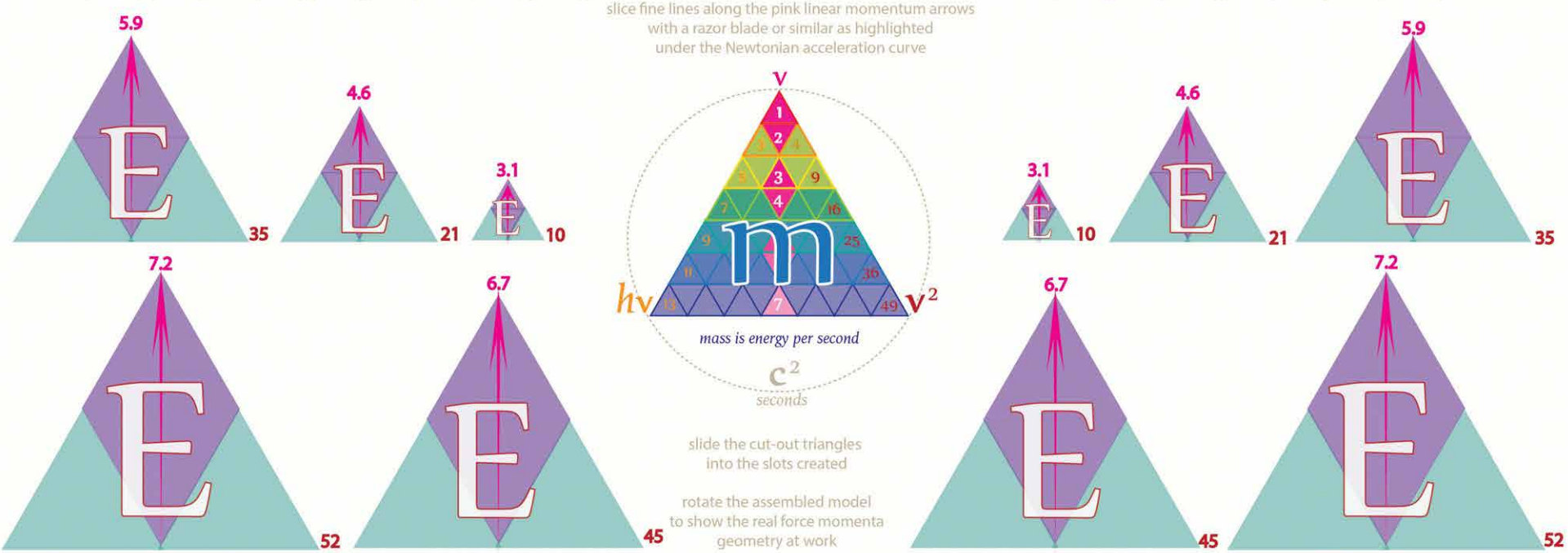

slide the cut-out triangles into the slots created

rotate the assembled model to show the real force momenta geometry at work

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linear momentum is the square root vector force
of the scalar energy required to do a set amount of work

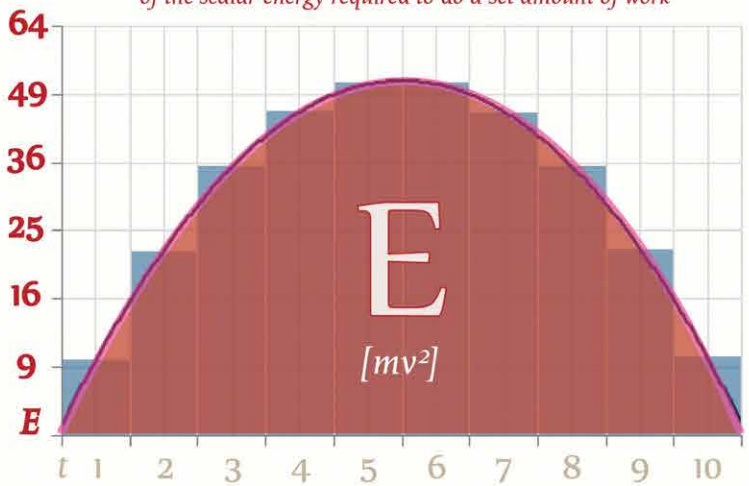

p

linear momentum

$kg\frac{m}{s}$

print out this page

$d[mv]/dt = dp/dt = ma$

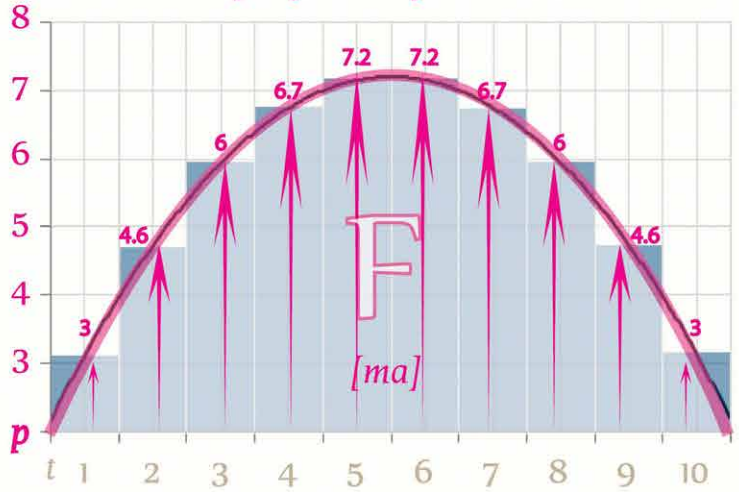

Leibniz
scalar energies

$$E = mv^2$$

mass-energy momenta relationship

square root equilateral energy is linear momentum

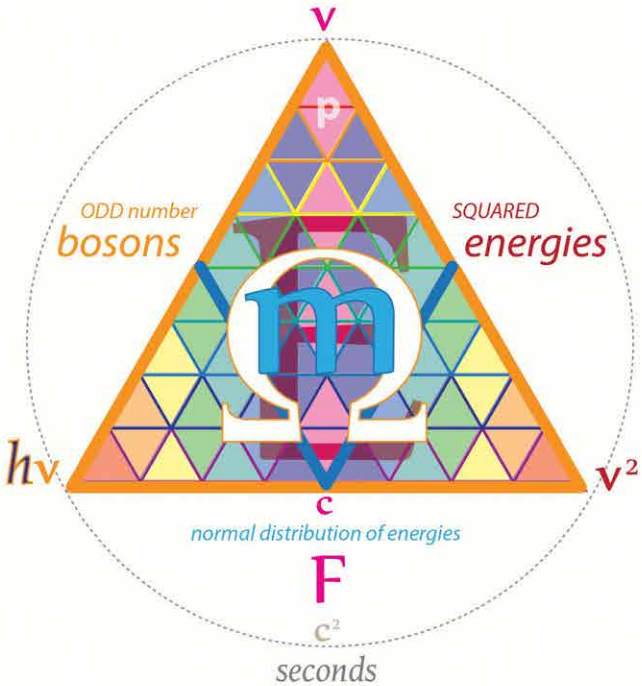

Newton
linear momentum

$$F = ma$$

mass is a scalar constant relating Force to acceleration

$$F = m\frac{\Delta v}{\Delta t}$$

Planck quanta and their vector linear momentum
lie at 90 degrees to the angle use in the graphs of motion in calculus

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Differentiation

Differentiation is concerned with things like speeds and accelerations, slopes and curves etc.
These are Rates of Change, they are things that are defined locally.

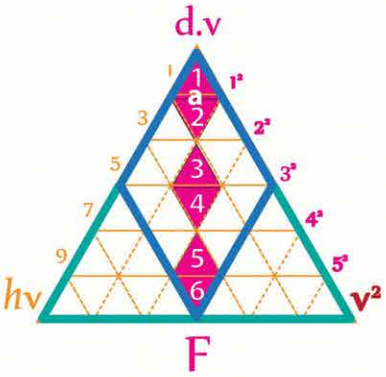

An increase in a force opposing an object's vector velocity results in
DECCELERATION

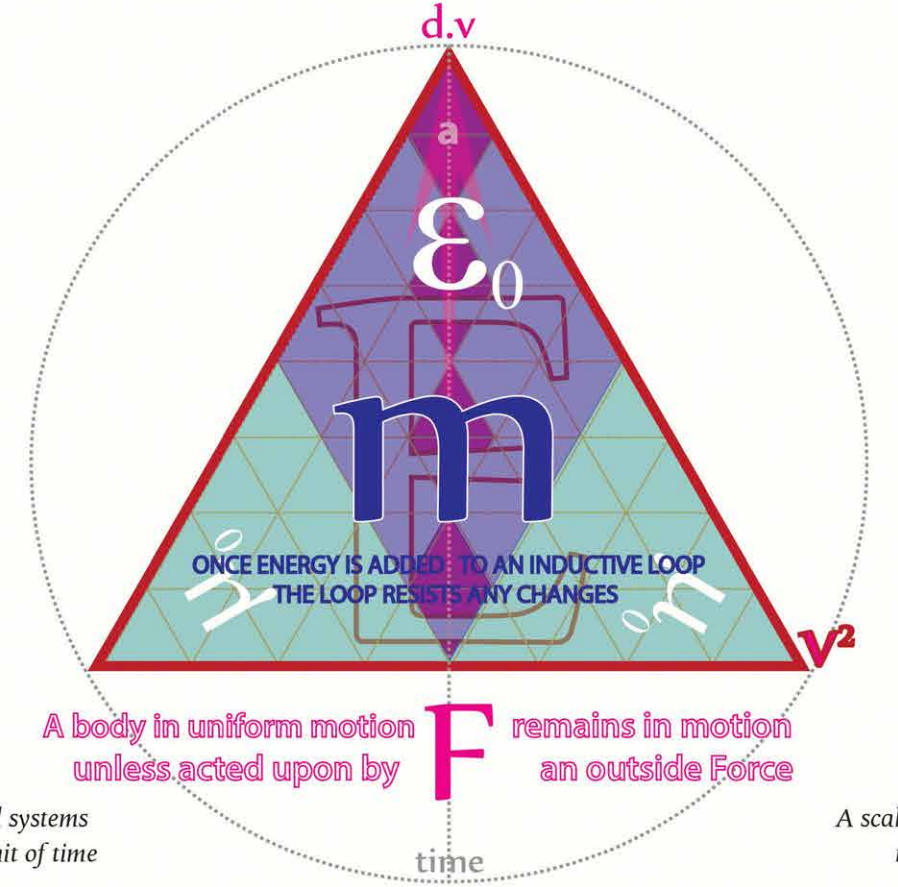

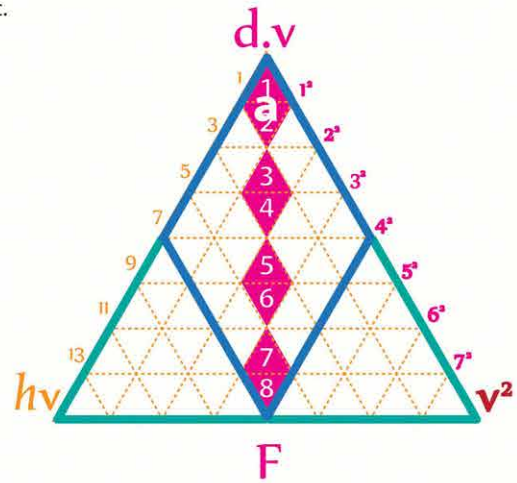

An increase in a force in line with an object's vector velocity results in
ACCELERATION

A linear measure of Forces acting on physical systems resulting in changes to distance covered per unit of time

A scalar measure of Forces acting on physical systems resulting in changes to their rate of motion

$$v = \frac{\Delta d}{\Delta t}$$

$$= m/s$$

$$F = ma$$

In physics, the derivative of the displacement of a moving body with respect to time is the velocity of the body, and the derivative of velocity with respect to time is acceleration.

$$\sum \mathbf{F} = \frac{d\mathbf{p}}{dt} = m\frac{d\mathbf{v}}{dt} + \mathbf{v}\frac{dm}{dt}$$

Newton's second law of motion states that the derivative of the momentum of a body equals the force applied to the body.

$$a = \frac{\Delta v}{\Delta t}$$

$$= m/s^2$$

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Visualising the geometric half-truths of relativistic physics

The source of all the physical relationships of mass-energy momenta and the constants in Physics is the Equilateral Triangle (and all texts must be corrected)

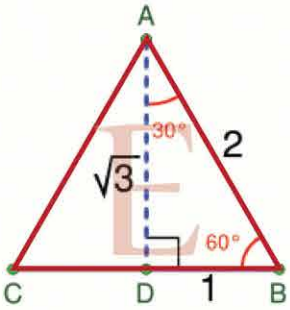

Energy geometries within Physics including Special Relativity with its Lorentz corrections have historically been incorrectly illustrated through the geometry of right angled triangles

F

$$\sum \mathbf{F} = \frac{\mathrm{d}\mathbf{P}}{\mathrm{d}t} = m\frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} = m\mathbf{a}$$

$$\mathbf{F} = m\mathbf{a}\,.$$

Physics is geometry, one cannot be separated from the other

Equilateral geomtries lead to a intuitive understandings of Physics, Chemistry, Electrodynamics and Gravitation along with all the other apsects of Nature.

$$mv^2 = E = hv^2$$

ENERGY

6.629432673 e-34 J

Planck quanta

$$[m\Omega v^2]$$

mass velocity

7.376238634 e-51 kg

momentum

$$p^2 = mv^2$$

$$E = m_0c^2 + K$$

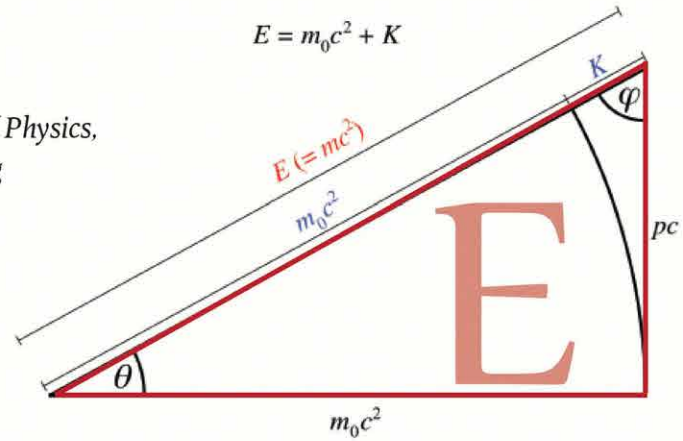

$$E^2 = p^2c^2 + m_0^2c^4$$

Generalizing, we see that the square of the total energy, mass, or distance in spacetime is the sum of the components squared.

We can see an origin of distance in spacetime relating to velocity in pc in which Energy is subject to Lorentz corrections [v/c]

$$E = pc.$$

Additionally, EM mass can be directly related tot the Energy content of a body by the velocity of Energy

$$E = mc^2$$

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Velocity

In physics, velocity is the measurement of the rate and direction of change in the position of an object.

It is a vector physical quantity; both magnitude and direction are required to define it.

The scalar absolute value (magnitude) of velocity is speed, a quantity that is measured in metres per second (m/s or ms−1) when using the SI (metric) system.

$\frac{m}{s}$

Speed is the scalar value of the Distance traveled per unit of TIme

$$\bar{\mathbf{v}} = \frac{\Delta \mathbf{x}}{\Delta t}.$$

Velocity is the vector value of the Distance traveled per unit of Time

$\frac{\vec{m}}{s}$

Velocity squared is the scalar value of the Distance traveled per unit of Time squared (Energy of a given spatial volume)

$\frac{m^2}{s^2}$

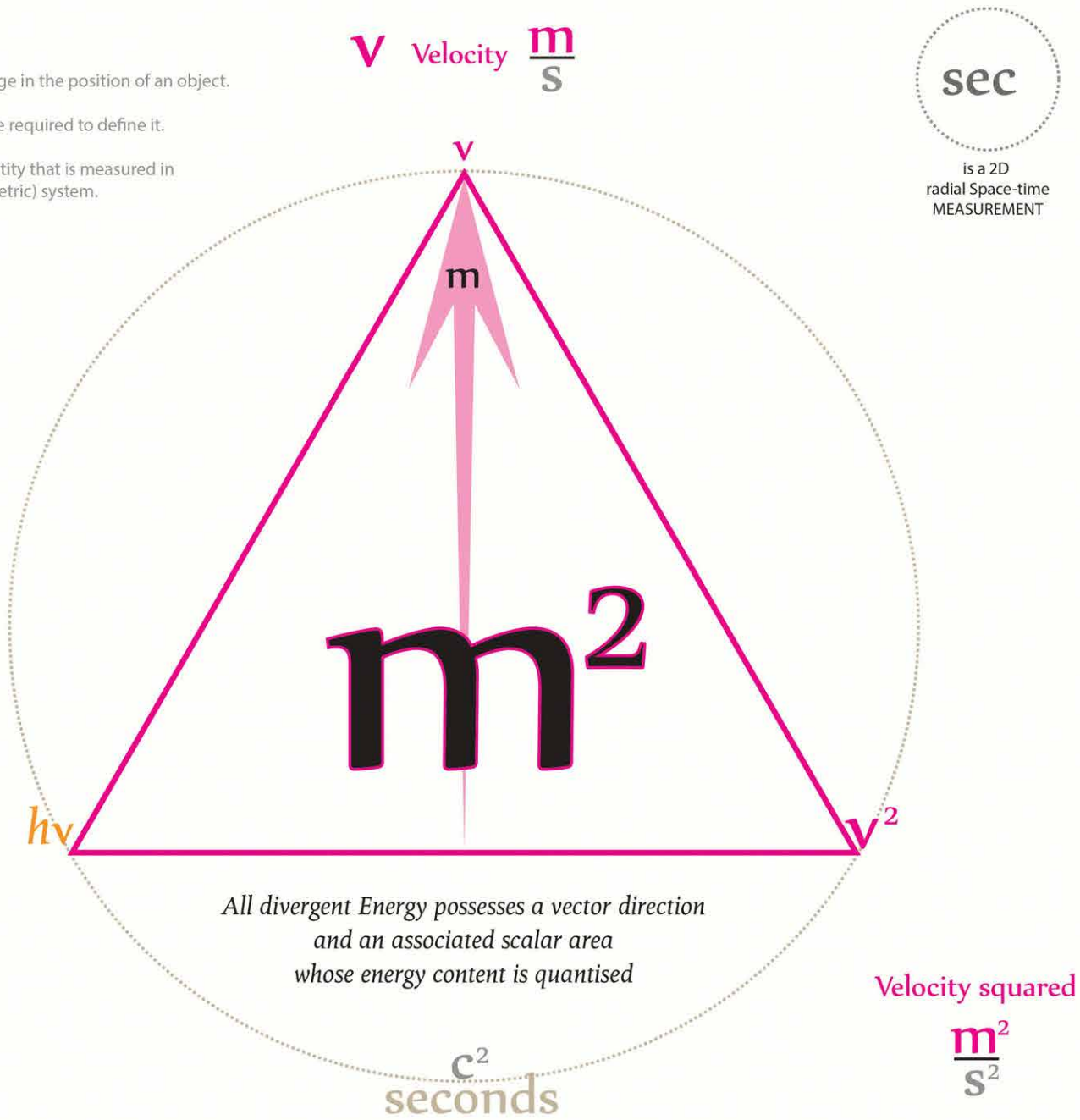

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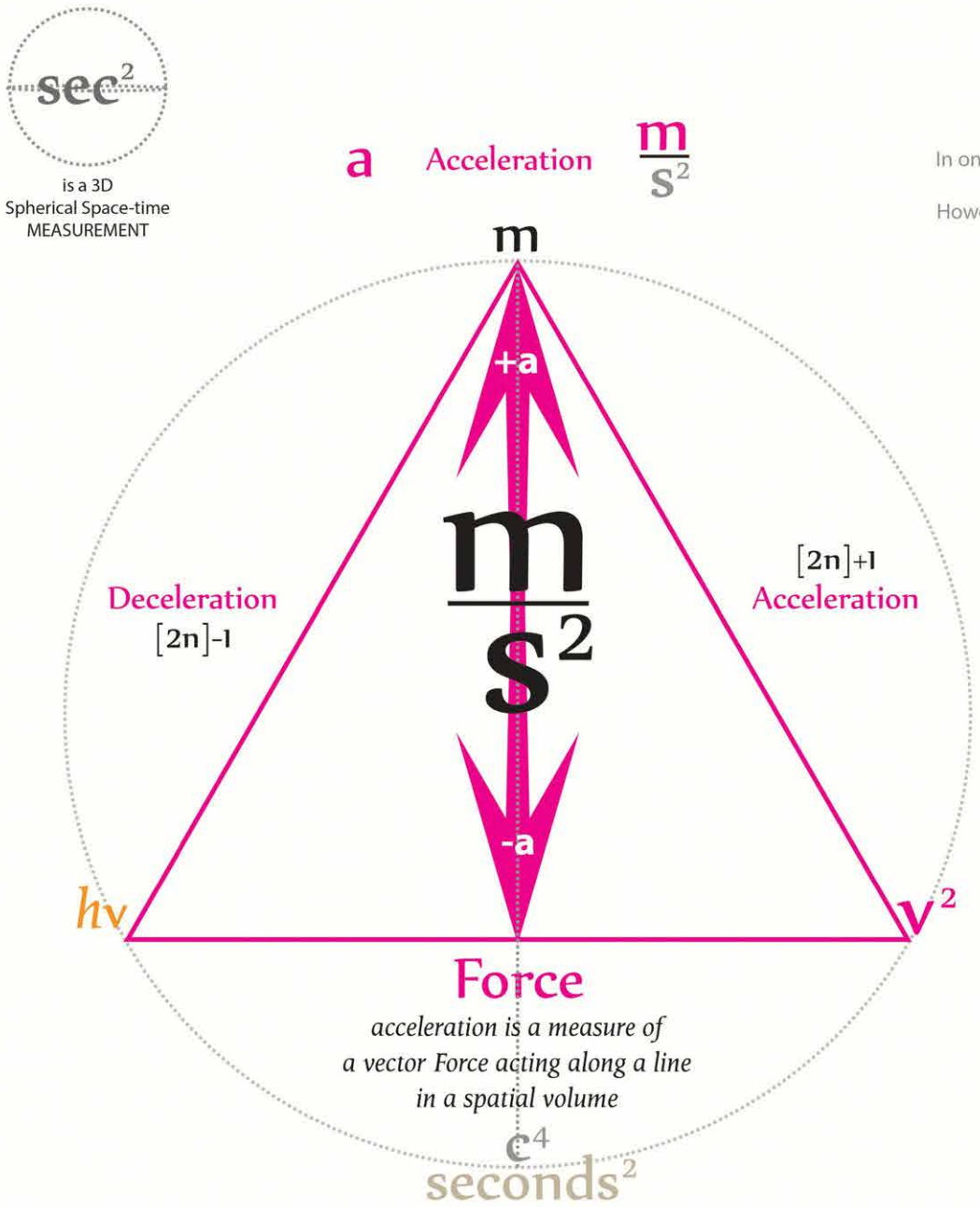

Acceleration

In physics, acceleration is the rate of change of velocity over time [dt]

In one dimension, acceleration is the rate at which something speeds up or slows down.

However, since velocity is a vector, acceleration describes the rate of change of both the magnitude and the direction of velocity.

Acceleration has the dimensions [Length]/[Time Squared]
In SI units, acceleration is measured in meters per second squared (m/s^2).

$$a = \frac{\Delta y}{\Delta x} = \frac{\Delta v}{\Delta t}.$$

In classical mechanics, for a body with constant mass,
the acceleration of the body is proportional to the net force acting on it
(Newton's second law)

$$F = ma \longrightarrow a = F/m$$

Force

$$kg\,\frac{m}{s^2}$$

Additionally, for a mass with constant velocity,
(ie in an inertial frame)
the energy of motion is expressed as its momentum
(acceleration causes changes in Energy-momentum)

$$p = kg\,\frac{m}{s}$$

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Momentum

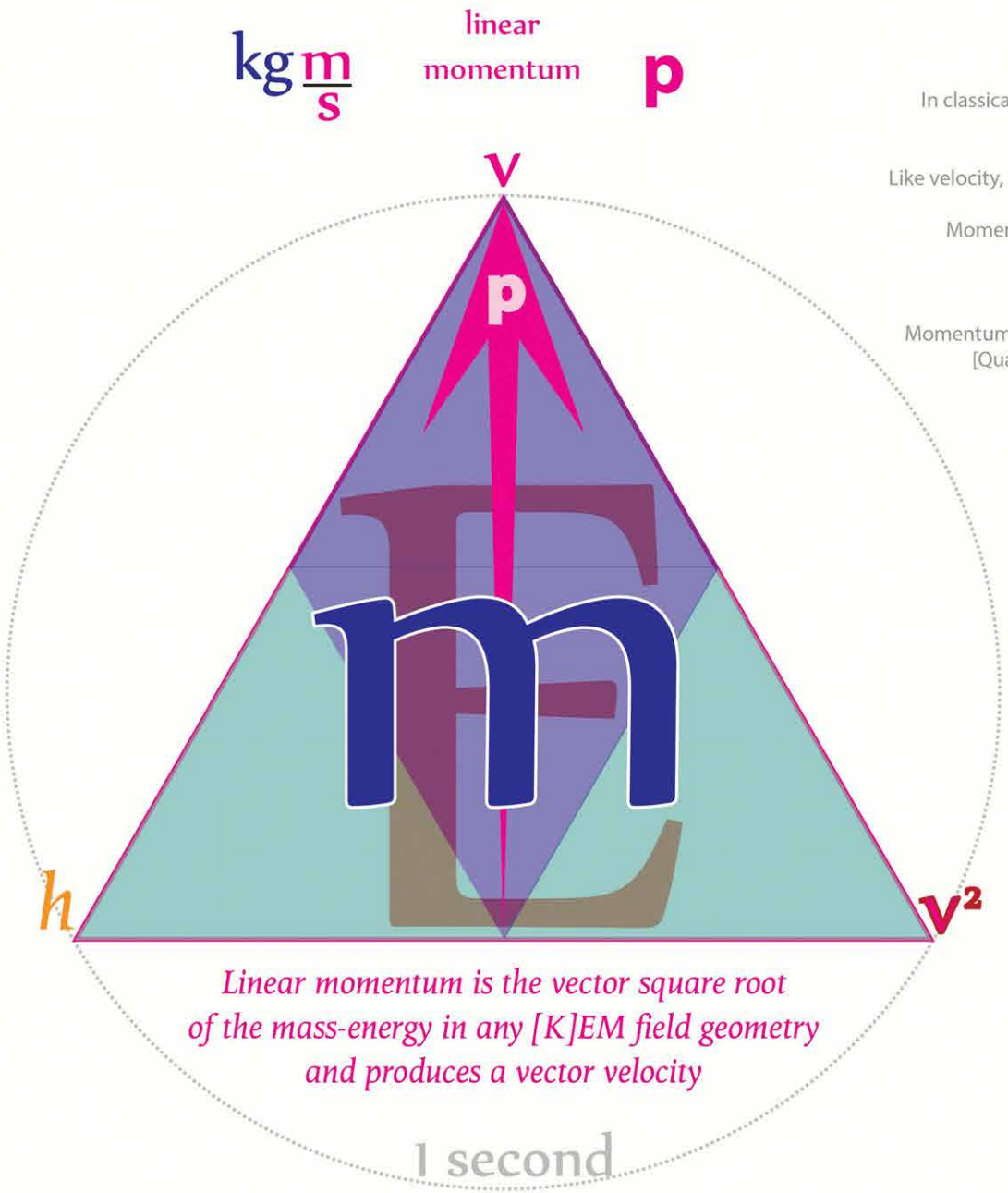

In classical mechanics, momentum (pl. momenta; SI unit kg·m/s, or, equivalently, N·s) is the product of the mass and velocity of an object (p).

Like velocity, momentum is a vector quantity, possessing a direction as well as a magnitude.

Momentum is a conserved quantity (law of conservation of linear momentum), meaning that if a closed system is not affected by external forces, its total momentum cannot change.

Momentum should be referred to in its specific forms to distinguish it in its various forms [Quantised Angular, Linear, Rotational and quantum/nuclear momentum]

$$\mathbf{p} = \frac{h\mathbf{v}^2}{\mathbf{v}} = m\mathbf{v}$$

Although originally expressed in Newton's Second Law, the conservation of momentum also holds in special relativity and, with appropriate definitions, a (generalized) momentum conservation law holds in electrodynamics, quantum mechanics, quantum field theory, and general relativity.

In relativistic mechanics, non-relativistic momentum is further multiplied by the Lorentz factor.

$$\mathbf{p}^2 = E = m\mathbf{v}^2$$

Energy can be expressed as the square of linear momentum

$$\mathrm{kg}\,\frac{\mathrm{m}^2}{\mathrm{s}^2}$$

equilateral Planck energy momenta

$$m\Omega\mathbf{v}^2$$

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Energy-momentum relationship

The total number of equilateral Planck quanta [quantised mass-energy momenta] is directly related to the square of its linear momentum [mass-velocity]

Quantum Mechanics

$$h = \frac{E}{v^2}$$

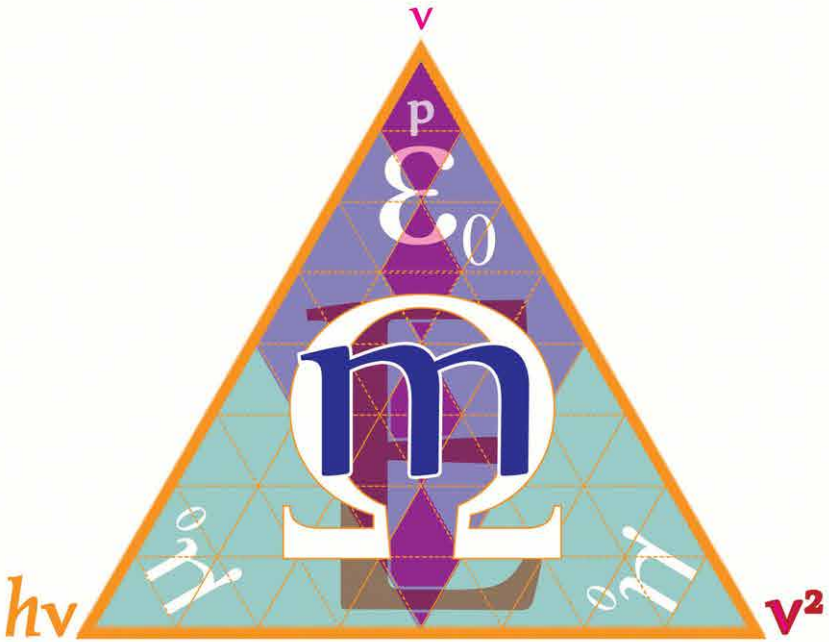

Newtonian physics

$$m = \frac{E}{v^2}$$

Quantised energy equilateral momenta

$$hv^2$$

Quantised Energy momenta is related to Scalar mass energy momenta through the equilateral geometry of Planck's constant

Scalar energy linear momentum

$$pv$$

$$m\Omega v^2 = E = mv^2$$

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Inertial resistance to Force

Inertia is the resistance of any physical object
to a change in its state of motion.

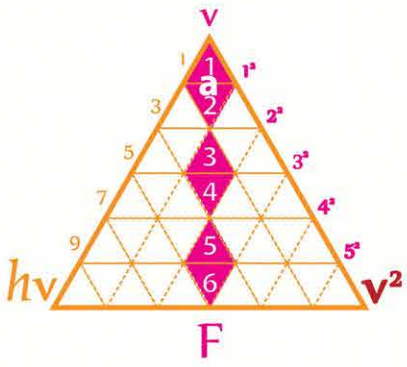

Changes to mass-velocity require a corresponding change to boson quanta

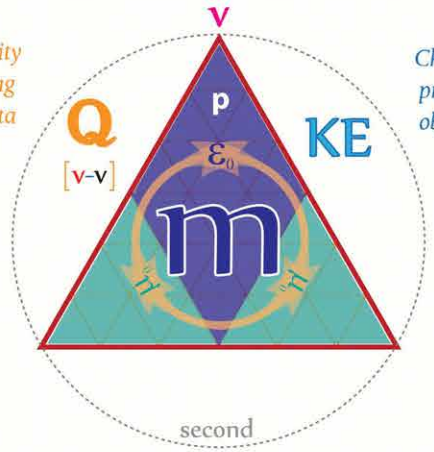

Changes to mass-velocity produces a change in an object's Kinetic Energies

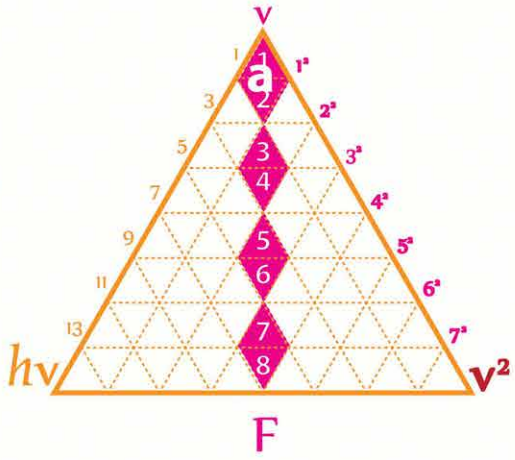

$$E = mc^2$$

The total intrinsic momenta of all energy waveforms is the sum of their constituent Quantised Angular momenta (mass-energy momenta)

$$M_0 = m/c^2$$

Any change in motion results in changes to the Charge geometries creating in turn proportional changes to KEM mass and momenta components

$$F = ma$$

The 'inductive resistance' of Charge quanta fields to changes in their mass-energy momenta content is what we term Inertia

$$KEM = Mv^2$$

Matter in motion has Kinetic Energies in addition to invariant rest mass-Energy

KE = RE - rest Matter

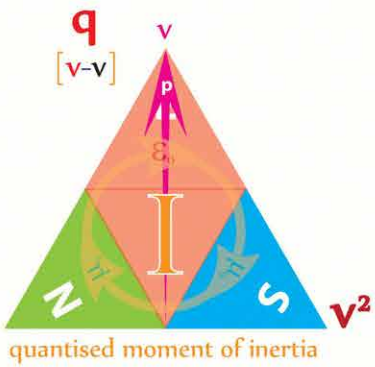

Any change to an object's velocity results in a corresponding change to its mass-Energy momenta which is reflected by its inertia

$$p^2 = E = mv^2$$

Inertial mass can be related to Charge through inductive Planck quanta

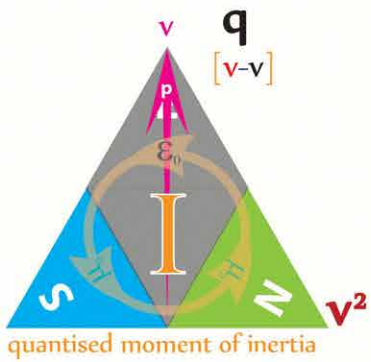

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Quantised Angular momentum

As it is a physical [equilateral] geometry QAM is conservative in any system where there are no external Forces and serves as the foundational geometric source for all the conservation laws of physics

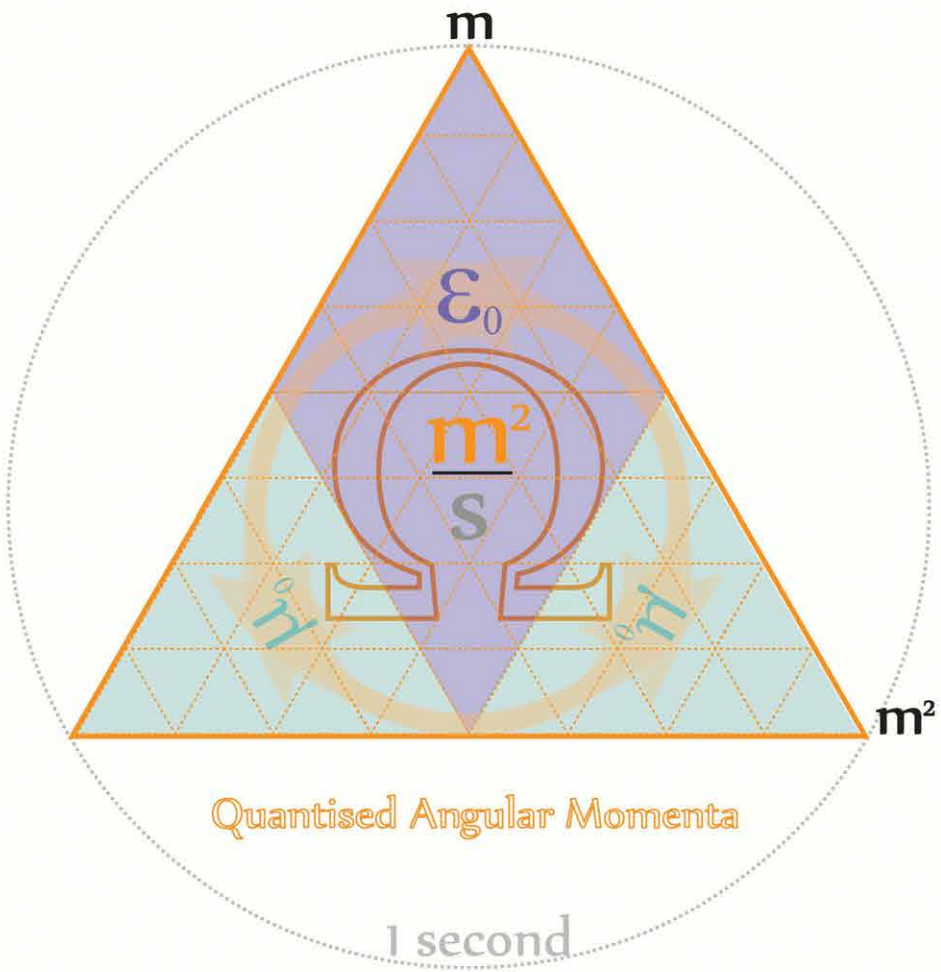

Angular momentum is sometimes described as the rotational analog of linear momentum, in Tetryonics it is revealed to be the equilateral geometry of quantised mass-energy momenta within any defined space-time co-ordinate system

A major re-definition of quantised angular momentum in physics is revealed

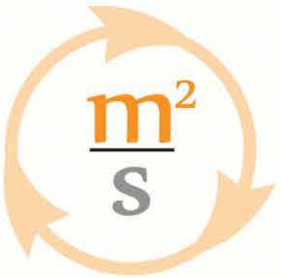

classical rotational angular momentum

≈

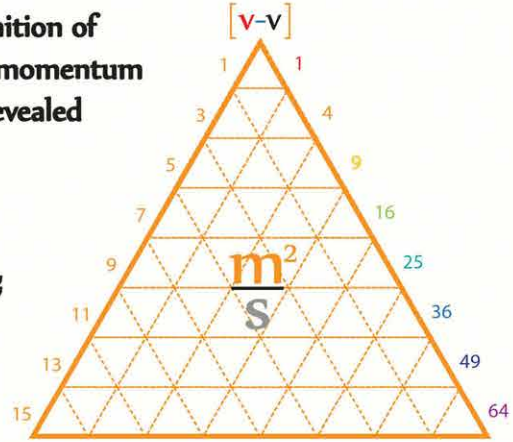

Quantised Angular momentum

In quantum mechanics, angular momentum is quantised – that is, it cannot vary continuously, but only in ODD number "quantum steps" between the allowed SQUARE nuclear Energy levels

In physics, angular momentum, moment of momentum, or rotational momentum is a conserved vector quantity that can be used to describe the overall state of a physical system.

When applied to specific mass-Energy-Matter systems QAM reveals the true quantum geometry and nature of Energy in our universe

h

$kg\frac{m^2}{s}$

$m\Omega$

mass x QAM

Planck's Constant

Normally viewed as an expression of rotational momentum Quantised Angular Momentum [QAM] is in fact a result of the equilateral geometric quantization of mass-energy

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Charged geometries

All charge geometries are nett divergent

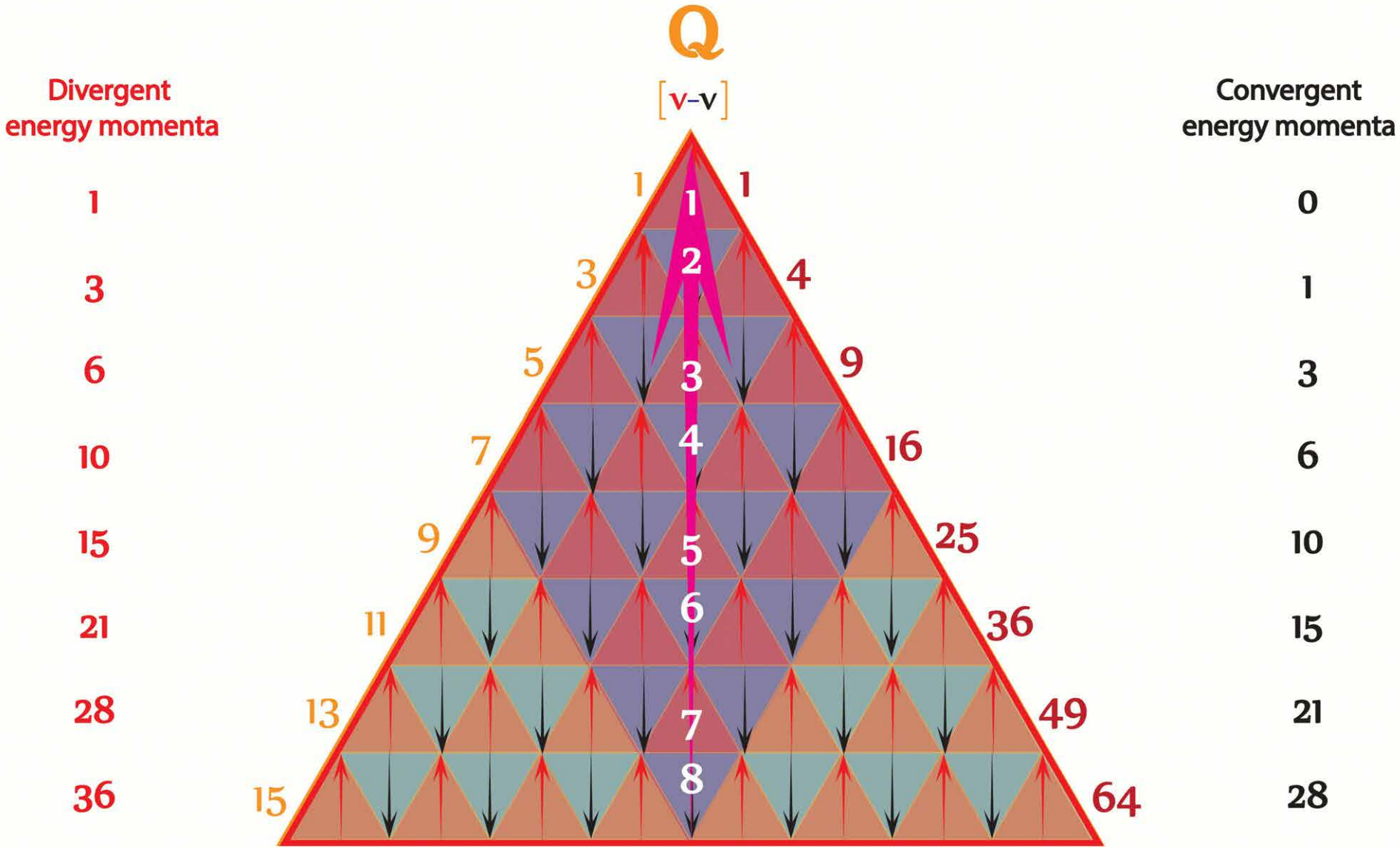

All charge geometries are comprised of finite equilateral energy momenta quanta

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Renormalisation

Renormalization was first developed in quantum electrodynamics (QED) to make sense of infinite integrals in perturbation theory. The problem of infinities first arose in the classical electrodynamics of point particles in the19th and later in the calculation of Gravitational fields in General Relativity in the early 20th century.

In QED Infinities must be cancelled

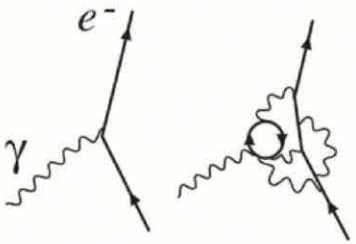

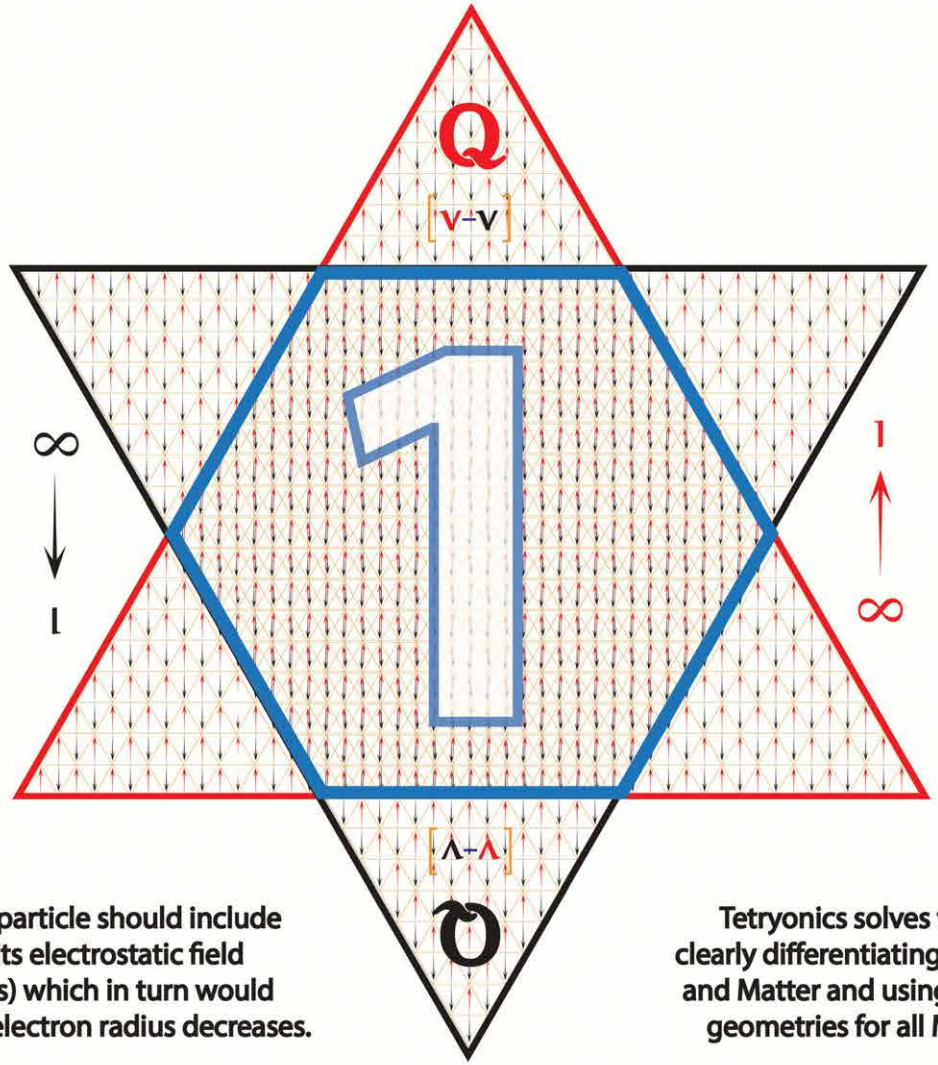

In Tetryonics Infinities do not exist

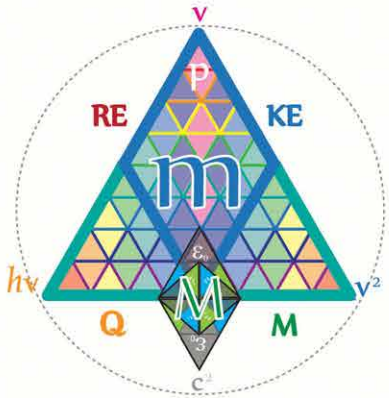

The mass of a charged particle should include the mass-energy in its electrostatic field (Electromagnetic mass) which in turn would approach infinity as the electron radius decreases.

Tetryonics solves the problem by clearly differentiating between EM mass and Matter and using finite equilateral geometries for all Matter in motion

Initially viewed as a suspicious provisional procedure by some of its originators, renormalization was eventually embraced as an important and self-consistent tool in several fields of physics and mathematics.

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2D space [c²]

The adjective Cartesian refers to the French mathematician and philosopher René Descartes who developed the coordinate system in 1637

Since then many other coordinate systems have been developed such as the polar coordinates for the plane, and the spherical and cylindrical coordinates for three-dimensional space.

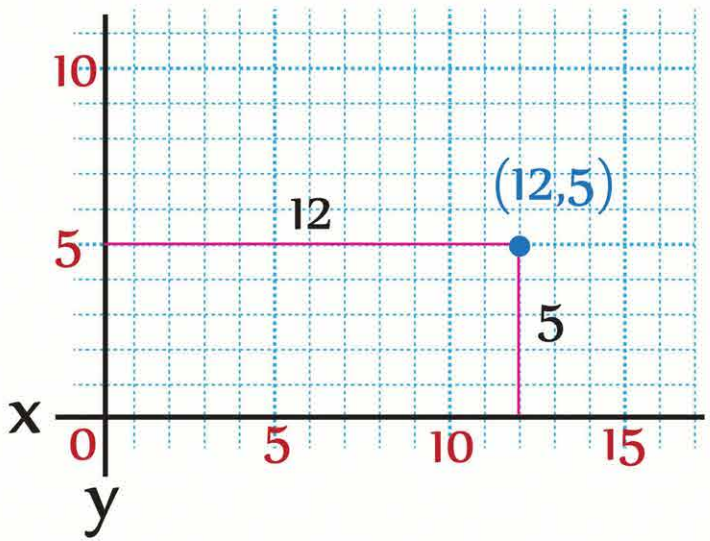

Cartesian coordinates are the foundation of analytic geometry, and provide enlightening geometric interpretations for many other branches of mathematics, such as linear algebra, complex analysis, differential geometry, multivariate calculus, group theory, and more

Mapping 3D spaces using Recti-linear co-ordinates

Cartesian coordinates can be defined as the positions of the perpendicular projections of a point onto the two or more axes, expressed as signed distances from the origin.

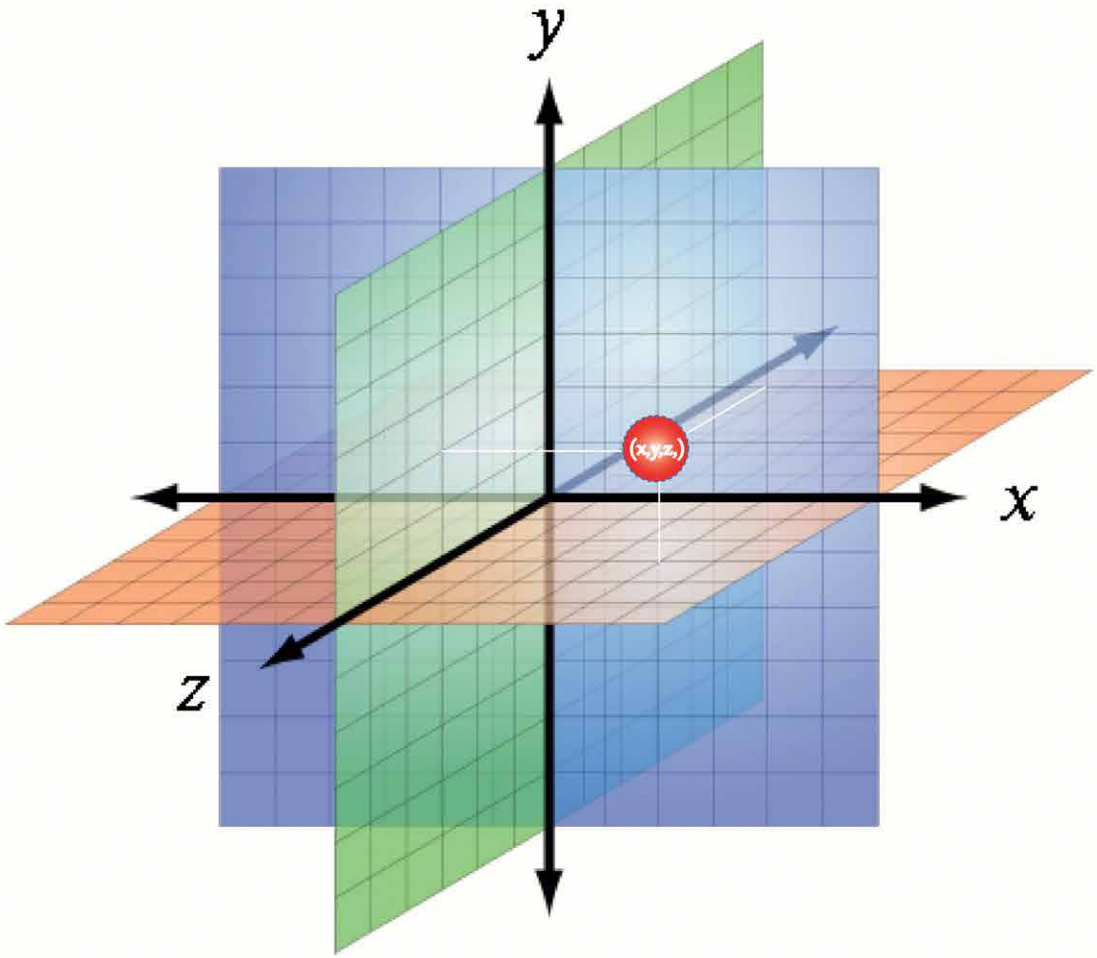

3D Cartesian co-ordinate [c³] systems are distinct from spherical co-ordinate [c⁴] systems

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Polar co-ordinates

In mathematics, the polar coordinate system is a two-dimensional co-ordinate system in which each point on a plane is determined by a distance from a fixed point and an angle from a fixed direction.

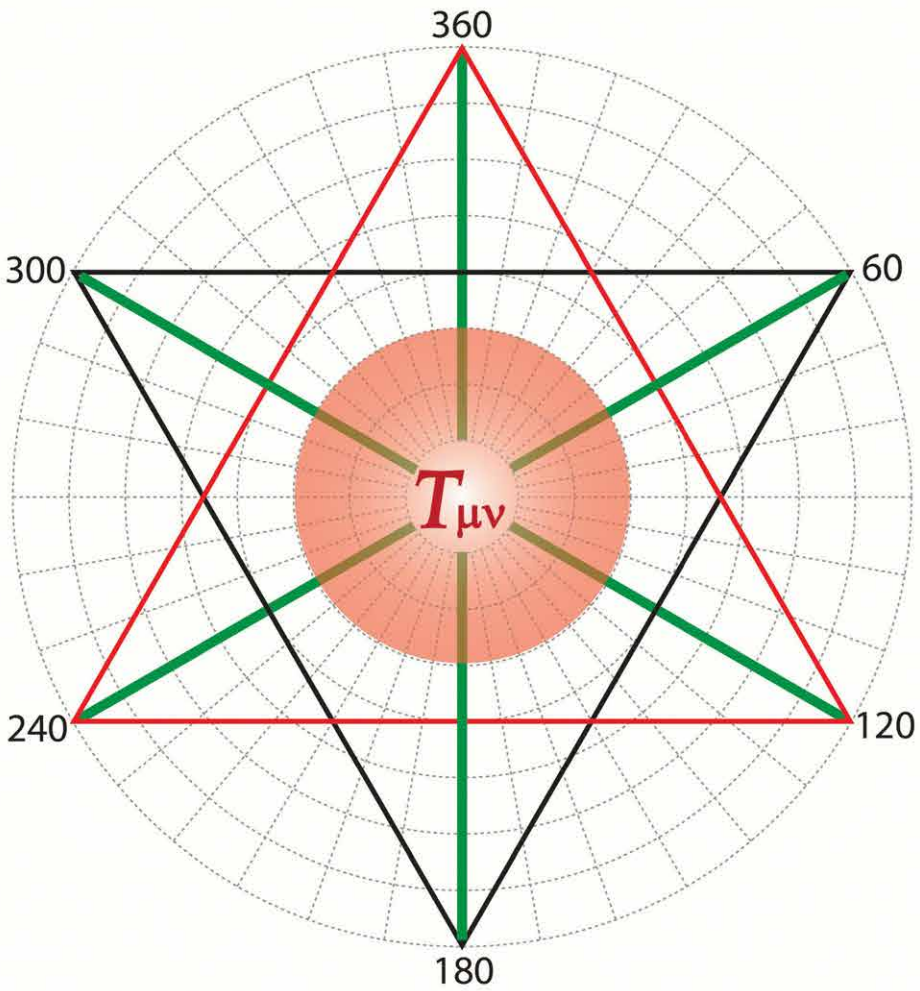

In geometry, curvilinear coordinates are a coordinate system for Euclidean space in which the co-ordinate lines may be curved.

Action Dynamics

Curvilinear co-ordinates may be derived from a set of rectilinear Cartesian coordinates by using a locally invertible transformation that maps one point to another in both systems

Metric Tensors

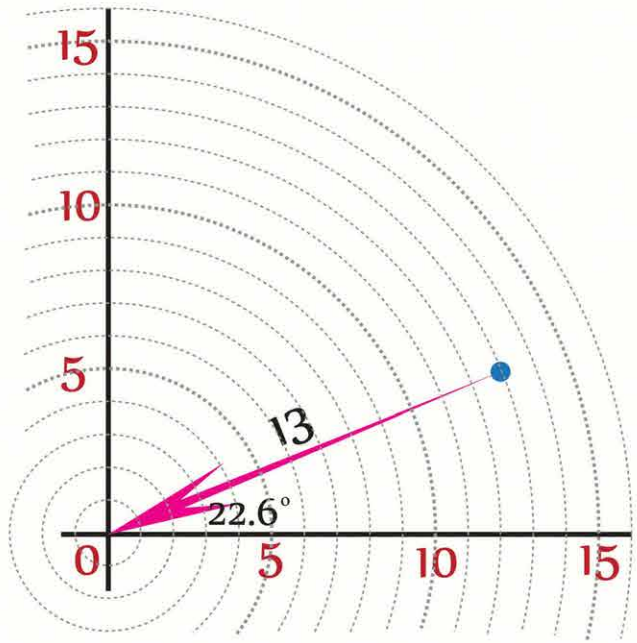

Gravitational acceleration

Polar or curvilinear co-ordinate systems are used extensively by Einstein in his theory of General Relavtivity

Reimannian curved space-time

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Co-ordinate transformations

There are many different possible coordinate systems for describing geometrical figures and they can all be related to one another.

Such relations are described by coordinate transformations which give formulas for the coordinates in one system in terms of the coordinates in another system

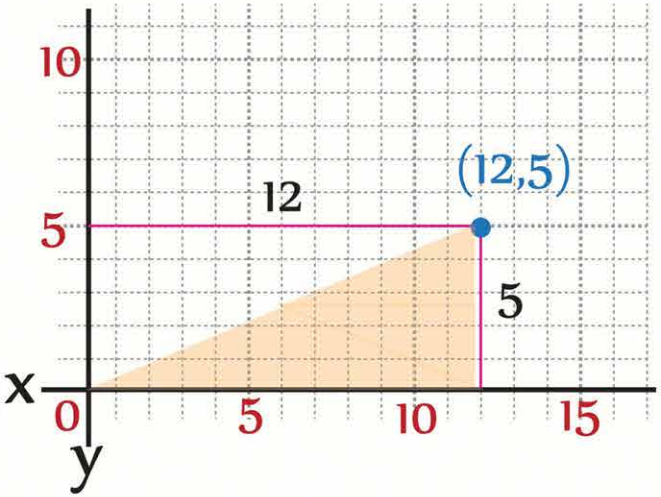

Converting between Polar and Cartesian coordinates

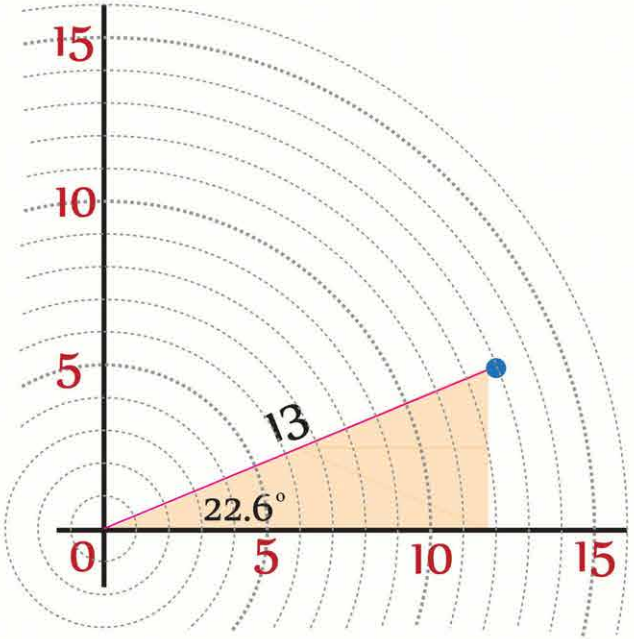

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$= \tan^{-1}(5/12)$$

$$= 22.619$$

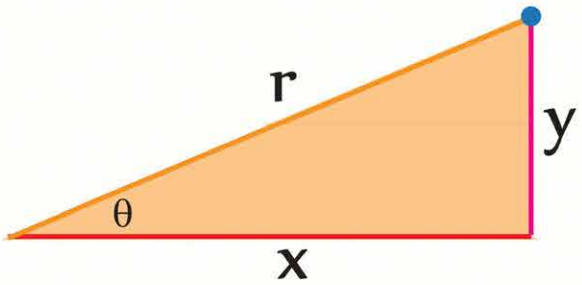

$$r^2 = 12^2 + 5^2$$

$$= \sqrt{169}$$

$$= 13$$

solving for the triangle using trigometric functions

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Spatial co-ordinate systems

Spacetime is any mathematical co-ordinate system or model that combines space and time into a single continuum.

Spacetime is usually interpreted with space as being three-dimensional with time playing the role of a fourth dimension that is different from the spatial dimensions.

From a Euclidean space perspective, the universe has three spatial dimensions and one dimension of time [reflected by quantised angular momentum].

Cubic

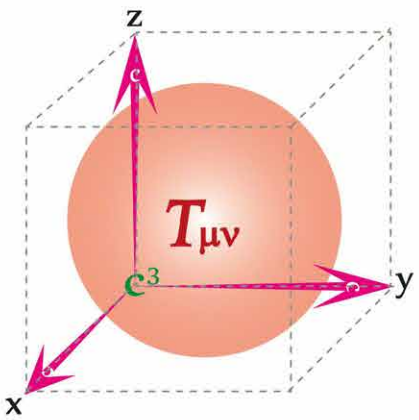

Spherical

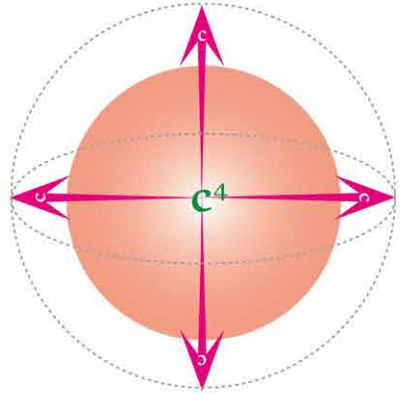

seconds²

Tetryonics maps spatial co-ordinates through the momenta vectors of equilateral Energy

Cartesian Space-Time

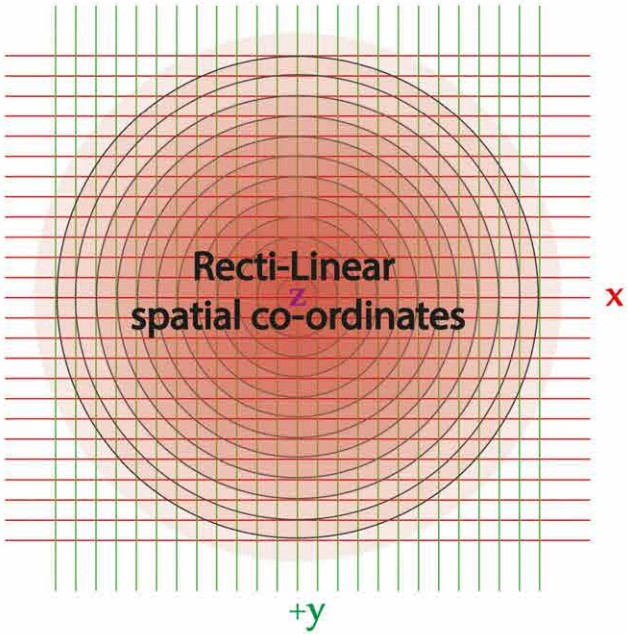

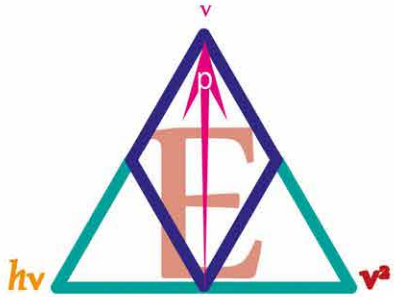

EM mass-ENERGY momenta are equilateral geometries

Mapping equilateral Energy geometries onto recti or curvi-linear spatial co-ordinate systems introduces mathematical complexity to a otherwise simplistic geometry for all EM mass-Energy-Matter interactions

Tetryonic Space-Time

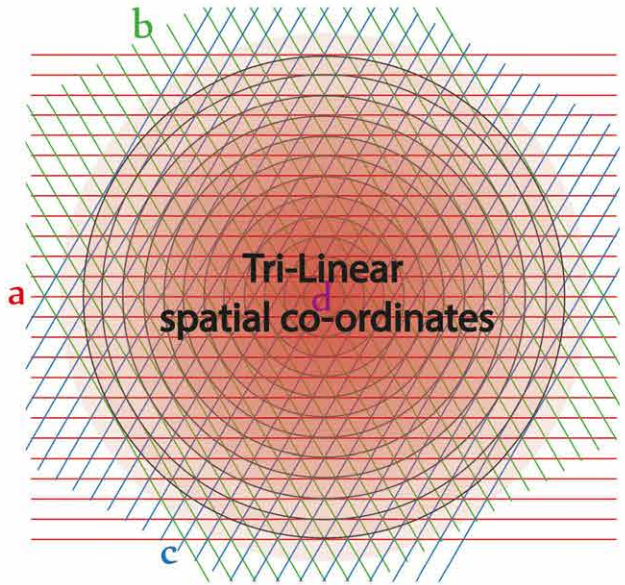

In physics spatial co-ordinates to date have been based on Cartesian co-ordinates when in fact Energy momenta follow a Tri-Linear co-ordinate geometry

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vectors

1 Dimensional velocity

Euclidean

2 Dimensions velocity squared

$$m = \frac{E}{c^2}$$

mass-energy equivalence

mass-Matter

$$\frac{m}{c^2} = M$$

equivalence

$T_{\mu\nu}$

energy-Matter equivalence

$$M = \frac{E}{c^4}$$

GR fails differentiate betweem EM mass-ENERGY-Matter unlike Tetryonic theory

Cartesian co-ordinates

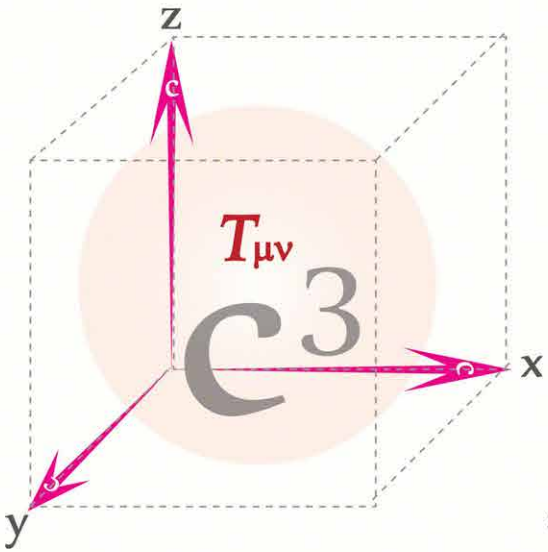

3 Dimensions velocity cubed

Spherical

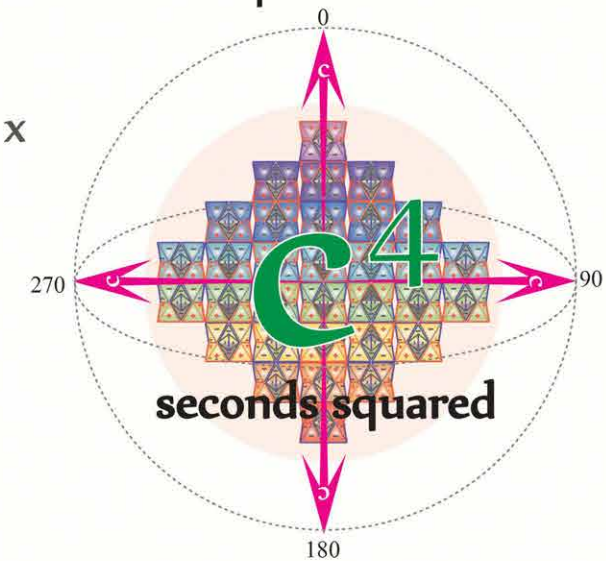

3 Dimensions quadrature velocity

Space-time co-ordinates

The propagation of Energy momenta forms distinct spatial co-ordinate systems

Where angles are typically measured in degrees (°) or radians (rad), where 360° = 2π rad = τ radians.

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Tetryonic co-ordinate systems

Energy per second

m

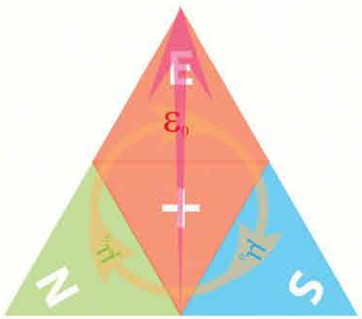

2D mass-energy geometries

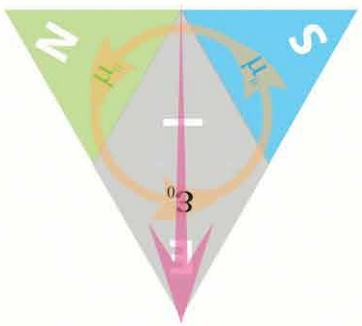

Energy per second squared

M

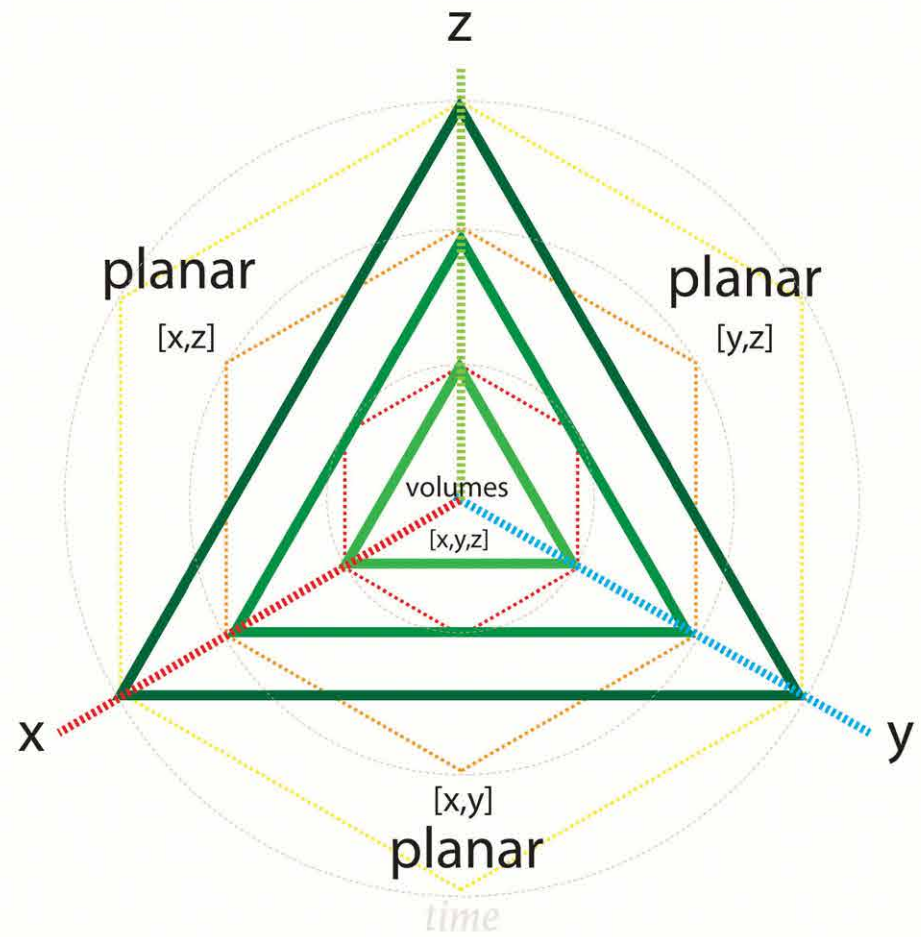

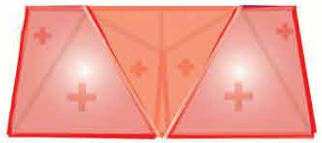

Proton

3D Matter topologies

Neutron

Planar mass-energy geometries have no z-components

Differentiation between 2D mass-energy & 3D Matter is key to extending our understanding of physics

Matter topologies have z-components

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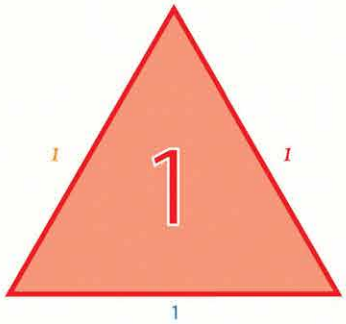

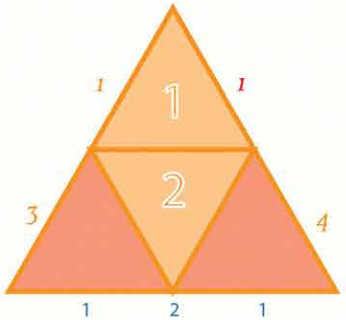

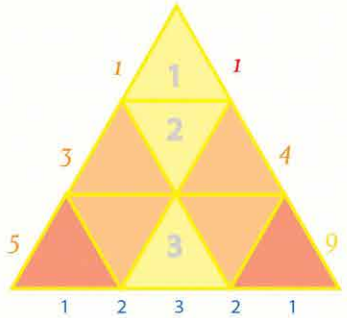

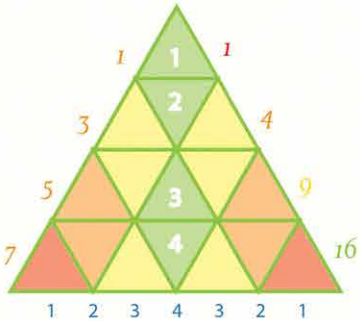

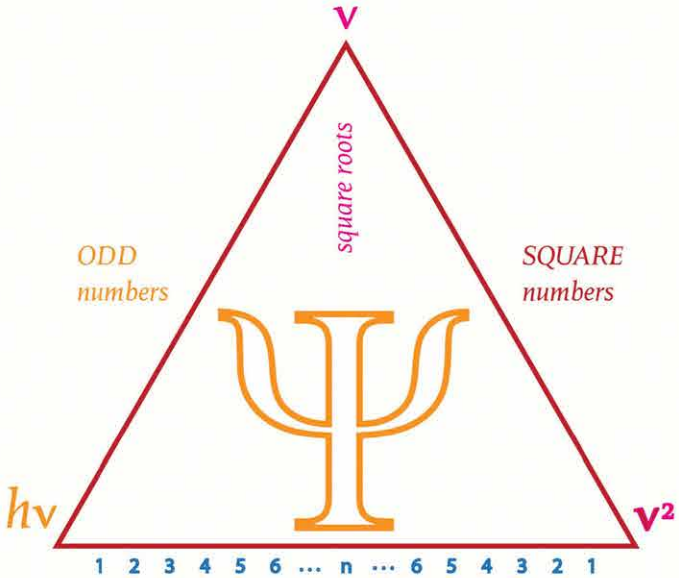

Quantum probability distributions

The equilateral geometry and distribution of quantised Energy momenta provides the basis for all statistical probabilities in Quantum mechanics, thermodynamic & information entropy - including a solution to Heisenberg's Uncertainty Principle thus paving the way forward for a new understanding, and manipulation of physical phenomena at the quantum level

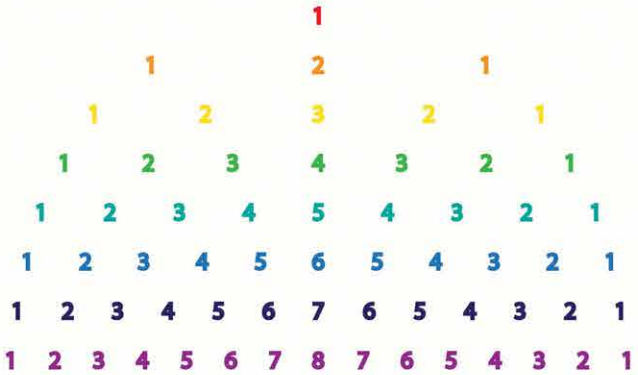

Normal distributions are extremely important in statistics, and are often used in the natural and social sciences for real-valued random variables whose distributions are not known

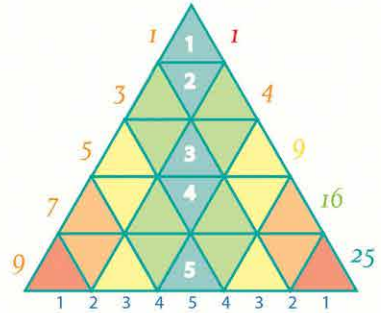

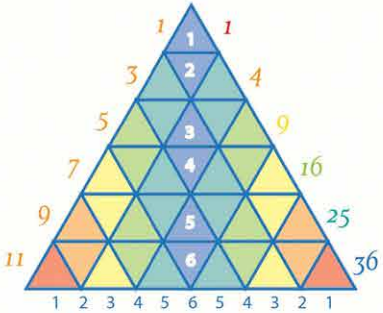

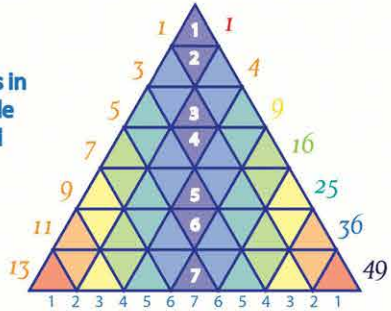

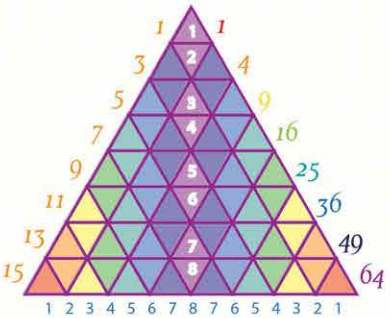

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Quantum Probability Distributions

The normal distribution is a probability distribution.
It is also called Gaussian distribution because it was discovered by Carl Friedrich Gauss.

x/n^2

Probabilities are the square of the Amplitude

n

$\Sigma\, x/n^2$

All probabilities are re-normalisable and sum to Unity

1

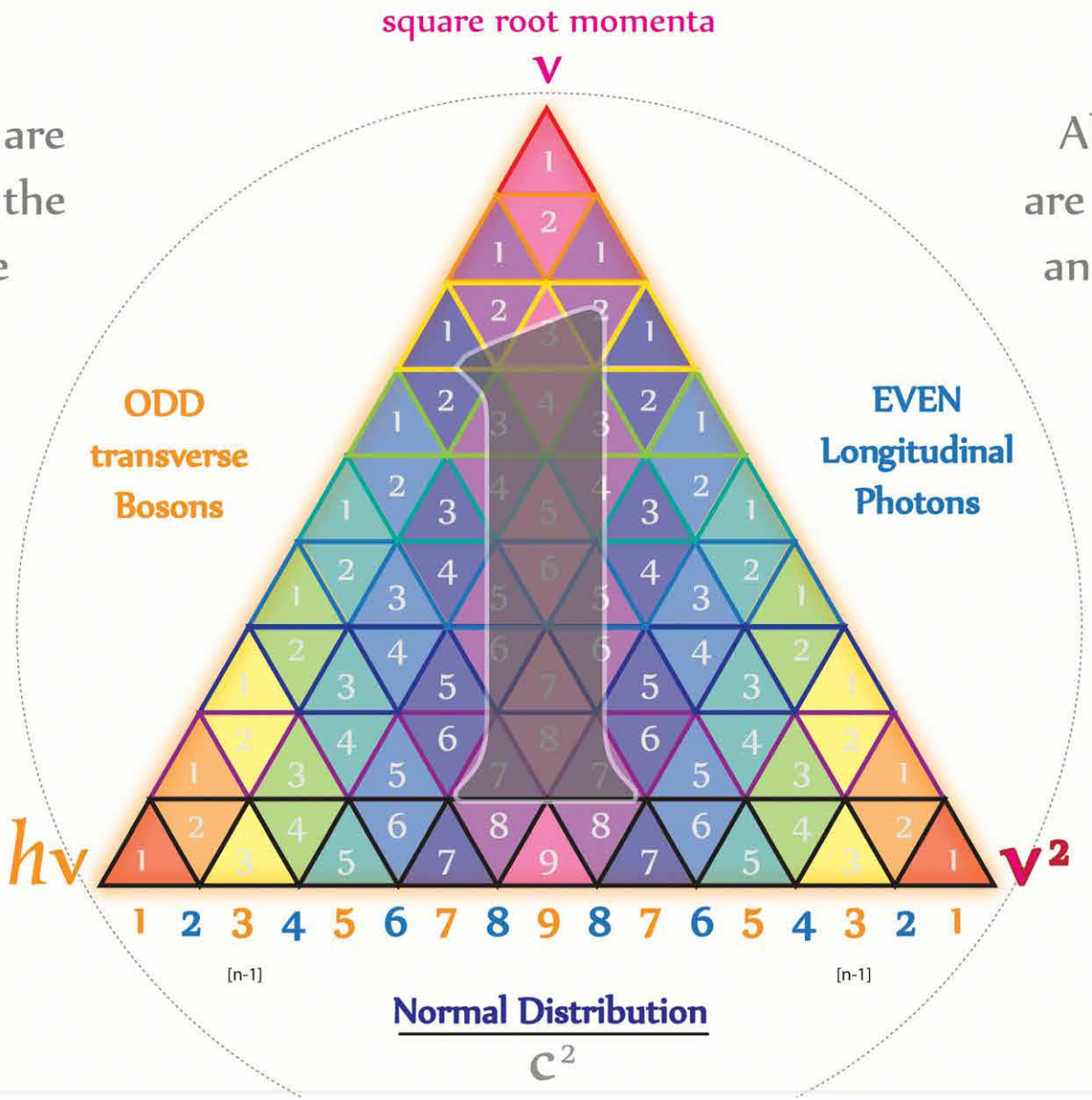

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Quanta Distributions

$$2h\nu = E = hf$$

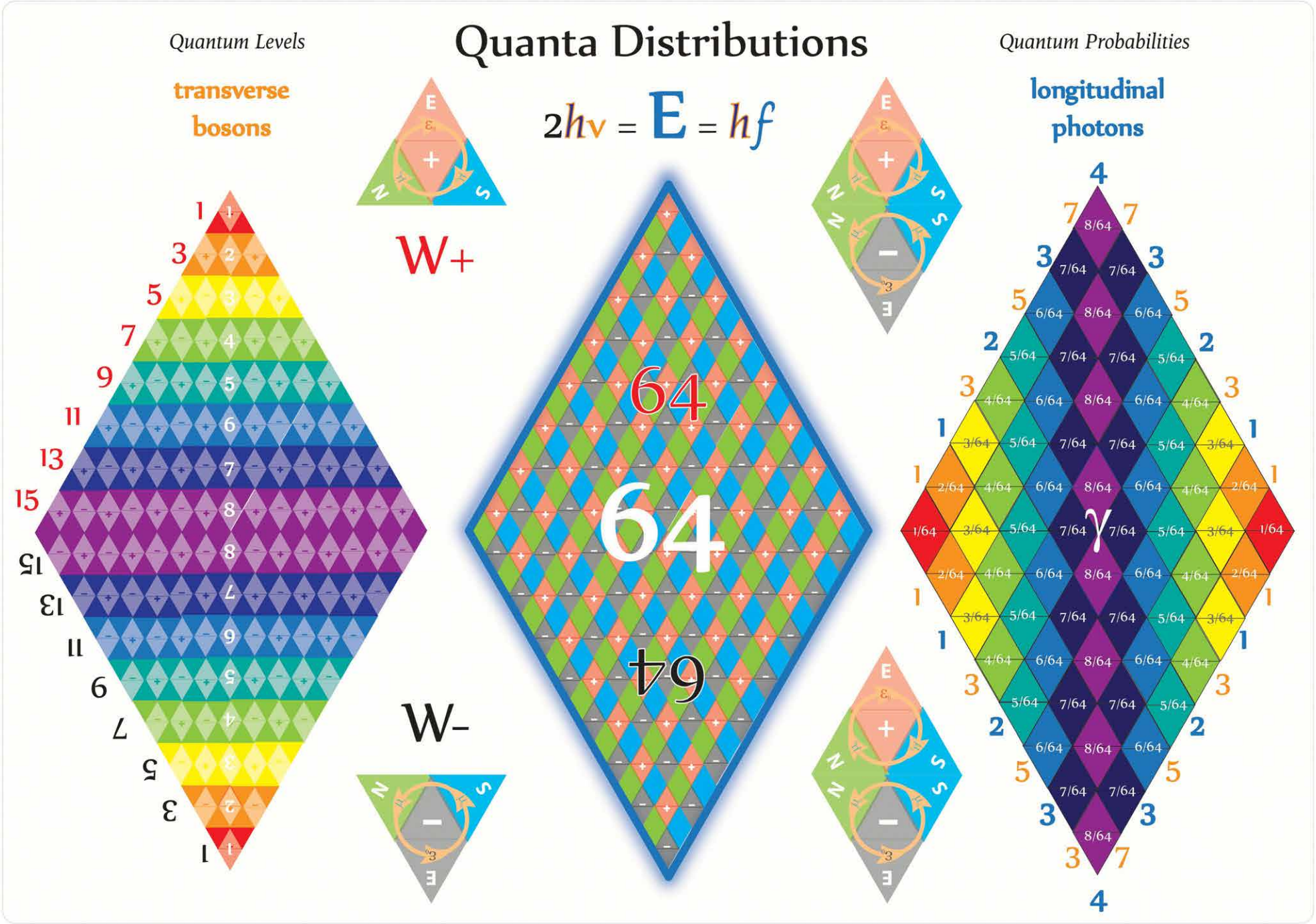

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Wavefunctions

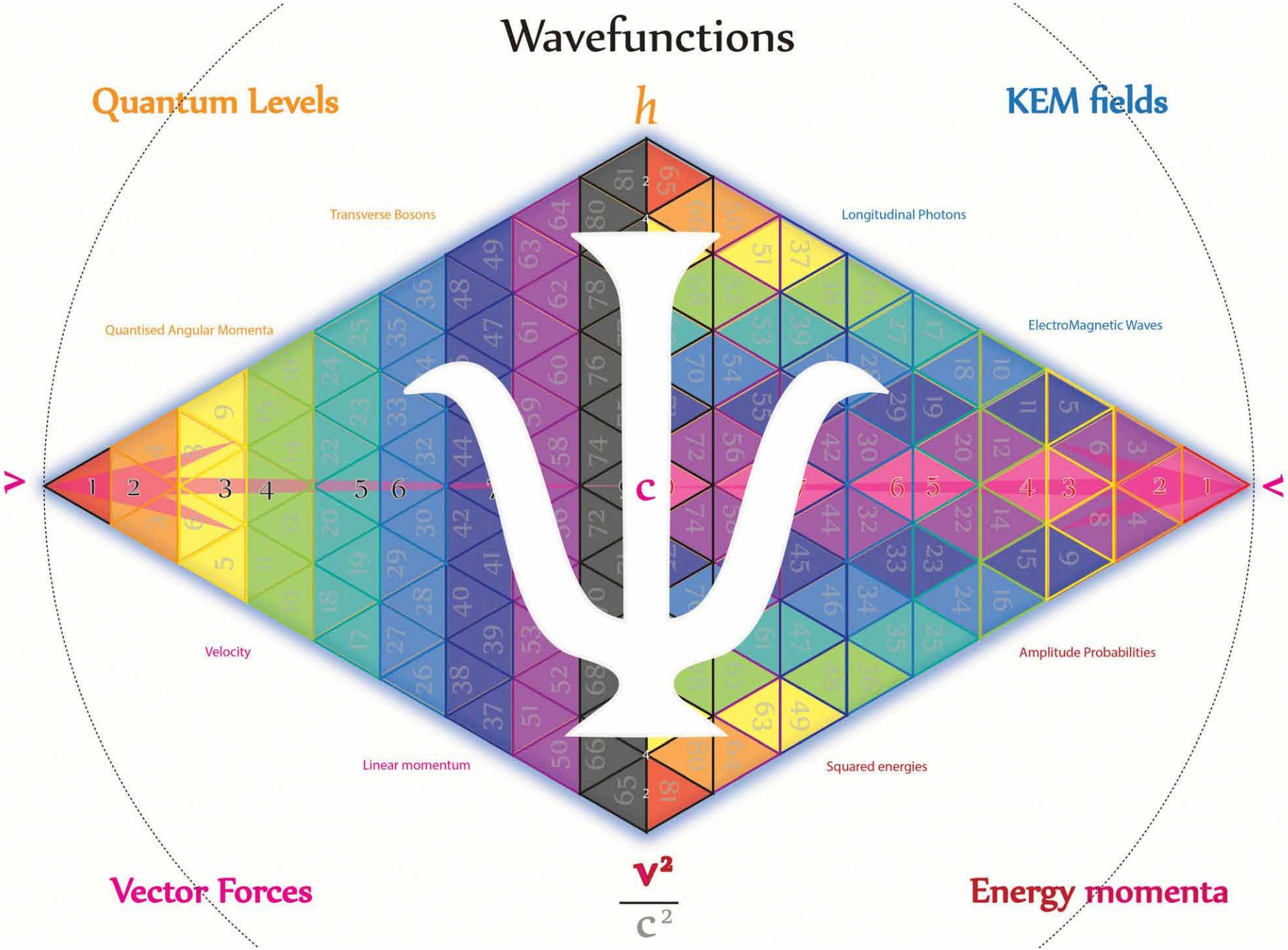

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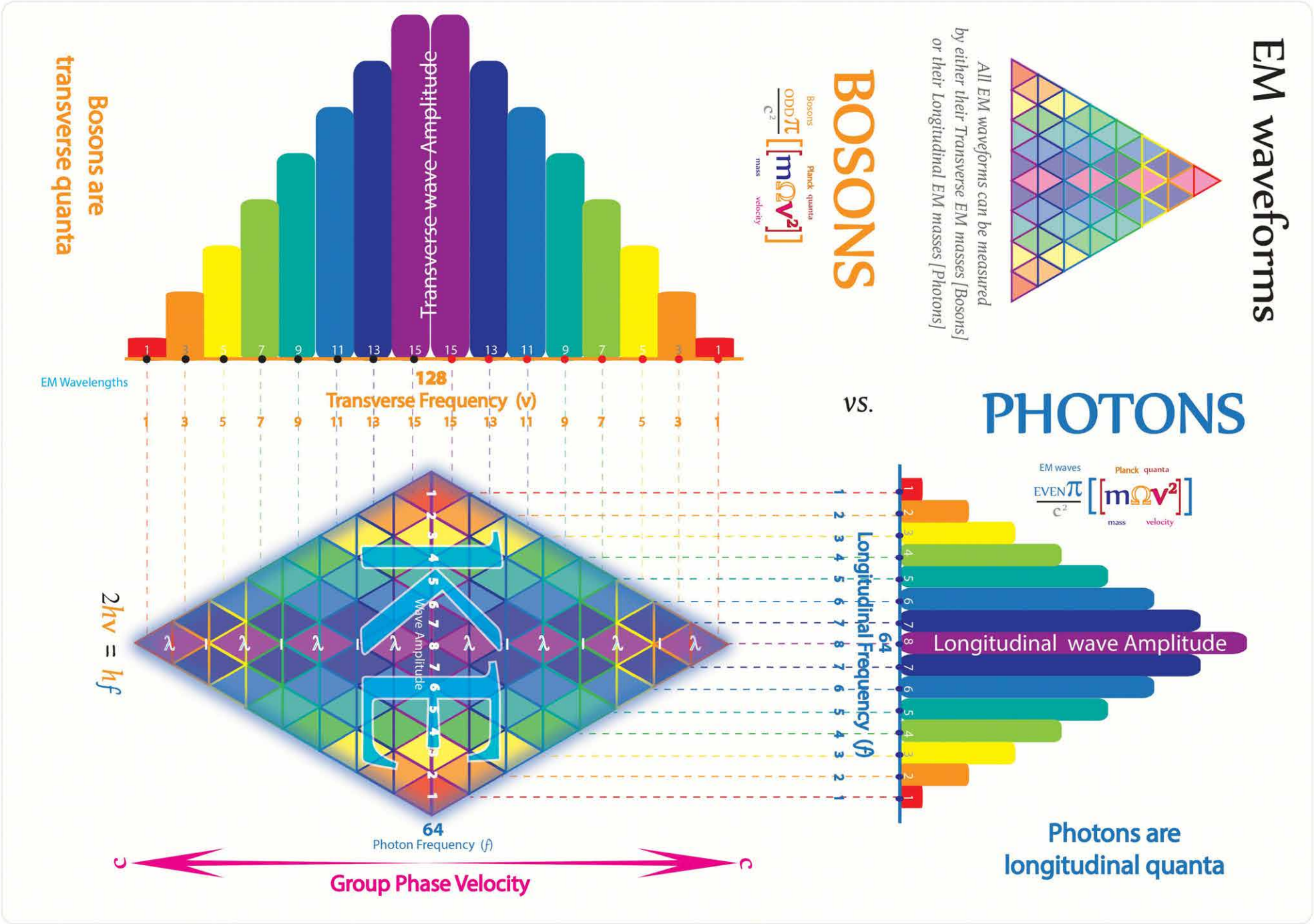

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Quantum Energy distributions

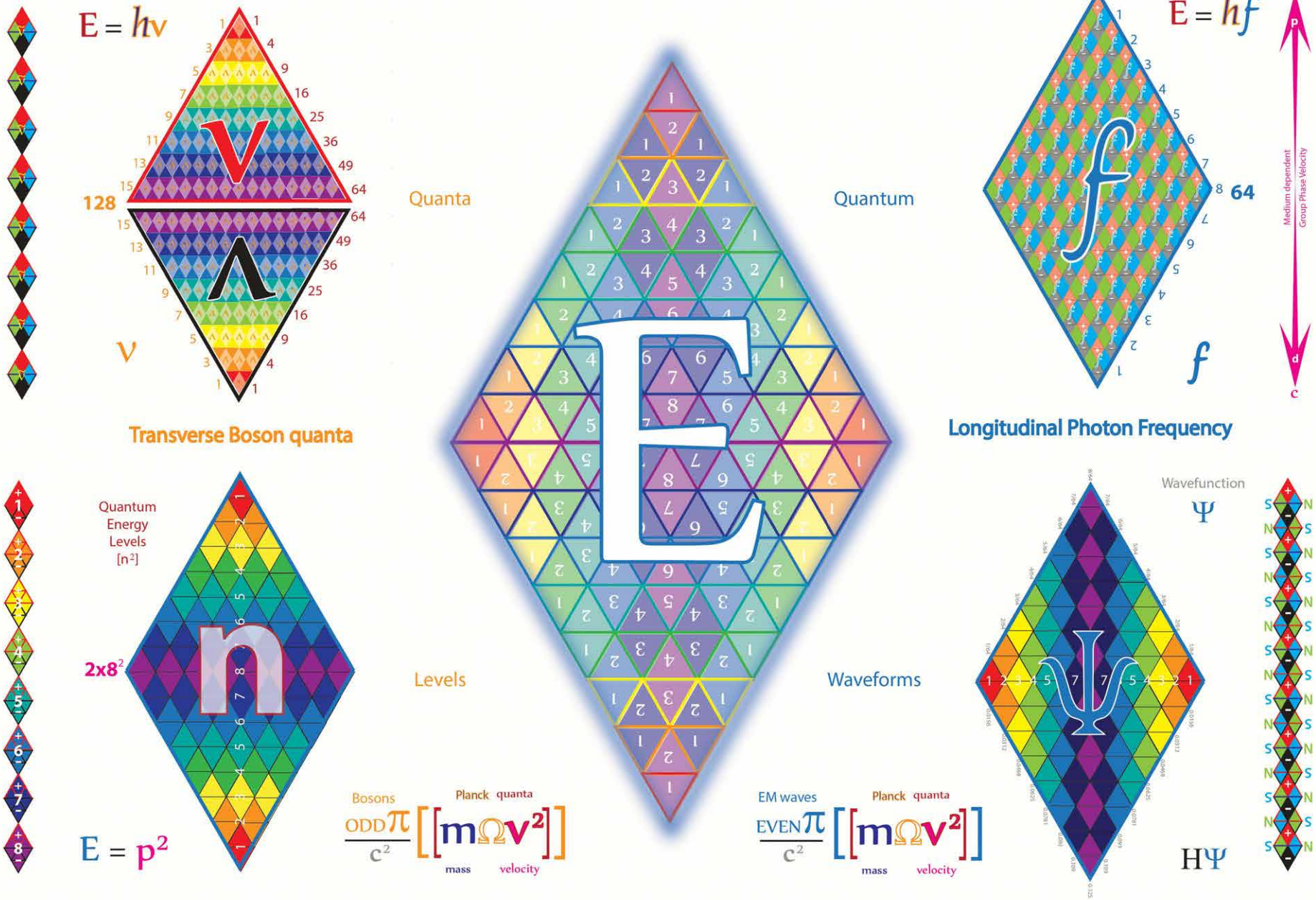

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Normal Distributions

The Gaussian distribution sometimes informally called the bell curve.

Pierre de Fermat

Pierre de Fermat is given credit for early developments that led to infinitesimal calculus.

$$\frac{1}{\sqrt{2\pi\sigma^2}}\, e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

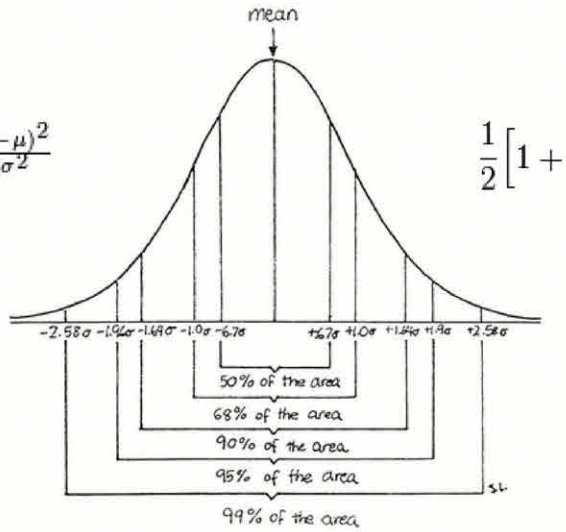

$$\frac{1}{2}\left[1+\operatorname{erf}\left(\frac{x-\mu}{\sqrt{2\sigma^2}}\right)\right]$$

Leonhard Euler

Leonhard Euler developed a formula which links complex exponentiation with trigonometric functions

A bell shaped curve defines the standard normal distribution, in which the probability of observing a point is greatest near the average, and declines rapidly as one moves away from the mean.

all ODD numbers are

$$a^2 - b^2 = [a-b].[a+b]$$

the difference of two squares

$$e^{i\pi} = -1$$

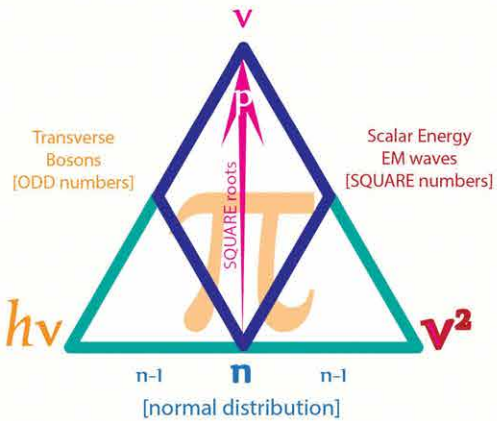

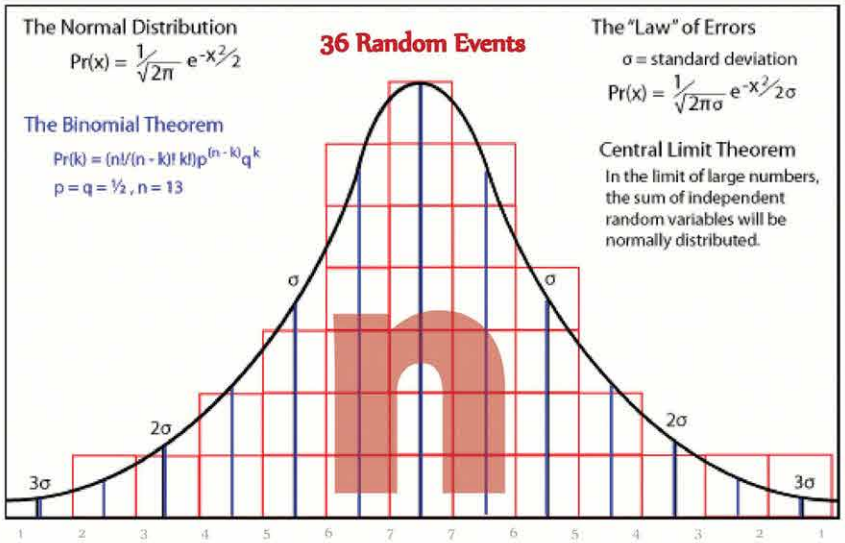

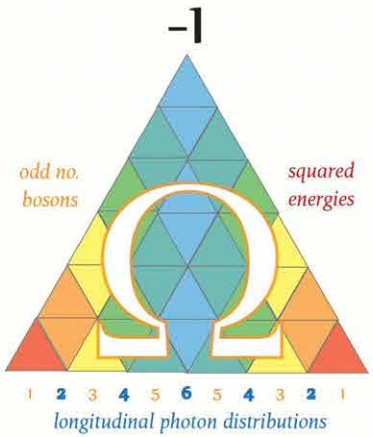

In probability theory, the normal (or Gaussian) distribution is a continuous probability distribution that has a bell-shaped probability density function, known as the Gaussian function

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Fundamental theorem of Energy momenta

A nth level scalar energy momenta waveform has exactly n linear momentum in unit circle co-ordinate systems
(with Longitudinal and Transverse equilateral Planck waveforms being orthogonal to each other)

scalar energies

E

mv^2

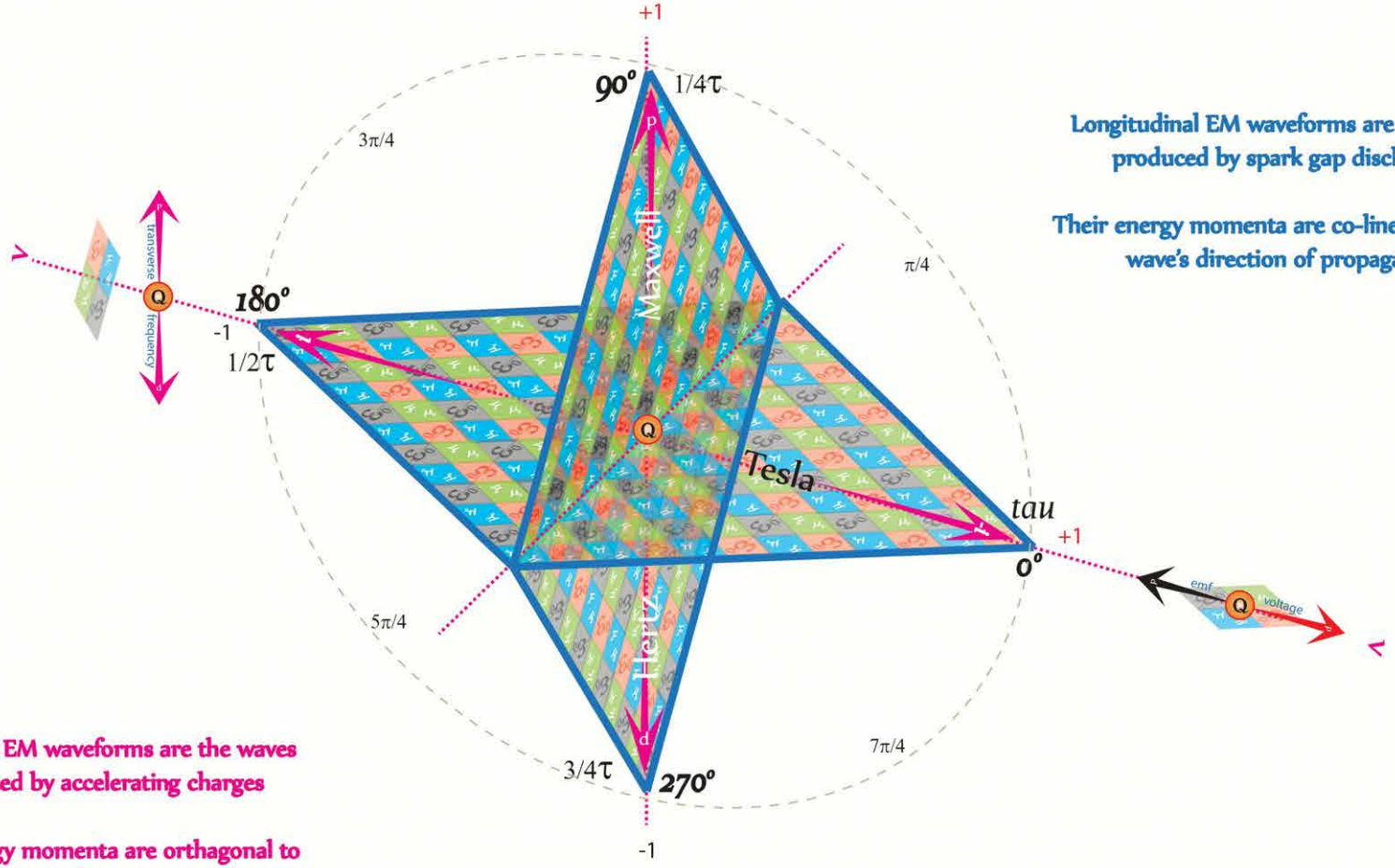

Longitudinal EM waveforms are the waves produced by spark gap discharges

Their energy momenta are co-linear with the wave's direction of propagation

Transverse EM waveforms are the waves produced by accelerating charges

Their energy momenta are orthagonal to the direction of wave propagation

p

mv

linear momentum

[Mathematics] *i or j* *[Electrical theory]*

square root of negative one

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Velocity and Time dependent EM fields

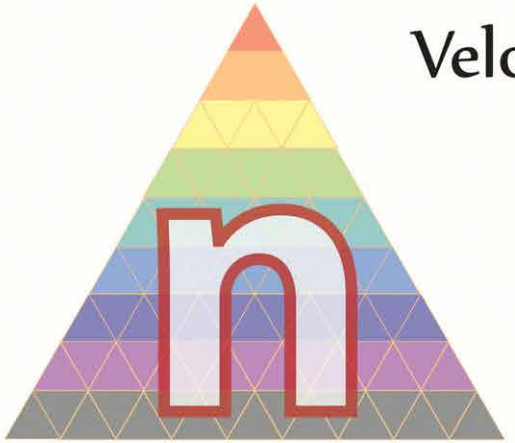

Quantum levels

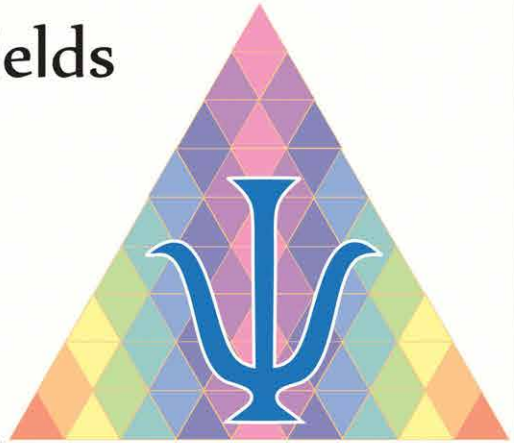

Wave probabilities

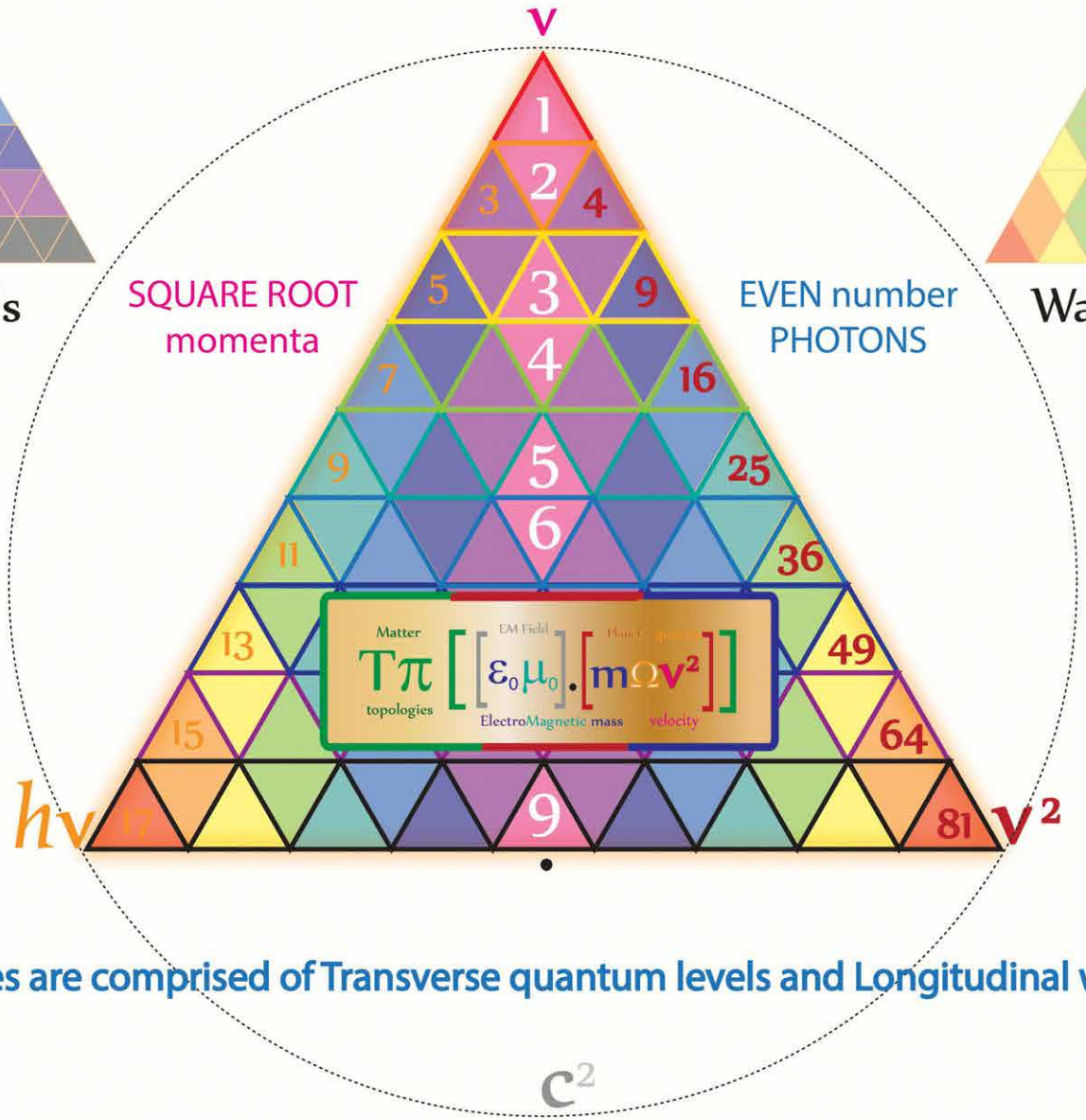

SQUARE ROOT momenta

EVEN number PHOTONS

ODD number BOSONS

SQUARE number ENERGIES

All EM geometries are comprised of Transverse quantum levels and Longitudinal wave probabilities

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Matrices

Matrices are a key tool in linear algebra. One use of matrices is to represent linear transformations, which are higher-dimensional analogs of linear functions of the form f(x) = cx, where c is a constant; matrix multiplication corresponds to composition of linear transformations.

Further developing equilateral Matrices and tensor mathematics to reflect the 2D geometry of EM , KEM and GEM quantum fields, along with the geometric quantisation of mass-energiy momenta and their energy distributions allows for field interactions to be accurately visualised and modelled

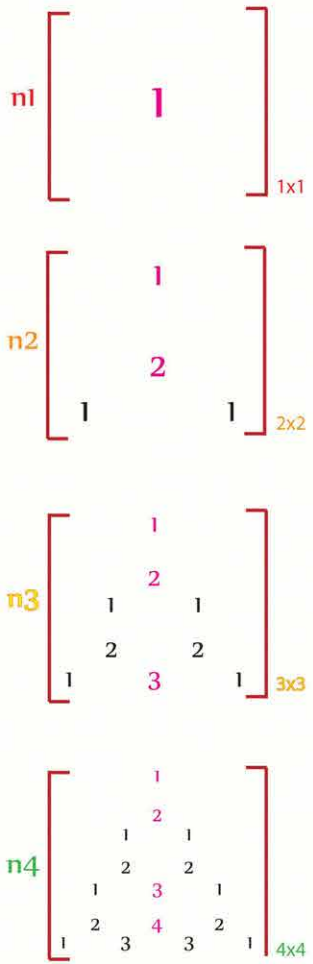

Positive Fields

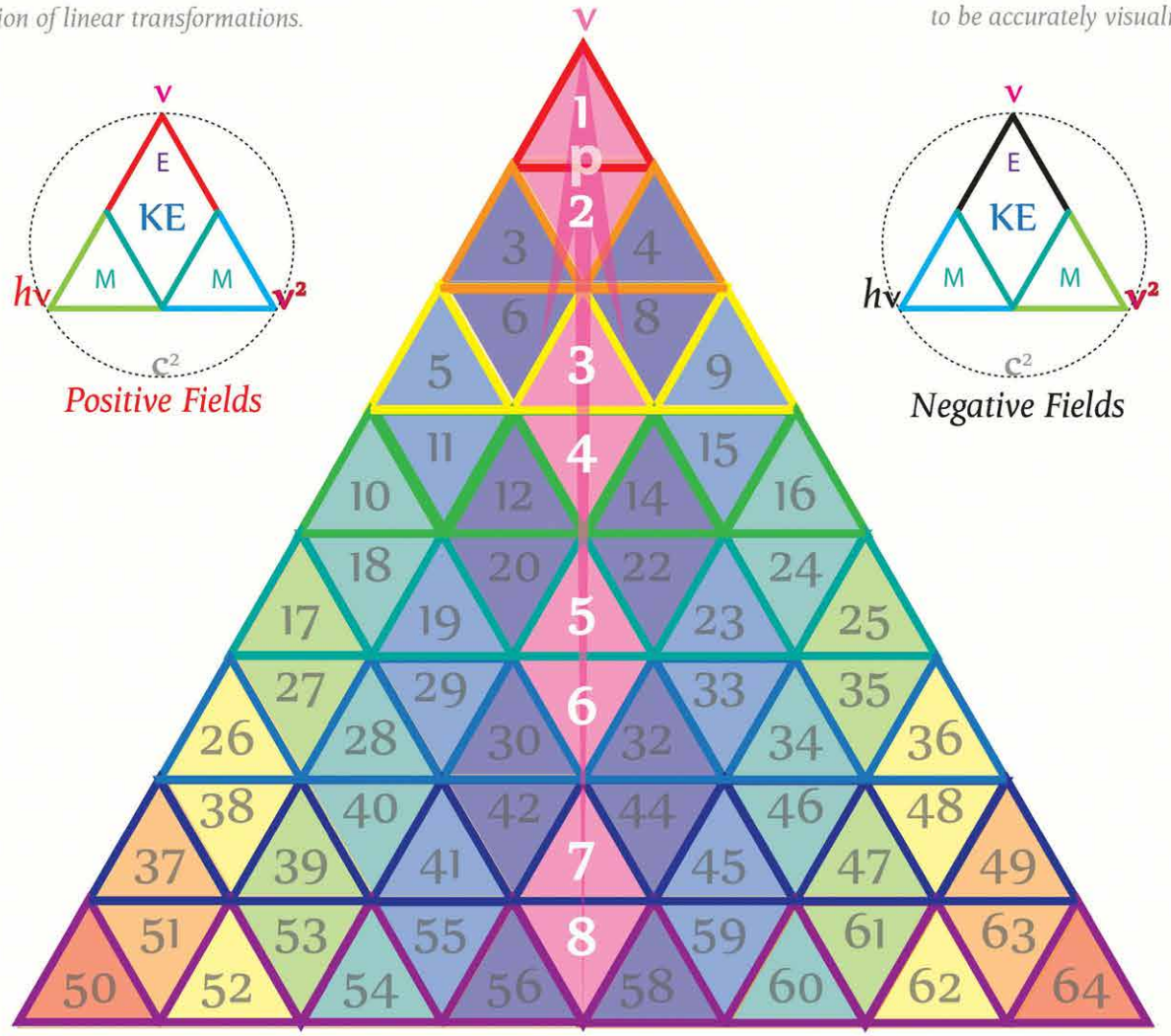

Negative Fields

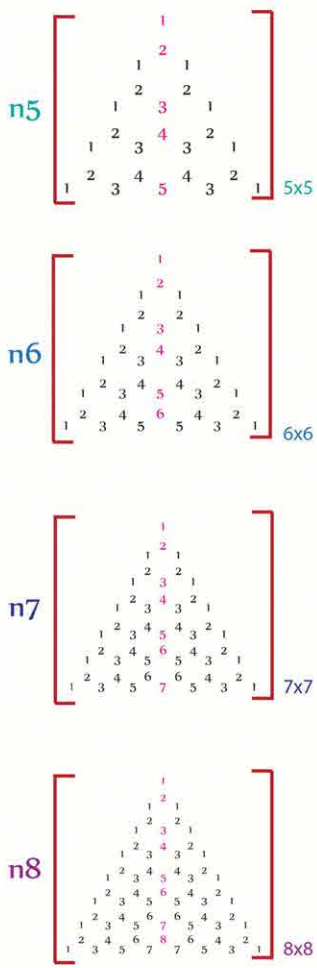

Tensors are geometric entities introduced into mathematics and physics to extend the notion of scalars, geometric vectors, and matrices to increasingly higher orders.

Modifying Square matrices to reflect the equialteral geometries of Tetryonic fields allows for the accurate geometric modelling of all Scalar & Vector fields along with their varied intrinsic quantum energies and physical properties

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Energy momenta Tensors

momenta
(a property of Energy)
is converative

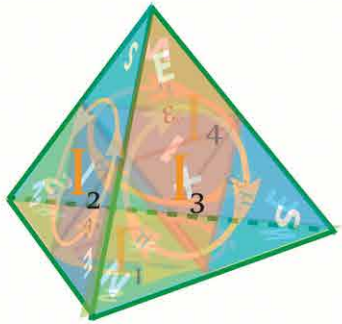

Matter
(a geometric property)
is NOT conservative

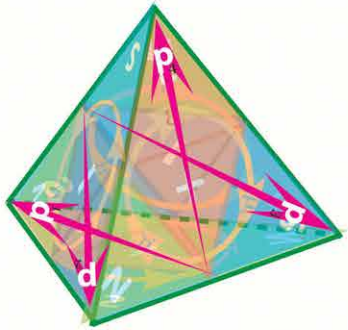

$p_M \rightarrow (E, p1, p2, p3, p4).$

All standing-wave Matter topologies can be modelled using its Tetryonic charge energy momenta Tensors

with an additional Kinetic EM energy-momenta tensor required for Matter in motion

$p_{KEM} \rightarrow (E, p5).$

2D+1 [SR] mass-energy momenta can be folded into 3D+1 [GR] Matter
that can be modelled using 4 Energy-momenta tensors

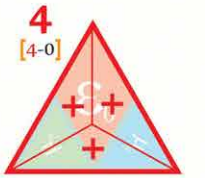

Positive standing-wave Matter

$$E = \sum_{\text{all fascia}} E$$

Energy of a massive particle is the total of all Planck quanta (compton frequency) in a 3D geometry

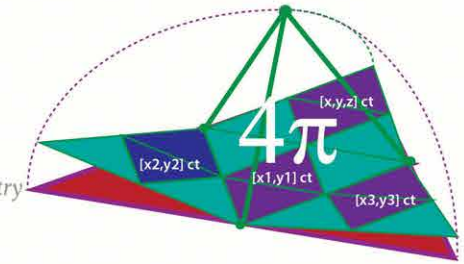

$$\vec{p} = \sum_{\text{all fascia}} \vec{p}$$

Total Momentum is the total of all quanta linear Momenta in a 3D particle

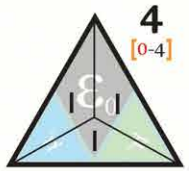

Negative standing-wave Matter

Relativistic Matter
in motion

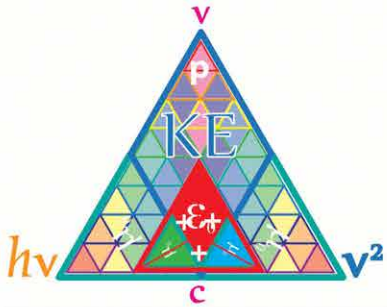

$$I = \sum_{\text{all fascia}} I$$

Inertial mass is the total of all inertia in a 3D particle

Photons have null energy-momentum tensors

Note that both 2D mass-energies [Special Relativity] and 3D Matter [General Relativity] have distinct Energy momenta

It is the 3D Tetrahedral topologies that provides a definative basis for Matter

Relativistic Matter
in motion

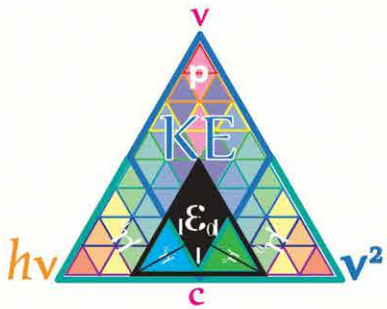

Tetryonic Energy momenta tensors should not be confused with Four vector tensors which map energy-momenta vectors in 3D spatial[cartesian] co-ordinate systems

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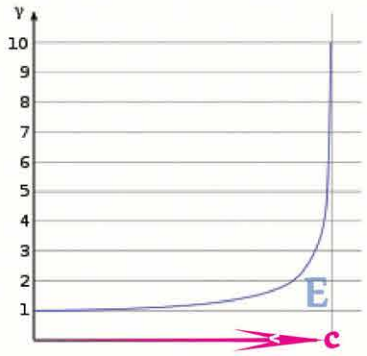

Relativistic Lorentz correction factor

The Lorentz factor or Lorentz term is an expression which appears in several equations in special relativity
It is often incorrectly graphed [as pictured to the right] as an increasing function of velocity approaching but never reaching c

'c' is the maximum velocity acheivable through the electrical acceleration of particles is NOT the maximum velocity possible for Matter in motion

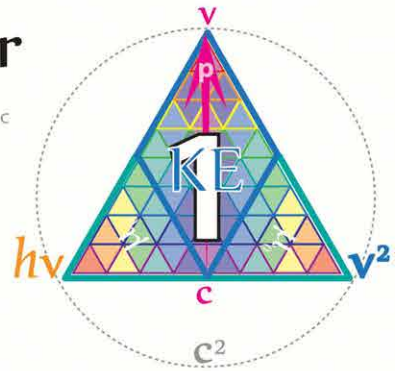

Linear correction factor

$$\beta = \left[\frac{v}{c}\right]$$

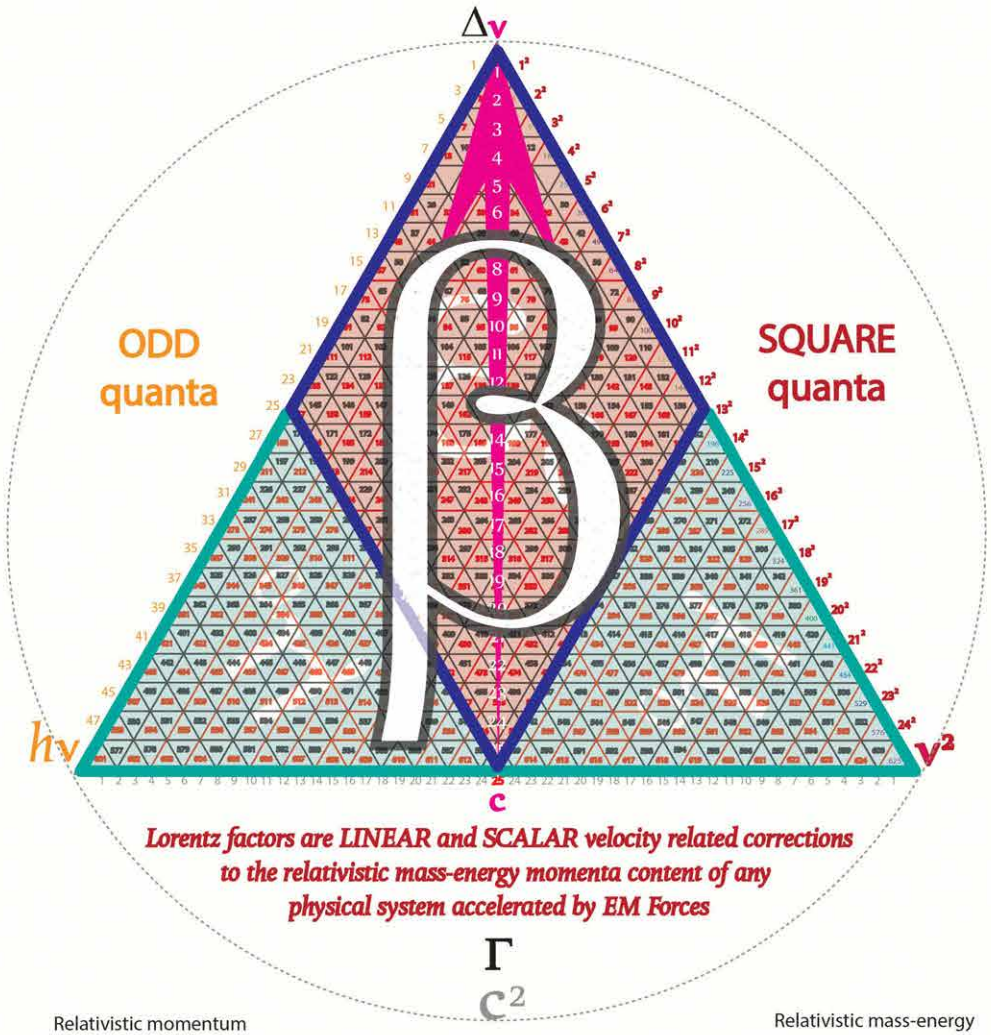

Scalar correction factor

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

$$\Delta\frac{\gamma}{c^2}$$ Wavelength contraction

$$\Delta\frac{\Omega}{c^2}$$ Time Dilation

$$\Delta\frac{mv}{c^2}$$ Relativistic momentum

Lorentz corrections

$$\Delta\frac{h\nu}{c^2}$$ Relativistic mass-energy

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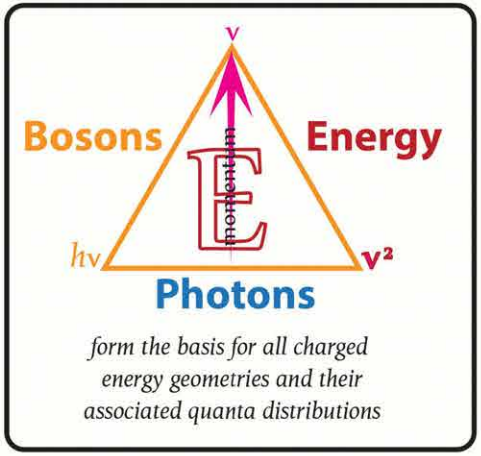

Equilateral energies

Any measurements of mass without a Space-Time co-ordinate system are measurements of Energy

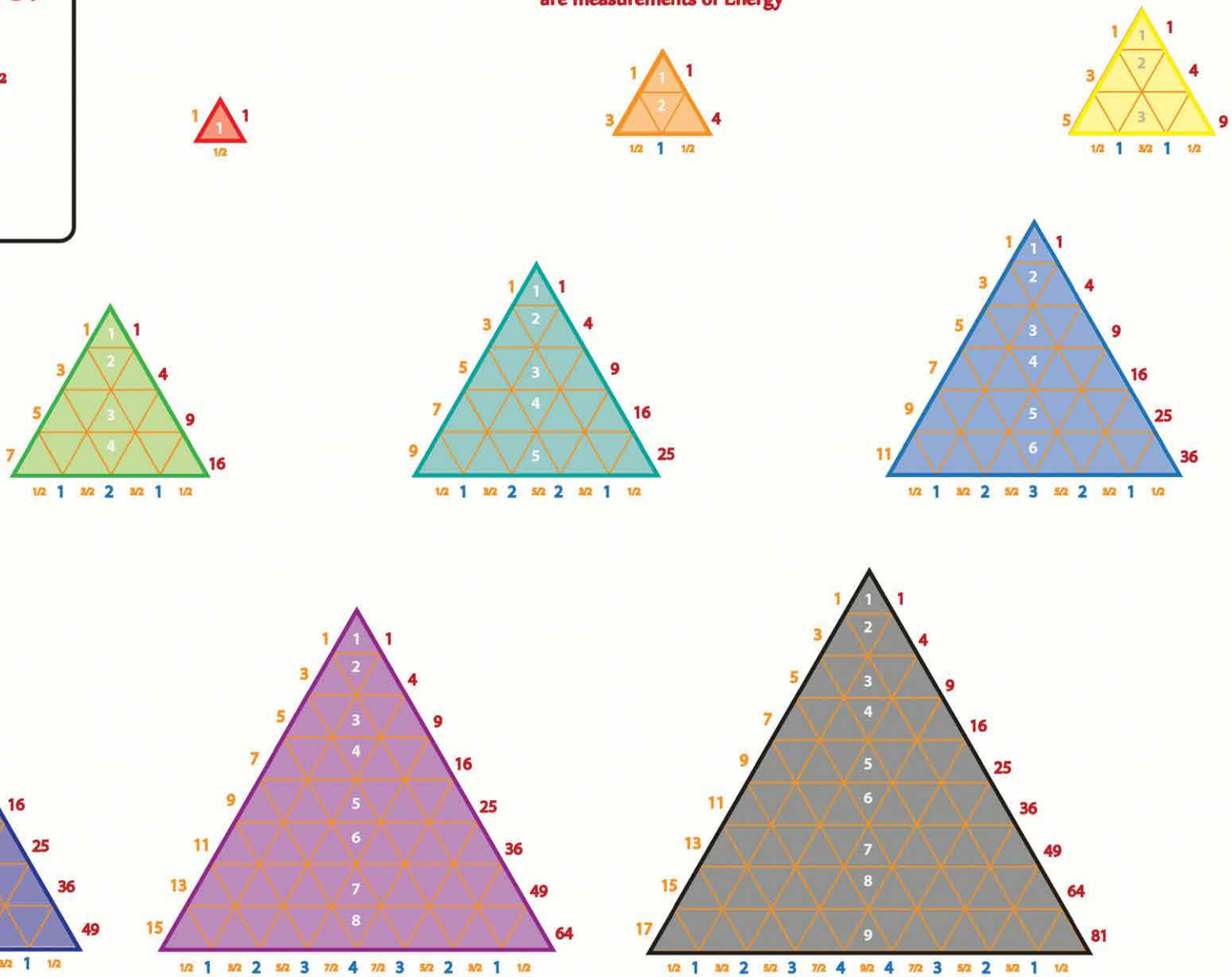

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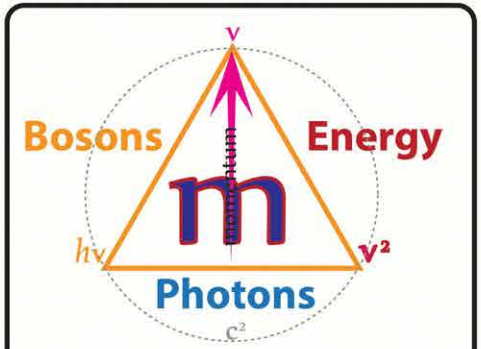

Time specific measurements of equilateral ENERGY momenta geometries forms the basis for EM mass

Electromagnetic mass

2D mass-energy is the surface integral of 3D Matter

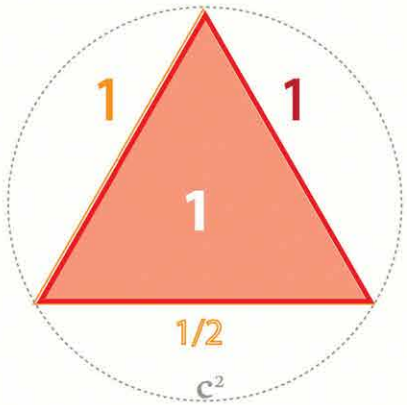

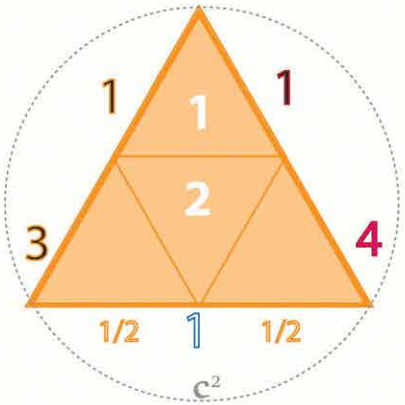

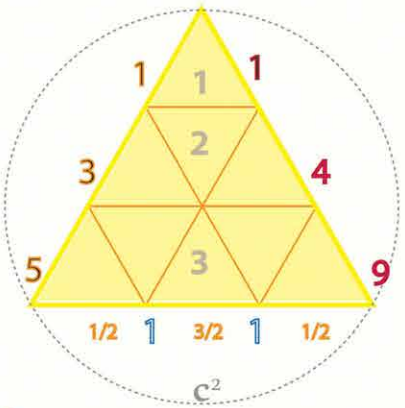

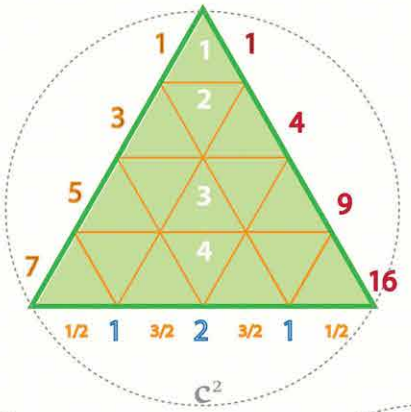

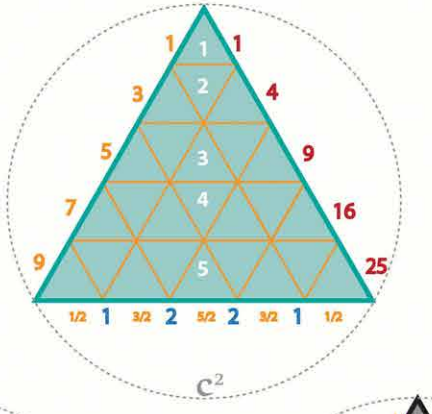

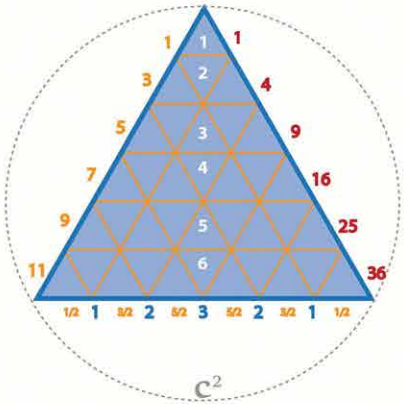

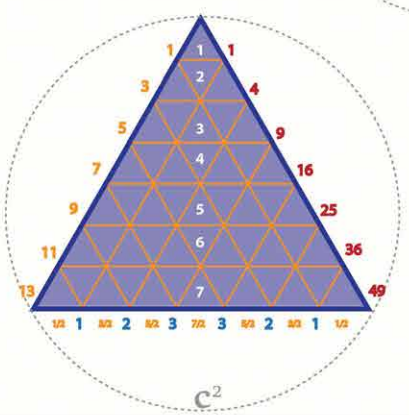

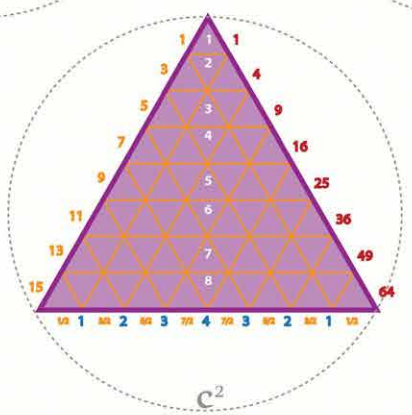

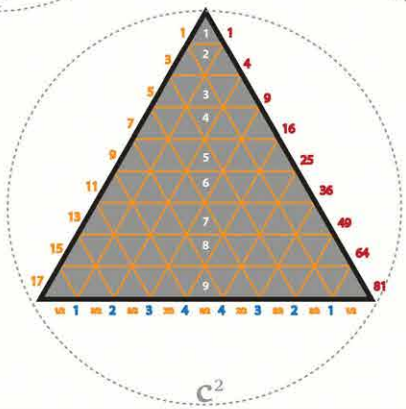

mass-less particles is a physical misnomer

All measurements of energy in spatial co-ordinate systems are measurements of mass

Matter-less is the appropriate terminology

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Standing-wave Matter

Matter is a higher order 3D topology created by standing wave mass-energies

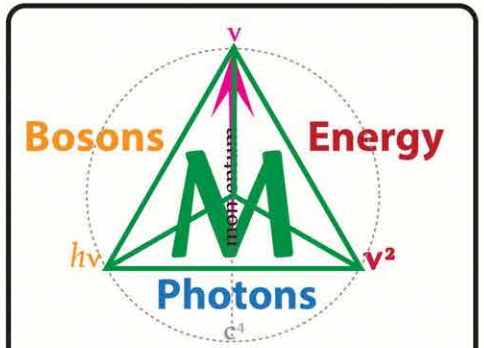

The equilateral mass-ENERGY content of 4nπ Tetrahedral standing-wave topologies forms the basis of Matter

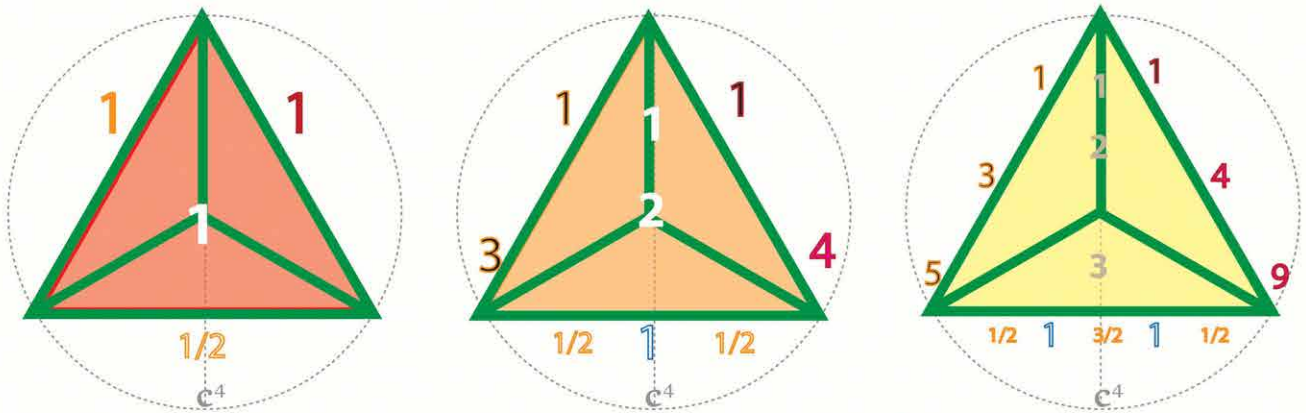

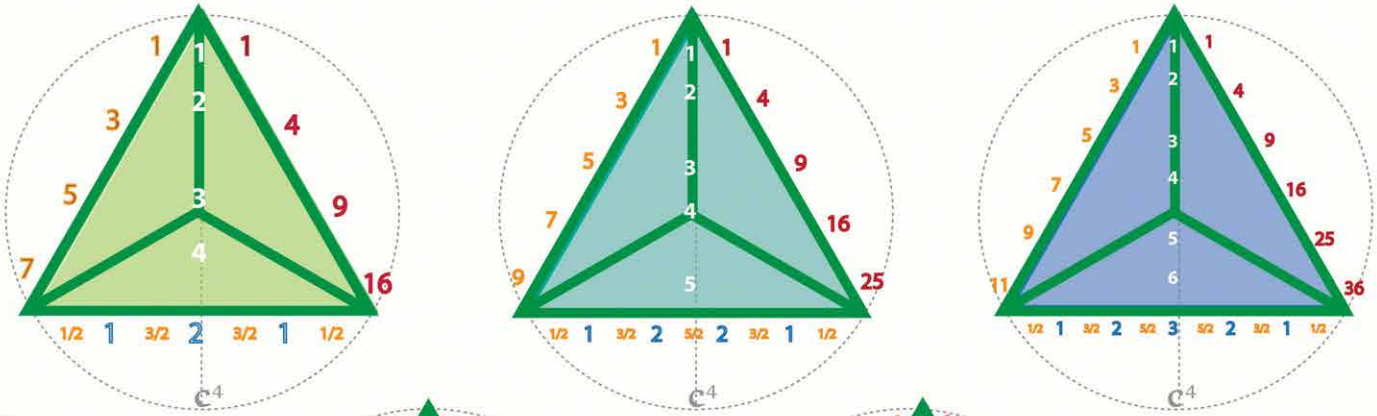

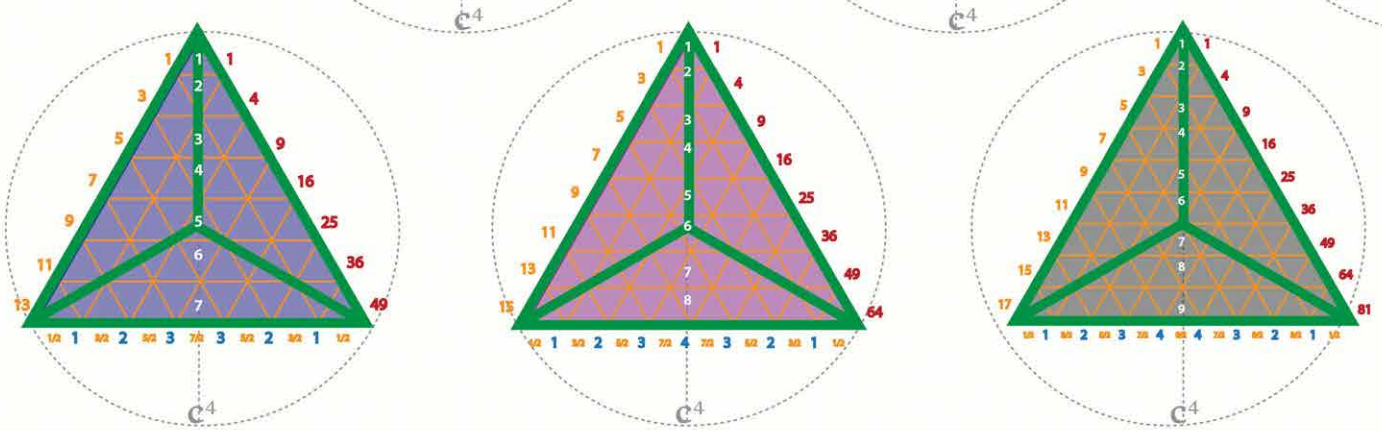

Only mass-ENERGIES contained in the tetryonic fascia of standing-wave topologies contribute to weight

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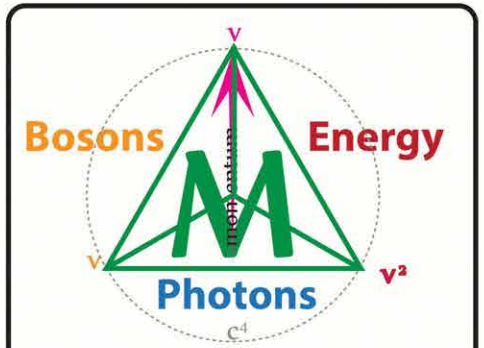

The mass-ENERGY content of
4nπ Tetrahedral standing-wave topologies
forms the basis of all periodic elements

Periodic element nuclei

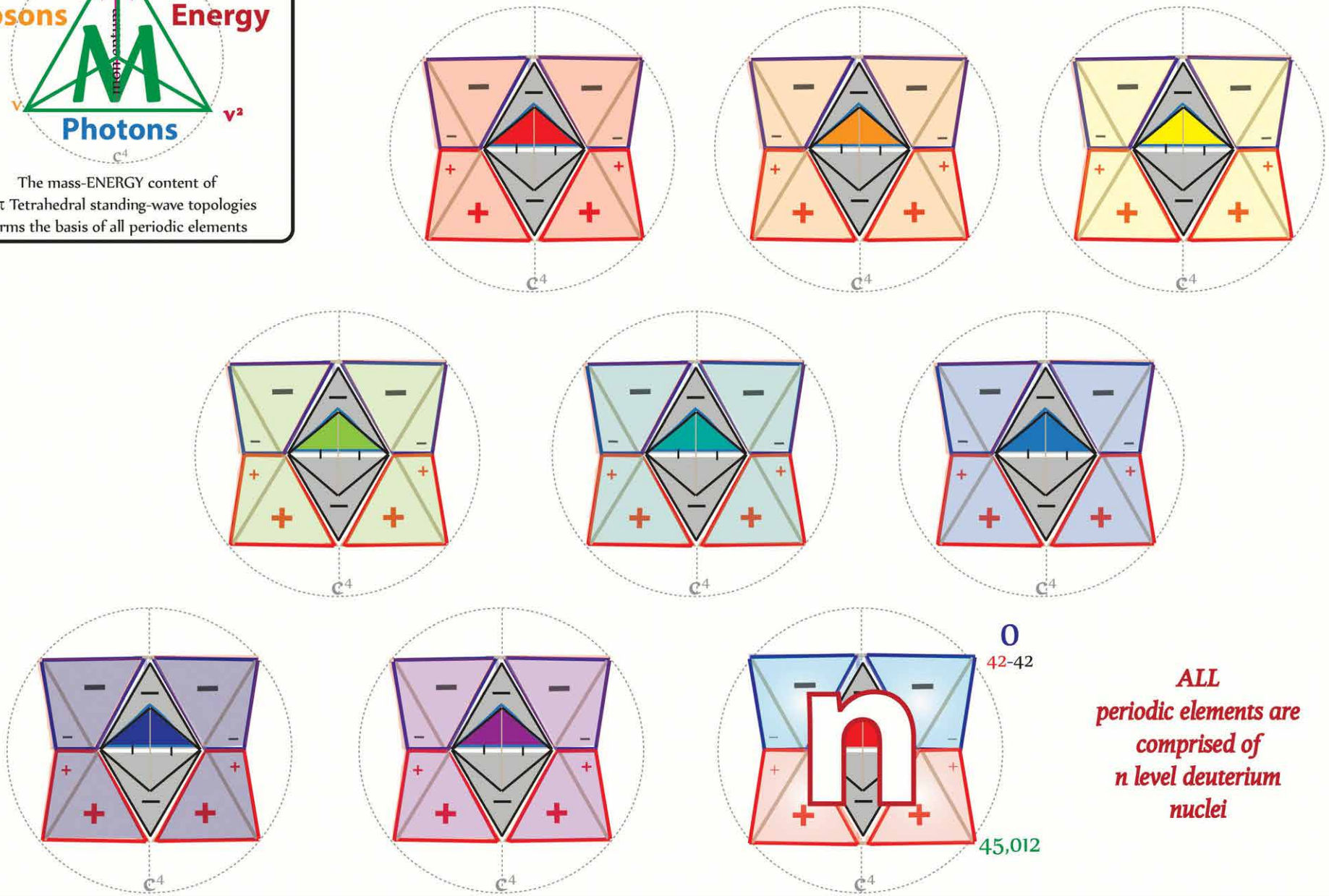

ALL periodic elements are comprised of n level deuterium nuclei

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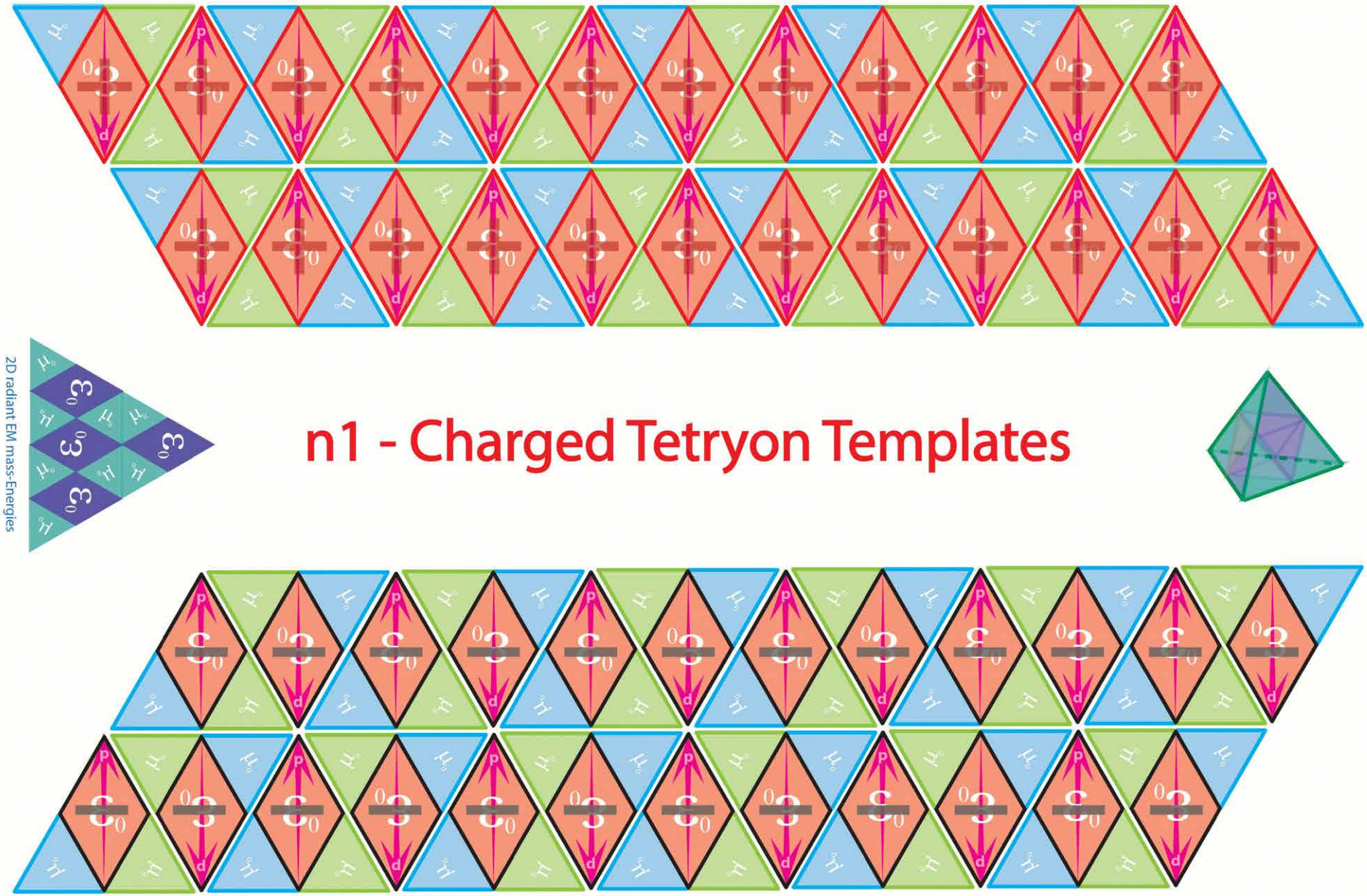

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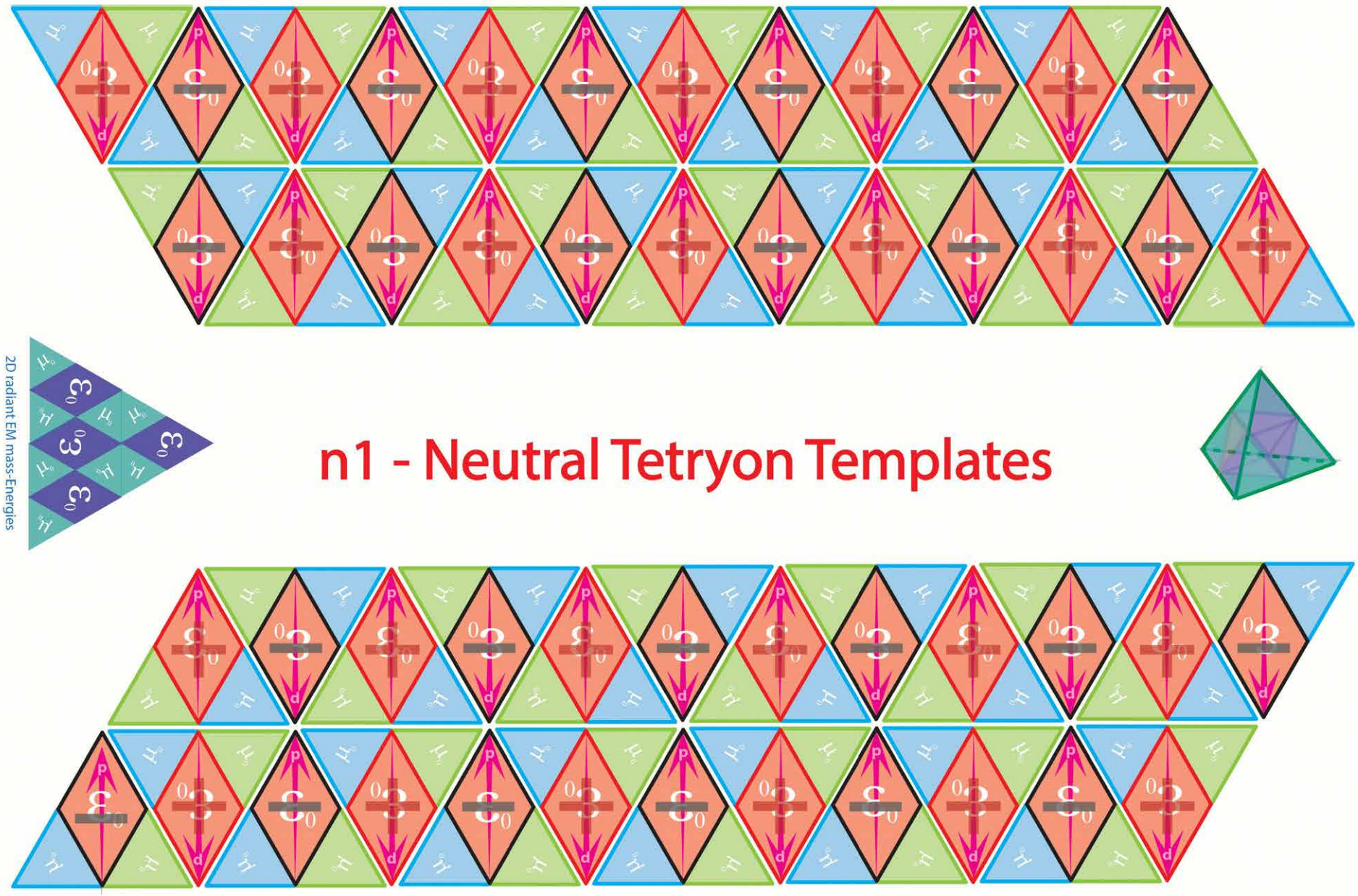

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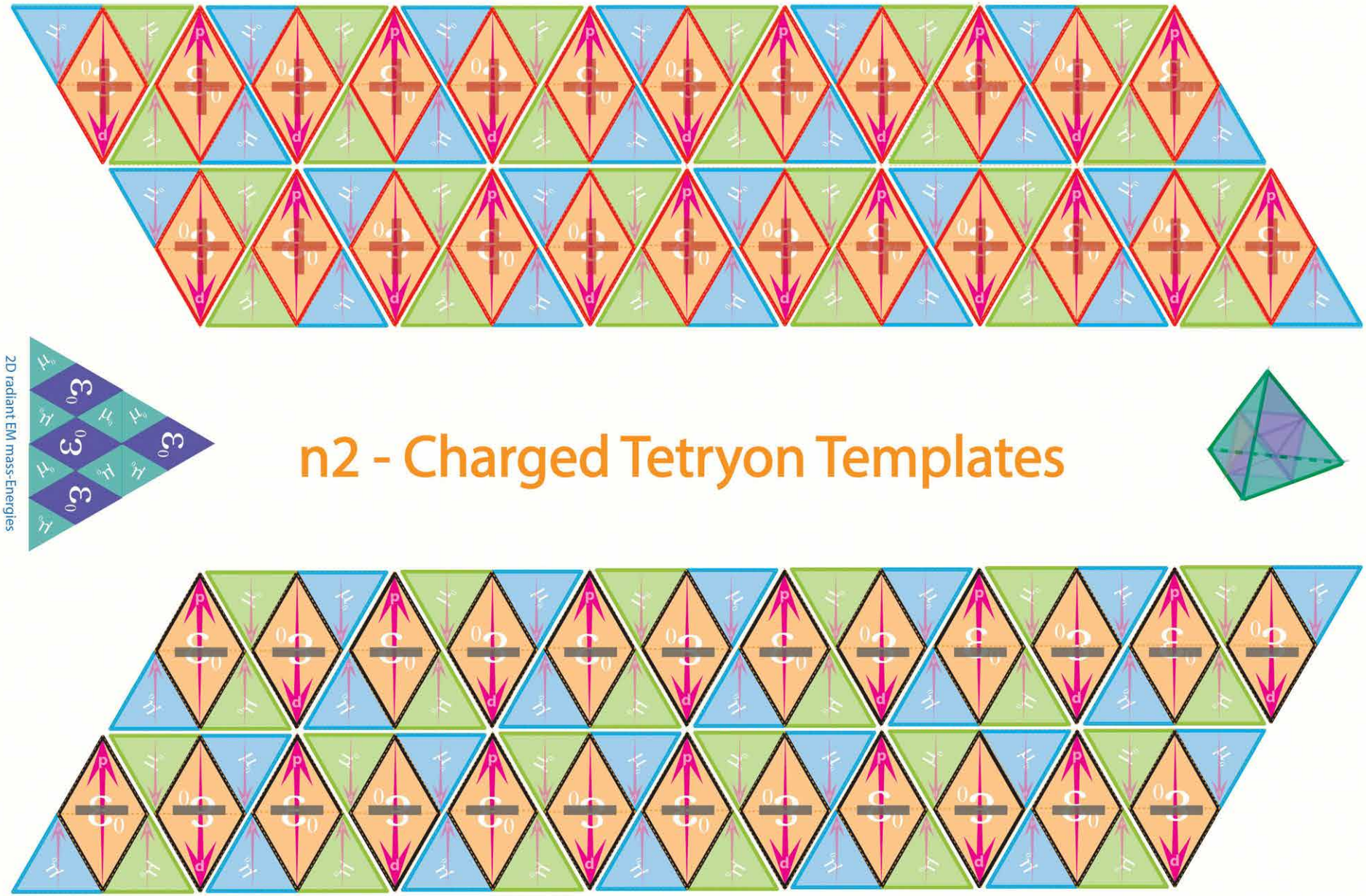

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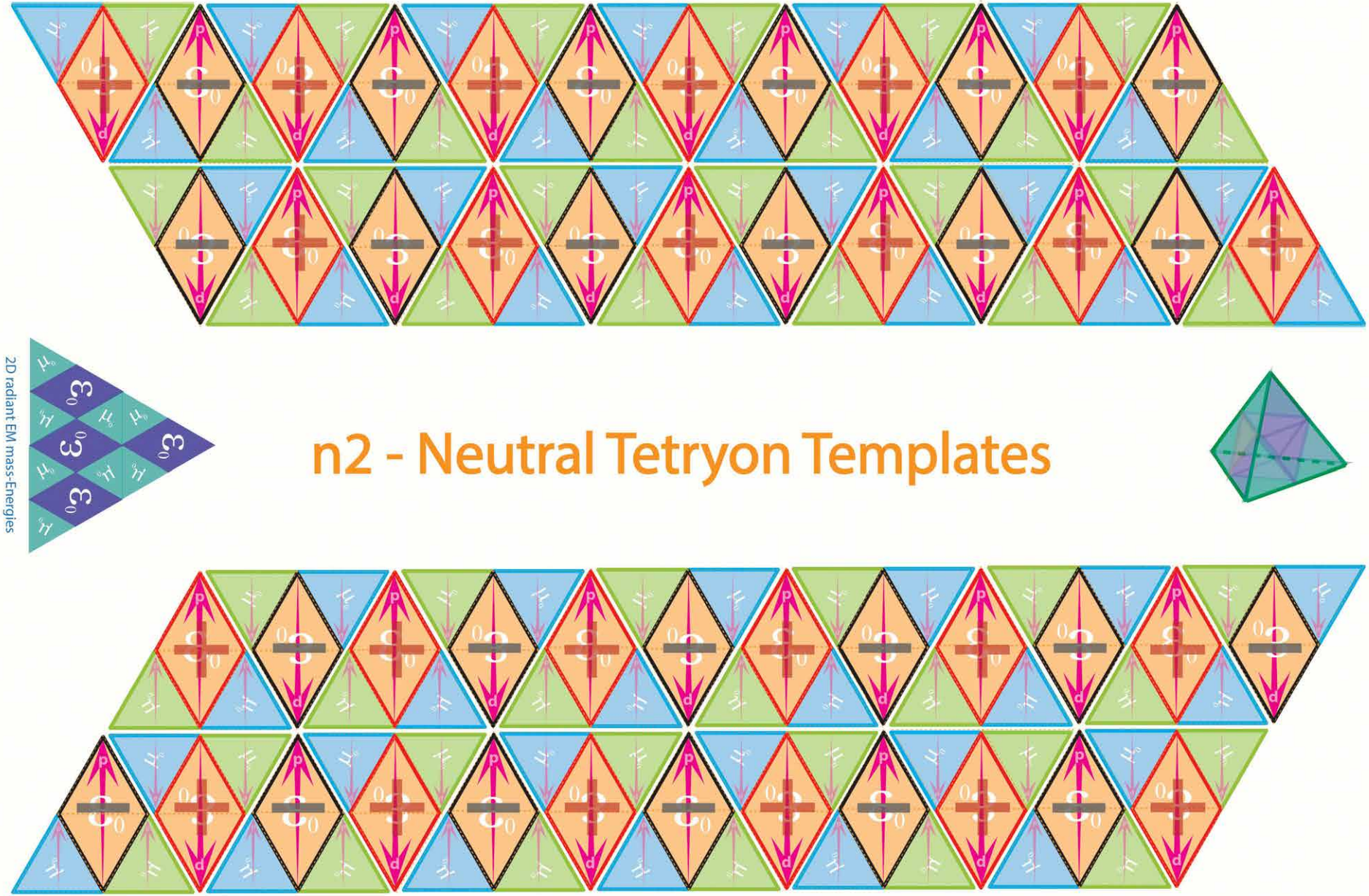

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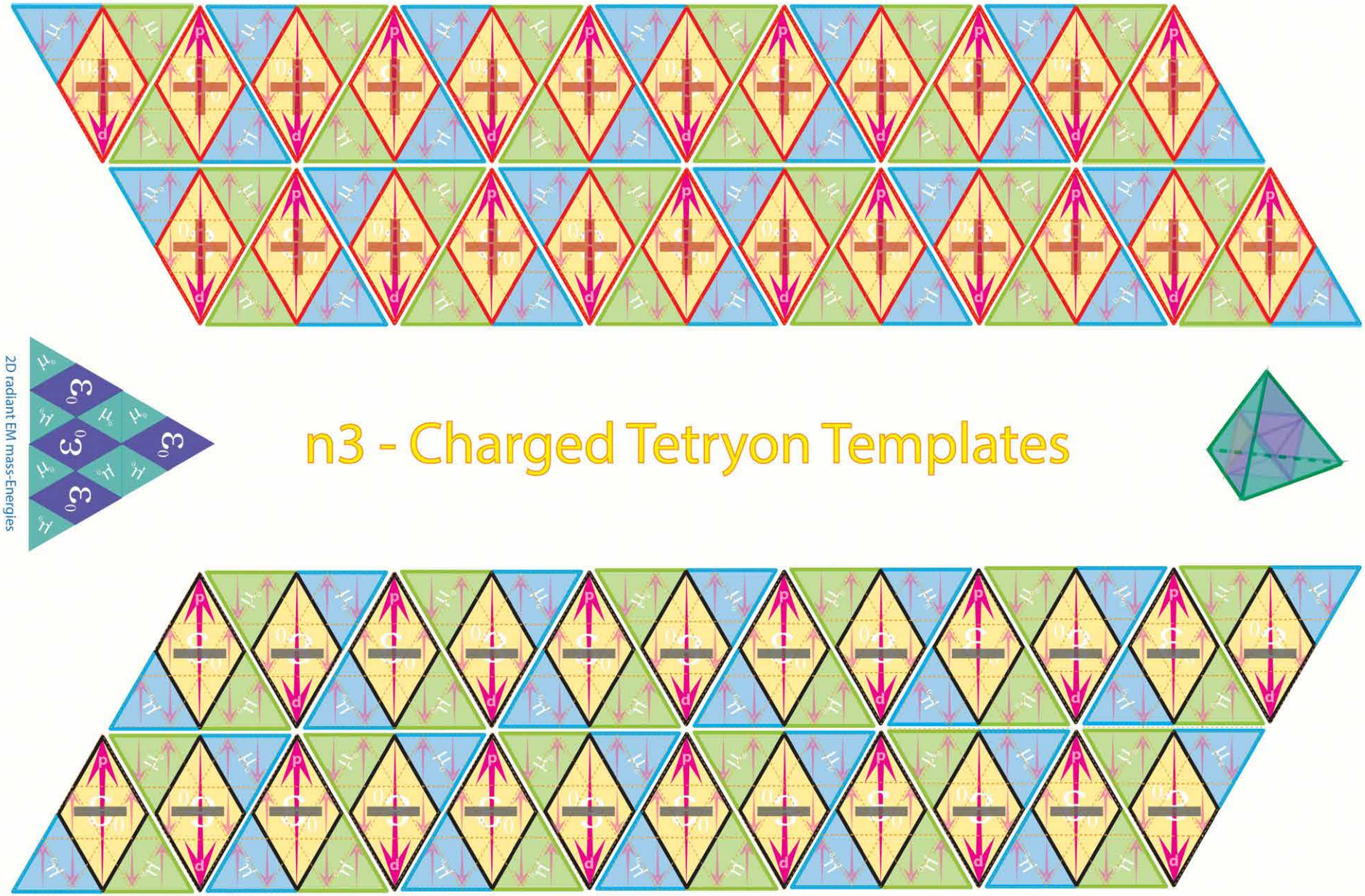

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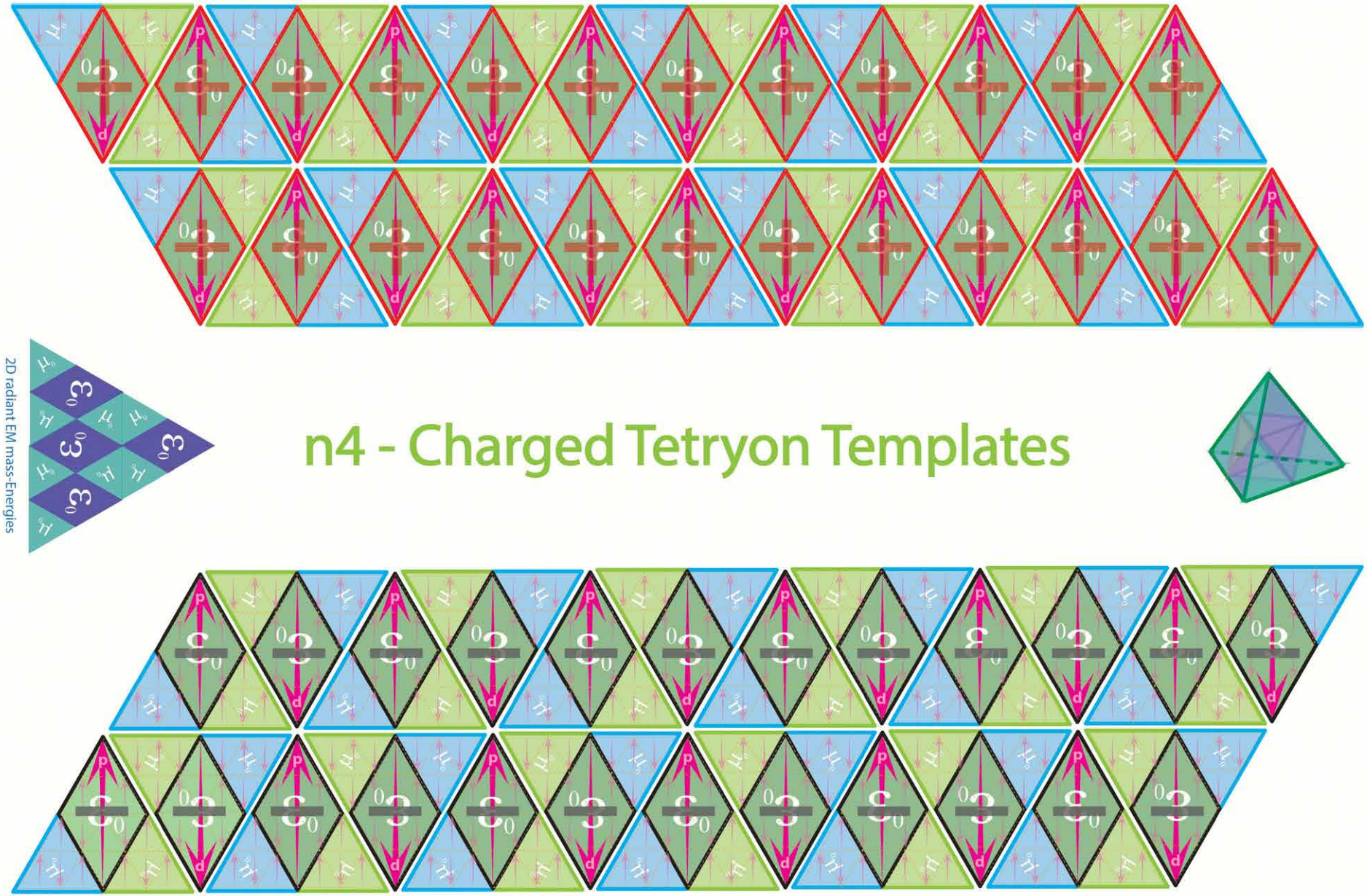

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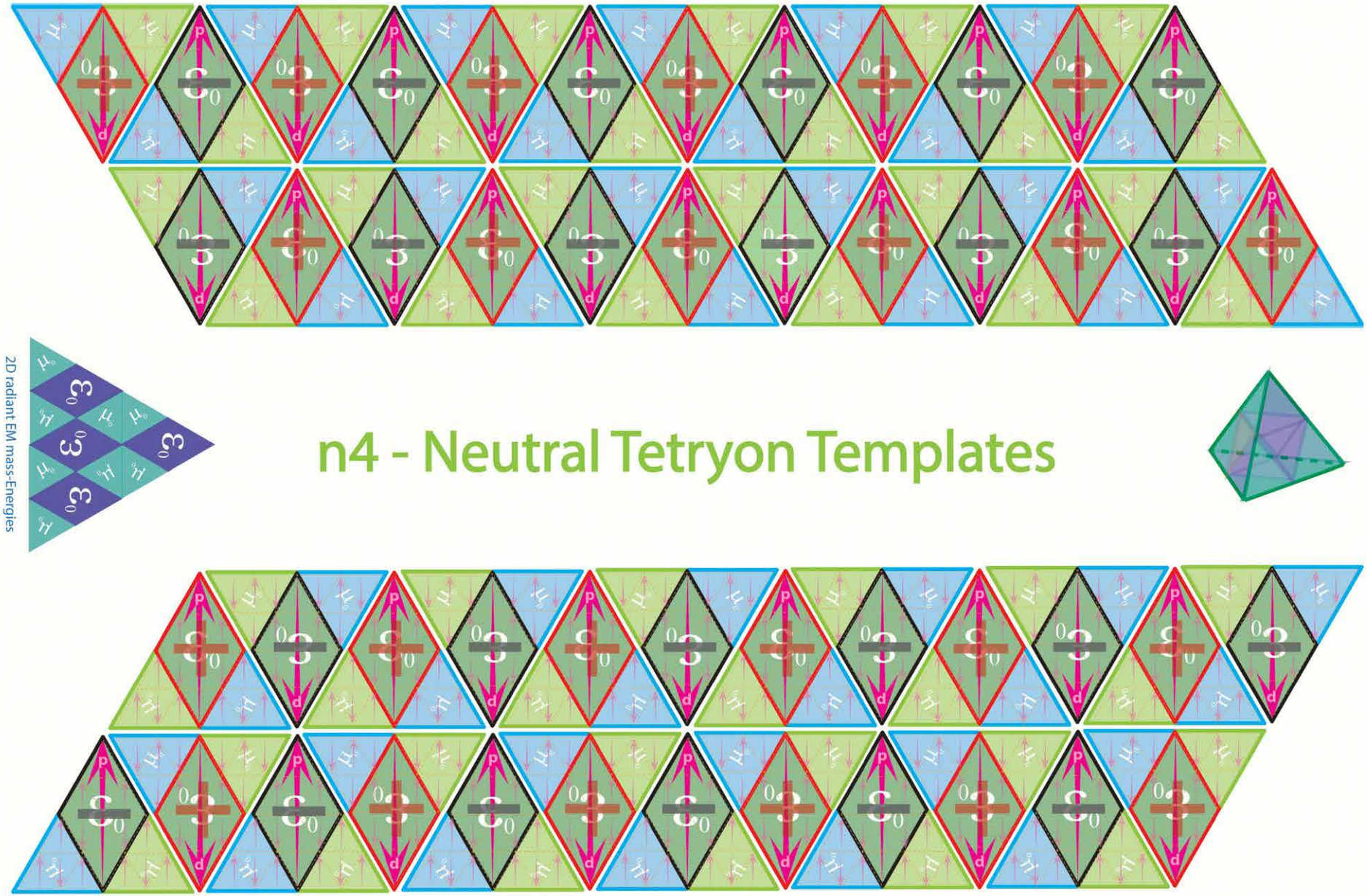

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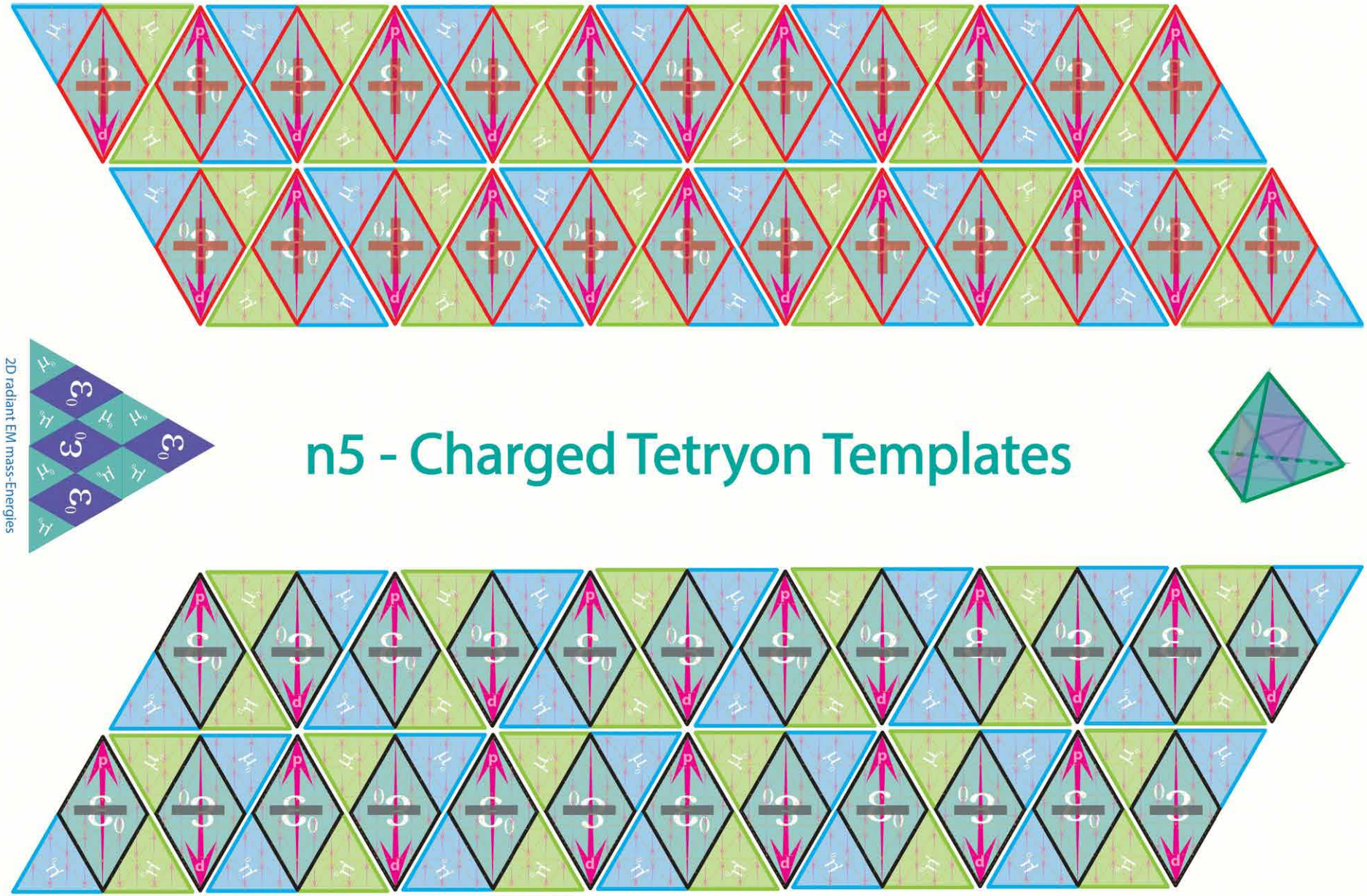

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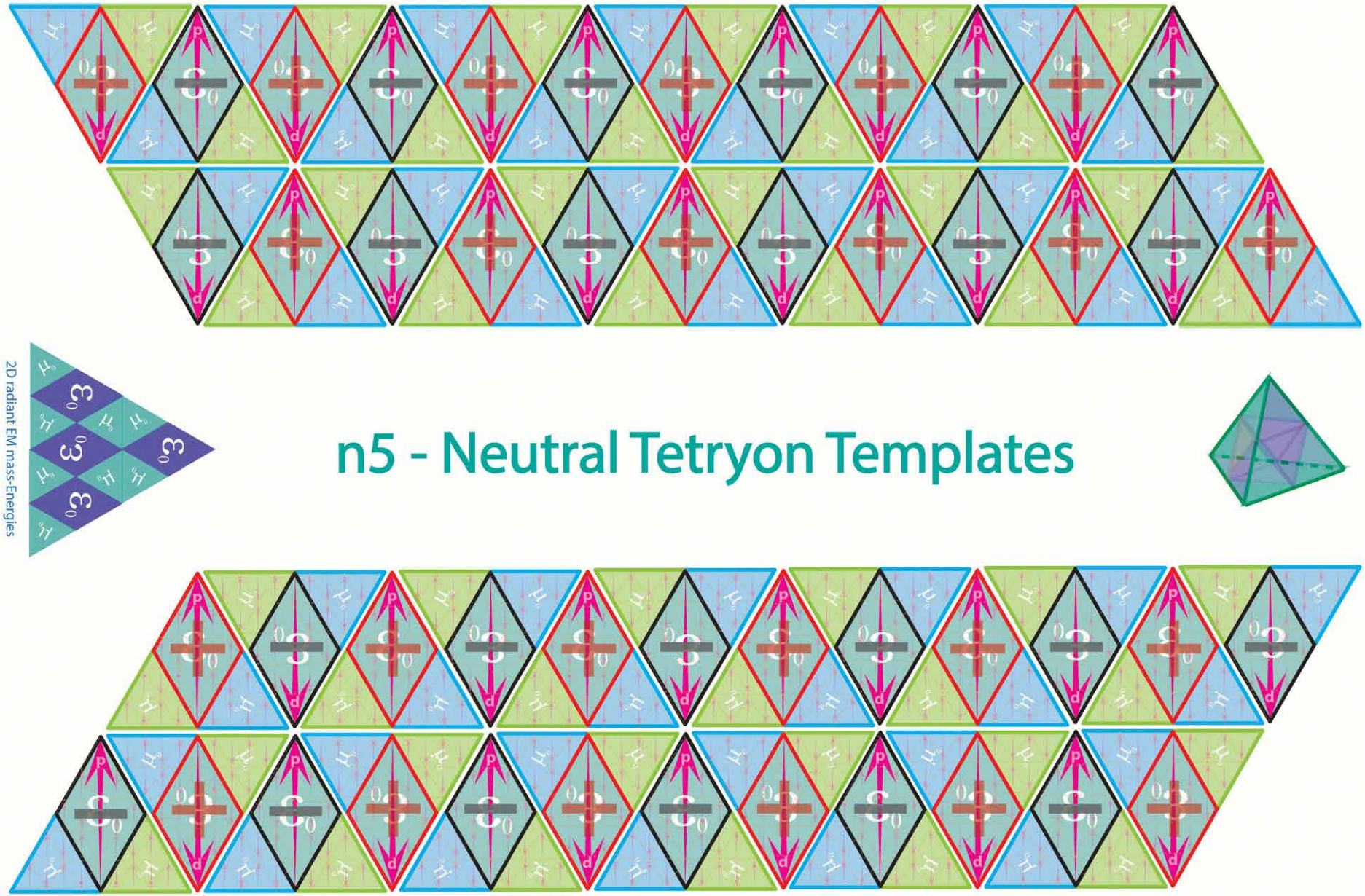

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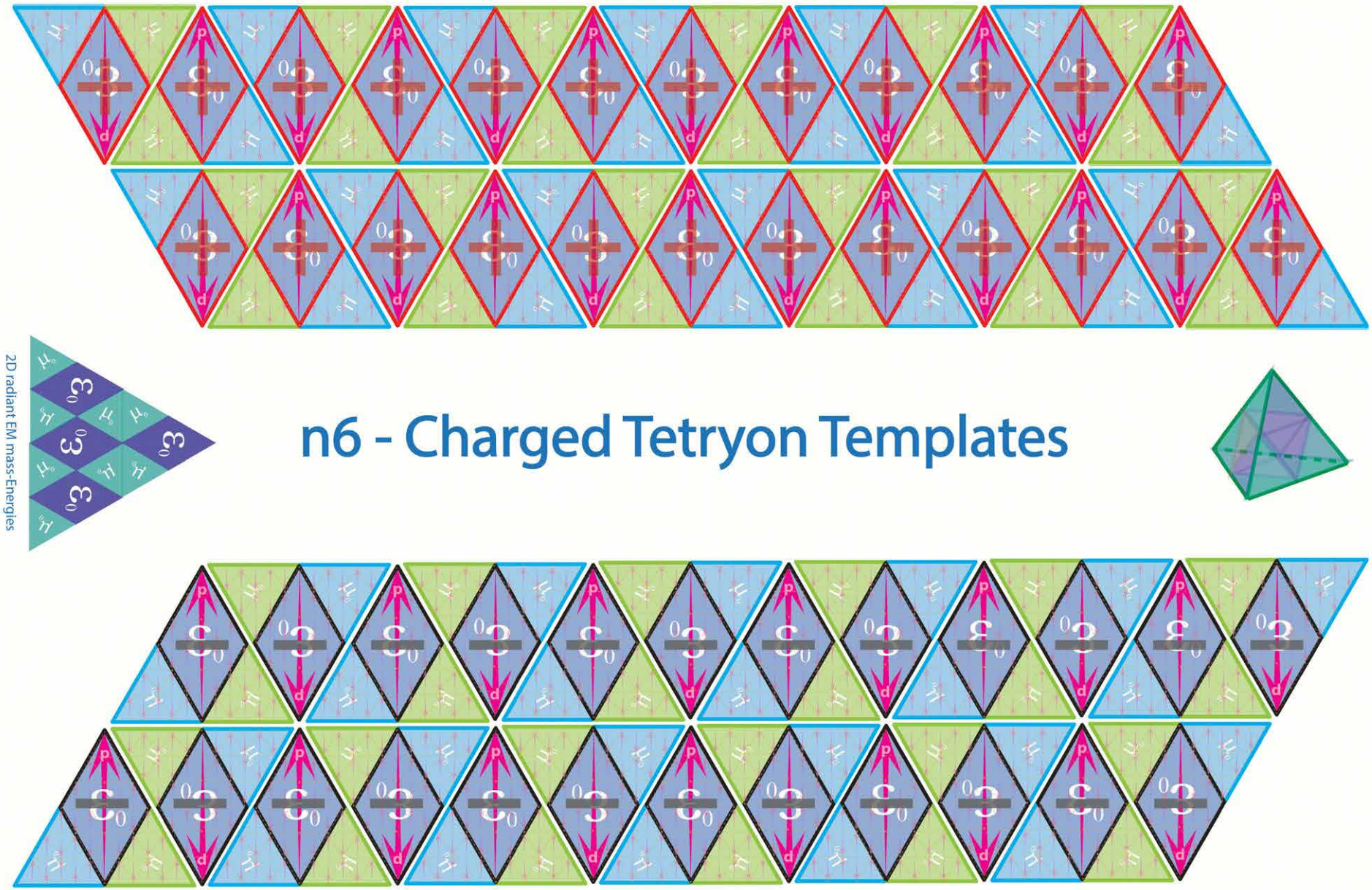

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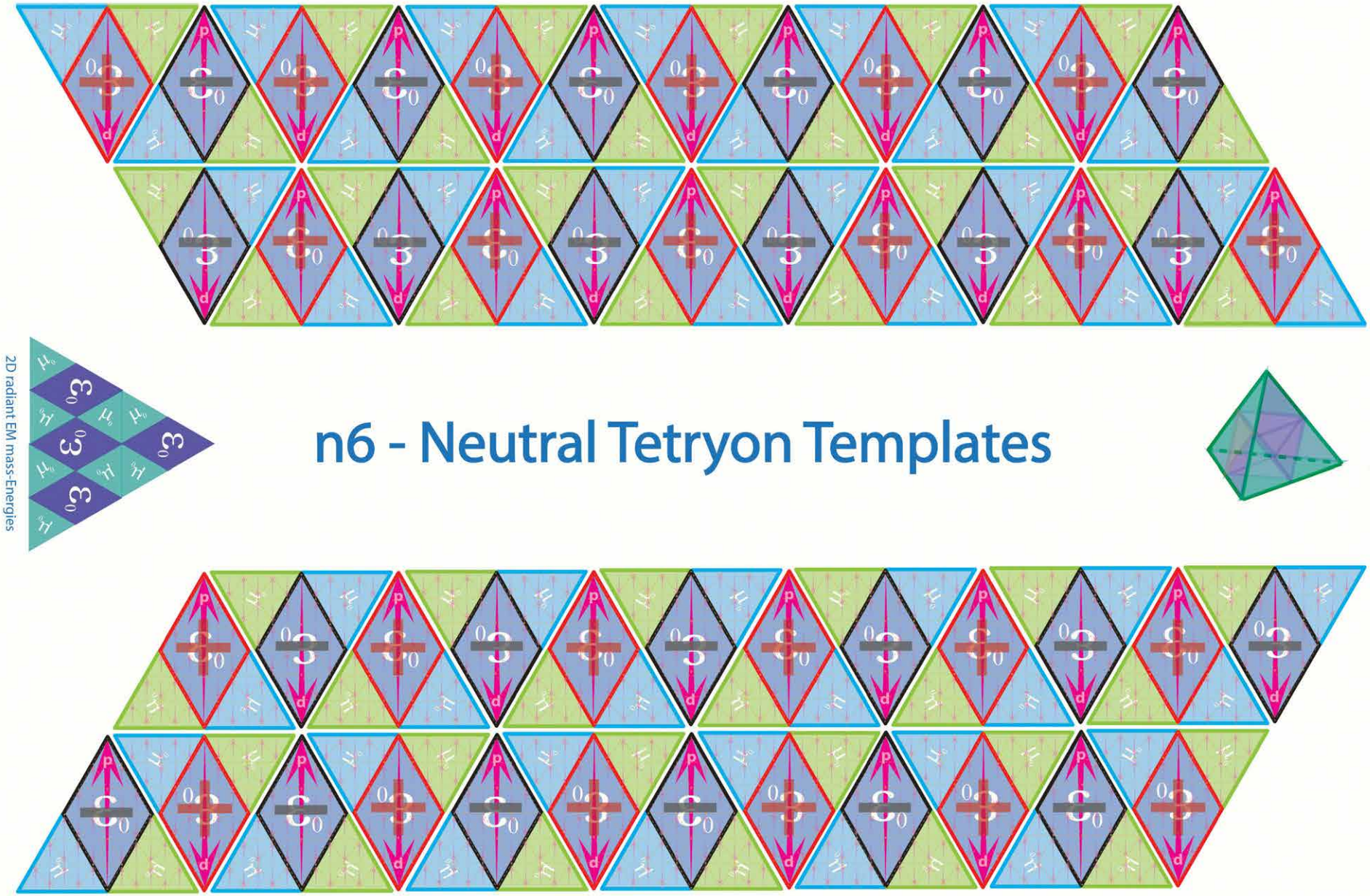

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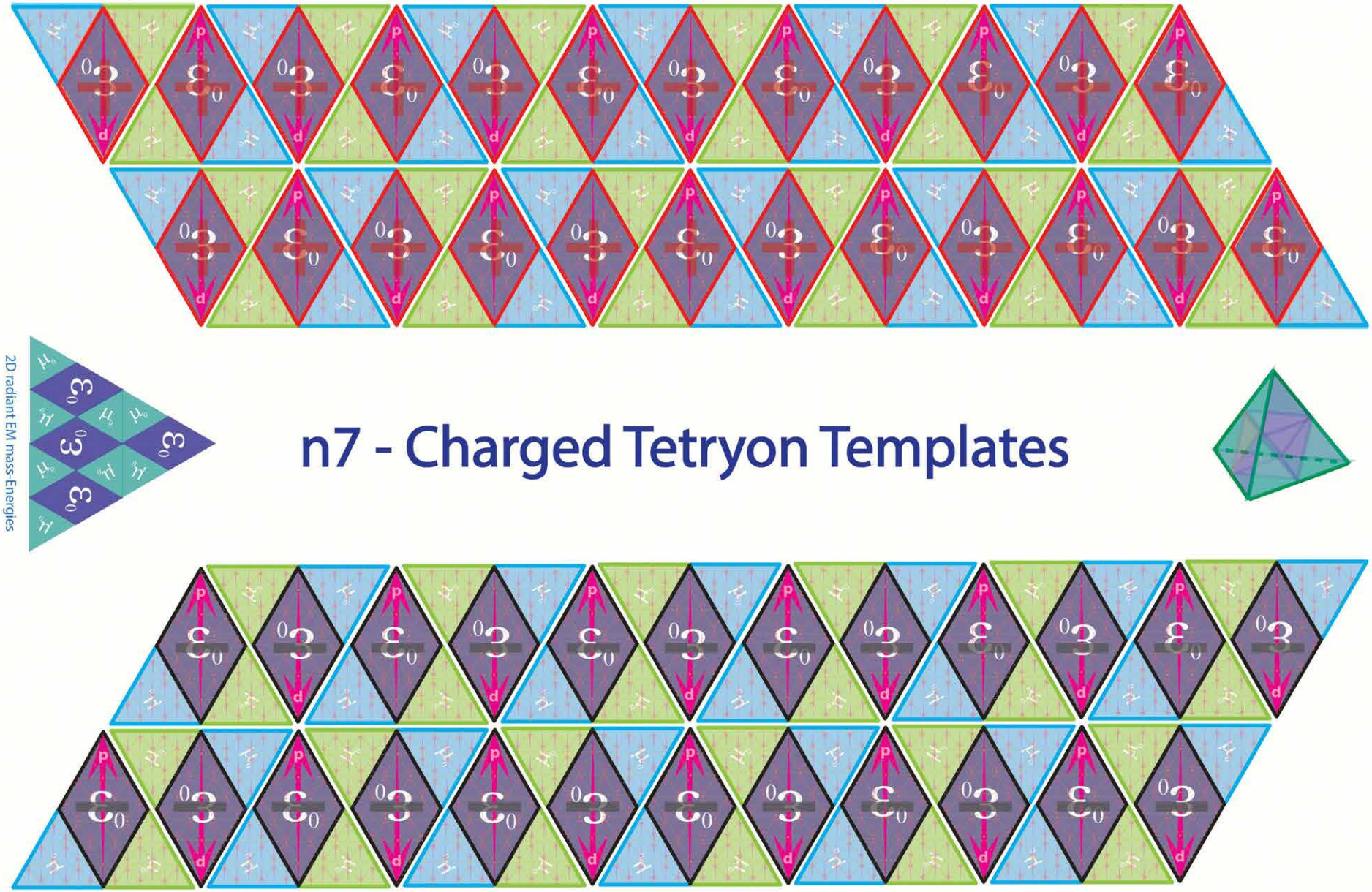

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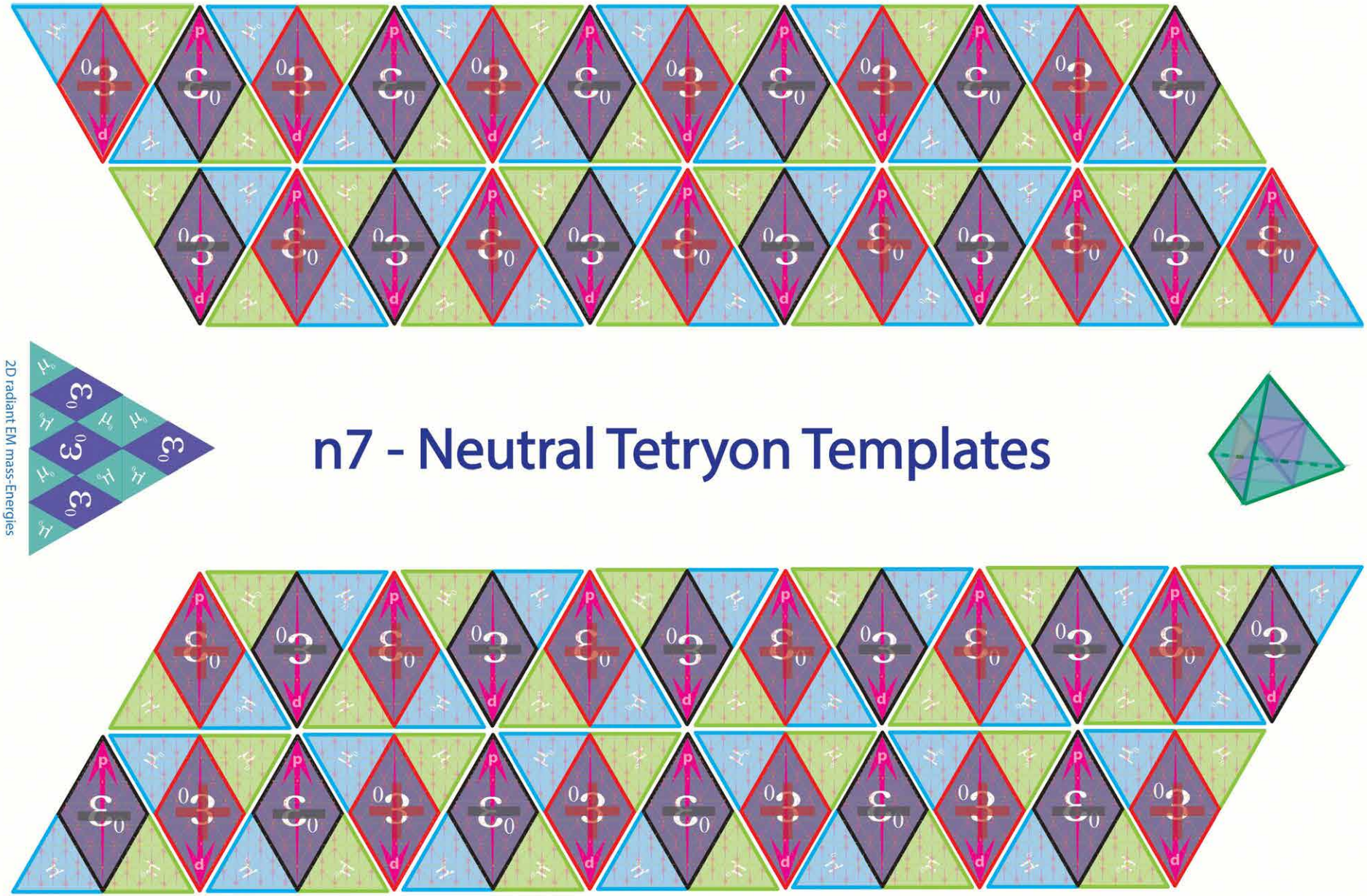

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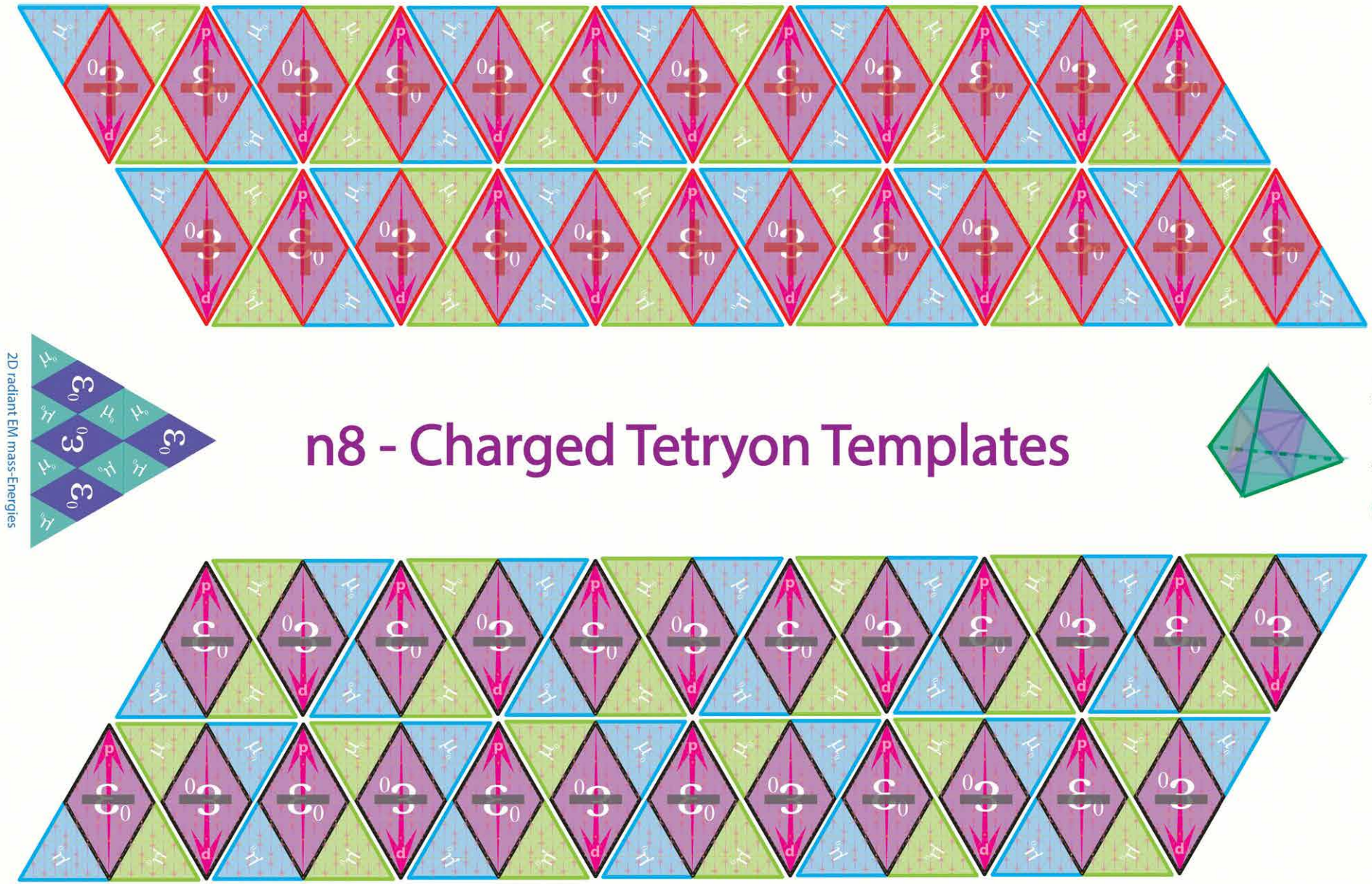

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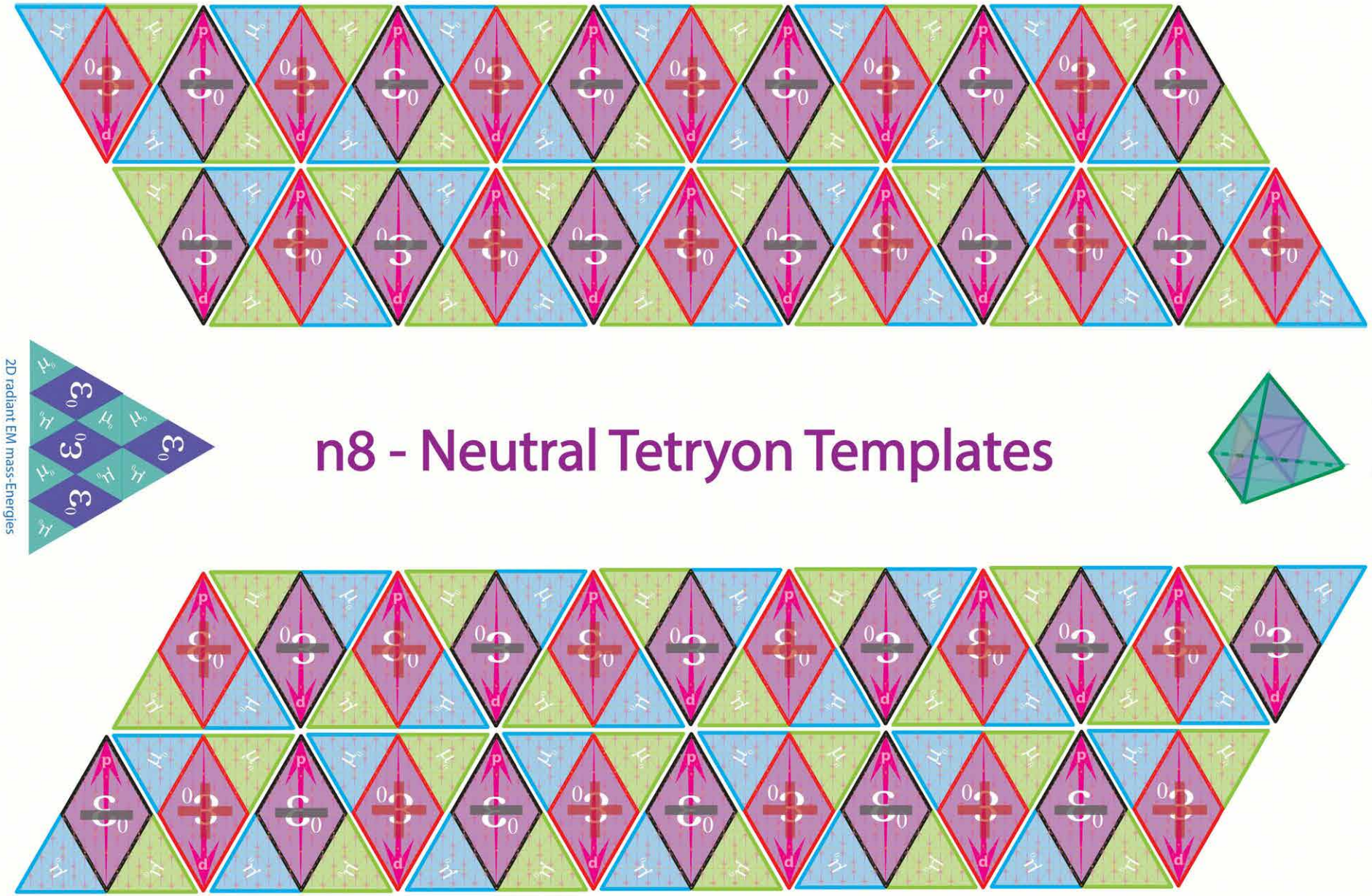

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Periodic element geometries

An electron shell may be thought of as an orbit followed by electrons around an atom's nucleus.
The closest shell to the nucleus is called the "1 shell" (also called "K shell"), followed by the "2 shell" (or "L shell"), then the "3 shell" (or "M shell"), and so on further and further from the nucleus.
The shell letters K, L, M, ... are alphabetical

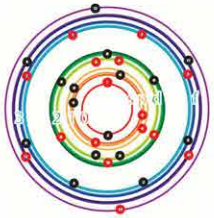

Each shell consists of one or more subshells, and each subshell consists of one or more atomic orbitals.

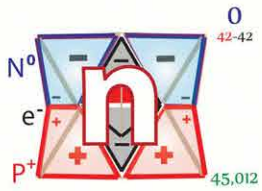

Each shell can contain only an integer number of whole deuterium nuclei [Proton, Neutron & electron]

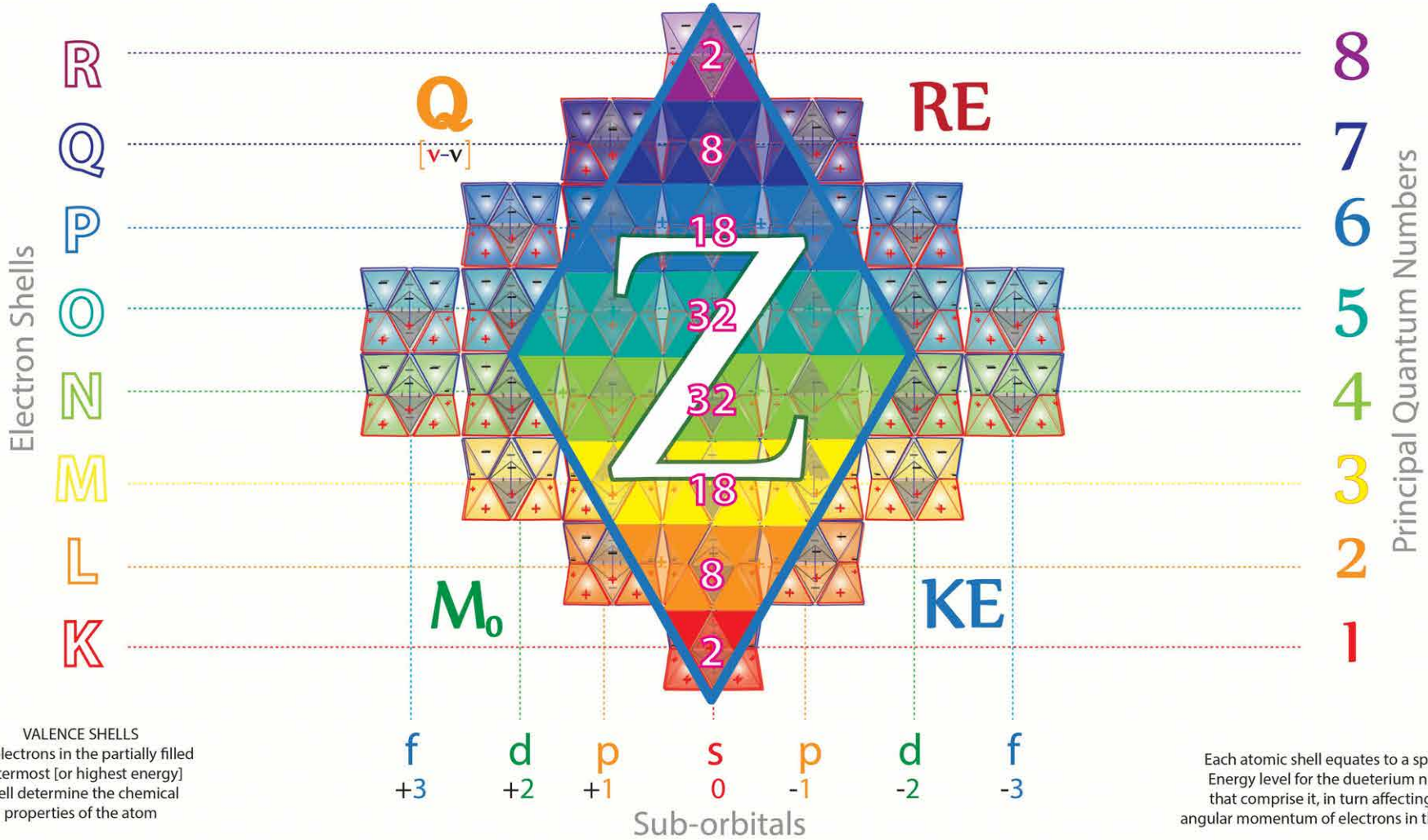

VALENCE SHELLS
The electrons in the partially filled outermost [or highest energy] shell determine the chemical properties of the atom

Each atomic shell equates to a specific Energy level for the dueterium nuclei that comprise it, in turn affecting the angular momentum of electrons in that shell

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Periodic Harmonic motions

$x = A \cos(\omega t + \varphi)$

Much of the math in of modern physics is predicated on the assumption that π [where it appears] is related to the properties of a circle

$F = -kx$

Circular motion

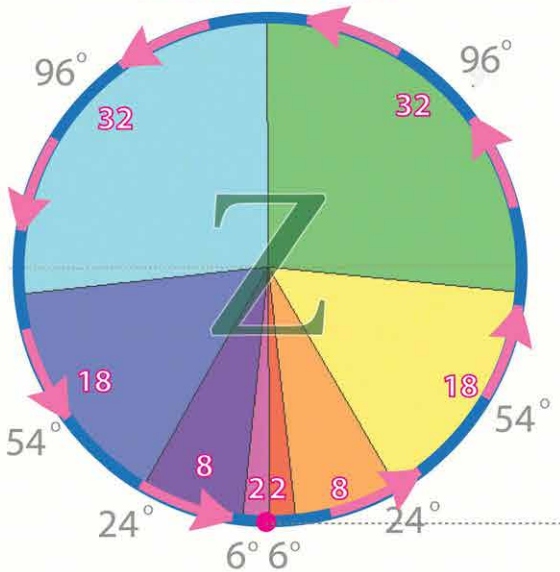

Linear motion

Simple harmonic motion can be visualized as the projection of uniform circular motion onto one axis

Principal Quantum Numbers

circular harmonic motion

simple harmonic motion

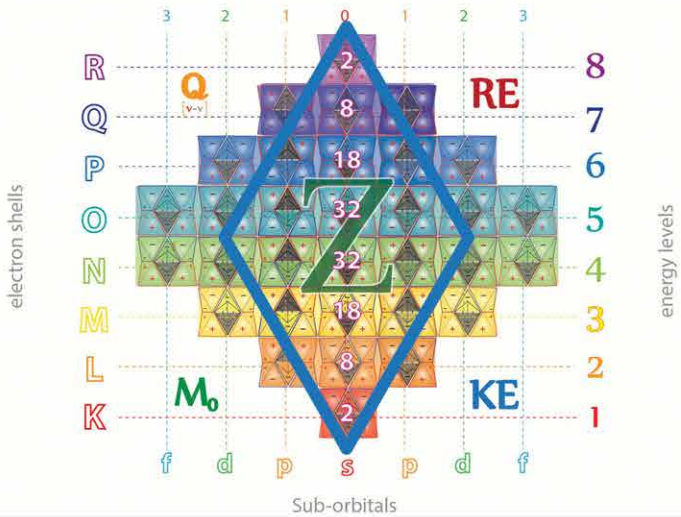

Circular motions describe the motion of a body with a changing velocity vector [the result of an acceleration force].

Nuclei per shell in elements follows a 'periodic summation rule' that is reflective of photonic energies

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Atomic nuclei mass-energies

Each element's weight [mass-Matter in a gravitational field] is the result of the total quanta comprising that element

Baryon mass-energies		E		electron KEM field
n		The quantum level mass-energies of Baryons determines the kinetic energies of electrons 1n - 1 e19v		hv^2
73,728	n32	8	v8	3.268969693 e15
69,192	n31	7	v7	2.502804921 e15
64,800	n30	6	v6	1.838795452 e15
60,552	n29	5	v5	1.276941286 e15
56,448	n28	4	v4	8.172424232 e14
52,488	n27	3	v3	4.596988631 e14
48,672	n26	2	v2	2.043106058 e14
45,000	n25	1	v1	5.107765145 e13
Compton frequencies		1.2 e20 electron rest Matter is velocity invariant		spectral frequencies
930 MeV		496 keV		13.6 eV

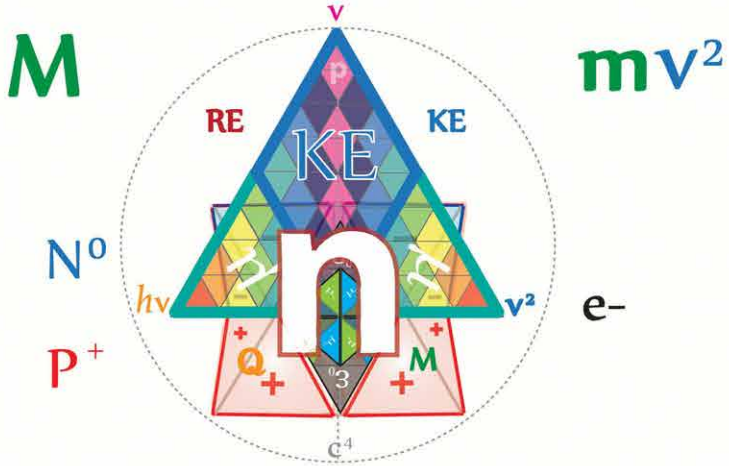

The nuclei forming each atomic shell have specific mass-energy quanta

$$\overset{8}{\underset{1}{n}}\left[\left[72(n)^2\right]+\left[12e19\right]+\left[m_e v^2\right]\right]$$

Baryon rest masses — lepton rest mass — KEM

Deuterium mass-energy per shell

Despite having differing mass-energies each Deuterium nuclei has the same velocity invariant Matter geometry [84π]

spin orbital coupling in synchronous quantum convertors

Electrons act as quantum scale rotating armatures in atomic nuclei and can only have specific energies reflective of the electron orbital energy level of the Baryons in which they are found

They acheive these energy levels by absorbing or emitting photons to acheive the specific angular momentum required

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Baryons **930.947 MeV** + KEM fields **13.525 ev** + electrons **496.519 keV**

Mapping Planck mass-energy contributions to elementary Matter and isotopes

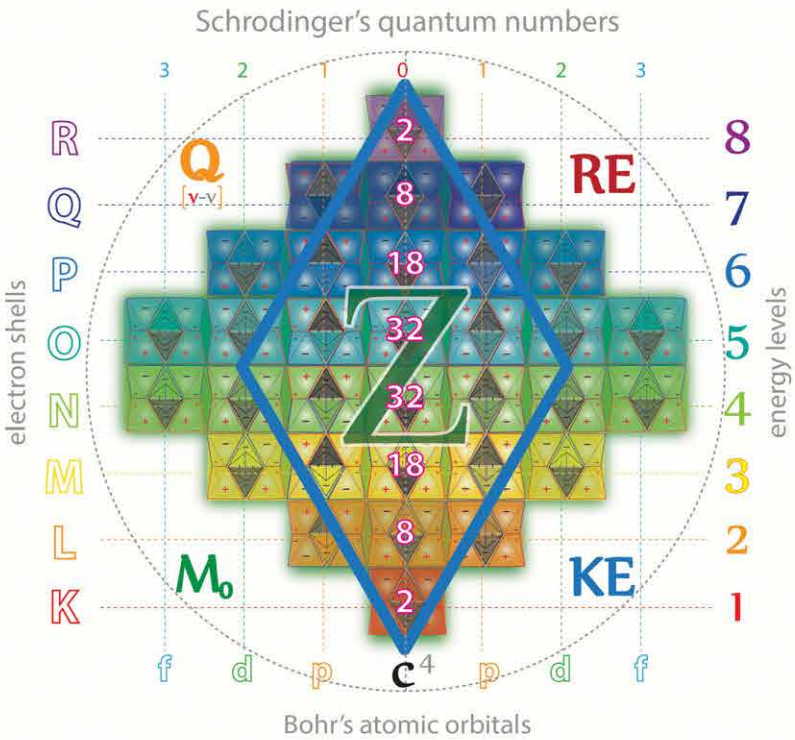

$$E = hv^2$$

$$n^2 + v^2 + e = Z$$

general form quatratic equation

$$ax^2 + bx + c = Z$$

$$E = nhv$$

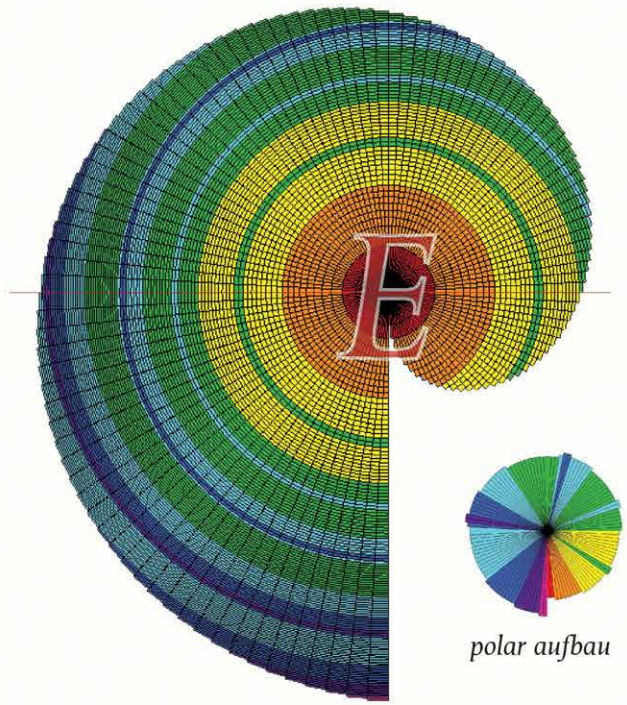

polar aufbau

polar energy spirals courtesy of Rene Cormier

Identifying electron rest Matter topologies as velocity invariant we can re-arrange the component Planck mass-energy geometry formulation of periodic elements to

$$h\left[72[v^2] + v + 1.20\,e20\,v\right]$$

Deuteron rest mass; Spectral lines; electron rest mass

reveal a quadratic formulation for all Z numbers

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$$\sum_{K}^{R}$$

R
nuclei per shell
K

STEP ONE

Periodic summation follows the atomic shell electron config

$$\sum_{K}^{R} 2(x^2) =$$

1 R
2
3
4
4
3
2
1 K

Each atomic shell can hold only a fixed number of deuterium nuclei

Periodic Summation

Periodic summation is a notation developed for Tetryonic theory to model the geometric series addtion of Z[n²] energy level Deuterium nuclei that form the periodic elements

$$\sum_{K}^{R} Z$$

$$\sum^{Z}$$

120
element number
1

STEP TWO

Periodic elements build up following the aufbau sequence

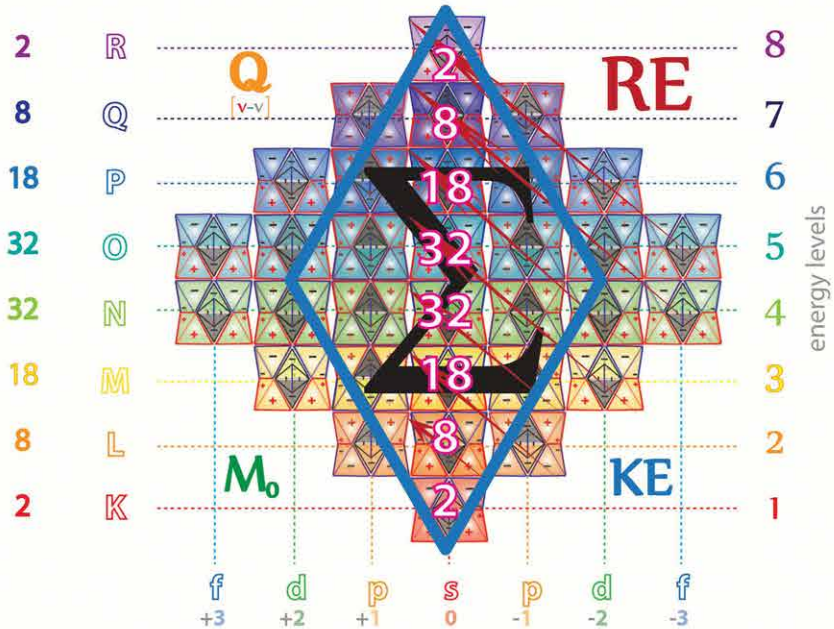

$\sum_{K}^{R}$ R = 2	2 nuclei [74.496 ea]	120	Unbinilium
+			
$\sum_{K}^{R}$ Q = 8	8 nuclei [69,780 ea]	118	Ununoctium
+			
$\sum_{K}^{R}$ P = 18	18 nuclei [65,232 ea]	110	Darmstadtium
+			
$\sum_{K}^{R}$ O = 32	32 nuclei [60,852 ea]	92	Uranium
+			
$\sum_{K}^{R}$ N = 32	32 nuclei [56,640 ea]	60	Neodymuim
+			
$\sum_{K}^{R}$ M = 18	18 nuclei [52,596 ea]	28	Argon
+			
$\sum_{K}^{R}$ L = 8	8 nuclei [48,720 ea]	10	Neon
+			
$\sum_{K}^{R}$ K = 2	2 nuclei [45,012 ea]	2	Helium
		0	Hydrogen

THe LHS of the notation determine the number of nuclei in each atomic shell, from the periodic mass-energy levels for atoms, and the RHS follows the aufbau building principle to determine the rest mass-Matter of any specific element

Aufbau

Each periodic element is made of Z [n² energy] deuterium nuclei

Z# [z Protons [24-12] / z Neutrons [18-18] / z electrons [0-12]] n1-8

Planck mass-energies form the surface integral of rest Matter topologies for each periodic element

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Proton - Neutron Curve

The graph below is a plot of neutron number against proton number.
It is used as rule to determine which nuclei are stable or unstable.

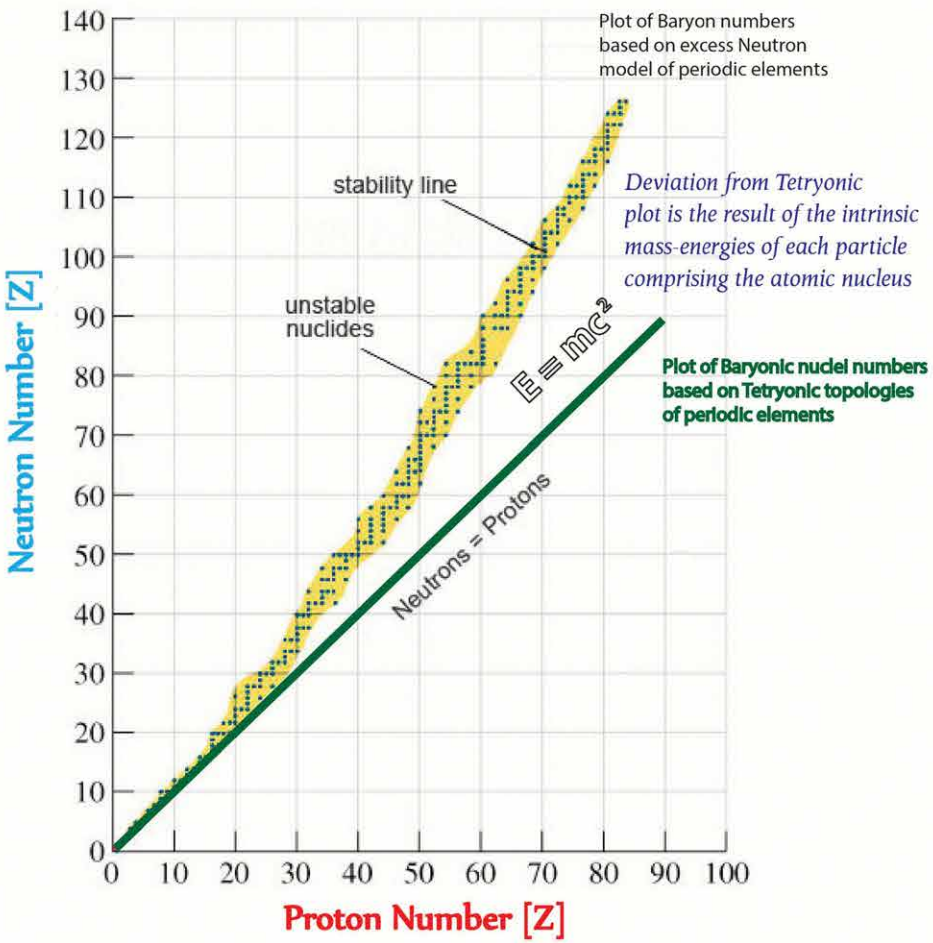

Historically, Proton-electron numbers are viewed as being equivalent in neutral elementary matter with the excess molar mass measured being the result of 'excess or extra' Neutrons in the atom

Atomic Nuclei Numbers

All periodic elements have an EQUAL number of Protons, Neutrons & Electrons with their molar mass-Matter being determined by their quantum level mass-energies

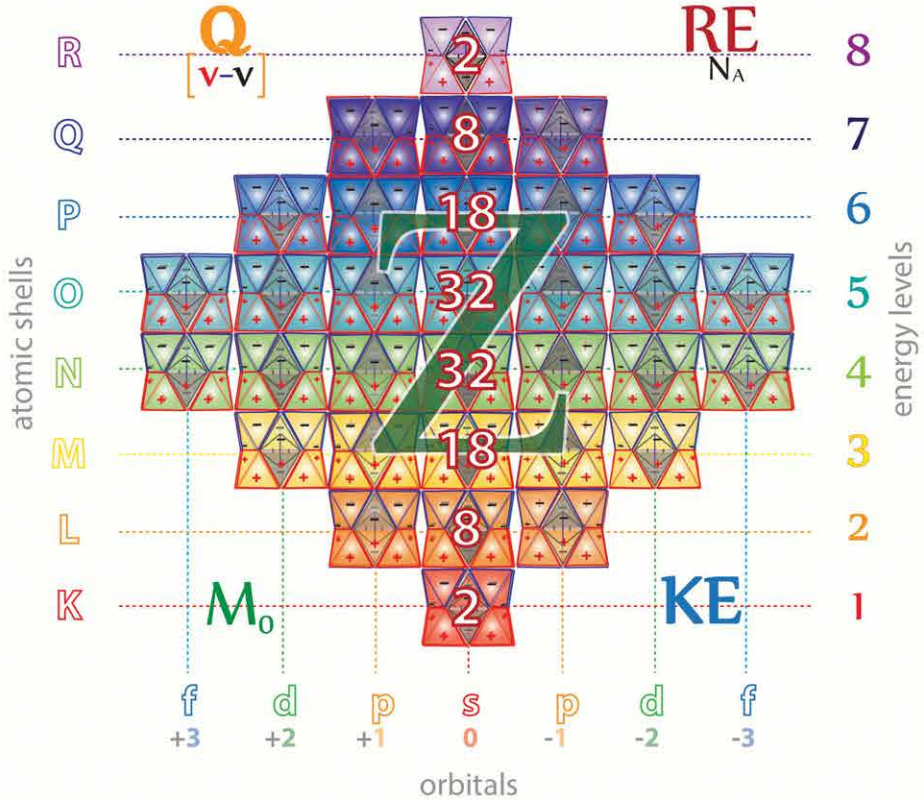

Tetryonic modelling of the charged mass-ENERGY-Matter topologies of elementary atoms and the nuclei that comprise them, reveals a DIRECT LINEAR relationship for the number of Protons-electrons-Neutrons in all periodic elements and nuclear isotopes

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Planck mass-energy contributions to elementary Matter and isotopes

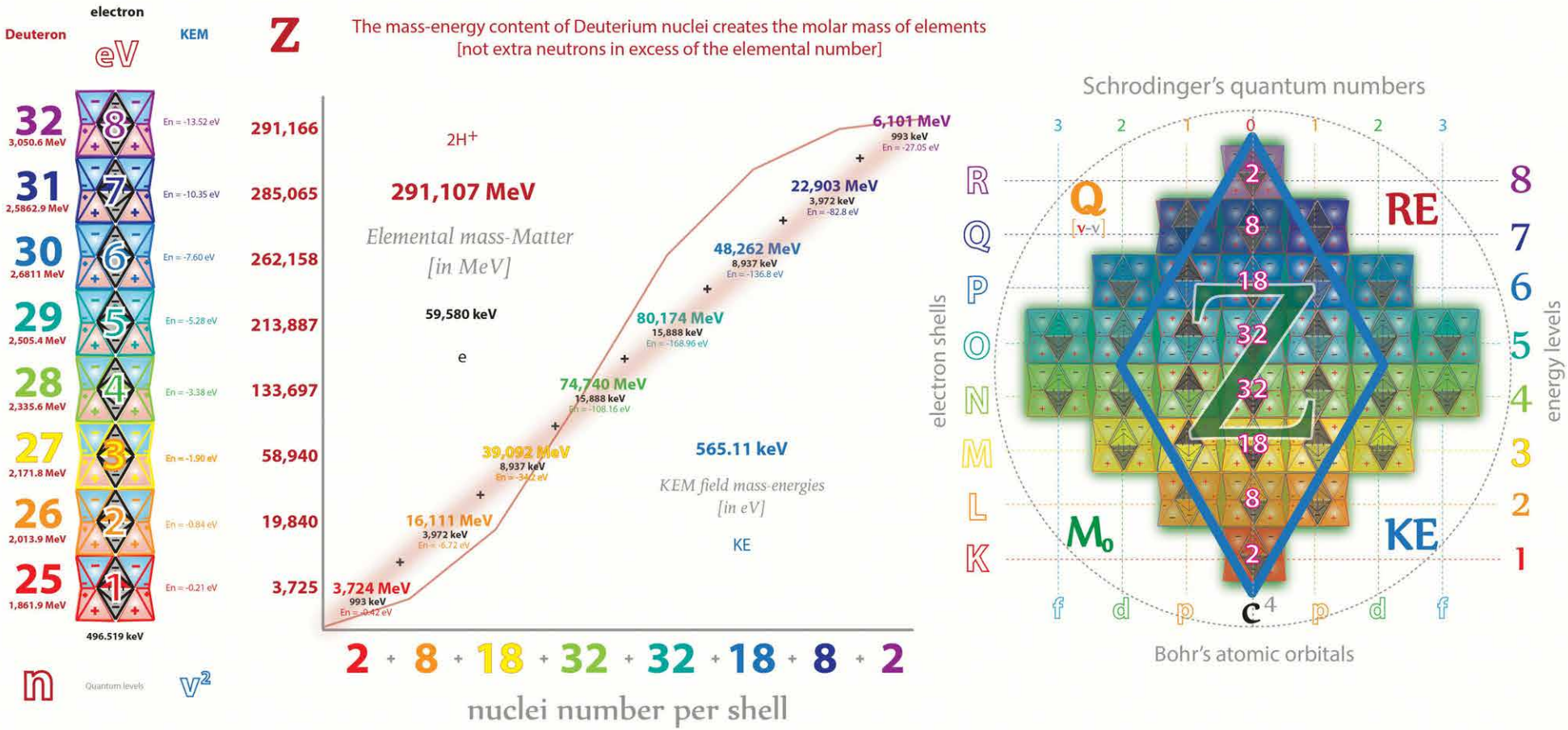

n1 Elementary nuclei

are comprised of equal numbers of Protons, Neutrons & electrons with varying energy levels

Baryons		electrons		KEM fields
930.947 MeV	+	**496.519 keV**	+	**13.525 ev**

The mass-energy content of Matter topologies is velocity invariant

The mass-energy content of Baryons determines the KEM field of electrons

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All elements are comprised of n level Duetrium nuclei

Baryons **KEM fields** **electrons**

$$Z\,[[72n^2] + [12v^2] + [1.2e20]]$$

1,861,949 MeV **13.525 eV** **496,519 keV**

$2H^+$ $[72n^2]$ Z γ $[M_e v^2]$

Elemental mass-Matter [in MeV]

The atomic shell energy levels of Deuterium nuclei in elements

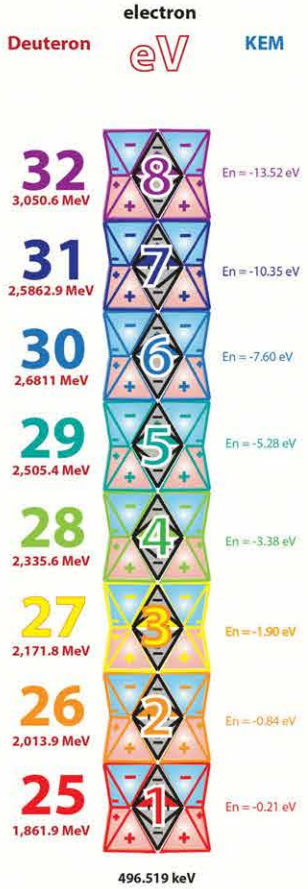

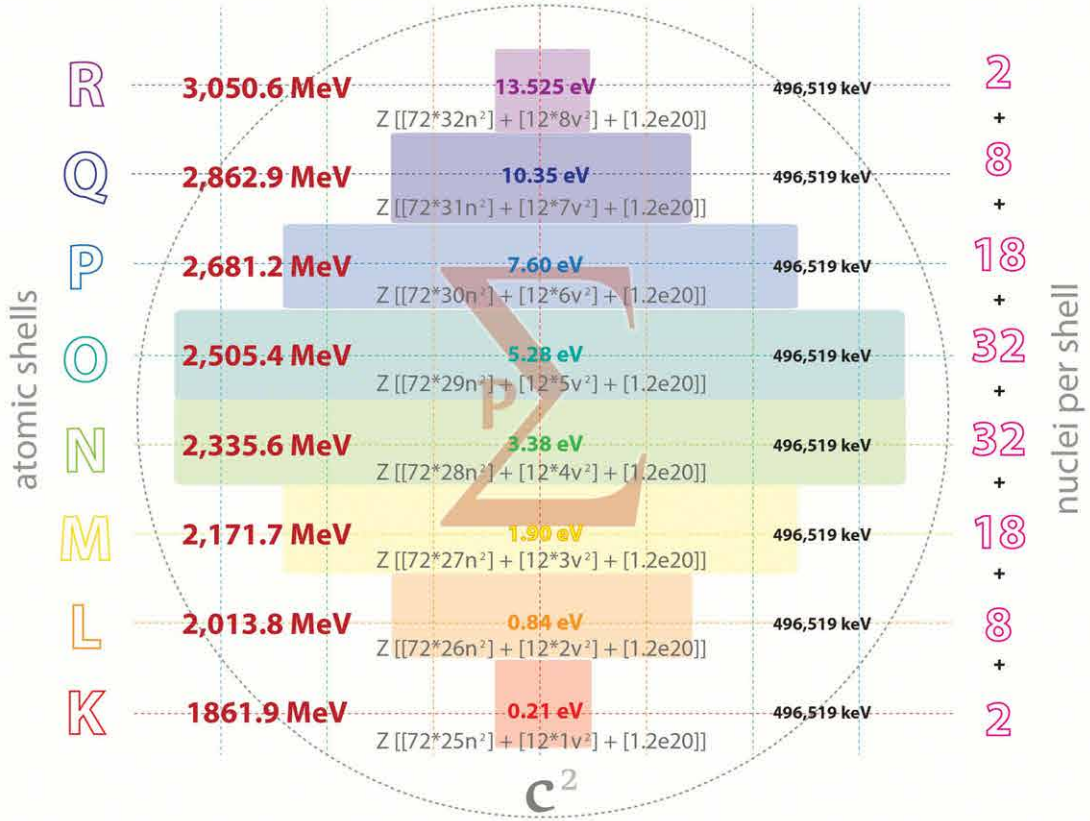

6,101 MeV 993 keV En = -27.05 eV
+
22,903 MeV 3,972 keV En = -82.8 eV
+
48,262 MeV 8,937 keV En = -316.8 eV
+
80,174 MeV 15,888 keV En = -168.96 eV
+
74,740 MeV 15,888 keV En = -108.16 eV
+
39,092 MeV 8,937 keV En = -34.2 eV
+
16,111 MeV 3,972 keV En = -6.72 eV
+
3,724 MeV 993 keV En = -0.42 eV

$[1.2e20]]$

e

the rest mass-Matter of bound photo-electrons is velocity invariant

Determines the spectral line [KEM field energies] of electrons bound to them

The relativistic rest mass-energy-Matter of all periodic elements

is the sum of the mass-energies of all atomic nuclei and spectral lines that comprise its mass-Matter topology as measured in any spatial co-ordinate system per unit of time

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Ionisation energies

Fractional quantum differentials

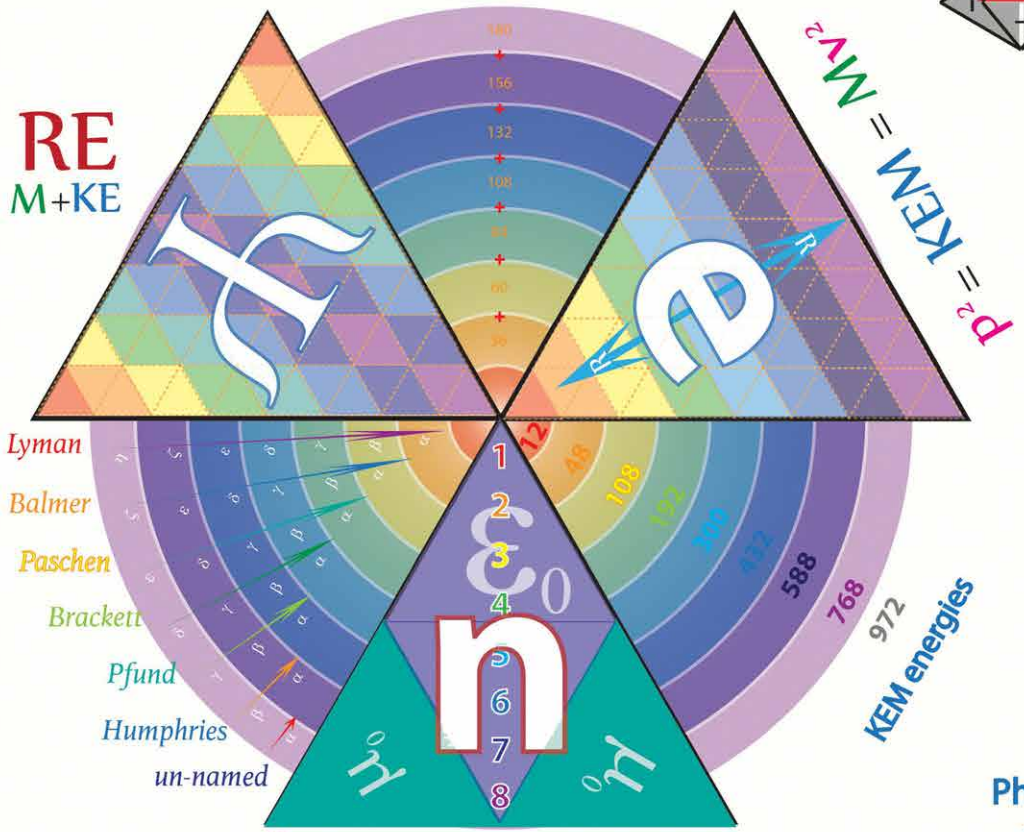

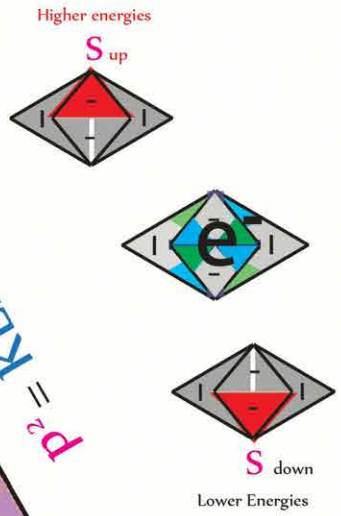

photo-electronic energy momenta

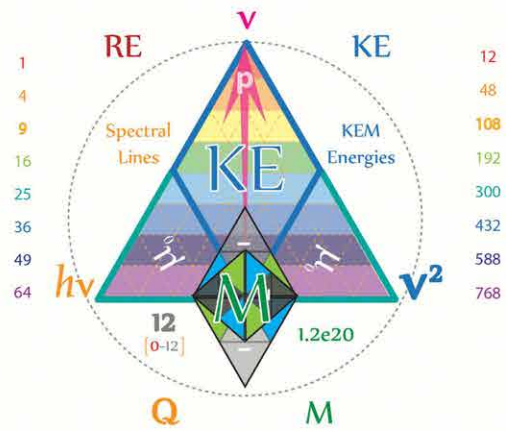

Mapping photo-electron transition energies to Tetryonic energy momenta geometries reveals many key facts about the ionisation energies of nuclei

$$E = -\frac{Z^2}{n^2}\frac{ke^2}{2a_0} = -\frac{13.6Z^2}{n^2}eV$$

The differing fractional KEM field energy momenta of electrons that results from their transitions to specific energy nuclei in elements results in differing QAM quanta and produces spectral lines and fine line splitting

$$hf = \Delta Mv = \Delta p$$

spectral lines are produced by accelerating electrons

Note: this is an Illustrative schema for modelling KEM field energies
All KEM fields possess the same physical spatial geometry
in radial-time defined spatial co-ordinate systems

Photo-electrons absorb/emit spectral energies

$$E = eV = \frac{1}{4\pi\epsilon_0}\frac{ne^2}{a}$$

Spectral line transitions

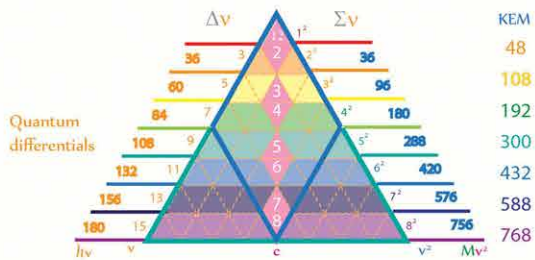

hv, R, β, p, KE
Planck, Rydberg, Lorentz, Newton, Leibniz

uniting classical physics and relativity through equilateral geometry

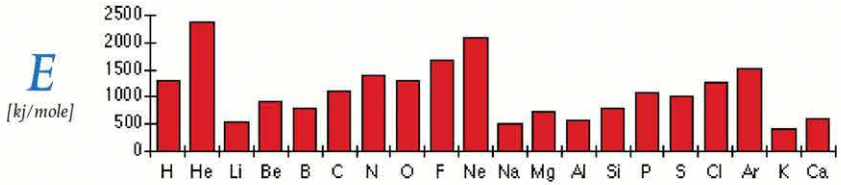

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Element numbers

Nuclei per shell in elements follow a 'periodic summation rule' that is reflective of photonic energies

$$\sum_{K}^{R} {}^{P} 2(x^2) = 2 + 8 + 18 + 32 + 32 + 18 + 8 + 2$$

Z

120	Unbinilium	n8
119	Ununennium	
118	Ununoctium	n7
87	Francium	
112	Copernicium	n6
55	Caesium	
102	Nobelium	n5
37	Rubidium	
70	Ytterbuim	n4
19	Potassium	
30	Zinc	n3
11	Sodium	
10	Neon	n2
3	Lithium	
2	Helium	n1
1	Deuterium	
Hydrogen	0	

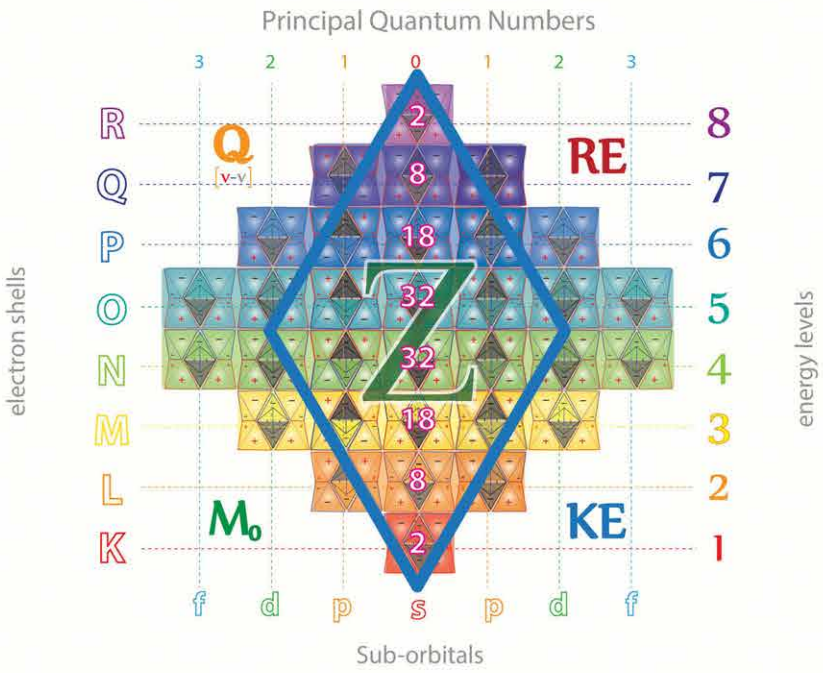

Periodic mass-ENERGY-Matter

Following periodic summation rules for shell filling n[1-8] quantum energy deuterium nuclei combine to form elementary Matter

$$\sum_{K}^{R} {}^{P}_{25}{}^{32} \left[\left[72(n)^2 \right] + \left[12e19 \right] + \left[m_e v^2 \right] \right]_{1}^{8}$$

Baryon rest masses; lepton rest mass; KEM; Deuterium mass-energy per shell

The measured weight of Matter in gravitational fields is the result of planar mass-energies in tetryonic standing-wave geometries

The periodicity of all the elements, along with their exact molar rest mass-energies and quantum wavefunctions can be described with Tetryonic geometries

Ionisation energies

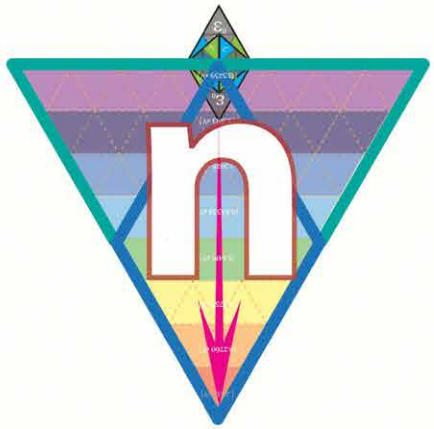

γ

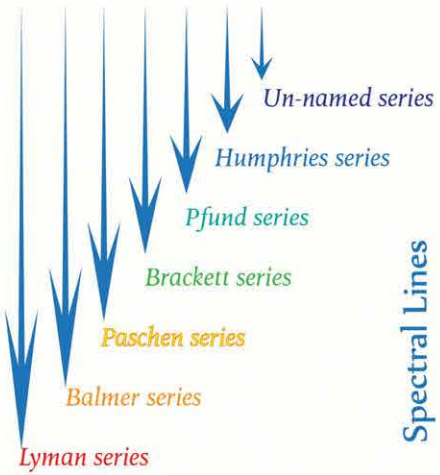

$$Mv^2 = KEM = hcR_H$$

Photon emission/absorption

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Spectral line differentials

$$\Delta h\nu = \Delta M\nu = \Delta p$$

changes to energy momenta

accelerate photo-electrons

$$\frac{1}{\lambda} = \frac{R_H}{hc}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Ryberg's formula is
a mathematical description
of Tetryonic energy geometry

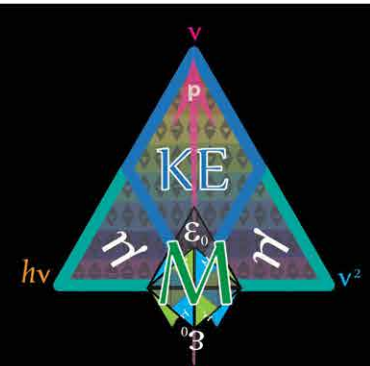

& produces spectral lines

Δhf

bosons

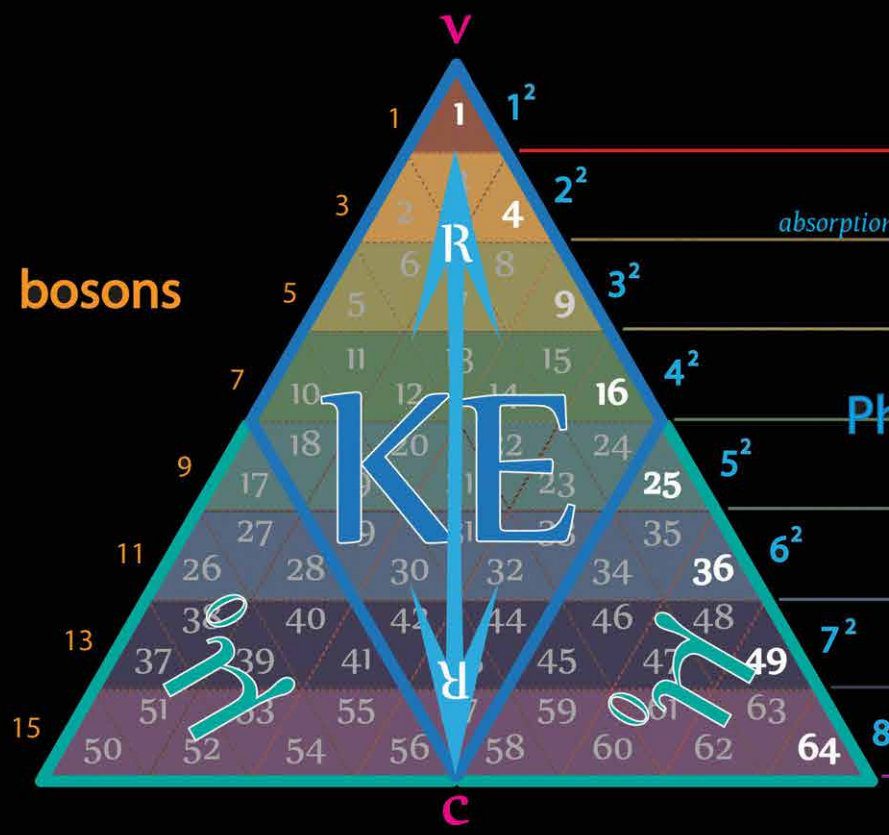

absorption $\frac{n_i^2}{n_f^2}$

Fractional energy level transitions

$\frac{n_f^2}{n_i^2}$ emission

Photo-electrons

						3/4
					5/9	8/9
				7/16	12/16	15/16
			9/25	16/25	21/25	24/25
		11/36	20/36	27/36	32/36	35/36
	13/49	24/49	33/49	40/49	45/49	48/49
15/64	28/64	39/64	48/64	55/64	60/64	63/64
Un-named	Humphries	Pfund	Brackett	Paschen	Balmer	Lyman

Ryberg's constant reflects the changing
energy momentum of a transitioning electron

$$Mv^2 = KEM = hcR$$

All of the transitions of photo-electrons bound to Hydrogen atoms can now be revealed in the fractional geometry of KEM field energies

KEM field energies

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Fermat's method of Factoring

also known as 'the difference of two squares' is used to factorise large numbers

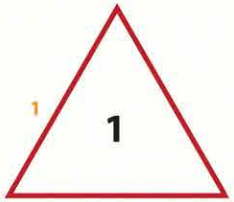

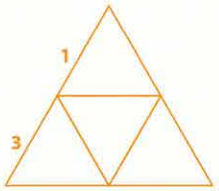

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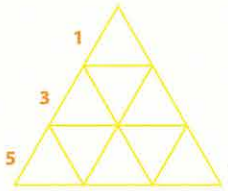

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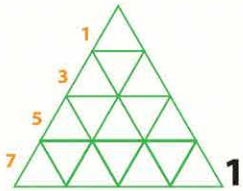

16

$[x-y].[x+y]$

$x^2 - y^2$

All
spectral
lines transitions
are an example of

Fermat's
difference of two squares
in action at the quantum level

leading in turn to Ryberg's formula

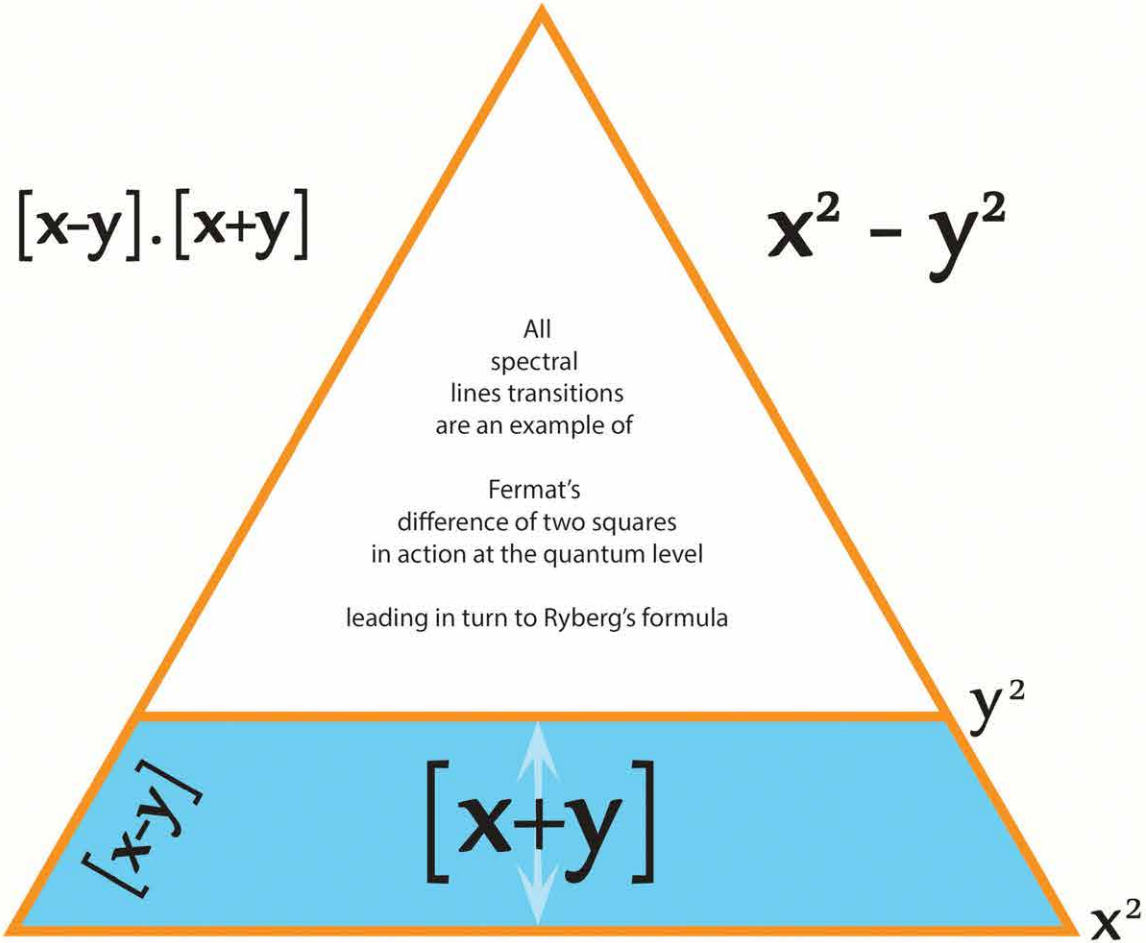

Fermat knew that every odd number could be written as the difference of two squares
or as revealed geometrically through Tetryonic theory's equilateral geometry,
every 'SQUARE' number is the sequential sum of ODD numbers

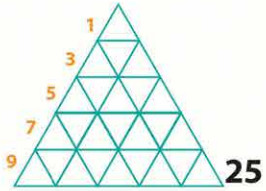

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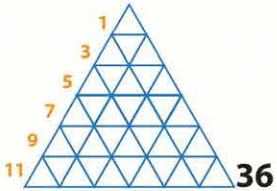

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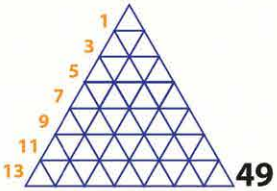

49

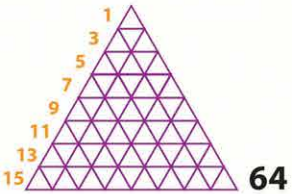

64

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Fractions

A fraction is a number that shows how many equal parts there are

In quantum mechanics fractions appear in quantum steps
as a result of the equilateral geometry of Planck energy momenta

3/4

24/25

40/49

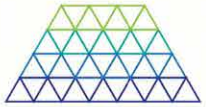

48/64

80/81

.987654321

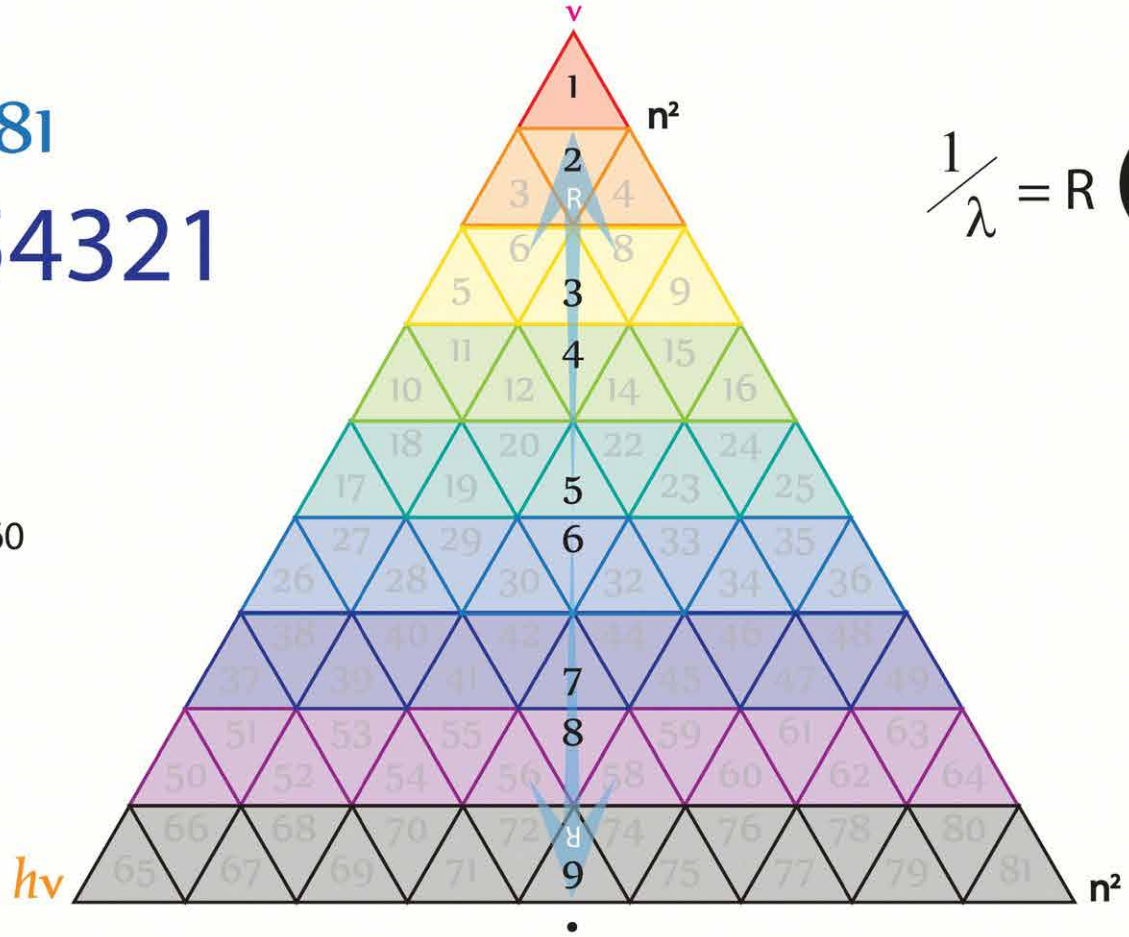

$$\frac{1}{\lambda} = R\left(\frac{1}{1} - \frac{1}{81}\right)$$

.987654321

Cos 60

.5

1/2

Sin 60

.866025403

$\sqrt{3/2}$

Tetryonic geometry explains the fractional mathematics of Rydberg's formula

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Lyman spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck — 13.525 eV — Rydberg

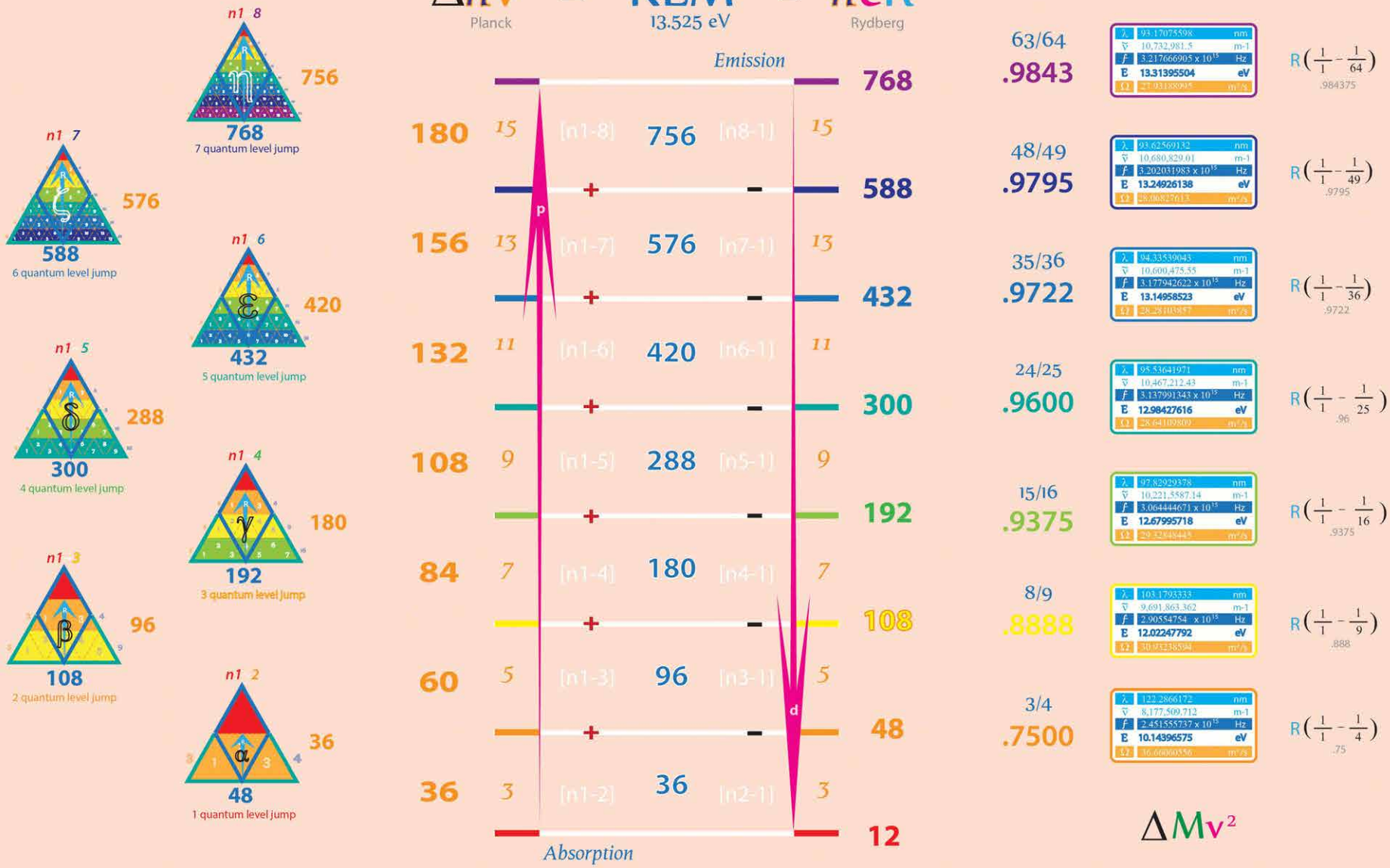

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Balmer spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck — 3.381 eV — Rydberg

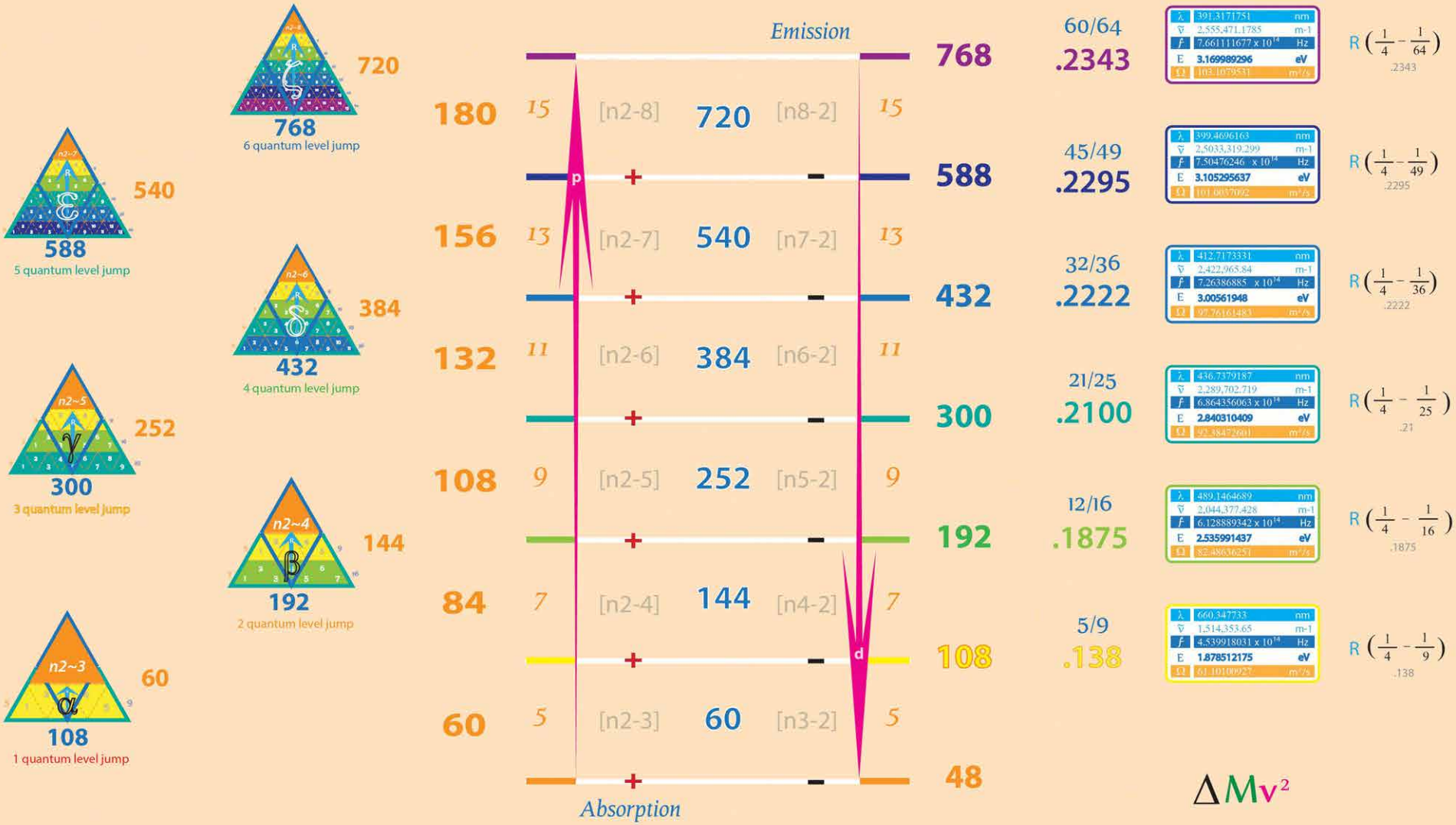

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Paschen spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck — 1.502 eV — Rydberg

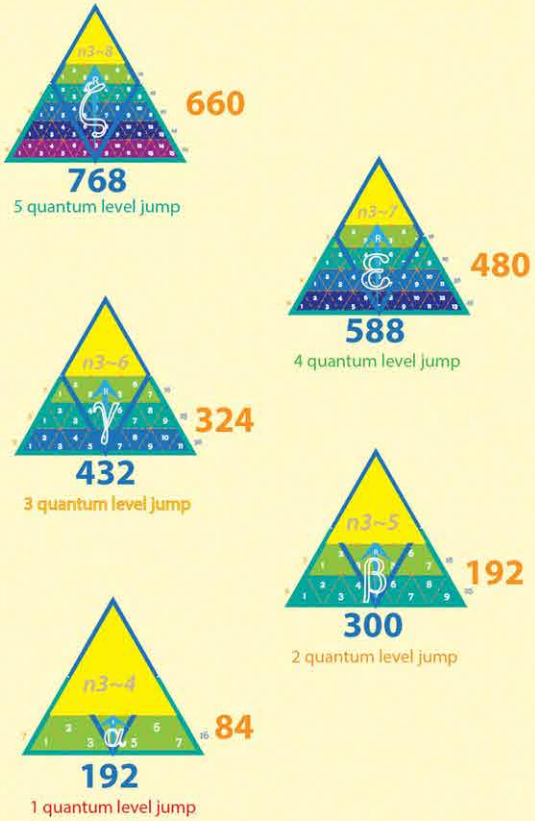

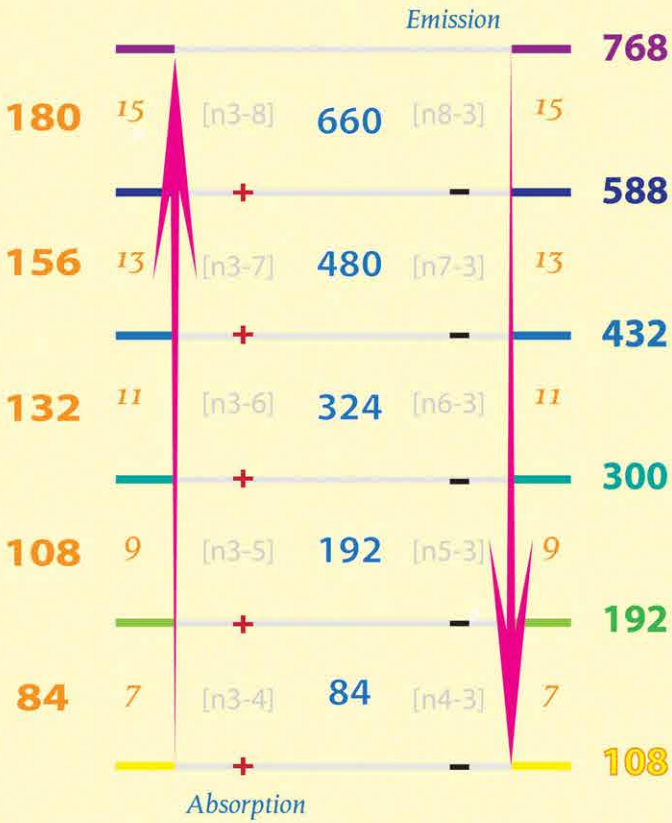

55/64 .0954	λ 960.5057935 nm; ν̃ 1,041,118.135 m-1; f 3.121193646 x 10^14 Hz; E 1.29147712 eV; Ω 287.9523928 m²/s	$R\left(\frac{1}{9}-\frac{1}{64}\right)$ .09548
40/49 .0907	λ 1,011.157466 nm; ν̃ 988,965.6492 m-1; f 2.9464844428 x 10^14 Hz; E 1.226783461 eV; Ω 303.1373822 m²/s	$R\left(\frac{1}{9}-\frac{1}{49}\right)$ .0907
27/36 .8033	λ 1,100.579555 nm; ν̃ 908,612.1902 m-1; f 2.723950819 x 10^14 Hz; E 1.127107305 eV; Ω 329.94545 m²/s	$R\left(\frac{1}{9}-\frac{1}{36}\right)$ .0833
16/25 .0711	λ 1,289.741666 nm; ν̃ 775,349.069 m-1; f 2.324438032 x 10^14 Hz; E 0.961798233 eV; Ω 386.6548243 m²/s	$R\left(\frac{1}{9}-\frac{1}{25}\right)$ .0711
7/16 .0486	λ 1,886.707809 nm; ν̃ 530,023.7776 m-1; f 1.588971311 x 10^14 Hz; E 0.657479261 eV; Ω 565.6207715 m²/s	$R\left(\frac{1}{9}-\frac{1}{16}\right)$ .0486

$$\Delta M v^2$$

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Brackett spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck — 0.8451 eV — Rydberg

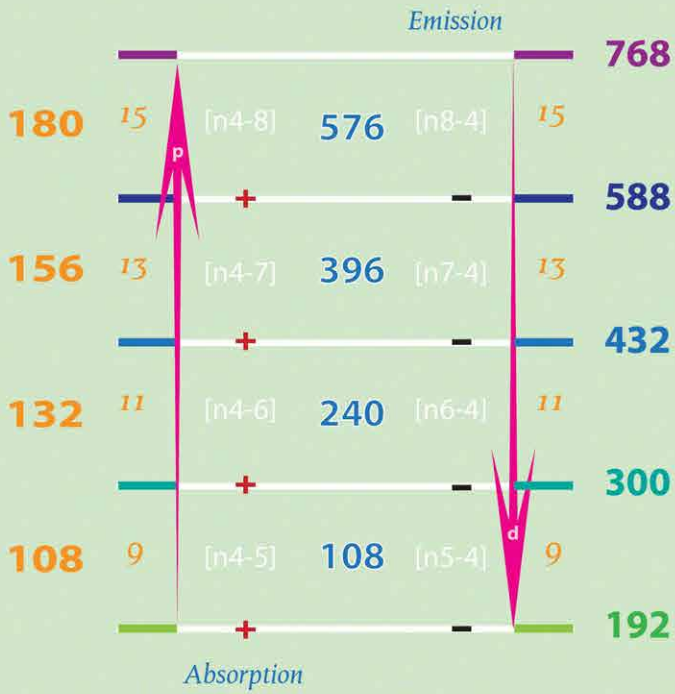

48/64	.0468	λ 1,956.585876 nm; ν̃ 511,094.357 m-1; f 1.532222335 x 10^14 Hz; E 0.634001085 eV; Ω 586.569689 m²/s	$R\left(\frac{1}{16}-\frac{1}{64}\right)$	.0468
33/49	.04209	λ 2,178.92518 nm; ν̃ 458,941.8716 m-1; f 1.375873118 x 10^15 Hz; E 0.569307096 eV; Ω 653.2253354 m²/s	$R\left(\frac{1}{16}-\frac{1}{49}\right)$	.04209
20/36	.0347	λ 2.641.390932 nm; ν̃ 378,588.4126 m-1; f 1.134979508 x 10^14 Hz; E 0.469630433 eV; Ω 791.8690801 m²/s	$R\left(\frac{1}{16}-\frac{1}{36}\right)$	.0347
9/25	.0225	λ 4.076.220574 nm; ν̃ 245,325.2914 m-1; f 7.35466721x 10^13 Hz; E 0.30432052 eV; Ω 1.222.020185 m²/s	$R\left(\frac{1}{16}-\frac{1}{25}\right)$	.0225

$\Delta M v^2$

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Pfund spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck P — 0.541 eV — Rydberg

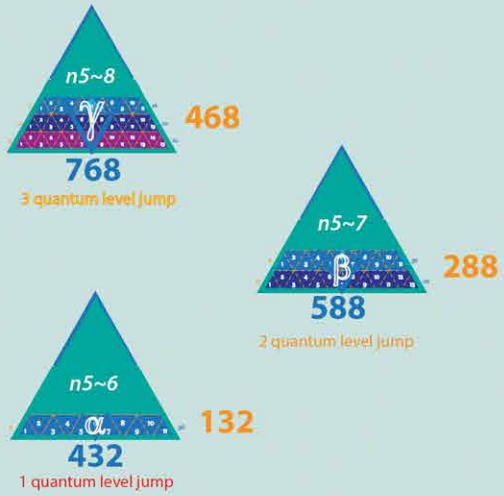

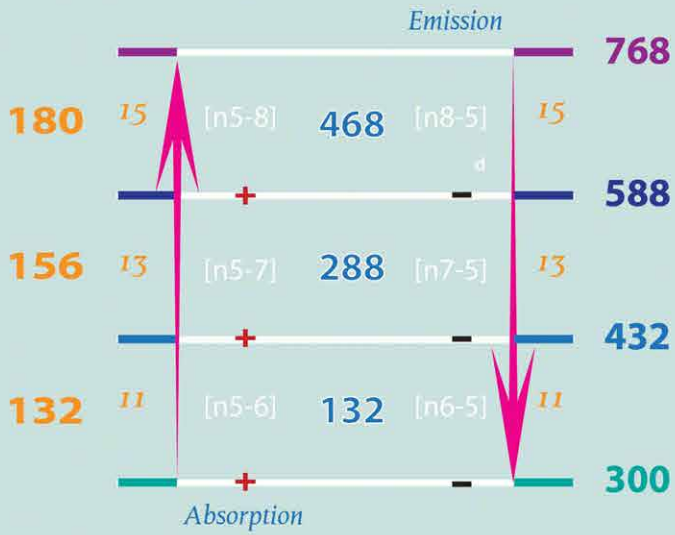

39/64
.0243

λ	3,762.665146	nm
$\tilde{\nu}$	265,769.0656	m-1
f	7.967556145 x 10^{13}	Hz
E	0.329678886	eV
Ω	1,128.018633	m^2/s

$R\left(\frac{1}{25}-\frac{1}{64}\right)$ .0243

24/49
.0195

λ	4,681.284566	nm
$\tilde{\nu}$	213,616.5802	m-1
f	6.404063965 x 10^{13}	Hz
E	0.264985227	eV
Ω	1,403.413807	m^2/s

$R\left(\frac{1}{25}-\frac{1}{49}\right)$ .01959

11/36
.0122

λ	7,503.951512	nm
$\tilde{\nu}$	133,263.1212	m-1
f	3.995127867 x 10^{13}	Hz
E	0.165309071	eV
Ω	2,249.628068	m^2/s

$R\left(\frac{1}{25}-\frac{1}{36}\right)$ .0122

ΔMv^2

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Humphreys spectral transitions

$$\Delta h\nu = \text{KEM} = hcR$$

Planck — 0.375 eV — Rydberg

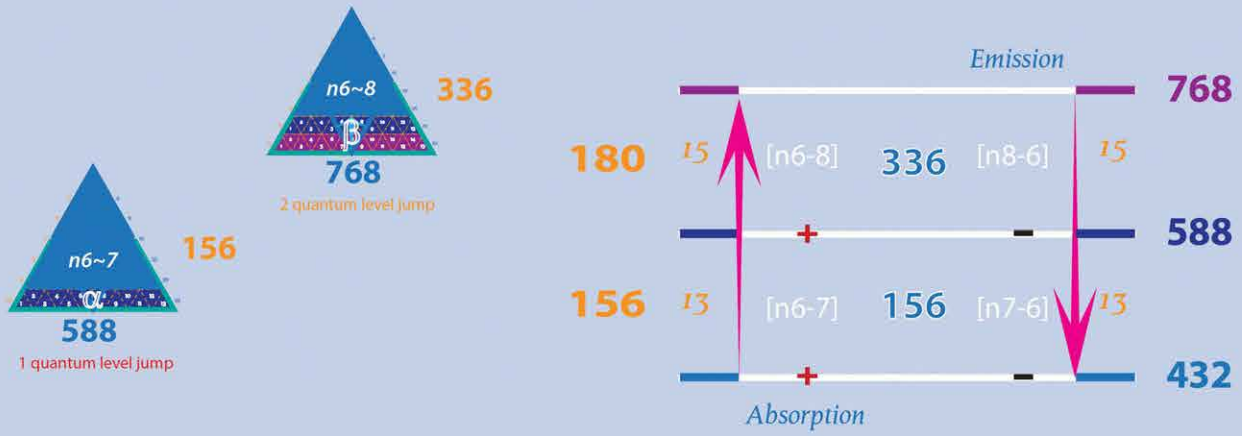

28/64

.01215

λ	7,546.831235	nm
ν̄	132,505.9444	m-1
f	3.972428277 x 10^{13}	Hz
E	0.164369815	eV
Ω	1,128.018633	m^2/s

$R\left(\frac{1}{36} - \frac{1}{64}\right)$ .01215

13/49

.00733

λ	12,445.01497	nm
ν̄	80,353.459	m-1
f	2.4089936098x 10^{13}	Hz
E	0.099676156	eV
Ω	1,403.413807	m^2/s

$R\left(\frac{1}{36} - \frac{1}{49}\right)$ .0073

$\Delta M v^2$

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Un-named spectral transition

$$\Delta h\nu = KEM = hcR$$

Planck — 0.276 eV — Rydberg

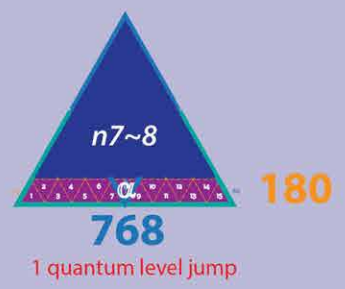

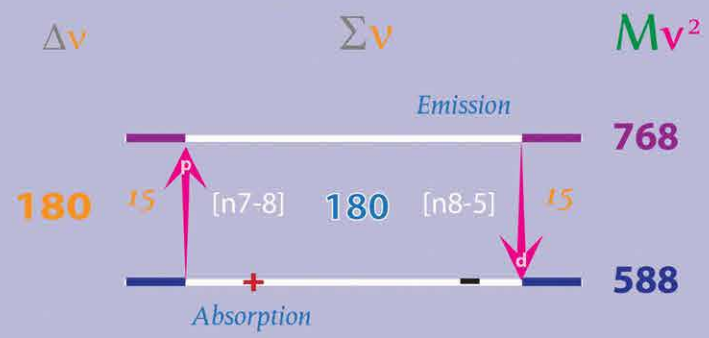

15/64

.0047

λ	19,174.54158	nm
$\tilde{\nu}$	52,152.48541	m-1
f	1.563492179 x 10^{13}	Hz
E	0.064693658	eV
Ω	5,748.382952	m^2/s

$R\left(\frac{1}{49} - \frac{1}{64}\right)$

.0047

ΔMv^2

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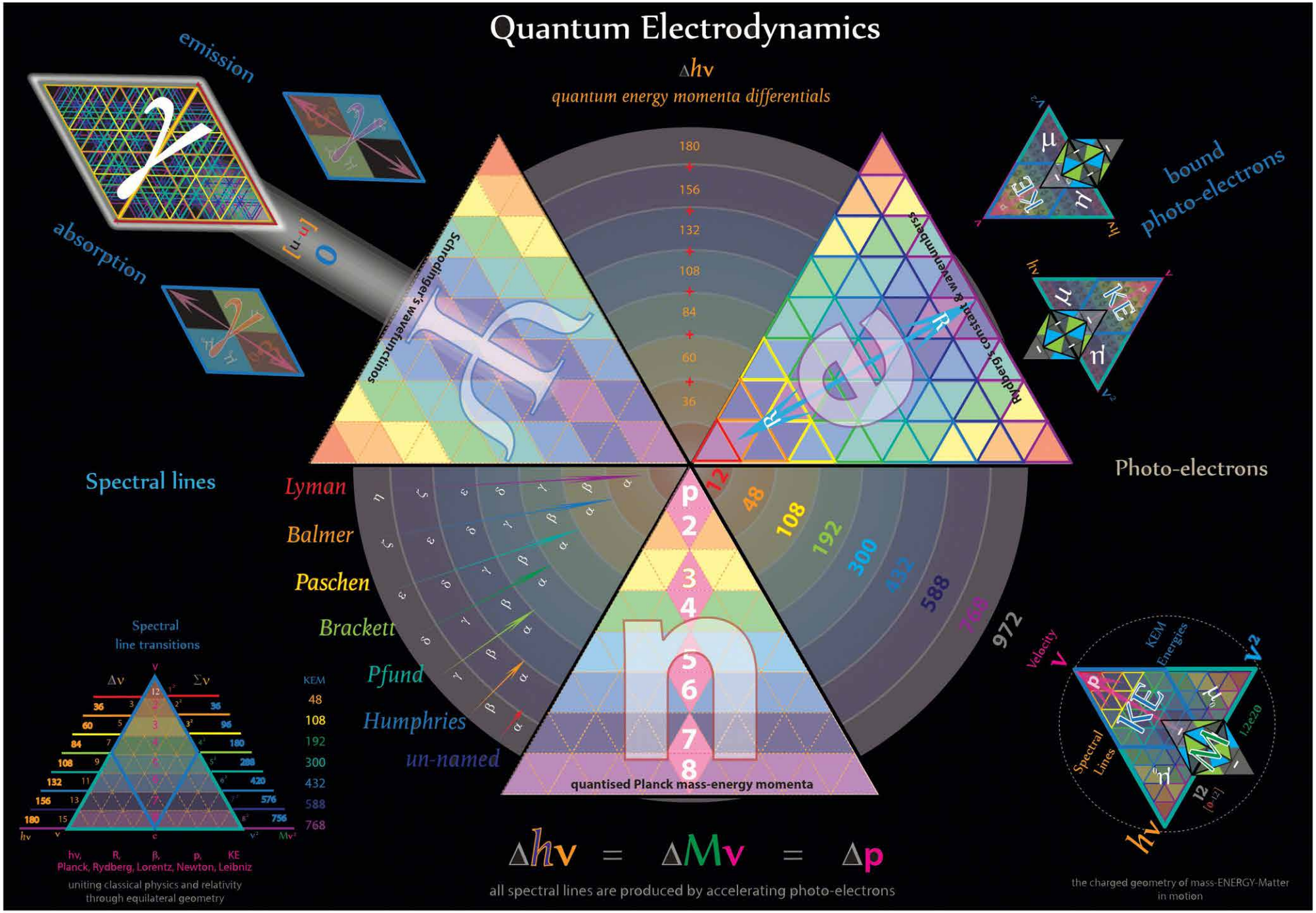

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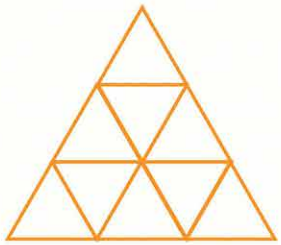
ninths

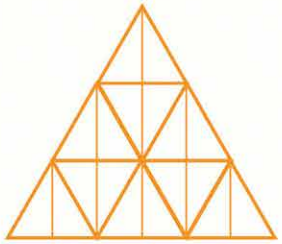
eigteenths

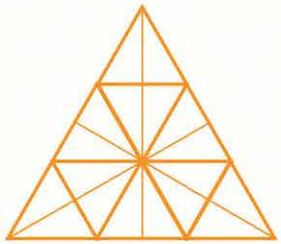
Eighteenths

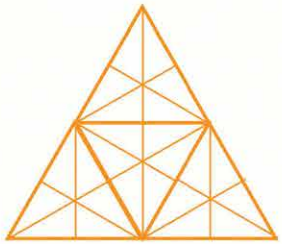
Twenty-fourths

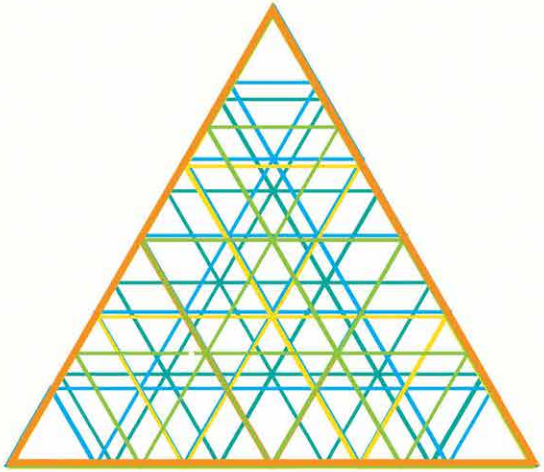

Fractionals and fractals

White light [EM radiation] is comprised of many superpositioned frequencies

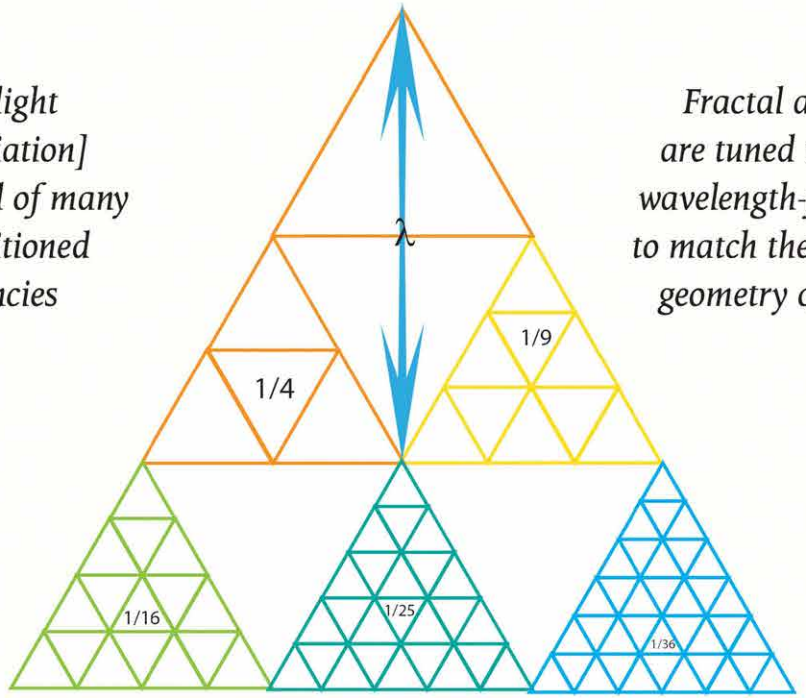

Fractal antennas are tuned to specific wavelength-frequencies to match the equilateral geometry of photons

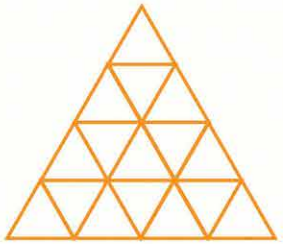
Sizteenths

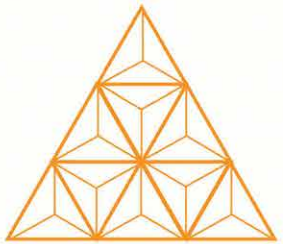
Twenty-sevenths

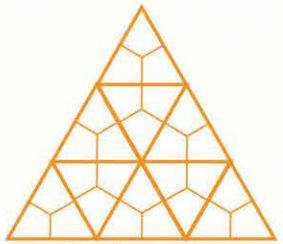
Twenty-sevenths

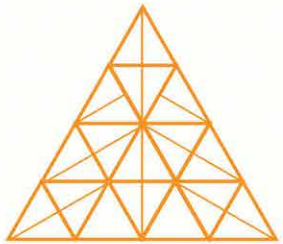
Thirty-seconds

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Polygons and Angles

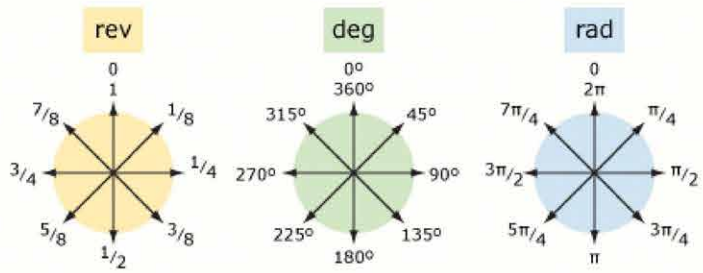

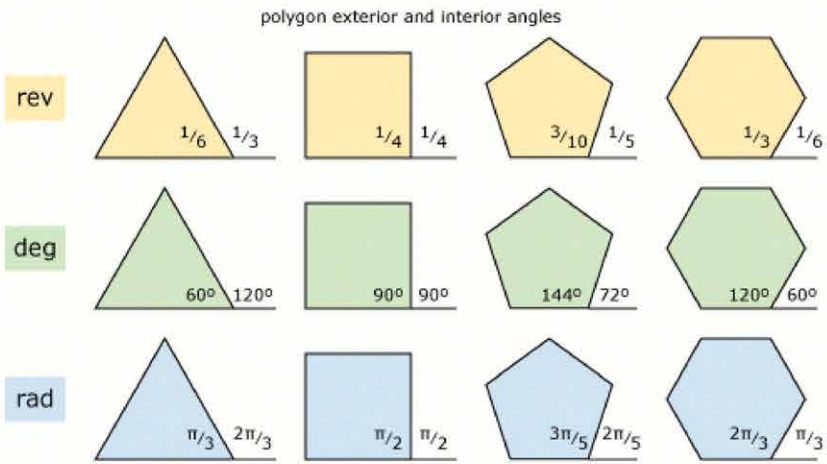

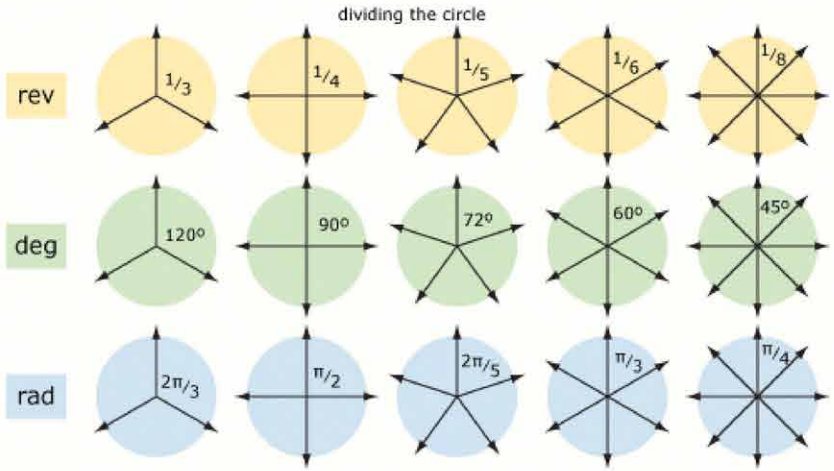

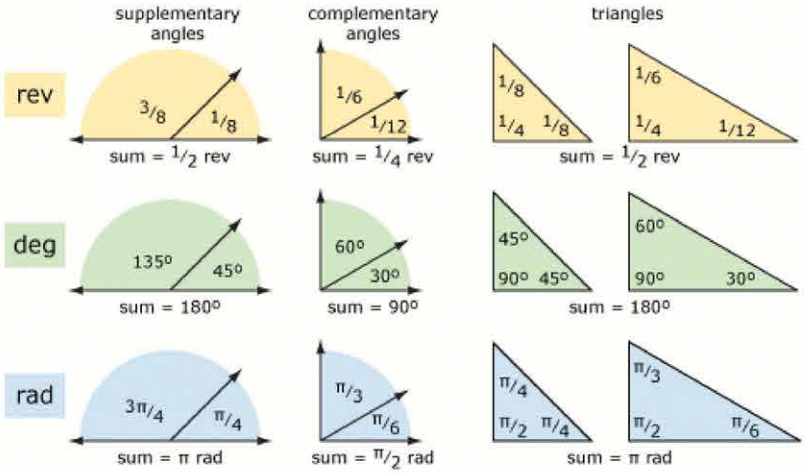

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Pi vs Tau

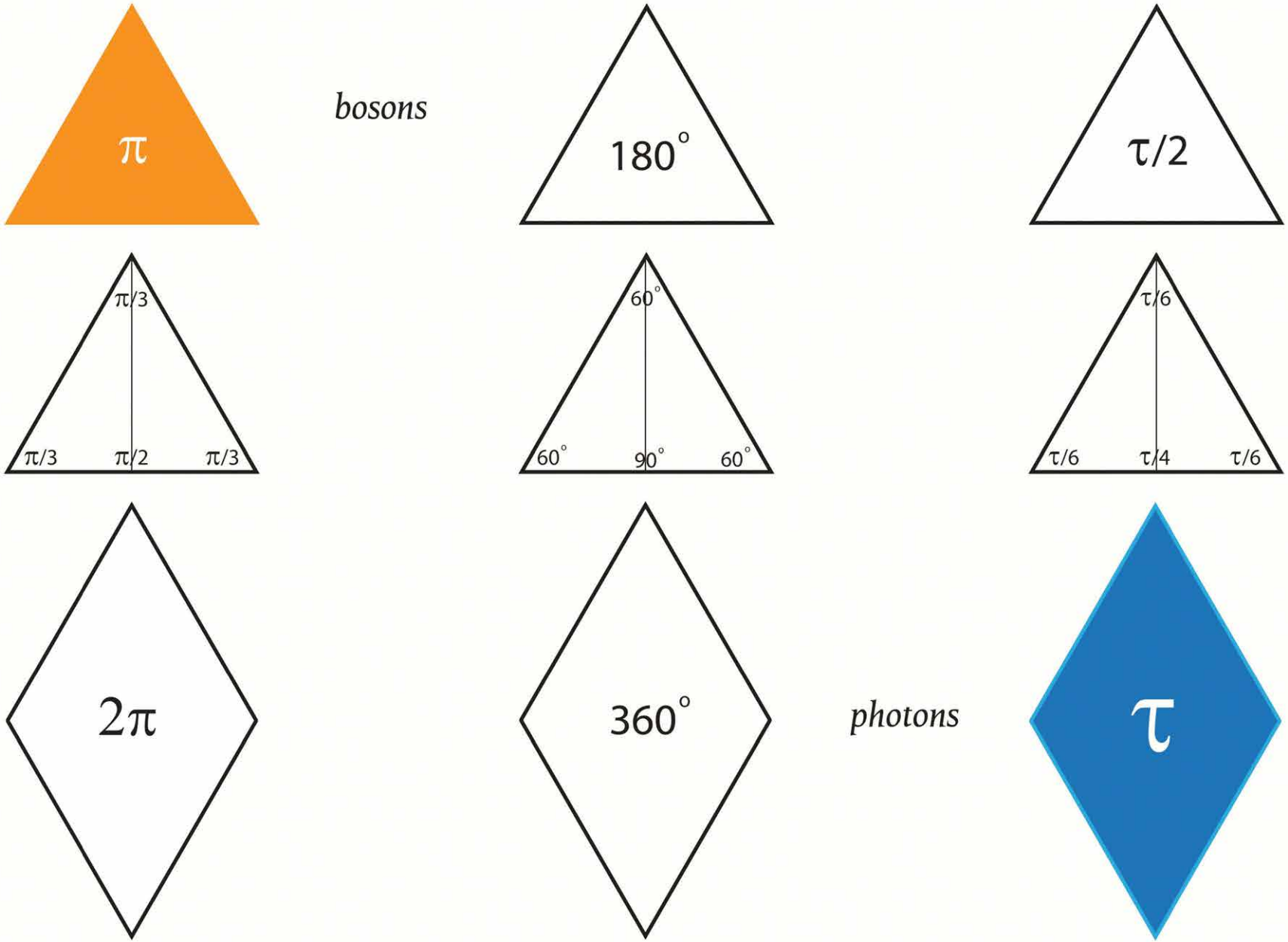

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Triangular dissection of an equilateral triangle

is a way of dividing up a original triangle into smaller equilateral triangles,
such that none of the smaller triangles overlap

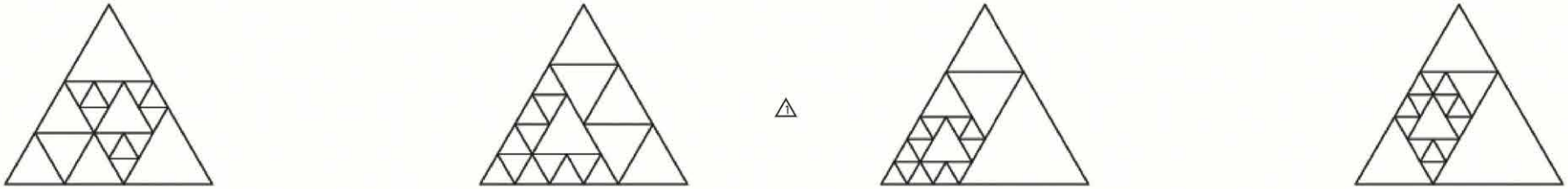

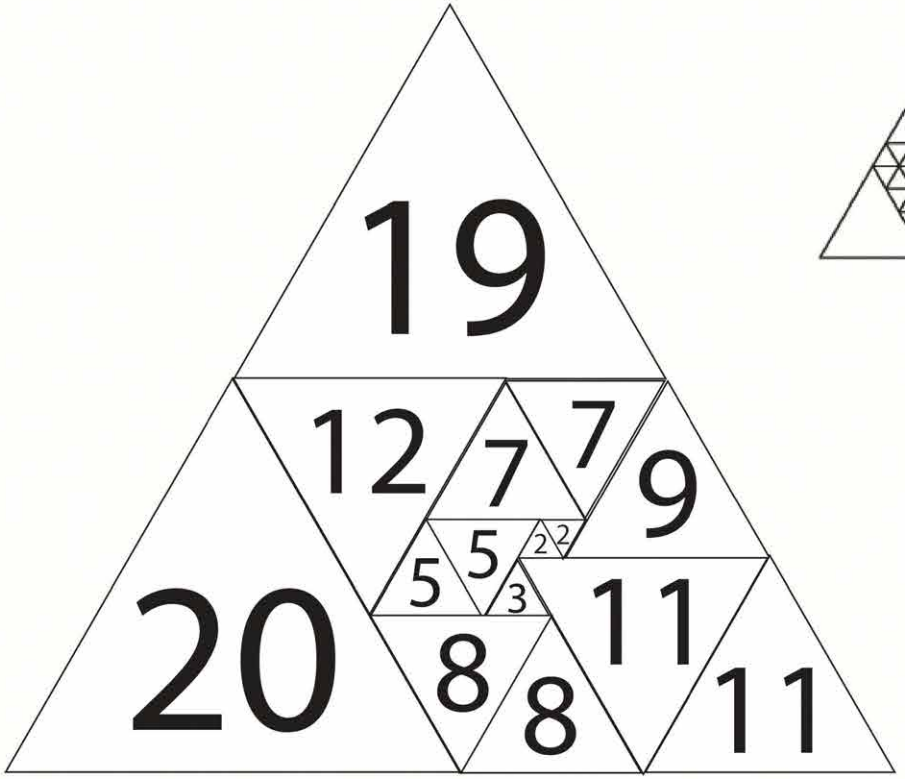

lowest order perfect equilateral triangle dissected by equilateral triangles

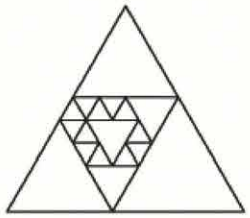

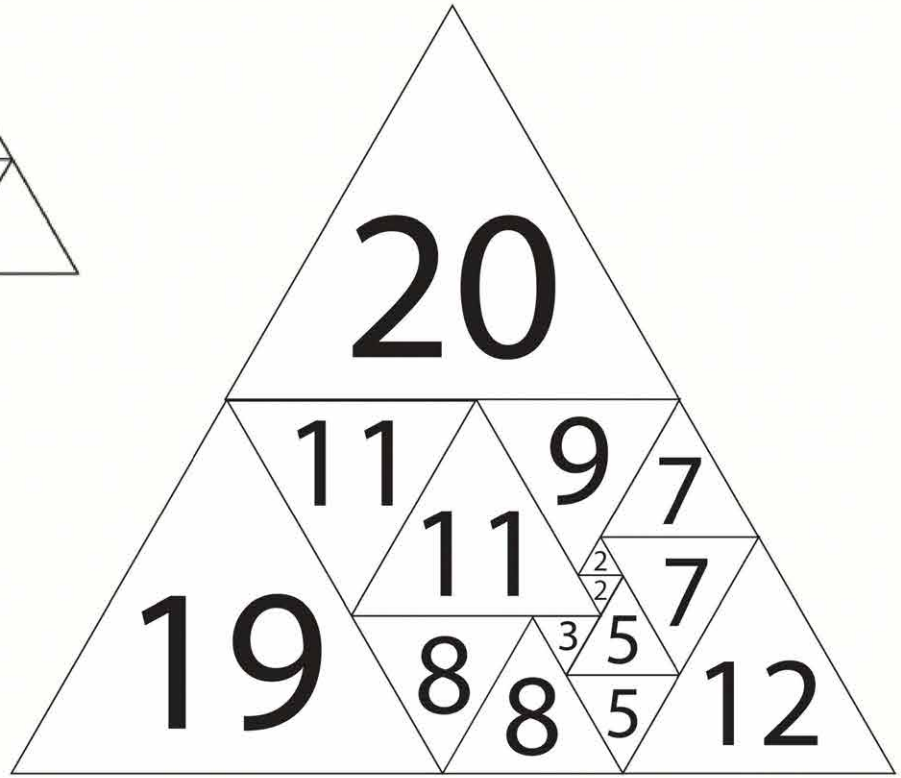

lowest order perfect dissected equilateral triangle, an isomer of the first

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Golden mean Spirals

Golden Mean Spiral – This spiral is derived via the golden rectangle, a unique rectangle which has the golden ratio.
This form is found everywhere in nature: the Nautilus Shell, the face of a Sunflower, fingerprints, our DNA, and the shape of the Milky Way

Golden spiral

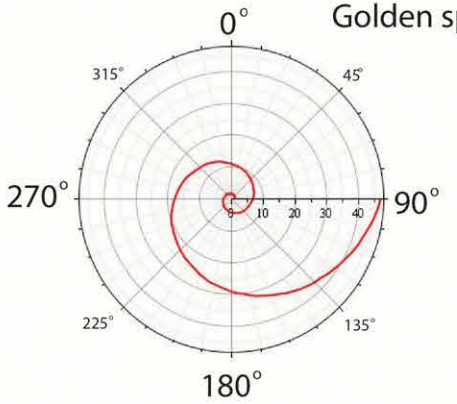

$0,\ 1,\ 1,\ 2,\ 3,\ 5,\ 8,\ 13,\ 21,\ 34,\ 55,\ 89,\ 144,\ \ldots$

Golden spirals

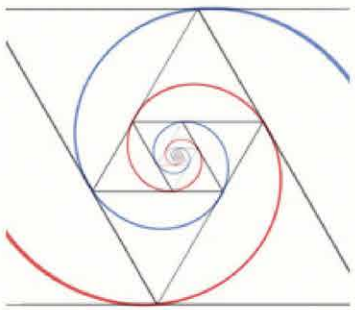

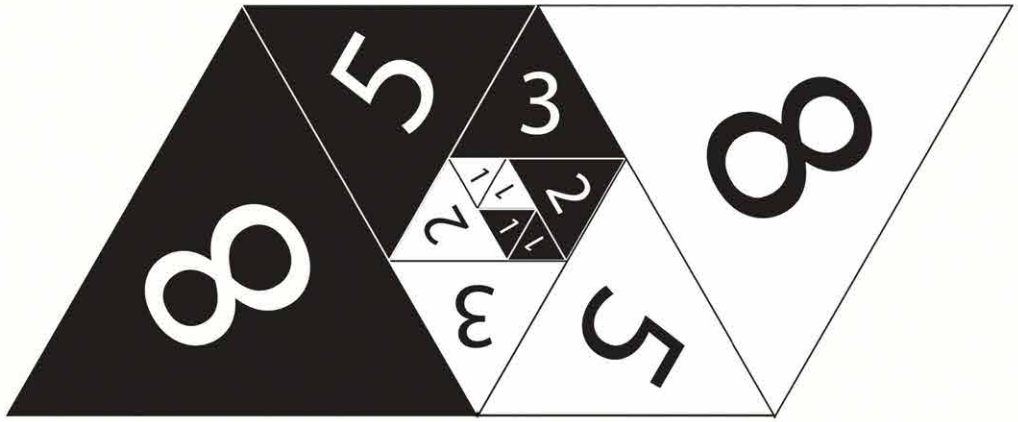

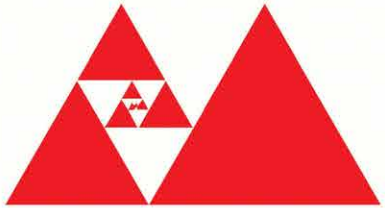

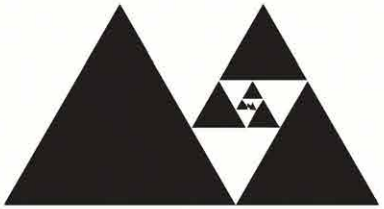

Continued fractions and the Fibonacci sequence

The convergence of the continued fractions

$$1 + \frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\ \cdots$$

are:

$$\frac{2}{1},\ \frac{3}{2},\ \frac{5}{3},\ \frac{8}{5},\ \frac{13}{8},\ \frac{21}{13},\ \frac{34}{21},\ \frac{55}{34},\ \frac{89}{55},\ \frac{144}{89},\ \frac{233}{144},\ \frac{377}{233},\ \frac{610}{377},$$

The Golden Ratio (Golden Mean, Golden Section)
is defined mathematically as:

$$\varphi = \frac{1+\sqrt{5}}{2} = 1.6180339887\ldots.$$

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Koch fractal Curve

Niels Fabian Helge von Koch (January 25, 1870 – March 11, 1924) was a Swedish mathematician who gave his name to one of the earliest fractal curves ever known

He described the Koch curve, or Koch snowflakes as it popularly known, in a 1904 paper entitled "On a continuous curve without tangents constructible from elementary geometry"

Von Koch wrote several papers on number theory . One of his results was a 1901 theorem proving that the Riemann hypothesis is equivalent to a strengthened form of the prime number theorem.

Three Koch curves form the snowflake.

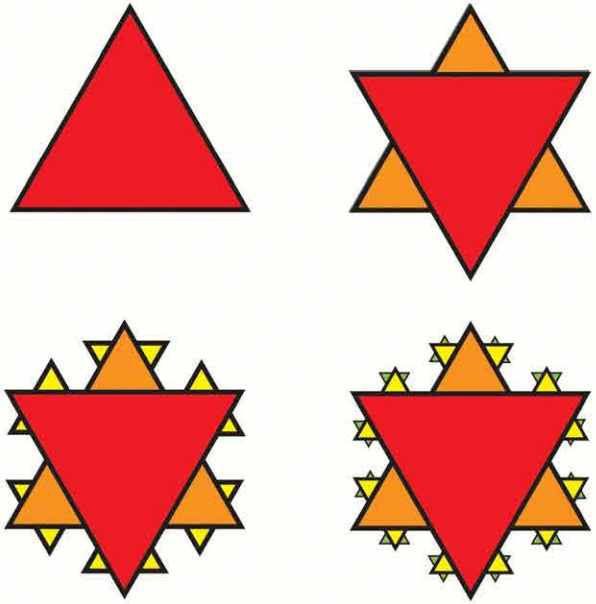

The Koch snowflake (or Koch star) is a mathematical curve and one of the earliest fractal curves to have been described.

Actually Koch described what is now known as the Koch curve, which is the same as the now popular snowflake, except it starts with a line segment instead of an equilateral triangle.

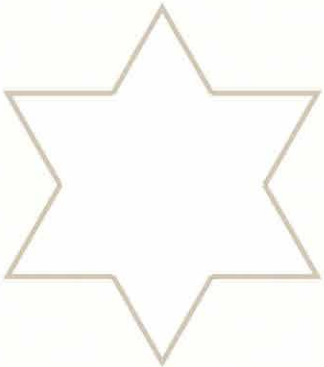

$$a = \frac{1}{2} + \frac{i}{\sqrt{12}}$$

The Koch curve is a special case of the Cesaro curve where:

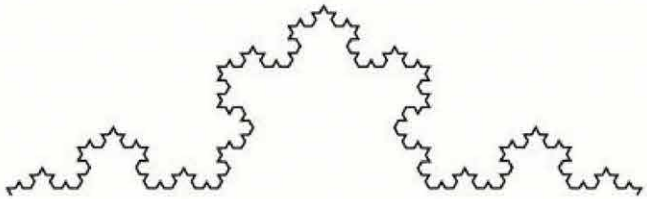

which is in turn a special case of the de Rham curve.

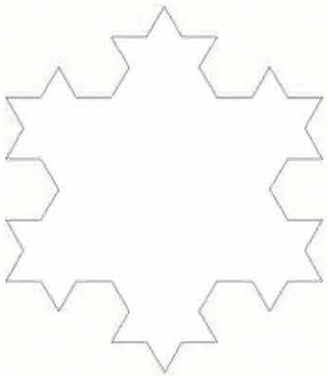

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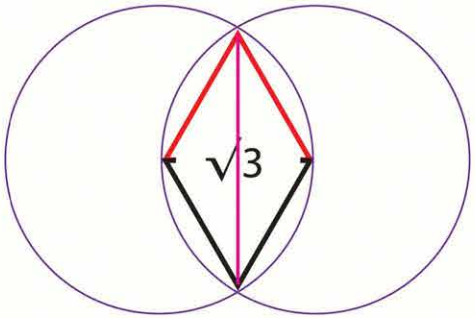

vesica piscis

$$\frac{1351}{780} > \sqrt{3} > \frac{265}{153}\,.$$

Koch snowflake

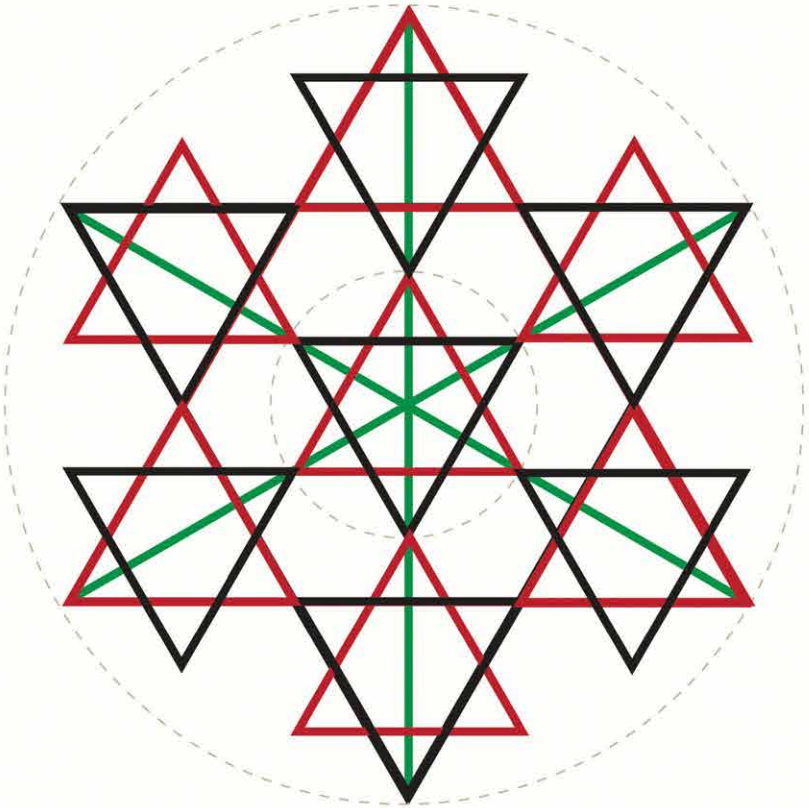

space-time

star tetrahedron

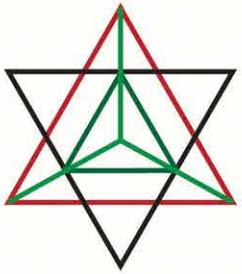

Flower of Life

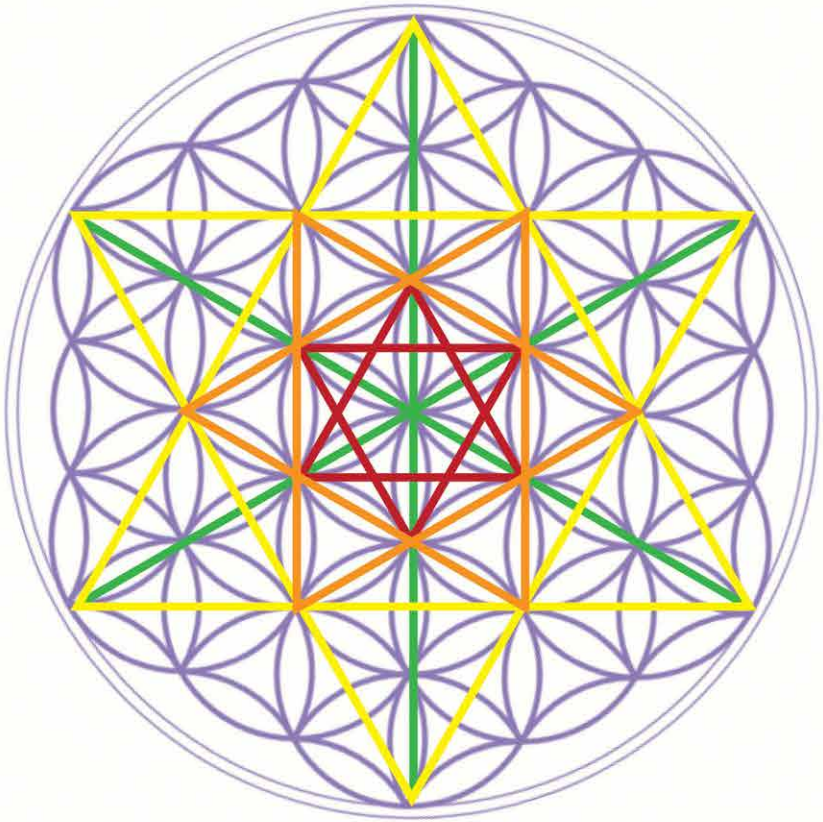

The Flower of Life is a name for a geometrical figure composed of multiple evenly-spaced, overlapping circles.

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Unit circles - SINE WAVES - Photons

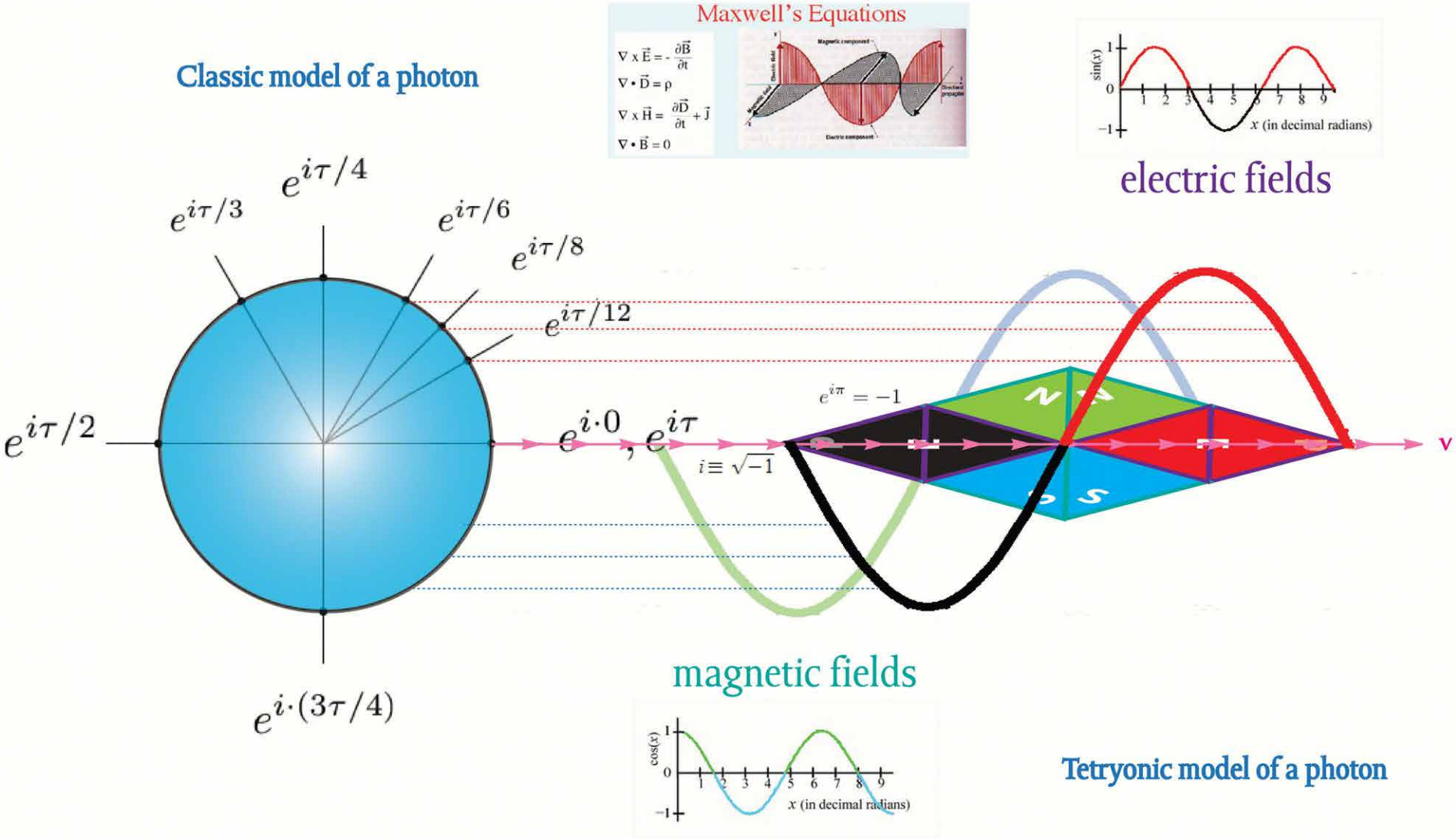

Magnetic waveforms are 90 degrees out of phase with Electric waveforms

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Boson distributions in monochromatic EM waves

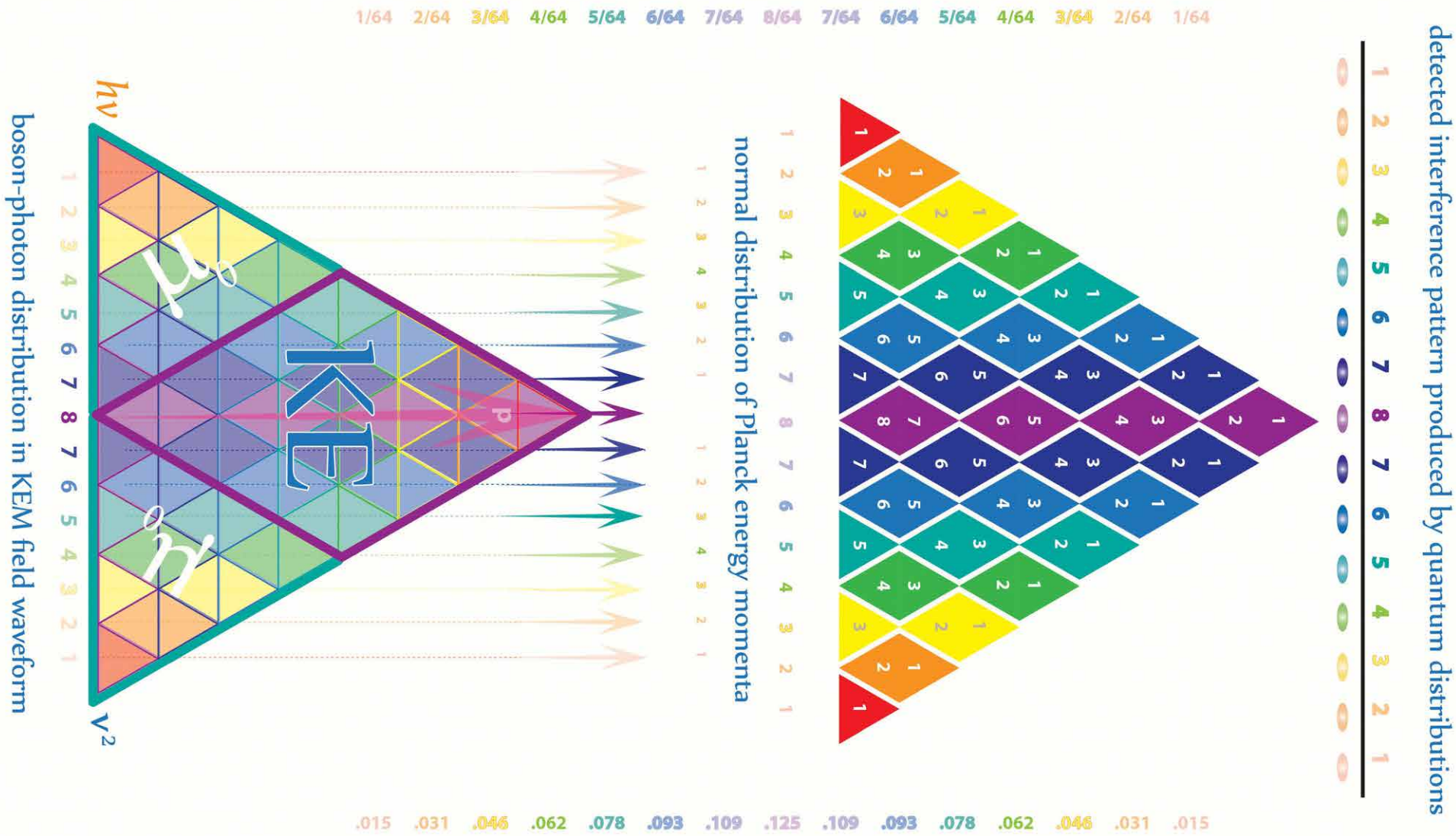

Probability distributions of monochromatic EM waves

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Wave interference patterns

The double-slit experiment, sometimes called Young's experiment, is a demonstration that matter and energy can display characteristics of both waves and particles, and demonstrates the fundamentally probabilistic nature of quantum mechanical phenomena and Establishes the quantum interference principle known as wave–particle duality.

Matter particles are stopped by the barrier but the [K]EM wave passes through both slits and is diffracted by them producing weaker EM waves that then superposition with each other to produce interference patterns

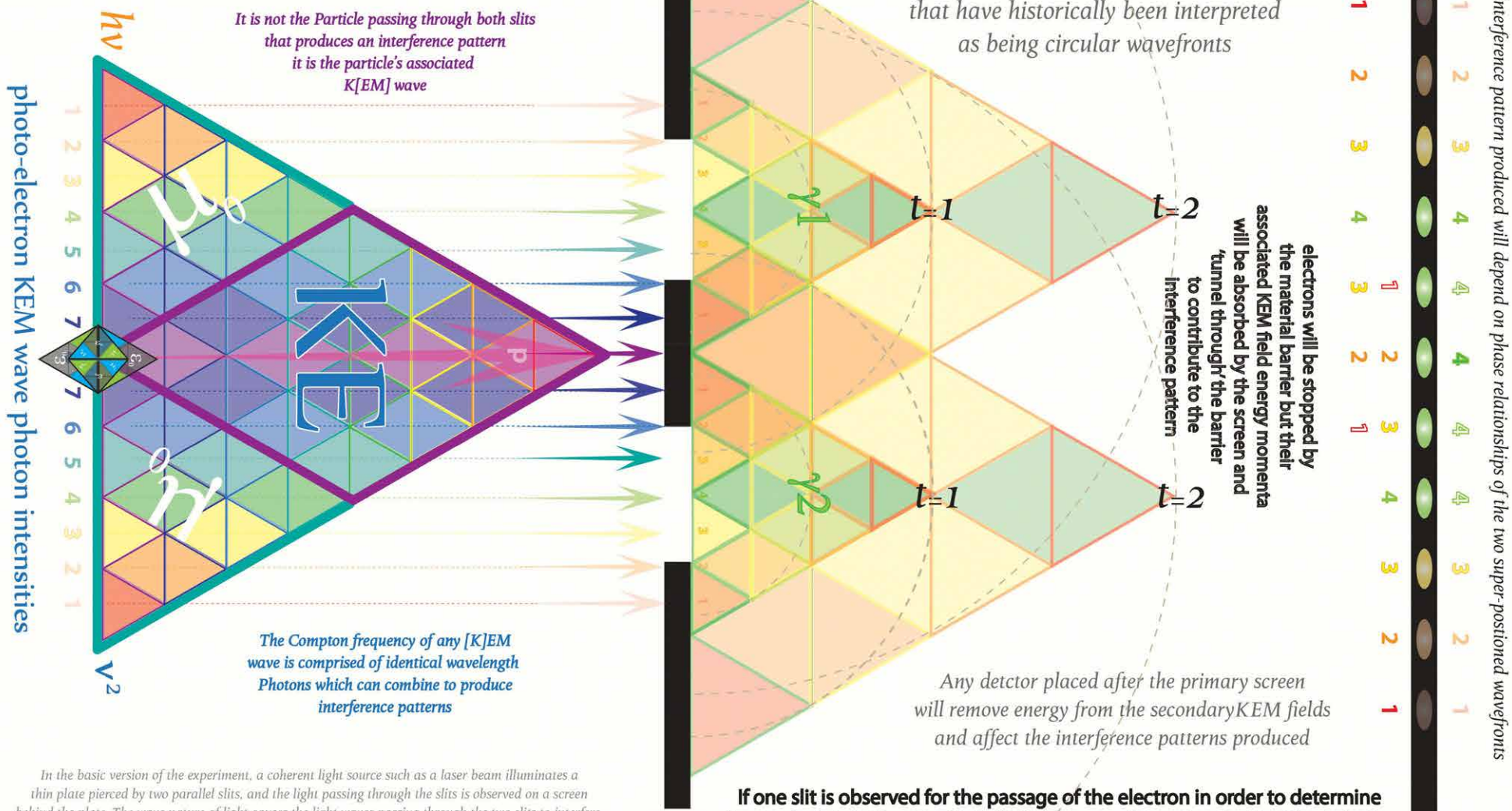

In the basic version of the experiment, a coherent light source such as a laser beam illuminates a thin plate pierced by two parallel slits, and the light passing through the slits is observed on a screen behind the plate. The wave nature of light causes the light waves passing through the two slits to interfere, producing bright and dark bands on the screen — a result that would not be expected if light consisted strictly of particles. However, on the screen, the light is always found to be absorbed as though it were composed of discrete particles or photons.

If one slit is observed for the passage of the electron in order to determine its physical state then the its KEM field wave will be absorbed by the detector resulting in only one wave remaining, enforcing a classical particle outcome

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Quantum computing via EM wave super-positioning

BY superpositioning two beams
of EM radiation the resultant 'colours'
will perform quantum level computations
that can be read via the resultant
interference patterns produced

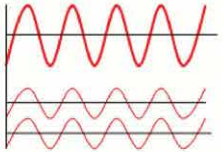

In phase

constructive interference

additive in-phase EM waves

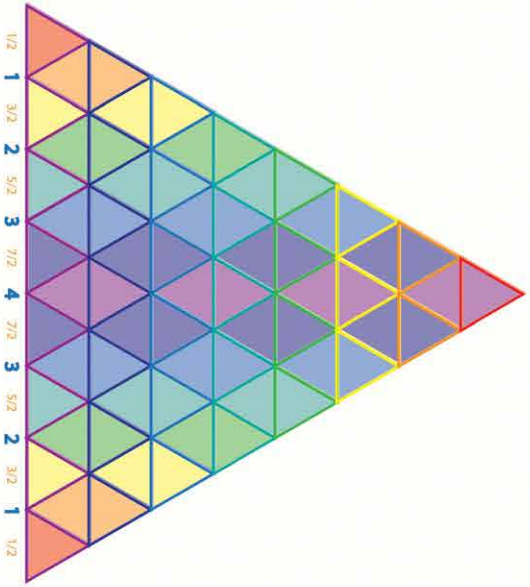

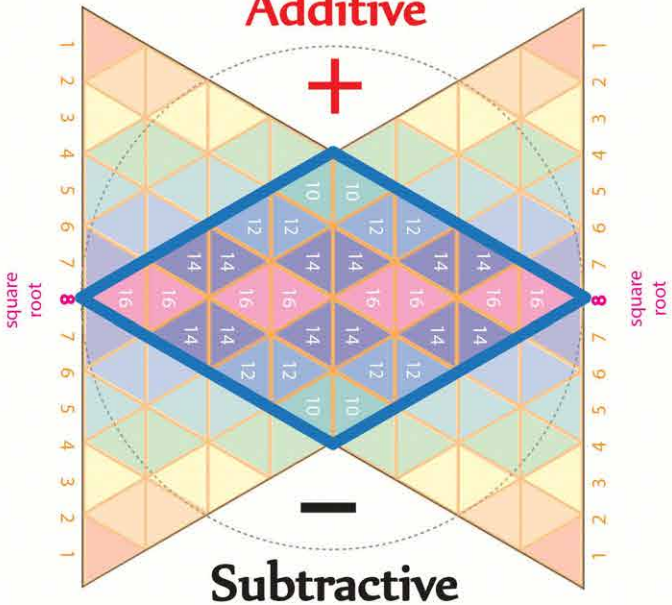

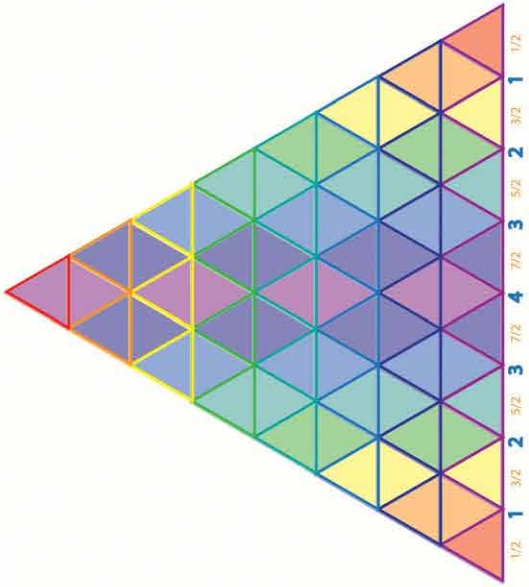

Out of phase

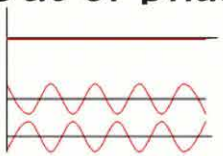

destructive interference

subtractive out-of-phase EM waves

Various basic operations, such as
ADDITION, SUBTRACTION and
SQUARE ROOTS etc
are all easily computed using
EM wave super-positioning

The lines of Force

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By utilising the statiscal distribution of equilateral Planck energy momenta quanta in EM waves
Tetryonic theory provides a practical geometric solution to quantum computing problems

q

bosons

The set of all decision problems for which an algorithm exists which can be carried out by a deterministic Turing machine in polynomial time

P vs. NP

the set of all decision problems for which an algorithm exists which can be carried out by a non-deterministic Turing machine in polynomial time

E

photons

An algorithm of time complexity ***O(n)*** is one which increases in time linearly as the "size of the problem" (whatever n stands for) increases.

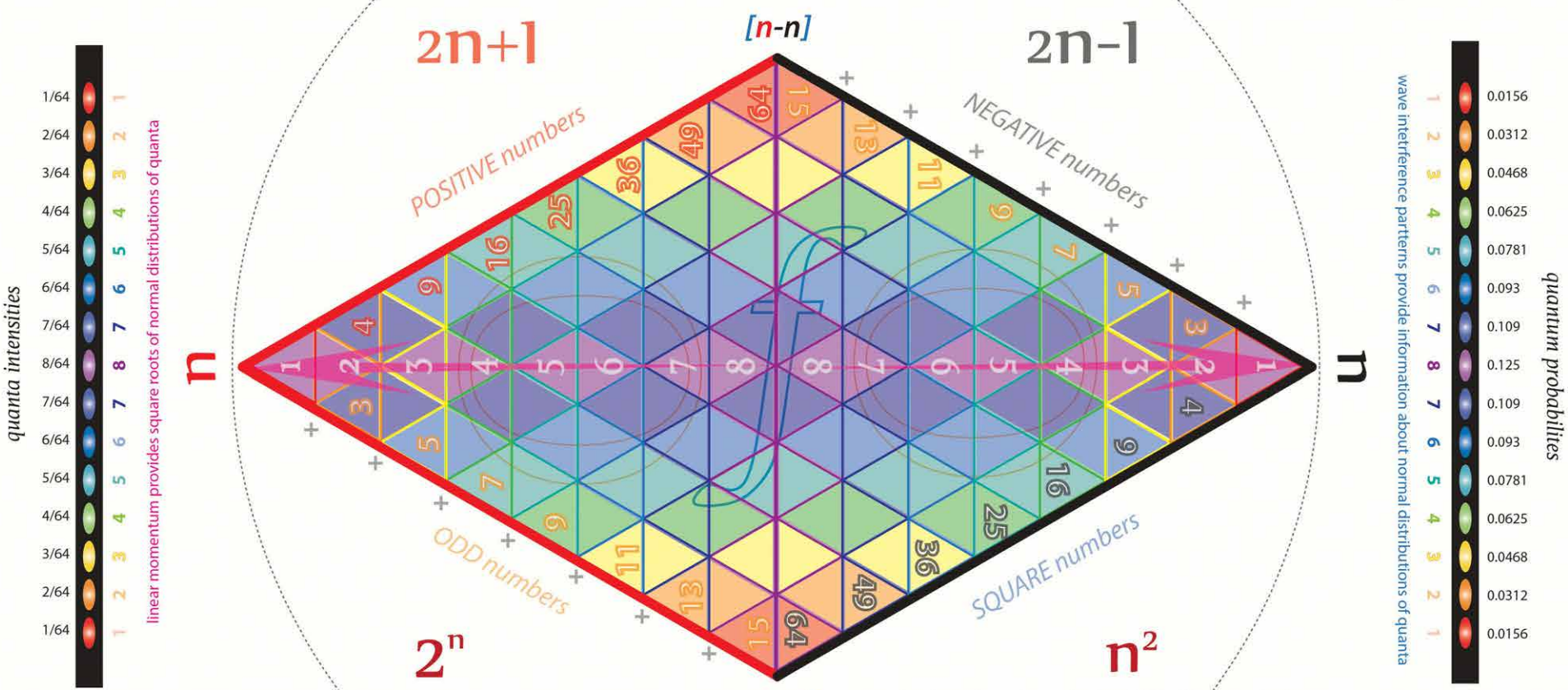

An algorithm of complexity ***O(2ⁿ)*** utlises exponential quanta; increasing n by 1 will double the quanta required

An algorithm of complexity ***O(n²)*** utilises quadratic quanta, meaning that if you double n it will use four times as many quanta.

Unlike Math treatise on P vs Np that require exponential polynomial time ***O(nᵏ)*** Tetryonic geometry of EM fields utilise exponential energies per second

2hv

1 second

hf

By relating p to the number of equilateral wave fields in any EM wave very large [pn²] data sets can be modelled and processed every second

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Quantum Cryptography

If the numerical sequences were applied to amplitude modulation their non-repeating numerical sequences would appear to be purely random noise

Using Tetryonic geometry advanced non-repeating cyphers of any complexity can be easily developed

The level of encryption can be easily increased (without limit) by increasing the dimensions of the cypher geometry

eg: number of quanta 2D vs 3D geometries

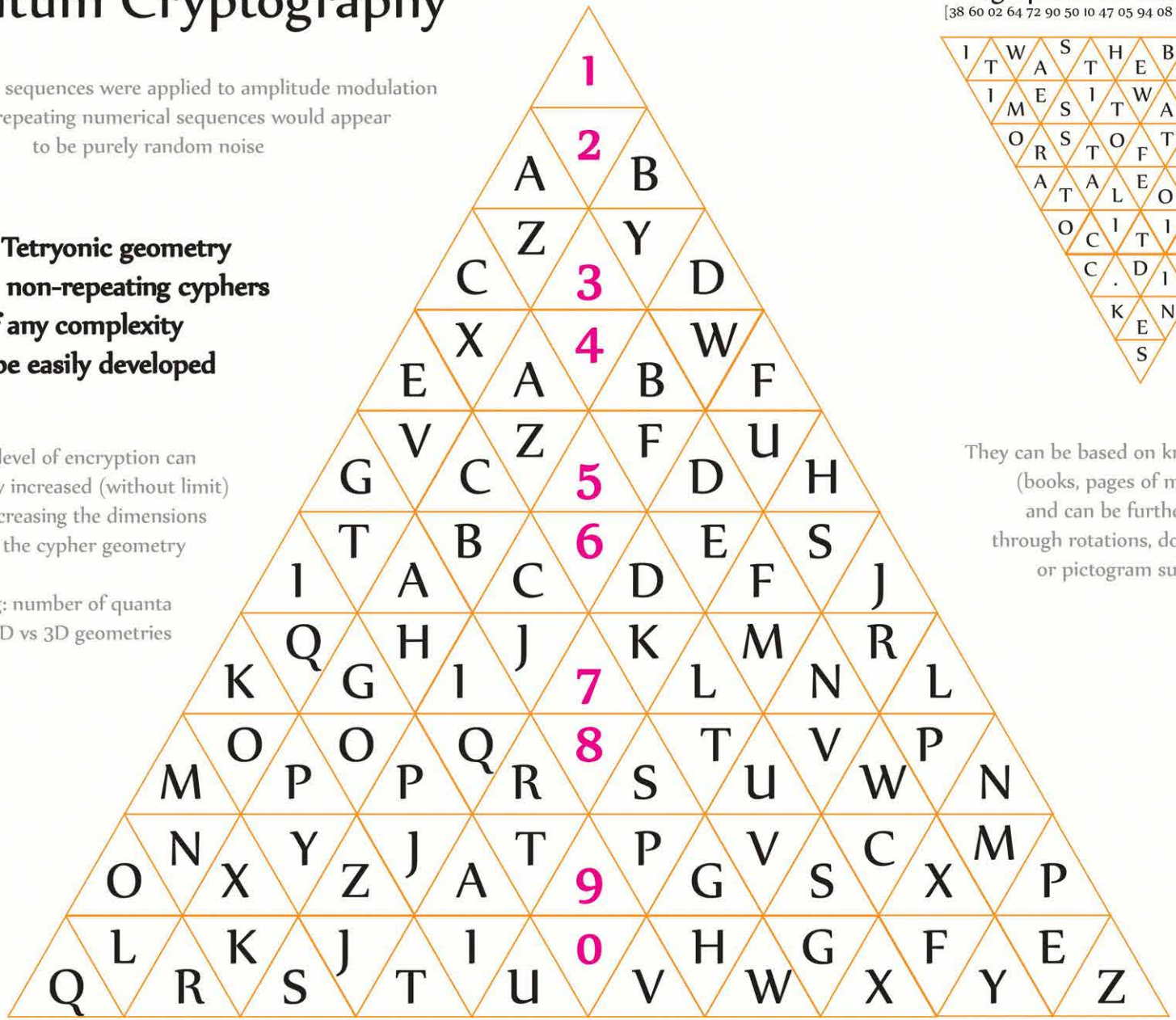

eg: quantum encryption 1024
[38 60 02 64 72 90 50 10 47 05 94 08 48 52 27 26 51 66 01 91 03 20]

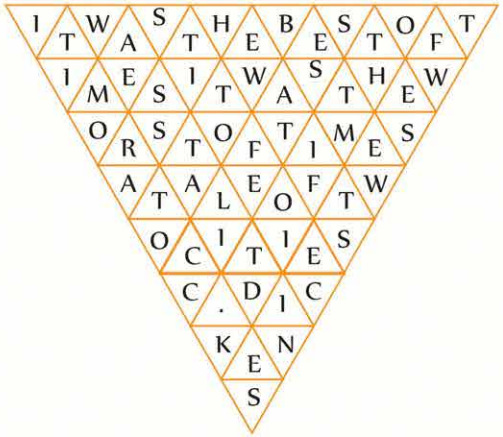

They can be based on known letter sources (books, pages of magazines etc) and can be further encrypted through rotations, double encrypting or pictogram substitutions

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Quantum Computing

The Proton/Neutron geometries of atomic nuclei can be built at the quantum scale
to create an atomic nuclei that can operate as a Opto-memory-transistive computing element,
many elements can then be combined in lattices to create super computers no larger than bacterium

Spin UP

Energy can be gated through individual nuclei
using the centre Baryon as the base transistor element,
in turn effecting the energies of bound photo-electrons

Spin DOWN

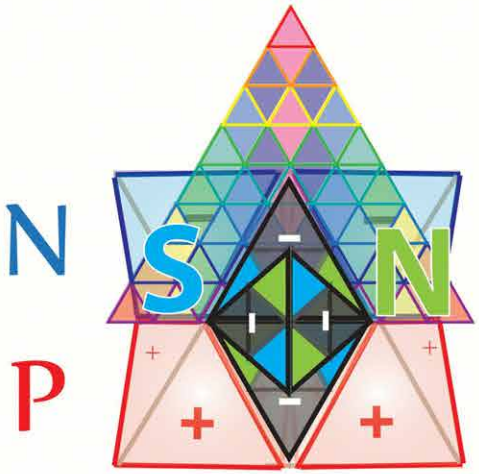

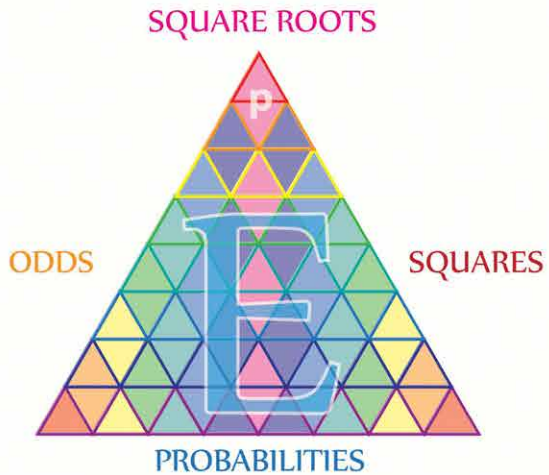

Q-bits

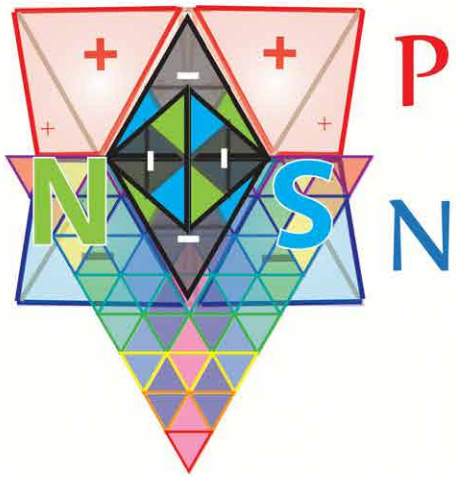

1

photo-electronic transitions can be used to directly recieve
or emit memory states through the absorption and emission
of spectral photons of specific energy momenta

0

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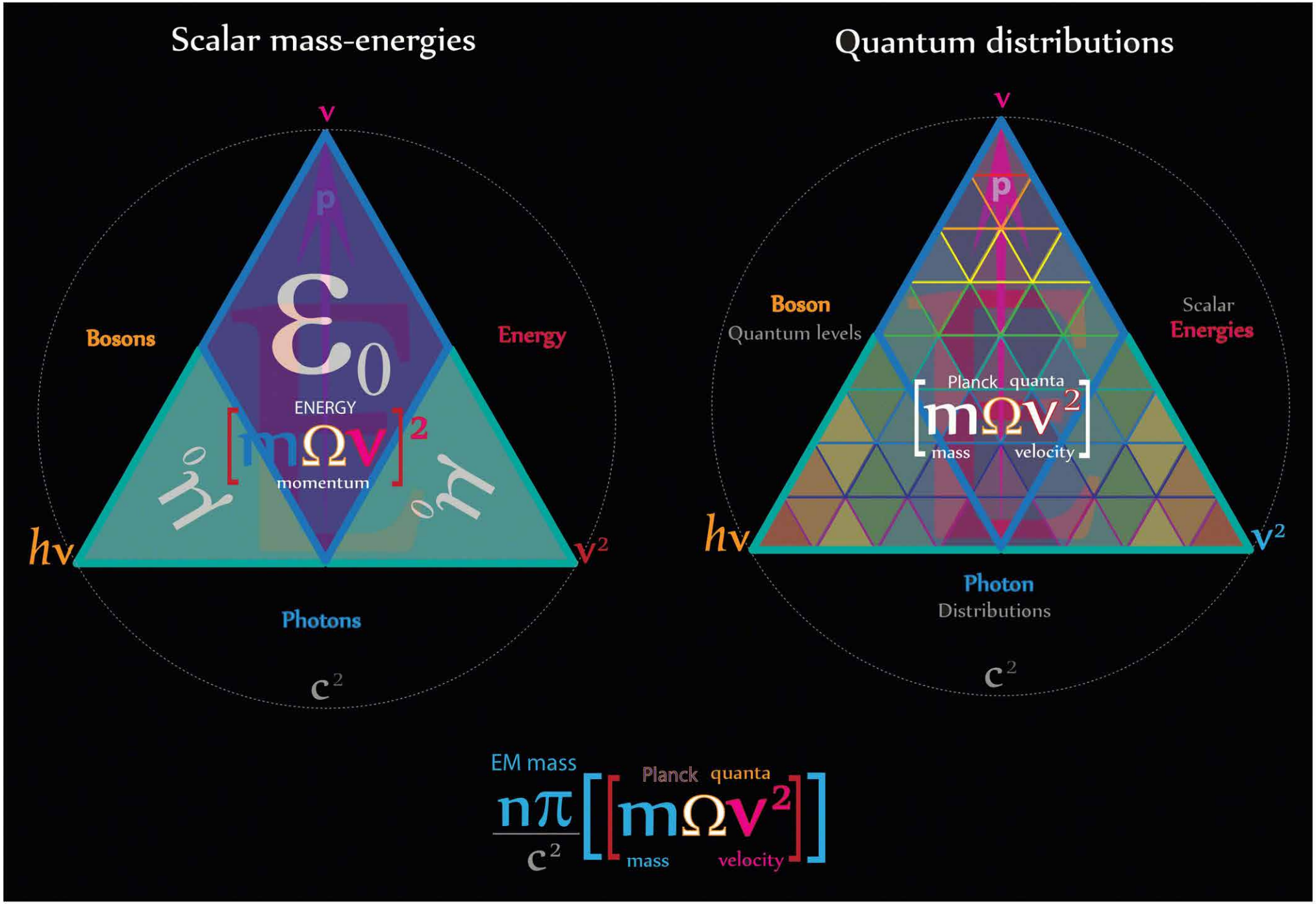

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2D mass

EM mass

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

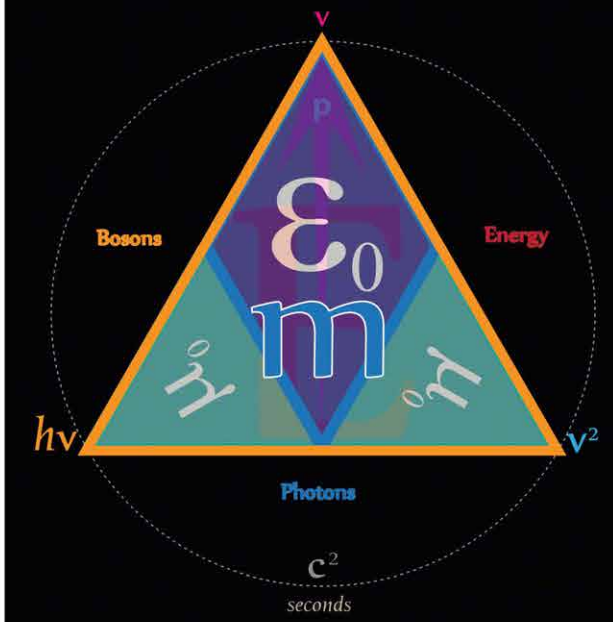

Measure of planar energies
in a nπ radiant wave
geometry
[per second]

mass quantum
7.376238634 e-51 kg

ENERGY

ENERGY

$$n\pi\left[\left[m\Omega v^2\right]\right]$$

momenta

Equilateral energy momenta
has a mass equivalence
per unit of Time

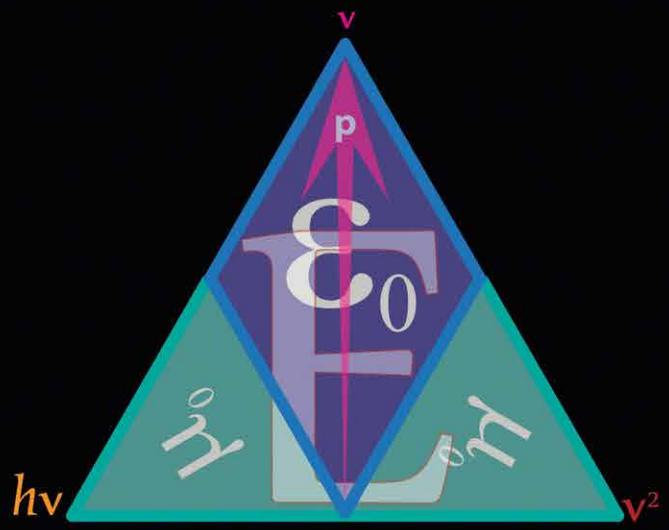

c² is the radial geometry
created by radiant energy
in 1 second

Planck Constant
6.629432672 e-34 J.s

3D Matter

Matter

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

Measure of mass-energy
in a 4nπ standing wave
topology
[per second squared]

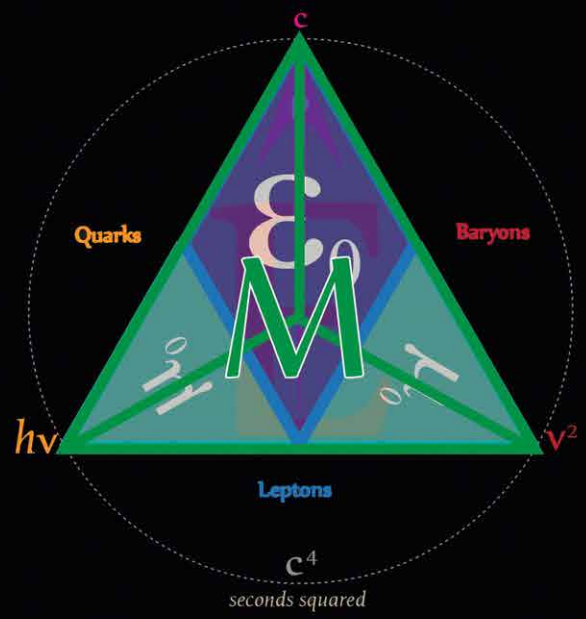

Matter quantum
2.9504955454 e-50 kg

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Planck's constant - the quantum of Action

all ideal quantum inductive loops resist changes to their energy levels

INERTIAL mass

all equilateral energy momenta produce square root vector Forces

quantum of WORK

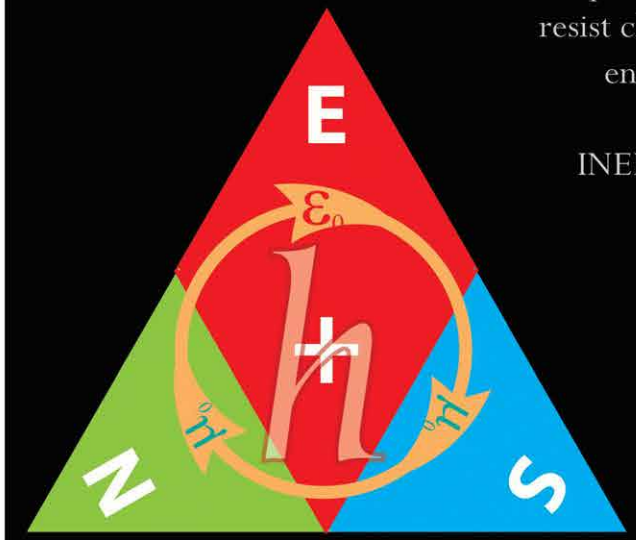

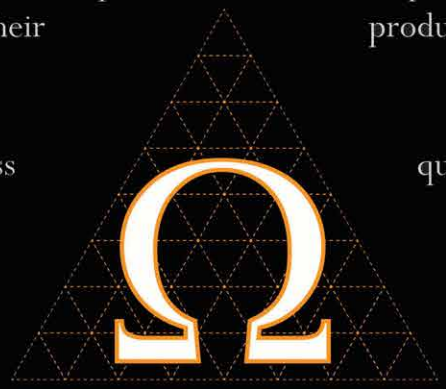

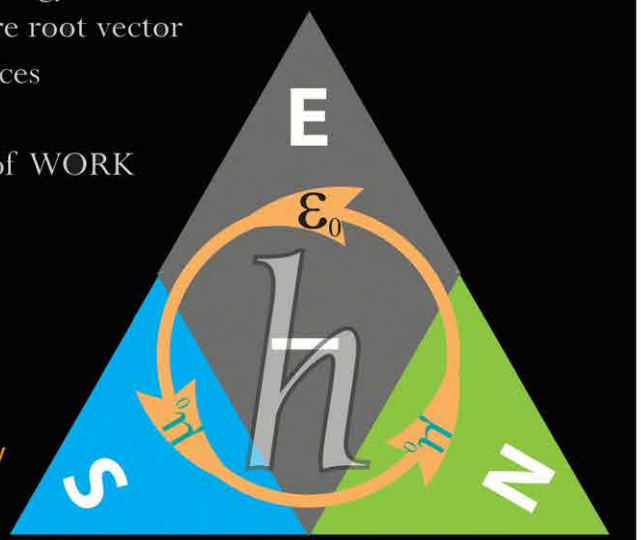

Quantised angular momentum is equilateral geometry

The two sides of Planck's Constant

The square root of all Energy is linear momentum

Equilateral energy quanta per second

Quantised angular momenta per second

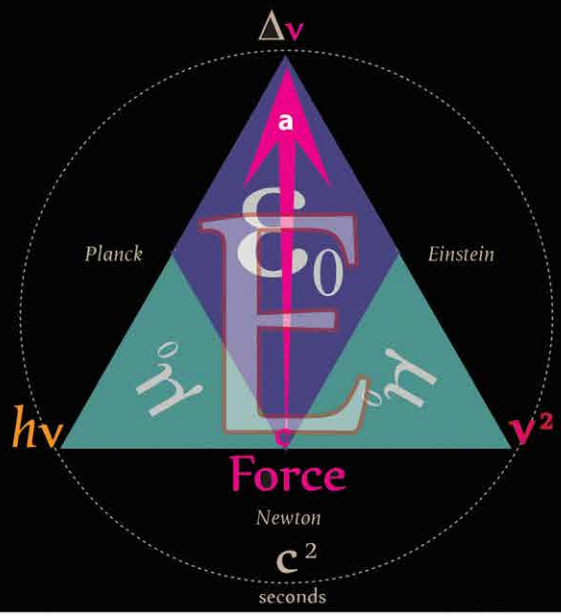

mass

time

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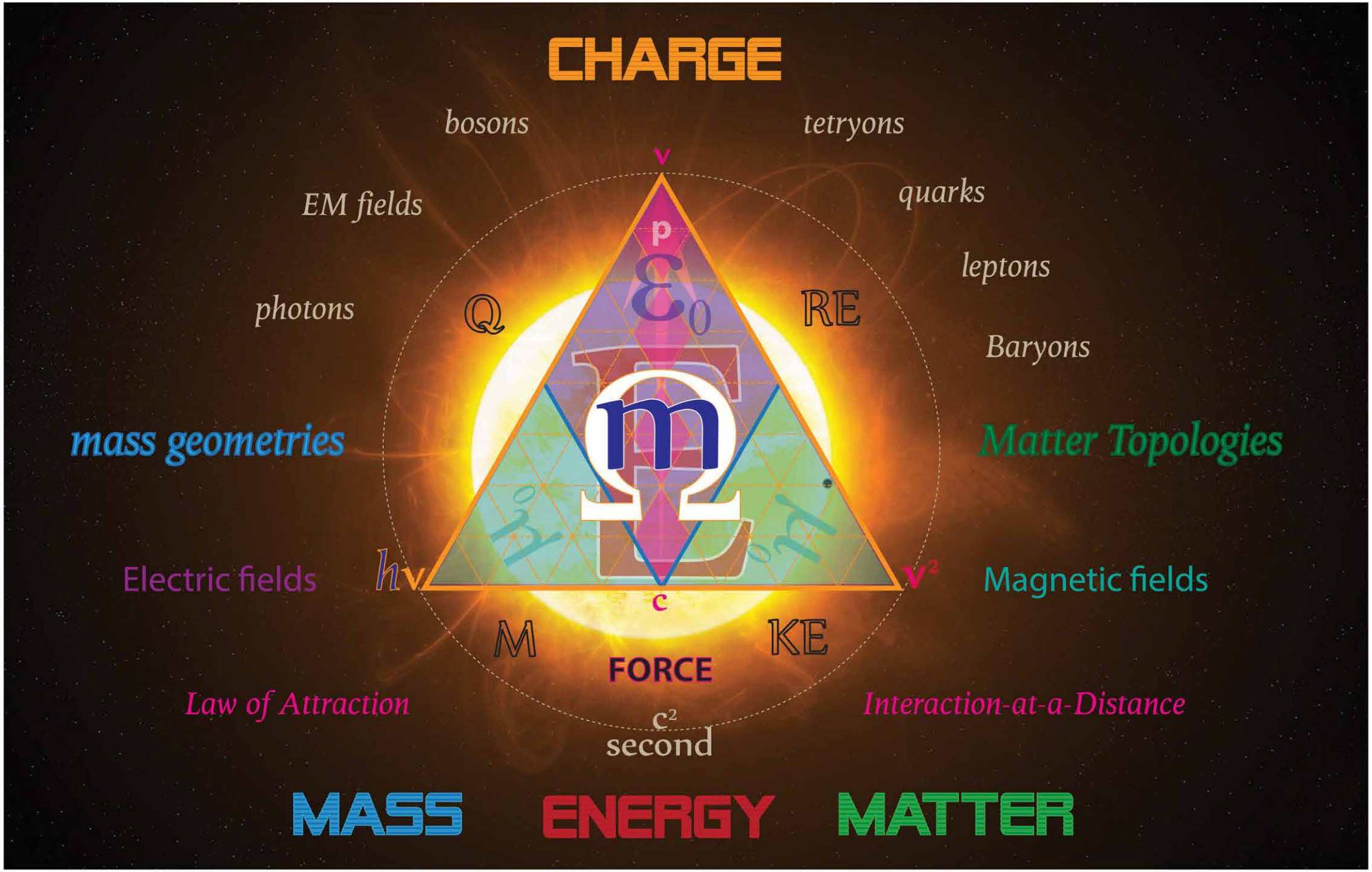

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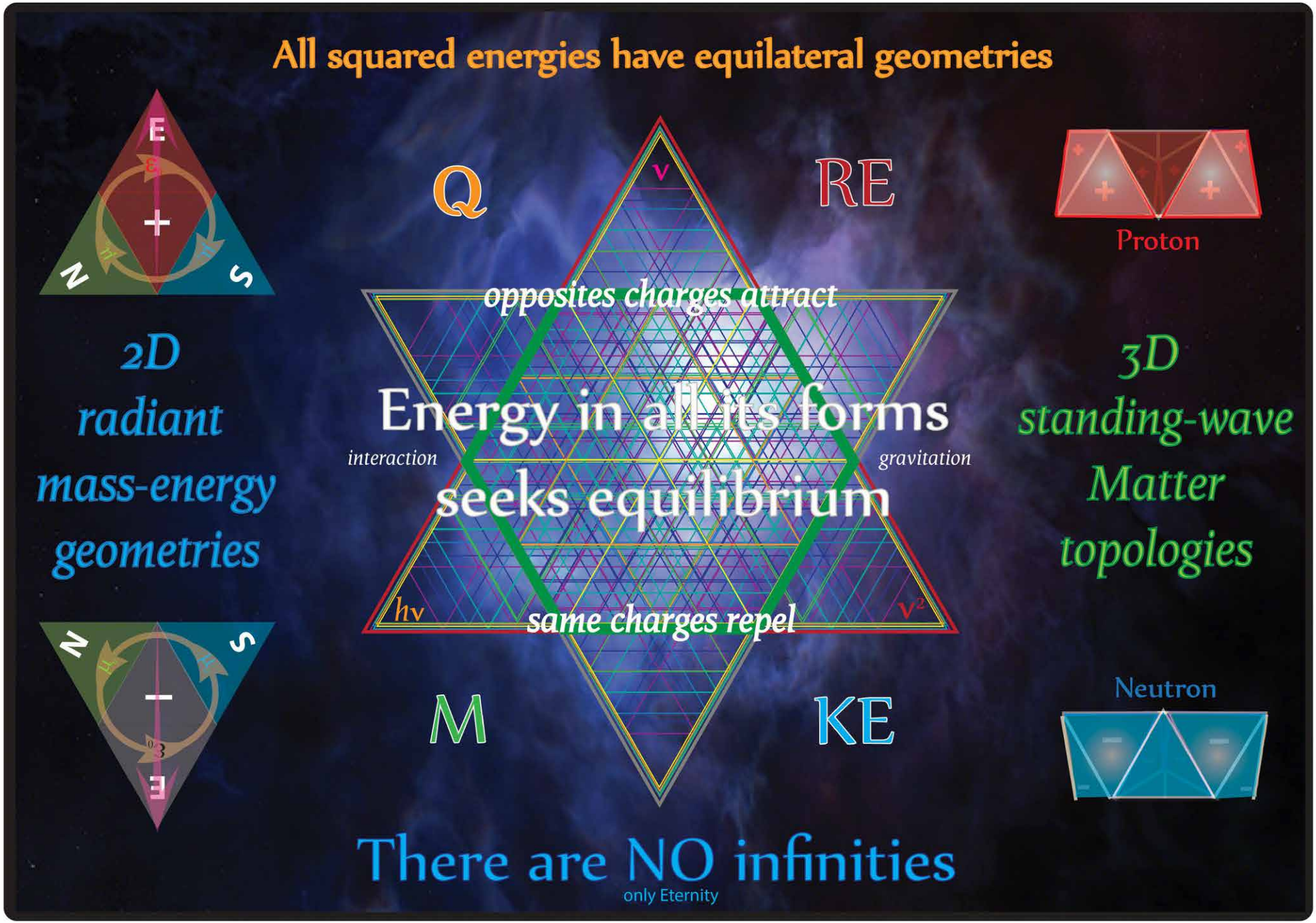

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Clean, limitless Energy

Unlimited resources

The geometric field equation of mass-ENERGY-Matter

$$\underset{\text{topology}}{\overset{\text{Matter}}{T\pi}}\left[\left[\underset{\text{impedance}}{\overset{\text{spatial}}{\varepsilon_0\mu_0}}\right].\left[\underset{\text{mass}}{\overset{\text{Planck}}{m}}\underset{\text{velocity}}{\overset{\text{quanta}}{\Omega v^2}}\right]\right]$$

Unifying Science and Religion

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Tetryonic Theory

All EM mass, energy momenta & Matter can be measured and geometrised with respect to equilateral Quantised Angular Momenta

charged Planck quanta

Bosons

$$\frac{\text{ODD}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

(mass, velocity; Planck quanta)

Total Relativistic energies

ENERGY

$$n\pi\left[\left[m\Omega v^2\right]\right]$$

(mass, velocity; Planck quanta)

Quantum Mechanics

Q [v-v]

RE

Quantum Cosmology

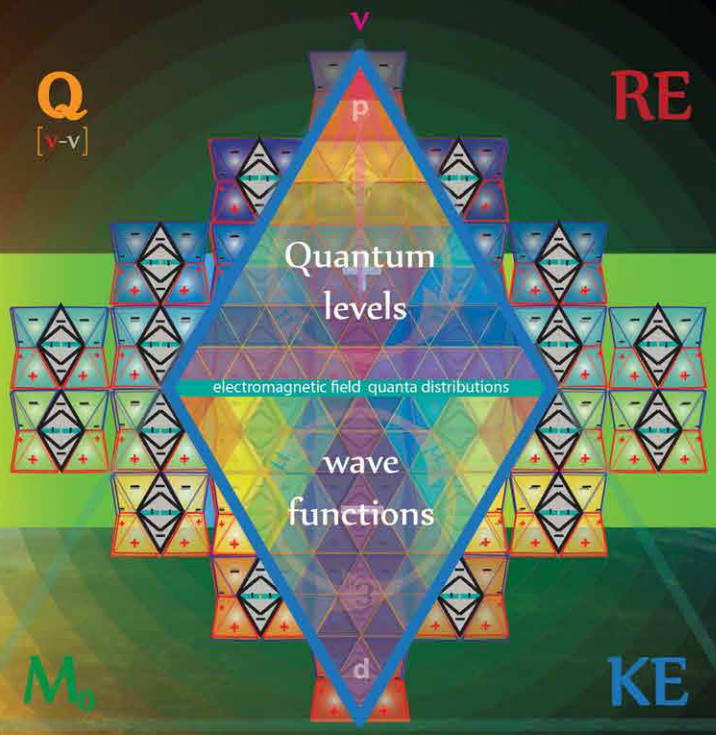

standing-wave mass-Matter

radiant EM mass-energies

Quantum Chemistry

$h\nu$ M_0 KE v^2

Electrodynamics

Matter

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

(mass, velocity; Planck quanta)

EM waves

$$\frac{\text{EVEN}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

(mass, velocity; Planck quanta)

3D standing-wave mass/Matter topologies

The application of equilateral QAM geometries covers all of the Physical disciplines

2D radiant mass-energy geometries

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Tetryonic Geometrics

The equilateral geometry underpinning the mathematics of Physics

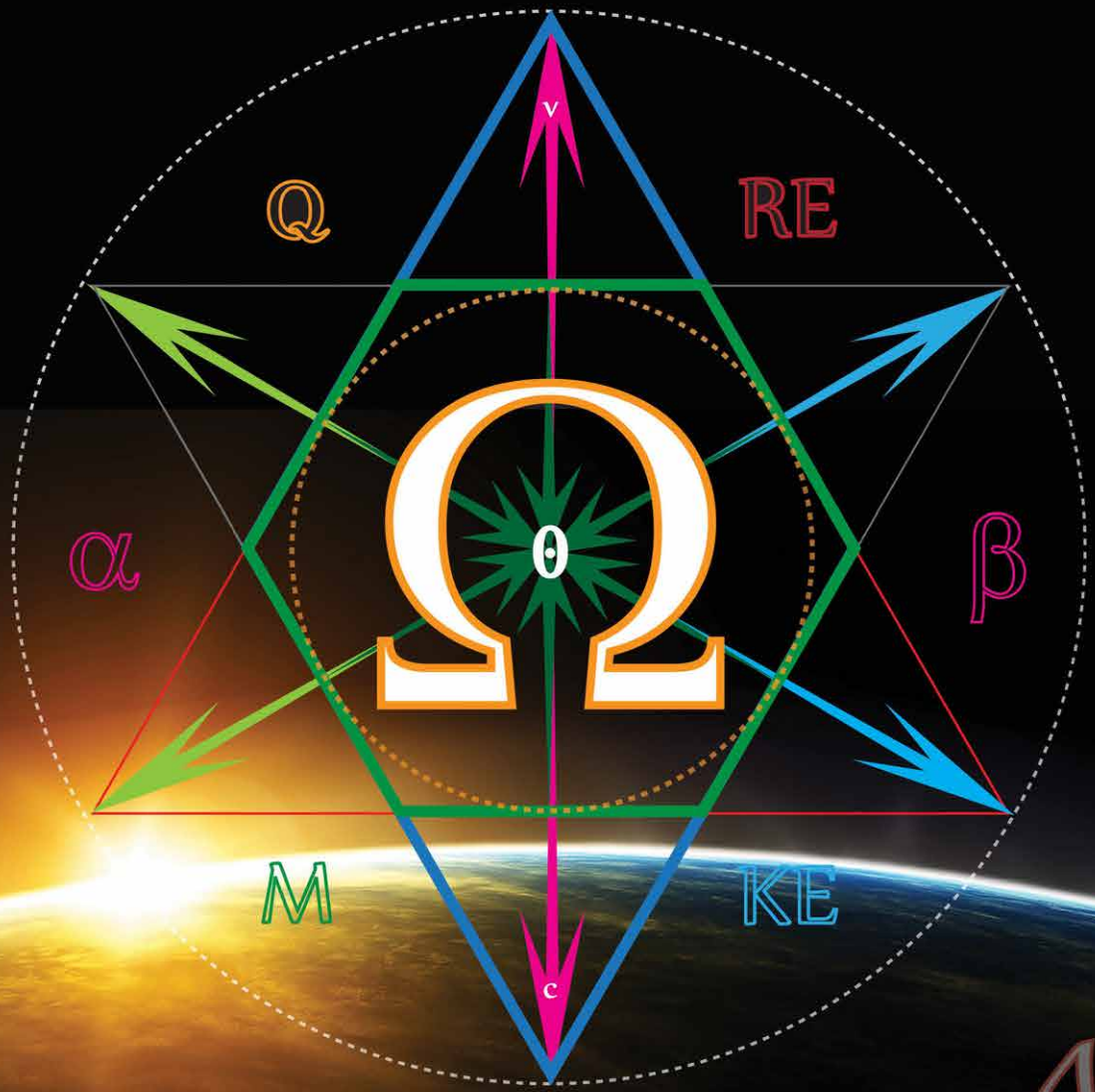

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TETRYONICS

The equilateral geometry underpinning the mathematics of Physics

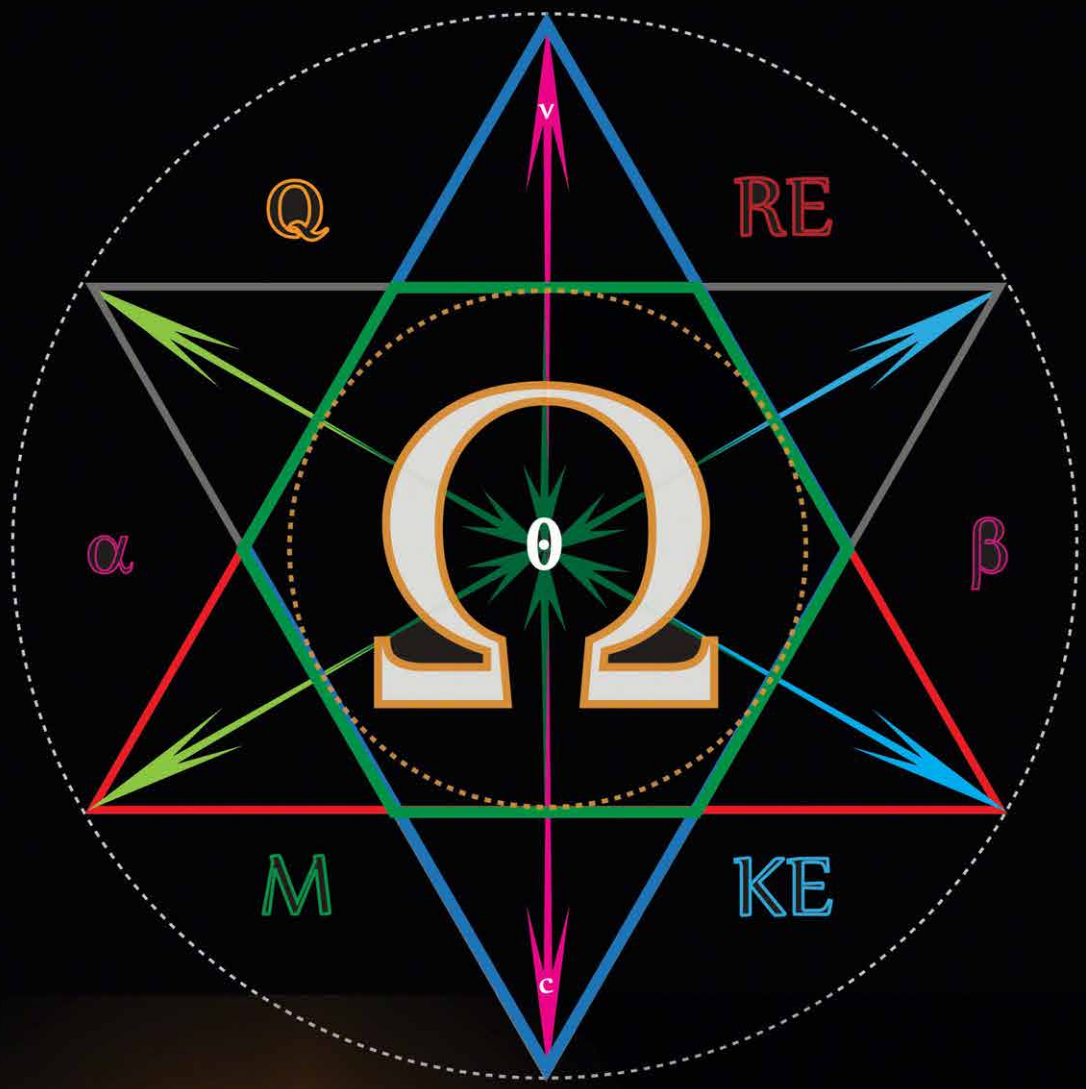

Foundational physics Mathematics

Abraham

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Geometry and the Theory of Everything

Plato

(c.428-348 BC)

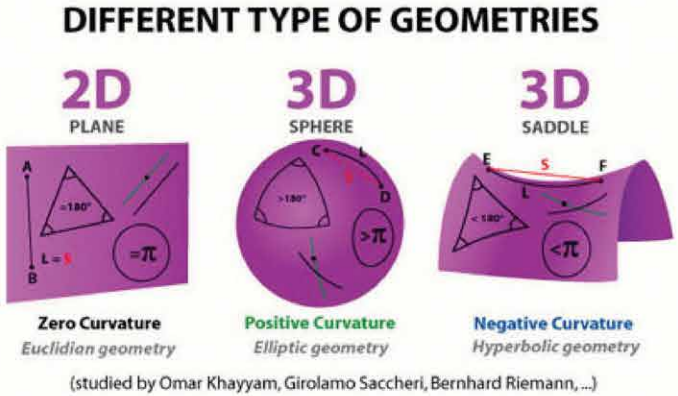

Euclid

(c.330-275 BC, fl. c.300 BC)

The Socratic tradition was not particularly congenial to mathematics, as may be gathered from Socrates' inability to convince himself that 1 plus 1 equals 2, but it seems that his student Plato gained an appreciation for mathematics after a series of conversations with his friend Archytas in 388 BC.

One of the things that most caught Plato's imagination was the existence and uniqueness of what are now called the five "Platonic solids".

It's uncertain who first described all five of these shapes - it may have been the early Pythagoreans - but some sources (including Euclid) indicate that Theaetetus (another friend of Plato's) wrote the first complete account of the five regular solids.

Presumably this formed the basis of the constructions of the Platonic solids that constitute the concluding Book XIII of Euclid's Elements.

In any case, Plato was mightily impressed by these five definite shapes that constitute the only perfectly symmetrical arrangements of a set of (non-planar) points in space, and late in life he expounded a complete "theory of everything", in the treatise called Timaeus, based explicitly on these five solids.

Interestingly, almost 2000 years later, Johannes Kepler was similarly fascinated by these five shapes, and developed his own cosmology from them

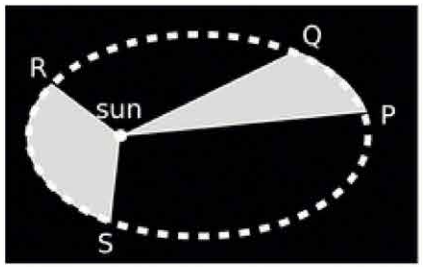

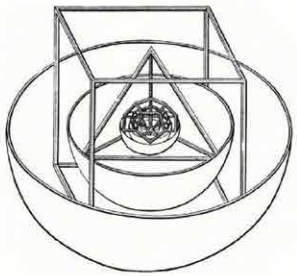

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Tetractys

The Greek Tetractys is a triangular figure consisting of ten points arranged in four rows:

one, two, three, and four points in each row, which is the geometrical representation of the fourth triangular number.

As a mystical symbol, it was very important to the secret worship of the Pythagoreans.

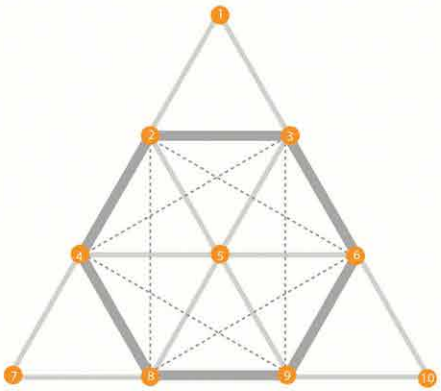

Sacred numbers

The Tetractys historically symbolized the four elements [Earth, Air, Fire, and Water] and the relationship between Humanity and the cosmos created by GOD

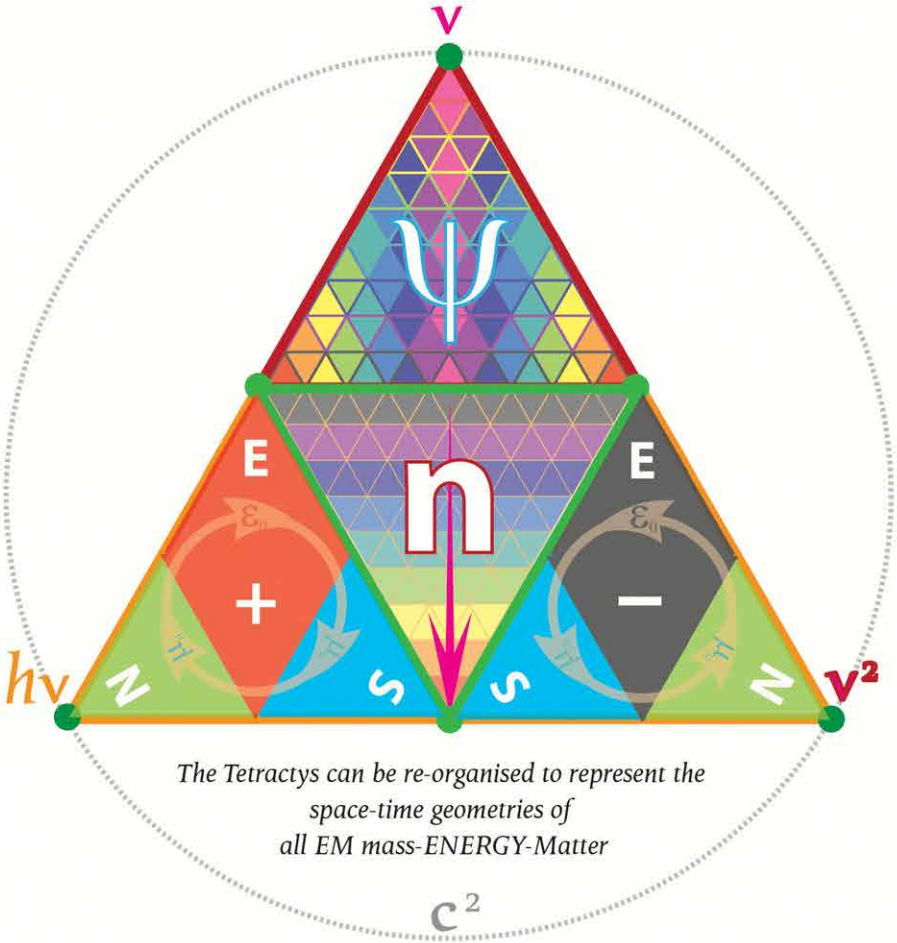

The Tetractys can be re-organised to represent the space-time geometries of all EM mass-ENERGY-Matter

The tetrad was the name given to the number four - in Pythagorean philosophy there were four seasons and four elements, and the number was also associated with planetary motions and music

As a mystical symbol, it was very important to the secret worship of the Pythagoreans.

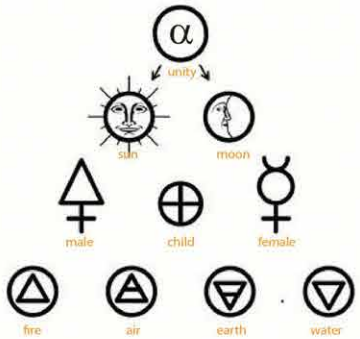

The Cosmos

The single triangle in the first row represents zero-dimensions (a point)
A vector direction in one-dimension can be represented as a line between any two points
The second row represents a Boson (two-dimensions in a plane defined by a rhombus of three triangles)
The whole figure folded represents three-dimensions (a tetrahedron defined by four apex points)
Photons of ElectroMagnetic mass-Energy quanta are represented by two opposing triangles

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The Greek Zodiac

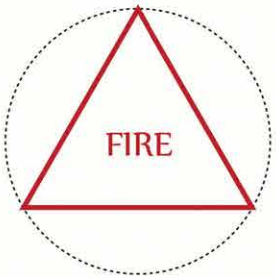

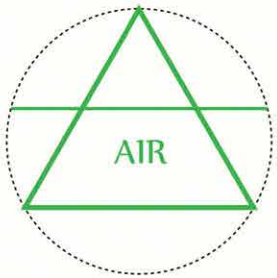

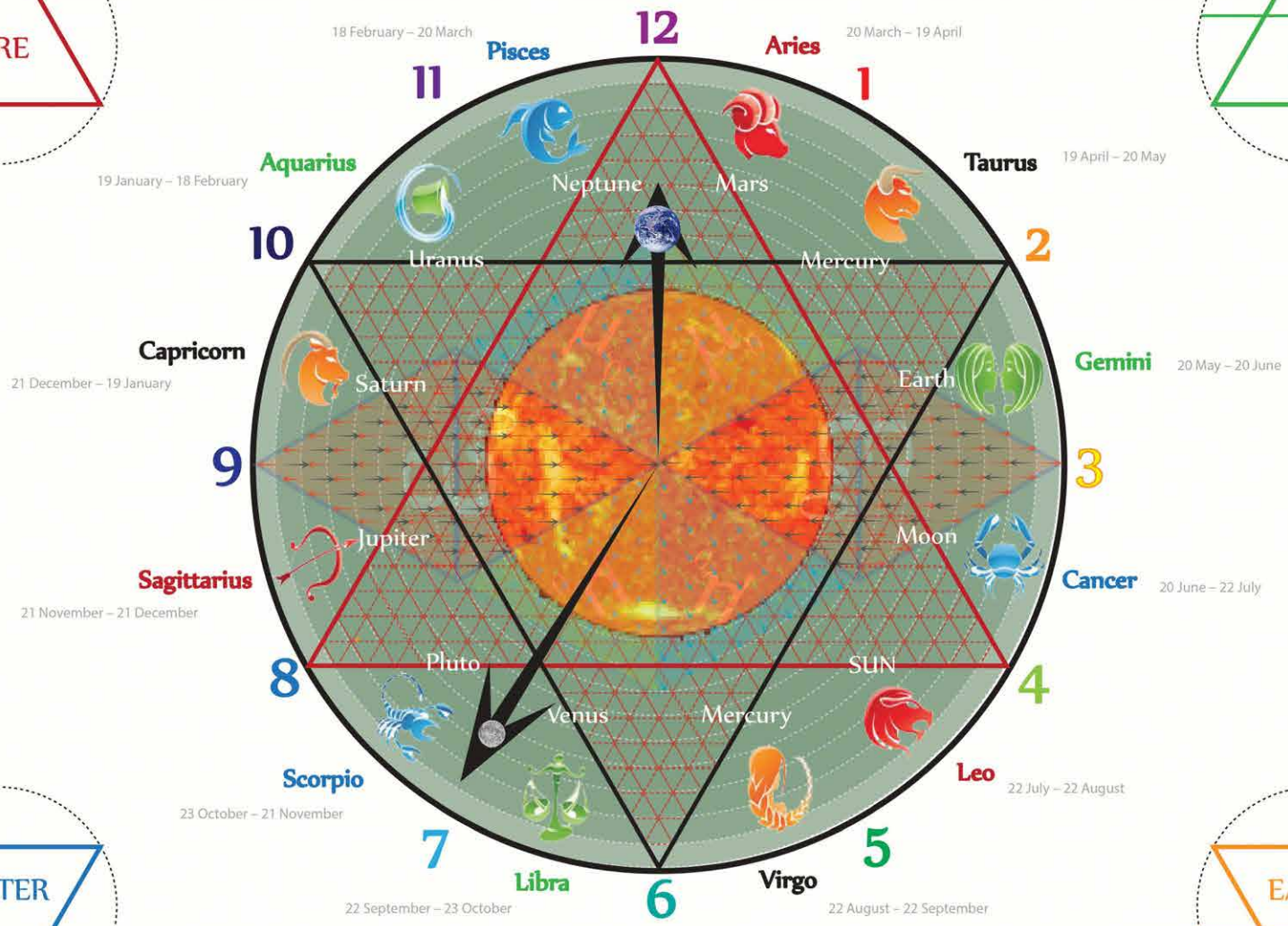

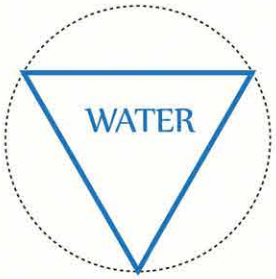

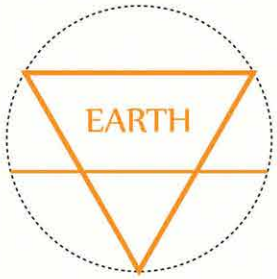

The Greek Elements

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Equilateral Triangles

An equilateral triangle is a triangle in which all three sides are equal

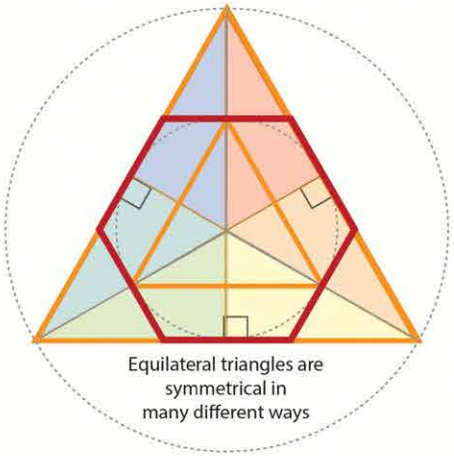

Equilateral triangles are symmetrical in many different ways

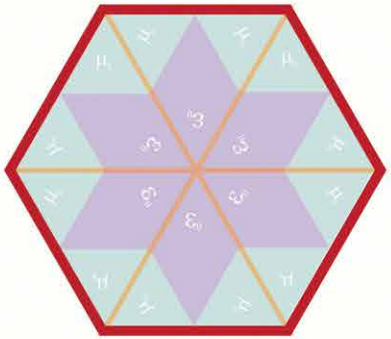

Any six equilateral triangles joined can make a hexagon.

It is unique in that it is the only polygon that can be tiled [or divided] and produce only identical geometries and squares numbers

The equilateral triangle is eminently suited for the construction of fractals

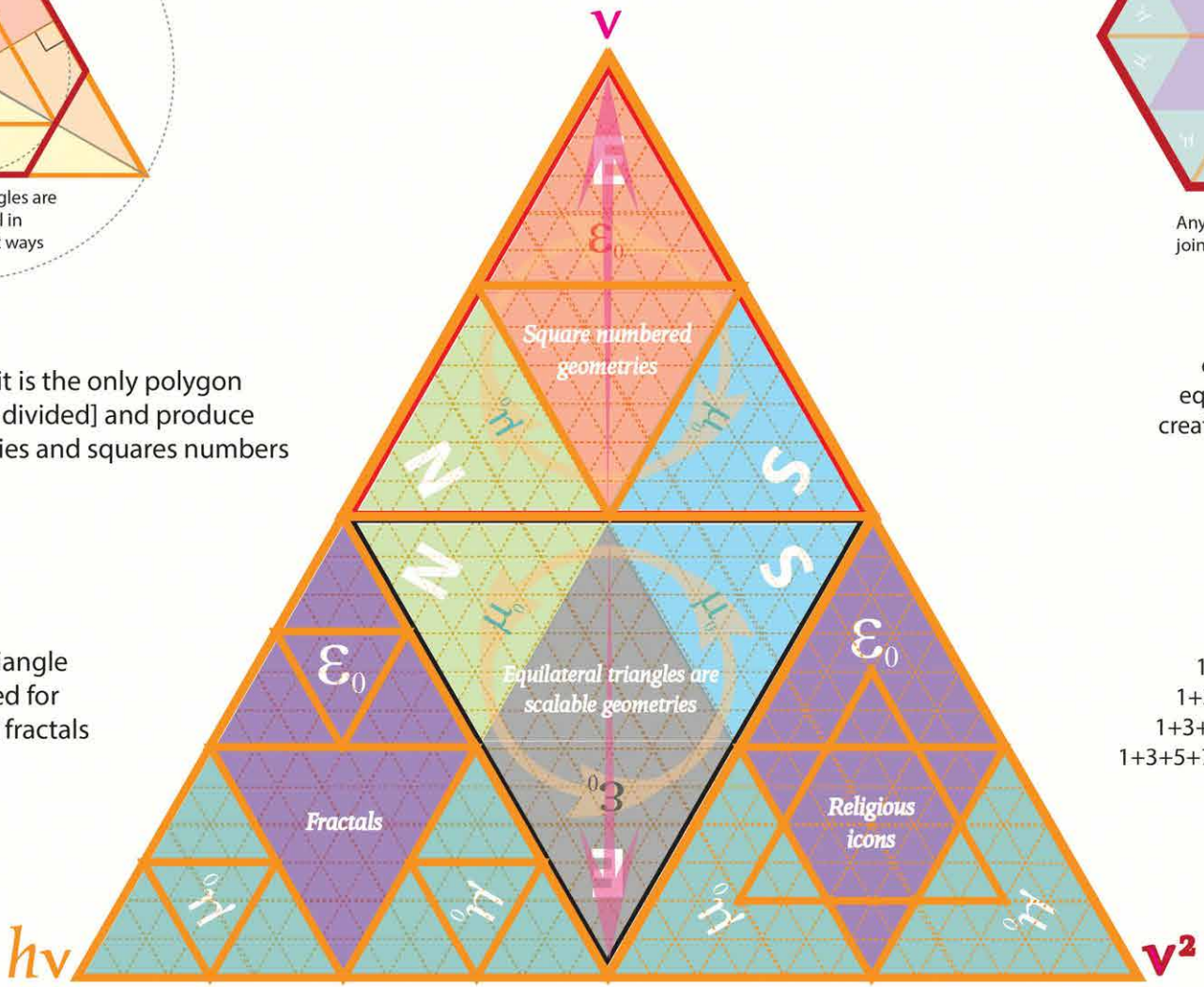

The tesselation of odd numbered equilateral triangles creates square numbers

That is,

1
1+3 = 4
1+3+5 = 9
1+3+5+7 = 16
1+3+5+7+9 = 25
1+3+5+7+9+11 = 36
1+3+5+7+9+11+13 = 49
1+3+5+7+7+9+11+13+15 = 64
etc

An equilateral triangle is simply a specific case of a regular polygon with 3 sides

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The Pythagorean Theorem

Though attributed to Pythagoras, it is not certain that he was the first person to prove it.

The first clear proof came from Euclid, and it is possible the concept was known 1000 years before Pythoragas by the Babylonians

$$a^2 + b^2 = c^2$$

The square of the hypotenuse of a triangle is equal to the sum of the squares of its sides.

In any right triangle,
the area of the square whose side is the hypotenuse
(the side opposite the right angle) is equal to
the sum of the areas of the squares
whose sides are the two legs
(the two sides that meet at a right angle)

Pythagoras of Samos

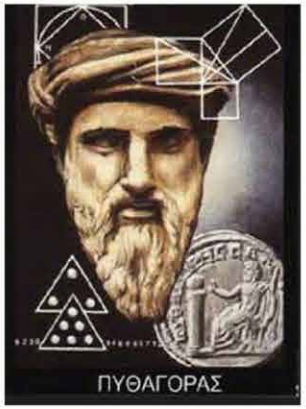

about (570 – 495 BC)

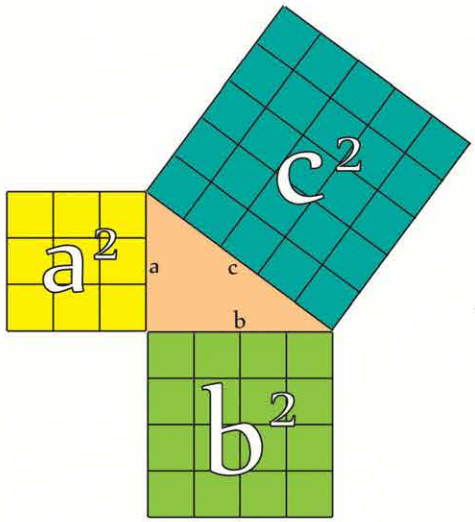

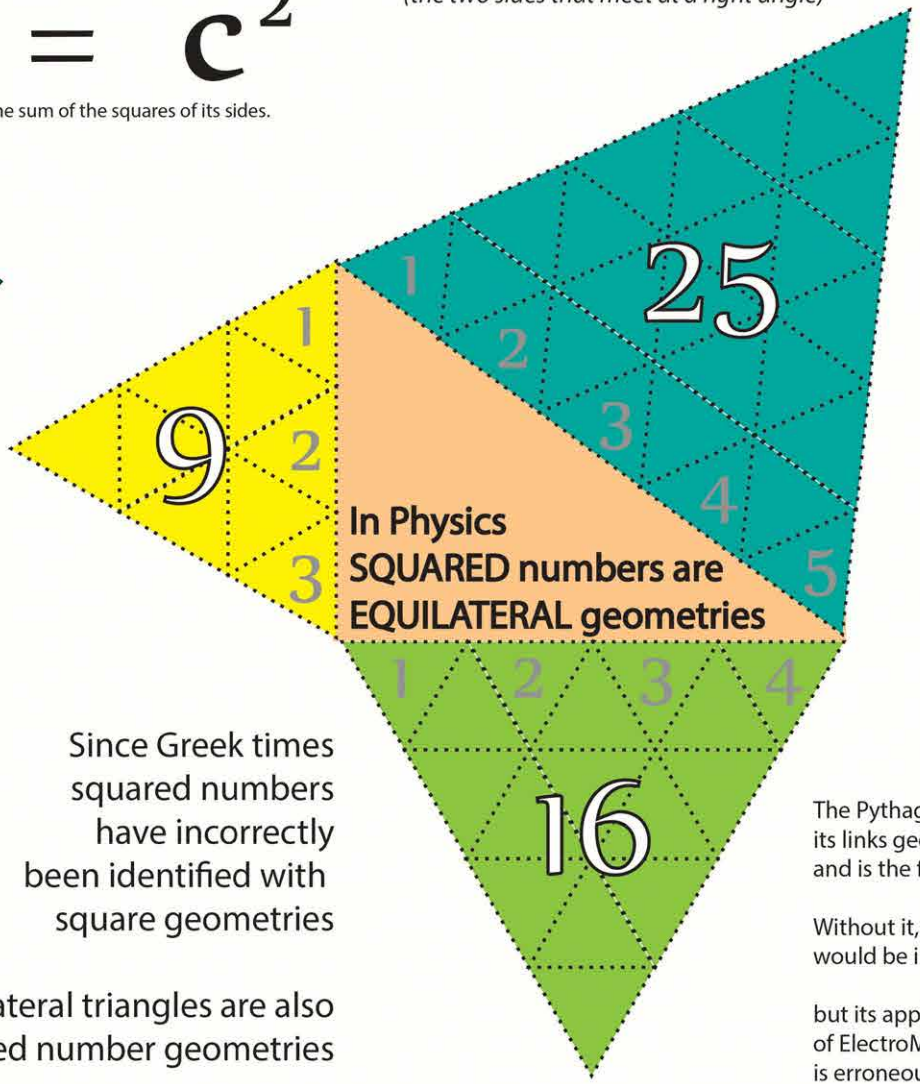

In Physics
SQUARED numbers are
EQUILATERAL geometries

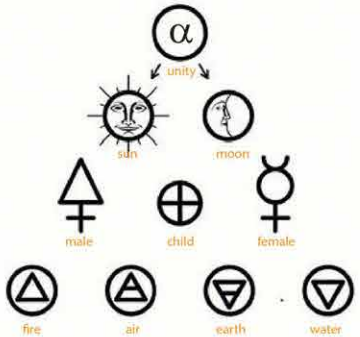

Pythagorean Tetractys

Since Greek times
squared numbers
have incorrectly
been identified with
square geometries

Equilateral triangles are also
squared number geometries

The Pythagorean equation is at the core of much of geometry,
its links geometry with algebra,
and is the foundation of trigonometry.

Without it, accurate surveying, mapmaking, and navigation
would be impossible,

but its application to the energy-momenta geometries
of ElectroMagnetic fields and Matter in motion in Physics
is erroneous and must be corrected for science to advance

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Hexagons

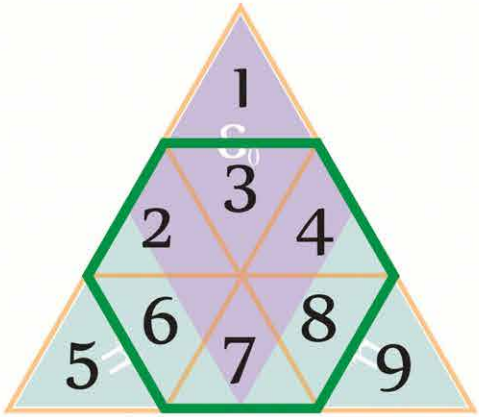

Energy geometries

A regular hexagon can be subdivided into six equilateral triangles

Hexagons are the only regular polygon that can be subdivided into another regular polygon

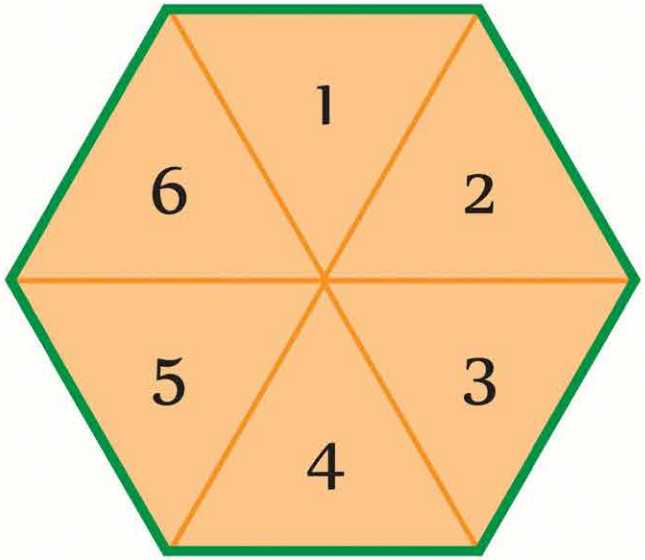

Hexagons are the unique regular polygon such that the distance between the center and each vertex is equal to the length of each side

An interesting relationship between circular and hexagonal geometry is that hexagonal patterns often appear spontaneously when natural forces are trying to approximate circles

Atomic nuclei geometries

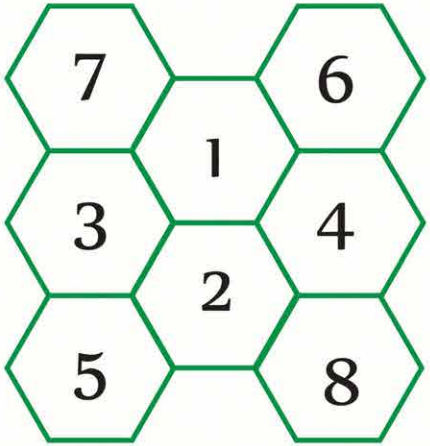

Hexagons can be tiled or tessellated in a regular pattern on a flat two-dimensional plane

Six is a highly composite number, the second-smallest composite number, and the first perfect number.

That is, 1*2*3=1+2+3=6

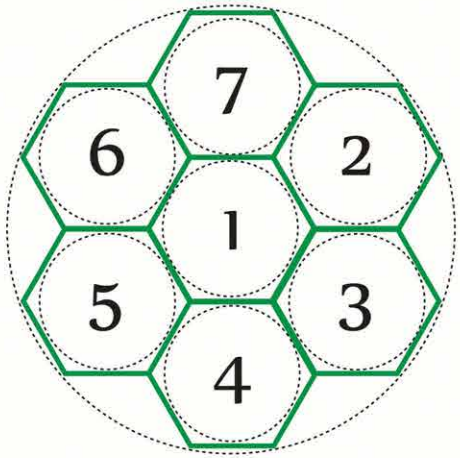

Hexagonal tessellation is topologically identical to the close packing of circles on a plane

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Platonic Solids

The Pythagoreans knew that there were only five regular convex solids, the tetrahedon, cube, octahedron, icosohedron and dodecahedron and each one could be accurately circumscribed by a sphere.

FIRE

4 triangles meet to form a Tetrahedron

EARTH

6 squares meet to form a Cube

AIR

8 triangles meet to form a Octahedron

tetryons **4**

regular deltahedrons

leptons **12**

F - E + V = 2

faces edges vertexs

8 *quarks*

regular deltahedrons

20 *Baryons*

Plato

(c.428-348 BC)

The philosopher Plato concluded that they must be the fundamental building blocks – the atoms – of nature, and assigned to them what he believed to be the essential elements of the universe.

12 pentagons meet to form a Dodecahedron

THE HEAVENS

20 triangles meet to form a Icosahedron

WATER

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Tetryonic Solids

Despite their unique topologies Tetryonic solids are not unlike Platonic solids save that their toplogies are comprised entirely from complex hitherto undescribed **4nπ equilateral Planck mass-energy momenta geometries** that also match the Euler numbers of Platonic solids

+ tetryon

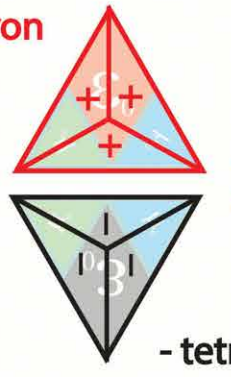

4 faces
6 edges
4 vertices

2

- tetryon

up quark

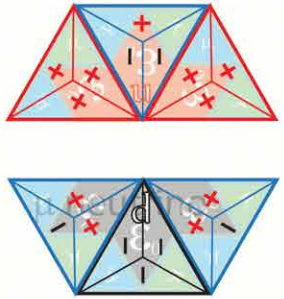

2

8 faces
12 edges
6 vertices

down quark

mass geometries

4π *tetryons* **4π**

regular deltahedrons

12π *leptons* **12π**

Matter topologies

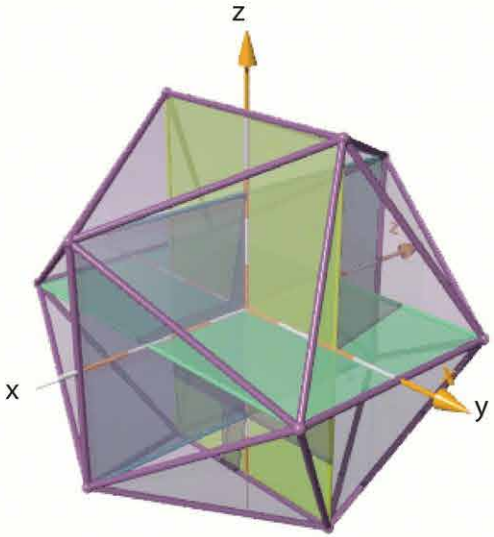

Matter topologies

8π *quarks* **12π**

regular deltahedrons

20π *Baryons* **36π**

mass geometries

neutrino

electron

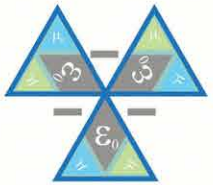

12 faces
18 edges
8 vertices

2

Their equilateral topologies are best described as regular topologic-deltahedrons:

tetra-delta-hedrals	tetryons	4π external charge fascia
octa-delta-hedrals	quarks	8π external charge fascia
dodeca-delta-hedrals	leptons	12π external charge fascia
icoso-delta-hedrals	Baryons	20π external charge fascia

note:
Charged mass-energy fascia geometries and edges become "hidden" upon the meshing of delta-hedra to form Matter topologies

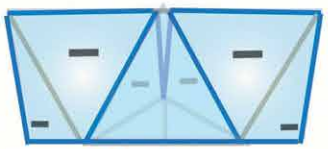

Neutron

2

Proton

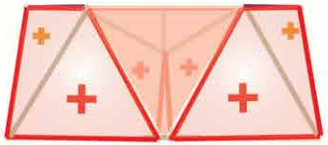

20 faces
30 edges
12 vertices

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Euclidean geometry

Euclid

(c.330-275 BC, fl. c.300 BC)

Arguably the most influential Mathematics book ever written is Euclid's 'The Elements'

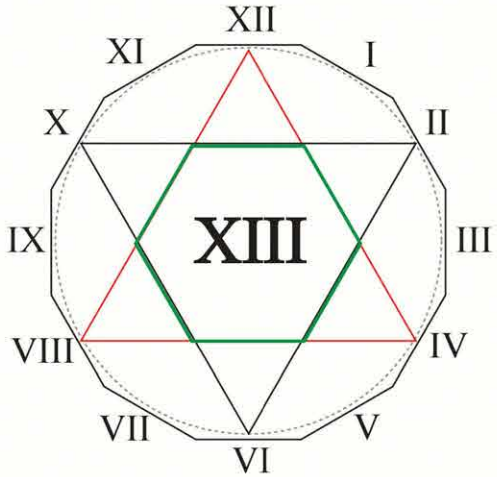

In all, it contains 465 theorems and proofs, described in a clear, logical and elegant style, and using only a compass and a straight edge.

The Elements - Book 1 - Definition 20

Of the trilateral figures, an equilateral triangle is that which has its three EQUAL sides

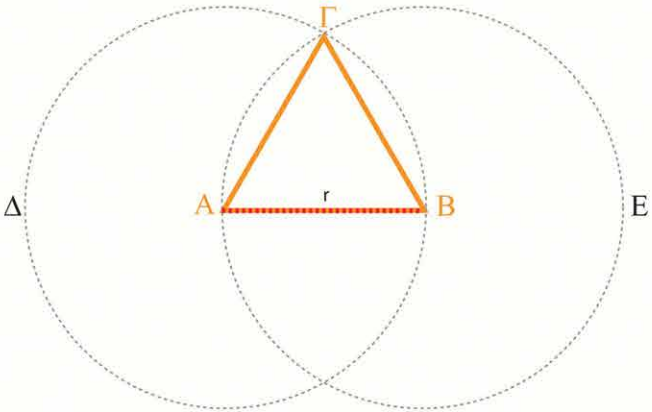

Euclid's Elements - Book 1 - Proposition 1
Method of constructing an Equialteral triangle

Euclid's five general axioms were:

Things which are equal to the same thing are equal to each other.

If equals are added to equals, the wholes (sums) are equal.

If equals are subtracted from equals, the remainders (differences) are equal.

Things that coincide with one another are equal to one another.

The whole is greater than the part

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Archimedes

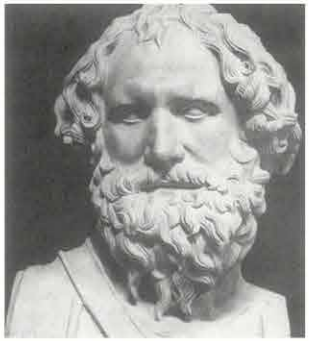

c. (287 BC – c. 212 BC)

As its definition relates to the circle,
π is found in many formulae in trigonometry and geometry,
especially those concerning circles, ellipses, or spheres.

It is also found in formulae from other branches of science,
such as cosmology, number theory, statistics, fractals,
thermodynamics, mechanics, and electromagnetism

Incorrect identification of Pi [c/d] as opposed to Pi radians
in Physics has led to the inappropriate association
of spherical particles to the physical sciences
whereas equilateral triangles & tetrahedra
form its true geometry

The number π is a mathematical constant that is
the ratio of a circle's circumference to its diameter.

Pi

π is an irrational number
its decimal representation
never ends and never repeats.

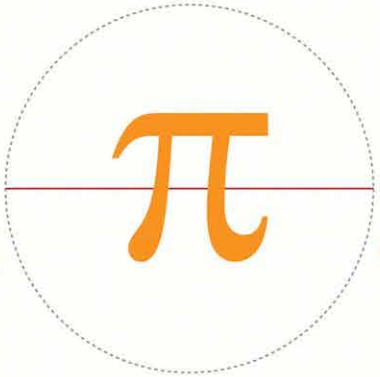

$\pi = c/d$

The ratio C/d is constant,
regardless of the circle's size

3.141592654.....

Proof of the fact that C=2πr and how Archimedes proved it

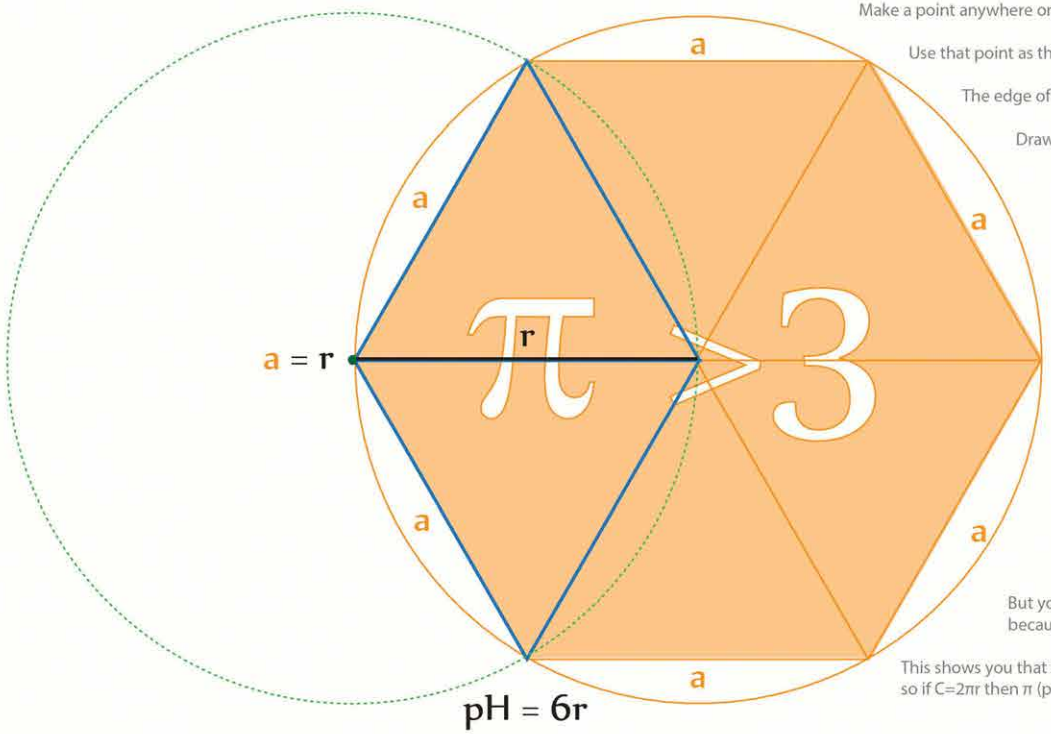

Draw any circle.

Make a point anywhere on the circumference of the [green] circle.

Use that point as the center of a second [blue] circle with the same radius as the green circle.

The edge of the blue circle should touch the center of the green circle.

Draw the line segment connecting the centers of the two circles.

That forms the radius of both of the circles.

Now draw the line connecting the center of the blue circle to where it crosses the green circle
on both sides, and complete the triangles.

You should have two equilateral triangles whose sides are equal to the radius of the green circle

Now extend all of the radius lines so they become diameter lines,
all the way across the circle, and finish drawing all of the triangles to connect them.

You've got six equilateral triangles now, that make an orange hexagon.

So the perimeter of your hexagon is the same as six times the radius of your circle.

But your circumference is a little bigger than the perimeter of your hexagon,
because the shortest distance between two points is always a straight line.

This shows you that the circumference of the blue circle has to be more than 6r,
so if C=2πr then π (pi) has to be a little bigger than 3, which it is.

The more sides we draw on our polygon, the closer we will get to the real value of pi (3.14159 etc.).
Using a polygon with 96 sides, Archimedes was able to calculate that π was a little bigger than 3.1408

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The Golden Ratio

Two quantities are in the golden ratio (φ) if the ratio of the sum of the quantities to the larger quantity is equal to the ratio of the larger quantity to the smaller one.

The figure to the right illustrates the geometric relationship

[1.61803]

L — Interior line length [LM] of the bisector line is equal to 1/2 the side of the original triangle [BC] [AB] or [CA] — M

Φ

Golden ratio phi

$$\hbar = \frac{h}{2\pi}$$

Tetryonic geometry reveals the maximum E-field amplitude of the reduced Planck constant to be an example of the Golden ratio in physics

velocity vectors

The height of the triangle [ALM] produced by the bisecting line is 1/2 the height of the height of [ABC]

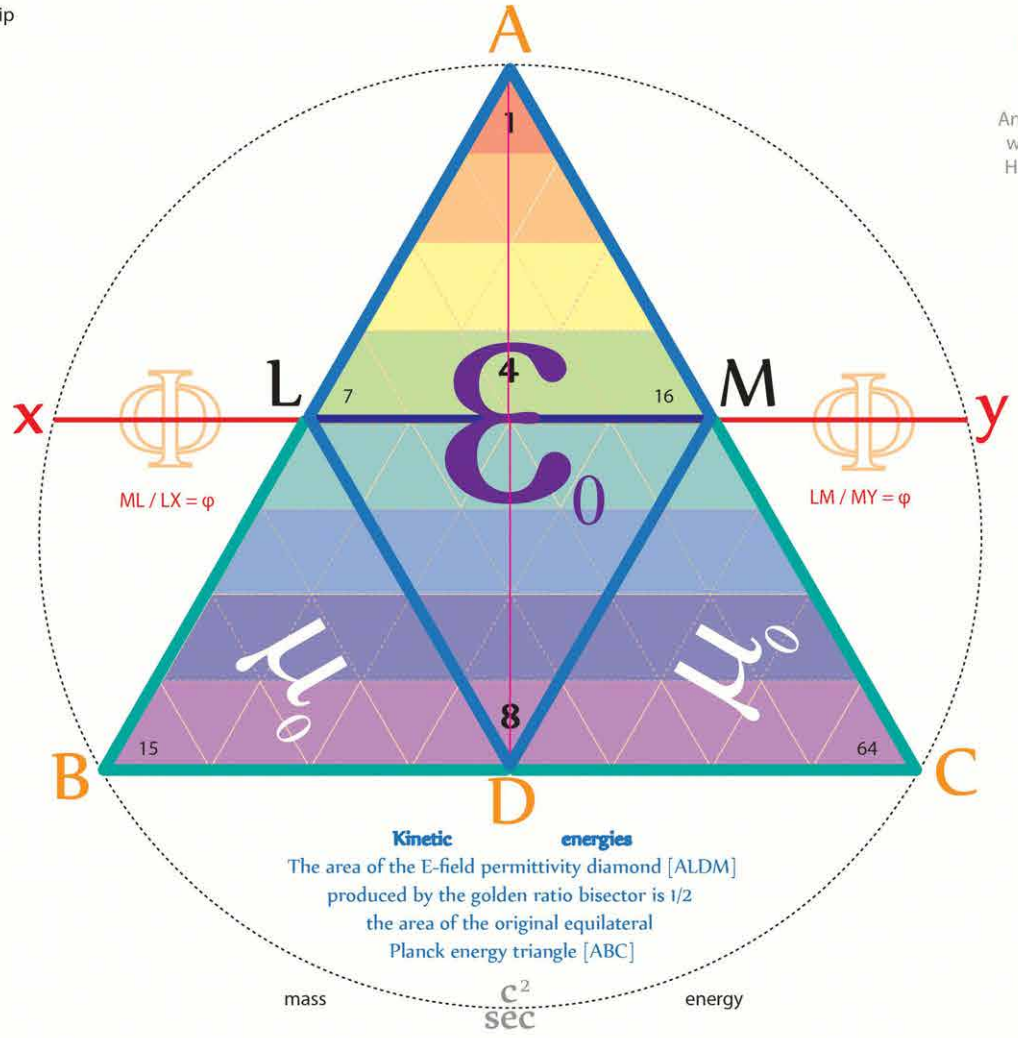

Planck's constant [h]

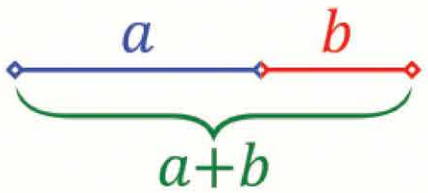

$a+b$ is to a as a is to b

An intriguing showing of φ in an equilateral triangle was observed by George Odom, a resident of the Hudson River Psychiatric Center, in the early 1980s

M — The exterior lines [My] and [Lx] are Phi ratios of the interior line [LM] — y

Let L and M be the midpoints of the sides AB and AC of an equilateral triangle ABC

By measurement and the Intersecting Chords Theorem

MX·MY = AM·MC.

which is of the form

(a + b)·b = a·a.

Denoting a/b = x, we see that

$1 + x = x^2$,

George Odom

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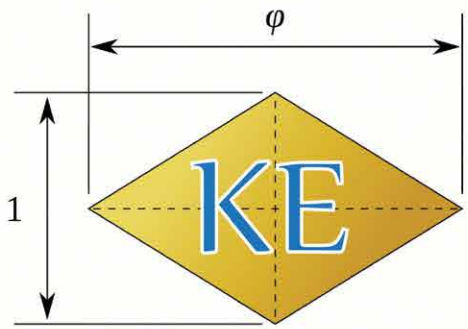

The Golden Rhombus

Applying the golden ratio (φ) to quantum scale electrodynamic geometry we can quickly determine that the linear momentum and magnetic moment vectors of photons & EM waves can also be expressed as a golden ratio

vector velocities
vs
magnetic vector

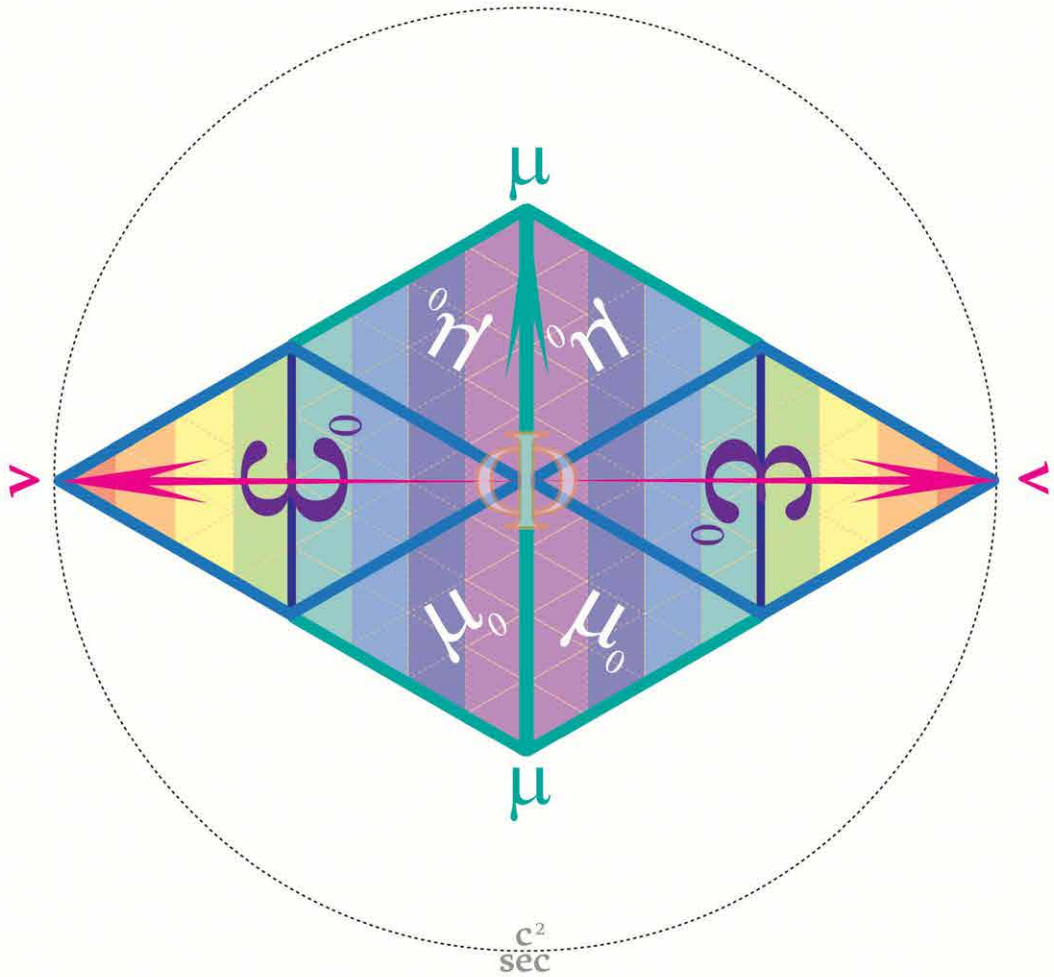

magnetic Force
vs
electric Force

photons
of
EM energy

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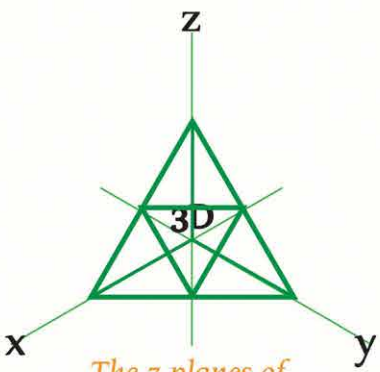

The 3 planes of Cartesian co-ordinates

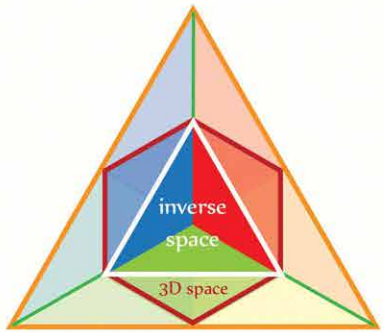

An equilateral [square] triangle divided into 12 equal semitones

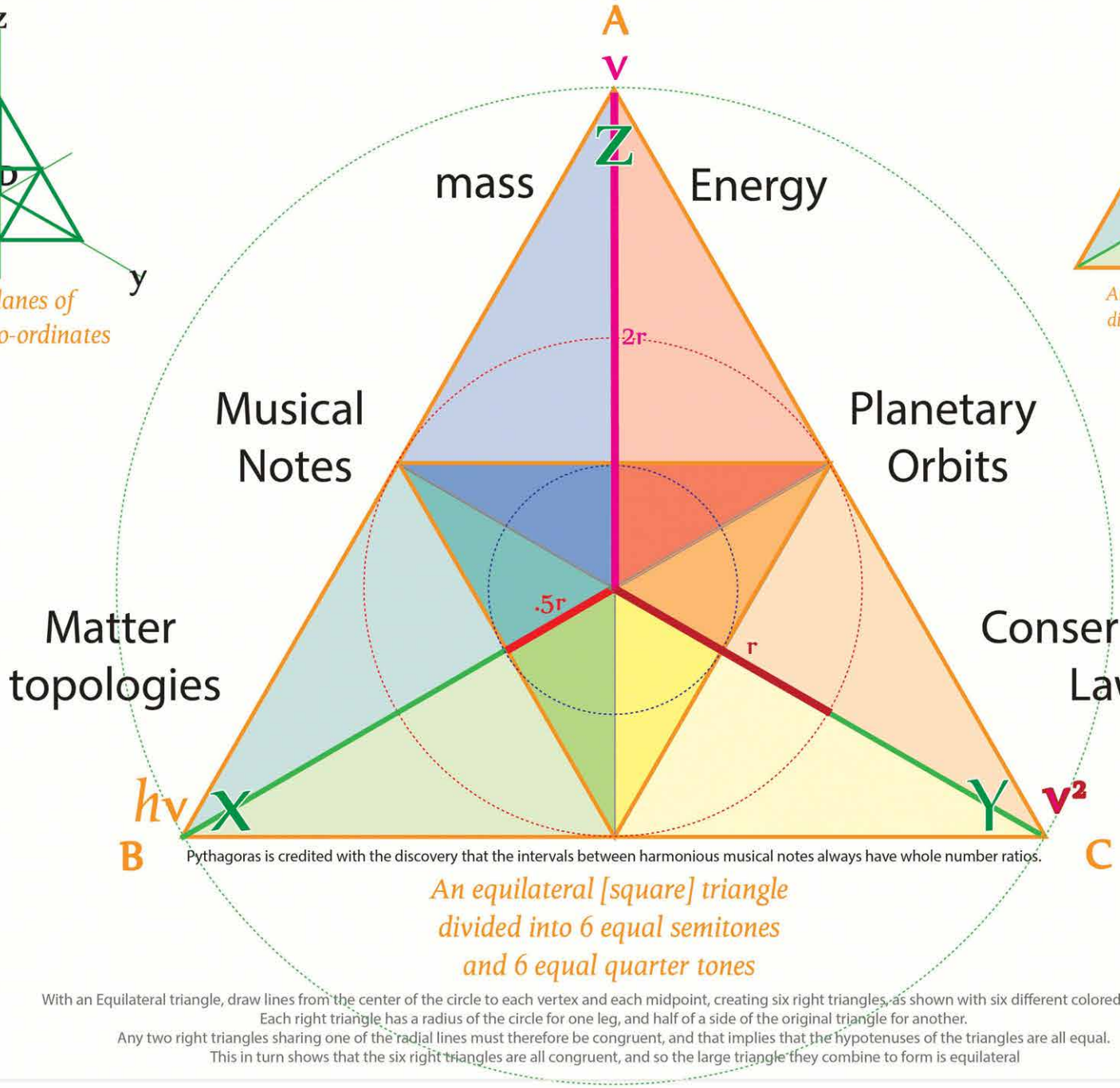

Pythagoras is credited with the discovery that the intervals between harmonious musical notes always have whole number ratios.

An equilateral [square] triangle divided into 6 equal semitones and 6 equal quarter tones

With an Equilateral triangle, draw lines from the center of the circle to each vertex and each midpoint, creating six right triangles, as shown with six different colored triangles.
Each right triangle has a radius of the circle for one leg, and half of a side of the original triangle for another.
Any two right triangles sharing one of the radial lines must therefore be congruent, and that implies that the hypotenuses of the triangles are all equal.
This in turn shows that the six right triangles are all congruent, and so the large triangle they combine to form is equilateral

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Equilateral Fifths

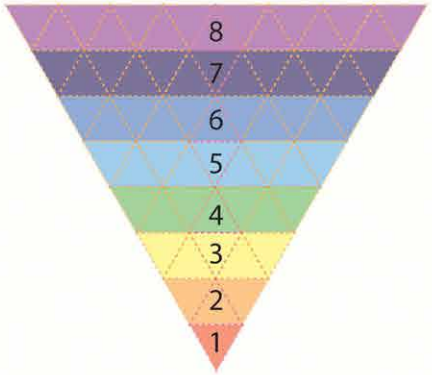

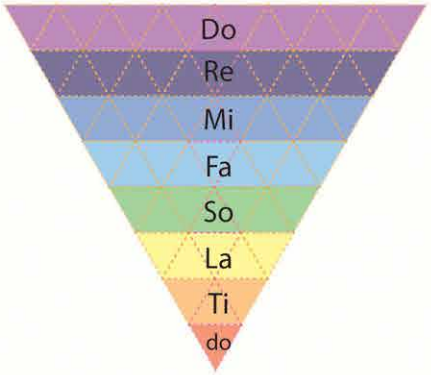

B
C
B flat
15:8
9:5
13/1
A
D flat
5:3
12
11
1
16:15
10
2
A flat
8:5
9
CDEFGABC
do re mi fa so la ti do
3
9:8
D
8
4
7
5
3:2
6
6:5
G
E flat
45:32
5:4
4:3
G flat
E
F

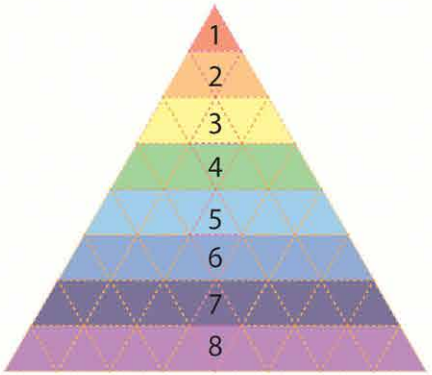

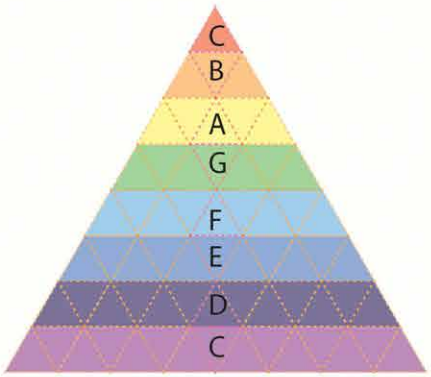

Musical Notes

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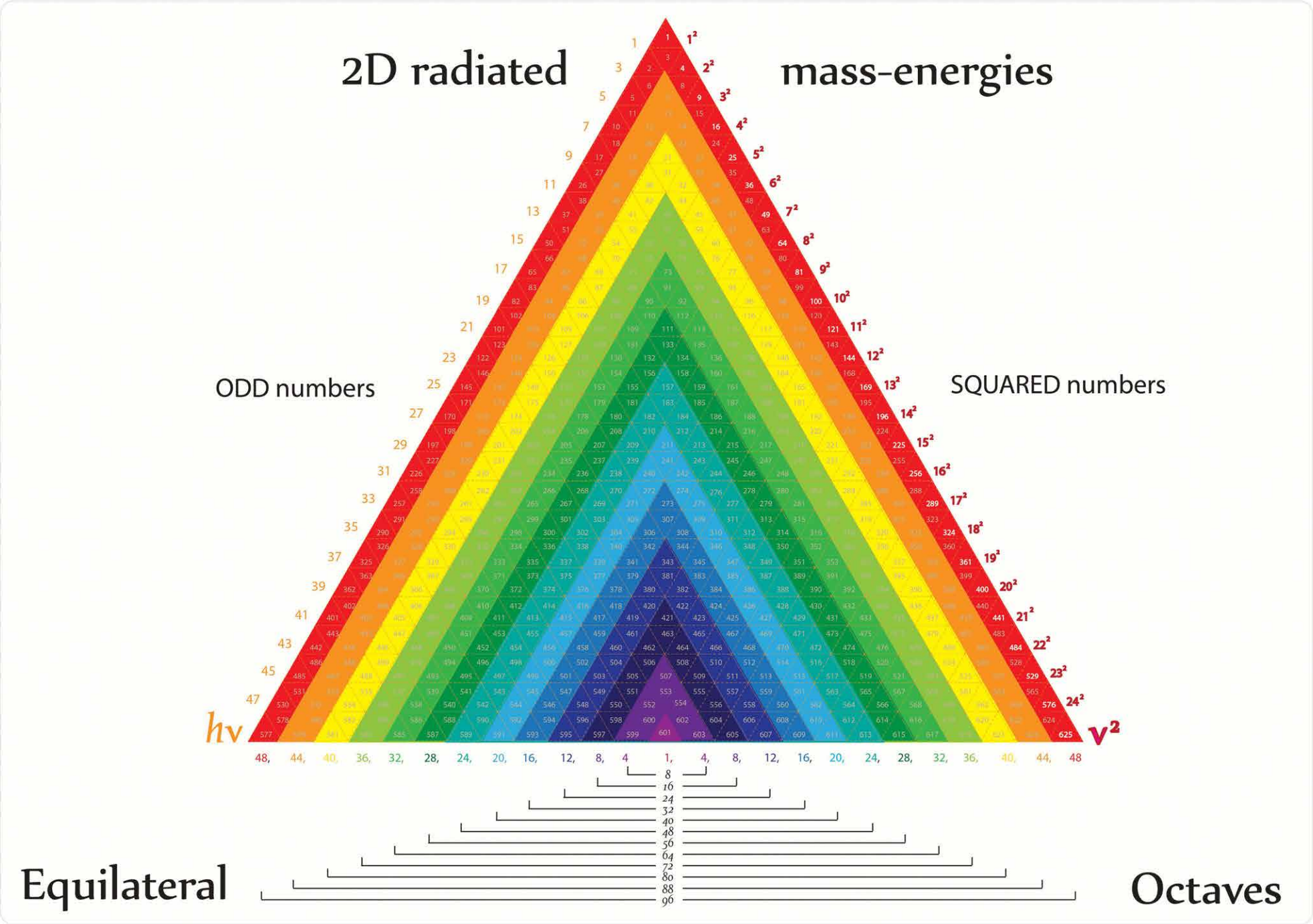

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Ternary Diagrams

Viviani's Theorem implies that lines parallel to the sides of an equilateral triangle provide (homogeneous/barycentric/areal/trilinear) coordinates for ternary diagrams for representing three quantities A,B,C whose sum is a constant (which can be normalized to unity).

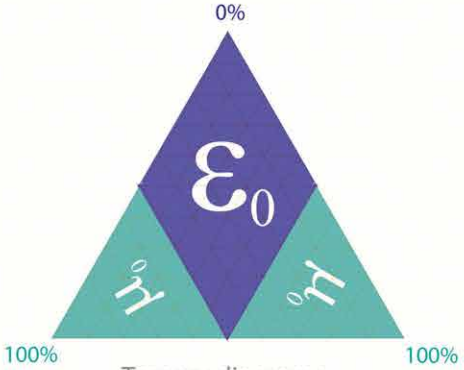

Ternary diagrams should NOT be used to model EM field strengths

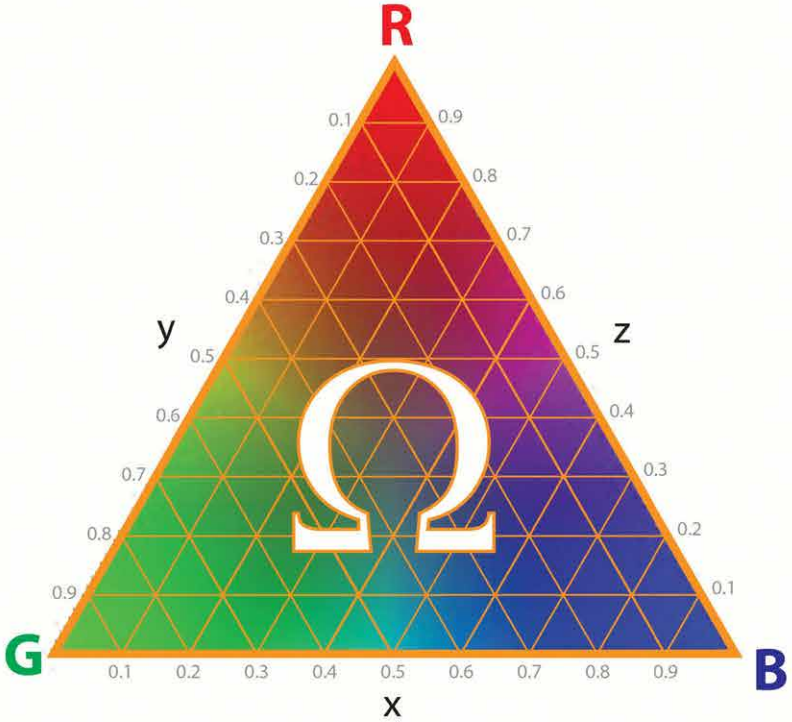

In a ternary plot, of EM energy the Electric field [E] and the Magnetic dipole [N-S] must renormalise to 1

A ternary diagram is simply a triangular coordinate system in which the 3 edges correspond to the axes.

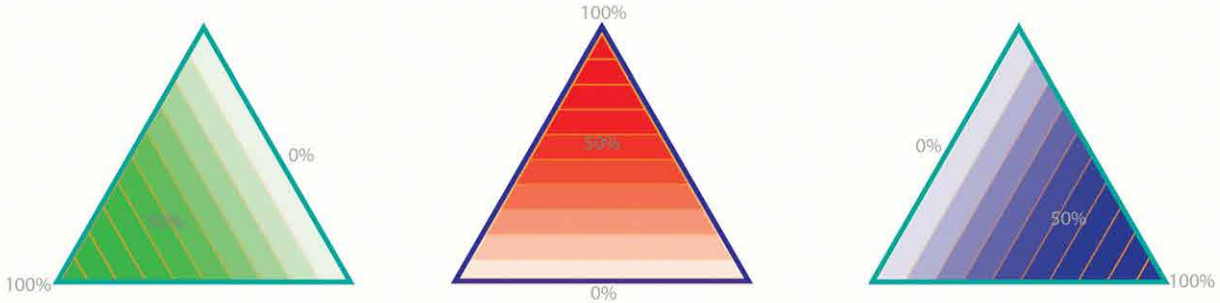

Trilinear charts are commonly used for finding the result of mixing three components (such as gases, chemical compounds, soil, color, etc.) that add to 100% of a quantity.

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Whilst the Pythagorean Theorem boasts a slightly greater economy of terms than the Eutrigon Theorem (Wayne Roberts 2003), the latter contains an important area not included in the former:

the area enclosed or swept out by the three points of the triangle in question

$$ab = a^2 + b^2 - c^2$$

the area of any eutrigon is equal to the combined areas of the equilateral triangles on legs 'a' and 'b', minus the area of the equilateral triangle on its hypotenuse 'c'.

The Pythagorean theorem

$$a^2 + b^2 = c^2$$

The square of the hypotenuse of a triangle is equal to the sum of the squares of its sides.

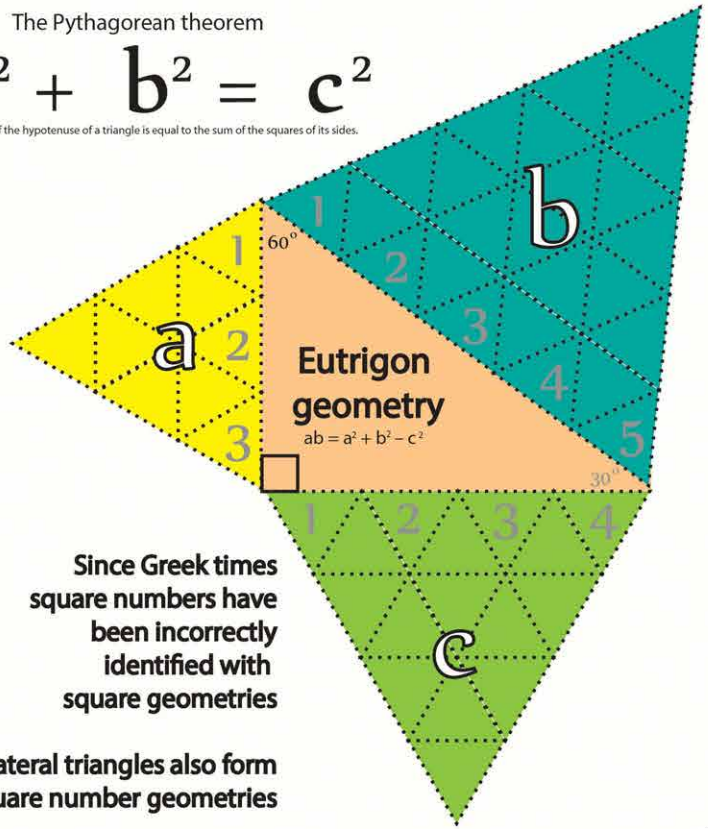

Since Greek times square numbers have been incorrectly identified with square geometries

Equilateral triangles also form square number geometries

Eutrigons

are an important new class of triangle (mathematically defined by Wayne Roberts), as the analogue of the right-triangle in orthogonal (Cartesian) coordinate geometry

Kepler's Second Law of planetary motion

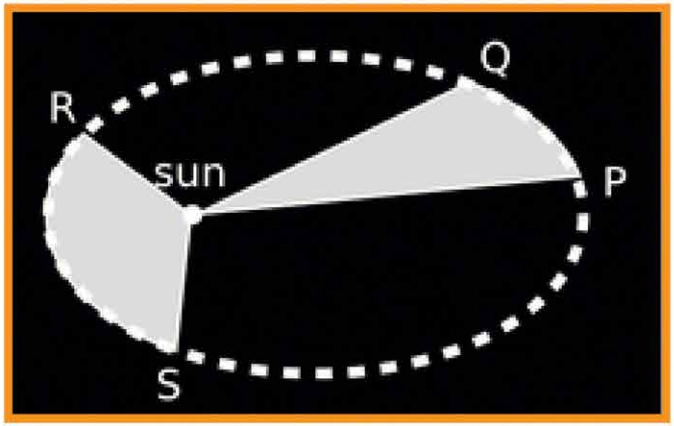

The orbit of every planet is an ellipse with the Sun at one of the two foci.

A line joining a planet and the Sun sweeps out equal areas during equal intervals of time.

The algebraic form of the Eutrigon Theorem, (like the algebraic form of Pythagoras' Theorem), is proven to be special case of the Cosine Rule...

Tetryonic theory reveals the equilateral [square] energy geometry that reveals the 'harmonics at play' in physical laws such as the second law of Kepler, and in many other phenomena in physics, chemistry, cosmology, biochemistry and number theory thus providing the foundation for the mathematics of quantum mechanics

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Number theory

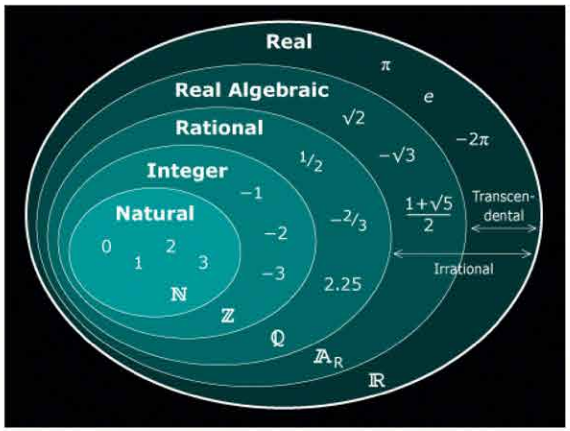

The Pythagoreans also established the foundations of number theory, with their investigations of triangular, square and also perfect numbers (numbers that are the sum of their divisors).

They discovered several new properties of square numbers, such as that the square of a number n is equal to the sum of the first n odd numbers (e.g. 1 + 3 + 5 + 7 = 16).

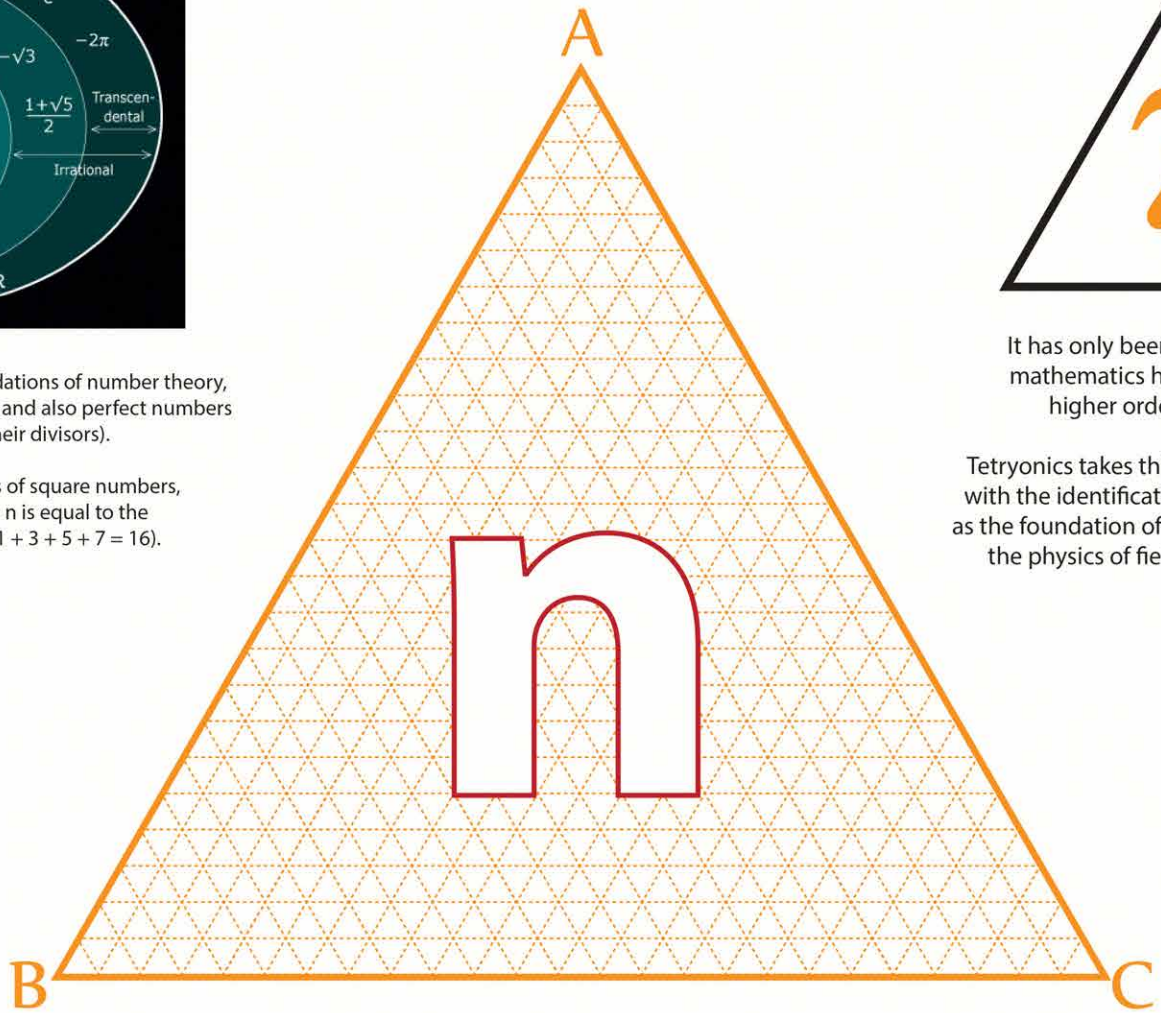

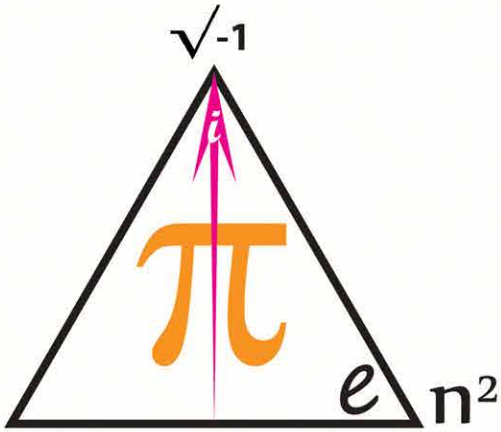

It has only been in recent centuries that mathematics has begun to explore the higher order irrational numbers

Tetryonics takes this investigation to new levels with the identification of equilateral geometries as the foundation of transcendental numbers and the physics of fields and particles in motion

What mathematics has failed to appreciate is the significance application of equilateral geometries to the 'square' numbers of physics and science in general

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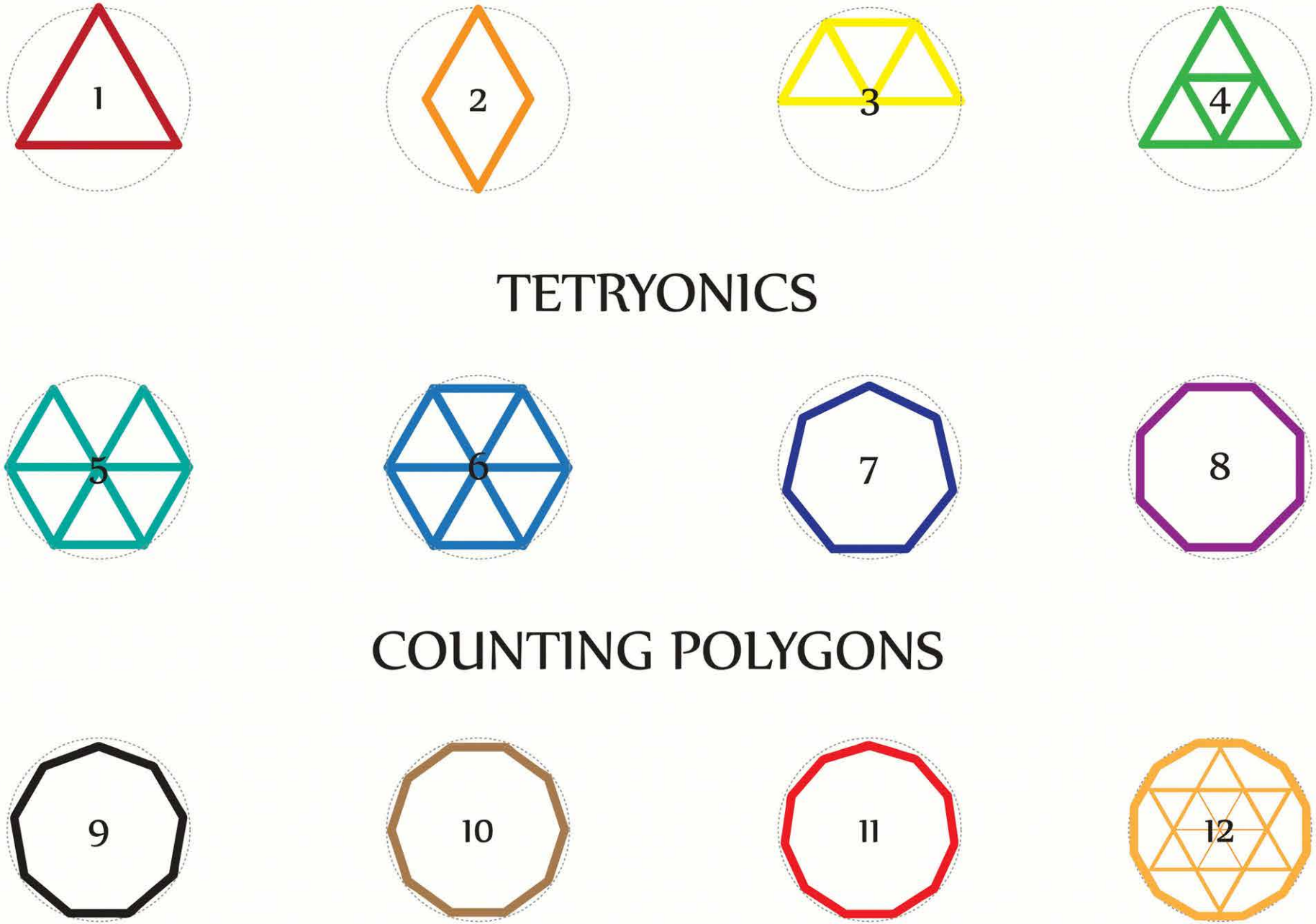

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SQUARED energies in quantum mechanics are EQUILATERAL geometries

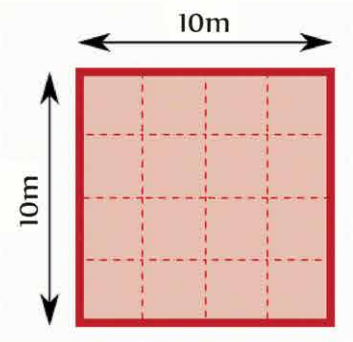

Square

area = s^2 = [100]

Circles

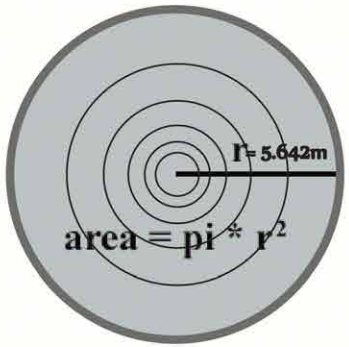

= pi *$[5.642]^2$
= 100

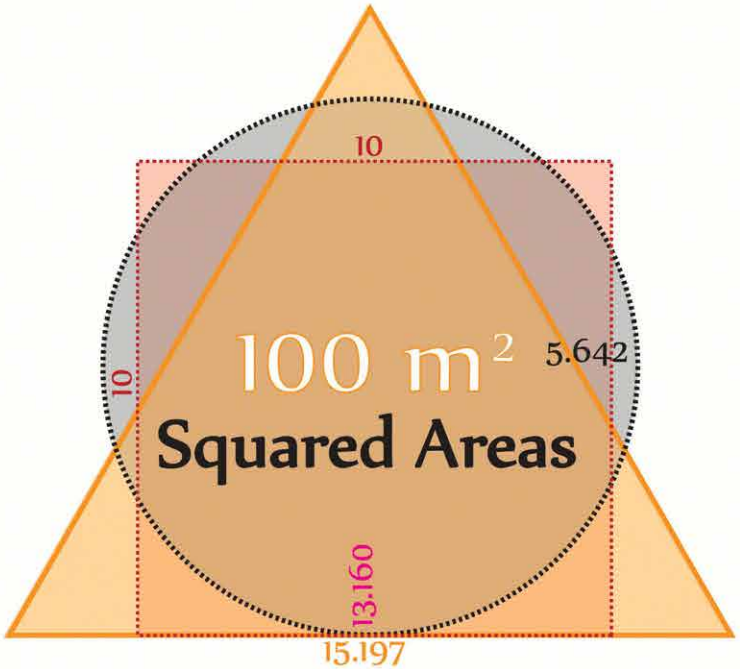

can be created by a number of planar geometries

For a long time it has been assumed by scientists (and mathematicians) that circular [and squared] geometries are the geometric foundation of all physics, leading to a serioulsy flawed model of particles and forces in quantum mechanics

Tetryonic theory now reveals that quantised equilateral angular momenta creates the foundational geometry of all the mass-Energy-Matter & forces of physics

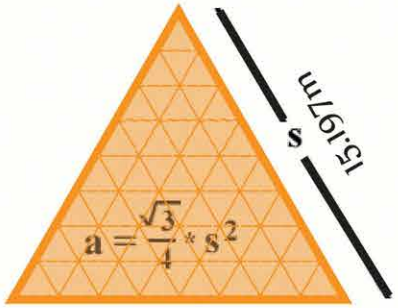

Equilateral

area = $(\frac{1}{2}*b)*h$

Triangles

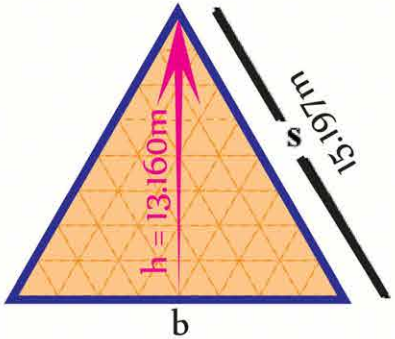

b h
[.5x15.197] x 13.160
= 100

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0.987654321

SQUARE ROOTS

80/81

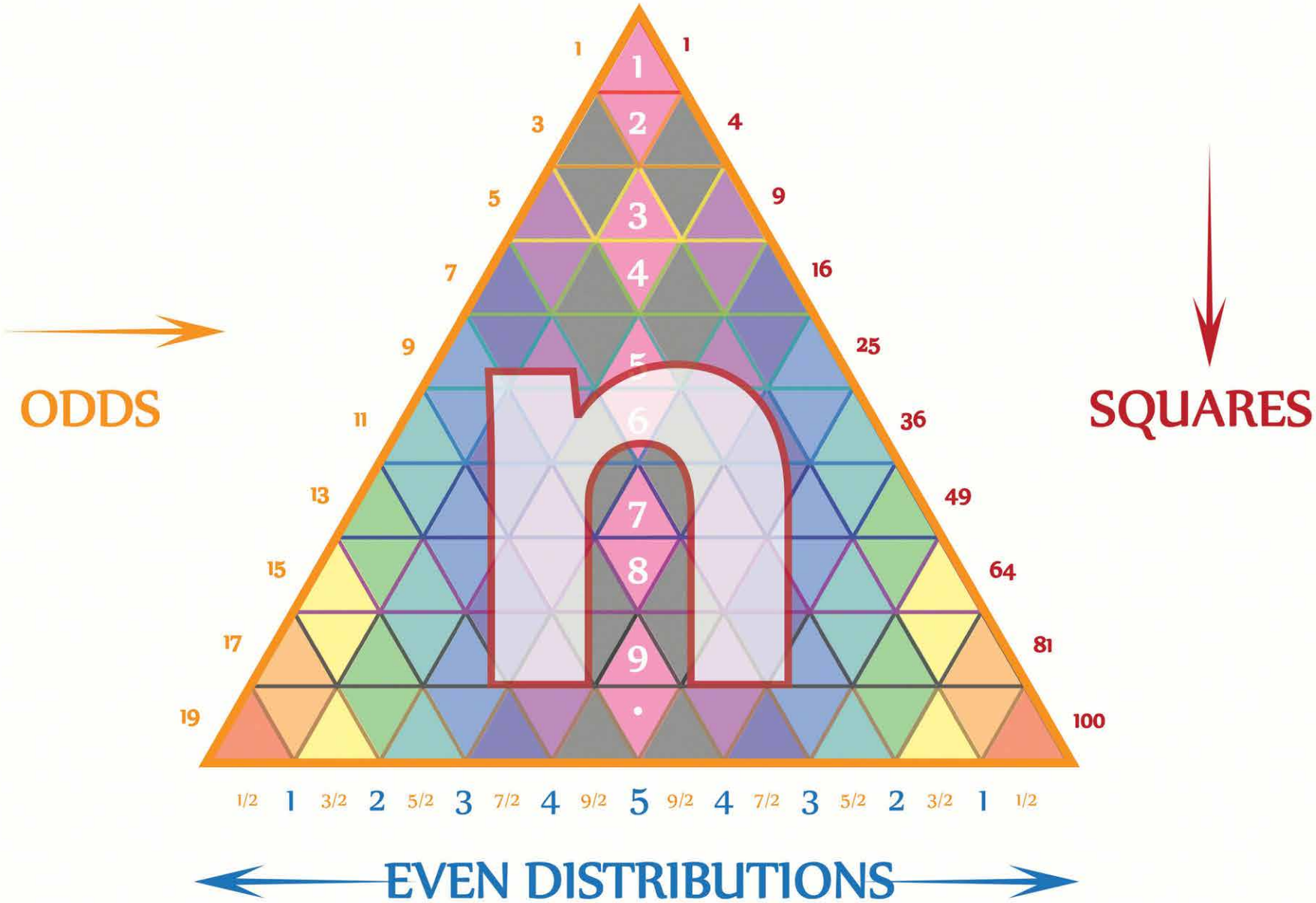

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Integers

The integers (from the Latin integer), literally "untouched", hence "whole"
in Tetryonics it is the basis for the Planck charge quantum

$$2n-1$$

$$[[n] + [n-1]]$$

Triangular numbered geometries are NOT equialteral geometries

0, 1, 3, 6, 10, 15, 21, 28, 36, 45, 55, ...

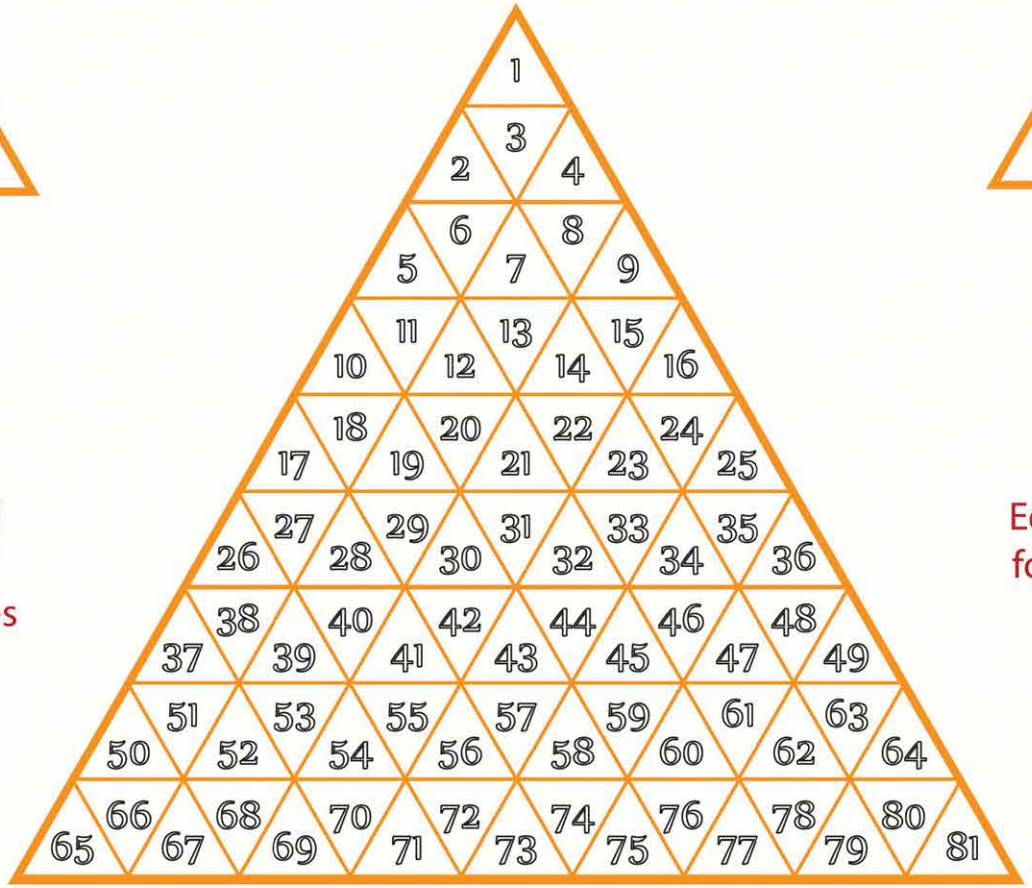

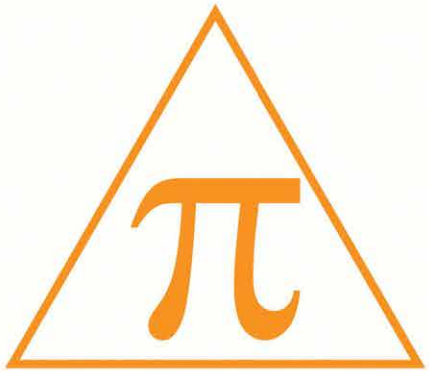

$$\sum_{1}^{n} [2n-1]$$

Equilateral geometries form **SQUARE** number geometries

1, 4, 9, 16, 25, 49, 64, 81, 100, 121, 144, ...

Equilateral energy quanta form a normal longitudinal distribution

Viewed as a subset of the real numbers, they are numbers that can be written without a fractional or decimal component

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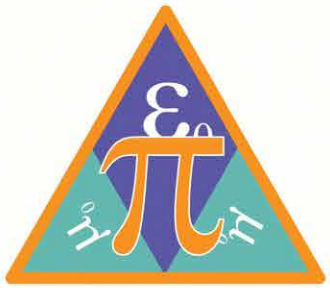

Bosons are a transverse measure of scalar energy momenta

ODD numbers

An odd number is an integer which is not a multiple of two.

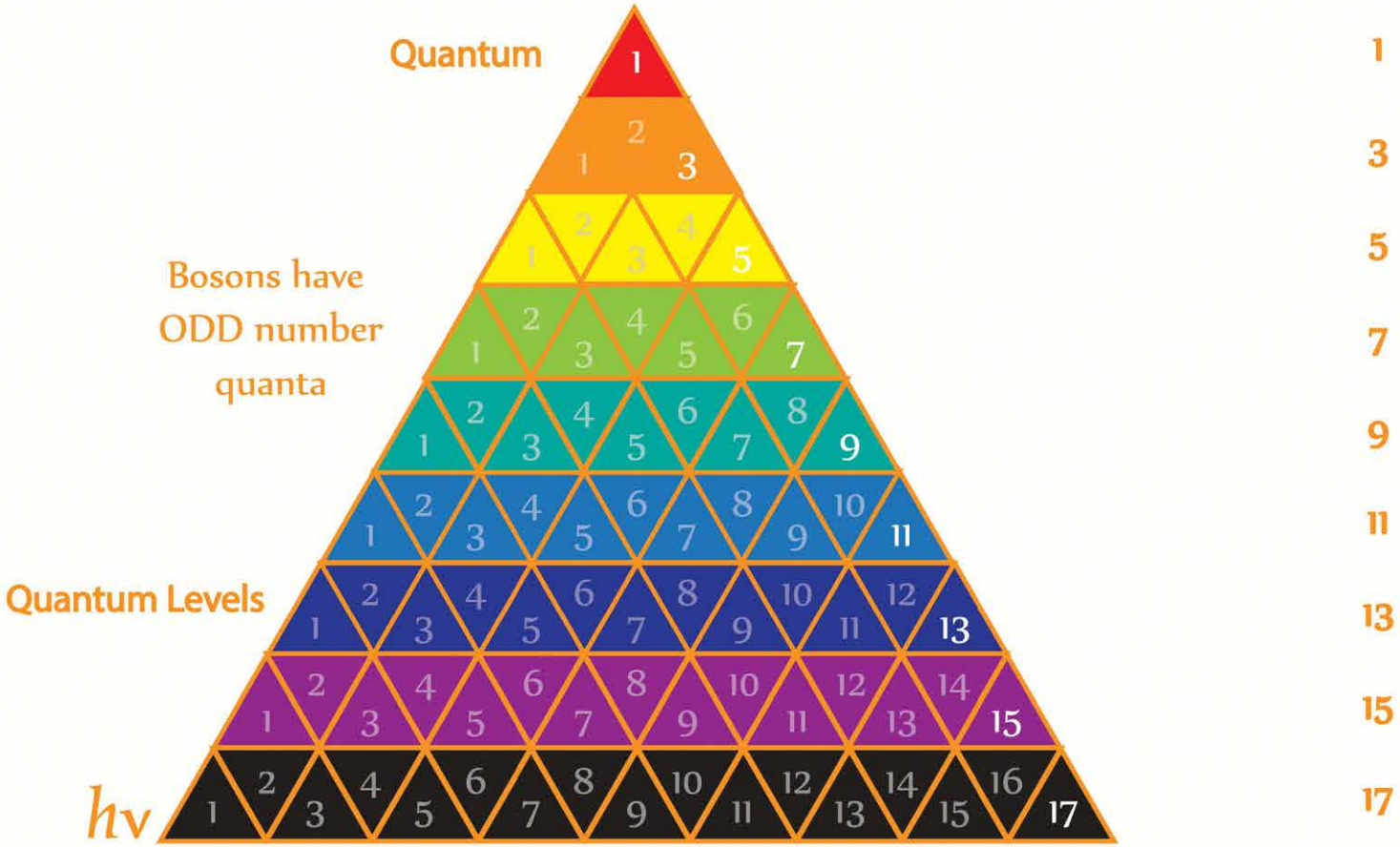

An odd number, when divided by two, will result in a fraction

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Tau radians

Around the whole outside of a circle,
there are about 6.283 radians - or, Tau radians

3.141592654

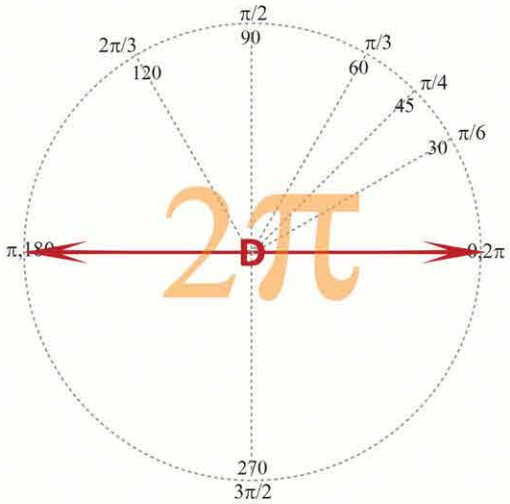

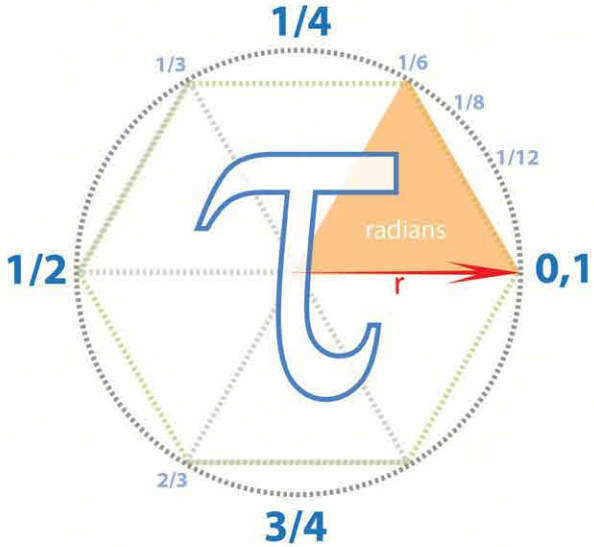

6.283185307

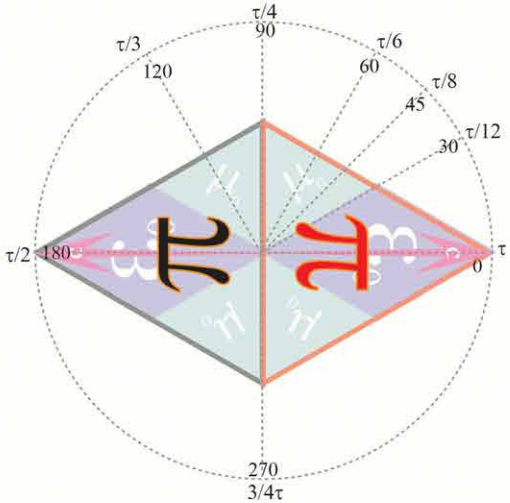

τ is a more 'natural' radian system for geometric physics than π
Tau = 2π = 360 degree rotation about a point

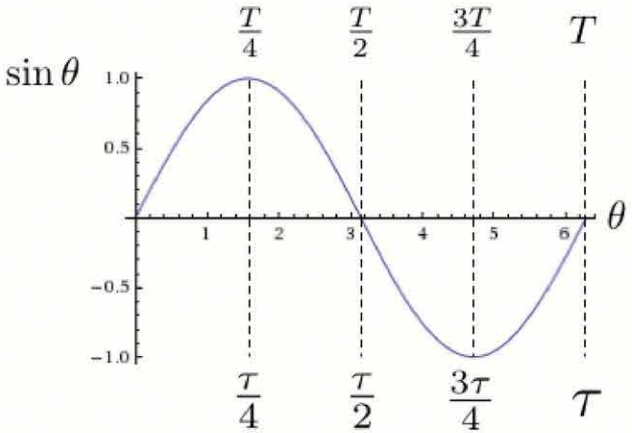

π
historically defined as the
ratio of a circle's circumference to its DIAMETER
should be redefined in physics to

τ
the ratio of its circumference to its RADIUS

in doing so many of the π/2 terms common to physics
will re automatically rationalised and will better reflect
the Tetryonic geometry of mass-ENERGY-Matter in motion

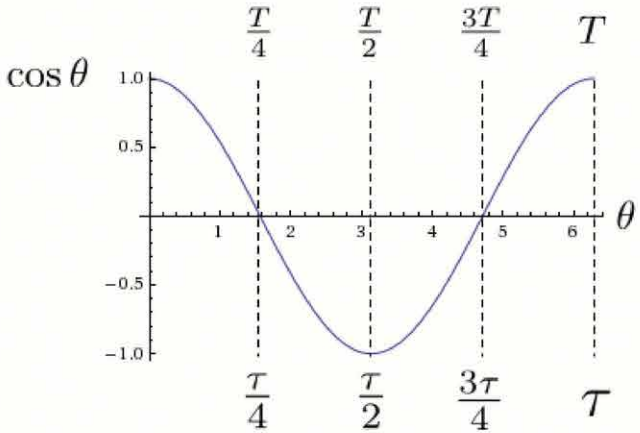

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Photons are a longitudinal measure of scalar energy momenta

Photons are EVEN number quantums

EVEN numbers

An integer that is not an odd number is an even number

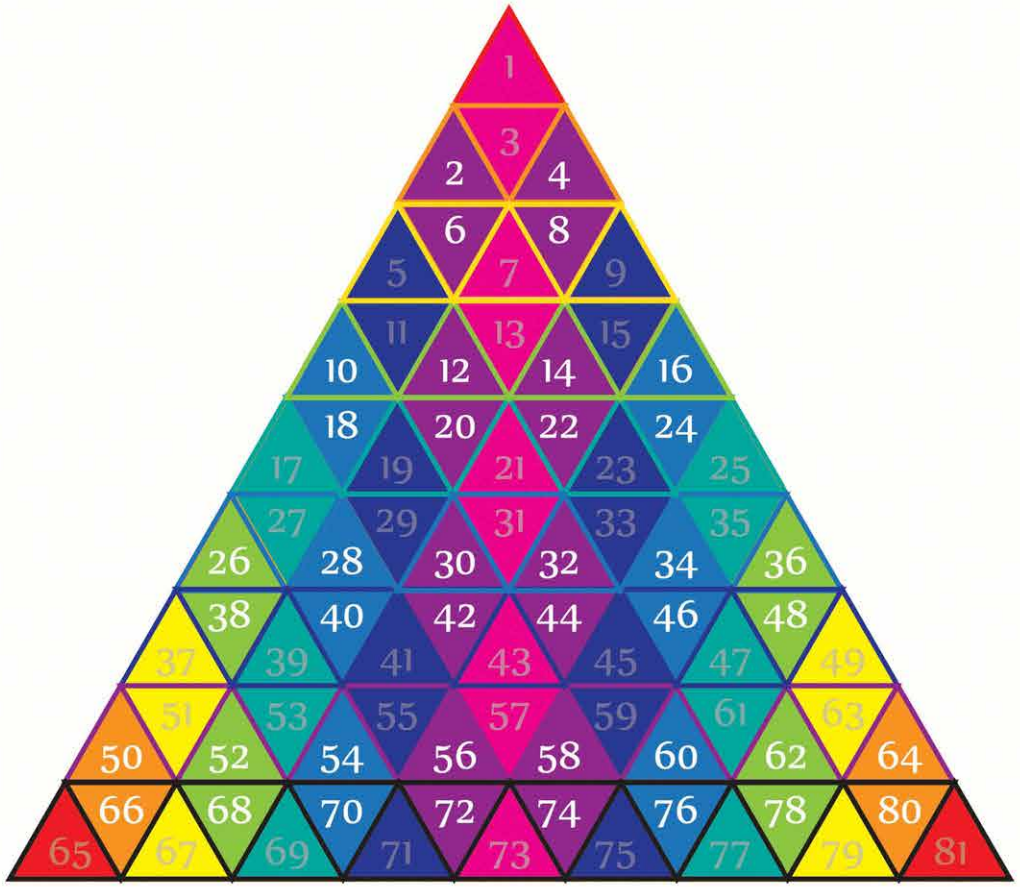

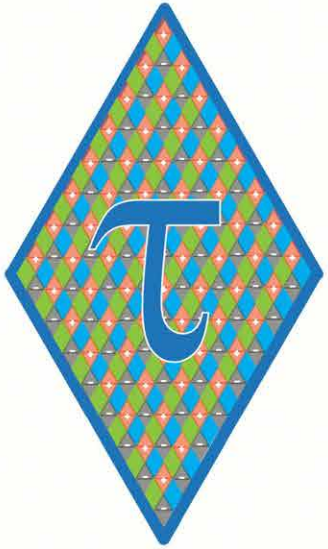

EM waves are comprised of EVEN numbered quanta

If an even number is divided by two, the result is another whole number

1/2 1 3/2 2 5/2 3 7/2 4 9/2 4 7/2 3 5/2 2 3/2 1 1/2

If an odd number is divided by two, the result is a fractional number

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Triangular numbers

Historically, a triangular number counts quanta that can pack together to form an equilateral triangle

1, 3, 6, 10, 15, 21, 28, 36, 45, 55, ...

this form of geometric counting of same charges over-complicated the simpler physical reality

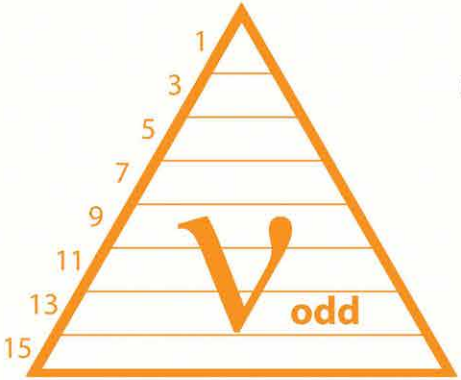

$$2\nu - 1$$

$$[[\nu] + [\nu-1]]$$

Equilateral chords or quantum levels are ODD numbers

1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21,....

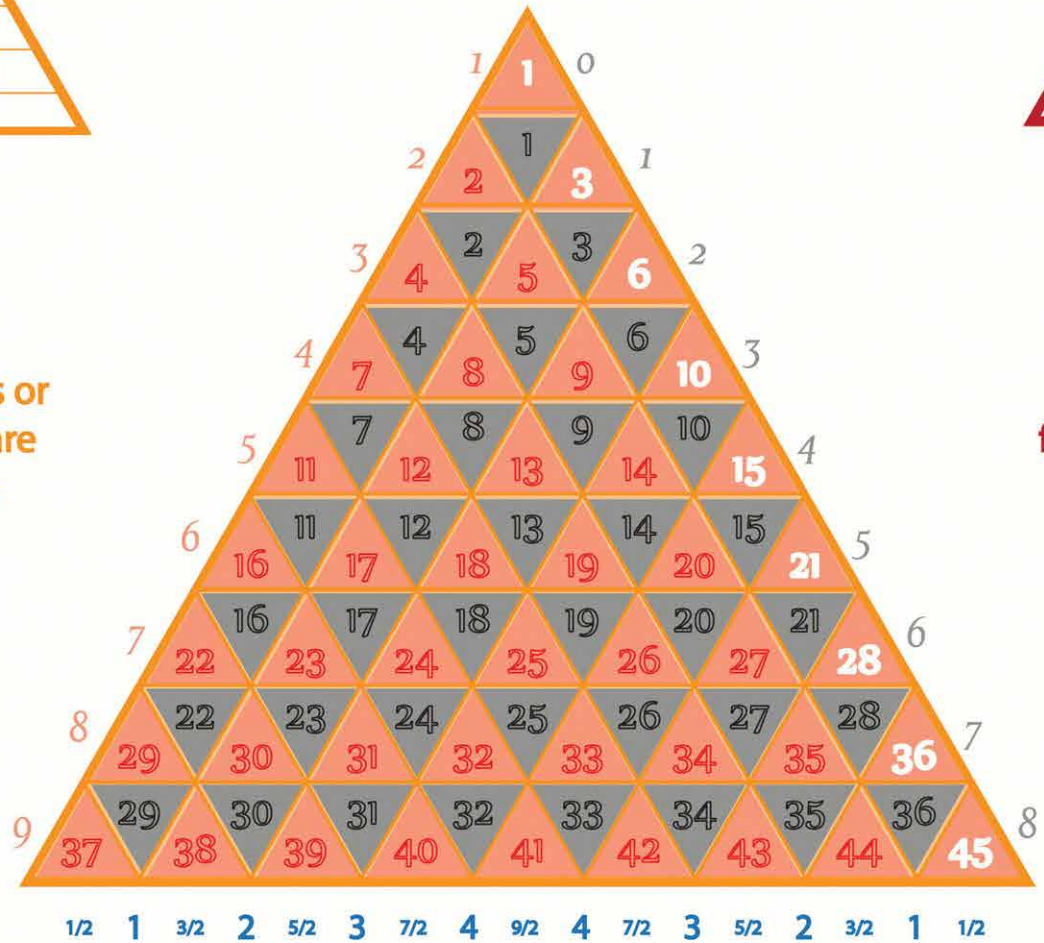

Triangular energy quanta form normal distributions

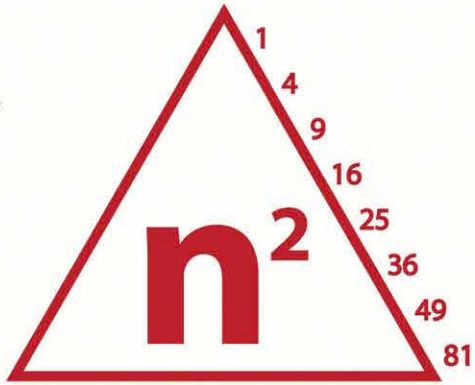

$$\sum_{1}^{n} [2n-1]$$

Equilateral geometries form SQUARE numbered geometries

1, 4, 9, 16, 25, 49, 64, 81, 100, 121, 144, ...

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Squared numbers

A square number, sometimes also called a perfect square,
is the result of an integer multiplied by itself

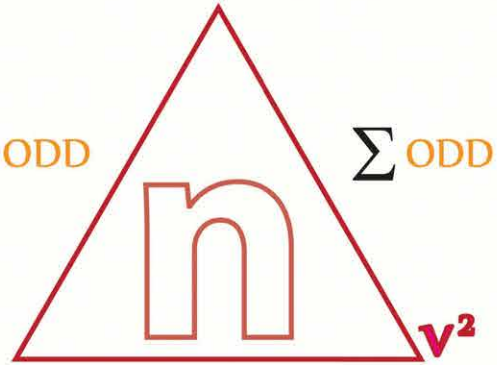

1 + 3 + 5 + 7 + 9 + 11 + 13 + 15 + 17

Square numbers result from the summing of consecutive ODD numbers

ODDS

2n-1

[[n] + [n-1]]

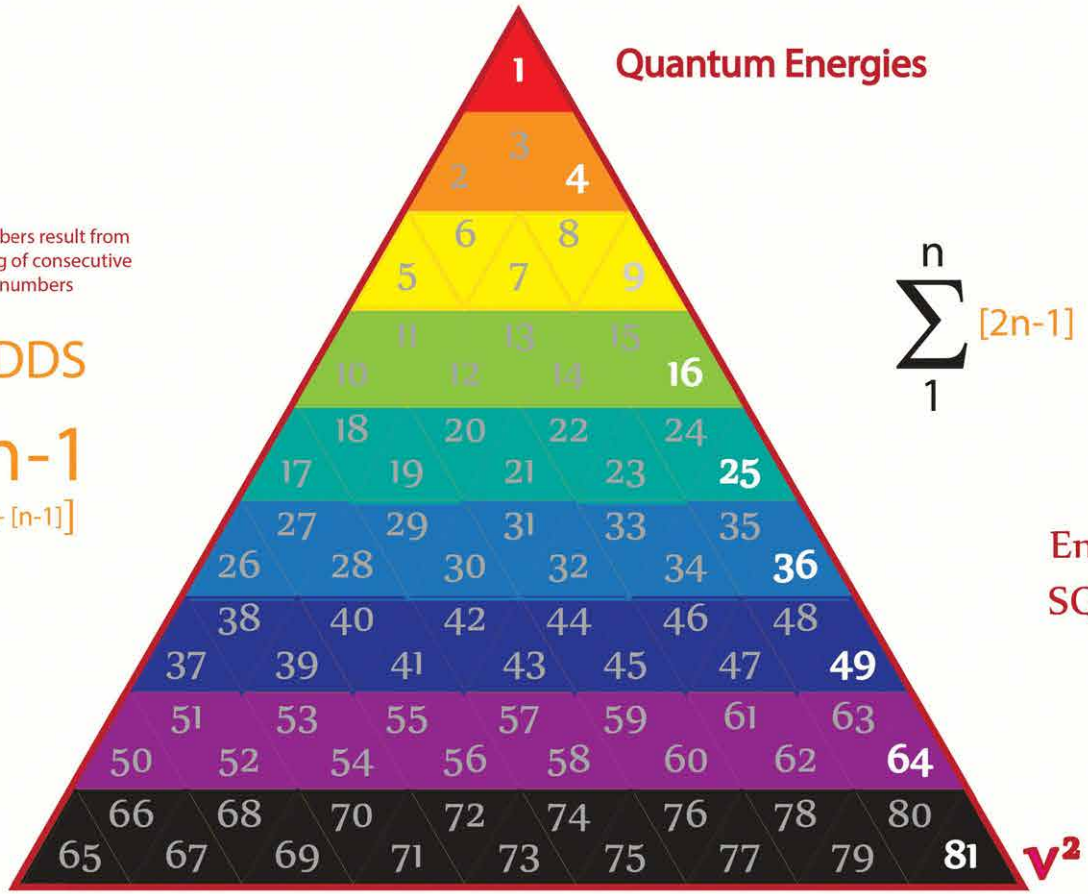

$$\sum_{1}^{n} [2n-1]$$

Energy levels have SQUARE number quanta

Compton Frequency

In Tetryonics Square numbers produce equilateral geometries

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Square roots

A square root of a number is a number that, when it is multiplied by itself (squared) , gives the first number again.

1
[1-0]

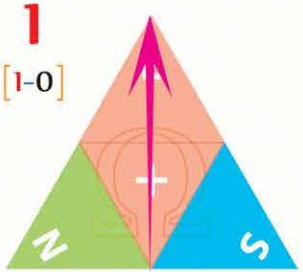

Root of positive one

$-i$ and $+i$

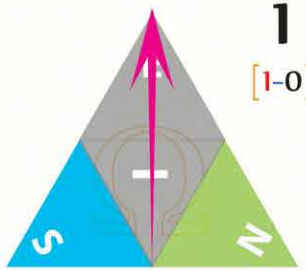

1
[1-0]

Root of negative one

Square roots of negative numbers have a basis in physical reality

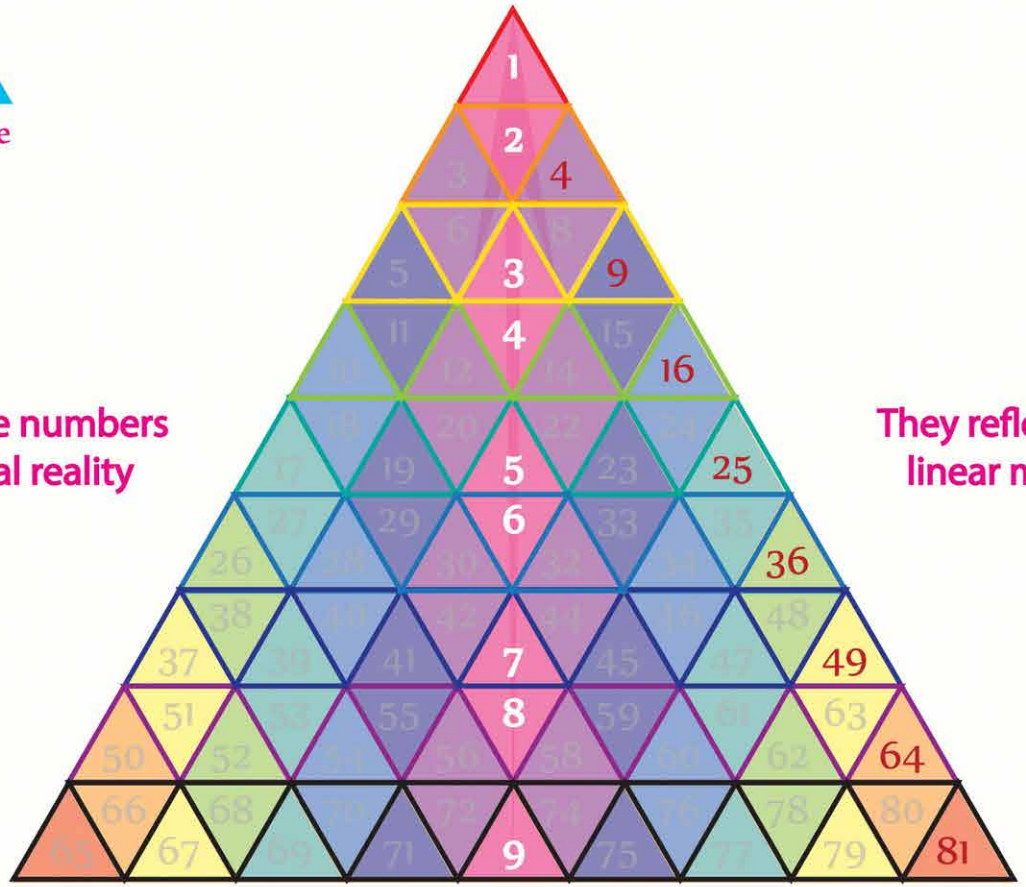

They reflect the real non-negative linear momentum of a system

A whole number with a square root that is also a whole number is called a perfect square in Tetryonic theory they are actually equilateral geometries

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Real Numbers

In mathematics, a real number is a value that represents a quantity along a continuous line. The real numbers include all the rational numbers,

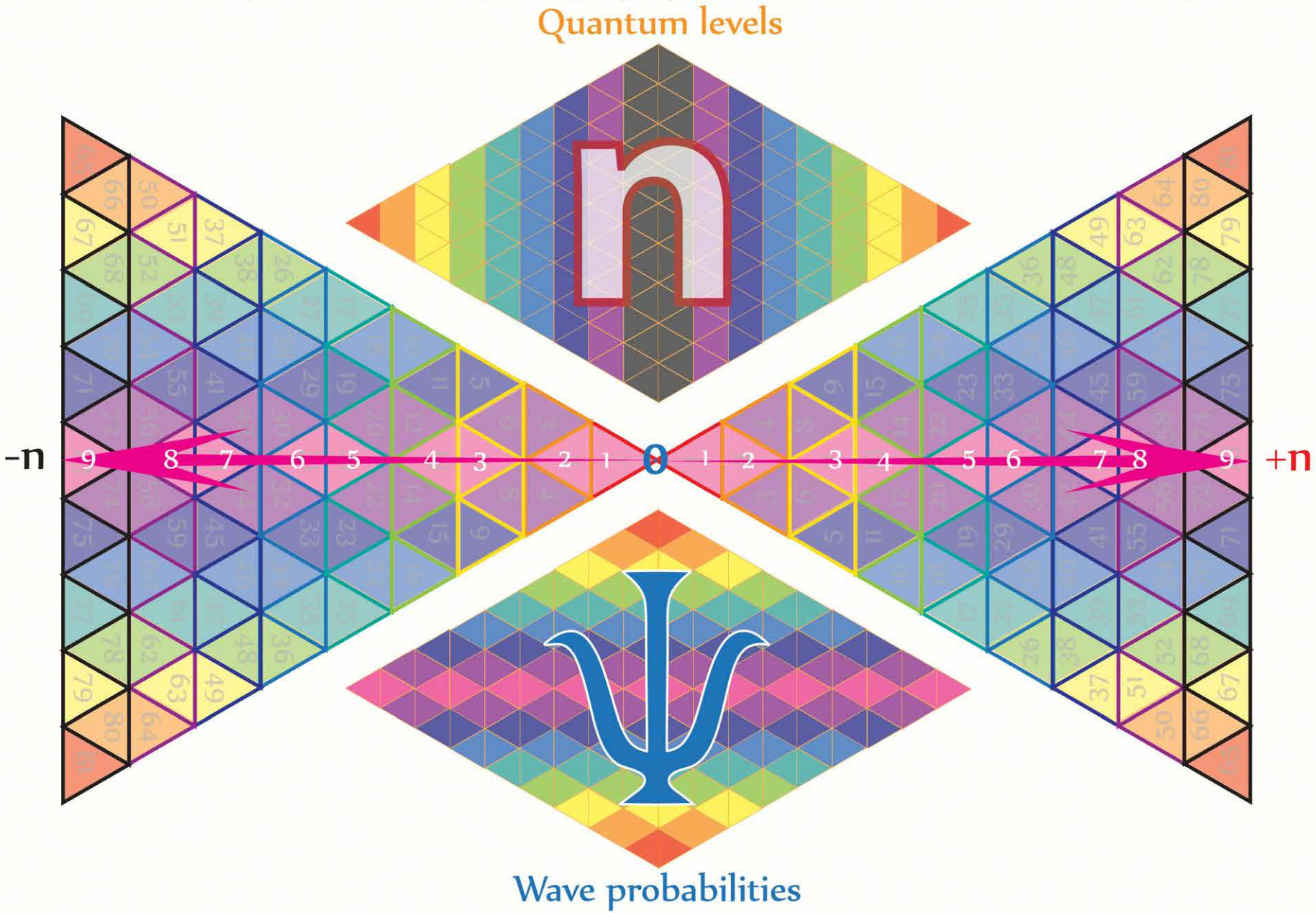

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ONE to ∞^2

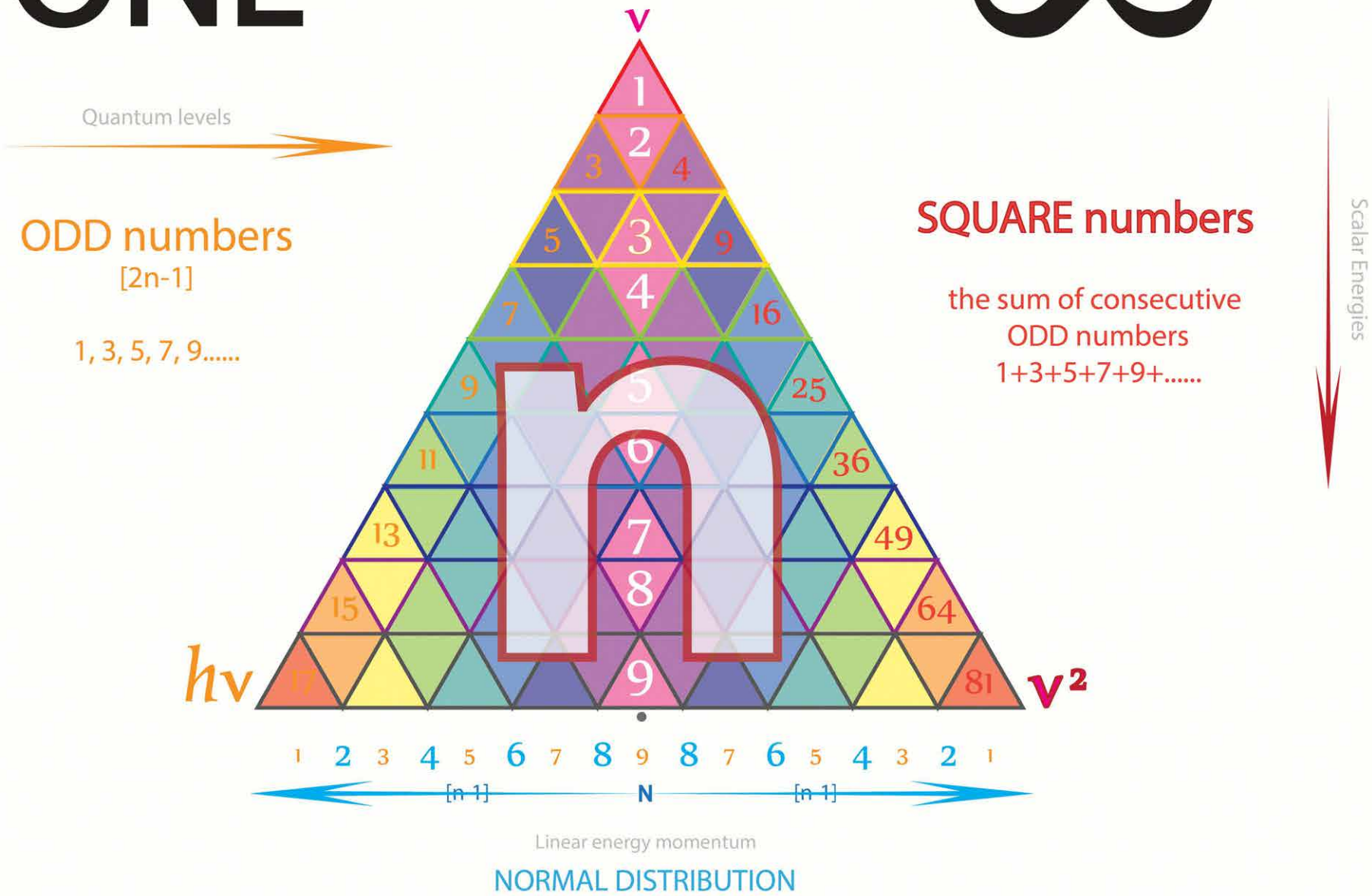

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Basic Properties of nested scribed Equilateral Triangles

Given an equilateral triangle of side s

altitude

$\sqrt{3/2}\,S$

$3S$

perimeter

$\sqrt{3/4}\,S^2$

area

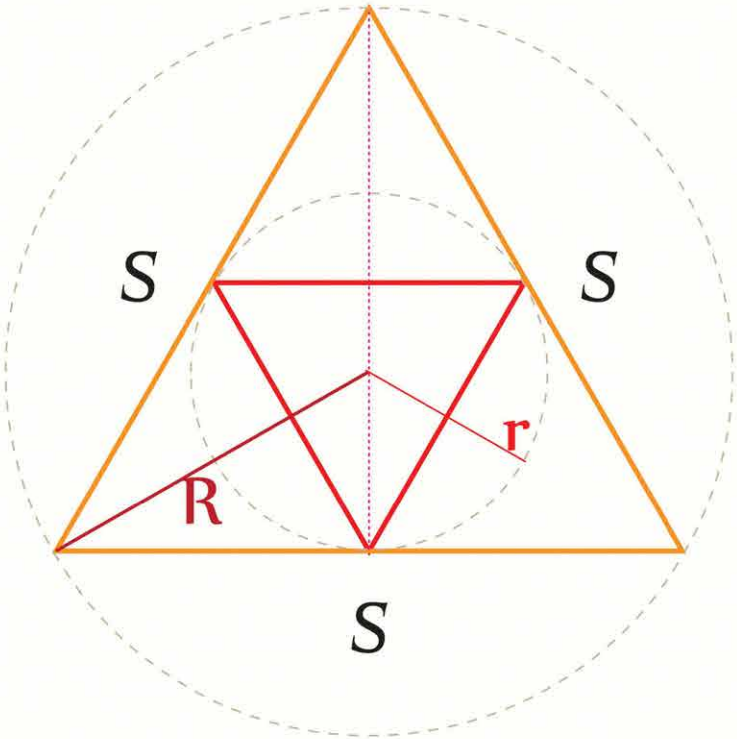

$\sqrt{3/6}\,S$

in-radius

$\sqrt{\pi/12}\,S^2$

in-circle area

circum-radius

$\sqrt{3/3}\,S$

circum-circle area

$\sqrt{\pi/3}\,S^2$

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Tetryonic [equilateral] geometry

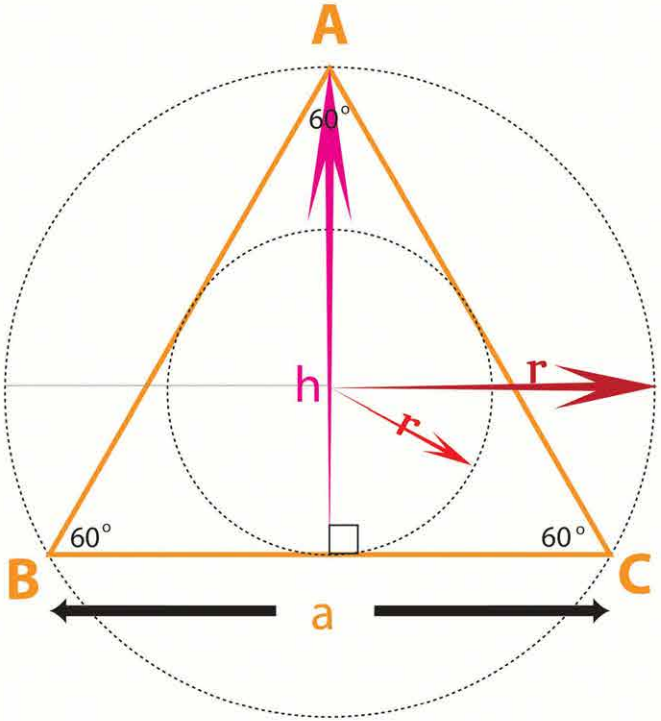

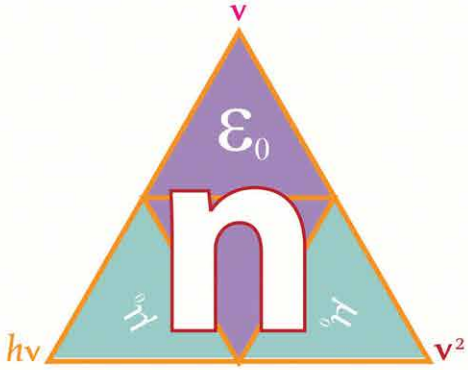

The equilateral triangle exhibits 'square symmetry'
it can always be divided into n^2 [number]
of smaller self-similar parts

All triangles are flat euclidean π radian geometries [180°]

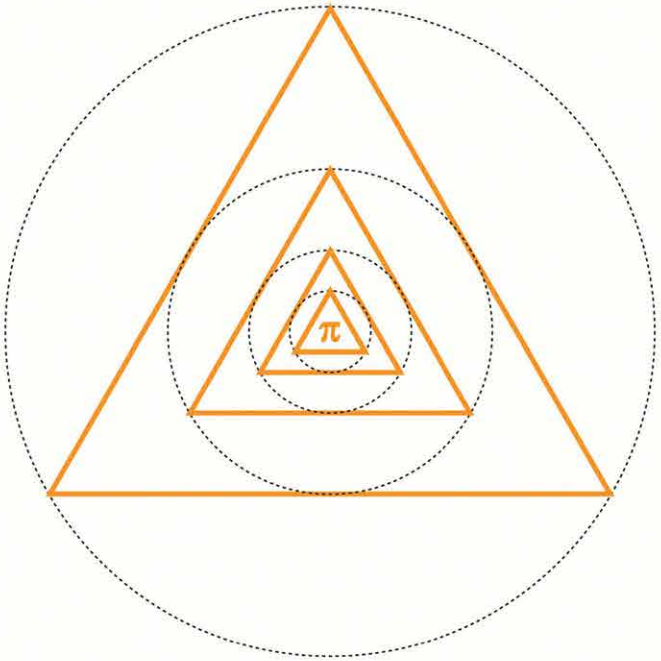

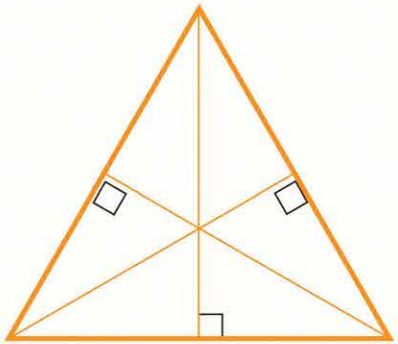

An equilateral triangle is the most symmetrical triangle,
having 3 lines of reflection and rotational symmetry of order 3 about its center

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CHARGE

Scribed equilateral geometries

reflect space-time's geometric relationship with charged mass-energy

Energy

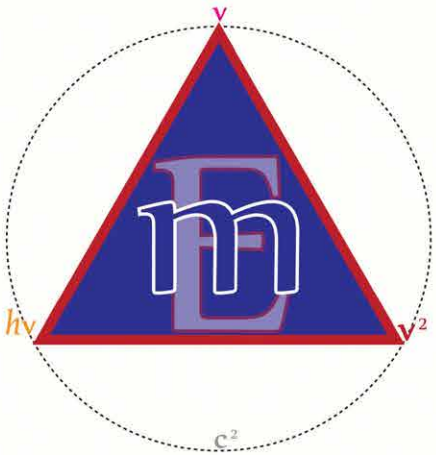

QAM

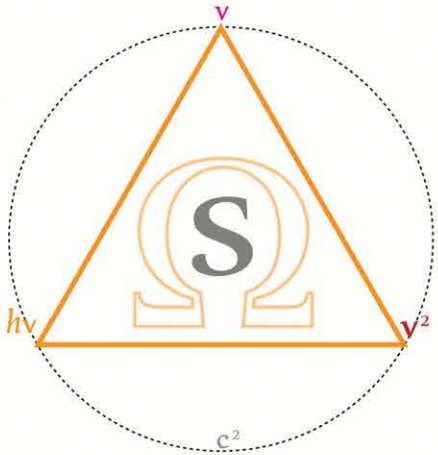

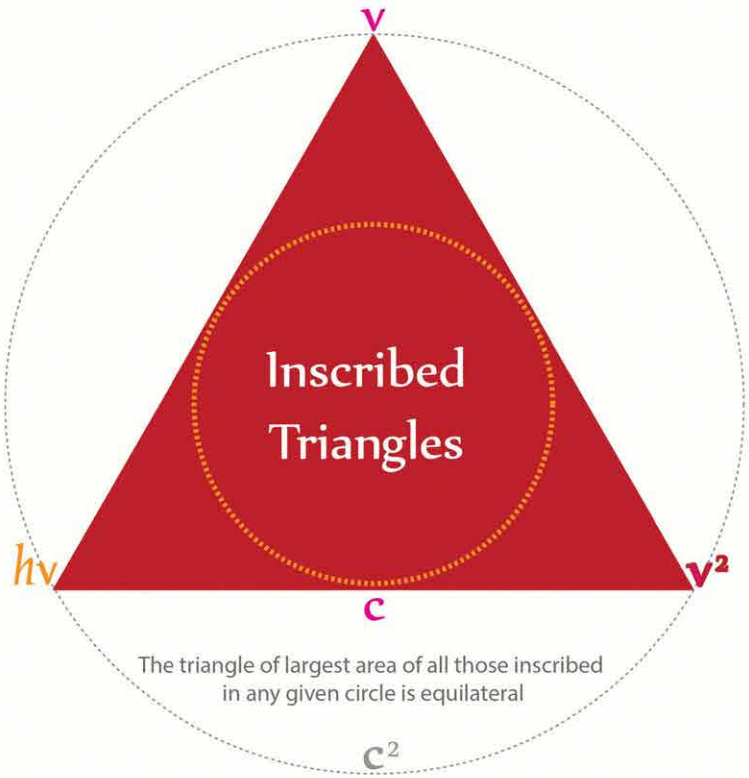

Energy per spatial unit

mass

QAM per spatial unit

seconds

$$m = \frac{E}{c^2}$$

$$\frac{\Omega}{c^2} = s$$

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Circumscribed Triangles

reflect Energy's relationship with Time

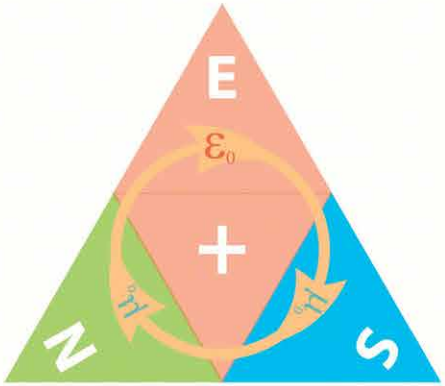

Positive Planck Charge

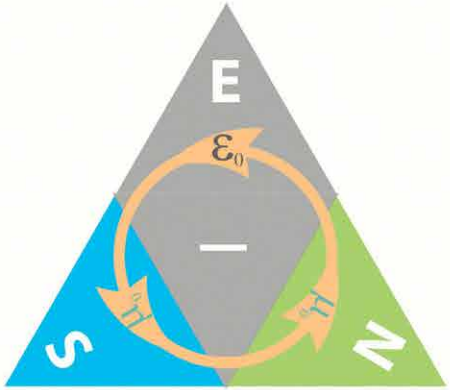

Negative Planck Charge

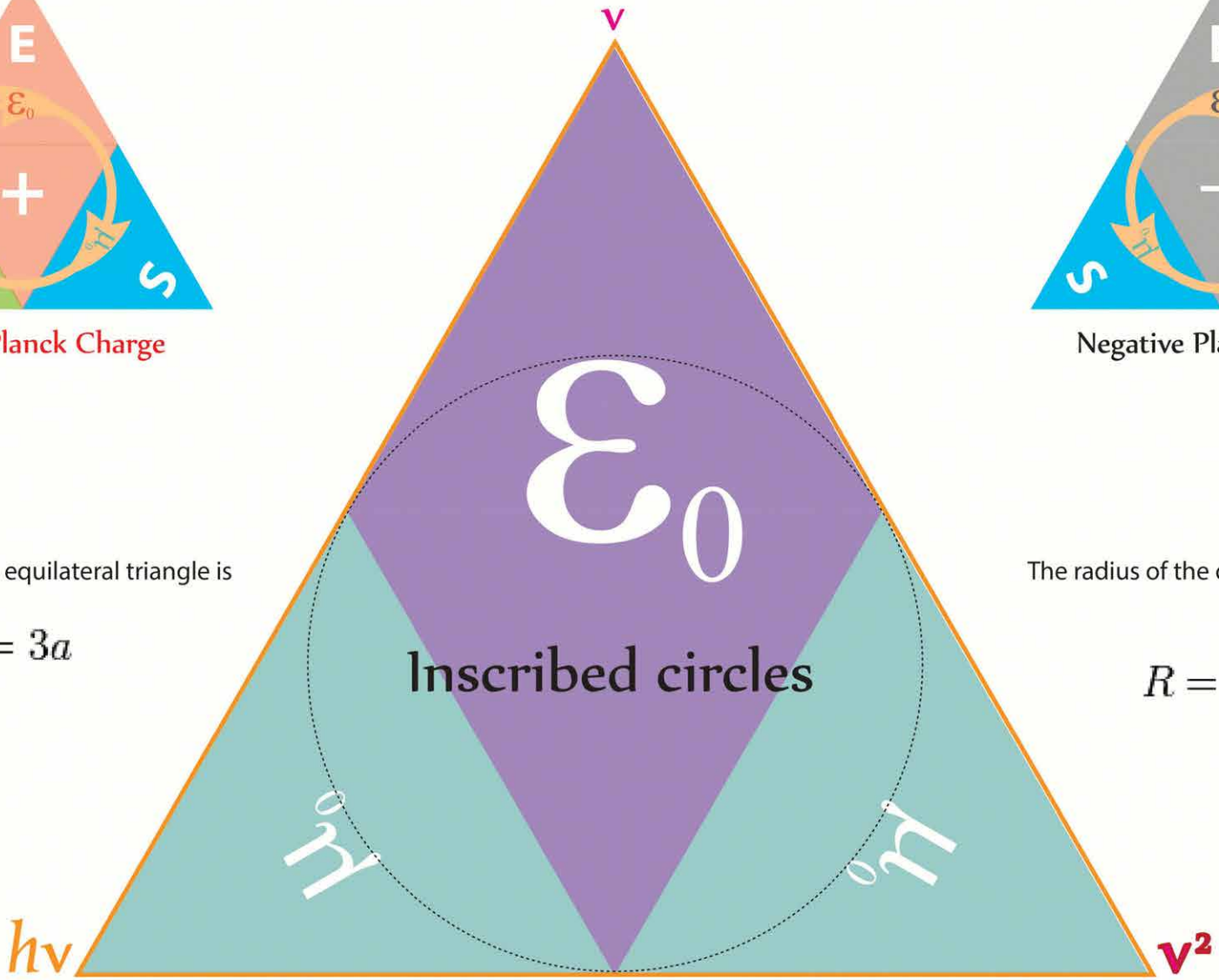

The perimiter of an equilateral triangle is

$$p = 3a$$

The radius of the circumscribed circle is

$$R = \frac{\sqrt{3}}{3}a$$

The equilateral triangle has the smallest area of all those circumscribed around a given circle

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Circumscribed circles

By Euler's inequality, the equilateral triangle has the smallest ratio R/r of the circumradius to the inradius of any triangle: specifically, R/r = 2

The ratio of the area to the square of the perimeter of an equilateral triangle

$$\frac{1}{12\sqrt{3}}$$

The ratio of the area of the incircle to the area of an equilateral triangle

$$\frac{\pi}{3\sqrt{3}}$$

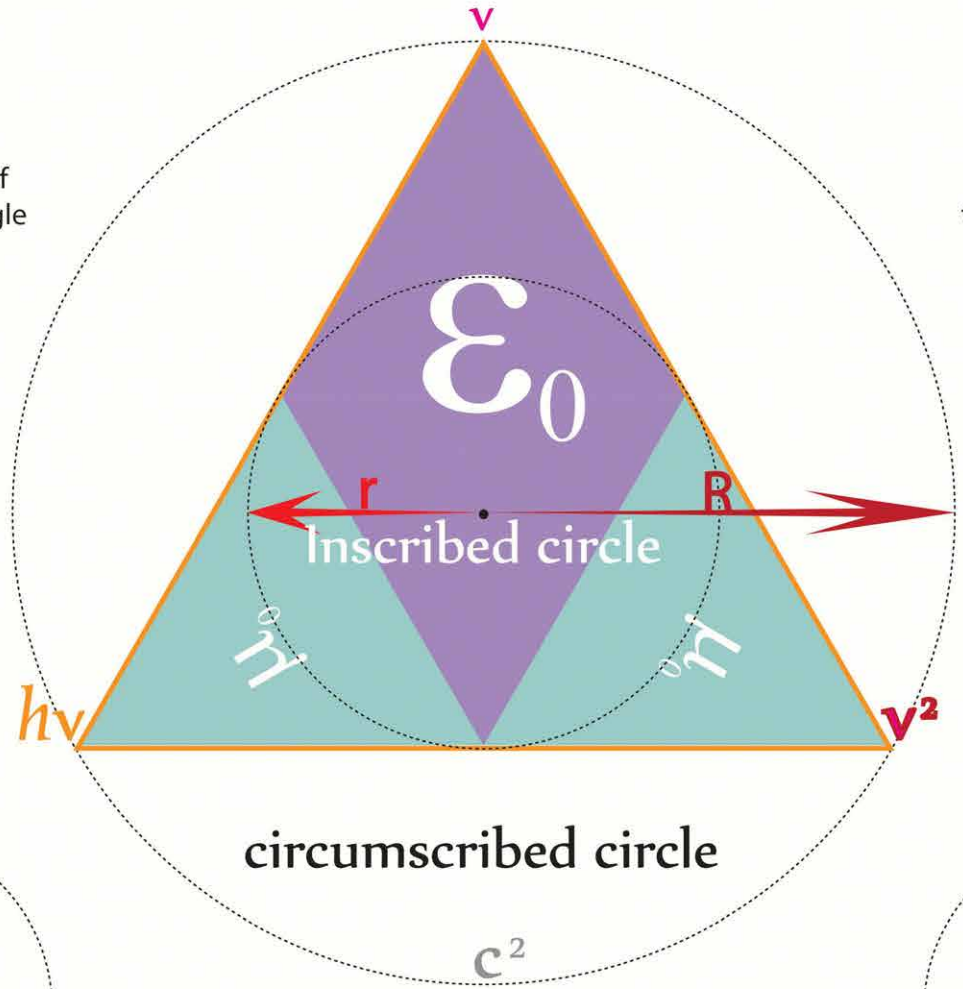

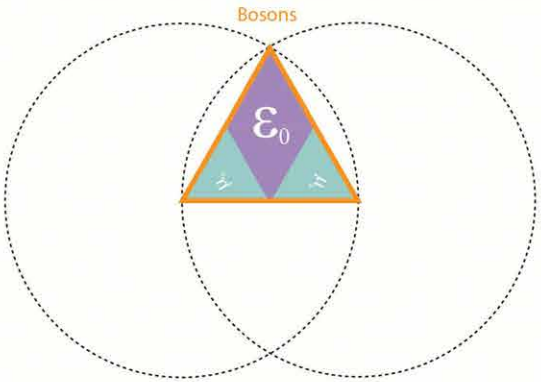

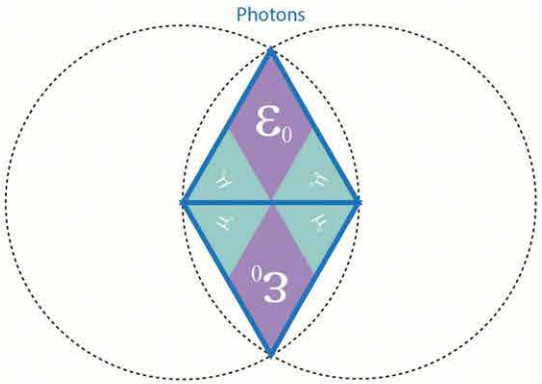

Equilateral triangles and Tetrahedrons will scale at exactly the same proportion as Circles and Spheres scribing them

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Charged mass-ENERGIES

Charge is the result of quantised angular momenta
[the inscribed circular flux of energy in equilateral geometries]

Time is a measure of changing quantised angular momenta
[the circumscribed spatial co-ordinate of equilateral energy geometries]

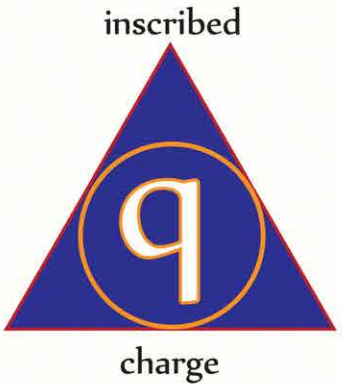

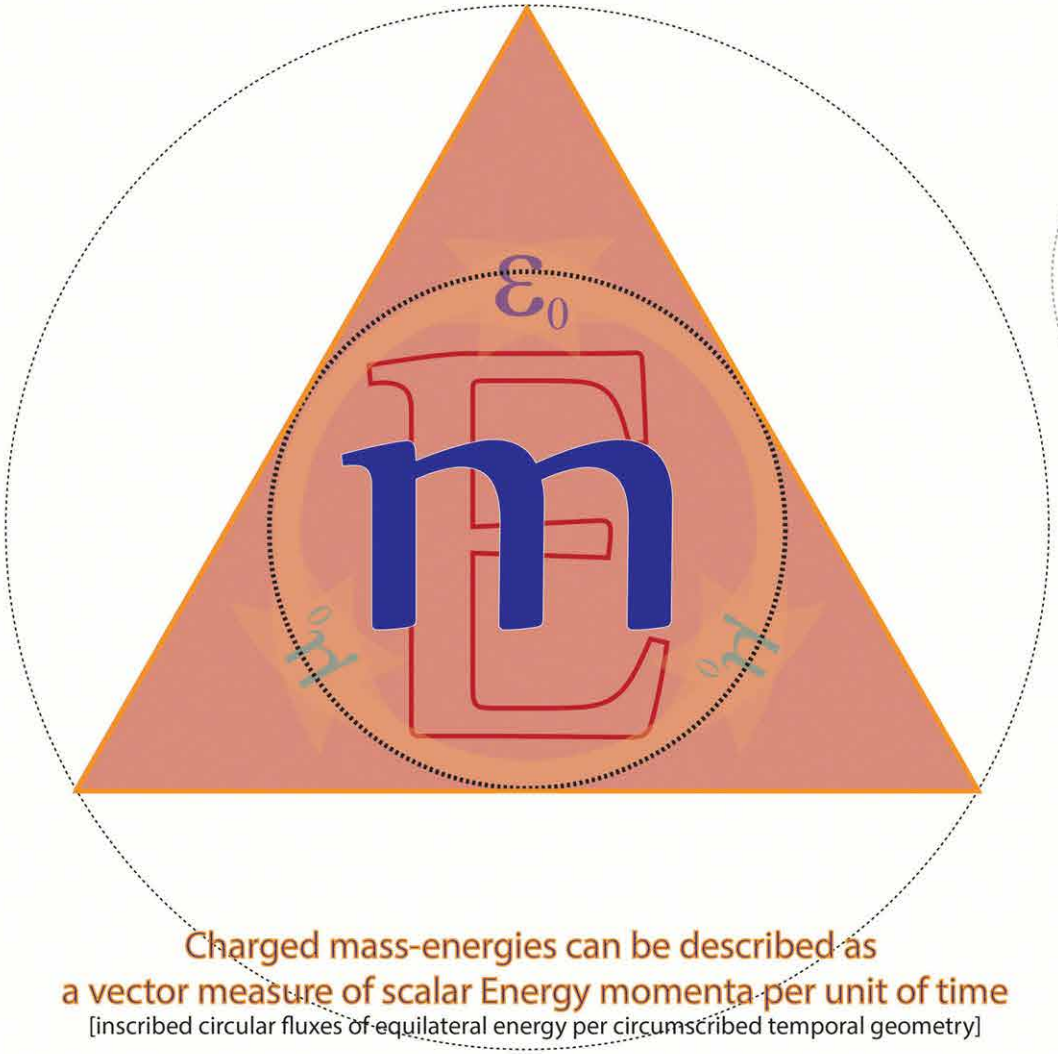

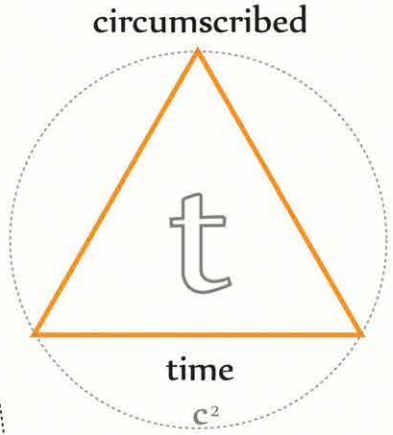

It is the equilateral geometry of energy not a classical vector rotation that creates QAM

Scalar EM mass is a measure of equilateral Planck energy per spatial co-ordinate system

m

Charged mass-energies can be described as a vector measure of scalar Energy momenta per unit of time
[inscribed circular fluxes of equilateral energy per circumscribed temporal geometry]

E

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Trigometric functions

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

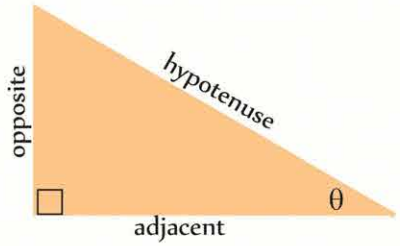

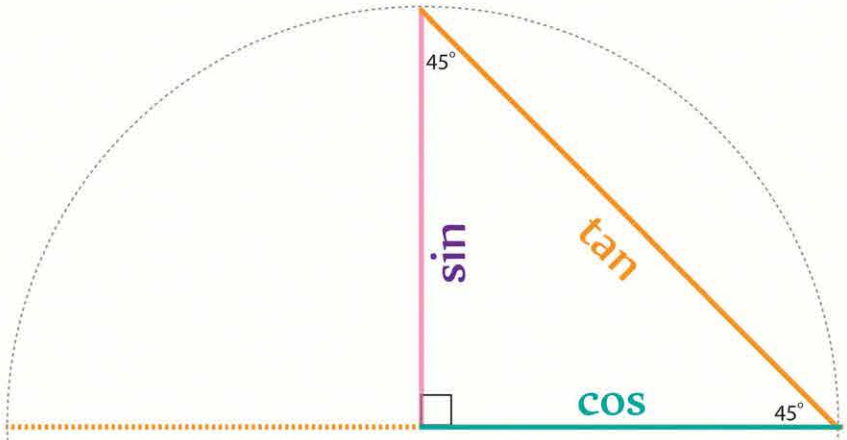

The most familiar trigonometric functions are the sine, cosine, and tangent.

In the context of the standard unit circle with radius 1,
where a triangle is formed by a ray originating at the origin and
making some angle with the x-axis,

the SINE of the angle gives the length of the y-component (rise) of the triangle,
the COSINE gives the length of the x-component (run), and
the TANGENT function gives the slope
(y-component divided by the x-component)

Standard trigometric functions must be carefully applied to
measurements of equilateral Planck mass-energy geometries
in scribed circular space-time co-ordinate systems

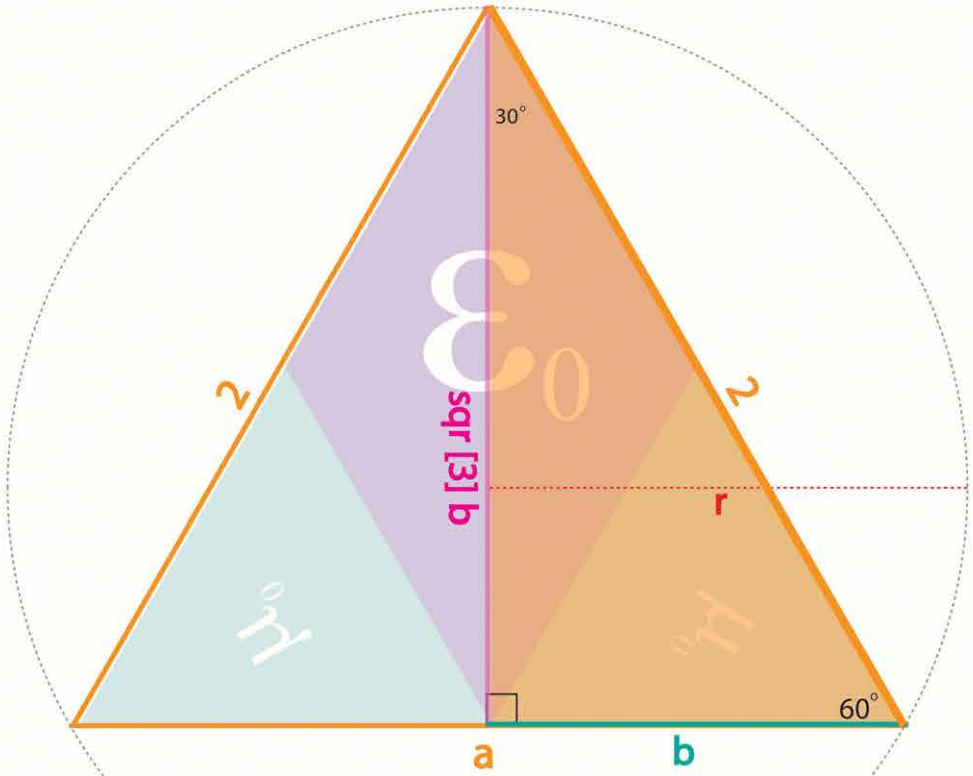

In most cases it is in fact easier to
ignore the trigonomteric functions and math
and simpy draw their related equilateral geometries

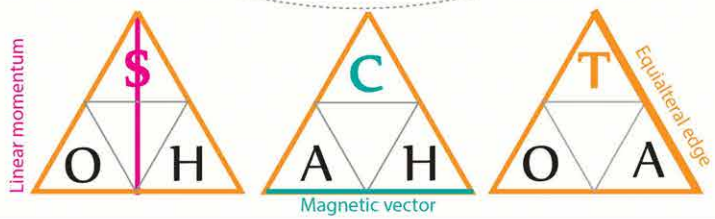

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The roots of scribed equilateral triangles

Scalar equilateral energies map directly onto circular space-time co-ordinates
through their square root linear momentum

r

The ratio of the
circumscribed circle of
an equilateral triangle
to its inscribed circle
is 2:1

d

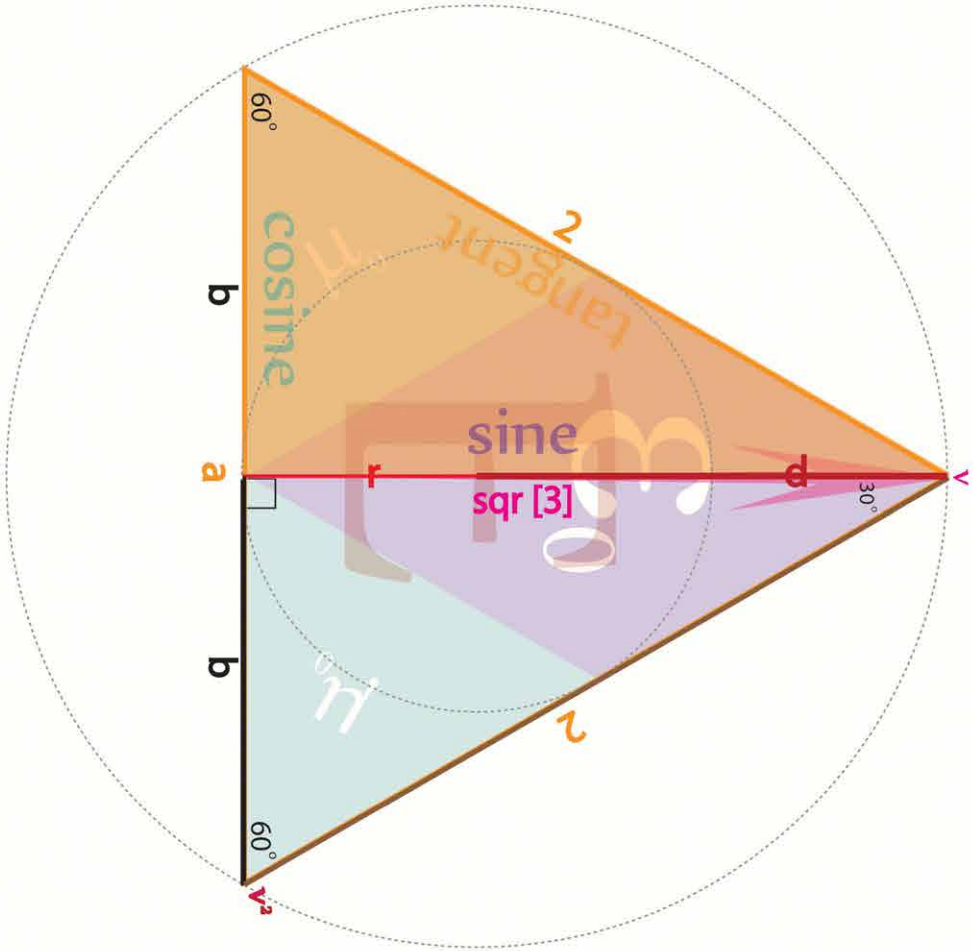

0.866 r

The ratio of the
side of an equilateral triangle
to the radius of
its incribed circle
is sqr [3]/2

a

The ratio of the
side of an equilateral triangle
to the radius of
its circumscribed circle
is sqr [3]

1.732 d

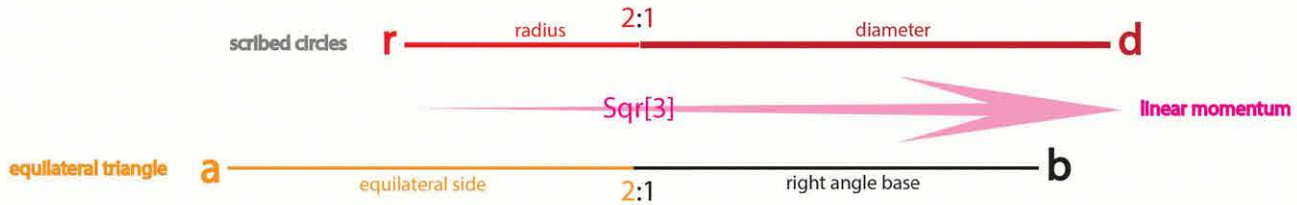

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Equilateral triangles and scribed circles

$$\gamma = \frac{1}{\sqrt{1 - v^2/c^2}} = \frac{1}{\sqrt{1-\beta^2}} = \frac{\mathrm{d}t}{\mathrm{d}\tau}$$

$$\gamma(\beta) = 1 + \frac{1}{2}\beta^2 + \frac{3}{8}\beta^4 + \frac{5}{16}\beta^6 + \frac{35}{128}\beta^8 + \ldots$$

$$L = L'\sqrt{1 - \frac{v^2}{c^2}}$$

$$E_k = \frac{mc^2}{\sqrt{1-(v/c)^2}} - mc^2$$

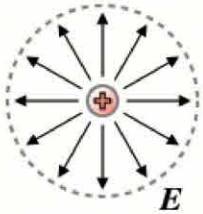

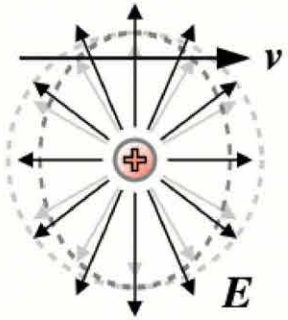

$$mc^2\left\{\frac{1}{\sqrt{1 - v^2/c^2}} - 1\right\}$$

$$p = \frac{m_0 v}{\sqrt{1 - \frac{v^2}{c^2}}} = \gamma m_0 v$$

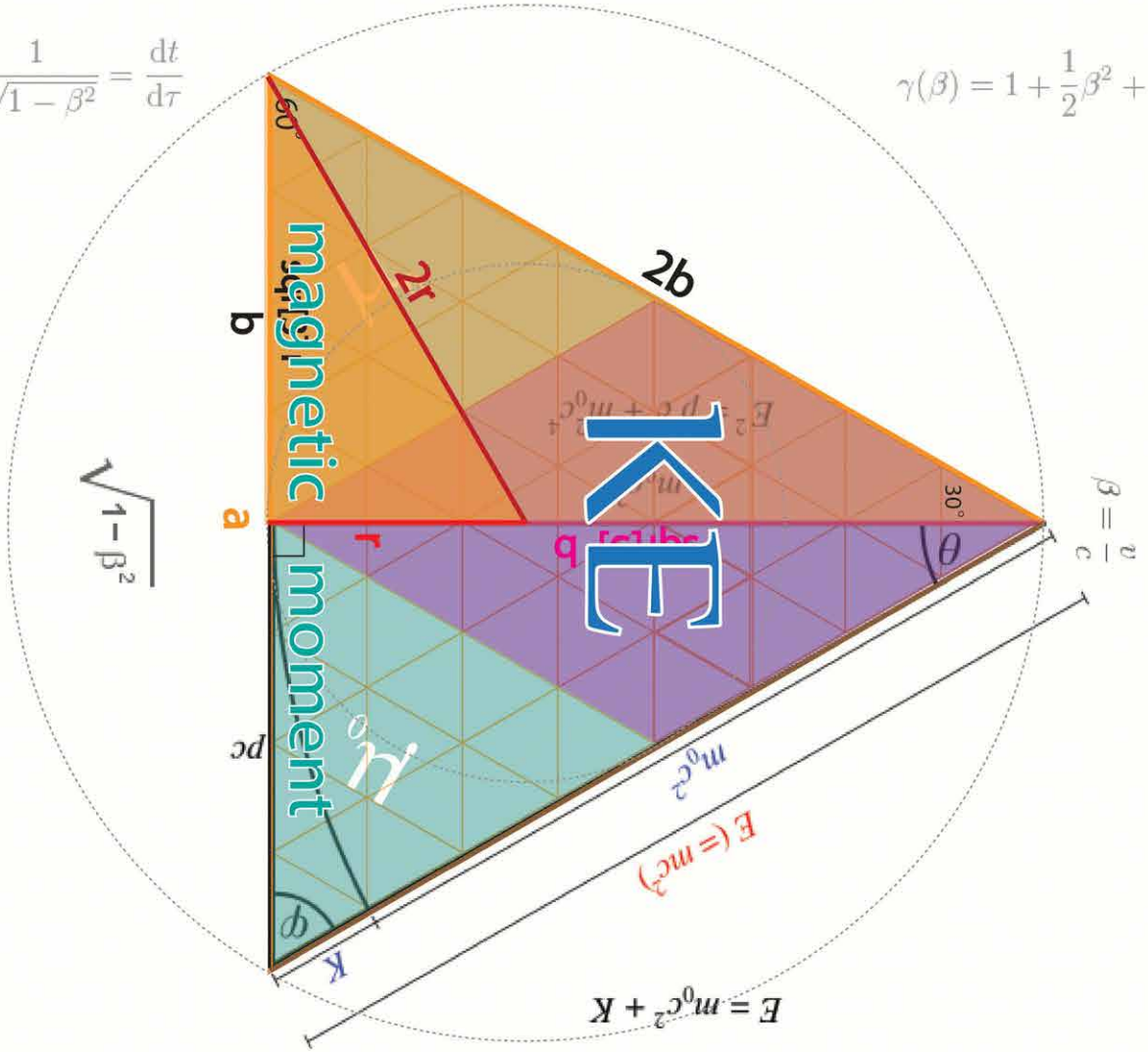

$$E = \frac{mc^2}{\sqrt{1 - \frac{v^2}{c^2}}}$$

All the relativistic relationships historically attributed to circularised energies and modelled through the use of the math of right angled triangles are in fact the result of equilateral, scalar geometries

$$\sqrt{1 - \left(\frac{v}{c}\right)^2}$$

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Finite sequences and series have defined first and last terms,

$$\sum a_n = a_0 + a_1 + a_2$$

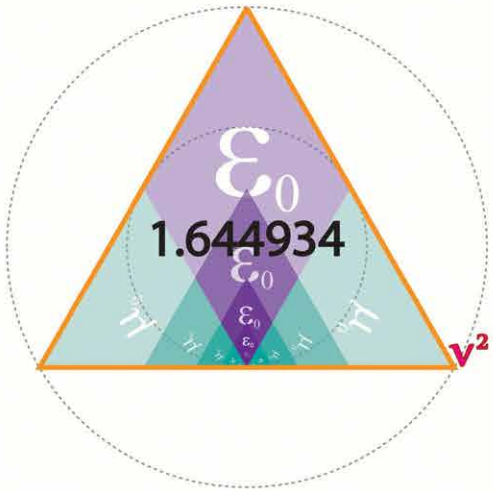

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \lim_{n \to +\infty} \left(\frac{1}{1^2} + \frac{1}{2^2} + \cdots + \frac{1}{n^2} \right).$$

whereas infinite sequences and series continue indefinitely

The Basel problem is a famous problem in mathematical analysis with relevance to number theory, first posed by Pietro Mengoli in 1644 and solved by Leonhard Euler in 1735.

$$\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \frac{1}{5^2} + \ldots = \frac{\pi^2}{6}$$

Tetryonics now provides a geometric solution to visualising and solving the Basel problem

$$\zeta(2) = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \cdots = \frac{\pi^2}{6} \approx 1.645;$$

Tetryonic Infinite Series

is a infinite sequence of square numbers,
the result of adding all those terms together
[or their geometric inverse]

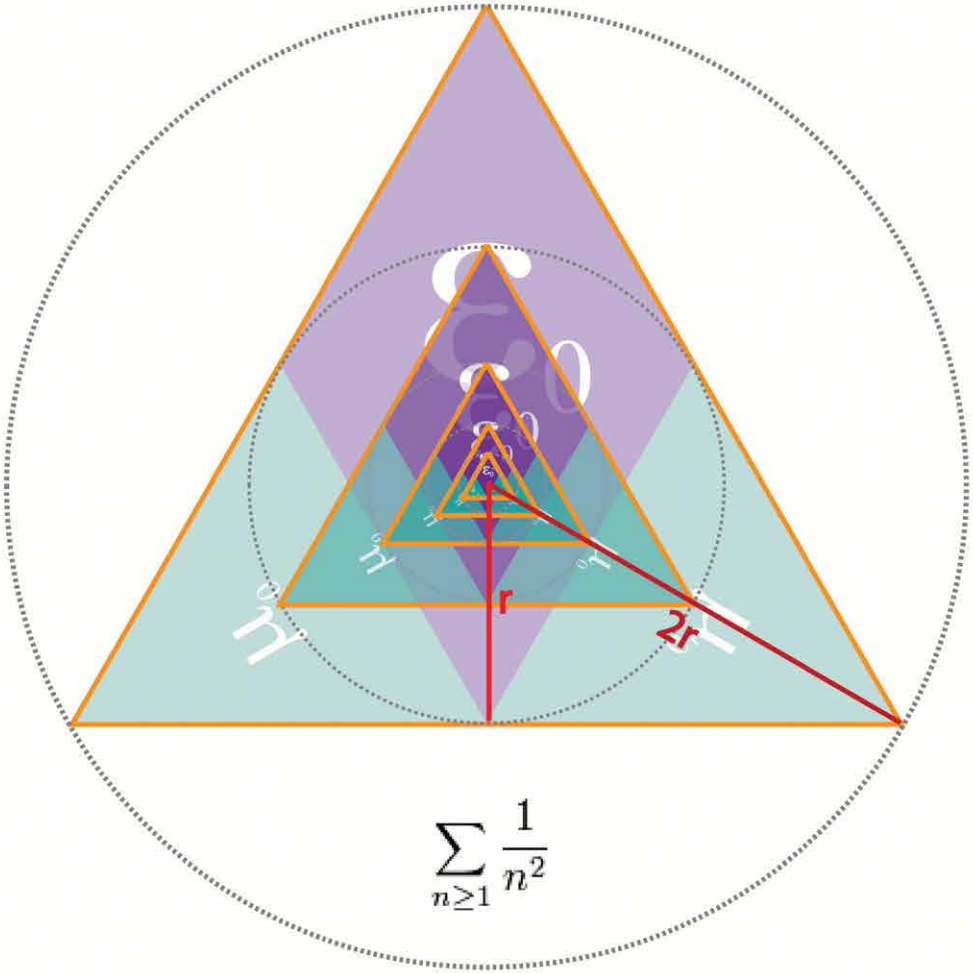

$$\sum_{n \geq 1} \frac{1}{n^2}$$

The entire sum of the series is equal to
twice the size of the radius of the largest inscribed circle
which is equal to the largest circle circumscribing the triangular series.

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Inverting the Circle

Electric Permittivity

ε_o

Magnetic Permeability

μ_o

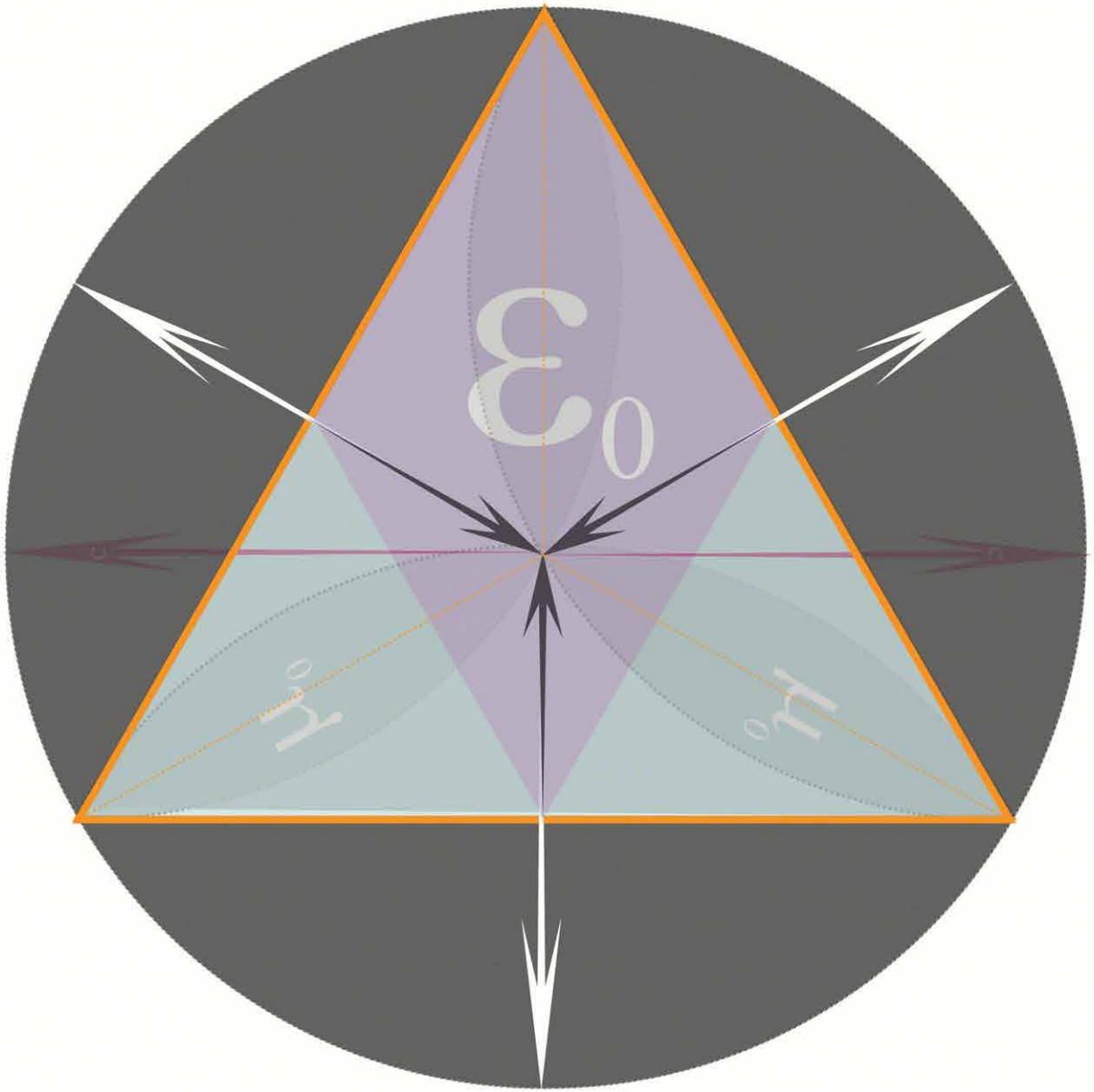

c^2

2D spatial co-ordinates

$\frac{1}{c^2}$

ElectroMagnetic fields

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Irrational numbers

an irrational number cannot be represented as a simple fraction.
Irrational numbers are those real numbers that cannot be represented as terminating or repeating decimals

sin(x)=-square root of (3)/2

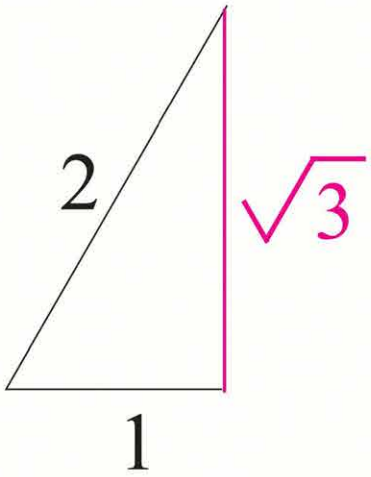

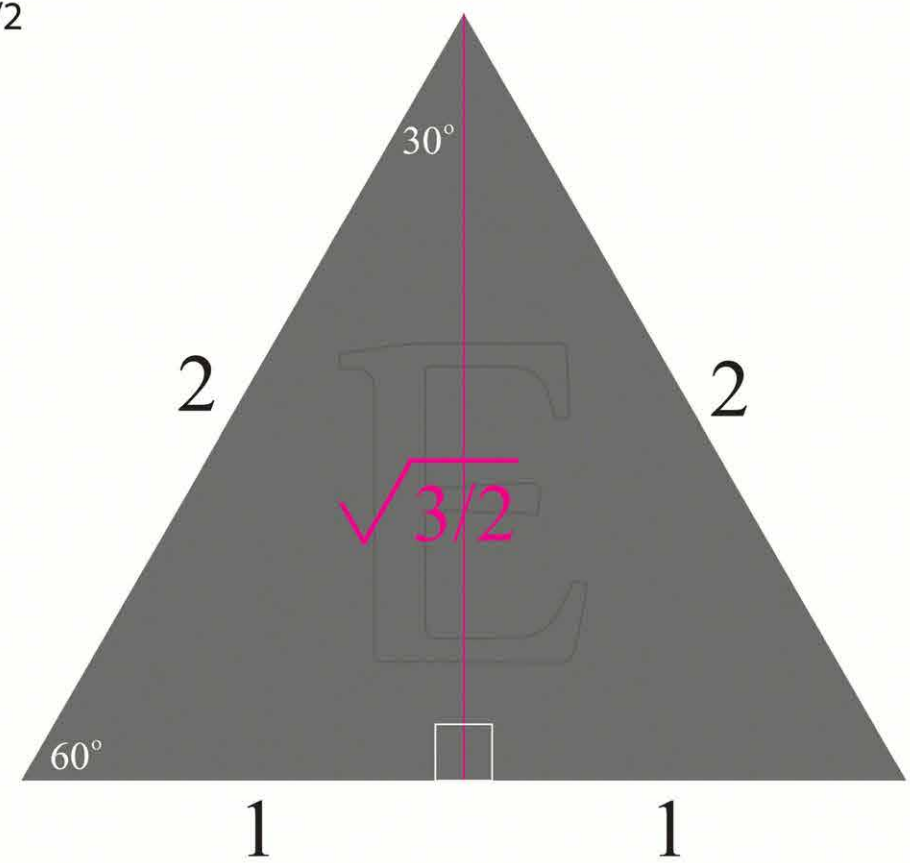

0.866025403.....

Pythagφras' theoreom
and irratiφnal numbers expressed in terms of right-angled triangles in Physics
offer a 'half truth' regarding the equilateral geometry of Energy

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Leibniz

Leibniz introduced the concept of vis viva (living force) which attempted to quantify life force

Newton

Newton focused his work on linear momentum which he developed into his famous laws of motion

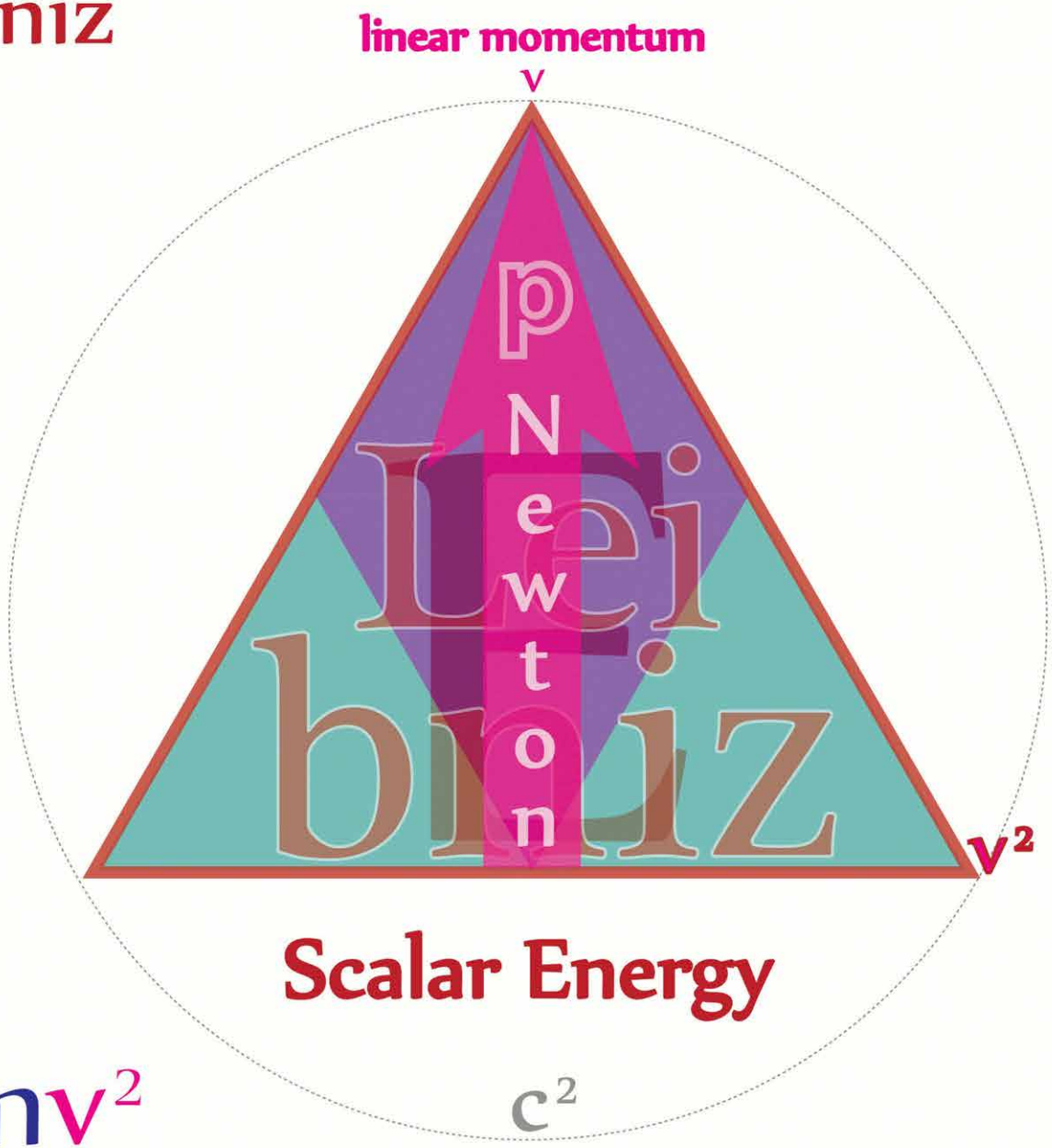

Newton and Leibniz disagreed about what the world is made of and how its physics shaped our scientific concepts of force, energy, and momentum

Tetryonics reveals the physical relationships they both described mathematically as geometric properties of equilateral Planck energy momenta

$E=mv^2$

$p=mv$

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Geometric Square Roots

In geometrical terms, the square root function maps the area of a square to its side length.

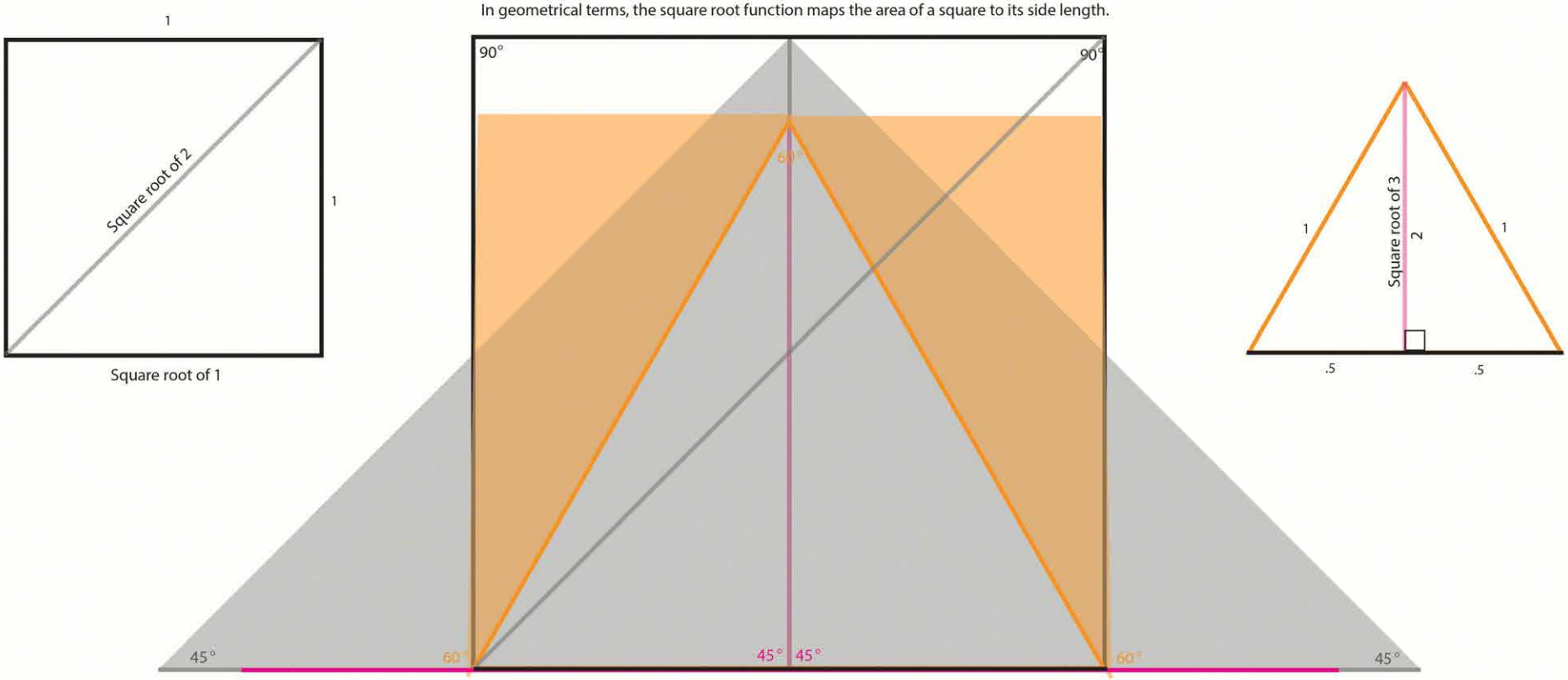

"In mathematics, as in any scientific research, we find two tendencies present. On the one hand, the tendency toward abstraction seeks to crystallize the logical relations inherent in the maze of material that is being studied, and to correlate the material in a systematic and orderly manner. On the other hand, the tendency toward intuitive understanding fosters a more immediate grasp of the objects one studies, a live rapport with them, so to speak, which stresses the concrete meaning of their relations"

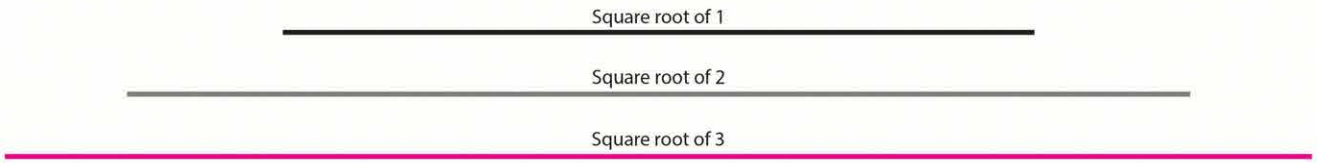

"As to geometry, in particular, the abstract tendency has here led to the magnificent systematic theories of Algebraic Geometry, of Riemannian Geometry, and of Topology; these theories make extensive use of abstract reasoning and symbolic calculation in the sense of algebra.

Notwithstanding this, it is still as true today as it ever was that intuitive understanding plays a major role in geometry. And such concrete intuition is of great value not only for the research worker, but also for anyone who wishes to study and appreciate the results of research in geometry"

David Hilbert [Geometry and the Imagination]

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Square Roots in Physics

In mathematics, a square root of a number a is a number [n] such that [n]2 = x,
or, in other words, a number [n] whose square (the result of multiplying the number by itself, or [n × n]) is x.

Modern calculators use the
Square Root Algorithm
to calculate the value

It is an approximate numerical value

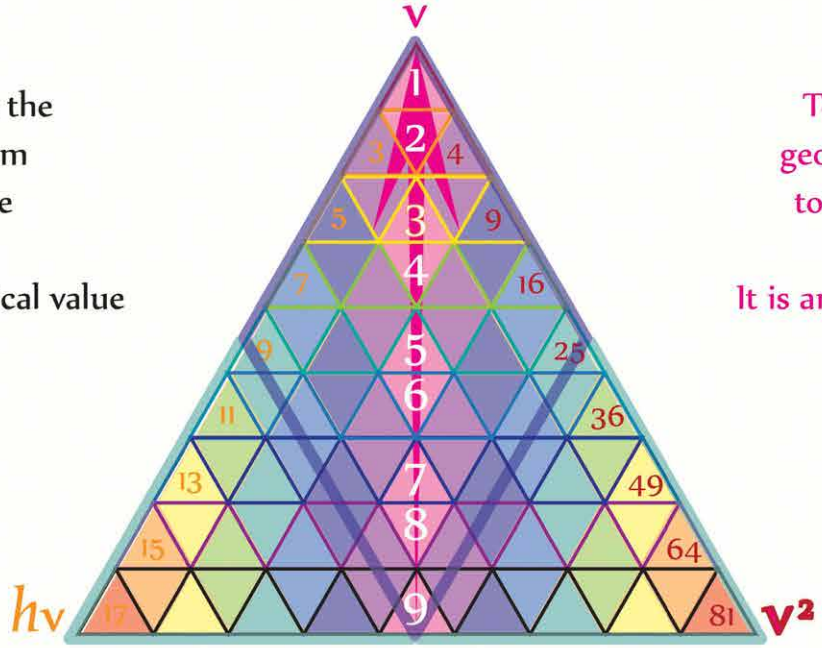

Tetryonics uses the
geometric Square Root
to calculate the value

It is an exact geometric value

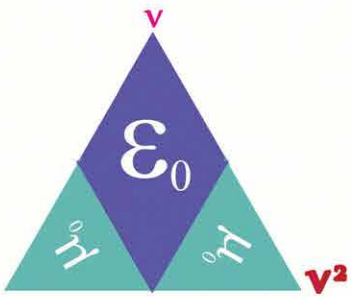

$$E = mv^2$$

In classical geometry,
the square root function maps the
area of a square to its side length.

$$p = \sqrt{E}$$

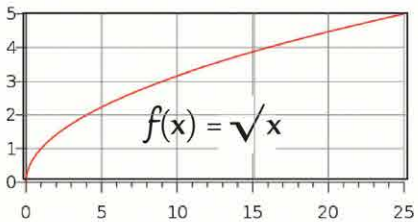

Geometry can easily map irrational numbers

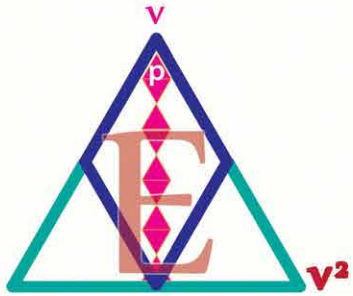

$$p^2 = E$$

In physics,
the square root function maps
ENERGY [E] to momentum [mv]

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The Square roots of n

Historically, any number raised to the power of 2 has been modeled using a polygon--the square
That's why we call raising a number to the second power "squaring the number."

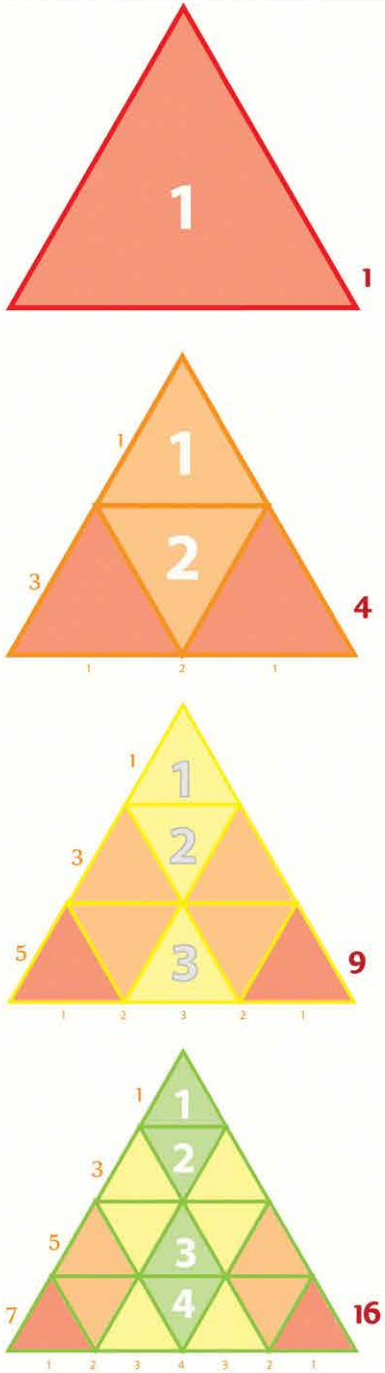

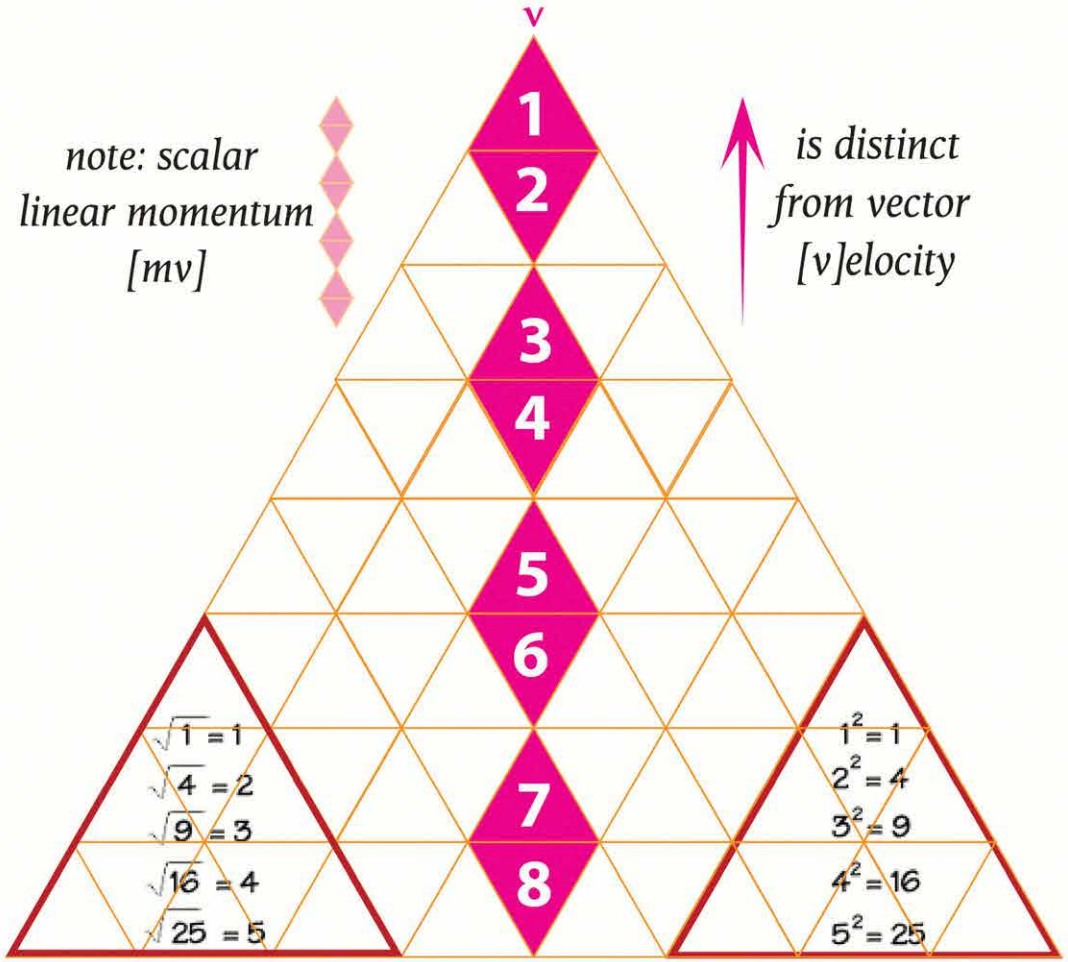

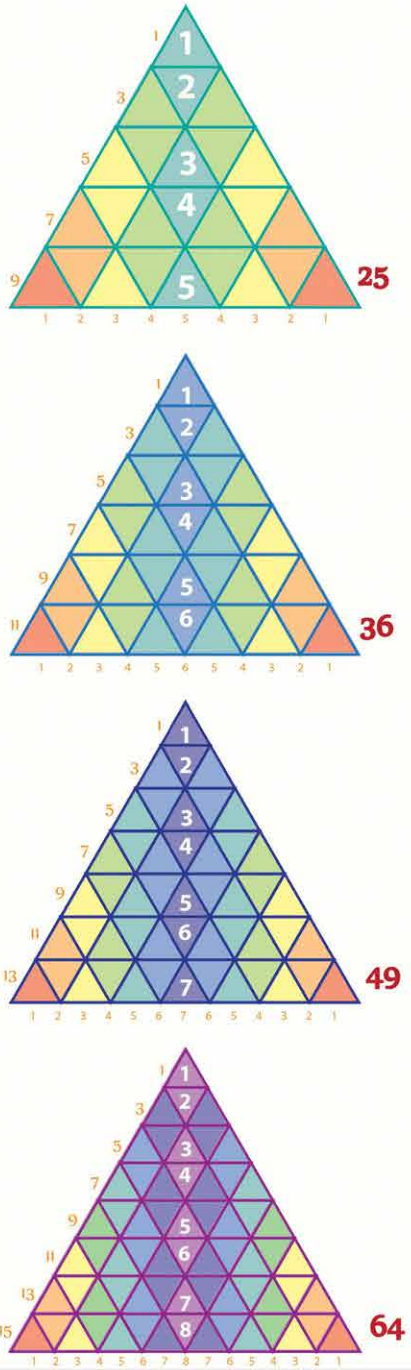

[In physics square numbers are in fact equilateral geometries]
The perfect squares are squares of whole numbers.
Here are the first eight perfect squares

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The Square root of Negative 1

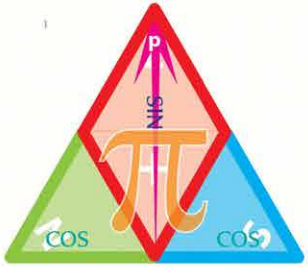

Positive fields are out of phase with Negative fields

Magnetic fields are out of phase with Electric fields

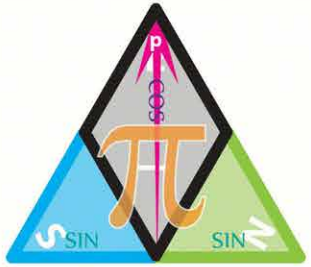

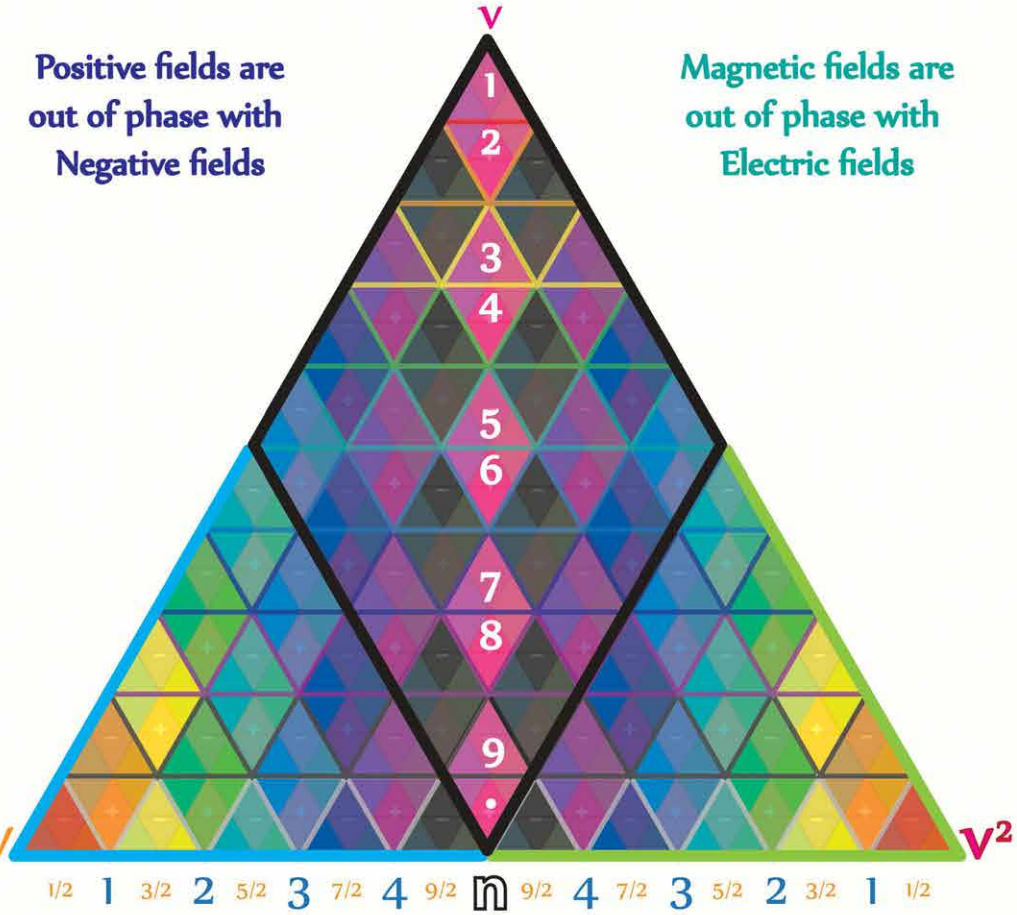

Euler's Formula

Euler's formula is often considered to be the basis of the complex number system. In deriving this formula, Euler established a relationship between the trigonometric functions, sine and cosine, and e raised to a power

$$e^{ix} = \cos(x) + i\sin(x)$$

a mathematical description of EM-Energy waveforms

Leonhard Euler

(15 April 1707 – 18 September 1783)

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \ldots$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \ldots$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \ldots$$

$$\sin x + \cos x = 1 + x - \frac{x^2}{2!} - \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \ldots$$

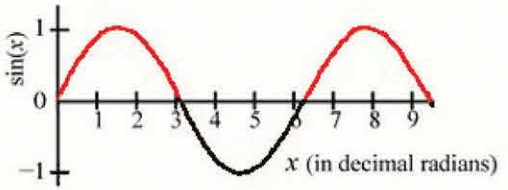

$$e^{i\pi} = -1$$

$$e^{i\pi} + 1 = 0$$

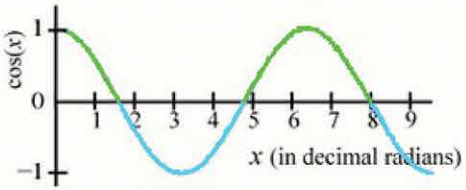

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Geometric means

The geometric mean of two numbers, is the square root of their product

geometric square root of positive one

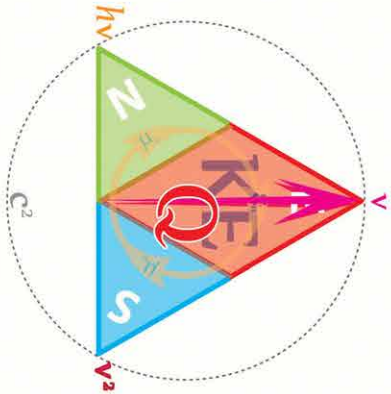

$$F = k\frac{Q_1 Q_2}{r^2}$$

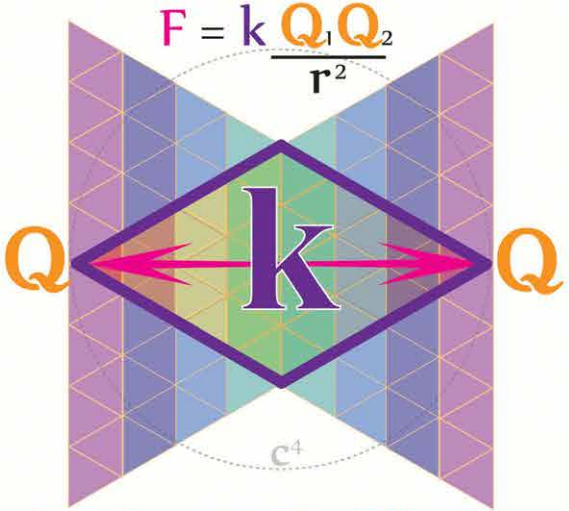

geometric square root of negative one

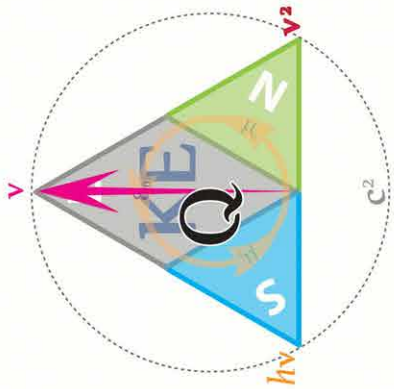

In physics, the geometric mean of two superpositioned fields produces a vector square root Force

It is generally stated that the geometric mean applies only to positive numbers.

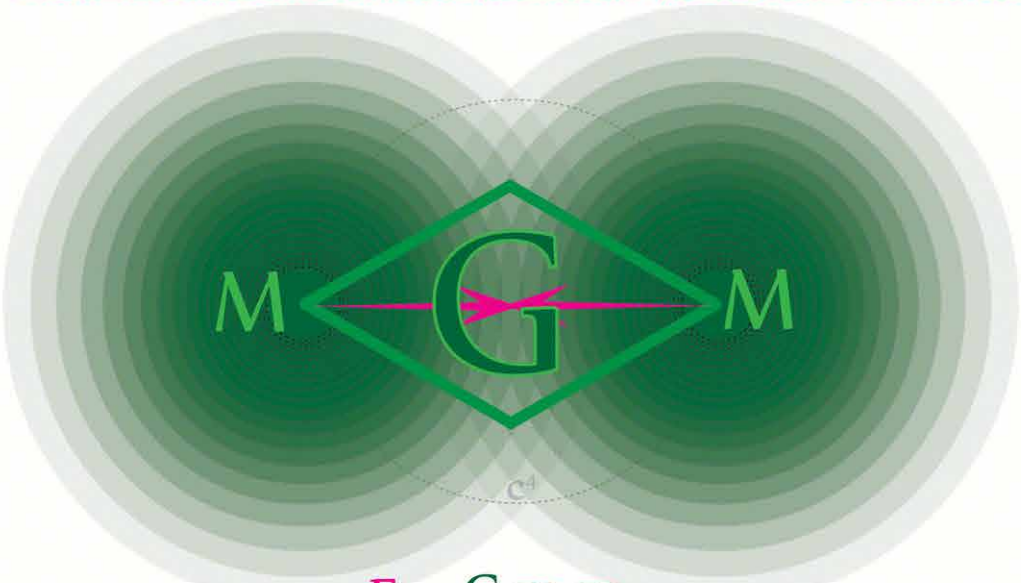

In Tetryonic geometry the geometric mean applies to positive & negative fields.

$$F = -G\frac{m_1 m_2}{r^2}$$

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Superpositioning

When two or more waves traverse the same space,
the net amplitude at each point is the
sum of the amplitudes of the individual waves.

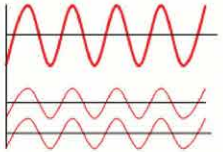

constructive interference

In phase

Additive

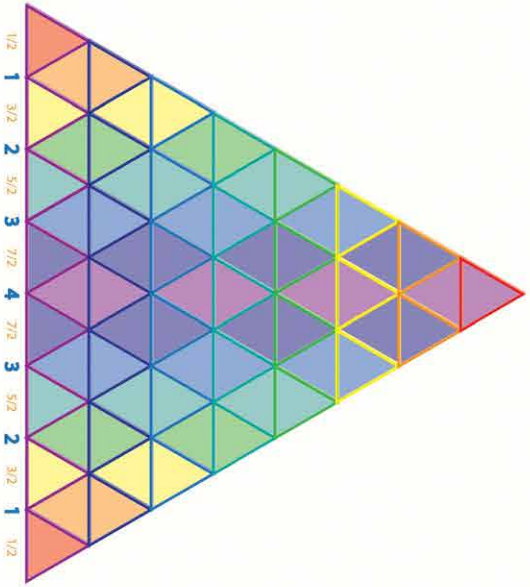

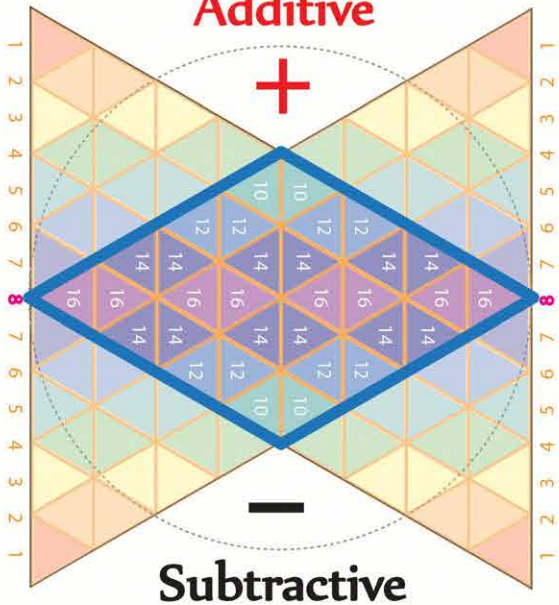

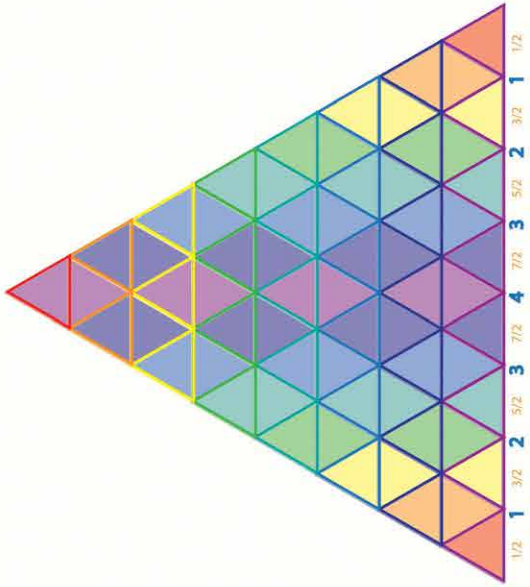

Subtractive

Out of phase

destructive interference

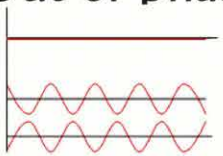

When two or more waves traverse the same space,
if the summed variation has a smaller amplitude
than the constiuent component variations.

The lines of Force

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Tetryonic Multiplication table

A multiplication table is a mathematical grid used to define a multiplication operation and its results

Multiplication Table

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	24	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	24	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120

Historically Multiplication tables have been based on Square geometries

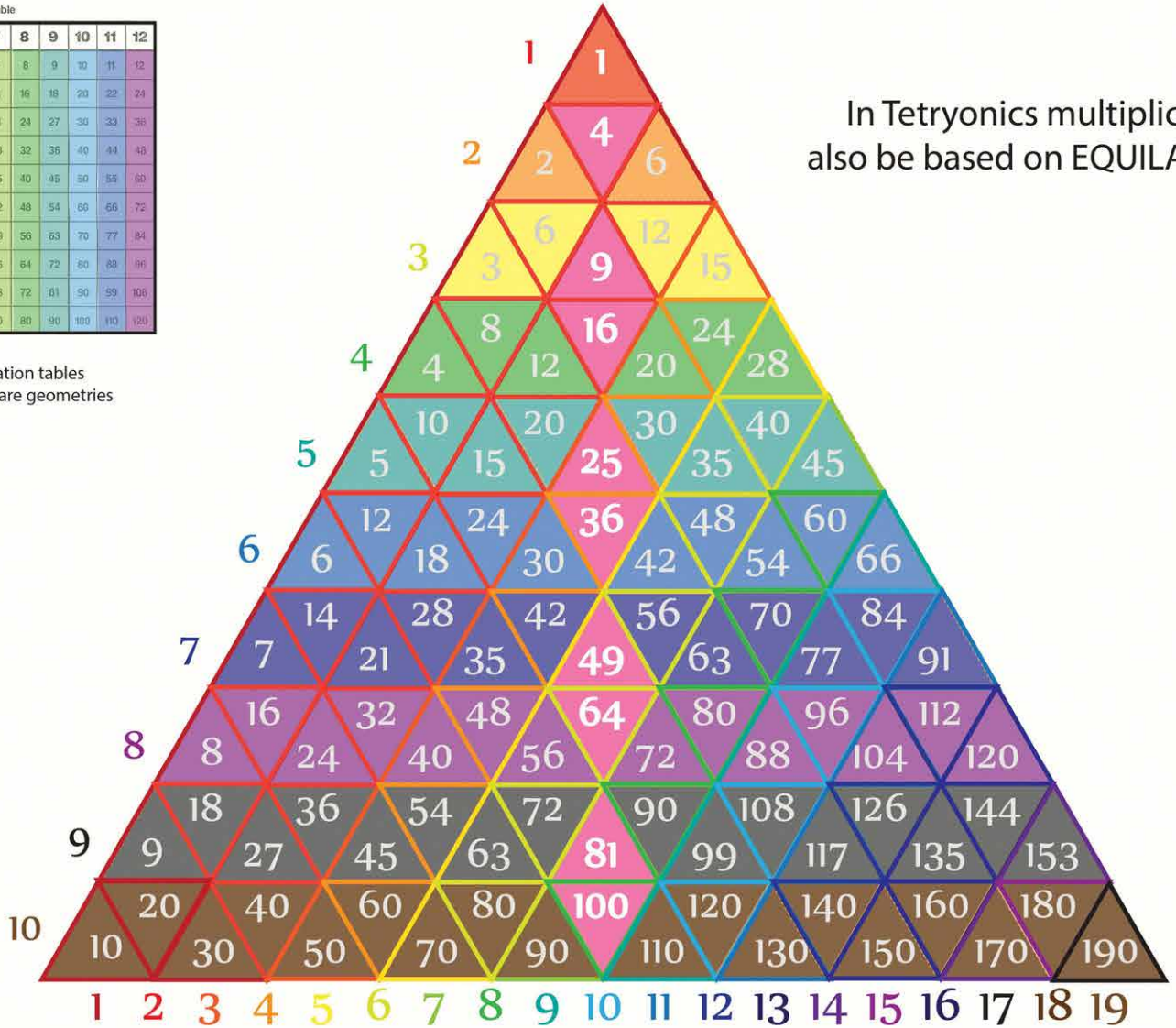

In Tetryonics multiplication tables can also be based on EQUILATERAL geometries

The integer multiplicitors are colour coded

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Rhombic Multiplication Tables

1	2	3	4	5	6	7	8	9	10
2	**4**	6	8	10	12	14	16	18	20
3	6	**9**	12	15	18	21	24	27	30
4	8	12	**16**	20	24	28	32	36	40
5	10	15	20	**25**	30	35	40	45	50
6	12	18	24	30	**36**	42	48	54	60
7	14	21	28	35	42	**49**	56	63	70
8	16	24	32	40	48	56	**64**	72	80
9	18	27	36	45	54	63	72	**81**	90
10	20	30	40	50	60	70	80	90	**100**

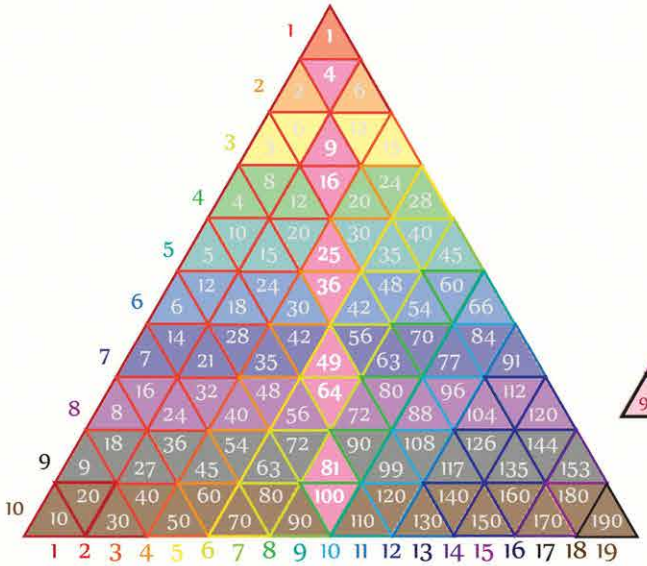

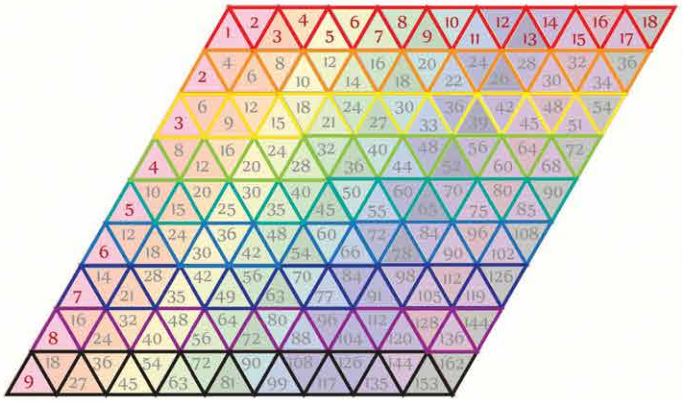

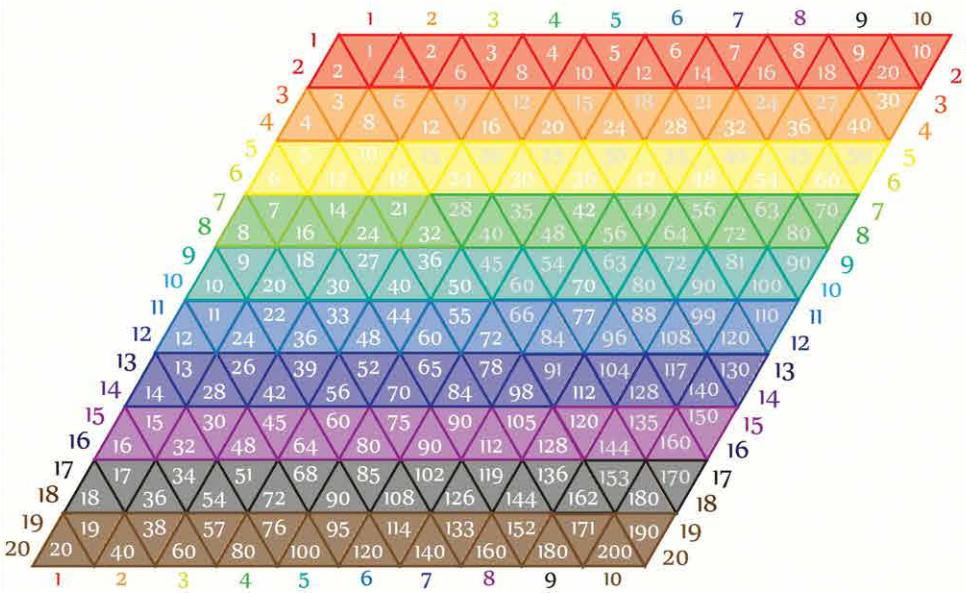

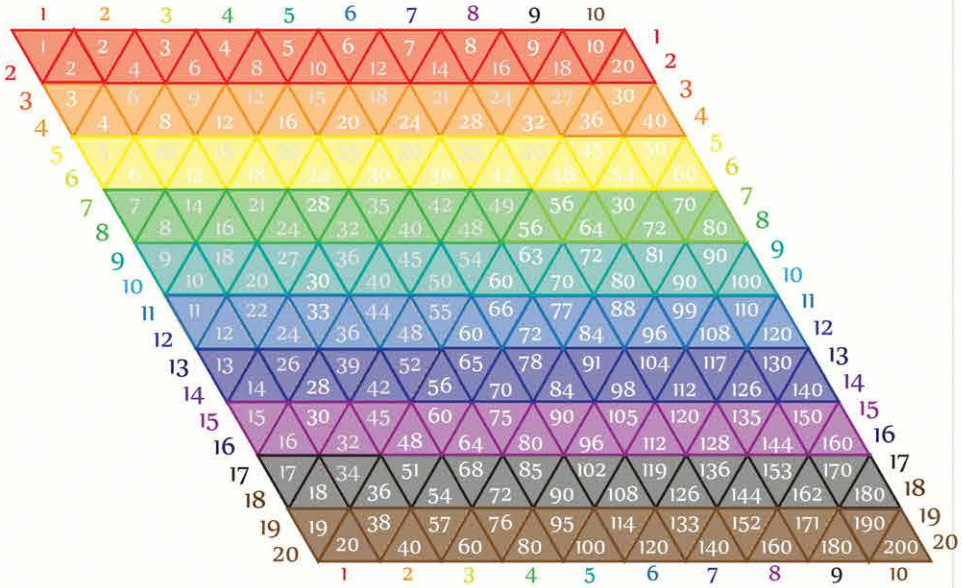

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Photonic Root Tables

Tetryonic multiplication table can take a number of geometric forms

Square root median

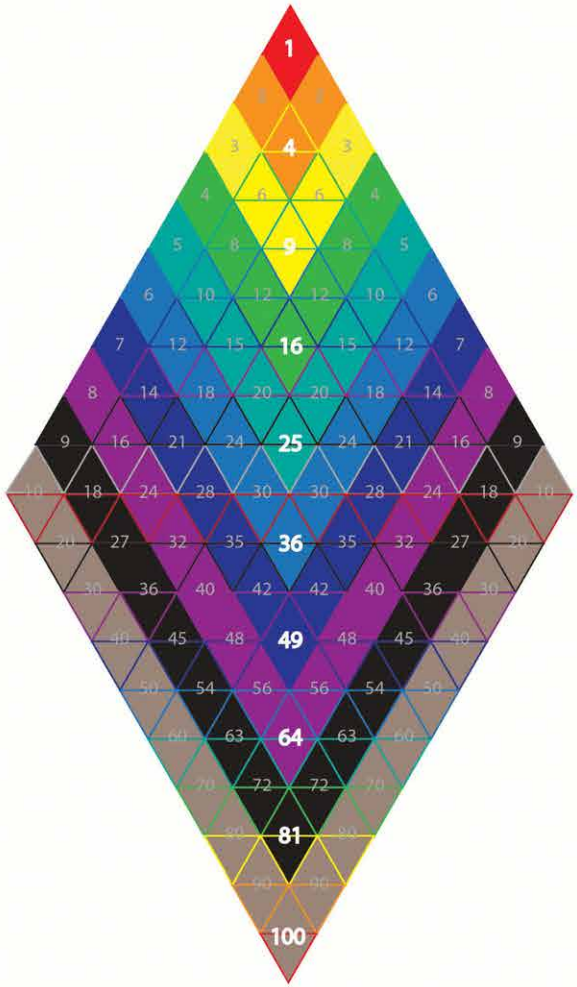

Table read diagonally

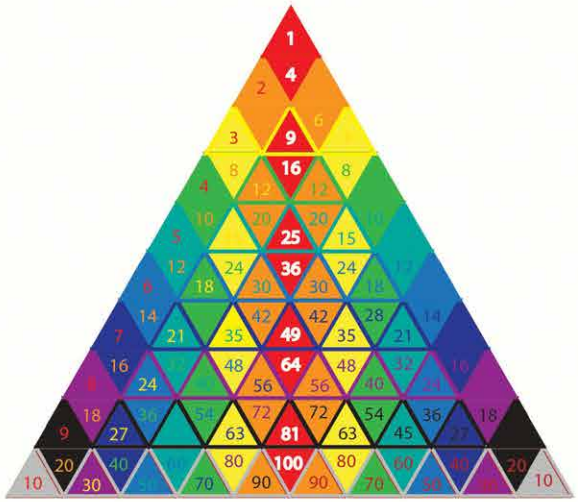

1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

Integer median

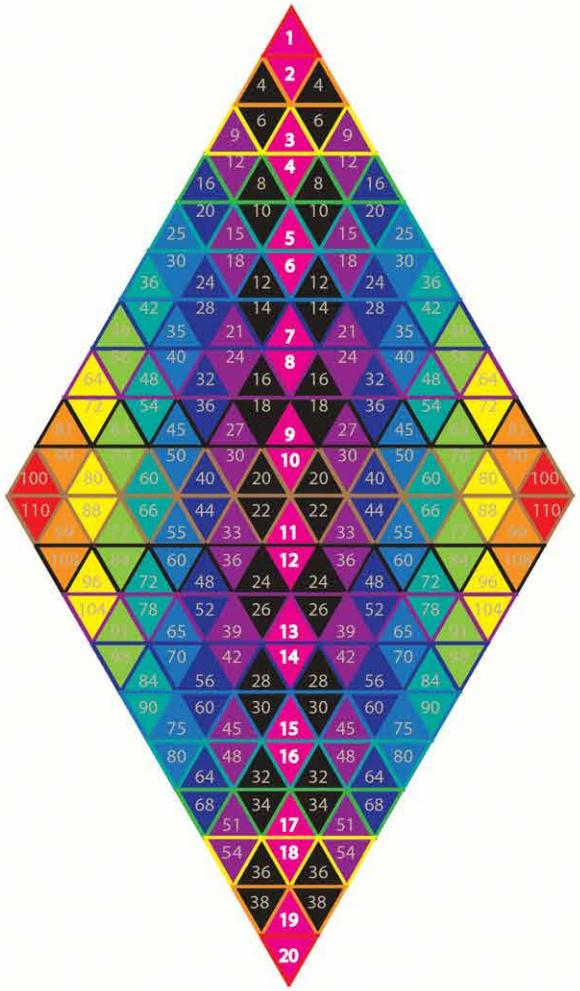

Table read from centre
to outside edge then down

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Divide [division] tables

Minus [subtraction] tables

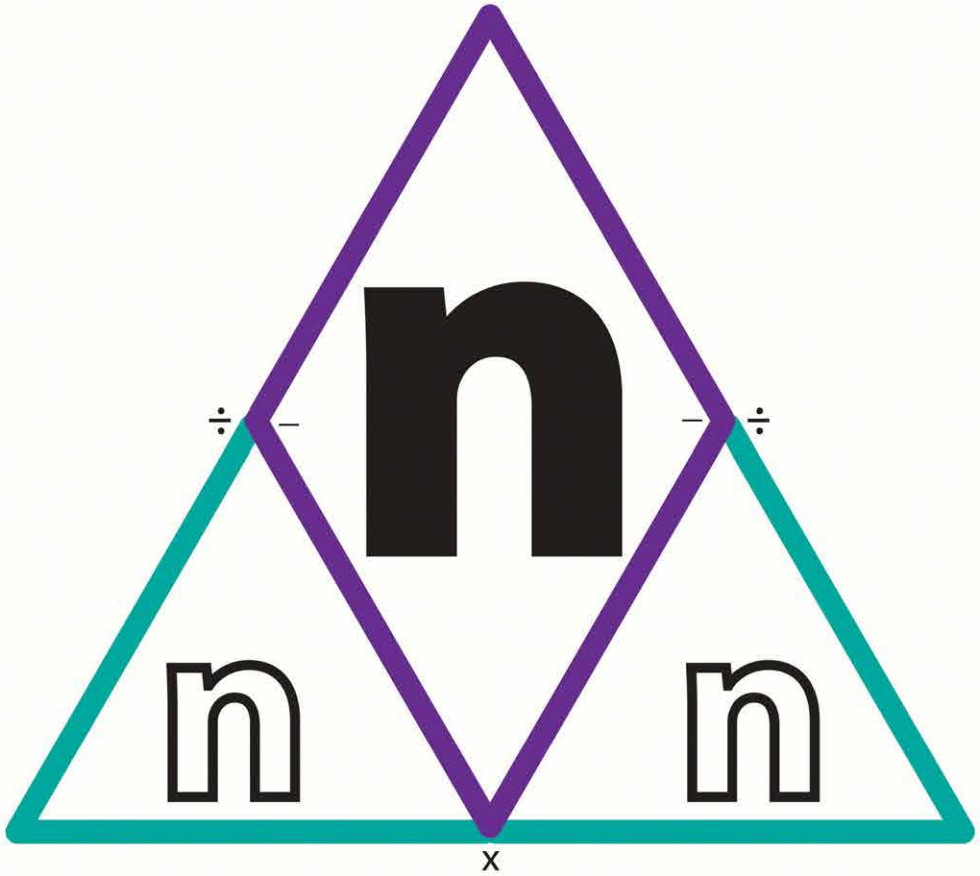

Times [multiplication] tables

Plus [addition] tables

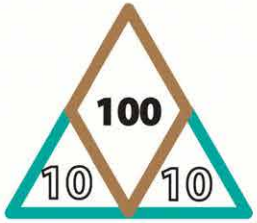

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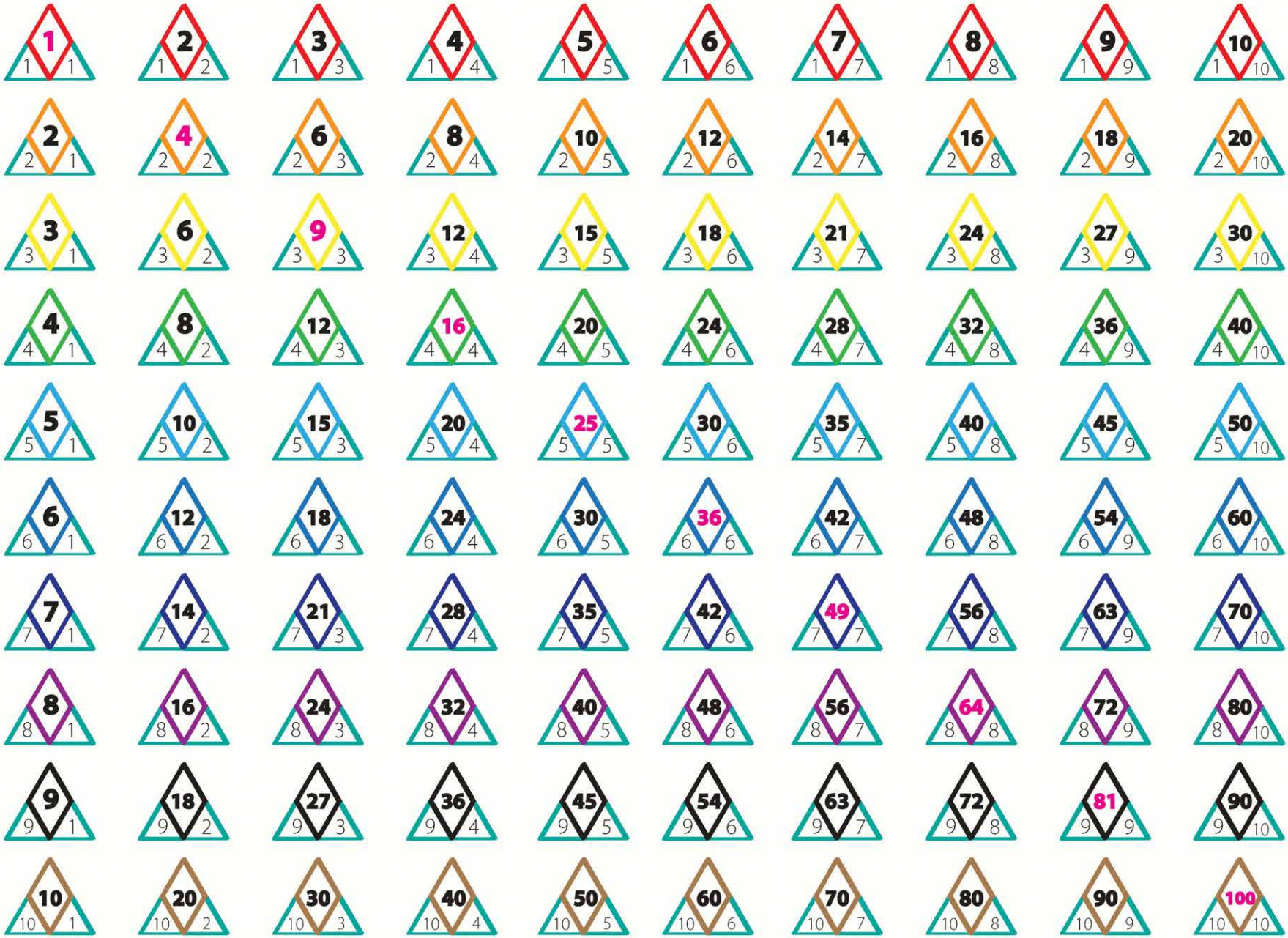

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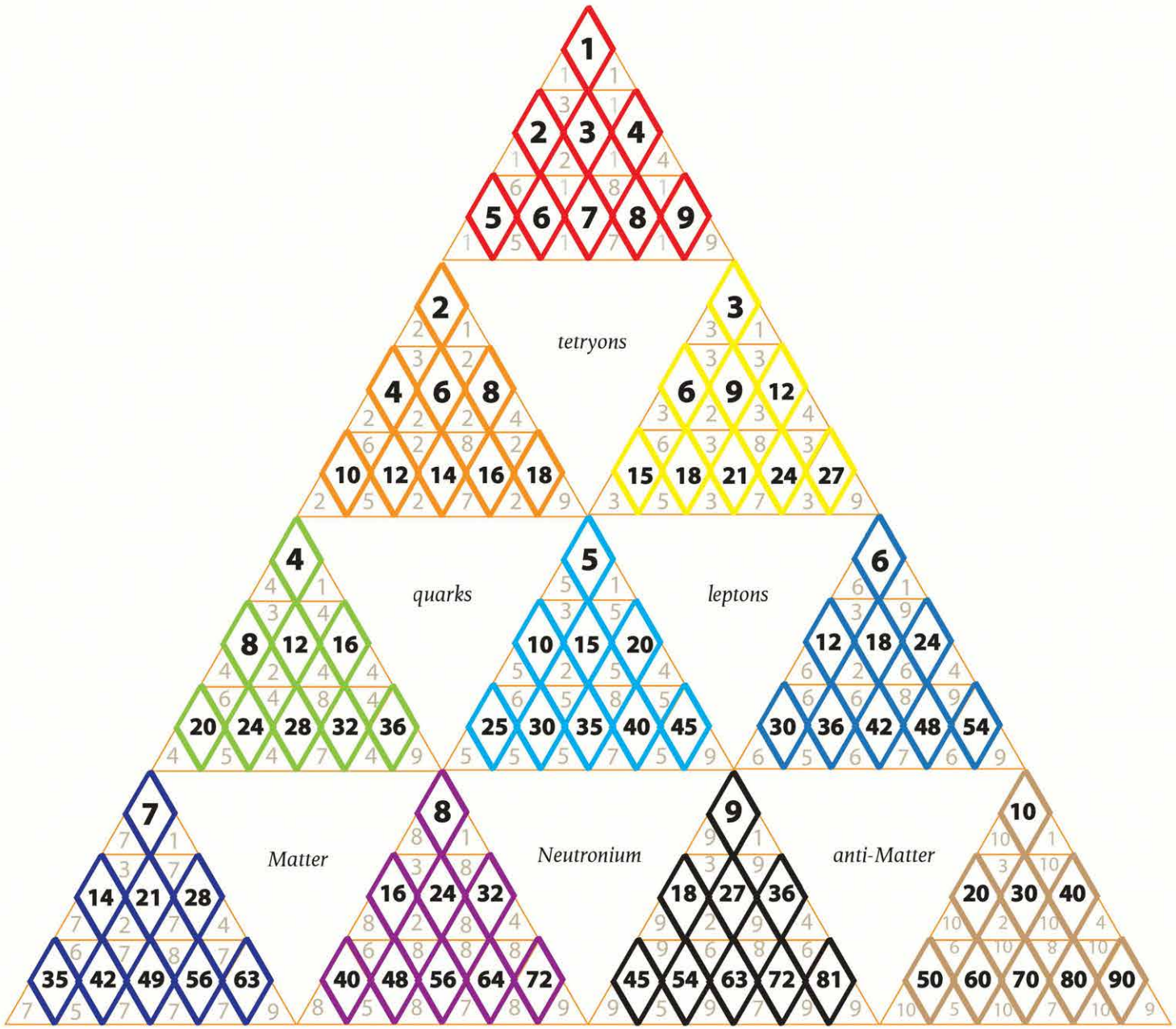

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Irrational Numbers

An irrational number is defined to be any number that is the part of the real number system that cannot be written as a complete ratio of two integers

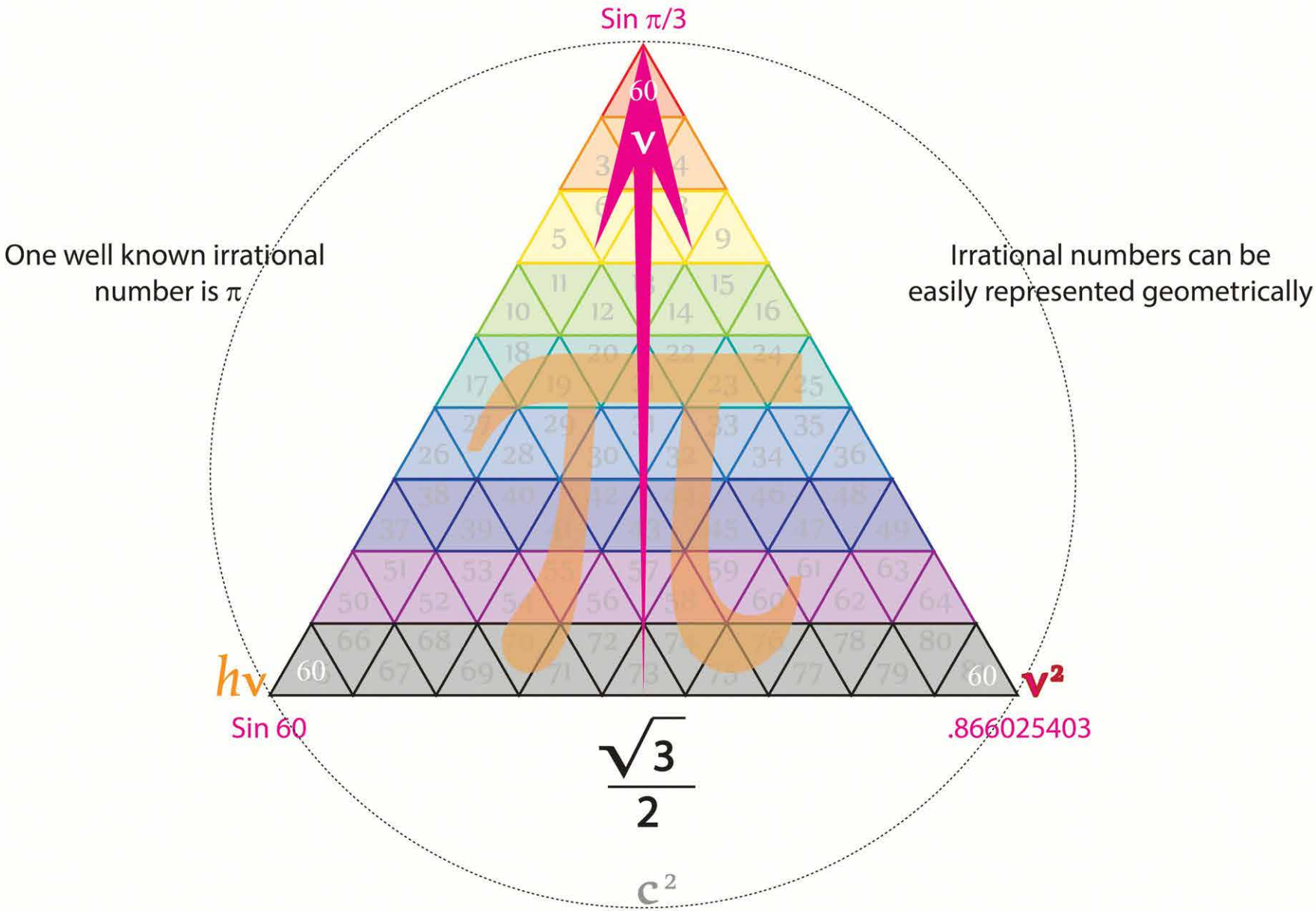

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Exponentials & Logarithms

1	0
10	1
100	2
1,000	3

e and the Natural Log are inverse functions of each other:

e^x is the amount of continuous GROWTH after a certain amount of time.
Natural Log (ln) is the amount of TIME of continuous growth to reach a certain level

$10{,}000 = 10^4$

$\log(10{,}000) = 4$

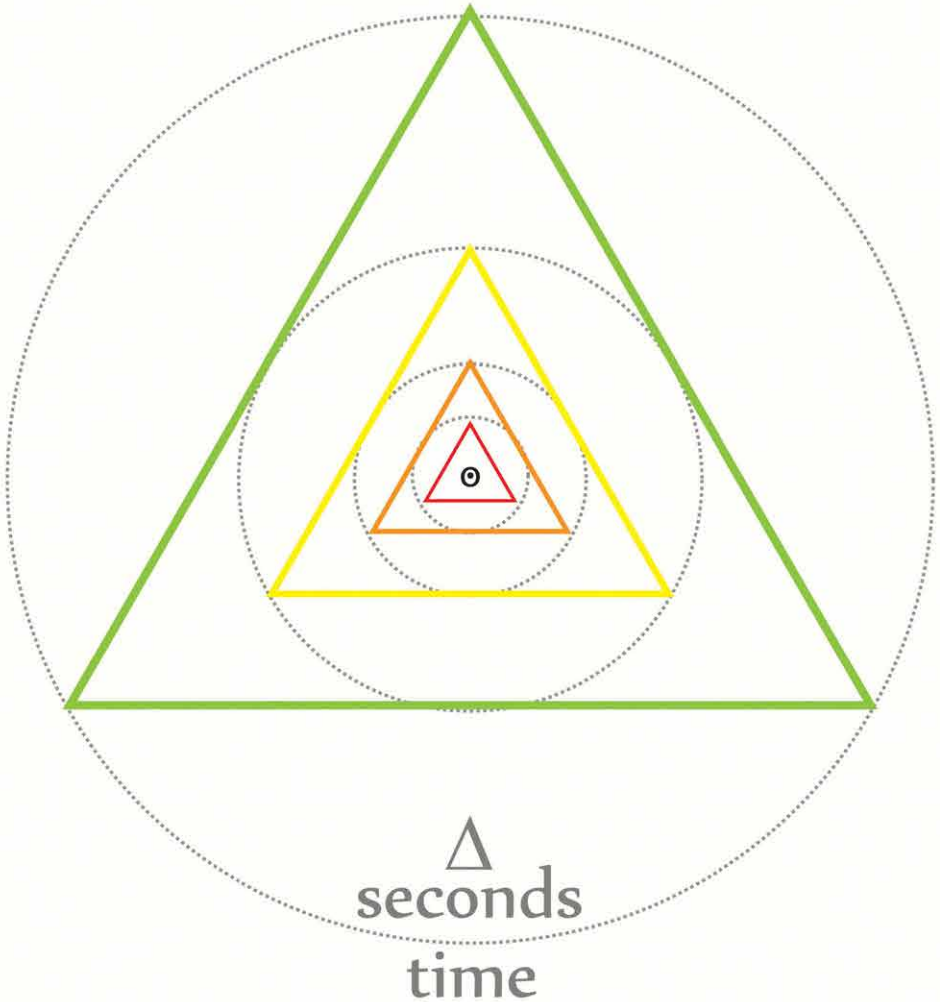

e

How much growth after x units of time
(and 100% continuous growth)

$$e^x = \lim_{n\to\infty}(1+x/n)^n,$$

GROWTH

ln

ln(x) lets us plug in continuous growth
and get the time it would take.

$$\ln(x) = \lim_{n\to\infty} n(x^{1/n}-1).$$

PERIOD

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Exponential growth

GEOMETRIC

3.141592654

π

Pi is the ratio between circumference and diameter shared by all circles.

It is a fundamental ratio inherent in all circles and therefore impacts any calculation of circumference, area, volume, and surface areas

Pi radians are equally important and show all quantised equilateral energy geometries are related to their scribed circles

$$\text{growth} = e = \lim_{n \to \infty}\left(1 + \frac{r}{n}\right)^t$$

e represents the idea that all continually growing systems are scaled versions of a common rate

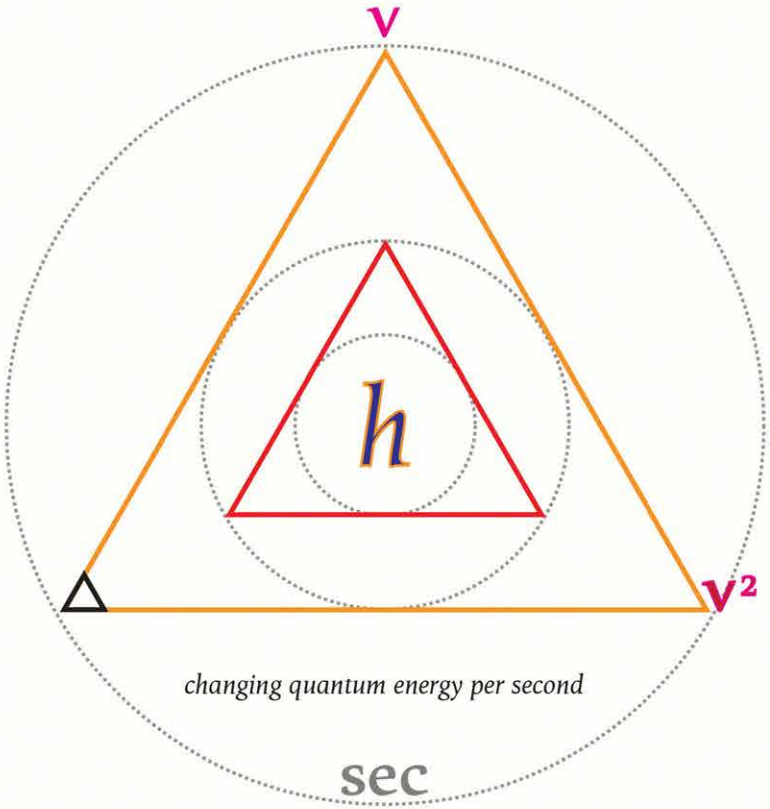

GROWTH

2.718281828

e

e is the base rate of growth shared by all continually growing processes.

e lets you take a simple growth rate (where all the change happens all at once at the end of a period of time - ie quantised growth)

e shows up whenever systems grow exponentially and continuously..... radioactive decay, interest calculations and populations

tetryons *EM fields* *quarks*

e can be applied to the equilateral energy geometries of physical systems only where the rate of increase is a integer factor of a squared number

leptons *Baryons*

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Nuclear Energy levels

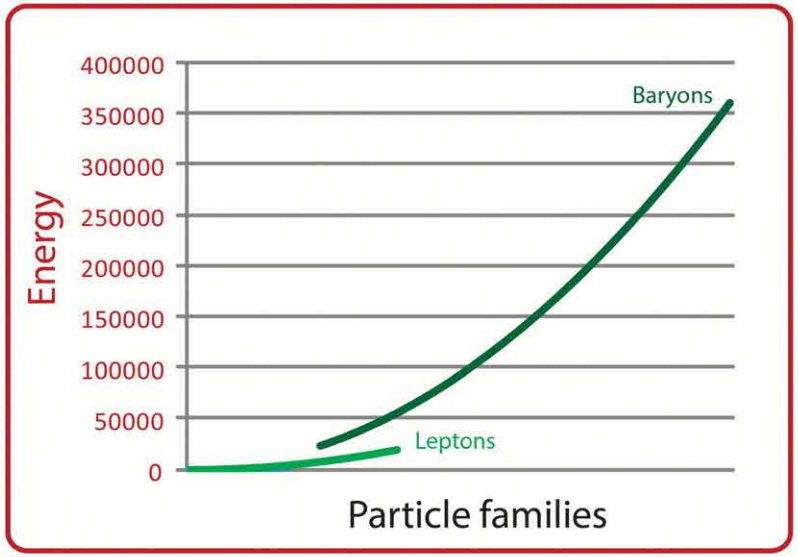

The emission and absorption of bosons and Photons within sub-atomic nuclei

Increase and decrease in integer amounts according to the charged Tetryonic topologies of the particles involved

Exponential energy levels

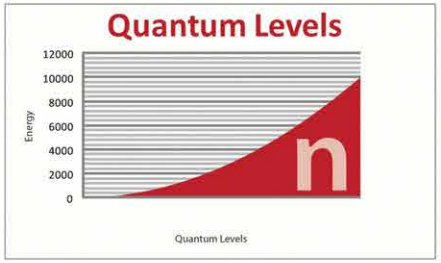

Radioactive decays follow exponential curves determined by the Tetryonic topology of the sub-atomic particle families

Proton
Neutron

antiNeutron
antiProton

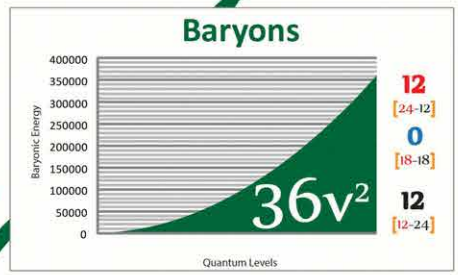

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

Electron
Positron

Neutrino

Up
Down
Strange
Charmed
Top
Bottom

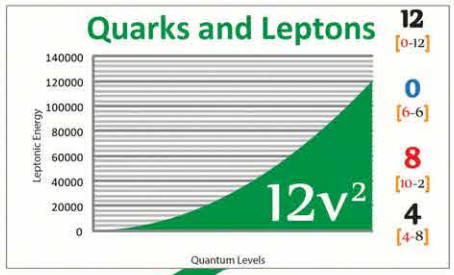

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

quarks, leptons; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

Positive
Negative
Neutral

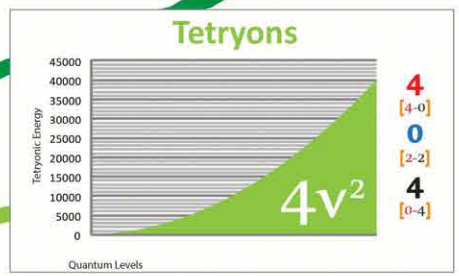

$$4\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

tetryons; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

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Series addition & the Riemann Zeta Function

The second series addition of the Reimann Zeta function is where x=2: (pi^2)/6=1+1/2^2+1/3^2+1/4^2+...
(the sum of the reciprocals of the squares)

$$\zeta(s) = \sum_n \frac{1}{n^s}$$

$$\zeta(2) = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots = \frac{\pi^2}{6}$$

$$\sum_{n=1}^{\infty} \frac{1}{n^x}$$

$$f(n) = 1/n^2$$

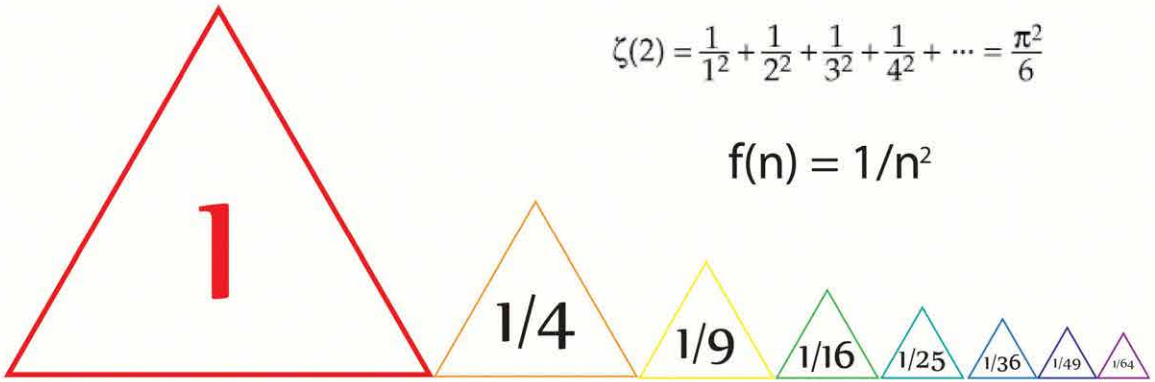

In mathematics, the Riemann zeta function, is a prominent function of great significance in number theory. It is a named after German mathematician Bernhard Riemann. It is so important because of its relation to the distribution of prime numbers. It also has applications in other areas such as physics, probability theory, and applied statistics

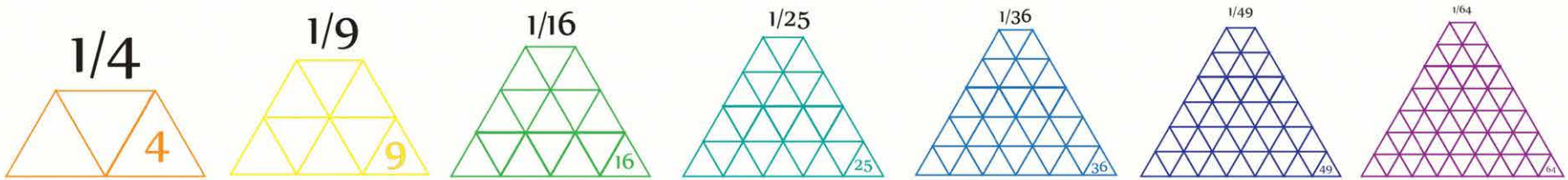

The mystery of prime numbers
Question: which natural numbers are prime? how are they distributed among natural numbers?

Primes are basic building blocks for natural numbers:

- any natural number is a product of prime numbers
- a prime number is only divisible by itself and by 1:
  (it cannot be further simplified)

We don't know how to predict where the prime numbers are:

"Prime numbers grow like weeds among the natural numbers, seeming to obey no other law than that of chance but also exhibit stunning regularity" (Don Zagier, number theorist)

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Adding the odd numbers in order produces the square numbers

Apart from 2, all primes are odd numbers;
the difference between two consecutive squares being odd,
every prime can be expressed as the difference between two squares

SPECTRAL LINES

Primes can be modelled as Bosons
[ODD number energy momenta geometries]

[2n-1]

KEM ENERGIES

Primes can be expressed as Bosons
[the difference of two squared energies]

$n^2 - [n-1]^2$

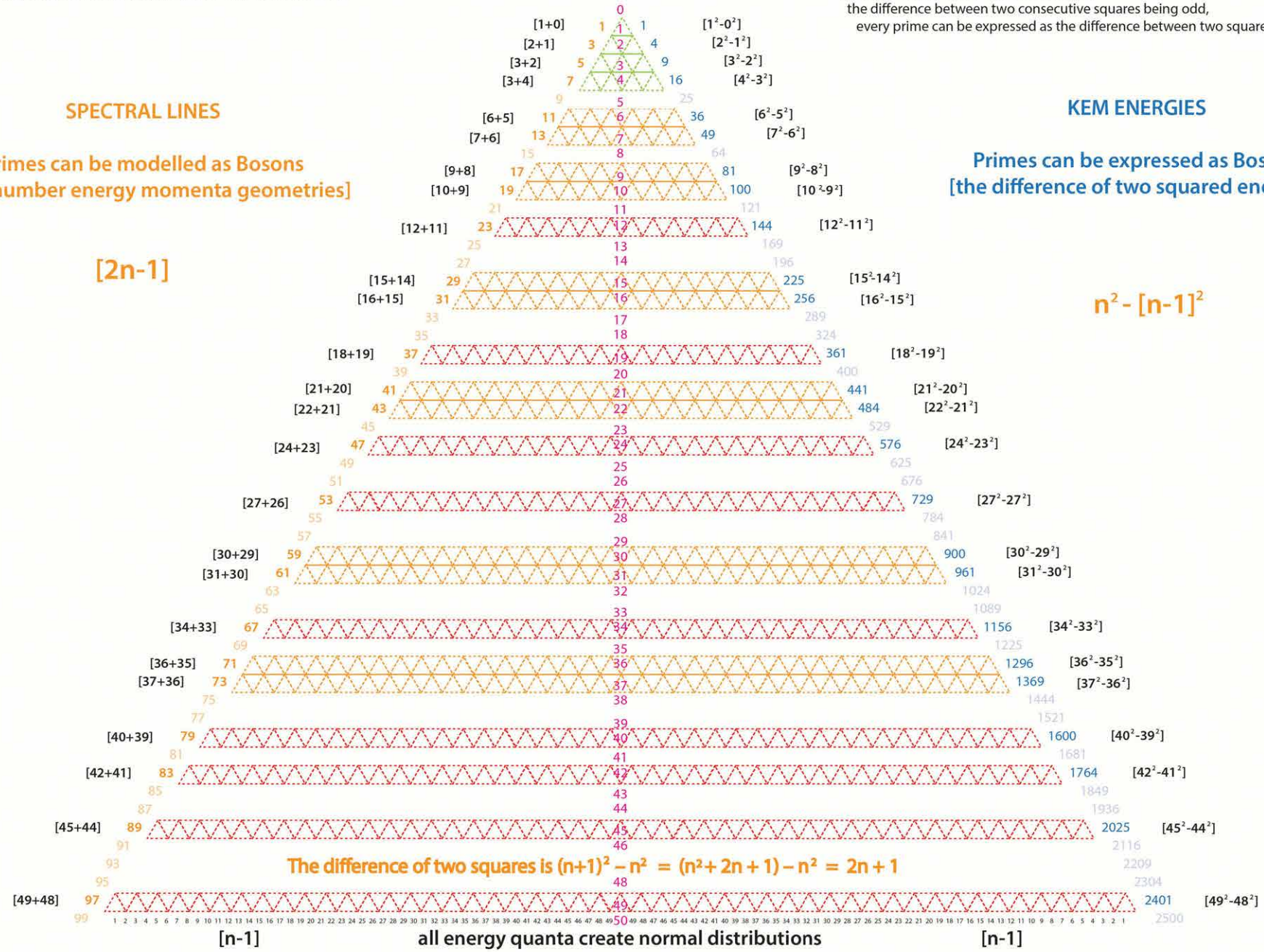

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Prime number Distributions

A twin prime is a prime number that differs from another prime number by two, for example the twin prime pair (41, 43). Sometimes the term twin prime is used for a pair of twin primes; an alternative name for this is prime twin or prime pair.

Twin primes appear despite the general tendency of gaps between adjacent primes to become larger as the numbers themselves get larger due to the prime number theorem (the "average gap" between primes less than n is log(n)).

$$p_2 - p_1 = 2$$

Every twin prime pair except (3, 5) is of the form (6n – 1, 6n + 1) for some natural number n, and with the exception of n = 1, n must end in 0, 2, 3, 5, 7, or 8

What Yitang Zhang just proved is that there are infinitely many pairs of primes that differ by at most 70,000,000. In other words, that the gap between one prime and the next is bounded by 70,000,000 infinitely often—thus, the "bounded gaps" conjecture.

On first glance, this might seem a miraculous phenomenon. If the primes are tending to be farther and farther apart, what's causing there to be so many pairs that are close together?

It is the geometry of Numbers themselves that causes a natural geometric convergence

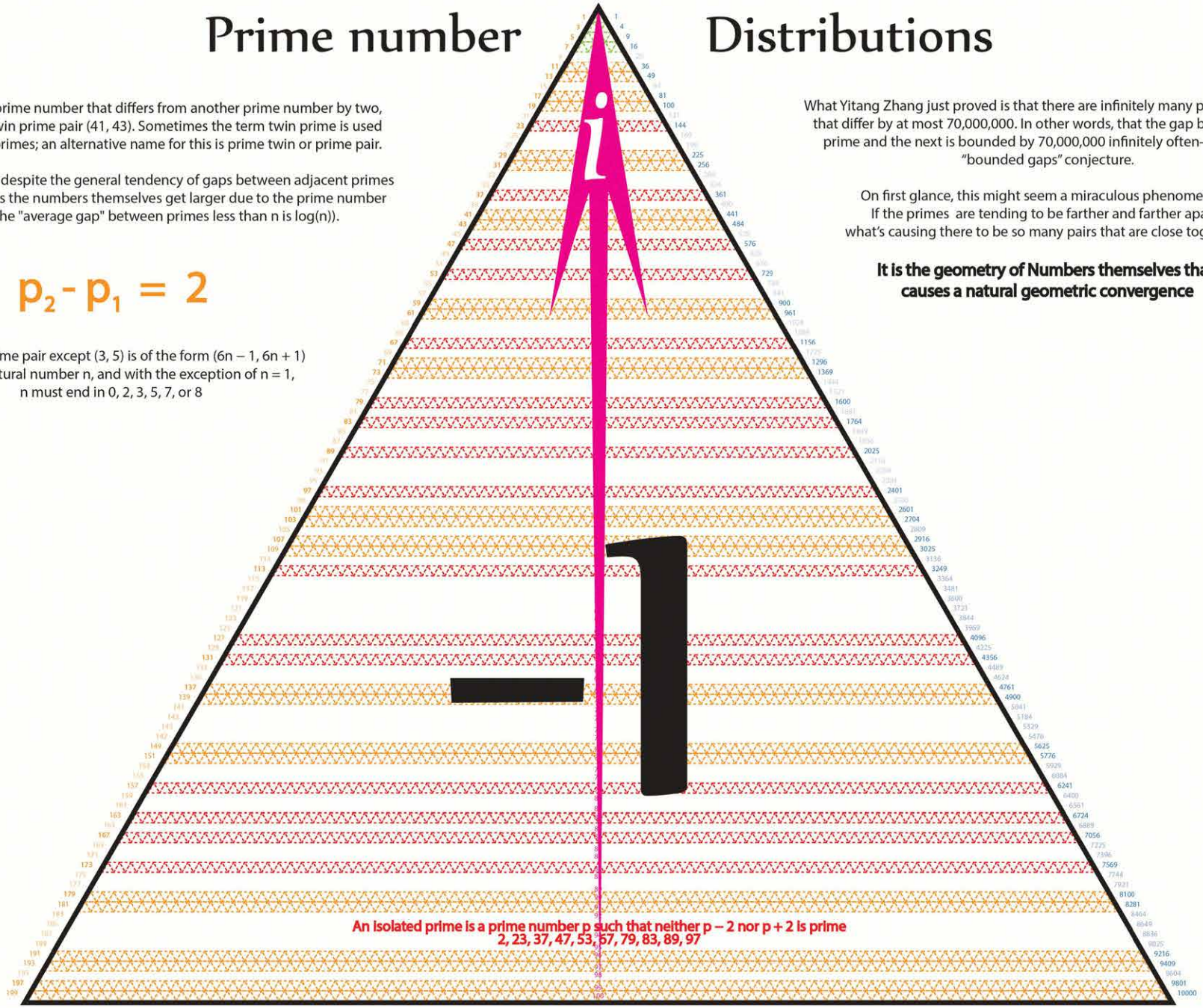

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The Digital roots of Prime numbers

The digital root (also repeated digital sum) of a number is the (single digit) value obtained by an iterative process of summing digits, on each iteration using the result from the previous iteration to compute a digit sum.

The process continues until a single-digit number is reached.

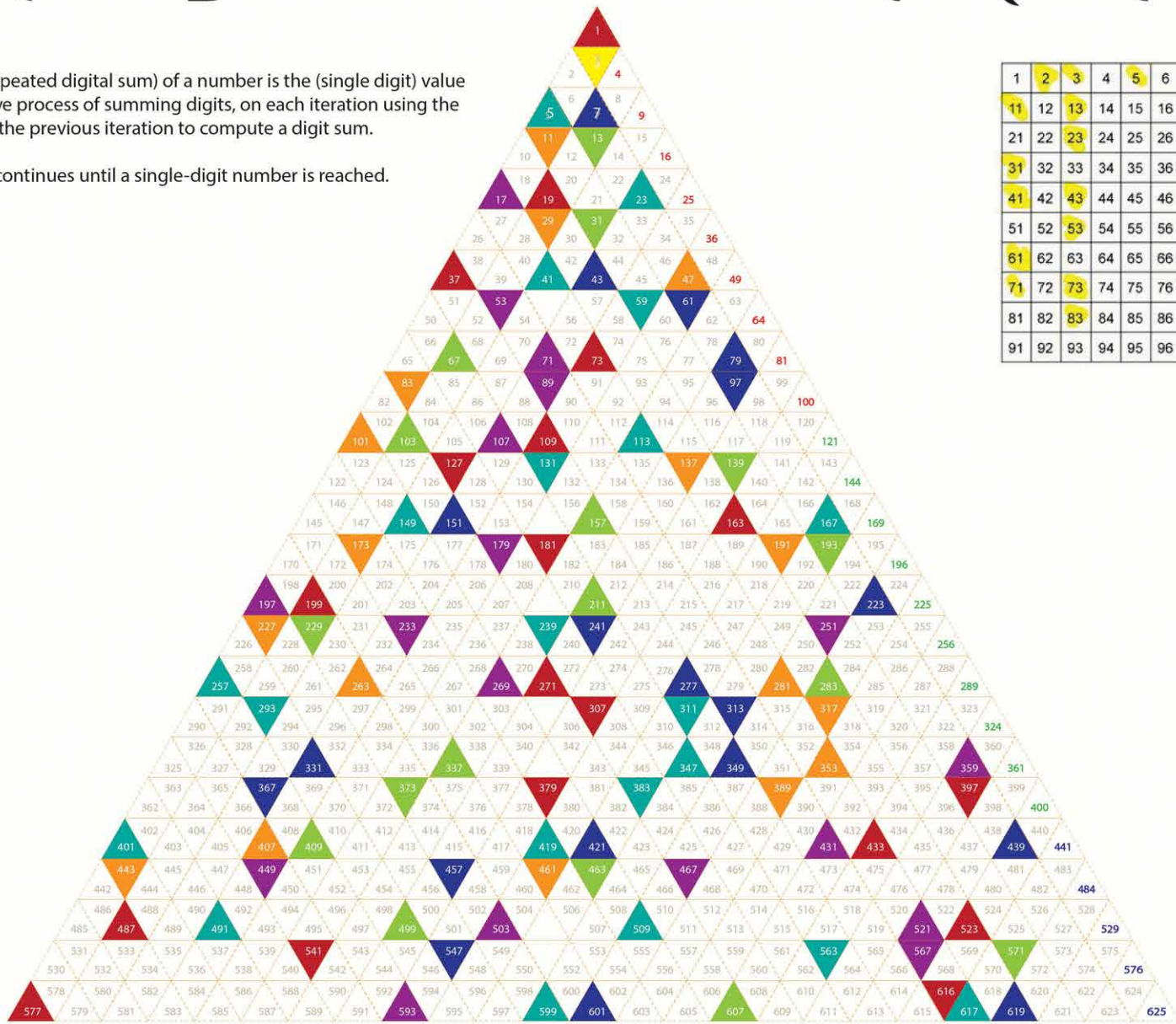

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

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Archimedes is given credit for the first calculus.

Archimedes infinite series

Today's calculus was published by Newton.

1 + 3/4 + 3/16 + 3/64 + 3/256 + 3/1024 + ...

1 + .75 + .1875 + .046875 + .01171875 + ...

$$3\left(\frac{1}{4}+\frac{1}{4^2}+\frac{1}{4^3}+\frac{1}{4^4}+\cdots\right)=1.$$

$$\frac{3}{4}+\frac{3}{4^2}+\frac{3}{4^3}+\frac{3}{4^4}+\cdots=1.$$

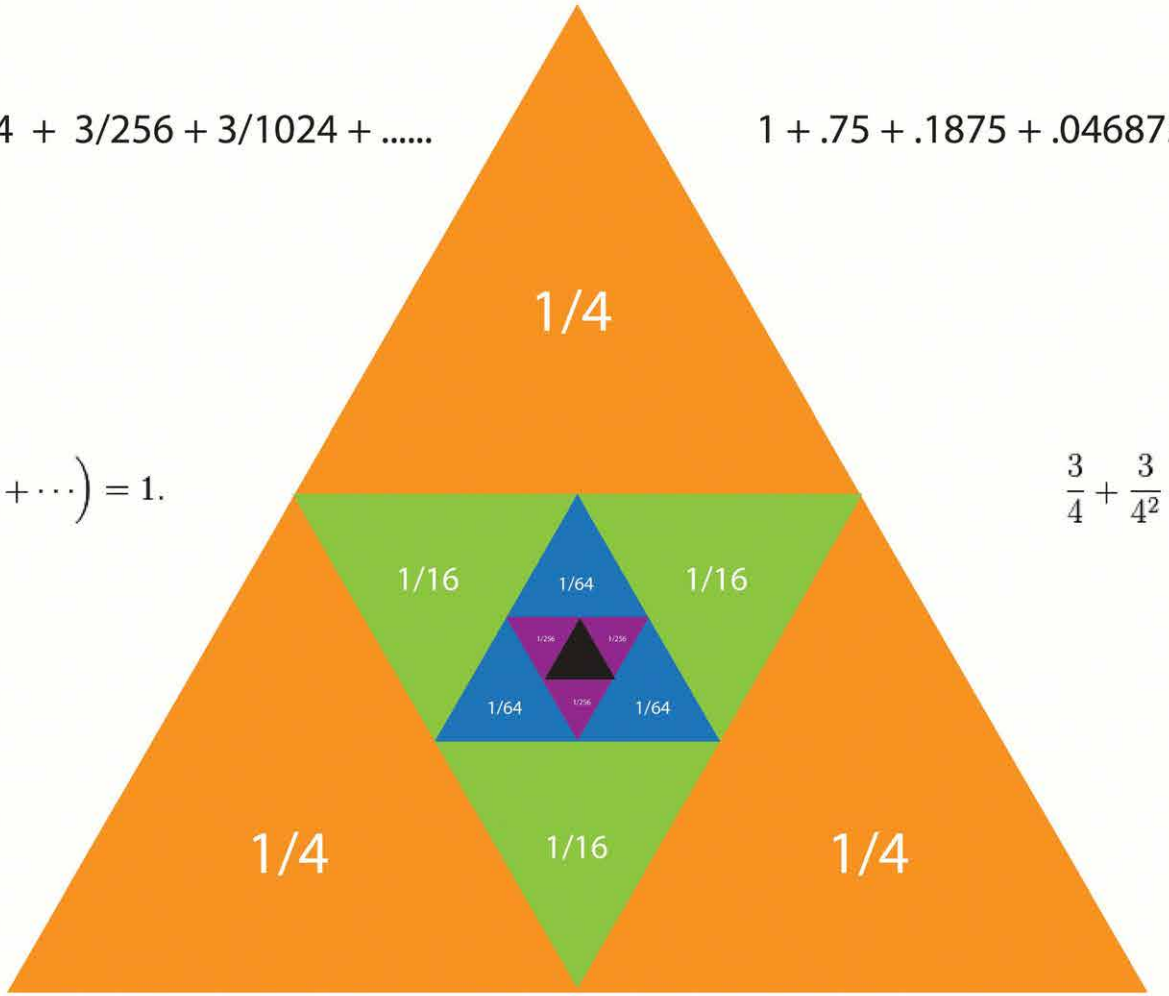

Nested convergent infinite series

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Summing a convergent infinite series

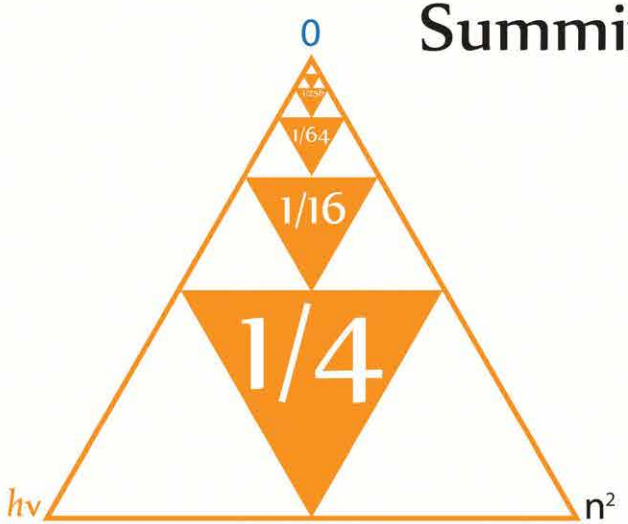

$1/4 + 1/4^2 + 1/4^3 + 1/4^4 + 1/4^5 + \ldots\ldots\ldots\ldots$

$$\sum_{n=0}^{\infty} a_n = a_0 + a_1 + a_2 + \cdots$$

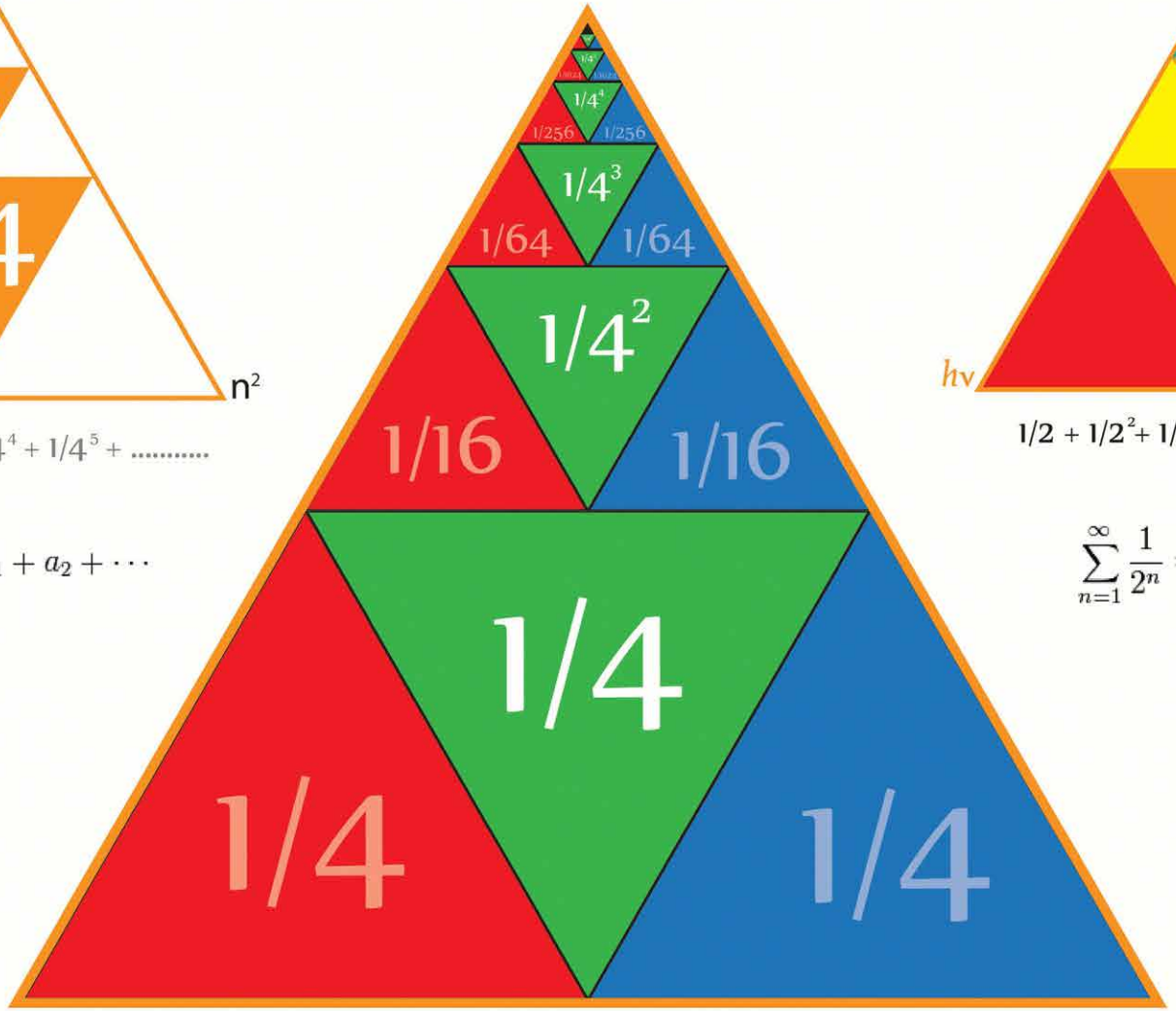

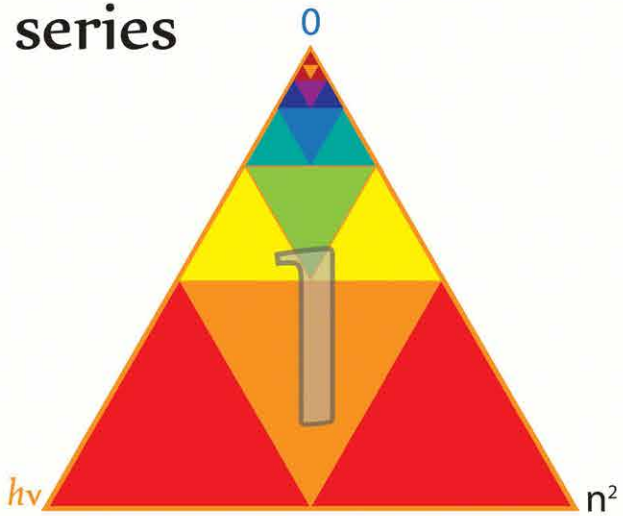

$1/2 + 1/2^2 + 1/2^3 + 1/2^4 + 1/2^5 + \ldots\ldots\ldots\ldots$

$$\sum_{n=1}^{\infty} \frac{1}{2^n} = \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots.$$

ODDS = 2n-1

$$\sum_{1}^{n} 2n-1 = n^2$$

Summing the dissimilar coloured equilateral triangles gives unity

1/3 1/3 1/3

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1/3 1/3 1/3

Summing the dissimilar coloured equilateral triangles gives unity

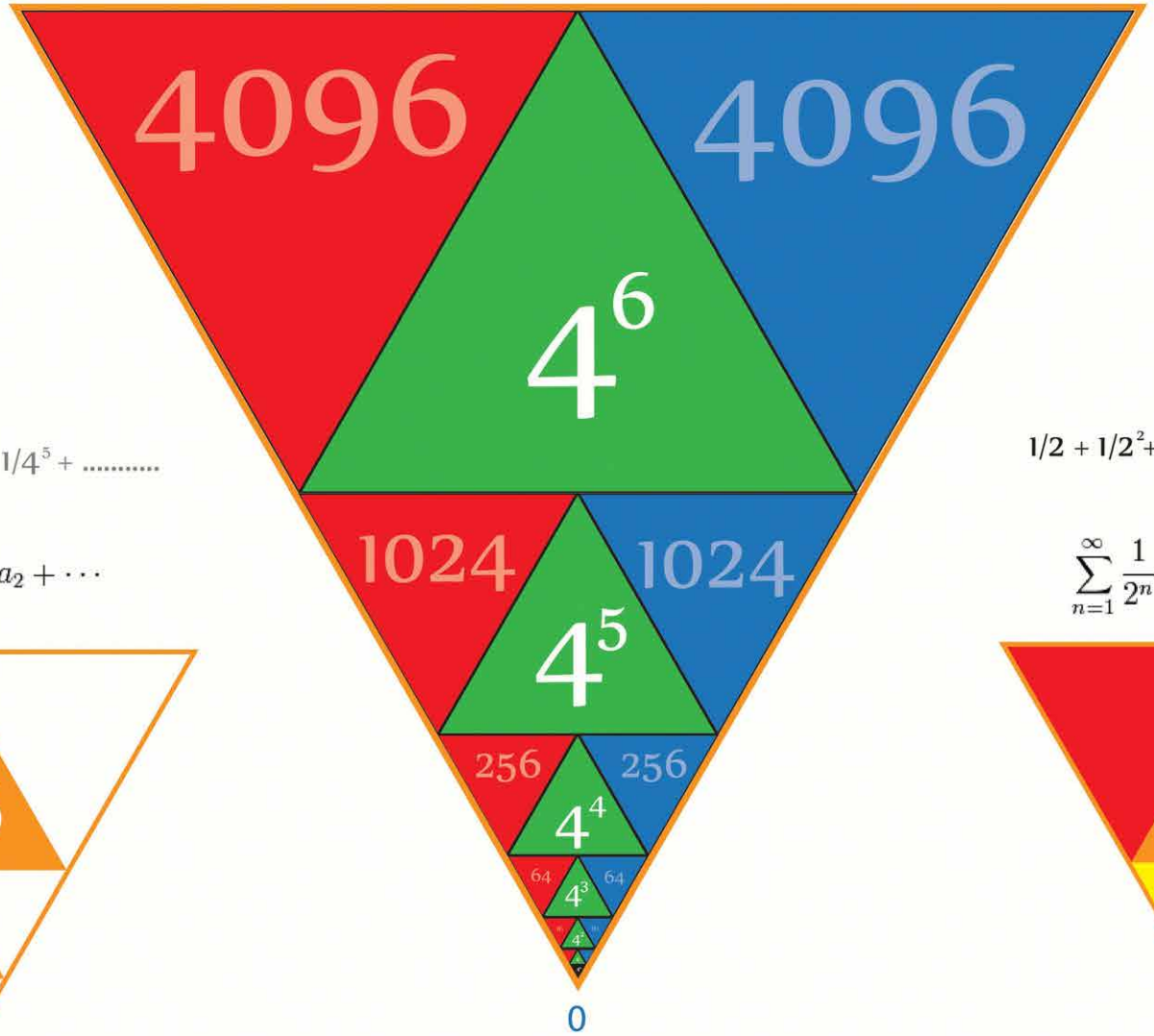

$1/4 + 1/4^2 + 1/4^3 + 1/4^4 + 1/4^5 + \ldots\ldots\ldots\ldots$

$$\sum_{n=0}^{\infty} a_n = a_0 + a_1 + a_2 + \cdots$$

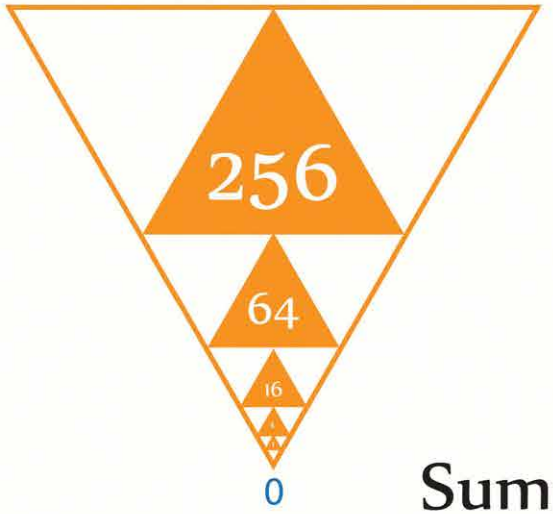

$1/2 + 1/2^2 + 1/2^3 + 1/2^4 + 1/2^5 + \ldots\ldots\ldots\ldots$

$$\sum_{n=1}^{\infty} \frac{1}{2^n} = \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots.$$

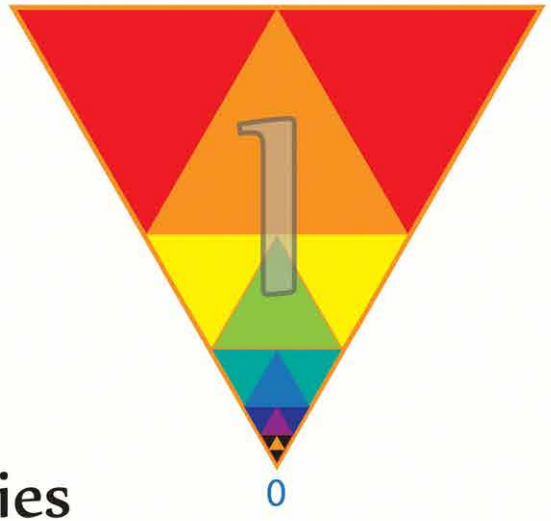

Summing a divergent infinite series

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Pietro Mengoli

(1626 – June 7, 1686)

The Basel Problem

Leonhard Euler

(15 April 1707 – 18 Sept 1783)

The Basel problem is a famous problem in mathematical analysis with relevance to number theory, first posed by Pietro Mengoli in 1644 and solved by Leonhard Euler in 1735.

$$\zeta(2) = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \cdots = \frac{\pi^2}{6} \approx 1.644934$$

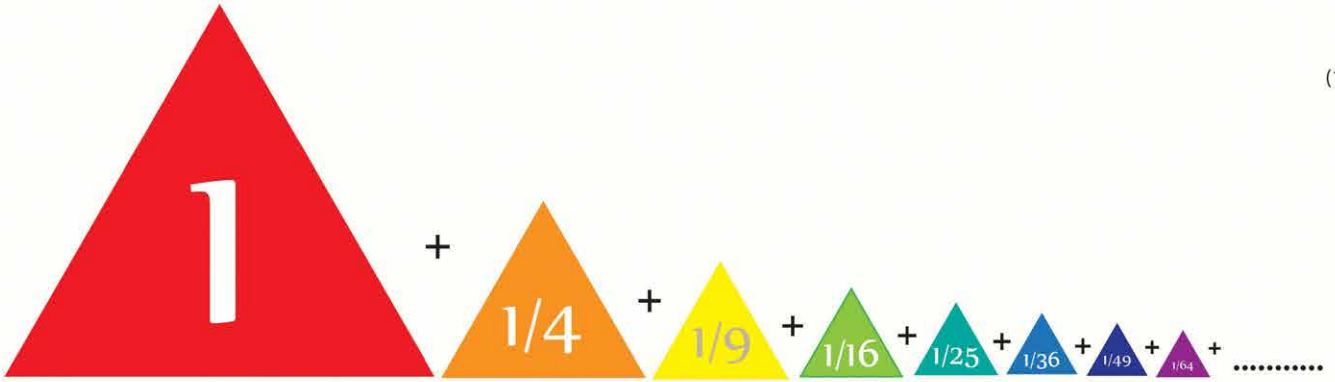

The Basel problem asks for the precise summation of the reciprocals of the squares of the natural numbers, i.e. the precise sum of the infinite series

$$f(n) = 1/n^2$$

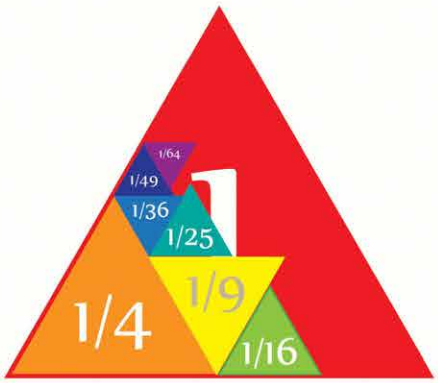

$$\approx$$

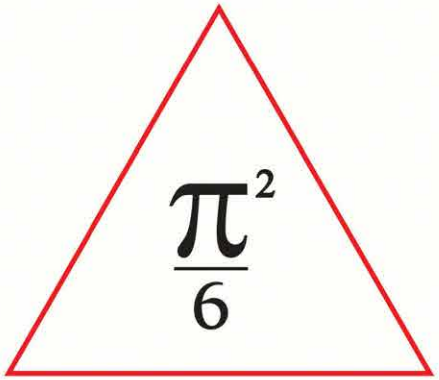

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Integrals of mass-energy

is a means of finding scalar areas using summation and limits.

Integration is a micro adding of ***CONTINUOUS*** quantities.

$$\int_{n}^{\infty} f(x)$$

Integration is a special case of summation.

Integration is defined as the limit of a summation as the number of elements approches infinity while a part of their respective value approaches zero.

Summation is the finite sum of multiple, fixed values.

$$\sum_{n}^{\infty} x$$

Summation is a macro adding of ***DISCRETE*** quantities.

The summation of equilateral energy momenta quanta with respect to their linear vector components

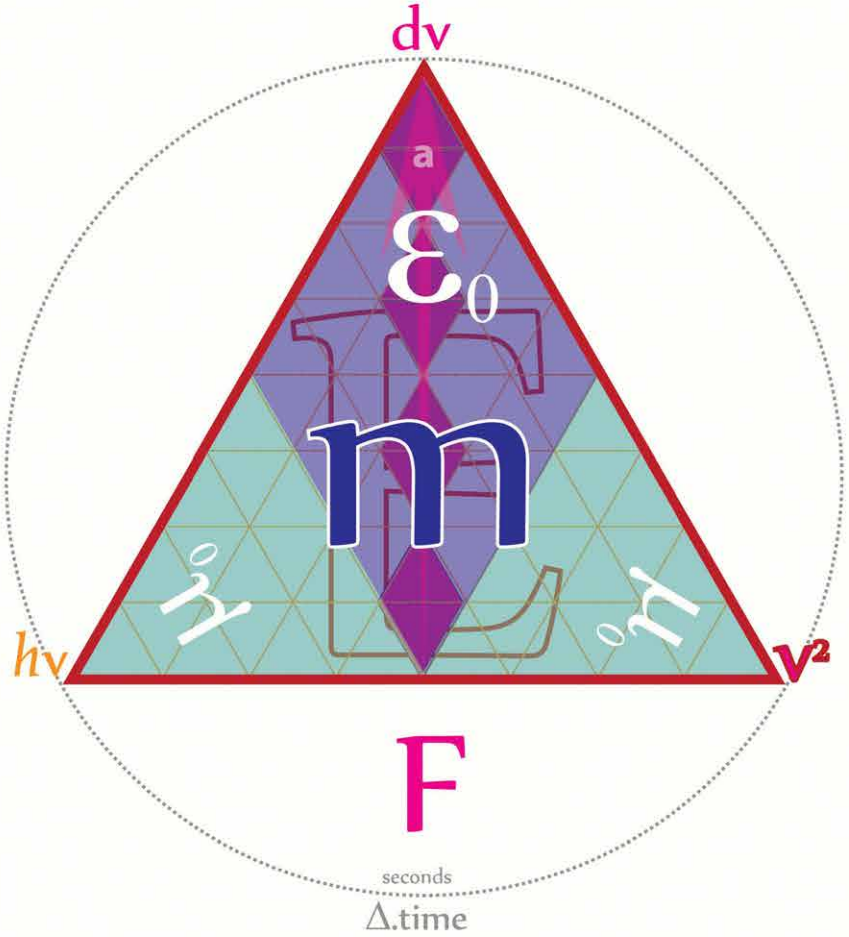

Integrating the energy quanta contained within equilateral charge geometry gives the variable Force required to acheive changes in motion [Energy, work, acceleration]

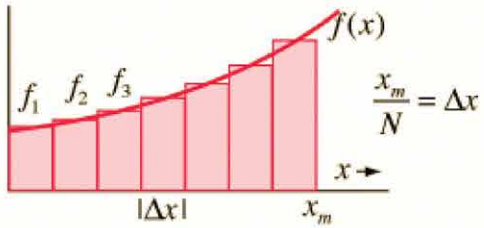

The Integral of the continuous area under the curve is the summation of an infinte number of disctrete rectangular measurements made to a specified limit

An integration isn't a simple summation, but the limit of a sequence of summations

All Planck energies are discrete equilateral geometries

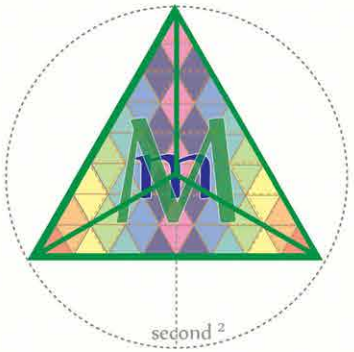

mass is the surface integral of EM energy geometries per unit of time

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"The calculus of infinitesimals"

The fundamental theorem of calculus
simply states that the sum of infinitesimal changes in a quantity over time
adds up to the net change in the quantity.

Scalar Energy

$E = mv^2$

Leibniz's vis viva (Latin for living force) is mv2,

[2 x kinetic energy]

Gottfried Wilhelm von Leibniz

(July 1, 1646 – November 14, 1716)

vector Force

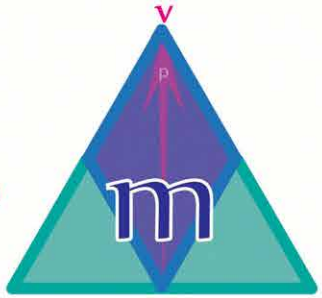

$F = m[dv/dt]$

Much of Newton's work centred around momentum and changes to it

[mass.velocity]

Sir Isaac Newton

(1643-1727)

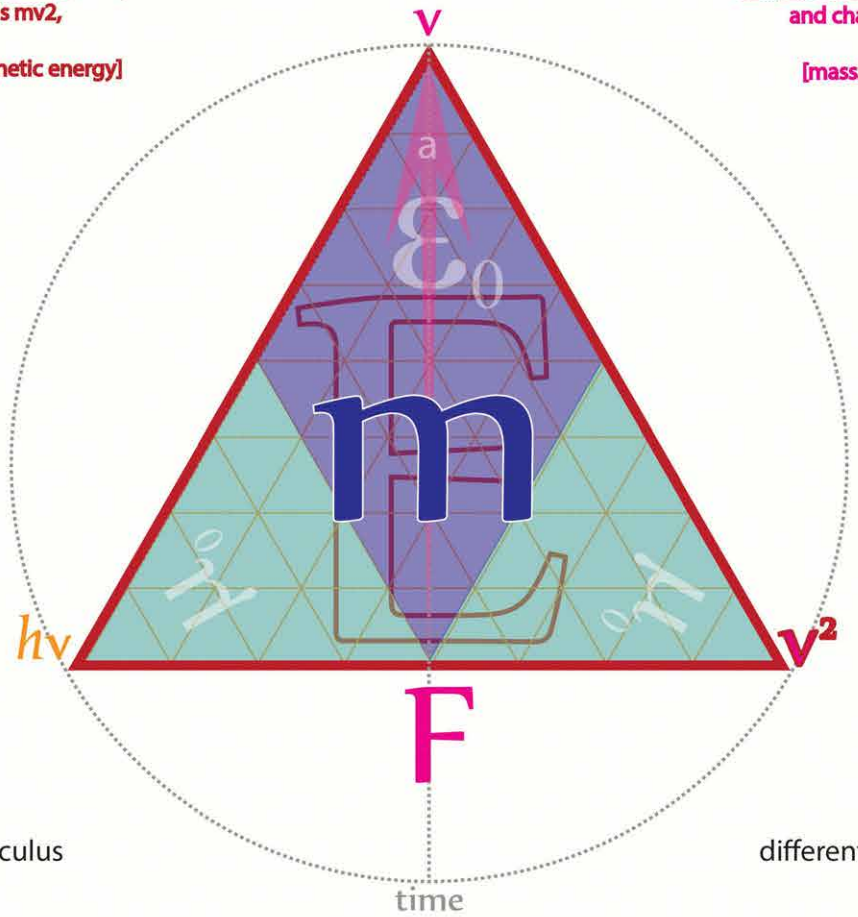

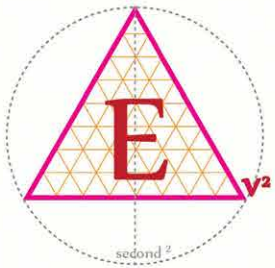

integral calculus

The founders of calculus thought of the integral as an infinite sum of rectangles of infinitesimal width

differential calculus

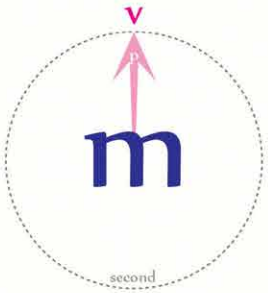

In calculus, a branch of mathematics, the derivative is a measure of how a function changes as its input changes

The fundamental theorem of calculus is a theorem that links the concept of the integral with the derivative of a function.

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Energy momentum geometries

Leibniz
scalar energies

linear momentum is the square root vector force of the scalar energy required to do a set amount of work

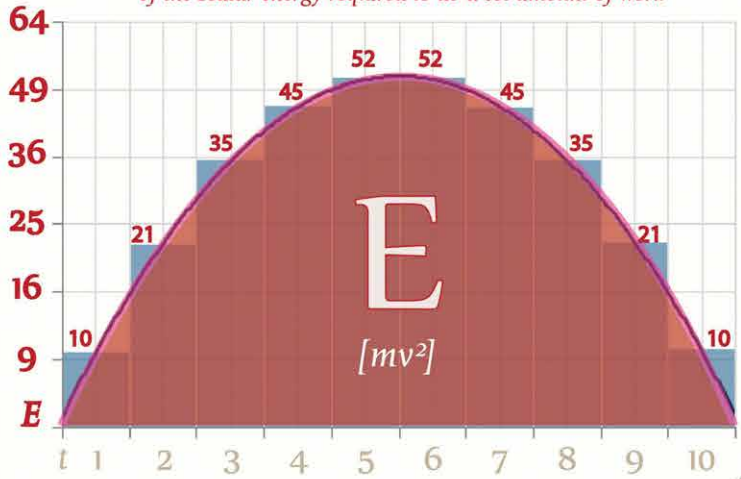

$$E = p^2$$

Energy momentum

$$kg\left[\frac{m}{s}\right]^2$$

Newton
linear momentum

$$d[mv]/dt = dp/dt = ma$$

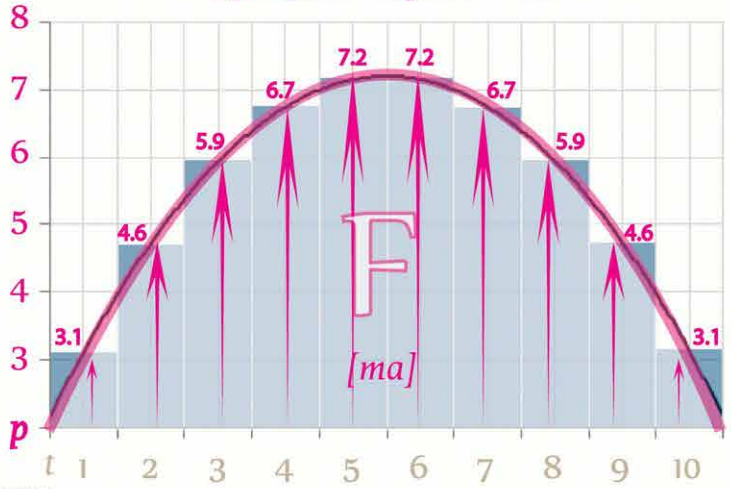

print out this page

then cut out the 10 Planck energy momenta triangles shown

slice fine lines along the pink linear momentum arrows with a razor blade or similar as highlighted under the Newtonian acceleration curve

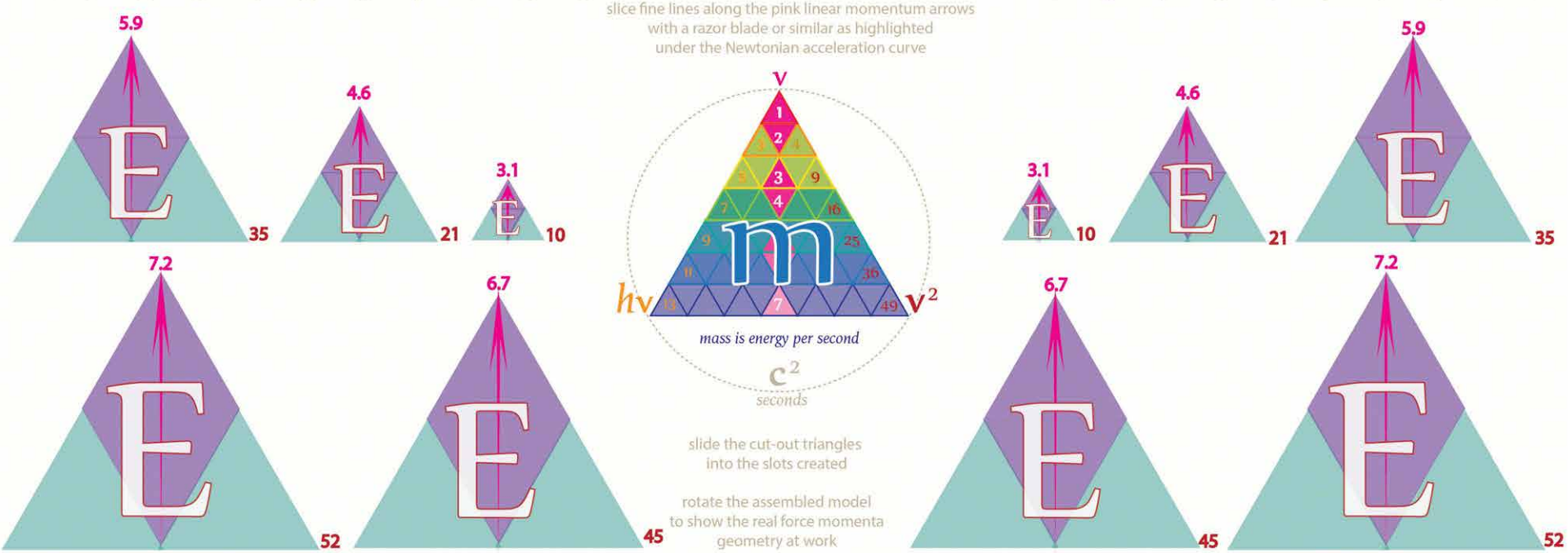

slide the cut-out triangles into the slots created

rotate the assembled model to show the real force momenta geometry at work

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linear momentum is the square root vector force
of the scalar energy required to do a set amount of work

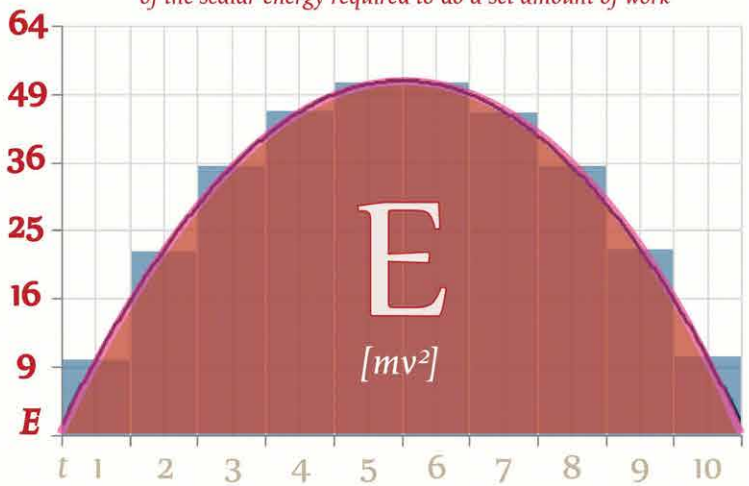

p

linear momentum

$kg\frac{m}{s}$

print out this page

$d[mv]/dt = dp/dt = ma$

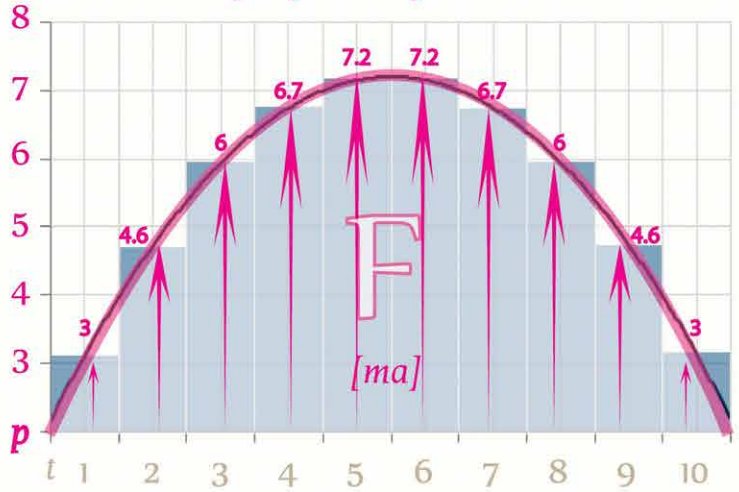

Leibniz
scalar energies

$$E = mv^2$$

mass-energy momenta relationship

square root equilateral energy is linear momentum

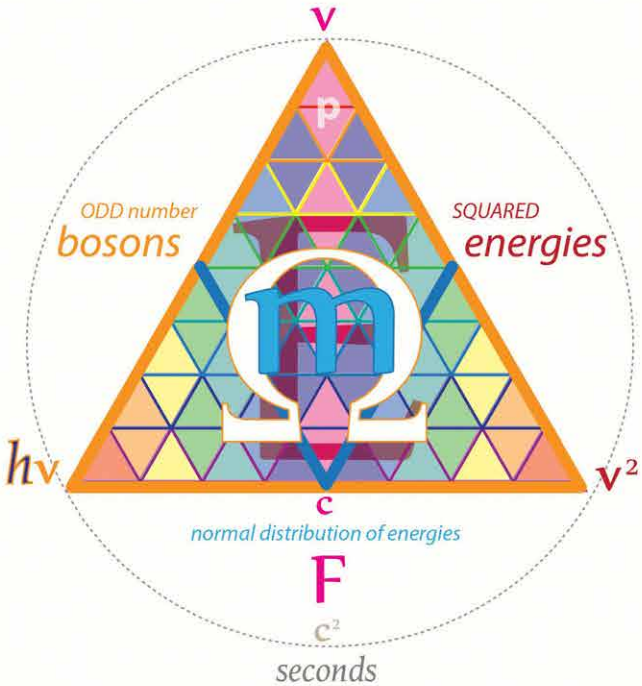

Newton
linear momentum

$$F = ma$$

mass is a scalar constant relating Force to acceleration

$$F = m\frac{\Delta v}{\Delta t}$$

Planck quanta and their vector linear momentum
lie at 90 degrees to the angle use in the graphs of motion in calculus

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Differentiation

Differentiation is concerned with things like speeds and accelerations, slopes and curves etc.
These are Rates of Change, they are things that are defined locally.

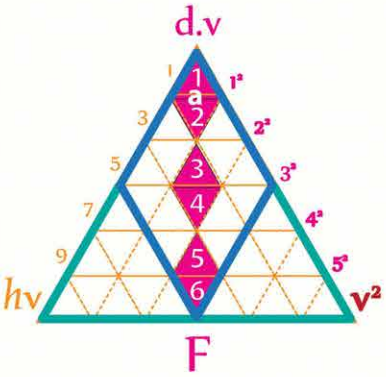

An increase in a force opposing an object's vector velocity results in
DECCELERATION

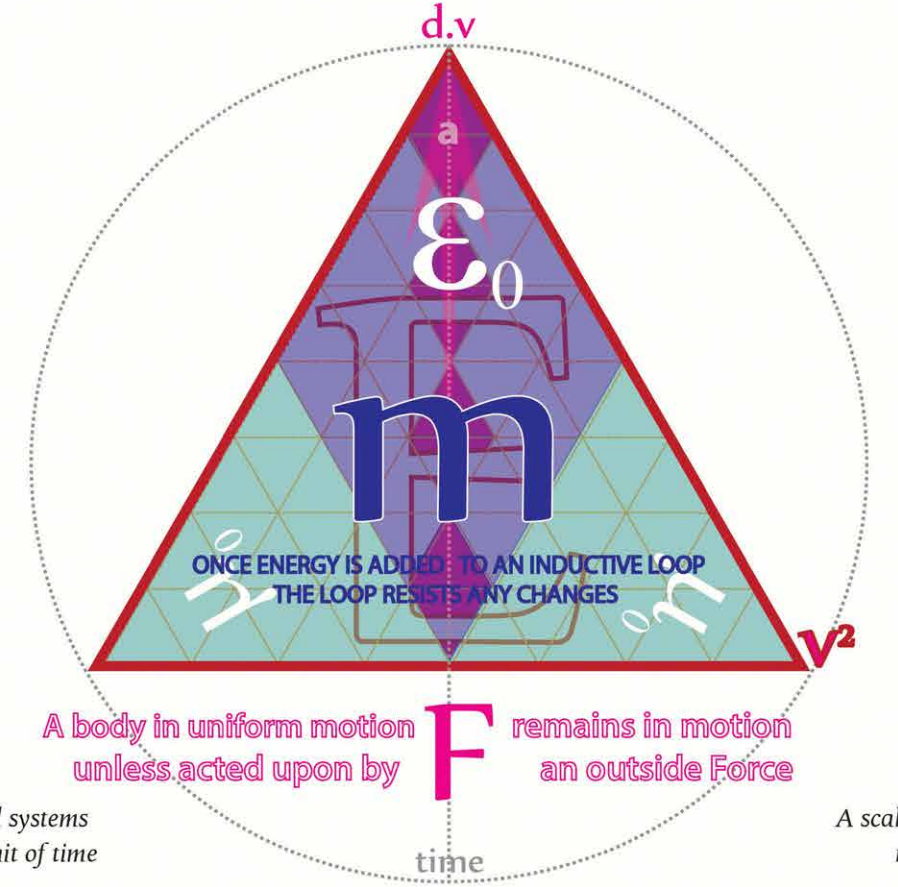

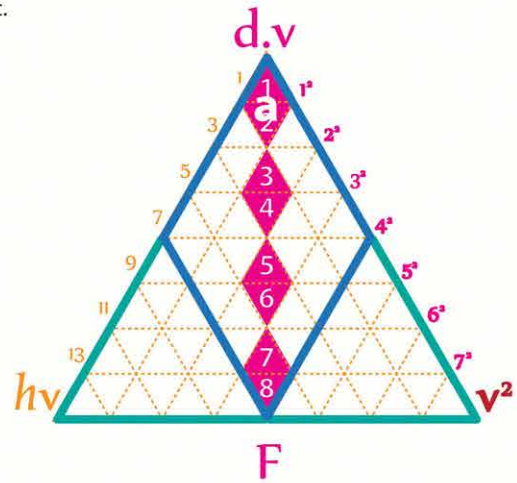

An increase in a force in line with an object's vector velocity results in
ACCELERATION

A linear measure of Forces acting on physical systems resulting in changes to distance covered per unit of time

A scalar measure of Forces acting on physical systems resulting in changes to their rate of motion

$$v = \frac{\Delta d}{\Delta t}$$

$$= m/s$$

$$F = ma$$

In physics, the derivative of the displacement of a moving body with respect to time is the velocity of the body, and the derivative of velocity with respect to time is acceleration.

$$\sum \mathbf{F} = \frac{d\mathbf{p}}{dt} = m\frac{d\mathbf{v}}{dt} + \mathbf{v}\frac{dm}{dt}$$

Newton's second law of motion states that the derivative of the momentum of a body equals the force applied to the body.

$$a = \frac{\Delta v}{\Delta t}$$

$$= m/s^2$$

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Visualising the geometric half-truths of relativistic physics

The source of all the physical relationships of mass-energy momenta and the constants in Physics is the Equilateral Triangle (and all texts must be corrected)

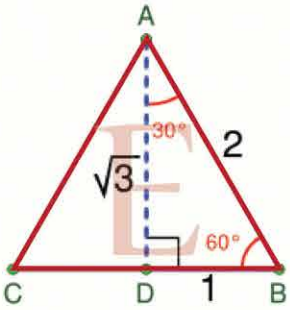

Energy geometries within Physics including Special Relativity with its Lorentz corrections have historically been incorrectly illustrated through the geometry of right angled triangles

F

$$\sum \mathbf{F} = \frac{\mathrm{d}\mathbf{P}}{\mathrm{d}t} = m\frac{\mathrm{d}\mathbf{v}}{\mathrm{d}t} = m\mathbf{a}$$

$$\mathbf{F} = m\mathbf{a}\,.$$

Physics is geometry, one cannot be separated from the other

Equilateral geomtries lead to a intuitive understandings of Physics, Chemistry, Electrodynamics and Gravitation along with all the other apsects of Nature.

$$mv^2 = E = hv^2$$

ENERGY

6.629432673 e-34 J

Planck quanta

$$[m\Omega v^2]$$

mass velocity

7.376238634 e-51 kg

momentum

$$p^2 = mv^2$$

$$E = m_0c^2 + K$$

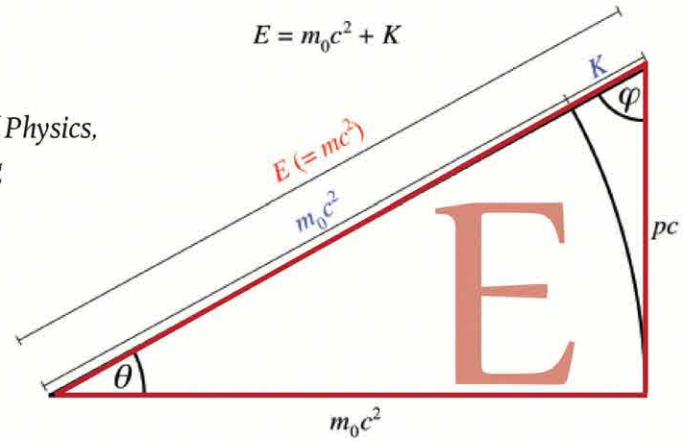

$$E^2 = p^2c^2 + m_0^2c^4$$

Generalizing, we see that the square of the total energy, mass, or distance in spacetime is the sum of the components squared.

We can see an origin of distance in spacetime relating to velocity in pc in which Energy is subject to Lorentz corrections [v/c]

$$E = pc.$$

Additionally, EM mass can be directly related tot the Energy content of a body by the velocity of Energy

$$E = mc^2$$

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Velocity

In physics, velocity is the measurement of the rate and direction of change in the position of an object.

It is a vector physical quantity; both magnitude and direction are required to define it.

The scalar absolute value (magnitude) of velocity is speed, a quantity that is measured in metres per second (m/s or ms−1) when using the SI (metric) system.

$\frac{m}{s}$

Speed is the scalar value of the Distance traveled per unit of TIme

$$\bar{\mathbf{v}} = \frac{\Delta \mathbf{x}}{\Delta t}.$$

Velocity is the vector value of the Distance traveled per unit of Time

$\frac{\vec{m}}{s}$

Velocity squared is the scalar value of the Distance traveled per unit of Time squared (Energy of a given spatial volume)

$\frac{m^2}{s^2}$

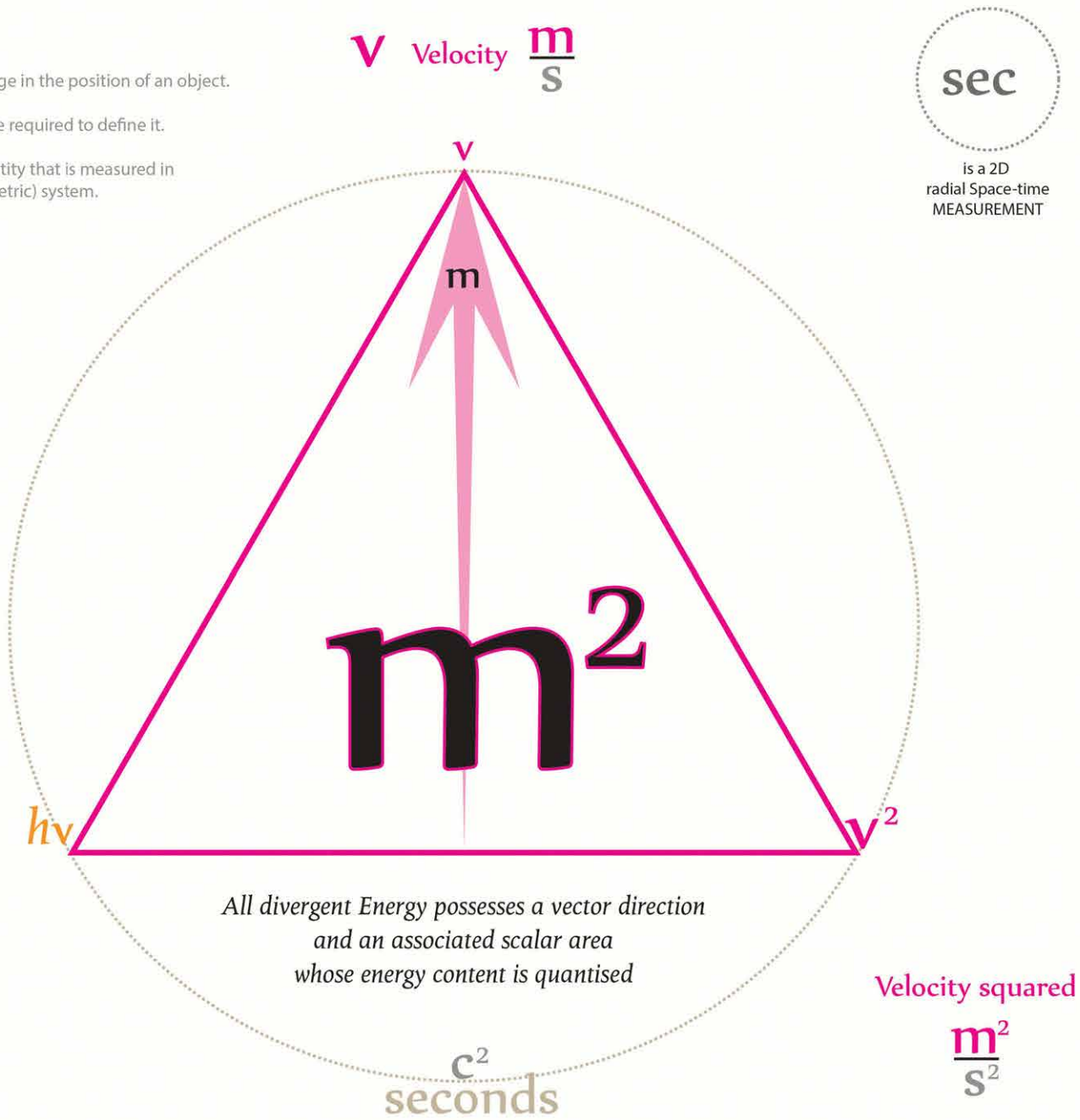

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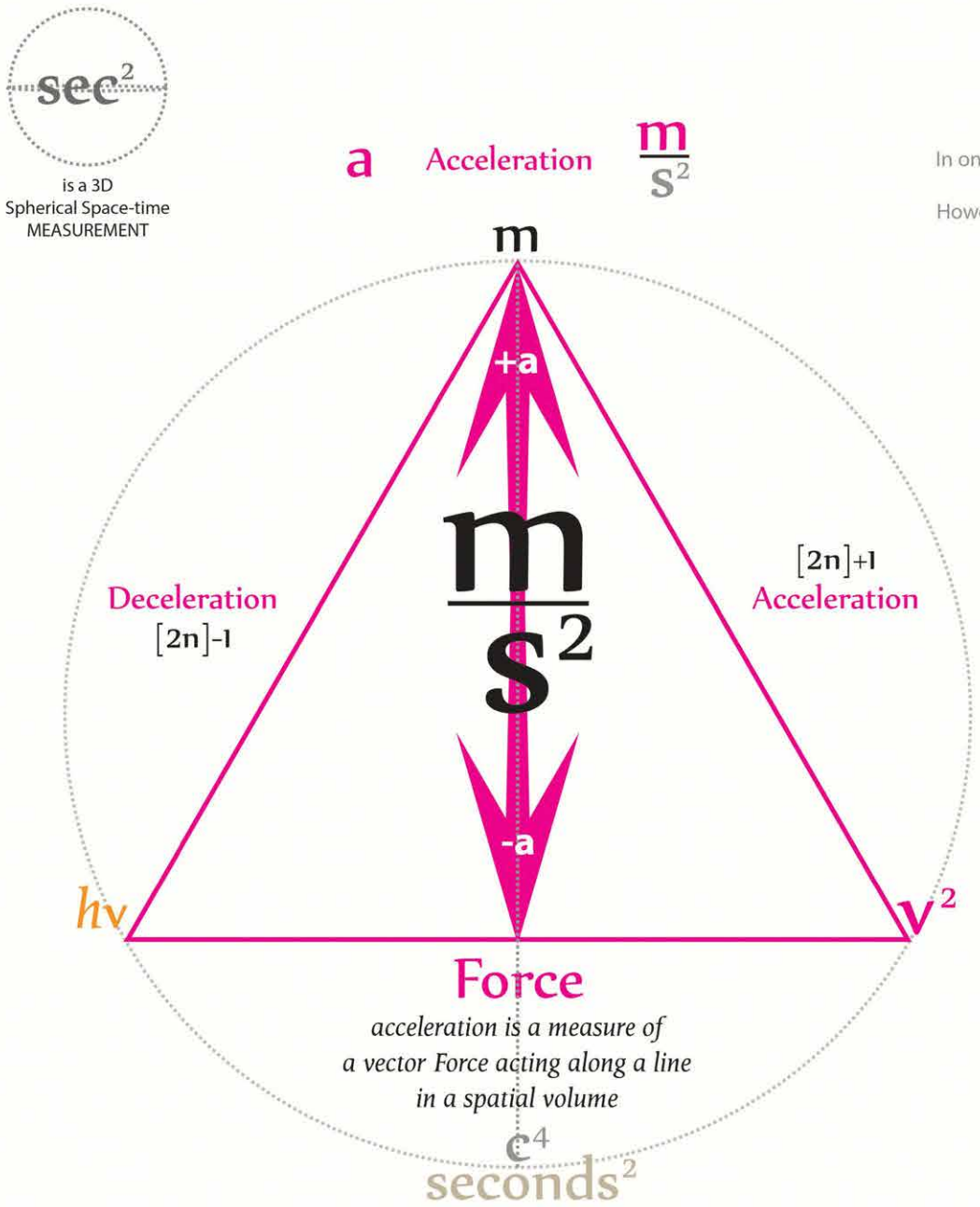

Acceleration

In physics, acceleration is the rate of change of velocity over time [dt]

In one dimension, acceleration is the rate at which something speeds up or slows down.

However, since velocity is a vector, acceleration describes the rate of change of both the magnitude and the direction of velocity.

Acceleration has the dimensions [Length]/[Time Squared]
In SI units, acceleration is measured in meters per second squared (m/s^2).

$$a = \frac{\Delta y}{\Delta x} = \frac{\Delta v}{\Delta t}.$$

In classical mechanics, for a body with constant mass,
the acceleration of the body is proportional to the net force acting on it
(Newton's second law)

$$F = ma \longrightarrow a = F/m$$

Force

$$kg\,\frac{m}{s^2}$$

Additionally, for a mass with constant velocity,
(ie in an inertial frame)
the energy of motion is expressed as its momentum
(acceleration causes changes in Energy-momentum)

$$p = kg\,\frac{m}{s}$$

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Momentum

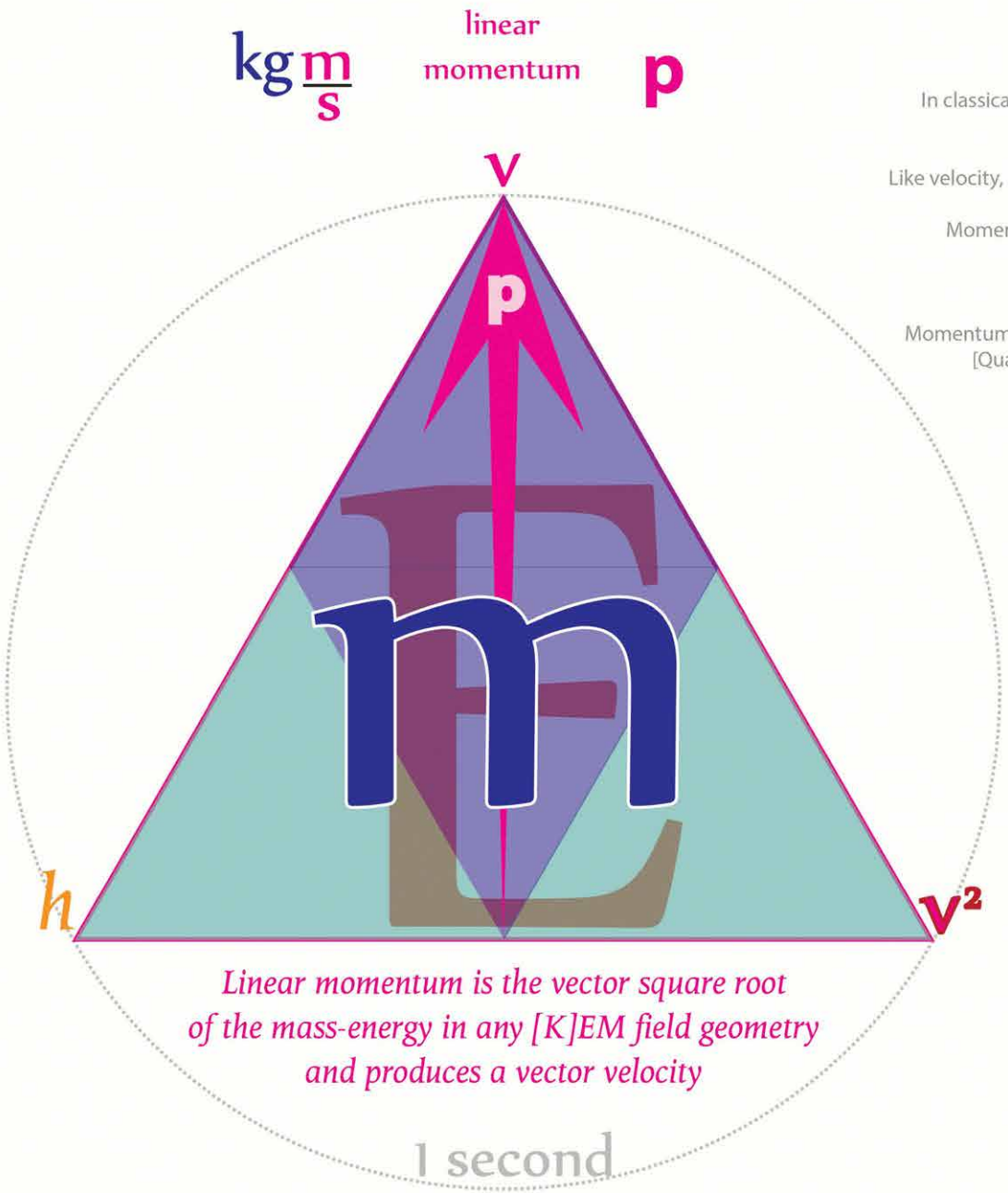

In classical mechanics, momentum (pl. momenta; SI unit kg·m/s, or, equivalently, N·s) is the product of the mass and velocity of an object (p).

Like velocity, momentum is a vector quantity, possessing a direction as well as a magnitude.

Momentum is a conserved quantity (law of conservation of linear momentum), meaning that if a closed system is not affected by external forces, its total momentum cannot change.

Momentum should be referred to in its specific forms to distinguish it in its various forms [Quantised Angular, Linear, Rotational and quantum/nuclear momentum]

$$\mathbf{p} = \frac{h\mathbf{v}^2}{\mathbf{v}} = m\mathbf{v}$$

Although originally expressed in Newton's Second Law, the conservation of momentum also holds in special relativity and, with appropriate definitions, a (generalized) momentum conservation law holds in electrodynamics, quantum mechanics, quantum field theory, and general relativity.

In relativistic mechanics, non-relativistic momentum is further multiplied by the Lorentz factor.

$$\mathbf{p}^2 = E = m\mathbf{v}^2$$

Energy can be expressed as the square of linear momentum

$$\mathrm{kg}\,\frac{\mathrm{m}^2}{\mathrm{s}^2}$$

equilateral Planck energy momenta

$$m\Omega\mathbf{v}^2$$

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Energy-momentum relationship

The total number of equilateral Planck quanta [quantised mass-energy momenta] is directly related to the square of its linear momentum [mass-velocity]

Quantum Mechanics

$$h = \frac{E}{v^2}$$

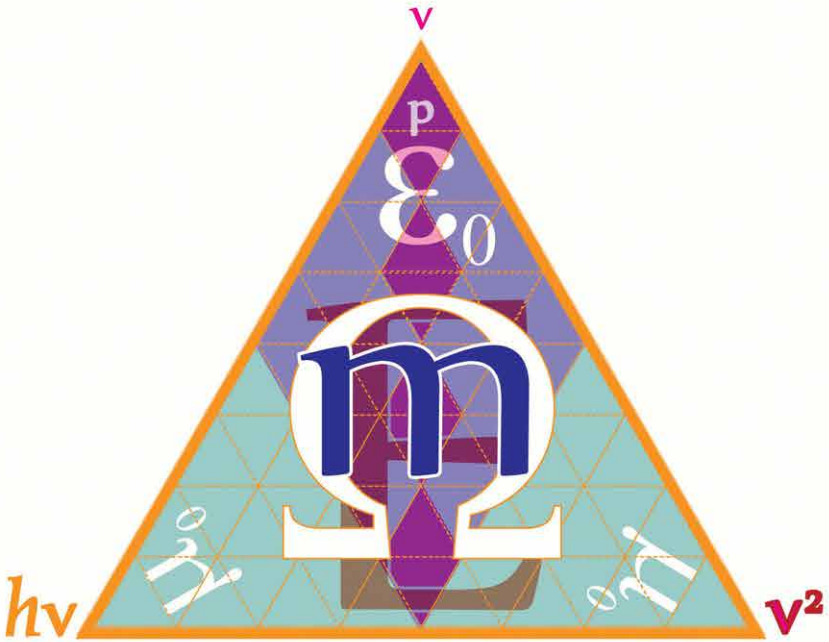

Newtonian physics

$$m = \frac{E}{v^2}$$

Quantised energy equilateral momenta

$$hv^2$$

Quantised Energy momenta is related to Scalar mass energy momenta through the equilateral geometry of Planck's constant

Scalar energy linear momentum

$$pv$$

$$m\Omega v^2 = E = mv^2$$

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Inertial resistance to Force

Inertia is the resistance of any physical object
to a change in its state of motion.

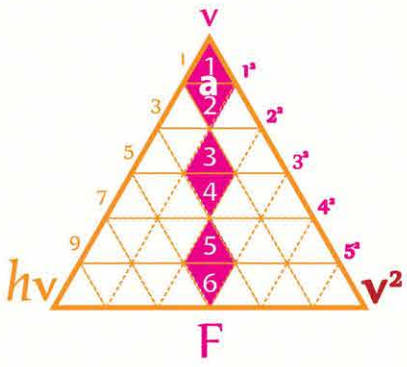

Changes to mass-velocity require a corresponding change to boson quanta

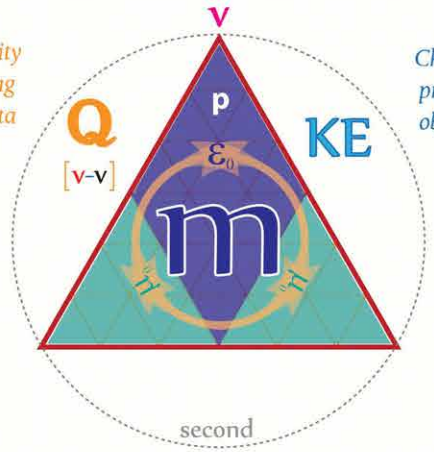

Changes to mass-velocity produces a change in an object's Kinetic Energies

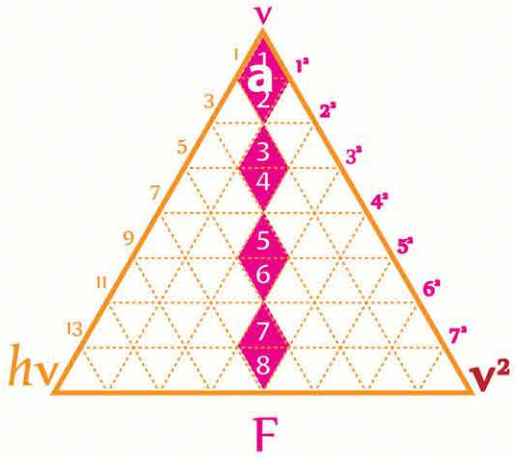

$$E = mc^2$$

The total intrinsic momenta of all energy waveforms is the sum of their constituent Quantised Angular momenta (mass-energy momenta)

$$M_0 = m/c^2$$

Any change in motion results in changes to the Charge geometries creating in turn proportional changes to KEM mass and momenta components

$$F = ma$$

The 'inductive resistance' of Charge quanta fields to changes in their mass-energy momenta content is what we term Inertia

$$KEM = Mv^2$$

Matter in motion has Kinetic Energies in addition to invariant rest mass-Energy

KE = RE - rest Matter

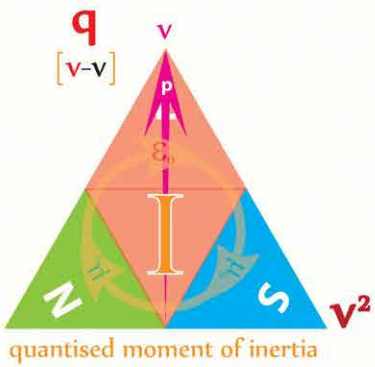

Any change to an object's velocity results in a corresponding change to its mass-Energy momenta which is reflected by its inertia

$$p^2 = E = mv^2$$

Inertial mass can be related to Charge through inductive Planck quanta

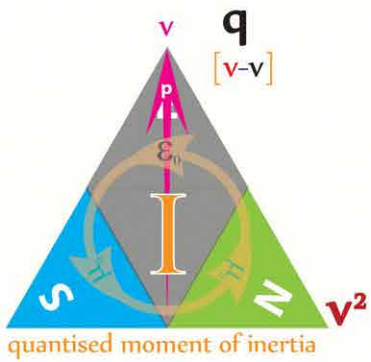

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Quantised Angular momentum

As it is a physical [equilateral] geometry QAM is conservative in any system where there are no external Forces and serves as the foundational geometric source for all the conservation laws of physics

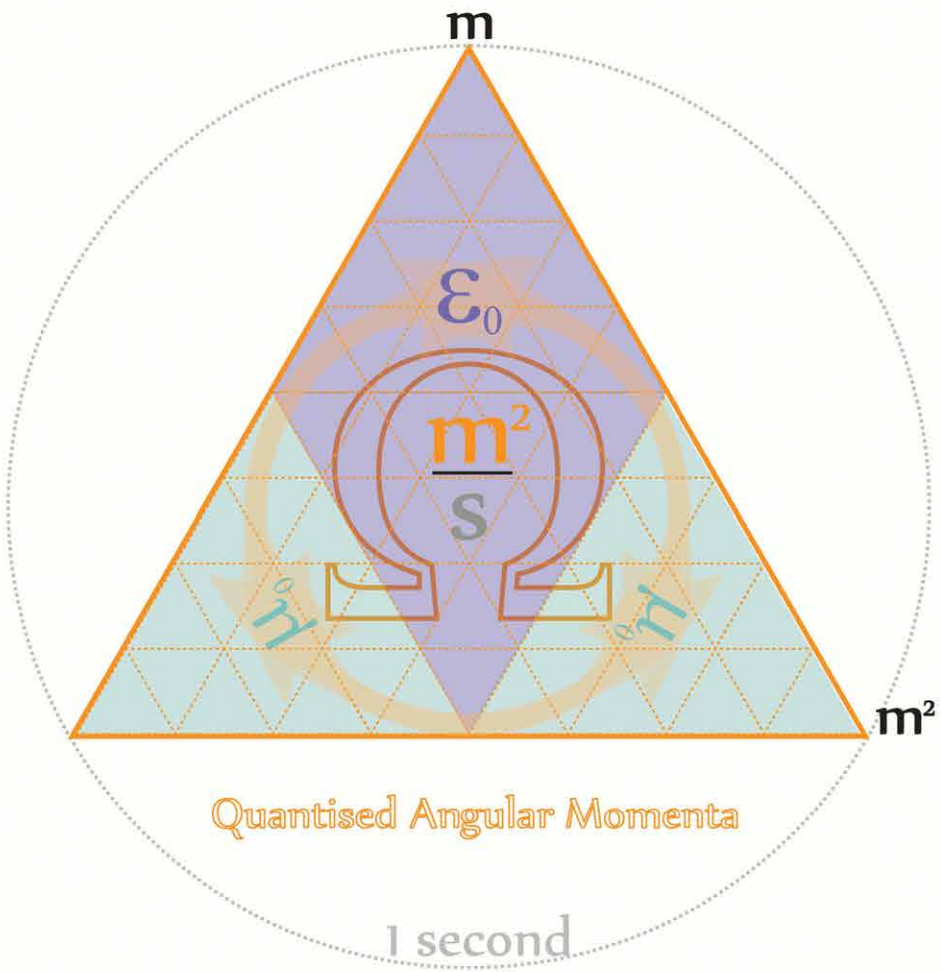

Angular momentum is sometimes described as the rotational analog of linear momentum, in Tetryonics it is revealed to be the equilateral geometry of quantised mass-energy momenta within any defined space-time co-ordinate system

A major re-definition of quantised angular momentum in physics is revealed

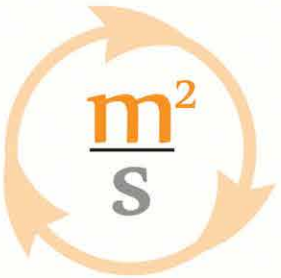

classical rotational angular momentum

≈

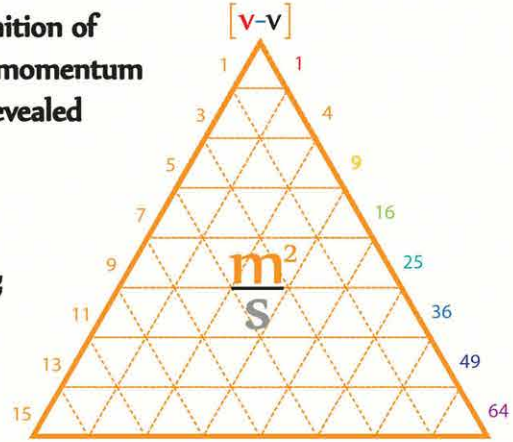

Quantised Angular momentum

In quantum mechanics, angular momentum is quantised – that is, it cannot vary continuously, but only in ODD number "quantum steps" between the allowed SQUARE nuclear Energy levels

In physics, angular momentum, moment of momentum, or rotational momentum is a conserved vector quantity that can be used to describe the overall state of a physical system.

When applied to specific mass-Energy-Matter systems QAM reveals the true quantum geometry and nature of Energy in our universe

h

$kg\frac{m^2}{s}$

$m\Omega$

mass x QAM

Planck's Constant

Normally viewed as an expression of rotational momentum Quantised Angular Momentum [QAM] is in fact a result of the equilateral geometric quantization of mass-energy

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Charged geometries

All charge geometries are nett divergent

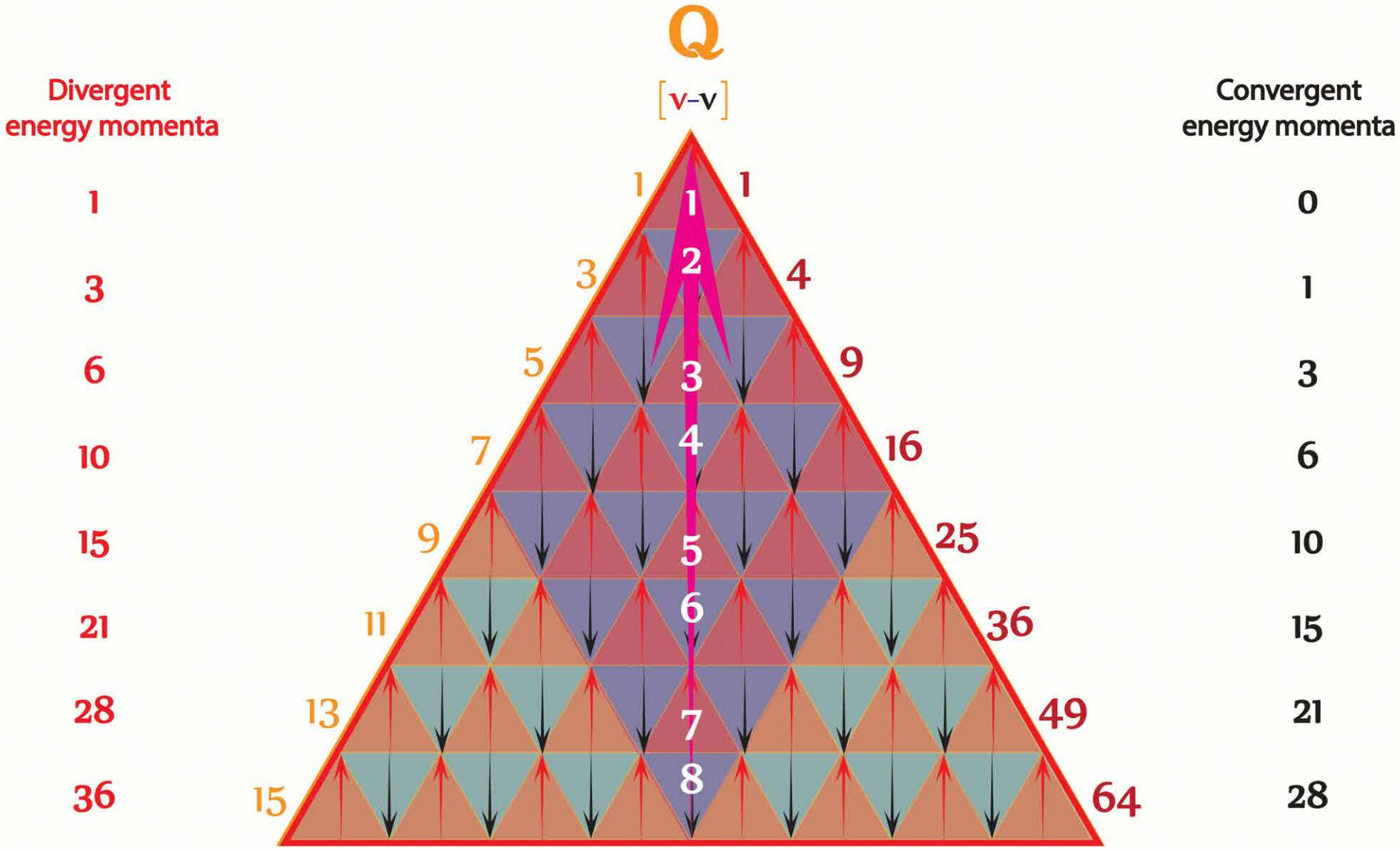

All charge geometries are comprised of finite equilateral energy momenta quanta

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Renormalisation

Renormalization was first developed in quantum electrodynamics (QED) to make sense of infinite integrals in perturbation theory. The problem of infinities first arose in the classical electrodynamics of point particles in the19th and later in the calculation of Gravitational fields in General Relativity in the early 20th century.

In QED Infinities must be cancelled

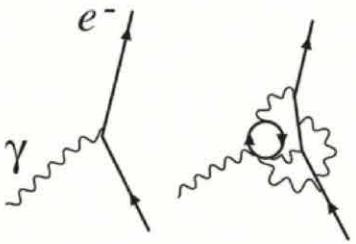

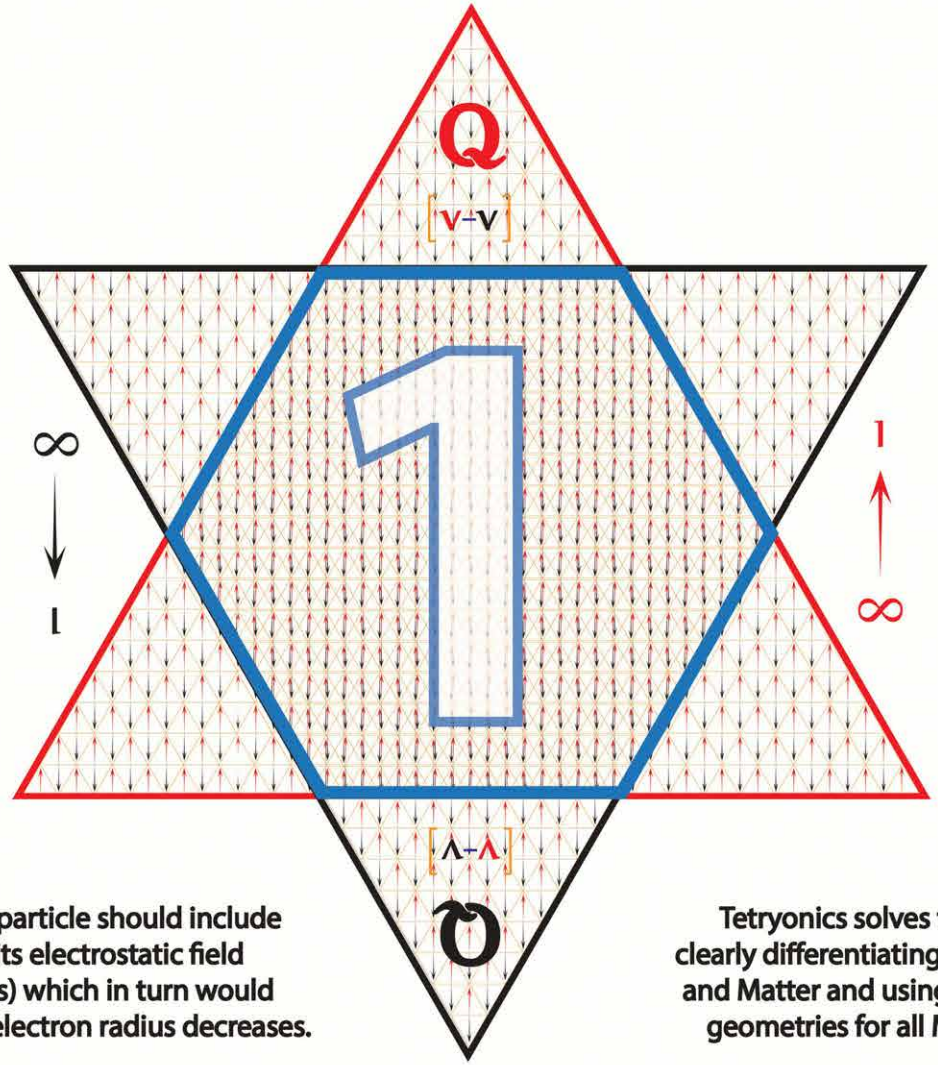

In Tetryonics Infinities do not exist

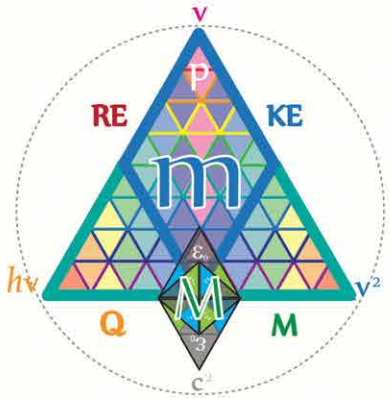

The mass of a charged particle should include the mass-energy in its electrostatic field (Electromagnetic mass) which in turn would approach infinity as the electron radius decreases.

Tetryonics solves the problem by clearly differentiating between EM mass and Matter and using finite equilateral geometries for all Matter in motion

Initially viewed as a suspicious provisional procedure by some of its originators, renormalization was eventually embraced as an important and self-consistent tool in several fields of physics and mathematics.

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2D space [c²]

The adjective Cartesian refers to the French mathematician and philosopher René Descartes who developed the coordinate system in 1637

Since then many other coordinate systems have been developed such as the polar coordinates for the plane, and the spherical and cylindrical coordinates for three-dimensional space.

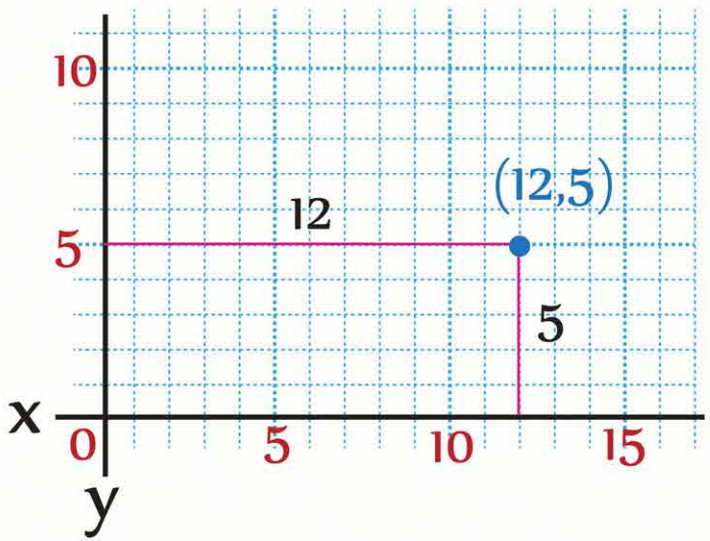

Cartesian coordinates are the foundation of analytic geometry, and provide enlightening geometric interpretations for many other branches of mathematics, such as linear algebra, complex analysis, differential geometry, multivariate calculus, group theory, and more

Mapping 3D spaces using Recti-linear co-ordinates

Cartesian coordinates can be defined as the positions of the perpendicular projections of a point onto the two or more axes, expressed as signed distances from the origin.

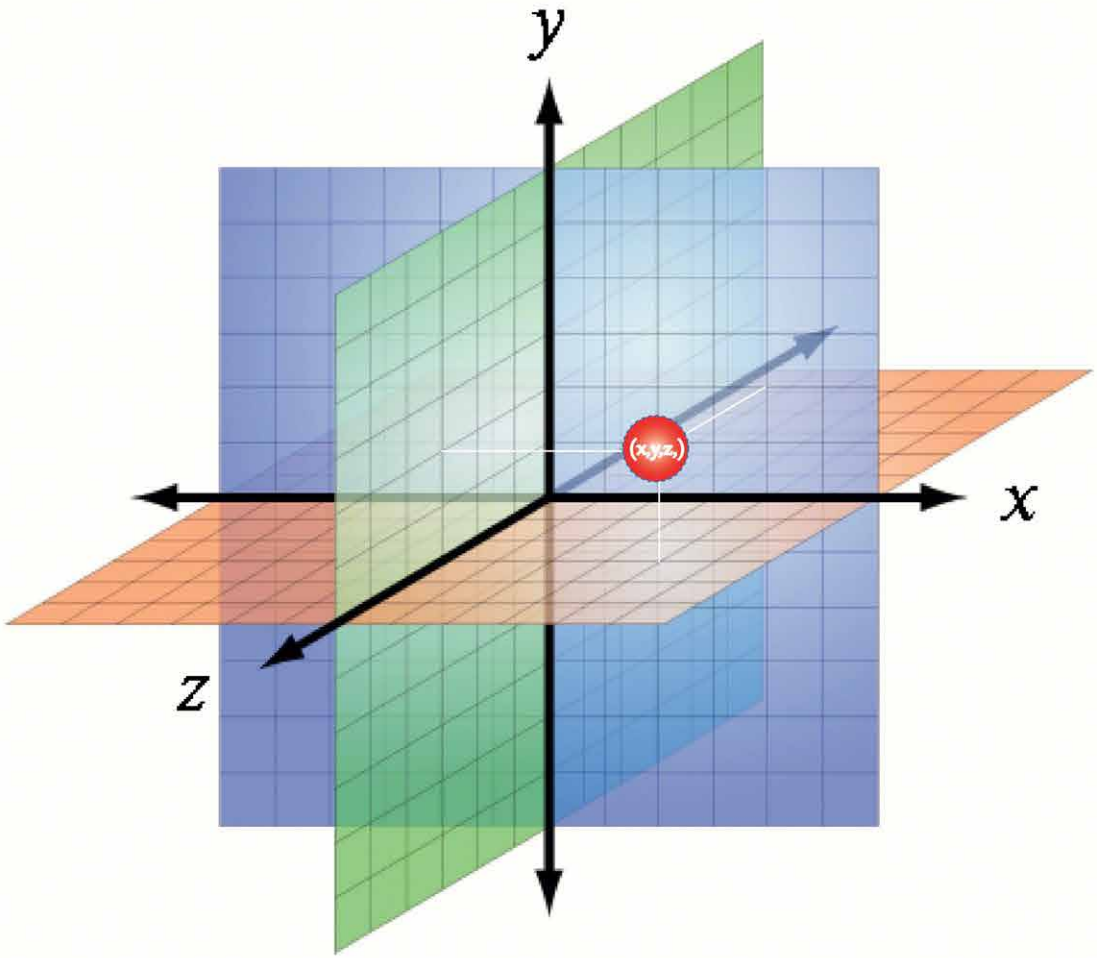

3D Cartesian co-ordinate [c³] systems are distinct from spherical co-ordinate [c⁴] systems

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Polar co-ordinates

In mathematics, the polar coordinate system is a two-dimensional co-ordinate system in which each point on a plane is determined by a distance from a fixed point and an angle from a fixed direction.

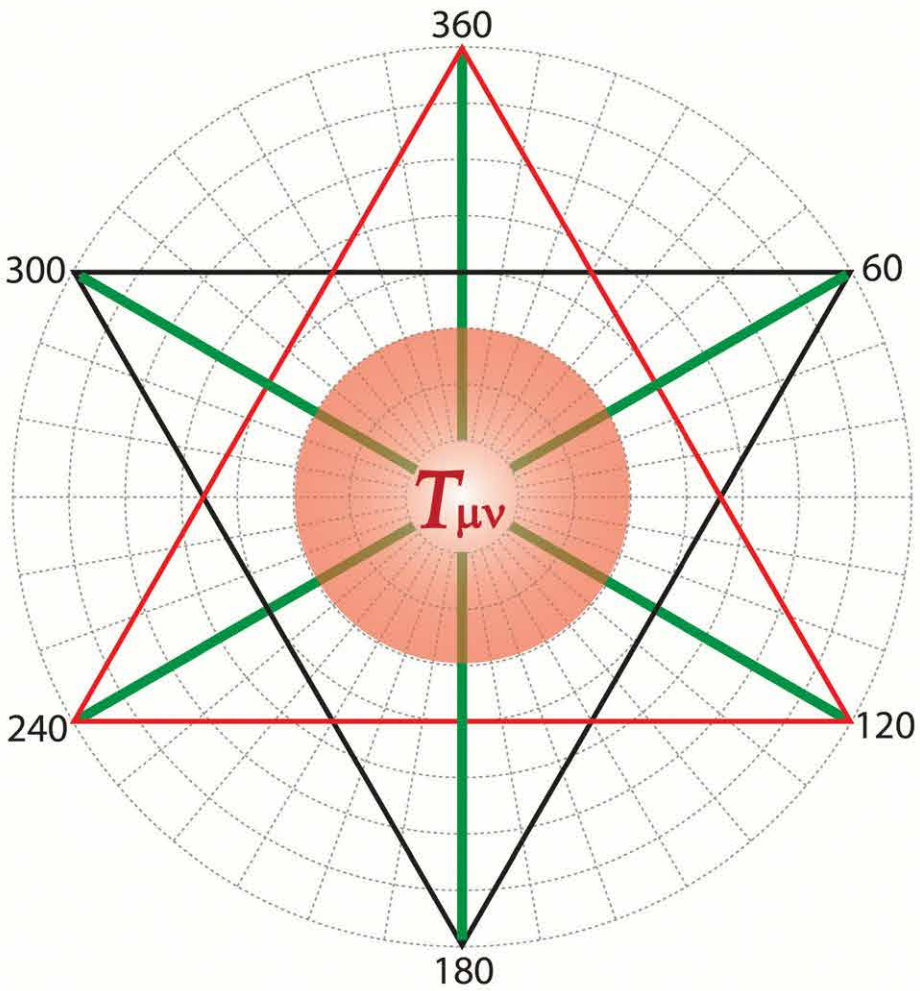

In geometry, curvilinear coordinates are a coordinate system for Euclidean space in which the co-ordinate lines may be curved.

Action Dynamics

Curvilinear co-ordinates may be derived from a set of rectilinear Cartesian coordinates by using a locally invertible transformation that maps one point to another in both systems

Metric Tensors

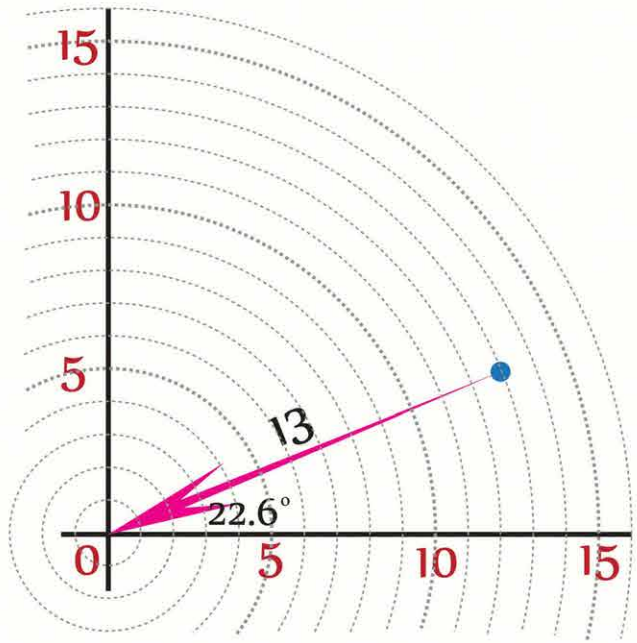

Gravitational acceleration

Polar or curvilinear co-ordinate systems are used extensively by Einstein in his theory of General Relavtivity

Reimannian curved space-time

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Co-ordinate transformations

There are many different possible coordinate systems for describing geometrical figures and they can all be related to one another.

Such relations are described by coordinate transformations which give formulas for the coordinates in one system in terms of the coordinates in another system

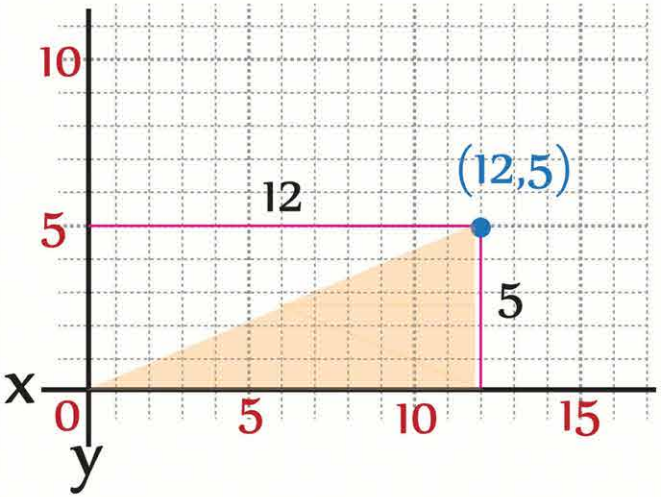

Converting between Polar and Cartesian coordinates

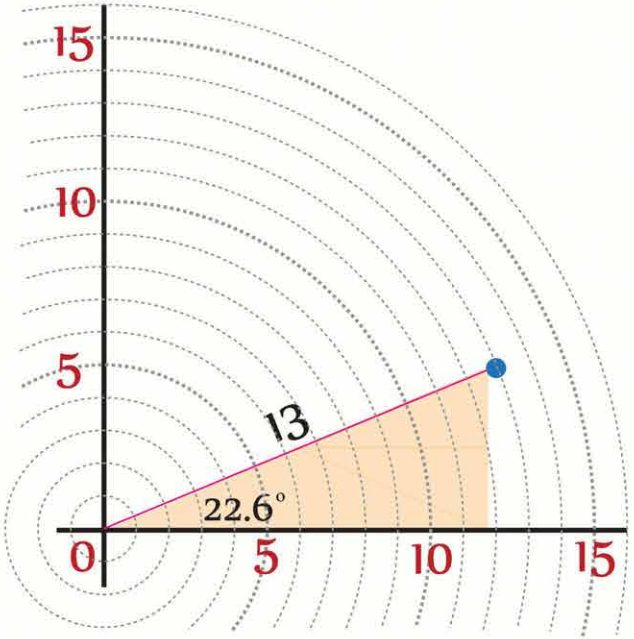

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$= \tan^{-1}(5/12)$$

$$= 22.619$$

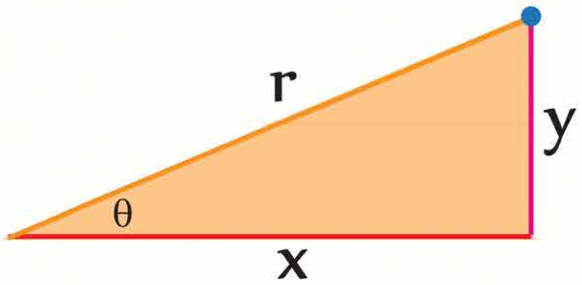

$$r^2 = 12^2 + 5^2$$

$$= \sqrt{169}$$

$$= 13$$

solving for the triangle using trigometric functions

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Spatial co-ordinate systems

Spacetime is any mathematical co-ordinate system or model that combines space and time into a single continuum.

Spacetime is usually interpreted with space as being three-dimensional with time playing the role of a fourth dimension that is different from the spatial dimensions.

From a Euclidean space perspective, the universe has three spatial dimensions and one dimension of time [reflected by quantised angular momentum].

Cubic

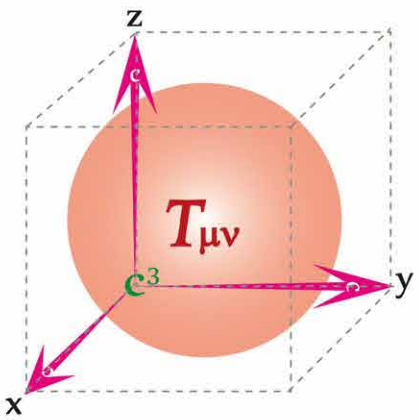

Spherical

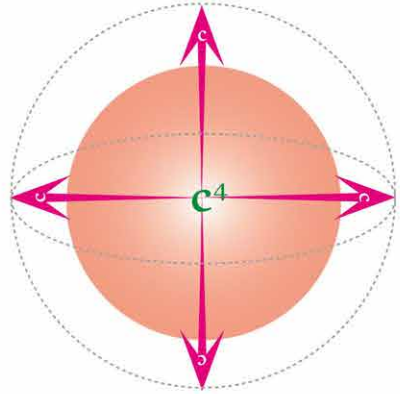

seconds²

Tetryonics maps spatial co-ordinates through the momenta vectors of equilateral Energy

Cartesian Space-Time

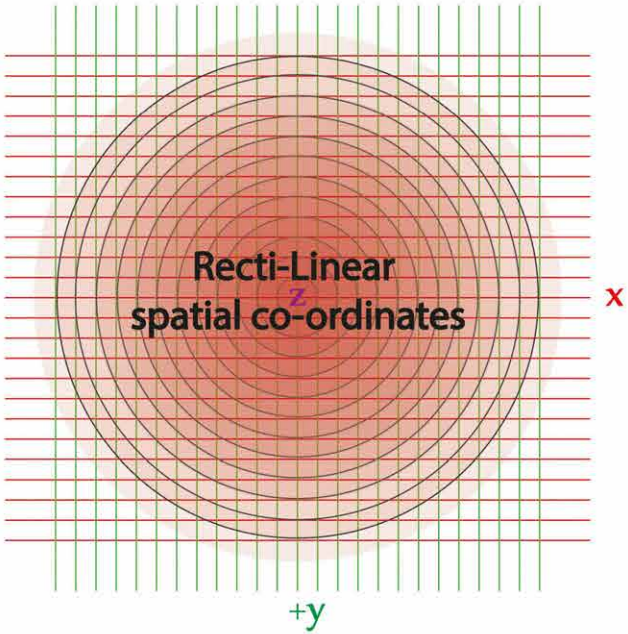

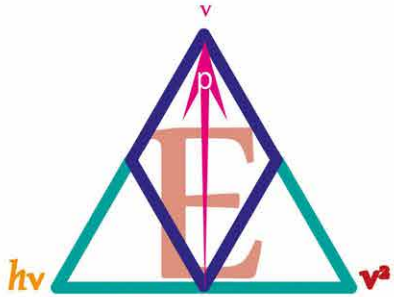

EM mass-ENERGY momenta are equilateral geometries

Mapping equilateral Energy geometries onto recti or curvi-linear spatial co-ordinate systems introduces mathematical complexity to a otherwise simplistic geometry for all EM mass-Energy-Matter interactions

Tetryonic Space-Time

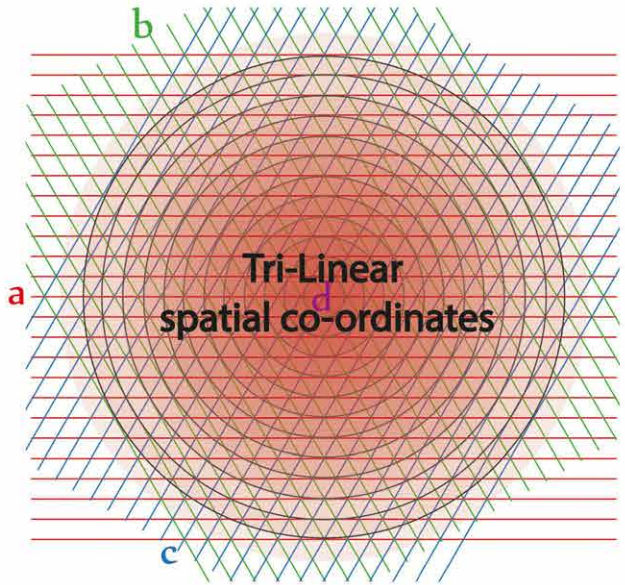

In physics spatial co-ordinates to date have been based on Cartesian co-ordinates when in fact Energy momenta follow a Tri-Linear co-ordinate geometry

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vectors

1 Dimensional velocity

Euclidean

2 Dimensions velocity squared

$$m = \frac{E}{c^2}$$

mass-energy equivalence

mass-Matter

$$\frac{m}{c^2} = M$$

equivalence

$T_{\mu\nu}$

energy-Matter equivalence

$$M = \frac{E}{c^4}$$

GR fails differentiate betweem EM mass-ENERGY-Matter unlike Tetryonic theory

Cartesian co-ordinates

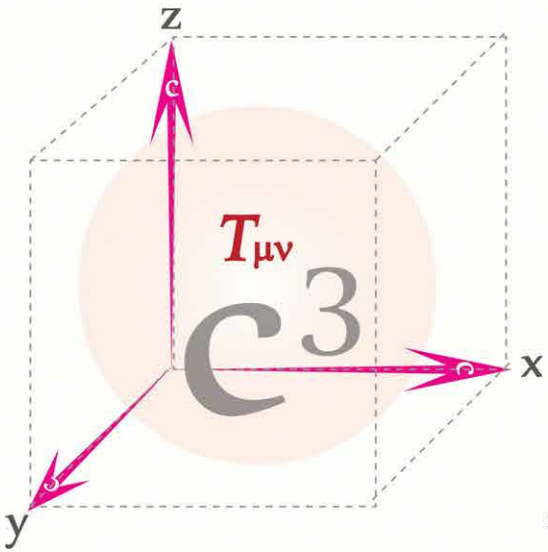

3 Dimensions velocity cubed

Spherical

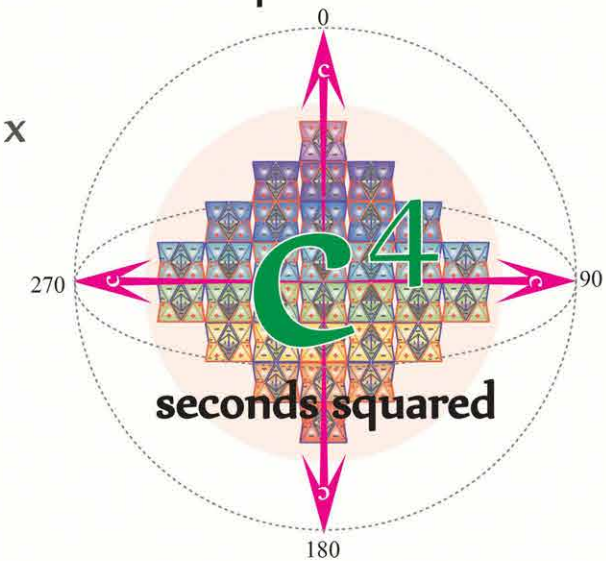

3 Dimensions quadrature velocity

Space-time co-ordinates

The propagation of Energy momenta forms distinct spatial co-ordinate systems

Where angles are typically measured in degrees (°) or radians (rad), where 360° = 2π rad = τ radians.

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Tetryonic co-ordinate systems

Energy per second

m

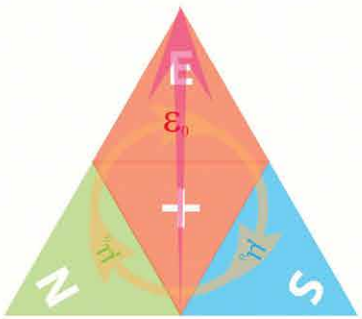

2D mass-energy geometries

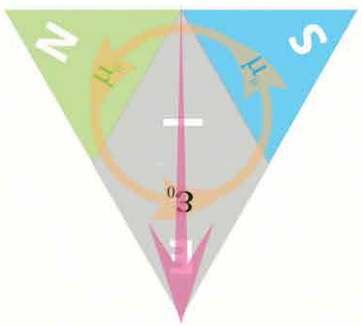

Energy per second squared

M

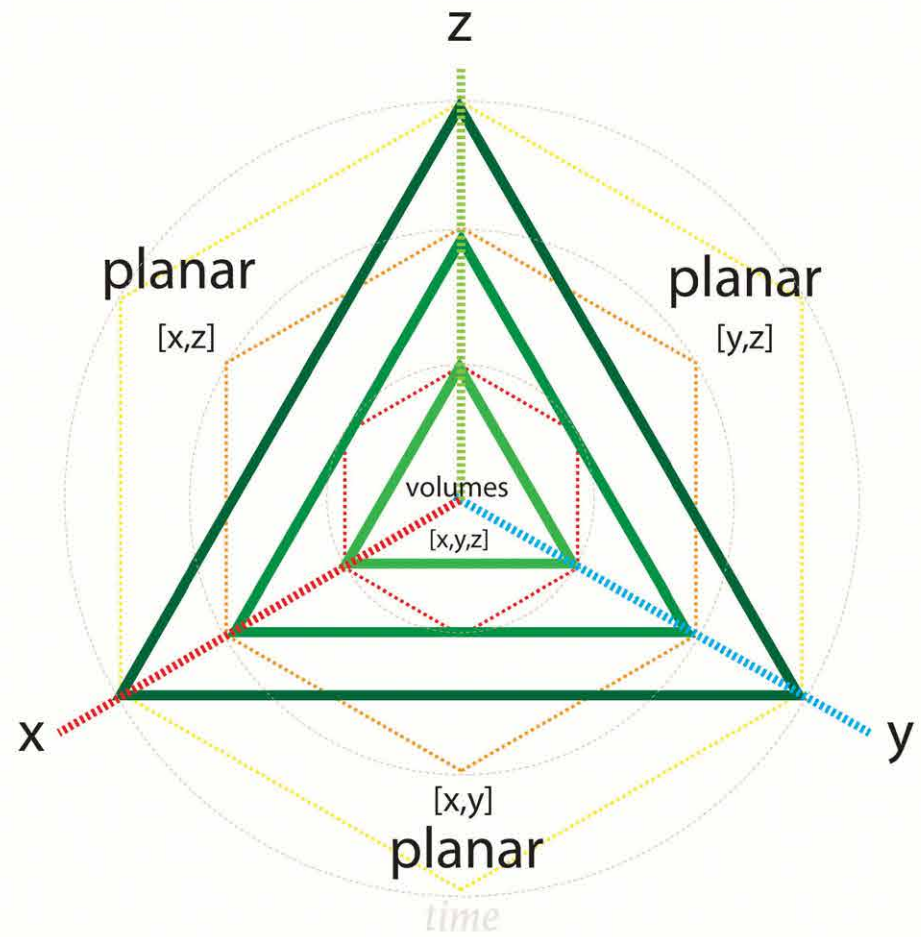

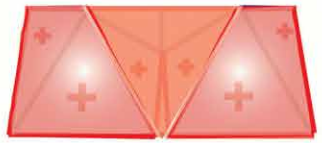

Proton

3D Matter topologies

Neutron

Planar mass-energy geometries have no z-components

Differentiation between 2D mass-energy & 3D Matter is key to extending our understanding of physics

Matter topologies have z-components

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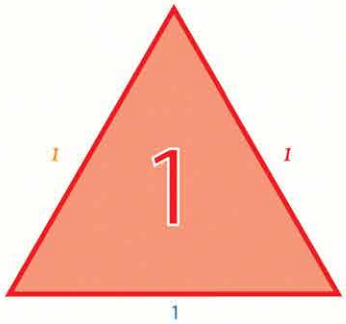

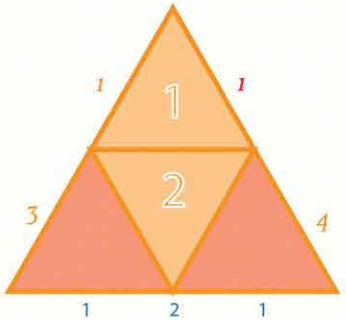

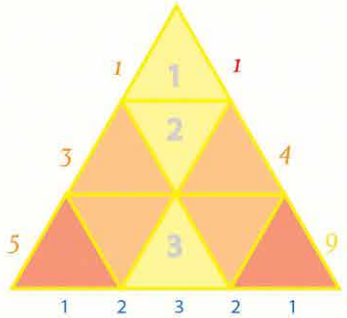

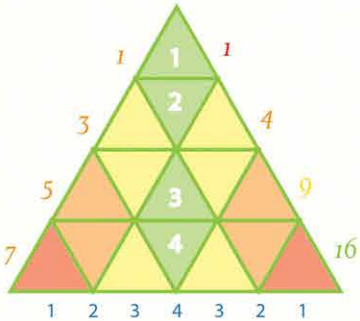

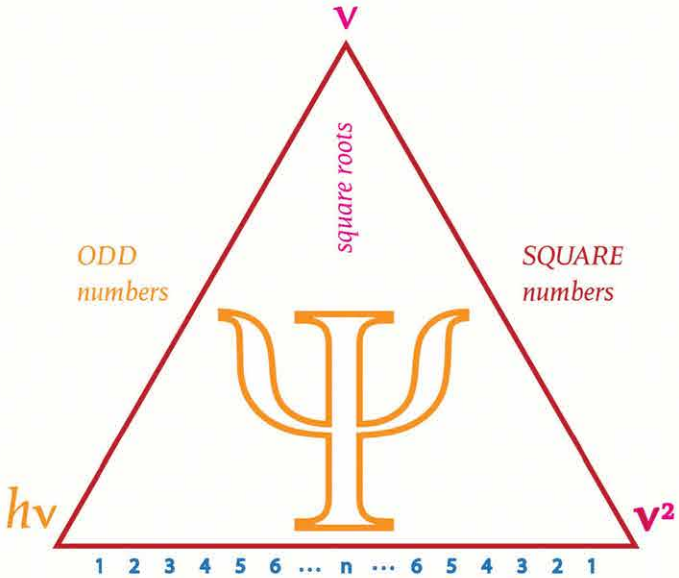

Quantum probability distributions

The equilateral geometry and distribution of quantised Energy momenta provides the basis for all statistical probabilities in Quantum mechanics, thermodynamic & information entropy - including a solution to Heisenberg's Uncertainty Principle thus paving the way forward for a new understanding, and manipulation of physical phenomena at the quantum level

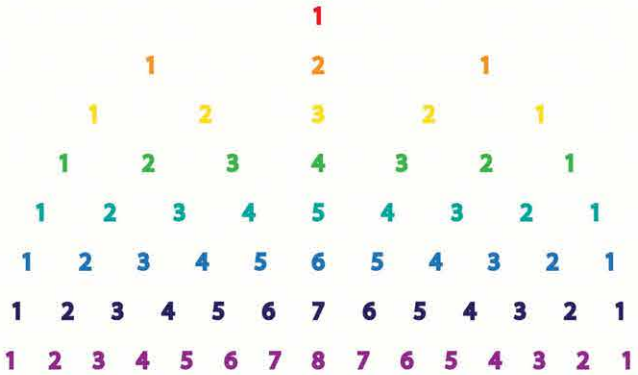

Normal distributions are extremely important in statistics, and are often used in the natural and social sciences for real-valued random variables whose distributions are not known

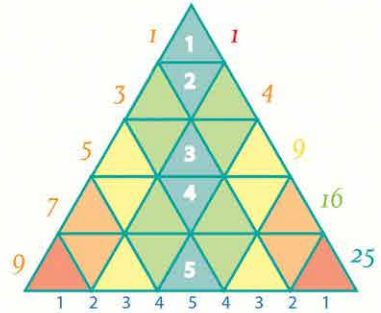

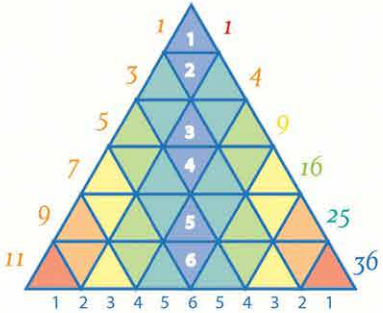

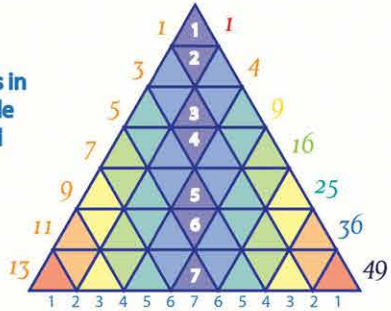

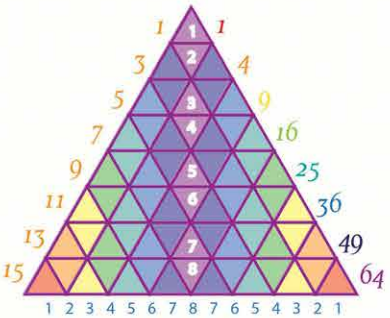

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Quantum Probability Distributions

The normal distribution is a probability distribution.
It is also called Gaussian distribution because it was discovered by Carl Friedrich Gauss.

x/n^2

Probabilities are the square of the Amplitude

n

$\Sigma\, x/n^2$

All probabilities are re-normalisable and sum to Unity

1

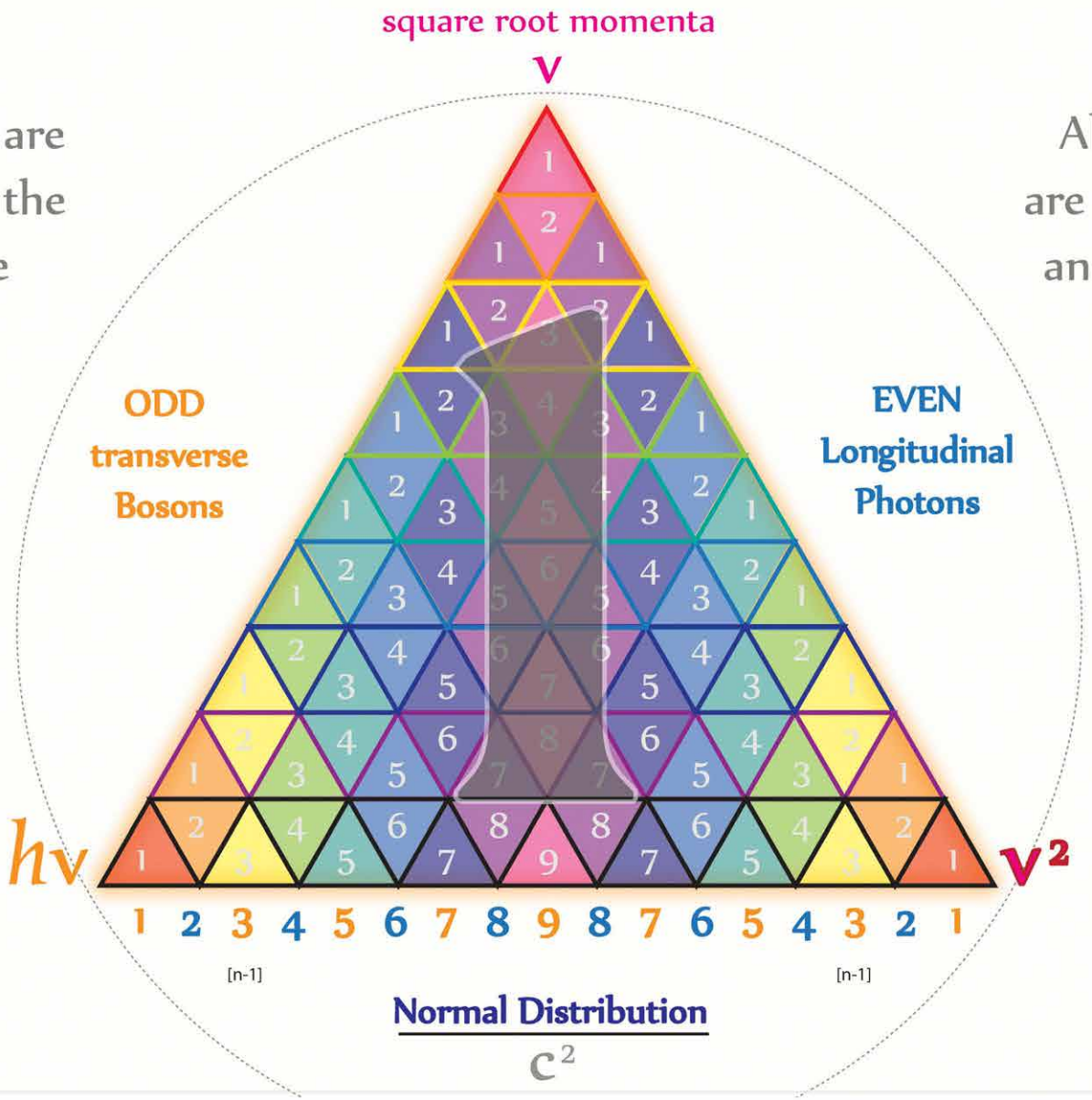

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Quanta Distributions

$$2h\nu = E = hf$$

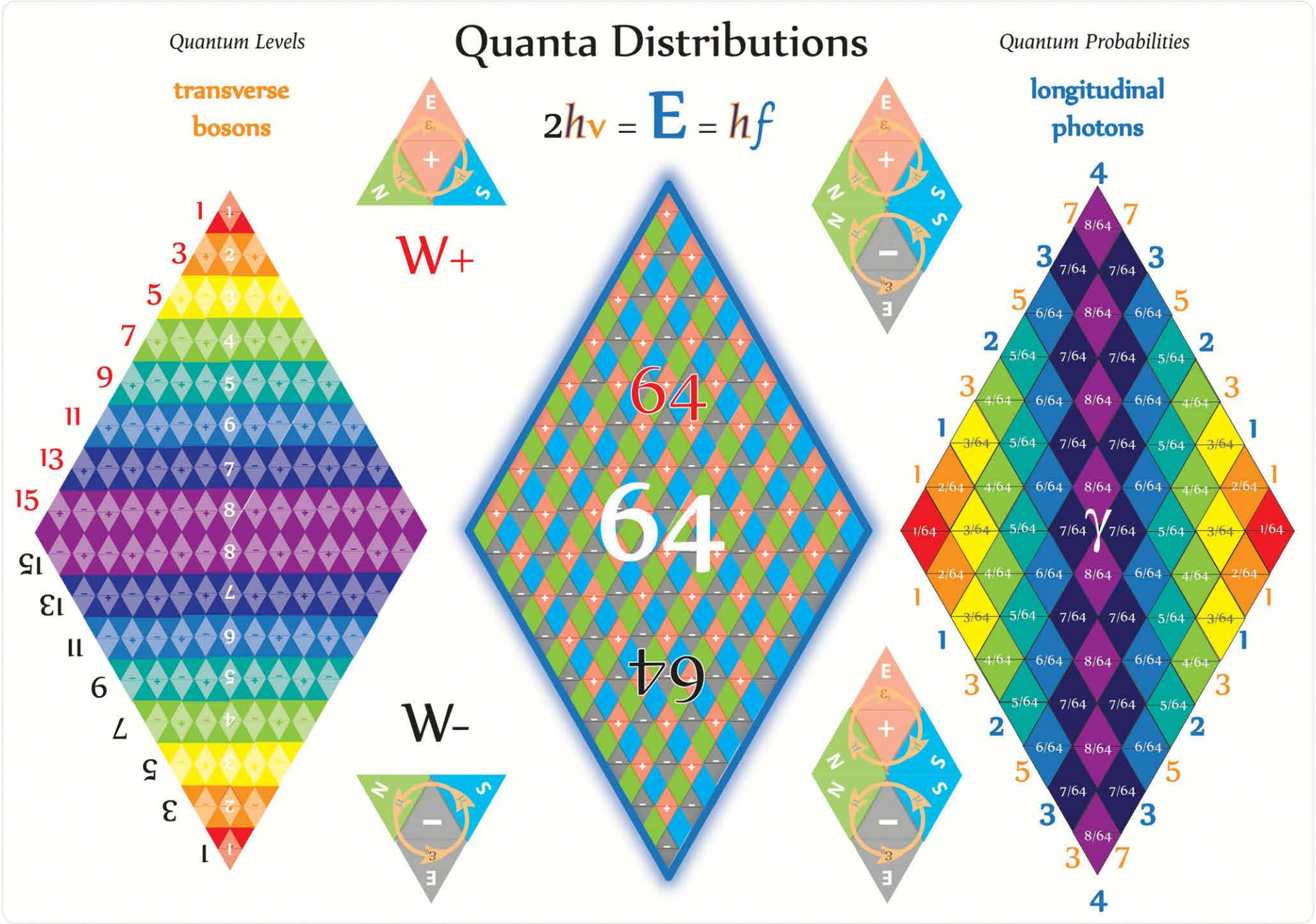

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Wavefunctions

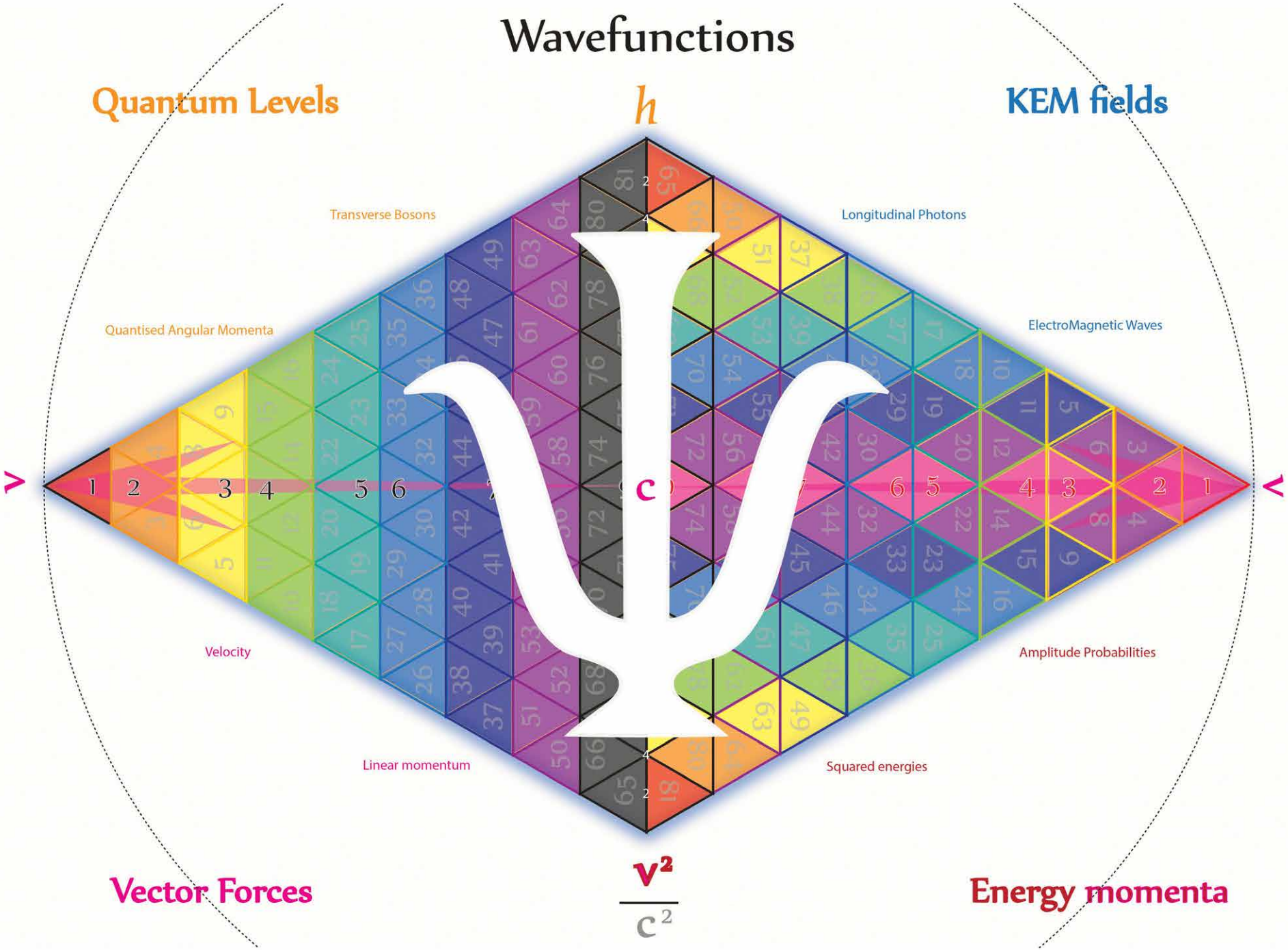

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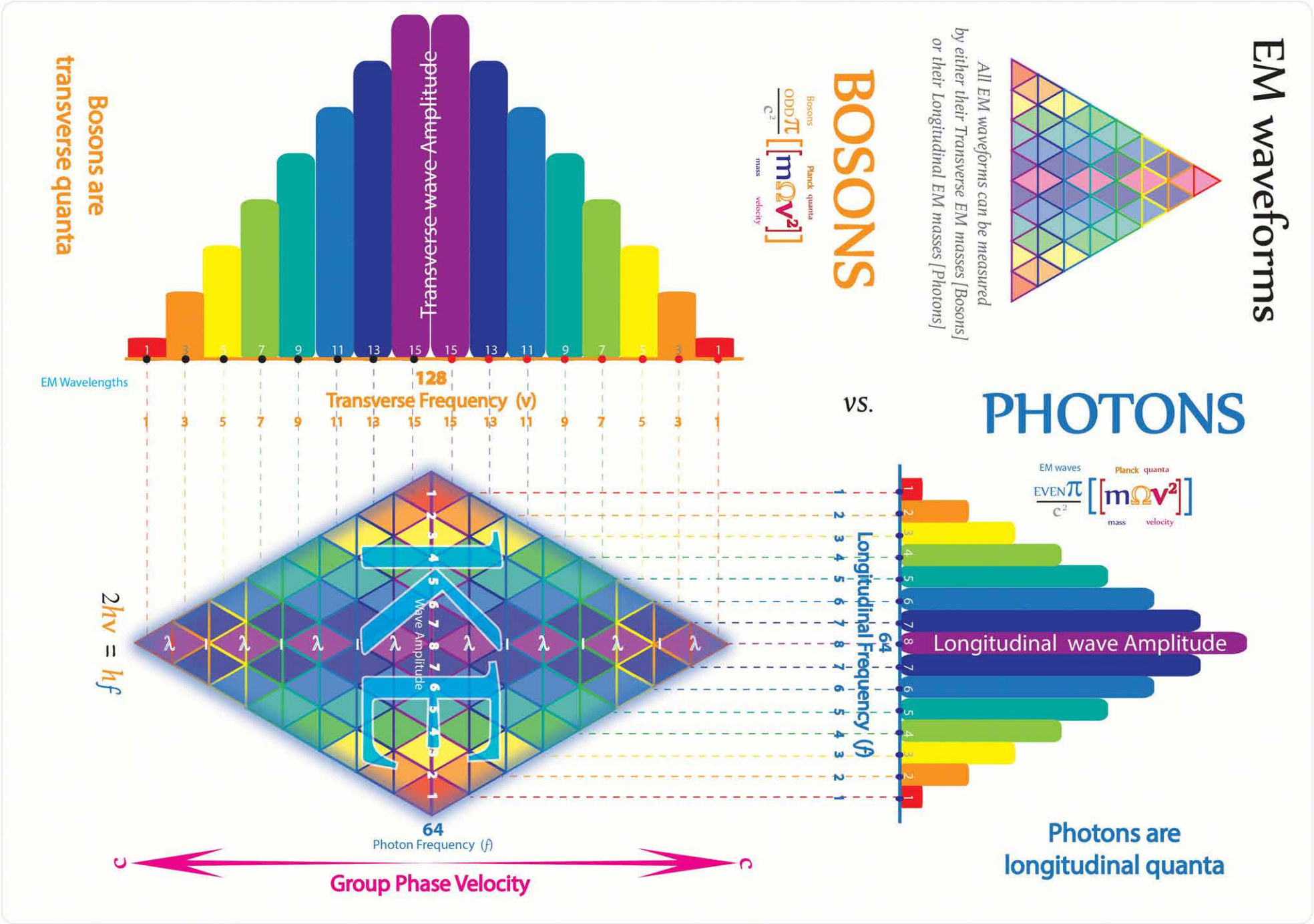

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Quantum Energy distributions

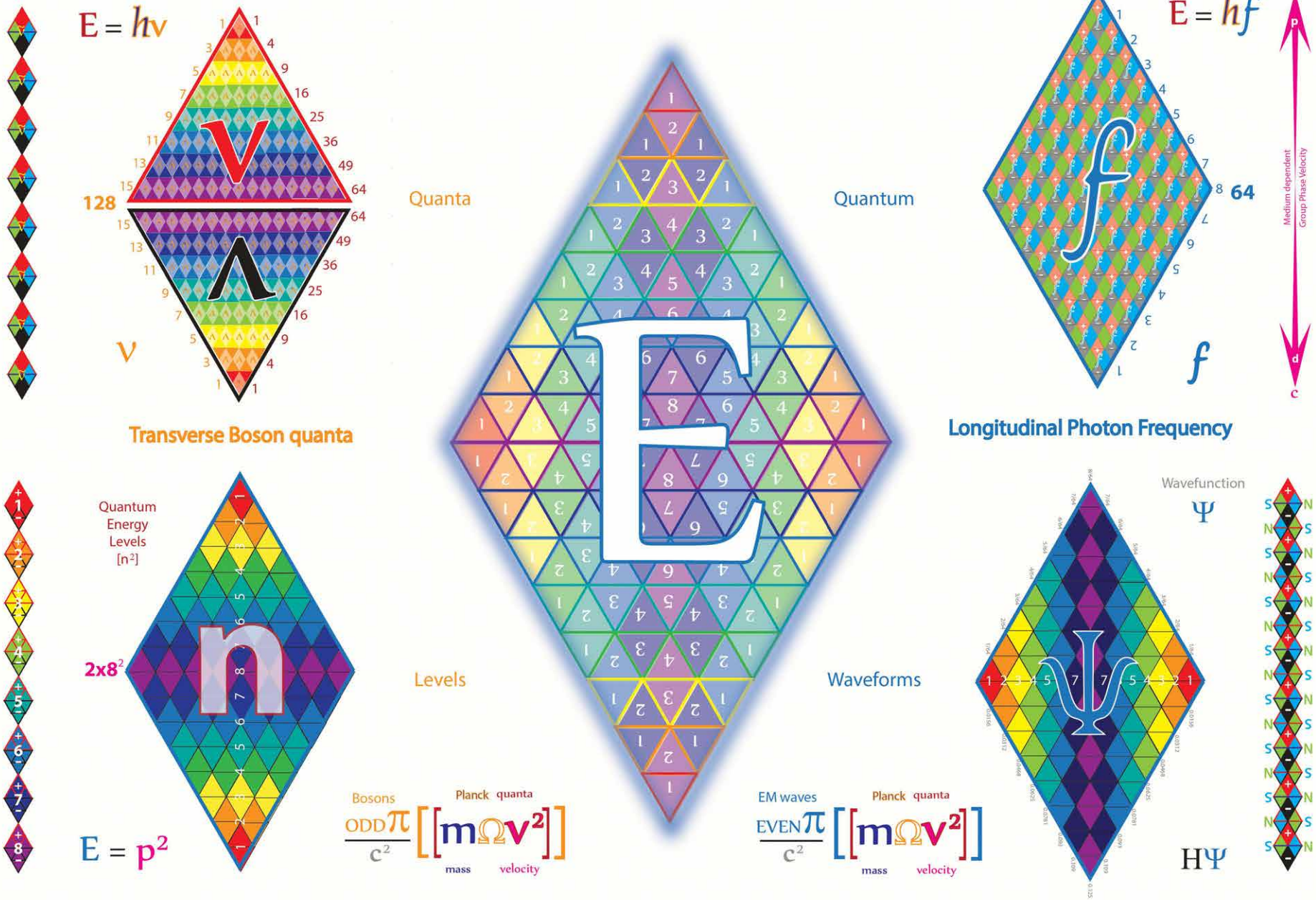

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Normal Distributions

The Gaussian distribution sometimes informally called the bell curve.

Pierre de Fermat

Pierre de Fermat is given credit for early developments that led to infinitesimal calculus.

$$\frac{1}{\sqrt{2\pi\sigma^2}}\, e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

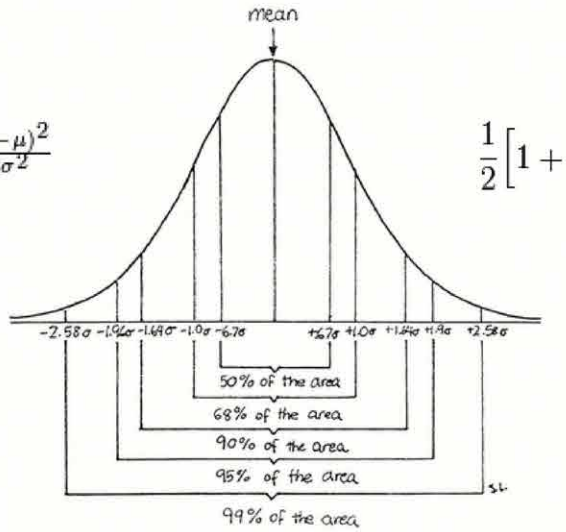

$$\frac{1}{2}\left[1+\operatorname{erf}\left(\frac{x-\mu}{\sqrt{2\sigma^2}}\right)\right]$$

Leonhard Euler

Leonhard Euler developed a formula which links complex exponentiation with trigonometric functions

A bell shaped curve defines the standard normal distribution, in which the probability of observing a point is greatest near the average, and declines rapidly as one moves away from the mean.

all ODD numbers are

$$a^2 - b^2 = [a-b].[a+b]$$

the difference of two squares

$$e^{i\pi} = -1$$

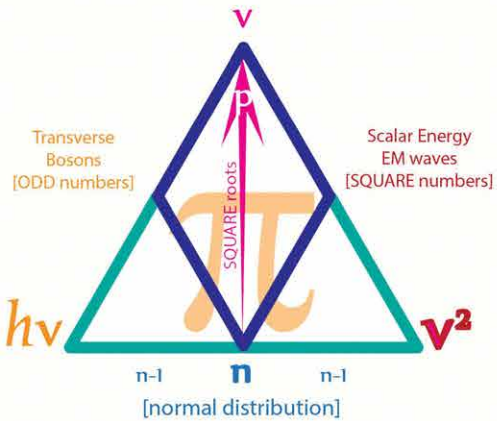

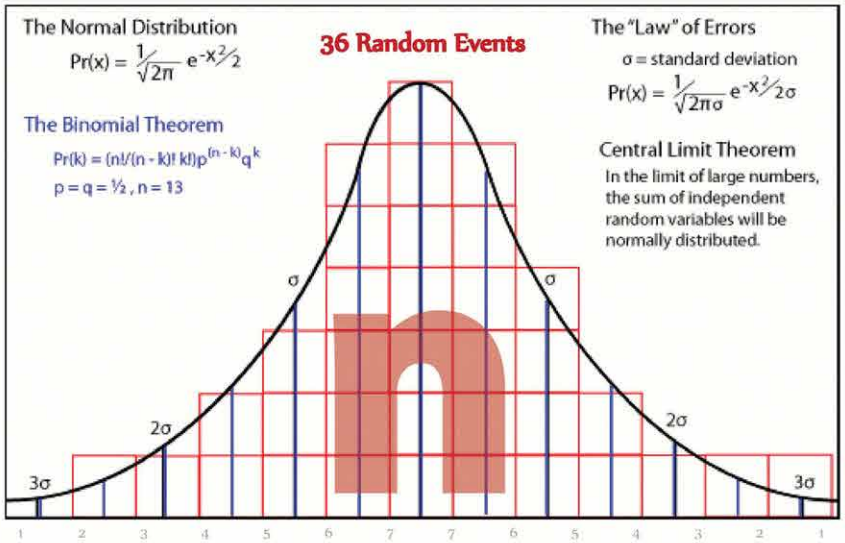

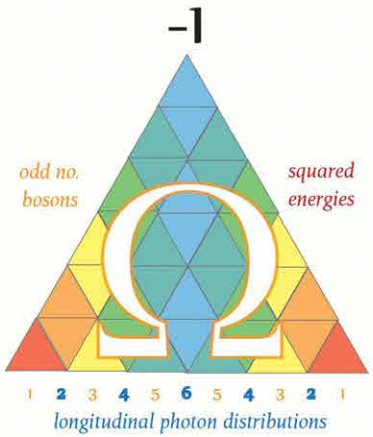

In probability theory, the normal (or Gaussian) distribution is a continuous probability distribution that has a bell-shaped probability density function, known as the Gaussian function

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Fundamental theorem of Energy momenta

A nth level scalar energy momenta waveform has exactly n linear momentum in unit circle co-ordinate systems
(with Longitudinal and Transverse equilateral Planck waveforms being orthogonal to each other)

scalar energies

E

mv^2

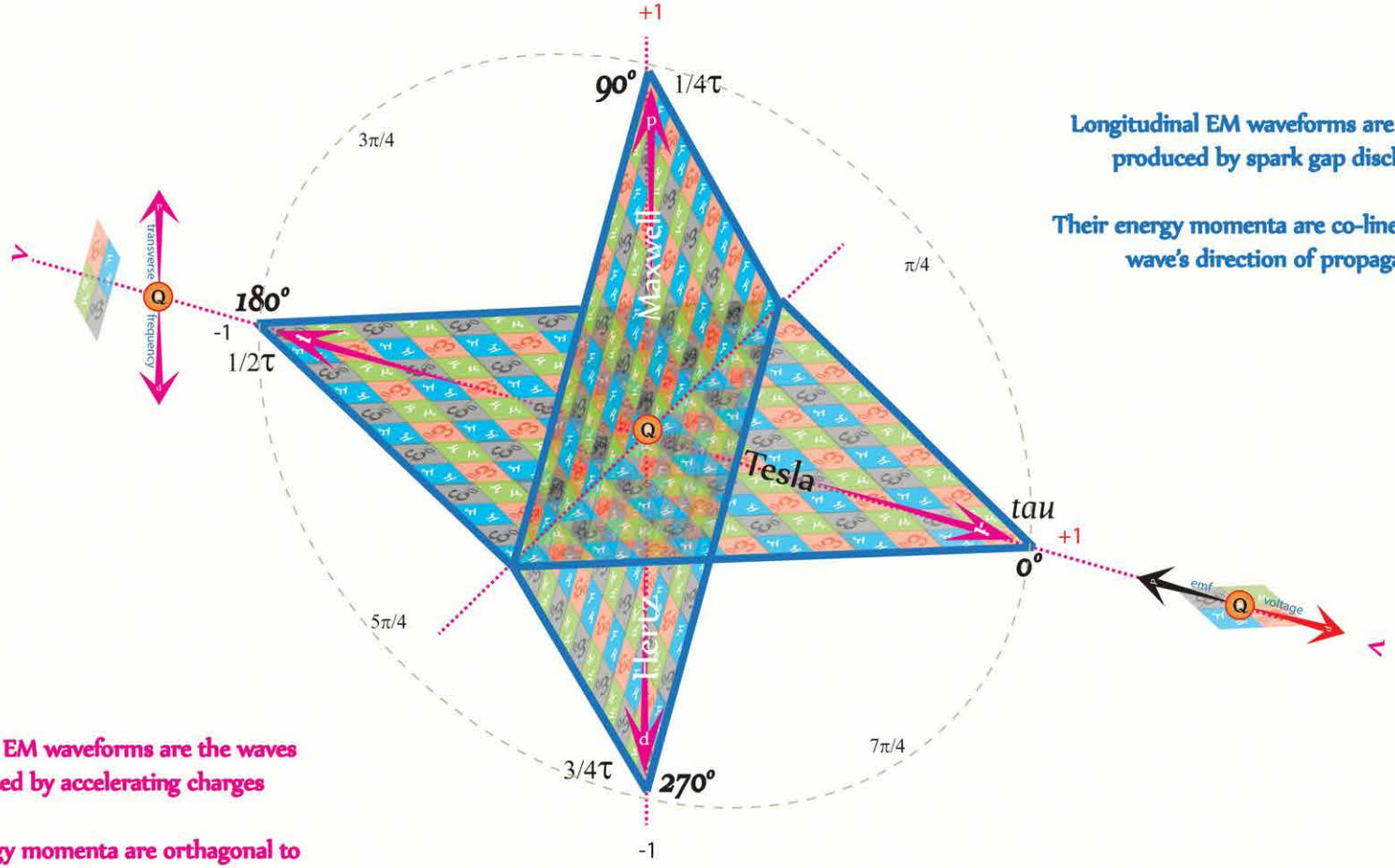

Longitudinal EM waveforms are the waves produced by spark gap discharges

Their energy momenta are co-linear with the wave's direction of propagation

Transverse EM waveforms are the waves produced by accelerating charges

Their energy momenta are orthagonal to the direction of wave propagation

p

mv

linear momentum

[Mathematics] *i or j* *[Electrical theory]*

square root of negative one

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Velocity and Time dependent EM fields

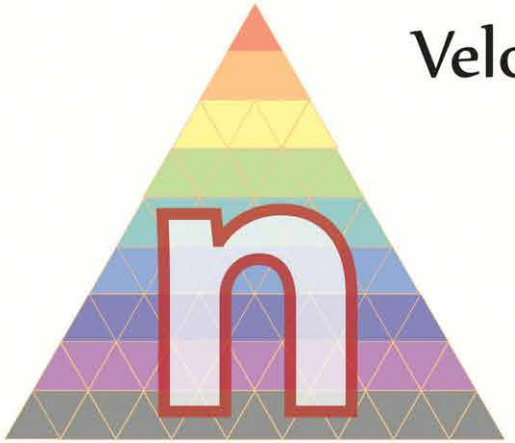

Quantum levels

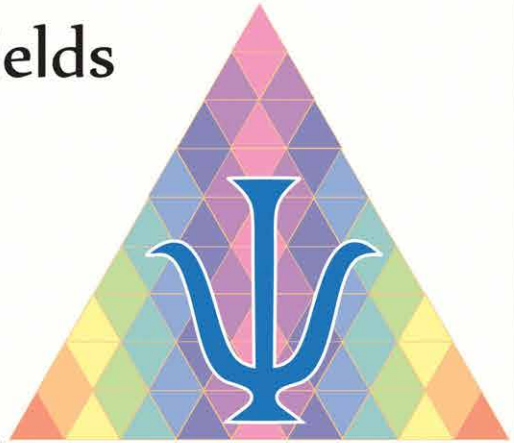

Wave probabilities

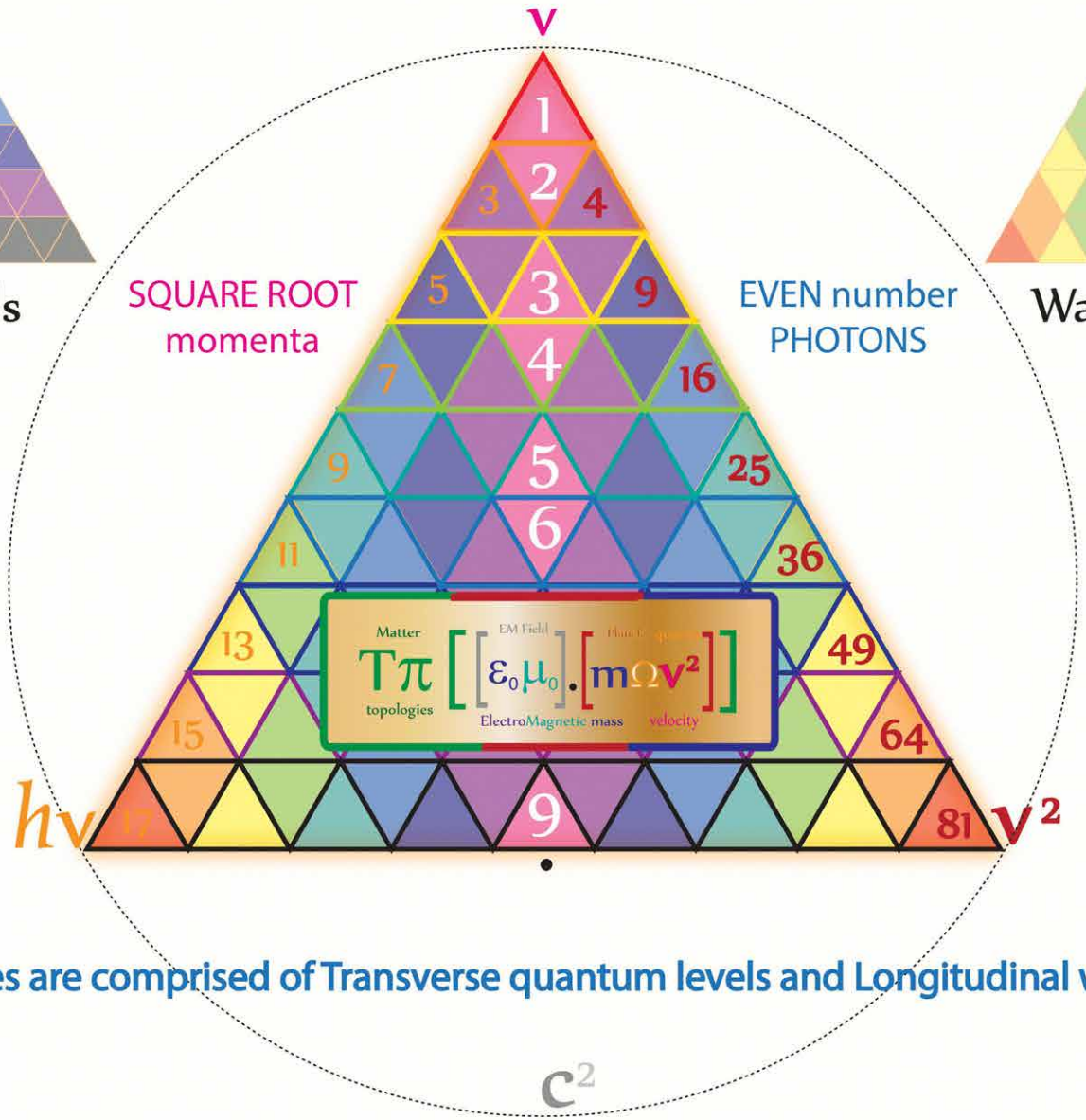

SQUARE ROOT momenta

EVEN number PHOTONS

ODD number BOSONS

SQUARE number ENERGIES

All EM geometries are comprised of Transverse quantum levels and Longitudinal wave probabilities

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Matrices

Matrices are a key tool in linear algebra. One use of matrices is to represent linear transformations, which are higher-dimensional analogs of linear functions of the form f(x) = cx, where c is a constant; matrix multiplication corresponds to composition of linear transformations.

Further developing equilateral Matrices and tensor mathematics to reflect the 2D geometry of EM , KEM and GEM quantum fields, along with the geometric quantisation of mass-energiy momenta and their energy distributions allows for field interactions to be accurately visualised and modelled

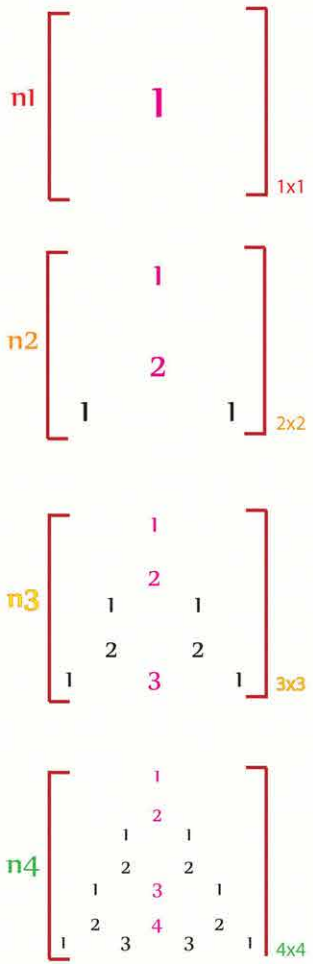

Positive Fields

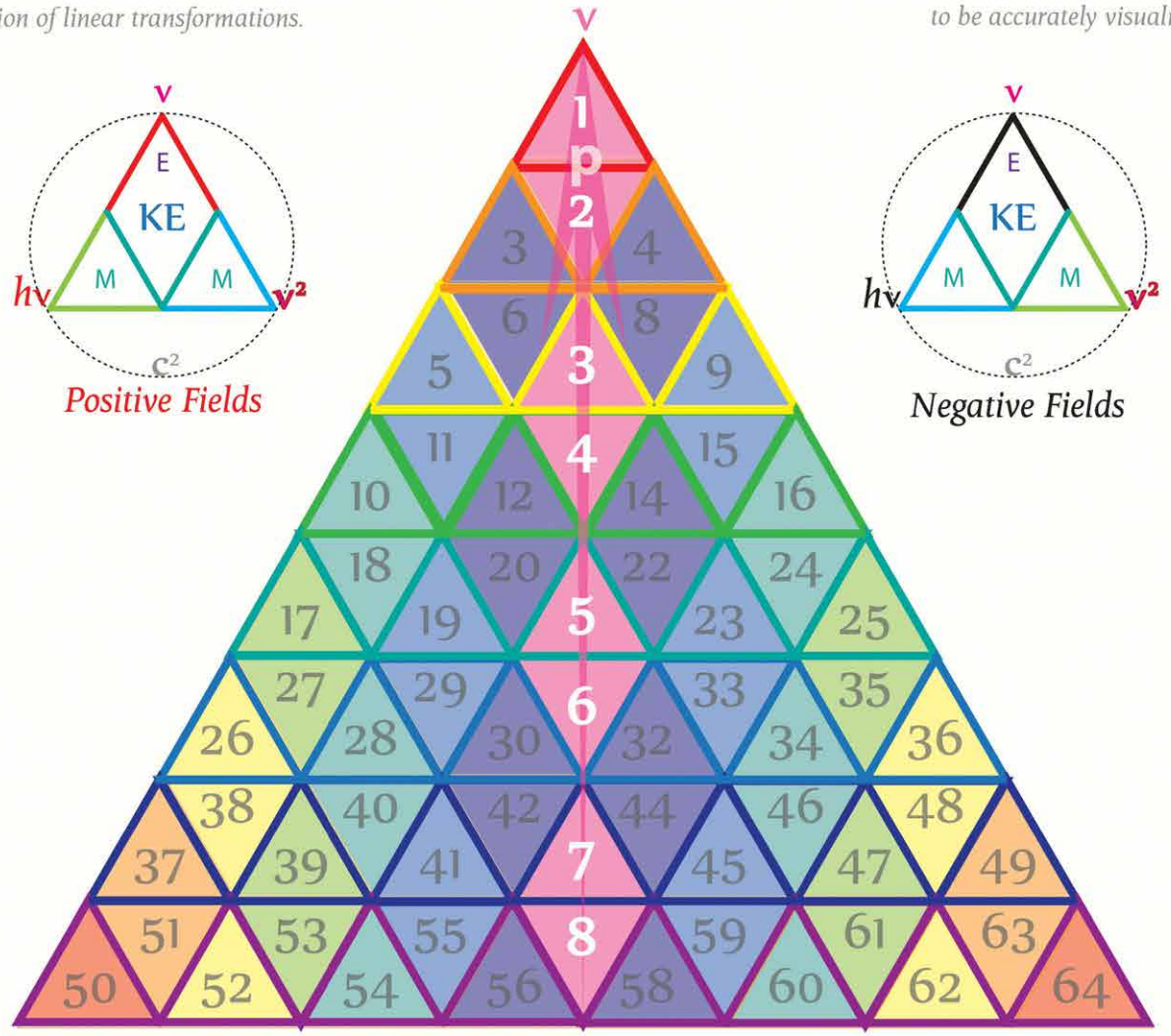

Negative Fields

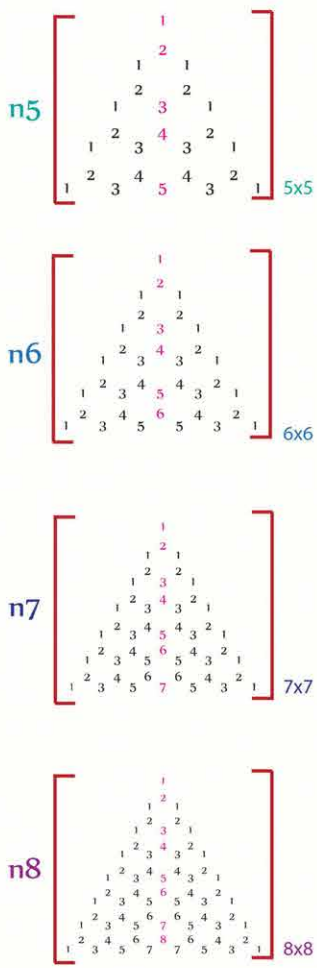

Tensors are geometric entities introduced into mathematics and physics to extend the notion of scalars, geometric vectors, and matrices to increasingly higher orders.

Modifying Square matrices to reflect the equialteral geometries of Tetryonic fields allows for the accurate geometric modelling of all Scalar & Vector fields along with their varied intrinsic quantum energies and physical properties

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Energy momenta Tensors

momenta
(a property of Energy)
is converative

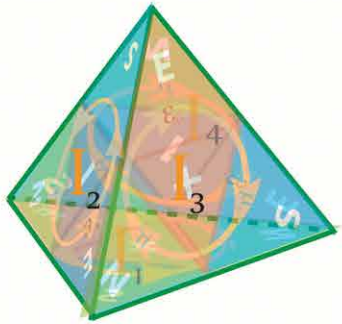

Matter
(a geometric property)
is NOT conservative

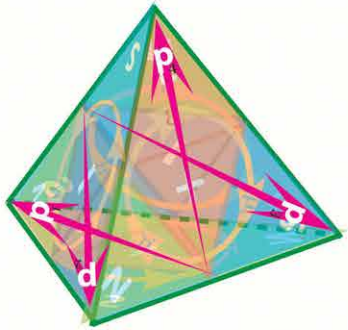

$p_M \rightarrow (E, p1, p2, p3, p4).$

All standing-wave Matter topologies can be modelled using its Tetryonic charge energy momenta Tensors

with an additional Kinetic EM energy-momenta tensor required for Matter in motion

$p_{KEM} \rightarrow (E, p5).$

2D+1 [SR] mass-energy momenta can be folded into 3D+1 [GR] Matter
that can be modelled using 4 Energy-momenta tensors

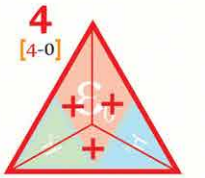

Positive standing-wave Matter

$$E = \sum_{\text{all fascia}} E$$

Energy of a massive particle is the total of all Planck quanta (compton frequency) in a 3D geometry

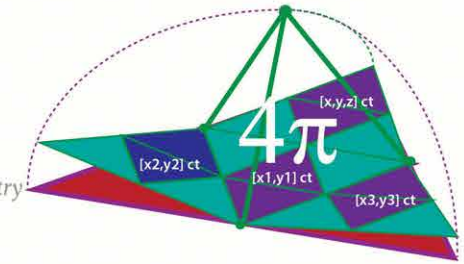

$$\vec{p} = \sum_{\text{all fascia}} \vec{p}$$

Total Momentum is the total of all quanta linear Momenta in a 3D particle

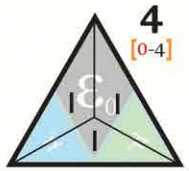

Negative standing-wave Matter

Relativistic Matter
in motion

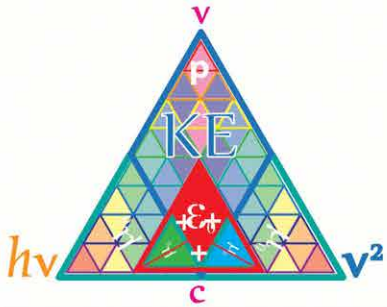

$$I = \sum_{\text{all fascia}} I$$

Inertial mass is the total of all inertia in a 3D particle

Photons have null energy-momentum tensors

Note that both 2D mass-energies [Special Relativity] and 3D Matter [General Relativity] have distinct Energy momenta

It is the 3D Tetrahedral topologies that provides a definative basis for Matter

Relativistic Matter
in motion

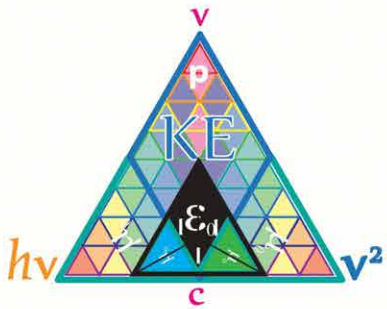

Tetryonic Energy momenta tensors should not be confused with Four vector tensors which map energy-momenta vectors in 3D spatial[cartesian] co-ordinate systems

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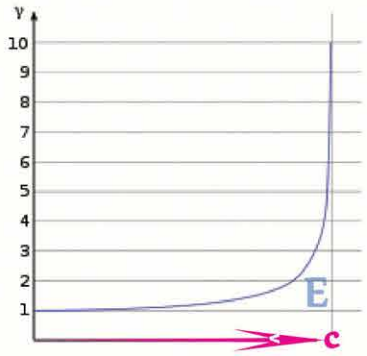

Relativistic Lorentz correction factor

The Lorentz factor or Lorentz term is an expression which appears in several equations in special relativity
It is often incorrectly graphed [as pictured to the right] as an increasing function of velocity approaching but never reaching c

'c' is the maximum velocity acheivable through the electrical acceleration of particles is NOT the maximum velocity possible for Matter in motion

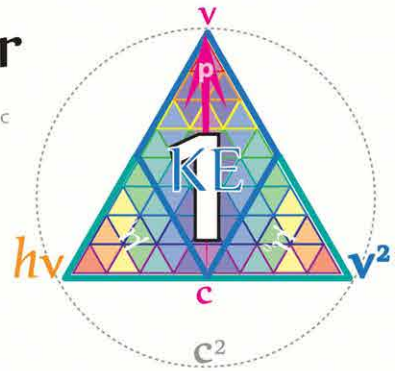

Linear correction factor

$$\beta = \left[\frac{v}{c}\right]$$

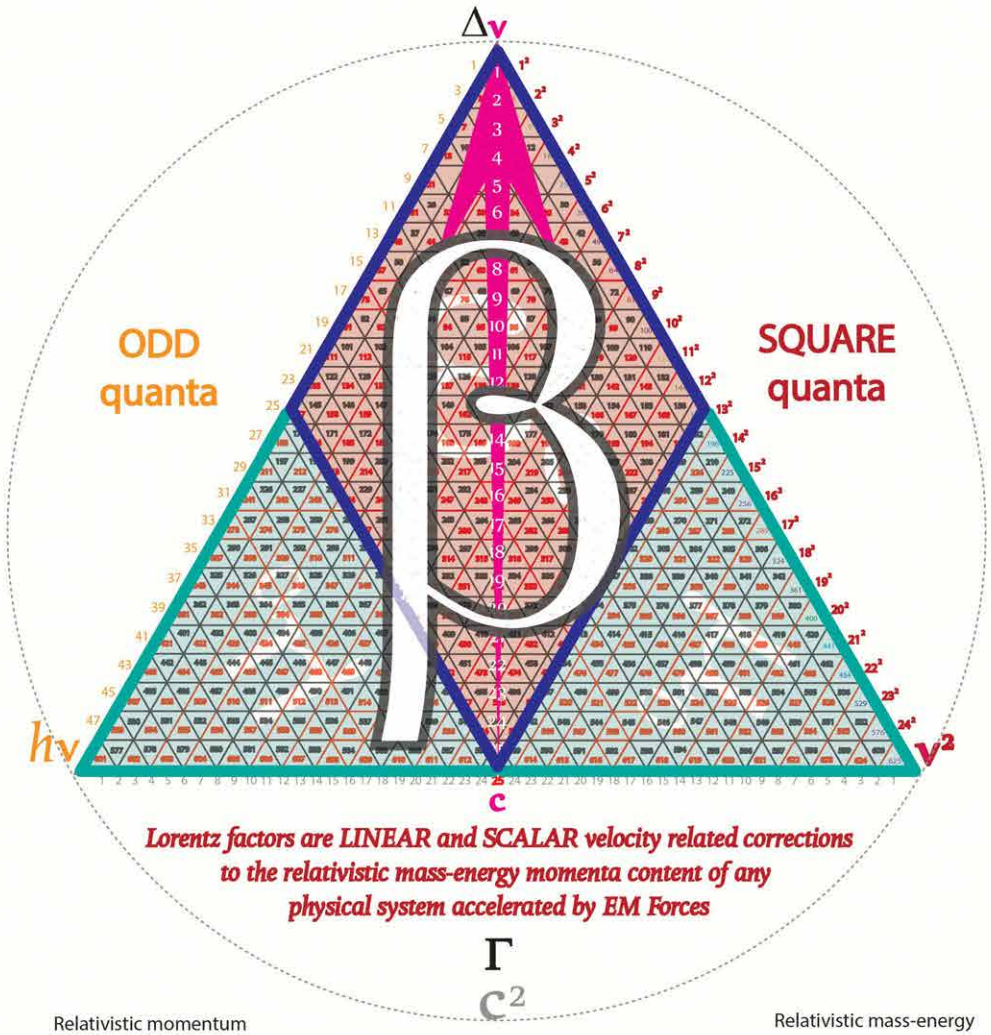

Scalar correction factor

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

$$\Delta\frac{\gamma}{c^2}$$ Wavelength contraction

$$\Delta\frac{\Omega}{c^2}$$ Time Dilation

$$\Delta\frac{mv}{c^2}$$ Relativistic momentum

Lorentz corrections

$$\Delta\frac{h\nu}{c^2}$$ Relativistic mass-energy

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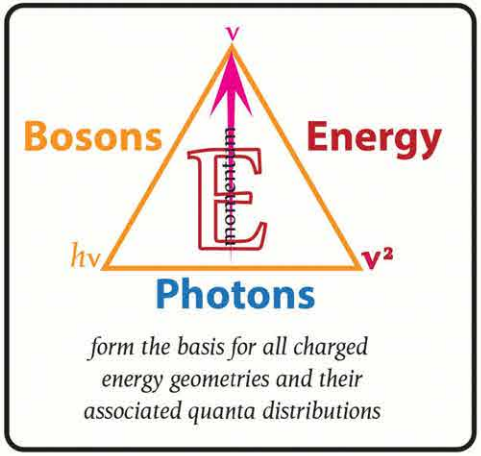

Equilateral energies

Any measurements of mass without a Space-Time co-ordinate system are measurements of Energy

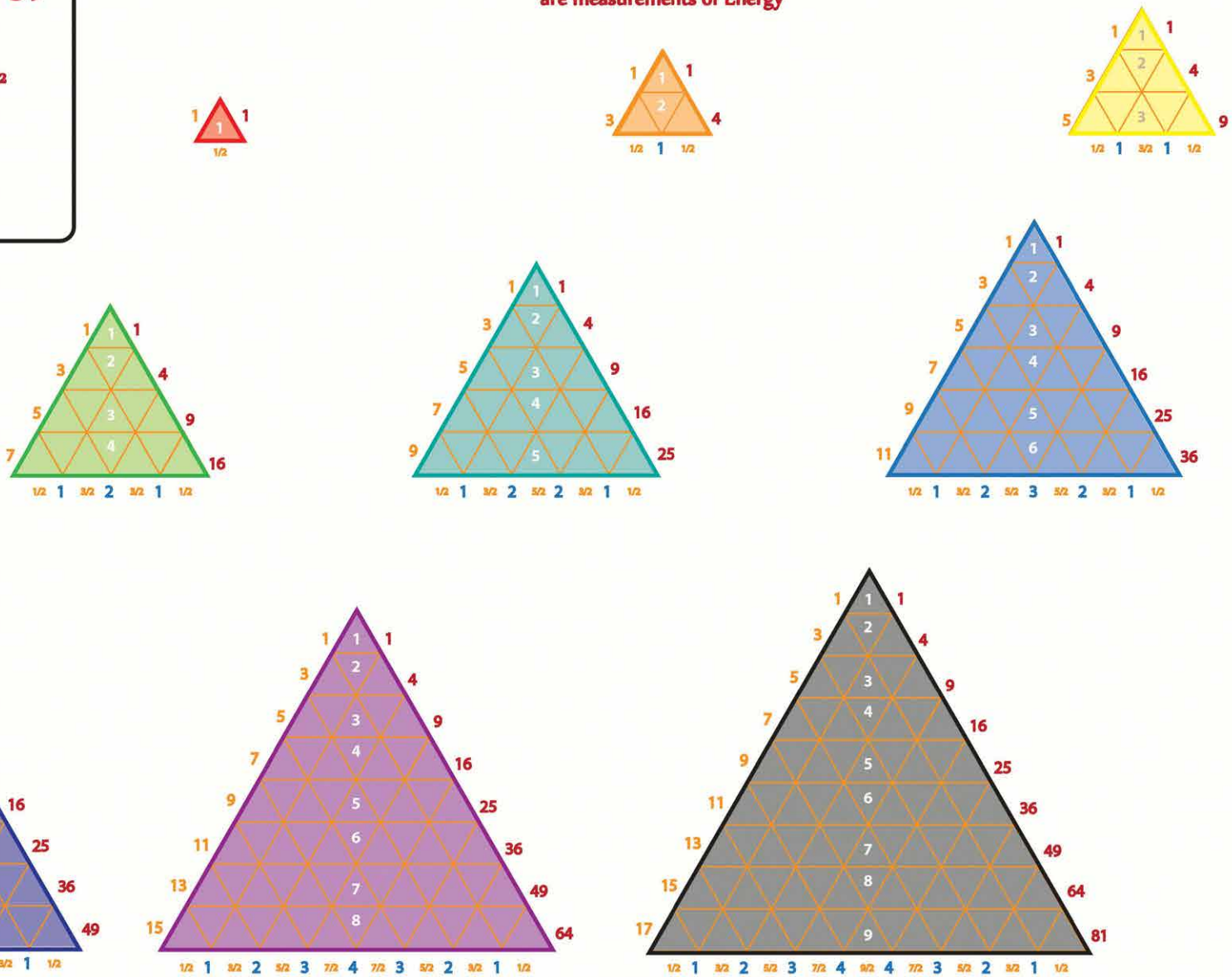

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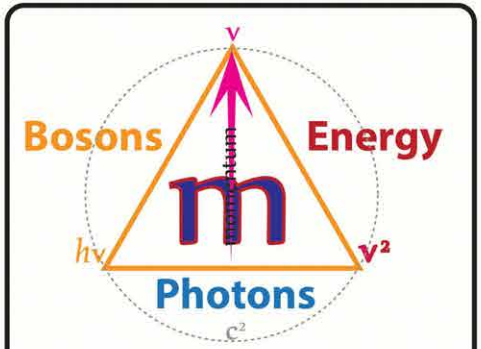

Time specific measurements of equilateral ENERGY momenta geometries forms the basis for EM mass

Electromagnetic mass

2D mass-energy is the surface integral of 3D Matter

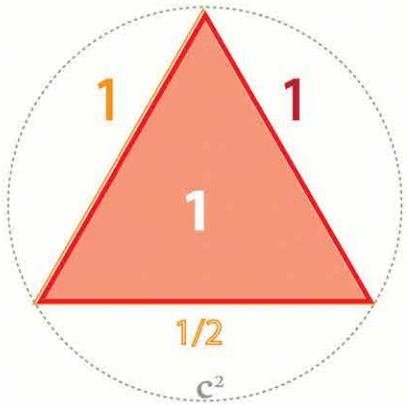

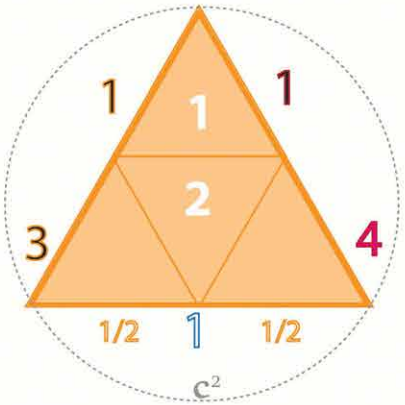

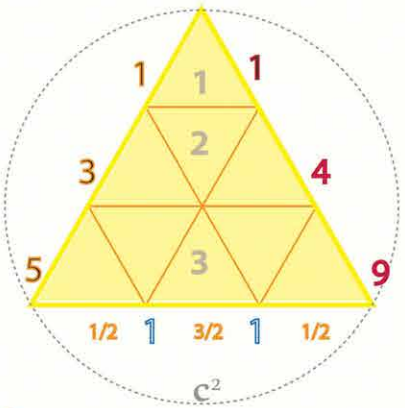

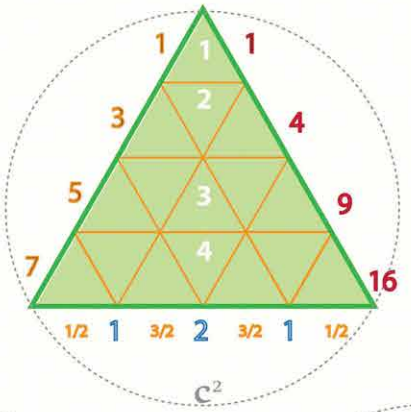

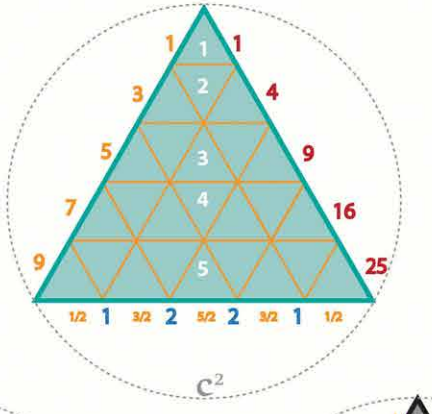

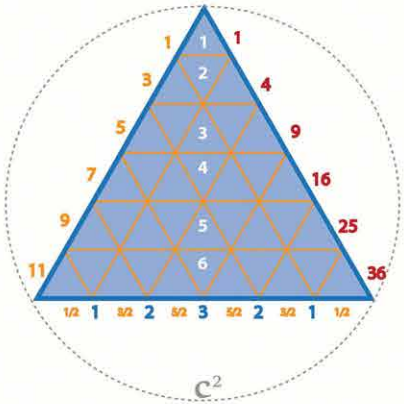

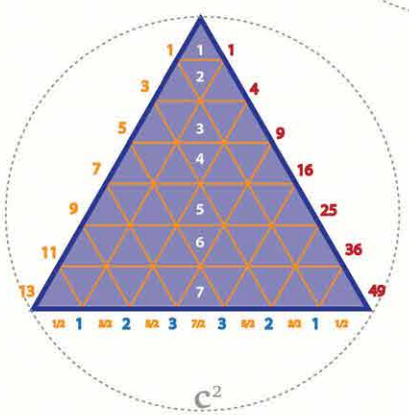

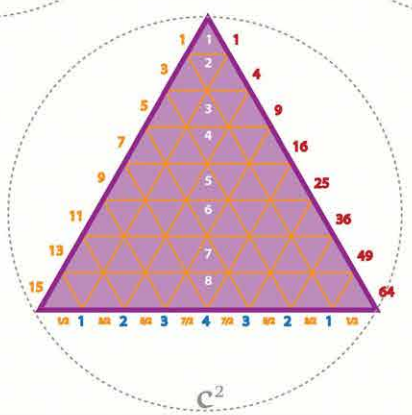

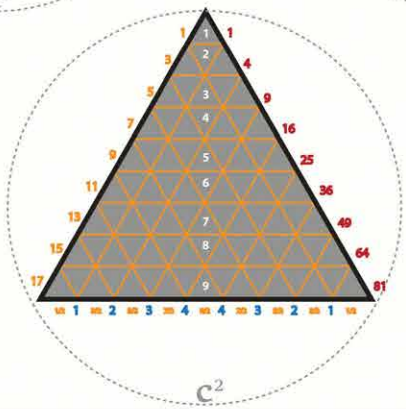

mass-less particles is a physical misnomer

All measurements of energy in spatial co-ordinate systems are measurements of mass

Matter-less is the appropriate terminology

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Standing-wave Matter

Matter is a higher order 3D topology created by standing wave mass-energies

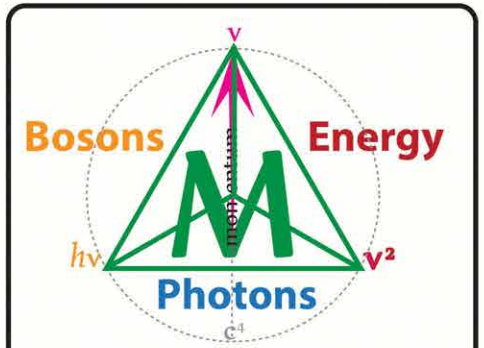

The equilateral mass-ENERGY content of 4nπ Tetrahedral standing-wave topologies forms the basis of Matter

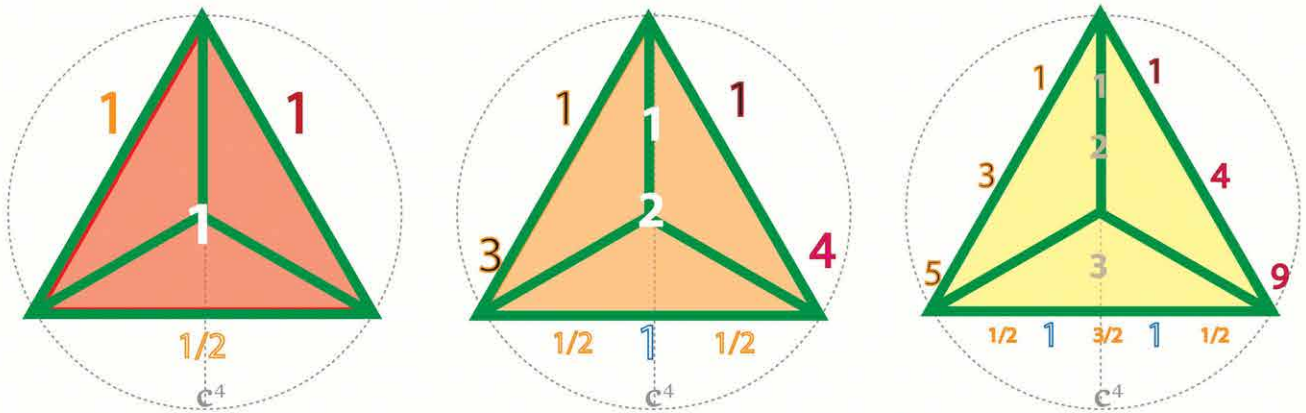

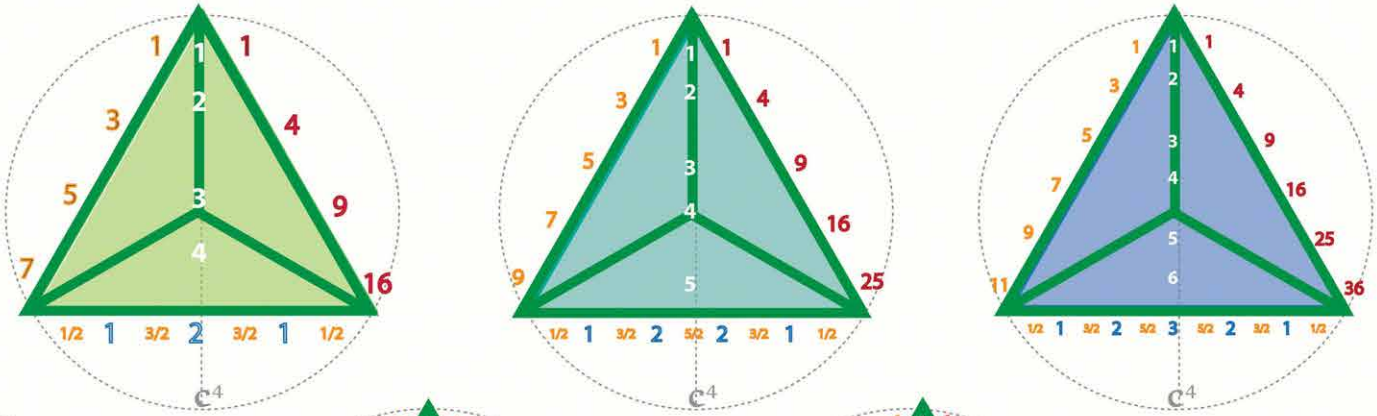

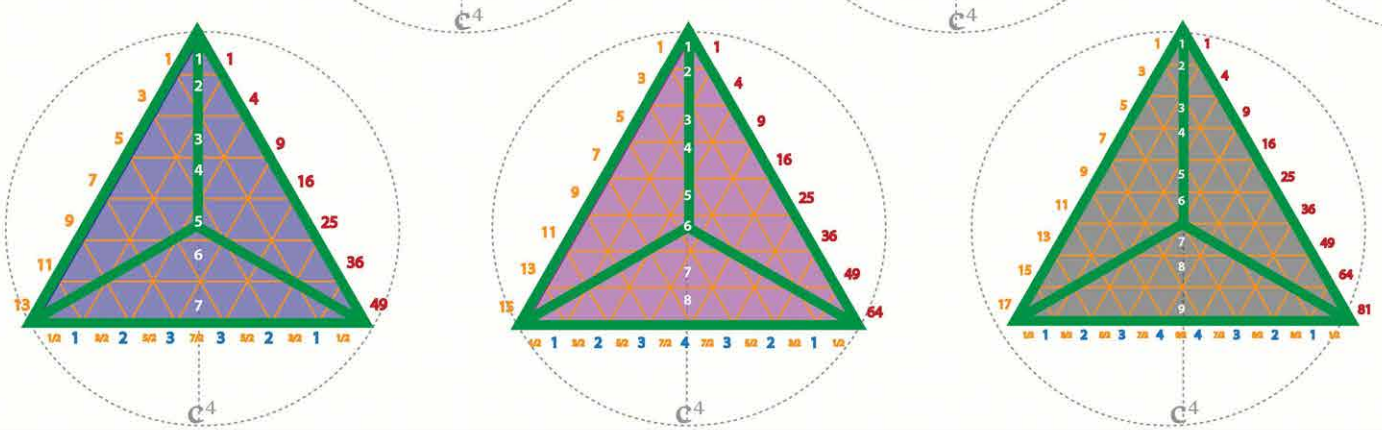

Only mass-ENERGIES contained in the tetryonic fascia of standing-wave topologies contribute to weight

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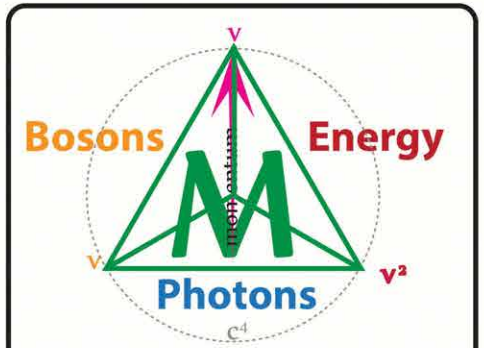

The mass-ENERGY content of
4nπ Tetrahedral standing-wave topologies
forms the basis of all periodic elements

Periodic element nuclei

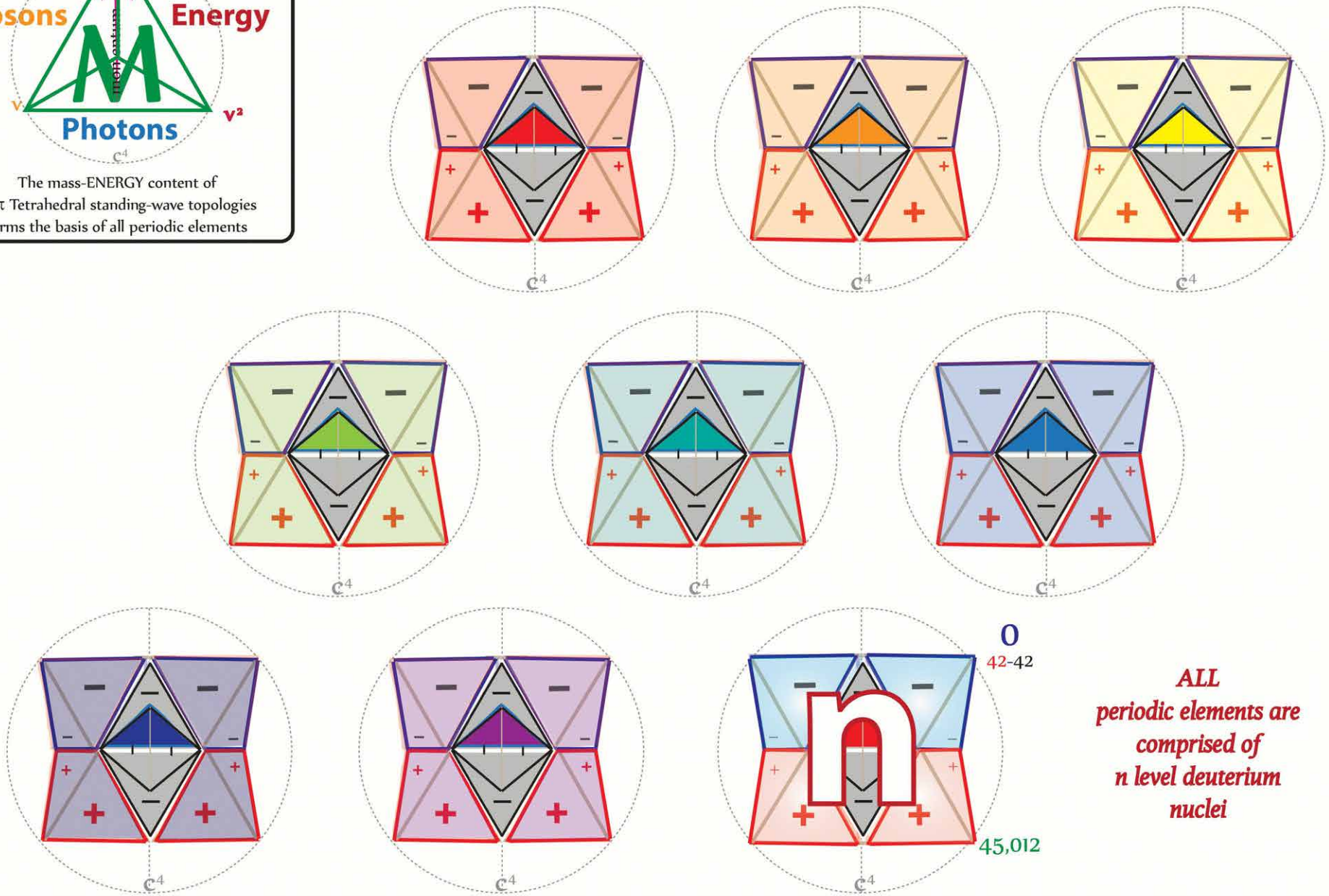

ALL periodic elements are comprised of n level deuterium nuclei

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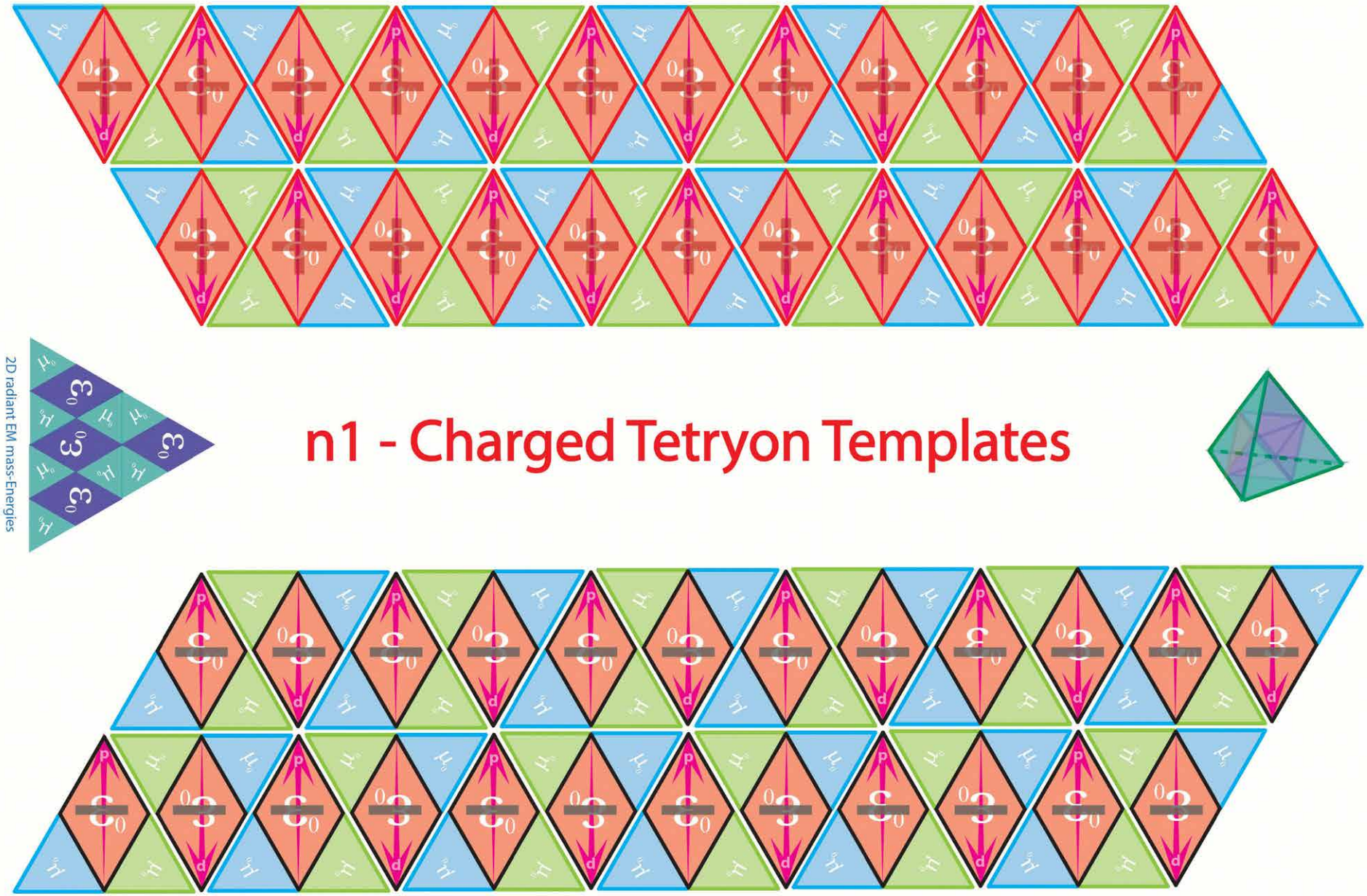

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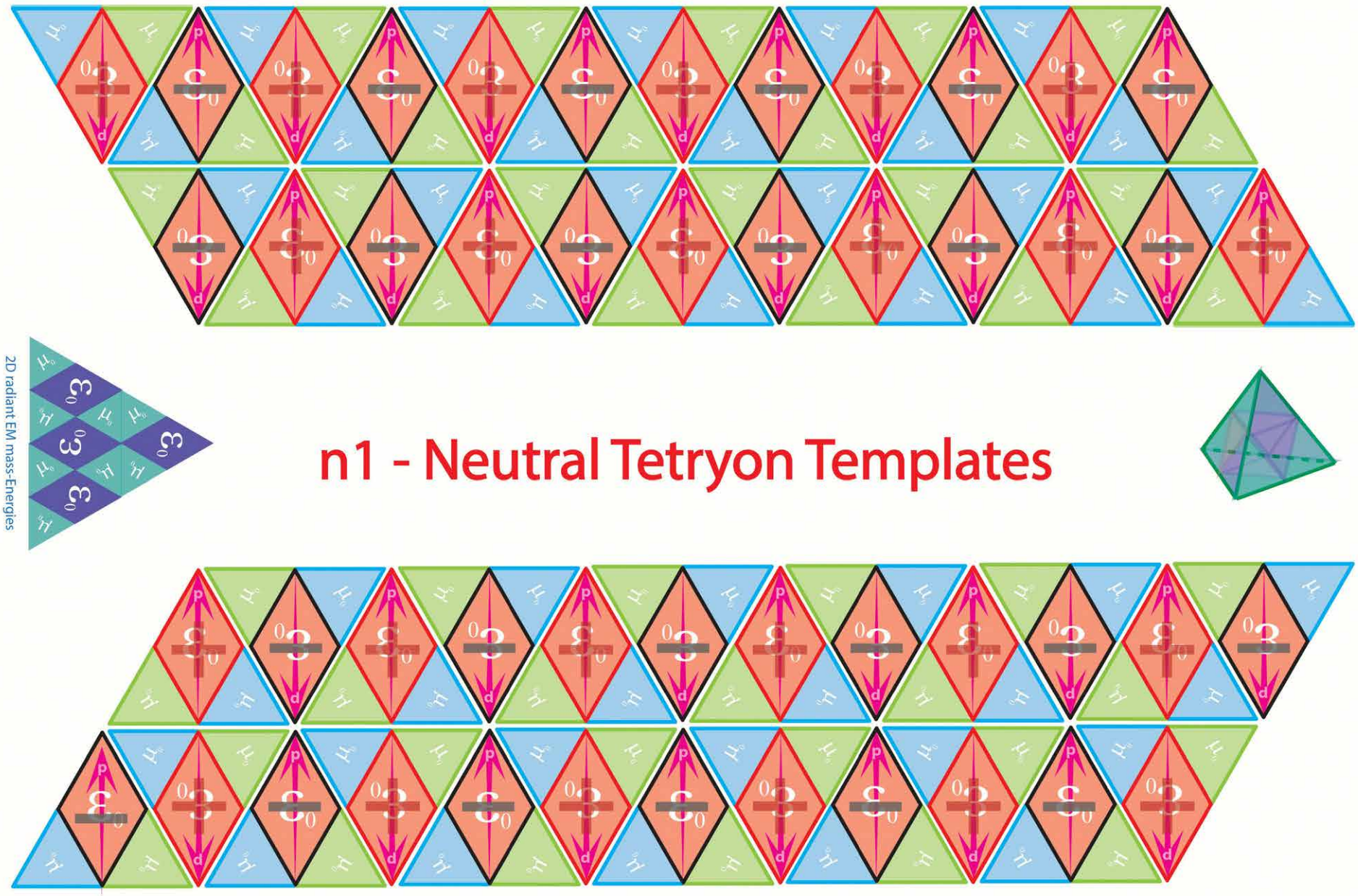

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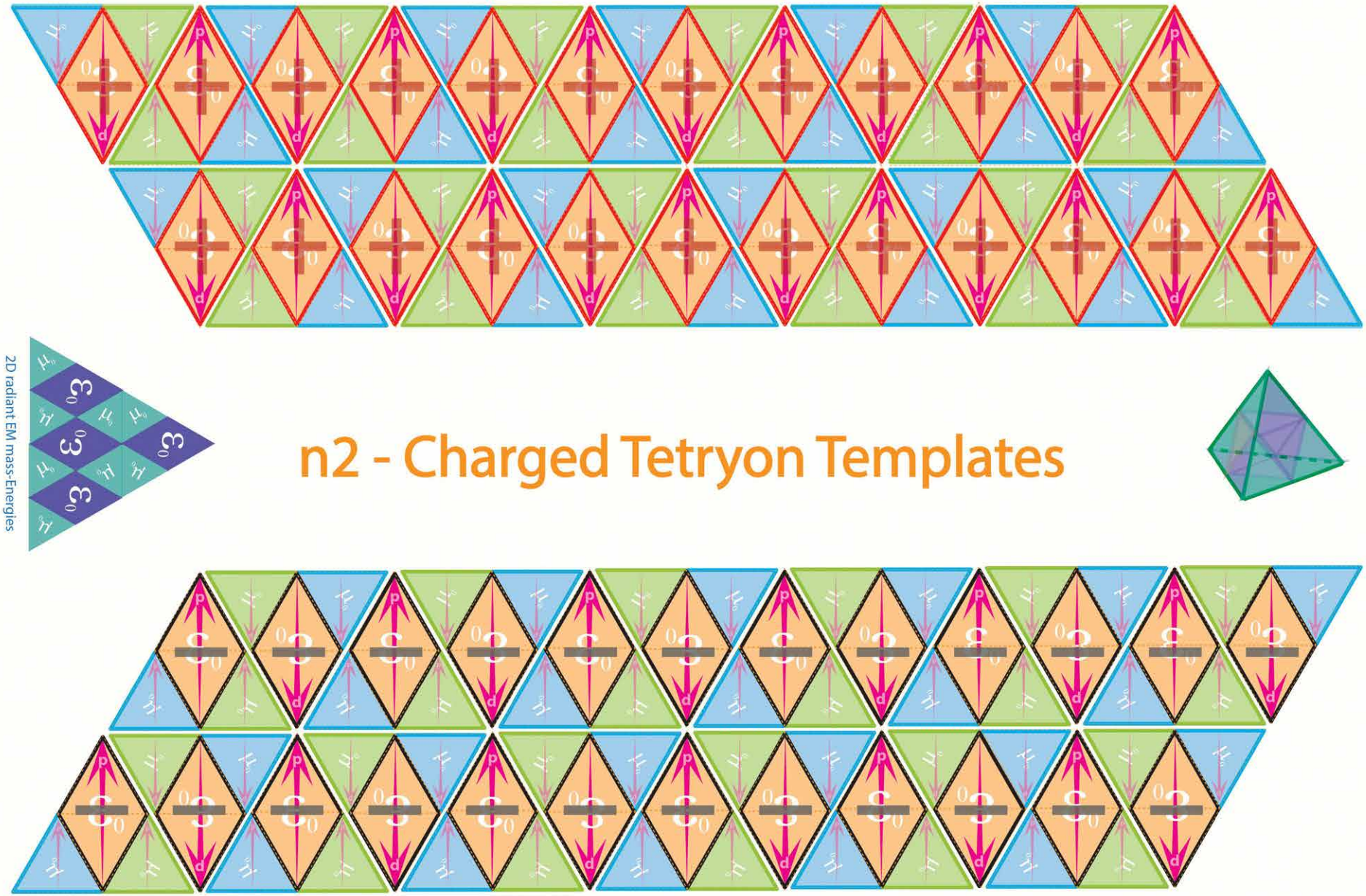

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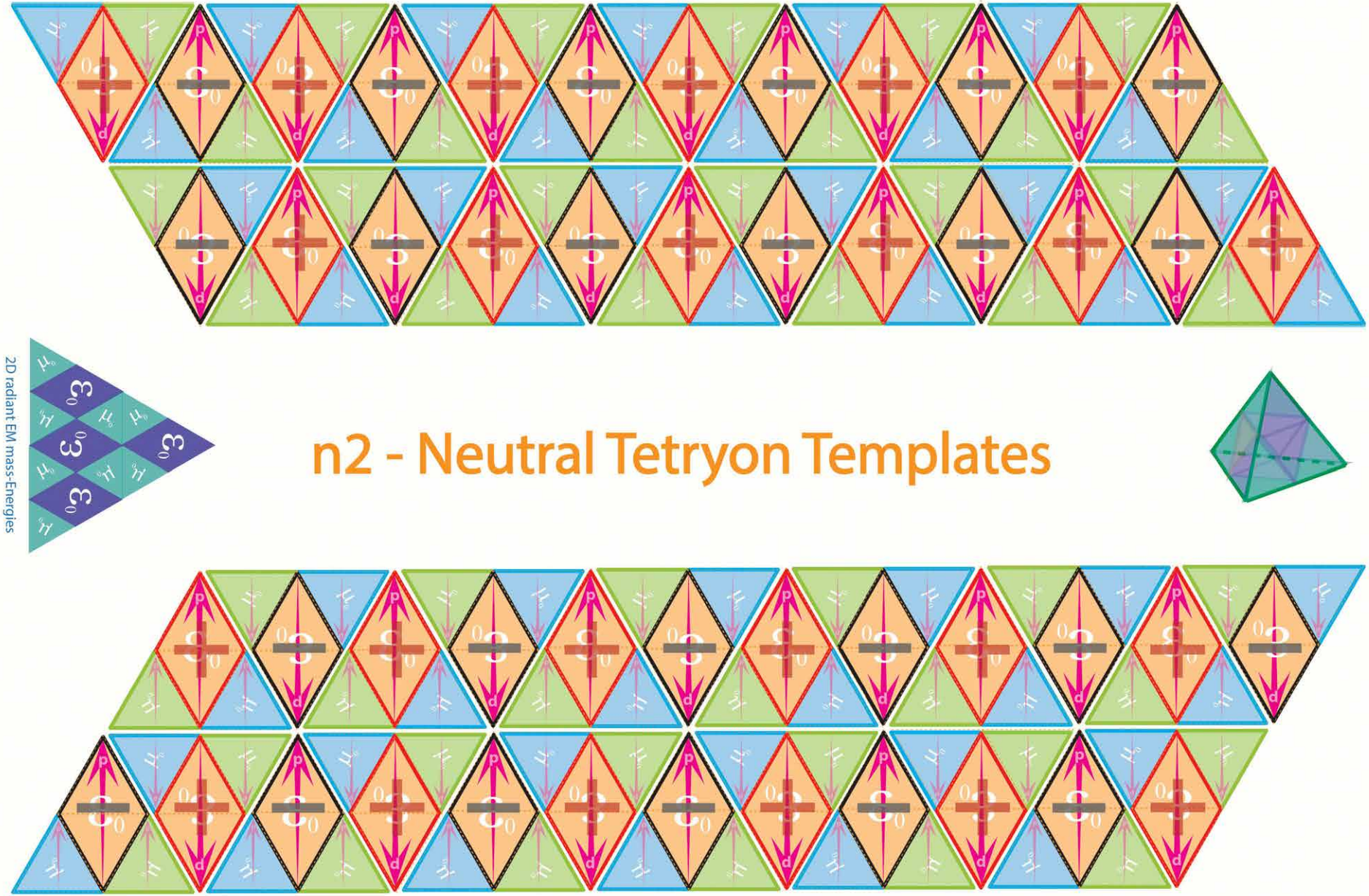

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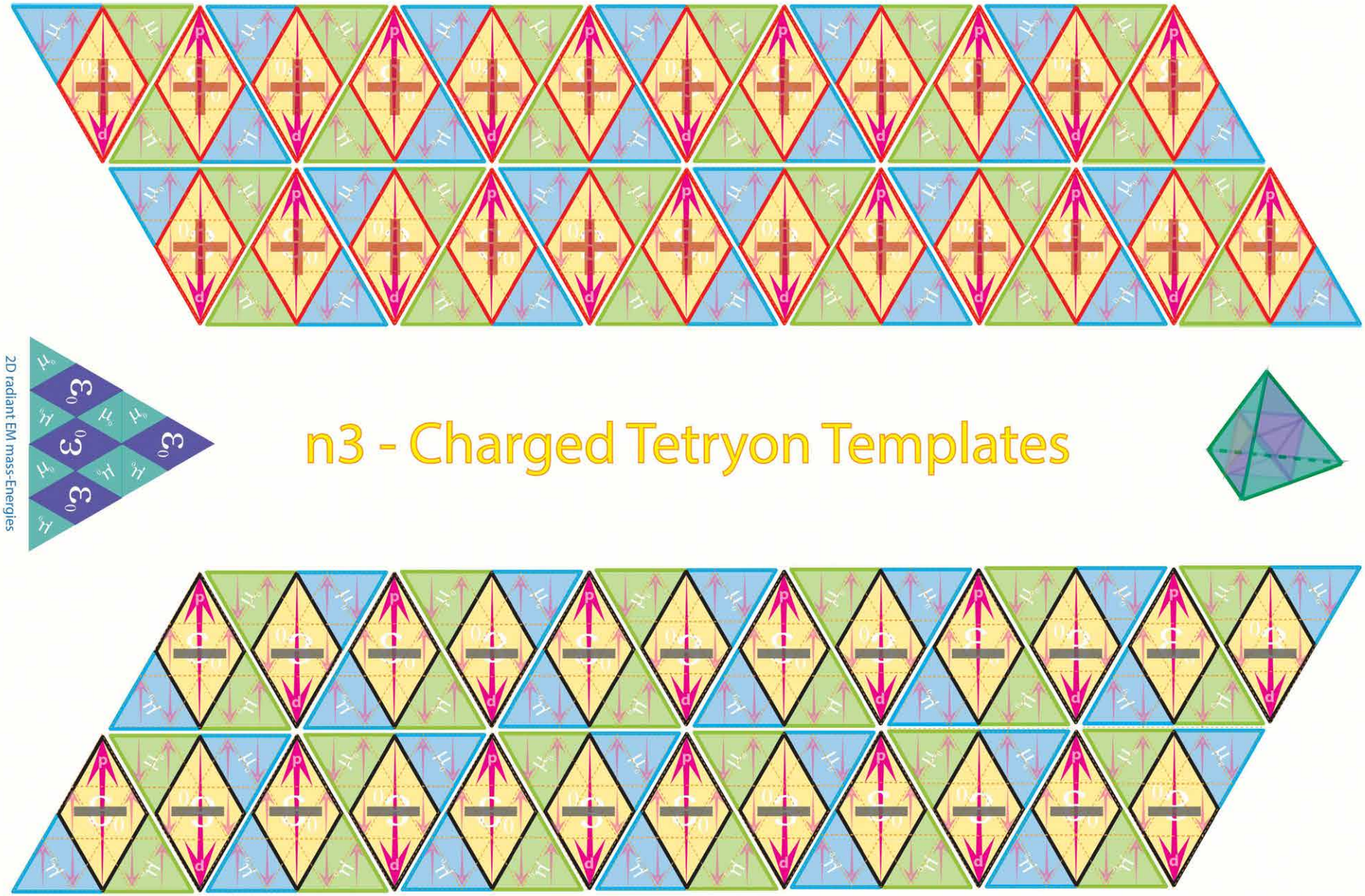

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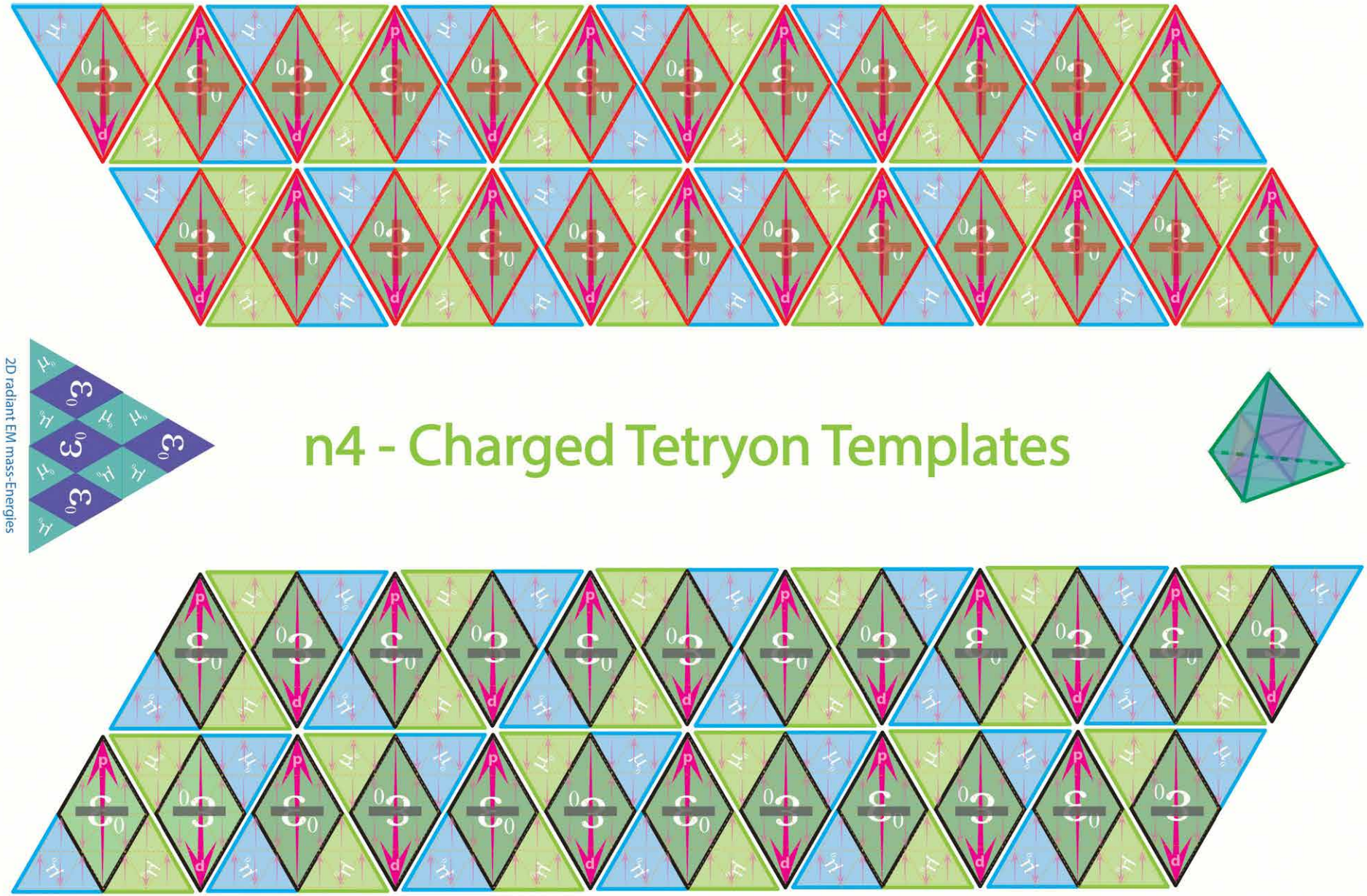

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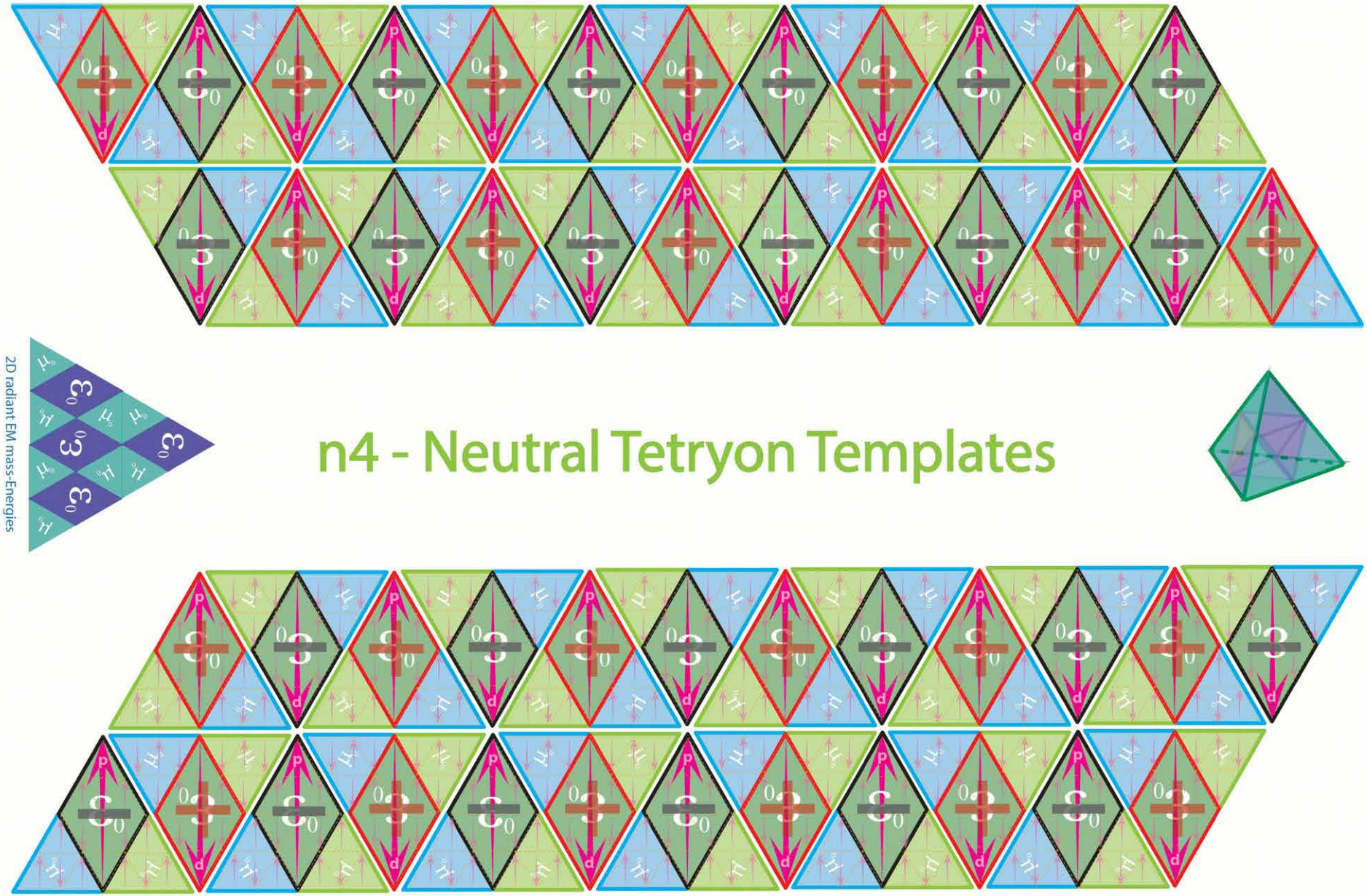

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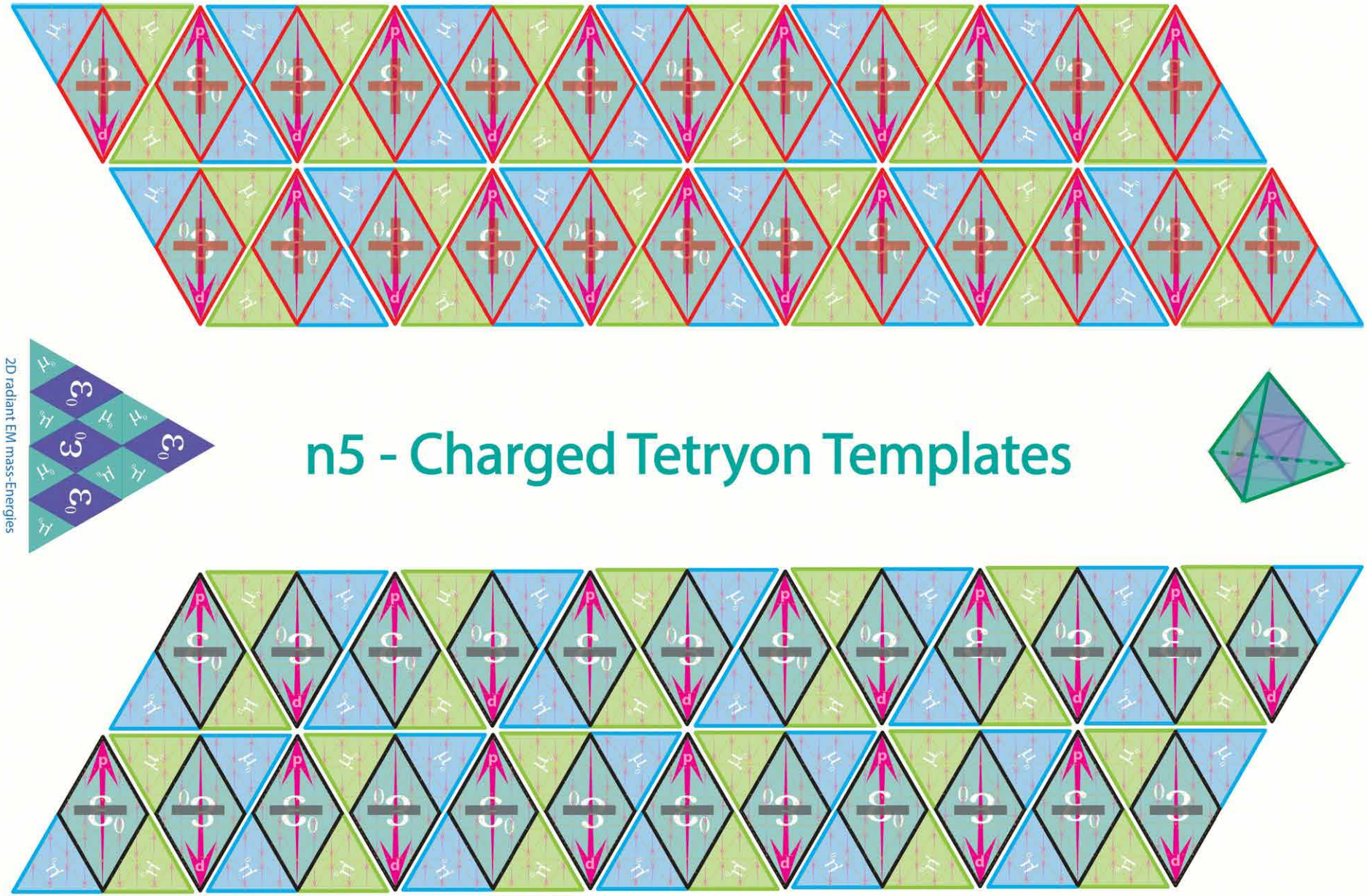

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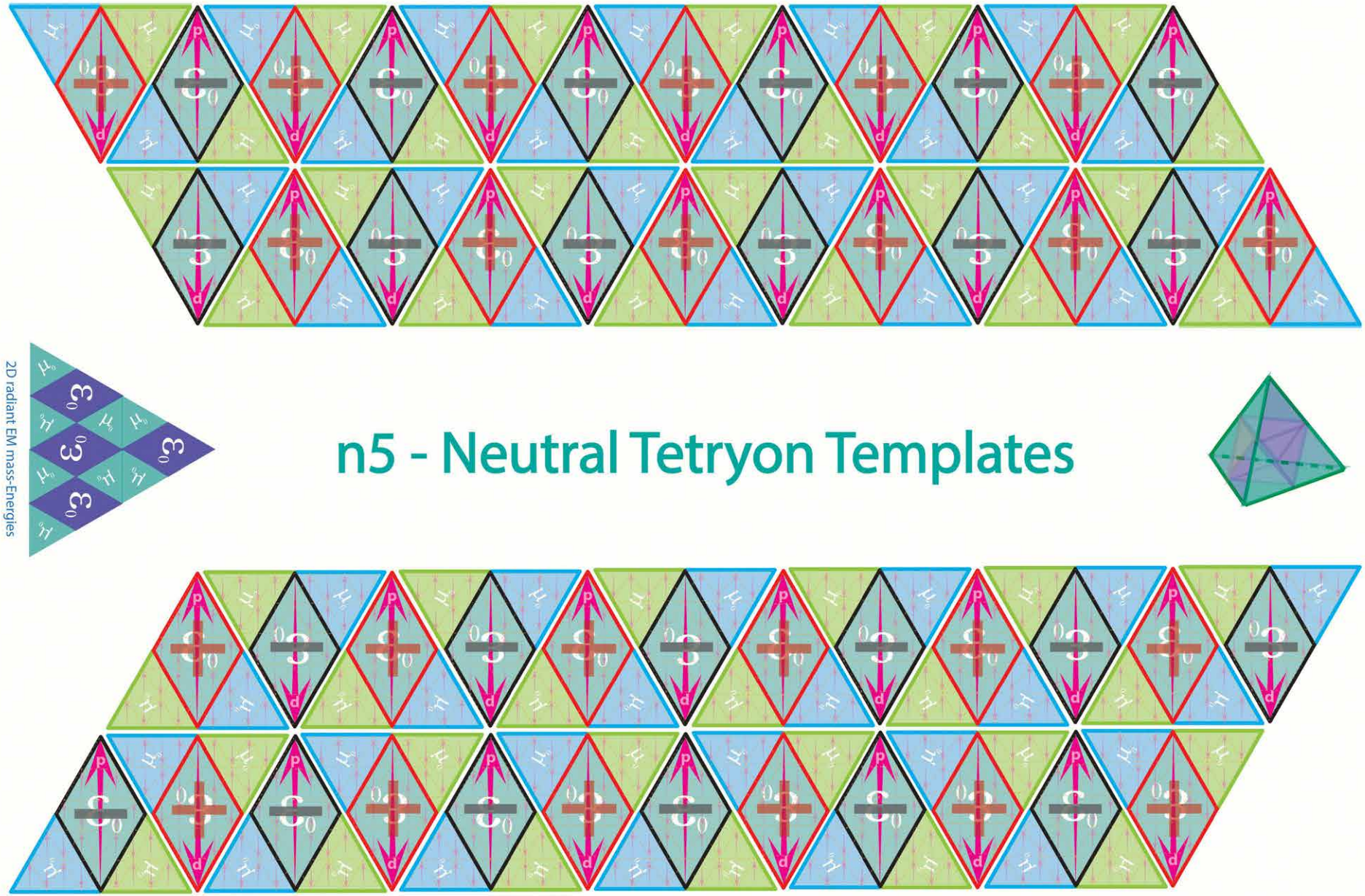

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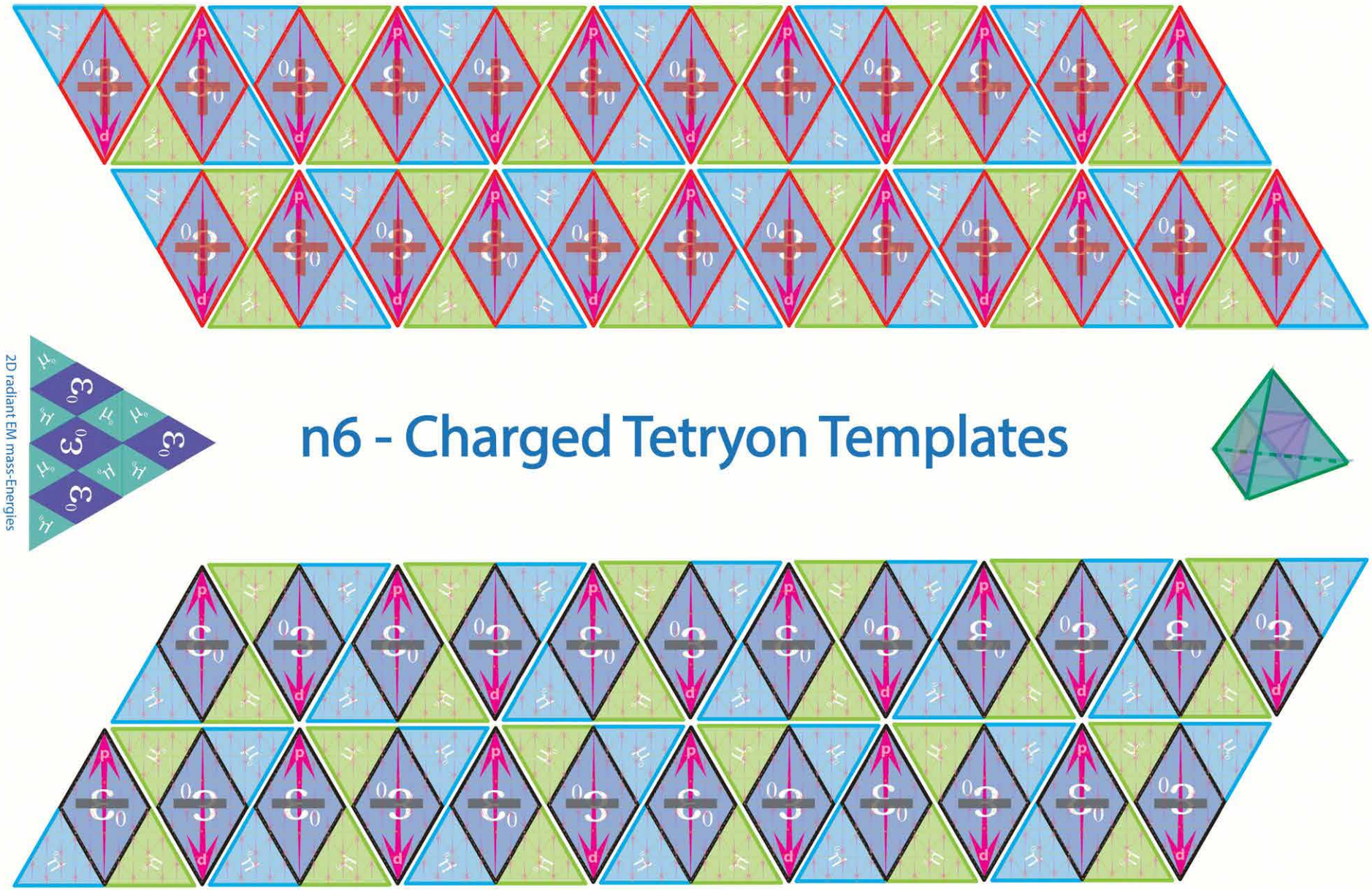

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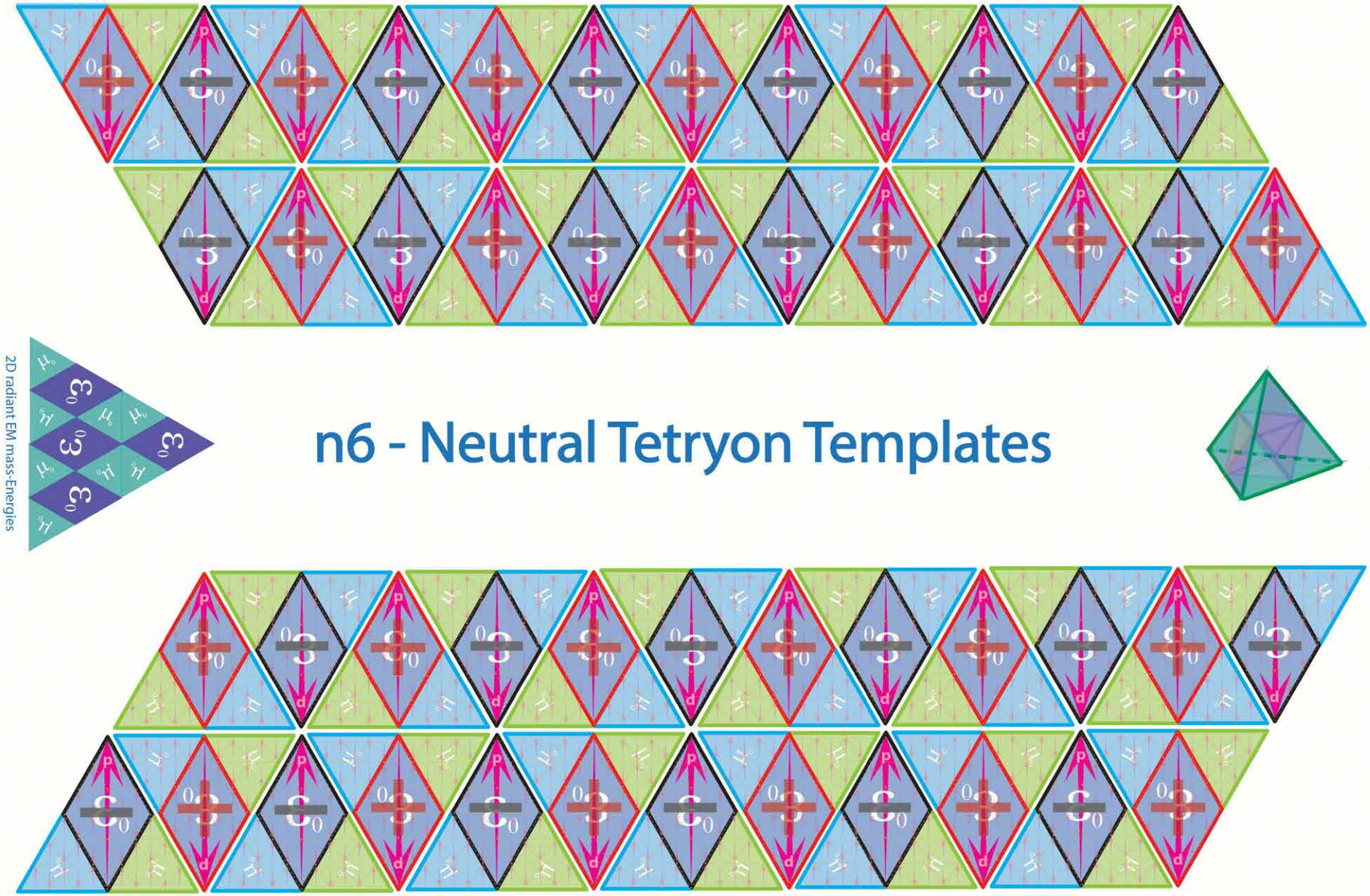

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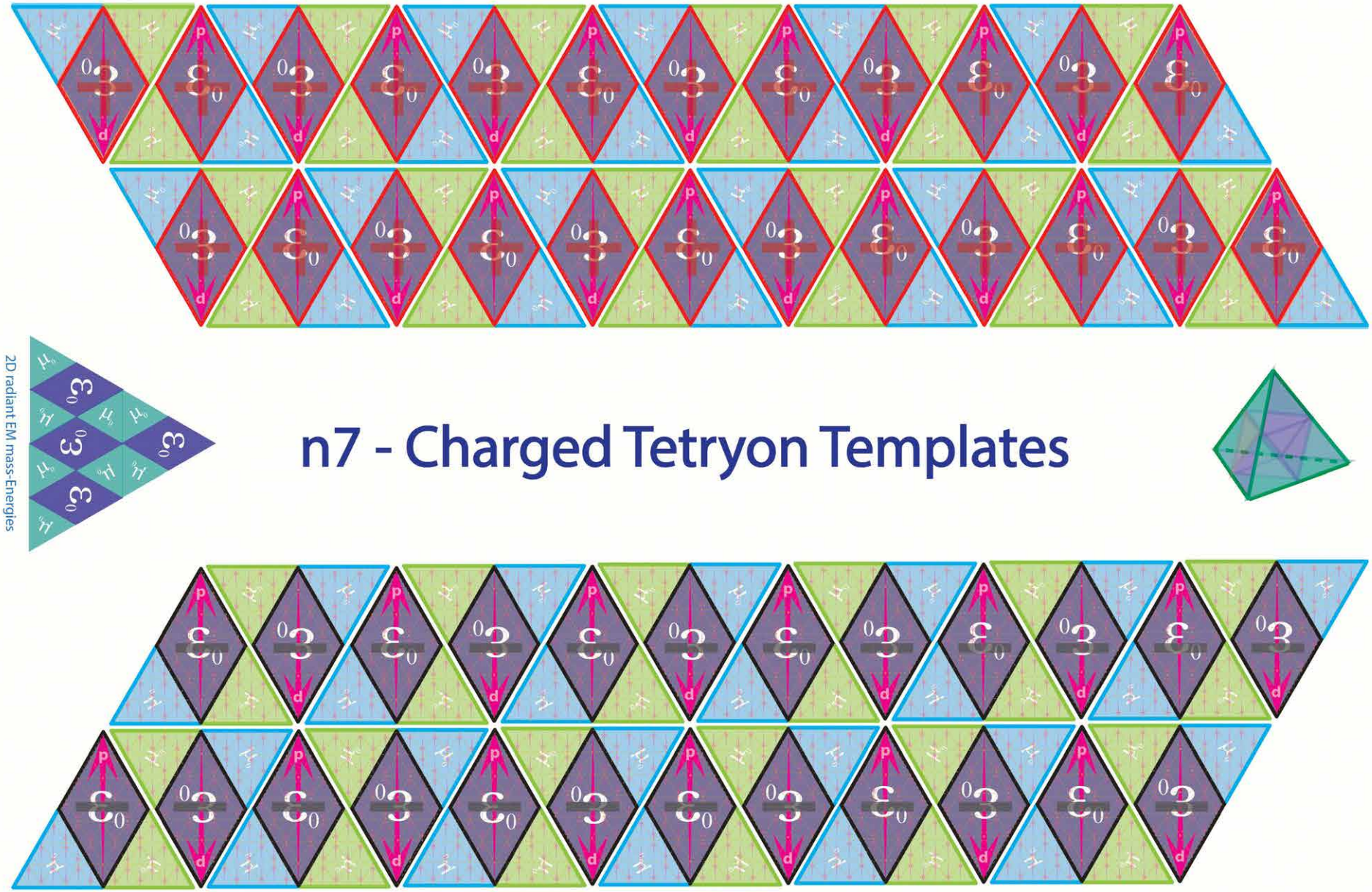

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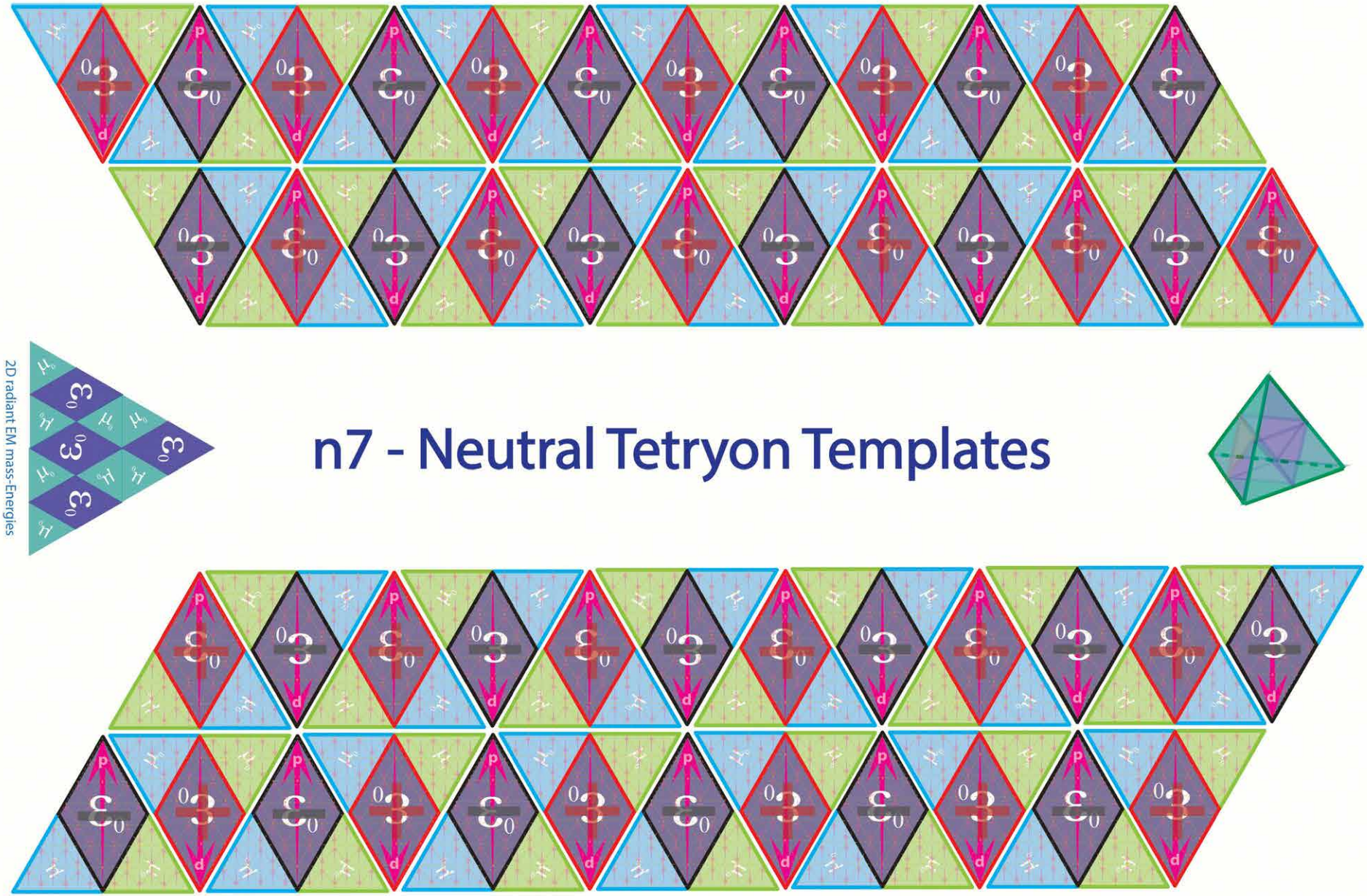

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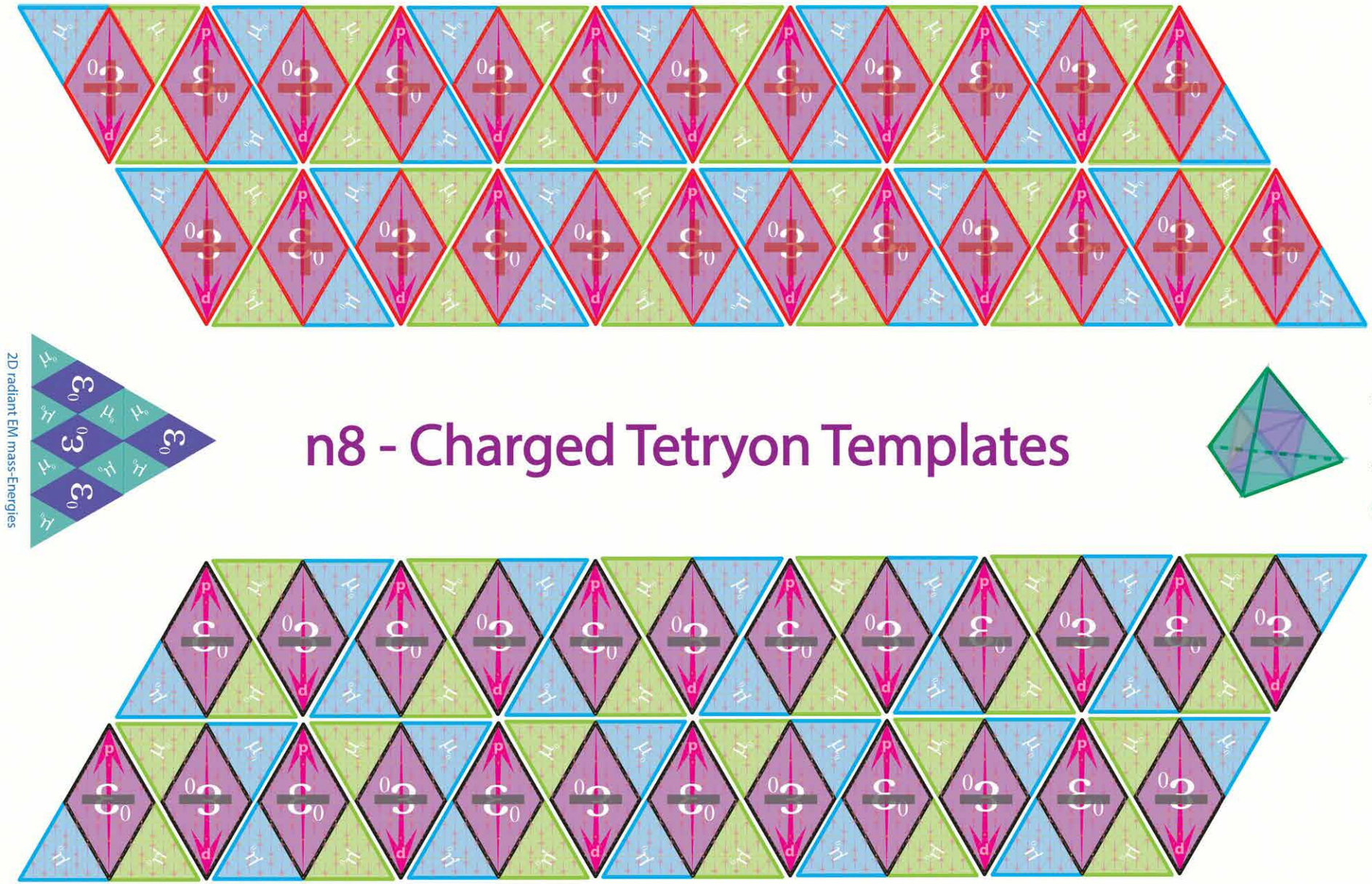

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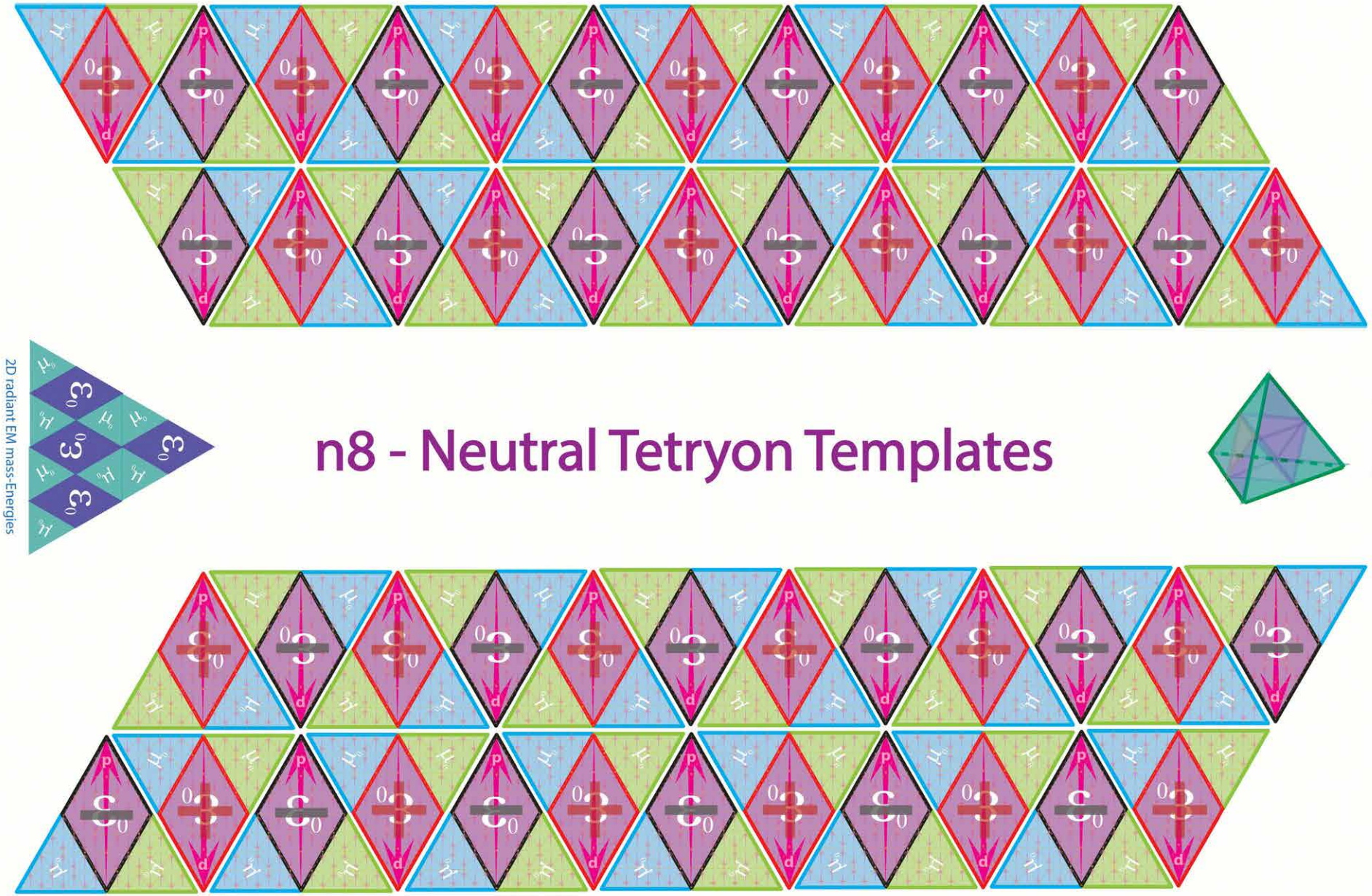

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Periodic element geometries

An electron shell may be thought of as an orbit followed by electrons around an atom's nucleus.
The closest shell to the nucleus is called the "1 shell" (also called "K shell"), followed by the "2 shell" (or "L shell"), then the "3 shell" (or "M shell"), and so on further and further from the nucleus.
The shell letters K, L, M, ... are alphabetical

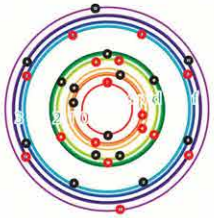

Each shell consists of one or more subshells, and each subshell consists of one or more atomic orbitals.

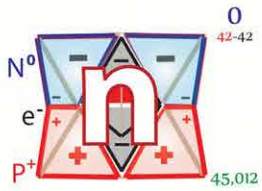

Each shell can contain only an integer number of whole deuterium nuclei [Proton, Neutron & electron]

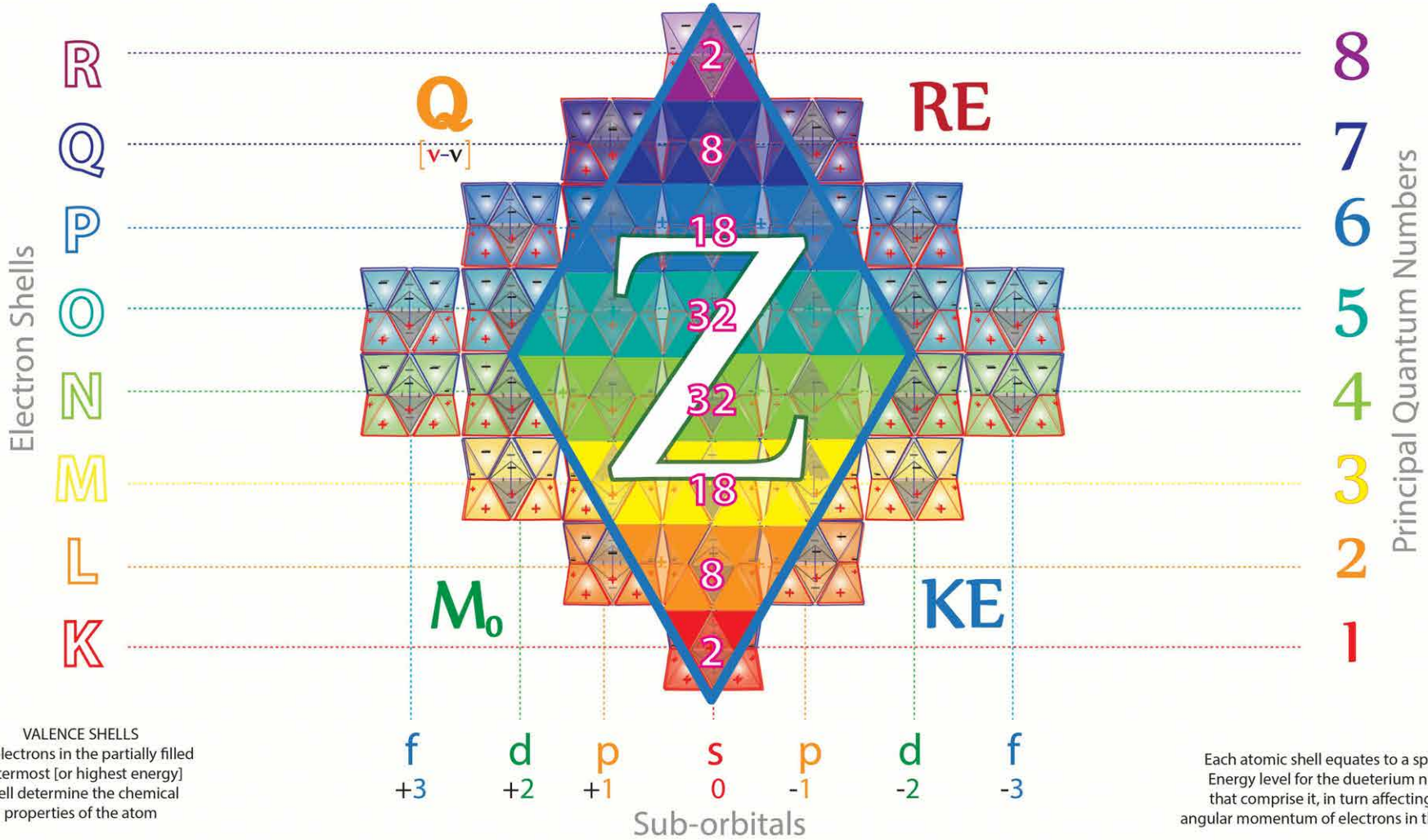

VALENCE SHELLS
The electrons in the partially filled outermost [or highest energy] shell determine the chemical properties of the atom

Each atomic shell equates to a specific Energy level for the dueterium nuclei that comprise it, in turn affecting the angular momentum of electrons in that shell

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Periodic Harmonic motions

$x = A \cos(\omega t + \varphi)$

Much of the math in of modern physics is predicated on the assumption that π [where it appears] is related to the properties of a circle

$F = -kx$

Circular motion

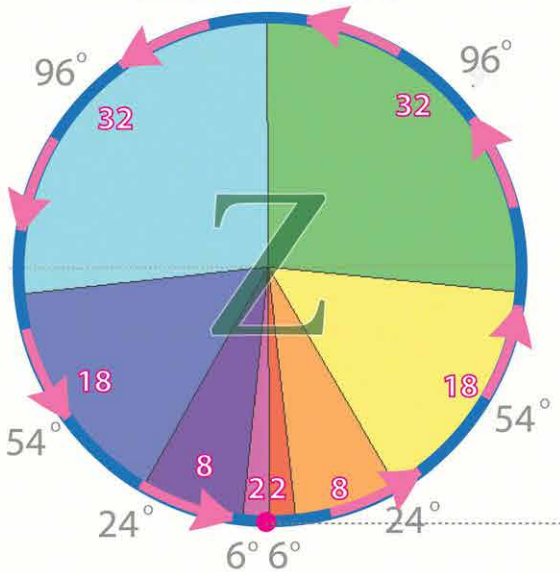

Linear motion

Simple harmonic motion can be visualized as the projection of uniform circular motion onto one axis

Principal Quantum Numbers

circular harmonic motion

simple harmonic motion

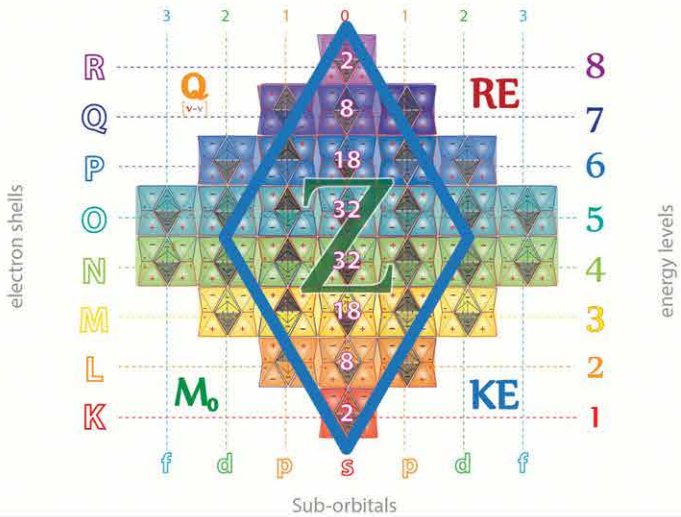

Circular motions describe the motion of a body with a changing velocity vector [the result of an acceleration force].

Nuclei per shell in elements follows a 'periodic summation rule' that is reflective of photonic energies

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Atomic nuclei mass-energies

Each element's weight [mass-Matter in a gravitational field] is the result of the total quanta comprising that element

Baryon mass-energies		E		electron KEM field
n		The quantum level mass-energies of Baryons determines the kinetic energies of electrons 1n - 1 e19v		hv^2
73,728	n32	8	v8	3.268969693 e15
69,192	n31	7	v7	2.502804921 e15
64,800	n30	6	v6	1.838795452 e15
60,552	n29	5	v5	1.276941286 e15
56,448	n28	4	v4	8.172424232 e14
52,488	n27	3	v3	4.596988631 e14
48,672	n26	2	v2	2.043106058 e14
45,000	n25	1	v1	5.107765145 e13
Compton frequencies		1.2 e20 electron rest Matter is velocity invariant		spectral frequencies
930 MeV		496 keV		13.6 eV

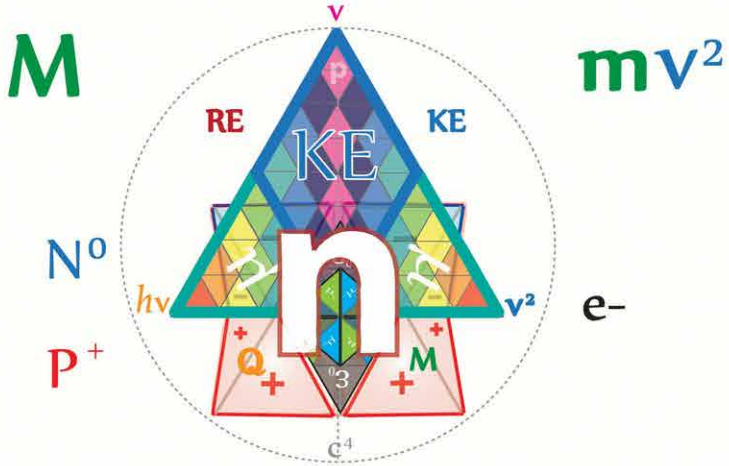

The nuclei forming each atomic shell have specific mass-energy quanta

$$\overset{8}{\underset{1}{n}}\left[\left[72(n)^2\right]+\left[12e19\right]+\left[m_e v^2\right]\right]$$

Baryon rest masses — lepton rest mass — KEM

Deuterium mass-energy per shell

Despite having differing mass-energies each Deuterium nuclei has the same velocity invariant Matter geometry [84π]

spin orbital coupling in synchronous quantum convertors

Electrons act as quantum scale rotating armatures in atomic nuclei and can only have specific energies reflective of the electron orbital energy level of the Baryons in which they are found

They acheive these energy levels by absorbing or emitting photons to acheive the specific angular momentum required

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Baryons **930.947 MeV** + KEM fields **13.525 ev** + electrons **496.519 keV**

Mapping Planck mass-energy contributions to elementary Matter and isotopes

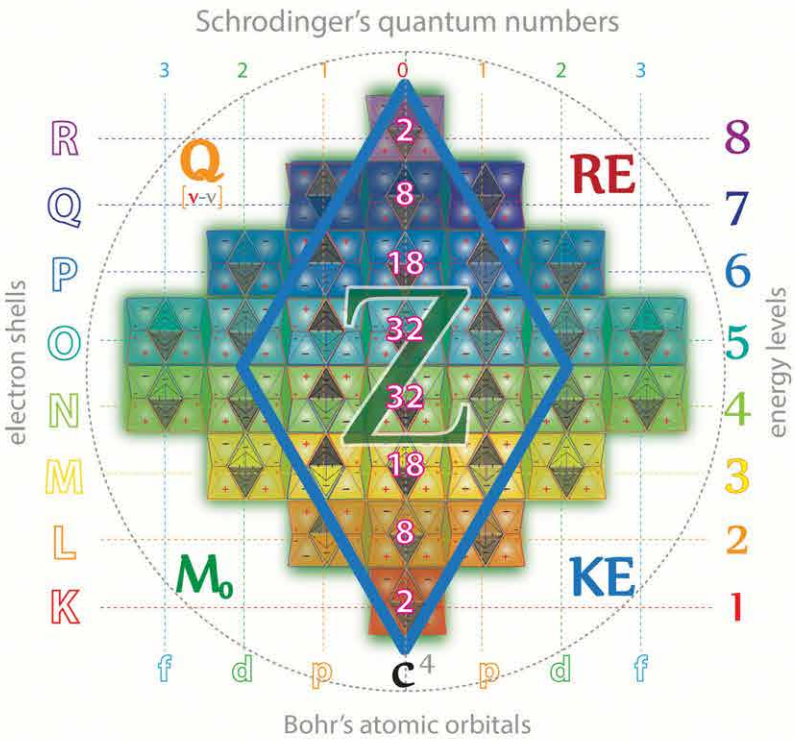

$$E = hv^2$$

$$n^2 + v^2 + e = Z$$

general form quatratic equation

$$ax^2 + bx + c = Z$$

$$E = nhv$$

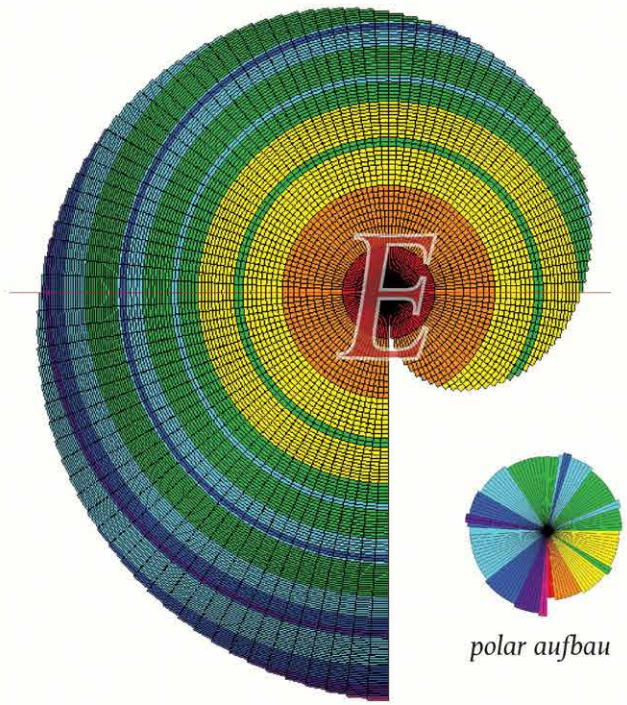

polar aufbau

polar energy spirals courtesy of Rene Cormier

Identifying electron rest Matter topologies as velocity invariant we can re-arrange the component Planck mass-energy geometry formulation of periodic elements to

$$h\left[72[v^2] + v + 1.20\,e20\,v\right]$$

Deuteron rest mass; Spectral lines; electron rest mass

reveal a quadratic formulation for all Z numbers

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$$\sum_{K}^{R}$$

R
nuclei per shell
K

STEP ONE

Periodic summation follows the atomic shell electron config

$$\sum_{K}^{R} 2(x^2) =$$

1 R
2
3
4
4
3
2
1 K

Each atomic shell can hold only a fixed number of deuterium nuclei

Periodic Summation

Periodic summation is a notation developed for Tetryonic theory to model the geometric series addtion of Z[n²] energy level Deuterium nuclei that form the periodic elements

$$\sum_{K}^{R} Z$$

$$\sum^{Z}$$

120
element number
1

STEP TWO

Periodic elements build up following the aufbau sequence

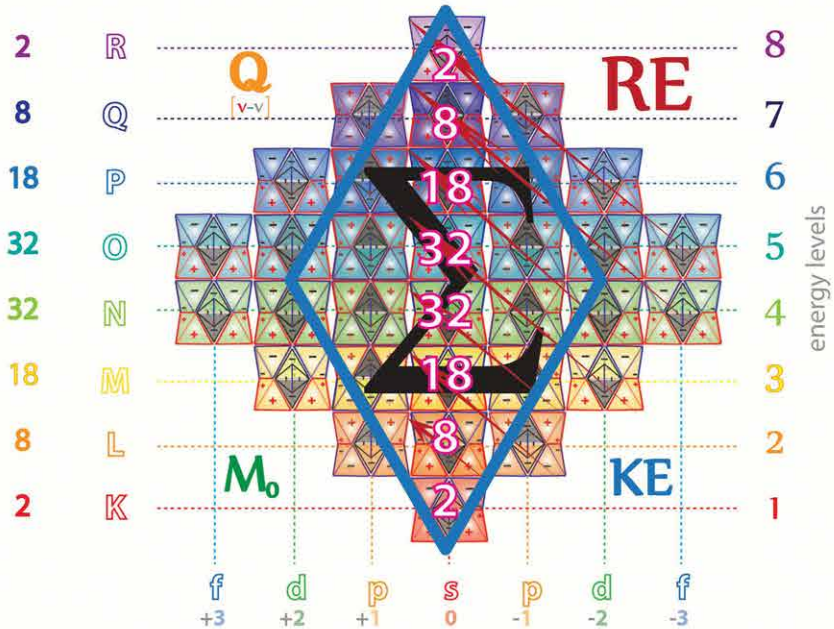

$\sum_{K}^{R}$ R = 2	2 nuclei [74.496 ea]	120	Unbinilium
+			
$\sum_{K}^{R}$ Q = 8	8 nuclei [69,780 ea]	118	Ununoctium
+			
$\sum_{K}^{R}$ P = 18	18 nuclei [65,232 ea]	110	Darmstadtium
+			
$\sum_{K}^{R}$ O = 32	32 nuclei [60,852 ea]	92	Uranium
+			
$\sum_{K}^{R}$ N = 32	32 nuclei [56,640 ea]	60	Neodymuim
+			
$\sum_{K}^{R}$ M = 18	18 nuclei [52,596 ea]	28	Argon
+			
$\sum_{K}^{R}$ L = 8	8 nuclei [48,720 ea]	10	Neon
+			
$\sum_{K}^{R}$ K = 2	2 nuclei [45,012 ea]	2	Helium
		0	Hydrogen

THe LHS of the notation determine the number of nuclei in each atomic shell, from the periodic mass-energy levels for atoms, and the RHS follows the aufbau building principle to determine the rest mass-Matter of any specific element

Aufbau

Each periodic element is made of Z [n² energy] deuterium nuclei

Z# [z Protons [24-12] / z Neutrons [18-18] / z electrons [0-12]] n1-8

Planck mass-energies form the surface integral of rest Matter topologies for each periodic element

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Proton - Neutron Curve

The graph below is a plot of neutron number against proton number.
It is used as rule to determine which nuclei are stable or unstable.

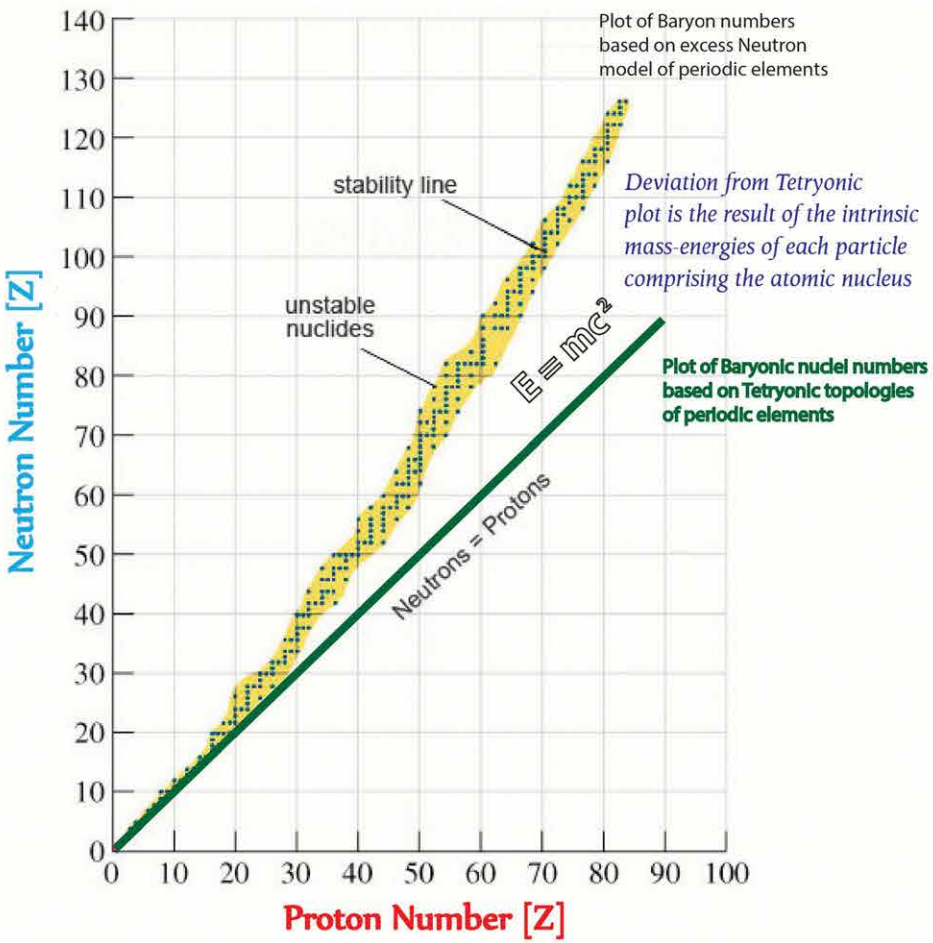

Historically, Proton-electron numbers are viewed as being equivalent in neutral elementary matter with the excess molar mass measured being the result of 'excess or extra' Neutrons in the atom

Atomic Nuclei Numbers

All periodic elements have an EQUAL number of Protons, Neutrons & Electrons with their molar mass-Matter being determined by their quantum level mass-energies

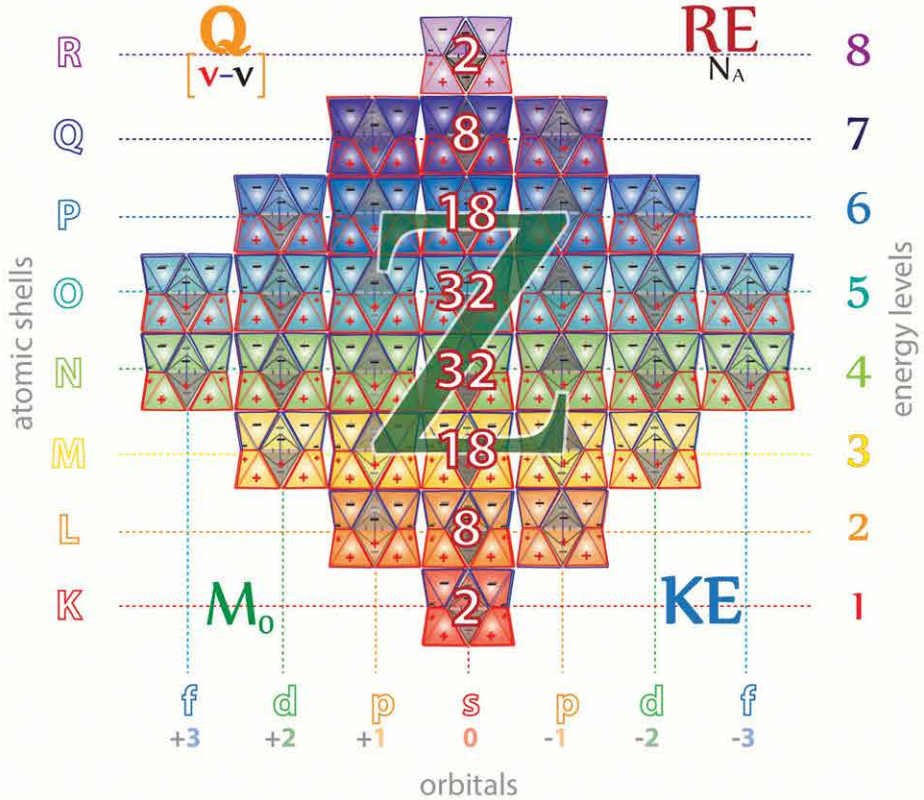

Tetryonic modelling of the charged mass-ENERGY-Matter topologies of elementary atoms and the nuclei that comprise them, reveals a DIRECT LINEAR relationship for the number of Protons-electrons-Neutrons in all periodic elements and nuclear isotopes

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Planck mass-energy contributions to elementary Matter and isotopes

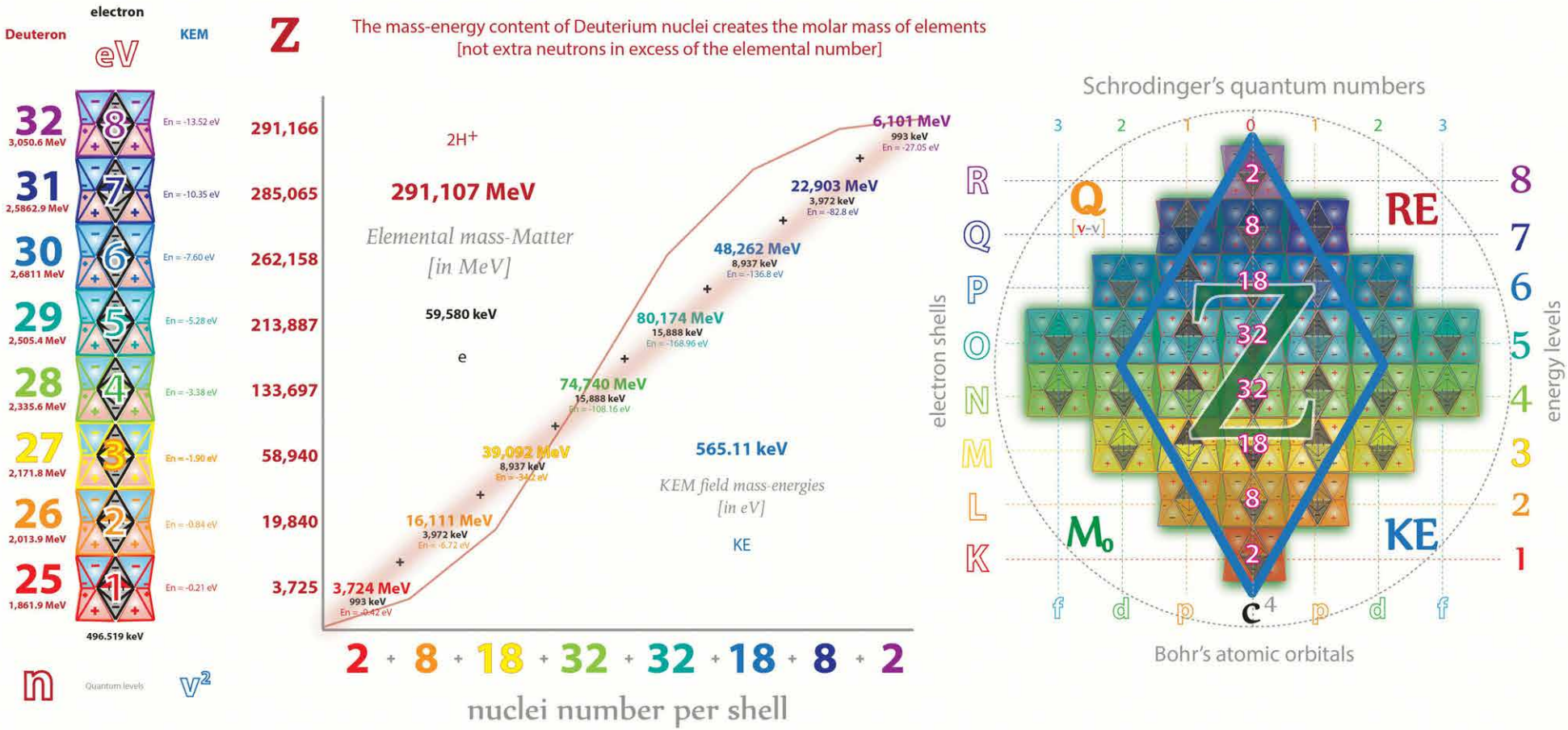

n1 Elementary nuclei

are comprised of equal numbers of Protons, Neutrons & electrons with varying energy levels

Baryons		electrons		KEM fields
930.947 MeV	+	**496.519 keV**	+	**13.525 ev**

The mass-energy content of Matter topologies is velocity invariant

The mass-energy content of Baryons determines the KEM field of electrons

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All elements are comprised of n level Duetrium nuclei

Baryons **KEM fields** **electrons**

$$Z\,[[72n^2] + [12v^2] + [1.2e20]]$$

1,861,949 MeV **13.525 eV** **496,519 keV**

$2H^+$ $[72n^2]$ Z γ $[M_e v^2]$

Elemental mass-Matter [in MeV]

The atomic shell energy levels of Deuterium nuclei in elements

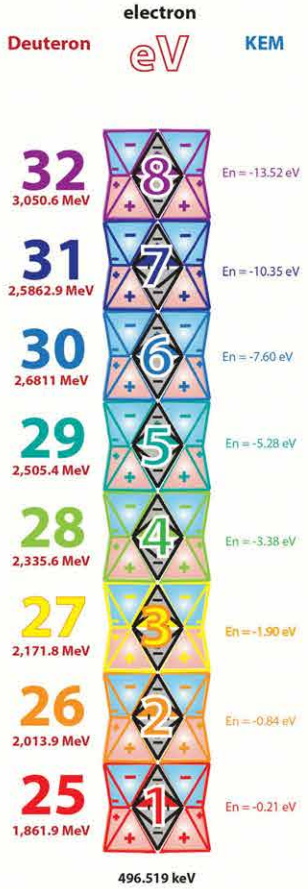

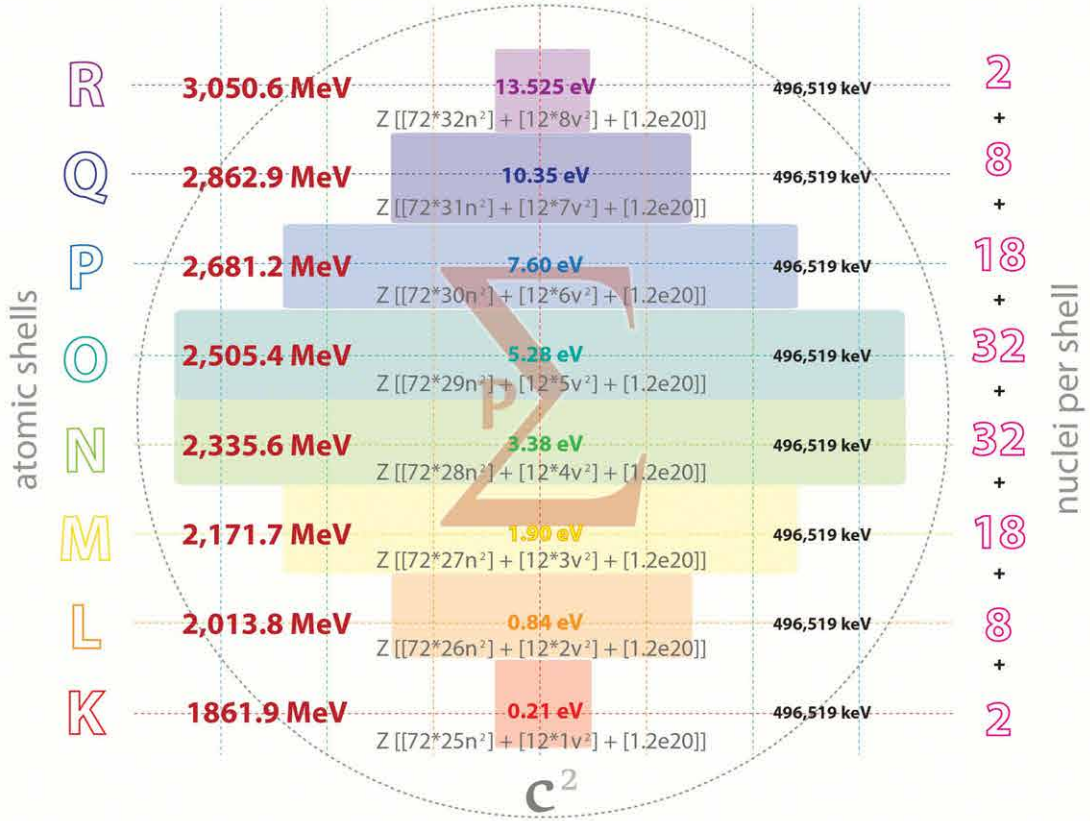

6,101 MeV 993 keV En = -27.05 eV
+
22,903 MeV 3,972 keV En = -82.8 eV
+
48,262 MeV 8,937 keV En = -316.8 eV
+
80,174 MeV 15,888 keV En = -168.96 eV
+
74,740 MeV 15,888 keV En = -108.16 eV
+
39,092 MeV 8,937 keV En = -34.2 eV
+
16,111 MeV 3,972 keV En = -6.72 eV
+
3,724 MeV 993 keV En = -0.42 eV

$[1.2e20]]$

e

the rest mass-Matter of bound photo-electrons is velocity invariant

Determines the spectral line [KEM field energies] of electrons bound to them

The relativistic rest mass-energy-Matter of all periodic elements

is the sum of the mass-energies of all atomic nuclei and spectral lines that comprise its mass-Matter topology as measured in any spatial co-ordinate system per unit of time

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Ionisation energies

Fractional quantum differentials

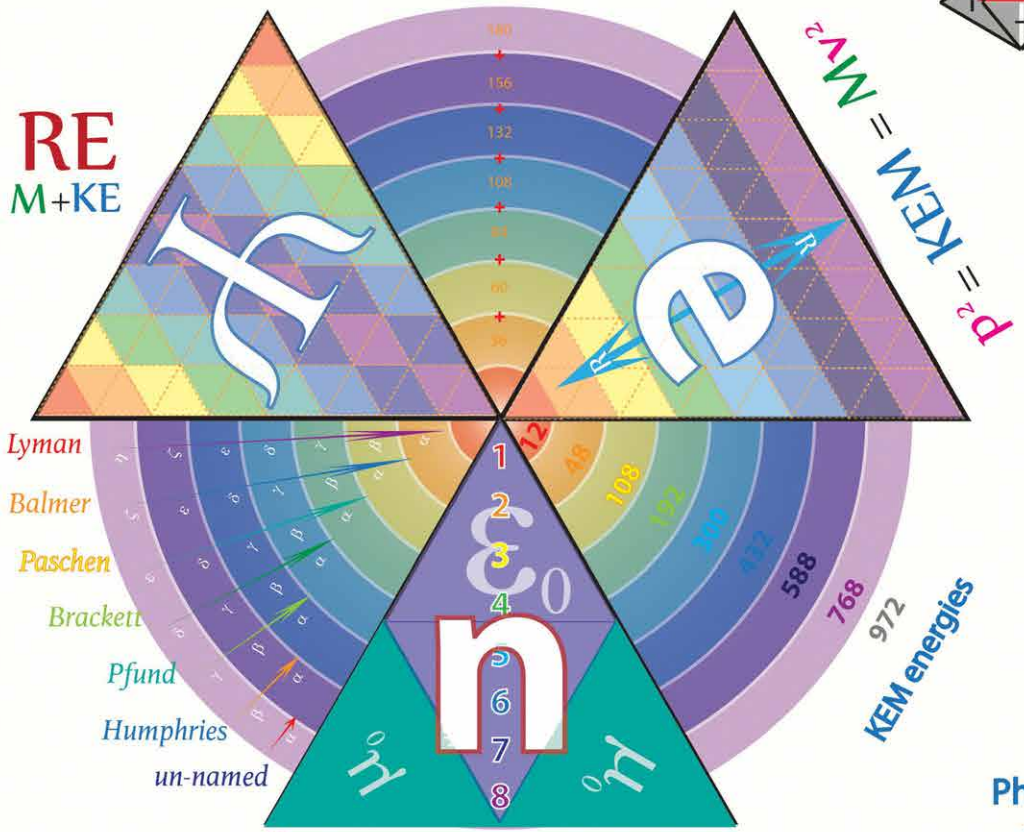

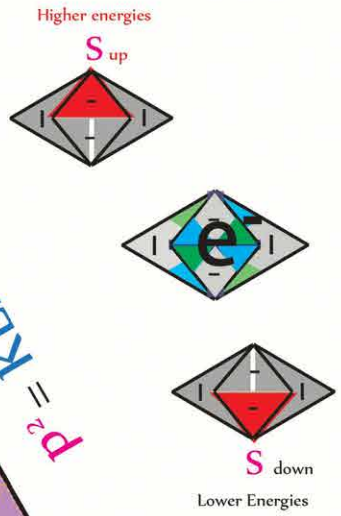

photo-electronic energy momenta

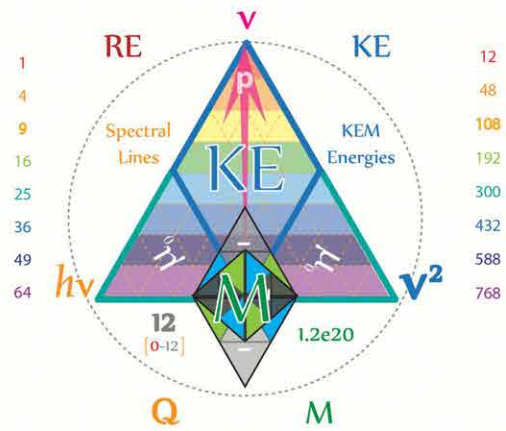

Mapping photo-electron transition energies to Tetryonic energy momenta geometries reveals many key facts about the ionisation energies of nuclei

$$E = -\frac{Z^2}{n^2}\frac{ke^2}{2a_0} = -\frac{13.6Z^2}{n^2}eV$$

The differing fractional KEM field energy momenta of electrons that results from their transitions to specific energy nuclei in elements results in differing QAM quanta and produces spectral lines and fine line splitting

$$hf = \Delta Mv = \Delta p$$

spectral lines are produced by accelerating electrons

Note: this is an Illustrative schema for modelling KEM field energies
All KEM fields possess the same physical spatial geometry
in radial-time defined spatial co-ordinate systems

Photo-electrons absorb/emit spectral energies

$$E = eV = \frac{1}{4\pi\epsilon_0}\frac{ne^2}{a}$$

Spectral line transitions

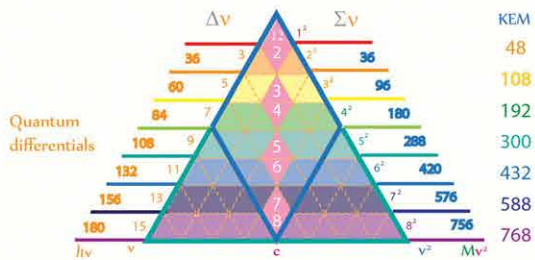

hv, R, β, p, KE
Planck, Rydberg, Lorentz, Newton, Leibniz

uniting classical physics and relativity through equilateral geometry

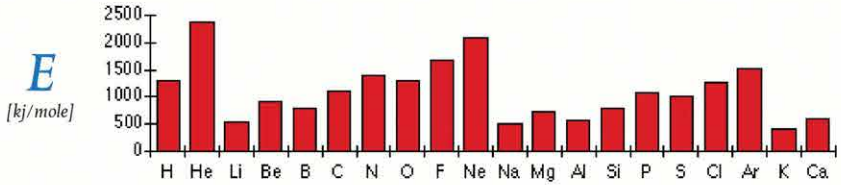

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Element numbers

Nuclei per shell in elements follow a 'periodic summation rule' that is reflective of photonic energies

$$\sum_{K}^{R} {}^{P} 2(x^2) = 2 + 8 + 18 + 32 + 32 + 18 + 8 + 2$$

Z

120	Unbinilium	n8
119	Ununennium	
118	Ununoctium	n7
87	Francium	
112	Copernicium	n6
55	Caesium	
102	Nobelium	n5
37	Rubidium	
70	Ytterbuim	n4
19	Potassium	
30	Zinc	n3
11	Sodium	
10	Neon	n2
3	Lithium	
2	Helium	n1
1	Deuterium	
Hydrogen	0	

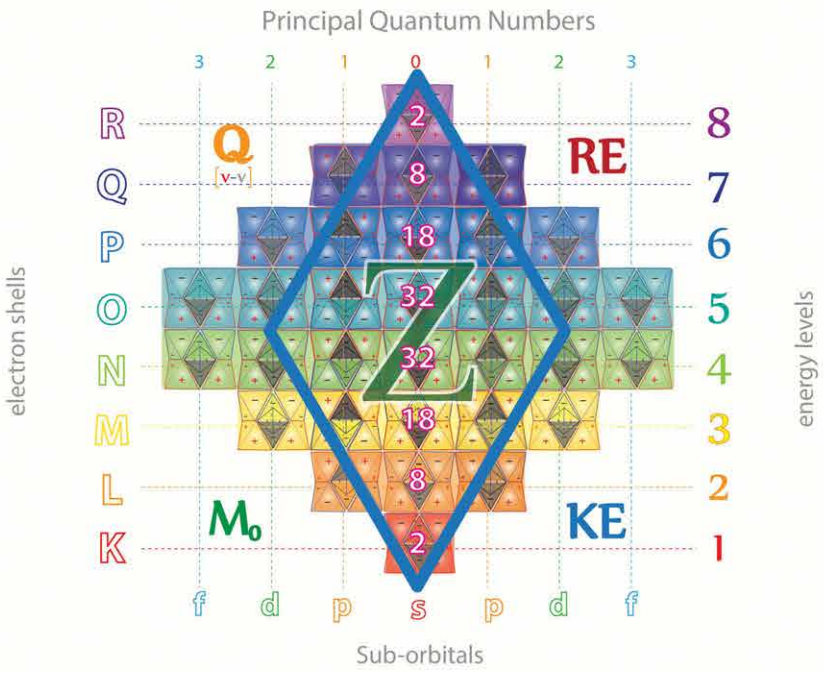

Periodic mass-ENERGY-Matter

Following periodic summation rules for shell filling n[1-8] quantum energy deuterium nuclei combine to form elementary Matter

$$\sum_{K}^{R} {}^{P}_{25}{}^{32} \left[\left[72(n)^2 \right] + \left[12e19 \right] + \left[m_e v^2 \right] \right]_{1}^{8}$$

Baryon rest masses; lepton rest mass; KEM; Deuterium mass-energy per shell

The measured weight of Matter in gravitational fields is the result of planar mass-energies in tetryonic standing-wave geometries

The periodicity of all the elements, along with their exact molar rest mass-energies and quantum wavefunctions can be described with Tetryonic geometries

Ionisation energies

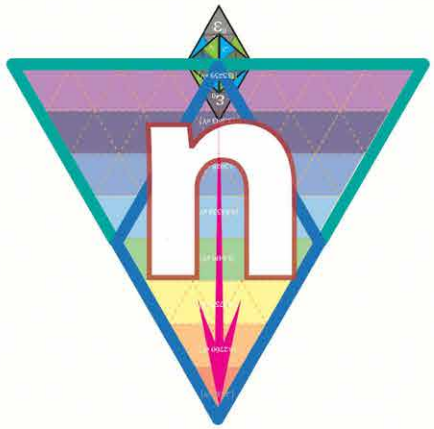

γ

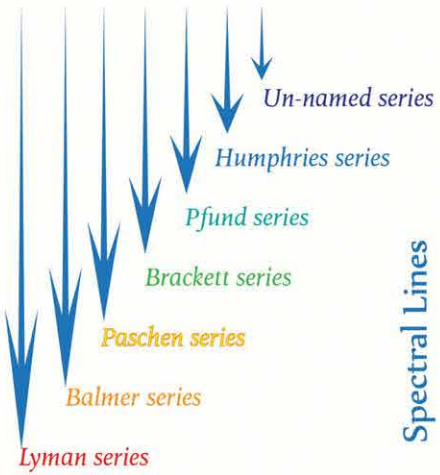

$$Mv^2 = KEM = hcR_H$$

Photon emission/absorption

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Spectral line differentials

$$\Delta h\nu = \Delta M\nu = \Delta p$$

changes to energy momenta

accelerate photo-electrons

$$\frac{1}{\lambda} = \frac{R_H}{hc}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Ryberg's formula is
a mathematical description
of Tetryonic energy geometry

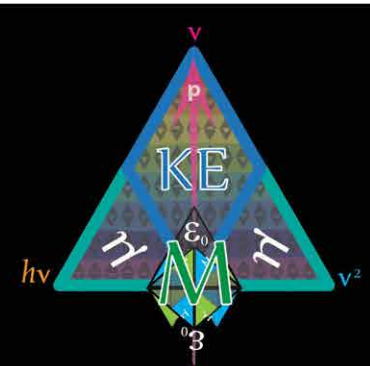

& produces spectral lines

Δhf

bosons

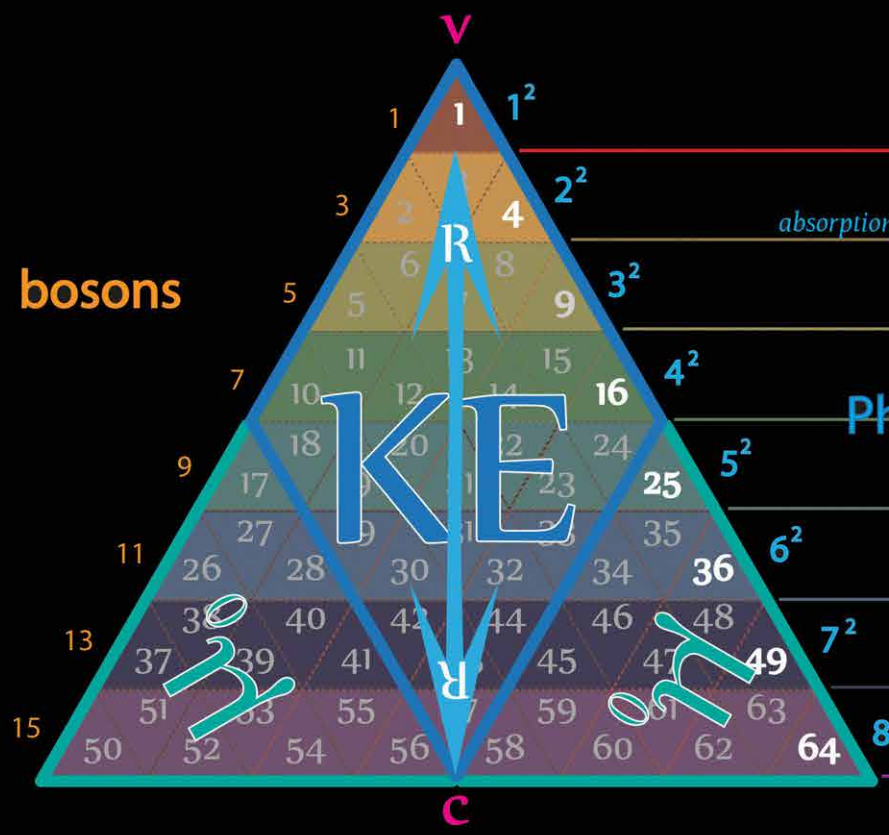

absorption $\frac{n_i^2}{n_f^2}$

Fractional energy level transitions

$\frac{n_f^2}{n_i^2}$ emission

Photo-electrons

						3/4
					5/9	8/9
				7/16	12/16	15/16
			9/25	16/25	21/25	24/25
		11/36	20/36	27/36	32/36	35/36
	13/49	24/49	33/49	40/49	45/49	48/49
15/64	28/64	39/64	48/64	55/64	60/64	63/64
Un-named	Humphries	Pfund	Brackett	Paschen	Balmer	Lyman

Ryberg's constant reflects the changing
energy momentum of a transitioning electron

$$Mv^2 = KEM = hcR$$

All of the transitions of photo-electrons bound to Hydrogen atoms can now be revealed in the fractional geometry of KEM field energies

KEM field energies

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Fermat's method of Factoring

also known as 'the difference of two squares' is used to factorise large numbers

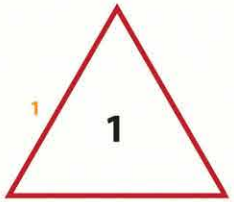

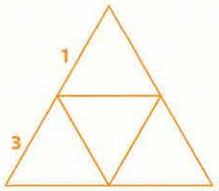

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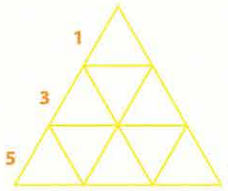

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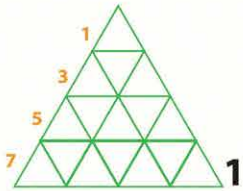

16

$[x-y].[x+y]$

$x^2 - y^2$

All
spectral
lines transitions
are an example of

Fermat's
difference of two squares
in action at the quantum level

leading in turn to Ryberg's formula

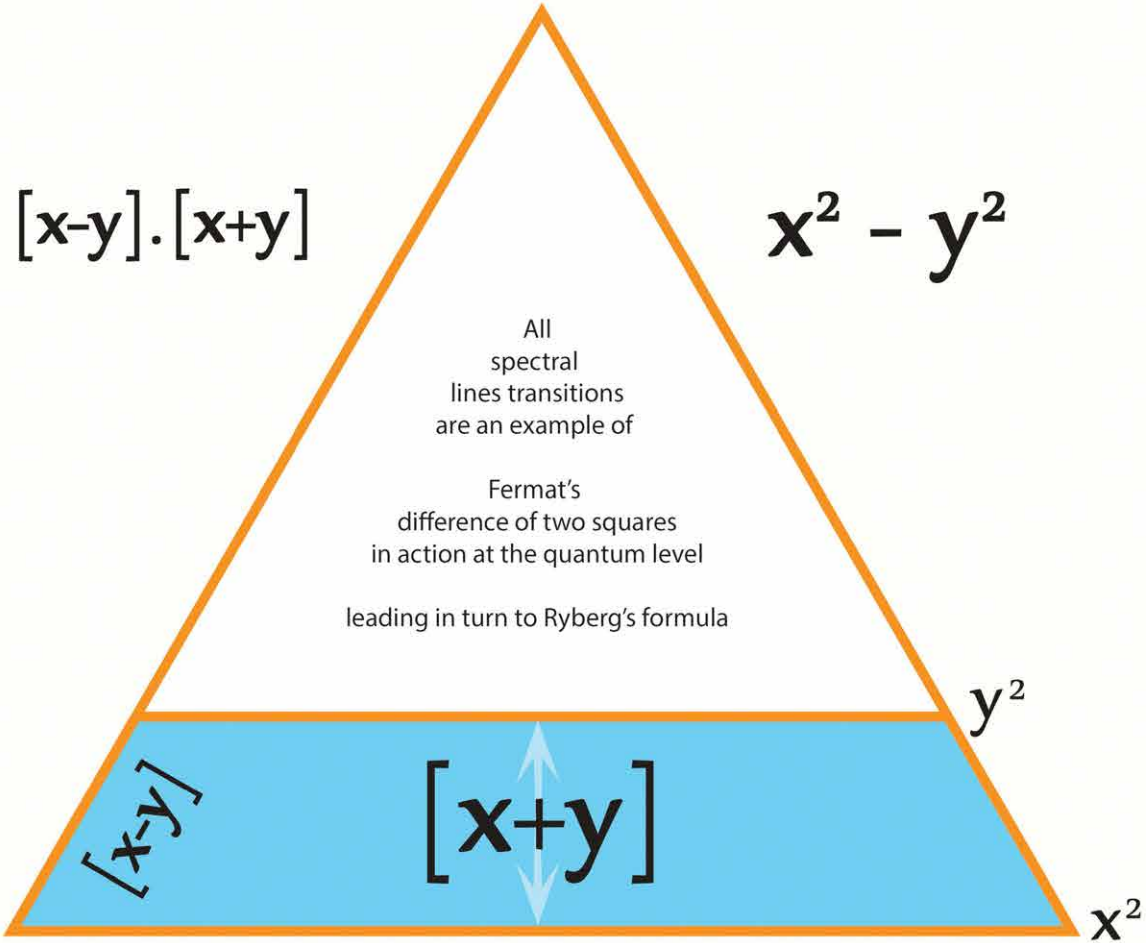

Fermat knew that every odd number could be written as the difference of two squares
or as revealed geometrically through Tetryonic theory's equilateral geometry,
every 'SQUARE' number is the sequential sum of ODD numbers

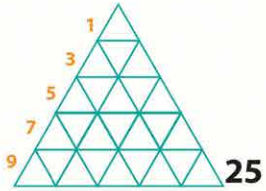

25

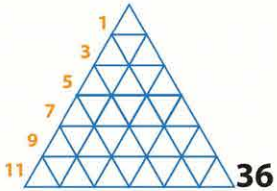

36

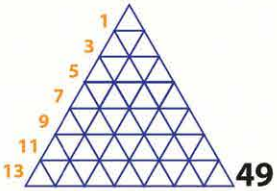

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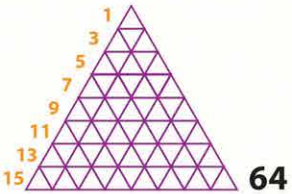

64

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Fractions

A fraction is a number that shows how many equal parts there are

In quantum mechanics fractions appear in quantum steps
as a result of the equilateral geometry of Planck energy momenta

3/4

24/25

40/49

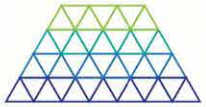

48/64

80/81

.987654321

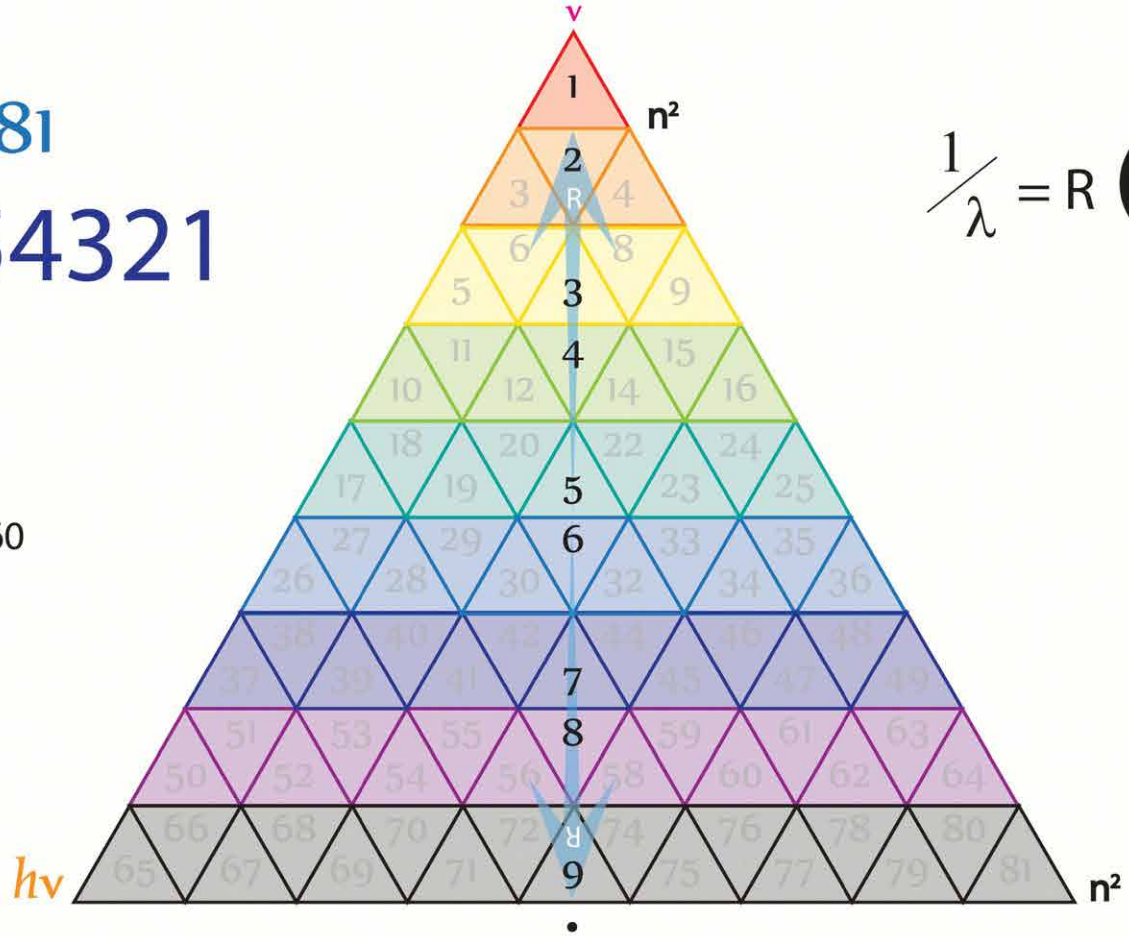

$$\frac{1}{\lambda} = R\left(\frac{1}{1} - \frac{1}{81}\right)$$

.987654321

Cos 60

.5

1/2

Sin 60

.866025403

$\sqrt{3/2}$

Tetryonic geometry explains the fractional mathematics of Rydberg's formula

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Lyman spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck — 13.525 eV — Rydberg

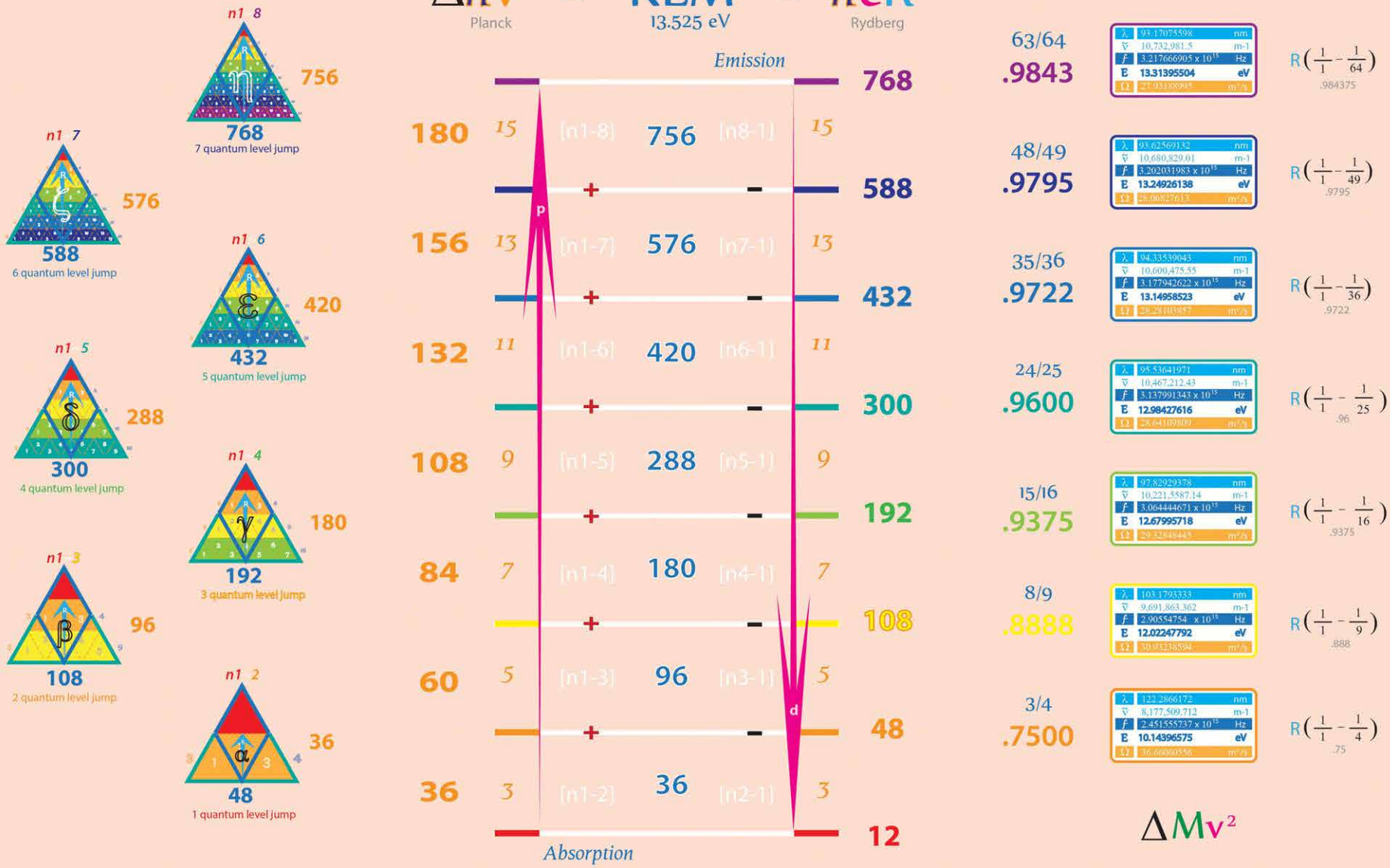

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Balmer spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck — 3.381 eV — Rydberg

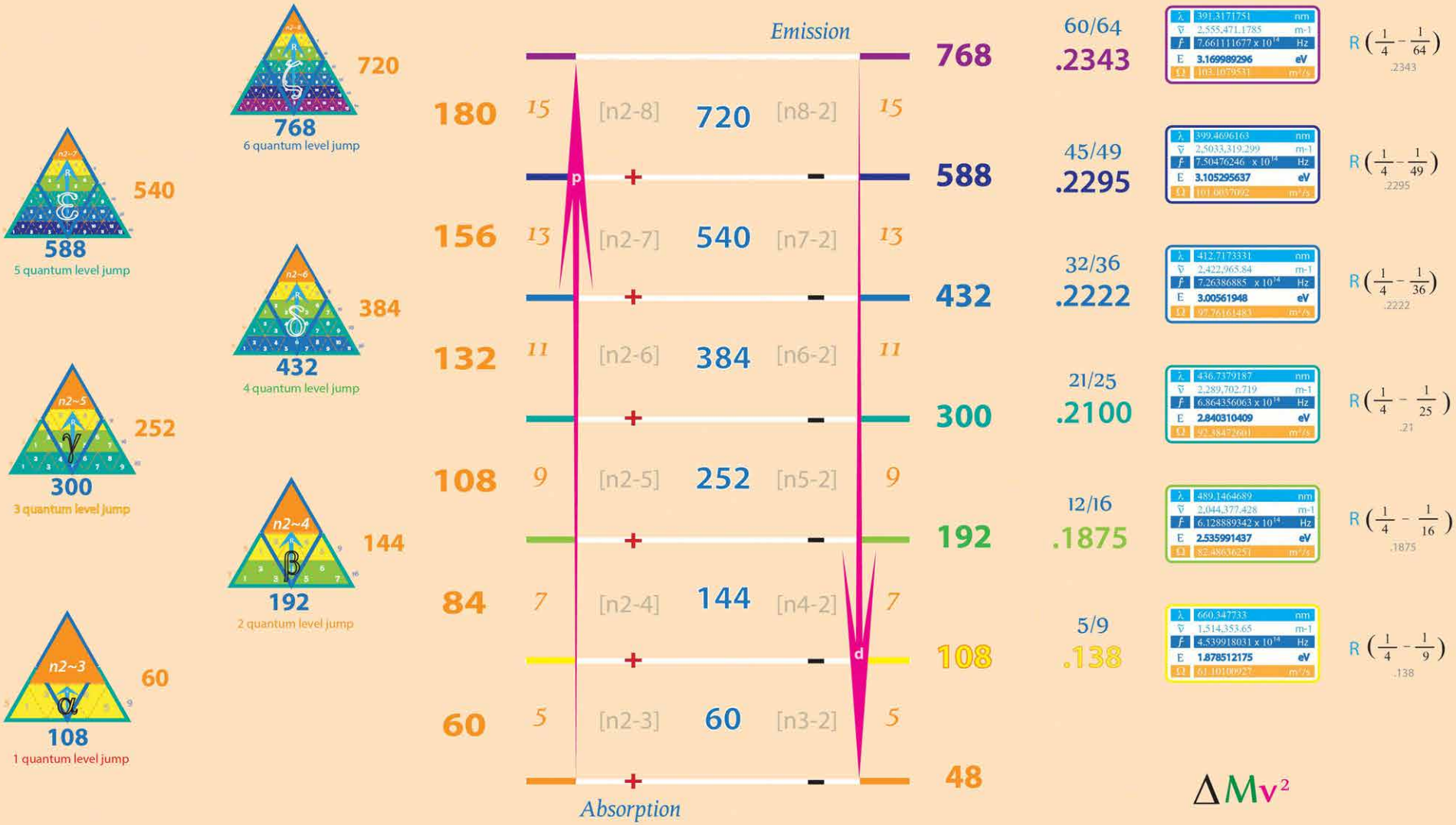

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Paschen spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck — 1.502 eV — Rydberg

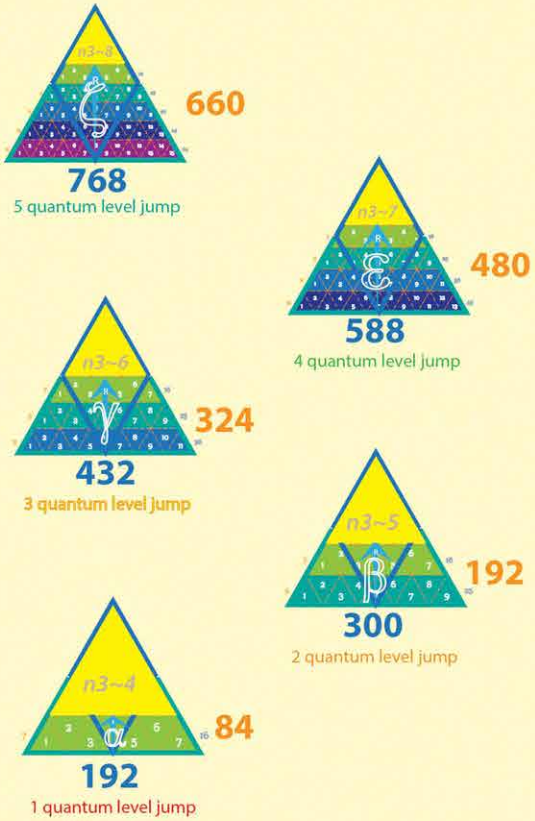

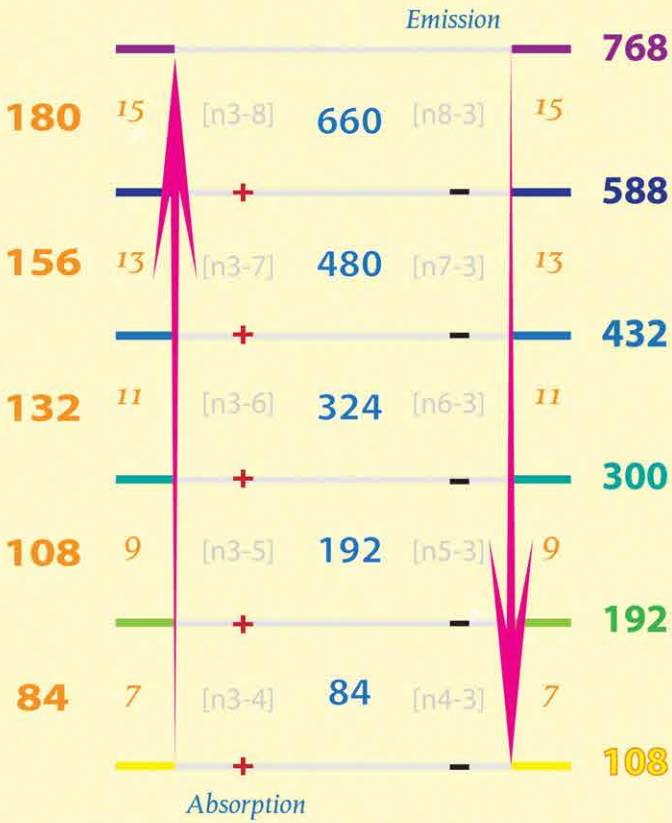

55/64 .0954	λ 960.5057935 nm; ν̃ 1,041,118.135 m-1; f 3.121193646 x 10^14 Hz; E 1.29147712 eV; Ω 287.9523928 m²/s	$R\left(\frac{1}{9}-\frac{1}{64}\right)$ .09548
40/49 .0907	λ 1,011.157466 nm; ν̃ 988,965.6492 m-1; f 2.9464844428 x 10^14 Hz; E 1.226783461 eV; Ω 303.1373822 m²/s	$R\left(\frac{1}{9}-\frac{1}{49}\right)$ .0907
27/36 .8033	λ 1,100.579555 nm; ν̃ 908,612.1902 m-1; f 2.723950819 x 10^14 Hz; E 1.127107305 eV; Ω 329.94545 m²/s	$R\left(\frac{1}{9}-\frac{1}{36}\right)$ .0833
16/25 .0711	λ 1,289.741666 nm; ν̃ 775,349.069 m-1; f 2.324438032 x 10^14 Hz; E 0.961798233 eV; Ω 386.6548243 m²/s	$R\left(\frac{1}{9}-\frac{1}{25}\right)$ .0711
7/16 .0486	λ 1,886.707809 nm; ν̃ 530,023.7776 m-1; f 1.588971311 x 10^14 Hz; E 0.657479261 eV; Ω 565.6207715 m²/s	$R\left(\frac{1}{9}-\frac{1}{16}\right)$ .0486

$$\Delta M v^2$$

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Brackett spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck — 0.8451 eV — Rydberg

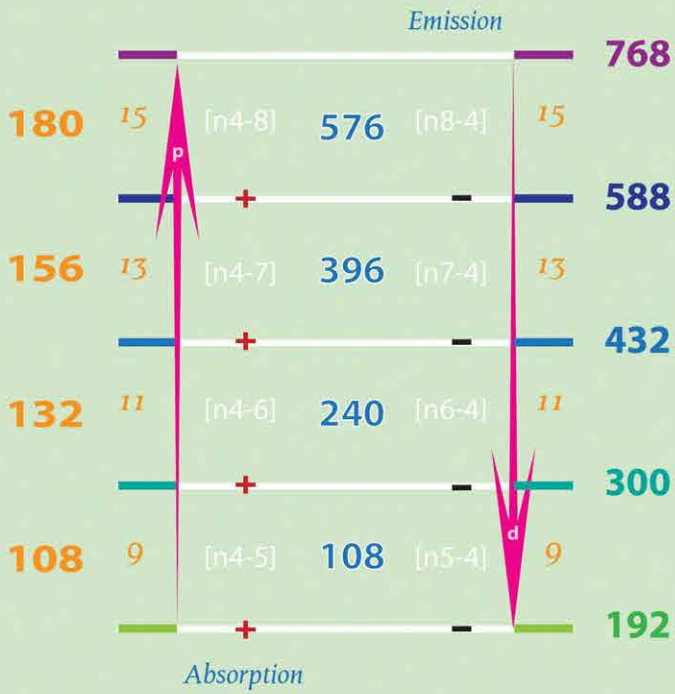

48/64	.0468	λ 1,956.585876 nm; ν̃ 511,094.357 m-1; f 1.532222335 x 10^14 Hz; E 0.634001085 eV; Ω 586.569689 m²/s	$R\left(\frac{1}{16}-\frac{1}{64}\right)$	.0468
33/49	.04209	λ 2,178.92518 nm; ν̃ 458,941.8716 m-1; f 1.375873118 x 10^15 Hz; E 0.569307096 eV; Ω 653.2253354 m²/s	$R\left(\frac{1}{16}-\frac{1}{49}\right)$	.04209
20/36	.0347	λ 2.641.390932 nm; ν̃ 378,588.4126 m-1; f 1.134979508 x 10^14 Hz; E 0.469630433 eV; Ω 791.8690801 m²/s	$R\left(\frac{1}{16}-\frac{1}{36}\right)$	.0347
9/25	.0225	λ 4.076.220574 nm; ν̃ 245,325.2914 m-1; f 7.35466721x 10^13 Hz; E 0.30432052 eV; Ω 1.222.020185 m²/s	$R\left(\frac{1}{16}-\frac{1}{25}\right)$	.0225

$\Delta M v^2$

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Pfund spectral transitions

$$\Delta h\nu = KEM = hcR$$

Planck P — 0.541 eV — Rydberg

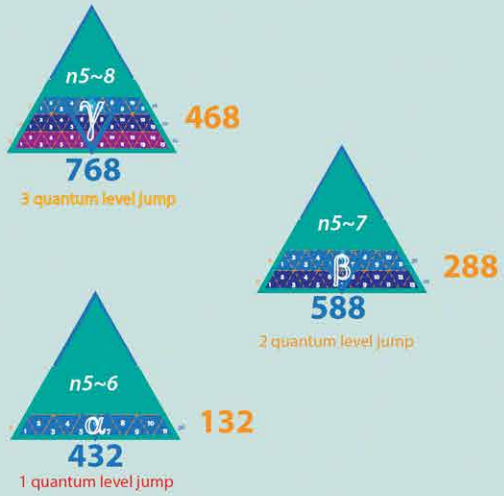

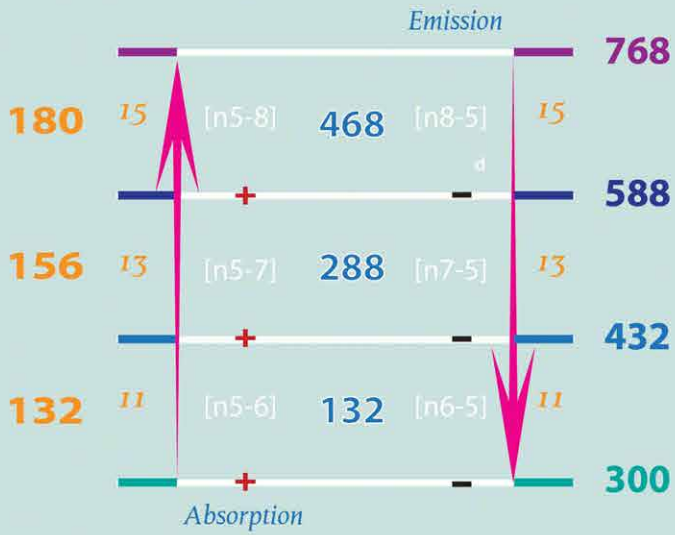

39/64
.0243

λ	3,762.665146	nm
$\tilde{\nu}$	265,769.0656	m-1
f	7.967556145 x 10^{13}	Hz
E	0.329678886	eV
Ω	1,128.018633	m^2/s

$R\left(\frac{1}{25}-\frac{1}{64}\right)$ .0243

24/49
.0195

λ	4,681.284566	nm
$\tilde{\nu}$	213,616.5802	m-1
f	6.404063965 x 10^{13}	Hz
E	0.264985227	eV
Ω	1,403.413807	m^2/s

$R\left(\frac{1}{25}-\frac{1}{49}\right)$ .01959

11/36
.0122

λ	7,503.951512	nm
$\tilde{\nu}$	133,263.1212	m-1
f	3.995127867 x 10^{13}	Hz
E	0.165309071	eV
Ω	2,249.628068	m^2/s

$R\left(\frac{1}{25}-\frac{1}{36}\right)$ .0122

ΔMv^2

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Humphreys spectral transitions

$$\Delta h\nu = \text{KEM} = hcR$$

Planck — 0.375 eV — Rydberg

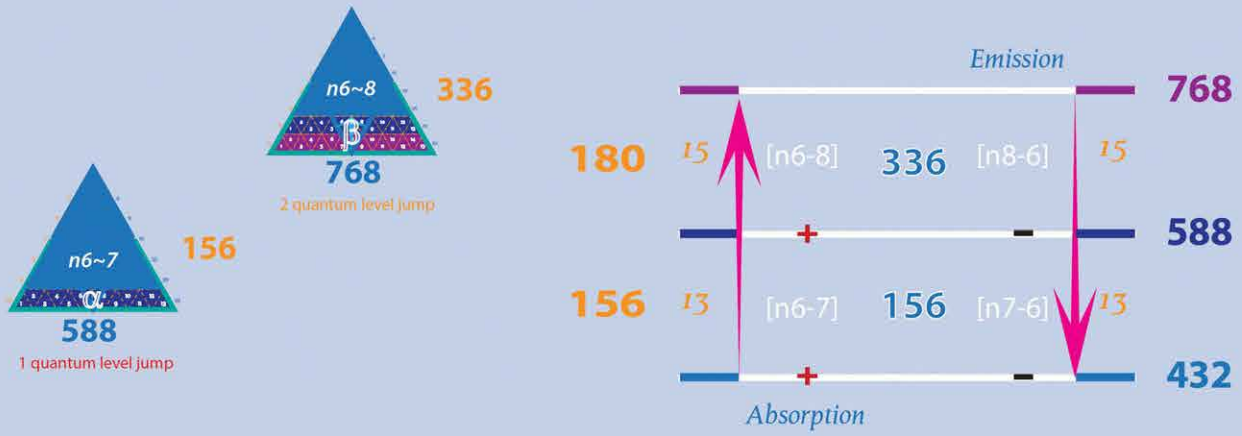

28/64

.01215

λ	7,546.831235	nm
ν̄	132,505.9444	m-1
f	3.972428277 x 10^{13}	Hz
E	0.164369815	eV
Ω	1,128.018633	m^2/s

$R\left(\frac{1}{36} - \frac{1}{64}\right)$ .01215

13/49

.00733

λ	12,445.01497	nm
ν̄	80,353.459	m-1
f	2.4089936098x 10^{13}	Hz
E	0.099676156	eV
Ω	1,403.413807	m^2/s

$R\left(\frac{1}{36} - \frac{1}{49}\right)$ .0073

$\Delta M v^2$

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Un-named spectral transition

$$\Delta h\nu = KEM = hcR$$

Planck — 0.276 eV — Rydberg

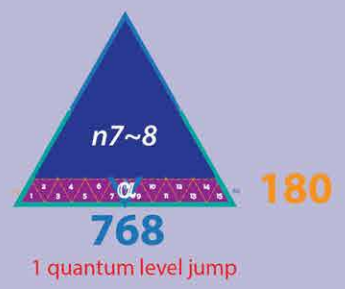

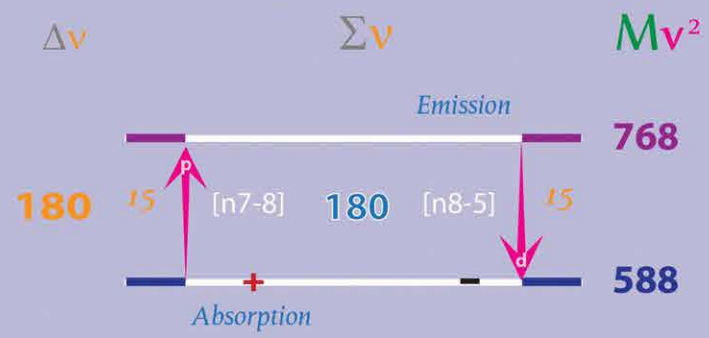

15/64

.0047

λ	19,174.54158	nm
$\tilde{\nu}$	52,152.48541	m-1
f	1.563492179 x 10^{13}	Hz
E	0.064693658	eV
Ω	5,748.382952	m^2/s

$R\left(\frac{1}{49} - \frac{1}{64}\right)$

.0047

ΔMv^2

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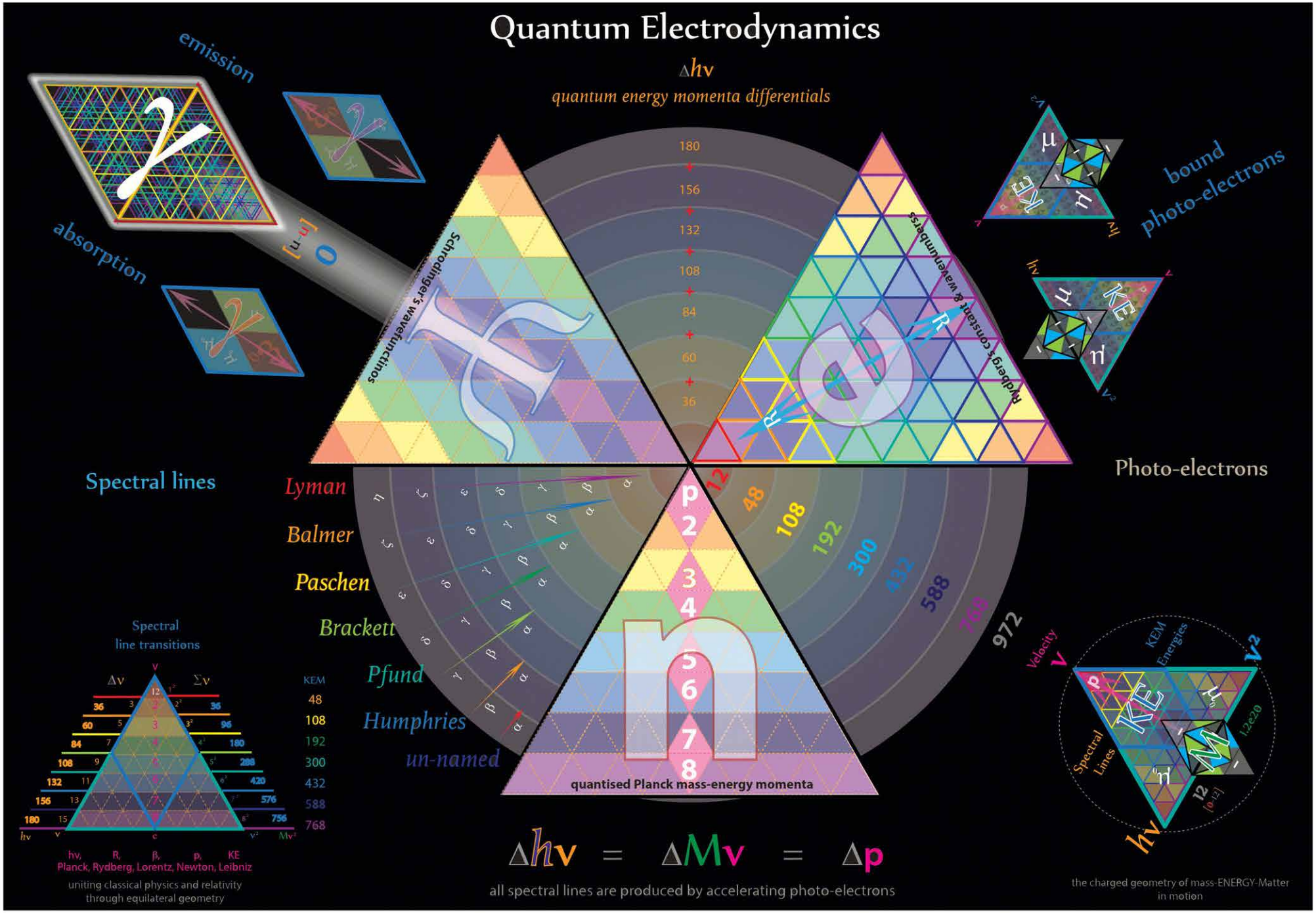

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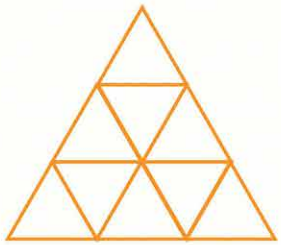
ninths

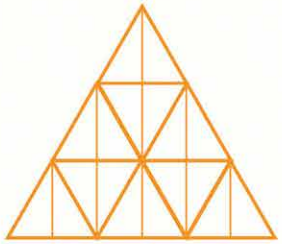
eigteenths

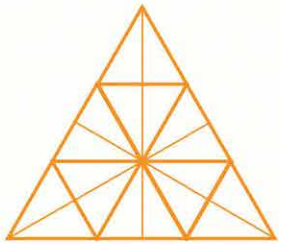
Eighteenths

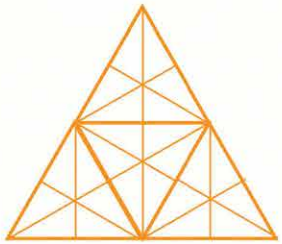
Twenty-fourths

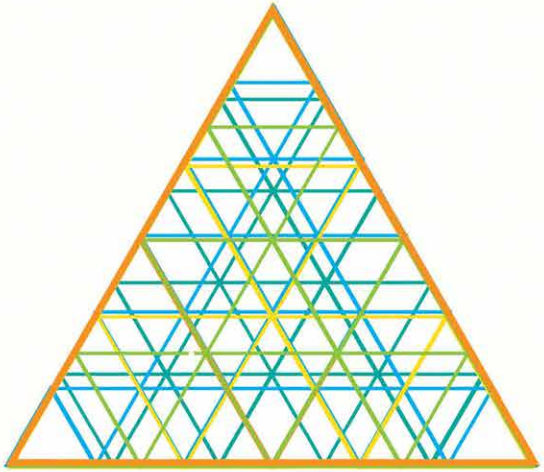

Fractionals and fractals

White light [EM radiation] is comprised of many superpositioned frequencies

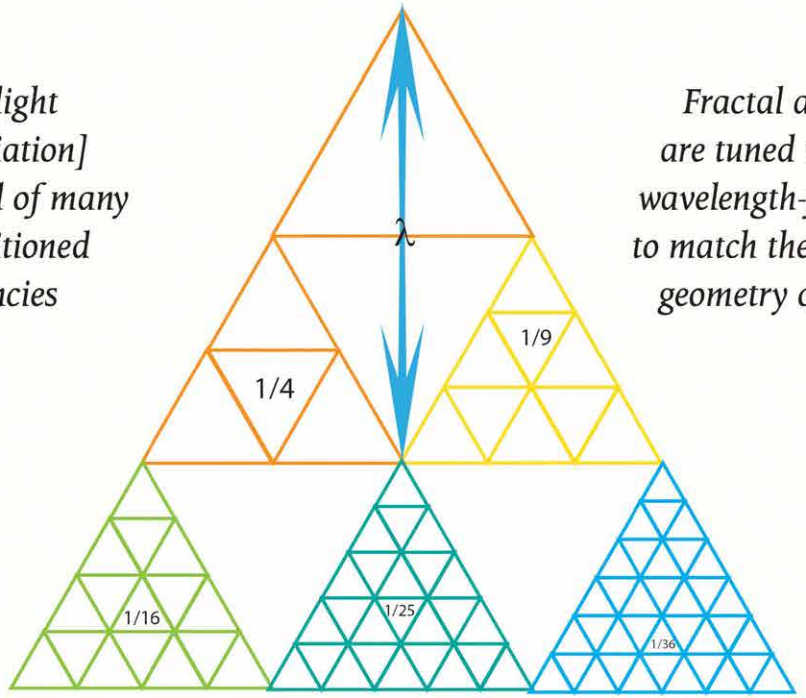

Fractal antennas are tuned to specific wavelength-frequencies to match the equilateral geometry of photons

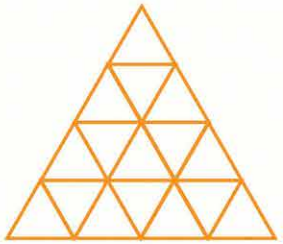
Sizteenths

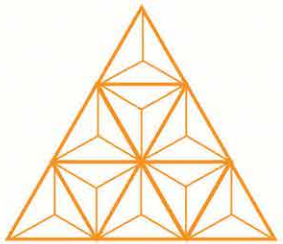
Twenty-sevenths

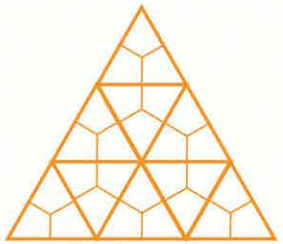
Twenty-sevenths

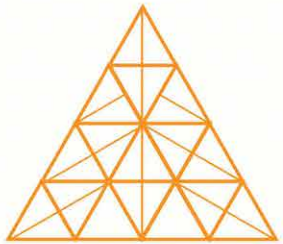
Thirty-seconds

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Polygons and Angles

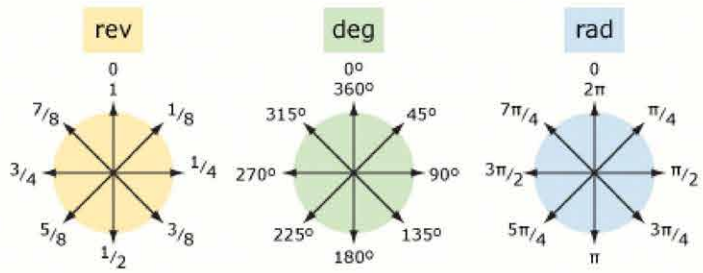

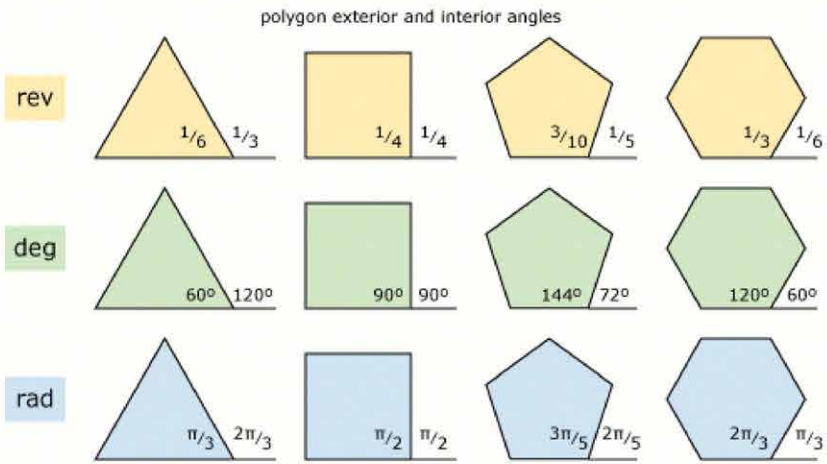

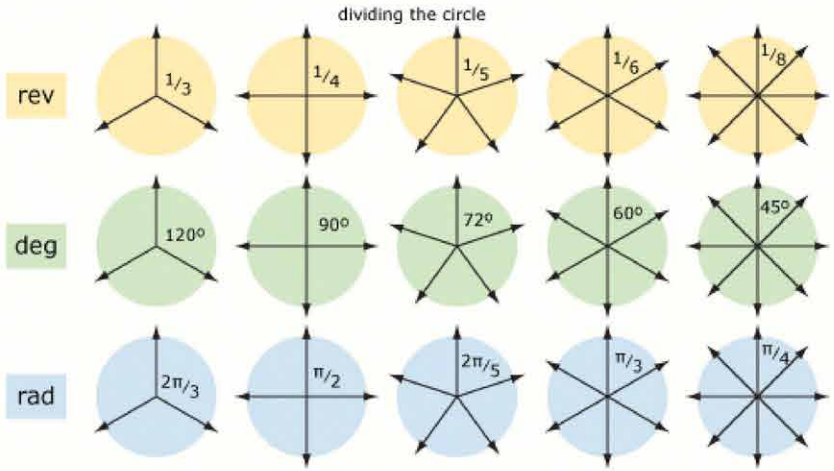

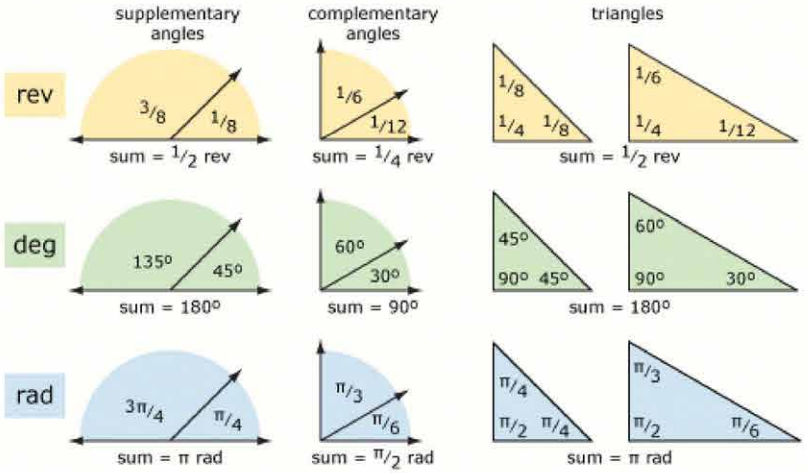

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Pi vs Tau

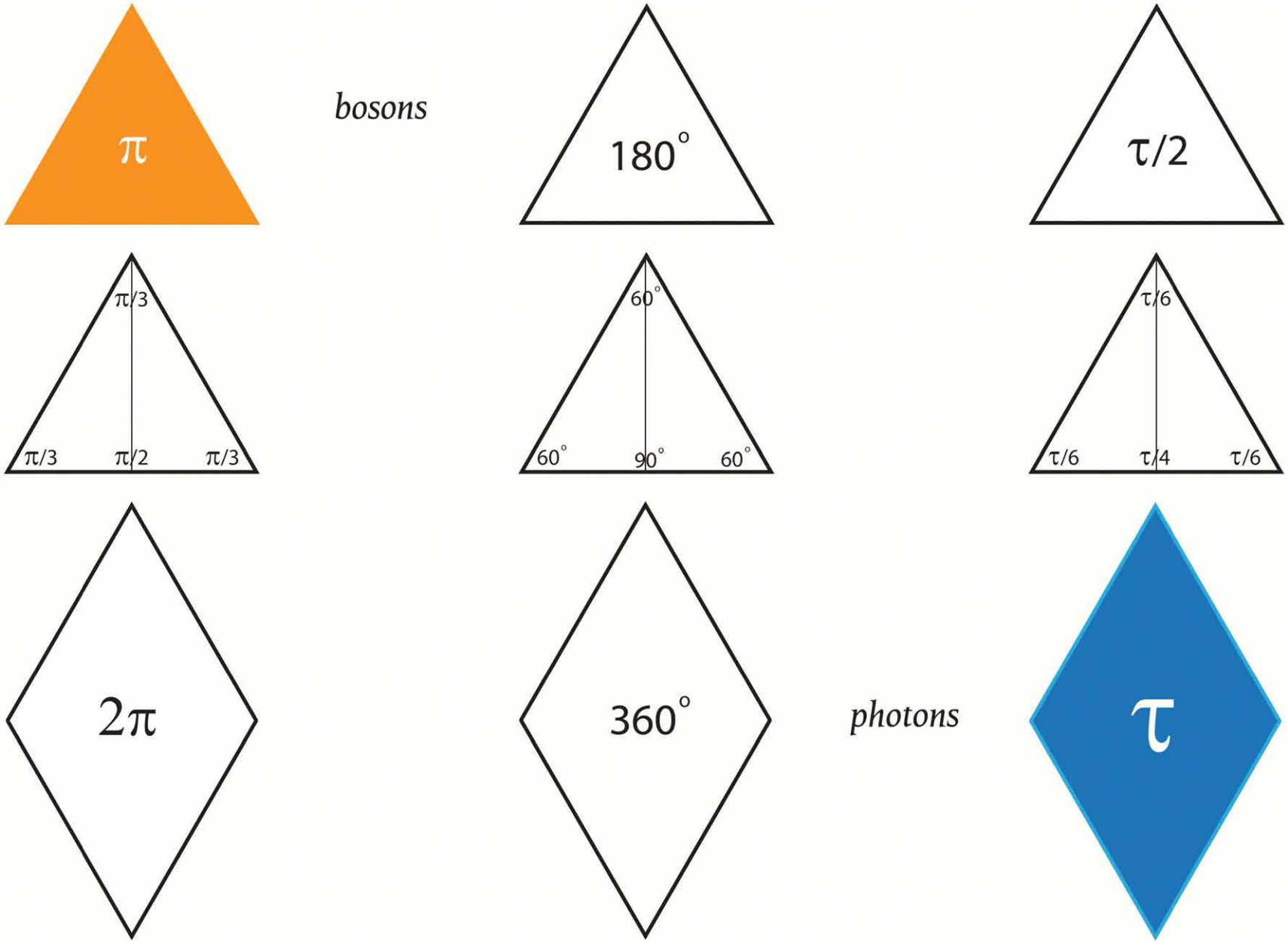

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Triangular dissection of an equilateral triangle

is a way of dividing up a original triangle into smaller equilateral triangles,
such that none of the smaller triangles overlap

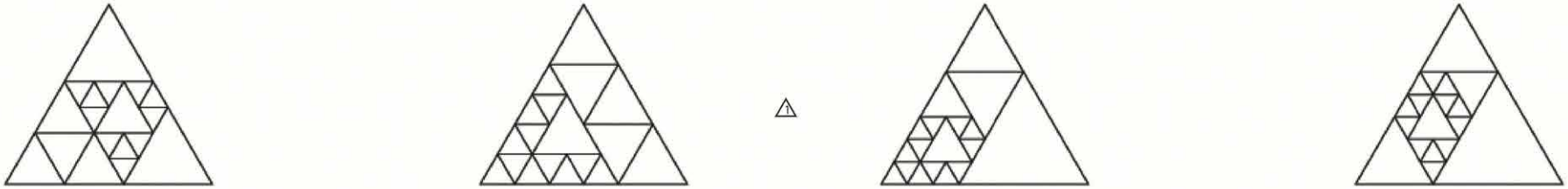

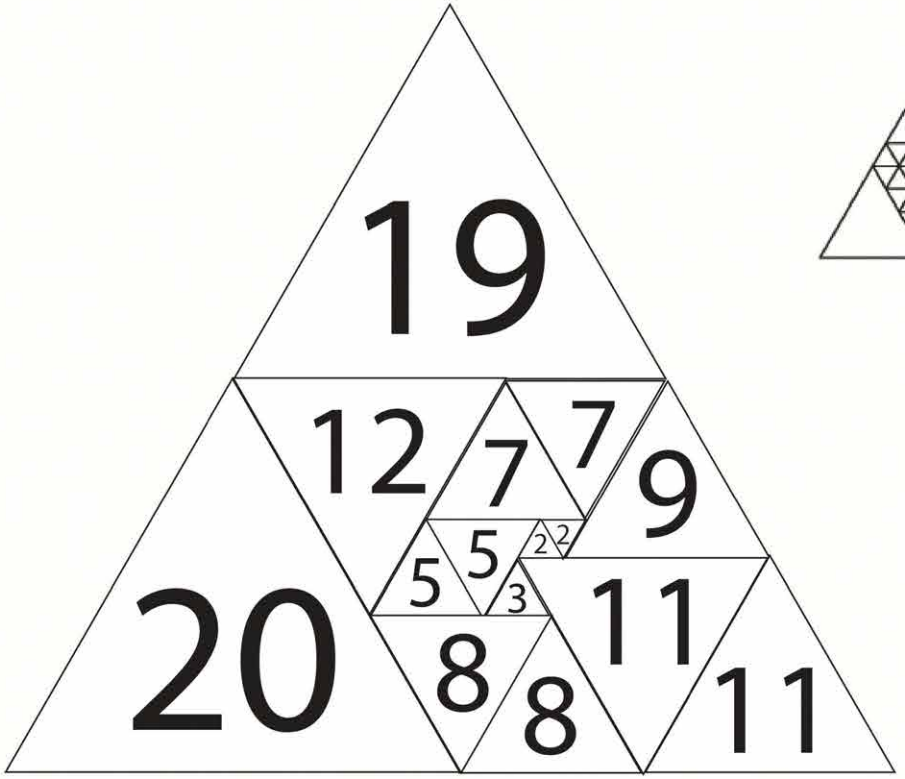

lowest order perfect equilateral triangle dissected by equilateral triangles

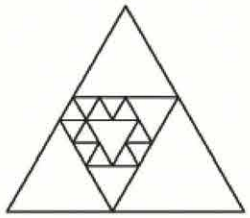

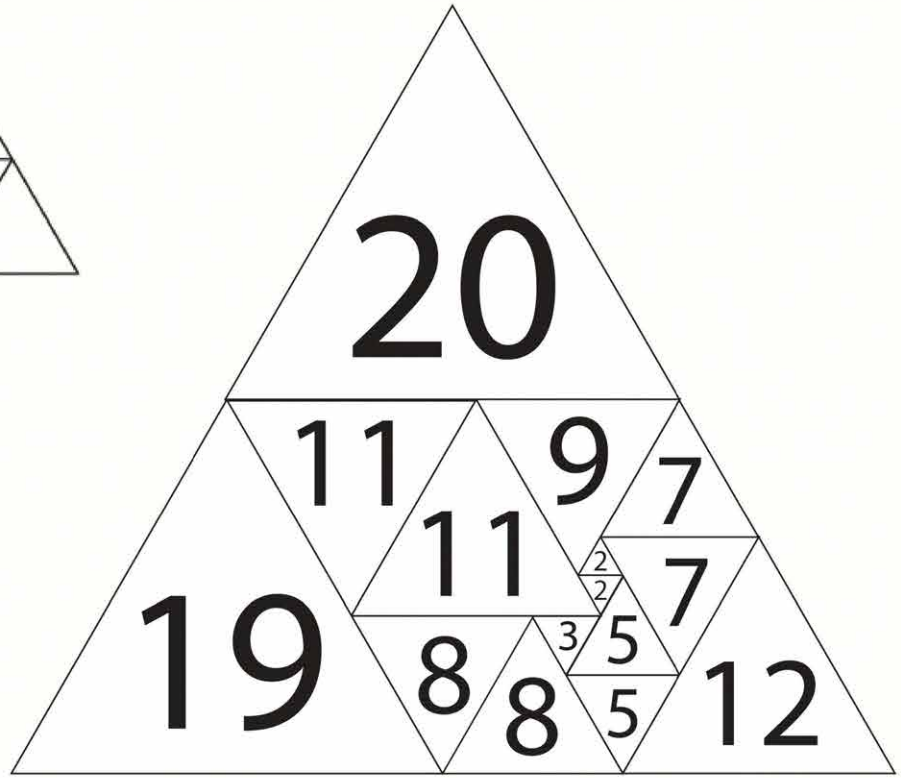

lowest order perfect dissected equilateral triangle, an isomer of the first

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Golden mean Spirals

Golden Mean Spiral – This spiral is derived via the golden rectangle, a unique rectangle which has the golden ratio.
This form is found everywhere in nature: the Nautilus Shell, the face of a Sunflower, fingerprints, our DNA, and the shape of the Milky Way

Golden spiral

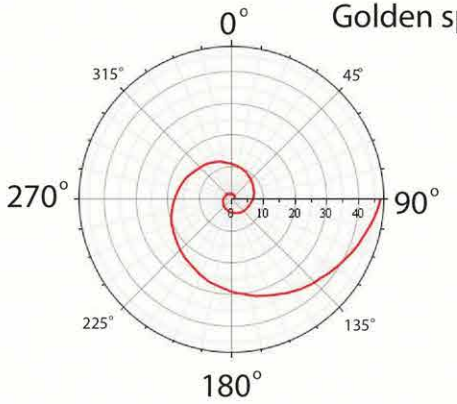

$0,\ 1,\ 1,\ 2,\ 3,\ 5,\ 8,\ 13,\ 21,\ 34,\ 55,\ 89,\ 144,\ \ldots$

Golden spirals

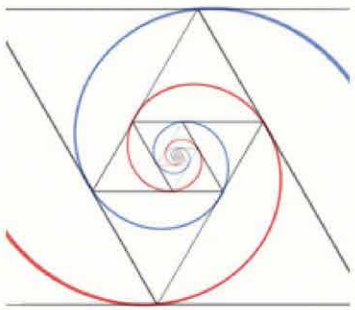

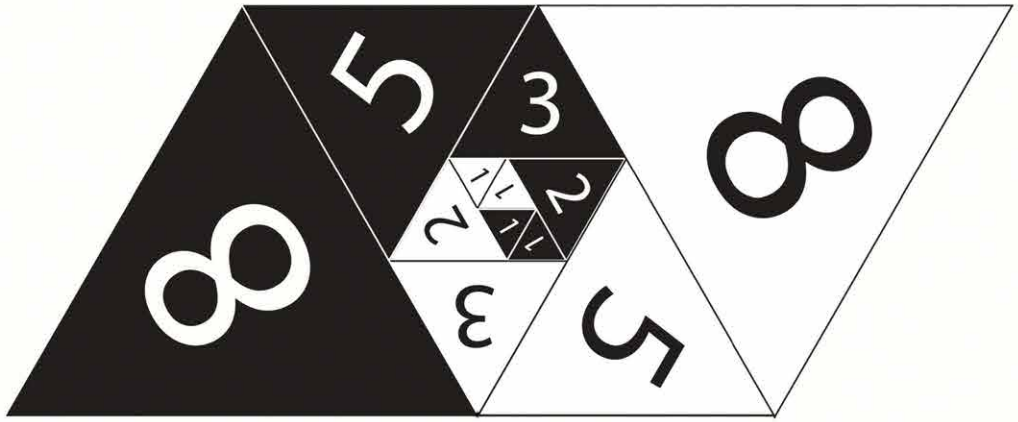

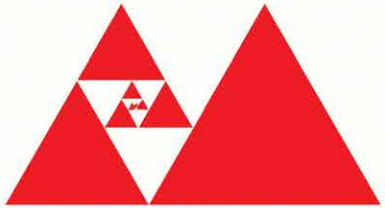

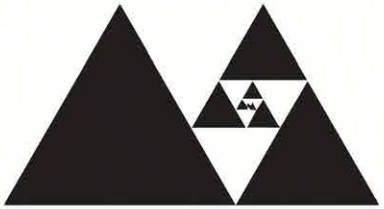

Continued fractions and the Fibonacci sequence

The convergence of the continued fractions

$$1 + \frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\frac{1}{1+}\ \cdots$$

are:

$$\frac{2}{1},\ \frac{3}{2},\ \frac{5}{3},\ \frac{8}{5},\ \frac{13}{8},\ \frac{21}{13},\ \frac{34}{21},\ \frac{55}{34},\ \frac{89}{55},\ \frac{144}{89},\ \frac{233}{144},\ \frac{377}{233},\ \frac{610}{377},$$

The Golden Ratio (Golden Mean, Golden Section)
is defined mathematically as:

$$\varphi = \frac{1+\sqrt{5}}{2} = 1.6180339887\ldots.$$

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Koch fractal Curve

Niels Fabian Helge von Koch (January 25, 1870 – March 11, 1924) was a Swedish mathematician who gave his name to one of the earliest fractal curves ever known

He described the Koch curve, or Koch snowflakes as it popularly known, in a 1904 paper entitled "On a continuous curve without tangents constructible from elementary geometry"

Von Koch wrote several papers on number theory . One of his results was a 1901 theorem proving that the Riemann hypothesis is equivalent to a strengthened form of the prime number theorem.

Three Koch curves form the snowflake.

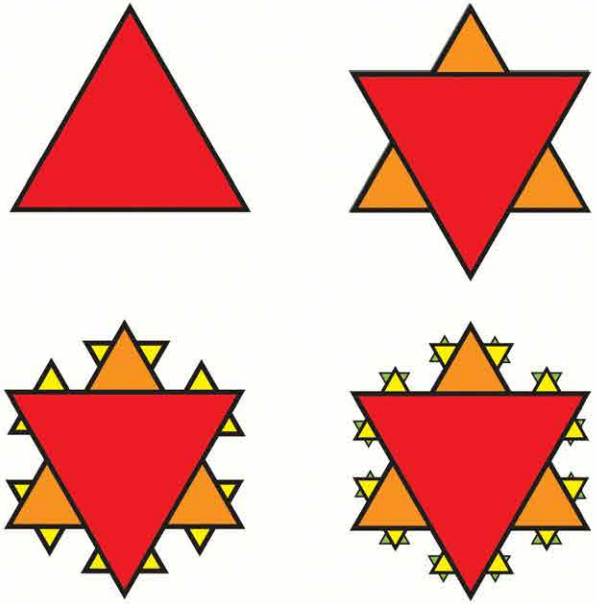

The Koch snowflake (or Koch star) is a mathematical curve and one of the earliest fractal curves to have been described.

Actually Koch described what is now known as the Koch curve, which is the same as the now popular snowflake, except it starts with a line segment instead of an equilateral triangle.

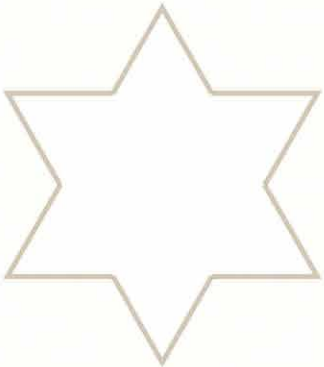

$$a = \frac{1}{2} + \frac{i}{\sqrt{12}}$$

The Koch curve is a special case of the Cesaro curve where:

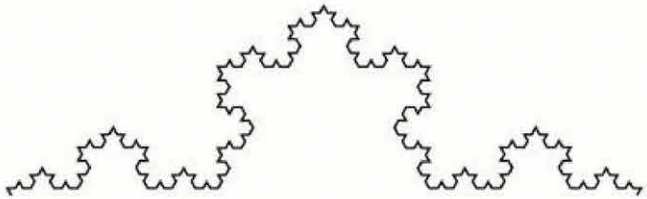

which is in turn a special case of the de Rham curve.

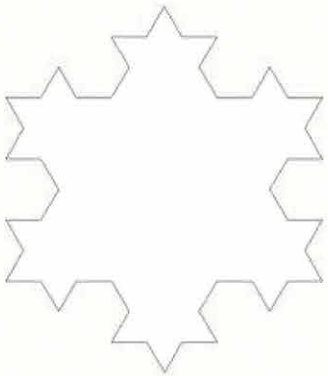

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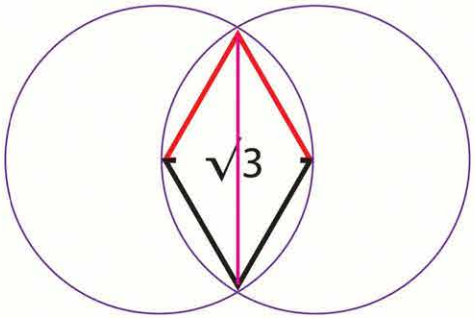

vesica piscis

$$\frac{1351}{780} > \sqrt{3} > \frac{265}{153}\,.$$

Koch snowflake

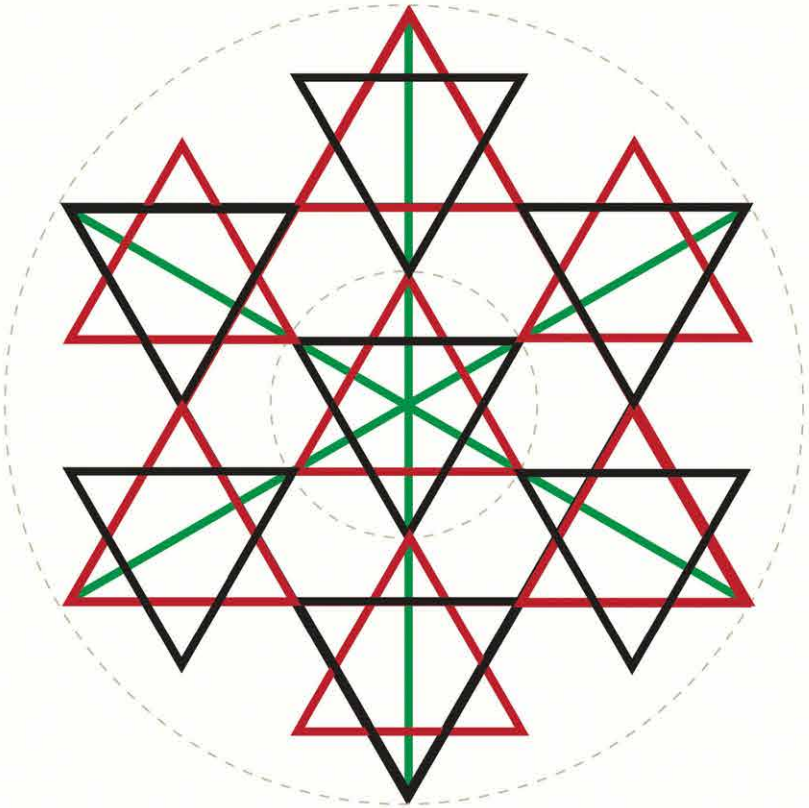

space-time

star tetrahedron

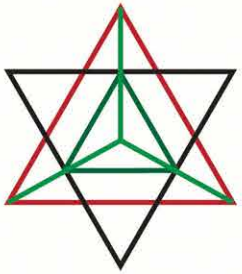

Flower of Life

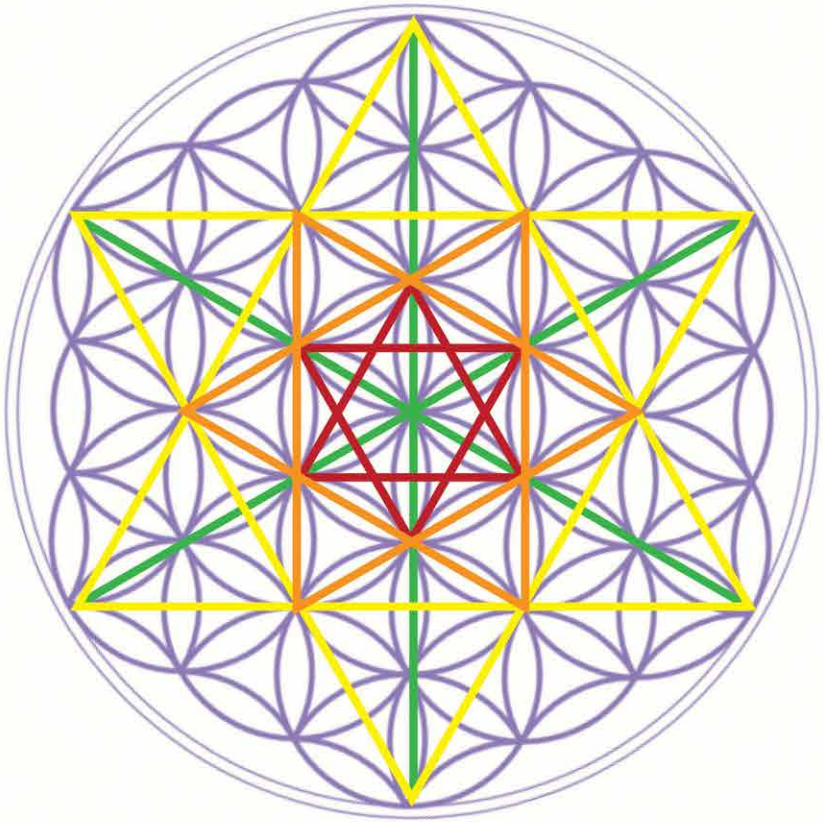

The Flower of Life is a name for a geometrical figure composed of multiple evenly-spaced, overlapping circles.

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Unit circles - SINE WAVES - Photons

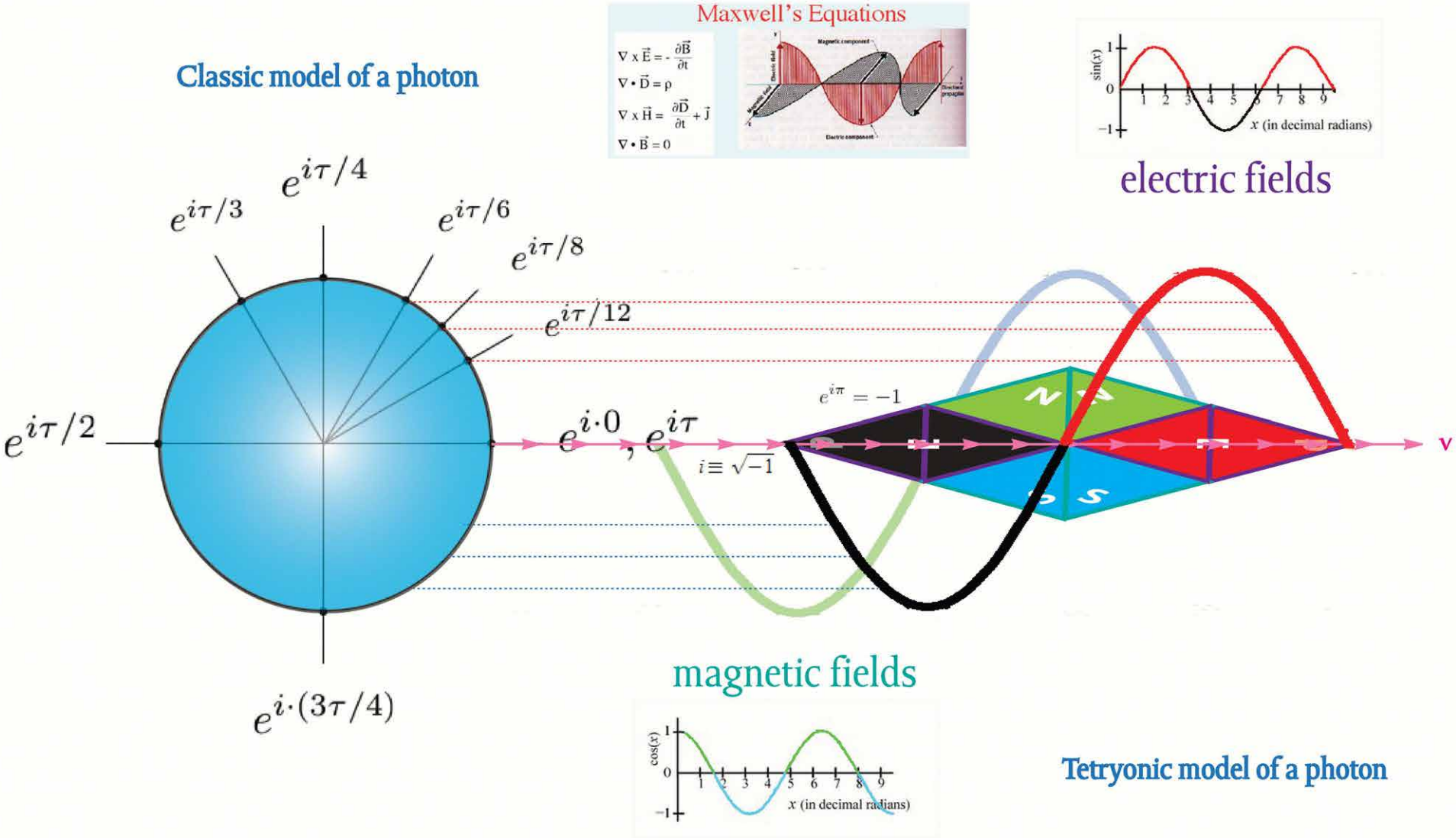

Magnetic waveforms are 90 degrees out of phase with Electric waveforms

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Boson distributions in monochromatic EM waves

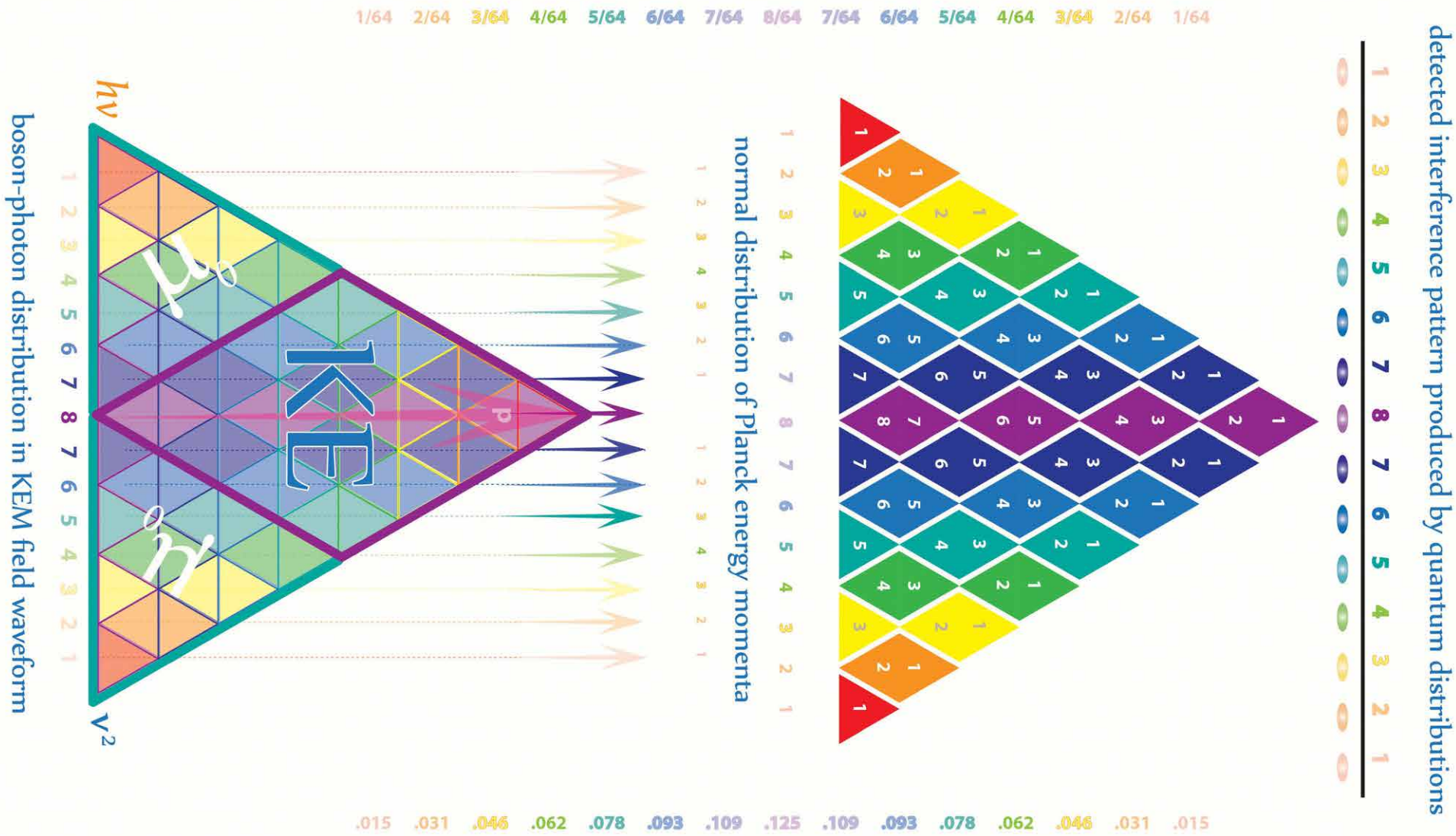

Probability distributions of monochromatic EM waves

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Wave interference patterns

The double-slit experiment, sometimes called Young's experiment, is a demonstration that matter and energy can display characteristics of both waves and particles, and demonstrates the fundamentally probabilistic nature of quantum mechanical phenomena and Establishes the quantum interference principle known as wave–particle duality.

Matter particles are stopped by the barrier but the [K]EM wave passes through both slits and is diffracted by them producing weaker EM waves that then superposition with each other to produce interference patterns

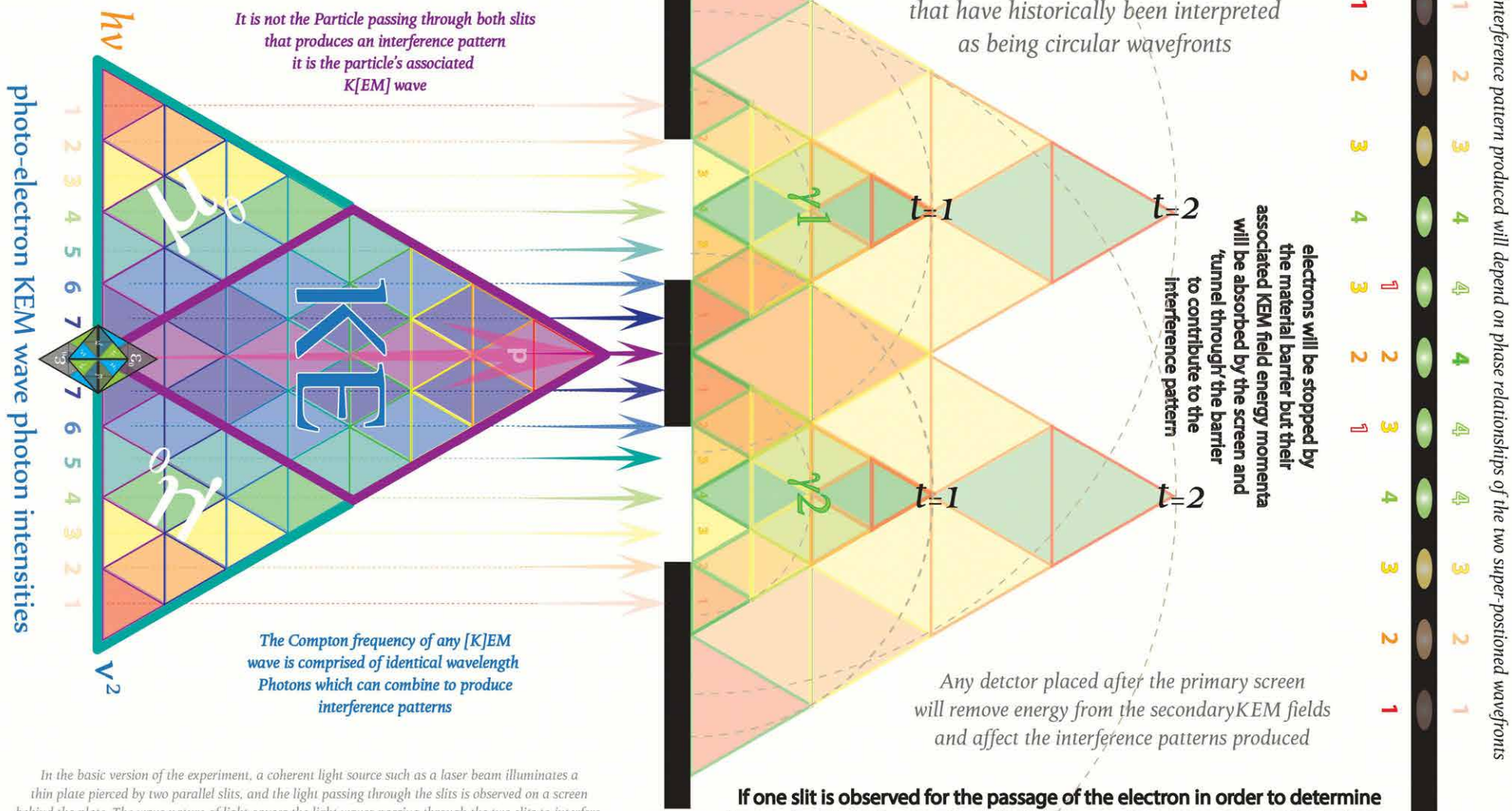

In the basic version of the experiment, a coherent light source such as a laser beam illuminates a thin plate pierced by two parallel slits, and the light passing through the slits is observed on a screen behind the plate. The wave nature of light causes the light waves passing through the two slits to interfere, producing bright and dark bands on the screen — a result that would not be expected if light consisted strictly of particles. However, on the screen, the light is always found to be absorbed as though it were composed of discrete particles or photons.

If one slit is observed for the passage of the electron in order to determine its physical state then the its KEM field wave will be absorbed by the detector resulting in only one wave remaining, enforcing a classical particle outcome

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Quantum computing via EM wave super-positioning

BY superpositioning two beams
of EM radiation the resultant 'colours'
will perform quantum level computations
that can be read via the resultant
interference patterns produced

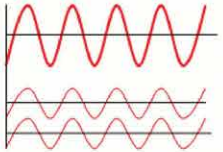

In phase

constructive interference

additive in-phase EM waves

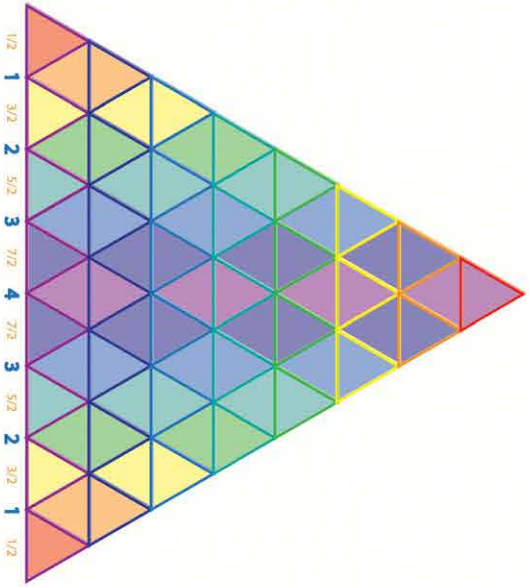

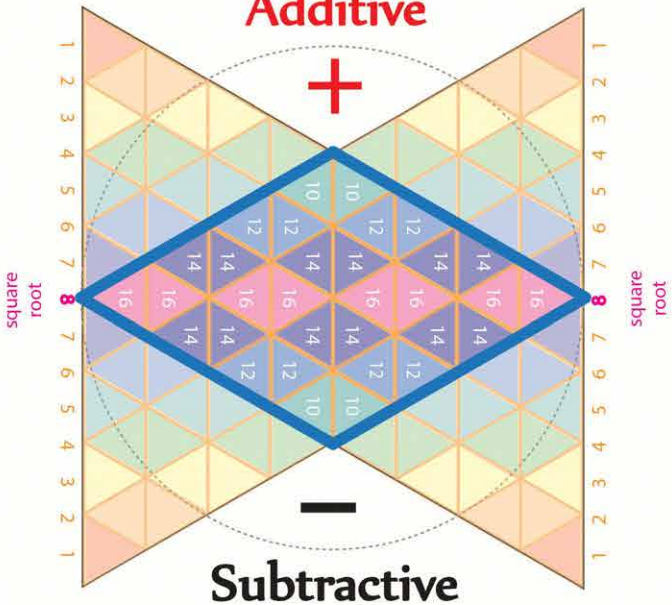

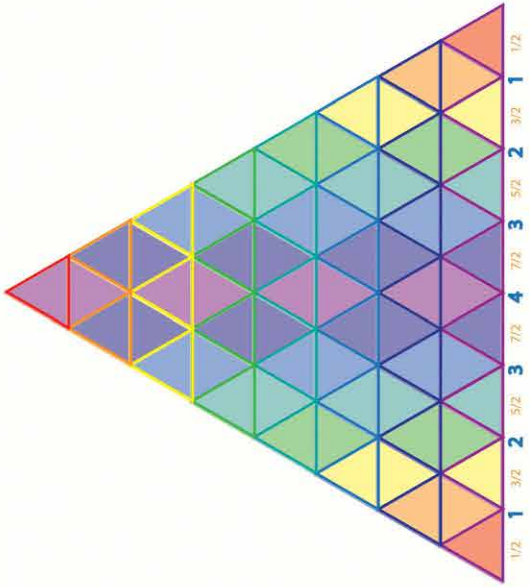

Out of phase

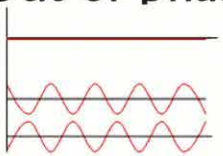

destructive interference

subtractive out-of-phase EM waves

Various basic operations, such as
ADDITION, SUBTRACTION and
SQUARE ROOTS etc
are all easily computed using
EM wave super-positioning

The lines of Force

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By utilising the statiscal distribution of equilateral Planck energy momenta quanta in EM waves
Tetryonic theory provides a practical geometric solution to quantum computing problems

q

bosons

The set of all decision problems for which an algorithm exists which can be carried out by a deterministic Turing machine in polynomial time

P vs. NP

the set of all decision problems for which an algorithm exists which can be carried out by a non-deterministic Turing machine in polynomial time

E

photons

An algorithm of time complexity ***O(n)*** is one which increases in time linearly as the "size of the problem" (whatever n stands for) increases.

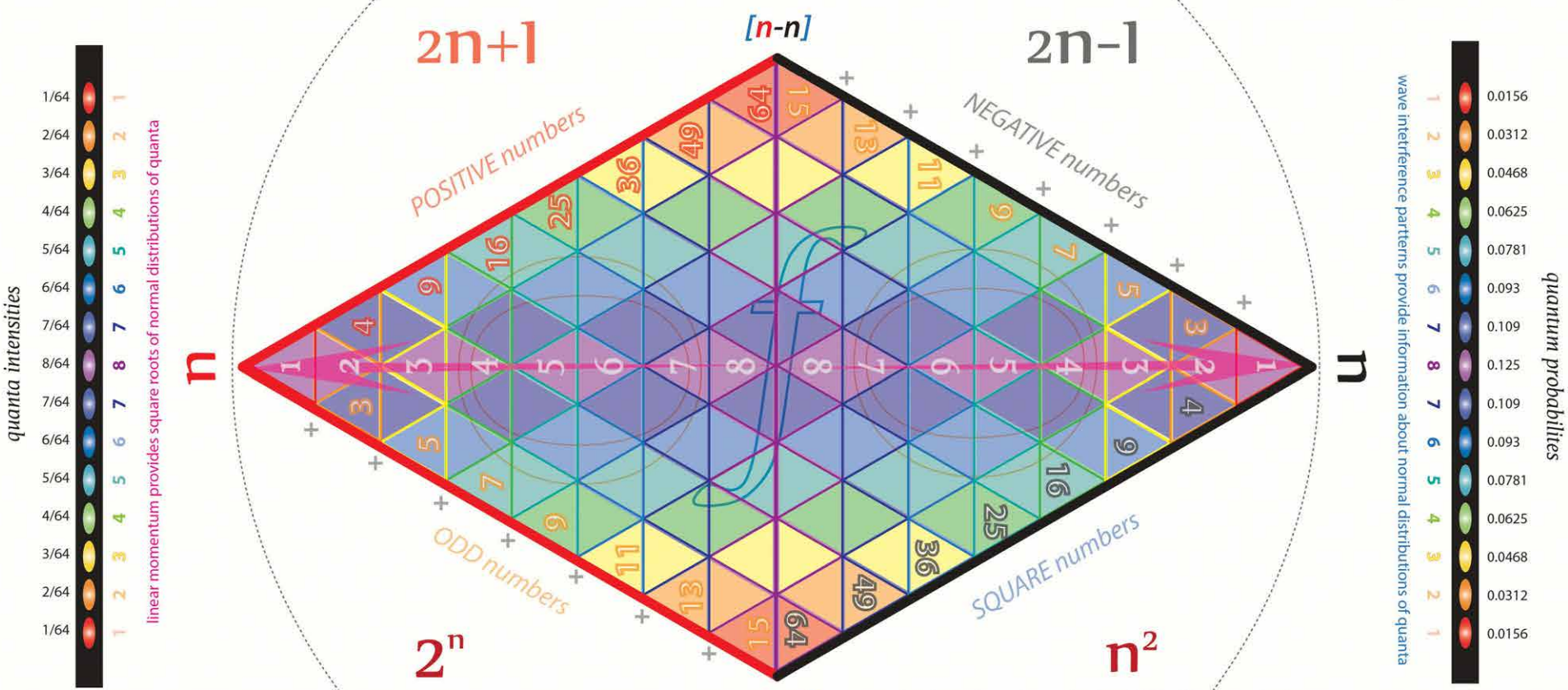

An algorithm of complexity ***O(2ⁿ)*** utlises exponential quanta; increasing n by 1 will double the quanta required

An algorithm of complexity ***O(n²)*** utilises quadratic quanta, meaning that if you double n it will use four times as many quanta.

Unlike Math treatise on P vs Np that require exponential polynomial time ***O(nᵏ)*** Tetryonic geometry of EM fields utilise exponential energies per second

2hv

1 second

hf

By relating p to the number of equilateral wave fields in any EM wave very large [pn²] data sets can be modelled and processed every second

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Quantum Cryptography

If the numerical sequences were applied to amplitude modulation their non-repeating numerical sequences would appear to be purely random noise

Using Tetryonic geometry advanced non-repeating cyphers of any complexity can be easily developed

The level of encryption can be easily increased (without limit) by increasing the dimensions of the cypher geometry

eg: number of quanta 2D vs 3D geometries

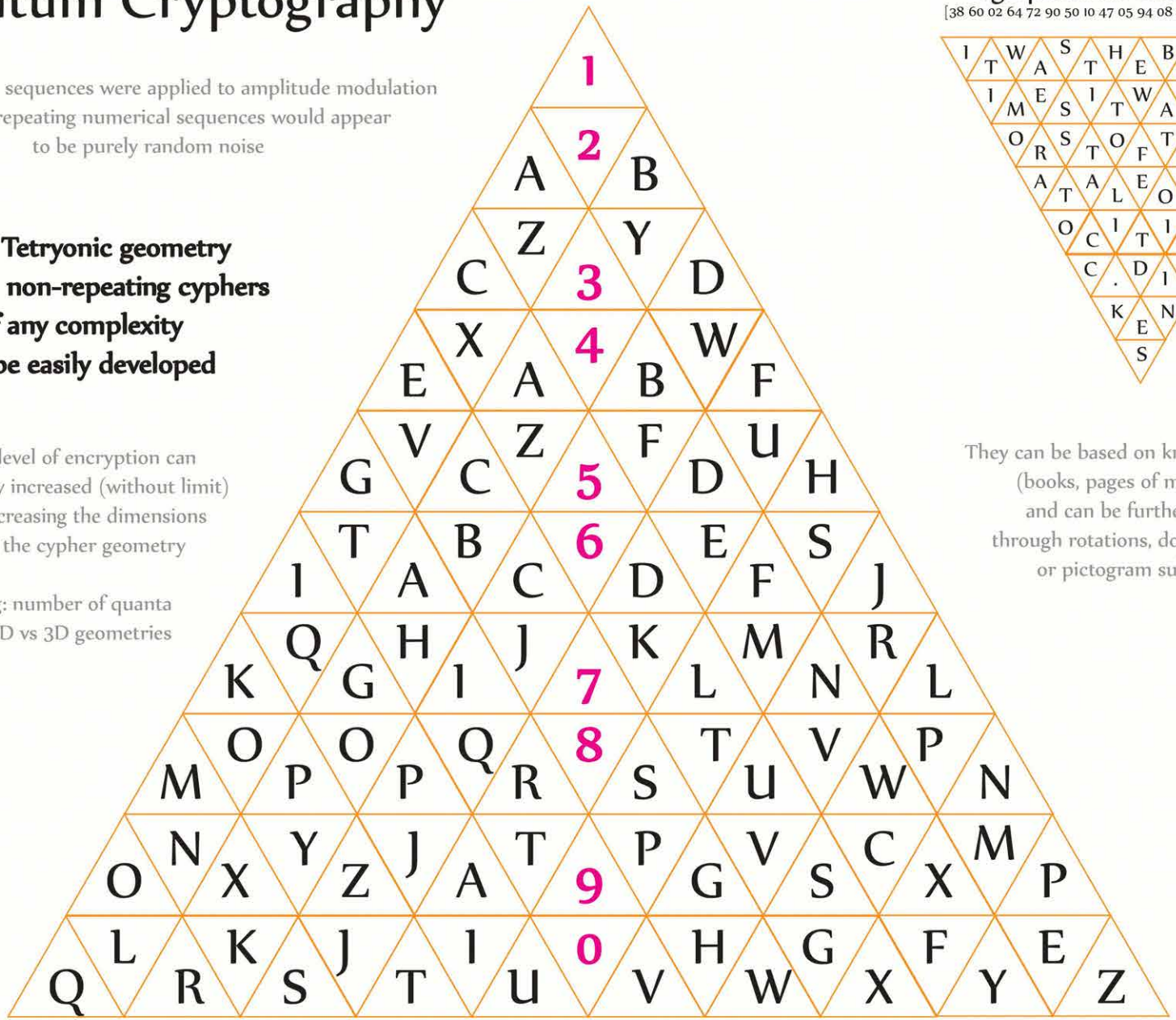

eg: quantum encryption 1024
[38 60 02 64 72 90 50 10 47 05 94 08 48 52 27 26 51 66 01 91 03 20]

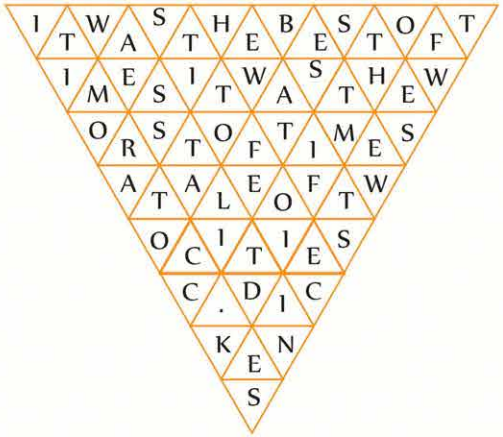

They can be based on known letter sources (books, pages of magazines etc) and can be further encrypted through rotations, double encrypting or pictogram substitutions

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Quantum Computing

The Proton/Neutron geometries of atomic nuclei can be built at the quantum scale
to create an atomic nuclei that can operate as a Opto-memory-transistive computing element,
many elements can then be combined in lattices to create super computers no larger than bacterium

Spin UP

Energy can be gated through individual nuclei
using the centre Baryon as the base transistor element,
in turn effecting the energies of bound photo-electrons

Spin DOWN

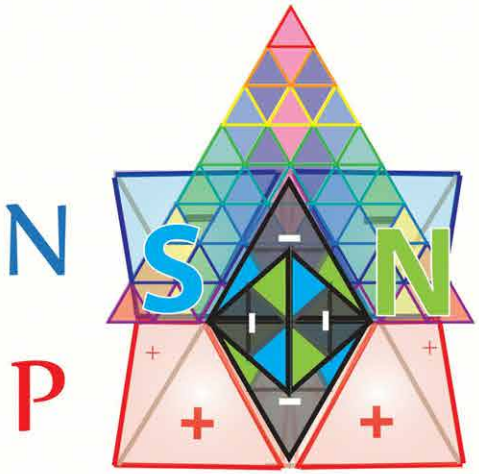

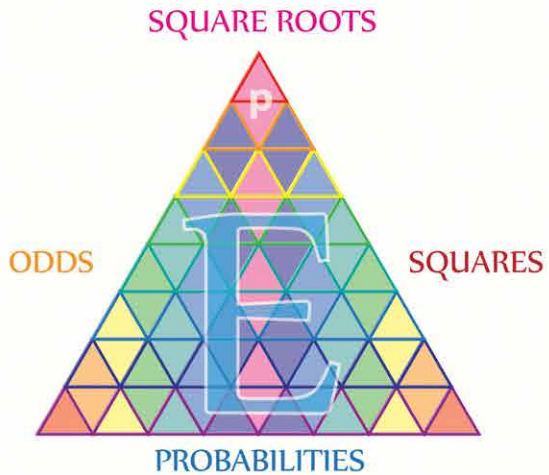

Q-bits

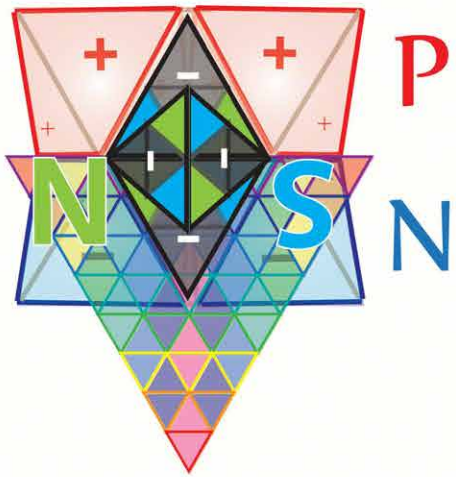

1

photo-electronic transitions can be used to directly recieve
or emit memory states through the absorption and emission
of spectral photons of specific energy momenta

0

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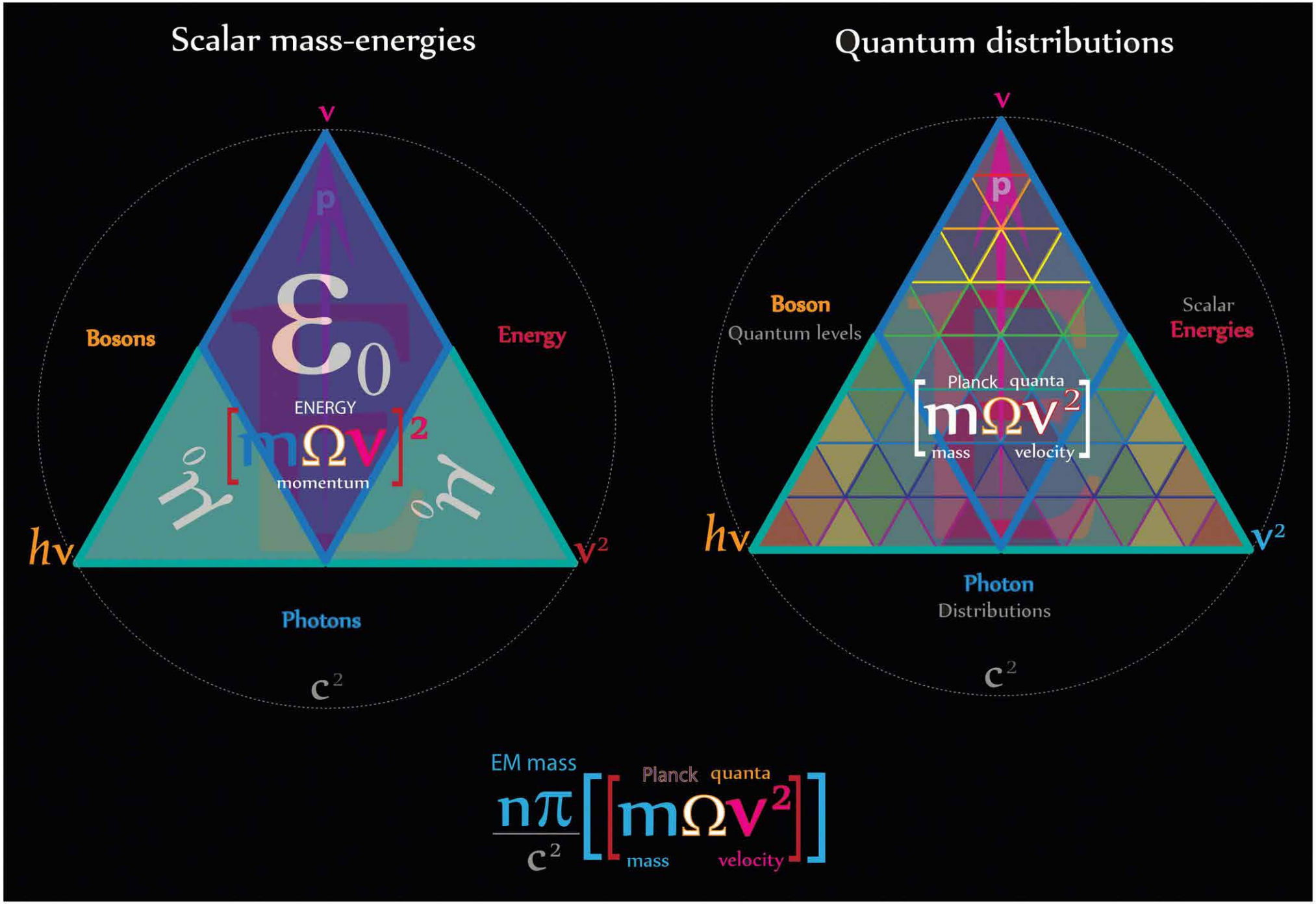

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2D mass

EM mass

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

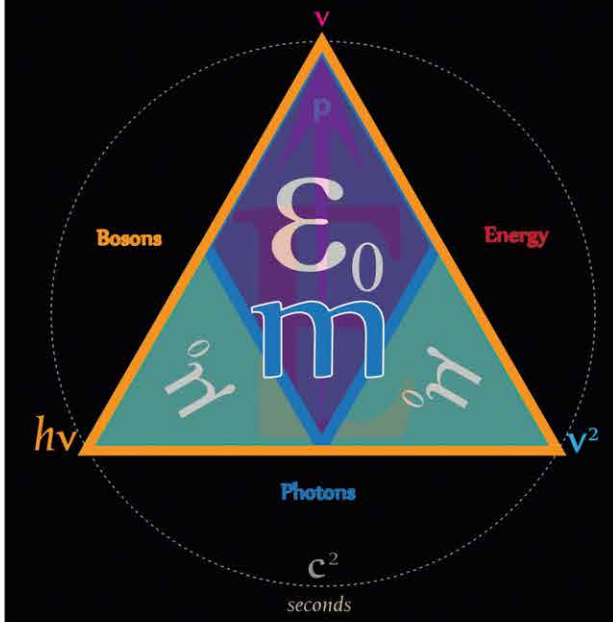

Measure of planar energies
in a nπ radiant wave
geometry
[per second]

mass quantum
7.376238634 e-51 kg

ENERGY

ENERGY

$$n\pi\left[\left[m\Omega v^2\right]\right]$$

momenta

Equilateral energy momenta
has a mass equivalence
per unit of Time

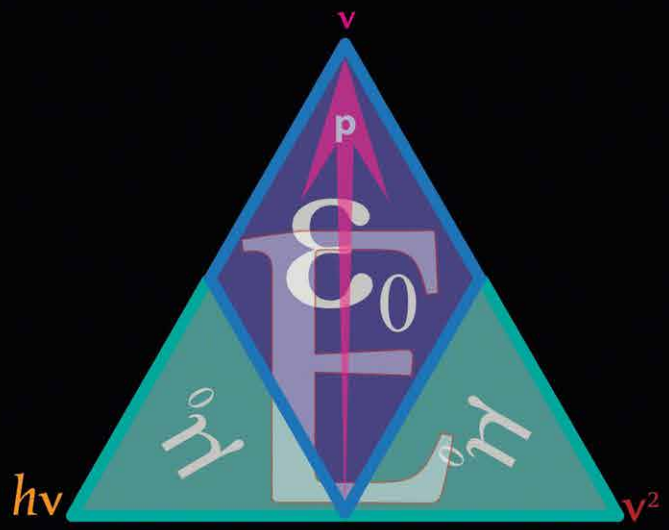

c² is the radial geometry
created by radiant energy
in 1 second

Planck Constant
6.629432672 e-34 J.s

3D Matter

Matter

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

Measure of mass-energy
in a 4nπ standing wave
topology
[per second squared]

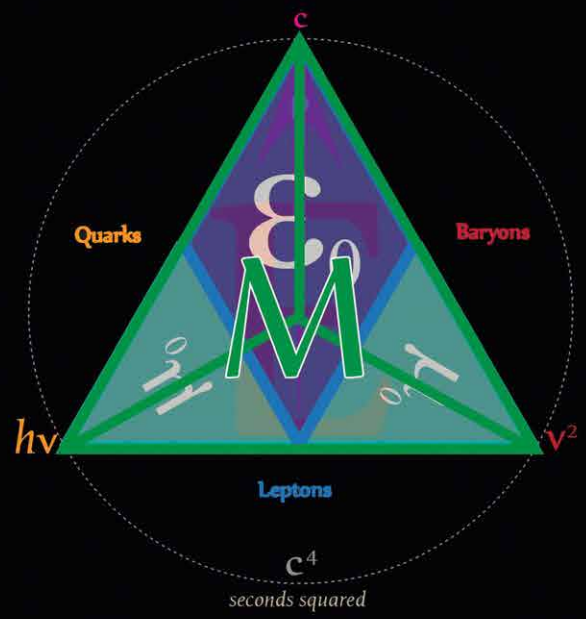

Matter quantum
2.9504955454 e-50 kg

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Planck's constant - the quantum of Action

all ideal quantum inductive loops resist changes to their energy levels

INERTIAL mass

all equilateral energy momenta produce square root vector Forces

quantum of WORK

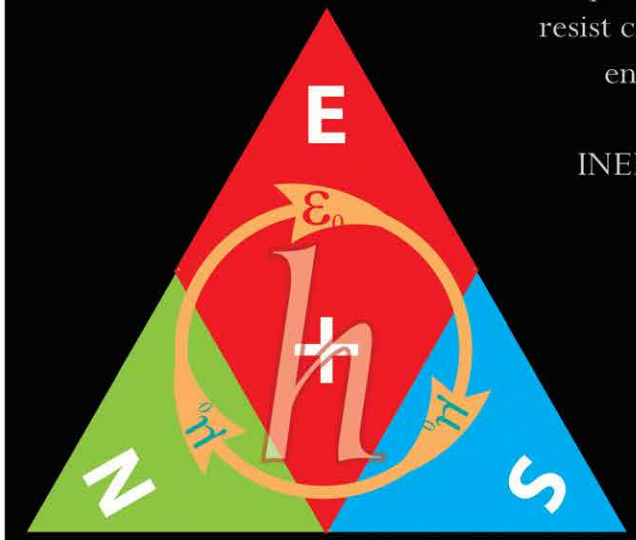

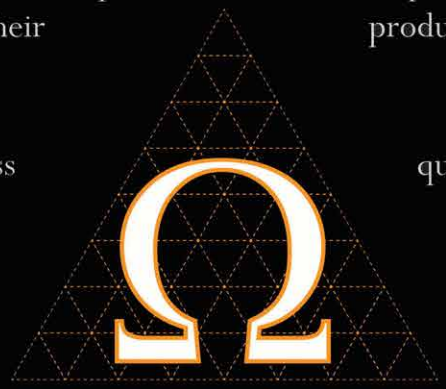

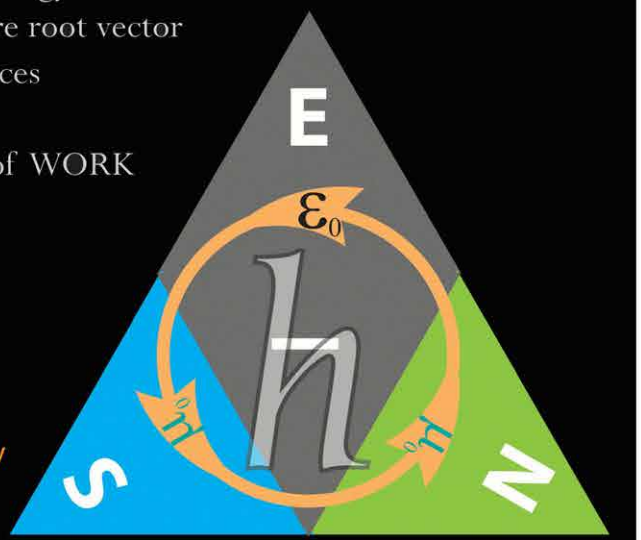

Quantised angular momentum is equilateral geometry

The two sides of Planck's Constant

The square root of all Energy is linear momentum

Equilateral energy quanta per second

Quantised angular momenta per second

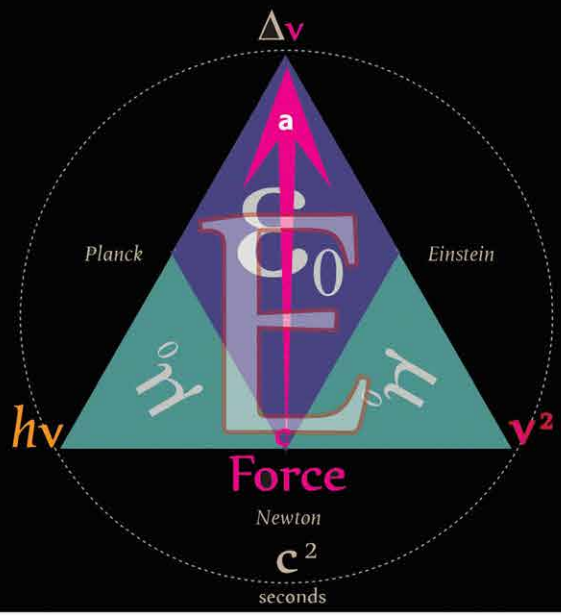

mass

time

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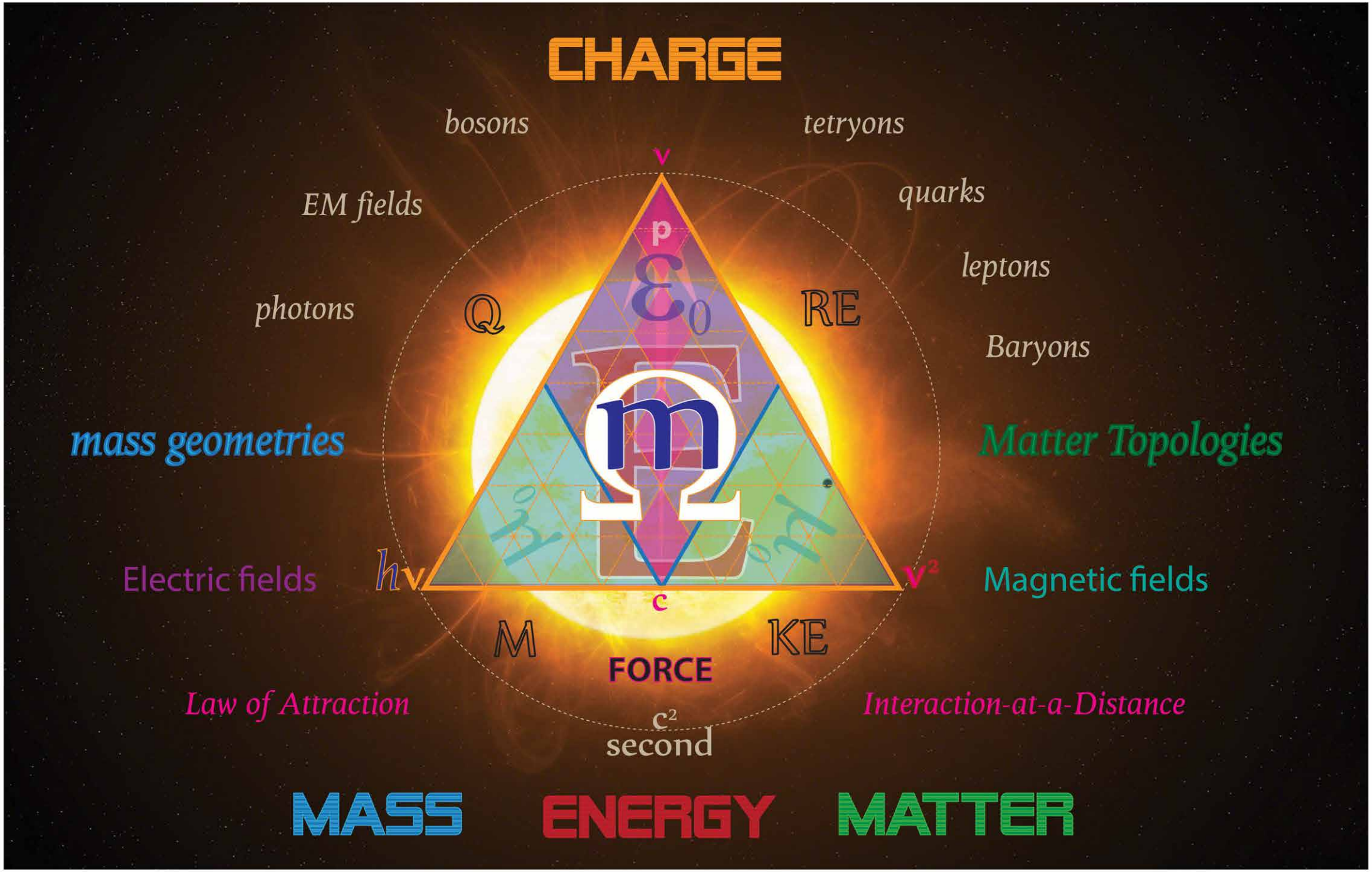

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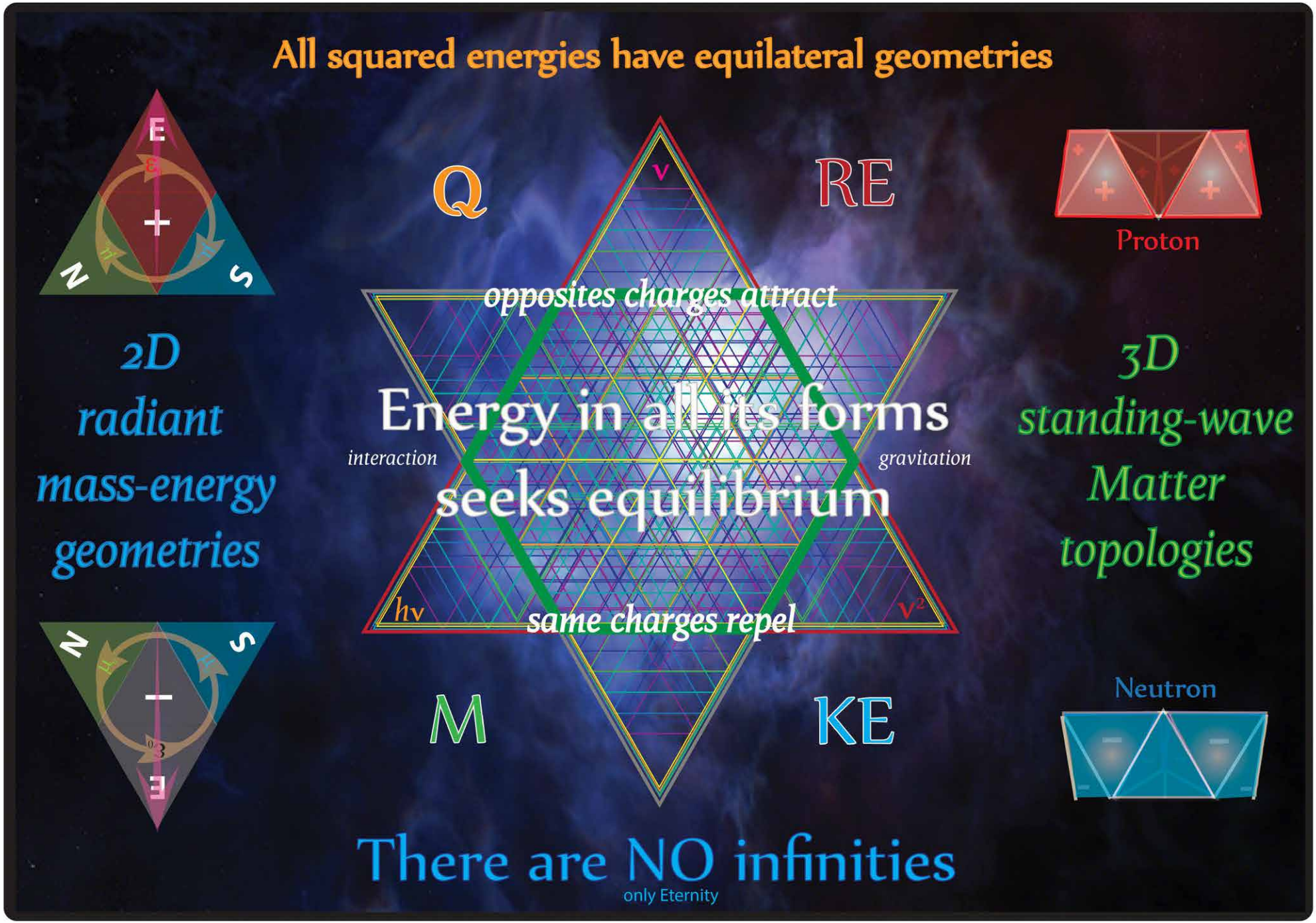

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Clean, limitless Energy

Unlimited resources

The geometric field equation of mass-ENERGY-Matter

$$\underset{\text{topology}}{\overset{\text{Matter}}{T\pi}}\left[\left[\underset{\text{impedance}}{\overset{\text{spatial}}{\varepsilon_0\mu_0}}\right].\left[\underset{\text{mass}}{\overset{\text{Planck}}{m}}\underset{\text{velocity}}{\overset{\text{quanta}}{\Omega v^2}}\right]\right]$$

Unifying Science and Religion

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Tetryonic Theory

All EM mass, energy momenta & Matter can be measured and geometrised with respect to equilateral Quantised Angular Momenta

charged Planck quanta

Bosons

$$\frac{\text{ODD}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

(mass, velocity; Planck quanta)

Total Relativistic energies

ENERGY

$$n\pi\left[\left[m\Omega v^2\right]\right]$$

(mass, velocity; Planck quanta)

Quantum Mechanics

Q [v-v]

RE

Quantum Cosmology

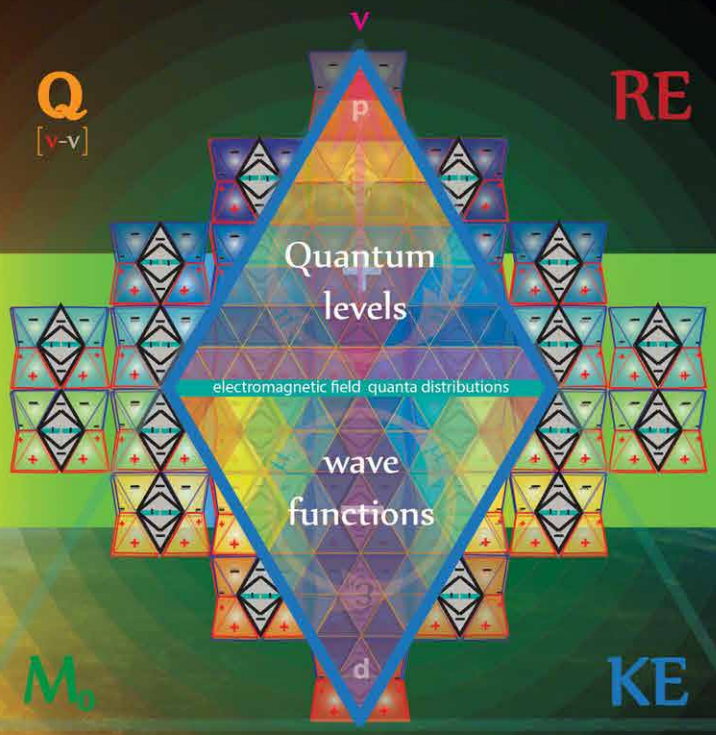

standing-wave mass-Matter

radiant EM mass-energies

Quantum Chemistry

$h\nu$ M_0 KE v^2

Electrodynamics

Matter

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

(mass, velocity; Planck quanta)

EM waves

$$\frac{\text{EVEN}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

(mass, velocity; Planck quanta)

3D standing-wave mass/Matter topologies

The application of equilateral QAM geometries covers all of the Physical disciplines

2D radiant mass-energy geometries

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Tetryonic Geometrics

The equilateral geometry underpinning the mathematics of Physics

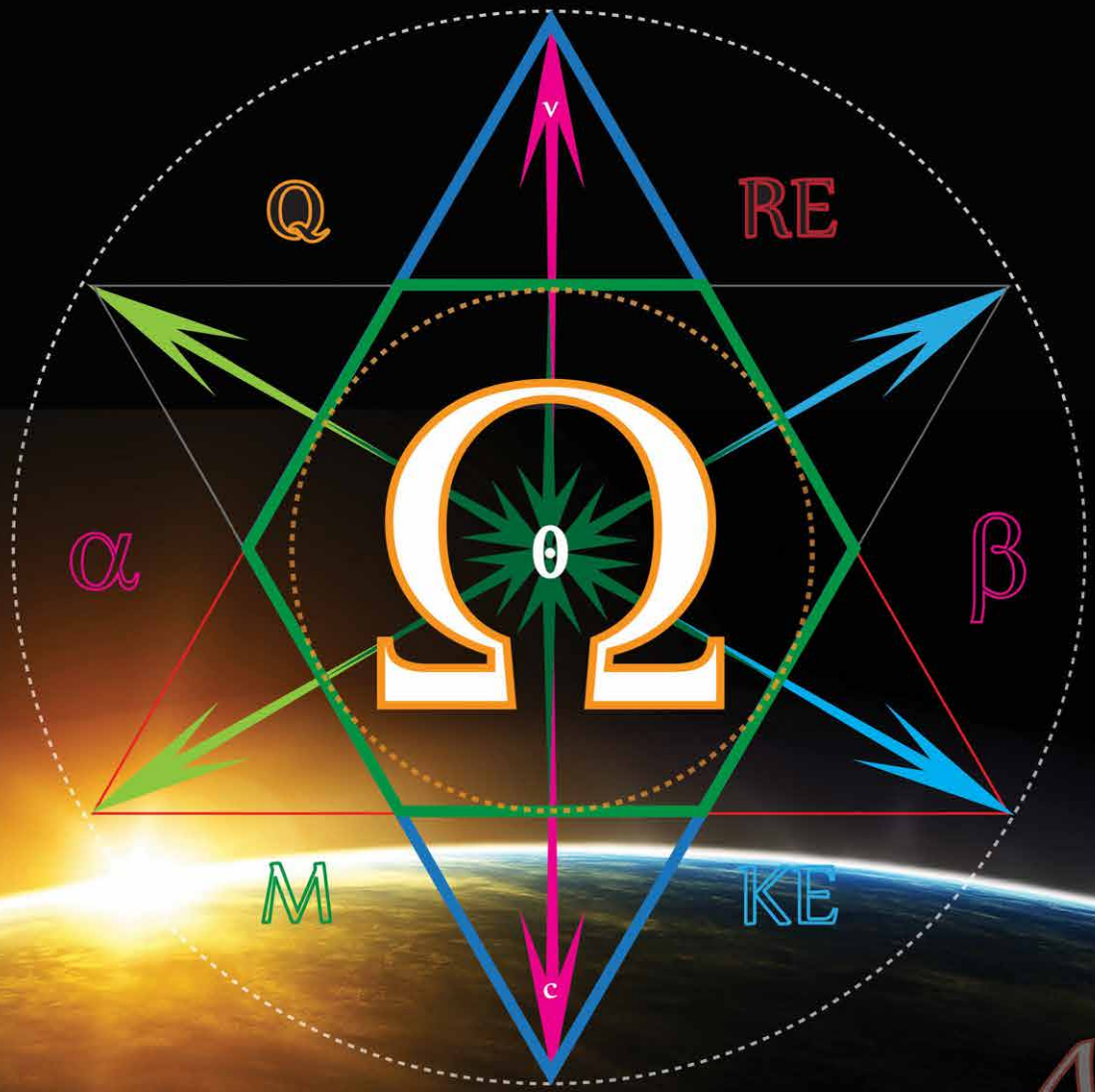

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TETRYONICS

The charged topology of periodic & compound Matter

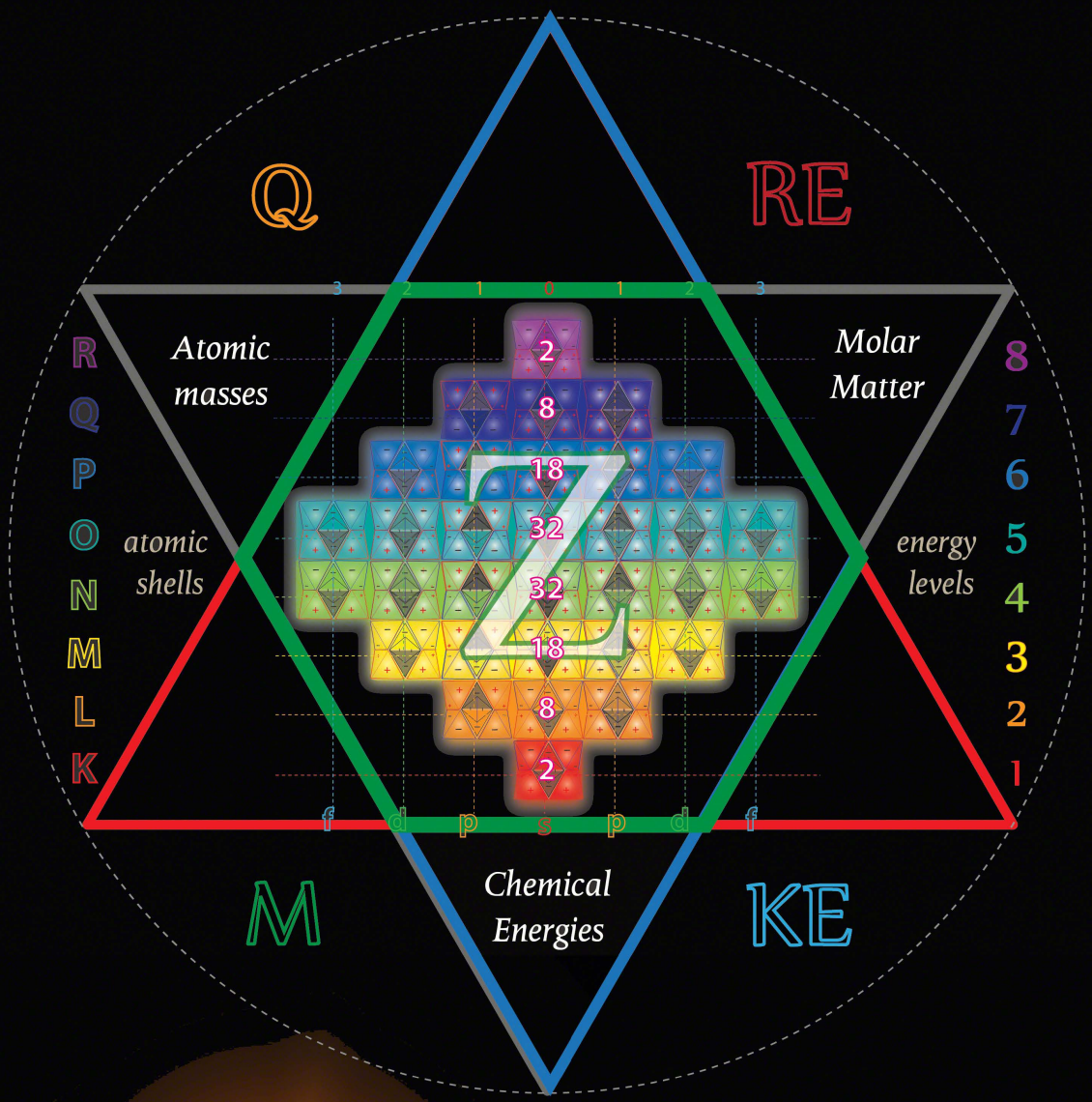

Foundational Quantum Chemistry

Abraham

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Residual Electro-Magnetic Forces

allow Neutrons and Protons to attract via the opposite Electric charge points created by their constituent Quarks in order to create Elementary Nuclei

Protons + *Neutrons*

u+d+u d+u+d

All electrons, quarks and Baryons are made up of 4n+ (Tetryonic) standing-wave EM fields.

As well as having nett Tetryonic charged topologies ranging between [+24] ~ [-12] they all posses distinct ELECTRIC FIELDS that are concentrated in 3 apex points as indicated in the illustrations

These points result from the orientation of Electric apexes and orthagonal Magnetic dipole field edges that make up each particle's externalised EM fields.

The Positive and Negative electric apex points, obey the Law of Interaction forcing separated nuceli to combine due to their individual nett Tetryonic charges and provide a means of orienting nuclei to each other to create larger particles [elements, allotropes and compounds]

External Magnetic (H) fields can interact with the integral magnetic (B) dipoles of Tetryonic particles forcing them to orientate in specific directions to facilite chemical bonding [nuclear forces]

Additionally, external Electric fields can intercct with the integral electric fields attracting or repelling them depending on the polarity of the external electric field [Electrostatics]

External energies can be induced into these integral EM fields via inductive coupling or the absorption of spectral photons in turn leading to an increase in the strengthes of the integral EM apexes in turn increasing the Strong Nuclear Force.

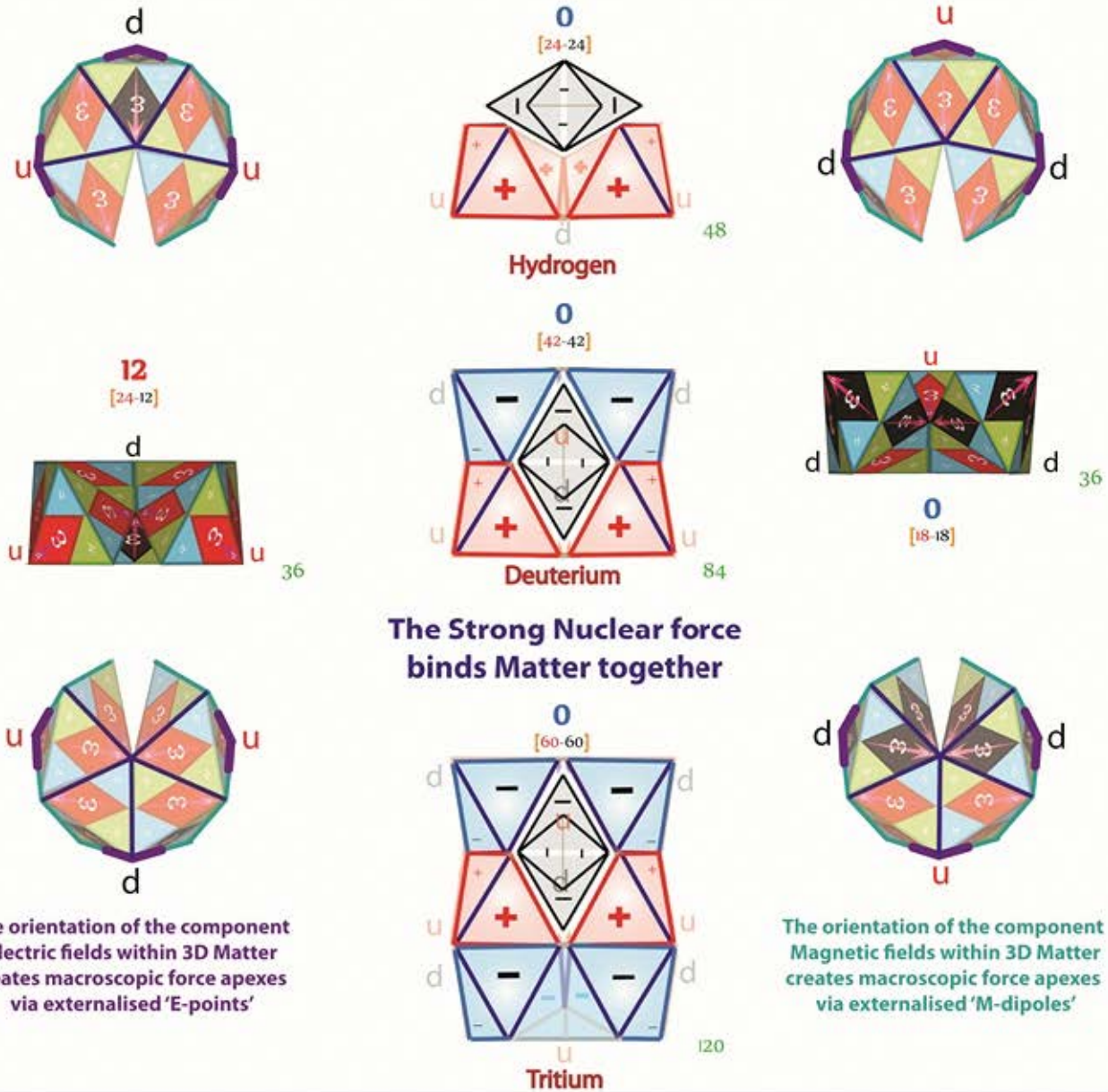

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Nucleonic residual EM force

Neutrons

Protons

The attraction between Baryonic E&M field apexs, a result of their component Quark arrangements, results in the formation of heavier and more complex Nuclei

The residual e-field apexes and m-field dipoles form two rings of residual EM fields around the circumference of atomic nuclei

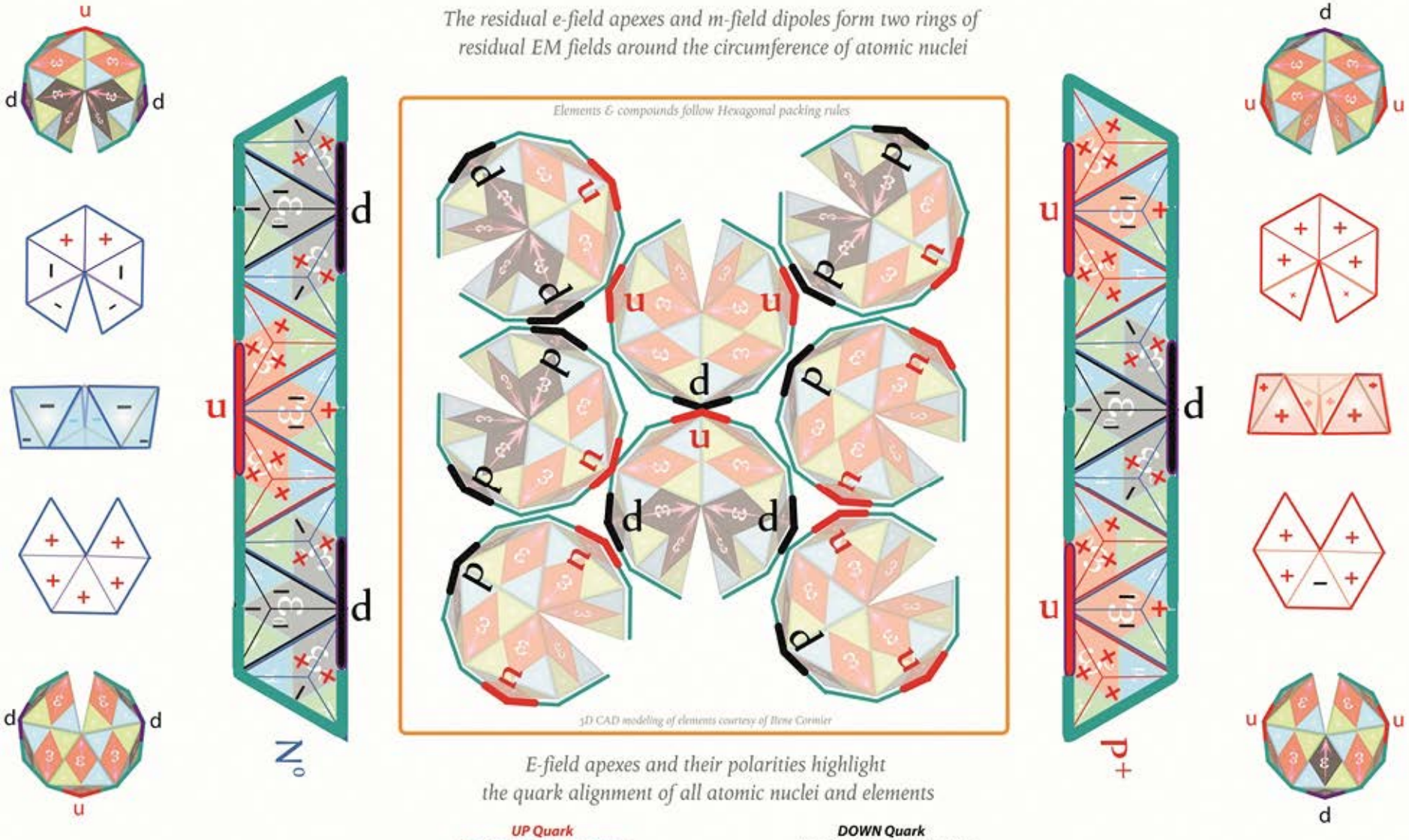

E-field apexes and their polarities highlight the quark alignment of all atomic nuclei and elements

UP Quark
Positive Electric field apex

DOWN Quark
Negative Electric field apex

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Insulators and Conductors

The position of electrons in Nuclei within Atomic Elements results in the properties of Insulators or Conductors

Coloumbic forces

Electrons are attracted to the residual EM net (+12) positive charge of Protons or n[+12] unbalanced Ionic charges of nuclei

Conductor

Electrical energies move around the material via boson exchanges and electron movement

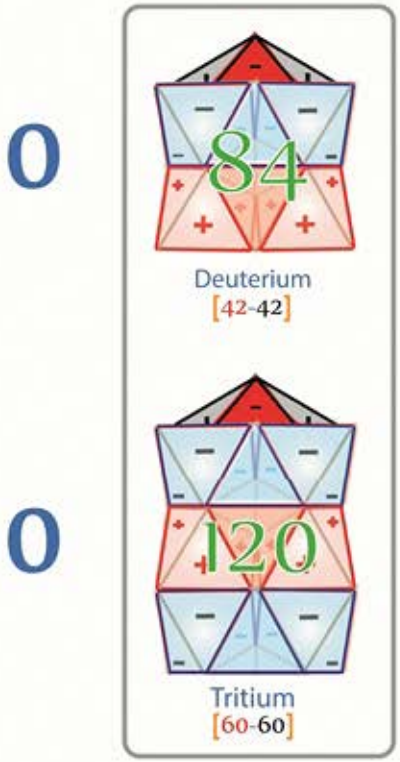

≈

Insulator

Electrical energy is fixed within the nucleus as electrostatic charges & released upon demand via electron rotation/motion within the nucleus

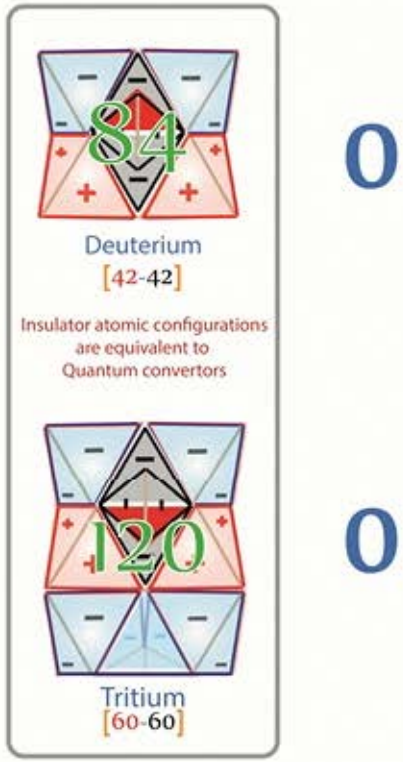

Ions

Charge (energy) is moved around material via electron movement

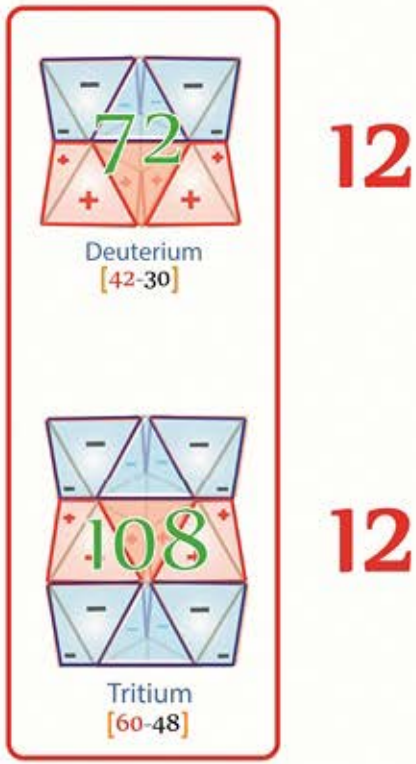

Conductive materials contain 'free' electrons that can be readily or easily moved within the material

Insulator materials have electrons that are 'bound' tightly to the atoms and store charges locally where they are applied

Materials that have been ionised are more likely to become Conductors as they easily attract and bind free electrons to them

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Nucleon Quark Arrangement

The nuclei arrangement of each atomic shell [quantum level] is the result of quark EM field interactions

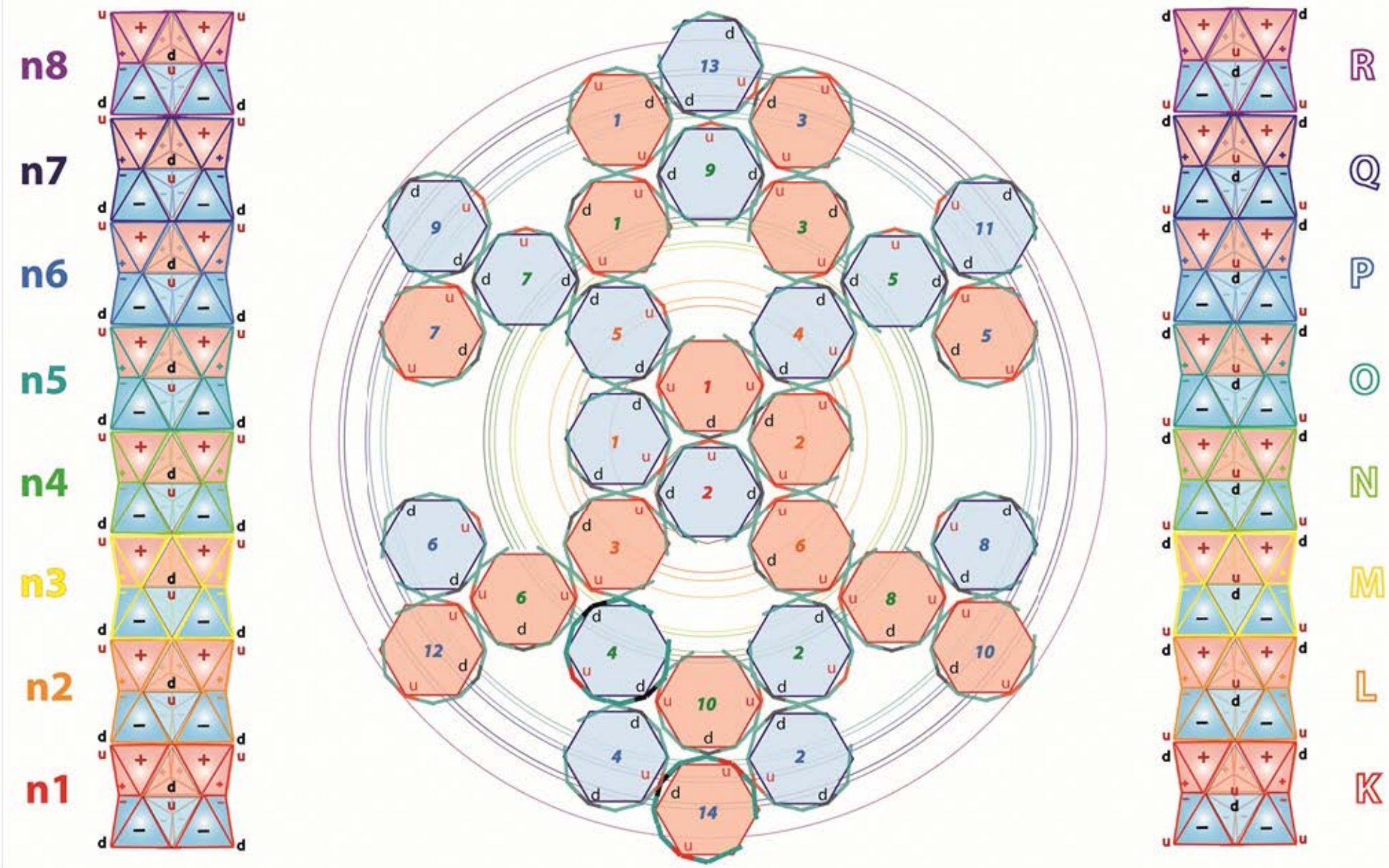

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Nucleon Charges and Bonding

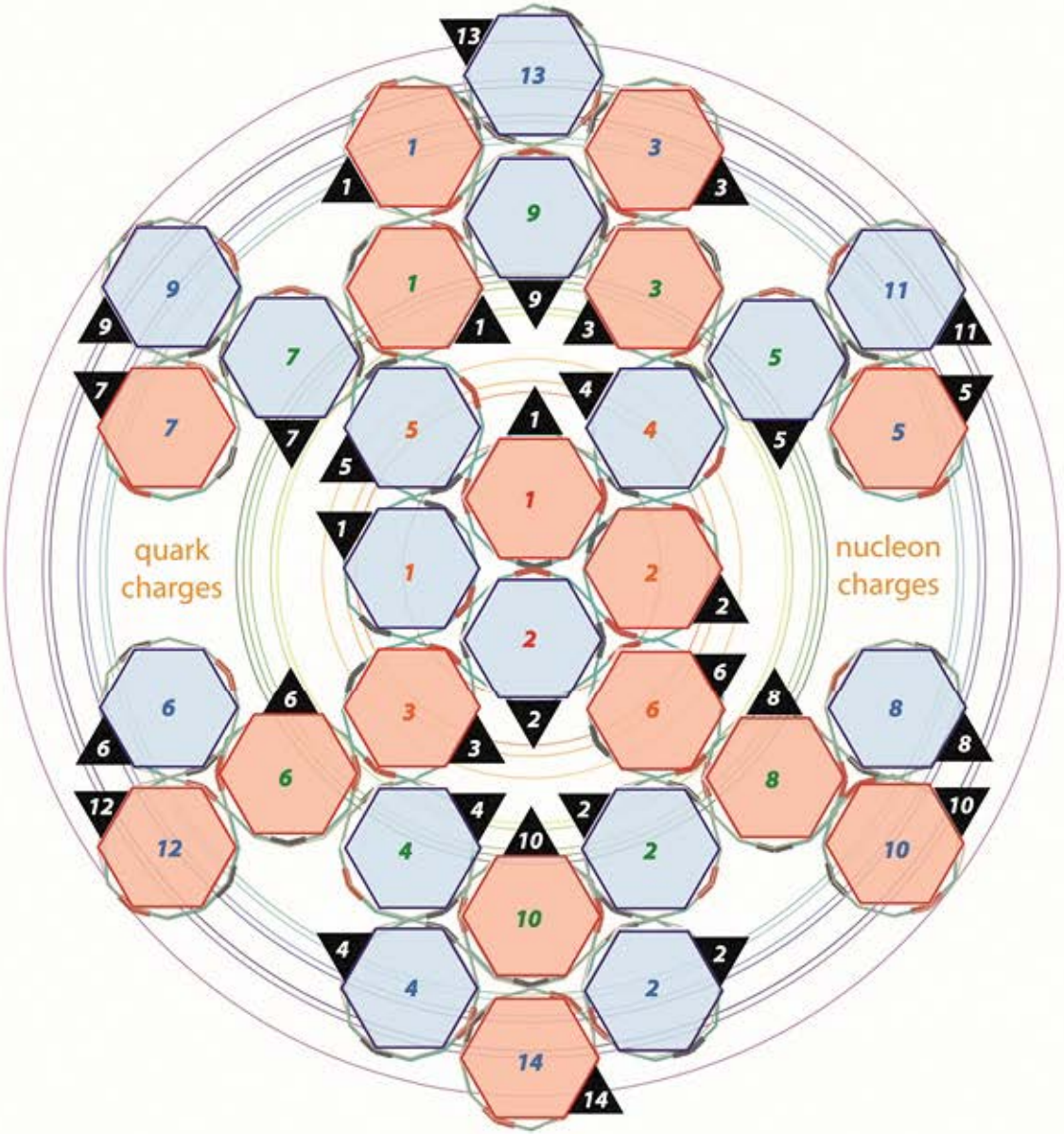

(Strong force - topological Electric Points)

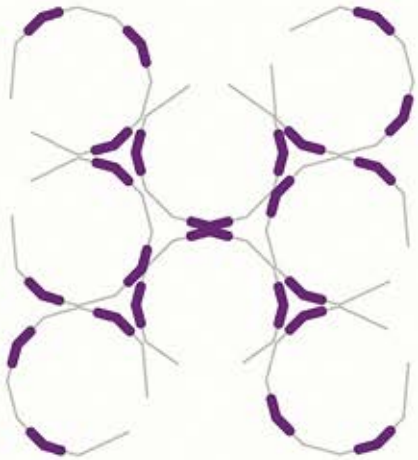

residual EM forces

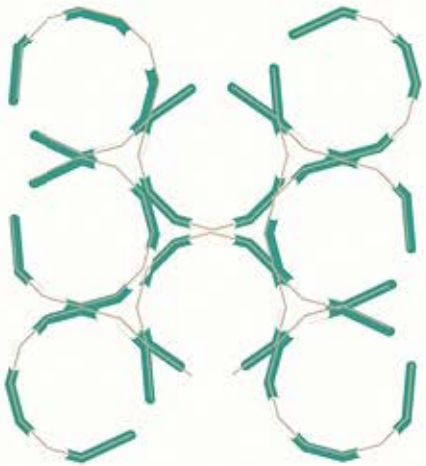

(Strong force - topological Magnetic dipoles)

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Bound electron arrangements

Externally bound electrons produce sub-orbital patterns different to the electron orbitals of internally bound electrons

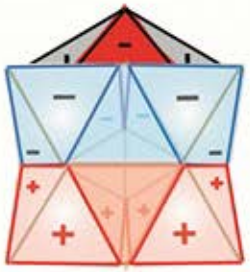

Deuterium

electrons are externally bound to the Deuteron nuclei

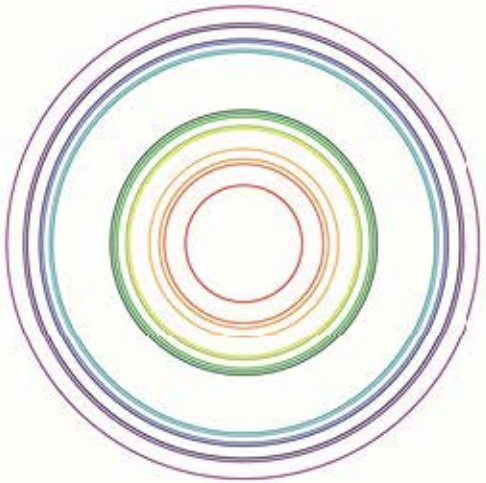

Conductors

Charges are free to move and equalise

electrons require less energy to 'break free' from Nuclei

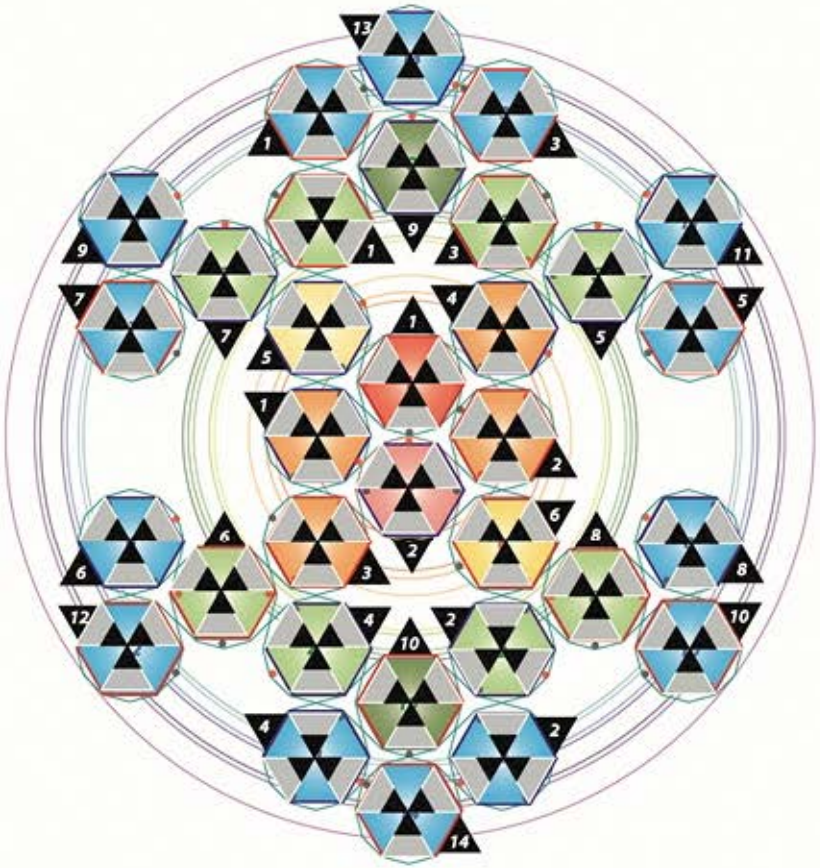

The electron orbitals of conductors are lower energies than those of insulators

Deuterium

electrons are internally bound in the Deuteron nuclei

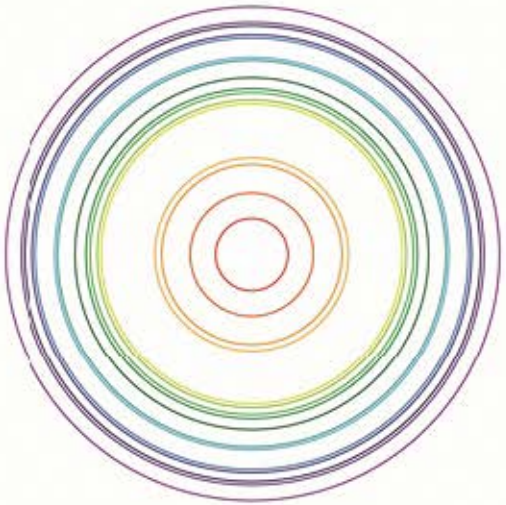

Insulators

Charges are bound to specific locations

electrons require more energy to 'break free' from Nuclei

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2D mass-energy geometries form the fabric of 3D Matter topologies

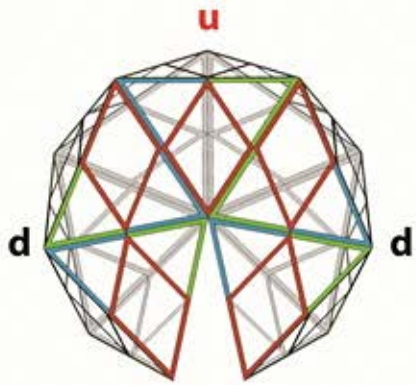

Proton

12
[24-12]

nett Charge
component charges

charged mass-energy geometry

20π

Matter topology

12
[42-30]

40π

Deuteron

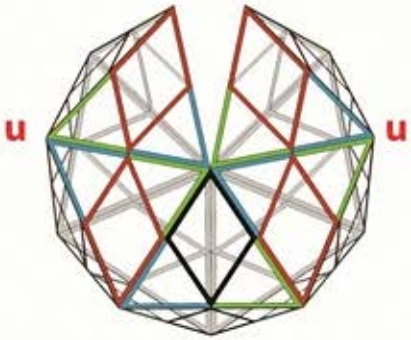

nett Charge
component charges

0
[18-18]

charged mass-energy geometry

Matter topology

20π

Neutron

Charge provides the framework for the mass-energy geometry of Matter

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All Matter topologies are the result of charged EM mass-energy geometries

Matter

$$\frac{36\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Baryons, Planck quanta, mass, velocity

mass-energy

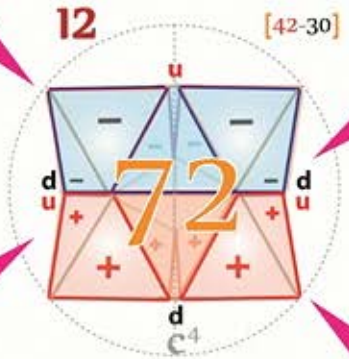

Matter

$$\frac{36\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Baryons, Planck quanta, mass, velocity

mass-energy

Deuterons

are the building blocks of
all periodic elements and compounds

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Strong Forces and Nuclear Bonding

How do Baryons with Positive and Neutral charges attract each other and bind to form stable elements ?

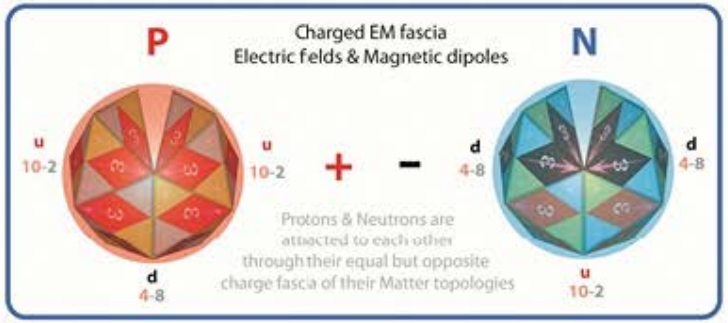

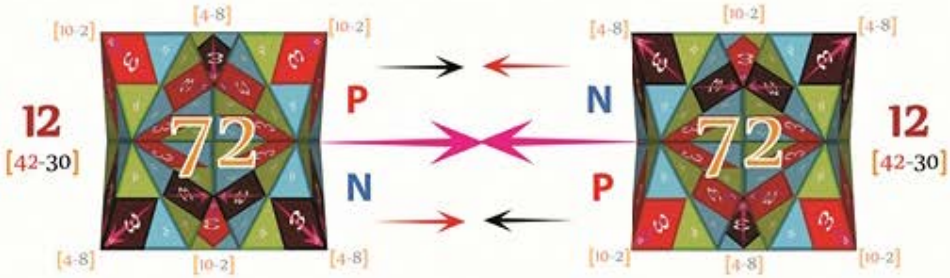

Once nuclei have been created their external electric fields & magnetic dipoles continue to attract and bind individual nuclei together via the Residual EM Force as nuclei seek charge equilibrium by combining with each other and electrons to form neutral elements

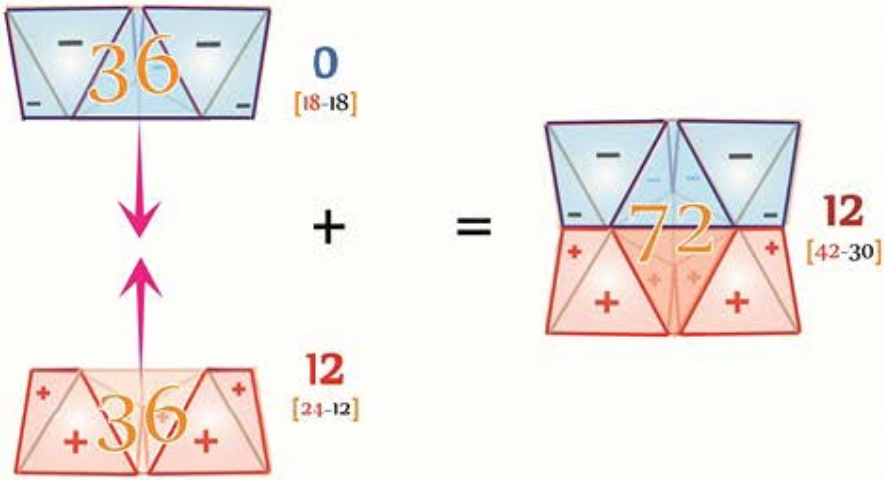

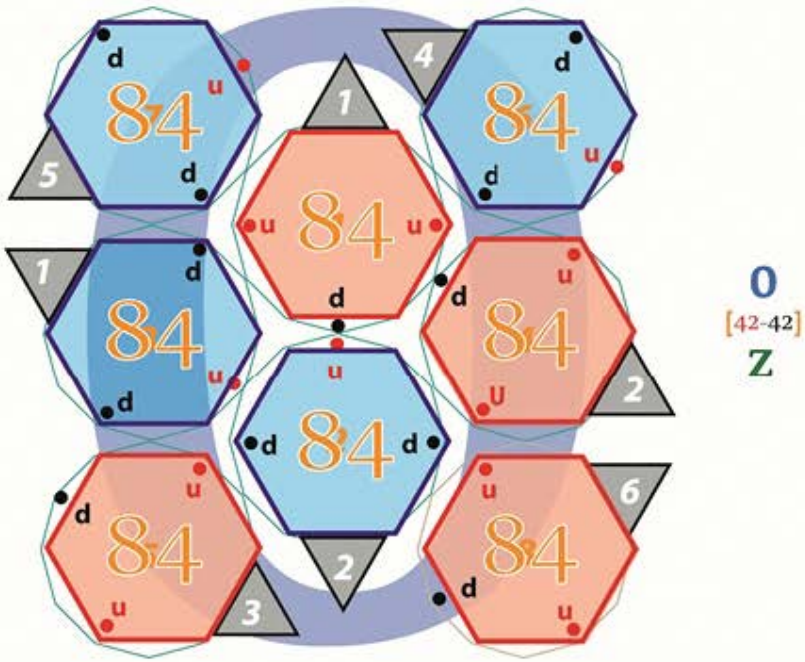

The attraction and binding of Protons and Neutrons through their electric charge imbalances creates Deuterons which have +12 charges

The residual Z[+12] charge is what attracts electrons to form neutral atomic nuclei via Coulombic attraction

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Strong Nucleonic Bonding

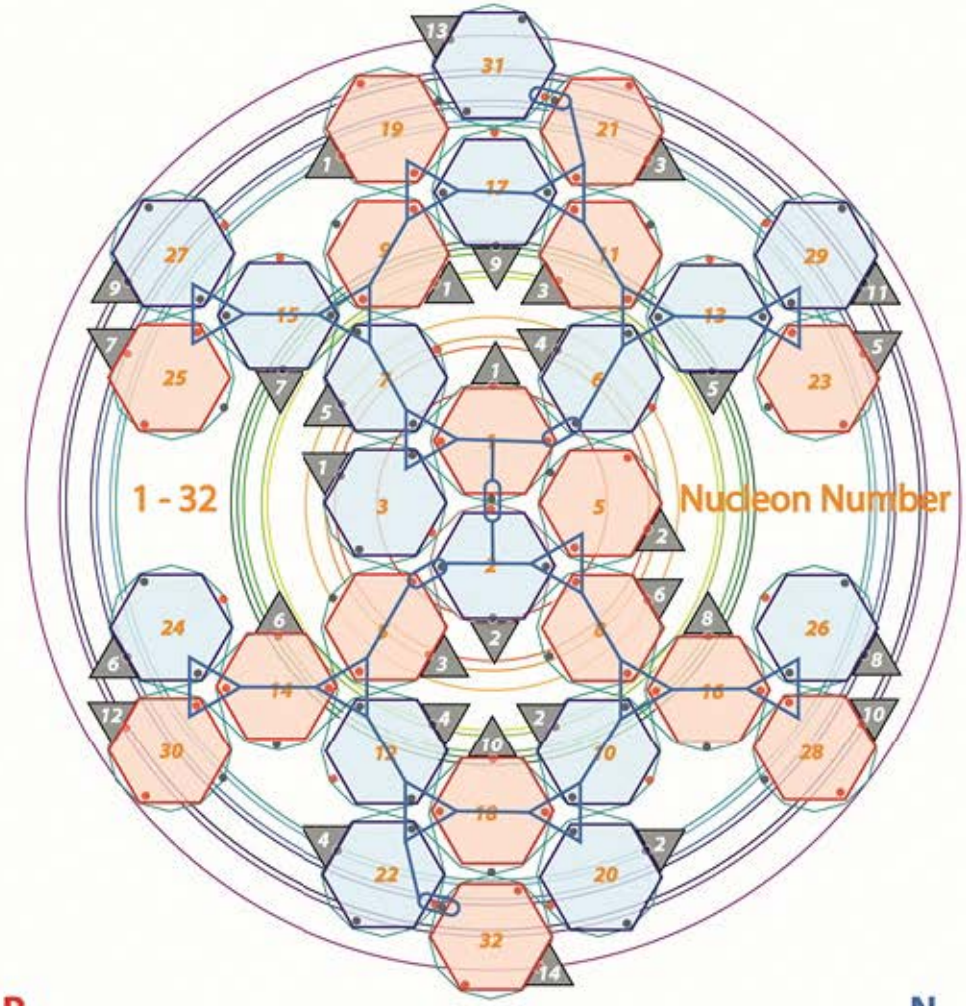

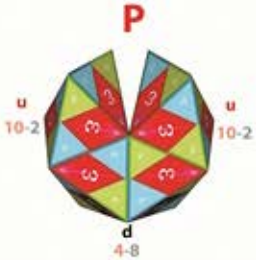

+

In addition to the Strong colour force
a separate residual binding force arises
from the external apexes formed by
Positive and Negative Electric points of quarks
in each Baryon [nuclear-chemical bonds]

-

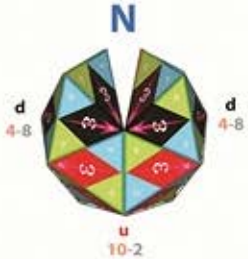

All energy seeks equilibrium

External Electric field points bind via Charge fascia interactions with Plus and Minus Electric points combining and sharing energy throughout the resultant nuclei

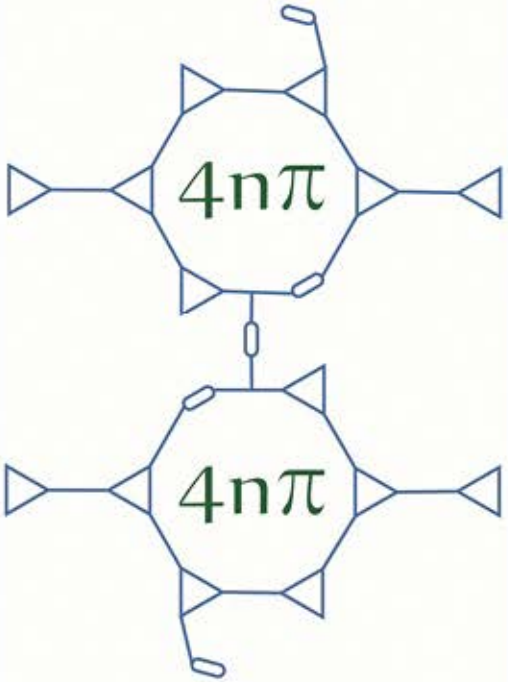

Positive Electric field apex

Negative Electric field apex

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Hydrogenic vs Nucleonic electron binding

If a unbound Proton attracts an Electron the Electron can be bound to the nuclei in a number of differing orientations [each with differing spin energies]

All atomic nuclei (and elements) are Deuteron'ic nuclei with a mixture of *orthagonal*, parallel and anti-paralllel spin orientations

(this is why Rydberg is less accurate for elemental nuclei compared to Hydrogenic atoms - see QM spin)

Electrons can be bound to deuteron nuclei in four distinct orientations [2 horizontal & 2 vertical] with each spin coupling orientation producing differing energy electron orbitals [wrt to the nuclear magnetic moments]

Ejecting electrons from atomic nuclei by adding energies to their KEM fields [the Photoelectric effect] creates Positive Ions

Vertically orientated electrons within Proton-Neutron Nuclei [Deuterons] create quantum synchronous convertor geometries

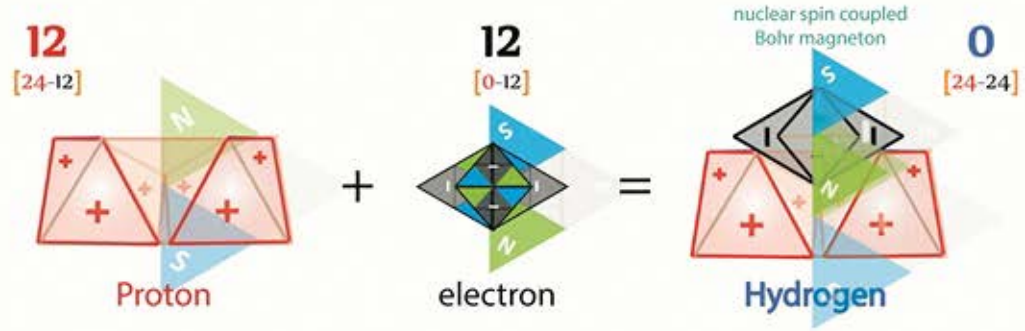

The energy levels of Baryons determines the KEM field energy of bound electrons

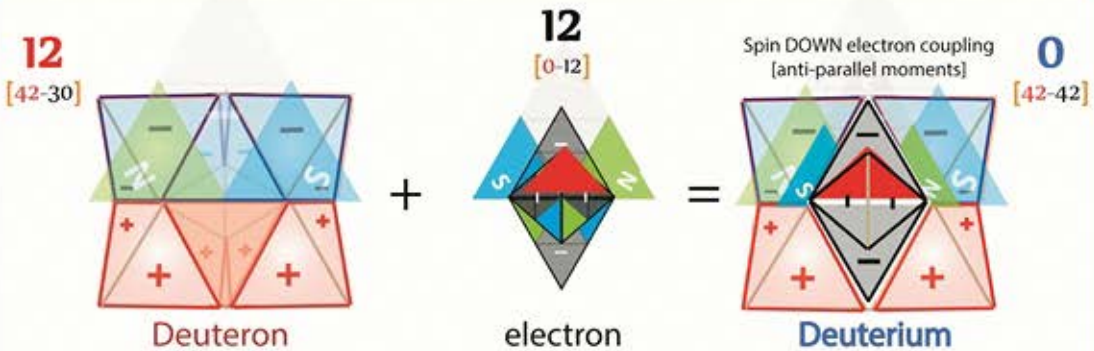

Bohr magnetons are always referenced wrt the Nuclear magneton

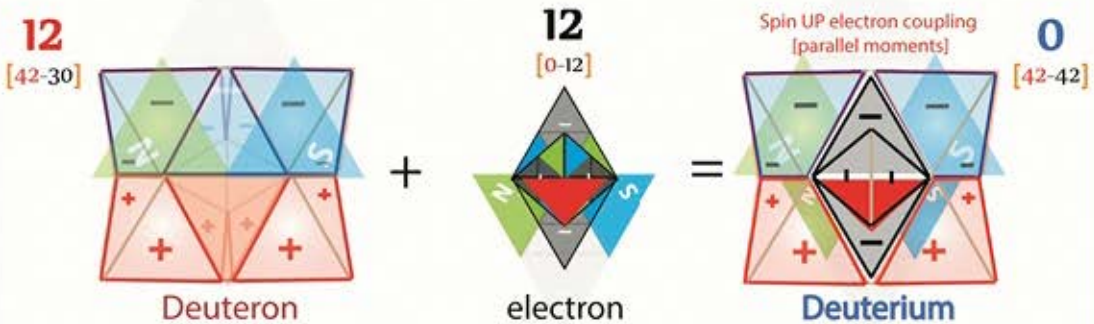

electrons produce stronger magnetic moments due to their mass-charge quotient

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Atomic Nucleus Master Template

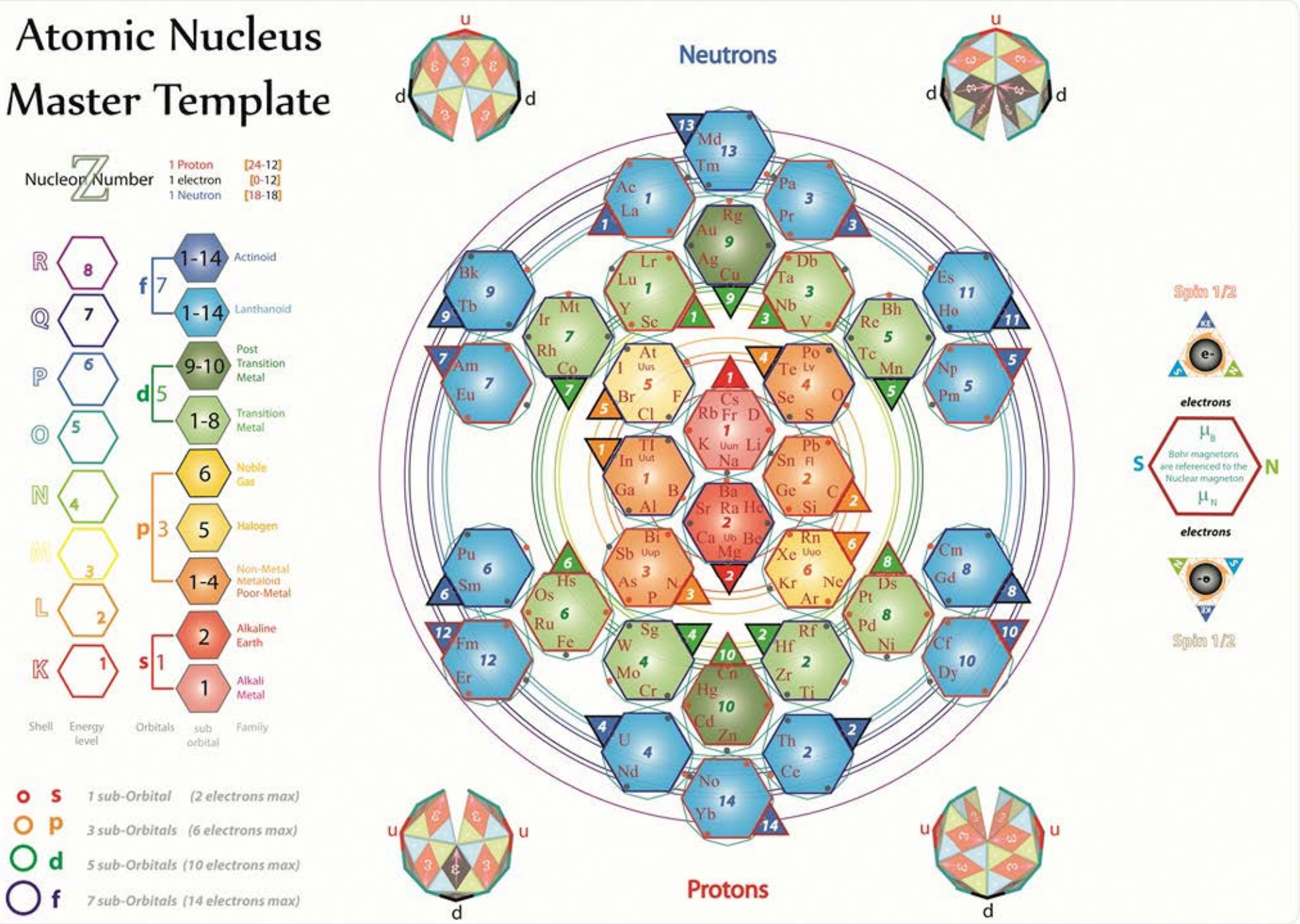

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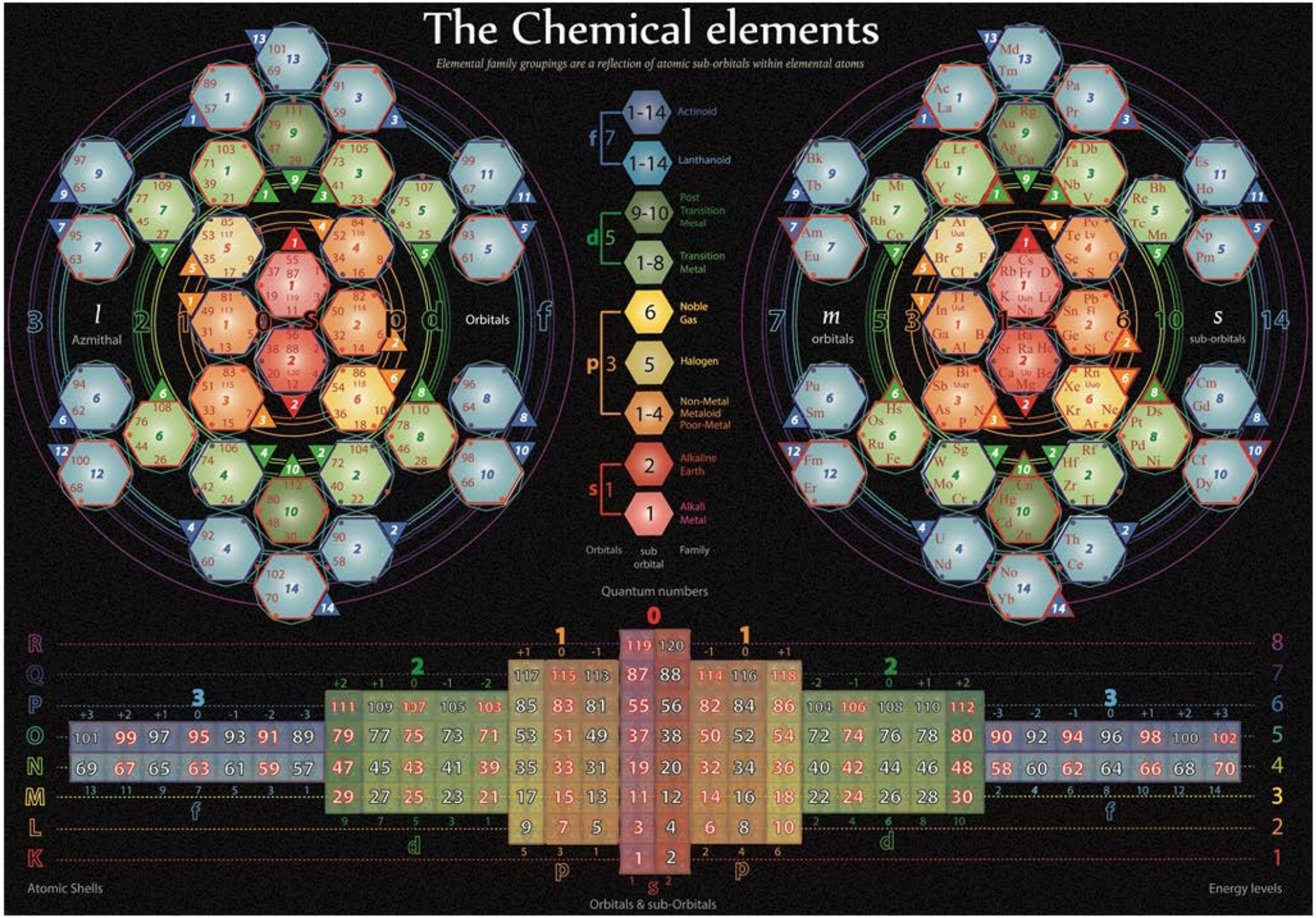

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Element Numbers

Z * 1 Proton [24-12]
1 Neutron [18-18]
1 electron [0-12]

Each elemental nuclei is made from Deuterium

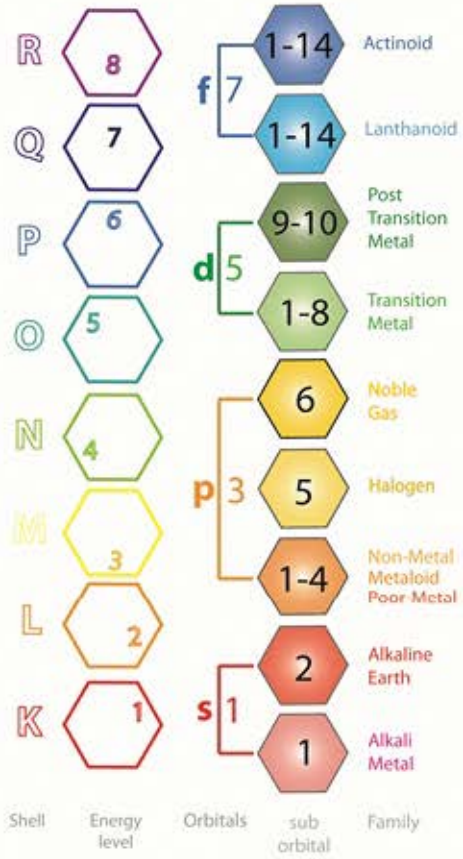

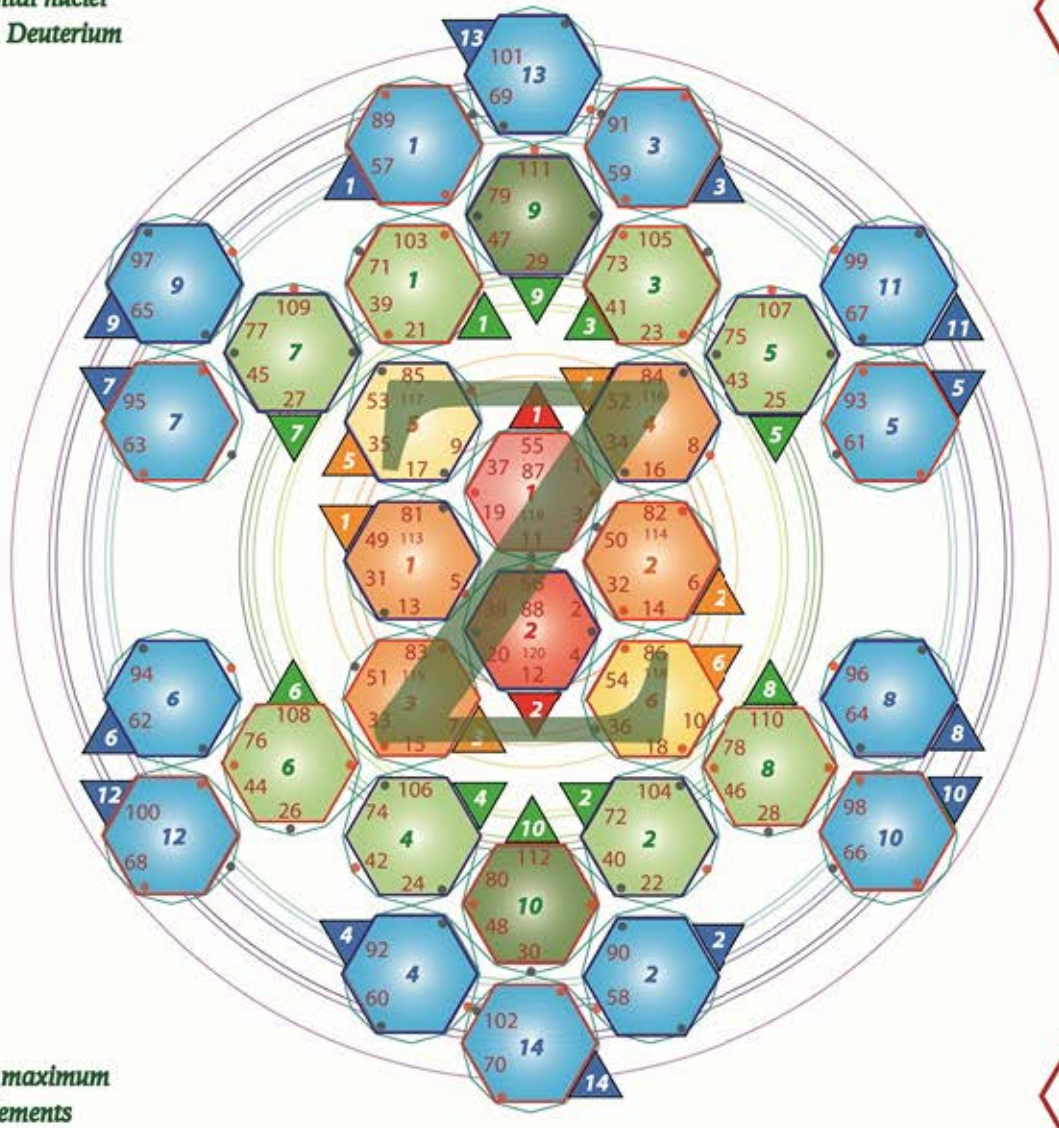

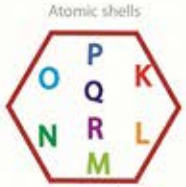

o s 1 sub-Orbital (2 electrons max)
o p 3 sub-Orbitals (6 electrons max)
o d 5 sub-Orbitals (10 electrons max)
o f 7 sub-Orbitals (14 electrons max)

There are a maximum of 120 elements possible

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Element Names

Z * 1 Proton [24-12] 1 Neutron [18-18] 1 electron [0-12]

There are a maximum of 120 elements possible

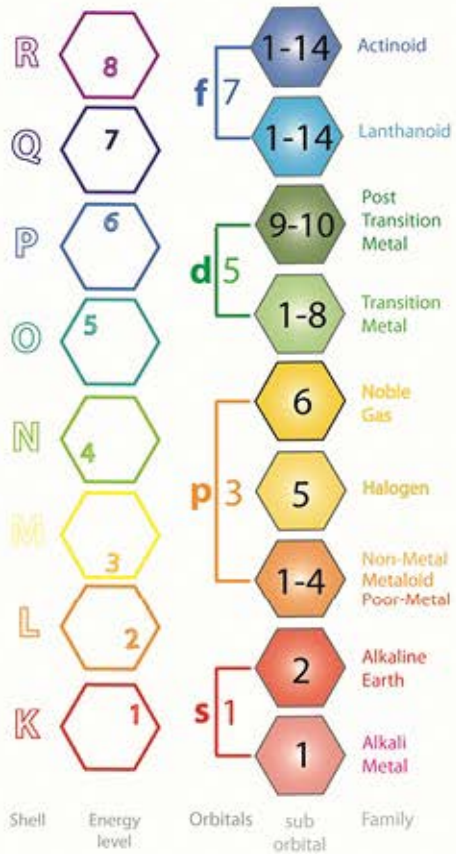

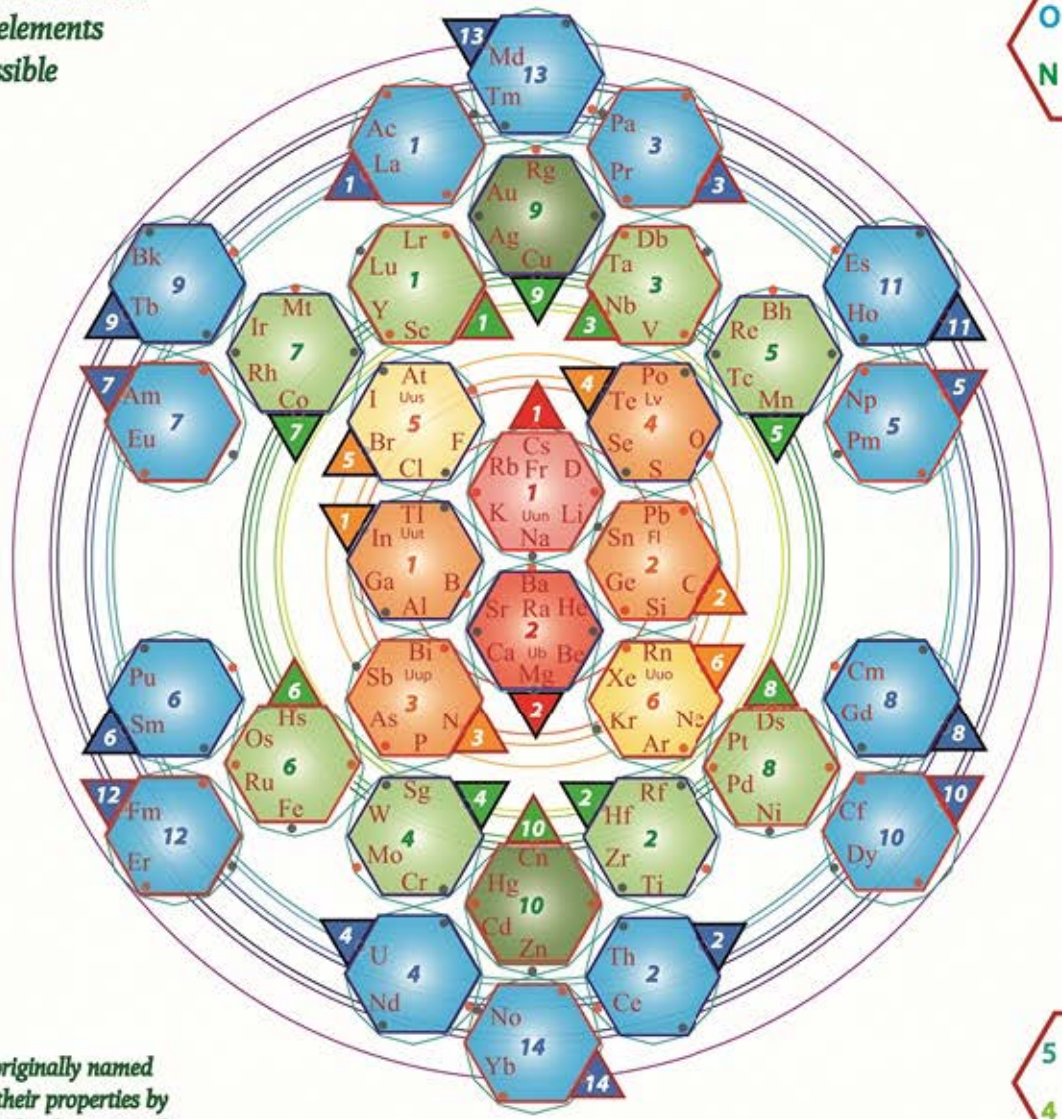

o s 1 sub-Orbital (2 electrons max)
o p 3 sub-Orbitals (6 electrons max)
o d 5 sub-Orbitals (10 electrons max)
o f 7 sub-Orbitals (14 electrons max)

They were originally named according to their properties by their discoverer but have recently been named after famous scientists

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Electron orbital configurations

A huge number of differing d and f orbital configurations are possible given the number of nuclei and bond points created by elemental topologies

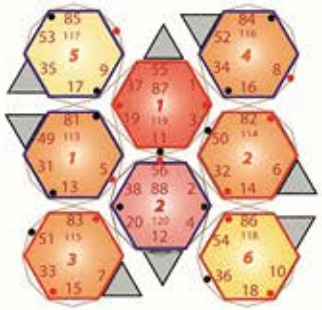

As the number of nucleons increases so does the complexity of the electron orbitals possible

quantum snowflakes

However all have a stable 'core' grouping of nuclei comprised of s and p electron orbitals

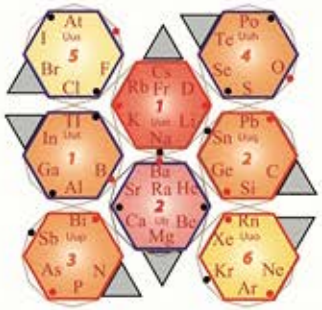

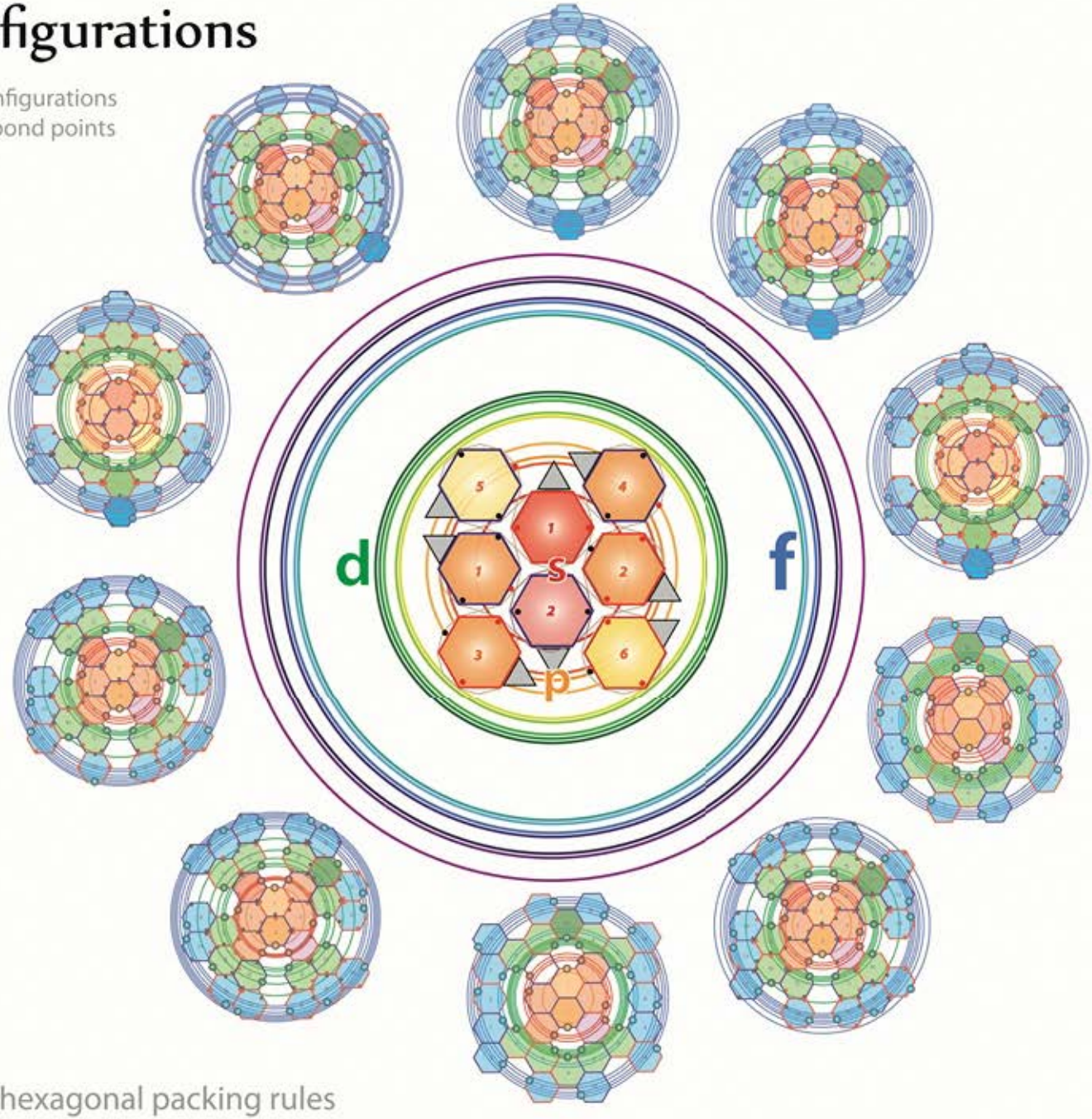

All nuclei bonding closely follows hexagonal packing rules

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Atomic Nucleus
Exploded view

1 Proton [24-12]
1 electron [0-12]
1 Neutron [18-18]

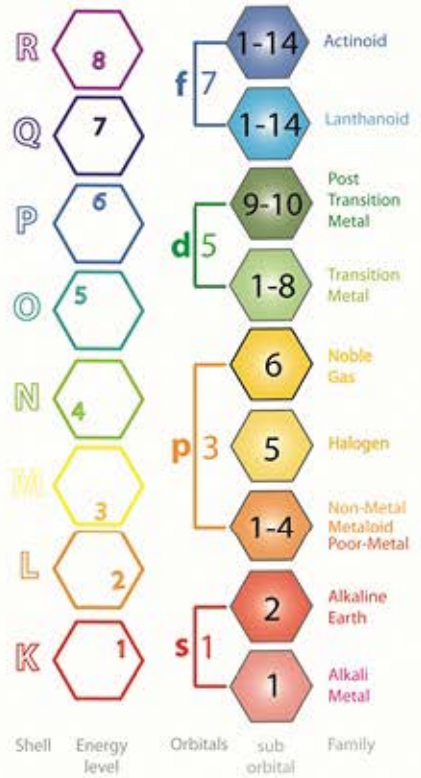

o s 1 sub-Orbital (2 electrons max)
o p 3 sub-Orbitals (6 electrons max)
o d 5 sub-Orbitals (10 electrons max)
o f 7 sub-Orbitals (14 electrons max)

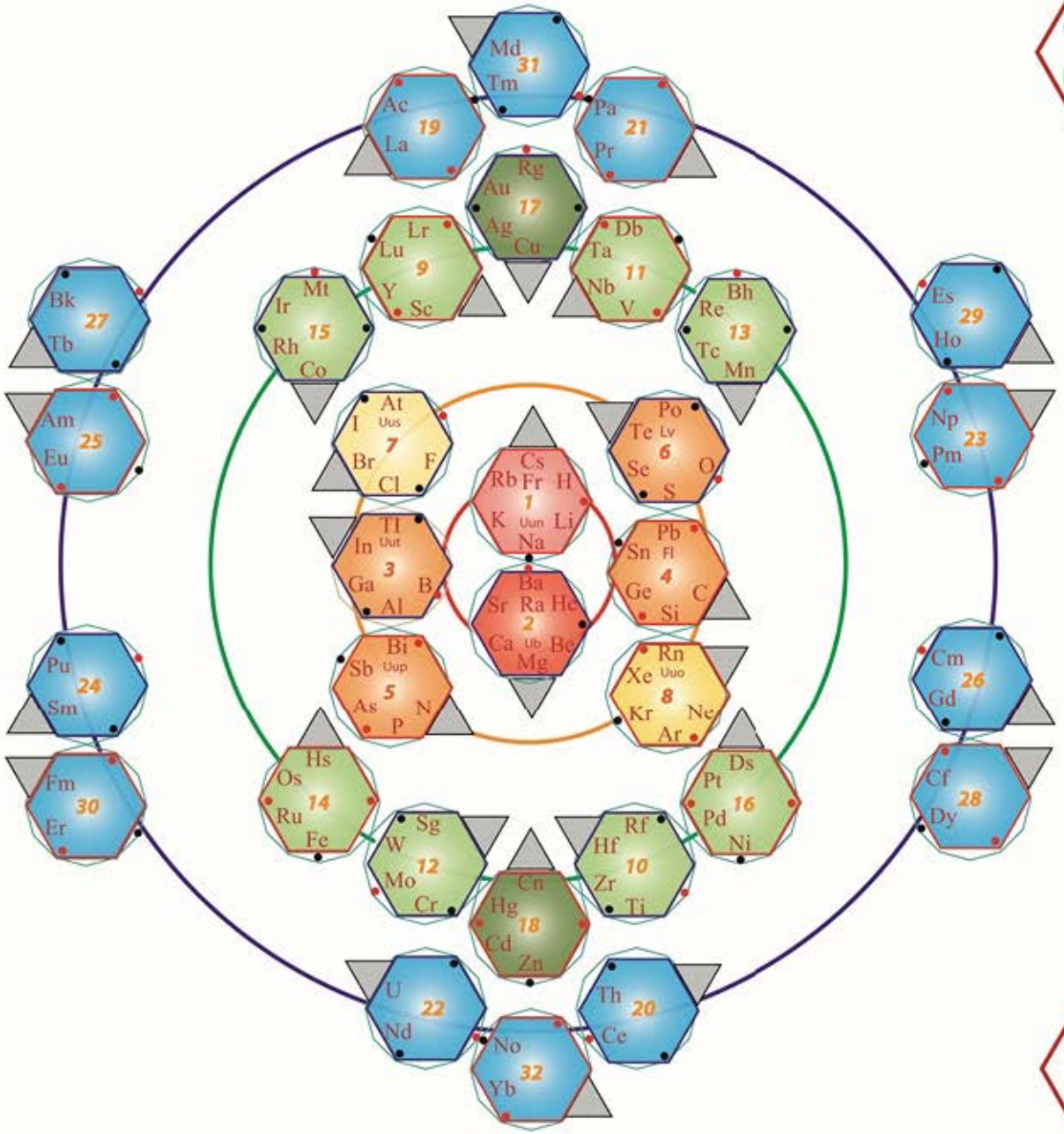

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Atomic radii of elements

The Mendeleev block arrangement of periodic elements presents a number of problems in representing the true topologies and properties of all the periodic elements:

Questions are raised over Hydrogen's appropriate position in the table

The table correctly positions elements according to their elemental properties but offers no insight into the individual geometries of the periodic elements themselves

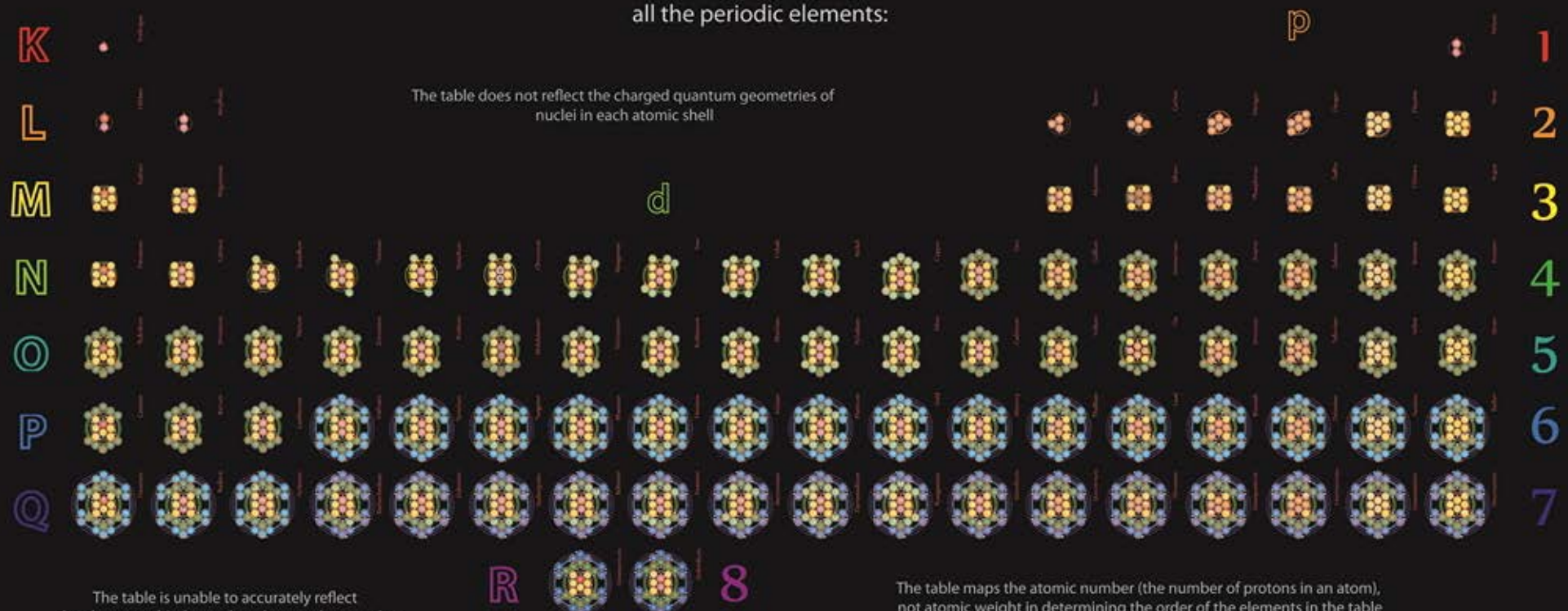

The table does not reflect the charged quantum geometries of nuclei in each atomic shell

The table is unable to accurately reflect the electron orbitals or other elemental properties described by the Bohr & Schrodinger models

The table maps the atomic number (the number of protons in an atom), not atomic weight in determining the order of the elements in the table resulting in a number of errors in periodic element placements

'f' orbitals elements are not normally presented in their true atomic number positions

f

Tetryonic charge geometry rectifies all of these deficiencies

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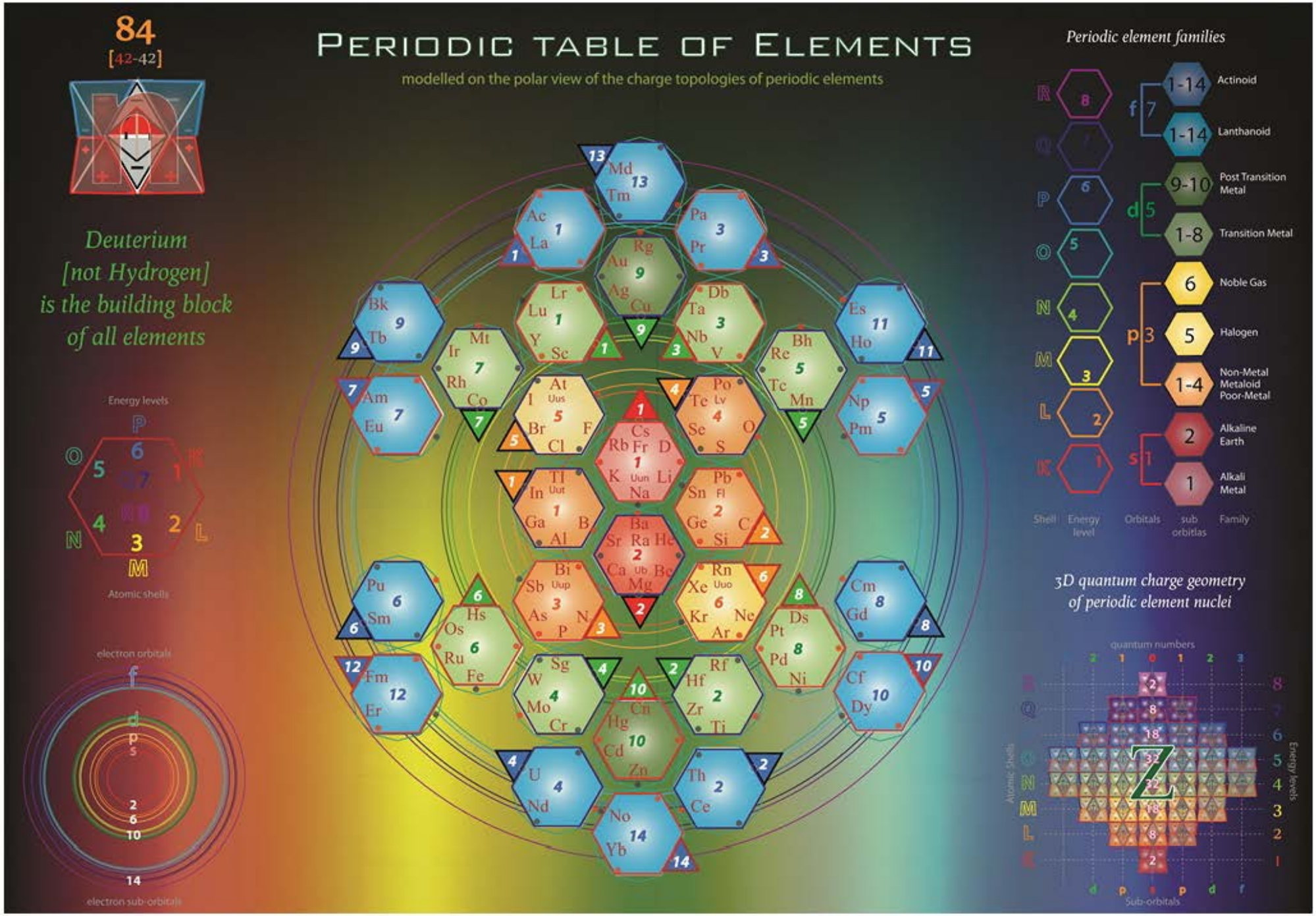

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THE ATOMIC NUCLEUS

the charged quantum mass-energy geometry of periodic element topologies

Neils Bohr

(7 October 1885 – 18 November 1962)

Erwin Schrödinger

[12 August 1887 – 4 January 1961]

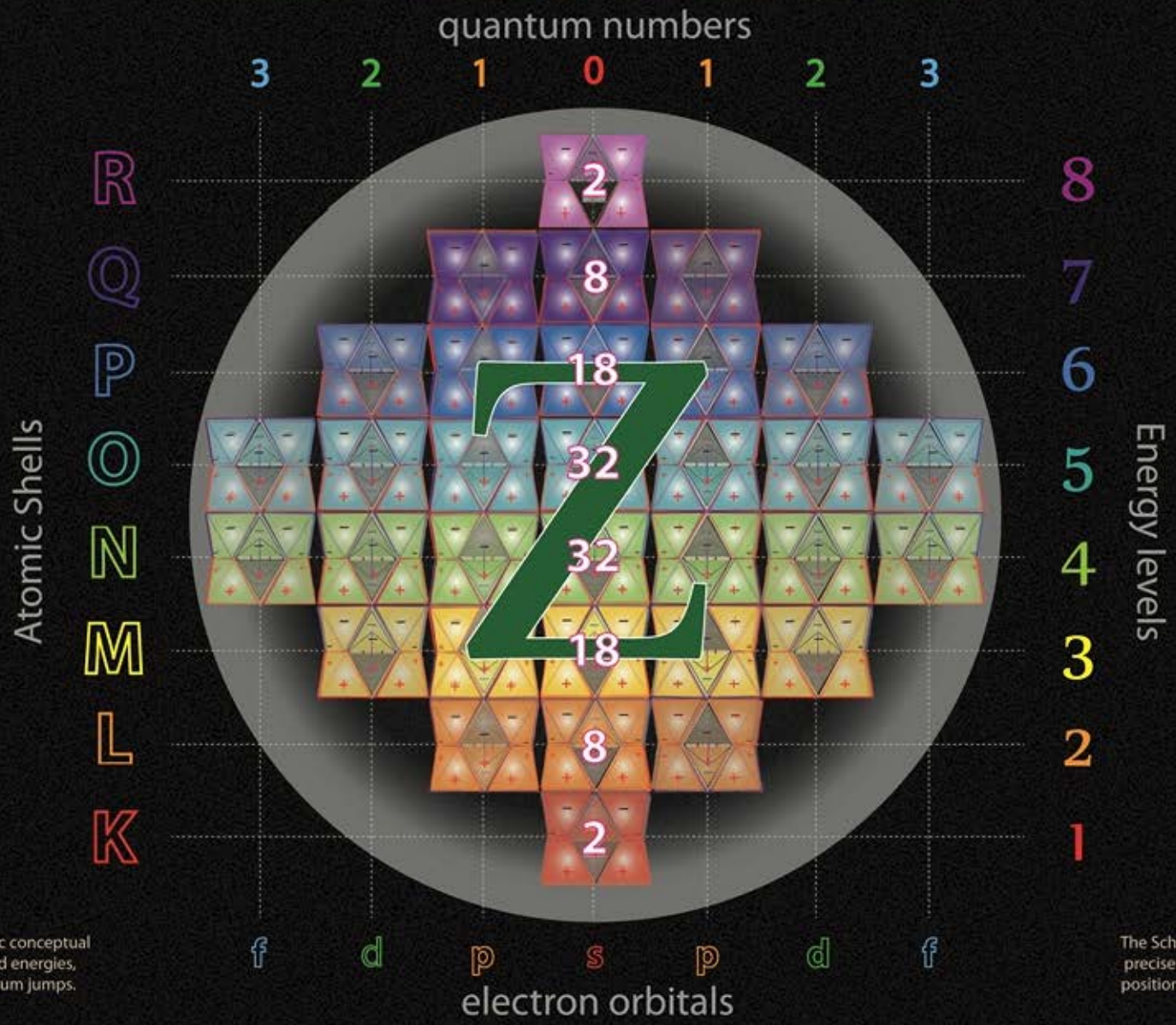

NEILS BOHR

The Bohr model gives us a basic conceptual model of electrons orbits and energies, along with the idea of quantum jumps.

SCHRÖDINGER

The Schrondinger wave equation gives precise details of spectra and electron position and motions within the nuclei

The uncertainty principle erroneously dictates that position and momentum cannot be simultaneously determined.

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Periodicity of atomic elements

An electron shell may be thought of as an orbit followed by electrons around an atom's nucleus. The closest shell to the nucleus is called the "1 shell" (also called "K shell"), followed by the "2 shell" (or "L shell"), then the "3 shell" (or "M shell"), and so on further and further from the nucleus. The shell letters K, L, M, ... are alphabetical

Each shell can contain only a fixed number of deuterium nuclei [Protons, Neutrons & electrons]

Each shell consists of one or more electron orbitals, and each orbital consists of one or more sub-orbitals.

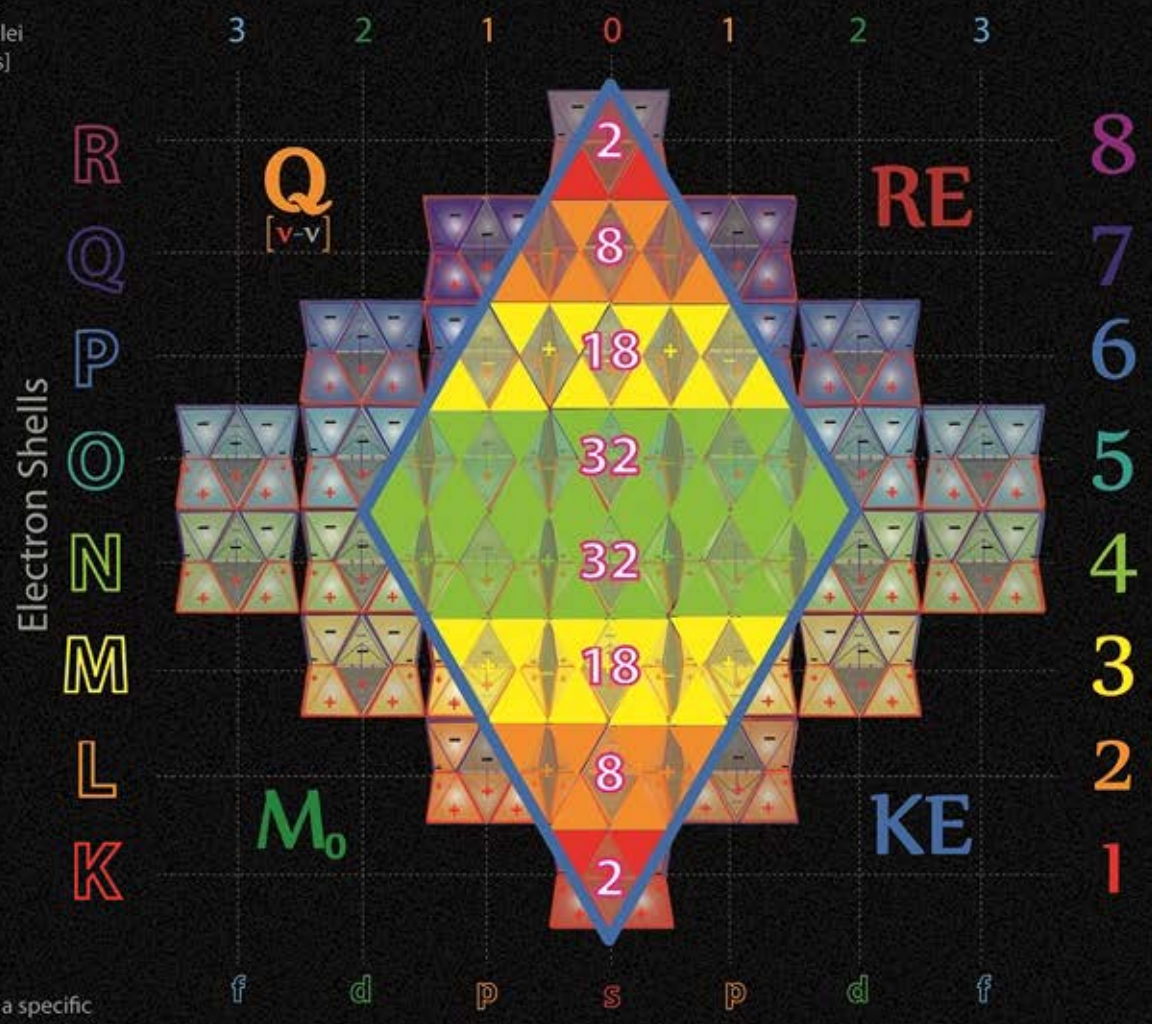

8 atomic energy shells with electrons

120 periodic elements in total

The number of deuterium nuclei that form each atomic shell in an elemental atom number is double that of Photon energy levels

Each atomic shell equates to a specific energy level for the Deuterium nuclei that comprise it with in turn affect the angular momentum of electrons in that shell

The electrons in the partially filled outermost atomic shell [or highest energy level] determine the chemical properties of the atom; they are called valence shell electrons.

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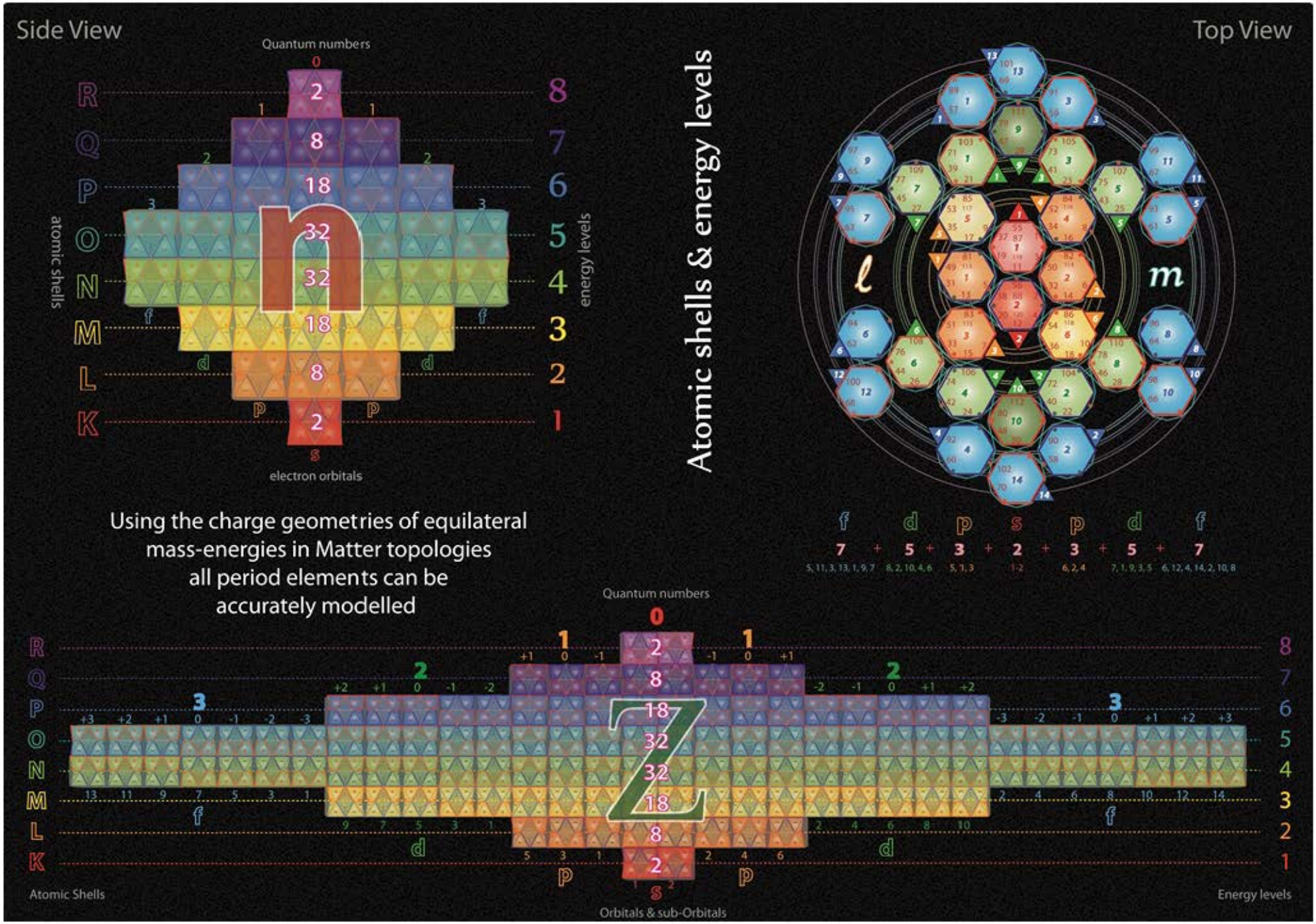

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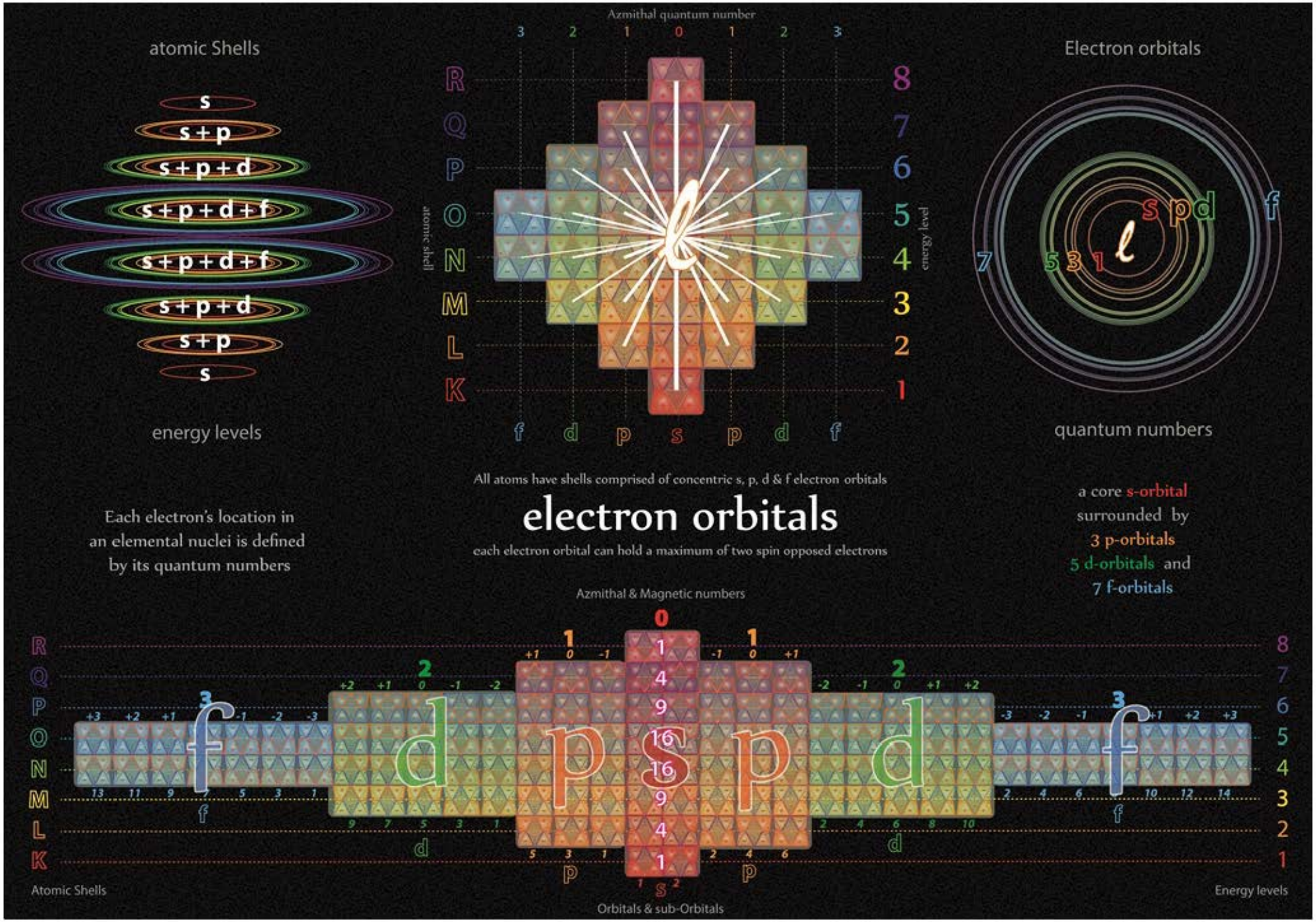

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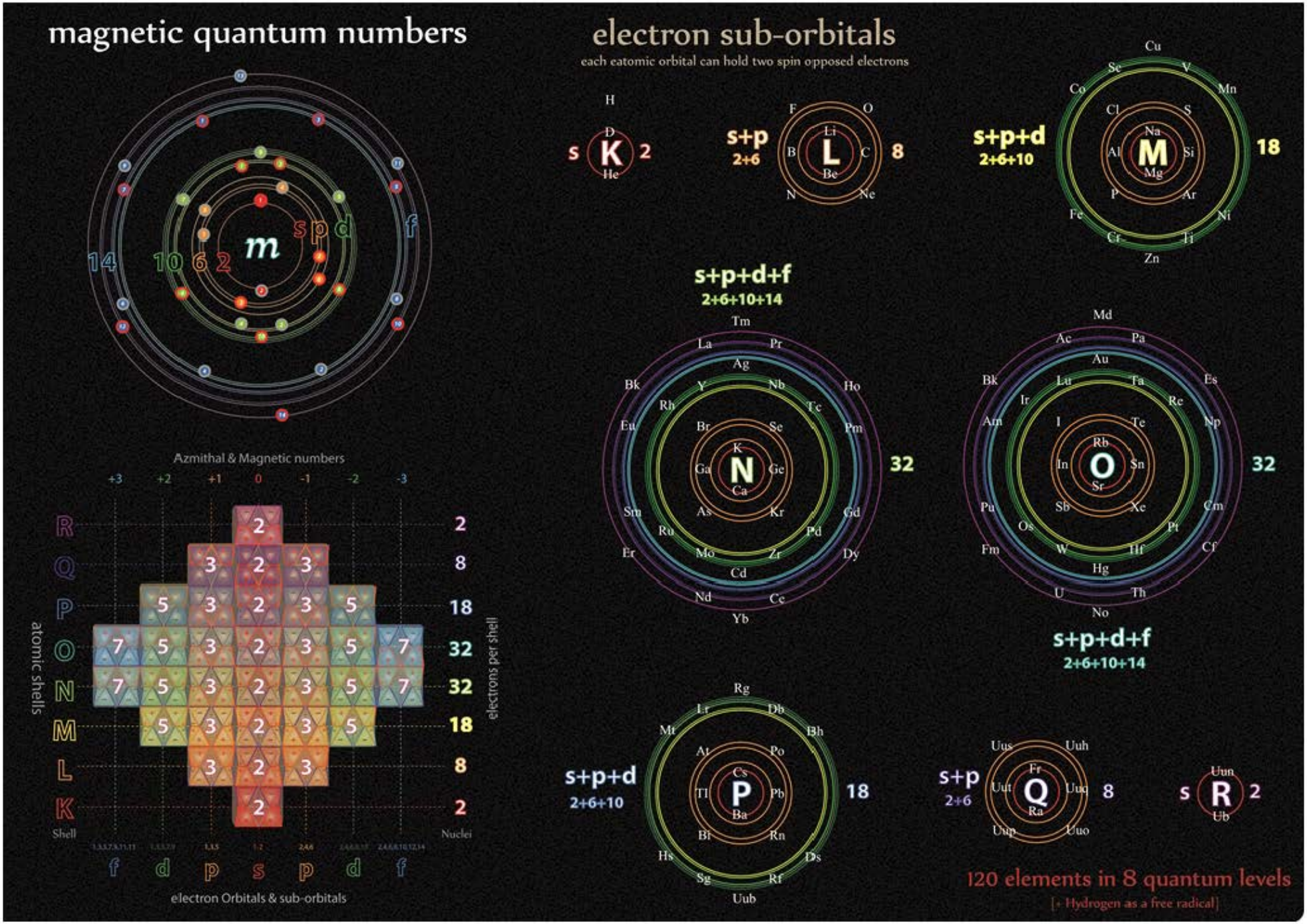

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Electron SPIN in atoms

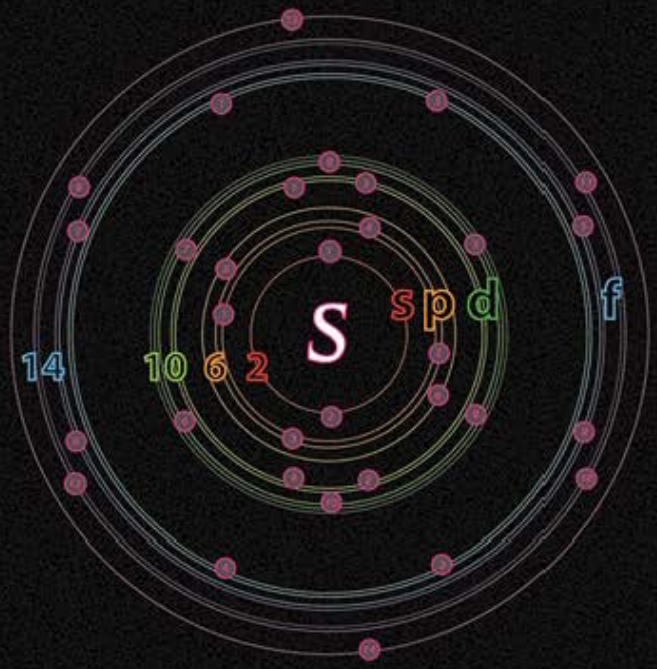

1 sub-Orbit	s	2 electrons
3 sub-Orbits	p	6 electrons
5 sub-Orbits	d	10 electrons
7 sub-Orbits	f	14 electrons

Hund's Rule
Each electron sub-orbital (Azimuthal number)
can not have electrons with the same spin direction

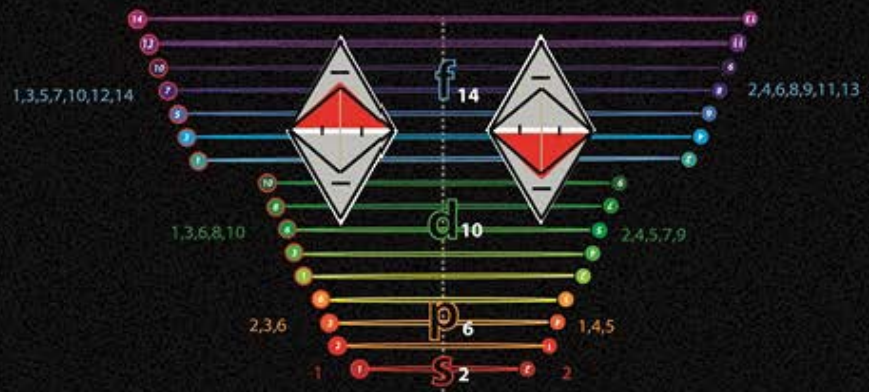

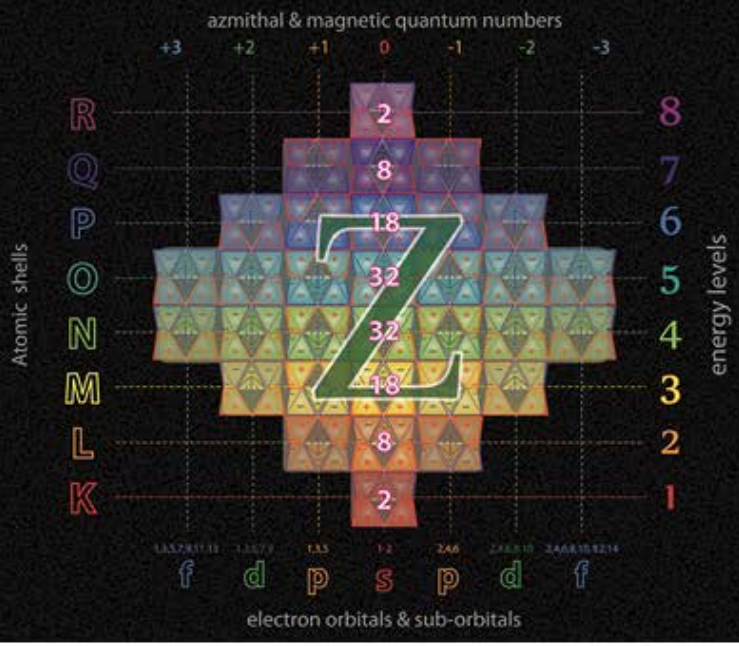

electron spin is always referenced to the Nuclear magneton

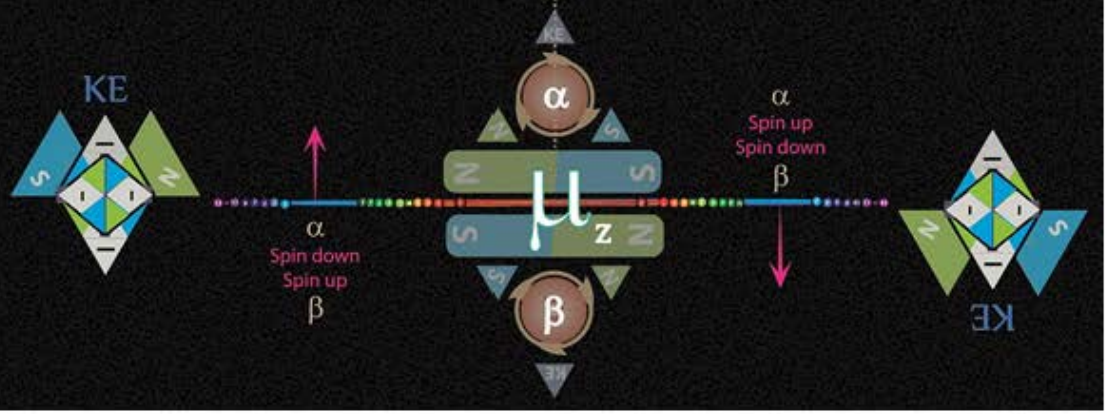

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Quantum numbers

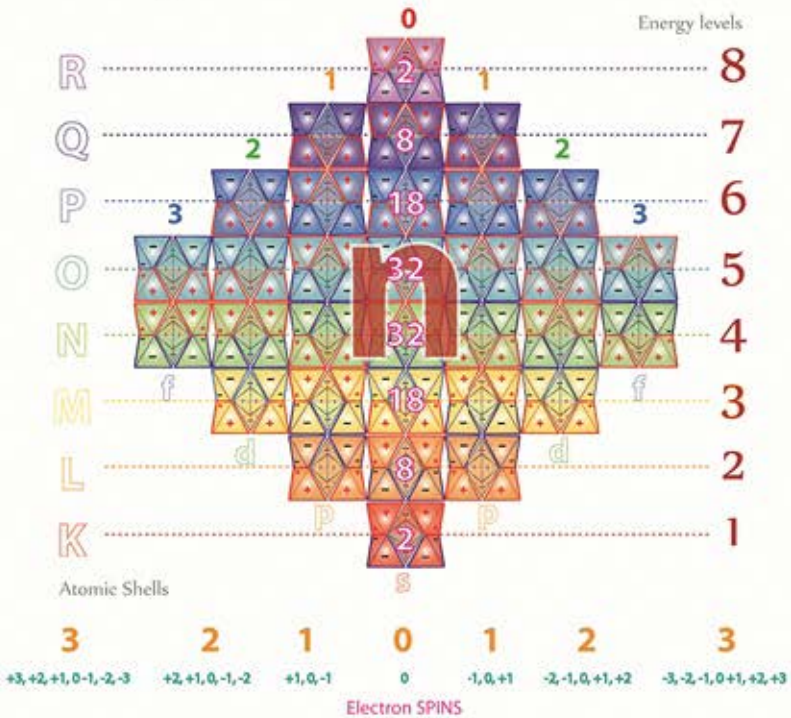

The properties of every atom's specific electron configuration can be described by four quantum numbers:

n (1-8)
Principal
(n = 1, 2, 3, 4 ...)

ℓ (0-3)
Azimuthal
(l = 0, 1 ... n−1)

m (2ℓ+1)
Magnetic
(ml = −l, −l+1 ... 0 ... l−1, l)

s ±½
electron Spin
(ms = −1/2 or +1/2),

The Bohr model was a one-dimensional model that used one quantum number to describe the distribution of electrons

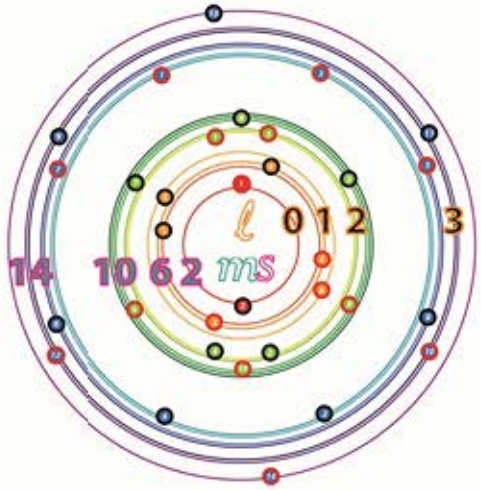

The three coordinates that come from Schrödinger's wave equations are the principal (n), angular (l), and magnetic (m) quantum numbers.

These quantum numbers describe the size, shape, and orientation in space of the orbitals of any particular atom mathematically.

These four numbers, n, ℓ, m and s can be used to describe any electron in a stable atom [and can be mapped back to the classical terminology of Shells and electron orbitals].

Each electron's quantum numbers are unique and cannot be shared by another electron in that atom.

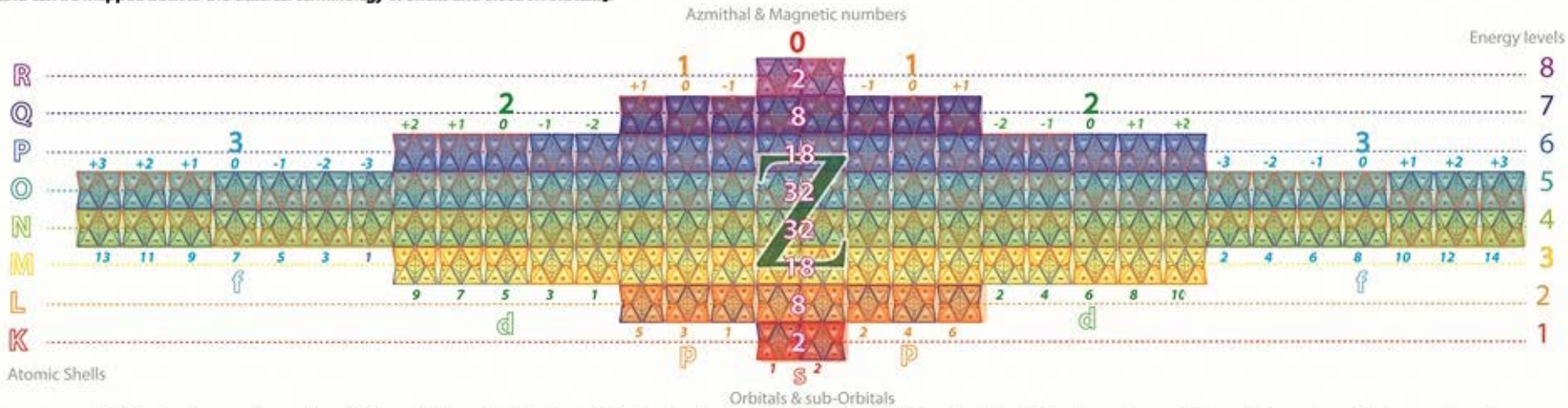

A stable atom has equal numebrs of Protons, electrons [and Neutrons], all following the Pauli Exclusion Principle thus orientating their spins so that each element has a unique electron configuration

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PRINCIPAL quantum number

The first describes the electron shell, or energy level, of an atom.

This is the only quantum number introduced by the Bohr model

The principal quantum number can only have positive integer values

atomic shells

n(1-8)

(n = 1, 2, 3, 4 ...)

energy levels

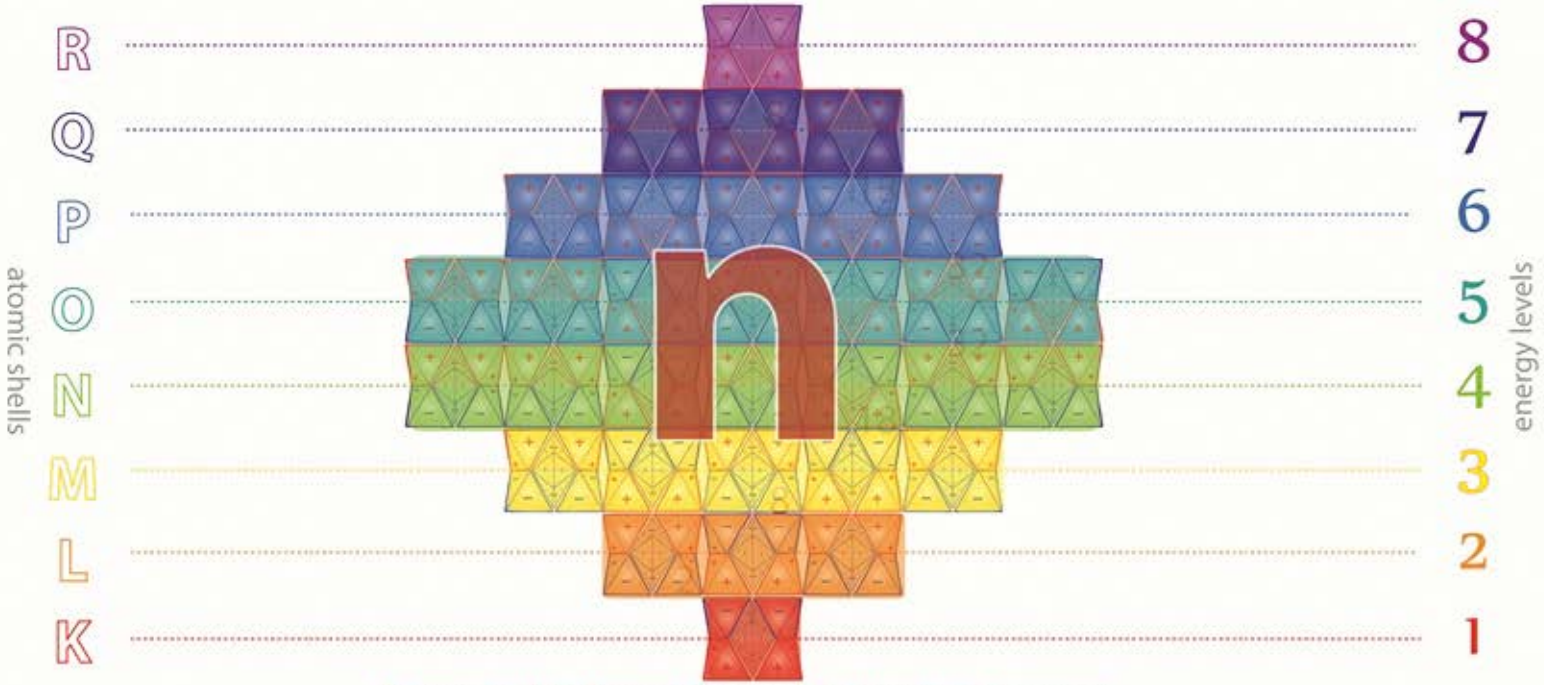

As energies of the Baryons comprising the atomic nuclei increases, the electron bound to each nuclei also possesses more KEM field energies and is therefore less tightly bound to the nucleus

Atomic Shells

(K, L, M, N, O, P, Q, R)

Atomic shells relate directly to Principal quantum numbers

(1, 2, 3, 4, 5, 6, 7, 8)

Energy levels

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AZMITHAL quantum number

The azimuthal quantum number is a quantum number assigned to any atomic orbital that describes its orbital angular momentum and determines the shape of the electron orbital

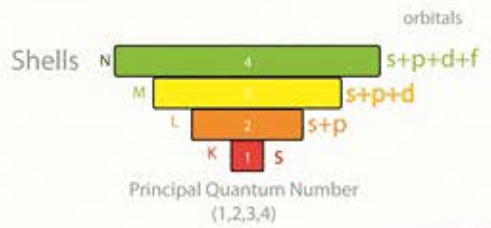

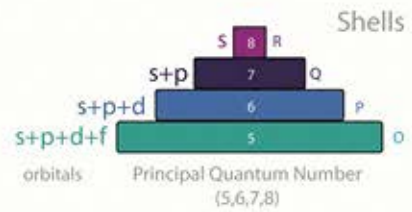

s p d f

electron orbitals

(l = 0, 1 ... n−1)

ℓ (0-7)
Azimuthal

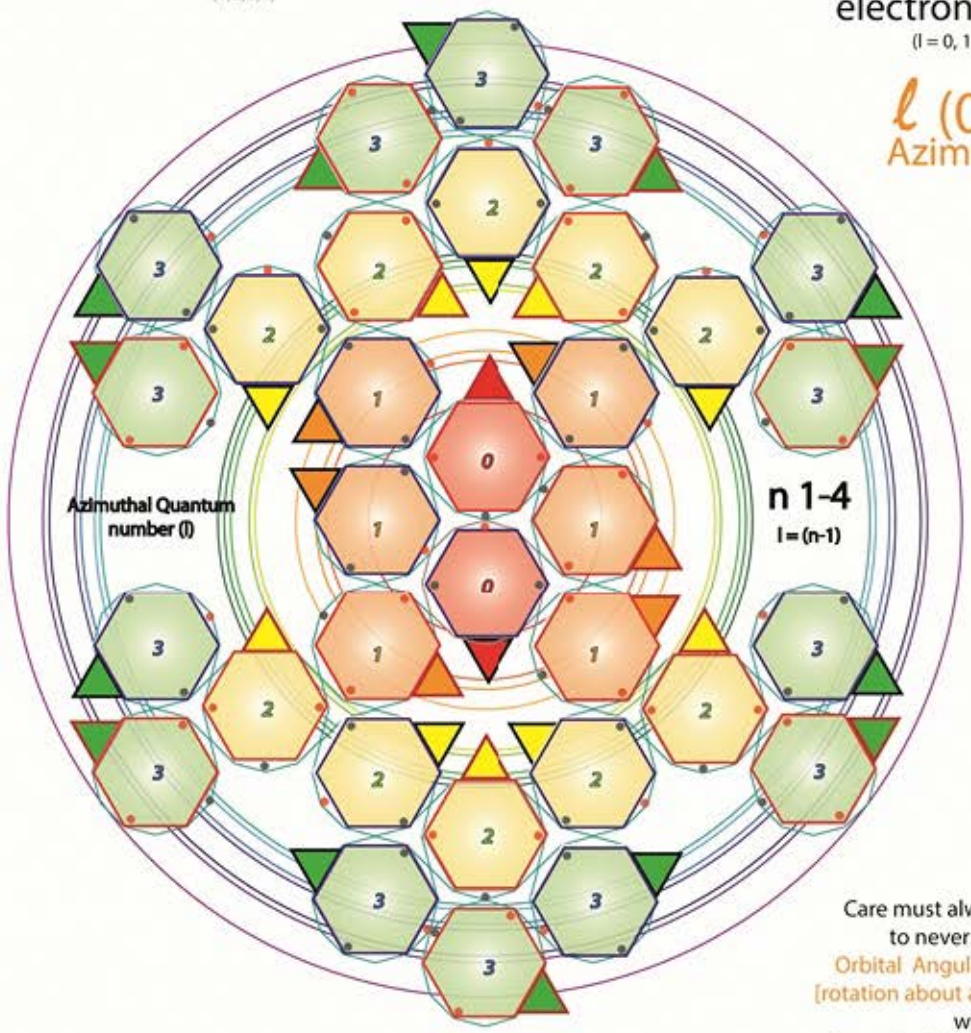

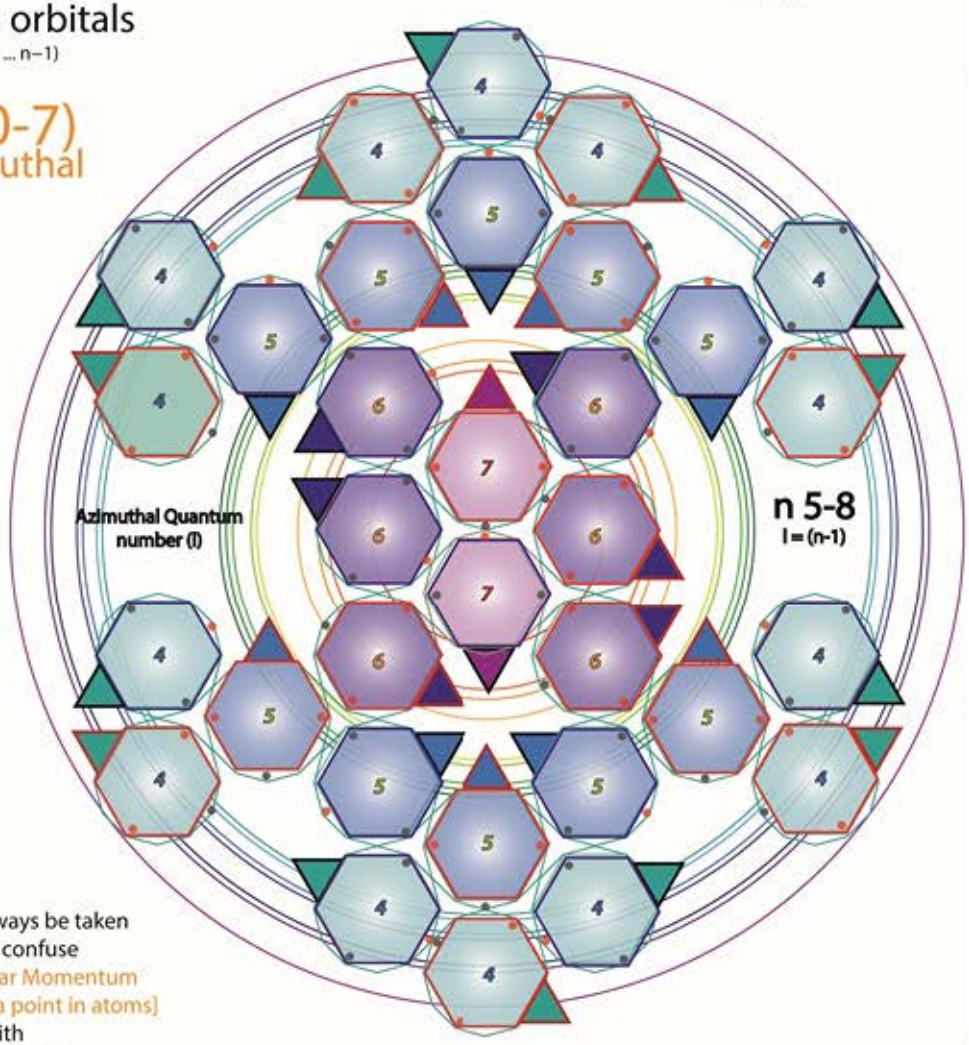

Care must always be taken
to never confuse
Orbital Angular Momentum
[rotation about a point in atoms]
with
Quantised Angular Momenta
[equilateral Planck energy geometries]

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MAGNETIC quantum number

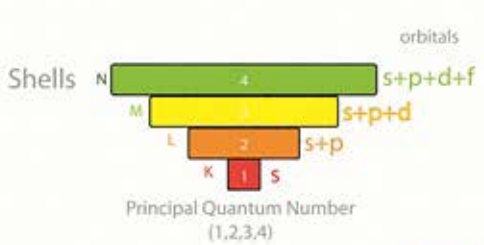

The magnetic quantum number denotes the energy levels available within any subshell

Magnetic numbers do not continue to increase as the Principal numbers increase instead they reverse after n4 to reflect the charged quanutm geometry of Elements and do not follow the current computer models in popular use

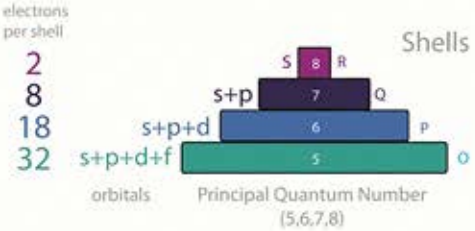

s p d f

electron sub-orbitals

(ml = −l, −l+1 ... 0 ... l−1, l)

mℓ (2ℓ+1)

Magnetic

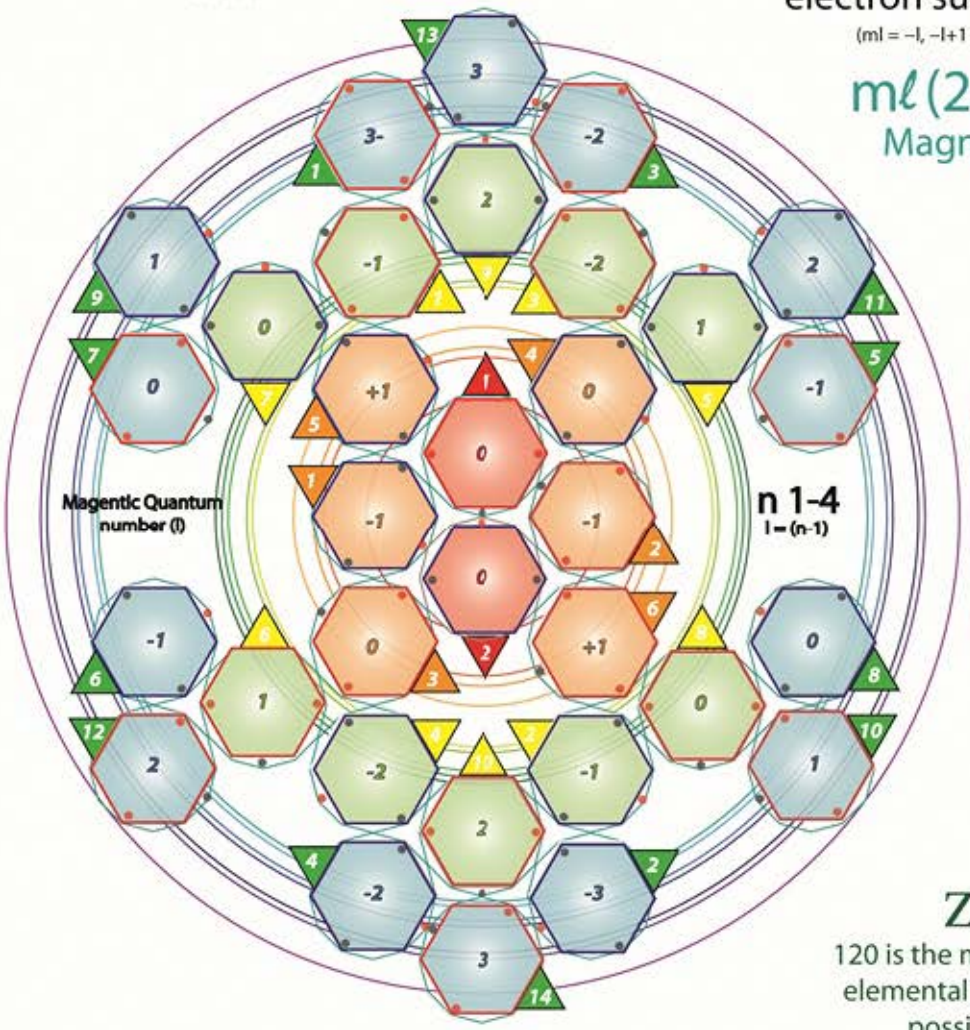

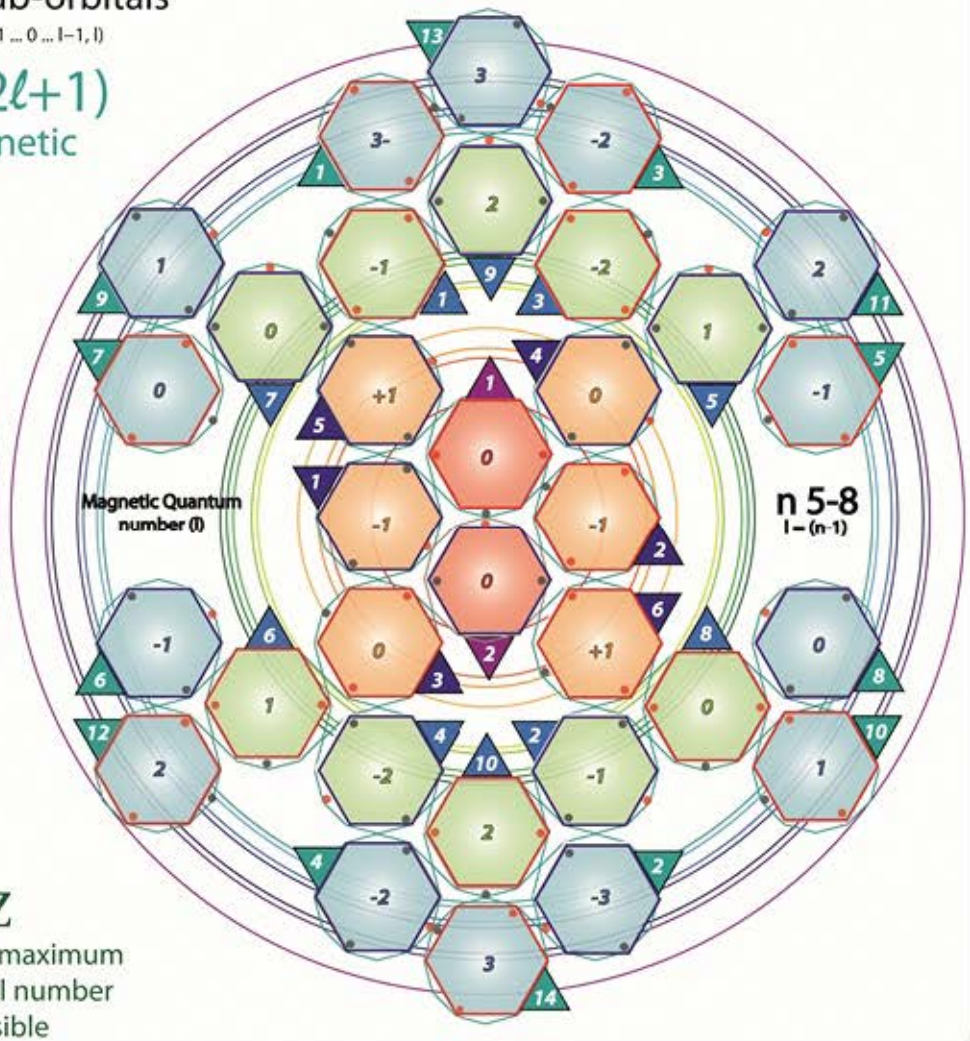

Z

120 is the maximum elemental number possible

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SPIN quantum number

The spin quantum number is a quantum number that parameterizes the intrinsic angular momentum (or spin angular momentum), of any given electron anywhere in an atomic nucleus

parallel magnetic moments

Spin UP

higher coupling energies

anti-parallel magnetic moments

Spin DOWN

lower coupling energies

Electron spin can orientate in either direction within Nuclei, providing the nett spins follow the Hund rule and Pauli exclusion principle

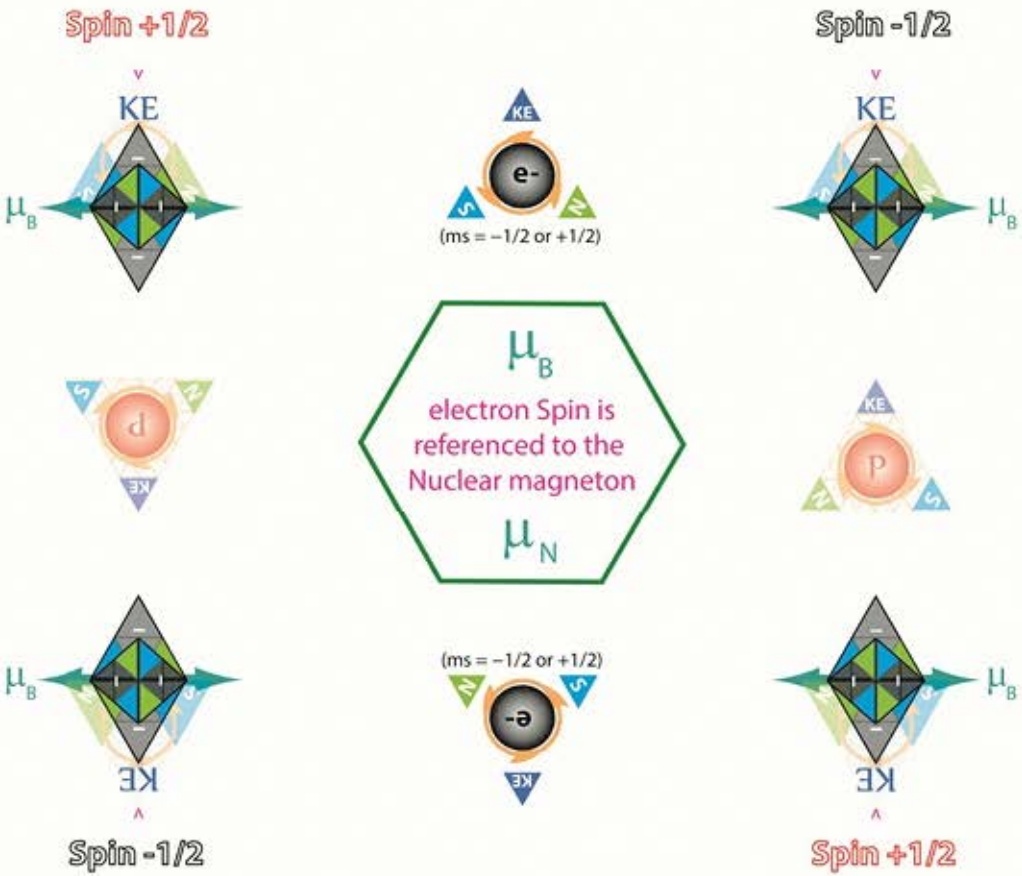

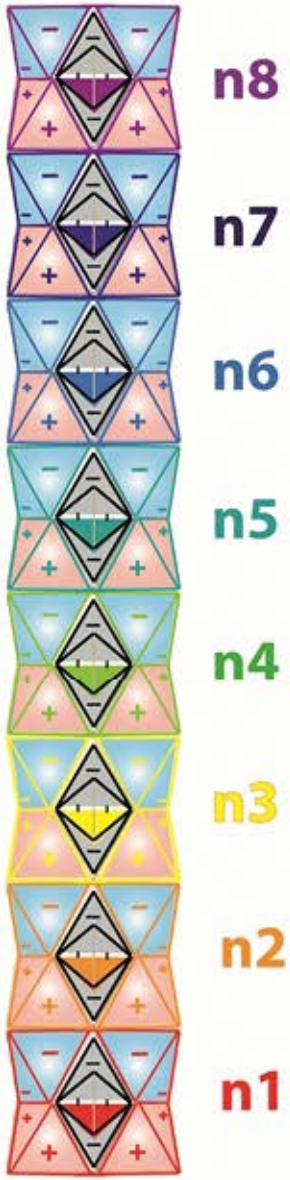

The nuclear energy levels of the Baryons comprising Elemental nuclei determine the energy-momenta of electrons bound to them

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Modifying Hund's Rule

Electrons fill orbitals in an alternating sequential numbering pattern due to nucleon placement creating opposed direction electron spins

The increased stability of the atom, most commonly manifested in a lower energy state, arises because the high-spin state forces the unpaired electrons to reside in different spatial orbitals.

A commonly given reason for the increased stability of high multiplicity states is that the different occupied spatial orbitals create a larger average distance between electrons, reducing electron-electron repulsion energy. In reality, it has been shown that the actual reason behind the increased stability is a decrease in the screening of electron-nuclear attractions[1].

The total spin state is calculated as the total number of unpaired electrons + 1, or twice the total spin + 1 written as 2s+1.

As a result of Hund's rule, constraints are placed on the way atomic orbitals are filled using the Aufbau principle.

Before any two electrons occupy an orbital in a subshell, other orbitals in the same subshell must first each contain one electron. Also, the electrons filling a subshell will have parallel spin before the shell starts filling up with the opposite spin electrons (after the first orbital gains a second electron).

As a result, when filling up atomic orbitals, the maximum number of unpaired electrons (and hence maximum total spin state) is assured

Sub-orbitals fill in order of numbering

Electrons spins pair before next orbital is filled

ie.
p1 [DOWN] and p2 [UP] fill before
p3 [UP] and p4 [DOWN] before
p5 [DOWN] and p6 [UP] etc

Hund's rule of orbital filling must be modified to reflect the true orbital filling order

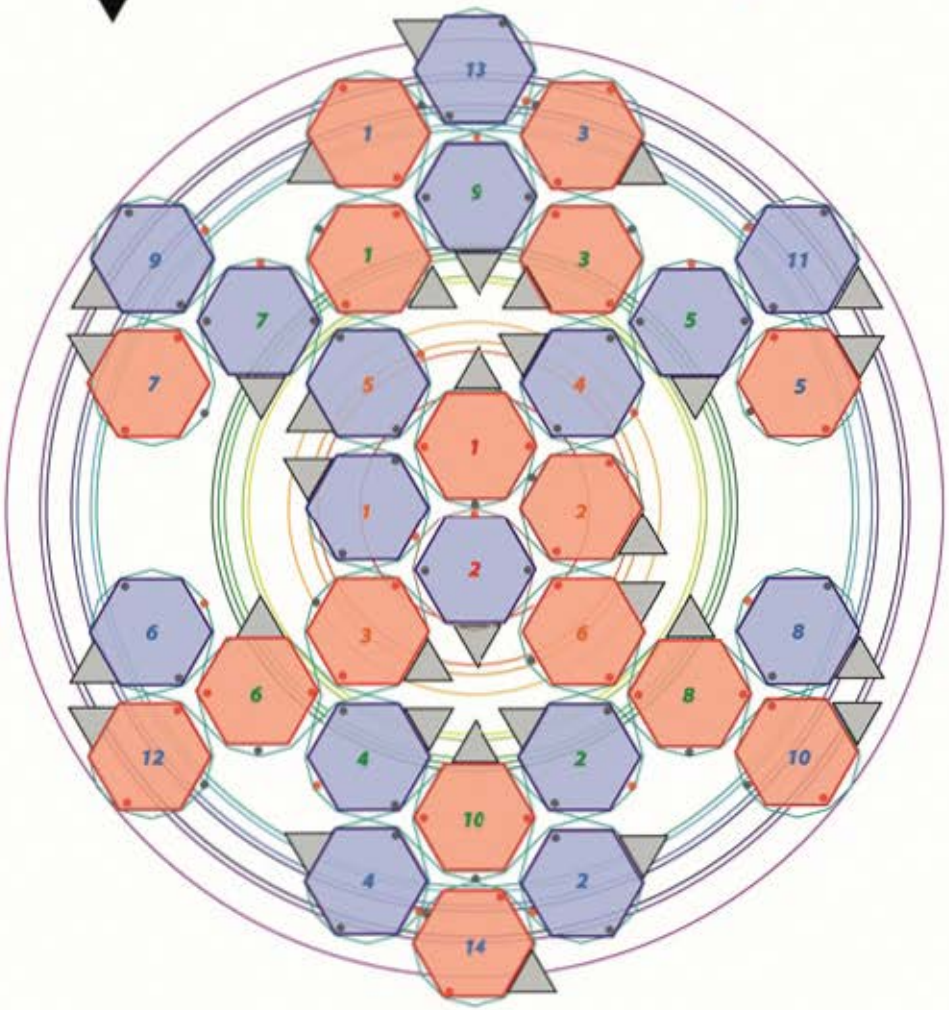

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Principle quantum Energies

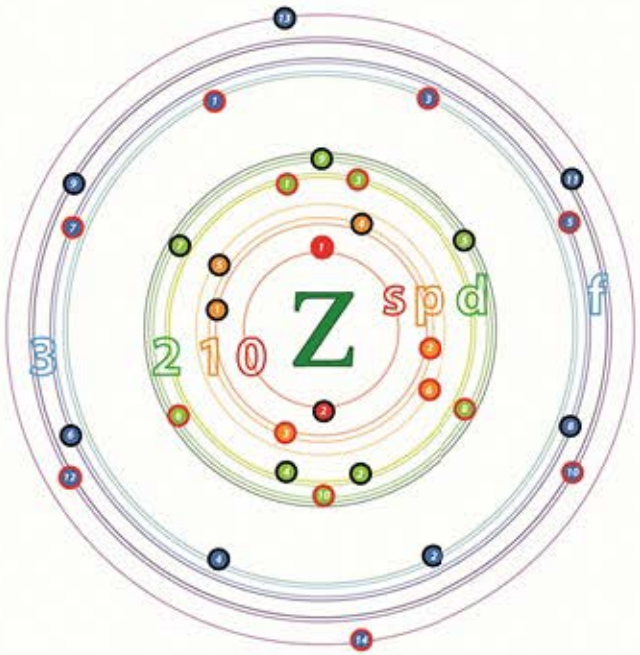

In an atom - electron energies are proportional to their intrinsic Kinetic Energies - which in turn are directly proportional to the quantum energy level of the nuclei which the electron binds to in their respective atomic shells

In a nucleus, lower energy orbits have less 'paired' nuclei supplying energy. The more energy you give a nuclei the faster it casuses the bound electron to rotate. If you give the nuclei enough energy, it will impart eneough energy to its electron for it to leave the system entirely.

The same is true for an electron orbital. Higher values of n mean more energy for the electron and the corresponding KEM field enegies of the electron is larger, resulting in increased angular momentum.

Values of n start at 1 and go up by integer amounts.

If enough energy is added to the system by incident Photons a electron will leave the atom creating a positively charged nuclei [ionisation].

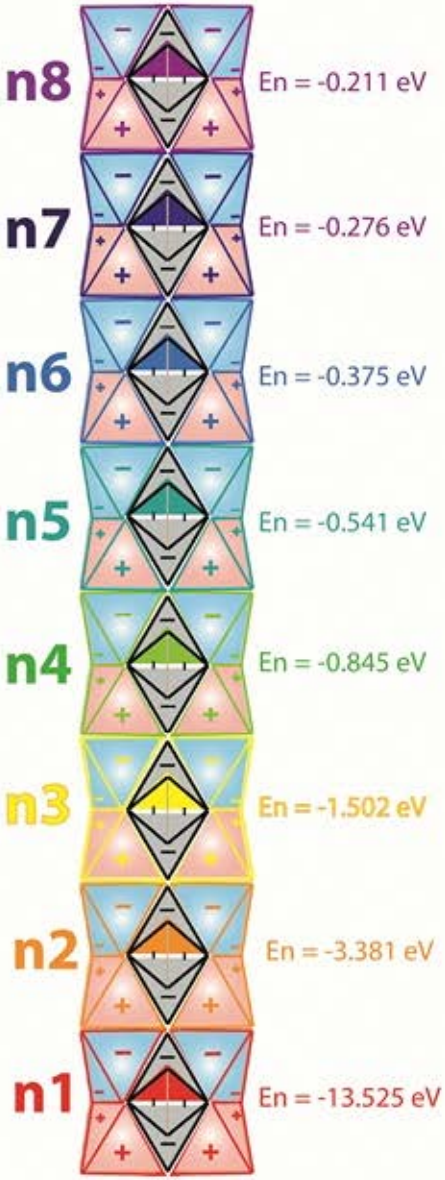

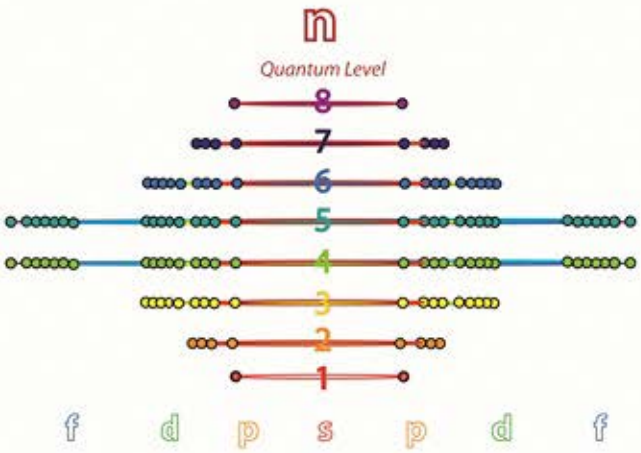

s orbits	n1-8
p orbits	n2-7
d orbits	n3-6
f orbits	n4-5

Eigenstate value

KEM field energy [per n] required to exceed 13.525 eV at which point the photo-electron has sufficient KE to break free of the Nucleus

$$E_n = \frac{E_1}{n^2} = \frac{-13.6eV}{n^2}, n = 1, 2, 3...$$

The possible Kinetic Energies (quantum levels) of an electron are directly related to the energy level of the Nuclei in each Quantum Level

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Quantum Level 1

K shell

n1

Ground State electron

$iE = -13.313\ eV$

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
1	1s1	Deuterium	1	1	1
2	1s2	Helium	2	2	2

2

Deuterium [not Hydrogen] is the building block of elements

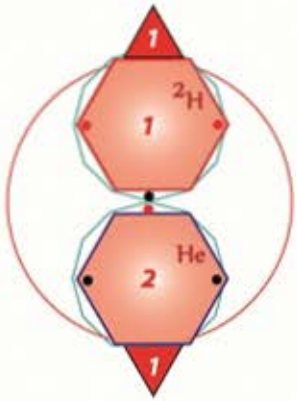

Z #		Name	Protons	electrons	Neutrons
1	1s1	Hydrogen	1	1	0

Hydrogen is a free radical element

n1

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Quantum Level 2

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
3	2s1	Lithium	3	3	3
4	2s2	Berylium	4	4	4
5	1p1	Boron	5	5	5
6	1p2	Carbon	6	6	6
7	1p3	Nitrogen	7	7	7
8	1p4	Oxygen	8	8	8
9	1p5	Fluorine	9	9	9
10	1p6	Neon	10	10	10

8

Deuterium [not Hydrogen] is the building block of elements

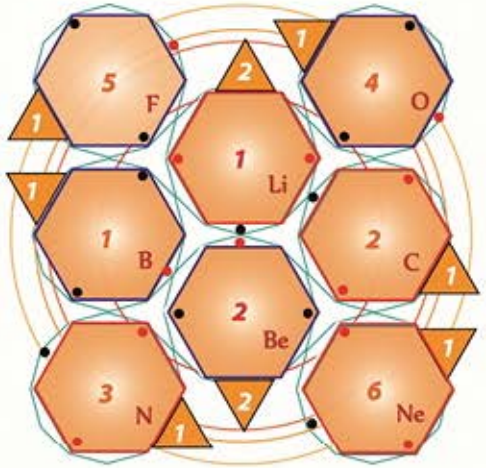

L shell

n2

Ground State electron

$iE = -12.679\ eV$

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Quantum Level 3

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
11	3s1	Sodium	11	11	11
12	3s2	Magnesium	12	12	12
13	2p1	Aluminium	13	13	13
14	2p2	Silicon	14	14	14
15	2p3	Phosphorus	15	15	15
16	2p4	Sulfur	16	16	16
17	2p5	Chlorine	17	17	17
18	2p6	Argon	18	18	18
21	3d1	Scandium	21	21	21
22	3d2	Titanium	22	22	22
23	3d3	Vanadium	23	23	23
24	3d4	Chromium	24	24	24
25	3d5	Manganese	25	25	25
26	3d6	Iron	26	26	26
27	3d7	Cobalt	27	27	27
28	3d8	Nickel	28	28	28
29	3d9	Copper	29	29	29
30	3d10	Zinc	30	30	30

18

Deuterium [not Hydrogen] is the building block of elements

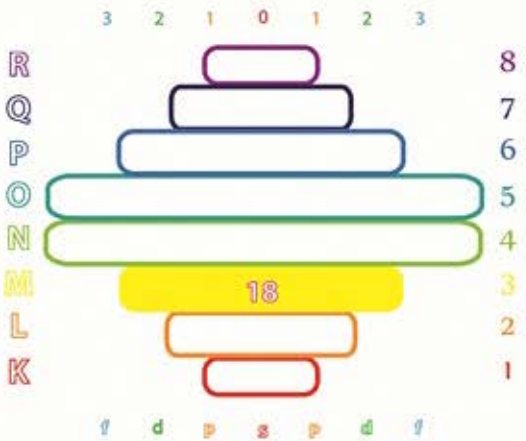

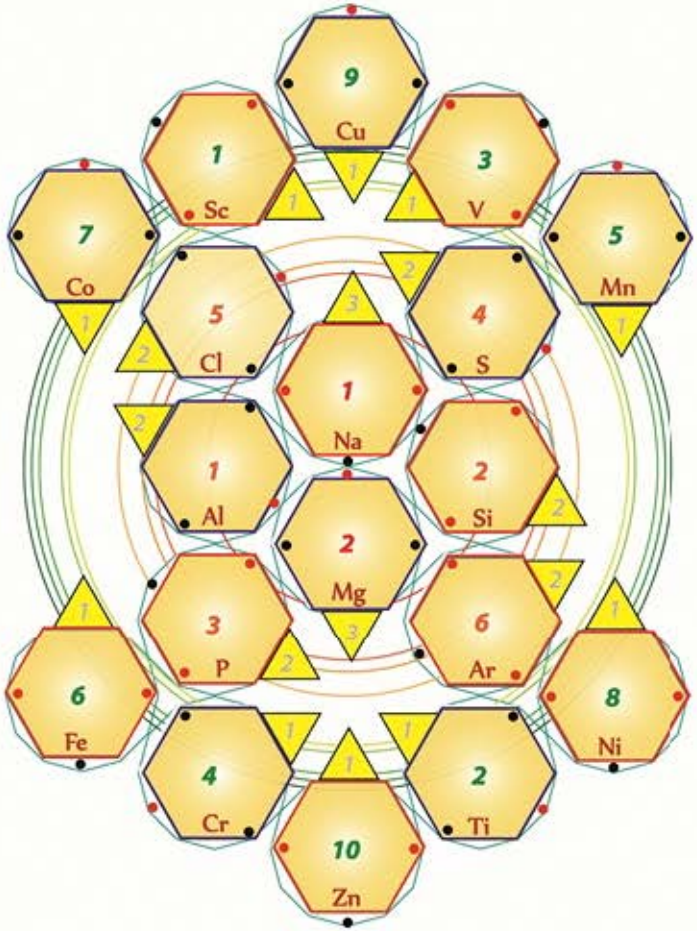

M shell

n3

Ground State electron

$iE = -11.623\ eV$

Energy level

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Quantum Level 4

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
19	4s1	Potassium	19	19	19
20	4s2	Calcium	20	20	20
31	4p1	Gallium	31	31	31
32	4p2	Germanium	32	32	32
33	4p3	Arsenic	33	33	33
34	4p4	Selenium	34	34	34
35	4p5	Bromine	35	35	35
36	4p6	Krypton	36	36	36
39	4d1	Yttrium	39	39	39
40	4d2	Zirconium	40	40	40
41	4d3	Niobium	41	41	41
42	4d4	Molybdenum	42	42	42
43	4d5	Technetium	43	43	43
44	4d6	Ruthenium	44	44	44
45	4d7	Rhodium	45	45	45
46	4d8	Palladium	46	46	46
47	4d9	Silver	47	47	47
48	4d10	Cadmium	48	48	48
57	4f1	Lanthanum	57	57	57
58	4f2	Cerium	58	58	58
59	4f3	Praseodymium	59	59	59
60	4f4	Neodymium	60	60	60
61	4f5	Promethium	61	61	61
62	4f6	Samarium	62	62	62
63	4f7	Europium	63	63	63
64	4f8	Gadolinium	64	64	64
65	4f9	Terbium	65	65	65
66	4f10	Dysprosium	66	66	66
67	4f11	Holium	67	67	67
68	4f12	Erbium	68	68	68
69	4f13	Thulium	69	69	69
70	4f14	Ytterbium	70	70	70

32

Deuterium [not Hydrogen] is the building block of elements

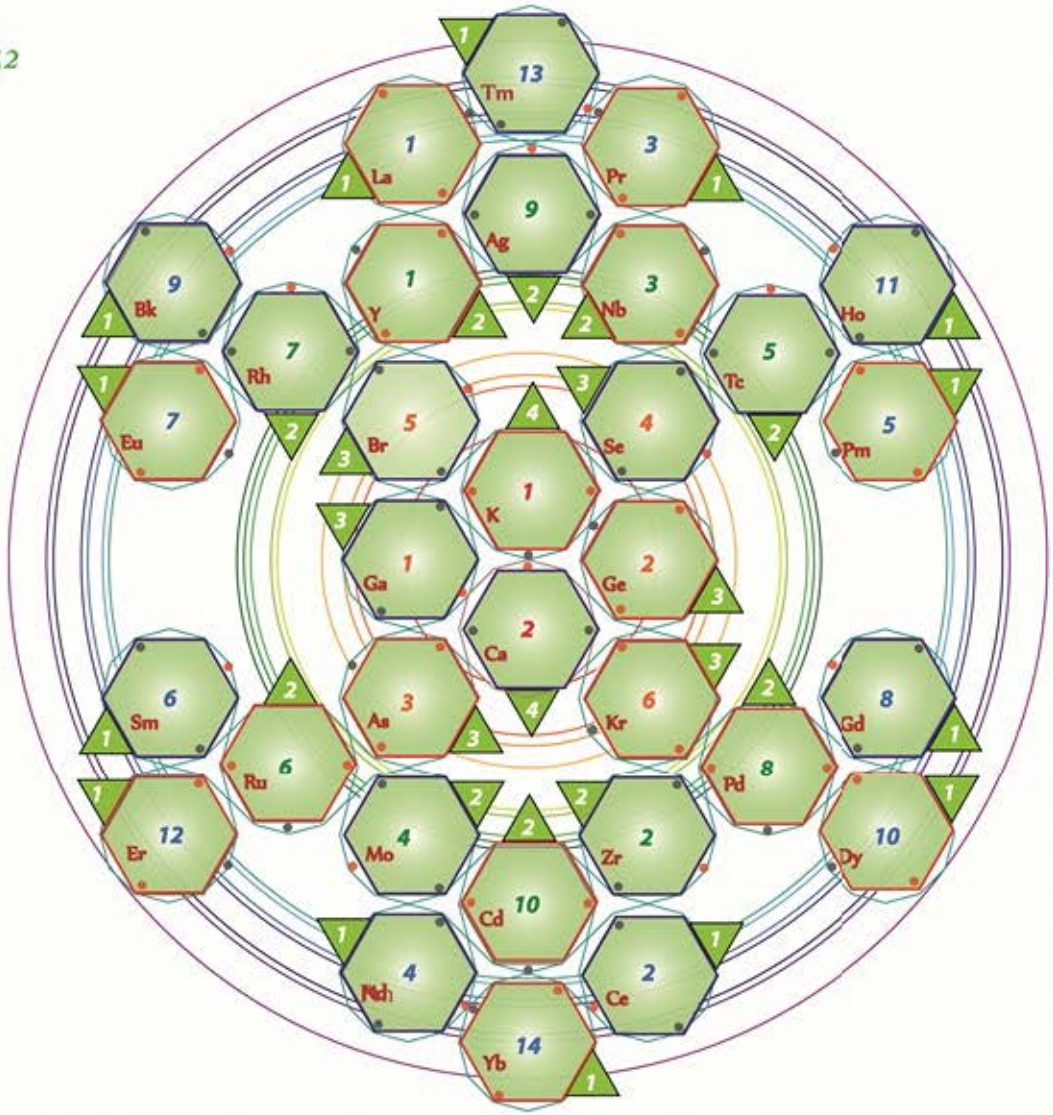

N shell

n4

Ground State electron

$iE = -10.143\ eV$

Energy level

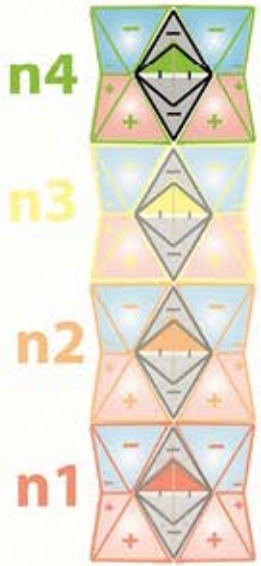

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Quantum Level 5

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
37	5s1	Rubidium	37	37	37
38	5s2	Strontium	38	38	38
49	5p1	Indium	49	49	49
50	5p2	Tin	50	50	50
51	5p3	Antimony	51	51	51
52	5p4	Tellurium	52	52	52
53	5p5	Iodine	53	53	53
54	5p6	Xenon	54	54	54
71	5d1	Lutetium	71	71	71
72	5d2	Hafnium	72	72	72
73	5d3	Tantalum	73	73	73
74	5d4	Tungsten	74	74	74
75	5d5	Rhenium	75	75	75
76	5d6	Osmium	76	76	76
77	5d7	Iridium	77	77	77
78	5d8	Platinum	78	78	78
79	5d9	Gold	79	79	79
80	5d10	Mercury	80	80	80
89	5f1	Actinium	89	89	89
90	5f2	Thorium	90	90	90
91	5f3	Protactium	91	91	91
92	5f4	Uranium	92	92	92
93	5f5	Neptunium	93	93	93
94	5f6	Plutonium	94	94	94
95	5f7	Americium	95	95	95
96	5f8	Curium	96	96	96
97	5f9	Berkelium	97	97	97
98	5f10	Californium	98	98	98
99	5f11	Einsteinium	99	99	99
100	5f12	Fermium	100	100	100
101	5f13	Mendelevium	101	101	101
102	5f14	Nobelium	102	102	102

32

Deuterium [not Hydrogen] is the building block of elements

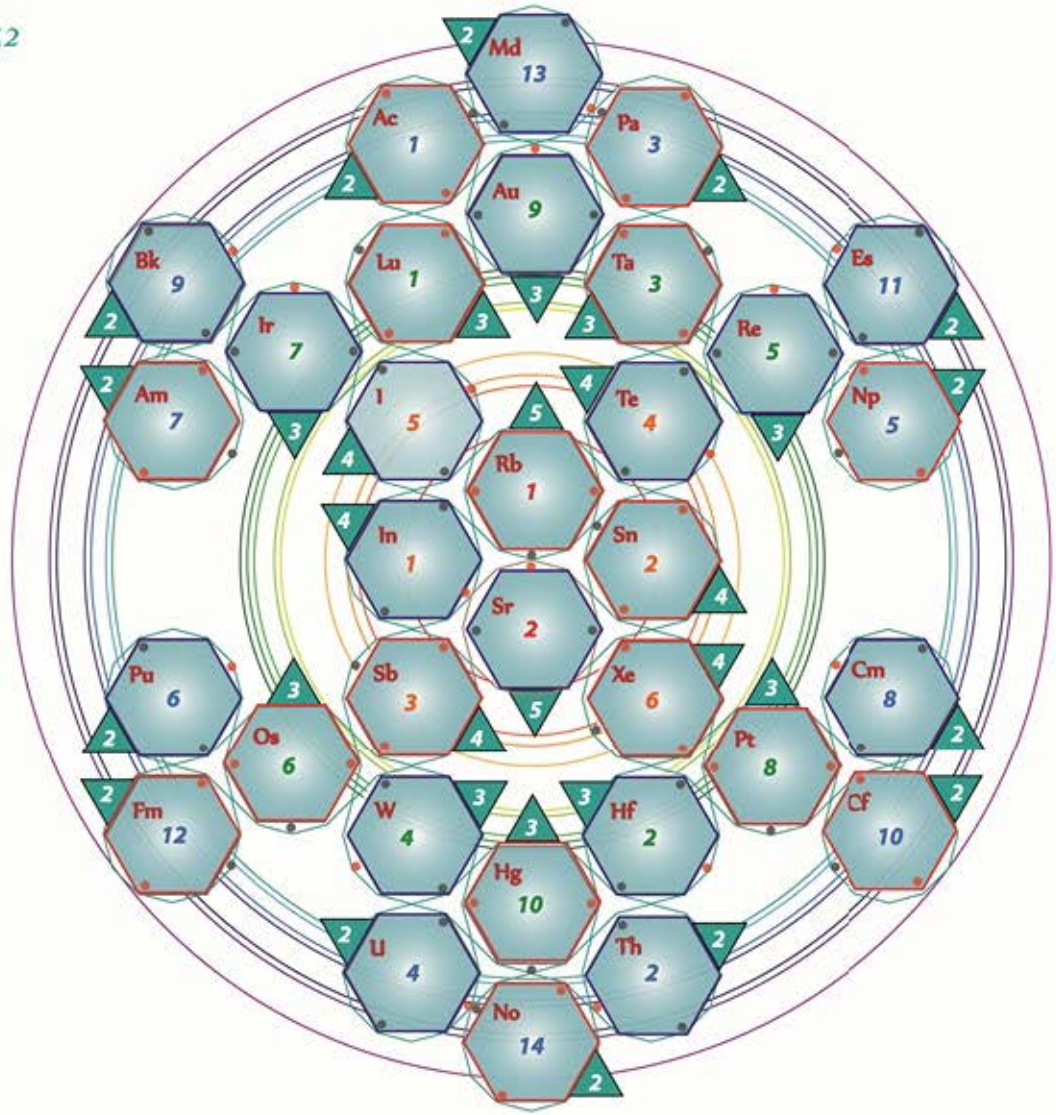

O shell

n5

Ground State electron

$iE = -8.241\ eV$

Energy level

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Quantum Level 6

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
55	6s1	Caesium	55	55	55
56	6s2	Barium	56	56	56
81	6p1	Thallium	81	81	81
82	6p2	Lead	82	82	82
83	6p3	Bismuth	83	83	83
84	6p4	Polonium	84	84	84
85	6p5	Astatine	85	85	85
86	6p6	Radon	86	86	86
103	6d1	Lawrencium	103	103	103
104	6d2	Rutherfordium	104	104	104
105	6d3	Dubnium	105	105	105
106	6d4	Seaborgium	106	106	106
107	6d5	Bohrium	107	107	107
108	6d6	Hassium	108	108	108
109	6d7	Meitnerium	109	109	109
110	6d8	Darmstadtium	110	110	110
111	6d9	Roetgenium	111	111	111
112	6d10	Copernicium	112	112	112

18

Deuterium [not Hydrogen] is the building block of elements

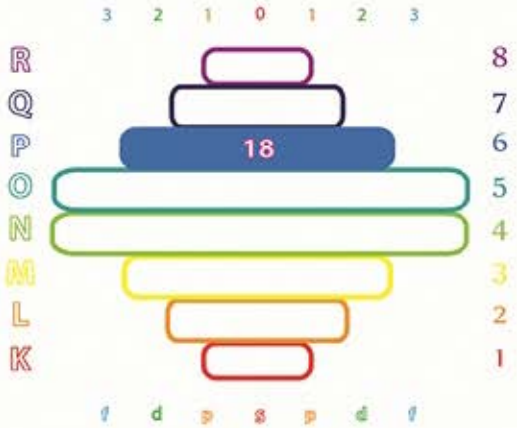

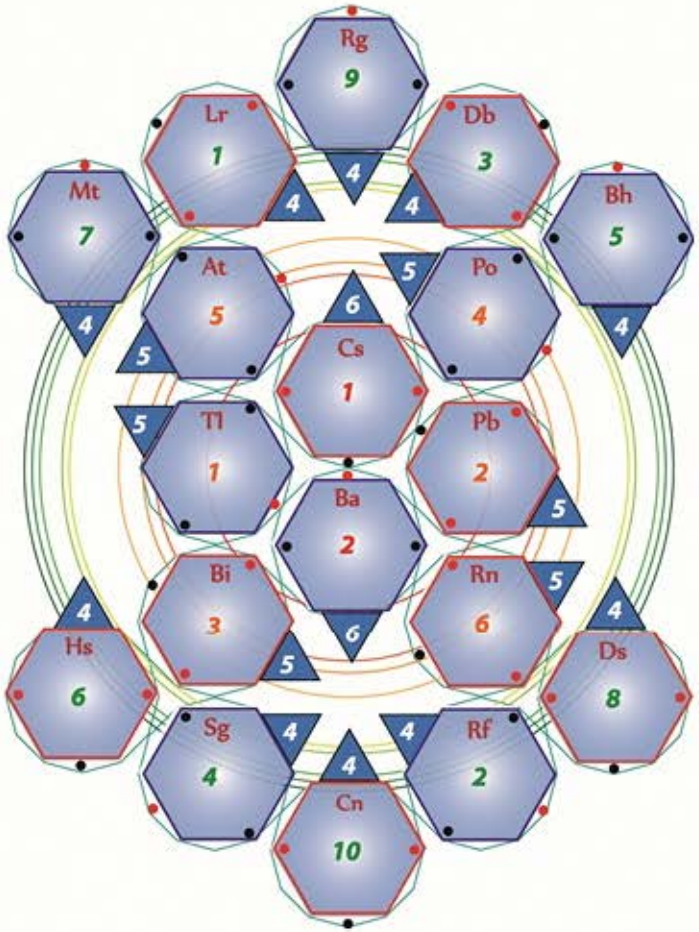

P shell

n6

Ground State electron

$iE = -5.917\ eV$

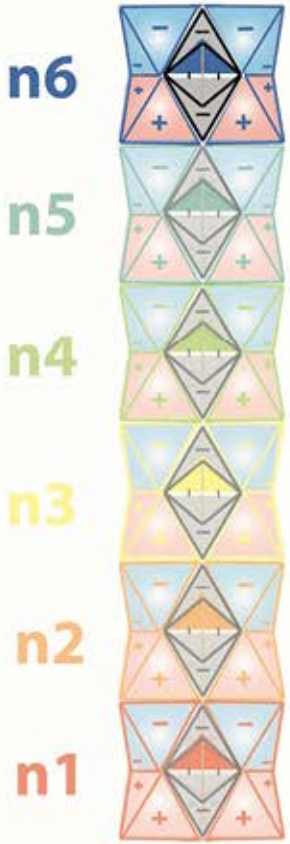

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Quantum Level 7

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
87	7s1	Francium	87	87	87
88	7s2	Radium	88	88	88
113	7p1	Ununtrium	113	113	113
114	7p2	Flerovium	114	114	114
115	7p3	Ununpentium	115	115	115
116	7p4	Livermorium	116	116	116
117	7p5	Ununseptium	117	117	117
118	7p6	Ununoctium	118	118	118

8

Deuterium [not Hydrogen] is the building block of elements

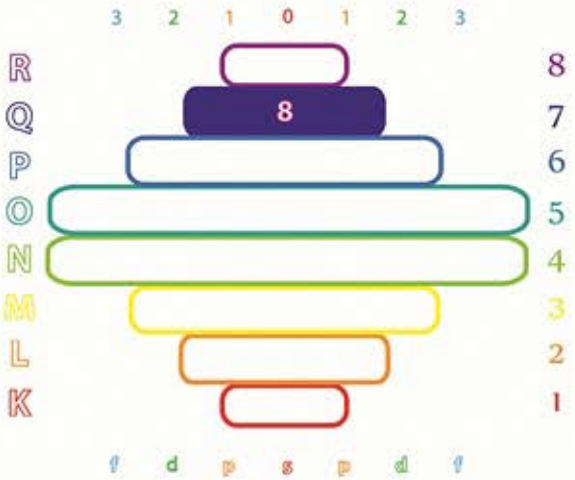

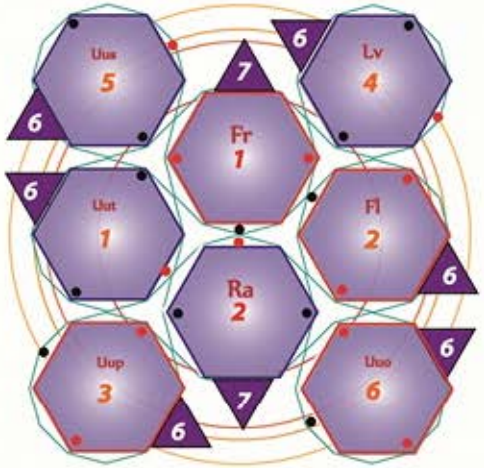

Q shell

n7

Ground State electron

$iE = -3.169\ eV$

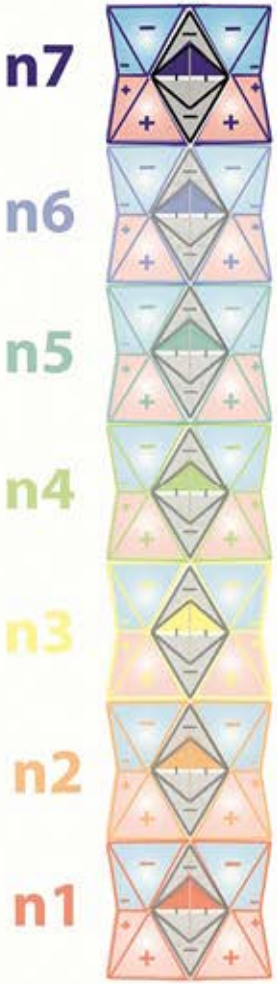

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Quantum Level 8

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
119	8s1	Ununnonium	119	119	119
120	8s2	Unbinilium	120	120	120

2

Deuterium [not Hydrogen] is the building block of elements

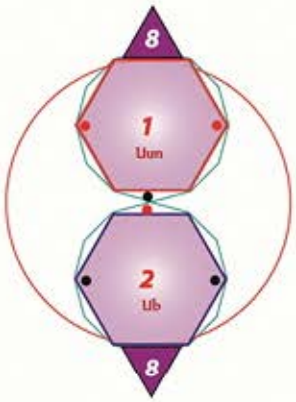

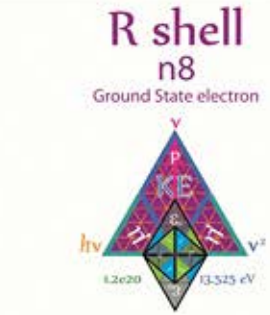

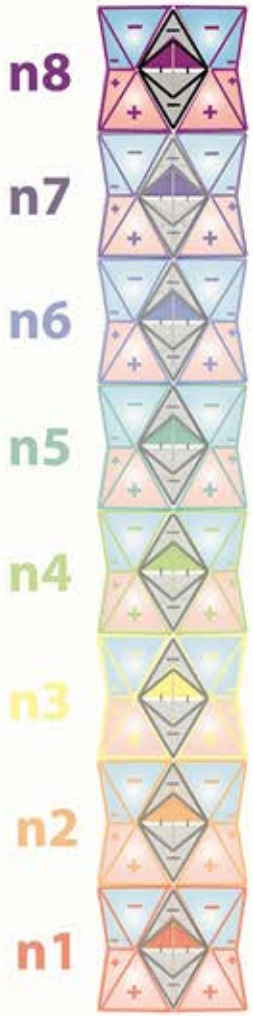

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Quantum Level Jumps

Photon Absorption and Release

Spectral line transitions

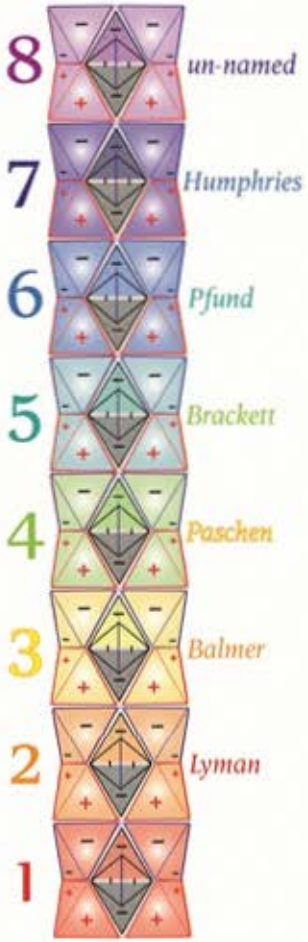

Quantum level jumps

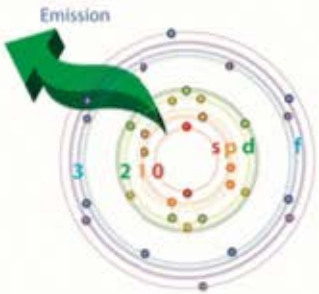

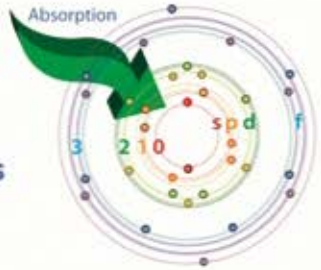

Photo-electrons can only transition between principal energy Baryons in the atomic nuclei in discrete steps [or quantum jumps] because Baryons determine the KEM energy levels of electrons in nuclei

[see Tetryonic QED for full details on spectral line mechanics]

Initial Quantum level									
8	768	756	720	660	576	468	336	180	0
7	588	576	540	480	396	288	156	0	
6	432	420	384	324	240	132	0		
5	300	288	252	192	108	0			
4	192	180	144	84	0				
3	108	96	60	0					
2	48	36	0						
1	12	0							
		12	48	108	192	300	432	588	768
		1	2	3	4	5	6	7	8

Final Quantum level

$$\Delta p = \Delta M v = hf$$

accelerating photo-electrons produce spectral lines

Spectral line transitions

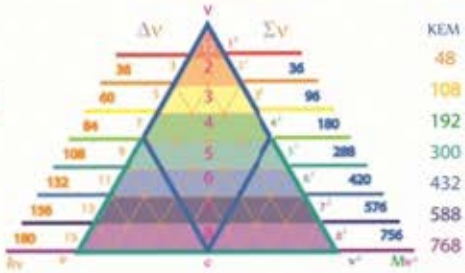

Nuclear energy emission~absorption

If atoms are left undisturbed, their electrons usually fill the lowest available energy levels and stay there, in their "ground state."

Occasionally, however, they may also be pushed up to some higher energy ("become excited") e.g. by a collision with a fast atom or electron, one which got extra speed from an electric voltage or from some source of heat.

An atom/electron elevated to one of its higher "excited levels" soon falls back to a lower level ("undergoes a quantum jump"), emitting a photon whose energy corresponds to the difference between the levels.

That need not be the ground state: the atom/electron might descend to that state in several steps, emitting a photon at each step on the way.

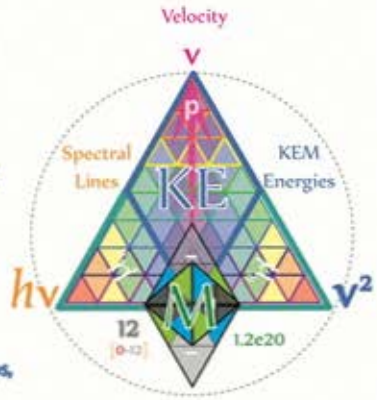

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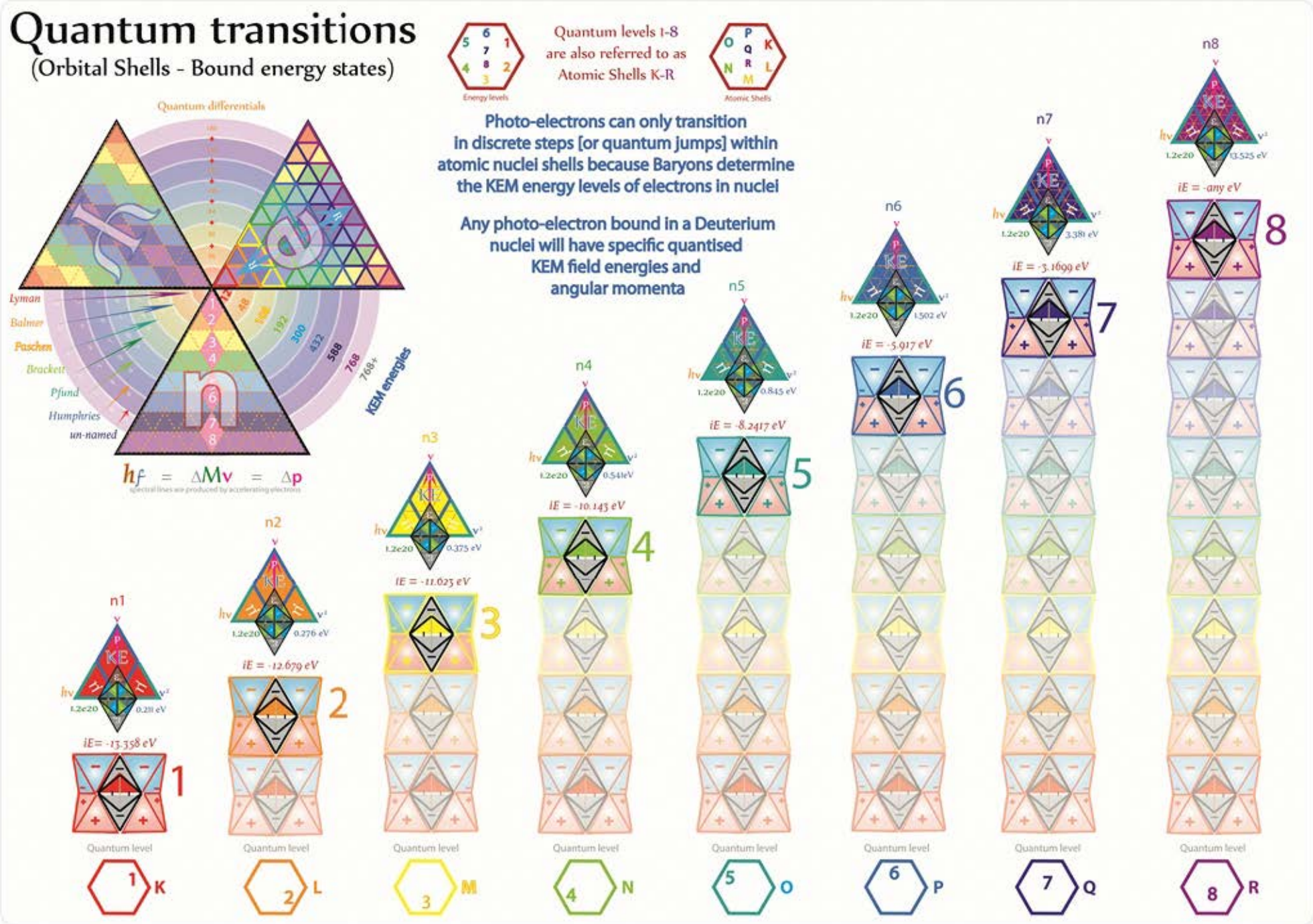

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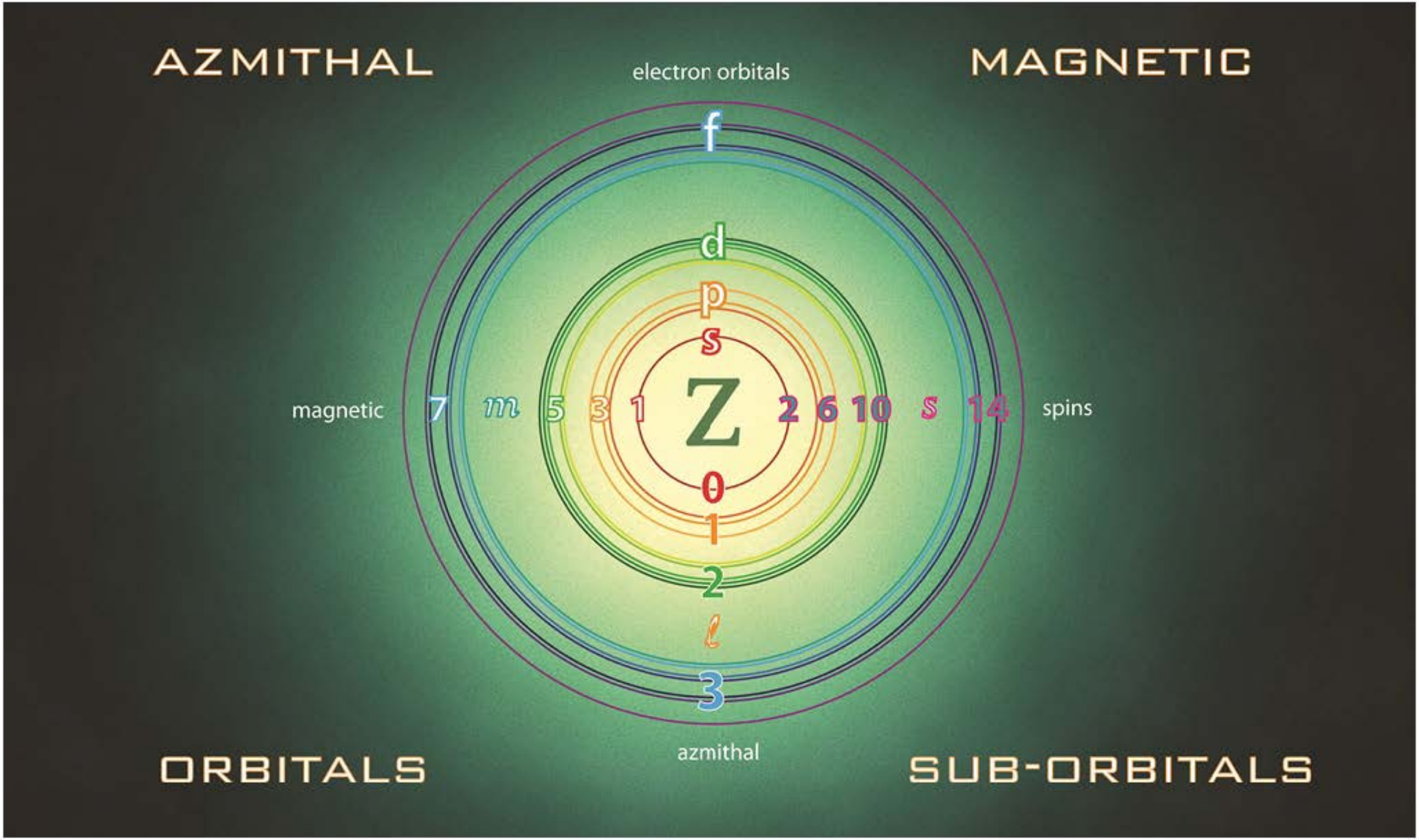

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Atomic Orbitals

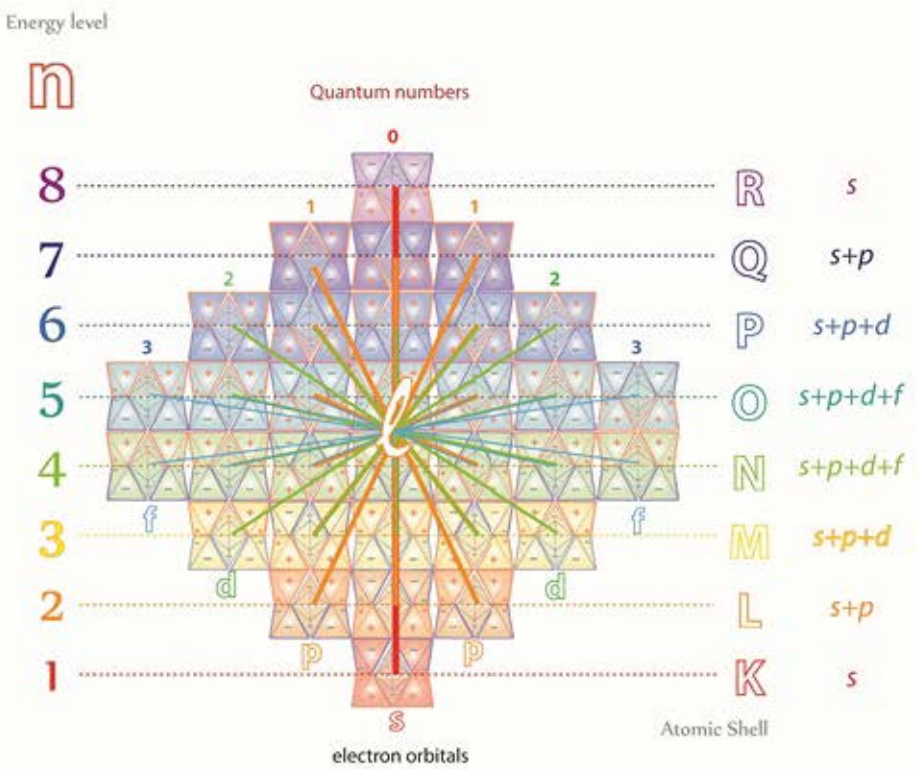

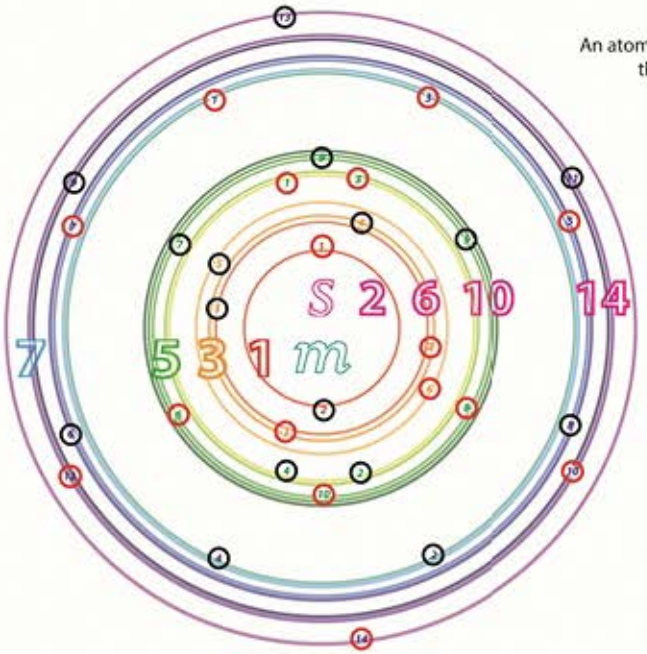

An atomic orbital is a mathematical function that describes the wave-like behavior of either one electron or a pair of electrons in an atom

Atomic orbitals are typically categorized by n, l, and m quantum numbers, which correspond to the electron's energy, angular momentum, and an angular momentum vector component, respectively.

Historically used to define the pedagogical electron cloud model of an atom Tetryonics reveals the true geometry of atomic nuclei

Each orbital is defined by a different set of quantum numbers and contains a maximum of two spin opposed electrons.

Aufbau

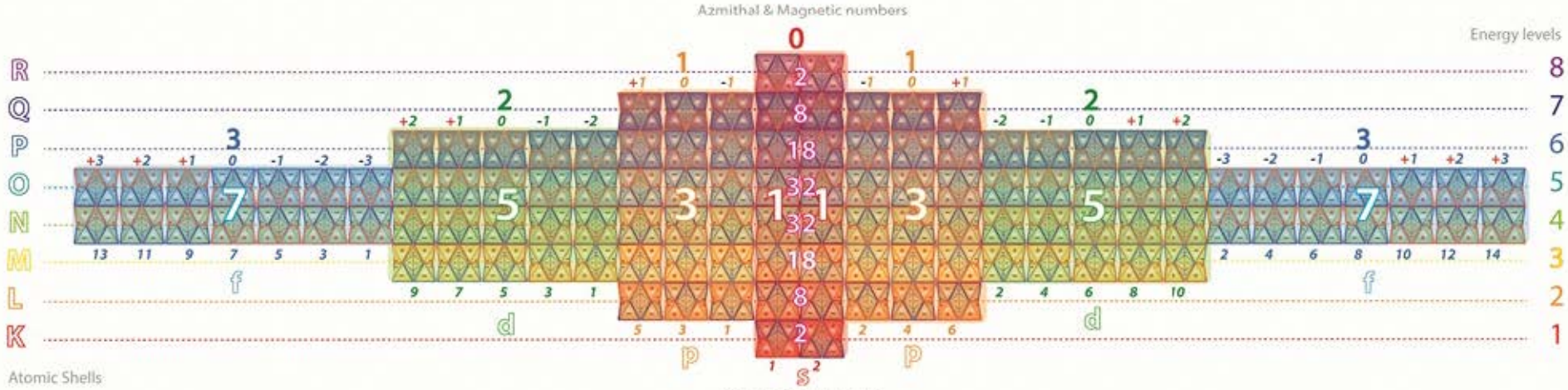

Electron Spins can be either up or down providing they obey the Pauli exclusion principle

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s Orbital

1 Orbit (2 electrons max)

Alkali Metals & Alkali Earths

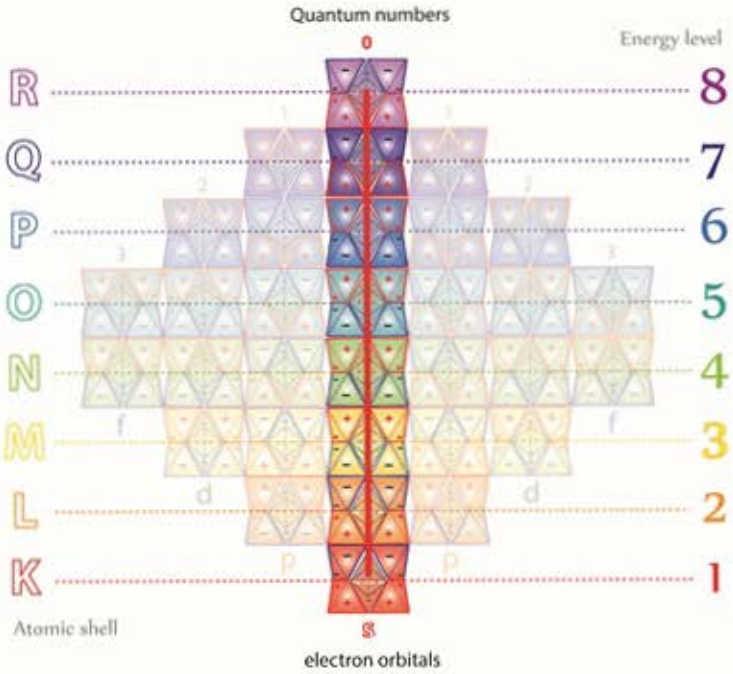

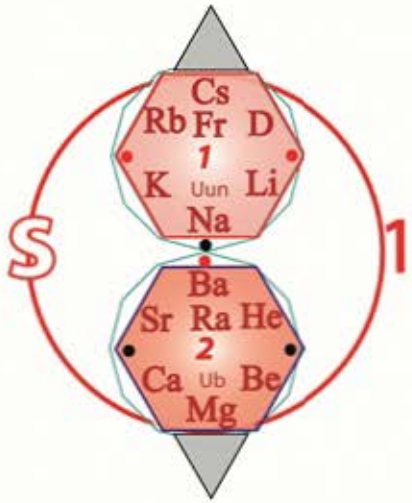

		n
azmithal number	0	ℓ
magnetic numbers	0	m
spins	-1/2 +1/2	s

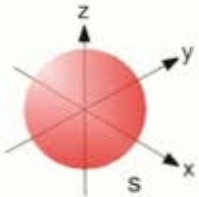

erroneous computer model of 's' electron orbitals

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p Orbital

3 Orbits (6 electrons max)

Non-Metals, Halogens & Nobel gases

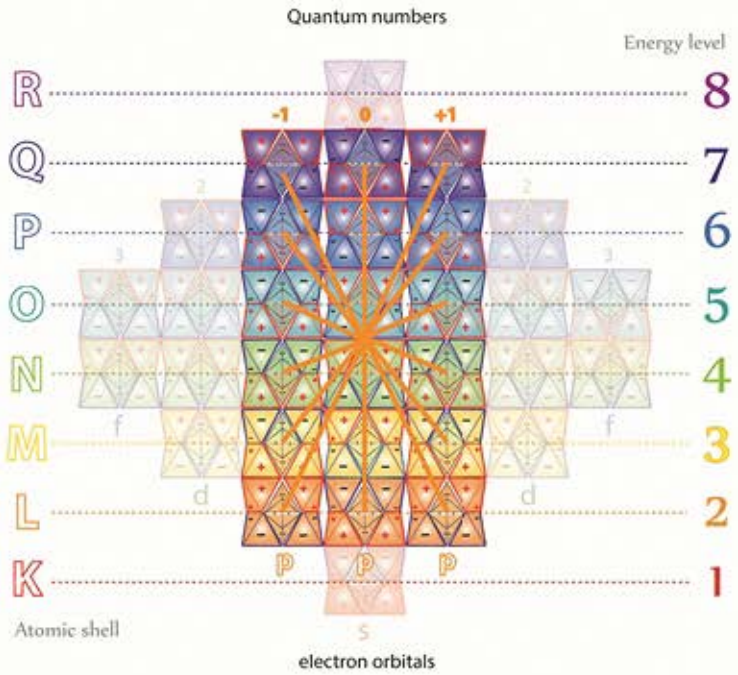

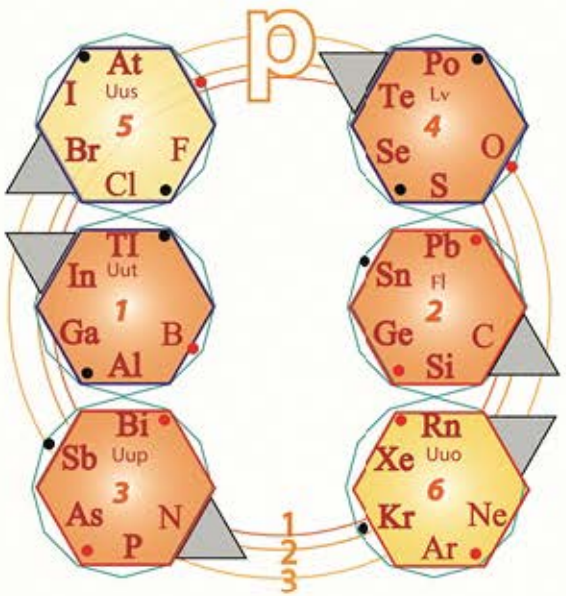

			n
azmithal number	1		ℓ
magnetic numbers	-1	0	+1	m
spins	-1/2 +1/2	-1/2 +1/2	-1/2 +1/2	s

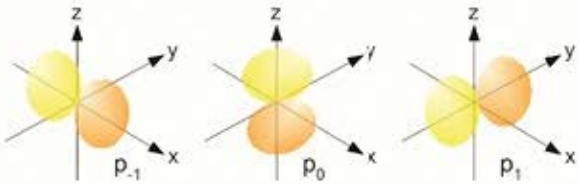

erroneous computer model of 'p' electron orbitals

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d Orbital

5 Orbits (10 electrons max)

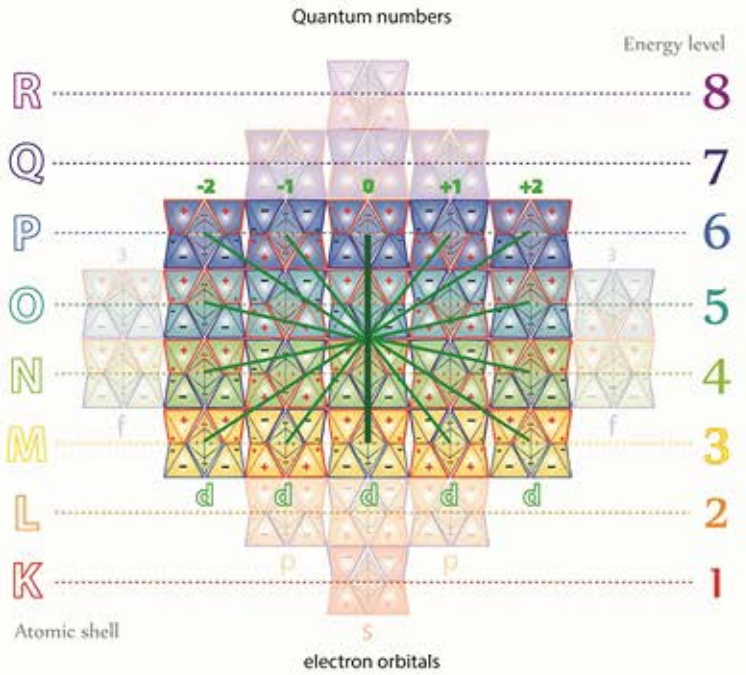

azmithal number			2			ℓ
magnetic numbers	-2	-1	0	+1	+2	m
spins	-1/2	-1/2	-1/2	-1/2	-1/2	s
	+1/2	+1/2	+1/2	+1/2	+1/2	

n

Transition & post-Transition Metals

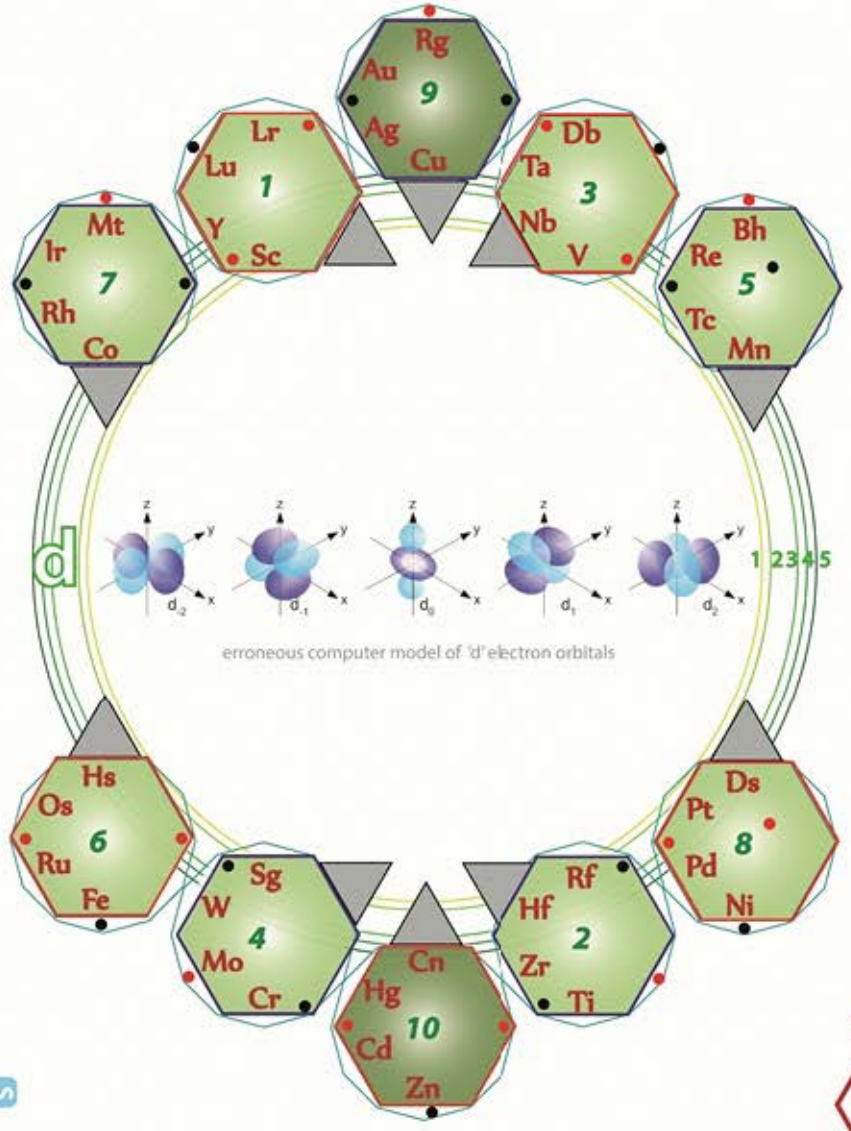

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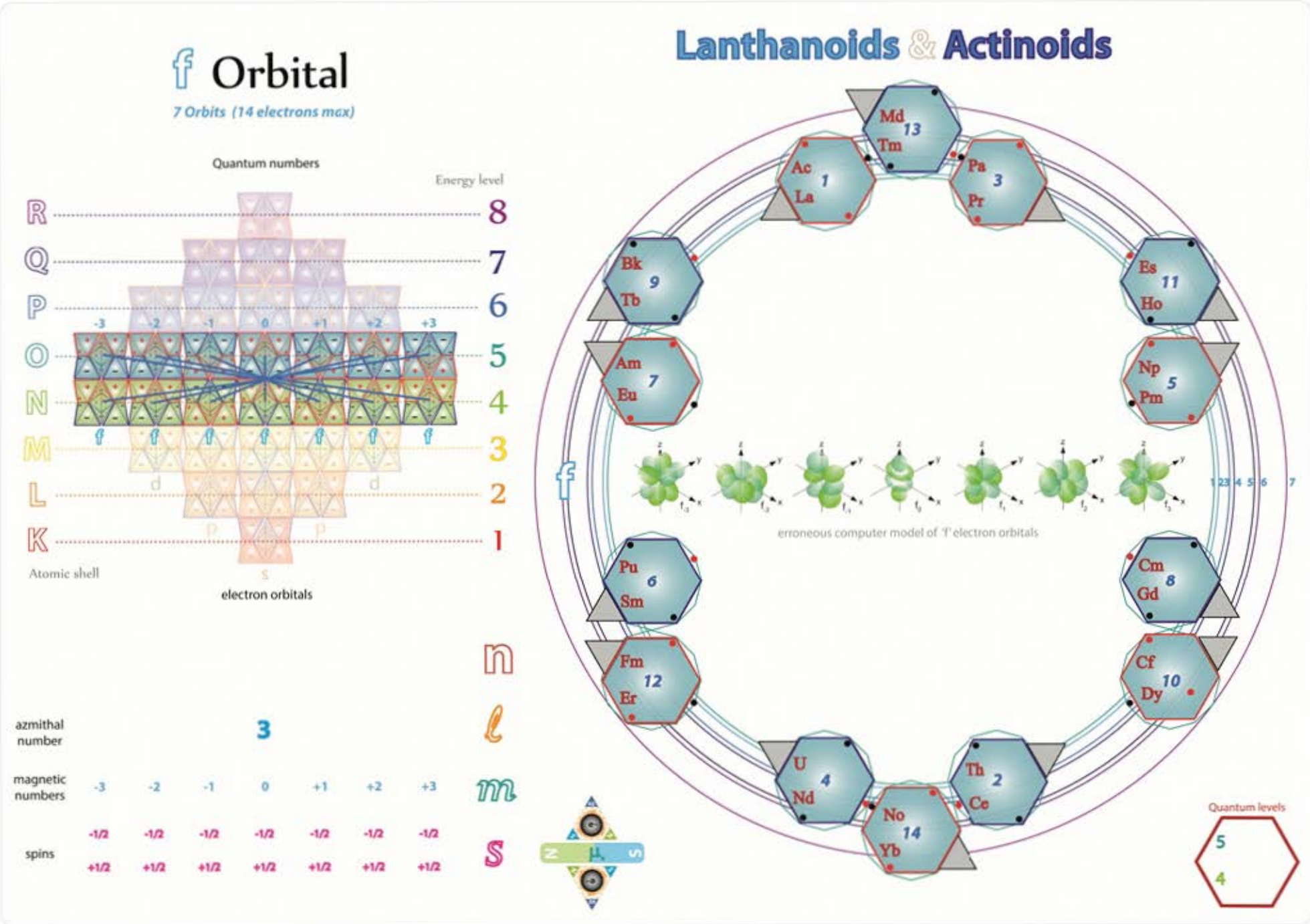

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Orbital energy variations

All Elements have stable core electron configurations of s & p orbitals for each energy level as revealed through diffraction studies

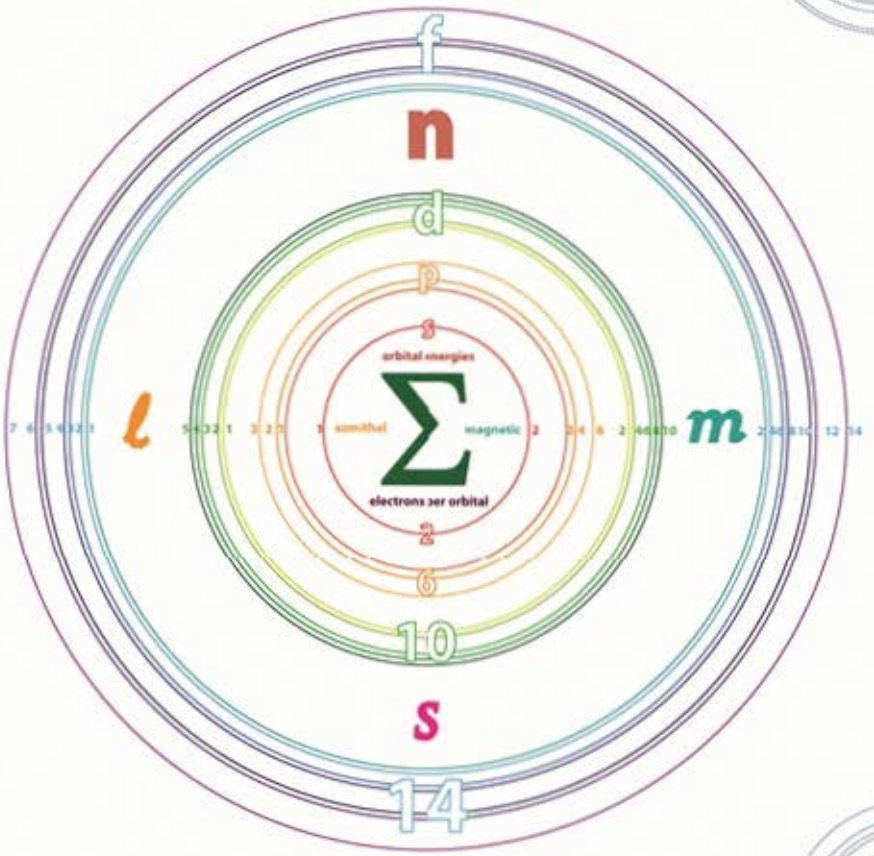

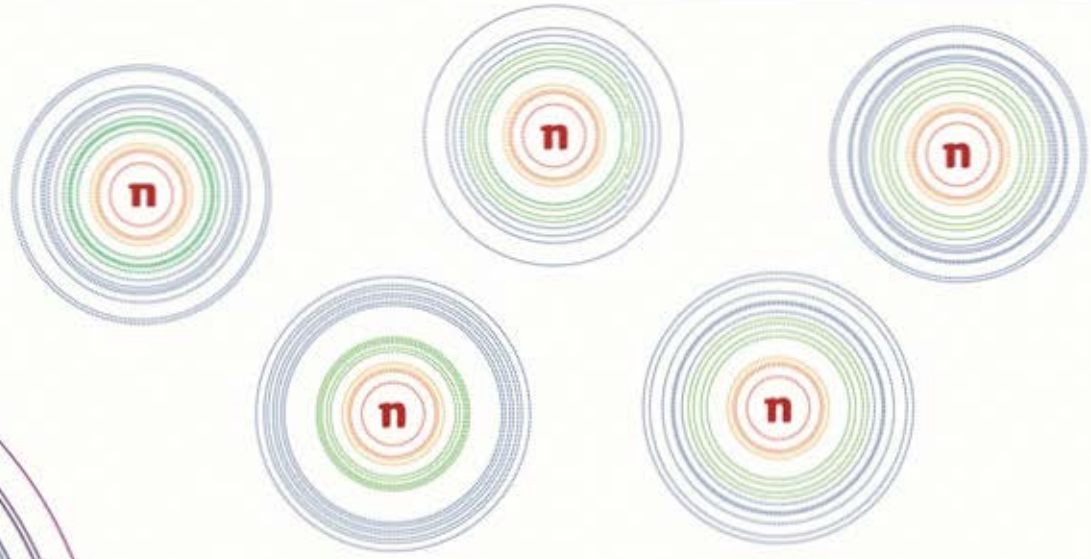

As additional nuclei bind to form d & f orbitals they can do so by bonding in many positions, with each location producing different orbital energies for each electron that binds to nuclei in that position

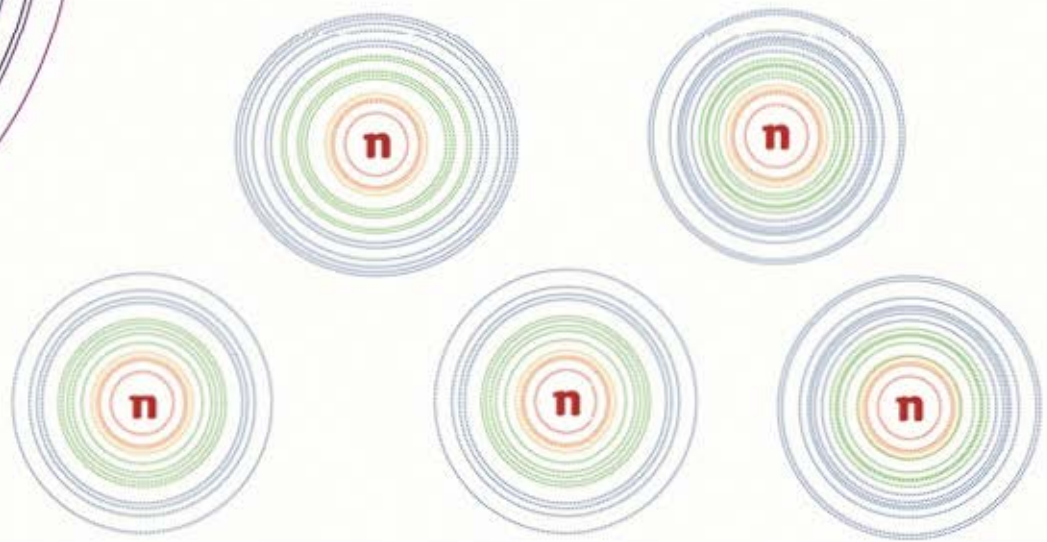

The final energy levels of each orbital is the result of the energy of the Baryons in the nuclei and the spin coupling energies of the photo-electrons bound to them

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Electrons per shell

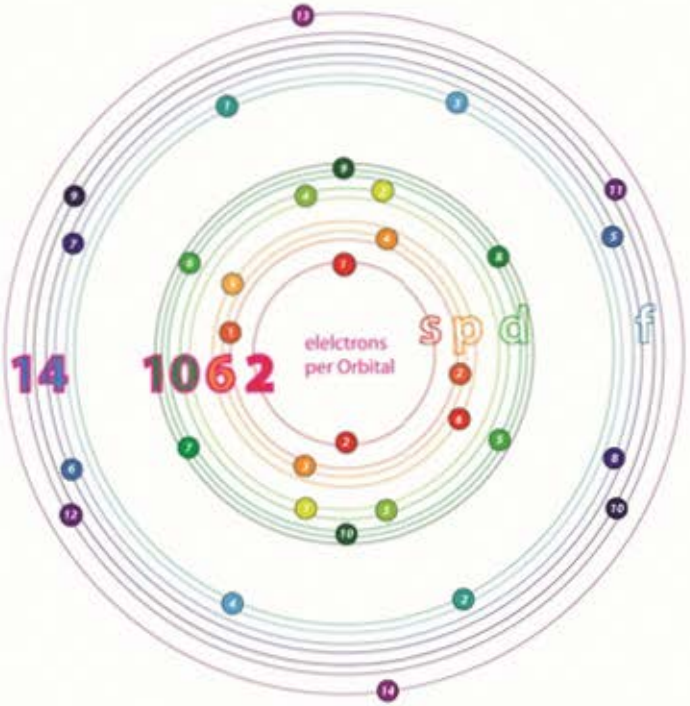

Each energy shell of a periodic element can hold only a fixed number of electrons

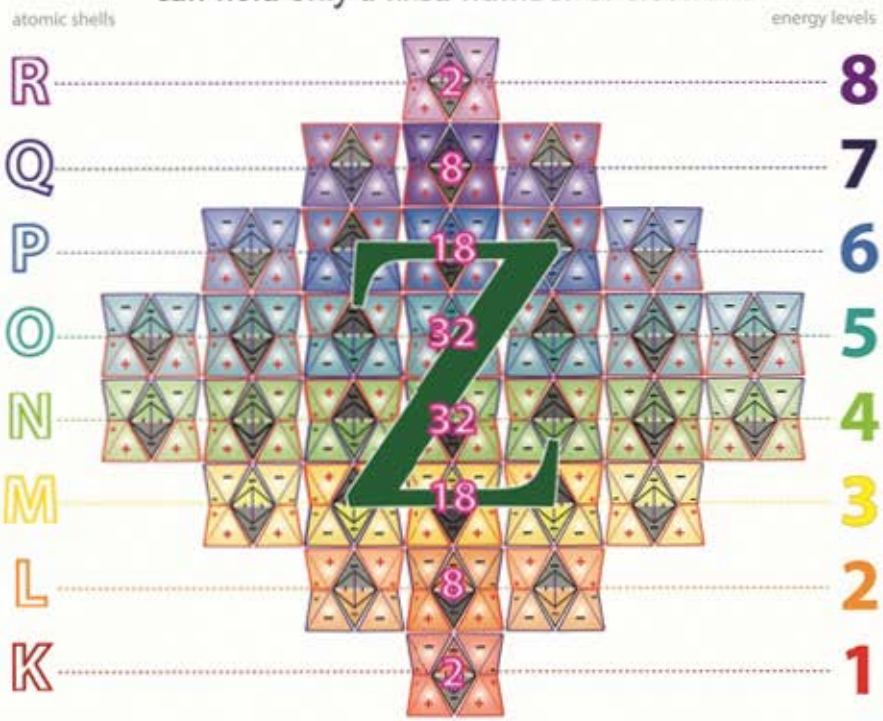

Rules governing the allowed combinations of Quantum Numbers

The three quantum numbers (n, l, and m) that describe an orbital are integers: 0, 1, 2, 3, and so on

n (1-8) Principal	The principal quantum number (n) cannot be zero.
ℓ (0-3) Azimuthal	The angular quantum number (l) can be any integer between 0 and n - 1.
mℓ (2ℓ+1) Magnetic	The magnetic quantum number (m) can be any integer between -l and +l.
m_s : $^1/_2$ Spin Projection	The Spin of electrons in any nuclear sub-orbital can only be +1/2 (Spin UP) or -1/2 (Spin DOWN).

Z

1, 2, 3, 4, 5, 6, 7, 8

s, p, d, f

1	2
1, 3, 5	2, 4, 6
1, 3, 5, 7, 9	2, 4, 6, 8, 10
1, 3, 5, 7, 9, 11, 13	2, 4, 6, 8, 10, 12, 14
down	up
up	down

Quantum Numbers

n	4-5	3-6	2-7	1-8	2-7	3-6	4-5
ℓ	3	2	1	0	1	2	3
m	-3	-2	-1	1	+1	+2	+3
s	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2

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Erwin Schrödinger

(12 August 1887 – 4 January 1961)

Using Tetryonic charged geometries for mass-ENERGY-Matter, an electron's position and velocity CAN be modelled simultaneously
(but any attempt to measure or interact with it, will affect its component energy-momenta)

Electron Position Uncertainty

Atomic orbitals are typically described as "hydrogen-like" (meaning one-electron) wave functions over any spatial region of measurement, categorized by n, l, and m quantum numbers, which correspond to the electron's energy, angular momentum, and a vector momentum component, respectively

Werner Heisenberg

(5 December 1901 – 1 February 1976)

Lepton's are physically Spin 1 fermion particles that can easily be misconstrued as having entirely different spin numbers without the correct physical topologies to base the observed measurements on

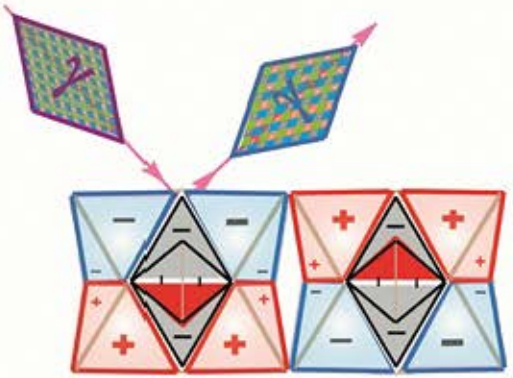

The energies of photo-electrons are determined by the Baryons they bind to & incident photons

Quantum Mechanics is a mathematical representation of equilateral energy momenta interactions and the charged geometries of mass-ENERGY-Matter

Determining the motion of electrons bound to atomic nuclei is akin to measuring the motion of variable speed electric fan blades mounted at various heights within a rotating carousel

Leptons are 12 loop quantum rotors

an identical fascia is presented with every 120 degree rotation

their spin number is a measure ment of their magnetic moment

The unique 12 faceted topology of leptons results in an identical EM geometry being oberved for every 120° rotation of the particle

Leading to the interpretation that the Lepton disappears and re-appears when being 'observed' or measured

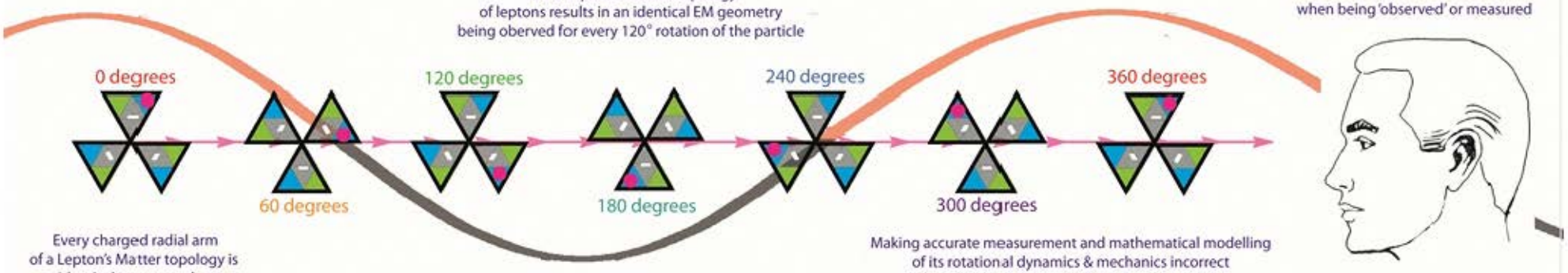

Every charged radial arm of a Lepton's Matter topology is identical to every other

Making accurate measurement and mathematical modelling of its rotational dynamics & mechanics incorrect without the correct physical topologies

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Electron modelling & probability calculations

Electron positional measurements have proven to be historically difficult to accurately model due to the charged 12π rotating topologies of leptons

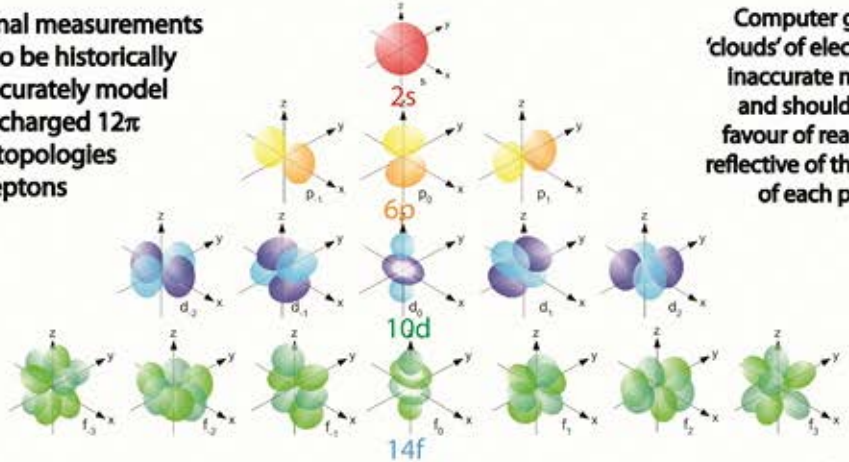

Computer generated plots of 'clouds' of electron probabilites are inaccurate mis-representations and should be abandoned in favour of realistic atomic models reflective of the charged geometry of each periodic element

Every elemental atom can be viewed as a quantum carousel with a unique number of oscillating fans positioned around it.

Each fan has 3 blades and a fixed speed n[1-8] related to its height above ground level, AND the carousel is turning around on its axis

All periodic elements are made form Deuterium nuclei

The baryonic energies of nuclei determines the energies of bound photo-electrons

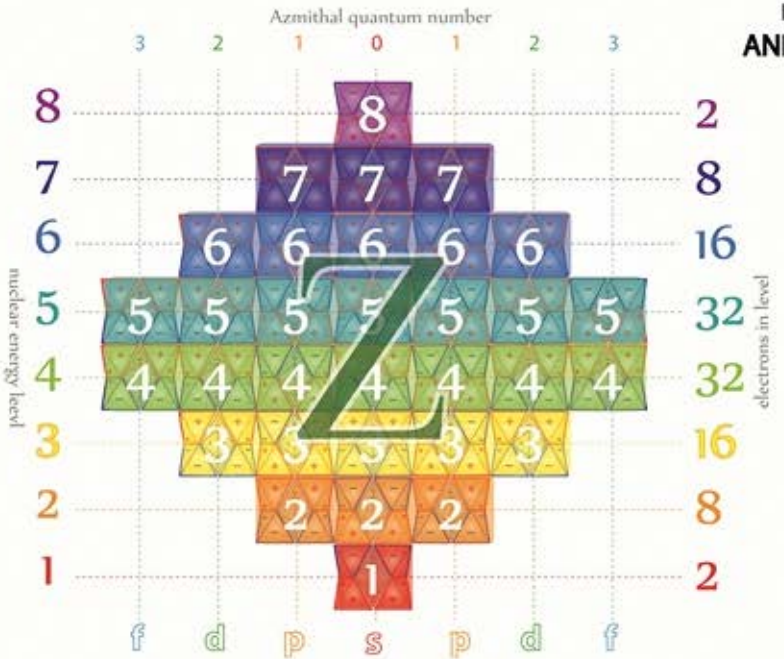

The current computer generated electron probability diagrams in popular use at present can now be show to be a misrepresentative model of mathematical modelling of electron sub-orbital energies

The nuclear quantum levels [n], intrinsic quantised angular momentum [h] and orbital angular momentum [l] of each electron bound within atomic nuclei are all the direct result of the Baryonic energies of the nuclei they are bound to

Each level of the quantum carousel can contain only a limited number of fans each running at a specific speed

Imagine trying to measure (or model) the motion of any 1 quantum scale blade while the carousel rotates

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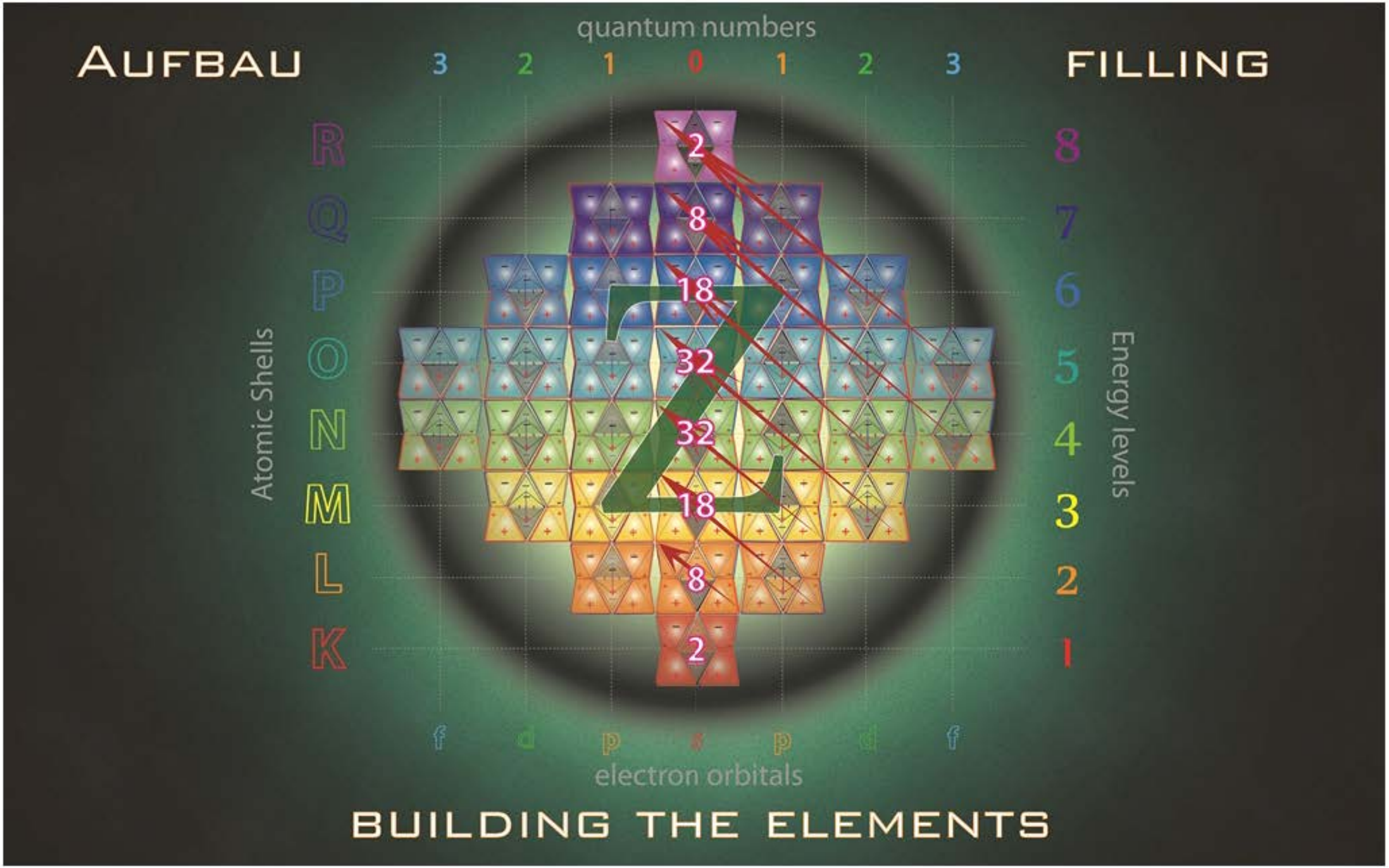

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Quantum Topologies

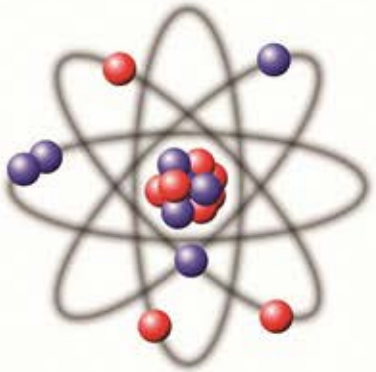

Dalton Model

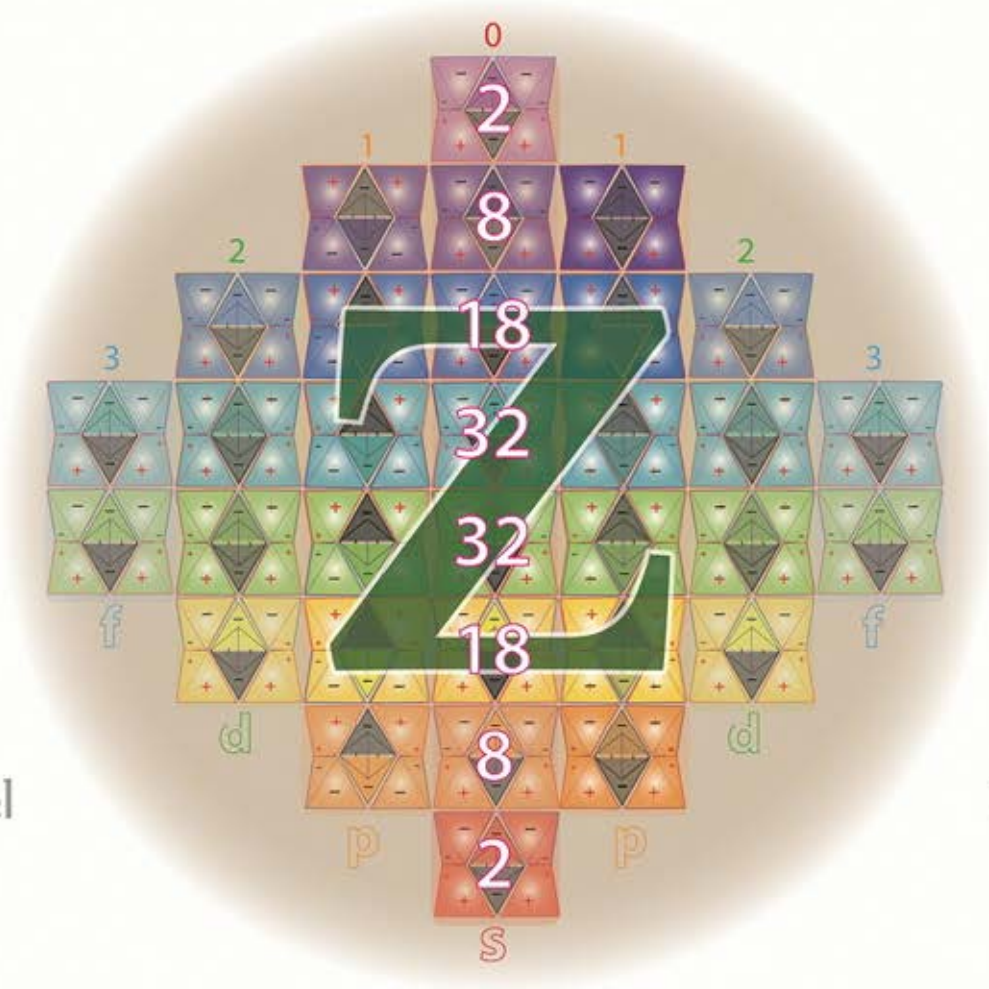

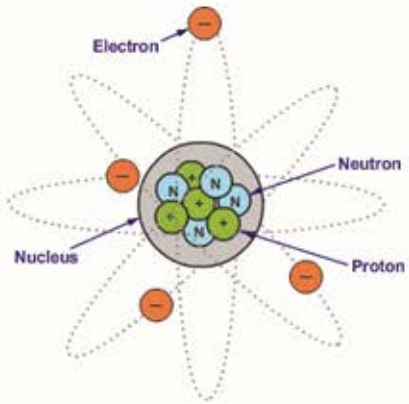

Quantum Model

Thomson Model

Rutherford Model

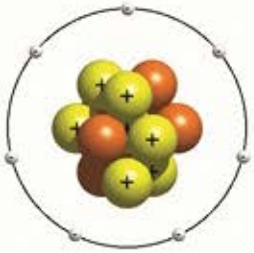

Historically viewed as a spherical object
Tetryonic charge geometry has finally revealed the true quantum topology of all atoms

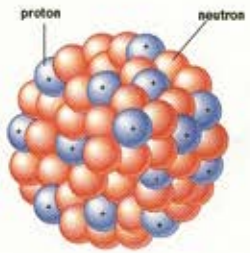

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Element numbers

The rule dictating how many nuclei form each Atomic shell is known as the Aufbau principle.

The physical and chemical properties of elements is determined by the atomic structure. The atomic structure is, in turn, detemined by the electrons and which shells, subshells and orbitals they reside in.

The maximum periodic elemental number is 120

$$Z = \sum_{1}^{1\,2\,3\,4\,4\,3\,2\,1} 2(n^2) = 2 + 8 + 18 + 32 + 32 + 18 + 8 + 2$$

Number of nuclei per level	Element #
2	120
+	119
8	118
+	111
18	110
+	93
32	92
+	61
32	60
+	29
18	28
+	11
8	10
+	3
2	2
	1

The number of nuclei per quantum level is reflective of photonic energy levels and provides the foundational geometry for all of the periodic elements

The number of possible nuclei in each Quantum level follows aufbau principle 'numbers' which can be determined using the following summation formula

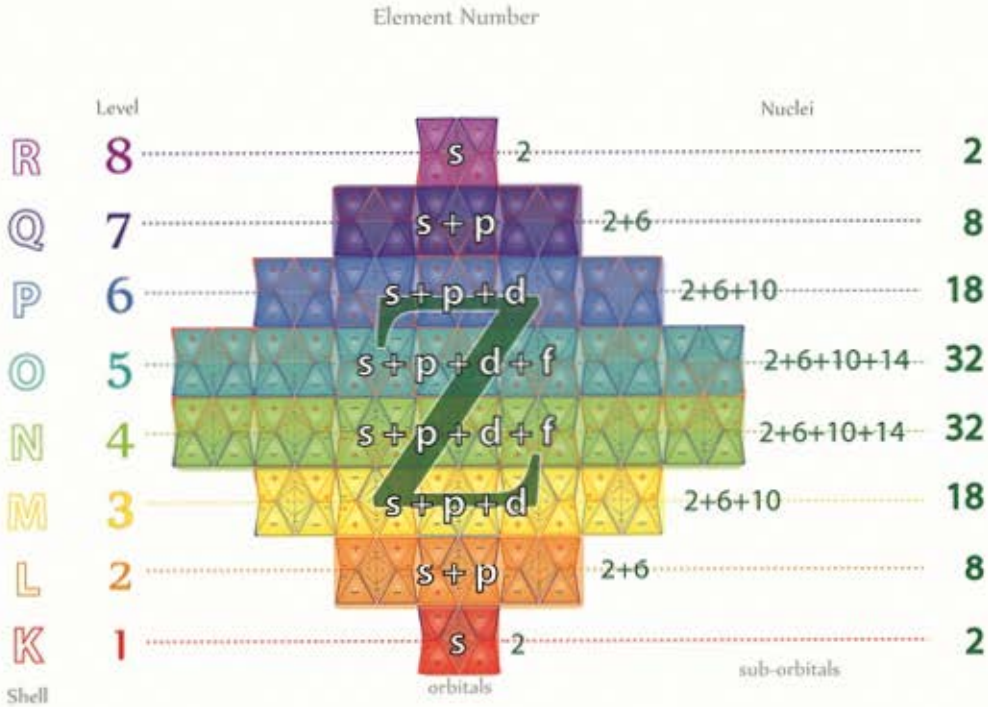

Deuterium is the building block of all elements

Each element has equal numbers of Protons, electron & Neutrons with their stored mass-energies making up the molar masses of elements not excess neutron as currently modelled

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Aufbau Principle
(Nuclei number and position)

1 Sub-Orbit (2 electrons max) — s
3 Sub-Orbits (6 electrons max) — p
5 Sub-Orbits (10 electrons max) — d
7 Sub-Orbits (14 electrons max) — f

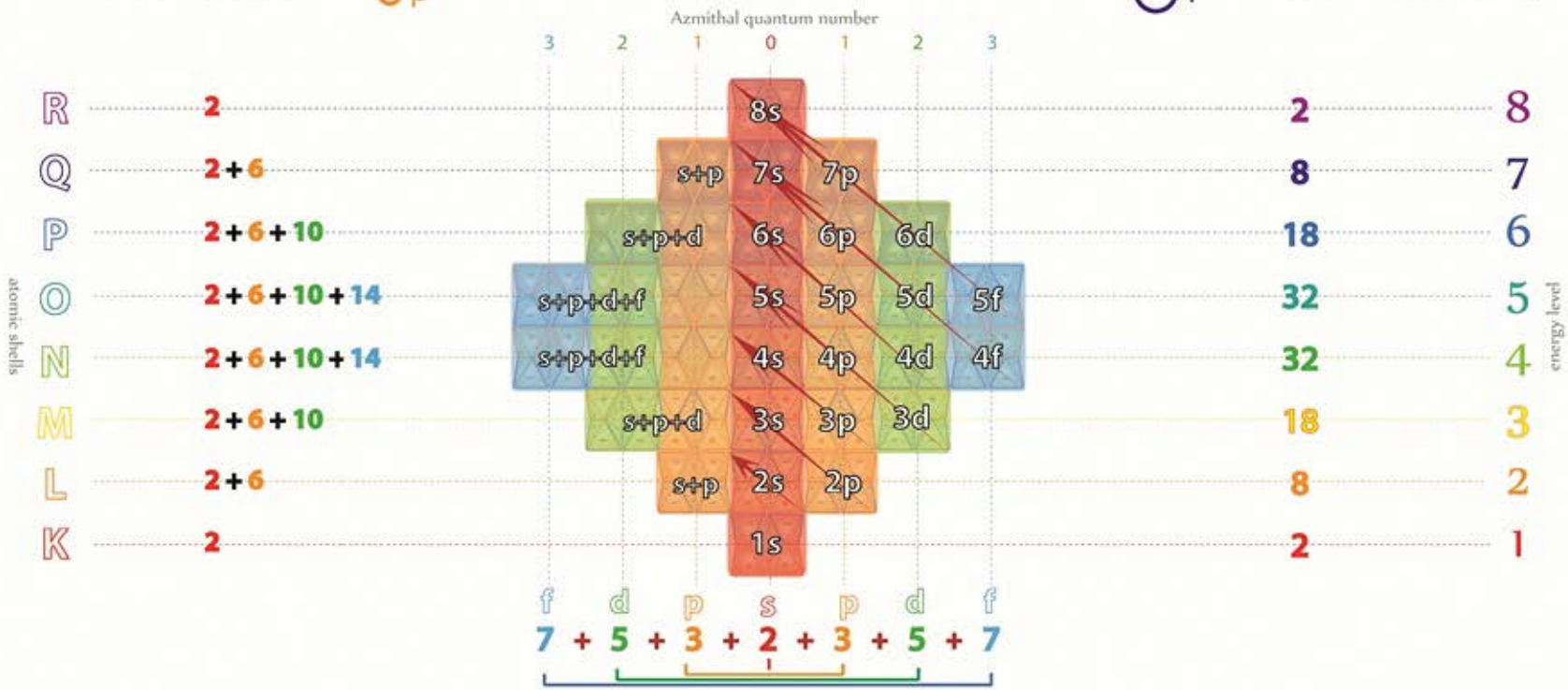

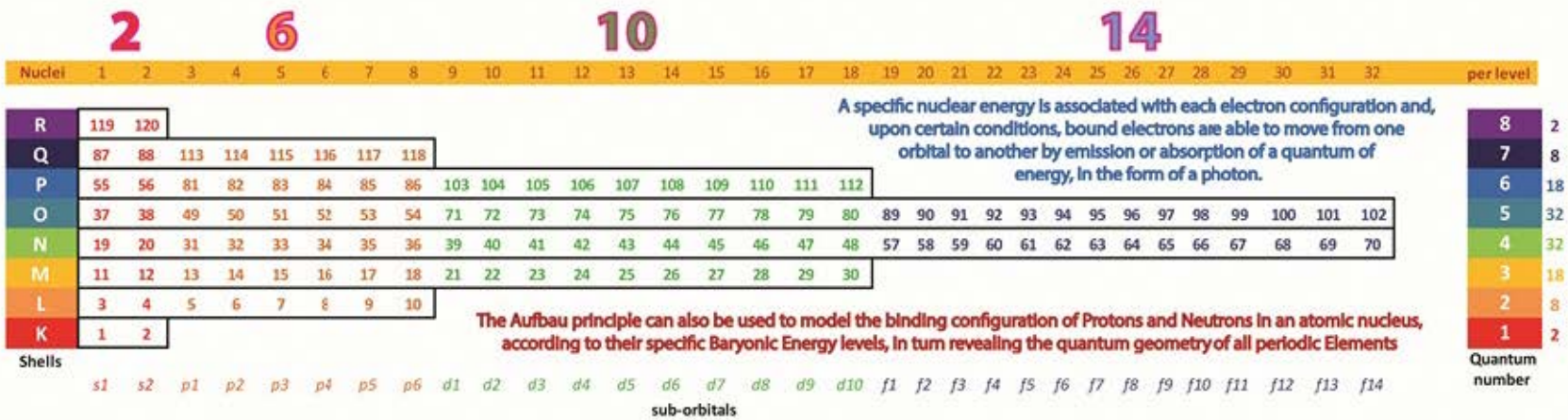

A specific nuclear energy is associated with each electron configuration and, upon certain conditions, bound electrons are able to move from one orbital to another by emission or absorption of a quantum of energy, in the form of a photon.

The Aufbau principle can also be used to model the binding configuration of Protons and Neutrons in an atomic nucleus, according to their specific Baryonic Energy levels, in turn revealing the quantum geometry of all periodic Elements

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Wolfgang Pauli

(25 April 1900 – 15 December 1958)

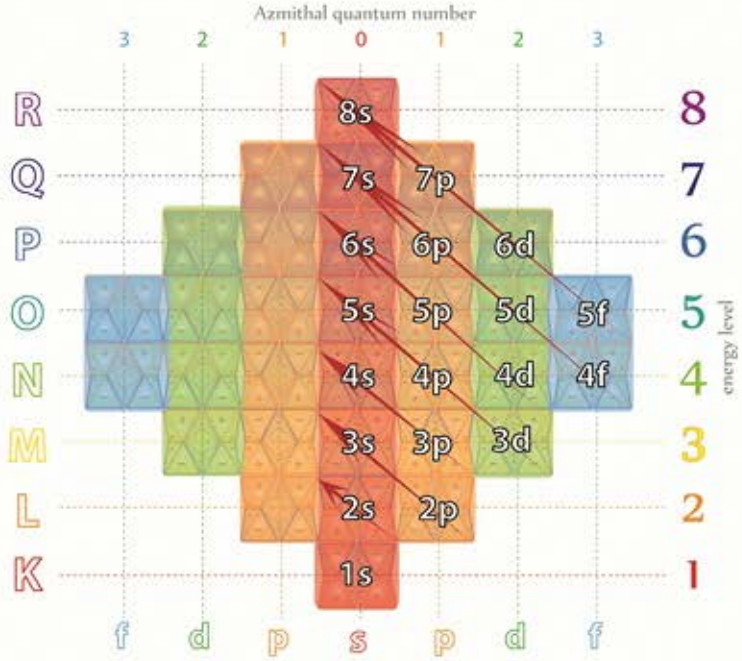

Friedrich Hermann Hund

(4 February 1896 - 31 March 1997)

The orbitals of lower energy are filled in first with the electrons and only then are the higher energy orbitals filled.

aufbau electron orbital filling

Orbitals of equal energy are each occupied by one electron before any orbital is occupied by a second electron, and all electrons in singly occupied orbitals must have the same spin state

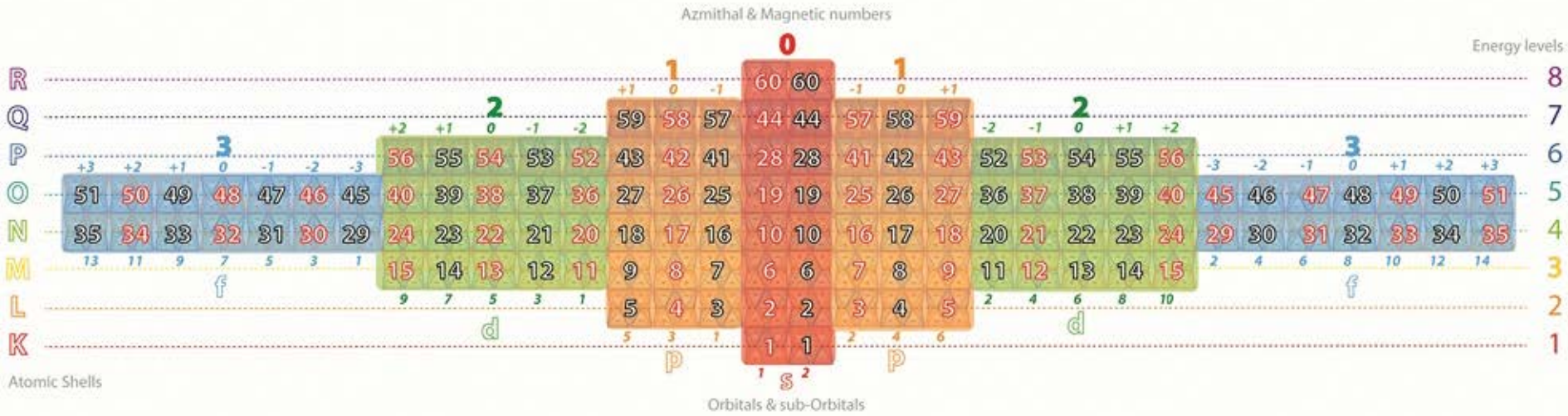

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Aufbau construction

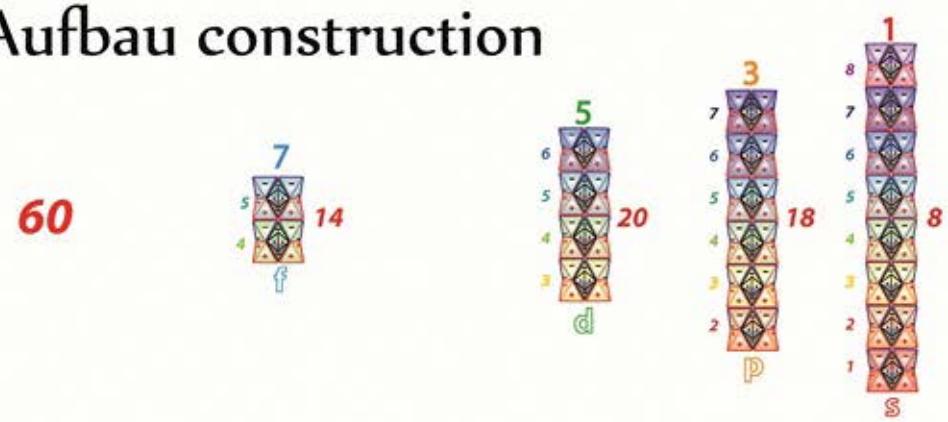

Proton base Hemisphere

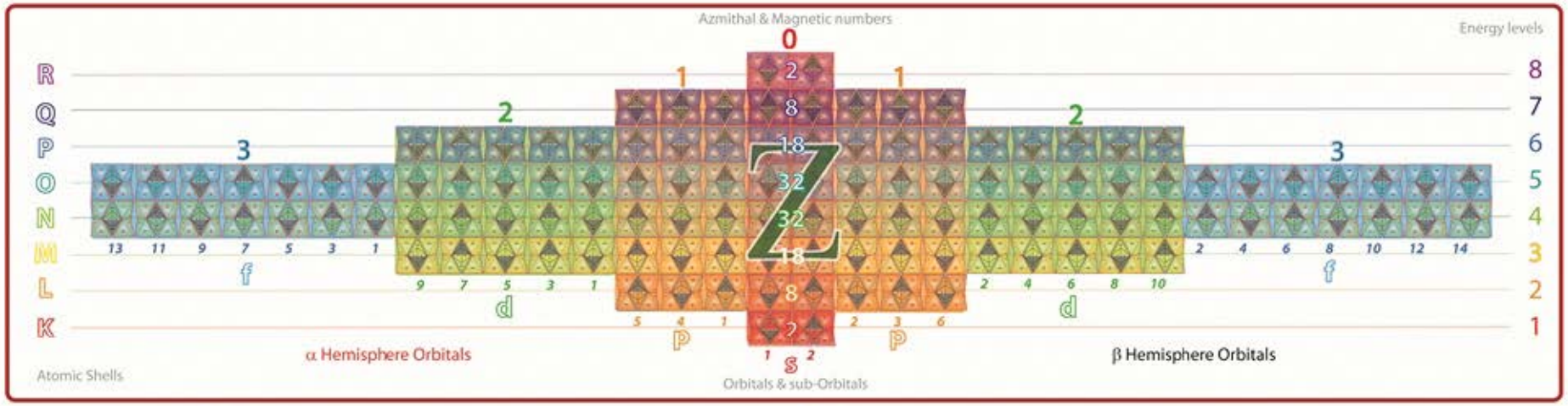

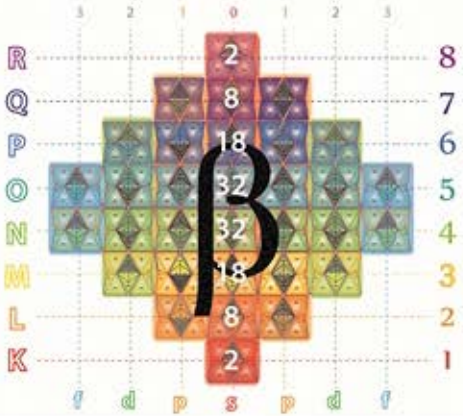

Neutron base Hemisphere

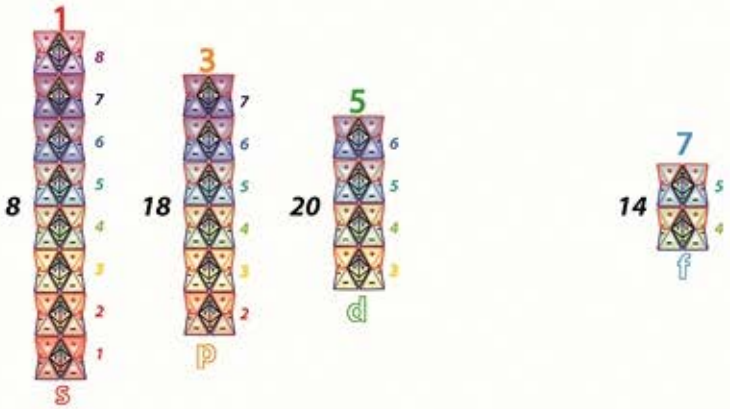

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Atomic Weights

[Molar mass-energies]

The table does not illustrate the quark compositions of the baryonic nuclei in elements

The Mendeleev table incorrectly positions Hydrogen as Element 1 in the table and does not show Deuterium [the building block of all Elements]

The Mendeleev block arrangement of periodic elements presents a number of problems in representing the true topologies and properties of all the periodic elements:

It provides no insight into the individual topologies of the periodic elements themselves

The physical dimensions of periodic elements and the electron orbitals of each element are not represented by the table

The table does not reflect elemental quantum numbers as defined by Schrodinger's wave equation

The table provides no additional insights or information on nuclei packing, aufbau element building processes or how nuclei energies contribute to total molar mass

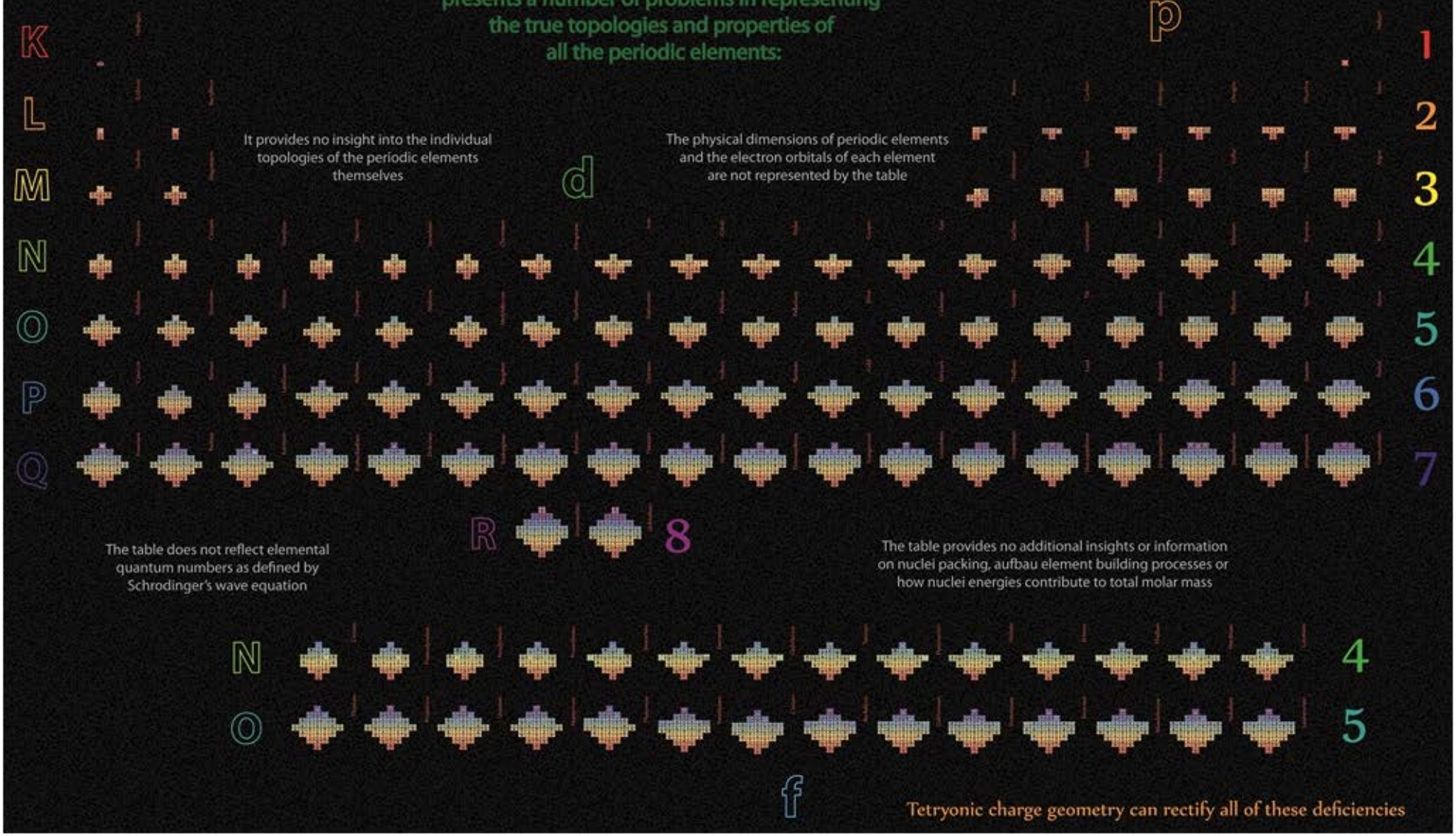

Tetryonic charge geometry can rectify all of these deficiencies

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Atomic nuclei mass-energies

Each element's weight [mass-Matter in a gravitational field] is the result of the total quanta comprising that element

Baryon mass-energies	E			electron KEM field
n	The quantum level mass-energies of Baryons determines the kinetic energies of electrons			hv^2
	1n - 1 e19v			
73,728	n32	8	v8	3.268969693 e15
69,192	n31	7	v7	2.502804921 e15
64,800	n30	6	v6	1.838795452 e15
60,552	n29	5	v5	1.276941286 e15
56,448	n28	4	v4	8.172424232 e14
52,488	n27	3	v3	4.596988631 e14
48,672	n26	2	v2	2.043106058 e14
45,000	n25	1	v1	5.107765145 e13
Compton frequencies	1.2 e20 electron rest Matter is velocity invariant			spectral frequencies
930 MeV	496 keV			13.6 eV

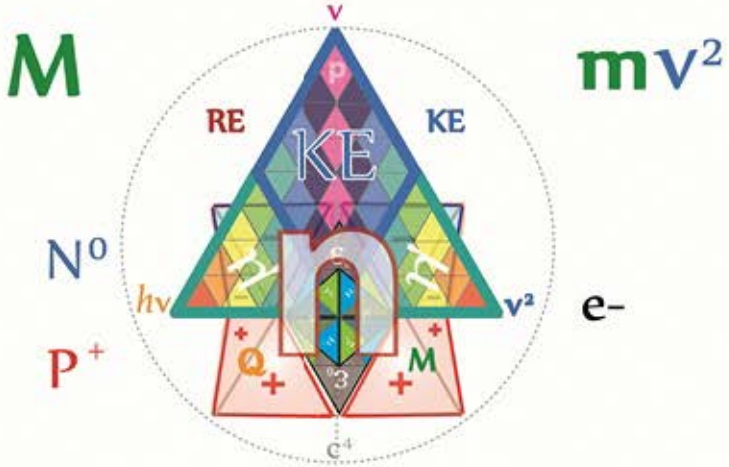

The nuclei forming each atomic shell have specific mass-energy quanta

$$\overset{8}{\underset{1}{n}}\left[\left[72(n)^2\right]+\left[12e19\right]+\left[m_e v^2\right]\right]$$

Baryon rest masses — lepton rest mass — KEM

Deuterium mass-energy per shell

Despite having differing mass-energies each Deuterium nuclei has the same velocity invariant Matter geometry [84π]

spin orbital coupling in synchronous quantum convertors

Electrons act as quantum scale rotating armatures in atomic nuclei and can only have specific energies reflective of the electron orbital energy level of the Baryons in which they are found

They acheive these energy levels by absorbing or emitting photons to acheive the specific angular momentum required

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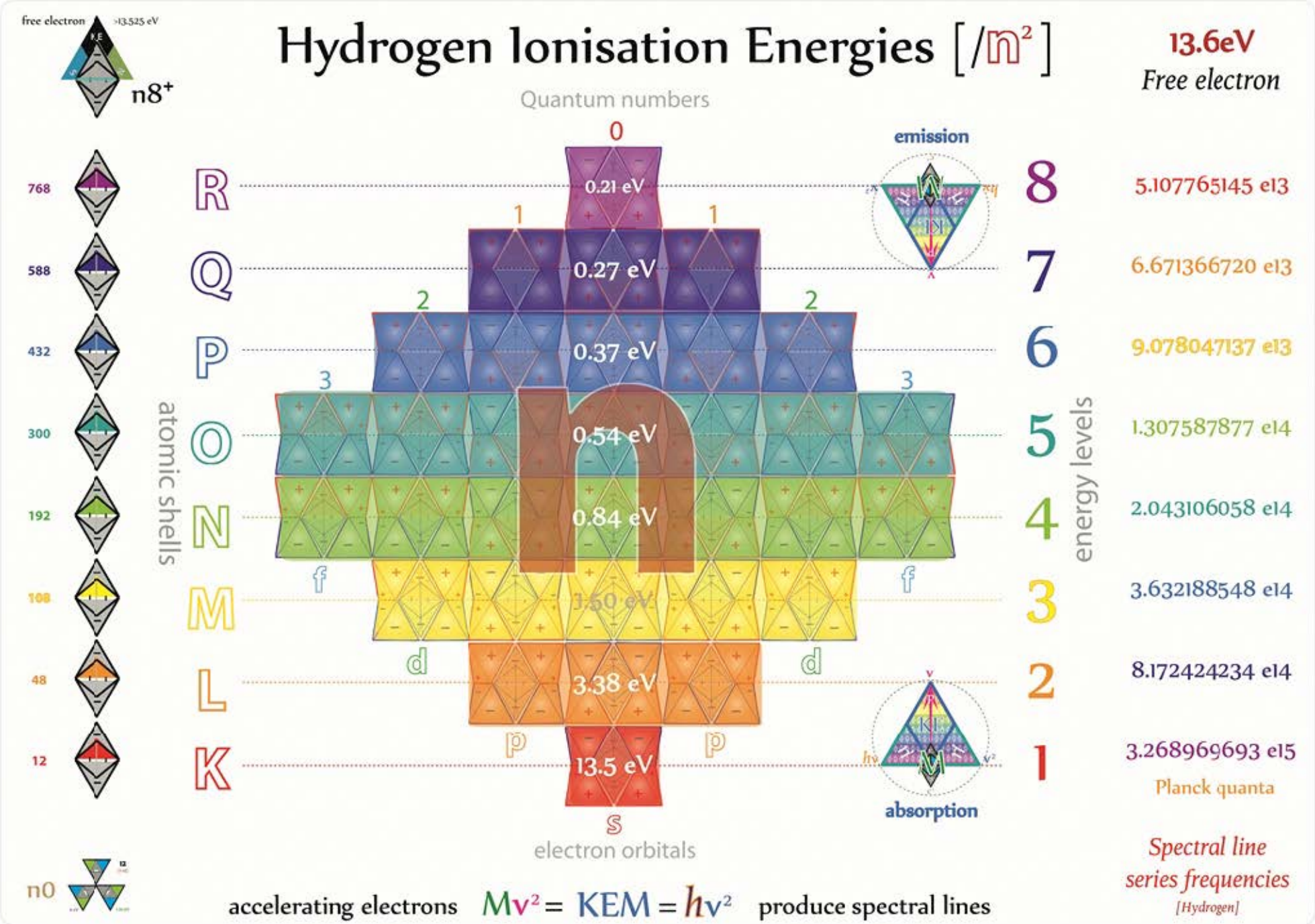

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Redefining Atomic weights

Atomic weight (symbol: Ar) is a dimensionless physical quantity, the ratio of the average mass of atoms of an element (from a given source) to 1/12 of the mass of an atom of carbon-12 (known as the unified atomic mass unit)

Carbon 12

504
[254-254]

12
C
11.996

270,072

6s1

6 Protons [24-12]
6 Neutrons [18-18] n1
6 electrons [0-12]

The 'unified atomic mass unit' currently in use is known to be inaccurate and must be corrected in order to bring clarity & increased accuracy to the atomic weights of all elements

A_r = 22,512
Hydrogen

Defining Hydrogen as having an exact atomic Planck mass of 22512n quanta provides uniformity with Tetryonics

1/12 C_{12}

A_r = 22,506

42
[24-18]

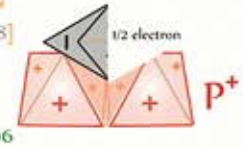

22,506

1.660096209e-27 kg

1 Proton [24-12]
.5 electron [0-6] n1

Unified atomic Matter unit

48
[24-24]

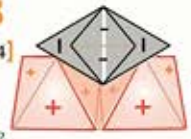

H
P+

22,512

1.660538783e-27 kg

1 Proton [24-12]
1 electron [0-12] n1

Deuterium is the building block of all elements in the period table

A_r = 45,012
Deuterium

Defining Deuterium as having an exact atomic Planck mass of 45012n quanta reflects the true charged geometries of all Elements & their topologies

D

1/6 C

84
[42-42]

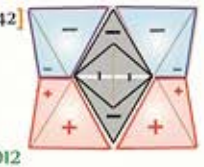

N°
e-
P+

45,012

3.320192418e-27 kg

1 Proton [24-12]
1 Neutron [18-18] n1
1 electron [0-12]

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Planck mass-energy units

NAu = 0.001 kg

48
[24-24]

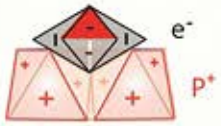

^{1}H

22,512

1.660538841 e-27 kg

One Da is approximately equal to the mass of one proton or one neutron

36
[18-18]

N^{0}

0.499866702 H

22,500

1.659653693 e-27 kg

36
[24-12]

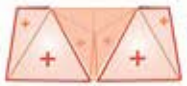

P^{+}

0.499866702 H

22,500

Deuterium is the building block of all elements

84
[42-42]

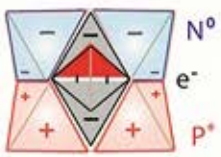

^{2}H

45,012

3.320192534 e-27 kg

The unified atomic mass unit (symbol: u) or Dalton (symbol: Da) is a unit that is used for indicating mass on an atomic or molecular scale

270,072

1/12 the mass of a C12 graphene atom at rest in its electronic ground state

1.660538782(83)×10−27 kg

22,506

is an inaccurate means of determining the exact rest mass of a Hydrogen atom

22,512

Carbon 12 has 270,072n planck quanta (270,072 / 12 = 22,506)

Hydrogen has a mass of 22,512n (22,500+12) requiring all mass to be calculated directly using the Planck mass-energy quantum (.001kg / N_A / 22,512) & Tetryonic charge geometries

Using Tetryonic theory to define n Planck mass = $7.376238634 \times 10^{-32}$ Kg

(see Tetryonics QM 15.04)

exact atomic rest masses for all particles, elements and compounds can be determined directly from atomic theory

N_A = 6.02214179 e23

The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12; its symbol is "mol".

NA(12u) = 0.012 kg

504
[254-254]

12
C
11.996

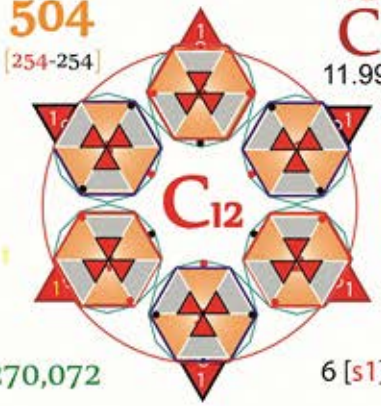

270,072

6 [s1]

6 Protons [24-12]
6 Neutrons [18-18] n1
6 electrons [0-12]

Carbon has a number of differing atomic configurations (allotropes)

6 Protons [24-12]
6 Neutrons [18-18] n1-2
6 electrons [0-12]

504
[252-252]

6
C
12.6493

284,760

[He] 2s2 2p2

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Planck mass-energy contributions to the measured weights of periodic, elementary mass-Matter topologies

36
[18-18]
N^0
45,000n

1.659653693 e-27 kg

36
[24-12]
P^+
45,000n

12
[0-12]
e-
12n

8.851486361 e-31 kg

n
[v-v]

2.411109611 e-35 kg

γ

0

KEM

Baryons have 2,25e23 Planck quanta comprising their rest Matter topologies

[930.974 MeV]

Δ 1875 x

[496.5 keV]

Leptons have 1.2 e20 Planck quanta comprising their rest Matter topologies

[496.5 keV]

Δ 36,711 x

[13.6 eV]

Photons are planar geometries [Matter-less] (purely Kinetic mass-Energy and momenta)

The Lyman alpha spectral line mass-energy contribution to the mass of a Deuterium nucleus is negligible

Electron quantum level energies are determined by the energy of the Nuclei they bind to in elements

D^+
[1.862 GeV]

84
[42-42]

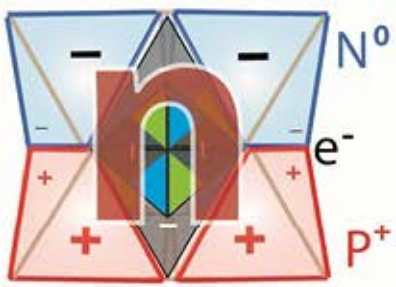

90,012n+

Photons contribute spectral mass-energies to the nuclei mass but are themselves Matterless [2D zero rest mass-energies]

Photons are 2π charge mass-energy geometries

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Ionisation energies

Fractional quantum differentials

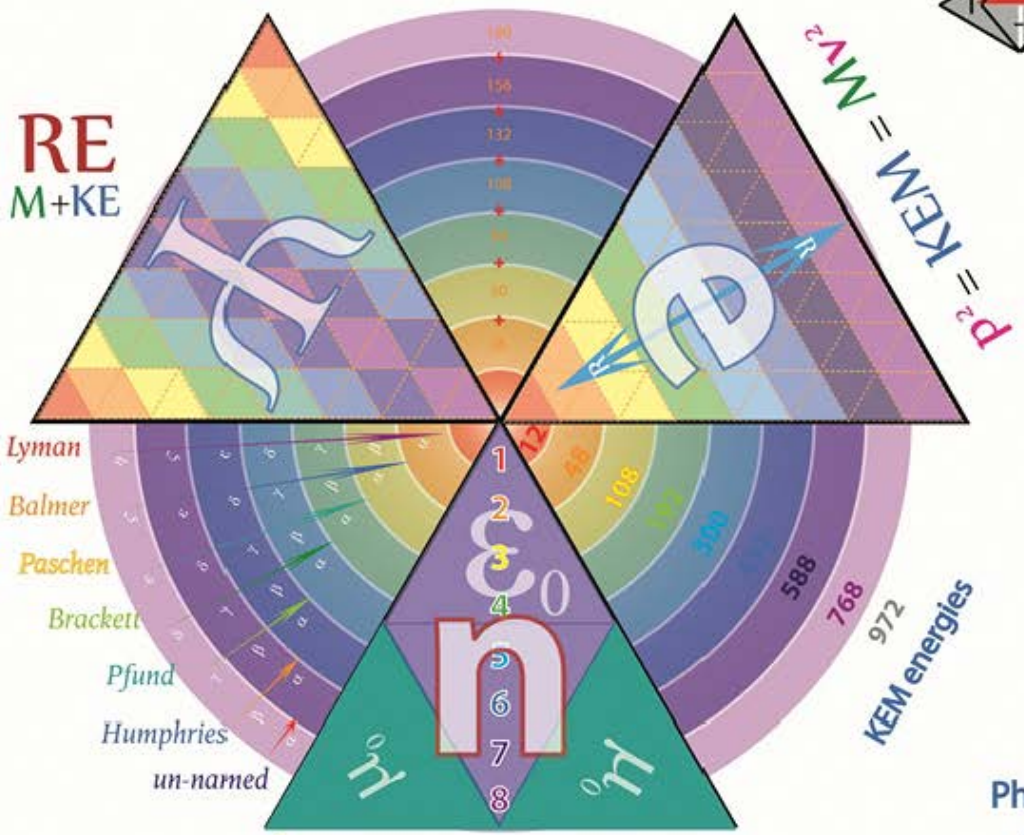

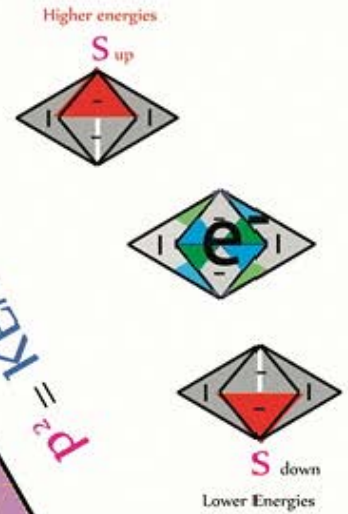

photo-electronic energy momenta

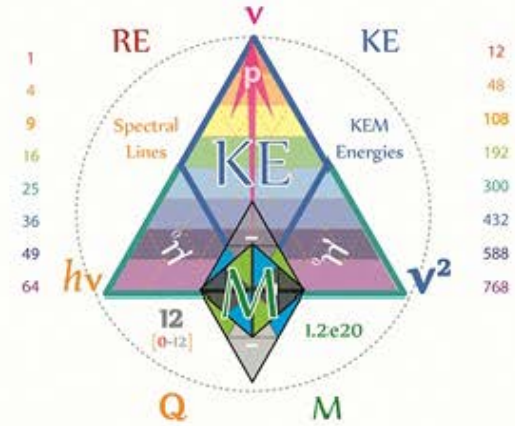

Mapping photo-electron transition energies to Tetryonic energy momenta geometries reveals many key facts about the ionisation energies of nuclei

$$E = -\frac{Z^2}{n^2}\frac{ke^2}{2a_0} = -\frac{13.6Z^2}{n^2}eV$$

The differing fractional KEM field energy momenta of electrons that results from their transitions to specific energy nuclei in elements results in differing QAM quanta and produces spectral lines and fine line splitting

$$hf = \Delta Mv = \Delta p$$

spectral lines are produced by accelerating electrons

Note: this is an Illustrative schema for modelling KEM field energies
All KEM fields possess the same physical spatial geometry
in radial-time defined spatial co-ordinate systems

c^2 c^4

Photo-electrons absorb/emit spectral energies

$$E = eV = \frac{1}{4\pi\epsilon_0}\frac{ne^2}{a}$$

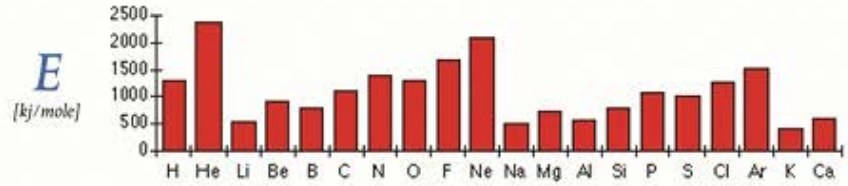

Spectral line transitions

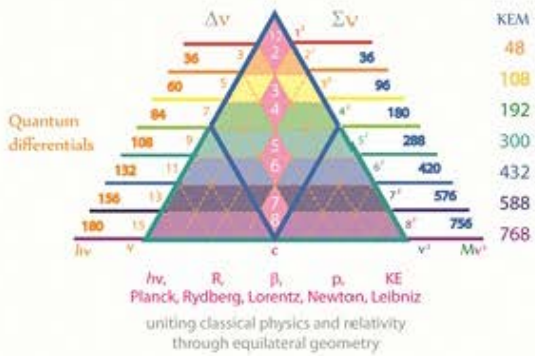

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Elementary ionisation energies

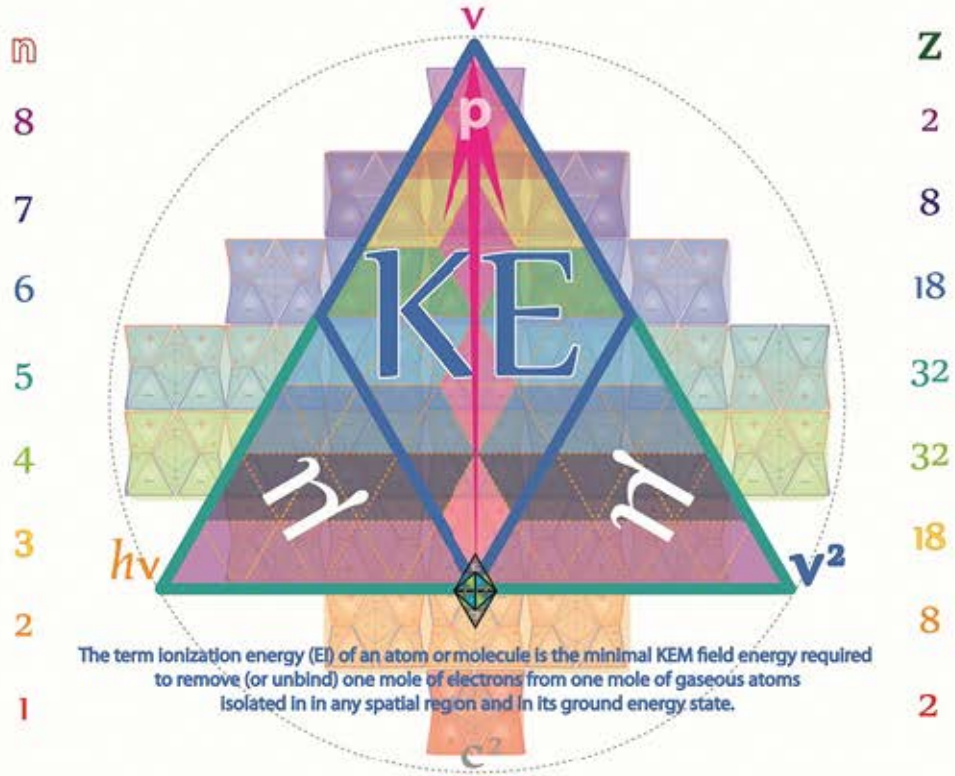

The term ionization energy (EI) of an atom or molecule is the minimal KEM field energy required to remove (or unbind) one mole of electrons from one mole of gaseous atoms isolated in in any spatial region and in its ground energy state.

The term "ionization energy" is sometimes used as a name for the work needed to remove (or un-bind) the highest energy photoelectron from an atom or molecule.

However, due to interactions with surfaces, this value differs from the ionization energy of the atom or molecule in question when it is located by itself in free space.

So, in the case of surface-adsorbed atoms and molecules, it may be better to use the more general term "electron binding energy", in order to avoid confusion.

Both these names are also sometimes used to describe the work needed to remove an electron from a "lower" orbital (i.e., not the topmost orbital) for both free and adsorbed atoms; in such cases it is necessary to specify the orbital from which the electron has been removed

$$E = -\frac{Z^2}{n^2}\frac{ke^2}{2a_0} = -\frac{13.6Z^2}{n^2}eV$$

Every electron in each elementary orbit has a unique ionisation energy

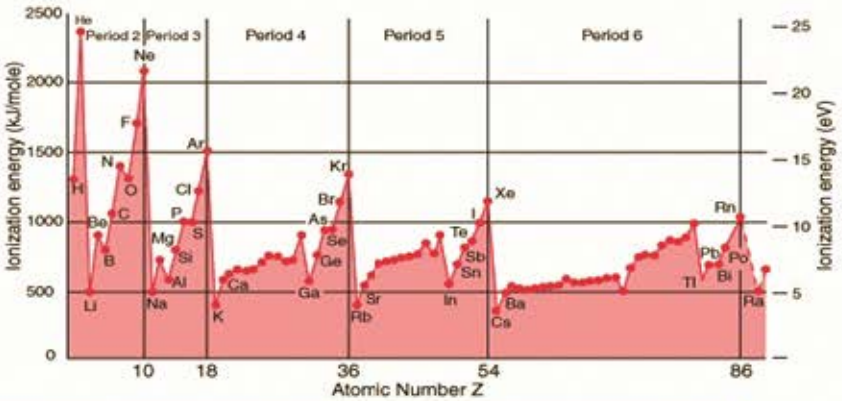

Nuclei	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	per shell

Element number

| Shells | | |

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Hyperfine splitting and Lamb Shifts

When the spectral lines of the hydrogen spectrum are examined at very high resolution, they are found to be closely-spaced doublets.
This splitting is called fine structure and was one of the first experimental evidences for electron spin.

The fine structure describes the splitting of the spectral lines of atoms due to first order relativistic corrections [principal quantum energies]

n

Differing electron spins within shells & quantum levels produces Hyperfine splitting

atomic shell energies result from Series addition of baryonic energies

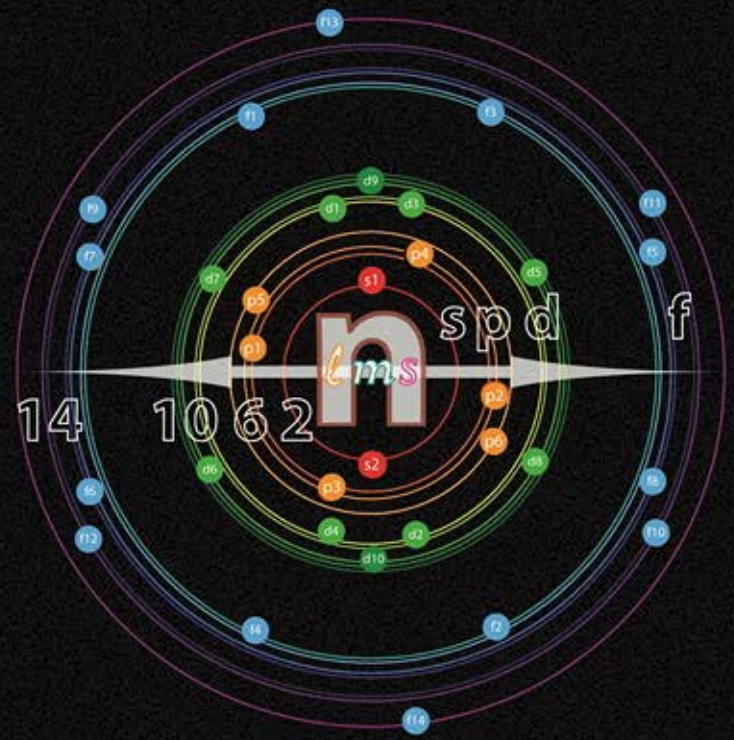

The electron energy levels of Hydrogen should depend only on the principal quantum number n.

In 1951 it was discovered that this was not so, the $2p_{(1/2)}$ state is slightly less than the $2s_{(1/2)}$ state resulting in the Lamb shift

$\ell m s$

Differing electron sub-Orbtial energies create Lamb Shifts

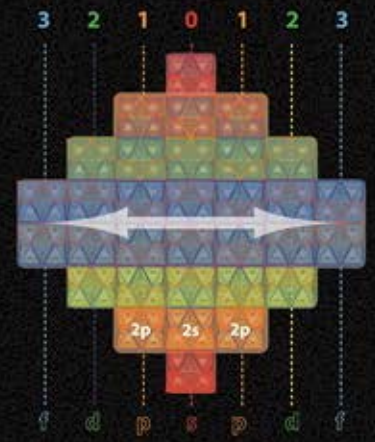

electron sub-orbital energies are Parallel energy configurations

If you measure the atomic energy levels of photo-electrons at an extremely high resolution, you'll find small deviations of individual KEM field energies of electrons in sub-orbitals which are primarily the result of parallel and anti-parallel electron spins

Higher energy
Parallel
Magnetic moments

Lower energy
Anti-parallel
Magnetic moments

All electron spins are referenced to the Nuclear magneton

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M_0

3D Matter topologies are comprised of charged 2D mass-energies

Energy per second²

RE

Relativistic mass-ENERGY-Matter

Relativity fails at the foundational level to explain and differentiate between mass-ENERGY and Matter in physical systems

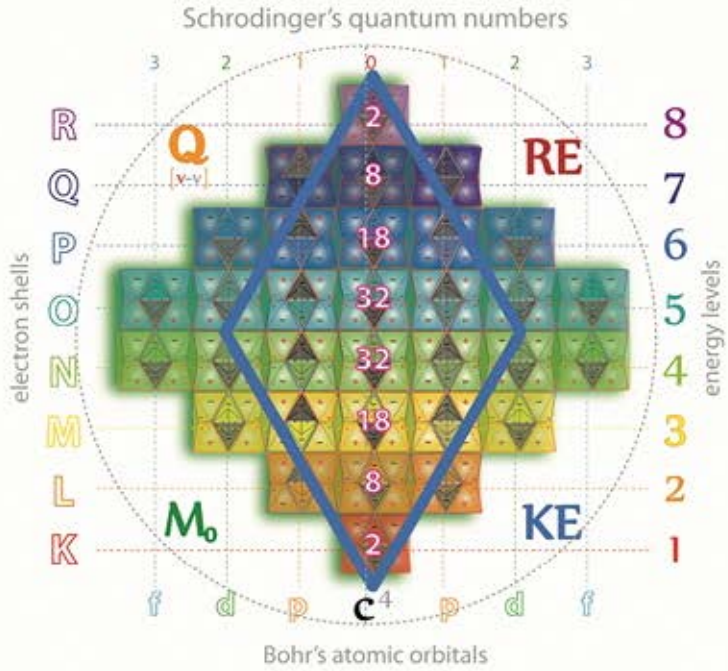

KE

2D equilateral mass-energies are euclidean geometries

Energy per second

Einstein's relativistic [Lorentz corrected] stress energy tensor aggregates all forms of energy into a single energy density gradient

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right] \quad \text{atomic energies} \quad \frac{Tm\eta}{c^4} + \frac{mv^2}{c^2} \quad \text{electron spins} \quad \frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Matter, Planck quanta, mass, velocity

Mass, Planck quanta, mass, velocity

mass-Matter

standing wave mass-energiescreate
the material substance of all chemical elements

3D rest Matter + Lorentz corrected 2D Kinetic Energies = total Relativistic Energies

mass-energies

radiant planar mass-energies create
EM fields, spectral lines & chemical interactions

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Deuterium is the building block of all Elements (save Hydrogen)

The geometry of any Element is determined by its Charge

The Molar Weight of any Element is a measure of its standing wave mass-energies

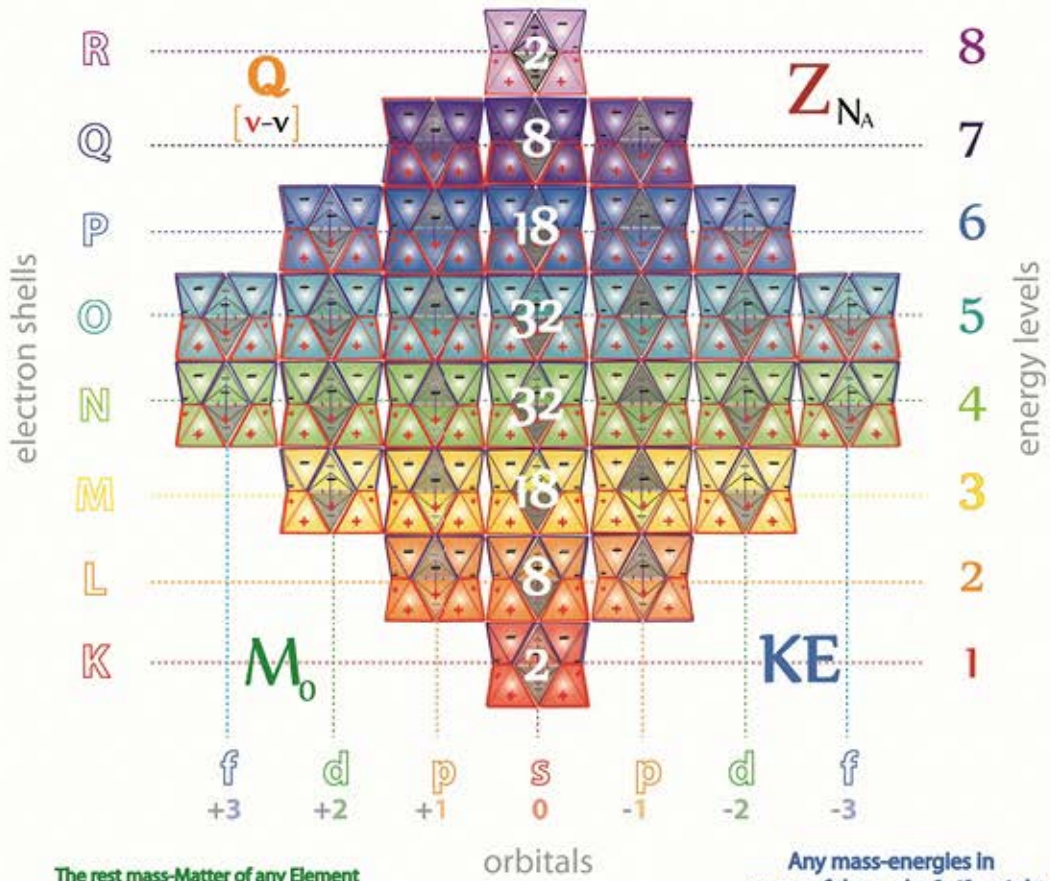

The rest mass-Matter of any Element is determined by the total number of quanta making up the Protons, Neutrons and electrons that comprise them (in their respective energy levels)

Any mass-energies in excess of the molar [n1] weight is a measurement of a element's CHEMICAL energies

Important point to note:
The Kinetic Energy difference between any Element's total [n1] Deuteron mass-energies and its Molar mass has historically been incorrectly explained as resulting from an excess number of Neutrons in the atom it is not, Z# = (number of Protons = number of electrons = number of Neutrons)

Elementary mass-Matter

n per nuclei
1e19v = n

$$\sum_{K}^{R}$$

2	2 nuclei [74,496 ea]	120	Unbinilium
		119	Ununennium
+			
8	8 nuclei [69,780 ea]	118	Ununoctium
		87	Francium
+			
18	18 nuclei [65,232 ea]	112	Copernicium
		55	Caesium
+			
32	32 nuclei [60,852 ea]	102	Nobelium
		37	Rubidium
+			
32	32 nuclei [56,640 ea]	70	Ytterbuim
		19	Potassium
+			
18	18 nuclei [52,596 ea]	30	Zinc
		11	Sodium
+			
8	8 nuclei [48,720 ea]	10	Neon
		3	Lithium
+			
2	2 nuclei [45,012 ea]	2	Helium
		1	Deuterium

The rest mass-Matter of any Element is the sum total of its constituent Z[n²] energy level Deuterium nuclei

Aufbau

$$Z\#\left[\begin{array}{ll} z \text{ Protons} & [24\text{-}12] \\ z \text{ Neutrons} & [18\text{-}18] \\ z \text{ electrons} & [0\text{-}12] \end{array}\right] n1\text{-}8$$

(ie Calcium [20] = 2+8+10 n level Deuterium nuclei)

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Periodic Harmonic motions

$x = A \cos(\omega t + \varphi)$

Much of the math in of modern physics is predicated on the assumption that π [where it appears] is related to the properties of a circle

$F = -kx$

Circular motion

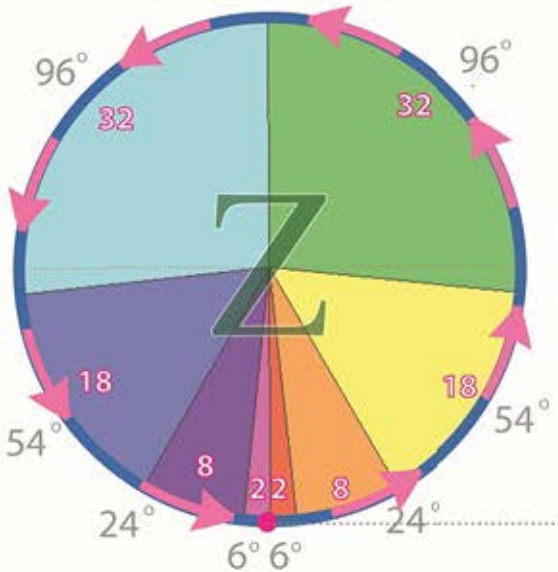

Linear motion

Simple harmonic motion can be visualized as the projection of uniform circular motion onto one axis

Principal Quantum Numbers

circular harmonic motion

simple harmonic motion

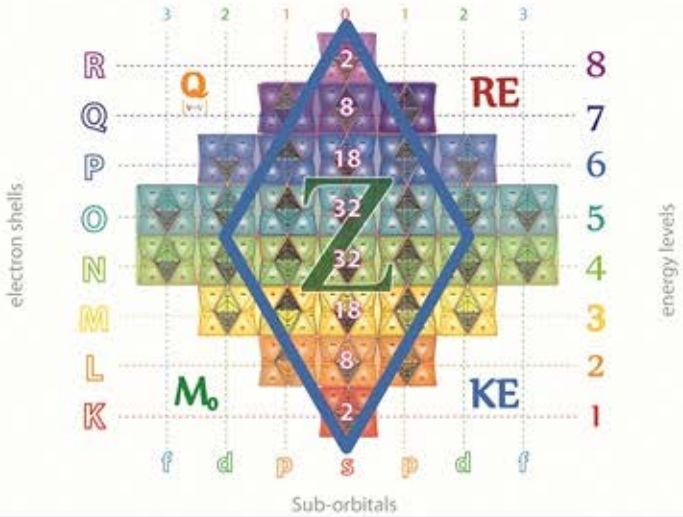

Circular motions describe the motion of a body with a changing velocity vector [the result of an acceleration force].

Nuclei per shell in elements follows a 'periodic summation rule' that is reflective of photonic energies

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$$\sum_{K}^{R}$$

nuclei per shell

$$\prescript{R}{K}{\sum} Z$$

Periodic Summation

Periodic summation is a notation developed for Tetryonic theory to model the geometric series addtion of Z[n²] energy level Deuterium nuclei that form the periodic elements

$$\sum^{120}_{1} Z$$

element number

STEP ONE

Periodic summation follows the atomic shell electron config

STEP TWO

Periodic elements build up following the aufbau sequence

$$\prescript{1\,R}{1\,K}{\sum}_{2,3,4,4,3,2} 2(x^2) =$$

Each atomic shell can hold only a fixed number of deuterium nuclei

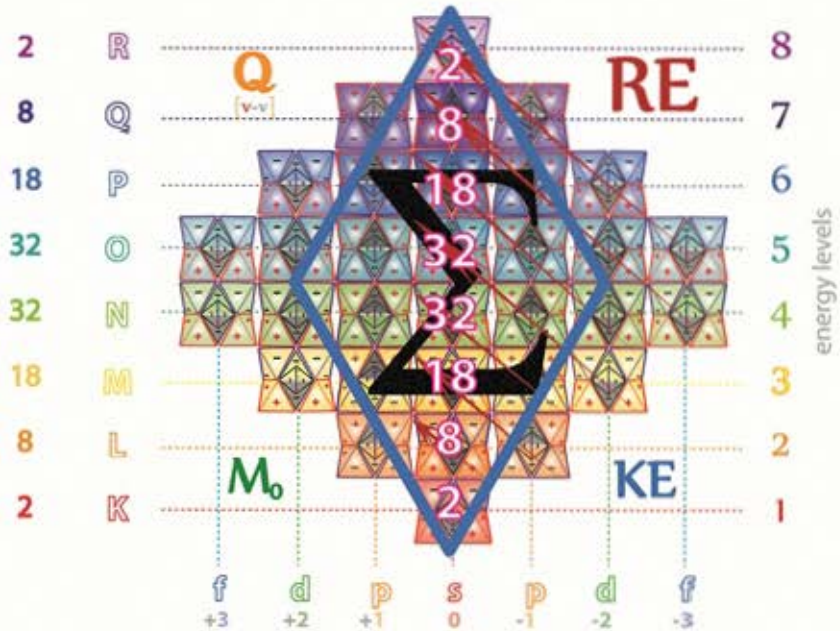

$\prescript{R}{}{\sum} = 2$	2 nuclei [74.496 ea]	120	Unbinilium
+			
$\prescript{Q}{}{\sum} = 8$	8 nuclei [69,780 ea]	118	Ununoctium
+			
$\prescript{P}{}{\sum} = 18$	18 nuclei [65,232 ea]	110	Darmstadtium
+			
$\prescript{O}{}{\sum} = 32$	32 nuclei [60,852 ea]	92	Uranium
+			
$\prescript{N}{}{\sum} = 32$	32 nuclei [56,640 ea]	60	Neodymuim
+			
$\prescript{M}{}{\sum} = 18$	18 nuclei [52,596 ea]	28	Argon
+			
$\prescript{L}{}{\sum} = 8$	8 nuclei [48,720 ea]	10	Neon
+			
$\prescript{K}{}{\sum} = 2$	2 nuclei [45,012 ea]	2	Helium
		0	Hydrogen

THe LHS of the notation determine the number of nuclei in each atomic shell, from the periodic mass-energy levels for atoms, and the RHS follows the aufbau building principle to determine the rest mass-Matter of any specific element

Aufbau

Each periodic element is made of Z [n² energy] deuterium nuclei

$$Z\# \left[\begin{array}{ll} z \text{ Protons} & [24\text{-}12] \\ z \text{ Neutrons} & [18\text{-}18] \\ z \text{ electrons} & [0\text{-}12] \end{array}\right] n1\text{-}8$$

Planck mass-energies form the surface integral of rest Matter topologies for each periodic element

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Element numbers

Nuclei per shell in elements follow a 'periodic summation rule' that is reflective of photonic energies

$$\sum_{K}^{R} {}^{P} 2(x^2) = 2 + 8 + 18 + 32 + 32 + 18 + 8 + 2$$

$$Z$$

120	Unbinilium	n8
119	Ununennium	
118	Ununoctium	n7
87	Francium	
112	Copernicium	n6
55	Caesium	
102	Nobelium	n5
37	Rubidium	
70	Ytterbuim	n4
19	Potassium	
30	Zinc	n3
11	Sodium	
10	Neon	n2
3	Lithium	
2	Helium	n1
1	Deuterium	
Hydrogen	0	

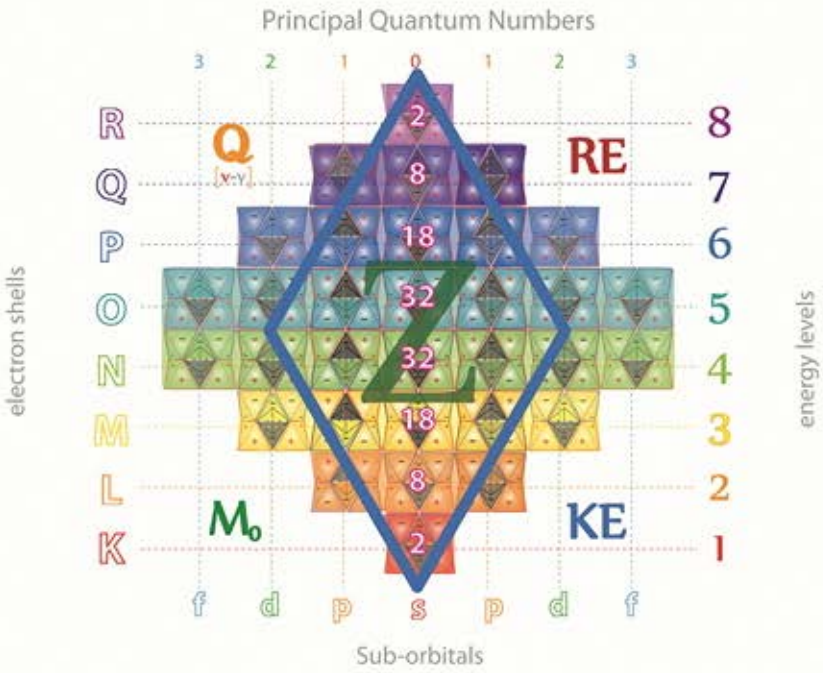

Periodic mass-ENERGY-Matter

Following periodic summation rules for shell filling n[1-8] quantum energy deuterium nuclei combine to form elementary Matter

$$\sum_{K}^{R} {}^{P}_{25}{}^{32} \left[\left[72(n)^2 \right] + \left[12e19 \right] + \left[m_e v^2 \right] \right]_{1}^{8}$$

Baryon rest masses; lepton rest mass; KEM

Deuterium mass-energy per shell

The measured weight of Matter in gravitational fields is the result of planar mass-energies in tetryonic standing-wave geometries

The periodicity of all the elements, along with their exact molar rest mass-energies and quantum wavefunctions can be described with Tetryonic geometries

Ionisation energies

$$\gamma$$

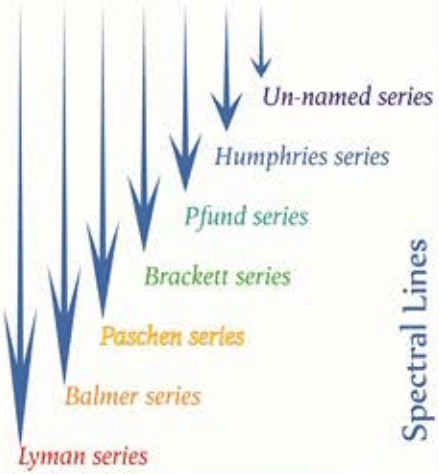

$$Mv^2 = KEM = hcR_H$$

Photon emission/absorption

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Photo-electron ionisation energies

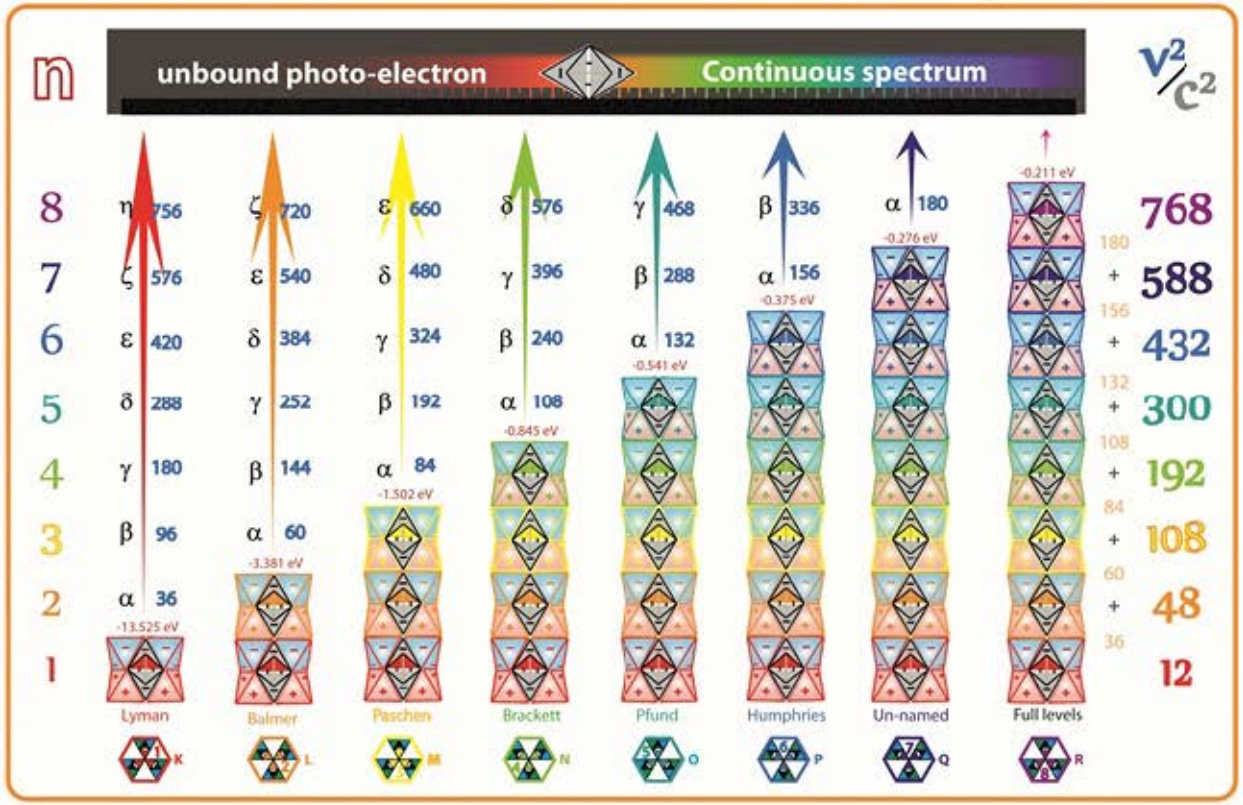

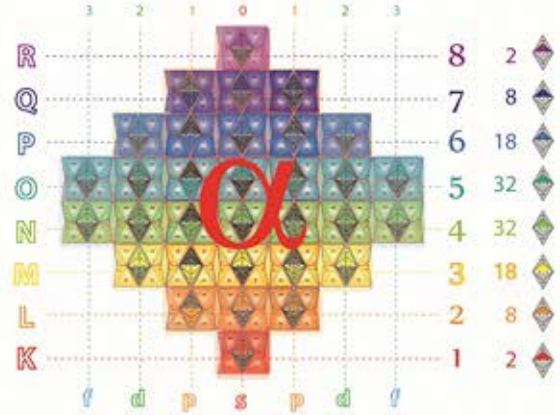

Opposed electron spins results in Hyperfine splitting & Lamb shifts

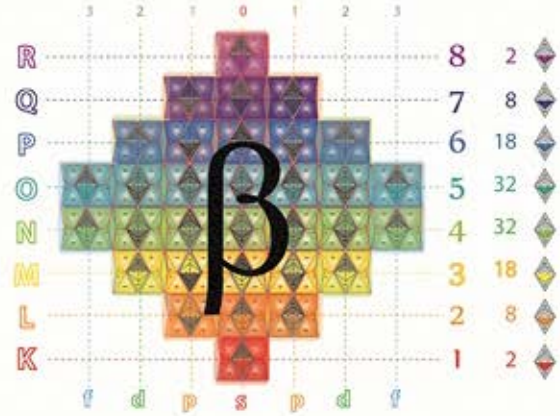

Energy levels

Azmithal & Magnetic numbers

Atomic Shells

Orbitals & sub-Orbitals

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Eigenstate - Ionisation energies

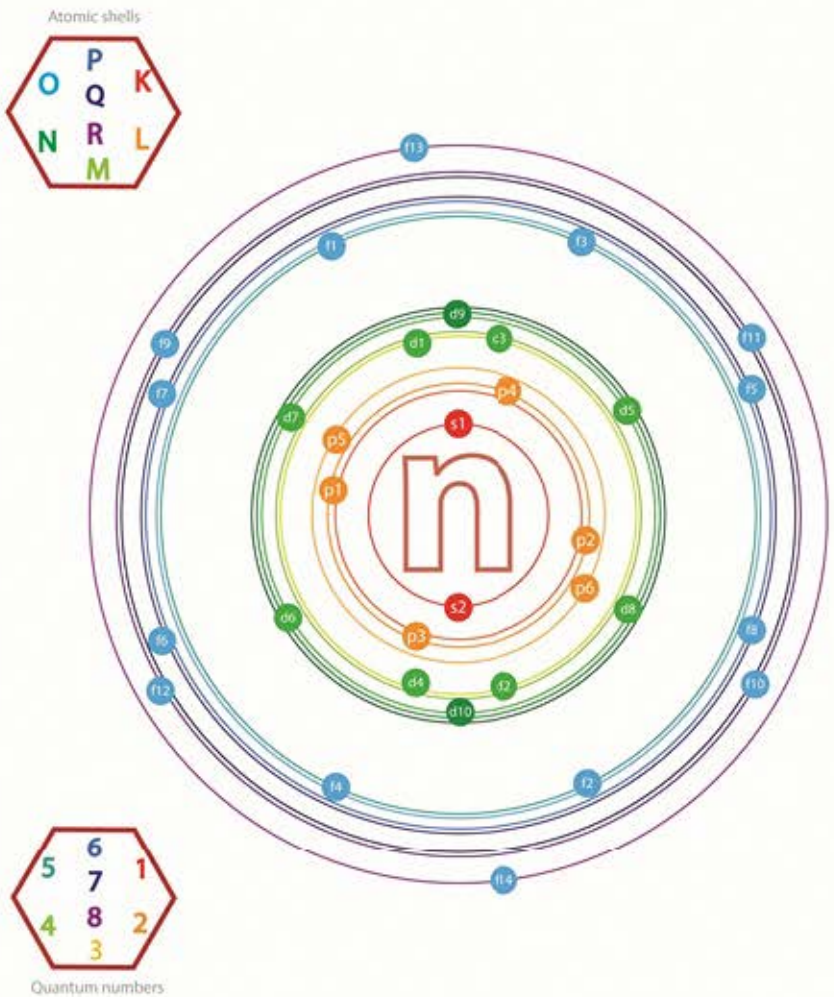

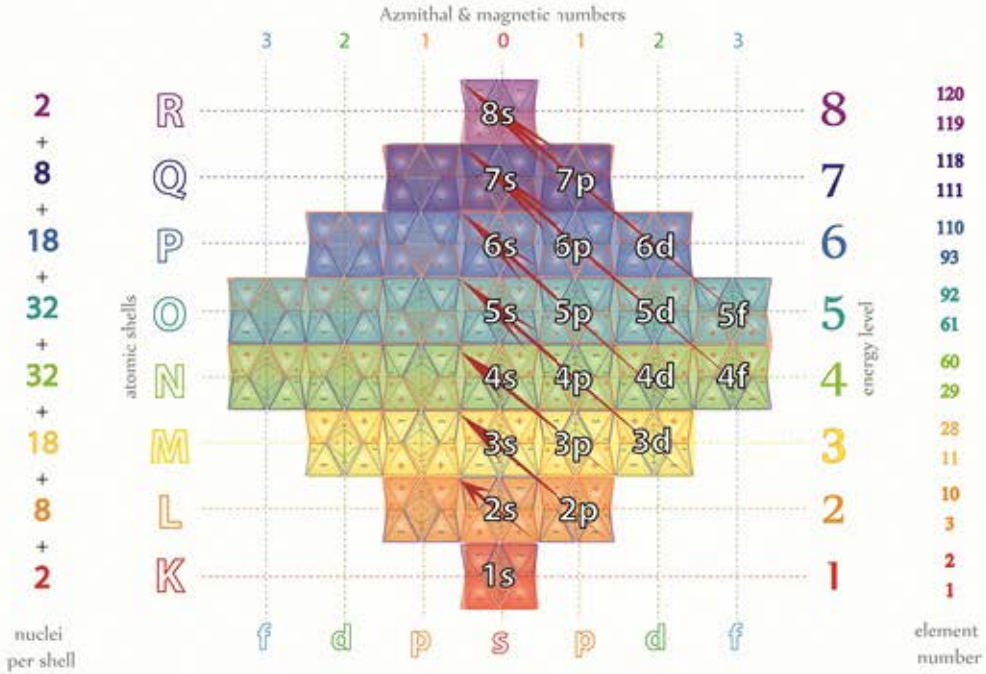

The ionisation energies of individual atoms varies due to many factors, namely:
electron spin-orbital coupling with Baryons of specific energies,
the relativistic energies of photo-electrons bound in nuclei
and Zitterbewegung effects on bound electrons

First ionisation energies for all periodic elements

$$E = -\frac{Z^2}{n^2}\frac{ke^2}{2a_0} = -\frac{13.6Z^2}{n^2}eV$$

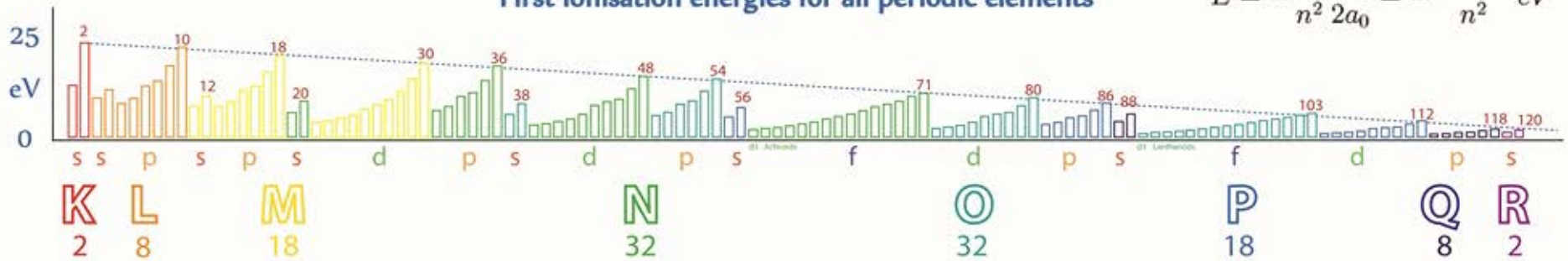

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Proton - Neutron Curve

The graph below is a plot of neutron number against proton number.
It is used as rule to determine which nuclei are stable or unstable.

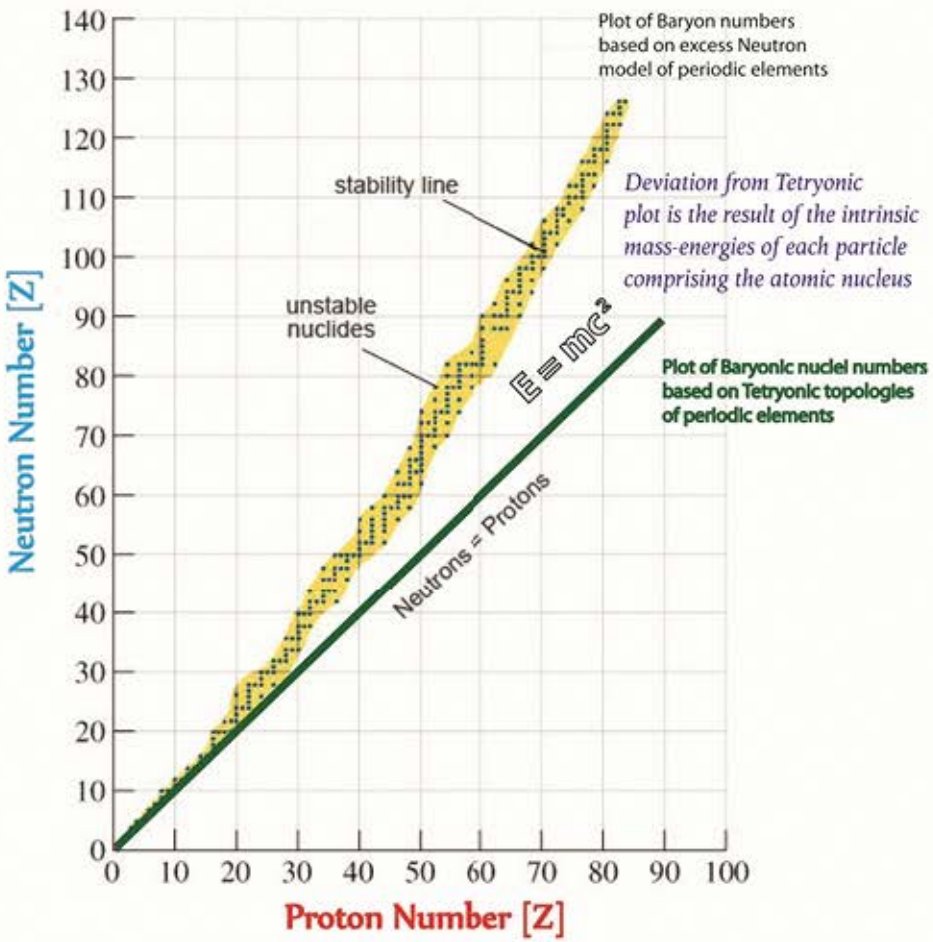

Historically, Proton-electron numbers are viewed as being equivalent in neutral elementary matter with the excess molar mass measured being the result of 'excess or extra' Neutrons in the atom

Atomic Nuclei Numbers

All periodic elements have an EQUAL number of Protons, Neutrons & Electrons with their molar mass-Matter being determined by their quantum level mass-energies

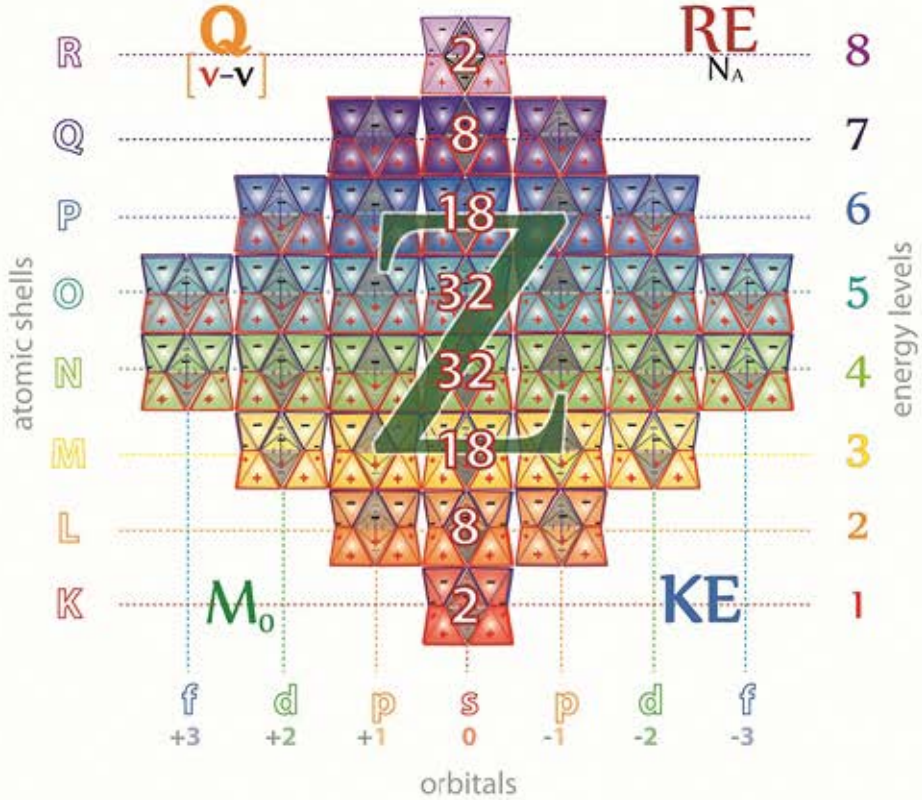

Tetryonic modelling of the charged mass-ENERGY-Matter topologies of elementary atoms and the nuclei that comprise them, reveals a DIRECT LINEAR relationship for the number of Protons-electrons-Neutrons in all periodic elements and nuclear isotopes

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Planck mass-energy contributions to elementary Matter and isotopes

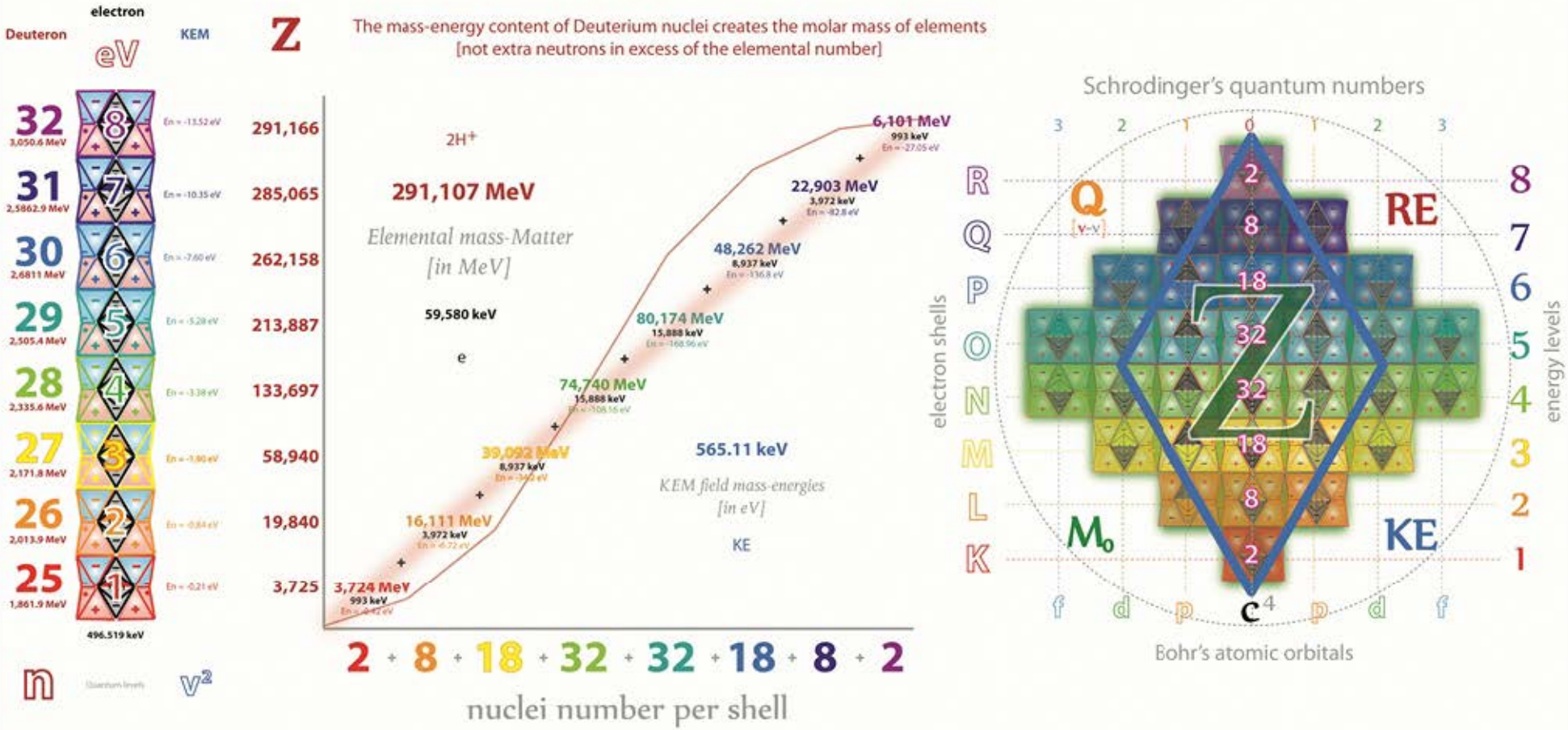

n1 Elementary nuclei

are comprised of equal numbers of Protons, Neutrons & electrons with varying energy levels

Baryons		electrons		KEM fields
930.947 MeV	+	**496.519 keV**	+	**13.525 ev**

The mass-energy content of Matter topologies is velocity invariant

The mass-energy content of Baryons determines the KEM field of electrons

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Baryons **930.947 MeV** + KEM fields **13.525 ev** + electrons **496.519 keV**

Mapping Planck mass-energy contributions to elementary Matter and isotopes

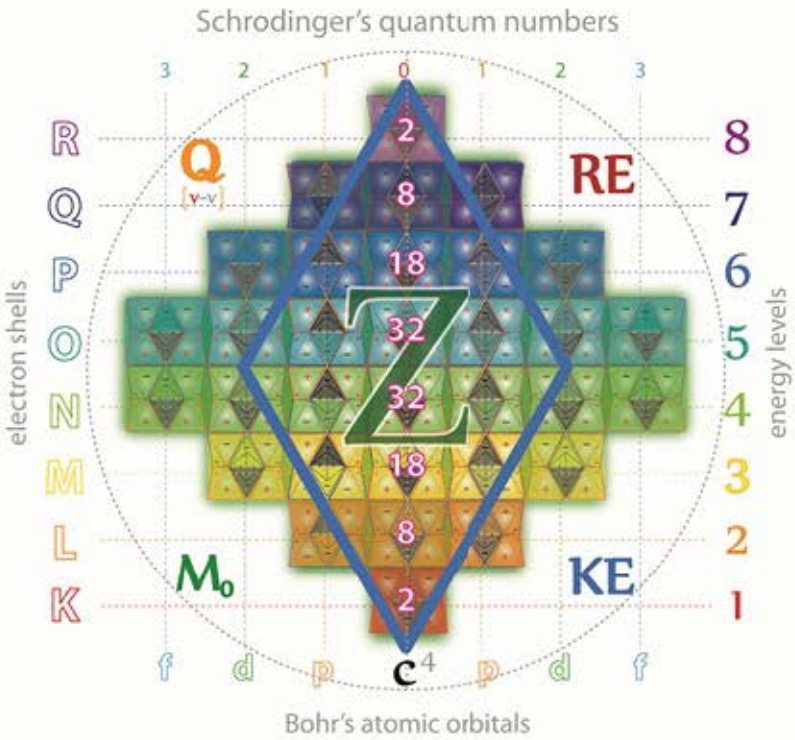

$$E = h\nu^2$$

$$n^2 + \nu^2 + e = Z$$

general form quatratic equation

$$ax^2 + bx + c = Z$$

$$E = nh\nu$$

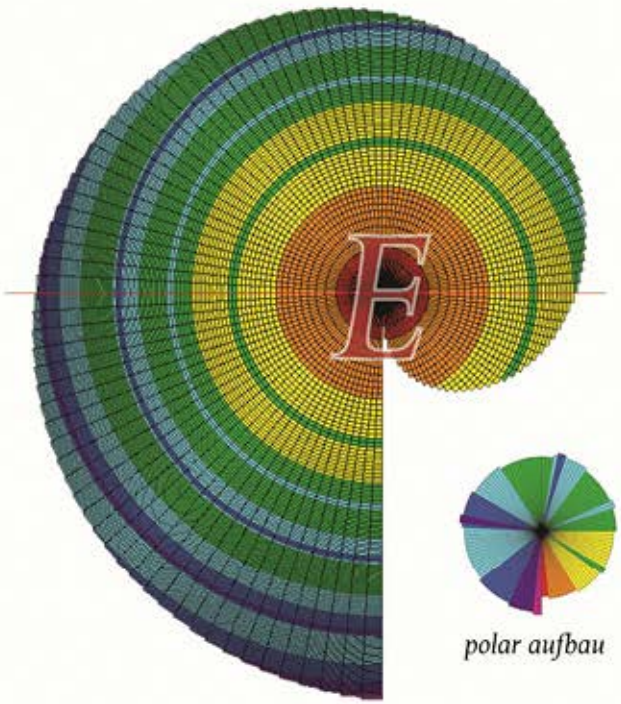

polar energy spirals courtesy of Rene Cormier

Identifying electron rest Matter topologies as velocity invariant we can re-arrange the component Planck mass-energy geometry formulation of periodic elements to

$$h\left[72[v^2]_{\text{Deuteron rest mass}} + v_{\text{Spectral lines}} + 1.20\,e20\,v_{\text{electron rest mass}}\right]$$

reveal a quadratic formulation for all Z numbers

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All elements are comprised of n level Duetrium nuclei

Baryons **KEM fields** **electrons**

$$Z\,[[72n^2] + [12v^2] + [1.2e20]]$$

1,861,949 MeV **13.525 eV** **496,519 keV**

$2H^+$ $[72n^2]$ — Z — γ $[M_e v^2]$

Elemental mass-Matter [in MeV]

The atomic shell energy levels of Deuterium nuclei in elements

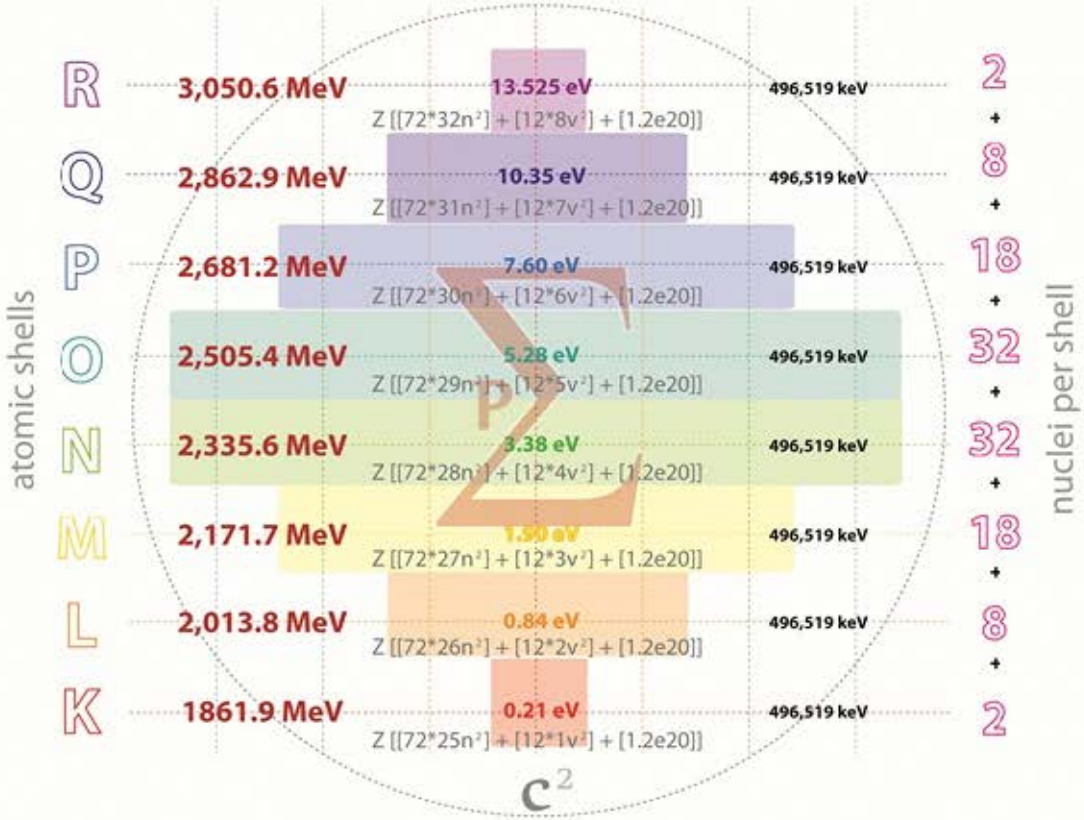

Elemental mass-Matter [in MeV]

6,101 MeV
993 keV
En = -27.05 eV
+
22,903 MeV
3,972 keV
En = -82.8 eV
+
48,262 MeV
8,937 keV
En = -316.8 eV
+
80,174 MeV
15,888 keV
En = -168.96 eV
+
74,740 MeV
15,888 keV
En = -108.16 eV
+
39,092 MeV
8,937 keV
En = -34.2 eV
+
16,111 MeV
3,972 keV
En = -6.72 eV
+
3,724 MeV
993 keV
En = -0.42 eV

[1.2e20]]

e

the rest mass-Matter of bound photo-electrons is velocity invariant

Determines the spectral line [KEM field energies] of electrons bound to them

The relativistic rest mass-energy-Matter of all periodic elements

is the sum of the mass-energies of all atomic nuclei and spectral lines that comprise its mass-Matter topology as measured in any spatial co-ordinate system per unit of time

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Avagadro's number

6.022141579 e26
atoms in 1KG of Matter

1 KG mass
[of Matter]

1.660538841 e-27 kg
atomic rest mass-Matter

Hydrogen

01

using SI units Avagadro's number can be expressed exactly as the inverse rest mass of Hydrogen

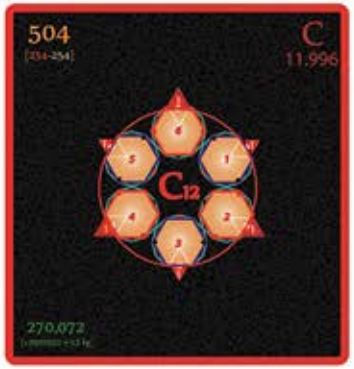

Weighted atomic mass

Carbon

12

5.019789213 e25
atoms in 1KG of Matter

6.02214078 e 23

1.99211552 e-26 kg
atomic rest mass-Matter

Tetryonic charge geometries make weighted atomic mass measurements and calculations obsolete

22,506 1/12 of Carbon 12 [Graphene] is not equal to 1 Hydrogen atom 22,512
(Deuterium is the building block of all atomic elements]

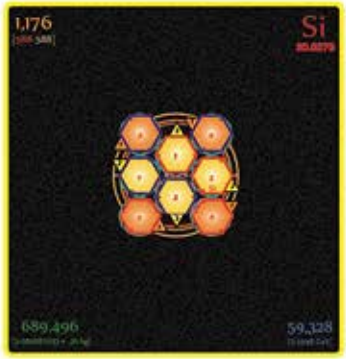

1.966225348 e25
atoms in 1KG of Matter

International Avagadro project

5.085887033 e-26 kg
atomic rest mass-Matter

Silicon

28

The gram was originally defined in 1795 as the mass of one cubic centimeter of water at 4°C, making the kilogram equal to the mass of one liter of water.

The prototype kilogram, manufactured in 1799 and from which the current kilogram is based has a mass equal to the mass of 1.000025 liters of water

In recent years two major experiments, namely the Watt balance & Avagadro projects, have been attempting to measure and define 1KG of mass-Matter in terms of electrical force and the number of atoms respectively in order to better define 1KG of mass-Matter precisely for all future physical references

Platinum

191

2.817950081 e24
atoms in 1KG of Matter
3.181804449 e23

90%
10%

La Grande K

The La grande K is an alloy of 90% Platinum & 10% Iridium that has been slowly losing mass since its manufacture

Pt
Ir

3.1893811012 e-25 kg
atomic rest mass-Matter
3.142870708 e-25 kg

All atomic rest masses are for atoms at absolute zero and any deviation is a measure of the topological Matter's Kinetic energy content [chemical energy, KEM fields and/or spectral lines]

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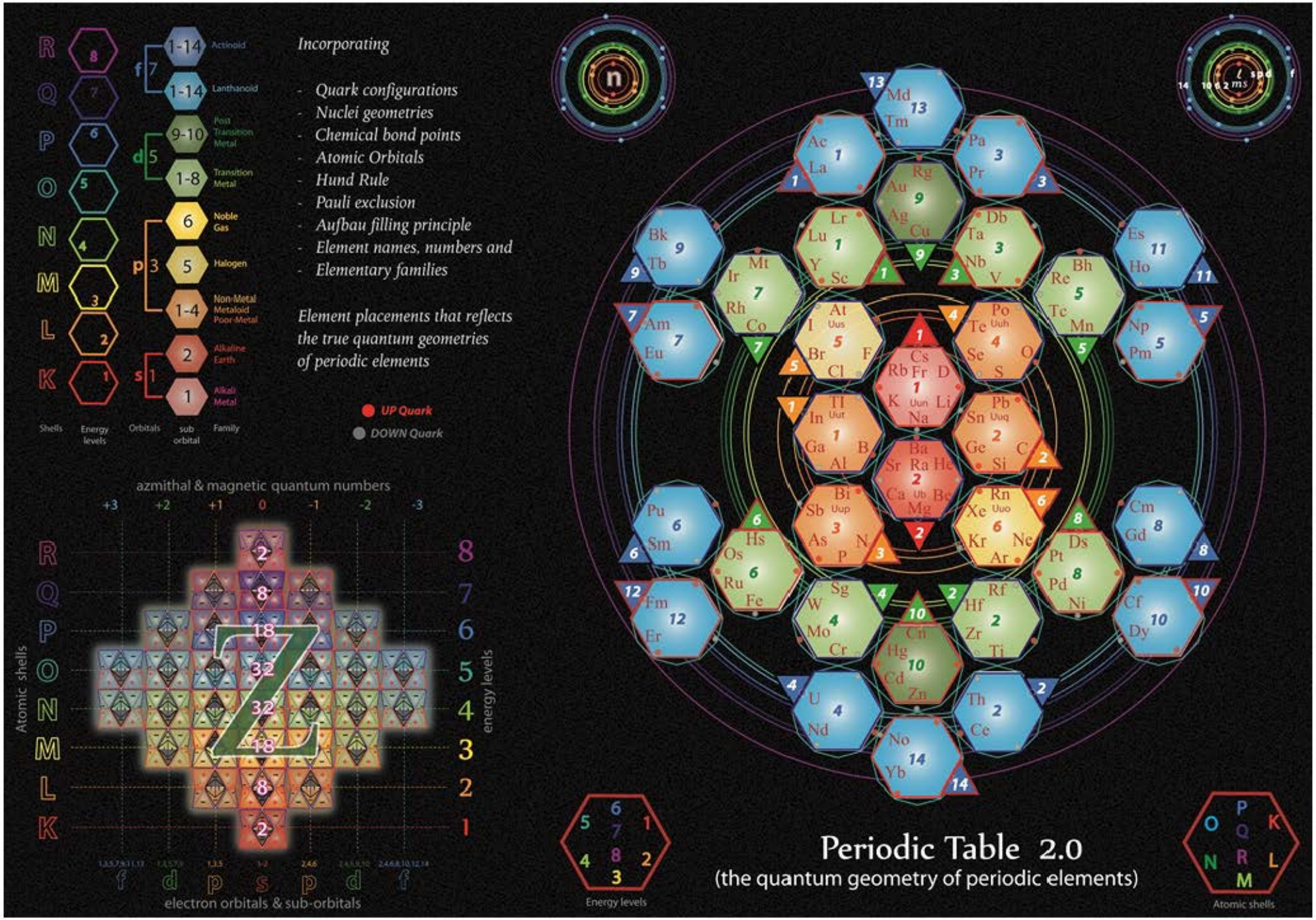

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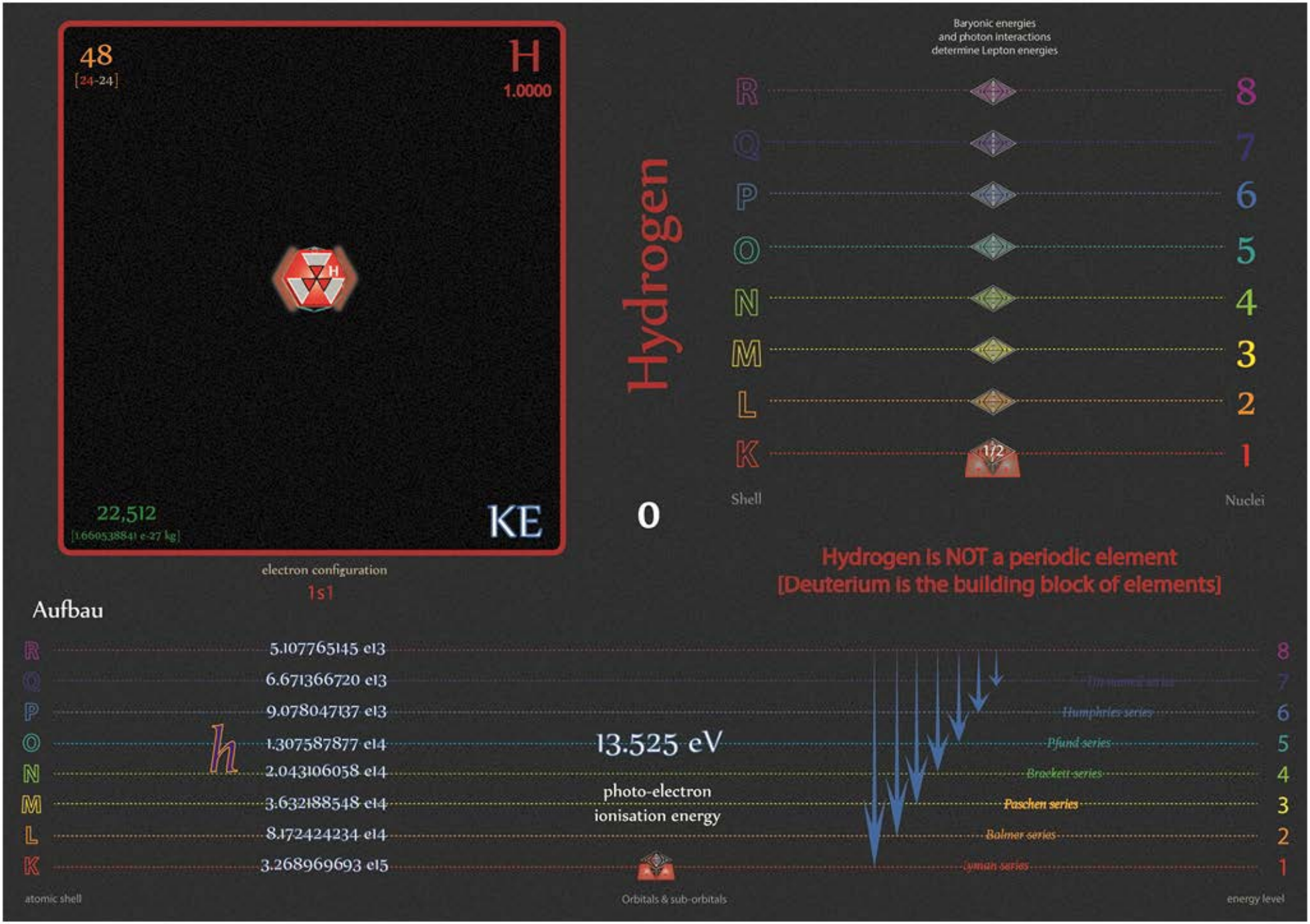

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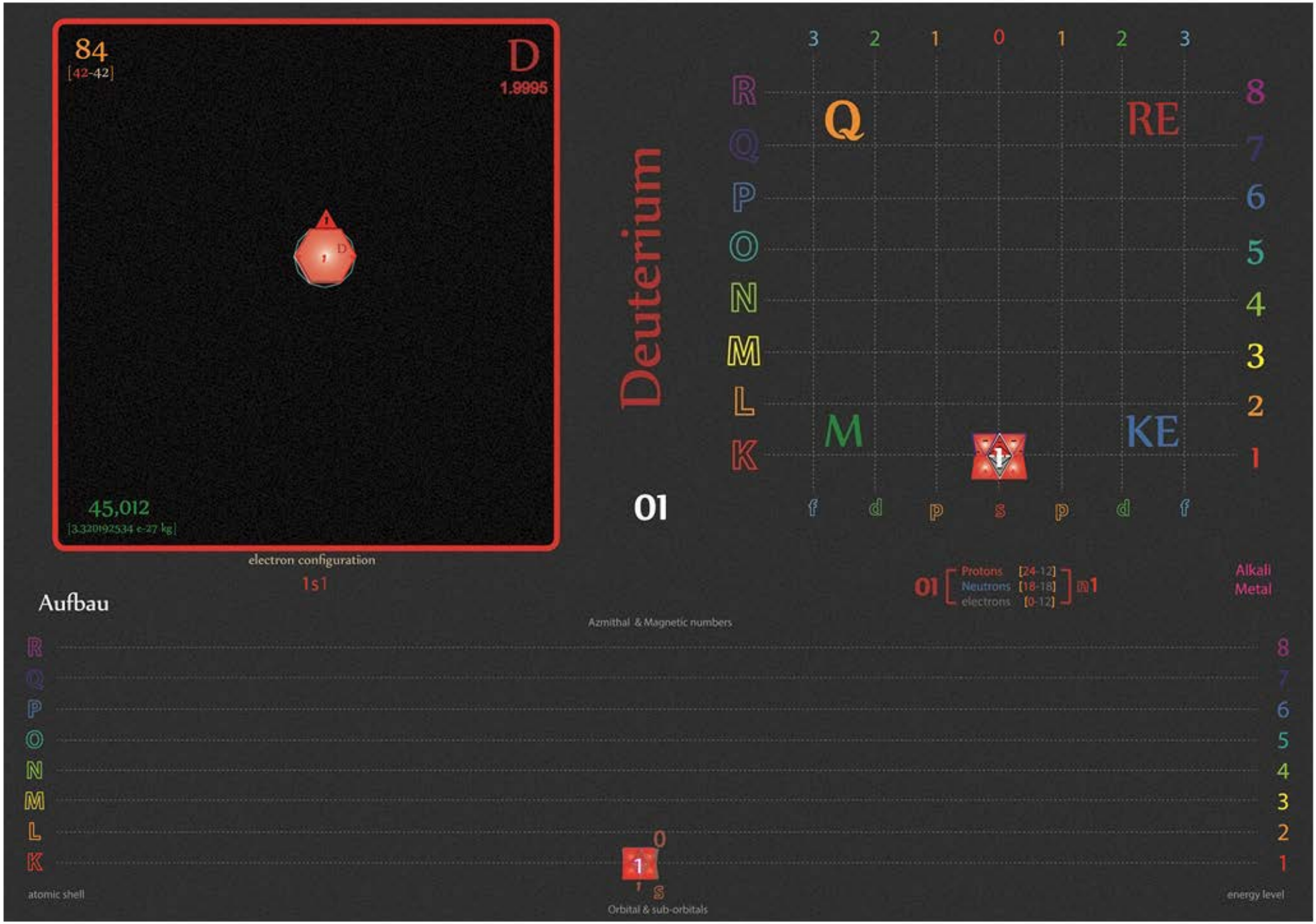

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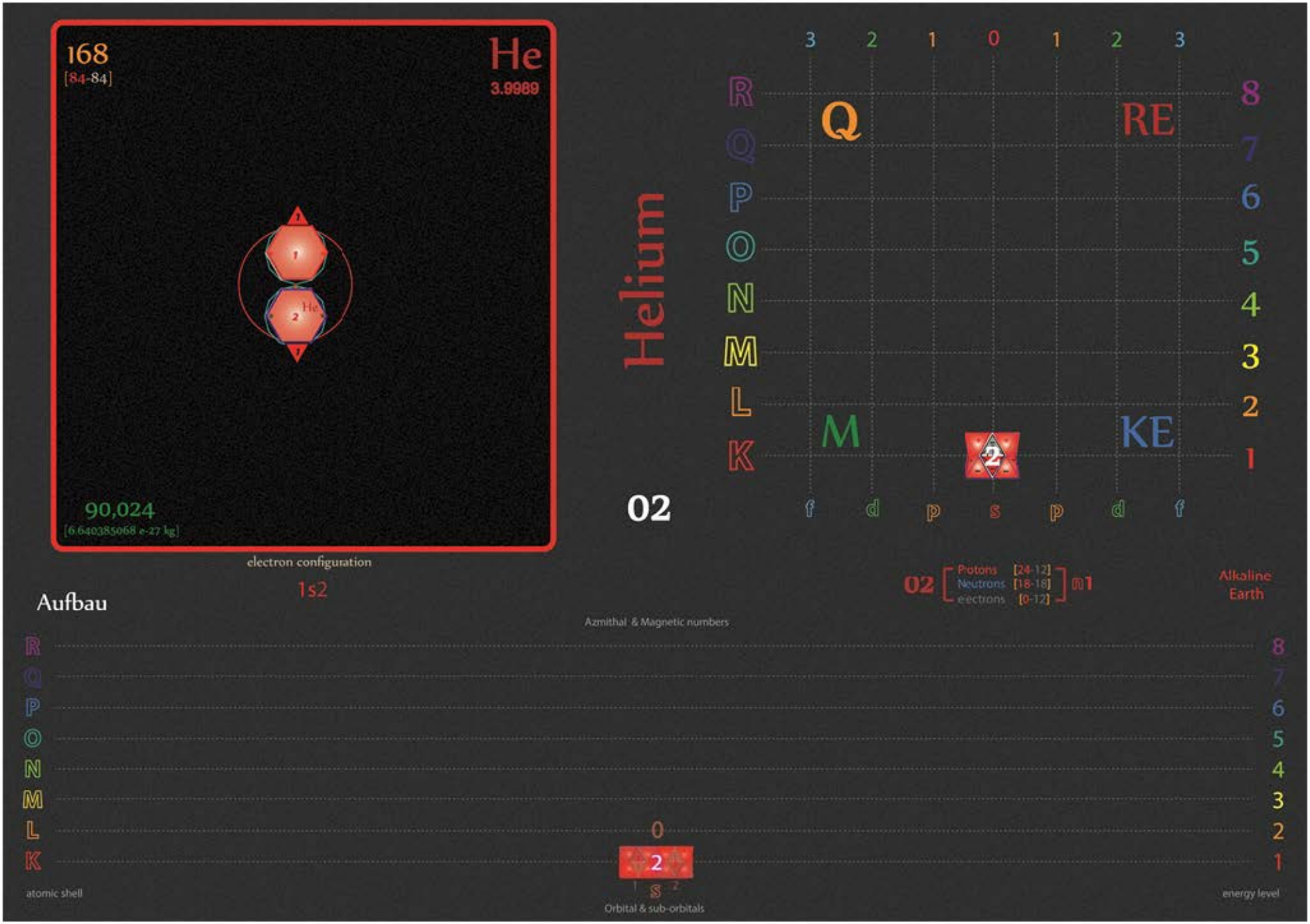

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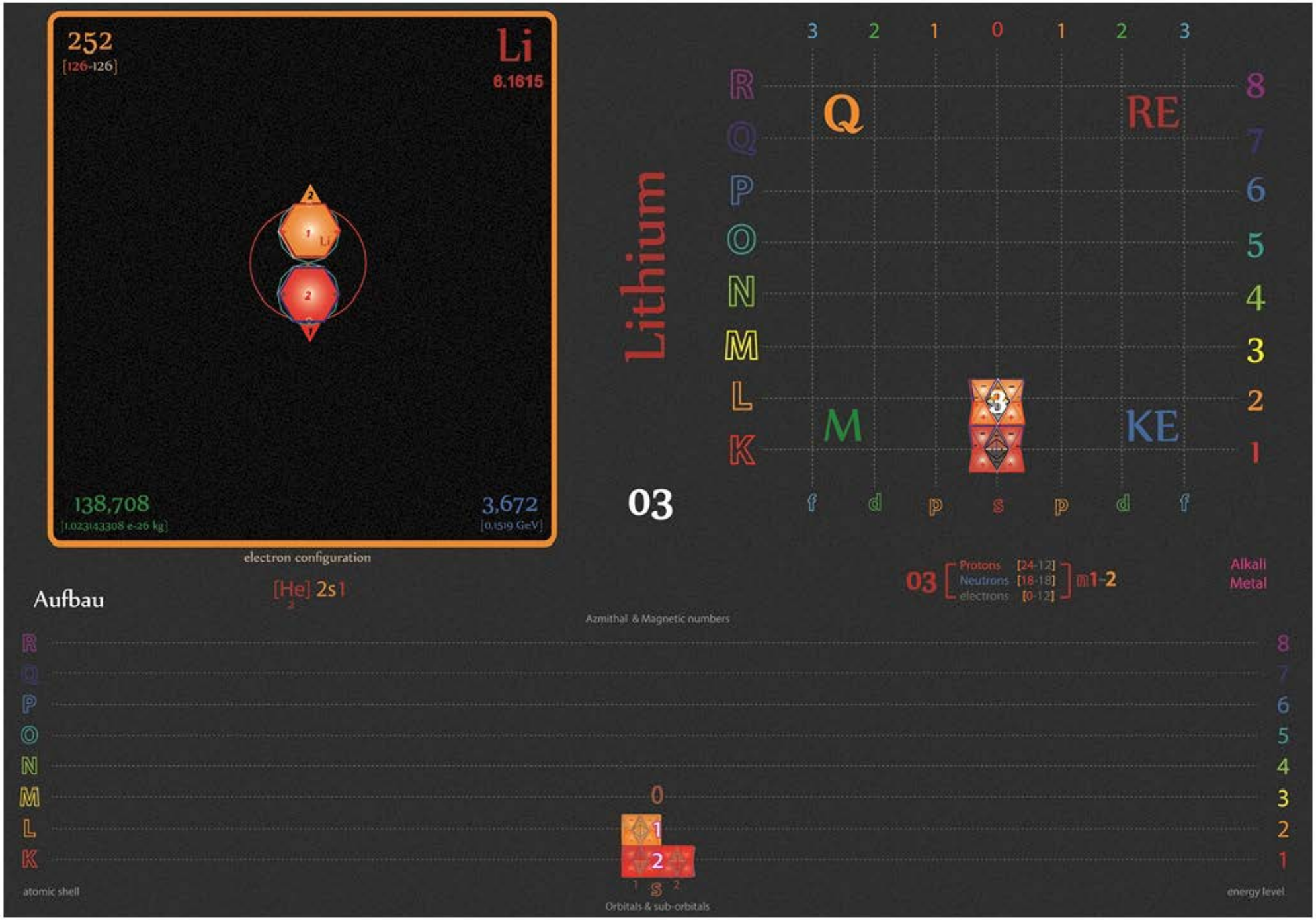

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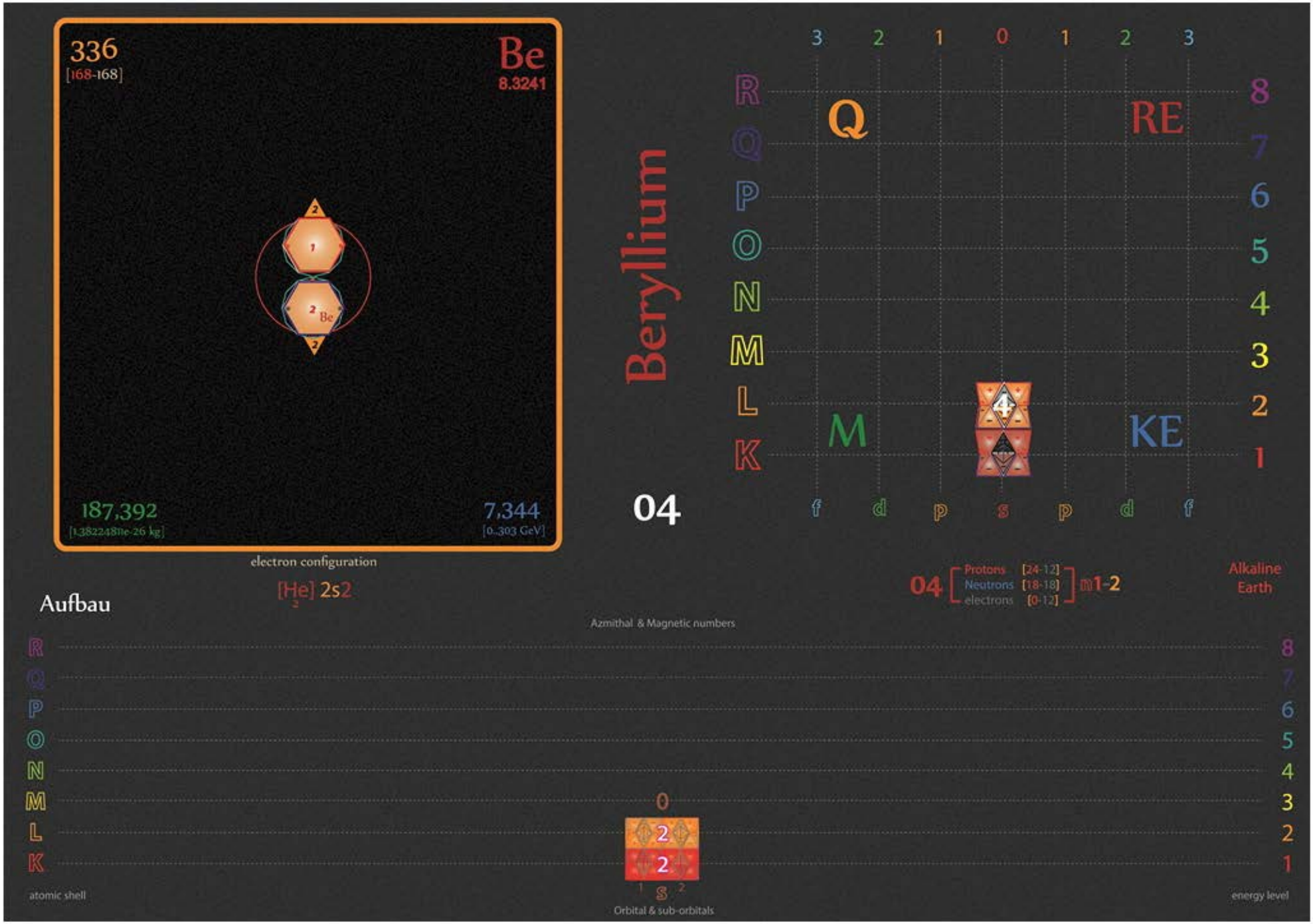

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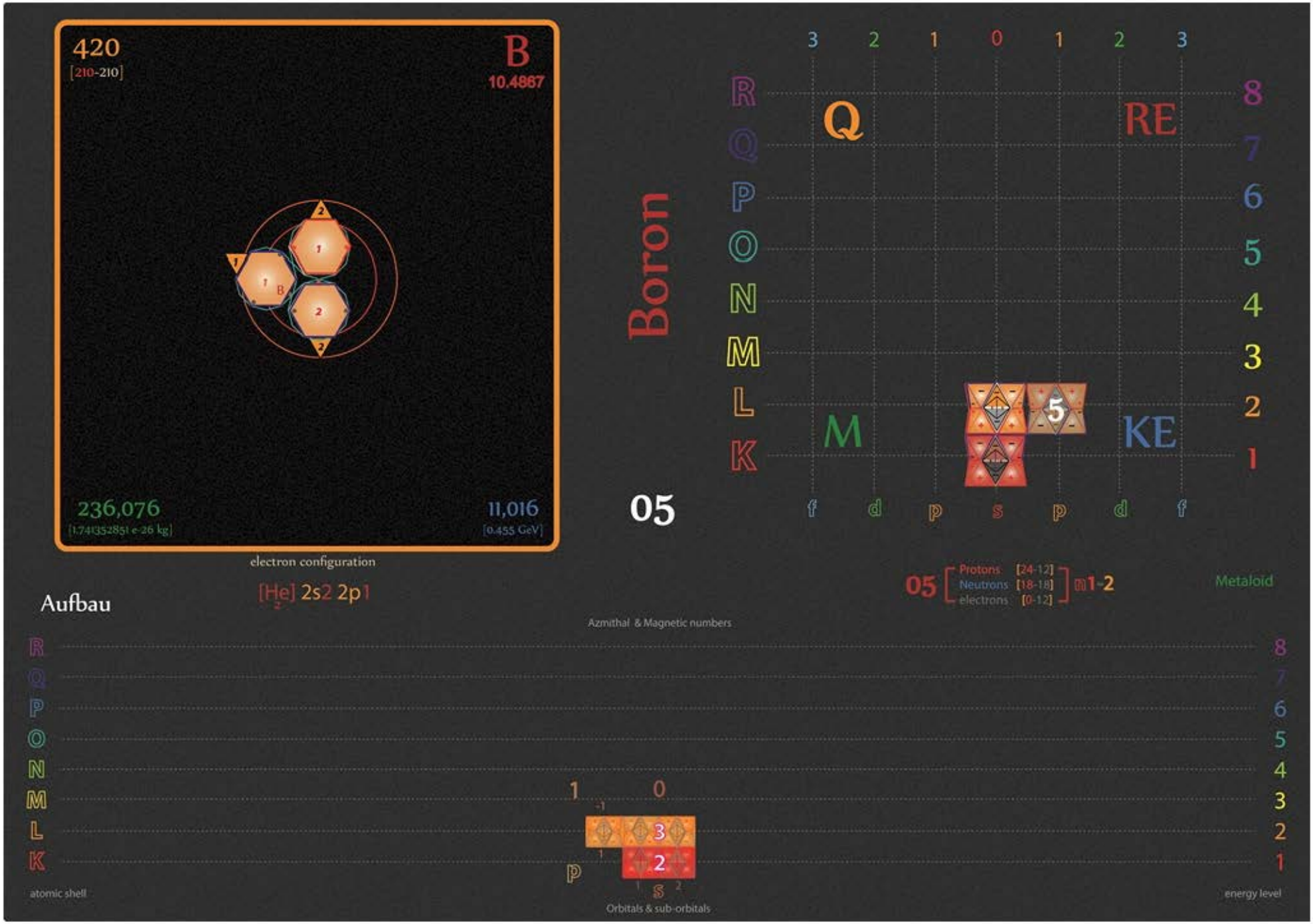

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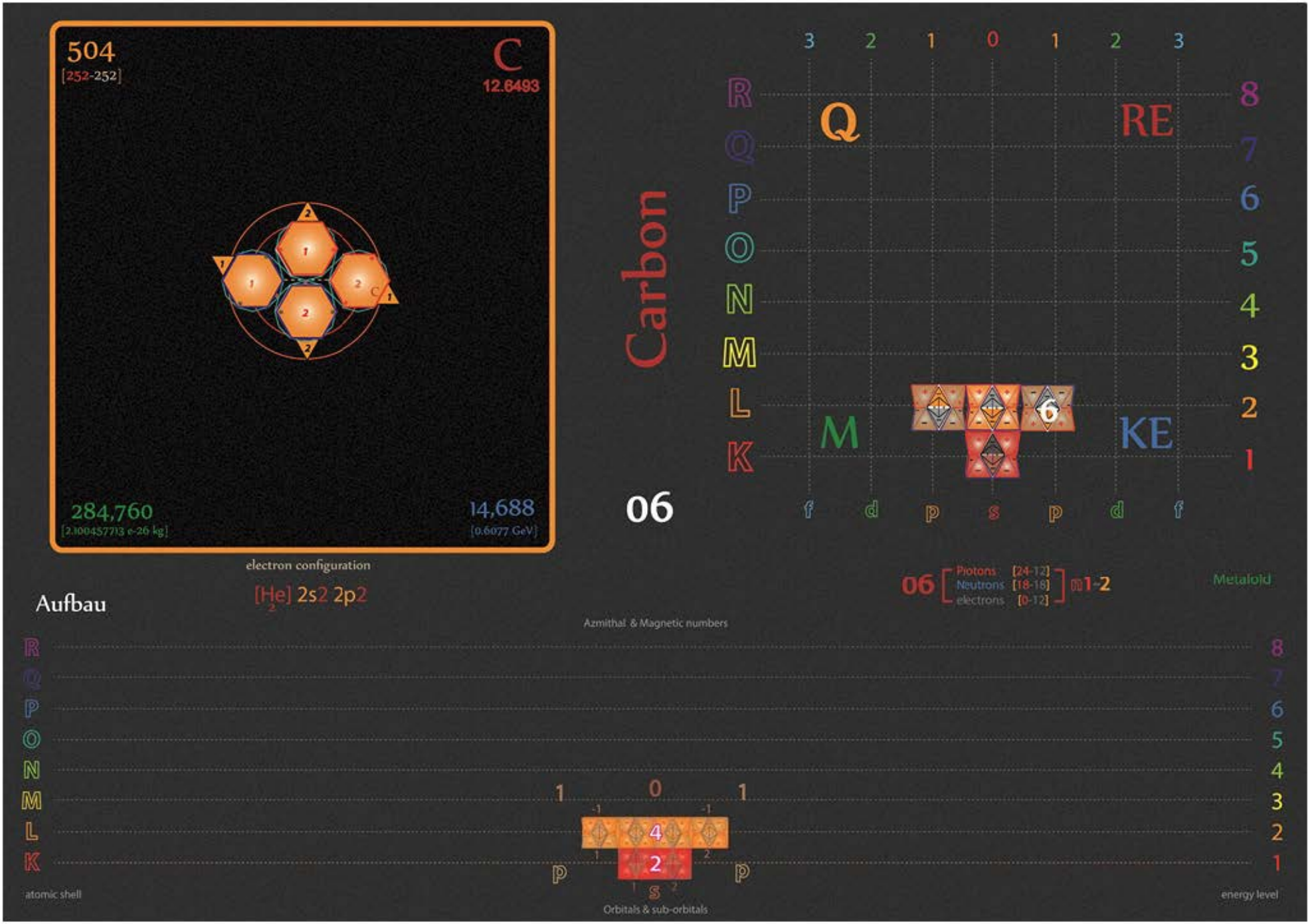

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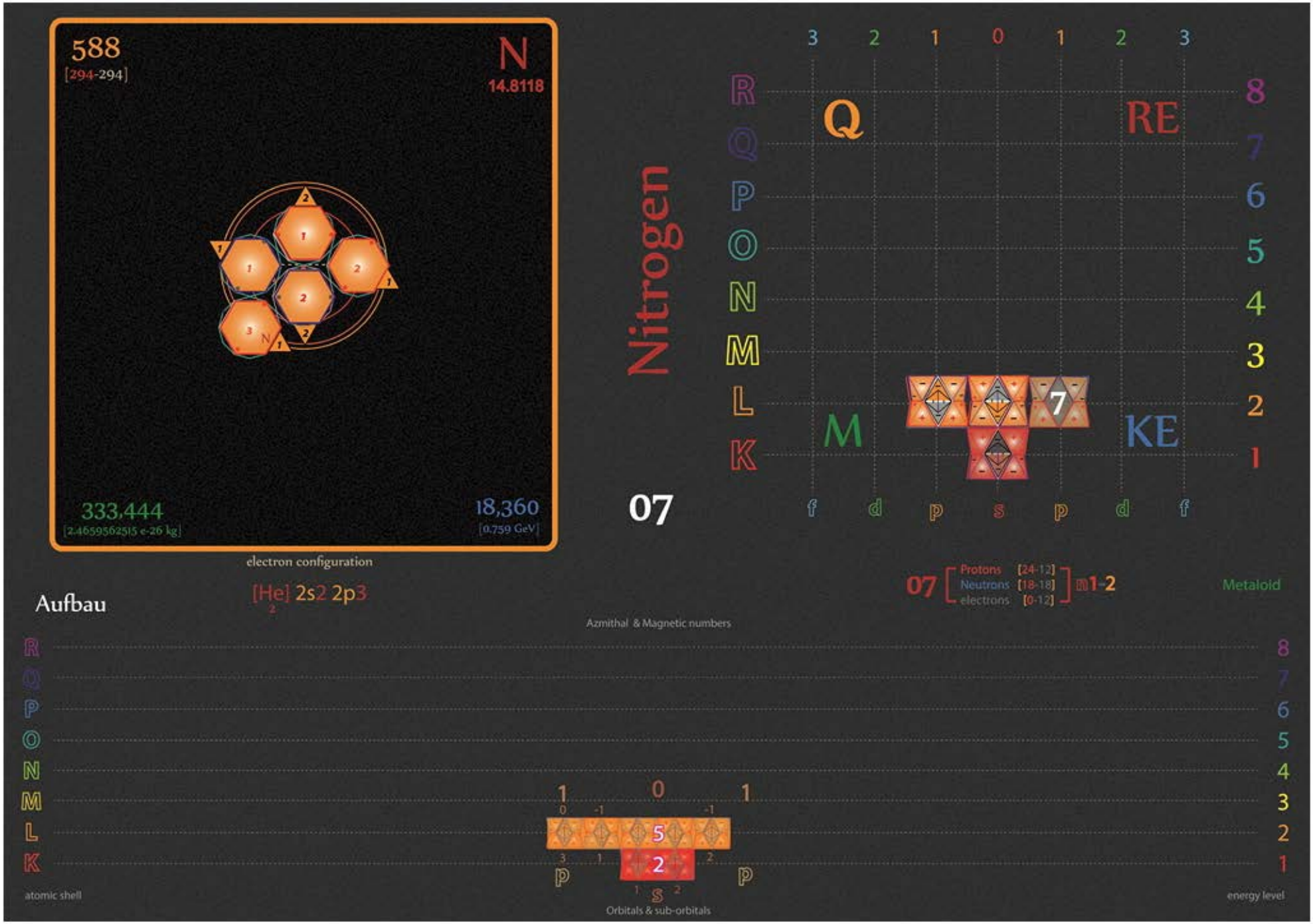

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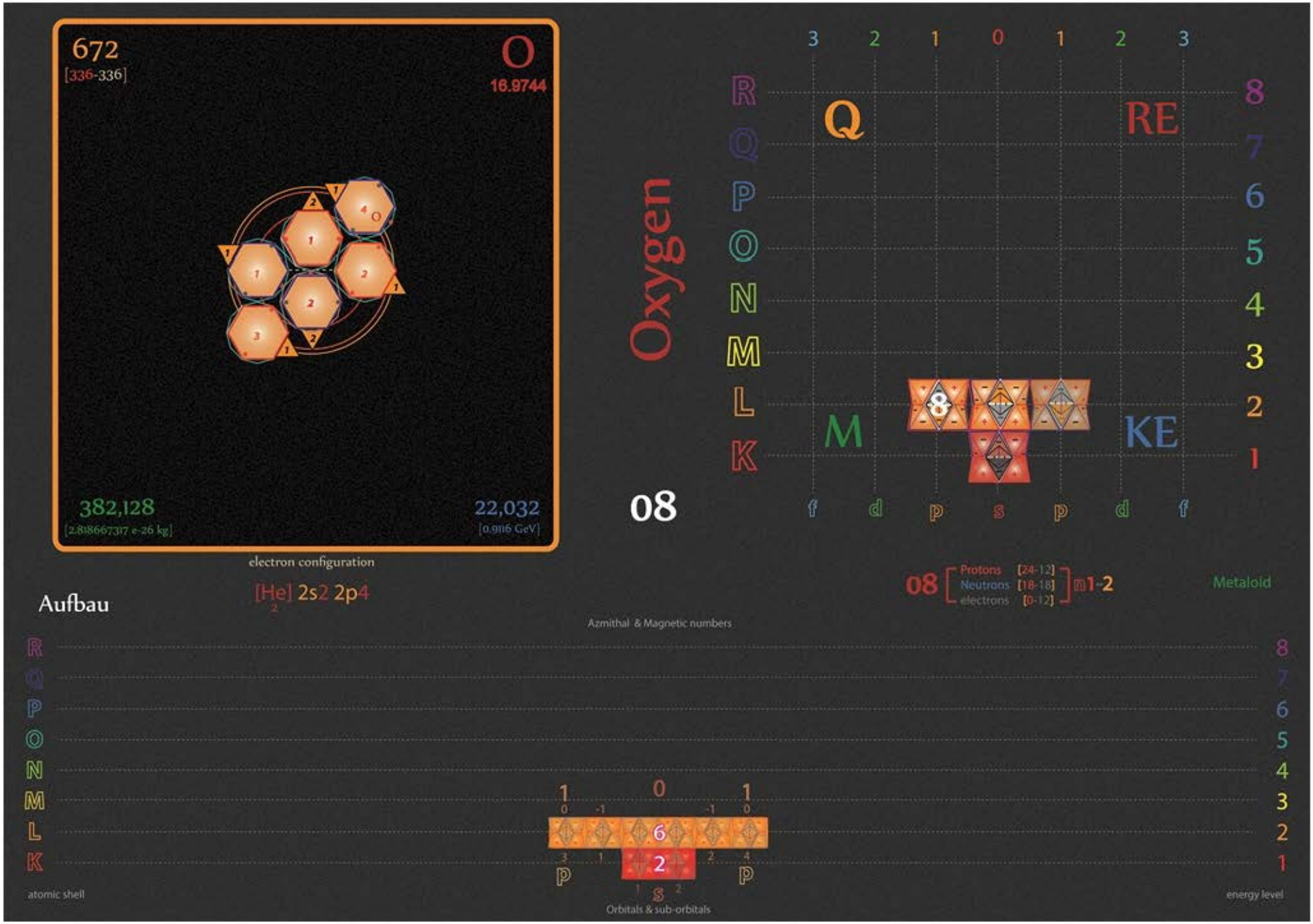

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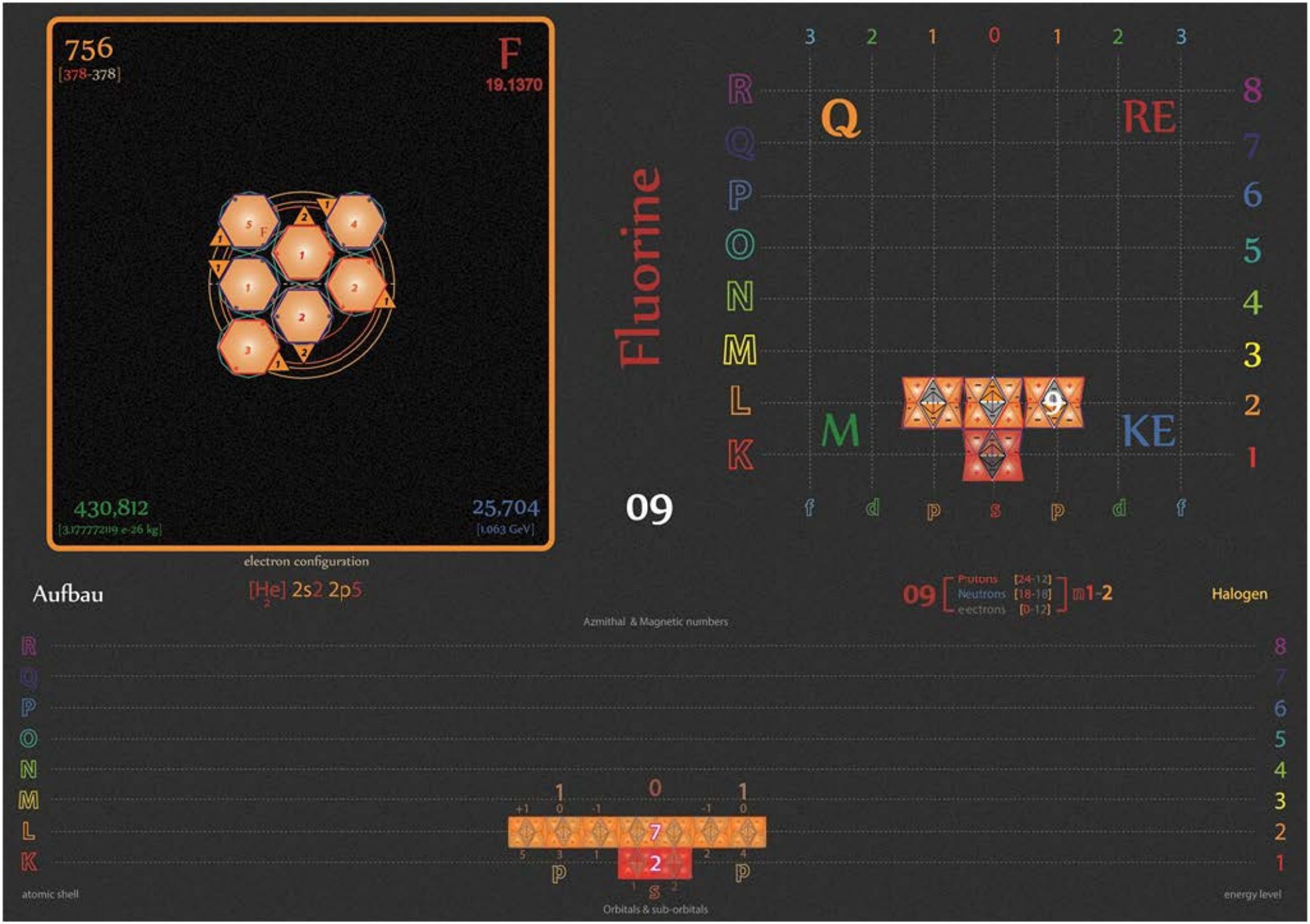

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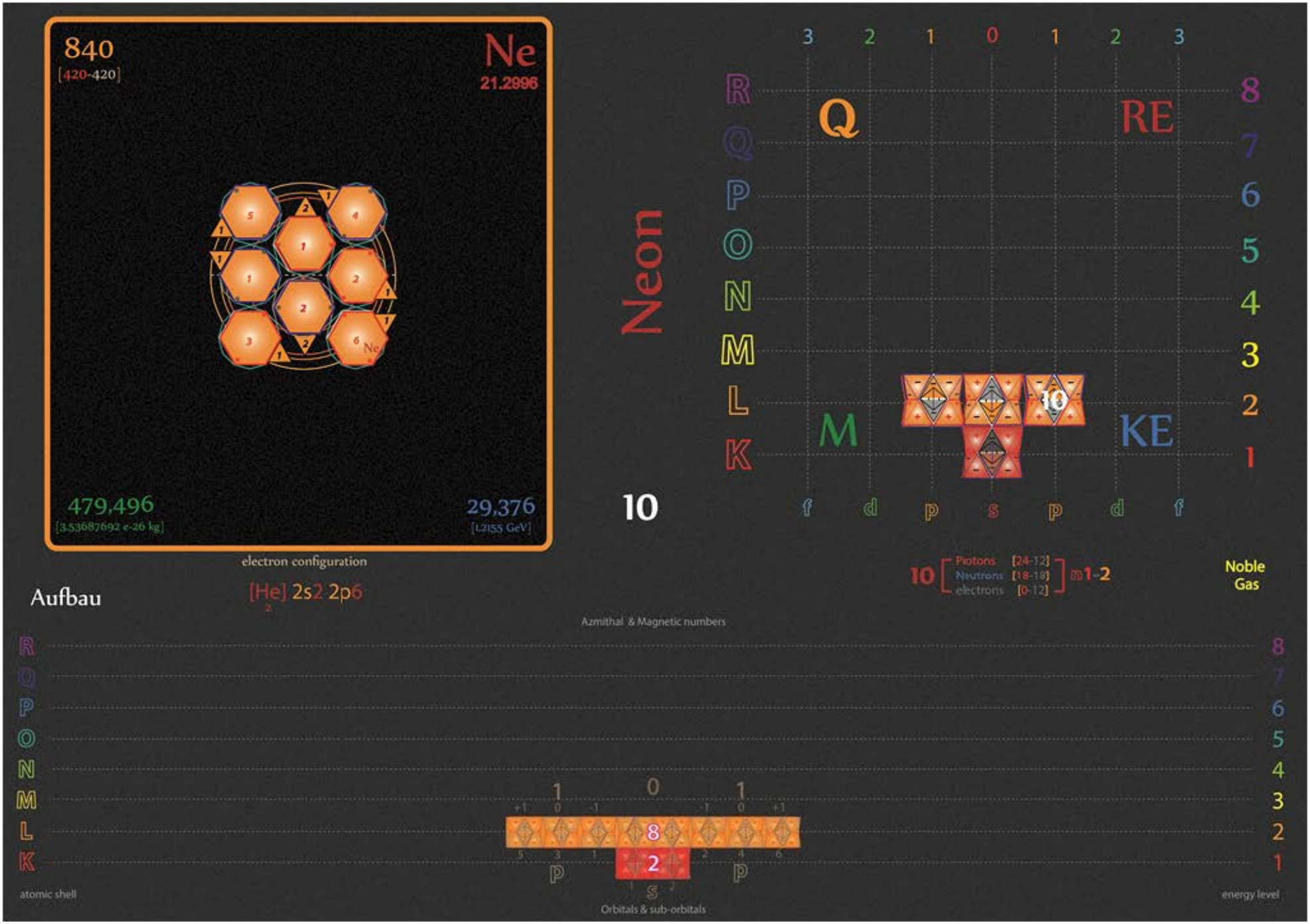

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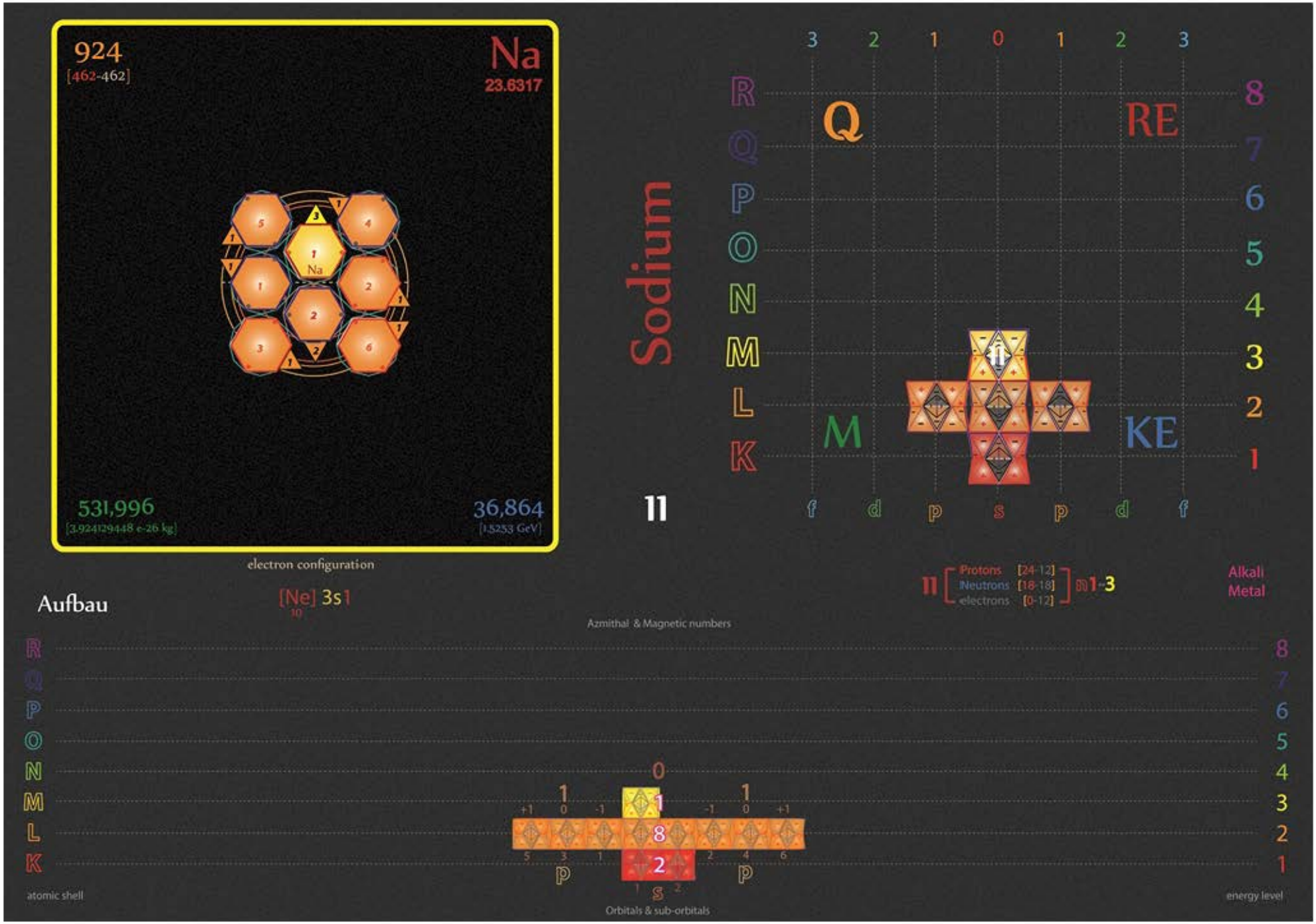

Tetryonics 51.11 - Sodium atom

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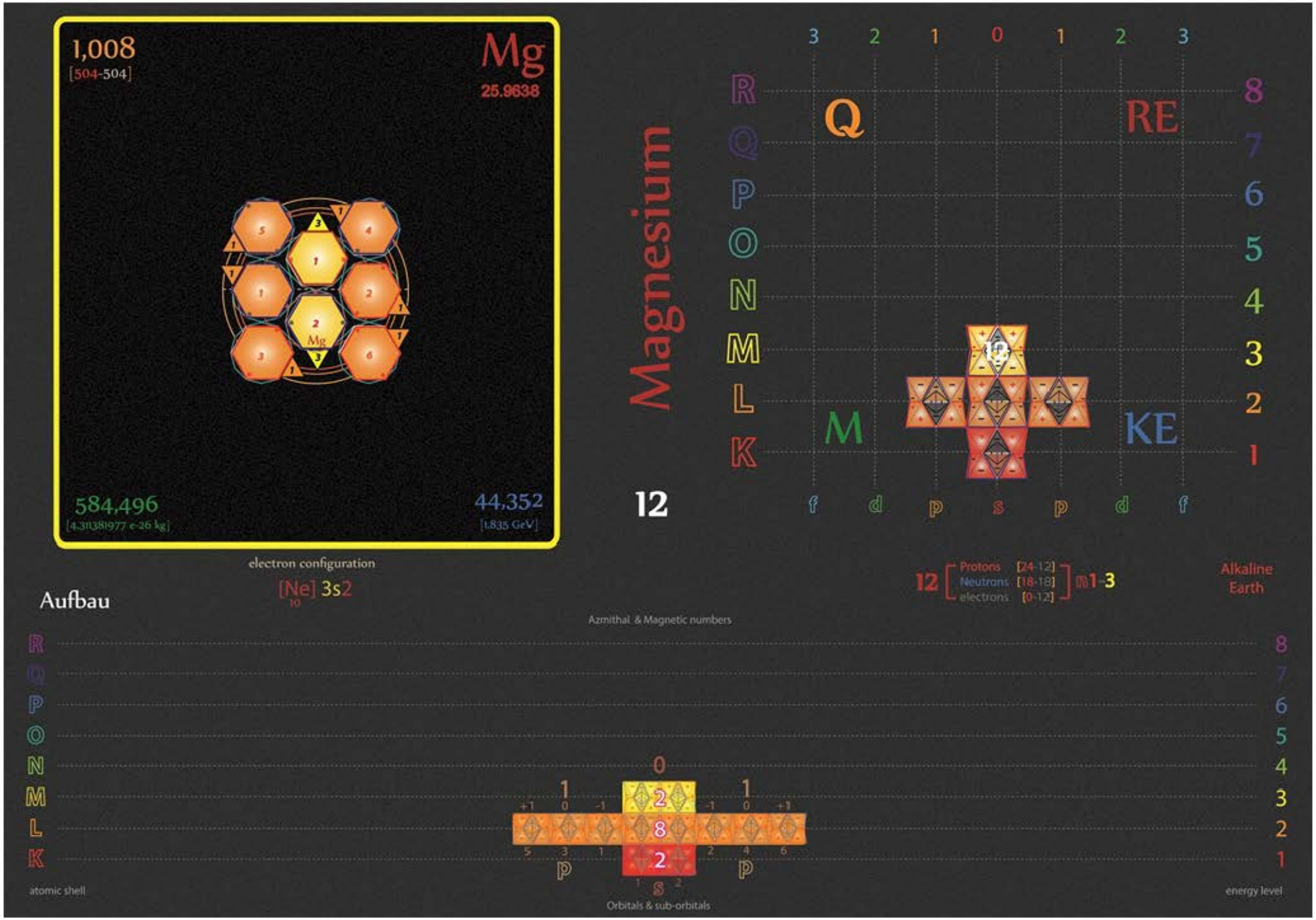

Tetryonics 51.12 - Magnesium atom

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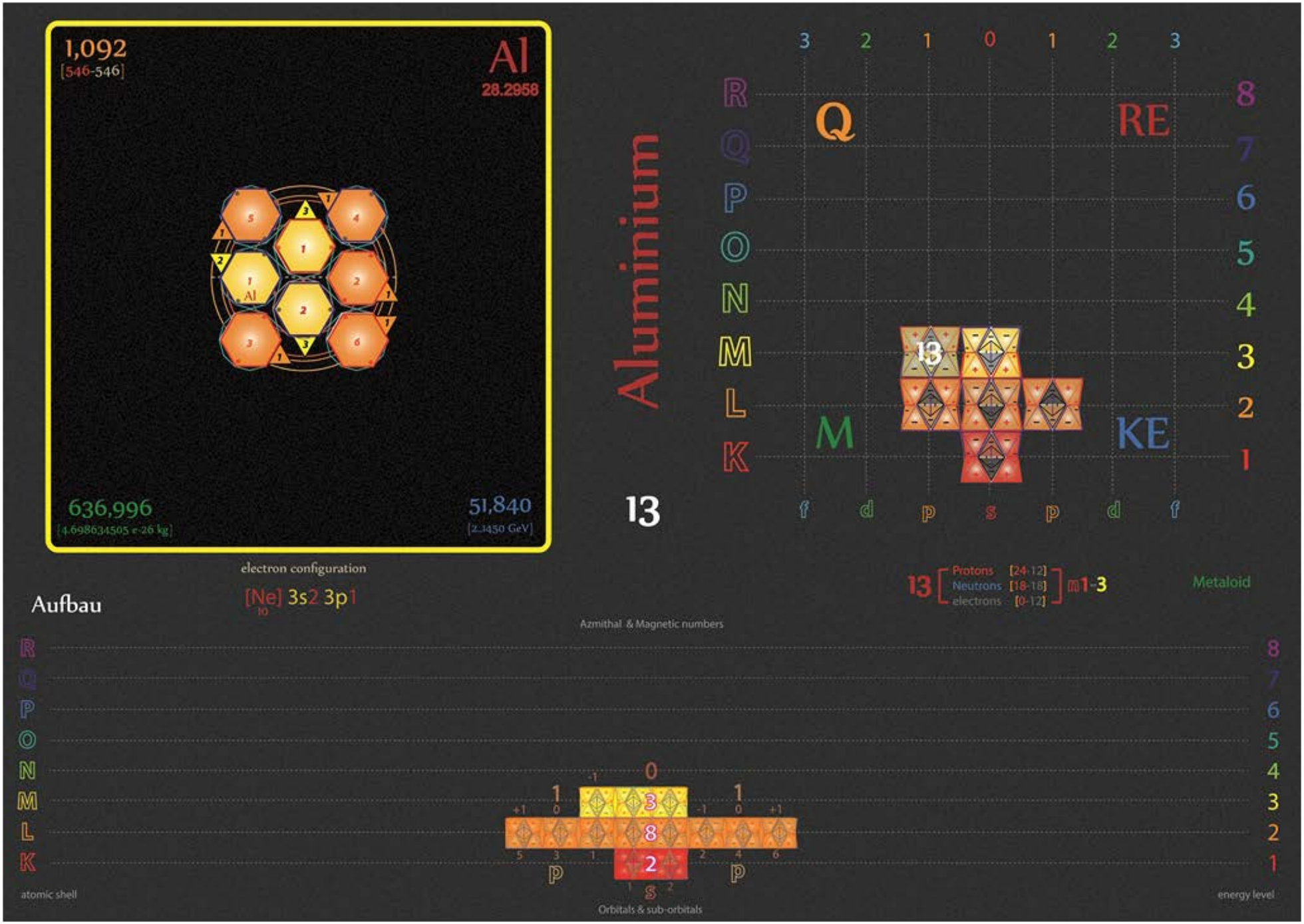

Tetryonics 51.13 - Aluminium atom

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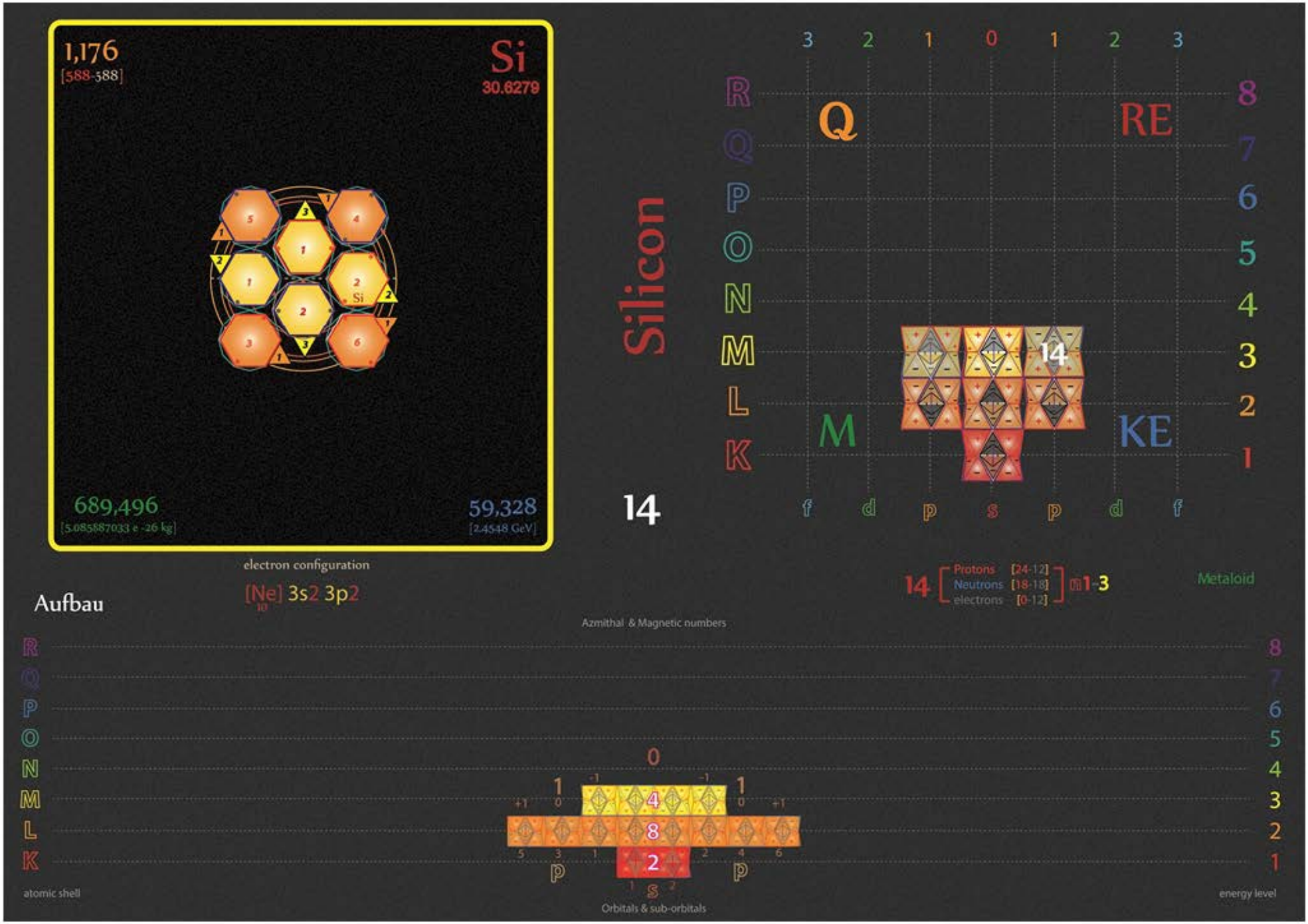

Tetryonics 51.14 - Silicon atom

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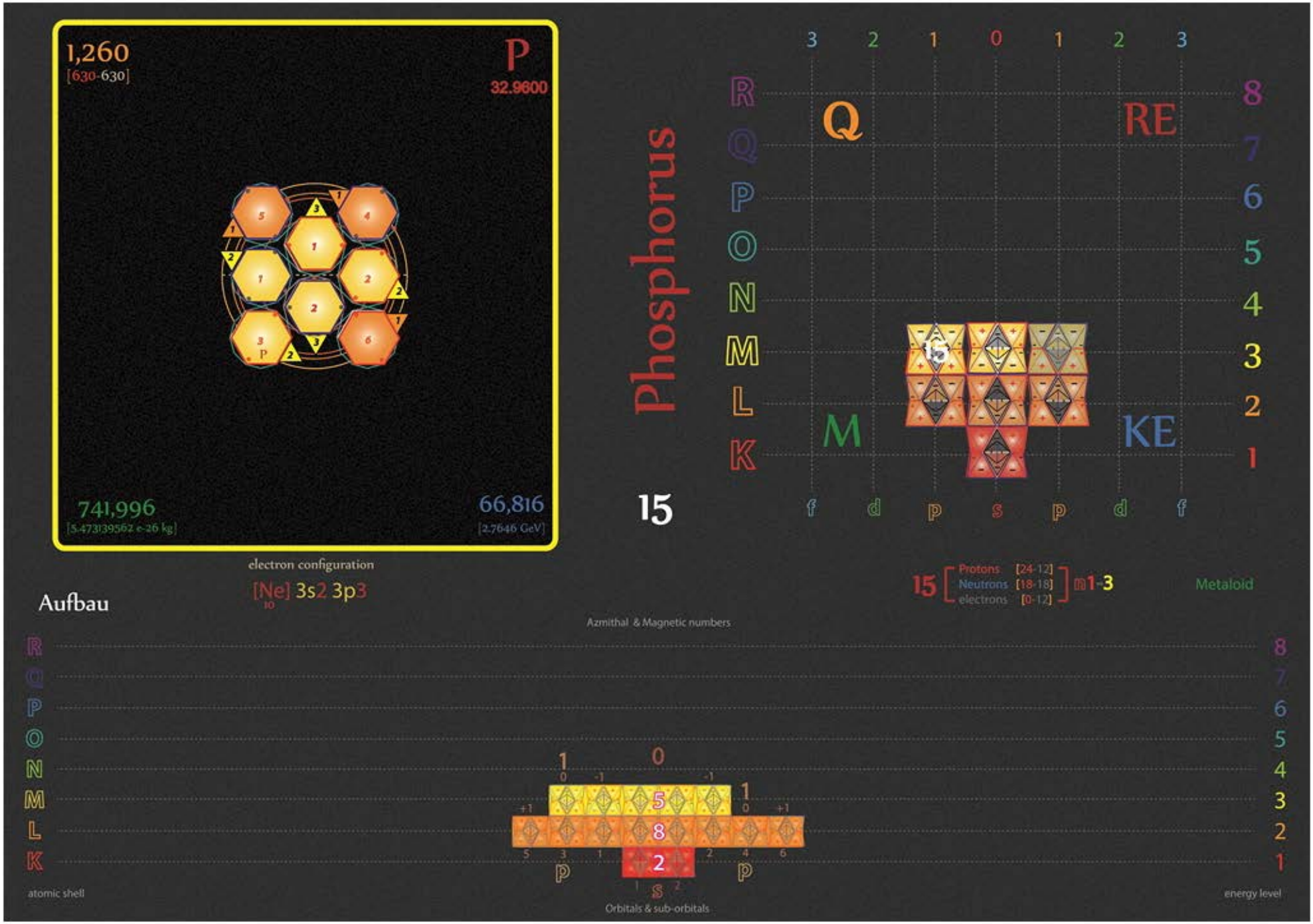

Tetryonics 51.15 - Phosphorus atom

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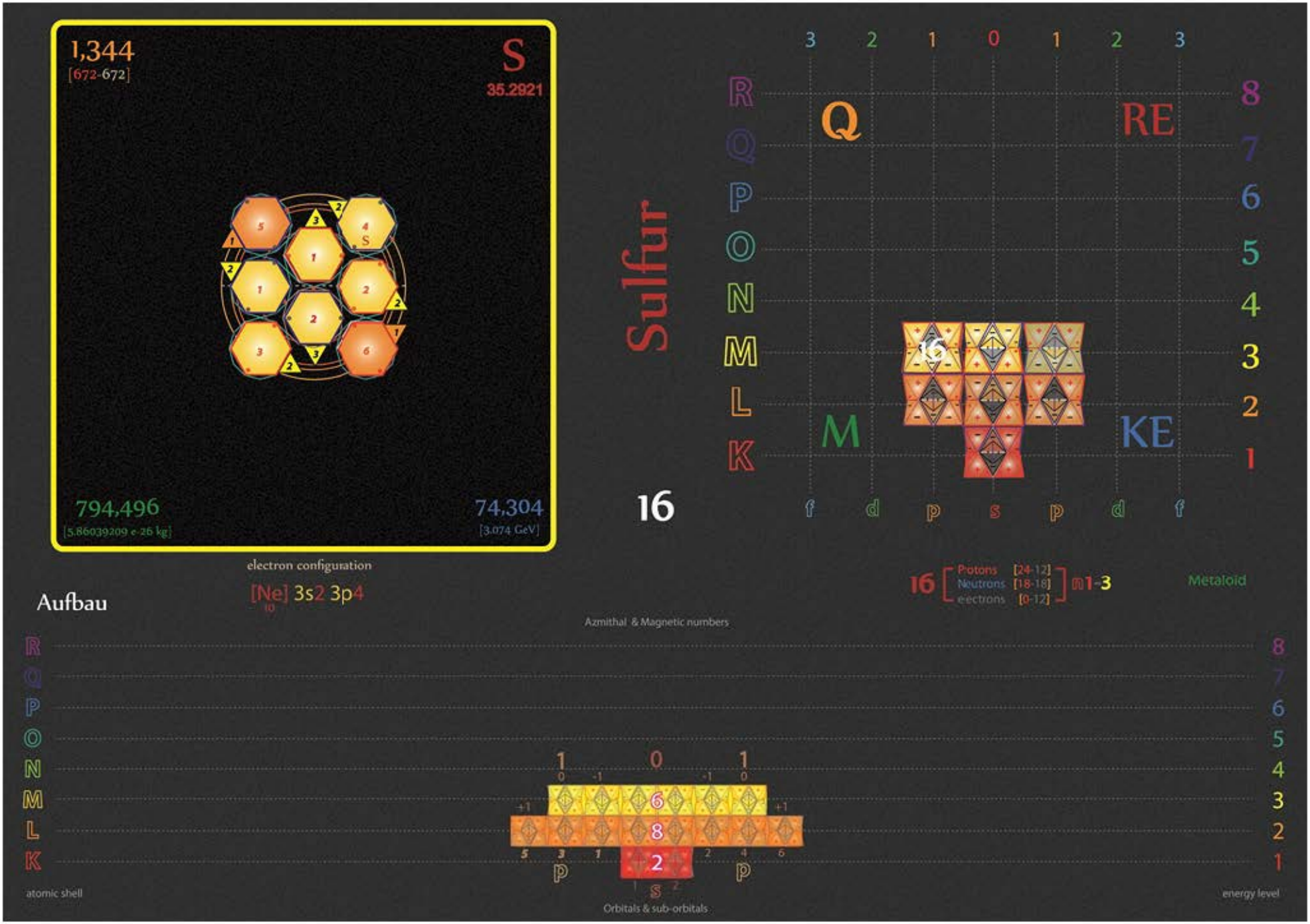

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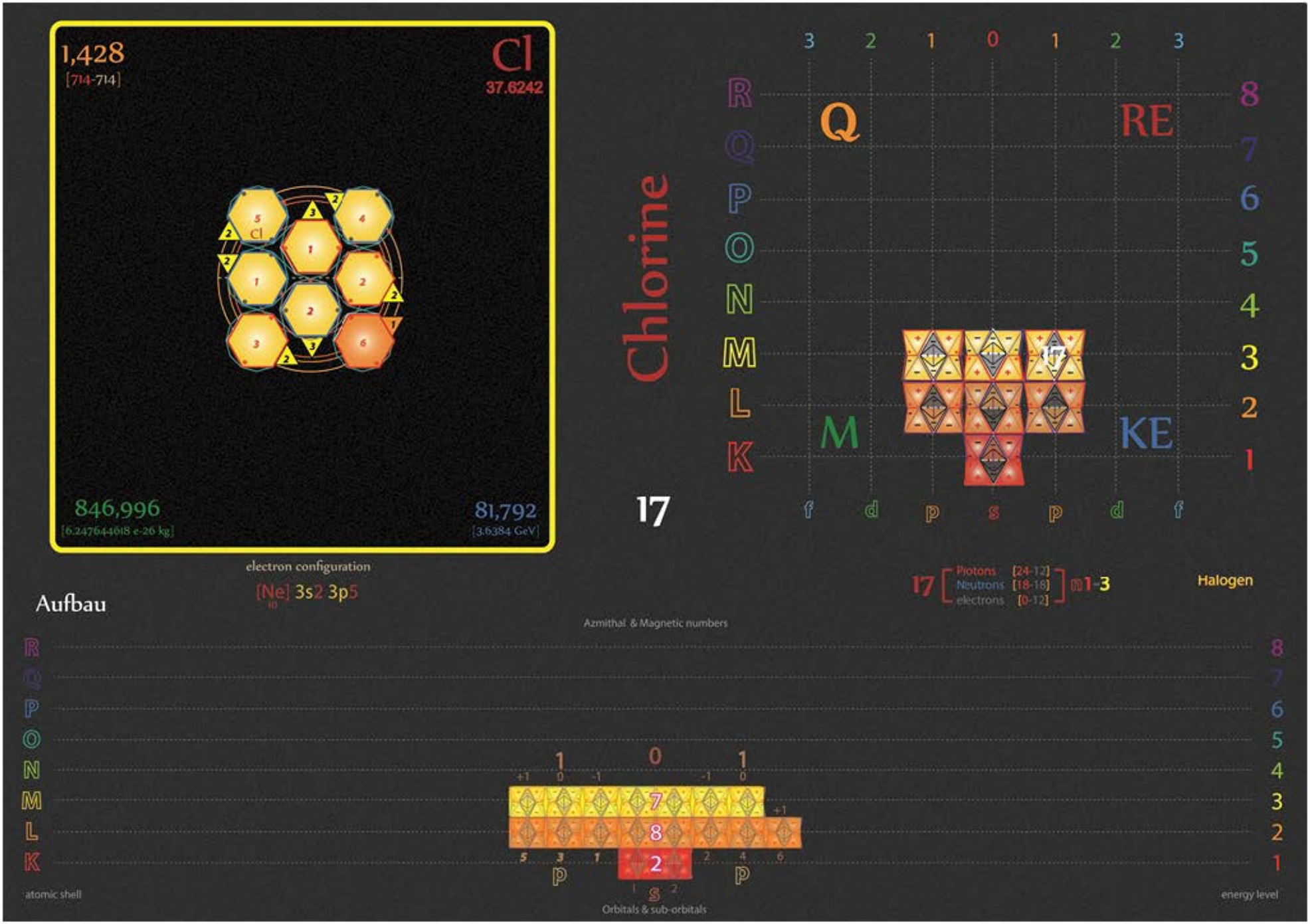

Tetryonics 51.17 - Chlorine atom

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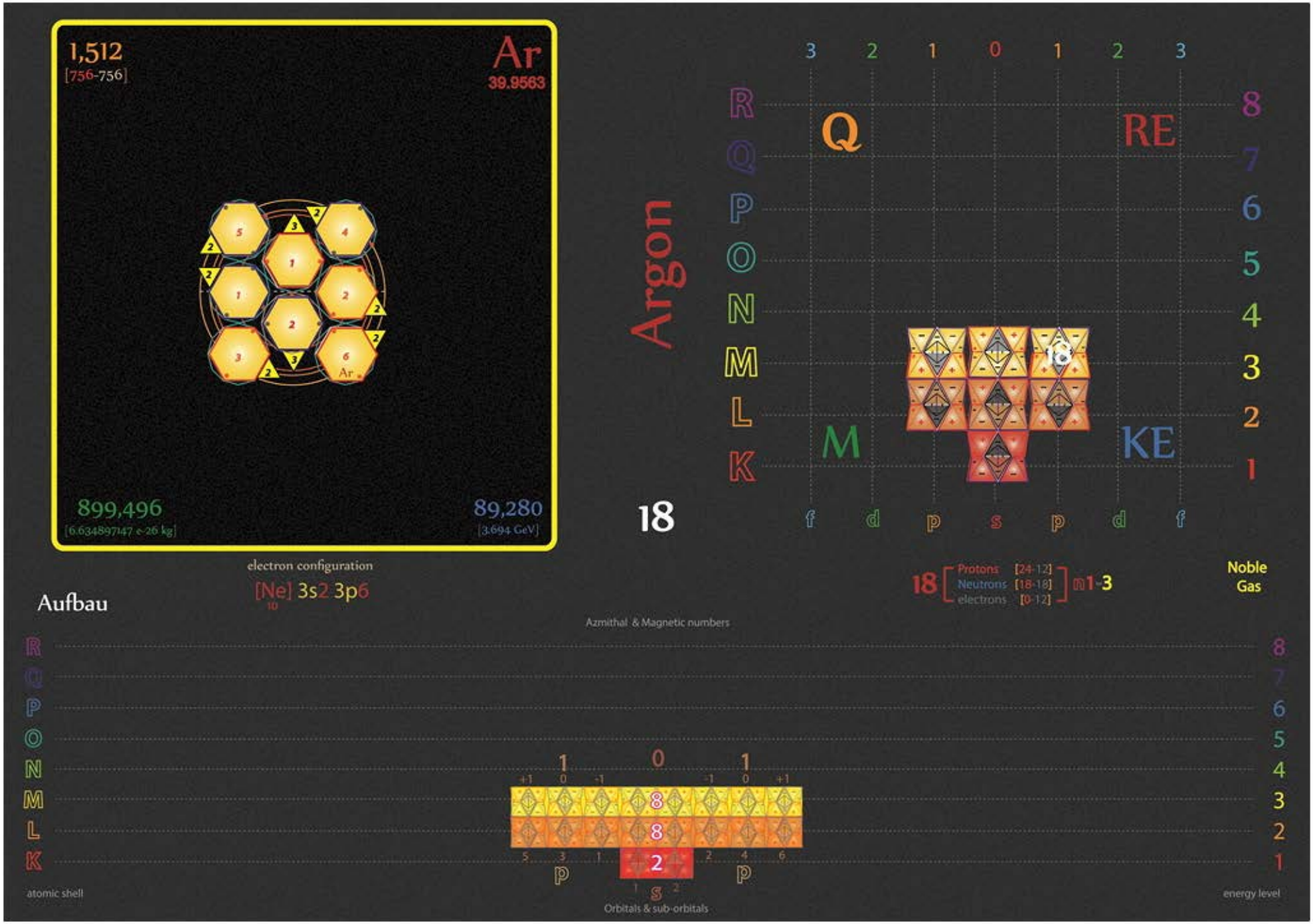

Tetryonics 51.18 - Argon atom

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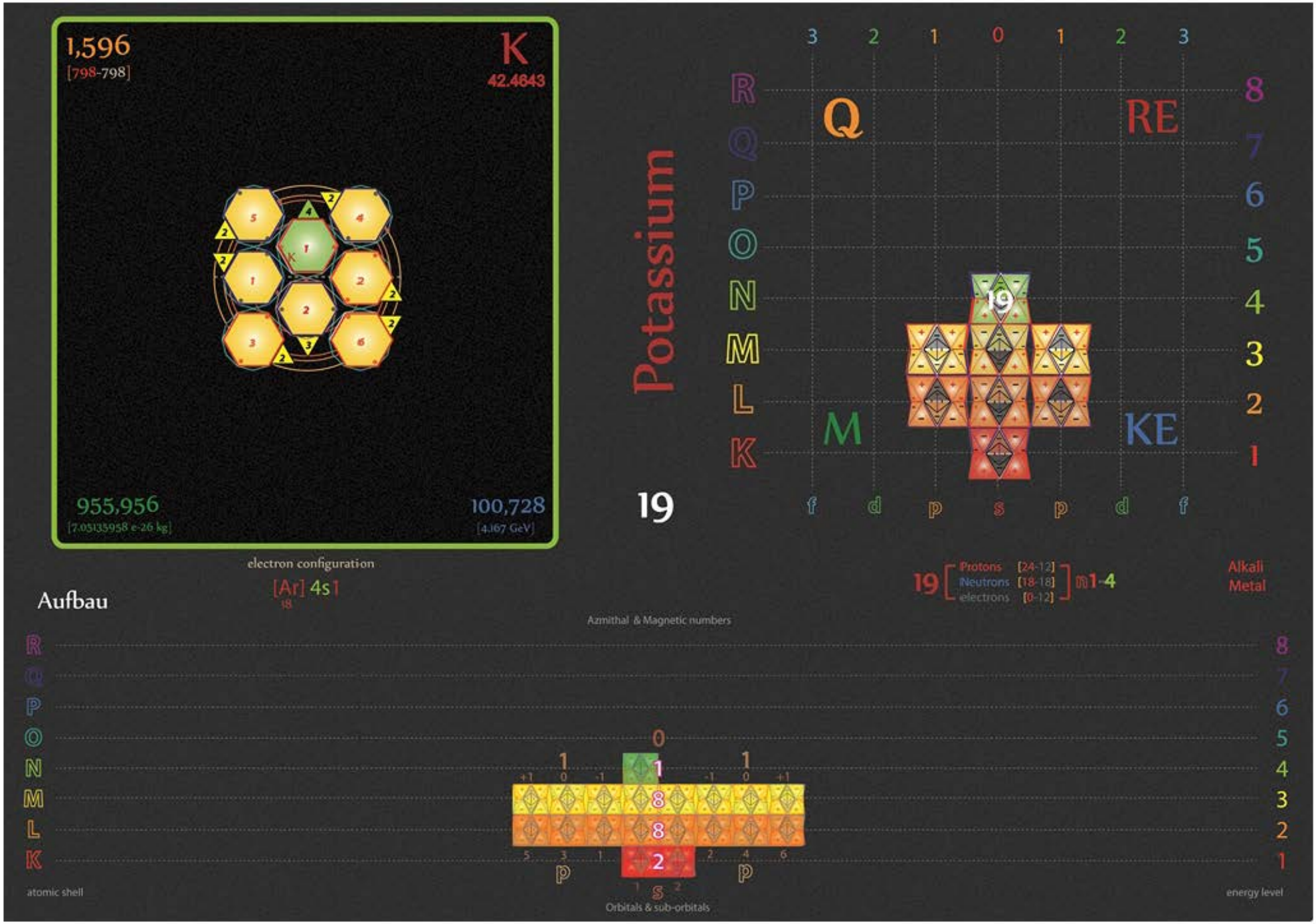

Tetryonics 51.19 - Potassium atom

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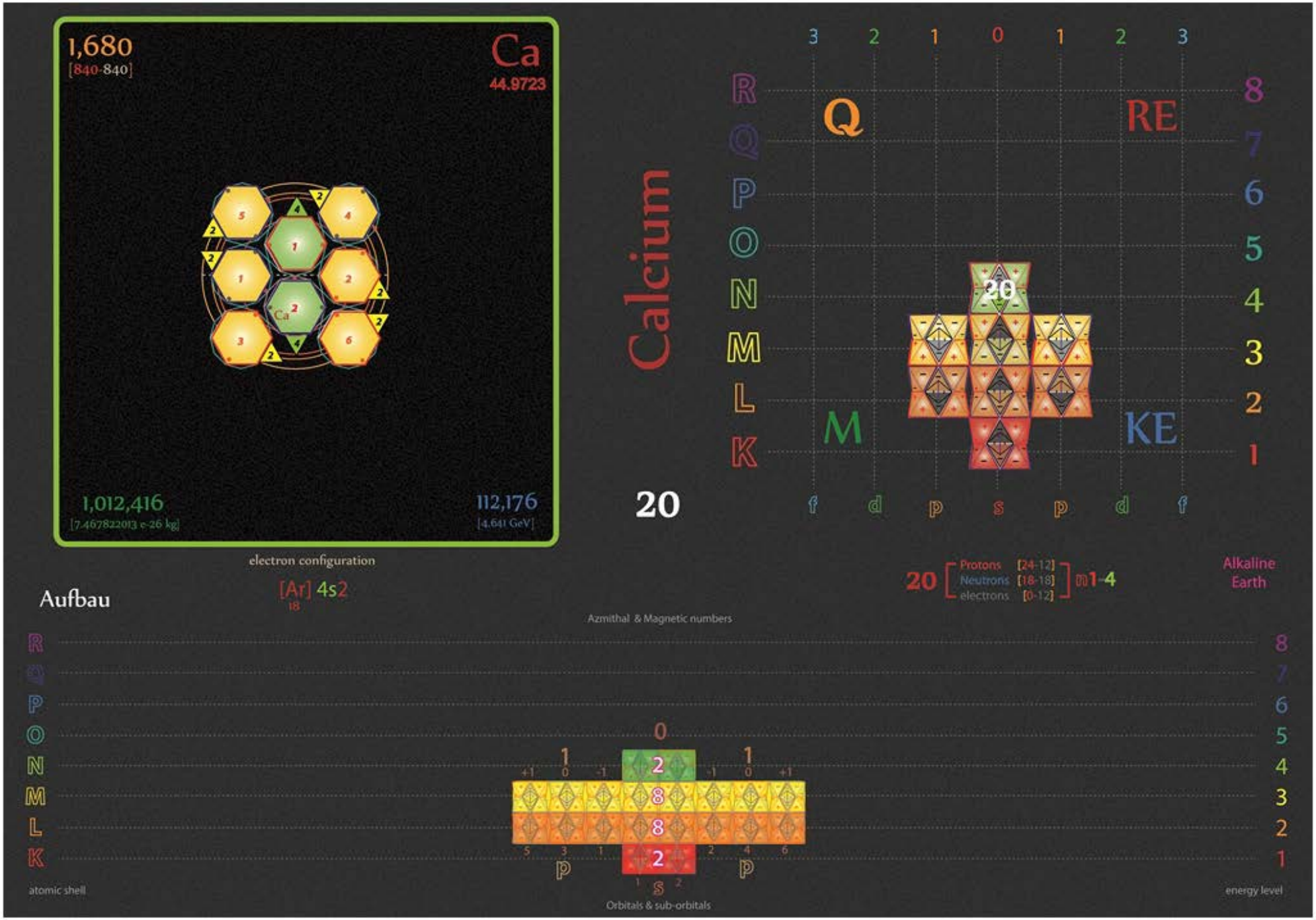

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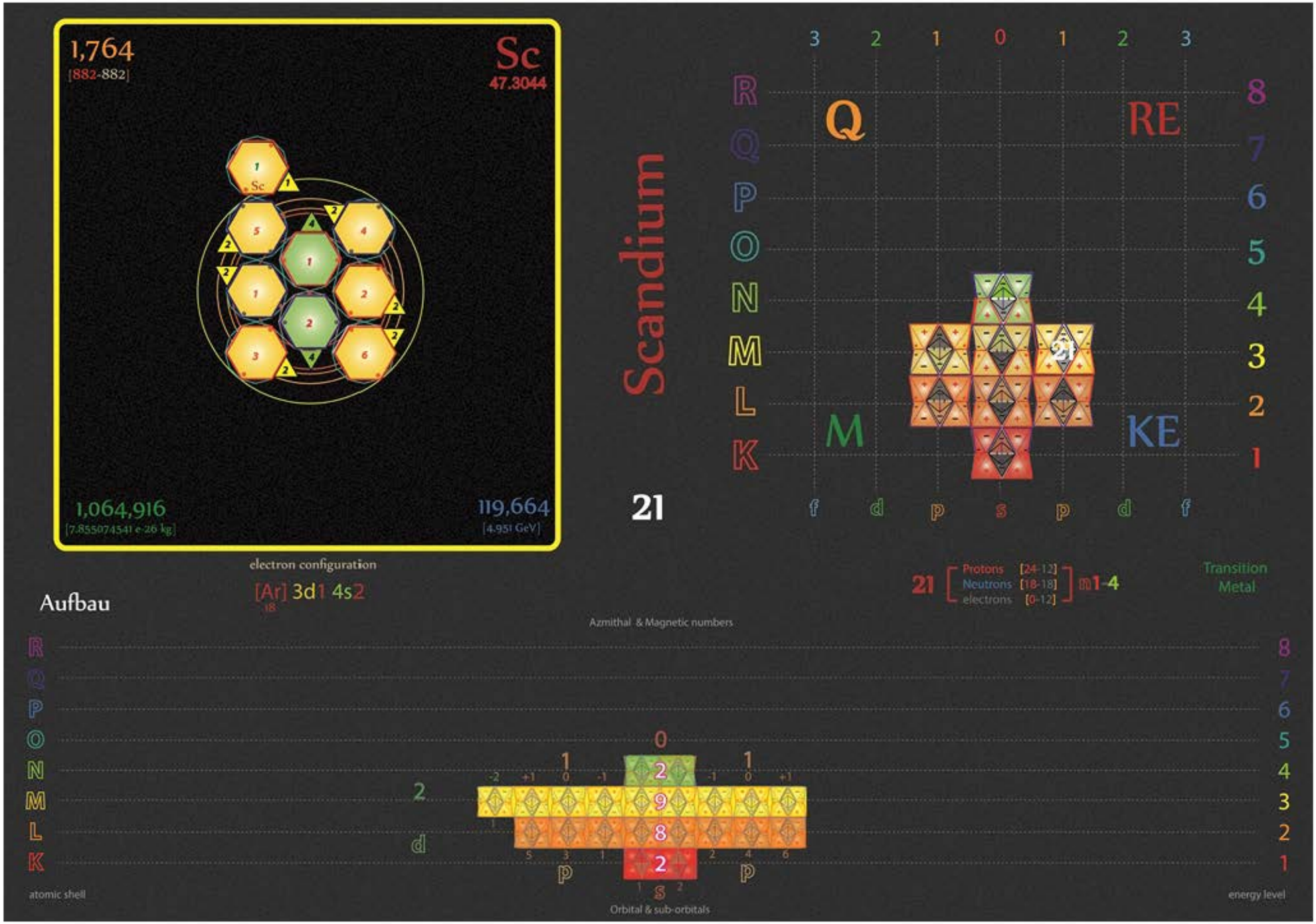

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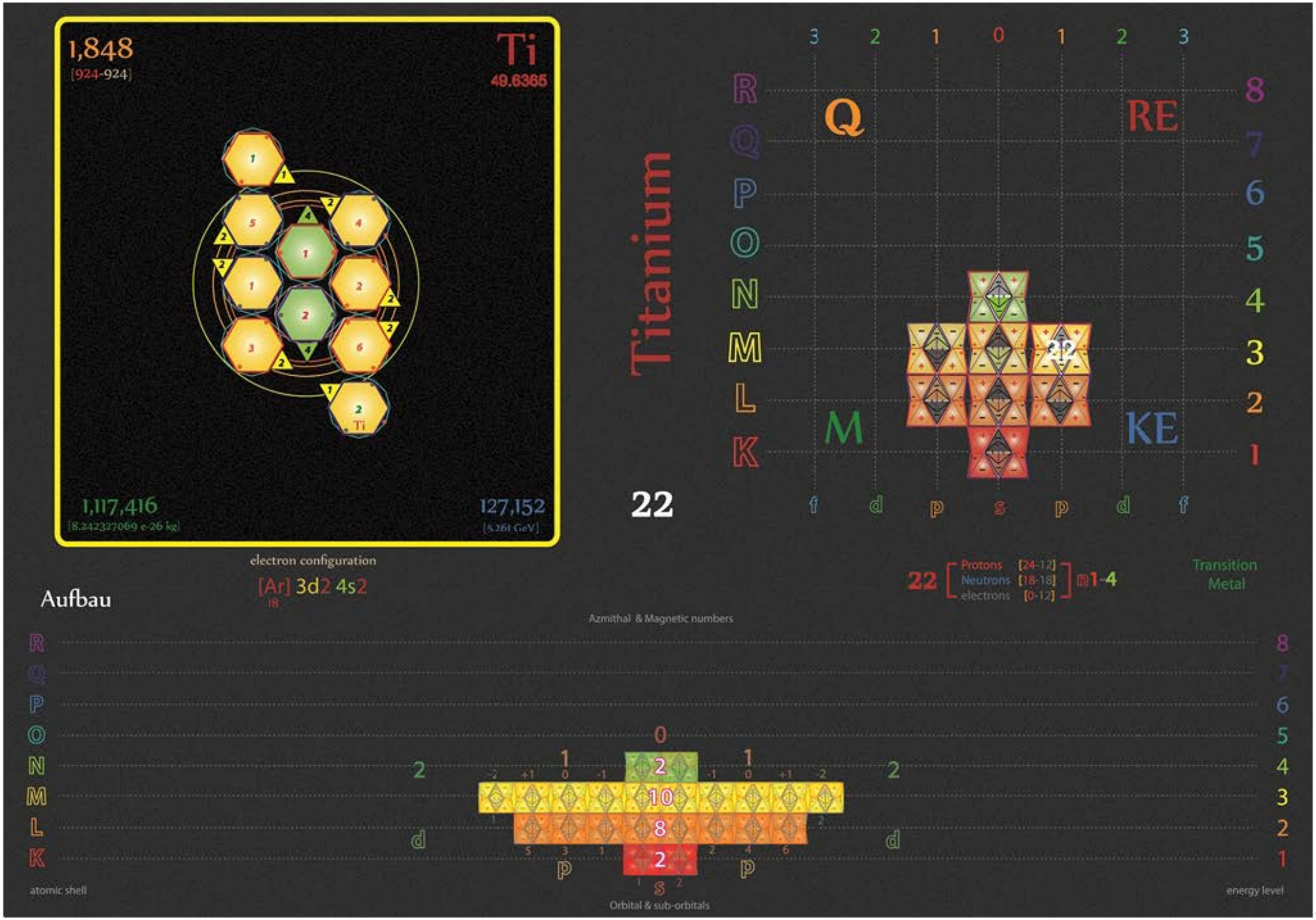

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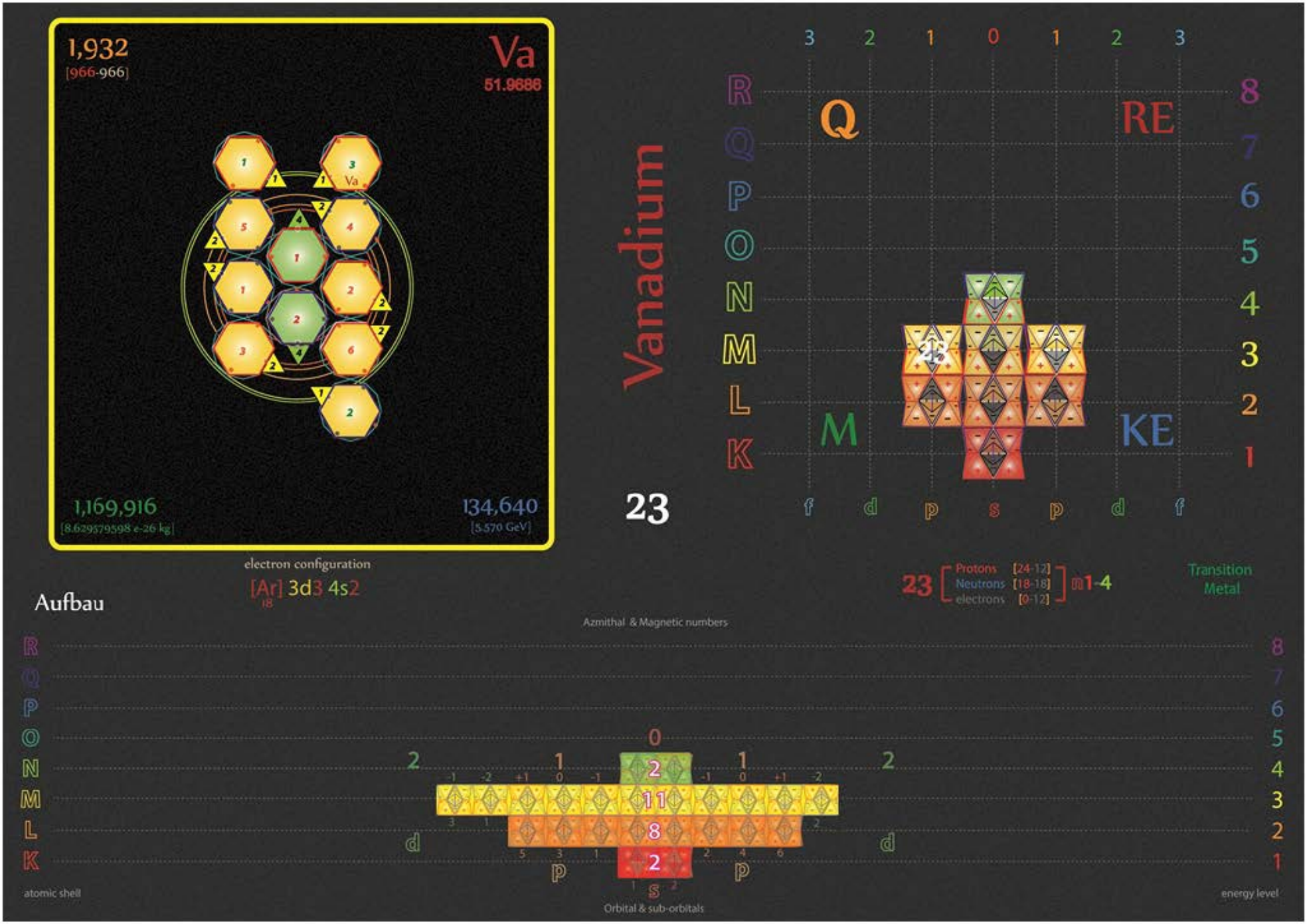

Tetryonics 51.23 - Vanadium atom

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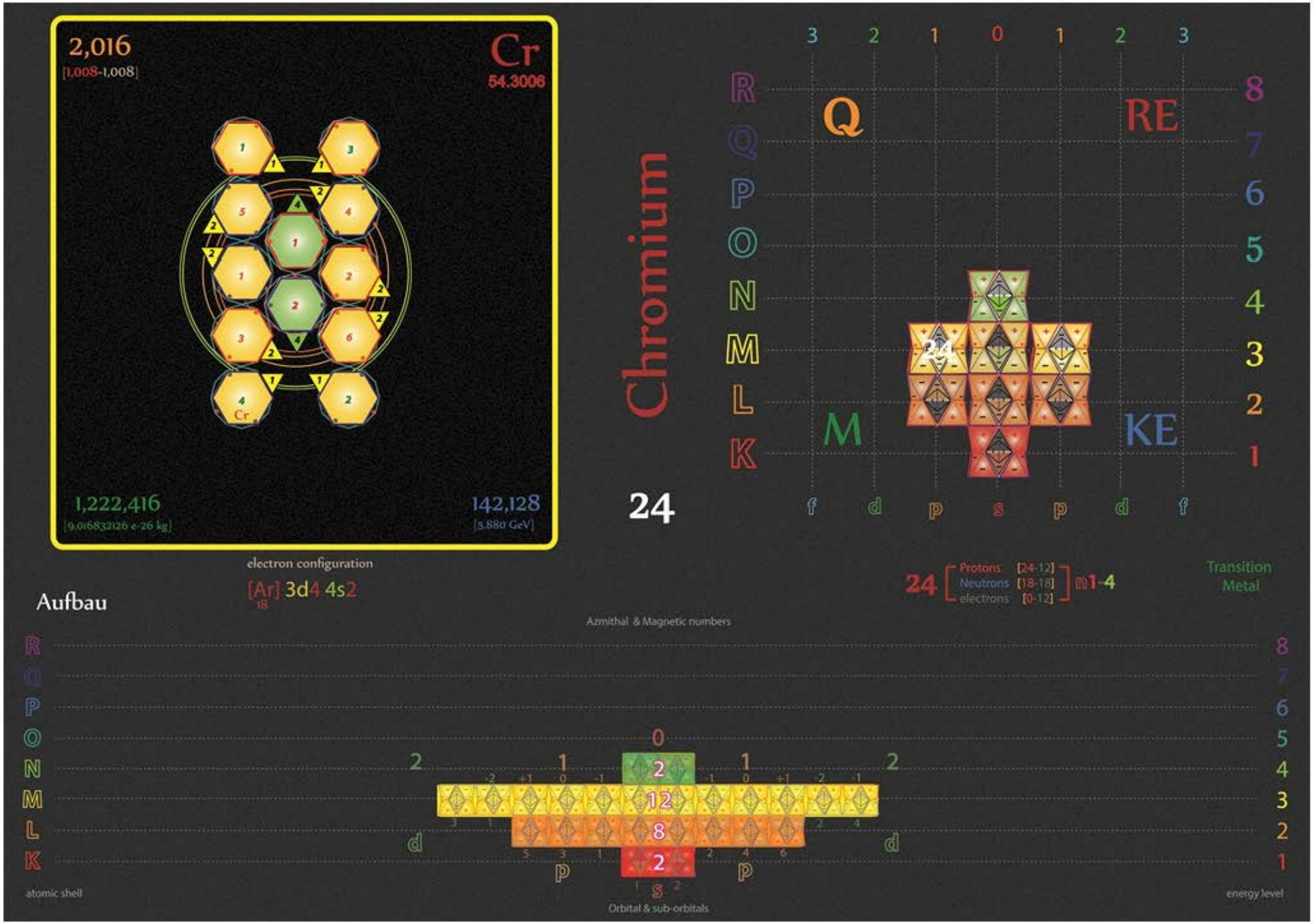

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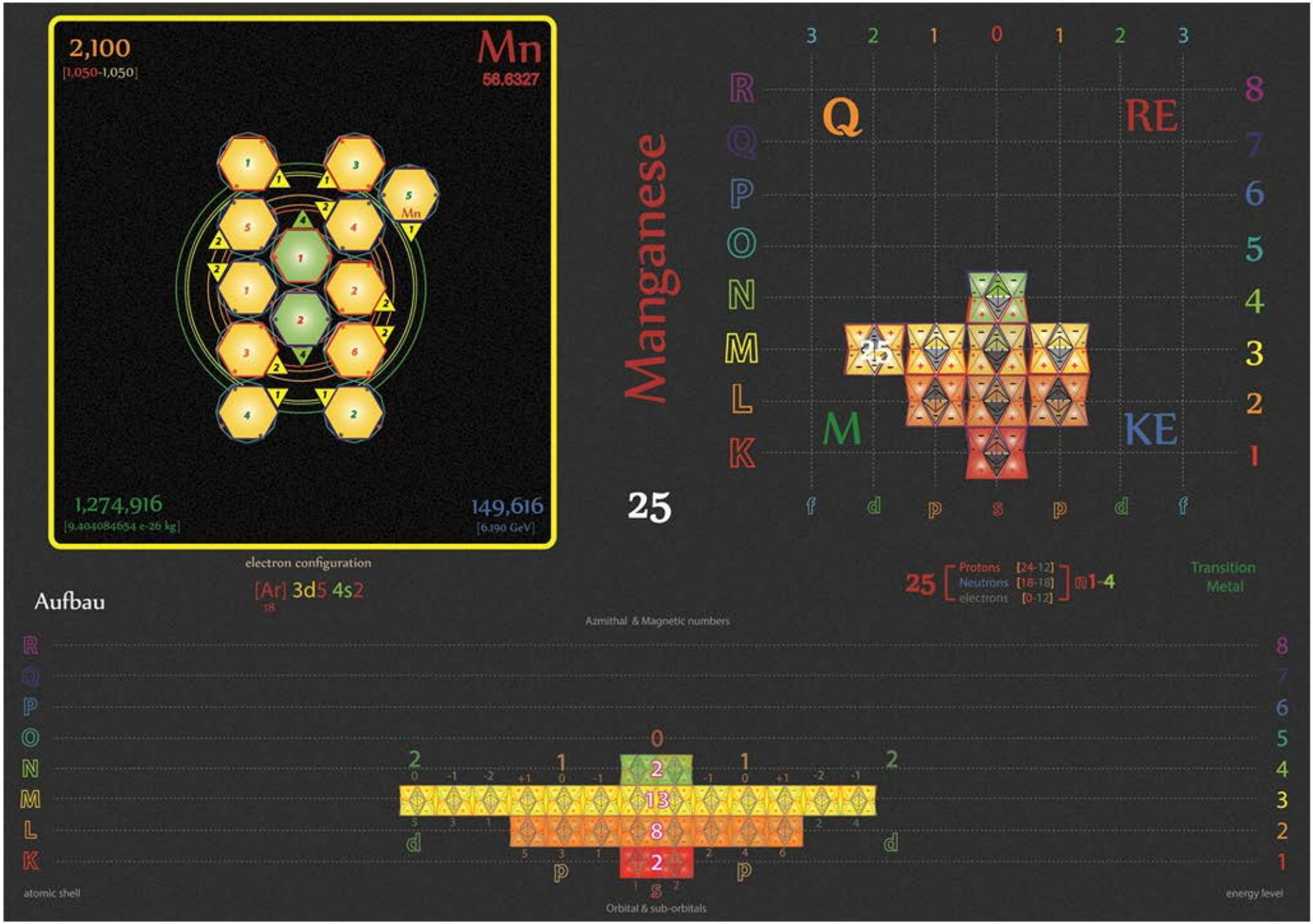

Tetryonics 51.25 - Manganese atom

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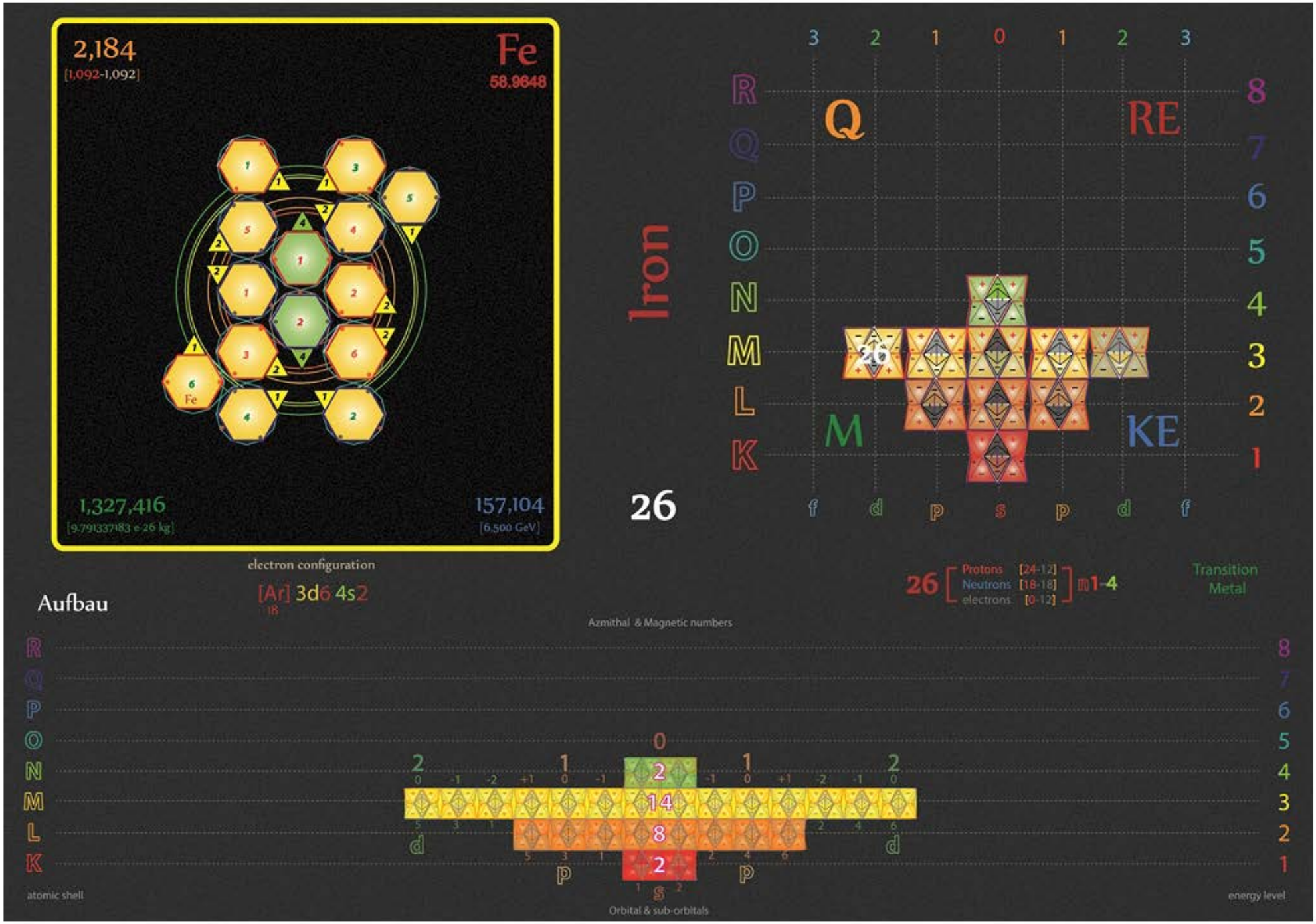

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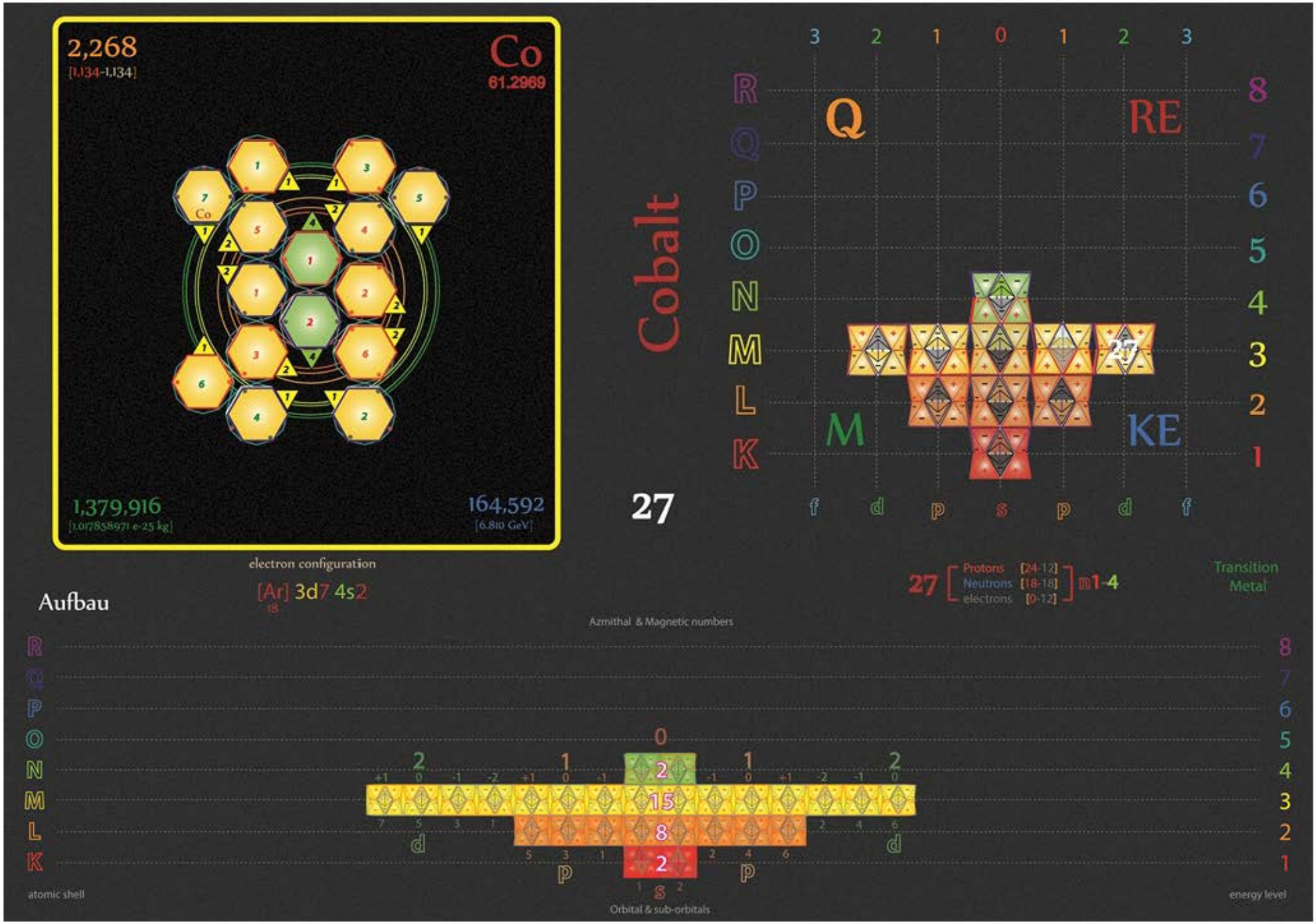

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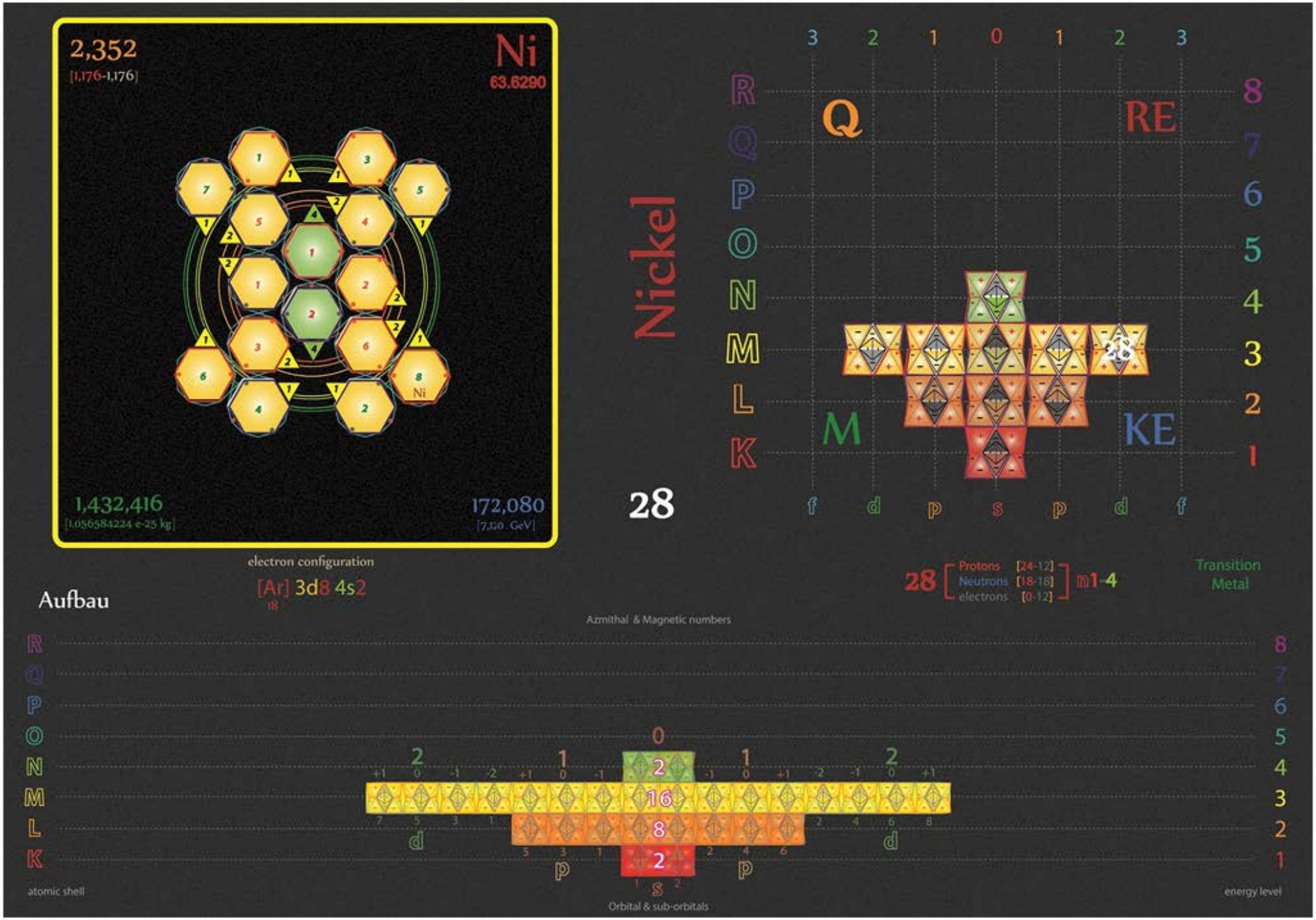

Tetryonics 51.28 - Nickel atom

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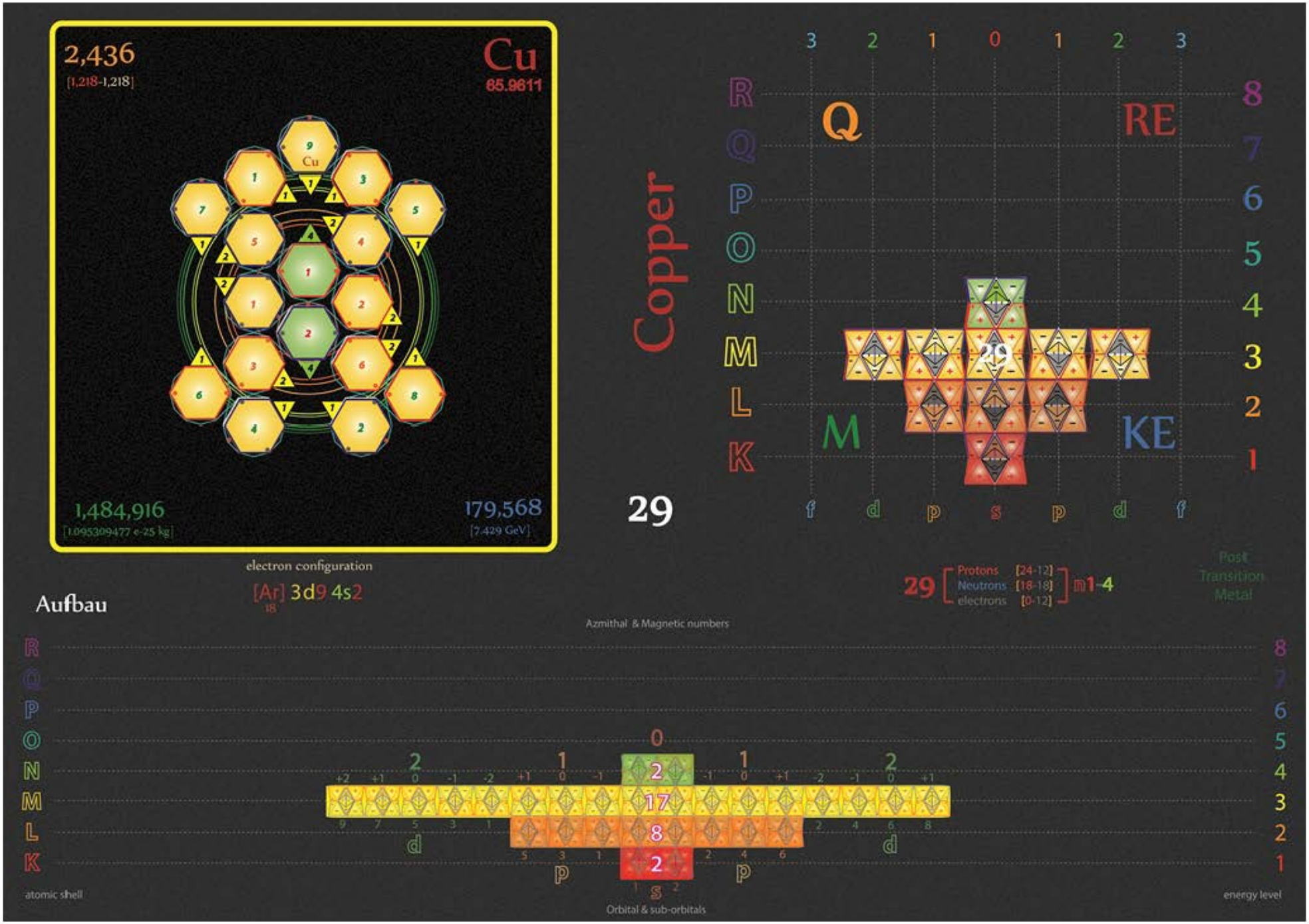

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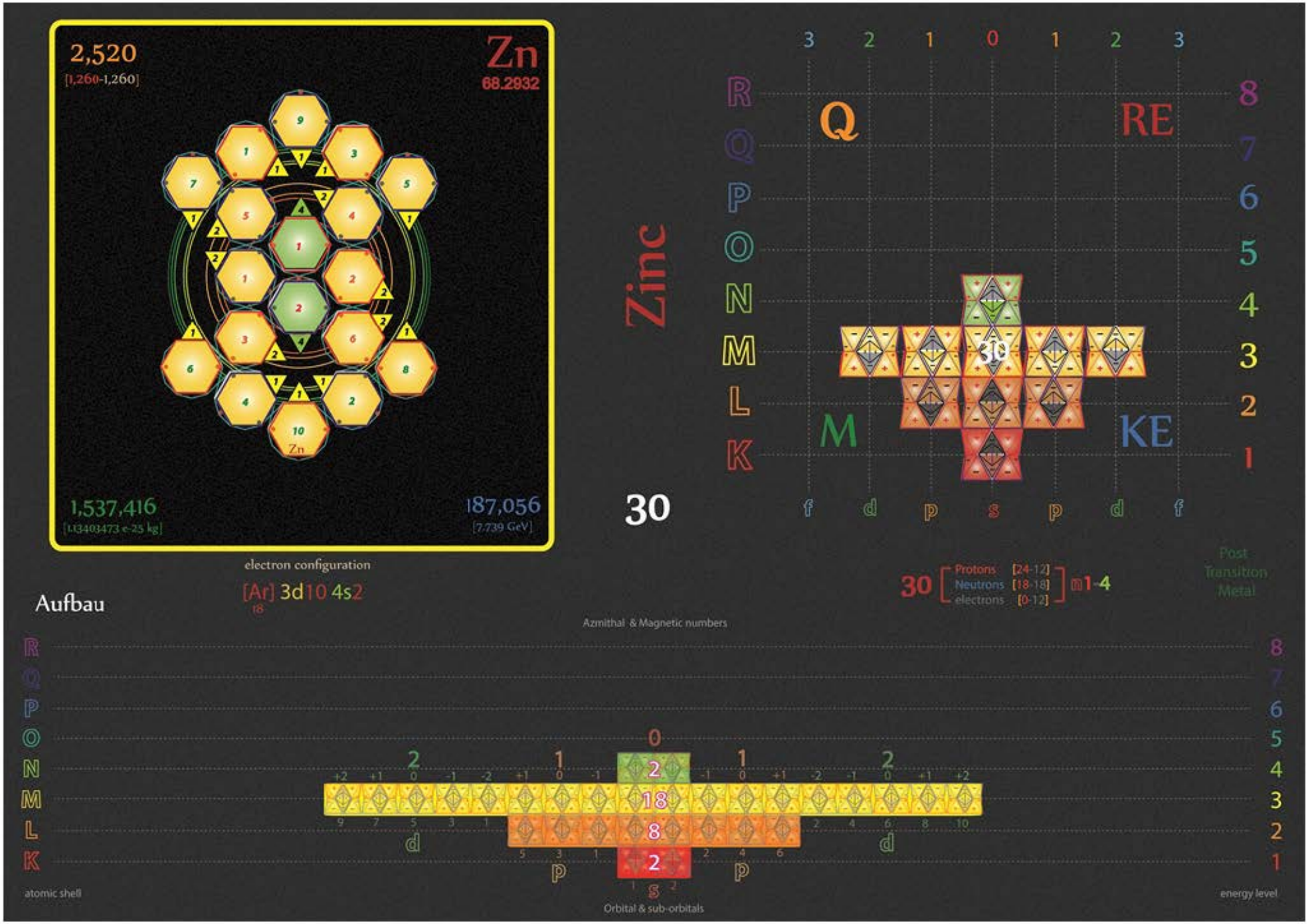

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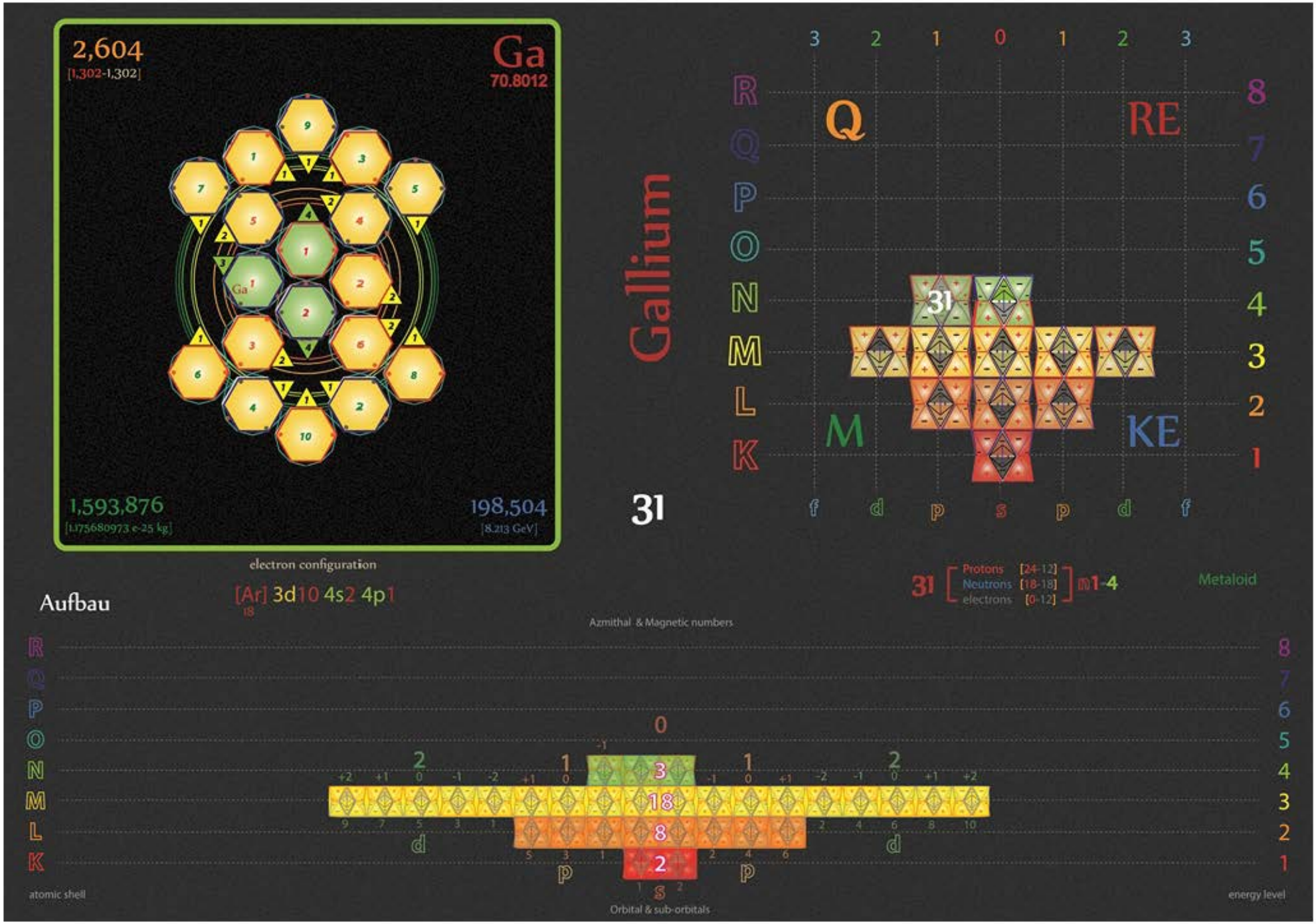

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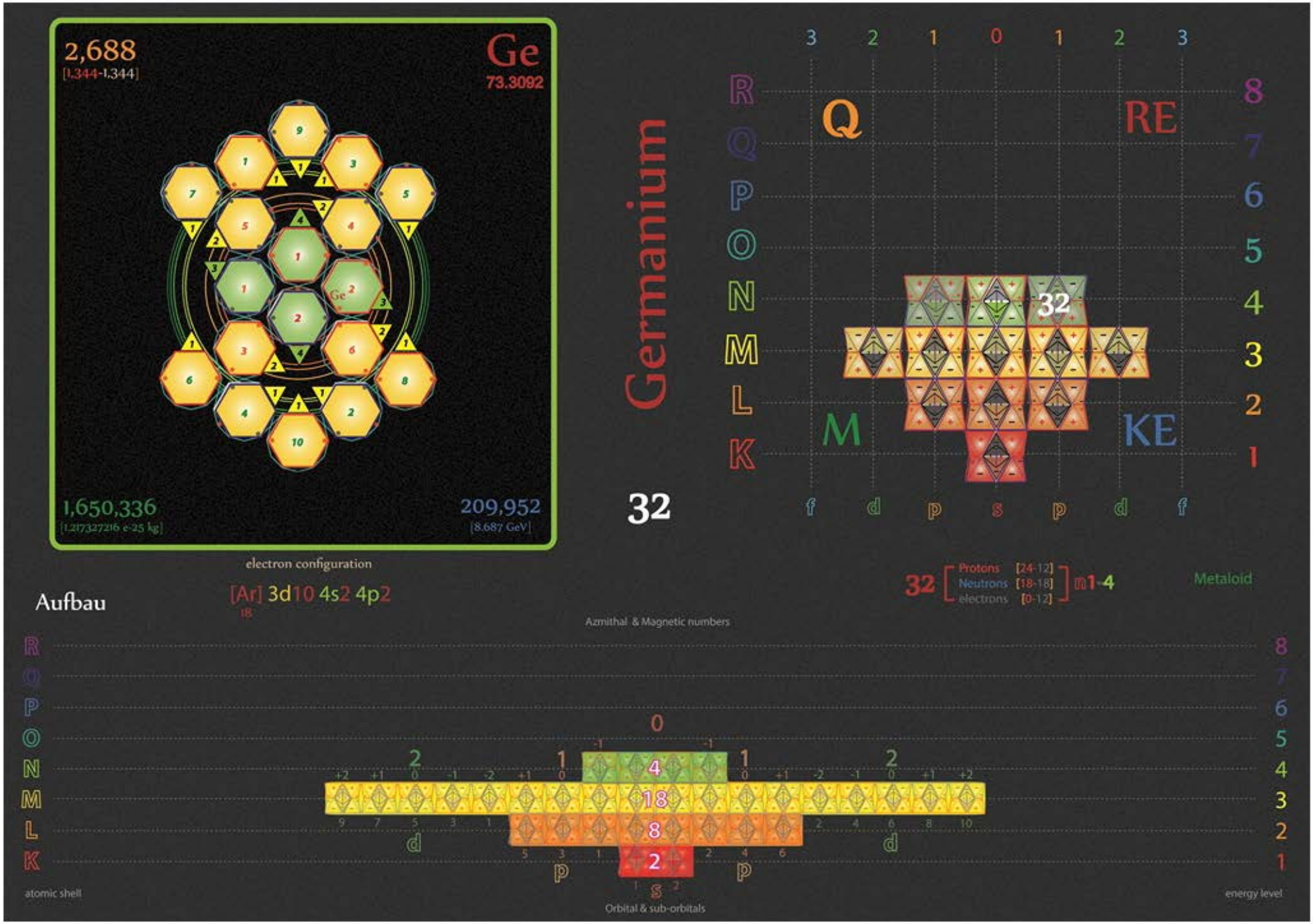

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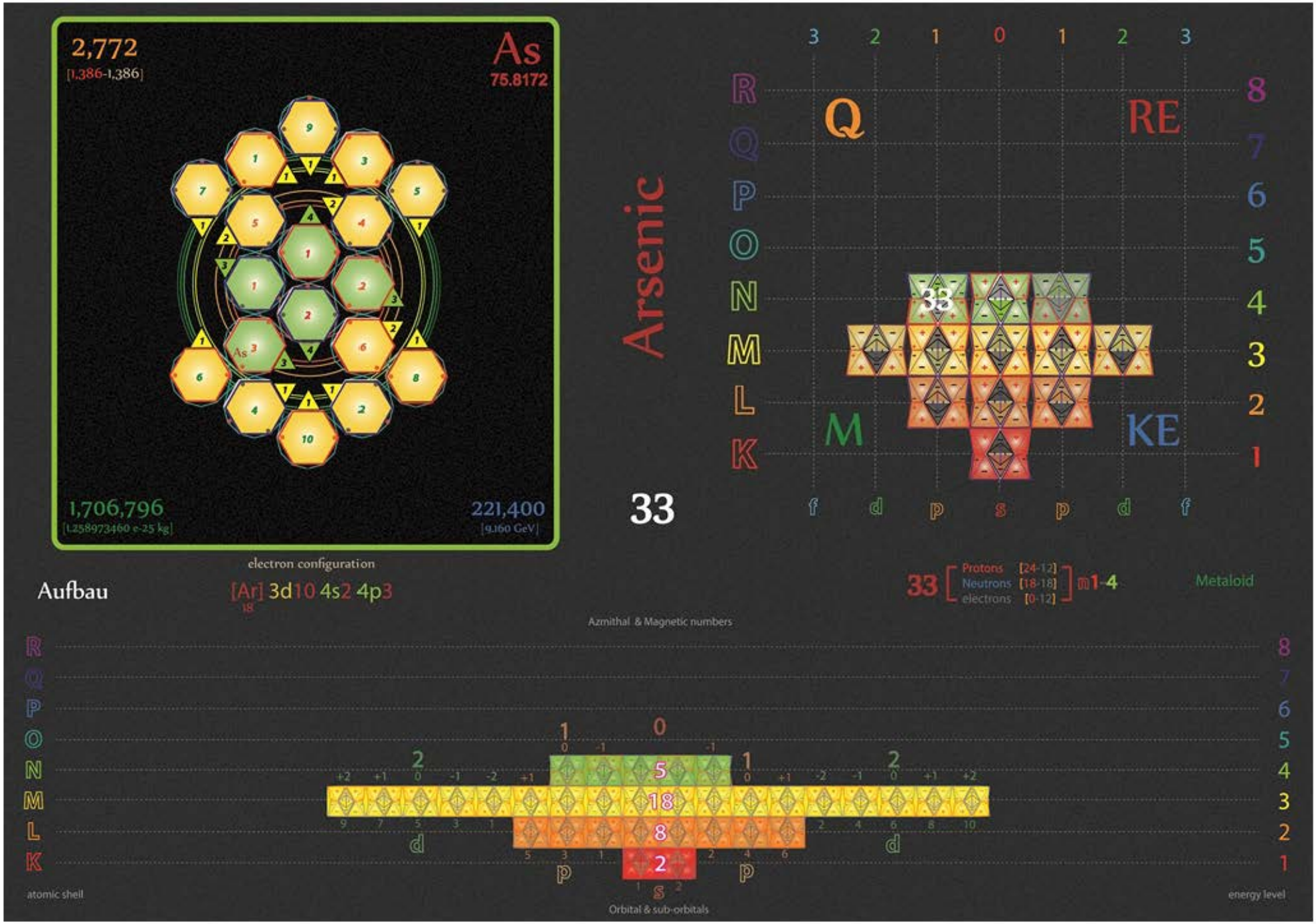

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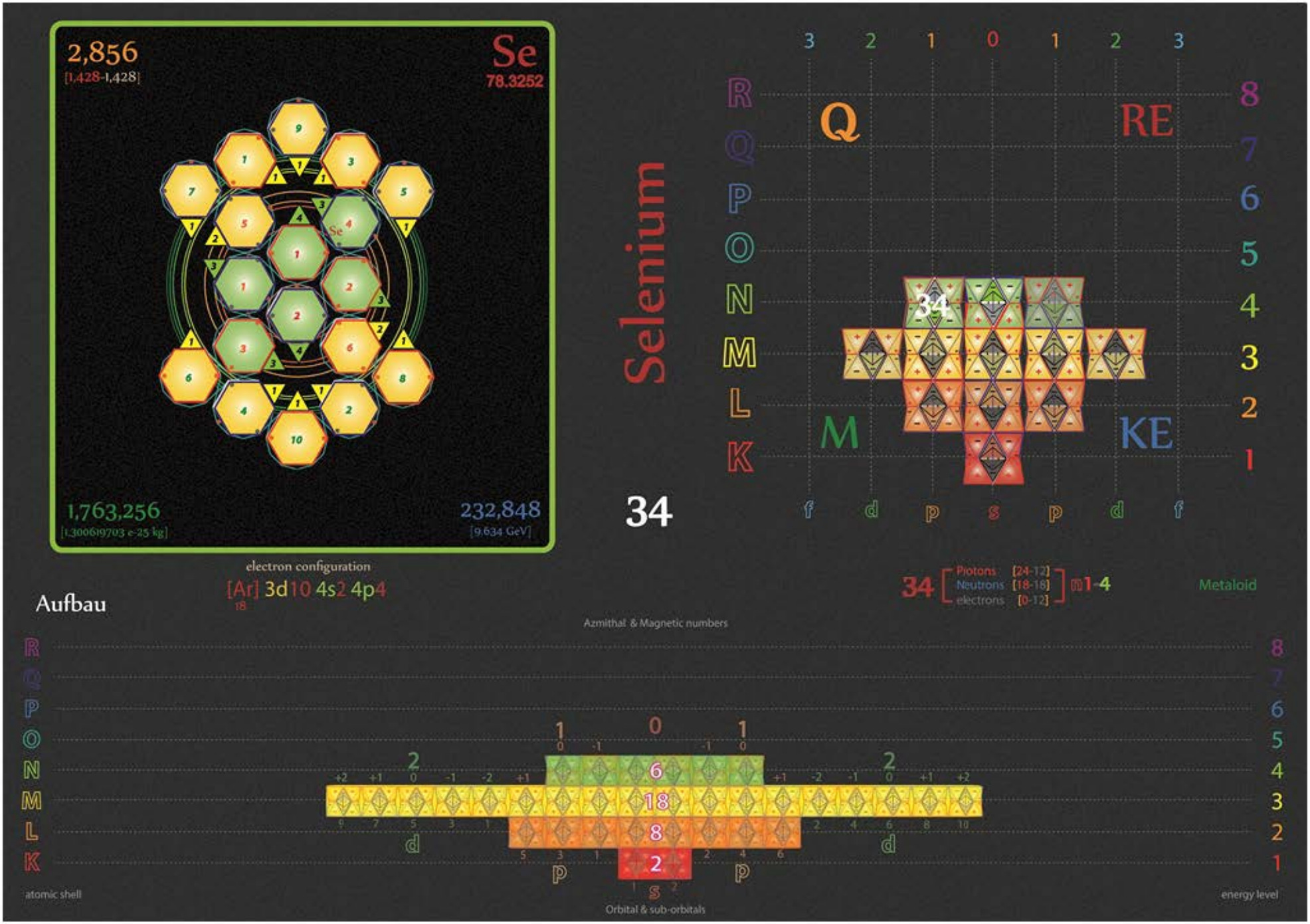

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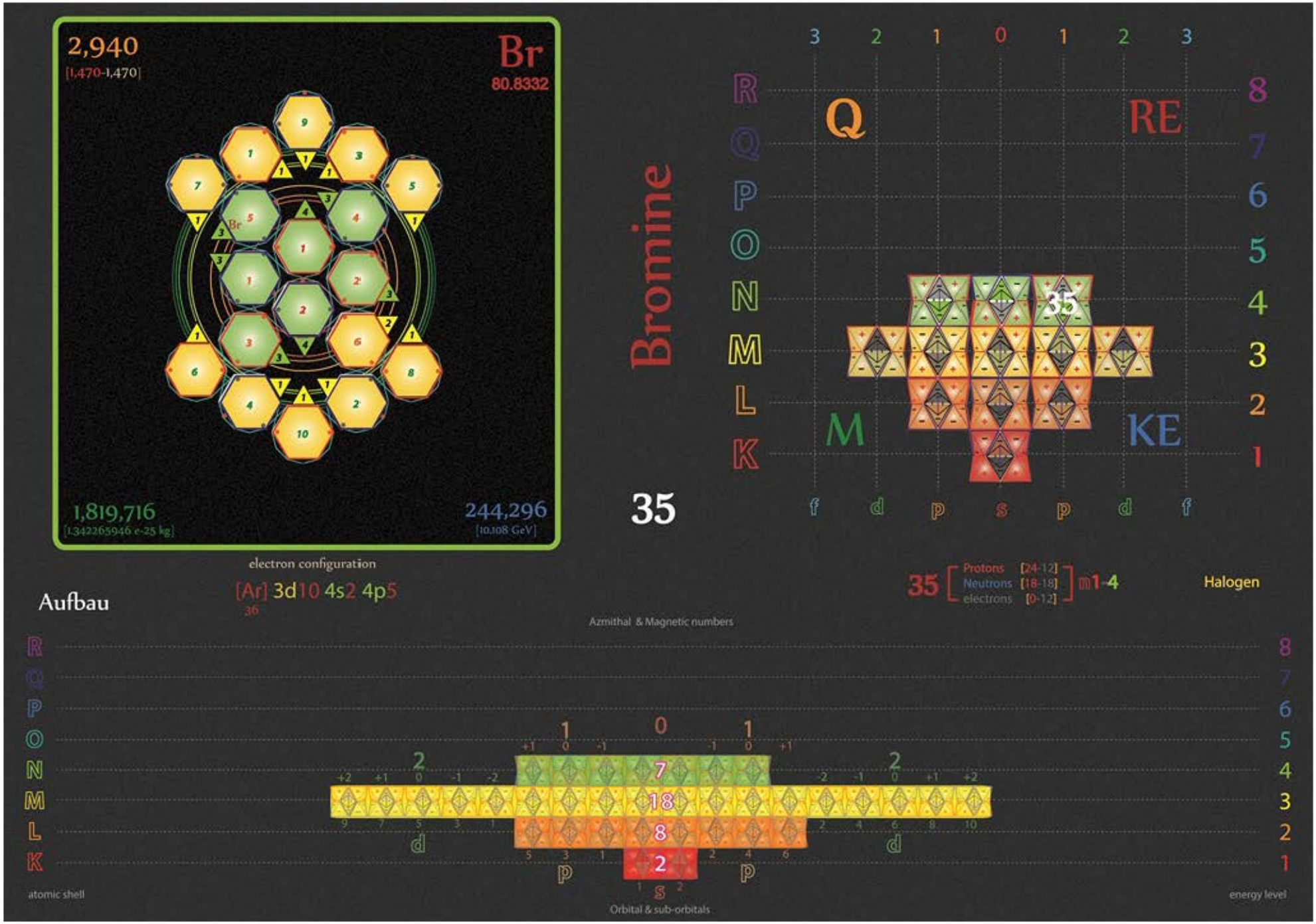

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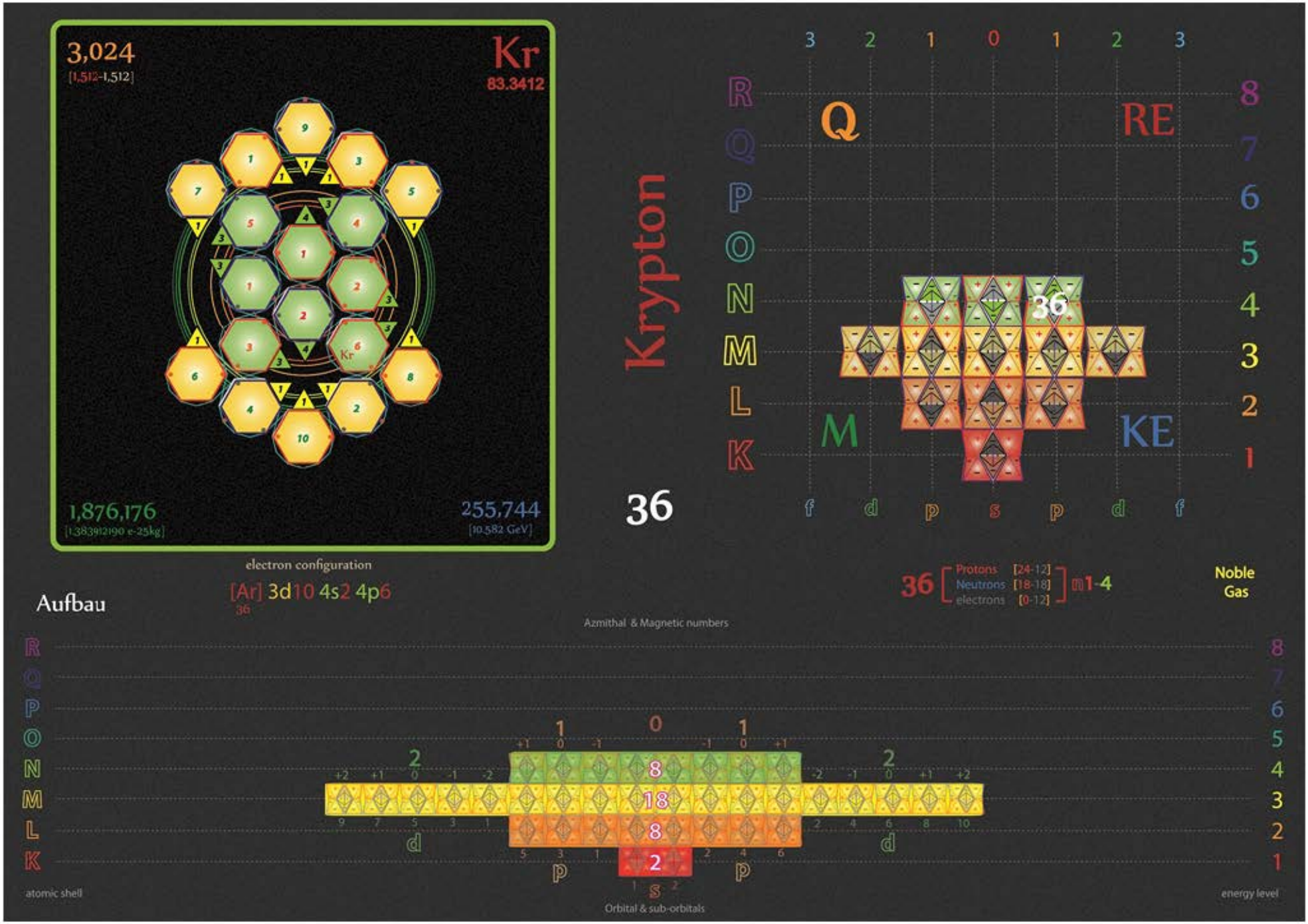

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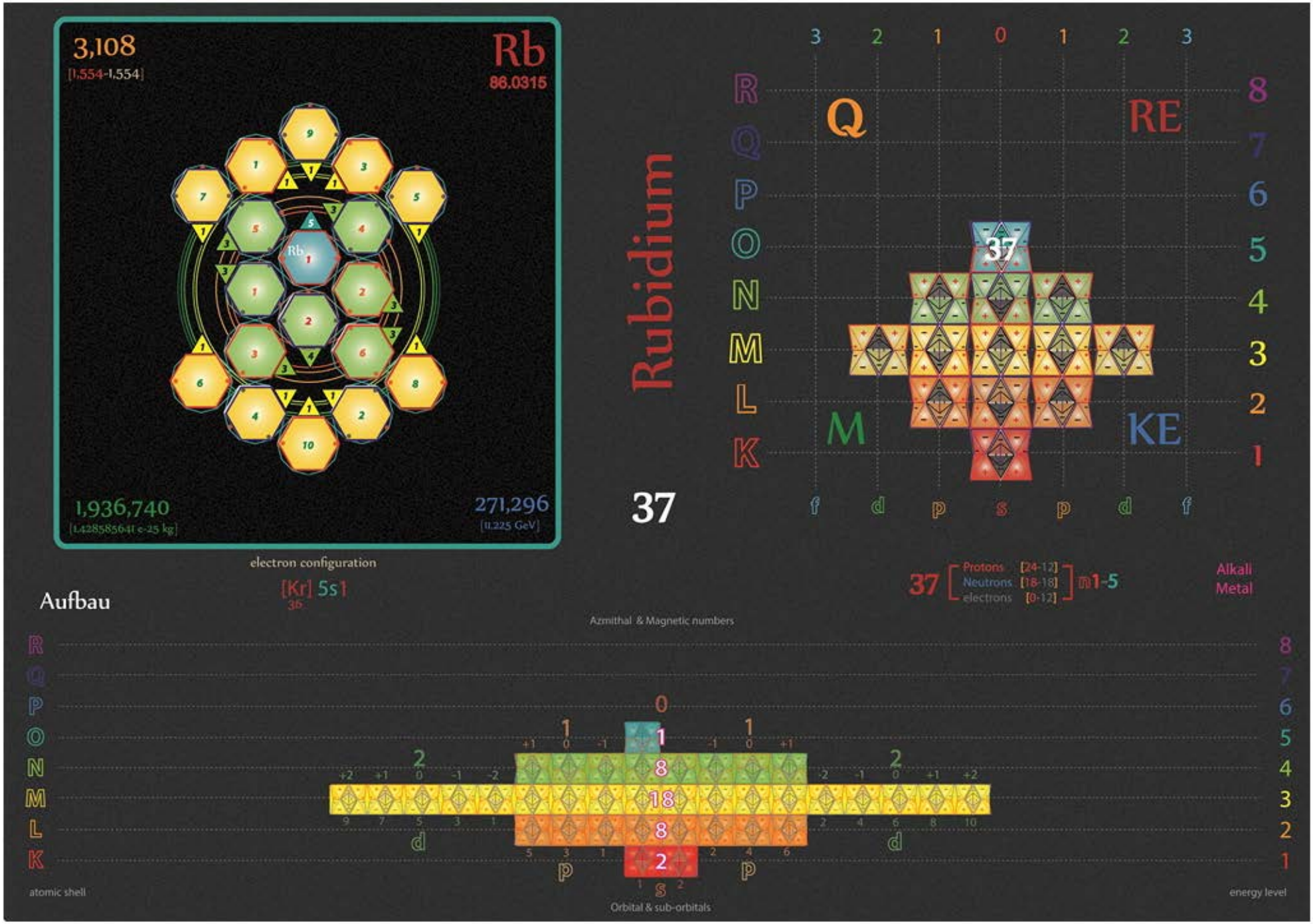

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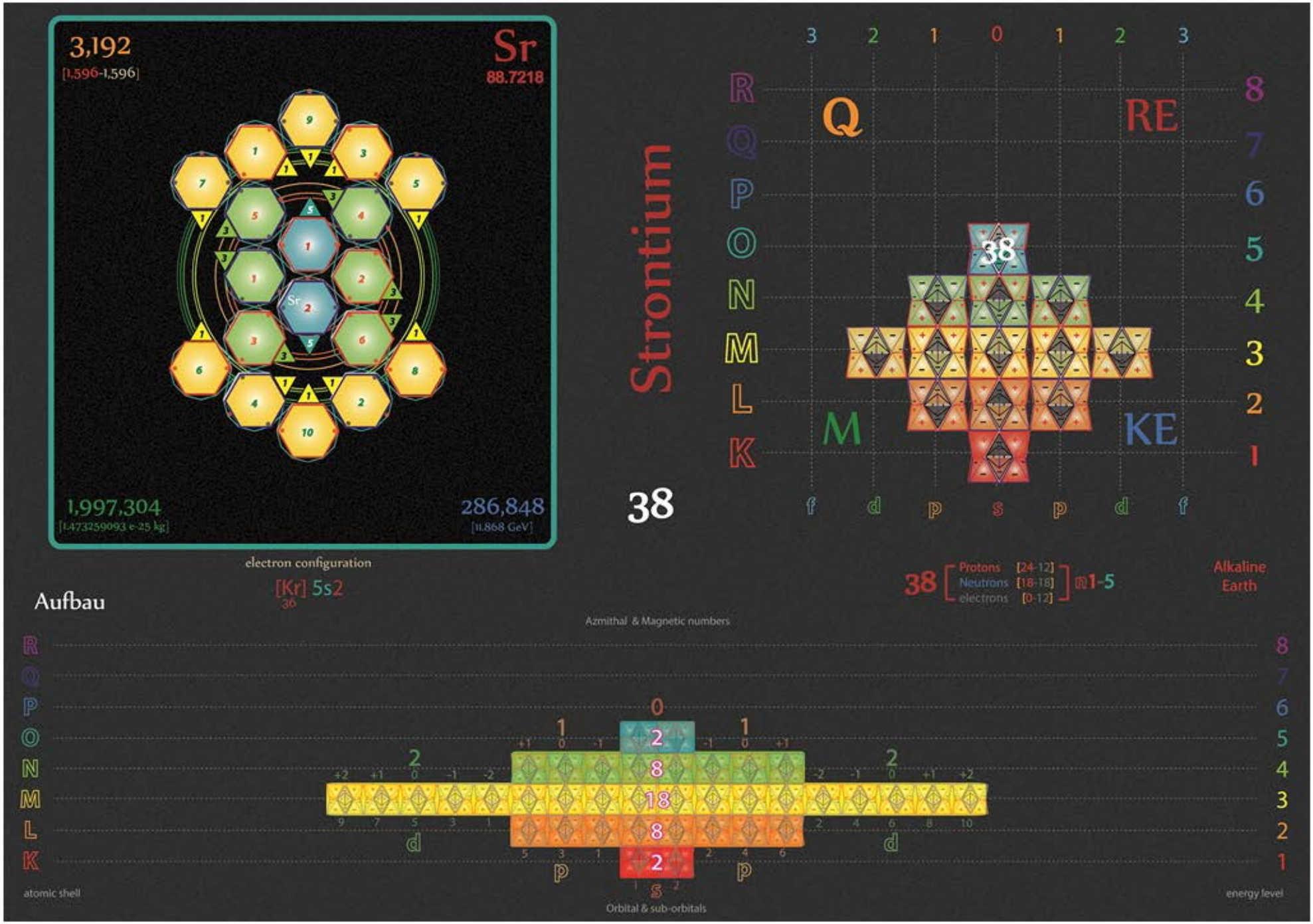

Tetryonics 51.38 - Strontium atom

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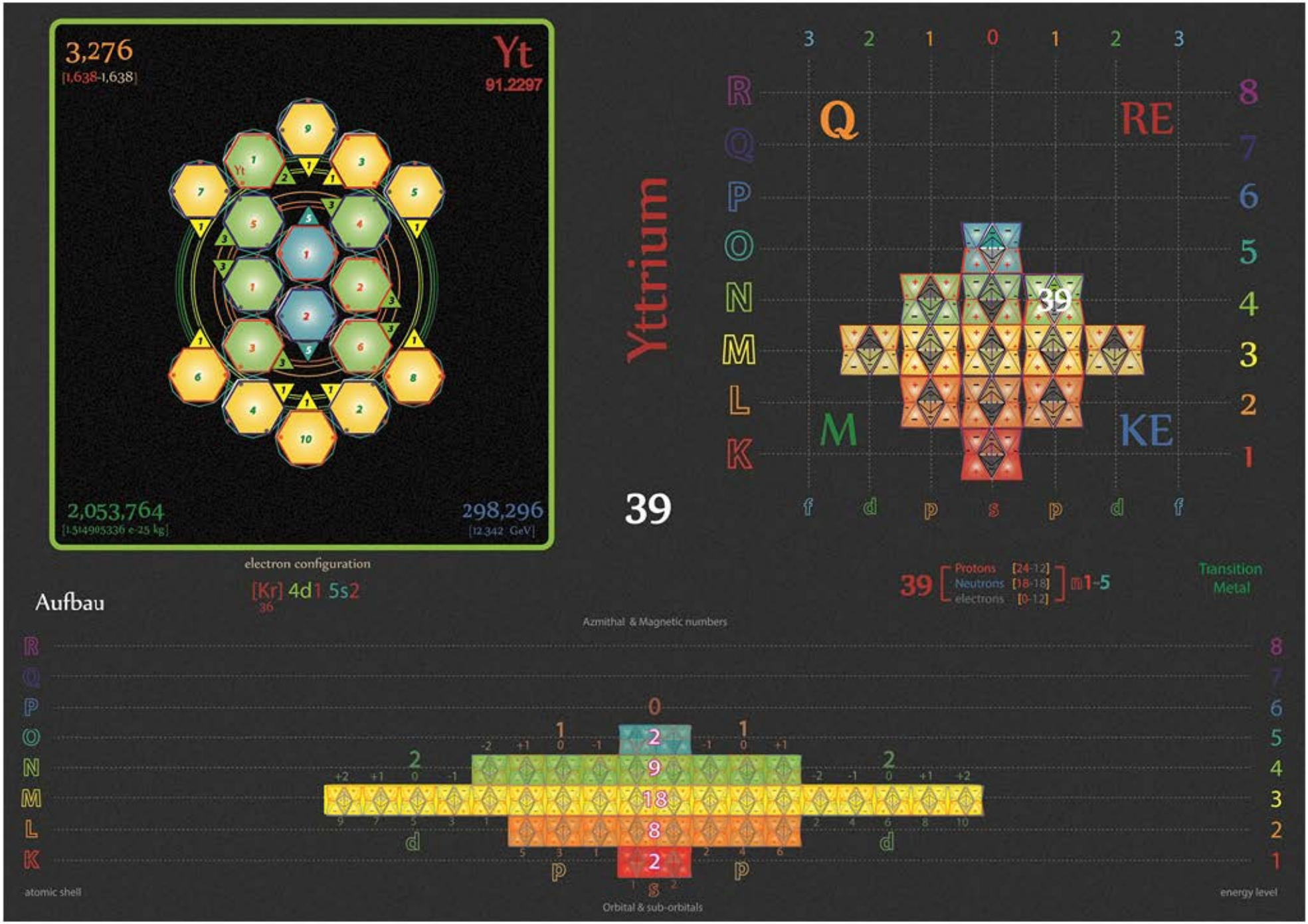

Tetryonics 51.39 - Yttrium atom

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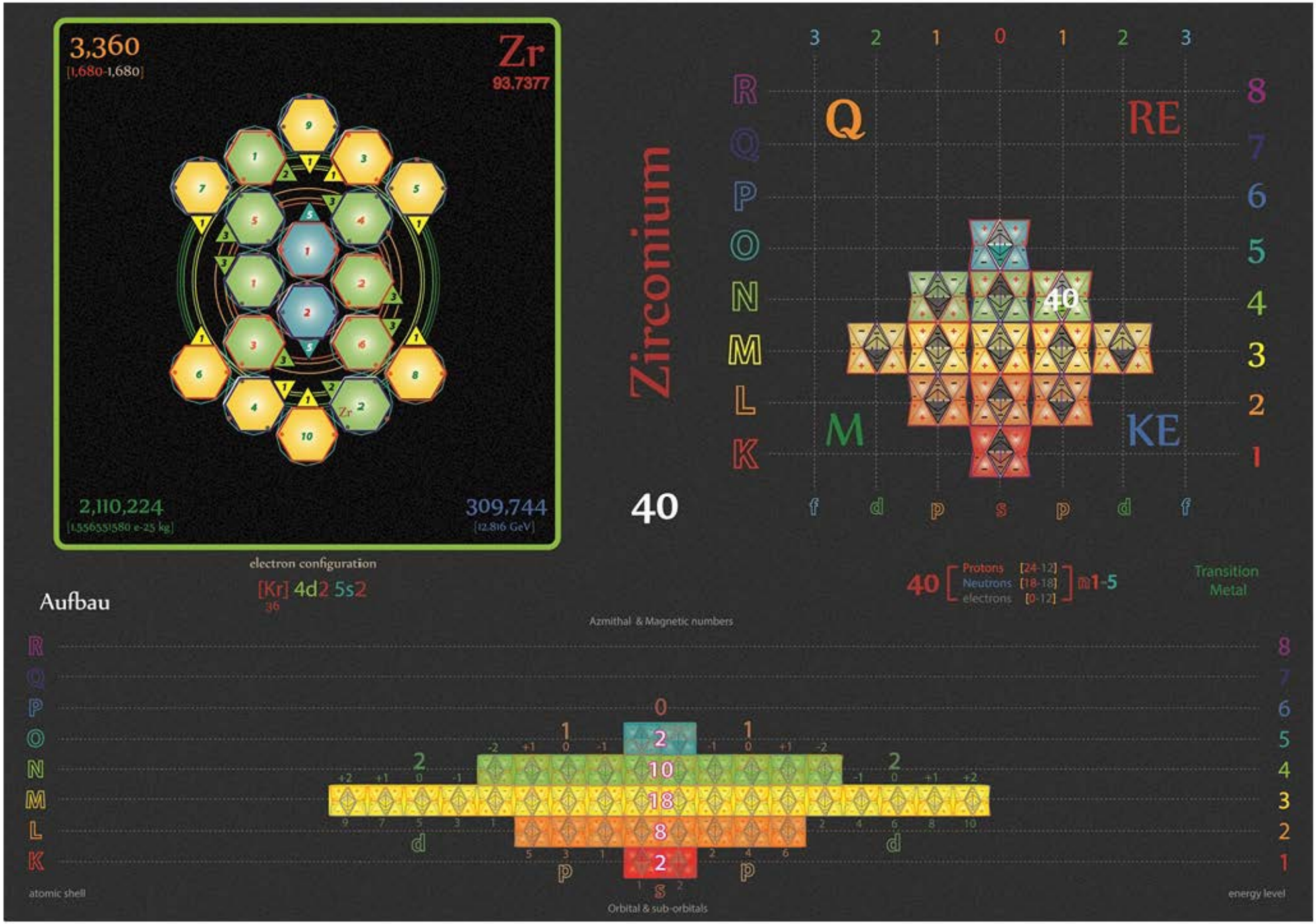

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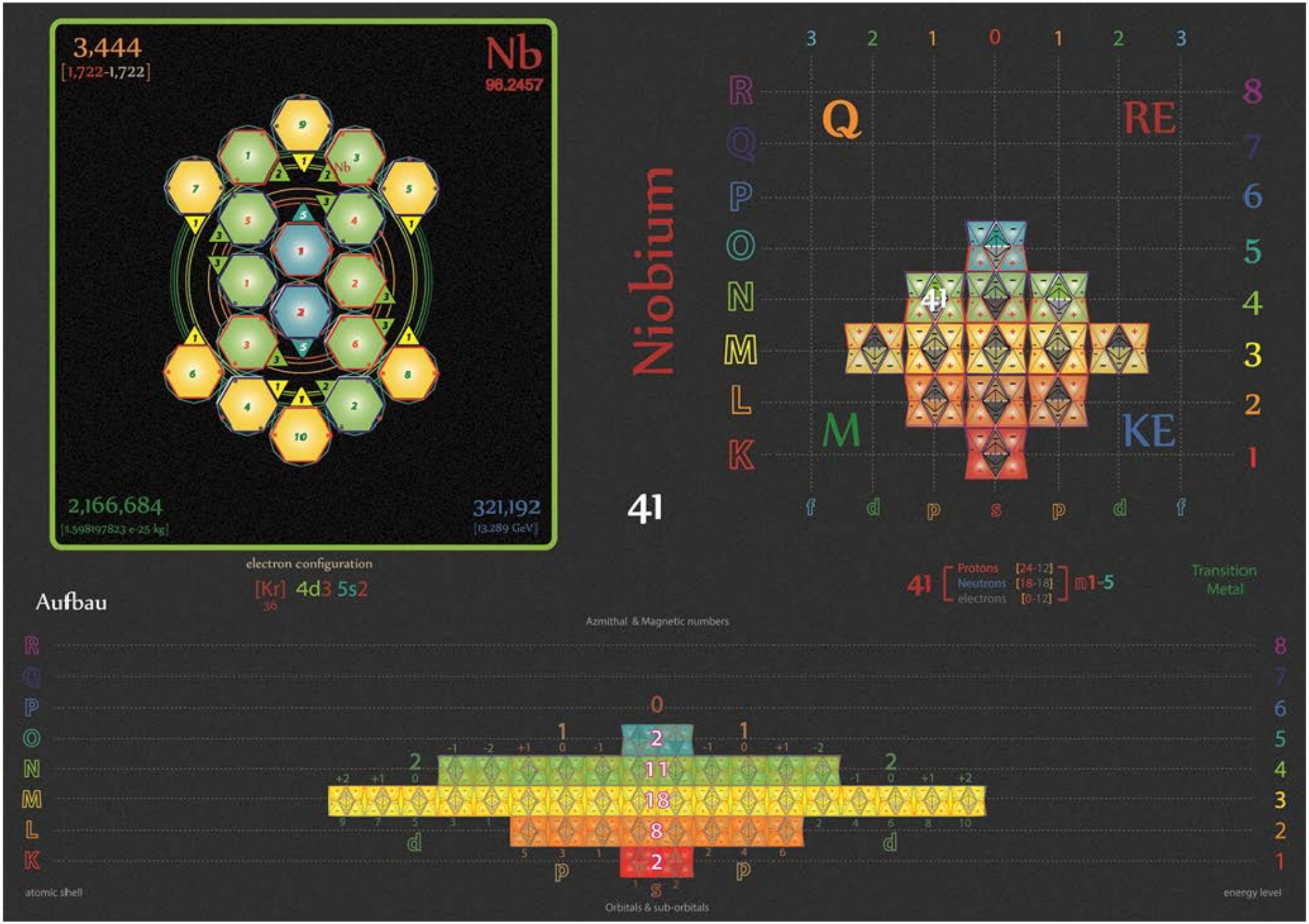

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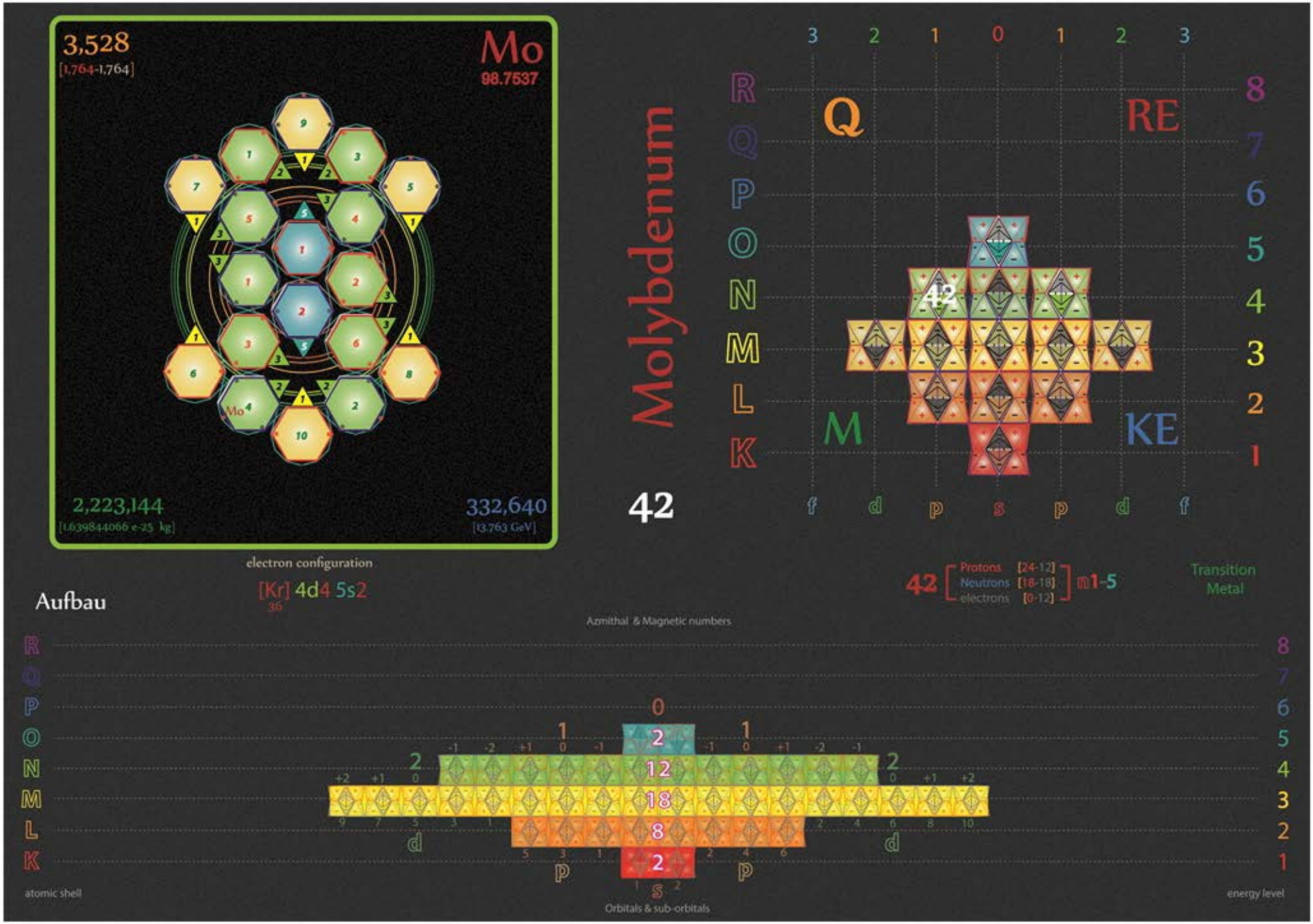

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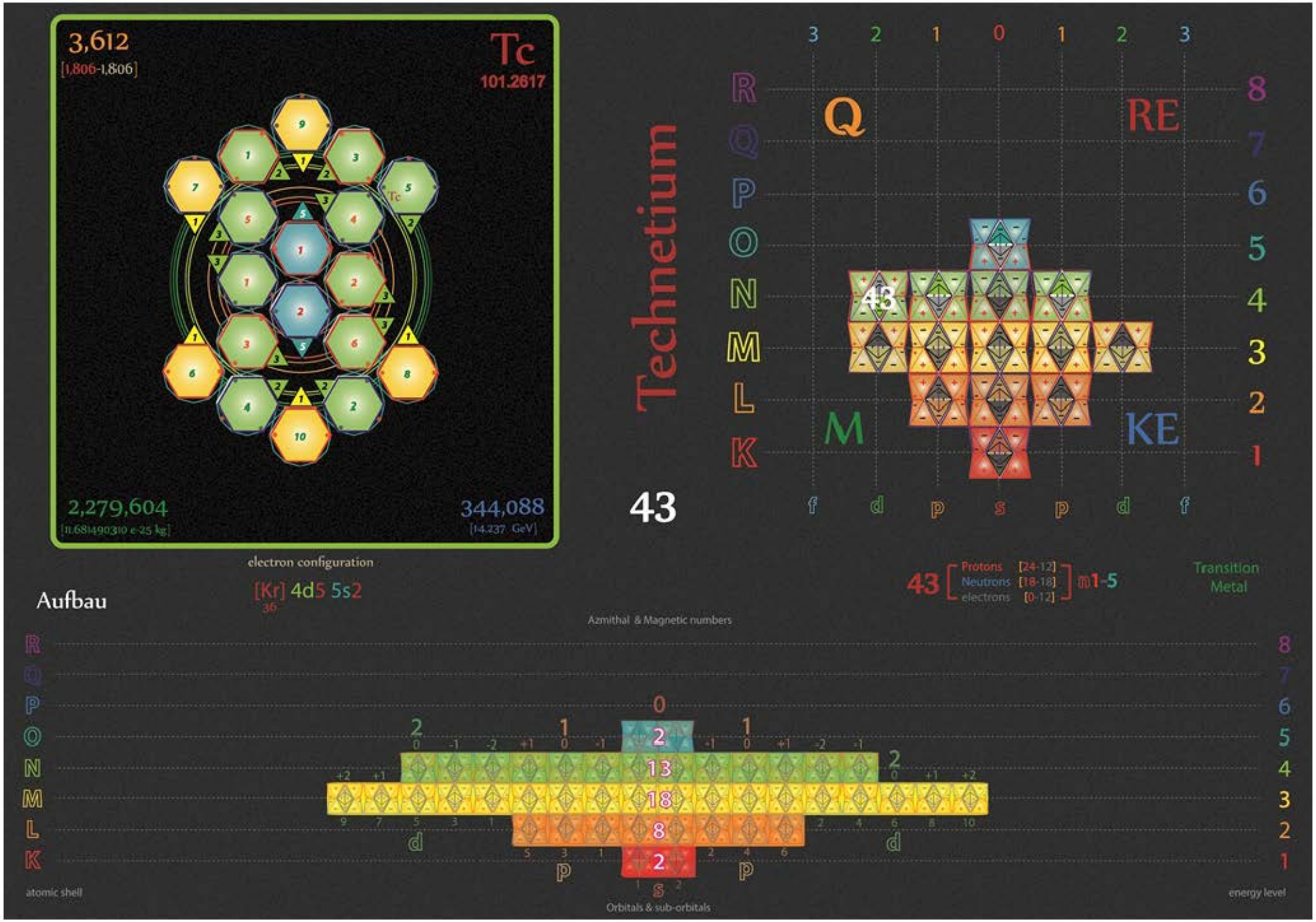

Tetryonics 51.43 - Technetium atom

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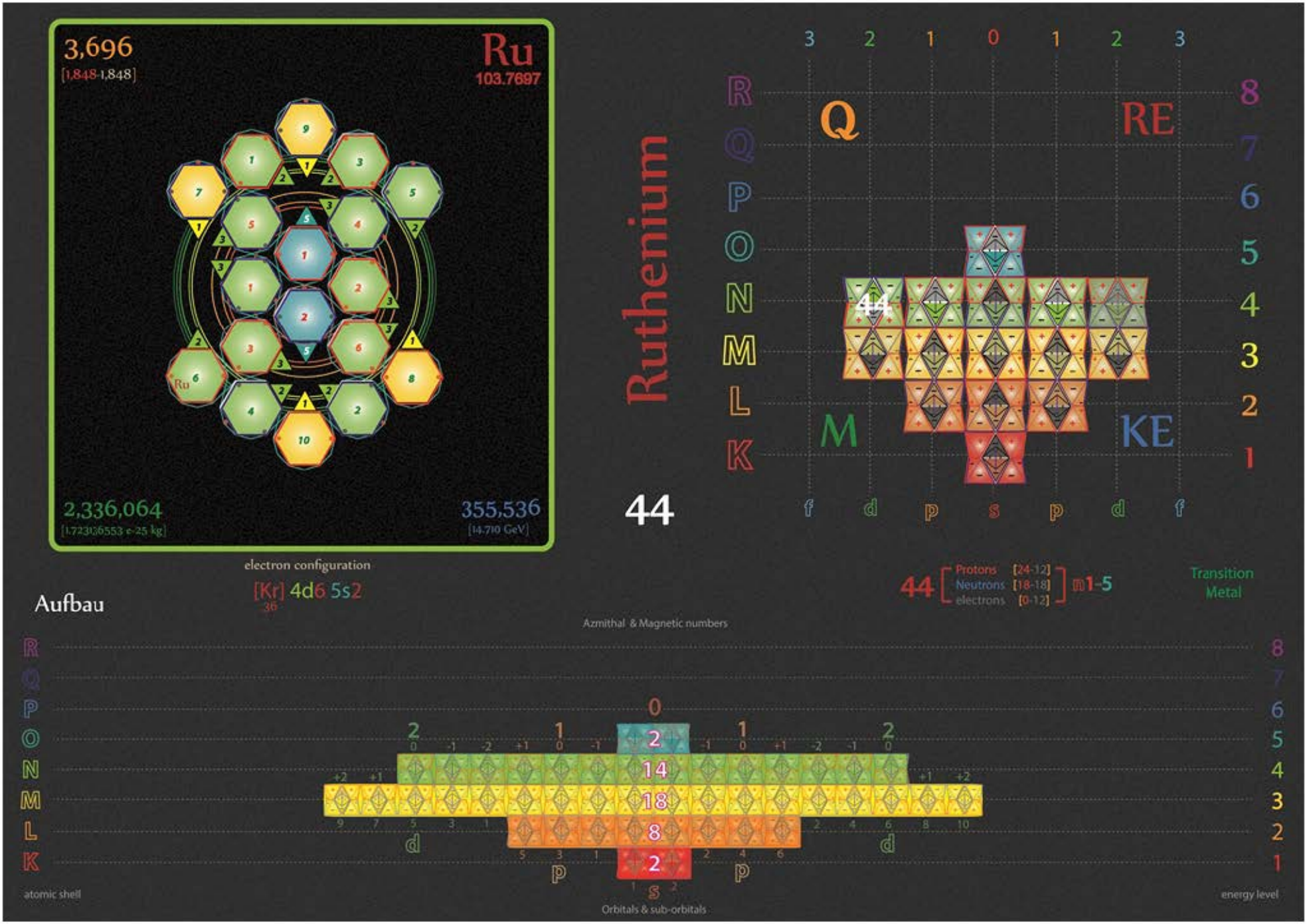

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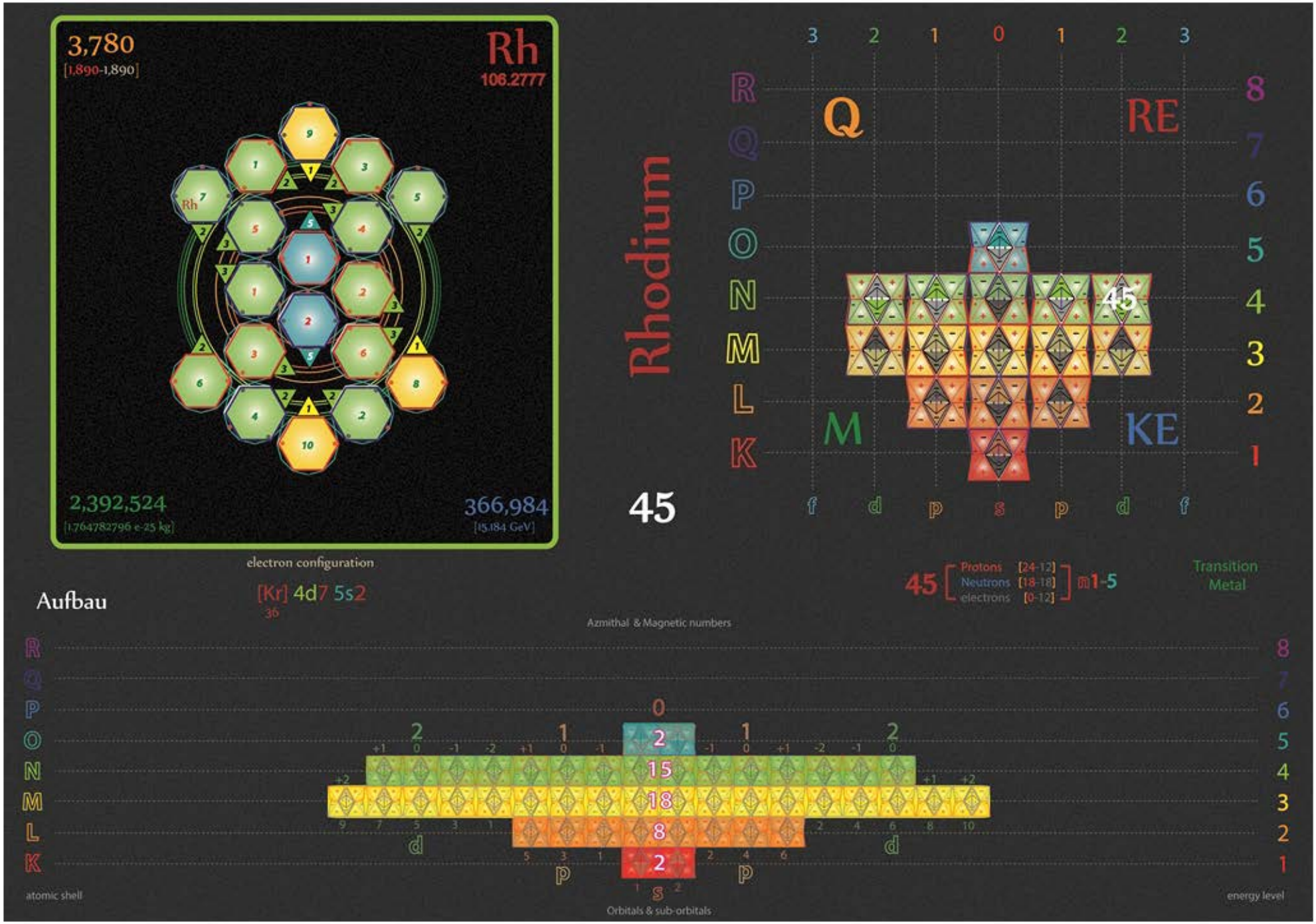

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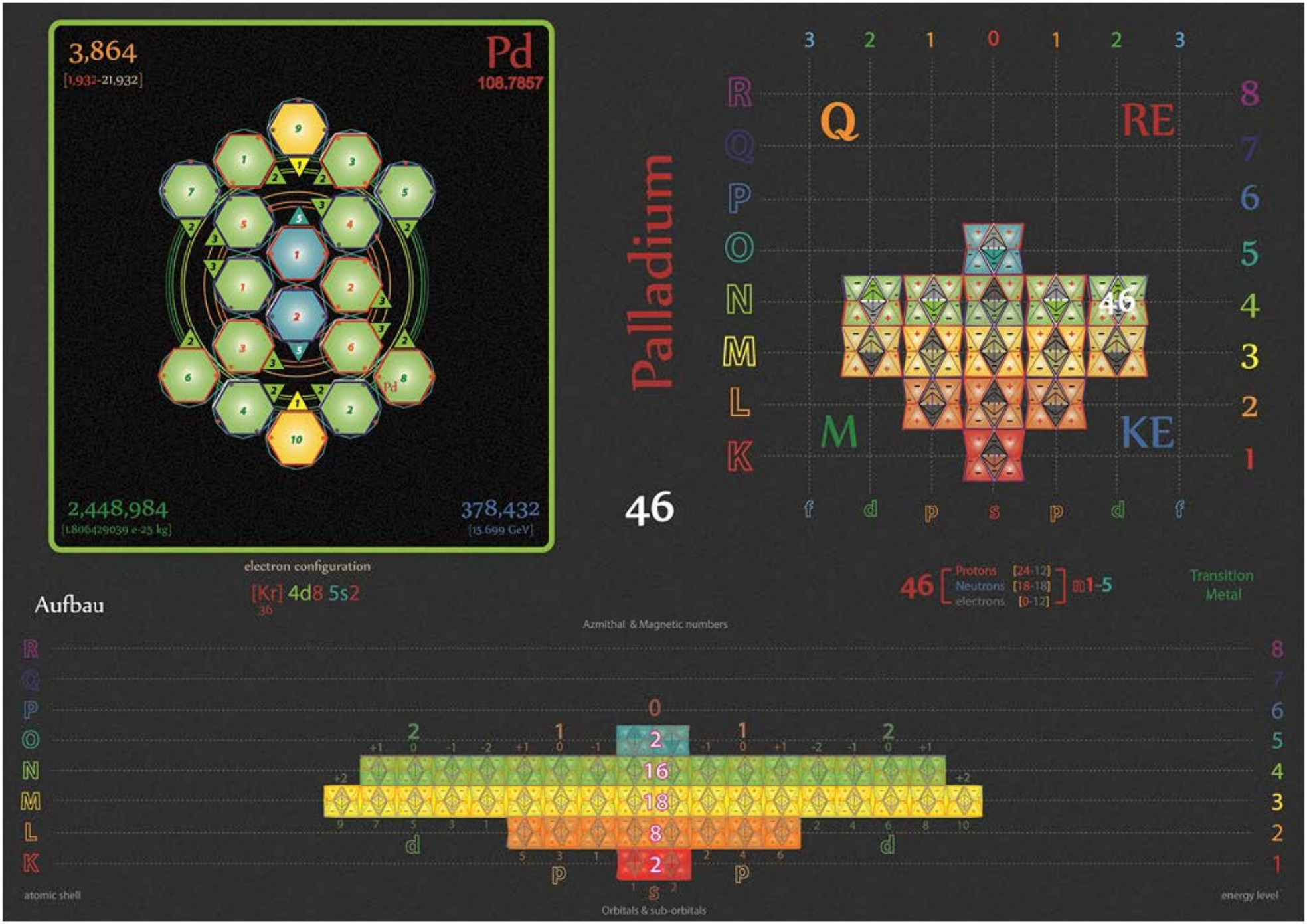

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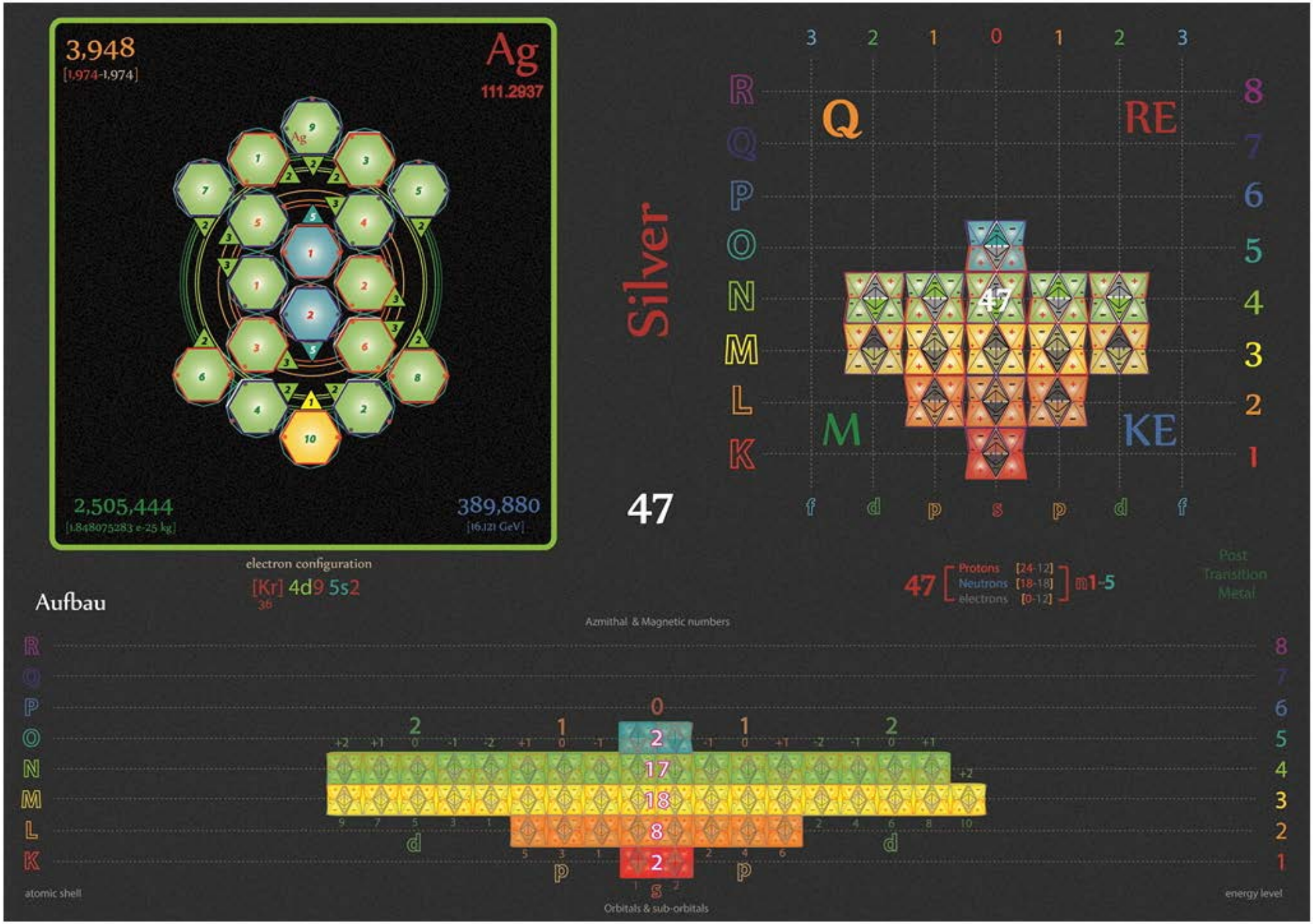

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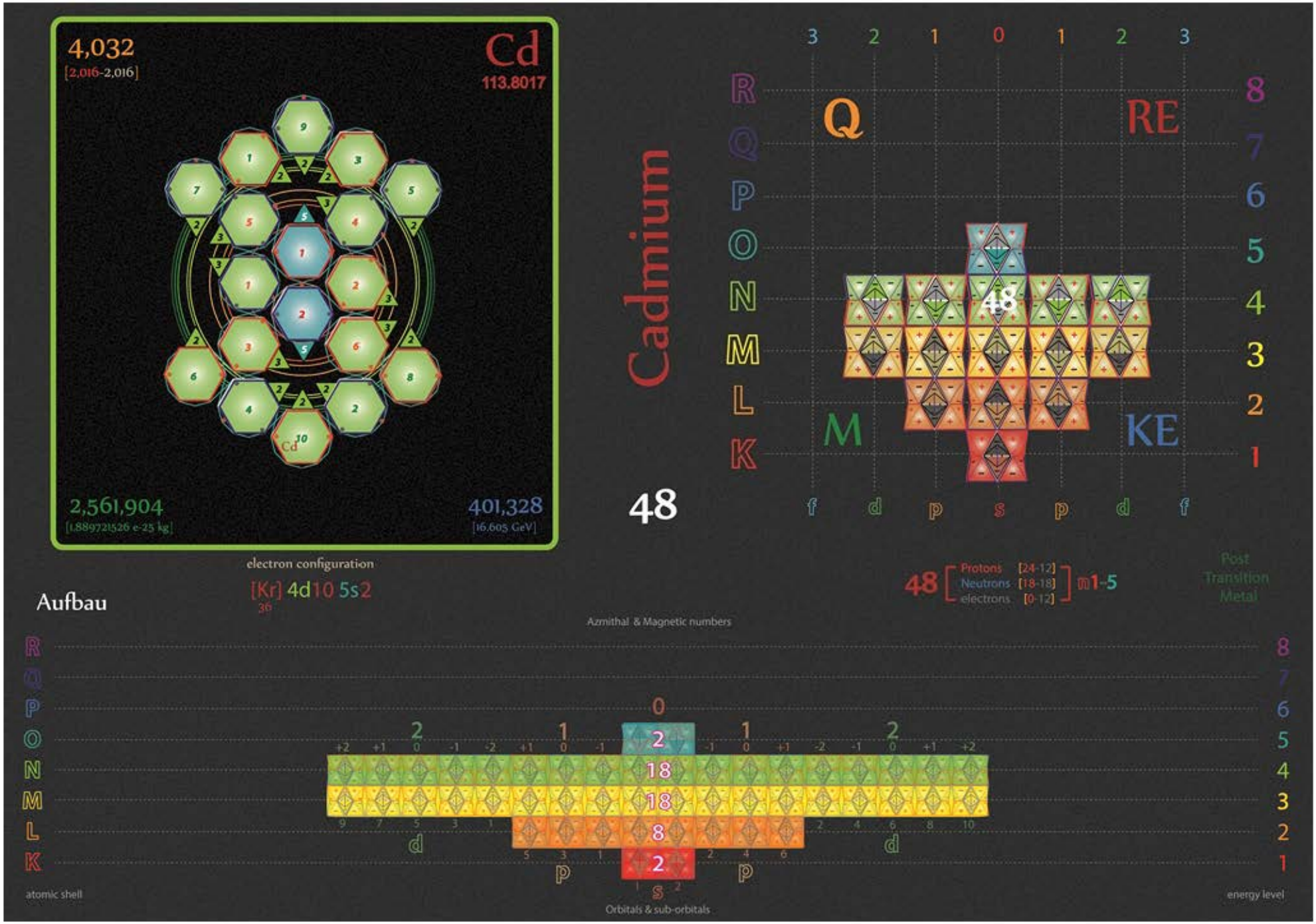

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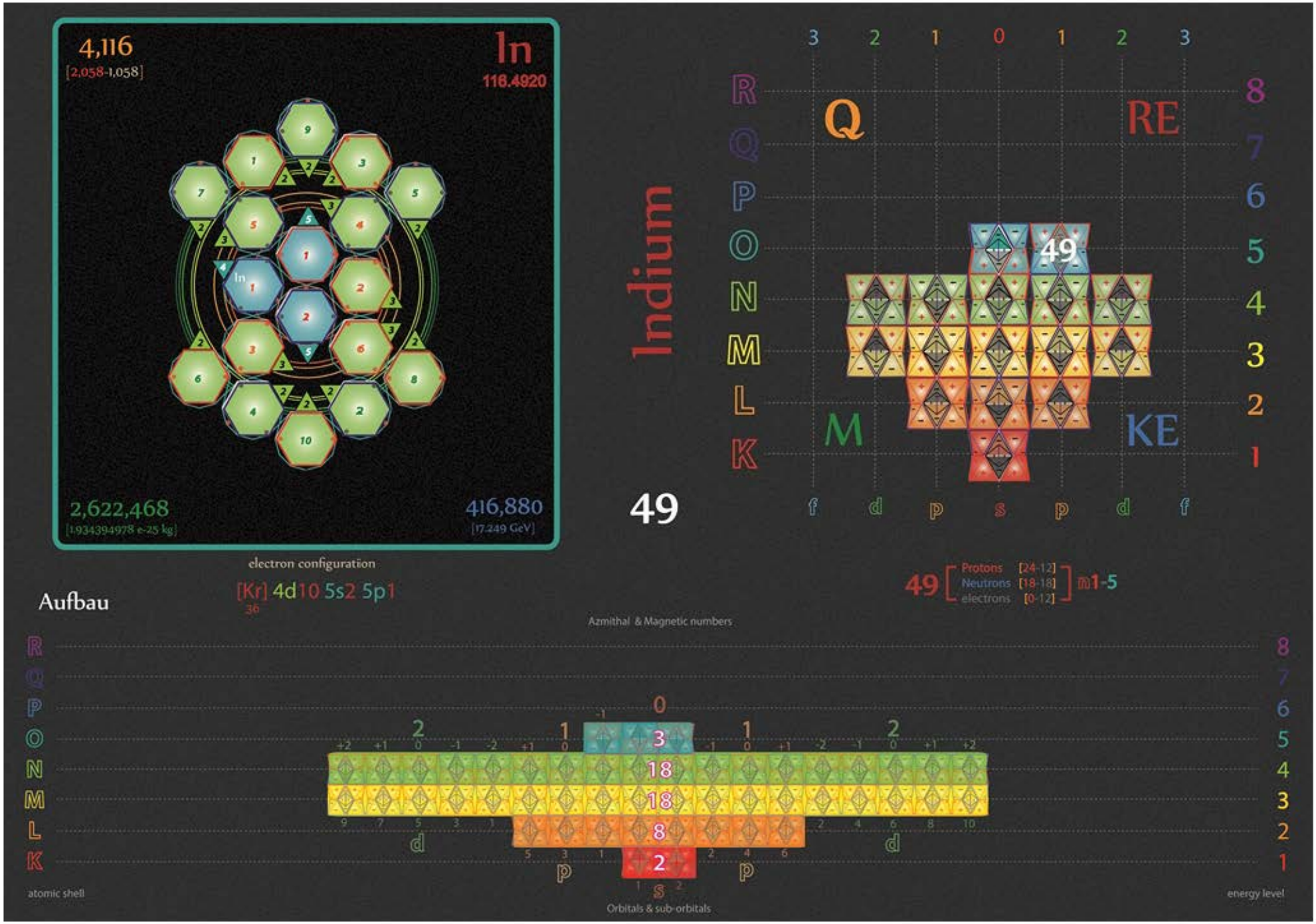

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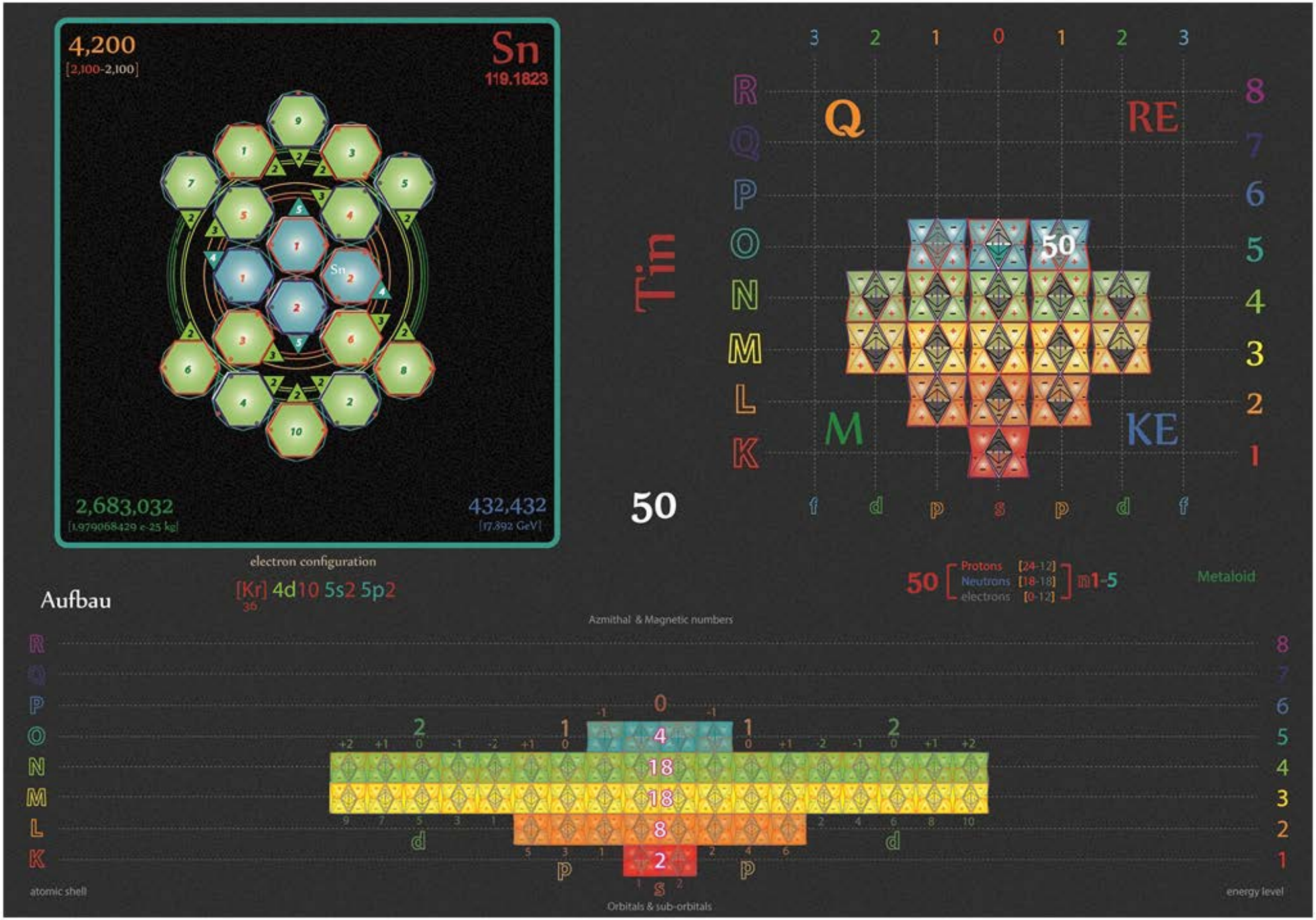

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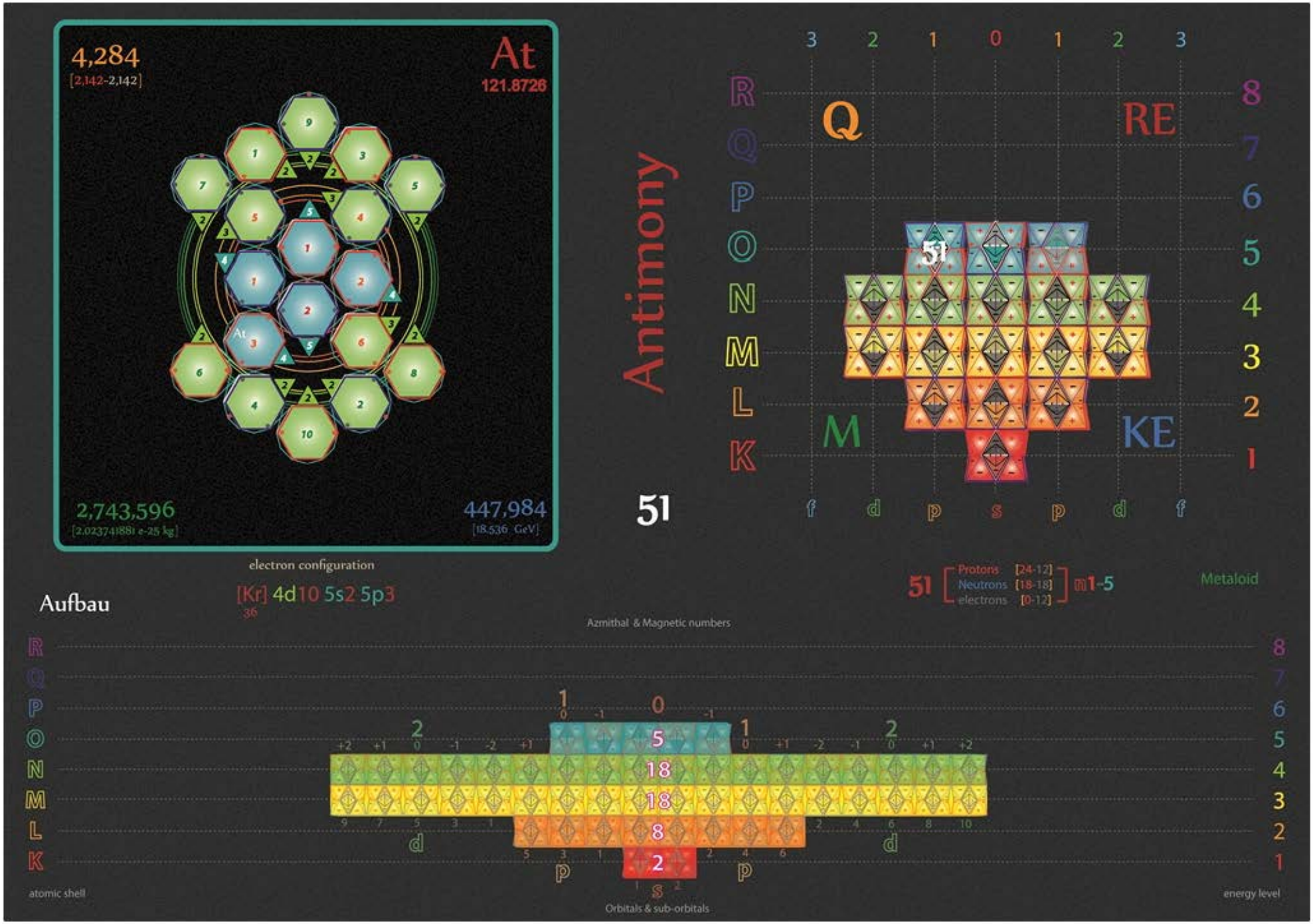

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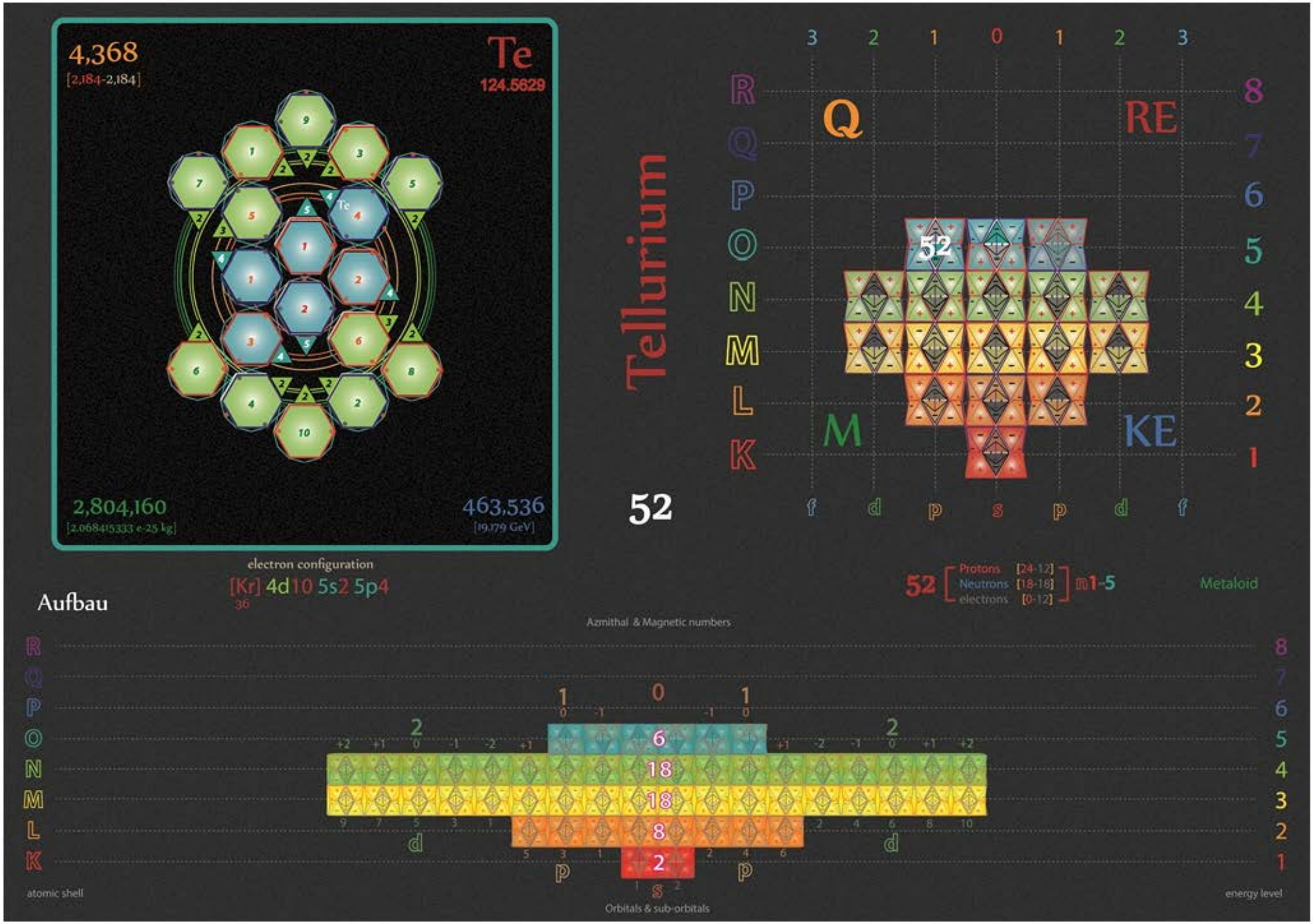

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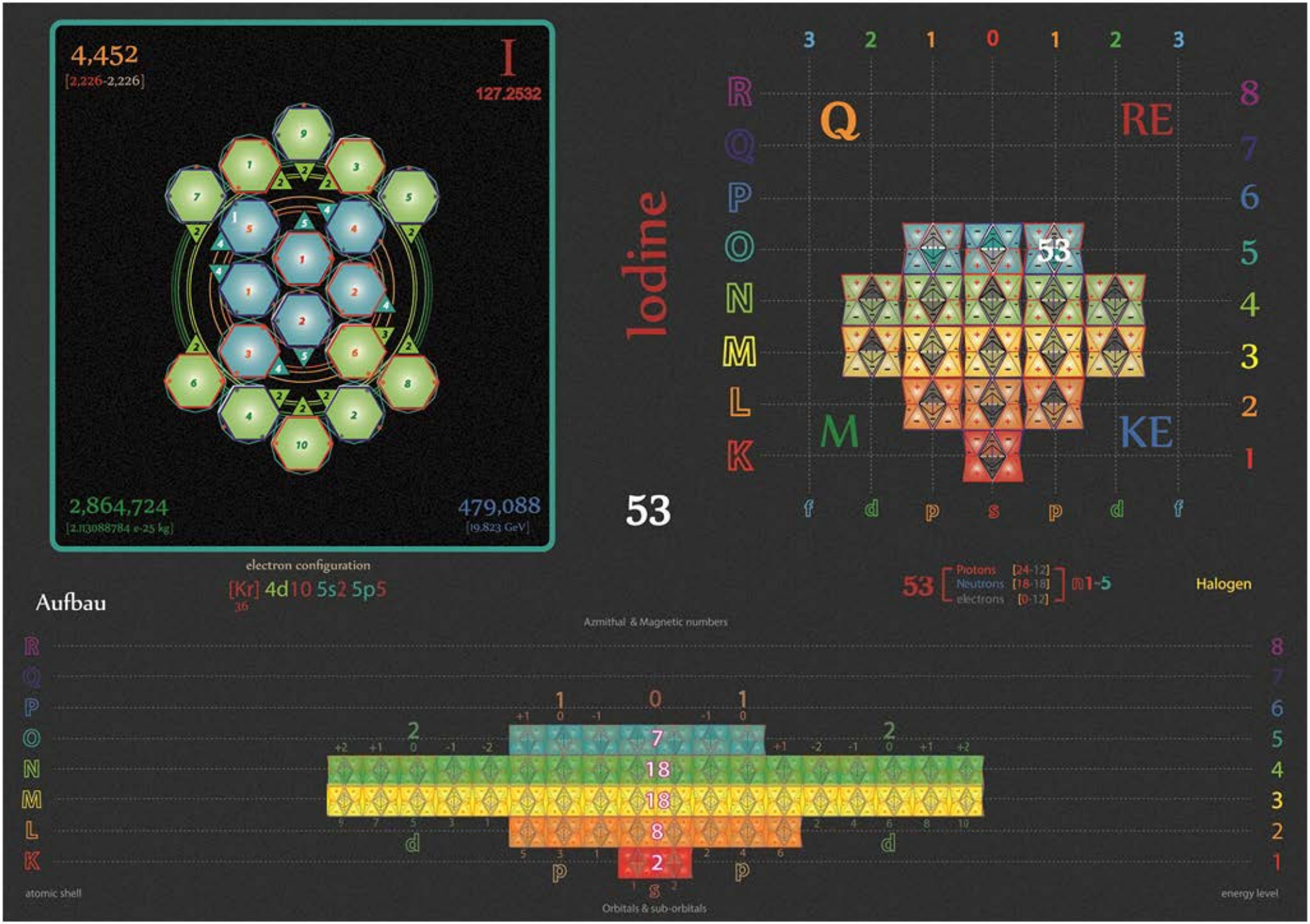

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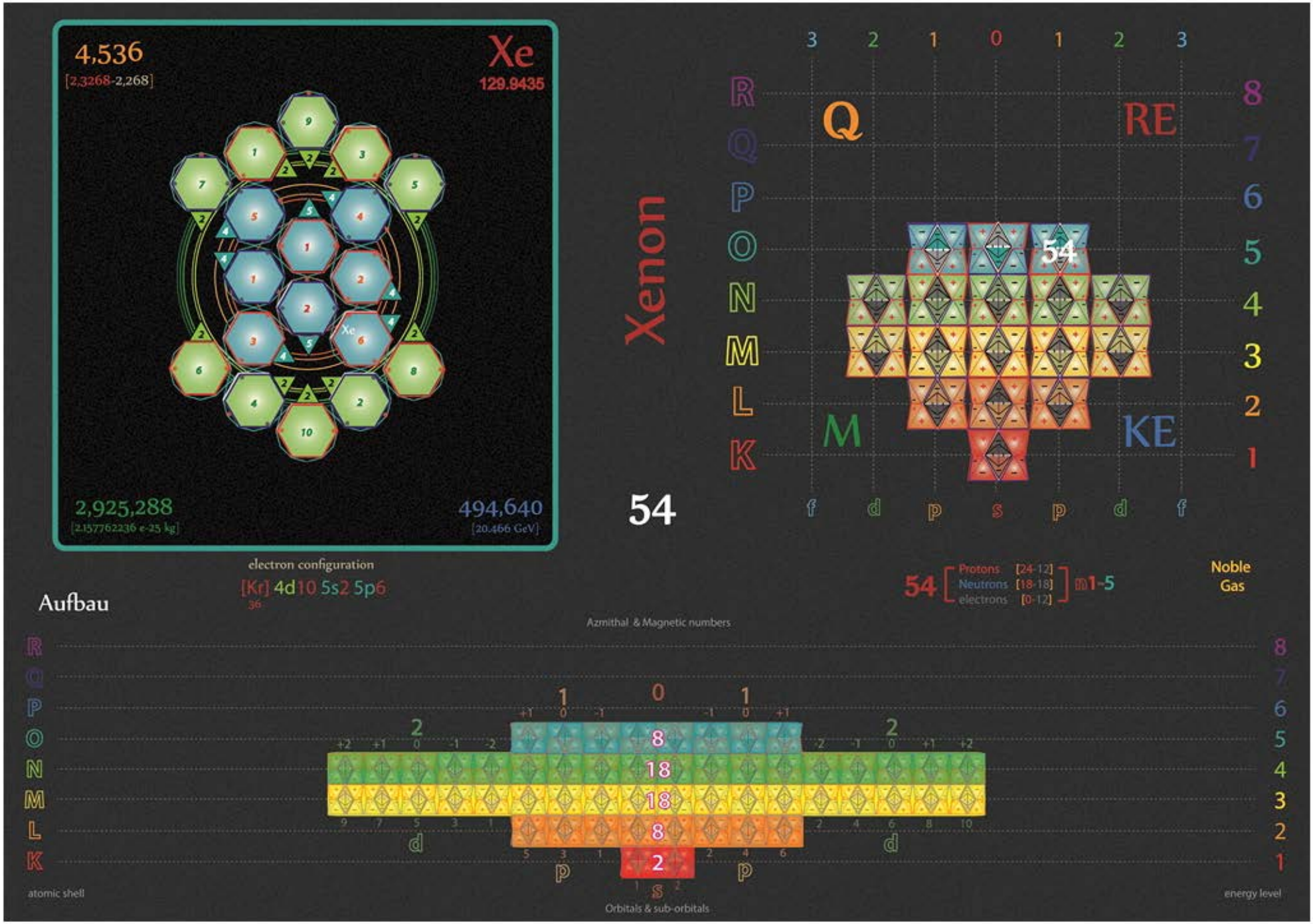

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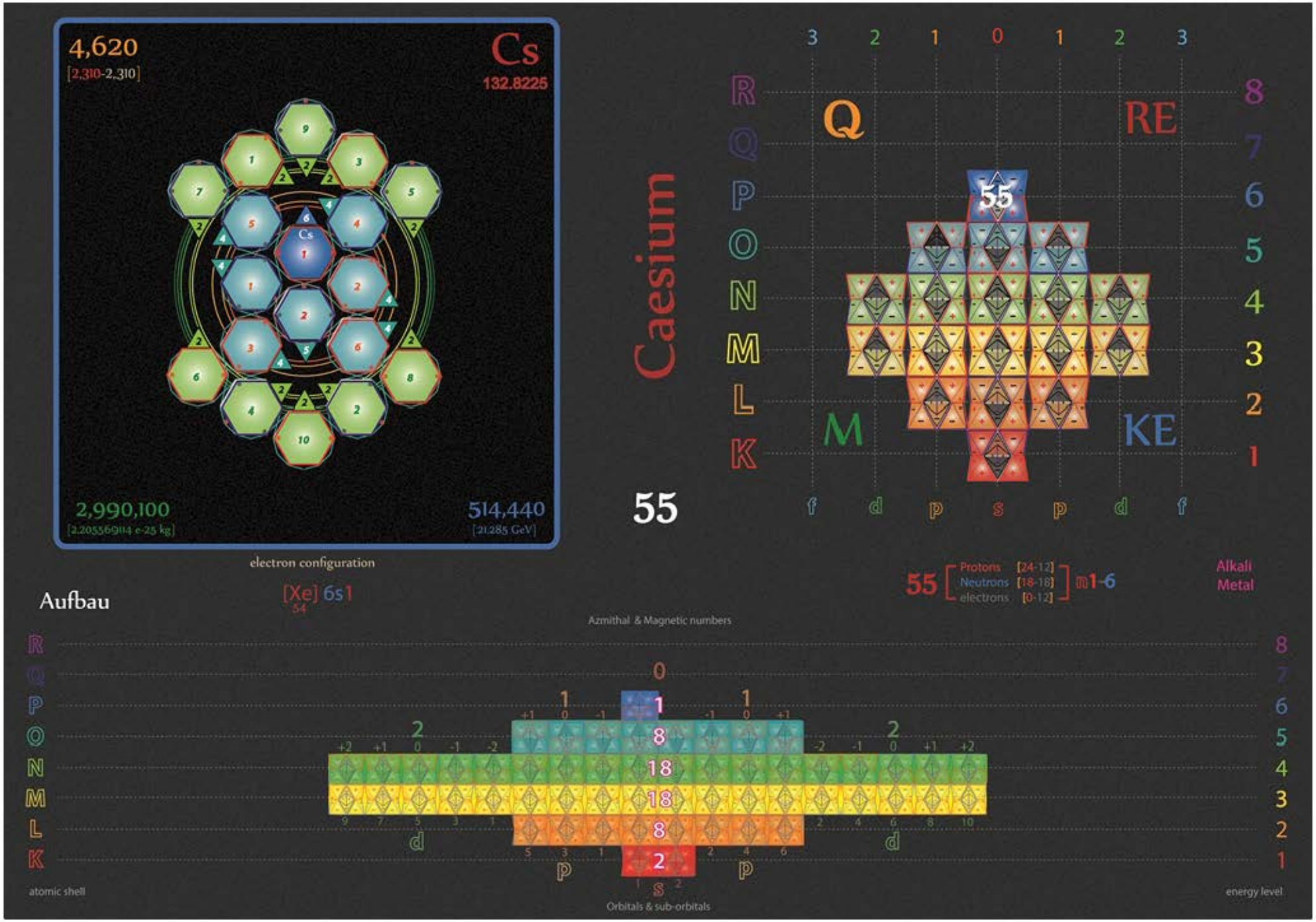

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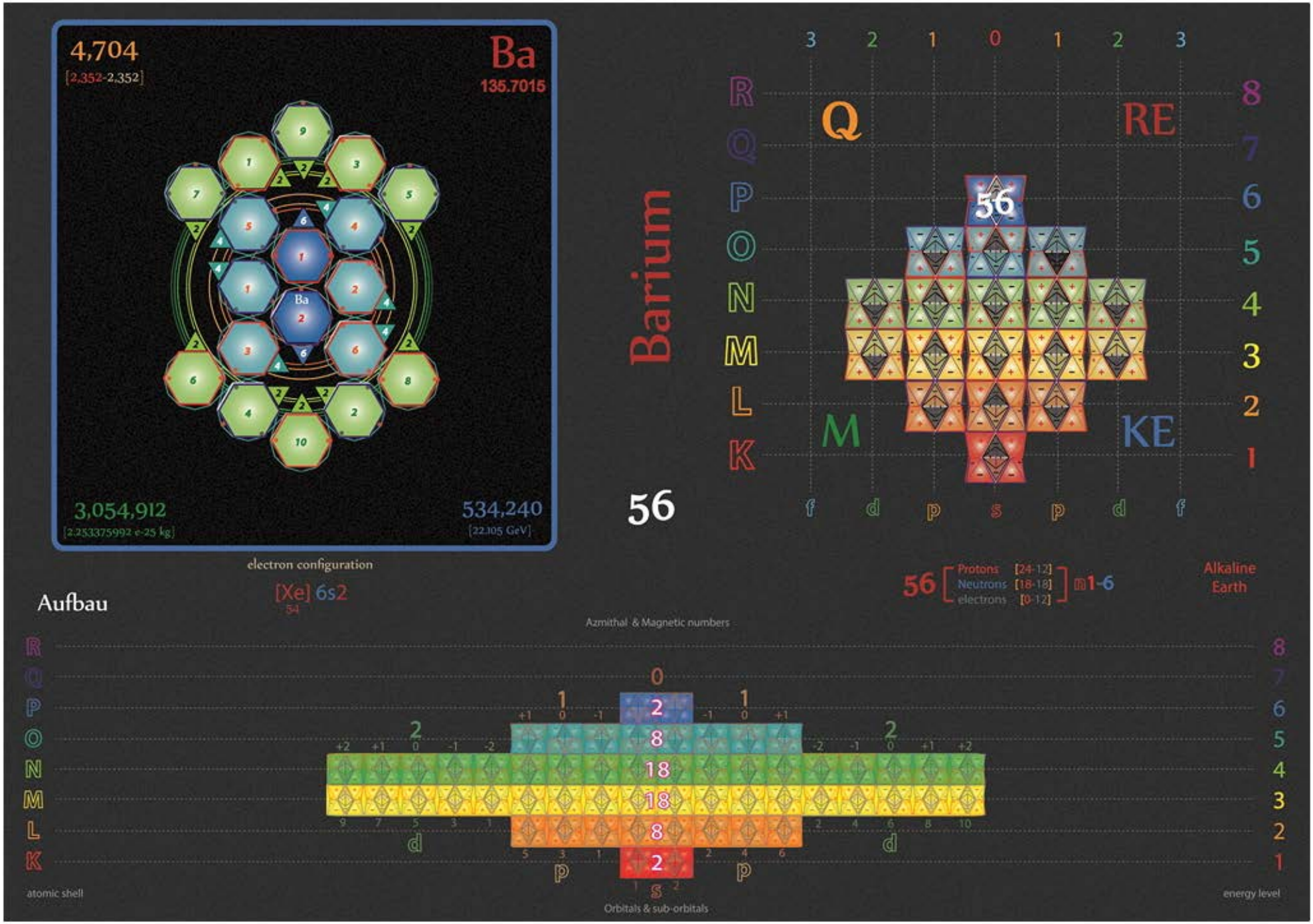

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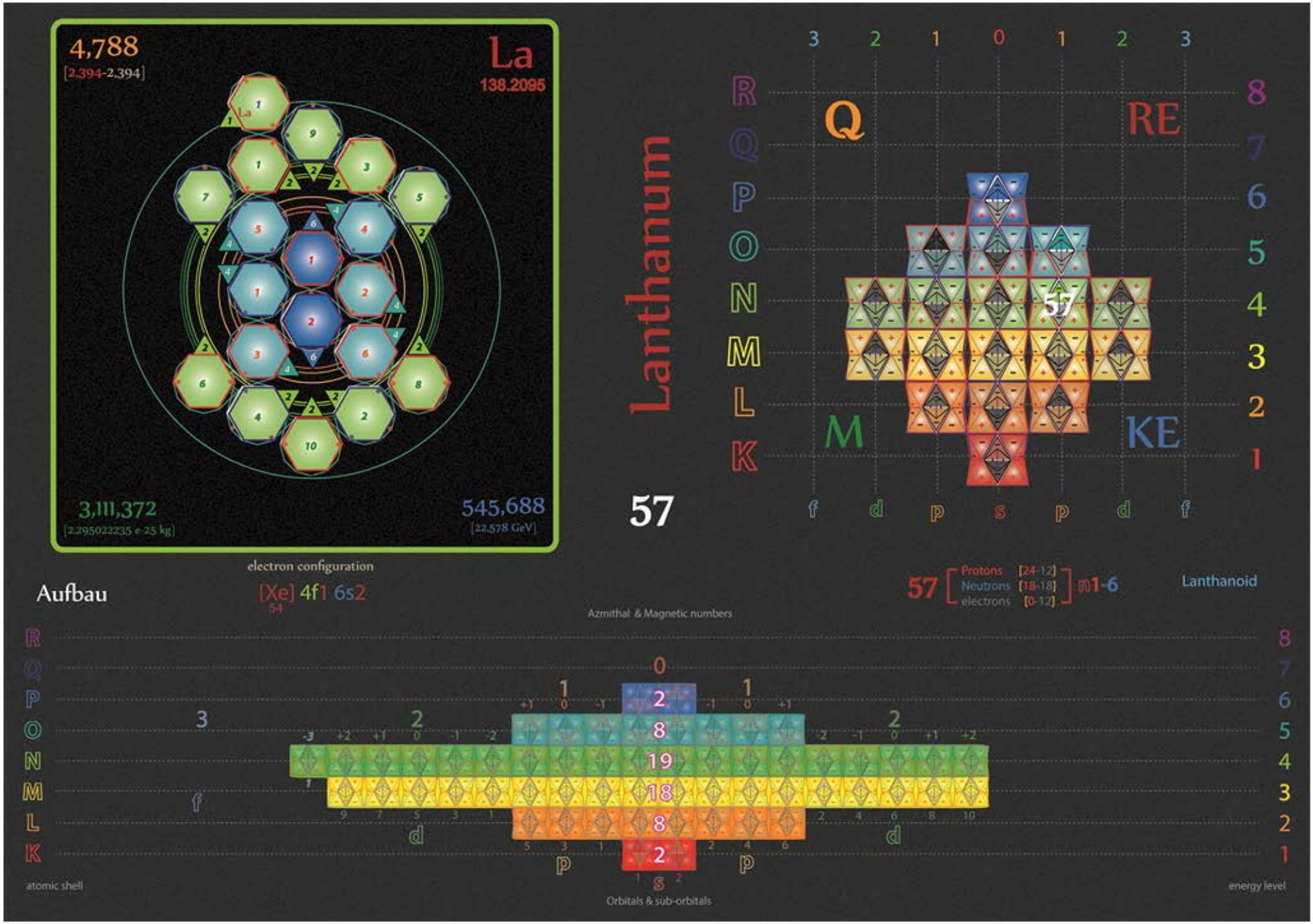

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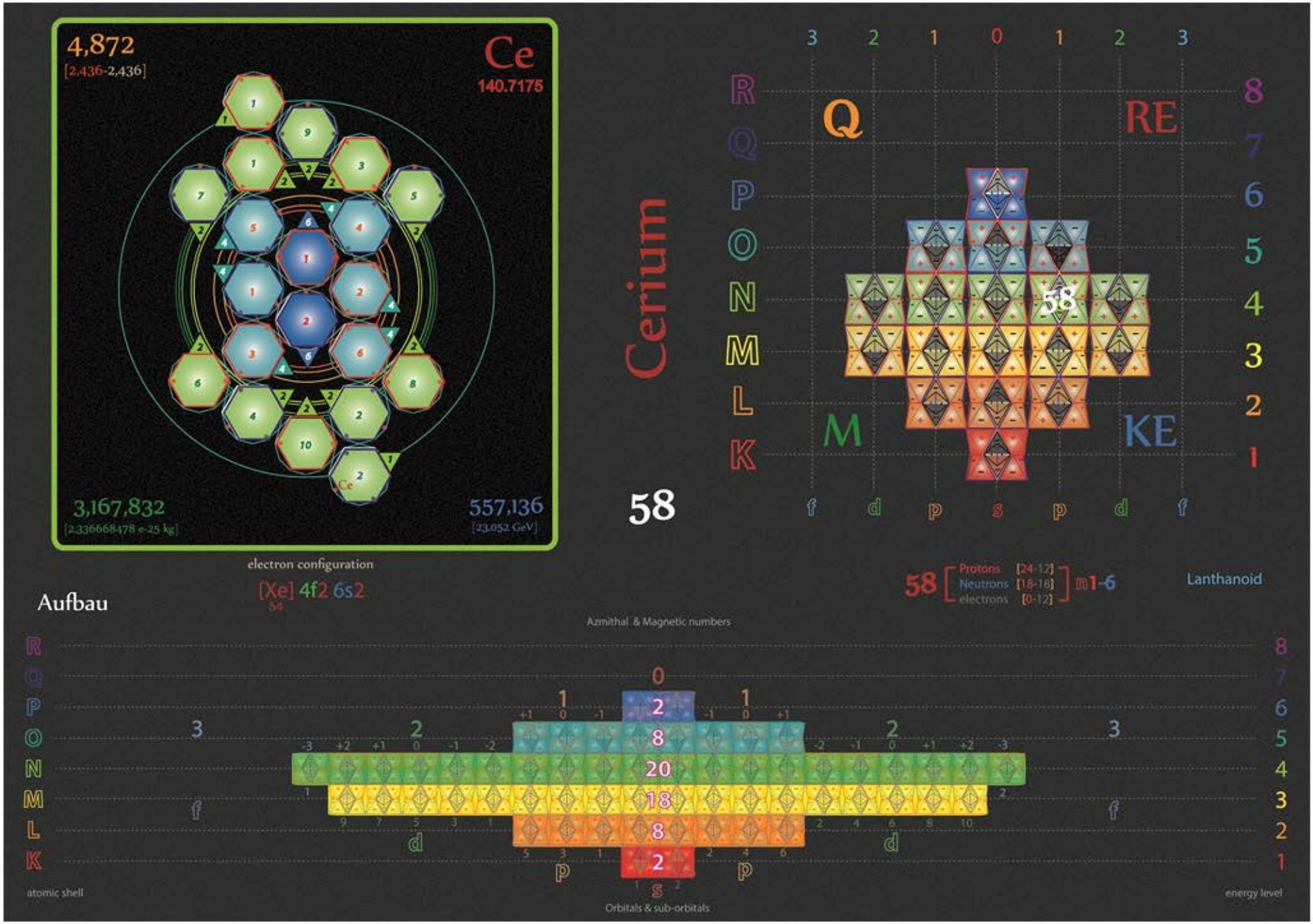

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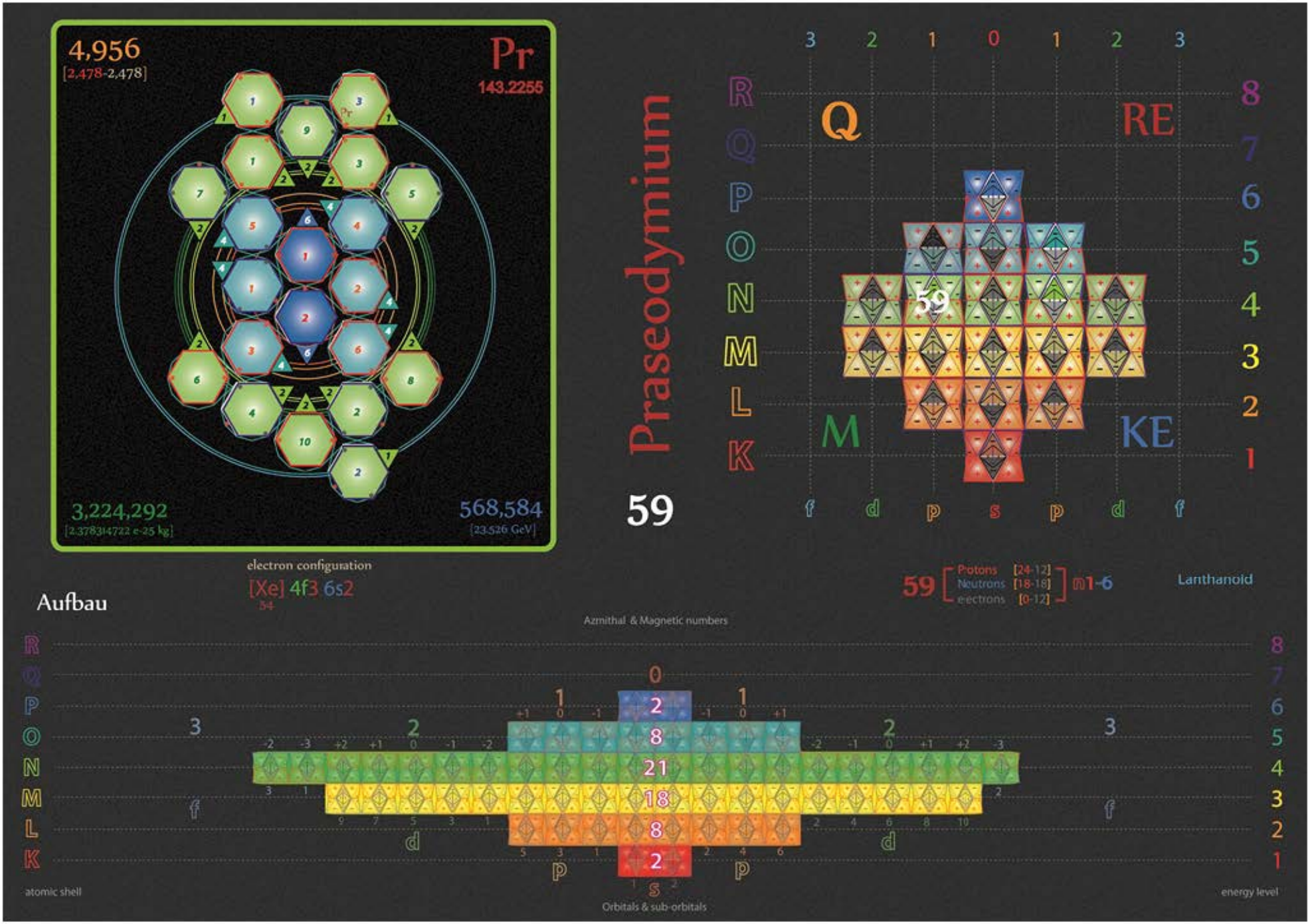

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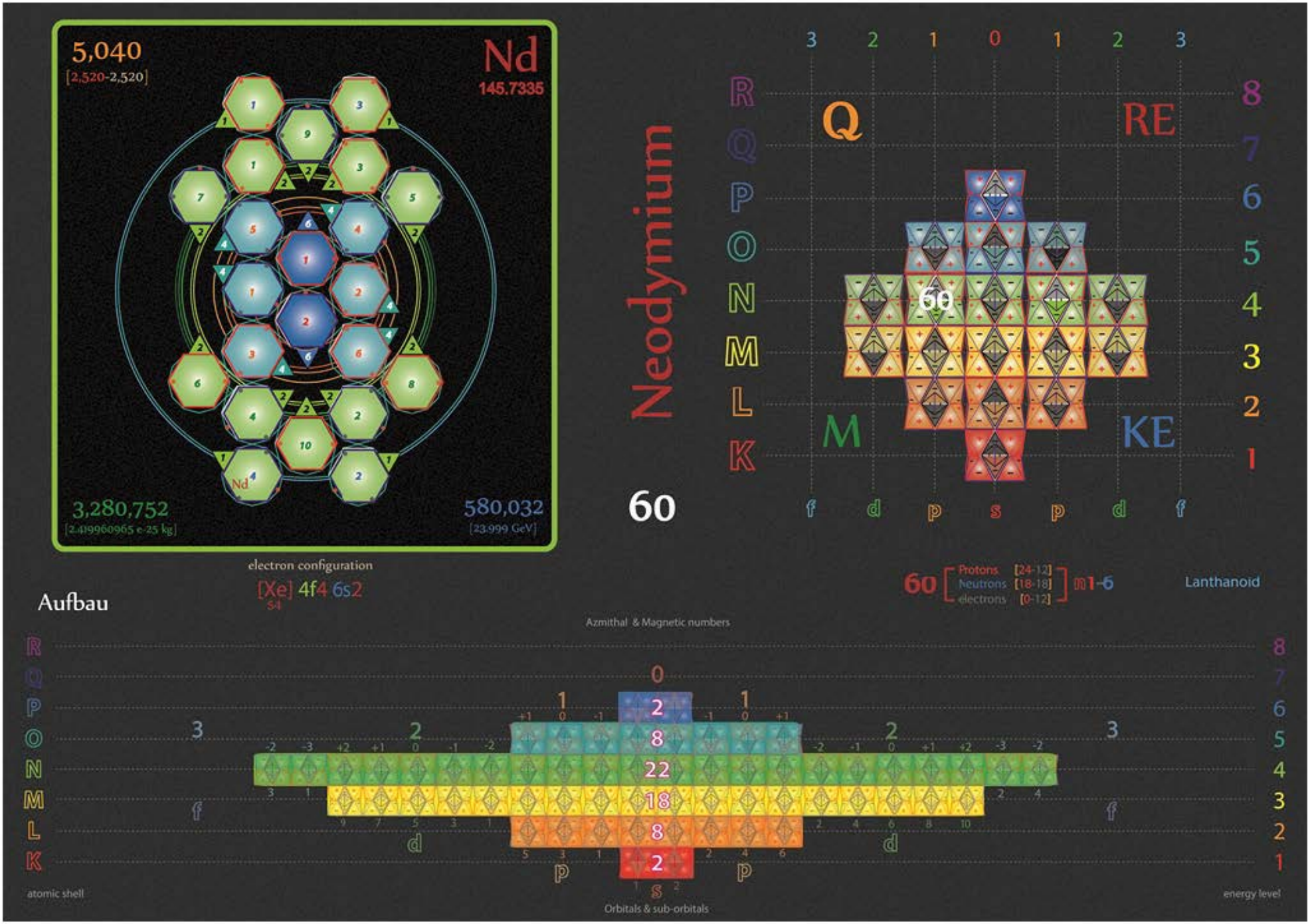

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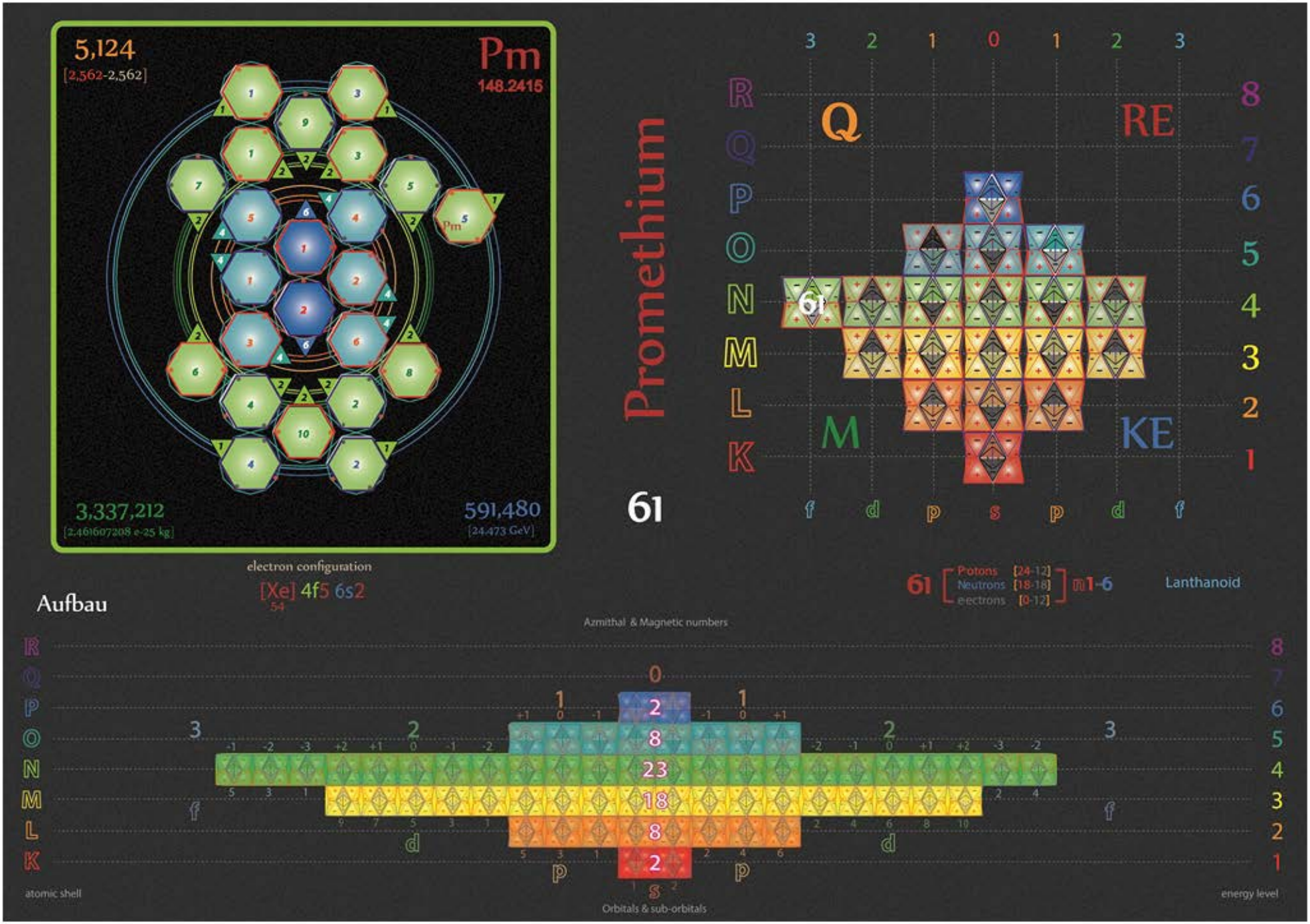

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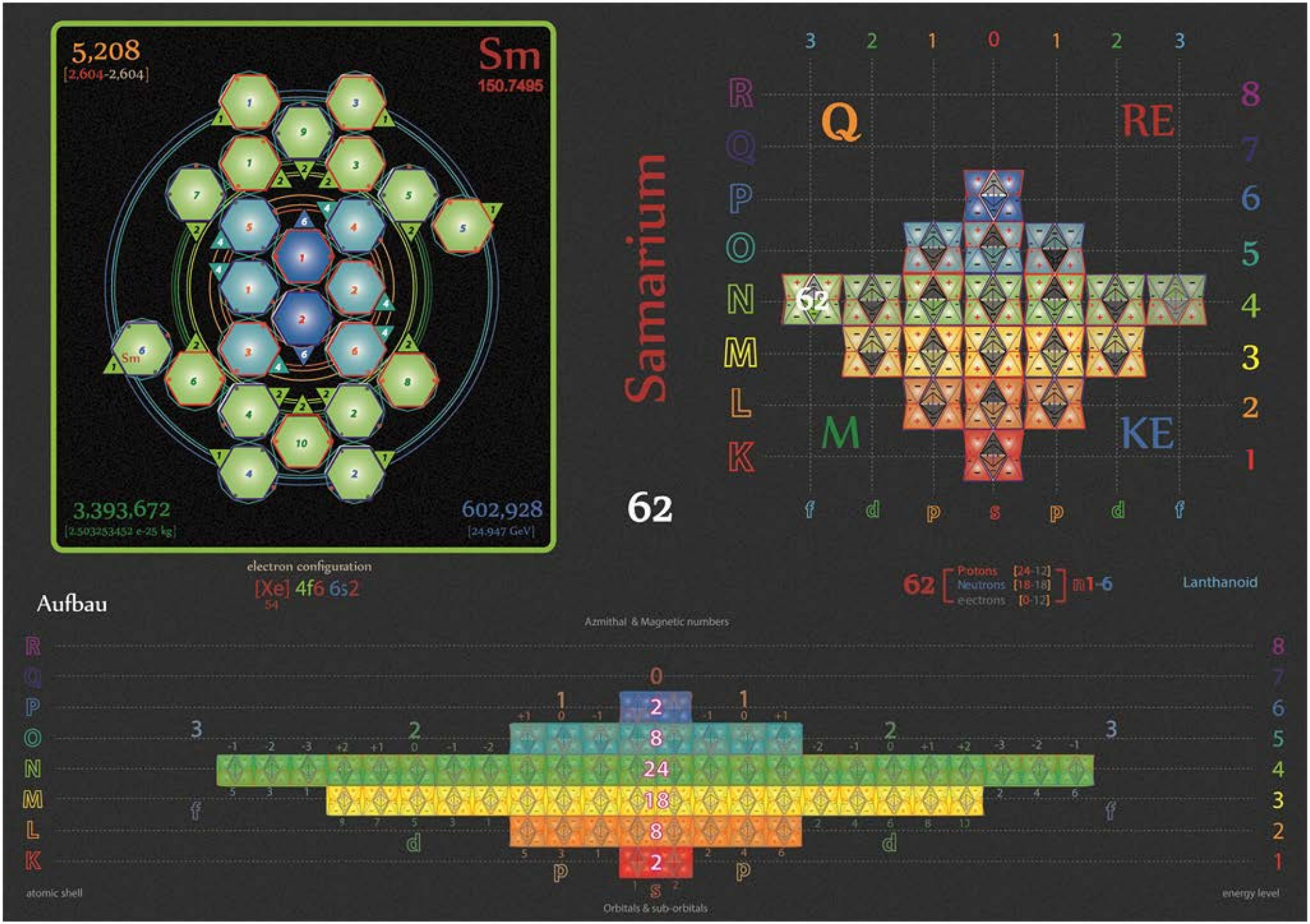

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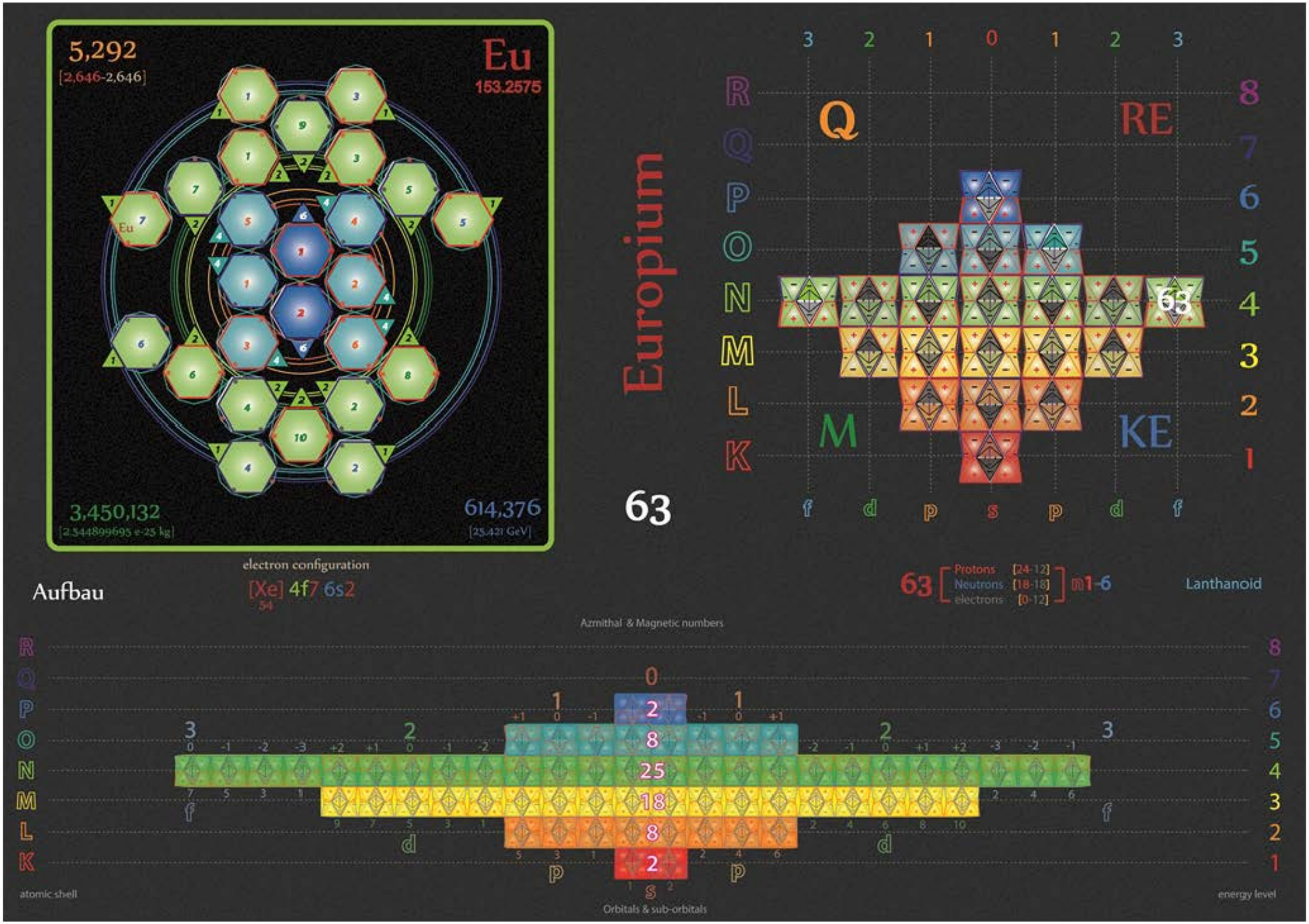

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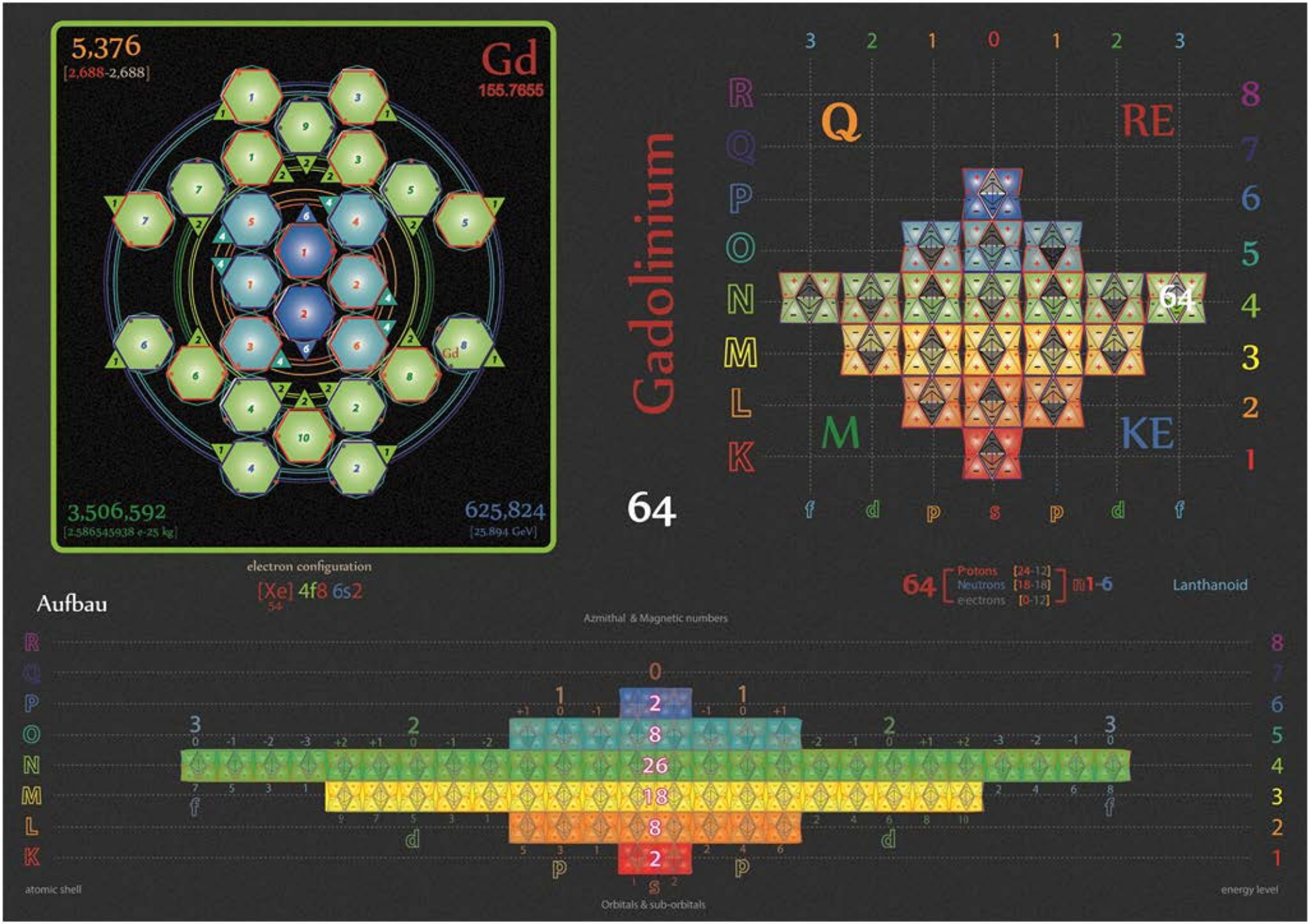

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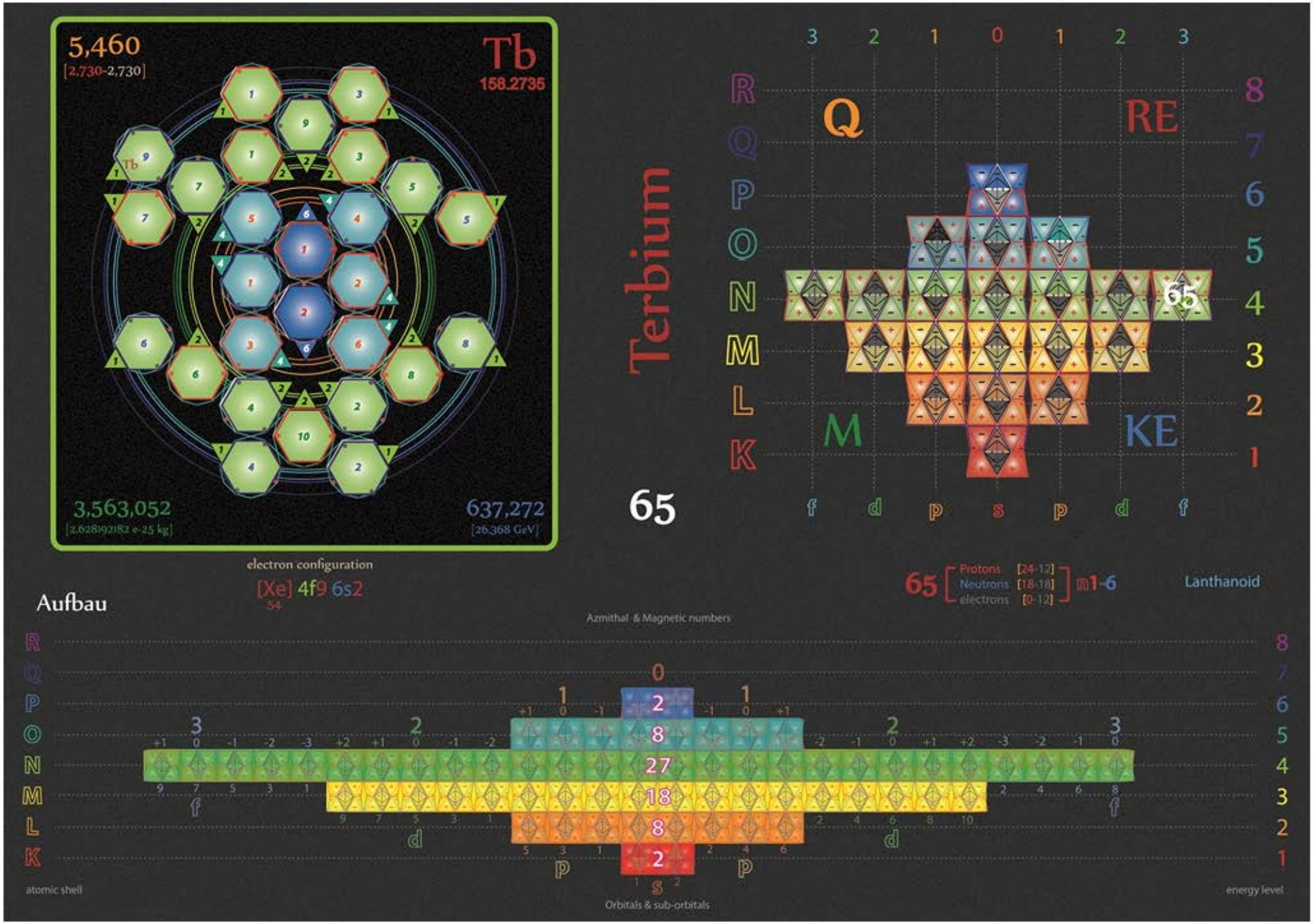

Tetryonics 51.65 -Terbium atom

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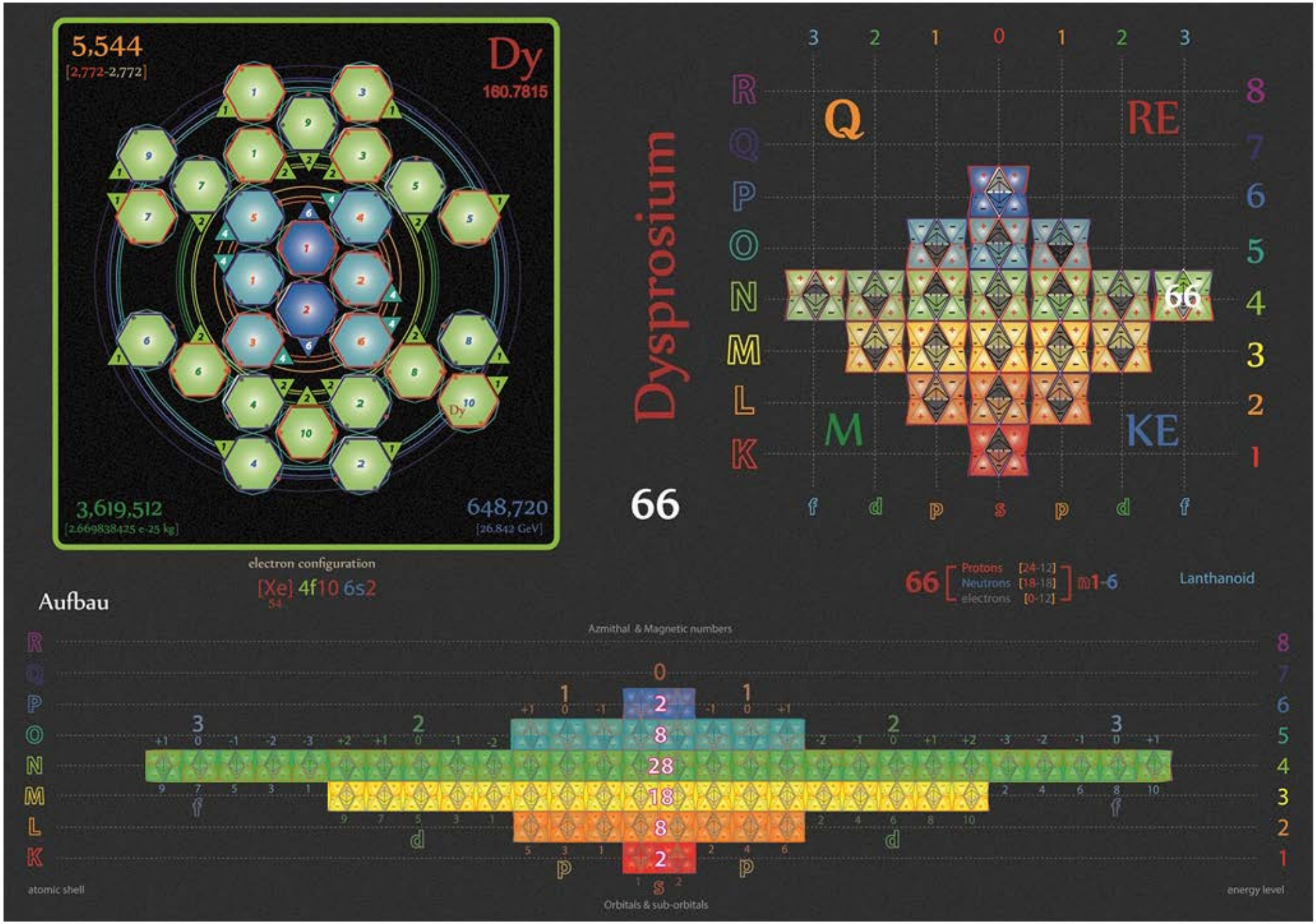

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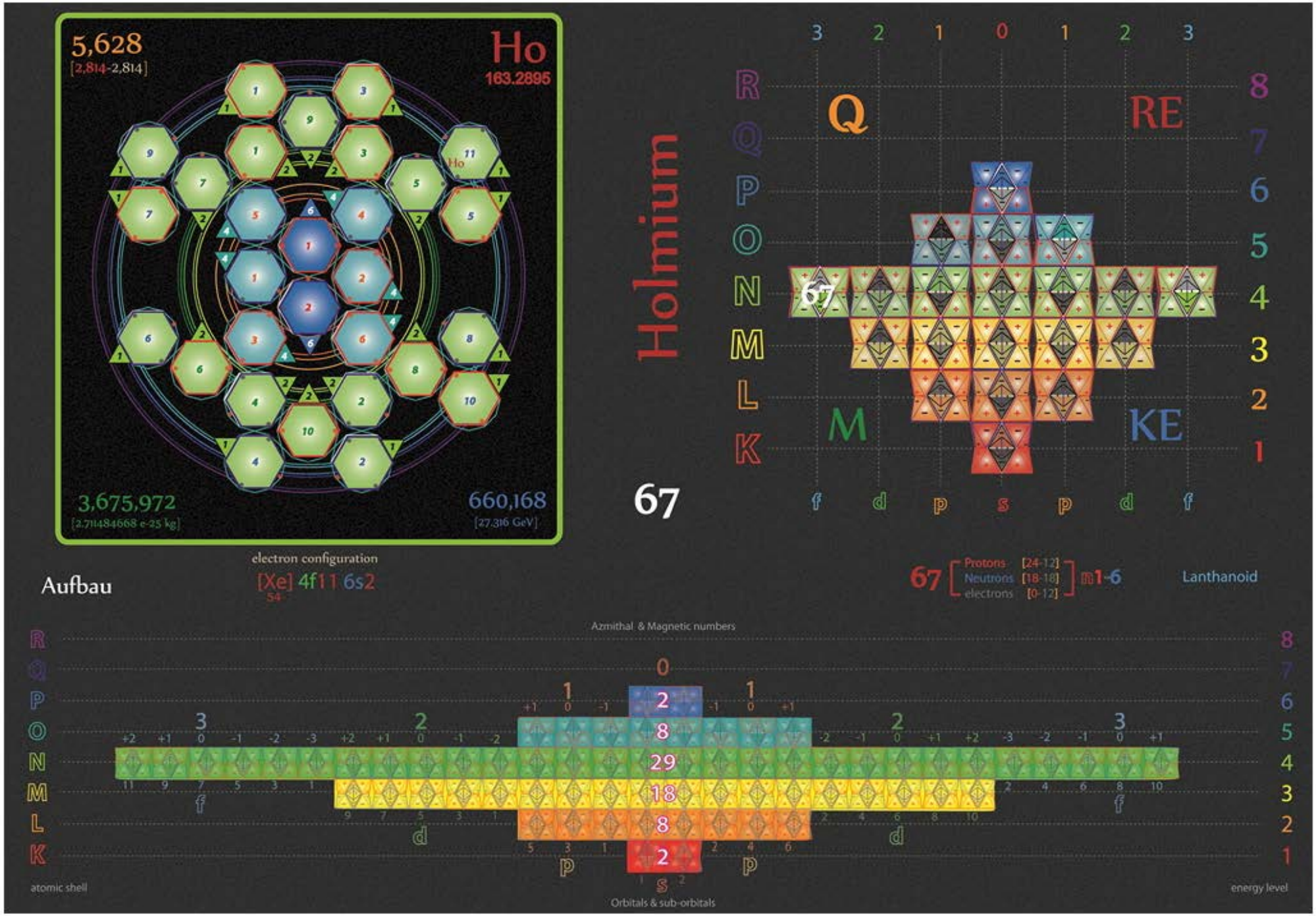

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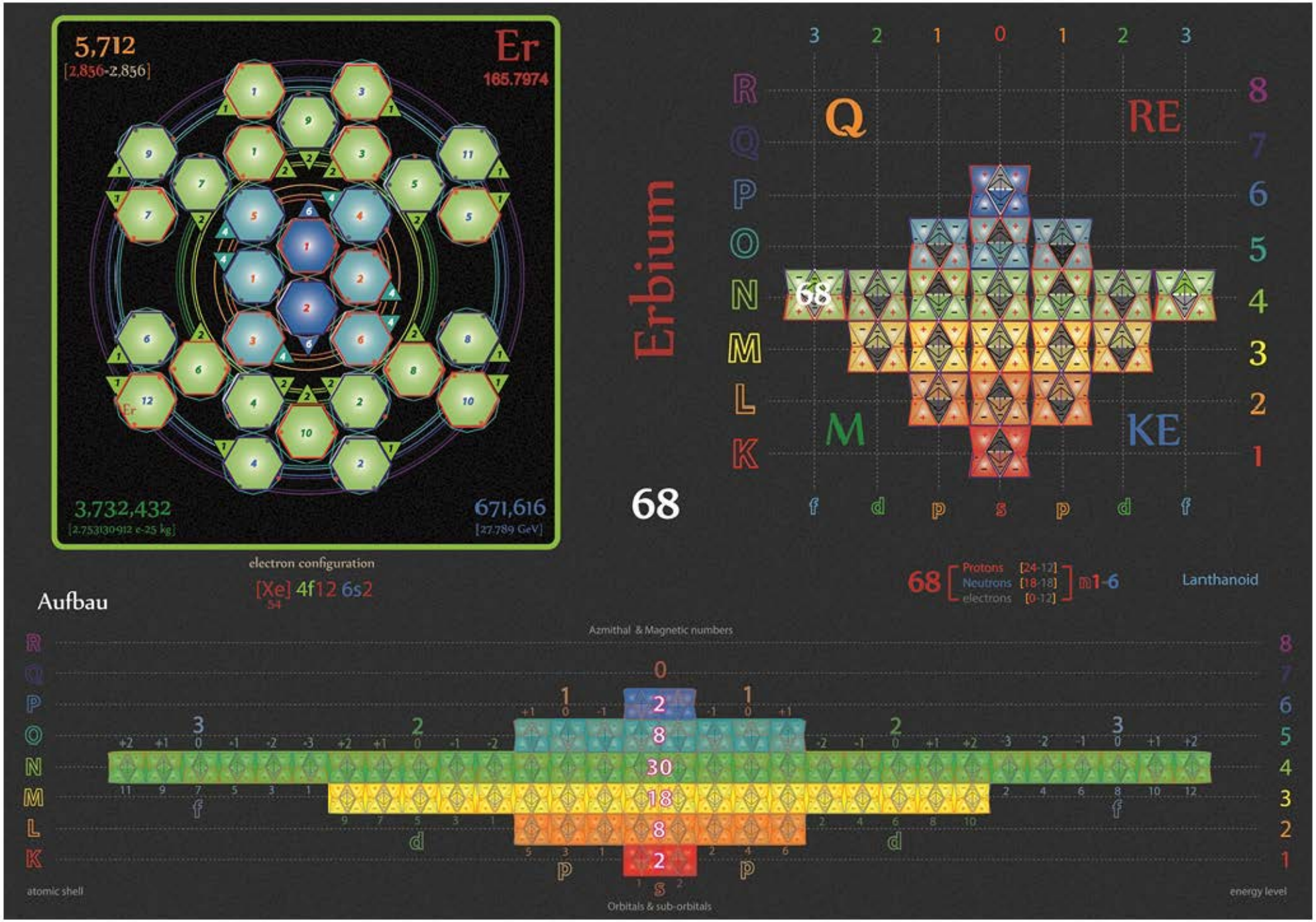

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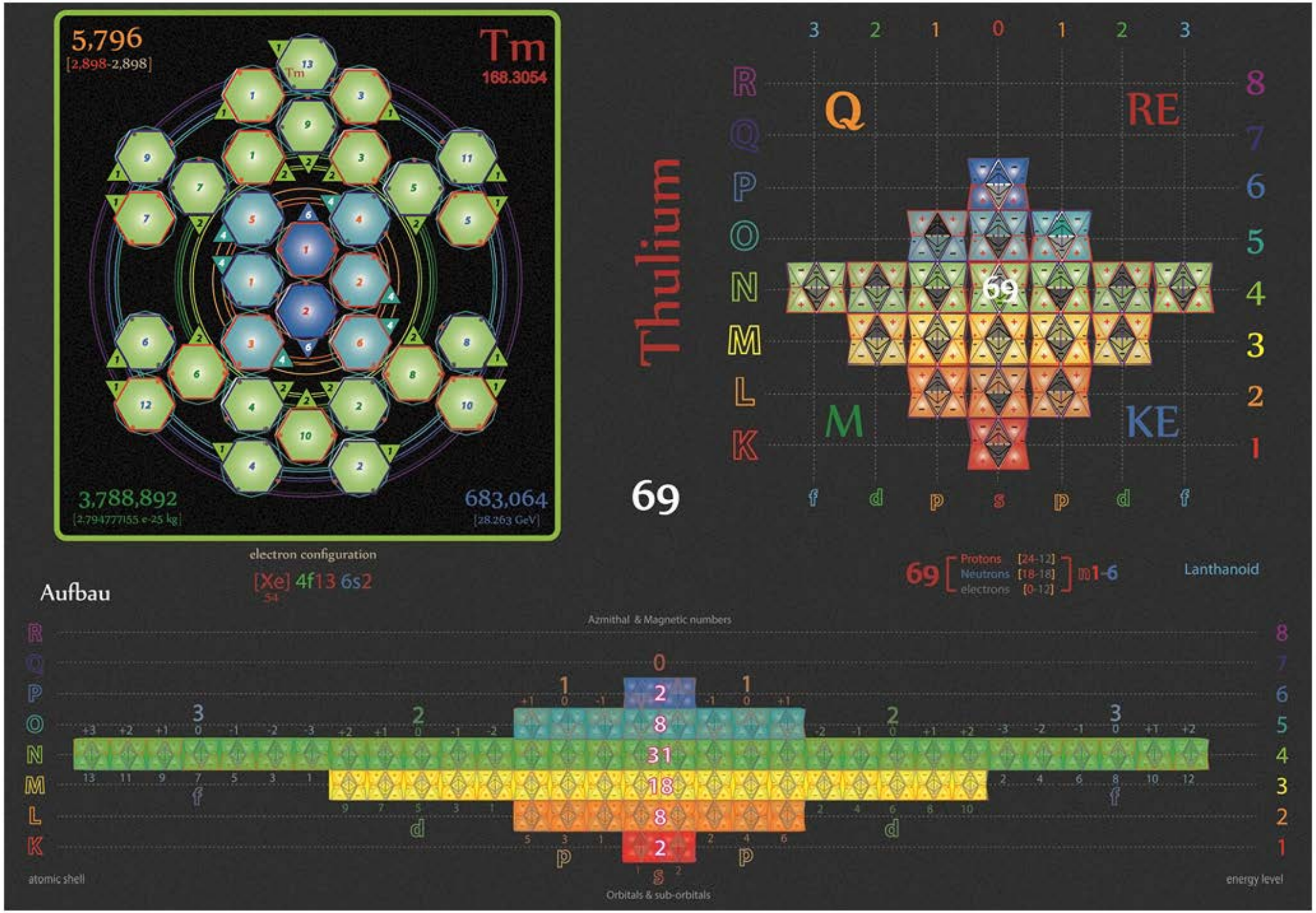

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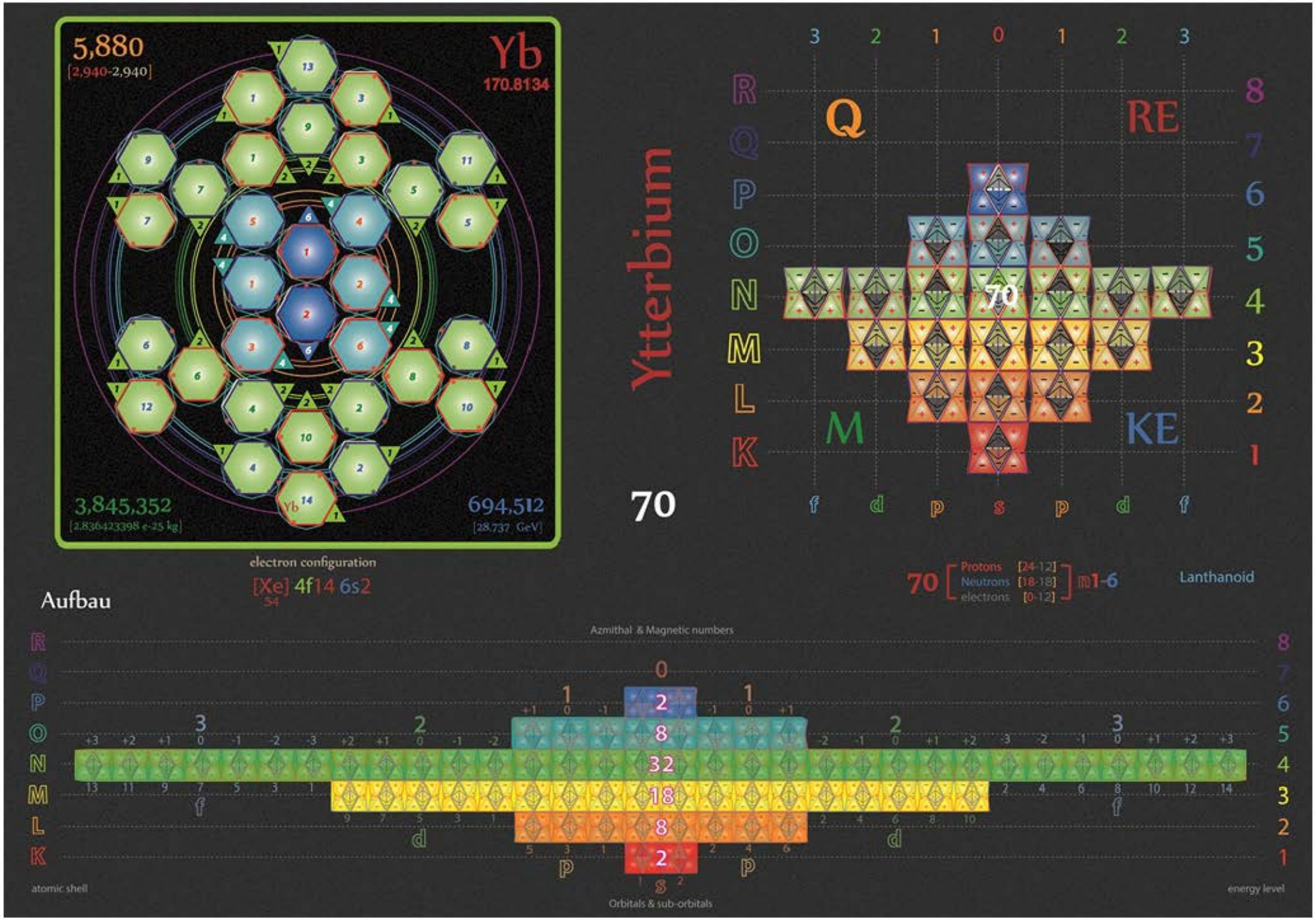

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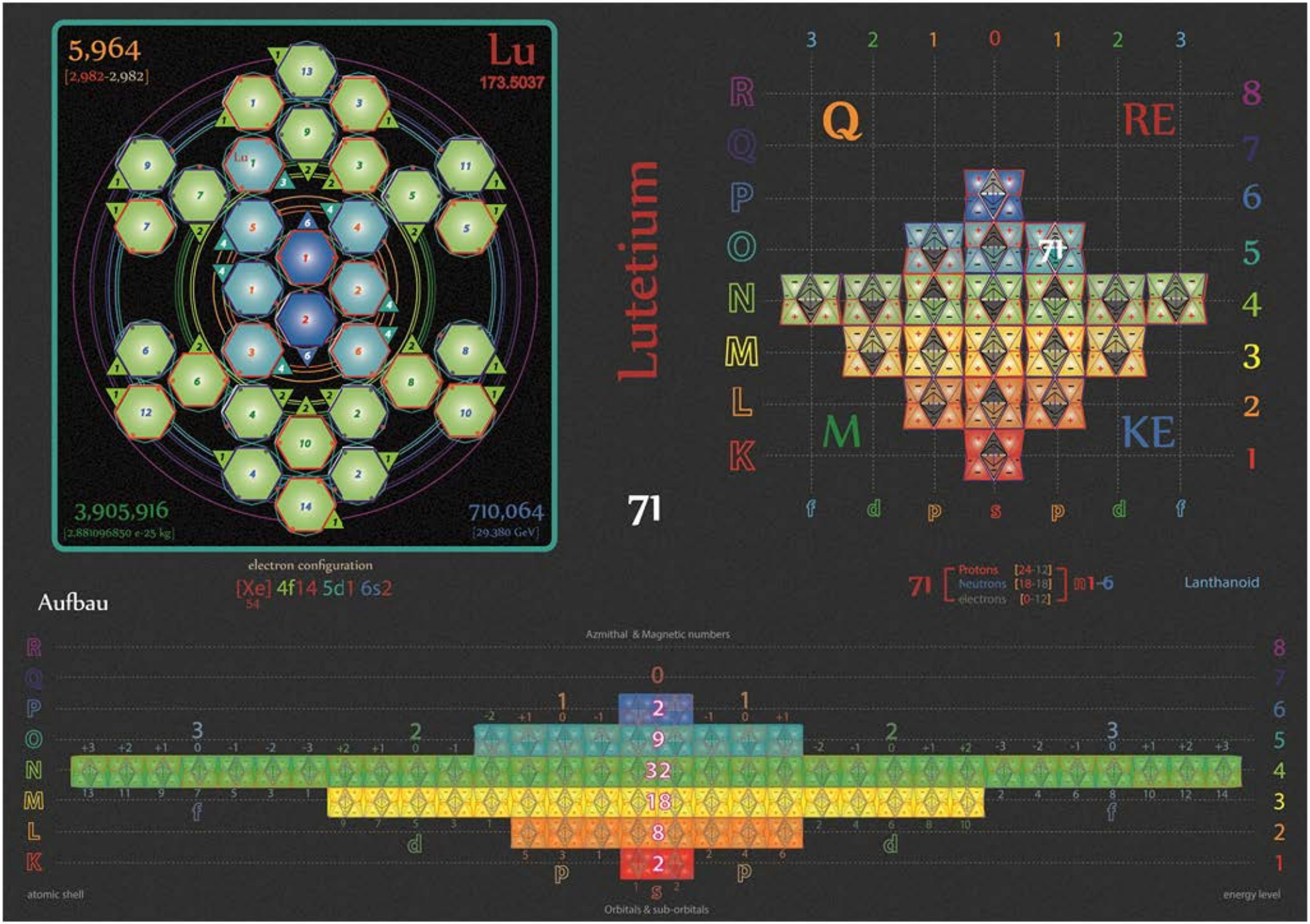

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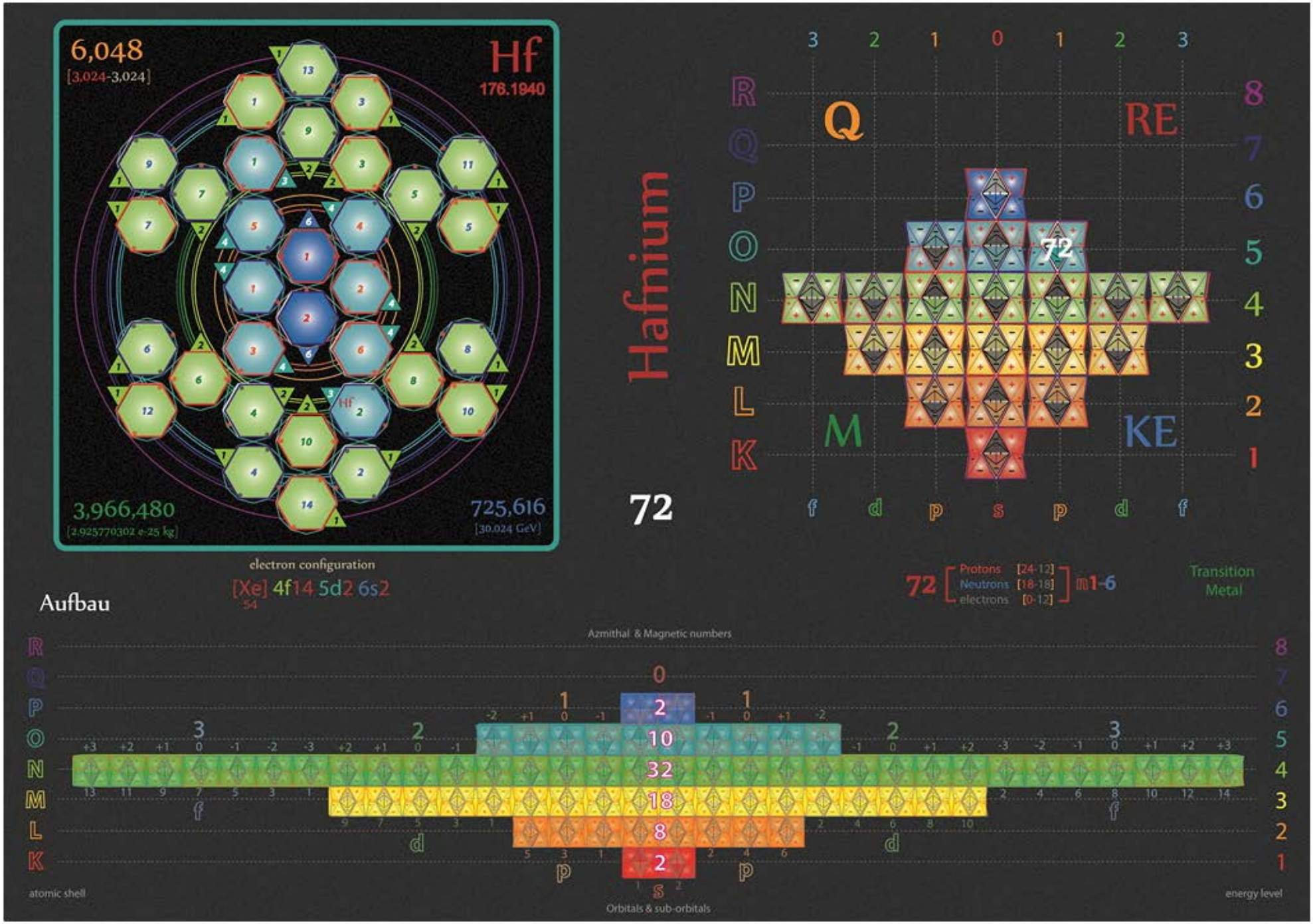

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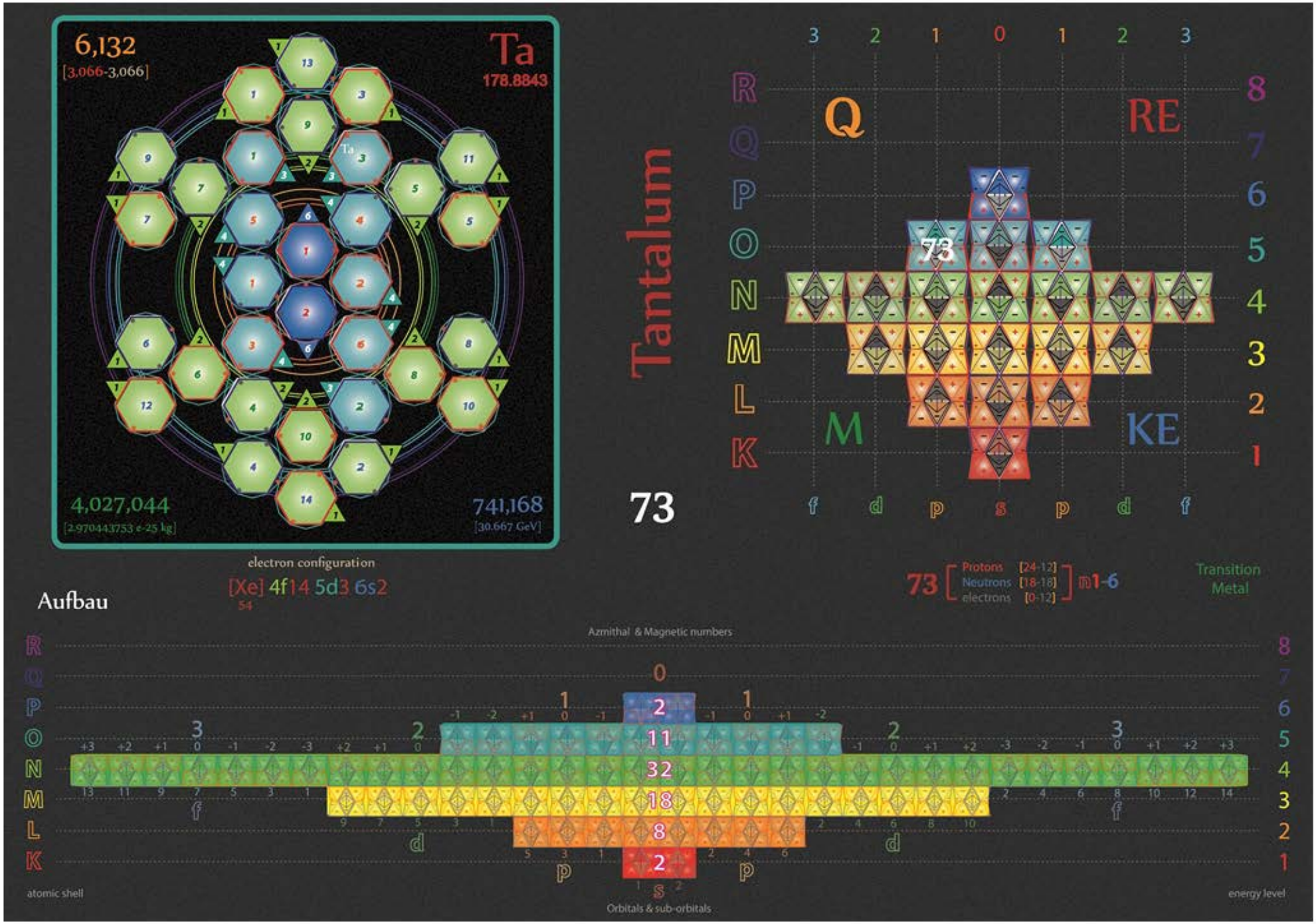

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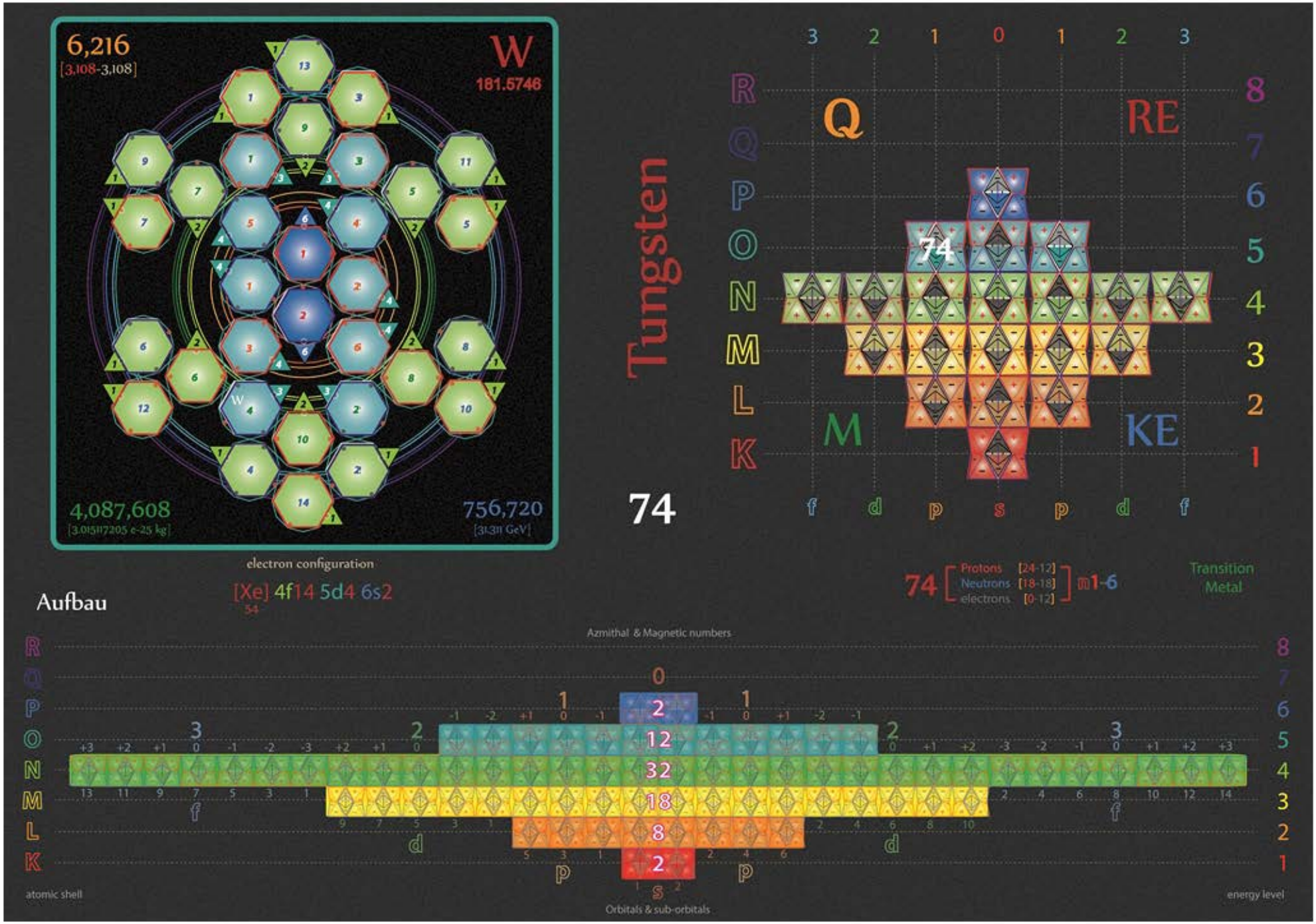

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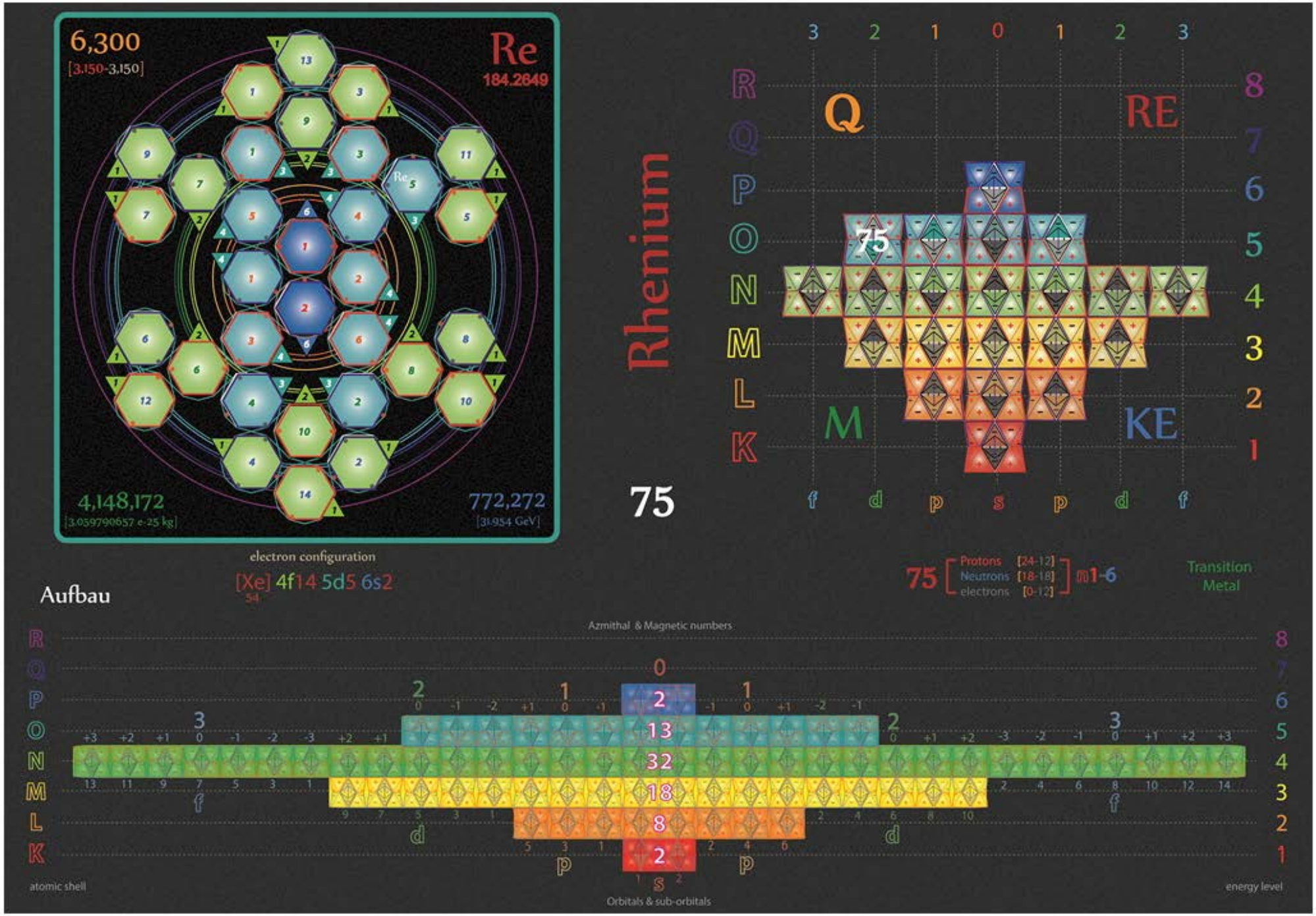

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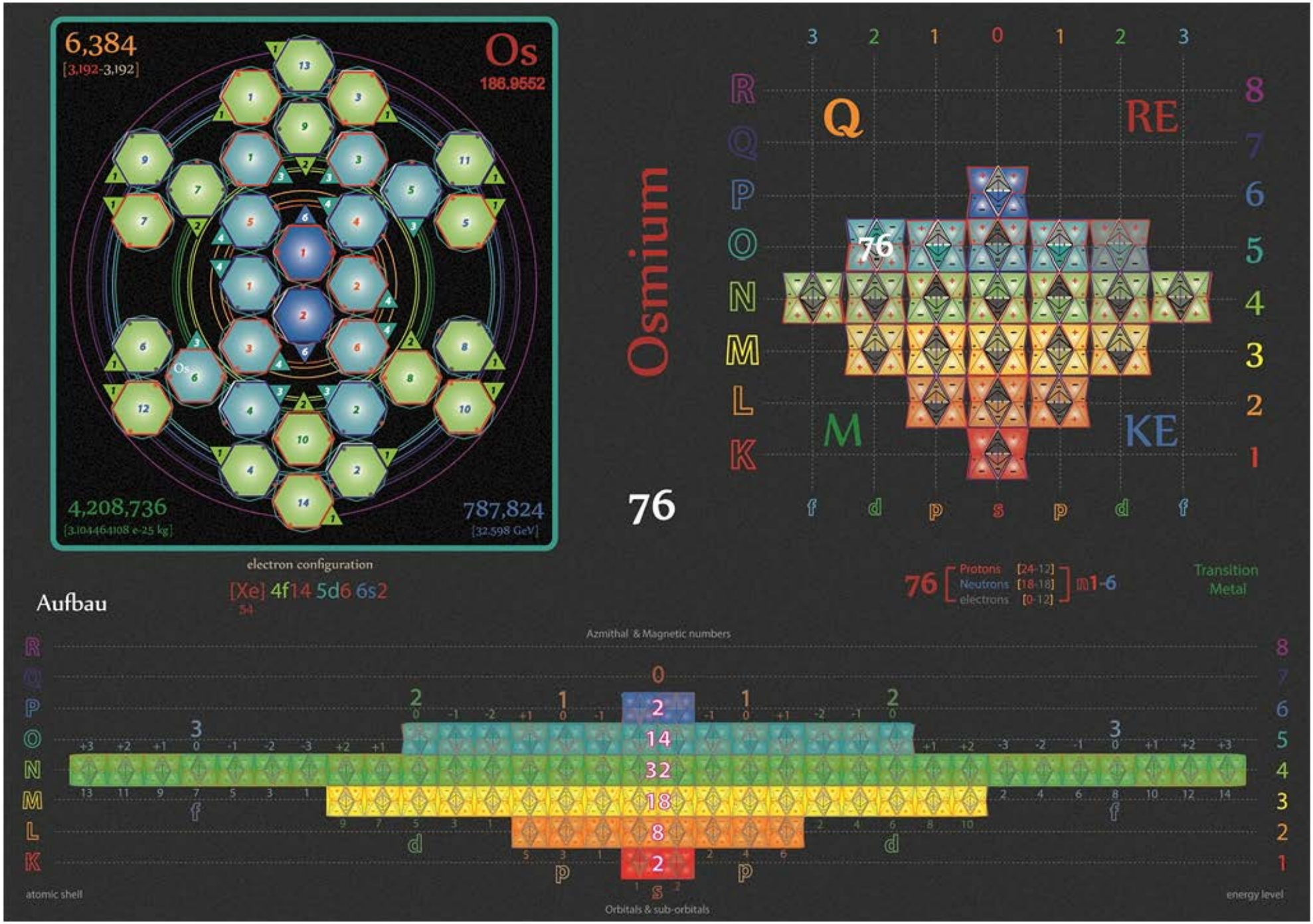

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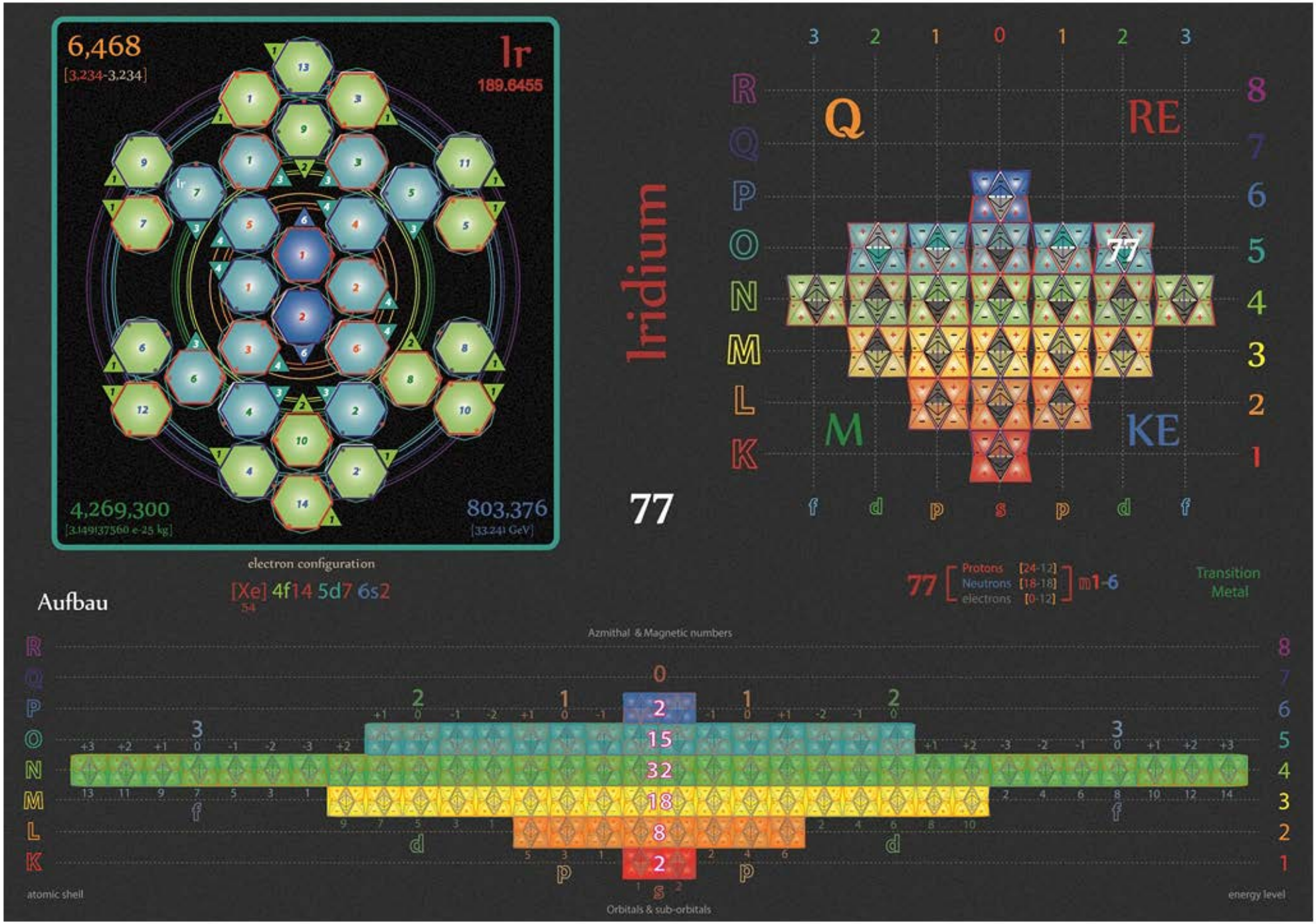

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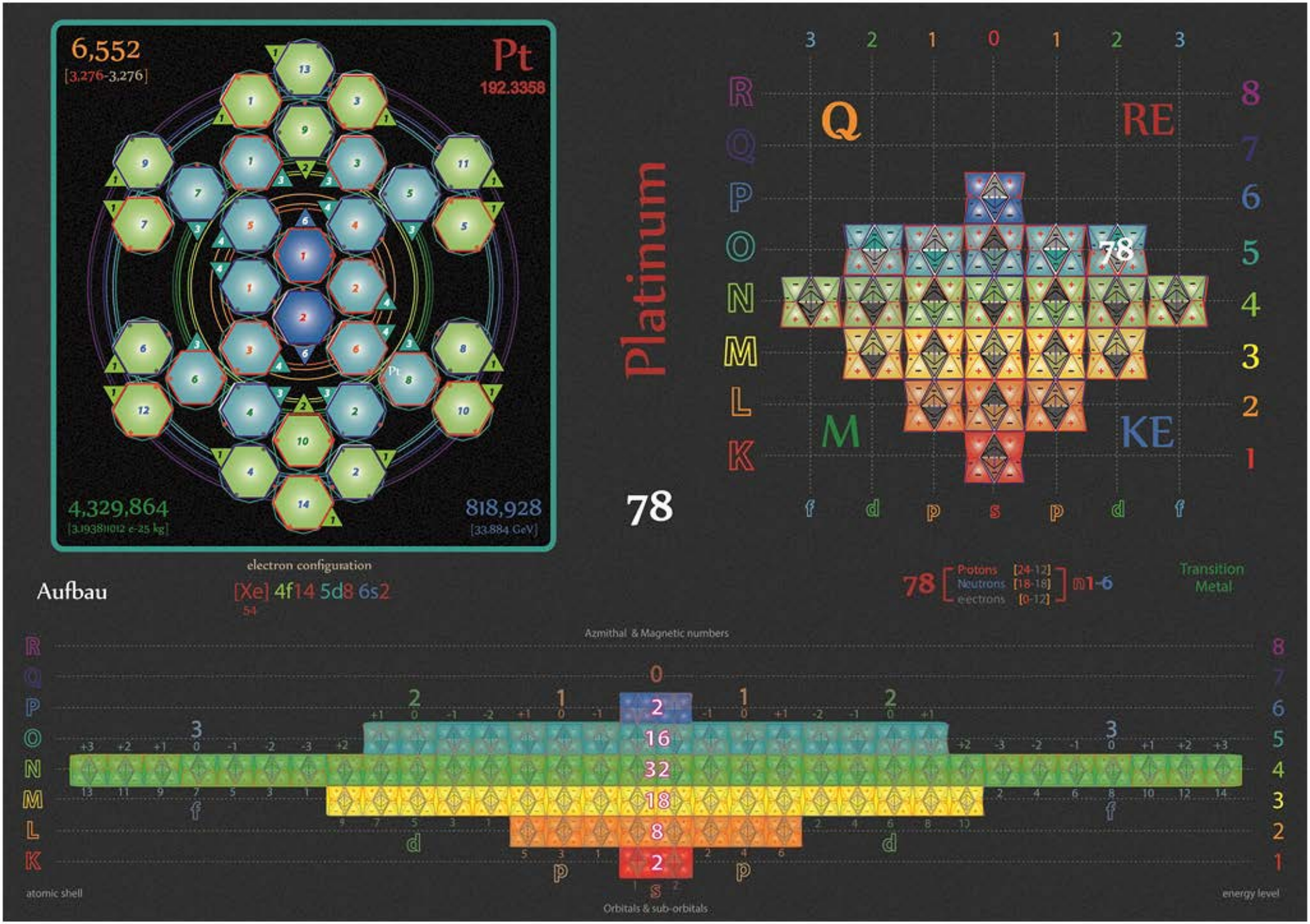

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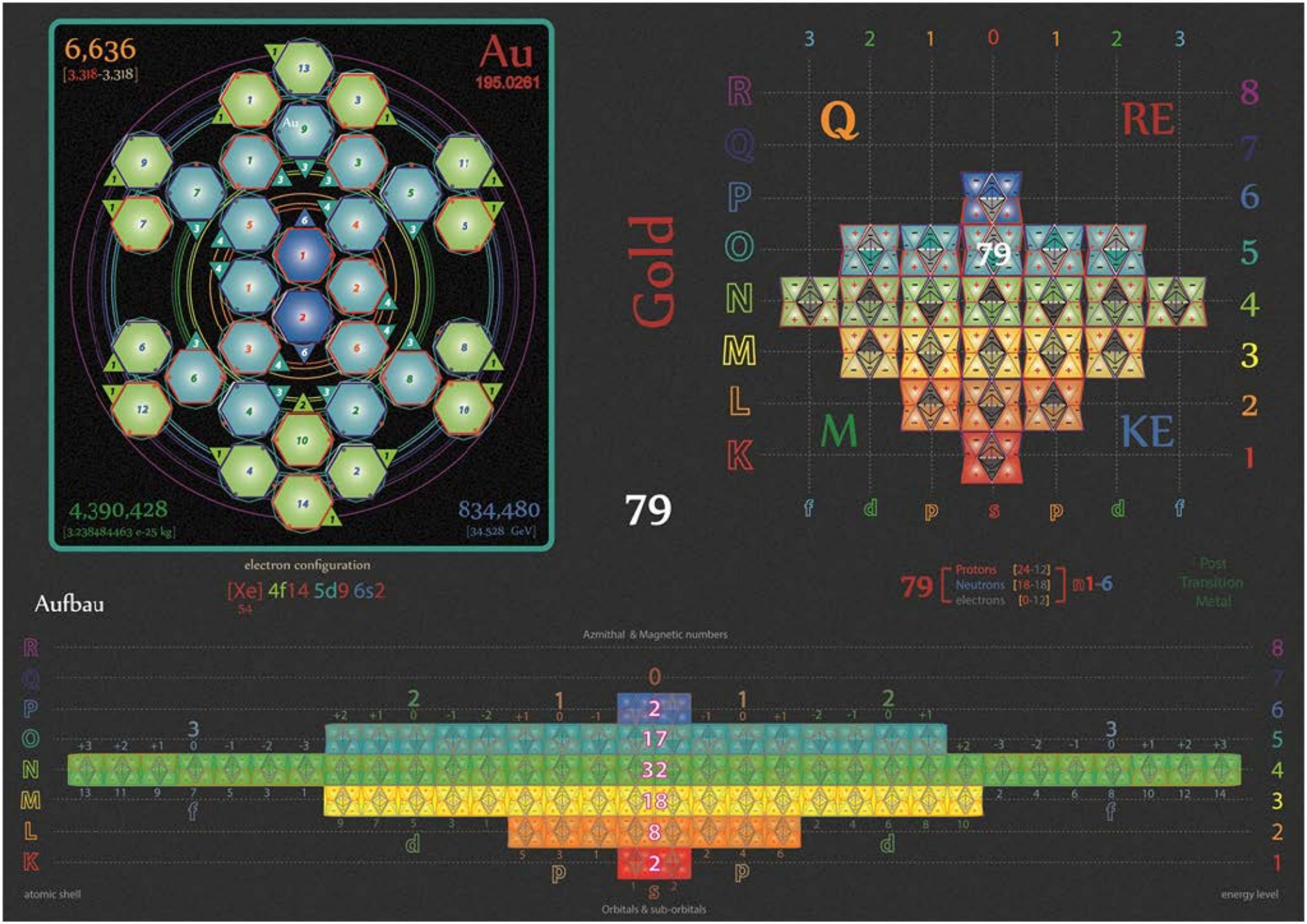

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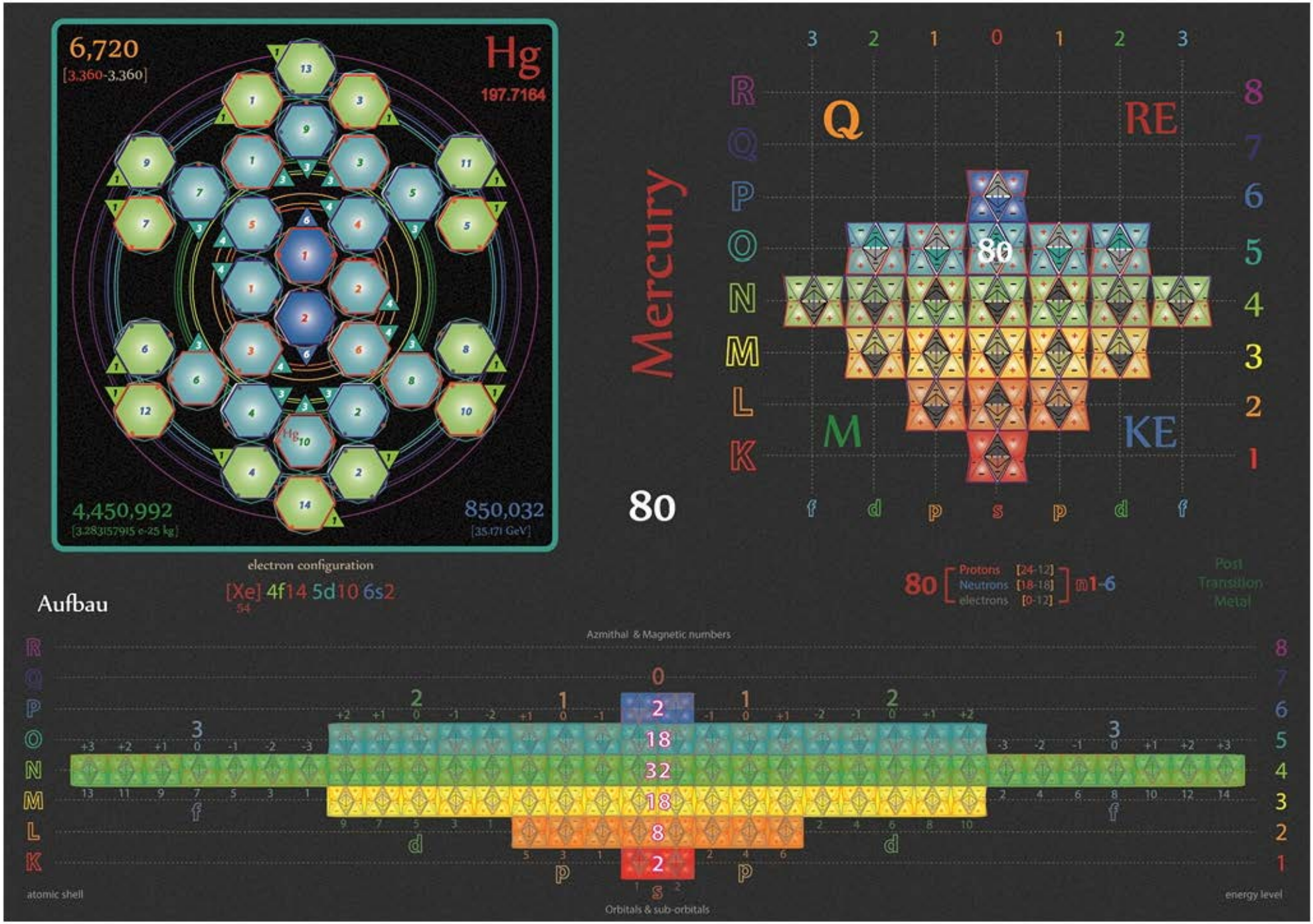

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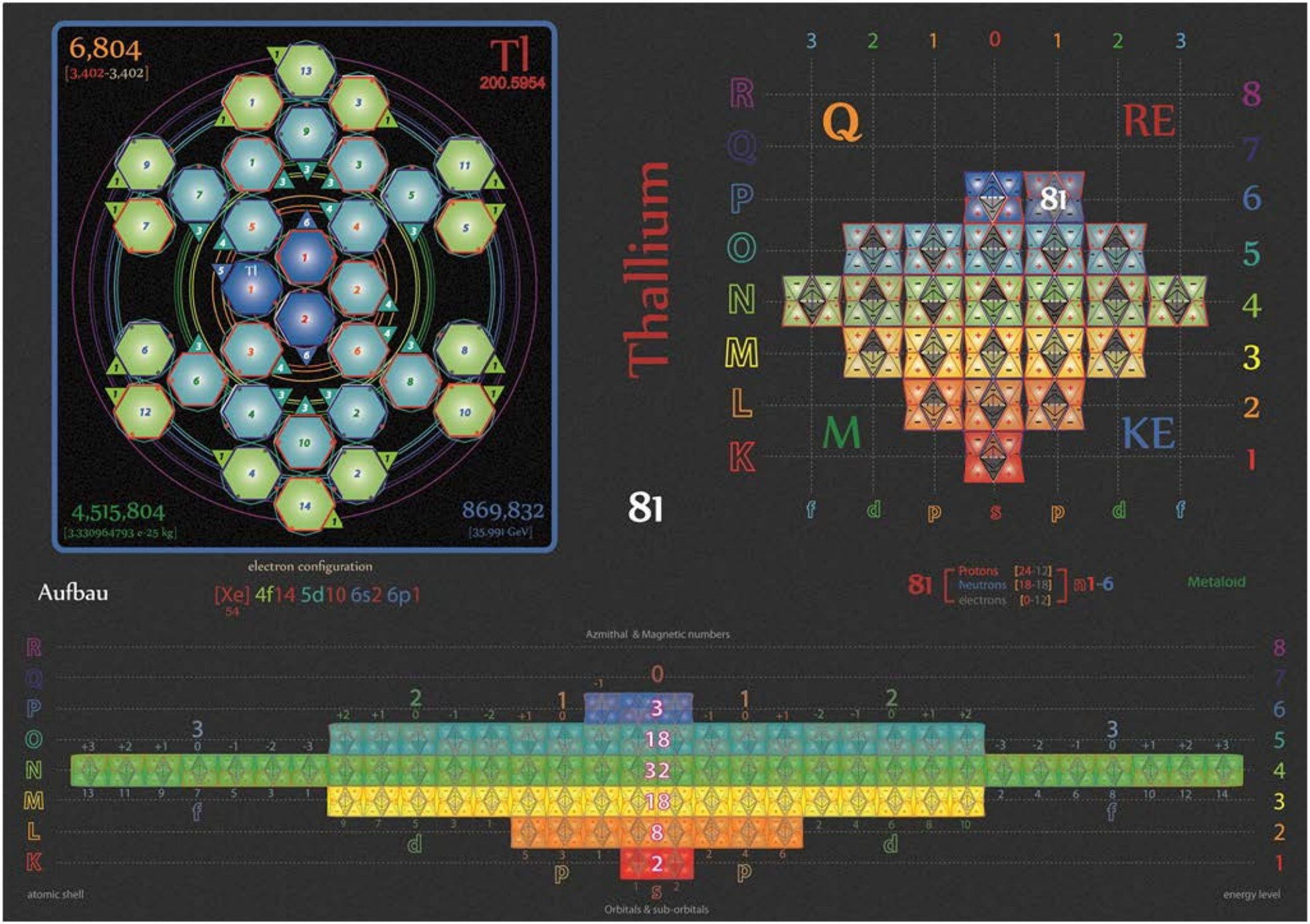

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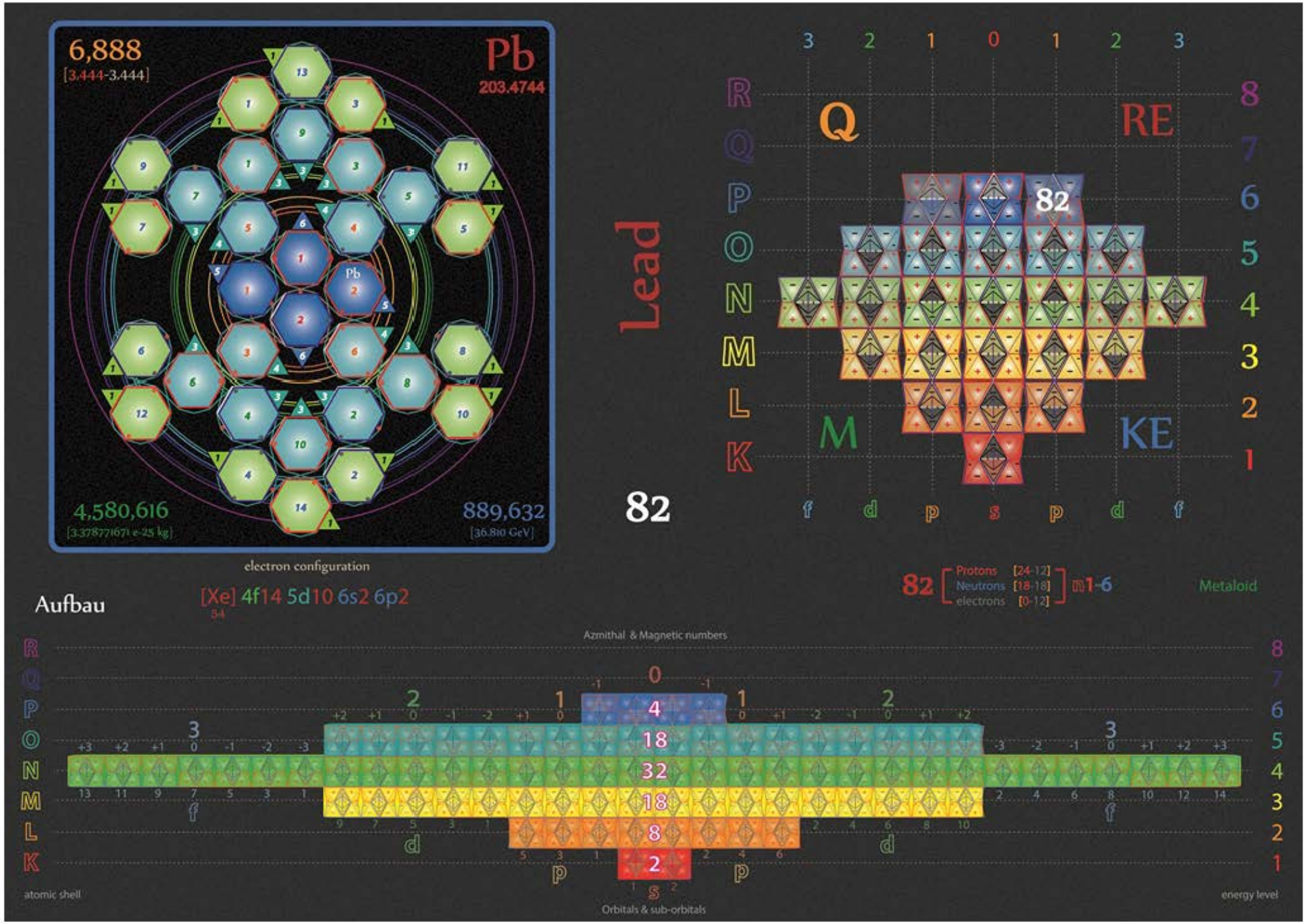

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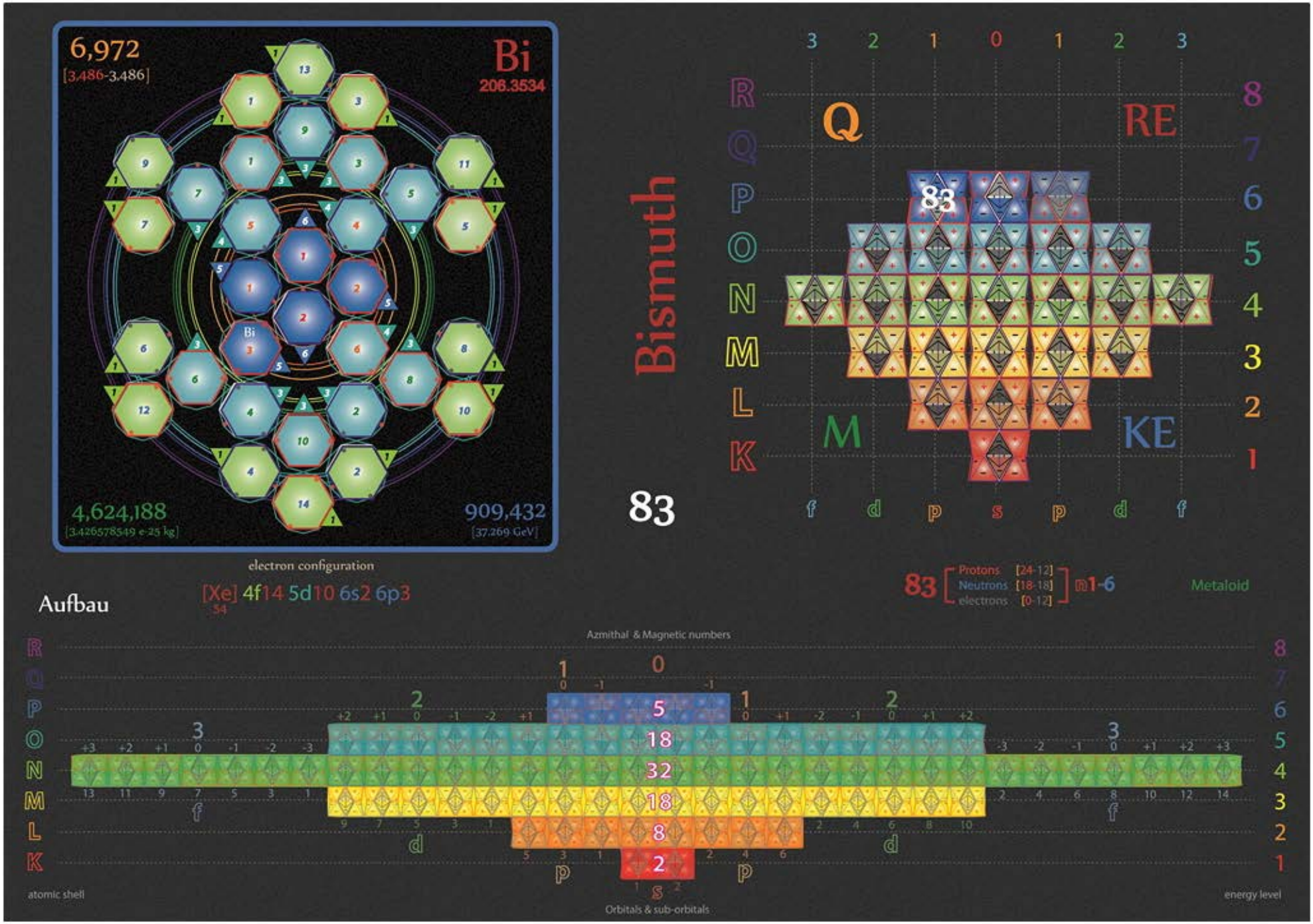

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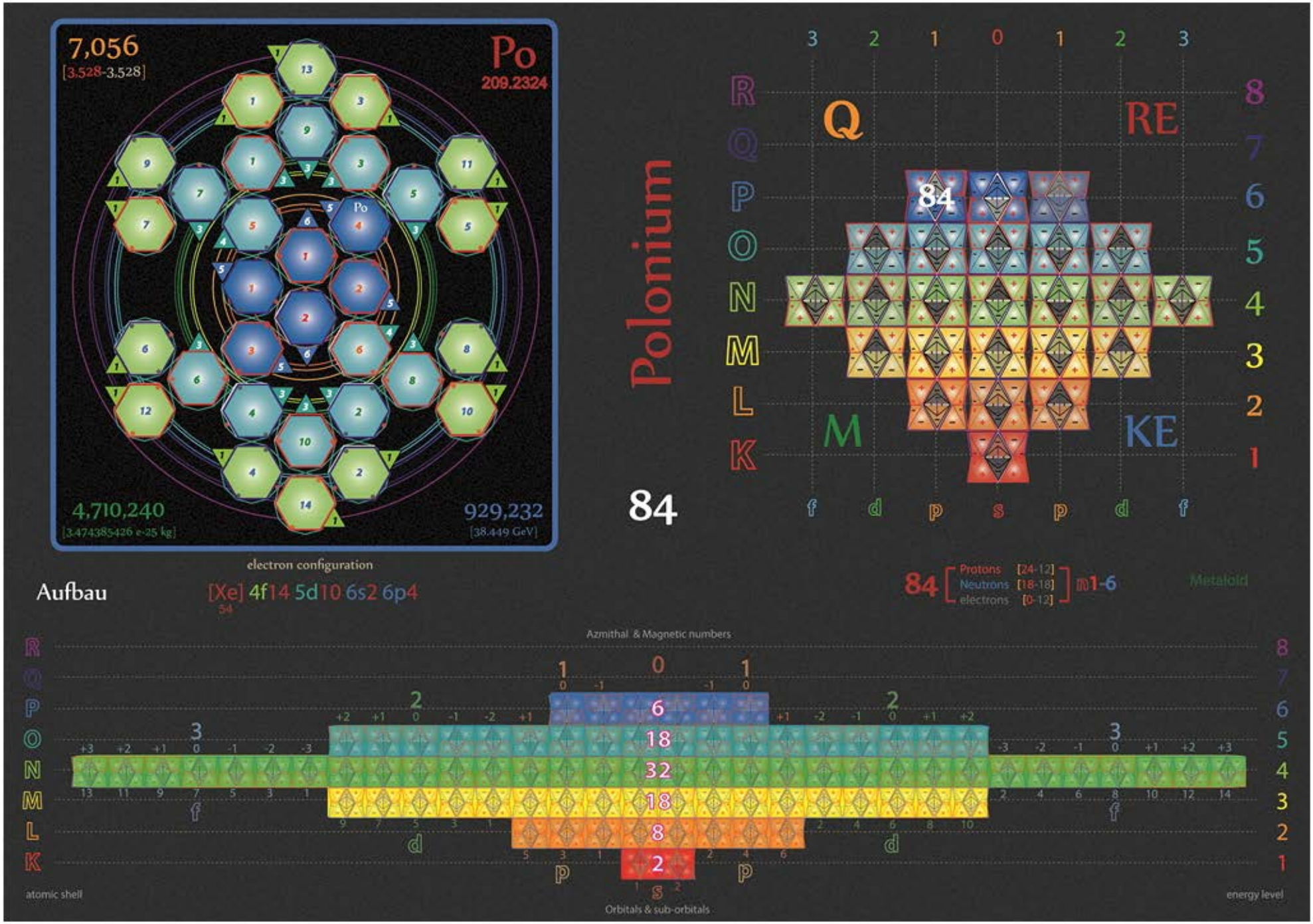

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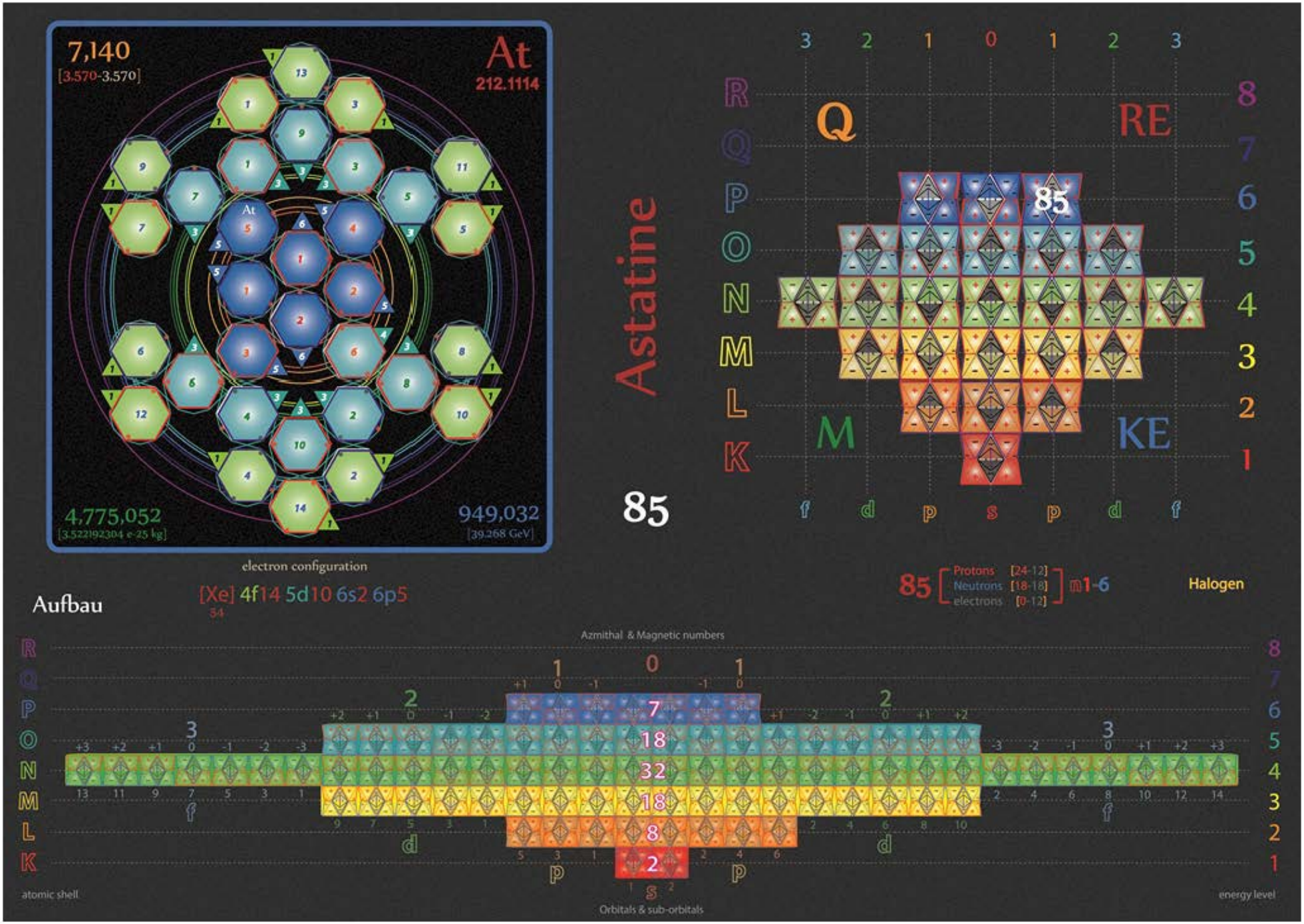

Tetryonics 51.85 - Astatine atom

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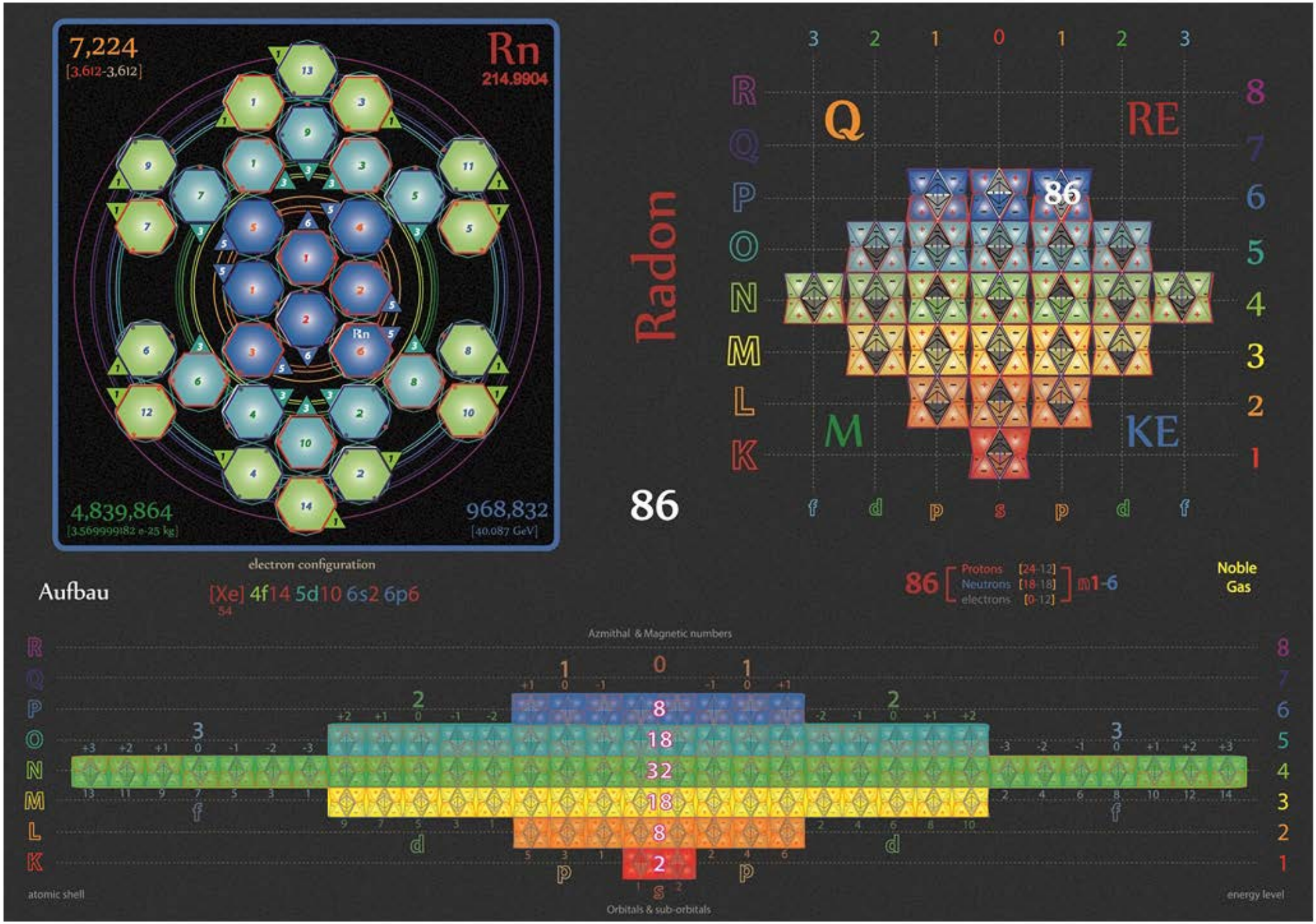

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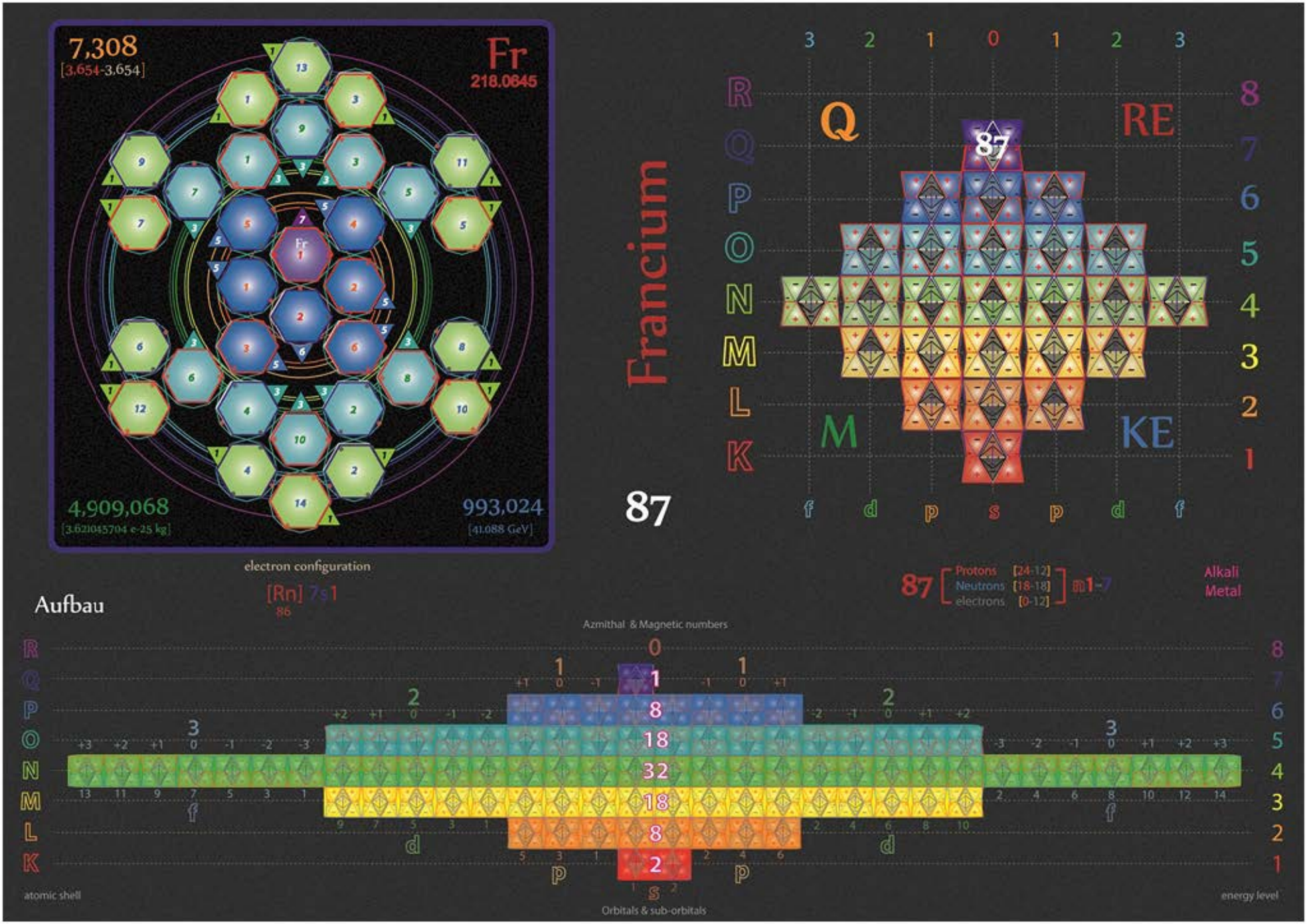

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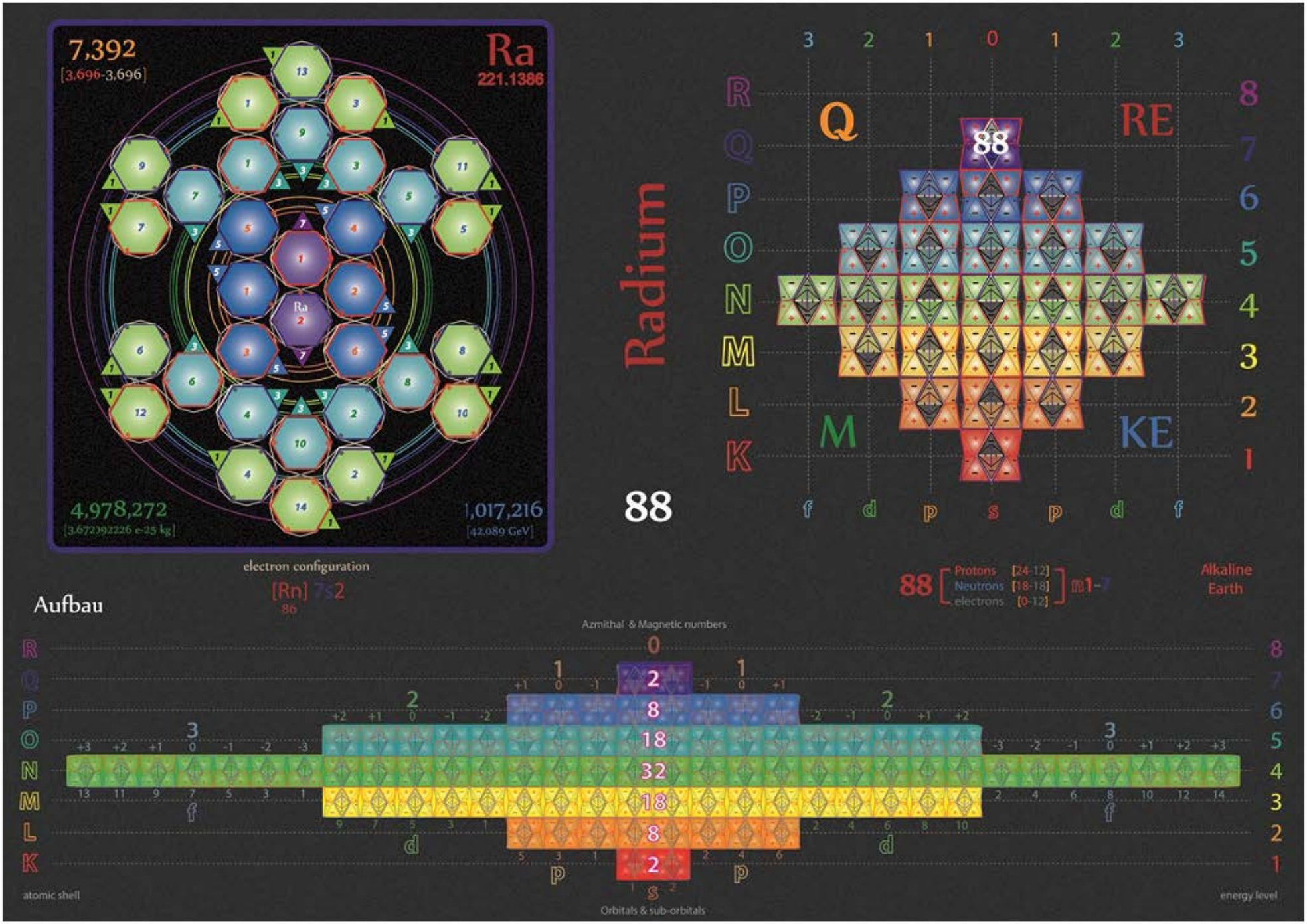

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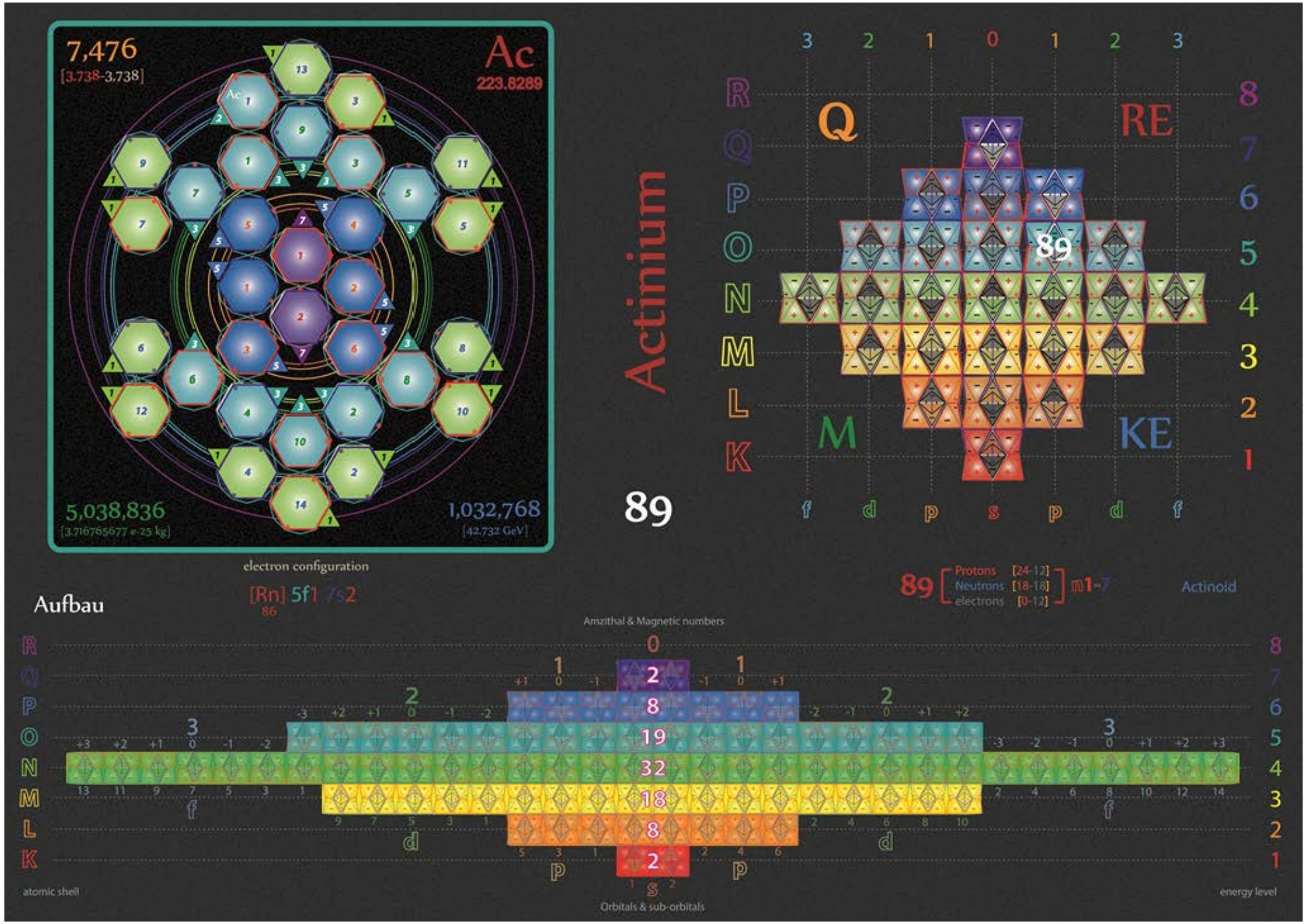

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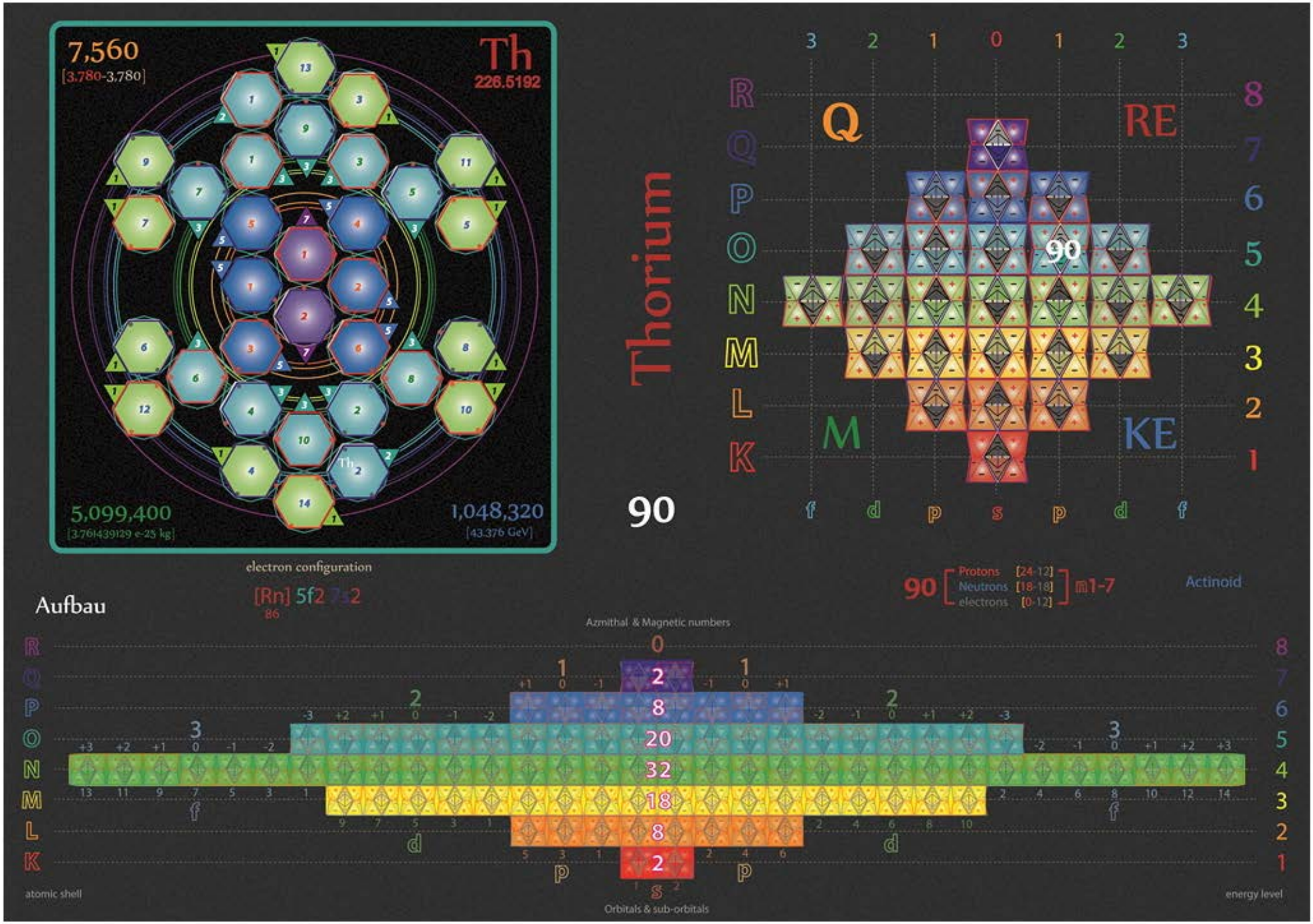

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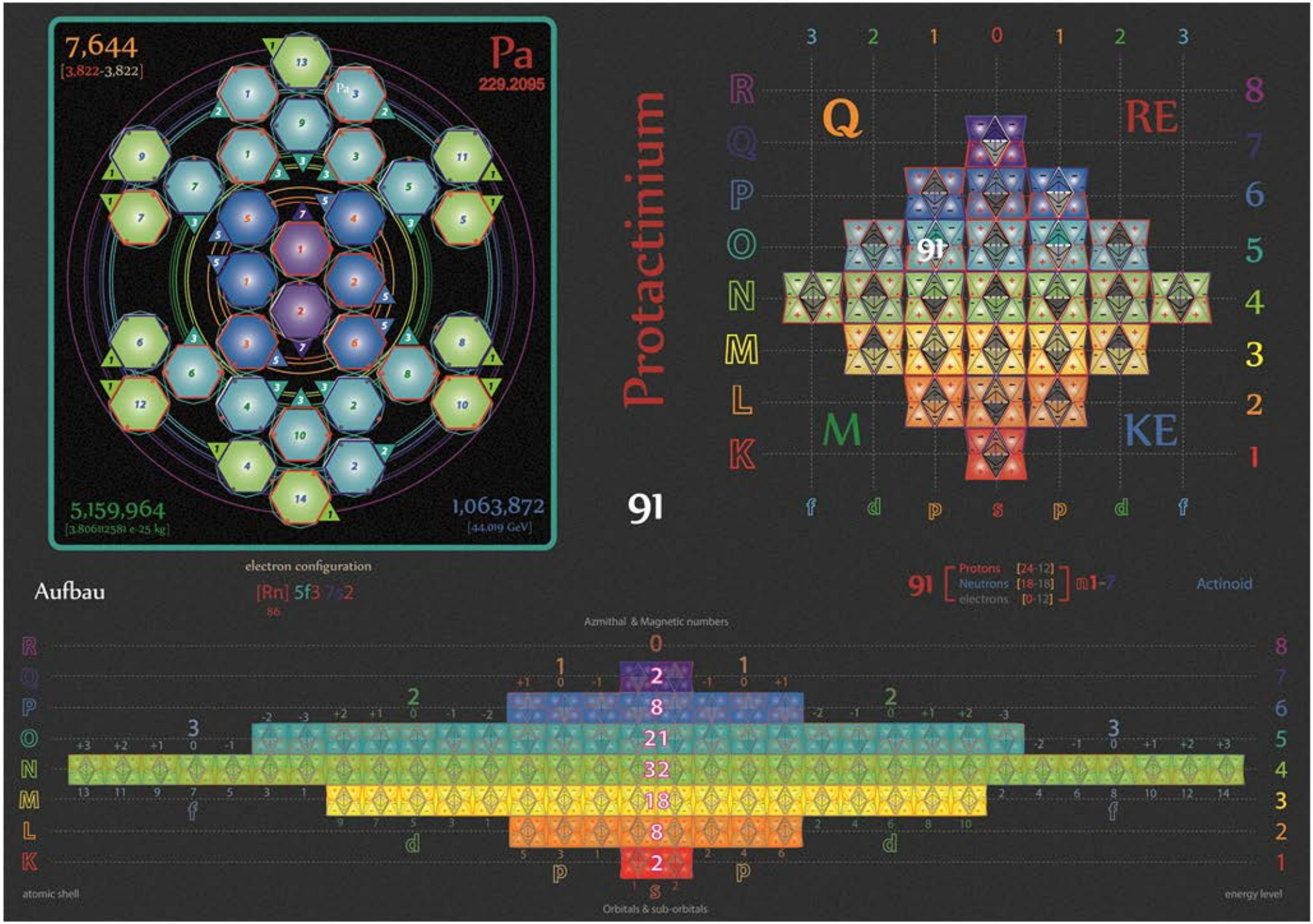

Tetryonics 51.91 - Protactinium atom

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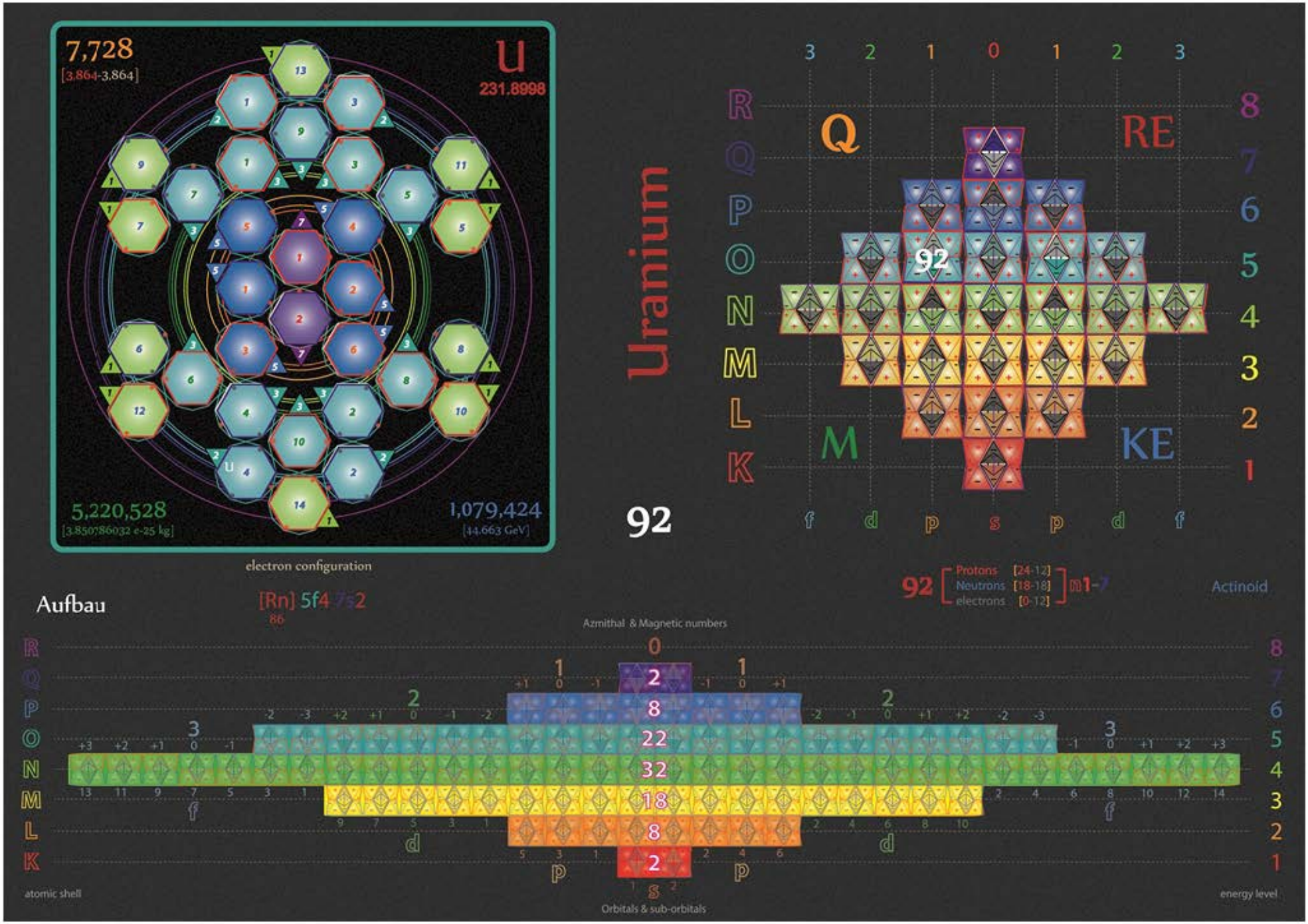

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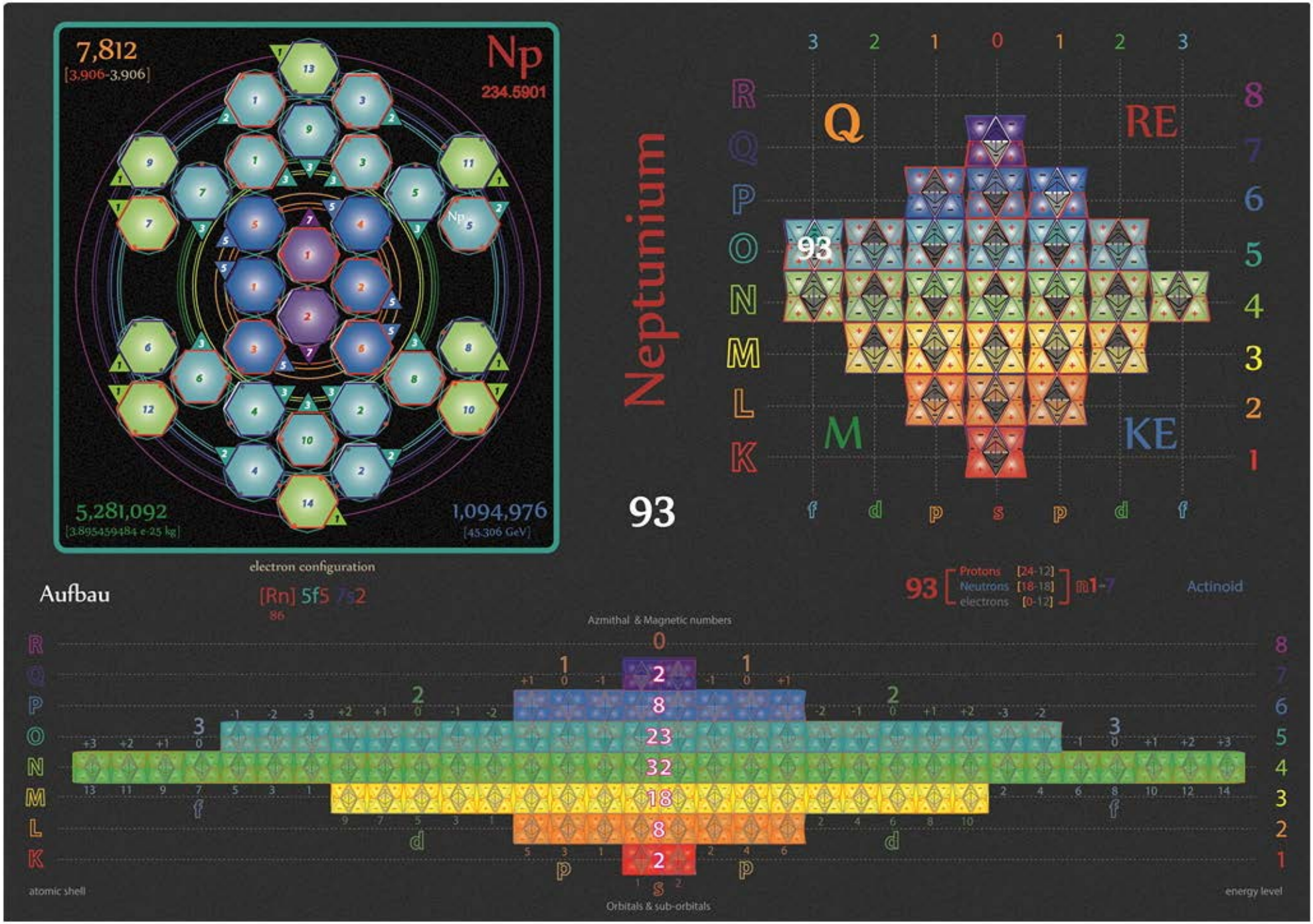

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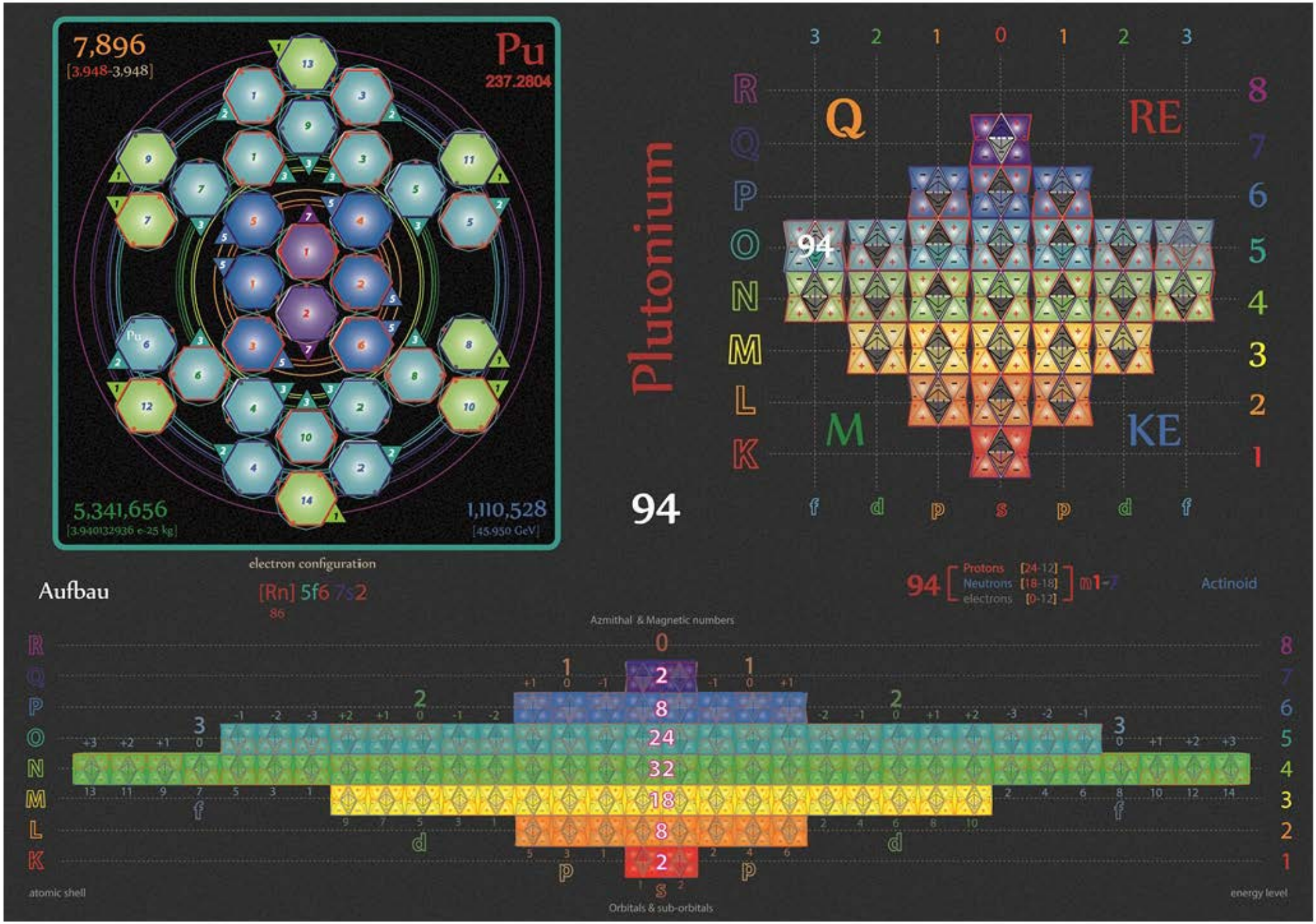

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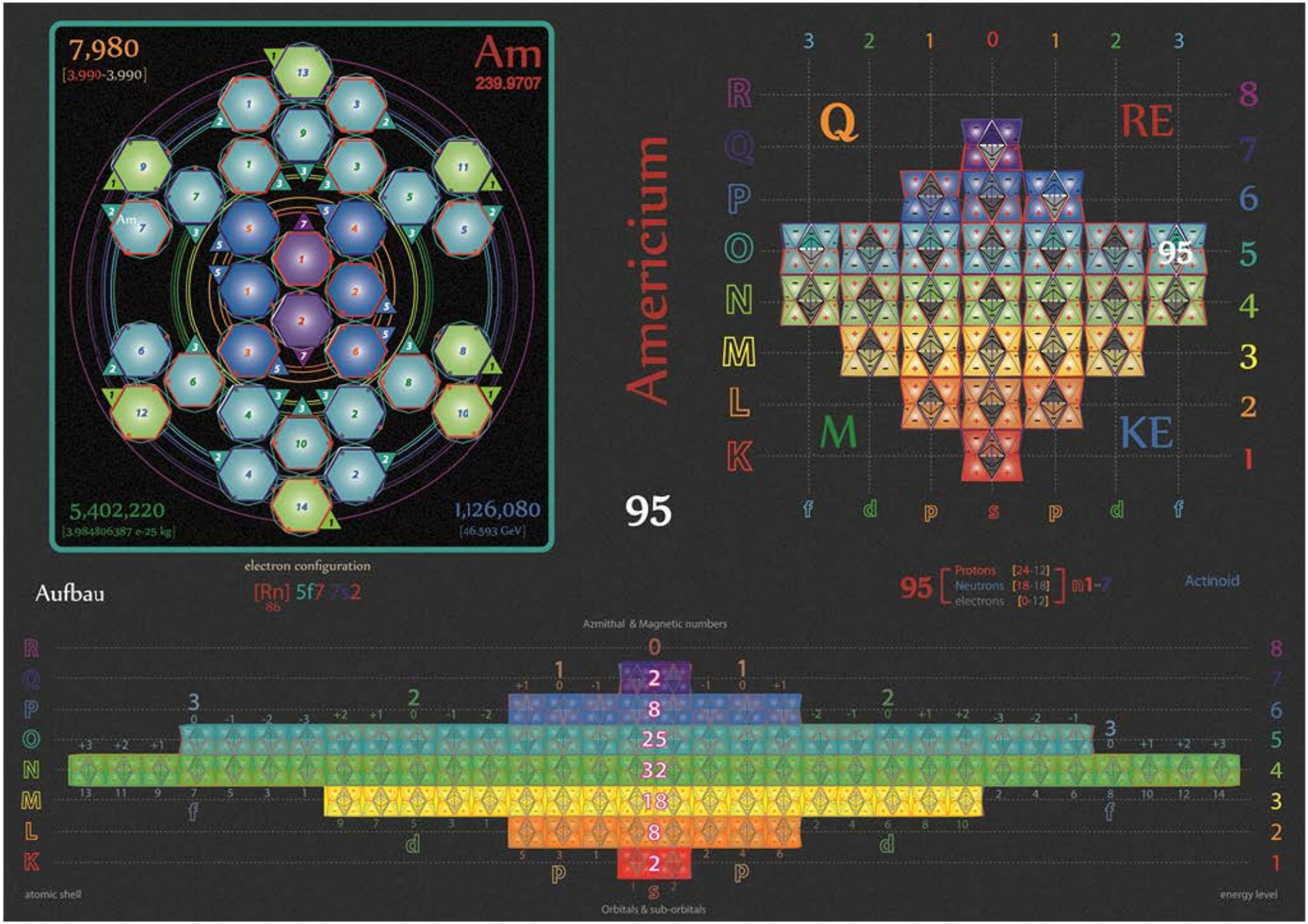

Tetryonics 51.95 - Americium atom

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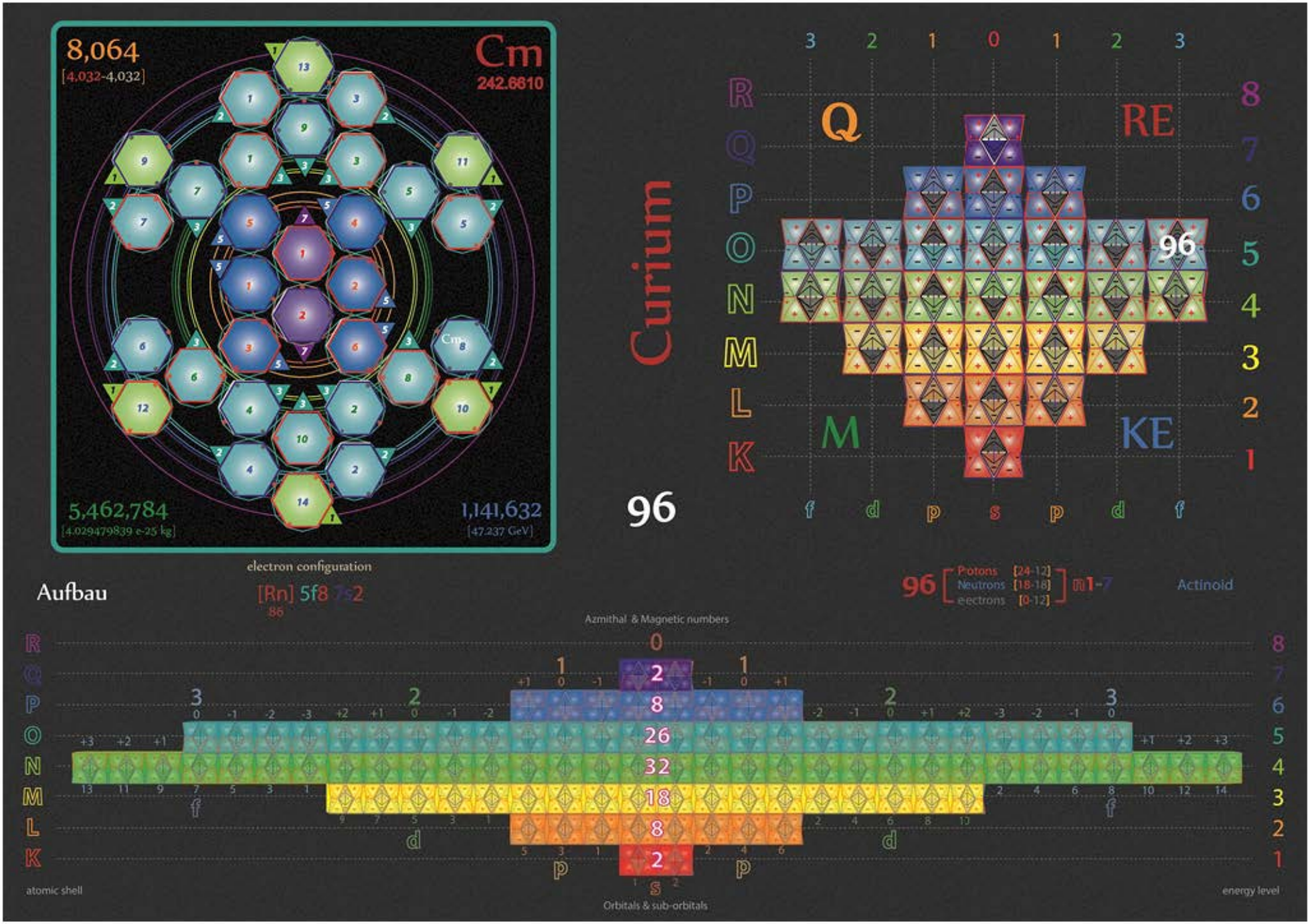

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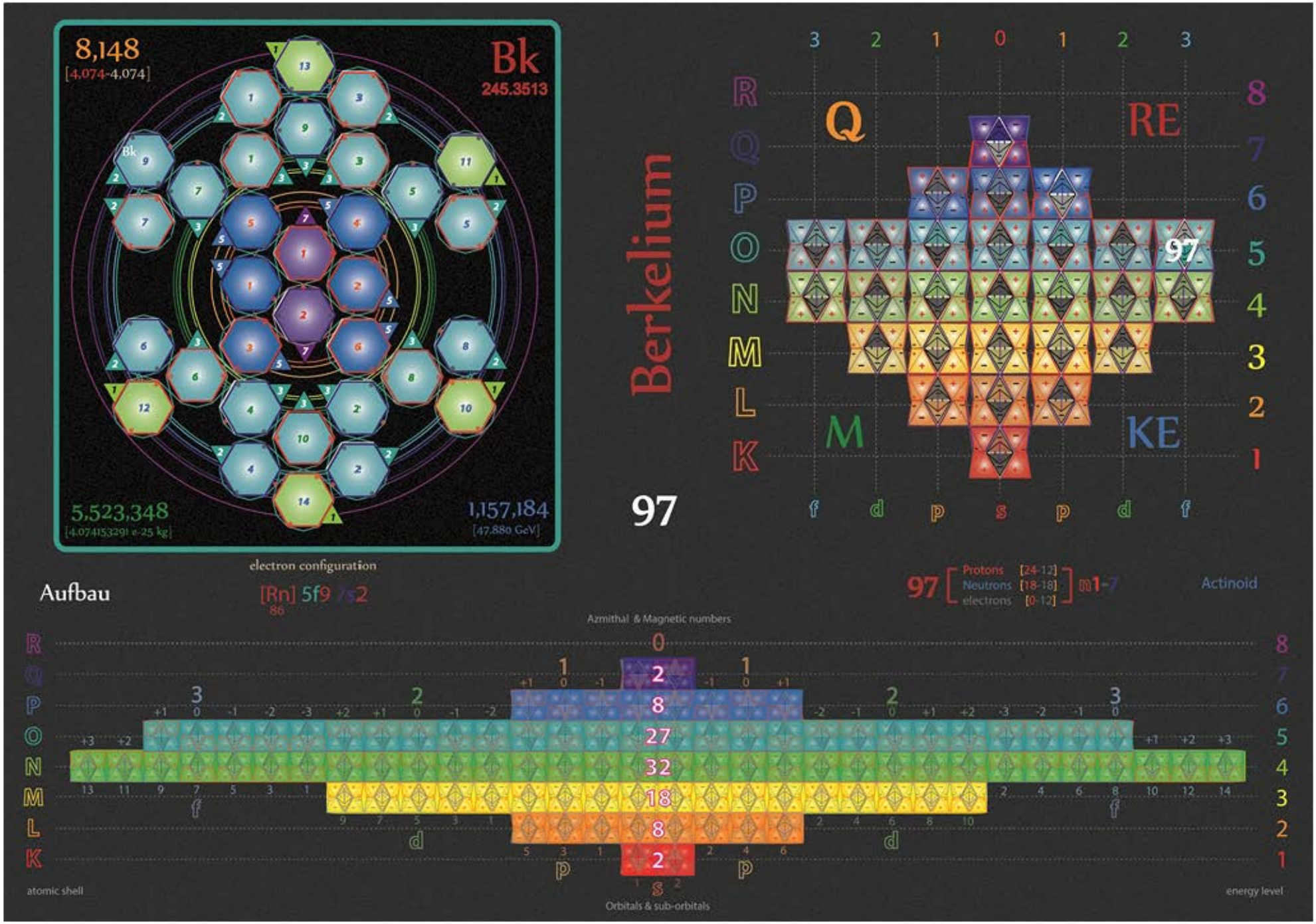

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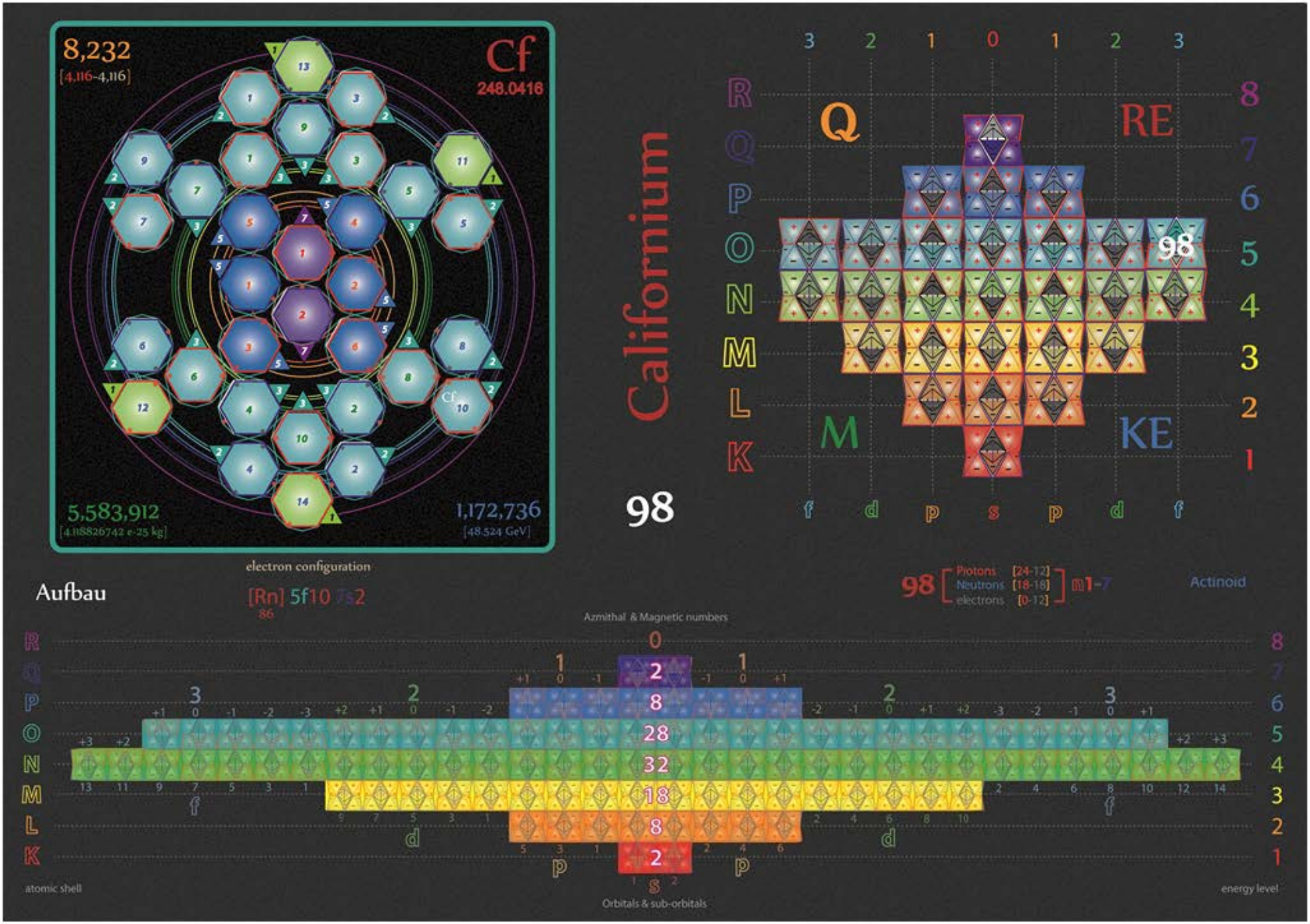

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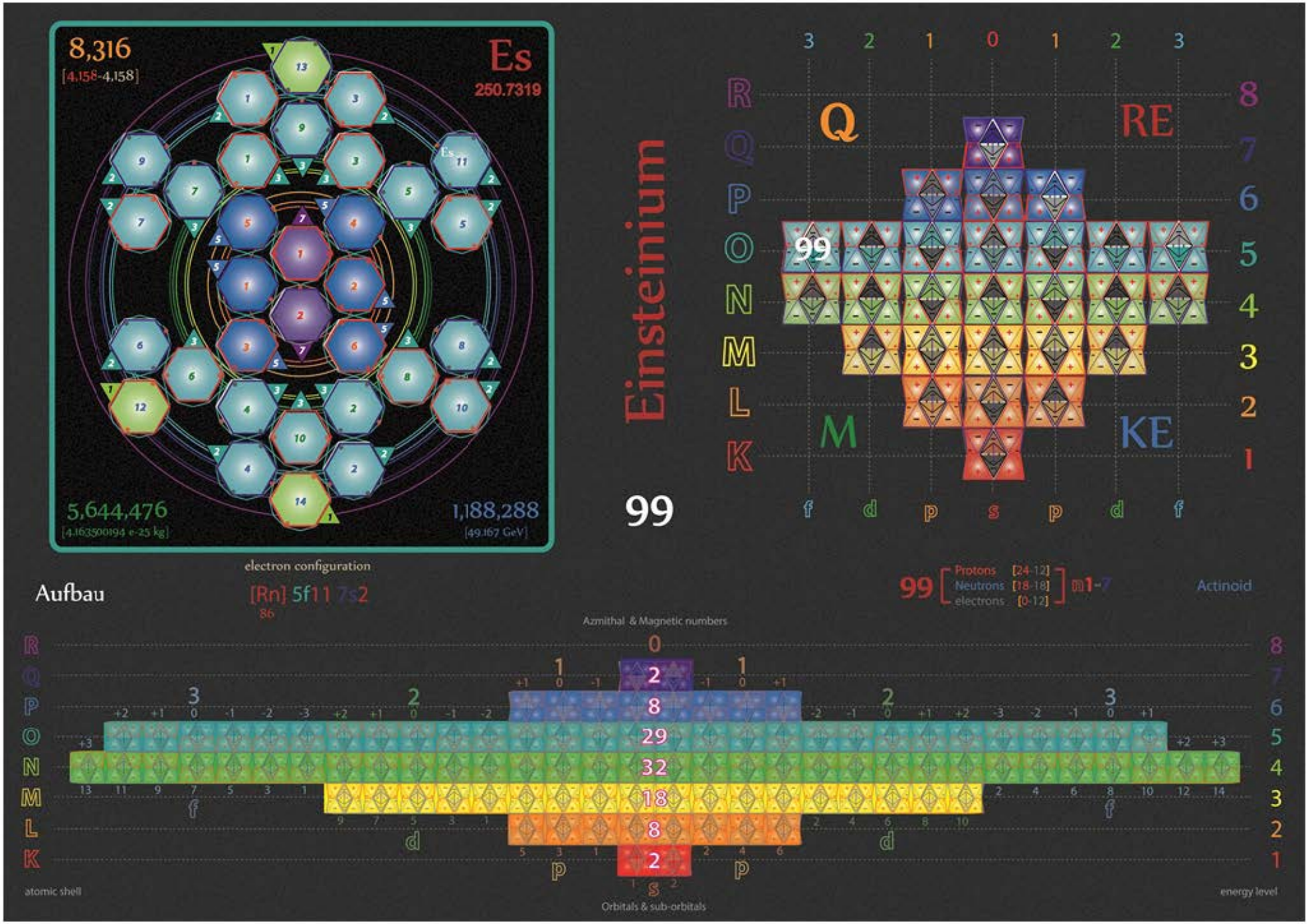

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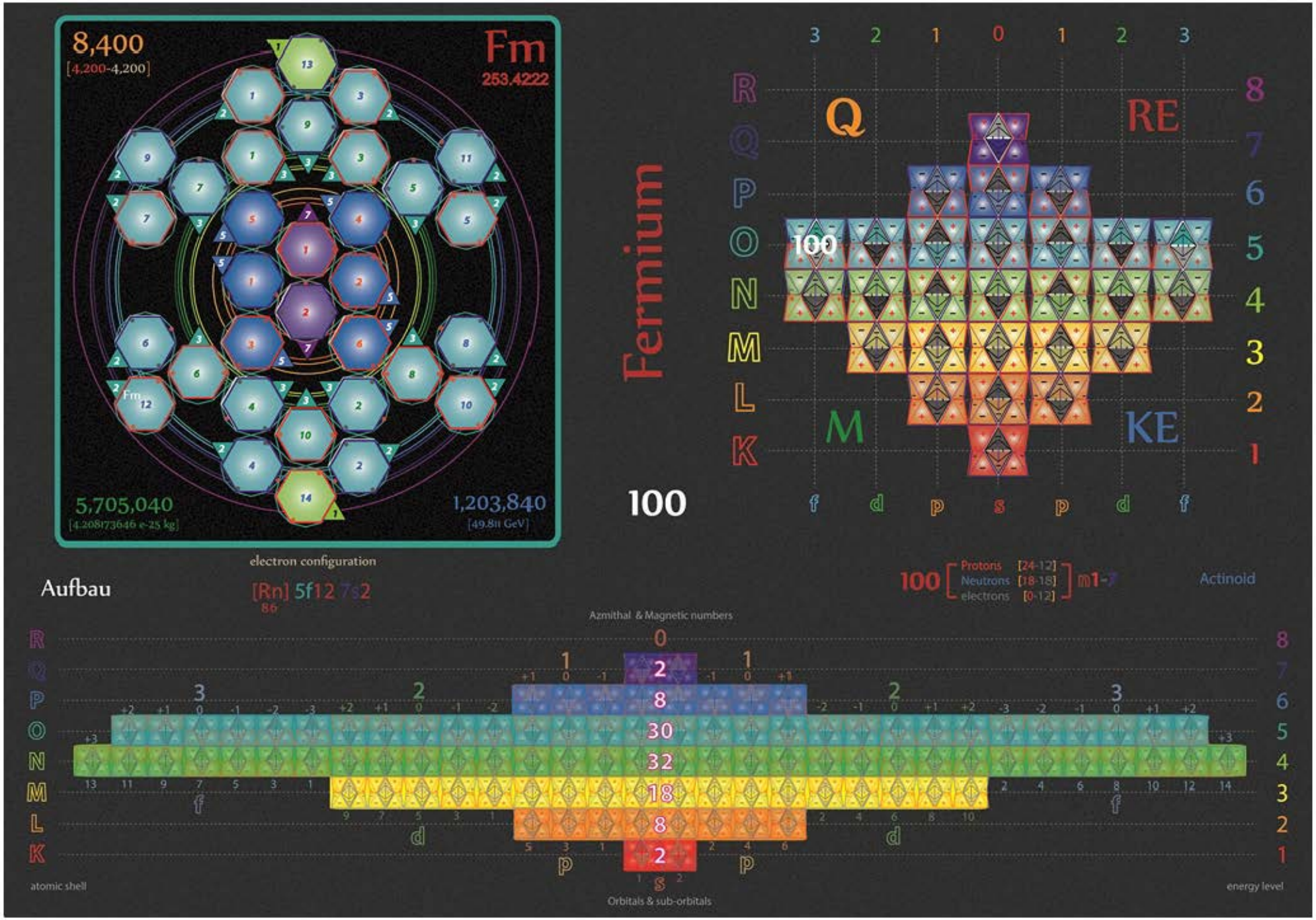

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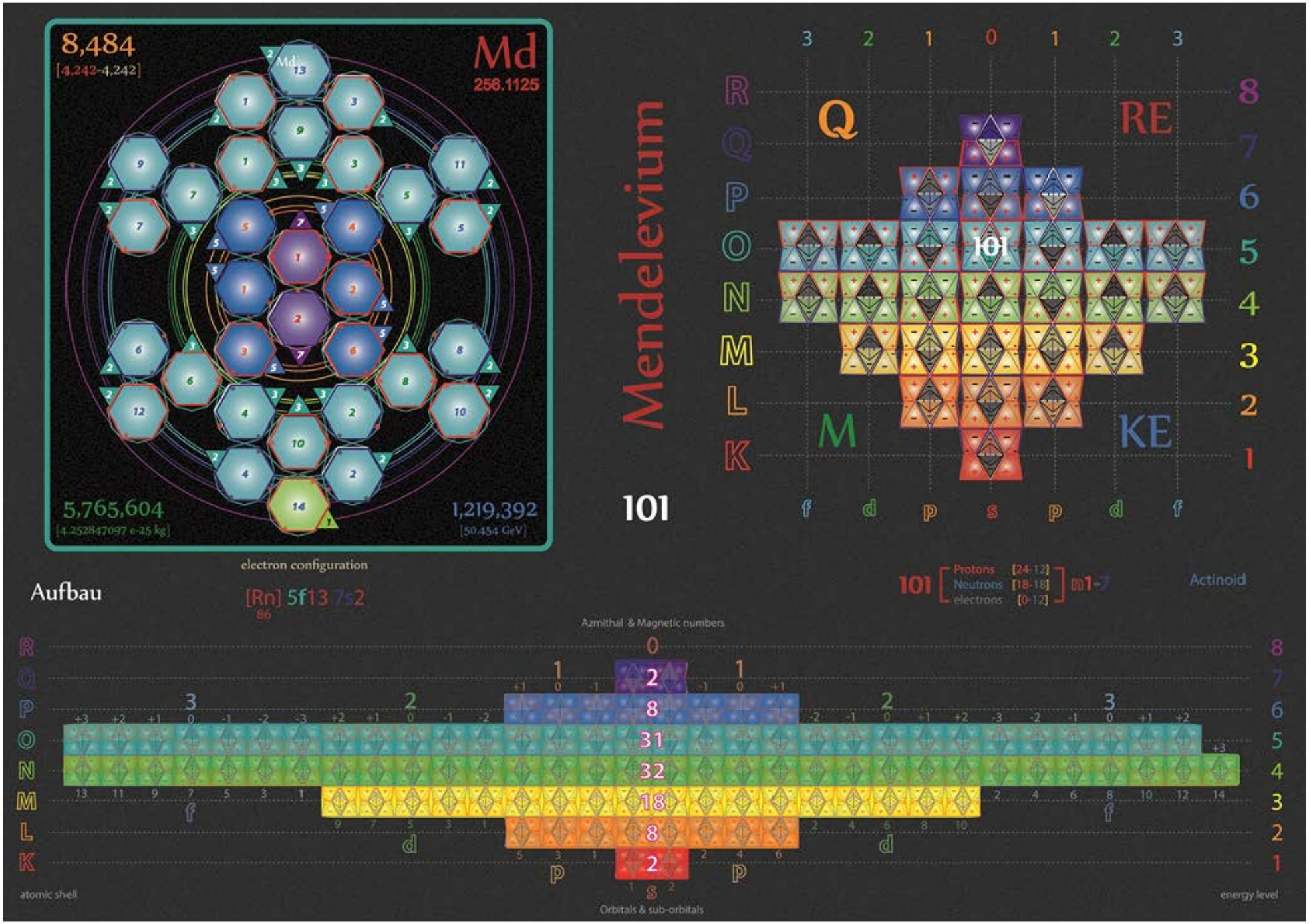

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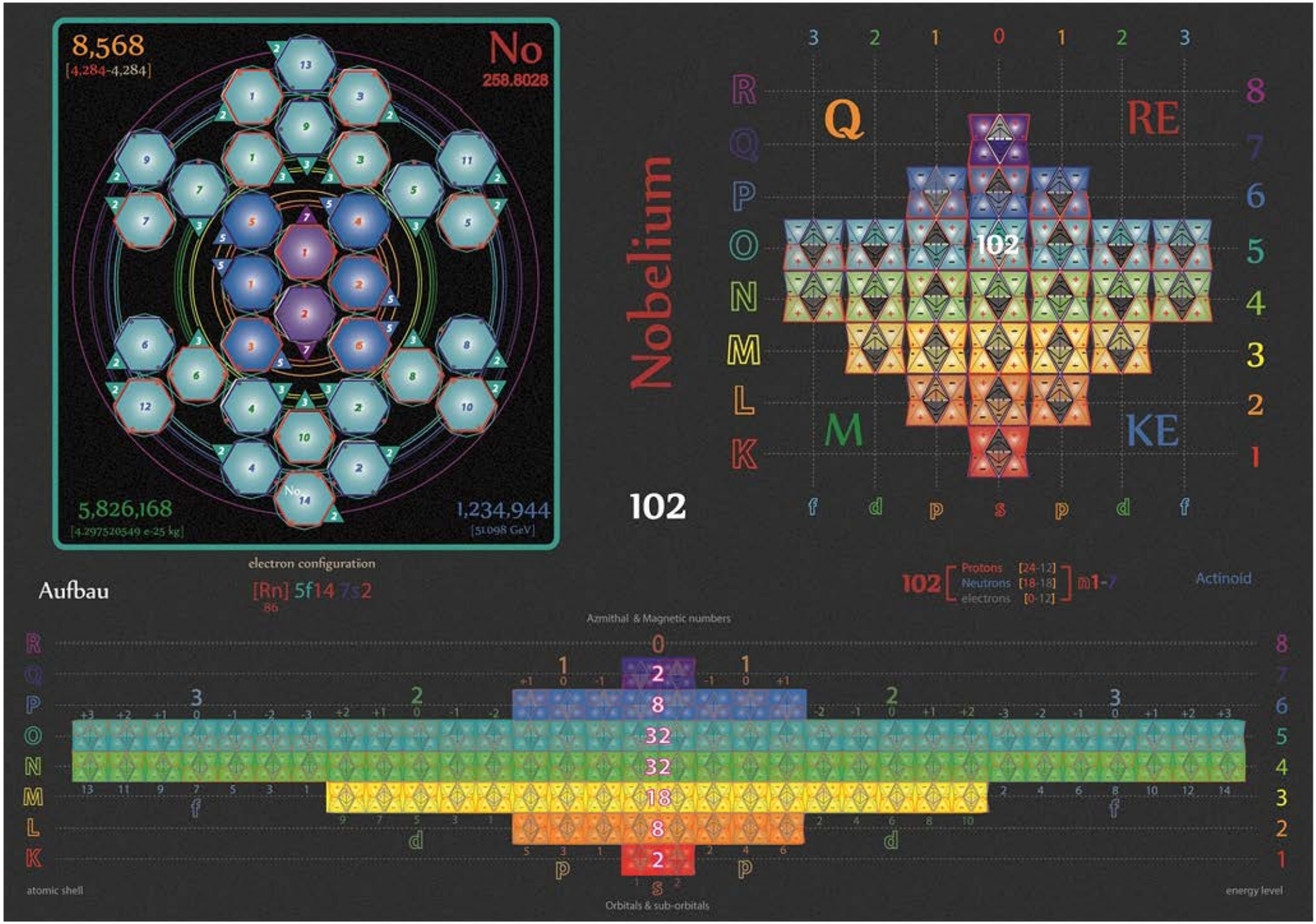

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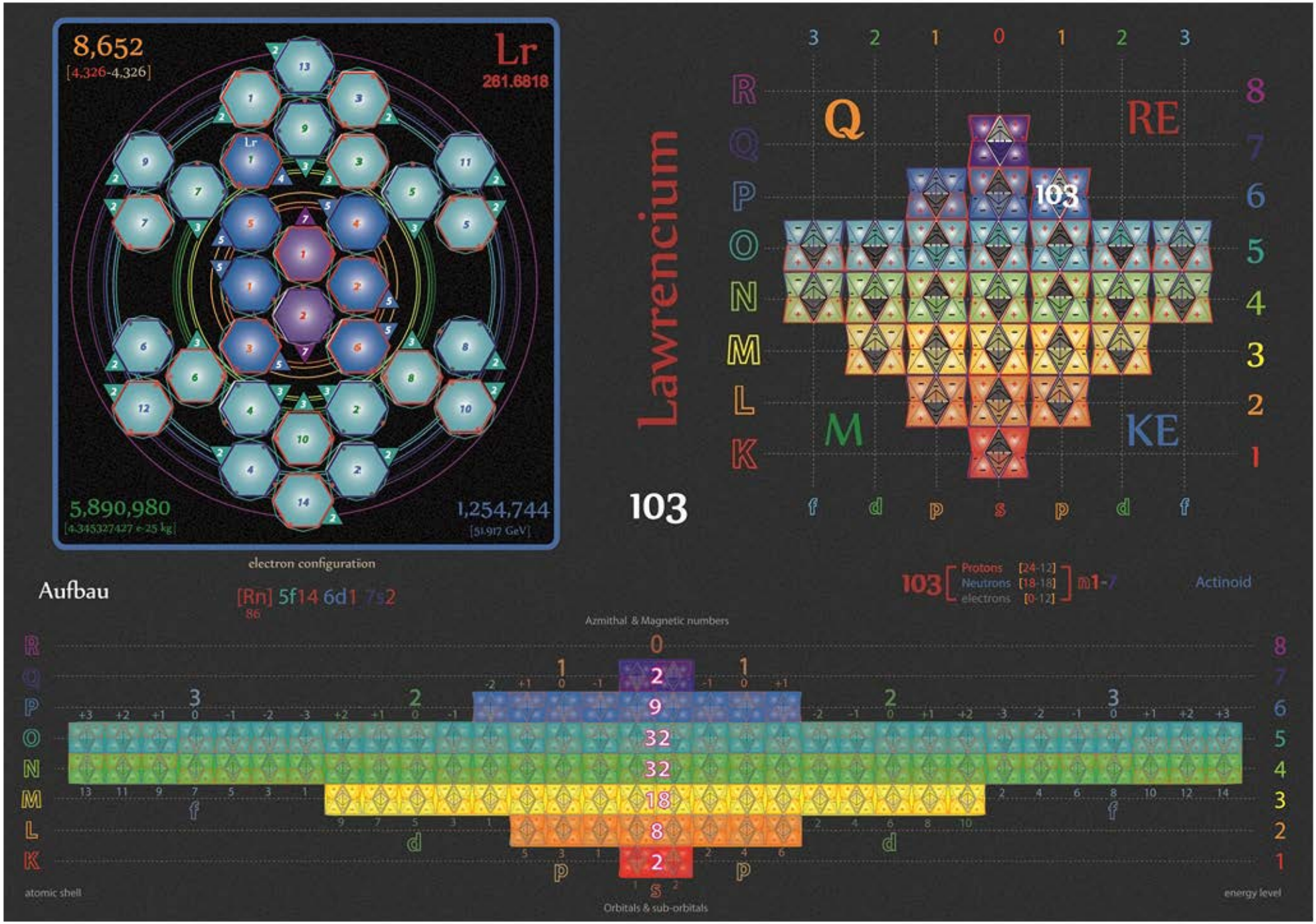

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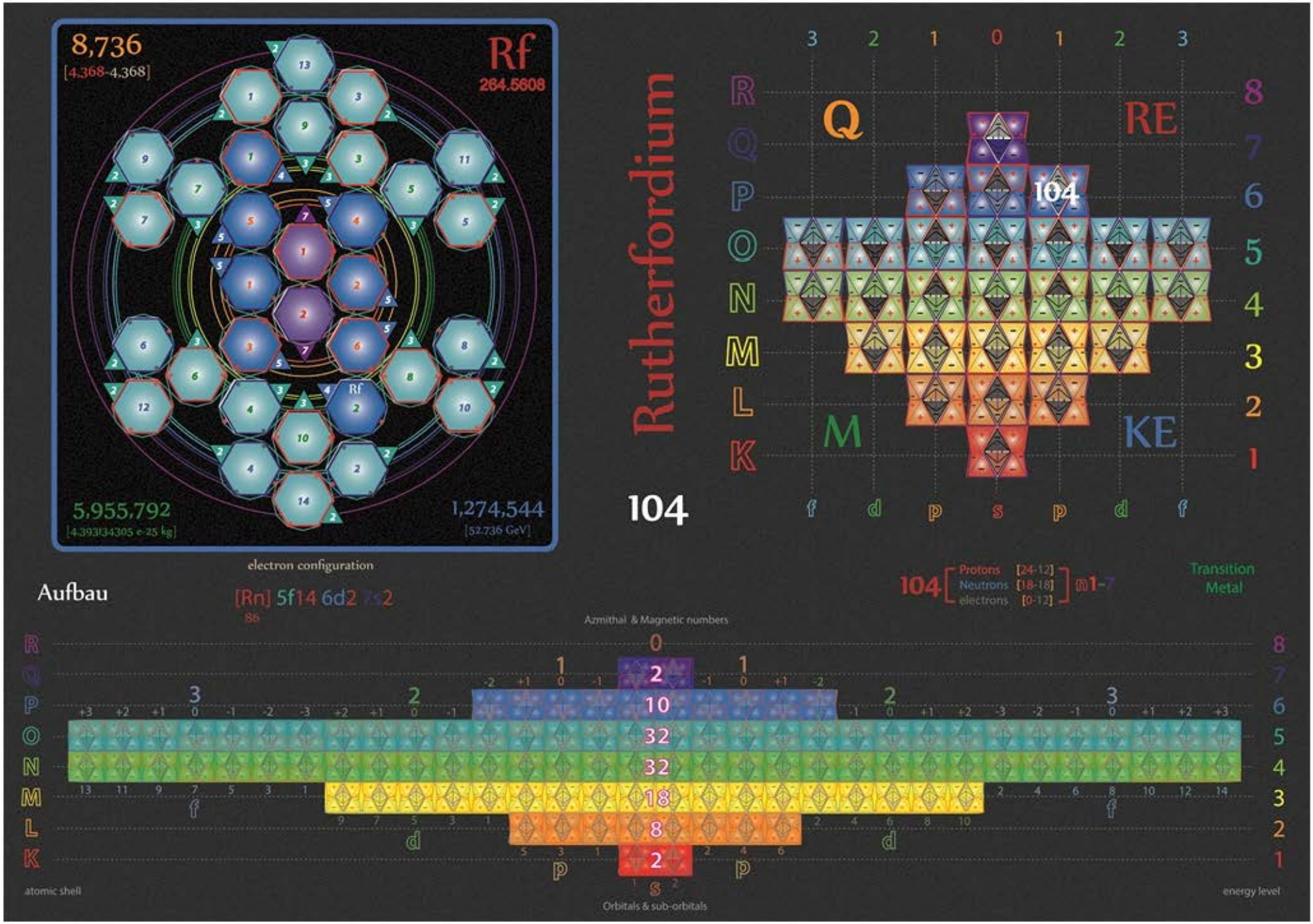

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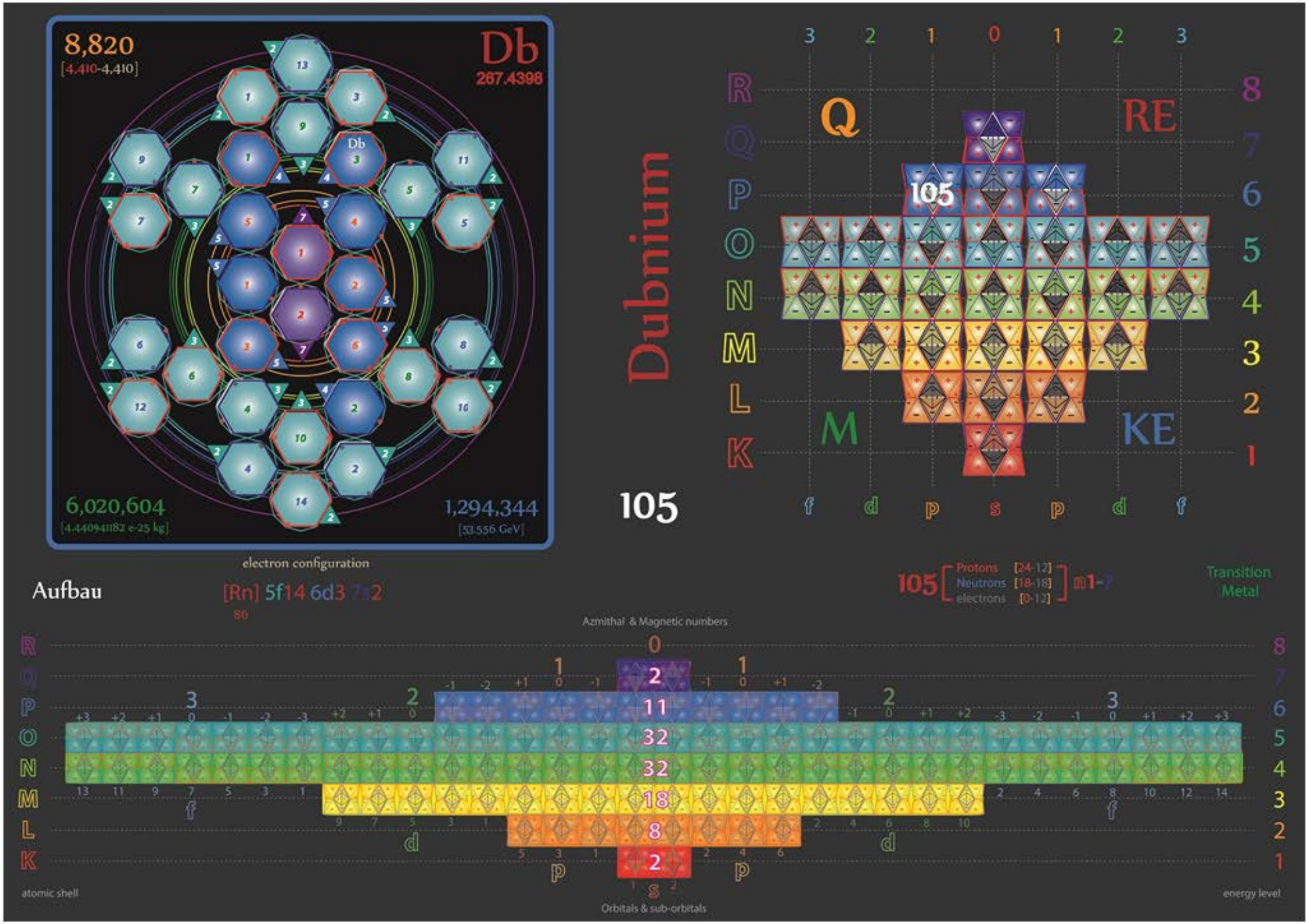

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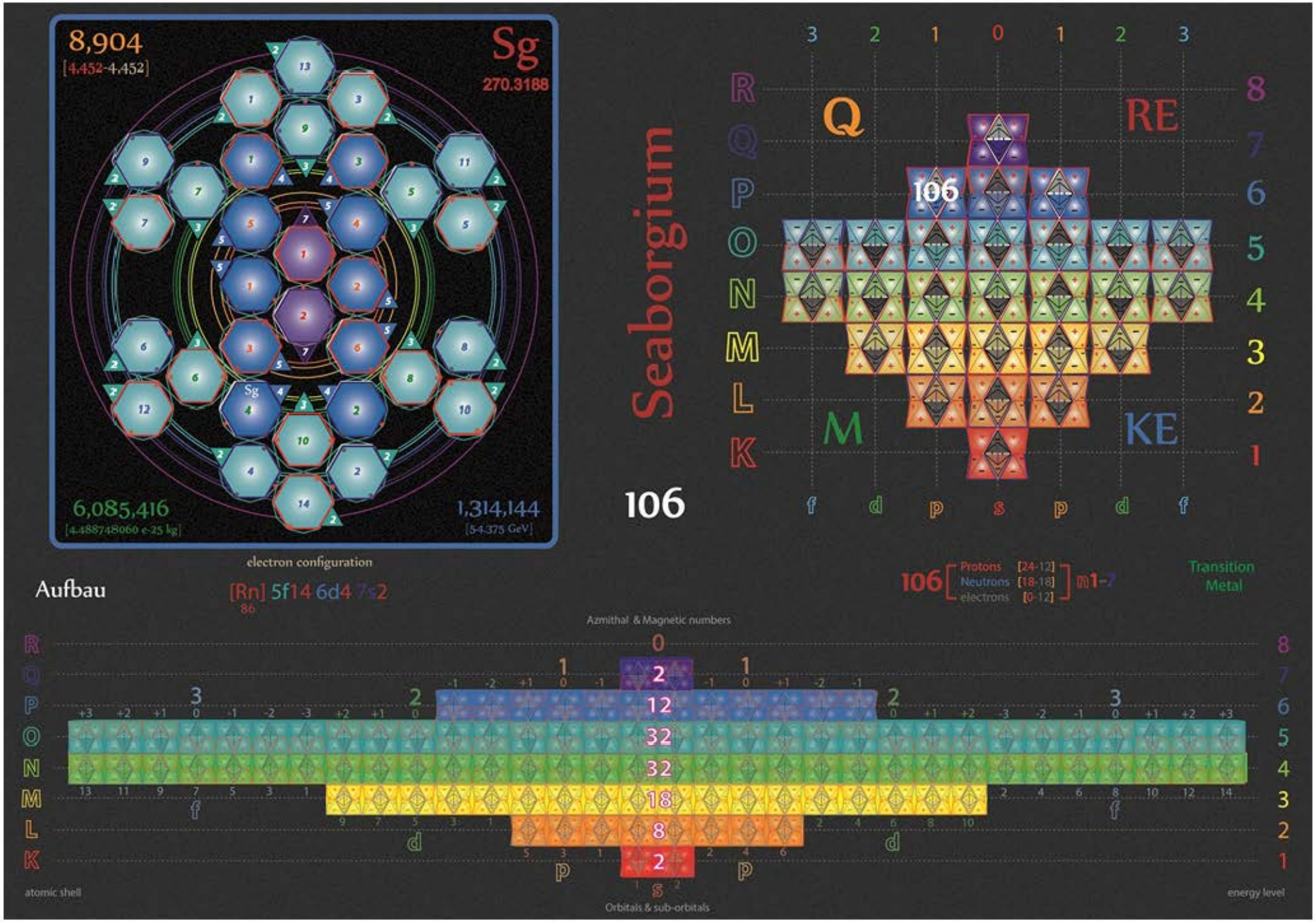

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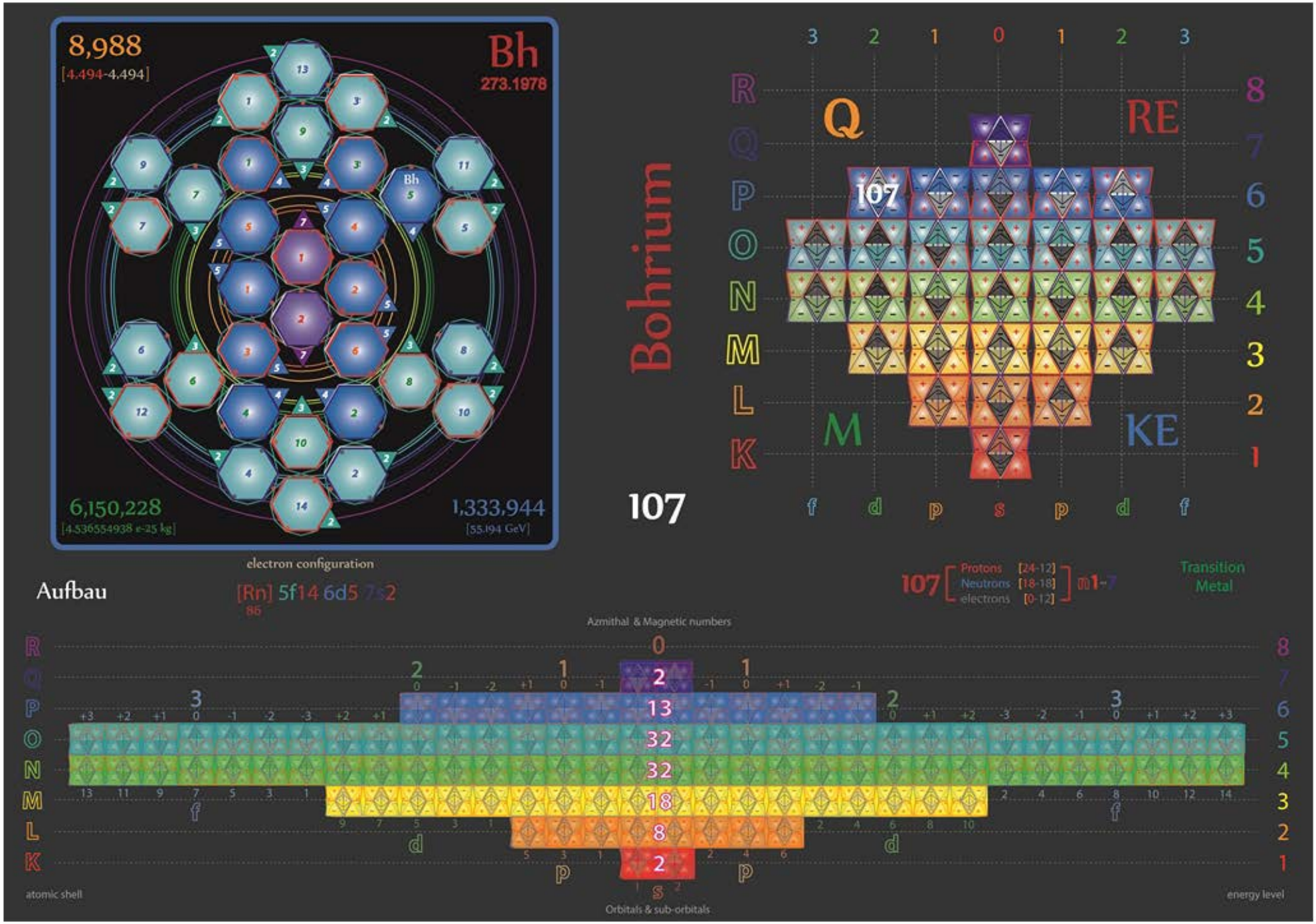

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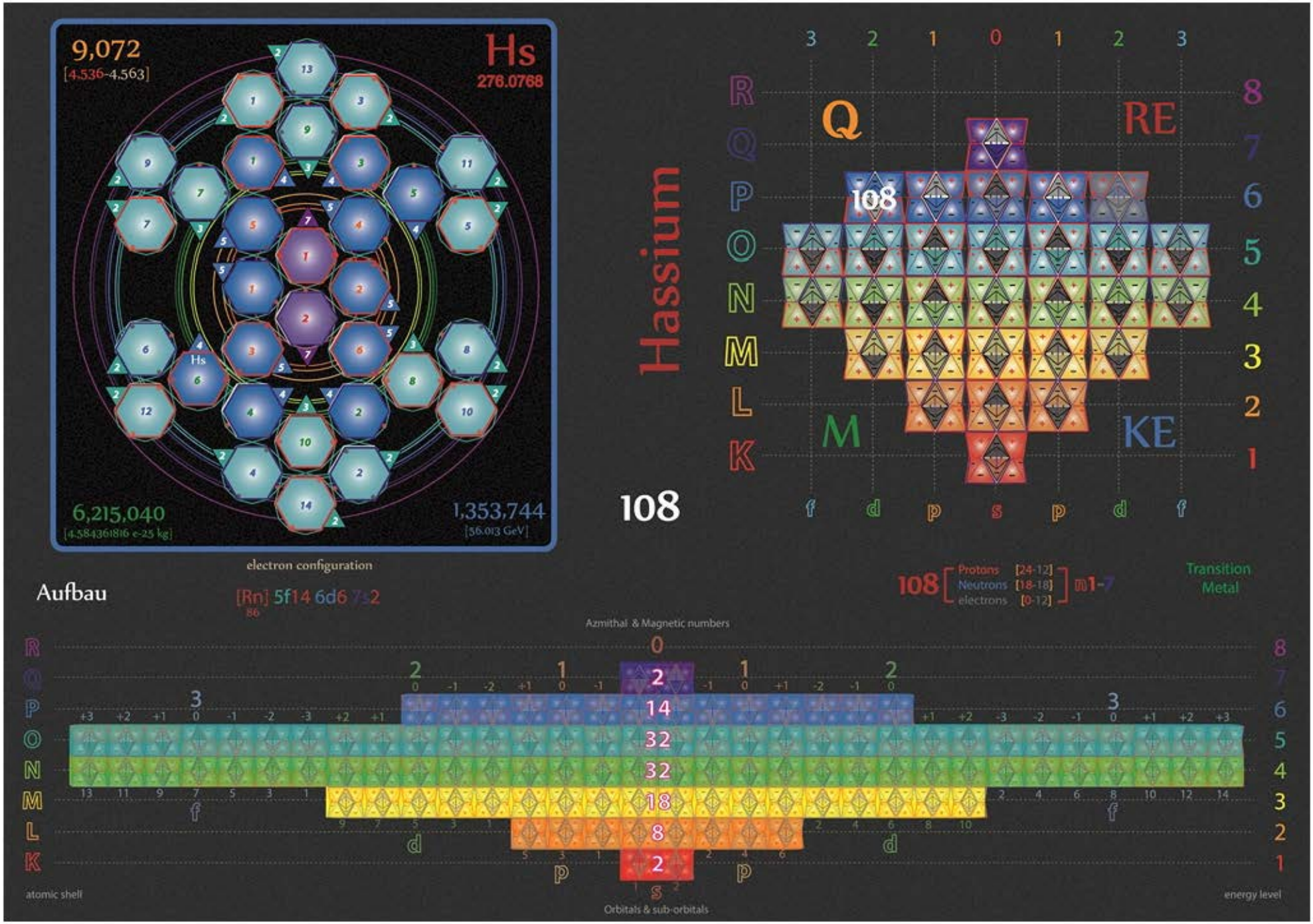

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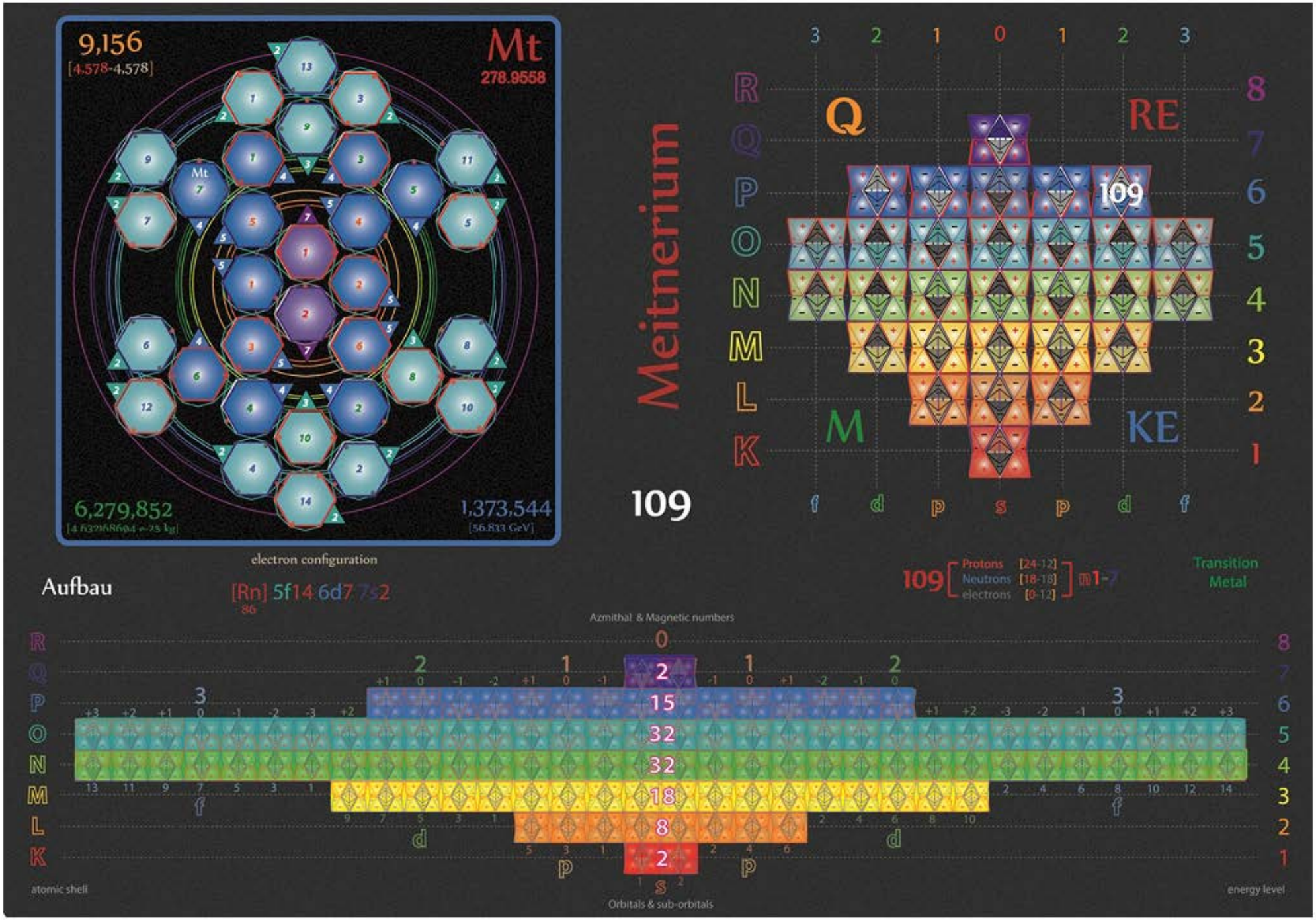

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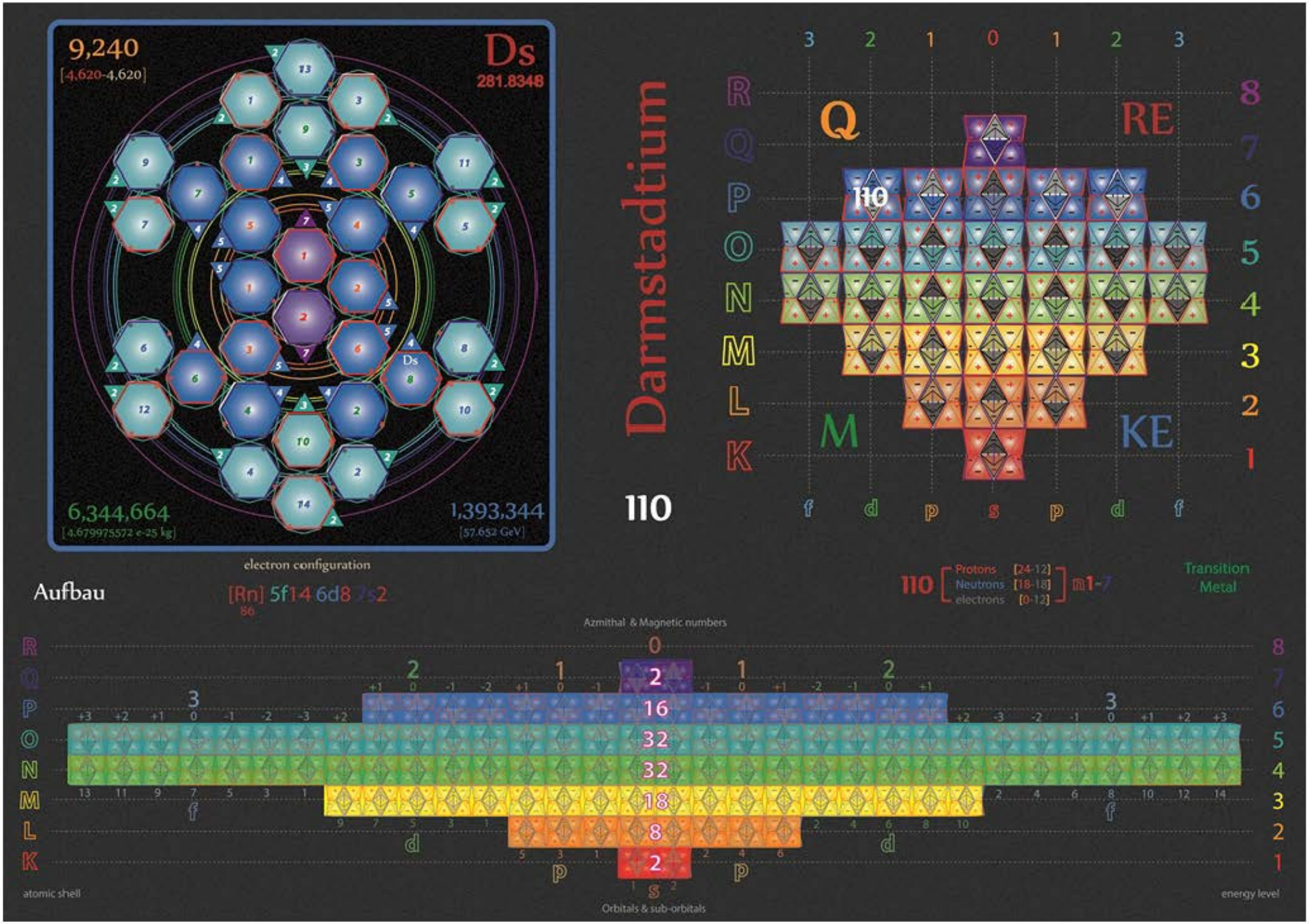

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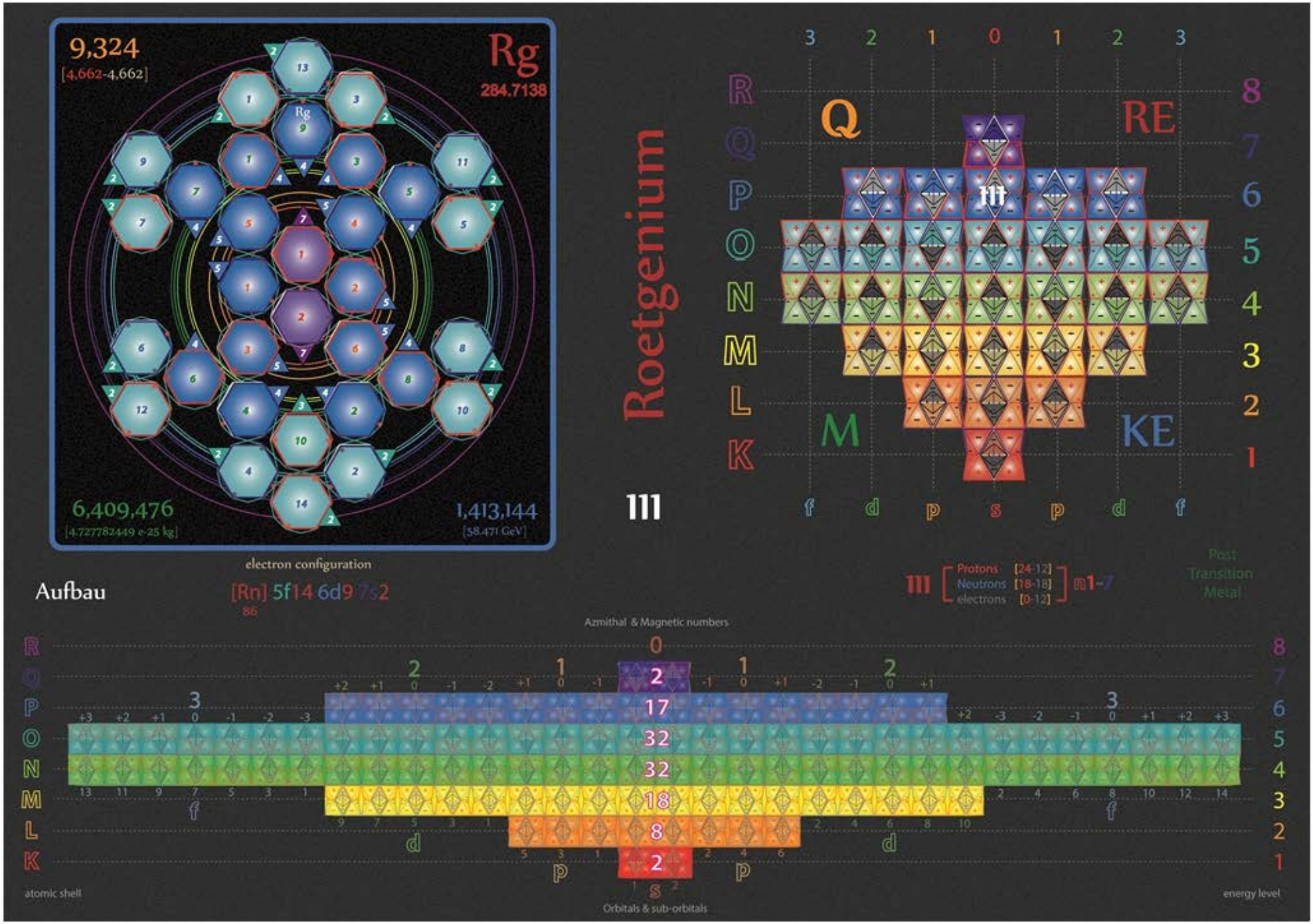

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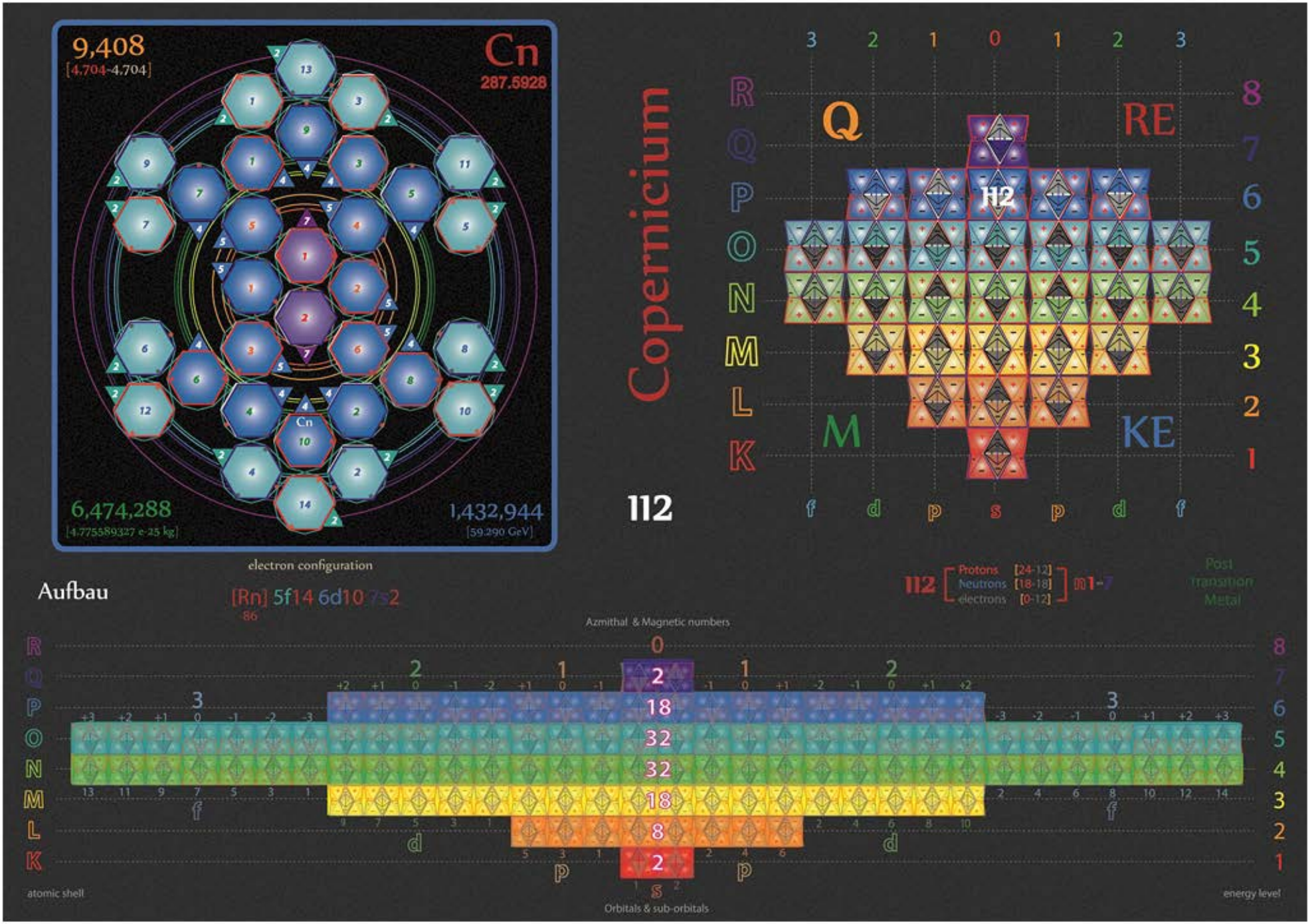

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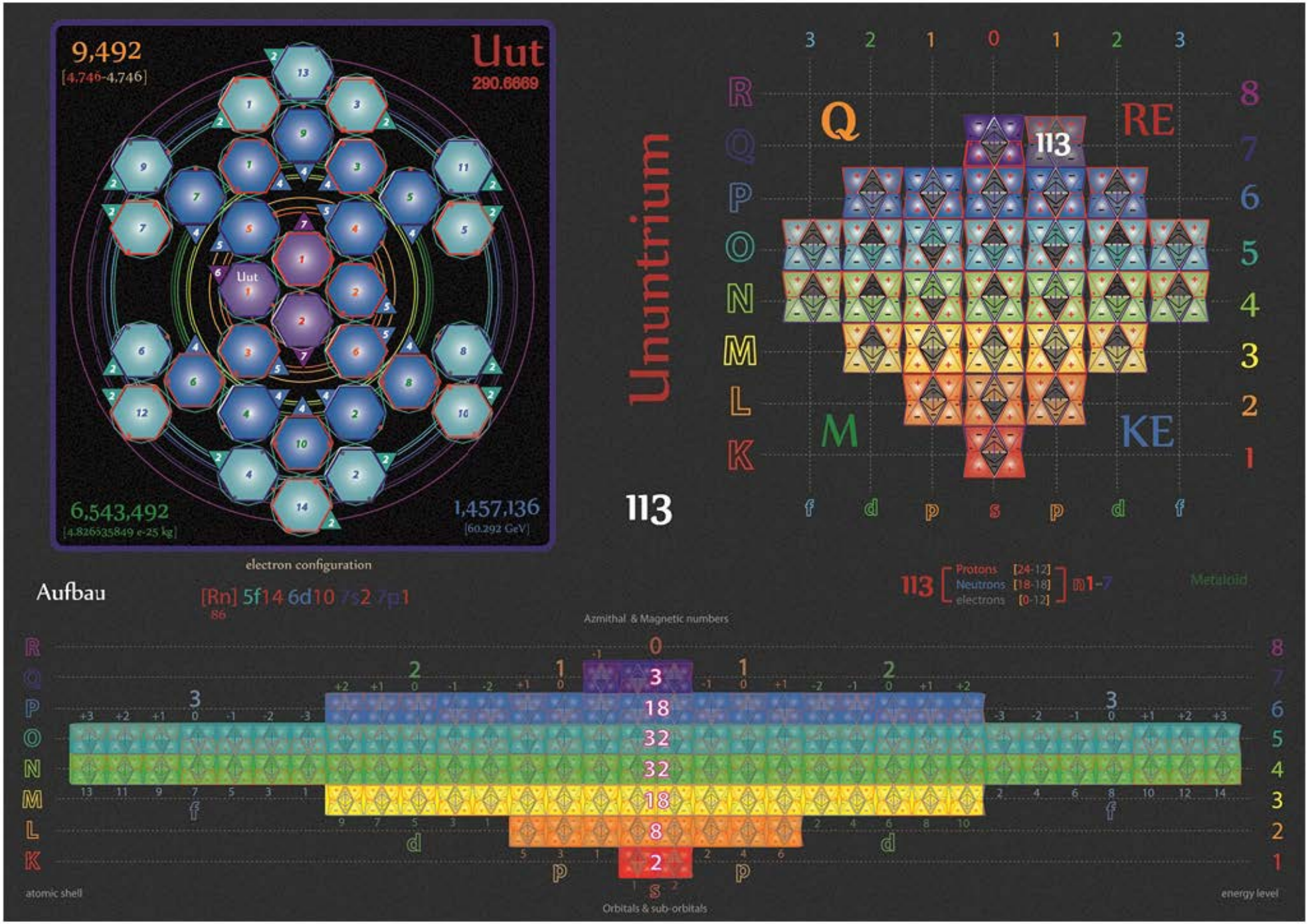

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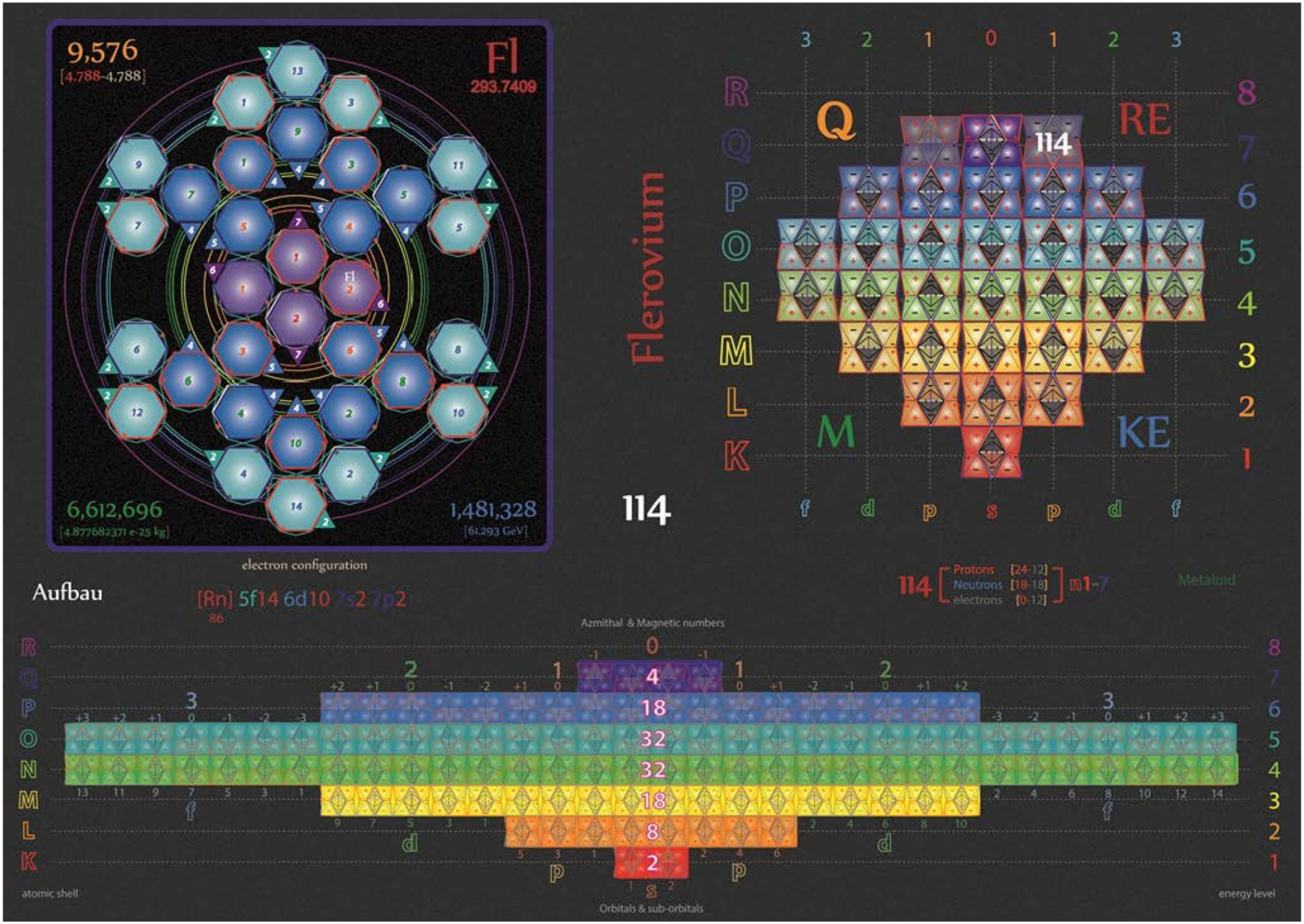

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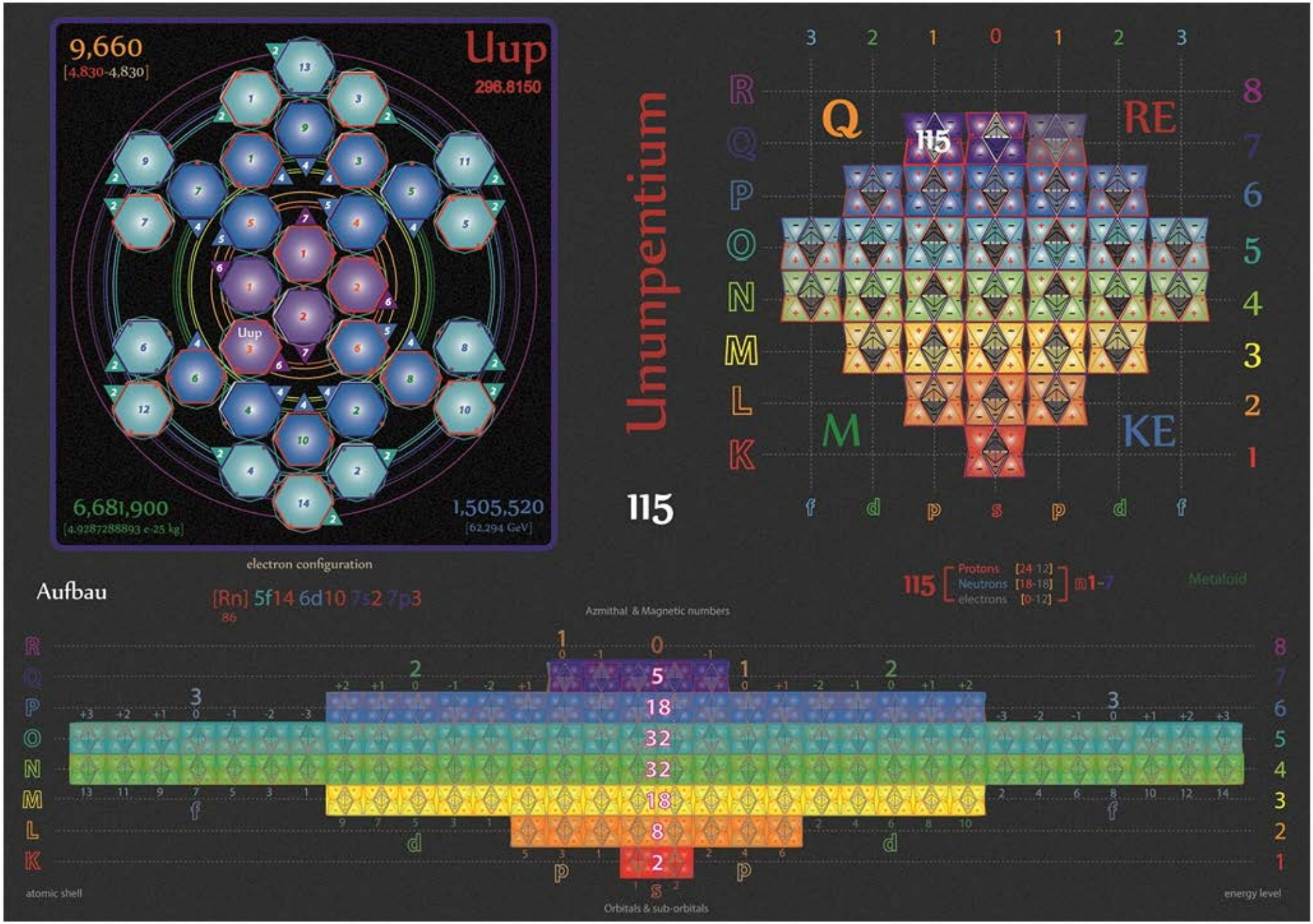

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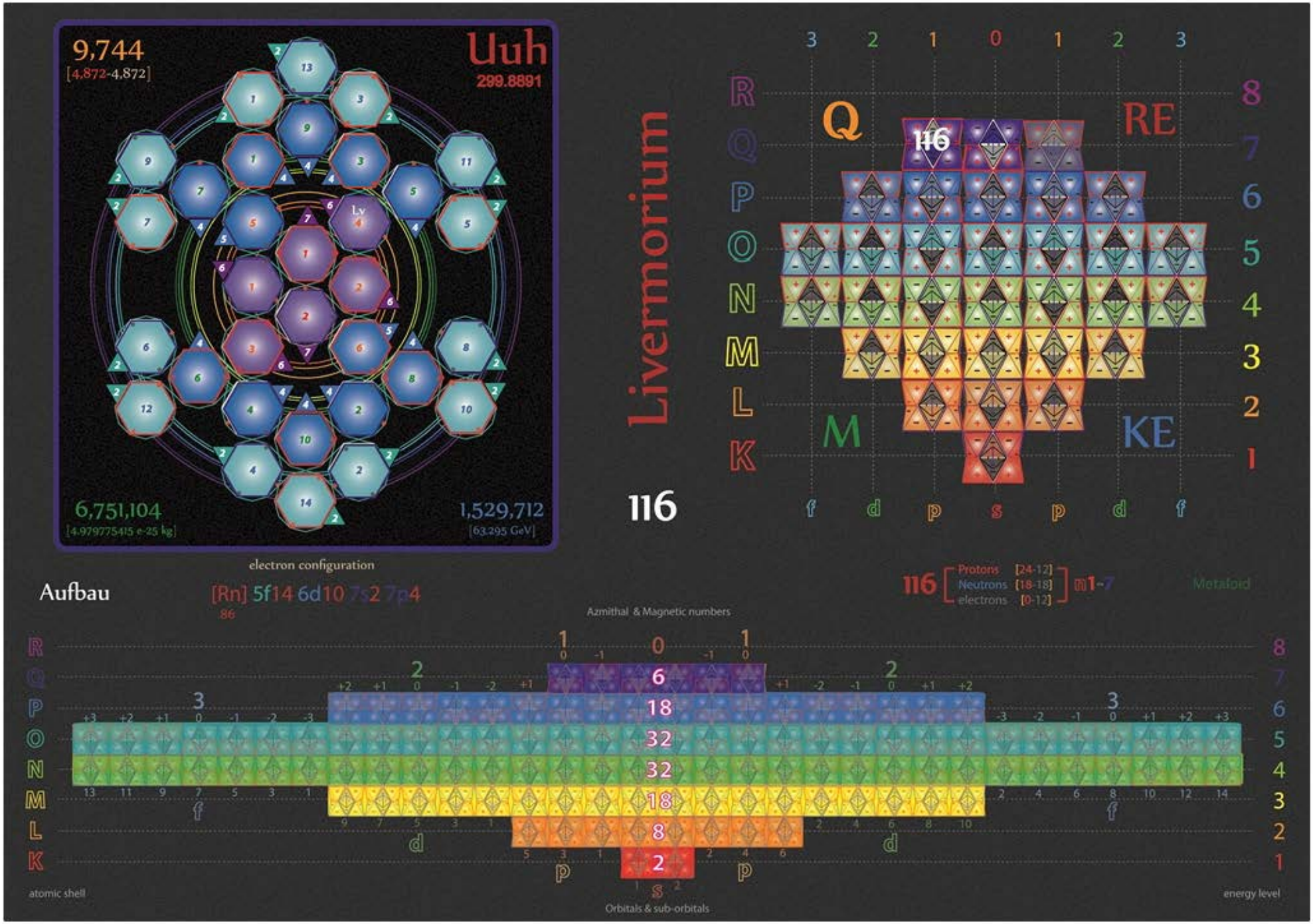

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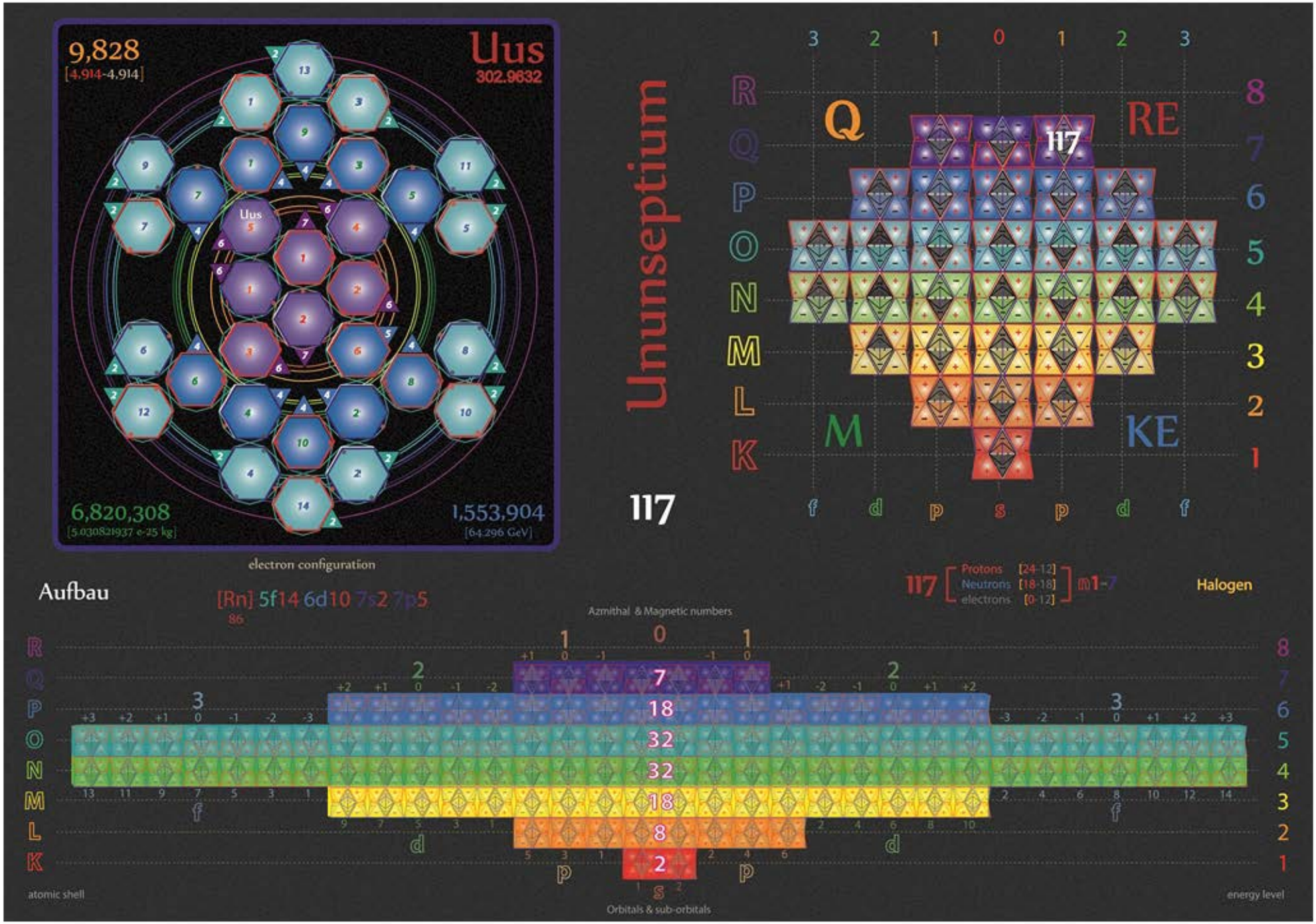

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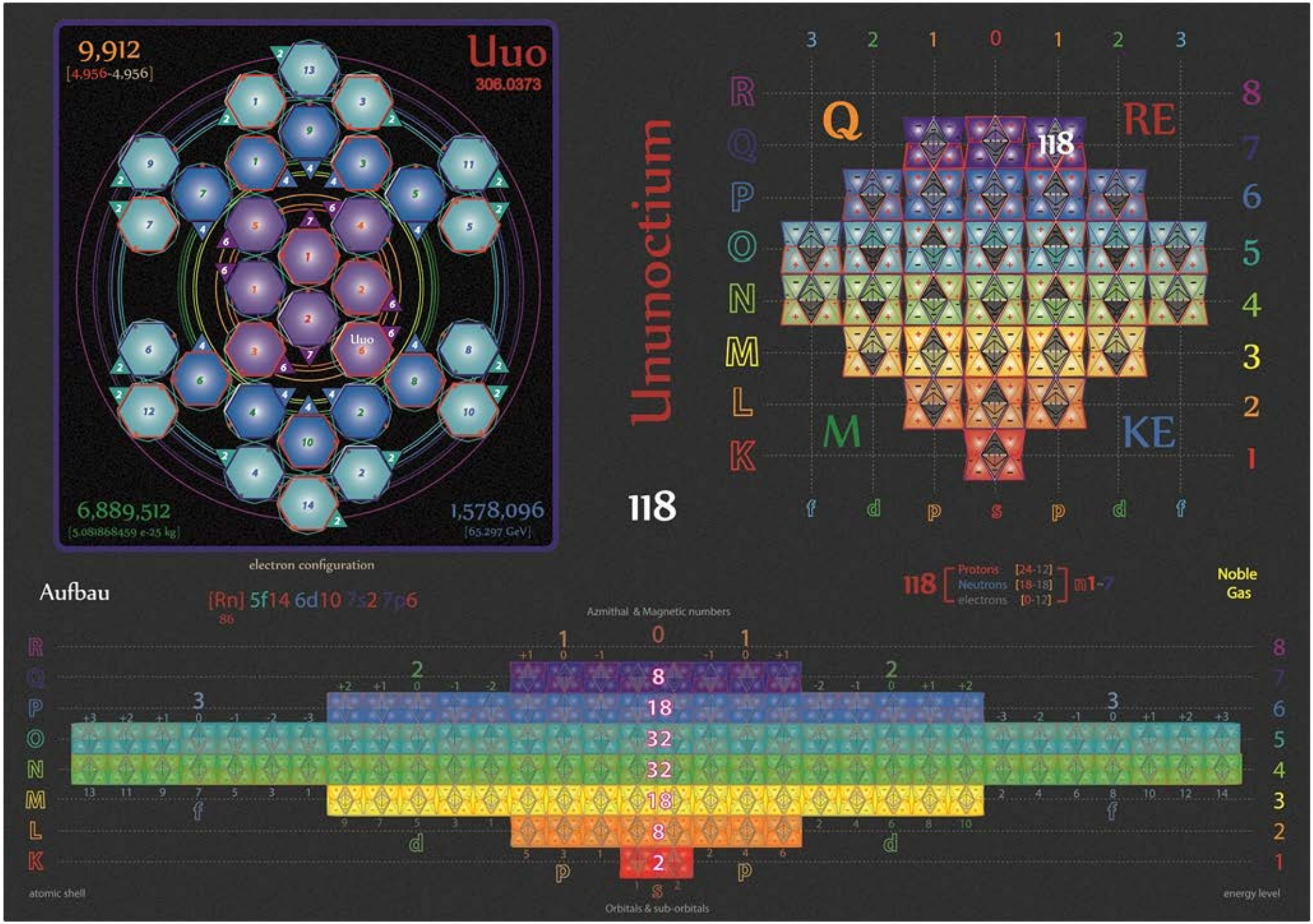

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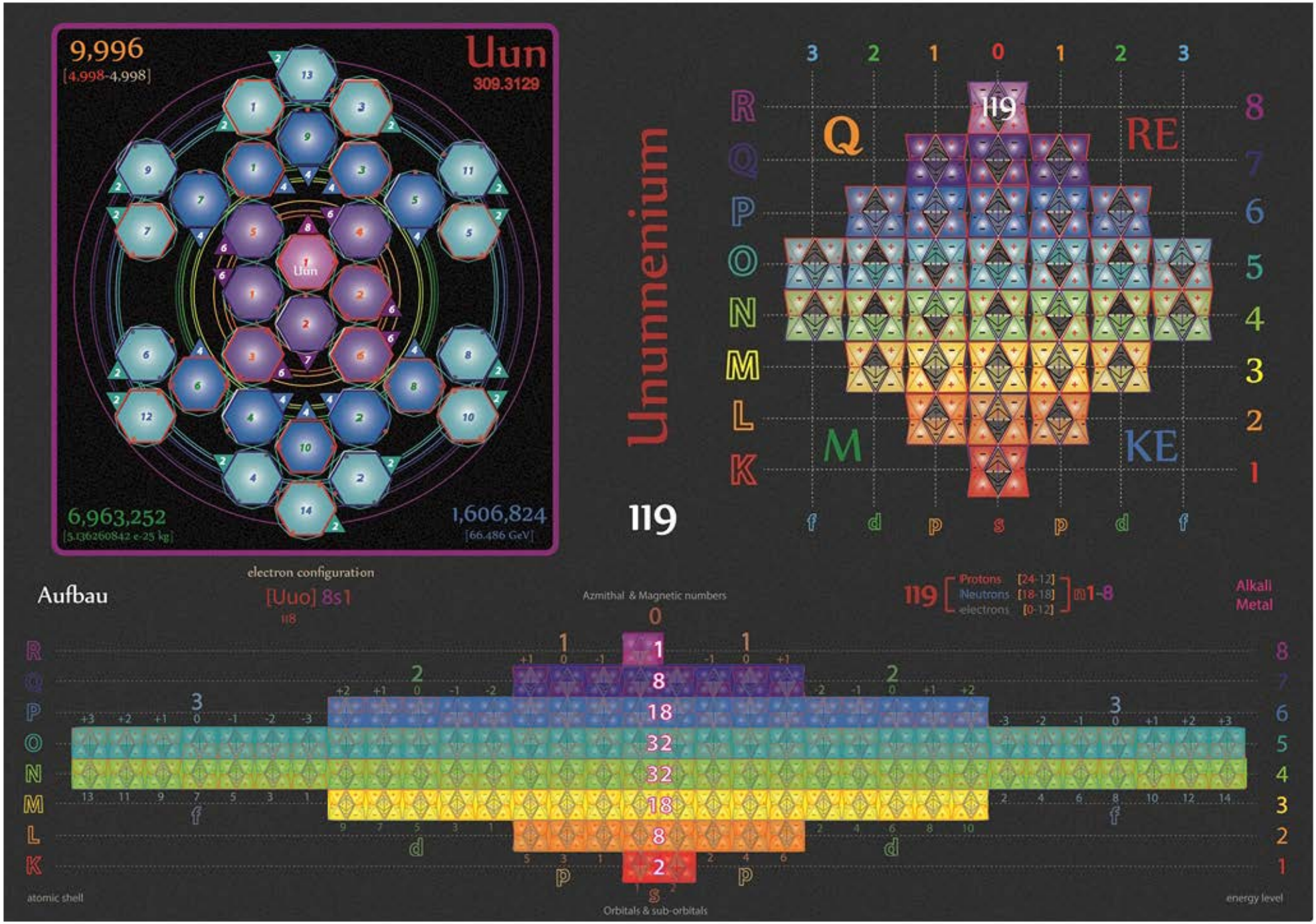

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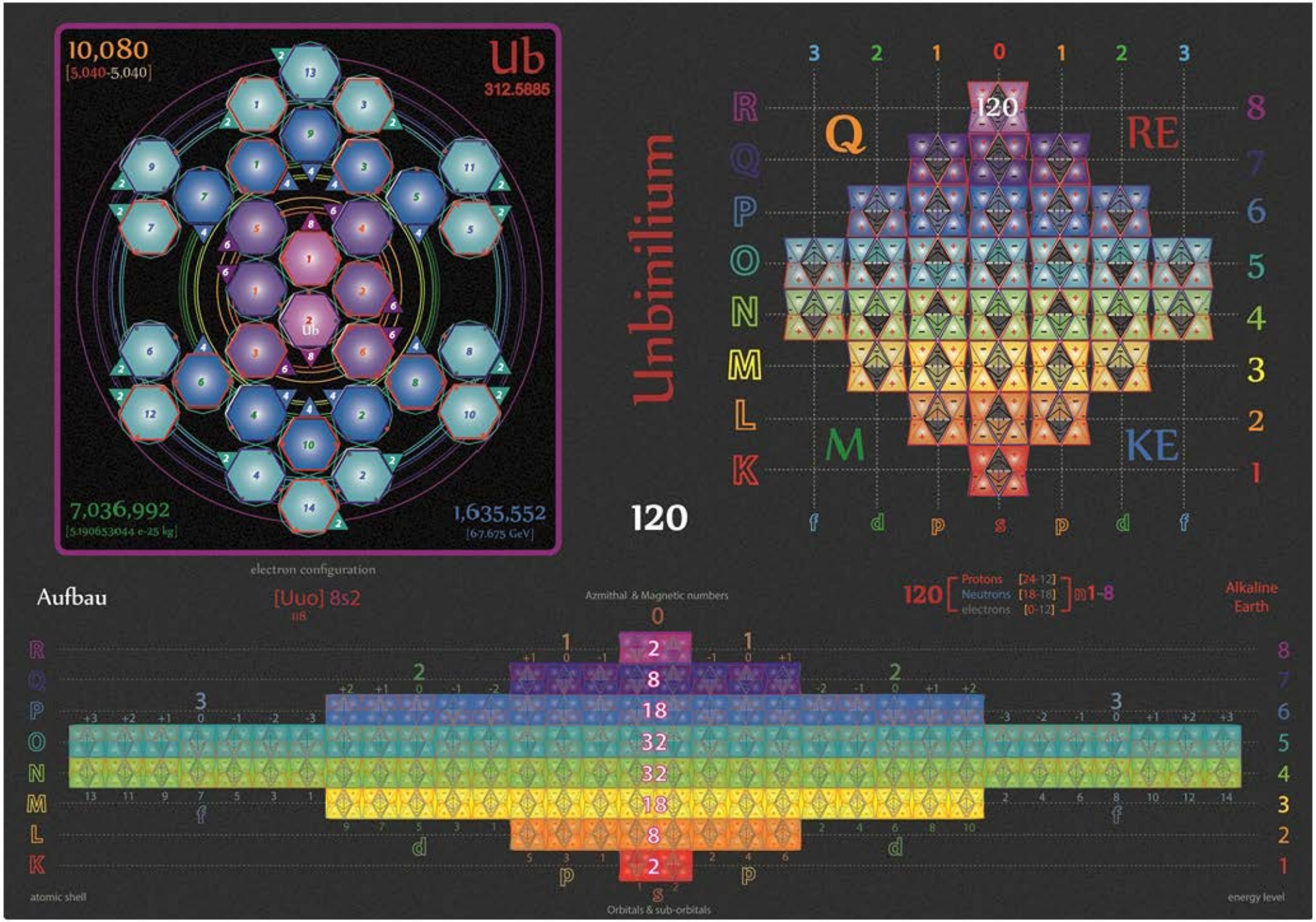

Tetryonics 51.120 - Unbinilium atom

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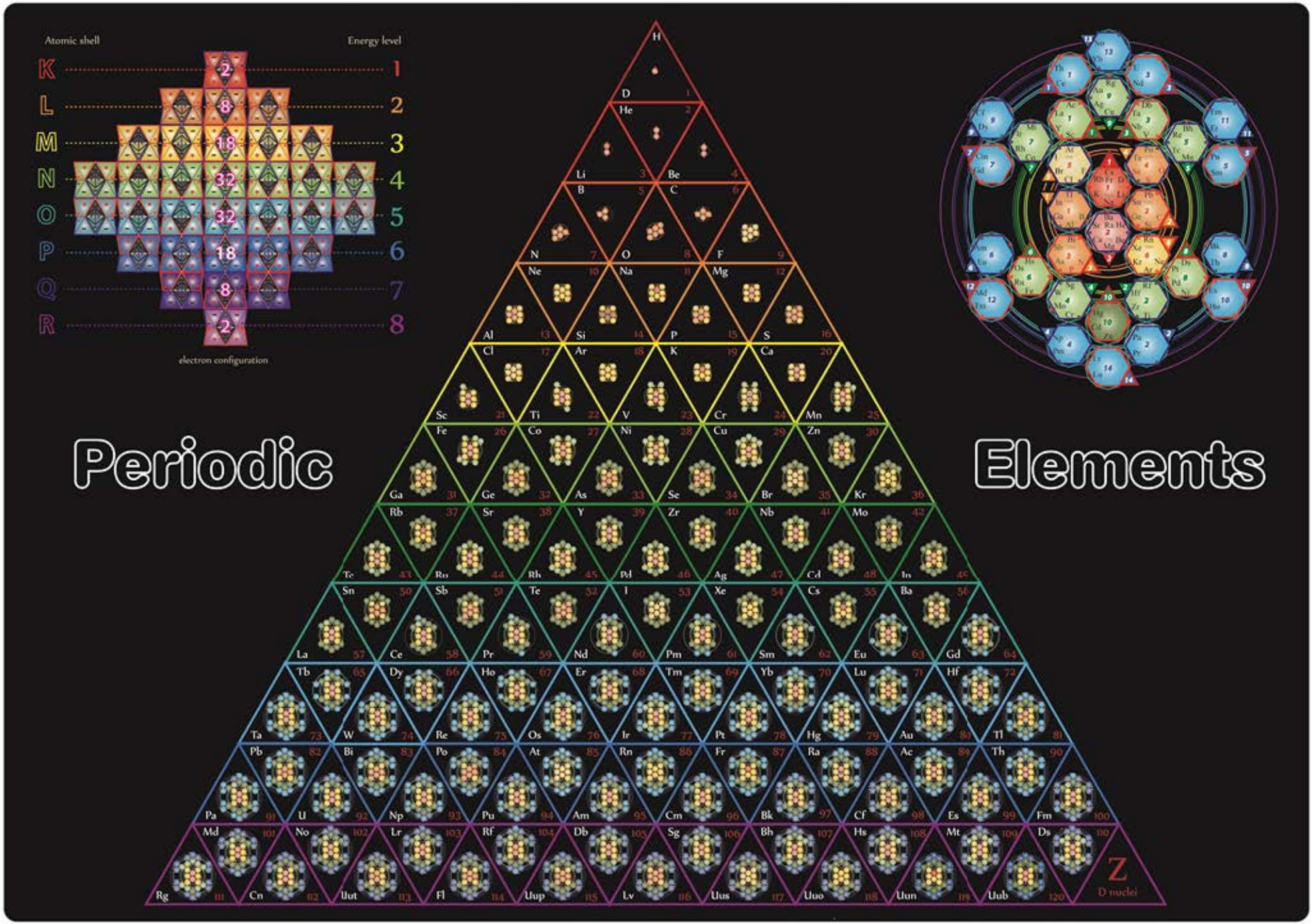

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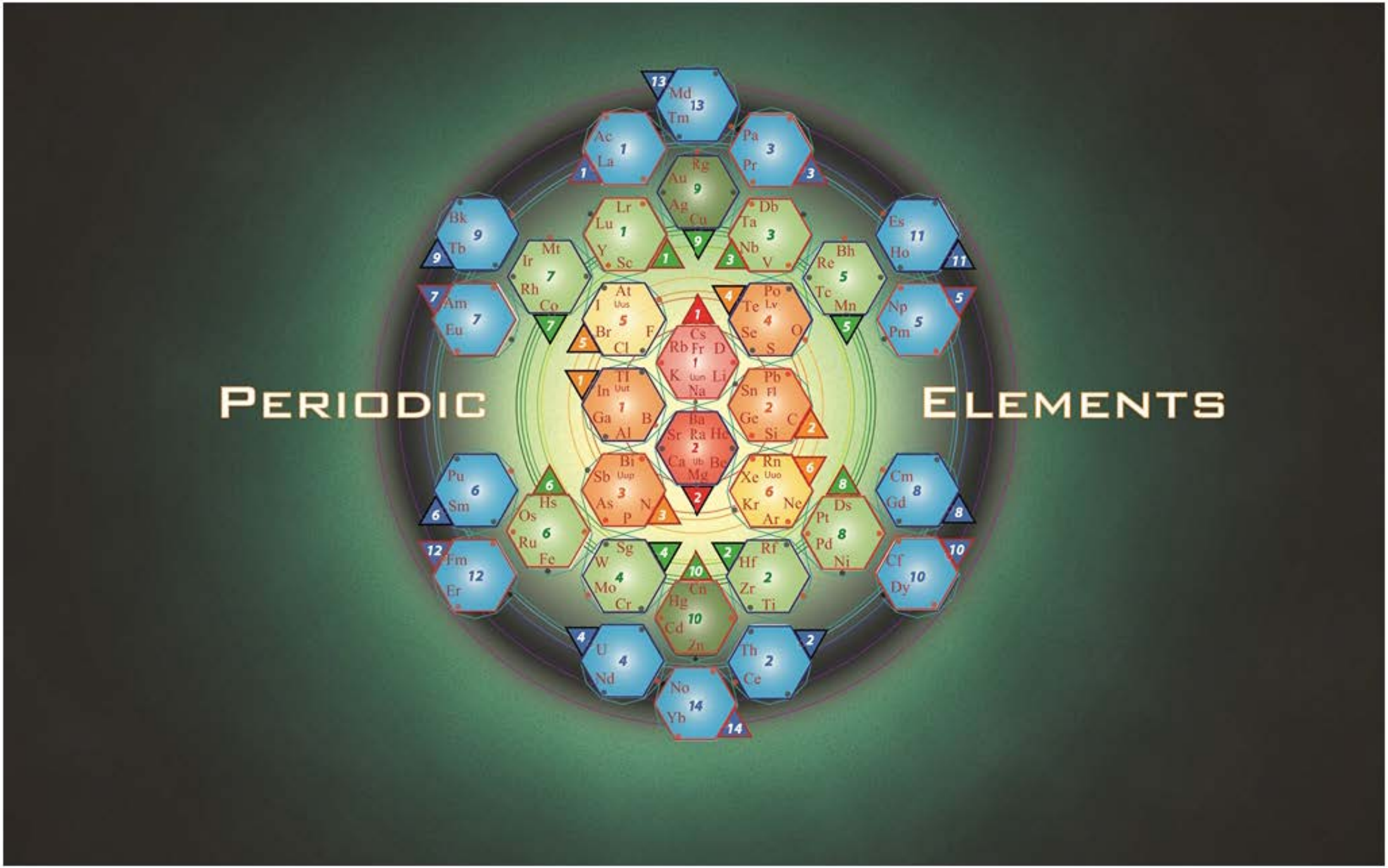

TETRYONICS

The charged geometry of mass-ENERGY-Matter

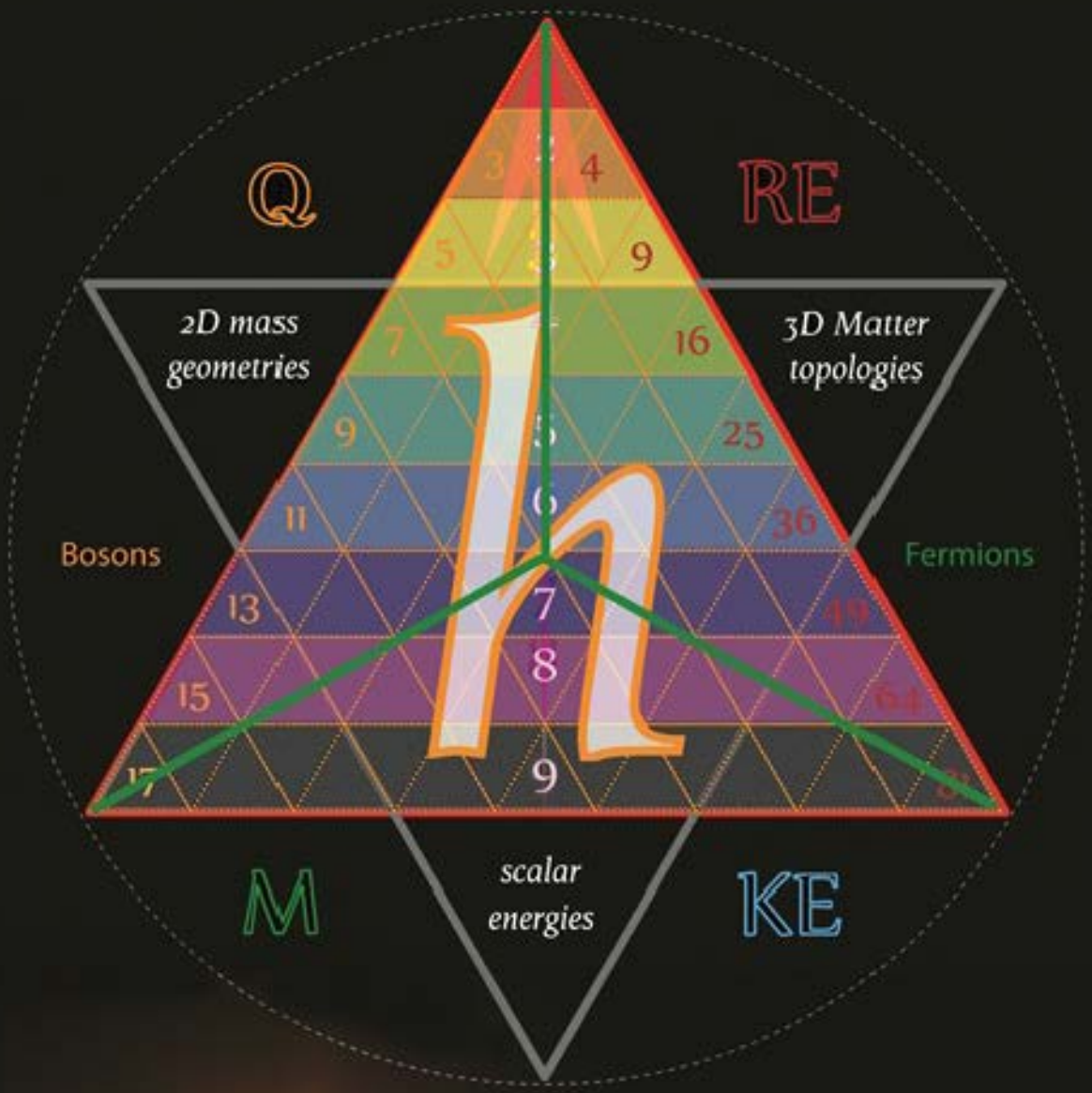

Foundational Quantum Mechanics

Abraham

ISBN 978-0-9872884-1-7

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questions **Q**

FUNDAMENTUM QUANTUM MECHANICA

A answers

[TETRYONICS]

A fundamental re-interpretation of the geometry of quantised angular momentum is required to complete the physics of 'The Standard model'

Having removed the impossible, anything that remains, however improbable, must be the truth

Mathematics is the language of Physics, and Geometry is its grammar

Philosophiae Naturalis Principia geometricae

"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them."

[Albert Einstein]

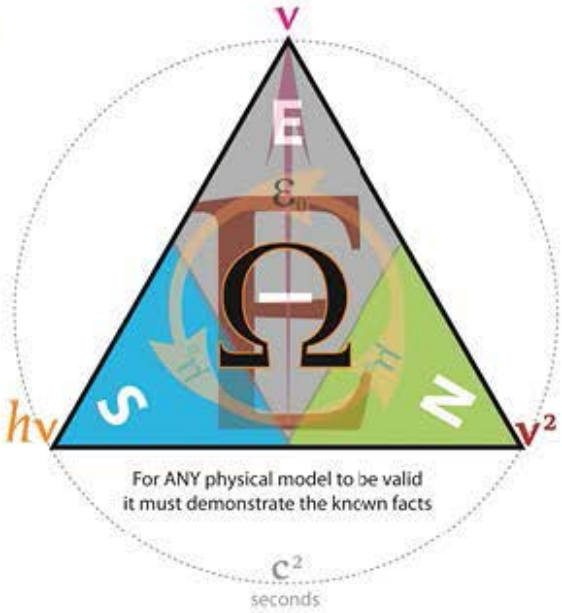

Science is born from observation, and the reasoning of known facts in search of underlying truths

In the following pages the true geometry of quantum mechanics is revealed, leading scientific endeavour into new realms of understanding

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mass-ENERGY-Matter

The a-priori revelation of Tetryonic theory is that all square mass-energies possess equilateral momenta geometries

The equilateral Quantised Angular Momentum intrinsic to Planck mass-energy momenta produces charged geometries

The quantum mechanics of velocity, quanta, EM fields and mass-Energy-Matter can be fully revealed through their equilateral geometries

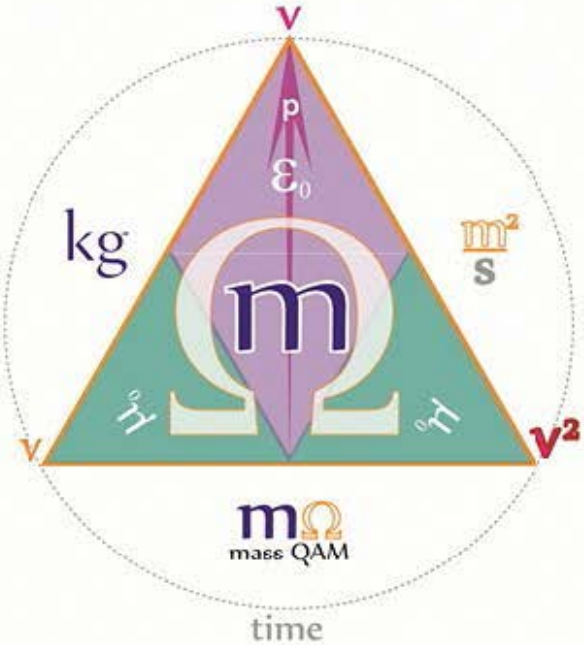

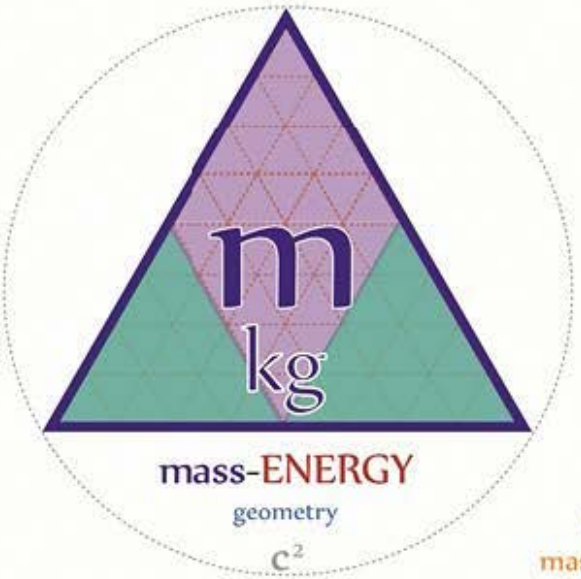

A long hidden topology is revealed

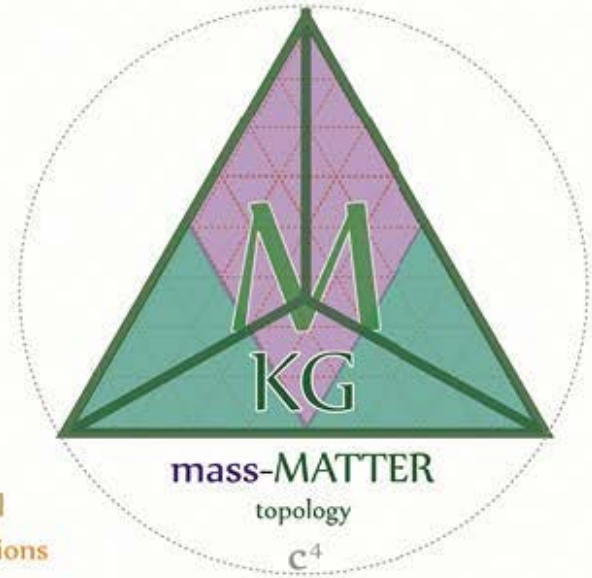

Equilateral triangles are the foundational geometry for all mass-ENERGY-Matter topologies and physical Force interactions

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SQUARED energies in quantum mechanics are EQUILATERAL geometries

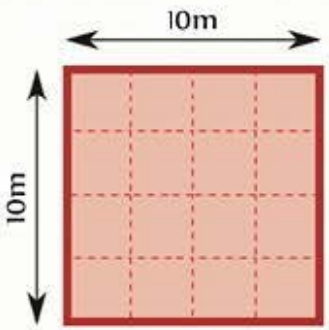

Square

area = s^2 = [100]

Circles

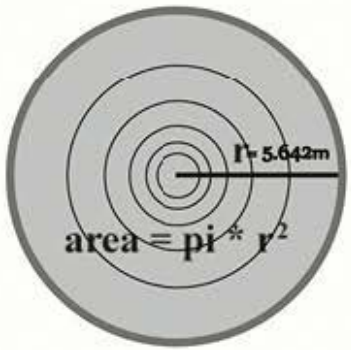

= pi *$[5.642]^2$
= 100

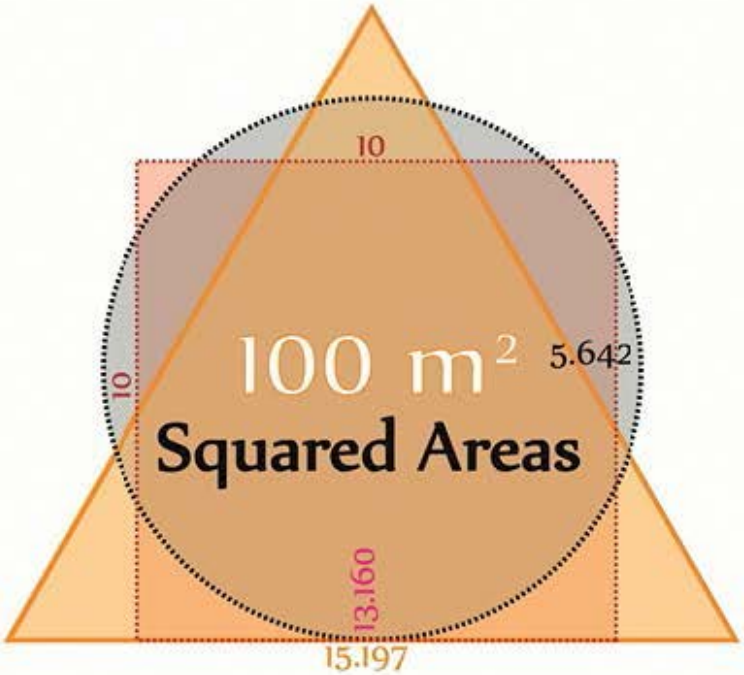

can be created by a number of planar geometries

For a long time it has been assumed by scientists (and mathematicians) that circular [and squared] geometries are the geometric foundation of all physics, leading to a serioulsy flawed model of particles and forces in quantum mechanics

Tetryonic theory now reveals that quantised equilateral angular momenta creates the foundational geometry of all the mass-Energy-Matter & forces of physics

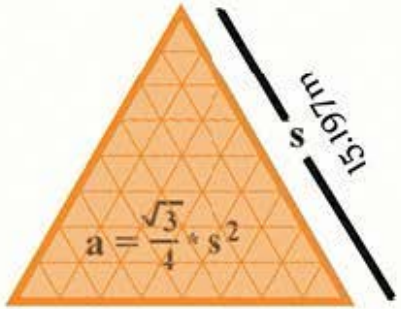

Equilateral

area = $(\frac{1}{2}*b)*h$

Triangles

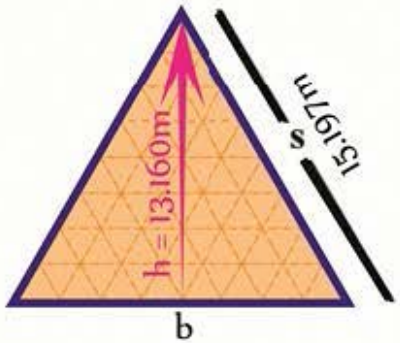

b h
[.5x15.197] x 13.160
= 100

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Integers

The integers (from the Latin integer), literally "untouched", hence "whole"
in Tetryonics it is the basis for the quantum

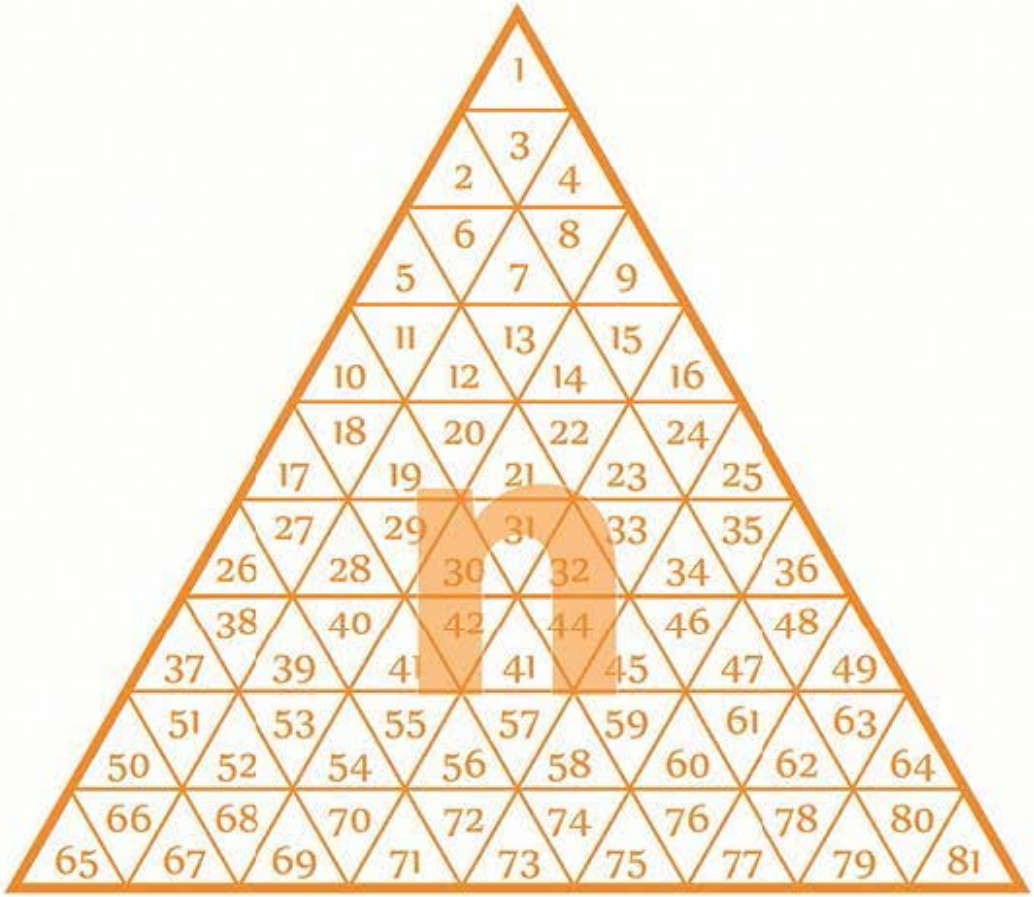

Viewed as a subset of the real numbers, they are numbers that can be written without a fractional or decimal component

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ODD numbers

An odd number is an integer which is not a multiple of two.

2n-1

2n+1

ODD numbers in each level

Bosons have ODD number quanta

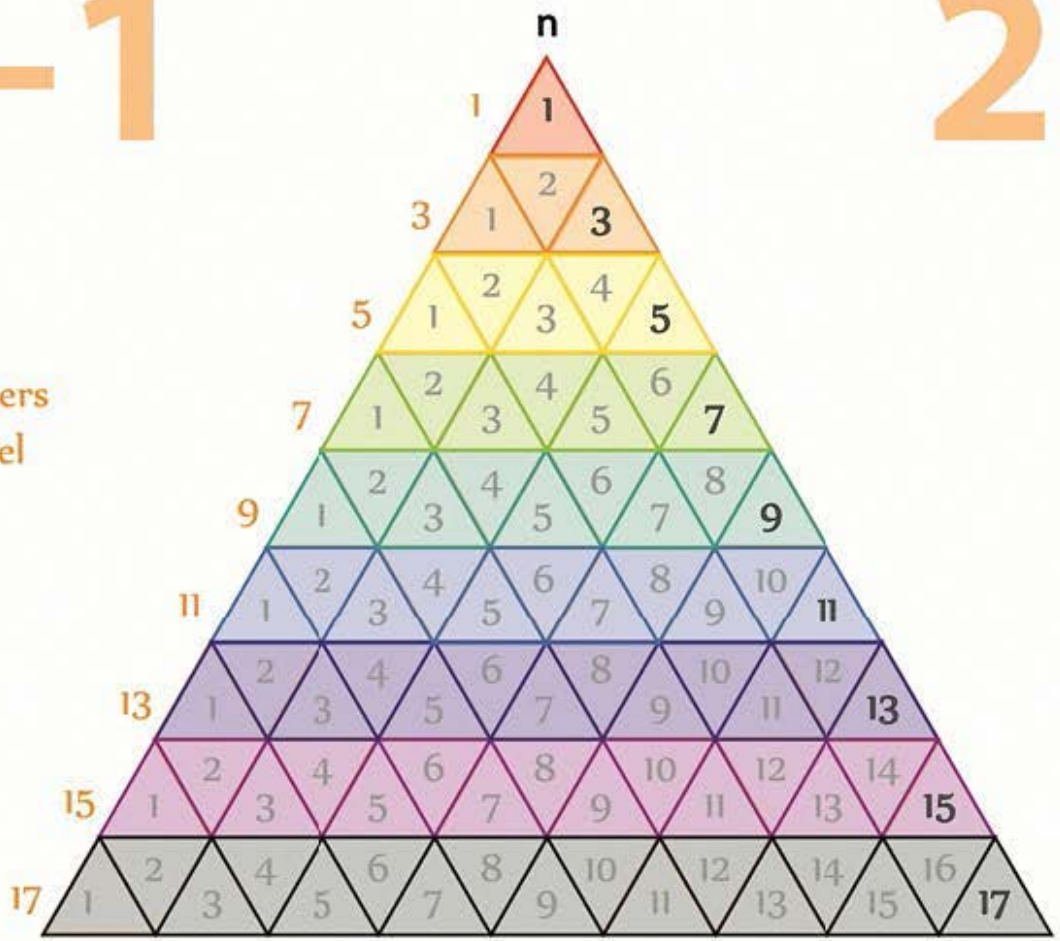

An odd number, when divided by two, will result in a fraction

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EVEN numbers

An integer that is not an odd number is an even number.

2

Photons have EVEN number quanta

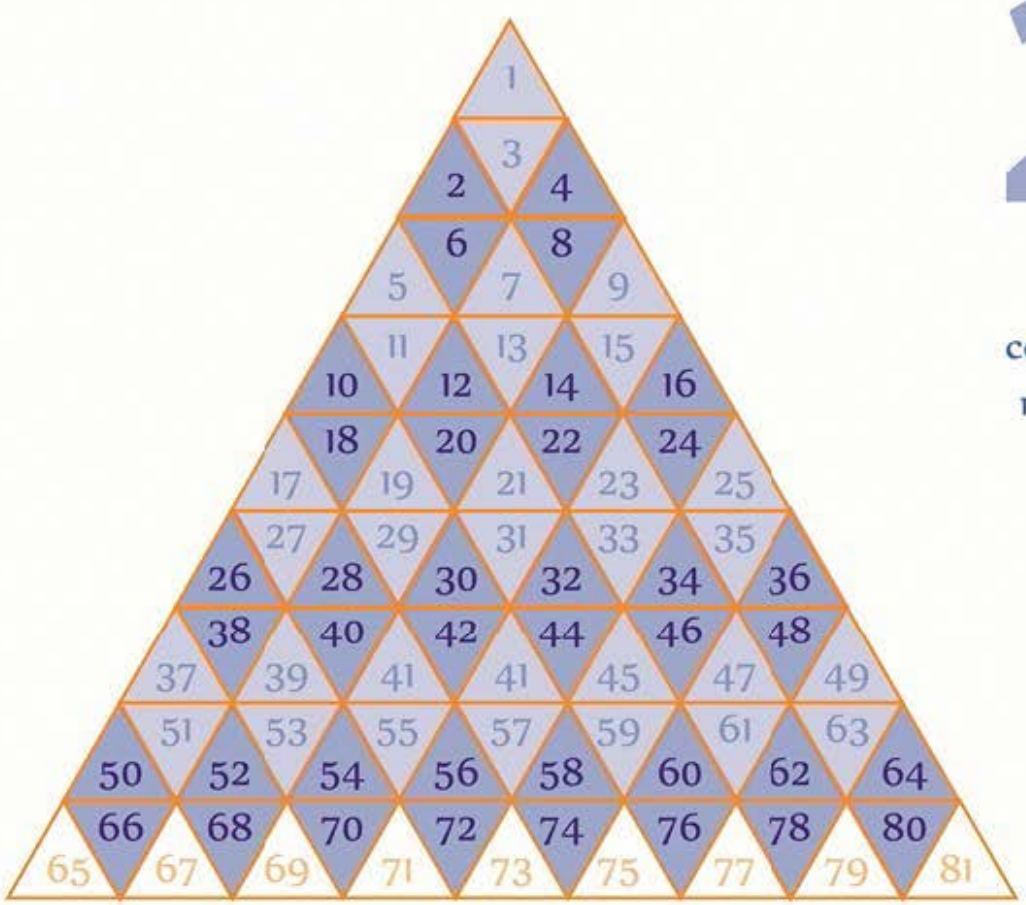

2n

EM waves are comprised of EVEN numbered quanta

An even number is defined as a whole number that is a multiple of two.
If an even number is divided by two, the result is another whole number.

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Square numbers

A square number, sometimes also called a perfect square,
is the result of an integer multiplied by itself

2n-1

Quantum levels
have ODD number
geometries

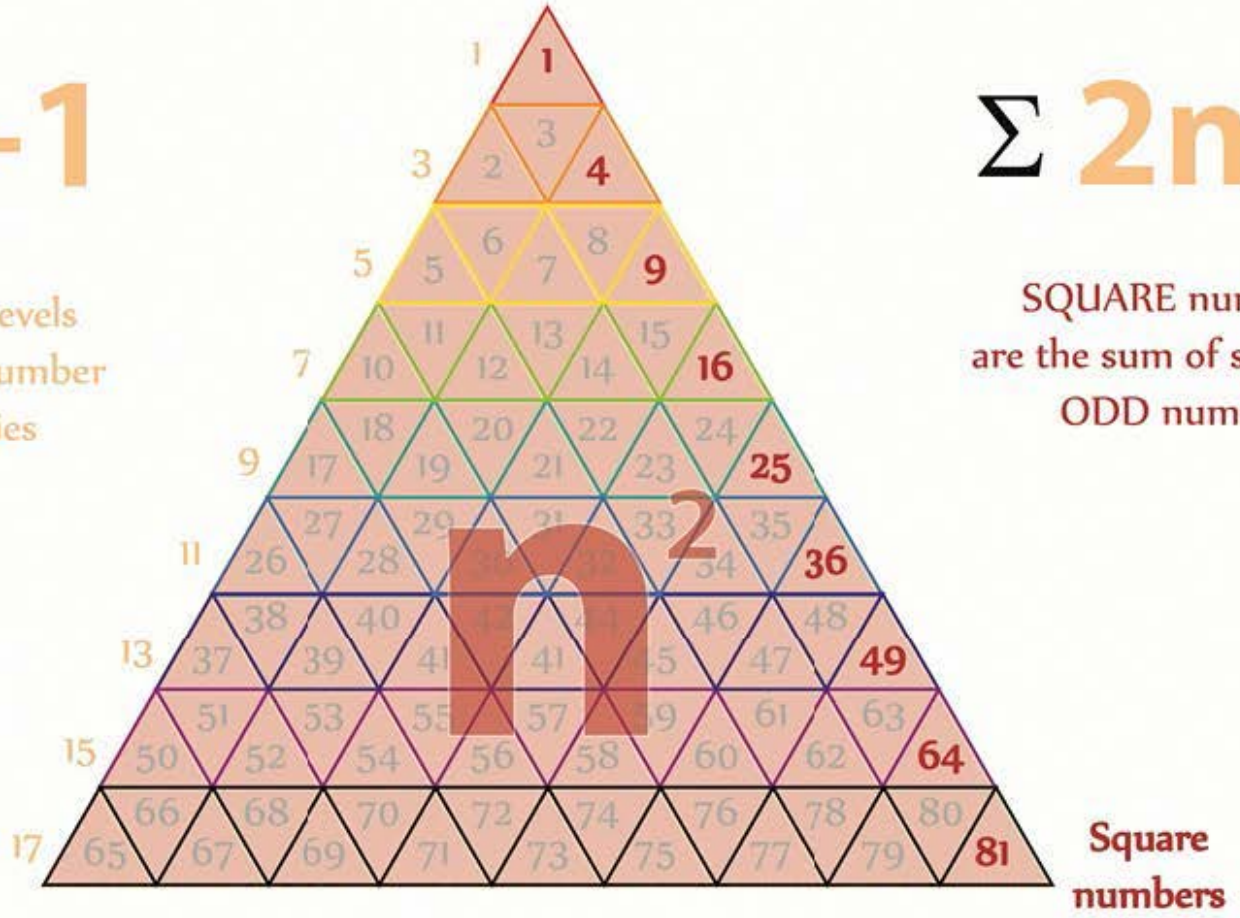

Σ 2n-1

SQUARE numbers
are the sum of successive
ODD numbers

In Tetryonics SQUARE numbers are EQUILATERAL geometries

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Square roots

A square root of a number is a number that, when it is multiplied by itself (squared) , gives the first number again.

$-i$ and $+i$

Against Mathematical convention, square roots of negative numbers are real numbers

In Physics every complex number except 0 has 2 square roots.

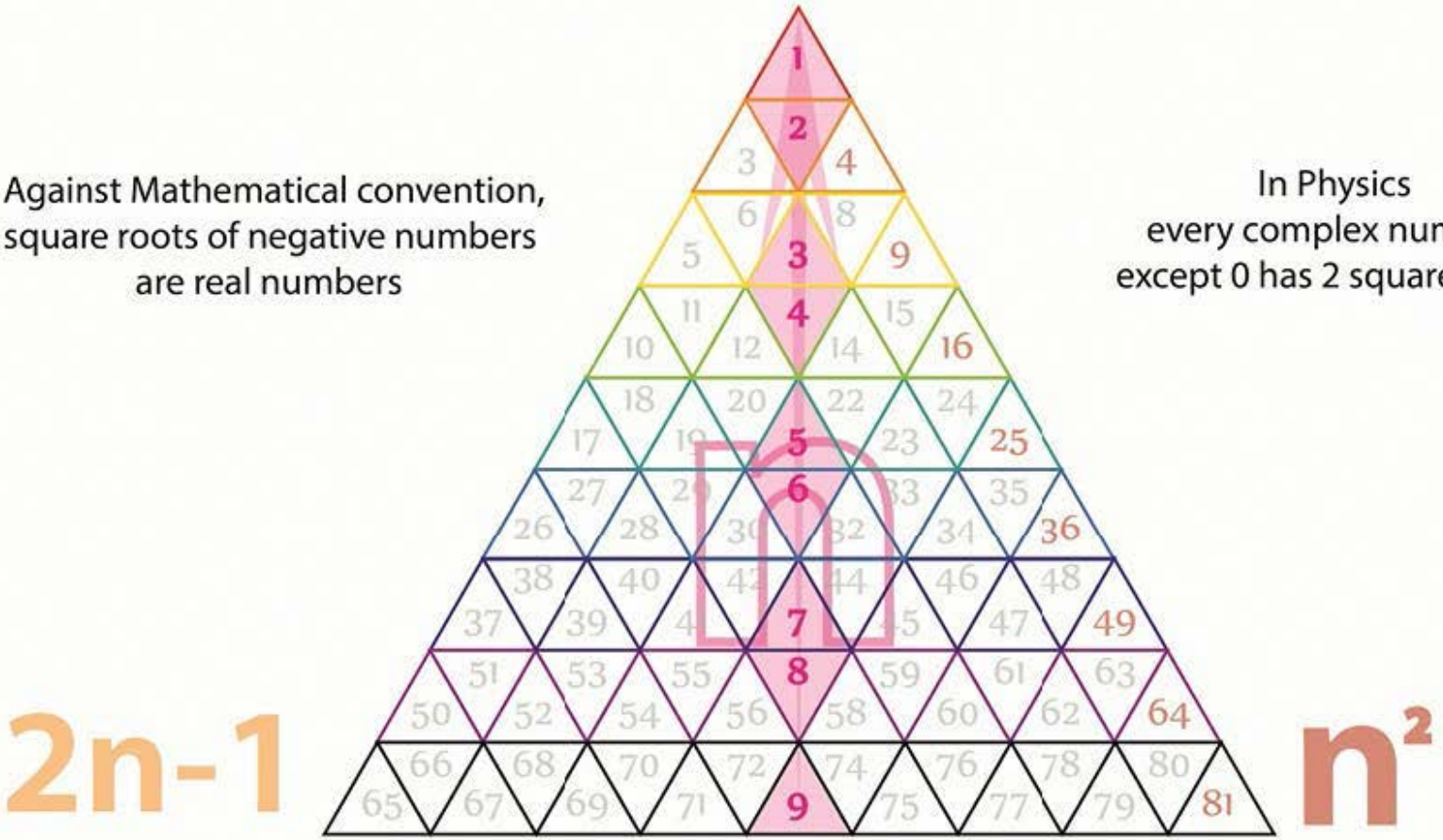

A whole number with a square root that is also a whole number is called a perfect square

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Real Numbers

A real number is a value that represents a quantity along a continuous line.

The real numbers include all the rational numbers,

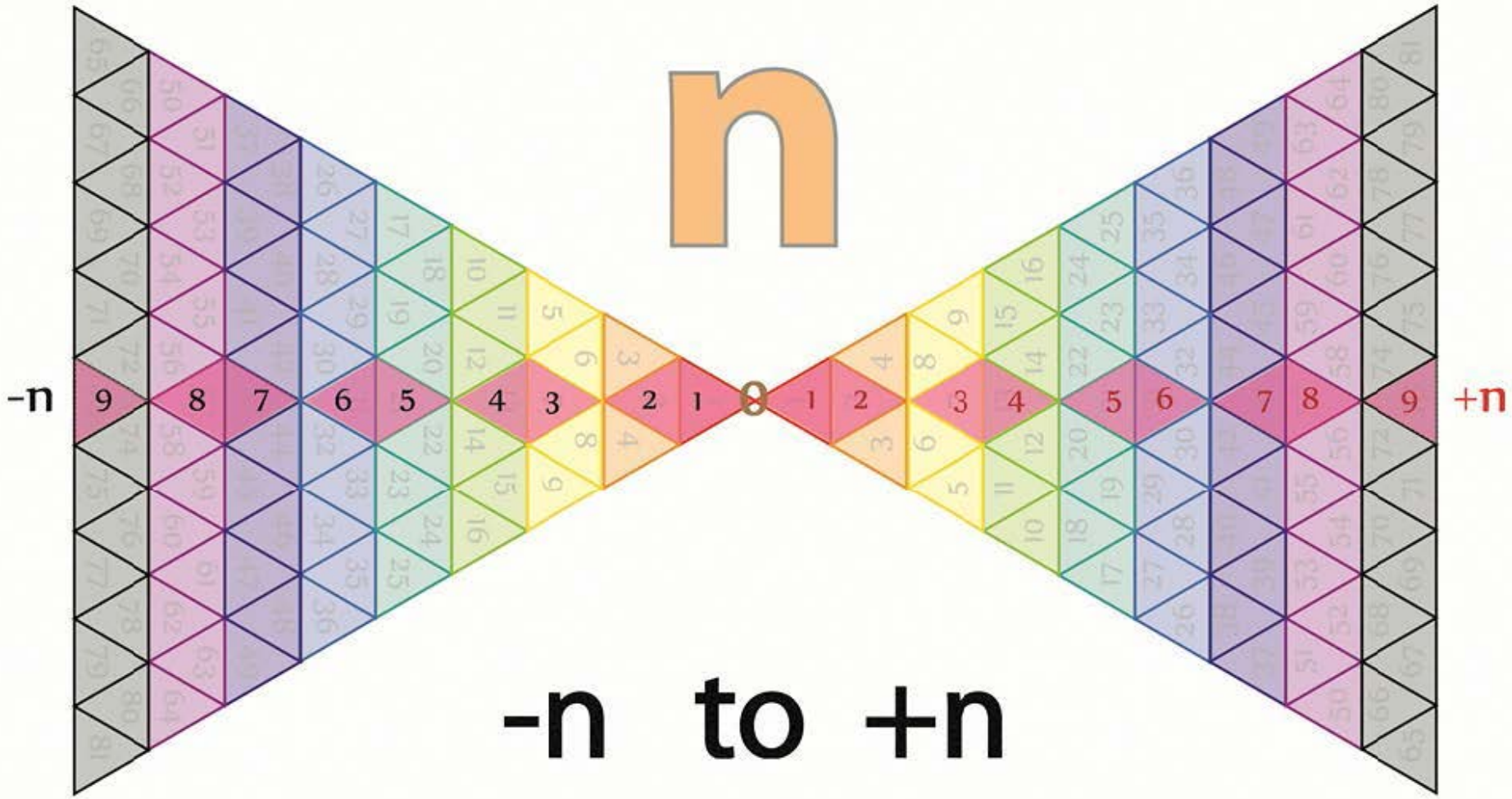

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Irrational Numbers

An irrational number is defined to be any real number that cannot be written as a complete ratio of two integers

$i^2 = -1$

$+i$ and $-i$

Well known irrational & imanginary numbers in Math are π and i

π

$\sqrt{n}$

in Tetryonics the SQR of a negative number is the linear momentum of a negative charge EM field

$\sqrt{-n}$

Irrational numbers often occur in mathematics

$\sqrt{-n}$

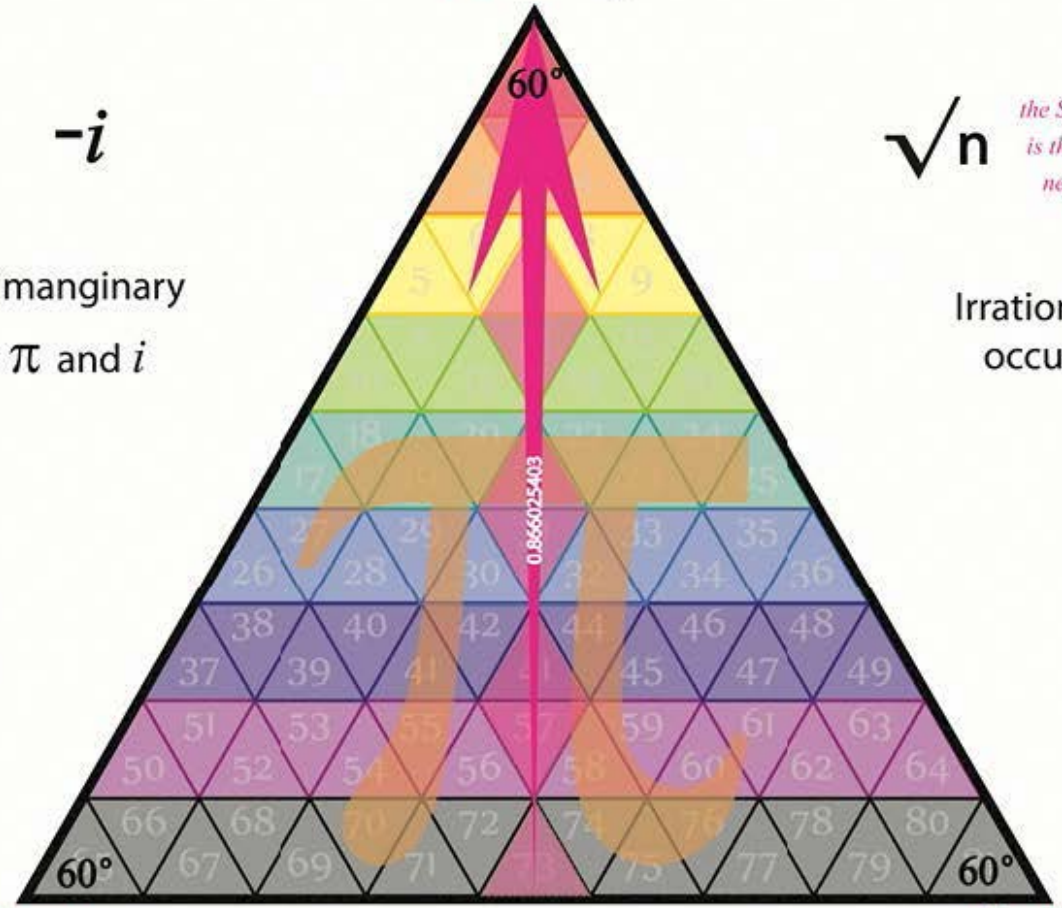

Sin 60

Sin $\pi/3$

$\sqrt{3/2}$

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Tetryonic Colour Code

A colour code is used to indicate the varying quantum levels of the numerous forms of mass-ENERGY-Matter and serves to illustrate relationships between various Physical properties.

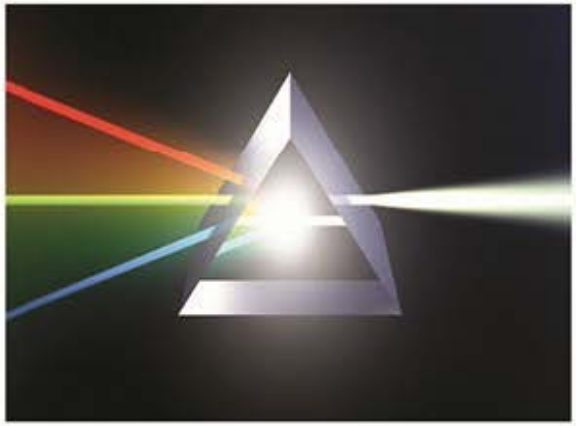

Tetryonics uses a colour code that is based on the spectral colours of dispersed White Light

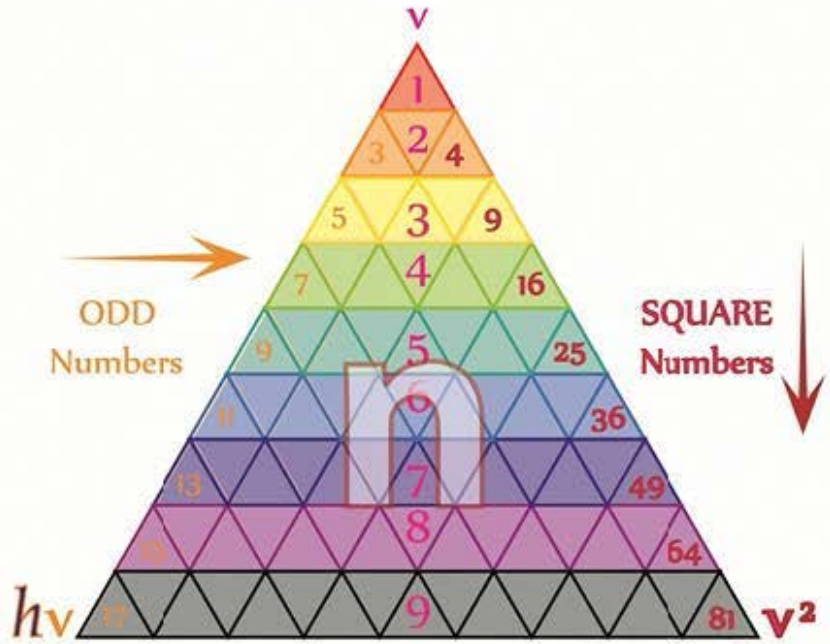

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Free Space

A contiguous volume or area
of any regular geometry
that is free, available, or unoccupied

$E = 0$
in any form

A Spatial region
is defined so as to
measure the physics
of mass-ENERGY-Matter
within its confines

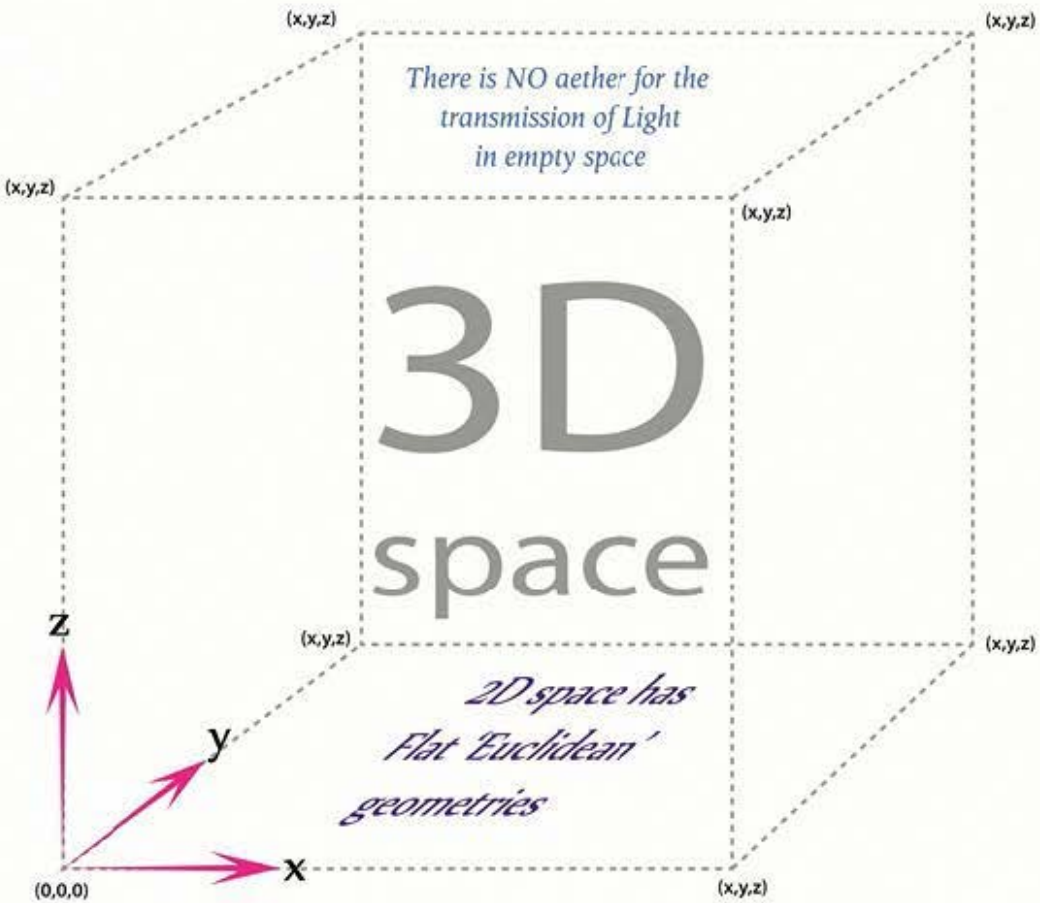

Energy moves through Space
in various forms:
radiant energies, Matter etc

Space can be
Cubic, Spherical or
Tetrahedral as defined by
the spatial co-ordinates
used to define the region

Empty Space is defined as a topology whose volume is devoid of Energy

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Space-Time co-ordinates

Vector forces

The linear vector of divergent Energy
forms various co-ordinate systems
based on its vector directions
per unit of Time

Euclidean
planar
space-time

c
299,792,458
linear metres
per sec

c^2
8.987551787 e16
radial square metres
per sec

Time in Physics is a measure
of how long it takes for light to
travel 299,792,458 metres
from its source in a vacuum

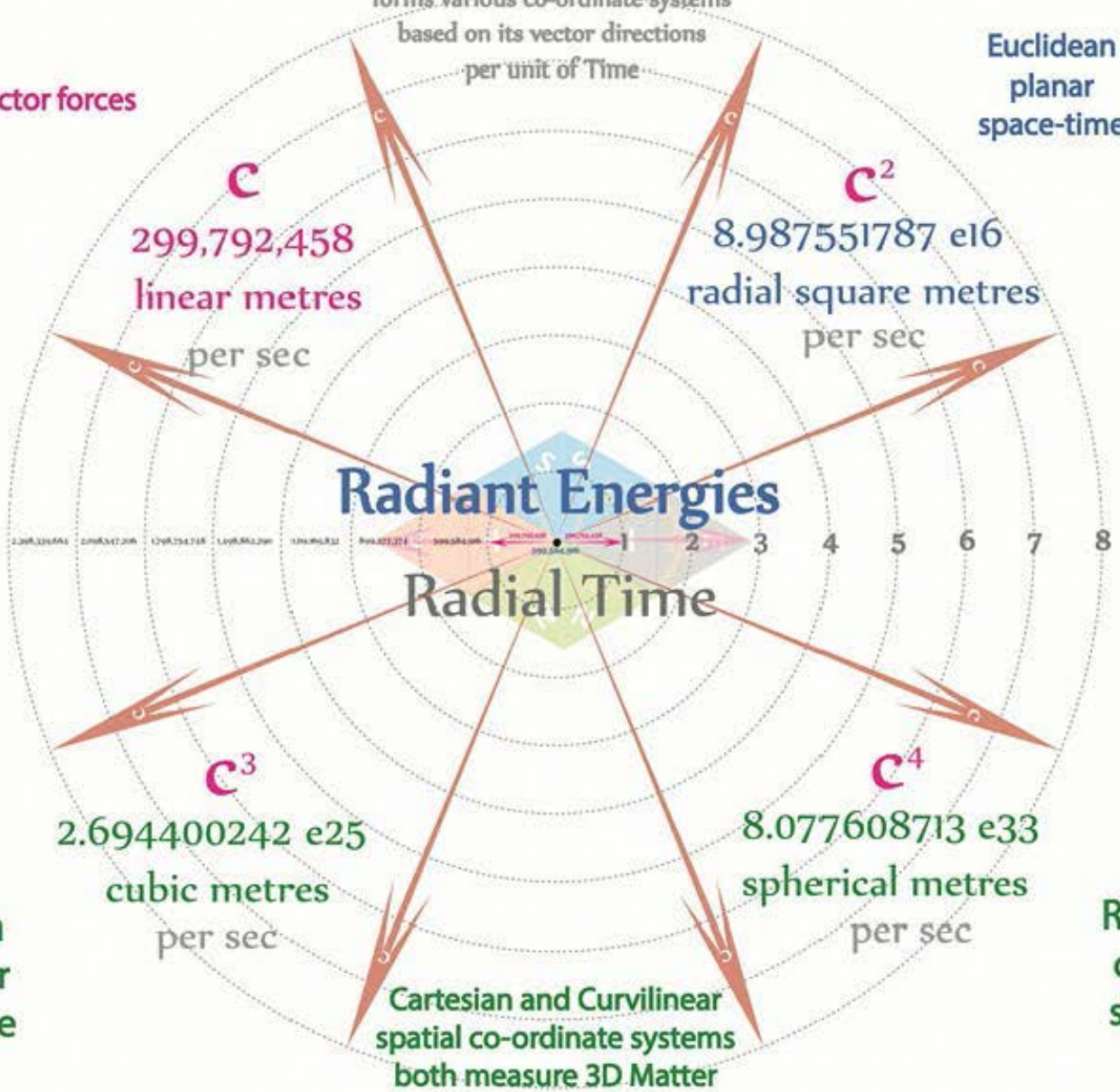

$$\frac{\text{metre}}{299{,}792{,}458 \text{ sec}}$$

A metre in Physics is
the distance light travels in
1/ 299,792,458 of a second
from its source

$$\frac{299{,}792{,}458 \text{ m}}{\text{second}}$$

c^3
2.694400242 e25
cubic metres
per sec

c^4
8.077608713 e33
spherical metres
per sec

Cartesian
rectilinear
space time

Cartesian and Curvilinear
spatial co-ordinate systems
both measure 3D Matter

Riemannian
curvilinear
space-time

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Spatial geometries

based on the vector speed of Light
form distinct spatial co-ordinate systems
for the measurement of physics

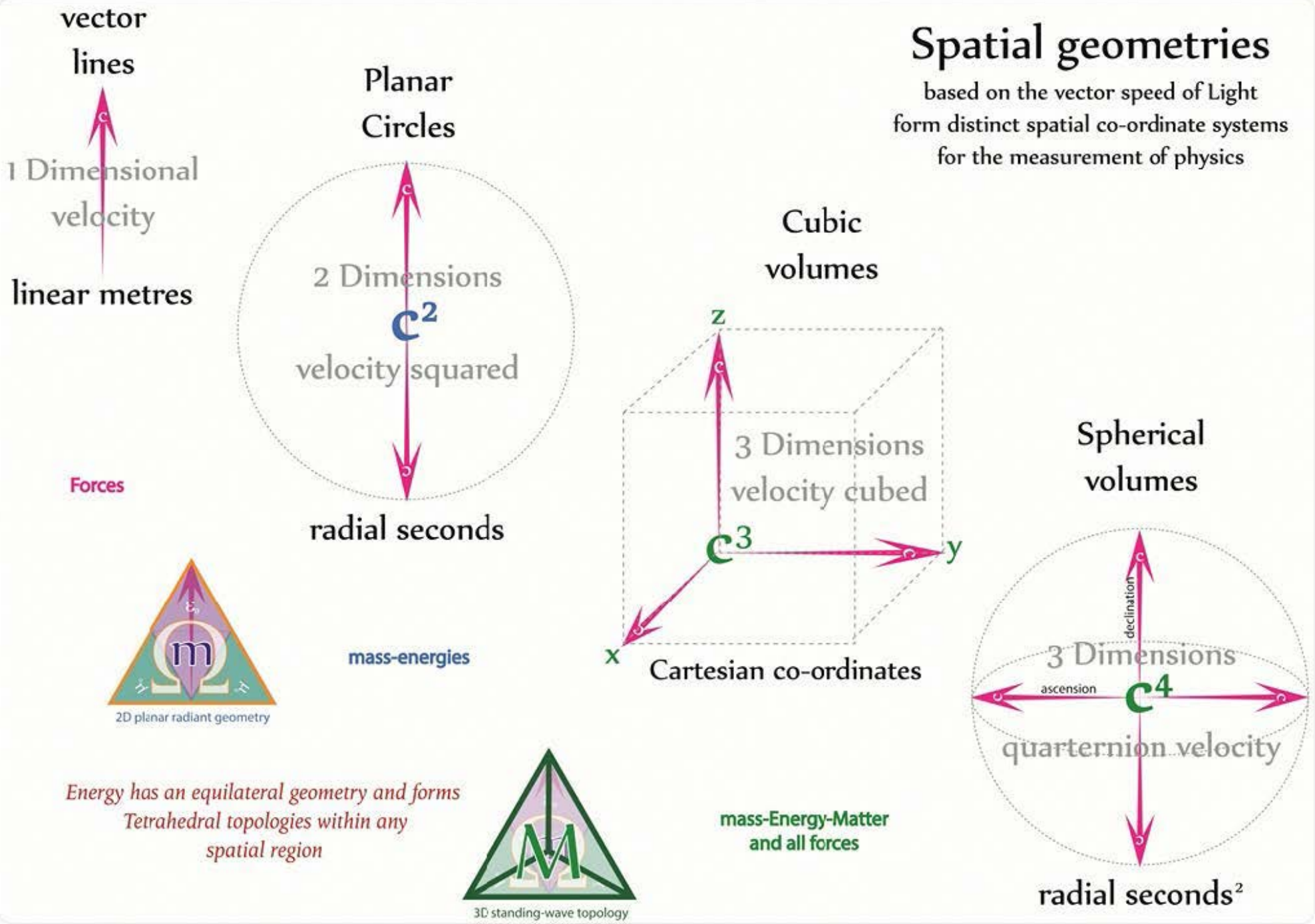

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c is the natural velocity of light

Energy has a 2D equilateral geometry [Euclidian]

Time - as a measure of divergent energies has a radial geometry

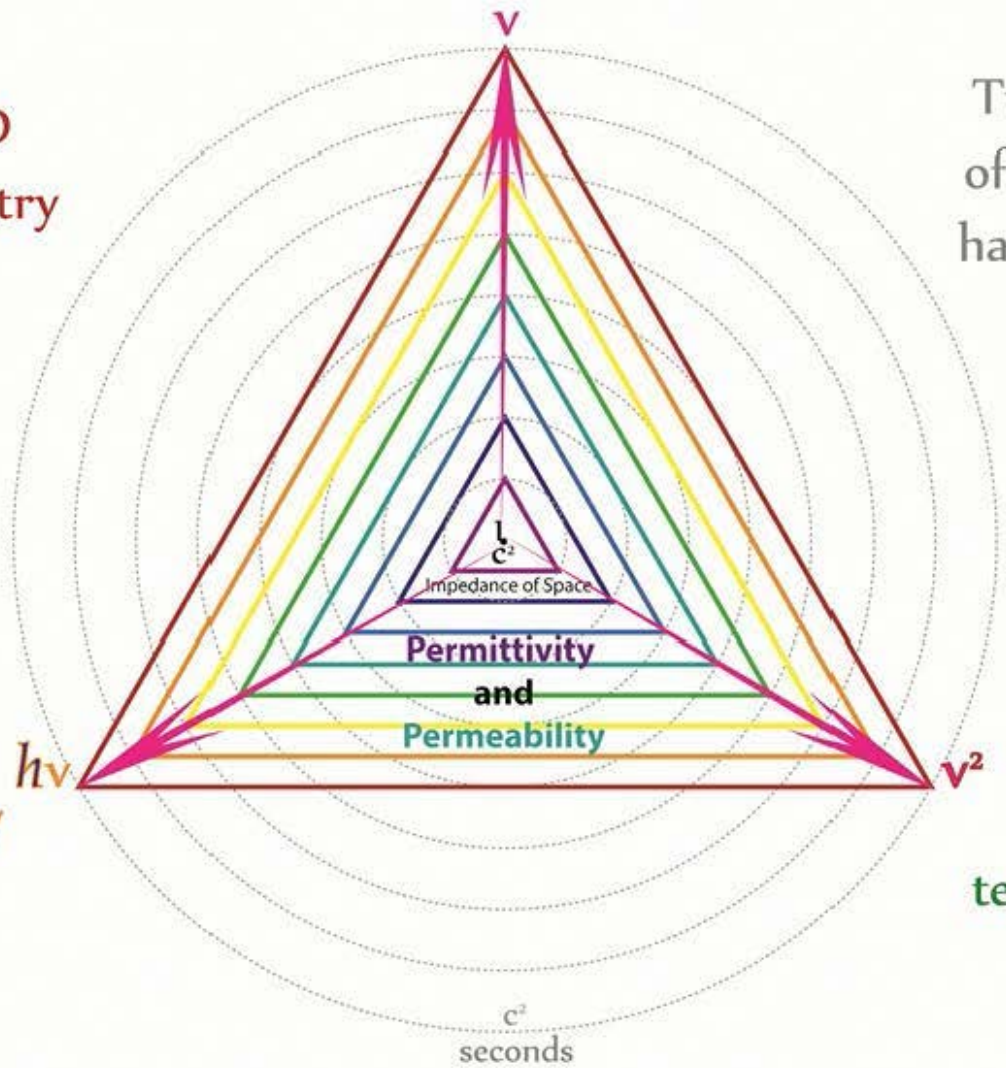

Equilateral geometry is the inverse of radial geometry

3D Matter has a tetrahedral mass-energy topology

The scalar spatial geometry of Energy

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Velocity

Velocity is the measurement of the rate and direction of change in the position of an object.

It is a vector physical quantity; both magnitude and direction are required to define it.

The absolute scalar value (magnitude) of velocity is speed, a quantity that is measured in metres per second (m/s or ms−1) when using the SI (metric) system.

$$\frac{m}{s}$$

Speed is the scalar value of the Distance traveled per unit of TIme

$$\bar{\mathbf{v}} = \frac{\Delta \mathbf{x}}{\Delta t}.$$

Velocity is the vector value of the Distance traveled per unit of Time

$$\frac{\vec{m}}{s}$$

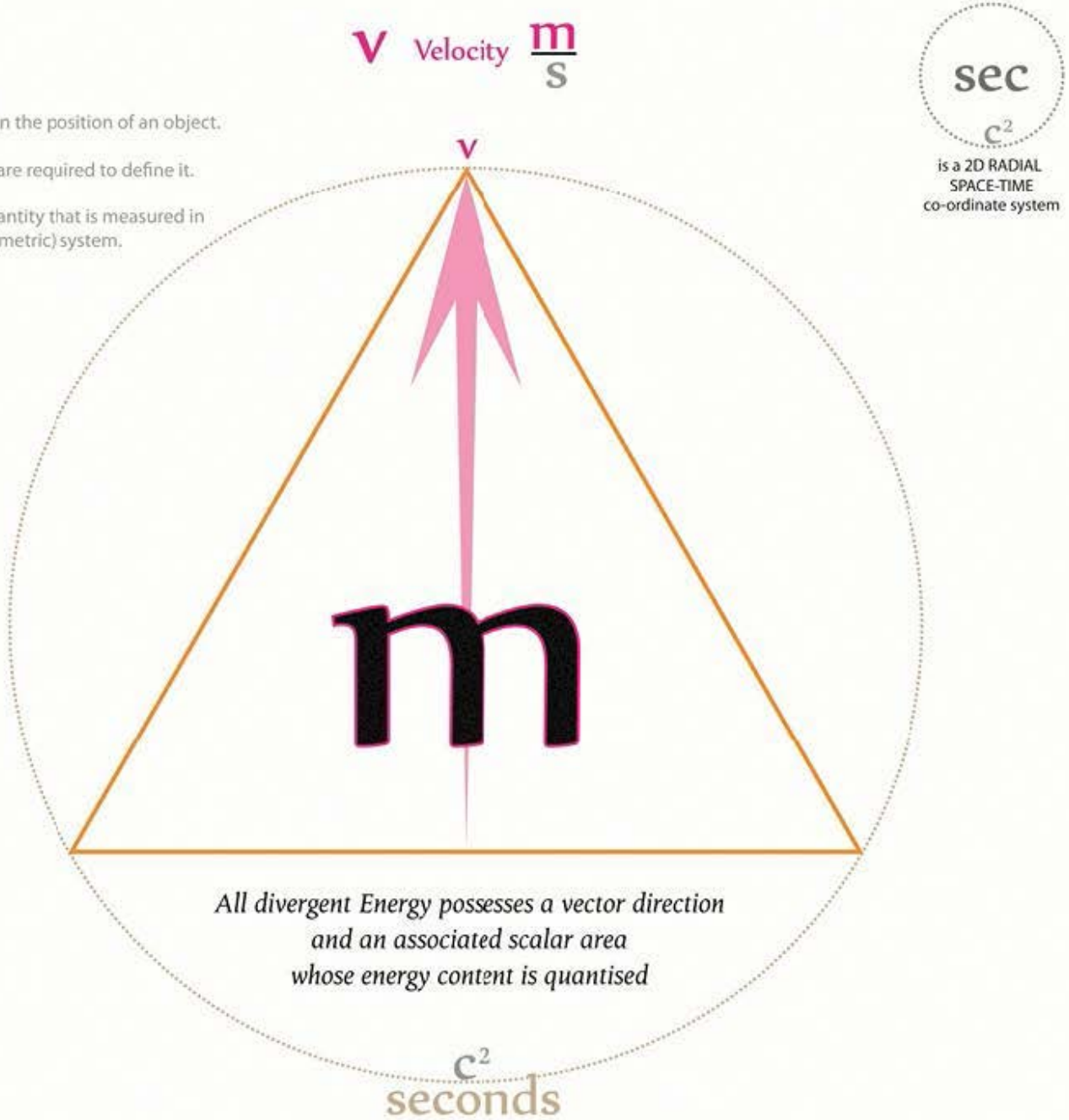

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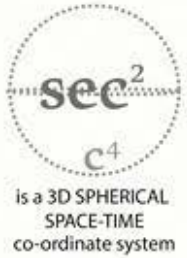

a acceleration $\frac{m}{s^2}$

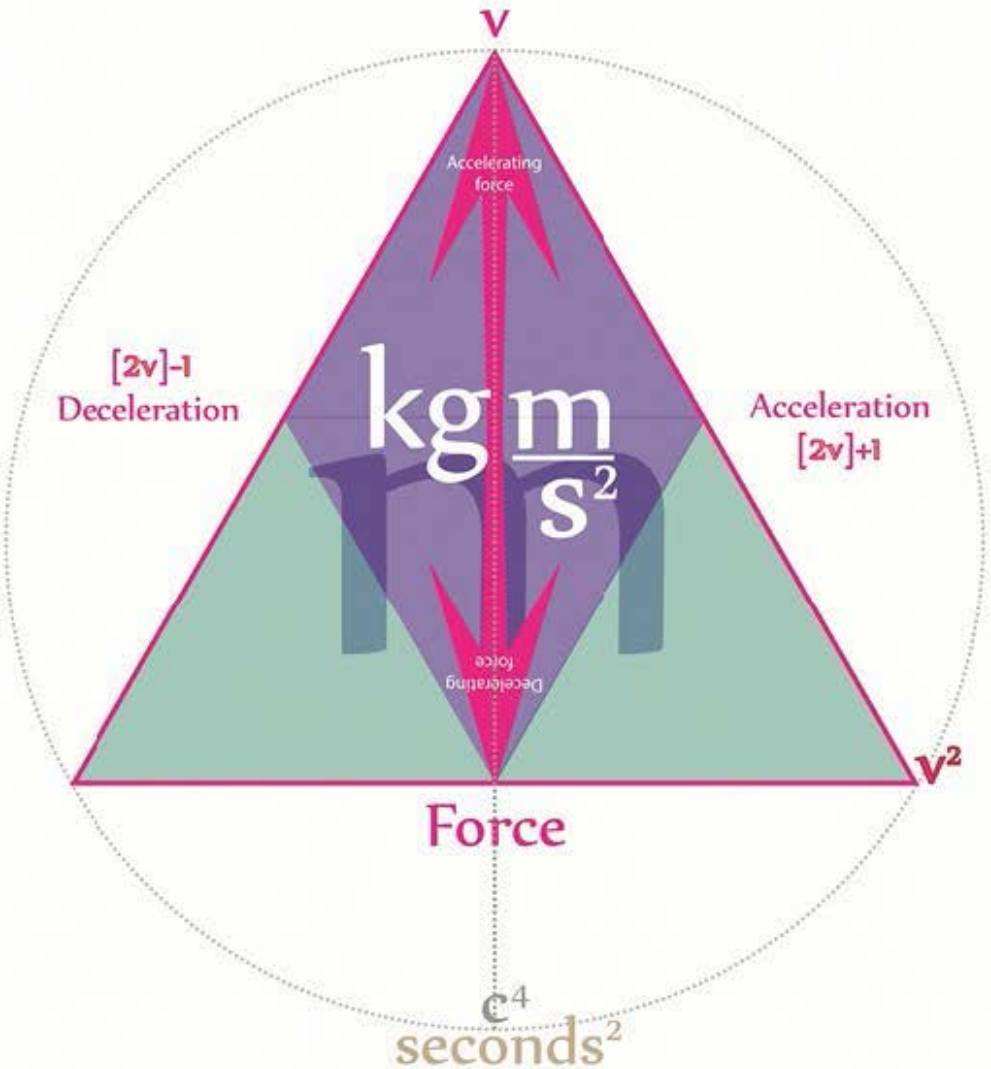

Acceleration

In physics, acceleration is the rate of change of velocity [dv] over time [dt]

In one dimension, acceleration is the rate at which something speeds up or slows down.

However, since velocity is a vector, acceleration describes the rate of change of both the magnitude and the direction of velocity.

Acceleration has the dimensions [Length]/[Time Squared]
In SI units, acceleration is measured in meters per second squared (m/s^2).

$$a = \frac{\Delta y}{\Delta x} = \frac{\Delta v}{\Delta t}.$$

In classical mechanics, for a body with constant mass,
the acceleration of the body is proportional to the net force acting on it
(Newton's second law)

$$F=ma \longrightarrow a=F/m$$

Force

$$kg\,\frac{m}{s^2}$$

Additionally, for a mass with constant velocity,
(ie in an inertial frame)
the energy of motion is expressed as its momentum
(acceleration causes changes in Energy-momentum)

$$p = kg\,\frac{m}{s}$$

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Quantised Angular momentum

As it is a physical [equilateral] geometry QAM is conservative in any system where there are no external Forces and serves as the foundational geometric source for all the conservation laws of physics

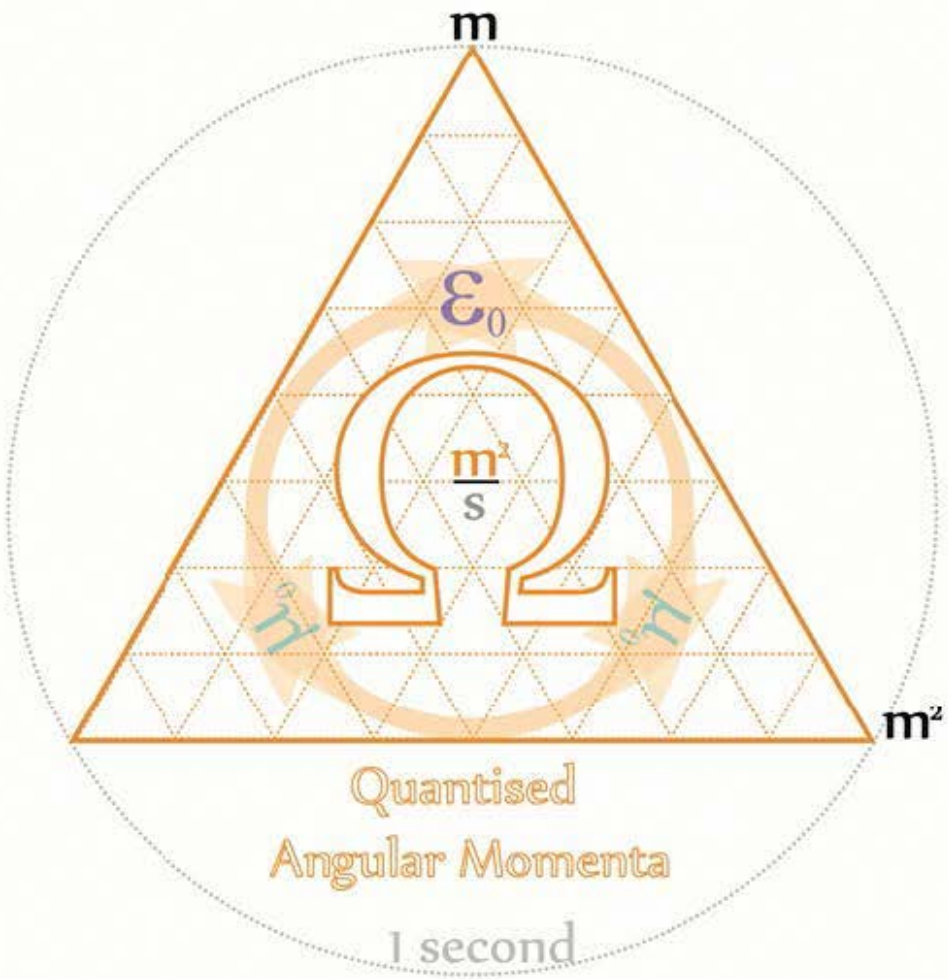

Conservation of Quantised Angular momenta

In QFT, angular momentum is is considered to be the rotational analog of linear momentum, in Tetryonics it is revealed to be the equilateral geometry of mass-energy within any defined spatial co-ordinate system

A major re-definition of quantised angular momenta in physics is revealed

classical rotational angular momenta

≈

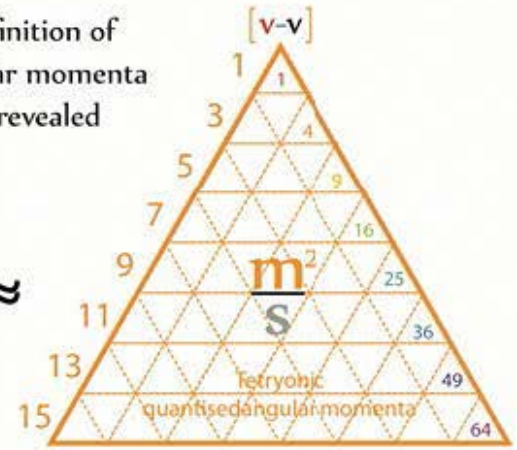

Tetryonic quantum mechanics

In quantum mechanics, angular momenta is quantised – that is, it cannot vary continuously, but only in ODD number "quantum steps" between the allowed SQUARE nuclear Energy levels

In physics, angular momentum, moment of momentum, or rotational momentum is a conserved vector quantity that can be used to describe the overall state of a physical system.

When applied to specific mass-energy-Matter systems QAM reveals the true quantum geometry and nature of Energy in our universe

h

$kg\frac{m^2}{s}$

$m\Omega$

mass x QAM

Planck's Constant

Normally viewed as an expression of rotational momentum Quantised Angular Momentum [QAM] is in fact a result of the equilateral geometric quantization of mass-energy

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mass - Energy geometry

Newton developed his Laws using Force
$p = mv$
(linear momentum)

Planck developed his Heat Law using quantised mass
$h = m\Omega$
(Planck Constant)

Gottfried Leibniz first described Scalar Energy as the square of velocity

Planck's equation for heat energy describes transverse masses [Bosons]

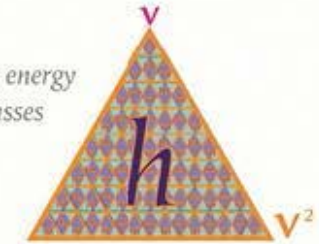

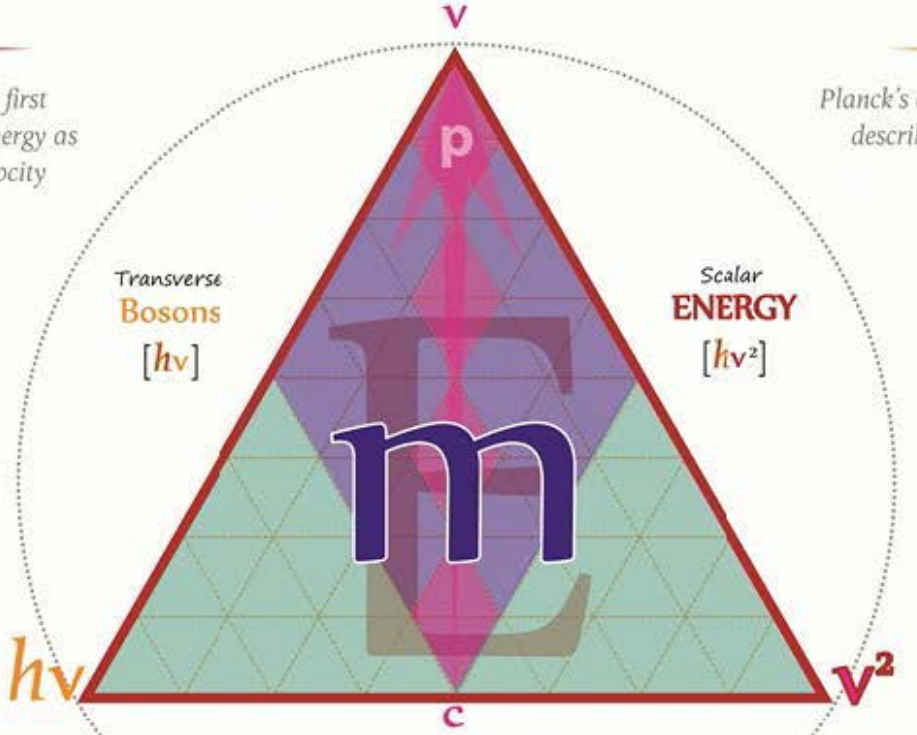

$$E = mv^2$$

Leibnitz mass-energy equivalence

$$E = nhv$$

Planck mass-energy equivalence

mass velocity squared

quantised mass per second

$$mv^2 = E = hv^2$$

Leibniz-Planck mass-Energy equivalence

$$kg\,\frac{m^2}{s^2}$$

Planck quanta per second

$$\left[kg\,\frac{m^2}{s}\,\frac{1}{s}\right]$$

scalar energies can be related to velocity-momenta through mass geometries

scalar

mv^2 Leibniz-Newton mass-Energy equivalence

quantised

$m\Omega v^2$ Tetryonic-Planck mass-Energy equivalence hv^2

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mass-Energy Forms

Scalar/Linear forms

mass x velocity squared

$$kg.\left[\frac{m}{s}\right]^2$$

Energy momentum

Leibniz [and Newton] showed that the Energy of a system can be viewed as a product of its mass x velocity squared or [equally as linear momentum squared], forever linking Energy to velocity through the scalar property of mass

$$mv^2 = E = p^2$$

Energy is the ability to do work in varying forms such as potential, kinetic, & mechanical energies, work, heat, and chemical or electrical energies.

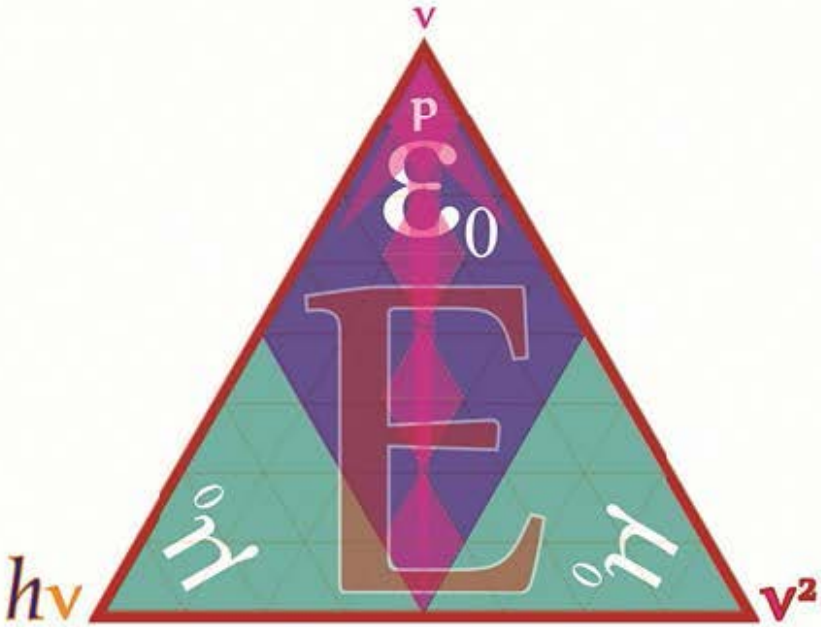

$$mv^2 = E = hv^2$$

The total energy contained in an object is identified with its EM mass, and Energy (like mass), cannot be created or destroyed

Tetryonic reveals mass to be a scalar measurement of quantised [equilateral] energy per unit of Time

$$m[\Omega]v^2$$

Energy is subject to the law of conservation

Quantised form

Planck quanta per second

$$\left[kg.\frac{m^2}{s}\right].s^{-1}$$

mass-Energy quanta

Max Planck reveealed that energy was not continuous, it was quantized – only certain energies are allowed. Continuous energy is a scalar propertyo of mass-energy and its quantisation is the result of its equilateral geometry

$$E = hv^2$$

In quantum mechanics energy is defined in terms of the energy operator as a time derivative of the wave function

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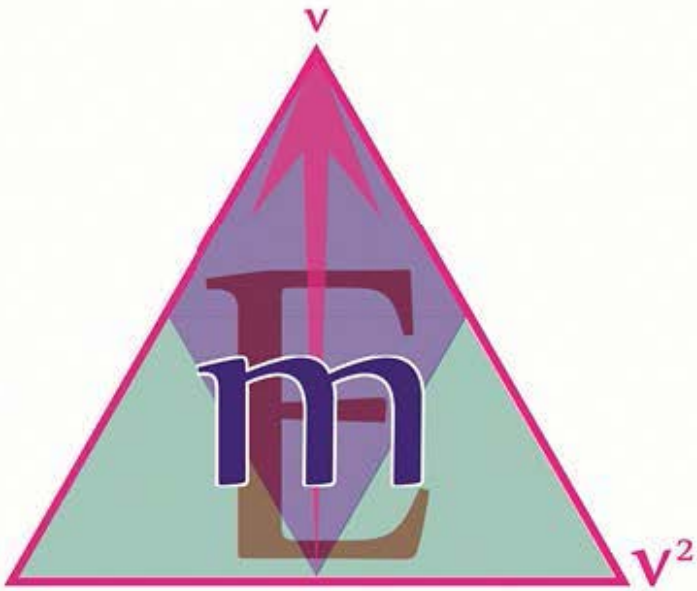

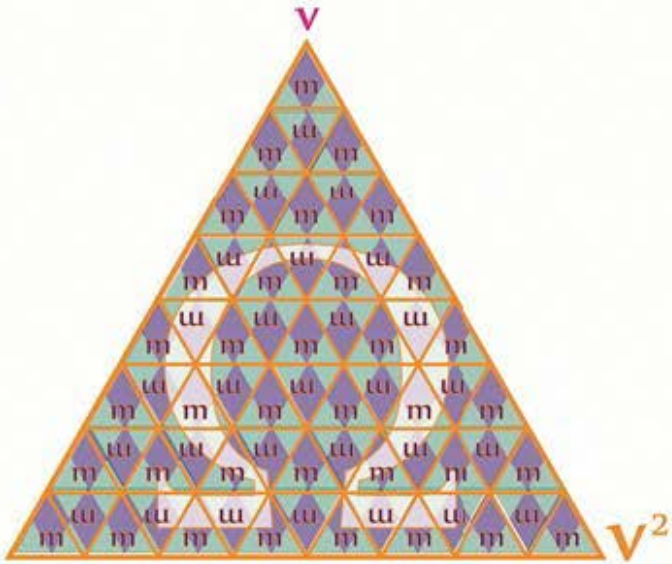

Energy is mass-velocity squared

Everything in our Universe results from the equilateral geometry of quantised mass-energies

Energy is Planck-quanta squared

$$E = mv^2$$

$$E = hv^2$$

Quantised Energy

scalar mass

kg

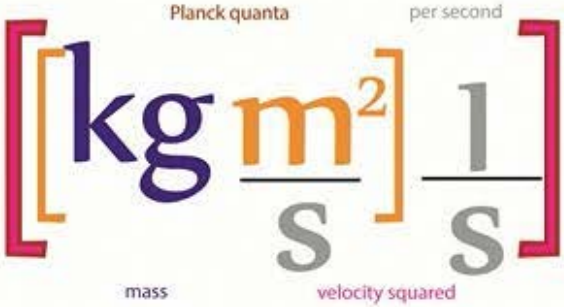

quantised mass

$$kg\,\frac{m^2}{s}$$

$$m = \frac{E}{v^2}$$

Scalar Energy

$$h = \frac{E}{v^2}$$

Note: There is a direct correspondence between Velocity and Planck quanta numbers (ie as velocity varies, the energy quanta varies as well by the square of the linear change)

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Linear Momentum

p Momentum $kg\frac{m}{s}$

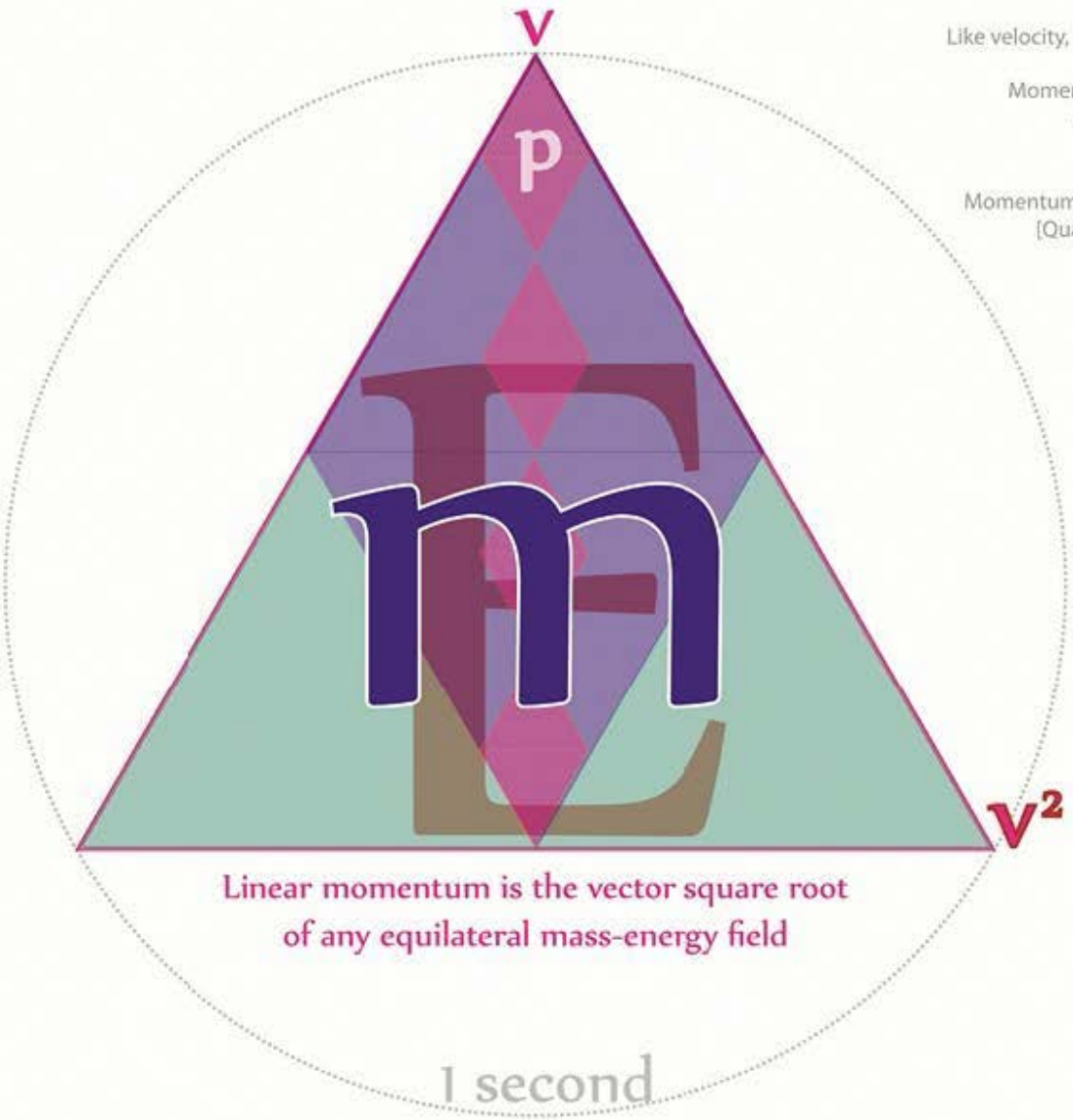

Linear momentum is the vector square root of any equilateral mass-energy field

In classical mechanics, momentum (pl. momenta; SI unit kg·m/s, or, equivalently, N·s) is the product of the mass and velocity of an object (p).

Like velocity, momentum is a vector quantity, possessing a direction as well as a magnitude.

Momentum is a conserved quantity (law of conservation of linear momentum), meaning that if a closed system is not affected by external forces, its total momentum cannot change.

Momentum should be referred to in its specific forms to distinguish it in its various forms [Quantised Angular, Linear, Rotational and quantum/nuclear momentum]

$$p = \frac{hv^2}{v} = mv$$

Although originally expressed in Newton's Second Law, the conservation of momentum also holds in special relativity and, with appropriate definitions, a (generalized) momentum conservation law holds in electrodynamics, quantum mechanics, quantum field theory, and general relativity.

In relativistic mechanics, non-relativistic momentum is further multiplied by the Lorentz factor.

$$p^2 = E = mv^2$$

Energy can be expressed as the square of linear momentum

$$kg\frac{m^2}{s^2}$$

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Ω

Just as Tetyonic geometry distingushes between angular momenta and linear momentum it also distingushes between linear momentum and the vector velocities it produces

p

Linear Momentum

$p = mv$

Velocity

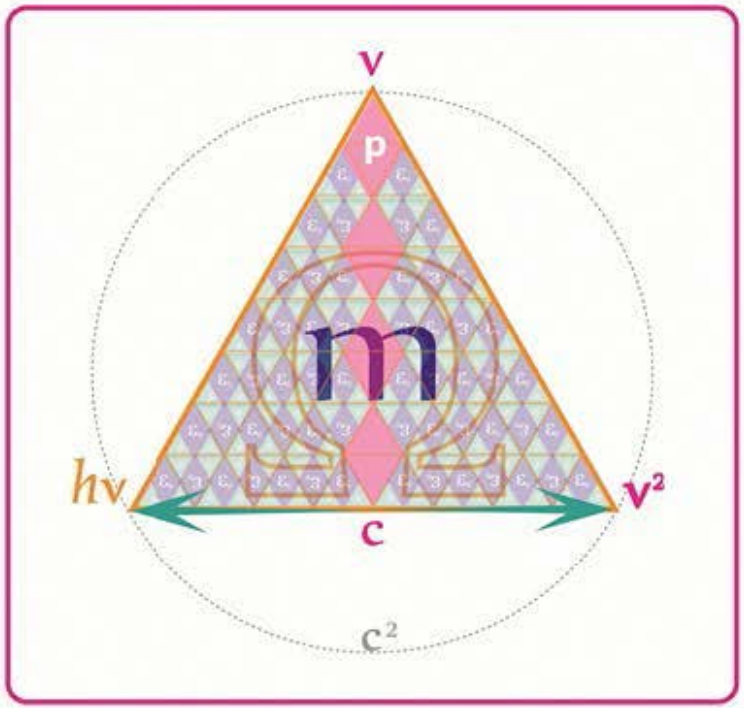

$E = pv$

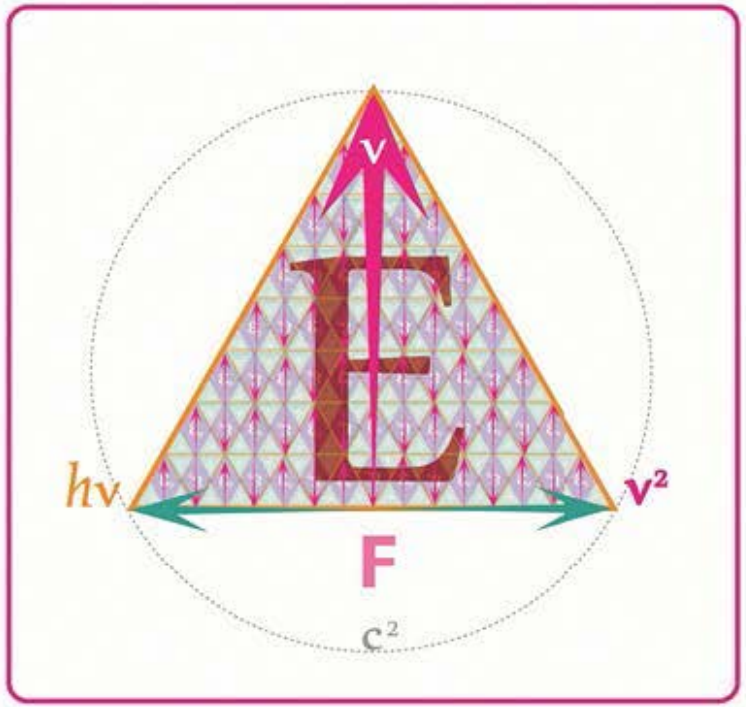

$E = p^2$

SCALAR square root

Scalars are quantities that are fully described by only their magnitude

$E = mv^2$

VECTOR square root

Vectors fully describe both the magnitude and direction.

p

linear momentum is a scalar component of all equilateral mass-energies that produce vector velocities

v

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Velocity-Quanta equivalence

Classically, the Energy of massive bodies was determined using the Newtonian mass-velocity relationship

but most recently Quantum mechanics was developed utilising the Planck's quantised Energy relationship

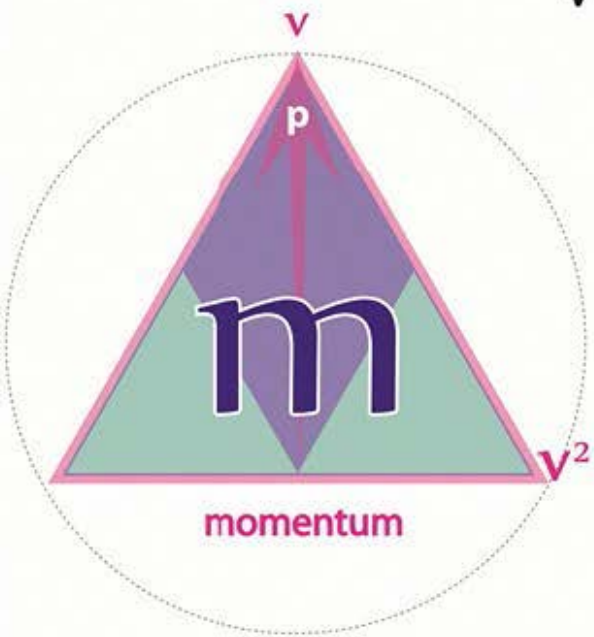

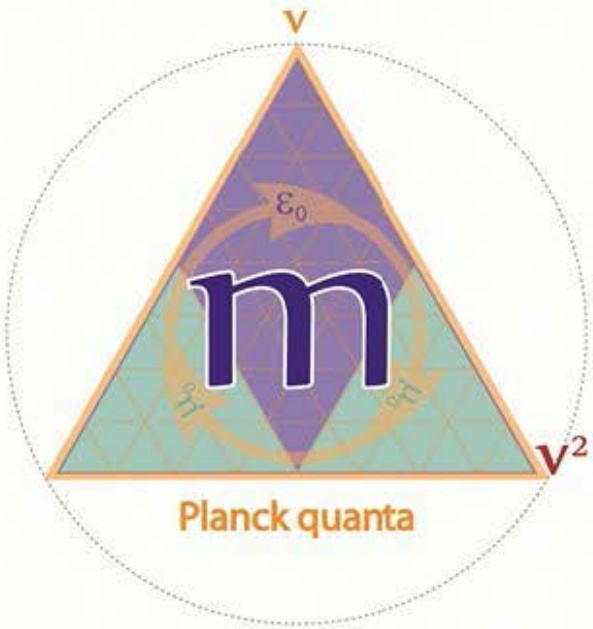

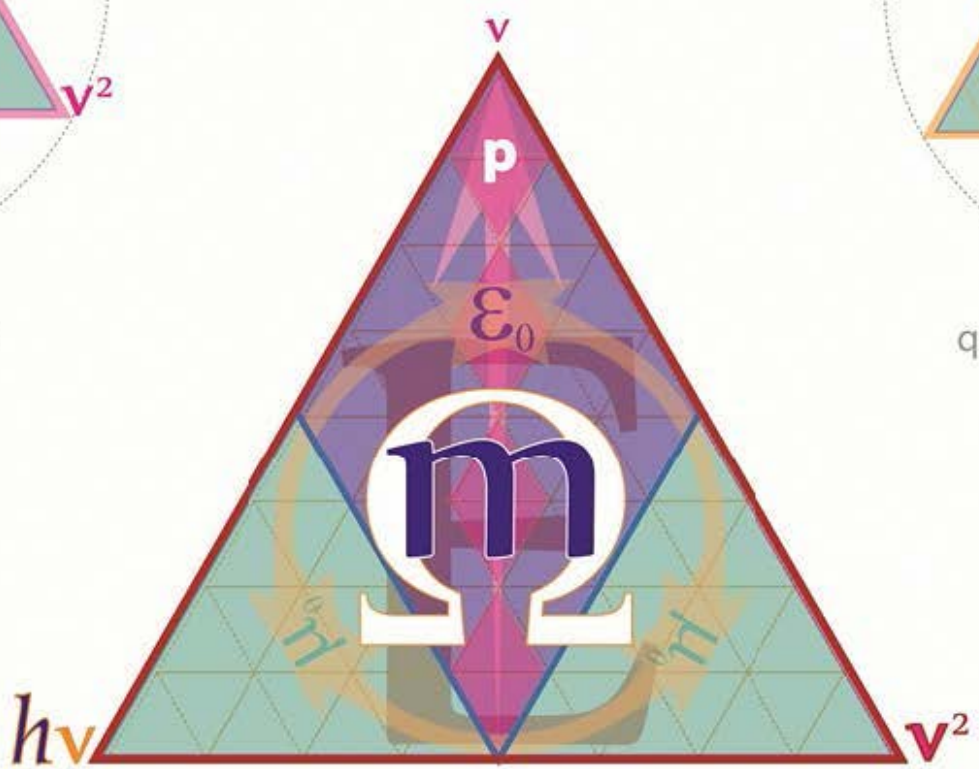

classical vector force

$$mv^2$$

mass
linear velocity
squared

$$kg\left[\frac{m}{s}\right]^2$$

quantised energy momenta

$$hv^2$$

mass
angular momenta
per second

$$kg\left[\frac{m^2}{s}\frac{1}{s}\right]$$

The EM mass-Energy relationship can be revealed either by linear or angular momentum analysis

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Energy-momentum relationship

The total number of Planck quanta [mass-angular momenta] in any physical system is directly related to the square of its linear momentum [mass-velocity]

$$h = \frac{E}{v^2}$$

$$m = \frac{E}{v^2}$$

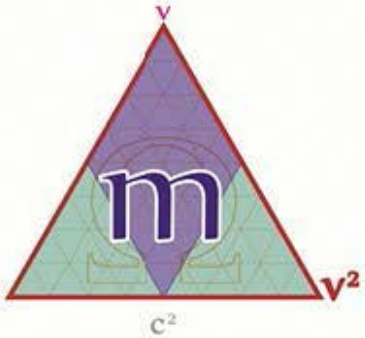

Quantised Energy-momentum

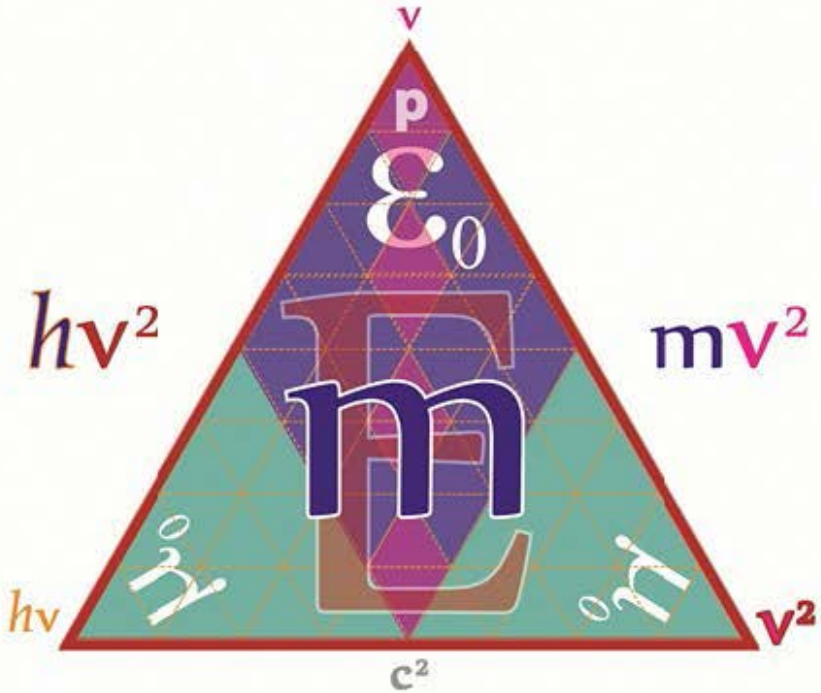

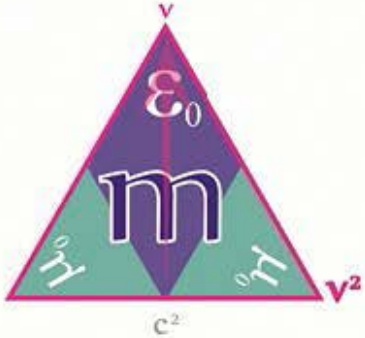

Linear Energy-momentum

mass-energy momenta

$$E = m\Omega v^2$$

Quantised Angular Momenta is an equilateral geometry

The omega geometry of Energy produces the direct relationships between Planck's constant-quanta and mass-Energy-momentum of any spatio-temporal co-ordinate system

$$E = pc$$

Linear momentum is a vector Force

$$m\Omega v^2 = E = mv^2$$

mass is a derived physical property relating Energy momenta to Velocity

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CHARGE

Charge is a measure of mass.QAM/second
[the equilateral geometry of Energy]
that gives form to all physics

ElectroMagnetic Charge
is a quantum property
resulting from the equilateral
QAM geometry of mass-Energy

The two ElectroMagnetic charge
geometries possible can be modelled
by the flux of electrical energy
in ideal inductive loops

It is a measure of the arrangment of Planck quanta
geometries/topologies within any specific
space-time co-ordinate system

Clockwise inductive
energy flux

q

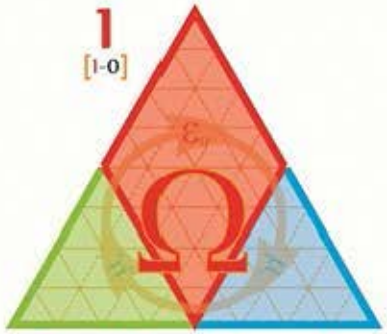

Positive charged
mass-energy momenta

$$\frac{hv}{c^2}$$

$$kg\,\frac{m^2}{s}\,\frac{s^2}{m^2}$$

$$kg.s$$

1.33518 e-20 s

Counter clockwise
energy flux

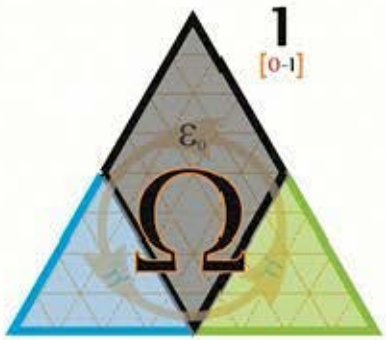

q

Negative charged
mass-energy momenta

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Measuring charge geometries

Charge comes in two types, called Negative and Positive
which create the Law of Interaction (historically, the Law of Attraction)

q

quantised Charge

[v] [v]

Q

nett Charge

[v–v]

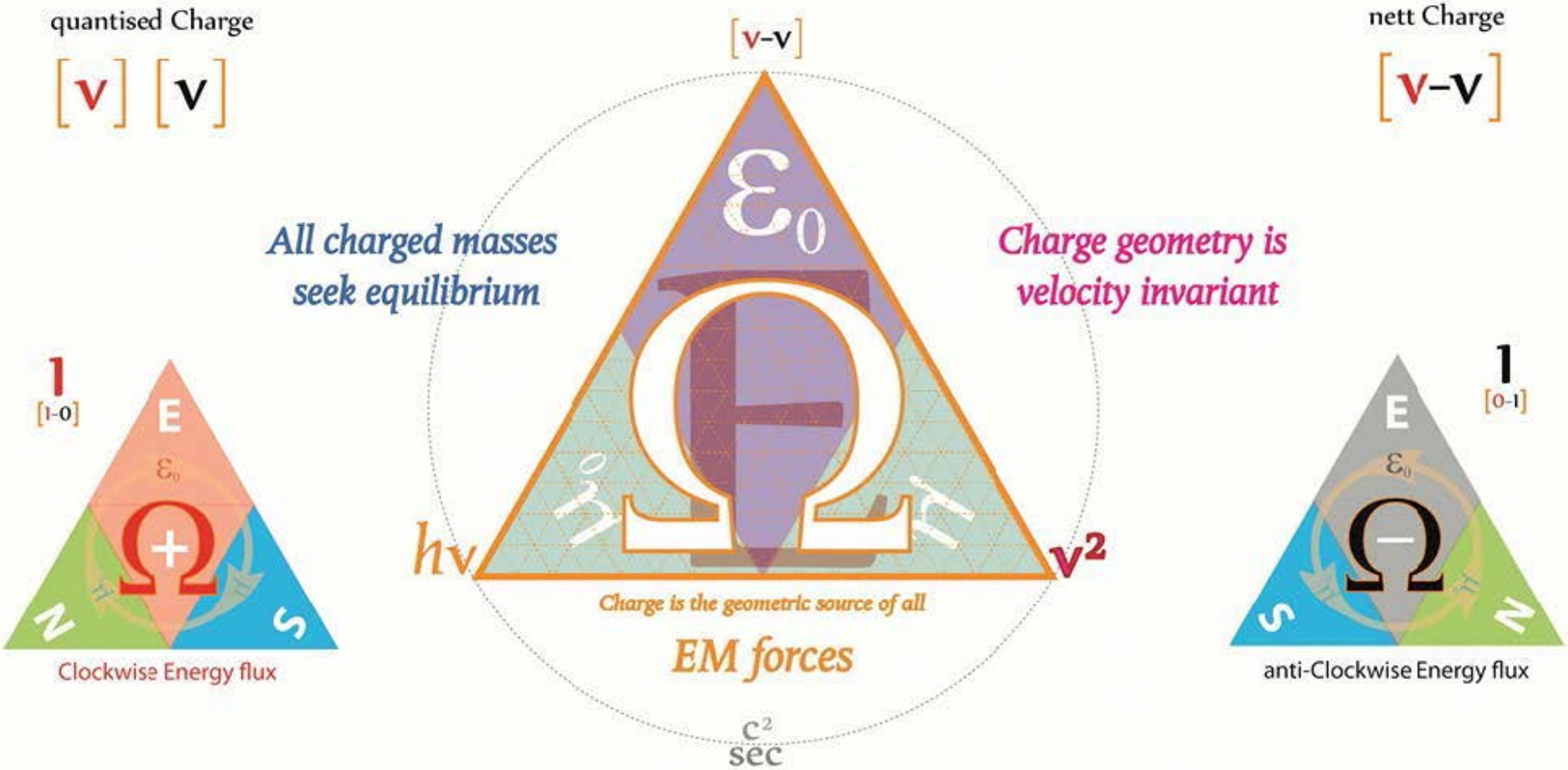

Historically defined as a physical property of mass-Matter that causes it to experience a force
charge is actually the result of the equilateral geometry of qantised mass angular momenta
which provides the physical mechanics of mass-ENERGY-Matter differentiation and interaction

The SI unit of quantity of charge is the Coulomb, $C \approx \text{mass seconds} \approx kg.s$ which can also be expressed as Amp-seconds

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EM Field Geometry

mass-energies are 2D radiant EM field geometries

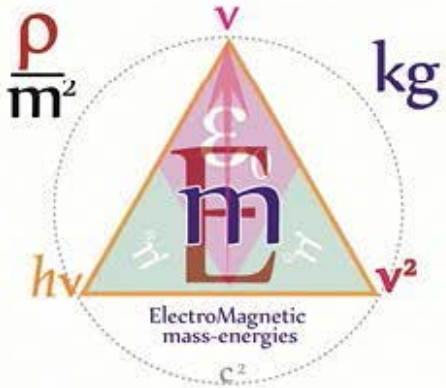

All Matter are 3D EM standing wave topologies

[299,792,458 m/s]

'c' forms a CONSTANT of proportionality for different spatio-temporal co-ordinate systems used to measure mass-ENERGY-Matter

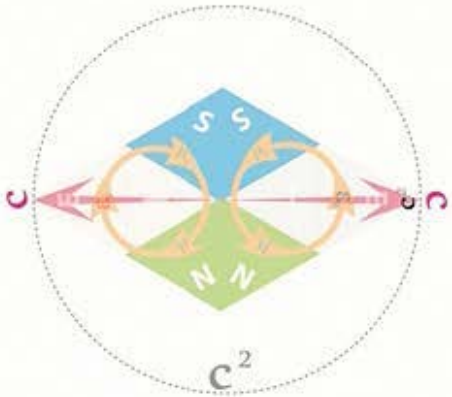

EM fields create 'interaction-at-a-distance'

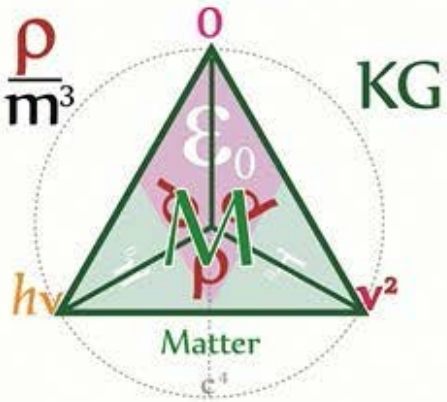

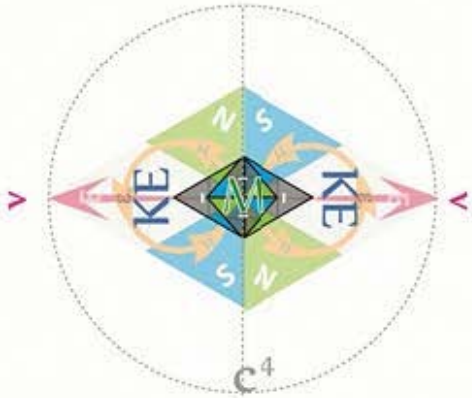

Electrostatic Matter has opposing 2D KEM fields

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Energy quantisation

All mass-Energy-Matter can only have certain integer Energy-momenta,
[mass-Energy in all its forms is QUANTISED]

q

Net quanitised angular momenta
[inductive energy flux]
determines Charge

$m\left[\frac{\Omega}{c^2}\right]$

$kg\,\frac{m^2}{s}.\frac{s^2}{m^2}$

seconds

Transverse quanta
create Quantum Levels

The equilateral geometry of
quantised angular momentum
creates charged masses

Planck's Constant is in fact
mass x equilateral QAM

$kg.\frac{m^2}{s}$

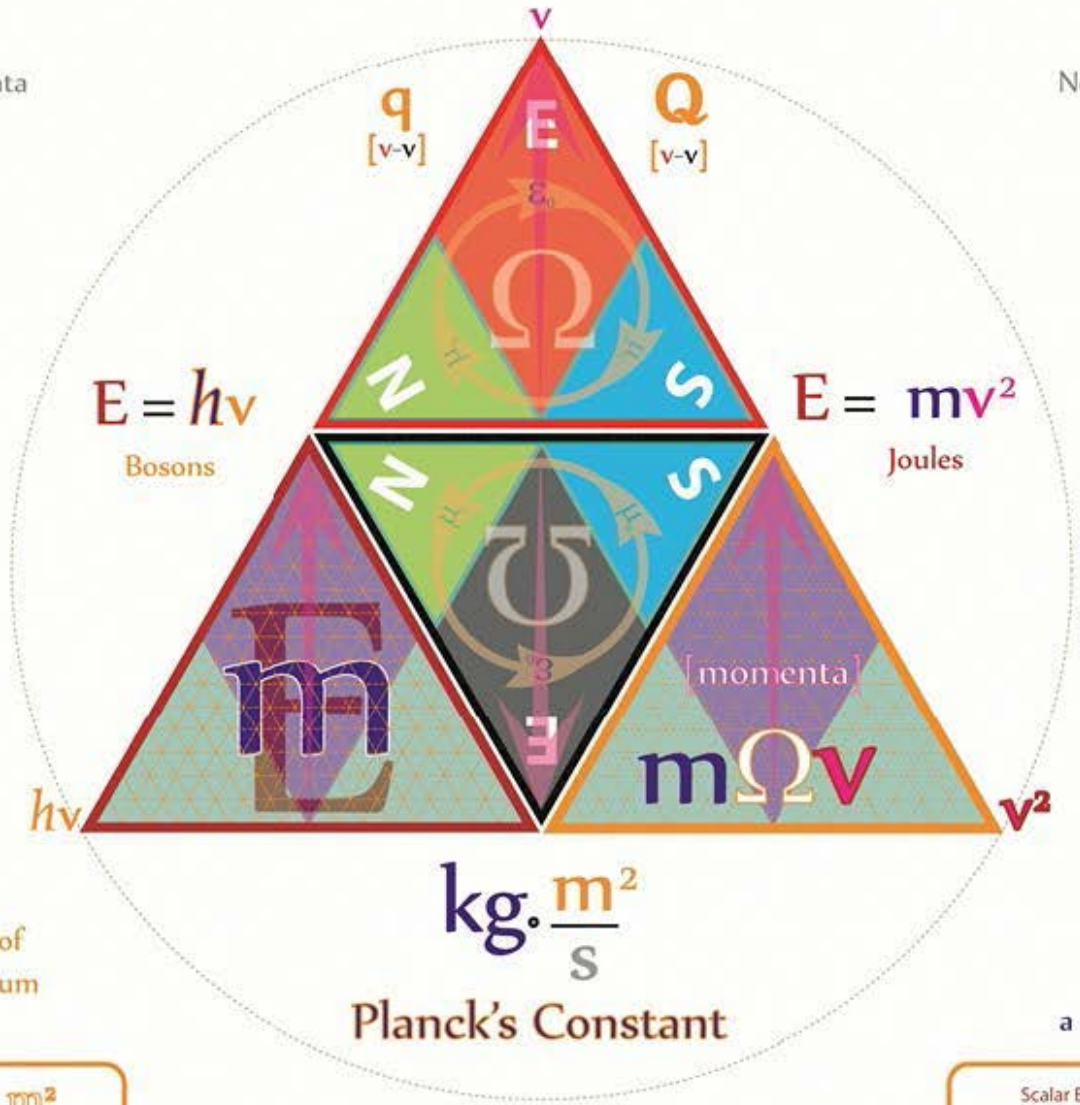

n.Planck quanta per second is Energy

q

Net quanitised angular momenta
[inductive energy flux]
determines Charge

$m\left[\frac{\Omega}{c^2}\right]$

$kg\,\frac{m^2}{s}.\frac{s^2}{m^2}$

seconds

Scalar (nett) quanta
create Square Energies

Planck's Constant
can be described in
a number of differing ways

Scalar Energy x Time $kg.\frac{m^2}{s^2}.s$

Linear momentum x Distance $kg.\frac{m}{s}.m$

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Tetryonic Mnemonics

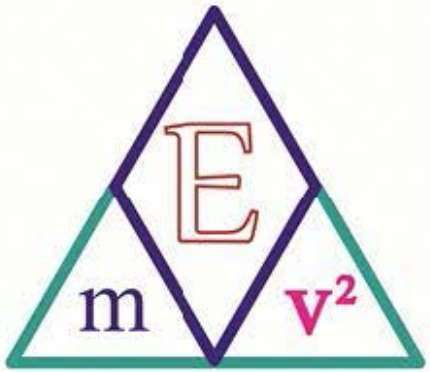

Energy momentum

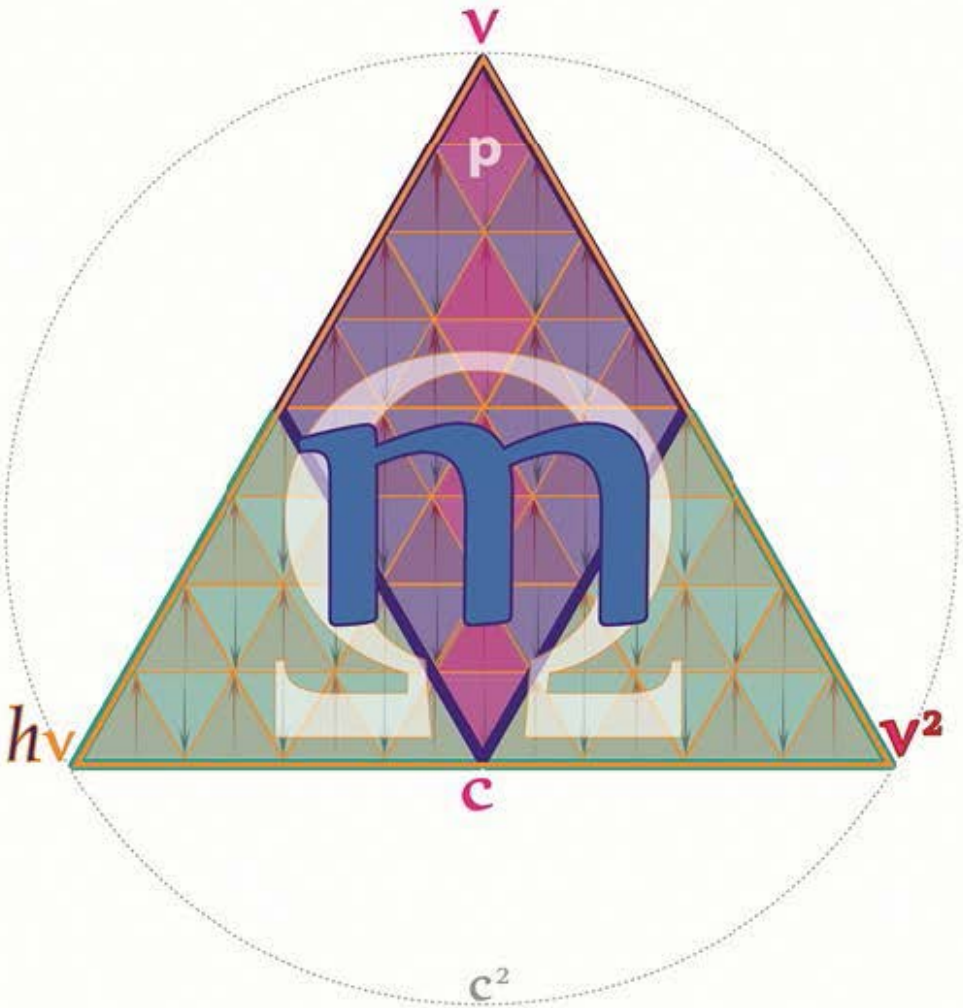

Electrical flow

velocity of propagation

Many physical relationships are can be represented with DELTA mnemonics

Inertial Force

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UNITS OF PHYSICS

λ	Wavelength	m	$\frac{1}{s}$	Frequency	f
v	Velocity	$\frac{m}{s}$	$\frac{m}{s^2}$	Acceleration	a
Ω	Quantised Angular Momentum	$\frac{m^2}{s}$	$kg\frac{m^2}{s}$	Planck's Constant	h
$\frac{1}{c^2}$	2D radiant mass-energies	$\frac{s^2}{m^2}$	$\frac{s^4}{m^4}$	3D standing-wave mass-Matter	$\frac{1}{c^4}$
As			$\frac{C}{s}$		
C	Coulombs	kg s	KG	Amperes	A
ε_0	Electric Constant	$\frac{F}{m}$	$\frac{H}{m}$	Magnetic Constant	μ_0
p	Momentum	$kg\frac{m}{s}$	$kg\frac{m}{s^2}$	Force	F
m	*mass-energy geometries*	kg	KG	*mass-Matter topologies*	M

mass

Matter

$N\frac{m^2}{C^2}$

Coloumb's Constant

k

c^2 c^4 v p E hv v^2 s s^2

Energy momenta

space

time

G

Newton's Constant

$N\frac{m^2}{KG^2}$

Physics is filled with numerous units of measurement comprised of various inter-related components of physical measurement

Tetryonic geometry offers a complete geometric understanding of physical terms such as Charge, mass geometries, Energy densities, Matter topologies and spatial impedance along with their roles in physical mechanics

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Scalar mass-energies

have an EQUILATERAL geometry
(60°- 60°- 60°)

$\frac{\sqrt{3}}{2}$ **s**

The Area of an Equilateral triangle

½ base x height

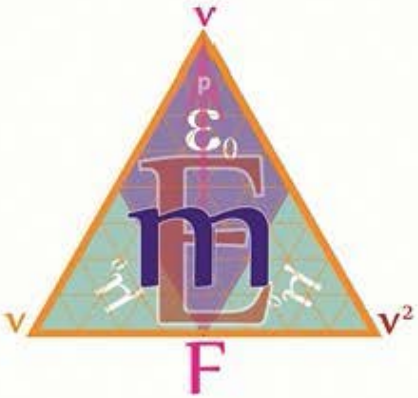

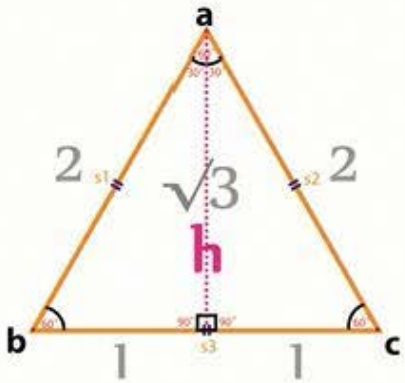

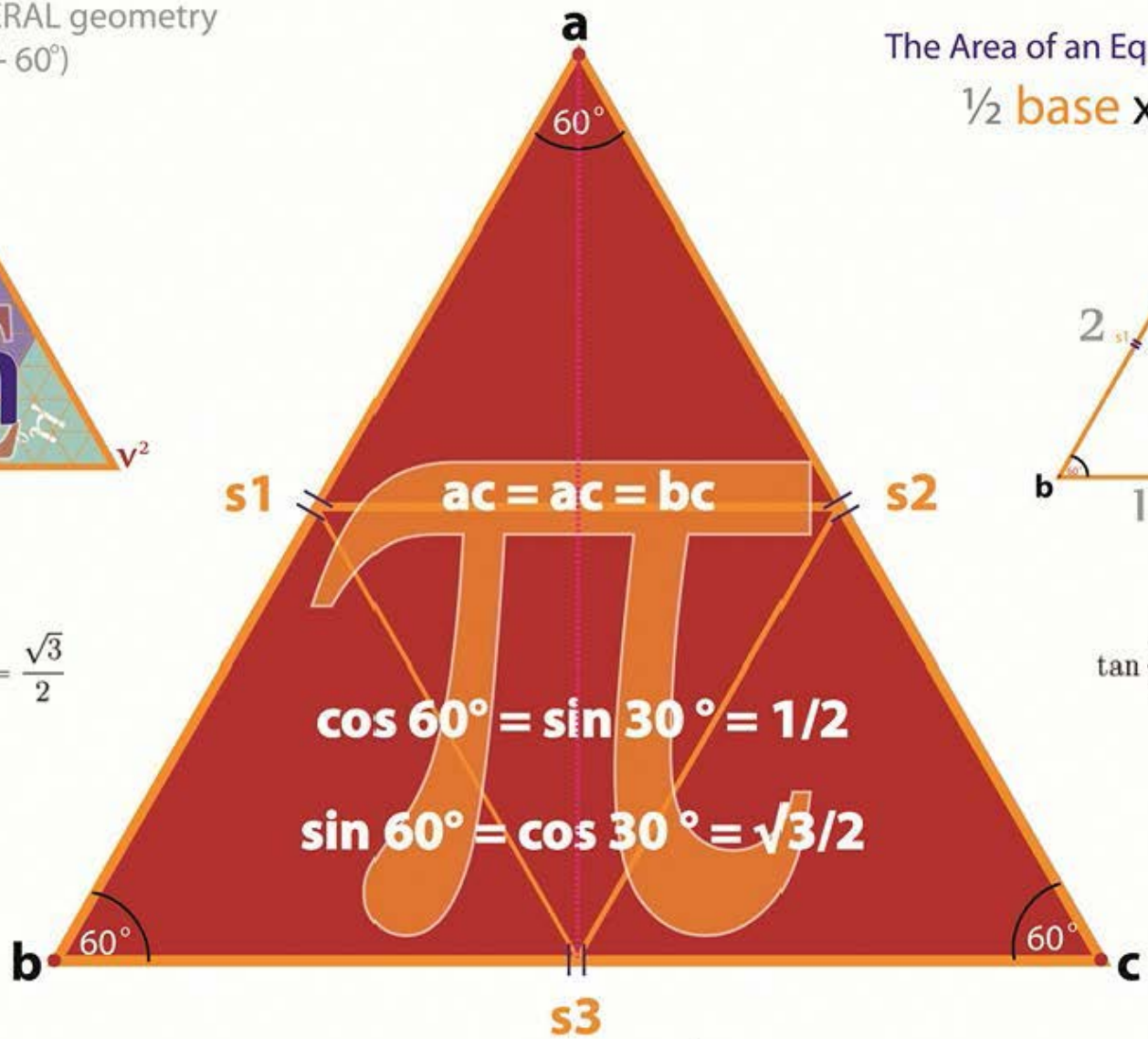

$$\sin\frac{\pi}{3} = \sin 60^\circ = \frac{\sqrt{3}}{2}$$

$$\tan\frac{\pi}{3} = \tan 60^\circ = \sqrt{3}$$

$$\cos\frac{\pi}{3} = \cos 60^\circ = \frac{1}{2}$$

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Pythagorian geometry

Energy geometries within Physics including Special Relativity and Lorentz corrections have historically been incorrectly illustrated as having the geometry of right angled triangles

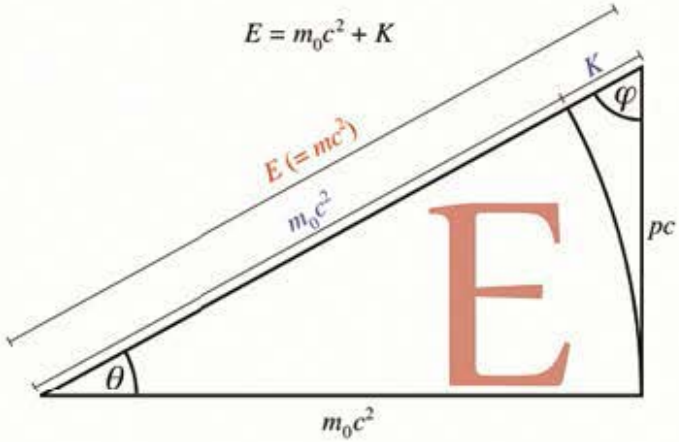

$$E^2 = p^2c^2 + m_0^2c^4$$

Generalizing, we see that the square of the total mass-energies is the sum of the components squared.
[shown incorrectly formulated in this above equation]

We can see an origin of distance in spacetime relating to velocity in pc in which Energy is subject to Lorentz corrections [v/c]

$$E = pc.$$

Additionally, EM mass can be directly related to the energy content of a body by the velocity of Energy

$$E = mc^2$$

Physics is geometry,
one cannot be separated from the other

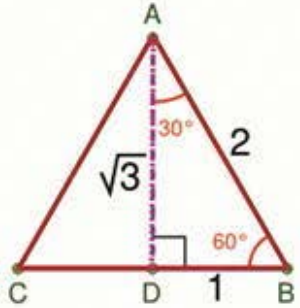

$$mv^2 = E = hv^2$$

There are three ways to look at geometry
– mathematically, verbally, and visually,

Of the three, Visually will be shown to be superior leading to intuitive understandings of Physics, Chemistry, Electrodynamics and Gravitation along with all their related physical attributes

6.629432672 e-34 J

Planck quanta

$$[m\Omega v]^2$$

mass velocity

7.376238634 e-51 kg

$$mv = p$$

Tetryonic geometry

The source of all the physical relationships of mass-Energy momenta & their constants is the geometry of equilateral Planck Triangles (and all texts must be corrected)

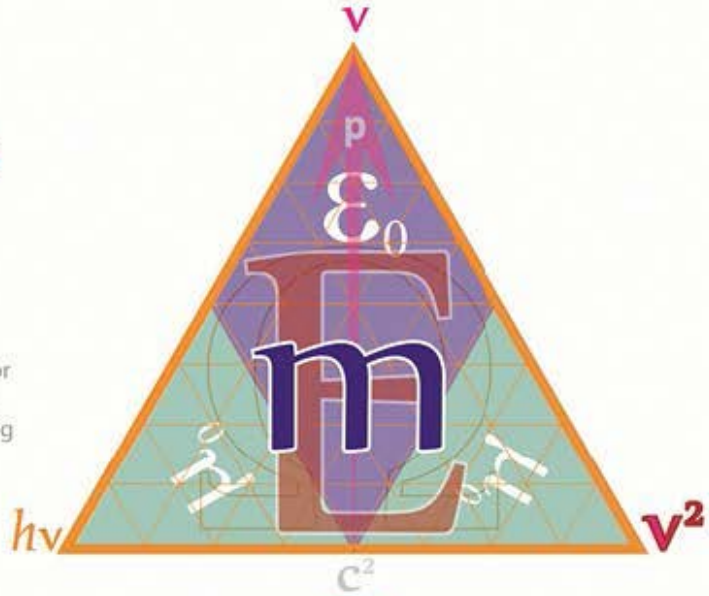

F

$$\sum \mathbf{F} = \frac{d\mathbf{P}}{dt} = m\frac{d\mathbf{v}}{dt} = m\mathbf{a}$$

Newton's Second law of Motion
is based on changes to linear momentum

$$\mathbf{F} = m\mathbf{a}\,.$$

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Tetryonics and Pi radians

Although not historically considered a physical constant, π appears routinely in equations describing fundamental principles of the Universe, due in no small part to its relationship to the nature of the circle and, correspondingly, spherical coordinate systems.

The quantised equilateral geometry of mass-energy momenta is measured in π radians

Using units such as Planck units can sometimes eliminate π from formulae.

Heisenberg's uncertainty principle, which shows that the uncertainty in the measurement of a particle's position (Δx) and momentum (Δp) can not both be arbitrarily small at the same time:

$$\Delta x \, \Delta p \geq \frac{h}{4\pi} = \frac{\hbar}{2}$$

Einstein's field equation of general relativity:

$$R_{ik} - \frac{g_{ik} R}{2} + \Lambda g_{ik} = \frac{8\pi G}{c^4} T_{ik}$$

The cosmological constant Λ from Einstein's field equation is related to the intrinsic energy density of the vacuum ρvac via the gravitational constant G as follows:

$$\Lambda = 8\pi G \; \rho_{vac}$$

Coulomb's law for the electric force, describing the force between two electric charges (q1 and q2) separated by distance r:

$$F = \frac{|q_1 q_2|}{4\pi\varepsilon_0 r^2}$$

Magnetic permeability of free space relates the production of a magnetic field in a vacuum by an electric current in units of Newtons (N) and Amperes (A):

$$\mu_0 = 4\pi \cdot 10^{-7} \, \mathrm{N/A^2}$$

Kepler's third law constant, relating the orbital period (P) and the semimajor axis (a) to the masses (M and m) of two co-orbiting bodies:

$$\left(\frac{2\pi}{P}\right)^2 a^3 = \omega^2 a^3 = G(M+m)$$

and the Gaussian formula for a Normal Distribution:

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/(2\sigma^2)}$$

$$\pi = \frac{C}{d}.$$

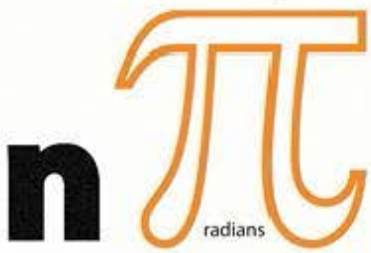

$$\pi = \frac{A}{r^2}.$$

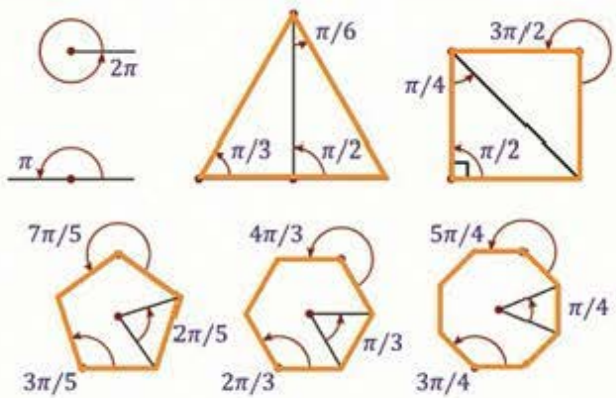

Pi radian mass-energy fascia geometries

All Equilateral triangles have internal angles that add up to 180°

Equilateral Triangles can be tessellated in turn forming larger equilateral geometries

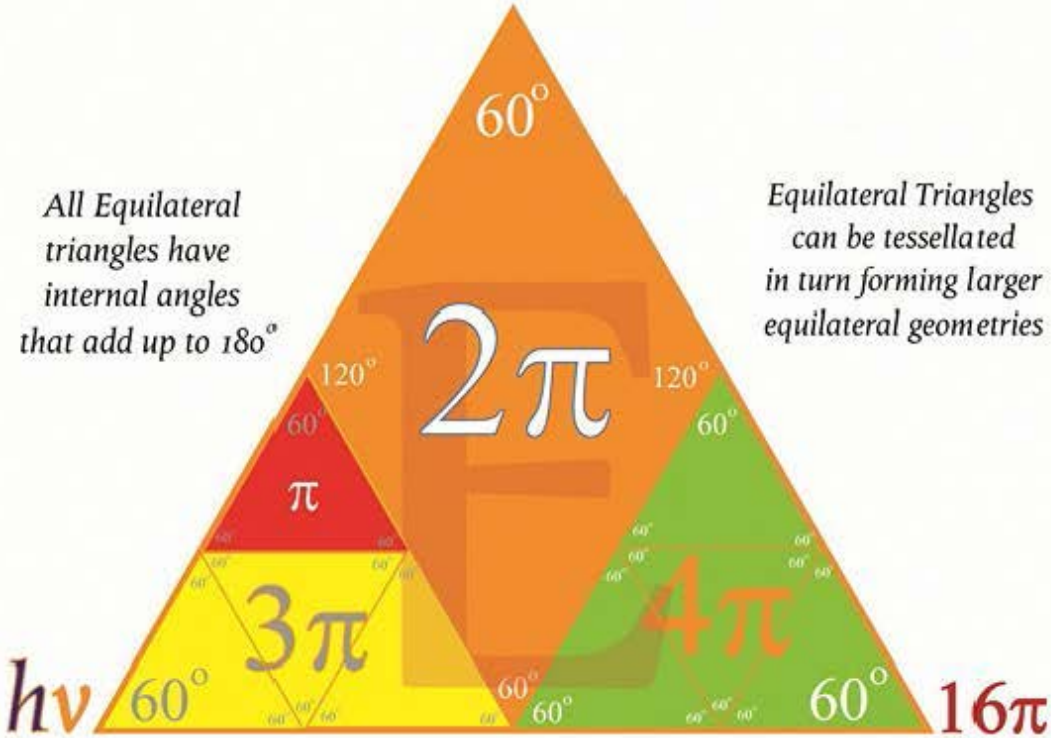

SQUARED numbers in physics are EQUILATERAL geometries

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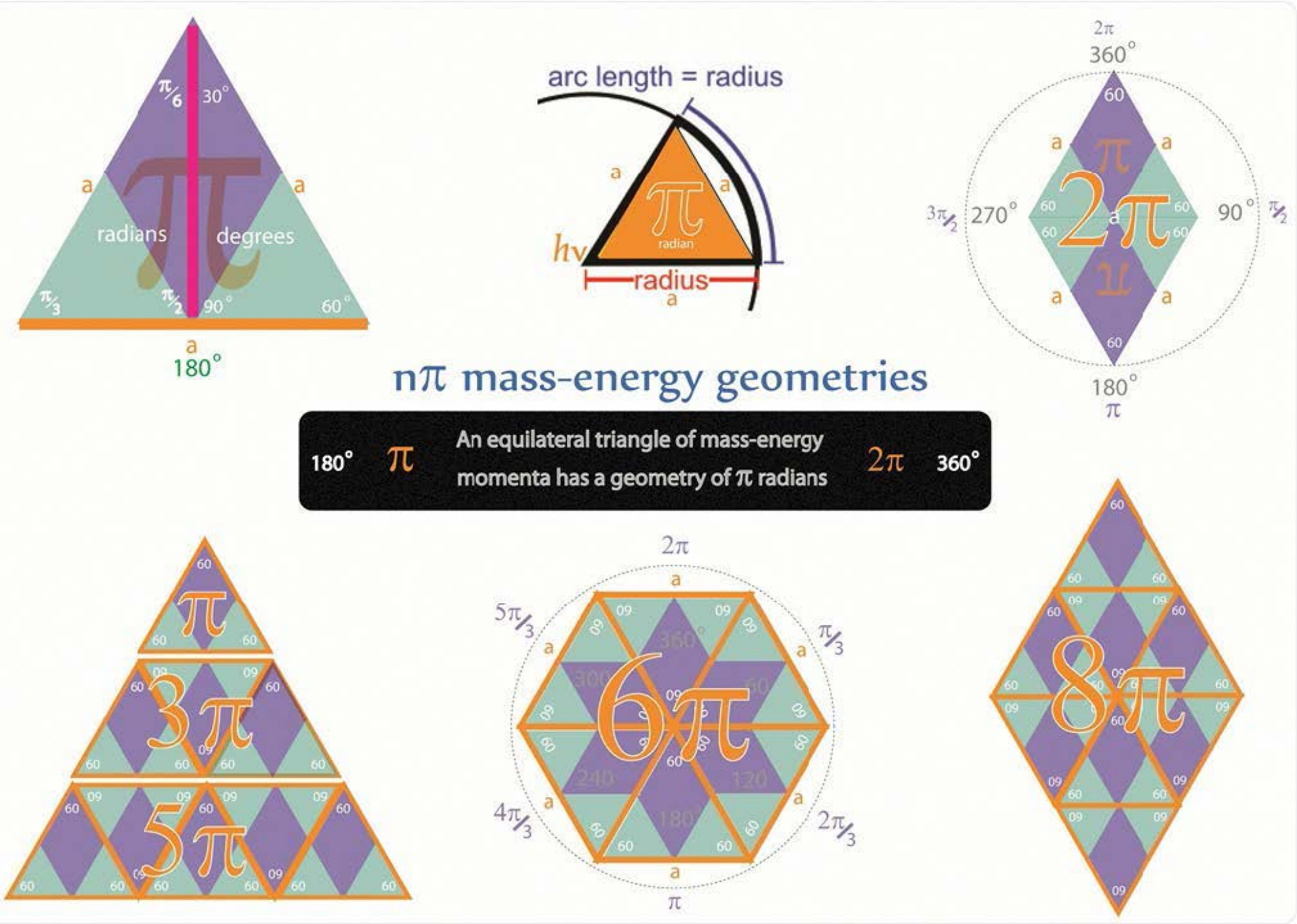

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Tetryonic Cardinal Angles

equilateral mass-energy geometries form tetrahedral mass-Matter topologies

EM Charge

Q

Equilateral energies

E

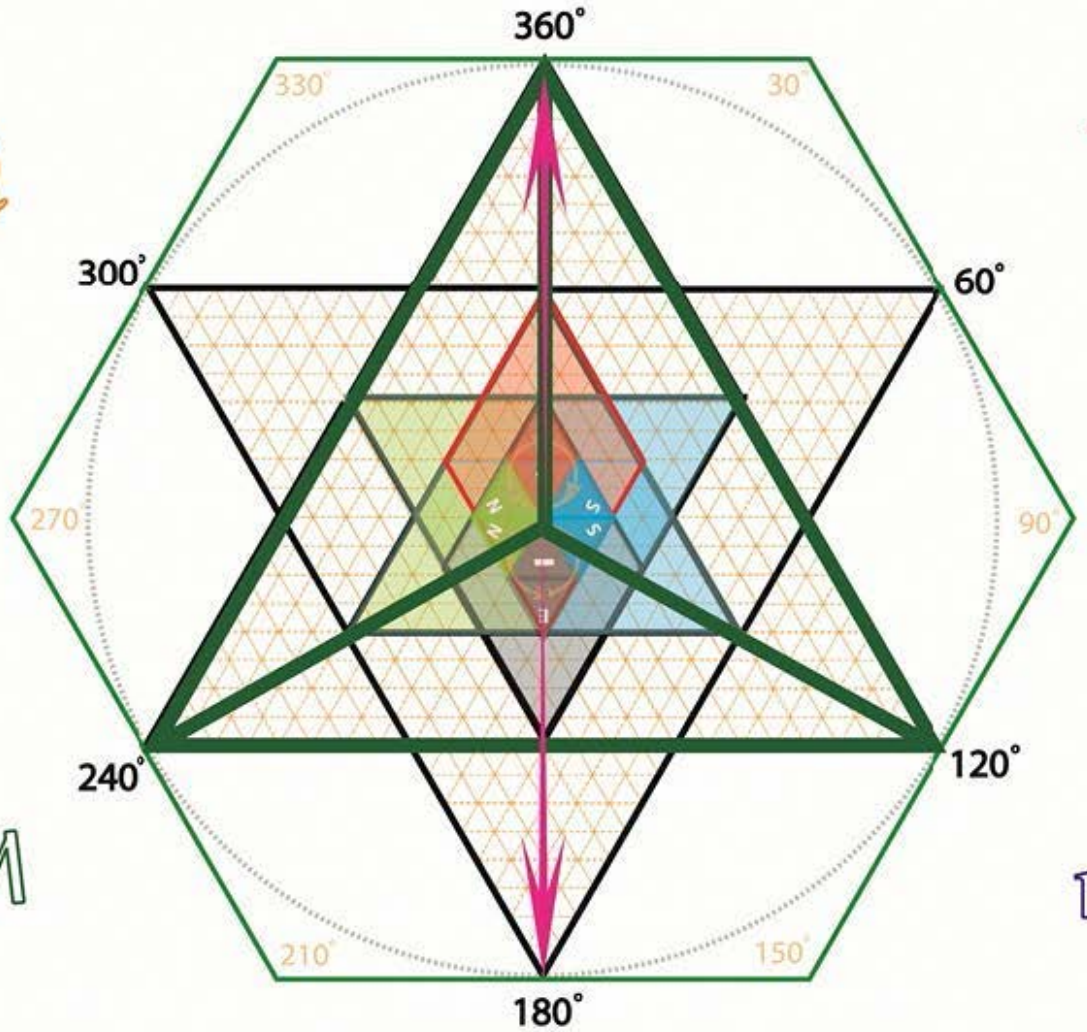

Space

Time

M

m

Matter topologies

mass geometries

radiant light

in radial spatial co-ordinate systems defined by the speed of light

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Charge
$ODD\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$
Bosons & quantum levels
EM Field — Planck quanta
ElectroMagnetic — mass — velocity

Kinetic Energies
$EVEN\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$
Photons & EM waves
EM Field — Planck quanta
ElectroMagnetic — mass — velocity

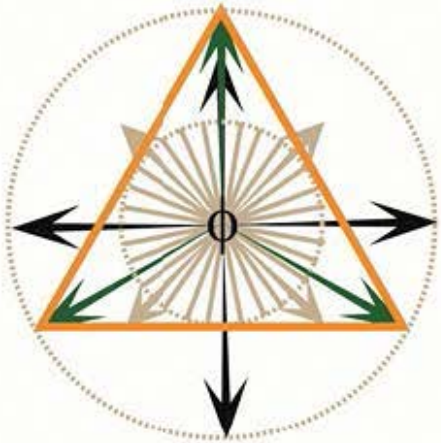

ALL Matter topologies stem from tessellated equilateral mass-energies

Matter
$4n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$
Fermions
EM Field — Planck quanta
ElectroMagnetic — mass — velocity

Matte´s 4π mass-Energies
ares Lorentz invariant to accelerations

mass-energy geometries

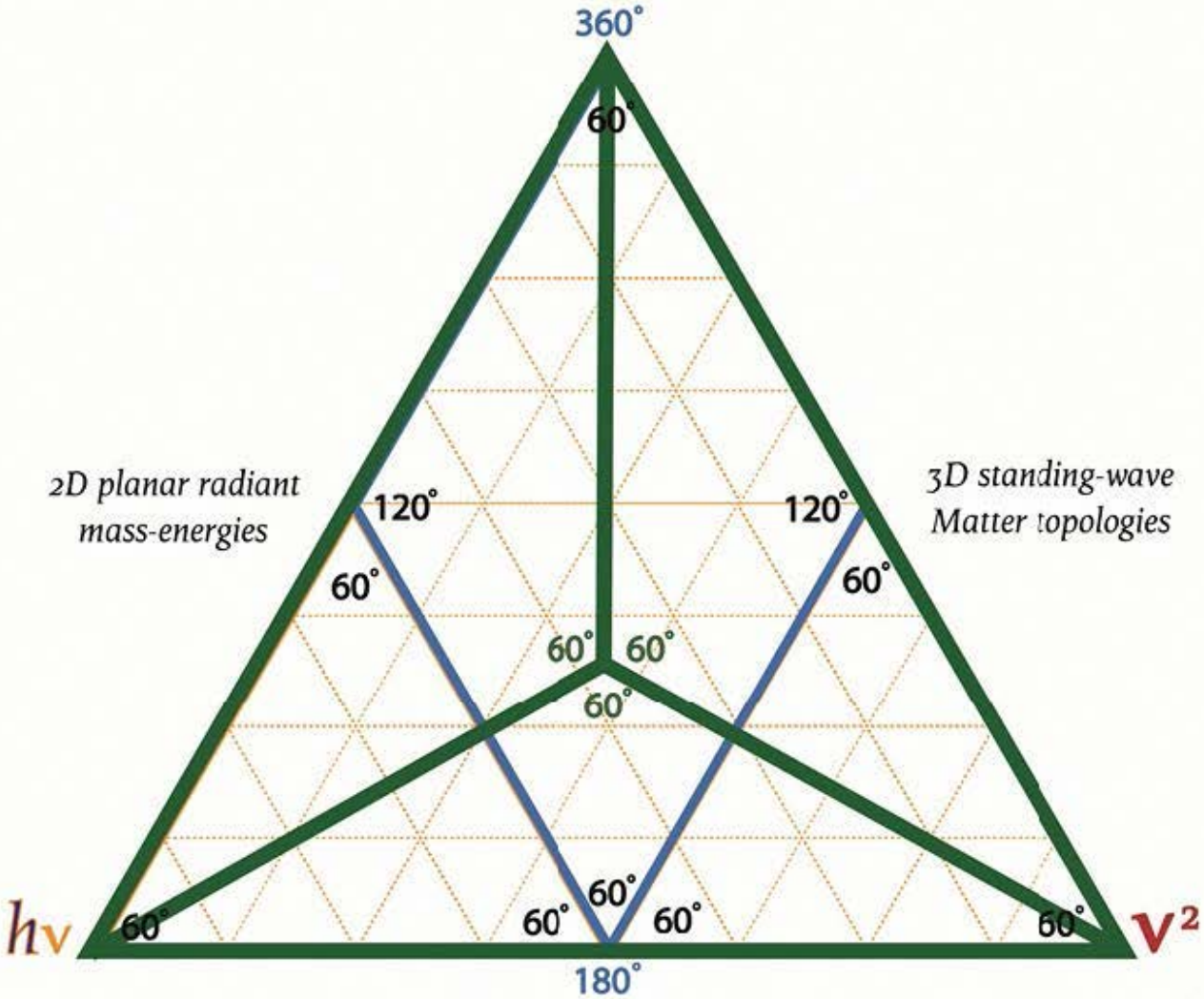

Matter topologies

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Tetryonic geometry

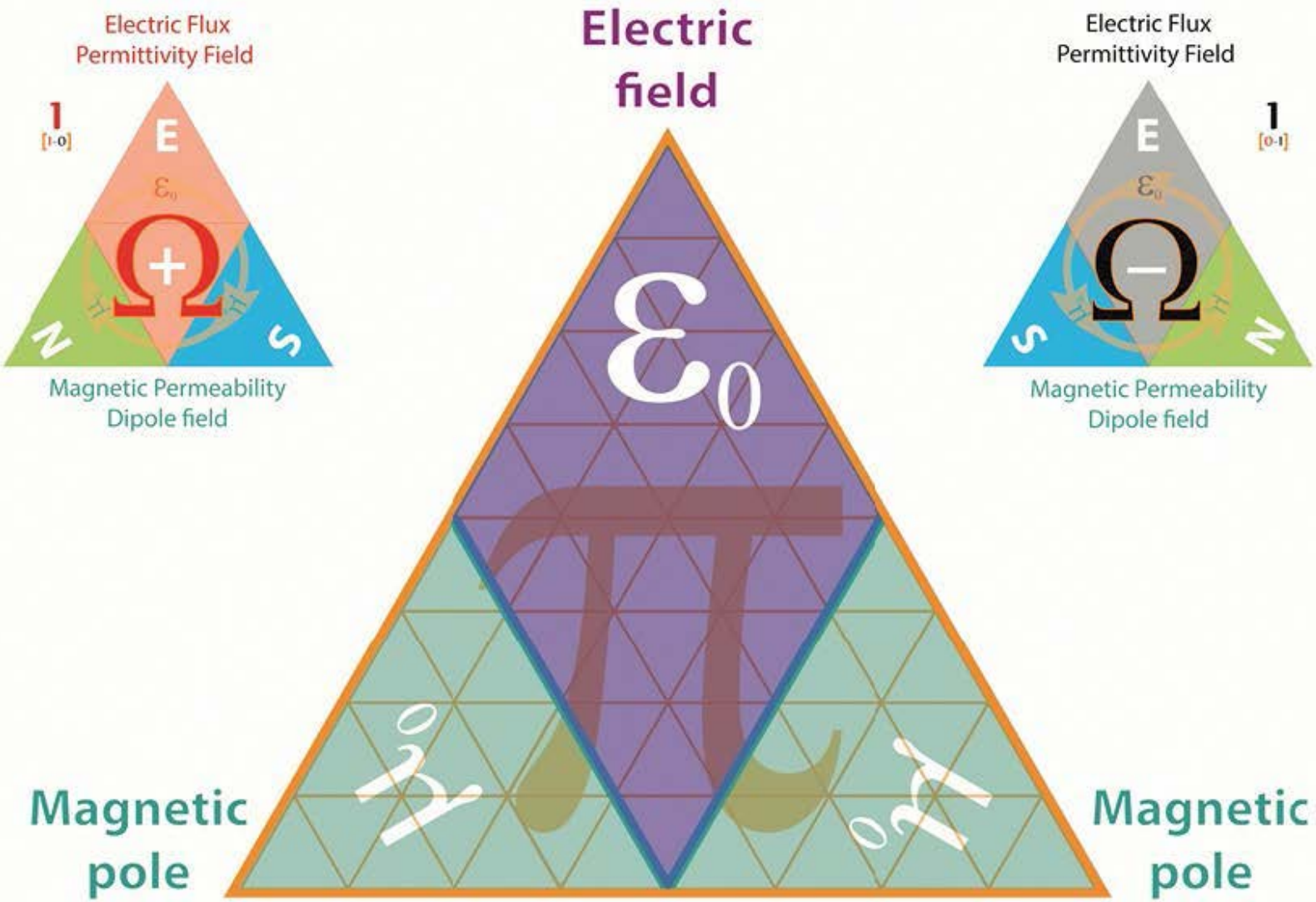

equilateral quantised angular momenta
is the foundational geometry of all mass-ENERGY-Matter

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The Golden Triangle

Planck's formulation for Energy is imprecise for use in Tetryonics and does not reflect the velocity-momenta relationship inherent in the equilateral geometry of Energy

Planck quantum levels

Energy is gained or lost in whole number multiples of the quantity hv

$$E = n[hv]$$

ODD

Charge, EM Field, Planck quanta

$$ODD\pi[[\varepsilon_0\mu_0].[m\Omega v^2]]$$

Bosons & quantum levels; ElectroMagnetic; mass; velocity

$$3 = 3.[1]$$
$$9 = 9.[1]$$
$$25 = 25.[1]$$

$$hv$$

The generalise formulation of Plank's heat law E = nhv is now changed to a specific formulation of E = [ODD] hv for transverse quantum levels [Bosons]

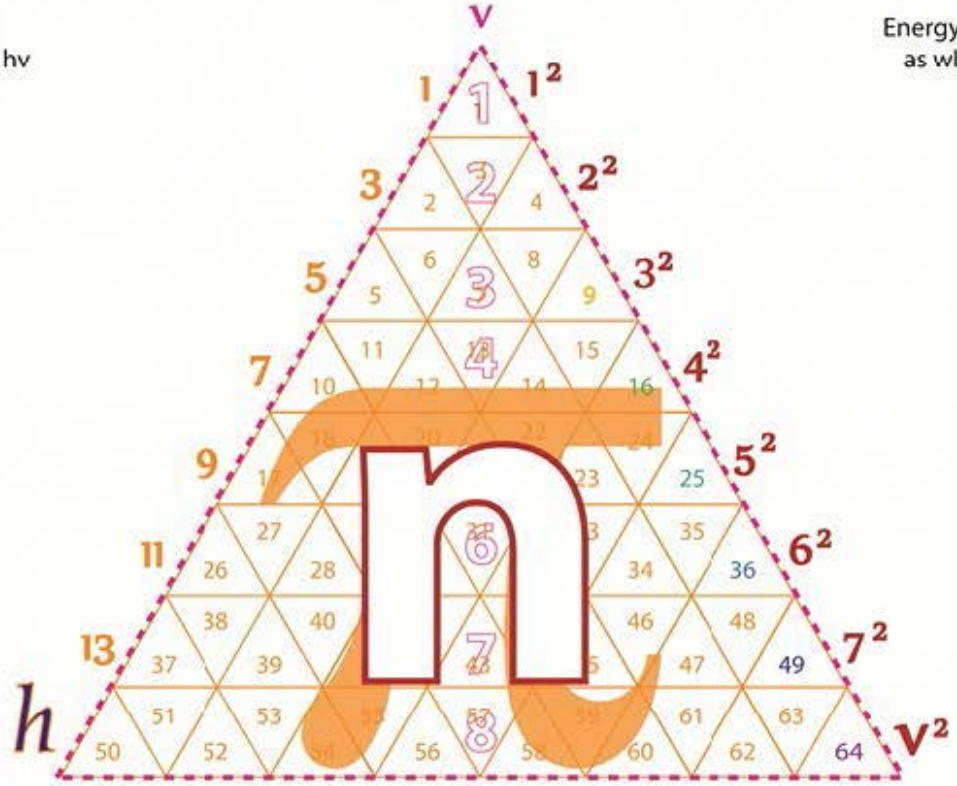

mass-energy momenta are geometrically related to velocity

Tetryonic geometry [nπ] redefines Planck's quantum formulation for heat energies from a generalised equation for 2D energy momenta into a geometric formulation for all mass-energy momenta in Matter

[all equilateral [π] geometries contain square number quanta]

Scalar energy quanta

Energy is gained or lost in equilateral geometries as whole number multiples of the quantity hv²

$$E = n[hv]$$

SQUARED

Planck quanta

$$E = n\pi[[m\Omega v^2]]$$

mass; velocity

$$3 = 3.[1^2]$$
$$9 = 1.[3^2]$$
$$25 = 1.[5^2]$$

$$hv^2$$

The general formulation of Plank's heat law is also changed to a specific formulation of E = hv² for scalar EM waveforms [ENERGY]

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Scalar field geometries

All scalar fields are comprised of Transverse and Longitudinal mass-energy momenta all of which are formed from equilateral quantum geometries

Charge is a conserved force

Energy is a conserved quantity

Bosons are transverse ODD planck geometries

$$E = n\pi[[h\nu]]$$

Planck quanta

Energy is scalar SQUARE planck quanta

$$E = n\pi[[h\nu^2]]$$

Planck quanta squared

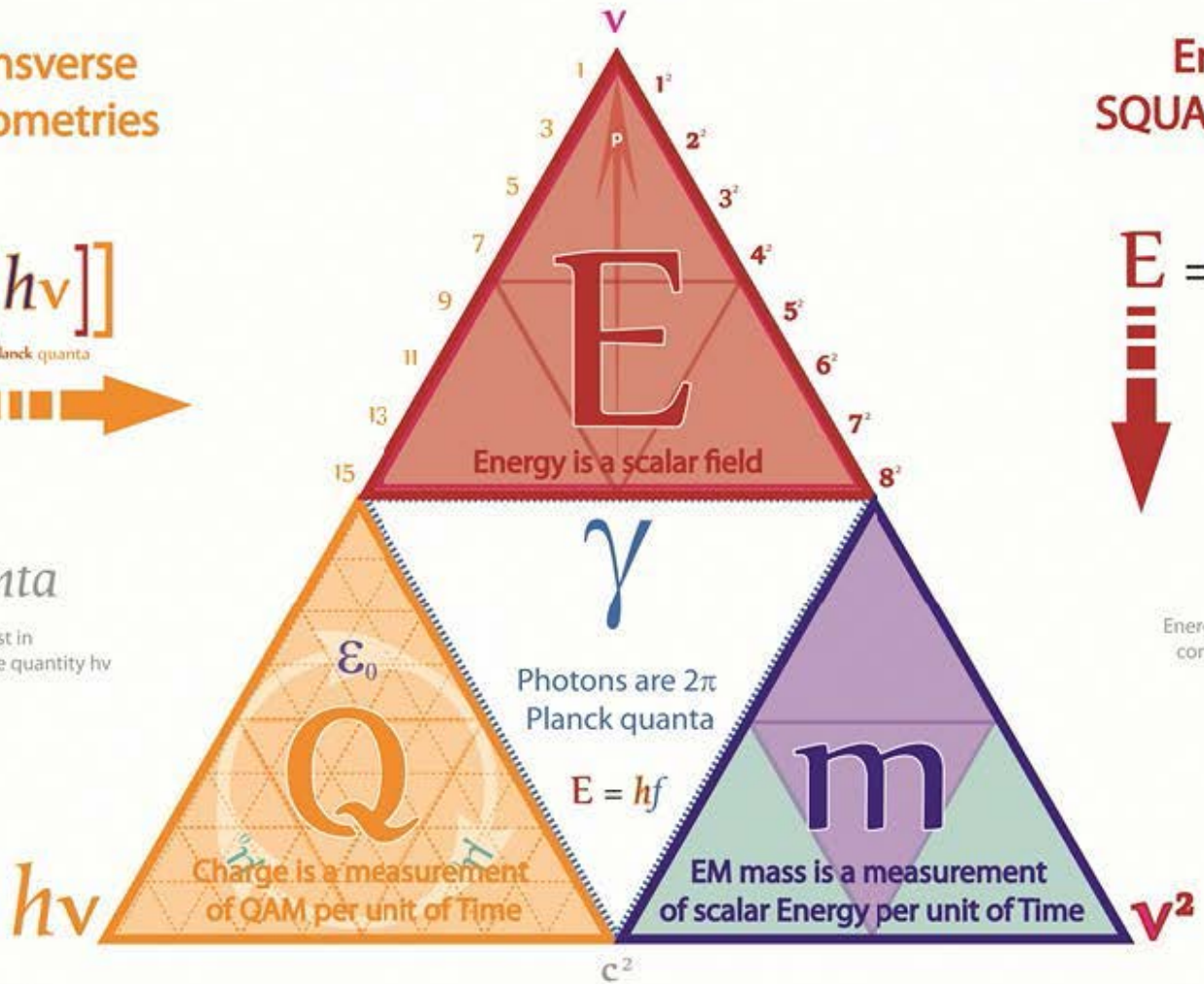

Planck quanta

Energy is gained or lost in whole number multiples of the quantity hν

Scalar energies

Energy is gained or lost in equilateral quanta containing whole number multiples of hν²

All energy is comprised of EM fields

All squared energy geometries have component quantum levels

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Squared energy levels in quantum physics

are in fact equilateral Planck mass-energy geometries

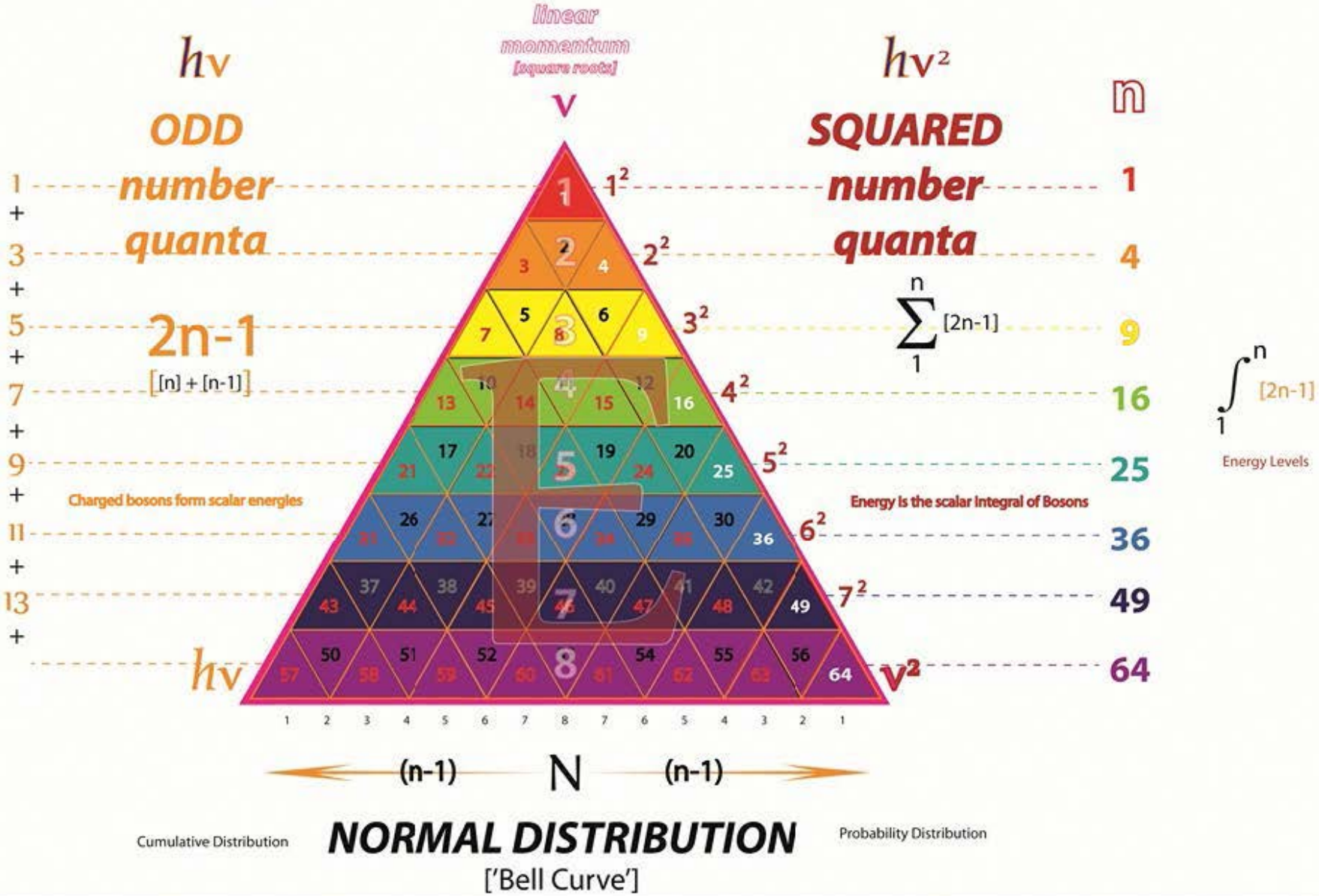

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Energy quanta defined

Quantum levels

Charge is gained or lost in
odd number multiples of the quantity hv

$$E = n\pi[[h\nu]]$$

Planck quanta

transverse

ODD quanta

Scalar Energies

Energy is gained or lost in equilateral geometries
containing whole number multiples of the quantity $h\nu^2$

$$E = n\pi[[h\nu^2]]$$

Planck quanta squared

scalar

SQUARE quanta

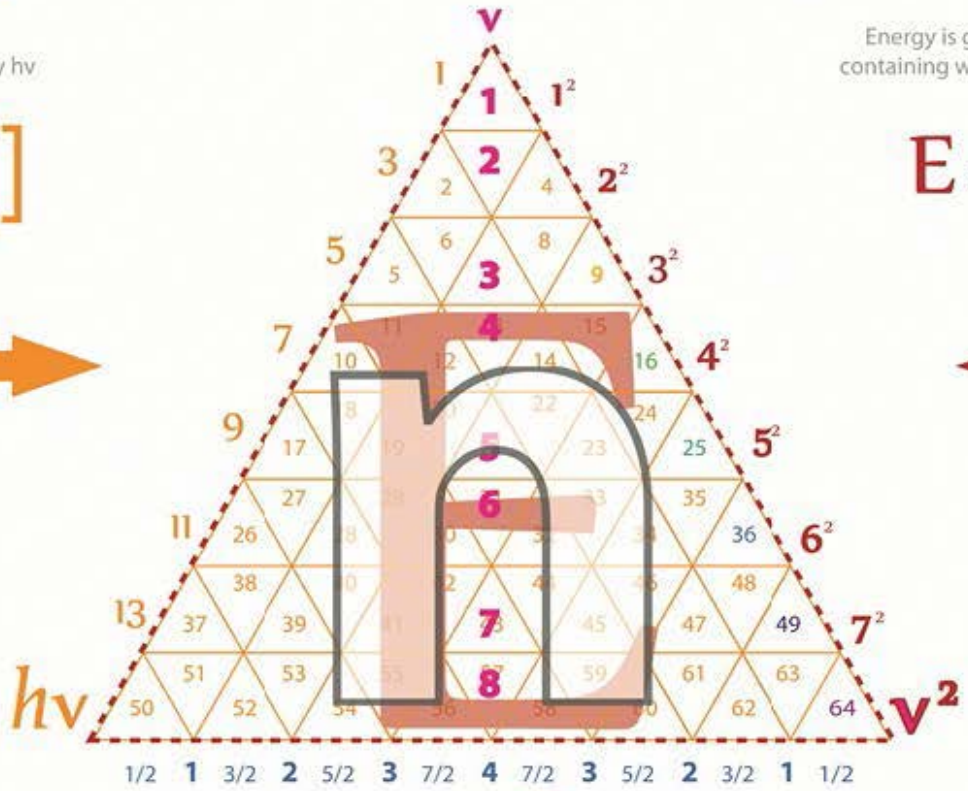

Quantum

The **number** of Planck quanta
in any physical system

$$\nu = f/2$$

Transverse

Quantum Levels

The number of
repeating waveform **cycles**
in a system

$$2\nu = f$$

Frequency

EVEN quanta

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Tetryonic field equation

E	$E = n\pi\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass; velocity)	electromagnetic energy is a scalar
m	$n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$ (EM Field; ElectroMagnetic; Planck quanta; mass; velocity)	mass is an inertial constant that relates Force to acceleration
[v-v] Q	$\mathrm{ODD}\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$ (Charge; Bosons & quantum levels; EM Field; ElectroMagnetic; Planck quanta; mass; velocity)	equilateral charge geometry is Lorentz invariant
KE	$\mathrm{EVEN}\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$ (Kinetic Energies; Photons & EM waves; EM Field; ElectroMagnetic; Planck quanta; mass; velocity)	KEM fields mass-energy geometries are Lorentz variant to accelerations
M	$4n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$ (Matter; Fermions; EM Field; ElectroMagnetic; Planck quanta; mass; velocity)	Matter's 4π mass-energy topologies are Lorentz invariant to accelerations

E	E
m	$\frac{E}{c^2}$
Q	$\frac{\Omega}{c^2}$
KE	$\frac{1}{2}m\left[\frac{v^2}{c^2}\right]$
M	$4n\pi\left[\frac{E}{c^4}\right]$

Energy momenta geometry

Energy is the total Planck quanta per second

EM mass is scalar energy per unit of Time

Charge is the nett Angular momentum per spatial co-ordinate system

Kinetic Energy is the Electric field mass-energy of Matter moving at v

mass-energy geometry

Matter topology

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mass-Energy equivalence

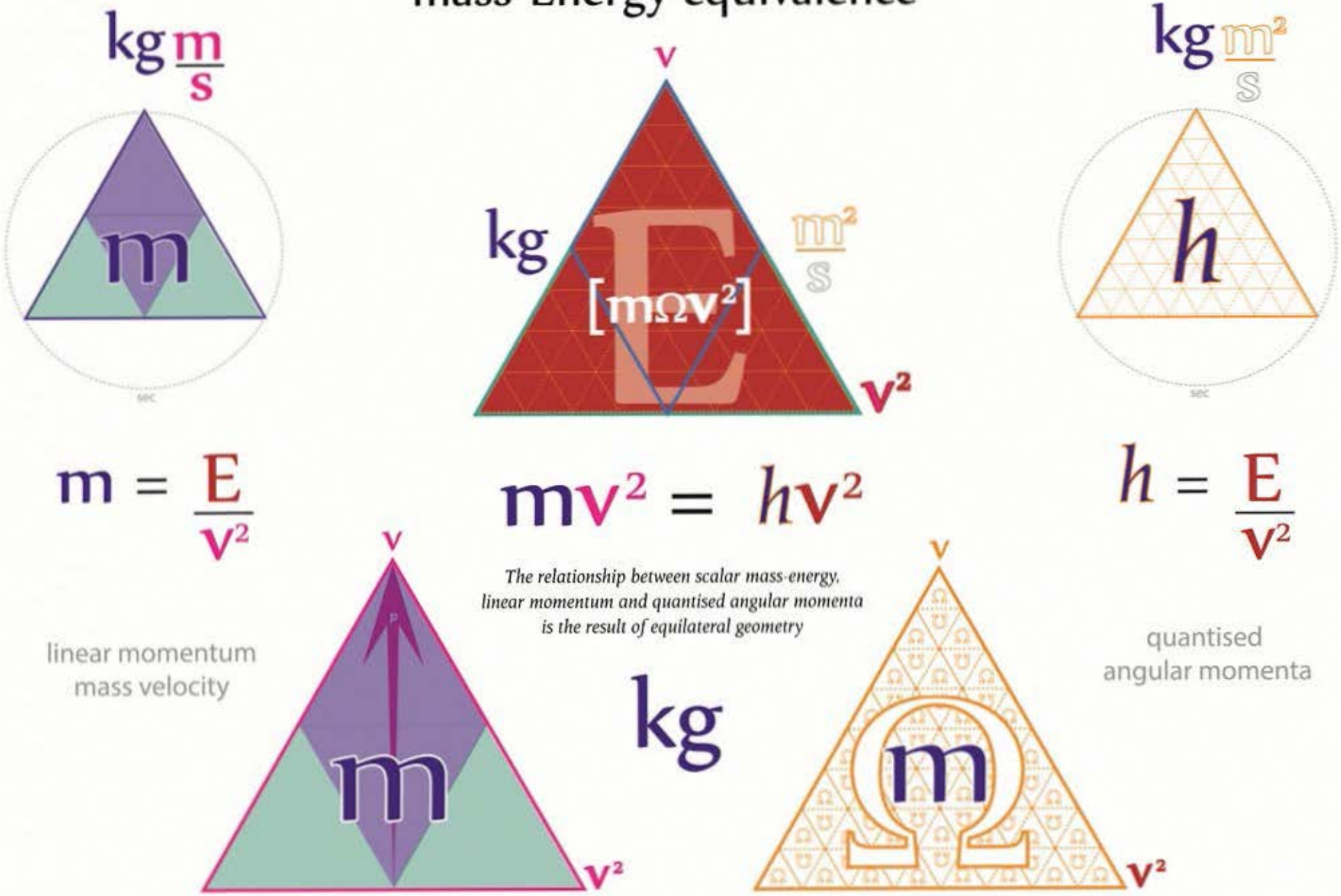

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mass-Energy geometries

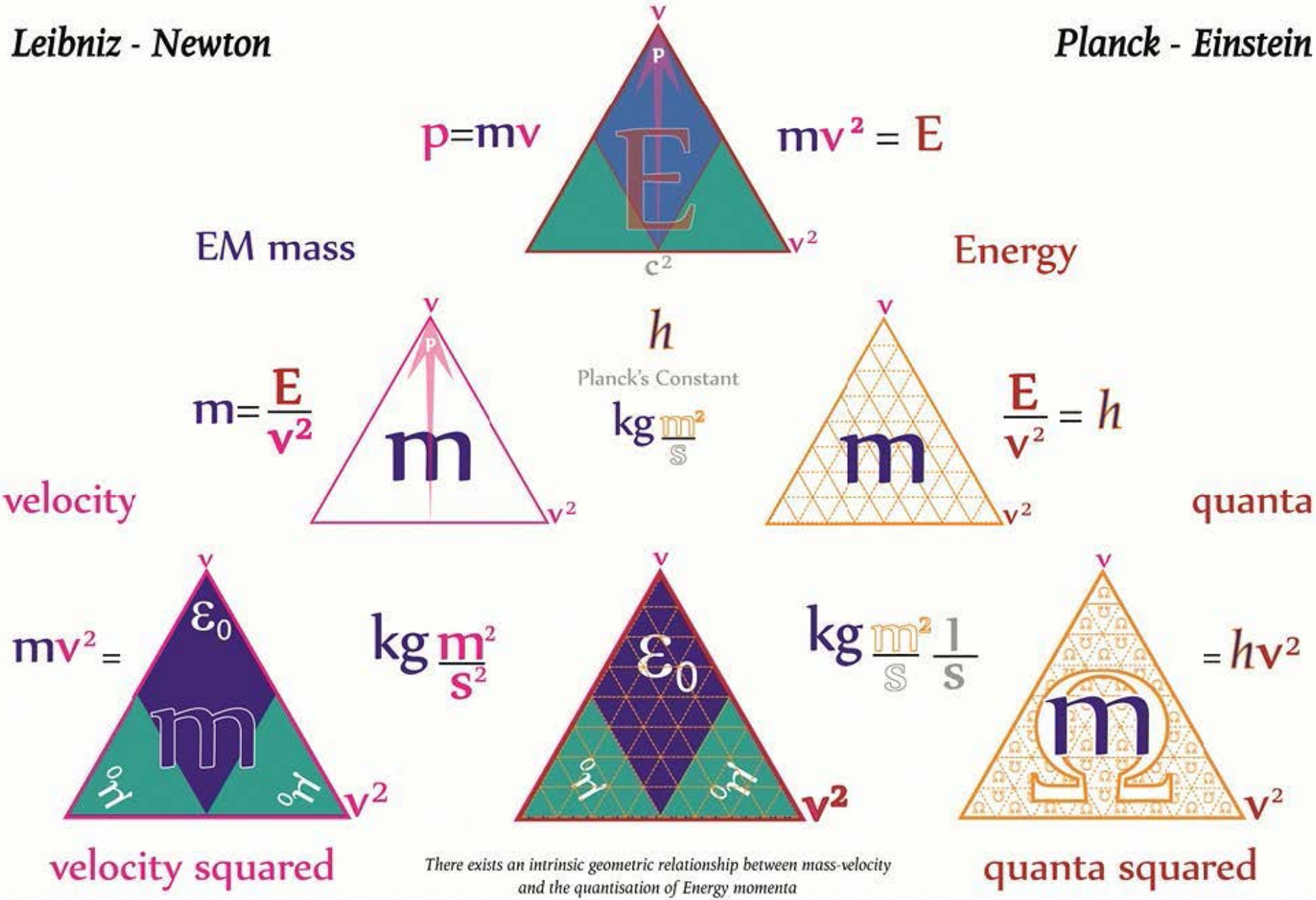

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EM mass-energy

$$E = mc^2$$

EM mass is related to Matter
throught the square of the velocity of light
of 8.987551787 e16 m²/s² [c²]

EM mass-Matter

$$E = Mc^4$$

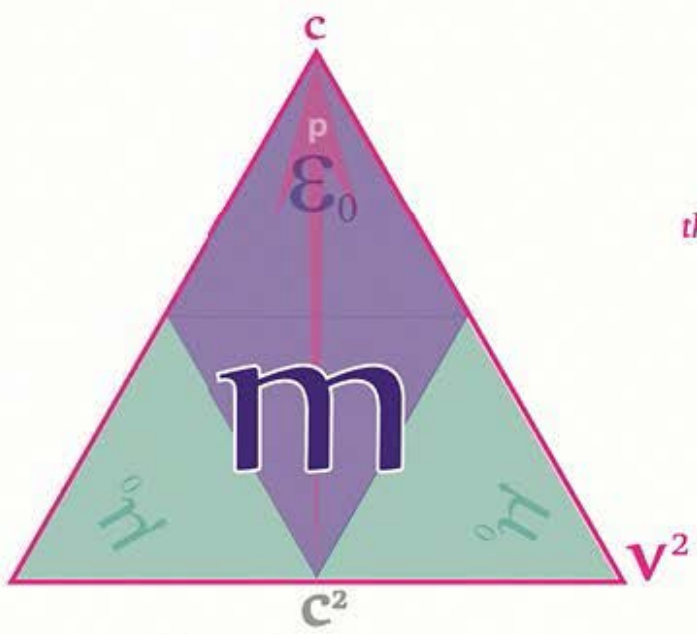

Electro-Magnetic mass

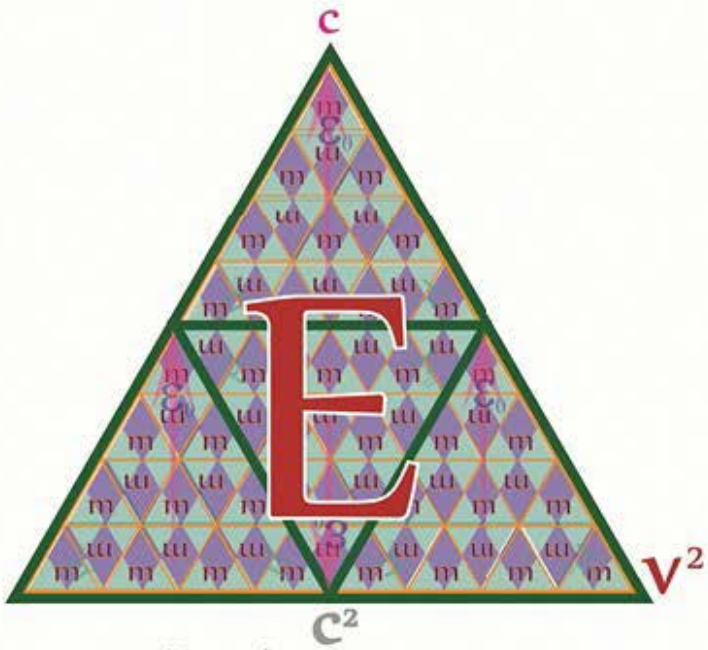

Matter's energy quanta

scalar EM mass

$$M = \frac{E}{c^4}$$

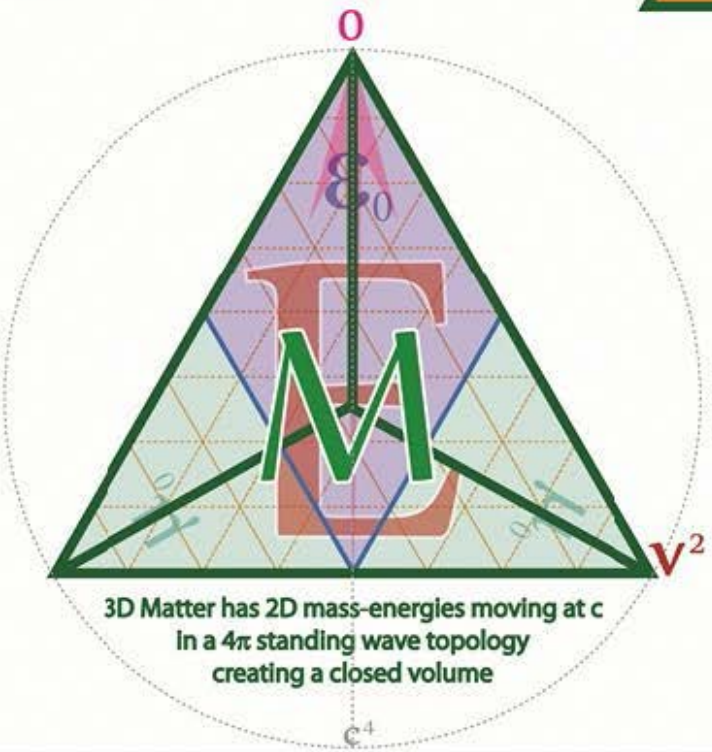

3D Matter has 2D mass-energies moving at c
in a 4π standing wave topology
creating a closed volume

quantised mass

$$h = \frac{E}{v^2}$$

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Kinetic Electro-Magnetic fields

[The energies of Motion]

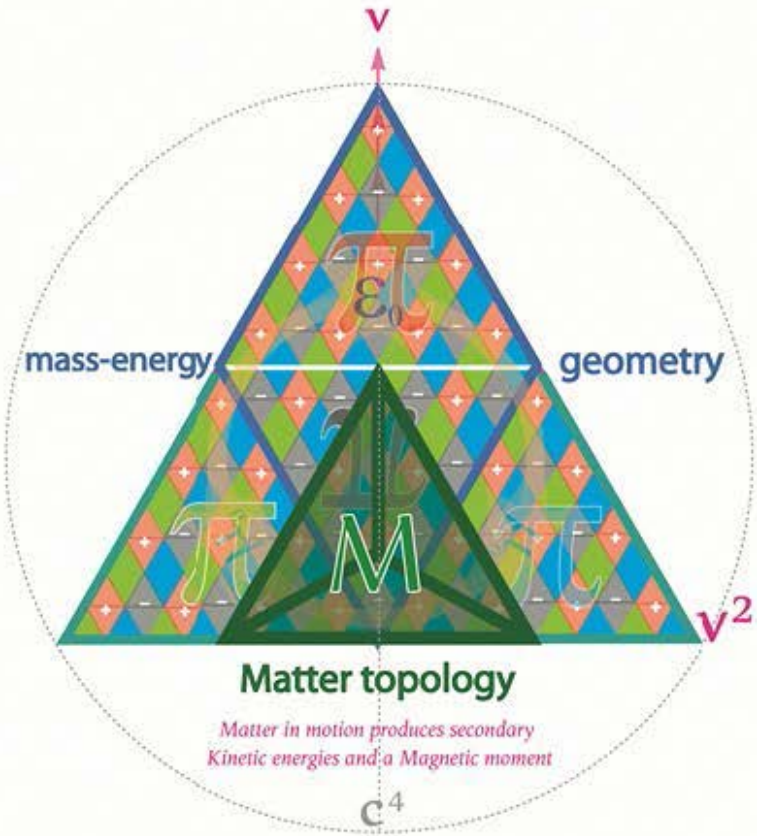

$$p^2 = E = Mv^2$$

The Electric field energy in any EM field is equal and orthogonal to the Magnetic field energy

$$p^2 = KEM = Mv^2$$

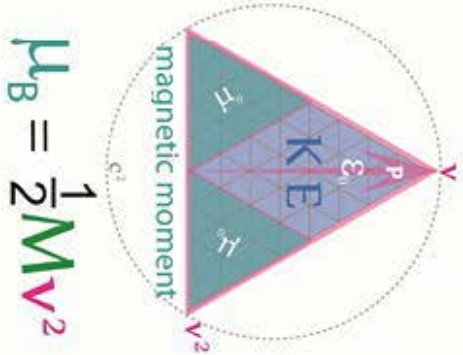

$$\mu_B = \frac{1}{2}Mv^2$$

$$KE = \frac{1}{2}Mv^2$$

All Matter in motion possess momenta and kinetic mass-energies in extrinsic KEM fields

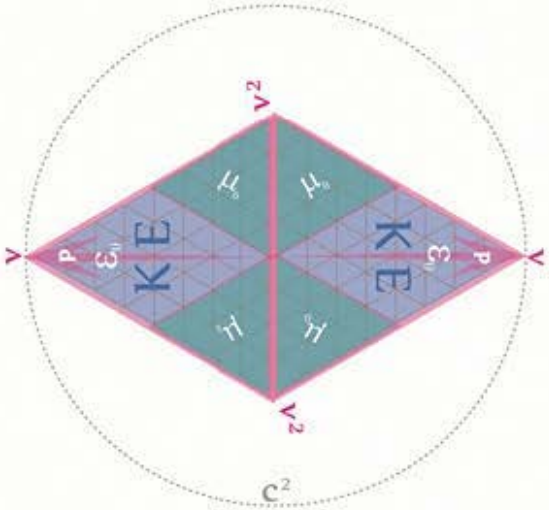

$$E_\gamma = \frac{2mv^2}{c^2}$$

These 2D planar fields are subject to Lorentz factor corrections that apply to the KEM field mass-energies of Matter in motion

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Charge & Kinetic EM fields

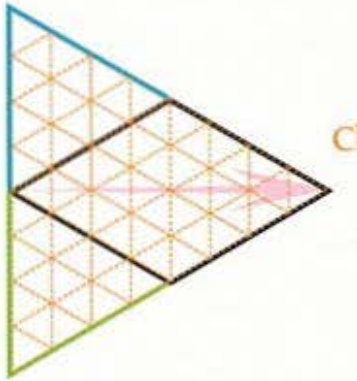

Charges are the result of quantised angular momenta

Kinetic Energies result from Matter in motion

$mv^2 = E = hv^2$

$p^2 = E = m\Omega v^2$

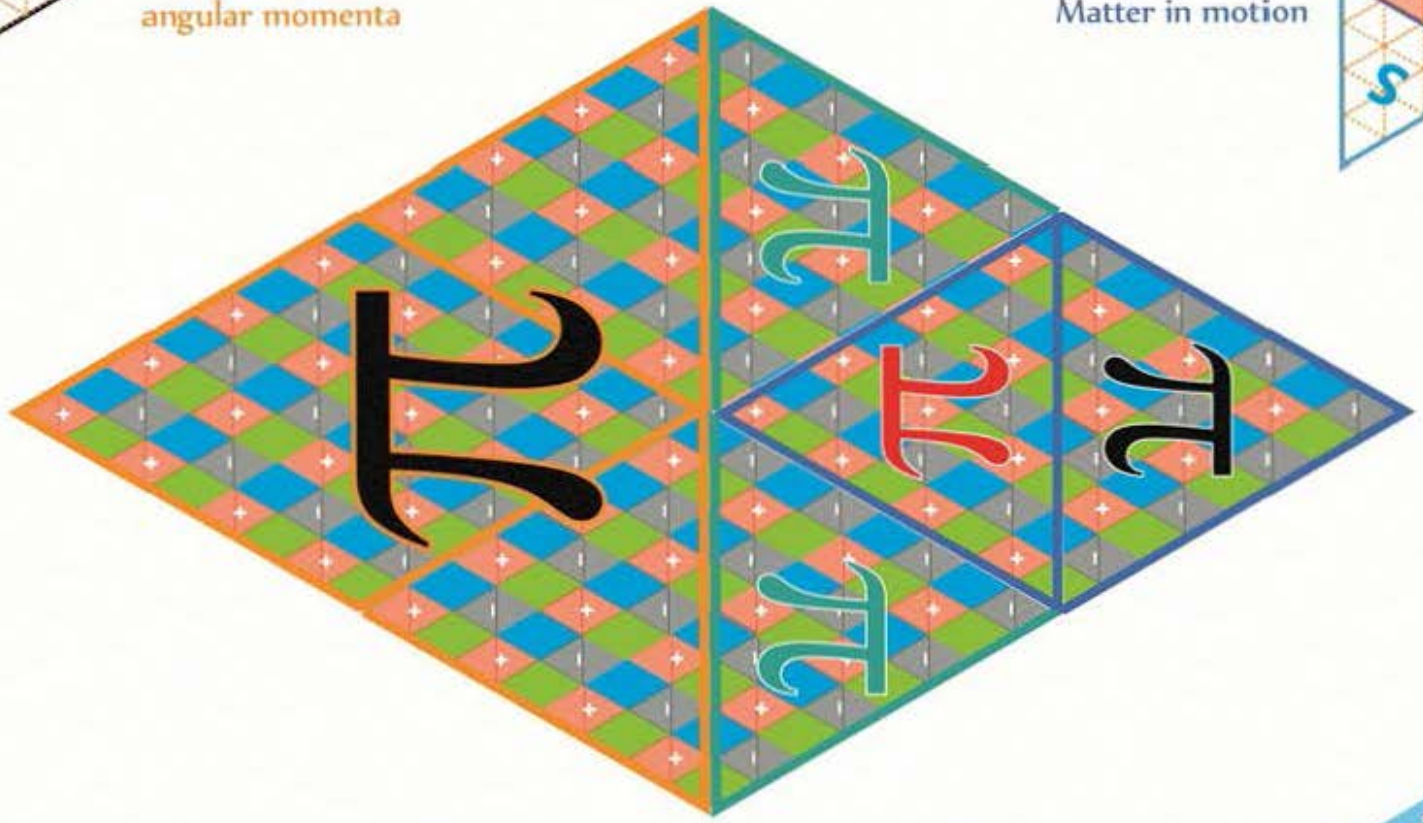

$KE = \frac{1}{2}Mv^2$

$KEM = Mv^2$

EM field energies externalised on the fascia of 3D Matter geometries form the physical property known as elementary Charge

[k]EM energies in amy region of free space are viewed as either a Kinetic energy field with an associated Magnetic moment or a neutral charge Photon of ElectroMagnetic mass-energy

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$$m_o = \frac{E}{c^2}$$

Rest mass is equivalent to the total quantity of Energy in a body or system (divided by c²)

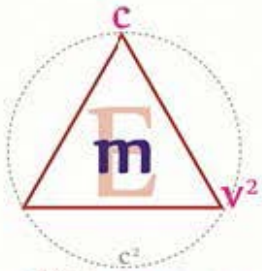

2D fields propagate at c
3D Matter moves at v

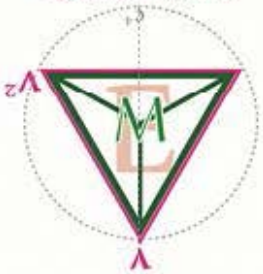

inertial mass

$$m = \frac{F}{a}$$

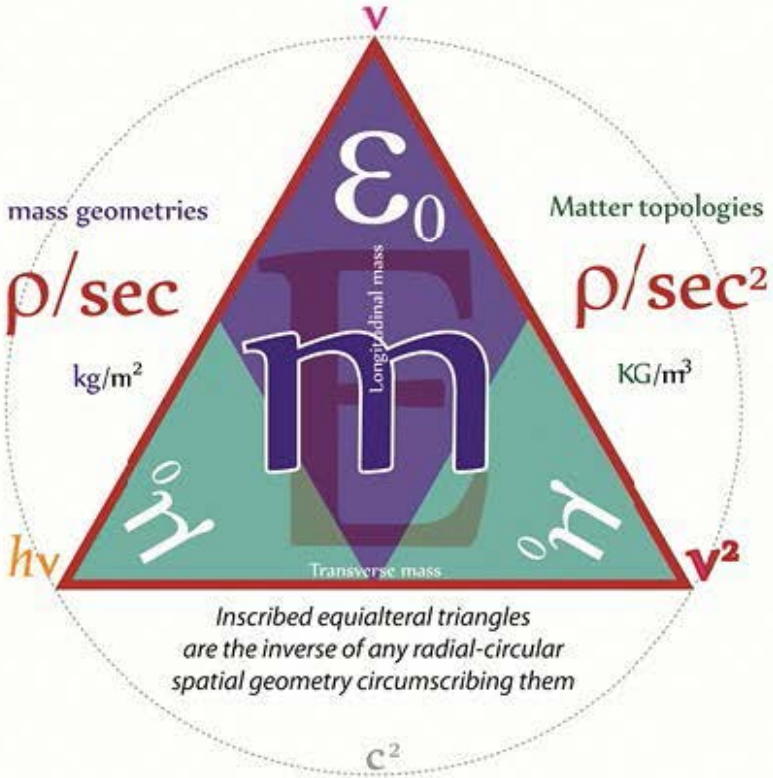

Inscribed equialteral triangles are the inverse of any radial-circular spatial geometry circumscribing them

mass must be distinguished from Matter in physics, because Matter is a poorly-defined concept in modern science, and although all types of agreed-upon Matter exhibit properties of mass, it is also the case that there many types of Energy that posses NO Matter topology, such as potential energy, kinetic energies and electromagnetic radiation (photons)

$$\underset{\text{mass}}{n\pi}\left[\left[\underset{\text{ElectroMagnetic}}{\varepsilon_0\mu_0}\right].\left[\underset{\text{mass}}{m}\,\underset{\text{velocity}}{\Omega v^2}\right]\right]$$

EM Field — Planck quanta

The term 'massless' must be re-termed 'Matterless' to reflect true physical attributes of mass-energy-momenta

EM mass is a planar measurement of 2D energy per unit of time

Thus, all 3D Matter topologies have charged fascia comprised of 2D scalar of mass-energies, but closed volume 3D topology is not a property of 2D EM mass-energy geometries

mass

$$\rho$$

EM mass is a measure of planar energy density per second

$$\frac{mv^2}{c^2} \quad \boxed{\frac{m\Omega v^2}{c^2}} \quad \frac{hv^2}{c^2}$$

per unit of time

EM mass geometries are subject to Lorentz corrections

velocity — QAM quanta

$$\frac{mv^2}{c^2} = \frac{m\Omega v^2}{c^2}$$

per unit of time

Gravitational Matter

$$g = G\frac{M}{r^2}$$

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Electromagnetic mass-energy

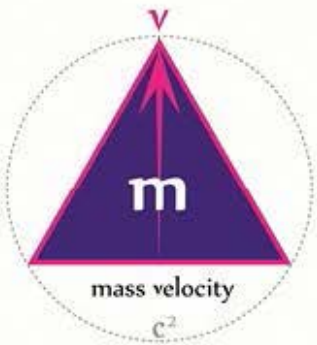

In physics, EM mass–energy equivalence is the concept that the EM mass of a body is a measure of its energy content

Using this concept, EM mass is a property of all Energy, and Energy is a property of all EM mass, and the two properties are connected by a constant.

Using Tetryonic geometry it can be shown that the constant is the equilateral geometry of QAM thus unifying Classical mechanics and Relativisic mechanics

2D mass-ENERGY geometry is NOT 3D Matter topology

$$m = \frac{E}{v^2}$$

Classical mass

$$m = \frac{E}{c^2}$$

Relativistic mass

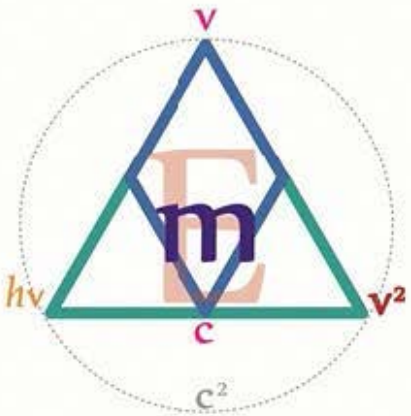

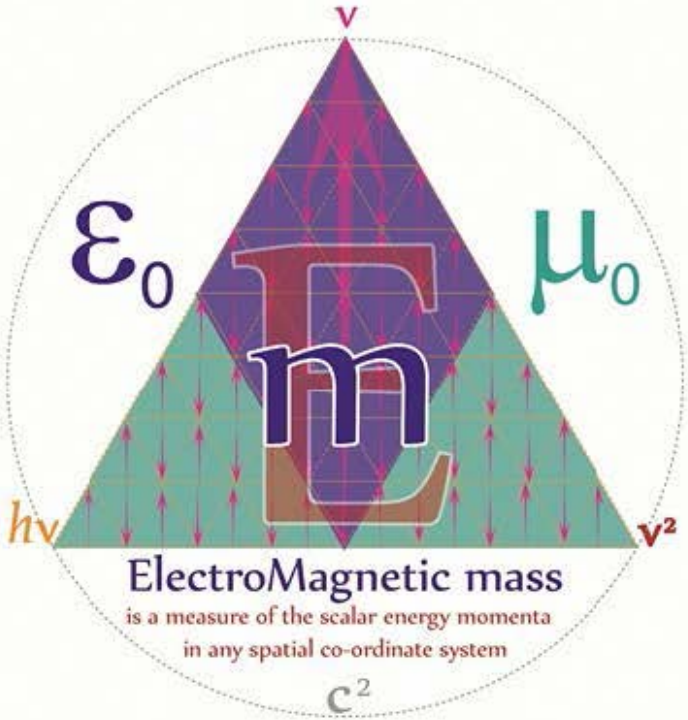

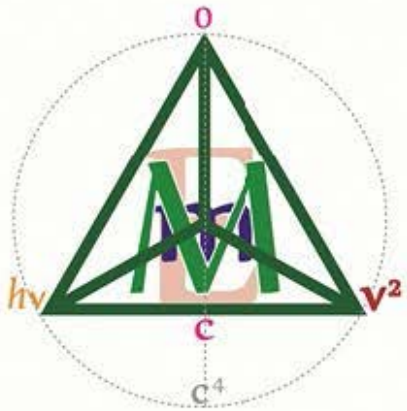

radiant 2D mass-energies are planar equilateral energy geometries

Relativity shows that rest mass and rest energy are essentially equivalent, via the well-known relationship ($E=mc^2$)

standing-wave 3d mass-Matter are tetrahedral energy momenta topologies

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EM mass-Energy-Matter

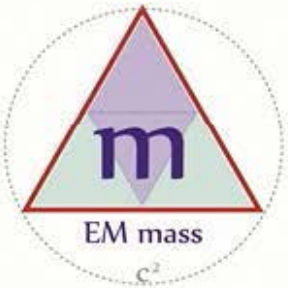

$$\left[\frac{\Omega}{c^2}\right]$$

Charge is a measure of the quantised angular momentum of any physical system

Tetryonic Matter — planar spatial Impedance — Planck quanta

$$T\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

3D topology — ElectroMagnetic — 2D mass — velocity

Planck quanta

$$\left[m\Omega v\right]^2$$

mass velocity

$$1\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

ODD quanta

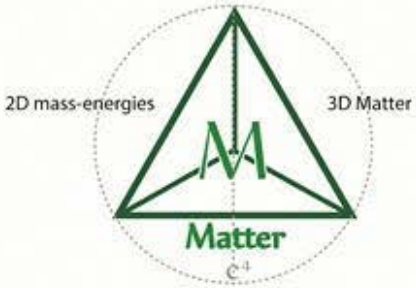

$$4n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

TETRYONS

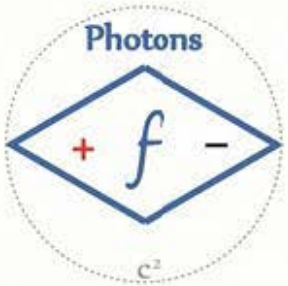

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EVEN quanta

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EM mass-Energy momenta

Energy

$$\left[\frac{m\Omega v^2}{s}\right]$$

$$E$$

6.629432672 e-34 J

mass-Energy

7.376238634 e-51 kg

$$m$$

$$\left[\frac{E}{c^2}\right]$$

mass

Planck's Constant

is the 'quantum of Action'

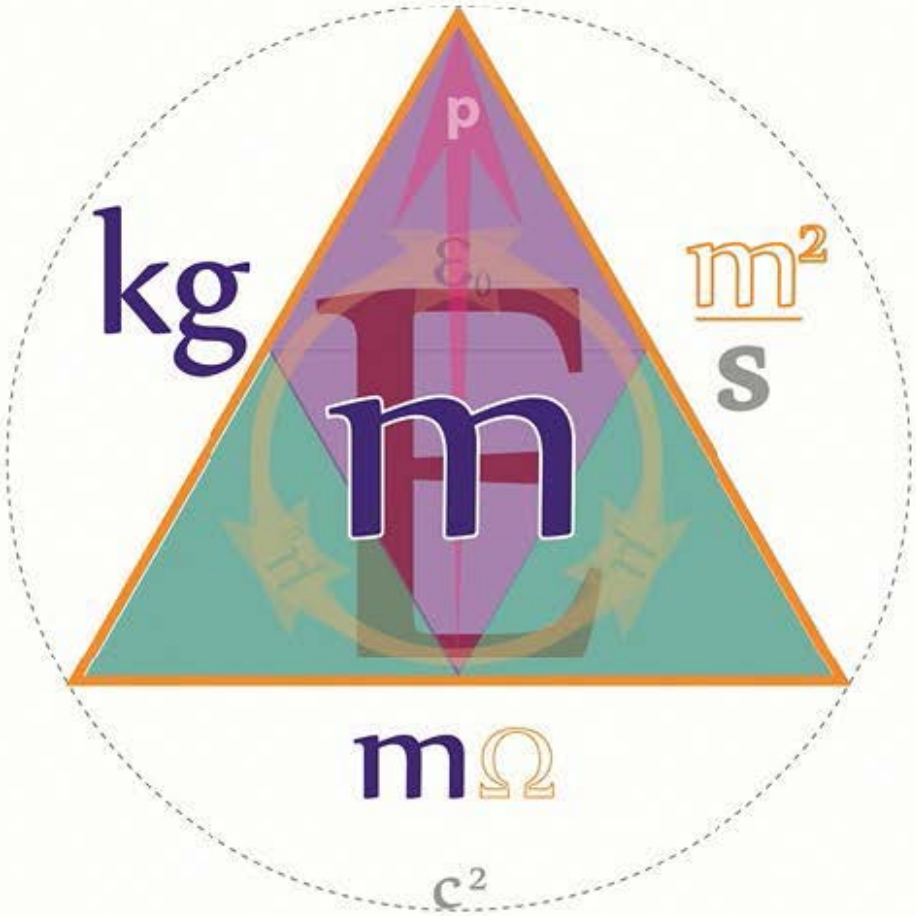

$$6.629432672 \times 10^{-34}\ \mathrm{J.s}$$

mass momenta

quantised angular momenta

$$\left[\frac{m^2}{s}\right]$$

$$\Omega$$

0.0012 m2/s

Charge-momenta

1.33518 e-20 s

$$s$$

$$\left[\frac{\Omega}{c^2}\right]$$

charge

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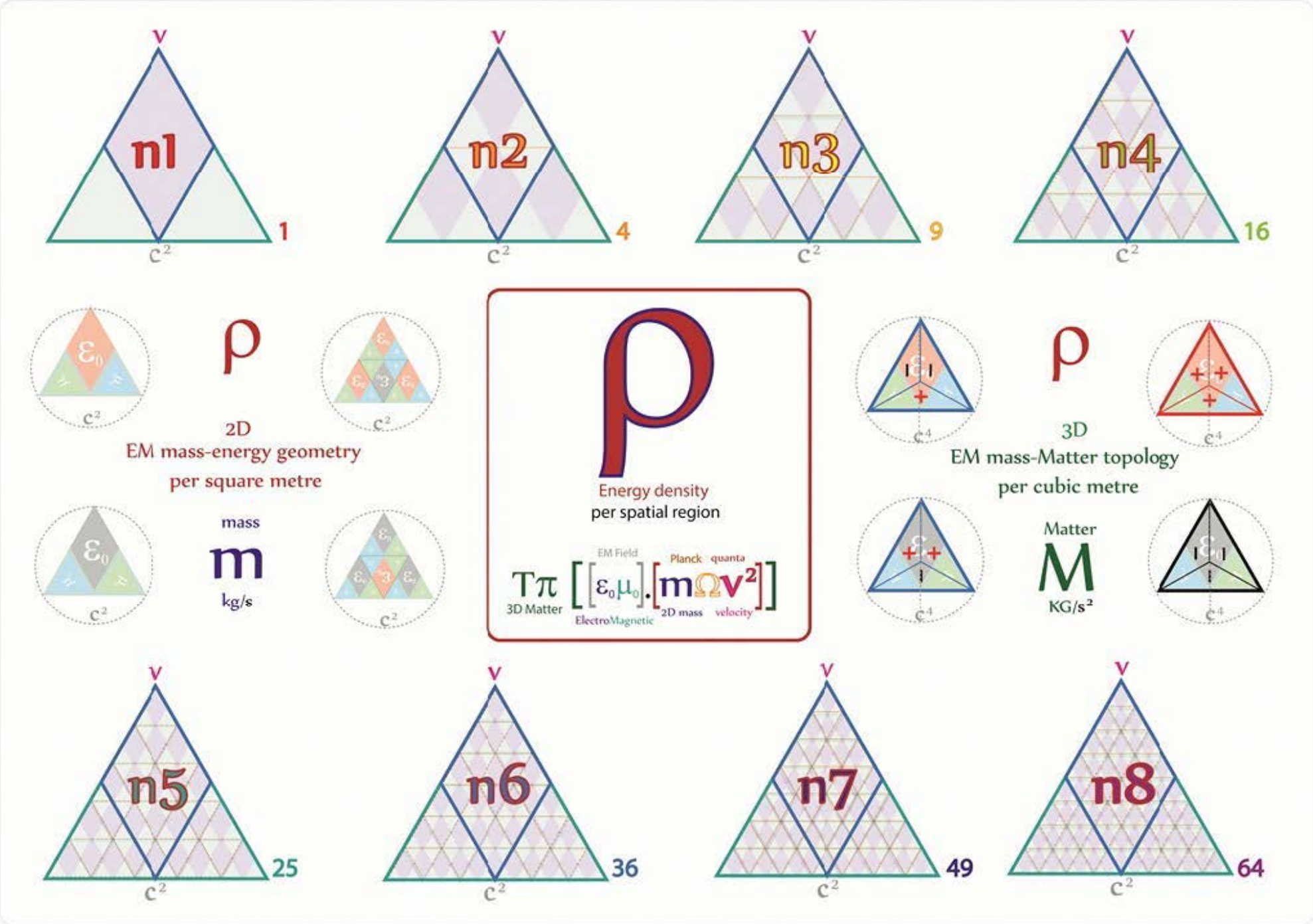

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Zero Point Fields [ZPFs]

ZPFs are quantum inductive tank circuits
(Short-circuited 'IDEAL' inductors with energy)
ZPFs charge energies do NOT oscillate
[The magnetic dipole vector determines charge]

IDEAL QUANTUM INDUCTORS
(equilateral triangle Energy geometry)

The EM FIELD

Electric flux fields can propagate in any direction
Magnetic fields are always at 90 degrees to Electric fields

Magnetic dipole fields propagate in 2 directions at
180 degrees to each other (bi-directionally)
forming North and South poles

Electric flux field energy is directly proportional to the resultant Magnetic dipole field energy and vice versa

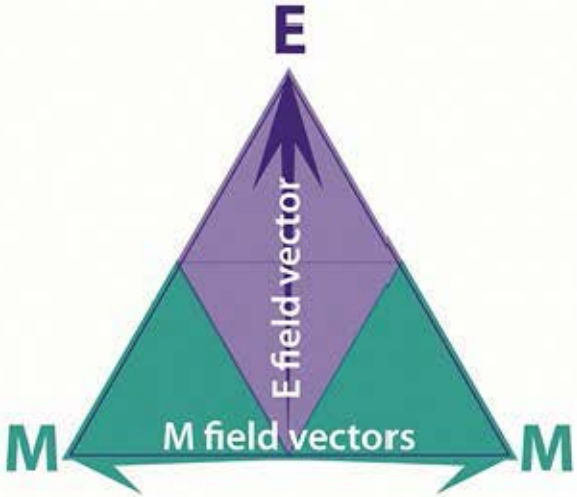

The linear Electric field strength is directly proportional to its associated transverse Magnetic field which propagates bi-directionally from & into the bloch wall of the Zero point field

Zero Point Fields consist of
Electric and Magnetic (EM) fields
propagating at 90 degrees
to each other

Magnetic MONOPLES do NOT exist
Energy quanta always form charged Electric fields and dipole Magnetic fields

As localised energy quanta increases
(number of ZPFs per time unit)
the charge geometry remains the same

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Quantised Angular Momentum

is the equilateral geometry of scalar energy momenta per unit of time

$mv^2 = E$

$E = hv^2$

$\frac{m^2}{s}$

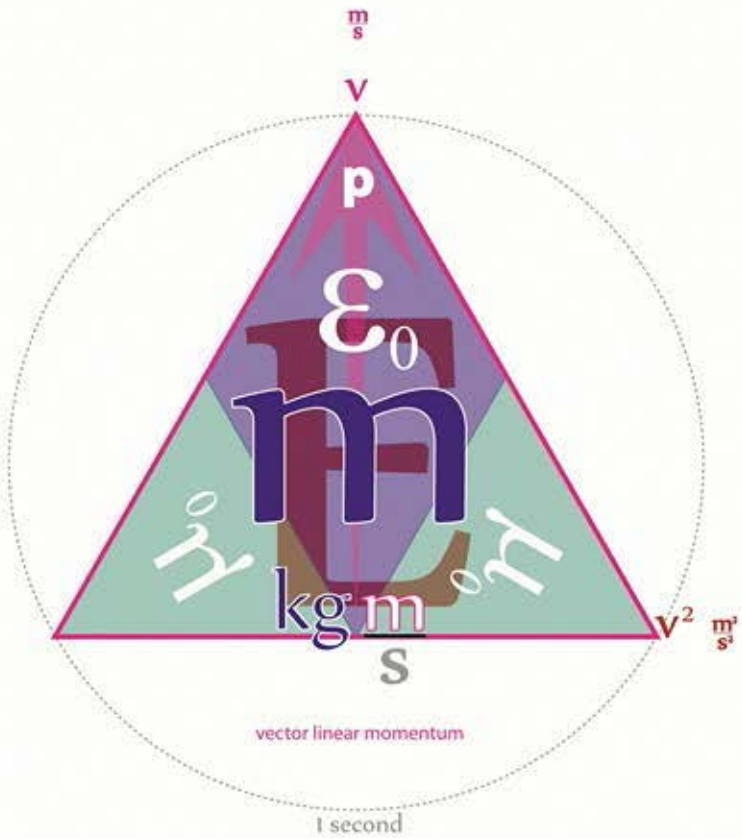

$m\Omega$

mass-QAM

6.629432672 e-34 J.s

$[m\Omega v]^2$

Planck quanta

mass velocity

7.376238634 e-51 kg

mass

m

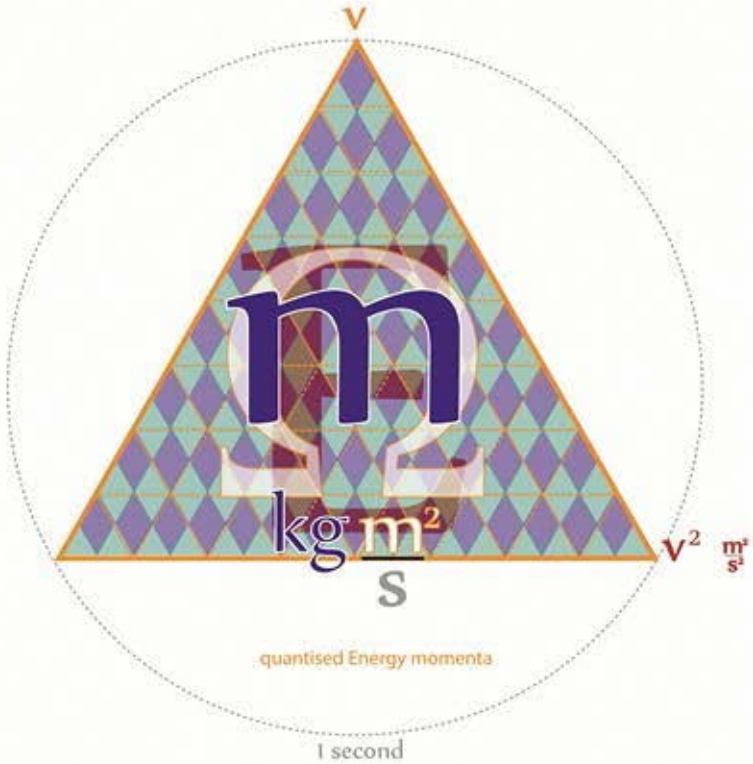

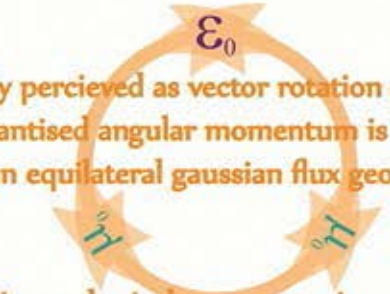

Normally percieved as vector rotation about a point
quantised angular momentum is actually
an equilateral gaussian flux geometry

(there is no physical vector rotation component)

p

linear momentum

$kg\frac{m^2}{s}$

h

Planck's Constant

$kg\frac{m^2}{s}$

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Charged mass & Matter in motion

produce differing but related measurments of EM force

Charged masses per second $\frac{C}{s} \approx kg \approx A$ Charged Matter in motion

Amperes

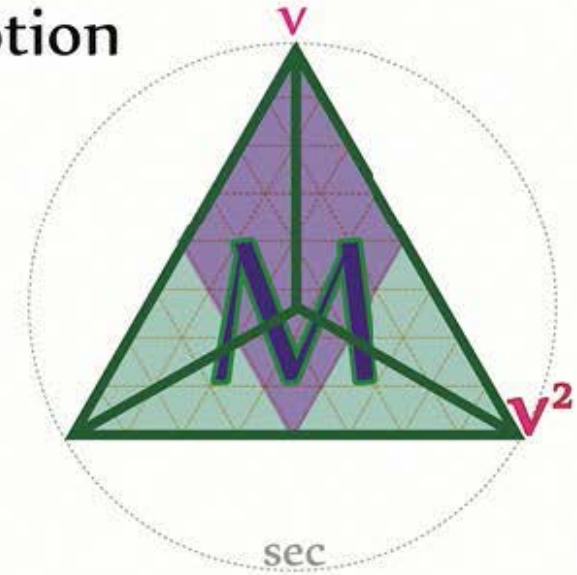

By definition in Tetryonics the quantised angular momentum of mass in any defined spatial co-ordinate system provides the quantum basis for

$$kg\,\frac{m^2}{s}$$

charged mass-energies

Quantised angular momenta creates CHARGE

Vector linear momentum creates CURRENT

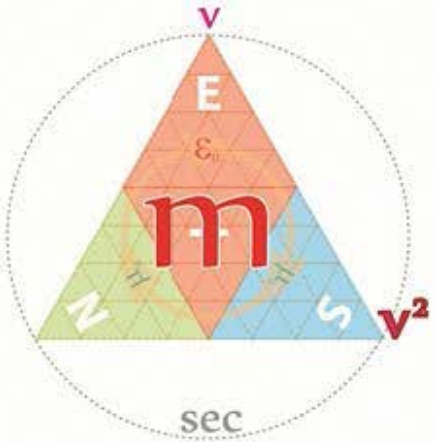

charged mass

$$C \approx kg.s \approx As$$

Coulombs Amp.sec

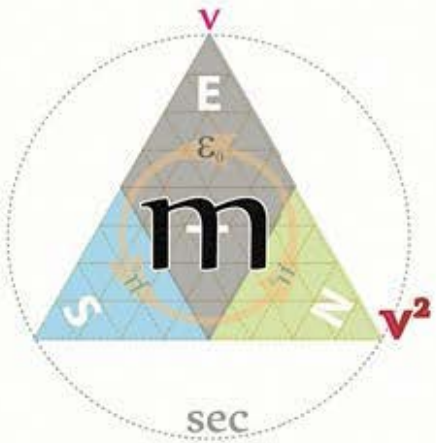

Charge, through its energy interactions, creates the geometric scaffolding for ALL 3D EM mass-Energy-Matter geometries

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Charged mass geometry

The symmetry of Charge geometries provides a geometric foundation
for all mass-Energy-Matter particles and physical forces

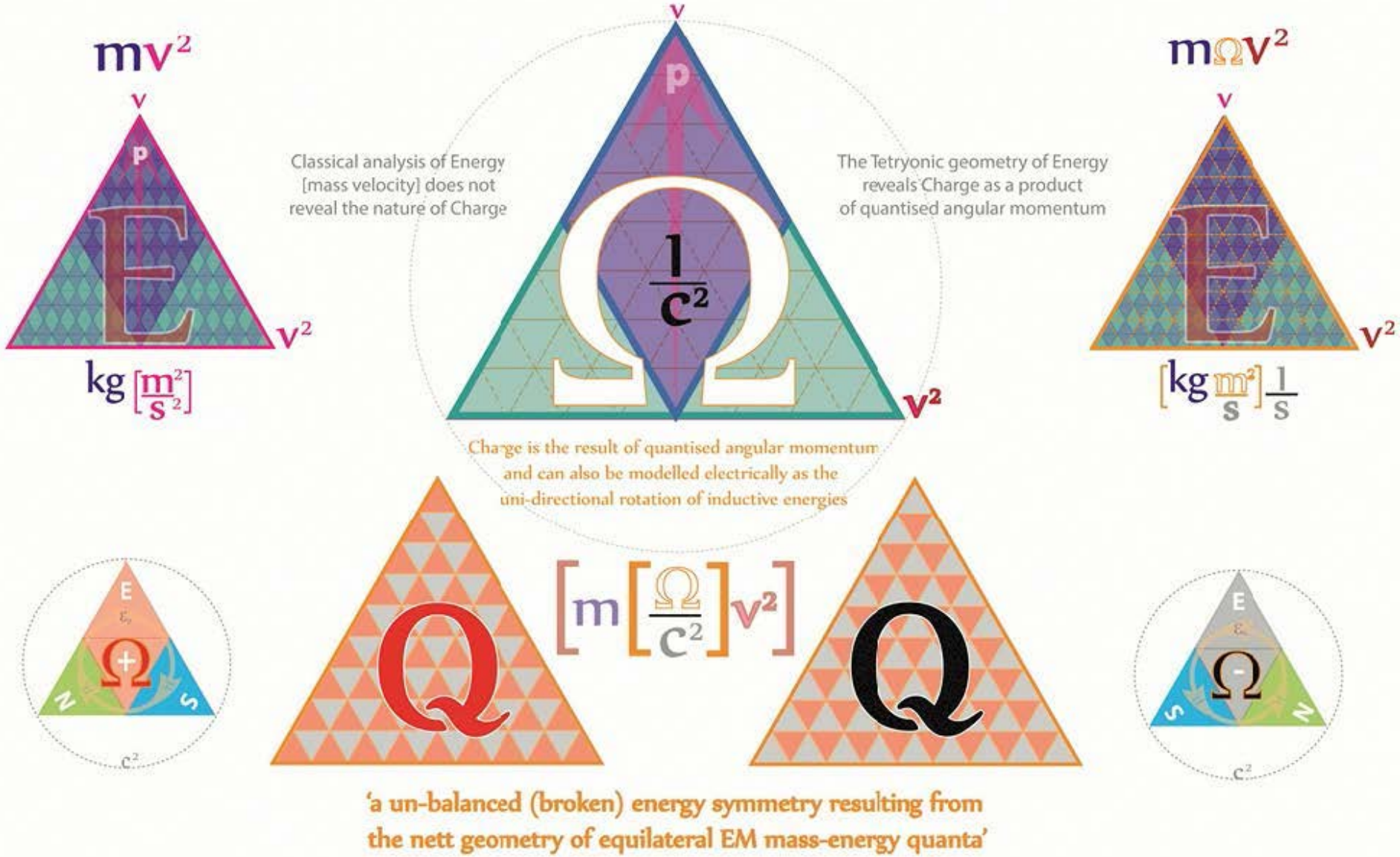

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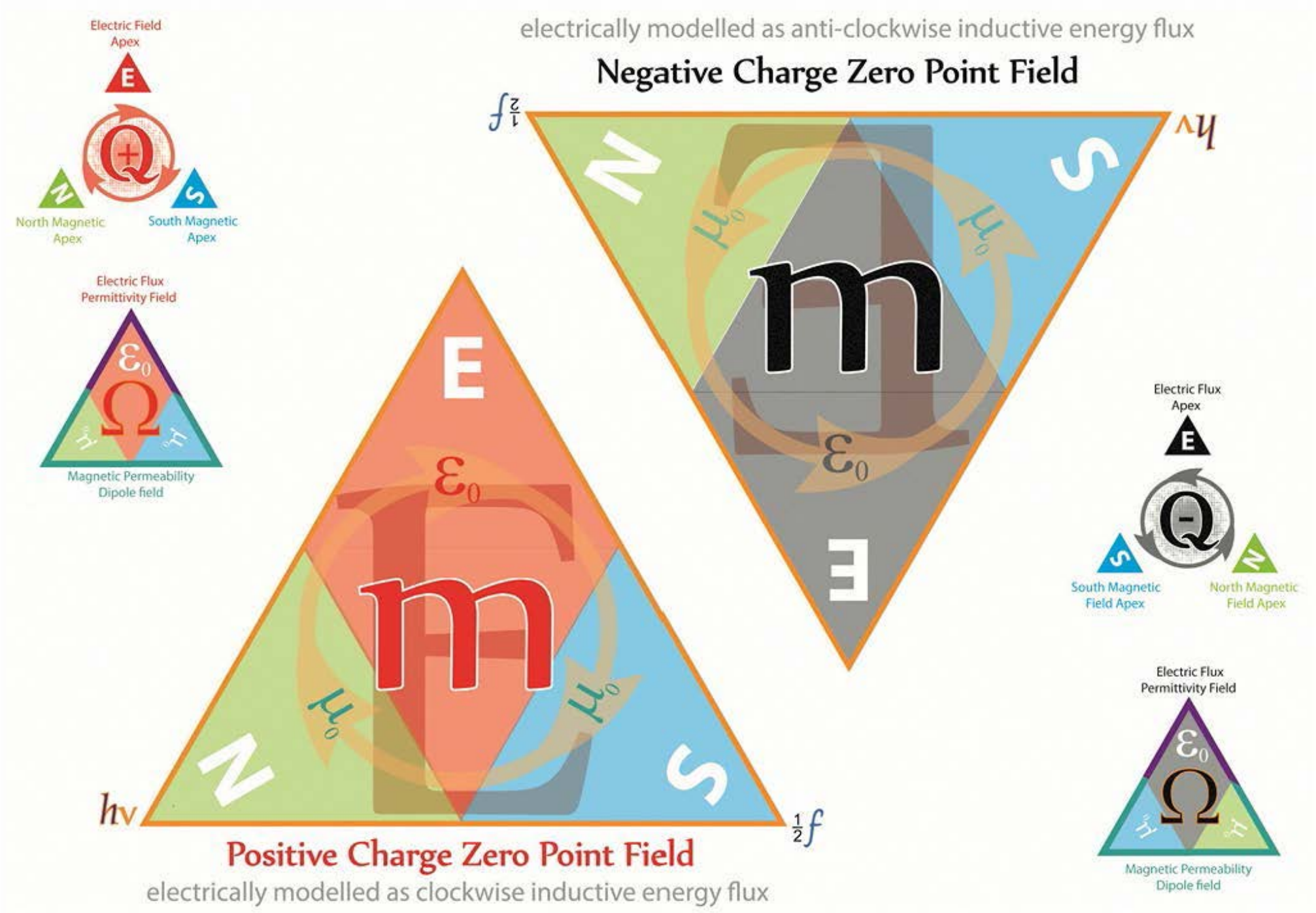

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Elementary and quantum Charges

"All kncwn Fermions have charge topologies that are integer 1/3 multiples of the elementary charge"

It can be shown that the "quantum of charge" is the intrinsic angular momentum of a Planck mass

It then follows that Quasi-particles [Tetryons and Quarks] have charge topologies with nett charges of 0, 4 and 8

Further, it can be shown that the "elementary charge" applied to Leptons and Baryons (12 times quantum charge) is reflective of their nett charged Matter topologies

$$T\pi[\pm q]$$

topology — charge — geometry

All Charged particles and their respective KEM fields can be modelled with ZPF field geometries reflective of their nett Charge topologies

Opposites attract
Similars repel

Quarks

up	anti-down	down	anti-up
+2/3	+1/3	-1/3	-2/3
Charmed Top	Strange Bottom	Strange Bottom	Charmed Top

Leptons

Positron	neutrino	Muon
Tau anti-electron	Tau neutrino	Tau

Baryons

+1	0	-1
Proton	Neutron	Negatron

quantised Charges
(EM energy flux rotation within a ZPF geometry)

q
quantum charges

[V] [V]

The elementary charge, usually denoted as e, is the electric charge carried by a single proton, or equivalently, the absolute value of the electric charge carried by a single electron

[V-V]

Q
Elementary charges

Elementary Charges
are the nett charge created by mass-energy-Matter topologies

Tetryons

4	0	4
[4-0]	[2-2]	[0-4]

Quarks

up	down	down	up
8	4	4	8
[10-2]	[8-4]	[4-8]	[2-10]

12	0	0	12
[12-0]	[6-6]	[6-6]	[0-12]
e	νe	νe	e

Leptons

Baryons

Proton	Neutron	Negatron
12	0	12
[24-12]	[18-18]	[12-24]

All Charges seek Equilibrium

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Sir Issac Newton

(25 December 1642 – 20 March 1727)

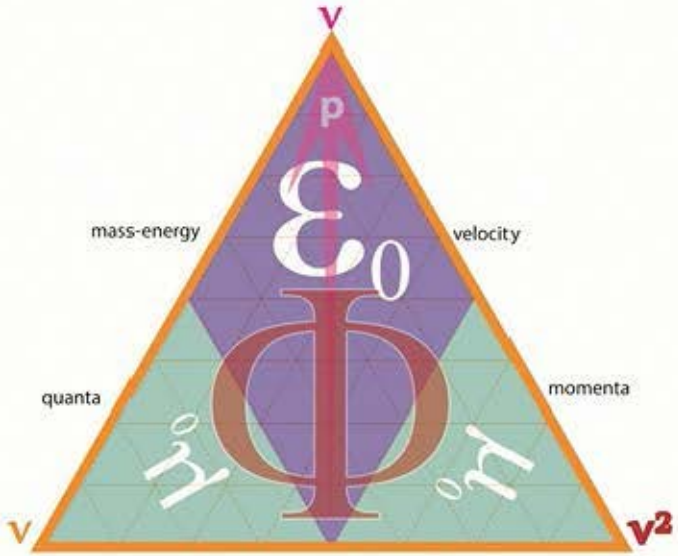

Any changes to velocity
result in changes to Energy-momenta
within a charged geometry

$$\sum \mathbf{F} = 0 \Rightarrow \frac{d\mathbf{v}}{dt} = 0$$

Newton's first law of motion says:
"A body maintains the current state of motion unless acted upon by an external force."

$$F = ma$$

Inertia is the resistance of any physical object to a change in its state of motion or rest, or the tendency of an object to resist any change in its motion.

It is proportional to an object's mass.

↑ [v–v] ↓

+

Ideal Inductive loops (ZPF quanta) will oppose ANY changes to their energy levels and consequently, Inertia can be viewed as an outcome of quantum ZPF self-Inductance

↓ [v–v] ↑

−

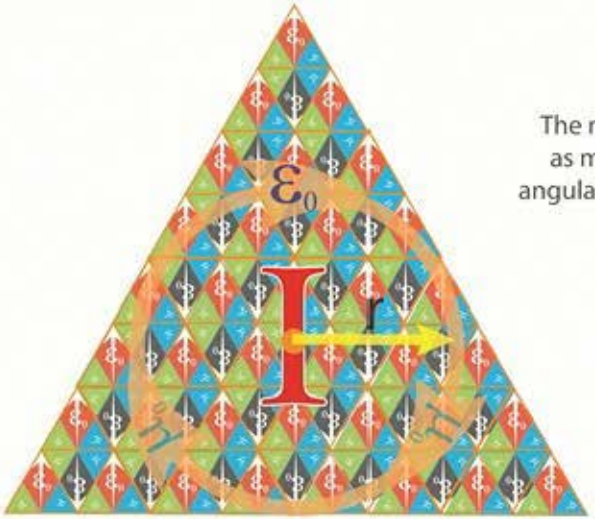

Inertia

The moment of inertia plays much the same role in rotational dynamics as mass does in linear dynamics, describing the relationship between angular momentum and angular velocity, torque and angular acceleration, and several other quantities

The difference between the impeding (inertial) linear momenta and the co-linear (supportive) momenta is a result of the nett Planck mass-energy momenta within the charged geometries of Matter & its KEM fields

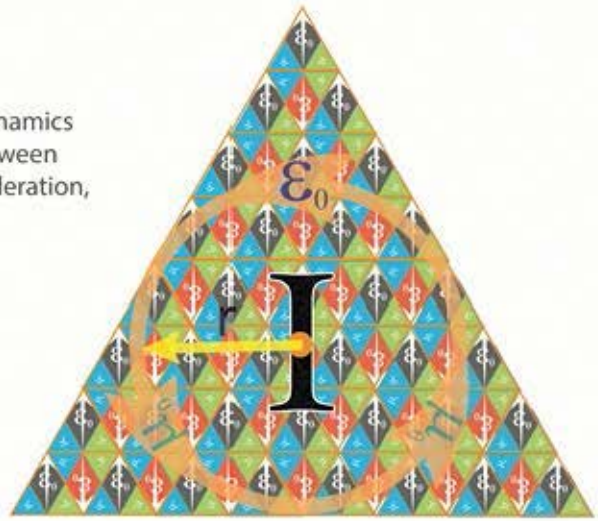

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Planck Quanta

are often defined as the "quantum of action"

h

Planck's Constant

$kg\,\frac{m^2}{s}$

The Planck constant (denoted h), is a geometric constant resulting from QAM in quantum mechanics

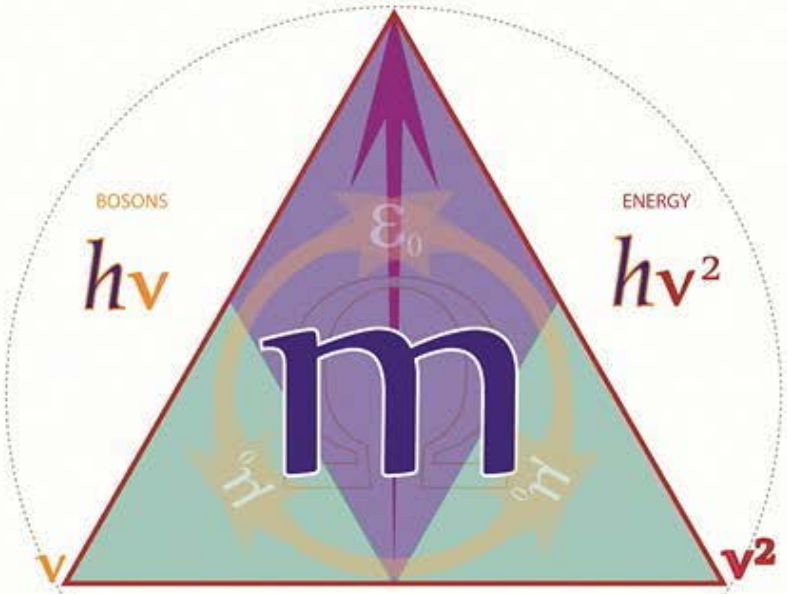

$h\nu$

$m\Omega\nu^2$

Planck quanta per second

$kg.\left[\frac{m^2}{s}\right].s^{-1}$

Planck's constant relates the energy in one quantum (photon) of electromagnetic radiation to the frequency of that radiation

Planck quanta are the minimum energy geometry possible (equilateral mass-energy momenta)

c^2

Charge is a result of QAM geometry

quantised angular momentum is the result of equilateral geometry

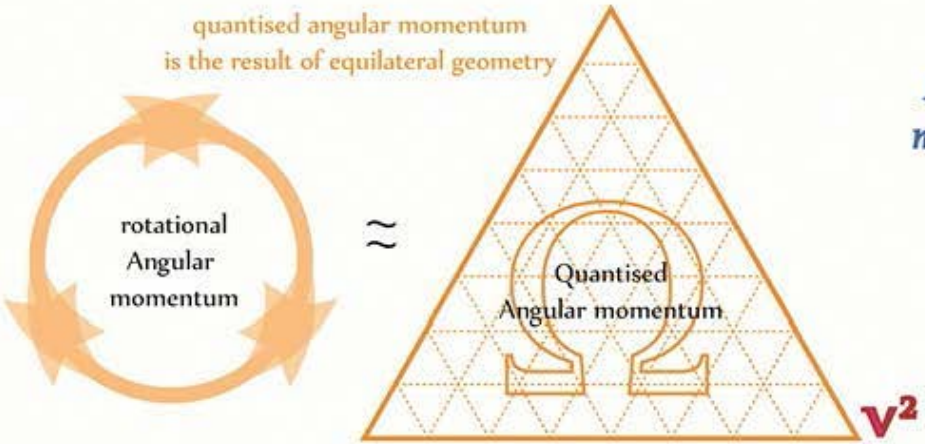

Photons have neutral quanta geometry

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$E = n.h\nu$

Planck Number

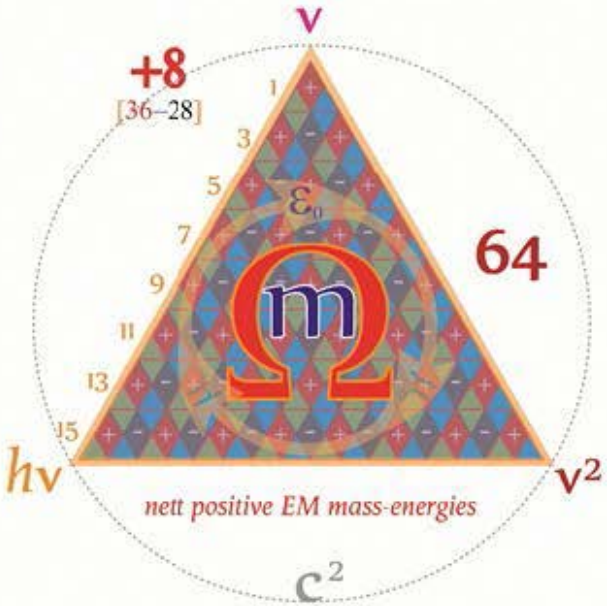

$h\nu$

tranverse Bosons

Max Planck

(April 23, 1858 – October 4, 1947)

$h\mathit{f}$

longitudinal Photons

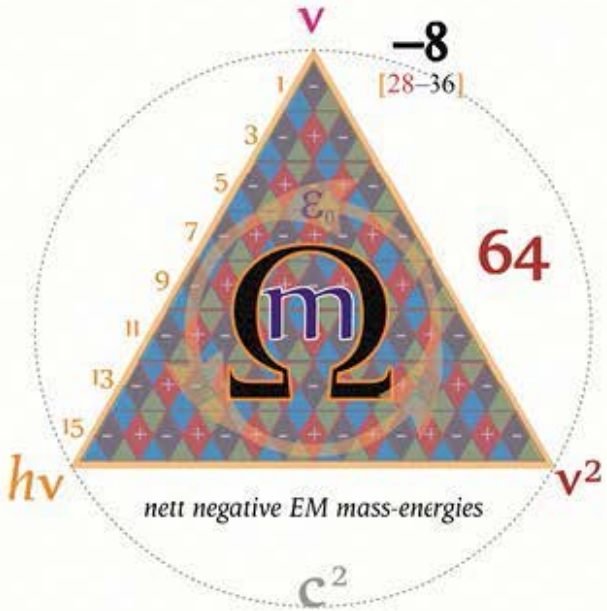

$1e19\nu = \mathbb{n} = 5e18\mathit{f}$

quantum number

BOSONS are the quanta of Charge

$1\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega\nu^2\right]\right]$

Boson; EM Field; Planck quanta; ElectroMagnetic; mass; velocity

Equating number of quanta is the source of a number

$h\nu \neq h\mathit{f}$

Planck Einstein

$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega\nu^2\right]\right]$

Photon; EM Field; Planck quanta; ElectroMagnetic; mass; velocity

to photon frequency of quantum misconceptions

PHOTONS are the neutral quanta of EM waves

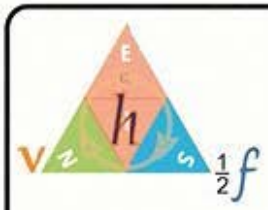

The Planck constant was first described as the proportionality constant between the energy (E) of a photon and the frequency (ν) of its associated electromagnetic wave. [it in fact describes the energy of bosons]

The zero-point energy for a simple harmonic oscillator of frequency f is ½ hf

The relation between the energy and frequency is called the Planck–Einstein relationship.

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Quantum Inductors

An "ideal inductor" has inductance, but no resistance or capacitance, and will not dissipate energy (until it interacts with other ZPFs or Matter) and forms the basis for all Charge-Parity-Time [CPT] interactions

A ZPF is fixed in either a + or - state
[Quantum Inductor circuit]

Its energy flux direction as modelled electrically] is relative to the observer's view or the direction of measurement

Charge polarity is opposed on opposite faces of the same quoin [quantum coin]

The direction of inherent energy flux from the presective of the observer determines ZPF charge polarity

+ ZPF

A positive ZPF can be viewed as a quantun quoin or an quantum 'ideal' inductor with an internalised energy flux that is the opposite of a negative ZPF

Clockwise current flow

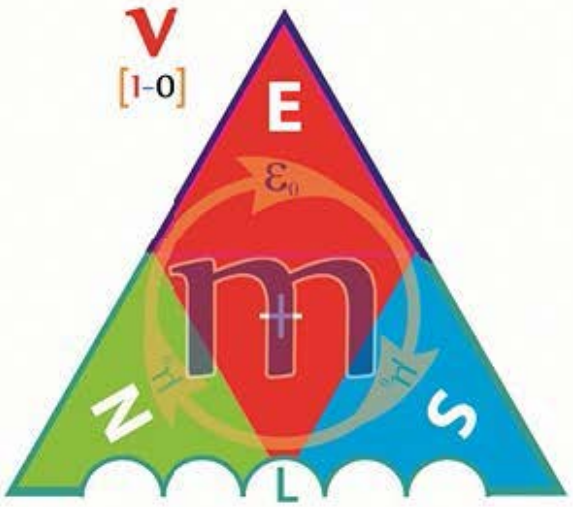

POSITIVE
Quantum L circuit
[quantum inductive circuit]

- ZPF

A negative ZPF can be viewed as a quantum quoin or an quantum 'ideal' inductor with an internalised energy flux that is the opposite of a positive ZPF

Counter-Clockwise Current Flow

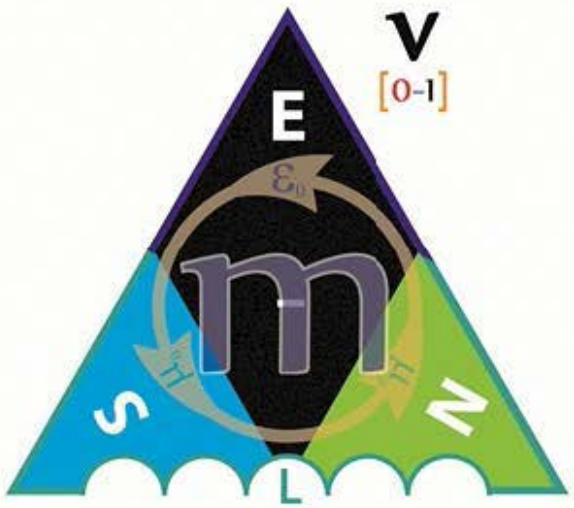

NEGATIVE
Quantum L circuit
[quantum inductive circuit]

The Quantum Inductor (L) circuit stores energy as EM mass in π geometries, it does not oscillate

Energy received is stored indefinitely until its release via weak interaction

[Inductive Magnetic coupling]

The quantum Inductive circuit is a SINGLE charge tri-field inductive energy loop

It does not oscillate energy between two opposing charges its differing energy fields are the reuslt of its equilateral QAM geometry storing Electric energy in its E field, and Magnetic energy in its M field

The direction of the QAM flux that models inertia is relative to the observer

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Quantum Inductors and EM energy Levels

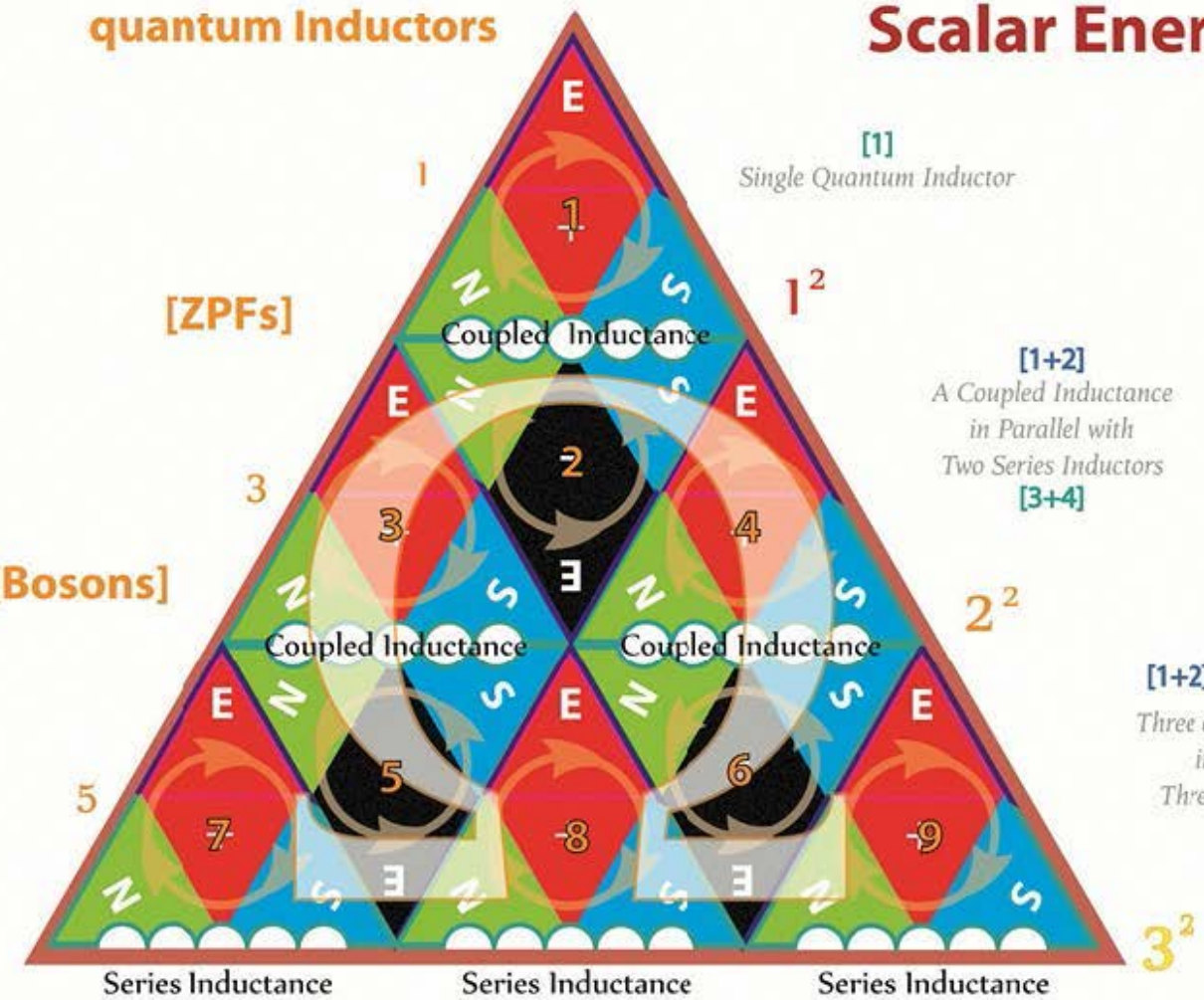

Scalar Energies

[1]
Single Quantum Inductor

[1+2]
Coupled Quantum Oscillator

[1+2]
A Coupled Inductance in Parallel with Two Series Inductors
[3+4]

E

[1+2] [3+5] [4+6]
Three coupled Inductances in Parallel with Three Series Inductors
[7+8+9]

coupled ODD# mass-energies form SQUARE energy geometries

Quantum energy levels can be viewed as various combinations of:

Coupled Inductances

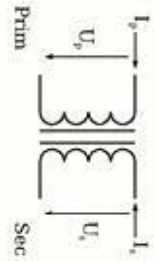

Parallel Inductances

$$L_{total} = \frac{1}{\frac{1}{L_1} + \frac{1}{L_2} + \ldots \frac{1}{L_n}}$$

Series Inductances

$$L_{total} = L_1 + L_2 + \ldots L_n$$

All quantum levels form inductive magnetic dipole bases
[Weak Force]

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The Golden Triangle

Charged mass-energy geometries

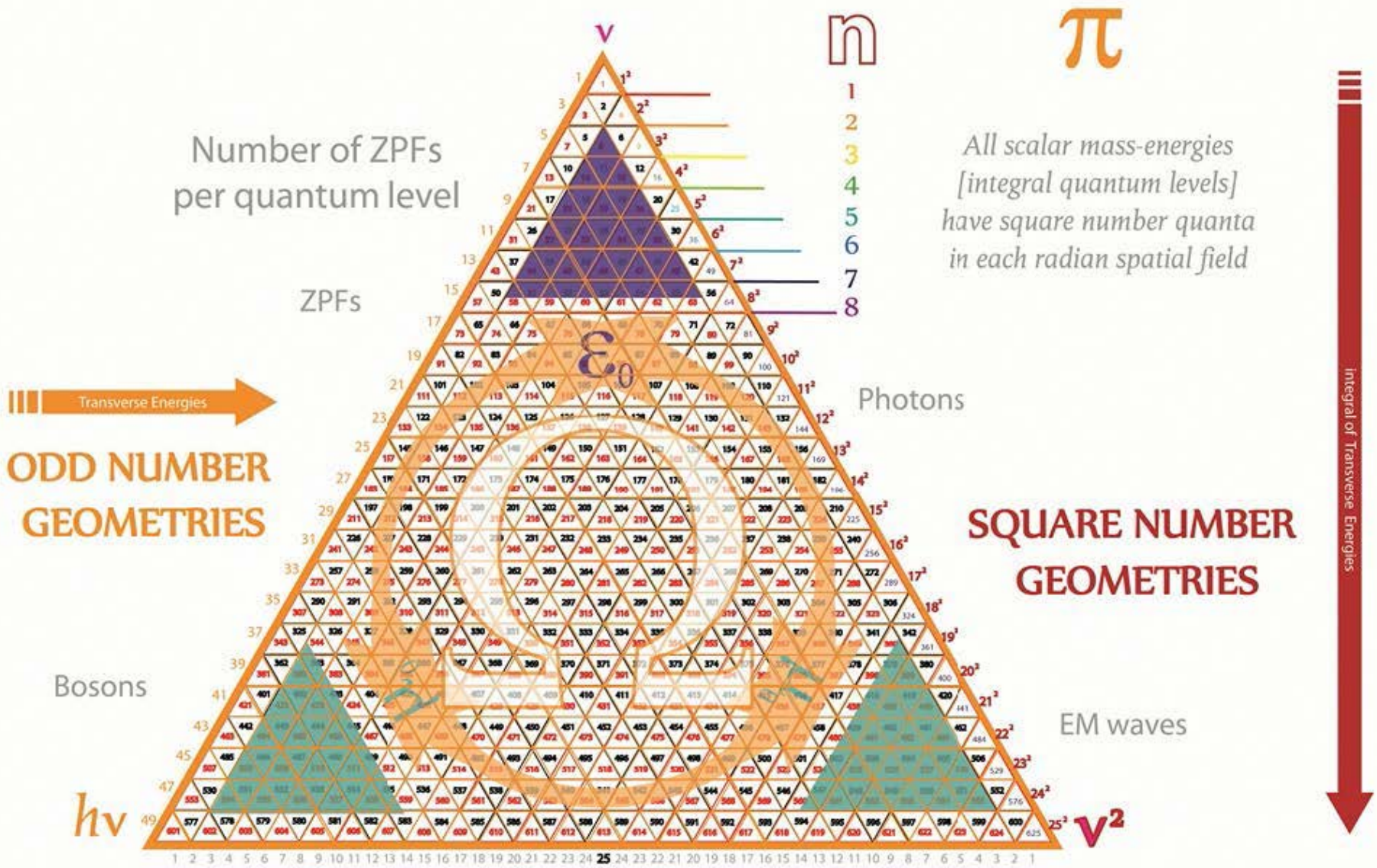

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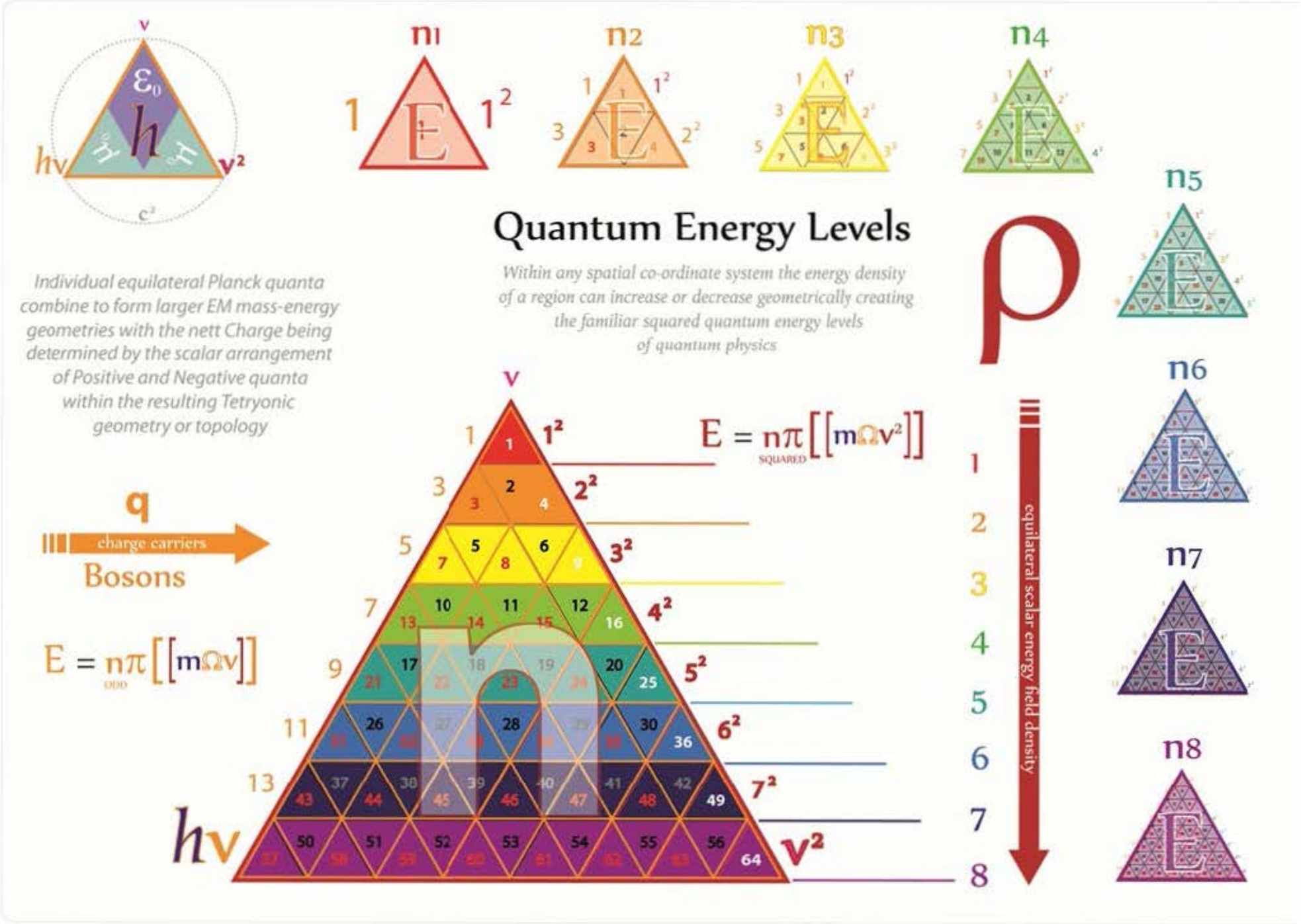

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Magnetic Vectors

Intrinsic Magnetic vectors are transverse to E fields

External Magnetic fields are termed B fields

Magnetic vectors can be modelled geometrically or electrically through energy field fluxes [quantised angular momenta]

Opposite charges moving in opposing directions produce co-directional Magnetic vectors

Within a Magnetic dipole

Magnetic Vector A

energy 'flows' South to North

External to a Magnetic dipole
energy 'flows' North to South

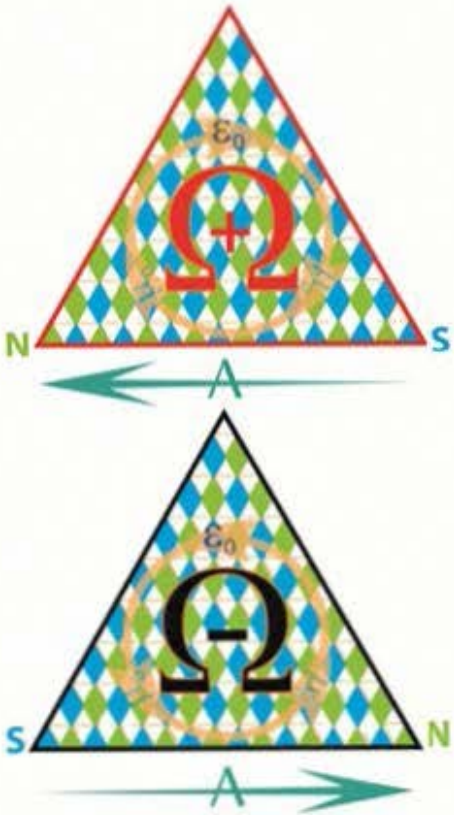

Opposite charges moving in the same direction produce Magnetic vectors in opposition

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Charge Fields

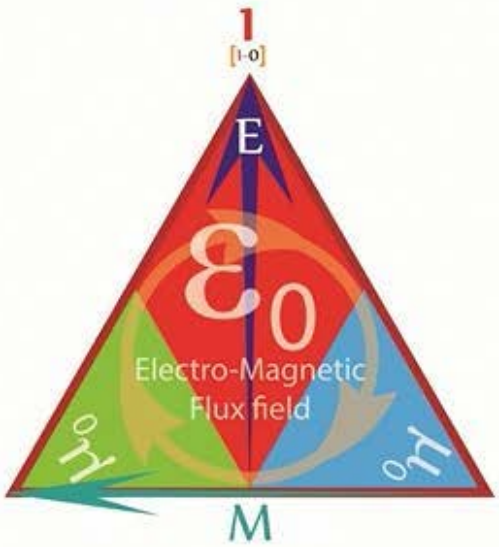

EM energy fluxes in a Positive ZPF flows
are electrically modelled as Clockwise
(from North to South)

The EM flux directions of Charges
can be modelled vectorially with
Electric and Magnetic vectors

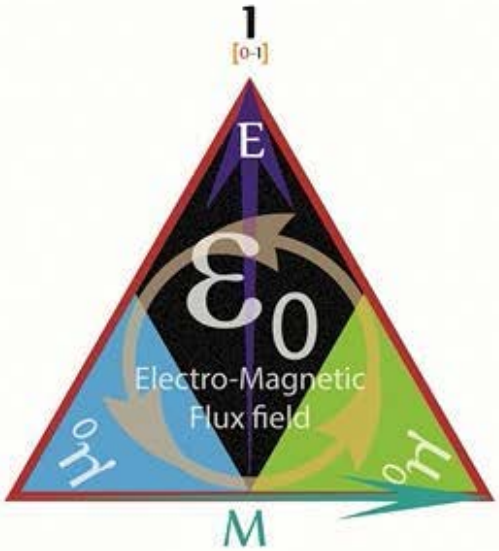

EM energy fluxes in a Negative ZPF
are electrically modelled as counter-Clockwise
(from North to South)

All rotational planck energy fluxes can serve as models for the nett quantised angular momenta of any mass-energy geometry

Polarised
Electric and Magnetic fluxes
in ElectroMagnetic fields arise from
intrinsic quantised angular momentum

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EM fields

are the combined Electric & Magnetic fields resulting from the quantised angular momentum of mass-energy in any region of free space

ZPF

$$\varepsilon_0 \mu_0 = \frac{1}{c^2}$$

EM Permittivity-Permeability is a measure of how much resistance is encountered when the quantised angular momenta of EM energies form an electro-magnetic field in a vacuum

Celeritas = 299,792,458 $\frac{m}{s}$

$$c_0 = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}.$$

EM field Permittivity-Permeability

$$\varepsilon_0 \mu_0 = 1.112650056\text{e-}17 \ \frac{s^2}{m^2}$$

$$\left[\frac{A^2\ s^4}{kg\ m^3} \cdot \frac{kg}{A^2}\frac{m}{s^2}\right]$$

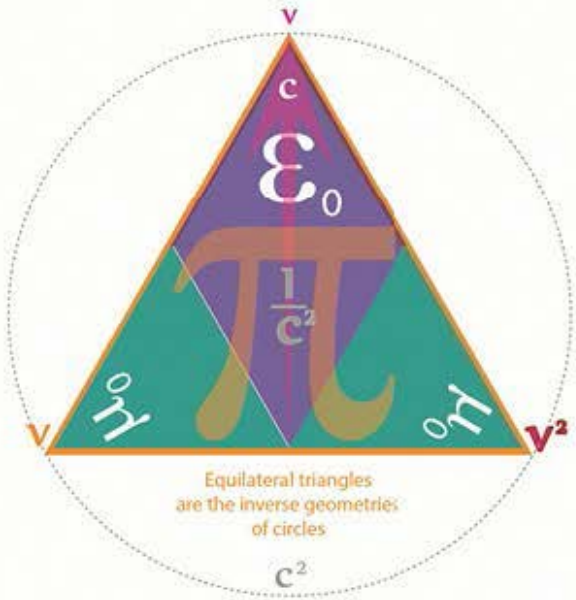

m		nπ	[ε0μ0]	[mΩv²]
mass	=	charged	Spatial geometry	Energy density

Electric Constant

$$\varepsilon_0 = \frac{1}{\mu_0 c^2}$$

$$= 8.85418785\text{ e-}12 \ \frac{F}{m} \quad \frac{A^2\ s^4}{kg\ m^3}$$

The permittivity of empty space, equal to 1 in centimeter-gram-second electrostatic units and numerically, to 8.854 × 10-12 farad per meter in International System units, where c is the speed of light in meters per second. Symbolized ε0.

Magnetic Constant

$$k_0 = \frac{1}{4\pi\varepsilon_0}$$

$$= 1.25663706\text{ e-}6 \ \frac{H}{m} \quad \frac{kg\ m}{A^2\ s^2}$$

A measure of the degree to which molecules of some material polarize (align) under the influence of an electric field; symbol k0, units F/m (farads per metre).

E = 2hν

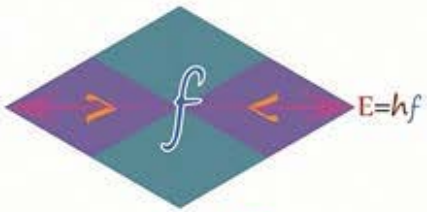

$$\vec{S} = E \times H, \qquad S = E \times H'$$

The Energy-momenta of ZPFs form natural Poynting vectors

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EM field Permittivity

The Electric constant, commonly called the vacuum permittivity, or permittivity of free space, relates the units for electric charge to mechanical quantities such as length and force.

The name Vacuum Permittivty is a misnomer and should be replaced with the correct term EM field Permittivity

The strength of Electric fields is determined by the Electrical Permittivity Constant

$$E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$

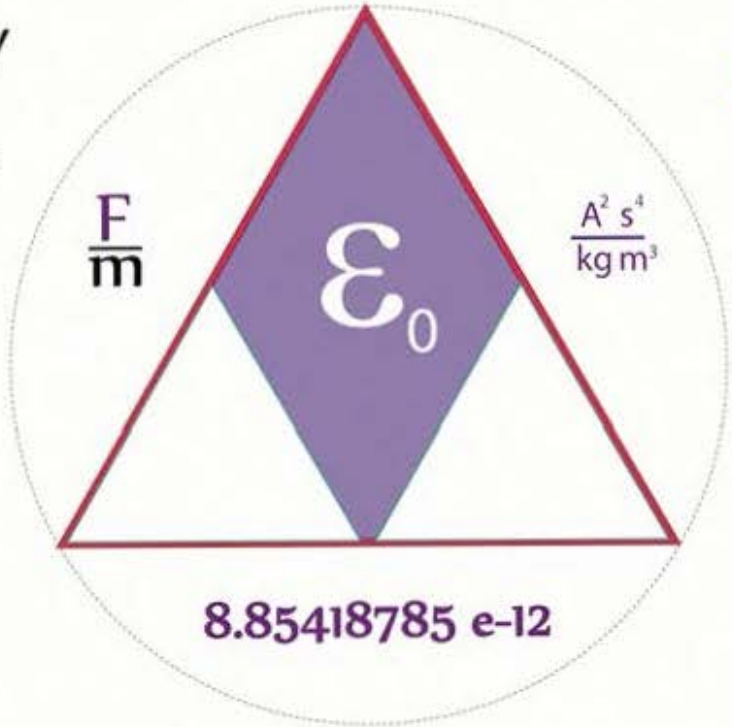

The permittivity of empty space, equal to 1 in centimeter-gram-second electrostatic units and to 107/4πc2 farads per meter or, numerically, to 8.854 × 10-12 farad per meter in International System units, where c is the speed of light in meters per second.

$$\varepsilon_0 = \frac{1}{\mu_0 c^2}$$

"Ampere's Law states that for any closed loop path, the sum of the quantities (B.ds) for all path elements into which the complete loop has been divided is equal to the product of μ0 and the total current enclosed by the loop."

$$k = \frac{1}{4\pi\varepsilon_0}$$

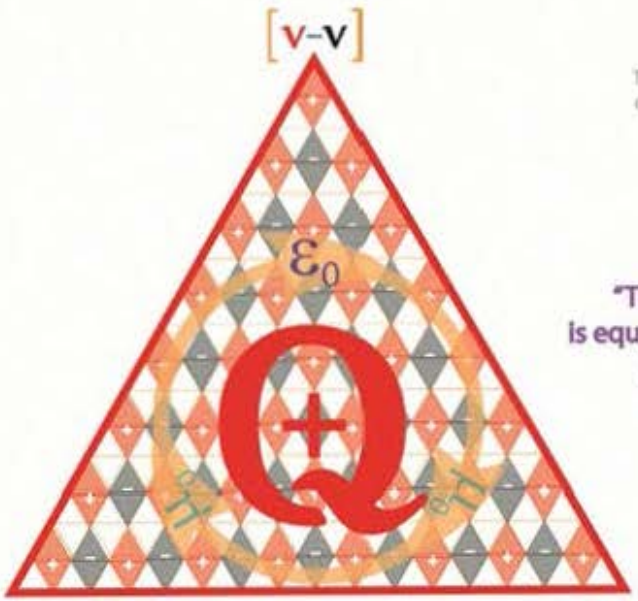

Positive Charge Electric Field

Gauss' Law:

"The total of the electric flux out of a closed surface is equal to the charge enclosed divided by the permittivity"

This applies equally to any geometry chosen to tessellate a surface area

Superpostioned E fields gives rise to Coulomb Forces

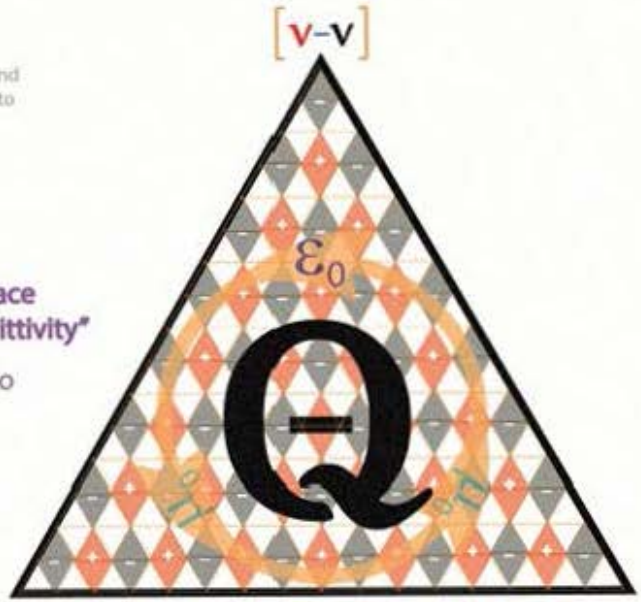

Negative Charge Electric Field

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Electric permittivity Fields

Negative externalised Planck quanta
(Counter-clockwise energy fluxs)

Coupled same charge ZPFs
have **neutralised** Magnetic fields

In Electro-statics superpositioned E fields with interactive energy momenta are the interactive mechanism for Coulombic forces

Electrostatic Particles
in motion have Kinetic energies
resulting in Magnetic moments

Positive externalised Planck quanta
(Clockwise energy fluxs)

Polar view

Negative E-fields

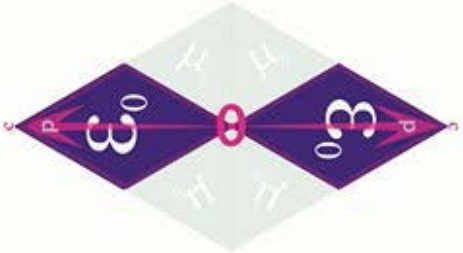

Polar view

Positive E-fields

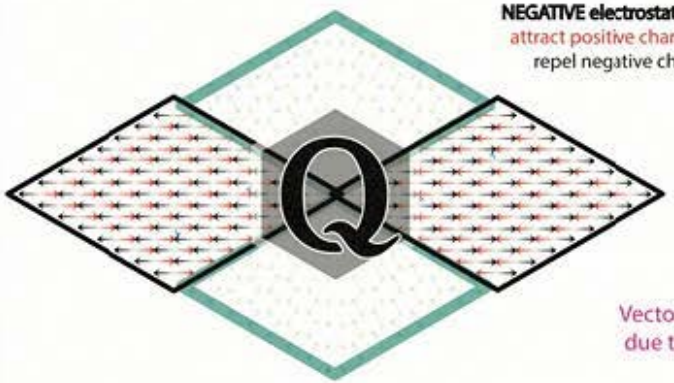

NEGATIVE electrostatic E fields
attract positive charges and
repel negative charges

ε_0

POSITIVE electrostatic E fields
attract negative charges and
repel positive charges

Opposites Attract
Similars Repel

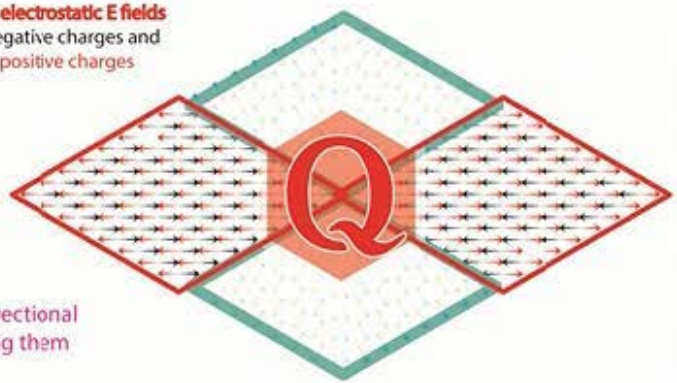

Vectorial momenta forces in EM fields are bi-directional
due to the energy-momenta quanta comprising them

The currently stated 'standard' premise of Electrical Energy flowing from Positive to Negative is misleading (as Energy also flows from Negative to Positive at the same time)

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EM field Permeability

The permeability of free space,
also called absolute permeability.

The name Vacuum Permeability is a misnomer and should be replaced with the correct term EM field Permeability

The magnetic constant has the value of
$4\pi \times 10\text{-}7$ henry per meter.

The strength of Magnetic fields is determined by the Magnetic Permeability Constant

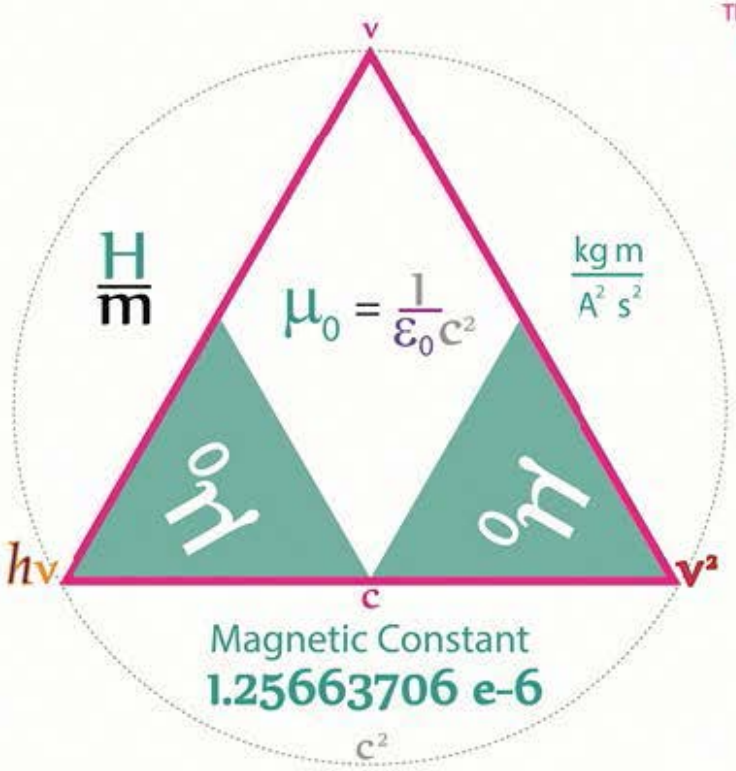

A measure of the degree to which molecules of some material polarize (align) under the influence of an electric field.

Measured in units of units H/m (Henries per metre).

There are
NO magnetic monopoles
[not under any condition]

F

The magnetic field is most commonly defined in terms of the Lorentz force it exerts on moving electric charges.

The magnetic field generated by a steady current (a constant flow of electric charges in which charge is neither accumulating nor depleting at any point) is described by the Biot–Savart law

μ_0

$B = \mu_0 H$

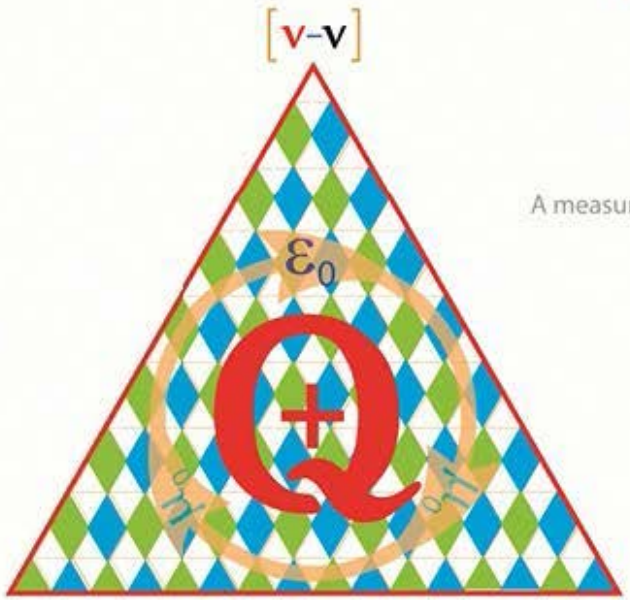

Positive Magnetic Moment

Negative Magnetic Moment

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Magnetic permeability Fields

Coupled opposite charge ZPFs
produce **neutralised** Electric fields

In Magneto statics superpositioned M fields with interactive energy momenta are the interactive mechanism for Lorentz forces

Magneto-static Particles
have enhanced Magnetic moments

Amperes law

Current flowing through a wire will create a magnetic field

Lorentz forces

charged particles in motion are subject to forces due to external EM fields

magnetic field forces are orthagonal to electric Coulomb forces

Vectorial momenta forces in EM fields are bi-directional due to the energy-momenta quanta comprising them

Opposites Attract
Similars Repel

NORTH M- fields
attract south M-fields and repel north M-fields

μ_0

SOUTH M- fields
attract north M-fields and repel south M-fields

Magentic fields can only exist in conjuction with Electric fields & Electric fields can only exist in conjunction with Magnetic fields

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Electro-static fields

Similar charge electric dipole pairings create 'neutralised' Magnetic dipoles

There are no such things as purely Electric or Magnetic fields

v=0

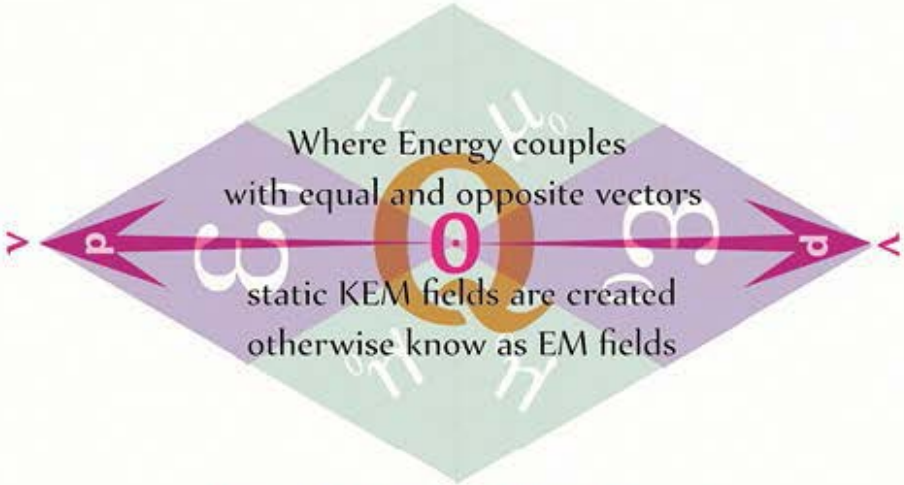

Fields of Force

All energy fields are Electro-Magnetic in nature a direct product of their equilateral geometry

'Neutralised' electric dipole pairings create Magnetic dipole fields

Magneto-static fields

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Charged EM field geometries

Opposite charge fields
can produce neutral E-fields
(with magnetic moments)

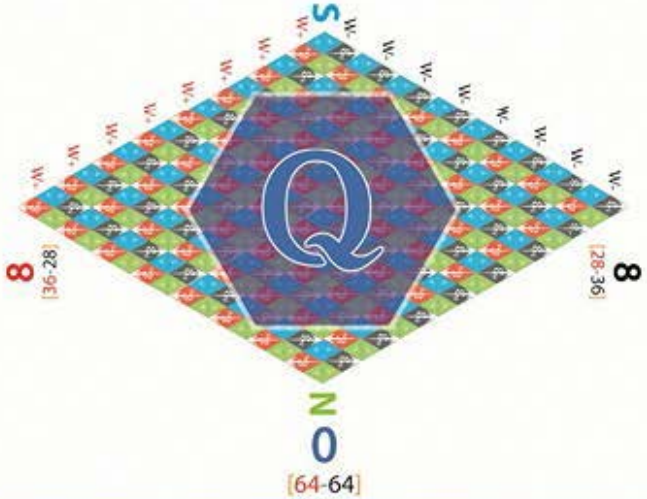

Electrostatic charged matter generate
charged energy fields around them

Moving charged particles generate
Kinetic energy & Magnetic moments

Charged electrostatic fields

accelerate charged particles
vectorally dependent on their quantum
charge mass-energy momenta field geometries

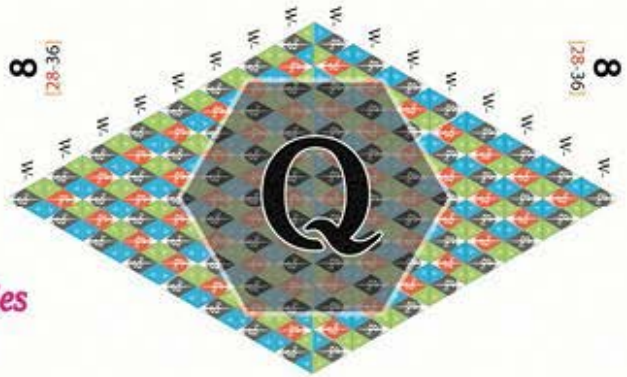

Positive charge electrostatic fields
attract Negative charges
repel Positive charges

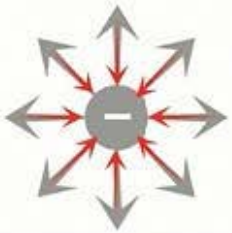

Negative charge electrostatic fields
attract Positive charges
repel Negative charges

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E field acceleration of charged particles

Electric fields can accelerate charged particles within their field geometry dependent on the particle's nett charged mass-Matter topology

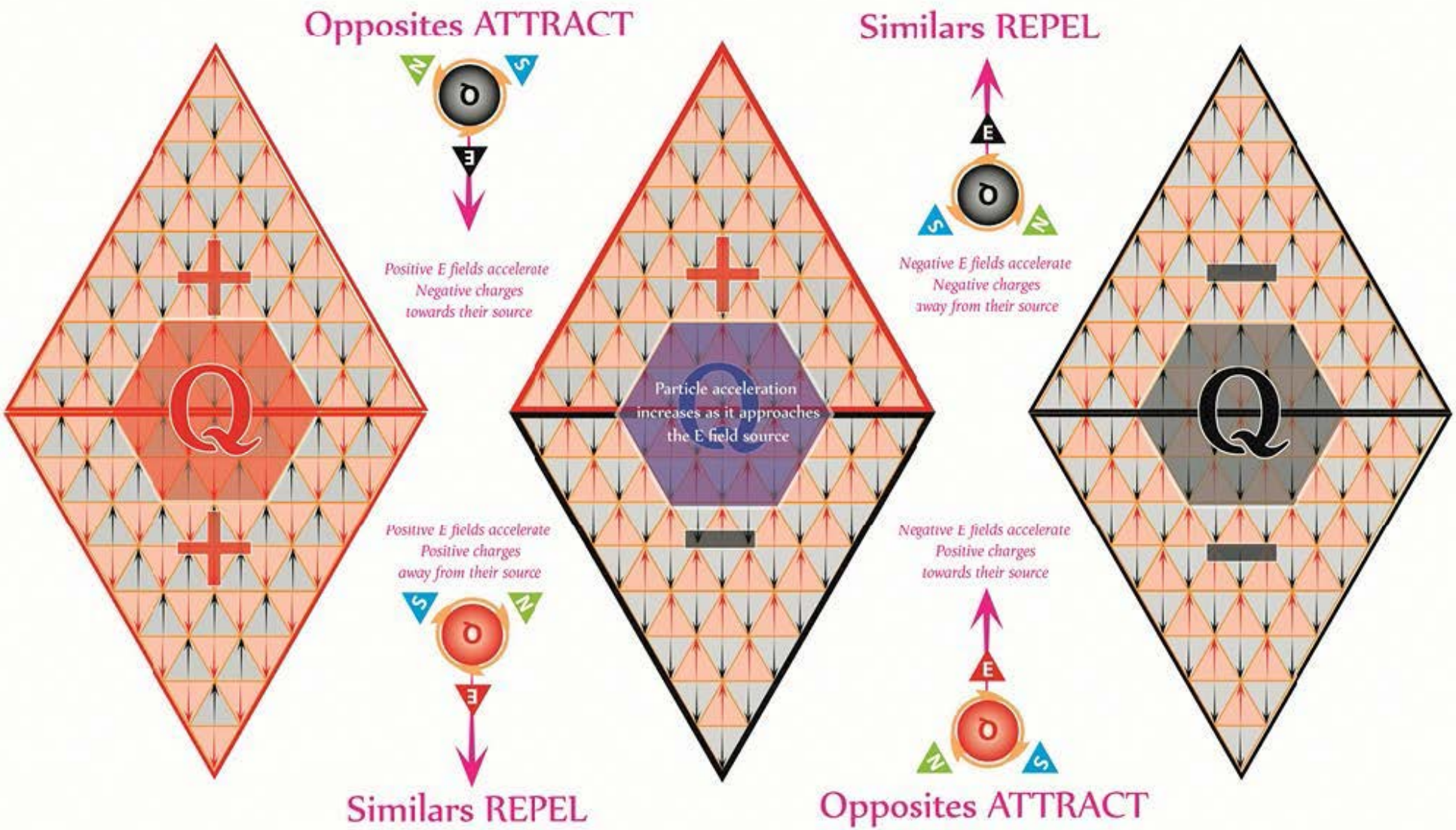

The charge quanta within Neutral particles are affected equally by Electric fields

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ZPFs can combine to form
4 distinct static EM fields

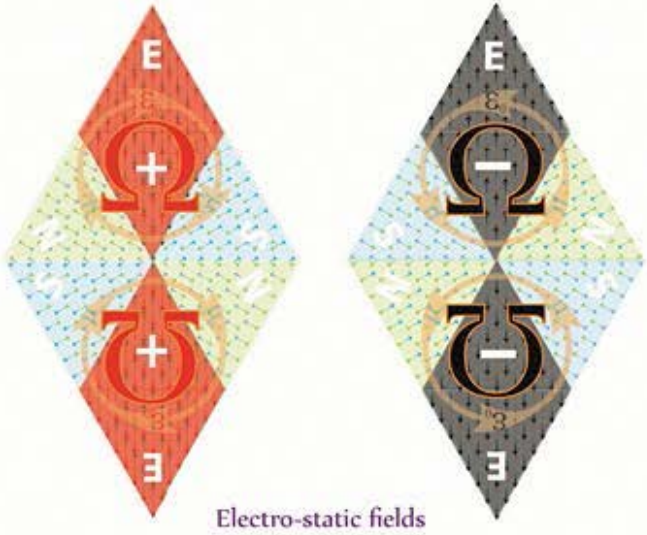

Electro-static fields

ElectroMagnetic fields

Magneto-static fields

Similars REPEL
[QAM momenta vectors in opposition]

Opposites ATTRACT
[QAM momenta vectors in same direction]

'THE LAW OF INTERACTION'

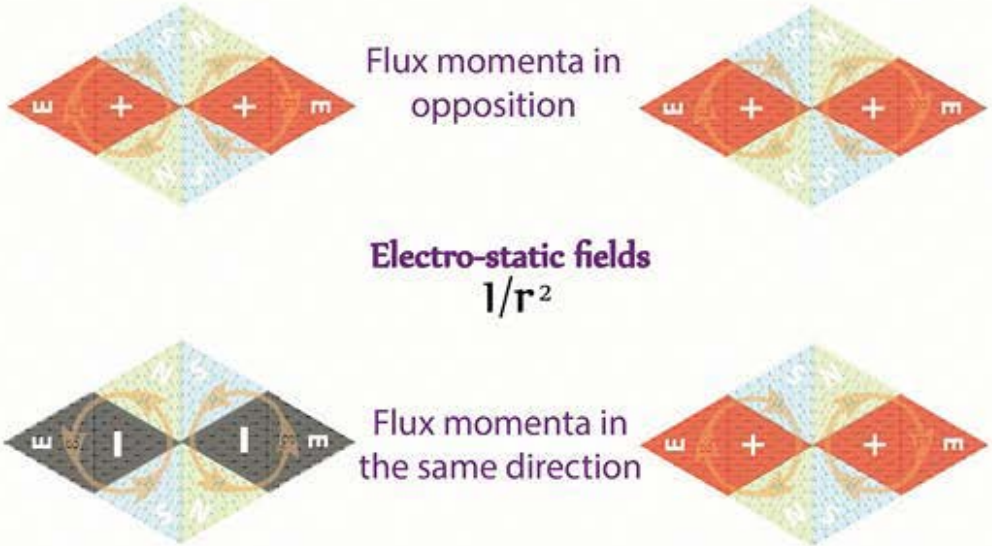

'FORCES OF INTERACTION'

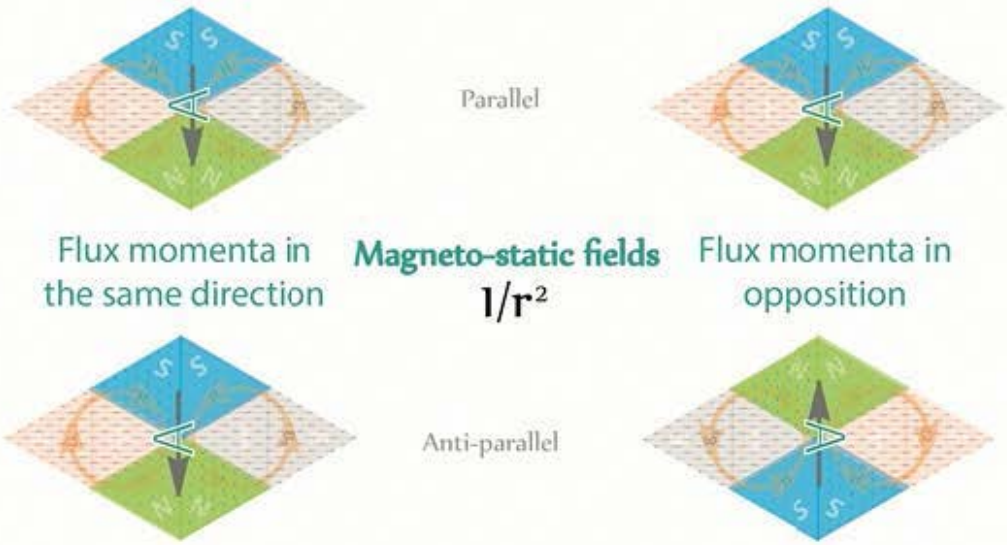

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Positive electrostatic fields

divergent positive momenta

convergent negative momenta

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{\mathbf{r}}$$

Coulomb's Force Law

$$E = \frac{F}{q} = \frac{kQ_{source}q}{qr^2} = \frac{kQ_{source}}{r^2}$$

Negative electrostatic fields

convergent positive momenta

divergent negative momenta

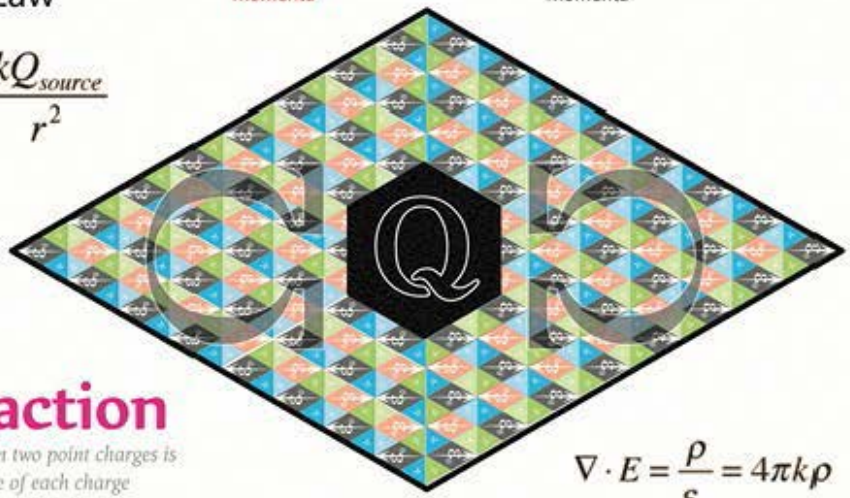

$$\nabla \cdot E = \frac{\rho}{\varepsilon_0} = 4\pi k\rho$$

Forces of Interaction

"The force of electrical attraction or repulsion between two point charges is directly proportional to the product of magnitude of each charge and inversely proportional to the square of distance between them"

attract Negative charged masses
repel Positive charged masses

attract Positive charged masses
repel Negative charged masses

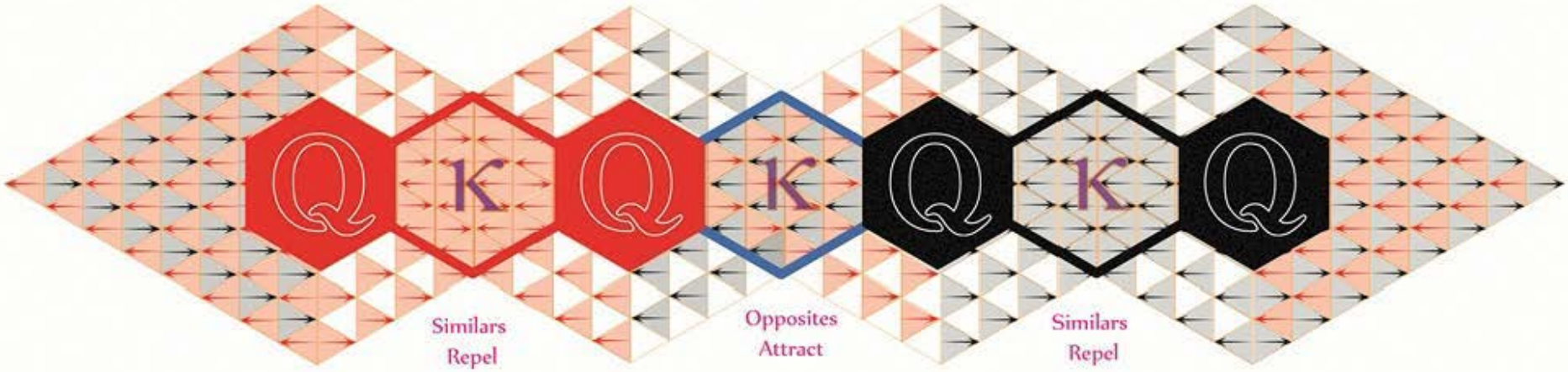

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Electro-Magnetic field Lines

The magnetic field at any given point is specified by both its direction and magnitude

Magnetic dipoles can be produced by the coupling of opposite electric charge fields

or

by accelerating charged bodies of Matter which in turn produce associated Kinetic energies
[Neutral Electric field and equal strength Magnetic moment]

Magnetic South Poles have divergent south vectors and convergent north vectors

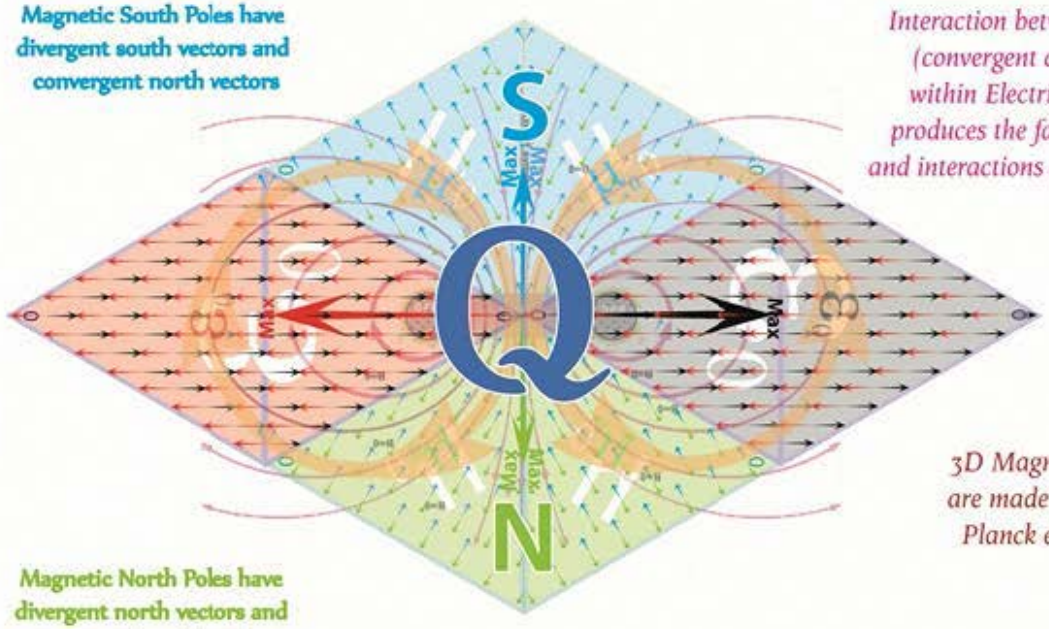

Interaction between vectorally opposed (convergent and divergent) vectors within Electric and Magnetic fields produces the familar lines of force and and interactions of Electro-Magnetic fields

Every particle of Matter in motion possesses intrinsic Planck M-field dipoles becasue of their nett charged quanta which combine to produce a nuclear magneton.

3D Magnetic lines of Force are made up of 2D fields of Planck energy momenta

Magnetic North Poles have divergent north vectors and convergent south vectors

The magnetic field lines of permanent bar magnets are the result of the equilateral charge [QAM] geometry of neutralised quanta that form their electrostatic fields

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Magnetic field Forces

$$\frac{m^2 \cdot kg}{s^2 \cdot A^2} = \frac{J}{A^2} = \frac{Wb}{A} = \frac{s^2}{F} = \frac{V \cdot s}{A} = \frac{J/C \cdot s}{C/s} = \frac{J \cdot s^2}{C^2} = \frac{m^2 \cdot kg}{C^2}$$

In physics superpositioned M fields with interactive energy momenta produce Lorentz forces

attractive magnetic forces

repulsive magnetic forces

Magnetic moments of same charges moving in the same direction

Magnetic moments of same charges moving in opposite directions

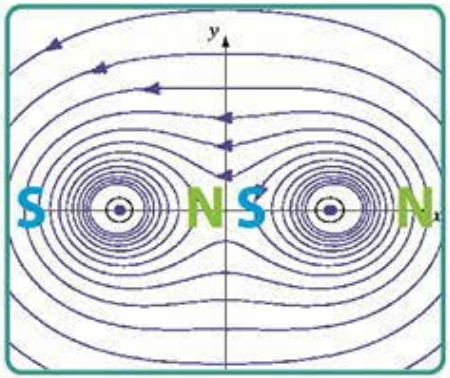

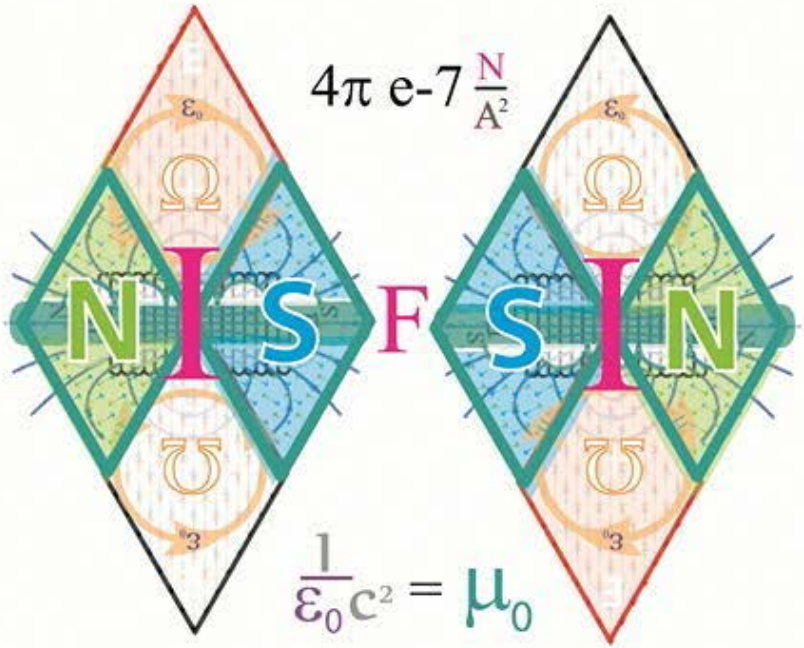

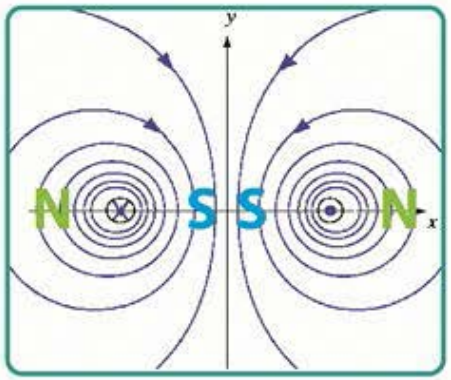

magnetostatic fields

$$\mathbf{H} = \frac{\mathbf{B}}{\mu_0}$$

Coupled opposite charge EM fields produce Magnetic dipole fields

Joseph Henry

(17 December 1797 – 13 May 1878)

μ_B

Electrostatic charged particles in motion create magnetic moments

kinetic EM fields

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Magnetic field lines

Magnetostatic Dipole

Magnetic field lines were introduced by Michael Faraday (1791-1867) who named them "lines of force"

Michael Faraday

(22 September 1791 – 25 August 1867)

Magnetic South Poles have divergent south vectors and convergent north vectors

External to the dipole field lines run from North to South

Positive Electric fields have divergent positive E vectors and convergent negative E vectors

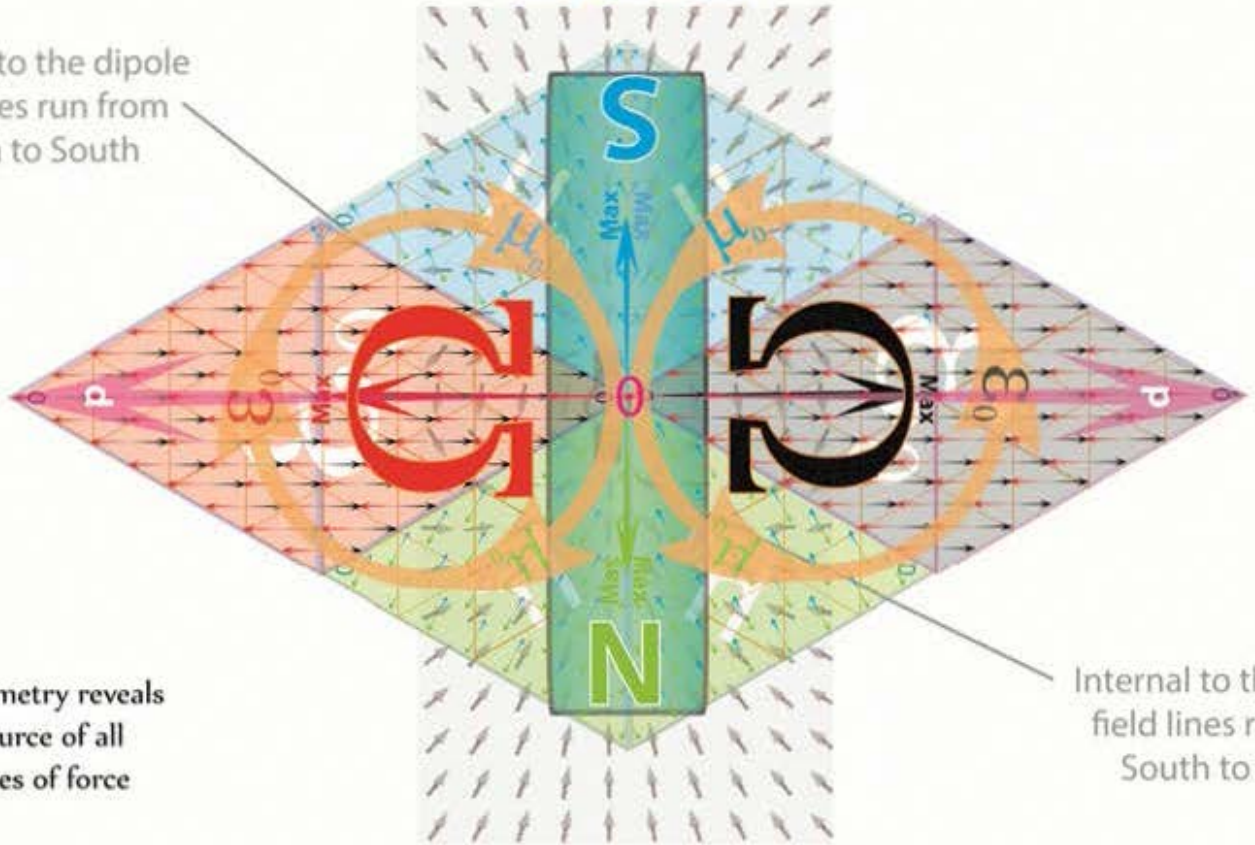

Negative Electric fields have divergent negative E vectors and convergent positive E vectors

Tetryonic geometry reveals the true source of all EM field lines of force

Internal to the dipole field lines run from South to North

Magnetic North Poles have divergent north vectors and convergent south vectors

Permanent Magnets can be viewed as neutral charge Electrostatic EM fields

Similar to conventional vs electron current flows Magnetic field vectors can be modelled with two directions of 'magnetic flux'

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Parallel Magnetic Dipoles

Michael Faraday

(22 September 1791 – 25 August 1867)

James Clerk Maxwell

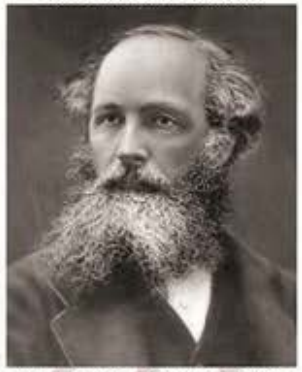

(13 June 1831 – 5 November 1879)

Magnetic lines of force are continuous and will always form closed loops.

Magnetic lines of force will never cross one another.

Parallel magnetic lines of force traveling in the same direction repel one another.

Parallel magnetic lines of force traveling in opposite directions tend to unite with each other and form into single lines traveling in a direction determined by the magnetic poles creating the lines of force.

Magnetic lines of force tend to shorten themselves.

Therefore, the magnetic lines of force existing between two unlike poles cause the poles to be pulled together.

Magnetic lines of force pass through all materials, both magnetic and nonmagnetic.

Magnetic lines of force always enter or leave a magnetic material at right angles to the surface

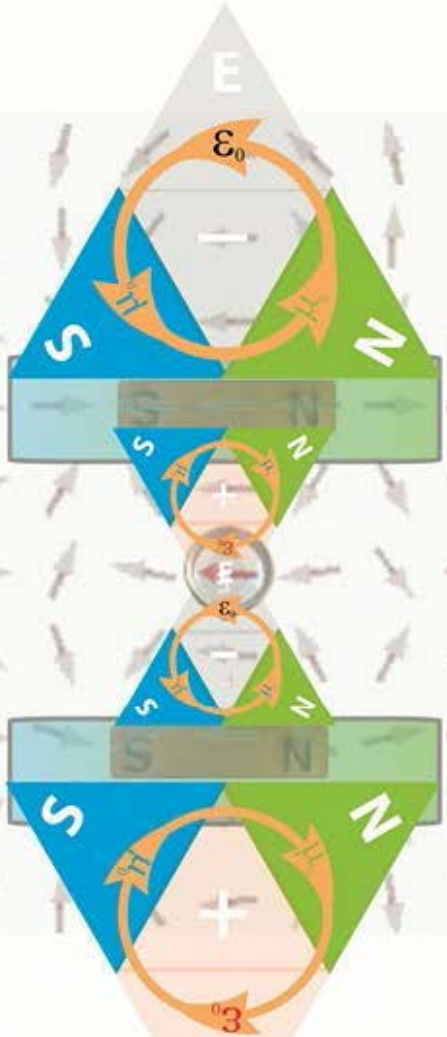
E
ε_0
S
N
$^0\mu$
$^0\mu$
$^0\mu$

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Anti-Parallel Magnetic Dipoles

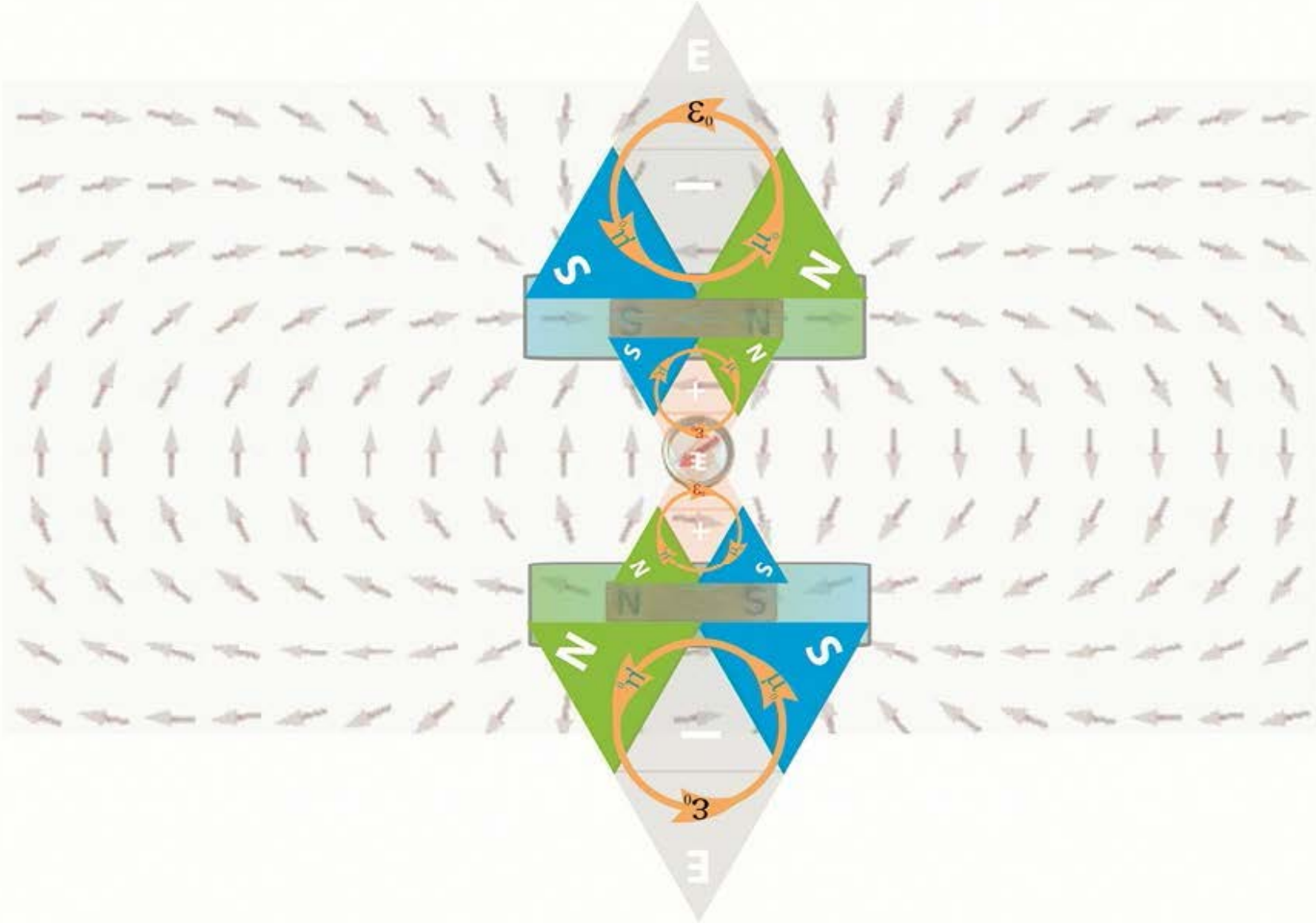

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Magnetic Moments

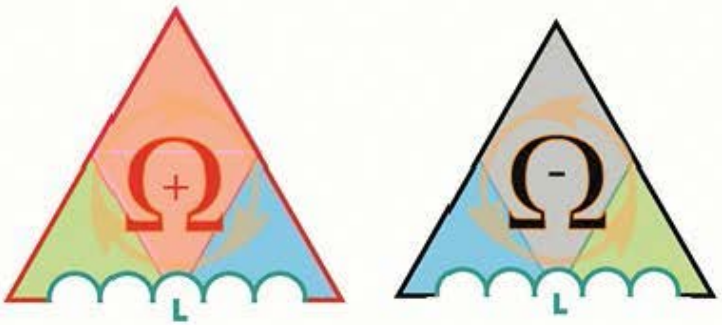

Single ZPFs are
'ideal quantum inductor elements'

1

Electro-static Energies
Charges

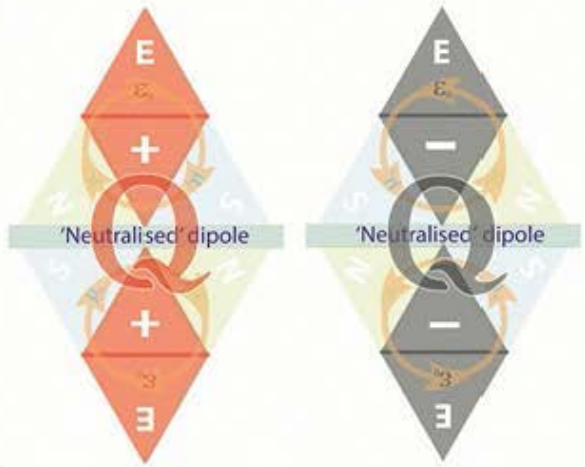

All Matter in motion possesses kinetic energies which are stored as Planck quanta in their KEM fields

The charge geometry of KEM fields are reflective of the interactive component of the charged topology of the particle in motion

Each charge geometry
has distinct Magnetic dipole
alignments

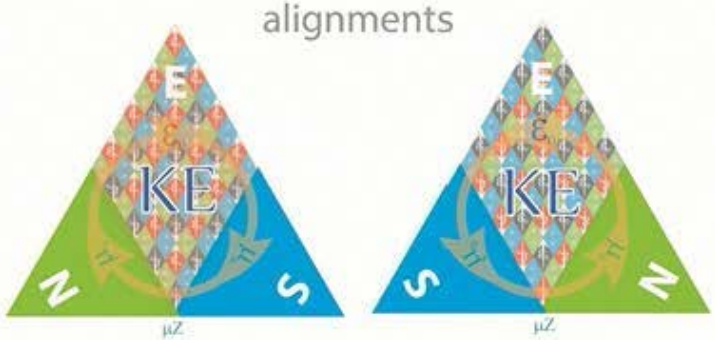

which in turn can only create
2 distinct orientations [spins] of
magnetic moments

2

Magneto-static Energies
Kinetic Energies

ZPF sets can form inductively coupled
quantum Harmonic Oscillators

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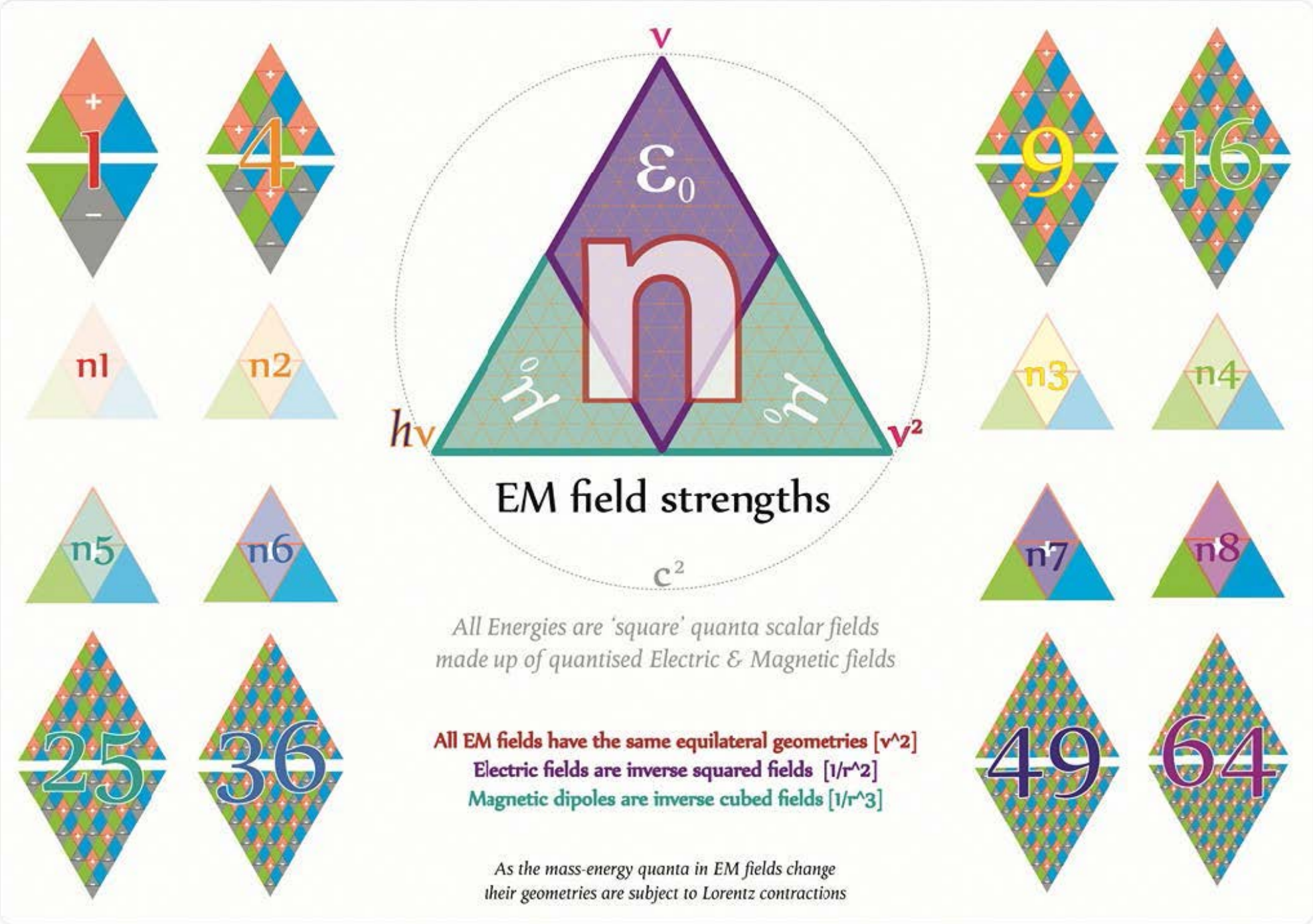

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Electrostatic particle modeling

Tetryonic [4np] standing wave charge fields form electrostatic Particle topologies [Charged and Neutral Matter]

m — EM mass-energy: Tetryonic field geometry

M — Matter: tetryonic Matter topology

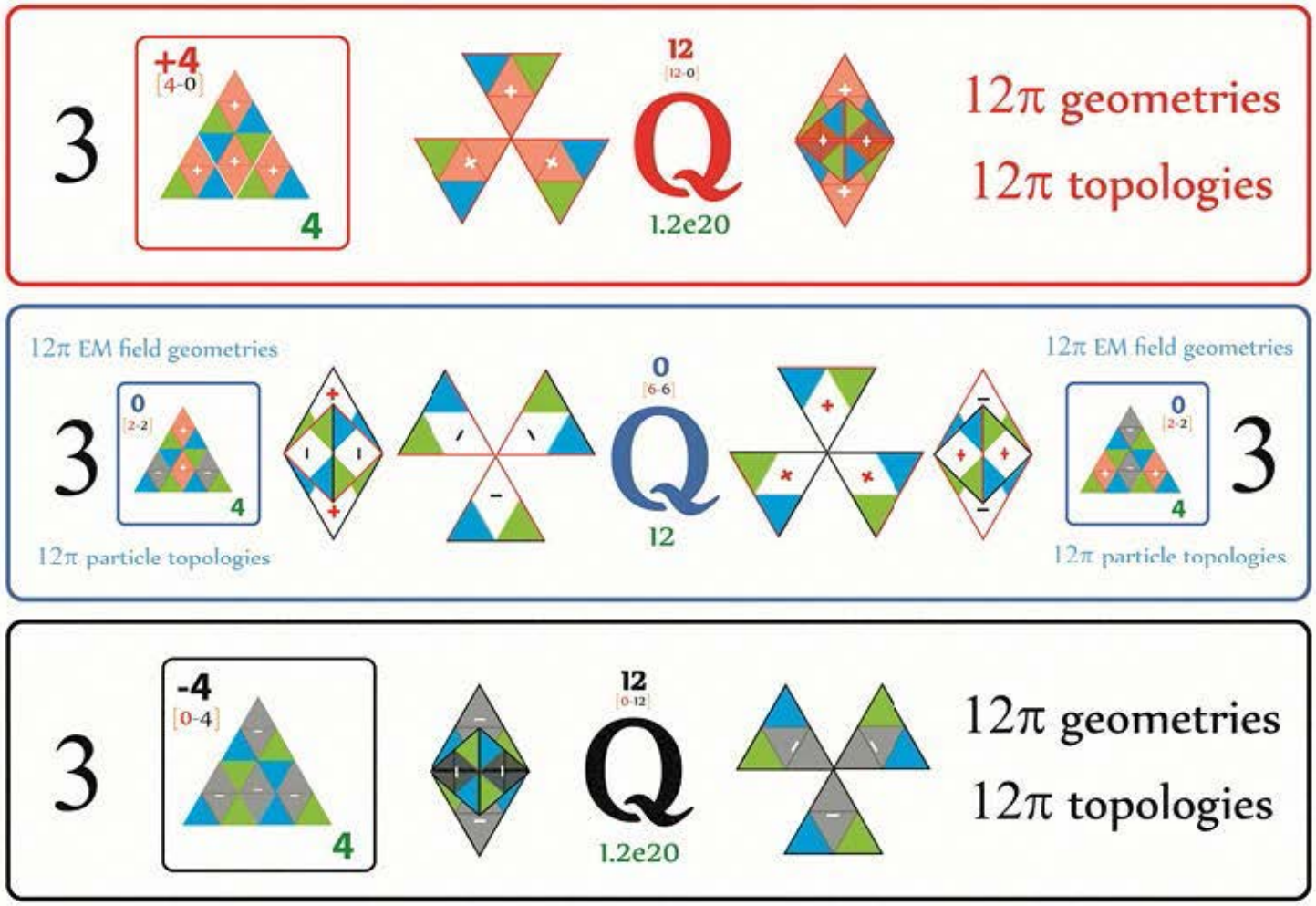

All particles in motion create secondary KEM field geometries [Kinetic energies and Magnetic moments]

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Electro-static Fields

Momenta acting in oppose directions results in zero velocity

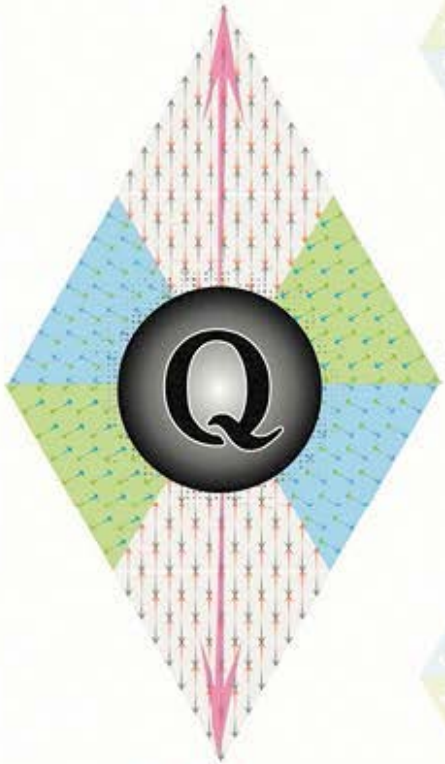

Stationary Charges have neutralised magnetic dipoles

Zero Velocity equates to Zero nett Momentum

The Kinetic Electric & Magnetic energies are contained in an KEM field extending from a charged particle in motion

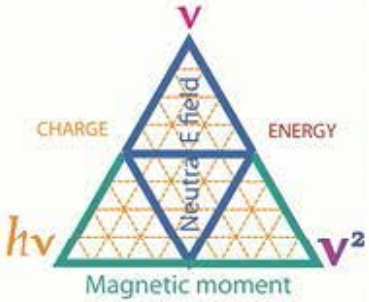

Charged particles in motion produce a Magnetic moment

Kinetic EM Fields

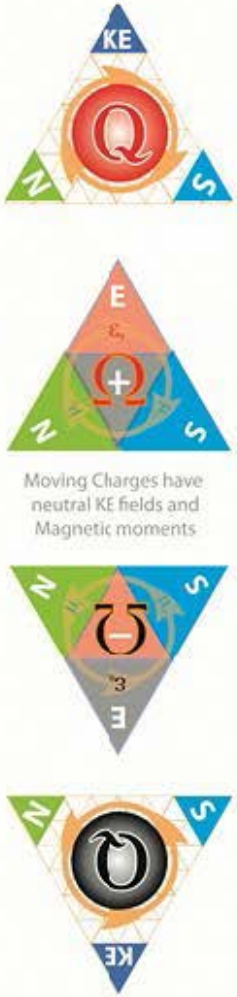

Motion in any direction produces Kinetic & Magnetic energies

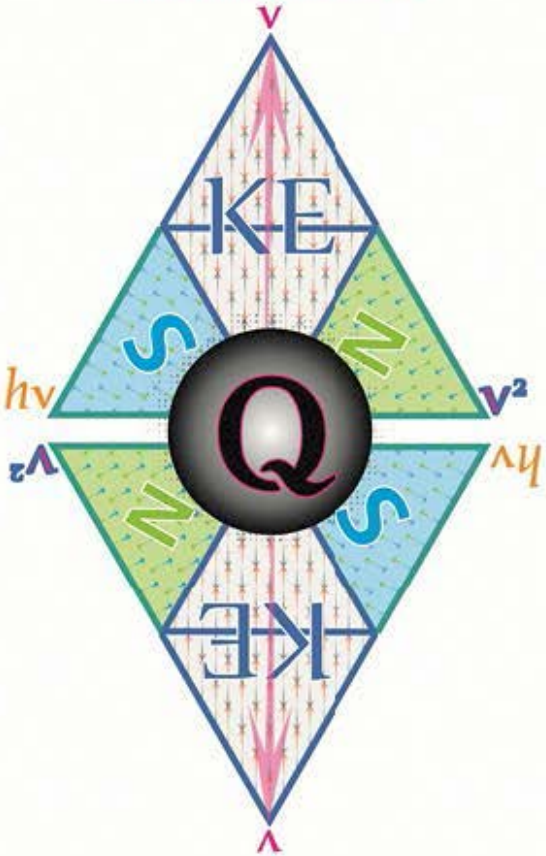

The Strength of the Kinetic Electric field & Magnetic moment is directly proportional to the square of the particle's Velocity

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Electric & Kinetic Fields

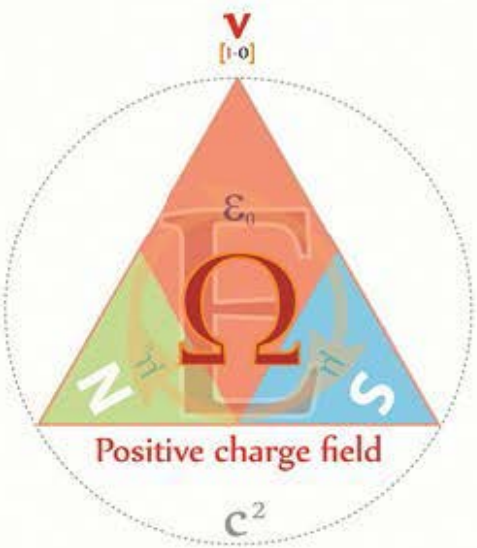

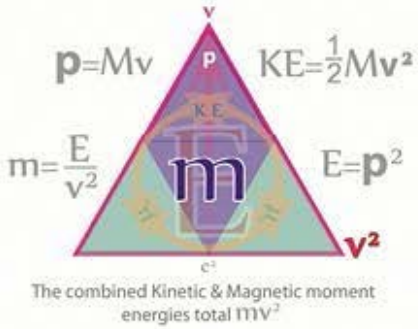

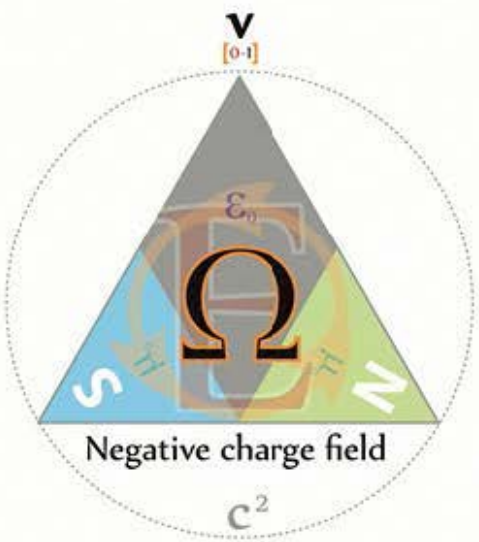

Kinetic Energy field

KEM field created by a Positive charged body

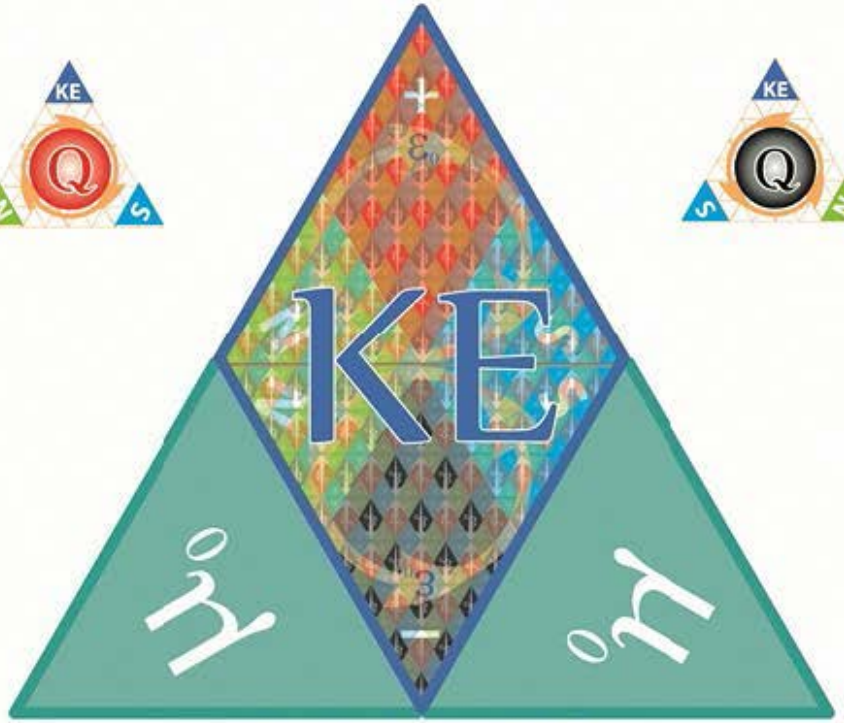

KEM field created by a Negative charged body

Positive charges repelled
Negative charges attracted

Neutralised Electric fields
Enhanced Magnetic moments

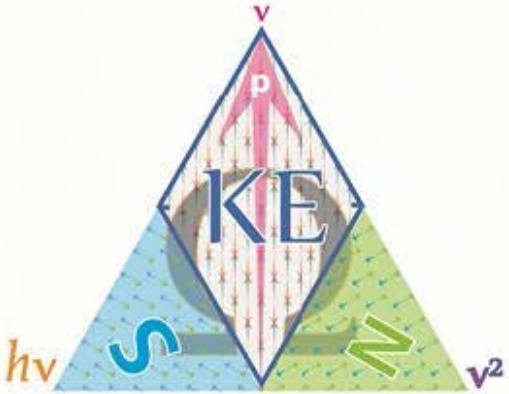

Negative charges repelled
Positive charges attracted

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EM & KEM force vectors

All mass-energy quanta are ideal quantum Inductors

The E&M force vectors create orthogonal equilateral EM Fields

Electric fields propogate orthogonally to the Magnetic dipole field

Magnetic flux external to the Magnetic dipole flows from North to South & Internal to a Magnetic dipole it flows South to North

When ZFFs combine to form a Magnetostatic dipole they form orthagonal magnetic vectors

Positive charge can be modelled electrically with clockwise EM fluxes [omegas]

Negative charge can be modelled electrically with anti-clockwise EM fluxes [omegas]

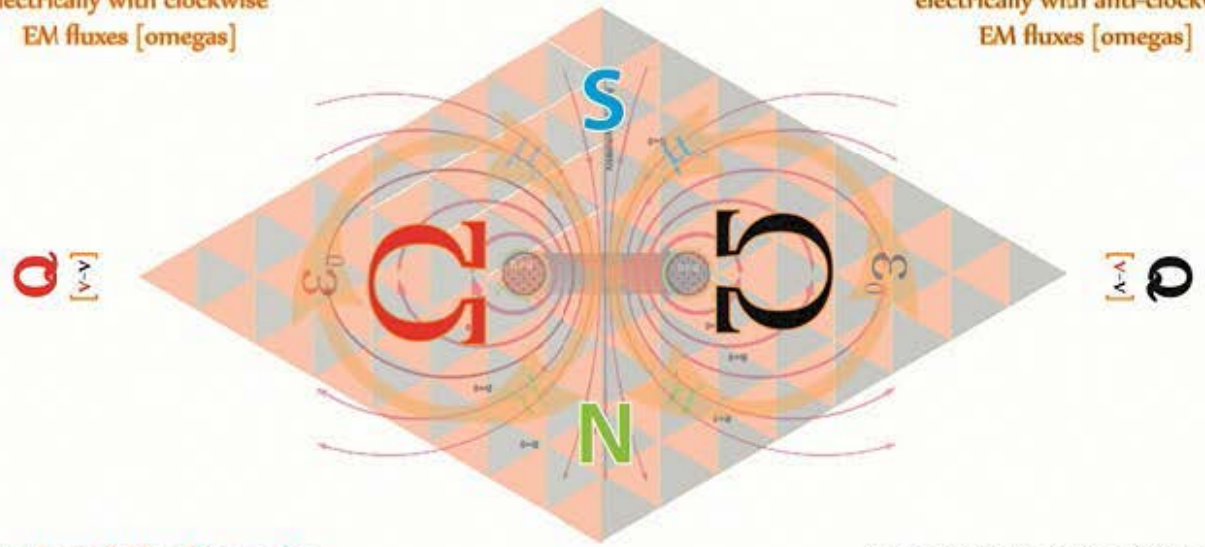

Positive charge fields of interaction result from an excess of divergent positive energy momenta

Equal energy-momenta in opposition create static fields

Negative charge fields of interaction result from an excess of divergent negative energy momenta

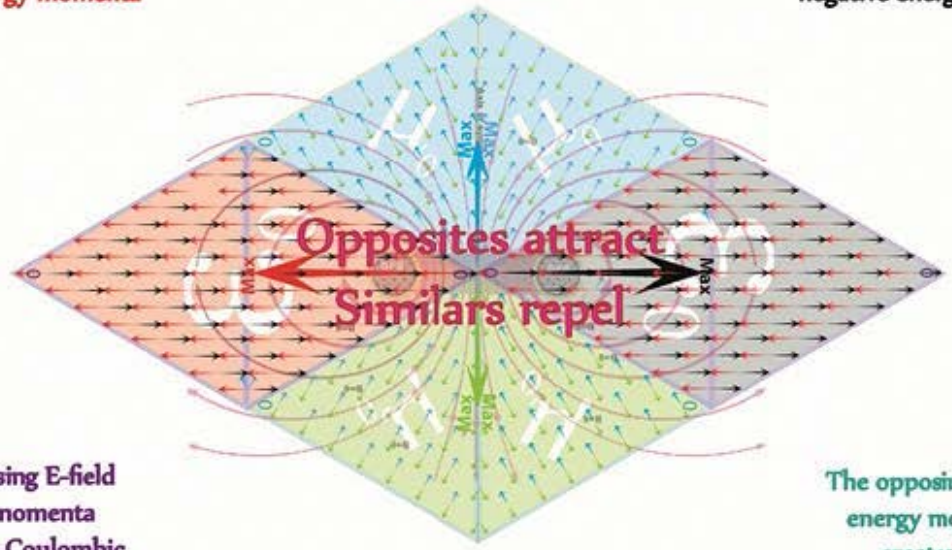

The opposing E-field energy momenta creates the Coulombic Law of Interaction

When E field is at Maximum - B field is at Minimum
when B field is at Maximum - E field is at Minimum

The opposing M-field energy momenta creates the Lorentz Force

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EM Forces and ZPFs

ZPF quanta can combine in differing combinations
to produce 3 distinct charged sets

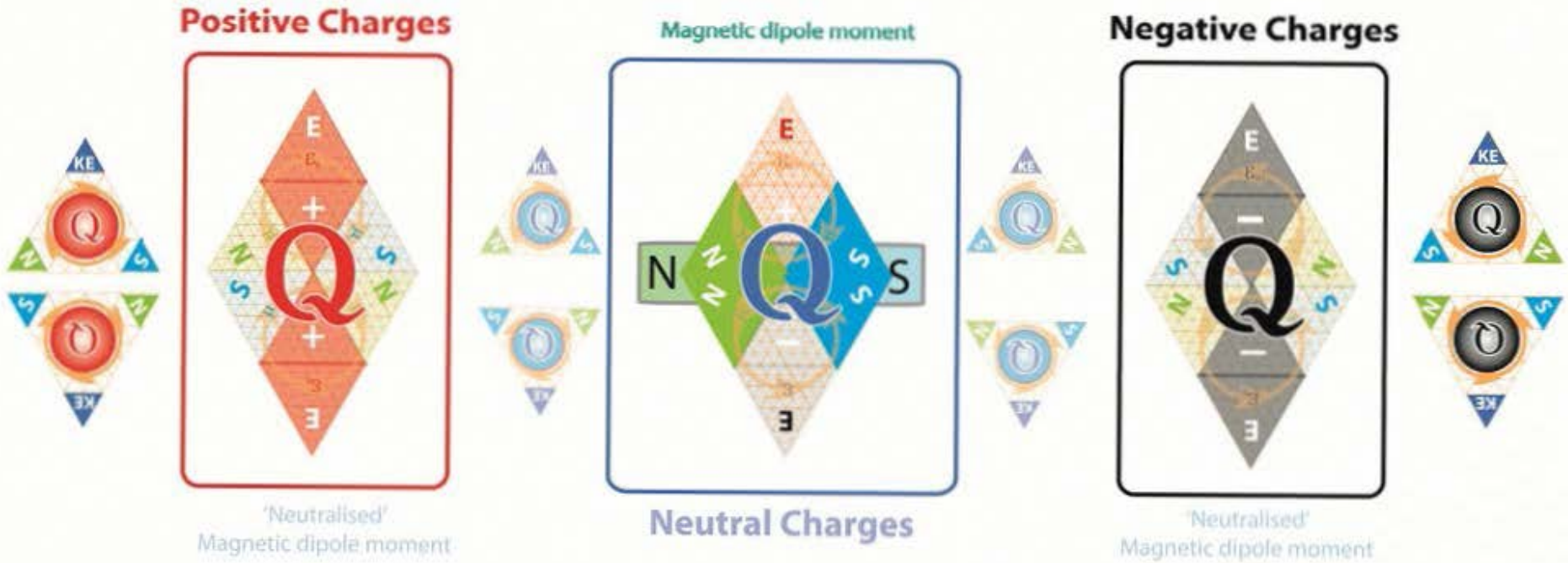

All EM mass-Energy-Matter & forces can be modelled using Tetryonic geometries

Positive charge particle KE field and magnetic moment

Zero Point Field EM geometry is the foundation for all the EM forces comprising, and acting between particles of Matter

Lorentz force, Lenz's Law, Right/Left Hand rules, etc can all be easily replaced with this simple geometric model

Negative charge particle KE field and magnetic moment

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Kinetic EM fields

All Kinetic EM fields resulting from motion have charge field geometries resulting from the charged Matter geometry of the particle in motion

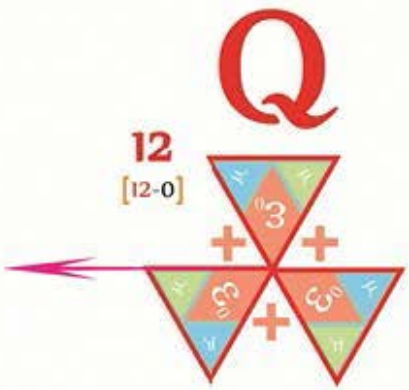

Positive charge particle topologies produce positive KEM fields

KEM field charge geometries do not contribute to the nett charge

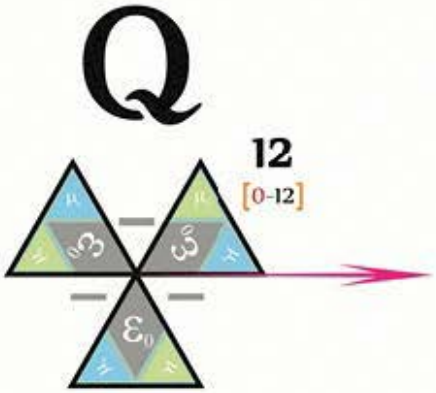

Negative charge particle topologies produce negative KEM fields

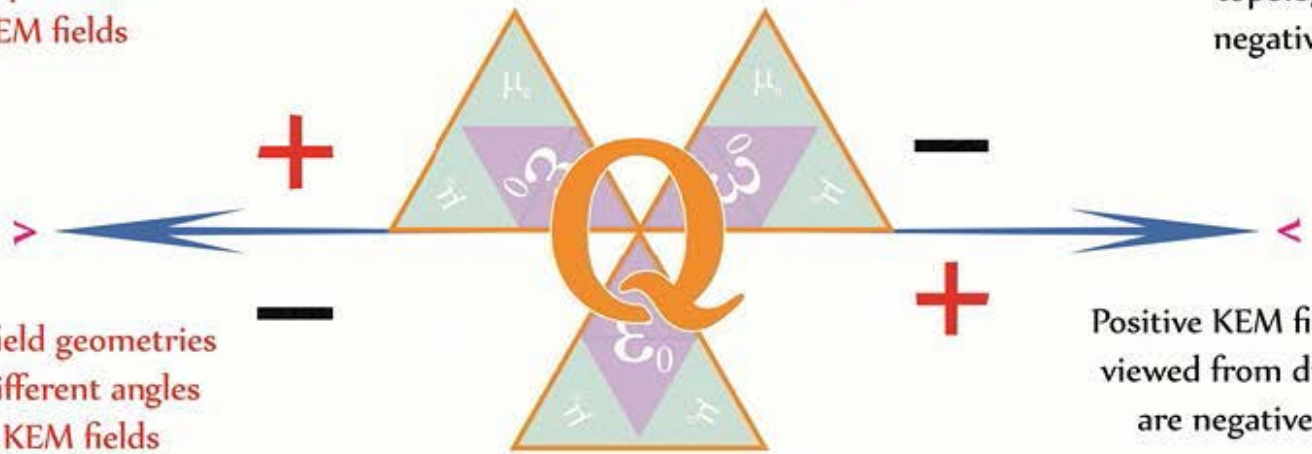

Negative KEM field geometries viewed from different angles are positive KEM fields

Positive KEM field geometries viewed from different angles are negative KEM fields

As a direct result of the KEM field being a EM field permeating free space the symmetry of EM fields results in KEM field geometries being viewed as having neutral KE fields with a magnetic moment

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Point Particles and KEM fields

e+

12

12

12n

e–

12

Charged rest mass-Matter topology

Quarks T[8π]
Leptons T[12π]

velocity invariant rest mass-Matter has a standing wave topology

Baryons T[20π]

Charged Leptons at rest are Electric field standing waves
(with neutral Magnetic poles)
KE from motion generates a Magnetic Moment

Bosons nπ [ODD]

Kinetic EM field geometry is divergent from a particle's rest Matter topology

Photons nπ [EVEN]

Charge

Q

[v-v]

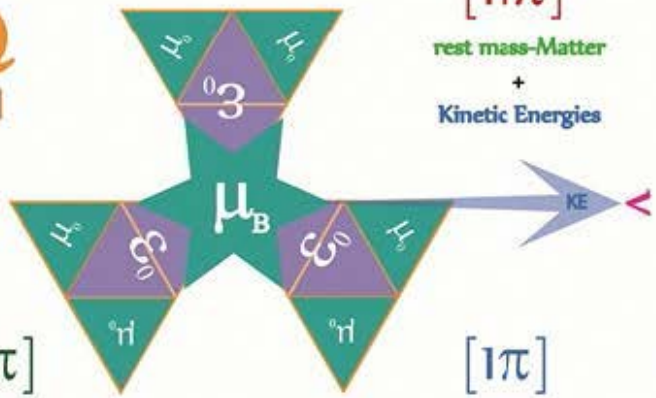

[nπ]

rest mass-Matter
+
Kinetic Energies

[12π]

rest Matter topology

[1π]

Kinetic Energy geometry

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KEM fields of Matter in motion

ZPFs geometries can be used to model the KEM fields of charged particles

2D charged EM field geometries create Matter topologies

tetryons	[4π]	tetryons	[4π]
quarks	[12π]	quarks	[8π]
leptons	[12π]	leptons	[12π]
Baryons	[36π]	Baryons	[20π]
Elements	[84π]	Elements	[54π]

The mass-energy content of all charged fascia constituting massive particles have momenta that is proportional to the intrinsic velocity [c] of the standing wave

rest Matter

Electro-static particles have neutralised magnetic dipoles

Relativistic mass

Kinetic motion produces Magnetic moments

Spherical point charges do NOT exist

positron

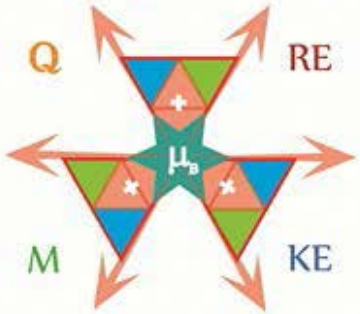

3D Matter is a standing-wave topology resulting from radiant 2D EM geometries
All leptons and quarks both have 12 charged fasica geometries,
[but differing mass-Matter-particle topologies]

electron

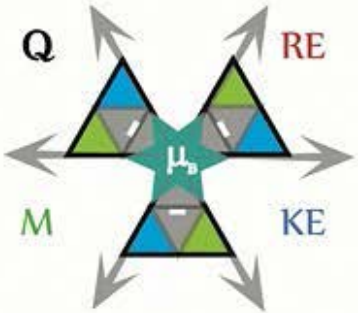

All EM fields resulting from Kinetic Energy (motion) radiate outwards
(the intrinsic KEM fields contain both Negative and Positive Energy momenta quanta)

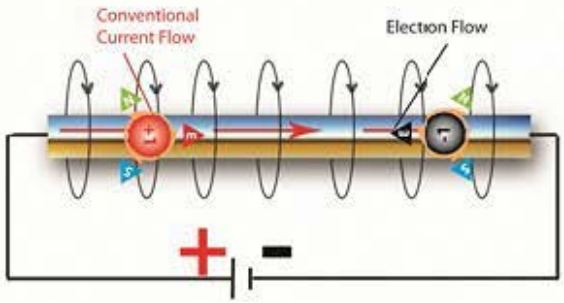

Magnetic field around a current carrying conductor

Magnetic field produced by a Solenoid

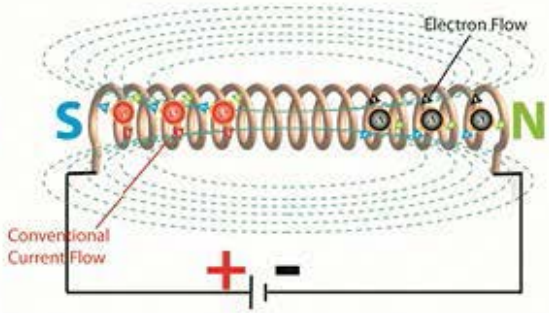

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Biot-Savart Law

is an equation in electromagnetism that describes the magnetic field B generated by an electric current.

μ_0 There is an inverse cube relationship between magnetic field strength and magnetic field force with respect to distance from the magnet. ε_0

The interaction between Magnetostatic fields for which a Magentic dipole exists obeys the inverse CUBED law of attraction and repulsion

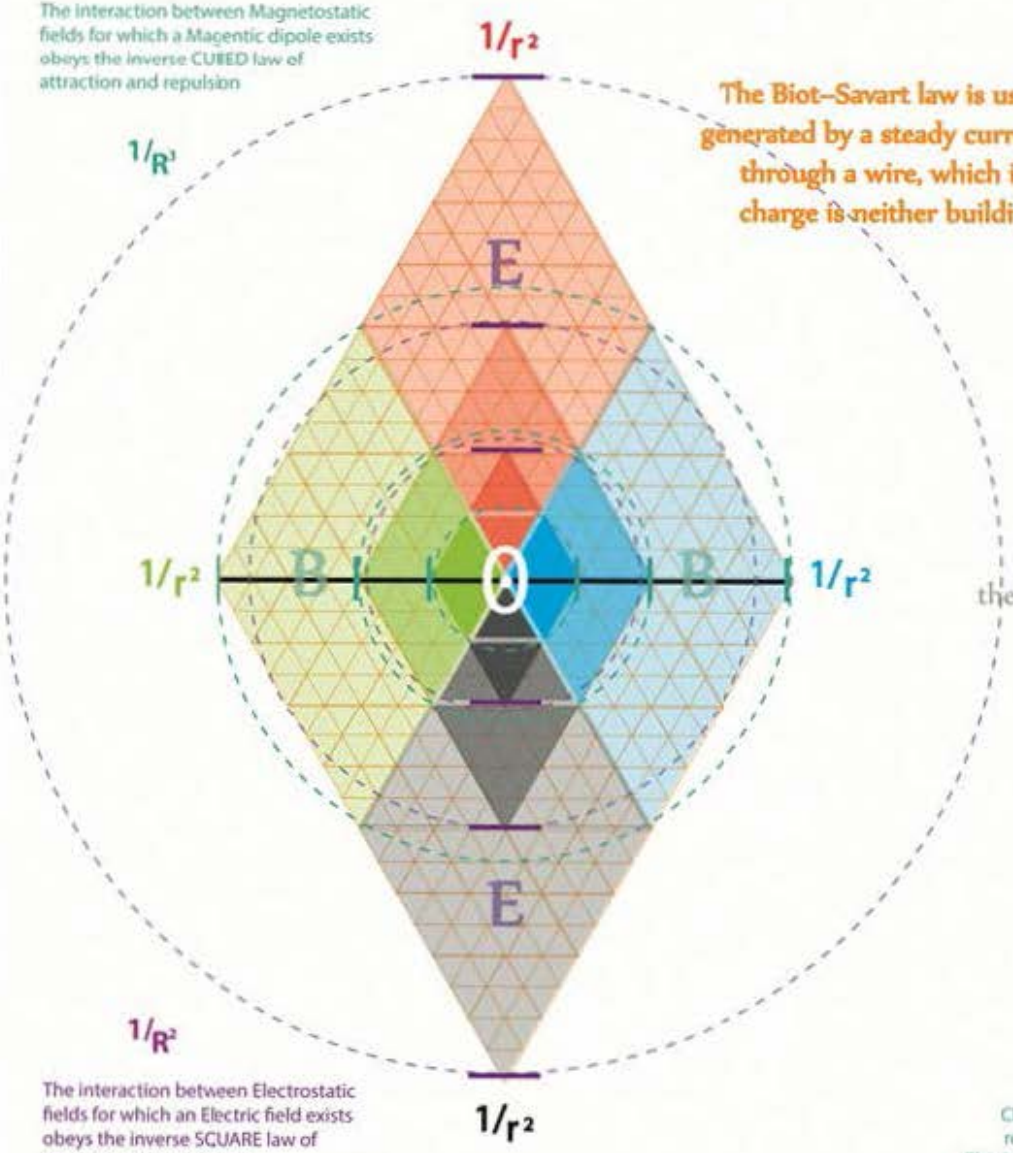

The interaction between Electrostatic fields for which an Electric field exists obeys the inverse SQUARE law of attraction and repulsion

The Biot–Savart law is used to compute the magnetic field generated by a steady current, i.e. a continual flow of charges, through a wire, which is constant in time and in which charge is neither building up nor depleting at any point

$$\mathbf{B} = \int \frac{\mu_0}{4\pi} \frac{I d\mathbf{l} \times \mathbf{r}}{|r|^3},$$

The radial distance between Magnetic dipoles is less than the distance between Electric dipoles

$$\mathbf{B} = \int \frac{\mu_0}{4\pi} \frac{I d\mathbf{l} \times \hat{\mathbf{r}}}{|r|^2},$$

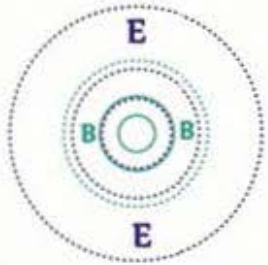

Close to one pole of a magnet, B field strength resembles the inverse square of Electric force. This is because it behaves as a "unipolar magnetic field"

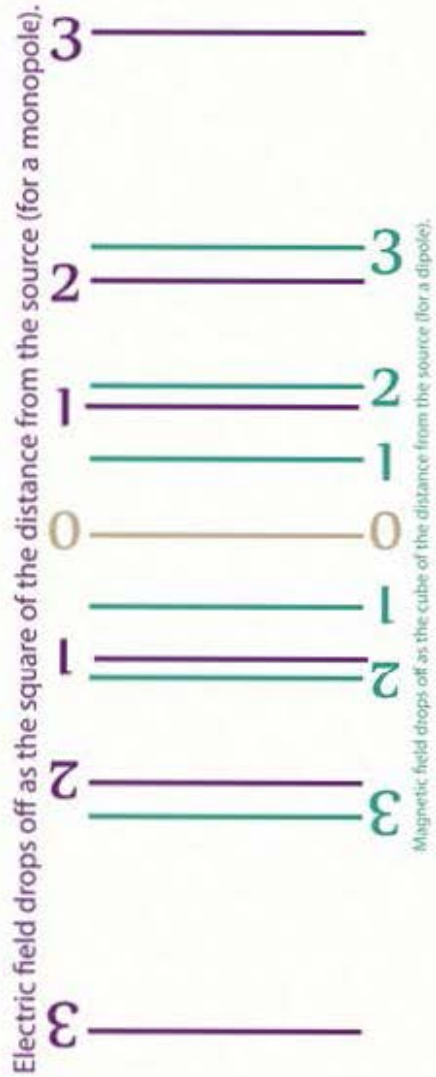

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Quantum Chirality

Its the equilateral geometry of quantised angular momenta that creates chirality in physics

Mirror imaged Planck quanta are NOT identical to each other

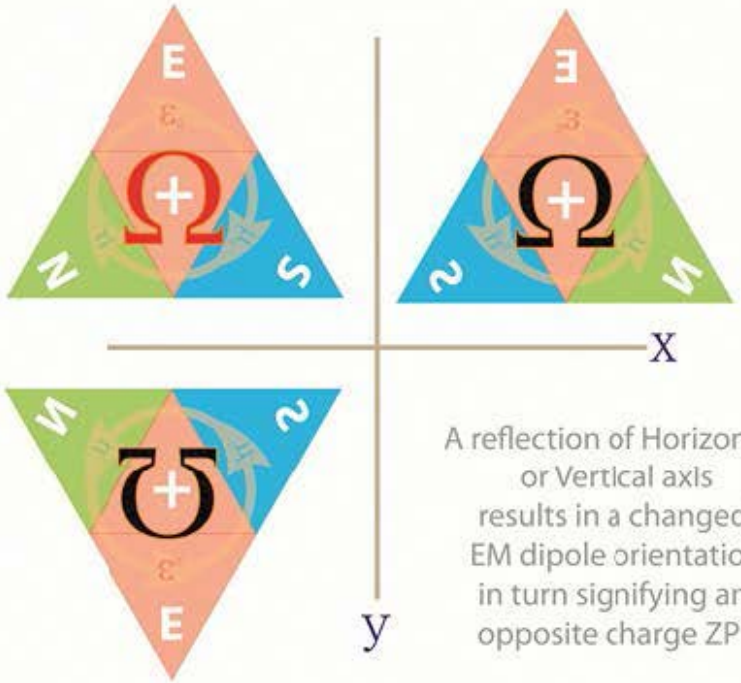

A reflection of Horizontal or Vertical axis results in a changed EM dipole orientation in turn signifying an opposite charge ZPF

The equilateral geometry of any EM field or Matter particle is determined by its nett Coulombic charge

Any nominal rotation about an axis results in a re-orientation of the electromagnetic vectors but does not affect any change to charge etc.

Irrespective of orientation or rotation:

Ω **Positive charge fields have clockwise inductive flux geometries** Ω

Negative charge fields have counter-clockwise inductive flux geometries

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Pi radian - energy momenta geometries

mass-energy momenta

Q

nett charge

[v-v]

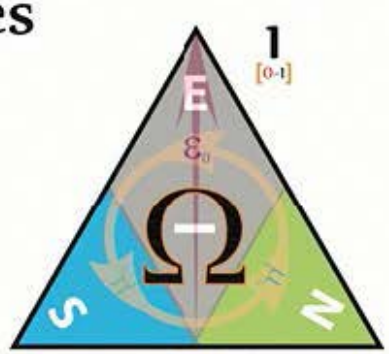

π

pi radian energy geometries

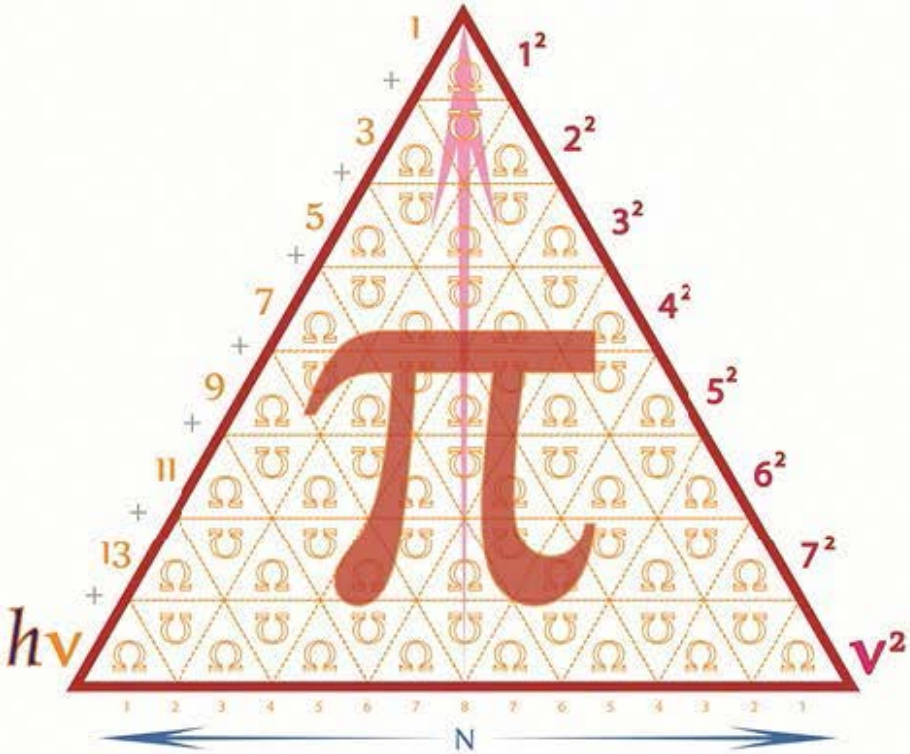

Ω

quantised angular momentum

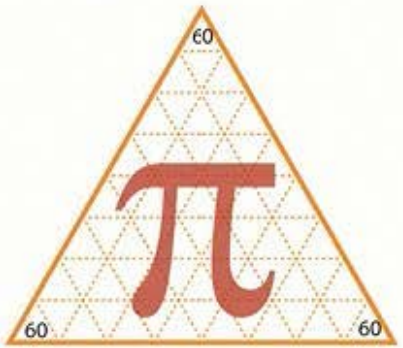

$$n\pi\left[m\Omega v\right]^2$$

energy, mass, velocity, Planck quanta

π radian geometries are comprised of equilateral mass momenta Ω

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ZPFs and Bosons

ZPFs are Planck energy quantum elements

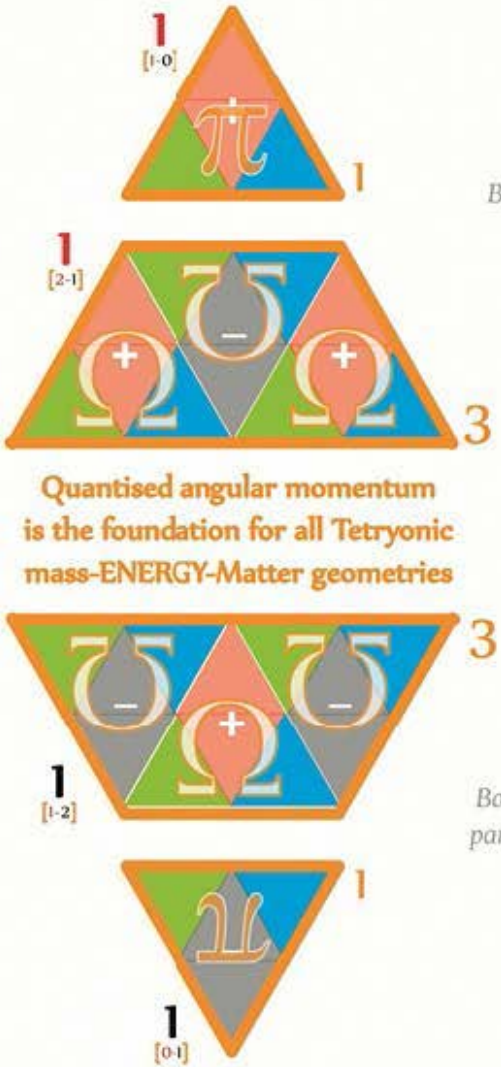

Bosons are transverse Quantum levels

Bosons are the exchange particles for the EM force

ZPFs are the quanta geometry for Charge, Bosons and Energy

Each Quantum level is an ODD number of quanta (Bosons)

Each 'squared' energy field is the sum of the preceeding Bosons

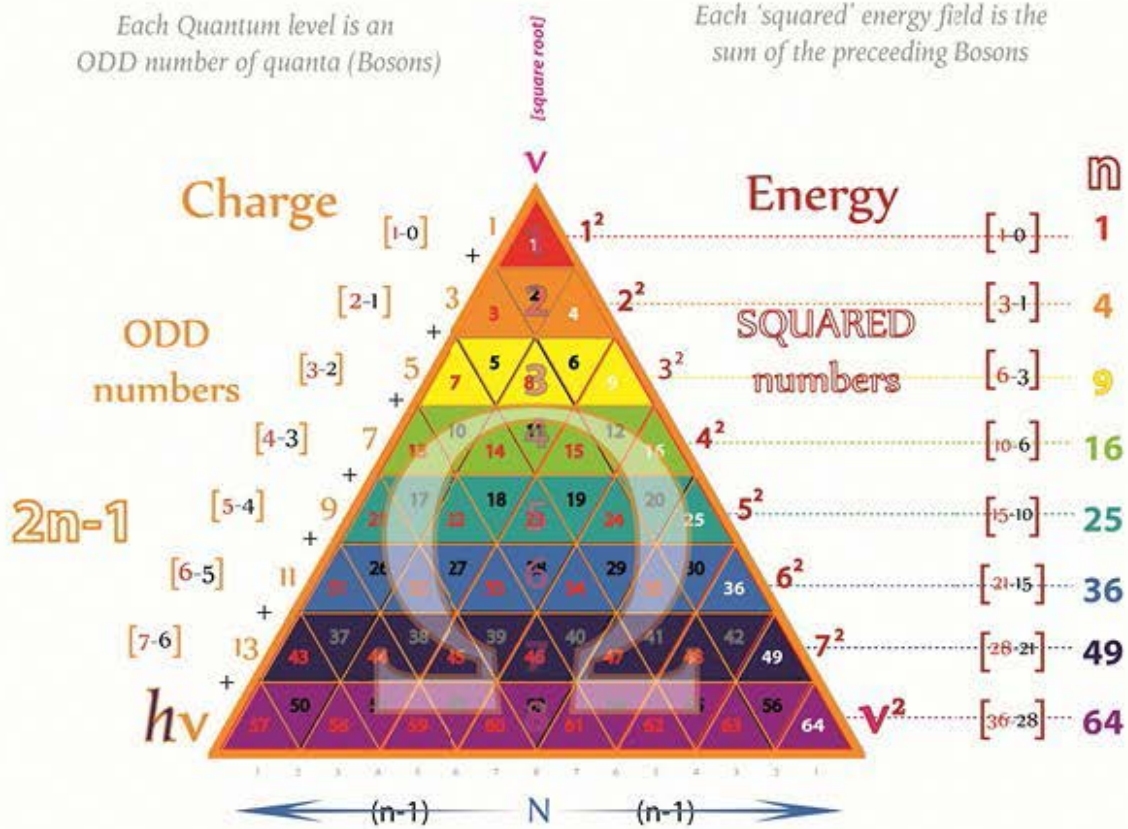

The charged quanta in all mass-Energy geometries create a NORMAL Distributions

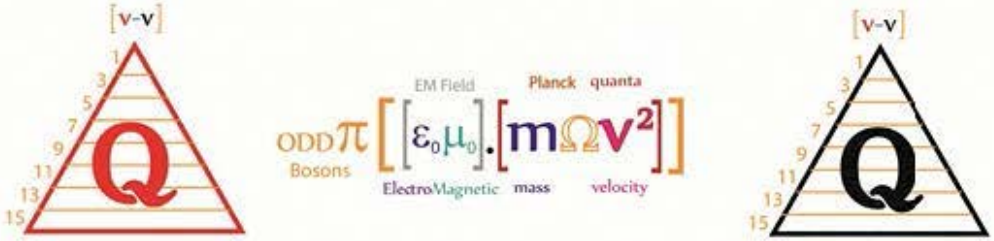

Bosons form the geometry of Quantum Levels

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$$W^{+} = n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

ODD

Force carrier for Positive charge particles

W^{+} Boson

$$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM field — Planck quanta — ODD Bosons — ElectroMagnetic — mass — velocity

CHARGE carrier Bosons
are ODD number quanta

Bosons

form unit charge Quantum levels
that facilitate EM induction between
mass-Energy-Matter

Neutral Z Bosons and Photons
are EVEN quanta Bosons

$$\text{EVEN}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — EVEN Photons — ElectroMagnetic — mass — velocity

Neutral charge parallelogram geometry EM force carriers

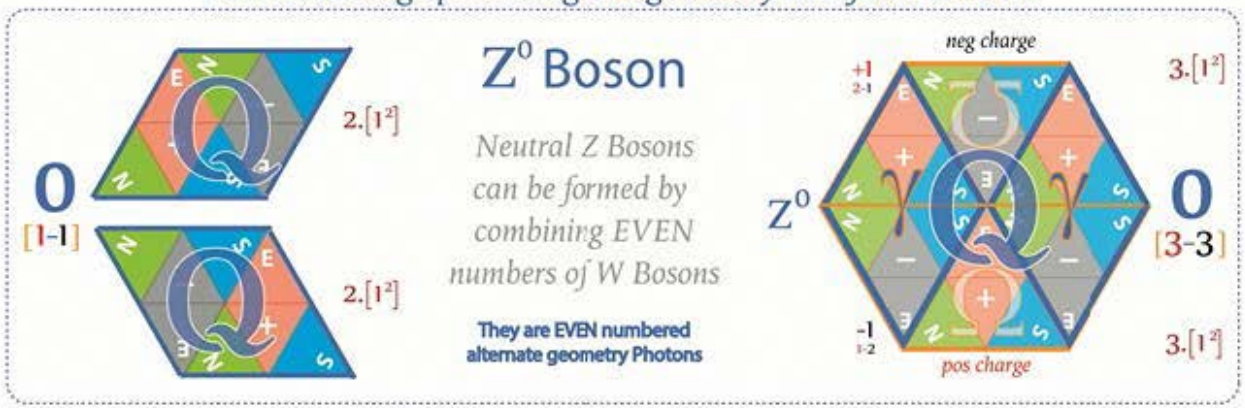

Z^0 Boson

Neutral Z Bosons can be formed by combining EVEN numbers of W Bosons

They are EVEN numbered alternate geometry Photons

Photons are alternate (diamond) EM geometries formed from Z Bosons

W^{-} Boson

Force carrier for Negative charge particles

$$W^{-} = n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

ODD

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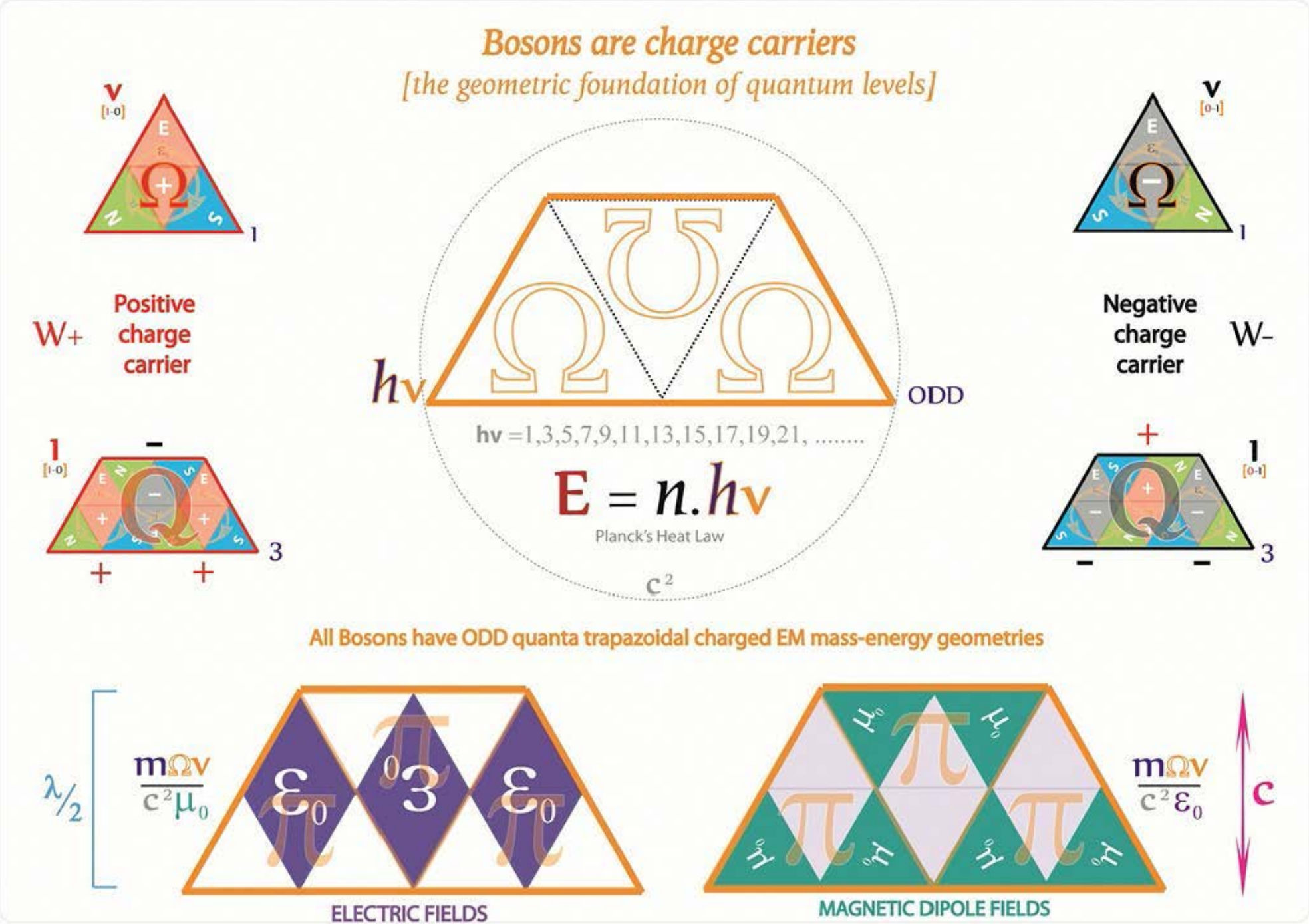

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Boson Frequencies

All Bosons are 1/2 wavelength EM fields with ODD number quanta
They are the geometric basis for transverse EM field Quantum levels

$$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; Bosons; ElectroMagnetic, mass, velocity

W Bosons are comprised of ODD number quanta

Bosons are TRANSVERSE Charge carriers

ODD #

$$Q$$

$$n\pi\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass, velocity

EVEN #

$$Q$$

$$2n\pi\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass, velocity

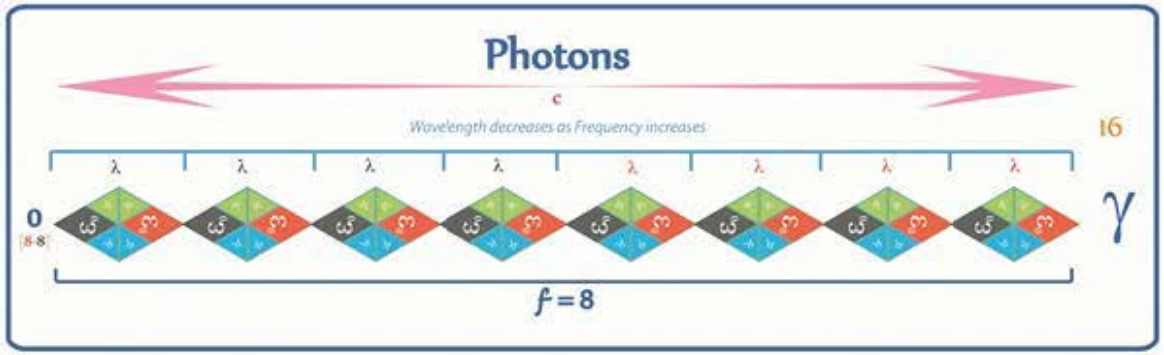

Neutral Z BOSONS and PHOTONS have differing EM geometries

Photons are LONGITUDINAL neutral EM force carriers resulting from Bosons

ODD #

$$Q$$

$$n\pi\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass, velocity

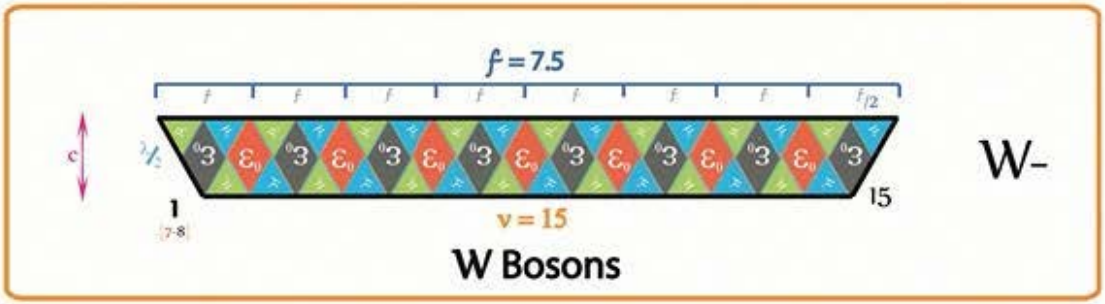

EM waves are comprised of EVEN number quanta [Photons]

$$\text{EVEN}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; EM waves; ElectroMagnetic, mass, velocity

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Boson Waveforms

W The Electro-weak force is the result of Bosons interacting along their edge of Permeability

Boson exchange is the basis of Electro-Magnetic Induction & Charge transfer

S

The Strong Colour Force is the result of Bosons interacting via their their Electric charge fascia

All ODD Ω geometries [bosons] create a quantum of charge

Positive charge carrier

W+

+1

ODD number quanta

All charges are comprised of odd numbered Bosons

[each Boson is a Quantum level]

ODD number quanta

W–

–1

Negative charge carrier

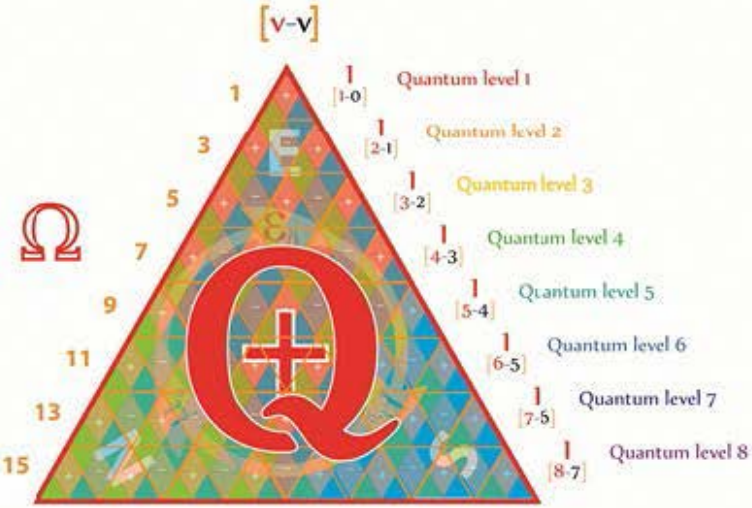

Integral W Bosons form square Energy geometries

Separated energy geometries create an electromotive force

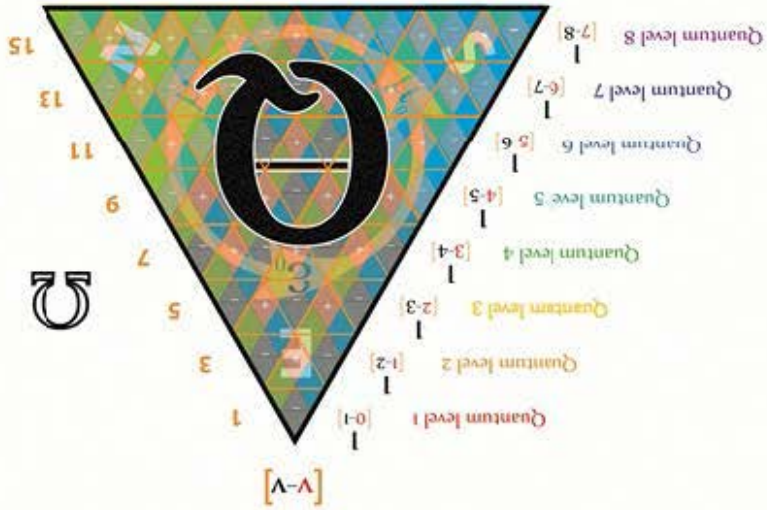

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Bosons

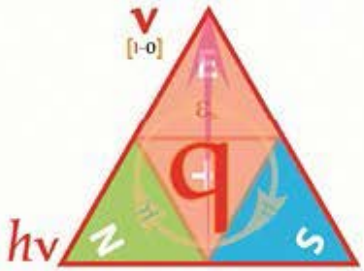

Positive Charges have nett
positive quantised angular momenta

Positive Bosons

$$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity — Bosons

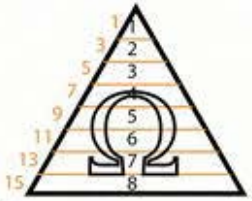

Bosons are the geometry of Quantum Levels

Each quantum Level is
a unit of Charge

Negative Bosons

Negative Charges have nett
negative quantised angular momenta

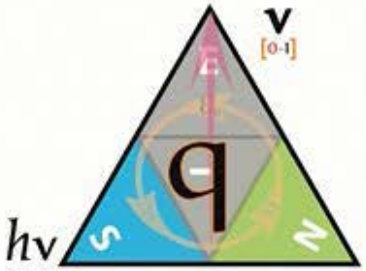

Bosons are TRANSVERSE EM fields [levels]

nett Charge is a SCALAR EM field property

Charge

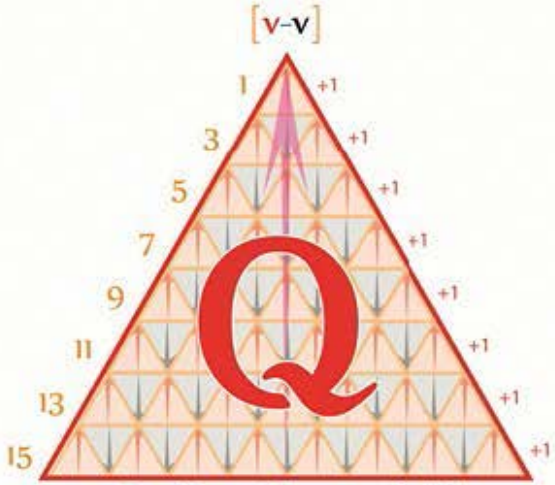

Positive Charge field

Charge is a measure of the nett quantised angular momenta - energy geometry of any given region of Space-time

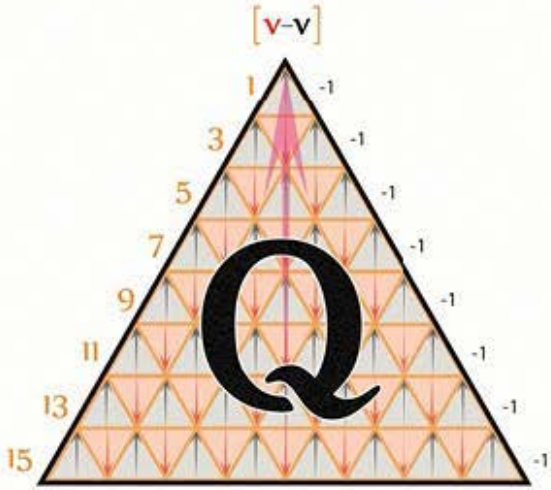

Negative Charge field

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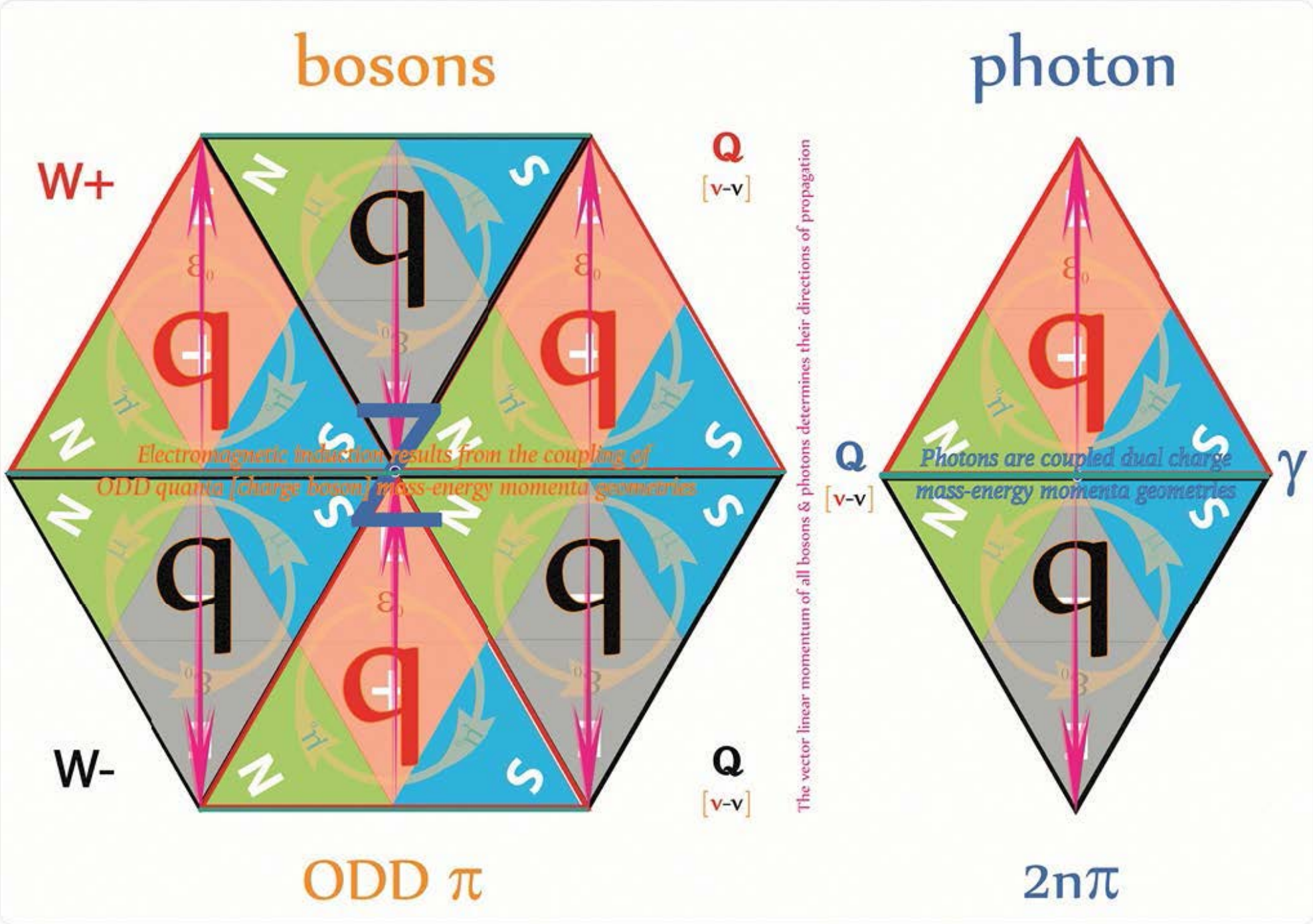

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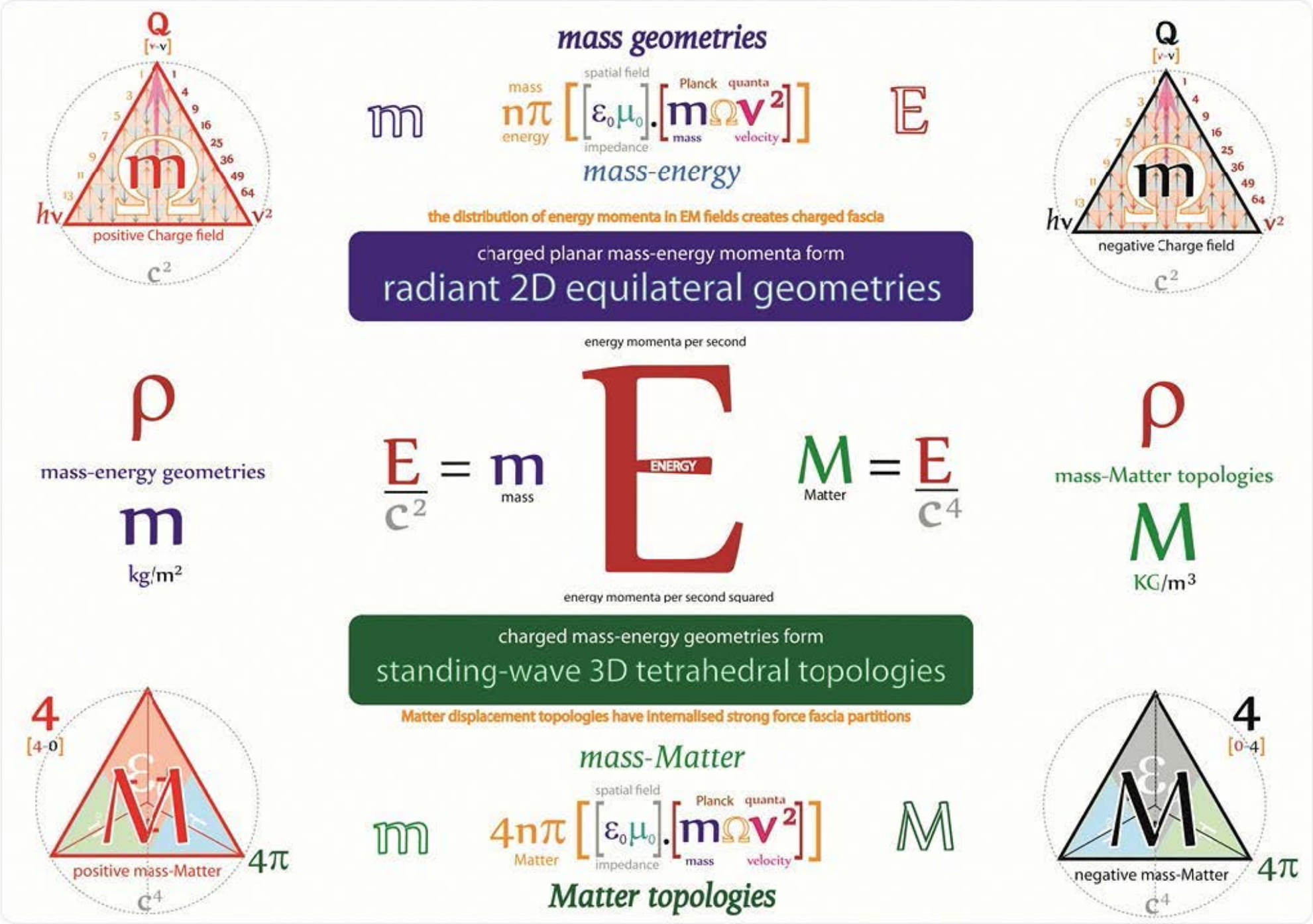

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Matter

4
[4-0]

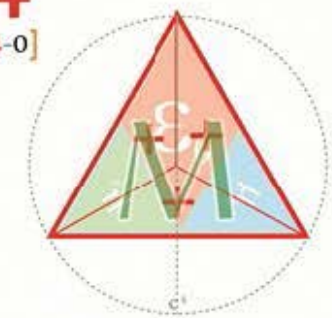

EM mass-energies have
2D planar geometries

$E = mv^2$

2D EM mass-Energy
forms
3D Matter

2D

ρ/sec

EM mass-energy per
square metre

EM mass geometries

m

kg/m^2

0
[2-2]

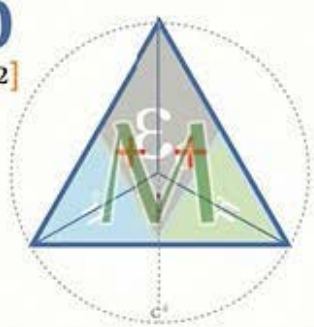

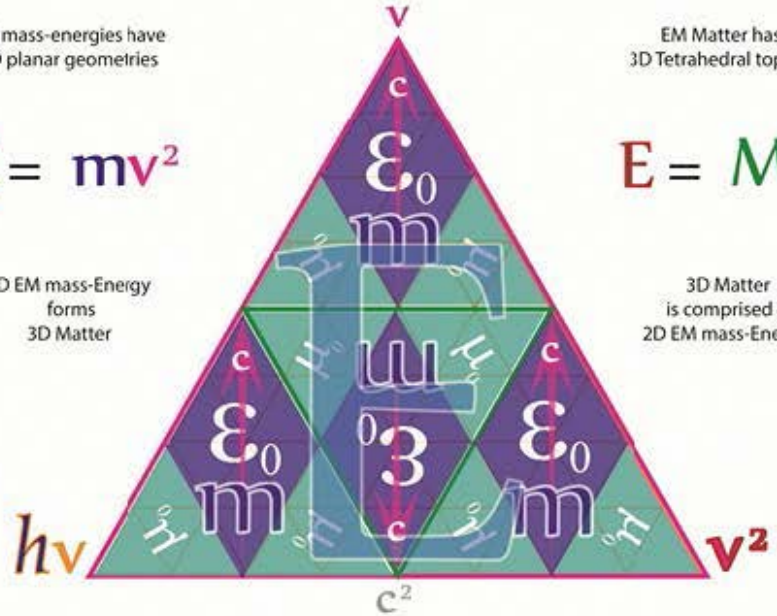

EM Matter has a
3D Tetrahedral topology

$E = Mc^4$

3D Matter
is comprised of
2D EM mass-Energies

0
[2-2]

3D

ρ/sec^2

EM mass-energy per
cubic metre

Matter topologies

M

kg/m^3

4
[0-4]

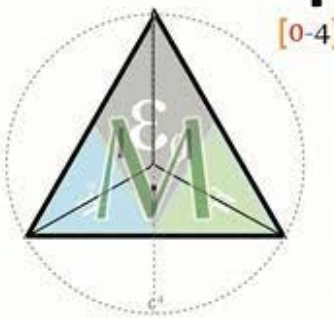

Matter is comprised of
$4n\pi$ mass-energy geometries
forming a 3D standing wave topology

$$\underset{\text{Matter quanta}}{\overset{\text{Tetryons}}{4n\pi}}\left[\left[\overset{\text{EM Field}}{\underset{\text{ElectroMagnetic}}{\varepsilon_0\mu_0}}\right].\left[\overset{\text{Planck quanta}}{\underset{\text{mass}}{m}}\,\Omega\,\underset{\text{velocity}}{v^2}\right]\right]$$

Matter is anything that has a closed mass-energy topology and displaces a volume
(the 3D massive building blocks of quantum particles and atomic elements)

The EM mass-energy quanta of Matter can be measured transversely and longitudinally
allowing them to exhibit a number of wave-like and particle-like properties
(de Broglie wavelength & Compton frequency)

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Tetryons - the quanta of Matter

'massless' is a physics mis-nomer as
all energy exhibits mass equivalence

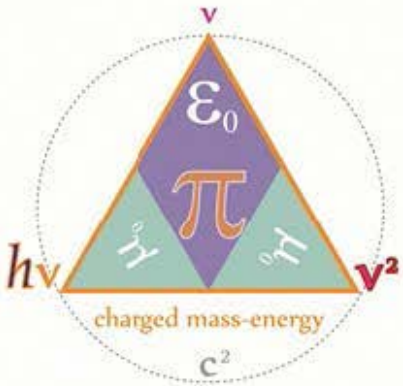

ZPF

mass-Energy quanta

m

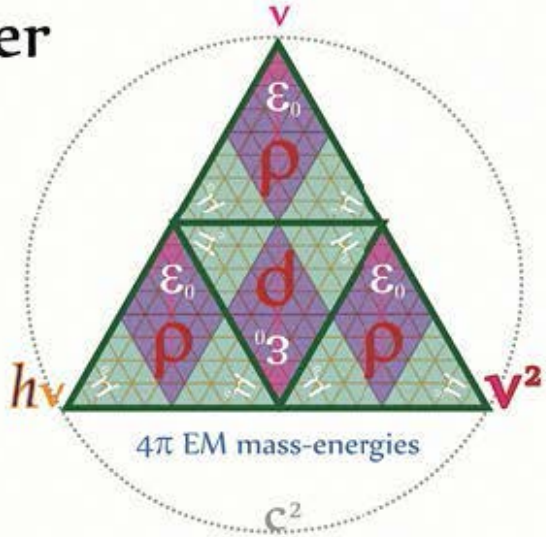

$$m = n\pi\left[\left[\frac{1}{c^2}\right].\left[m\Omega v^2\right]\right]$$

spatial impedance; Planck quanta mass velocity; Energy momenta

TETRYONS

Platonic tetrahedrons are the foundational topologies of all 3D Matter

$$T\pi\left[\left[\frac{1}{c^4}\right].\left[m\Omega v^2\right]\right] = M$$

spatial impedance; Planck quanta mass velocity; Energy momenta; Matter

Tetryon

Matter Quantum

M

2D mass-energy geometries
can be combined to form
3D mass-ENERGY-Matter particles

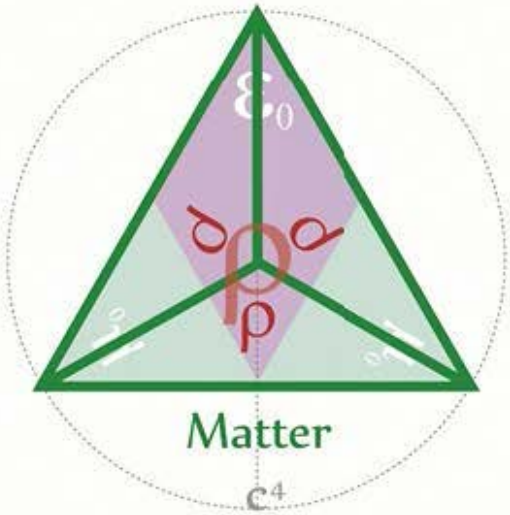

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Standing wave mass-energy geometries and Matter topologies

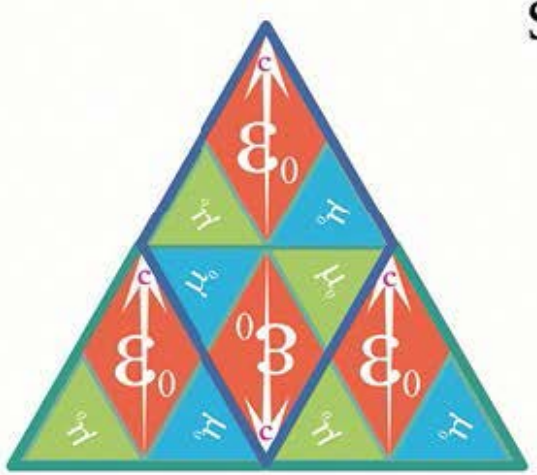

As each charged fascia's E field tries to propagate outwards it interacts with a M field dipole at each apex

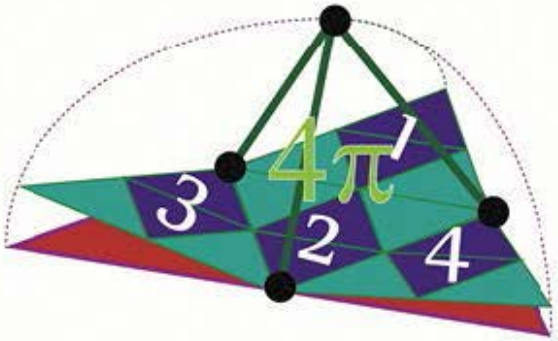

$$\underset{\text{Matter}}{M} = T\pi\left[\left[\underset{\text{impedance}}{\overset{\text{spatial}}{1/c^4}}\right].\left[\underset{\text{momenta}}{\overset{\text{Energy}}{\overset{\text{Planck}}{m}\overset{\text{quanta}}{\Omega}\underset{\text{velocity}}{v^2}}}\right]\right]$$

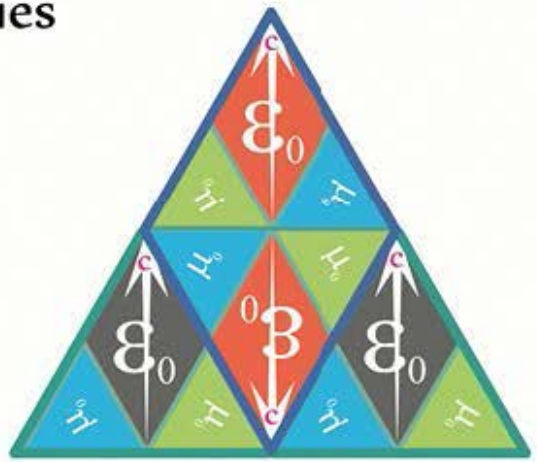

In turn energised M fields supply energy to the E Fields creating a EM standing wave [the EM topology of Matter]

Matter stores EM mass-energies geometries in its 3D Tetrahedral topology

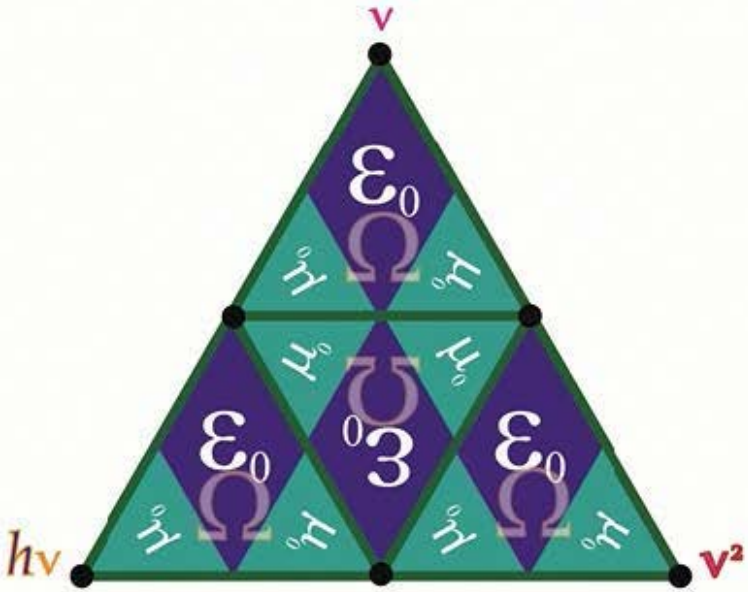

All mass-energy propagate at the speed of light creating linear energy momentum

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Tetryonic charge topologies

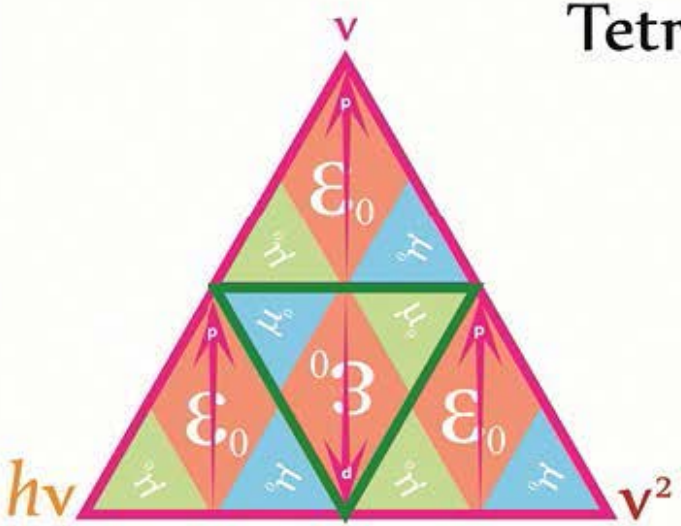

Positive Tetryon

The 3D Tetryonic volume of Matter is what distingushes it from 2D EM mass-energies

Negative Tetryon

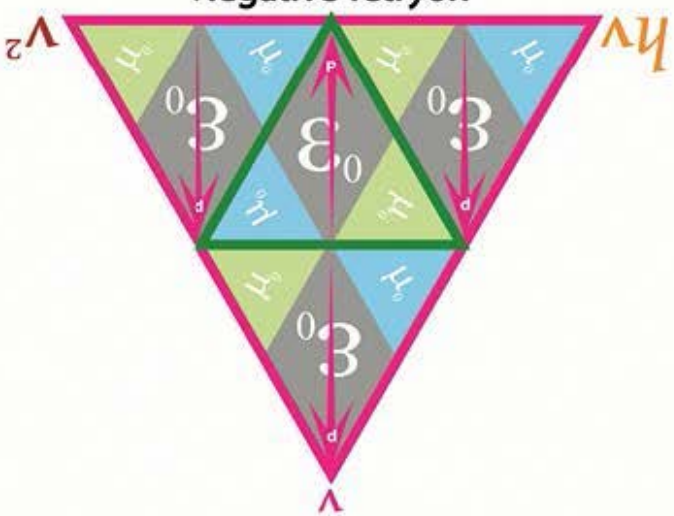

TETRYONS

[MATTER]

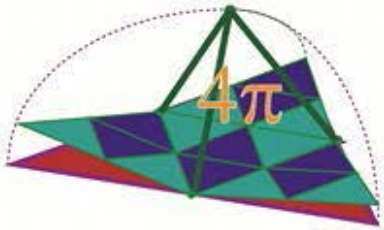

The four EM mass-energy momenta produced by Tetryonic collapse must not be confused with the classical 4 Energy-momenta (which refers to x,y,z co-ordinates & v)

4pi radiant mass-energies

Four 2D mass-energy geometries can combine to form via charge interactions 3D tetrahedral Matter topologies

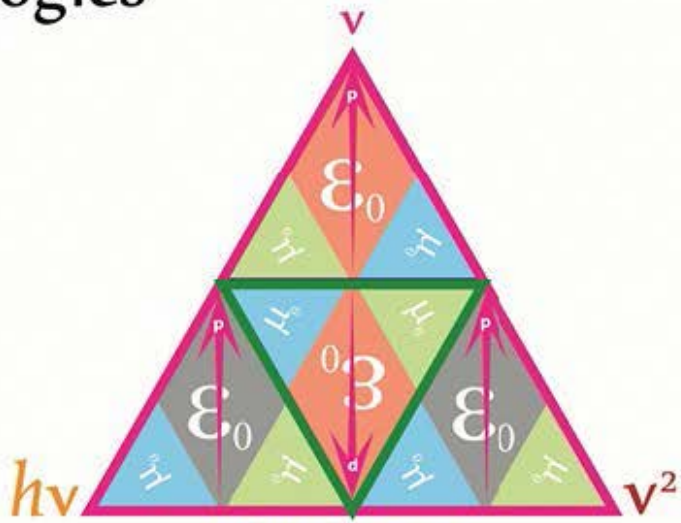

Neutral Tetryon

A 3D Tetryon can be 'collapsed' into a 2D waveform radiant four energy momenta EM waveform that conserves all of its 2D mass-energy-momenta

Neutral Tetryon

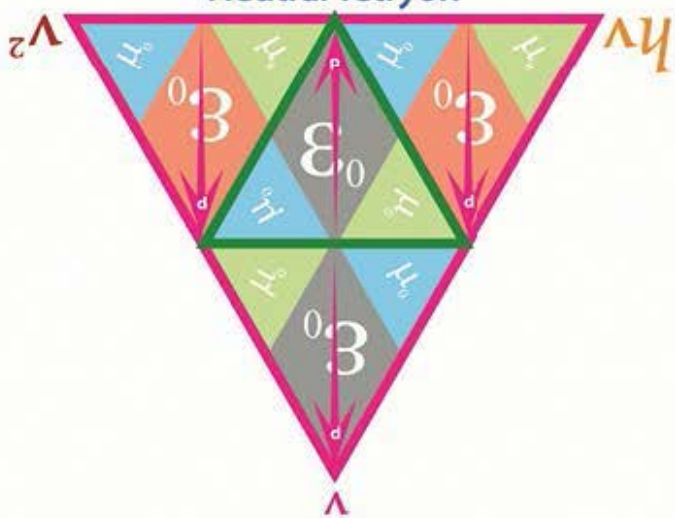

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Tetryon Genesis

1. WEAK interaction
Mutual Inductive Coupling
[Magnetic dipoles interact]

ODDπ
charged mass-energies

Non-Zero
nett mass-Energy-momenta
result in Linear momentum

2. *2D EM mass-energies*
interact to form
3D Matter topologies

EM wave momenta
can form standing waves
[Matter geometries]

3. STRONG interaction
Electrostatic Matter attract
via Electric charges and
Magnetic dipoles

4nπ
mass-Matter geometries

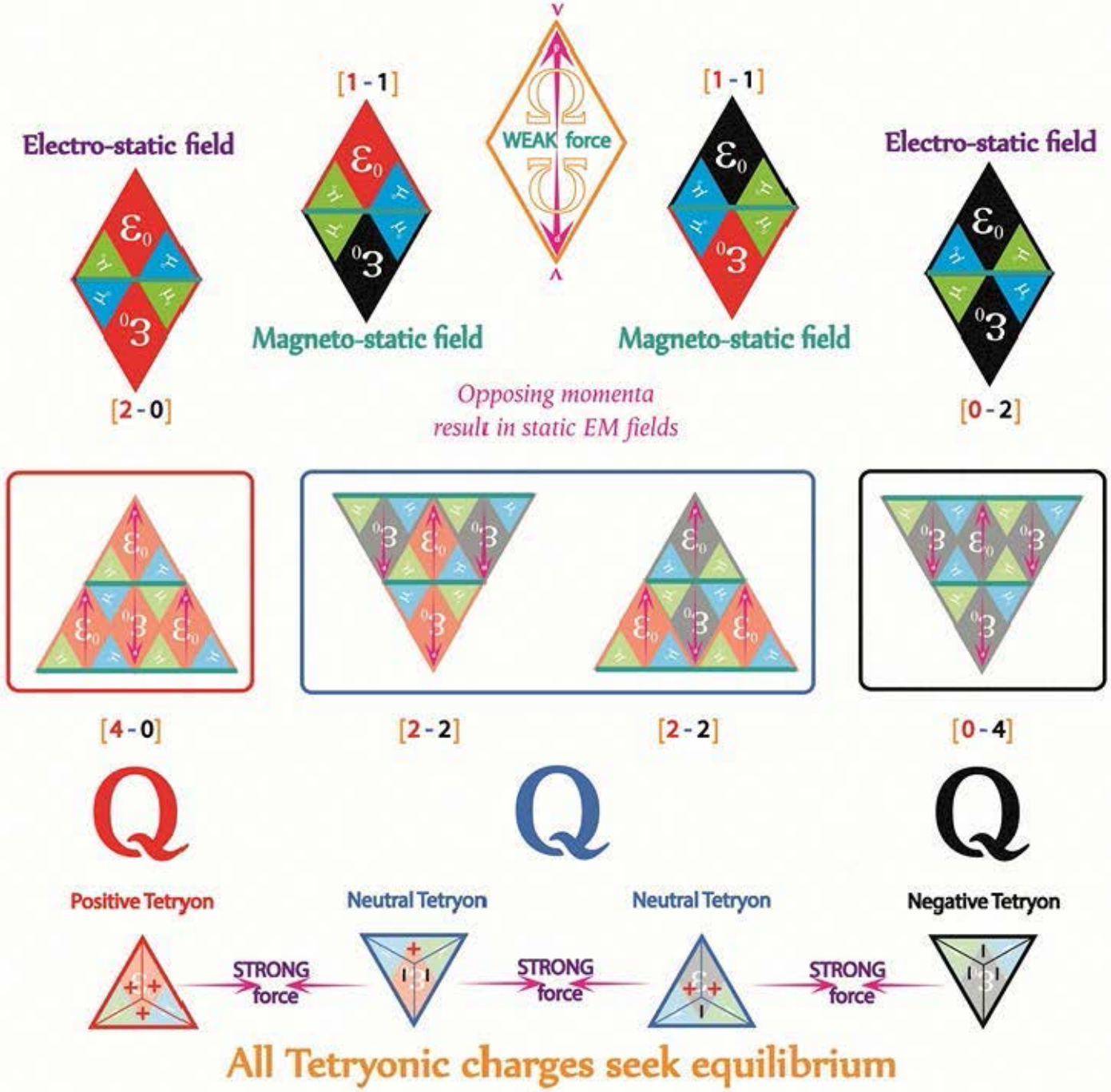

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Positive Tetryon

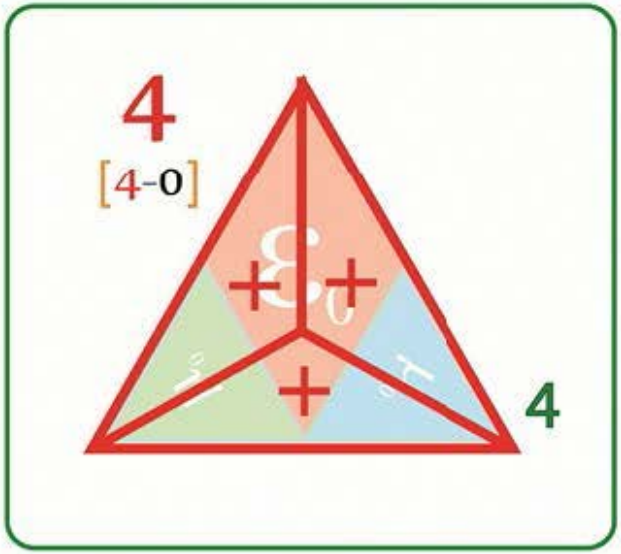

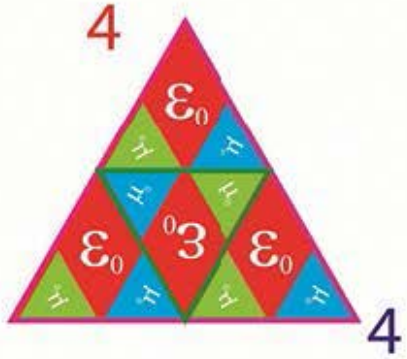

charged boson geometry

standing-wave Matter topology

radiant mass-energy geometries

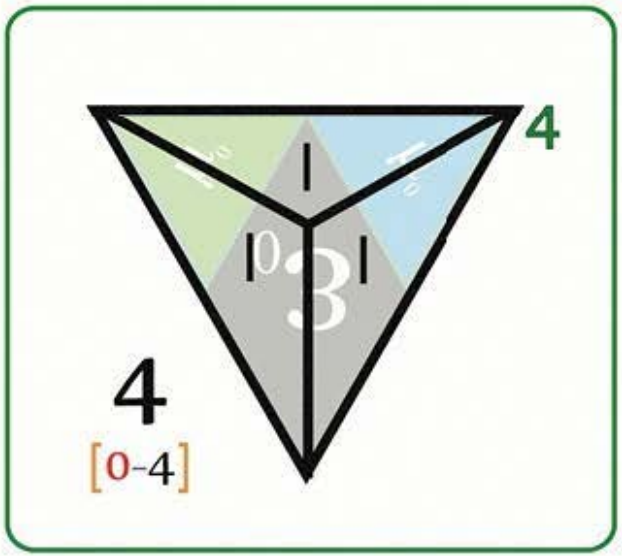

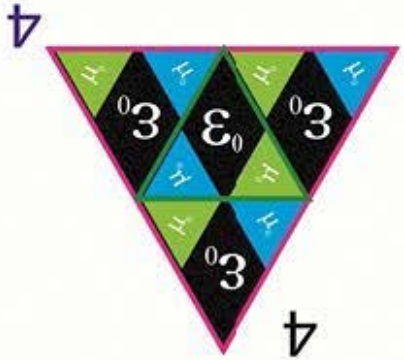

Negative Tetryon

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Neutral Tetryons

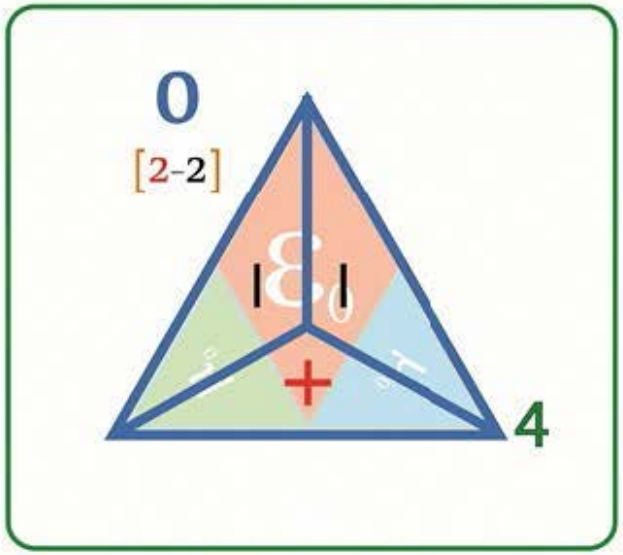

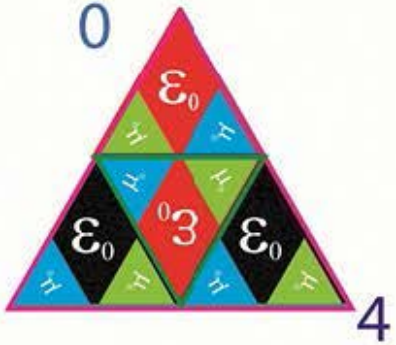

charged boson geometry

standing-wave Matter topology

radiant mass-energy geometries

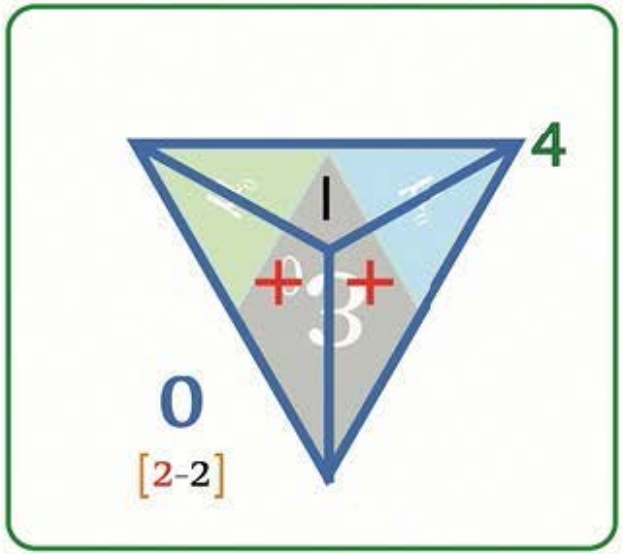

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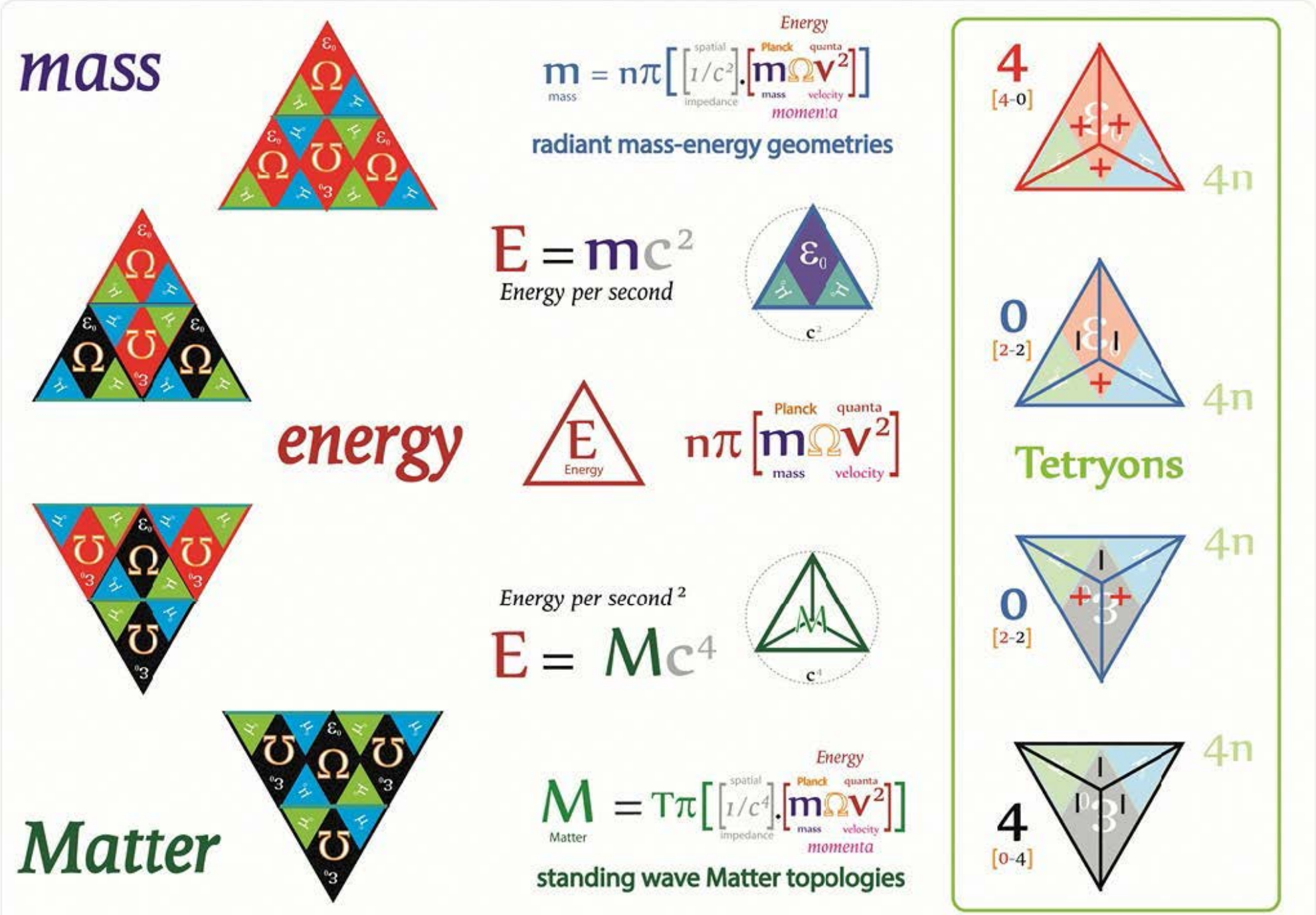

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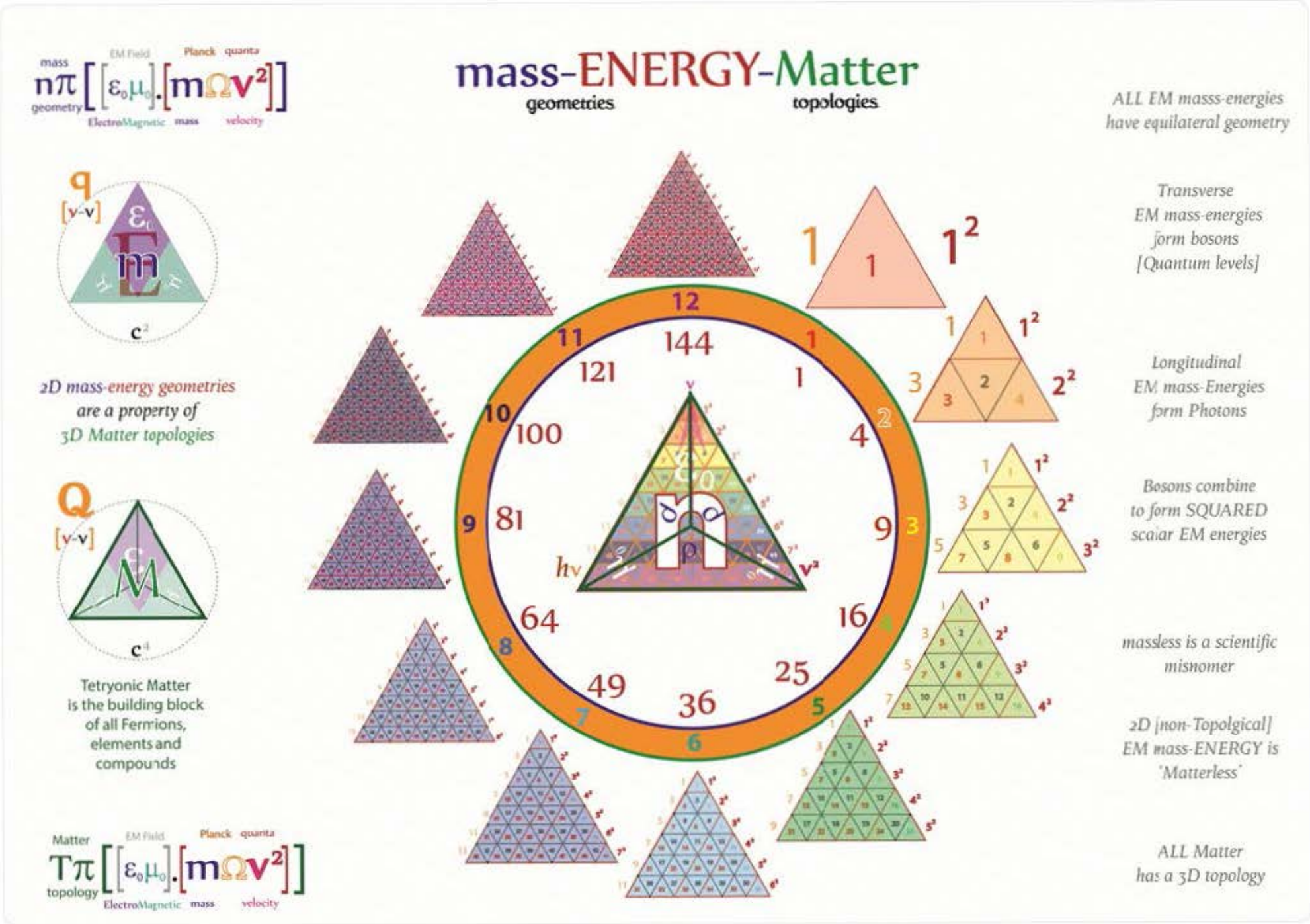

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Tetryonic Matter

All quantum Matter has a foundational tetrahedral topology as a result of their equilateral mass-energy geometries
[not spherical as has been assumed from the math]

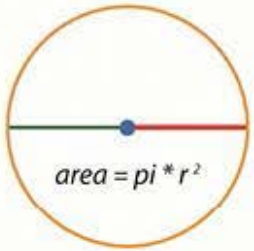

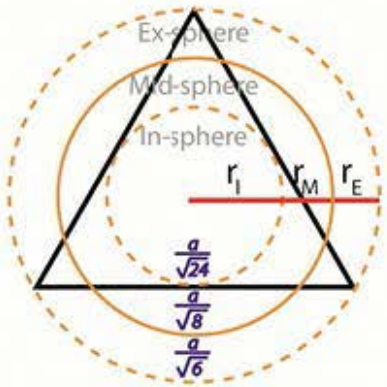

Sphere

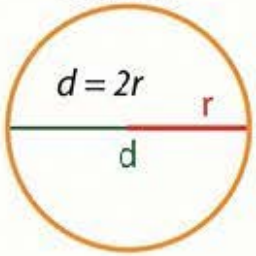

Area sphere= $4\pi r^2$
Surface curvature = $1/r^2$
Total curvature = 4π

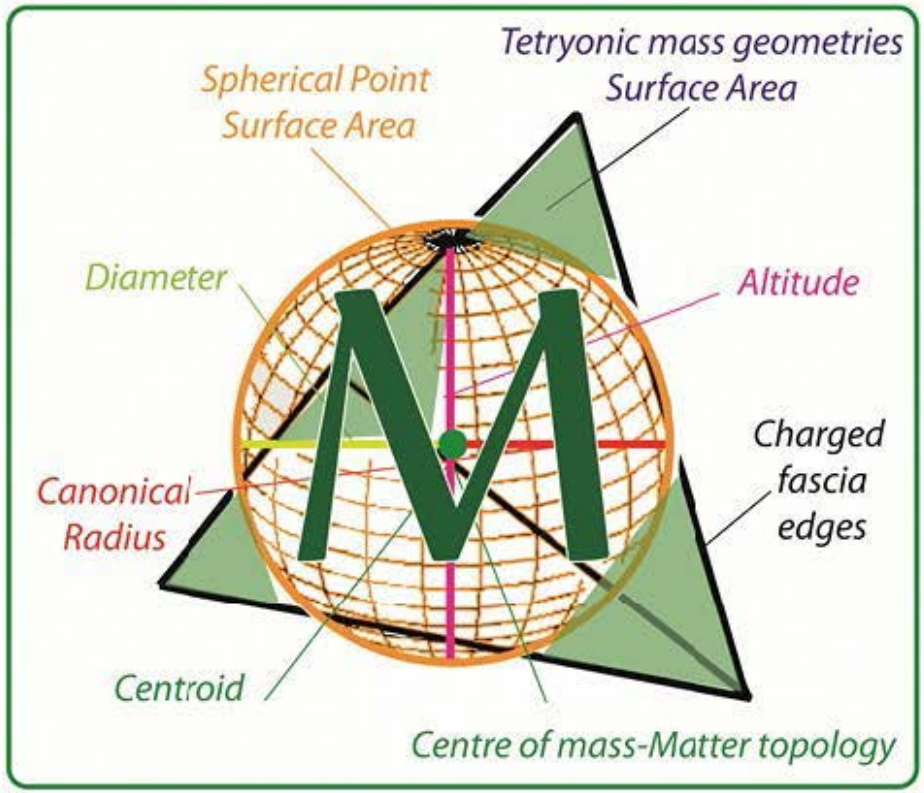

Spheres & Tetrahedra are both 3D Platonic solids with 4π scalar integral Gaussian topologies and physical displacement volumes [Gauss-Bonnet theorem]

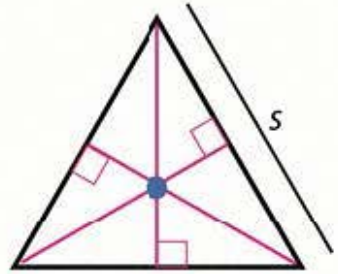

area = $\sqrt{3/4} * a^2$

ZPF fascia

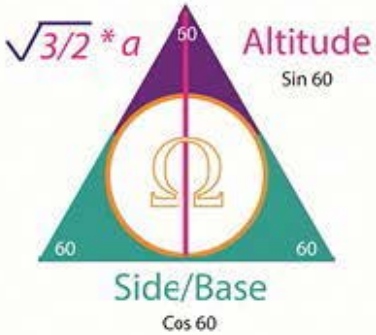

Area Tetryon

$A = 4\,A_0 = \sqrt{3}a^2$
Vertex curvature = π
Total curvature = 4π

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Dodecyons

while quarks & leptons are comprised of
12π mass-energy geometries
they have differing final Matter topologies

+1/3

up quark

8 [10-2]

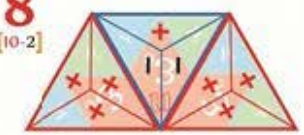

+2/3

anti-strange quark

top quark

charmed quark

8π

strange quark

-1/3

bottom quark

anti-bottom quark

-2/3

8 [2-10]

anti-up quark

anti-down quark

4 [8-4]

anti-charmed quark

quarks

anti-top quark

4 [4-8]

down quark

electron neutrino

0 [6-6]

neutrinos

0 [6-6]

positron neutrino

positron

12 [12-0]

e +1

anti-τ neutrino

anti-μ neutrino

tau

12π 0

muon

muon neutrino

tau neutrino

12 [0-12]

e -1

electron

EM Field Planck quanta

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

ElectroMagnetic mass velocity

Quarks have octahedral topologies

Leptons have dodecahedral topologies

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anti-up quark

-2/3

quark octahedral topology

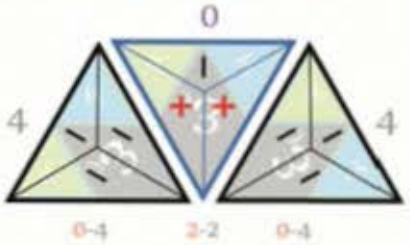

attractive dodecyon geometry

as mass-energy momenta is added to Matter topologies & KEM fields of motion different generations of particles are created

EM Field Planck quanta

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

dodecyon

ElectroMagnetic mass velocity

1. **anti-up** quark
2. **anti-charmed** quark
3. **anti-top** quark

net charge

8

[2-10]

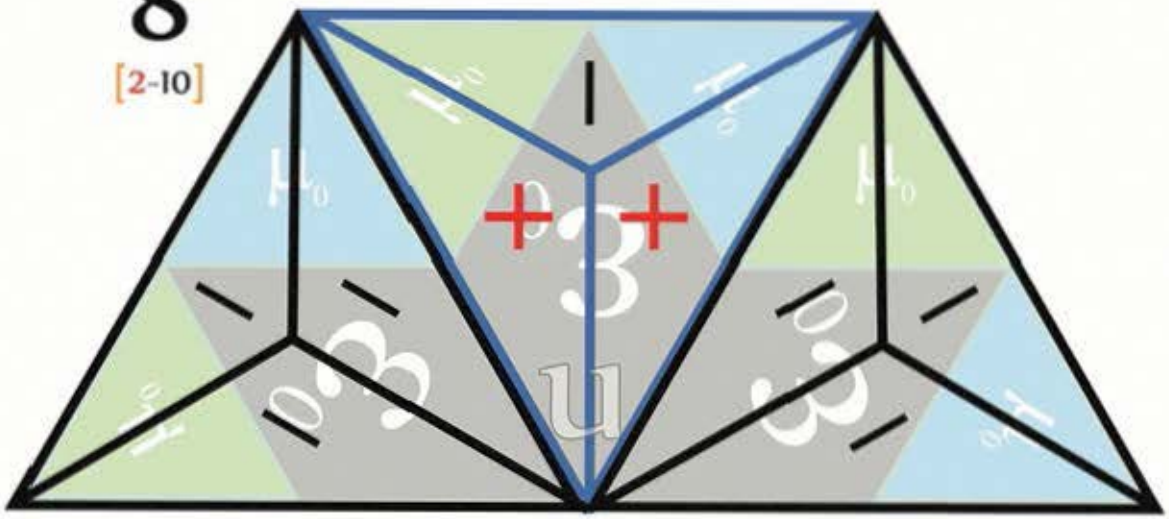

charged mass-Matter topology

8π

Quarks have 12 charged fascia - mass-energy geometries

2 Positive 10 Negative

Quarks have octahedral mass-Matter topologies

[-2/3 elementary charge]

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down quark

-1/3

quark octahedral topology

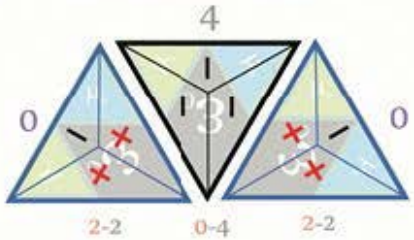

attractive dodecyon geometry

EM Field Planck quanta

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

dodecyon ElectroMagnetic mass velocity

as mass-energy momenta is added to Matter topologies & KEM fields of motion different generations of particles are created

1. **down** quark
2. **strange** quark
3. **bottom** quark

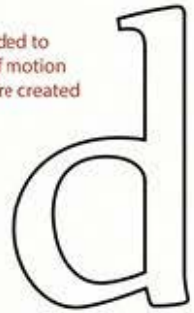

nett charge

4

[4-8]

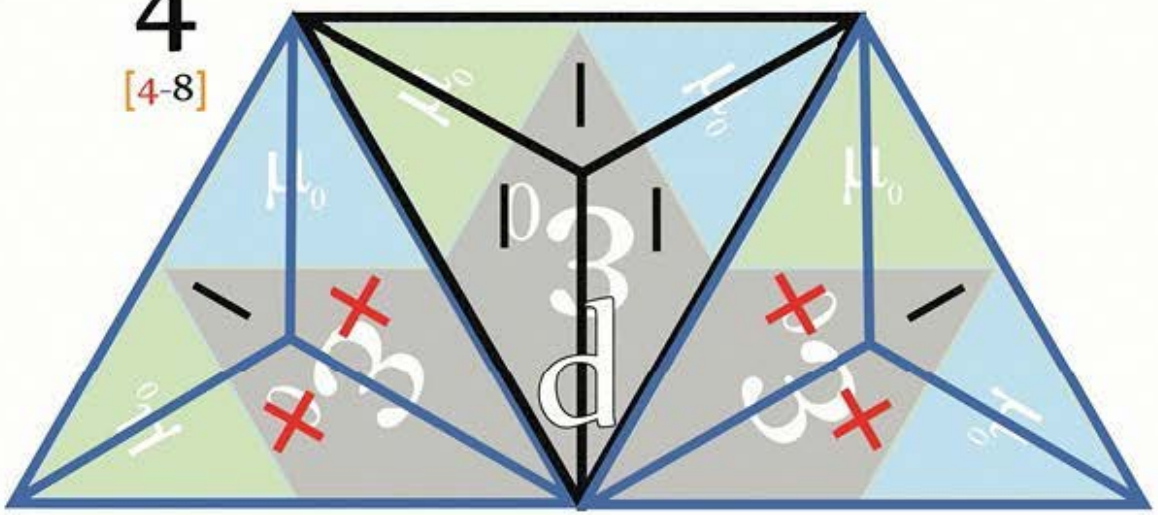

charged mass-Matter topology

8π

Quarks have 12 charged fascia - mass-energy geometries

4 Positive 8 Negative

Quarks have octahedral mass-Matter topologies

[-1/3 elementary charge]

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anti-down quark

+1/3

quark octahedral topology

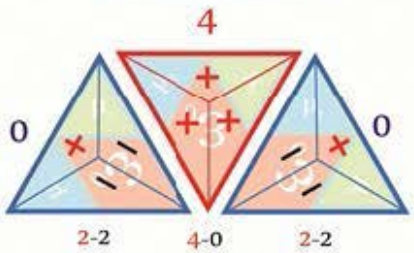

attractive dodecyon geometry

EM Field Planck quanta

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

dodecyon

ElectroMagnetic mass velocity

as mass-energy momenta is added to Matter topologies & KEM fields of motion different generations of particles are created

1. **anti-down** quark
2. **anti-strange** quark
3. **anti-bottom** quark

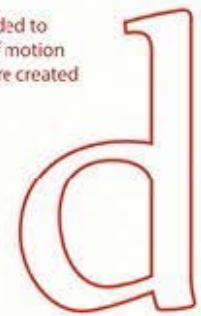

nett charge

4

[8-4]

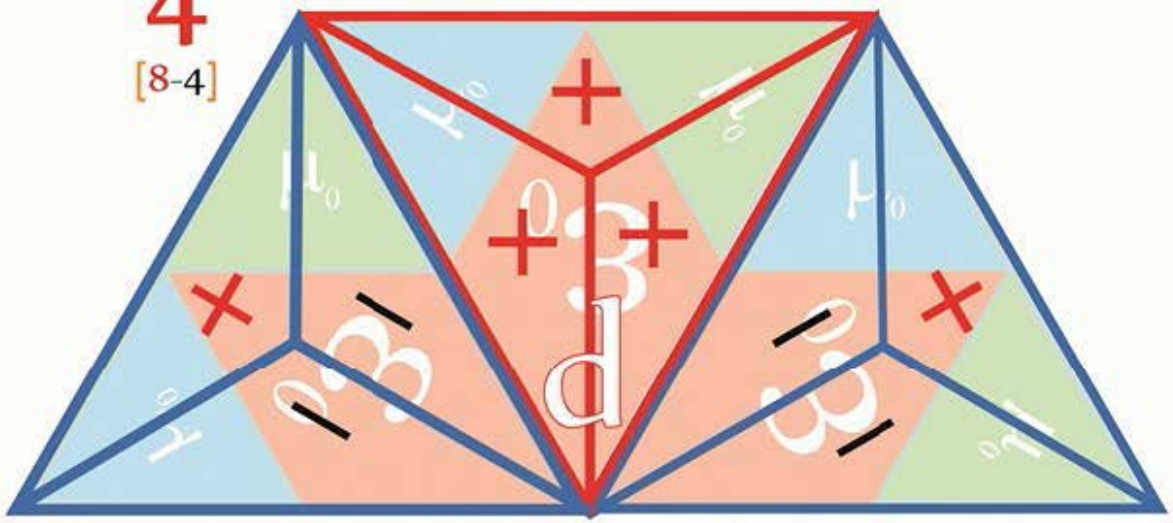

charged mass-Matter topology

8π

Quarks have 12 charged fascia - mass-energy geometries

8 Positive 4 Negative

Quarks have octahedral mass-Matter topologies

[+1/3 elementary charge]

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up quark

+2/3

quark octahedral topology

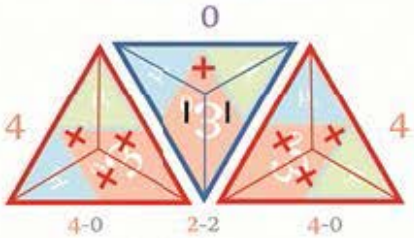

attractive dodecyon geometry

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

dodecyon; EM Field: $\varepsilon_0\mu_0$ (ElectroMagnetic); Planck quanta: $m\Omega v^2$ (mass, velocity)

as mass-energy momenta is added to Matter topologies & KEM fields of motion different generations of particles are created

1. **up** quark
2. **charmed** quark
3. **top** quark

nett charge

8

[10-2]

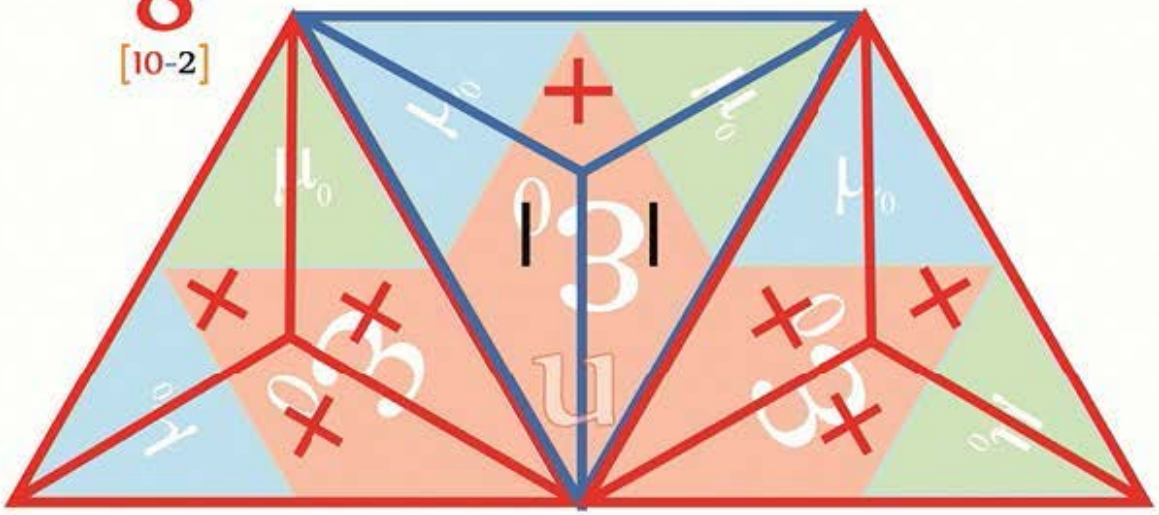

charged mass-Matter topology

8π

Quarks have 12 charged fascia - mass-energy geometries

10 Positive 2 Negative

Quarks have octahedral mass-Matter topologies

[+2/3 elementary charge]

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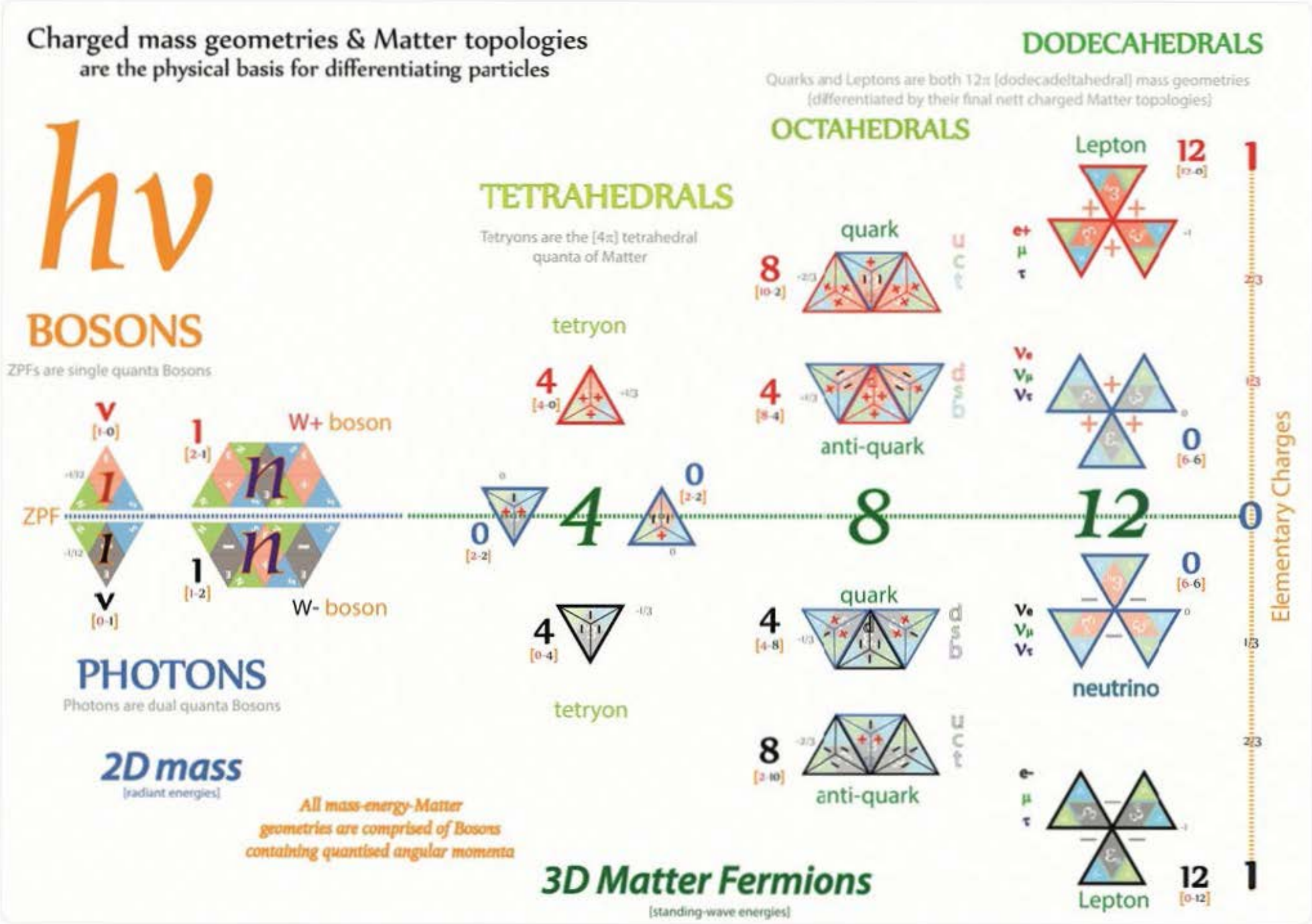

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divergent negative E-fields

electron

convergent negative E-fields

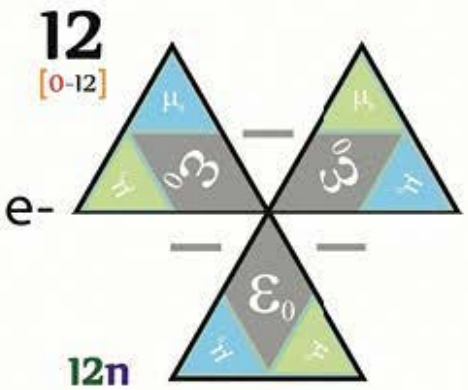

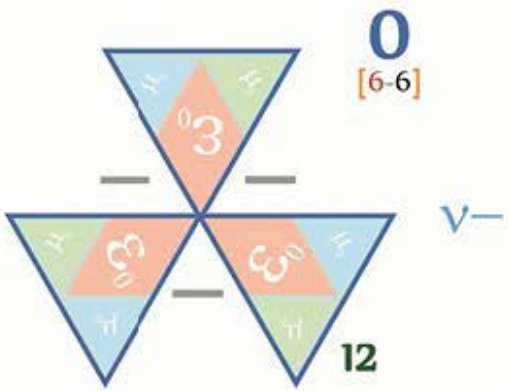

divergent negative E-fields

electron neutrino

convergent positive E-fields

Leptons have 12 charged mass-energy fascia geometries

Repulsive STRONG force creates Lepton topologies

12π

Tetryonic charged fascias creates the Matter topologies of all Leptons

Repulsive STRONG force creates Neutrino topologies

Leptons have dodecadeltahedral mass-Matter topologies

divergent positive E-fields

positron

convergent positive E-fields

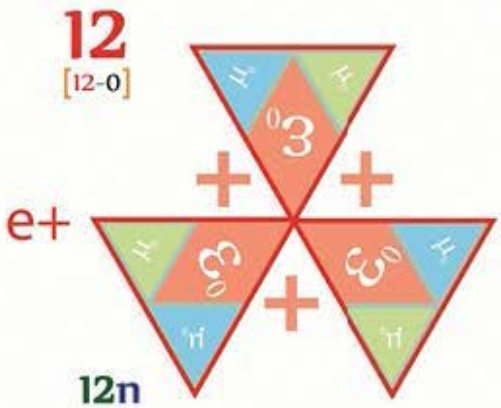

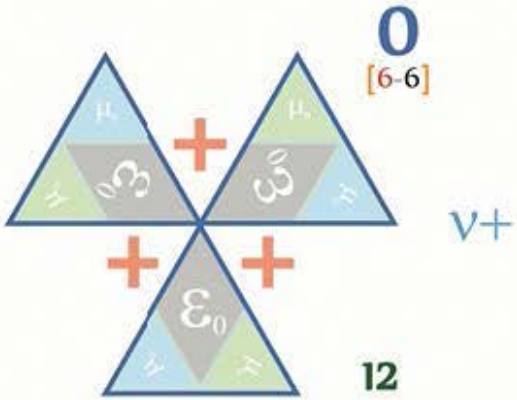

divergent positive E-fields

positron neutrino

convergent negative E-fields

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Charged Leptons

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — Dodecyon — ElectroMagnetic — mass — velocity

positron

e+
12

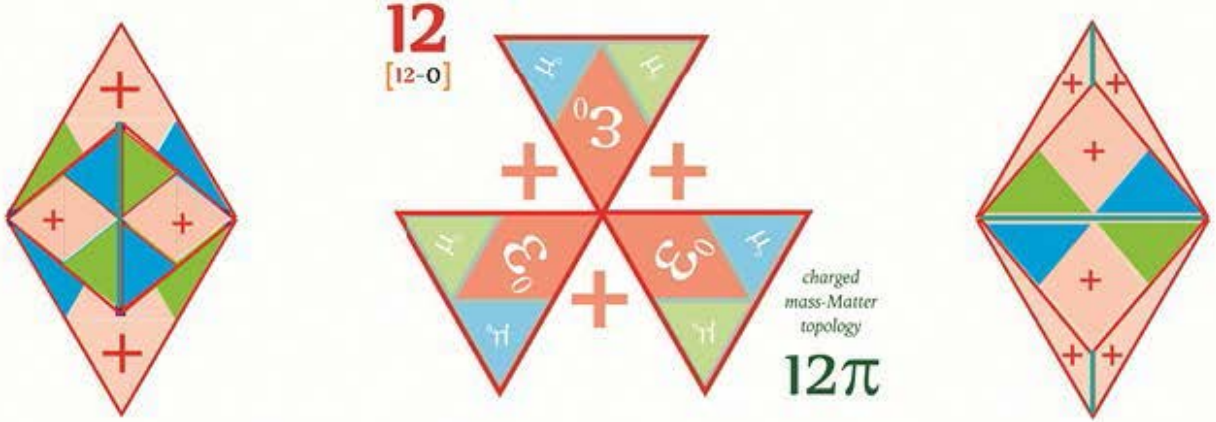

1. positron
2. anti-muon
3. anti-tau

Leptons have 12 charged mass-energy fascia geometries

12 positive charge fascia or 12 Negative charge fascia

repulsive dodecyon geometries

lepton topologies

Charged Leptons have dodecadeltahedral mass-Matter topologies

[1 elementary charge]

e-
12

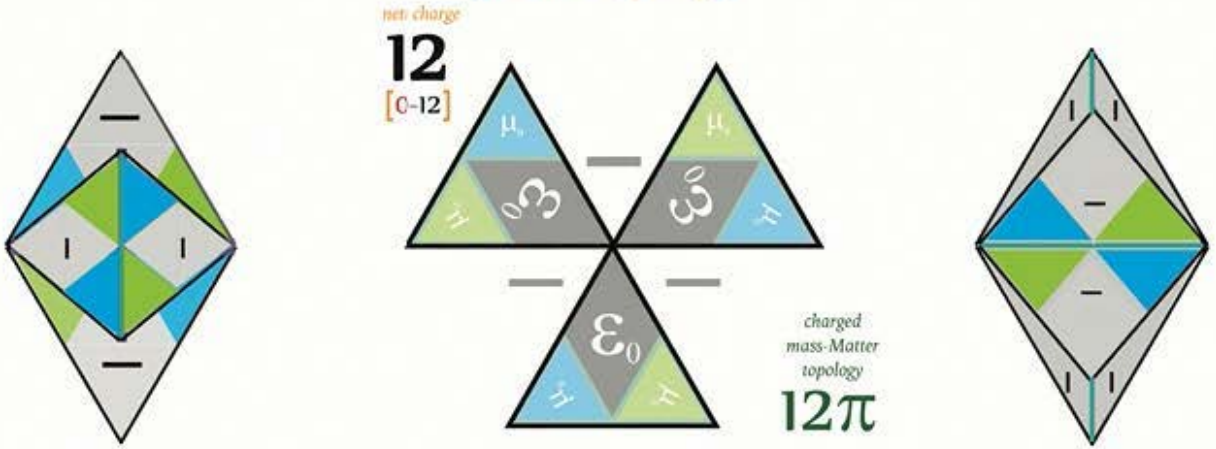

1. electron
2. muon
3. tau

electron

as mass-energy momenta is added to Matter topologies & KEM fields of motion different generations of particles are created

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positron

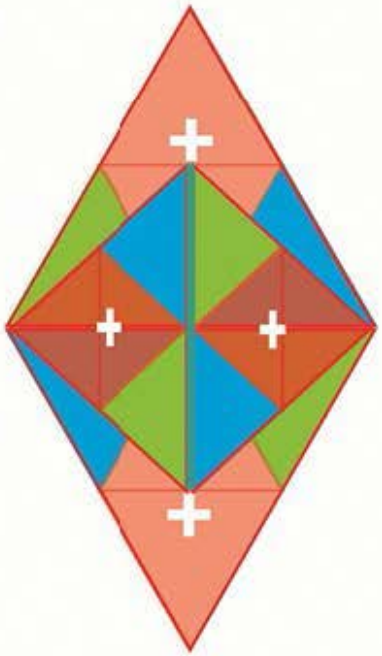

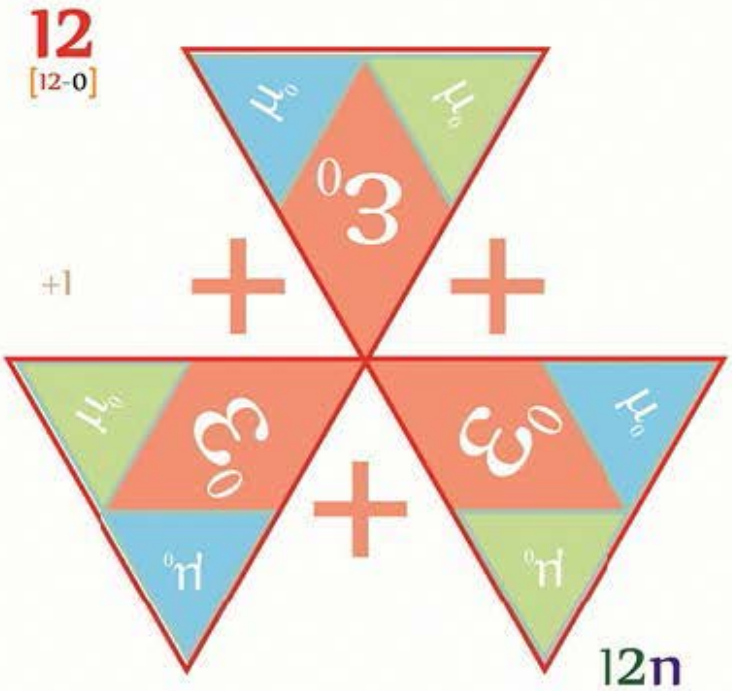

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Dodecyon; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

1. positron
2. anti-muon
3. anti-tau

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Neutral Leptons

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Dodecyon — EM Field (ElectroMagnetic) — Planck quanta (mass, velocity)

$\nu-$
0

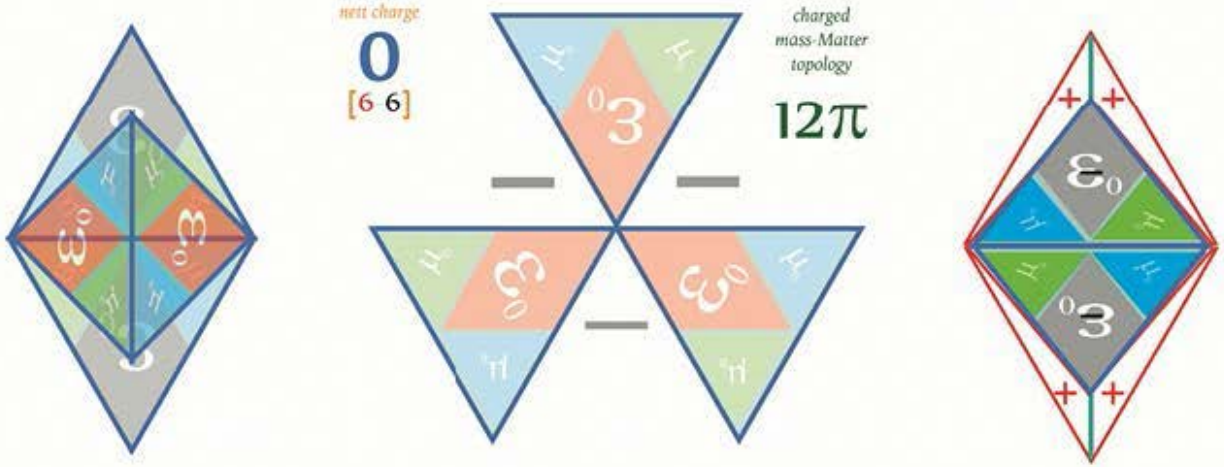

1. electron neutrino
2. muon neutrino
3. tau neutrino

Neutrinos have 12 charged mass-energy fascia geometries

6 Positive & 6 Negative

repulsive dodecyon geometries

lepton topologies

Neutrinos have neutral dodecadeltahedral mass-Matter topologies

[0 elementary charge]

$\nu+$
0

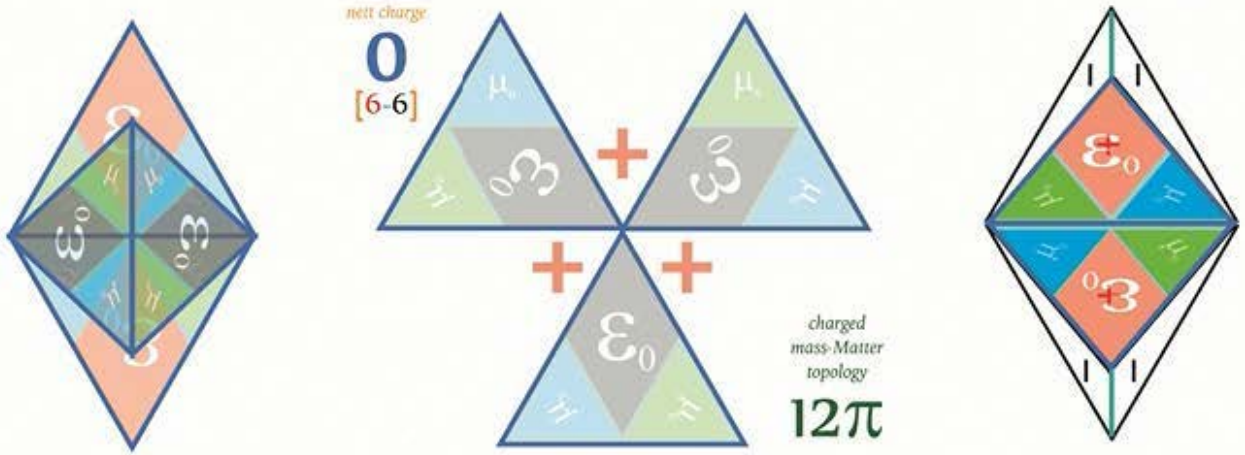

1. positron neutrino
2. anti- muon neutrino
3. anti-tau neutrino

as mass-energy momenta is added to Matter topologies & KEM fields of motion different generations of particles are created

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electron

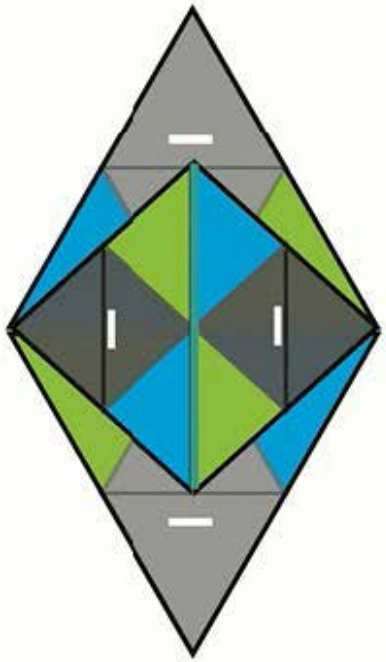

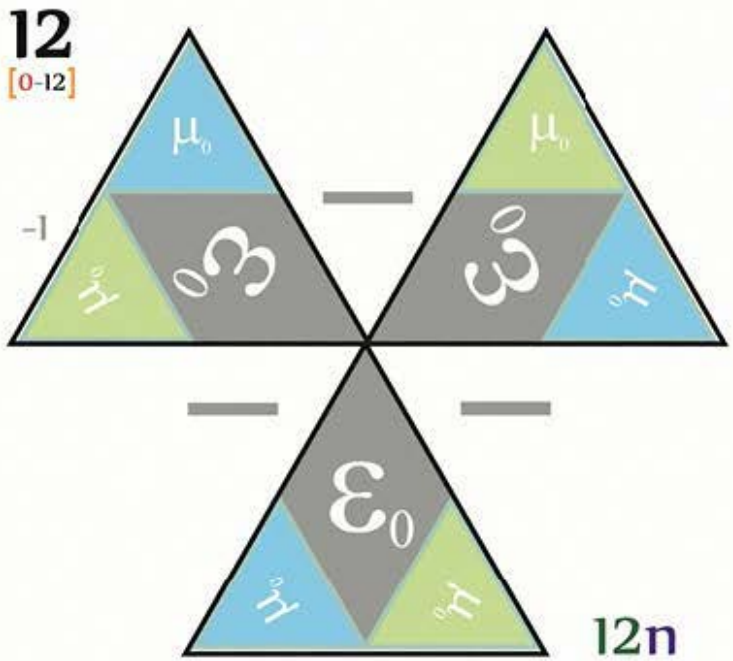

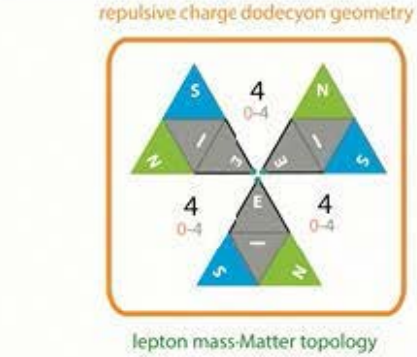

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Dodecyon; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

1. electron
2. muon
3. tau

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Leptronic Quantum levels

[KEM field mass-energy geometry]

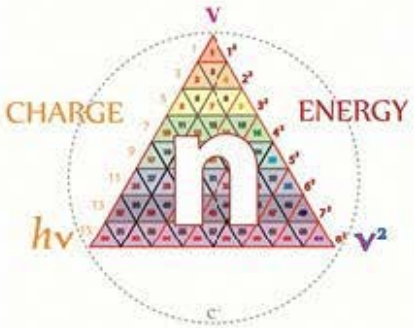

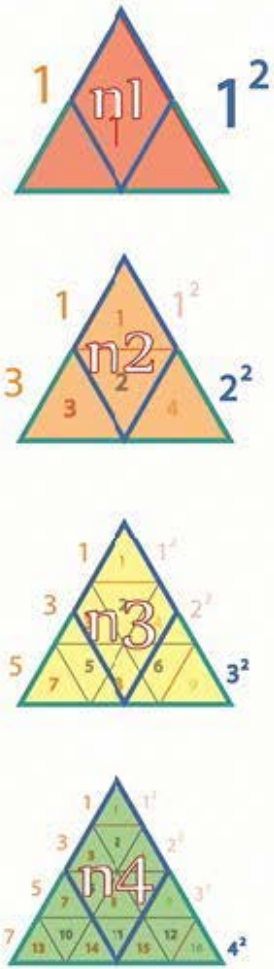

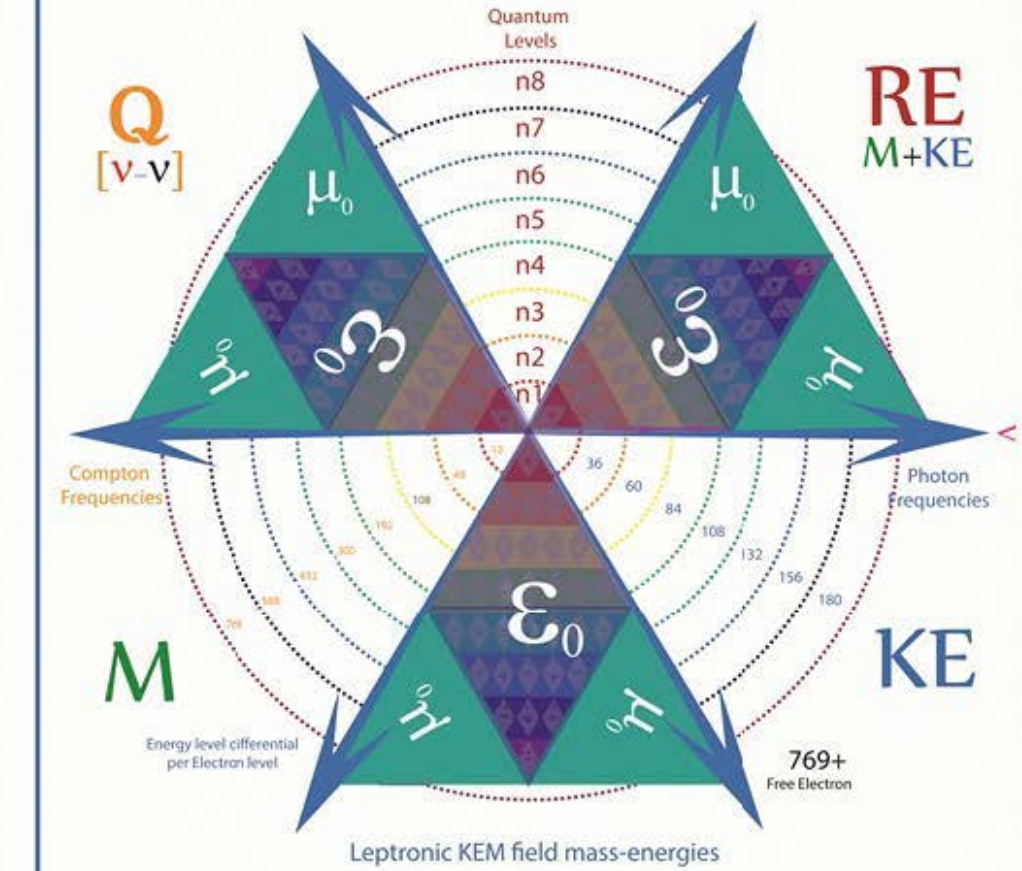

Illustrative schema only: All Leptonic quantum levels have the same equilateral KEM geometry as the compton frequency of the KEM field increases the wavelengths of the quanta decrease

ν² Total quanta	n Electron quantum level
1.2e20	1
4.8e20	4
1.08e21	9
1.92e21	16
3.00e21	25
4..32e21	36
5.88e21	49
7.68e21	64

1e19

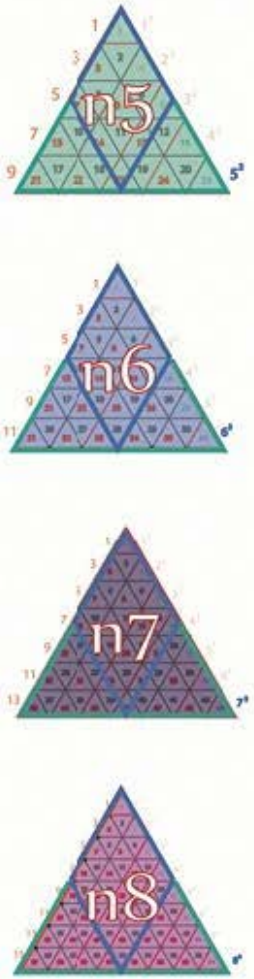

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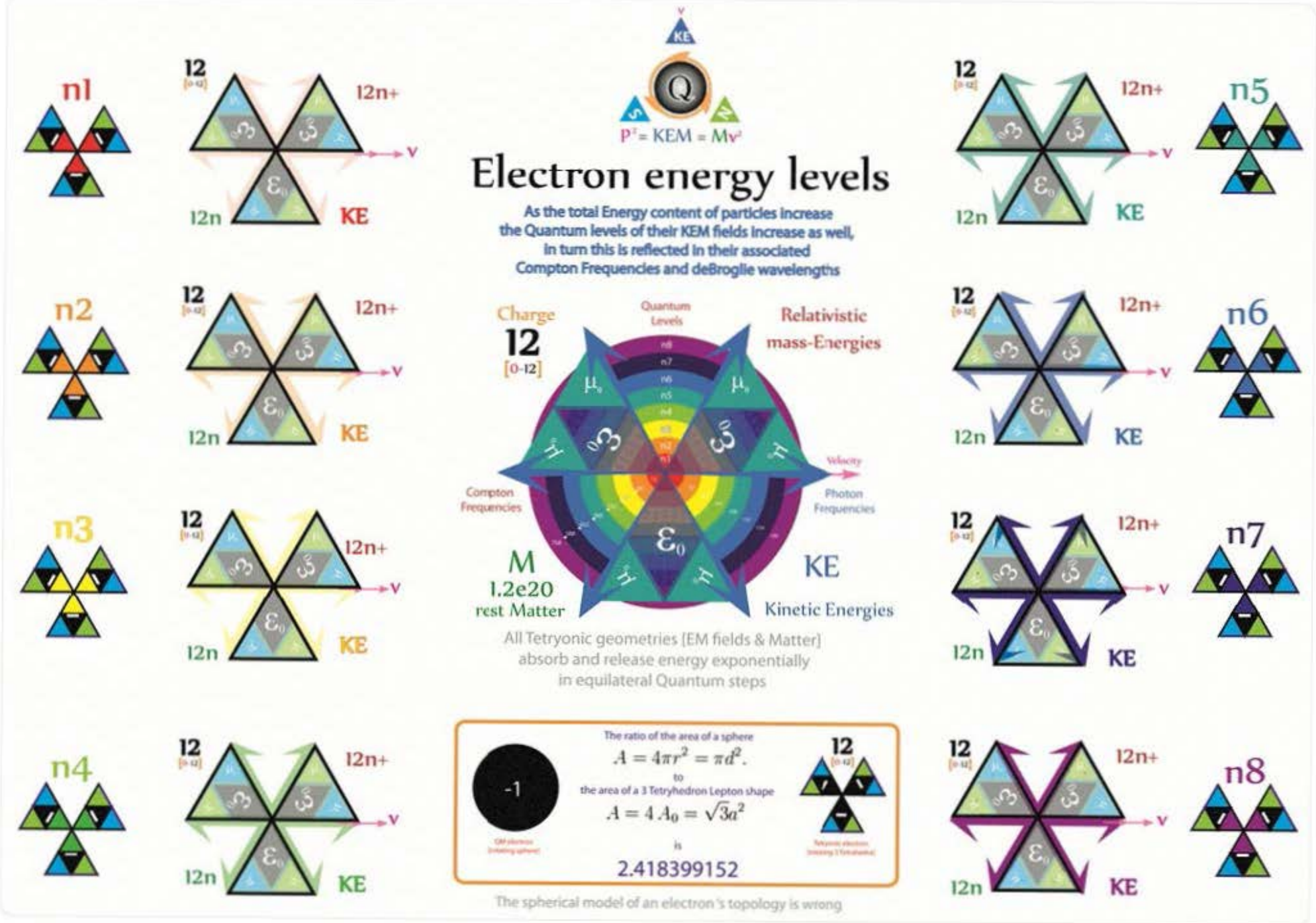

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Leptronic Kinetic EM Fields

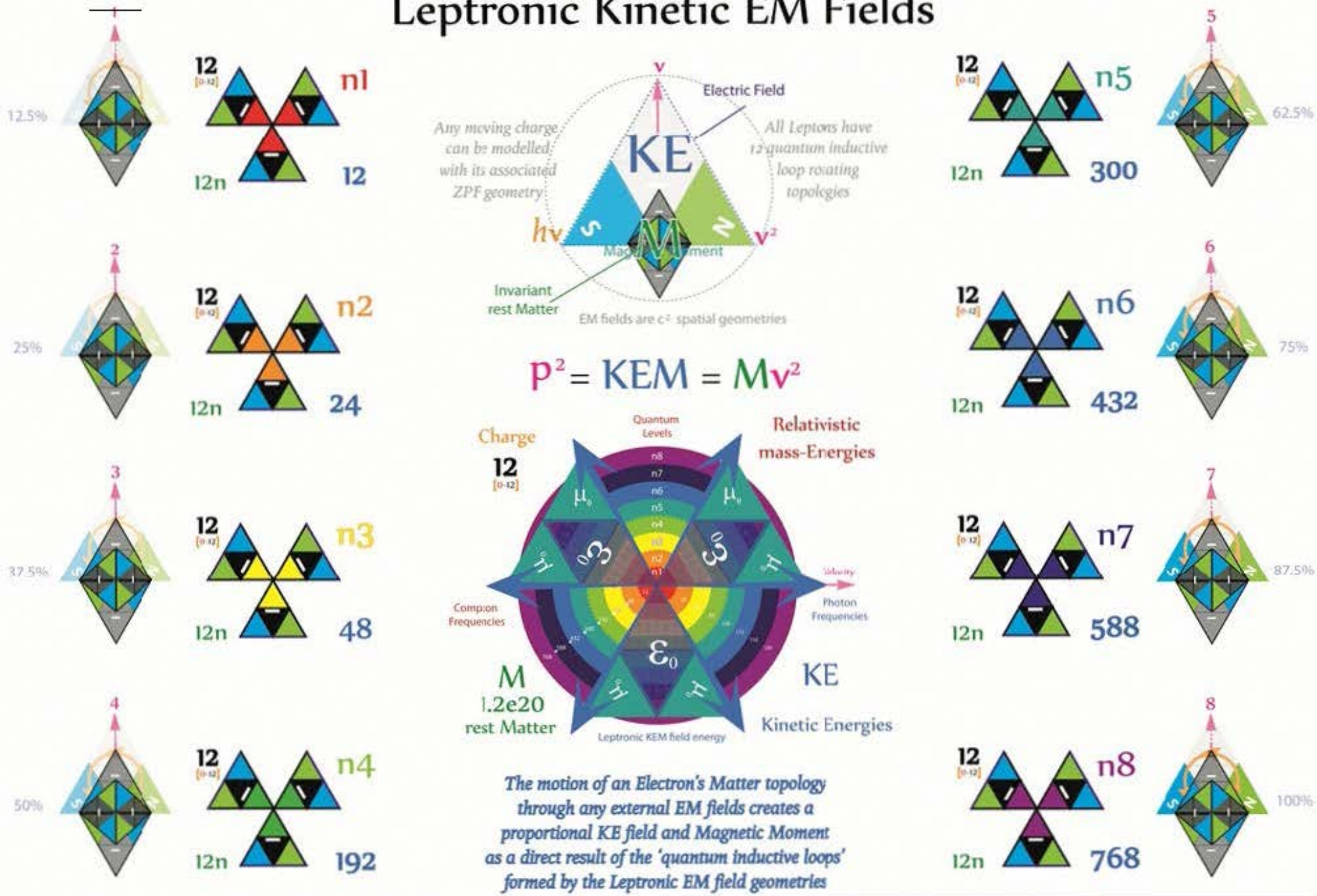

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Kinetic field modelling

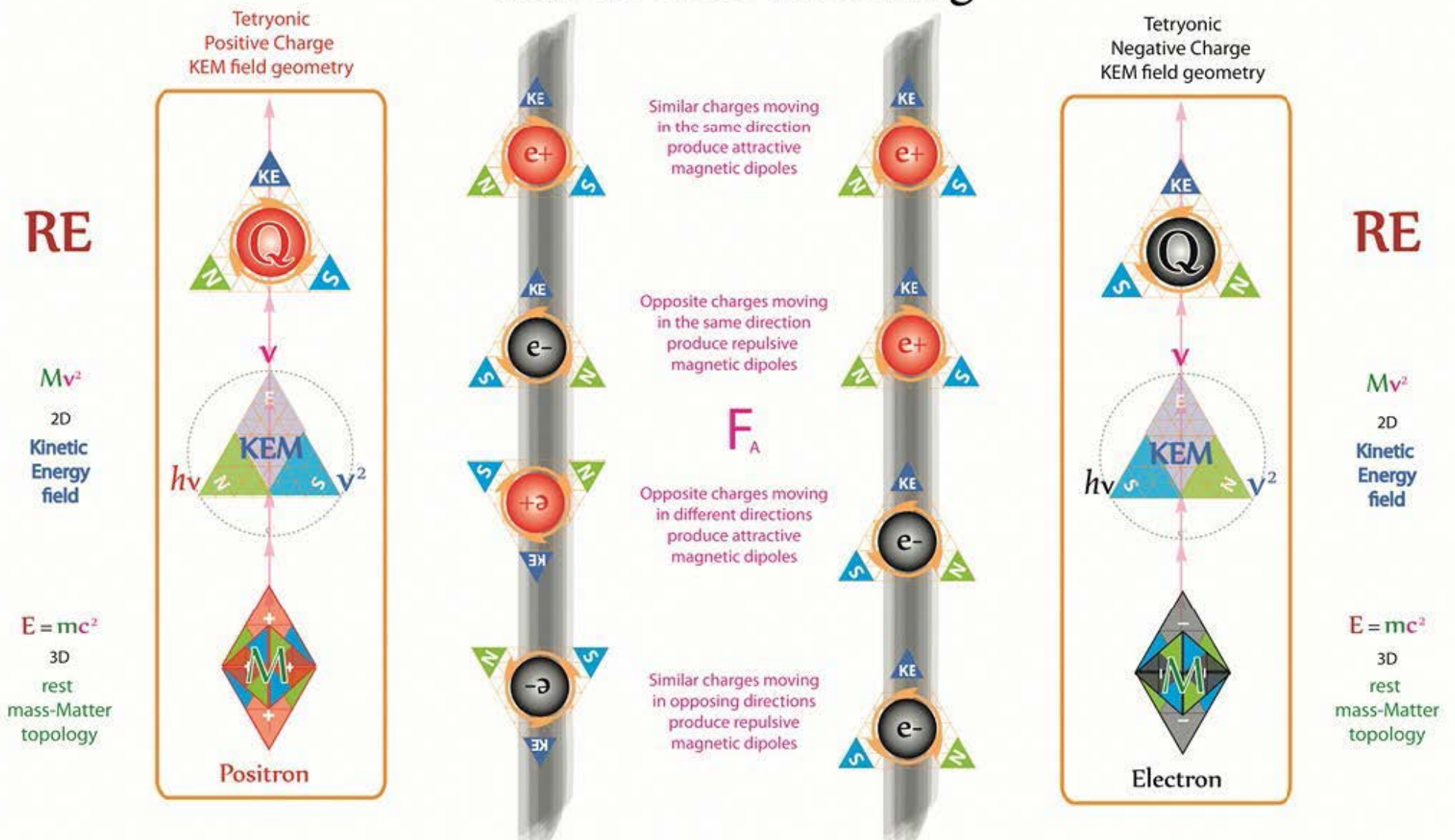

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Lepton Families & Generations

Charged Matter topologies in motion creates Kinetic EM field geometries

Charged mass-energy geometries form elementary particle topologies

$$12\pi$$

$$KEM = Mv^2$$

Total relativistic mass-energies
[rest Matter + KEM]

All high mass-energy particles 'decay' into low mass-energy particles by emitting photons

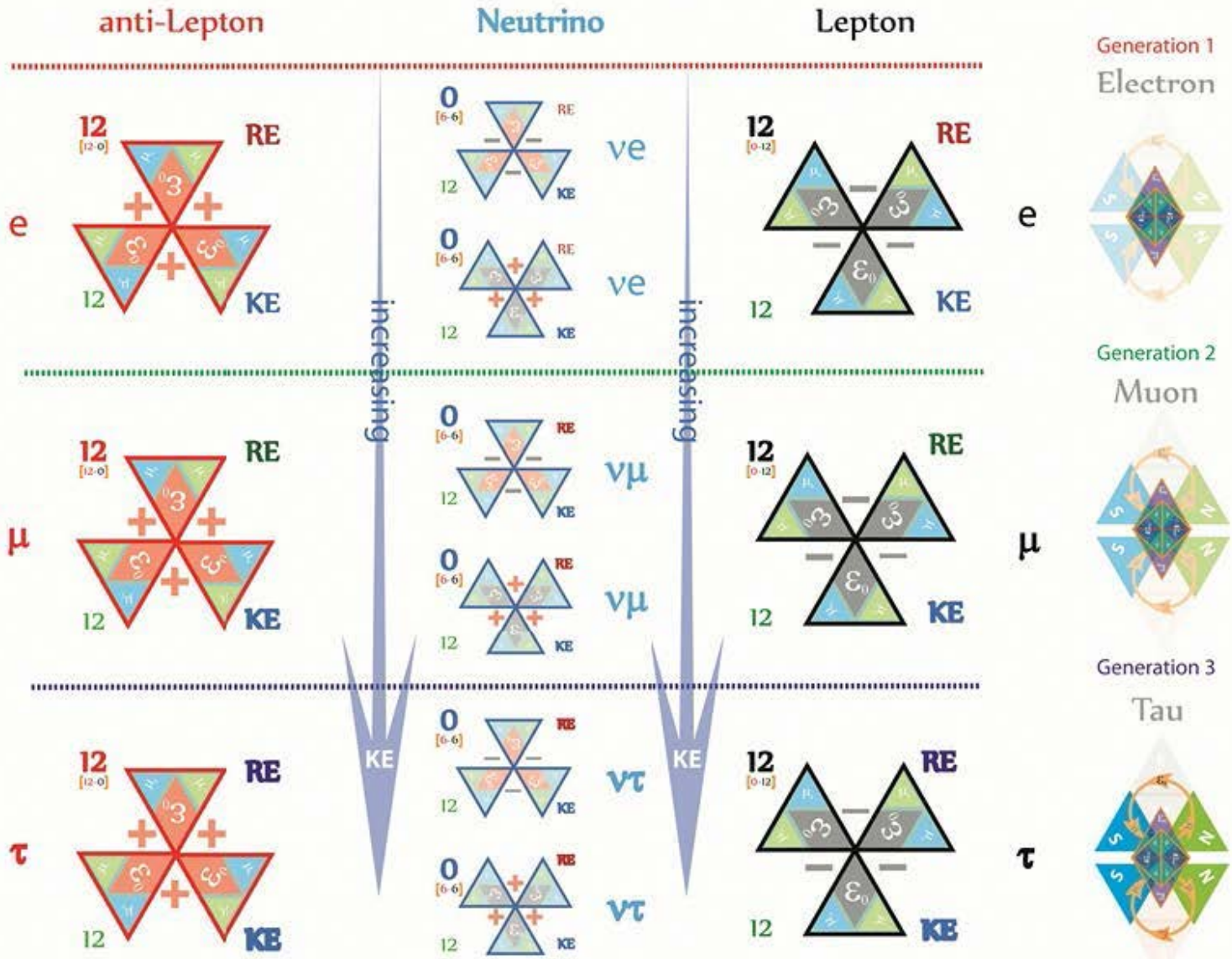

Note: All Lepton geometries are the same size - only the energy density of the EM field changes

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Lepton Helicity and Chirality

Particle Spin and Handedness is always referenced
with respect to the direction of nett total system linear Momentum

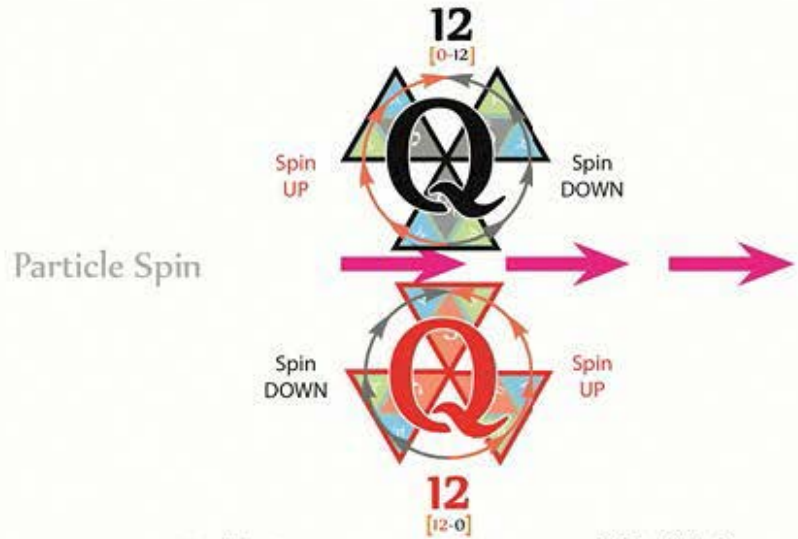

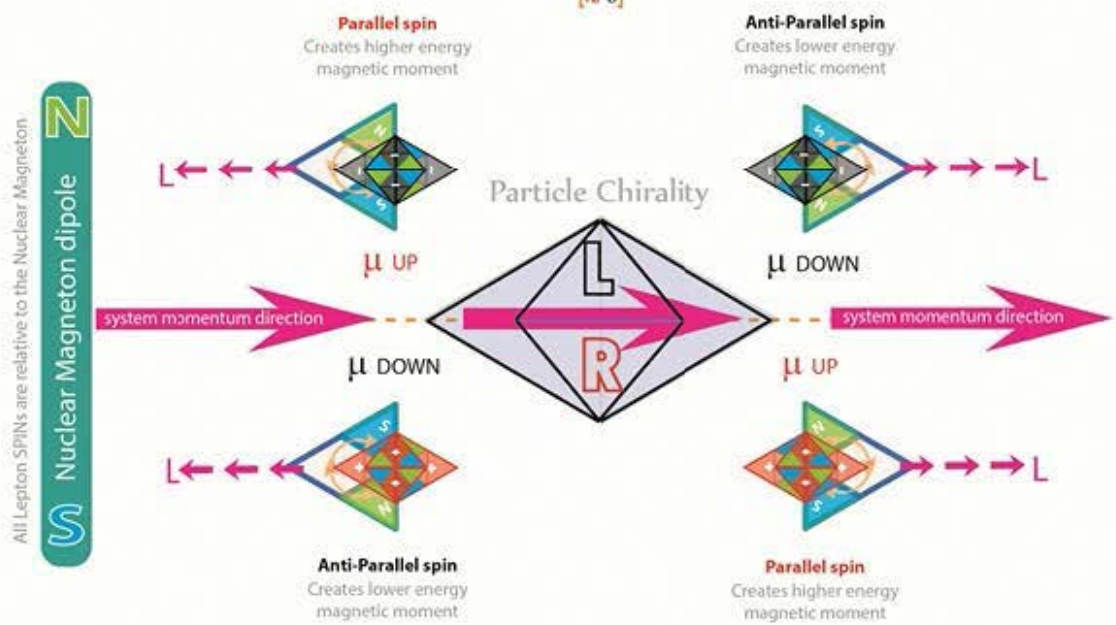

Particle Chirality

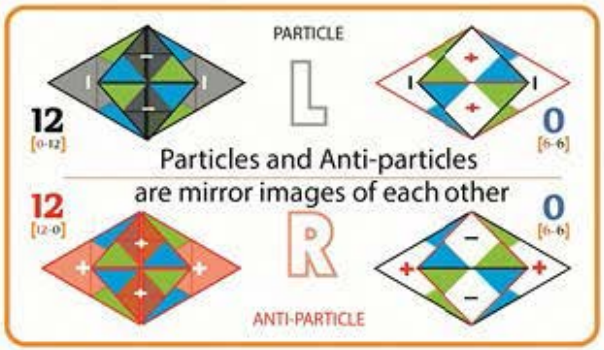

Particle Helicity

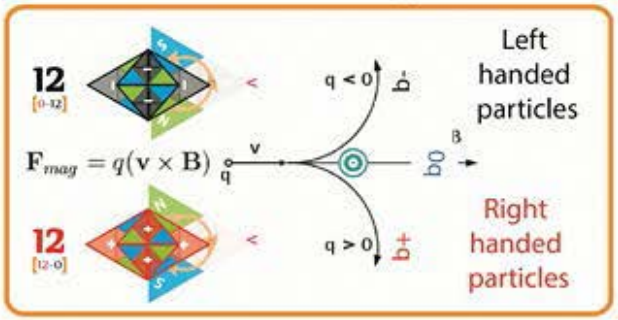

Lorentz Force and Transformation

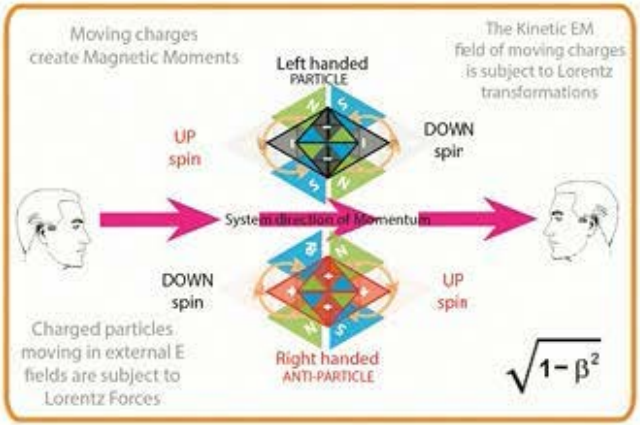

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'Point Charges'

The only true 'point charges' are Zero Point Fields

Positive Particles

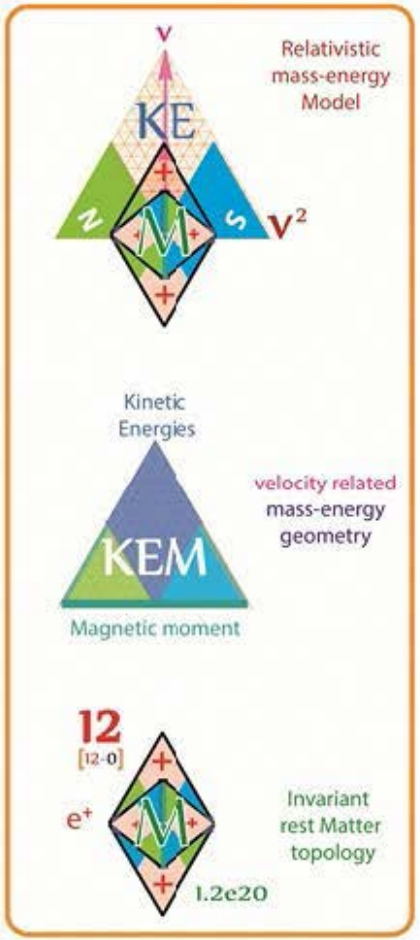

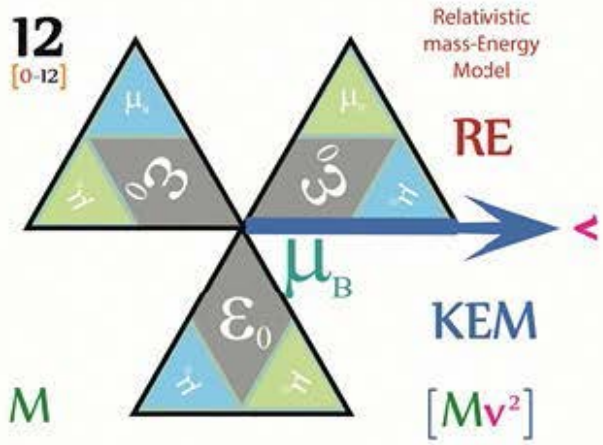

It is the Kinetic EM field geometry of charged Matter topologies in motion that produces Magnetic Moments

[not a relativistic distortion of speherical charge topologies]

Negative Particles

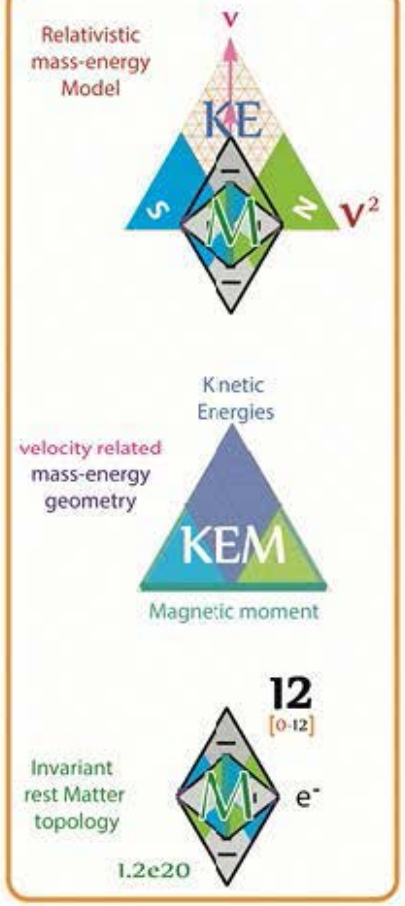

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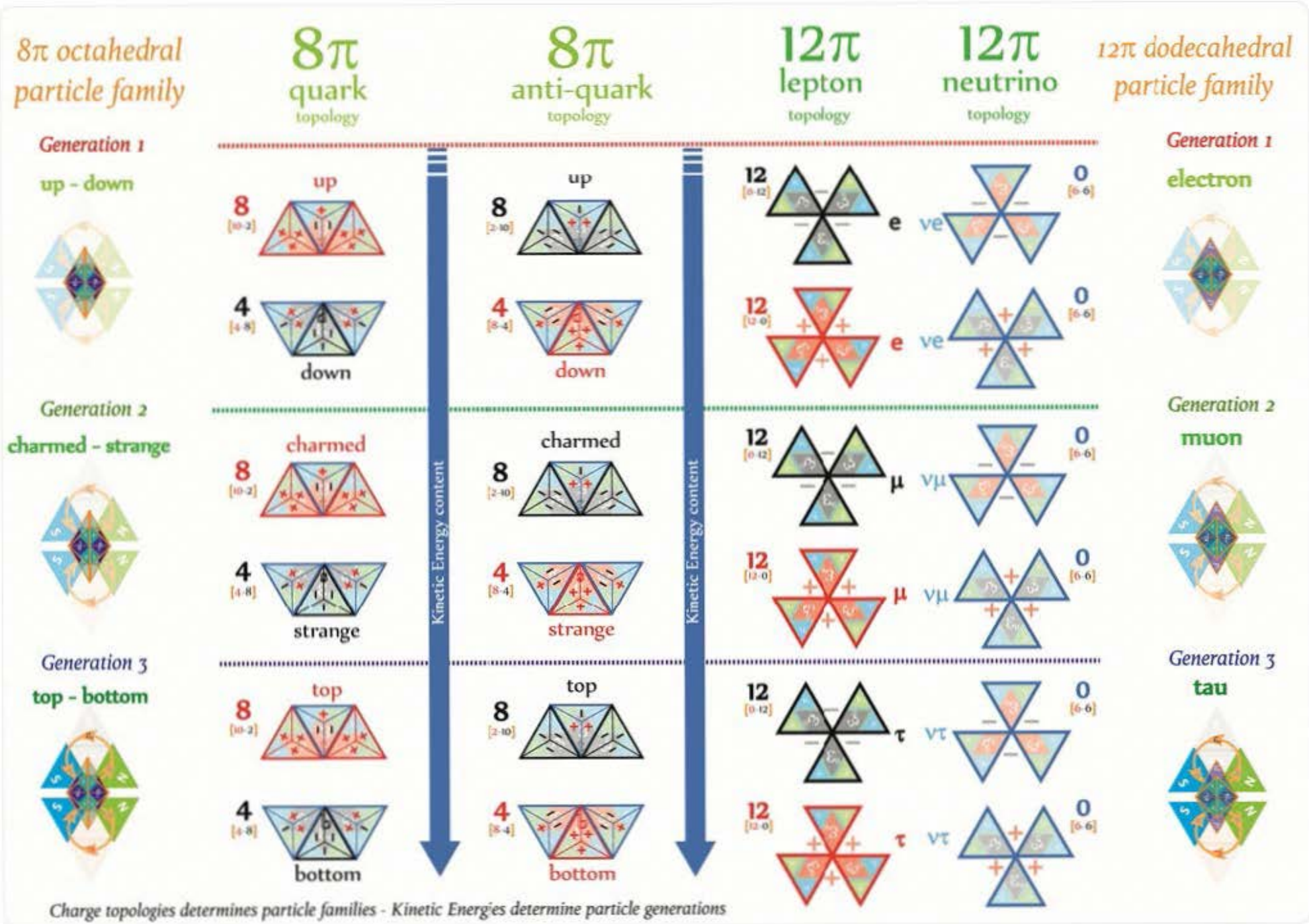

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Mesons

are 24π subatomic mass-Matter particles composed of one quark and one antiquark

$$24\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Mesons — EM Field (ElectroMagnetic) — Planck quanta (mass, velocity)

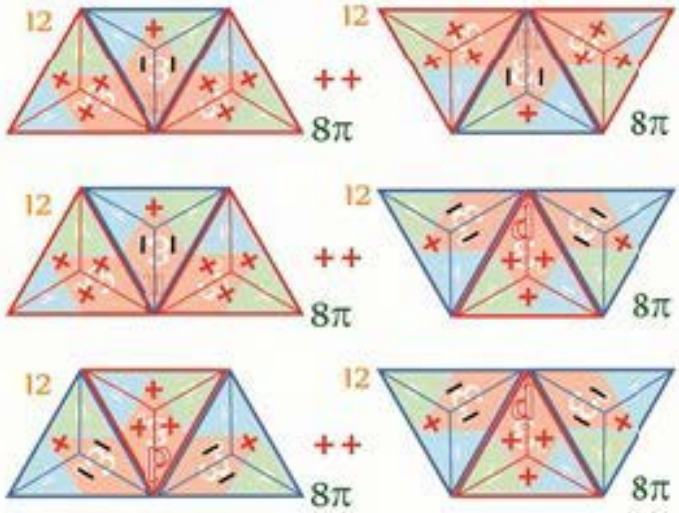

+16 [20-4]

+12 [18-6]

+8 [16-8]

prevented by strong repulives forces

24π charged mass-energy fascia geometries

Pions

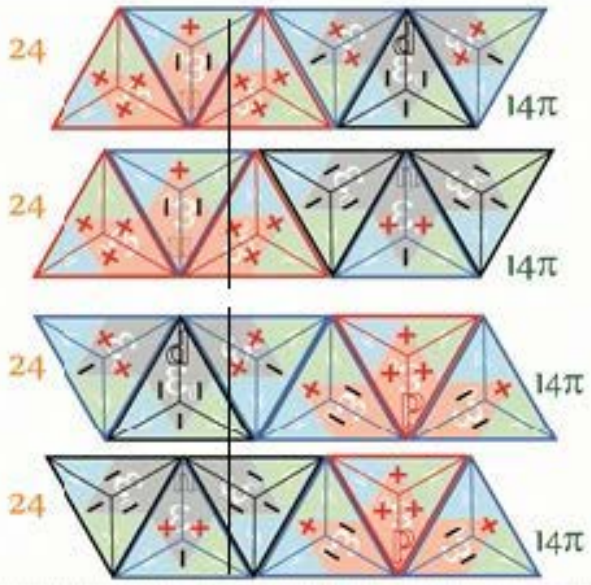

π+ +4 [14-10]

π0 0 [12-12]

π0 0 [12-12]

π- -4 [10-14]

Short lived combinations

14π final mass-Matter topologies

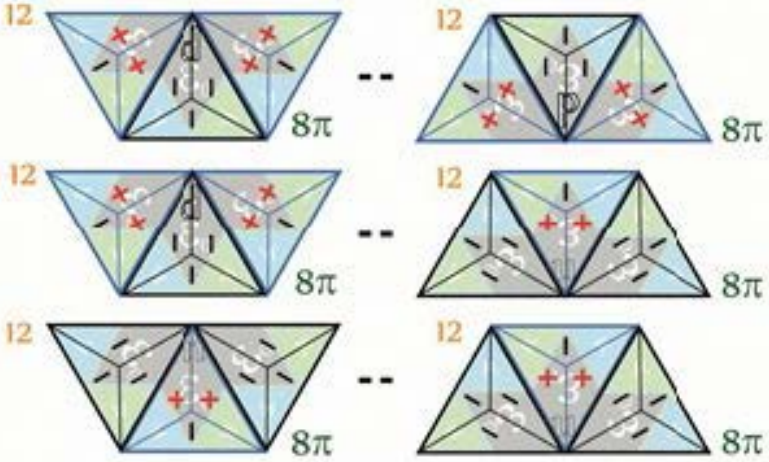

-8 [8-16]

-12 [6-18]

-16 [4-20]

prevented by strong repulives forces

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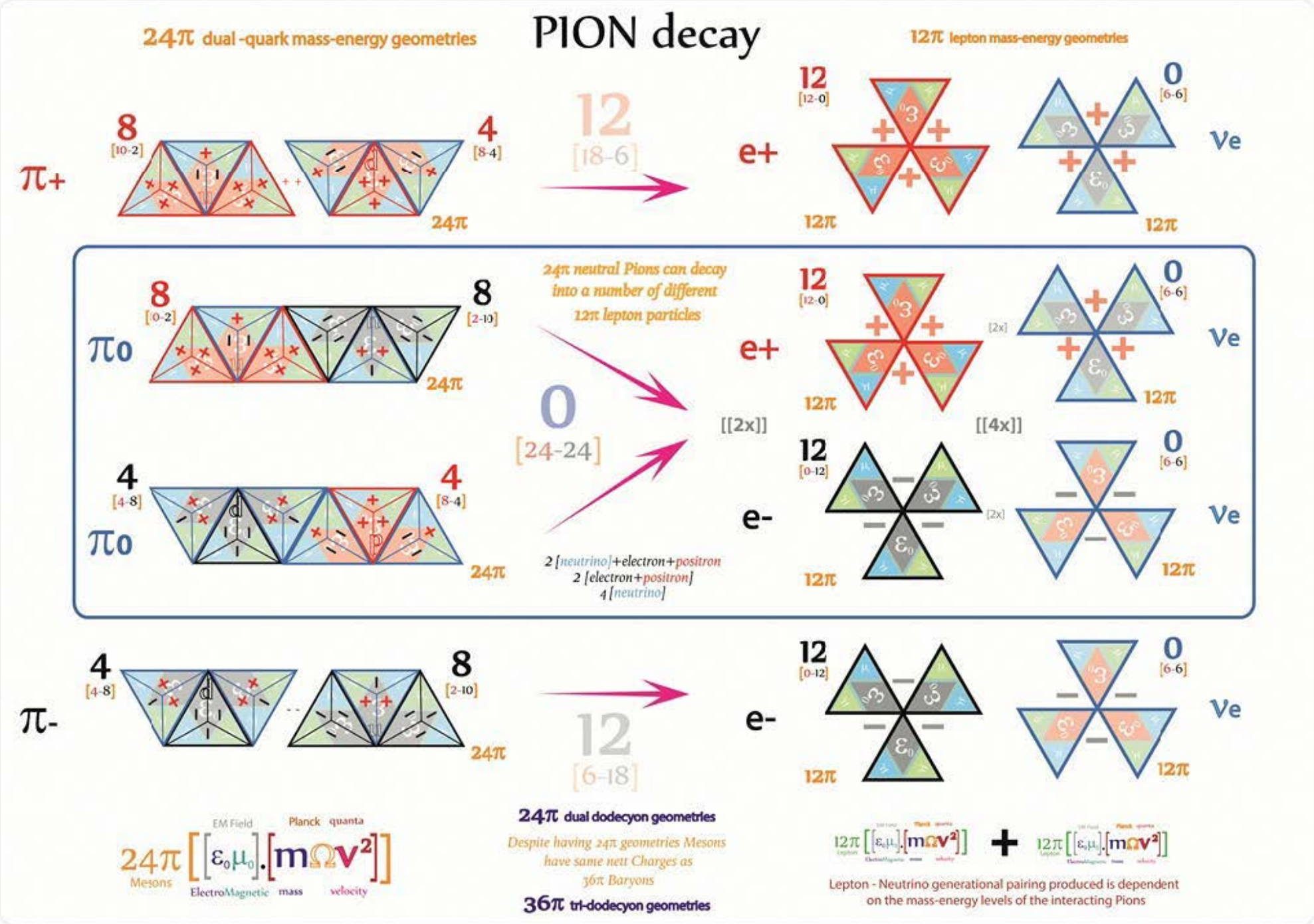

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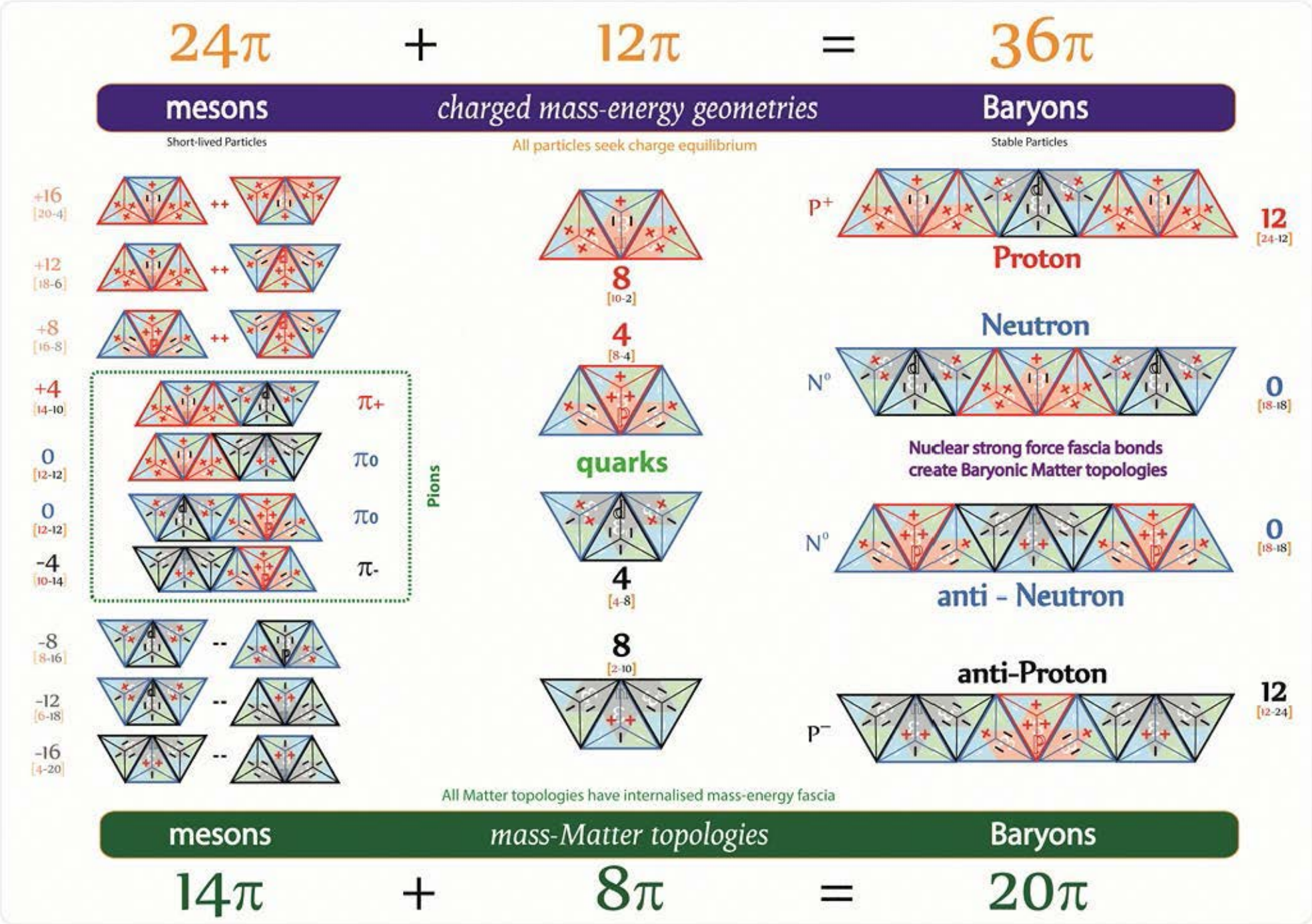

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Baryons

Baryons are 36π mass-energy geometries

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

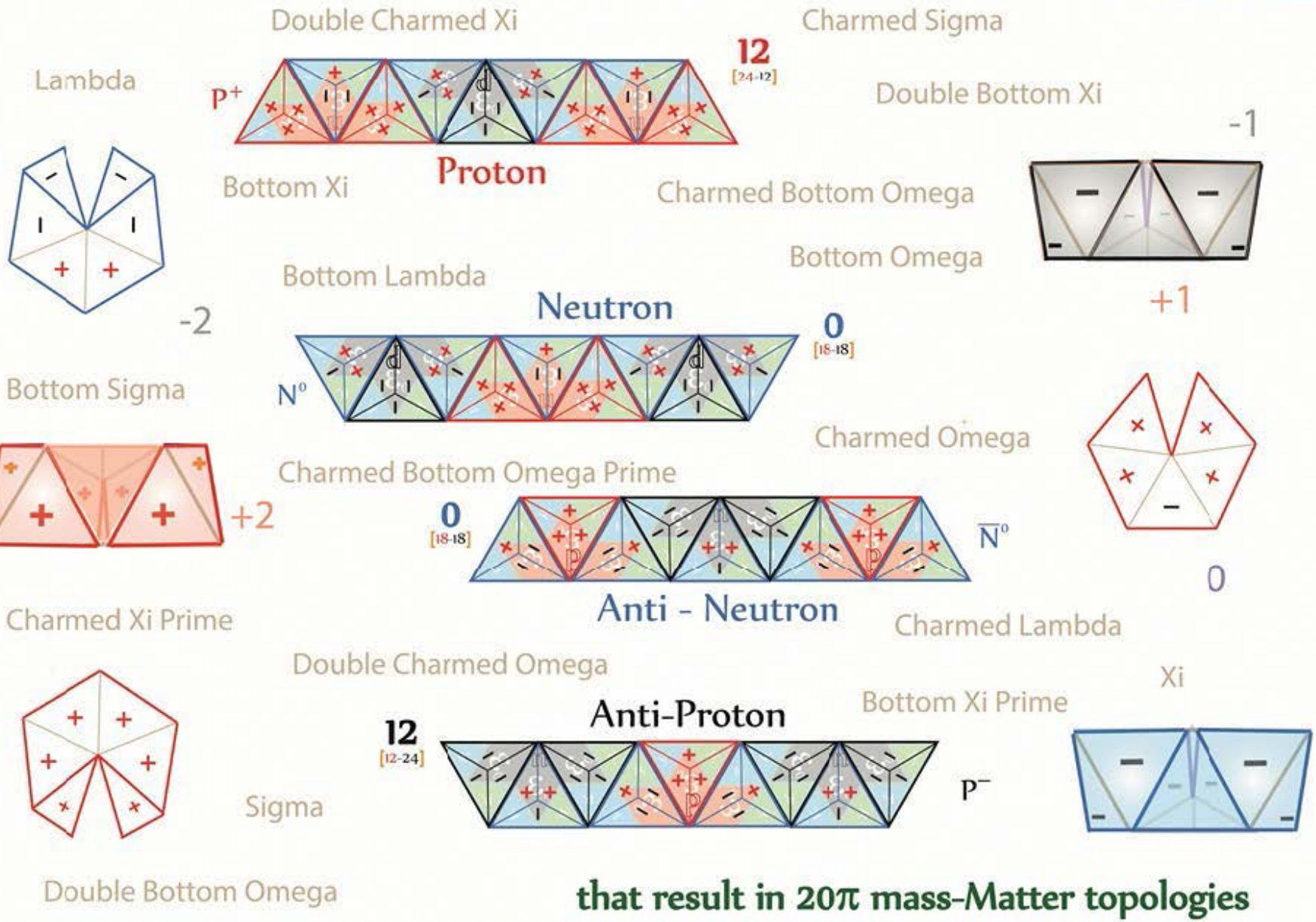

that result in 20π mass-Matter topologies

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Proton

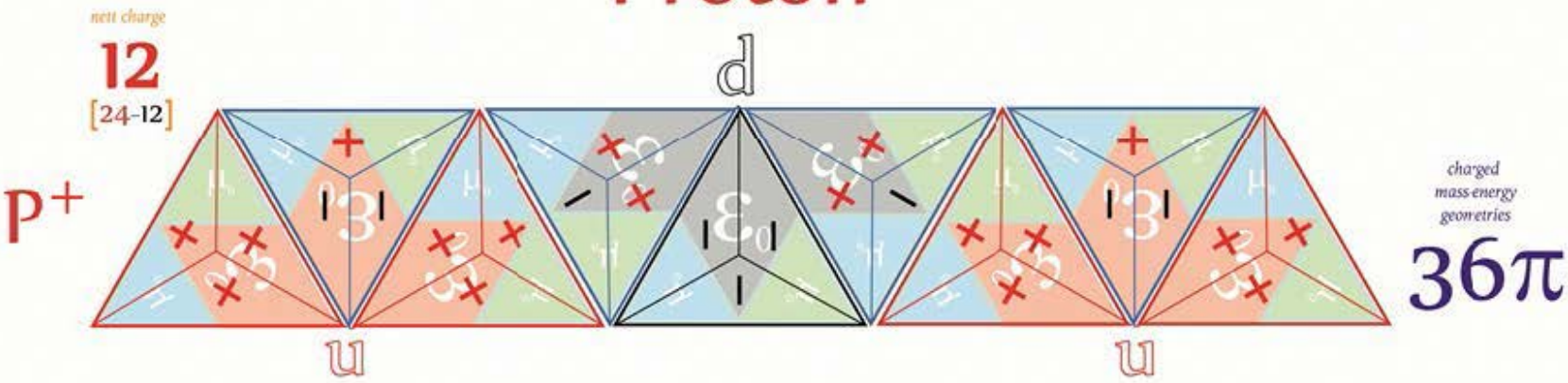

Tri-quark mass-energy geometry

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons; EM Field: ElectroMagnetic; Planck quanta: mass, velocity

Baryon mass-Matter topology

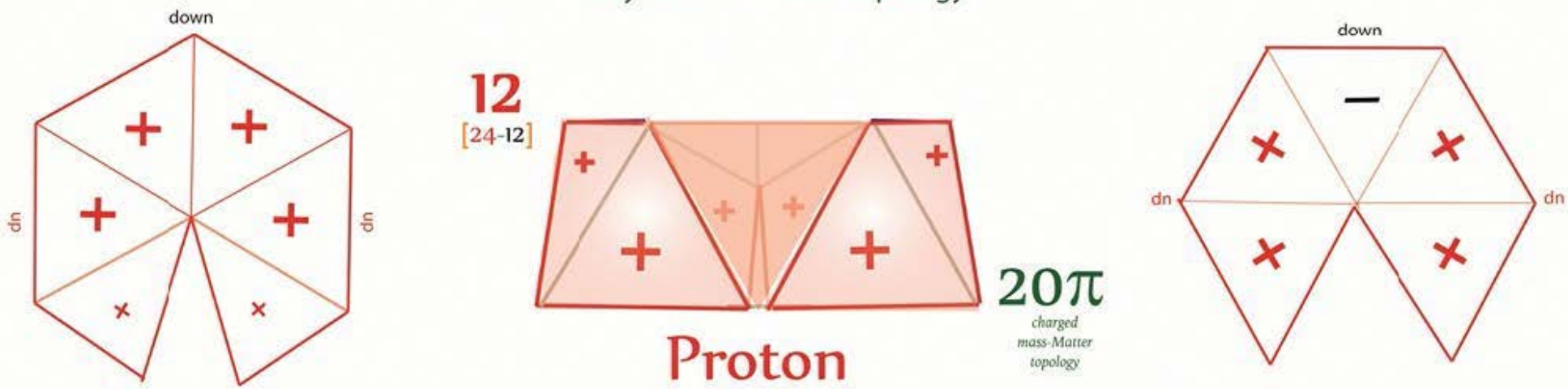

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Neutron

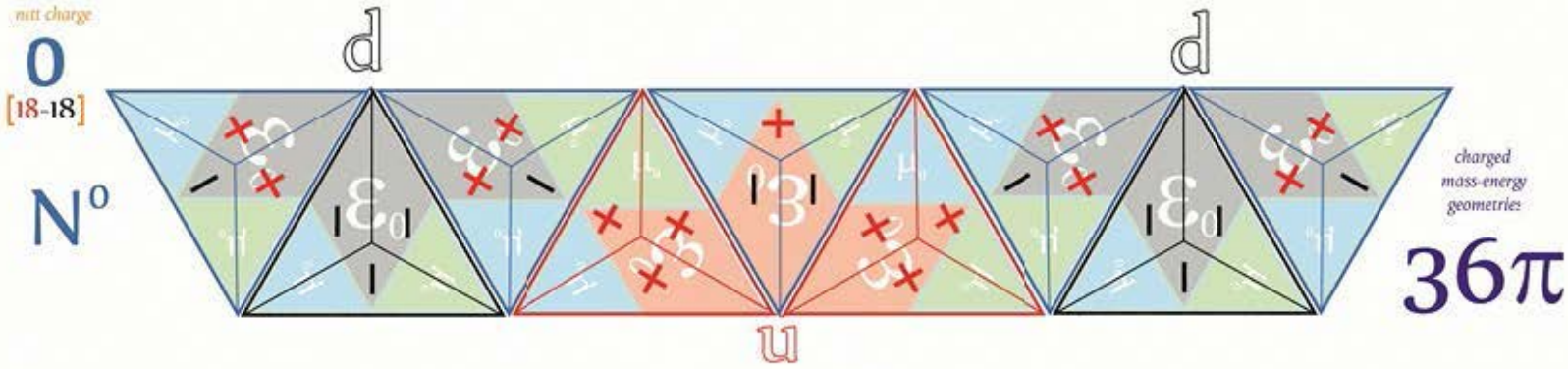

Tri-quark mass-energy geometry

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons; EM Field ($\varepsilon_0\mu_0$): ElectroMagnetic; Planck quanta ($m\Omega v^2$): mass, velocity

Baryon mass-Matter topology

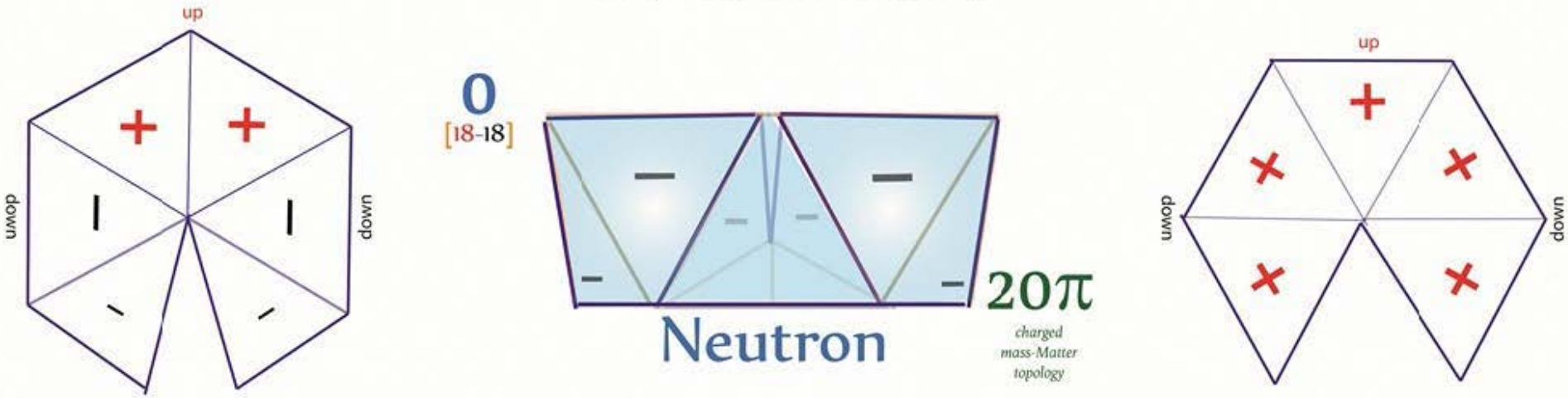

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anti-Neutron

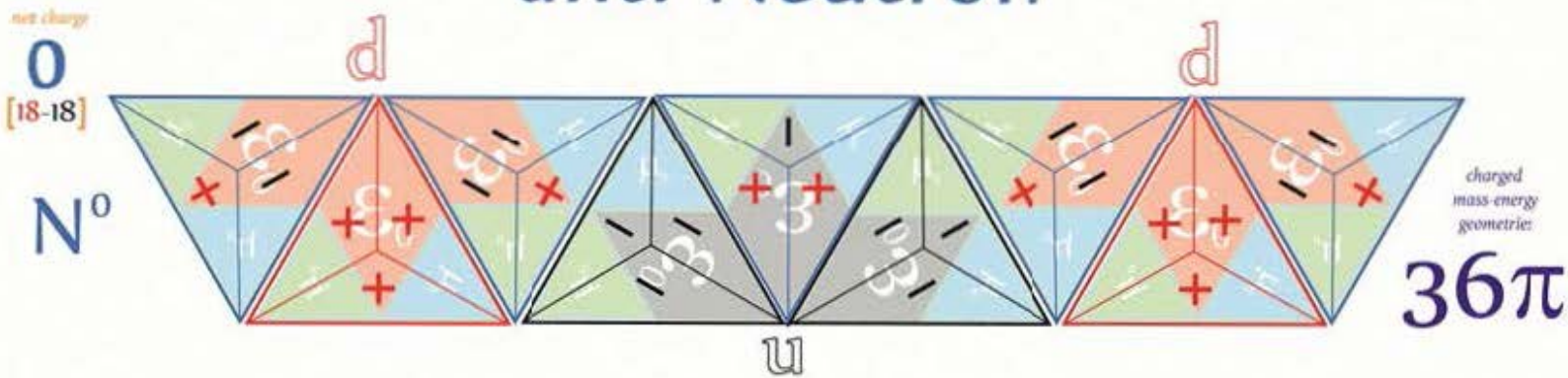

Tri-quark mass-energy geometry

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons — EM Field: $\varepsilon_0\mu_0$ (ElectroMagnetic); Planck quanta: $m\Omega v^2$ (mass, velocity)

Baryon mass-Matter topology

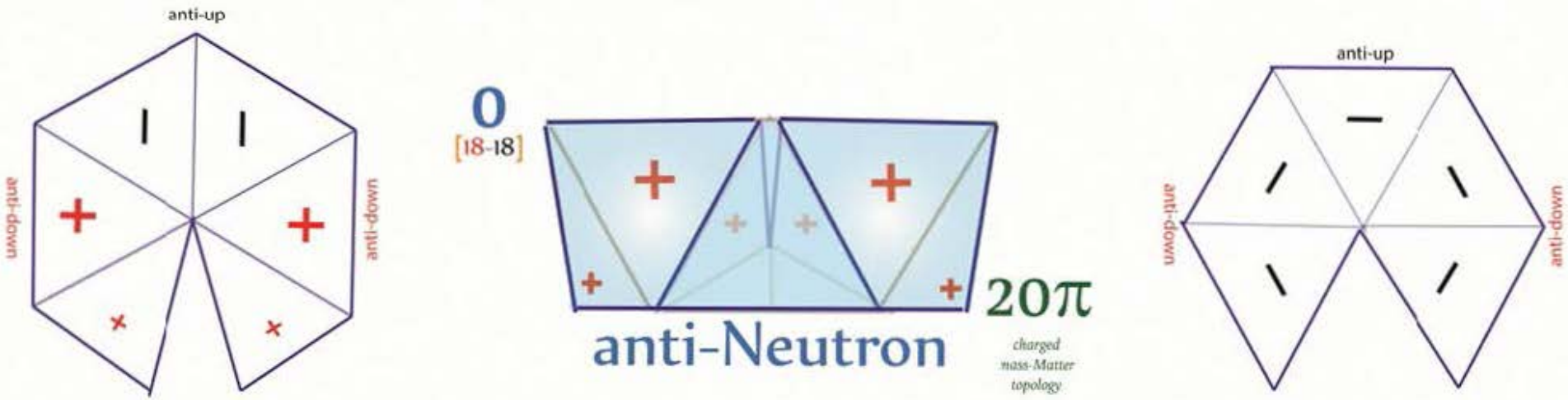

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anti-Proton

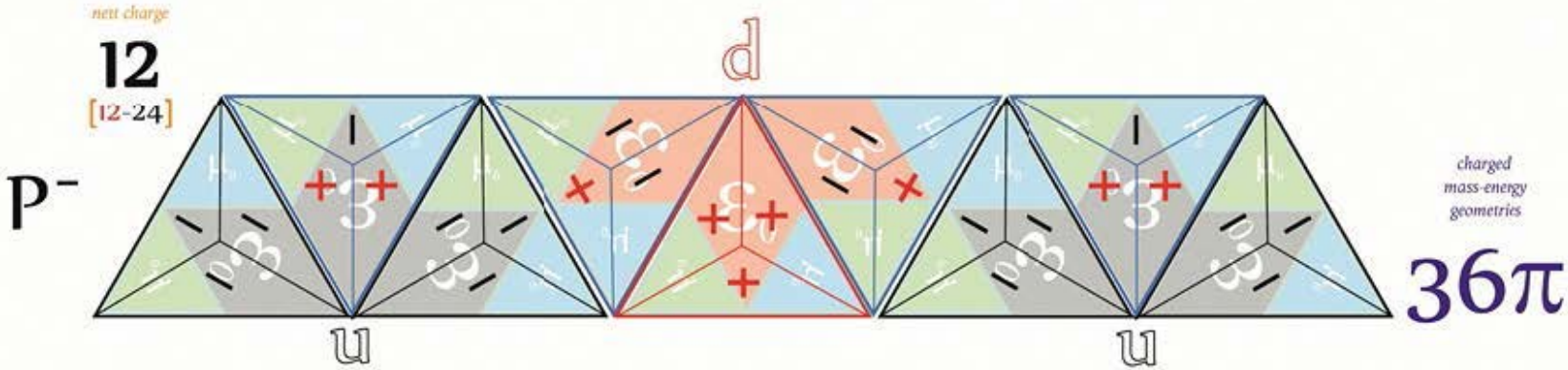

Tri-quark mass-energy geometry

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons; EM Field ($\varepsilon_0\mu_0$): ElectroMagnetic; Planck quanta ($m\Omega v^2$): mass, velocity

Baryon mass-Matter topology

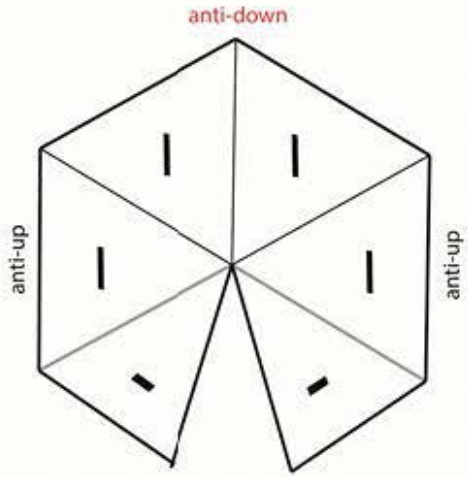

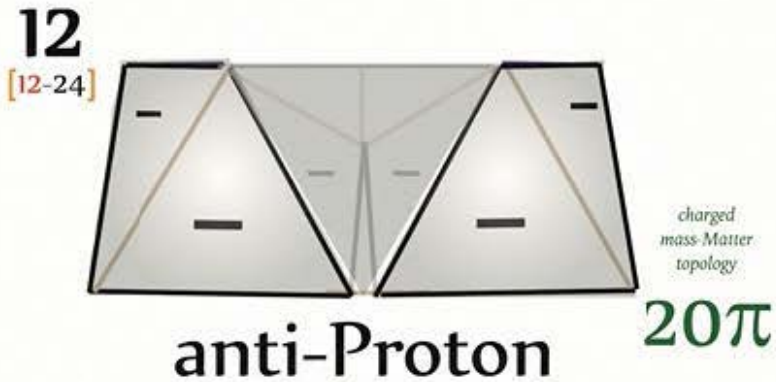

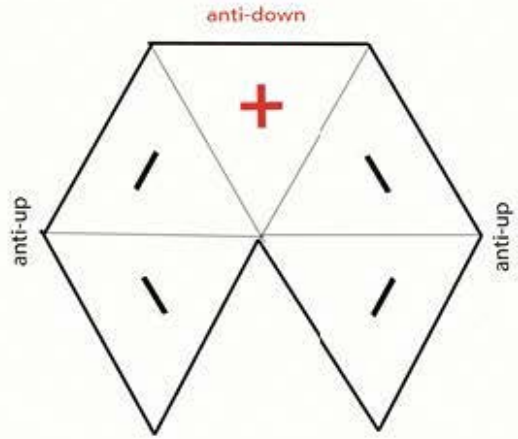

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Baryon geometry

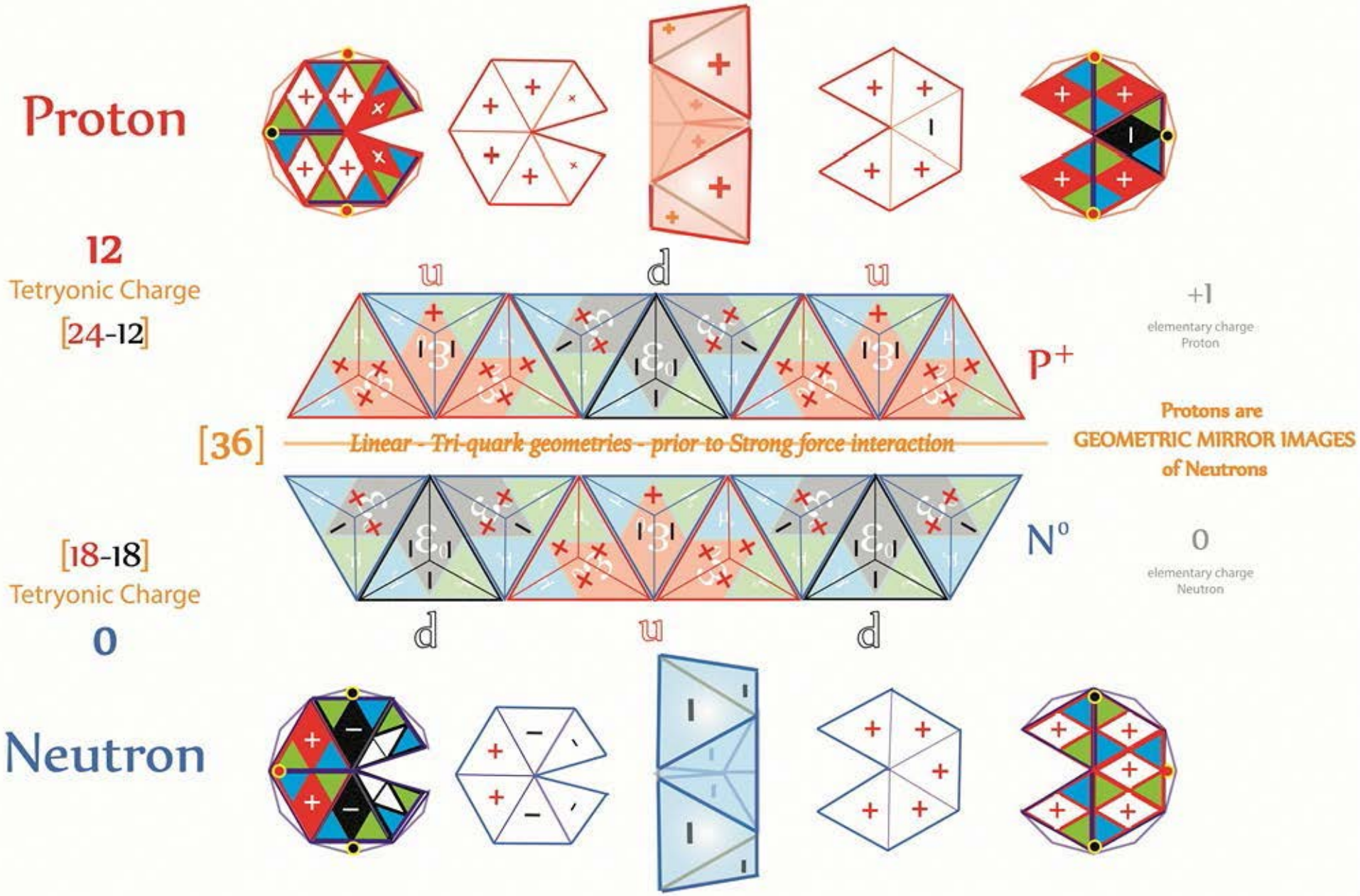

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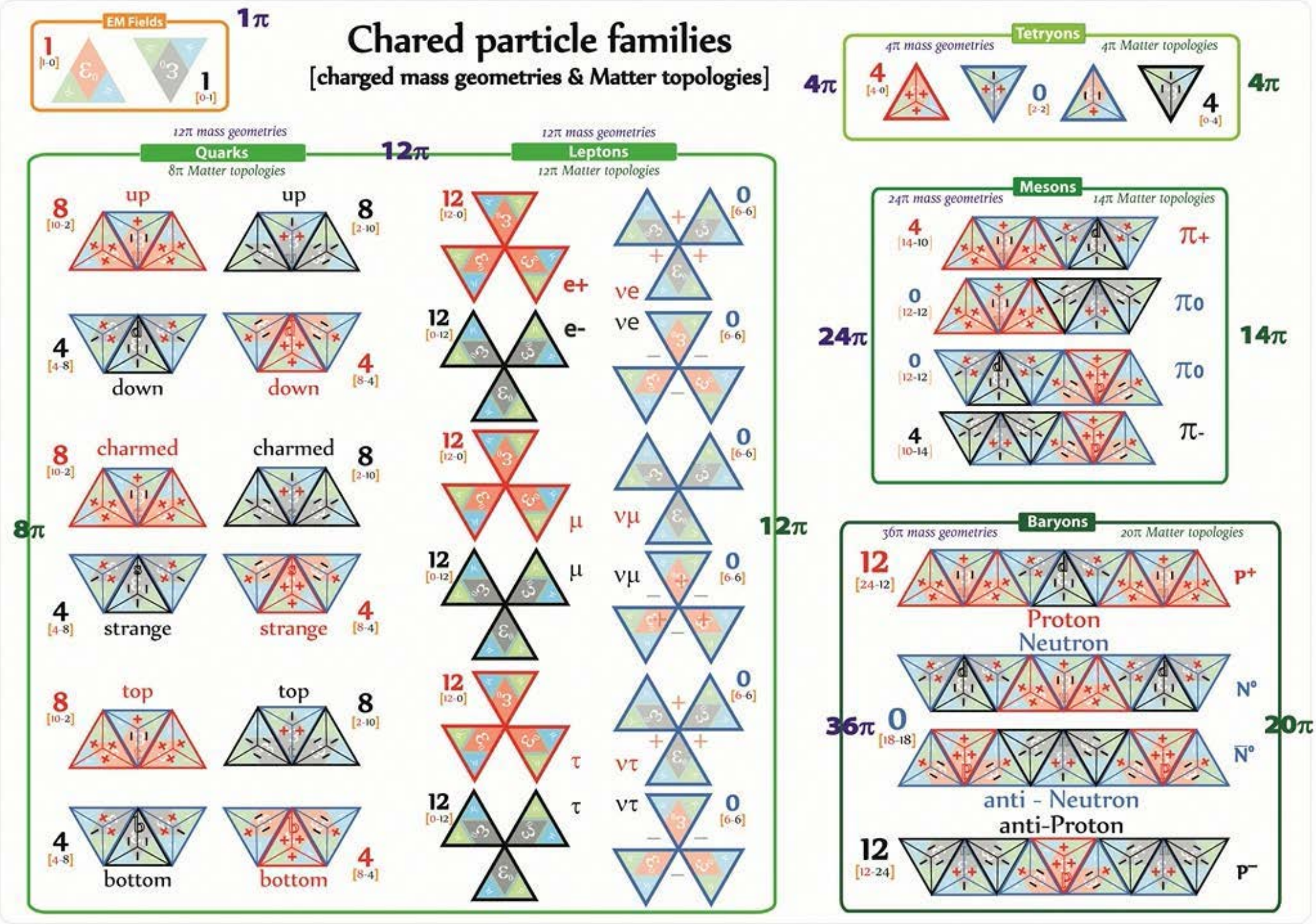

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Tetryonic Energy levels

$$E = n\pi\left[\left[m\Omega v^2\right]\right]$$

Energy; Planck quanta; mass; velocity; momentum

Energy levels

m

1e19 $h\nu = n$

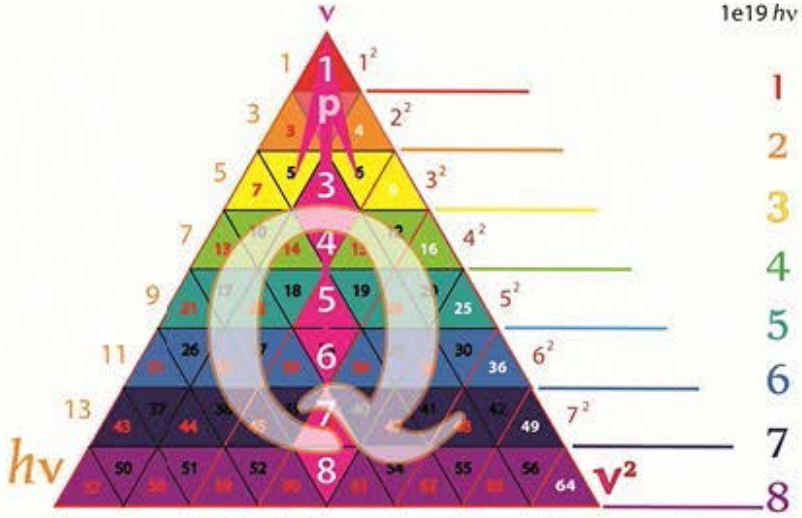

charged field quantisation

Every charged fascia of a Field or Particle holds squared energy levels
[equilateral EM mass-energy geometries & Matter topologies]

The Tetryonic KEM Colour code

As the energy levels of atomic nuclei increase/decrease
the KEM fields of leptons bound to them change accordingly

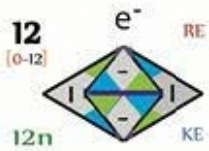

Electron

1	2	3	4	5	6	7	8
1	4	9	16	25	36	49	64

All energy levels are Tetryonic square number quantas
ie 1, 4 , 9, 16, 25 etc (1,2,3,4,5)

rest mass-Matter

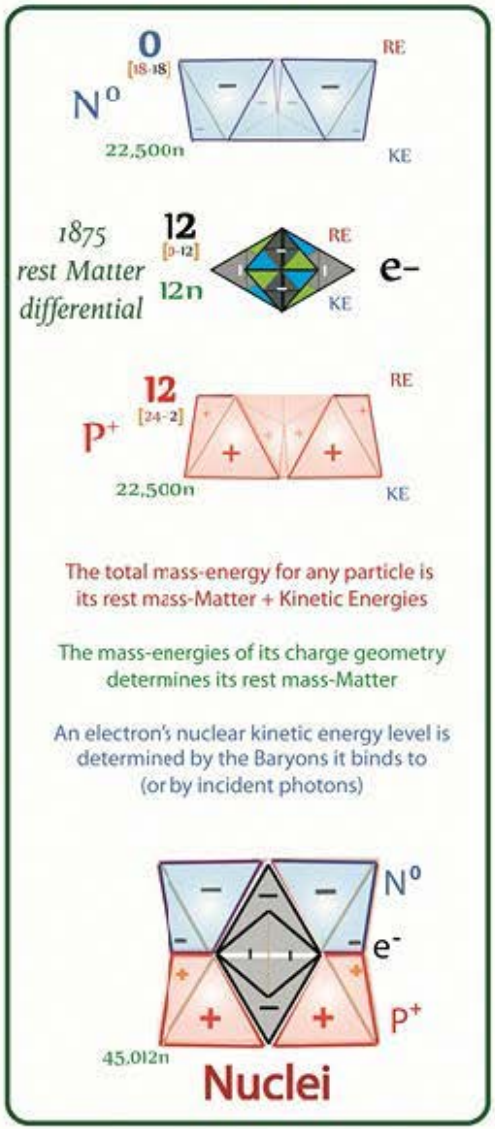

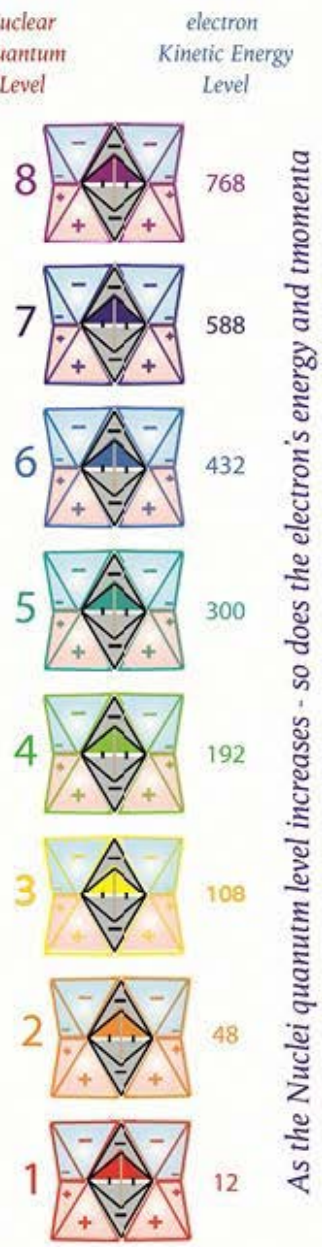

$$KEM = 4\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Kinetic energies; Electric Field; Electromagnetic; Planck quanta; mass; velocity

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The Particle Zoo

tri-quark charged toplogy combinations

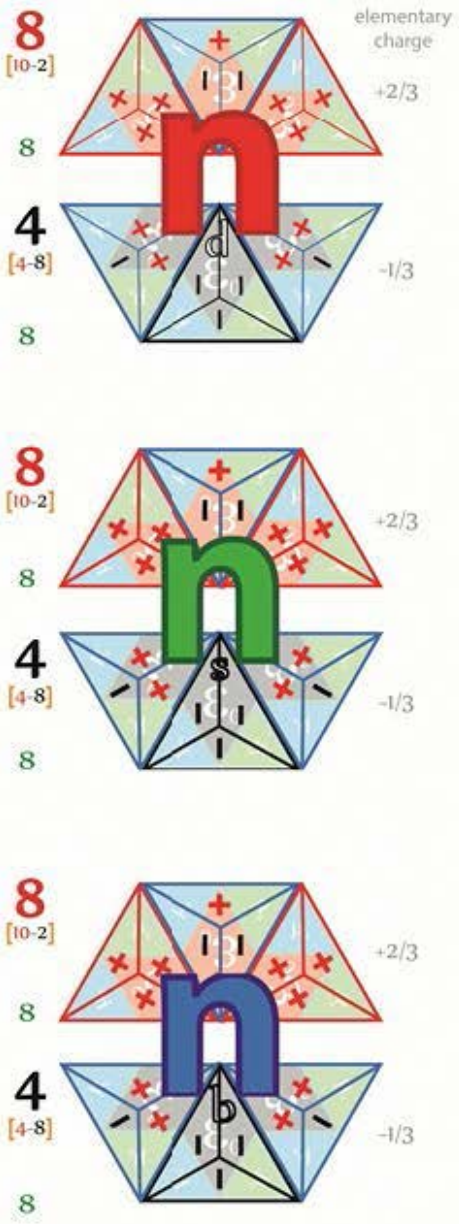

Quarks seek charge equilibrium by forming Baryonic Matter topologies as a result of charge interactions [STRONG nuclear Force]

UP	gen 1
DOWN	
CHARMED	gen 2
STRANGE	
TOP	gen 3
BOTTOM	

[+8 +8 +8] [10-2] [10-2] [10-2]	24	+	2	2/3 2/3 2/3
[+8 -4 +8] [10-2] [4-8] [10-2]	12	+	1	2/3 1/3 2/3
[-4 +8 -4] [4-8] [10-2] [4-8]	0	0	0	1/3 2/3 1/3
[-4 -4 -4] [4-8] [4-8] [4-8]	12	-	1	1/3 1/3 1/3

The particle Zoo is the result of tri-quark mass-energy topologies

Twice the number of combinations are possible with the inclusion of anti-matter topologies

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons; EM Field: $\varepsilon_0\mu_0$ (ElectroMagnetic); Planck quanta: m (mass), Ω, v^2 (velocity)

Any combinations of inter-generational quarks results in differing final mass-energies in the created Baryonic Matter due to energy equalisation

uuu	udu	ucu	usu	utu	ubu	suu	sdu	scu	ssu	stu	sbu
uud	udd	ucd	usd	utd	ubd	sud	sdd	scd	ssd	std	sbd
uuc	udc	ucc	usc	utc	ubc	suc	sdc	scc	ssc	stc	sbc
uus	uds	ucs	uss	uts	ubs	sus	sds	scs	sss	sts	sbs
uut	udt	uct	ust	utt	ubt	sut	sdt	sct	sst	stt	sbt
uub	udb	ucb	usb	utb	ubb	sub	sdb	scb	ssb	stb	sbb
duu	ddu	dcu	dsu	dtu	dbu	tuu	tdu	tcu	tsu	ttu	tbu
dud	ddd	dcd	dsd	dtd	dbd	tud	tdd	tcd	tsd	ttd	tbd
duc	ddc	dcc	dsc	dtc	dbc	tuc	tdc	tcc	tsc	ttc	tbc
dus	dds	dcs	dss	dts	dbs	tus	tds	tcs	tss	tts	tbs
dut	ddt	dct	dst	dtt	dbt	tut	tdt	tct	tst	ttt	tbt
dub	ddb	dcb	dsb	dtb	dbb	tub	tdb	tcb	tsb	ttb	tbb
cuu	cdu	ccu	csu	ctu	cbu	buu	bdu	bcu	bsu	btu	bbu
cud	cdd	ccd	csd	ctd	cbd	bud	bdd	bcd	bsd	btd	bbd
cuc	cdc	ccc	csc	ctc	cbc	buc	bdc	bcc	bsc	btc	bbc
cus	uds	ucs	uss	uts	ubs	bus	bds	bcs	bss	bts	bbs
cut	cdt	cct	cst	ctt	cbt	but	bdt	bct	bst	btt	bbt
cub	cdb	ccb	csb	ctb	cbb	bub	bdb	bcb	bsb	btb	bbb

216 possible Baryon topologies [excluding anti-matter] with each combination producing differing Baryonic nett energy levels

Quarks always form symmetrical [udu] or [dud] charged Baryonic topologies [same charges never combine except under high energy conditions] ie. Proton is a [udu] not [uud] as is commonly stated

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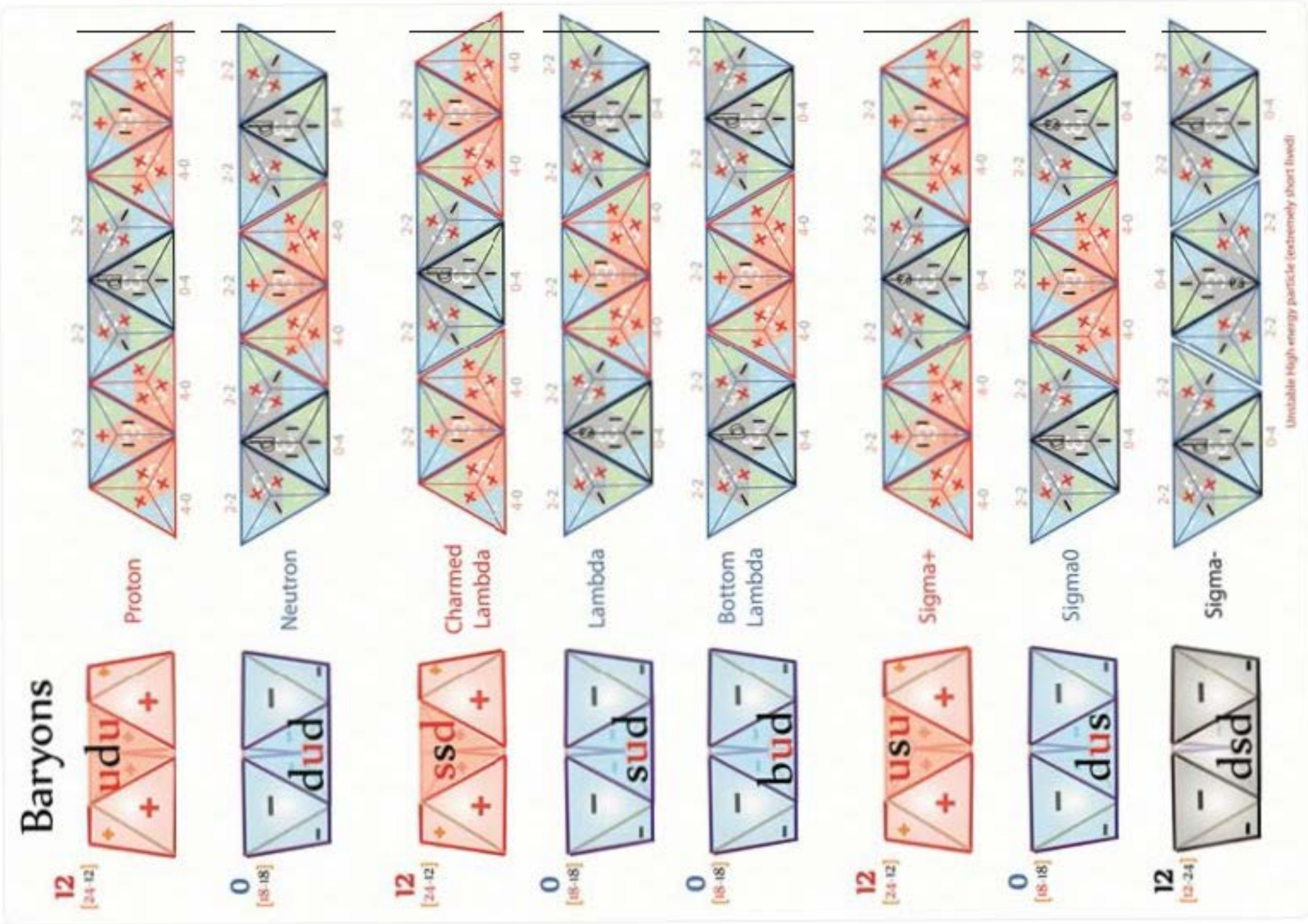

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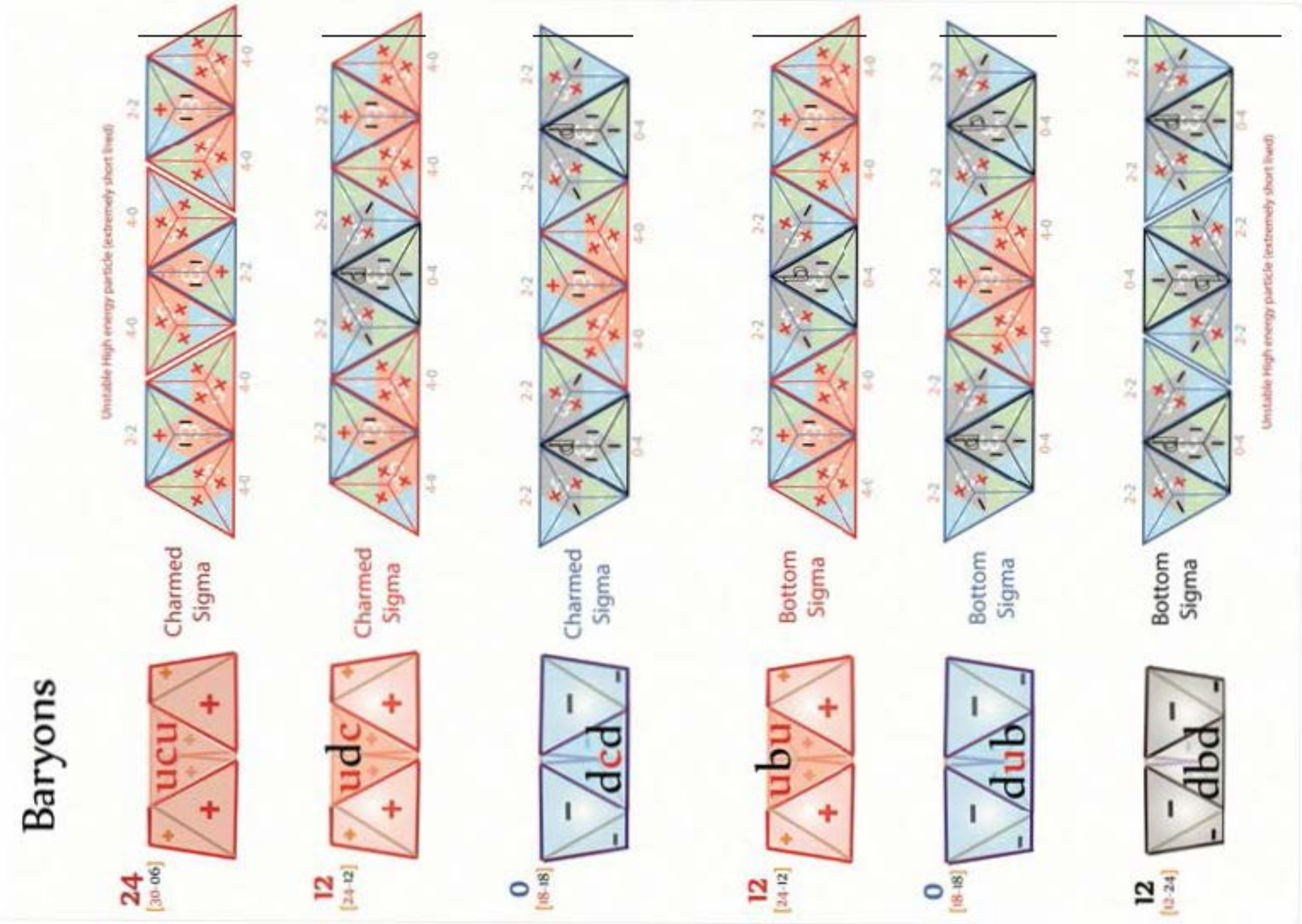

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Baryons

0
[18-18]

Xi

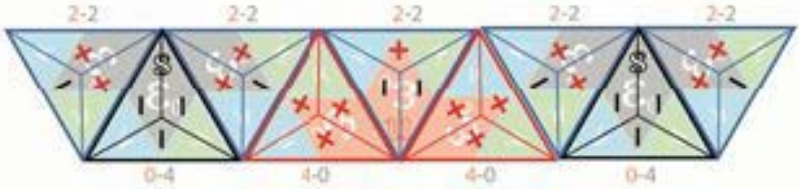

12
[12-24]

Xi

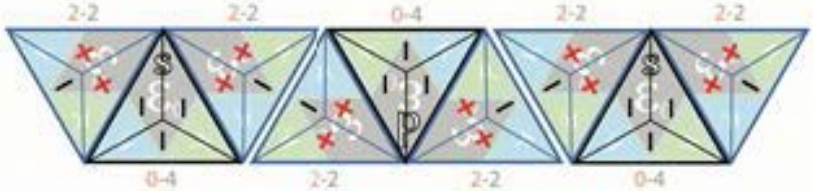

Unstable High energy particle (extremely short lived)

Charmed Xi Prime

12
[24-12]

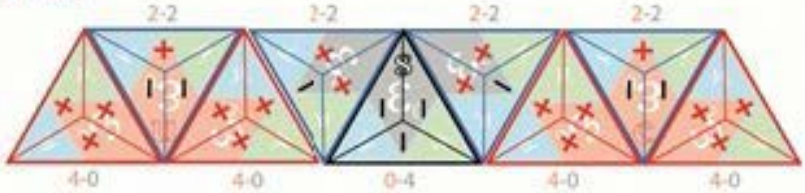

Charmed Xi Prime

0
[18-18]

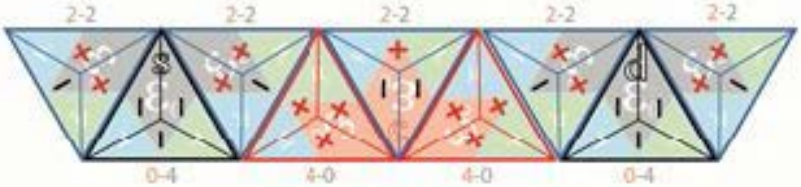

Double Charmed Xi

24
[30-06]

Unstable High energy particle (extremely short lived)

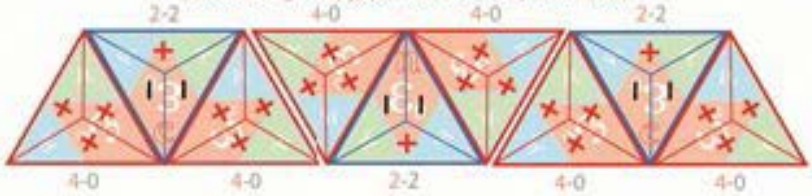

Double Charmed Xi

12
[24-12]

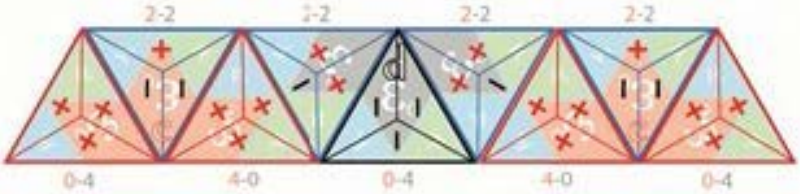

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Baryons

0
[18-18]

Bottom Xi
(Cascade B)

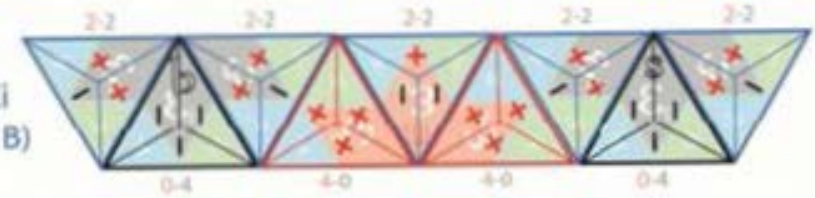

12
[12-24]

Bottom Xi
(Cascade B)

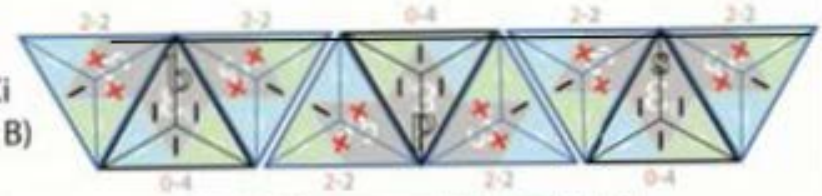

Unstable High energy particle (extremely short lived)

0
[18-18]

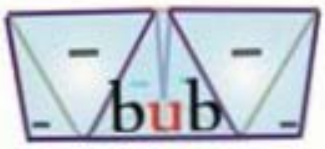

Double
Bottom Xi

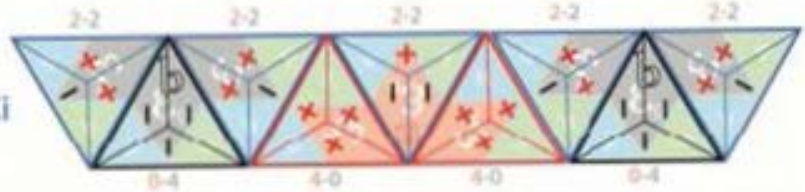

12
[12-24]

Double
Bottom Xi

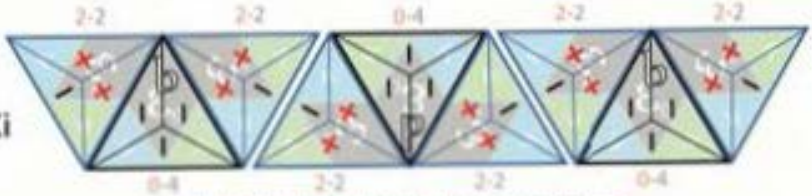

Unstable High energy particle (extremely short lived)

12
[24-12]

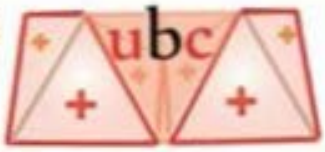

Charmed
Bottom Xi

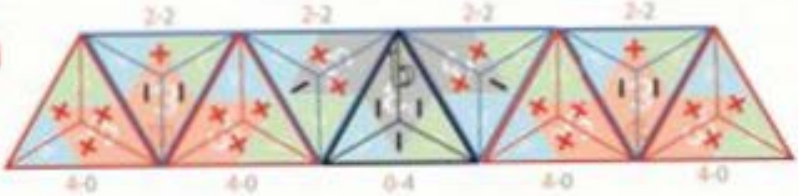

0
[18-18]

Charmed
Bottom Xi

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Baryons

0
[18-18]

Charmed Omega

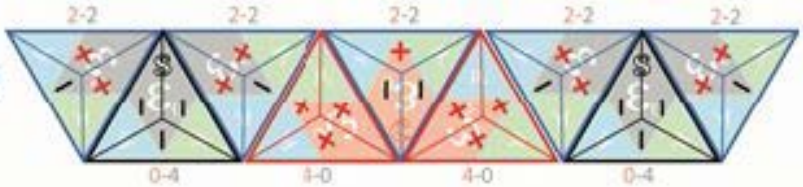

12
[12-24]

Bottom Omega

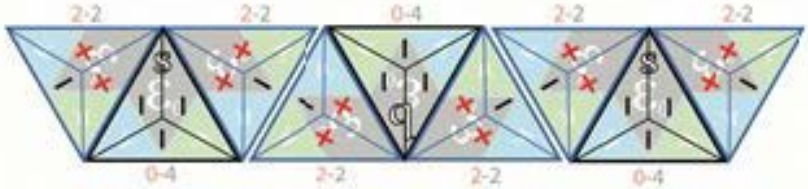

Unstable Highenergy particle (extremely short lived)

12
[24-12]

Double Charmed Omega

0
[18-18]

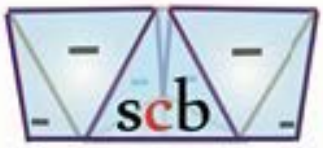

Charmed Bottom Omega

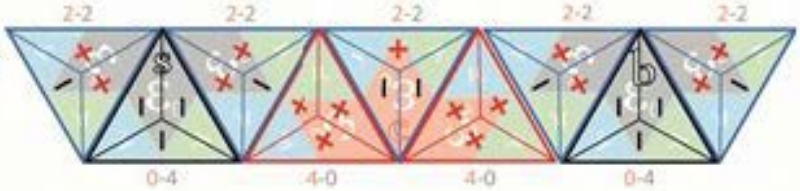

12
[12-24]

Double Bottom Omega

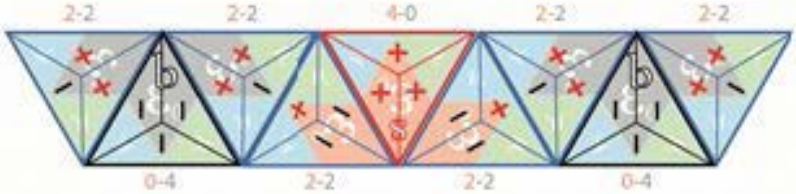

12
[24-12]

Double Charmed Bottom Omega

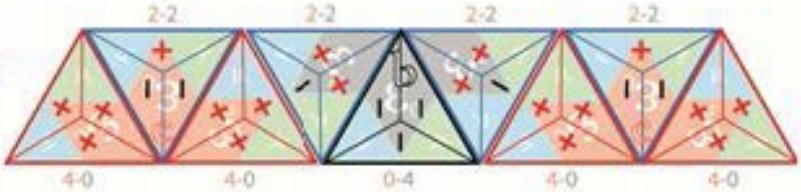

0
[18-18]

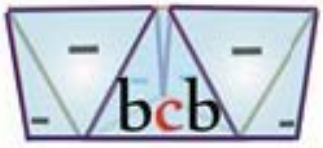

Charmed Double Bottom Omega

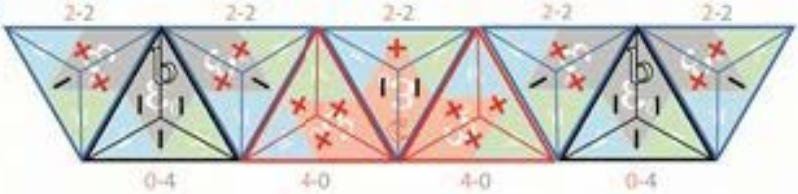

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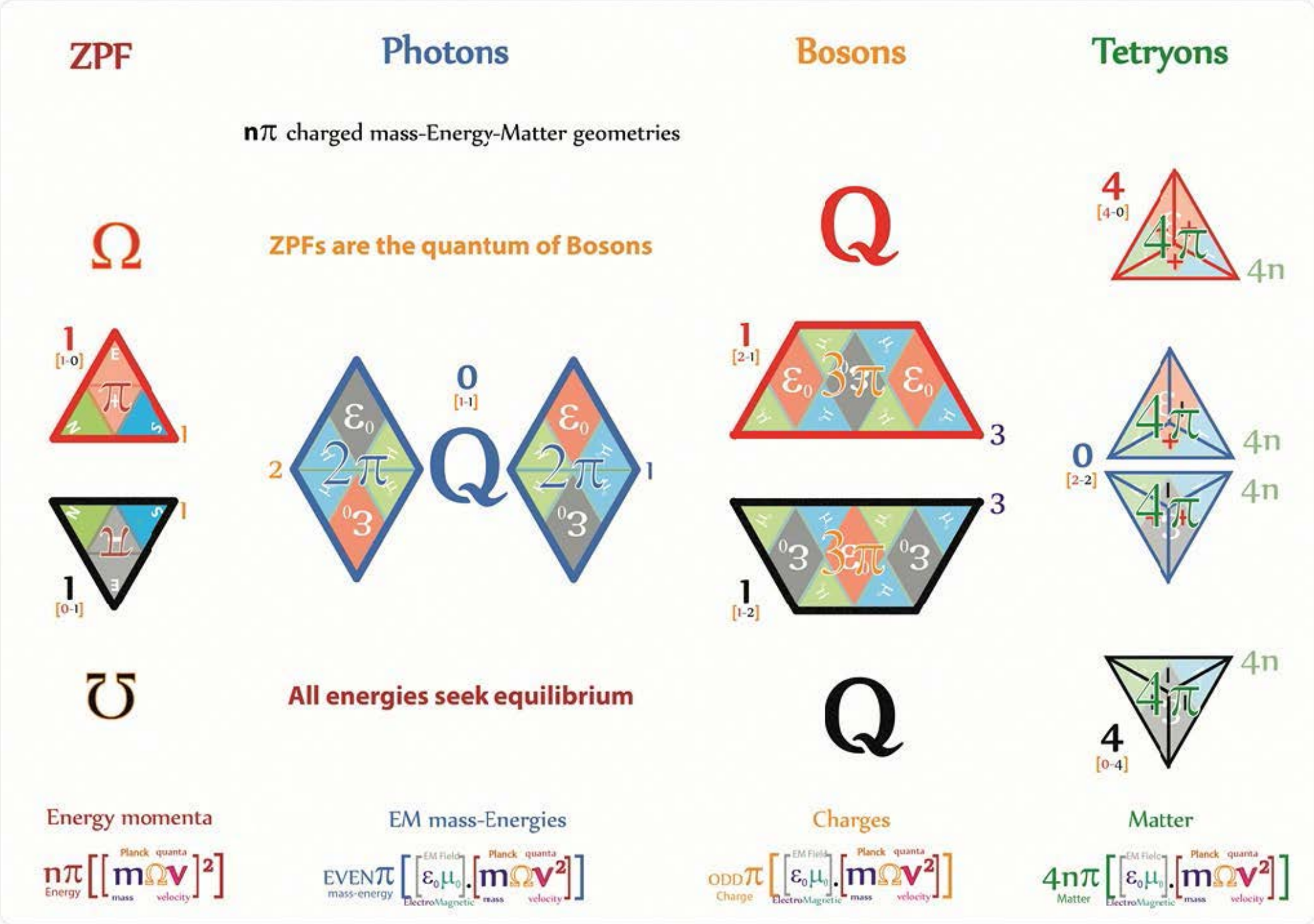

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Gluons

The gluon can be considered to be the fundamental exchange particle facilitating the strong interaction between protons and neutrons in a nucleus.

Gluons are the exchange particles for the 'colour' strong force between quarks, analogous to the exchange of photons in the electromagnetic force between two charged particles.

Ω

Gluons are considered to be bi-coloured, carrying a unit of colour and a unit of anti-colour

Ʊ

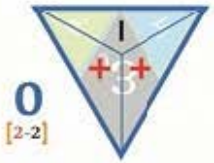

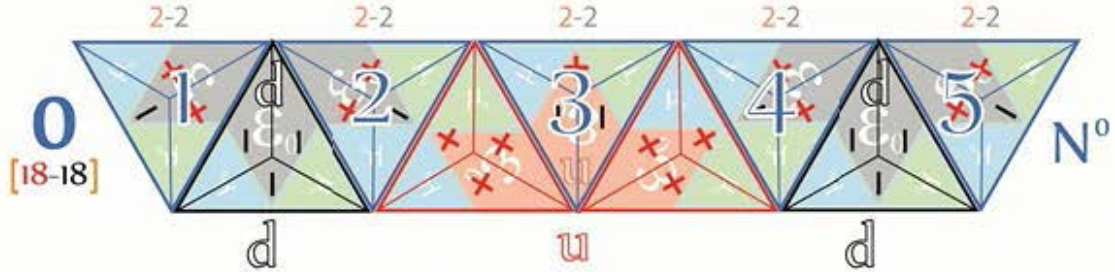

Q

Gluons are the neutral Tetryons inside all fermionic Matter topologies

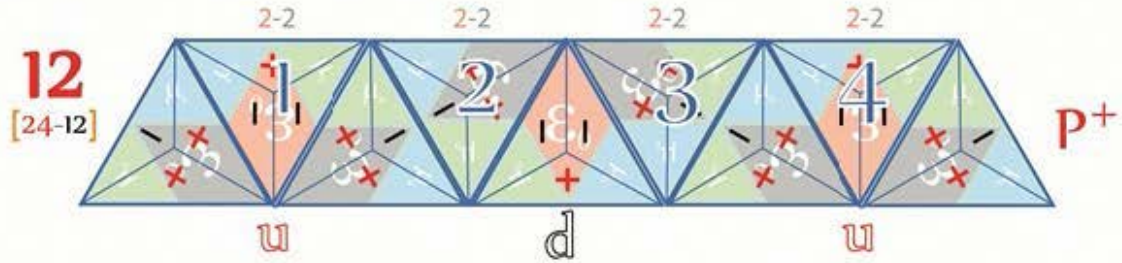

They are the neutral charge [di-electric] Tetryons located between charged Tetryons in Matter topologies

[attractive coulombic forces between their opposite charged fascia create the 'colour force]

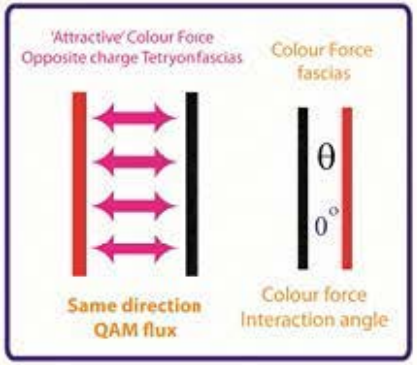

The interaction between neutral Tetryons (Gluons) and all charged Tetryons is the Strong Colour force

nett charge of Gluons is same as a Neutron

Electrons contain no Gluons

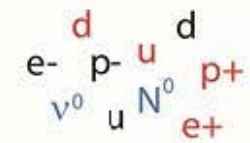

Neutral Tetryons combine with charged Tetryons to form all Particles

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Gluons in Fermions

In the Standard model Gluons have no mass and no electric charge.
They carry a special 'colour charge' property that hold quarks together to form Baryons

Tetryonics reveals that gluons are neutral charge tetryons comprised of equal positive & negative mass-energies & are elementary Matter particles

'Gluons' are neutral tetryons

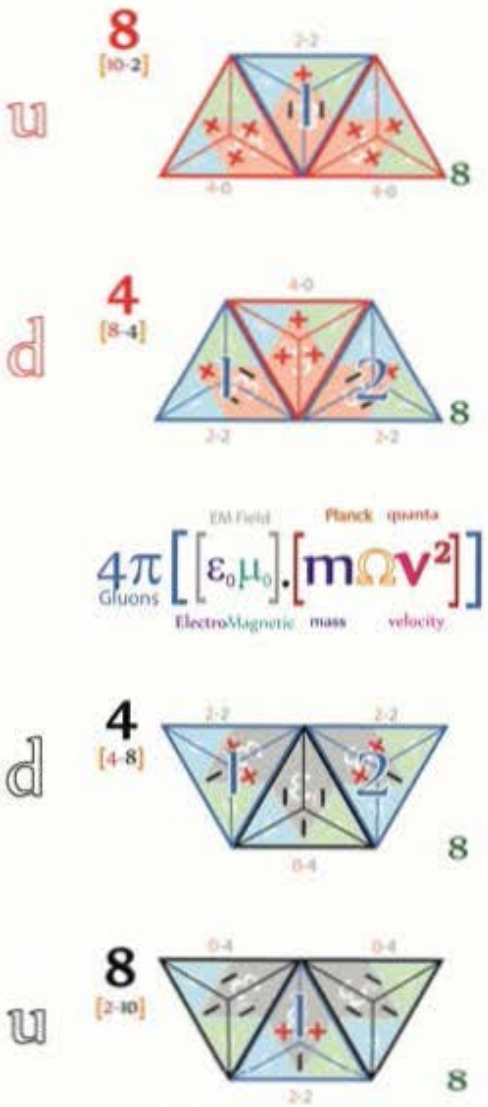

up Quarks have 1 Gluon
[Neutral Tetryon]

anti-down Quarks have 2 Gluons
[Neutral Tetryons]

GLUONS
are the neutral tetryons in Matter topologies acting as a di-electric between charged tetryons

down Quarks have 2 Gluons
[Neutral Tetryons]

anti-up Quarks have 1 Gluon
[Neutral Tetryon]

Neutrinos are 3 Gluon sets

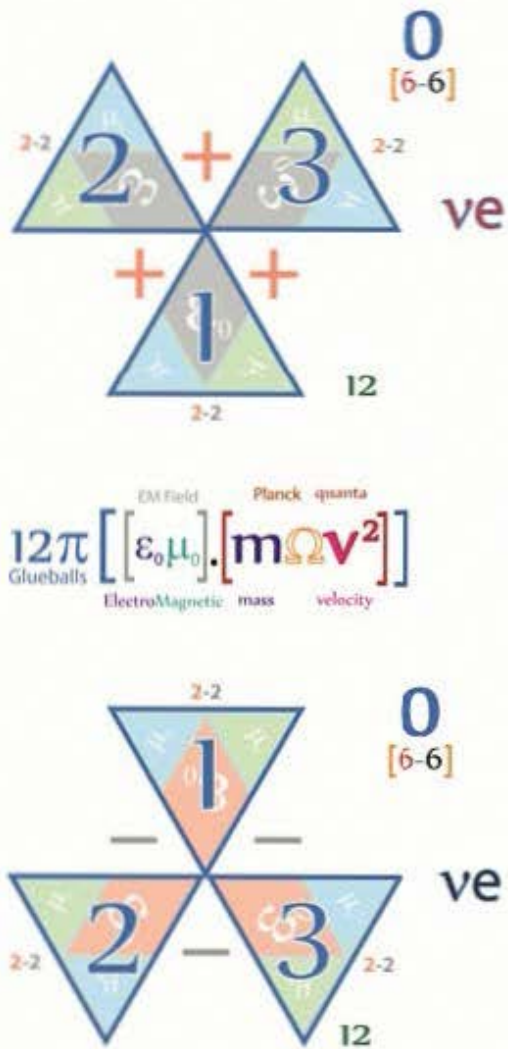

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Baryonic Gluons

In 'the Standard Model', Gluons are vector gauge bosons that mediate strong interactions of quarks in quantum chromodynamics (QCD). Unlike the electrically neutral photon of quantum electrodynamics (QED), gluons themselves carry colour charge and therefore participate in the strong interaction in addition to mediating it, making QCD significantly harder to analyze than QED.

They are considered to be elementary particles which act as the exchange particles (or gauge bosons) for the colour force between quarks, analogous to the exchange of photons in the electromagnetic force between two charged particles

Tetryonics simplifies the current definition of Gluons and clearly identifies their geometric properties, along with their role in particle genesis

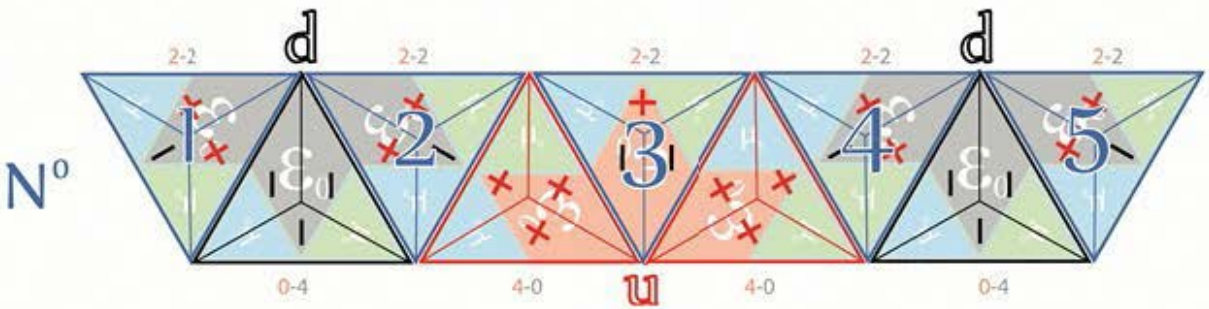

Neutrons have 5 Gluons

[Neutral Tetryons]

0

[18-18]

Deuterium nuclei (being the constituent quanta of all Elements) have 9 neutral Tetryons (Gluons) which in turn contribute to their gravitational mass along with the charged Tetryons

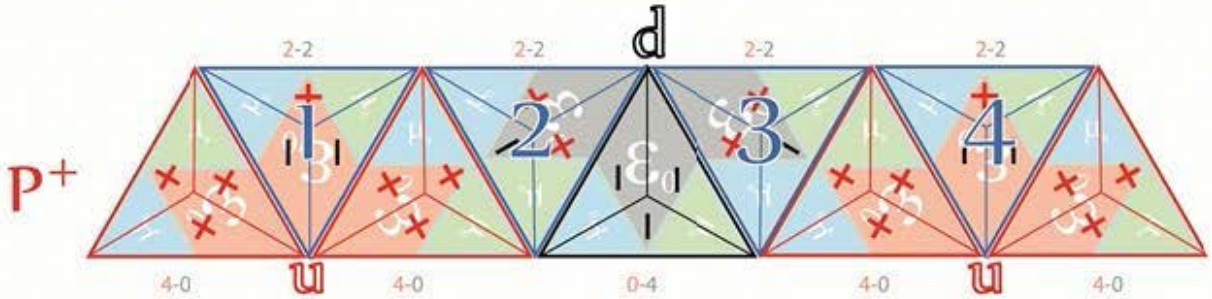

12

[24-12]

Protons have 4 Gluons

[Neutral Tetryons]

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'Glueballs'

In particle physics, a glueball is a hypothetical composite particle. It solely consists of gluon particles, without valence quarks.

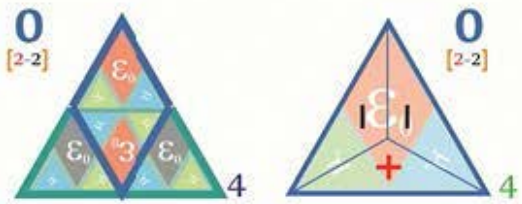

Neutral Tetryons
are the result of equal number charged EM fields combining to form neutral charge Tetryonic topologies

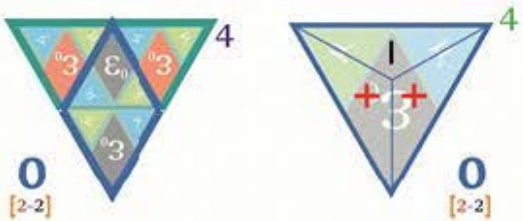

It is conceivable that given the right conditions (ie a cloud of neutral Tetryons), that in the absence of charged Tetryons to interact with, a Glueball topology can be formed entirely from neutral Tetryons

Note: Despite their total neutral charge Glueball topologies are polarised

Neutrinos and some exotic neutral charge Baryons can be considered to be 'Gluon topologies'

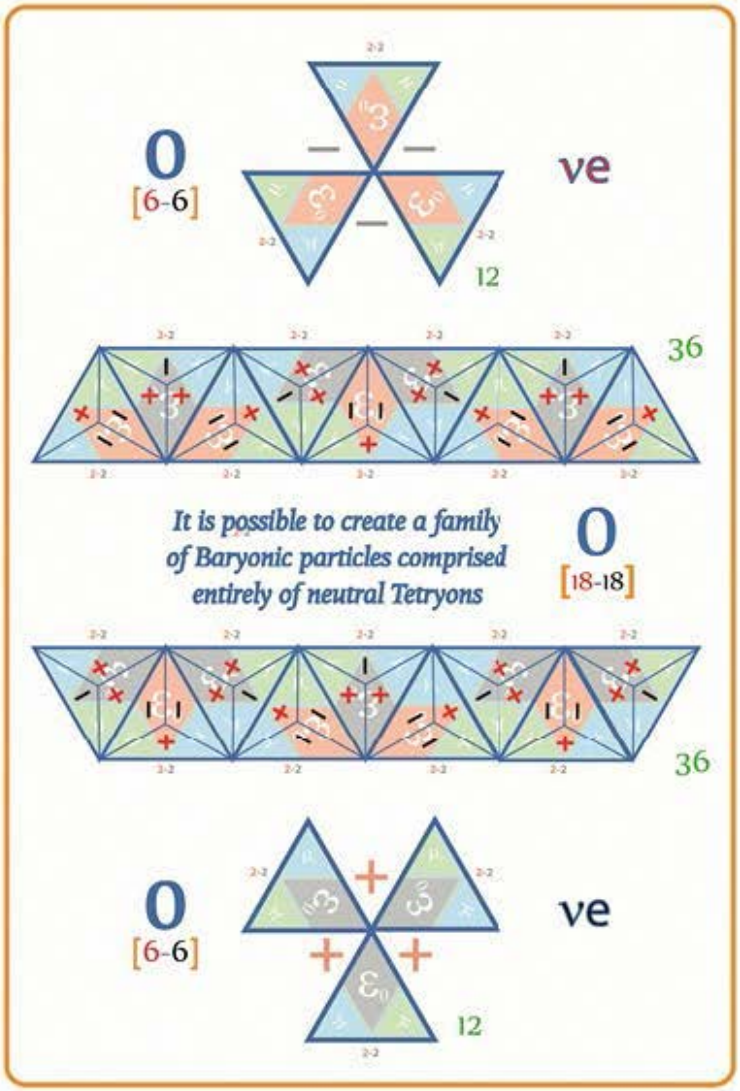

Neutrons are not considered to be Glueballs as they contain charged Tetryons

OMEGA Particle
Icosahedron Glueball

20 Neutral Teryons

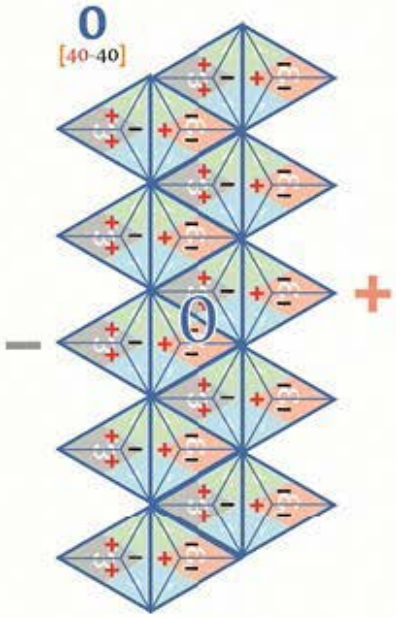

The 3 internalised planes formed by the external apex points correspond with the 3 spatial dimensions of Cartesian geometry

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Non-gluonic Baryon formation

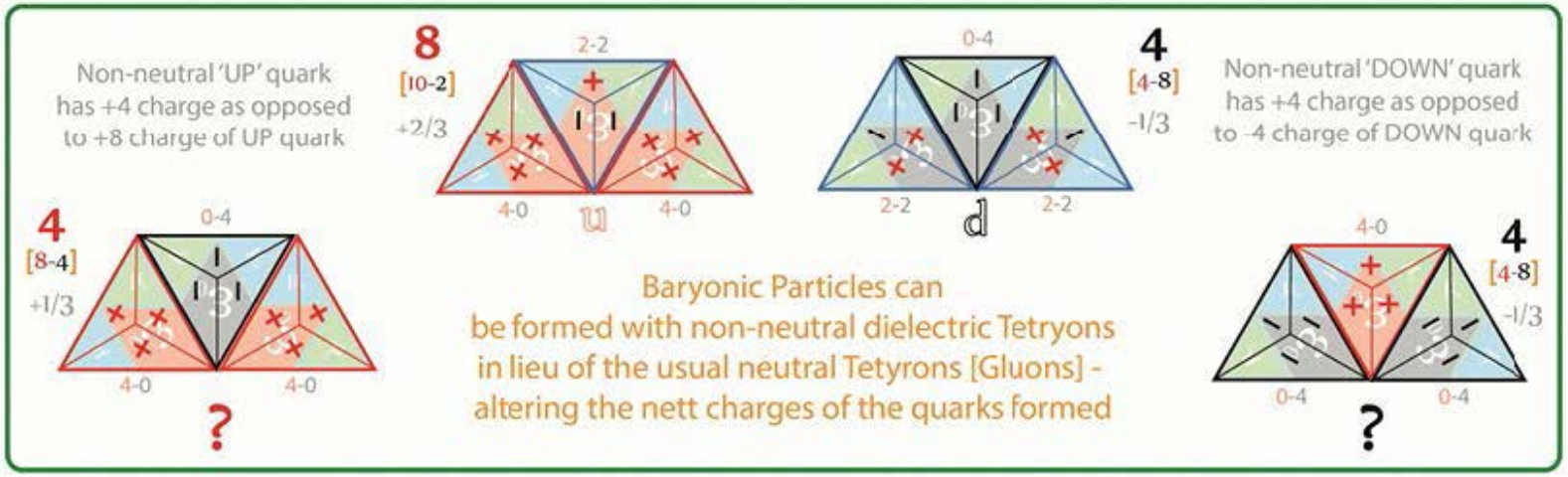

Un-stable form

[rapidly decays into constituent Quarks]

Resulting in another family of Baryons [CHARGEBALLS]

Stable Form

[possibly mistakenly viewed as Bottom Quarks]

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Electro-Magnetic fields

Quantised Charge
is the nett geometry of mass-Energy-Matter formed by equilateral ElectroMagnetic fields and can be modelled with classical vector flux rotations

Positive Charge ZPF

Magnetic Monopoles do NOT exist

Negative Charge ZPF

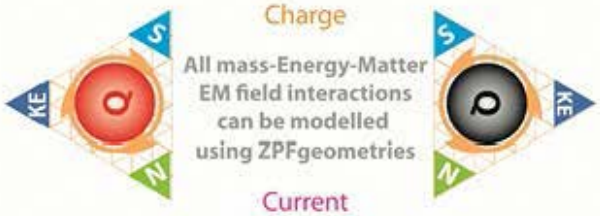

ε_0 The charge geometry of all EM fields determines their Electric Permittivity and Magnetic Permeability μ_0

The 'zero point' field has scalar EM energies

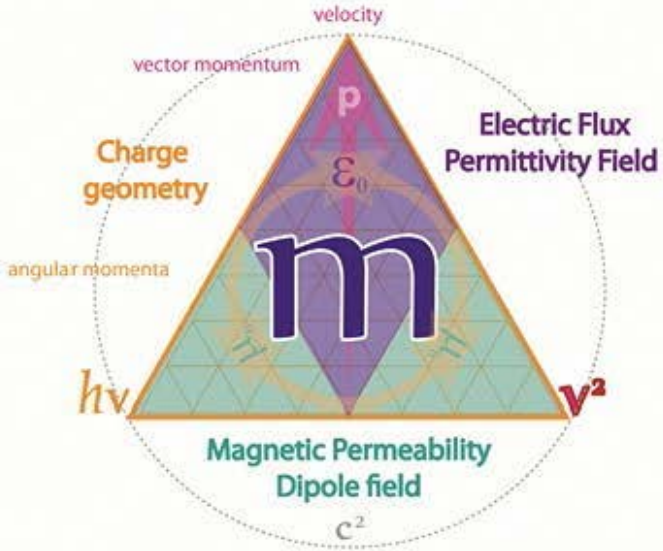

The EM field is a equilateral waveform with the Magnetic field always orthogonal to the Electric

The Magnetic fields propogate bi-directionally and the Electric field is responsible for producing linear momentum

The Electric field and Magnetic fields are equal to each other and directly proportional to the velocity of propagation

Photons
are the neutral quanta of EM waves
they are comprised of two opposite charge EM field quanta

Zero Point fields are polarised and are the sources of

Electro-static and **Magneto-static** fields and particles

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The Weak Force

Quantum Inductive loops

Quantum Tank circuit

Energy received is stored in quantum inductive loops
(until its release via weak interaction - Boson exchange)

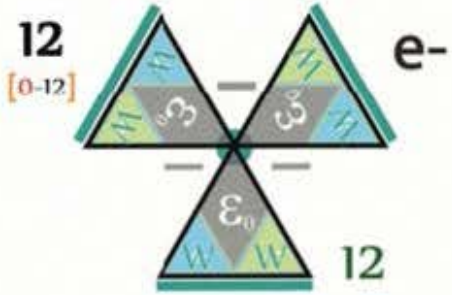

6 Inductive 'Weak' edges
(3 internalised)
(3 externalised)

Quantum Energy is stored or released, and distributed throughout Tetryonic geometries in ODD number quanta [Bosons]

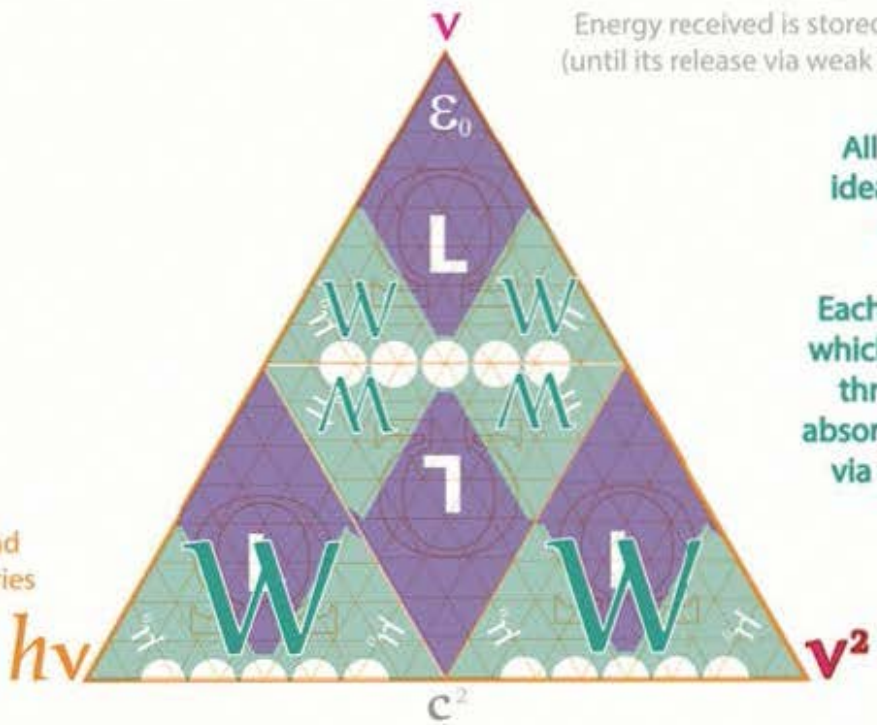

All ElectroMagnetic fields are ideal quantum inductive loops of EM energy momenta

Each has a Magnetic edge (base) which acts as a quantum inductor through which energy can be absorbed or released in EM quanta via electro**Magnetic** induction [exchange Bosons]

Leptons and Quarks
have the same Tetryonic numbers
but differing Matter topologies

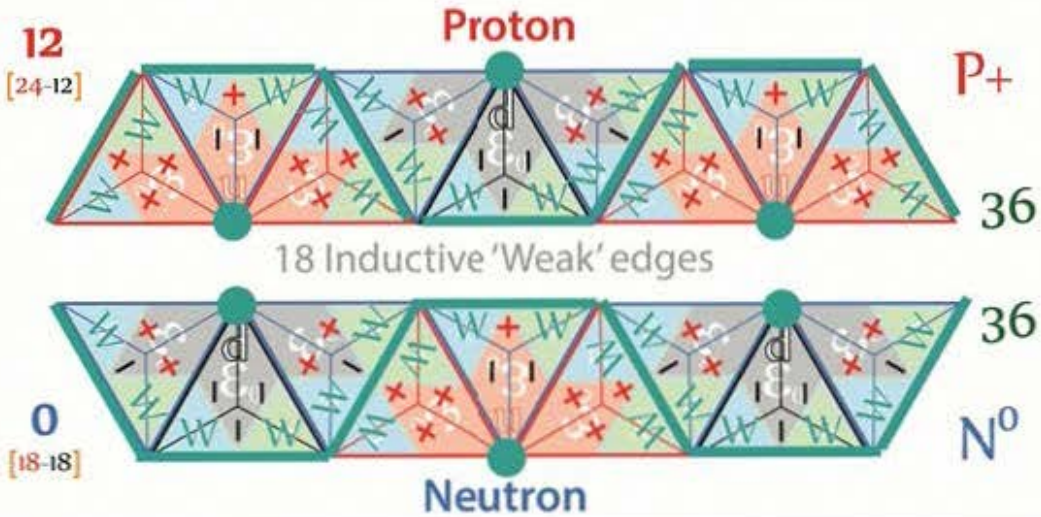

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The Strong Force

The force resulting from the interaction of 2 Tetryons along their parallel planar (Electric charge) surfaces

Leptons and Quarks result from the Strong 'colour' force interactions in dodeca-deltahedrons

(In Quarks the attractive strong force produces Octahedral topologies)
(In Leptons the repulsive strong force produces Dodecahedral topologies)

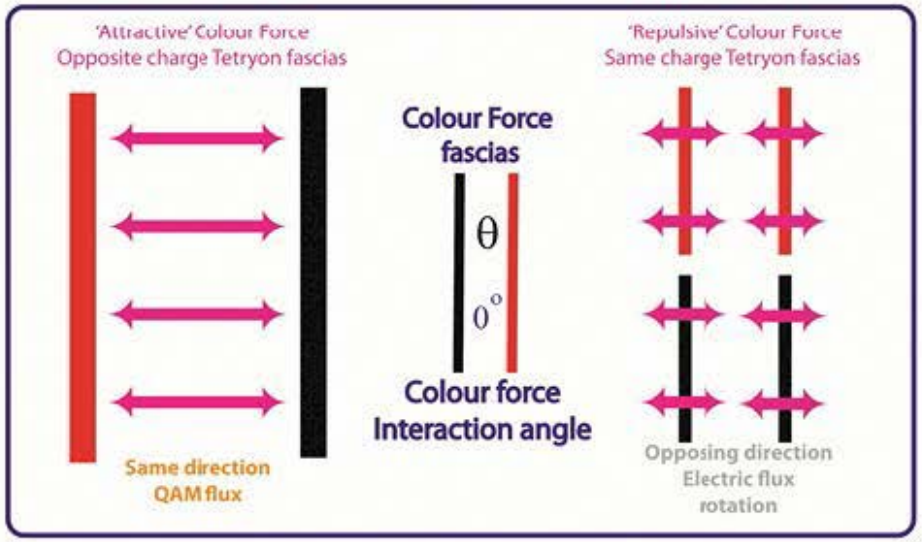

Strong Force strength is directly proportional to the nett mass-energy quanta involved
(Increases/decreases as total Tetryon mass-energy quanta increases/decreases)

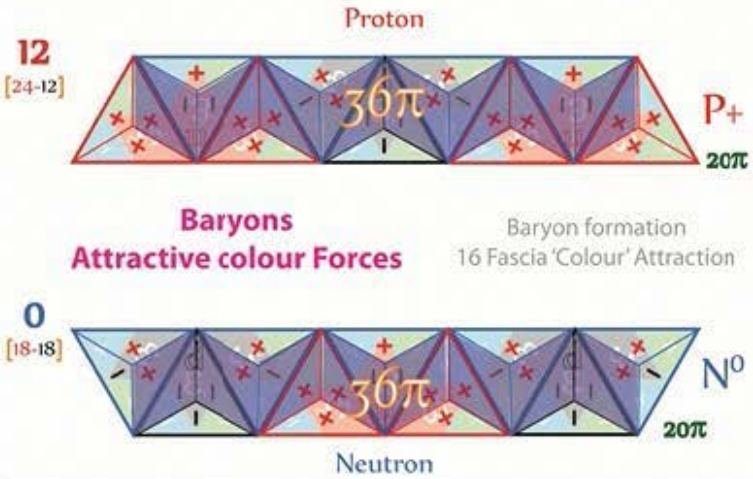

The Strong Colour Force is the binding force that holds Nuclei together

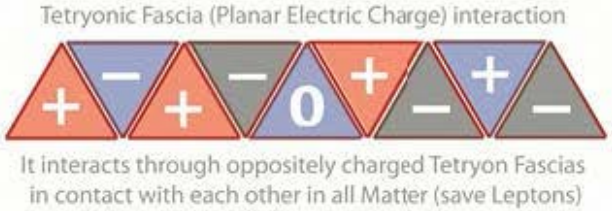

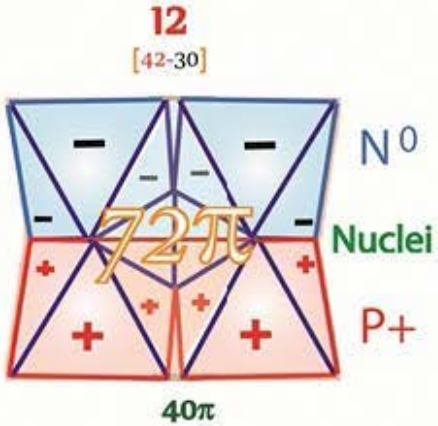

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Strong Force Interaction

On the smallest scale (less than about 0.8 fm), it is the Electric force (mediated by gluons in nuclei) that holds Tetryons together in order to form Quarks, Protons and Neutrons

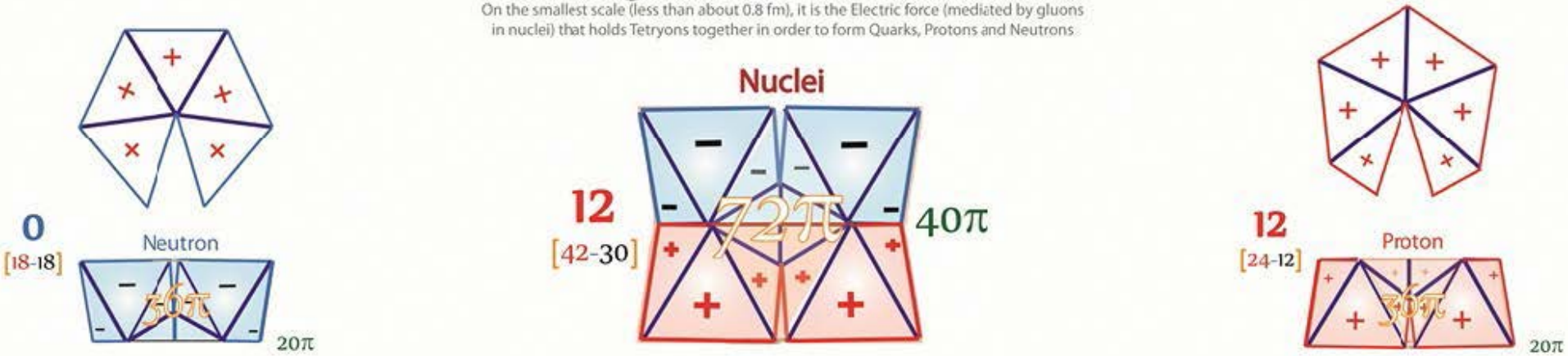

The residual Electric field force produced by the Strong Force is also facilitates the binding of Protons and Neutrons together to form the nucleus of an atom

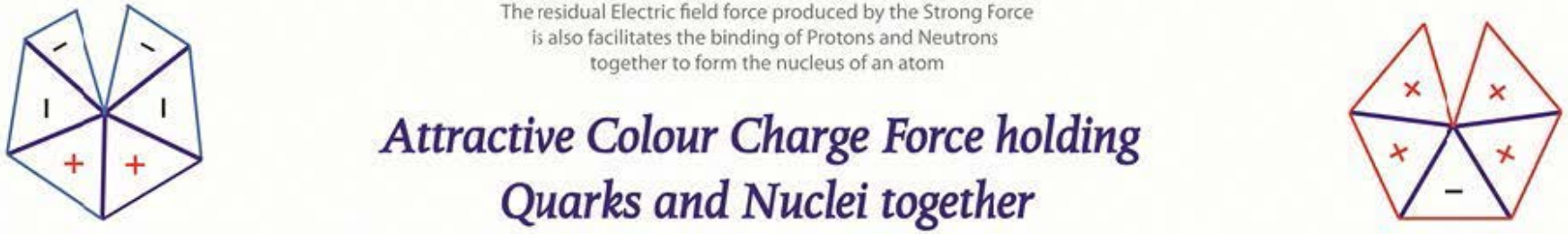

Attractive Colour Charge Force holding Quarks and Nuclei together

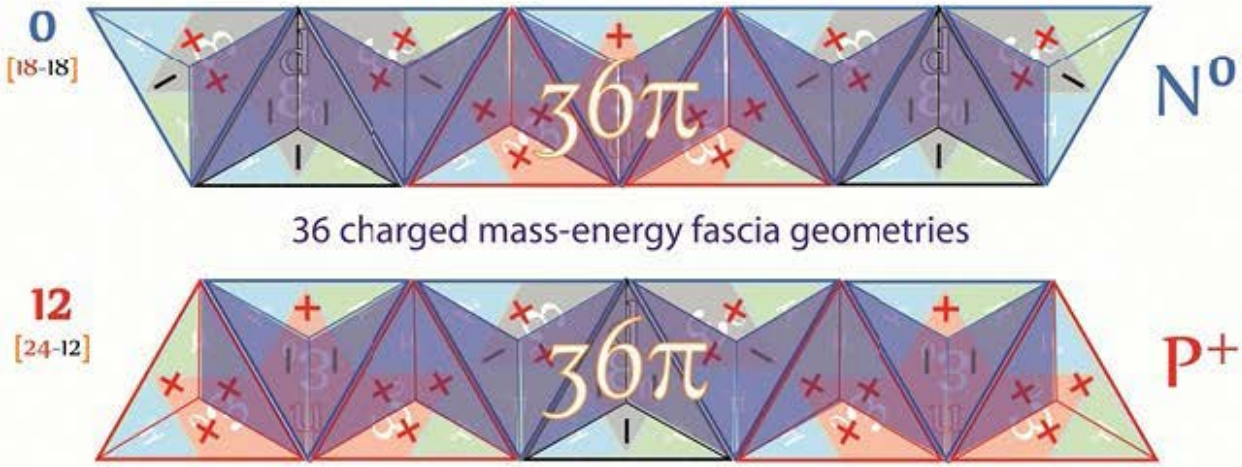

Atomic Nucleus

36 charged mass-energy fascia geometries

12
[42-30]

creates an external Baryons topology with 20 charge fascia

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Proton - Hydrogen ion

Proton Hydrogen ion

36

1 Proton	24-12
Total Charge	24-12 [+12]

H^+

F+ n=25

The Proton is a Baryon with a Positive Tetryonic charge geometry of +12 [24-12] [and a final Matter topology of 20π]

It attracts electrons [0-12] and Neutrons [13-18] through their opposite charged facia in order to reach charge equilibrium

The Proton's opposite charge particle is the electron
If it binds with one or more Neutrons it will still attract electrons in order to acheive Tetryonic charge equilibrium.

As a Hydrogen nuclei it is highly reactive

Neutral Hydrogen

Neutral Hydrogen

48

1 Proton	24-12
1 electron	0-12
Total Charge	24-24 [0]

H^0

F+ n=25
e- n=1

Hydrogen is the Second Neutral Tetryonic geometry [Baryon] formed in the creation of Matter

It is a [24-24] NEUTRAL [balanced] Tetryonic charge geometry

The Neutral Hydrogen Atom interacts with Deuterium and other Elements via its external nucleon fascia charges (residual EM Interactions)

Deuterium

Deuterium

84

1 Proton	24-12
1 Neutron	18-18
1 electron	0-12
Total Charge	42-42 [0]

D^1

N° n=25
F+ n=25
e- n=1

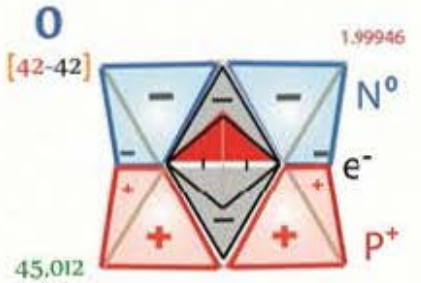

Deuterium has the same nett charge as Neutral Hydrogen but has an increased Tetryonic mass- Matter topology

It has an additional 9 Tetryons in its nucleus (due to the Neutron) and consequently is larger than the Hydrogen nucleus

It has a [42-42] NEUTRAL Tetryonic charge geometry
Deuterium nuclei combine to form all other elements

Tritium

Tritium

84

1 Proton	24-12
1 Neutron	18-18
1 electron	0-12
Total Charge	42-42 [0]

D^7

N° n=31
F+ n=31
e- n=7
Radioactive Isotope

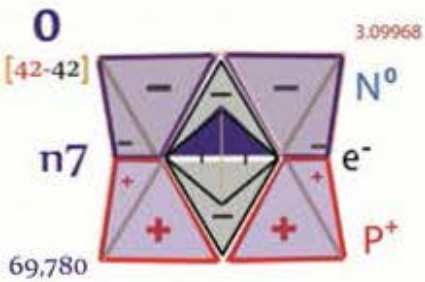

(Radioactive Deuterium)

Tritium has the same nett Tetryonic charge as Neutral Hydrogen and Deuterium (D) but due to its higher quantum energy levels it has additional mass-energy quanta in its charged geometry

It has the same 84 charged fascia in its nucleus as Deuterium but its increased mass-energy is equivalent to that of 1 Neutron.

This extra nuclear energy is the source of its radioactivity and ongoing confusion in chemistry where it is released as a variety of decay particles over time

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Hydrogen - Helium genesis

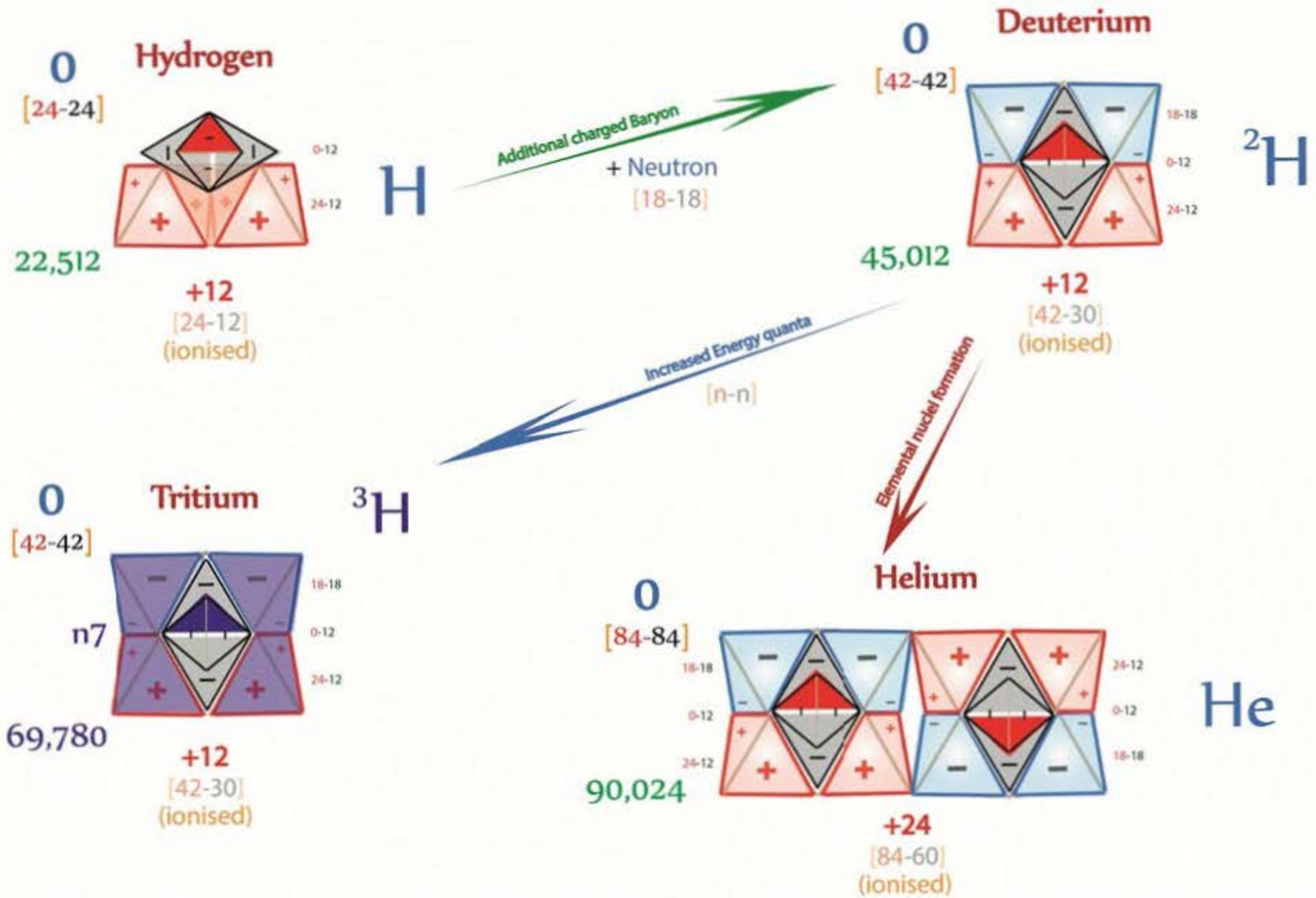

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Hydrogen Family

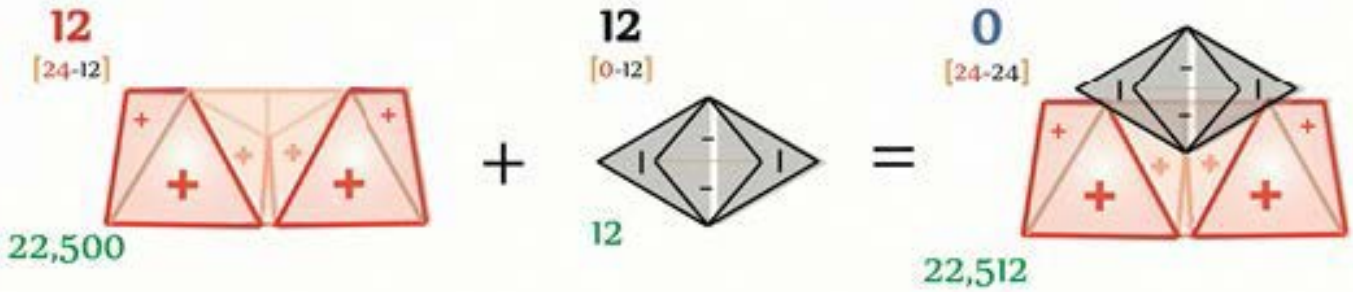

Proton	electron	Hydrogen
36π	12π	48π

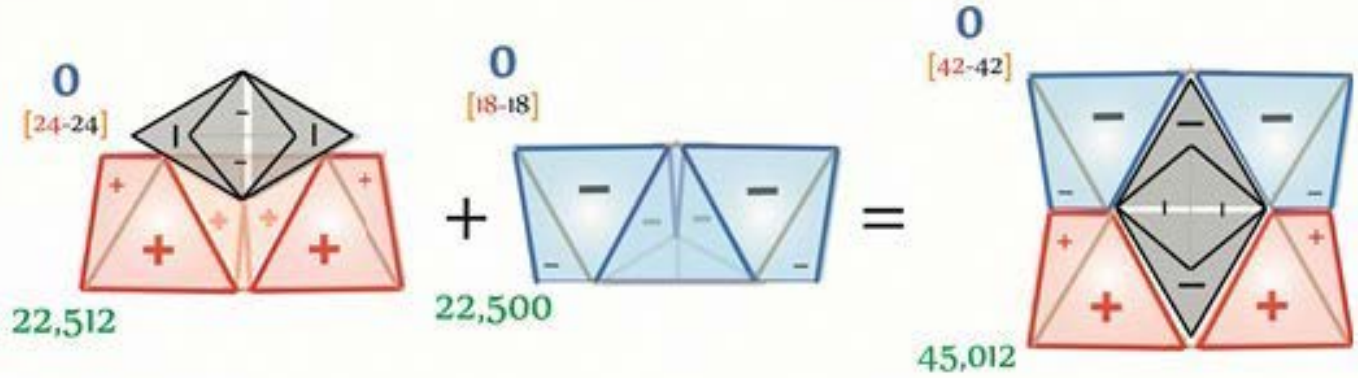

Hydrogen	Neutron	Deuterium
48π	36π	84π

Deuterium	Tritium
84π	84π

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Hydrogen-Helium3 genesis

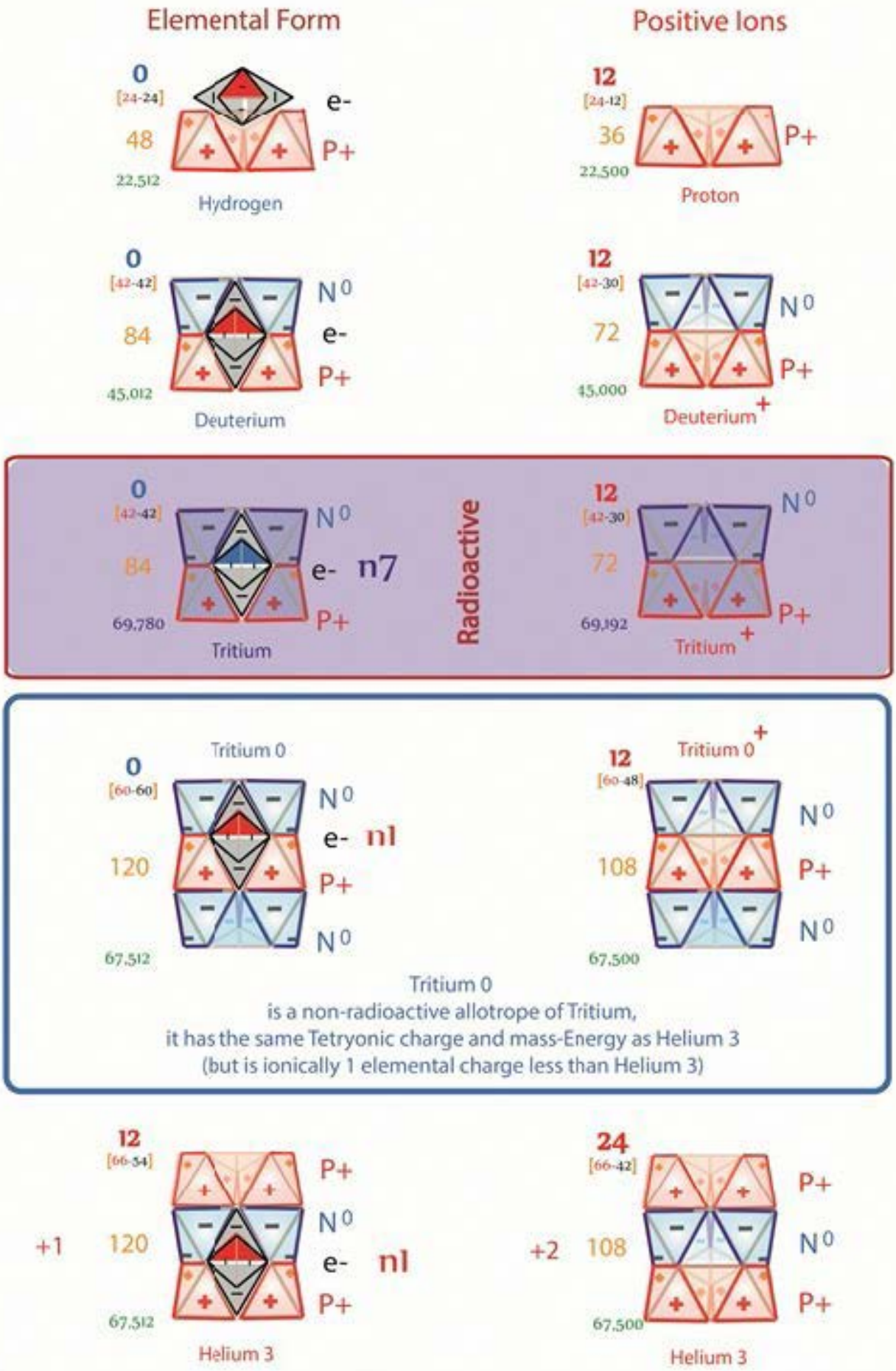

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Quantum Batteries

Atomic nuclei can be easily scaled to non-quantum sizes to offer clean, safe and portable long term energy storage devices that can store energy indefinitely and release it on demand anywhere in the World

12 loop quantum inductive rotor

The quantum battery is unique in that in addition to storing energy indefinitely, when the nuclei combine with a lepton it has the ability to release specific energies [photons] by way of its synchronous quantum convertor topology

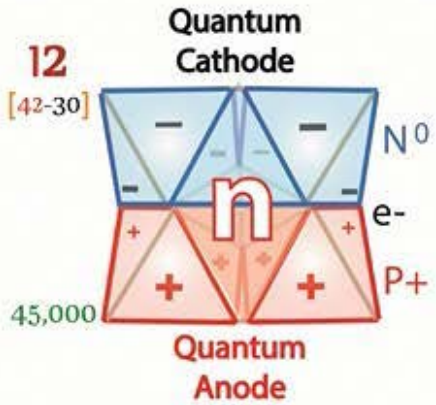

Energy stored in quantum batteries is measured as mass

(Atomic Nuclei)

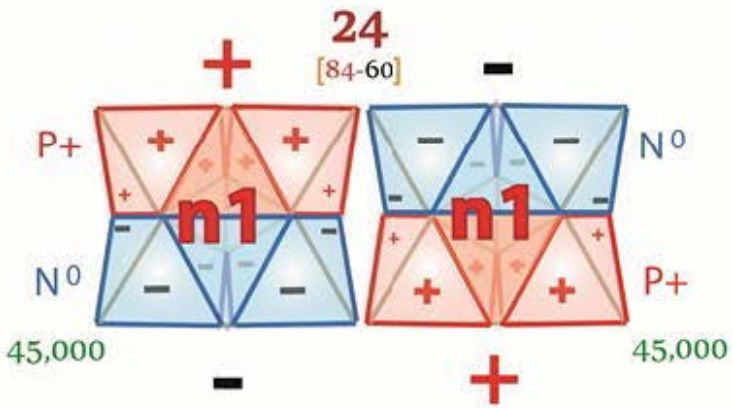

The non-neutral charge of atomic nuclei attract free leptons into 'bound' states within the various **n** levels of atomic shells releasing energy as spectral photons

anti-Parallel Configuration

Series Configuration

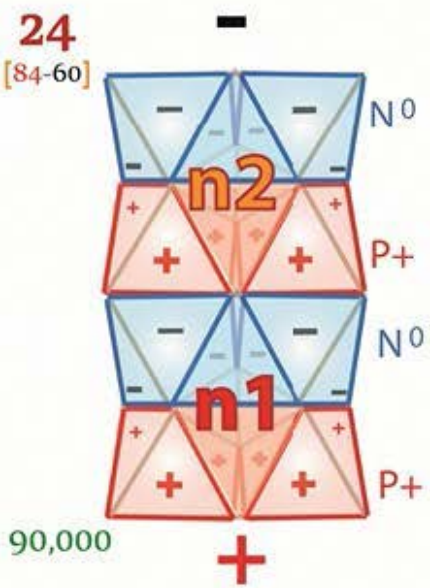

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Quantum synchronous Converters

With the addition of a quantum rotor (lepton) a quantum battery can be converted from a storage device into a energy distribution device.

And just like the quantum battery, the quantum convertor can be scaled to any size in order to provide tailor-made energy efficient delivery devices

The electron can be viewed as a rotating inductor consisting of 3 negative Tetryons

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]^{n8}_{n1}$$

Leptons; EM Field (ElectroMagnetic); Planck quanta (mass, velocity)

The electron has a charged Matter topology that is electrically equivalent to a quantum 6 loop inductive rotor

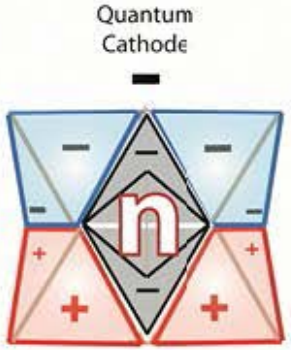

$$72\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]^{n32}_{n25}$$

Nuclei; EM Field (ElectroMagnetic); Planck quanta (mass, velocity)

$$84\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]^{n32}_{n25}$$

Deuterons; EM Field (ElectroMagnetic); Planck quanta (mass, velocity)

Where varying levels and frequencies of Energy are transmitted long distances and need to be stored for later release on demand the 'ideal' mechanical device is the rotating (or synchronous) convertor

Changes in energy-momenta results in photon emission/absorption lines
photon emission/absorption produces changes in leptronic energy-QAM
and results in the quantum transition of electrons in atomic orbitals

Changes in Baryonic energy levels induces a directly proportional change in electron energy levels

3 forms of mass-energy momenta are possessed by quantum convertors

Angular Momentum (motional energy)
linear momentum of Baryons & leptons

Photonic spectral energies (emission/absorption)
KEM fields geometries of photo-electrons

Nuclear mass-energies (stored energy quanta)
standing wave mass-energies of Matter topologies

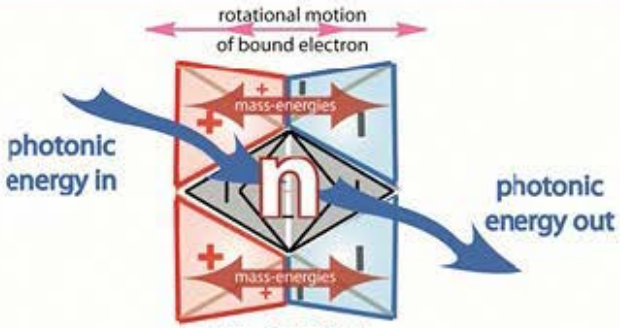

QAM of KEM field
creates angular momentum

A change in any 1 of the 3 types of energy in a atom results in a proportional change in the other 2

External EM fields and incident photons can all affect the quantum energy levels of the atomic nuclei

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Hydrogen Ionisation Energies

$Mv^2 = KEM = hv^2$

The KEM Planck quanta required to ionise a photo-electron

The ionisation energy level for each quantum level is proportional to the square of the quantum number

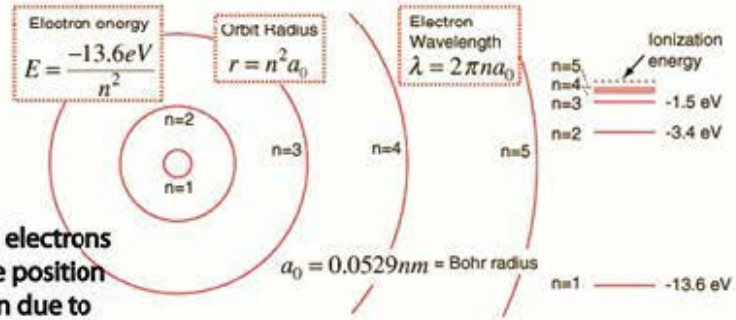

In Hydrogen nuclei electrons remain in the same position close to the Proton due to Coulombic attraction.

The established model of electron orbitals having circular radii of increasing size in proportion to their energies is incorrect

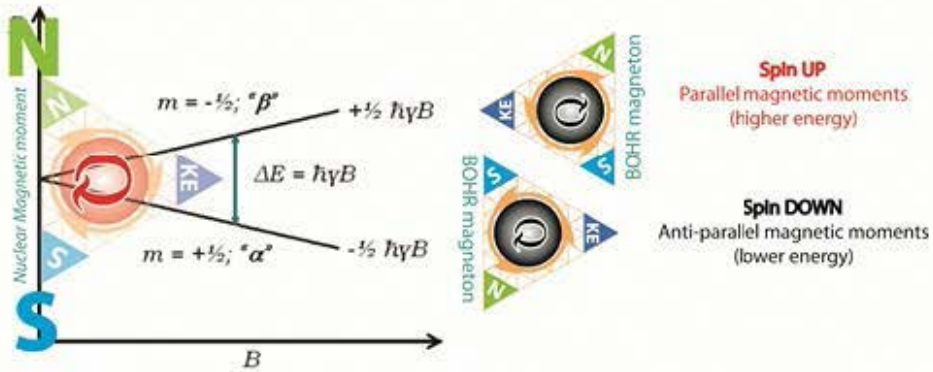

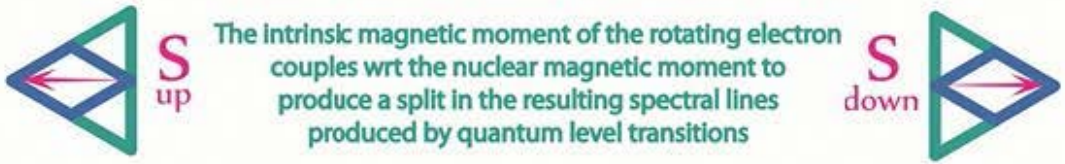

The intrinsic magnetic moment of the rotating electron couples wrt the nuclear magnetic moment to produce a split in the resulting spectral lines produced by quantum level transitions

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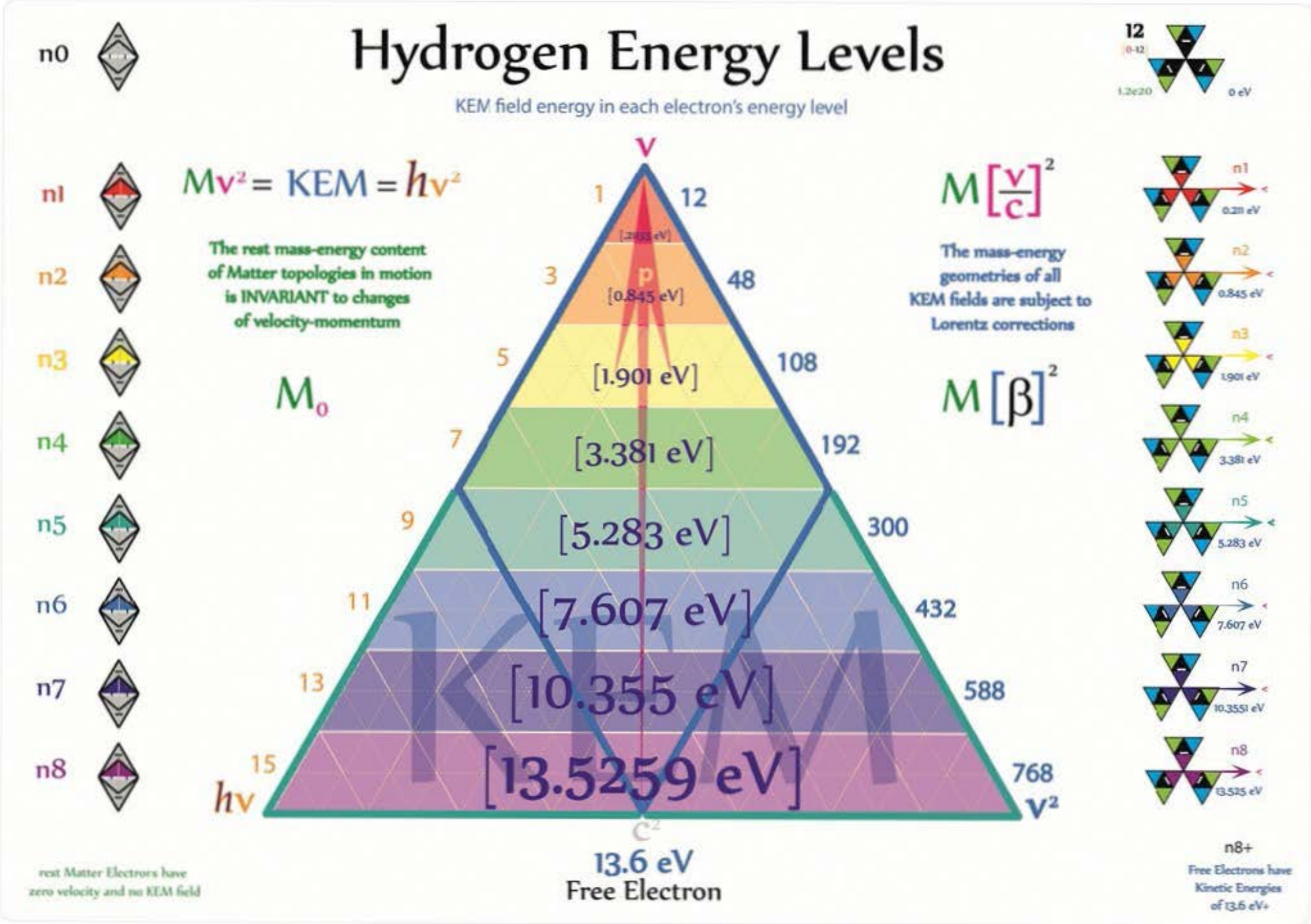

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Kinematics

An inertial frame of reference is one in which the motion of a particle not subject to forces and results in motion in a straight line at constant velocity

Deceleration

[Inertial Frame MINUS odd quanta]

Newton's First Law

$$\sum \mathbf{F} = 0 \Rightarrow \frac{d\mathbf{v}}{dt} = 0$$

Every body persists in its state of being at rest or of moving uniformly straight forward, except insofar as it is compelled to change its state by force impressed

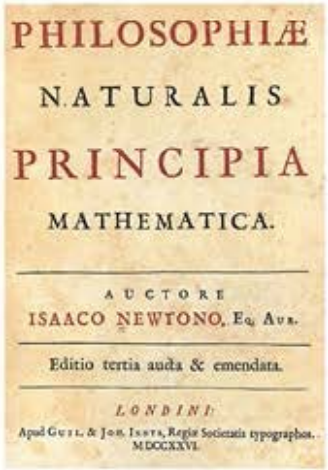
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NATURALIS
PRINCIPIA
MATHEMATICA.
AUCTORE
ISAACO NEWTONO, Eq. Aur.
Editio tertia aucta & emendata.
LONDINI:
Apud Guil. & Jos. Innys, Regiæ Societatis typographos.
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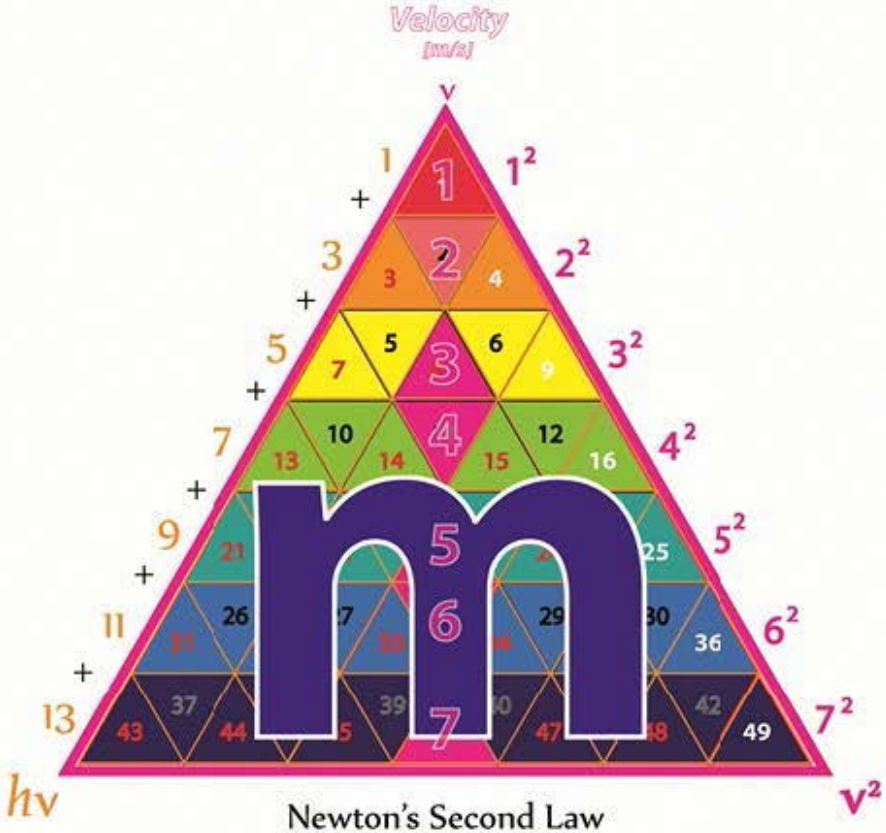

Newton's Second Law

$$\sum \mathbf{F} = \frac{\mathrm{d}\mathbf{p}}{\mathrm{d}t} = m\frac{\mathrm{d}\mathbf{v}_{cm}}{\mathrm{d}t} = m\mathbf{a}_{cm}$$

Force creates a change in Momentum over Time

A body of [m]ass subject to a net [F]orce undergoes an [a]cceleration that has the same direction as the force and a magnitude that is directly proportional to the force and inversely proportional to the mass, i.e., F = ma.

Alternatively, the total force applied on a body is equal to the time derivative of linear momentum of the body.

Sir Issac Newton

(25 December 1642 – 20 March 1727)

$$a = \frac{\Delta y}{\Delta x} = \frac{\Delta v}{\Delta t}.$$

$$\mathbf{F} = m\mathbf{a} \quad \rightarrow \quad \mathbf{a} = \mathbf{F}/m$$

Acceleration

[Inertial Frame PLUS odd quanta]

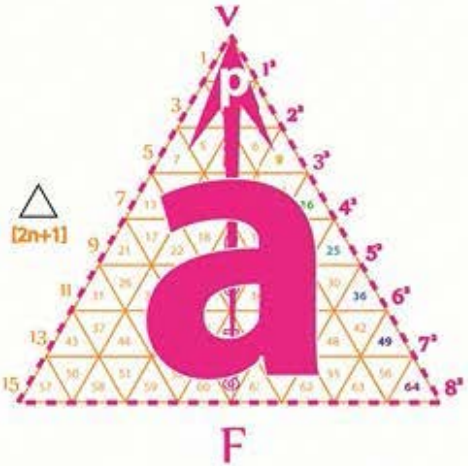

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Inertia and Force

momentum

The classical definition of Momentum relates the mass of a material body at given velocity (v) to its Momentum (p); it is a proportionality factor in the formula

$$p = mv$$

Any change to the energy-momenta content of a closed inductive loop requires a proportional change to the loop's energy density

linear quanta forces

divergent ↑ [v - v] ↓ convergent

Force

This meaning of a body's inertia therefore is altered from the classsical definition of "a tendency to maintain momentum" to a description of the measure of how difficult it is to change the momentum of a body

$$F = ma$$

Transverse Bosons

Any change to energy-momenta levels in Tetryonic geometry requires specific number quanta

Scalar mass-energy

Inertia is resistance to change of energy momenta vectors within spatial geometries

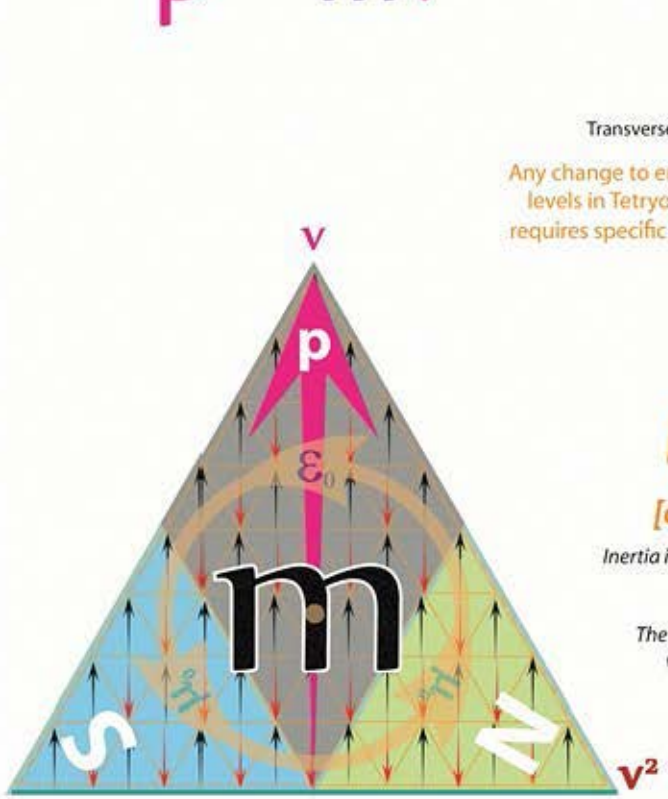

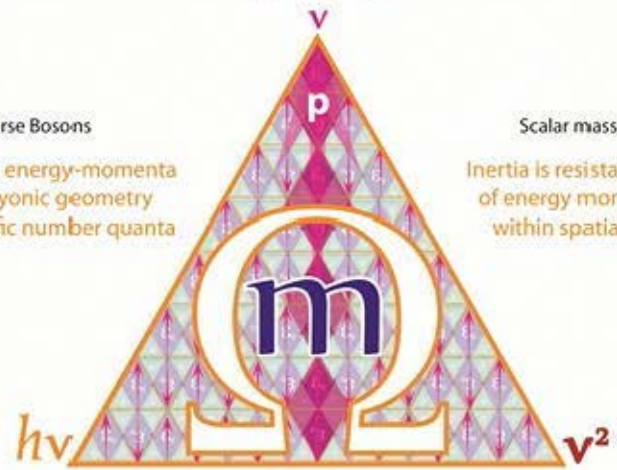

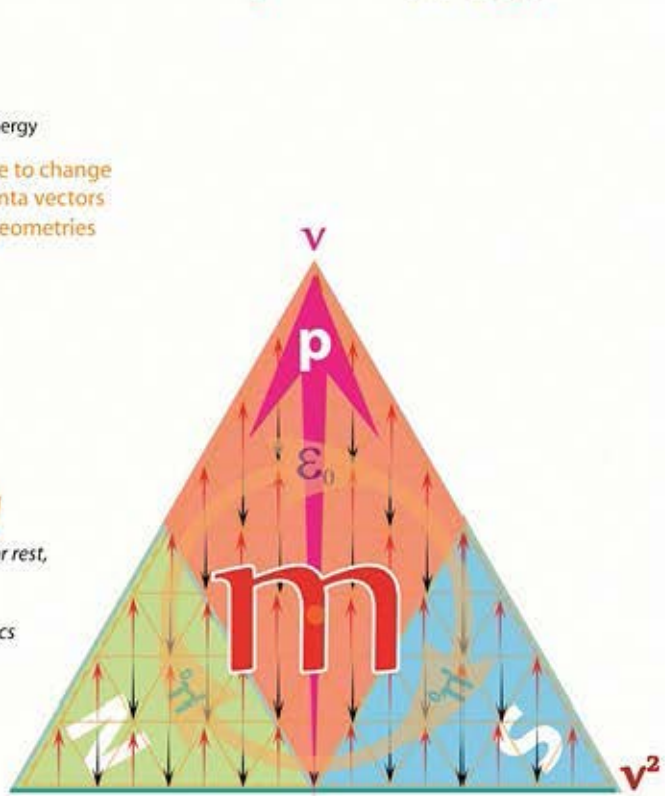

[all inductive loops resist changes to their energy levels]

Inertia is the resistance of any physical object to a change in its state of motion or rest, or the tendency of an object to resist any change in its motion.

The principle of inertia is one of the fundamental principles of classical physics which is used to describe the motion of matter and how it is affected by applied forces

$$E = mv^2$$

Linear momentum is the nett square root of mass-energy quanta

p

Any change in the energy-momenta content of a body of mass-Matter results in a proportional change in its momentum-velocity

Force is the sum of the linear mass-energy momenta quanta

F

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Gottfried Wilhelm von Leibniz

(July 1, 1646 – November 14, 1716)

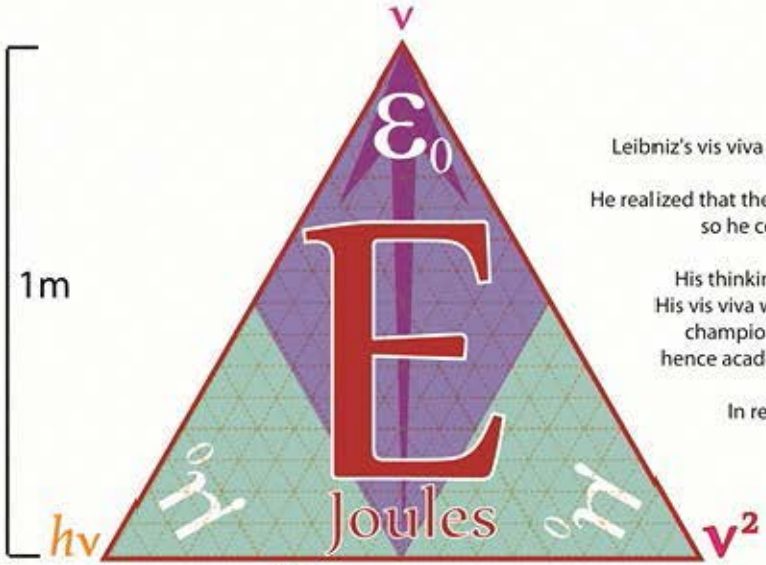

Scalar Energy

Leibniz's vis viva (Latin for living force) is mv^2, twice the modern kinetic energy.

He realized that the total energy would be conserved in certain mechanical systems, so he considered it an innate motive characteristic of Matter.

His thinking gave rise to another regrettable nationalistic dispute. His vis viva was seen as rivaling the conservation of linear momentum championed by Newton in England and by Descartes in France; hence academics in those countries tended to neglect Leibniz's idea.

In reality, both energy and momentum are conserved, so the two approaches are equally valid.

Newtons

of force

The nett direction of Force within energy geometry is UNIDIRECTIONAL
ie the force exerted is the result of the nett linear momenta irrespective of charge

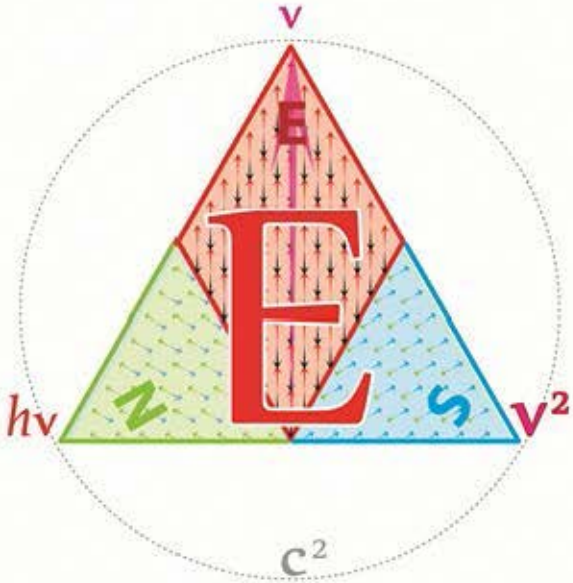

[Joule seconds] per second

mass x velocity squared $\quad kg.\left[\frac{m}{s}\right]^2$

Energy $\quad kg.\frac{m^2}{s^2}$

$$J = \frac{kg \cdot m^2}{s^2} = N \cdot m = Pa \cdot m^3 = W \cdot s$$

A Joule is equal to the energy expended (or work done) in applying a force of one newton through a distance of one metre (1 newton metre or N·m)

momentum x velocity $\quad \left[kg.\frac{m}{s}\right].\frac{m}{s}$

Planck's quanta per second $\quad \left[kg.\frac{m^2}{s}\right].s^{-1}$

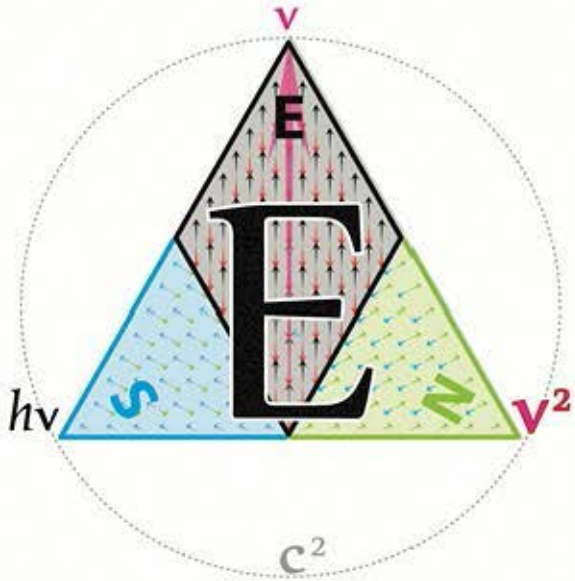

[Joule seconds] per second

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Linear Momentum

Linear momentum is the SQUARE ROOT of equilateral Planck mass-energy geometries and produces a undirectional vector force

The Energy-momentum relationship is a fundamental physical property used to determine the mass of a body

Using the formula for mass-Energy equivalence as it relates to Photons moving at 'c'

$$E = h\nu = \frac{hc}{\lambda} = mc^2$$

Noting that the rest mass in the case of EM fields (Bosons and Photons) is to equal Zero

we can derive a relationship for Momentum - Energy - Wavelength showing that

$$p = E/c$$

Thus momentum in Photons is directly related to the EM energy content of the photon and the mass-energy content of any massive 3D body

$$p = \hbar k = \frac{h\nu}{c} = \frac{h}{\lambda}.$$

and momentum in Particles is related to the total EM Energies of an object. (its rest Matter + KE) and the wavelengths associated with those distinct energy levels

$$p = \frac{E}{c} = \frac{h\nu}{c} = \frac{h}{\lambda}$$

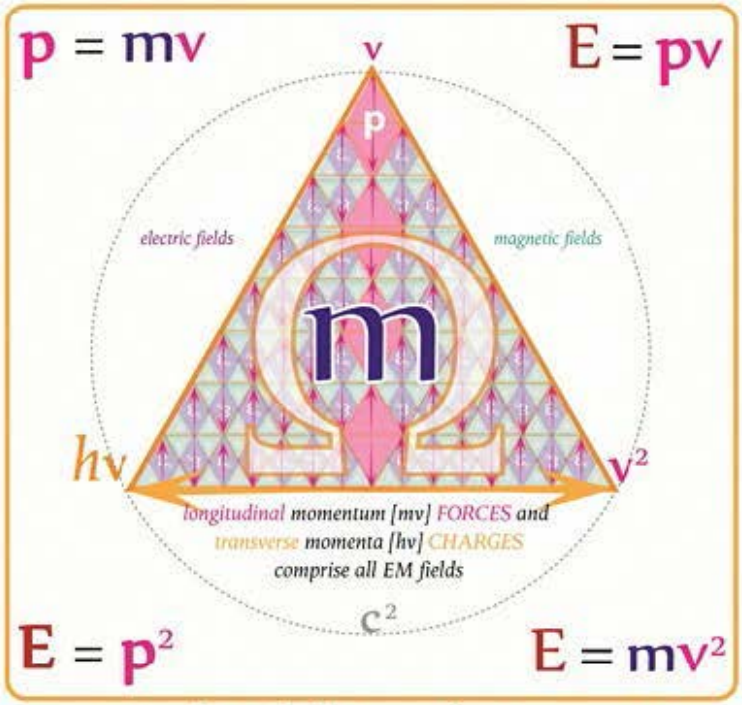

Longitudinal [linear] momentum

Energy

$$p = n\pi\left[\left[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v}\right]\right]$$

Planck quanta

momentum

Momentum is a conserved quantity, meaning that the total momentum of any closed system (one not affected by external forces) cannot change.

Linear Momentum is the intrinsic sqare root vector component of Force

$$p = mv$$

In classical mechanics, momentum is the product of the mass and velocity of an object.

$$\sum \mathbf{F} = \frac{d\mathbf{p}}{dt} = m\frac{d\mathbf{v}}{dt} + \mathbf{v}\frac{dm}{dt}$$

In relativistic mechanics, this quantity is multiplied by the Lorentz factor.

$$p = n\pi\,\frac{\left[\left[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v^2}\right]\right]}{v} = mv$$

Planck quanta

EM field momentum is a function of its energy density, and is directly proportional to the group velocity

$$\left[\sqrt{\left[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v}\right]^2}\right]$$

Planck quanta

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Vector linear momentum

is the square root of the KEM field energies produced by Matter in motion

Energy

$$n\pi\,[[m\Omega v]]$$

momenta

Classical formulation

$$p = mv$$

Linear Momentum is the vector force of mass times its velocity

Quantum formulation

$$p = \frac{E}{v}$$

Linear Momentum is Energy divided by the square root of its quanta

$$\frac{E}{c^2}.v$$

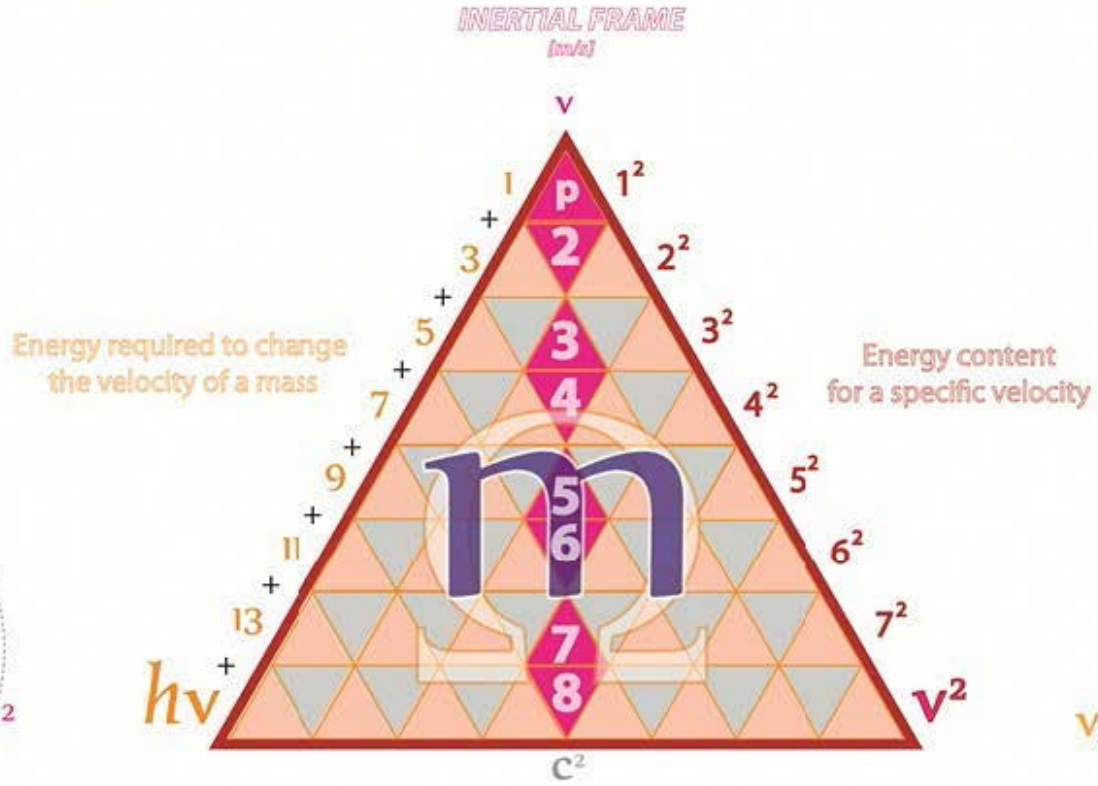

$$\frac{hv^2}{v}$$

$$\mathbf{p} = \sum_{i=1}^{n} m_i \mathbf{v}_i = m_1\mathbf{v}_1 + m_2\mathbf{v}_2 + m_3\mathbf{v}_3 + \cdots + m_n\mathbf{v}_n\,,$$

The linear momentum of a EM field or system of particles is the vector sum of the linear momenta in the KEM fields of individual particles in any spatial co-ordinate system

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Kinetic Energy

is the Electric field energy of Matter in motion

$$1/2\left[4n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]\right]$$

EM Field, Planck quanta, Matter, ElectroMagnetic, mass, velocity

Kinetic Energy is the diamond electric field extending from charged Matter topologies as a result of its motion, it follows Tetryonic omega geometry and is proportional to an object's mass-Matter and its vector velocity

Charge

Q

$[v-v]$

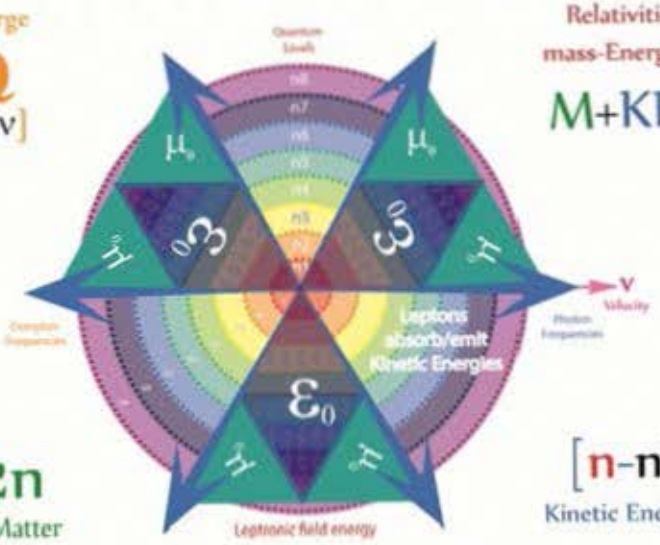

Relativitic mass-Energies

$M+KE$

Kinetic Energy is 1/2 of the secondary KEM field energies created when Matter particles are in motion

$$2\pi\left[\left[m\Omega v^2\right]\right]$$

mass, velocity

c^2

EM Field

and is shown to be subject to Lorentz corrections

$12n$

rest Matter

$[n-n]$

Kinetic Energies

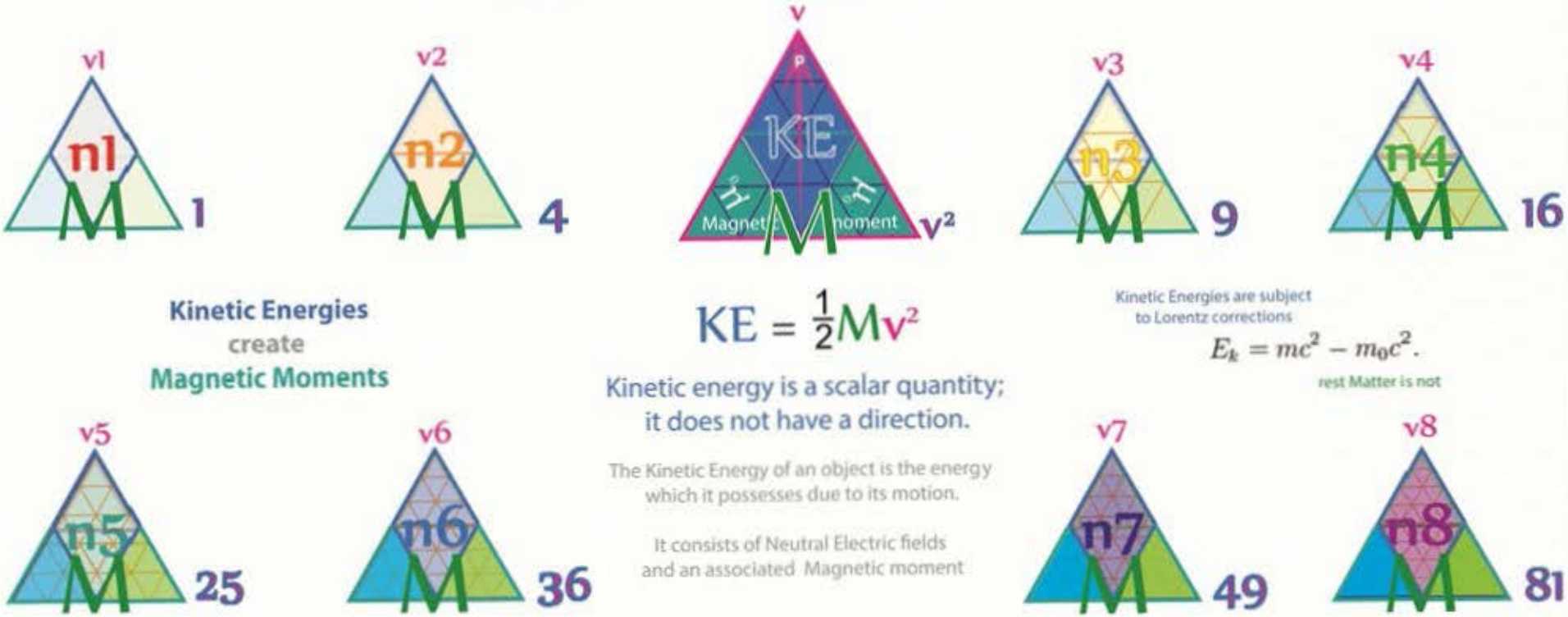

Kinetic Energies
create
Magnetic Moments

$$KE = \frac{1}{2}Mv^2$$

Kinetic energy is a scalar quantity; it does not have a direction.

The Kinetic Energy of an object is the energy which it possesses due to its motion.

It consists of Neutral Electric fields and an associated Magnetic moment

Kinetic Energies are subject to Lorentz corrections

$$E_k = mc^2 - m_0c^2.$$

rest Matter is not

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Kinetic Energy and Magnetic moments

KEM field geometry of positive charged Matter in motion

$$Mv^2 = KEM = p^2$$

Unlike charged fields KEM fields have neutralised Electric Fields

$$KE = \frac{1}{2}Mv^2$$

KEM field geometry of negative charged Matter in motion

Often noted as being two distinct EM energies [Kinetic Energy and Magnetic moments] are shown to be orthogonal aspects of the same KEM field of motion

As the velocity of a particle increases so does its Kinetic Energy and Magnetic moment creating Lorentz variable KEM fields

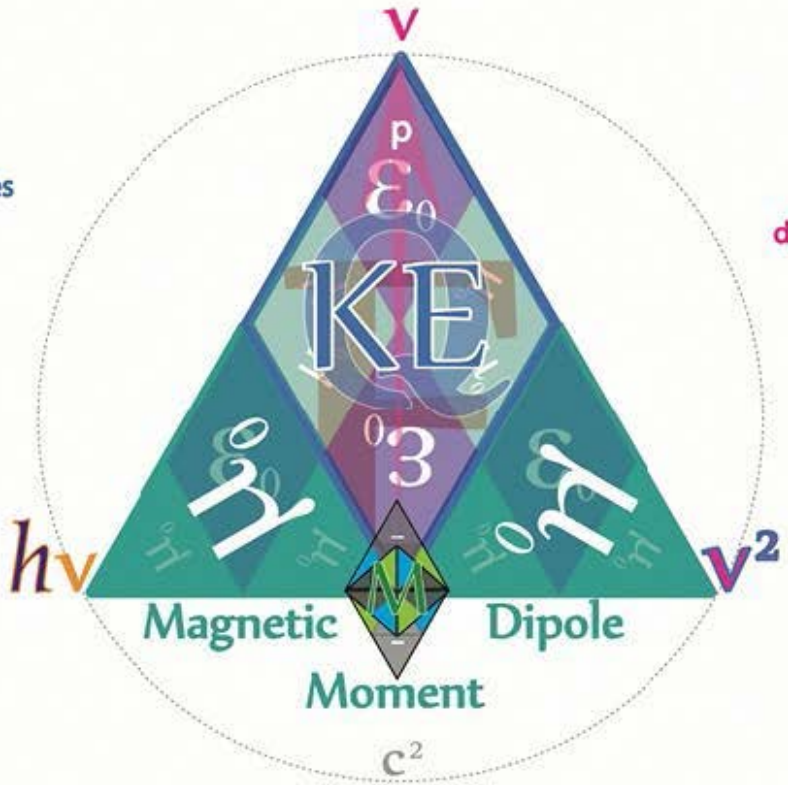

$$\mu_B = \frac{1}{2}Mv^2$$

$$\mu_B = \frac{1}{2}Mv^2$$

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Types of Momentum

There are 3 forms of momenta in physics

equilateral charge geometry

Ω

quantised angular momenta

[m²/s]

The quantised 'angular momentum' of each Planck mass-energy geometry, gives rise to the two quantum Charges

vector momentum

p

Linear momentum

[kg·m/s]

The square root (v) of each Planck quanta's mass-energy geometry (v^2) is vector Linear Momentum

vector rotation about a point

ℓ

Angular momentum

[kg·m²/s]

The orbital angular momentum of electrons in atoms associated with a given quantum state

... [n-1] [n] [n+1] ...

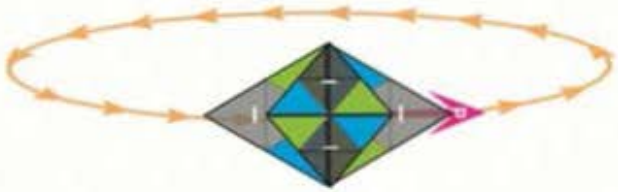

$$L^2 = L_x^2 + L_y^2 + L_z^2$$

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Kinetic Energy vs Momentum

An important difference is that Kinetic energy is a scalar quantity - it has no direction in space
momentum is a vector quantity - it has a direction in space, momenta combine like forces do.

$$p = Mv$$

$$KE = 1/2\left[Mv^2\right]$$

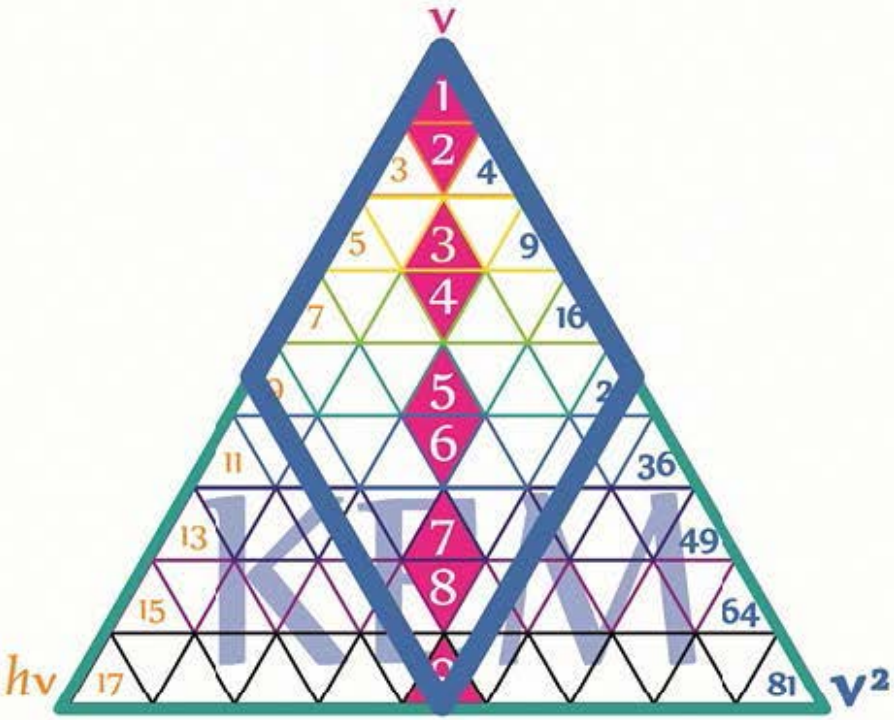

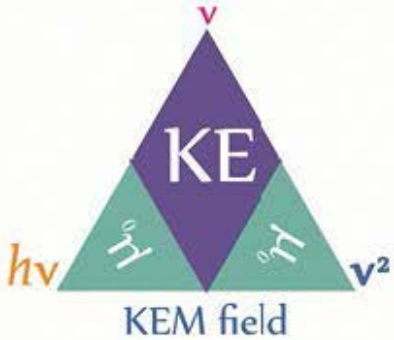

$$p = \sqrt{E}$$

$$KEM = Mv^2$$

In Tetryonic geometry, the square root maps the linear momenta [mv] of a field to its ENERGY

$$p^2/_{2m} = KE$$

In Tetryonic geometry, E-field geometry maps the kinetic energy [1/2 mv] of a field to its ENERGY

Linear momentum has a different geometric ENERGY relationship to that of Electric fields

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mass-Energy-momentum

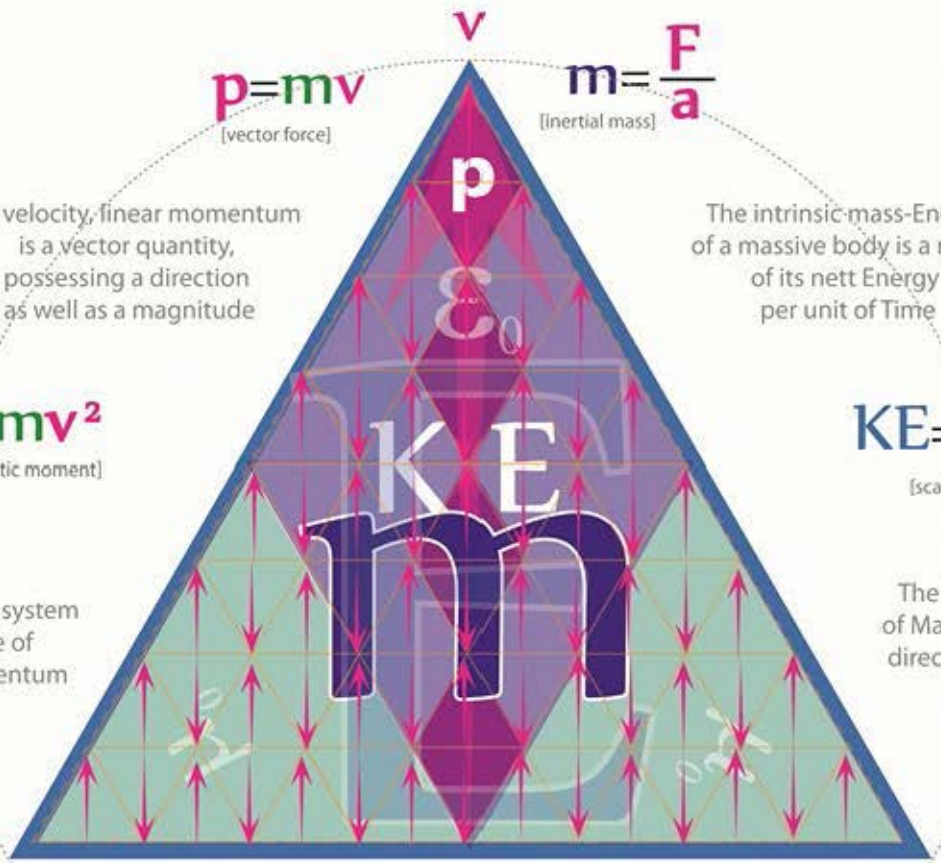

$p=mv$
[vector force]

$m=\frac{F}{a}$
[inertial mass]

Like velocity, linear momentum is a vector quantity, possessing a direction as well as a magnitude

The intrinsic mass-Energy of a massive body is a result of its nett Energy per unit of Time

$KEM=mv^2$
[Kinetic Energy & magnetic moment]

$KE=\frac{1}{2}mv^2$
[scalar E-field]

The Energy of a system is the square of its linear momentum

The Kinetic energy of Matter in motion is directly related to its velocity

$E=mv^2$
[scalar KEM field energies of Matter in motion]

$E=p^2$
[Energy momenta]

Planck quanta
$[m\Omega v]$
mass velocity

acceleration results in changes to momenta

$F=ma$

Newton's Second law of Motion

Linear momentum is the square root of the Energy of a system.

It is the nett linear Force resulting from Matter in motion and was used by Newton as the foundation for his Laws of motion

Linear momentum is also a conserved quantity, meaning that if a closed system is not affected by external forces, its total linear momentum cannot change. Although originally expressed in Newton's second law, the conservation of linear momentum also holds in special relativity and, with appropriate definitions, a (generalized) linear momentum conservation law holds in electrodynamics, quantum mechanics, quantum field theory, and general relativity. In relativistic mechanics, non-relativistic linear momentum is further multiplied by the Lorentz factor

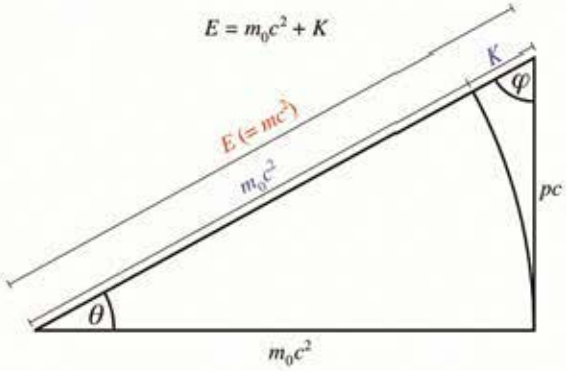

Often generalised as having the geometry of right angled triangles the mass-energy momenta relationship is fully revealed using Equilateral geometry

E^2

is the energy content of a superpositioned EM field

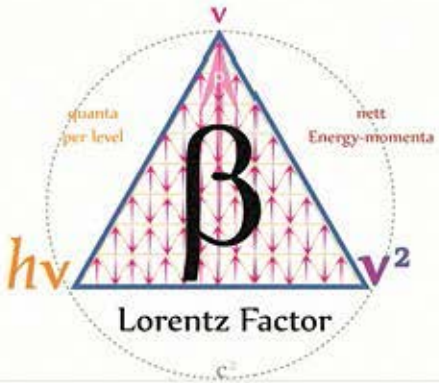

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Lorentz velocity correction Factor

The Lorentz factor or Lorentz term is an expression which appears in several equations in special relativity. It arises from deriving the Lorentz transformations. The name originates from its earlier appearance in Lorentzian electrodynamics - named after the Dutch physicist Hendrik Lorentz.

Wavelength, momentum

mass-ENERGY

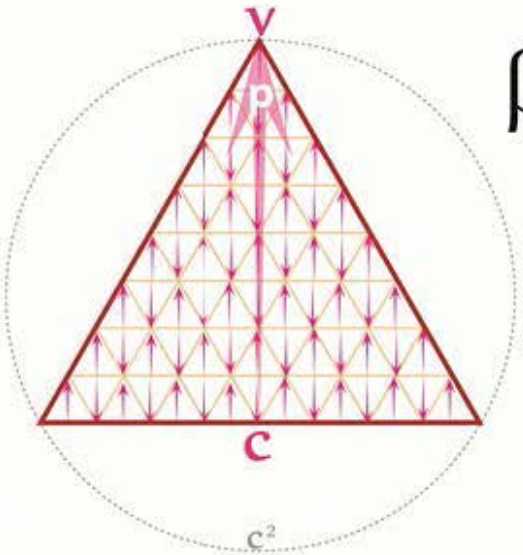

$$\beta = \left[\frac{v}{c}\right]$$

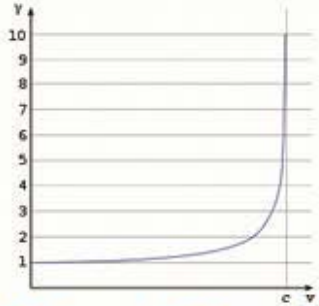

$$\left[\frac{v^2}{c^2}\right] = \beta^2$$

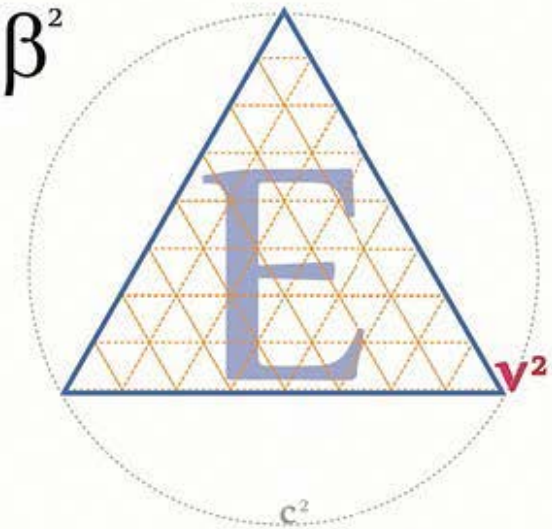

Classically modelled as an infinite series approaching c
Tetryonics reveals it to be a physical property
of equilateral energy-momenta geometries

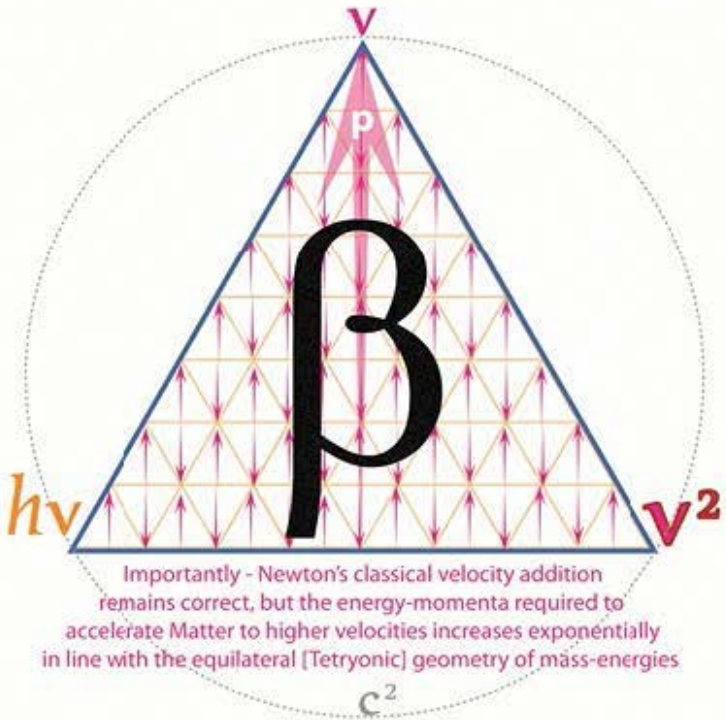

Importantly - Newton's classical velocity addition remains correct, but the energy-momenta required to accelerate Matter to higher velocities increases exponentially in line with the equilateral [Tetryonic] geometry of mass-energies

A vector measure of the Energy content of a waveform

$$\gamma \equiv \frac{c}{\sqrt{c^2 - v^2}} = \frac{1}{\sqrt{1-\beta^2}} = \frac{\mathrm{d}t}{\mathrm{d}\tau}$$

$$\gamma$$

A scalar measure of a KEM waveform's energies

$$\gamma = 1/\sqrt{1 - v^2/c^2}$$

$$\Gamma$$

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Unified Energy momenta geometry

$$m = n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

$$p = n\pi\left[m\Omega v\right]$$

energy, mass, velocity; Planck quanta

$$E = n\pi\left[\left[m\Omega v\right]^2\right]$$

$$mv = p \qquad p^2 = E$$

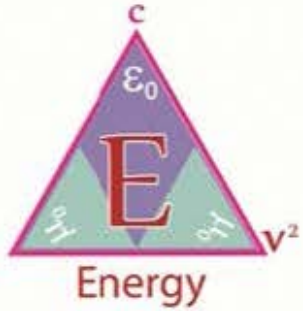

$$\beta = \left[\frac{v}{c}\right]$$

Linear Lorentz factor

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

Scalar Lorentz factor

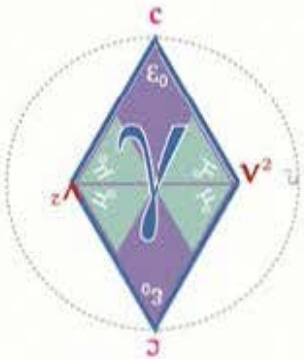

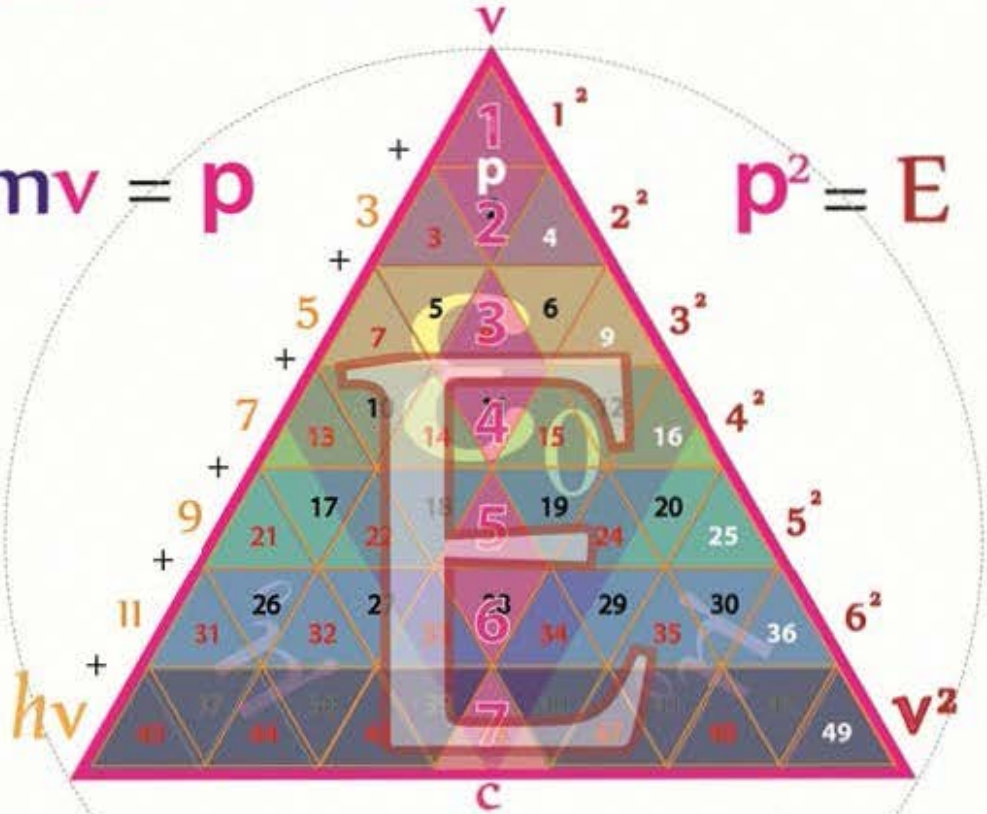

Tetryonic's equilateral geometries model
EM mass-ENERGY momenta
in all its forms

c^2

$$E_\gamma = 2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

$$m = 4n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

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Squared Energy distributions

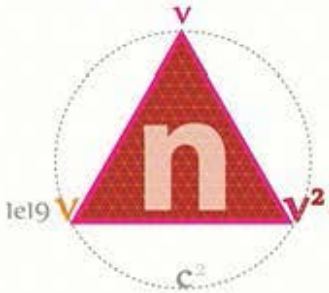

Bosons

Transverse EM mass-Energies

Odd number sequence

Number of quanta per geometry

n = (2n-1)

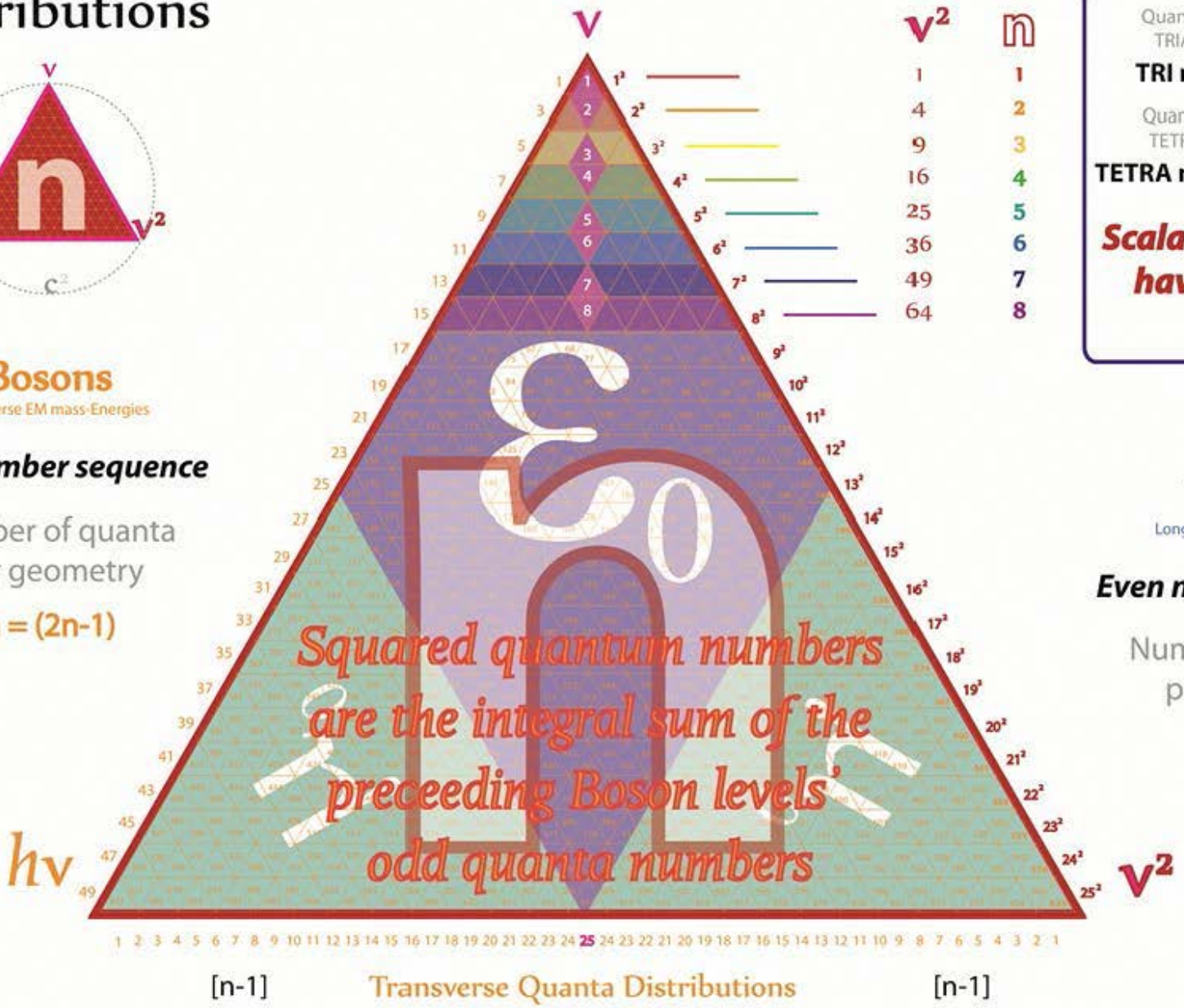

EM mass-energy

Quantum numbers are *not* TRIANGULAR NUMBERS

TRI n = (n/2) x (n+1)

Quantum numbers are *not* TETRAHEDRAL NUMBERS

TETRA n = (n/6) (n+1) (n+2)

Scalar energy levels have SQUARED quanta

Photons

Longitudinal EM mass-Energies

Even number sequence

Number of quanta per geometry

n = (2n)

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Tetryonic Energy and Charge relationships

Scalar energies
(are 'squared' numbers)

Quantised angular momenta is the geometric source of all mass-Energy-Matter relationships

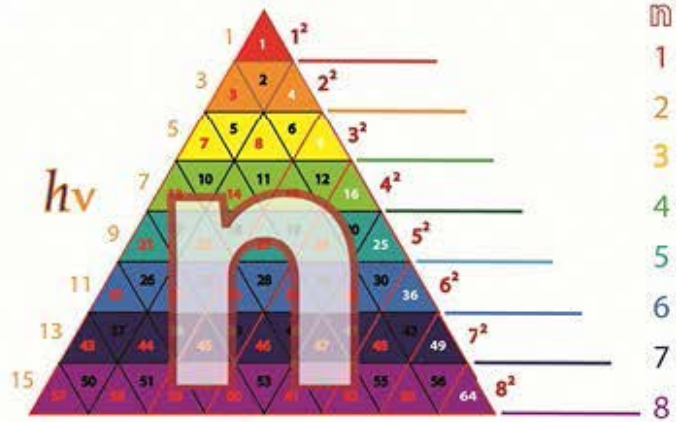

The Energy density of a particle's charged fascia geometry determines its mass

m

Charged mass-energy geometry & Matter topology determines a particle's physical characteristics (Type, Family, generation, mass etc)

M

Charge

-12

Opposite nett elementary charge geometries

+12

electron

12
[0-12]

1.2 e20

mass-Matter

e-

8.851486 e-31 KG

1875x
(differential)

differing Matter topologies

Proton

12
[24-12]

2.25 e23

1.65965 e-27 KG

P+

[ν-ν]

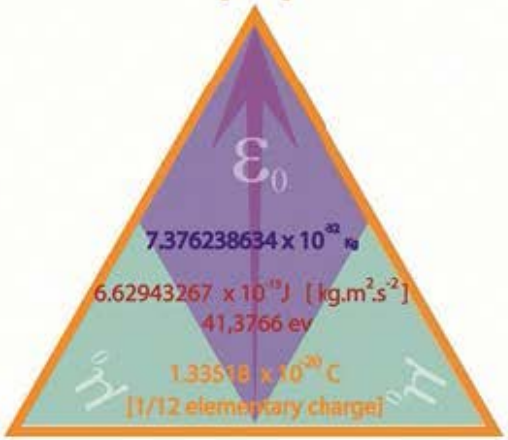

Planck mass-energy

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Planck's energy momenta quantum

$\frac{E}{c^2}$

m

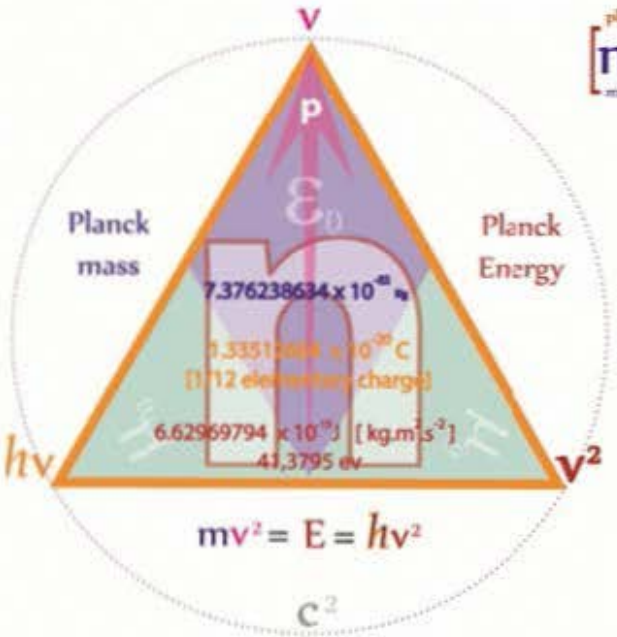

[m Ω v²] (mass, velocity)

E

Planck mass	m	m - mass quantum
Planck Charge (quantised angular momentum / spatial co-ordinate system)	Ω	v - quanta of Charge (elemental charge / 12)
Planck Energy	E	E - Energy quantum

q q

v^2 Compton Frequency	$\frac{mc^2}{h}$	1×10^{19} quanta per second
λ de Broglie wavelength	$\frac{h}{mc}$	$2.99792458 \times 10^{-11}$ meters
p Momentum	mc	2.21134×10^{-23} Ns

Planck's constant is the equilateral geometry of rest mass-energy momenta in standing wave Matter topologies

Currently the Atomic masses are calculated using 1/12 of a Molar Carbon12 atom's mass as the reference mass.

Tq [Carbon] - [252-252] C [270,072] / 12
Tm [Carbon] - 270,072 12 22,506

If we calculated for the molar mass of C12 in 12 grams we would get
(.012/N/270072) $7.378205107 \times 10^{-32}$ kg/mol
this is in error by 1/2 of the mass of an electron

Tetryonic mass [Hydrogen] - 2.2512 e23 v

Using Tetryonic geometry we can solve for an exact Compton frequency of any mass-Matter topology and account exactly for all quantum energy contributions to the rest Matter of all electrons and Baryons in any element thus determining exact molar masses exclusive of blackbody radiation, kinetic energies and energies of measurement and avoiding 'weighted' masses

Defining [N] as the number of rest mass Hydrogen atoms in 1gram exactly and makes Avagadro's number the inverse of this number

$$\text{Molar mass} = \frac{H_1 \text{ Atomic mass}}{\text{Avagadro's No.}}$$

$$\text{mass } H_{mol}/Av = \frac{.001}{6.022141579 \times 10^{23}}$$

rest mass Hydrogen = $1.660538841 \times 10^{-27}$ g/mol

$$H_{mole}/m[H] = \frac{1.660738412 \times 10^{-27}}{22,512}$$

n Planck mass = $7.376238634 \times 10^{-32}$ Kg

This is an exact Atomic rest mass as opposed to the current weighted molar Atomic mass estimates (which is incorrect by 1/2 the mass of an electron)

Planck's constant is the 'quantum of action' and also contributes to the mass-energies of radiant EM wave geometries

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Nuclear Energy levels

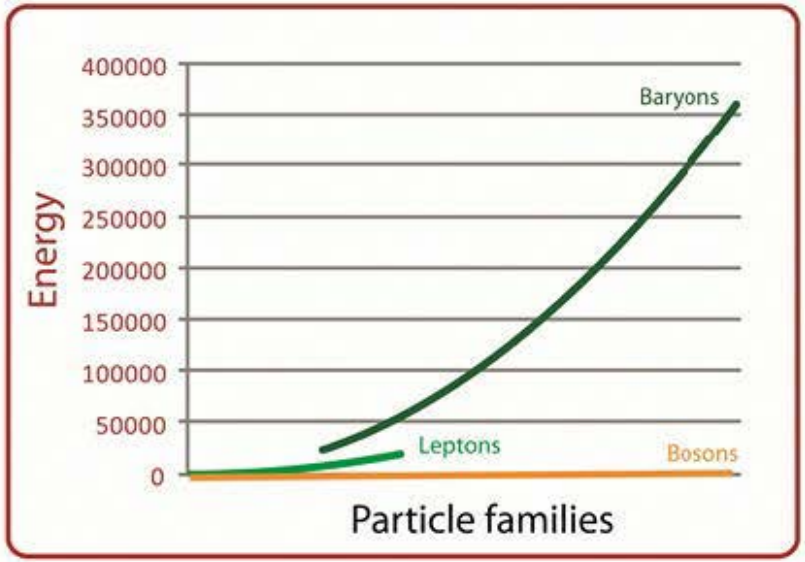

Exponential energy levels

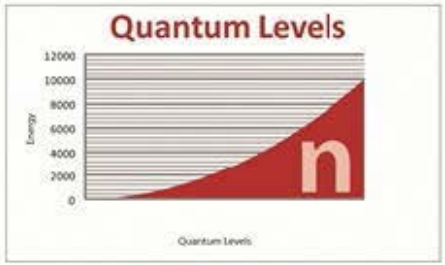

Radioactive Decays follow exponential curves determined by the Tetryonic topology of the particle families

1e19v = n = 5e18f

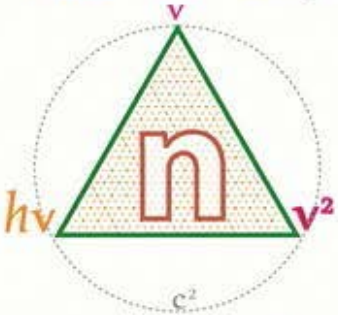

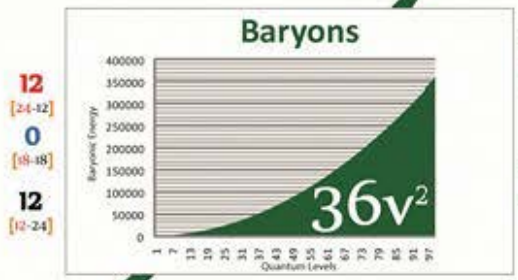

12 [24-12]
0 [18-18]
12 [12-24]

Proton
Neutron
antiNeutron
antiProton

Electron
Positron

$$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field; Planck quanta; Bosons; ElectroMagnetic; mass; velocity

$$T\pi\left[\left[m\Omega n\right]\right]$$

Energy; mass; QAM; quanta

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field; Planck quanta; Photons; ElectroMagnetic; mass; velocity

12 [12-0]
12 [0-12]
0 [6-6]
8 [10-2]
4 [4-8]

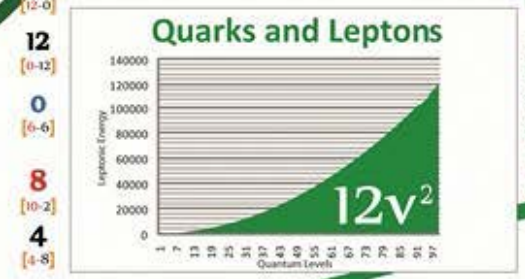

Neutrino
Up
Down
Strange
Charmed
Top
Bottom

Linear energy levels

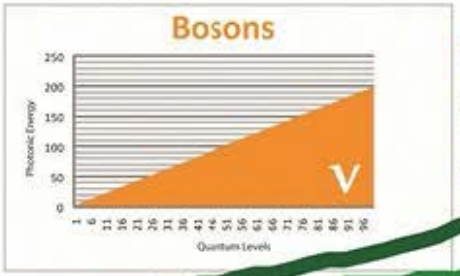

1 [1-0]
0 [1-1]
1 [0-1]

Emission and Absorption of Bosons and Photons within Atomic Nuclei

Increase and decrease in integer amounts according to the Tetryonic geometries and topologies of the particles involved

4 [4-0]
0 [2-2]
4 [0-4]

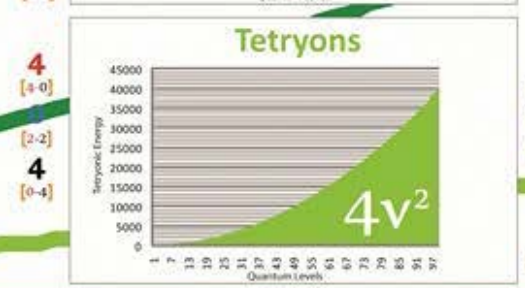

Positive
Negative
Neutral

Bosons

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Energy momenta geometry

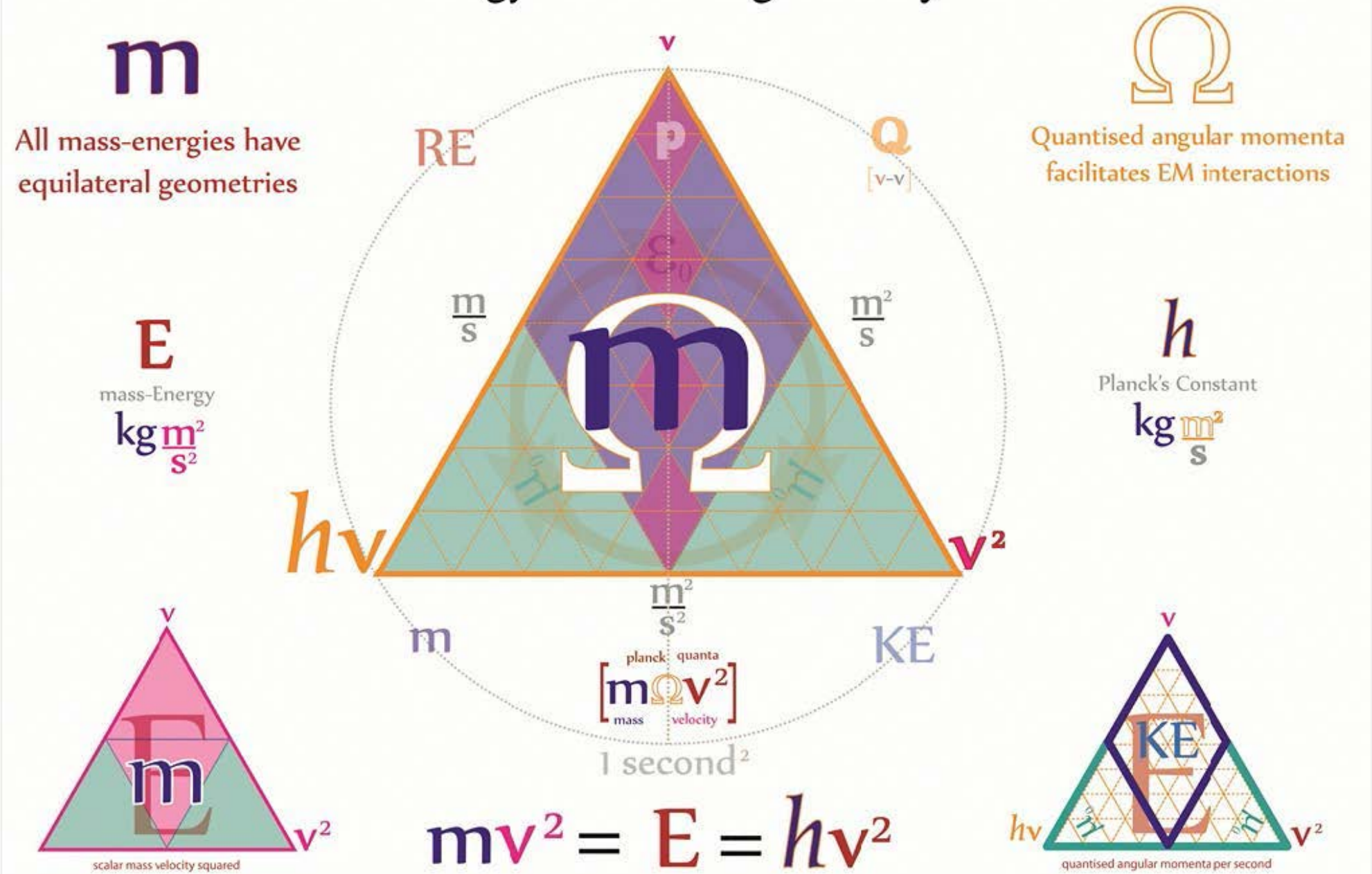

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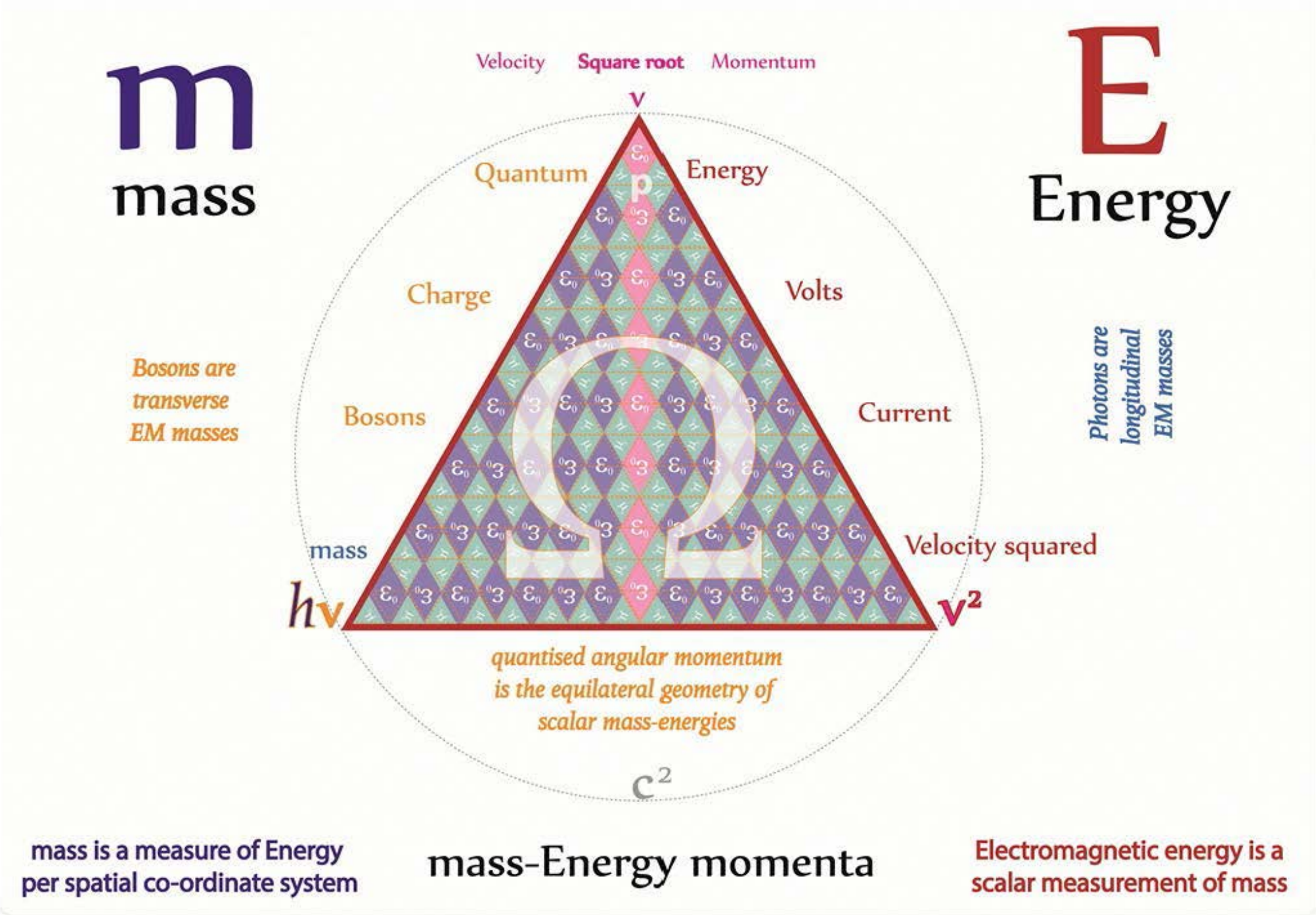

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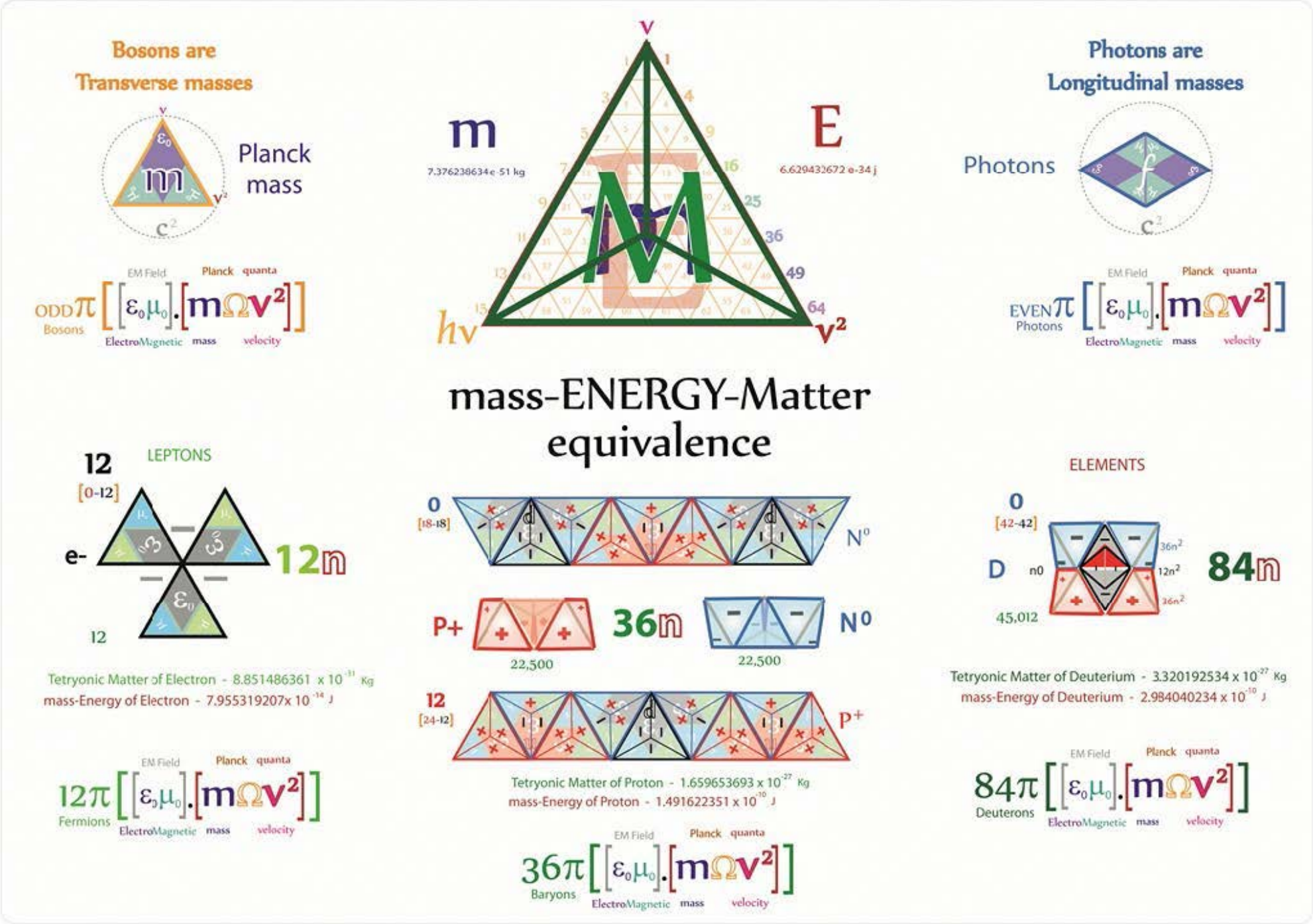

Tetryonics 15.08 - mass-Energy-Matter equivalence

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EM mass quanta in Matter

kg

q

$$n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; mass; ElectroMagnetic, mass, velocity

mass

1

¼M

½M

ODDπ

EVENπ

$$\text{ODD}\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Bosons; EM Field, Planck quanta; ElectroMagnetic, mass, velocity

$$\text{EVEN}\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM waves; EM Field, Planck quanta; ElectroMagnetic, mass, velocity

KG

f

Q

3m

4m

M

4

Matter

$$4n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Matter; EM Field, Planck quanta; ElectroMagnetic, mass, velocity

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Lorentz velocity corrections

[result from the measurement of EM mass-energy quanta in a planar spatial co-ordinate system]

$$\beta = m\left[\frac{v}{c}\right]$$

[Linear momentum corrections are linear]

$$\beta^2 = m\left[\frac{v^2}{c^2}\right]$$

[EM mass-Energy corrections are Scalar]

$$m \quad \frac{E}{c^2} = \frac{\overset{\text{Energy}}{[\underset{\text{mass}}{m}\underset{\text{quanta}}{\Omega}v^2]}}{\underset{\text{EM Field}}{c^2}} = \underset{\text{mass}}{n\pi}\left[\underset{\text{ElectroMagnetic}}{[\varepsilon_0\mu_0]}.\underset{\text{mass velocity}}{[\overset{\text{planck quanta}}{m\Omega}v^2]}\right] \quad \left[\frac{1}{c^2}\right]E$$

$$p \quad mv = \left[\frac{E}{v^2}\right].v = \underset{\text{linear momentum}}{n\pi}\left[\underset{\text{ElectroMagnetic}}{[\overset{\text{EM Field}}{\varepsilon_0\mu_0}]}.\underset{\text{mass velocity}}{[\overset{\text{Planck quanta}}{mv}]}\right] \quad \frac{E}{v}$$

$$E \quad mv^2 = \frac{mv^2}{\underset{\text{EM Field}}{c^2}} = \underset{\text{Matter}}{4n\pi}\left[\underset{\text{ElectroMagnetic}}{[\overset{\text{EM Field}}{\varepsilon_0\mu_0}]}.\underset{\text{mass velocity}}{[\overset{\text{Energy}}{mc^2}]}\right] \quad m\left[\frac{c^2}{c^2}\right]$$

mass-energy in Matter propagates at c

$$KE \quad 1/2\,Mv^2 = 1/2\left[4\left[\frac{\overset{\text{Energy}}{[\underset{\text{mass}}{m}\underset{\text{quanta}}{\Omega}v^2]}}{\underset{\text{EM Field}}{c^2}}\right]\right] = \underset{\text{Photons}}{2\pi}\left[\underset{\text{ElectroMagnetic}}{[\varepsilon_0\mu_0]}.\underset{\text{mass velocity}}{[\overset{\text{planck quanta}}{m\Omega}v^2]}\right] \quad 2m\left[\frac{v^2}{c^2}\right]$$

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The geometry of Constants

Quantised angular momentum is the source of all physical Constants

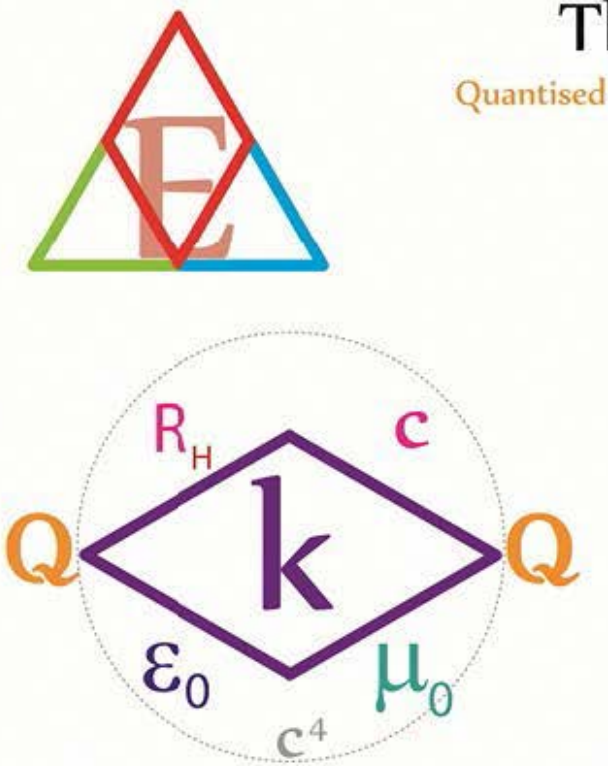

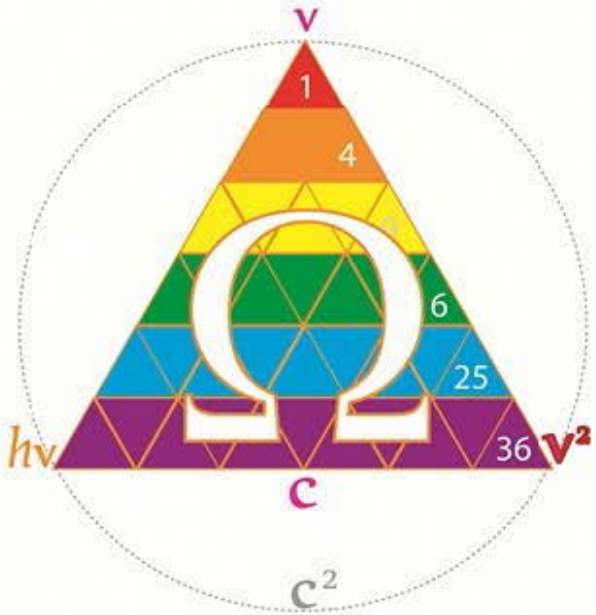

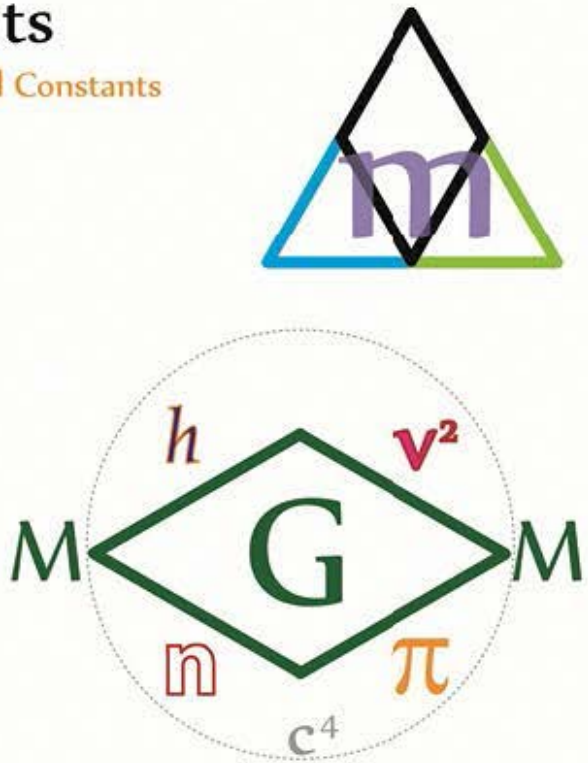

A physical constant is a physical quantity that is generally believed to be both universal in nature and constant in time.

It can be contrasted with a mathematical constant, which is a fixed numerical value but does not directly involve any physical measurement

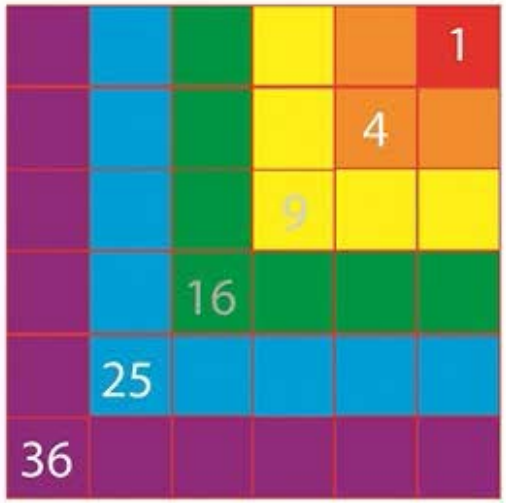

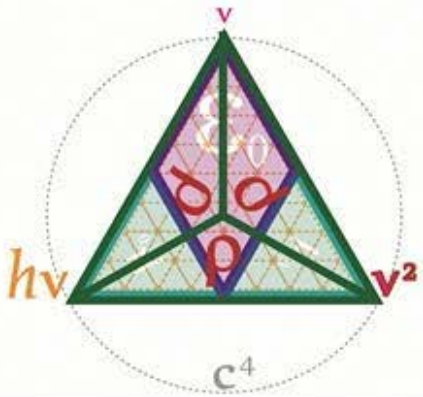

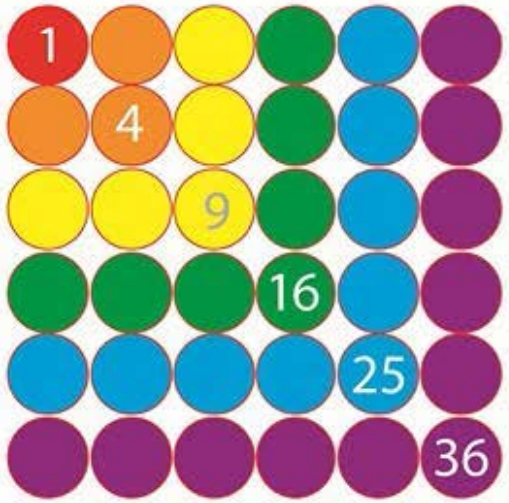

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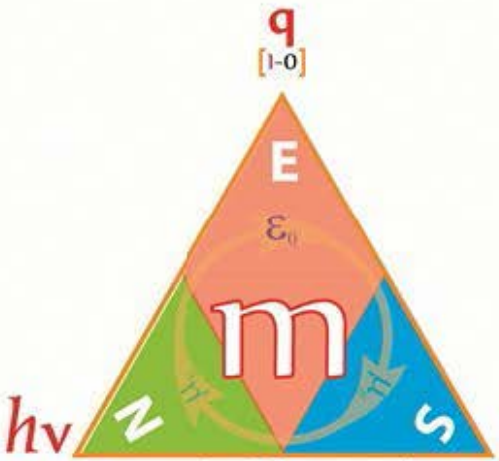

"To interpret the vibrational energy of N oscillators not as a continuous, infinitely divisible quantity, but as a discrete quantity composed of an integral number of finite equal parts.

Max Planck

(April 23, 1858 – October 4, 1947)

$$\varepsilon = nh\nu$$

"Let us call each such part of the energy element h "

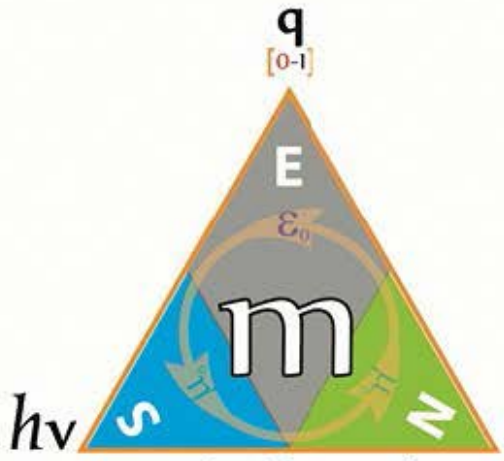

Planck's Constant

[quantised mass-energy angular momenta]

N_A

1 mole of Hydrogen atoms has a rest-mass of 1 gram

Solving for Planck's Constant using the inverse of Avogadros number & Tetryonic geometry we obtain an exact corrected value of :

$$\pm\ 6.629432672 \times 10^{-34}\ \text{J.s}$$

$4.137664546 \times 10^{-15}$ eV.s

$$mv^2 = E = h\nu^2$$

A rest mass Hydrogen atom has a Compton frequency of 2.2512 e23 Planck quanta

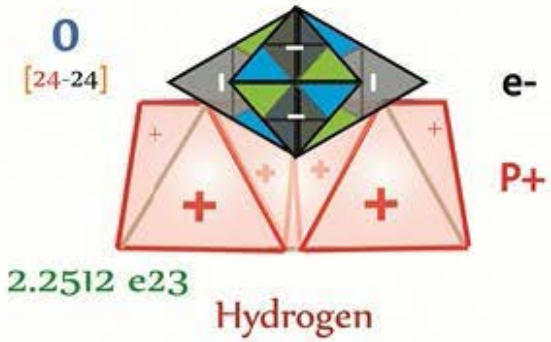

$$T\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Matter — EM Field — Planck quanta — ElectroMagnetic — mass — velocity

Planck's constant is the relationship between EM mass-energy and quantised angular momenta that provides the basis for EM charge in Tetryonic geometries

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Amedeo Avogadro

(9 August 1776 – 9 July 1856)

Avogadro's Number

The number of rest mass Hydrogen atoms in 1 gram (and the rest molar mass of any element or compound) can be determined directly from tetryonic theory

[exclusive of any measurement, blackbody or kinetic energies]

Using a Compton frequency of 2.2512 e23 Planck quanta for a rest mass-Matter Hydrogen atom

atomic mass unit

$$1\ \mathrm{u} = \frac{M_{\mathrm{u}}}{N_{\mathrm{A}}} = 1.660\,538\,782(83) \times 10^{-24}\ \mathrm{g}$$

Avogadro N = 6.022141579 x 10^{23}

$$N^{-1} = \frac{2.2512\ \mathrm{e23\ v}}{[\text{Hydrogen mass}]\ 1.660538841 \times 10^{-24}\ \mathrm{g}}$$

0

[24-24]

1.0000 g

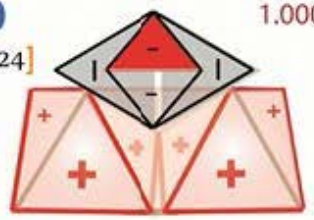

22,512

Hydrogen

n0 *1 mol = 1 g*

Hydrogen = 1.660538841 x 10^{-27} Kg

n1 *1 mol = 1.000533 g*

n0 *1 mol = 11.996801 g*

Carbon 12 = 1.99211552 x 10^{-26} Kg

n1 *1 mol = 12 g*

Hydrogen's rest Tetryonic mass is 22,512 n Planck quanta [Proton - 22,500n + electron 12n]

$$\left[22{,}512\left[\underbrace{[\varepsilon_0\mu_0]}_{\text{EM Field / ElectroMagnetic}}.\underbrace{[m\Omega v^2]}_{\text{Planck quanta / mass velocity}}\right]\right]^{-1}$$

The inverse mass of Hydrogen is equal to Avogadro's number

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Coulomb's Constant

$$k = \frac{1}{4\pi\varepsilon_0}$$

The proportionality constant ke, called the Coulomb constant (sometimes called the Coulomb force constant), is related to defined properties of EM Energy-momenta and is used to define Electric field forces

$$c = \frac{1}{\sqrt{\mu_0\varepsilon_0}}$$

$$8.987\ e9\ \frac{Nm^2}{C^2}$$

$$\varepsilon_0 = \frac{1}{\mu_0 c^2}$$

$$\mu_0 = \frac{1}{\epsilon_0 c^2}$$

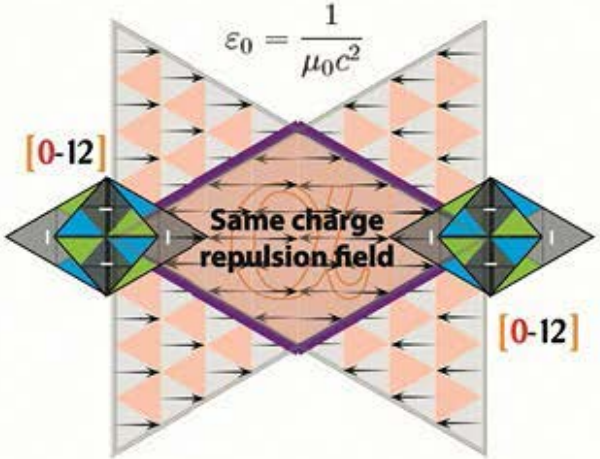

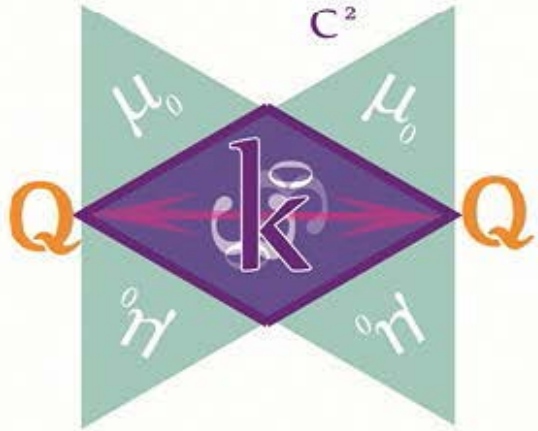

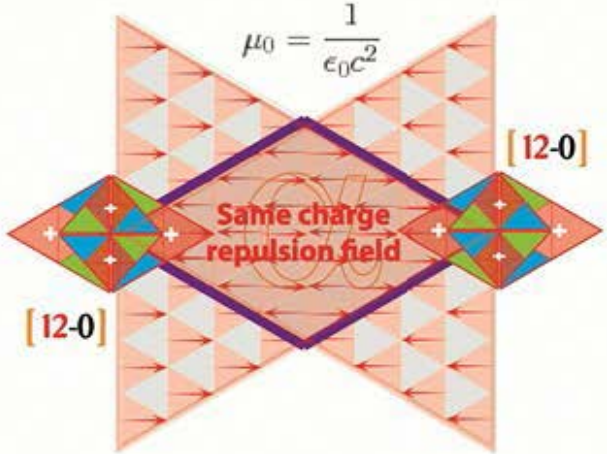

Similars repel

Opposites attract

Similars repel

Linear Coulombic force interactions are a result of charged E field linear momenta

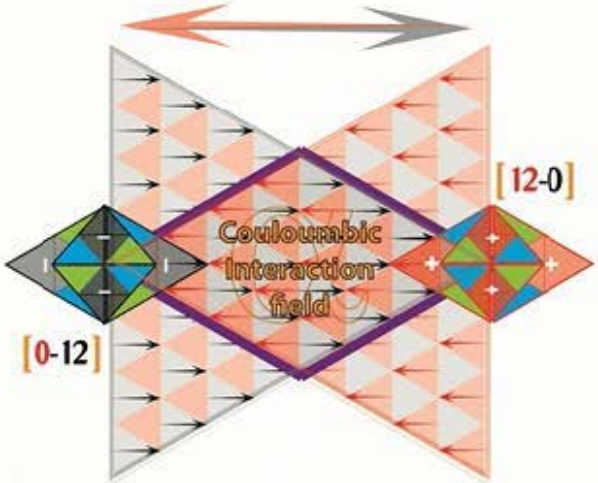

Longitudinal E field forces between Charged particles are mediated by Photons

$$\mathbf{E} = \frac{\mathbf{F}}{q_t}$$

The Electric field can be defined as the longitudinal Force exerted by charged masses

It is a measure of the interactive force produced by the Electric field energy-momenta of two superpositioned charge KEM fields

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{\mathbf{r}}$$

The Electric field can also be derived from Coulomb's Law

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The Speed of ElectroMagnetic energies

The classical behaviour of the electromagnetic field is described by Maxwell's equations, which predict that the speed c with which electromagnetic waves (such as light) propagate through the vacuum is related to the electric constant ε0 and the magnetic constant μ0 by the equation $c = 1/\sqrt{\varepsilon_0 \mu_0}$.

c

Celeritas is a Latin word for "swiftness" or "speed". It is often given as the origin of the symbol c, the universal notation for the speed of light in a vacuum

EM

The distance energy travels in 1 second from its source

EM waves and energy momenta can be measured as either Transverse or Longitudinal waveforms with respect to their velocity vector

All EM waves and energy are symmetrical waveforms whose quanta contain ElectroMagnetic mass-energy and momenta

The equilateral geometry of EM energy is the inverse of the spatial geometry of 1 second

The square root of equilateral energies [scalar speed] is a vector velocity

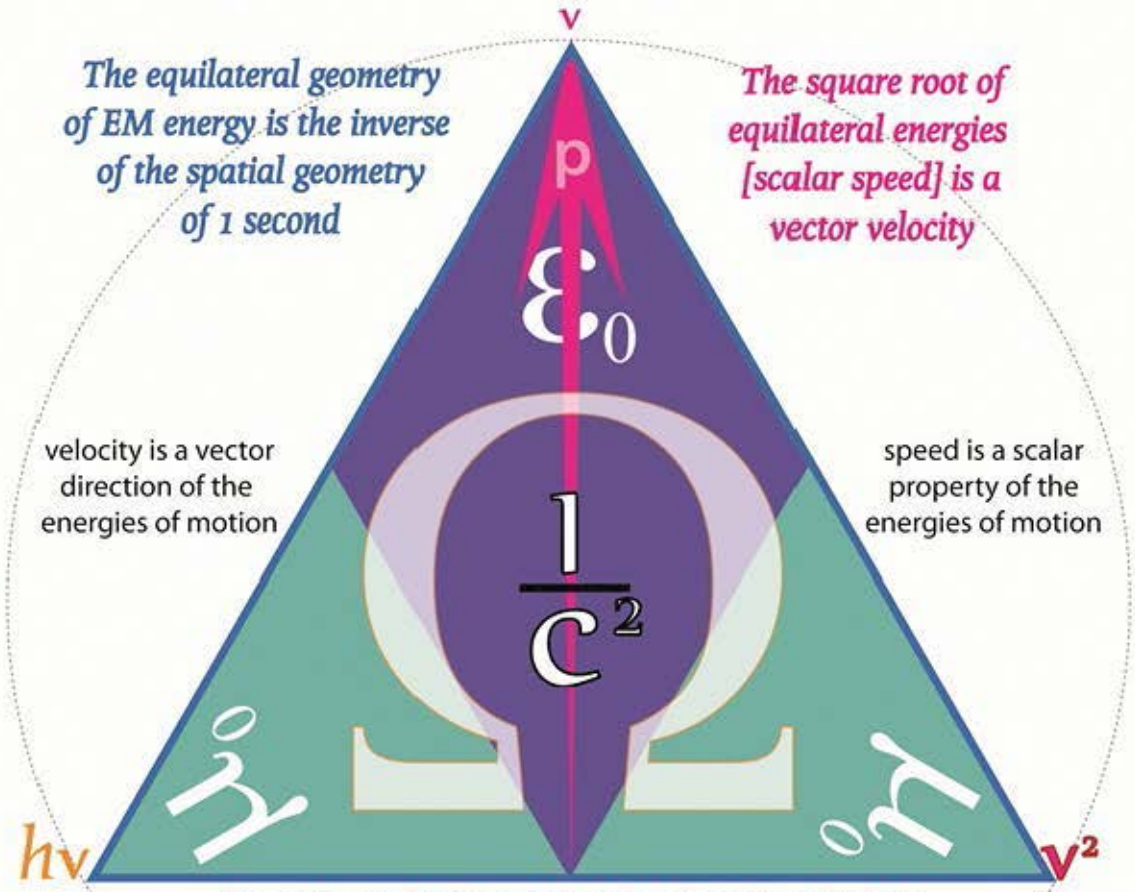

velocity is a vector direction of the energies of motion

speed is a scalar property of the energies of motion

The maximum velocity possible due to electrical accelerations or the impedance of any spatial region that energy propagates through it is often referenced in physics as 'the speed of Light'
IT IS NOT AN ABSOLUTE LIMIT or BARRIER

All EM waves radiate outwards in accord with Biot-Savart's law

c^2

The velocity vectors of EM energies form the geometries of spatial co-ordinate systems

The speed of EM energies in a vacuum is defined as 299,792,458 meters per second (1,079,252,848.8 km/h).

$$\frac{K_E}{K_M} = 9e16 \frac{\frac{N\,m^2}{c^2}}{\frac{N\,s^2}{c^2}}$$

$$c^2 = 9e16 \frac{m^2}{s^2}$$

$$c = 299{,}792{,}458 \frac{m}{s}$$

The natural velocity of EM energies can be calculated from the field's EM permittivity & permeability and is affected by the medium it is propagating through

EM waveforms are bidirectional radiant emissions of 2D energy

with velocity [Lorentz] variable energy contents

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Quantum masses

$$h\nu^2 = E = m\nu^2$$

$$\mathrm{kg}\,\frac{m^2}{s}\,\frac{1}{s} \qquad \mathrm{kg}\,\frac{m^2}{s^2} \qquad \mathrm{kg}\,\frac{m^2}{s^2}$$

The quantum of mass-energy can be derived with several methodolgies using Tetryonic Geometry

mass quanta

EM mass-energy quanta

Matter is a KEM standing wave propagating at c

EM Field — planck quanta

$$[\varepsilon_0\mu_0]\,[m\Omega v^2]$$

mass — velocity

1.112650056 e-17 s2 m-2 — 6.629432672 e-34 kg m2 s-2

Permittivity x Energy density

$$\frac{E}{c^2} = m$$

$$\text{mass} = 7.376238634 \times 10^{-51}\ \text{Kg}$$

Planck-Einstein

Planck mass-energy geometries

quantised energy momenta

$$h$$

$$\mathrm{kg}\,\frac{m^2}{s}$$

6.629432672 e-34 J

Planck quanta

$$[m\Omega v^2]$$

mass — velocity

7.376238634 e-51 kg

$$\mathrm{kg}\,\frac{m^2}{s^2}$$

$$m$$

scalar mass-energy

Charged mass-Matter topologies

The mass of Matter

EM Field — Planck quanta

$$T\pi\,[[\varepsilon_0\mu_0].[m\Omega v^2]]$$

ElectroMagnetic — mass — velocity

Matter Quanta

Tetryonic molar mass [Hydrogen] - 1 g

$$\text{Molar mass} = \frac{H_1\ \text{Atomic mass}}{\text{Avagadro's No.}}$$

$$\text{mass}\ H_{mol}/Av = \frac{.001}{6.022141579 \times 10^{23}}$$

$$= 1.660538841 \times 10^{-27}\ \text{g/mol}$$

$$H_{mole}/\Delta m\,[H] = \frac{1.660538841 \times 10^{-27}}{22{,}512}$$

$$\text{mass} = 7.376238634 \times 10^{-32}\ \text{KG}$$

Avogadro - Mandeleev

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2D mass-Energy equivalence

'The Speed of Light' is the Natural velocity of Energy propagation

$$mv^2 = hv^2$$

Energy

EM mass

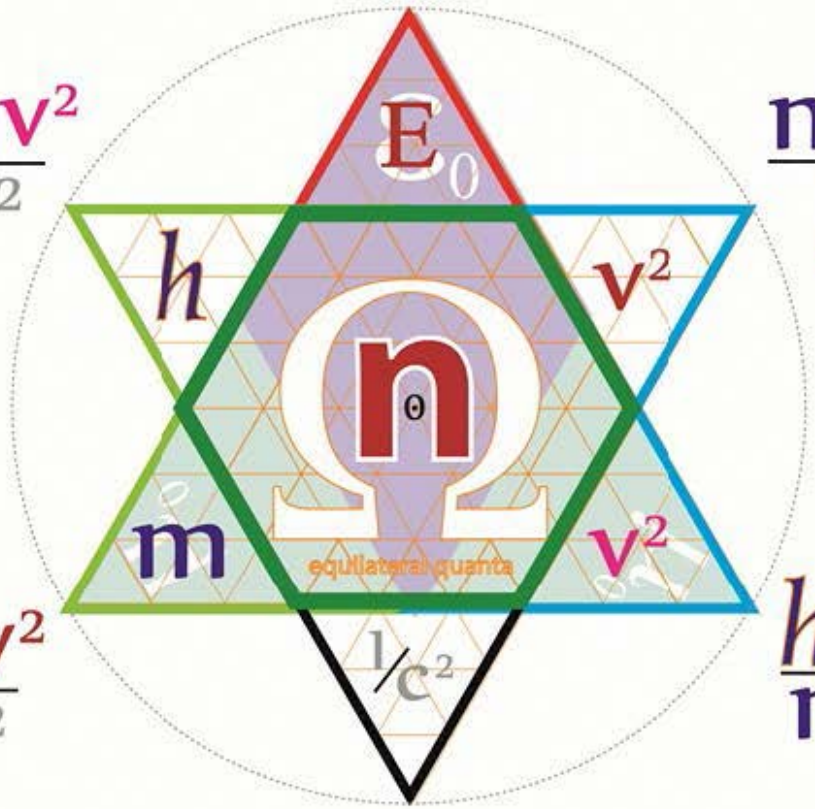

$$\frac{mv^2}{c^2}$$

$$\frac{mv^2}{h}$$

$$\frac{c^2}{v^2}$$

8.987551787 e16

1.112650056 e-17

$$\frac{m}{h}$$

$$\frac{hv^2}{c^2}$$

$$\frac{hv^2}{m}$$

$$\frac{m}{hv^2}$$

Photons

Matter

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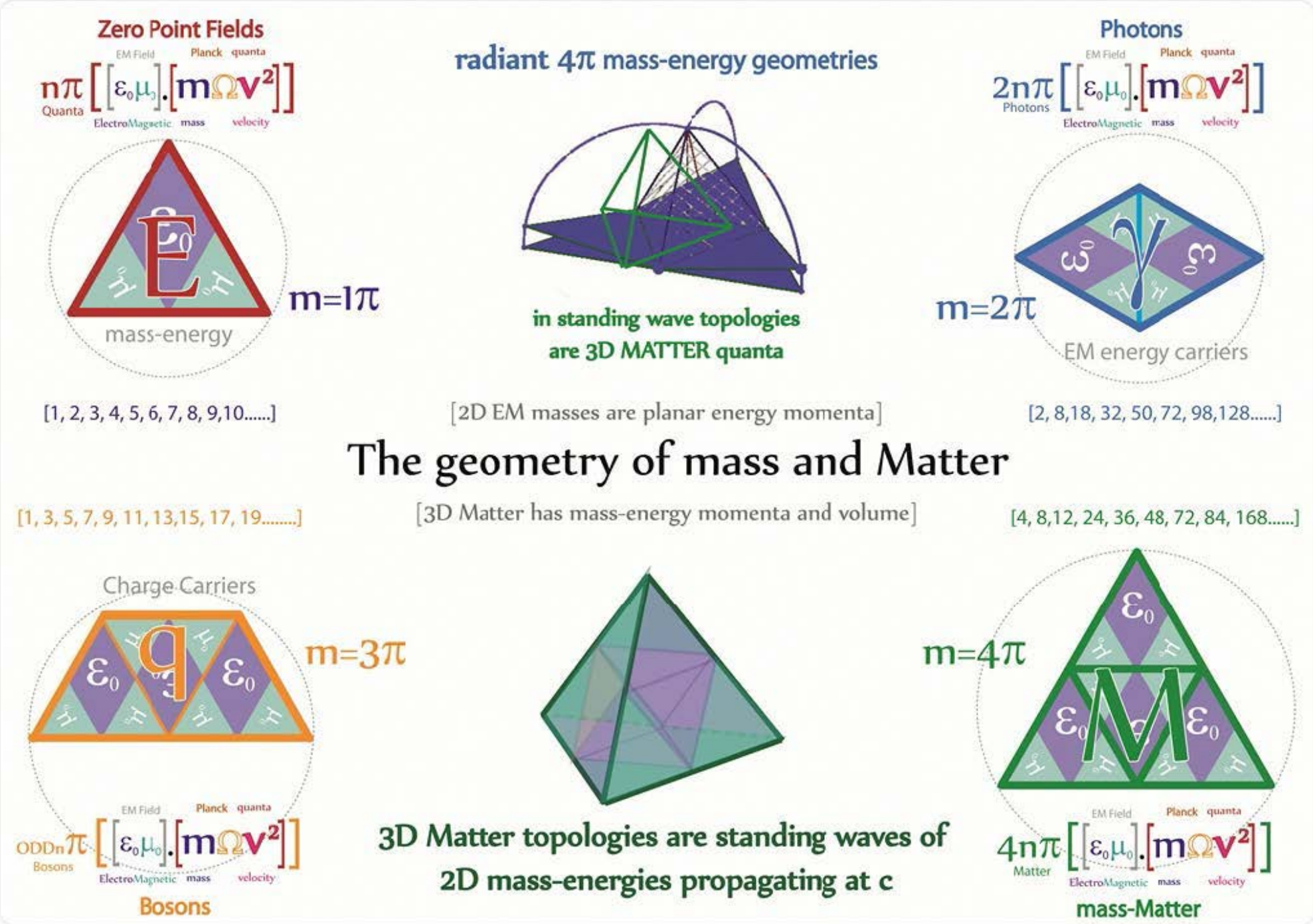

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mass geometries & rest Matter topology

2D

m

mass

kg

M

Matter

KG

3D

Quanta number

1e19 v

Compton frequency

Matter is a three dimensional charged mass-energy topology

EM Field — Planck quanta

$$M = 4n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Matter — ElectroMagnetic — mass — velocity

Energy density is mass - the term 'massless particle' is a misnomer

Quantum number

n

Nuclear Level

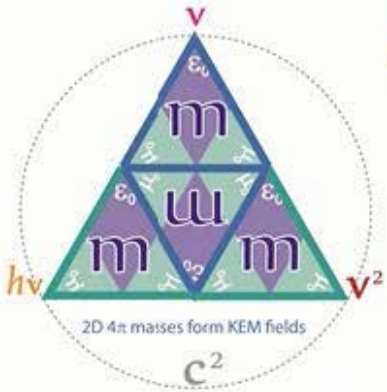

Kinetic Energies

RE = Matter + KE

Relativistic mass is the total EM energy content of a massive body (or system) in motion

The relativistic rest mass-energies of Matter are velocity invariant as 3D Matter is a EM standing wave with 2D mass- energy fascia whose velocity of propagation is the speed of Light

Matter

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Charge topologies and rest mass-energies

mass-Matter topologies

mass-energy geometries

12 [0-12]

1.2 e20

Electron

n=0

Q

0.00000053 g
molar mass

Tm Electron = 12n

electron Charge	$-1.602216081 \times 10^{-19}$ C
electron rest mass	$8.851486361 \times 10^{-31}$ kg
electron rest energy	$7.955319207 \times 10^{-14}$ J 496,519.7 eV [0.5 MeV]

12 [24-12]

Proton

2.25 e23

Q

$n=25^2$

0.000999 g
molar mass

Tm Proton = 22,500n

Proton Charge	$+1.602216081 \times 10^{-19}$ C
Proton rest mass	$1.659653693 \times 10^{-27}$ kg
Proton rest energy	$1.491622351 \times 10^{-10}$ J 930,974,522.8 eV [930 MeV]

Protons and Neutrons have identical masses to each other and equivalent topologies but differing charges

0 [18-18]

Neutron

2.25 e23

Q

$n=25^2$

0.000999 g
molar mass

Tm Neutron = 22,500n

Neutron Charge	0
Neutron rest mass	$1.659653693 \times 10^{-27}$ kg
Neutron rest energy	$1.491622351 \times 10^{-10}$ J 930,974,522.8 eV [930.5 MeV]

Hydrogen

When Protons and electrons interact to form neutral Hydrogen the electron's KEM quantum field energies increase in direct proportion to the Proton's energy levels

0 [24-24]

2.2512 e23

n=0

Q

$n=25^2$

1.000533 g
molar mass

Tm Hydrogen = 22,512n

Hydrogen = Proton + electron

H Charge	0
H rest mass	$1.660538841 \times 10^{-27}$ kg
H rest energy	$1.492417883 \times 10^{-10}$ J 931,967,562.3 eV [931.9 MeV]

0 [42-42]

4.5012 e23

quantum synchronous converters

n=0

Q

$n=25^2$

1.999466 g
molar mass

Tm Deuterium = 22,512n

Hydrogen = Proton + electron

H Charge	0
H rest mass	$3.320192534 \times 10^{-27}$ kg
H rest energy	$2.984040234 \times 10^{-10}$ J 1,862,445,565 eV [1.9 GeV]

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In order to make an exact 1kg reference mass-Matter topology

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass, Planck quanta, mass, velocity

mass-energy

Energy per second

$$mc^2 = E = hv^2$$

$$m = E/c^2$$

mass is the scalar integral surface area of Matter topologies

which is equivalent to exactly 1,000 molar Hydrogen masses

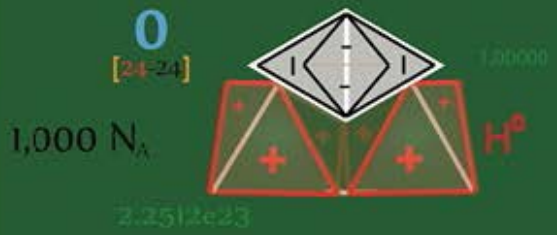

whose Tetryonic Matter topology can be modelled using charged Planck mass-energy geometries

$$M = 1{,}000 \times N_A \cdot T\pi\left[\left[m\Omega v^2\right]\right]$$

1kg, Avogadro's number, Energy

revealing that there are exactly

1.355704512 e50

Planck quanta in standing wave Matter

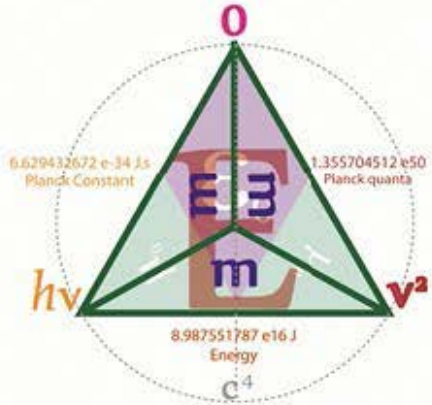

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter, Planck quanta, mass, velocity

Matter-energy

Energy per second squared

$$hv^2 = E = Mc^4$$

$$M = E/c^4$$

Matter topologies are standing-waves of mass-energy

you need to create a standing-EM wave with a specific compton frequency

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EM mass and Matter defined

There remains a lot of confusion over the exact definition of EM mass and Matter resulting in the frequent interchanging of one term for the other in physical processes

This must be clarified and the two terms must be properly defined in a manner that explains their derivation and physical properties in detail.

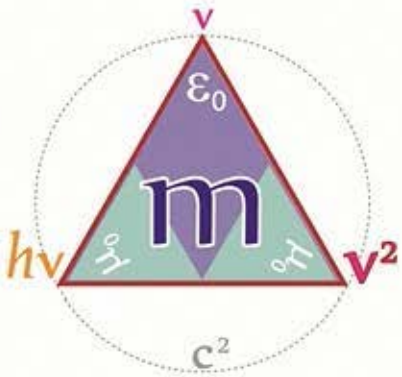

$$m = \frac{E}{c^2}$$

$$n\pi_{\text{mass}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; ElectroMagnetic, mass, velocity

$$n\pi_{\text{Energy}}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass, velocity

2D mass-Energies

EM mass is a measure of equilateral scalar energy per unit of Time

$$4n\pi_{\text{Matter}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; ElectroMagnetic, mass, velocity

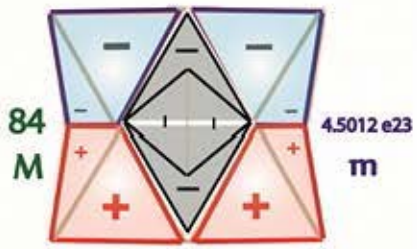

$$84\pi_{\text{Deuterium}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; ElectroMagnetic, mass, velocity

EM mass

3D Matter is comprised of 2D mass-energies

2D mass-energy cannot contain 3D Matter

Matter

$$\beta = \left[\frac{v}{c}\right]$$

mass is the Lorentzian velocity corrected energy content of Tetryonic geometries

All forms of EM mass-Energy are subject to Lorentz factor relationships

$$\beta^2 = \left[\frac{v}{c}\right]^2$$

Matter is Lorentz invariant as its mass-energies propagate in a 4π standing wave geometry

Matter is the 3D topology of standing wave 2D mass-energies

$$M = \frac{4\pi E}{c^4}$$

Bosons and Photons are not 'massless' they are 'Matterless' [2D waveforms]

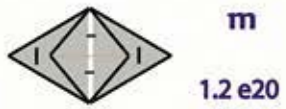

$$12\pi_{\text{electrons}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right] \quad e-$$

$$+$$

$$72\pi_{\text{Nuclei}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right] \quad \text{Deuteron}$$

EM Field, Planck quanta; ElectroMagnetic, mass, velocity

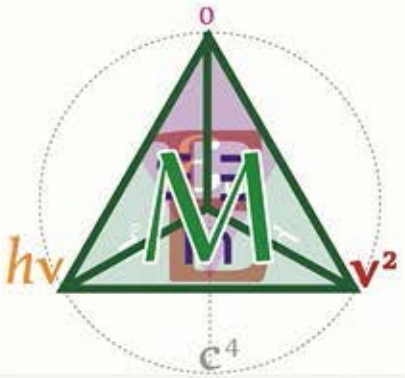

Bosons

$$m_p = \frac{hv}{c^2}$$

Planck masses

Photons

$$m_\gamma = \frac{hf}{c^2}$$

Photon mass

$$\text{ODD}\,\pi_{\text{Bosons}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; ElectroMagnetic, mass, velocity

$$\text{EVEN}\,\pi_{\text{EM waves}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; ElectroMagnetic, mass, velocity

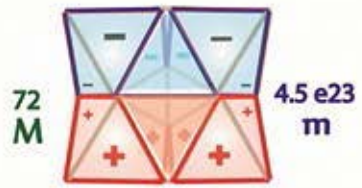

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Charged mass-Matter geometries

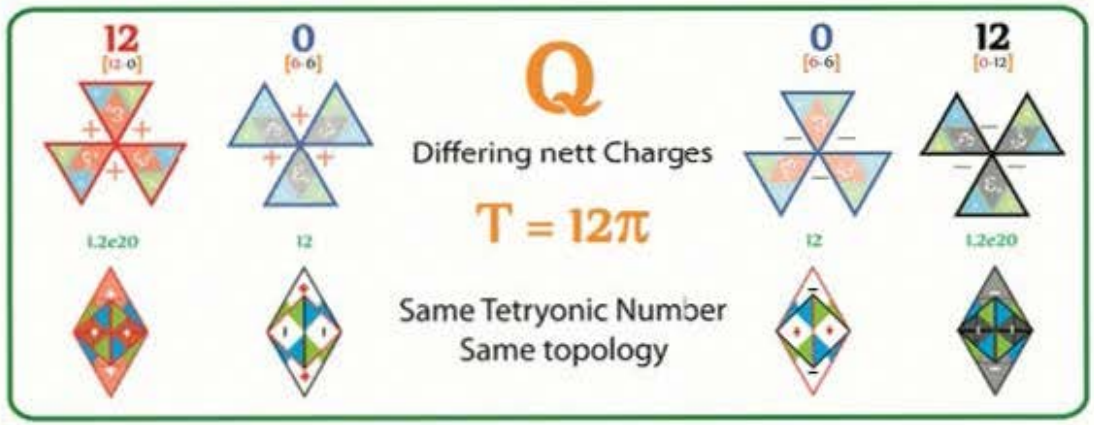

Matter Topology is determined by the geometry of charged Planck T[q] quanta

Any measurement of a system's mass is subject to velocity corrections

mass = EM energy density

$$n\pi\left[m\Omega v^2\right]$$

mass quanta; Planck quanta; mass; velocity; Spatial geometry c^2

n [7.376238634 e-51] kg

EM mass is a measure of 2D planar energies comprising the fascia of charged topologies

$$m \qquad n\pi\left[\left[m\Omega v^2\right]\right] \qquad M$$

ENERGY; Planck quanta; mass; velocity

c^2 2D space

The mass - ENERGY - Matter contents of any physical system are all related through the spatial co-ordinate system used (which in turn is determined by the speed of light)

c^4 3D space

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right] \qquad E \qquad \frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

mass; Planck quanta; mass; velocity; Matter; Planck quanta; mass; velocity

The Energy content of any physical system remains the same irrespective of the spatial co-ordinates used

Matter and Charge are velocity invariant properties

Differing Tetryonic charge numbers produce differing particle topologies

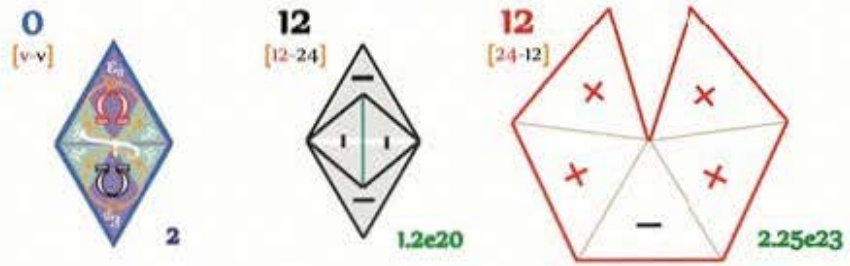

Photons $\frac{2\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$ Dodecagons $\frac{12\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ Baryons $\frac{36\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$

As the energy content [levels] of particles and fields increase their intrinsic Planck quanta and EM mass increases but their charge geometries remain the same

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Charged mass-Energies

All 3D Matter particles are comprised of charged fascia whose energy content determines their 2D mass

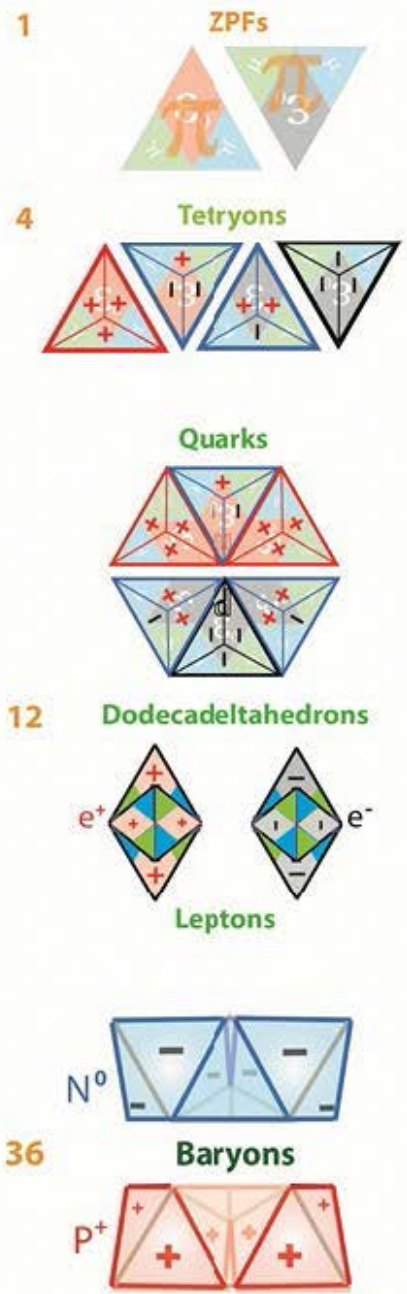

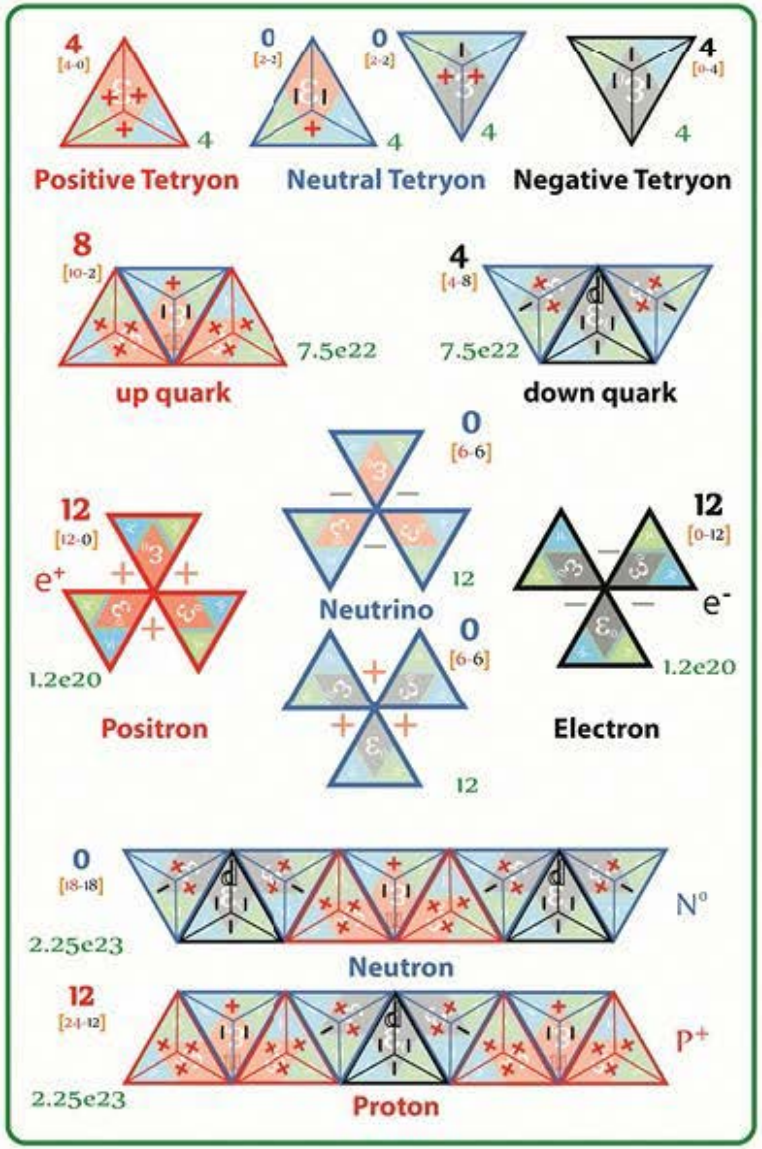

3D Matter geometries	$\frac{T\pi}{c^4}[[m\Omega v^2]]$ (Matter; Planck quanta; mass; velocity)	
Tetryons 4 charge fascia	4π $2.950495454 \times 10^{-50}$ kg 4 quanta	$2.651773069 \times 10^{-33}$ J
Quarks 12 charge fascia	12π $5.532178976 \times 10^{-28}$ kg 7.5×10^{22} quanta	$4.97207450 \times 10^{-11}$ J
Neutrinos 12 charge fascia	12π $8.851486361 \times 10^{-50}$ kg 12 quanta	$7.955319207 \times 10^{-33}$ J
Leptons 12 charge fascia	12π $8.851486361 \times 10^{-31}$ kg 1.2×10^{20} quanta	$7.955319207 \times 10^{-14}$ J
Baryons 36 charge fascia	36π $1.659653693 \times 10^{-27}$ kg 2.250×10^{23} quanta	$1.491622351 \times 10^{-10}$ J
Deuterium 72 charge fascia ion	72π $3.320192534 \times 10^{-27}$ kg 4.5012×10^{23} quanta	$2.984040234 \times 10^{-10}$ J

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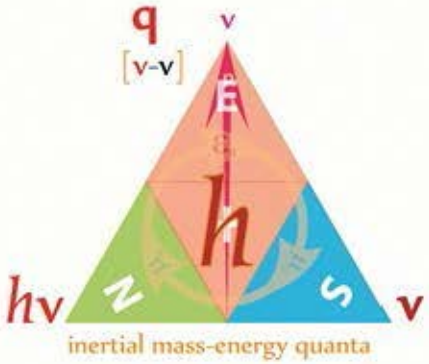

In physics there exists
2 forms of energy momenta
[linear momenta &
quantised angular]

MOMENTA

The nett scalar
energy momenta
required to effect
changes in velocity

ENERGY

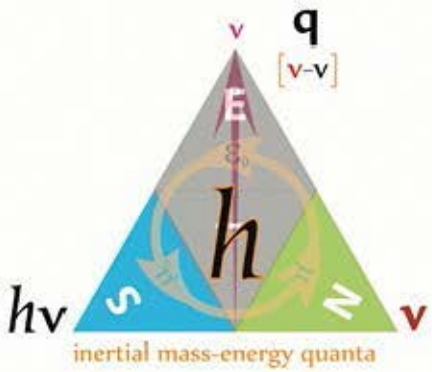

Net Charge is reflective of the total energy momenta
of any EM field or Matter subjected to acceleration
[inertial mass]

Inertial resistance to Force

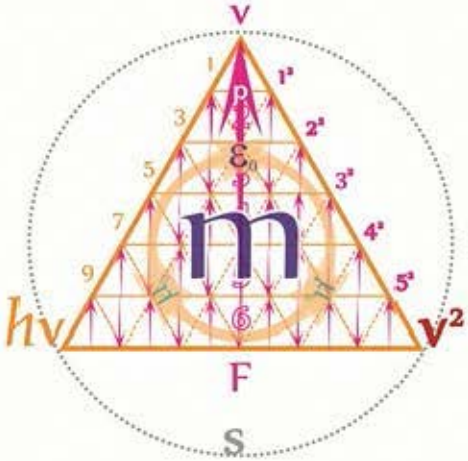

Any change in motion results in changes to
the Charge geometries creating in turn proportional
changes to the nett KEM mass-energy momenta components

$$F = ma$$

The inductive resistance of quanta in charged EM fields
to any changes to their nett mass-energy geometry
is the source ofwhat we term inertial mass

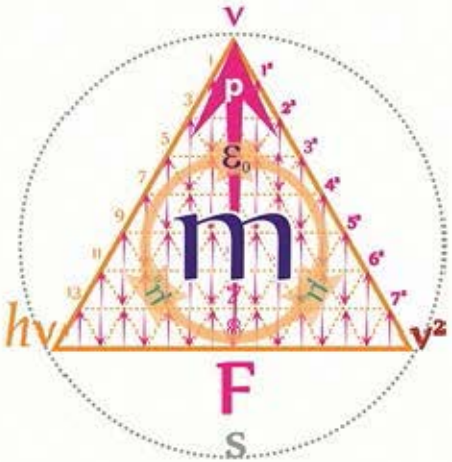

**Inertia is the resistance of any physical object
to a change in its state of motion.**

Force does work when it results in movement

$$W = F.d = ma.d = E$$

$$kg\frac{m}{s^2}\,m$$

classical mechanics — scalar — quantum mechanics

$$\Delta mv = \Delta E = \Delta m\Omega v$$

linear momenta — energies — angular momenta

$$kg\frac{m^2}{s^2}$$

The Planck constant is the quantum of Action

$$E = m\Omega v^2 = hv^2$$

$$kg\frac{m^2}{s}\frac{1}{s}$$

Changing an object's velocity results in a corresponding energy momenta change which relate to each other through its inertial mass

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EM field densities

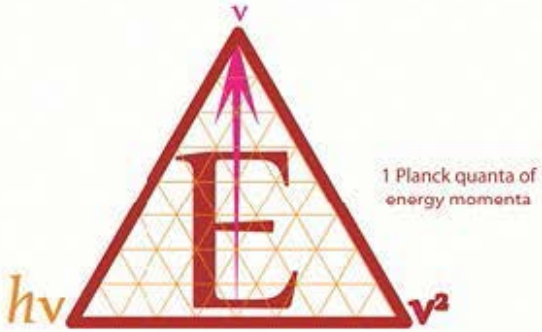

EM mass is a measure of the energy content of any spatial co-ordinate system

$$\beta^2 = \left[\frac{v}{c}\right]^2$$

and is subject to Lorentz velocity corrections in 2D EM fields

6.629432672 e-34 J
1 planck quantum has a EM mass-Energy of
7.376238634 e-51 kg
and
Quantised Angular Momentum which creates Charge
1.33518 e-20 C

mass-Energy equivalence

mass velocity

7.376238634 e-51 kg — 6.629432572e-34 j.s

$$mv^2 = E = hv^2$$

8.987551787 e16 [m/s]² — 6.629432672 e-34 j — quanta/sec

Matter is only mass-energy in Tetrahedral topologies [T4π+]
[else it is nπ EM mass-energies that propagate away at c]

planck quanta

6.629432672 e-34 J

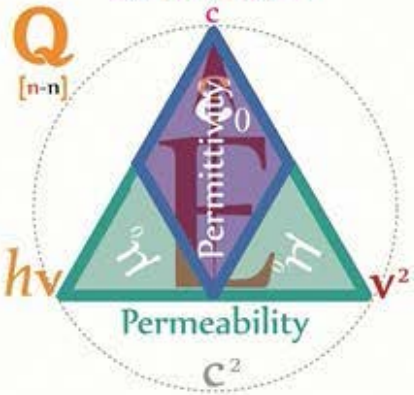

7.376238634 e-51 kg
radiant mass-energies

If reduced to a flat Euclidean space geometry
Matter topologies become radiant mass-energies

m	E	M
mass	ENERGY	Matter
$\left[\frac{n\pi}{c^2}\rho\right]$	$\left[m\Omega v^2\right]$ (Planck quanta; mass, velocity)	$\left[\frac{4n\pi}{c^4}\rho\right]$

The inertial properties of electromagnetic mass - ENERGY & Matter
[can all be differentiated as energy densities per unit of time]
in any spatial co-ordinate system

2.984040234 e-10 J

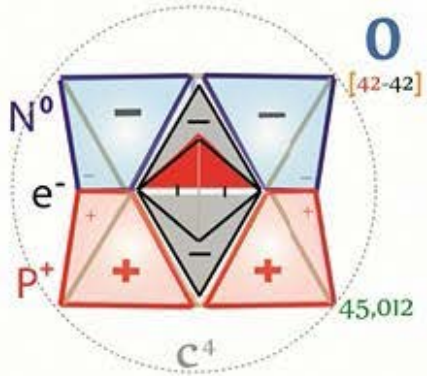

3.320192534 e-27 kg
rest mass-Matter

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m
[oddπ]hν

Q
[v-v]

$$1\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

(1π: Charge; $\varepsilon_0\mu_0$: EM Field; $m\Omega v^2$: Planck quanta; ElectroMagnetic mass velocity)

Bosons

2D

Photons

m
[evenπ]hν

0
[v-v]

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

(2π: Photons; $\varepsilon_0\mu_0$: EM Field; $m\Omega v^2$: Planck quanta; ElectroMagnetic mass velocity)

2D planar Euclidean electromagnetic mass-energies propagate through the vacuum energy aether without interaction

$$n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

(nπ: mass; $\varepsilon_0\mu_0$: EM Field; $m\Omega v^2$: Planck quanta; ElectroMagnetic mass velocity)

EM Field geometries & Matter topologies

2D Fields

3D Matter

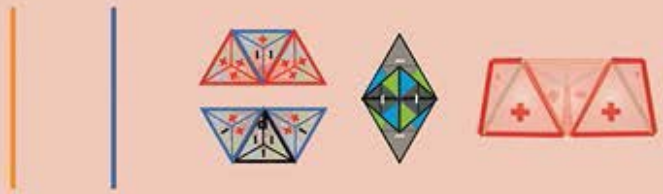

Tetryonic charged geometries provides a clear mechanism for providing all particles with their distinct properties of 2D inertial EM mass-energy and 3D Matter.

M
[4nπ]hν

12
[12-24]

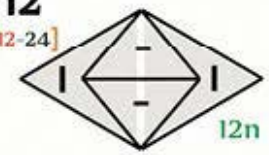

12n

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

(12π: Dodecyon; $\varepsilon_0\mu_0$: EM Field; $m\Omega v^2$: Planck quanta; ElectroMagnetic mass velocity)

Leptons

3D

Baryons

M
[4nπ]hν

12
[24-12]

22,500n

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

(36π: Baryons; $\varepsilon_0\mu_0$: EM Field; $m\Omega v^2$: Planck quanta; ElectroMagnetic mass velocity)

$$T\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

(Tπ: Matter; $\varepsilon_0\mu_0$: EM Field; $m\Omega v^2$: Planck quanta; ElectroMagnetic mass velocity)

3D standing wave topologies of electromagnetic mass-energies interact with the vacuum energy aether at various angles through their charged [inductive] fascia

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Velocity invariant rest Matter

Electrostatic charges have no Magnetic Moments

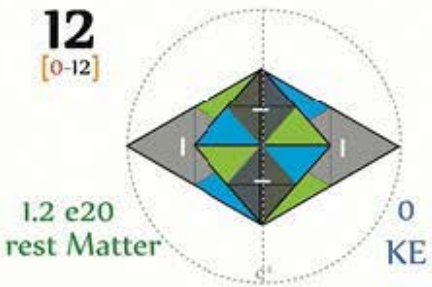

All Matter are 3D standing wave topologies

$$M = \frac{E}{c^4}$$

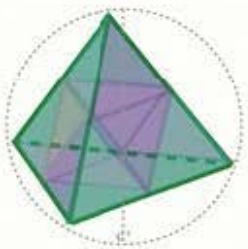

$$E = Mc^4$$

rest mass-Matter is composed of $4n\pi$ standing wave topologies and is INVARIANT to velocity changes

The Relativistic EM mass-energies of a system in motion is the sum of its invariant rest Matter and Kinetic Energies

Electron rest Matter — Kinetic Energy field

$$RE = \underset{\text{Fermions}}{12\pi}\left[\left[\frac{m\Omega v^2}{c^4}\right]\right] + \underset{\text{Photons}}{2\pi}\left[\left[\frac{m\Omega v^2}{c^2}\right]\right]$$

EM fields resulting from motion are subject to Lorentz correction

Kinetic mass-energies are divergent from invariant rest Matter topologies as a result of a particle's motion

At zero velocity the relativistic mass is equal to the invariant mass.

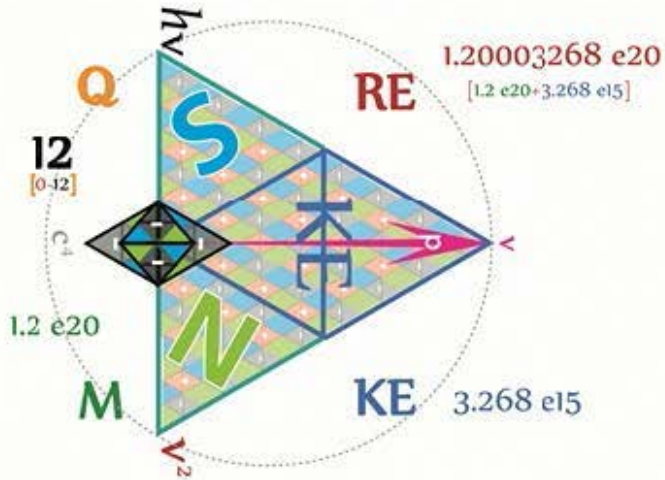

The energy which an object has due to its motion will not add mass into the invariant rest Matter of the particle in motion (it increases the total Planck quanta [EM mass-enegies] of its extended KEM field)

Wavelengths are proportional to EM energy content

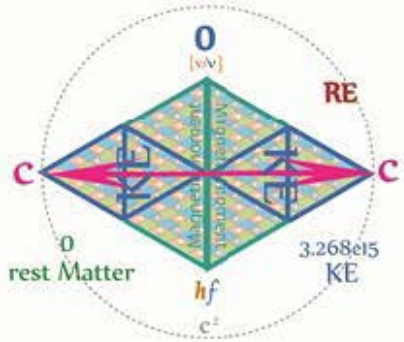

Photons are bidirectional Kinetic EM Fields

$$\frac{E}{c^2} = m$$

Matter in motion has a resultant velocity related Energy field that posseses the physical properties of Kinetic energy and Magnetic moments

$$KEM = Mv^2$$

KEM field Energy is directly related to the Velocity changes of massive particles

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All 2D EM fields and 3D Matter particles have ElectroMagnetic fields, inertial mass-energies & momenta resulting from their constituent equilateral Planck quanta which possess the additional physical properties of Compton Frequency and De Broglie Wavelength

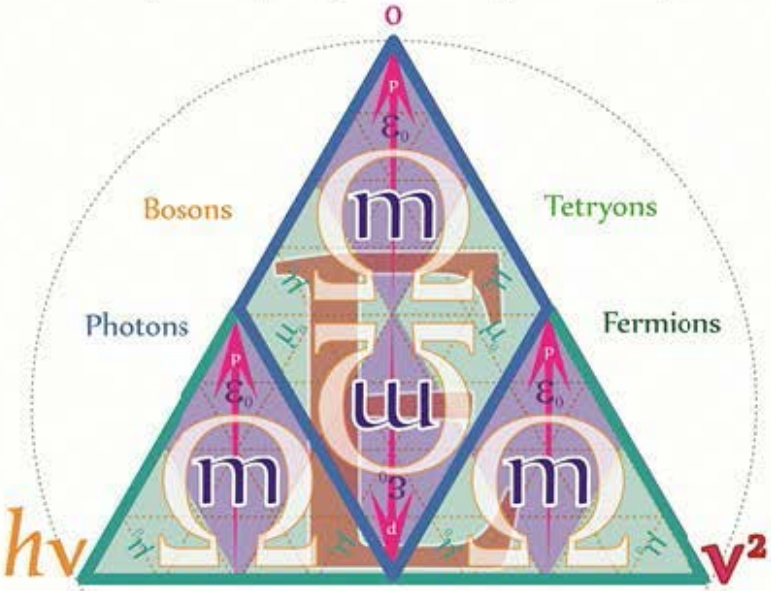

EM mass is a measure of the inertial energy density of any 2D [EM field] or 3D [Matter] energy geometry

c^2

$$m\Omega v^2 = E = mv^2$$

EM mass-energy momenta

The EM mass of an object is a fundamental property of the object; a numerical measure of its inertia; a fundamental measure of the energy density of an object.

mass geometries and Matter Topologies

All 3D Matter topologies contain 2D EM mass-energy geometries
not all 2D EM mass-energy geometries form 3D Matter topologies

EM mass can be clearly defined as a measure of the energy density of any charged geometry

$$\underset{\text{Matter}}{T\pi}\Big[\underbrace{[\varepsilon_0\mu_0]}_{\text{EM Field}}.\underbrace{[m\Omega v^2]}_{\text{Planck quanta}}\Big]$$

ElectroMagnetic mass velocity

3D Matter is any mass-energy geometry that creates a closed volume Topology (4nπ Tetryonic geometry)

EM waves [FIELDS] are distinguishable from Material Particles [MATTER] through their non-Tetrahedral topologies

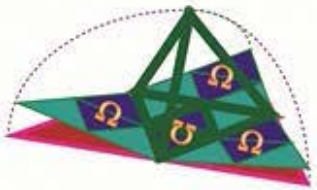

$$\frac{E}{c^2} = m$$

mass-energy is a conserved property
Matter is not conservative

$$M = \frac{E}{c^4}$$

The term 'massless' is a misnomer and should be discontinued in its use as all EM fields and Particles have EM mass [Energy quanta per second] geometries [other alternatives could be 2D, EM field, or Matterless]

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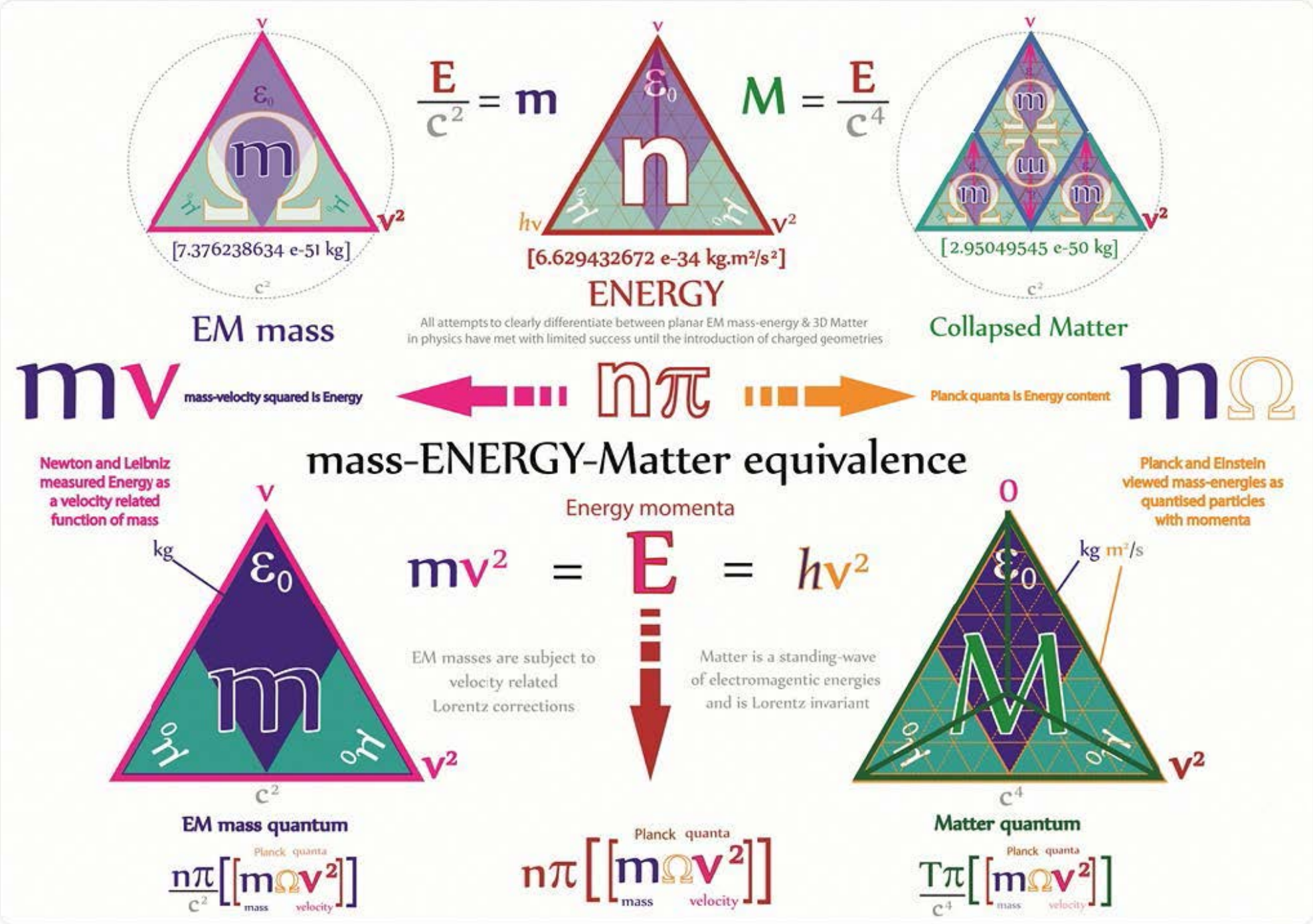

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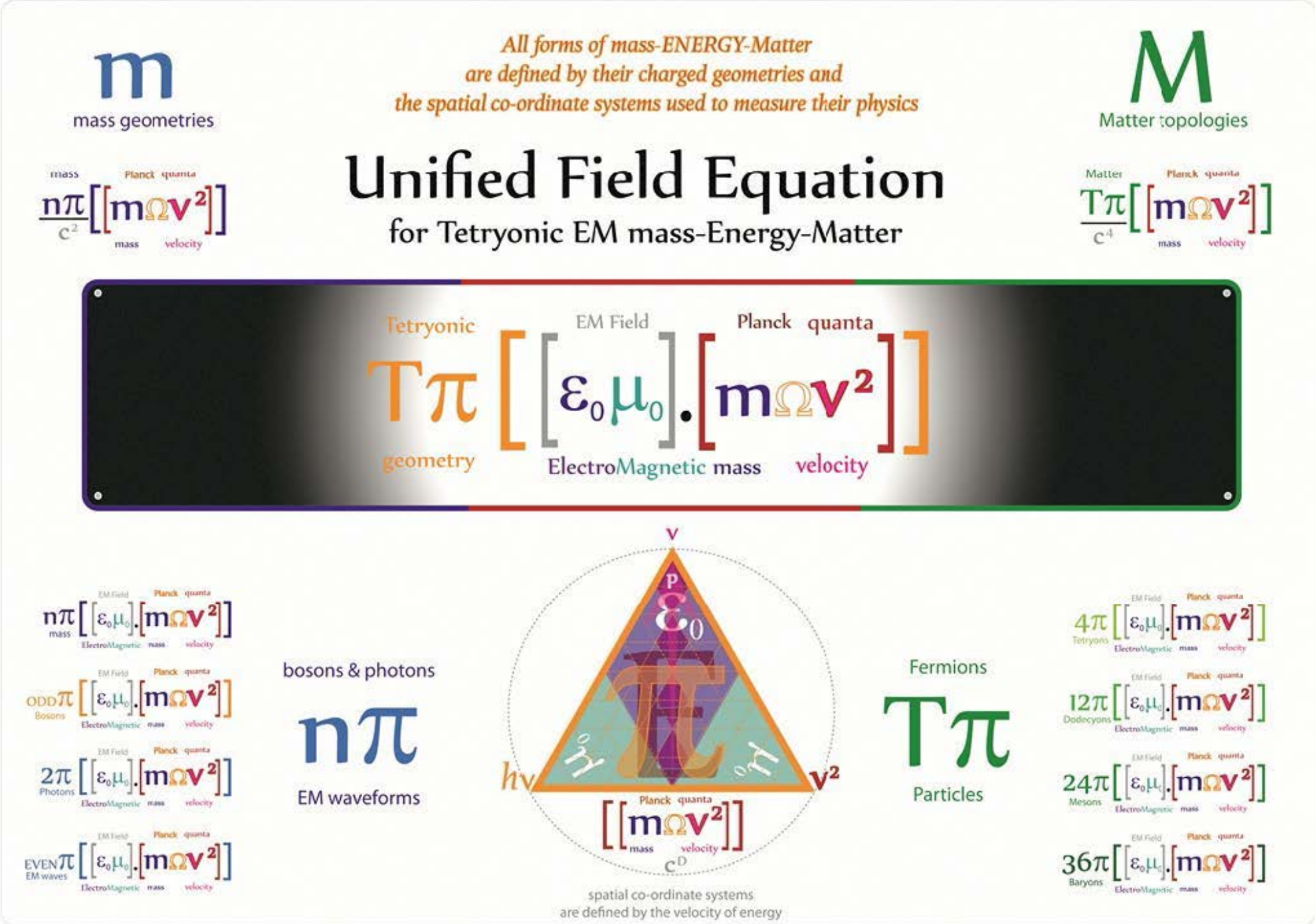

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EM mass

Matter

$$m$$

$$M$$

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass, Planck quanta, mass, velocity

$$n\pi\left[m\Omega v\right]^2$$

energy, Planck quanta, mass, velocity

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter, Planck quanta, mass, velocity

Classical Mechanics

Quantum Mechanics

Tetryonic unified field Geometry

p

mass velocity

7.376238634 e-51 kg

$$mv^2 = E = hv^2$$

8.987551787 e16 (m/s)² 6.629432672 e-34 j quanta/sec

6.629432672e-34 j.s

mass-Energy momenta equivalence

planck quanta

h

The equilateral geometry of quantised angular momentum is the key to understanding Energy

$$kg\,\frac{m}{s}$$

$$mv$$

linear momentum

charge

$$m\Omega$$

$$kg\,\frac{m^2}{s}$$

quantised angular momentum

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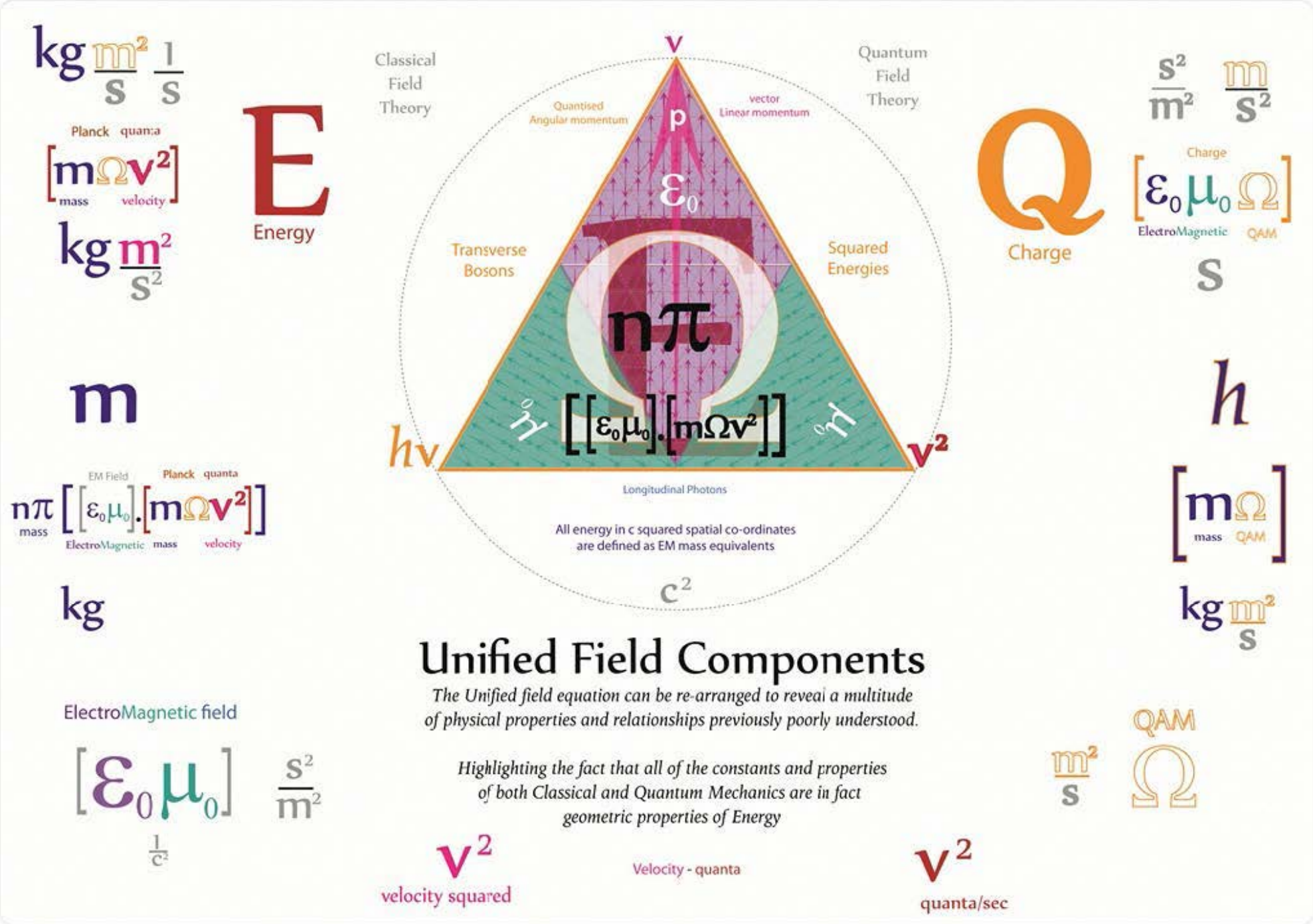

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EM mass Relationships

v	Velocity	$\frac{m}{s}$
a	Acceleration	$\frac{m}{s^2}$
m		
p	Momentum	$kg\frac{m}{s}$
F	Force	$kg\frac{m}{s^2}$

$kg \quad \frac{m^2}{s} \quad \frac{1}{s}$

EM mass is revealed to be the scalar property of 2D Energy waveforms that is at the core of many important physical processes and measurements

Ω	Quantum Angular Momentum	$\frac{m^2}{s}$
v^2	Celeritas squared	$\frac{m^2}{s^2}$
m		
h	Planck's Constant	$kg\frac{m^2}{s}$
E	Energy	$kg\frac{m^2}{s^2}$

f	Frequency	$\frac{1}{s}$
T	Period	s
m		
I	Current	$\frac{kg}{s}$
C	Charge	$\frac{s}{kg}$

E/second

E/second²

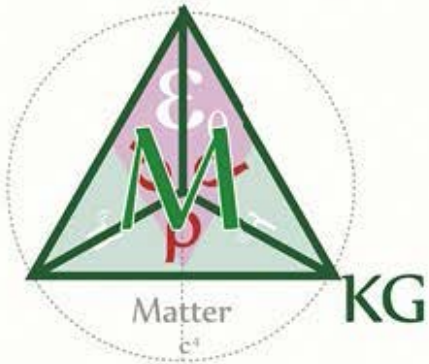

2D mass geometries should never be confused with 3D Matter topoplogies; nor should the terms be used in exchange for each other

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Relativistic mass-Matter

The property of Matter cannot be measured using a planar [c squared] spatial co-ordinate system

Rest Matter

$$\underset{\text{mass-Matter}}{T\pi}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

3D rest mass-Matter topolgy = closed volume of 2D mass-energies

3D Electrostatic particle
No Magnetic Moment

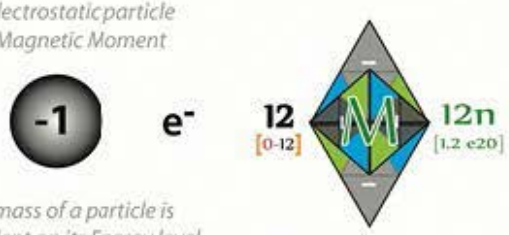

rest mass of a particle is dependent on its Energy level

All Matter is a Tetryonic standing-wave charged geometry occupying a volume in 3D spherical space

$$\left[\begin{array}{c} \text{Matter}\quad \overset{\text{Planck quanta}}{\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]} \\ \downarrow \\ \text{Dodecyon}\quad \overset{\text{Planck quanta}}{\frac{12\pi}{c^4}\left[\left[m\Omega v^2\right]\right]} \end{array}\right]$$

rest mass-Matter is velocity invariant (not subject to Lorentz corrections)

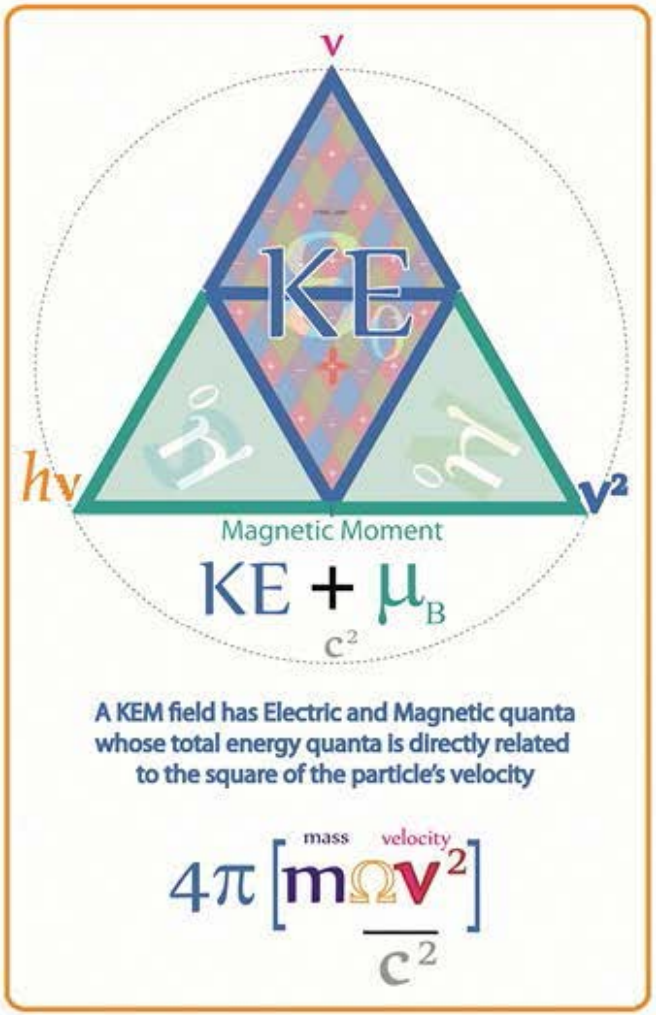

A KEM field has Electric and Magnetic quanta whose total energy quanta is directly related to the square of the particle's velocity

$$4\pi\frac{\left[m\Omega v^2\right]}{c^2}$$

All KEM fields are subject to Lorentz corrections

Kinetic Energies

$$\underset{\text{KEM field}}{4n\pi}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Matter-Energy

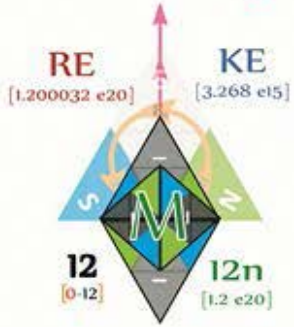

electron KEM model

Relativistic mass Energy = rest Matter + Kinetic EM Energies

$$\left[\begin{array}{c} \text{Electron rest Matter} \\ \text{Lepton}\quad \overset{\text{Planck quanta}}{\frac{12\pi}{c^4}\left[\left[m\Omega v^2\right]\right]} \\ + \\ \text{KEM wave}\quad \overset{\text{Planck quanta}}{\frac{4\pi}{c^2}\left[\left[m\Omega v^2\right]\right]} \\ \text{Kinetic Energies} \end{array}\right]$$

KEM mass-energies are velocity dependent (subject to Lorentz corrections)

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Tetryonic mass & Matter

Historically interchanged due to the lack of proper definitions the physical properties of EM mass & Matter can now be firmly defined with respect to their energy equivalence and spatial geometries

m

mass is a measure of the 2D planar energy content of any physical system

mass Planck quanta

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

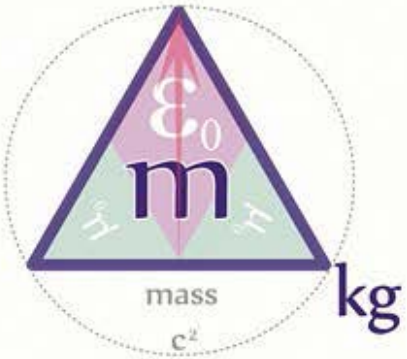

E/second

2D
radiant equilateral geometry
of EM mass-ENERGY momenta
EM mass

EM mass should replace the generic term mass with reference to ElectroMagnetic energy densities

MATTER is a geometric 4nπ standing wave topology of EM mass-energy geometries

The electromagnetic energies of rest Matter is never 'at rest' as the electromagnetic field energies creating mass-Matter topologies alway propagate at c

M

Matter is a measure of the 3D volumetric energy content of any physical system

Matter Planck quanta

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

E/second²

3D
standing-wave topology
of EM mass-ENERGY momenta
rest Matter

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Photoelectron KEM fields

The linear momenta produced as a result of energy momenta in KEM fields is converted into angular momentum when leptons are bound to atomic nuclei

SPIN UP

The EM mass-energy content of Baryons directly influence the KEM field energy levels of bound Leptons

EM mass-energy-momenta

Changes in the momenta of bound Leptons [linear & quantised angular]

prouduces spectral lines of varying frequencies

and Spin are always conserved

The motion of leptons within atomic nuclei produces Magnetic moments at various orientations to the nuclear magneton

SPIN DOWN

If an electron is 'ejected' from the Nuclei it will obey conservation of EM mass-energy momentum

ie Its ejected energy-momentum equals the absorbed photon's energy-momenta [minus the work energy required to free it]

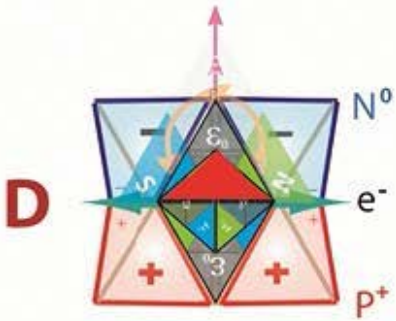

UP spin

Parallel Magnetic Moments

DOWN spin

Antiparallel Magnetic moments

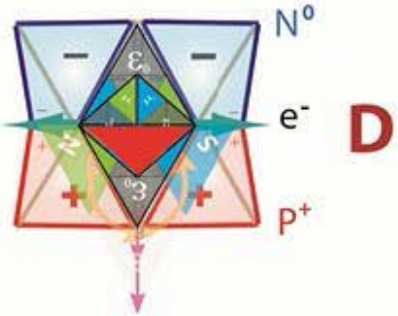

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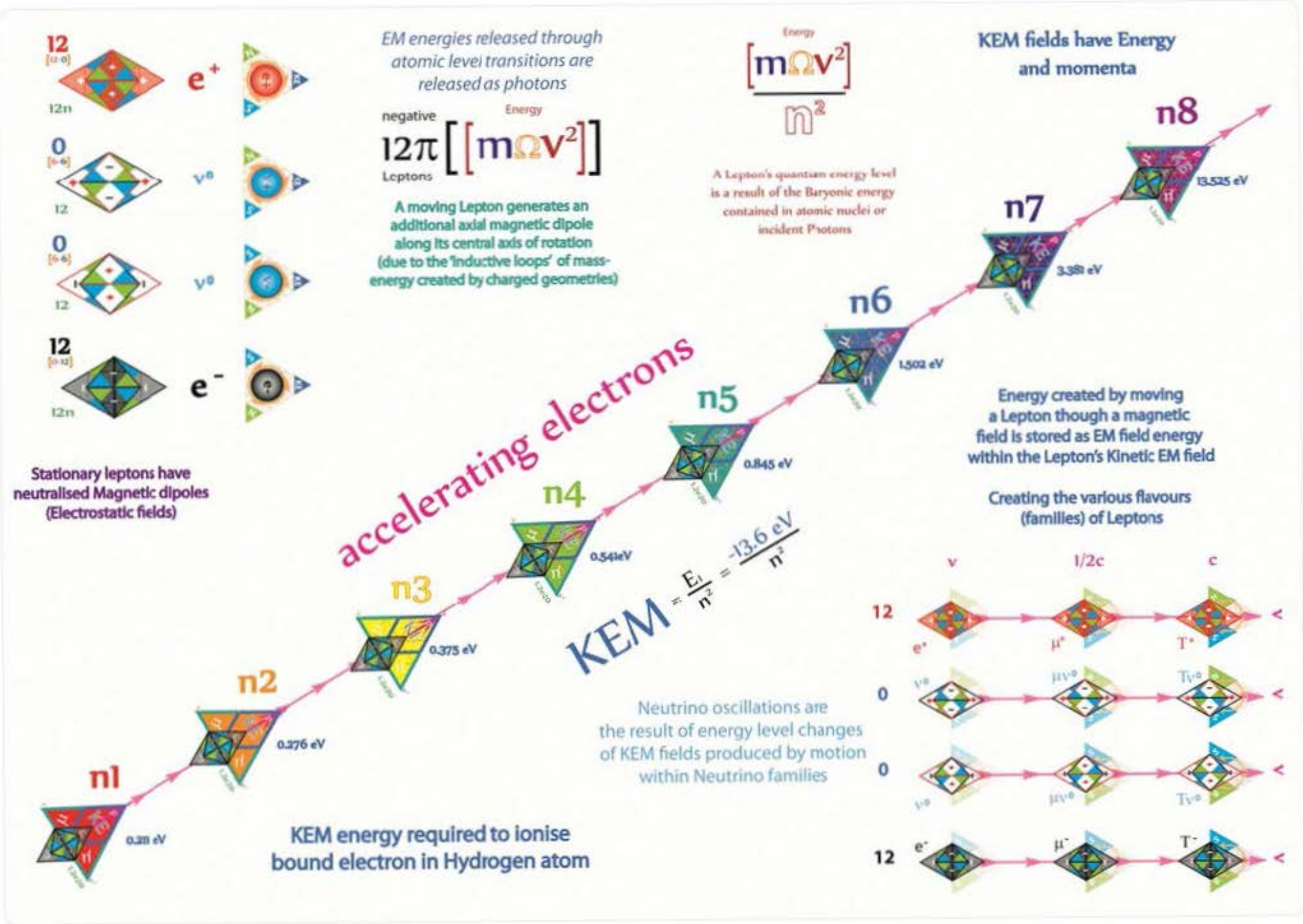

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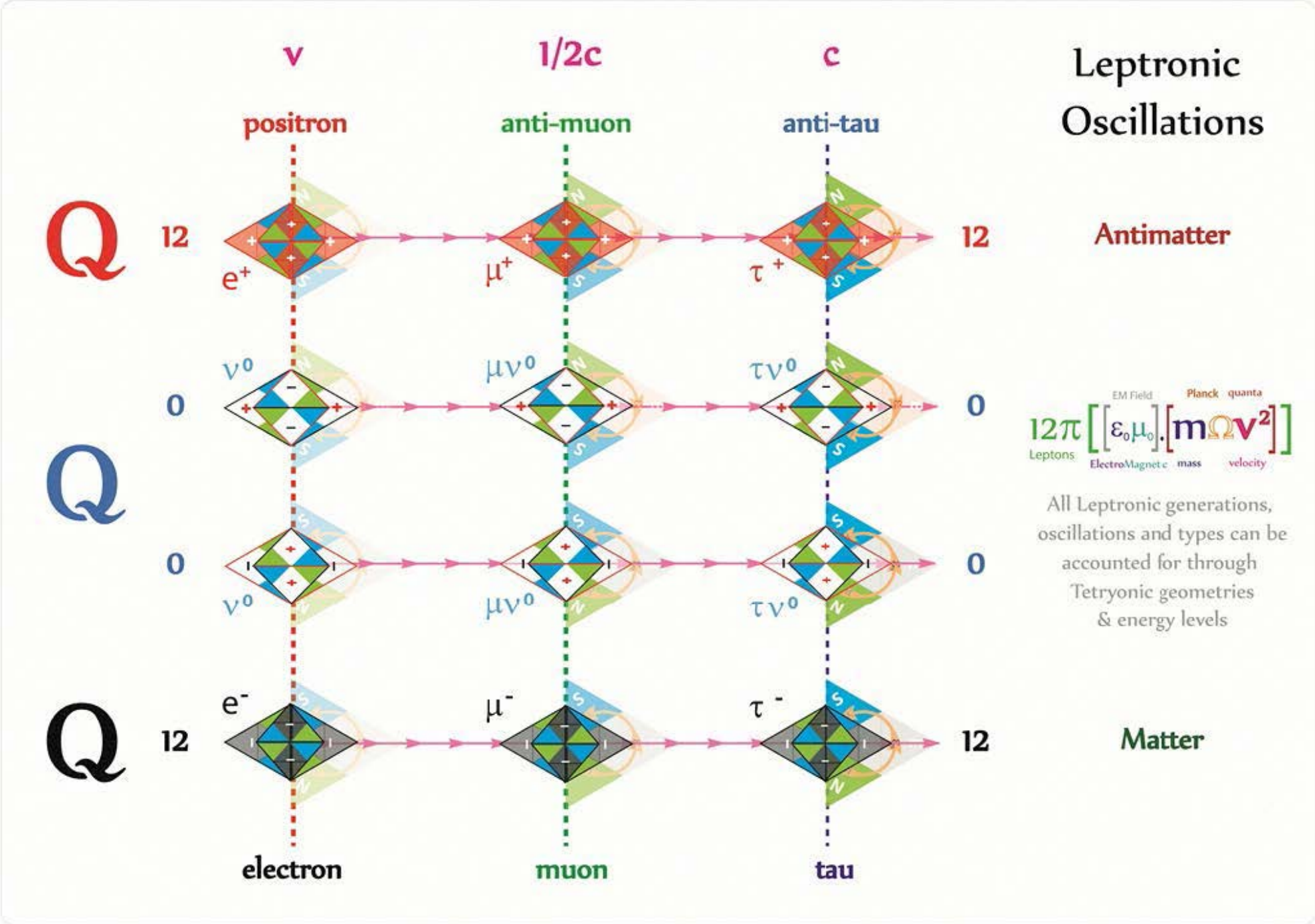

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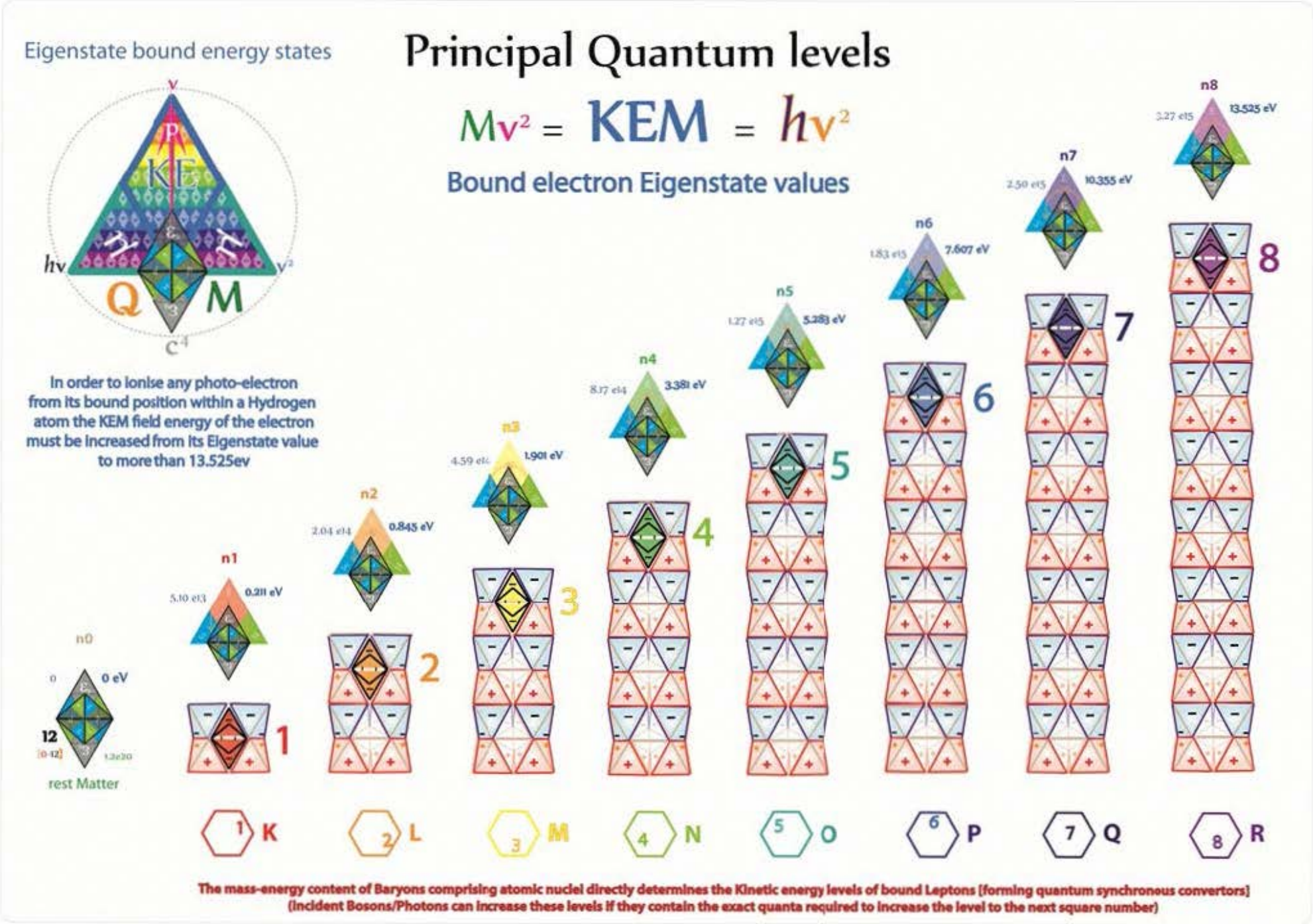

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Bohr radius

As the Electron's angular velocity increases the measu'eable Bohr magnetic moment strength increases and its associated KEM field Planck wavelengths decrease (due to the increased Planck quanta).

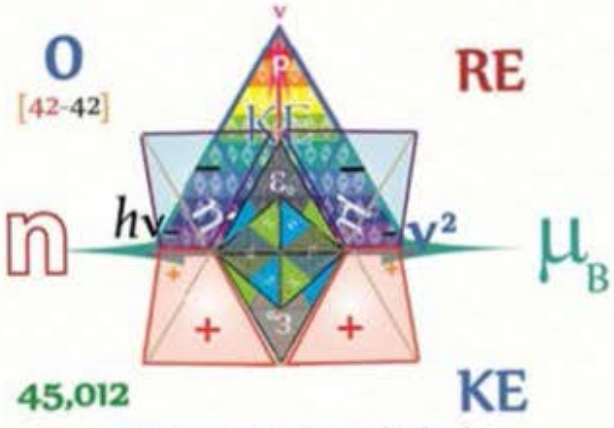

The highest quantum number level produces the strongest Magnetic Moment

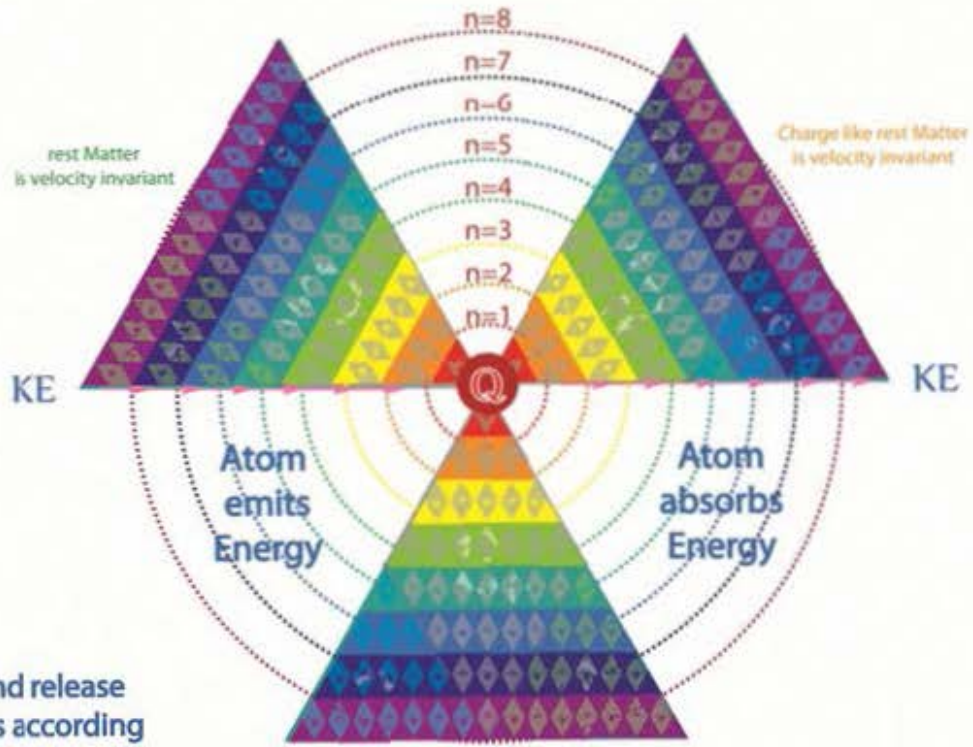

Model is for illustrative purposes only - actual quanta illustrated are stored in radial KEM fields

All massive particles asbsorb and release energy in discrete quantum steps according to their respective Tetryonic geometries and changes in velocities

Kinetic Energies

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Nuclear Magnetons

are weaker than Bohr magnetons
due to differing mass-charge ratios
and non-parallel Quark magnetons

Baryons

are tri-Dodecyon geometries

$$36\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Baryons — EM Field (ElectroMagnetic) — Planck quanta (mass, velocity)

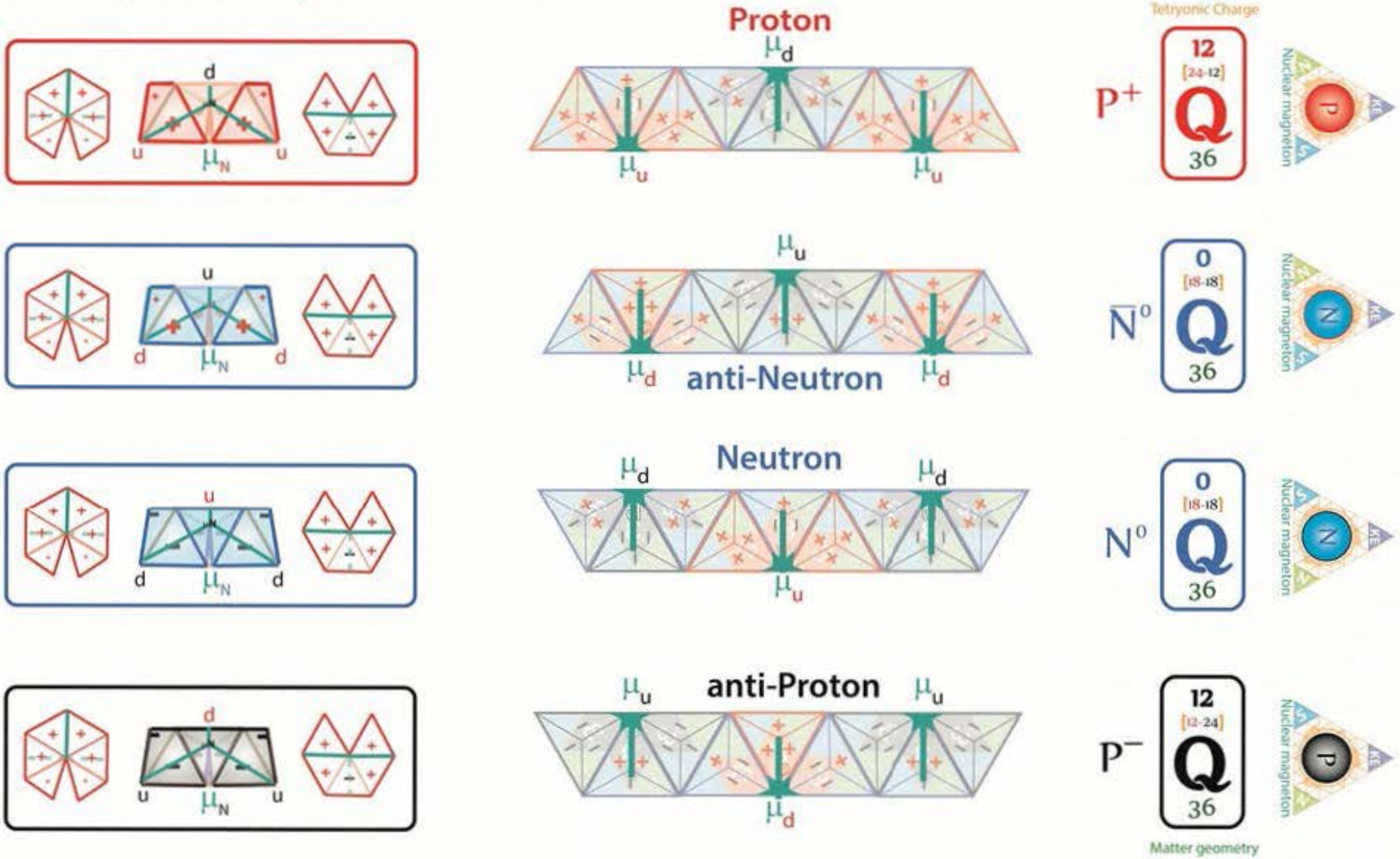

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Baryonic Magnetic Moments

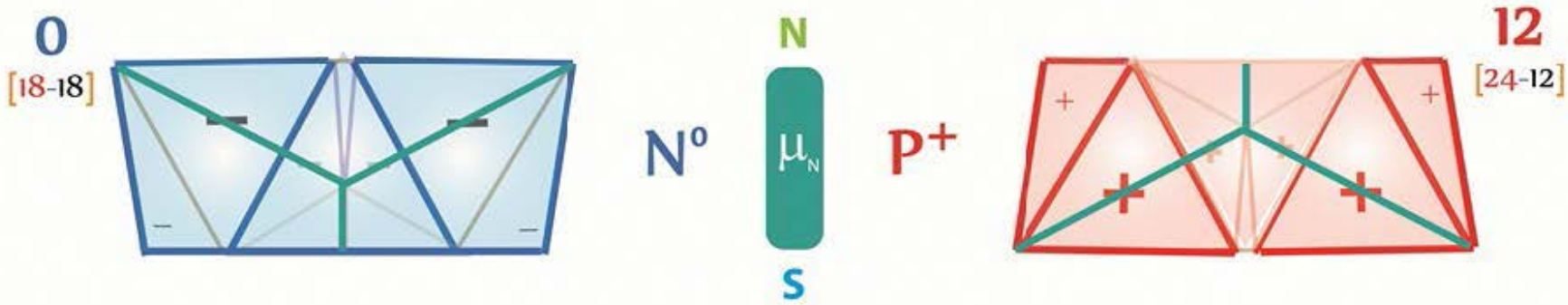

A Baryon's Magnetic Moment is a result of the combined non-parallel Magnetic moments of its Quarks

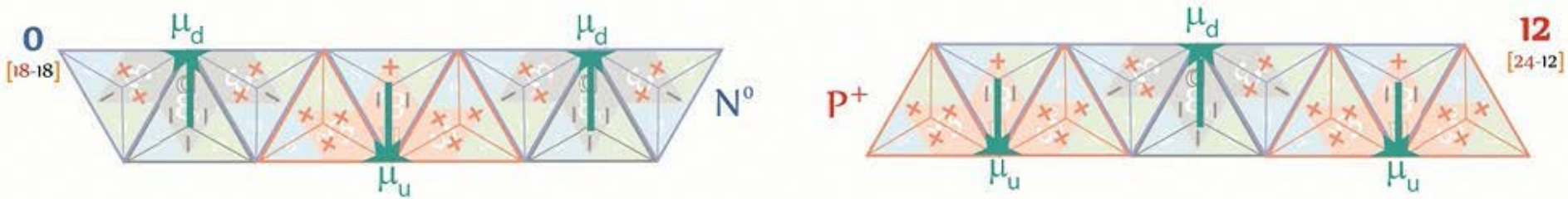

As a result of the 3 non-aligned Quark magnetic moments
resulting from their Tetryonic geometry,
the Nuclear Magneton is considerably weaker than the Bohr Magneton

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Nuclear Quantum Energies

[Principal Quantum Numbers]

All electron energy levels are reflective of the KEM field of a electron in a specific quantum level (The rest Matter of each electron is invariant)

Higher Quantum Level electrons already have high Kinetic energies and thus require lower frequency photons (low additional KE) in order to be ejected from their bound nuclear positions

-13.6 eV Hydrogen ionisation Energy

An Electron's energy can only increase in steps that reflect the Tetryonic Matter geometry of Leptons and their square mass-energies

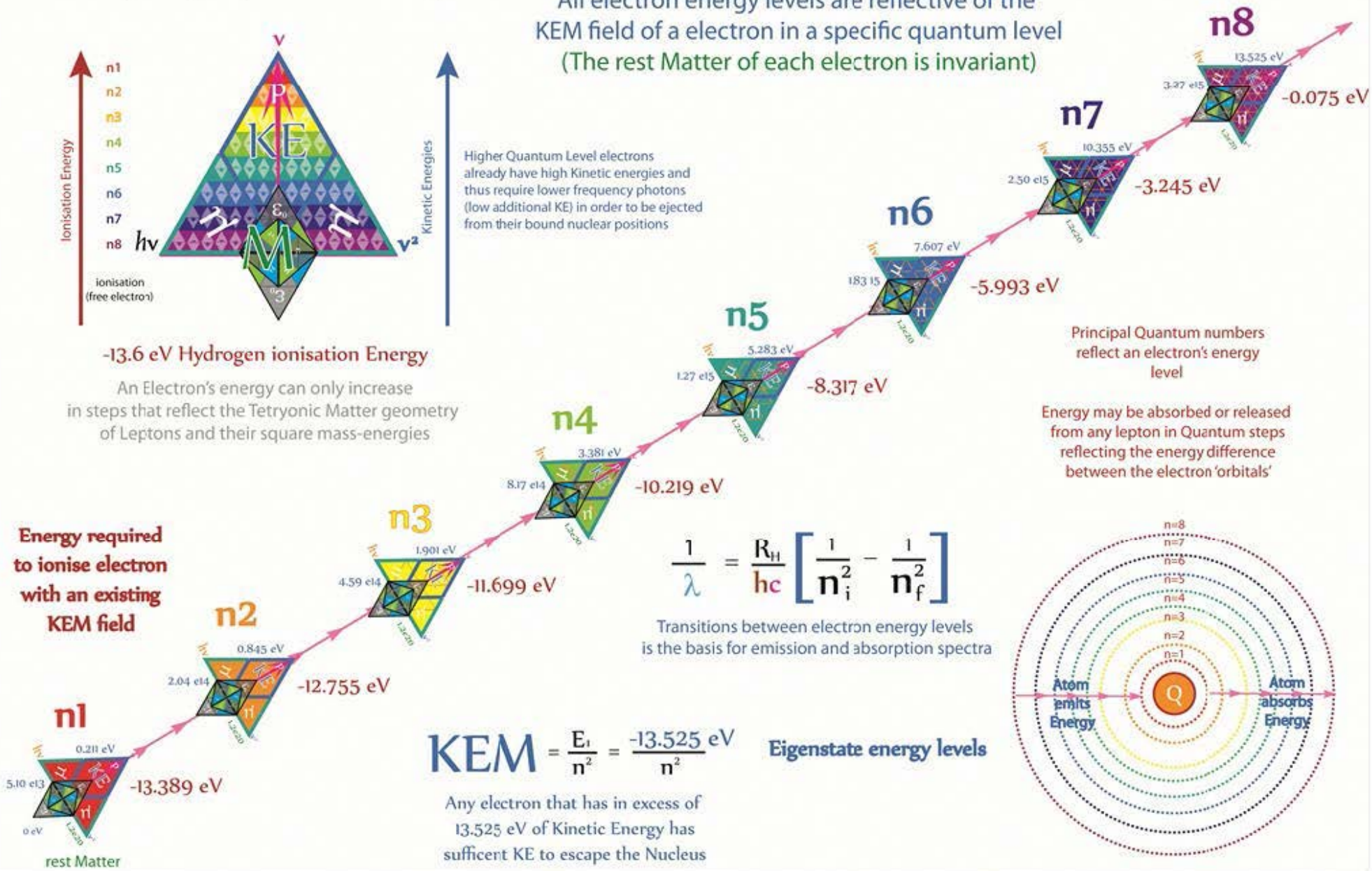

Principal Quantum numbers reflect an electron's energy level

Energy may be absorbed or released from any lepton in Quantum steps reflecting the energy difference between the electron 'orbitals'

Energy required to ionise electron with an existing KEM field

$$\frac{1}{\lambda} = \frac{R_H}{hc}\left[\frac{1}{n_i^2} - \frac{1}{n_f^2}\right]$$

Transitions between electron energy levels is the basis for emission and absorption spectra

$$KEM = \frac{E_1}{n^2} = \frac{-13.525\ eV}{n^2}$$

Eigenstate energy levels

Any electron that has in excess of 13.525 eV of Kinetic Energy has sufficent KE to escape the Nucleus

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Leptons are historically classified as Spin 1/2 particles (by the spin-statistics theorem and the Pauli exclusion principle) as determined by their magnetic moments

Quantum Spin Numbers

(rotations about an axis)

Spin 1/2

720°

Rotating a spin-1/2 particle by 360 degrees does not bring it back to the same quantum state it needs a 720 degree rotation

Planck bar relates to the electric field content of KEM fields resulting from Matter in motion (as reference to the Nuclear magneton or external Magnetic field)

Spin 0

any°

A spin-zero particle can only have a single quantum state, even after torque is applied.

+1 Spherical 'point particles' of charge do not exist -1

Spin 1

360°

Rotating a spin-1 particle 360 degrees can bring it back to the same quantum state

SPIN
must not to be confused with
Chirality (reflections)

Spin 2

180°

Rotating a spin-2 particle 180 degrees can bring it back to the same quantum state

Photons are their own anti-particle

electro-static field magneto-static field electro-static field

Spin 3

120°

Rotating a spin-3 particle 120 degrees can bring it back to the same quantum state

On a geometric basis all Leptons are in fact spin 3 particles

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Magnetic moments are determined by the KEM fields created by vector linear momentum

Nuclear Magnetic moments are complicated by the tri-quark magnetons within all Matter topologies

The KEM field of any charged particle in motion is reflective of the particle's nett charge topology

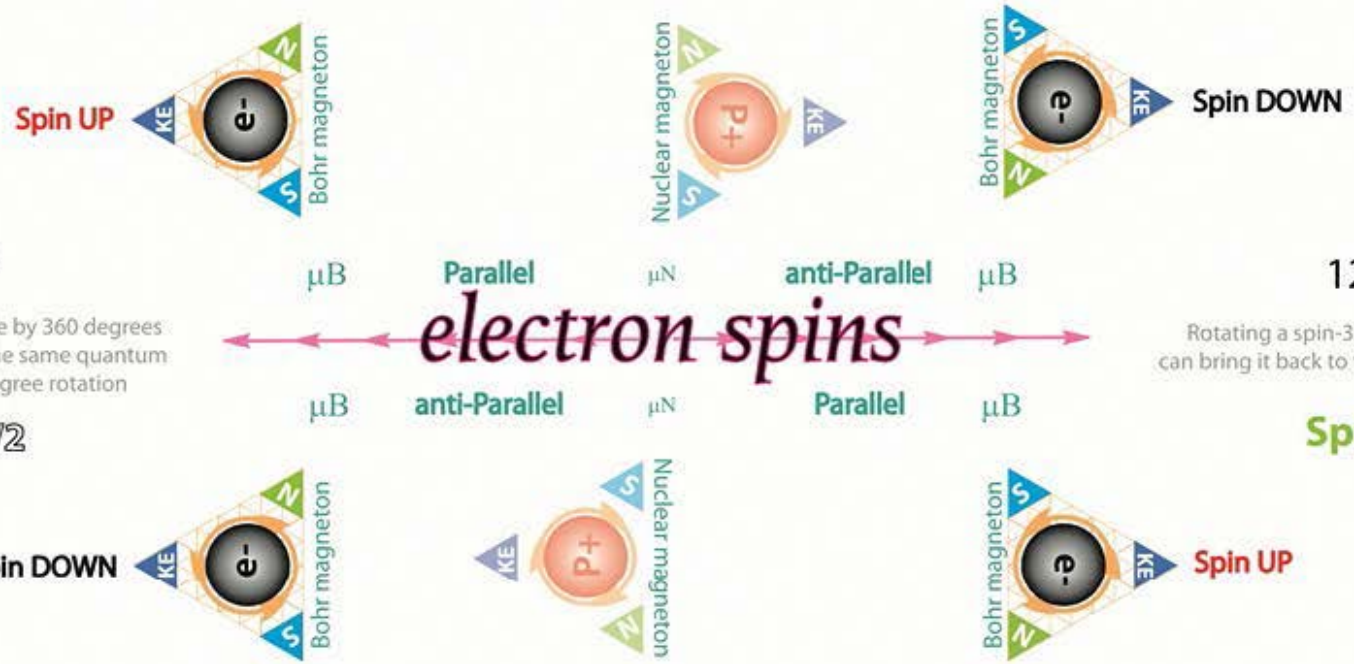

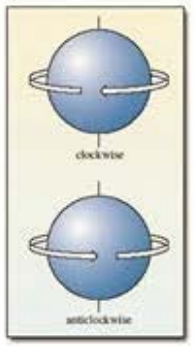

All atomic particles have a particular "spin" analogous to the Earth's rotation on its axis.

$$\mu_B = \left[\frac{Q}{2mv}\right]/\ell$$

An isolated electron has an angular momentum and a magnetic moment resulting from its spin. While an electron's spin is sometimes visualized as a literal rotation about an axis, it is in fact a fundamentally different, quantum-mechanical phenomenon with no true analogue in classical physics.

The quantum mechanical reality underlying spin is complex and still poorly understood Consequently, there is no reason to expect the above classical relation to hold.

$$\mu_B = g\left[\frac{e-}{2mv}\right]S$$

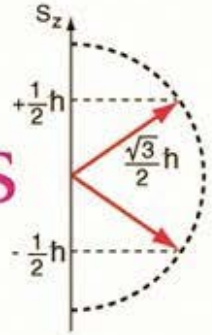

Tetryonic KEM field geometries reveals the source and orientation of all atomic magnetic moments

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Generating Magnetons

A static Electron has a negative Tetryonic charge [0-12] topology with neutralised magnetic dipoles

Leptons are
12 loop inductive
charge rotors

Tetryonic geometry
fully explains Leptronic 'spins'

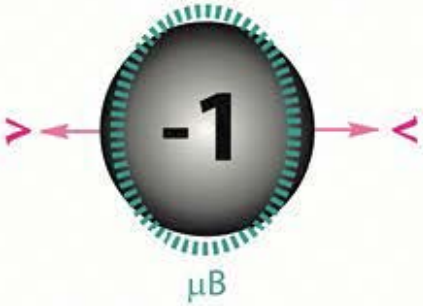

Einstein's Special Relativity model of distorted moving charges producing magnetic moments is incorrect

BOHR Magneton produced by Lorentzian distortion of charges due to relativistic velocities

$$\mu_B = \frac{e\hbar}{2m_e}$$

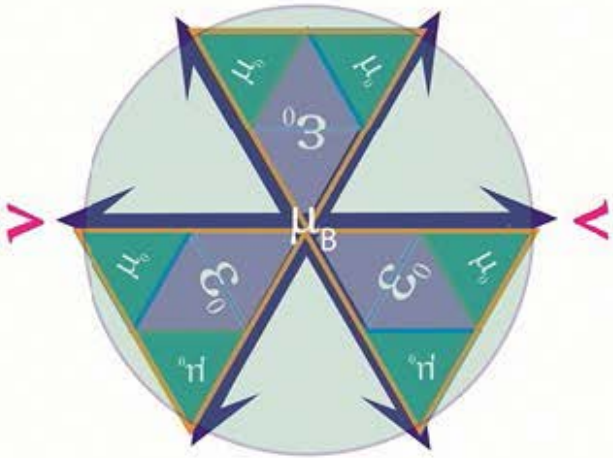

The term "electron spin" can now be taken literally (when modelled with Tetryonic geometries) as an accurate description of the origin of Magnetic moments for all Leptonic [BOHR] magnetons.

The previously held model of the electron as a spinning sphere of charge must be abandoned in favour of the true Tetryonic charge geometries of EM mass-Energy-Matter

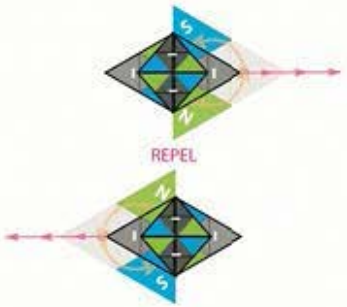

Ampere Force

$$\mathbf{B} = \frac{\mu_0 I}{4\pi}\int \frac{d\boldsymbol{\ell}\times\hat{\mathbf{r}}}{r^2},$$

$$F = 2\mathbb{k}_A \frac{I_1 I_2}{r}$$

$$\mathbf{F} = q[\mathbf{E} + (\mathbf{v}\times\mathbf{B})].$$

Lorentz Force

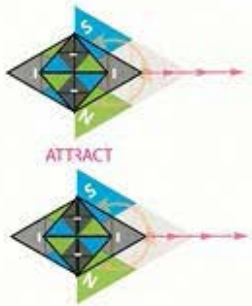

A moving Electron has a KEM field with an Electric field and a Magnetic Moment

The gyromagnetic ratio of a particle or system is the ratio of its magnetic dipole moment to its angular momentum

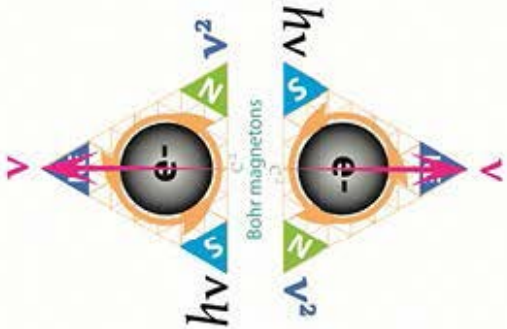

The KEM field energy of an Electron in motion is subject to relativistic corrections due to energy changes resulting from its acceleration

$$\lambda = L'\sqrt{1-\frac{v^2}{c^2}}$$

WAVE-length contraction
of mass-energy quanta of KEM field

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Stern Gerlach Experiment

In 1922 O. Stern and W. Gerlach measured the intrinsic spin angular momentum of silver atoms and found it to take only two discrete values, + h / 2 and - h / 2 commonly called "spin up" and "spin down

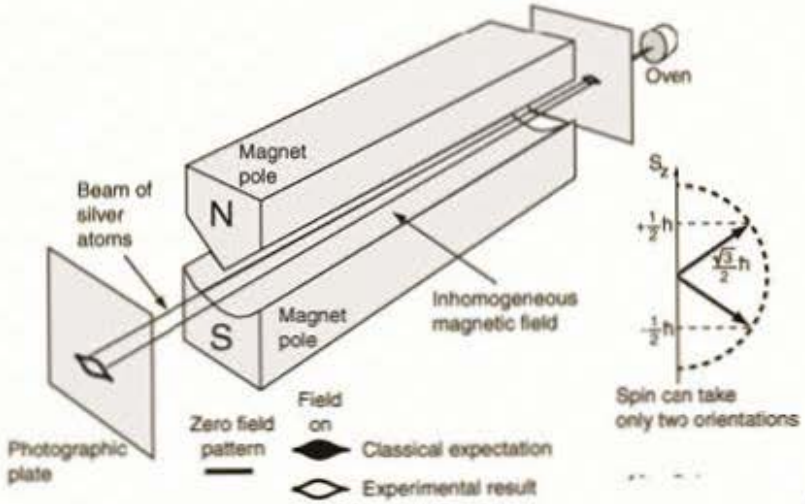

The Stern-Gerlach experiment to determine electron SPIN

The results were interpreted to show that particles possess an intrinsic angular momentum that is most closely analogous to the angular momentum of a classically spinning charged sphere, that takes on only certain quantized values of angular momentum

Tetryonics shows the results are a product of the KEM field produced by charge particles in motion, with all charged particles being able to produce 2 distinct magneton orientations as a result of the real motion of their intrinsic quantum inductive loop [Matter]geometries through external E fields & as referenced to external M moments.

This along with the Lorentz force produced by an external Magnetic field acting on the KEM magnetons produces the two results obtained

Any increase in electron energies results in an increase in quantised angular momenta and its vector linear momentum

Any change in the KEM energy level of an electron results in Photon emission or absorption

Electron Spins based on the measured Bohr Magnetons of moving electrons are reflected with KEM field geometries

Electrons bound in atomic nuclei increase of decrease their energy levels dependent on the energy level of the nuclei in which they are bound

Bound and unbound electrons can rotate in one of two directions influenced only by external magnetic and electric fields or incident Photons

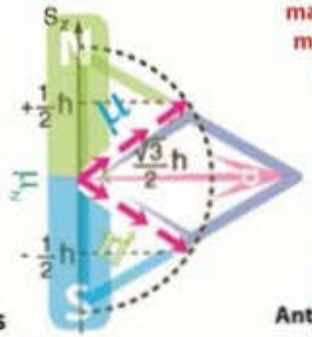

N
Parallel magnetic moment
S

μ_B

The BOHR magneton dipole is measured against either the Nuclear Magneton or external magnetic fields

S
Antiparallel magnetic moment
N

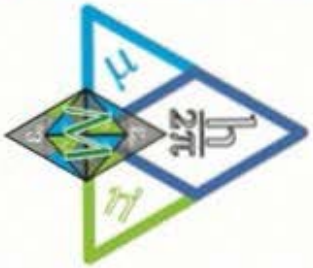

The two separated beams of electrons produced are defined as having differing SPINS [UP or DOWN]

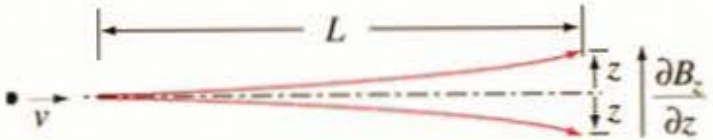

$$z = \frac{1}{2}at^2 = \frac{1}{2}\frac{F}{m}\left[\frac{L}{v}\right]^2 = \pm\frac{\mu_B L^2}{4KE}\frac{\partial B_z}{\partial z}$$

The orientation of the BOHR magneton wrt the NUCLEAR magneton determines the 'direction' of electron SPIN

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Bohr Magnetons

A moving electron is a 12 loop rotating inductor

Energy created by moving a Lepton though an external EM field is stored as Planck quanta within the Lepton's extended KEM field

Leptronic 'spin' is always determined by the Leptronic Magnetic moment as referenced against the Nuclear Magnetic Moment

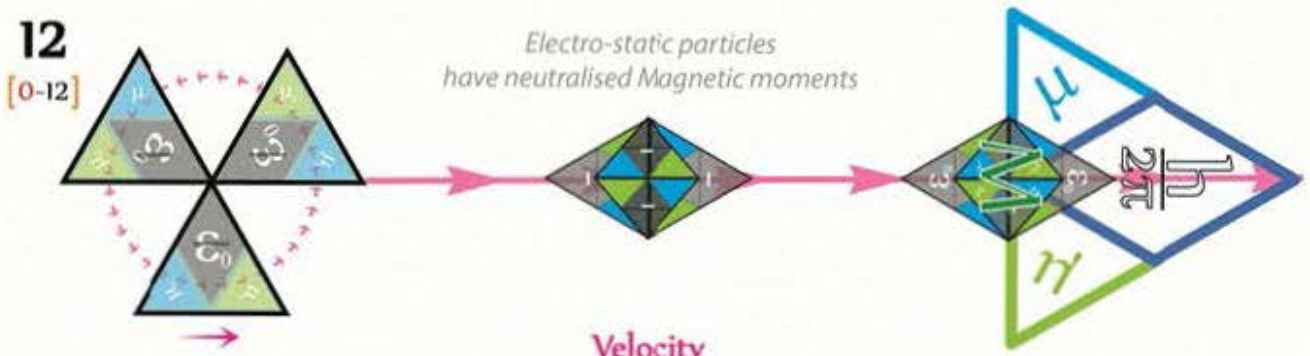

A moving Lepton creates a secondary stronger intrinsic magnetic dipole moment within its KEM field which interacts with external magnetic fields

Velocity creates Kinetic Energy and Magnetic moments

Reversing the vector direction of the particle's linear momentum creates a reversed dipole Magnetic moment

Leptons are not point particles

All Leptronic macro-KEM fields and interactions with external fields can be modelled using Tetryonic geometries

Magnetic moment 'spin orientations' are reversed for opposite charge particles

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Electron Spin orientation

The Bohr magneton dipole produced by Kinetic Energies is located axially about the centre of rotation

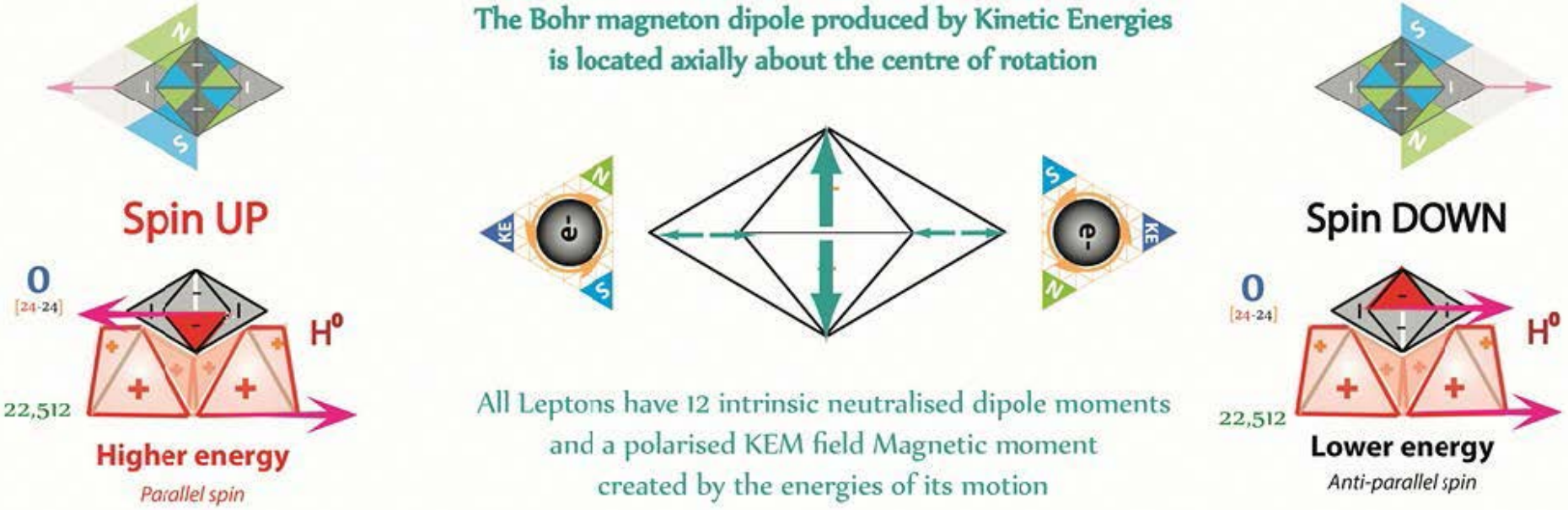

All Leptons have 12 intrinsic neutralised dipole moments and a polarised KEM field Magnetic moment created by the energies of its motion

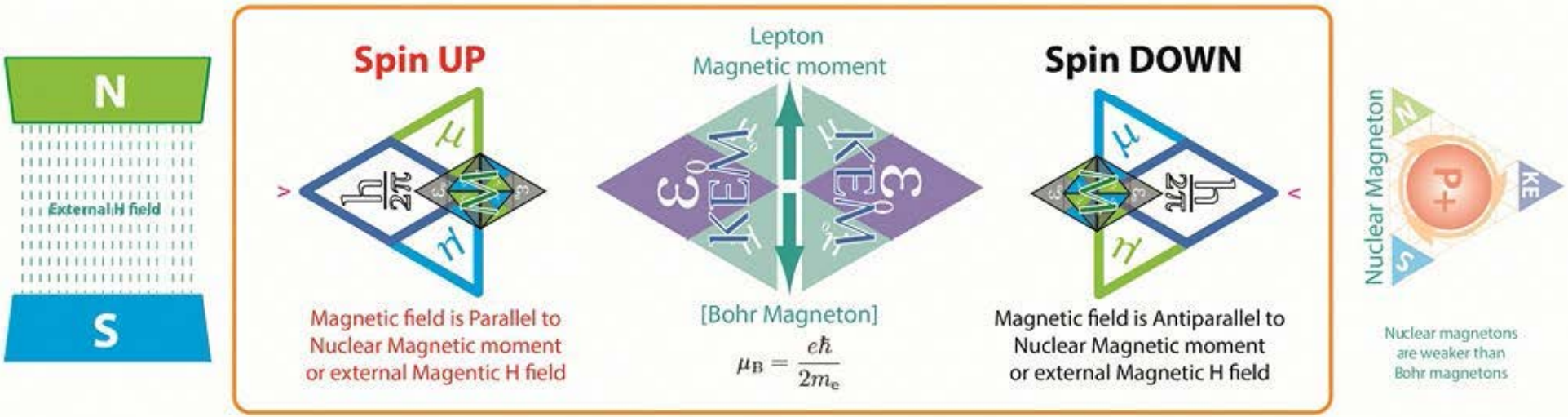

All Leptronic spin directions are referenced to external Magnetic fields [either Nuclear Magnetons or H fields]

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Nuclear Spins

are determined by the orientation of Bohr Magneton
with respect to the Nuclear Magneton
[or an external Magnetic field]

electron Matter geoemtries are negative charged fascia which create neutral intrinsic magnetic dipole configurations

MAGNETIC MOMENT

In a moving electron Kinetic energy produces an axial Magnetic moment

In a static electron all intrinsic dipoles are neutralised through their orientations

Quantum Inductive Loops in motion produce Kinetic Energies in turn creating Magnetic Moments

Electron

PARALLEL
Magnetic moments

UP

BOHR
Magneton

ANTIPARALLEL
Magnetic moments

DOWN

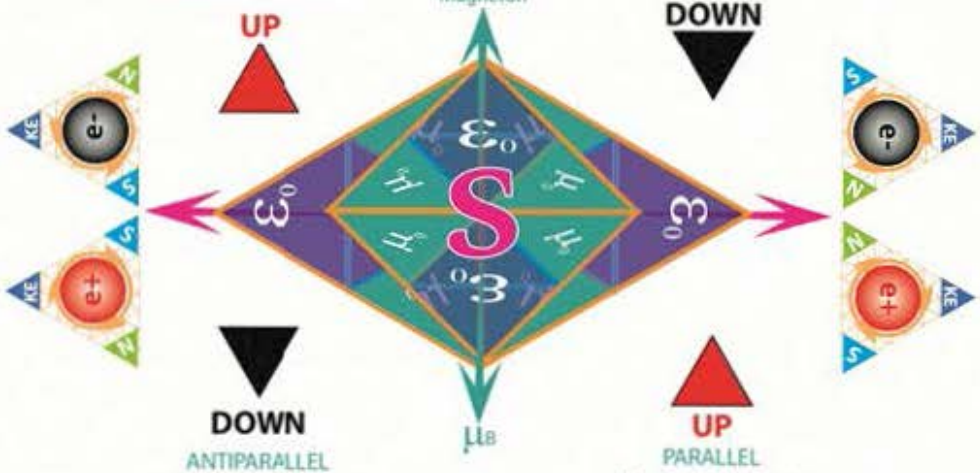

DOWN
ANTIPARALLEL
Magnetic moments

UP
PARALLEL
Magnetic moments

Positron

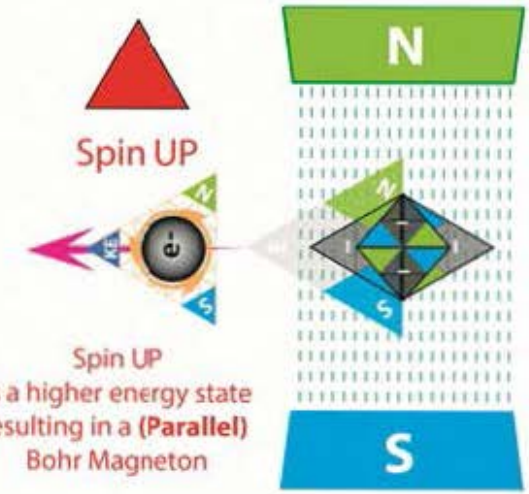

Spin UP

Spin UP
is a higher energy state
resulting in a **(Parallel)**
Bohr Magneton

Nuclear magneton or external Magnetic field

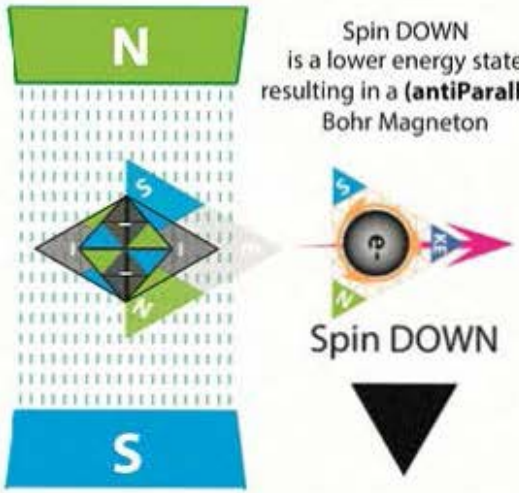

Spin DOWN
is a lower energy state
resulting in a **(antiParallel)**
Bohr Magneton

Spin DOWN

Lorentz Force

When moving in an
external magnetic field

The axial dipole
moment of an
electron will experience
torque force
proportional to
its velocity

Opposites attract
Similars repel

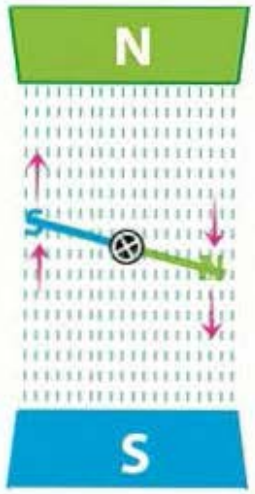

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Nuclear magnetic Moment

[Nuclear magneton]

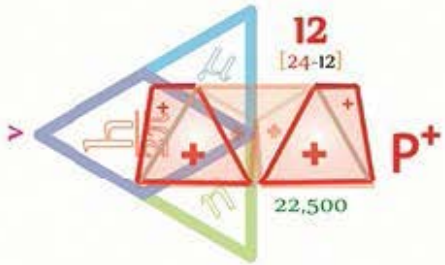

NUCLEAR magnetons are much weaker than BOHR magnetons due to the higher charge to mass ratio of electrons

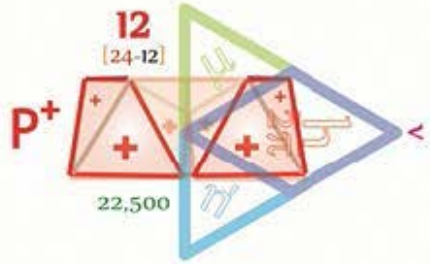

$$\frac{M_p}{M_e} = \frac{1}{1875}$$

The nuclear spins for individual protons and neutrons parallels the treatment of electron spin, with spin 1/2 and an associated magnetic moment.

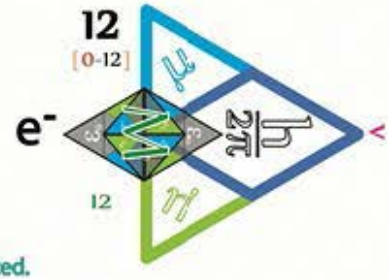

For the combination of electron, neutrons and protons in periodic elements, the situation is even more complicated.

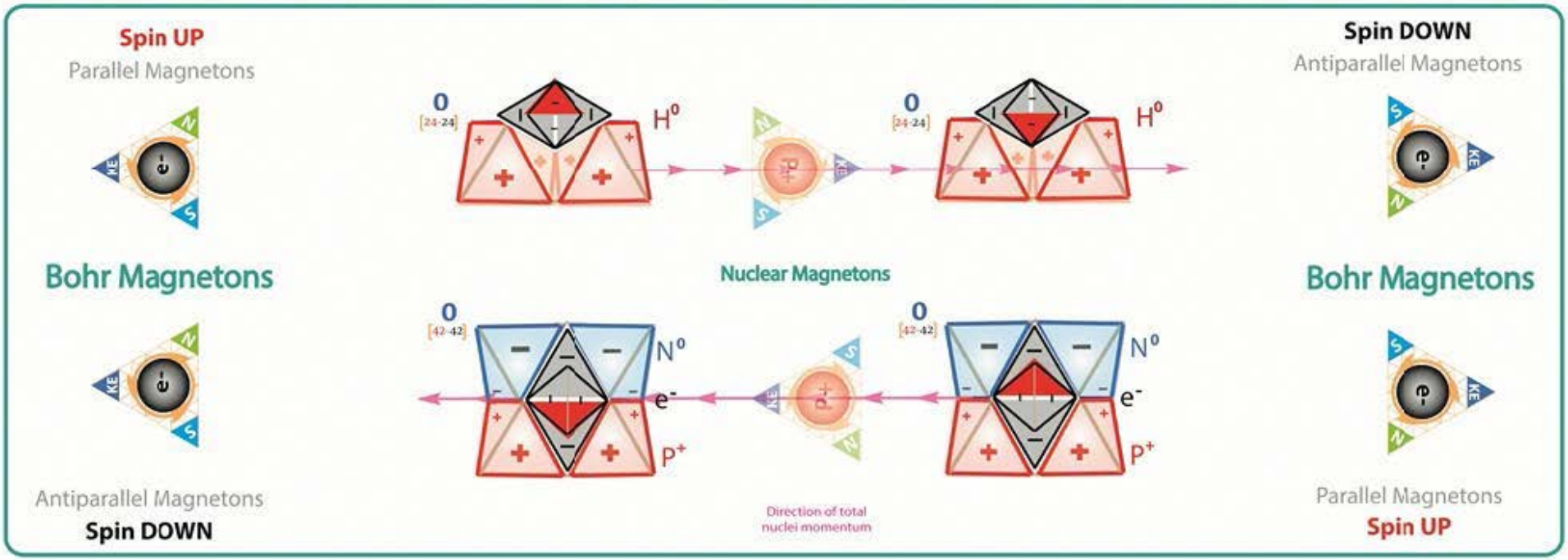

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Spin orbital coupling mechanics

The induced magnetic moment of electrons in atomic nuclei combine vectorally with the magnetic moment of the nuclei

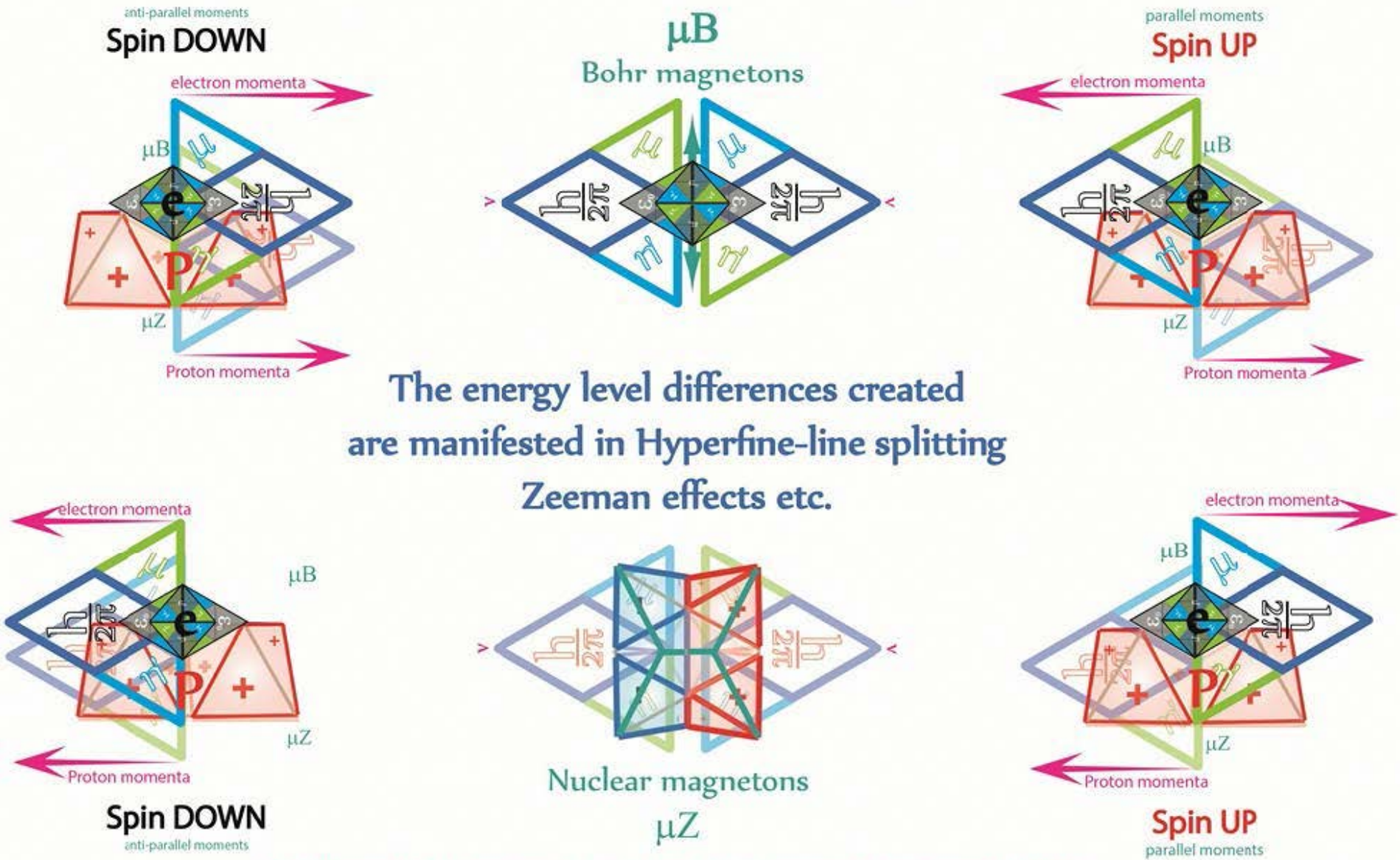

The alignment of electron spins in nuclei results in diamagnetic, para-magnetic Matter

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Gyromagnetic Ratio

The electron is a 12 charge quantum rotor with a uniform charge to mass density ratio, the ratio of its magnetic moment to its orbital angular momentum, also known as gyromagnetic ratio

This implies that a more massive assembly of charges spinning with the same angular momentum will have a proportionately weaker magnetic moment, compared to its lighter counterpart.

12
[0-12]
1.2 e20

1
electron
12π

The Bohr Magneton is determined by the charged KEM field geometry of Leptons

1875
charged mass-Matter differential

The combined Kinetic energy of Motion [KEM field] and Electron Spin coupling with Nuclear Magnetons will effect any measured Gyromagnetic ratios

22,550
Proton
36π

12
[24-12]

2.25 e23

-1

9.1 e-31 kg

Classical electron model
[rotating sphere]

4π

An electron is
NOT
a spherical particle

12π

12
[0-12]

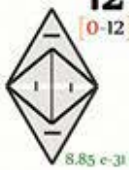

8.85 e-31 kg

Tetryonic electron
[rotating tri-tetryon topology]

In physics, the gyromagnetic ratio (also sometimes known as the magnetogyric ratio in other disciplines) of a particle or system is the ratio of its magnetic dipole moment to its angular momentum, and it is often denoted by the symbol γ, gamma.

An isolated electron has an angular momentum and a magnetic moment resulting from its spin.

Its SI units are radian per second per tesla (s−1·T −1) or, equivalently, coulomb per kilogram (C·kg−1).

Tetryonic quantum mass to Charge ratio

$1.810109642 \times 10^{11}$

The 2006 CODATA
− e / me = -1.758 820 150(44) x 10[11]

Nuclear Magnetons

e-
e_m

Tetryonic elementary charge
1.602216081 e-19 coulombs
Tetryonic electron mass
8.851486361 e-31

12q
1.2 e20

[q/m]

181,010,964,200 C/kg

Spin UP
K.E.

Electron Spin
[Orbital Angular Momentum]

Spin DOWN
K.E.

N
Nuclear Magneton
S

Lower energy

Higher energy

12q
2.25 e23

Tetryonic elementary charge
1.602216081 e-19 coulombs
Tetryonic Proton mass
1.659653693 e-27

e+
P_m

[q/m]

96,539,180.9 C/kg

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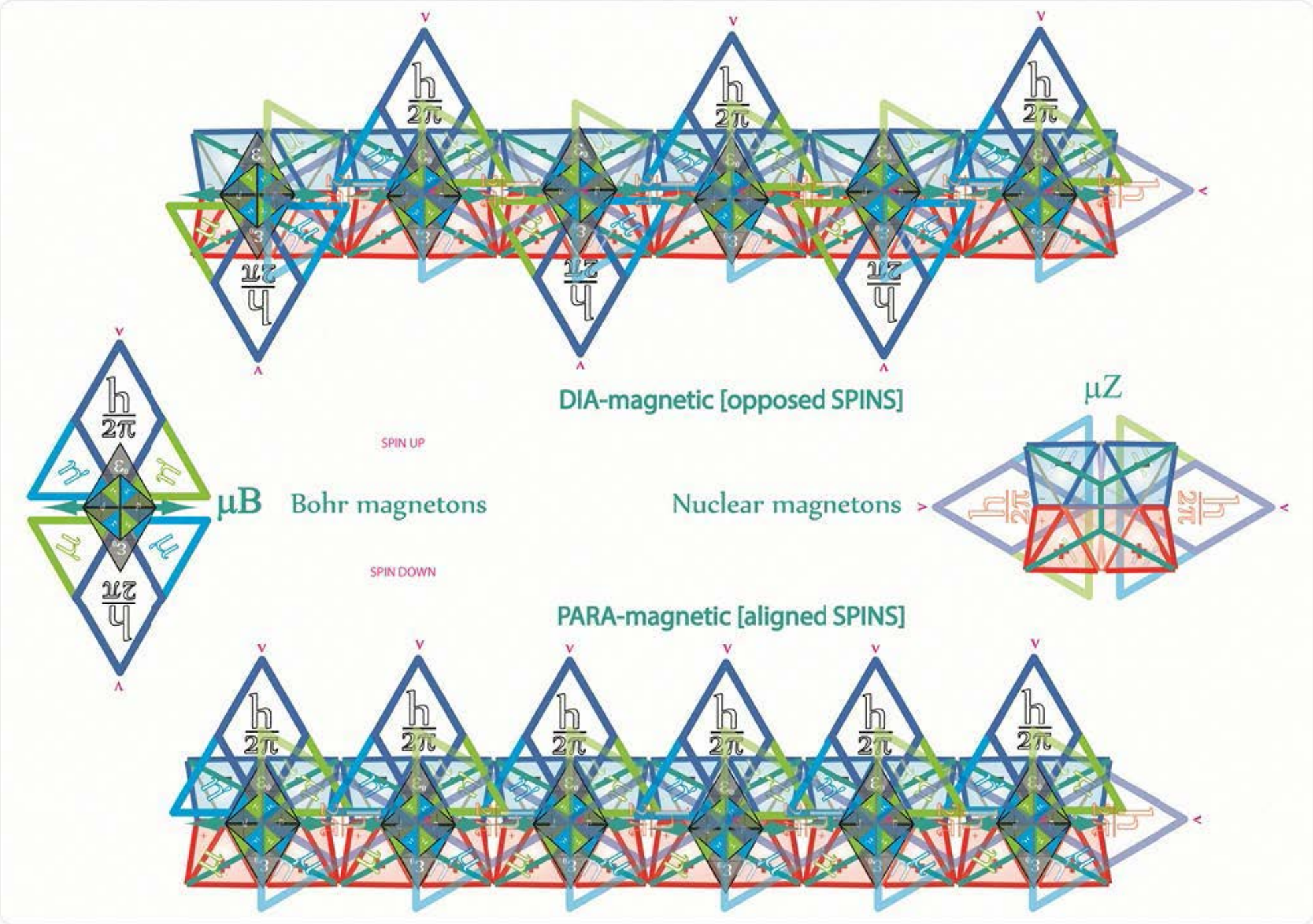

Tetryonics 19.11 - DIA & PARA-magnetic fields

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12
[12-0]
1.2e20

e^+ Positron

Leptons

181,010,964,200 C/kg

12
[0-12]
1.2e20

e^- Electron

12
[24-12]
2.25e23

P^+ Proton

Baryons

96,539,180.9 C/kg

0
[18-18]
2.25e23

N^0 Neutron

All mass-Matter have distinct charge geometries and once in motion are subject to EM forces as a result of their geometries & KEM field

Lorentz force Law

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$$

LORENTZ force — Electric force — charge velocity — Magnetic force

all Matter in motion is subject to NEWTON'S SECOND LAW OF MOTION

$$F = ma$$

Combining Lorentz's force law & Newton's Third Law we obtain a EM mass-charge quotient for any particle of mass-Matter in motion

$$(M/Q)a = E + v \times B$$

mass-charge ratios

1.335180067 e-20 C

1.810109642 e11 $\left[\frac{q}{m}\right]\mathbb{n}$ 1e19 V

7.376238634 e-51 kg

are the basis for mass spectroscopy

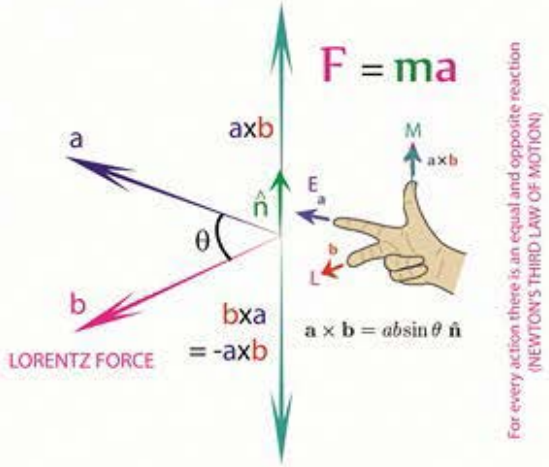

Q *Any two particles with the same EM mass-to-charge ratio follow the same path in a vacuum when subjected to the same external electric field* **M**

Dependent on their generations

Charge/mass

$\left(\frac{q_t}{m_t}\right)$ 181,010,964,200 C/kg $\left(\frac{q_e}{m_e}\right)$

4:4 12:12

Tetryons and Leptons can have identical mass-charge ratios

Elements

96,487,720.78 C/kg

48,256,721.99 C/kg

0
[24-24]
2.2512e23

Hydrogen

Deuterium

0
[42-42]

4.5012e23

Tetryonic theory shows mass-charge ratios are a measure of mass-energy geometries in Matter topologies

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Collider particle track physics

A collider is a type of a particle accelerator involving directed beams of particles.

E

Q

Colliders may either be ring accelerators or linear accelerators,
and may collide a single beam of elementary particles against a stationary target or two beams head-on.

t 4 [0-4]

4 [4-0] t

Tetryons have the same 1/3 elementary charge as some Quarks

d 4 [4-8]

4 [8-4] d

2D bosons & photons are radiant mass-enery geometries

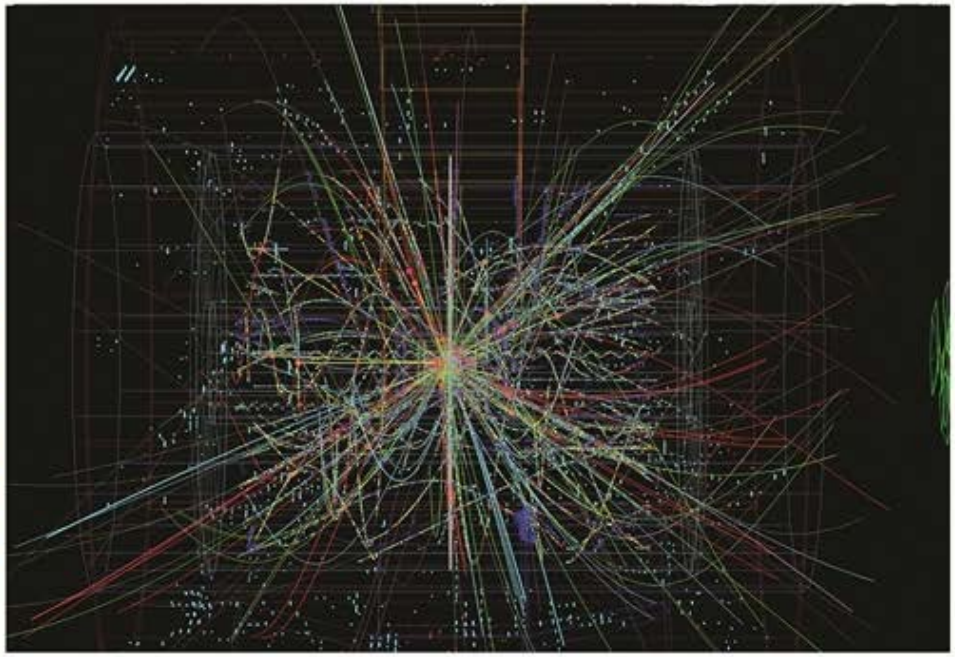

3D Matter Fermions are standing wave mass-energy topologies

Analysis of the by-products of these collisions without a clear definition of, and distinction between, EM mass-energy geometries & Matter topologies through the charged geometrics of Tetryonics ceates a misleading and erroneous picture of the particles created in high energy collisions within particle physics accelerator experiments

181,010,964,200 C/Kg

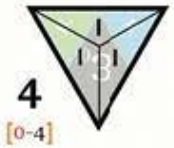

Tetryons can have the same mass-charge ratios as Leptons

181,010,964,200 C/Kg

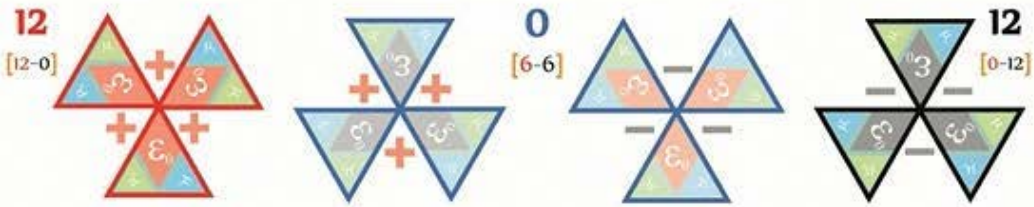

m

M

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Radiant EM mass-energy geometries

mass Planck quanta

$$\frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

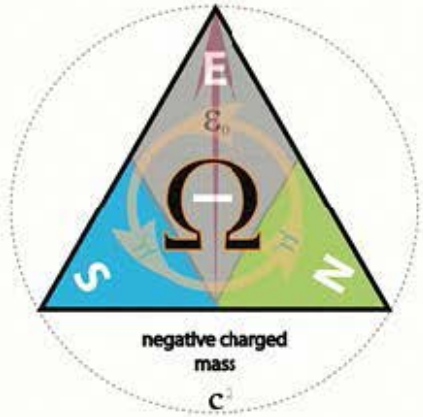

Charge Planck quanta

$$\frac{1\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

Bosons Planck quanta

$$\frac{\text{ODD}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

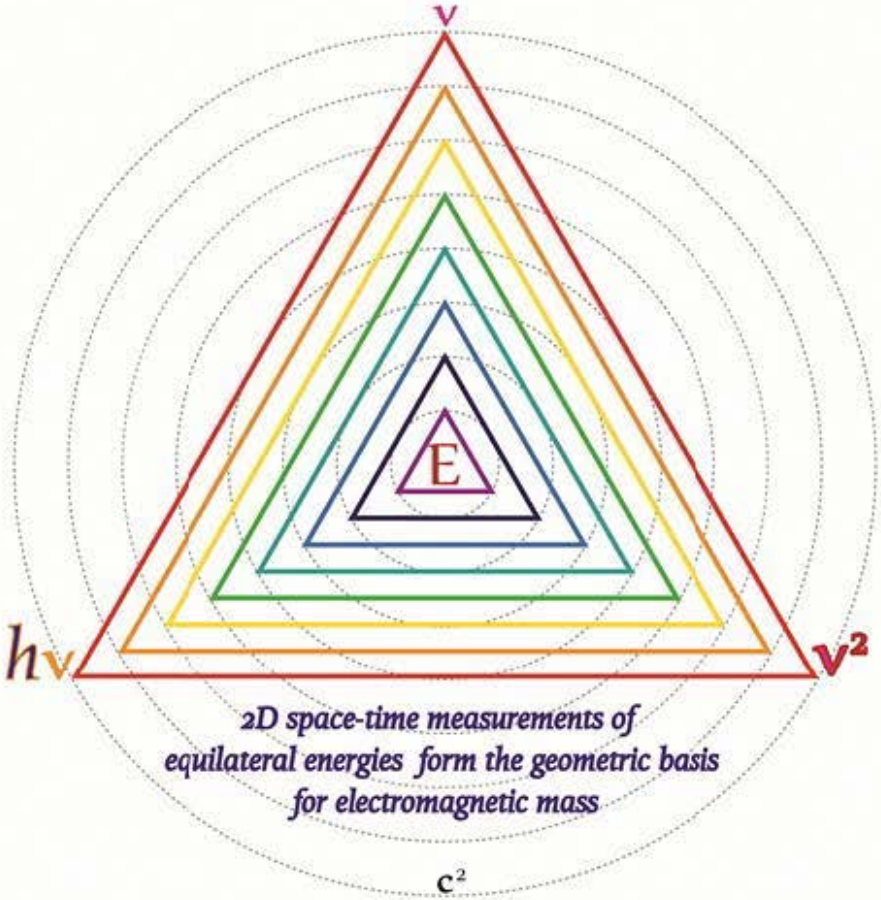

Photons Planck quanta

$$\frac{2\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

EM waves Planck quanta

$$\frac{\text{EVEN}\,\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

mass velocity

2D Planar divergent EM mass-energies form radiant Electromagnetic waves

ElectroMagnetic mass is a property of Matter
[being the energy content of its charged geometry per unit time]

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ENERGY

2D Equilateral scalar energy-momenta

Q
charge

E
energy

Quantised angular momenta are energy geometries

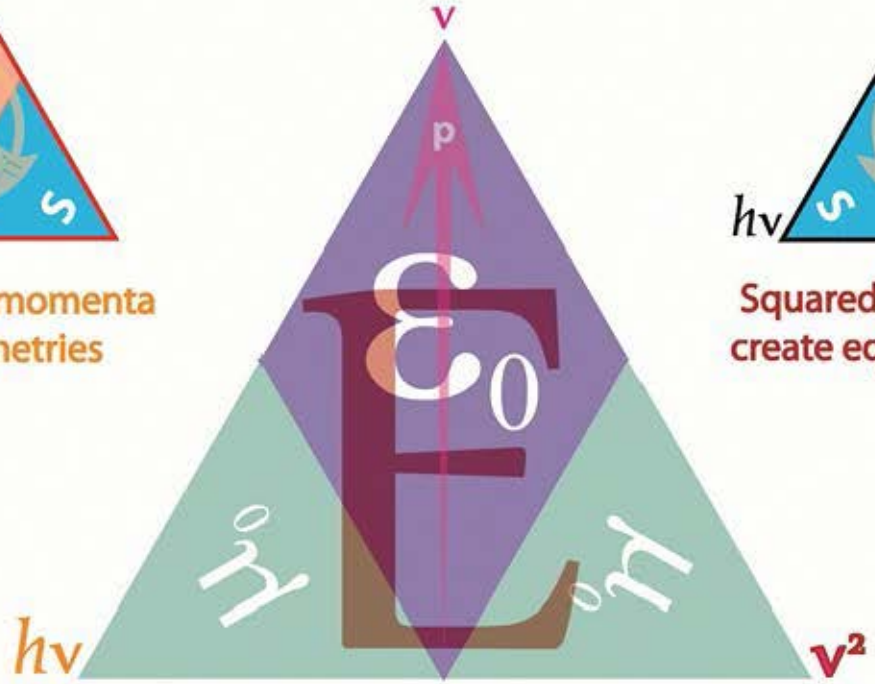

Squared numbers in physics create equilateral geometries

Planck's constant of mass-energy momenta is the source of all physical constants and force relationships

Separated fields of charge create electromotive forces accelerating Material bodies within them

ENERGY Planck quanta

$$n\pi\left[\left[m\Omega v^2\right]\right]$$

mass velocity

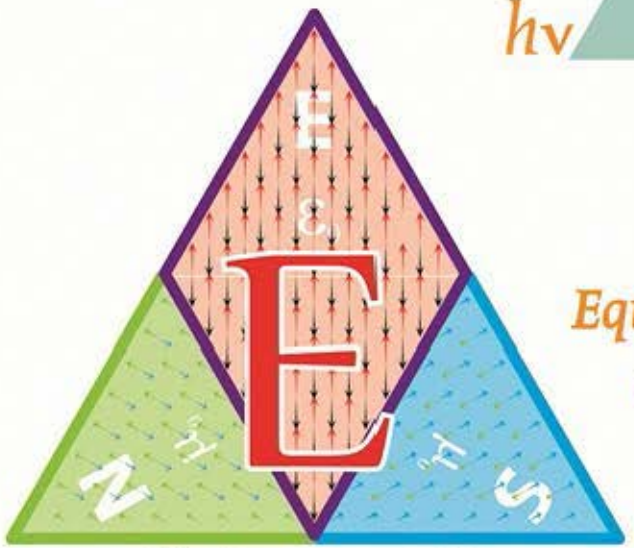

Positive charge energy momenta fields

Equilateral energy-momenta form the foundation of all Forces, EM masses & Matter

All energy seeks equilibrium

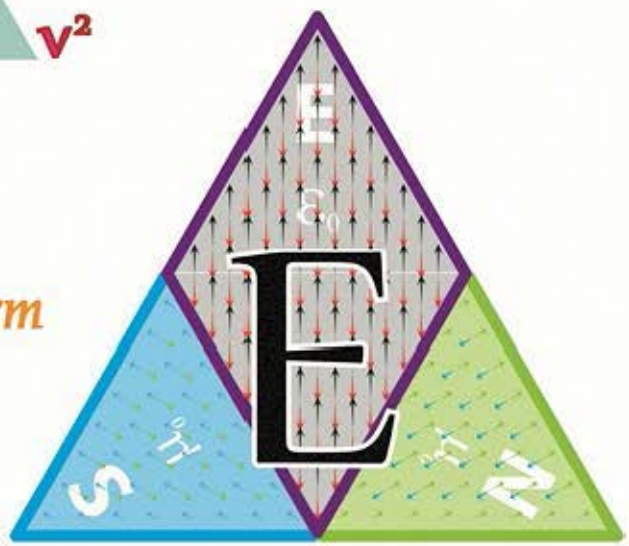

Negative charge energy momenta fields

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3D Matter topology is NOT a property of 2D ElectroMagnetic mass-energies

it is a measure of the closed 3D standing-wave spatial topology of all fermionic particles created by their charged equilateral mass-energy momenta geometries

Matter displaces vacuum energies to create convergent gravity fields around it

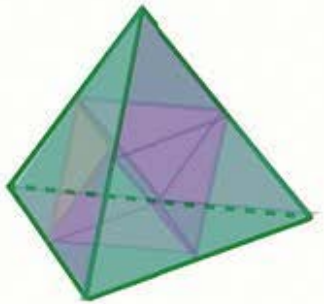

Tetryons are the quantum of Matter

Tetryons $\frac{4\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Fermions $\frac{12\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Mesons $\frac{24\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

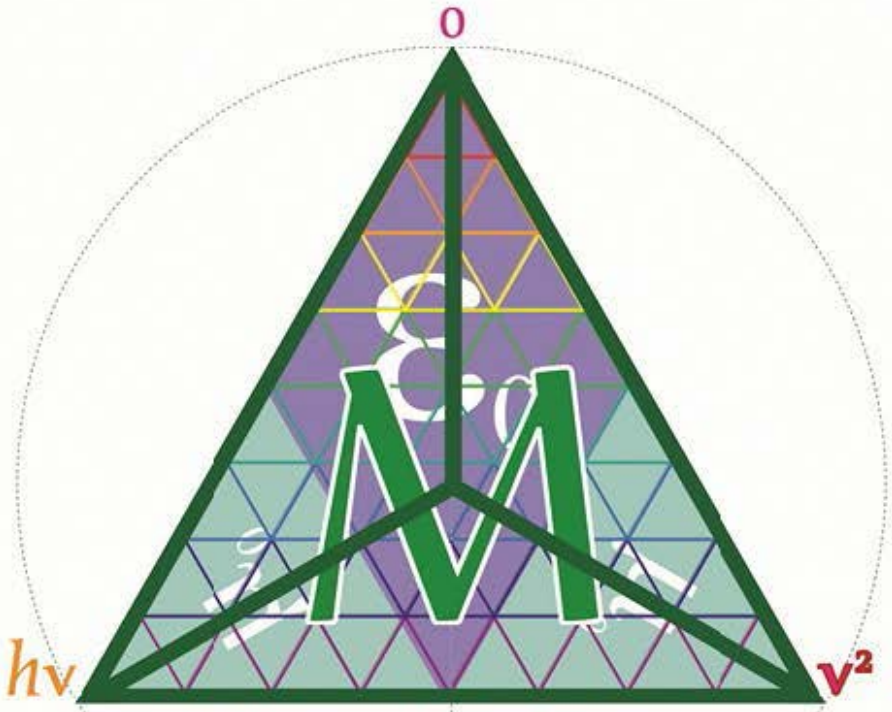

3D Matter particles are Z component second squared mass-energy topologies & created closed volumes

c^4

Matter $\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

The mass-energies of Matter are Lorentz invariant to velocity changes

All Matter is comprised of [and radiates divergent] kEM mass-energies

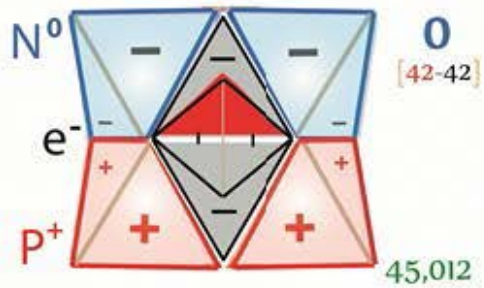

Deuterium is the quantum of all Elements

Baryons $\frac{36\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Nuclei $\frac{72\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

Deuterons $\frac{84\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$ (Planck quanta; mass, velocity)

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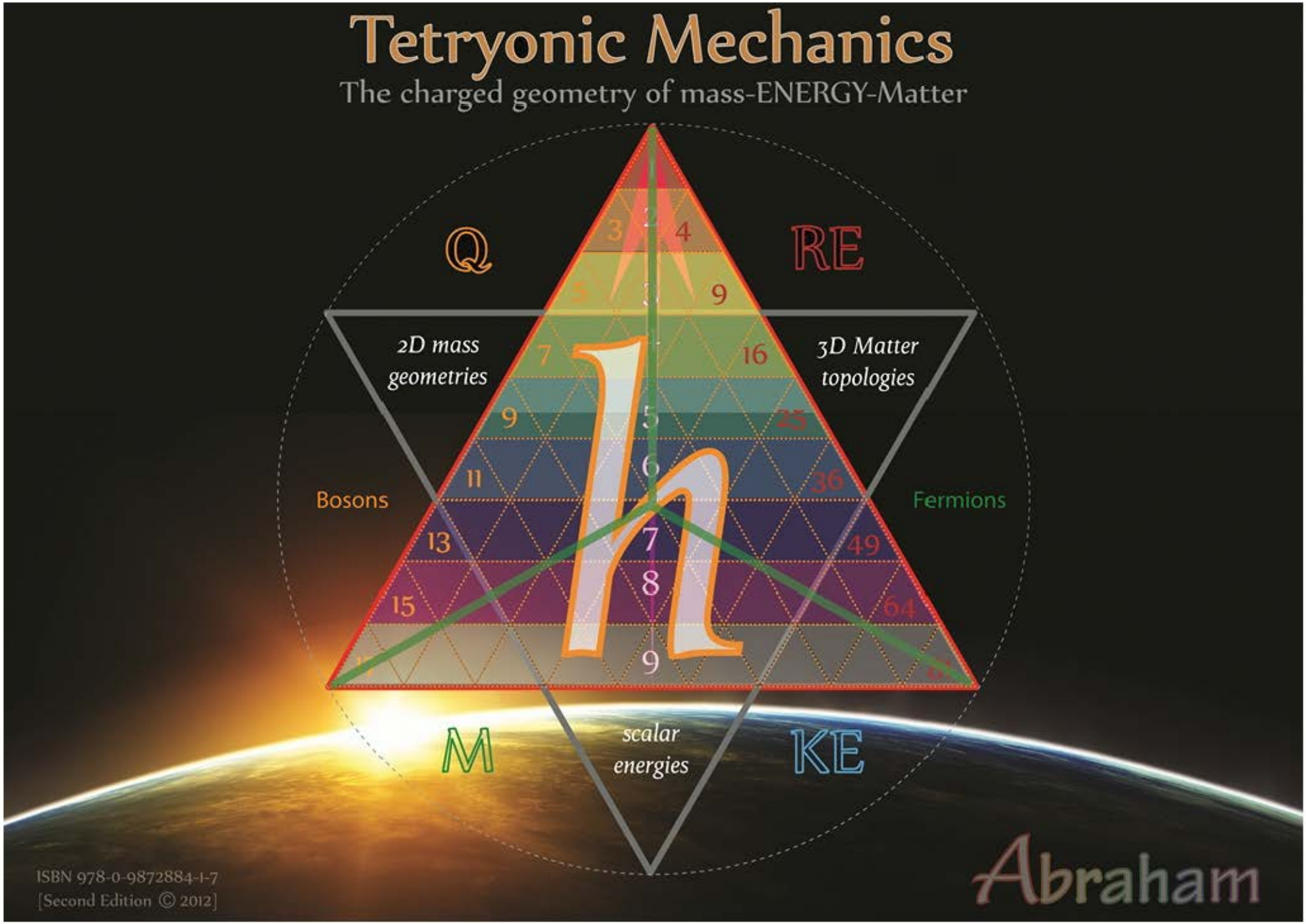

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TETRYONICS

The charged geometry of mass-ENERGY-Matter in motion

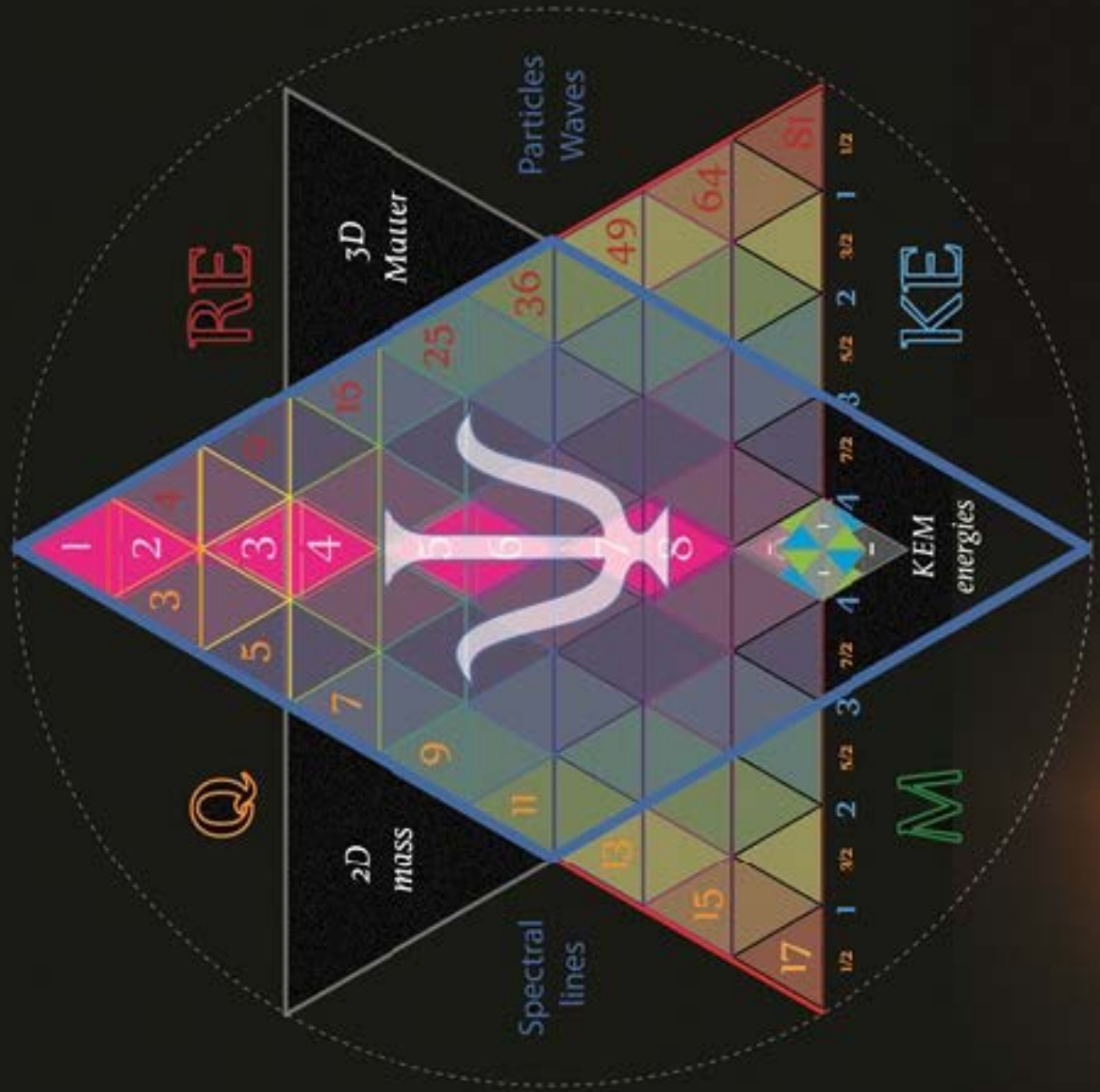

Foundational Quantum Electrodynamics

Abraham

ISBN 978-0-987288-2-4
[Second Edition © 2012]

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James Clerk Maxwell

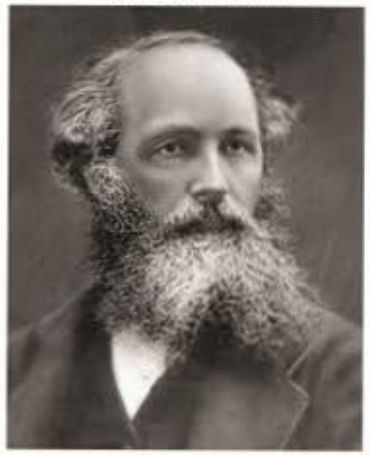

(13 June 1831 – 5 November 1879)

Maxwell's equations describe how Electric and Magnetic fields are generated and altered by each other and by charges and currents.

Q
[v-v]

Net Electric charge is the result of quanta imbalances in equilateral geometry

EM Planck Energy

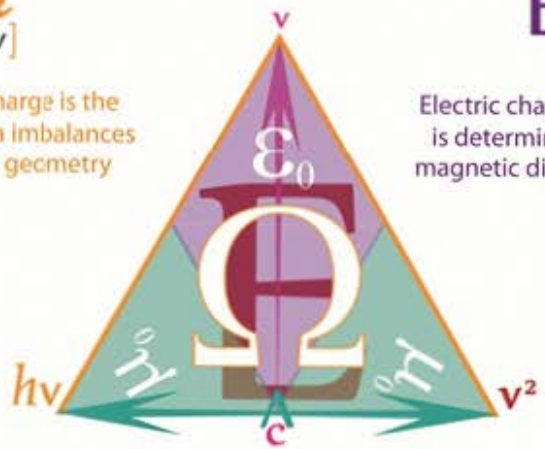

ORTHOGONAL MAGNETIC DIPOLE FIELD

E

Electric charge polarity is determined by the magnetic dipole vector

$$\oint \overline{E}\cdot d\overline{A} = \frac{q}{\varepsilon_0}$$
Gauss's Law for Electricity

$$\oint \overline{B}\cdot d\overline{A} = 0$$
Gauss's Law for Magnetism

$$\oint \overline{E}\cdot d\overline{s} = \frac{-d\Phi_B}{dt}$$
Faraday's Law

$$\oint \overline{B}\cdot d\overline{s} = \mu_0 i + \frac{\mu_0 \varepsilon_0 d\Phi_E}{dt}$$
Ampere's Law

E = electric field
A = area
q = charge
ε_0 = permittivity of free space (a constant)
B = magnetic field intensity
s = path length
Φ_B = magnetic flux
Φ_E = electric flux
t = time
μ_0 = permeability of free space (a constant)
i = current electric charge
$\mu_0\varepsilon_0$ = $1/c^2$, where c=speed of light

Maxwell's Equations

Maxwell's equations are a set of partial differential equations that, together with the Lorentz force law, form the foundation of classical electrodynamics, classical optics, and electric circuits.

ElectroMagnetic fields in turn provide the foundation of our modern electrical and communications technologies.

q
[1-0]

POSITIVE [Ω] CHARGE

E Field strength equal to dipole M-field

c²
seconds

Q

Gauss' Law of Electric Flux
Electric fields diverge from Electric charge, and produce the Coulomb force,

Q

N

Gauss' Law of Zero Nett Magnetism
there are no isolated Magnetic poles, but the Henry force acts between the poles of a magnet,

S

ε_0

Faraday's Law of Inductance
Electric fields are produced by changing Magnetic fields,

μ_0

Ampere's Circuital Law
circulating Magnetic fields are produced by moving Electric fields and by electric currents.

NEGATIVE [Ω] CHARGE

q
[0-1]

M-field dipole strength equal to E-field

c²
seconds

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Gauss' Laws

- Gauss' Law of Electric Flux and
- Gauss' Law of Magnetic dipoles

The laws were formulated by Carl Friedrich Gauss in 1835, but was not published until 1867.

They form two of Maxwell's equations which are the basis of classical electrodynamics.

The other two being:
- Faraday's law of induction, and
- Ampère's law with Maxwell's correction.

Gauss's law can be used to derive Coulomb's law, and vice versa.

Equilateral triangles are the foundational charge geometry of EM mass-Energy and Matter

Electric Charge
results from an imbalance of Energy momenta quanta in v² geometries

Carl Friedrich Gauss

(30 April 1777 – 23 February 1855)

Integral form

$$\oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0} = 4\pi k q$$

Differential form

$$\nabla \cdot E = \frac{\rho}{\varepsilon_0} = 4\pi k \rho$$

Electric fields are divergent from their source

Although originally envisaged as a property applied to spherical geometries and usually illustrated with square sectional boundaries integrating a surface area

$$\Phi = EA = E4\pi r^2 = \frac{Q}{\varepsilon_0}$$

Charge is shown to be the result of the symmetry of equilateral quantised angular momenta

Integral form

$$\oint \vec{B} \cdot d\vec{A} = 0$$

Differential form

$$\nabla \cdot B = 0$$

There are NO Magnetic Monopoles

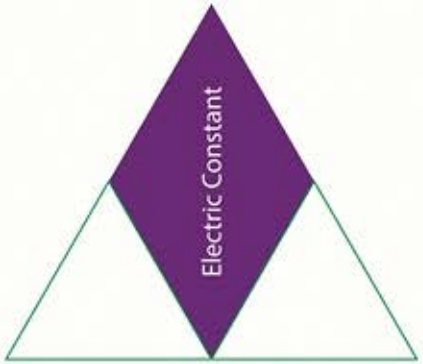

$$\varepsilon_0 = 8.85418785\text{e-}12 \ \frac{F}{m}$$

$$\oint \vec{E} \cdot d\vec{A} = \frac{q}{\varepsilon_0}$$

$$\oint \vec{B} \cdot d\vec{A} = 0$$

The electric flux through any closed surface is proportional to the enclosed electric charge

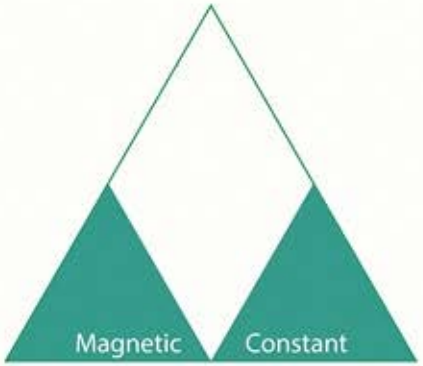

$$\mu_0 = 1.25663706\text{e-}6 \ \frac{H}{m}$$

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The Divergent force of Charge

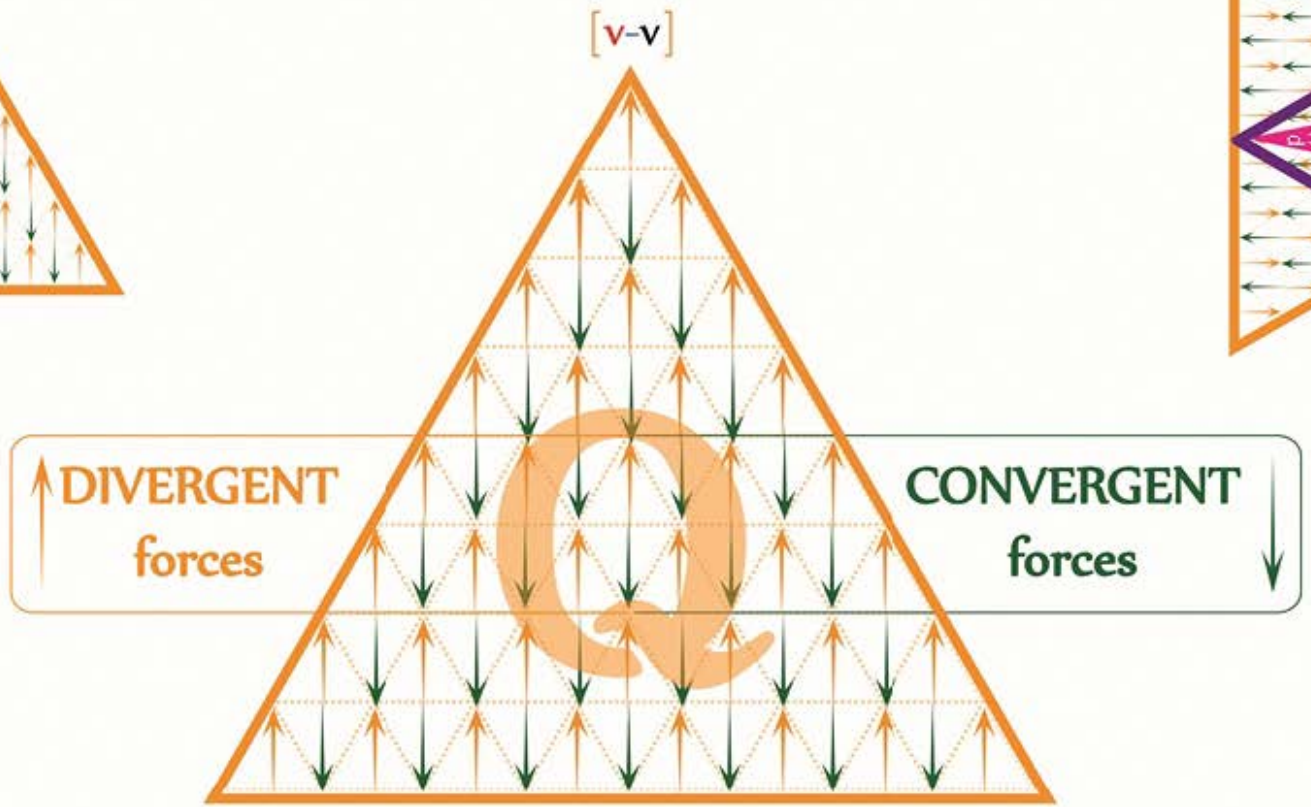

Charged EM fields create a net DIVERGENT force
as a result of their outward radiant energy momenta

but still possess CONVERGENT forces as a result of
their inherent equilateral energy momentum symmetries

Where these radiant charged fields diverge from their source
and overlap their superpositional energy momenta
create the forces of the Law of Interaction

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Coulomb's Law

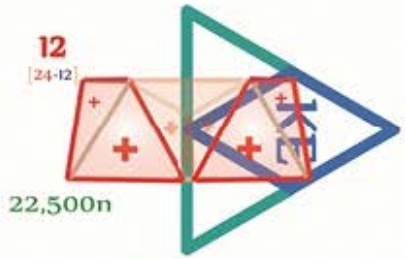

Proton

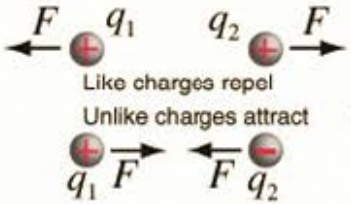

$$F = \frac{kq_1q_2}{r^2} = \frac{q_1q_2}{4\pi\varepsilon_0 r^2}$$ *Coulomb's Law*

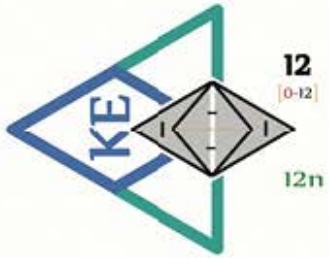

Electron

The magnitude of the electrostatic force between two point electric charges is directly proportional to the product of the magnitudes of each of the charges and inversely proportional to the square of the distance between the two charges.

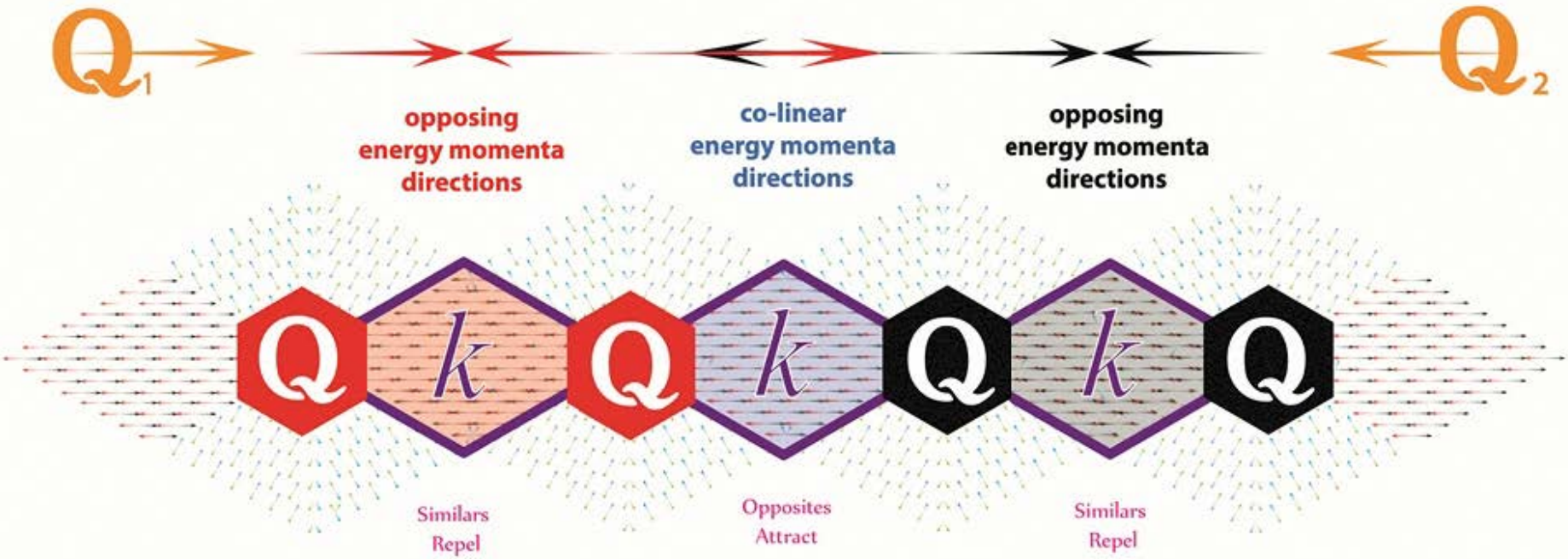

The law of Interaction

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Photons are chiral EM fields

The geometry of EM fields is invariant to the energy levels that produces them

The quantum harmonic oscillator is the quantum mechanical analog of the classical harmonic oscillator.

It is one of the few quantum mechanical systems for which a simple exact solution is known.

Changing Electric Fields produce changing Magnetic fields

Changing Magnetic fields produce changing Electric fields

Zero + E field
No Magnetic dipole
t=1

Maximum + E field
Minimum Magnetic dipole
t=2

Zero + E field
Maximum Magnetic dipole
t=3

Maximum - E field
Minimum Magnetic dipole
t=4

Zero - E field
No Magnetic dipole
t=5

Observes South Magnetic field

Observes North Magnetic field

Photons are shown to be Quadrature waves with multiple Electric and Magnetic components 90 degrees out of phase

The symmetric EM field geometry of photons and EM waves

As viewed from the Right-hand side (a LHS oberserver sees opposite Magnetic poles)

The symmetric ElectroMagnetic field strengths measured

Michael Faraday

(22 September 1791 – 25 August 1867)

EM field symmetry

" It is proposed that if a changing magnetic field can make an oscillating electric field, then

a changing electric field (from a oscillating electric charge) should make a changing magnetic field "

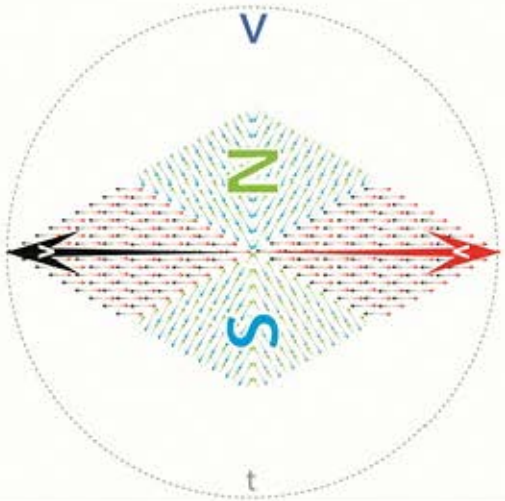

Any change in the magnetic environment of a coil of wire will cause a voltage (emf) to be "induced" in the coil.

No matter how the motional change is produced, a changing electromotive force will be generated.

The change could be produced by changing the magnetic field strength, moving a magnet toward or away from the coil, moving the coil into or out of the magnetic field, rotating the coil relative to the magnet.

All the resulting changes to the E & M fields and the vector strengths etc are the result of the inherent equilateral geometries of EM fields

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Electromagnetic Induction

All ElectroMagnetic circuits are comprised of quantum inductive fields [ZPFs] and energies that obey Newton's third law and the conservation of energy

EM field coupling

Electromagnetic induction is the production of an electric current across a conductor moving through a magnetic field.
It underlies the operation of generators, transformers, induction motors, electric motors, synchronous motors, and solenoids.

Inductive Coupling

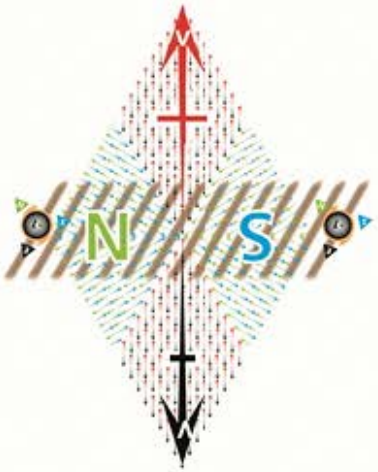

$$|\mathcal{E}| = \left|\frac{d\Phi_B}{dt}\right|$$

Michael Faraday formulated that electromotive force (EMF) produced around a closed path is proportional to the rate of change of the magnetic flux through any surface bounded by that path.

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$V_{\mathrm{P}} = N_{\mathrm{P}}\frac{\mathrm{d}\Phi}{\mathrm{d}t}.$$

For the special case of a coil of wire, or a transformer circuit composed of N loops with the same area, Faraday's general equation becomes

$$V_{\mathrm{s}} = N_{\mathrm{s}}\frac{\mathrm{d}\Phi}{\mathrm{d}t},$$

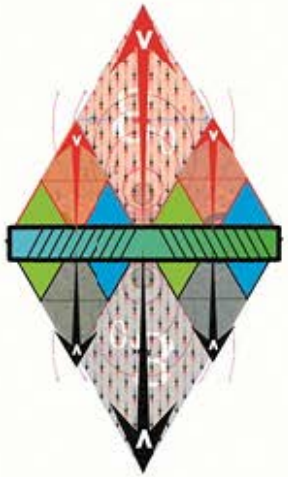

A corollary of Faraday's Law, together with Ampère's law and Ohm's law is Lenz's law:
The EMF induced in an electric circuit always acts in such a direction that the current it drives around the circuit opposes the change in magnetic flux which produces the EMF

$$\mathcal{E} = -N\frac{d\Phi_B}{dt}.$$

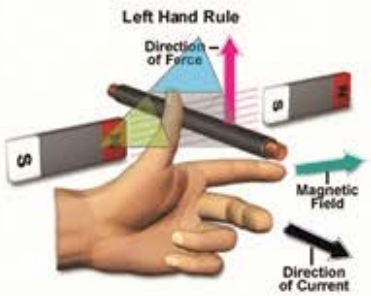

Flemings left hand rule
(for electric motors)

Coil moves UP

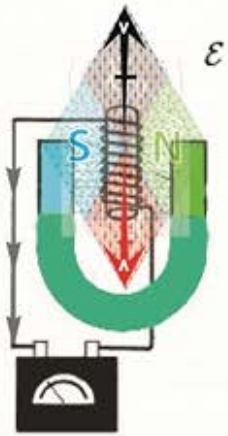

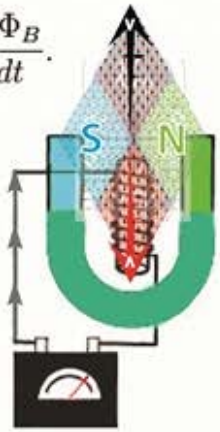

Coil moves DOWN

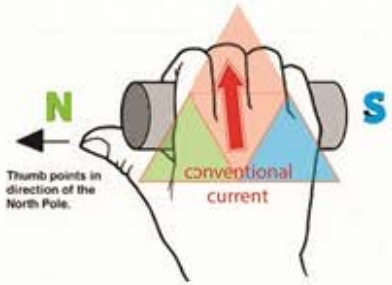

Fleming's right hand rule
(for EM induction)

An electric current passes through a solenoid, resulting in a magnetic field. When you wrap your right hand around the solenoid with your fingers in the direction of the conventional current, your thumb points in the direction of the magnetic north pole.

An electric current passes through a straight wire. Here, the thumb points in the direction of the conventional current (from positive to negative), and the fingers point in the direction of the magnetic lines of flux.

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Faraday's Law of Induction

Michael Faraday

(22 September 1791 – 25 August 1867)

Electromagnetic induction is the production of a potential difference (voltage) across a conductor when it is exposed to a varying magnetic field.

In the frame of a conductor moving relative to the magnet, charged particles in the conductor experience a coulombic force due to the neutralised electric fields of the permanent magnet.

Faraday's law states that:
The induced electromotive force (emf) in any closed circuit is equal to the time rate of change of the magnetic flux through the circuit.

$$\oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt}$$

The motion of EM fields creates an induced motion in external fields and particles

The linear energy momenta of the neutralised E-fields produces differing directions of induced emf (current flow)

A permanent magnet has a static Magnetic dipole field and neutralised Electric field geometries

Charged particles in the conductor are subject to voltage emfs

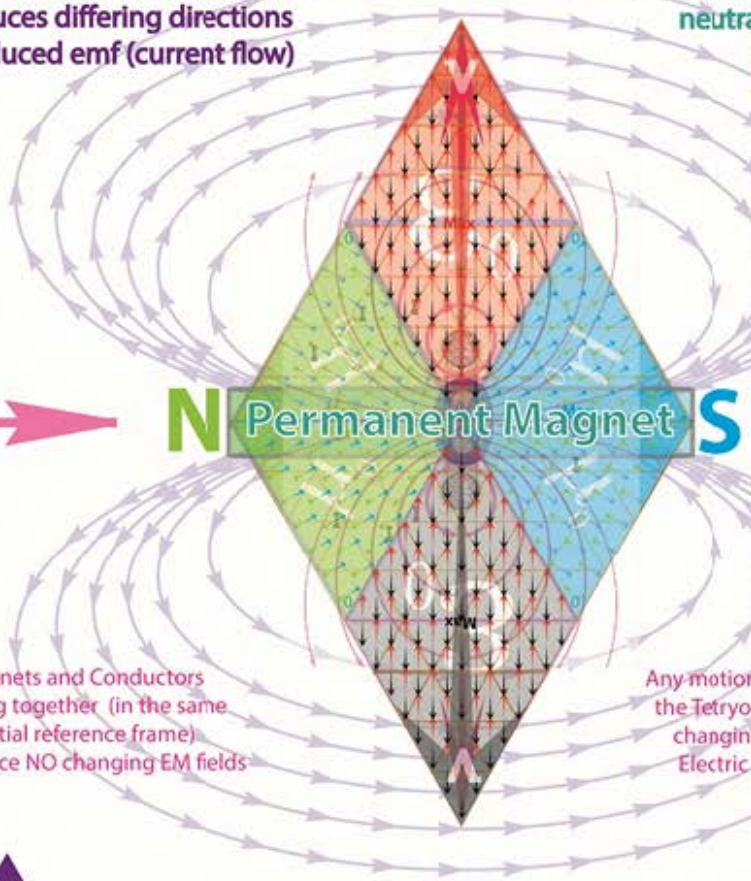

Charged particles in the conductor are subject to voltage emfs

Magnets and Conductors moving together (in the same inertial reference frame) experience NO changing EM fields

Any motion of the conductor relative to the Tetryonic field geometry produces changing force vectors in both the Electric fields and Magnetic fields

An Electrostatic (charged) particle has Electric fields of a particular polarity and neutralised Magnetic fields

It is impossible (due to the geometry of EM fields) to move either the permanent Magnet or the Conductor without producing variations in the Electric and Magnetic fields

A Magneto-static body of Matter has a dipolar Magnetic field and neutralised Electric fields

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Ampere's Law

In classical electromagnetism, Ampère's circuital law, relates the integrated magnetic field around a closed loop to the electric current passing through the loop.

Q

[v-v]

All energy momenta quanta have equilateral geometries, [quantised angular momenta [Ω]] that can be modelled as a continuous steady current within a closed inductive loop

$$\oint \vec{B}\cdot d\vec{s} = \mu_0 i + \frac{1}{c^2}\frac{\partial}{\partial t}\int \vec{E}\cdot d\vec{A}$$

The nett Charge of any particle or surface is the result of the quantised equilateral energy momenta symmetries of its integral surface area

All charged bodies in motion posses a Magnetic moment in addition to their kinetic energy

As the velocity of a charged body increases so does its energy momenta

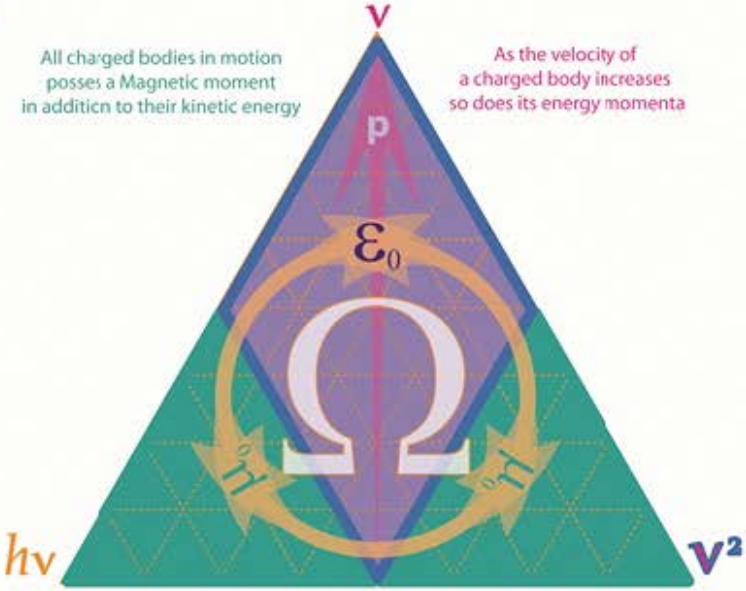

$$\oint_C \mathbf{B}\cdot d\boldsymbol{\ell} = \mu_0 I_{\text{enc}}$$

$$\mathbf{J_f} + \mathbf{J_D} + \mathbf{J_M} = \mathbf{J_f} + \mathbf{J_P} + \mathbf{J_M} + \varepsilon_0\frac{\partial \mathbf{E}}{\partial t} = \mathbf{J} + \varepsilon_0\frac{\partial \mathbf{E}}{\partial t},$$

With the addition of Maxwell's Displacement current to account for time varying electric fields without a physical flow of charged Matter the way forward is paved for Planck, Lorentz and Tetryonics

The Closed circuit or loop can be any geometric shape with Tetryonics dictating equilateral [triangular] Planck energies & quantum charge geometries with Tetrahedral geometries for Matter quanta

Andre Ampere

(20 January 1775 – 10 June 1836)

Ampere's law relates magnetic fields to the electric currents that produce them.

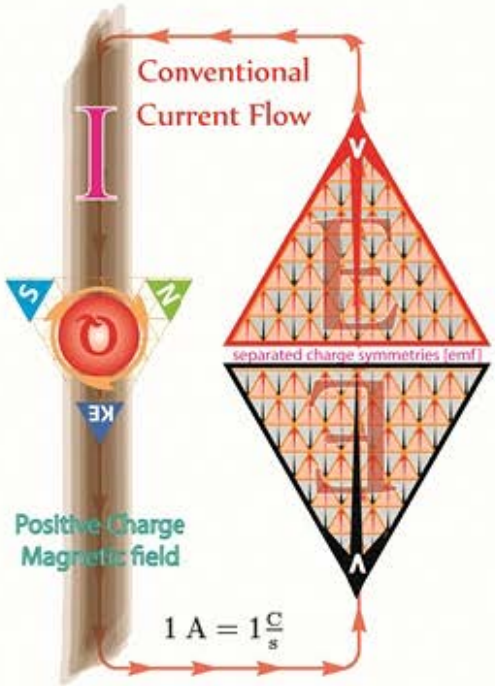

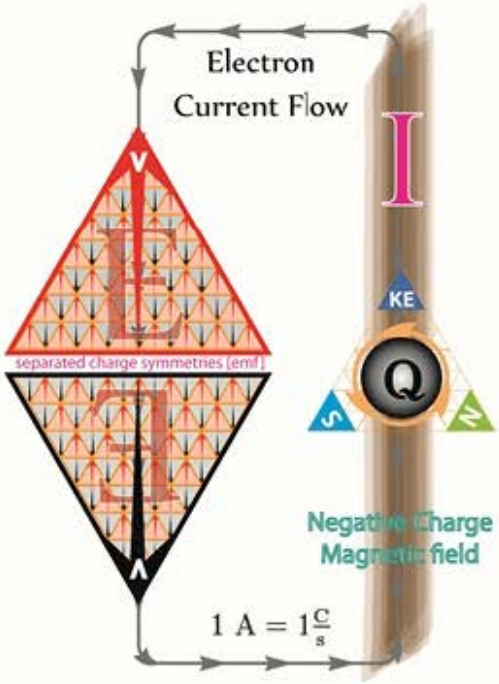

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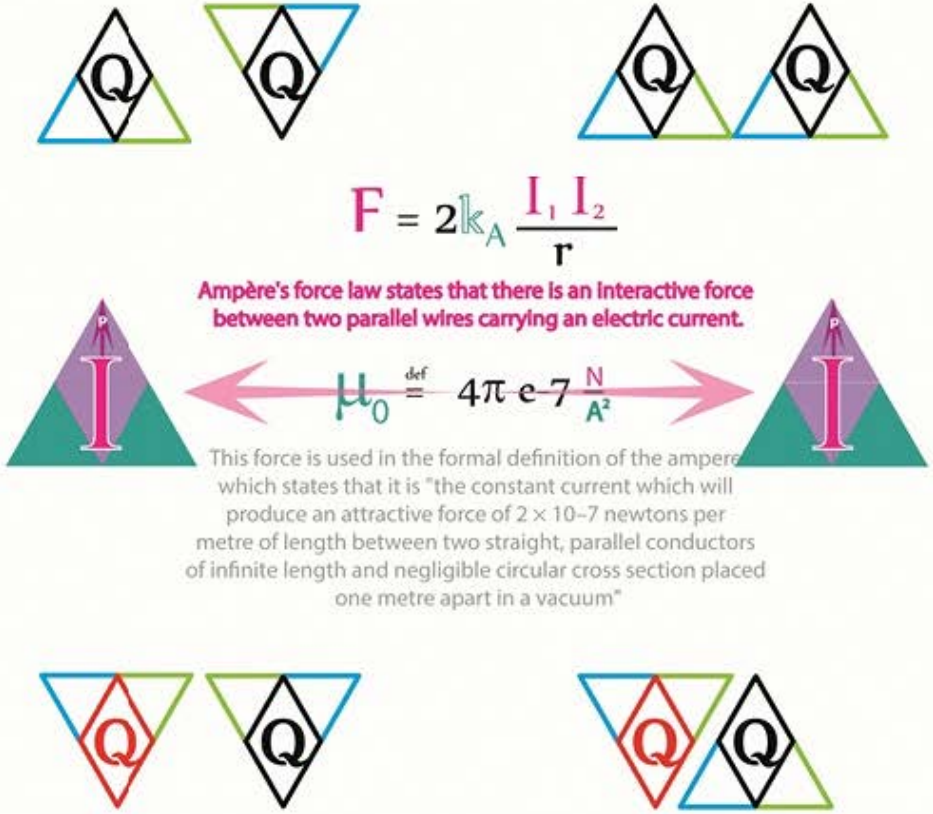

These attractions and repulsions between electric currents differ fundamentally from the effects produced by electricity in repose. First, they cease, as chemical decompositions do, as soon as we break the circuit. Second, in ordinary electric attractions and repulsions, opposite charges attract, and like charges repel; in the attractions and repulsions of electric currents, we have precisely the contrary; it is when the two conducting wires are placed parallel in such a way that their ends of the same sign are next to each other that there is attraction, and there is repulsion when the ends of the same sign are as far apart as possible. Third, in the case of attraction, when it is sufficiently strong to bring the movable conductor into contact with the fixed conductor, they remain attached to one another like two magnets, and do not separate after a while, as happens when two conducting bodies, oppositely electrified, come to touch.

André Marie Ampère (1775 - 1836)

Figure 3

$$1\ A = 1\frac{C}{s}$$

Interactive force between Conductors

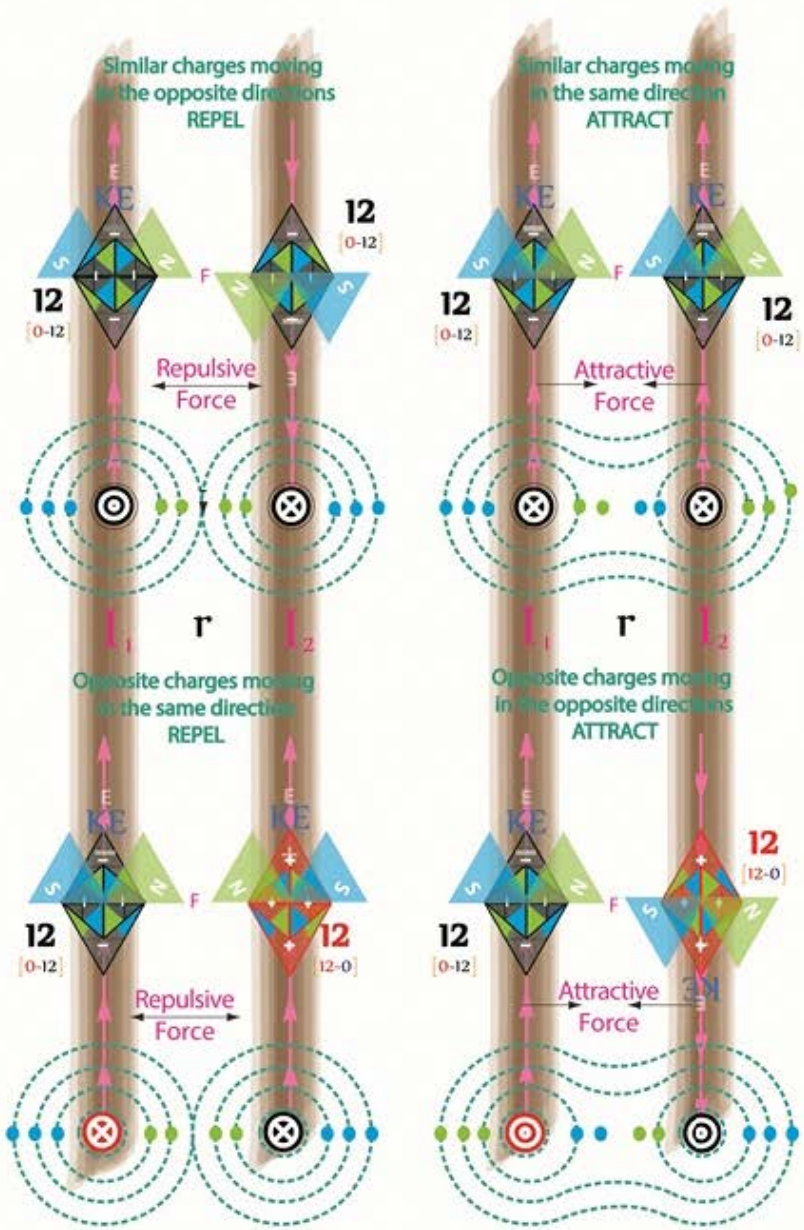

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ElectroMotive exchange particles

W

All four of the fundamental forces involve the exchange of ODD numbers of electromagnetic charge bosons so as to transfer discrete energy momenta between separated Matter

In ElectroMagnetic field or circuits, when charged Matter moves along electric field lines, electrical work is done on them by the electromotive force, whether it involves storing potential energy (negative work) or increasing kinetic energy (positive work)

γ

The EM exchange force denotes a force produced by the exchange of force carrier particles, such as the electromagnetic force produced by the exchange of photons between electrons

KEM field energy momenta attracts opposite charges

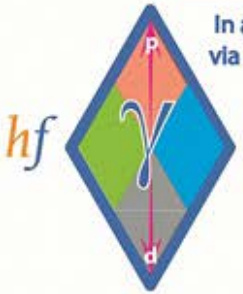

In accordance with Newton's 3rd Law Q2 can also act on Q1 via the superpositioning of energy fields and their momenta

This layered interaction of EM force quanta [EM charge carriers - Z bosons & Photons] is what constitutes the electromotive inductive force [emf]

The closer that Q1 and Q2 are, the greater the effect.

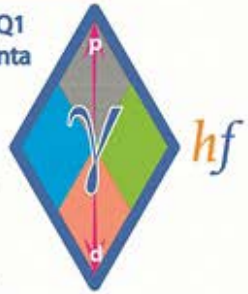

KEM field energy momenta repels same charge particles

Bosons

$$1\pi_{\text{Charge}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity

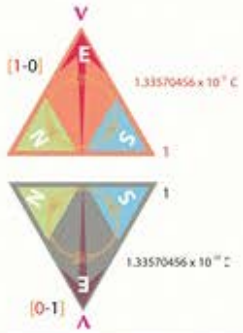

Photons

$$2\pi_{\text{Photons}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity

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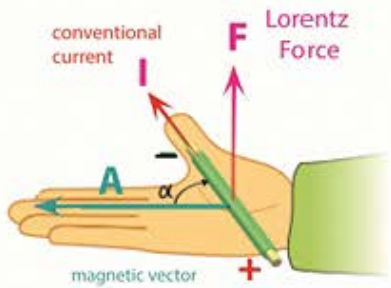

In physics, the Lorentz force is the force on a point charge due to electromagnetic fields.

It is given by the following equation in terms of the electric and magnetic fields

Lorentz Force

The magnetic force component of the Lorentz force manifests itself as the force that acts on a current-carrying wire in a magnetic field.

In that context, it is also called the Laplace force.

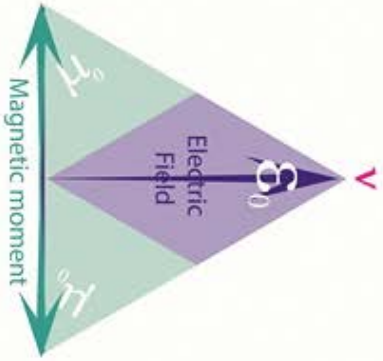

Hendrik Lorentz

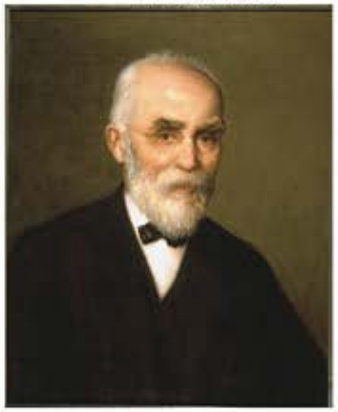

(18 July 1853 – 4 February 1928)

$$\vec{F} = q\vec{E} + q\vec{v} \times B$$

LORENTZ force — *Electric force* — *charge velocity* — *Magnetic force*

Magnetic fields created by moving charges are perpendicular to the direction of motion (and can do NO work)

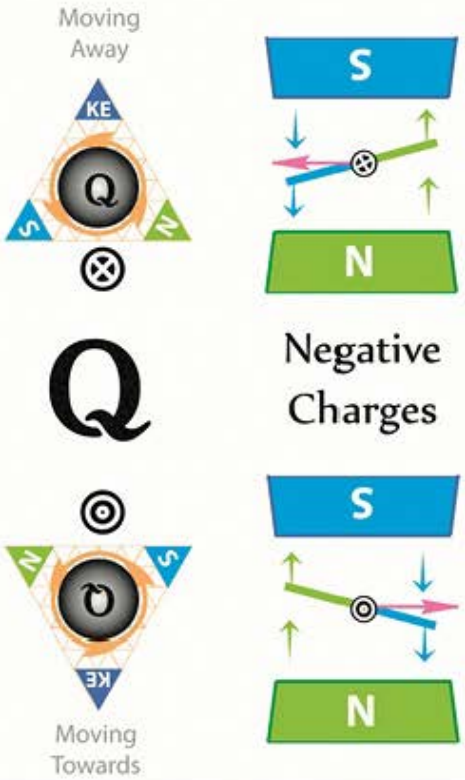

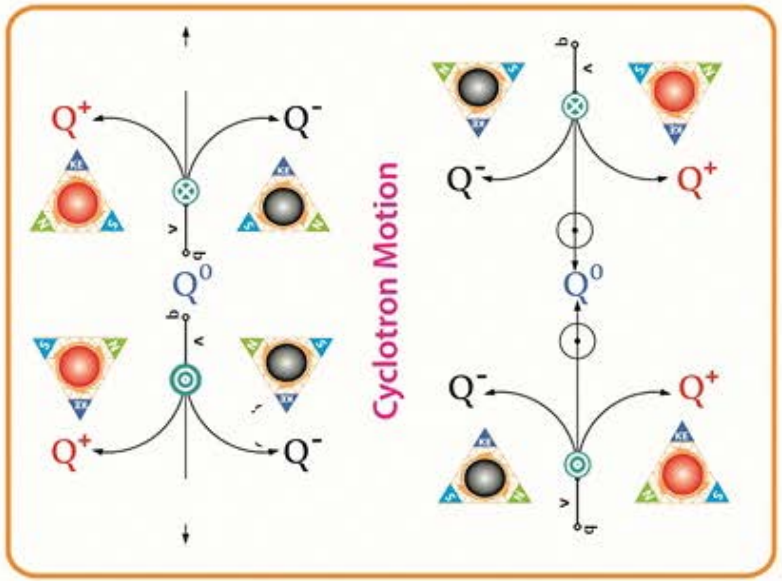

Up out of page ⊙ Magnetic Field ⊗ Down into page

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Work - Force - Energy

Work is the result of energy-momenta transfer (by means other than Matter-transfer), and produces changes in the second system's nett energy-momenta

Work

refers to an activity involving a force and movement in the directon of the force

Work

$$W = F.d = ma.d = E$$

The Planck constant is the quantum of Action

$$kg\frac{m}{s^2}\,m$$

Mechanical work is a scalar quantity that can be described as the product of a force times the distance through which it acts

[Force per meter]

Force

$$ma = \frac{\Delta p}{\Delta t} = \Delta\left[\frac{mv}{t}\right] \qquad kg\frac{m}{s^2}$$

Momentum is the quantum of Force

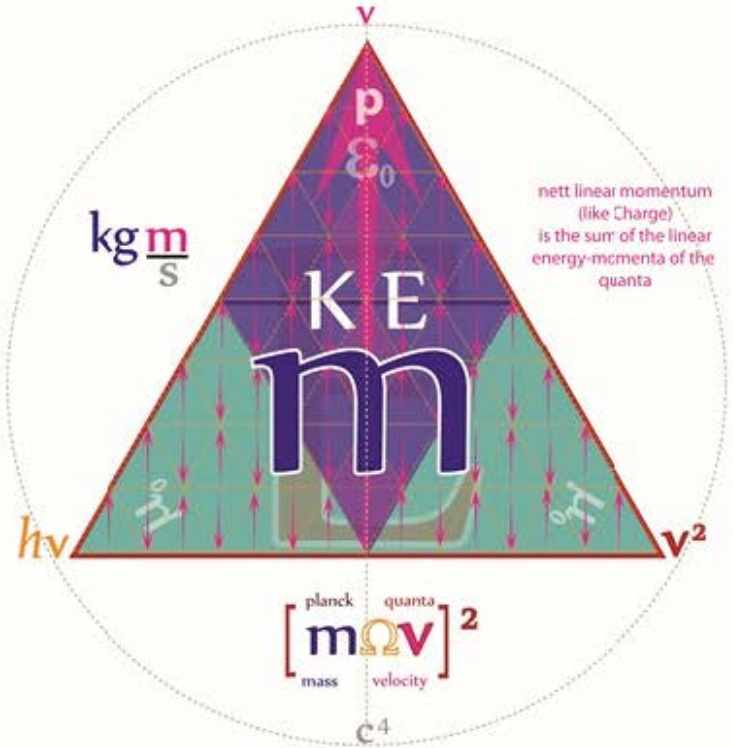

nett linear momentum (like Charge) is the sum of the linear energy-momenta of the quanta

Power is defined as the rate of using Energy or the rate of doing work

Energy

is the scalar capacity to do work
You must have energy to accomplish work

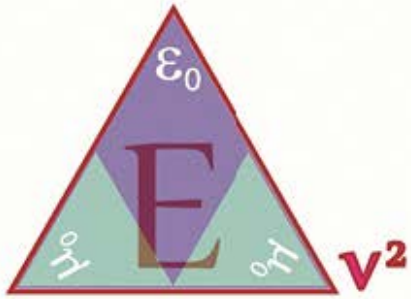

Energy

$$E = mv^2 = hv^2$$

Energy is the square of Momentum

$$kg\frac{m^2}{s^2}$$

Energy is always equivalent to the ability to exert pulls or pushes against the basic forces of nature, along a path of a certain length.

[mass-energy momentum squared]

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Watts
[Joules per second]

WORK

Force per second

In Classical Mechanics

One watt is the rate at which work is done when an object's velocity is held constant at one meter per second against constant opposing force of one newton.

Work in physics is measured in Joules

Nm/s

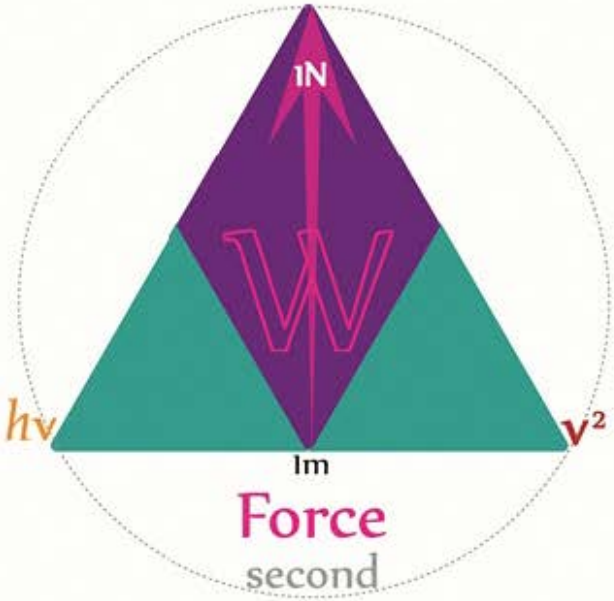

James Watt

(19 January 1736 – 25 August 1819)

The watt second is a unit of energy, equal to the joule

$$W = \frac{J}{s} = \frac{N \cdot m}{s} = \frac{kg \cdot m^2}{s^3}$$

One Watt, defined as one joule per second, measures the rate of energy conversion.

$$W = V.A$$

Energy / second
[Joules/sec]

POWER

Energy per second

In ElectroDynamics

One watt is the rate at which work is done when one ampere (A) of current flows through an electrical potential difference of one volt (V).

Electrical power is measured in Watts

J/s

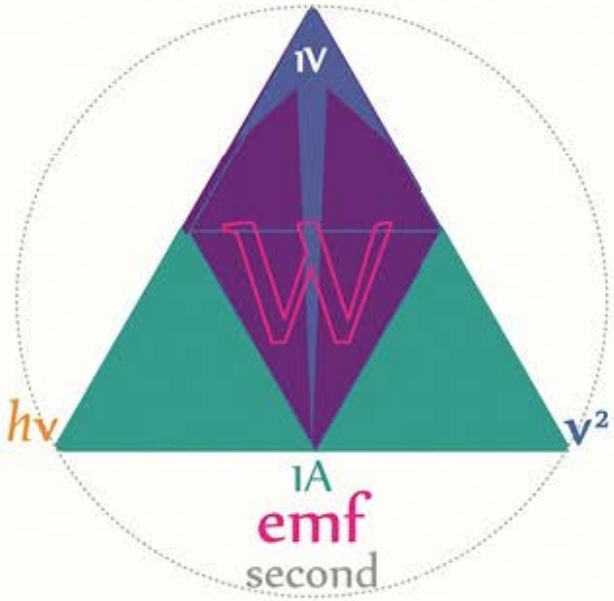

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The electromotive Force

The electromotive force, or most commonly emf (seldom capitalized), or (occasionally) electromotance is "that which tends to cause current (actual electrons and ions) to flow.

A conductor creates a circuit between the 'Quantum potentials' allowing charges to seek an eqilibrium (current flow)

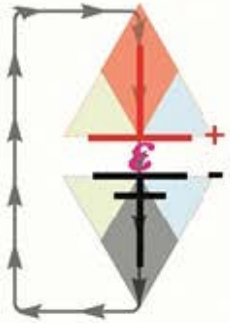

$$\mathcal{E} = -\frac{d\Phi_B}{dt},$$

Electric Fields contain bi-directional energy-momenta

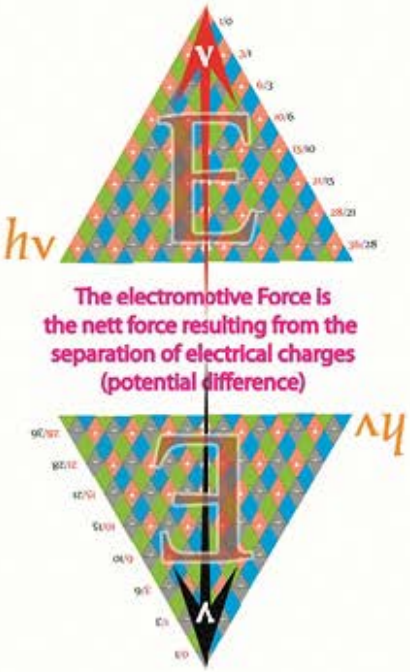

The electromotive Force is the nett force resulting from the separation of electrical charges (potential difference)

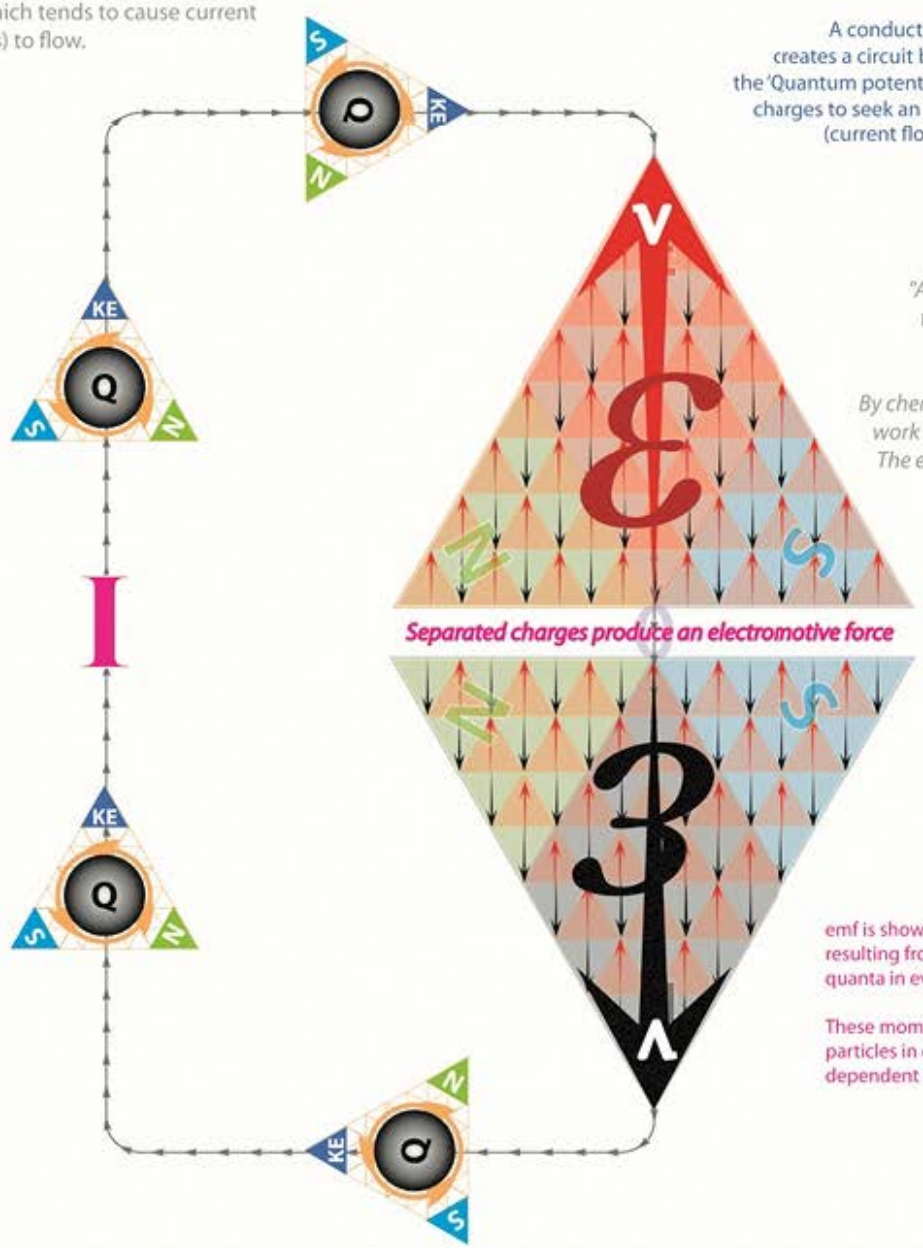

"A source emf can be thought of as a kind of charge pump that acts to move charge from a point of high potential through its interior to a point of opposite potential. . . .

By chemical, mechanical or other means, the source of emf performs work dW on that charge to move it to the high potential terminal. The emf of the source is defined as the work dW done per charge dq: = dW/dq."

A Magnet stores charge quanta (bosons) in static Electro-Magnetic fields that in turn produce a Magnetic dipole

emf is shown to be the nett force resulting from the linear momenta quanta in every Electric 'voltage' field

These momenta accelerate charged particles in one of two directions dependent of the particle's nett charge

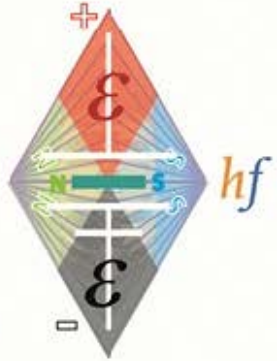

A Magnet can be viewed as a neutralised quantum emf source

All Charges seek Equilibrium

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Poynting Vectors

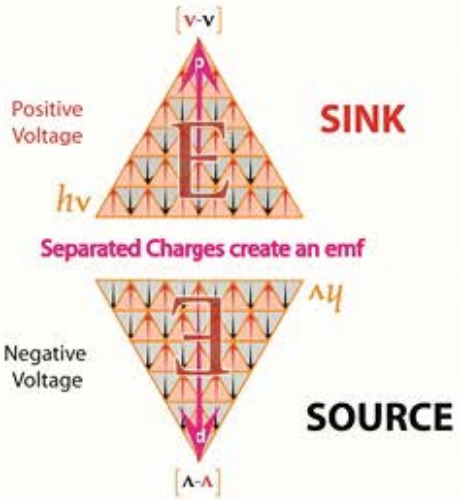

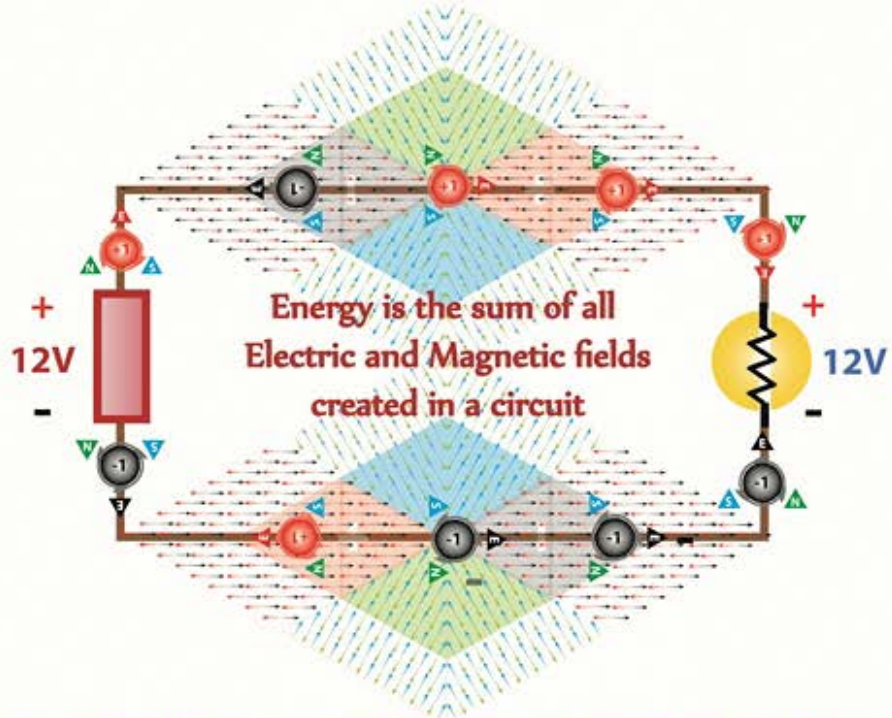

Poynting Field

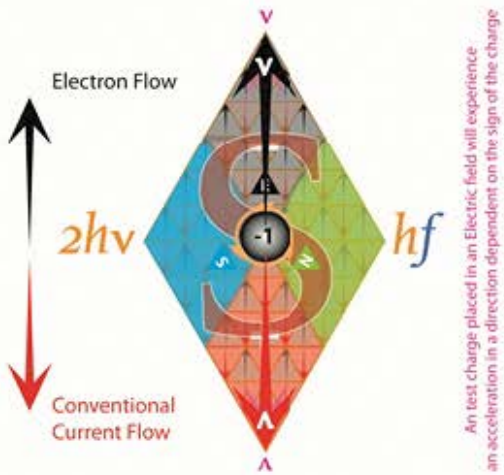

John Henry Poynting

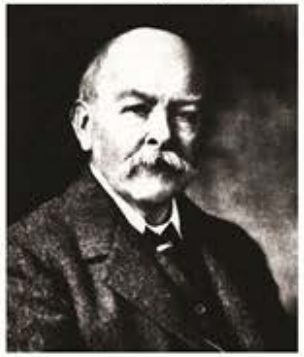

(9 September 1852 – 30 March 1914)

Electrical energy is transferred along a conductive path in an electrical circuit accelerating charged particles and ions in turn imbuing them with Kinetic Energy [voltage leads current]

There is an electric field running down the middle of the wire, which extends to just beyond its surface.

This electric field pushes the charges along against the resistance and adds to the electric field caused by the surface charges. The resultant electric field changes its direction around the circuit as the wires form a loop back to the battery.

Moving charged topologies inside the wire create a secondary magnetic field geometry around the wire

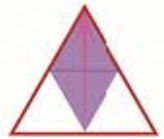

Energy

$$S = E \times H$$

momenta

Energy is transferred through empty space around (and NOT in) the wires of an electric circuit via an electromagnetic field called the Poynting field

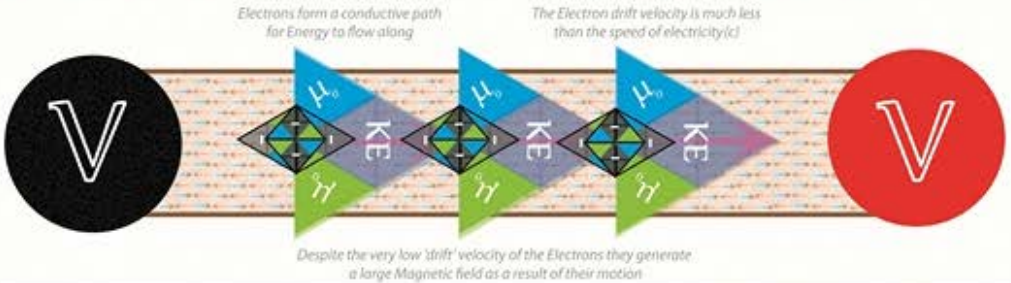

It's important to remember that the current doesn't flow in both directions, only the energy does

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Coulomb's Electric Interactions

$$k = \frac{1}{4\pi\varepsilon_0}$$

The proportionality constant ke, called the Coulomb constant (sometimes called the Coulomb force constant), is related to defined properties of linear EM energy momentum and is used to define Electric field forces

$$c = \frac{1}{\sqrt{\mu_0\varepsilon_0}}$$

8.987 e9 $\frac{\text{Nm}^2}{\text{C}^2}$

$$\varepsilon_0 = \frac{1}{\mu_0 c^2}$$

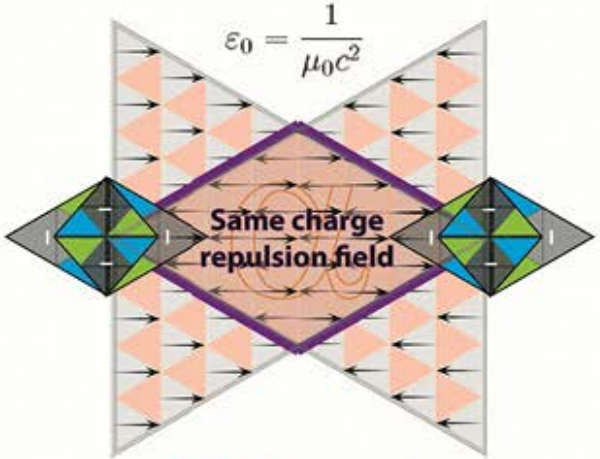

$$\mu_0 = \frac{1}{\epsilon_0 c^2}$$

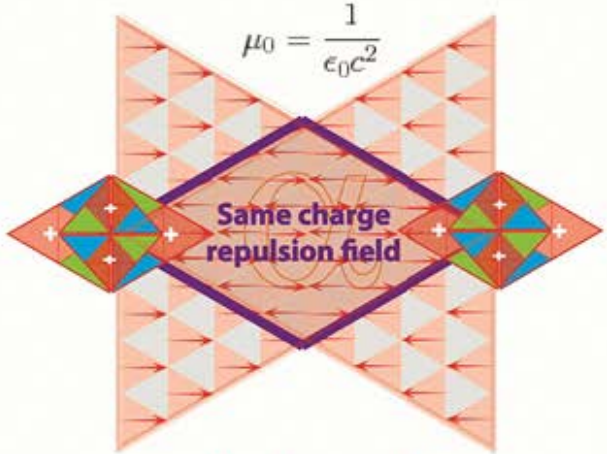

Similars repel

Opposites attract

Similars repel

Linear Coulombic force interactions are a result of charged E field linear momenta

$$\mathbf{E} = \frac{\mathbf{F}}{q_t}$$

The Electric field can be defined by the Force exerted by a Charge

It is a measure of the interactive force produced by the Electric field energy-momenta of two superpositioned charge KEM fields

Longitudinal E field forces between Charged particles are mediated by Photons

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{\mathbf{r}}$$

The Electric field can also be derived from Coulomb's Law

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Coulomb Force

Electric fields produce Coulombic forces

$$F = k\frac{Q_1 Q_2}{r^2}$$

It is defined as the nett Charge transported by a steady current of one Ampere in one second.

C

1 Coulomb of nett charge is comprised of

$(12 \times 1.335180067\ e\text{-}20)^{-1}$

6.240355408 e18 electrons

kg.s

$$k = \frac{1}{4\pi\varepsilon_0}$$

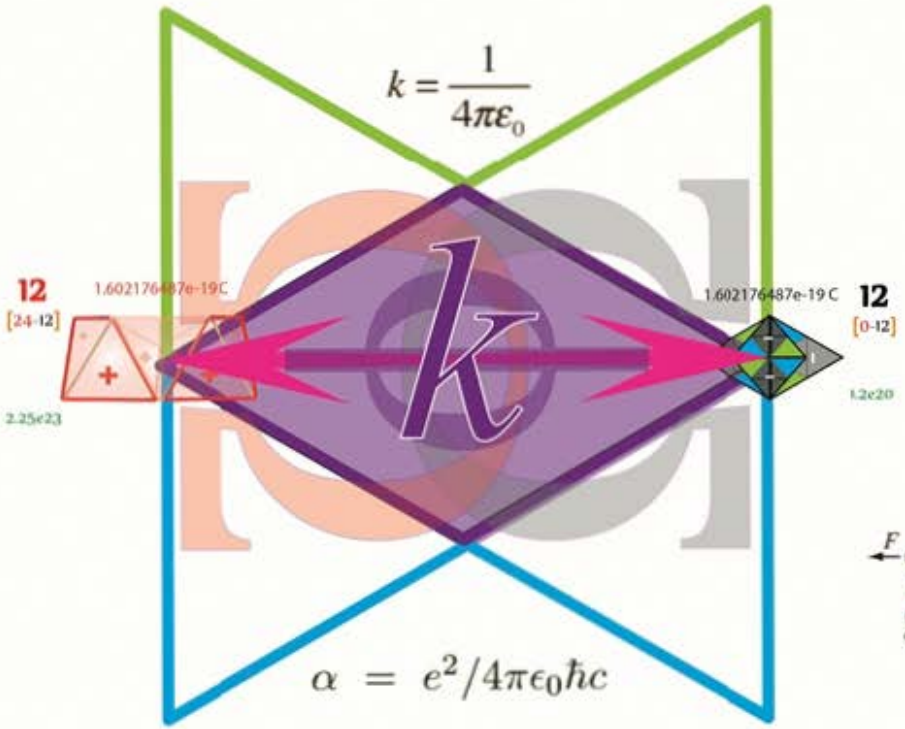

$$\alpha = e^2/4\pi\epsilon_0\hbar c$$

Charles-Augustin de Coulomb

(14 September 1736 – 23 August 1806)

Coulomb's Law is a law of physics describing the electric interaction between any two charged particles (and forms the basis for Ampere's Law)

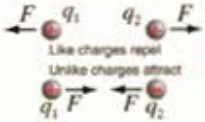

$$F = \frac{kq_1q_2}{r^2} = \frac{q_1q_2}{4\pi\varepsilon_0 r^2}$$ *Coulomb's Law*

The interactive linear momenta of super-positioned E-fields creates Coulombic forces

Coulombs

As

$1C = 1A \cdot 1s$

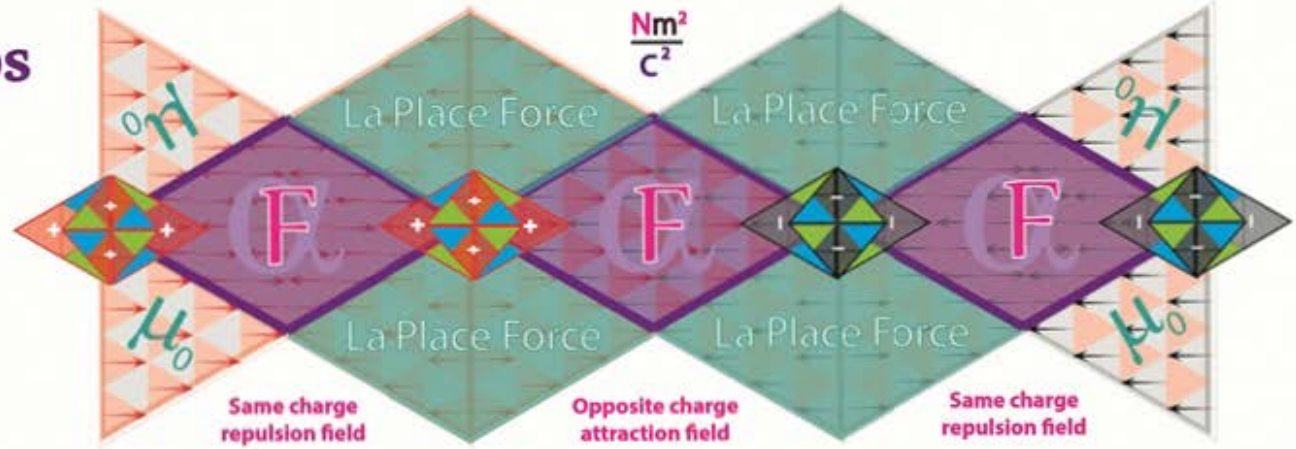

Amperes

$$\frac{C}{s}$$

$$1\,A = 1\frac{C}{s}$$

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Charles-Augustin de Coulomb

(14 September 1736 – 23 August 1806)

Coulomb force

$$k_c \frac{Q_1 Q_2}{r^2}$$

As

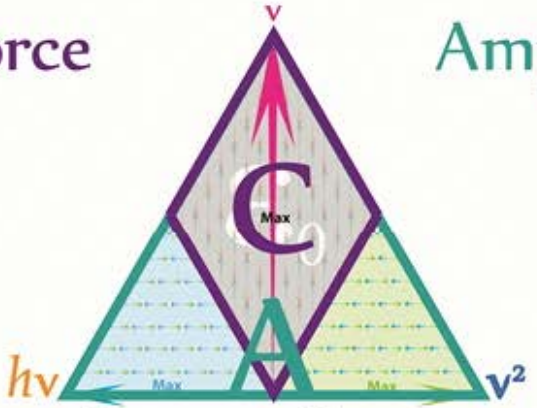

Ampere force

$$2k_A \frac{I_1 I_2}{r}$$

$$\frac{C}{s}$$

Andre Ampere

(20 January 1775 – 10 June 1836)

Lorentz Forces

are the forces on a point charge due to external electromagnetic fields

$$\vec{F} = q[\vec{E} + (\vec{v} \times B)]$$

electric force — velocity

magnetic forces do not accelerate charged particles

Linear acceleration
Electric force
between charged particles

Transverse perturbative
Magnetic force
between charged particles

Q

Same charges

Q

Opposite charges

Q

Same charges

Q

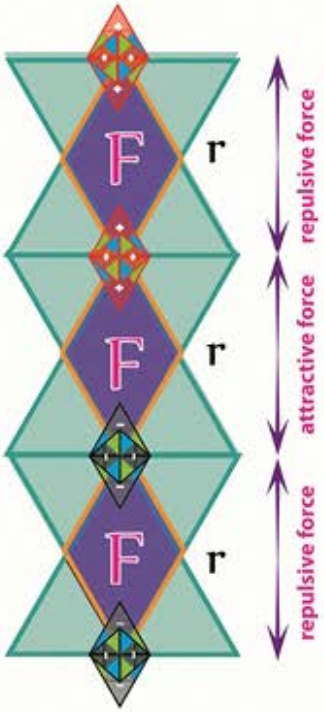

I

The amount of charged mass-Matter topologies moving passing a point per unit time

Current

Charge

The angular mass momenta possessed by a steady current of one ampere in one second.

Q

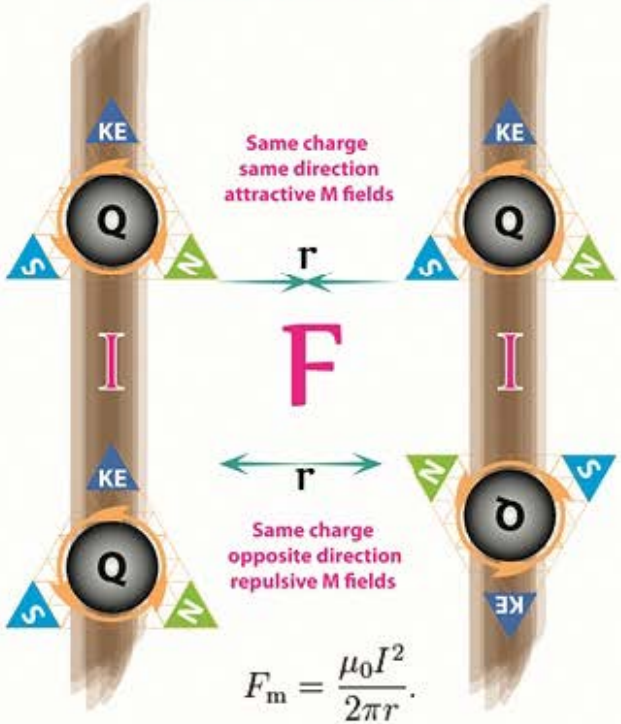

$$F_m = \frac{\mu_0 I^2}{2\pi r}.$$

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Capacitance

Any two electrical conductors separated by a non-conducting (or very high resistance) medium is a capacitor
[these can be plates, conductive wires or coaxial cables etc]

Plate capacitors

Capacitance is a function only of the physical dimensions (geometry) of conductors and the permittivity of the dielectric separating them

Coaxial cables

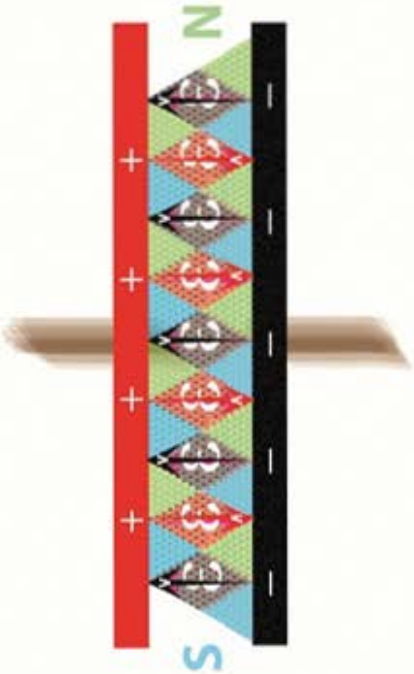

separated conductive cables

In general any separated charges will create a emf voltage

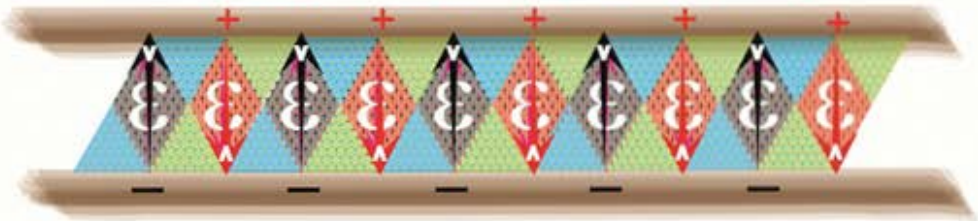

should a current flow in the conductors the capacitive field will be dominated by perpendicular, superpositioned amperian M-fields of greater strength

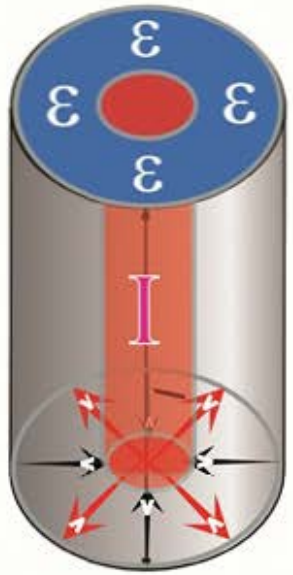

The SI unit of capacitance is the farad (symbol: F)
named after the English physicist Michael Faraday;

Capacitance is the ability of a body to store an electrical charge.

$$C = \frac{Q}{V}$$

Any object that can be electrically charged exhibits capacitance

A 1 farad capacitor when charged with1 coulomb of electrical charge will have a potential difference of 1 volt between its plates.

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Amperian Forces

Currents produce magnetic field forces

$$F = 2k_A \frac{I_1 I_2}{r}$$

6.241335 e18 electrons passing a given point per second constitutes one Ampere.

Coulombs are charged masses

m

that produce accelerations

Andre Ampere

(20 January 1775 – 10 June 1836)

Current is charged Matter in motion

M

that produce magnetic fields

A

1 Amp of electrons has a EM mass of

6.241355408 e18 x 8.851486361 e-31

5.524527227 e-12 kg

kg

An Ampere is a Coulomb per second.
a measure of the rate at which charged Matter moves.

A coulomb is the quantity of charge transported by one amp in one second

1.60221681 e-19 1.60221681 e-19 1.60221681 e-19 1.60221681 e-19 1.60221681 e-19 1.60221681 e-19

C

$1C = 1A \cdot 1s$

As

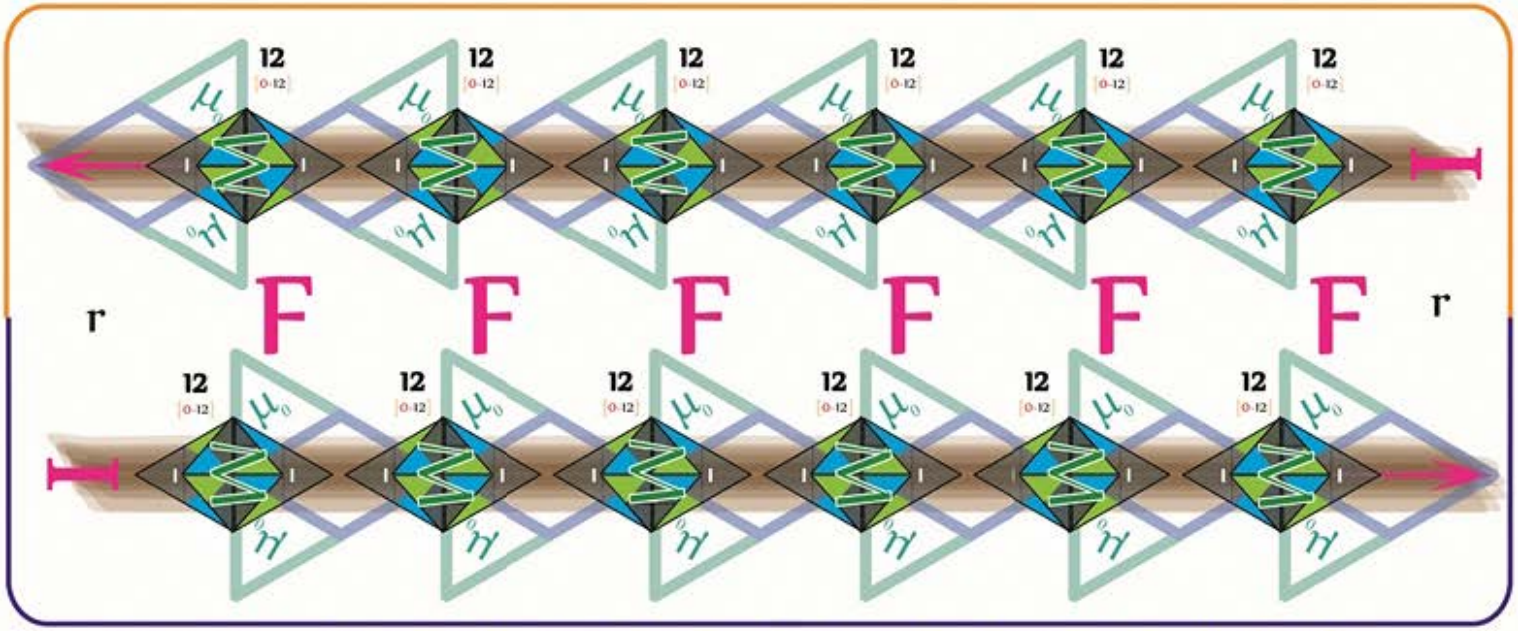

A

$1\,A = 1\frac{C}{s}$

$\frac{C}{s}$

8.851486 e-31 kg 8.851486 e-31 kg 8.851486 e-31 kg 8.851486 e-31 kg 8.851486 e-31 kg 8.851486 e-31 kg

An ampere is one coulomb per second

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Ampere's Magnetic Interactions

the force of attraction or repulsion between two current-carrying wires (see first figure below) is often called Ampère's force law.

The best-known and simplest example of Ampère's force law, which underlies the definition of the ampere, the SI unit of current, states that the force per unit length between two straight parallel conductors is

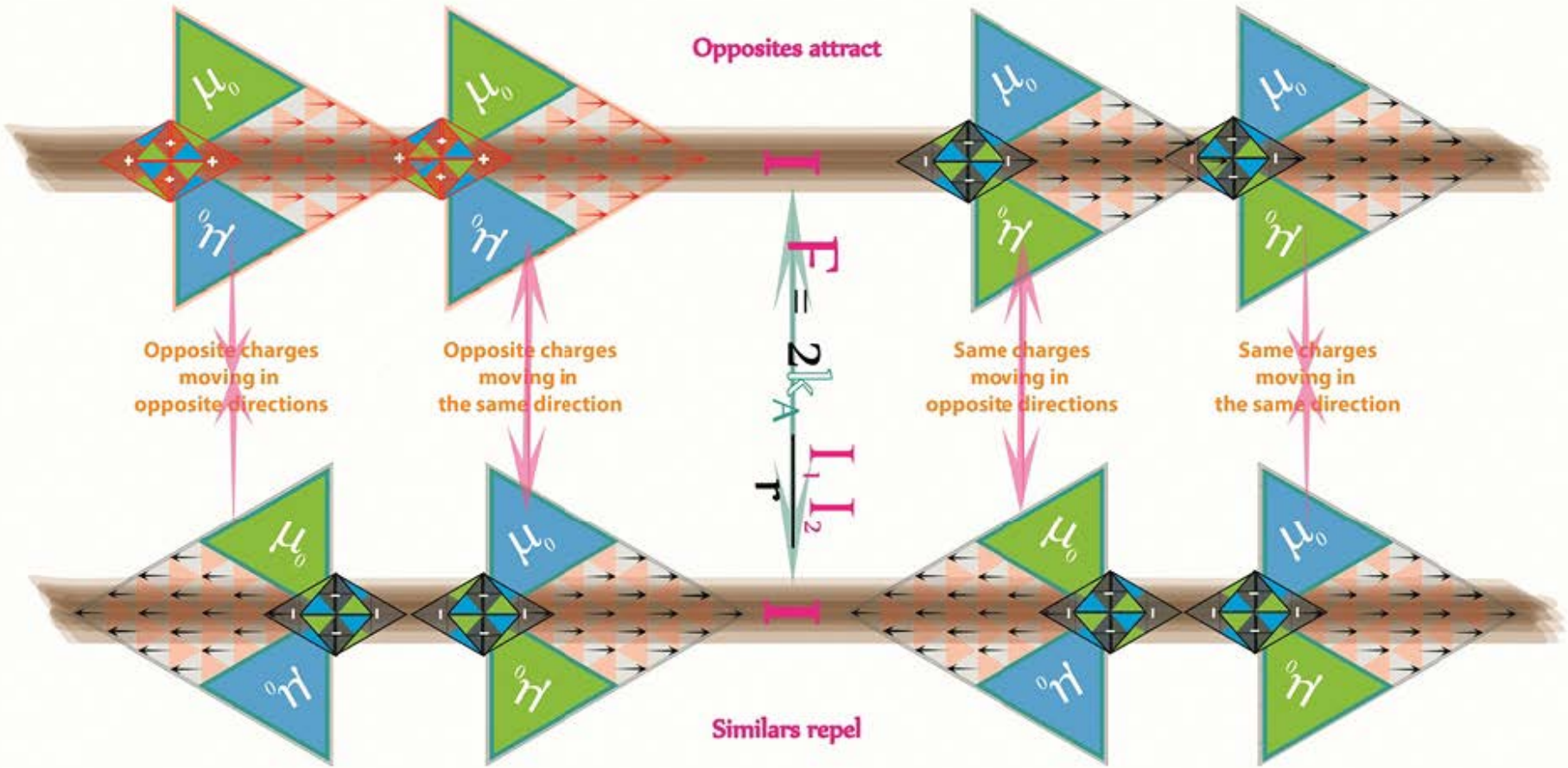

$$F = \frac{2k_A I_1 I_2}{r}$$

It is a measure of the interactive force produced by the Magnetic field energy-momenta of two superpositioned KEM field geometries

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Lorentz Forces

If a particle of charge q moves with velocity v in the presence of an electric field E and a magnetic field B, then it will experience a force

2D Electric field geometries accelerate charged particles

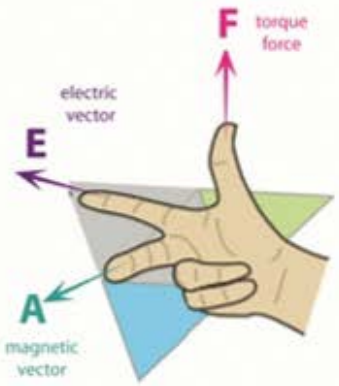

charged particles in motion produce KEM fields with magnetic moments

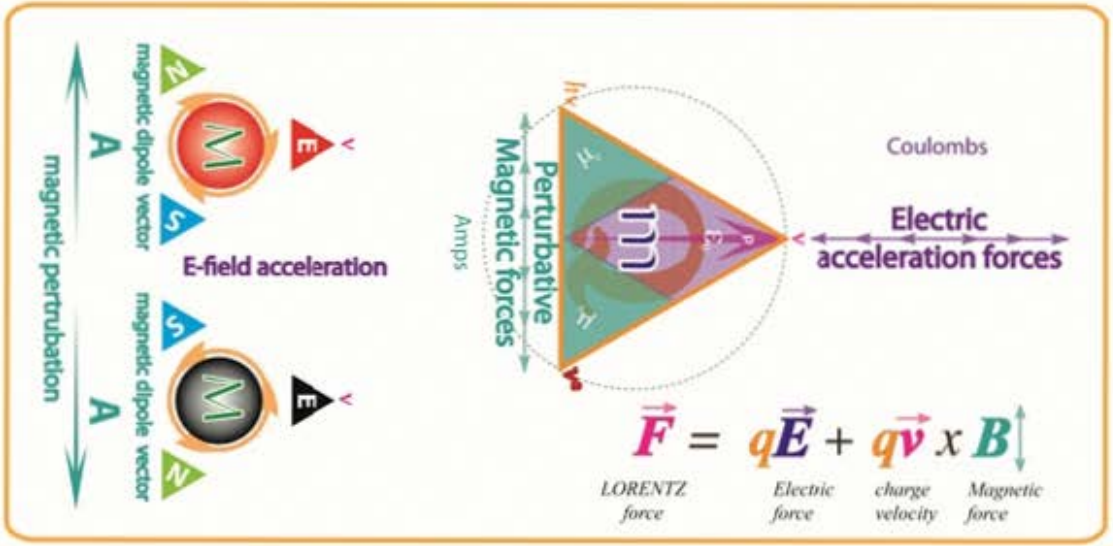

3D Matter topologies in motion create magnetic moments

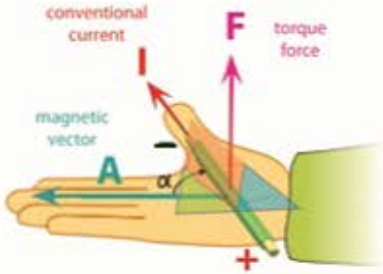

external magnetic fields create torque forces on the M dipoles of KEM fields

The Lorentz force is the force on a charged particle due to external electromagnetic fields.

Charles-Augustin de Coulomb

(14 September 1736 – 23 August 1806)

Magnetic field upwards through paper

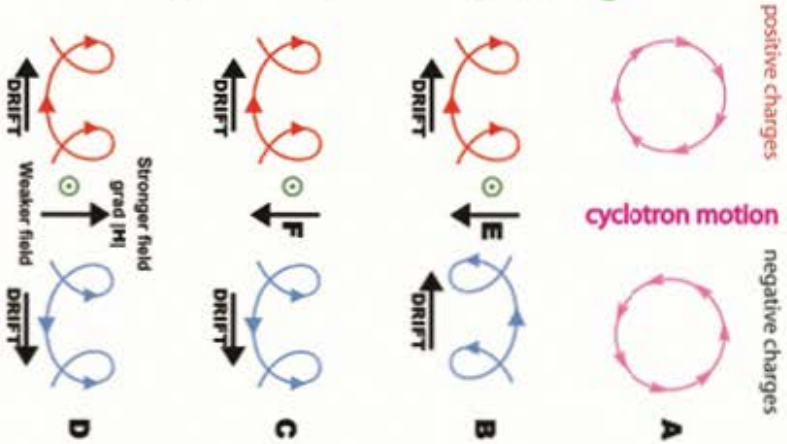

All charges in motion are subject to external EM forces on their KEM fields

Andre Ampere

(20 January 1775 – 10 June 1836)

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Neutral Particle interactions

Opposites Attract

Classical Forces of interaction
are unable to explain
how Neutral particles
are attracted to other particles

Similars Repel

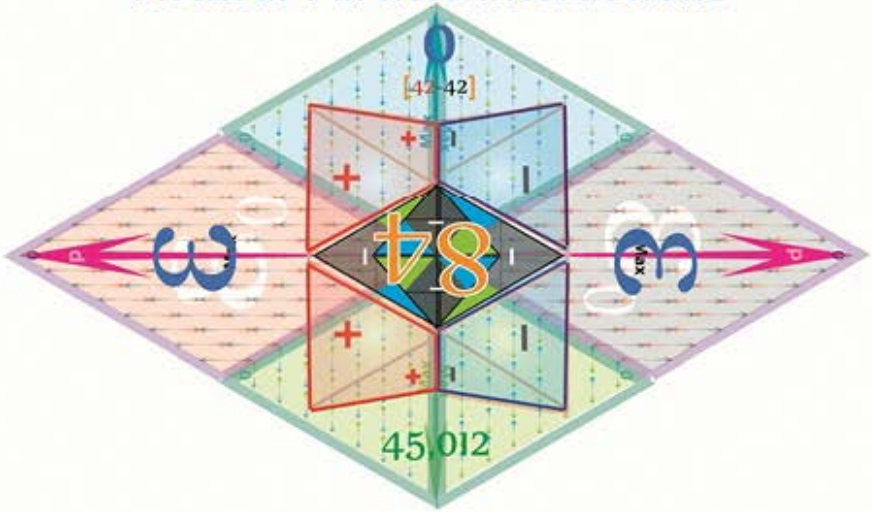

Tetryonic charge geometry

reveals the equilateral field mechanics behind
EM Induction and all the physical forces

All Matter topologies are comprised of charged mass-energy quanta
that effect atomic interactions via their KEM field energy momenta

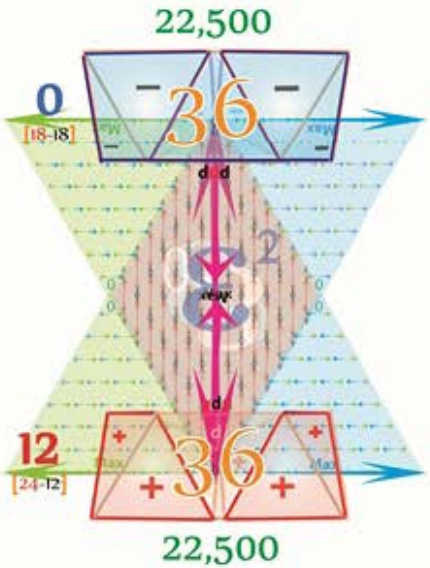

Coulombic Interactions

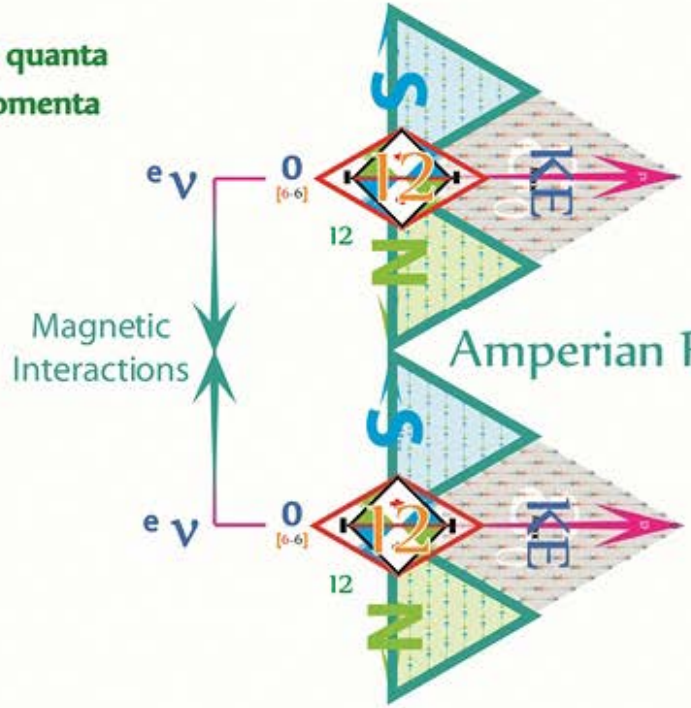

All Matter in motion produces a secondary interactive KEM field

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Coulombs

C

kg.s

mass seconds

$1C = 1A \cdot 1s$

An elementary charge is 1.602216081 e-19 C

Charged mass-Matter

All particles and fields have charged mass-energy geometries

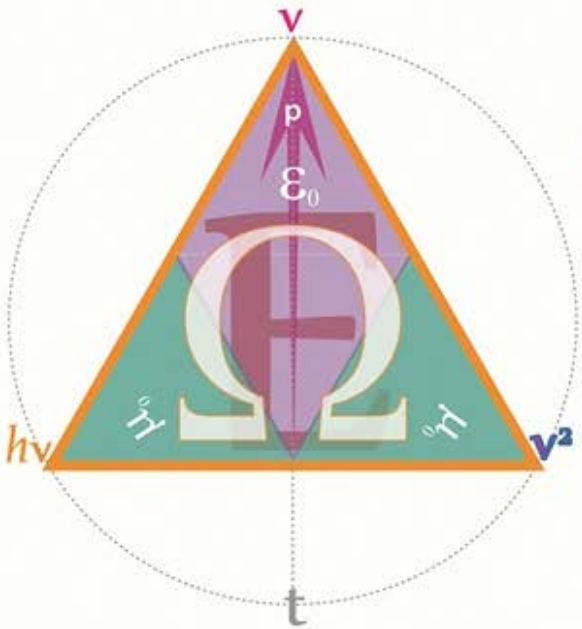

Amperes

A

KG

mass-Matter per second

$1\,A = 1\frac{C}{s}$

6.241355408 e18 electrons /sec constitutes one ampere.

Charge is measured by the linear forces produced by the 2D equilateral geometry of mass-energy momenta

2D kEM angular mass-energy momenta

It is defined as the charge provided by a steady current of one ampere in one second.

CHARGE

One coulomb of charge flowing per second equals one ampere of current.

CURRENT

$$Q = I \cdot t$$

Charge and Current are related to each other through time

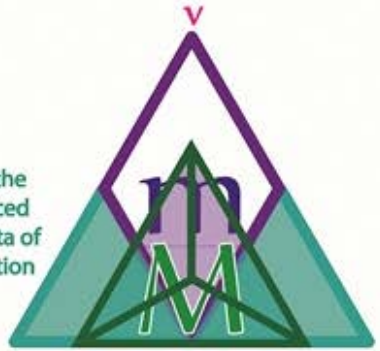

Current is measured by the transverse forces produced by mass-energy momenta of Matter topologies in motion per unit of time

3D mass-Matter momentum

The amount of charged mass- Matter passing a point per unit time

Charge

Q

Current

I

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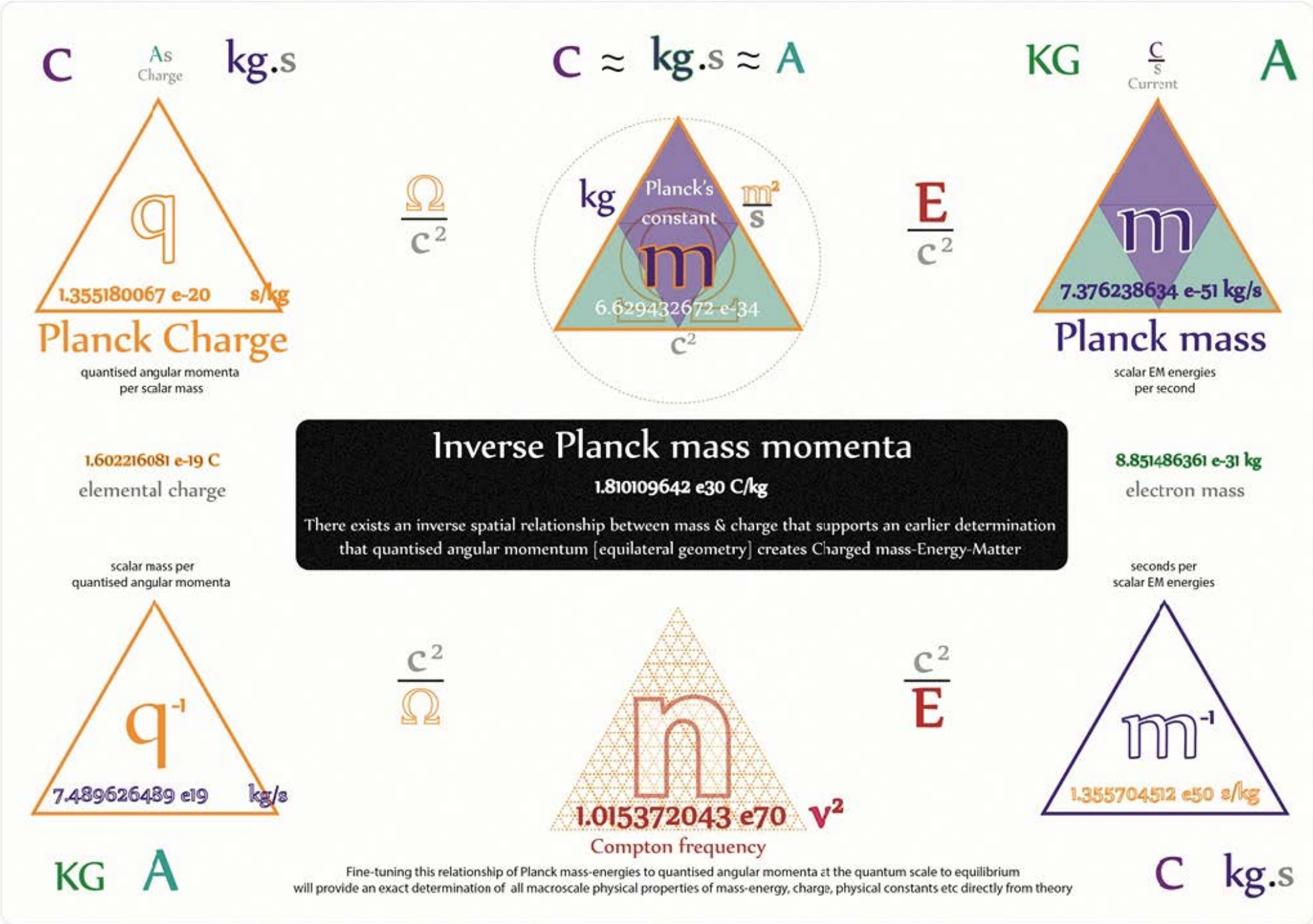

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Electricity

"There exists Negative and Positive electrical quanta"

Electromagnetism: a fundamental interaction between the magnetic field and the presence and motion of an electric charge topology.

Electric charge: the geometry of EM energy momenta, also determines their electromagnetic interactions.

Electrically charged Matter topologies are influenced by, and produce, electromagnetic fields when in motion

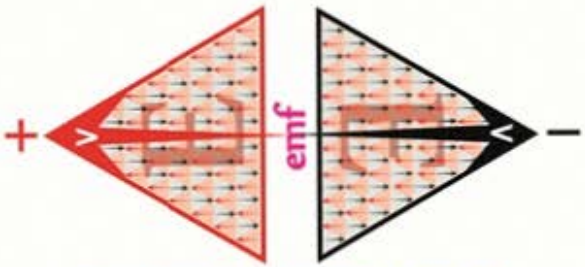

Electric potential: the capacity of an electric field to do work on an electric charge, typically measured in volts..

(January 17, 1706 – April 17, 1790)

Charles-Augustin_de_Coulomb
(14 September 1736 – 23 August 1806)

Andre Ampere
(20 January 1775 – 10 June 1836)

Georg Simon Ohm
(16 March 1789 – 6 July 1854)

Carl Friedrich Gauss
(30 April 1777 – 23 February 1855)

Heinrich Lenz
(February 12, 1804 – February 10, 1865)

Michael Faraday
(22 September 1791 – 25 August 1867)

James Clerk Maxwell
(13 June 1831 – 5 November 1879)

James Prescott Joule
(24 December 1818 – 11 October 1889)

John Henry Poynting
(9 September 1852 – 30 March 1914)

Nikola Tesla
(10 July 1856 – 7 January 1943)

Electric field: an influence produced by one electric charge on other charges in its vicinity.

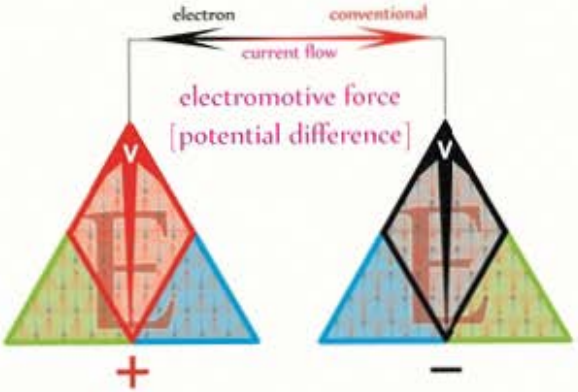

Electricity is the flow of Energy between separated Charge potentials when an electric circuit is formed measured in Volts [Joules/C]

Electric current: is a secondary effect resulting from electrical energy in a circuit It is the movement or flow of electrically charged particles, typically measured in amperes.

Electricity is a general term encompassing a variety of phenomena resulting from the presence and flow of electric charge. These include many easily recognizable phenomena, such as lightning, static electricity, and the flow of electrical current in an electrical wire. In addition, electricity encompasses less familiar concepts such as the electromagnetic field and electromagnetic induction.

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EM field Permittivity

The Electric constant, commonly called the vacuum permittivity, or permittivity of free space, relates the units for electric charge to mechanical quantities such as length and force.

The name Vacuum Permittivty is a misnomer and should be replaced with the correct term EM field Permittivity

The strength of Electric fields is determined by the Electrical Permittivity Constant

$$E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$

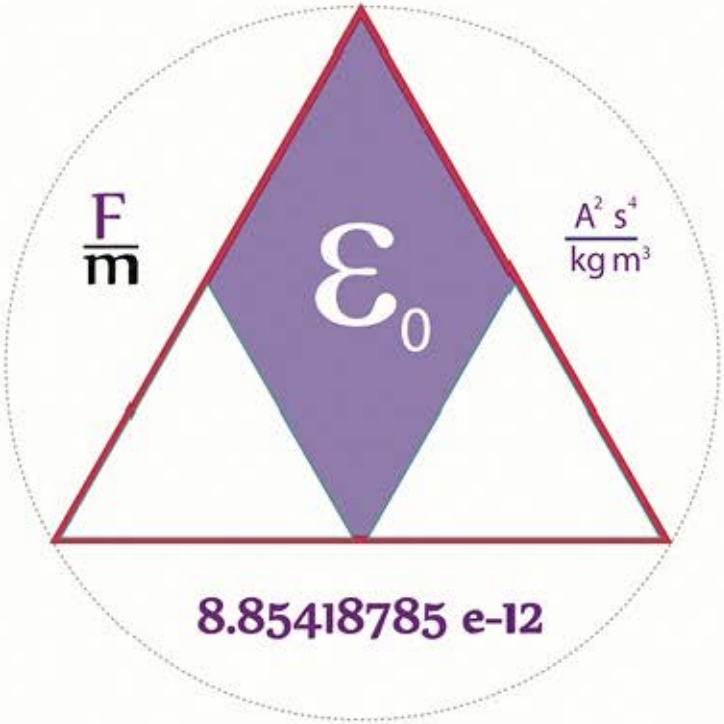

The permittivity of empty space, equal to 1 in centimeter-gram-second electrostatic units and to 107/4πc2 farads per meter or, numerically, to 8.854 × 10-12 farad per meter in International System units, where c is the speed of light in meters per second.

$$\varepsilon_0 = \frac{1}{\mu_0 c^2}$$

"Ampere's Law states that for any closed loop path, the sum of the quantities (B.ds) for all path elements into which the complete loop has been divided is equal to the product of μ0 and the total current enclosed by the loop."

$$k = \frac{1}{4\pi\varepsilon_0}$$

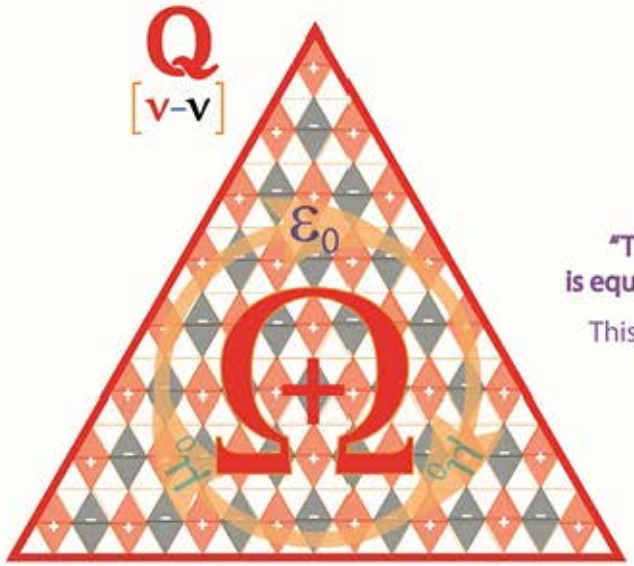

Positive Charge Electric Field

Gauss' Law:

"The total of the electric flux out of a closed surface is equal to the charge enclosed divided by the permittivity"

This applies equally to any integral geometry chosen to tessellate a surface area

Superpostioned E fields gives rise to Coulomb Forces

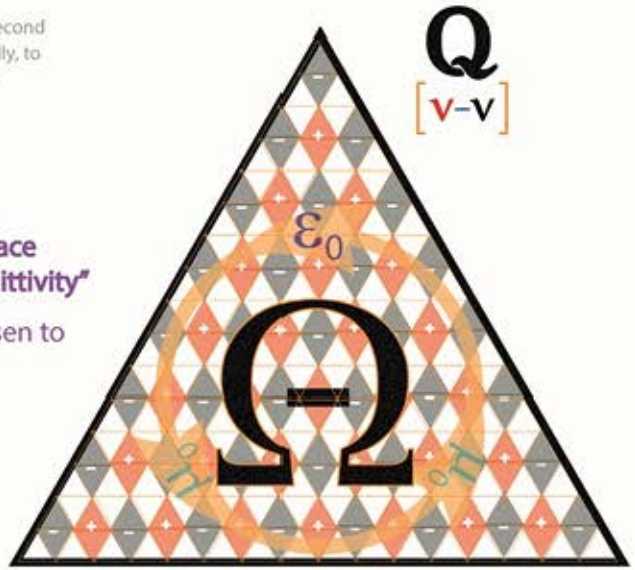

Negative Charge Electric Field

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EM field Permeability

The permeability of free space, also called absolute permeability.

The name Vacuum Permeability is a misnomer and should be replaced with the correct term EM field Permeability

The magnetic constant has the value of $4\pi \times 10\text{-}7$ henry per meter.

The strength of Magnetic fields is determined by the Magnetic Permeability Constant

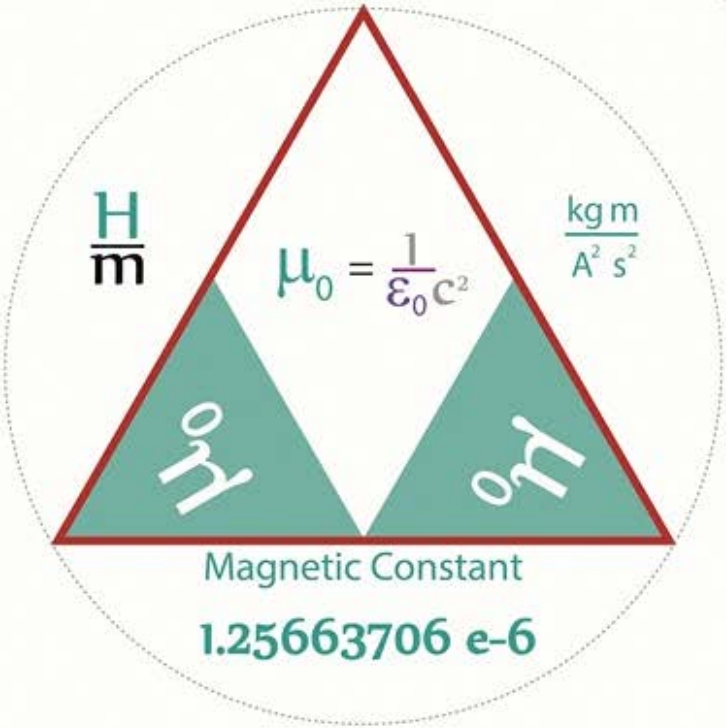

μ_0

The magnetic field is most commonly defined in terms of the Lorentz force it exerts on moving electric charges.

F

The magnetic field generated by a steady current (a constant flow of electric charges in which charge is neither accumulating nor depleting at any point) as described by the Biot–Savart law

$$B = \mu_0 H$$

Positive Magnetic Moment

Magnetic monopoles do NOT exist

they are a mathematical identity and not physically possible due to the equilateral geometry of Planck energies

Negative Magnetic Moment

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James Prescott Joule

(24 December 1818 – 11 October 1889)

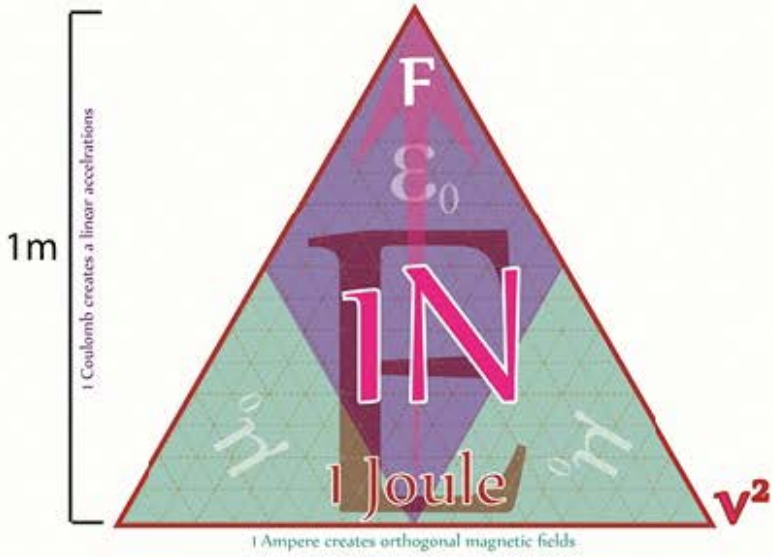

Joule

A measure of the equilateral charged mass-energy momenta that can to do work

... the mechanical power exerted in turning a magneto-electric machine is converted into the heat evolved by the passage of the currents of induction through its coils; and, on the other hand, that the motive power of the electro-magnetic engine is obtained at the expense of the heat due to the chemical reactions of the battery by which it is worked (1845)

$$n\pi \left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

mass; EM Field; ElectroMagnetic; Flanck quanta; mass; velocity

It is equal to the energy expended (or work done) in applying a force of one newton through a distance of one meter (1 newton metre or N·m), or in passing an electric current of one ampere through a resistance of one ohm for one second

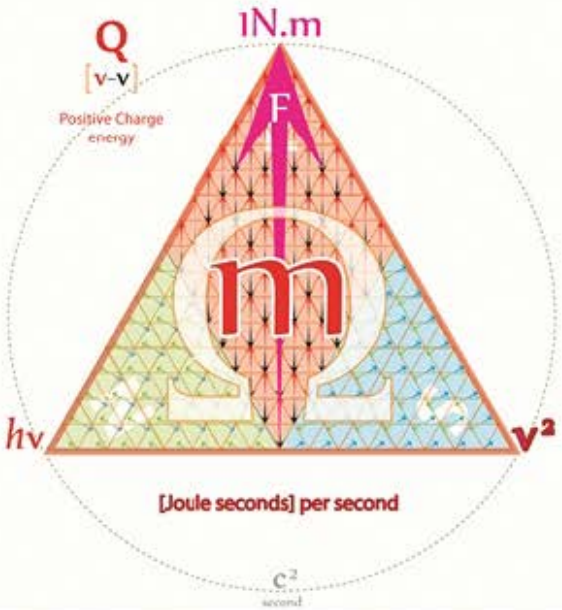

Energy $kg.\frac{m^2}{s^2}$

$$J = \frac{kg \cdot m^2}{s^2} = N \cdot m = Pa \cdot m^3 = W \cdot s$$

Planck's Constant x frequency $\left[kg.\frac{m^2}{s}\right].s^{-1}$

mass x velocity squared $kg.\left[\frac{m}{s}\right]^2$

Momentum x velocity $\left[kg.\frac{m}{s}\right].\frac{m}{s}$

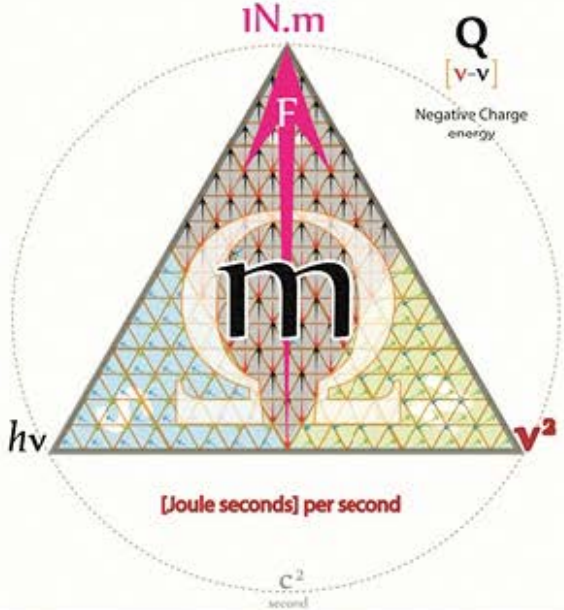

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Volts

[Joules per Coulomb]

The volt is the unit for electric potential (voltage), electric potential difference, and electromotive force.

$$V = \frac{W}{A} = \frac{J}{A \cdot s} = \frac{N \cdot m}{A \cdot s} = \frac{kg\, m^2}{A\, s^3} = \frac{kg \cdot m^2}{C \cdot s^2} = \frac{N \cdot m}{C} = \frac{J}{C}$$

A single volt is defined as the difference in electric potential across a wire when an electric current of one ampere dissipates one watt of power.
It is also equal to the potential difference between two parallel, infinite planes spaced 1 meter apart that create an magnetic field of 1 newton per coulomb.
Additionally, it is the potential difference between two points that will impart one joule of energy per coulomb of charge that passes through it

Positive charge

$1V = 1J/C$

One Volt is defined as energy consumption of one joule per electric charge of one coulomb

Negative charge

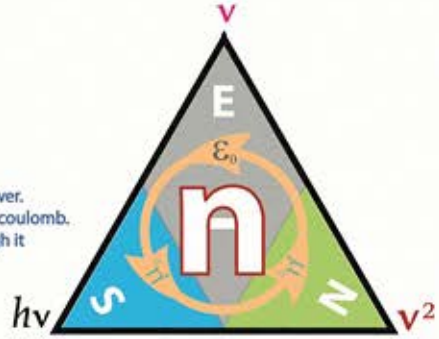

$1V = 1A \cdot 1ohm$

One volt is equal to current of 1 amp times resistance of 1 ohm

Positive voltage

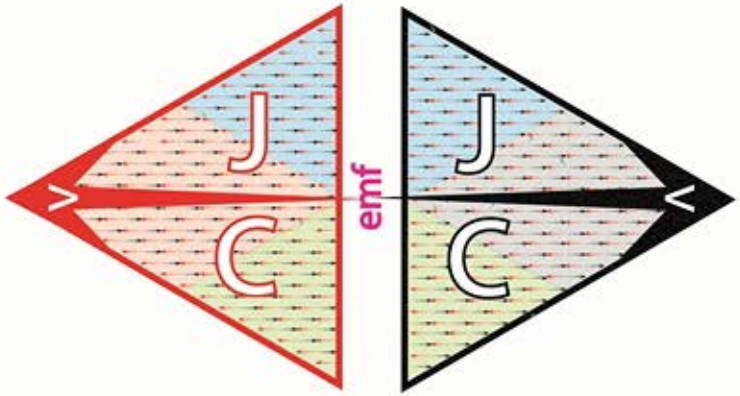

Negative voltage

Any separation of electrostatic charges, results in a voltage.
[Potential Difference]

Voltage is a scalar measure of linear electromotive forces of separated charges seeking potential equilibrium

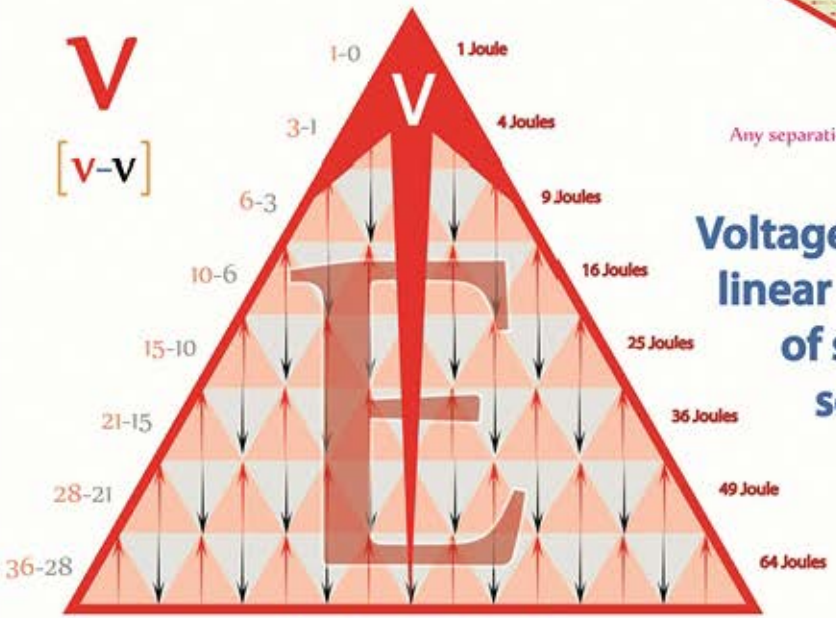

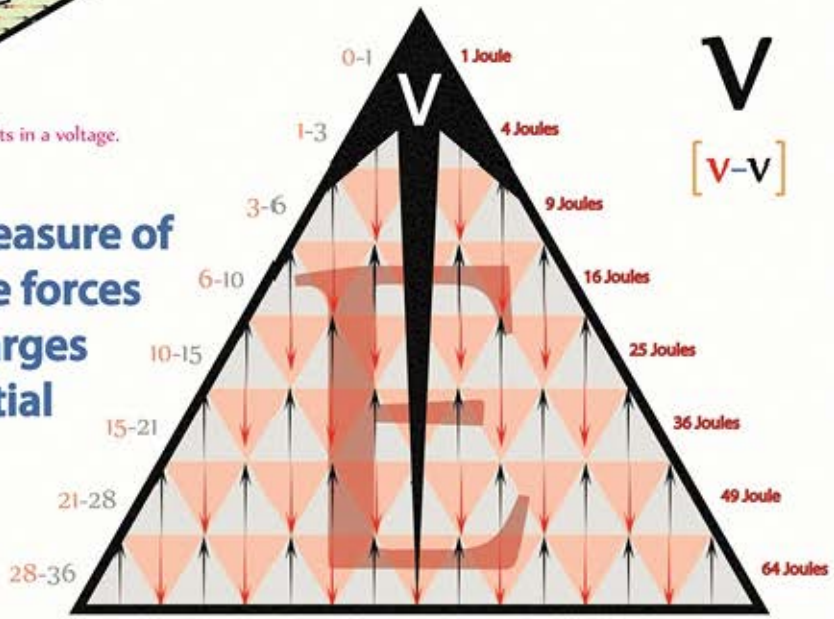

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Positive charged mass-energy

1
[1-0]

Clockwise inductive energy flux

Charge is the equilateral geometry of Energy that gives form to all mass & Matter

charge

time

Negative charged mass-energy

1
[0-1]

Counter clockwise energy flux

q

$$\frac{\Omega}{c^2}$$

$$\frac{m^2}{s}\,\frac{s^2}{m^2}$$

$$s$$

seconds

q

t

t

ElectroMagnetic Charge is a quantum property resulting from the equilateral QAM geometry of mass-Energy

1.33518 e-20 s

Changes to nett quantised angular momenta [charged mass-energies] within any space-time co-ordinate system forms the basis of time

The two ElectroMagnetic charge geometries possible can be created through tesselation of electrical energy in ideal inductive loops

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Coulombs

are a measure of 2D charged mass geometries
and the electromagnetic forces they produce per unit time

W+ boson integrals
nett positive charged
mass momenta

Q
[v-v]

Charles-Augustin de Coulomb

(14 September 1736 – 23 August 1806)

Q
[v-v]

W- boson integrals
nett negative charged
mass momenta

Derived in 1785 Coulomb's Law is a law of physics describing the electrostatic interaction between any two charged particles (and forms the basis for Ampere's Law)

Electric forces

$m\frac{\Omega}{c^2}$

Magnetic forces

Coulombs

The coulomb (unit symbol: C) is the SI derived unit of electric charge (symbol: Q or q).
It is defined as the charge transported by a steady current of one ampere in one second:

Amperes

As

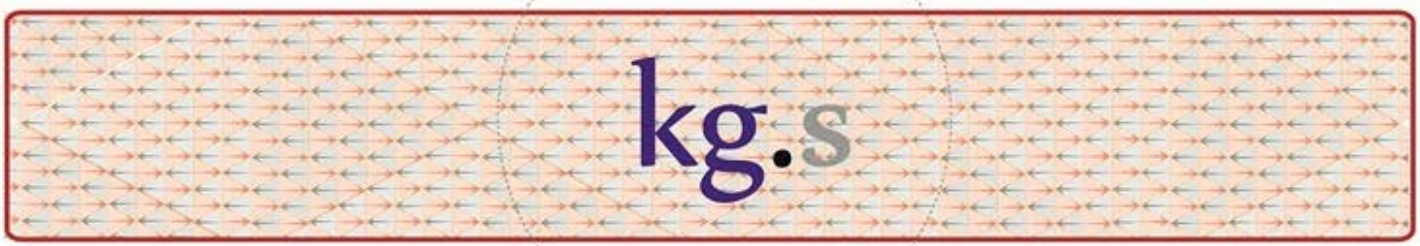

$\frac{C}{s}$

Interactive linear momenta of super-positioned E-fields creates Coulomb's force law

1A.1s

$\frac{c^2}{sec}$

1F.1V

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$1\mathrm{C} = 1\mathrm{A} \cdot 1\mathrm{s}$

1 COULOMB is a measure of linear 2D electric field energy momenta in EM field geometries

1 AMPERE is a measure of orthogonal 2D magnetic field forces produced by Matter topologies in motion

$1\,\mathrm{A} = 1\frac{\mathrm{C}}{\mathrm{s}}$

quantised electrical energy momenta

1C is the quantity of charged masses which pass any point in a circuit in which a current of 1A flows for 1s

C

Coulombs

A

Amperes

kg.s

KG

linear acceleration energy momenta

magnetic perturbation energy momenta

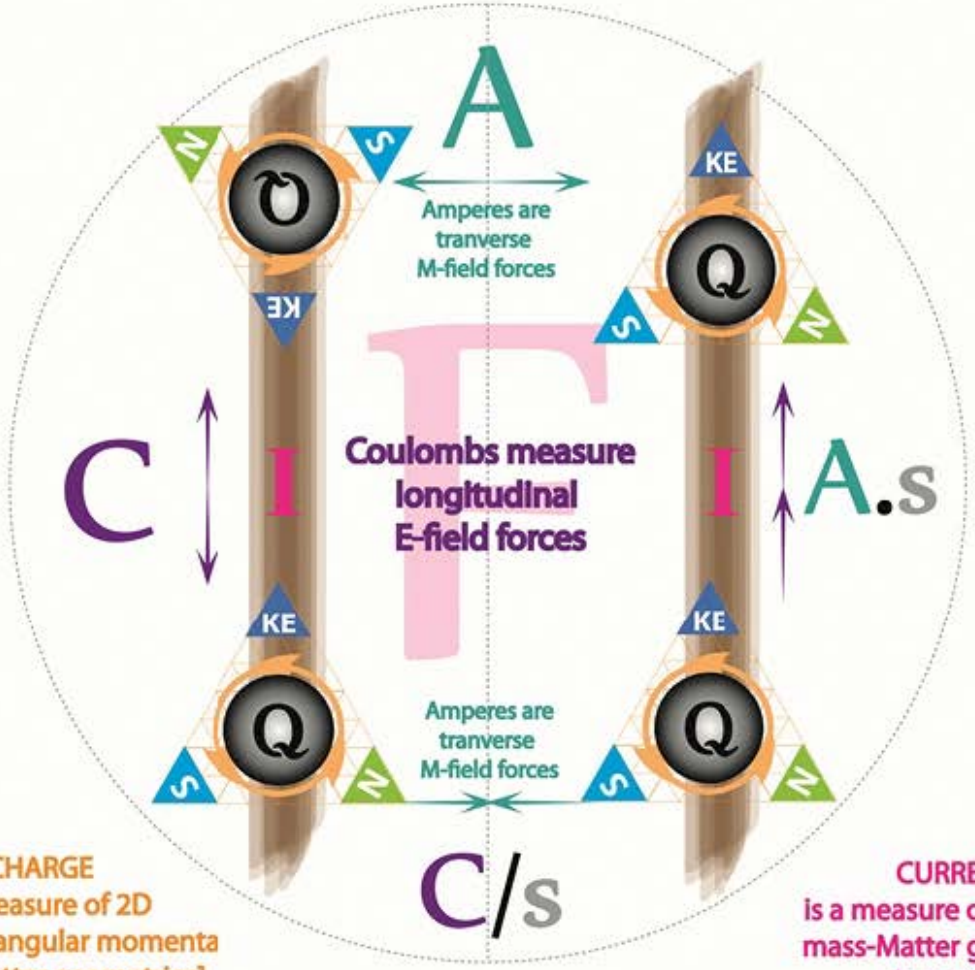

Q

Charge

CHARGE is a measure of 2D quantised angular momenta [mass -Matter geometries]

CURRENT is a measure of charged mass-Matter geometries in motion

I

Current

$Q = I.t$

quantity of charge = rate of flow of charge × time

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Current

is a measure of charged Matter in motion in a circuit per unit of Time

An elementary charge is 1.602216081 e-19 C

C

Coulombs

It is defined as the charge transported by a steady current of one ampere in one second.

I

Amperes

The amount of electric charge passing a point per unit time

A

6.2413354 e18 electrons passing a given point each second constitutes one ampere.

charged masses

kg.s

1.33518 e-20 kg.s

7.489626 e19 kg

Matter

KG

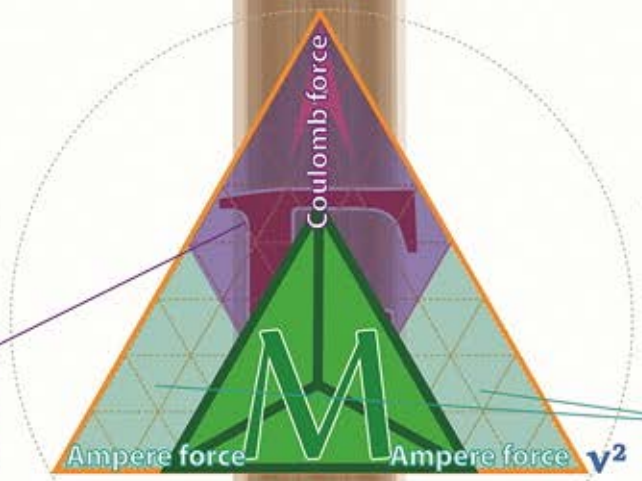

The 2D linear mass-energy momenta capable of accelerating charged particles

The transverse magnetic forces produced by Matter in motion

The ampere is a measure of the amount of charge topologies passing a point in an electric circuit per unit time with 6.241 × 10^18 electrons, or one coulomb per second constituting one ampere

$1C = 1A \cdot 1s$

$1\,A = 1\frac{C}{s}$

Electric current is a measure of the flow of electrically charged mass-Matter in a circuit as a result of an electrical Voltage potential

As

5.524527227 e-12 kg

Charged mass | 1 second | Matter in motion

6.241355408 e18 electrons

$\frac{C}{s}$

Voltage [emf] is a measure of the energy momenta per coulomb available to exert a force on charged Matter in a circuit

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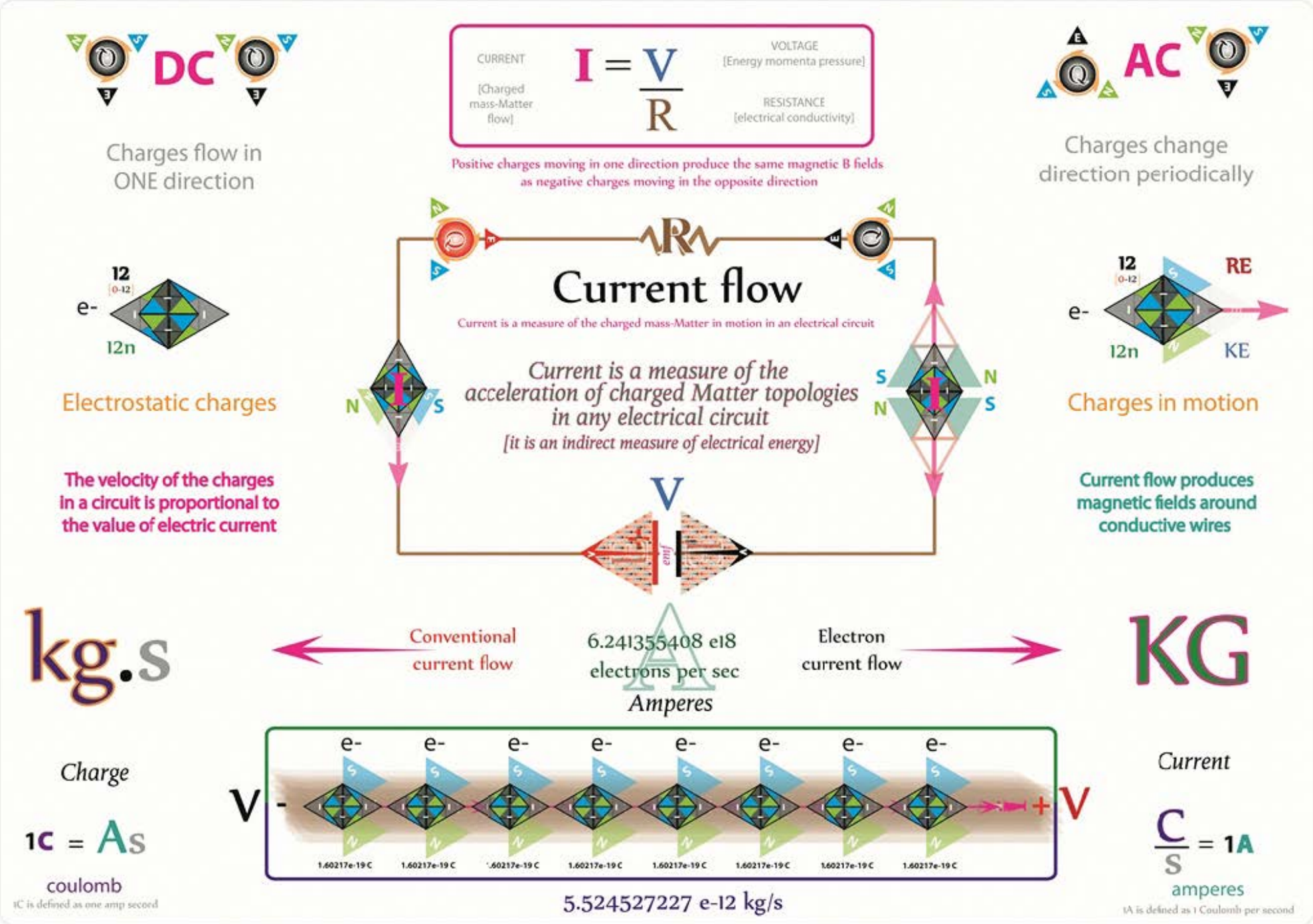

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The electrical resistance of a conductor is a measure of how much it opposes the passage of an electric current through it

OHM's Law

Georg Simon Ohm

(16 March 1789 – 6 July 1854)

$$\mathcal{E} = \rho J$$

resistivity

Electric field

Current density

General vector equation

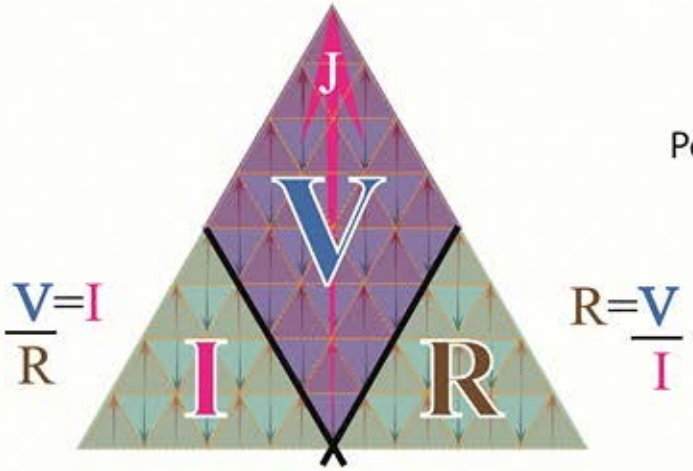

$\frac{V}{R} = I$

$R = \frac{V}{I}$

$V = I.R$

$$P = I.V = I^2.R$$

Power is the amount of current times the voltage level at a given point measured in watts.

Current is the flow of charged mass-Matter resulting from an electromotive force

Resistance determines how much current will flow through a conductor

Current [I.V] Voltage
POWER
Current squared [I^2R] Resistance

Ohm's law states that the current through a conductor between two points is directly proportional to the potential difference across the two points.

By introducing the constant of proportionality, Resistance, one arrives at the usual mathematical equation that describes this relationship

Voltage is the force motivating charges to "flow" in a circuit, it is measured as the difference in electrical potential between two points in a circuit

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Electrical Resistance

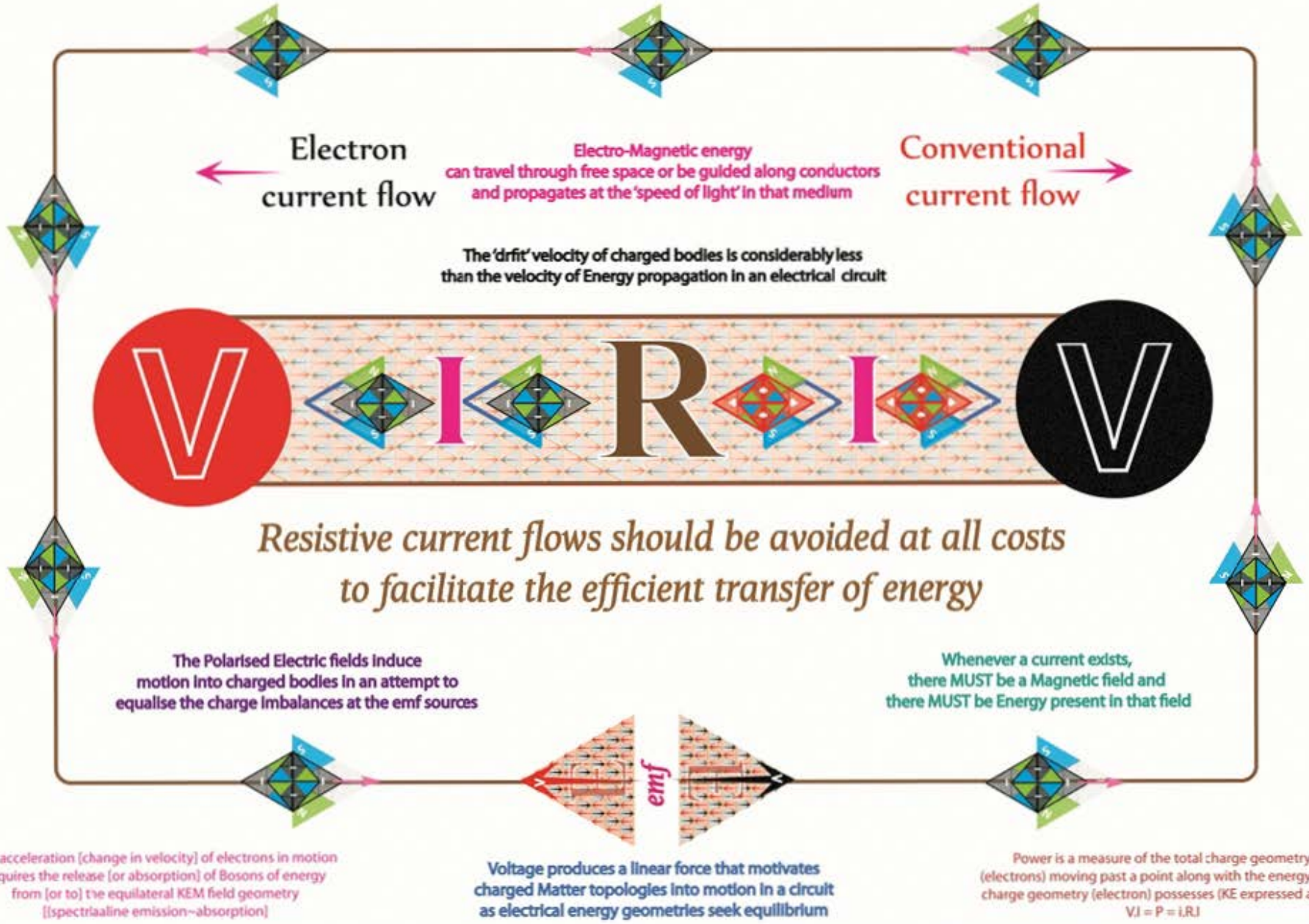

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James Prescott Joule verified Ohm's Law and determined that the heat delivered by a conductor is directly proportional to its resistance and to the square of the current through it.

All energy is comprised of 2D charged masses

He defined Power physically to be the rate at which electrical energies are created or transferred in an electric circuit

Electrical Power

Power is the integral of the cross-product of all electrical and magnetic field vectors produced by scalar energy momenta within a specific area defined by time

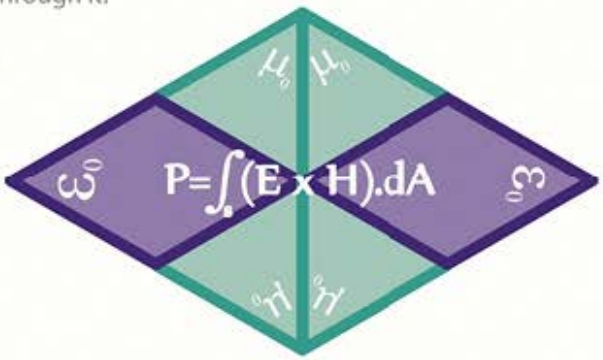

The scalar surface integral of the Poynting vector.

The SI unit of power is the watt, one joule per second.

Electrical power flows wherever Electric and Magnetic fields exist together and change over time

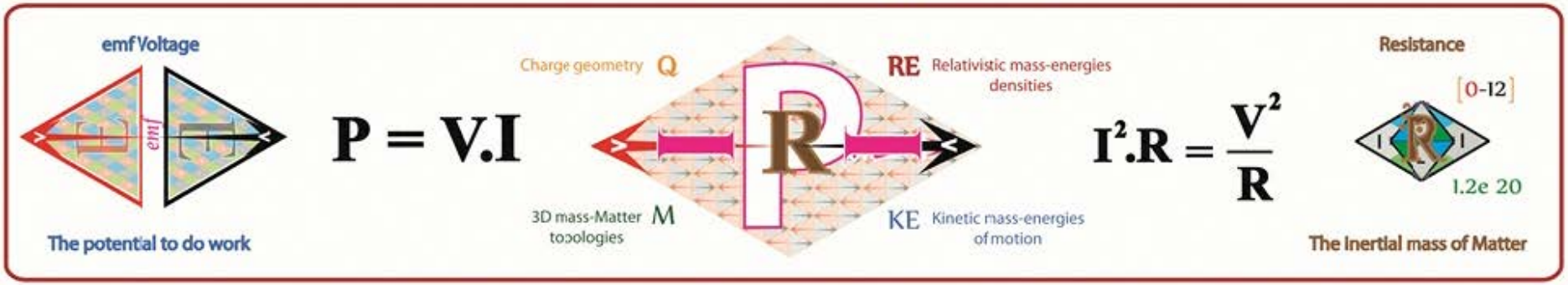

Electrical power propagates at the speed of light in an electrical circuit [dependent on the voltage source] electrons have a vastly slower 'drift' velocity resulting from their inertial interaction with energy momenta of the Voltage [emf] field

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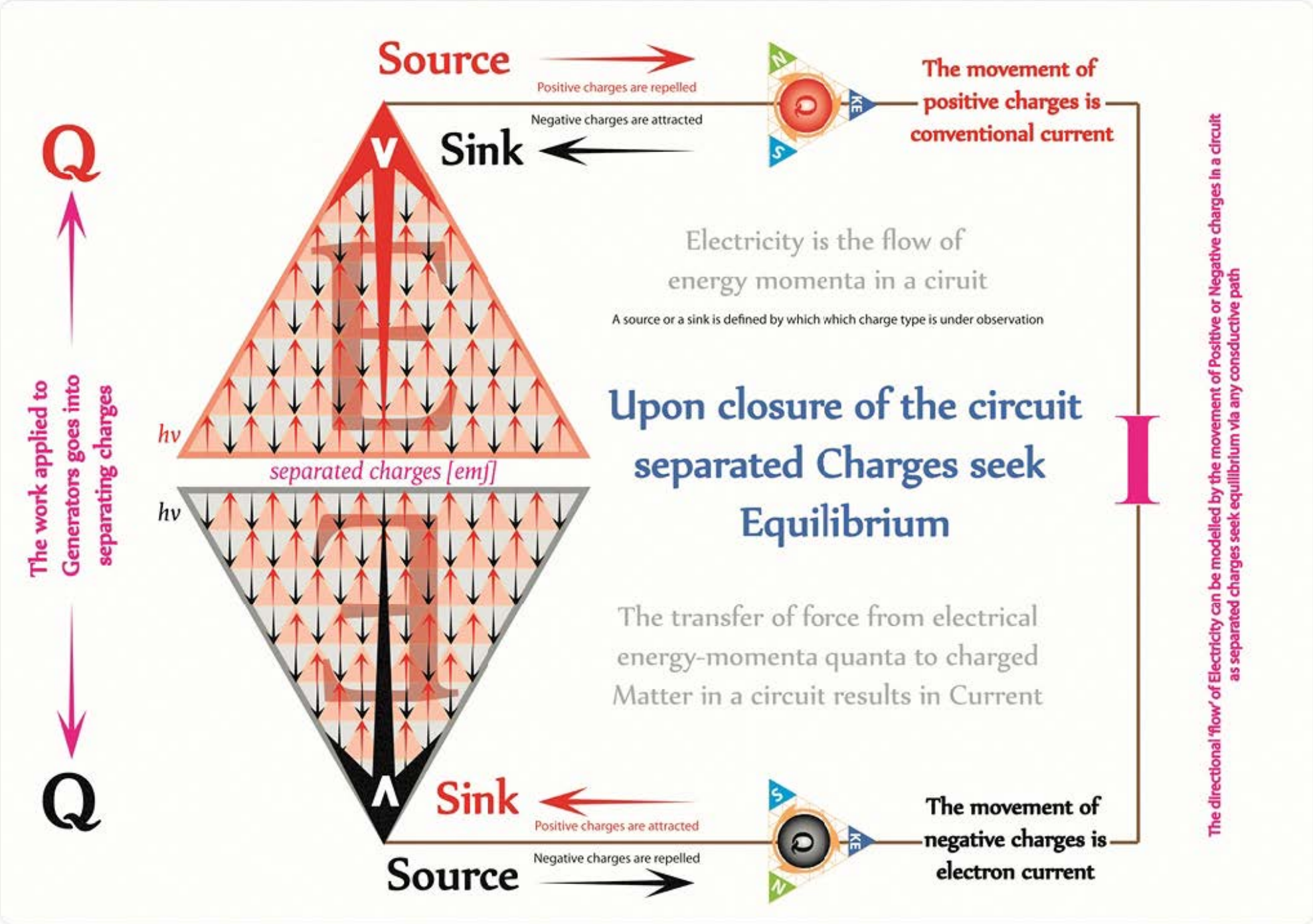

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EM Inductive circuits

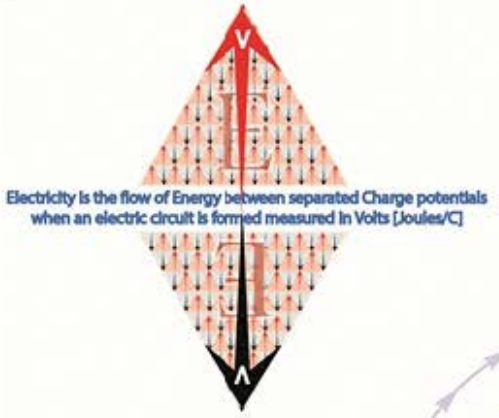

Electricity is the flow of Energy between separated Charge potentials when an electric circuit is formed measured in Volts [Joules/C]

The Electrical emf created by the energy momenta comprising the neutral EM field will cause electrons to flow in a conductor

Neutral Electric field with Magnetic dipole

Current is produced in a conductor when it is moved through a magnetic field because the neutralised Electric field lines are applying a emf on the free electrons in the conductor and causing them to move.

The process of generating current in a conductor by placing the conductor in a changing magnetic field is called induction

The stronger the Magnetic dipole the greater the potential emf

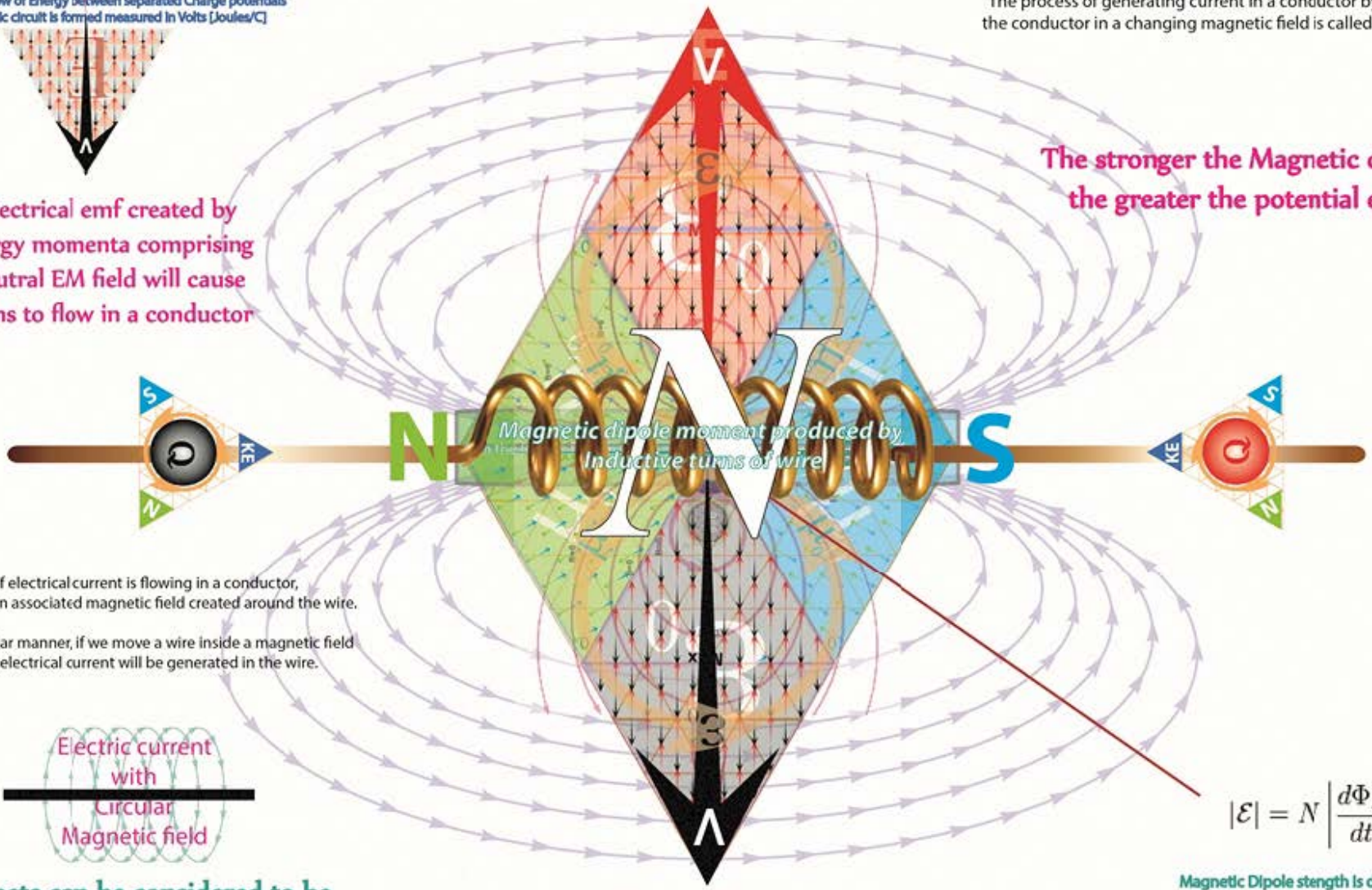

If electrical current is flowing in a conductor, there is an associated magnetic field created around the wire.

In a similar manner, if we move a wire inside a magnetic field an electrical current will be generated in the wire.

Magnets can be considered to be static stores of potential [emf fields]

Magnetic DIpole with Neutral Electric field

$$|\mathcal{E}| = N\left|\frac{d\Phi_B}{dt}\right|$$

Magnetic DIpole stength is dependent on:

The total Number of turns in the Inductor & the current flowing through the circuit

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Electron Volts

The electron volt can also be used as a unit of mass-energy by applying Einstein's relation $E = mc^2$.

For example, the rest mass-energy of electron topologies if 496,532 eV (496.532 MeV).

Chemically, for 1 mole of electrons 1 eV ~ 100 kJ mol-1 (96.49 kJ mol-1)

eV

A unit of energy equal to the work required to move one electron through a potential difference of 1 volt.

An Electron Volt is also a measure of Electrical Kinetic Energy

$$\frac{1}{2}\left[4\pi\left[[\varepsilon_0\mu_0].[m\Omega v^2]\right]\right]$$

Tetryons; EM Field; ElectroMagnetic; Planck quanta; mass; velocity

As distinct from Matter's ENERGY Kinetic Energy is 'extended from the Tetryonic geometry of all Matter in motion in a separate 2D KEM field

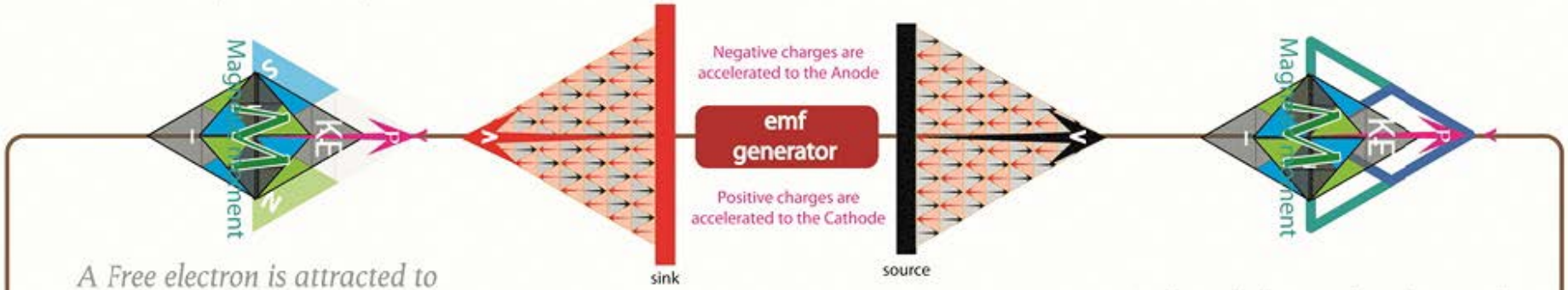

A Free electron is attracted to Positive anode of an emf source

The application of UFE to Kinetic energy calculations reveals the underlying processes of the Photo-electric effect and Light-Energy interactions with respect to Kinetic energy

Accelerated electrons have increased KE, Magnetic moments & momentum

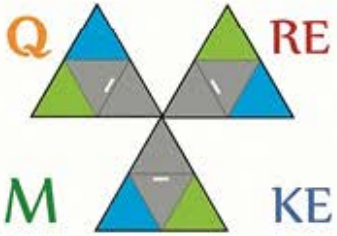

$$12\pi\left[[\varepsilon_0\mu_0].[m\Omega v^2]\right]$$

Fermions; EM Field; ElectroMagnetic; Planck quanta; mass; velocity

$$\frac{P^2}{2m} = KE = \frac{1}{2}Mv^2$$

By definition, it is equal to the amount of kinetic energy momenta gained by a single unbound electron when it accelerates through an electric potential difference of one volt.

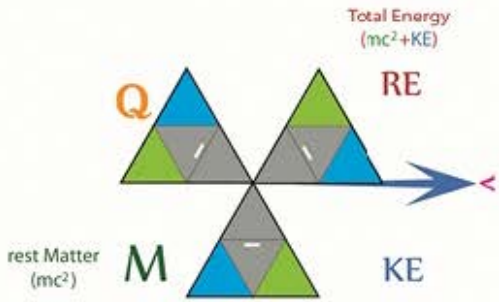

(Total Energy = Absolute rest Matter + Kinetic energy) additionally the Lorentz relativistic correction factor (β) presents itself naturally from the UFE when velocity is applied

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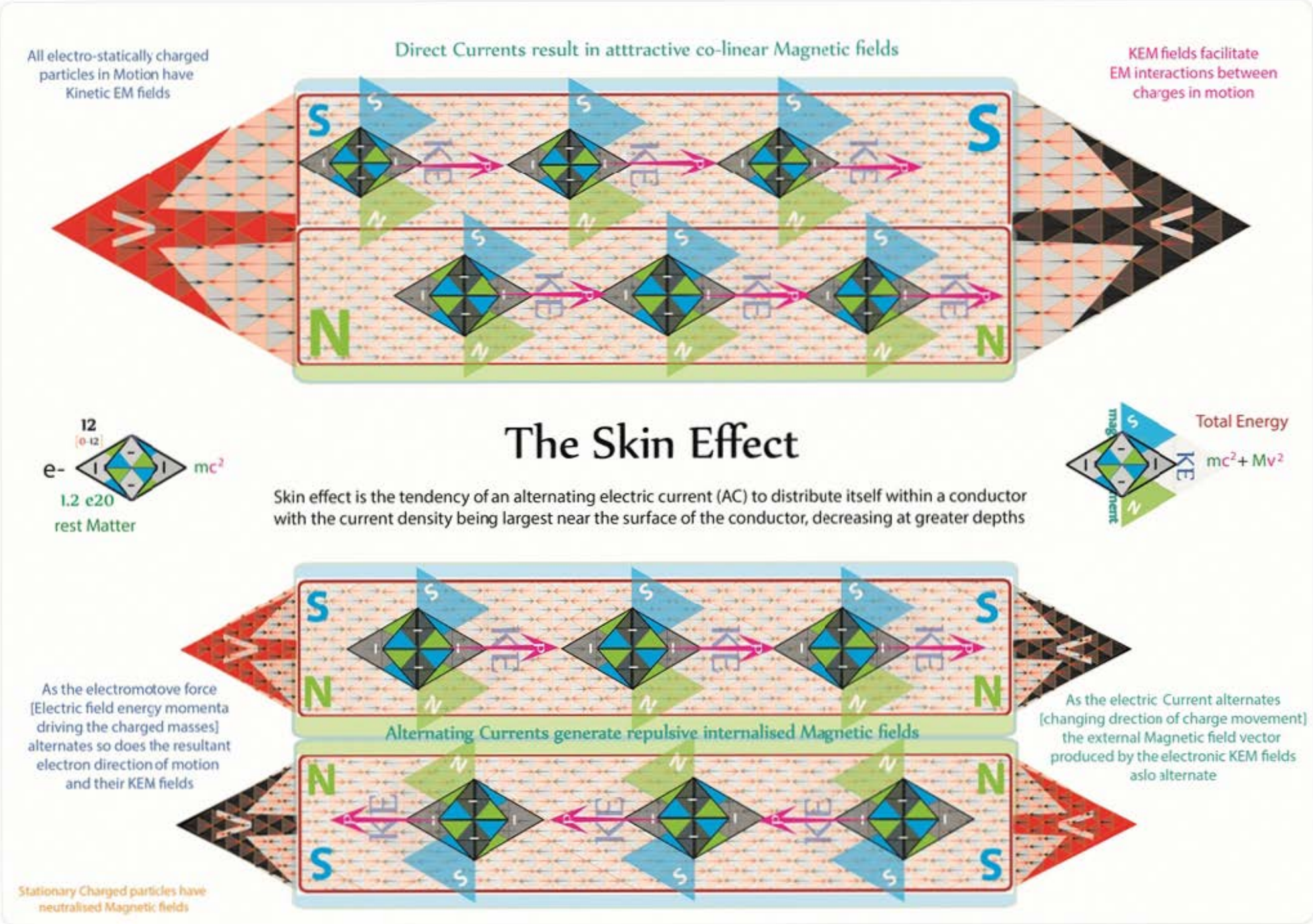

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EM fields of particles in Motion

Positive changed quanta traveling anti-clockwise in a solonoid creates a North-South magnetic field orientated in the direction shown

Negative charged quanta create a reversed Magnetic dipole field and reversing the direction of particle motion also reverses the magnetic vector

Solenoidal Motion

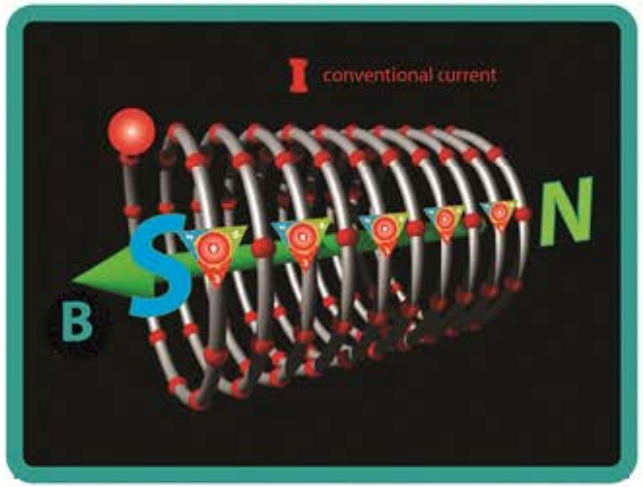

Charged particles moving in a spiral produce a Circular Magnetic field

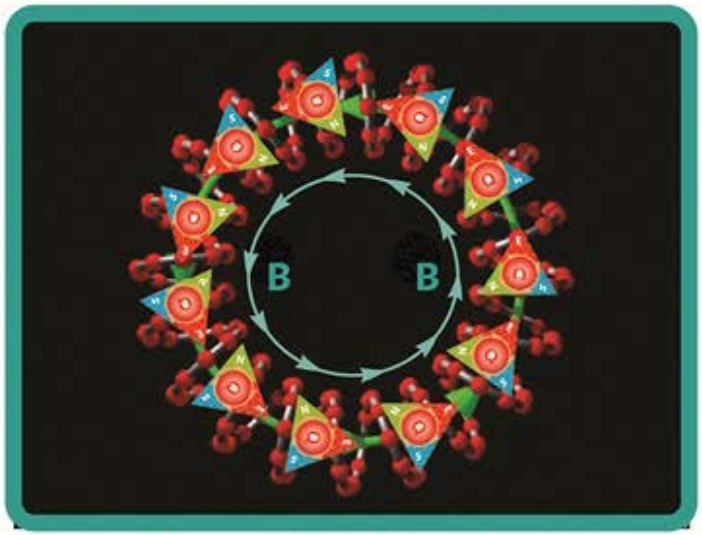

Toroidal Motion

A toroidally wound conductor produces a Circular Magnetic field

Helical Motion

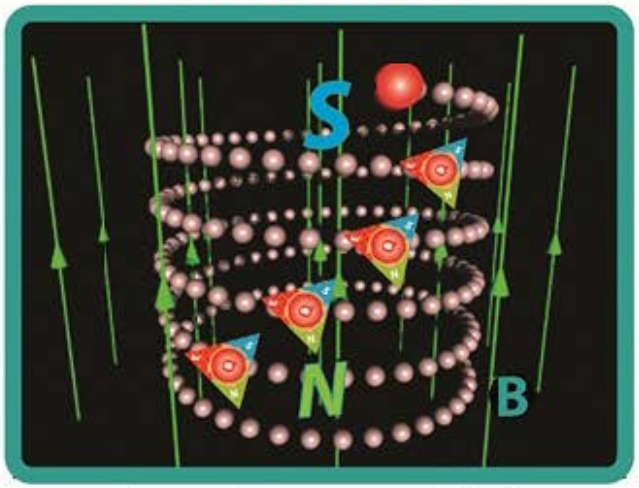

Motion in a Magnetic field

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Inductors

An inductor (also choke, coil, or reactor) is a passive two-terminal electrical component that stores energy in its magnetic field.

For comparison, a capacitor stores energy in an electric field, and a resistor does not store energy but rather dissipates energy as heat

An inductor with an inductance of 1 henry produces an EMF of 1 volt when the current through the inductor changes at the rate of 1 ampere per second.

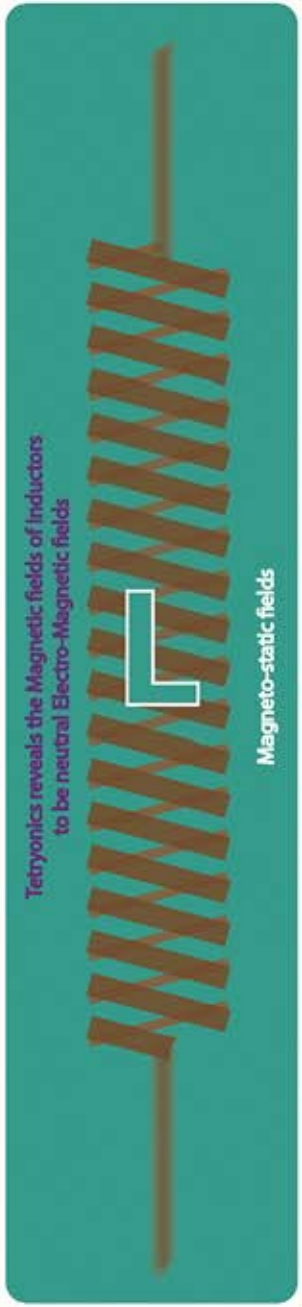

When the current flowing through an inductor changes, a time-varying electromagnetic field is created around the coil, and a changing emf voltage is formed

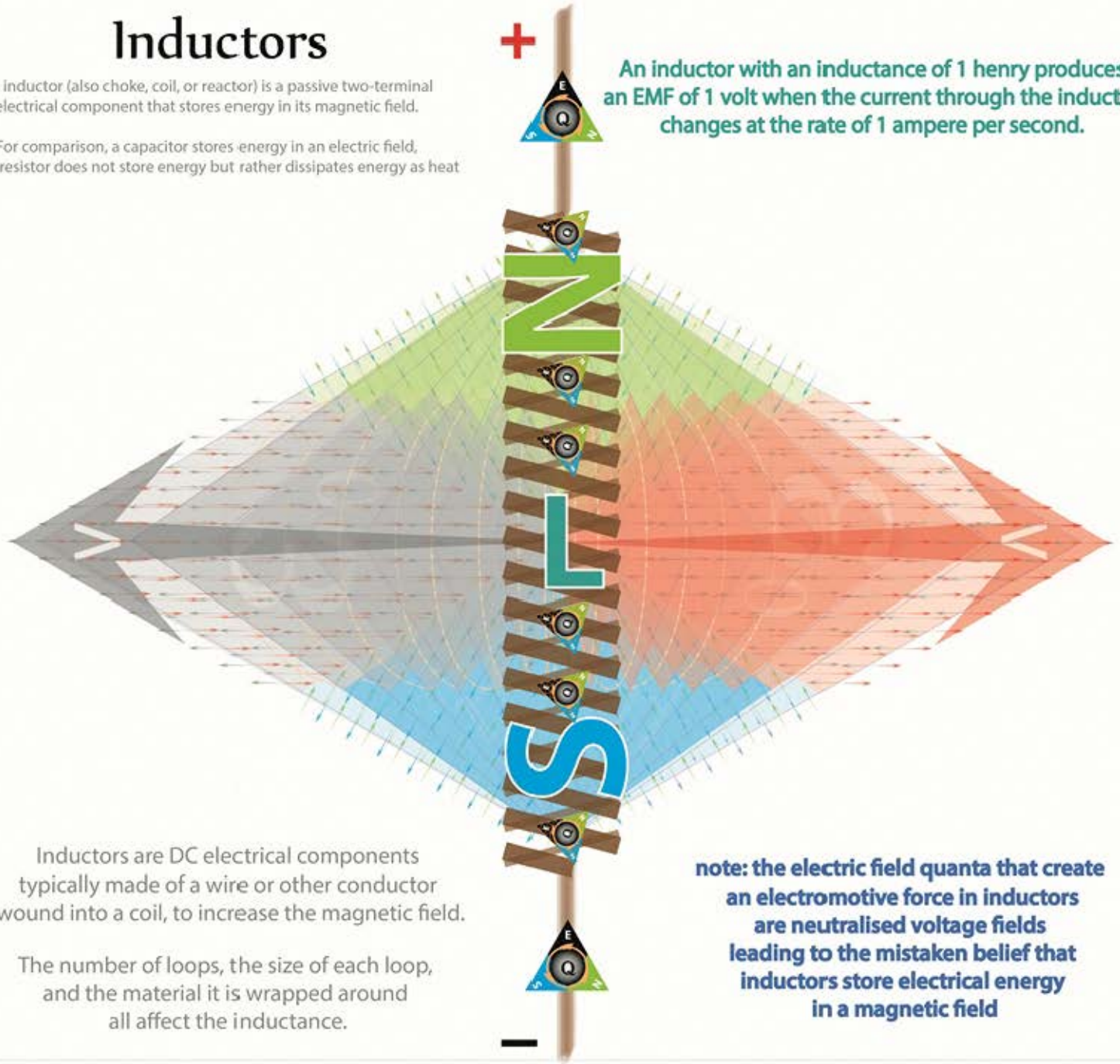

Inductors are DC electrical components typically made of a wire or other conductor wound into a coil, to increase the magnetic field.

The number of loops, the size of each loop, and the material it is wrapped around all affect the inductance.

note: the electric field quanta that create an electromotive force in inductors are neutralised voltage fields leading to the mistaken belief that inductors store electrical energy in a magnetic field

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Charges moving in an Inductive winding

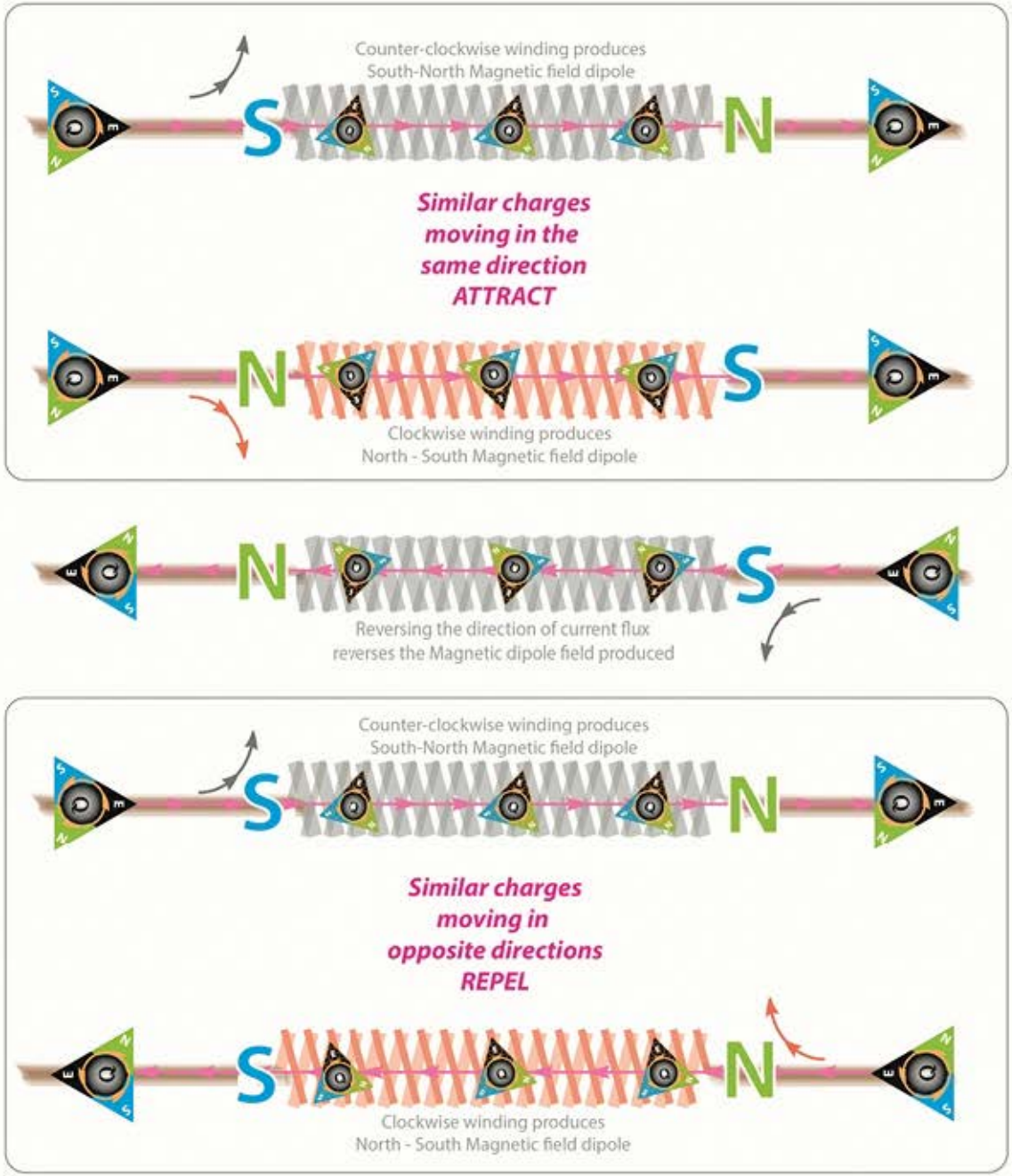

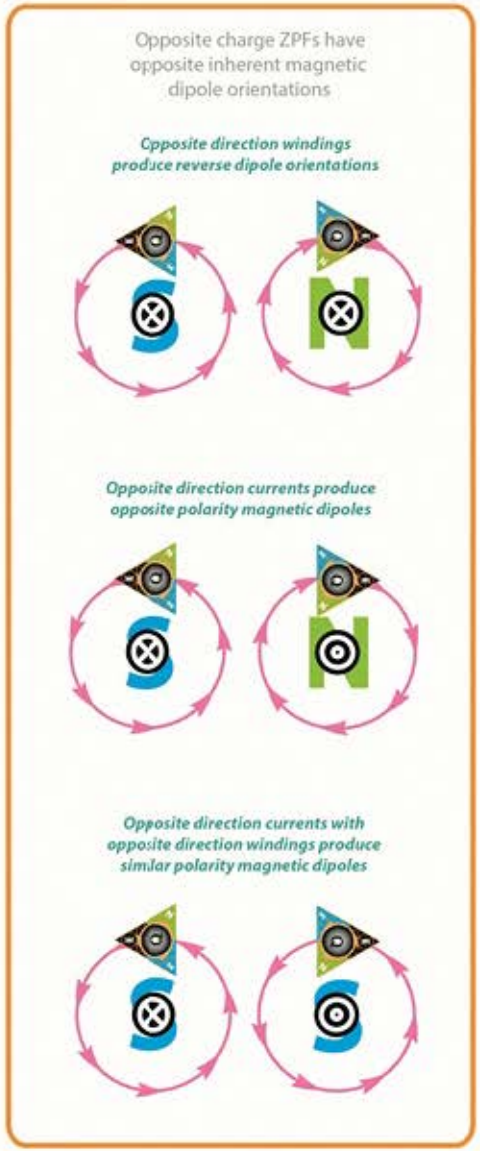

This is best viewed using physical models

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Capacitors

Changing Electric fields
create
changing Magnetic fields

A capacitor is a passive two-terminal AC electrical component used to store alternating electrical energy in an electric field. It blocks the block of direct currents.

Changing Magnetic fields
create
changing Electric fields

Capacitors store & pass electrical energy as charged 2D masses

Capacitors store EM Energy
as transverse Bosons

Capacitors store charged
masses between their plates

Charged Matter [current] does not
flow between the plates
of a Capacitor

ODD.hv

charge

A common form of energy storage device is a parallel-plate capacitor whose capacitance is directly proportional to the surface area of the conductor plates and inversely proportional to the separation distance between the plates.

volts

hv^2

Capacitance

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Capacitance

The SI unit of capacitance is the farad (symbol: F), named after the English physicist Michael Faraday

In general any separated charges will create a emf voltage

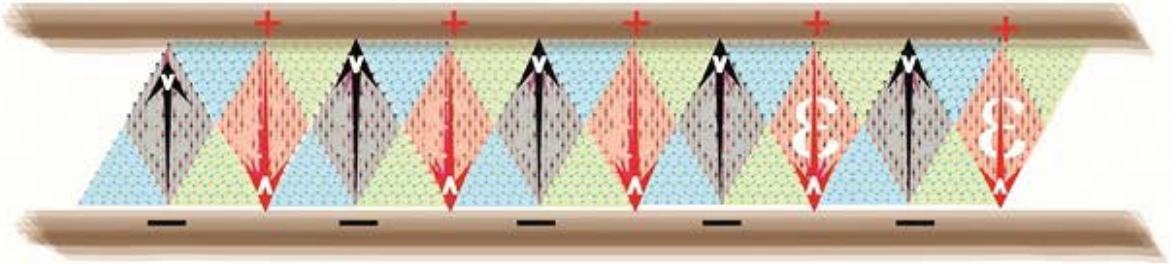

Any two electrical conductors separated by a non-conducting (or very high resistance) medium is a capacitor
[these can be plates, conductive wires or coaxial cables etc]

Plate capacitors

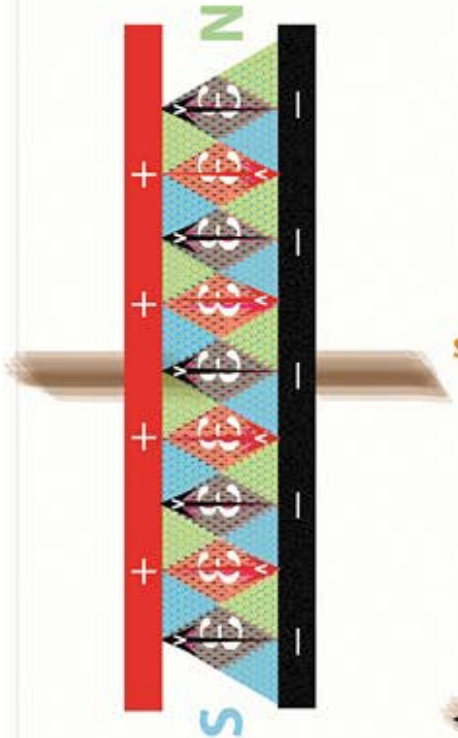

Coaxial cables

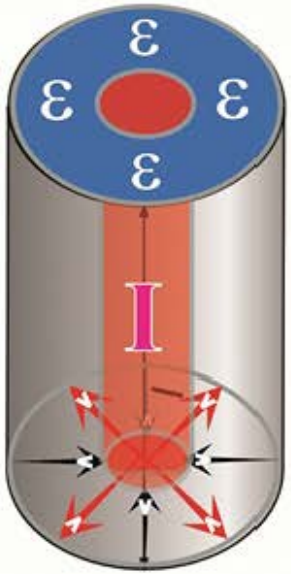

Capacitance is the ability of a body to store an electrical charge.

$$C = \frac{Q}{V}$$

Any object that can be electrically charged exhibits capacitance

A 1 farad capacitor when charged with1 coulomb of electrical charge will have a potential difference of 1 volt between its plates.

should a current flow in the conductors the capacitive field will be dominated by orthogonal, superpositioned Amperian M-fields of greater strength

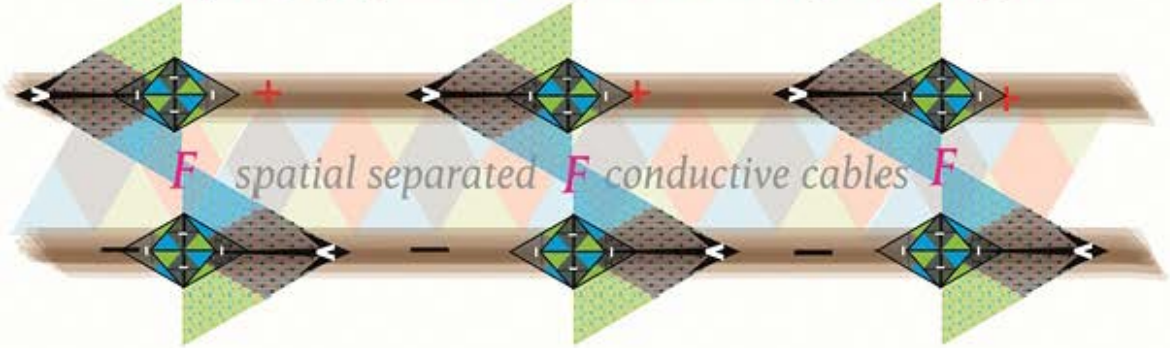

Capacitance is a function only of the physical dimensions (spatial geometry) of conductors and the permittivity of the dielectric separating them

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Inductive and Capacitive energy storage

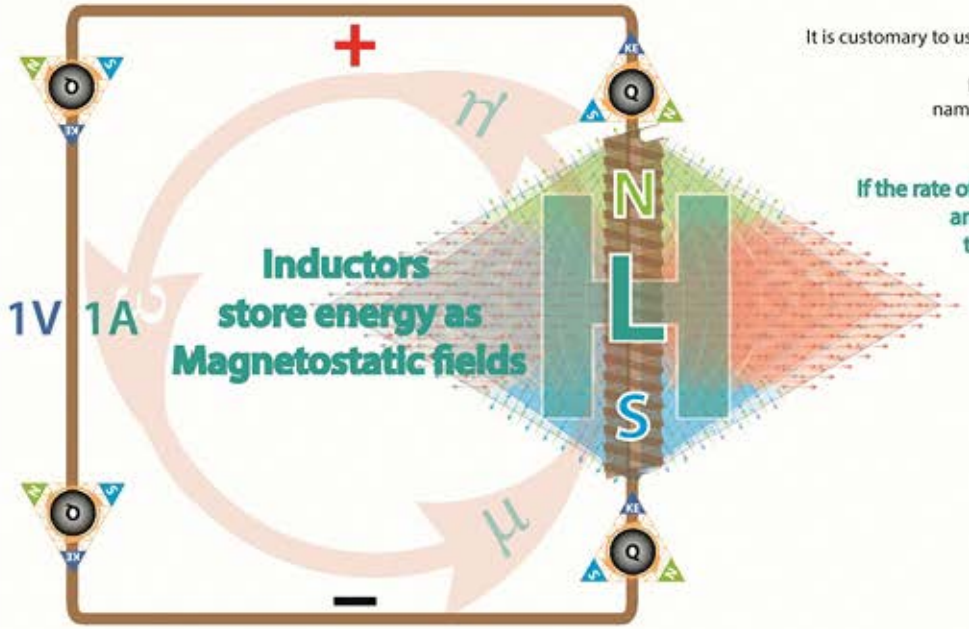

It is customary to use the symbol L for inductance, in honour of the physicist Heinrich Lenz.

In the SI system the unit of inductance is the Henry, named in honor of the scientist who discovered inductance, Joseph Henry.

If the rate of change of current in a circuit is one ampere per second and the resulting electromotive force is one volt, then the inductance of the circuit is one henry

$$v_m = \sum_{n=1}^{K} L_{m,n} \frac{di_n}{dt}.$$

The voltage across an inductor is equal to the product of its inductance and the time rate of change of the current through it

Joseph Henry

[17 December 1797 – 13 May 1878]

Michael Faraday

[22 September 1791 – 25 August 1867]

The SI unit of capacitance is the farad (symbol: F), named after the English physicist Michael Faraday

a 1 farad capacitor when charged with 1 coulomb of electrical charge will have a potential difference of 1 volt between its plates.

$$W_{\text{stored}} = \frac{1}{2}CV^2 = \frac{1}{2}\varepsilon_r\varepsilon_0\frac{A}{d}V^2.$$

Capacitance is the ability of a body to store an electrical charge. Any object that can be electrically charged exhibits capacitance.

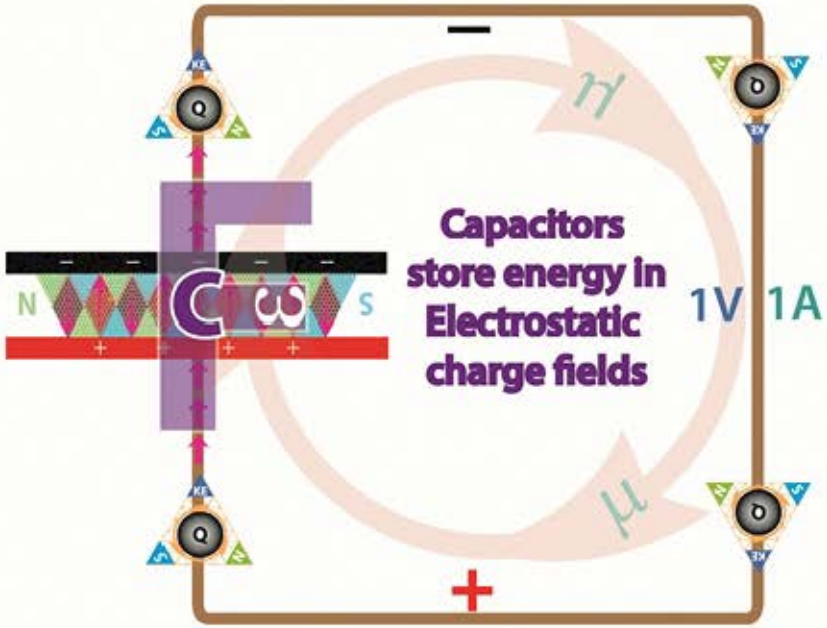

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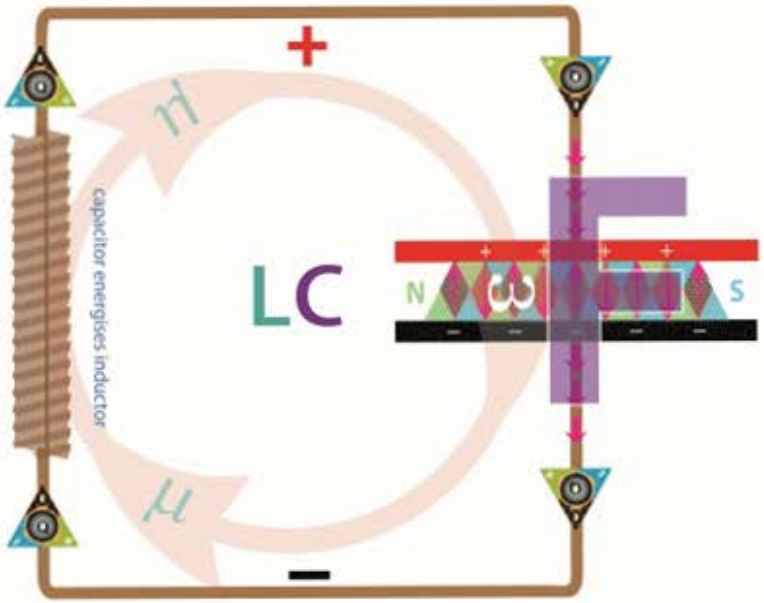

Inductive - Capacitive circuits

An LC circuit, also called a resonant circuit, tank circuit, or tuned circuit, consists of an inductor, represented by the letter L, and a capacitor, represented by the letter C.

LC

When connected together, they can act as an electrical resonator, an electrical analogue of a tuning fork, storing energy oscillating at the circuit's resonant frequency

These LC circuits are idealised models assuming there is no dissipation of energy due to resistance over time, with the circular EM vectors representing electron current flow in the circuit and its translation between inductive and capacitive forms of energy storage.

If a charged capacitor is connected across an inductor, charge will start to flow through the inductor, building up a magnetic field around it and reducing the voltage on the capacitor.

Eventually all the charge on the capacitor will be gone and the voltage across it will reach zero.

However, the current will continue, because inductors resist changes in current.

The energy to keep it flowing is extracted from the magnetic field, which will begin to decline.

The current will begin to charge the capacitor with a voltage of opposite polarity to its original charge.

When the magnetic field is completely dissipated the current will stop and the charge will again be stored in the capacitor, with the opposite polarity as before.

Then the cycle will begin again, with the current flowing in the opposite direction through the inductor.

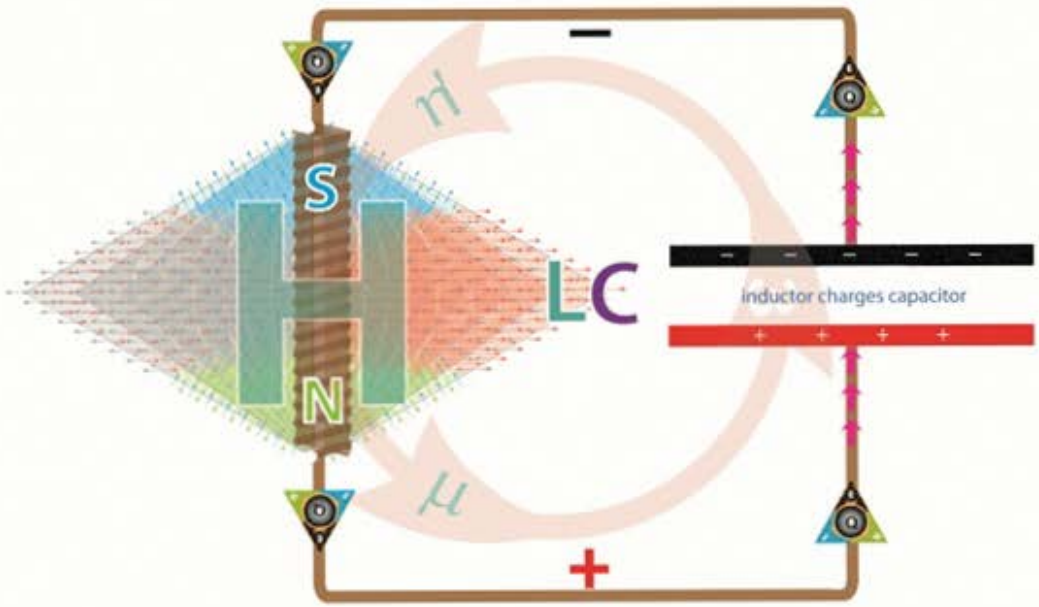

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Capacitors store EM Energy as transverse Bosons

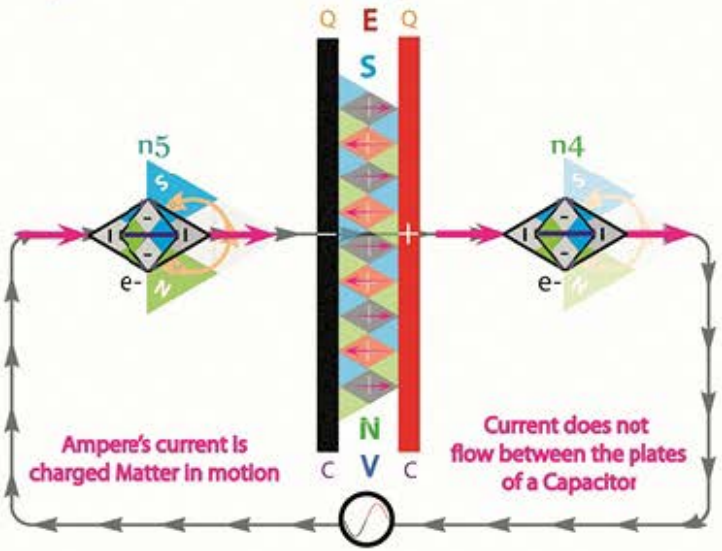

Capacitors store Energy as Joules per charge

Capacitors store & pass energy as charged masses

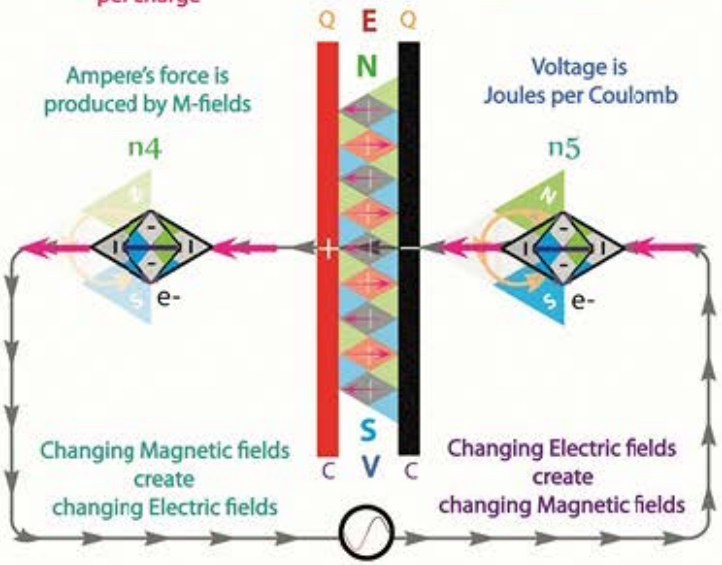

Capacitors store charged masses between their plates

Displacement Current

Maxwell's displacement current is better termed a 'displacement voltage' in light of the fact the charged Matter does not move/flow between the charged plates of a capacitor only the charged mass-energies.

Changing Electric fields produce changing Magnetic fields and vice versa as a direct result of their respective E&M field geometries within the Planck quanta of EM fields

$$\nabla \times \mathbf{B} = \epsilon_0 \mu_0 \frac{\partial \mathbf{E}}{\partial t} + \mu_0 \mathbf{J},$$

As opposed to Maxwell's view of a 'stretching ether' that stores energy between the capacitive plates

As the energy content of a charge increases so does its voltage

Equilateral energy momenta is stored compressively in the inductive quantum fields [ZPF] as it increases, and is released via charged exchange W-Bosons

Producing a capacitive region of ElectroMagnetic fields and stress energies

Bosons are transverse stores of energy momenta

$$\mathbf{J}_D = \epsilon_0 \frac{\partial \mathbf{E}}{\partial t}$$

'Displacement Currents' between charged surfaces are produced by a increasing Electric Field component that seeks equilibrium

It must be carefully borne in mind that we have made only one step in the theory of the action of the medium. We have supposed it to be in a state of stress, but we have not in any way accounted for this stress, or explained how it is maintained. This step, however, seems to me to be an important one, as it explains, by the action of the consecutive parts of the medium, phenomena which were formerly supposed to be explicable only by direct action at a distance.

Maxwell - On Physical Lines of Force (1861)

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mass

$$\frac{E}{c^2} = m$$

mass-energy momenta in a 2D equilateral geometry

Radiant waveform
EM mass-energies

$$mc^2 = E = Mc^4$$

A clear geometric distinction can now be made between **EM mass geometries** and standing wave **Matter topologies**

Matter

$$M = \frac{E}{c^4}$$

Four mass-energy momenta in a 3D tetrahedral topology

Standing waveform
EM energies

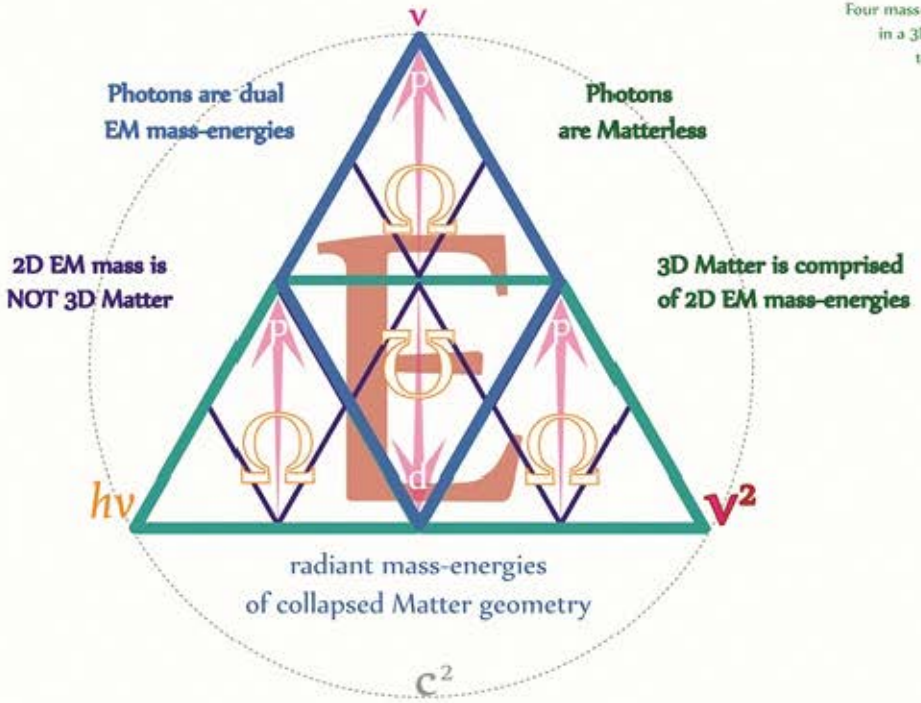

$$n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; mass, ElectroMagnetic, mass, velocity

$$T\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field, Planck quanta; Matter, ElectroMagnetic, mass, velocity

ρ/second

ρ/second^2

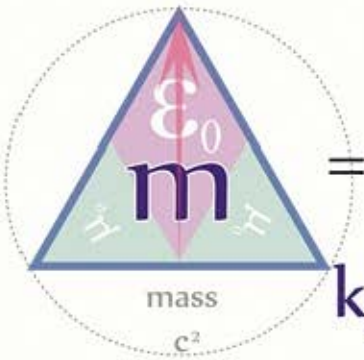

$$= m\Omega\left[\frac{v^2}{c^2}\right]$$

kg

Radiant EM masses

$$\frac{4\pi m}{c^2} = M$$

Standing-wave mass-Matter

$$m\Omega\left[\frac{v^2}{c^4}\right] =$$

KG

massless particles are a scientific misnomer and massless must now be re-termed Matterless

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de Broglie Matter-waves

EM CHARGE
provides the foundational
interaction geometry for
all mass & Matter

In quantum mechanics, a Matter wave or de Broglie wave is the probabilistic electromagnetic quantum wave-form created by the Planck elements constituting Matter

Relativistic mass-energy
is the total sum of all Planck
energy momenta in any
spatial co-ordinate
system

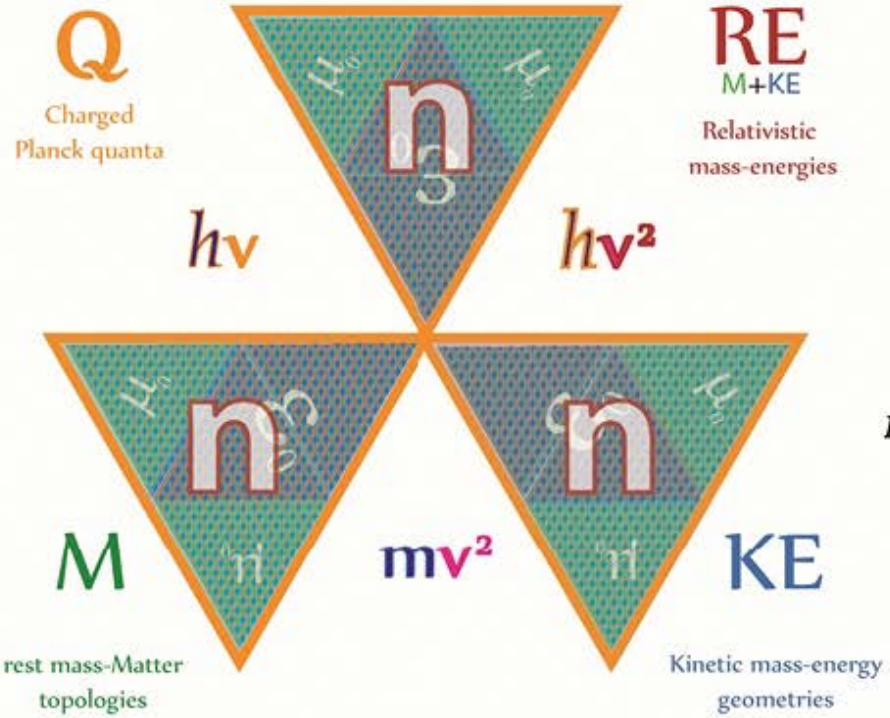

All EM waves and Matter are made up of integral Planck quanta [any imbalance results in Charge] as the number of Planck quanta increases their associated wavelengths decrease

The relativistic stress tensor mass-energies of Matter in motion is the sum of its standing-wave mass-Matter topology and its Lorentz corrected kEM field mass-energy geometries

3D MATTER
is the charged topology
created by standing-waves
of 2D mass-energies

Kinetic EM mass-energy levels depend on the velocity of the Matter particle in motion
[in Matter energy travels in a standing wave at the speed of Light]

Kinetic EM fields
are the mass-energy
fields created by
Matter in motion

The rest mass-energy geometries comprising all Matter topologies are velocity invariant

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Material EM masses

deBroglie wavelength & Compton frequency

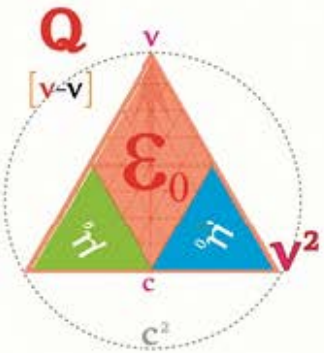

λ

Any increase in Energy quanta results in
a decrease in EM mass quanta wavelengths

v^2

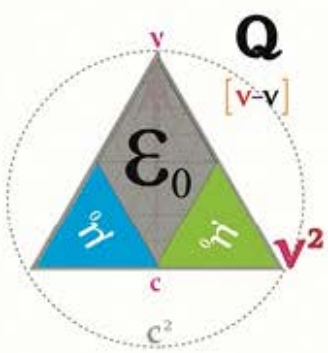

In Matter all energy propagates at c

$$mv^2 = E = hv^2$$

in Standing wave Matter
v=c

Number of Quanta comprising rest Matter

Compton Frequency

$$\frac{mc^2}{h} = 1 \times 10^{19}$$

Electron Compton Frequency
$= 1.2 \times 10^{20}$ quanta

v^2

Wavelength of Quanta comprising rest Matter

de Broglie wavelength

$$\frac{h}{mc} = 2.99792456 \times 10^{-15}\ \text{m}$$

Electron de Broglie wavelength
$= 4.002769142 \times 10^{-11}$ m

λ

Linear momentum of standing wave Energy comprising Matter

Intrinsic Particle Momenta

$$mc = 2.211340633 \times 10^{-23}\ \text{Ns}$$

Intrinsic Electron momenta
$= 2.95253793 \times 10^{-30}$ Ns

p

The Compton frequency, deBroglie wavelength and Energy momenta of any physical system are all related through the speed of Energy [c]

The examples above are for stationary Electrons any motion will NOT affect the results for the electron itself (however a extended KEM field will be produced by the motion and its properties will be affected by changes in velocity)

In Lorentz invariant Matter the standing wave Energy always propagates at the speed of Light [c] (with the KEM field subject to Lorentz corrections)

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KEM Quantum levels

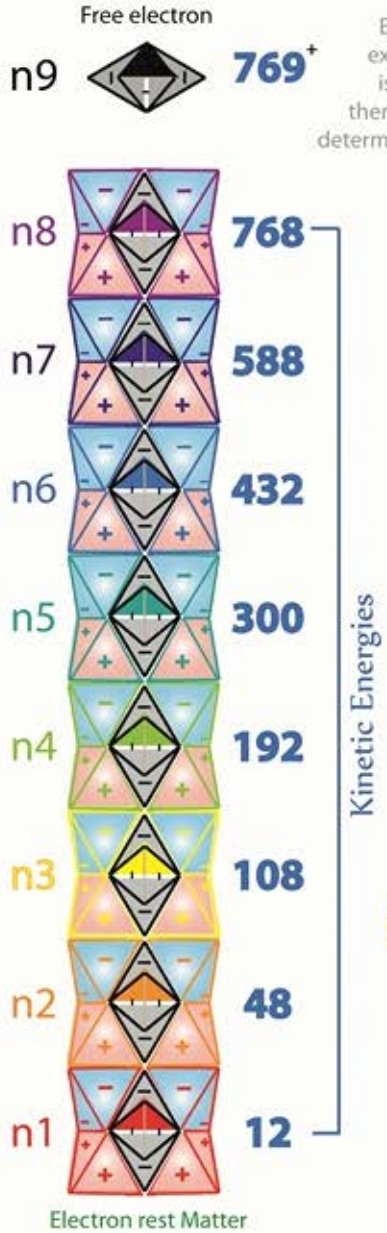

Electron energy external to Nuclei is continuous as there are no Nuclei to determine electron energies

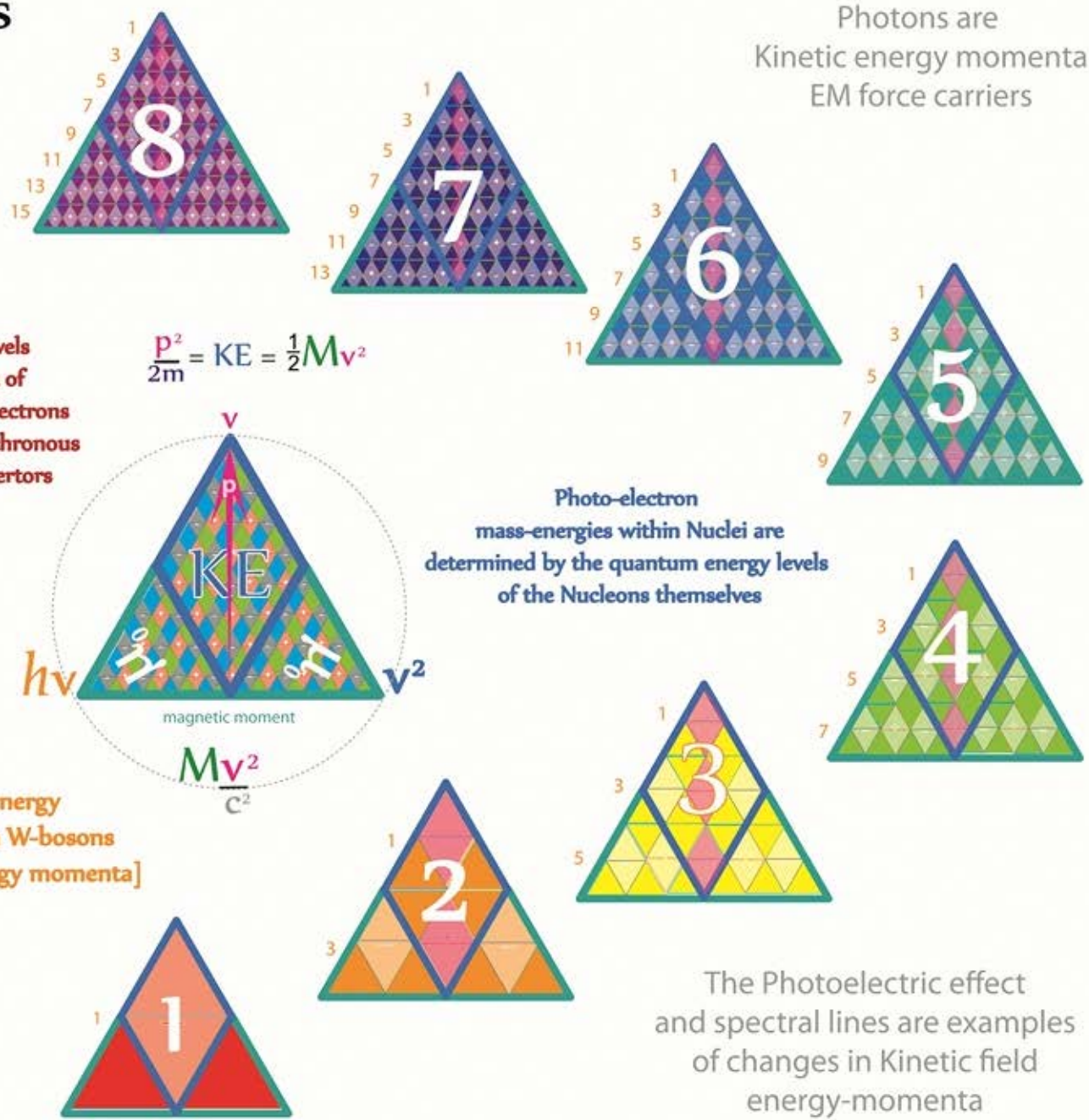

Photons are
Kinetic energy momenta
EM force carriers

Quantum levels are the result of Nucleons and electrons interacting as synchronous quantum convertors

$$\frac{p^2}{2m} = KE = \frac{1}{2}Mv^2$$

Photo-electron mass-energies within Nuclei are determined by the quantum energy levels of the Nucleons themselves

EM mass-energy is exchanged via W-bosons [with varying energy momenta]

The Photoelectric effect and spectral lines are examples of changes in Kinetic field energy-momenta

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deBroglie relationships

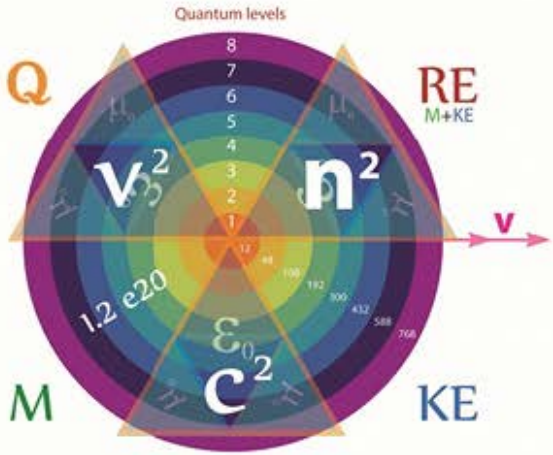

rest mass-Matter is velocity invariant

" The electron which is moving in a sine wave circular path, will repeat the same sine wave path in each successive orbit. The sine wave paths in consecutive orbits will exactly overlap. The electron wave reconnects with itself and is in phase with itself. "

An electron bound in a atomic nuclei will trace a toroidal path around the nuclei mapped by the sine wave motion of any point on its charged geometric surface

The relativistic energy of Matter in motion is a measure of its standing wave mass-energies, and the object's velocity related kinetic energy and magnetic moment in the form of a KEM wave geometry

$$\lambda = \frac{h}{p}$$

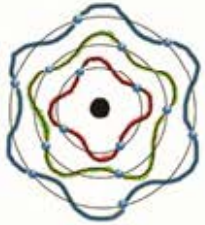

$$f = \frac{E}{h}$$

Louis de Broglie

(15 August 1892 – 19 March 1987)

$$p = \frac{h}{\lambda} = \frac{h}{2\pi}\frac{2\pi}{\lambda} = \hbar k$$

Although Mathematically correct the illustrative model commonly used to depict the deBroglie relationships is incorrect

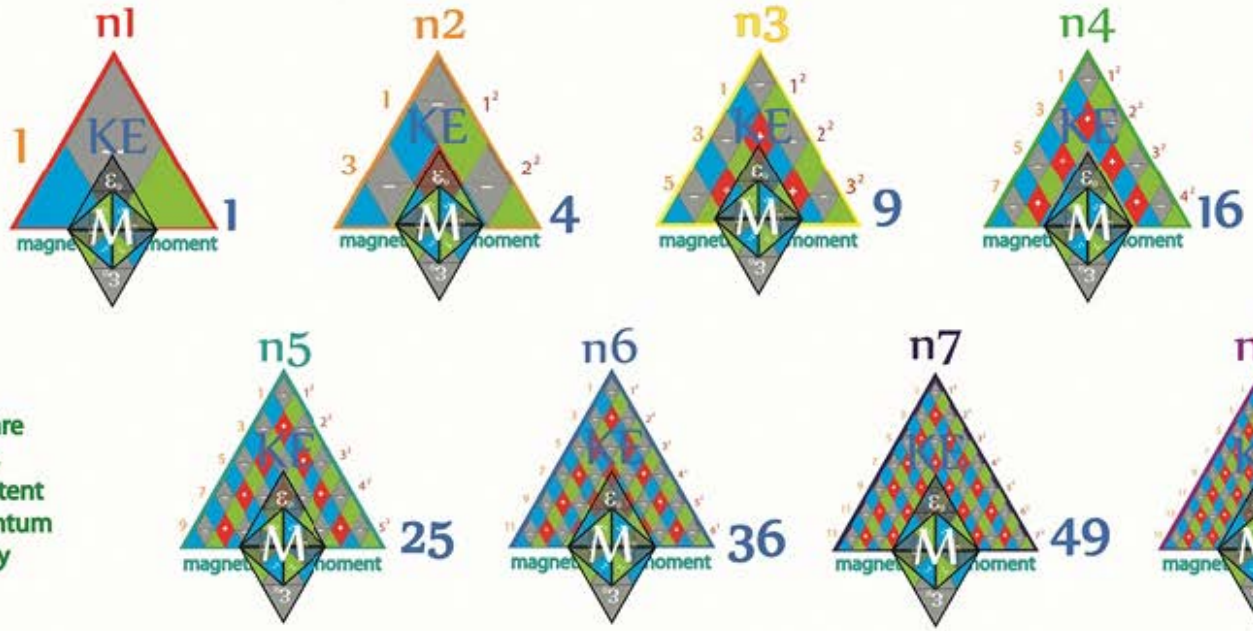

The greater the KEM field energy level the smaller the quantum wavelength of the KEM field's EM mass

All mass-Matter topologies are Lorentz velocity invariant, only the EM mass-energy content and quantised angular momentum of the Kinetic EM fields vary

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Electron Positions in Atomic Orbitals

Werner Heisenberg

(5 December 1901 – 1 February 1976)

Atomic orbitals are typically described as "hydrogen-like" (meaning one-electron) wave functions over space, categorized by n, l, and m quantum numbers, [as covered in Tetryonic Chemistry] which correspond to the electron's energy, angular momentum, and an angular momentum vector component, respectively

Using Tetryonics as a EM field model, an electron's position and velocity CAN be modelled simultaneously (but any attempt to measure or interact with it, will affect its energy levels)

Quantum Mechanics is a statistical [mathematical] representation of equilateral, charged geometries and EM energy interactions

Erwin Schrödinger

(12 August 1887 – 4 January 1961)

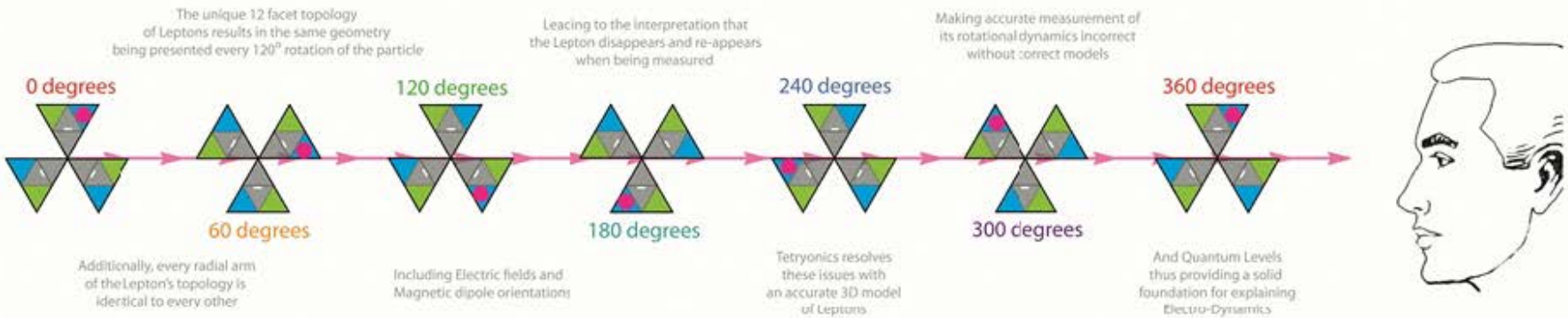

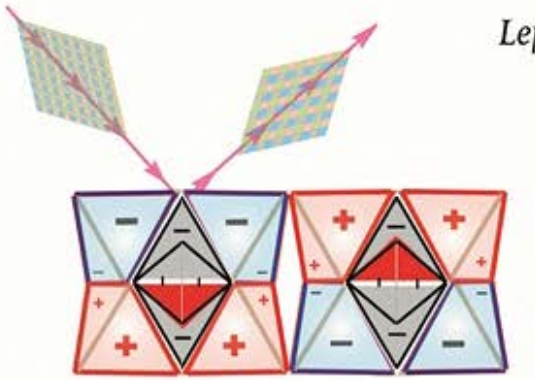

Leptons are 6 loop quantum loop inductive rotors

Lepton's are Spin 1 particles that can easily be misinterpreted as 1/2 or 3 quantum spin numbers without the correct physical models to interpret physcical observations on

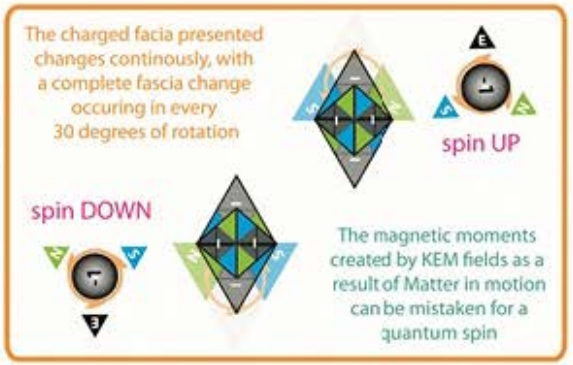

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Distributions and Uncertainty

A Bell Curve (Normal Distribution) is a mathematical reflection of the integral Planck mass-energy momenta quanta distributions found in all equilateral charge geometries

Probabilities are the square of the Amplitude

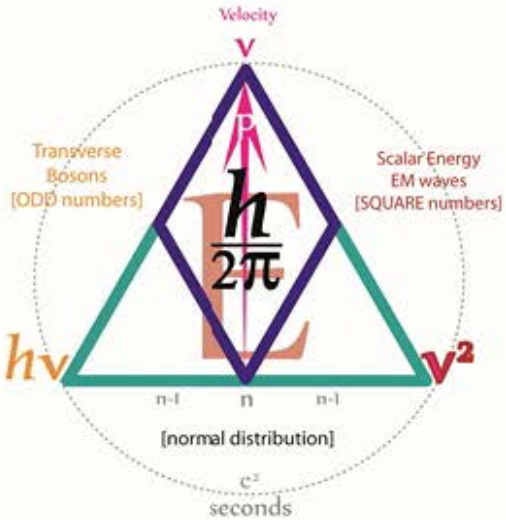

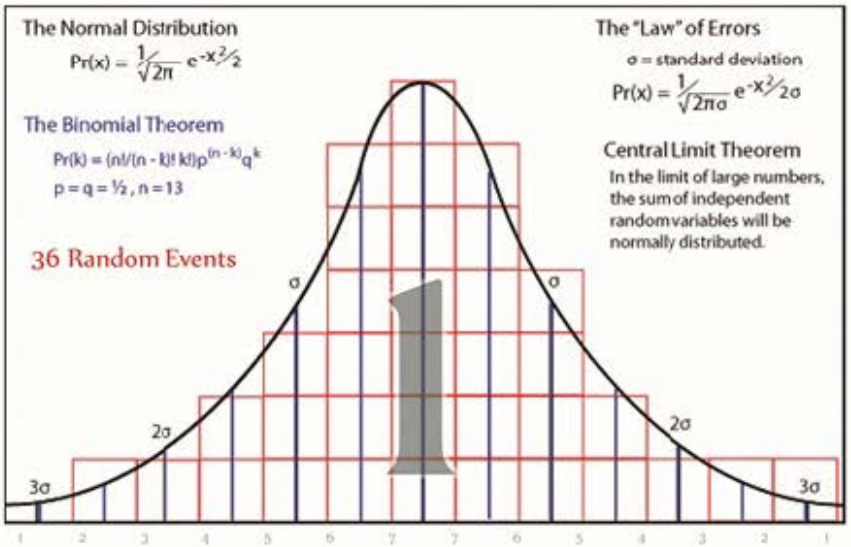

All probabilities are re-normalisable and sum to Unity

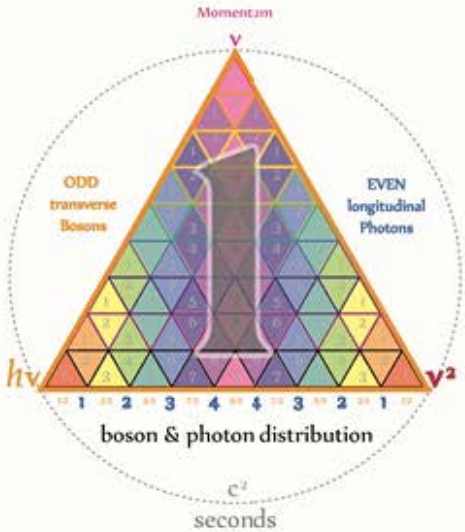

All Matter and EM fields are comprised of equilateral mass-energy momenta and any attempt to measure the system involves the introduction of additional Planck EM quanta into the systems

John Stewart Bell

(28 June 1928 – 1 October 1990)

No physical theory of local hidden variables can reproduce all of the predictions of quantum mechanics.

WRONG

$$\Delta p \, \Delta x \geq \frac{1}{2} \hbar$$

Quantum uncertainty formulation

$$\Delta E \, \Delta t \geq \frac{1}{2} \hbar$$

The more precisely the position is determined, the less precisely the momentum is known in this instant, and vice versa.

Heisenberg, uncertainty paper, 1927

WRONG

Werner Heisenberg

(5 December 1901 – 1 February 1976)

Chance is closely related to the ideas of uncertainty and indeterminacy.
Uncertainty today is best known from Werner Heisenberg's principle in quantum mechanics.
It states that the exact position and momentum of an atomic particle can only be known within certain limits.
The product of the position error and the momentum error is equal to a multiple of Planck's constant of action.
This irreducible randomness in physical processes established the existence of chance and indeterminism in physics

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Leptronic Self-energies

As the velocity of a charged particle increases
the energy level of its KEM field increases

$$\frac{4n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

KEM field — Energy — Planck quanta — mass — velocity — momenta

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Matter — Energy — Planck quanta — mass — velocity — momenta

mass

radiant energy per second

$$E/c^2$$

KEM field geometries generated as a product of Matter in motion are Lorentz variant

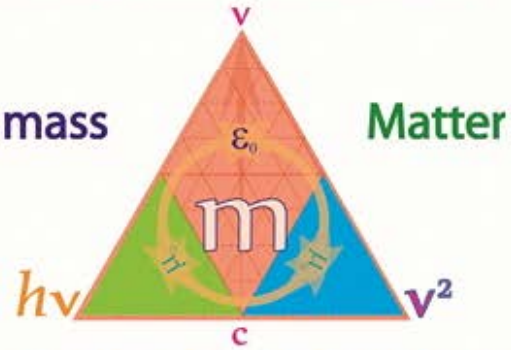

Quantum inductive loops resist changes to energies contained in their equilateral energy fields [inertial mass]

Matter

standing-wave energy per second squared

$$E/c^4$$

rest mass-Matter topologies are not affect by changes in velocity [Matter is Lorentz invariant]

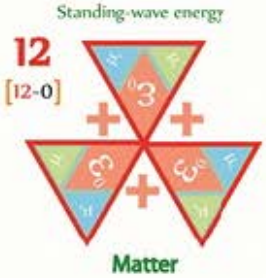

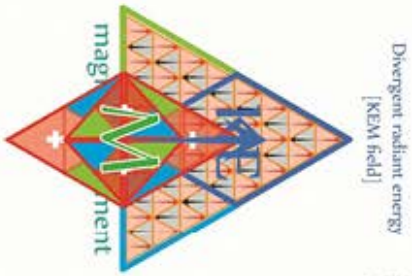

The Law of Interaction

The Energy momenta of an electron's KEM field polarises the region surrounding its Matter and creates fields of interaction through the super-positioning of these fields

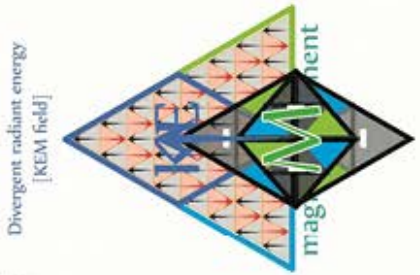

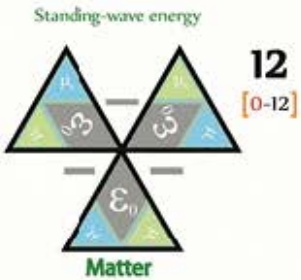

a particle's self-energy represents the contribution to the particle's energy, or effective mass, due to interactions between the particle and the system it is part of.

$$KEM = Mv^2$$

All Matter topologies are made up of quantum inductive loops which extract energy from any EM field they move through

Matter stores energy in its 3D planar facsia as charged mass-energy

additional to creating the familiar laws of interaction [opposite attract - similars repel] the KEM fields of leptons can act as tuned antennas extracting energy from their environment

KEM fields store energy in their 2D planar EM field as neutral divergent mass-energies

$$E = Mc^4$$

All Matter contains EM energy propagating in a standing wave topology at the speed of light (the source of inertial mass)

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Resonant EM fields

Transmitting in order to efficiently recieve via resonant inductive coupling of EM fields

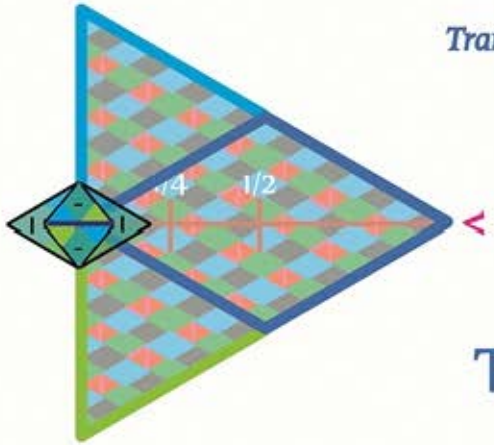

1:1

[or other harmonics]

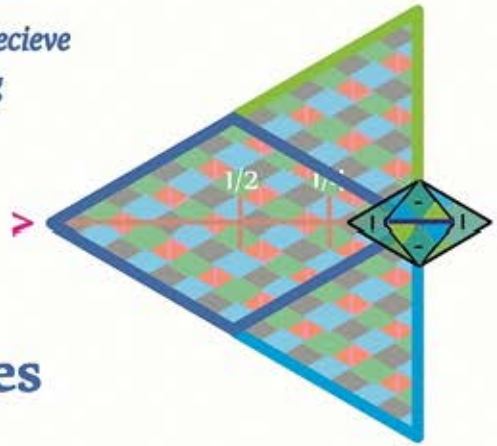

Tuned KEM waves

Quantum inductive antenna fields

Historically, all recieiving antennas have been mechanically tuned to match the sought EM wavelength
But if power is applied to a small wavelength electrostatic topology it creates a KEM field
that produces a much larger, tuned rhombic antenna field

EM waves are hf geometries

Electron's rest Matter stores EM mass-energy in a standing wave

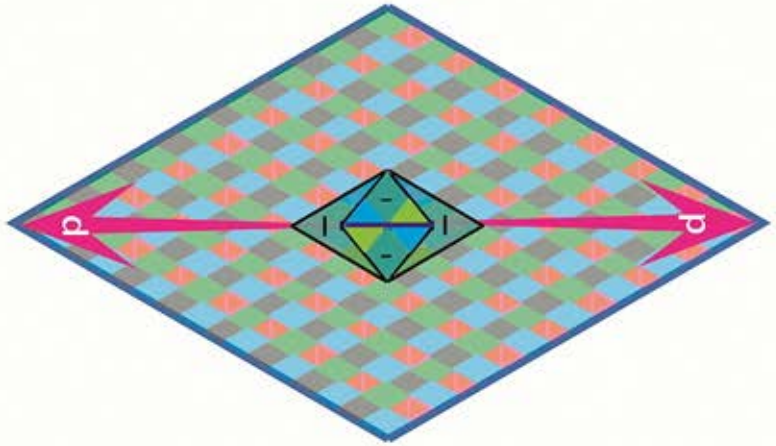

EM bosons have $h\nu$ geometries

Electrostatic particles of Matter have dual KEM energy fields that can act as resonant antennas

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Bosons

All Light is made of transverse EM energy Quanta

$$1\pi_{\text{Bosons}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity

James Clerk Maxwell

$$\nabla\cdot\mathbf{D} = 4\pi\rho$$

$$\nabla\times\mathbf{H} = \frac{4\pi}{c}\mathbf{J} + \frac{1}{c}\frac{\partial\mathbf{D}}{\partial t}$$

$$\nabla\times\mathbf{E} + \frac{1}{c}\frac{\partial\mathbf{B}}{\partial t} = 0$$

$$\nabla\cdot\mathbf{B} = 0$$

ElectroMagnetic waveforms propagate at the speed of light

Photons

All Light consists of longitudinal harmonic oscillators

$$2\pi_{\text{Photons}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity

Energy is quantised

Max Planck

$$E = n.h\nu$$

All Photons have mass-Energy and momentum

$$\lambda = \frac{h}{p} = \frac{h}{mv}\sqrt{1-\frac{v^2}{c^2}}$$

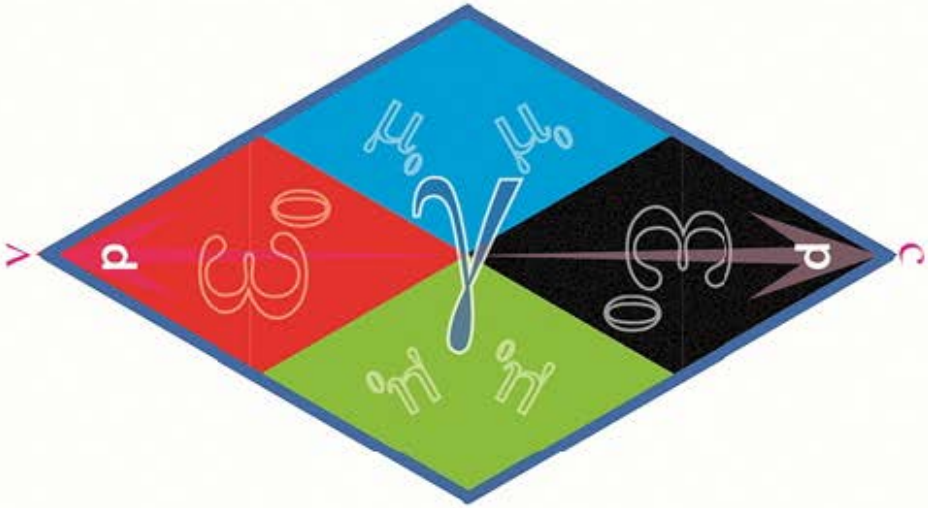

Photons are particles

Albert Einstein

$$E = hf$$

All EM waves and Matter exhibit a Wave-Particle duality

$$i\hbar\frac{\partial}{\partial t}\Psi = \hat{H}\Psi$$

Matter is a probabilistic wave of EM particles

p

Louis de Broglie

Erwin Schrodinger

Ψ

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Photonic EM fields

In 1865, James Clerk Maxwell's prediction that light was an electromagnetic wave, [which was confirmed experimentally in 1888 by Heinrich Hertz's detection of radio waves], seemed to be the final blow to particle models of light.

James Clerk Maxwell

(13 June 1831 – 5 November 1879)

$$2\pi_{\text{Photons}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity

8.8541e-12

All EM mass-energy momenta propagates bi-directionally at c [the speed of light] in a vacuum

$$E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}$$

$$\frac{K_E}{K_M} = 9e16\ \frac{\frac{N\,m^2}{C^2}}{\frac{N\,s^2}{C^2}}$$

$$c^2 = 9e16\ \frac{m^2}{s^2}$$

$$c = 299{,}792{,}458\ \frac{m}{s}$$

The speed of light can be calculated using the Electric and Magnetic constants

$$\frac{F}{m}\quad \varepsilon_0\quad \frac{A^2\,s^4}{kg\,m^3}$$

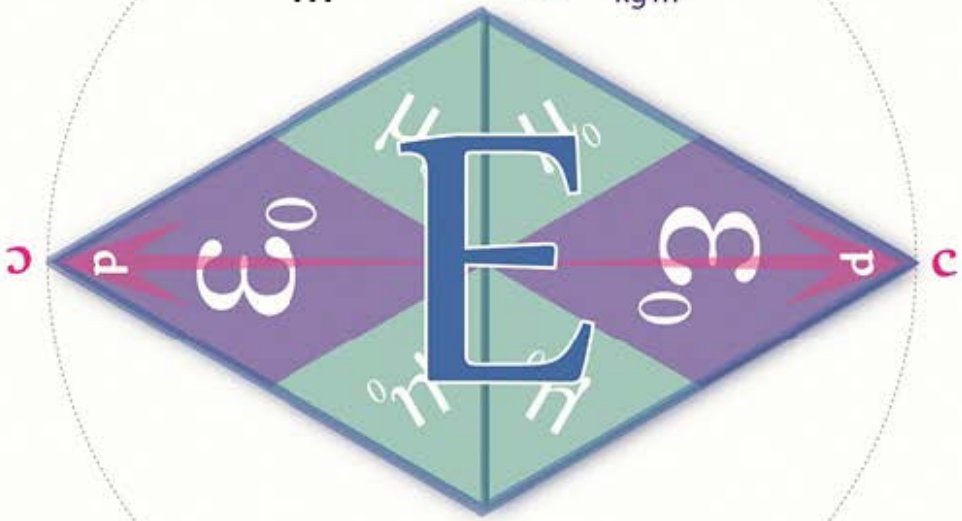

$$\frac{H}{m}\quad \mu_0\quad \frac{kg\,m}{A^2\,s^2}$$

[4π]e-7

Electric field strength

The strength of Electric fields is determined by the Electrical Permittivity Constant

$$\varepsilon_0\mu_0 = \frac{1}{c^2}$$

The strength of Magnetic fields is determined by the Magnetic Permeability Constant

$$B = \mu_0 H$$

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The ElectroMagnetic field geometry of Photons

$$2mv^2 = KE = hf$$

Matter is comprised entirely of equilateral electromagnetic energies

$$4n\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Matter topologies contain standing-wave EM mass-energies moving at the speed of light

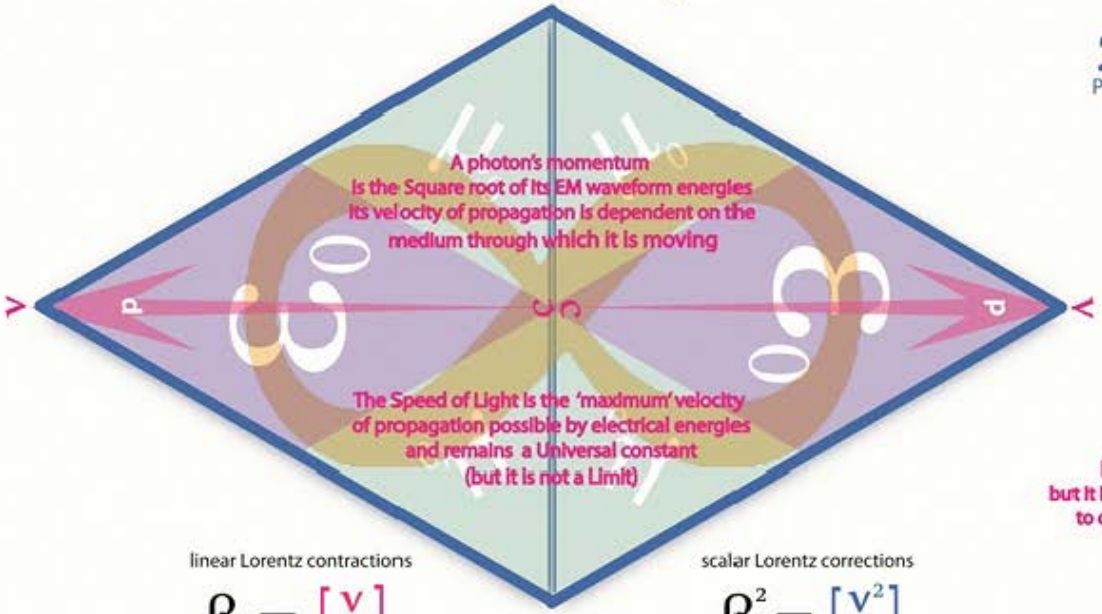

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[hv^2\right]\right]$$

Photons are diamond geometry ElectroMagnetic mass-energies

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega 0^2\right]\right]$$

Light cannot have zero velocity or stand still but it is possible (against Einstein's thought experiment) to catch up to a photon and observe its waveform

linear Lorentz contractions

$$\beta = \left[\frac{v}{c}\right]$$

scalar Lorentz corrections

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

Any addition of energy quanta to an existing photonic waveform is subject to relativistic Lorentz velocitycorrections to the Photon's KEM waveforms

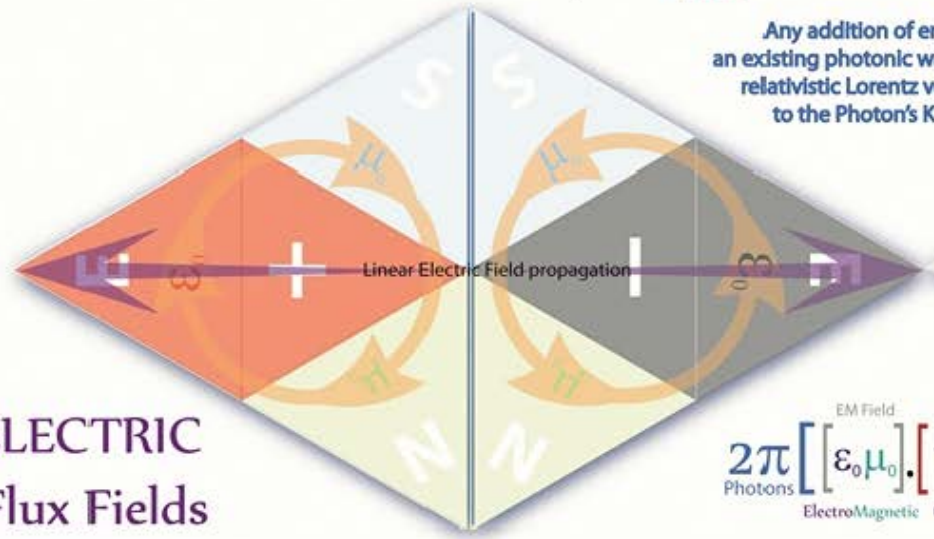

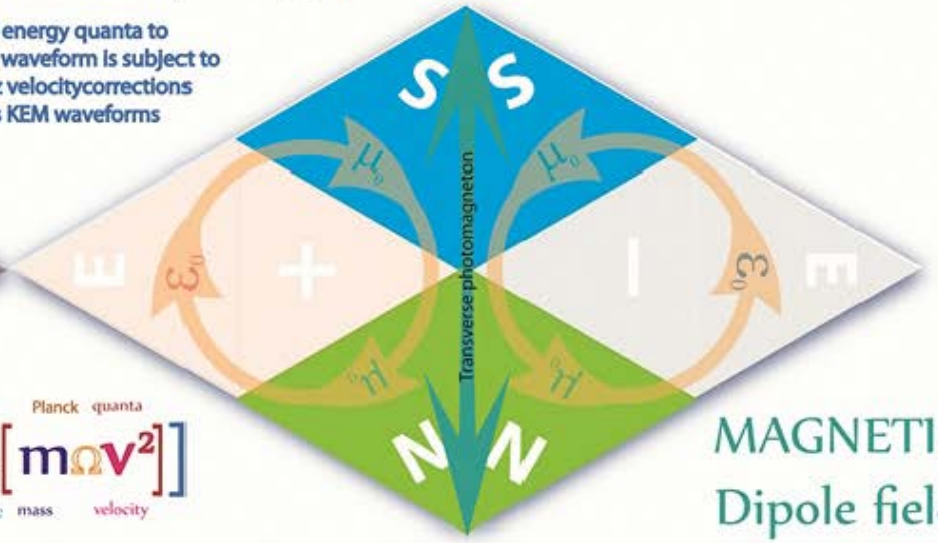

ELECTRIC Flux Fields

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

MAGNETIC Dipole fields

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Photons and Charge bosons

Photons are dual [2π]
neutral charge quanta

$$2\pi_{\text{Photons}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity

Their Electric and Magnetic
fields are orthogonal to each other

**Bosons are transverse charge carriers
they combine to create ElectroMagnetic
photons which are longitudinal charge carriers**

They propagate
in differing mediums
at v/c

$$\text{EVEN}\,\pi_{\text{EM waves}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity

nπ electromagnetic waves are comprised of
numerous 2π photons of the same wavelength
(save in superpositioned states - White light)

Photons are dual Boson waveforms

$$E = 2h\nu$$

$$E = hf$$

**A moving charge creates a magnetic field throughout space
that is perpendicular to the direction of motion.**

**Photons require NO ether to propagate
they are discrete bundles of EM energy-momenta**

**Similarly, a magnet has an intrinsic neutral electric field
that is perpendicular to its Magnetic Dipole.**

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Photon EM strength vectors

Electric field force vectors

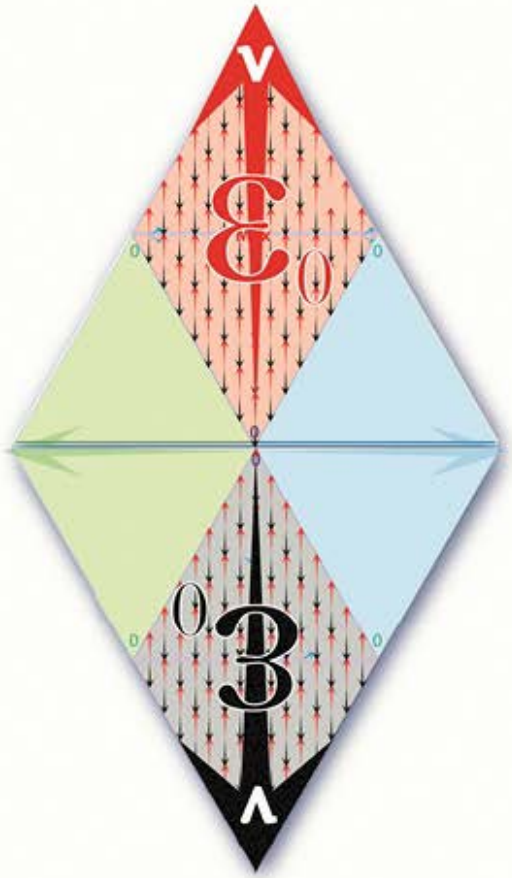

When E field flux is at Maximum
B field flux is at Minimum

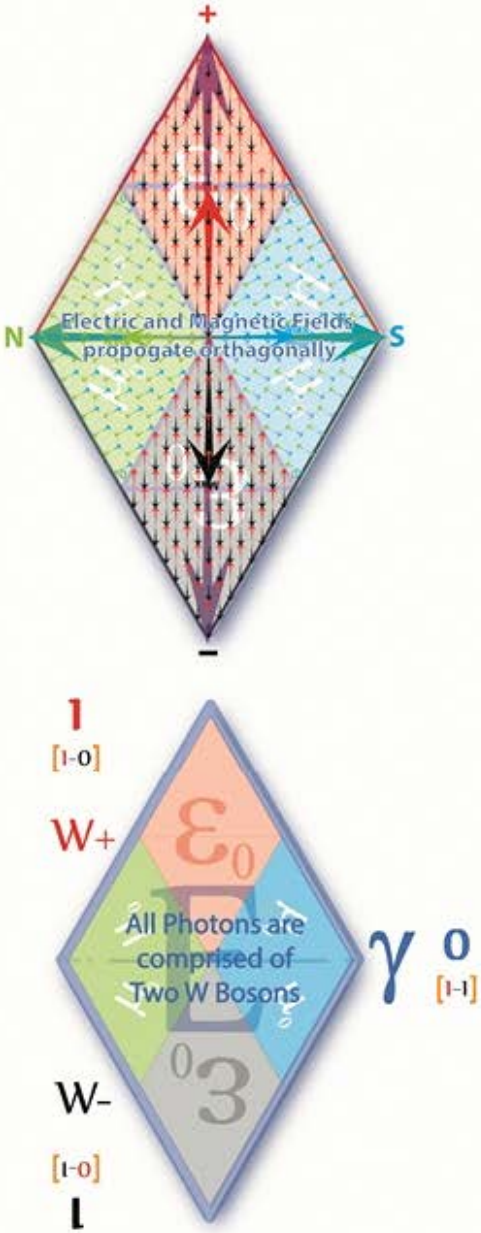

Magnetic field force vectors

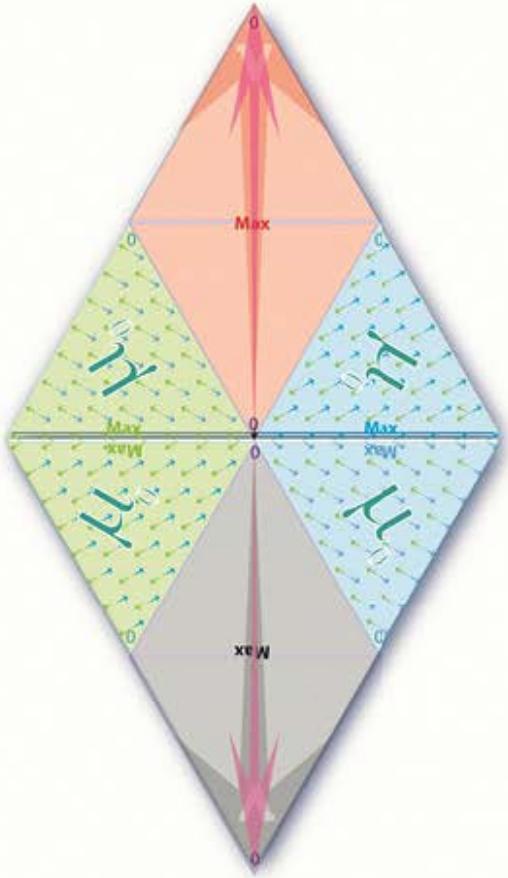

When B field flux is at Maximum
E field flux is at Minimum

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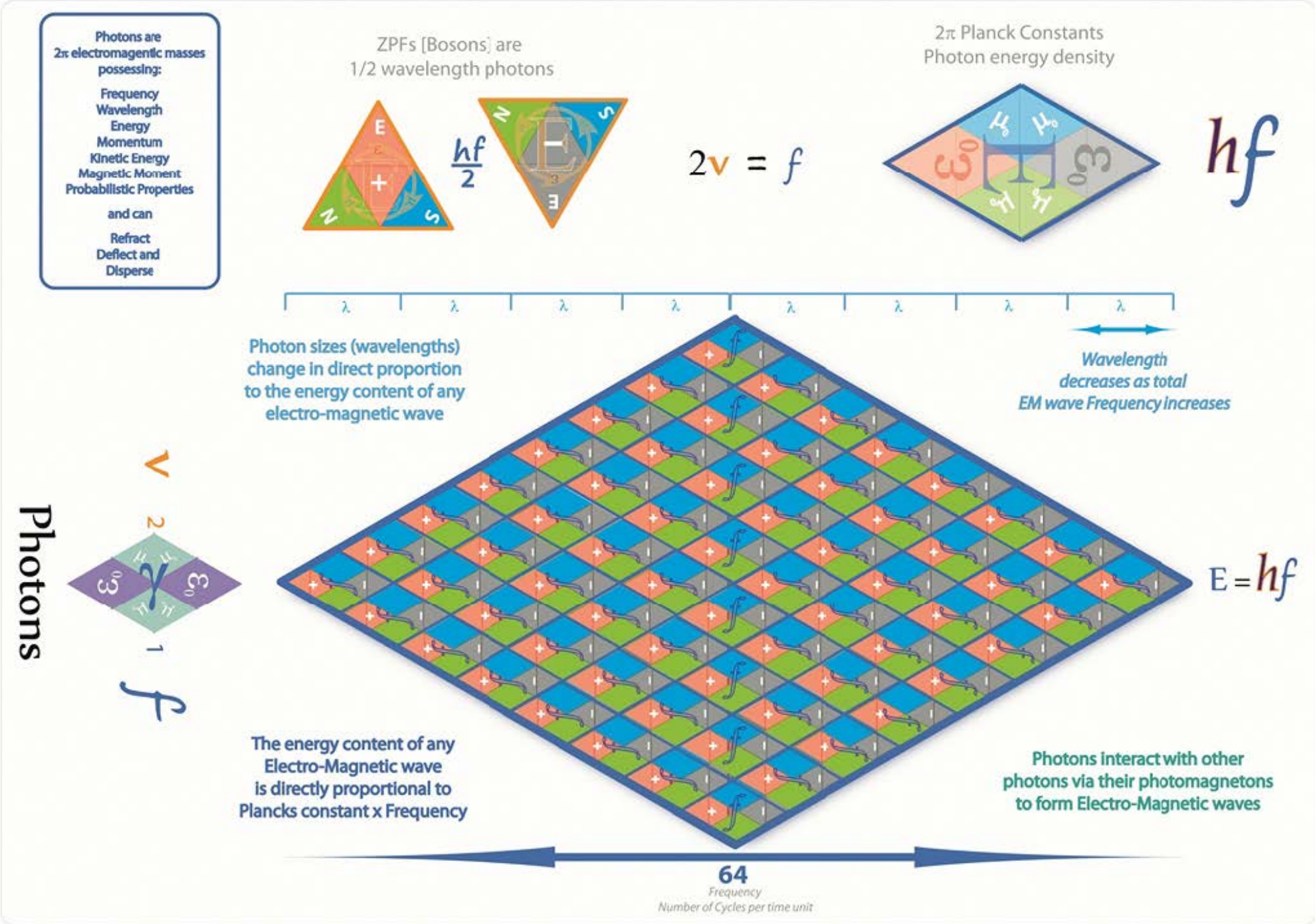

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Bosons in a EM wave

EM waves are comprised of transverse W Bosons

Odd numbers totaling to a Square number

$E = h\nu$

$2\nu = f$

$E = hf$

Even numbers totaling to a Square number

EM waves are also comprised of longitudinal Photons

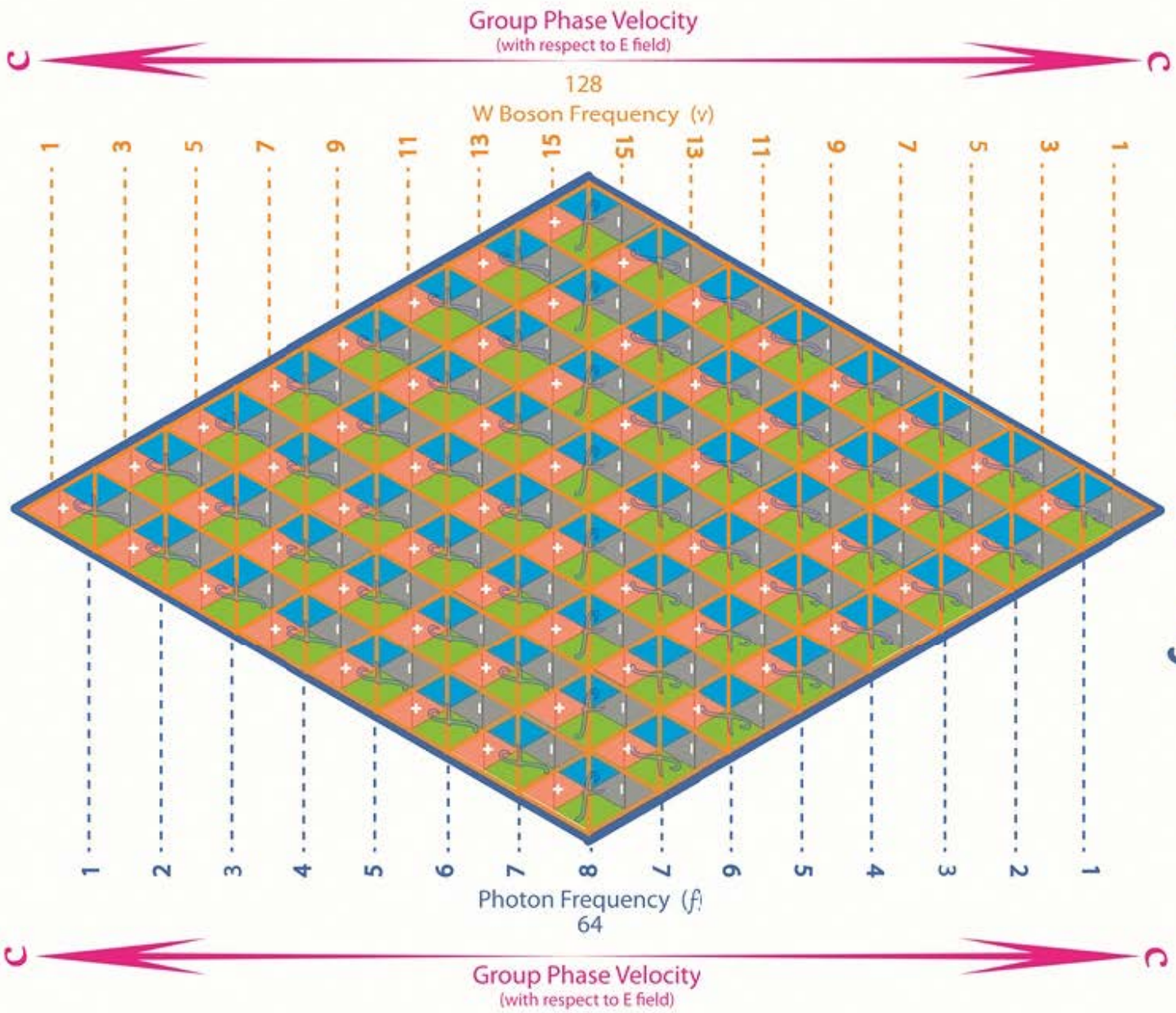

$2h\nu = E = hf$

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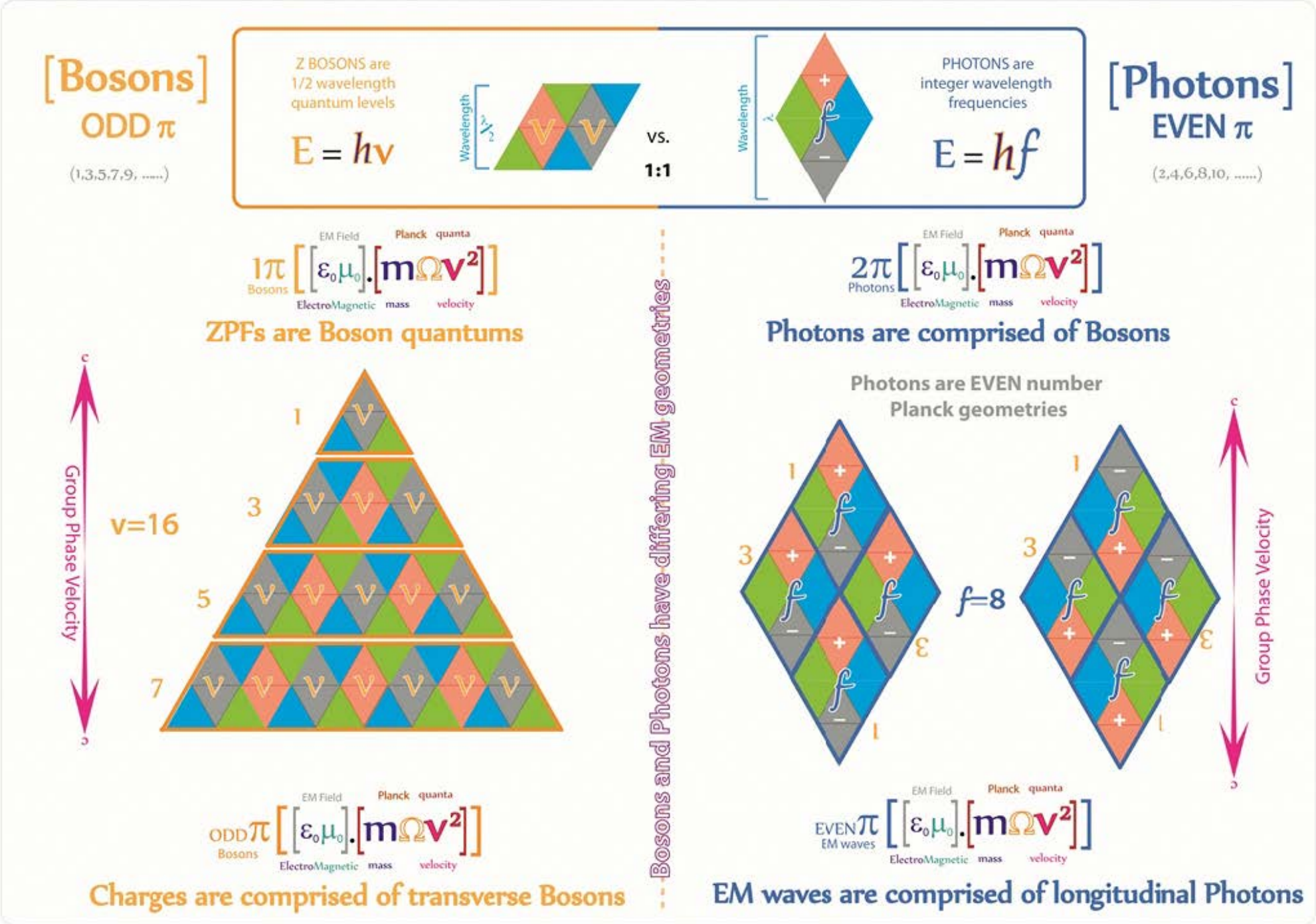

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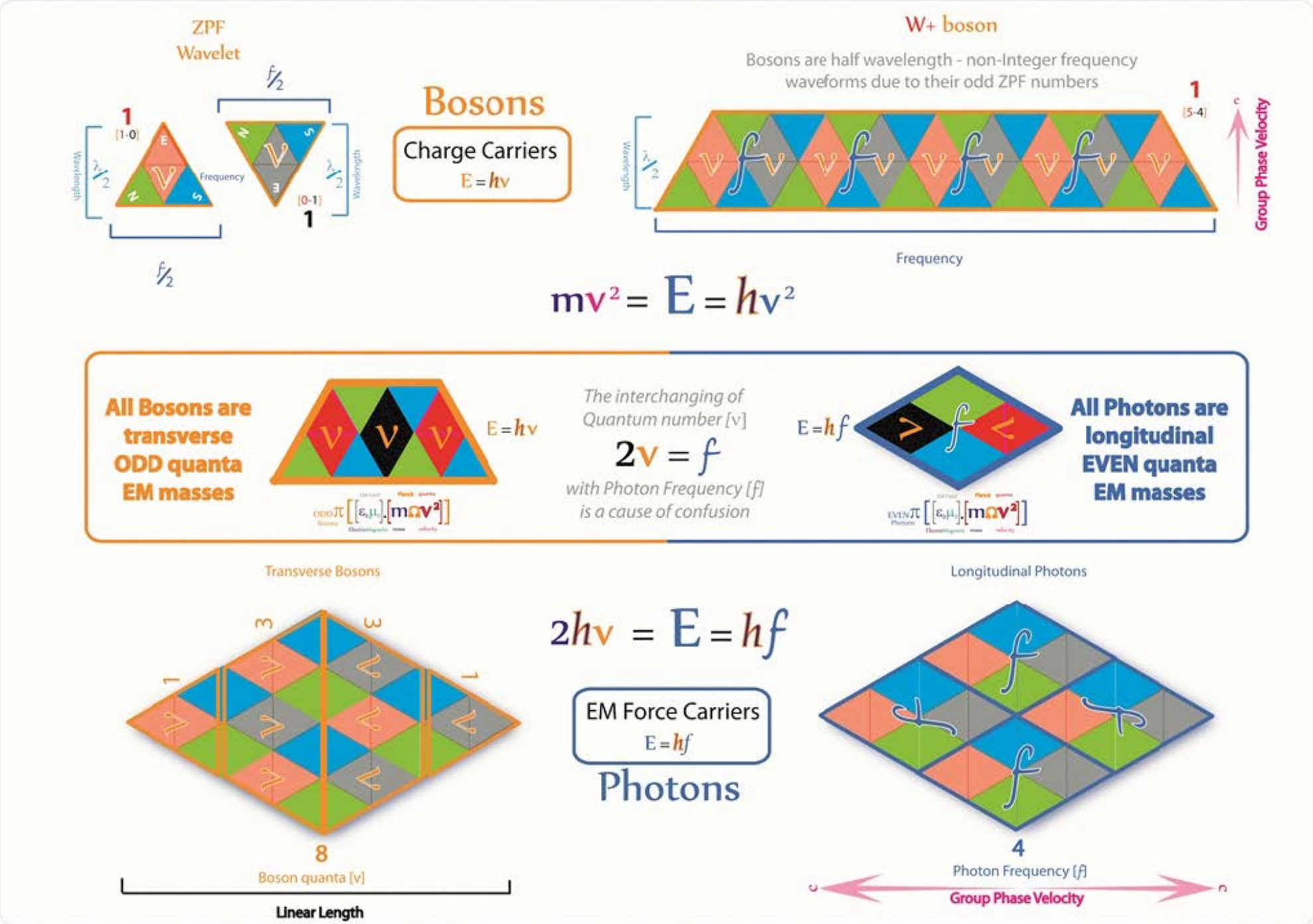

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Photonic Energies

$$2p^2 = KE = 2mv^2$$

The equilateral geometries of Quantised Angular Momentum of Planck energy quanta is the source of linear Momentum

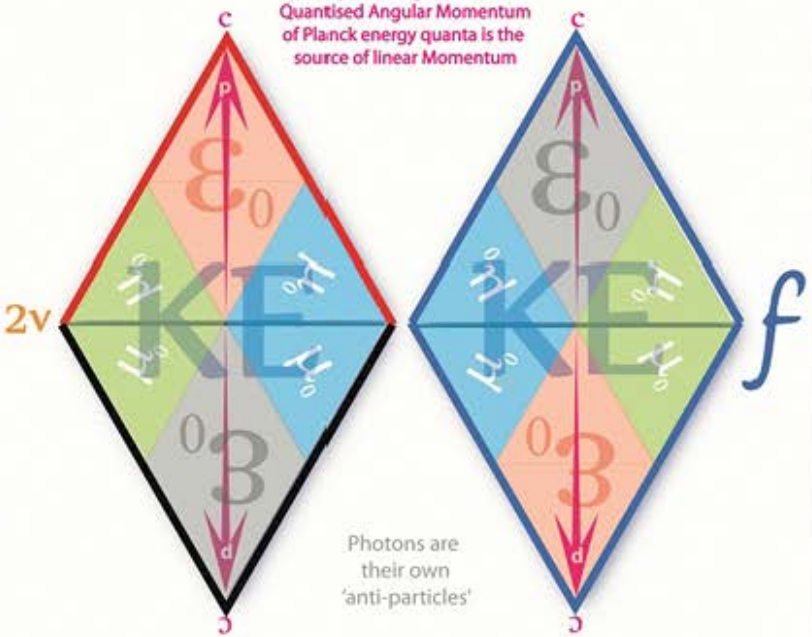

$$2hv = E = hf$$

$$E_\gamma = 2mc^2$$

As Photons are 2D EM energy waveforms they should always be referred to as having EM mass-energy equivalence

γ

$$2\pi\left[m\Omega v^2\right]$$

Planck quanta; mass; velocity

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field; Planck quanta; Photons; ElectroMagnetic; mass; velocity

Photons are kinetic energy [KE] wave packets:

$KE = (1/2) * m_\gamma * v^2$

$= 1/2 * (E/c^2) * c^2$

$= E/2$

KE

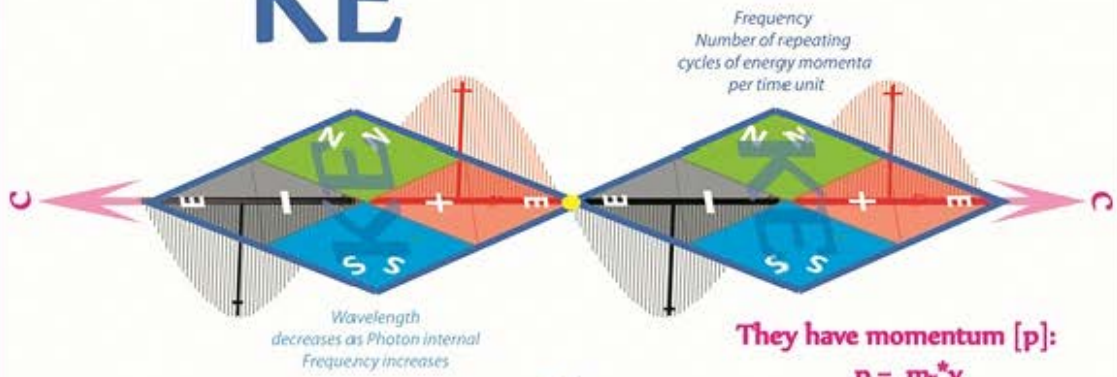

They have momentum [p]:

$p = m_\gamma * v$

$= (E/c^2) * c$

$= E * c$

0

[v-v]

Photons are 2n neutral charge waveforms

Photons are divergent kinetic waveforms

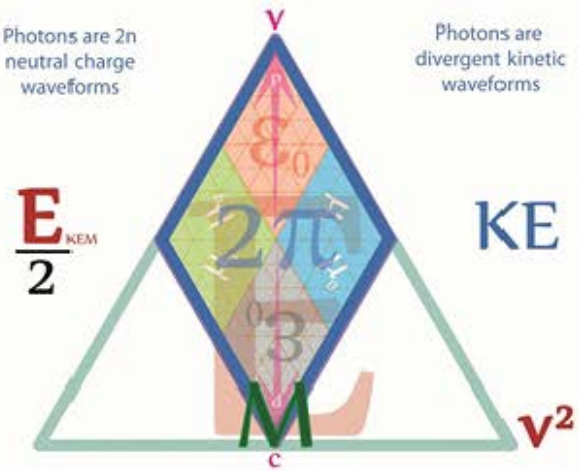

$$KE = \frac{E_{KEM}}{2}$$

$$KE = \frac{1}{2}Mv^2$$

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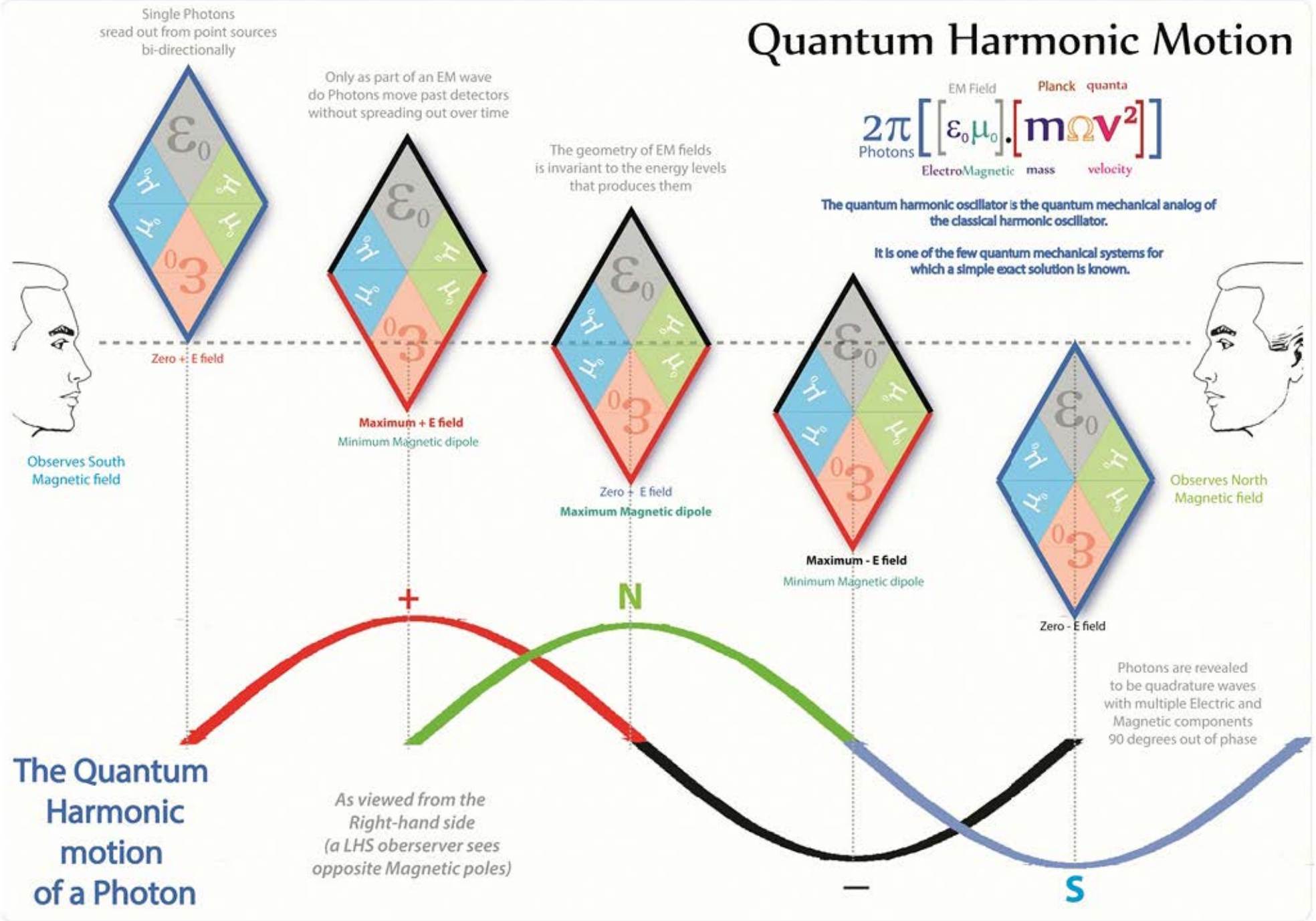

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Photonic EM fields

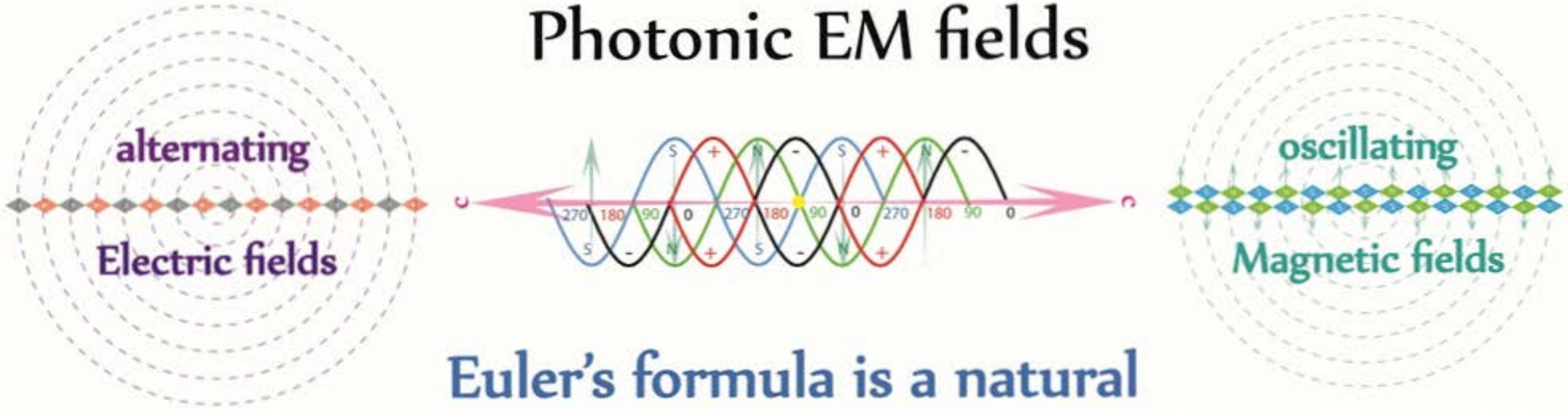

Euler's formula is a natural geometric expression of electromagnetic waves

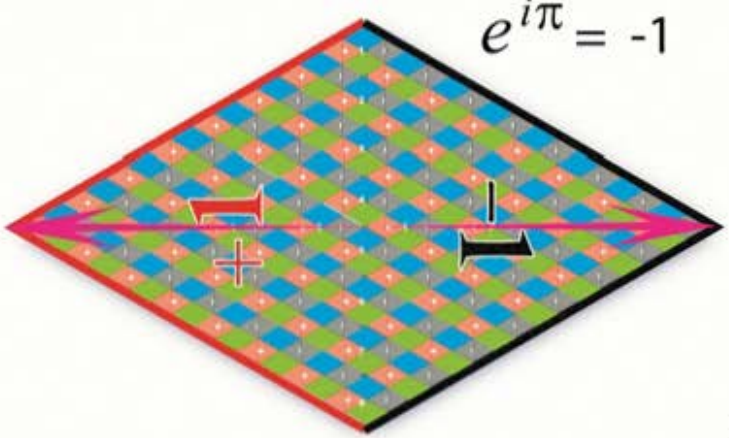

$e^{i\pi} = -1$

$e^{i\pi} + 1 = 0$

$$e^{ix} = \cos x + i \sin x$$

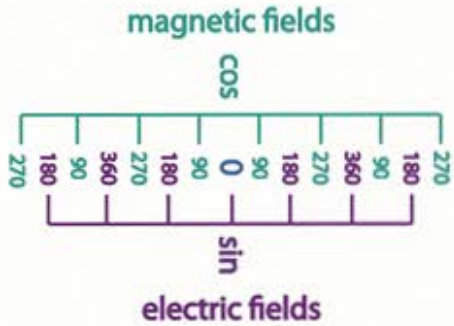

Every field geometry in a EM wave is 90 degrees out of phase with the E or M field adjacent to it

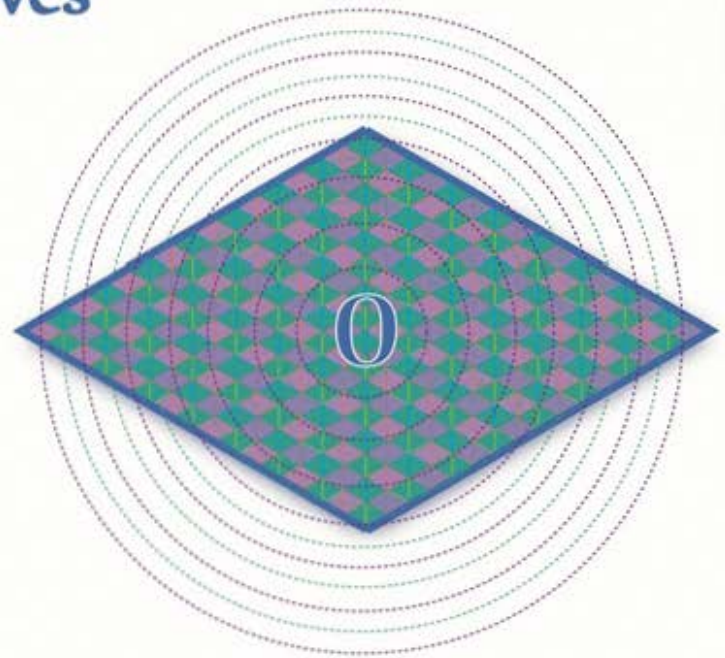

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Euler's Formula

Euler's formula is often considered to be the basis of the complex number system. In deriving this formula, Euler established a relationship between the trigonometric functions, sine and cosine, and e raised to a power

$$e^{ix} = \cos(x) + i\sin(x)$$

a mathematical description of EM-Energy waveforms

adjacent EM fields are 90-180° out of phase

$$e^{i\pi} = -1$$

$$e^{i\pi} + 1 = 0$$

Leonhard Euler

(15 April 1707 – 18 September 1783)

Positive E-fields are out of phase with Negative fields

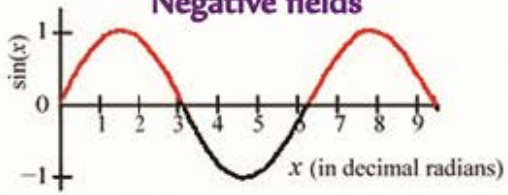

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \ldots$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \ldots$$

Magnetic fields are out of phase with Electric fields

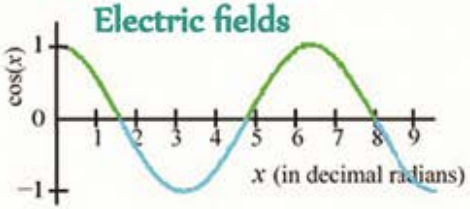

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \ldots$$

$$\sin x + \cos x = 1 + x - \frac{x^2}{2!} - \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \ldots$$

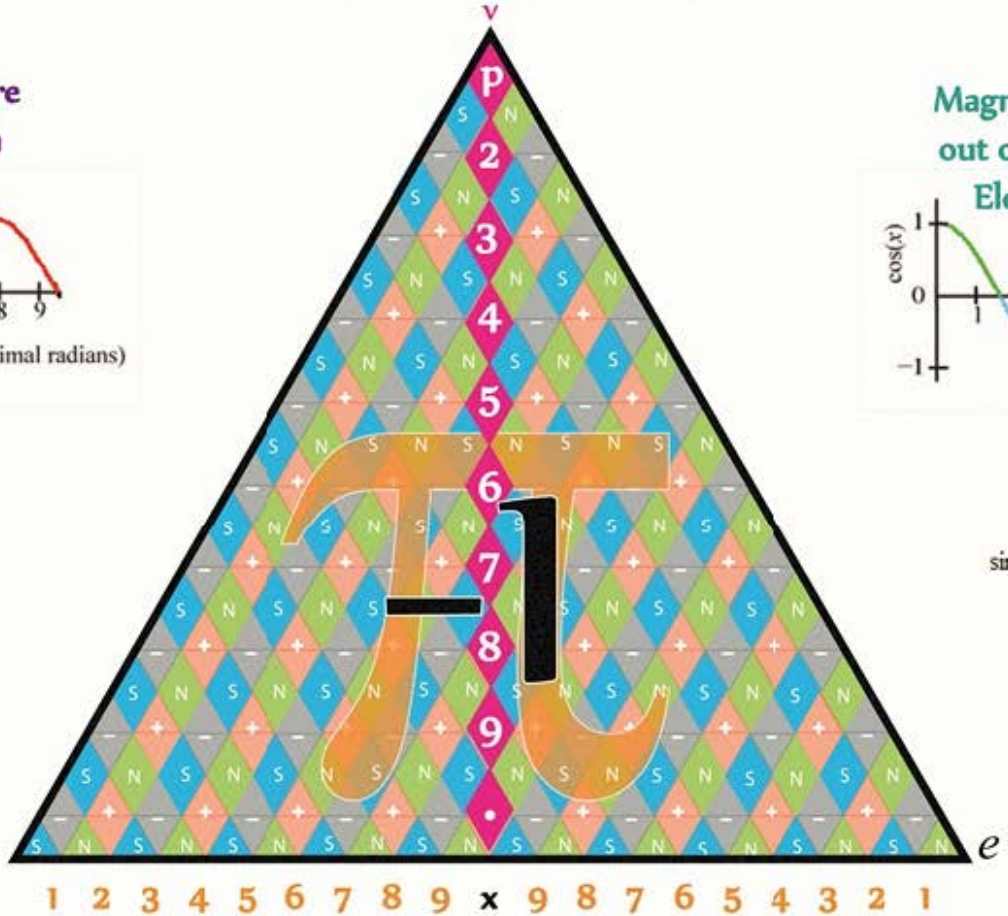

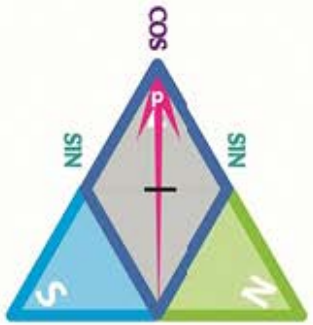

The above geometry is reflective of negative charge energy momenta Planck geometries

the momentum of the nett charged geometry is the Square root of Negative 1

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Inverse Square Law

Squared numbers are equilateral geometries

Any point source which spreads its influence equally in all directions without a limit to its range will obey the inverse square law

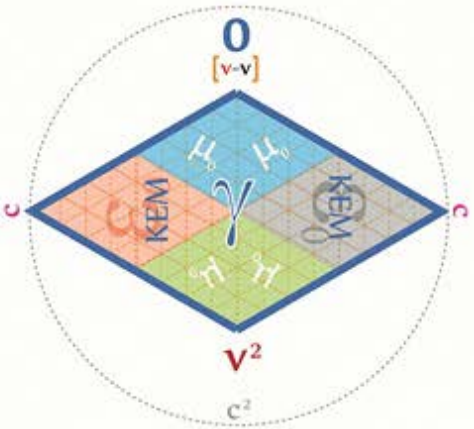

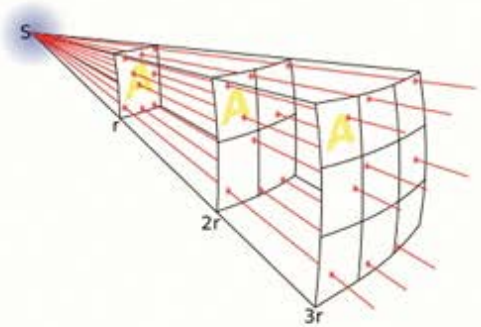

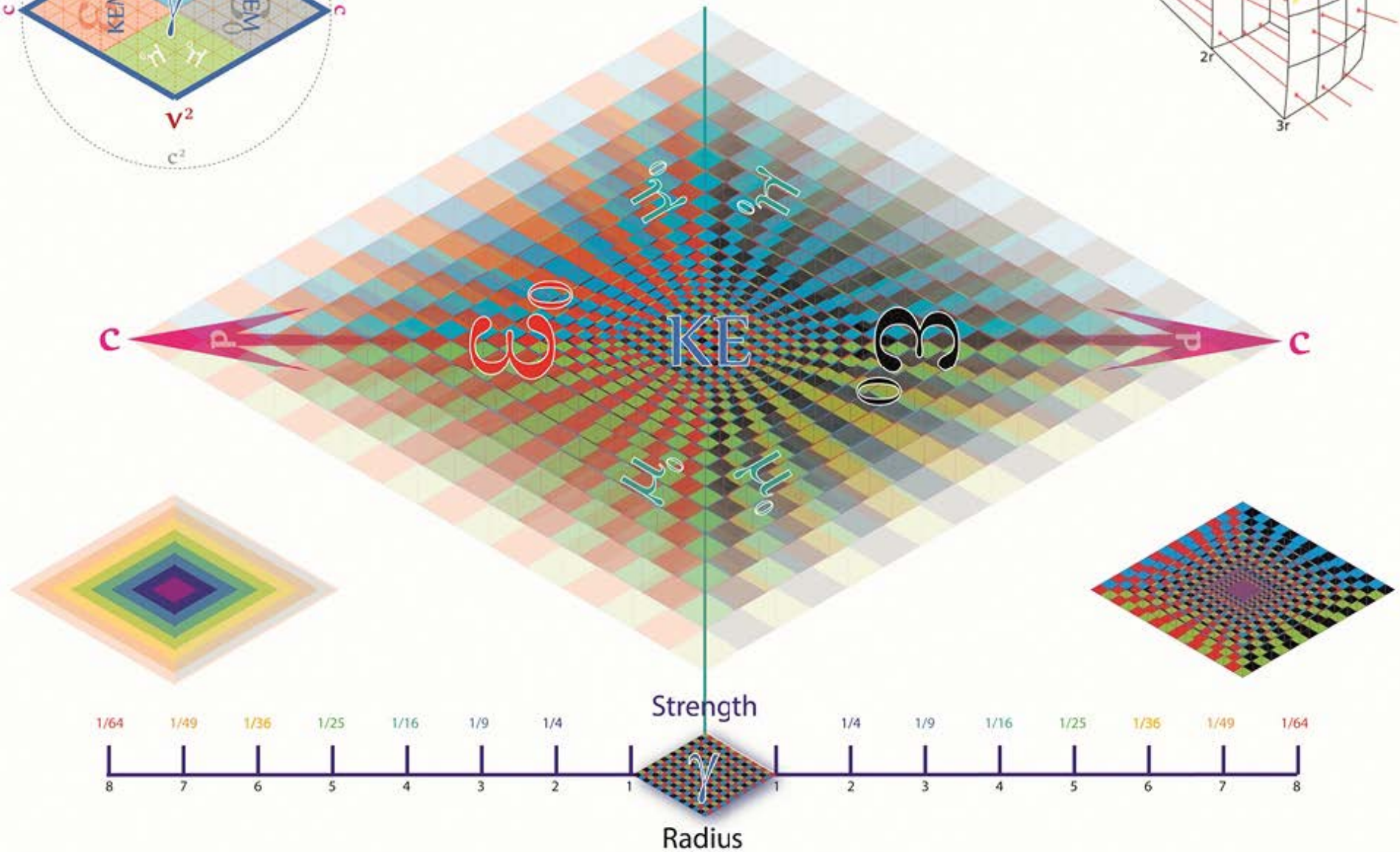

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$$n\pi \left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta; mass — ElectroMagnetic mass — velocity

Throughout history Physicists have sought relationships between EM mass-Energy and momenta in an attempt to discern the true Nature of these physical properties

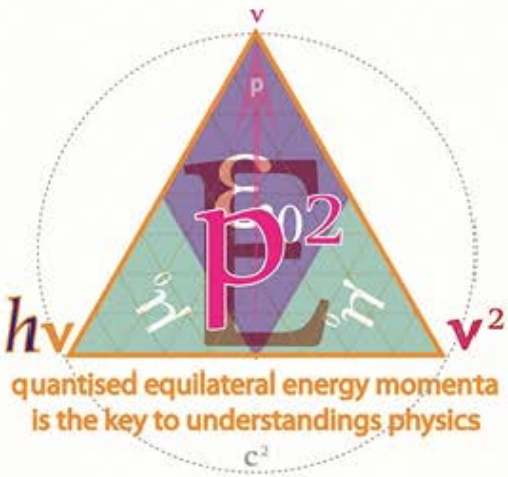

quantised equilateral energy momenta is the key to understandings physics

mass-Energy momenta

$$E$$

Energy

$$kg\,\frac{m^2}{s^2}$$

Compton Frequency

$$\left[\frac{E}{h}\right]$$

$E = mv$ — *Newton*

$E = mv^2$ — *Leibnitz*

$v = \frac{1}{\sqrt{\varepsilon_0\mu_0}}$ — *Maxwell*

Velocity of Light

$$v = \left[\left[\frac{c^2}{\Omega}\right].\left[\frac{\Omega}{c}\right]\right]$$

f — Scalar Frequency; λ — Linear Wavelength

Planck $E = hv$

Einstein $E = hf$

de Broglie h/p

Planck's Constant

$$kg\,\frac{m^2}{s}$$

de Broglie wavelength

$$\left[\frac{E}{p}\right]$$

Wavelength

$$p$$

Linear momentum

$$kg\,\frac{m}{s}$$

Ryberg wavenumber

$$\left[\frac{p}{E}\right]$$

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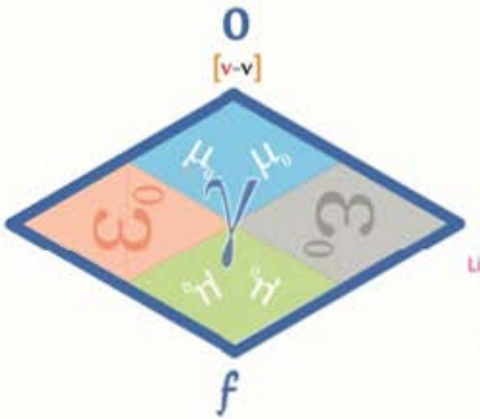

$$mv^2 = KE = hv^2$$

All Photons contain Energy momenta
and therefore have electromagnetic mass
but they are 'Matterless' geometries

Light cannot have zero velocity
[stand still] but it is possible
to catch up to a photon
and observe its waveform

The Speed of Light is
the maximum speed of Electrical energy
and remains a Universal constant
(but it is not a Limit)

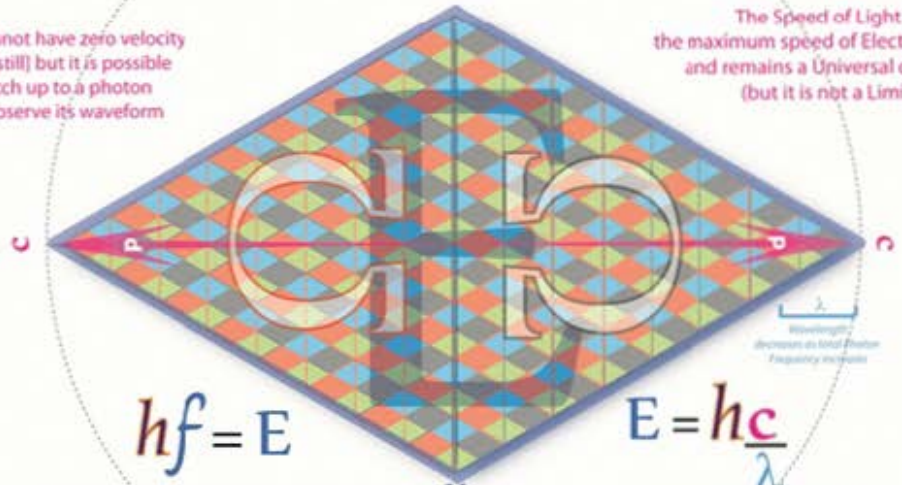

$$hf = E \qquad E = h\frac{c}{\lambda}$$

Frequency
[number of cycles per unit time]

c^2

Wavenumber

$$\frac{m}{s}\cdot\frac{s}{m^2} \quad \left[\frac{c}{\Omega}\right] \frac{1}{m}$$

Celeritas

[Frequency x Wavelength]

EM waves are typically described
through any of their following
three physical properties:

frequency f,
wavelength λ, or
photon energy E

ElectroMagnetic Fields

$$\varepsilon_0 \mu_0 = \frac{1}{c^2}$$

1.112650056 e-17 $\frac{s^2}{m^2}$

Frequency, momentum, and Wavelength
are all related through the geometries of c & c²

$$\lambda \qquad m\left[\frac{\Omega}{c}\right] \quad \frac{m^2}{s}\cdot\frac{s}{m}$$

Wavelength

Velocity of Light

$$c = \left[\left[\frac{c^2}{\Omega}\right]\cdot\left[\frac{\Omega}{c}\right]\right]$$

$$v = \frac{1}{\sqrt{\varepsilon_0 \mu_0}}$$

Frequency (f) Wavelength (λ)

$$f \qquad \frac{m^2}{s^2}\cdot\frac{s}{m^2} \quad \left[\frac{c^2}{\Omega}\right] \frac{1}{s}$$

Frequency

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Frequency is the number of neutral quanta sets repeating per unit time in a EM wave

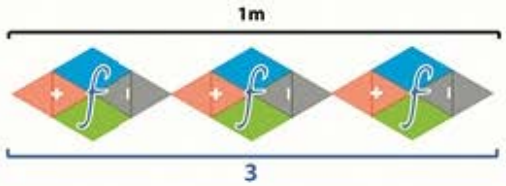

EM waves frequencies [photon number] change in direct proportion to the energy content of any electromagnetic wave

The specific wavelengths and frequencies of energy momenta in KEM fields form the basis for Spectral emission/absorption lines [care must be always taken to specify if quanta or photons are being measured]

$2v = f$

$E = hv$

Bosons are charged transverse energy momenta quanta

2 charge quanta

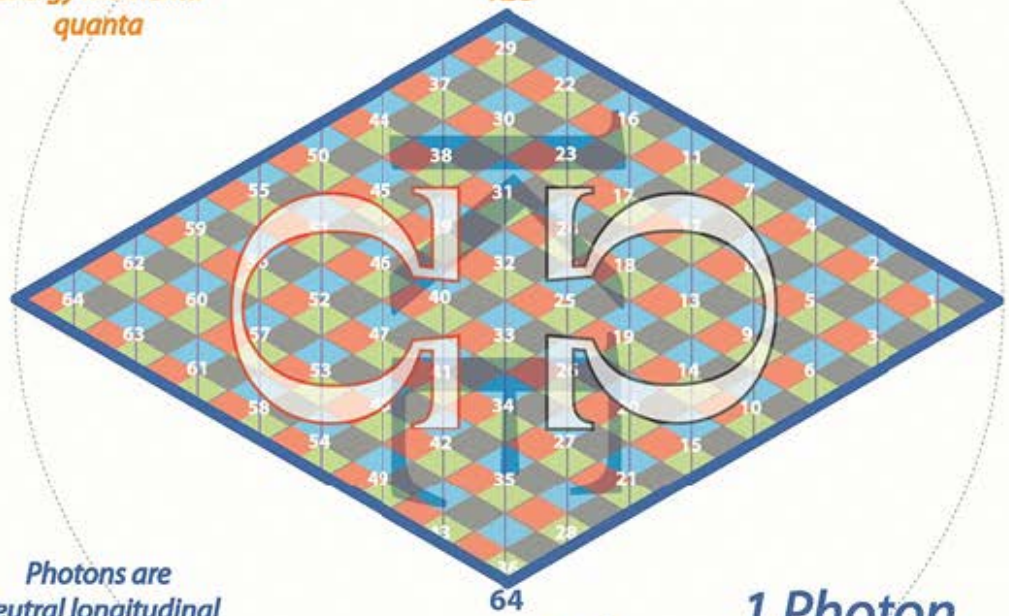

Photons are neutral longitudinal energy momenta waveforms

$E = hf$

1 Photon

c^2

Irrespective of whether its measured as a transverse or longitudinal electromagnetic wave

Frequency is the inverse of Charge

$$f \left[\frac{c^2}{\Omega}\right]$$

Frequency

Frequency
(Number of Neutral ZPF sets per unit of time)

is directly related to the nett quantised angular momentum of any space time geometry

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λ

Wavelength

Wavelength is a measure of the distance between repetitions of geometric features such as maximums, minimums, or zero-points of Electric and Magnetic fields

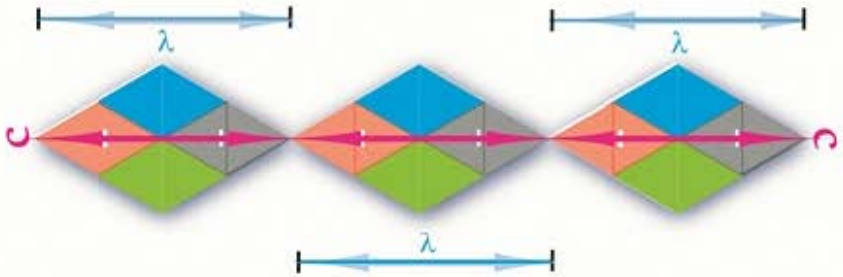

$\tilde{\nu}$

Wavelengths are the inverse of Wavenumbers

λ

For additional quantised energy momenta to be added to any spatial geometry their physical wavelengths must decrease

Lorentz velocity dependent length contractions must be correctly retermed electromagnetic WAVE-length contractions

$$\lambda$$

$$\left[\frac{\Omega}{c}\right]$$

Wavelength

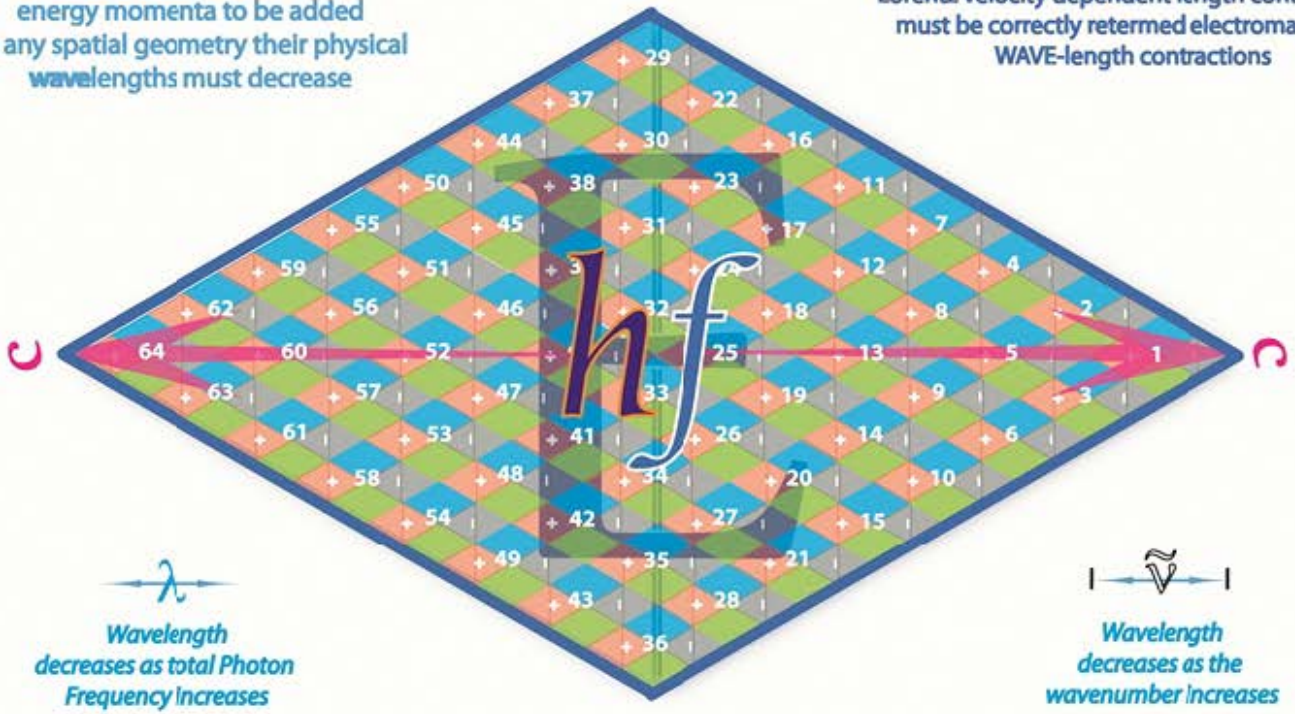

λ

Wavelength decreases as total Photon Frequency increases

$\tilde{\nu}$

Wavelength decreases as the wavenumber increases

In physics, the wavelength of a sinusoidal wave is the spatial period of the wave – the distance over which the wave's shape repeats. It is usually determined by considering the distance between consecutive corresponding points of the same phase, such as crests, troughs, or zero crossings, and is a characteristic of both traveling waves and standing waves, as well as other spatial wave patterns.

The concept can also be applied to periodic complex or non-sinusoidal waves

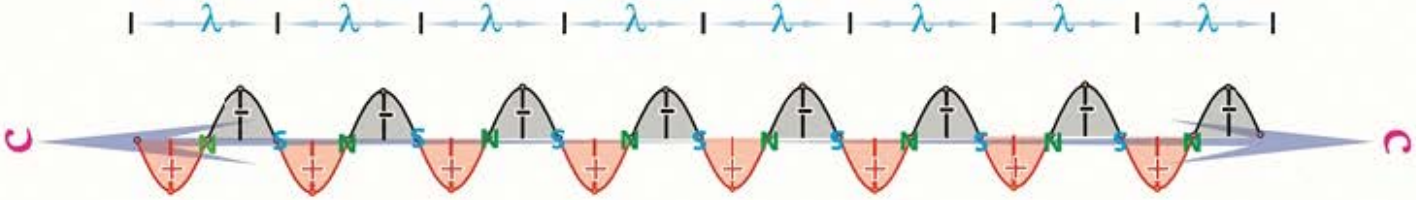

299,792,458
linear metres per second

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Wavenumbers

$\tilde{\nu}$

Wavenumbers are the inverse of Wavelengths

λ

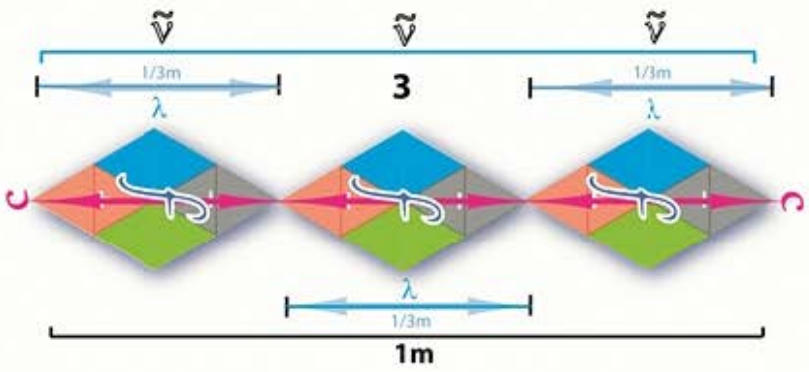

Wavenumbers are the spatial equivalent of Frequency

$$\left[\frac{c}{\Omega}\right]$$

$$\lambda \left[\frac{\Omega}{c}\right]$$

Wavelength and Frequency are related to the group velocity of quanta in an EM wave

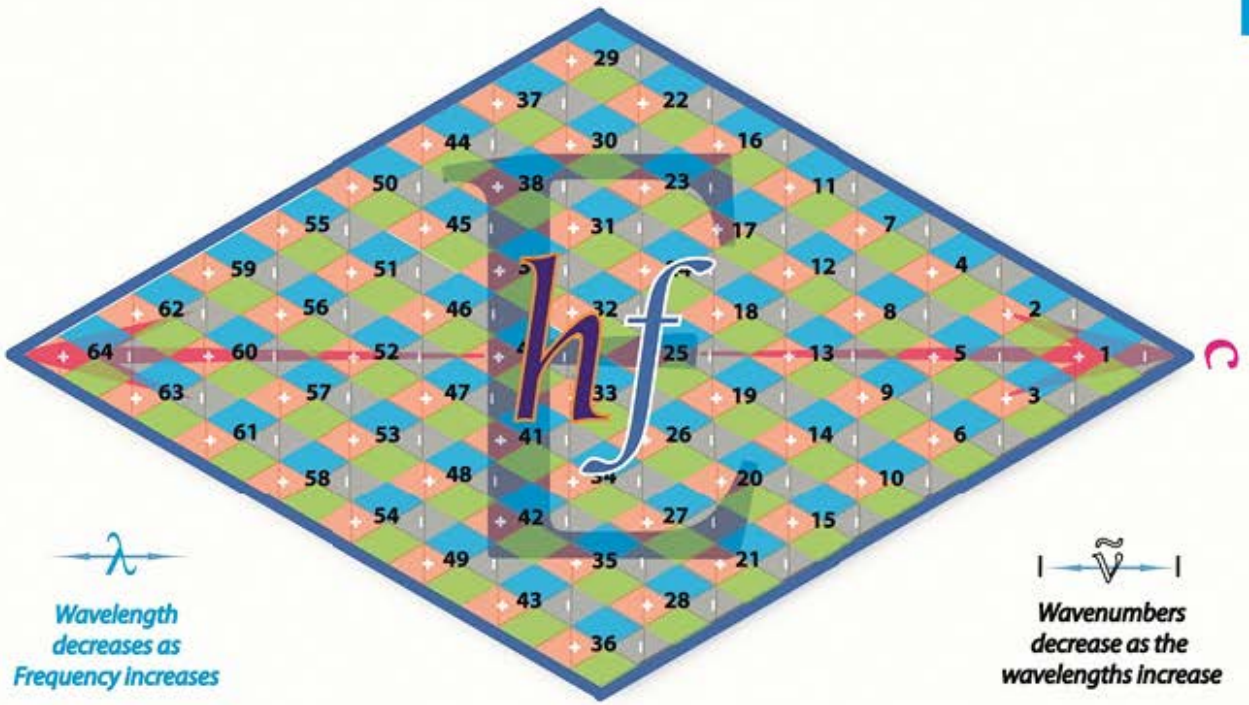

$$\tilde{\nu} = 1/\lambda$$

Wavenumbers are inversely proportional to Wavelengths

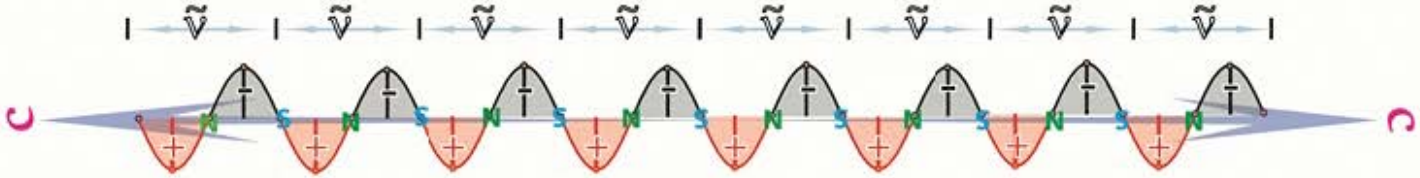

299,792,458
linear metres per second

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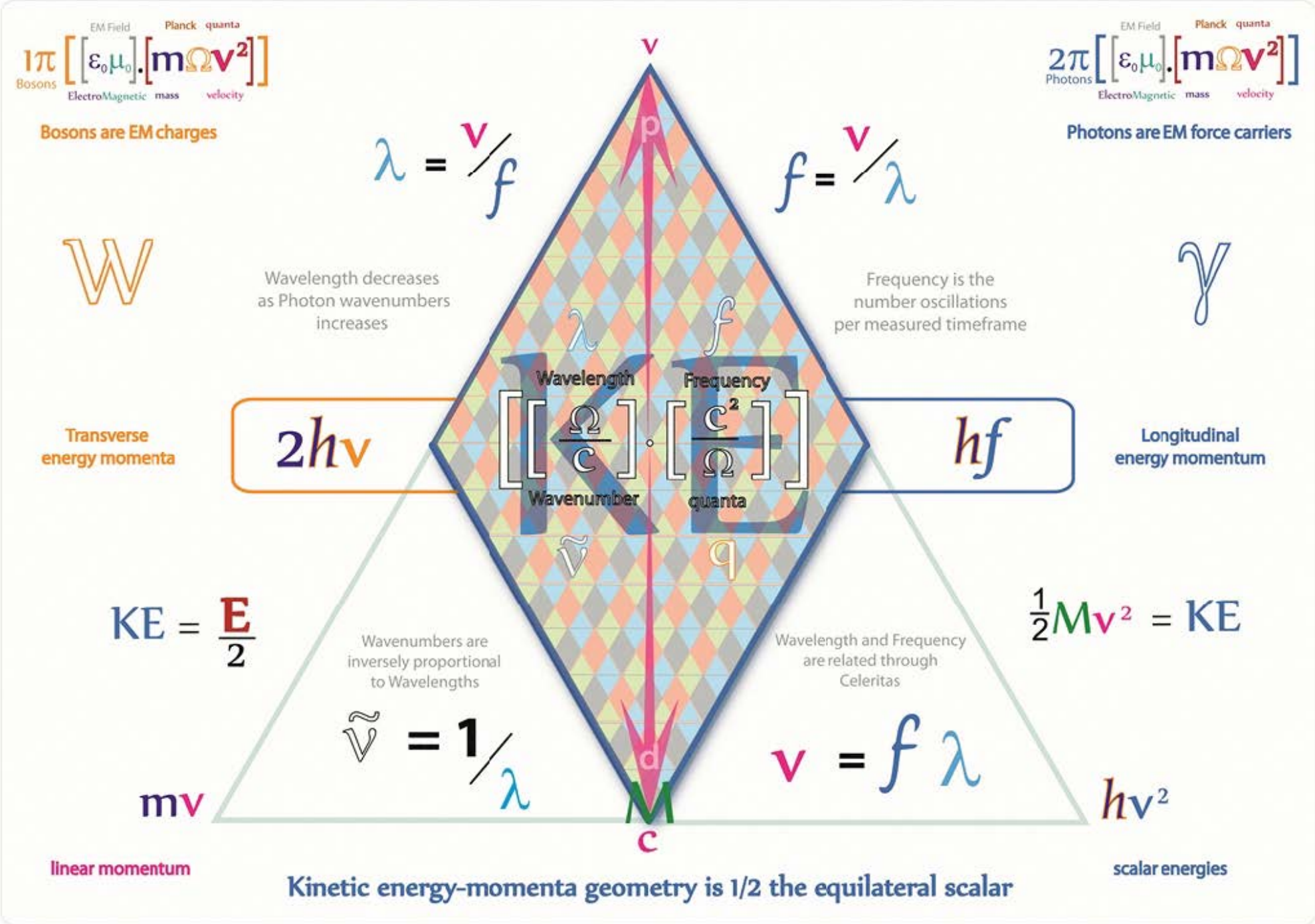

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Faraday Rotation

The Faraday effect or Faraday rotation is a Magneto-optical phenomenon, that is, an interaction between light and a magnetic field in a medium. The Faraday effect causes a rotation of the plane of polarization which is linearly proportional to the component of the magnetic field in the direction of propagation.

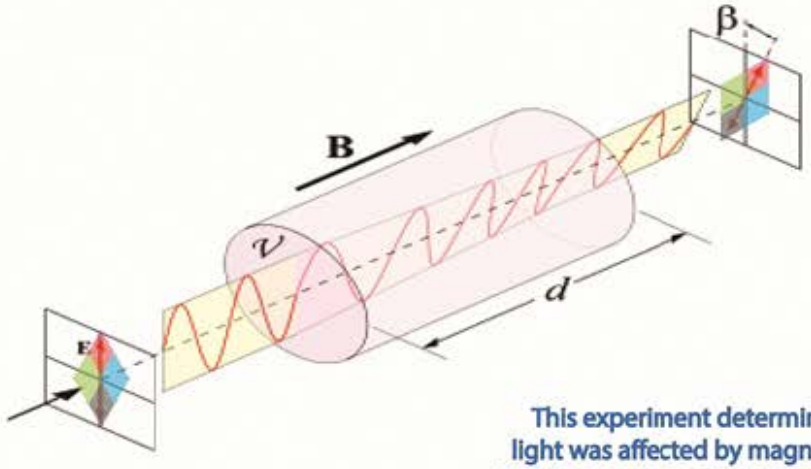

Discovered by Michael Faraday in 1845, the Faraday effect was the first experimental evidence that light and electromagnetism are related

Faraday summarized the entire effect as follows:

"Magnetic lines, then, in passing through silicated borate of lead, and a great number of other substances, cause these bodies to act upon a polarized ray of light when the lines are parallel to the ray, or in proportion as they are parallel to it: if they are perpendicular to the ray, they have no action upon it.

They give the diamagnetic the power of rotating the ray; and the law of this action on light is, that if a magnetic line of force be going from a north pole, or coming from a south pole, along the path of a polarized ray coming to the observer, it will rotate that ray to the right-hand; or, that if such a line of force be coming from a north pole, or going from a south pole, it will rotate such a ray to the left hand."

Michael Faraday

(22 September 1791 – 25 August 1867)

This experiment determined that light was affected by magnetic force. This "magneto-optical effect" was later termed the Faraday effect.

Faraday experimented with other substances that yielded similar results.

The resultant effect he termed "diamagnetism" concluding that magnetism was an inherent property of all EM mass-ENERGY-Matter

Before the Magnetic field

After the Magnetic field

Evan's Photomagneton

A photon has a magnetic dipole. It is an elementary magnet. Evans discovery of the photon's longitudinal magnetic field in 1992 is as significant, as Einstein's discovery of relativity.

It helps in giving a physical interpretation of wave mechanics, two-slit interference and the Faraday effect,

all accounted for in Tetryonic Theory.

Every Photon and EM wave has polarised magnetic apexes as a result of the Planck quanta constituing them (creating Magnetic moments)

These Photo-Magnetic Moments allow for the interaction of Photons with external magnetic fields resulting in Faraday rotation of Photons and EM fields

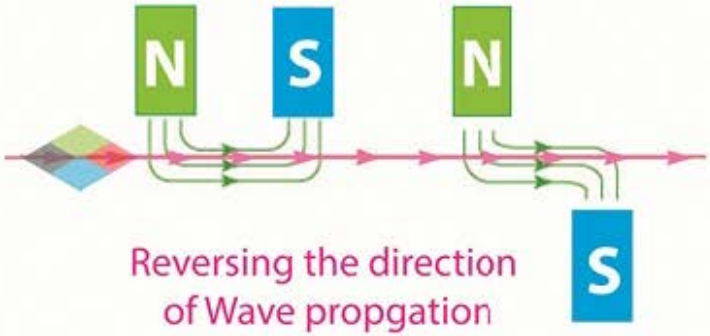

Reversing the direction of Wave propgation reverses the rotation effected by the external magnetic field

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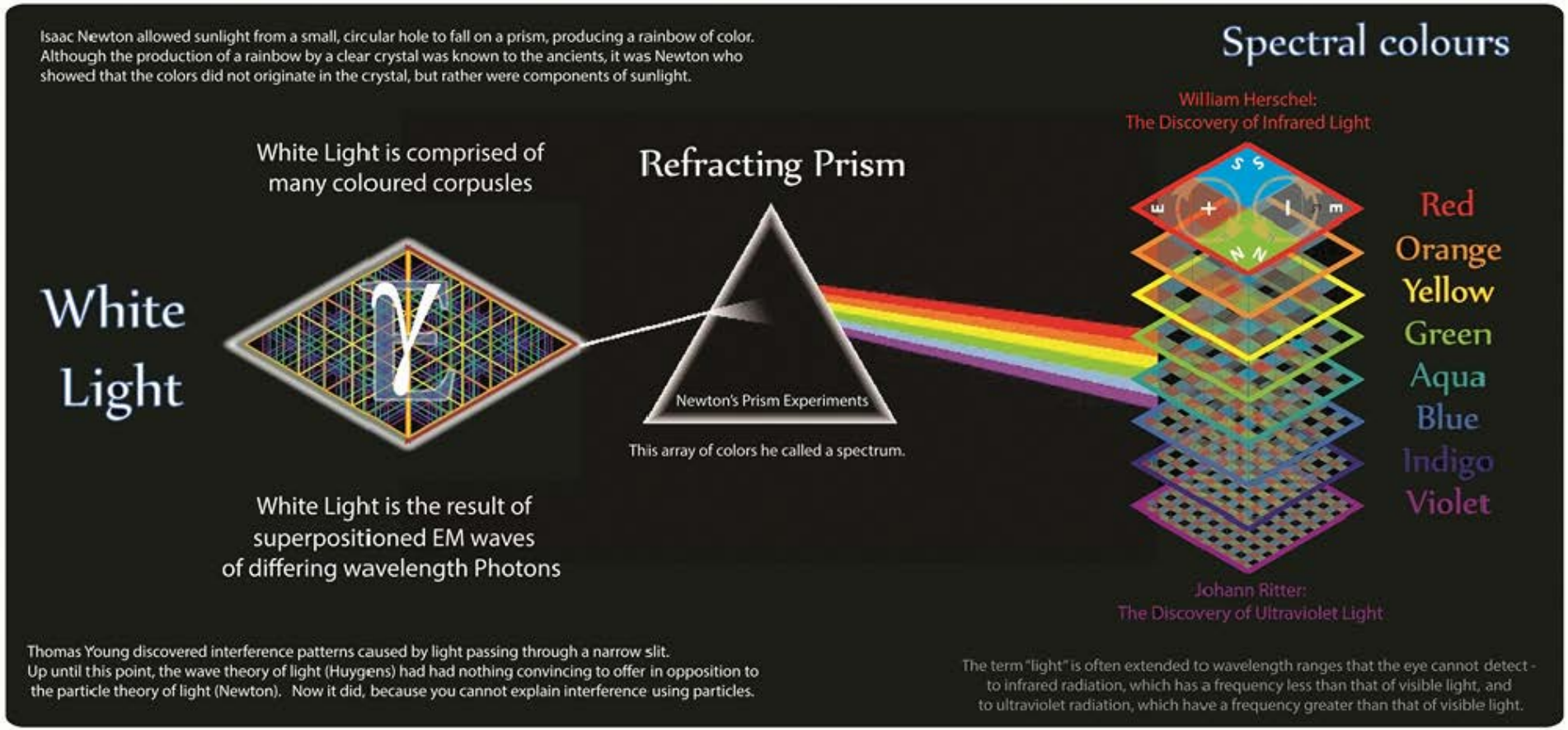

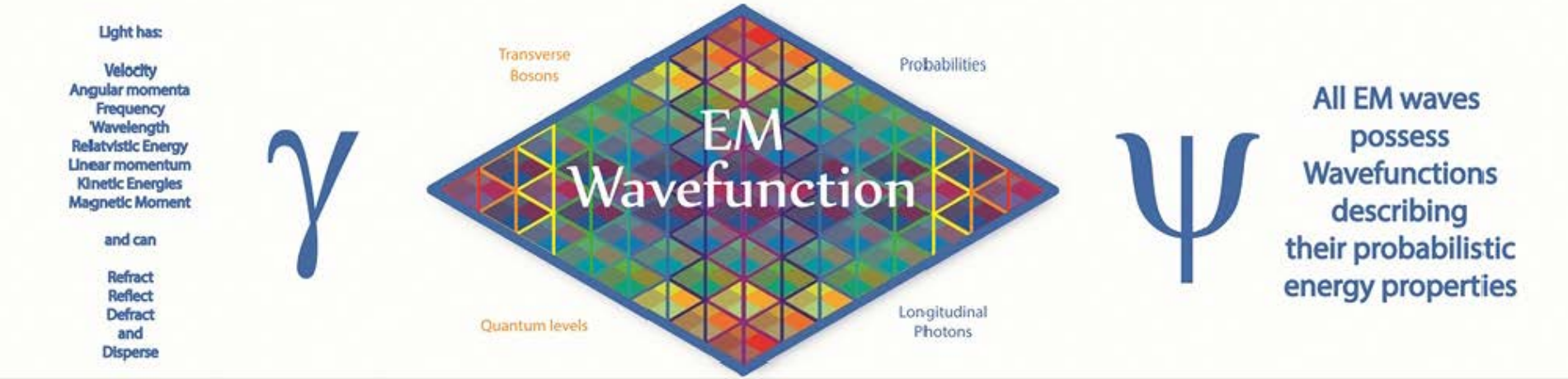

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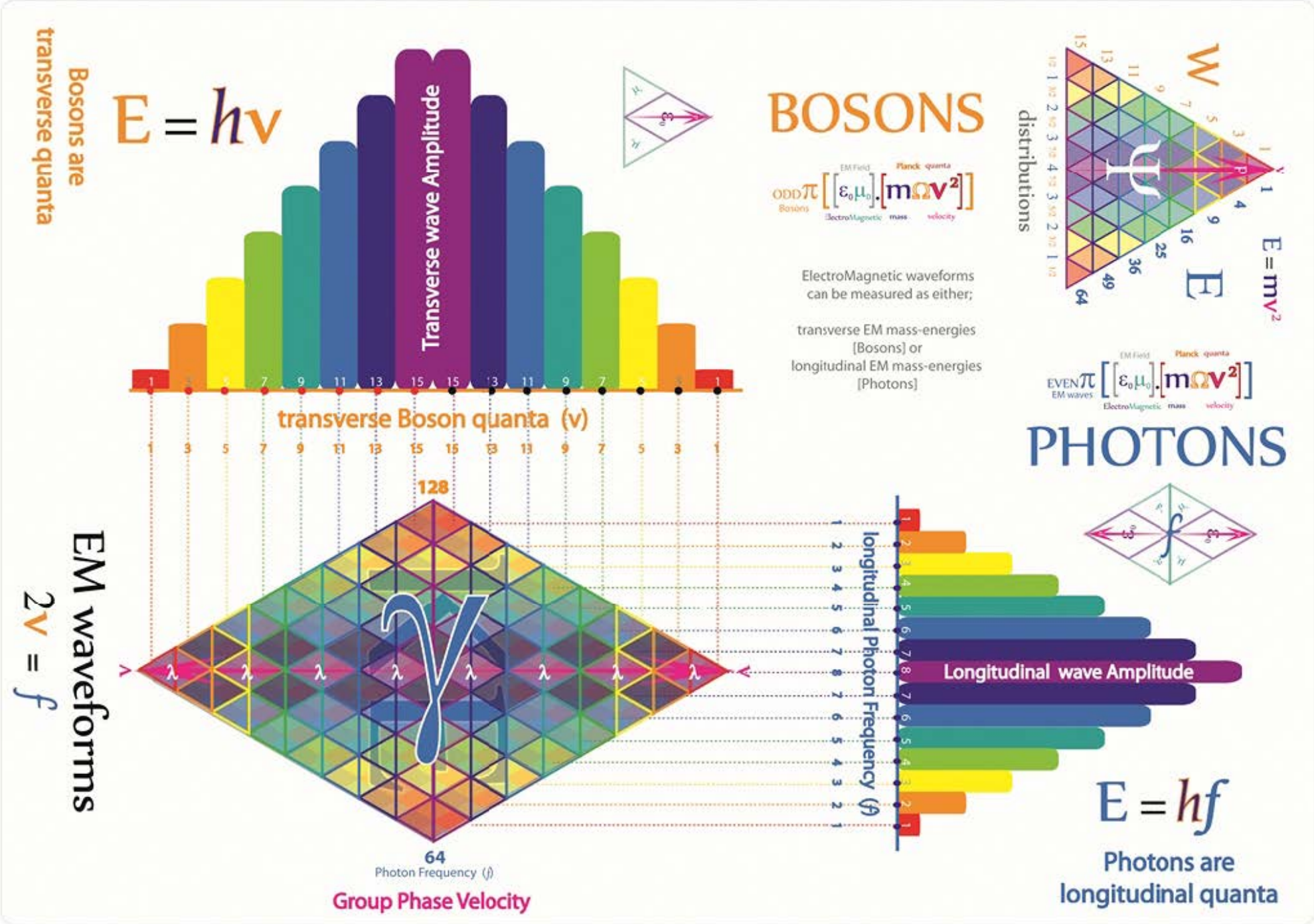

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Wavefunction probabilites

Wave Amplitude

Amplitude = bi-directional Momentum

Probability = [Amplitude]²

In his 1926 paper, Max Born suggested that the wave function of Schrödinger's wave equation represents the probability density of finding a particle

Probability of finding a Photon in a electromagnetic wave is the Square of its Amplitude

The de Broglie-Schrodinger wave fields should not to be interpreted as a mathematical description of how an event actually takes place in time and space, though, of course, they have reference to such an event.

Rather they are a mathematical description of what we can actually know about the system. They serve only to make statistical statements and predictions of the results of all measurements which we can carry out upon the system.

(Albert Einstein, on Quantum Physics, 1940)

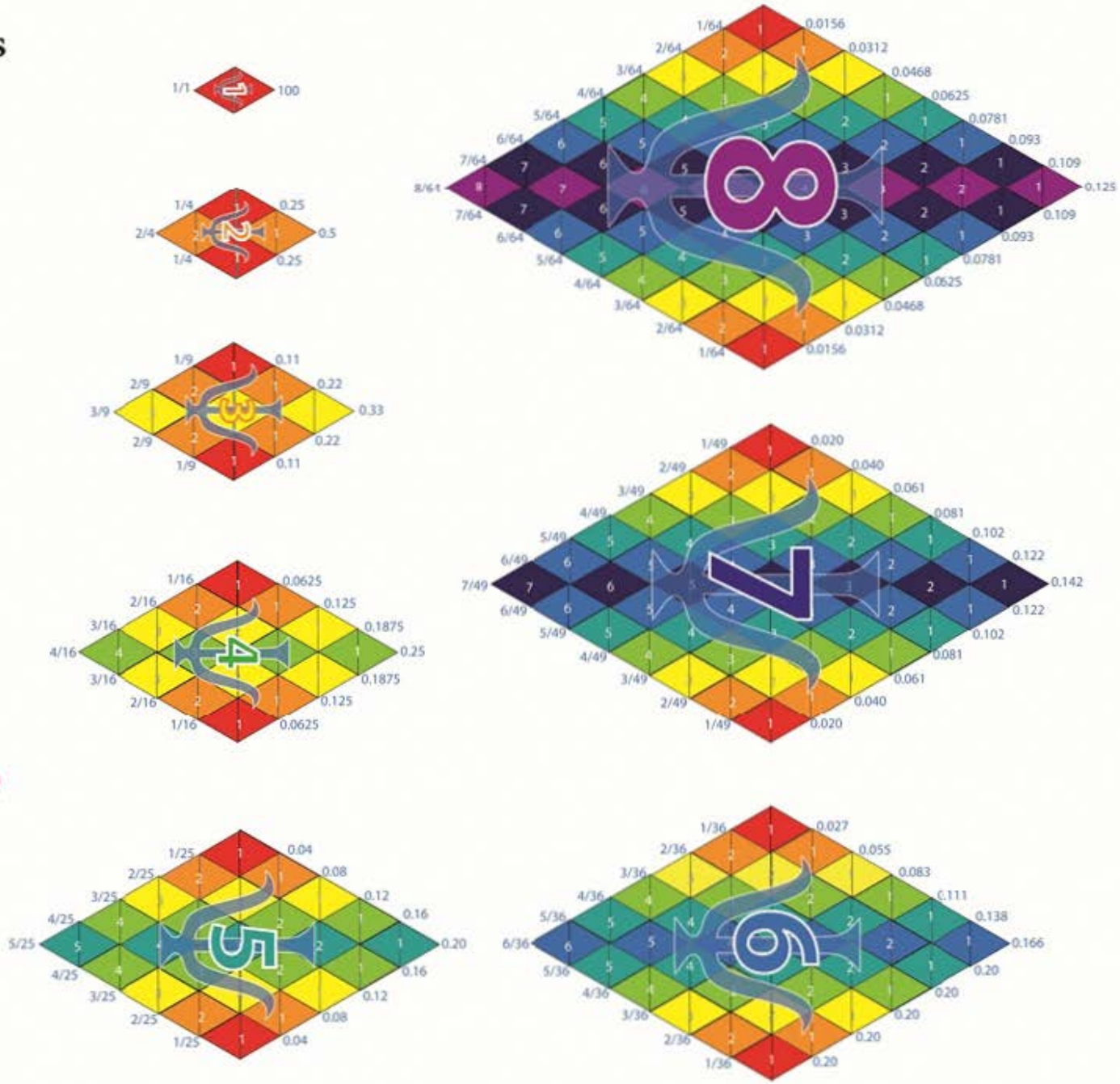

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EM radiation patterns

Quantum wavefunctions mathematically model the statistical probability distributions of electromagnetic mass-energy within EM waves

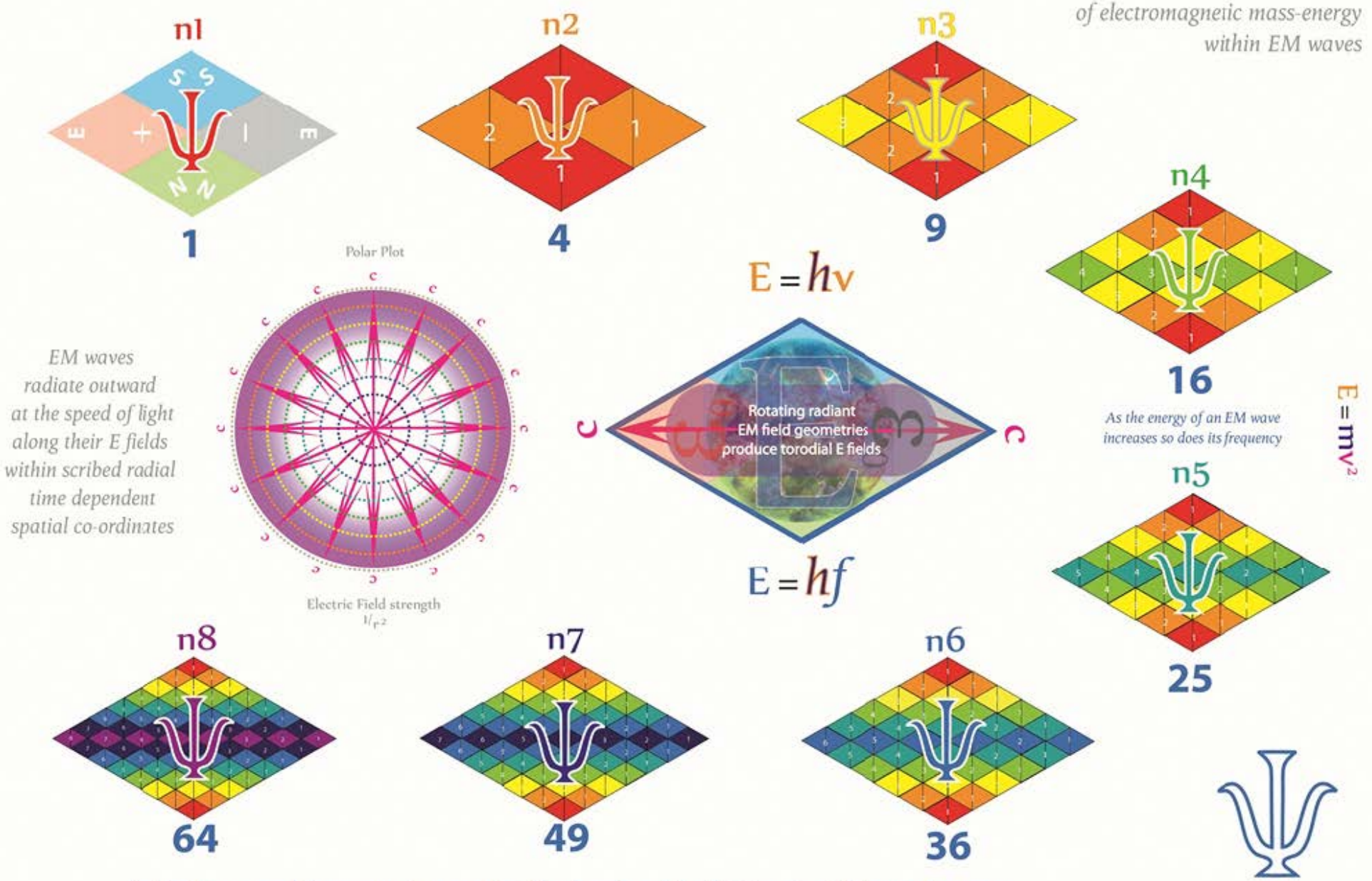

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EM wave geometry

Electromagnetic waves transport energy through empty space, stored in the propagating electric and magnetic fields.

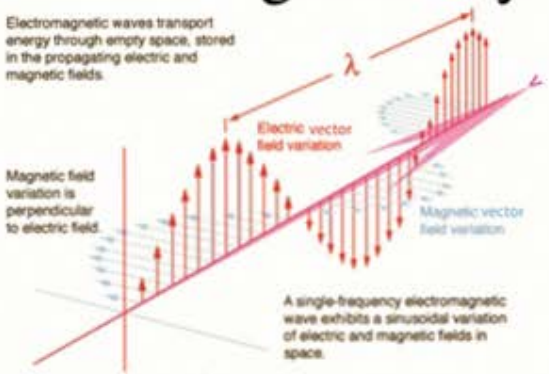

Bosons

$E = h\nu$

transverse mass-energies

When E fields are at Maximum the B fields are at Minimum (and Vice-a-versa)

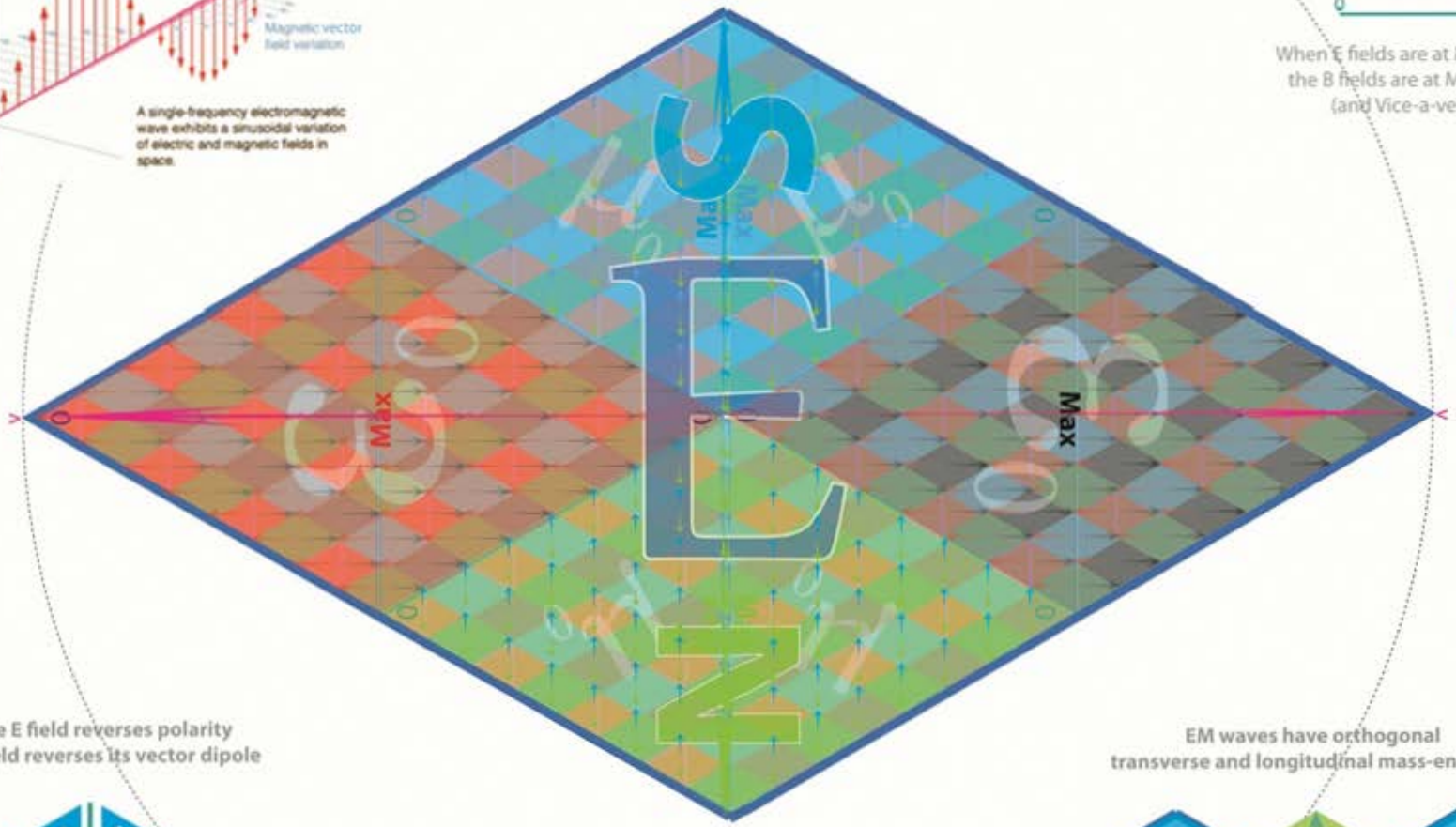

Photons

$E = hf$

longitudinal mass-energy frequency

$2\nu = f$

As the E field reverses polarity the M field reverses its vector dipole

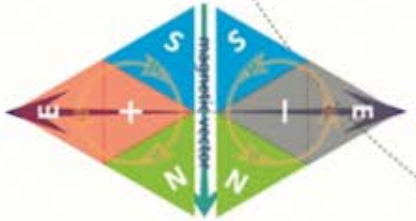

E Field oscillations

EM waves are comprised of relativistic photons of mass-energy

$$RE = 2m\frac{v^2}{c^2}$$

EM waves have orthogonal transverse and longitudinal mass-energies

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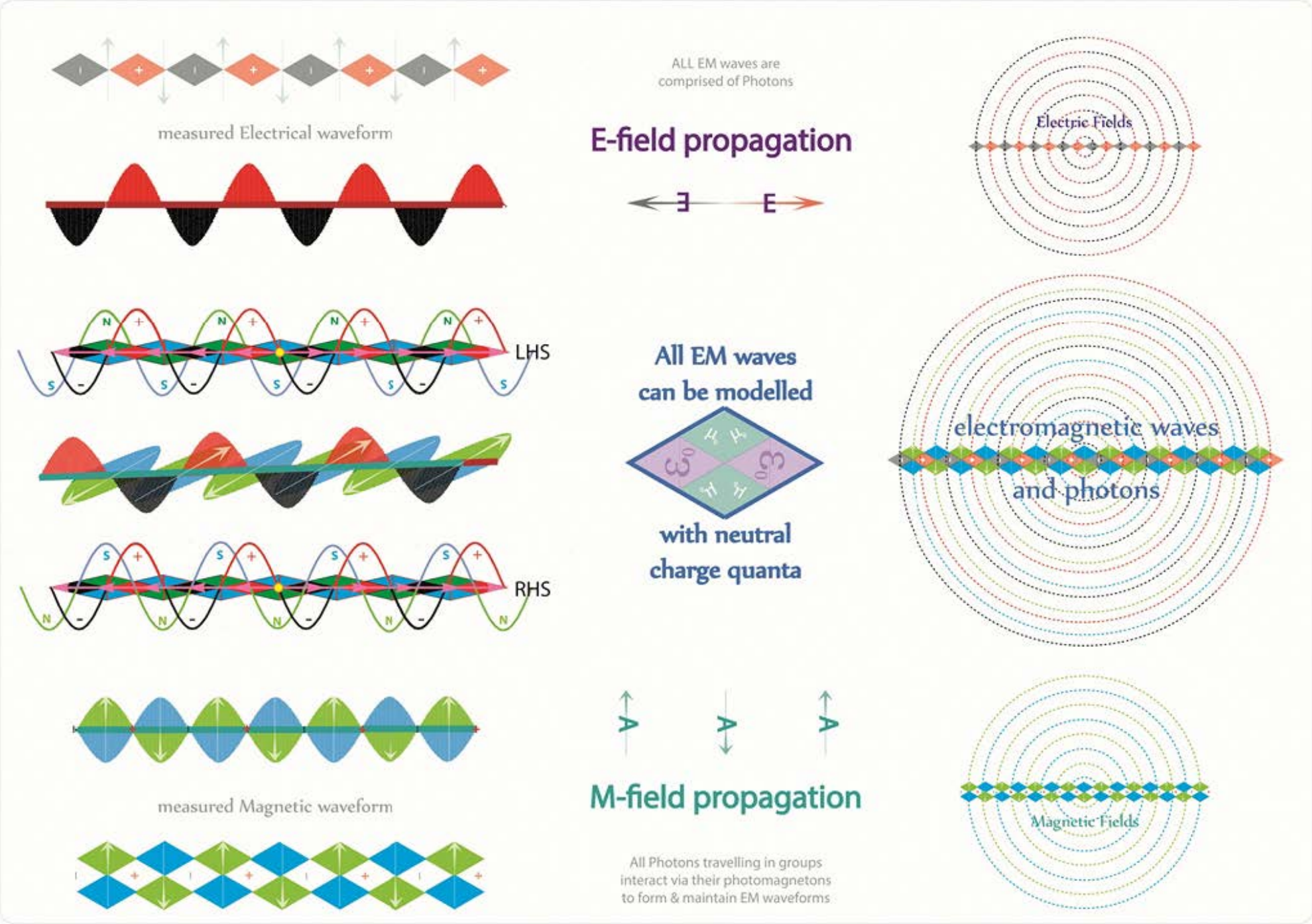

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Energy momenta in EM waveforms

Linear energy momentum creates physical vector forces

Tesla invested considerable effort into trying to draw attention to the distinctions between these 2 forms of EM radiation

Longitudinal EM waveforms are the waves produced by spark gap discharges

Their energy momenta are co-linear with the wave's direction of propagation

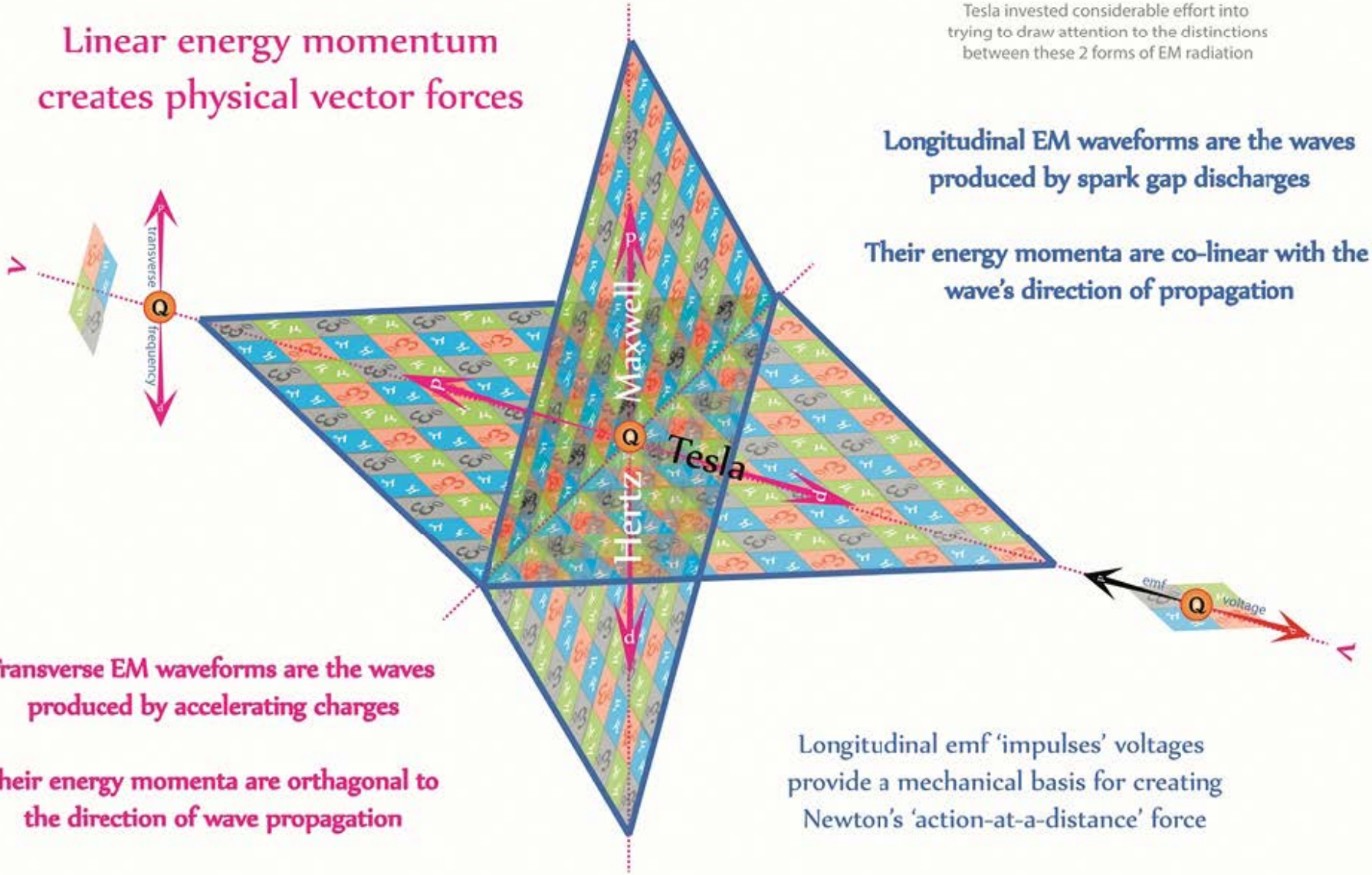

Transverse EM waveforms are the waves produced by accelerating charges

Their energy momenta are orthagonal to the direction of wave propagation

Longitudinal emf 'impulses' voltages provide a mechanical basis for creating Newton's 'action-at-a-distance' force

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Producing Longitudinal EM waves

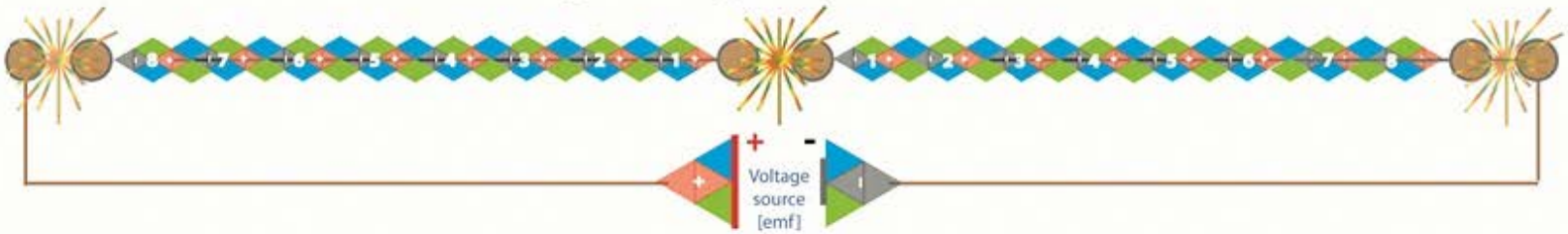

The short circuiting of voltage potentials or spark gap discharges of electrical energy are two ways to produce longitudinal EM waves

After inventing AC electricity Nikola Tesla began to investigate disruptive DC discharges

He noted the deadly power of the spark discharges and how they 'stung his face'

Orthagonal Magnetic fields produce reactive inductance fields

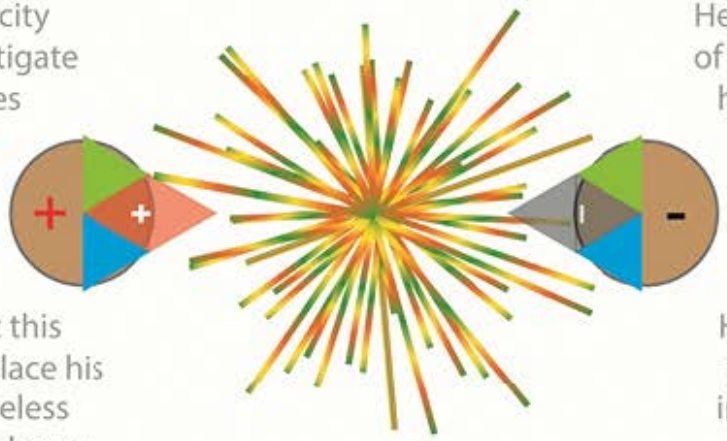

Longitudinal Electric fields produce lines of force

and he was convinced that this form of EM energy would replace his AC system and provide wireless energy to the World without losses

He strove to point out that the load circuits must be inductively coupled to the transmission circuits

or a combination of the two

Very large Voltage

High frequency

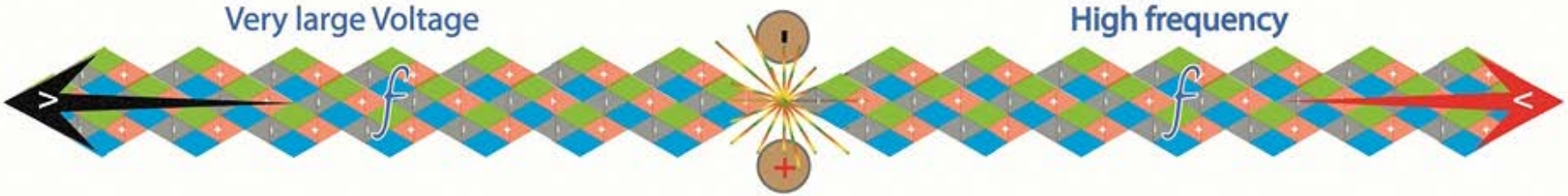

disruptive discharges

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Longitudinal energy momenta

Maxwell's equations lead to the prediction of transverse electromagnetic waves as a means of transefering electrical power (where the wave's Electric fields and Magnetic fields vary perpendicularly to their direction of propagation).

Longitudinal Photons & EM waves are 2D electromagnetic waveforms with co-planar energy momenta that is co-linear with their directions of propagation and that can 'cut like a knife'

Longitudinal energy momenta waves [created by the use of spark gap technologies] are the EM energy forms created and radiated by Stars

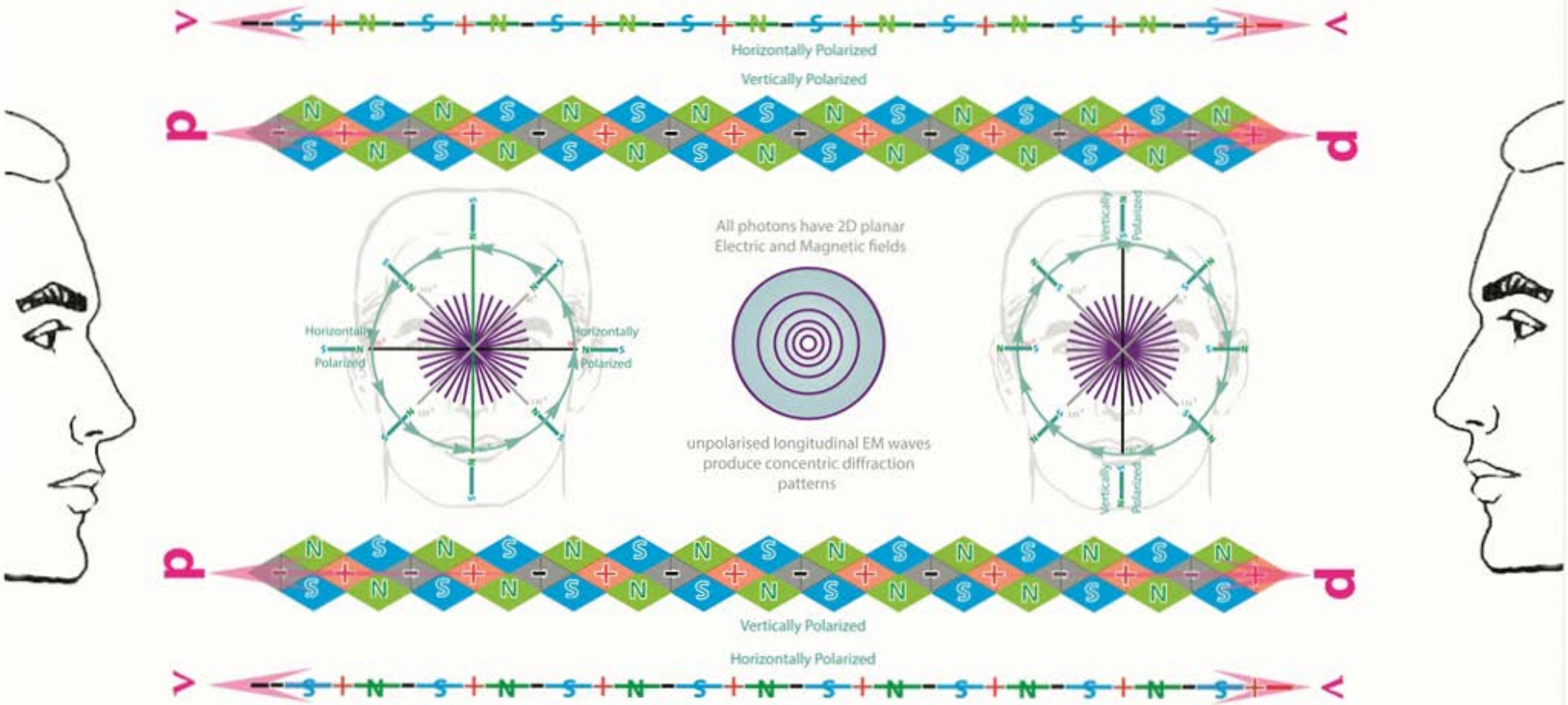

The longitudinal alignment of E field momenta with their direction of propagation produces 'action-at-a-distance' and can produce material 'faster than light' velocities, if sufficient energies are inputted

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The velocity of Electrical energy momenta

The velocity of light is the limit for electrical energy acceleration
(the induced velocity of charged particles resulting from electric field energy-momenta interactions)

c

Transverse EM waves propagate at energy at the speed of light

Γ

Longitudinal EM waves can propagate energies & information in excess of the speed of light

470,912,891 m/s

463,491,072 km/second

288,000 miles/second

$v = [\pi/2]c$

Longitudinal electrical fields can create near-instantaneous 'action-at-a-distance' EM fields

once established, these fields can transfer momentum and information at speeds faster than light through co-linear impulses of momentum

Wheatsone achieved renown by a great experiment
The measurement of the velocity of electrical Energy in a wire.

He cut the wire at the middle, to form a gap which a spark might leap across, and connected its ends to the poles of a Leyden jar filled with electricity. Three sparks were thus produced, one at either end of the wire, and another at the middle. He mounted a tiny mirror on the works of a watch, so that it revolved at a high velocity, and observed the reflections of his three sparks in it.

The points of the wire were so arranged that if the sparks were instantaneous, their reflections would appear in one straight line; but the middle one was seen to lag behind the others, because it was an instant later. The electricity had taken a certain time to travel from the ends of the wire to the middle.

This time was found by measuring the amount of lag, and comparing it with the known velocity of the mirror. Having got the time, he had only to compare that with the length of half the wire, and he could find the velocity of electricity.

His results gave a calculated velocity of 288,000 miles per second, i.e. faster than what we now know to be the speed of light

Charles Wheatstone

(6 February 1802 – 19 October 1875)

Wheatstone measured the velocity of LONGITUDINAL electrical energy using spark gaps
[as opposed to transverse waveforms produced by oscillating voltages]

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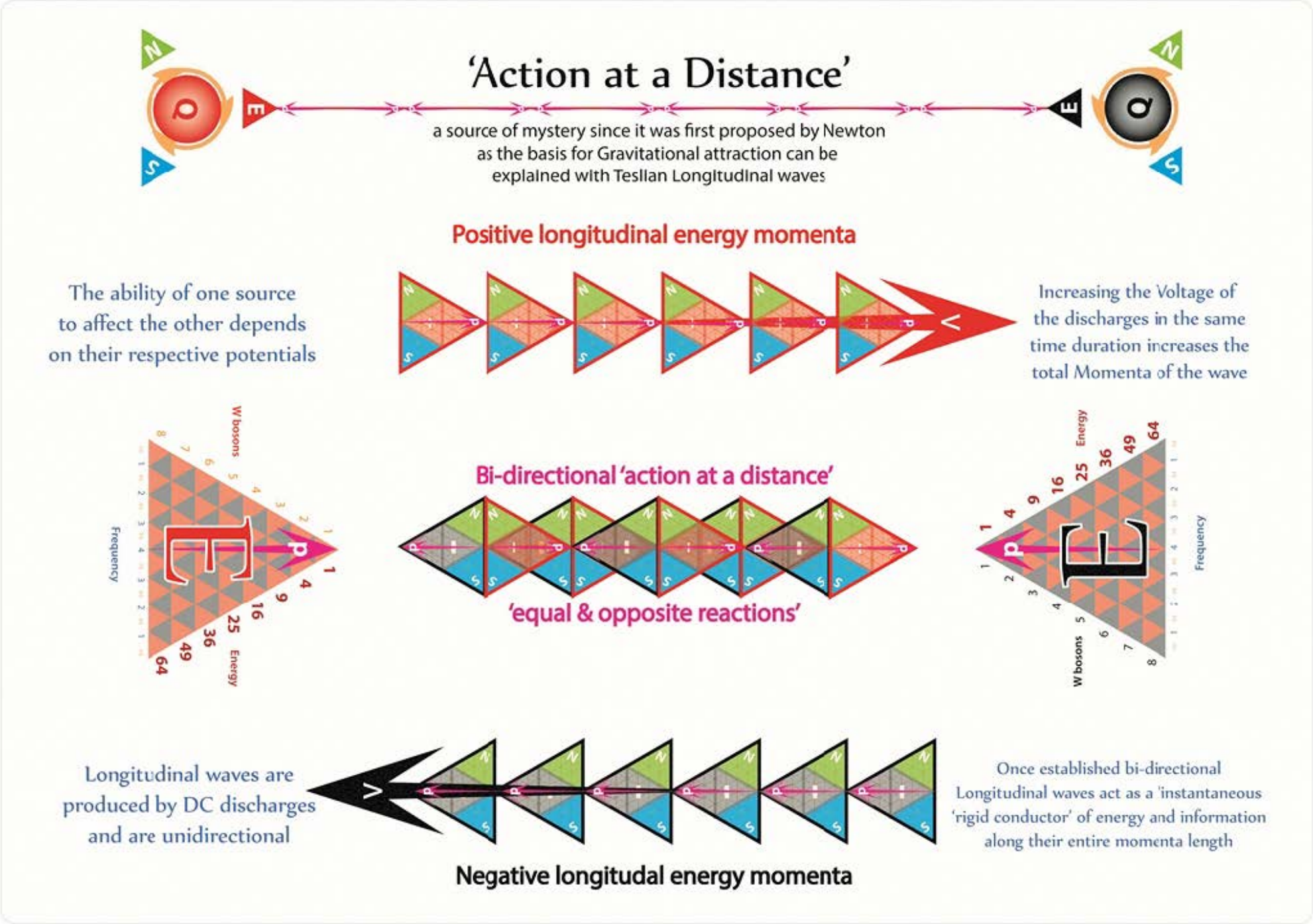

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Longitudinal EM waves have their E-fields co-linear with their direction of propagation

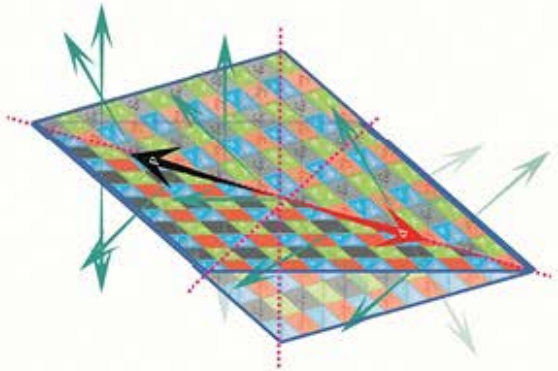

M field has NO preferential axial alignment (and can arrive at any angle)

Un-Polarised

Longitudinal Photons & EM waves are produced by disruptive spark gap discharges

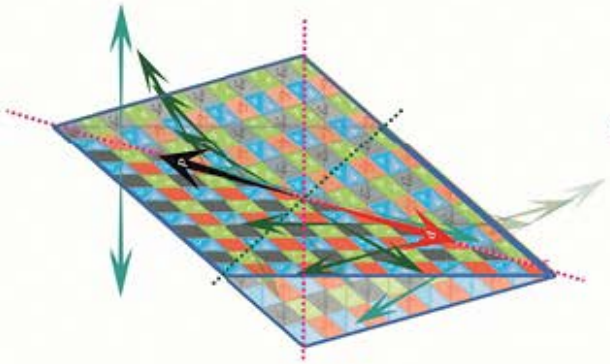

M field has an alignment that follows a circular pattern (Clockwise or Counter-clockwise)

Circularly (or Elliptically) Polarised

Longitudinal wave

polarisations

As a convention, the polarization of longitudinal EM waves must be described by specifying the orientation of the wave's magnetic field at a point in space over one period of the oscillation

Longitudinal waves have their linear momenta aligned along their direction of propagation and are extremely efficient at accelerating charges they interact with, creating co-linear accelerations [parallel to their direction of field propagation] - they do not produce charge oscillations along their vector direction of propagation like transverse waves.

Examples of transverse waves include seismic P (primary) waves, and Tesla's longitudinal 'stinging' rays, whose electric fields and energy momenta are both co-linear with each other and parallel to the direction of energy transfer.

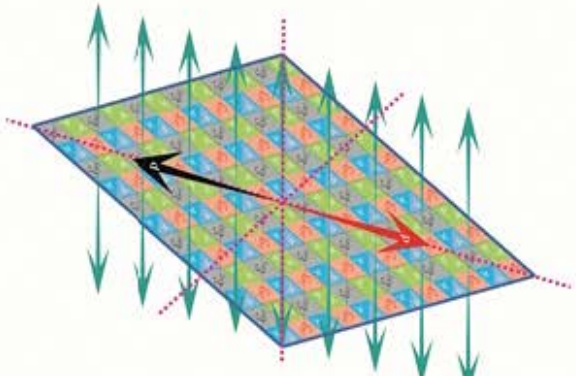

M field alignment is along the Vertical axis

Vertically Polarised

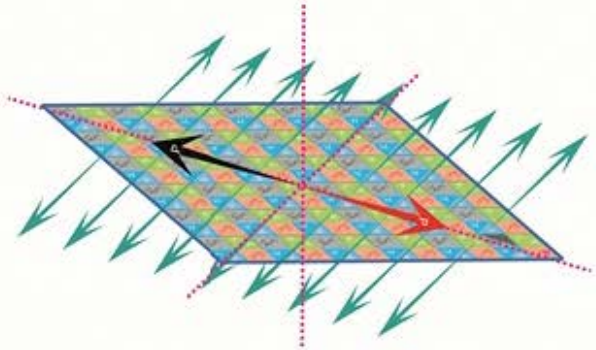

M field alignment is along the Horizontal axis

Horizontally Polarised

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ElectroMagnetic waveforms

In Teslian longitudinal waves, produced by disruptive EM discharges, the E fields are co-linear with the direction of propagation

After inventing AC electricity Tesla investigated transferring energy through the air via electrostatic longitudinal waves to receiving devices. and noted the differing 'lethality' of the forces produced by these waves

Although comprised of the same energy momenta quanta
EM waves can be formed with Electric fields perpendicular to each other
thus leading to conflicting theories of EM wave propagation

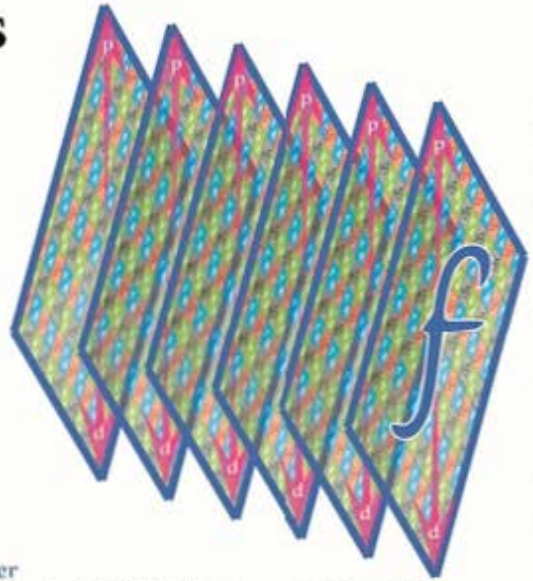

Hertzian transverse waveforms have their EM fields perpendicular to the direction of propagation

In 1887, Heinrich Hertz demonstrated the reality of Maxwell's electromagnetic waves by experimentally generating radio waves in his laboratory

T

Teslian waves transmit Energy in a LONGITUDINAL waveform producing 'action-at-a-distance'

Nikola Tesla

(10 July 1856 – 7 January 1943)

Volt Seconds [per metre²]

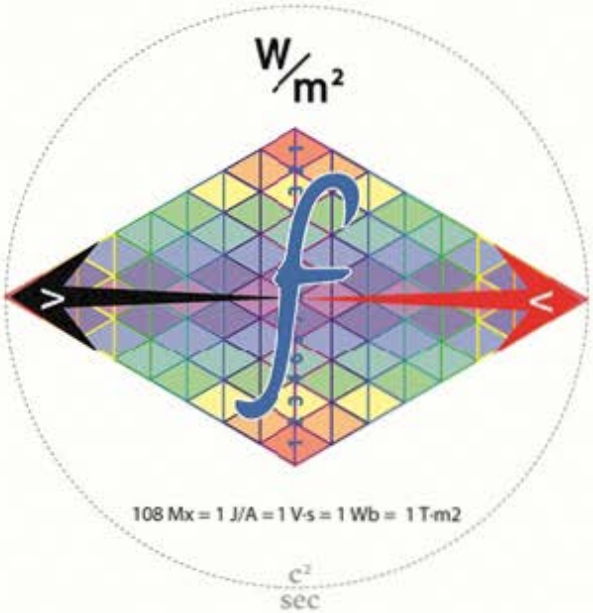

Heinrich Hertz

(22 Feburary 1857 - January 1 1894)

Cycles per Second

Hz

Hertzian waves transmit Energy in a TRANSVERSE waveform producing 'radio waves'

Soon after Hertz's claim of discovering Maxwell's transverse EM waves Tesla visited him and personally demonstrated the experimental error to him.
Hertz agreed with Tesla and had planned to withdraw his claim, but varying agendas intervened and set the stage for a major rift in the 'accepted' theories

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Transverse EM waves have their E&M fields orthagonal with their direction of propagation

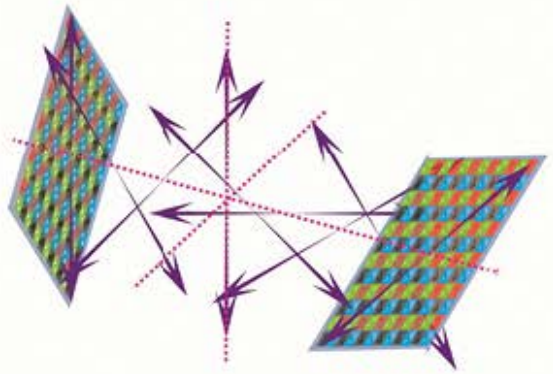

E field has NO preferential axial alignment (and can arrive at any angle)

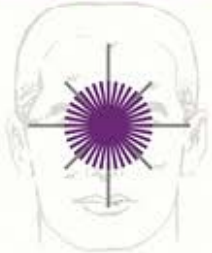

Un-Polarised

Transverse Photons & EM waves are produced by accelerating/oscillating charges

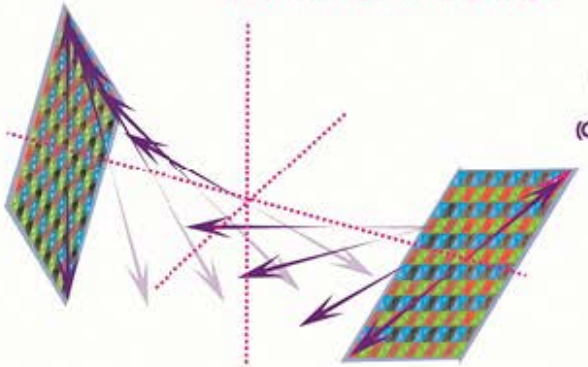

E field has an alignment that follows a circular pattern (Clockwise or Counter-clockwise)

Circularly (or Elliptically) Polarised

Transverse wave polarisations

By convention, the polarization of EM waves is described by specifying the orientation of the wave's electric field at a point in space over one period of the oscillation

Transverse waves are inefficient propagators of EM energy as they apply their linear momenta tangentially to the charges they interact with, creating lateral accelerations [orthagonal to their direction of field propagation] - they do not accelerate charges along their vector direction of propagation like longitudinal waves.

Examples of transverse waves include seismic S (secondary) waves, and electromagnetic plane wave, whose electric (E) and magnetic (M) fields both oscillate perpendicular to each other and orthogonal to the direction of energy transfer.

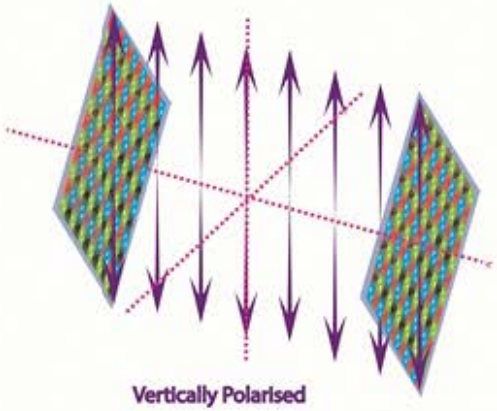

E field alignment is along the Vertical axis

Vertically Polarised

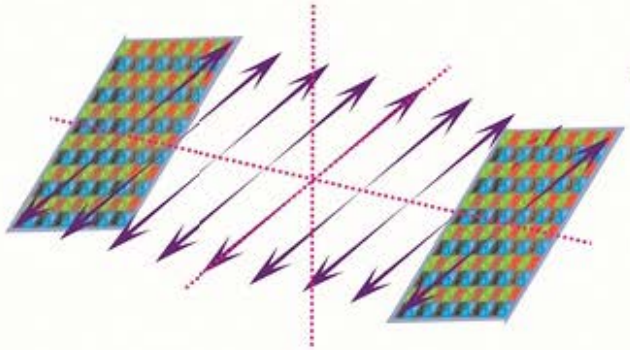

E field alignment is along the Horizontal axis

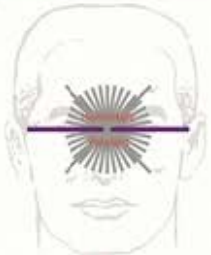

Horizontally Polarised

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EM wave modulations

In telecommunications, modulation is the process of varying one or more properties of a periodic waveform, called the carrier signal, with a modulating signal which typically contains information to be transmitted

Amplitude modulation

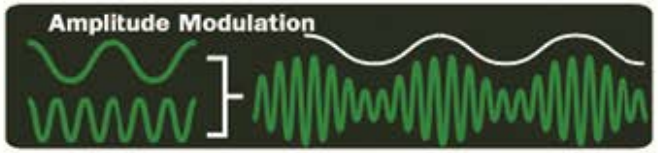

the amplitude of the carrier signal is varied

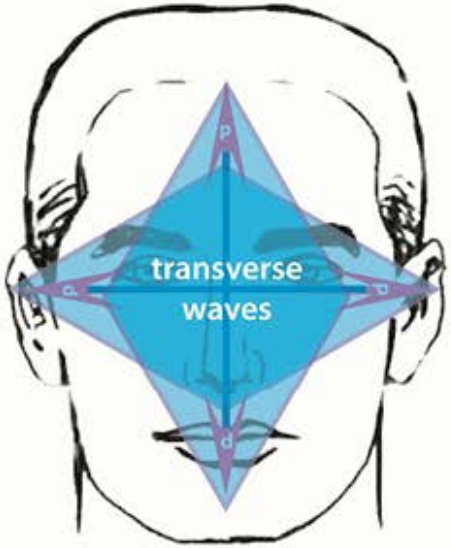

the frequency of the carrier signal is varied

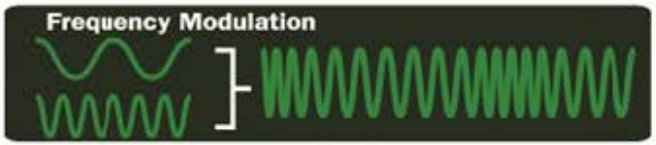

Frequency modulation

In addition to planar Hertzian waves there exists Longitudinal EM waves

Impulse propagation

As the voltage [energy/coulomb] of longitudinal waves increases their co-linear energy-momenta increase and these forces provide a mechanical basis for near instantaneous 'action-at-a-distance'

Impulse propagation is distinct from pulse modulations

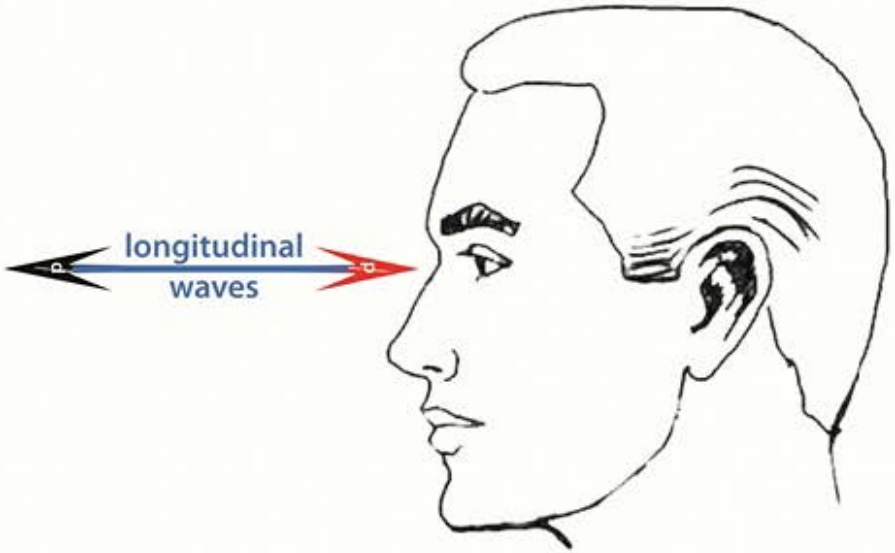

a narrowband analog signal is pulsed over an analog baseband channel

PCM Pulsed modulation TDM

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Transverse EM wave production

Alternating the Voltage potentials in an electrical circuit produces an Alternating Current of electrons with Kinetic EM energies reflective of the Time-Energy duration of the AC circuit

Alternating Voltages provide an electromotive force to Electrically charged Particles producing tranverse Kinetic Energy fields with orthagonal Magnetic fields

Kinetic Energies from motion (diverge from rest Matter)

F=ma

$$\sum \mathbf{F} = \frac{d\mathbf{p}}{dt} = m\frac{d\mathbf{v}}{dt} + \mathbf{v}\frac{dm}{dt}$$

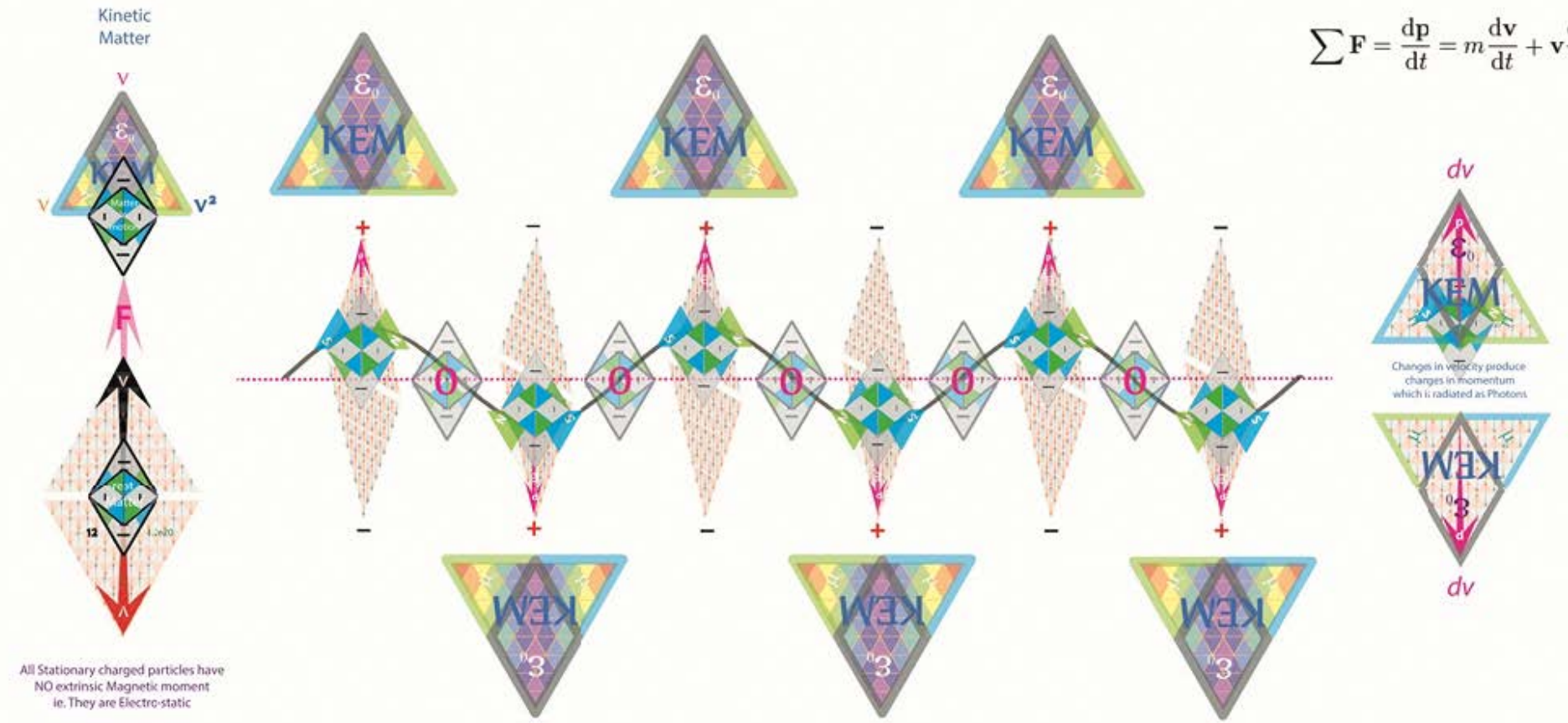

Charges with constant velocities produce REACTIVE [K]EM FIELDS

Any change to the momentum of a charged particle in motion requires a corresponding quantum level energy-momentum change through the emission/absorption of quantised EM mass-ENERGY momenta in the form of W bosons

Accelerating Charges produce RADIANT EM WAVES

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Modelling of planar transverse waves
(of varying amplitudes)

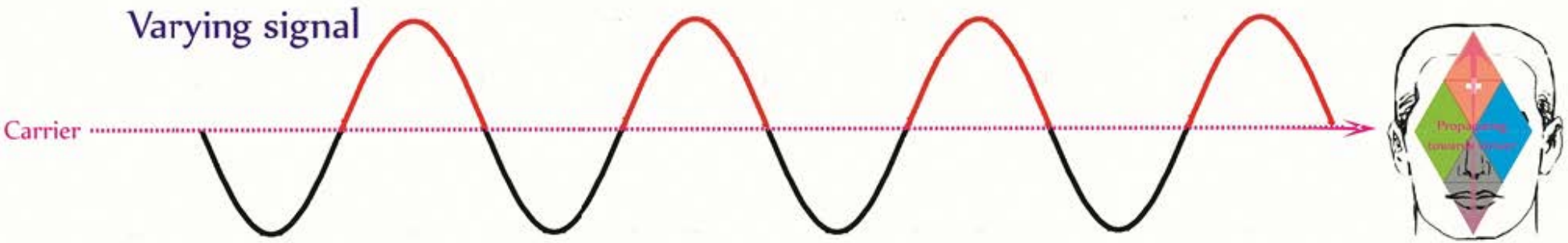

AM waveform

Amplitude Modulation (AM) works by varying the strength of the transmitted signal in relation to the information being sent.

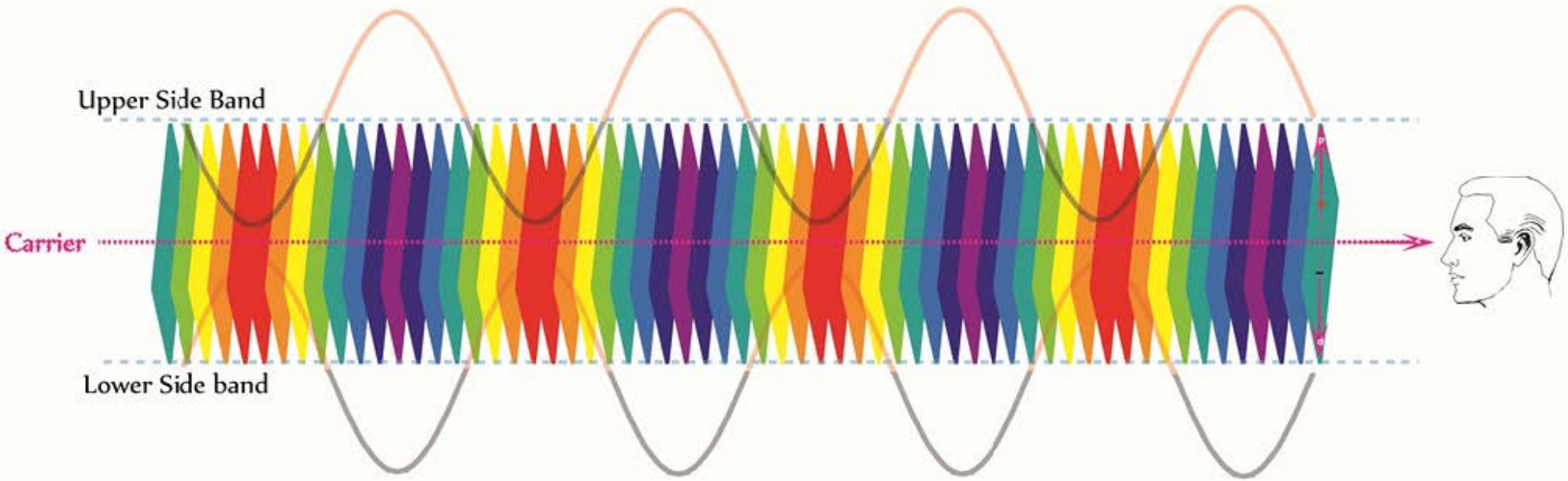

Note: In amplitude modulation each colour planar wave contains differing energy momenta [n1-red to n8-violet]

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Modelling of planar transverse waves

(of the same frequencies)

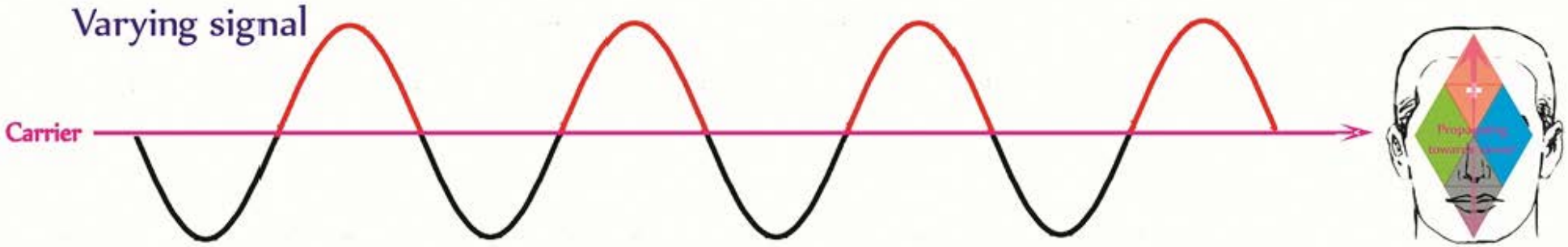

FM waveform

Frequency modulation (FM) is a form of modulation which conveys information over a carrier wave by varying its frequency (in contrast with amplitude modulation, in which the amplitude of the carrier is varied while its frequency remains constant).

In analog applications, the instantaneous frequency of the carrier is directly proportional to the instantaneous value of the input signal

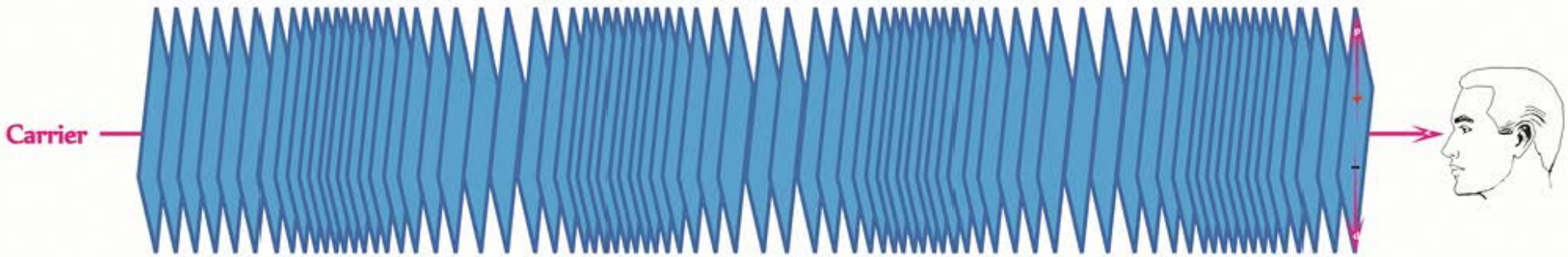

Note: In Frequency modulation all the planar waves have the same energy momenta [only the number of waves per sec varies]

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ElectroMagnetic waves

Mathematics alone [without a correct foundational geometry] is insufficent to describe EM radiation
EM waves can be Longitudinal or Transverse with respect to their direction of propagation

Tesla

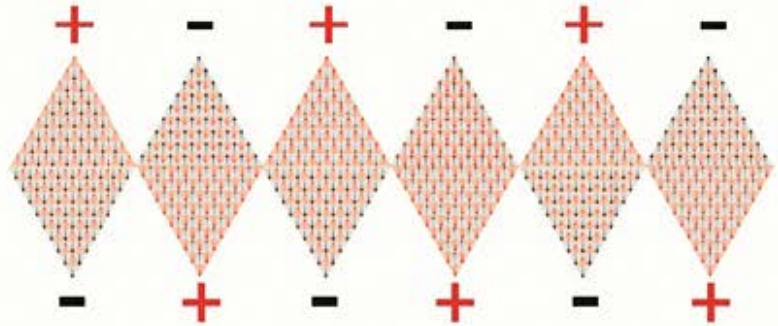

Maxwell - Hertz

It is now clear [using Tetryonic geometry] that both Tela and Maxwell were correct in their opposing theories of EM waveforms with Tesla proposing Longitudinal waves [from experiment] and Maxwell proposing Transverse waves [from his equations].

The differing opinions on the EM waveforms is shown to be a direct result of the sources of EM wave generation employed in their creation. After the discovery of the photo-electric effect Hertz and others moved to oscillating charges to produce Transverse [planar] waves while Tesla continued to investigate and utilise the older spark gap technology to produce Longitudinal waves

Spark Gaps & Plasma discharges
produce
longitudinal EM radiation

Accelerating charges
produce
transverse EM radiation

Transmitter

Action-at-a-Distance

Radio waves

Reciever

In order to explain and advance our understanding of all EM phenomena we must return to, and utilise, the older discharge technologies

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Planar electromagnetic waves

In the physics of wave propagation, a plane wave (also spelled planewave) is a wave whose wavefronts are infinite parallel planes of peak-to-peak amplitude normal to the phase velocity vector.

transverse Radio waves

longitudinal Spectral lines

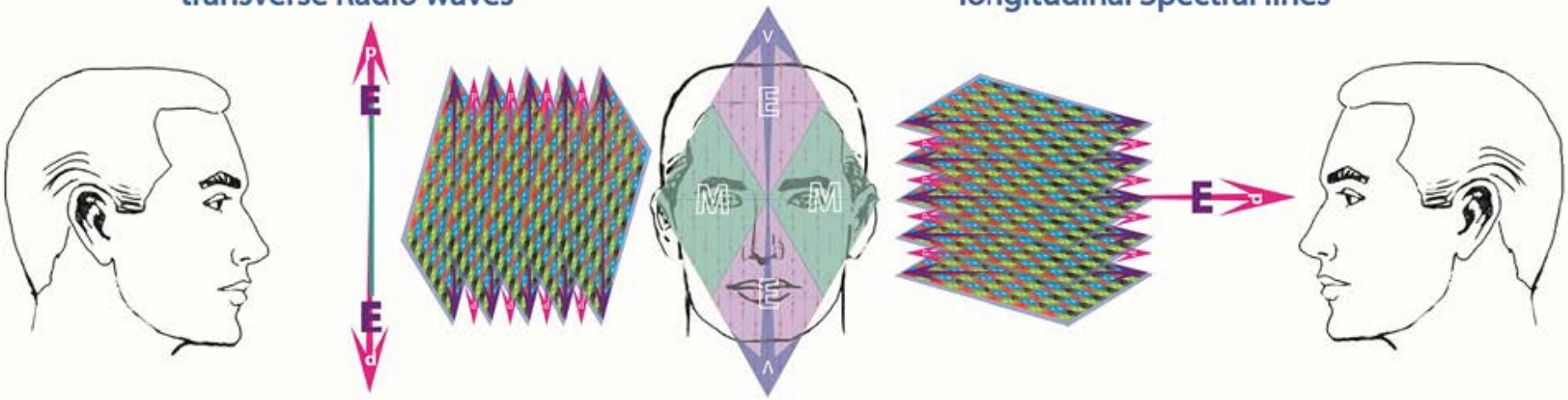

The phase relationships of their EM energy momenta can all be finally visualised and drawn through Tetryonic theory geometries

[with appropriate radian units]

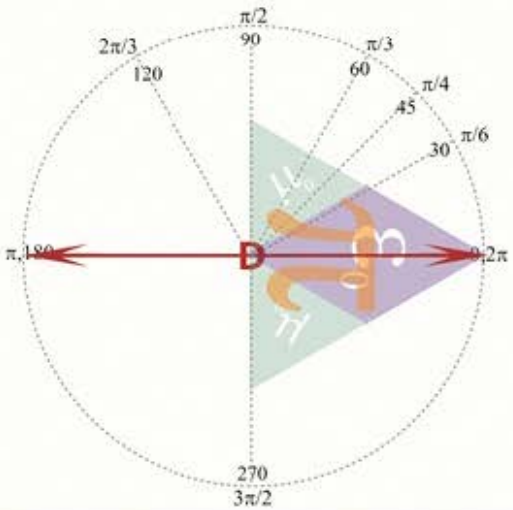

bosons $2\pi[h\nu] = hf$ photons

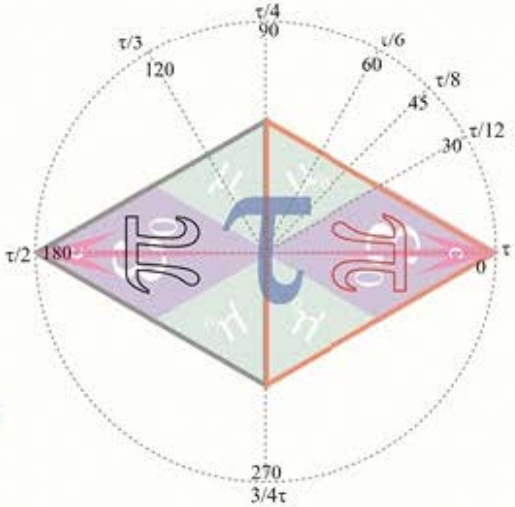

τ is a more 'natural' radian unit for describing EM waves than π
tau = 2π = 360 degree rotation about a point

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Lorentz co-ordinate transforms

In physics, the Lorentz transformation (or transformations) are named after the Dutch physicist Hendrik Lorentz.

The transformations describe how measurements of mass-energies in space and time by two observers are related through mathematics

It was the result of attempts by Lorentz and others to explain how the speed of light was observed to be independent of the reference frame, and to understand the symmetries of the laws of electromagnetism.

All photons are comprised of two dual-sided equilateral Planck quanta

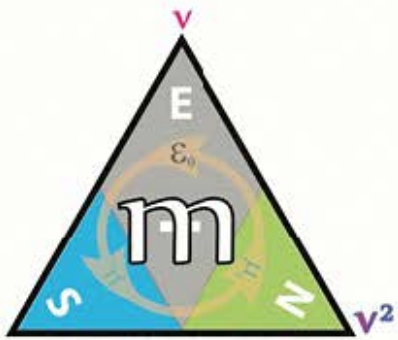

All EM waves are comprised of neutral charge quanta called Photons

Photons are comprised of mass-energies and the term 'mass-less' is not appropriate

Forces add mass-energies to KEM fields resulting in WAVElength changes

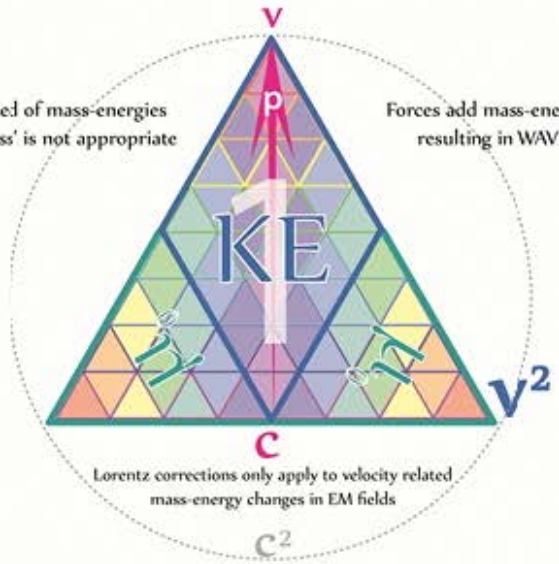

Lorentz corrections only apply to velocity related mass-energy changes in EM fields

Linear correction factor

$$\beta = \left[\frac{v}{c}\right]$$

Linear Lorentz boosts produce changes to the velocity and momenta of a system

Scalar correction factor

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

As the velocity and momenta of a system changes so does its scalar energies

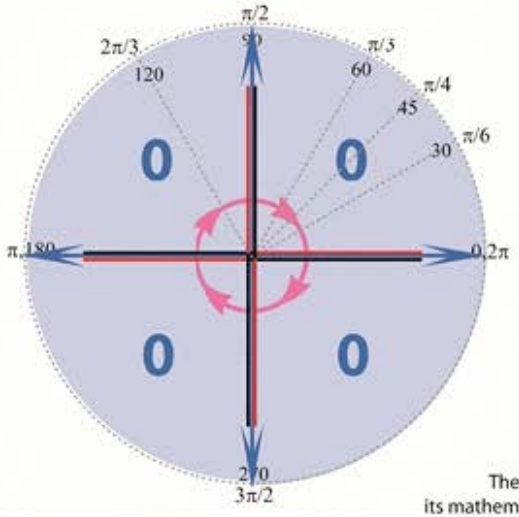

The Lorentz transformation is a linear transformation

It may include a rotation of space;
a rotation-free Lorentz transformation is called a Lorentz boost.

bosons $2\pi[hv] = hf$ photons

π

As photons are neutral charge mass-energy geometries care must alway be taken in identifying and specifying the planar wavefront polarities and direction of wave propagation when developing co-ordinate systems to describe their motions and resulting electromagnetic properites

τ

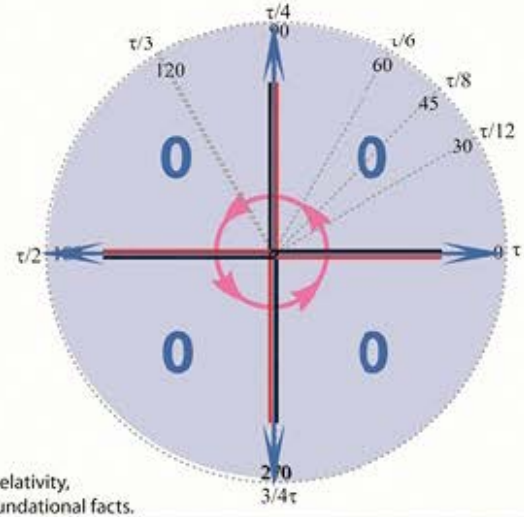

The Lorentz transformation is in accordance with special relativity, but was derived well before special relativity, its mathematical development in relativity theory has resulted in erroneous assumptions being accepted as foundational facts.

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Photoelectron KEM fields

As electrons bound to nuclei are accelerated by external forces their energies of motion are stored in their KEM fields

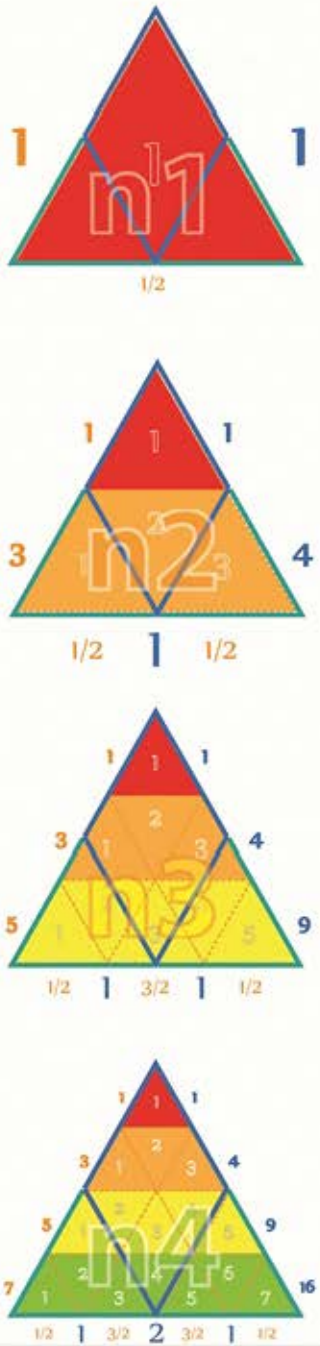

Transverse

quantum level jumps of photoelectrons are created by the ODD quanta geometries of bosons

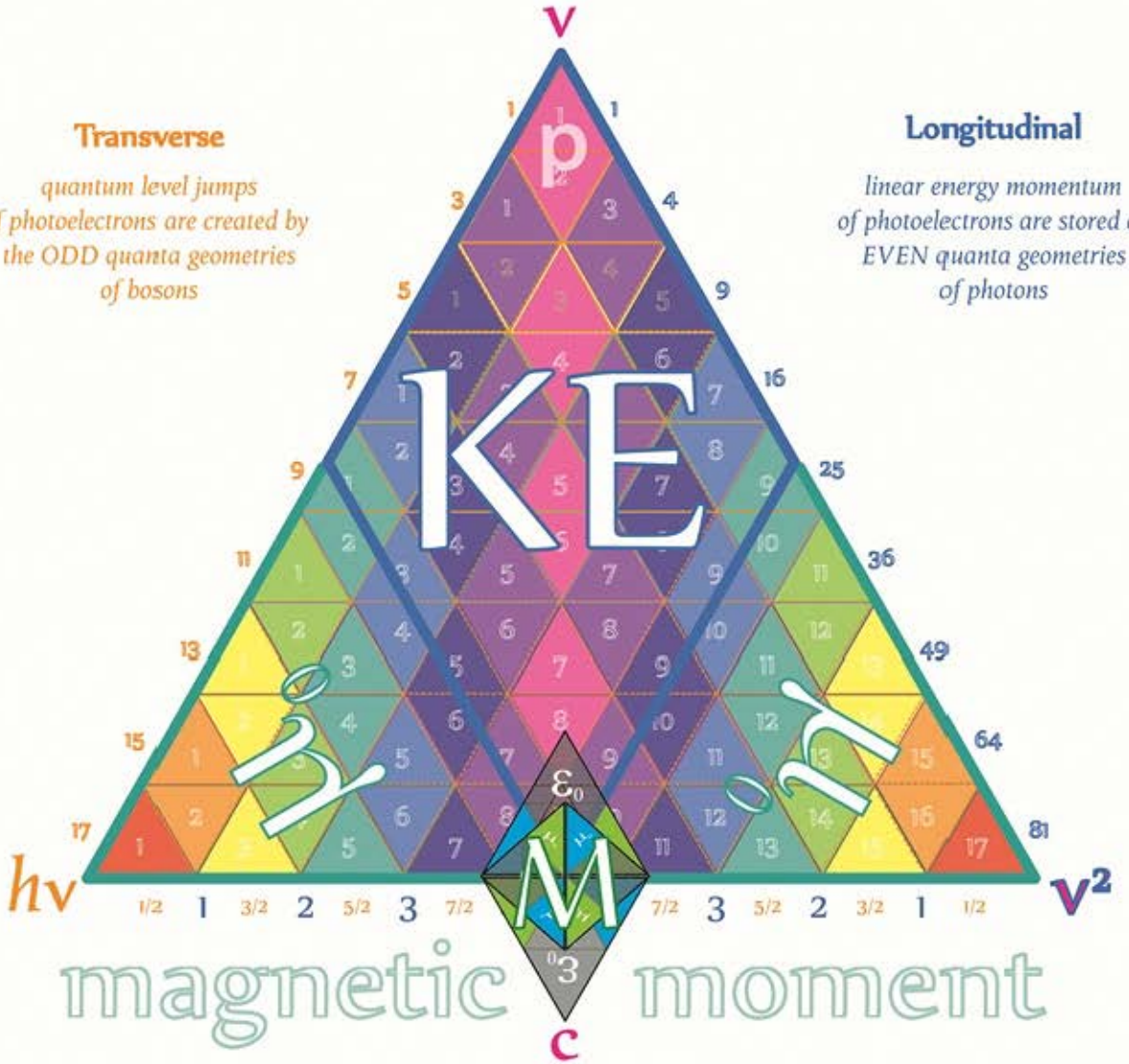

Longitudinal

linear energy momentum of photoelectrons are stored as EVEN quanta geometries of photons

KEM mass-energies are subject to velocity related Lorentz corrections and produce magnetic moments

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Kinetics & Photons

The photon has several properties that distinguish it from all other subatomic particles.

It is the only elementary particle wherein a high-energy photon can transform/split into two or more low-energy photons.

A photon is a magnetic dipole. It is an elementary magnet. Evans discovery of the photon's longitudinal magnetic field in 1992 is considered as significant as Einstein's discovery of Relativity.

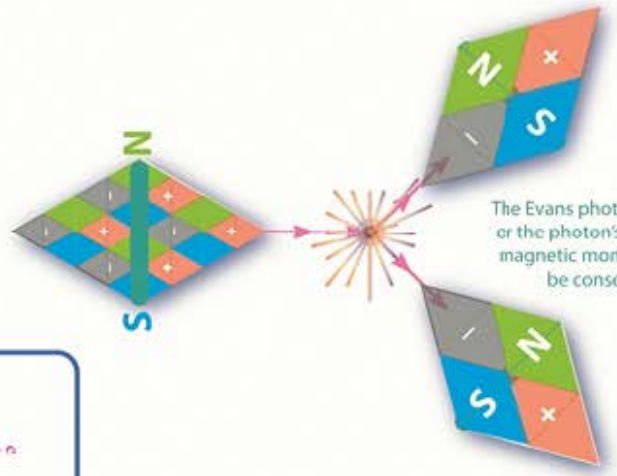

The Evans photomagneton or the photon's transverse magnetic moment has to be conserved.

Photons can form super-position EM waves

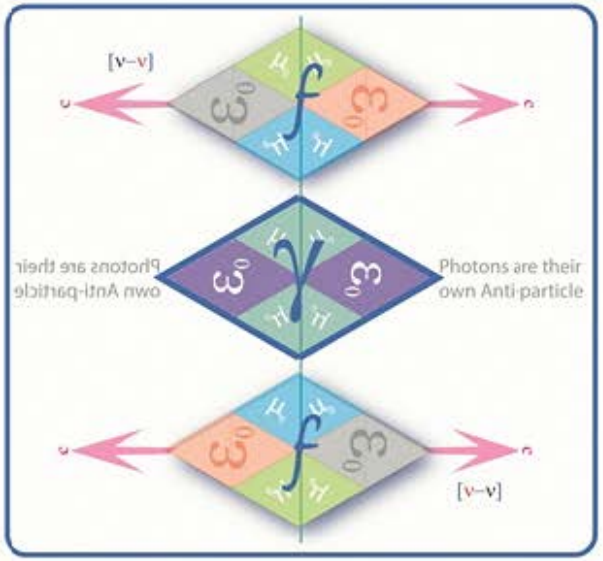

PAIR PRODUCTION
A photon with sufficient energy can be transformed into a real electron-positron pair.

The EM mass-energy is conserved as per Einstein's equivalence of mass and energy.

The photon's magnetic charge is conserved in the magnetic moments of the created electron-positron pair.

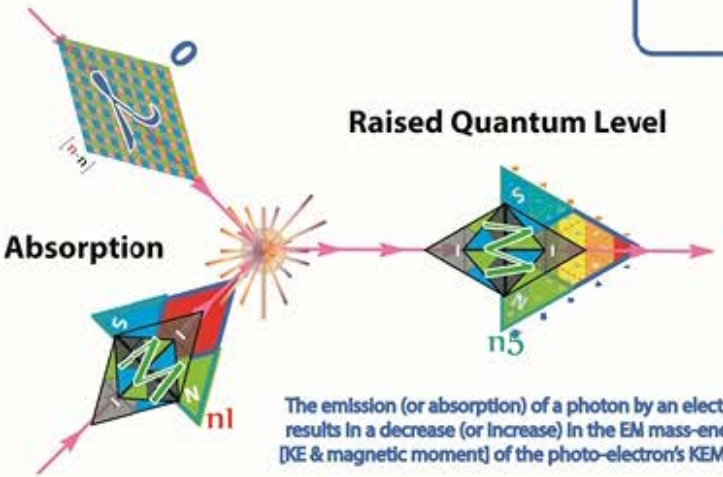

The emission (or absorption) of a photon by an electron, results in a decrease (or increase) in the EM mass-energy [KE & magnetic moment] of the photo-electron's KEM field

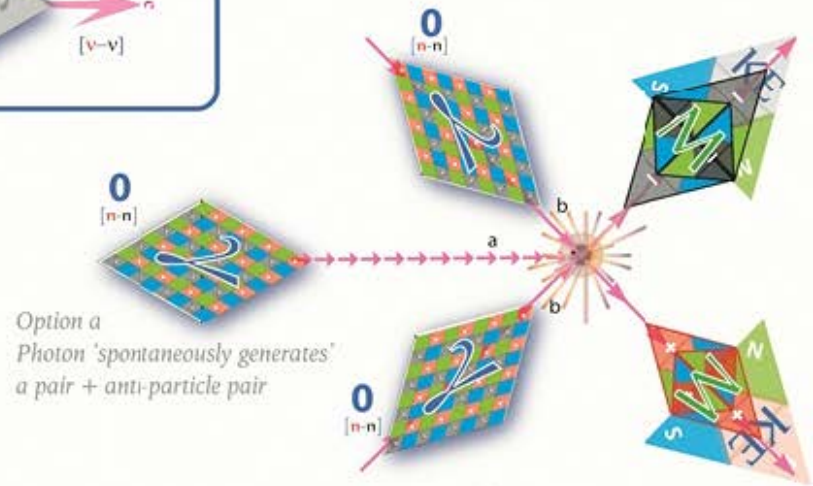

Option a
Photon 'spontaneously generates' a pair + anti-particle pair

Option b
Two Photons combine

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Arthur Compton

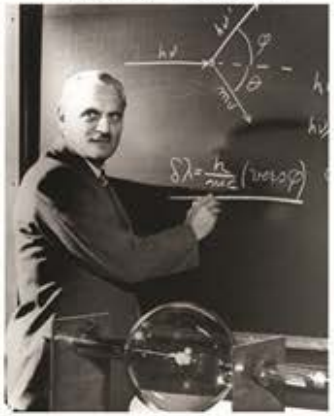

(September 10, 1892 - March 15, 1962)

Compton Scattering

The in-elastic scattering of photons in matter results in a decrease in energy (increase in wavelength) of an X-ray or gamma ray photon and is called the Compton effect.

Part of the energy of the X/gamma ray is transferred to a scattering electron, which recoils and is ejected from its atom (which becomes ionized), and the rest of the energy is taken by the scattered, "degraded" photon.

Compton frequency of photons

$$E = hf = \frac{hc}{\lambda} = mc^2$$

where v = c

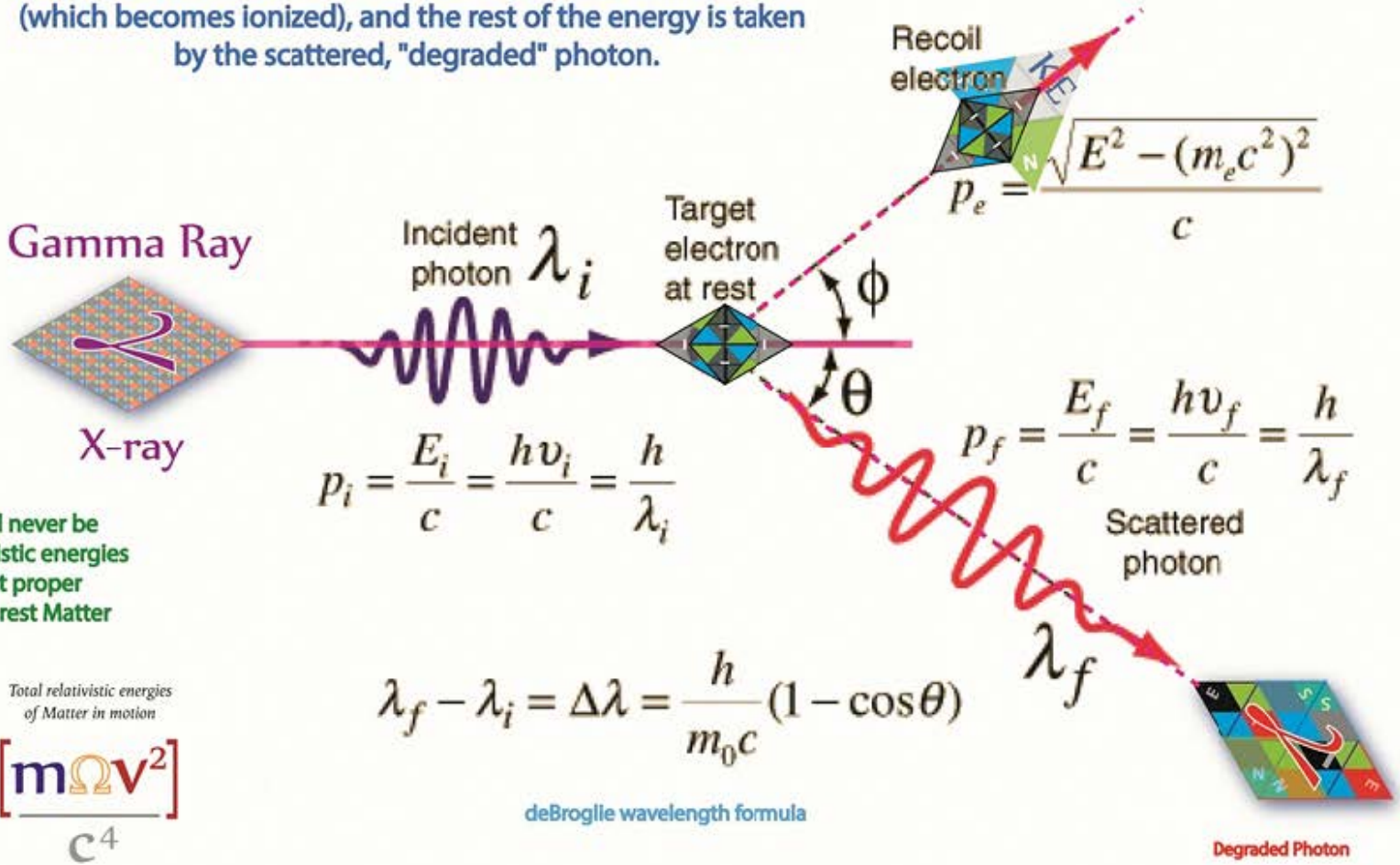

Lorentz corrected energies of EM masses in motion

$$n\pi\frac{[m\Omega v^2]}{c^2}$$

Compton frequencies should never be calculated from the total relativistic energies of Matter in motion without proper consideration of the invariant rest Matter

Total relativistic energies of Matter in motion

$$n\pi\frac{[m\Omega v^2]}{c^4}$$

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Pair Production

$$mv^2 = E = \tfrac{1}{2}hf$$

A photon with sufficient energy can be transformed into a real, material electron-positron pair.

The EM mass-energies of the system are conserved as per the equivalence of mass and Energy.

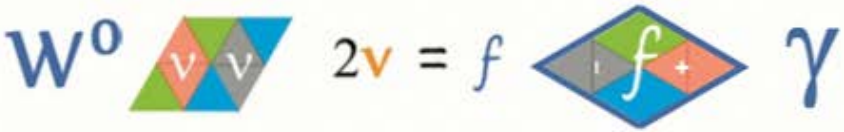

The photon's magnetic dipole and charges are also conserved (but in differing charge geometries)

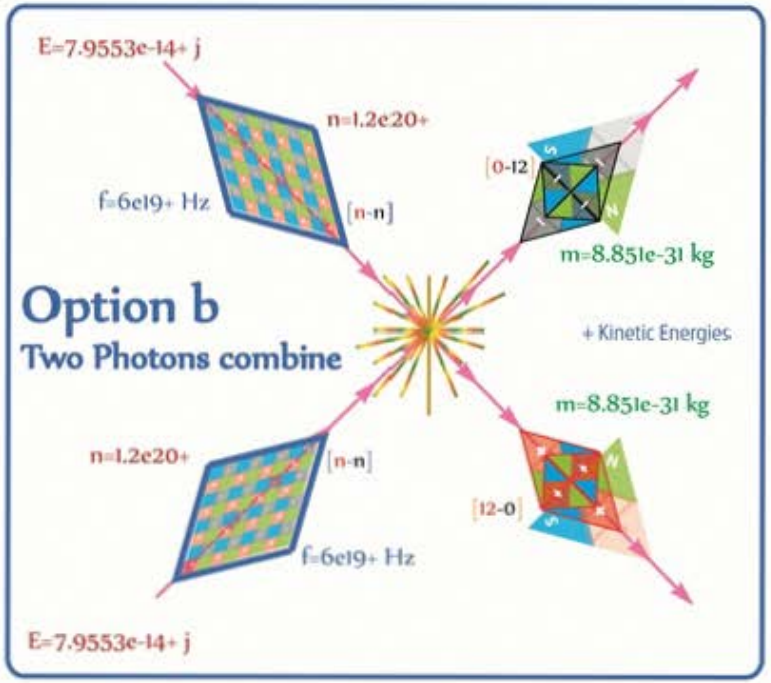

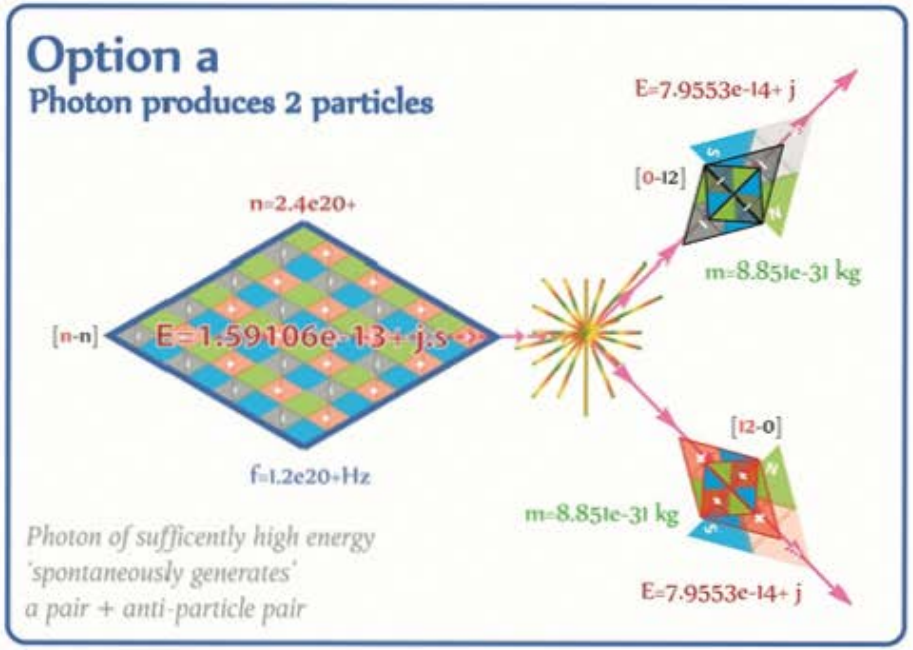

Planck's constant	Energy	electron rest mass-Matter
6.62432672 e-34 kgm^2/s	7.9553 e-14 j	8.8514860 e-31 kg

$$n\pi[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v}^2] = E = T\pi[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v}^2]$$

(Planck quanta)

6 e19	1.2 e20
photon frequency	Compton frequency

All pair production - annihilations must follow the mass-Energy-Matter equivalency formula

mass c^2 ← *per second* — E — *per second squared* → c^4 Matter

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Kinetic Energies

$$KE = \frac{1}{2}Mv^2$$

As velocity increases so does the number of energy momenta quanta per spatial geometry

Photons contain Kinetic energies and momentum

Photonic Energy

$$E_\gamma = 2\pi\left[\left[\underset{\text{mass}}{m}\Omega\underset{\text{velocity}}{v^2}\right]\right]$$

Kinetic Energy and momenta are all related through Tetryonic geometry

Photons

$$p = \frac{h}{\lambda} = \frac{E}{c}$$

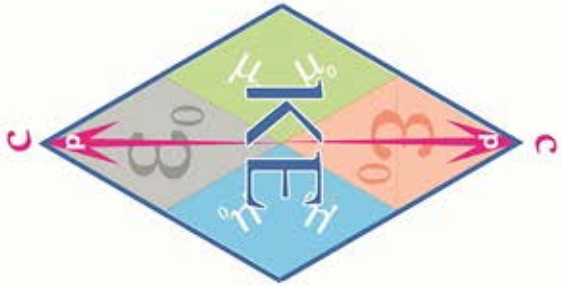

$$E = hf$$

Momentum

$$\frac{p^2}{2m} = KE = \frac{1}{2}Mv^2$$

As the number of Photons increases so does the Momentum

$$p = \frac{n\pi\left[\left[\underset{\text{mass}}{m}\Omega\underset{\text{velocity}}{v^2}\right]\right]}{v} = E/v$$

Planck quanta

All Photons travel at the 'speed of light' in their medium of transmission

$$p = \frac{E}{c} = \frac{hv}{c} = \frac{h}{\lambda}$$

$$p = n\pi\left[\left[\underset{\text{mass}}{m}\Omega\underset{\text{velocity}}{v}\right]\right]$$

Planck quanta

linear energy-momentum

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Electronic Kinetic Energies

have discrete energy levels within the nucleus and continuous energy levels in unbound electrons

Boson exchanges between quantum levels provides the basis for all electron - photon interactions

0.211 eV / n^2

Relativistic KEM formula must always remove invariant rest Matter PRIOR to Lorentz correction being applied

$$KEM = RE - mc^2$$

As rest Matter is invariant and the Lorentz factor applies to EM waves only

$$KEM = 4\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field (ElectroMagnetic) · Planck quanta (mass, velocity)

Electric & Magnetic energies are contained in the KEM field geometry extending from all Matter topologies in motion

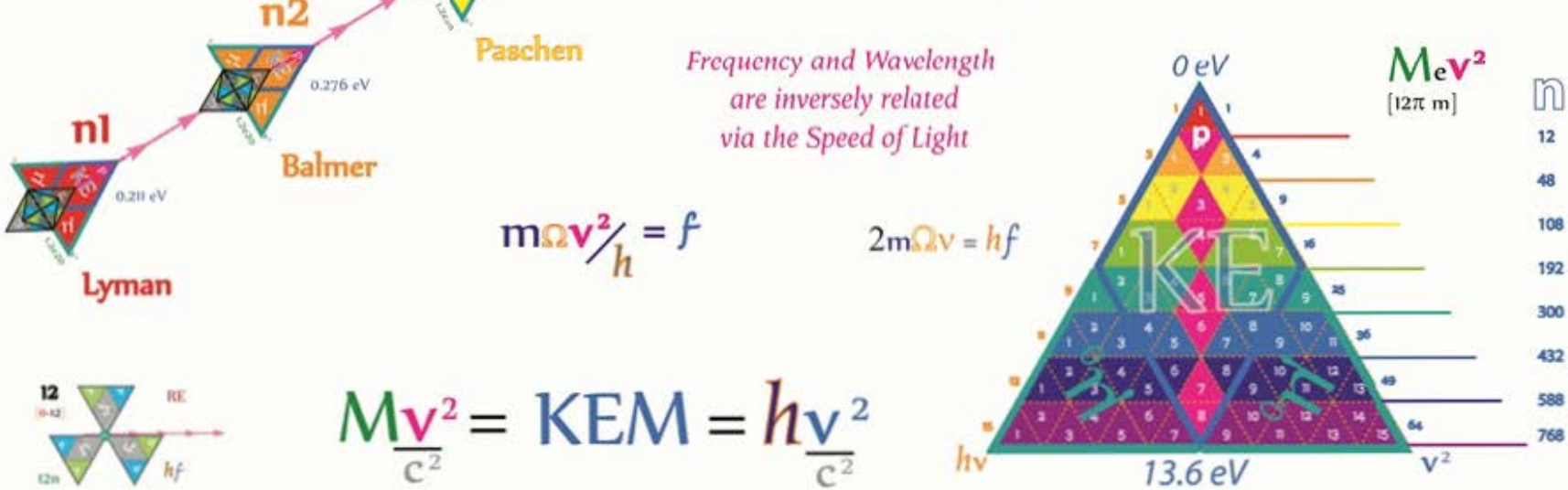

$$p/h = \tilde{\nu}$$

Wave numbers are the inverse of Wavelengths

$$h/p = \lambda$$

Frequency and Wavelength are inversely related via the Speed of Light

$$m\Omega v^2/h = f$$

$$2m\Omega v = hf$$

$$\frac{Mv^2}{c^2} = KEM = \frac{hv^2}{c^2}$$

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Photonic energy
momenta of KEM fields

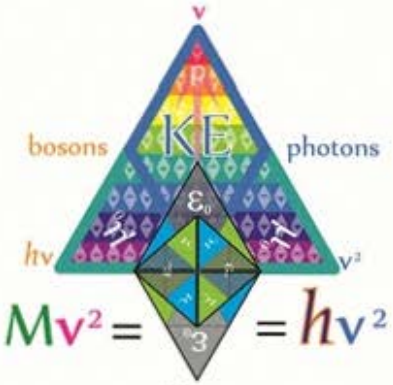

Rydberg's formula is a wavenumber equivalent re-expression of Lorentz's velocity correction formula as it applies to the quantised energy momentum of Photo-electrons bound in atomic nuclei

$$\frac{1}{\lambda} = \frac{R_H}{hc}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

The difference of two inverse squared KEM energies

Rydberg — Tetryonic

$$R\left(\frac{1}{1} - \frac{1}{4}\right) = R\left(36 / 48\right)$$

.75 — .75

n1 and n2 are integers greater than or equal to 1 such that n1< n2

$$\frac{1}{2}Mv^2 = KE = hcR$$

Whereas Rydberg calculated for wavenumbers using the difference of two inverse squared KEM energies. (inverse wavelengths)

$$\left(\frac{1}{1} - \frac{1}{4}\right)$$

.75

A mathematical solution that works but whose physical mechanics has eluded explanation

Tetryonics obtains the same answers geometrically using the difference of the two KEM energies. (quanta differentials)

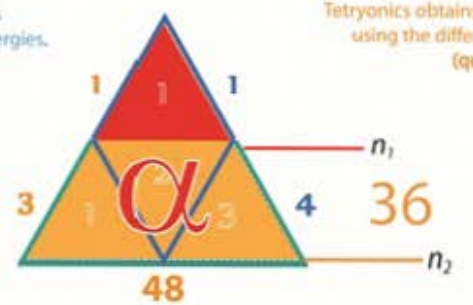

(36/48)

.75

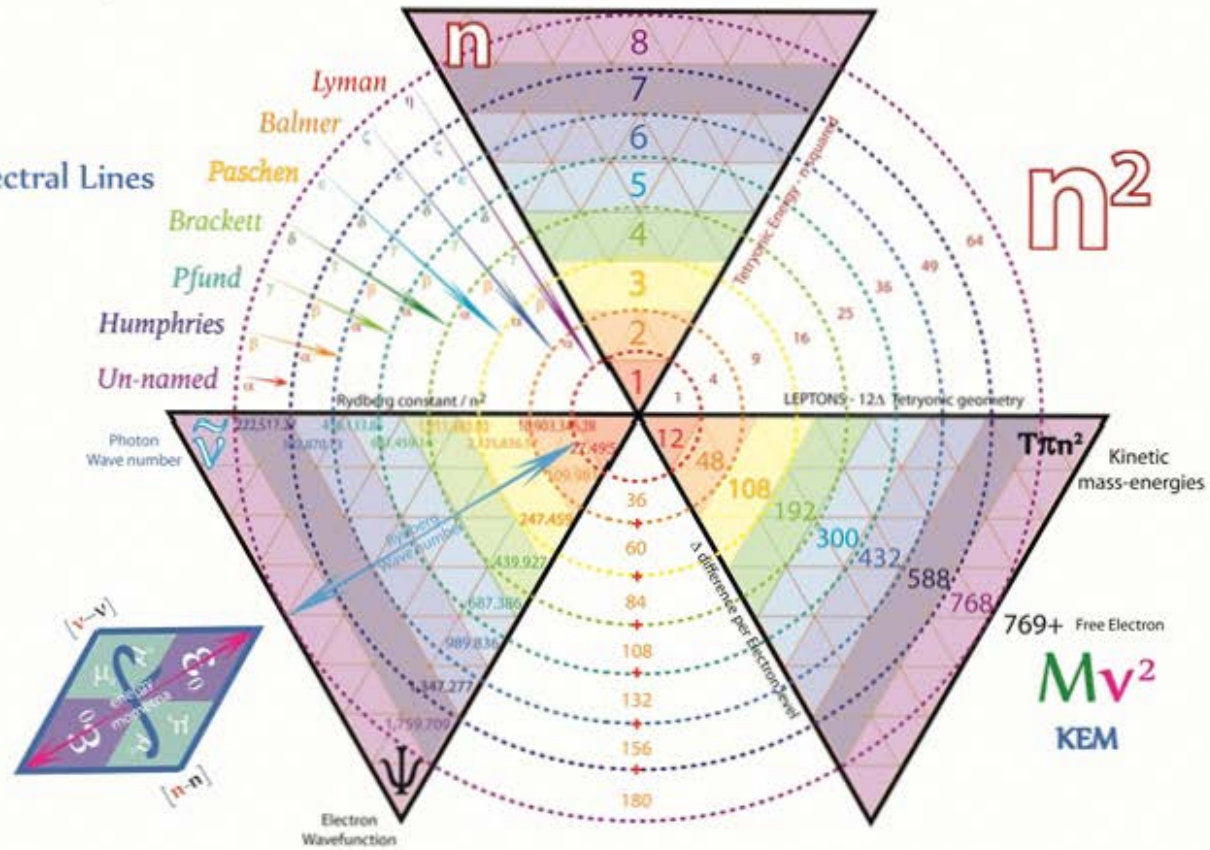

Any changes to the Energy momenta of the electron's KEM field must be reflected in the Energy momenta of the Photo-electrons emitted [absorbed]

$$\pm\Delta hv = KEM_i - KEM_f$$

The difference of two KEM energies

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Kinetic Energies of Photoelectrons

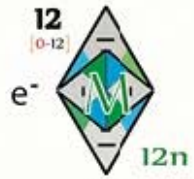

rest Matter

Kinetic energies are DIVERGENT from Matter topologies

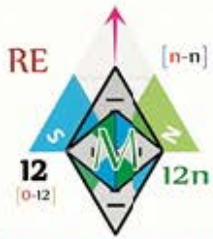

Relativistic mass-energies

rest Matter + Kinetic Energies

The total energy of a photon is absorbed into the electron's KEM field geometry

All velocity changes produce changes to mass-energies, momenta and wavefunction relationships

$$KEM = Mv^2$$

rest Matter is velocity invariant

$1e19\nu = n$

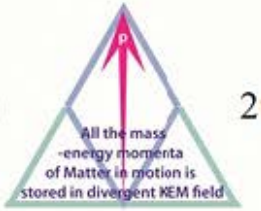

$2\nu = f$

6.62943 e -34 J.s

13.5252 eV
2.1669 e -18 J

$$E = h\nu^2$$

3.26874 e15 quanta

KEM fields are velocity variant

Δp

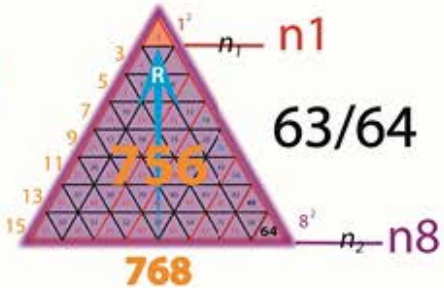

$$4\pi_{\text{KEM field}}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta — ElectroMagnetic — mass — velocity

Electron KEM Quantum levels

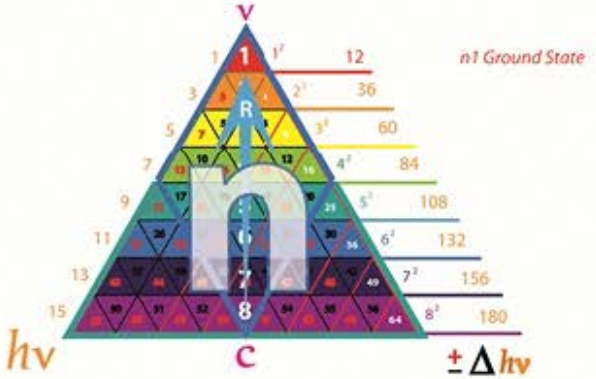

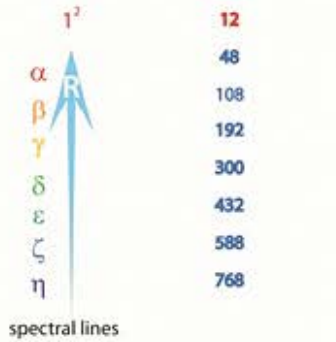

Rydberg spectral transition jumps

$$R_H\left(\frac{1}{1}-\frac{1}{64}\right) = \frac{1}{\lambda} = KEM\left(\frac{63/64}{1}\right)$$

Rydberg .984375 — Tetryonic .984375

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Spectral line energies

$1\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$ (Charge; EM Field; Planck quanta; ElectroMagnetic; mass; velocity)

ZPF

ZPF

Each quantum level transition requires kinetic energies with an ODD number of EM mass-energy momenta quanta [bosons - charge carriers]

γ $2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$ (Photons; EM Field; Planck quanta; ElectroMagnetic; mass; velocity)

$n.h\nu$

Bosons are
Odd number Charge carriers

In order to transistion between levels for each emission and absorption leptons must release or absorb specific W bosons (neutral Z bosons - photons) for each KEM field change

Photons are
Even number EM force carriers

$n.hf$

$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$ (Bosons; EM Field; Planck quanta; ElectroMagnetic; mass; velocity)

W+

W-

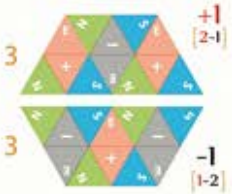

Pairs of charged W bosons combine to form neutral bosons / photons [EM induction]

W^0 $\text{EVEN}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$ (EM waves; EM Field; Planck quanta; ElectroMagnetic; mass; velocity)

KEM field Differentials

Bosonic quantum level changes

Mv^2

Absorption

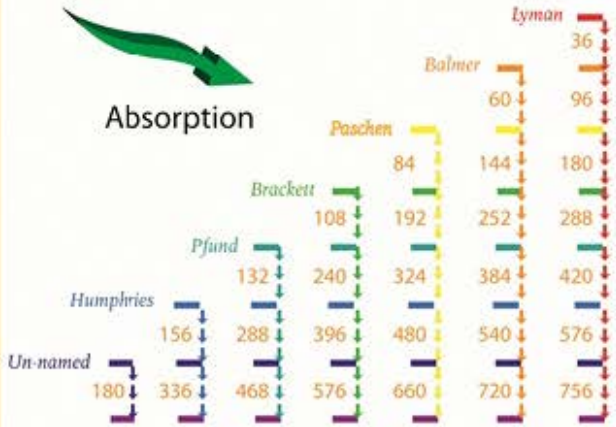

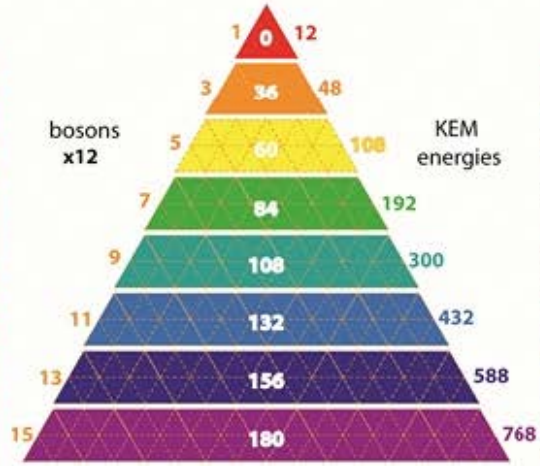

Mv^2

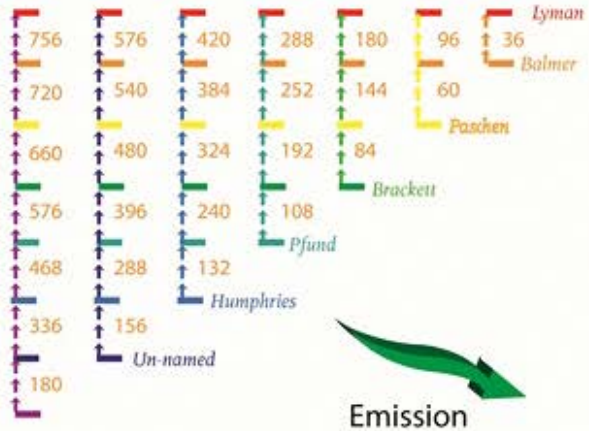

Emission

All quantum level changes are the result of boson increases or decreases

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Quantum level differentials

The exact number of Kinetic energy quanta (ZPFs) required for each bound electron transition within a nucleus

$$\frac{1}{\lambda} = \frac{R_H}{hc}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Ryberg calculated this as the wavenumber differerential of two inverse squared energies

n_f^2 Rydberg $R_H\left(\frac{1}{1} - \frac{1}{4}\right)$ .75 = Tetryonic $R_H(36/48)$ .75 n_i^2

Tetryonic geometry reveals it to be sum of ODD integer bosons between two squared KEM energies

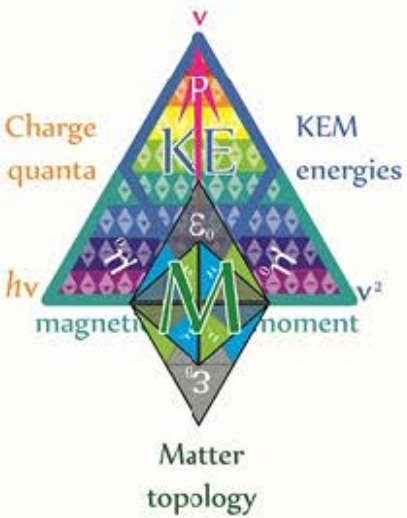

Each Quantum level jump within an Atomic Nucleí is discrete and requires an exact number of EM mass-energy quanta

The calculation of the quanta required is historically done utilising Rydberg's Constant and its associated formula

The quantum level [boson] differential equates it to the release or absorption of consecutive ODD number Planck quanta from squared KEM field energy geometries Δ[hv]

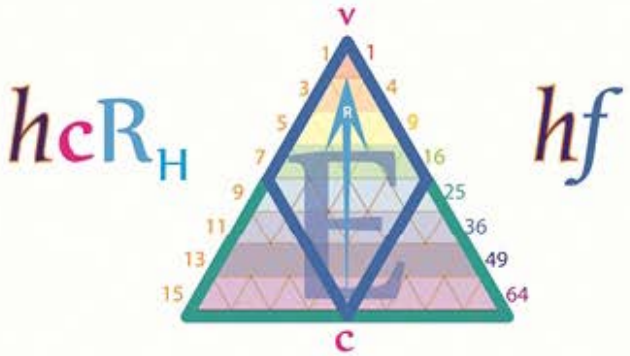

Rydberg's constant is a LINEAR measurement of wavenumbers which can be related to squared KEM energies through the velocity-frequency-wavelength relationship

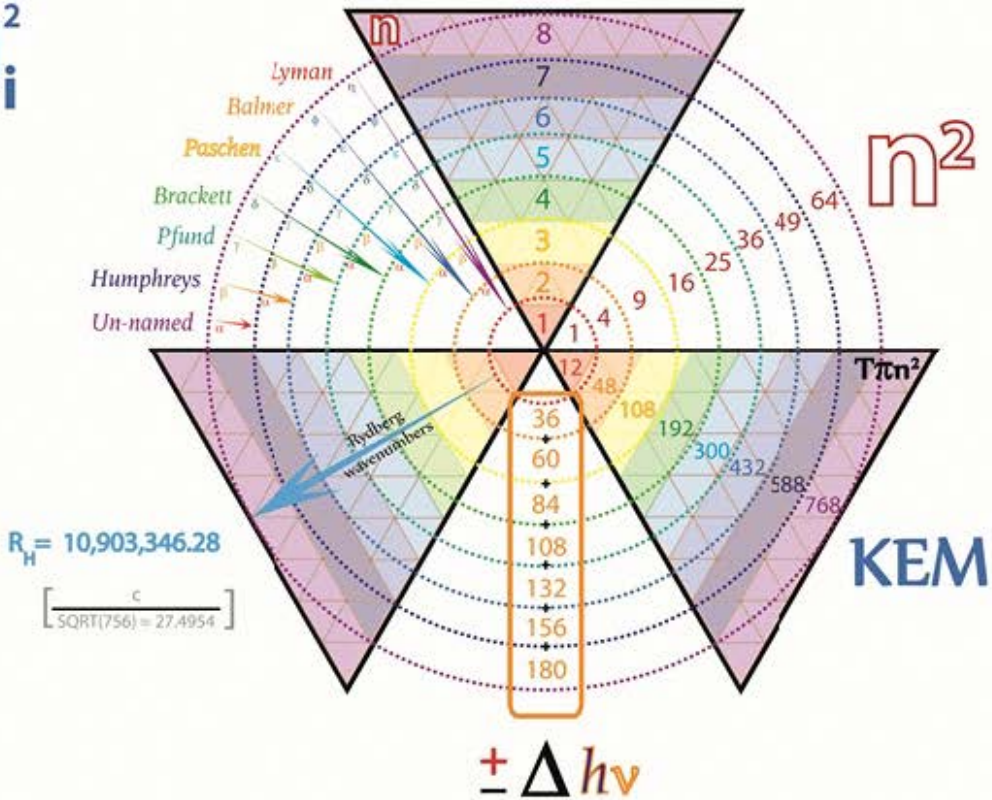

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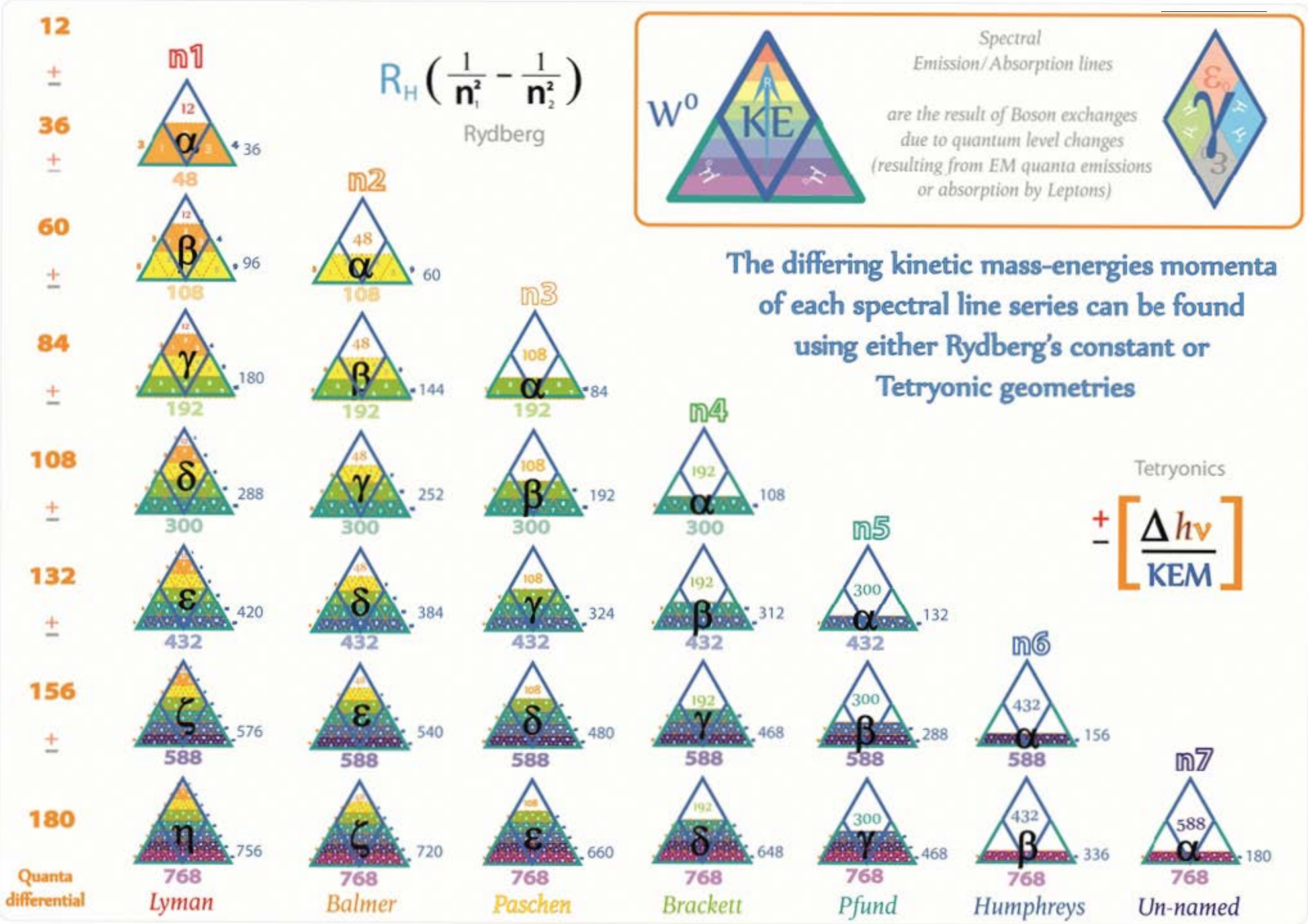

Tetryonics 28.11 - Boson differentials

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Absorption~Emission lines

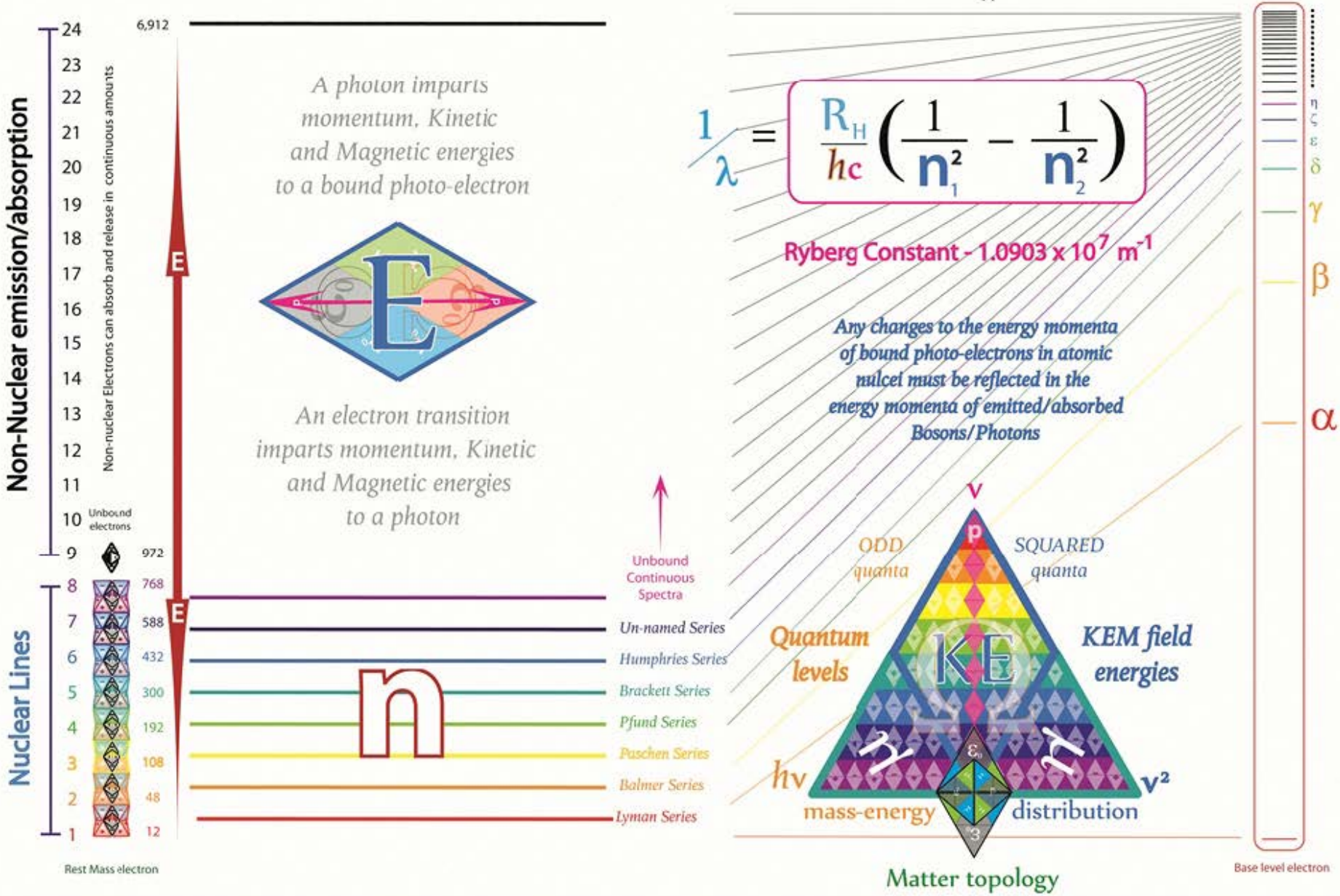

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Spectral Lines

Spectral lines are the result of interaction between a quantum system (usually atoms, but sometimes molecules or atomic nuclei) and a single photon. When a photon has exactly the right amount of energy to allow a change in the energy state of the system (in the case of an atom this is usually an electron changing orbitals), the photon is absorbed. Then it will be spontaneously re-emitted, either in the same frequency as the original or in a cascade, where the sum of the energies of the photons emitted will be equal to the energy of the one absorbed (assuming the system returns to its original state). The direction and polarization of the new photons will, in general, correlate with those of the original photon.

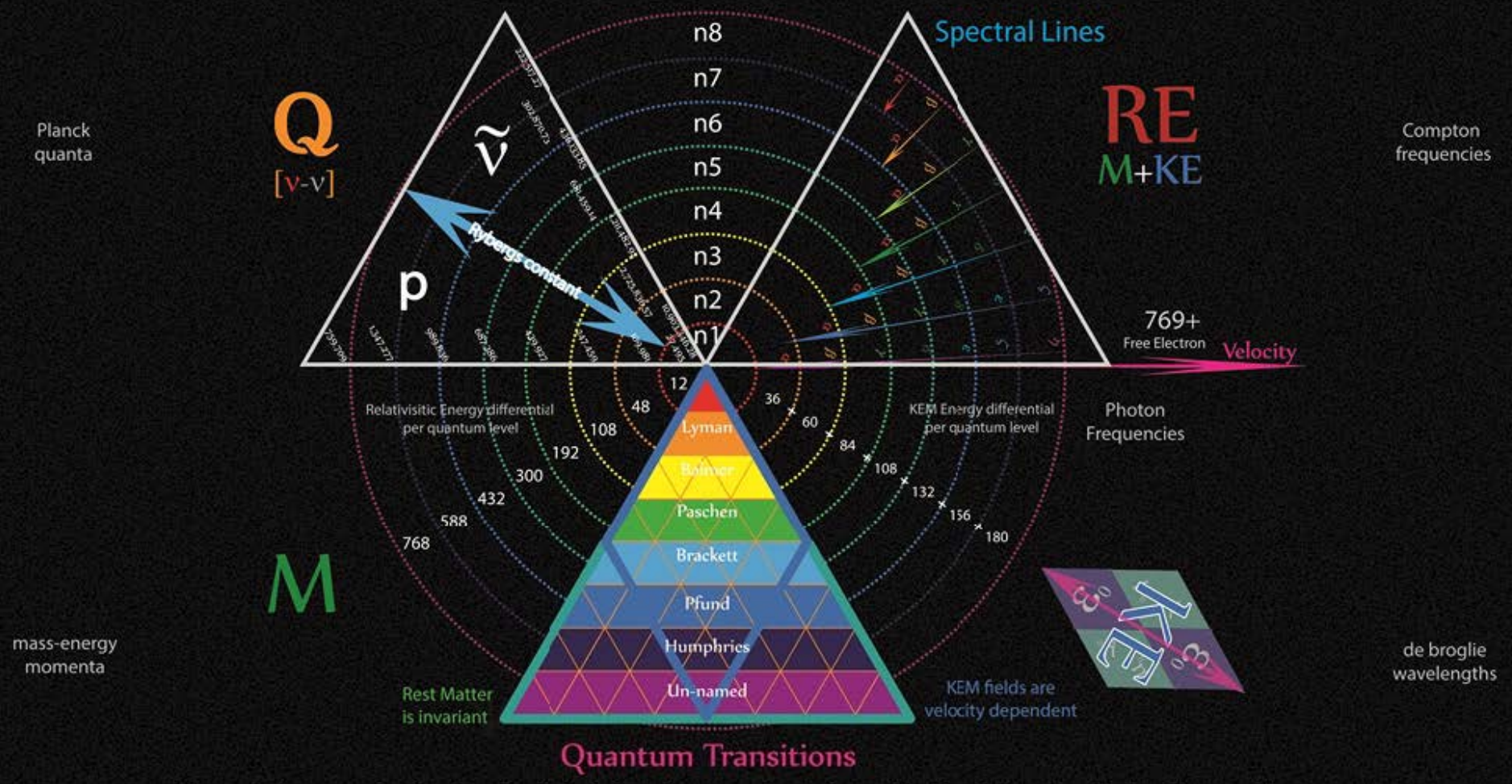

Spectral lines are highly atom-specific, and can be used to identify the chemical composition of any medium capable of letting light pass through it (typically gas is used). Several elements were discovered by spectroscopic means, such as Helium [04], Rubidum [37], Cerium [58] and Thallium [81]

Spectral lines also depend on the physical conditions of the gas, so they are widely used to determine the chemical composition of stars and other celestial bodies that cannot be analyzed by other means, as well as many other of their physical properties.

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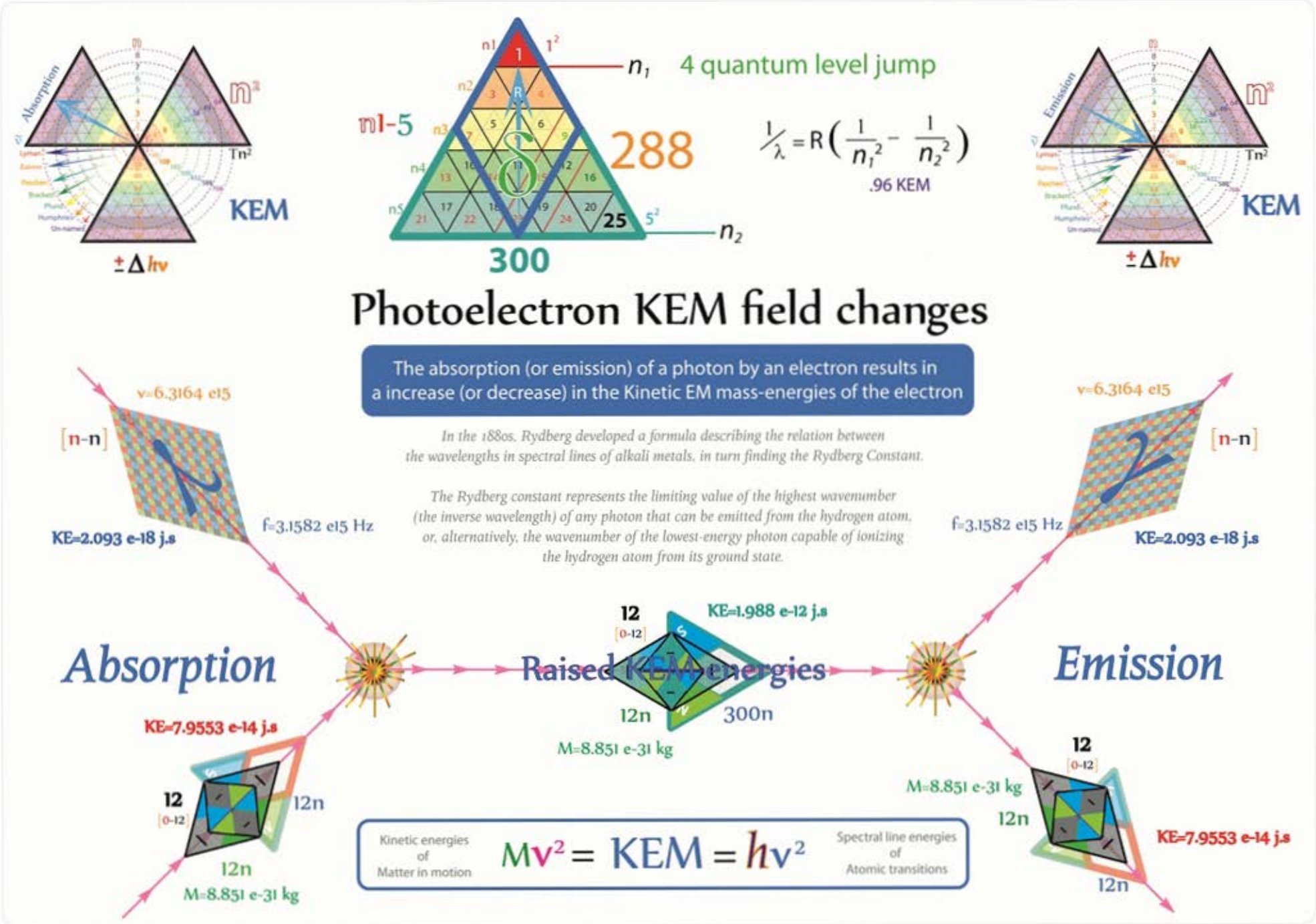

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Revealing Rydberg Formula's geometry

The Rydberg formula is used in atomic physics to determine the wavenumber of spectral lines of many chemical elements.

$$\frac{h}{Mv} = \lambda$$

Wavelength is inversely related to Frequency

$$1/\lambda = \frac{R_H}{hc}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$p/h = \tilde{\nu}$$

Wavenumbers are a inverse measure of Wavelengths

$$p^2 = E = Mv^2$$

Tetryonic geometry can be applied to Kinetic EM field variations produced by the emission and absorption of Photons by electrons in Nuclear orbits to reveal the geometry behind Rydberg's formula

$$p = \frac{E}{v} = hv$$

EM Field — Planck quanta

$$12\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Photoelectron (EM fields) — ElectroMagnetic — mass — velocity

$$\boxed{Mv = \frac{KEM}{v} = hv}$$

13.525 eV

linear momentum — *longitudinal quanta*

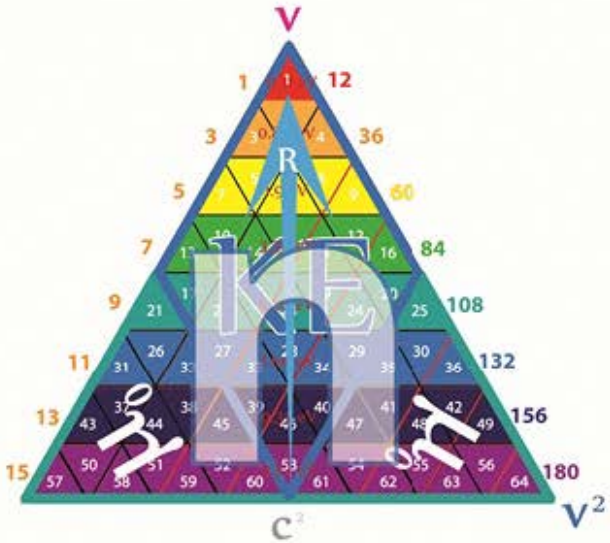

Wavelengths and Frequency are related through the velocity of propagation

Spectral line emissions reveals Rydberg's formula to be a measure of longitudinal KEM momenta

Compton frequency

$$\frac{Mv^2}{h} = f$$

$$KEM = hcR$$

$$\lambda_{KEM} = \frac{f}{v}$$

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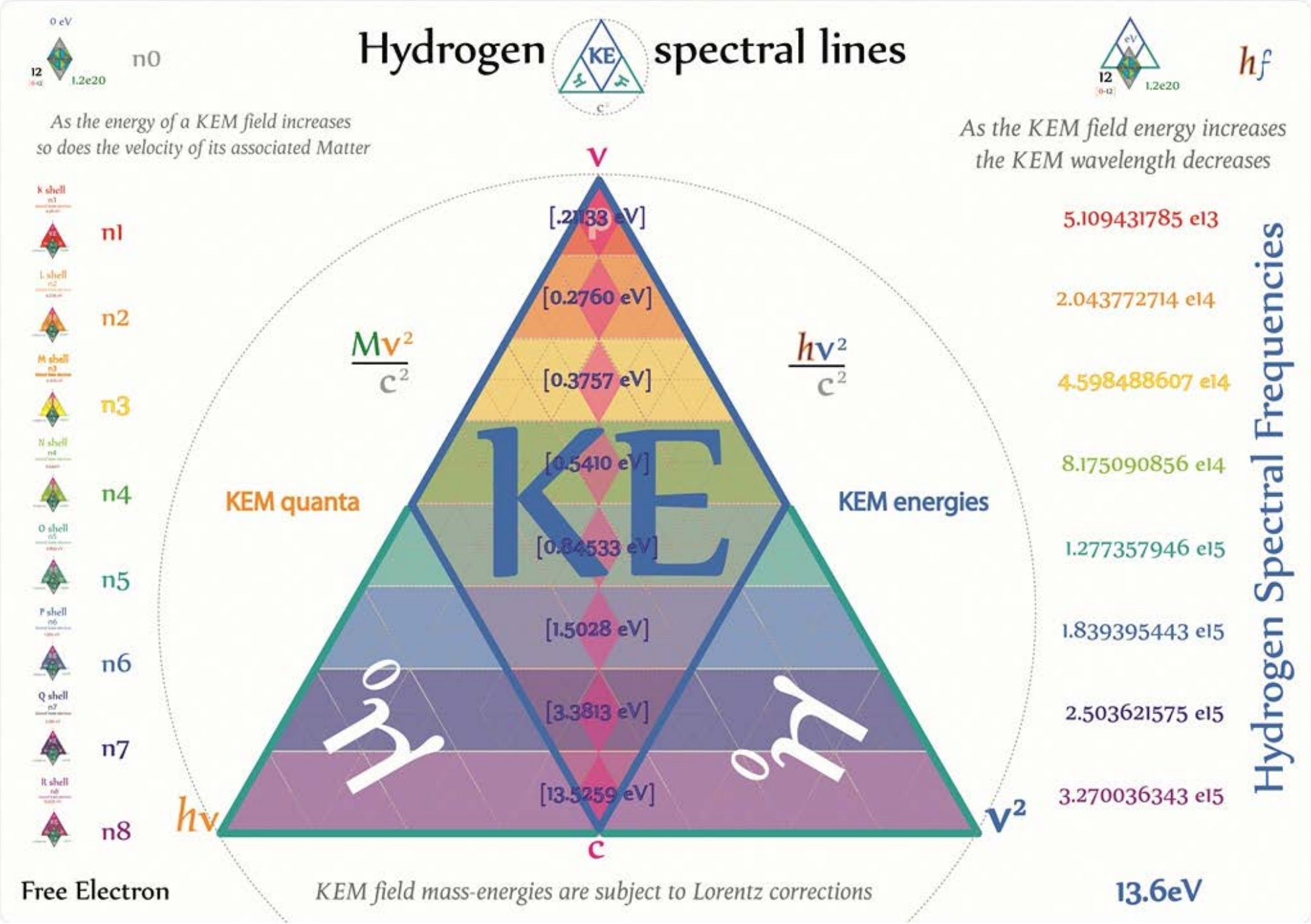

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Absorption lines

Increase in photo-electronic energies

$$\Delta 2h\nu = E = hf$$

When an electron 'absorbs' a photon of energy momenta it 'jumps' from one energy level to another, dependent on the energy and frequency of the incident photon

$$f = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

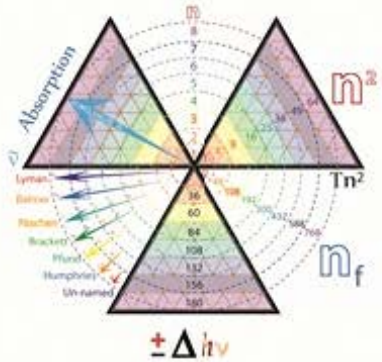

The quantum level of the nuclei determines the ground quantum level of electrons within the nucleus
All transitions within the nulceus are discrete quantum jumps - outside the nucleus all spectra are continuous

KEM A Hydrogen photo-electron can only exist in specific energy levels below 13.525eV within the nucleus (any excess KE results in a unbound electron with KE - velocity)

KE in excess of 13.525 eV results in unbound electron

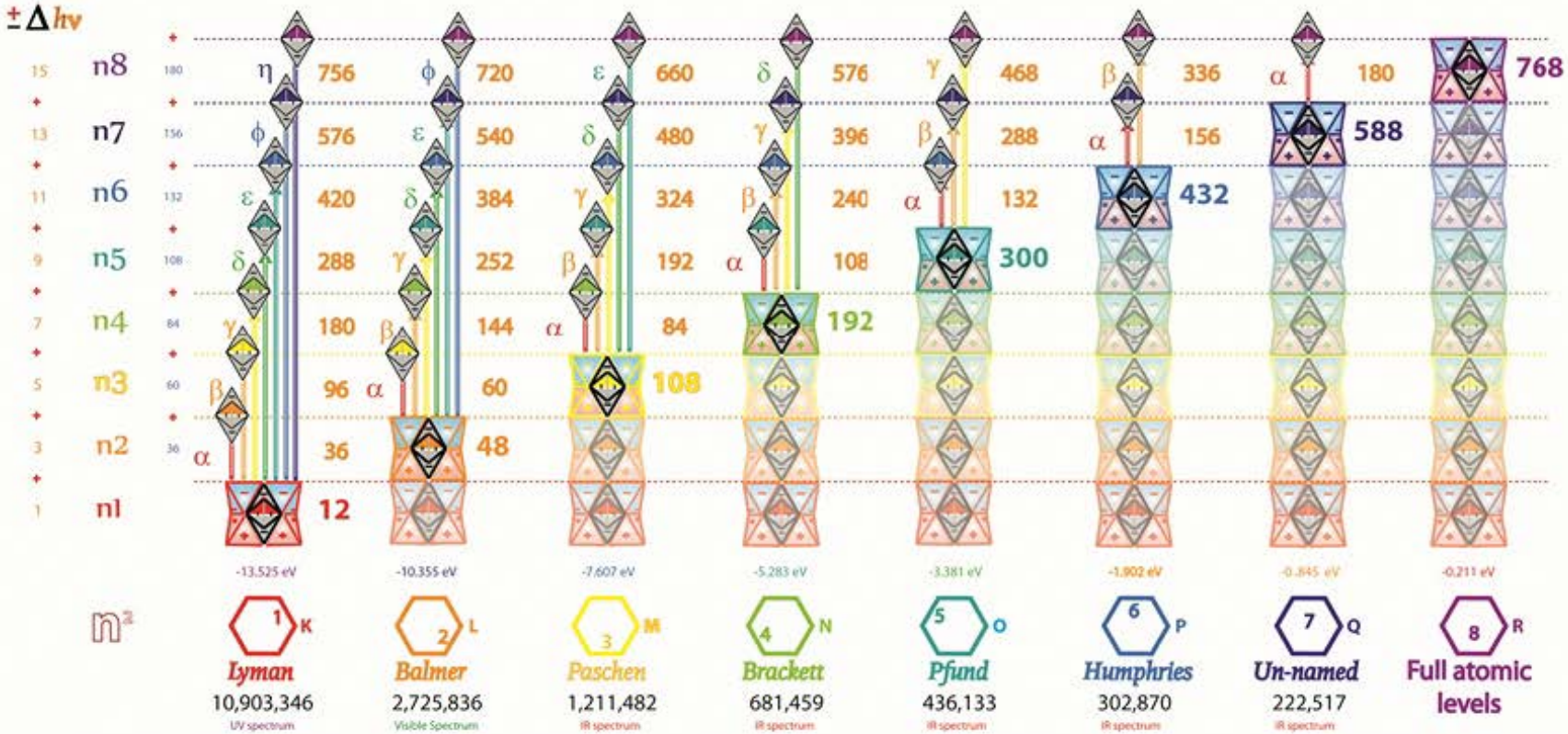

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KEM fields & quantum jumps

$$Mv^2 = KEM = hv^2$$

$$f = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

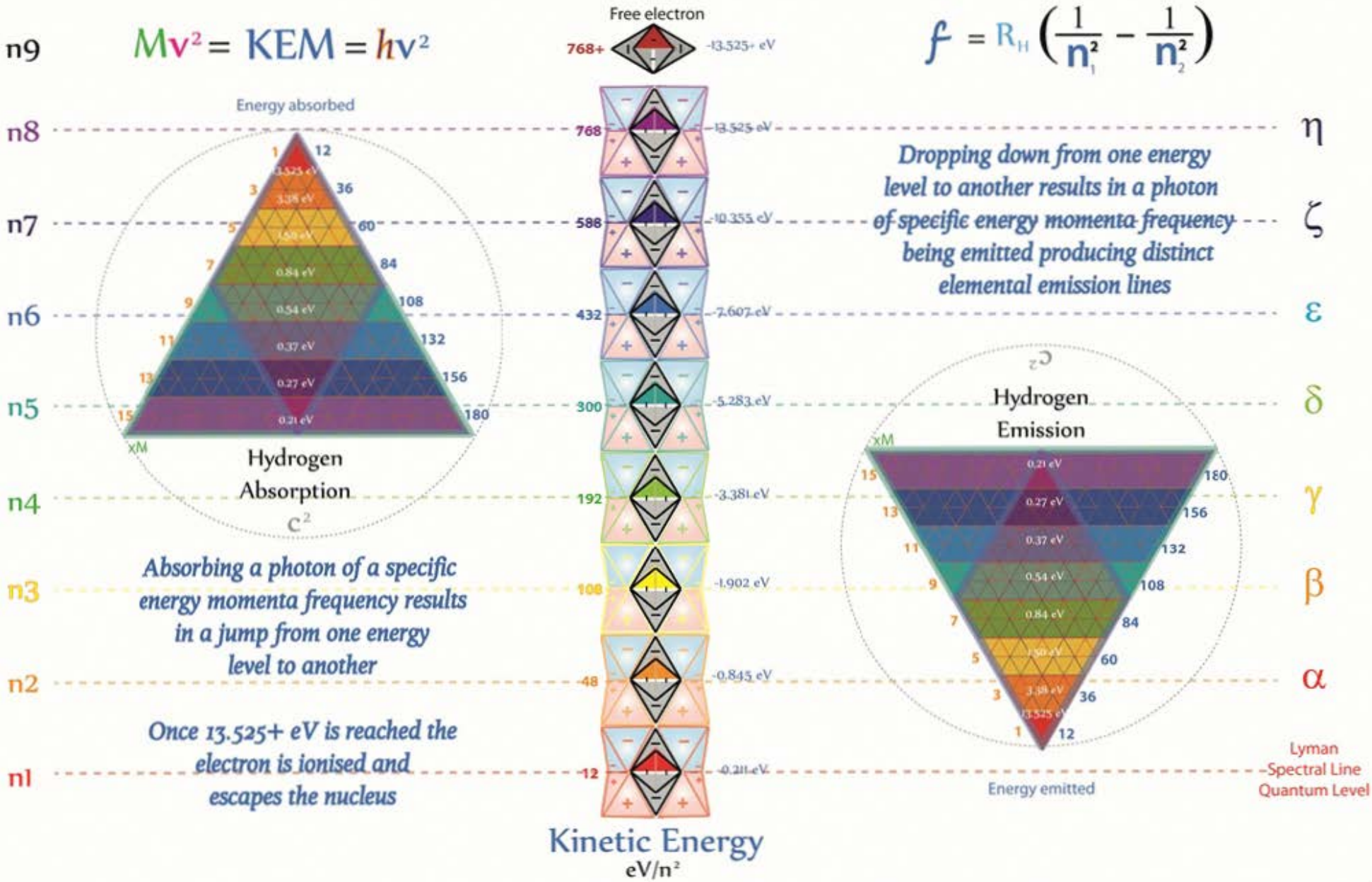

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Emission lines

Decrease in photo-electronic energies

$$\Delta 2h\nu = E = hf$$

When an electron 'emits' a photon of energy momenta it 'drops' from one energy level to another dependent on the energy and frequency of the ejected photon

$$f = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

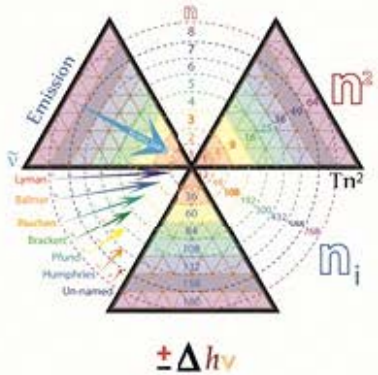

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KEM

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KE in excess of 13.525 eV results in unbound electron

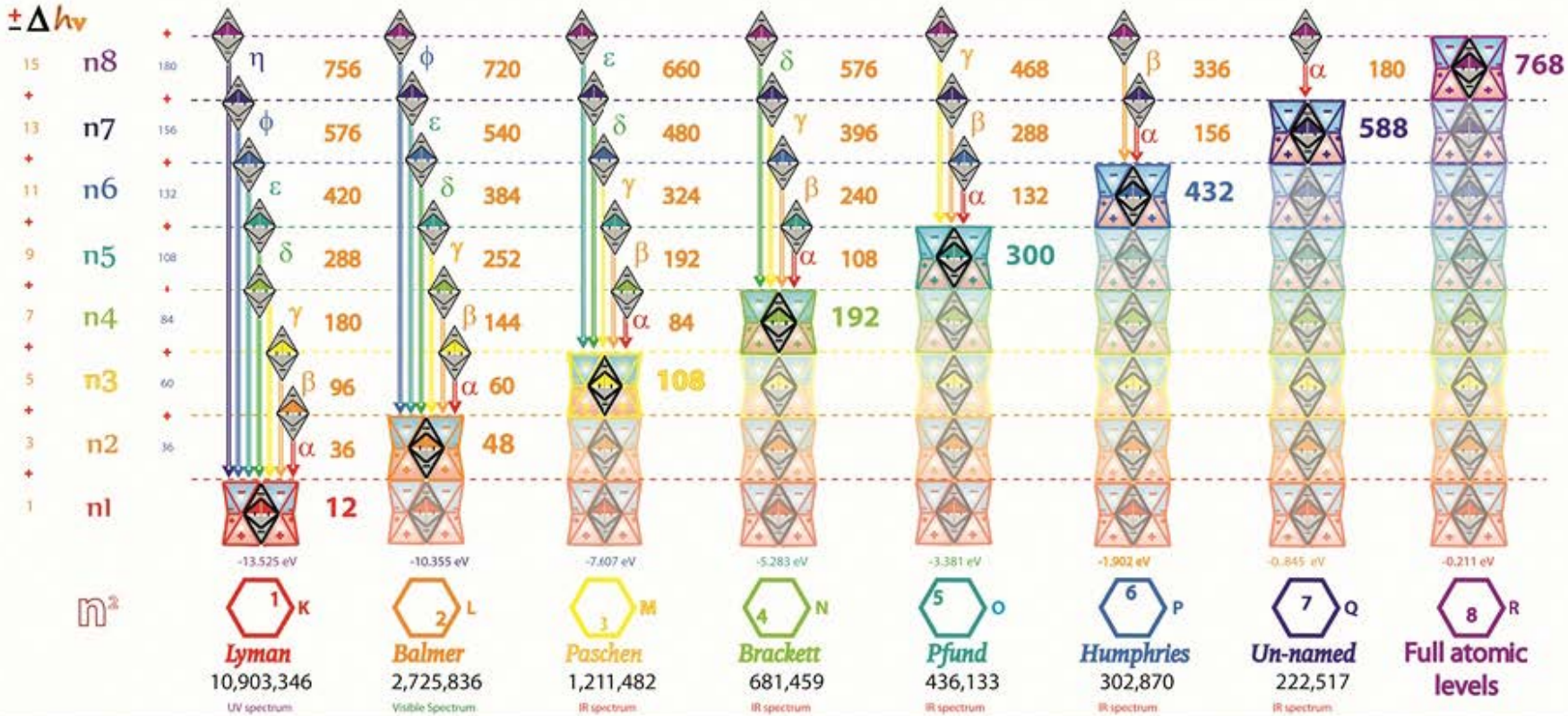

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Spectral line series

(are produced by changes in linear momentum in photo-electric KEM fields due to atomic transitions of electrons between squared energy levels)

Lyman

n1-8

Balmer

n2-8

Paschen

n3-8

Brackett

n4-8

Un-named

n7-8

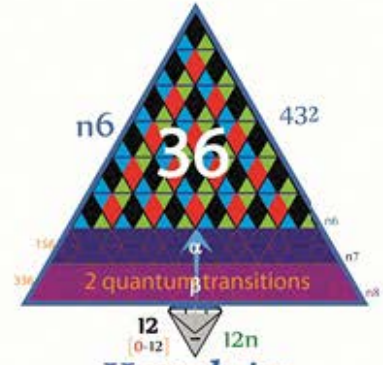

Humphries

n6-8

Pfund

n5-8

Lyman	27.49545417
Balmer	109.9818167
Paschen	247.4590875
Brackett	439.9272667
Pfund	687.3863542
Humphries	989.8363501
Un-named	1,347.277254

Square root of Energy required to transition nuclear quantum levels

$$\left[\sqrt{756}\right].n^2$$

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Rydberg's Constant

Johannes Robert Rydberg

(November 8, 1854 – December 28, 1919)

$$\tilde{\nu} = \frac{c}{27.49545}$$

$$f = \frac{c^2}{27.49545}$$

$$\lambda = \frac{27.49545}{c}$$

$$p = 27.49545$$

$$R_H = \frac{c}{27.49545}$$

$1.0903346.28 \times 10^7$ m-1

$$R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\lambda = v/f$$

Using the Tetryonic model of a photo-electron and its associated quantum KEM energy levels we see that Rydberg's constant is a linear measure of the photo-electronic KEM field - and in turn directly related to its scalar energy-momenta through 'c'

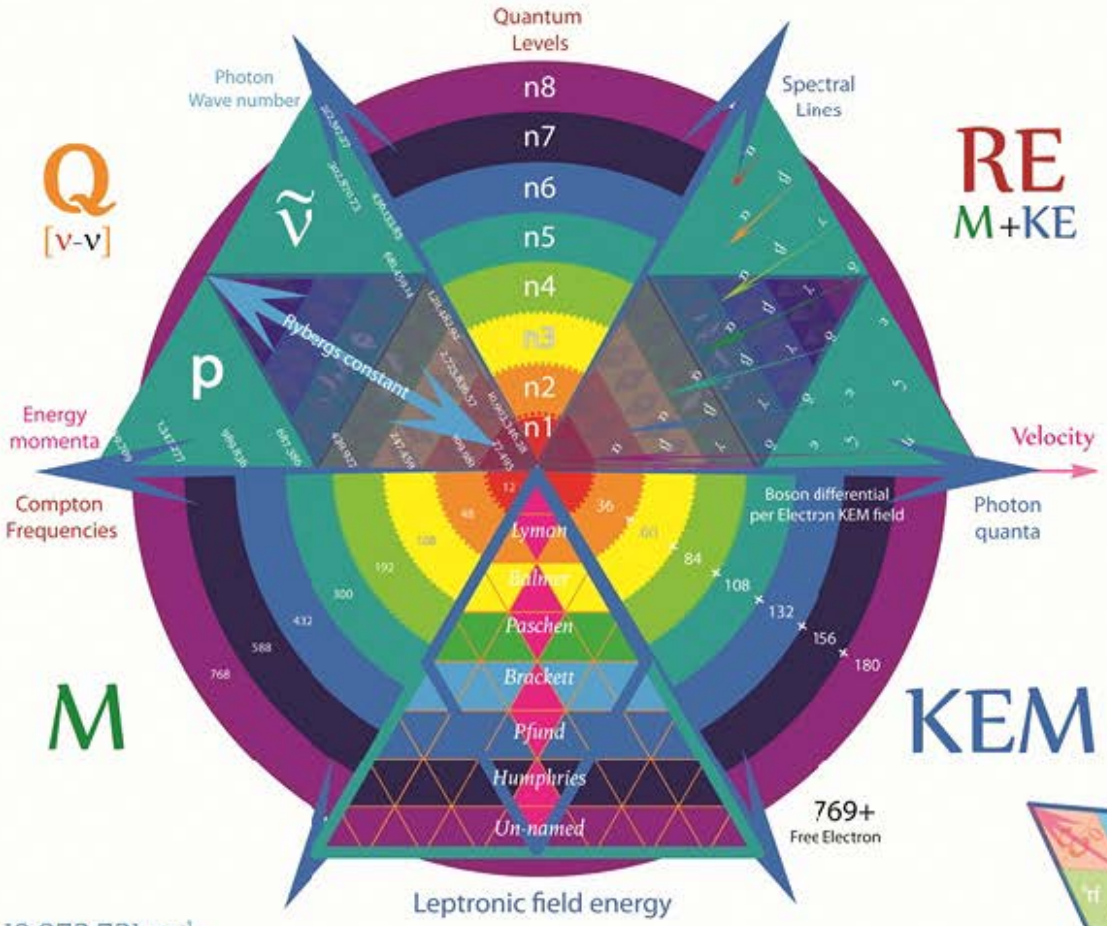

Currently accepted value - 10,973,731 m^{-1}

Rydberg's Constant can be shown to be the square root of the total number of quanta required to transition a n1 electron to n8
(the highest quantum level possible in elemental nuclei)
as per Planck's heat law

Tetryonic theory value - 10,903,346 m^{-1}

$$p^2 = KEM = Mv^2$$

Quantum Jump

The energy momenta of emitted photons is a function of the photo-electron's KEM wavefunction

27.49545

KE
Photons

$$Mv^2 = KEM = hcR_H$$

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Wavenumbers and Planck's Law

Wavenumbers are revealed to be the number of quanta [nhv] required for a photo-electron to transition between specific quantum levels divided by the speed of light [c]

Balmer spectral lines [absorption]

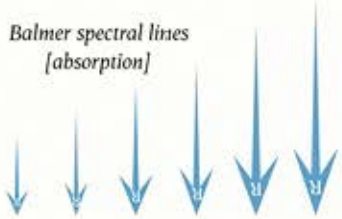

$$E = n[h\nu]$$

Wavenumbers are the number of Planck quanta required to reach a specific energy level

Max Karl Ernst Ludwig Planck

(April 23, 1858 – October 4, 1947)

Balmer spectral lines [emission]

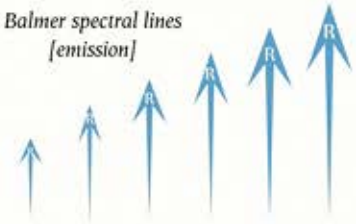

$$E = hc\tilde{\nu}$$

Photo-electrons emit and absorb photons to create blackbody radiation

Planck's law describes the electromagnetic radiation emitted by a black body in thermal equilibrium at a specific temperature

$$\Delta[nh\nu]$$

SQUARED energy levels have ODD numbered quanta in each energy level [bosons]

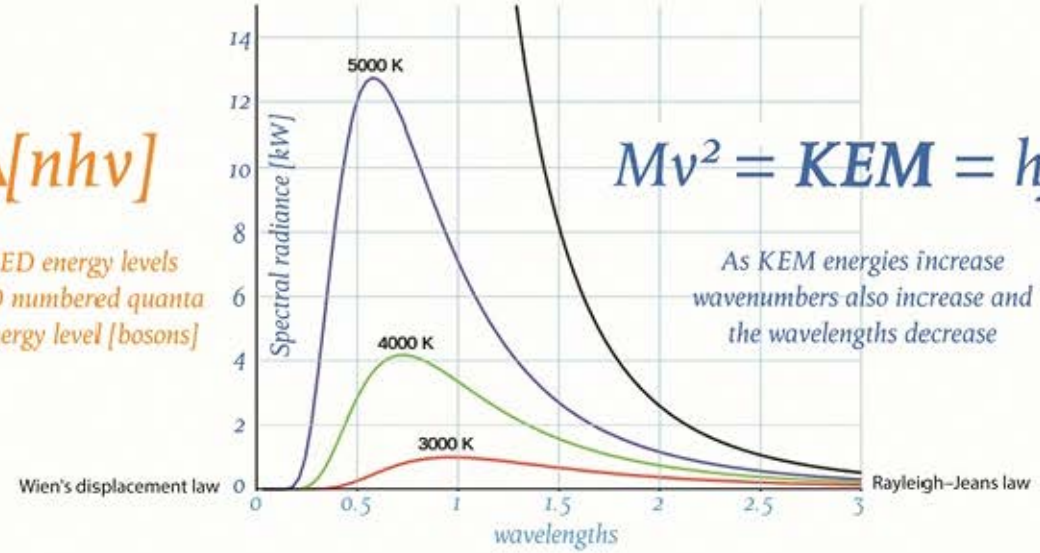

$$Mv^2 = KEM = hf$$

As KEM energies increase wavenumbers also increase and the wavelengths decrease

Spectral lines can be understood in quantum theory as differences between energy levels and proportional to wavenumber, frequency or wavelengths

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Kinetic mass-energy momenta relationships

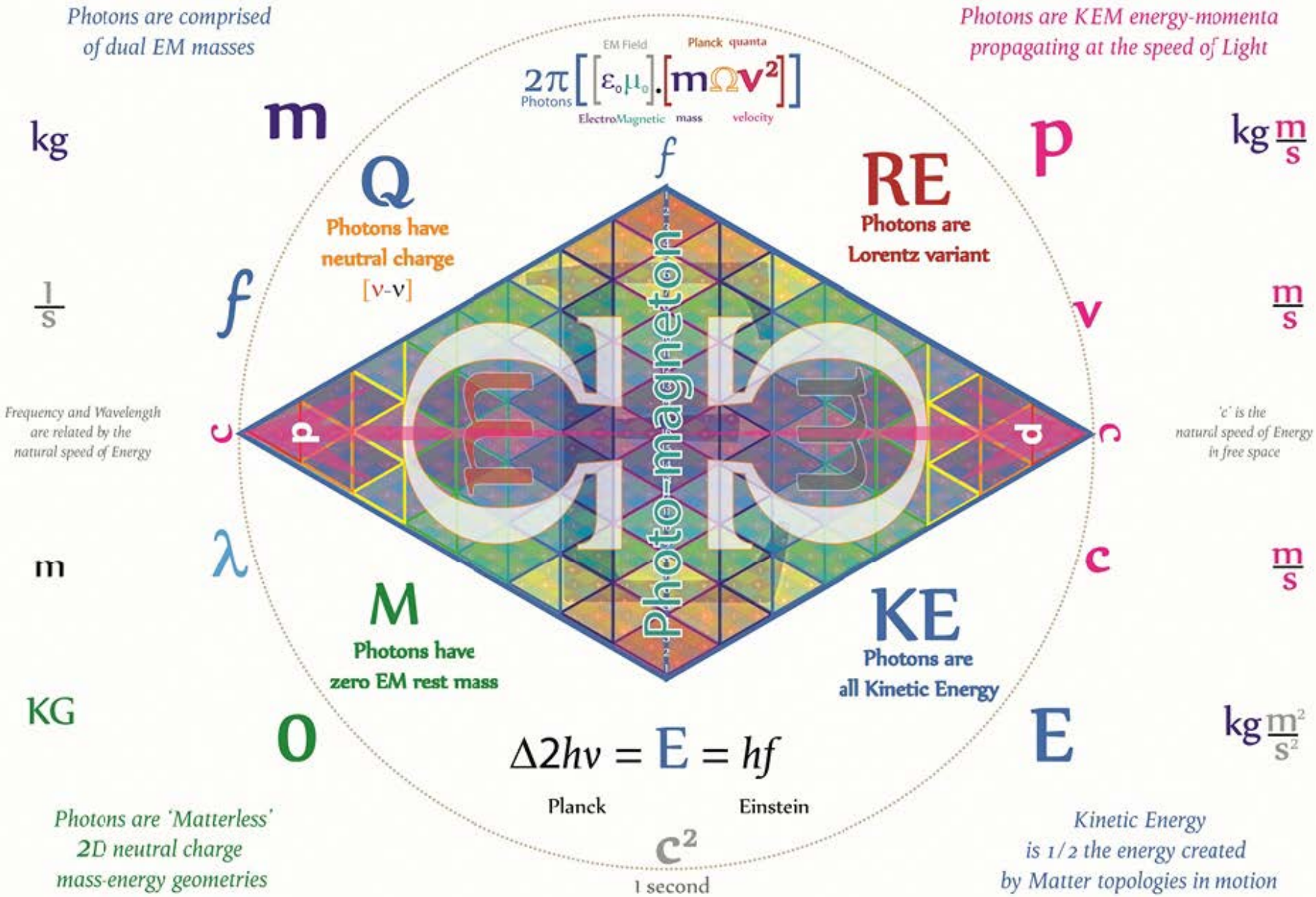

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Relativistic Lorentz corrections

Hendrik Lorentz

(18 July 1853 – 4 February 1928)

$$\sqrt{1-\beta^2}$$

$$E=\frac{mc^2}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$\sqrt{1-\left(\frac{v}{c}\right)^2}$$

The Lorentz transformation was originally the result of attempts by Lorentz and others to explain how the speed of light was observed to be independent of the reference frame and later expanded upon in an attempt to understand the creation of emfs in magnets and symmetries in electromagnetic forces

Einstein inlcuded the transformation in his theory of Special relativity [SR].

The Lorentz transformation supersedes the Galilean transformation of Newtonian physics, which assumes an absolute space and time.

According to special relativity, the Galilean transformation is a good approximation only at relative speeds much smaller than the speed of light.

Tetryonics expands upon all of this revealing this relationship as a result of the geometry of electromagnetic mass-energies in motion

rest mass-Matter — Energy

$$\frac{4n\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity; momentum

spatial co-ordinate system

Matter is EM energy propagating at the 'speed of Light' in a standing wave energy topology

One of the greatest mistakes in relativistic mechanics is the application of Lorentz corrections to Matter.

It stems from there being no definition and enforced differentiation between EM mass and Matter

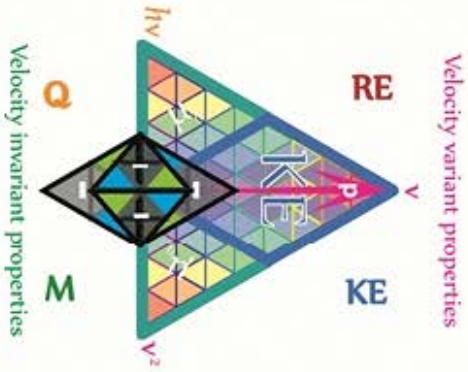

$$m = \frac{E}{c^2}$$

2D planar fields are relativisitic

radiant EM mass geometry

$$\frac{m}{c^2} = M$$

standing-wave Matter topology

3D standing-waves are velocity invariant

$$\frac{E}{c^4} = M$$

mass is a property of Matter - Matter is not a property of mass [they are directly related throught the velocity of light]

$$\beta = \left[\frac{v}{c}\right]$$

velocity is a result of vector forces

All 2D energy waveforms propagate at the 'speed of Light'

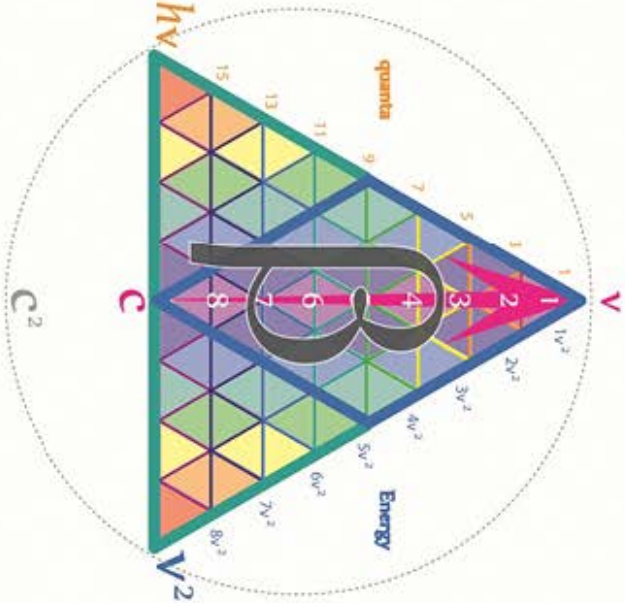

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

The Kinetic Energy of Matter in motion is directly related to the square of the velocity

$$\gamma \equiv \frac{c}{\sqrt{c^2-v^2}} = \frac{1}{\sqrt{1-\beta^2}} = \frac{dt}{d\tau}$$

The 'speed of Light' is a EM constant and is the limiting velocity achelvable by the electrical acceleration of Matter

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Spectral Energy relationships

$kg\frac{m^2}{s^2}$ $E = p^2$

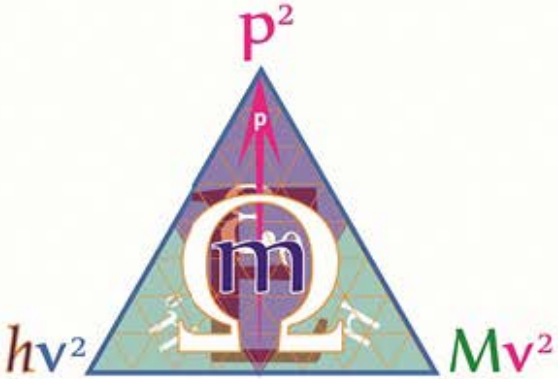

Scalar EM mass -energy momenta

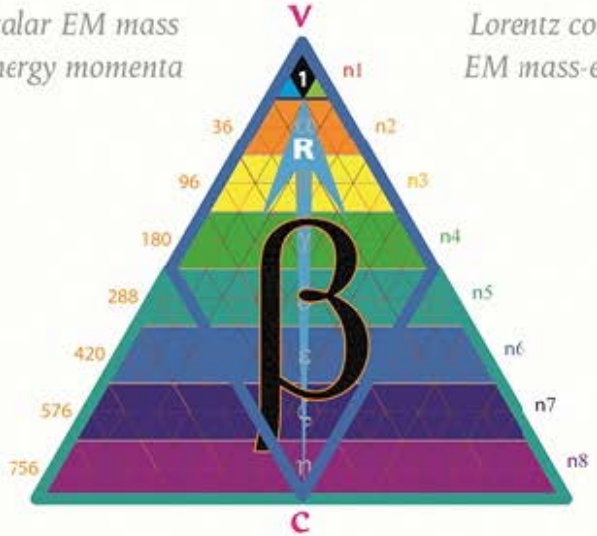

Lorentz corrected EM mass-energies

$KEM = m\frac{v^2}{c^2}$

$$Mv^2 = \underset{13.525\ eV}{KEM} = hcR_H$$

All Spectral line emissions and absorptions produce changes in KEM energies, Angular momentum, Linear momentum, Frequency and Wavelengths

Linear

$$\left[\frac{\Omega}{c}\right] = \lambda$$

de Broglie wavelengths

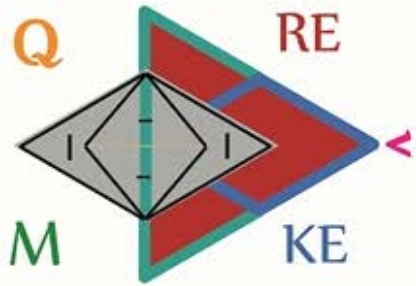

The 'speed of Light' is the maximum velocity acheivable by electrical energies

Scalar

$$f = \left[\frac{c^2}{\Omega}\right]$$

Compton frequencies

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Spectral line photon production

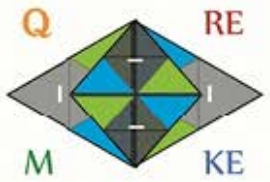

At no time does the 3D rest Matter-energy content of the electron change

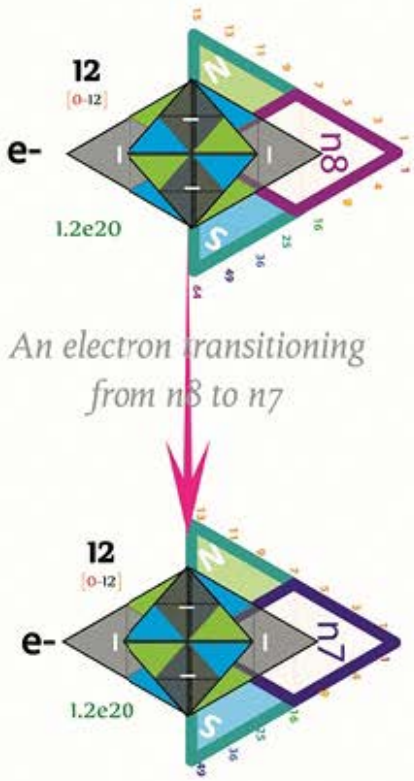

An electron transitioning from n8 to n7

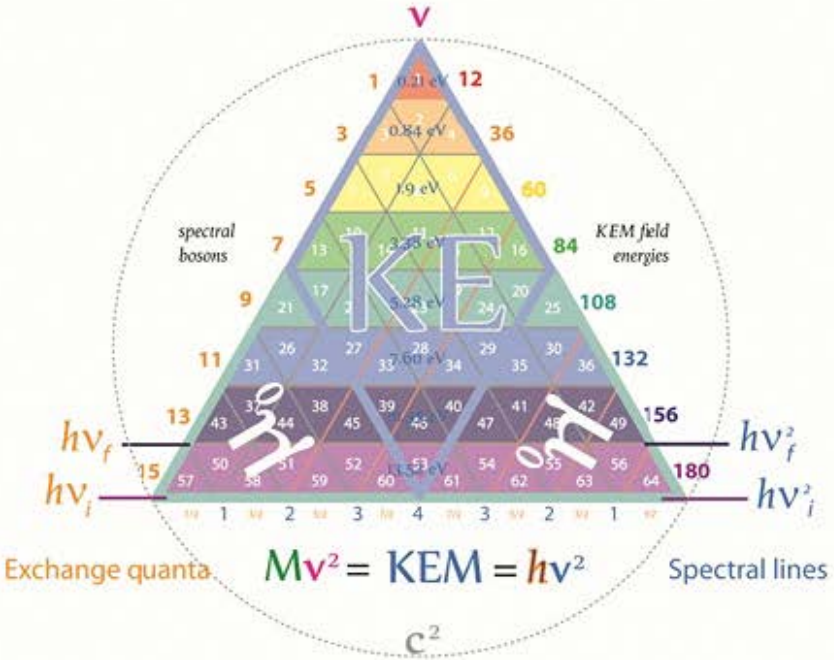

$$E = hf$$

As the 3D rest Matter of any particle in motion is Lorentz invariant any changes in velocity-momentum produces changes to the mass-energy momenta content of the 2D KEM field
[boson changes are the difference of two squares]

Spectral line wavenumbers

Tetryonic $\left(\frac{15/49}{64}\right)$ .0047

$1/\lambda$

Rydberg $R\left(\frac{1}{49} - \frac{1}{64}\right)$ .0047

Does so by emitting Kinetic Energy quanta

λ	19,174.54158	nm
$\tilde{\nu}$	52,152.48541	m-1
f	$1.563492179 \times 10^{13}$	Hz
E	0.064693658	eV
Ω	5,748.382952	m^2/s

Which are released as photons of specific energy-momenta

of specific wavelengths (Spectral Lines)

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Wavenumbers

are the number of energy momenta wavelengths per unit distance

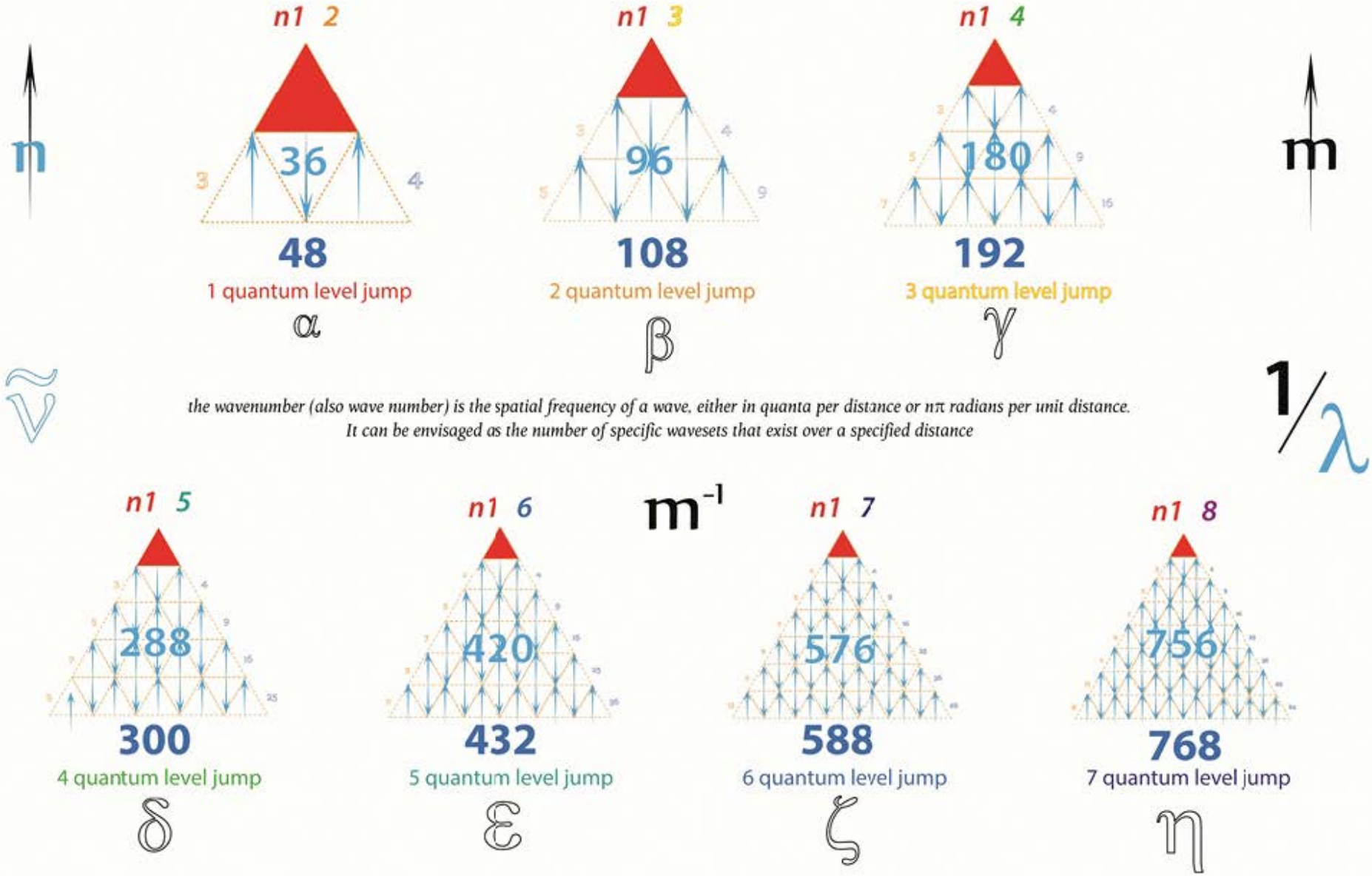

For electromagnetic radiation in vacuum, wavenumber is proportional to frequency and to photon energy

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Bosons, Photons and quantums of energy momenta

$\tilde{\nu}$ WAVENUMBERS

$E = \Sigma h\nu$

$KEM = Mv^2$

LINEAR MOMETNUM p

γ Spectral lines are produced $\Delta m\Omega v = \Delta mv = \Delta p$ by accelerating electrons a

equilateral energy momenta is the foundation of all quantum EM wave-functions

ODD distribution $2\nu = f$ **SQUARED distribution**

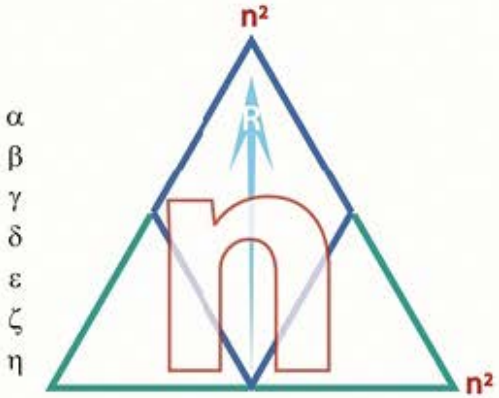

Spectral lines

Bosons

$h\nu$

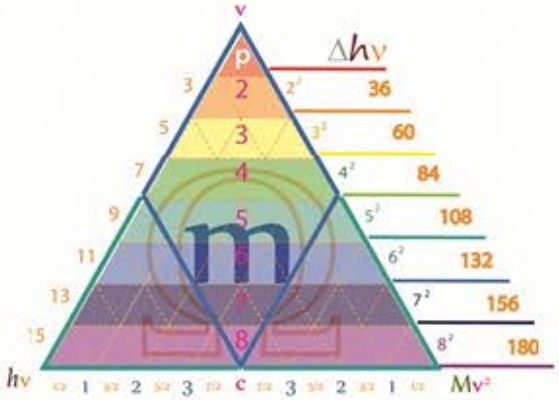

EVEN distribution

hf

Photons

Kinetic energies

$h\nu^2$

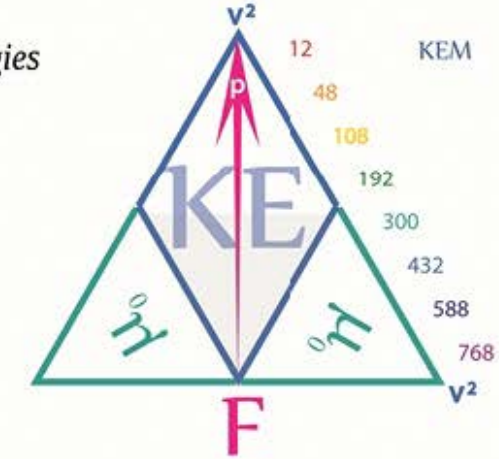

energy momenta

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Spectral Energy - Planck relationships

$$\frac{E}{v^2} = m\Omega = \frac{E}{c^2}$$

deBroglie wavelength λ

Planck quanta differential

spectral mass-energies

f Frequency

p MOMENTUM

h

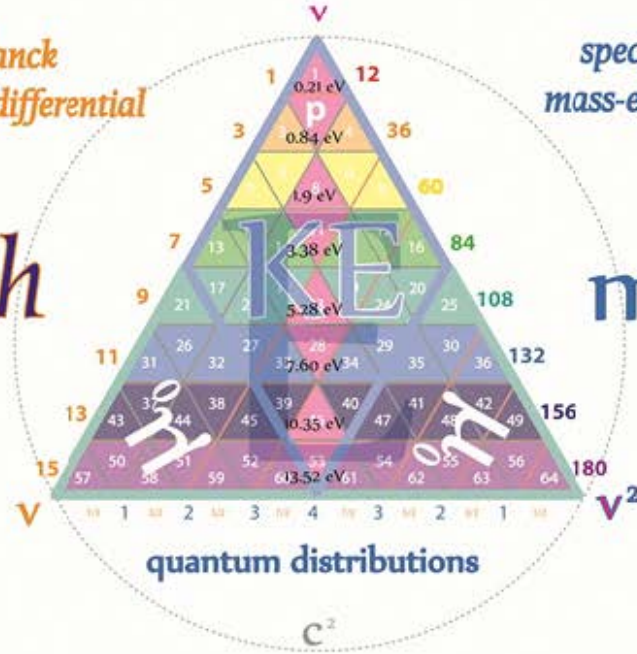

m

ENERGY E

quantum distributions

Wave number $\tilde{\nu}$

v^2 Compton Frequency

Applying mass to spectral energy relationships reveals the familiar quantum mechanical wave-particle relationships and properties

	2D waves						3D Matter	
EM wave wavelength	Ω / c	=	planck constant	h / p	linear momentum	=	$m\Omega / mc$	deBroglie wavelength
EM wavenumber	c / Ω	=	linear momentum	p / h	planck constant	=	$mc / m\Omega$	Matter waves
EM wave Frequency	c^2 / Ω	=	kinetic energy	E / h	planck constant	=	$mc^2 / m\Omega$	Compton Frequency

Thus reinforcing the geometric role of quantised angular momenta in Planck's constant

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White Light

White light is radiated by our SUN and all the stars throughout the Universe.
In fact, most of the energy radiated by the sun is within the visible spectrum, which is most likely why we see this range.

Incandescence is the greatest known generator of white light. The verb incandesce means to glow white. This is also referred to as black-body radiation.

The color of a black body object at high temperatures causes it to glow, and the waves emitted include visible light.
In addition to the sun and common light bulb, molten materials such as metal or glass also glow incandescently.

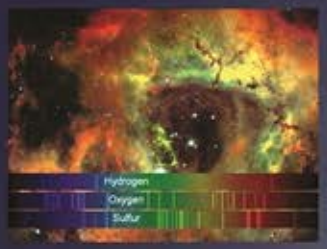

Spectroscopy

Planck's Heat Law

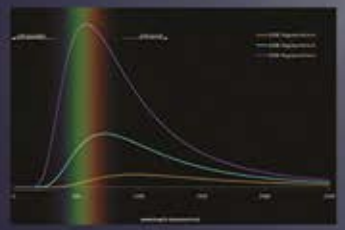

Most light sources are thermal, meaning the type of radiation they emit is a characteristic of the source's temperature.

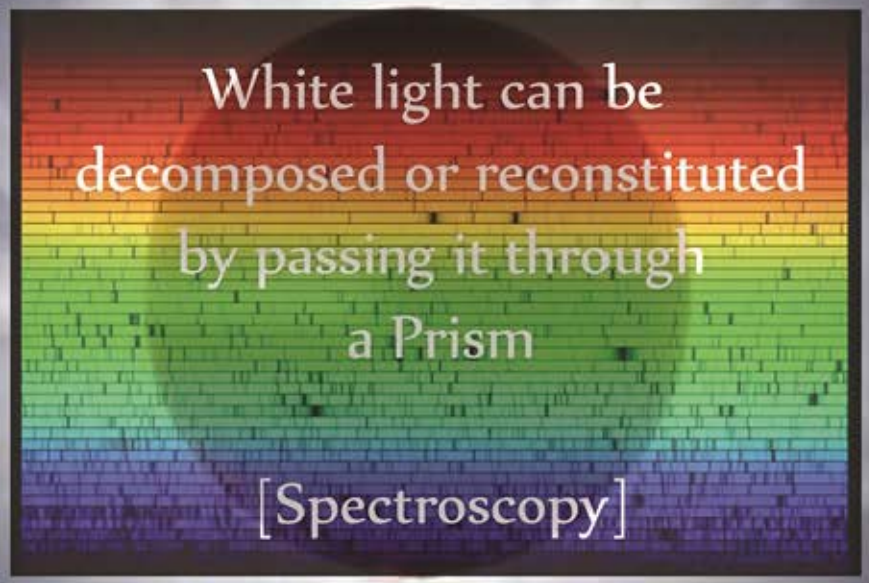

White light is comprised of many photons of varying frequencies and wavelengths

Each colour of light has a specific frequency and wavelength

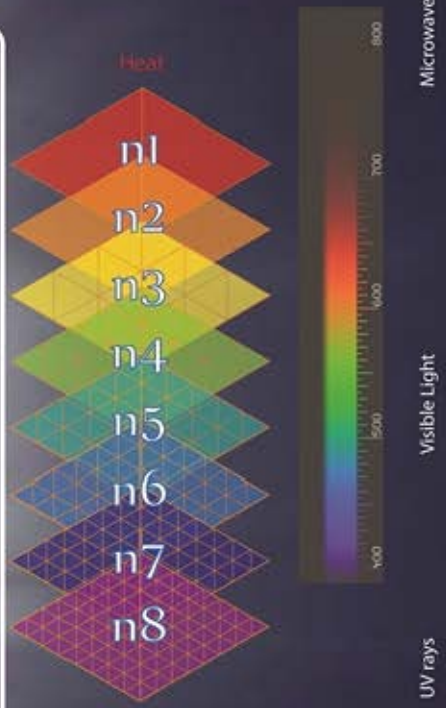

Until Newton's work proved otherwise, most scientists believed that white was the fundamental color of light; and that other colors were formed only by adding something to light. Newton demonstrated this was not true by passing white light through a prism, then through another prism. If the colors were added by the prism, the second prism should have added further colors to the single-colored beam. Since the single-colored beam remained a single color, Newton concluded that the prism merely separated the colors already present in the light.

White light is the result of superpositioning of the visible colors [varying frequencies] of EM waves

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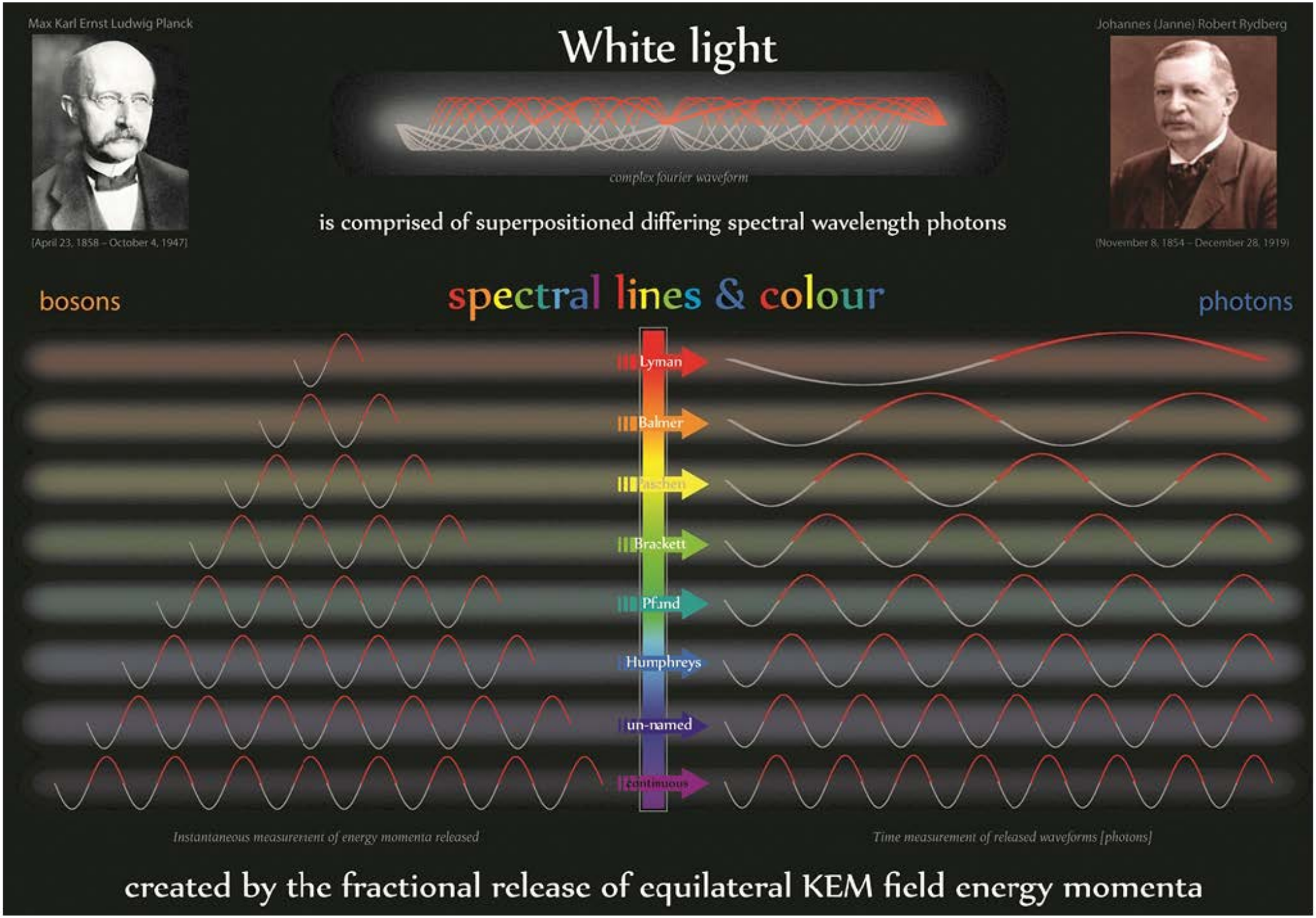

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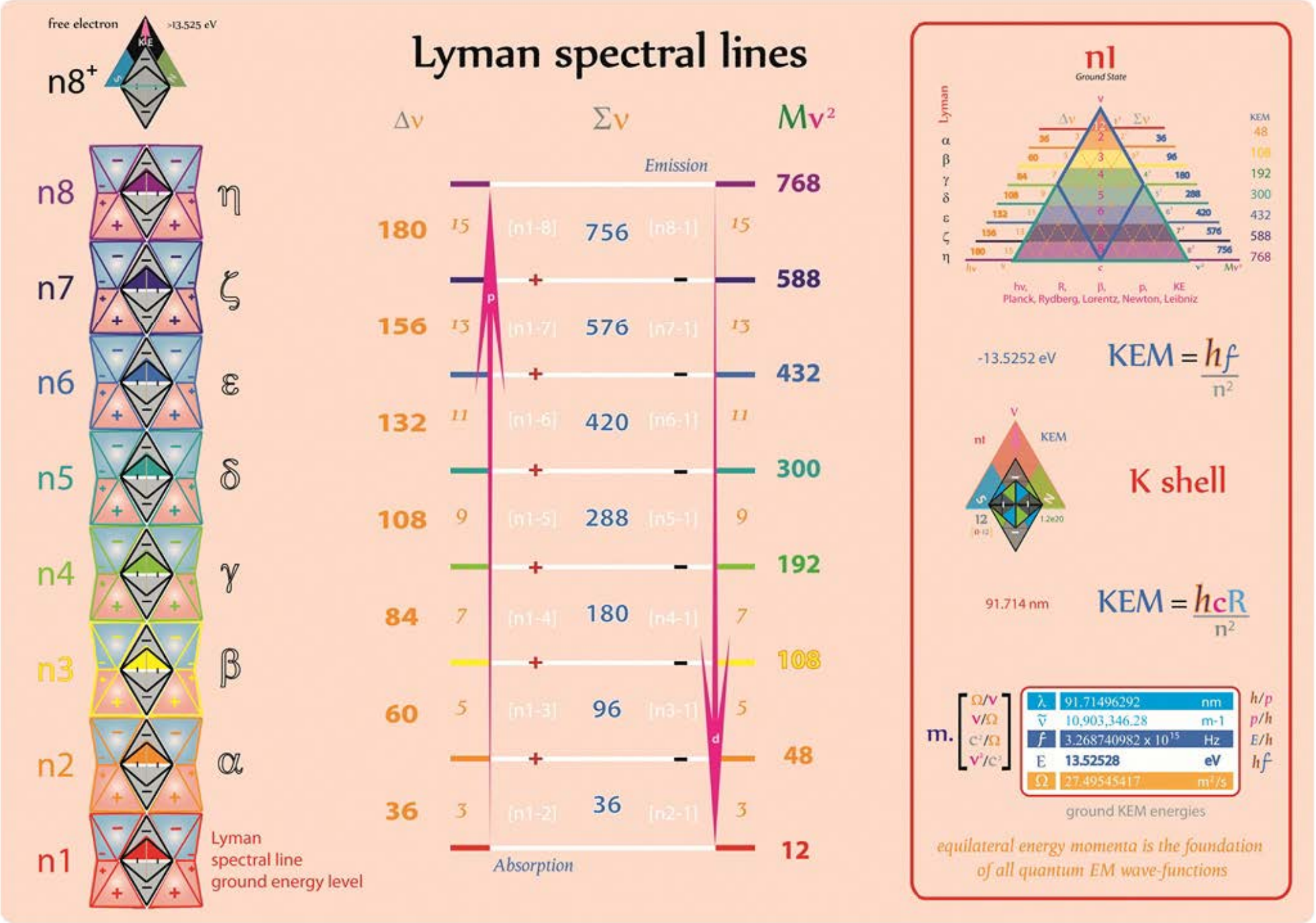

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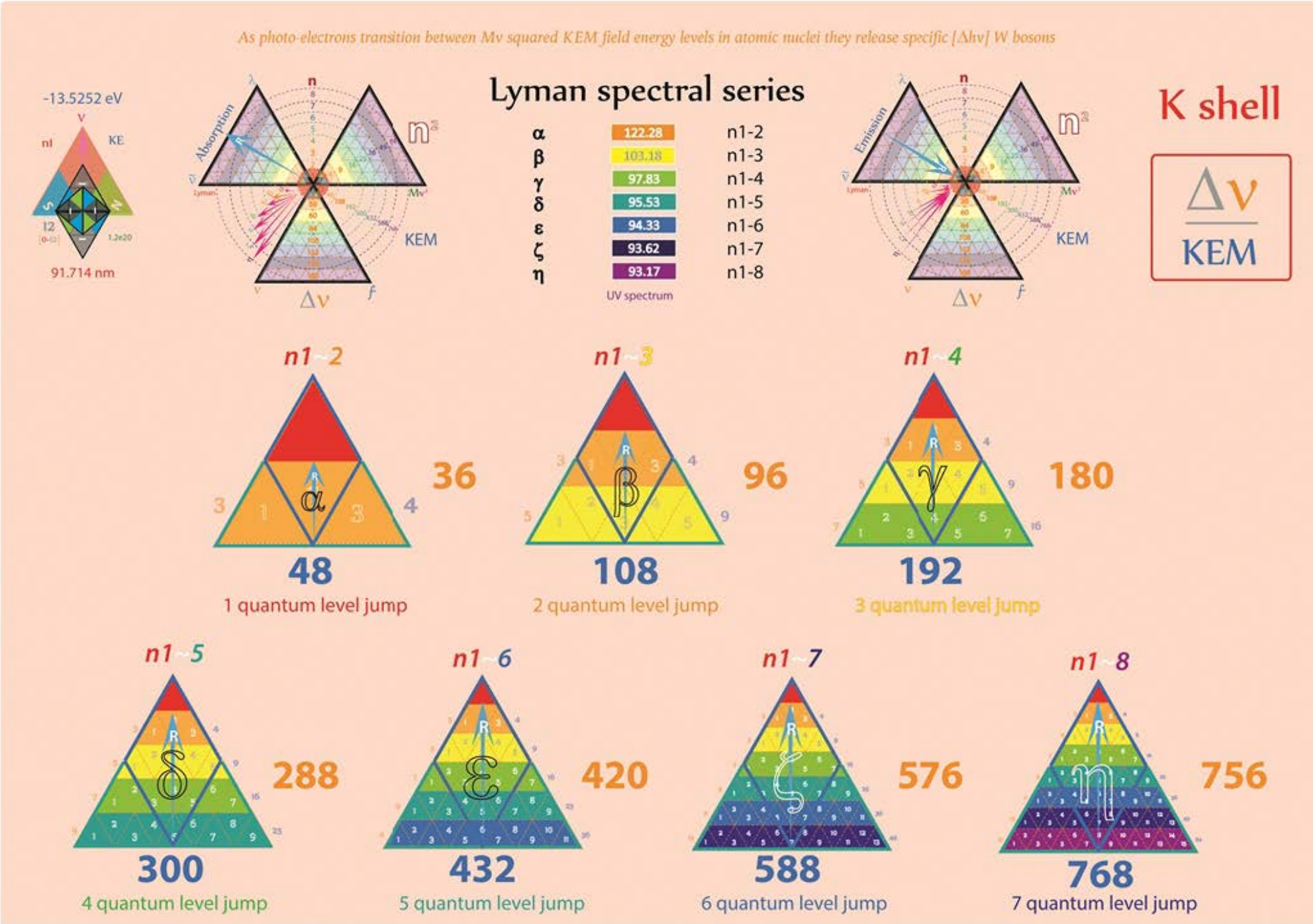

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Lyman series energy momenta

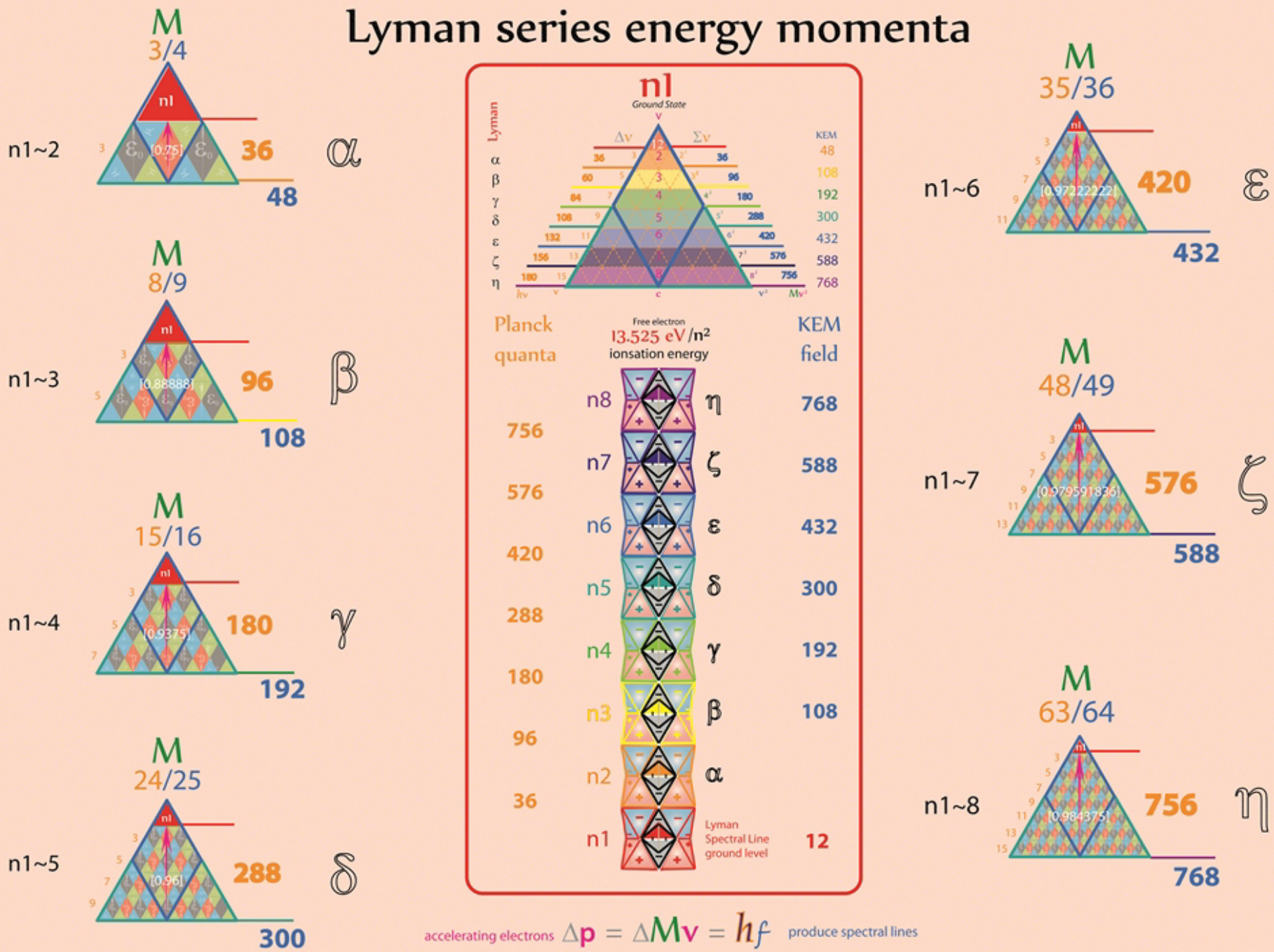

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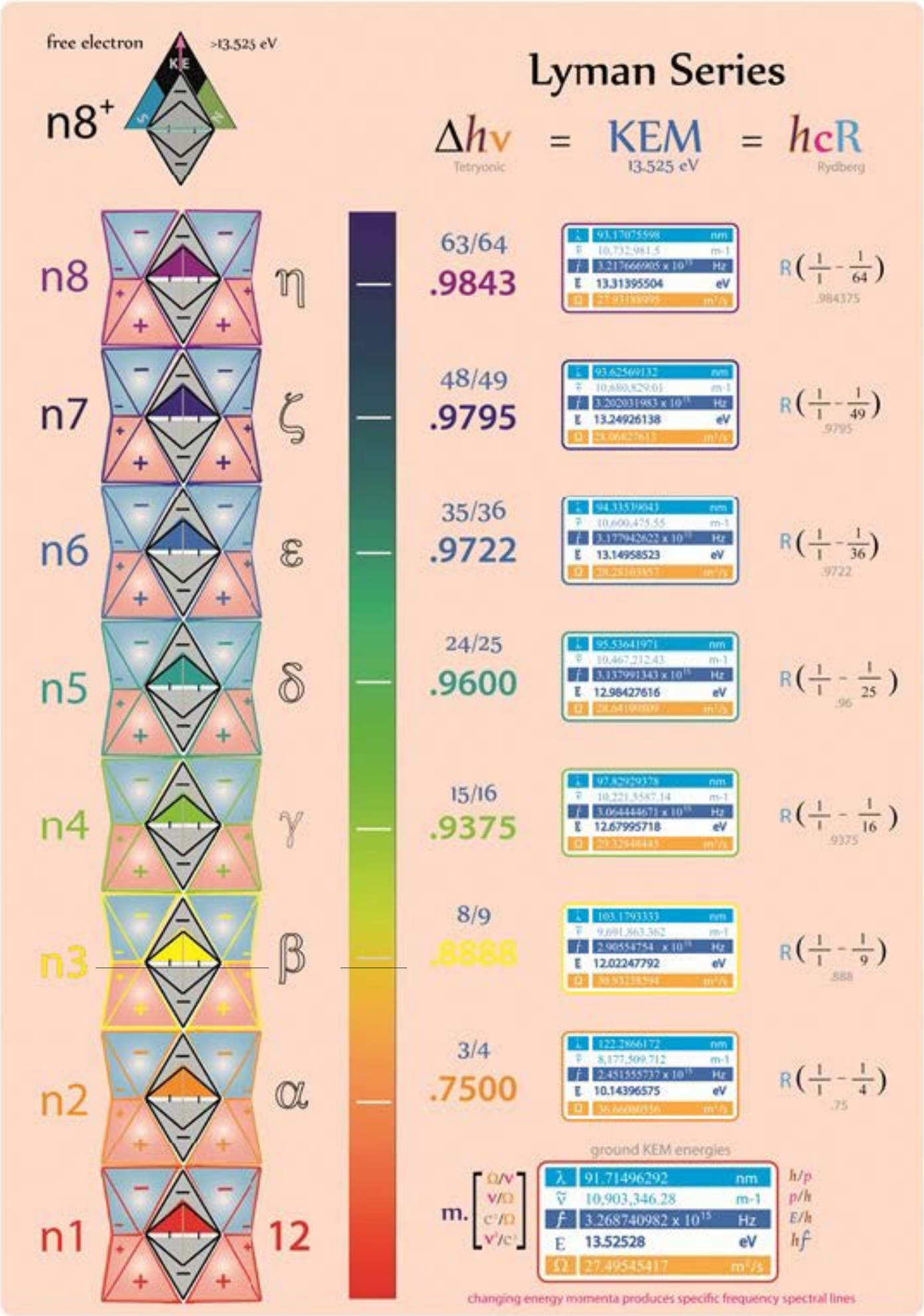

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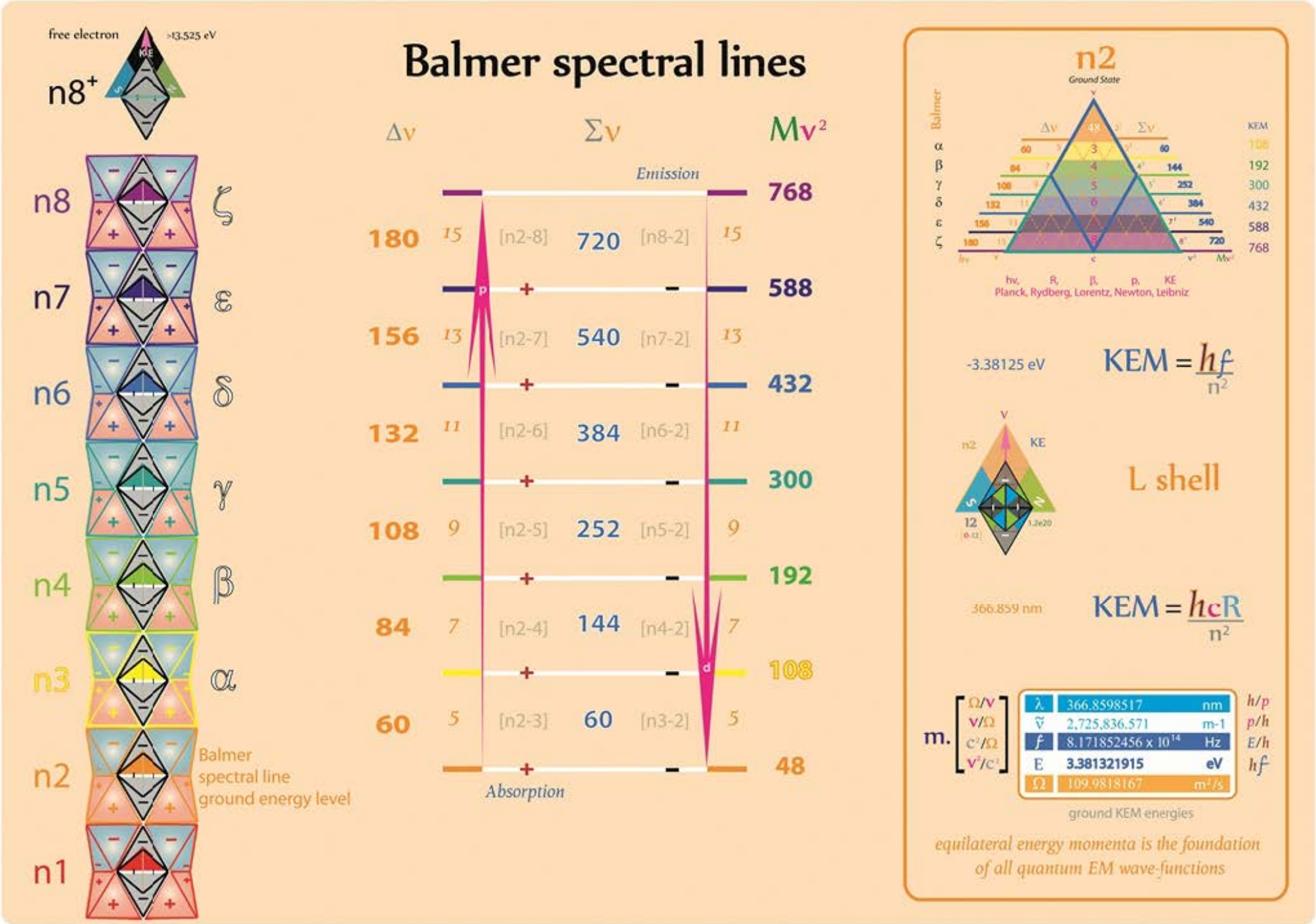

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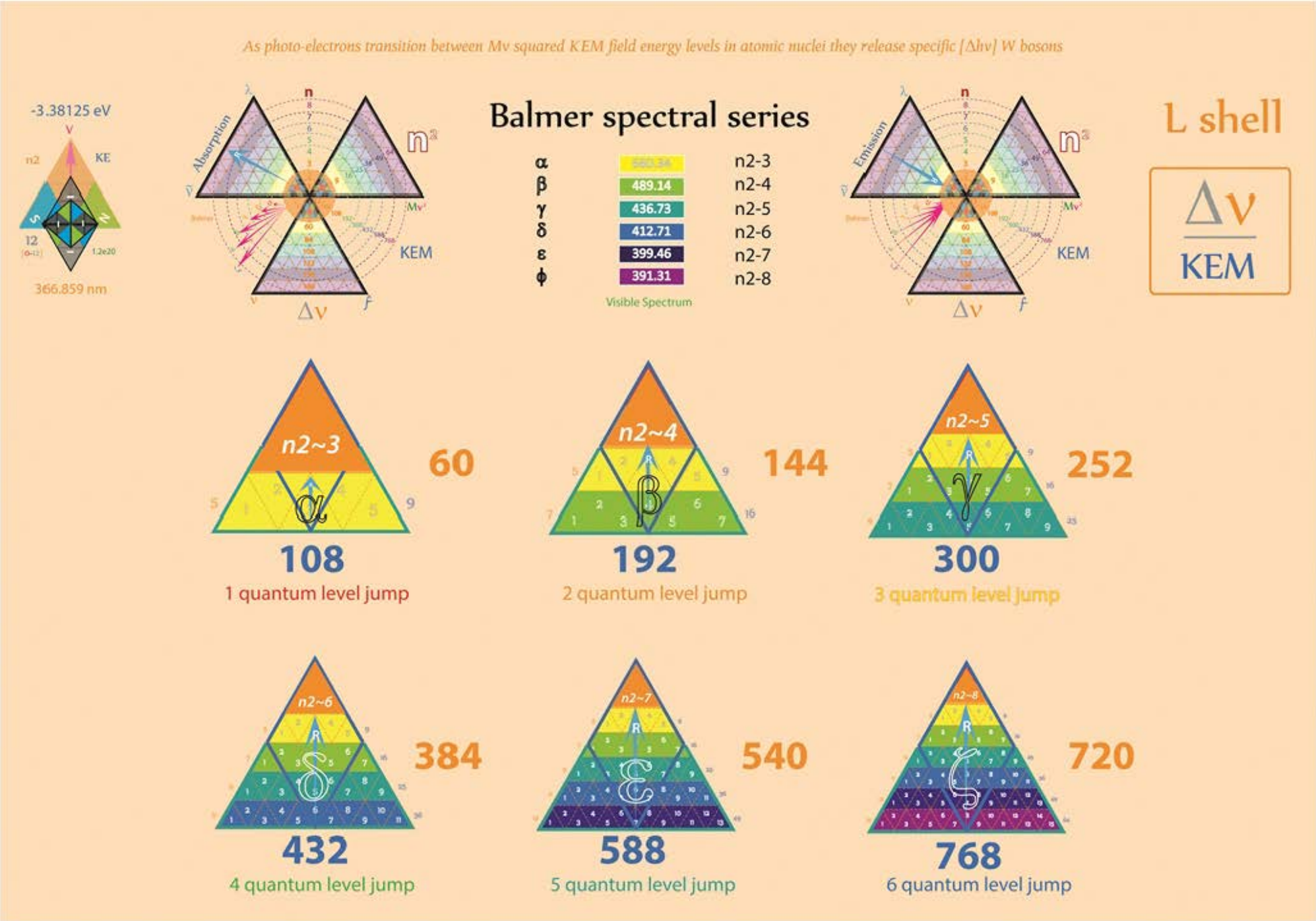

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Balmer series energy momenta

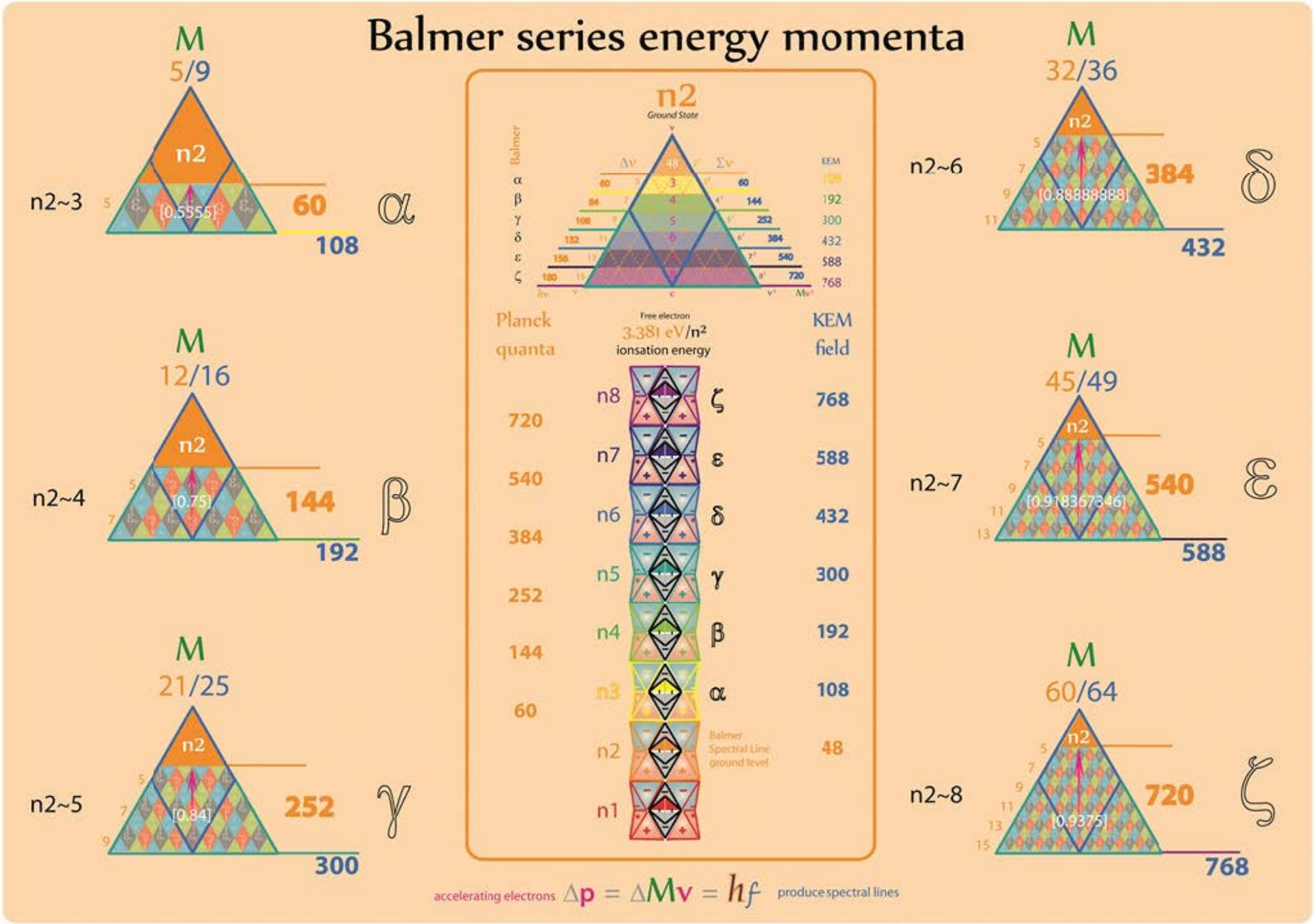

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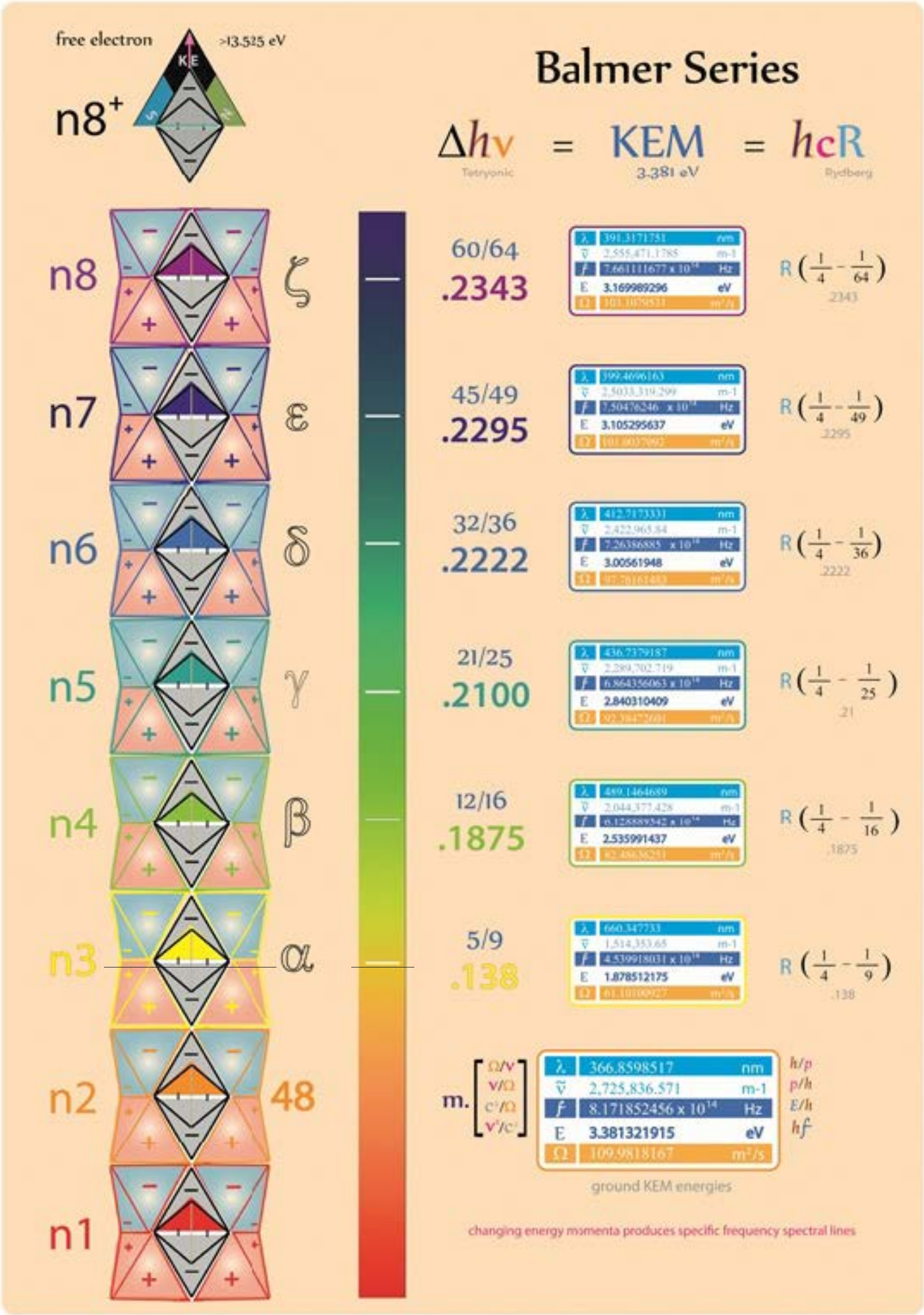

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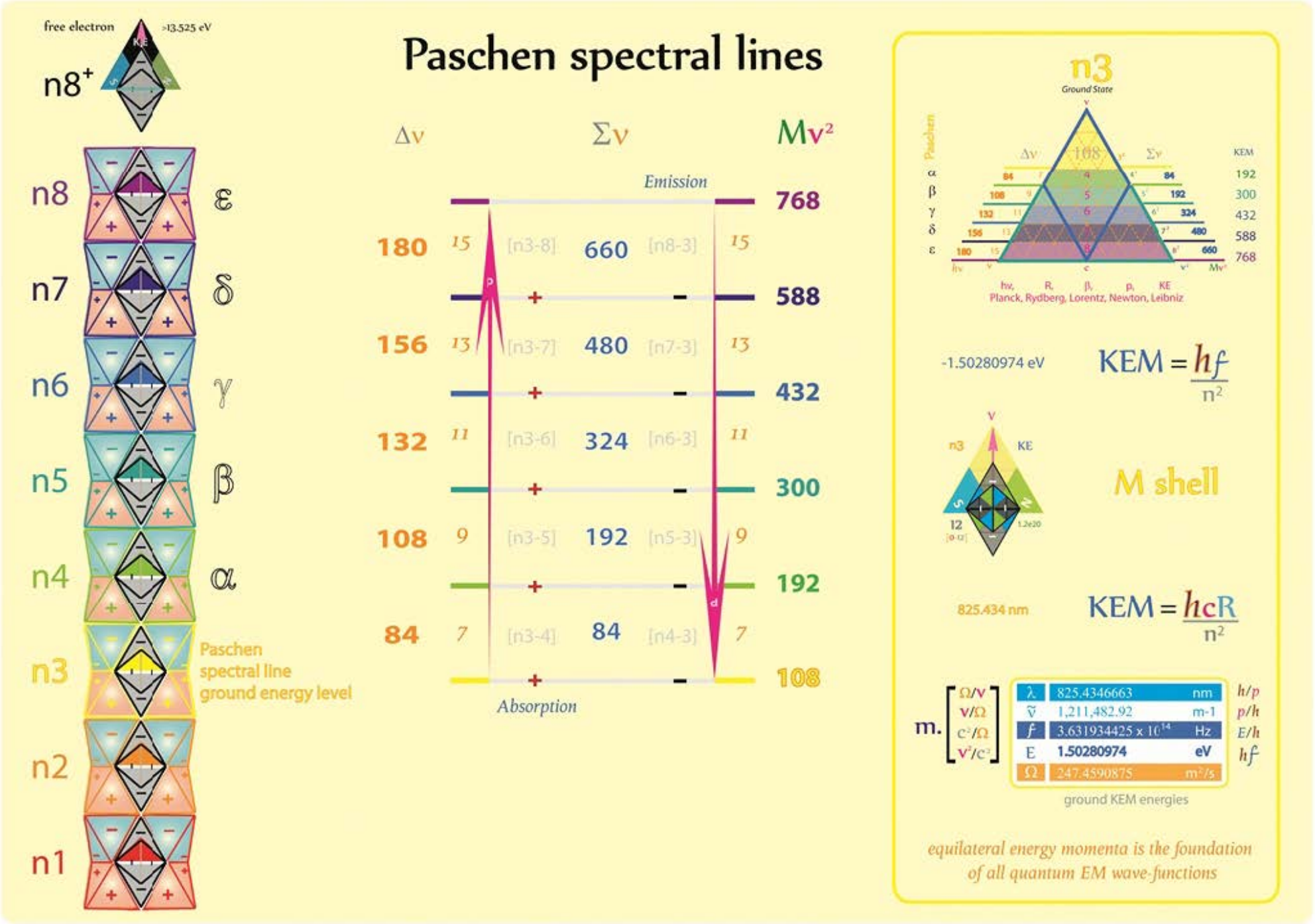

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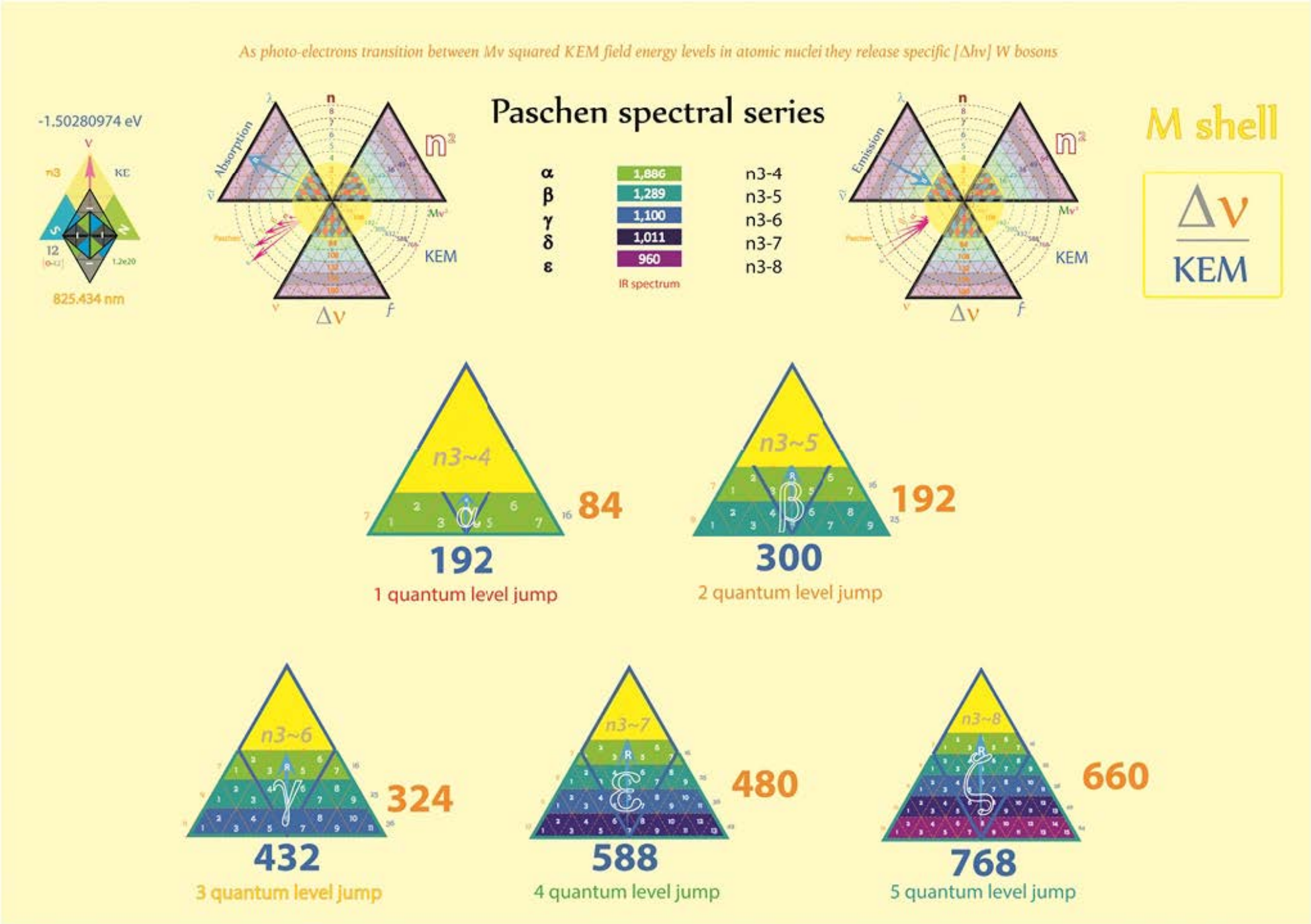

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Paschen series energy momenta

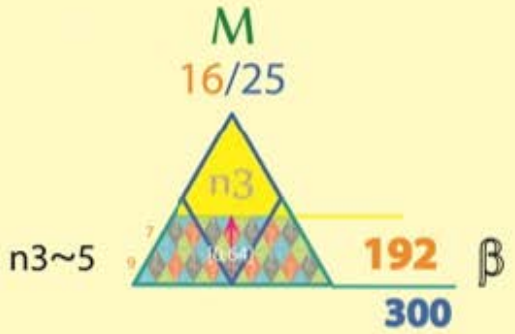

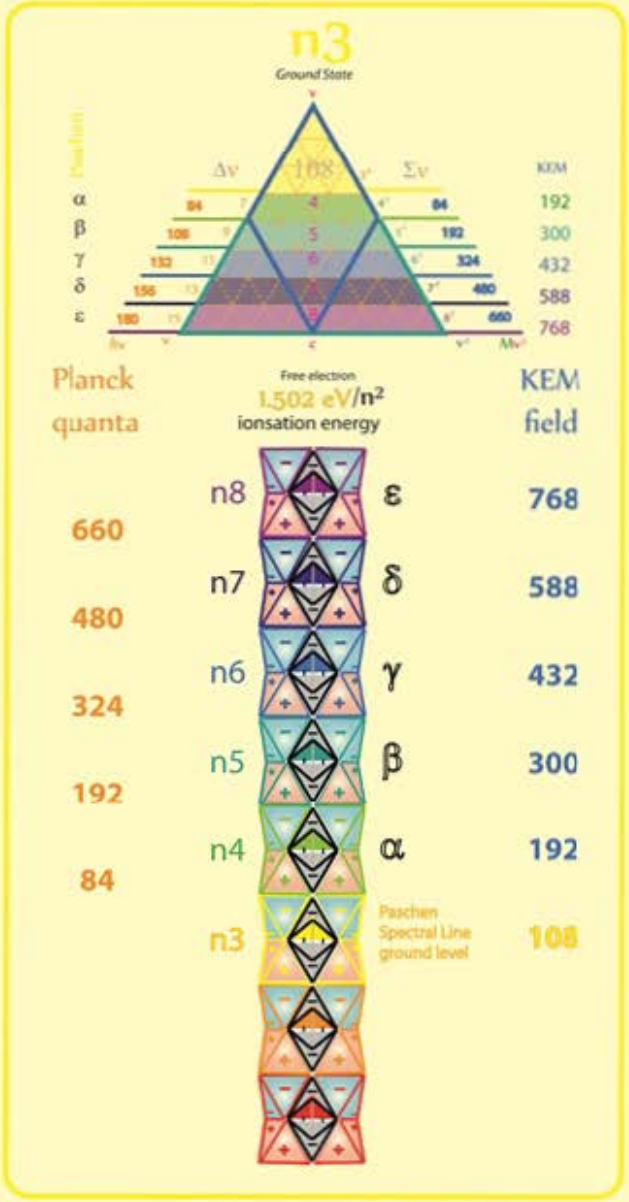

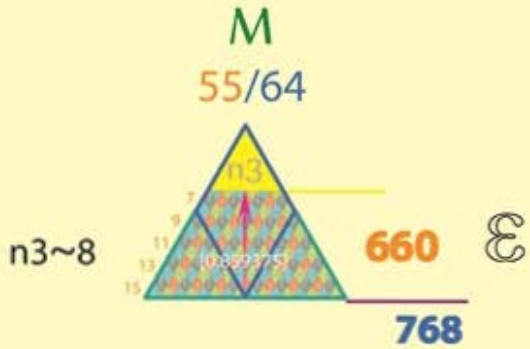

accelerating electrons $\Delta p = \Delta M v = hf$ produce spectral lines

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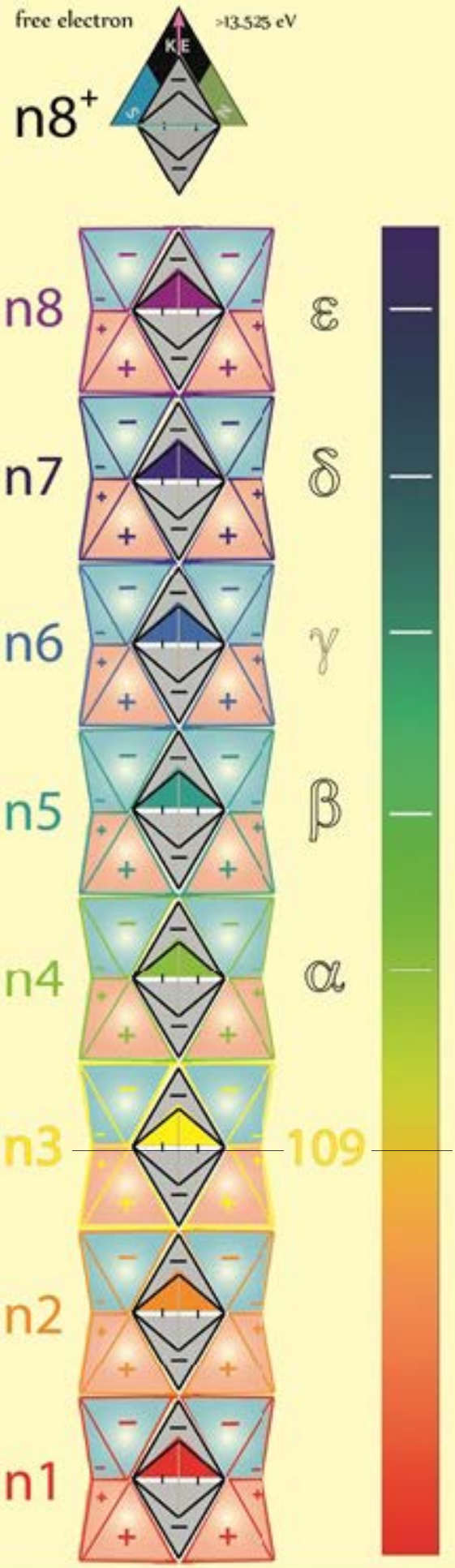

Paschen Series

$$\Delta h\nu = KEM = hcR$$

Tetryonic — 1.502 eV — Rydberg

55/64 .0954	λ	960.5057935	nm		$R\left(\frac{1}{9}-\frac{1}{64}\right)$ .09548
	ν̃	1,041,118.135	m-1		
	f	3.121193646 x 10^{14}	Hz		
	E	1.29147712	eV		
	Ω	287.9523928	m²/s		
40/49 .0907	λ	1,011.157466	nm		$R\left(\frac{1}{9}-\frac{1}{49}\right)$ .0907
	ν̃	988,965.6492	m-1		
	f	2.9464844428 x 10^{14}	Hz		
	E	1.226783461	eV		
	Ω	303.1373822	m²/s		
27/36 .8033	λ	1,100.579555	nm		$R\left(\frac{1}{9}-\frac{1}{36}\right)$ .0833
	ν̃	908,612.1902	m-1		
	f	2.723950819 x 10^{14}	Hz		
	E	1.127107305	eV		
	Ω	329.94545	m²/s		
16/25 .0711	λ	1,289.741666	nm		$R\left(\frac{1}{9}-\frac{1}{25}\right)$ .0711
	ν̃	775,349.069	m-1		
	f	2.324438032 x 10^{14}	Hz		
	E	0.961798233	eV		
	Ω	386.6548243	m²/s		
7/16 .0486	λ	1,886.707809	nm		$R\left(\frac{1}{9}-\frac{1}{16}\right)$ .0486
	ν̃	530,023.7776	m-1		
	f	1.588971311 x 10^{14}	Hz		
	E	0.657479261	eV		
	Ω	565.6207715	m²/s		
m. [Ω/v, v/Ω, c²/Ω, v²/c²]	λ	825.4346663	nm		h/p, p/h, E/h, hf
	ν̃	1,211,482.92	m-1		
	f	3.631934425 x 10^{14}	Hz		
	E	1.50280974	eV		
	Ω	247.4590875	m²/s		

ground KEM energies

changing energy momenta produces specific frequency spectral lines

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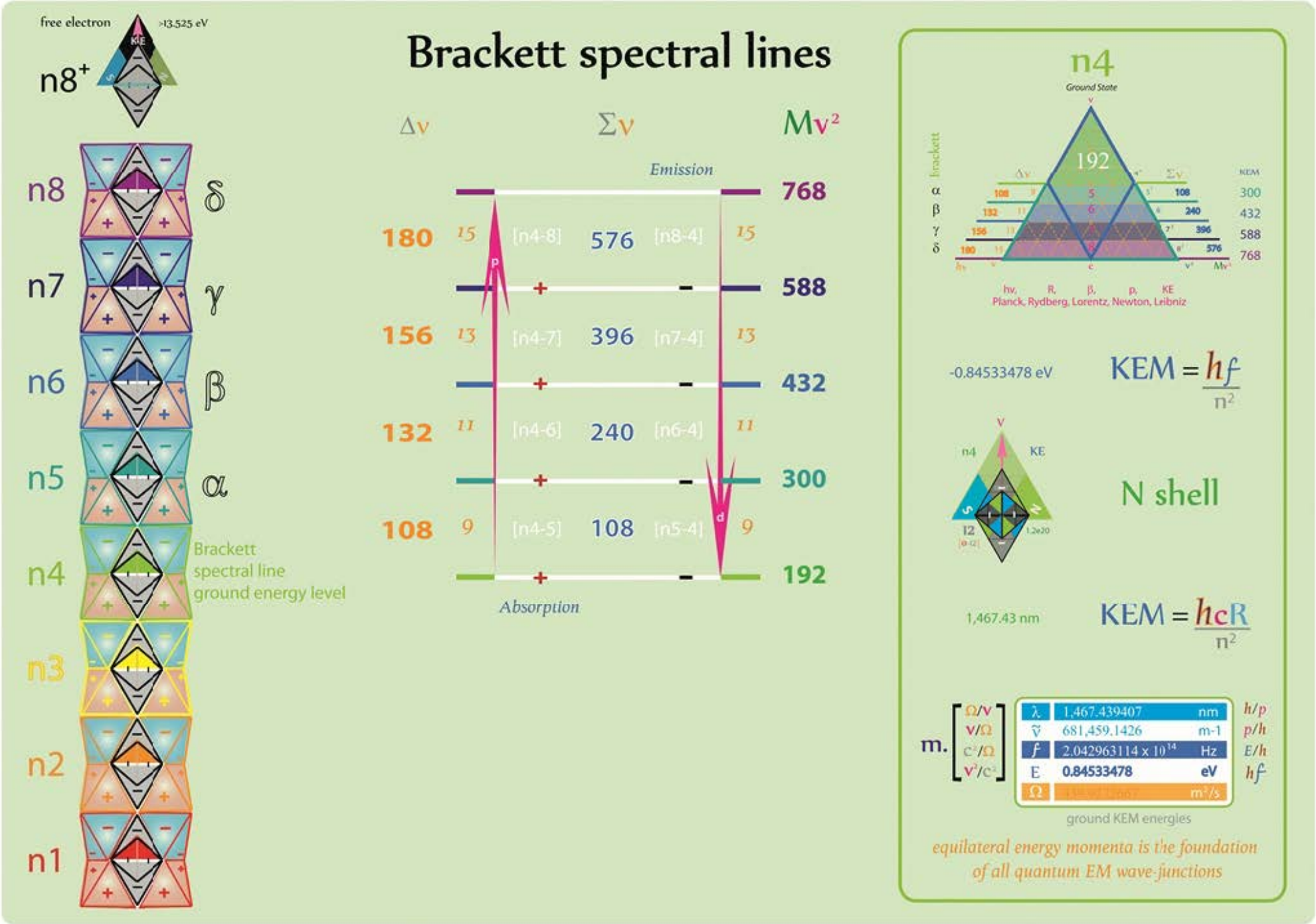

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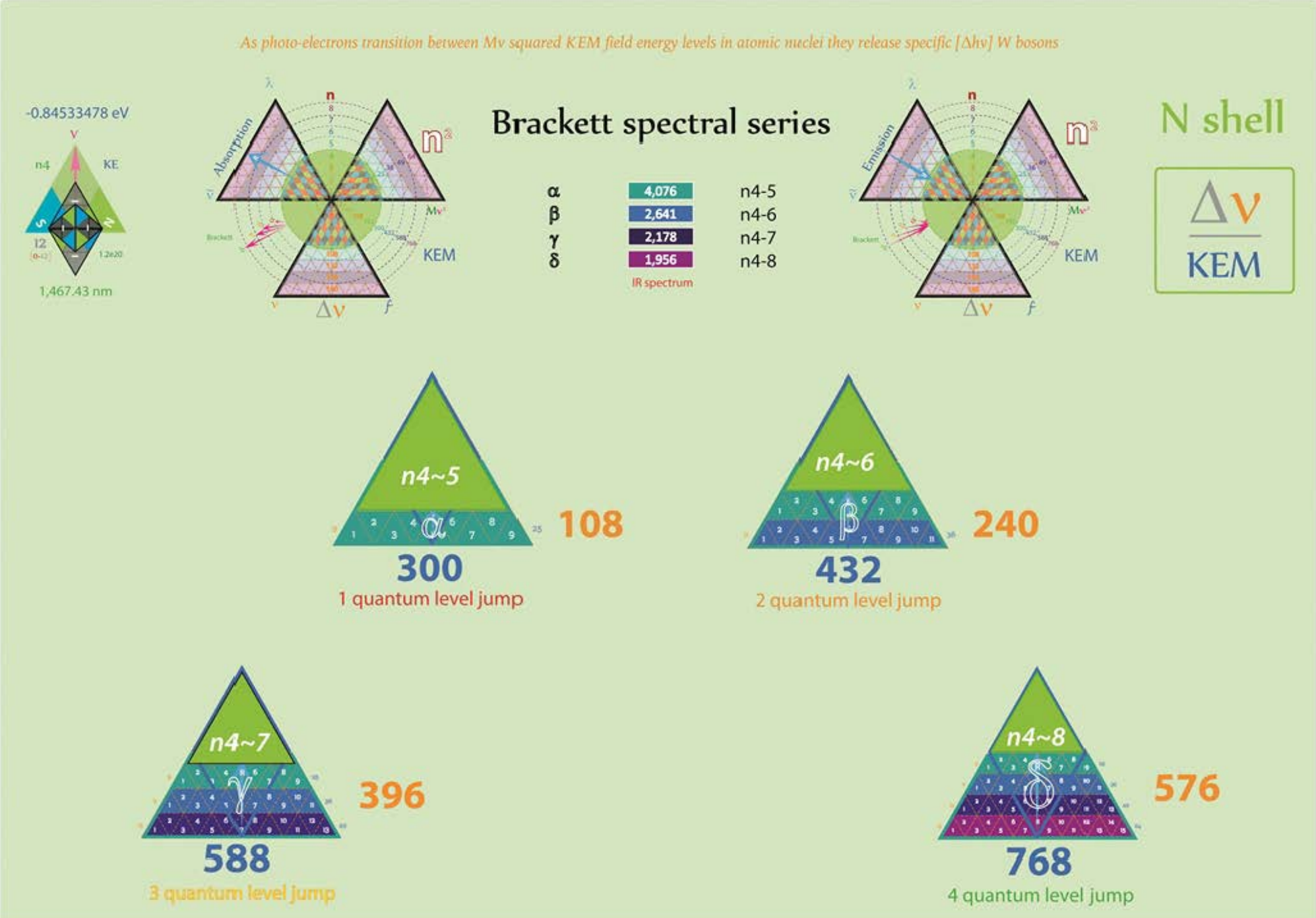

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Brackett series energy momenta

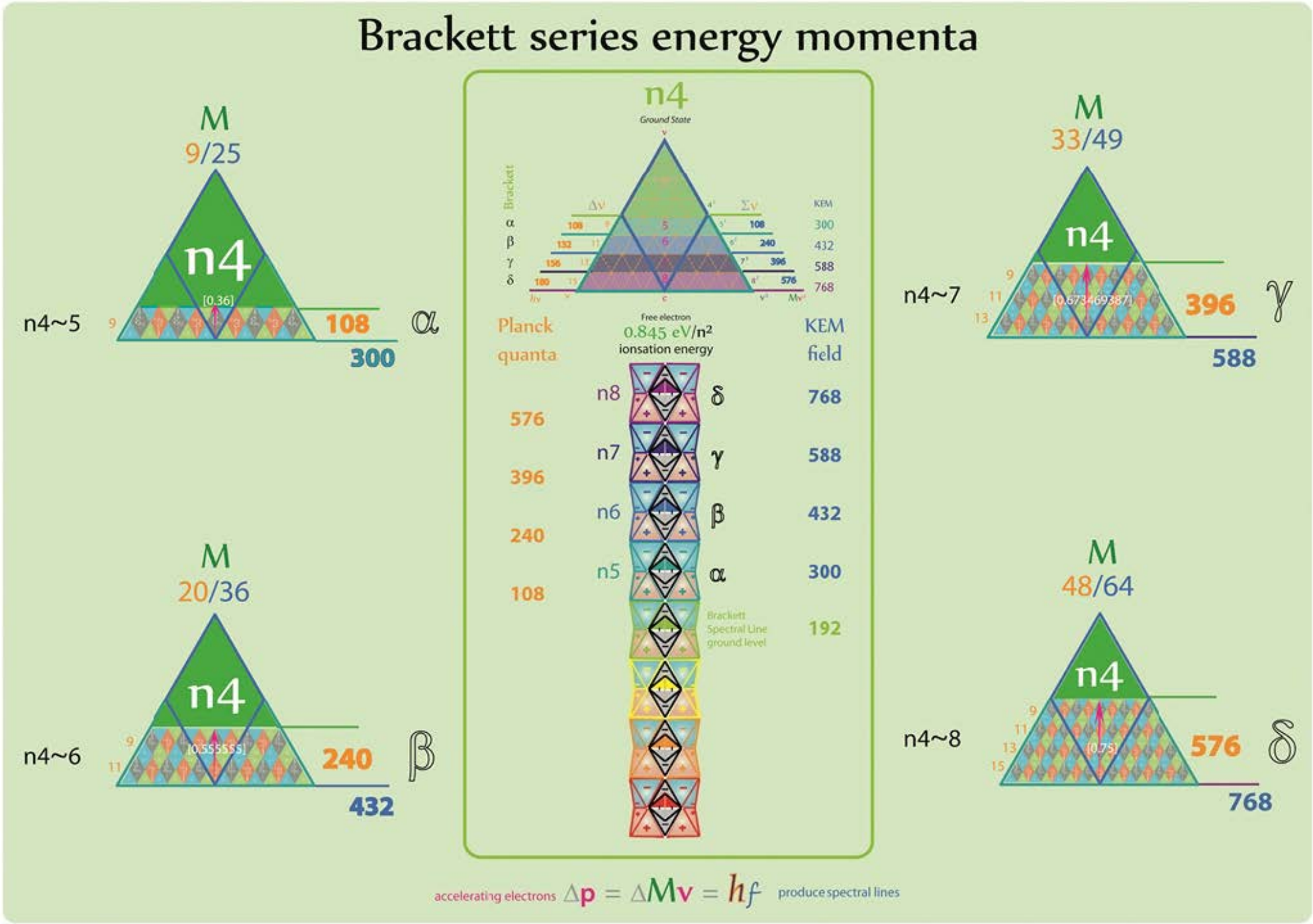

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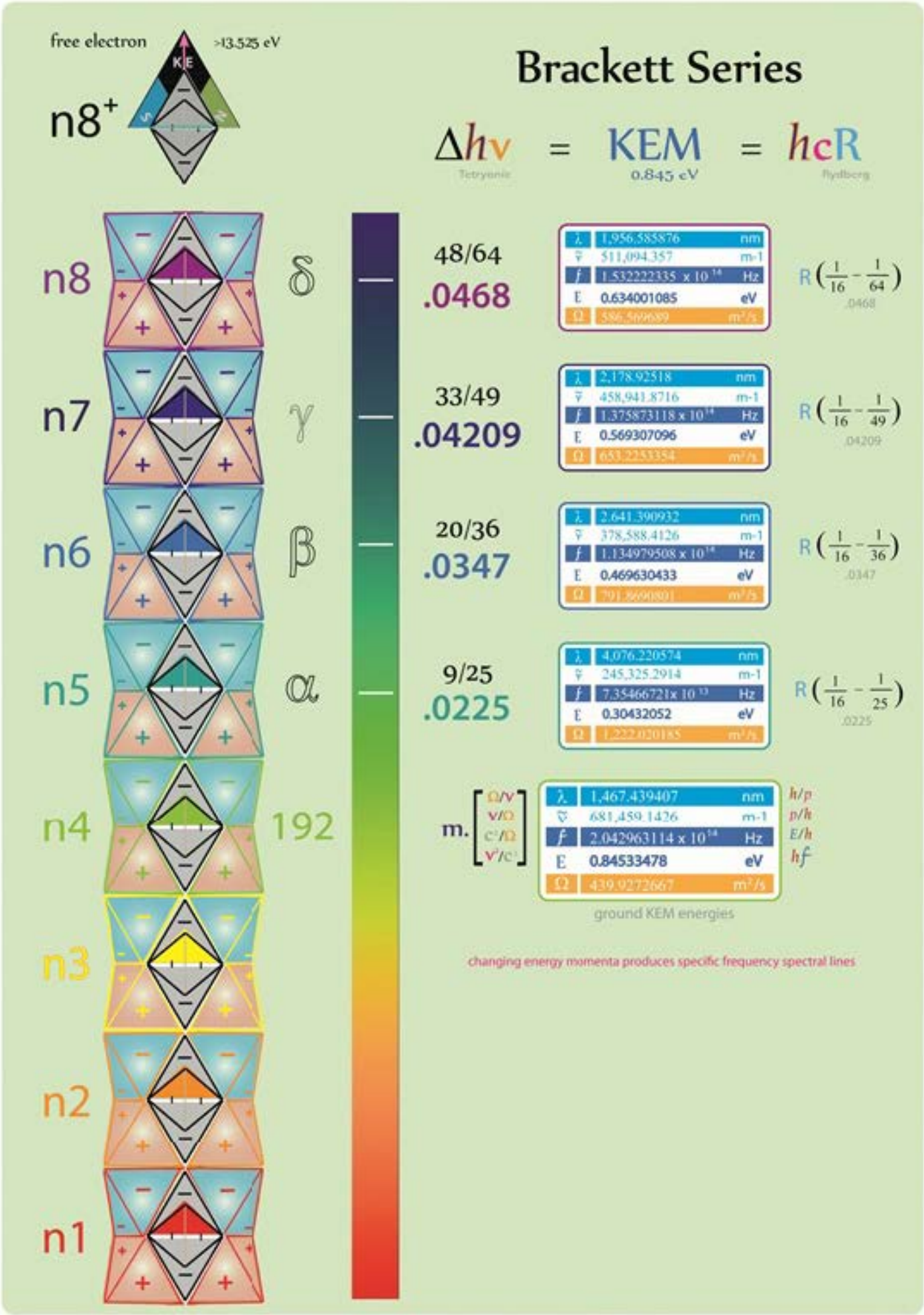

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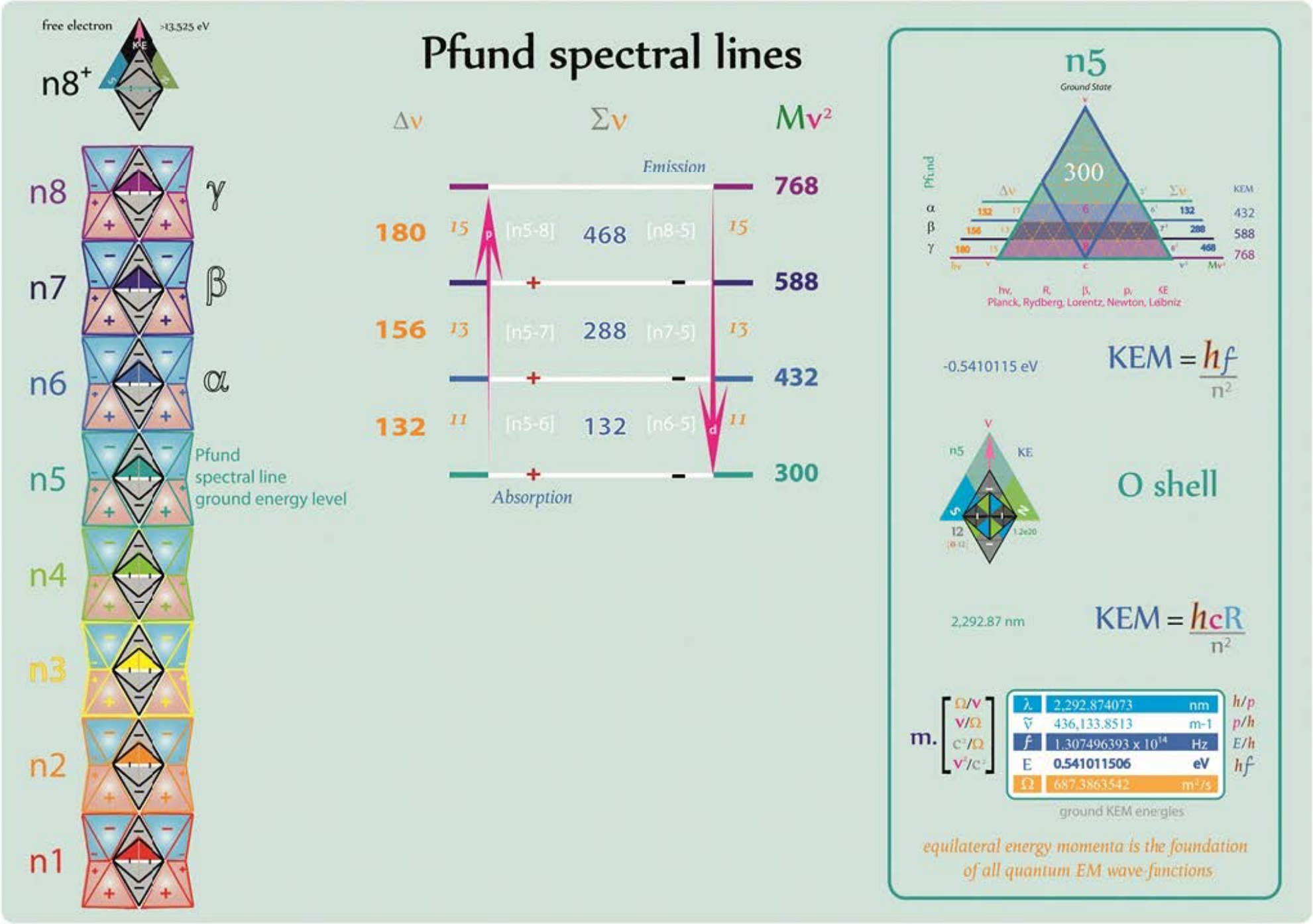

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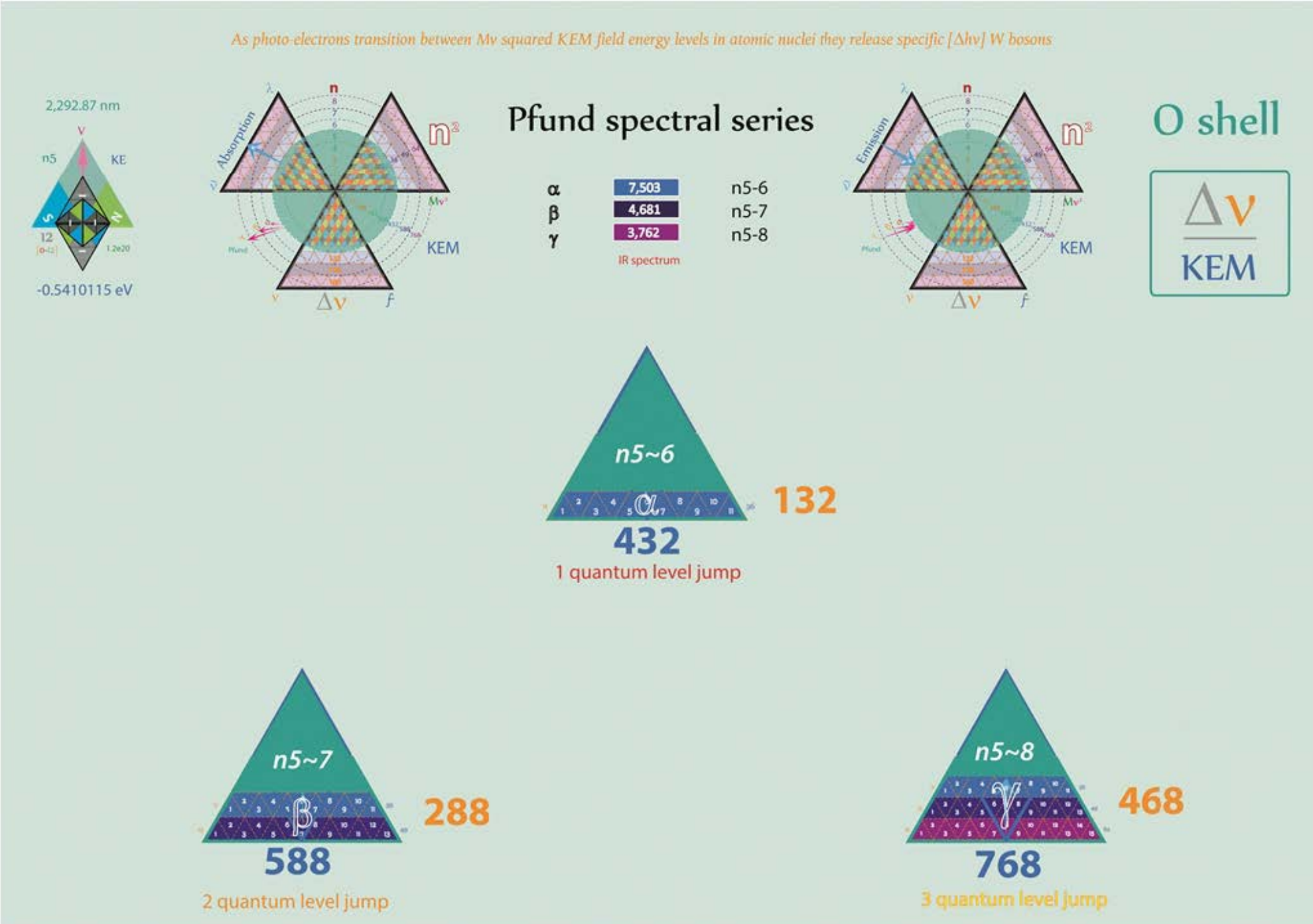

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Pfund series energy momenta

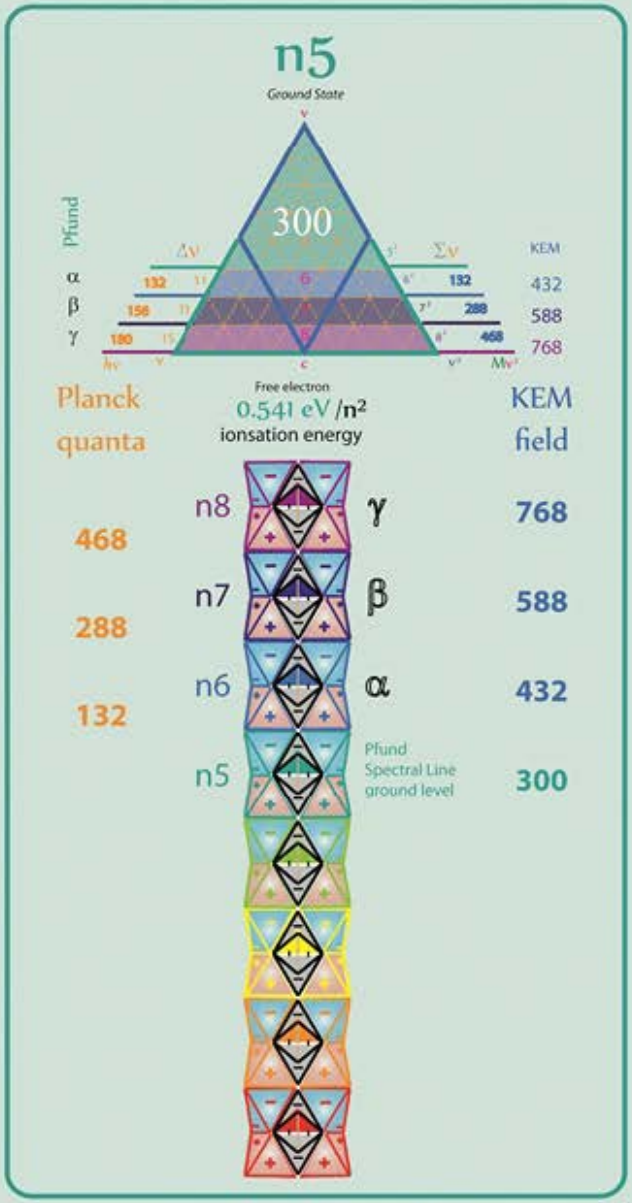

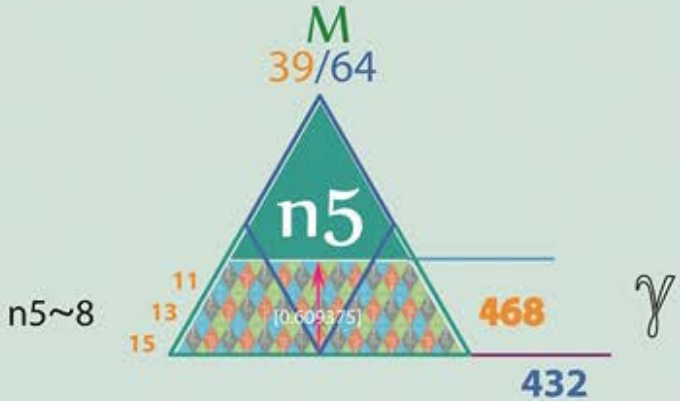

accelerating electrons $\Delta p = \Delta M v = hf$ produce spectral lines

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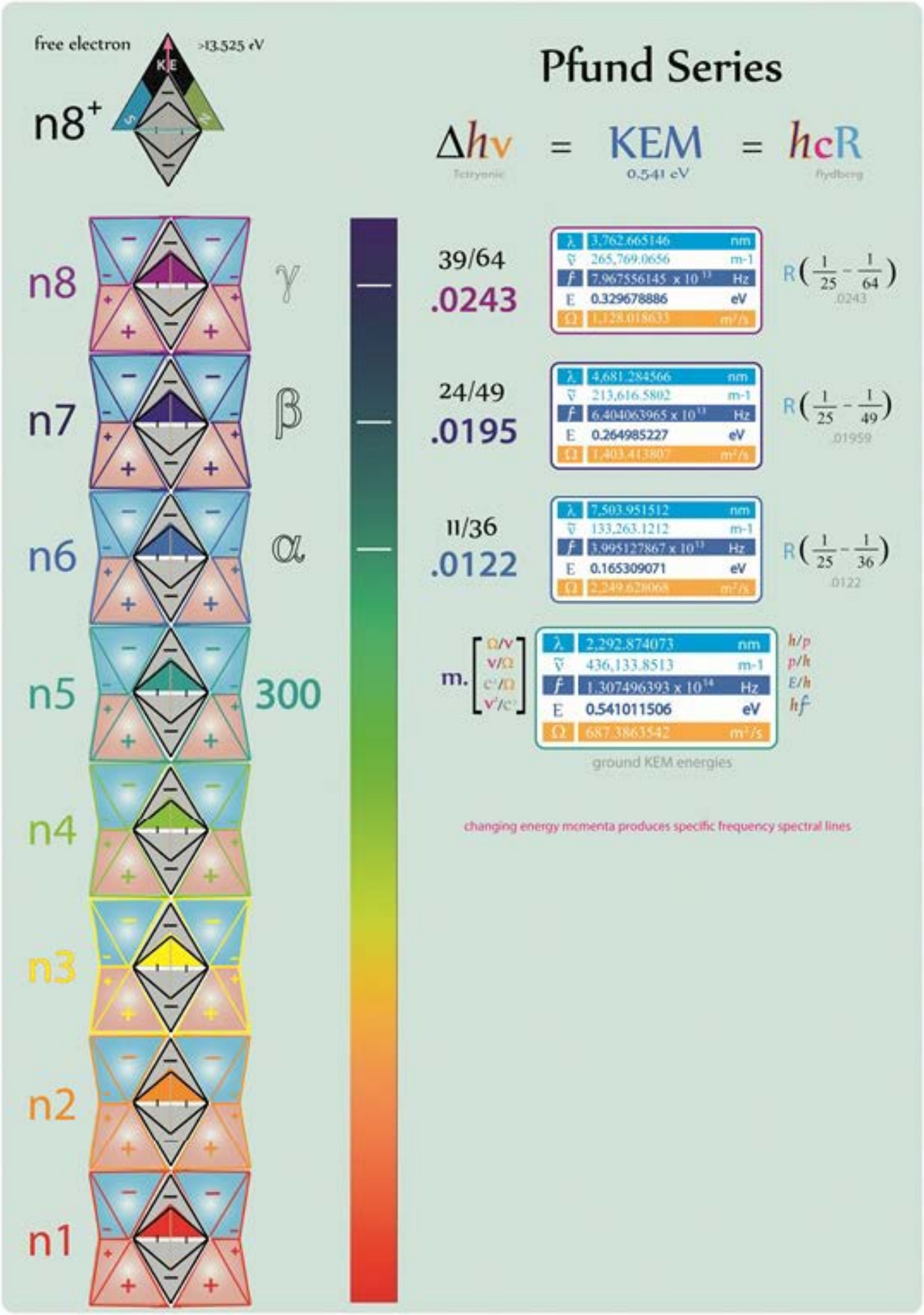

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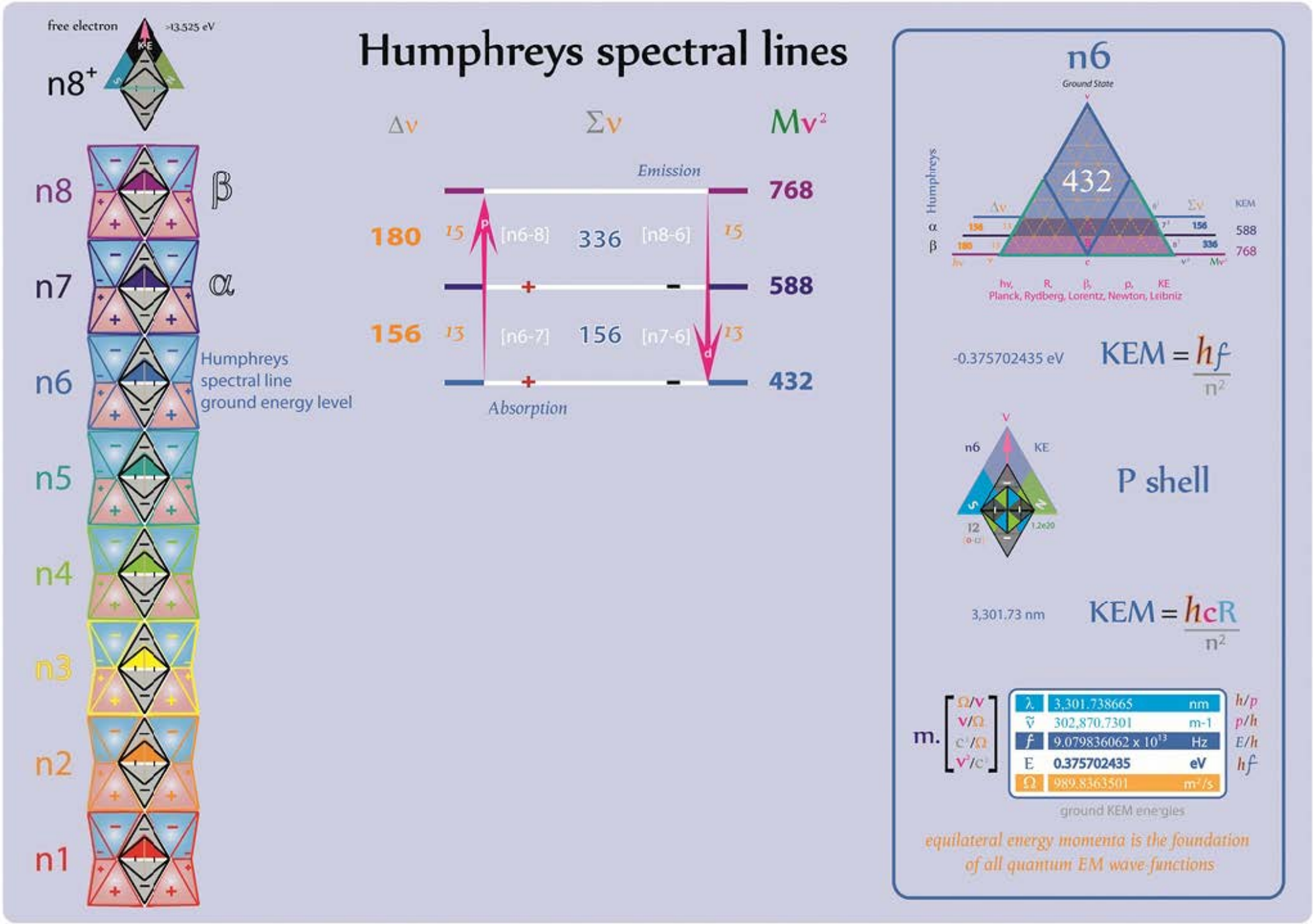

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As photo-electrons transition between Mv squared KEM field energy levels in atomic nuclei they release specific [Δhν] W bosons

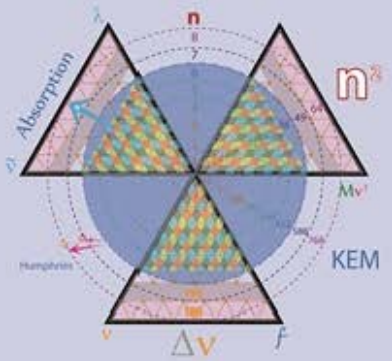

Humphries spectral series

α	12,445	n6-7
β	7,546	n6-8

IR spectrum

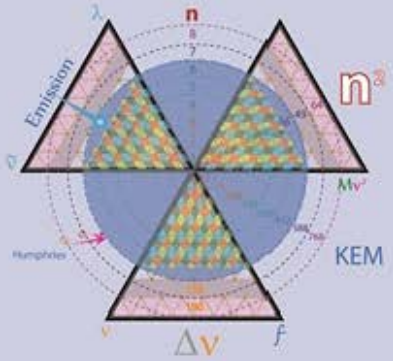

P shell

$$\frac{\Delta\nu}{KEM}$$

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Humphreys series energy momenta

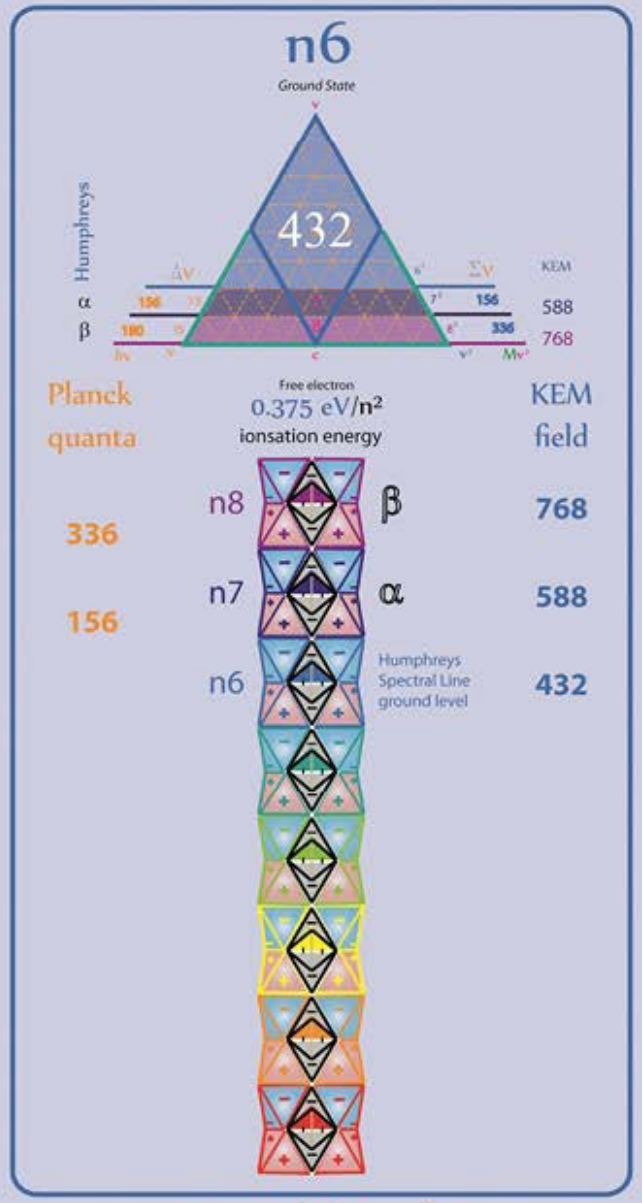

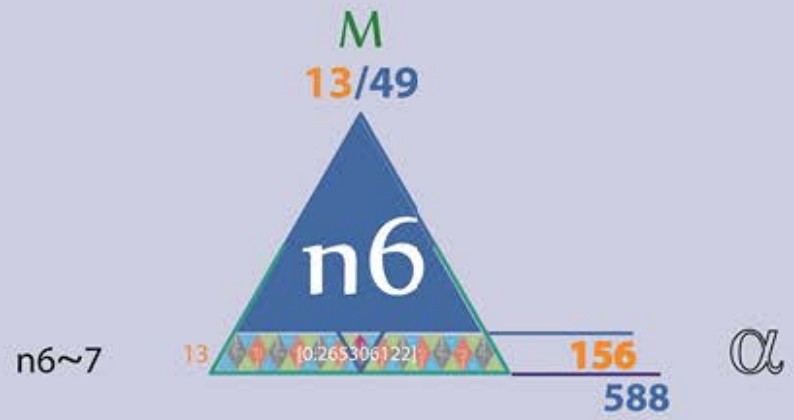

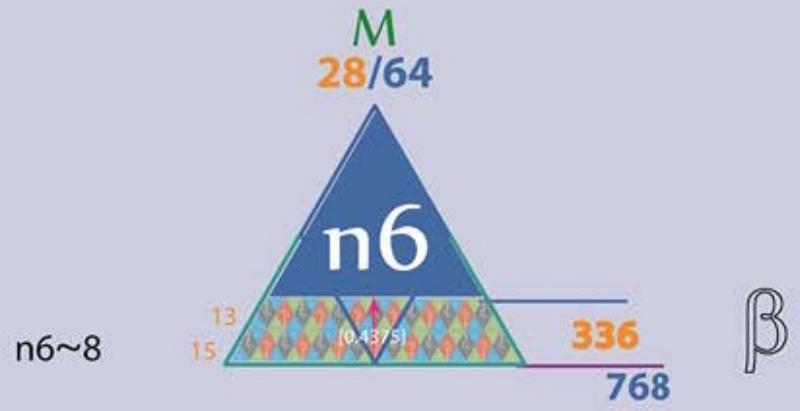

accelerating electrons $\Delta p = \Delta M v = hf$ produce spectral lines

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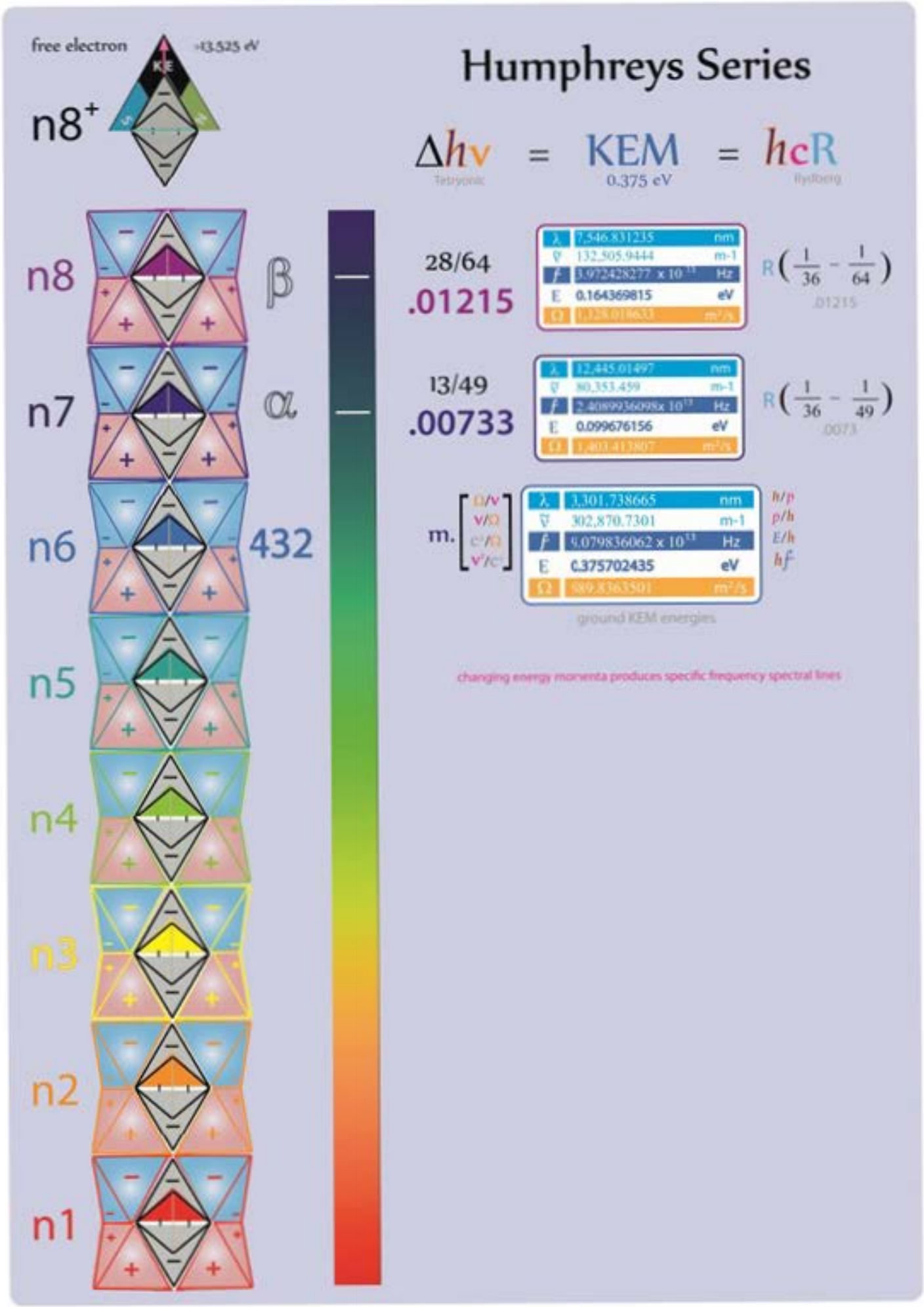

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Un-named spectral line

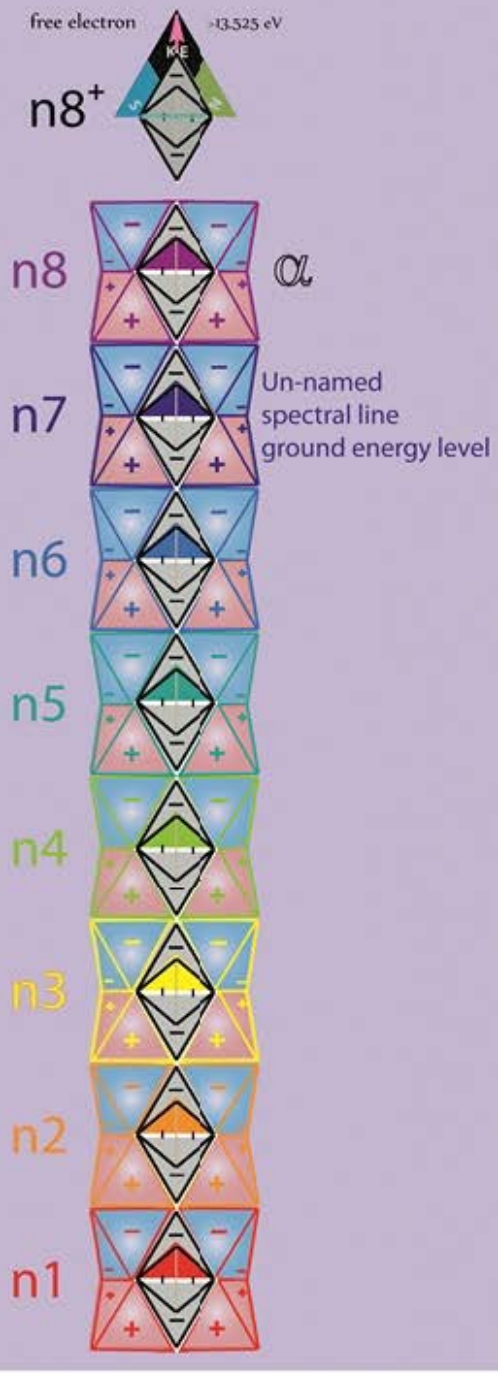

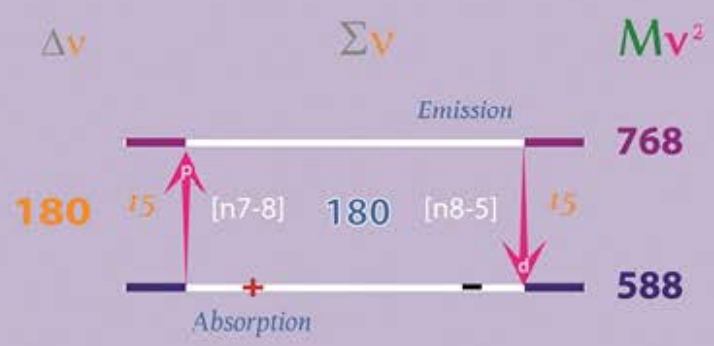

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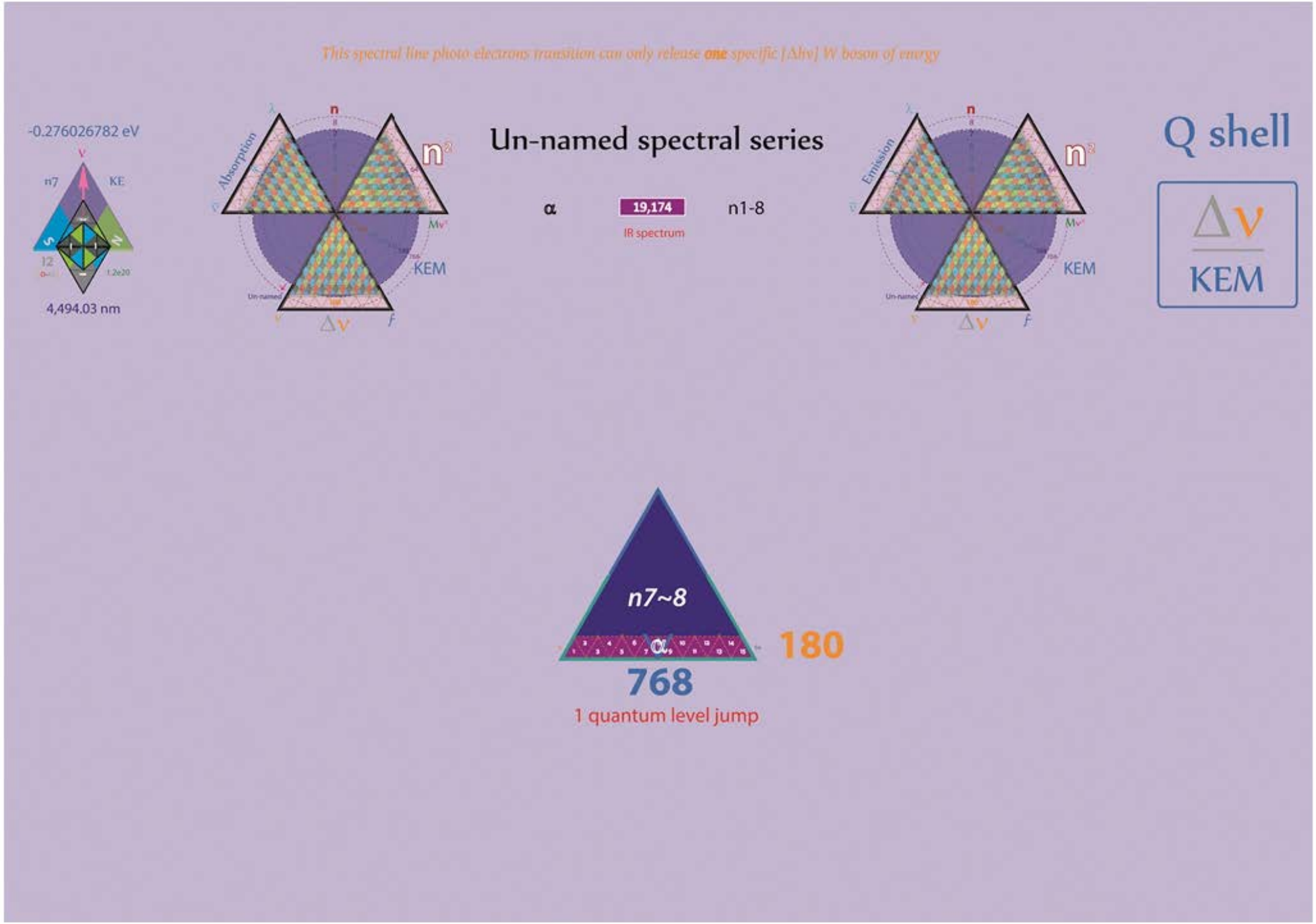

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Un-named series energy momenta

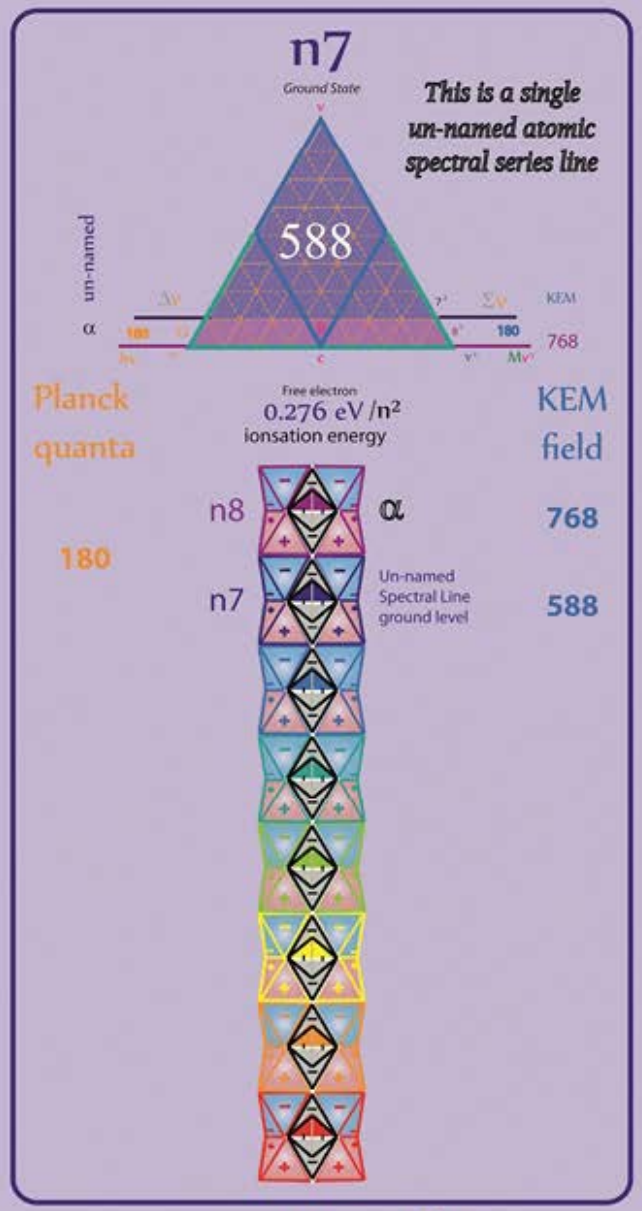

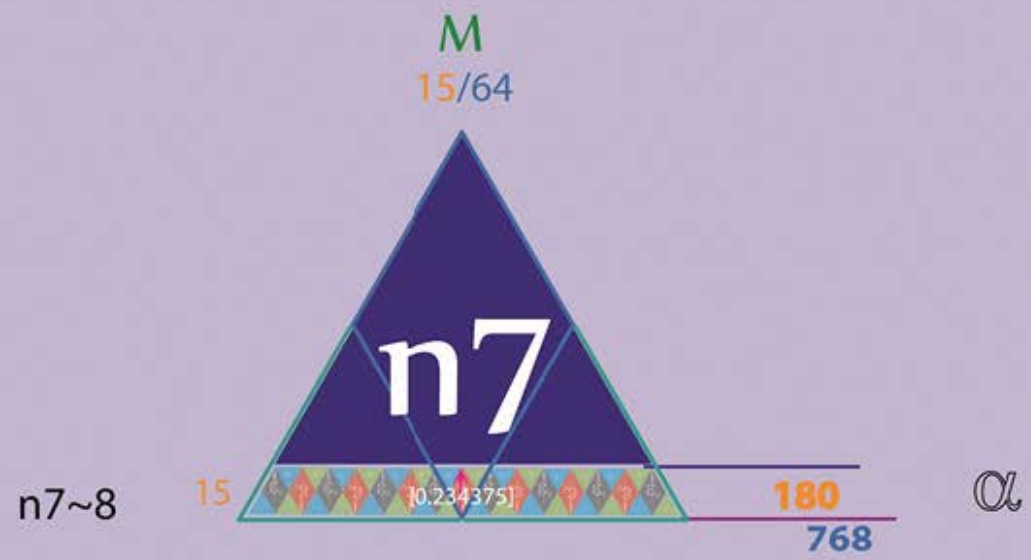

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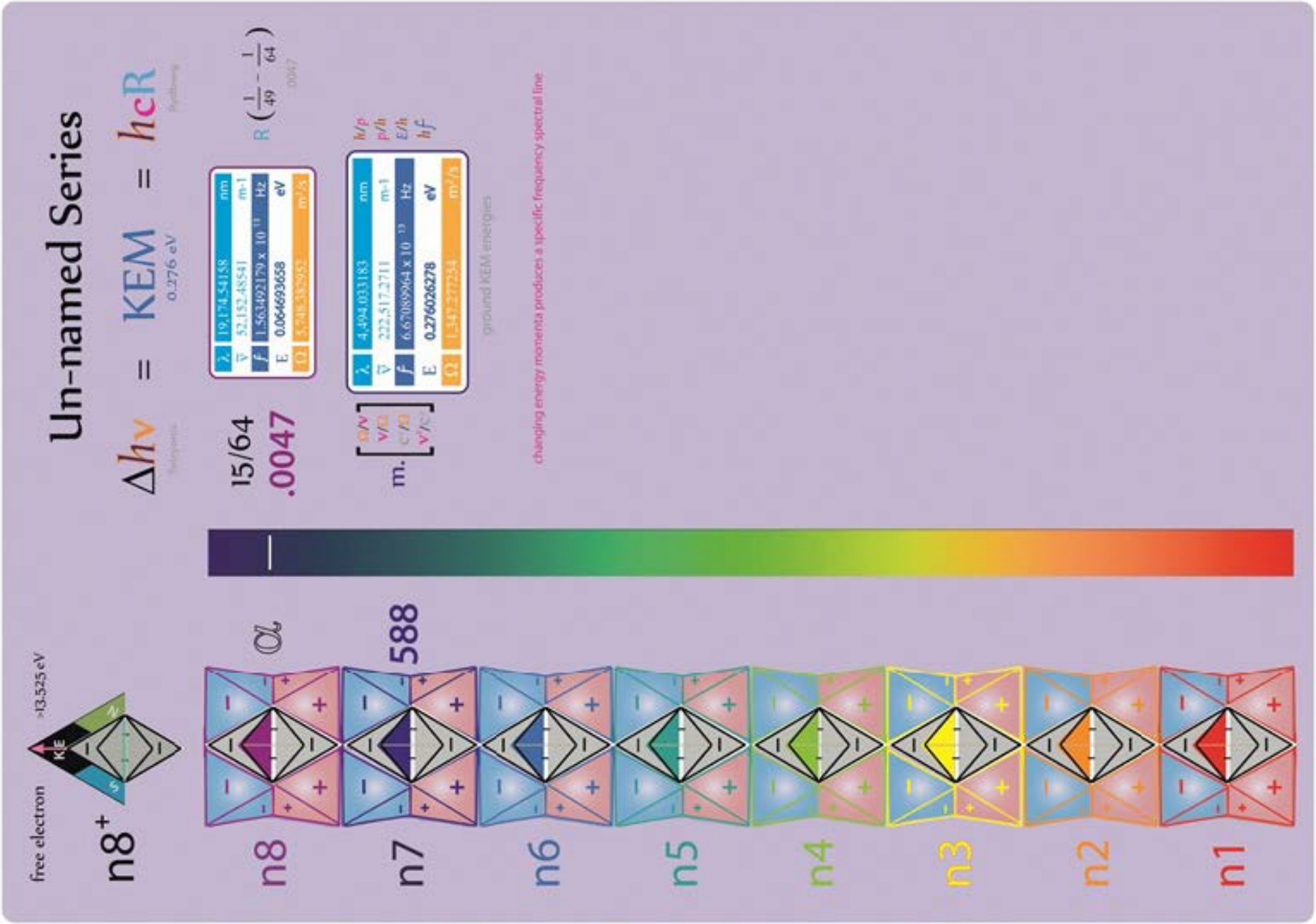

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KEM field geometry

The Lorentz corrected velocity of electron resulting from atomic energy level transitions

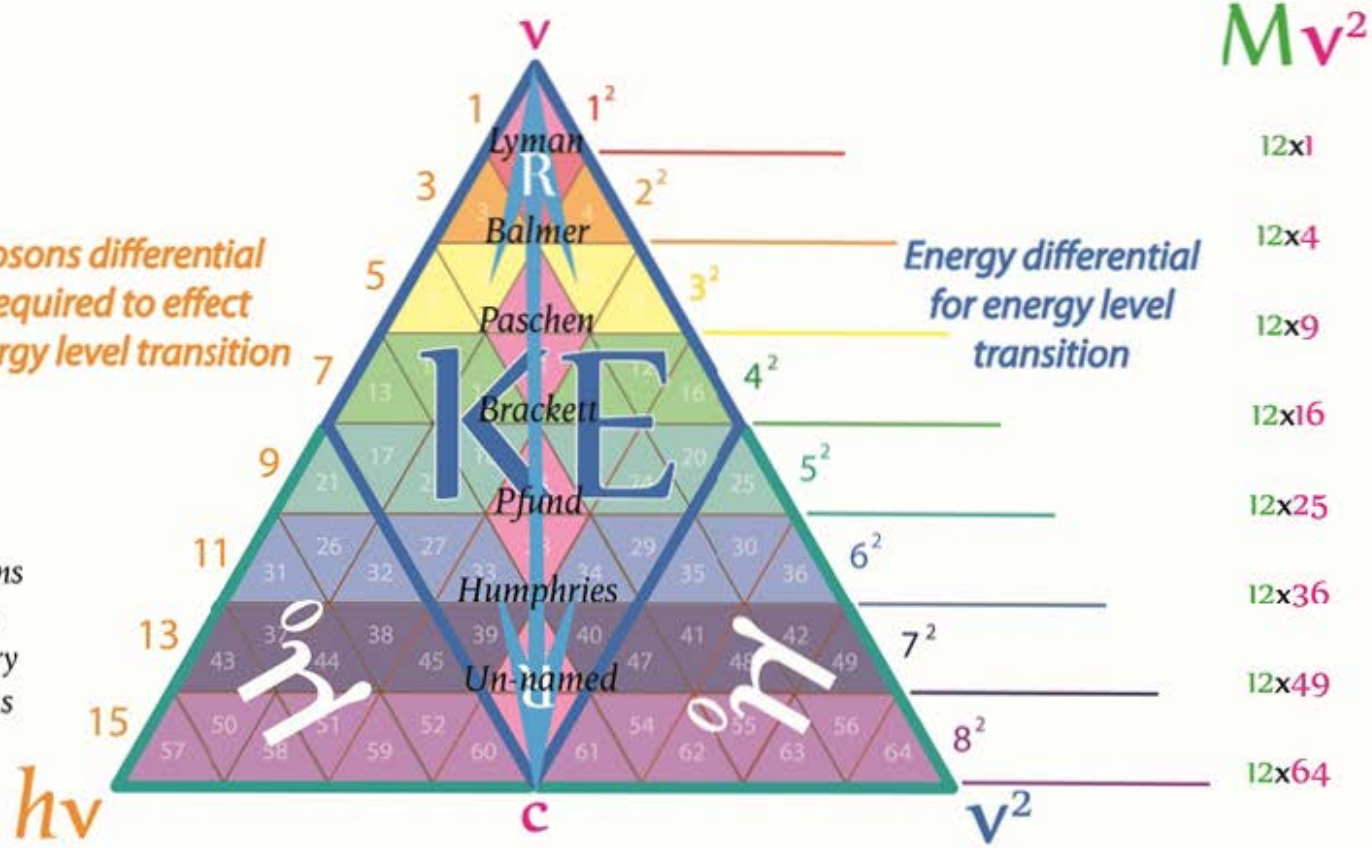

Bosons differential required to effect energy level transition

Energy differential for energy level transition

All of the quantum jumps of electrons bound in a Hydrogen atom can be summerised in the Tetryonic geometry reflecting the energy level transitions

Ryberg's constant is reflective of the wavelengths and linear momentum of a transitioning electron's KEM field

Ryberg's formula is a mathematical description of Tetryonic energy geometry

$$Mv^2 = KEM = hcR_H$$

KEM field quanta

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Photoelectron transitions

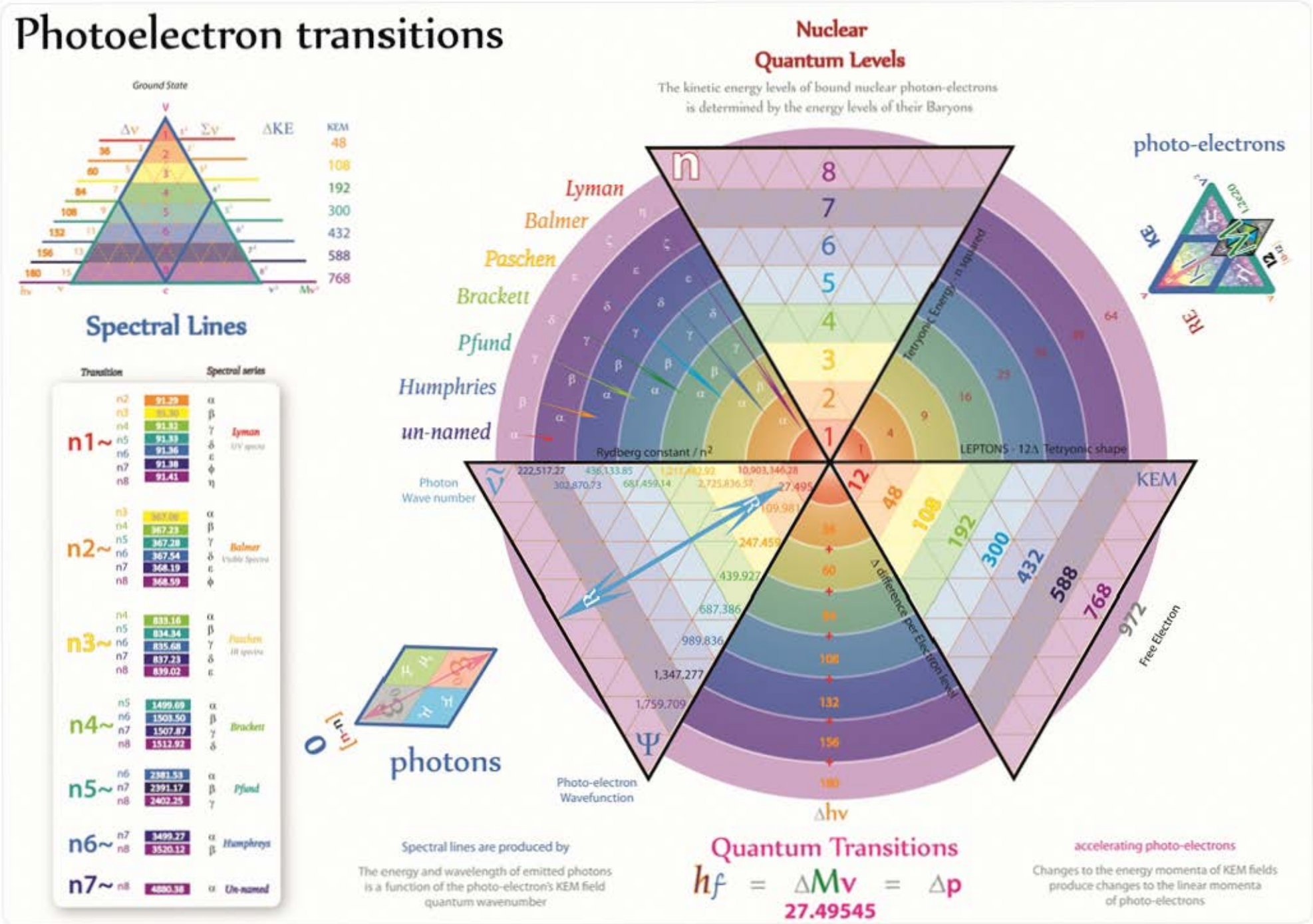

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Photoelectric energy level transitions

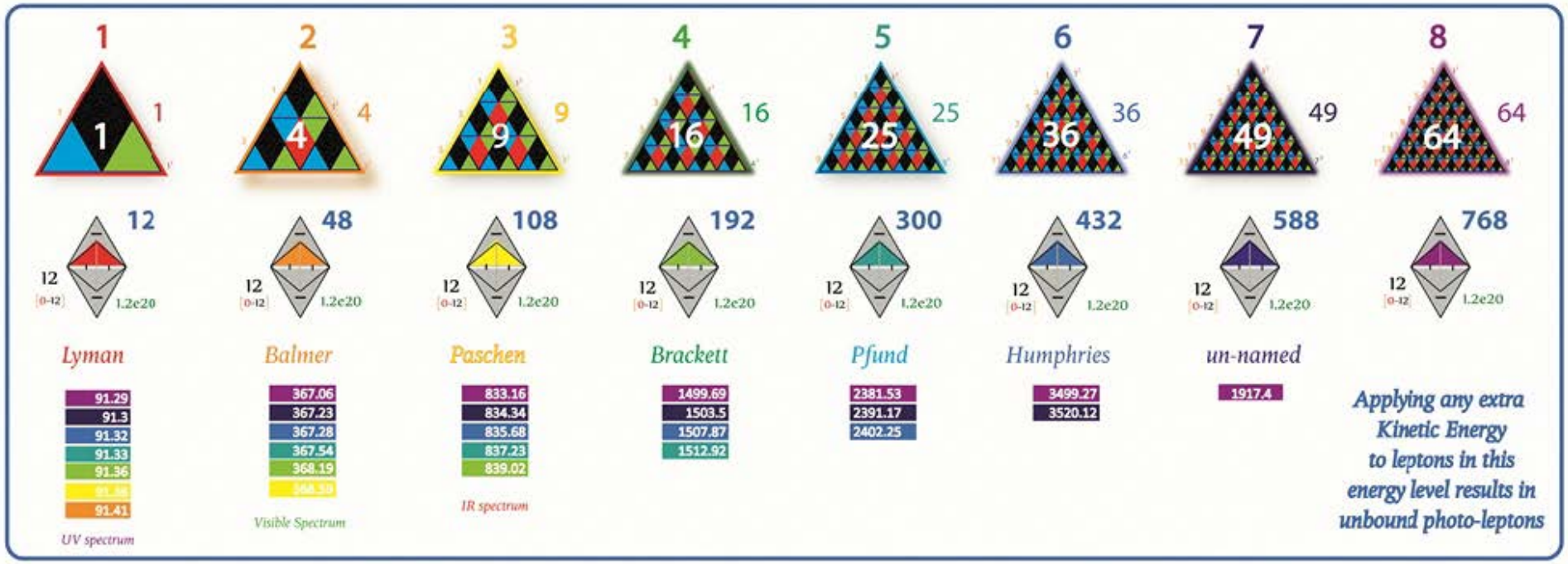

$$Mv^2 = KEM = hcR_H$$

These specific quantum level steps create the Photoelectric effect

$$\Delta h\nu = \phi = hf$$

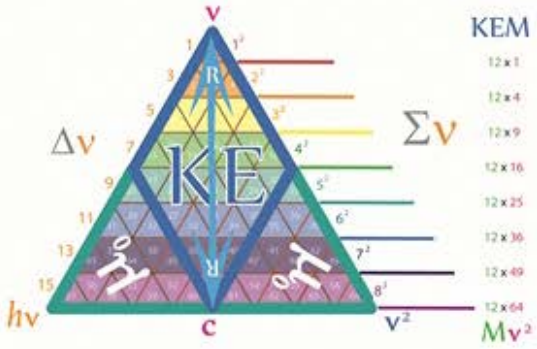

Photo-electrons bound to atomic nuclei can only transition between Mv squared KEM energies as a direct result of the energy levels of Baryons

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The Photoelectric effect

The photoelectric effect was first observed in 1887 by Heinrich Hertz (1857-1894) during experiments with a spark-gap generator — the earliest form of radio receiver

There are specific frequencies of light that are more efficient at exciting photo-electrons from atoms

$p^2 = KEM = Mv^2$

The energies of the emitted electrons are independent of the intensity of the incident radiation but are dependent on the photon frequency

n2-4 specific transitions can release
8 times the number of electrons
that n3-4 can release &
4 times the number of electrons
that n1-4 can release

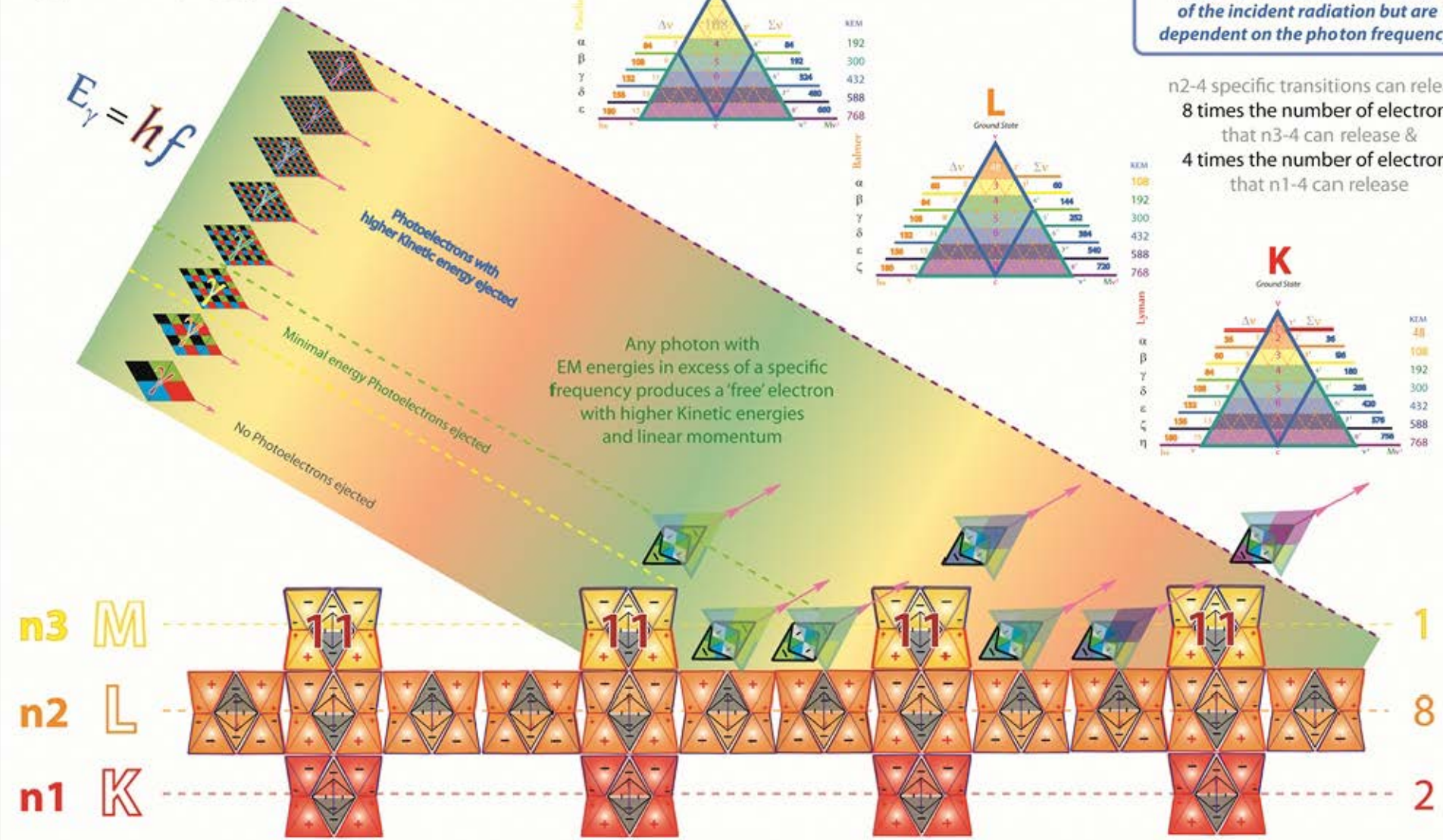

Soon after the discovery of Planck's Heat law and the quantisation of energy at the quantum level experiments by others, most notably Robert Millikan (1865-1953), found that light with frequencies below a certain cutoff value, called the threshold frequency, ould not eject photoelectrons from the metal surface no matter how bright the source

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Photonic mass-energy momenta

Bosons

$$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Bosons; EM Field; Planck quanta; ElectroMagnetic; mass; velocity

$$2m\Omega v^2 = E = n.hf$$

All 2D EM waveforms possess mass-energy and momenta

Photons

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Photons; EM Field; Planck quanta; ElectroMagnetic; mass; velocity

charged mass-energy-momentum

$$E = mv^2$$

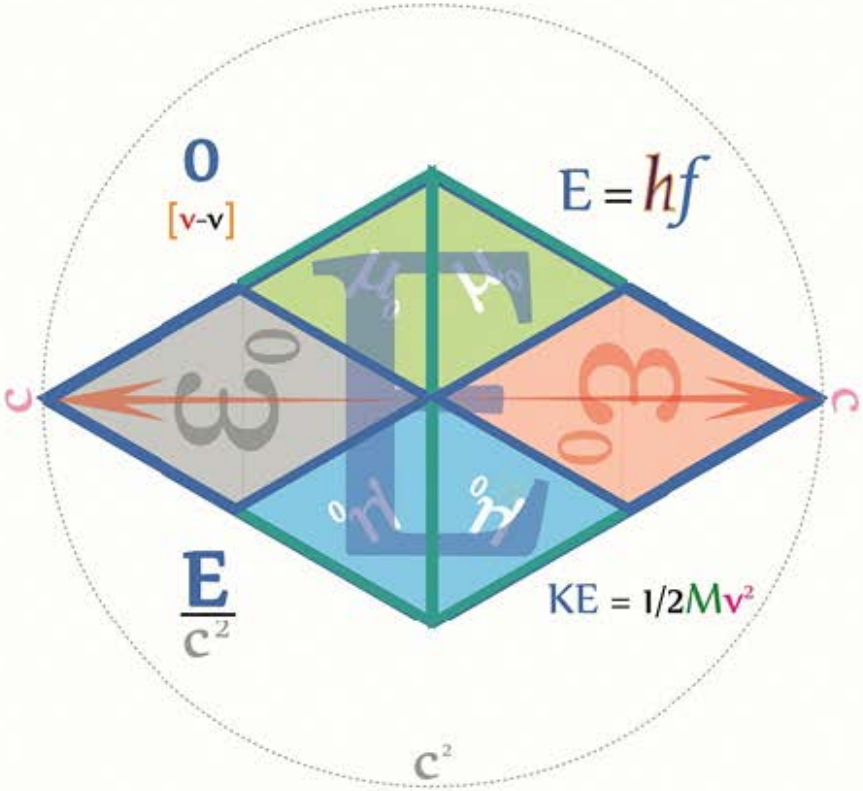

radiant mass-energy momenta

$$E = hv^2$$

Planck energies

All 2D EM waveforms propagate at the speed of light

$$\underset{\text{Velocity of Light}}{v} = \left[\left[\frac{\overset{f}{c^2}}{\Omega}\right]\cdot\left[\frac{\overset{\lambda}{\Omega}}{c}\right]\right] = \underset{\text{Speed of Light}}{c}$$

scalar frequency; linear wavelength

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Wave~Particle duality

First proposed by Christian Huygens in the 1600's, it wasn't until the 1800's that Thomas Young proved this wave-particle duality with the classic double-slit experiment.

Sir Isaac Newton

(1643-1727)

Particles

In 1678, Dutch physicist, Christiaan Huygens, believed that light was made up of waves vibrating up and down perpendicular to the direction of the light travels, and therefore formulated a way of visualising wave propagation.

This became known as 'Huygens' Principle' and was the successful theory of light wave motion in three dimensions

Sir Isaac Newton, held the theory based on his spetral observations that light was made up of tiny particles or 'corpusles of colour'

English physicist Thomas Young argued that Isaac Newton's theory of particle light was incorrect, and instead argued that light is a transverse wave.

In 1803, Thomas Young studied the interference of light waves by shining light through a screen with two slits equally separated, the light emerging from the two slits, spread out and produced wave-like interference patterns.

Waves

Thomas Young

(1773-1829)

In 1900
Max Planck proposed the existence of a light quantum, [n.hv] a finite packet of energy which depends on the frequency and spectral energy of the radiation

Light - a Wave, or a Particle?

In 1905
Albert Einstein, suggested that light is composed of tiny particles called photons, and that each photon has energy related to its frequency [hf].

Max Karl Ernst Ludwig Planck

(April 23, 1858 – October 4, 1947)

Bosons

$$nh\nu = E = hf$$

Mathematically directly relating the number of Planck quanta [n.hv] with Photon frequencies [hf] and the frequent interchanging of one term for the other in physics is the source of considerable quantum confusion

$$2h\nu = hf$$

Photons

Albert Einstein

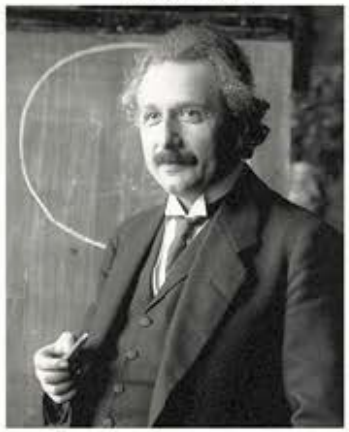

(14 March 1879 – 18 April 1955)

The quantum idea was soon seized upon to explain the photoelectric effect, and became part of the Bohr theory of discrete atomic spectra, quickly becoming part of the foundation of modern quantum theory in turn this led to the quantum wierdness of wave-particle dualty, Heisenberg's Uncertainty principle and Schrodinger's quantum wave equation & wavefunctions.

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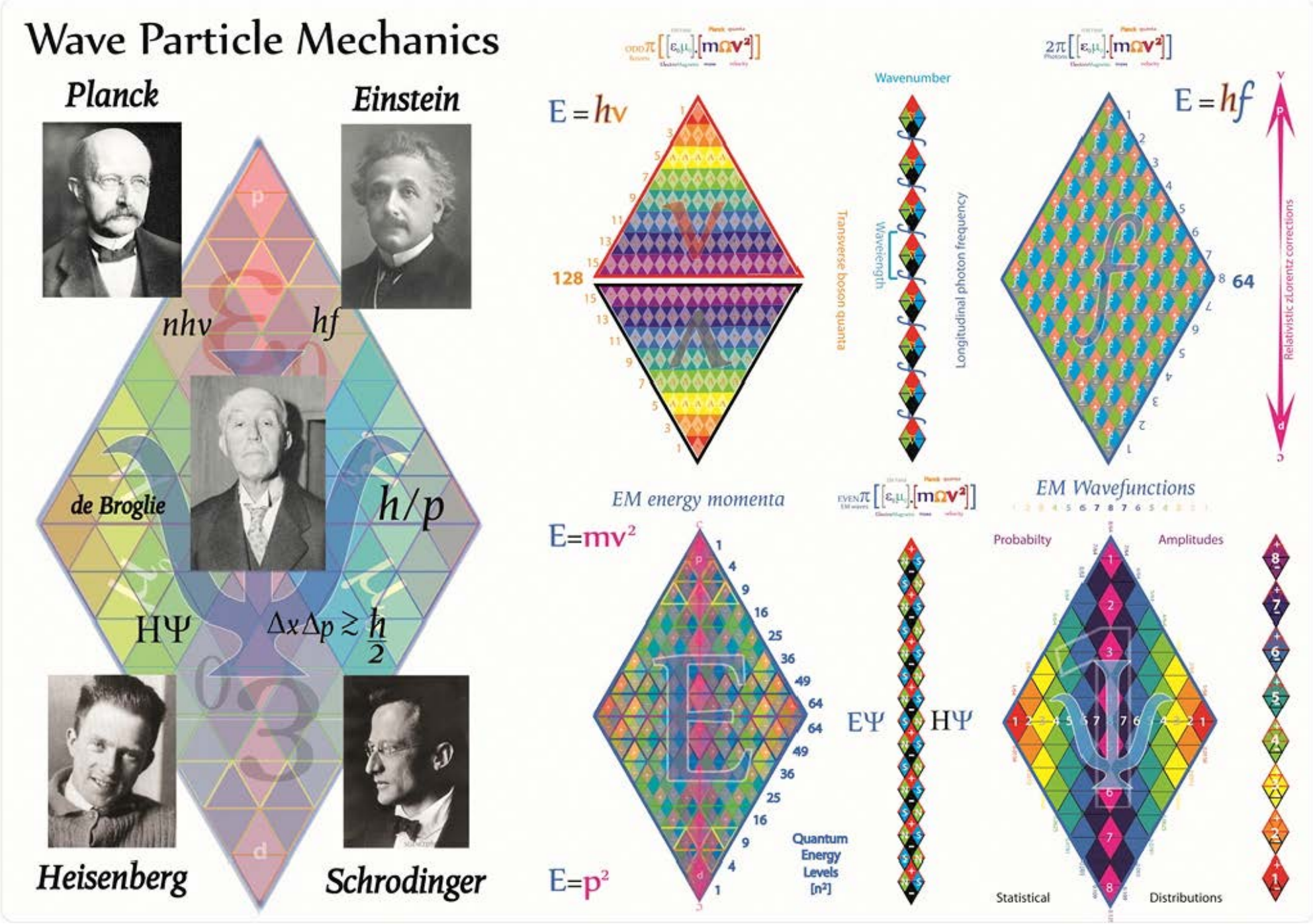

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Blackbody Radiation

Wien's displacement law

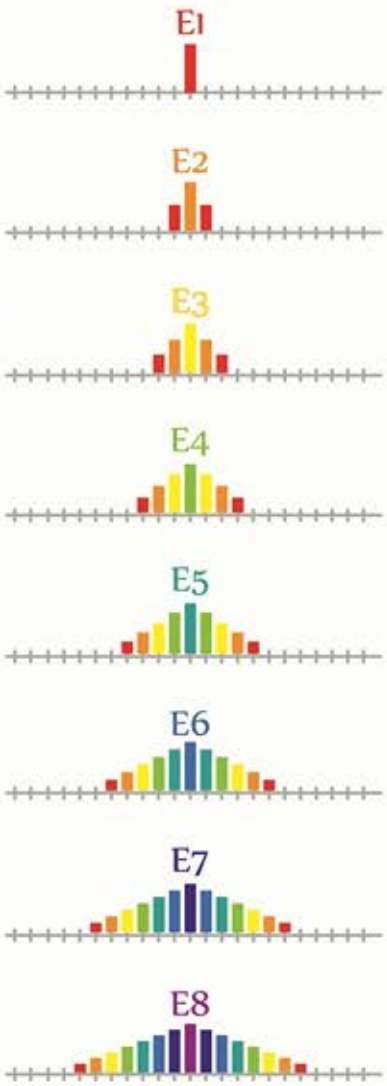

Rayleigh–Jeans law

Max Planck

(April 23, 1858 – October 4, 1947)

In physics, Planck's law describes the amount of electromagnetic energy with a certain wavelength radiated by a black body in thermal equilibrium (i.e. the spectral radiance of a black body).

The law is named after Max Planck, who originally proposed it in 1900. The law was the first to accurately describe black body radiation, and resolved the ultraviolet catastrophe by introducing Planck's Constant.

It is a pioneer result of modern physics and quantum theory leading to mass.QAM being termed Planck's constant.

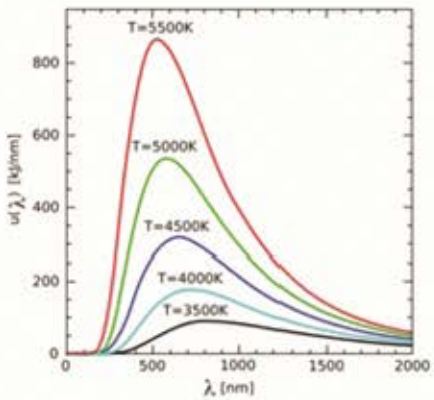

$m\Omega = 6.62943244\ e\text{-}34\ J.s = h$

nhν

All EM waves are comprised of discrete energy quanta

As their frequency increases the wavelength of emitted Photons decreases

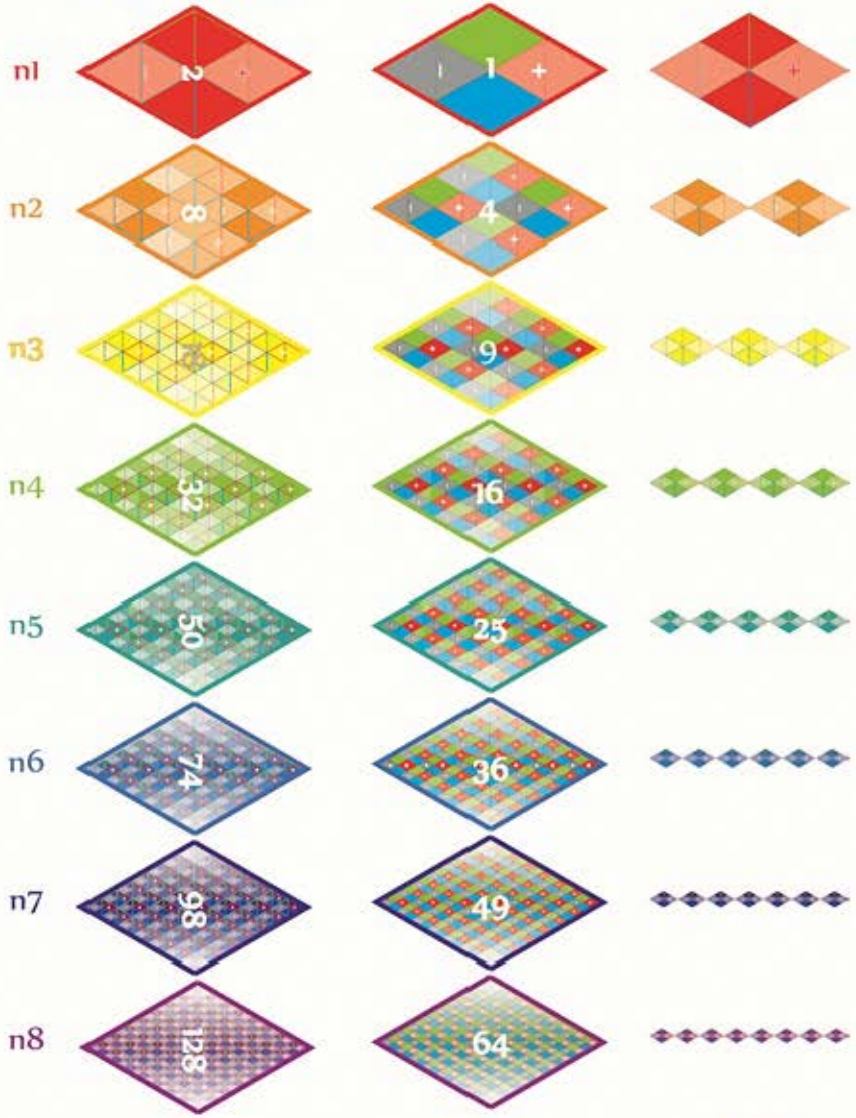

$2h\nu = hf = hc\tilde{\nu}$

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EM field energies

$$E = n\pi\left[\left[m\Omega v^2\right]\right]$$

Planck quanta; mass; velocity

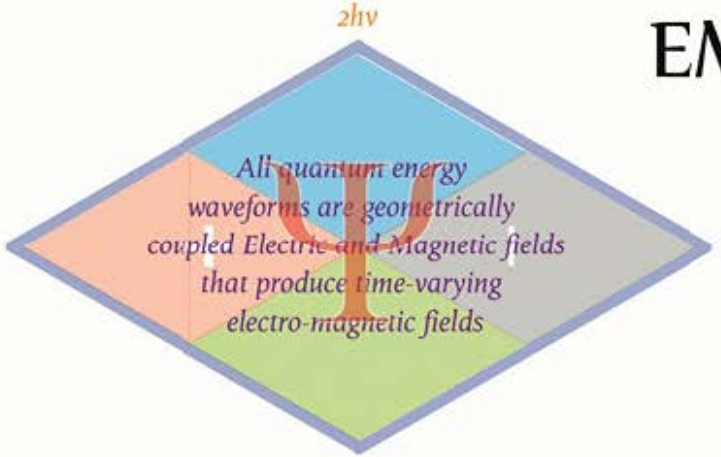

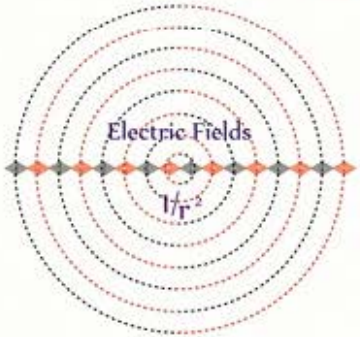

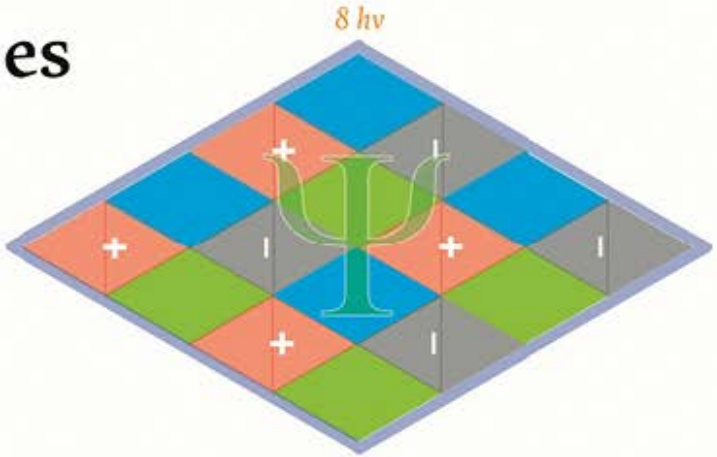

$$1\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Charge; EM Field; ElectroMagnetic; mass; Planck quanta; velocity

$$E = h\nu$$

EM waves are subject to Lorentz co-ordinate transformations

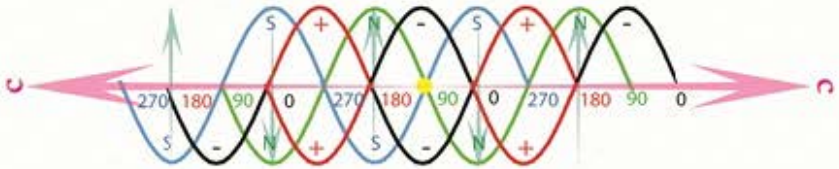

EM waves are a quadrature waveform of bi-directional electromagnetic oscillations

$$E = hf$$

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Photons; EM Field; ElectroMagnetic; mass; Planck quanta; velocity

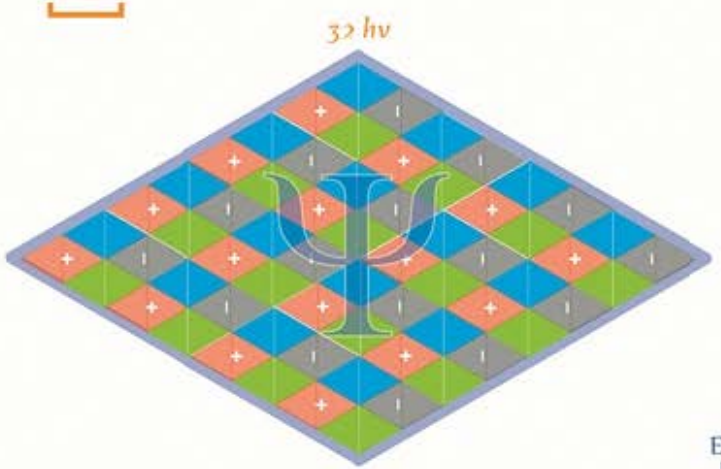

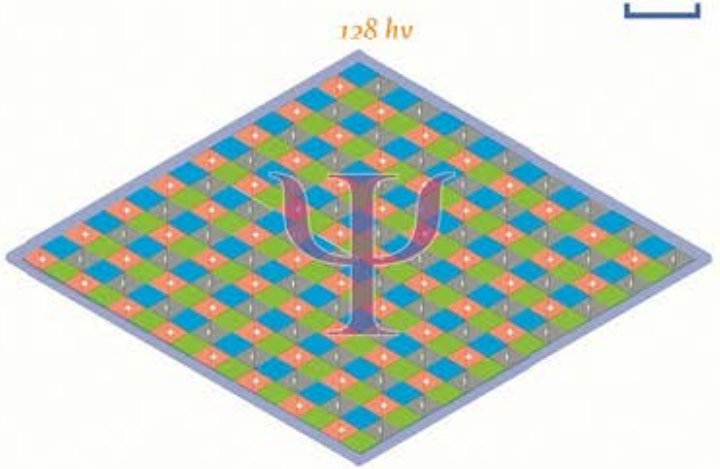

$$\text{EVEN}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EVEN EM waves; EM Field; ElectroMagnetic; mass; Planck quanta; velocity

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Bosons and Photons in EM waves

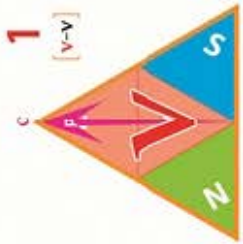

$$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta; Bosons; ElectroMagnetic mass — velocity

Transverse charge Quanta

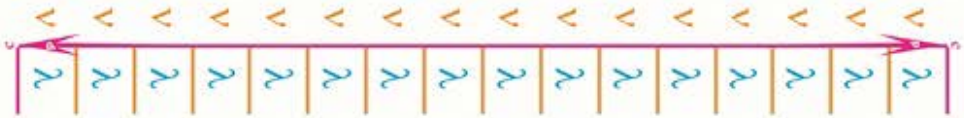

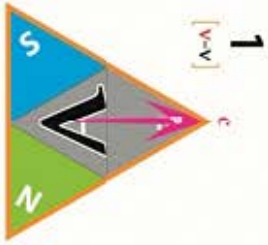

$E = h\nu$

All EM waves are comprised of transverse Bosons

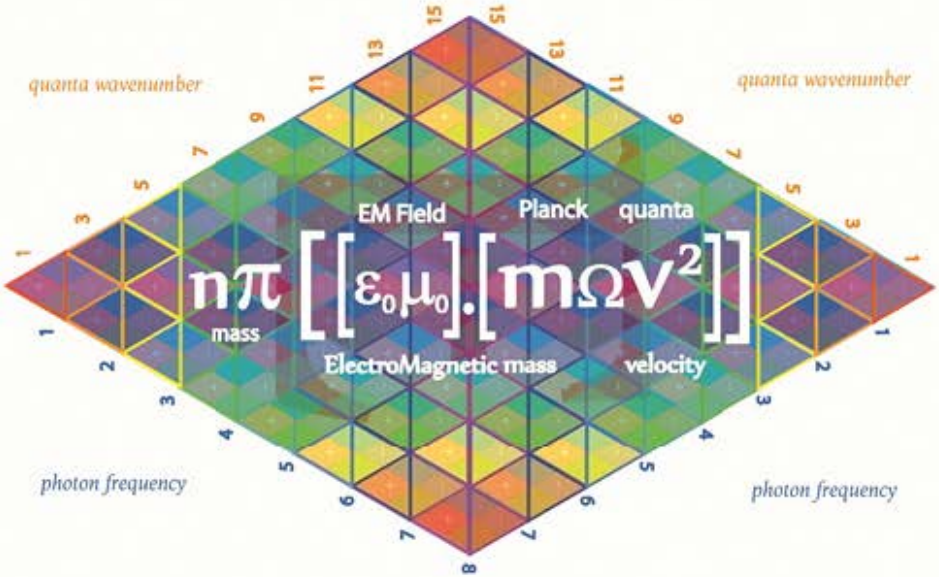

$E = hf$

All EM waves are comprised of longitudinal Photons

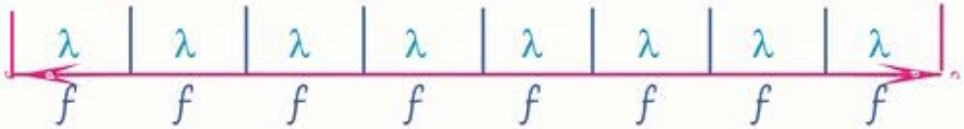

Longitudinal neutral Photons

$$\text{EVEN}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM Field — Planck quanta; Photons; ElectroMagnetic mass — velocity

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EM wave energy quanta

Tranverse Bosons in EM wave energies should be modelled using [n] Planck quanta

Wavefunction

$$i\hbar\frac{\partial}{\partial t}\Psi \quad \Psi \quad \hat{H}\Psi$$

Probability = |Amplitude|²

The Longitudinal EM wave energies should be modelled using [f] Photon frequencies

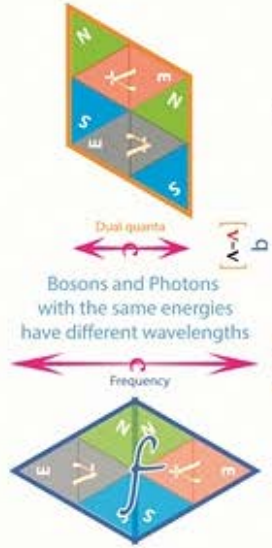

All EM waves are composed of Bosons

ODD π [[$\varepsilon_0\mu_0$] . [$m\Omega v^2$]]

Bosons — EM Field — Planck quanta — ElectroMagnetic mass velocity

Boson

$E = n.h\eta$

$$E = n\pi\left[m\Omega v^2\right]$$

Planck quanta — mass — velocity

All Wave~Particle geometries and mass-energies can be calculated from and modelled with the Tetryonic Unified Field Equation

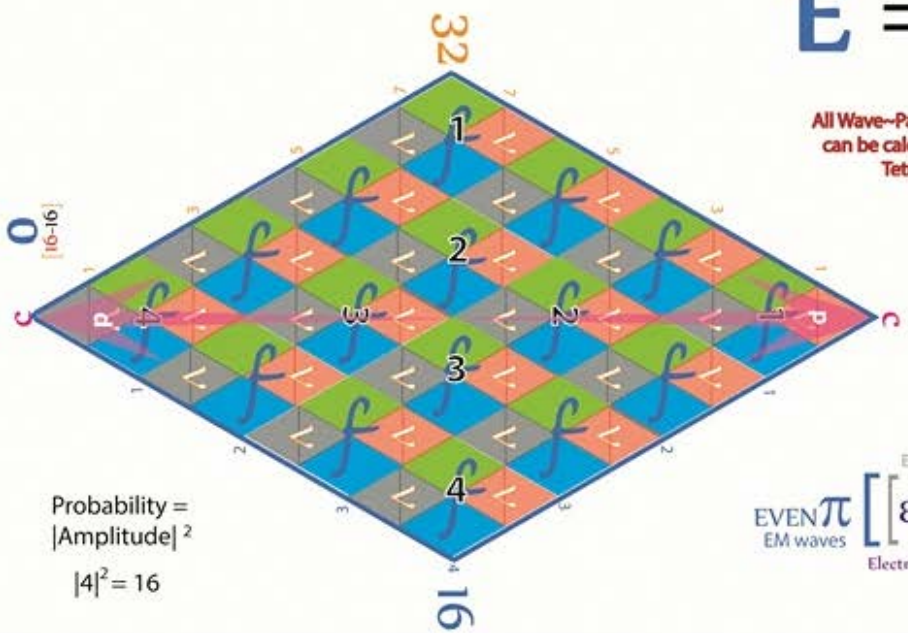

Probability = |Amplitude|²

$|4|^2 = 16$

$E = hf$

Photon

EVEN π [[$\varepsilon_0\mu_0$] . [$m\Omega v^2$]]

EM waves — EM Field — Planck quanta — ElectroMagnetic mass velocity

All EM waves are composed of Square number Photons

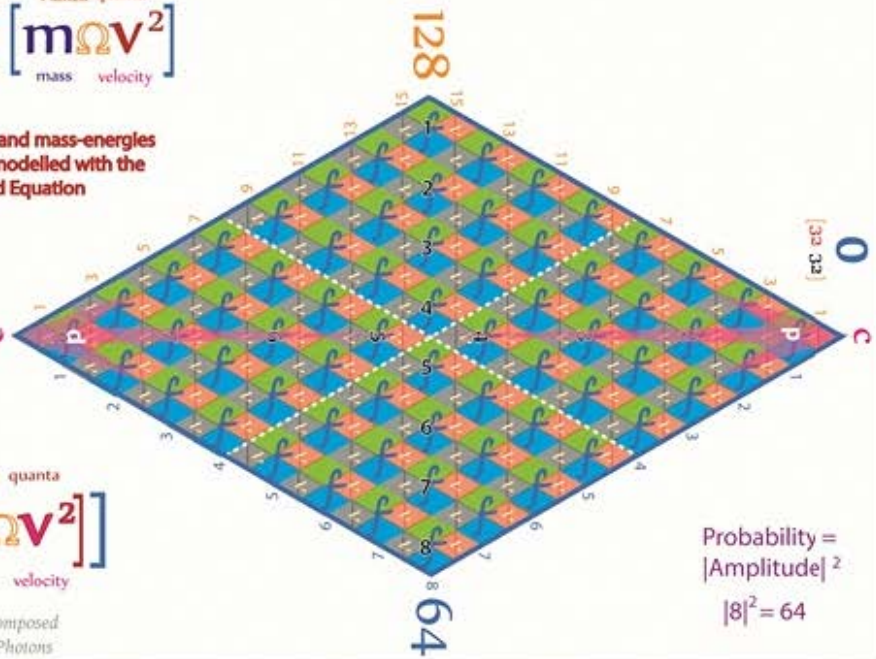

Probability = |Amplitude|²

$|8|^2 = 64$

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EM wave properties

Linear momentum is the square root of scalar mass-energies

$$\left[\sqrt{\overset{\text{Energy}}{[m\Omega v^2]}}\right]$$

mass quanta

EM waveform geometries

EM waves are comprised of Photons with Kinetic energies, momenta and a photo-magnetic moment

$$p_\gamma = 2\pi\left[\left[\overset{\text{Energy}}{m\Omega v}\right]\right]$$

momenta

Photonic energy-momentum

Transverse waveforms

Longitudinal waveforms

Scalar Planck quanta per second is the scalar source of all linear energy-momenta

$$p^2$$

Conservation of Energy momenta

Energy momenta a conserved quantity in physical systems (laws of conservation), meaning that if a closed system is not affected by external forces, its total momentum cannot change

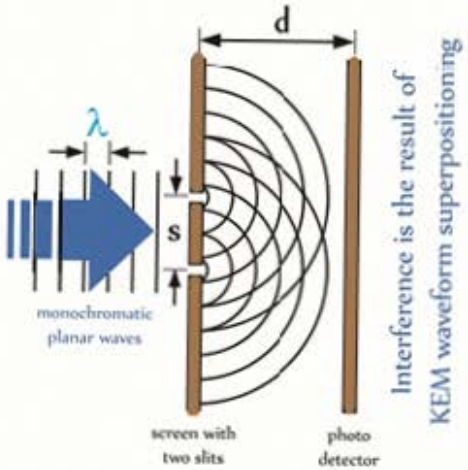

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Statistical probabilities of energy distributions

form the basis for quantum mechanical probabilities and wavefunctions

$E = 2mv$

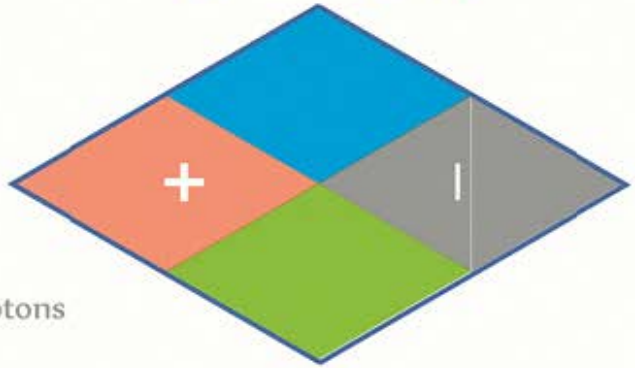

Photons

$E = Mc^4$

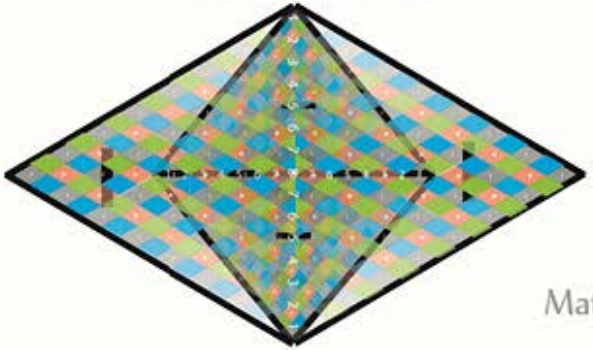

Matter

All ENERGY in motion has probabilistic distribtutions of energy quanta resulting from the equilateral Tetryonic geometries of electromagnetic mass-ENERGY-Matter

EM waves

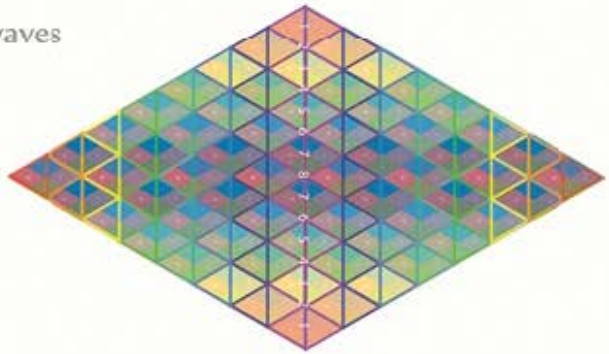

$p^2 = E = mv^2$

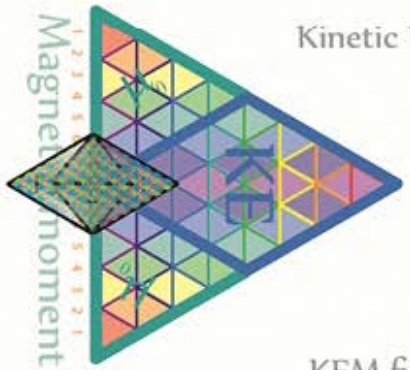

Kinetic Energies

$KE = \frac{1}{2}Mv^2$

KEM fields

$Mv^2 = KEM$

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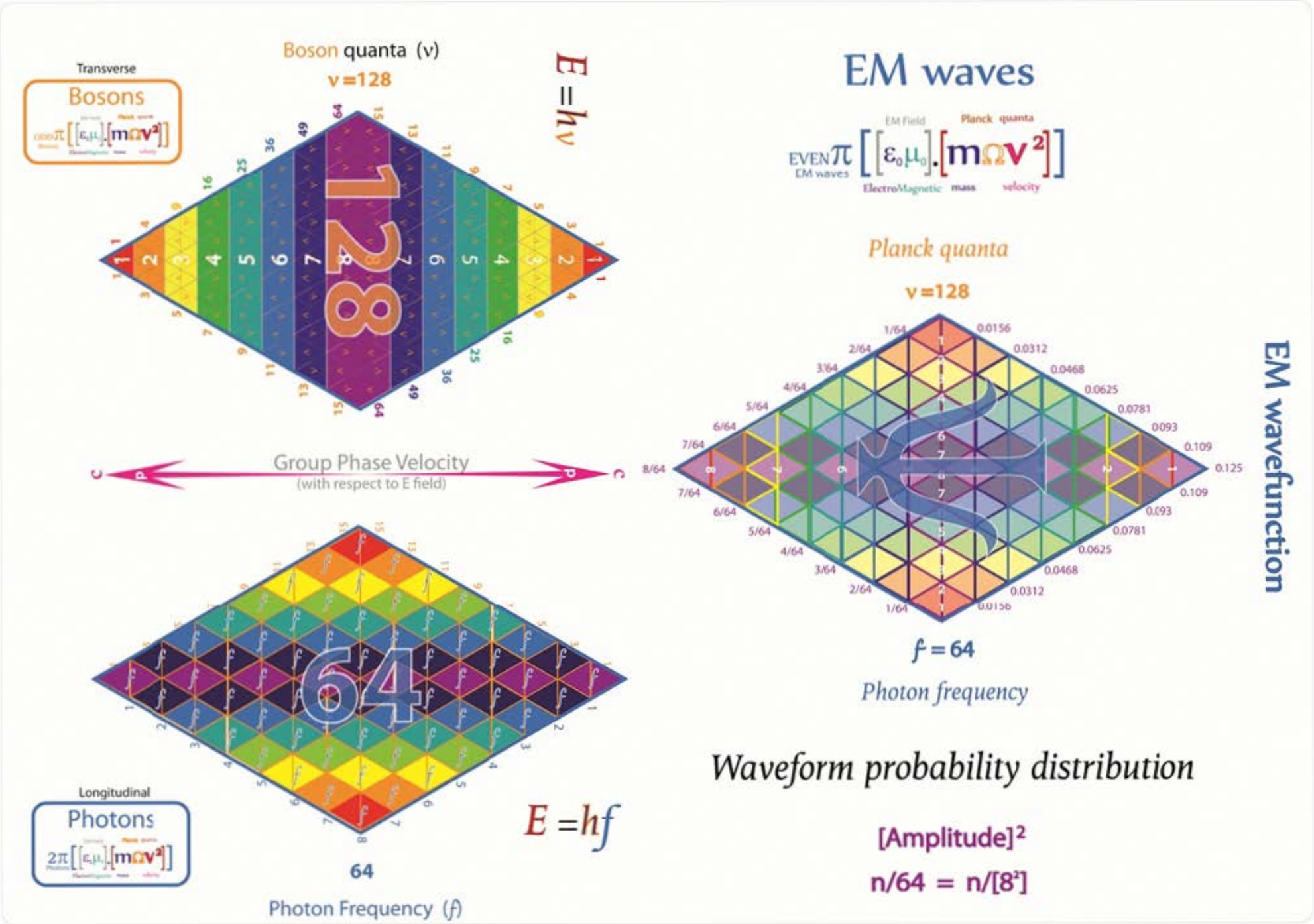

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Wave functions

All EM waves and Photons exhibit quantum levels of mass-energy momenta determined by their constituent bosons

Transverse EM Waveforms

Bosons

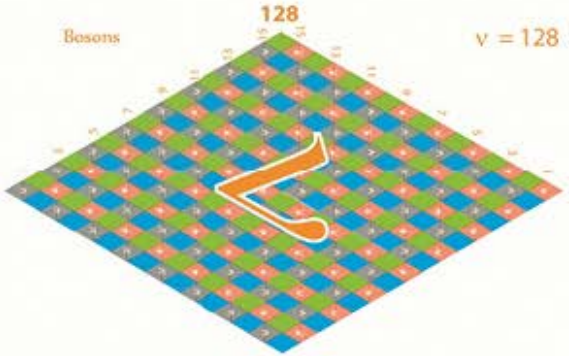

$E = h\nu$

[Planck quanta are single-quanta Bosons]

All EM waves are comprised of Longitudinal Photons which in turn are made up of Transverse Bosons

[Photons are neutral dual-quanta Bosons]

$E = hf$

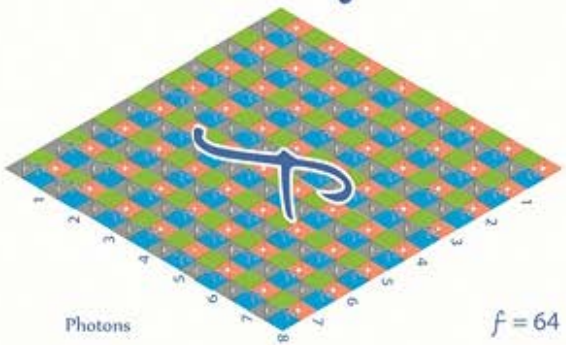

Photons

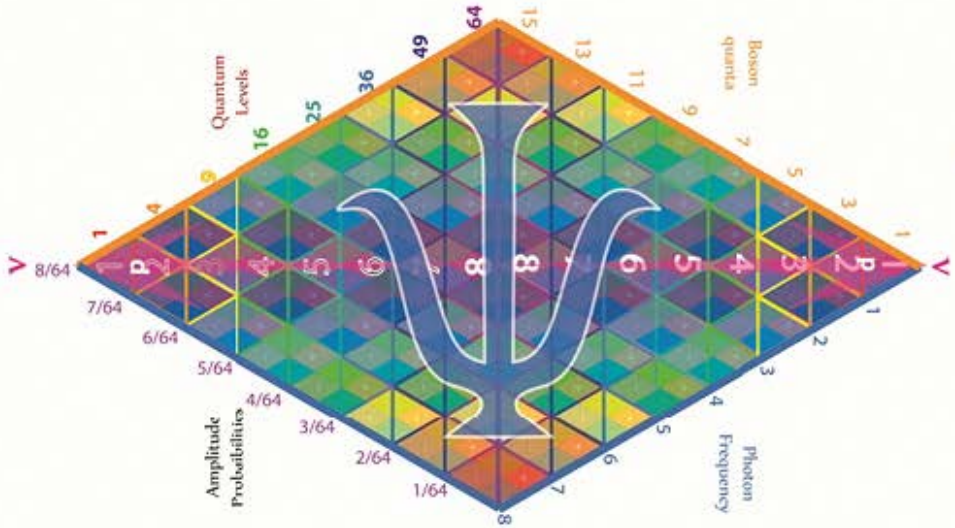

Longitudinal EM waveforms

All electromagnetic waves exhibit wave probabilities and amplitude functions determined by their constituent photons

Energy levels

Squared numbers

Wave-particle duality holds that light and matter simultaneously exhibit properties of waves as well as particle-like properties (photons).

This concept is a consequence of the mathematical treament of mass-energy physics in quantum mechanics and a comprehensive explanation of this duality has been elusive to Physics since its discovery.

Any attmpt to develop an unified quantum theory must explain the root cause and processes behind Wave-Particle duality and must also explain:

Diffraction, Deflection and Reflection along with Bosons, Photons, EM radiation, energy quantisation and mass-Matter.

Probabilities

Waves

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EM Wavefunctions

The wavefunction for a system contains all the information about the quantum state that a particle/system is in and gives a complete description of that part of the world at any one particular instant in time.

Transverse mass-energy distrbutions

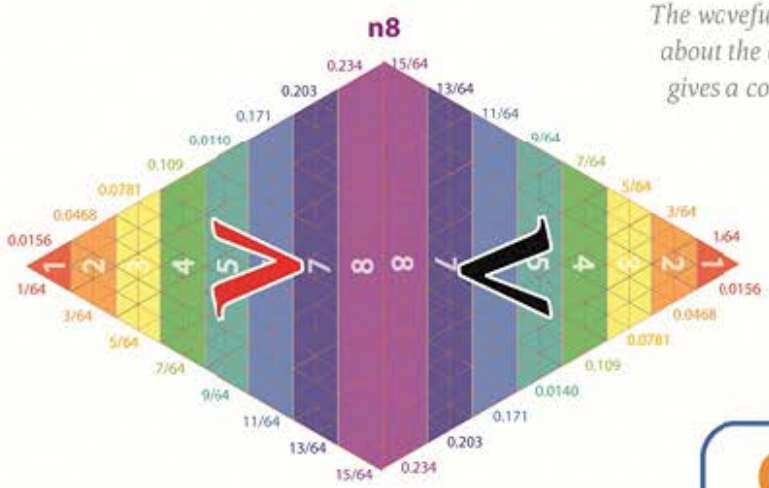

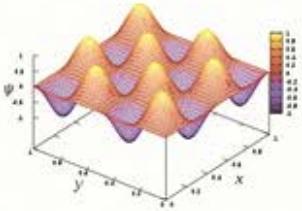

Longitudinal mass-energy distributions

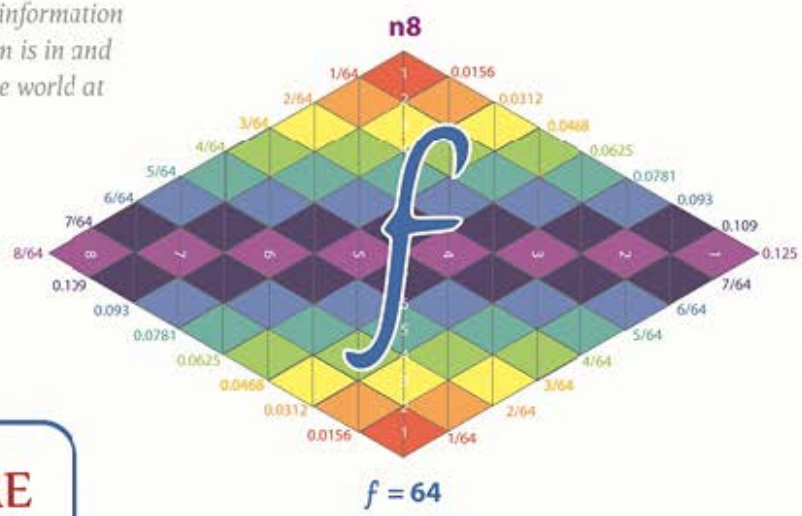

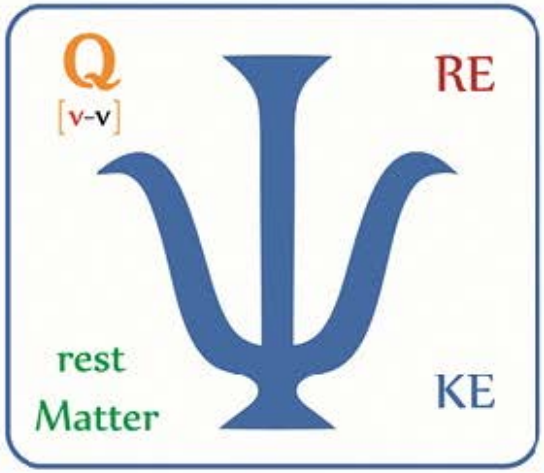

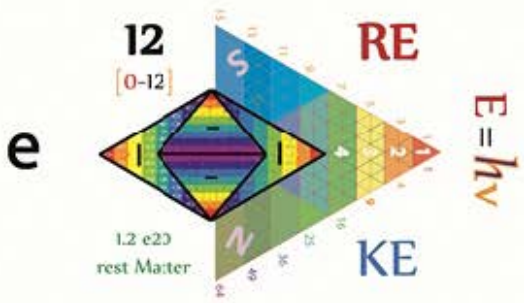

The wavefunction of an EM wave (KEM) geometry is distinct from that of rest mass-Matter toplogies due to the number of Planck quanta contained in it but both can be modelled using Tetryonic geometry

Quantum Energy Levels

The wavefunction itself is often said to be un-observable. In fact, it can modelled as it is a reflection of the quantas making up the quantum state of any particle and is complex-valued.

As the system evolves over time, the wavefunction also changes, so it can be written as a function of time Ψ(t).

$$\int_{-\infty}^{\infty} |\Psi|^2 \mathrm{d}x = 1.$$

The absolute square of the function must be normalizable

Wave-Particle Probabilities

The absolute square of the wavefunction is a probability density (the area of highest probability for a measurement to take place.

For example, if the wavefunction is expressed in real space and our system is a particle, the absolute square gives a probability density for the position of the system. Integrating this probability density between some bounds will give the probability that the particle will be found in that region when its position is measured

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Wave~Particle energies

Equilateral energy is the foundational geometry of Kinetic EM Waveforms [WAVES] and standing wave Matter [PARTICLES]

All Matter in motion exhibits a Wave-Particle duality

Everything is made up of *charged mass-energy quanta*

ZPFs combine in ODD numbers to form *Bosons*

Bosons combine to form *Quantum Levels*

The quantum Planck quanta tesslation of Matter can be accurately modelled with ***Wave Probability mechanics***

Transverse

Bosons

$$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

$$E = h\nu$$

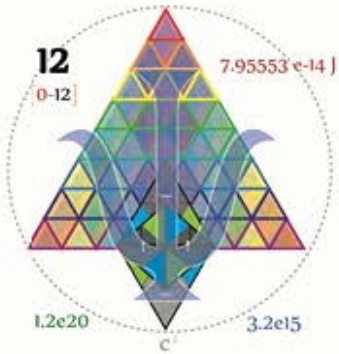

$$E = hf$$

Photons

$$\text{EVEN}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

Longitudinal

A n8 Electron is a massive particle which has a Kinetic EM energy field [6.4e15 planck quanta]

2D EM field geometries can combine to form 3D Tetryonic Matter topologies

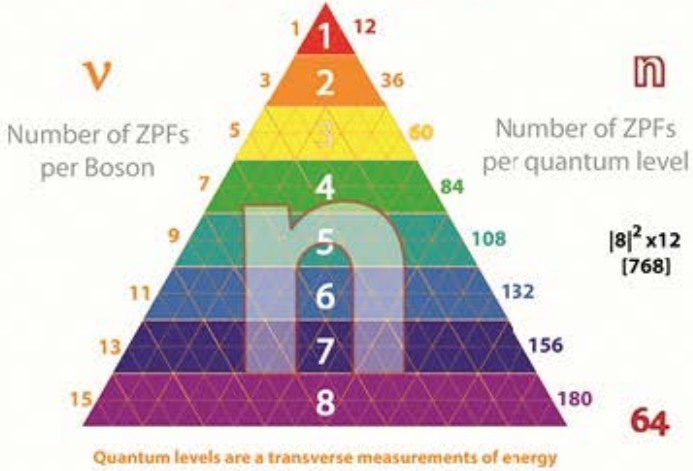

Equivalently, all Matter & EM waves can be viewed either in terms of their transverse boson or longitudinal photon content and/ or their associated mass-energy momenta geometries

Square of Wave function is Normalizable

[1]

Probability is Square of Amplitude

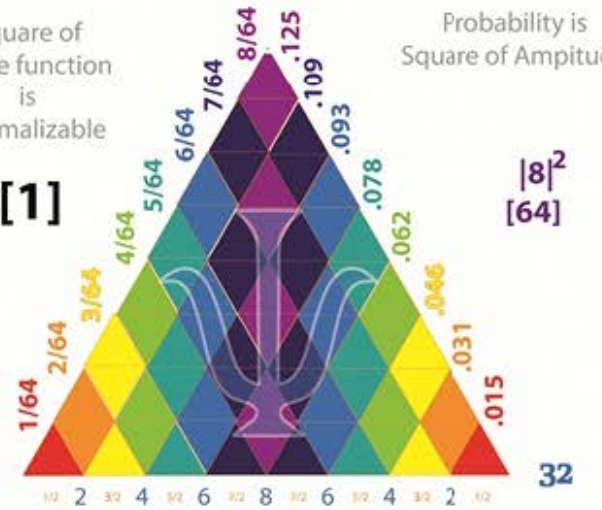

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Wave-particle Probabilities

All Particles in motion exhibit a Wave-Particle duality
due to the 2D waveform geometry of its KEM wave
and the lorentz velcoity invariant
3D standing wave geometry of its Matter

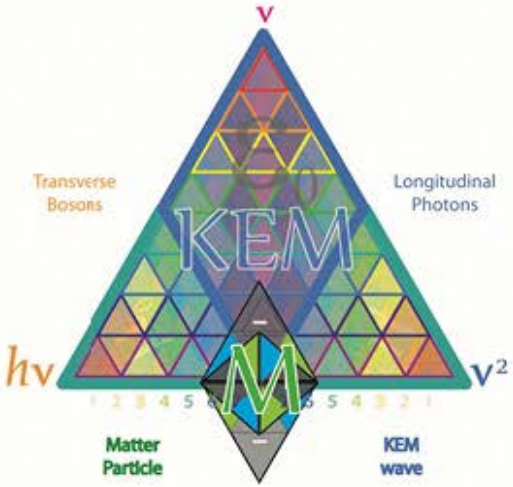

Equilateral energy tessellation
provides the basis for the probabilistic
statisical mechanics and math for
all of Quantum Mechanics

Schrodinger Wavefunction
The Wavefunction of a Particle
equates to its Amplitude

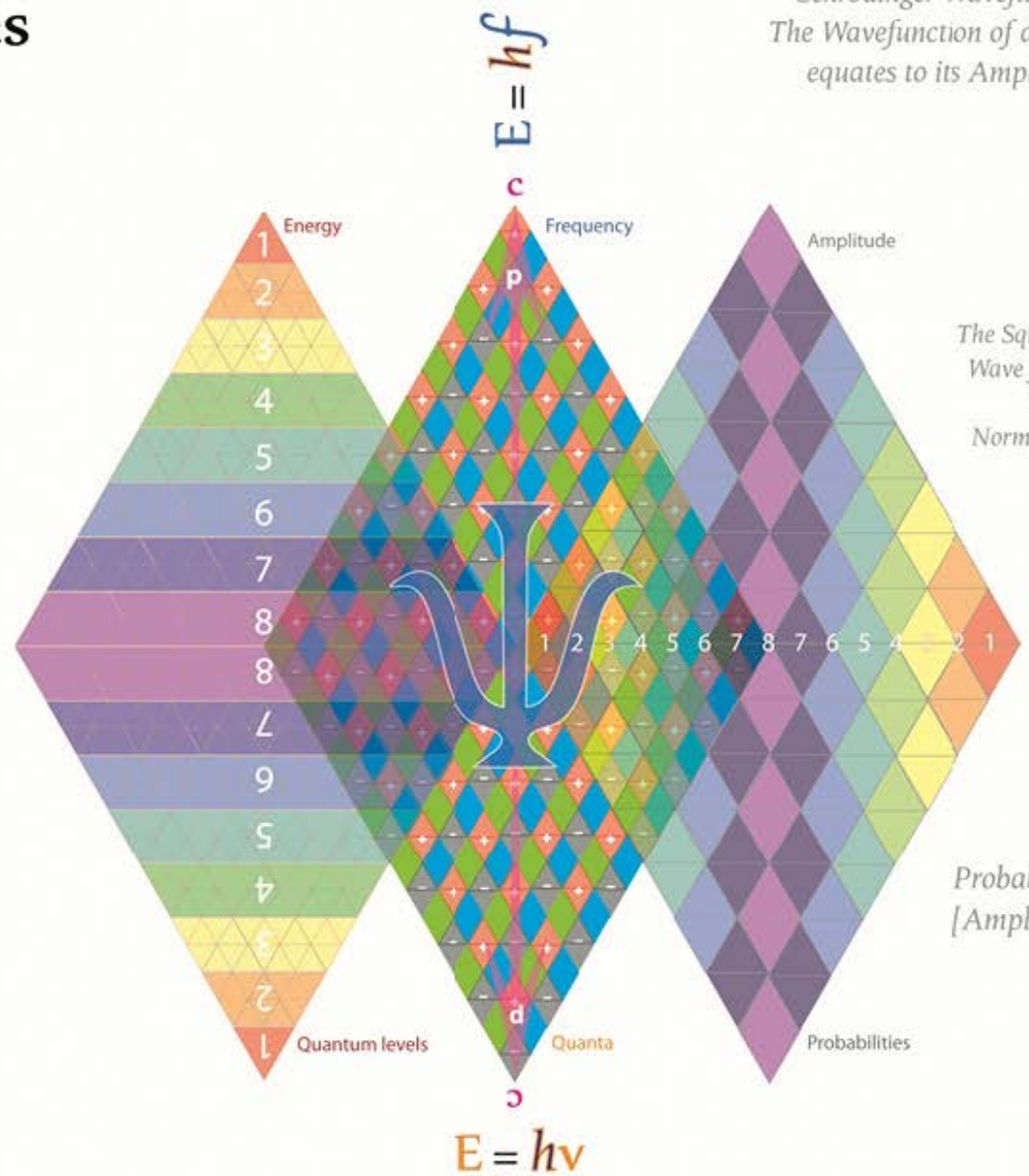

The Square of a
Wave function
is
Normalizable

Probability =
[Amplitude]²

Born Probability Rule
The Probability of finding a Particle
is the Square of its Amplitude

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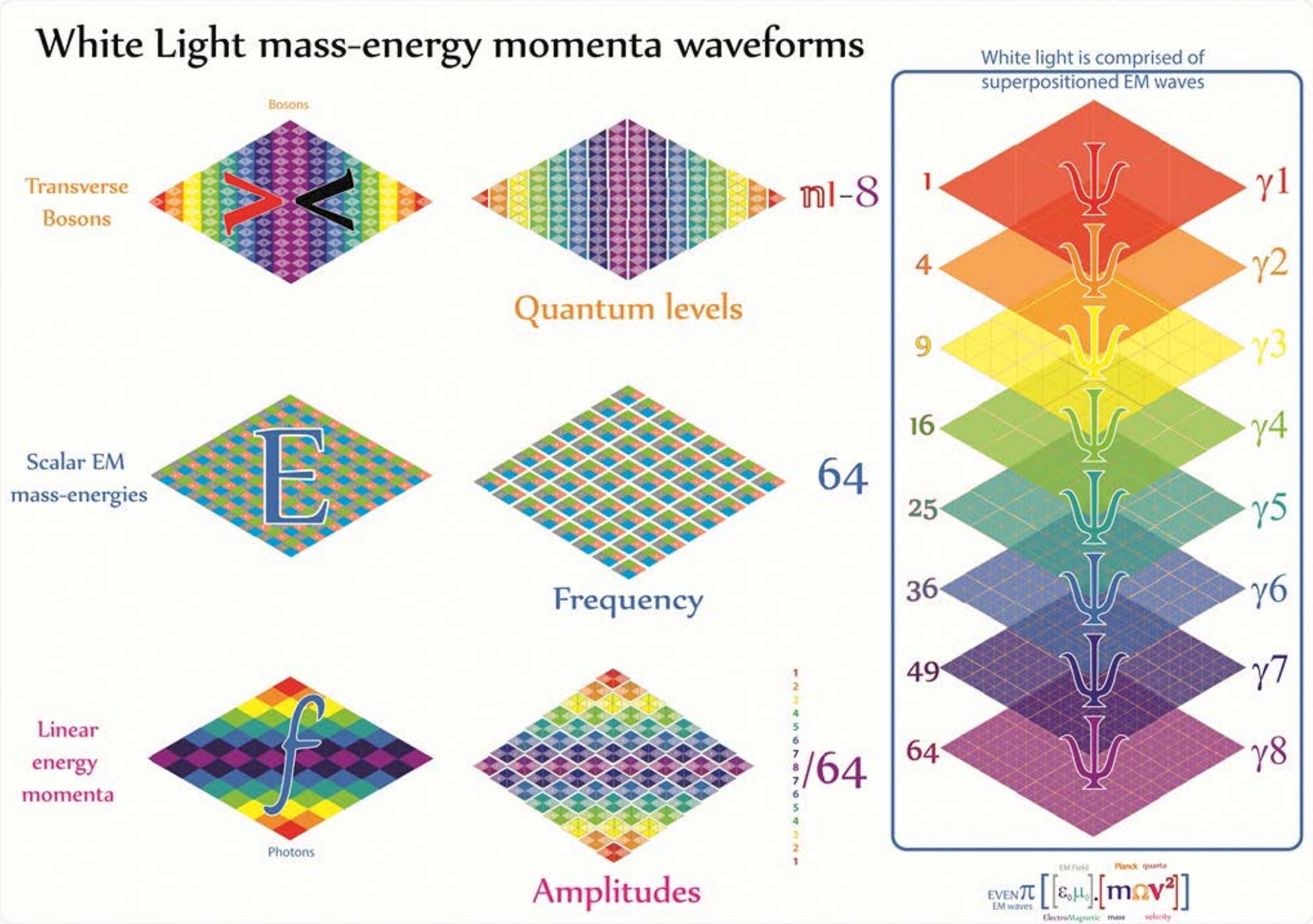

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Bosons and Photons

EM waves are comprised of longitudinal [E=hf] Photons which in turn can also be measured as transverse [E=nhv] Bosons

Electro-Magnetic Fields

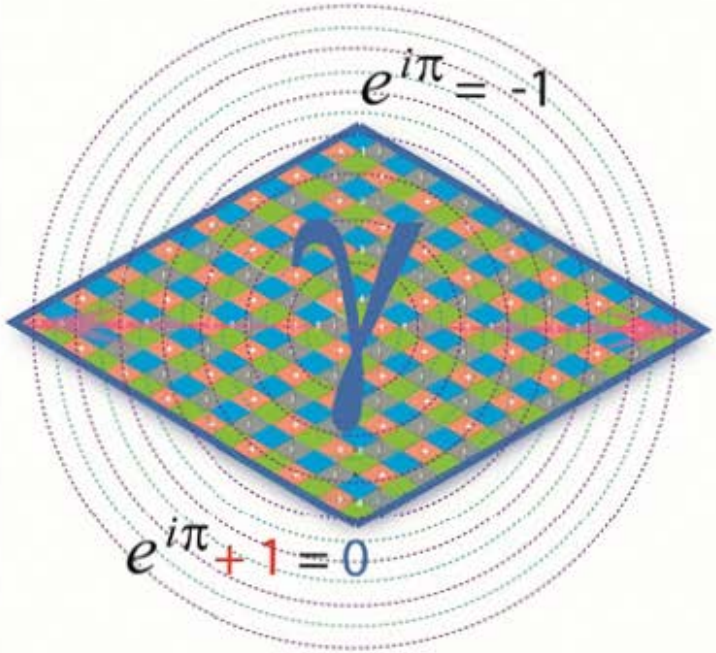

As described by Lorentz co-ordinate transforms the neutral quantum coin [quoin] geometry of all photons and EM waves have mirror E-field charges on each of their opposing fascia

2D planar mass-energy momenta waveforms

$$\underset{\text{Photons}}{2\pi}\left[\left[\underset{\text{ElectroMagnetic}}{\varepsilon_0\mu_0}\right].\left[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v^2}\right]\right]$$

EM Field — Planck quanta

Photons and EM waves have dual c² space-time geometries
(8.987551787 e16 m/s)

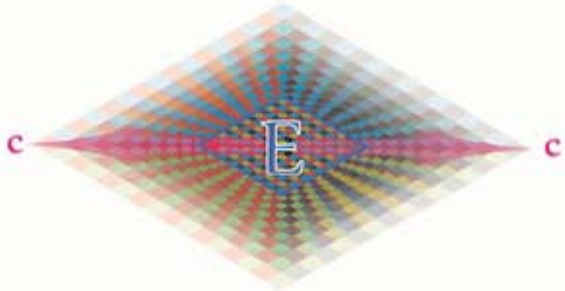

Photons and EM waves propagate outwards from their source at 'c'
(299,792,458 m/s)

$$\underset{\text{EM waves}}{\text{EVEN}\,\pi}\left[\left[\underset{\text{ElectroMagnetic}}{\varepsilon_0\mu_0}\right].\left[\underset{\text{mass}}{m}\,\Omega\,\underset{\text{velocity}}{v^2}\right]\right]$$

EM Field — Planck quanta

EM waves are detected as alternating radial electric E-wave radiation fields

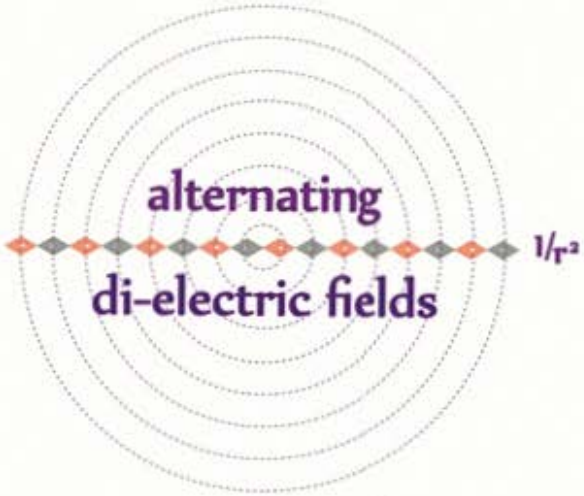

EM wave radiation

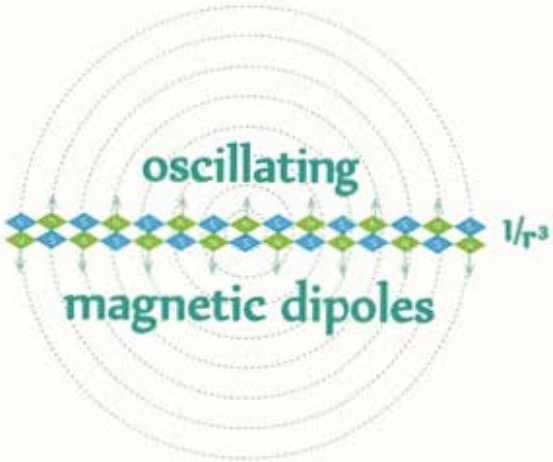

The Magnetic vector of EM energy momenta propagate orthagonally to their E-fields

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EM wave patterns

Polarised Photons and EM waves produce linear interference patterns

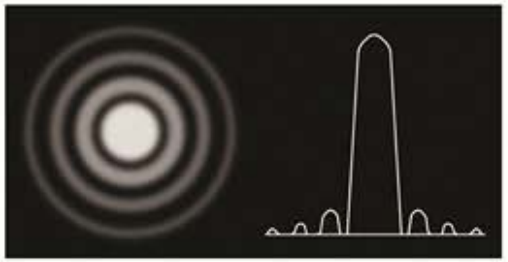

Diffraction occurs whenever propagating waves appear to bend around small obstacles in their path and spread out as smaller waves waves past any openings. its effects are generally most pronounced for waves whose wavelength is roughly similar to the dimensions of the diffracting objects.

If the obstructing object provides multiple, closely spaced openings, a complex pattern of varying intensity can result.

This is due to the superposition, or interference, of different parts of a wave that travels to the observer by different paths

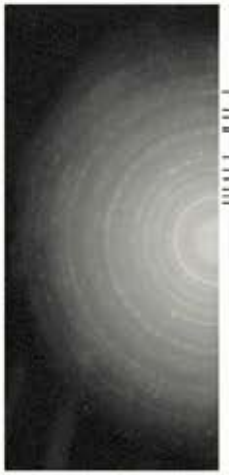

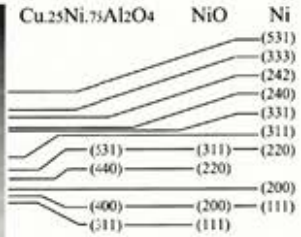

atomic diffraction spectroscopy of matter plays an important role in the chemical analysis of elements and compounds

Diffraction occurs with all waves, including sound waves, water waves, as well as with electromagnetic waves such as visible light, X-rays and radio waves.

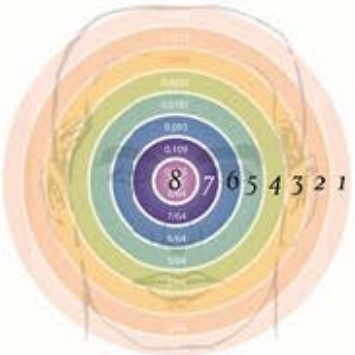

Un-Polarised Photons and EM waves produce circular diffraction patterns

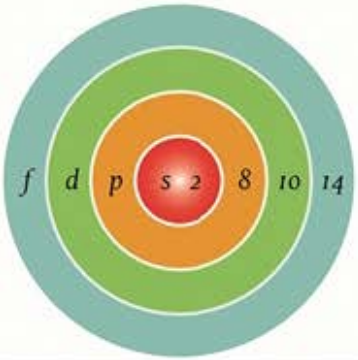

Richard Feynman once commented that:
"No-one has ever been able to define the difference between interference and diffraction satisfactorily. It is just a question of usage, and there is no specific, important physical difference between them."

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Light waves

Thomas Young

(13 June 1773 – 10 May 1829)

In order to establish his wave theory of light Young had to overcome the century-old view, expressed by Sir Isaac Newton' in his treatise "Optics", that light is a particle of colour.

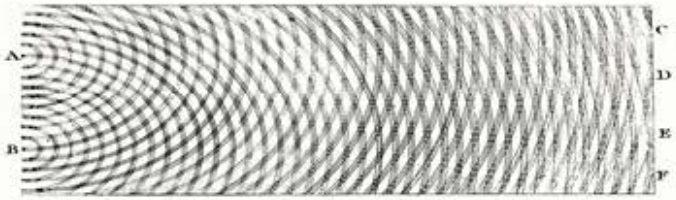

Thomas Young studied the interference of light waves by shining light through a screen with two slits equally separated, where the light emerging from the two slits would spread out and eventually superposition [overlap] each other to produce a distinct interference pattern

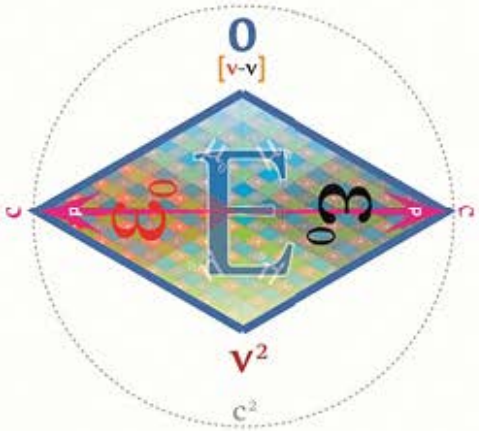

$$E = mv^2$$

"The term energy may be applied, with great propriety, to the product of mass or weight of a body, into the square of the number expressing its velocity.

Thus, if the weight of one ounce moves with a velocity of a foot in a second, we call its energy 1; if a second body of two ounces has a velocity of three feet in a second, its energy will be twice the square of three, or 18."

$$KE = \frac{1}{2}Mv^2$$

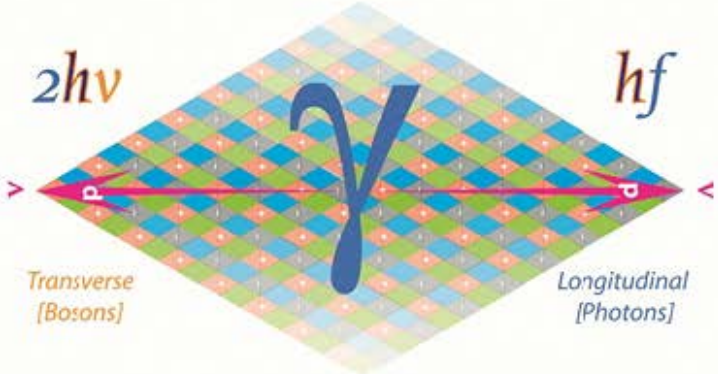

$$E_\gamma = 2mv^2$$

Photons are radiative Kinetic EM mass-energies

$$p^2 = KEM = Mv^2$$

All EM waves have energy momenta geometries whose physical properties can be modeled with statisical probabilities due to their equilateral wavefunctions

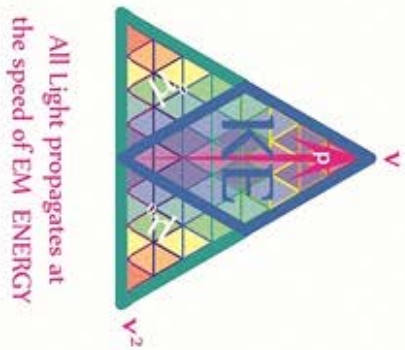

Tetryonics reveals the true geometry of Light
and dispels the misconceptions surrounding its physical properties of wave-length, energy momenta, frequency and associated wave-function

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Photon-EM Wave Superpositioning

In physics, the Superposition principle, also known as superposition property, states that, for all linear systems, the net response at a given place and time caused by two or more stimuli is the sum of the responses which would have been caused by each stimulus individually.

$$F(\psi_1+\psi_2)= F(\psi_1) + F(\psi_2)$$

Positive quantum charge state is one side of the quantum energy momenta quoin

Negative quantum charge state is the other side of the quantum energy momenta quoin

Photons are neutral EM wavepackets

whose chiral quantum charges can be determined through Lorentz co-ordinate transformations

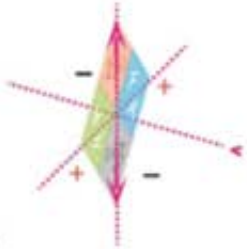

The linear momenta of transverse waves is orthagonal to the direction of wave propagation

The linear momenta of longitudinal waves is co-linear to the direction of wave propagation

transverse Radio waves

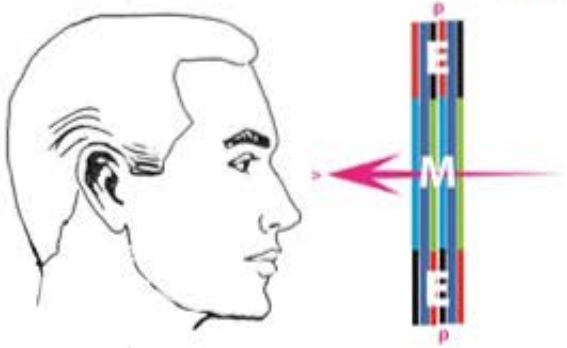

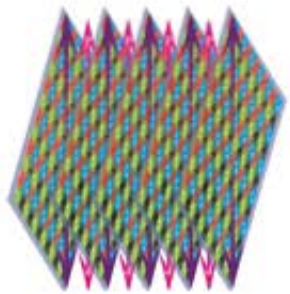

longitudinal Spectral lines

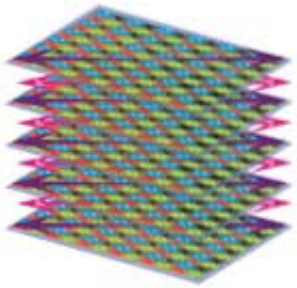

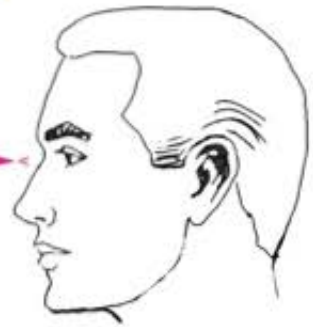

$mc^{2\,2}$ *Superpositioned EM waves can be likened to the cells of a chemical battery* mv^4

E^2

p^4

It is the superpositioning of longitudinal EM waveforms that creates white light and linear interaction-at-a-distance forces

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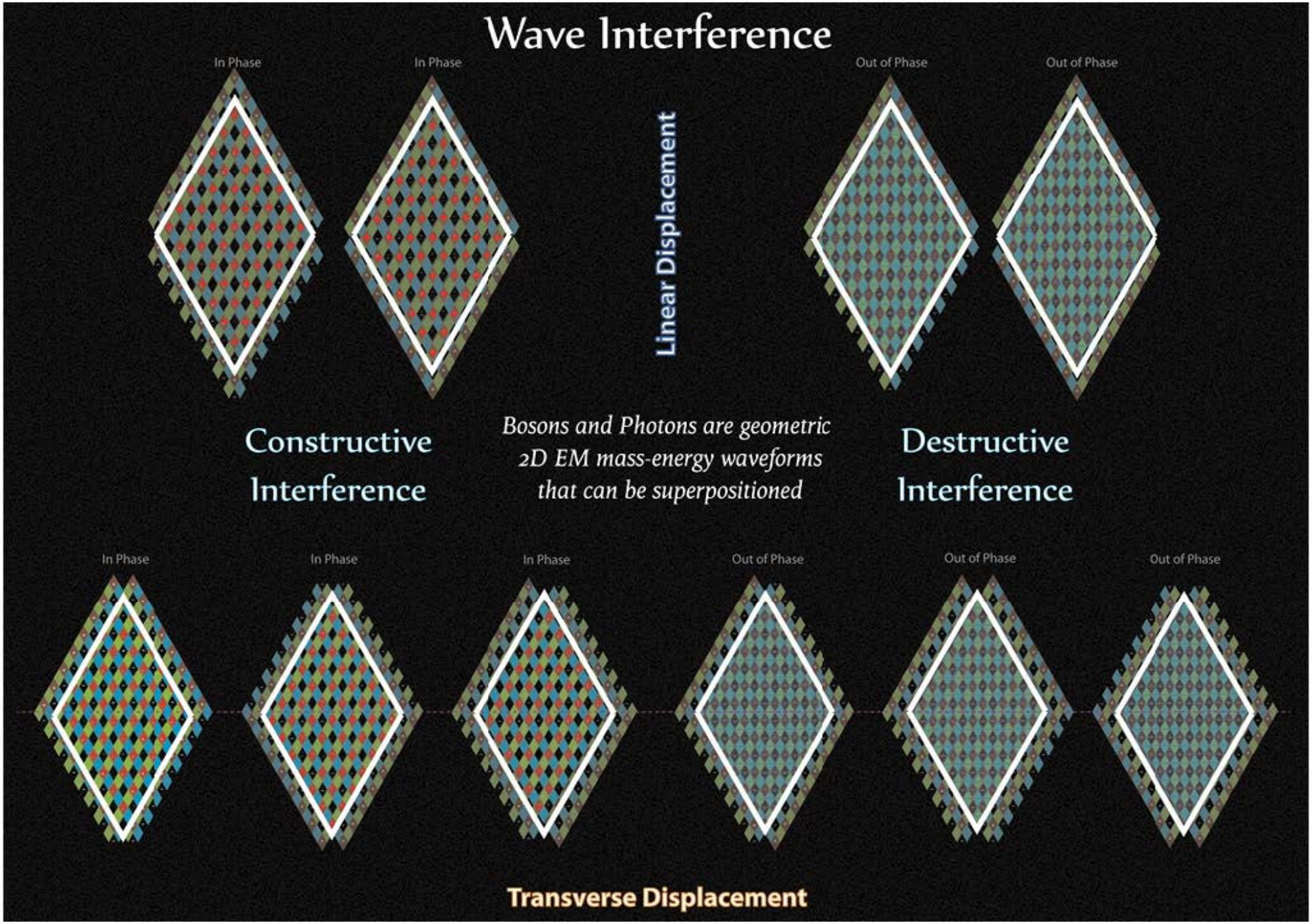

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Wave phase interference

The interference patterns produced by the photon intensities of superpositioned EM waveforms have been historically interpretted as being the result of transverse radial wave fronts

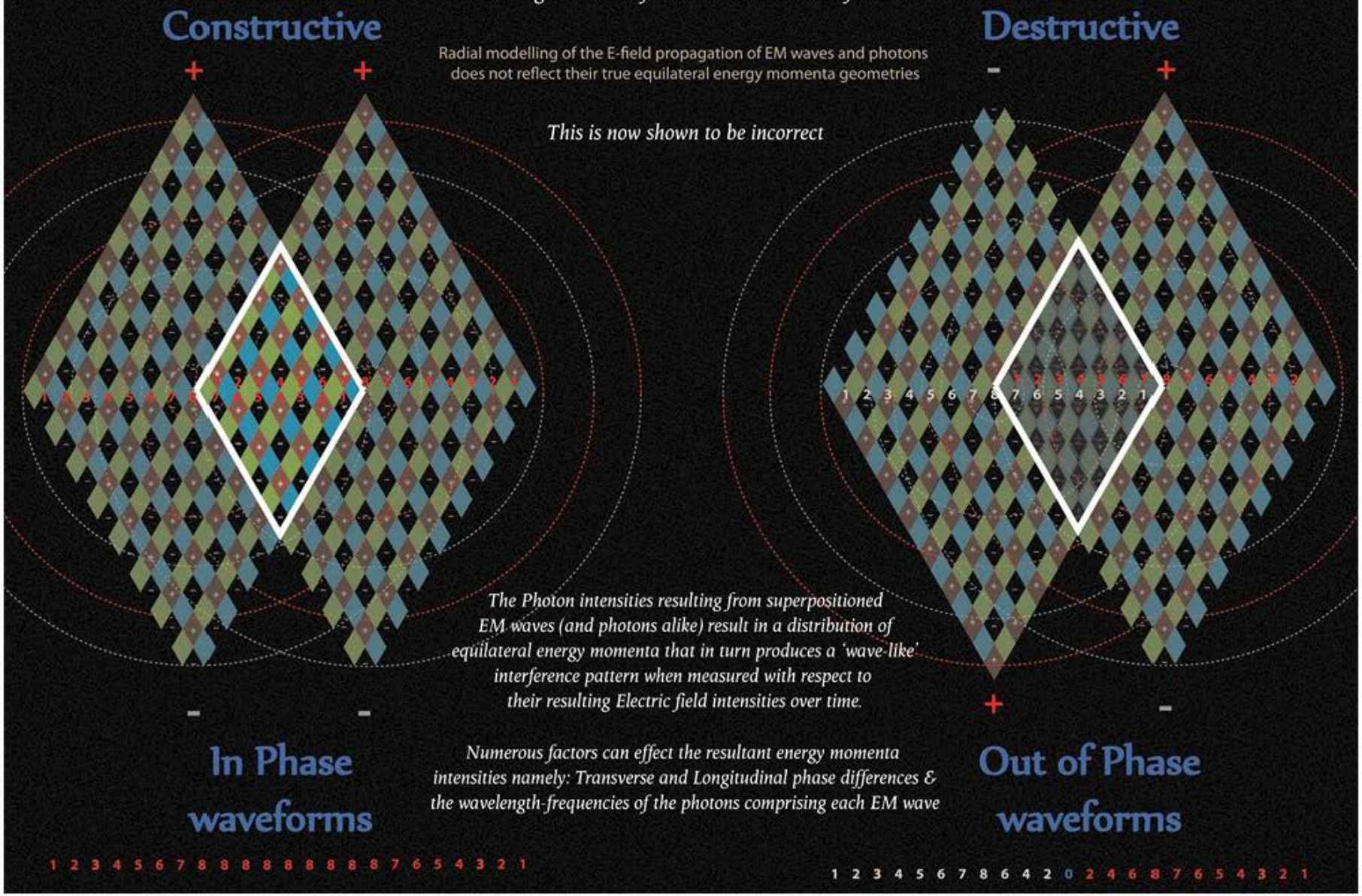

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Matter in motion

Transverse EM mass-energies

$E = h\nu$

Longitudinal EM mass-energies

$E = hf$

Historically modeled through relativistic stress energy tensors
all Matter in motion is possessive of distinct energy waveforms:
a standing wave mass-energy geometry [Matter particle] &
a divergent kinetic mass-energy field [KEM wave]

$T\mu\nu$

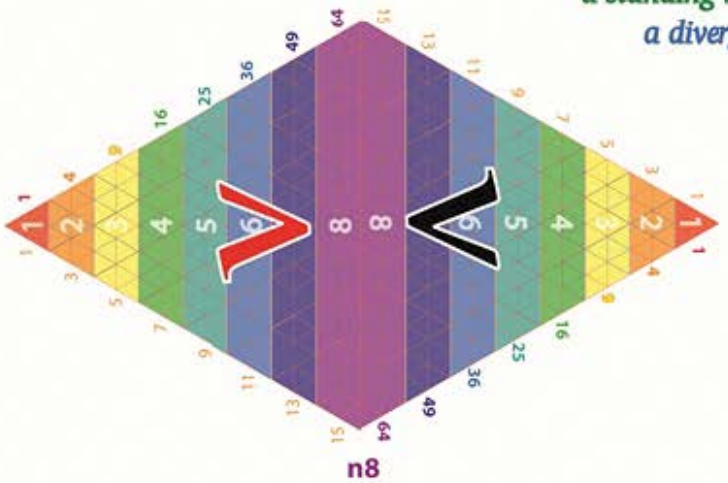

EM induction and forces are effected by
neutral bi-directional KEM mass-energy fields
with interactive energy momenta

Negative charges in motion

Positive charges in motion

unidirectional negative KEM fields
with interactive energy momenta

electromagnetic waves
[neutral bosons and/or photons]

unidirectional positive KEM fields
with interactive energy momenta

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Photon Intensity

Photon Intensity is a result of the geometry of EM waves [which in turn is directly proprtional to the velocity of the mass-Matter] and can be measured in a number of vaying ways related to the mass-energy momenta of the EM wave

Wavenumbers, frequency or wavelength
Transverse EM masses [BOSONS]
Longitudinal EM masses [PHOTONS]
Wavefunction probabilities [WAVE-FUNCTIONS]

The wave~particle nature of mass-Matter in motion has been the subject of much debate since Lucretius in 55BC with the debate intensitying with Newton's and Young's differing views and the development of Planck-Einstein quantum mechanics of the photo-electric effect

All Matter in motion [or not]
has both an intrinsic Matter-wave function
and an extrinsic KEM mass-energy wave function

Transverse boson wavefunction

$$\text{ODD}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right] \qquad E = n.h\nu$$

EM Field — Planck quanta — Bosons — ElectroMagnetic — mass — velocity

128

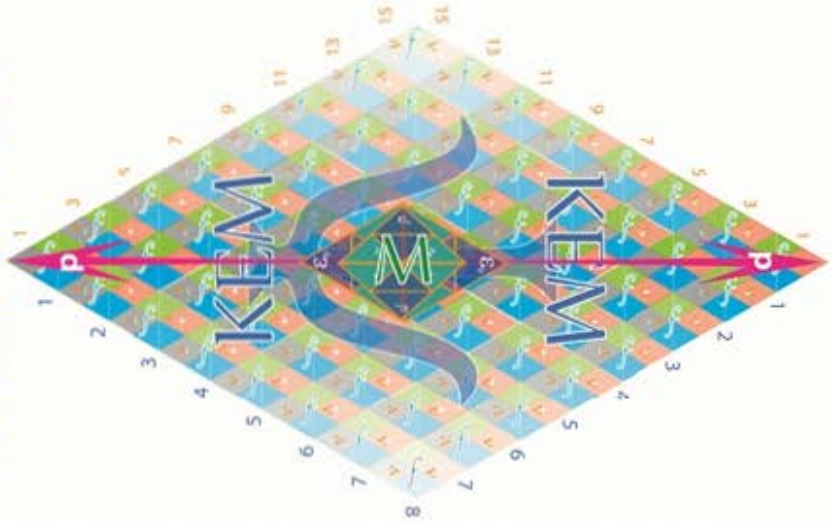

$$\text{EVEN}\,\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

EM waves — EM Field — ElectroMagnetic — mass — Planck quanta — velocity

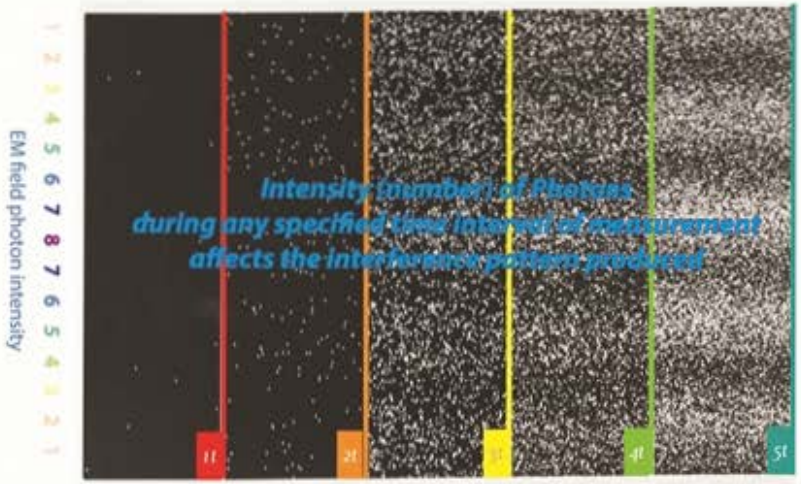

64

$$2\pi\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right] \qquad E = hf$$

EM Field — Planck quanta — Photons — ElectroMagnetic — mass — velocity

Longitudinal photon wavefunction

The measurement of Photons with the use of Photo-multipliers and Charge coupled Devices results in the measurement of the E field properties of EM waves (producing the long confusing wave particle results obtained by diffraction gratings)

In turn these results have been historically misinterpreted as a waveform property that cannot be attributed to the particle properties of a Photon.

Tetryonic geometry clears this matter up once and for all.

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Interference Patterns

ε_0

When EM waves pass through
the slits they are detected via their E-fields
as photons of varying strength energy momenta
producing the impression of a interference pattern

μ_0

$E = h\nu$

$E = hf$

Every EM wave is comprised of identical, specific wavelength photons which are arranged in a Normal distribution resulting from the electromagnetic Wavefunction with a peak value equal to the wave's amplitude

[the square root of the EM wave's Wavefunction/Probability amplitude]

Photons impact screens and
photo-detectors with intensities
that are determined by their
energy momenta distributions

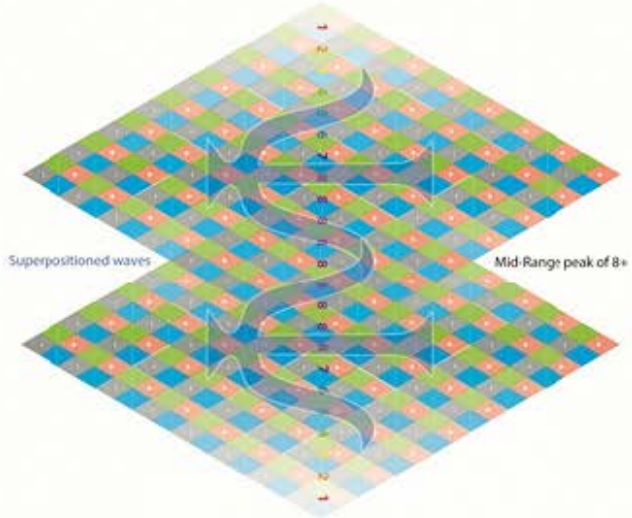

The resultant amplitudes are a direct result of the Phase of the Superpositioned photons within EM waves

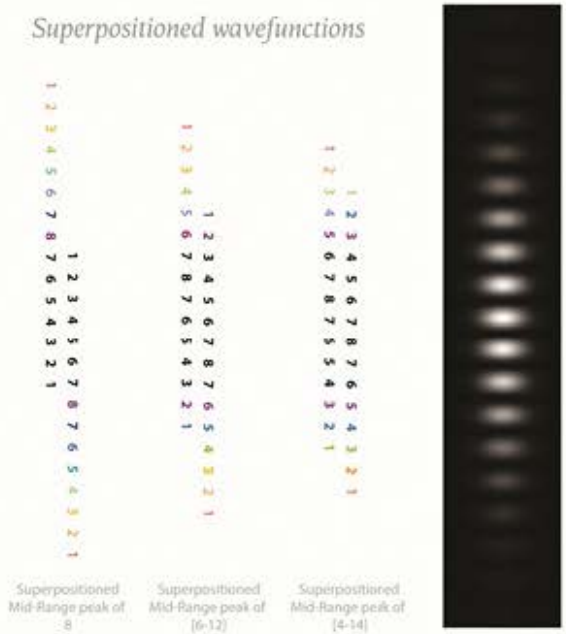

ALL EM mass-ENERGY Matter geometries
being comprised of energy-momenta quanta
are capable of producing interference patterns

The amplitudes of the detected photons in the resultant interference patterns are determined by their constructive/destructive superpositioning in each wave explaining the interference patterns currently accounted for by Young's wave theory

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Single slit experiment

If light consisted strictly of ordinary or classical particles, and these particles were fired in a straight line through a slit and allowed to strike a screen on the other side, we would expect to see a pattern corresponding to the size and shape of the slit. However, when this "single-slit experiment" is actually performed, the pattern on the screen is a diffraction pattern with a fairly narrow central band with ever diminishing bands parallel to it on either side

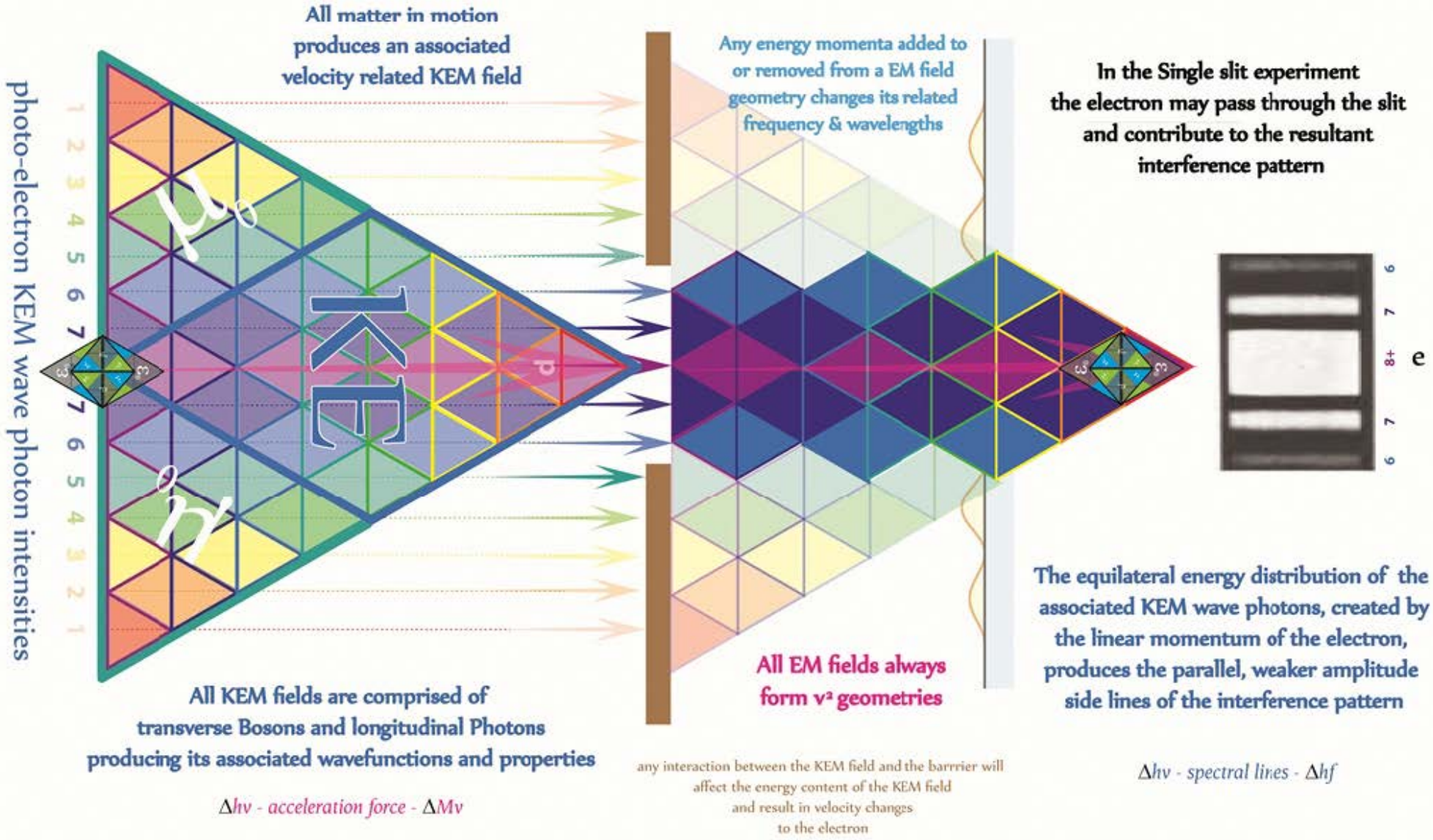

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Double slit experiments

The double-slit experiment, sometimes called Young's experiment, is a demonstration that matter and energy can display characteristics of both waves and particles, and demonstrates the fundamentally probabilistic nature of quantum mechanical phenomena and Establishes the quantum interference principle known as wave–particle duality.

Matter particles are stopped by the barrier but the [K]EM wave passes through both slits and is diffracted by them producing weaker EM waves that then superposition with each other to produce interference patterns

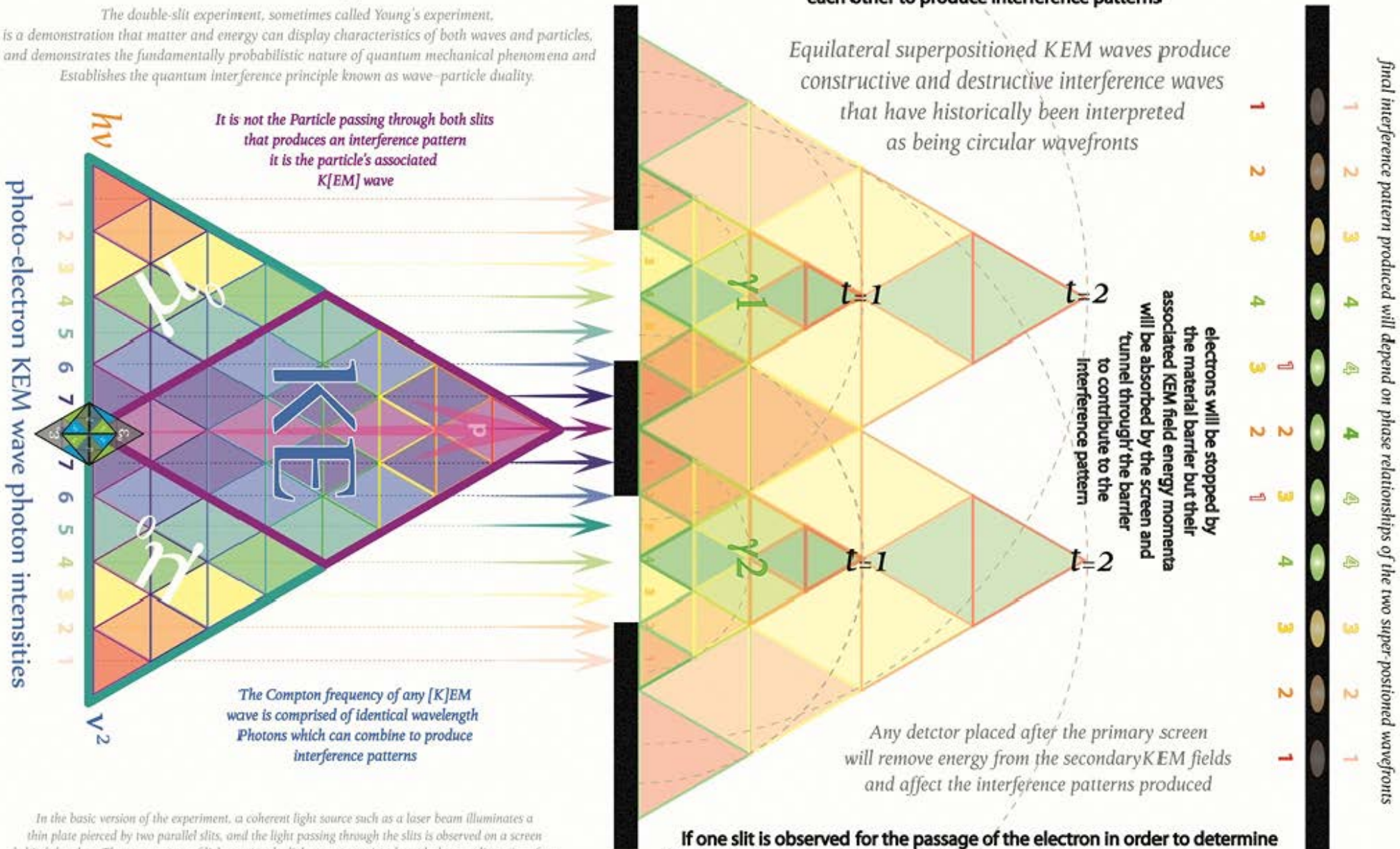

In the basic version of the experiment, a coherent light source such as a laser beam illuminates a thin plate pierced by two parallel slits, and the light passing through the slits is observed on a screen behind the plate. The wave nature of light causes the light waves passing through the two slits to interfere, producing bright and dark bands on the screen — a result that would not be expected if light consisted strictly of particles. However, on the screen, the light is always found to be absorbed as though it were composed of discrete particles or photons.

If one slit is observed for the passage of the electron in order to determine its physical state then the its KEM field wave will be absorbed by the detector resulting in only one wave remaining, enforcing a classical particle outcome

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Light wave Reflection

Excited (or higher energy) Atoms and Molecules can emit light and energy via Electro-dynamics

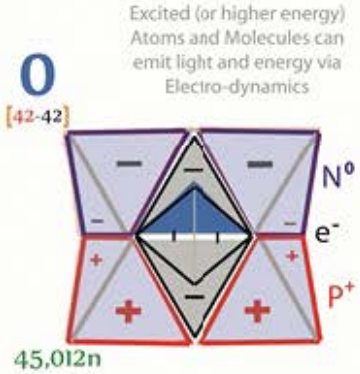

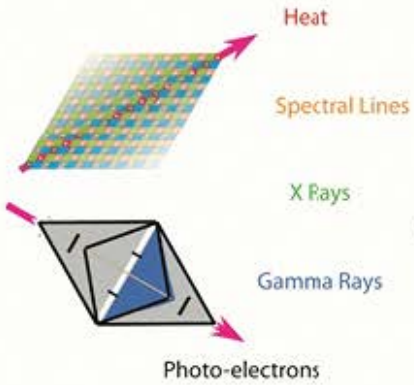

The emitted photon/particle can go in any direction so this is the mechanism for diffuse reflection/radiation.

All Atoms and Molecules have ANGULAR charged fascia in their topologies

Incoming light interacts with a surface and may be absorbed, refelected, and/or transmitted.

Materials have a reflectance spectrum which is a function of the angle of incidence of the incoming light.

The color of an object is a function of the color spectrum of the incident light and the reflectance spectrum of the object's surface.

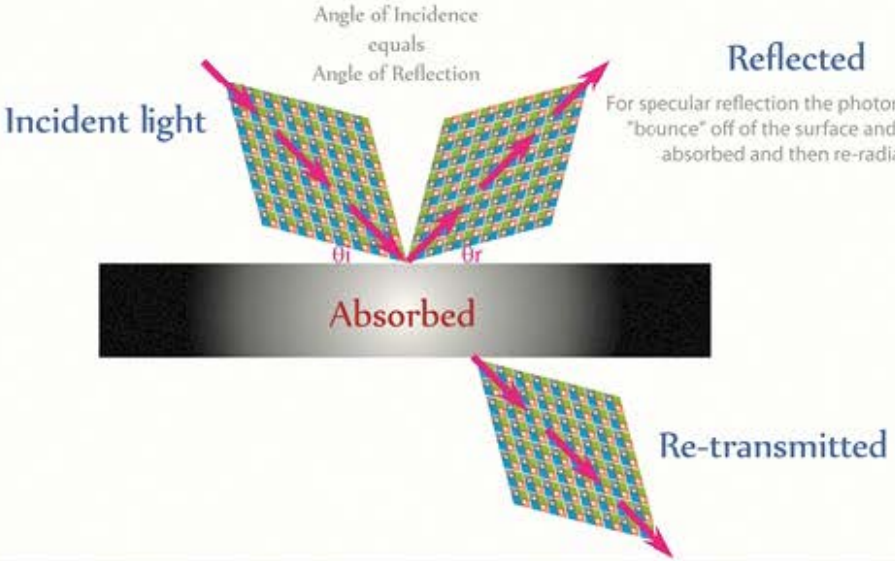

For specular reflection the photons actually "bounce" off of the surface and are not absorbed and then re-radiated

Photon Re-Transmission

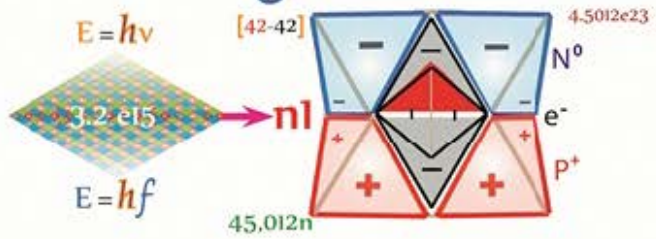

When a photon strikes a atom or molecule it generally imparts EM energy as heat and the photon is absorbed

Photon absorption

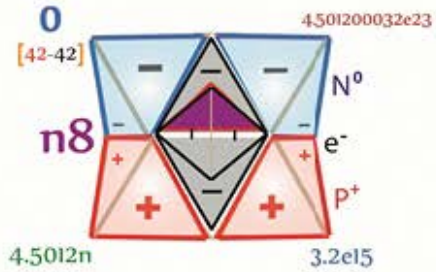

For some photons their EM energy is equal to the resonance energy of the molecule.

When this happens the photon is absorbed and the molecule is put into an excited state

Photon emission

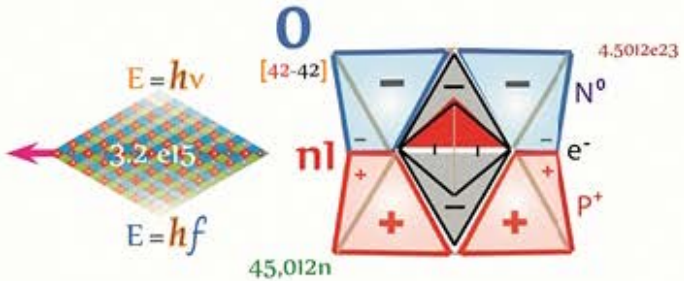

The molecule relaxes from the excited state back to the ground state by emitting a photon with EM energy equal to that of the original photon so the photon appears to have been reflected (but is actually absorbed then emitted)

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Lightwave Refraction

The refraction of light when it passes from a fast medium to a slow medium bends the light ray toward the normal at the boundaries between any two media.

The amount of bending depends on the indices of refraction of the two media and is described quantitatively by Snell's Law.

White light can be refracted into its component spectral colours

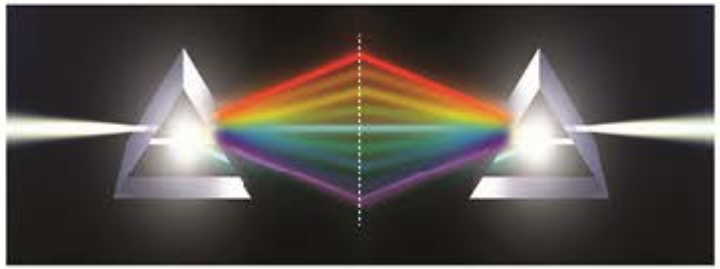

or be re-combined back into white light through superpositioning

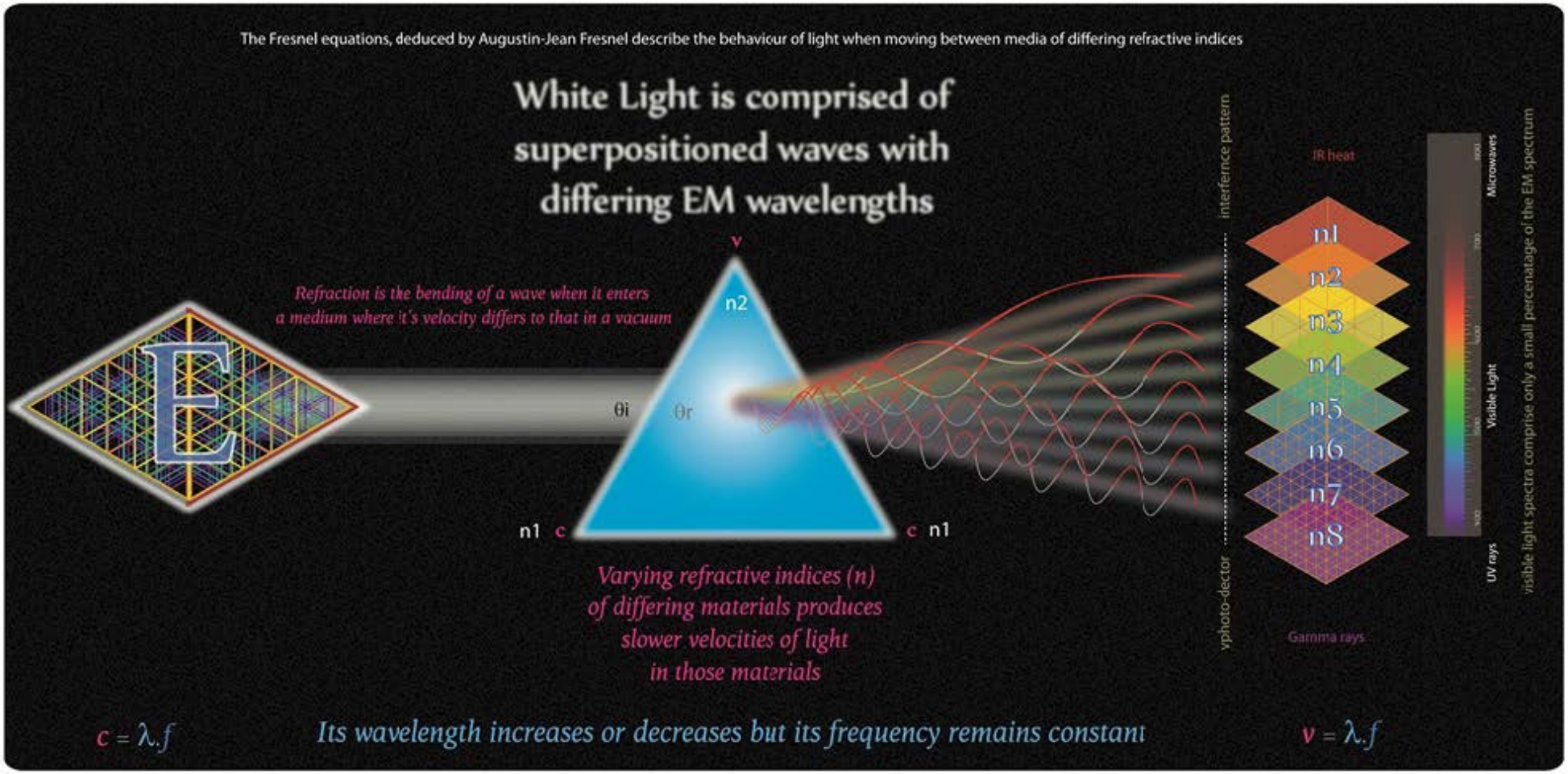

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Ball Lightning

An alternative radiant geometry for electromagnetic waves exists

γ1

The EM energies in radiant 'ball' lightning are transformer-couplings of energy momenta & self-sustaining until any interaction with Matter topologies occurs

γ3

Descriptions of ball lightning vary wildly. It has been described as moving up and down, sideways or in unpredictable trajectories, hovering and moving with or against the wind; attracted to, unaffected by, or repelled from buildings, people, cars and other objects.

Ball lightning has been described as transparent, translucent, multicolored, evenly lit, radiating flames, filaments or sparks, with shapes that vary between spheres, ovals, tear-drops, rods, or disks

γ5

γ2

Any interaction with a 'ball' of EM energies will result in an explosive discharge of it's EM energy momenta

γ7

γ4

γ6

Nikola Tesla was reportedly able to artificially produce 1.5" (3.8 cm) balls using spark gap technologies

Ball lightning creates a strong Magnetic moment and divergent E fields [similar to a bar magnet without the Matter] creating a "Ball" of light with varying EM energies that is sensitive to external M fields

γ8

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Wave~Particle interaction-at-a-distance

All Matter in motion has both:

a standing wave energy topology [Particle] and

a divergent relativistic, Lorentz velocity corrected geometric field of mass-energy momenta [KEM Wave]

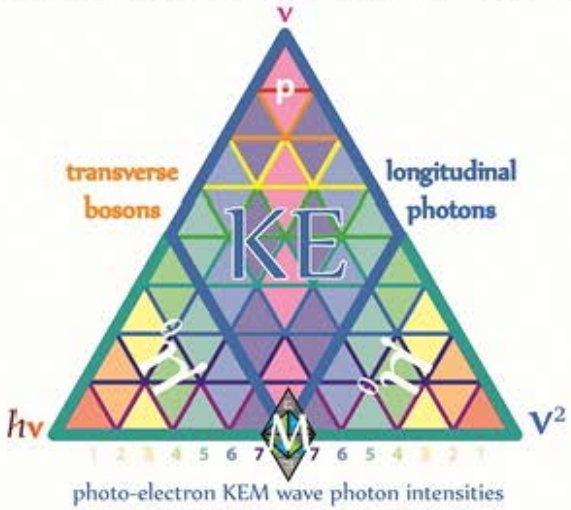

Whether it is Light itself or the KEM field of Matter in motion all EM fields are comprised of transverse bosons and longitudinal photons with probabillistic wave geometries

$$RE = M + KEM$$

relativistic energies — Matter — kinetic energies

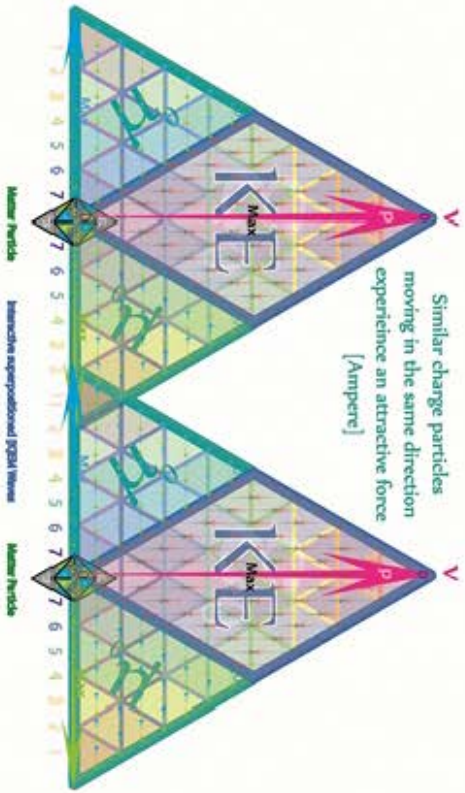

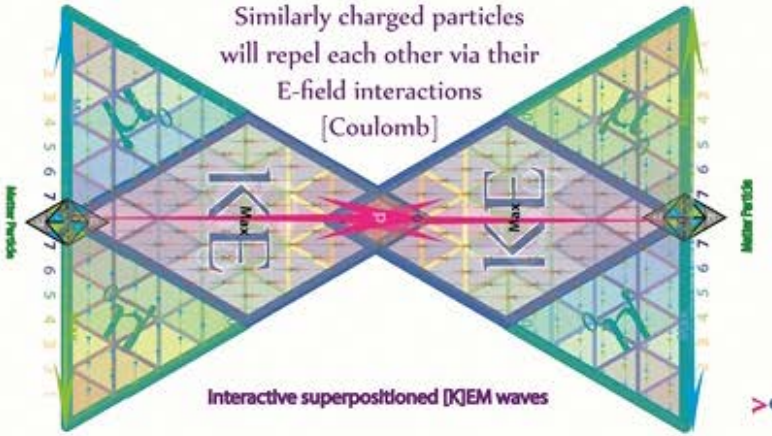

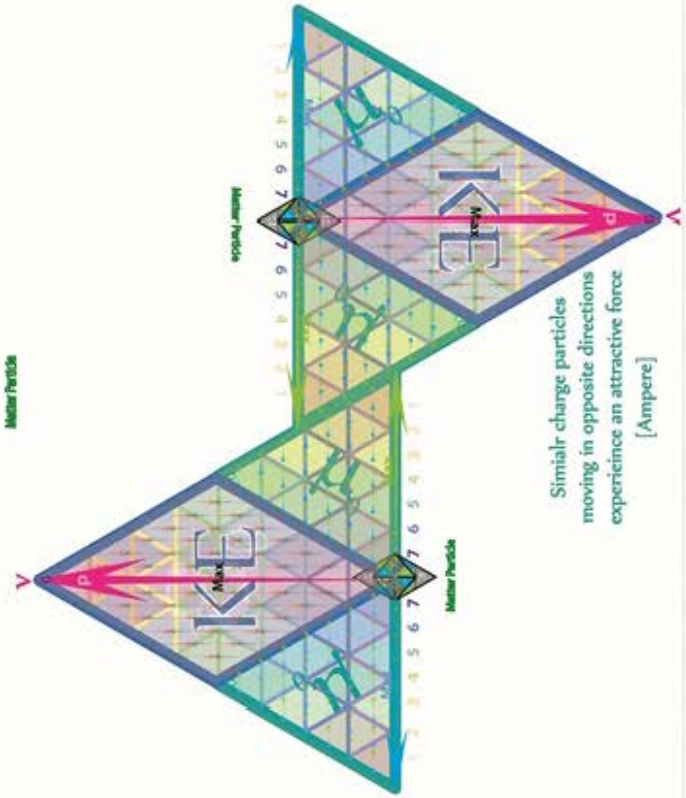

Force fields and interaction-at-a-distance

All Matter in motion produces an associated Lorentz velocity corrected KEM field of interactive energy momenta photons

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Quantum Tunnelling

Particles attempting to travel between potential barriers can be compared to a ball trying to roll over a hill; quantum mechanics and classical mechanics differ in their treatment of this scenario.

Classical mechanics predicts that particles that do not have enough energy to classically surmount a barrier will not be able to reach the other side. Thus, a ball without sufficient energy to surmount the hill would roll back down.

Or, lacking the energy to penetrate a wall it would bounce back (reflection) or in the extreme case, bury itself inside the wall (absorption).

In quantum mechanics, these particles can, with a very small probability, tunnel to the other side, thus crossing the barrier.

The quantum magician's slight of hand trick is where the incident electron is swapped another

All electrons are IDENTICAL

It is practically impossible to identify a particular electron and track it

even using spin orientations only eliminates half of the total electrons in the barrier

Reflection of Particle

If the collision is inelastic the KEM field energy will be reduced along with the particle's velocity

Absorption of Particle

When the electron is captured by an atom its KEM energies will continue to propagate until it is absorbed or makes its way out through re-emission

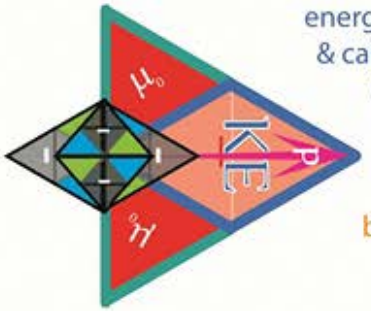

KEM field 'tunnels' out

Quantum KEM field tunnelling is an example of conservation of energy momenta on the atomic scale & can be likened to a unidirectional version of Newton's cradle

Removal of all electrons but the one under measurement is impractical as it would result in an attractive coloumbic force that would trap the electron in the barrier

The most probable explanation of quantum tunneling is that the original electron was bound to atoms in the material barrier and its KEM field propagated through the barrier along its original direction of momentum.

Upon reaching the opposite side/edge of the barrier its remaining energies are able to accelerate any weakly bound electron found there

Quantum 'tunnelling' is revealed to be the result of an electron's KEM wave propagation through the barrier not the electron itself

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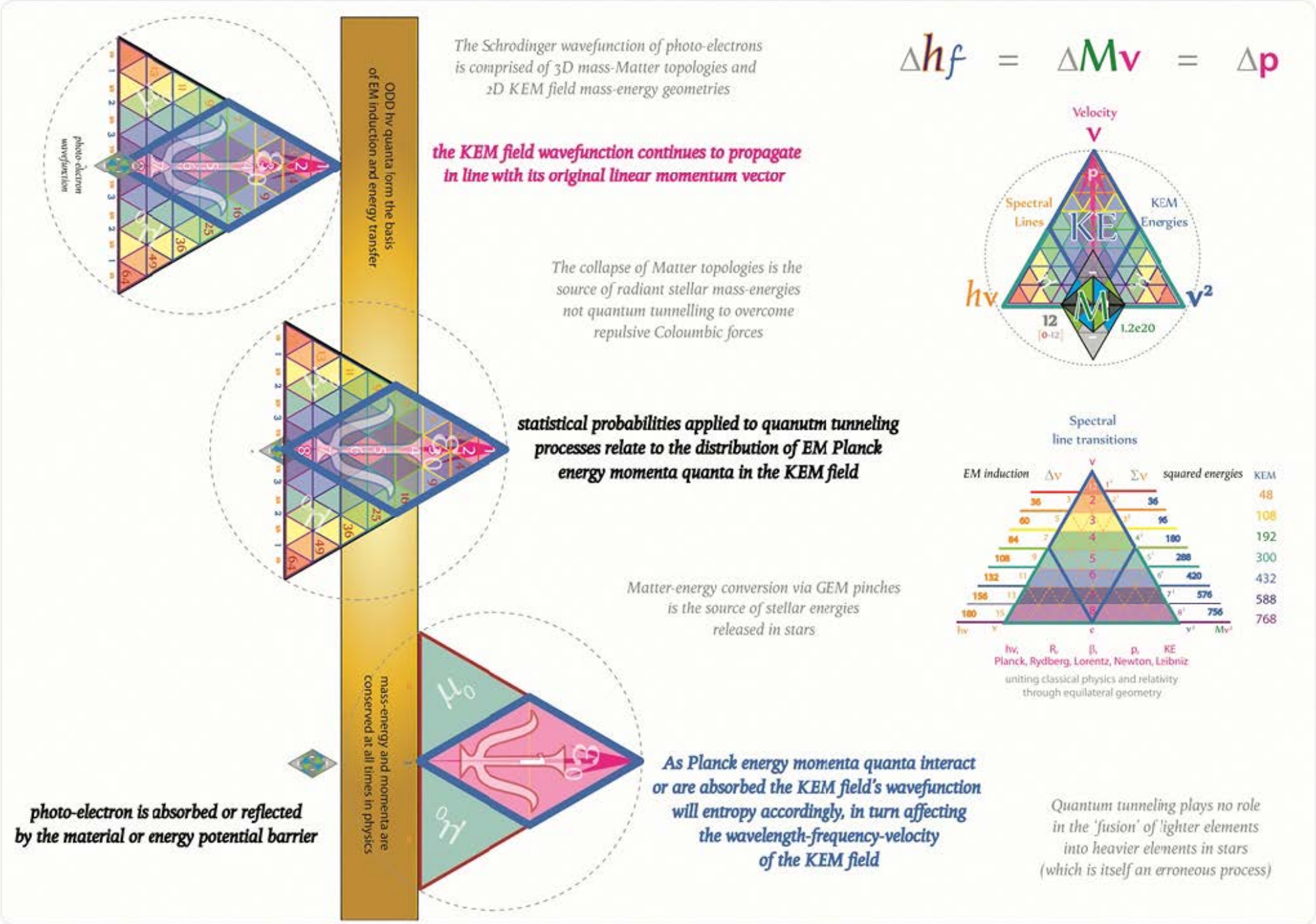

Tetryonics 39.17 - mass-energy momenta induction & conservation

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All Matter in motion is comprised of:

a mass-Matter standing-wave topology,
and
a KEM mass-energy field geometry

whose quantised energy momenta is reflective of the particle's vector velocity

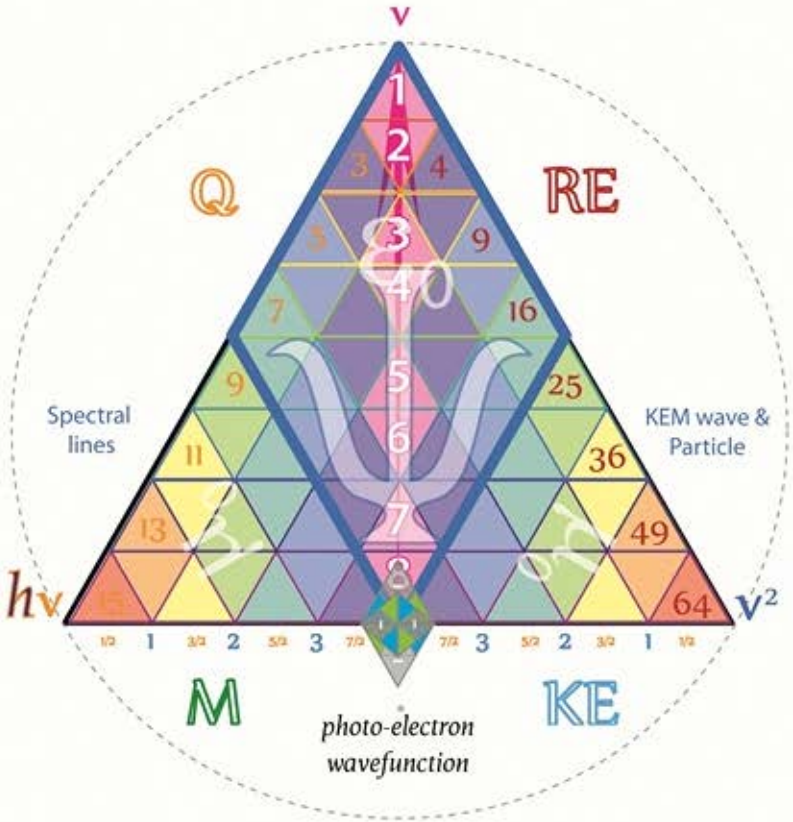

The normal distribution of Planck energy momenta in any KEM field is the quantum foundation for the statistical probability mechanics of quanutm mechanics and quantum electrodynamics

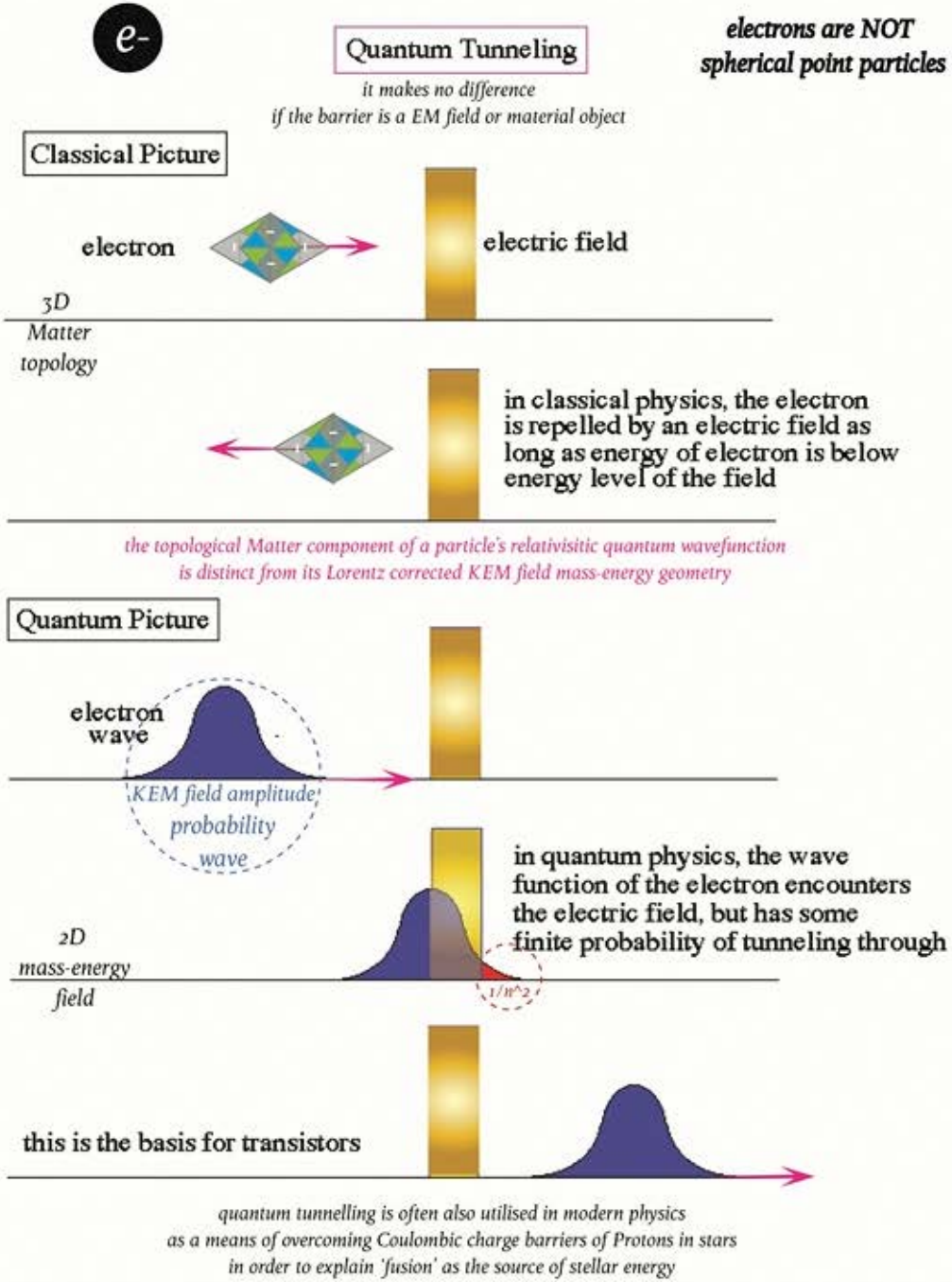

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Relativistic Kinetic Energies

$$KE = \frac{1}{2}M\frac{v^2}{c^2}$$

The relativistic Kinetic mass-energies of all Matter topologies in motion are contained in their KEM fields and are subject to Lorentz velocity corrections

$$p^2 = E = m\frac{v^2}{c^2}$$

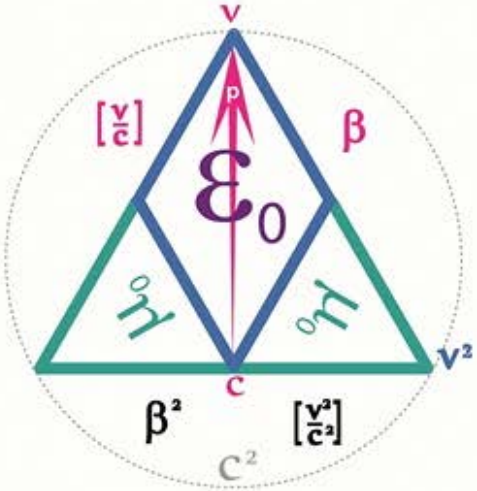

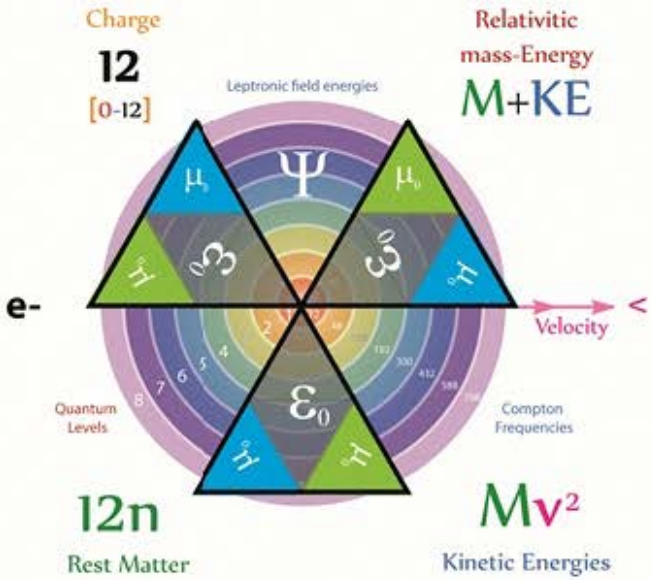

Lorentz contractions only apply to the KEM fields of Matter in motion

The Kinetic Energies of a particle in motion can be expressed in terms of its linear momentum

$$\frac{p^2}{2m} = KE = \frac{1}{2}Mv^2$$

or equally as 1/2 the total relativistic EM mass-energies [exclusive of its invariant rest mass-Matter]

Charge and Matter topologies are Lorentz invariant

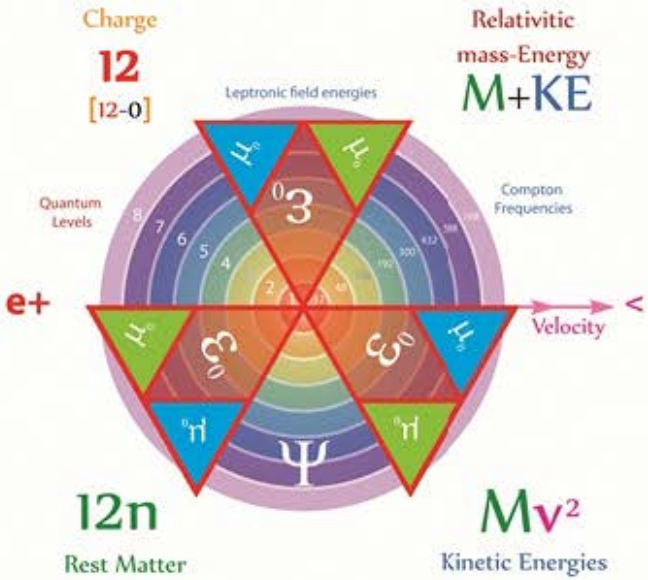

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Relativistic Lorentz Corrections

ges their name from their earliest appearance, in Lorentzian electrodynamics
as velocity increases the wavelengths and physical scalar geometries of Planck quanta decreases

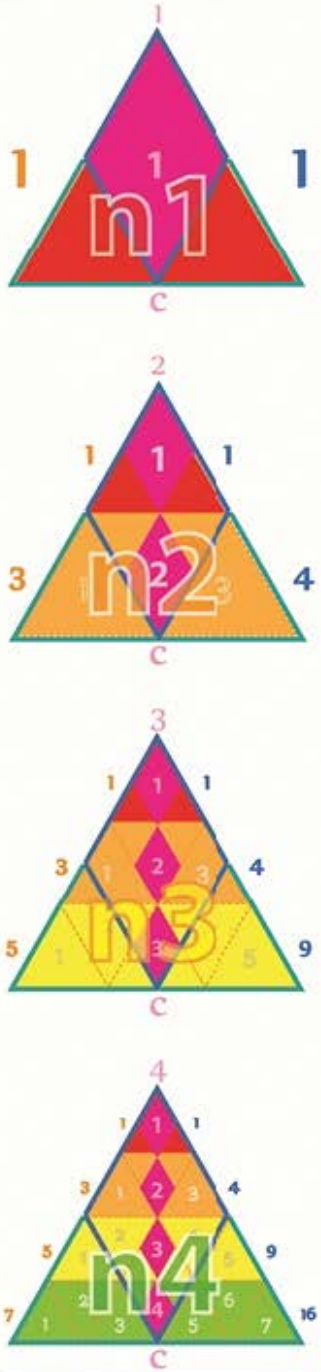

Linear correction factor

$$\beta = \left[\frac{v}{c}\right]$$

Scalar correction factor

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

Equilateral QAM contractions

$$t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}}$$

ODD number transverse bosons

SQUARED number scalar energies

'WAVE-length' contractions

$$L = L'\sqrt{1-\frac{v^2}{c^2}}$$

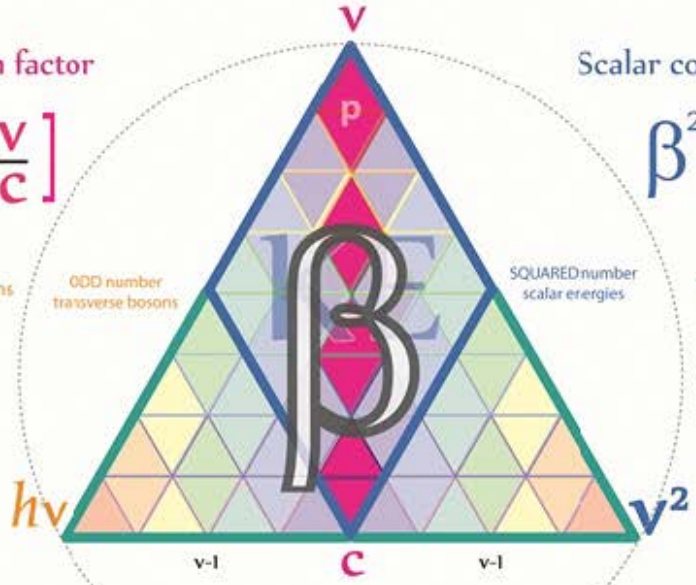

normal proabability distributions

c^2

Matter topologies are Lorentz invariant

KEM geometries are relativistic fields

v $\quad$ v^2

all the quantum energy momenta probabilites of wavefunction distributions re-normalise [or sum] to

c $\quad$ c^2

c is the limiting velocity for the electrical acceleration of Matter

The poor definitions of EM mass & Matter has led to the incorrect application of Lorentz corrections to Matter

Lorentz contractions apply to [K]EM waveforms only

$$\sqrt{1-\beta^2}$$

Incorrectly applied to Matter topologies in motion, The Lorentz factor or Lorentz term appears in several equations in special relativity.

$$\sqrt{1-\left(\frac{v}{c}\right)^2}$$

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The Energy of a Magnet

It is known that Maxwell's electrodynamics--as usually understood at the present time--when applied to moving bodies, leads to asymmetries which do not appear to be inherent in the phenomena. Take, for example, the reciprocal electrodynamic action of a magnet and a conductor. The observable phenomenon here depends only on the relative motion of the conductor and the magnet, whereas the customary view draws a sharp distinction between the two cases in which either the one or the other of these bodies is in motion. For if the magnet is in motion and the conductor at rest, there arises in the neighborhood of the magnet an electric field with a certain definite energy, producing a current at the places where parts of the conductor are situated. But if the magnet is stationary and the conductor in motion, no electric field arises in the neighborhood of the magnet.

In the conductor, however, we find an electromotive force, to which in itself there is no corresponding energy, but which gives rise--assuming equality of relative motion in the two cases discussed--to electric currents of the same path and intensity as those produced by the electric forces in the former case. [On the electrodynamics of moving bodies, A. Einstein, 1905]

Investigation of the source of the emf produced by magnets in conductive loops placed around them led to the development of relativity theory

V

Energy can be removed by placing a conductive loop between any Positive and Negative quanta the EM field thus creating a potential difference & an electro-motive force

ε_0

The neutralised [K]EM fields are divergent from a permanent magnet and create a Magneto-static EM field with neutral Electro-static energies

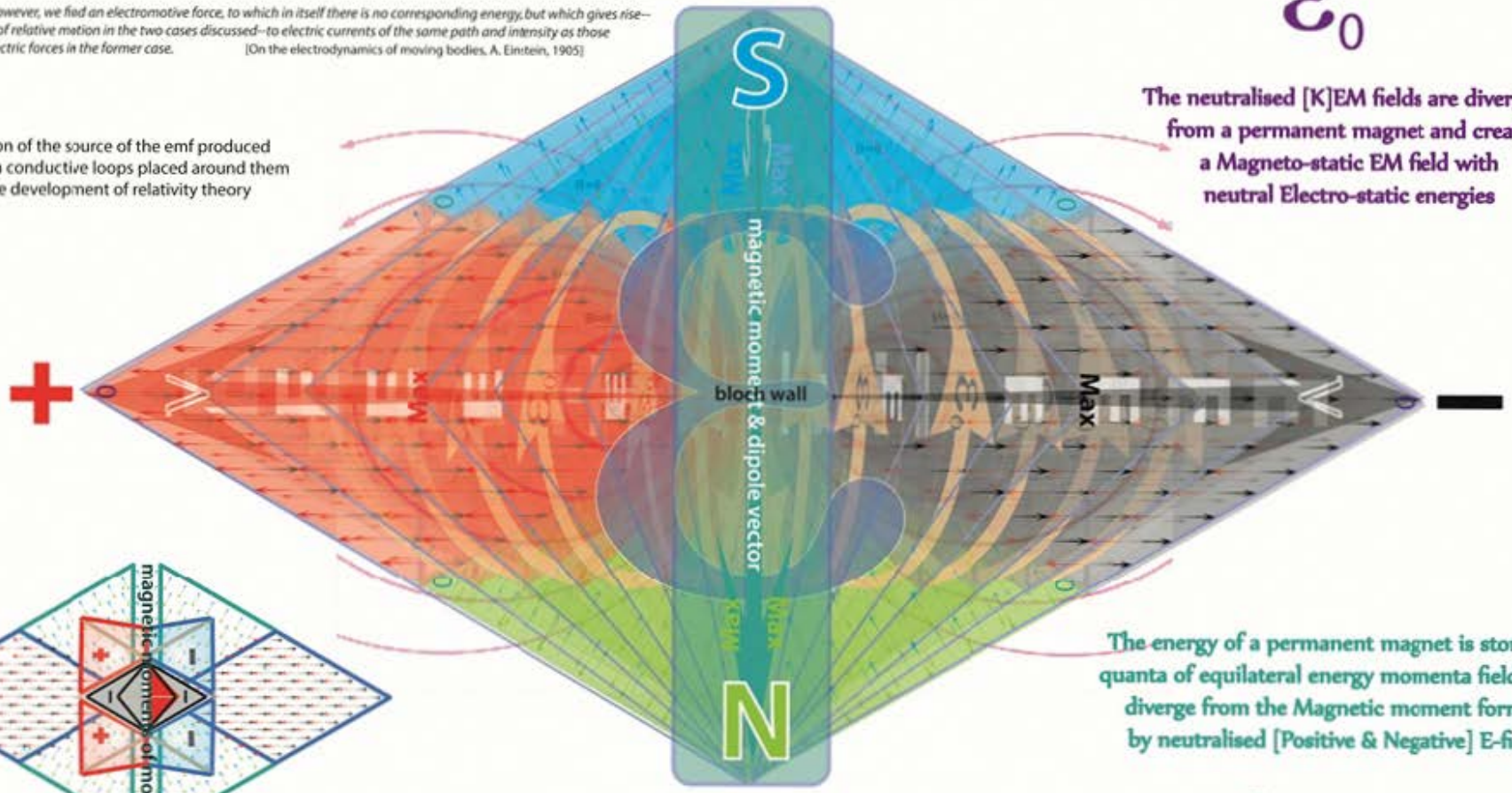

The energy of a permanent magnet is stored in quanta of equilateral energy momenta fields that diverge from the Magnetic moment formed by neutralised [Positive & Negative] E-fields

μ_0 μ_0

Magnetic fields are produced by moving electric charges and the intrinsic magnetic moments of elementary particles associated with a fundamental quantum property, their spin. In special relativity, electric and magnetic fields are two interrelated aspects of a single object, called the electromagnetic field tensor; the aspect of the electromagnetic field that is seen as a magnetic field is dependent on the reference frame of the observer. In QED, the electro-magnetic field is quantized and electromagnetic interactions result from the exchange of photons.

Ω

Classically, the energy of a permanent magnet 'circulates in endless loops' from North to South in 3 dimensions around the magnetic moment

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$E = h\nu$

BOSONS are transverse EM waves [charge carriers]

PHOTONS are longitudinal EM waves [neutral charge carriers]

$E = hf$

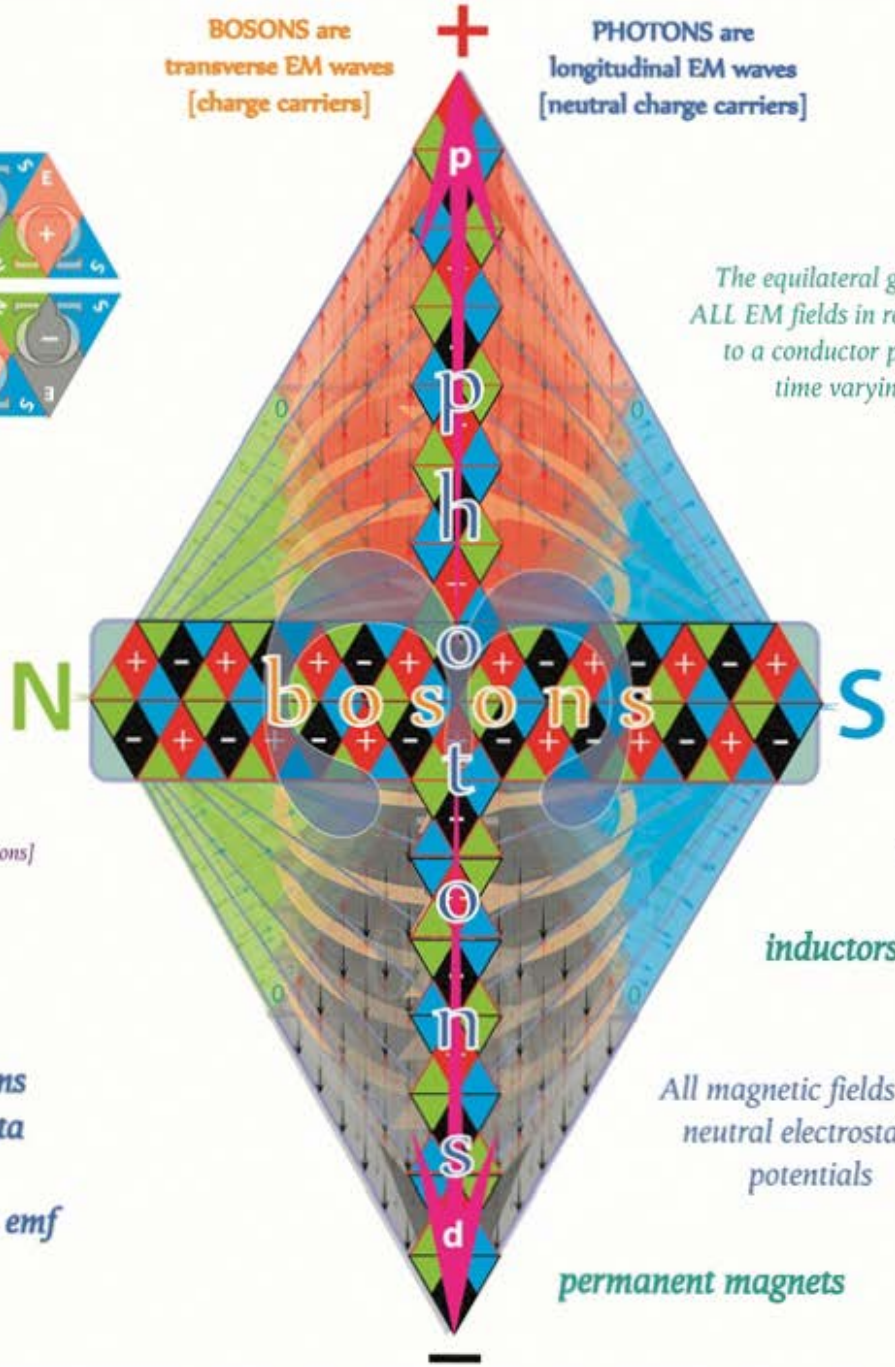

The equilateral geometry of ALL EM fields in relative motion to a conductor produces a time varying emf

$B = -\frac{d\phi_\varepsilon}{dt}$

A changing Electric field produces a changing Magnetic field

The is no such entity as a purely Electric field [all fields are Electro-Magnetic in their geometric foundations]

$\varepsilon = -\frac{d\phi_B}{dt}$

A changing Magnetic field produces a changing Electric field

The is no such entity as a purely Magnetic field [all fields are Electro-Magnetic in their geometric foundations]

inductors

Any two separated charge bosons contain charged energy momenta that once connected via a conductive circuit will produce an emf

All magnetic fields store neutral electrostatic potentials

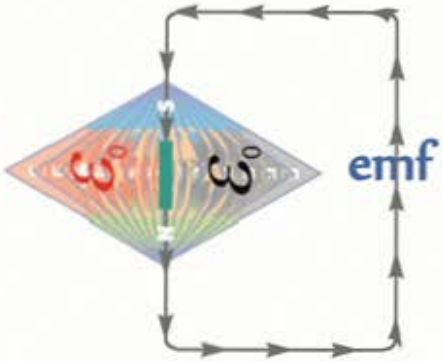

permanent magnets

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The moving magnet - conductor problem

$$B = -\frac{d\phi_\varepsilon}{dt}$$

$$\varepsilon = -\frac{d\phi_B}{dt}$$

All permanent magnets are electromagnetic fields comprised of
transverse bosons and longitudinal photons

We see two observers both moving, approaching each other.

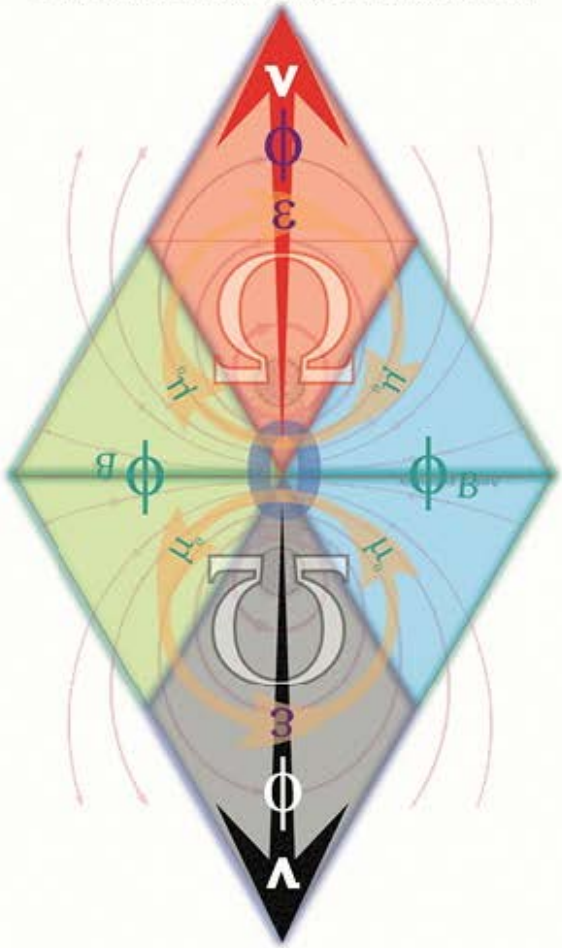

Neutral photon field geometries produce electromotive forces as a result of the charged bosons that make them

Observer 1 says:

The conductive loop is stationary and the magnet is moving toward it. The electrons in the loop are stationary and have no magnetic moments There is a magnetic field, but it can't produce any force on the electrons since they are stationary within the loop.

Instead, the magnetic field is changing, growing stronger as the magnet gets closer, and this changing magnetic field produces an electric field which causes forces on the electrons, and drives them around the loop producing the current in the galvanometer.

Conductor Frame of Reference
(Moving Magnet)

Charged boson field geometries contain equilateral energy momenta with transverse magnetic dipoles

Magnet Frame of Reference
(Moving Conductor)

Observer 2 says:

The magnet is stationary and the loop is moving toward it. The electrons in the loop, since they are moving with the loop, generate their own magnetic moments and experience Lorentz forces as a result of the external magnetic field [F = q v X B], which drives them around the loop and produces the current in the galvanometer.

There is no electric field.

Special relativity postulates that electric fields in one reference frame become magnetic fields in another frame

Tetryonic theory shows geometrically that the Electric and Magnetic fields are discrete, invariant geometries resulting from the equilateral 'inductive' mass-energy [Planck quanta] geometries that comprise all EM fields.
It is the relative motion of these geometries wrt a conductor that creates changing E&M field flux strengths in turn producing an emf.
When there is no relative motion in either the EM field or the conductor, no emf is produced

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The Electromotive Force

"A source of emf can be thought of as a kind of charge pump that acts to move a charge from a point of low potential through its interior to a point of high potential. . . .
The emf of the source is defined as the work done per charge dq: = dW/dq."

The electromotive force, [or emf] or electromotance is "that which tends to cause a current (electrons and ions) to flow in a conductor.

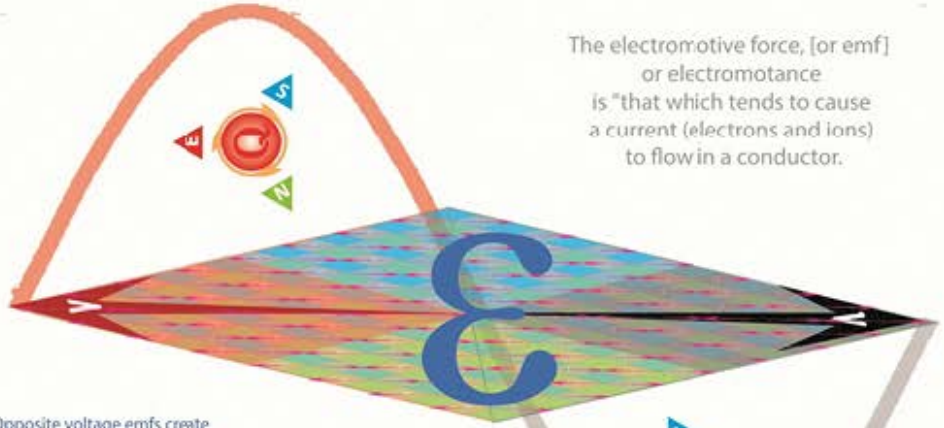

Opposite voltage emfs create opposite forces on the same charged particles

Transverse energy momenta
OSCILLATE CHARGES
[wrt direction of EM wave propagation]
Longitudinal energy momenta
ACCELERATE CHARGES

Opposite charged particles experience opposing forces due to the emf

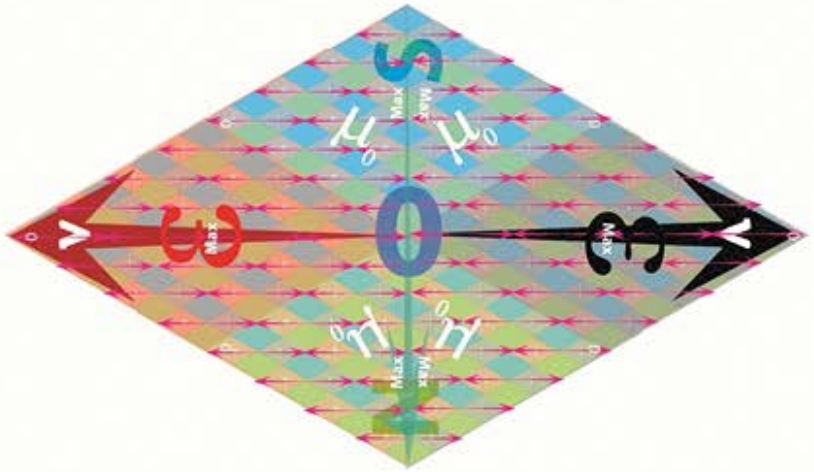

THe magneto-static fields of all Magnets are comprised of electromagnetic fields of discrete Planck energy momenta quanta, which in turn are capable of accelerating charged particles

All ElectroMagnetic fields have distinct equilateral electric and magnetic field geometries that produce velocity related sinusodal waveforms

$$B = -\frac{d\phi_\varepsilon}{dt}$$

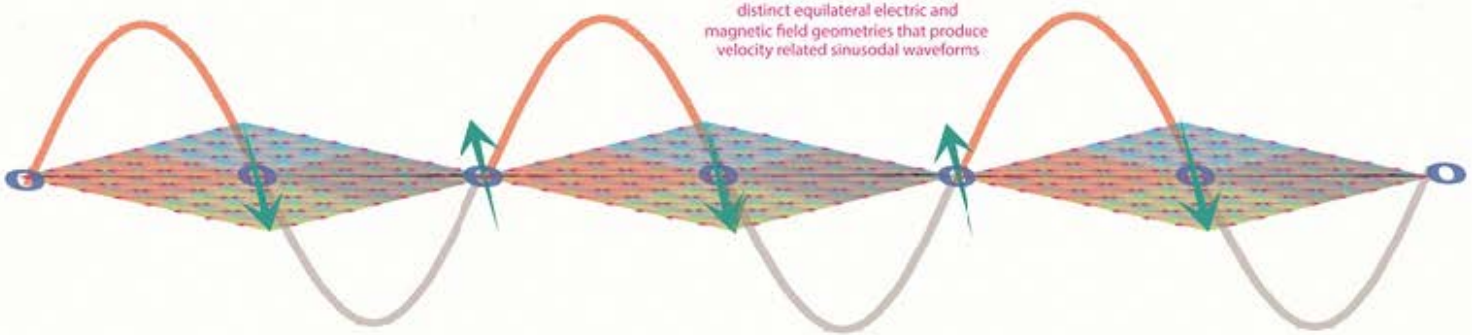

$$\varepsilon = -\frac{d\phi_B}{dt}$$

Charged boson field geometries can be viewed as transverse quantum capacitors

Lenz's law:
" The emf induced in an electric circuit always acts in such a direction that the current it drives around the circuit opposes the change in magnetic flux which produces the emf. "

Neutral photon field geometries can be viewed as longitudinal quantum batteries

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The Moving Magnet problem

An electromotive Force results from the motion of a conductor relative to a magnetic field

A Magnet is really an electrostatic store of neutralised emf potential differences [creating an orthagonal Magnetic moment]

The moving magnet and conductor problem is a famous 19th century thought experiment, and provides the intersection for classical and relativistic electromagnetism.

The moving magnet and conductor problem, along with Michelson-Morley experiment, formed the basis of Einstein's theory of special relativity.

Relativistic theory explanation

In the frame of a conductor moving relative to the magnet, the conductor experiences a force due to an electric field.

A Magnetic field is an Electric field viewed in a differing inertial frame

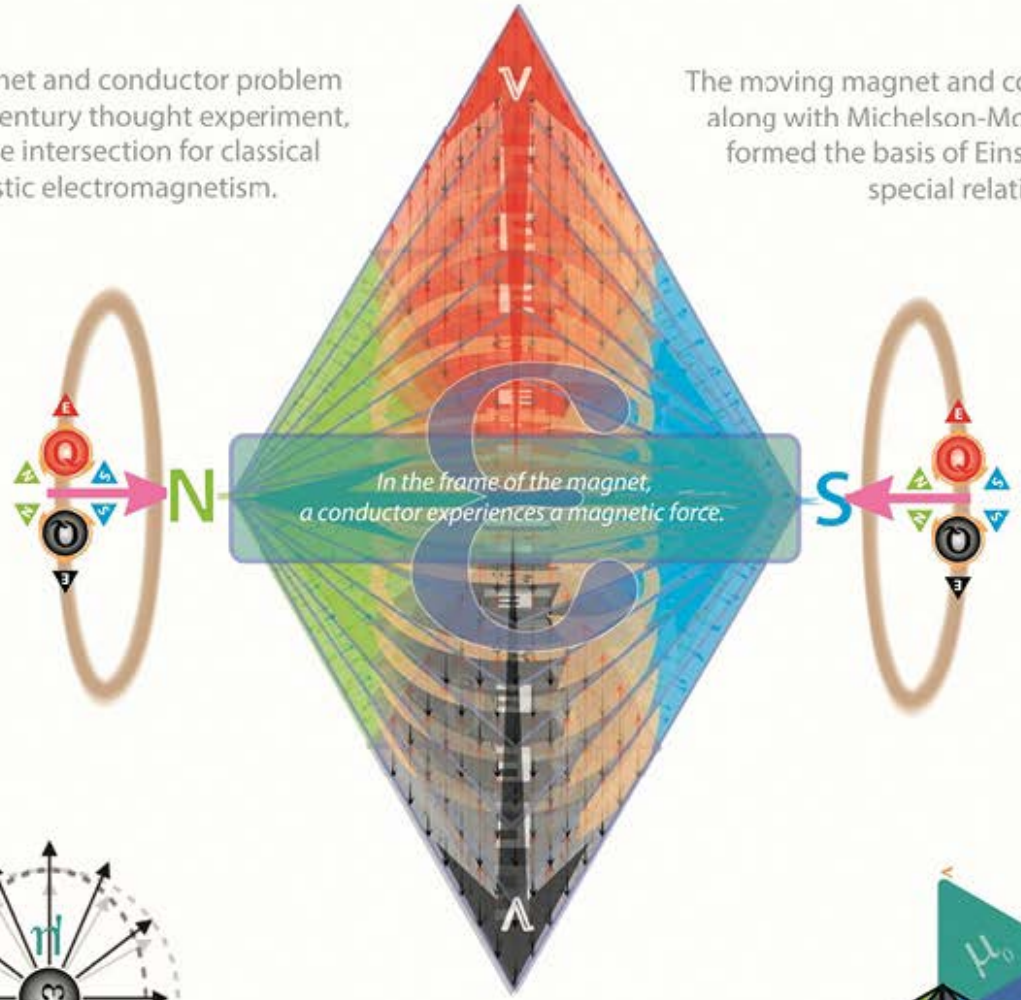

Tetryonic theory explanation

The conductor moves through continuously changing electric and magnetic field geometries experiencing sinuodal E/M forces that are directly related to each other at all times

Electric and Magnetic fields are discrete geometrically related energies

SR requires that all observers in inertial frames arrive at the same form for Maxwell's equations

SR seeks to modify space and time in a manner such that the forces and fields transform consistently.

producing expressions that differ from Newton's law of motion by a factor of γ

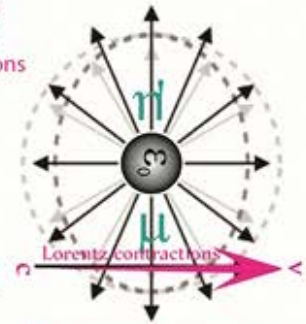

the relativistic distortion of accelerating spherical point charges creates magnetic moments

Electrostatic particles have no magnetic moment

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B}$$

Electric force — *Magnetic force*

Once in motion it posseses a magnetic moment and kinetic energies and is subject to Lorentz forces when it moves throuhg an external EM field

magnetic moments are the result of secondary KEM fields of Matter in motion

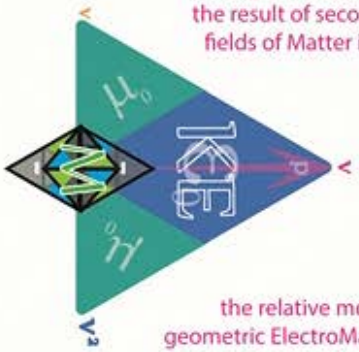

Lorentz corrections only all to KEM field mass-energies

the relative motion of geometric ElectroMagnetic fields creates changing EM forces

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rest mass-Matter

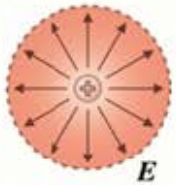

v=0

Einstein's Error of perception

In its rest frame the electric field of a point charge has the same strength in all directions and diverges away from the charge.

Electric fields are distorted due to relativistic speed effects to create Magnetic fields
The faster the velocity the greater the Magnetic field
At rest the Magnetic field becomes an Electric field

What led me more or less directly to the special theory of relativity was the conviciion that the electromotive force acting on a body in motion in a magnetic field was nothing else but an electric field

Albert Einstein 1953

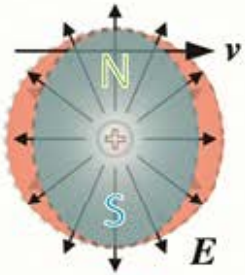

v=.6c

The SR theoretical model of a spherical charged body being relativisitically distorted as the the source of the Magnetic moments for charges in motion is incorrect

Lorentz velocity dependent factors relate only to Kinetic EM mass-energies of motion

M + *It is the KEM field mass-energies that produce Magnetic moments in relativistic partlces due to the motion of ElectroStatic Matter (12 + loop Inductive geometries)* = RE

Stationary Leptons are 12pl charged standing waves [Matter] topologies with NO secondary Kinetic EM mass-energies geometries

Matter is Lorentz invariant

Stationary charges have Electric Fields and neutralised Magnetic fields

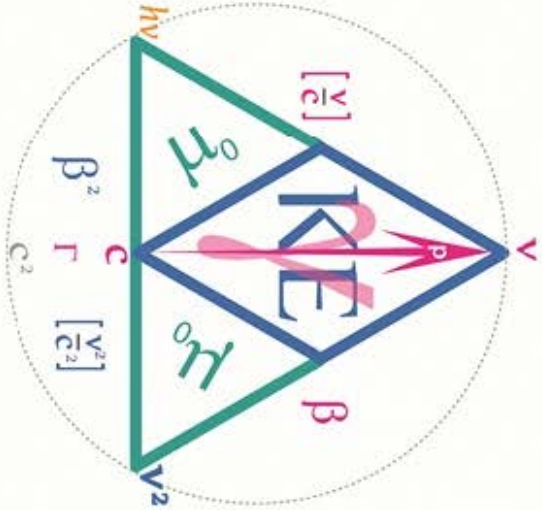

The speed of light in a vacuum [c] is the limit for electrically accelerated particles
Tetryonic geometry reveals it is NOT the limit of acheivable velocities

Moving Leptons are 12pl charged standing waves [Matter] topologies with Kinetic EM mass-energies geometries

Moving charges have Electric fields and Magnetic moments

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Tetryonic relativistic motion

The [K]EM mass-energy content of a particle in motion is velocity dependent
its rest Matter toplogy & charge geometries are velocity invariant

In a frame in which the particle is at rest, we can detect only electric field

rest Matter

all Magnetic dipoles are neutral dipole pairs

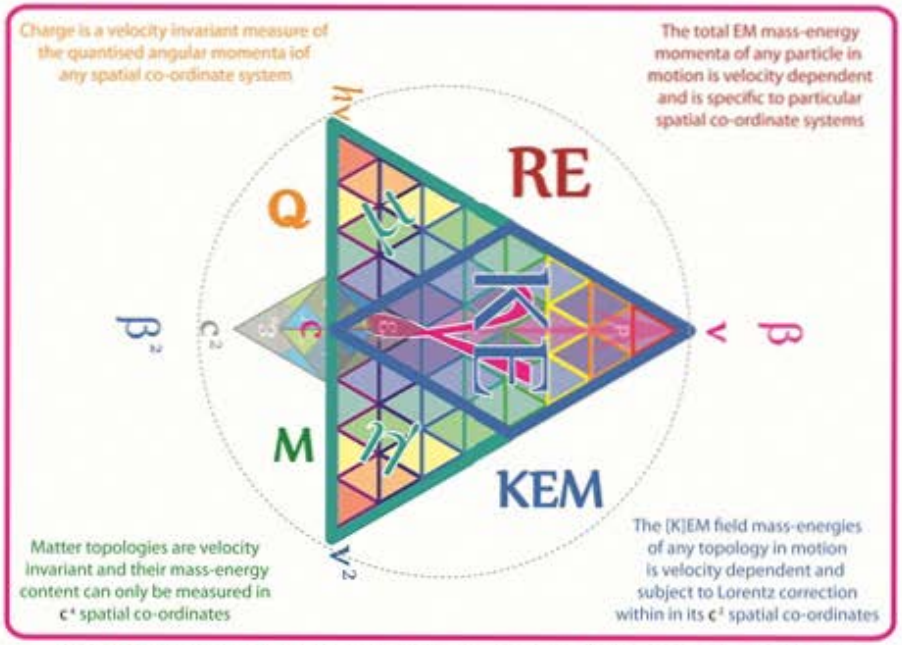

It is well demonstrated that the fields of charged particles appear different in different inertial frames

In a frame in which the particle is moving, we also see a magnetic field.

rest Matter+KEM

relativistic KEM fields produce a secondary magnetic moment

$$Mv^2 = KEM = hv^2$$

Tetryonics has revealed that the Kinetic Electro-Magnetic [KEM] field of a particle in motion has a distinct geometric identity of its own rather than being the relativistic distortion of a charged EM particle

Virtual particles and action-at-a-distance are negatived by Tetryonic KEM field mass-energy momenta and the problem of simultanity is avoided because a second particle responds not directly to the first particle, but rather to the first particle's extended, velocity related [K]EM field generated by its motion at its own position.

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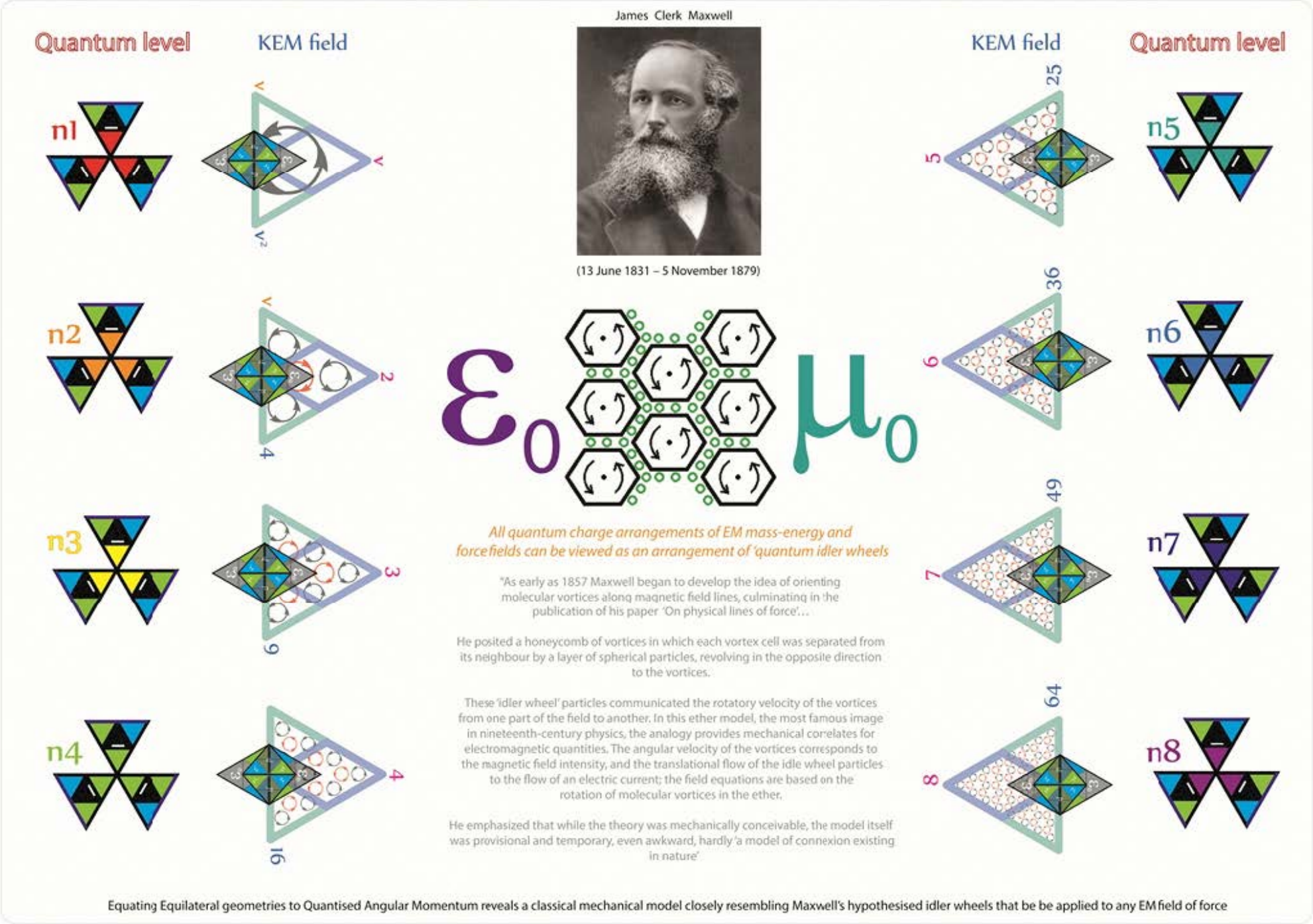

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Virtual Particles

In physics, a virtual particle is a particle that exists for a limited time and space, it has become a commonplace mechanism in current Physical theories to provide a basis for the Force interactions between particles

The energy and momentum of a virtual particle are uncertain according to the uncertainty principle.

$$m^2v^4 = E^2 = p^4$$

The degree of uncertainty of each is inversely proportional to time duration (for energy) or to position span (for momentum).

Original Feymar diagram illustrating the exchange of a quantum between 2 electrons

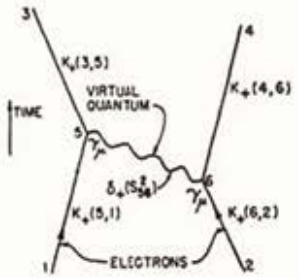

$$mv^2 = E = pv$$

Bohr understood that if you are going to try to be mechanical, you have to show some convincing mechanics.

If you can't show some convincing mechanics, you might as well dodge all mechanics from the beginning, staying with the math.

He had learned this from Maxwell, who had done the same thing 60 years earlier.

In the 1860's, Maxwell had tried to create vortices to explain the field mechanics, but, finding himself under heavy fire from Lord Kelvin and others, he decided to give it up and go to other mathematical alternatives like quaternions instead.

$m^2c^4 = E^2 - p^2c^2$

is in-correct for superpositioned 2D KEM fields the real interaction geometry is illustrated below:

$$\frac{m\Omega^2v^4}{2} = KE^2 = \frac{p^2v^2}{2}$$

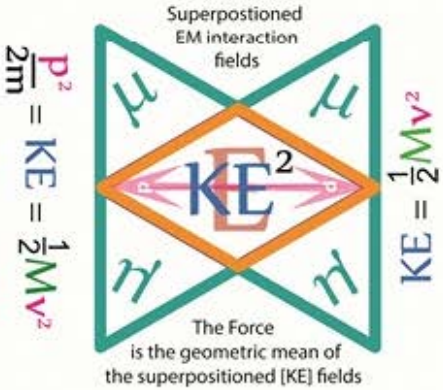

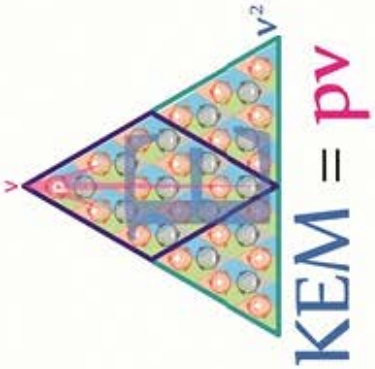

The equilateral energy geometry of Tetryonics clears up this issue once and for all, virutal particles do NOT exist. The Force interactions between all Matter in relative motion is mediated by the equilateral geometries of [K]EM mass-ENERGY momenta that spread out from their source Matter through Space-time

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Equilateral geometry - the Hidden Constant

$$\overset{kg}{m}\,\frac{\overset{m^2}{\Omega}}{s} = h \quad \frac{kg\,m^2}{s}$$

Quantised Angular Momenta has an equilateral geometry

EM Field — Planck quanta

$$\underset{\text{Charge}}{1\pi}\left[\left[\varepsilon_0\mu_0\right].\left[m\Omega v^2\right]\right]$$

ElectroMagnetic — mass — velocity

Tetryonics has revealed the equilateral relationships between Charge, Planck energies and the Constants showing quantised angular momentum to be the 'hidden' geometric constant driving the physics of our Universe on all scales

Alpha is the geometric coupling constant between Magnetic and Electrical energies that acts as a scaling constant between Kinetic and Potential quantum energies

It is the source of the quantum charges of all EM mass-energy momentum & inertia

Classically modelled as a 'rotational' vector Quantised Angular Momentum is in fact an Equilateral geometry

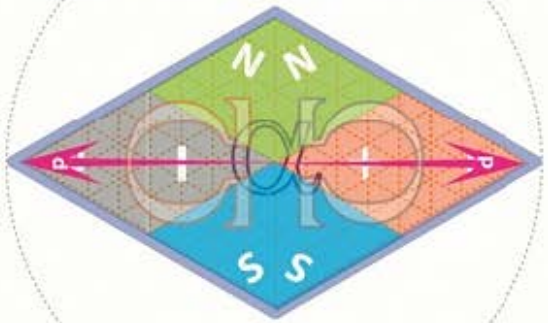

Photons are dual equilateral geometries creating a neutral charge with two opposed coupling constants

c²

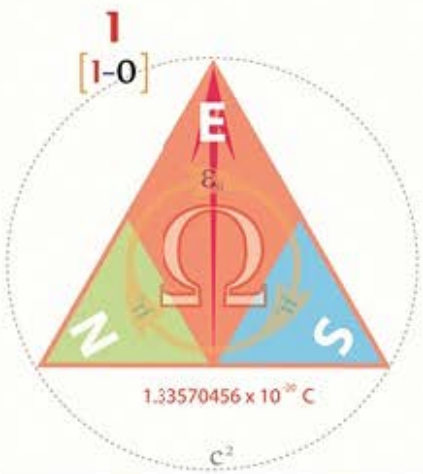

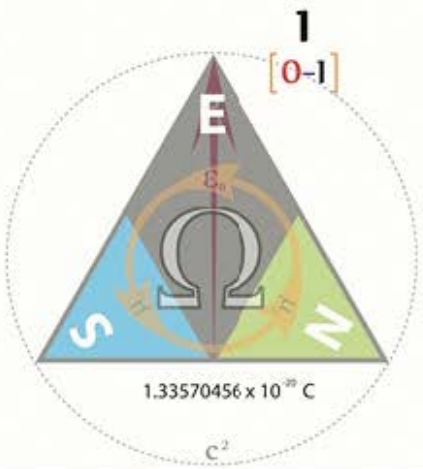

Quantised Angular Momenta creates charged EM mass-energies

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.0012

2π

.007539822

$$\alpha = \frac{e^2}{\hbar c}$$

$$\alpha = \frac{e^2}{\hbar c\, 4\pi\varepsilon_0}$$

$$7.297\,352\,5376(50) \times 10^{-3}$$

$$= \frac{1}{137.035\,999\,679}$$

132.6291192 $^{-1}$

The ALPHA Constant is the scalar coupling field of quantised energy momenta in superpositioned EM fields that facilitates Force (linear energy momenta) exchanges, resulting in the familiar Laws of Attraction/Interaction

In physics, the fine-structure constant is a fundamental physical constant, namely the coupling constant characterizing the strength of the electromagnetic interaction.

The numerical value of α is the same in all systems of units, because α is a dimensionless quantity.

There is a most profound and beautiful question associated with the observed coupling constant, e the amplitude for a real electron to emit or absorb a real photon. It is a simple number that has been experimentally determined to be close to 0.08542455.

It has been a mystery ever since it was discovered more than fifty years ago, and all good theoretical physicists put this number up on their wall and worry about it.

Immediately you would like to know where this number for a coupling comes from: is it related to pi or perhaps to the base of natural logarithms? Nobody knows. It's one of the greatest dcmn mysteries of physics: a magic number that comes to us with no understanding by man.

We know what kind of a dance to do experimentally to measure this number very accurately, but we don't know what kind of dance to do on the computer to make this number come out, without putting it in secretly

Richard Feynman

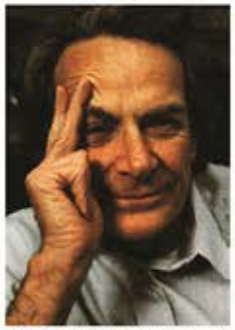

(May 11, 1918 - February 15, 1988)

equilateral energies

.0012 m²/s

Superpositioned Fields

0.007539822

132.6291192 $^{-1}$

Alpha coupling Constant

You might say the "Hand of GOD" wrote that number, but "we don't know how HE pushed his pencil."

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The Fine Structure Constant

$2\pi[QAM] = 0.007539822$ (.0012)

Arnold Sommerfeld introduced the fine-structure constant in 1916 as a fundamental physical constant, namely the coupling constant characterizing the strength of the electromagnetic interaction.

$2\pi[QAM]^{-1} = 132.6291192$ (.00119997)

In quantum electrodynamics, α is the coupling constant determining the strength of the interaction between electrons and their exchange photons

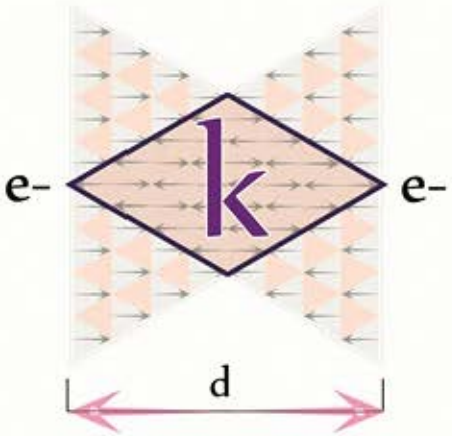

Similar Charges REPEL

10^{-6}
weak force

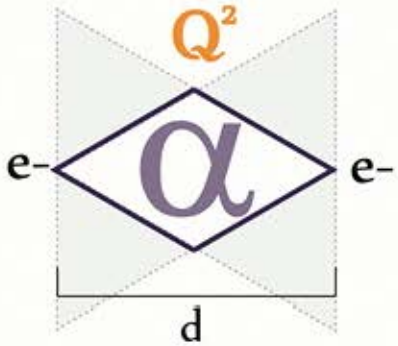

It is a dimensionless quantity that has a constant numerical value in all systems of units that is the direct result of its equilateral geometry.

1
strong force

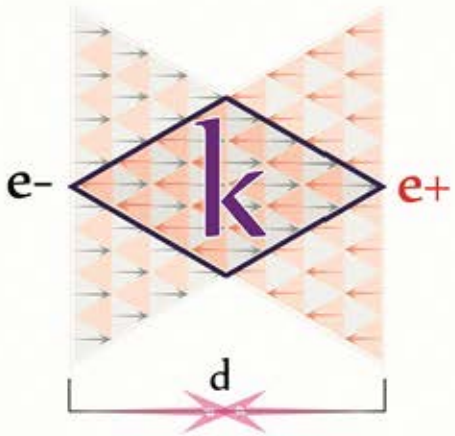

Opposite Charges ATTRACT

$$\alpha = .007539822$$

It can now be revealed to be a measure of the forces produced by, or contained in, the geometry of two superpositioned KEM [E^2] field energies

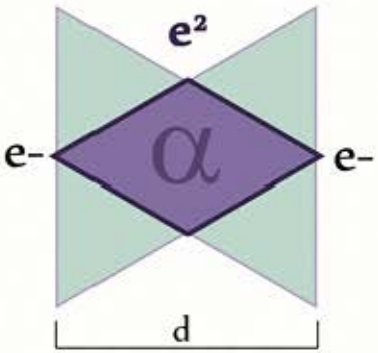

the energy needed to overcome the electrostatic repulsion between two electrons separated by a distance of d

The alpha constant applies equally to the coupling of Electric and Gravitational superpositioned fields

10^{-39}
gravity

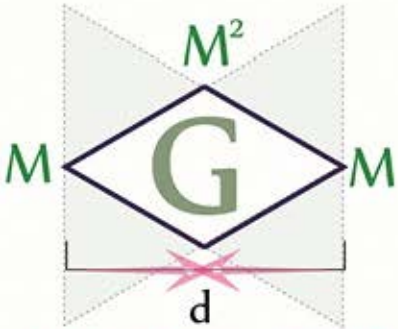

Gravitational Matter is always ATTRACTIVE

$7.5e^{-3}$
EM forces

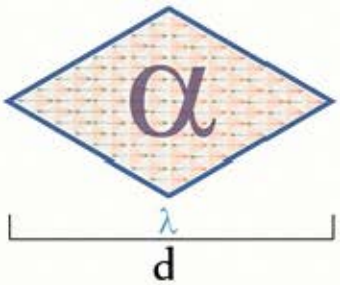

the energy of a single photon of wavelength λ that provides the energy momenta required to create a force between particles

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Coupling Constants

$$k\,\frac{Q_1 Q_2}{r^2} = F$$

Coulomb's [k], the Fine structure constant [α] and Newton's [G] are all reflections of the same coupling constant geometries differing only by the strength of their respective superpositioned energy field densities

$$F = -G\,\frac{M_1 M_2}{r^2}$$

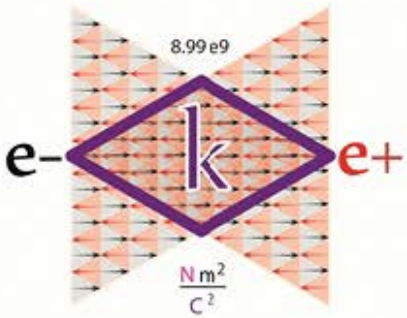

Coulomb's constant

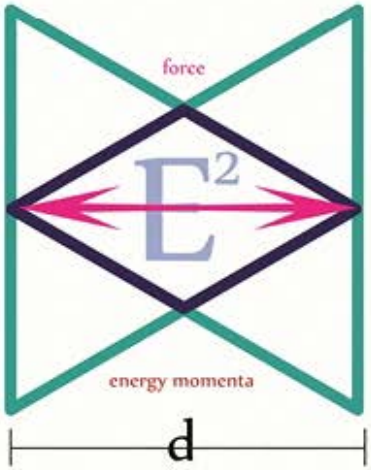

Newton's constant

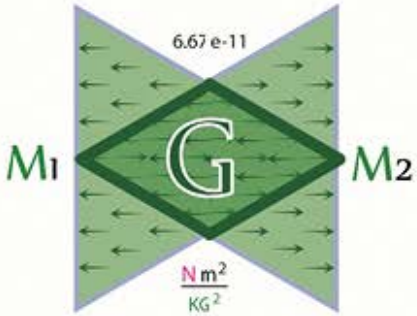

$$\beta = \left[\frac{v}{c}\right]$$

Linear force coupling constant

$$\beta^2 = \left[\frac{v^2}{c^2}\right]$$

Scalar energy coupling constant

In physics, a coupling constant is a number that determines the strength of an interaction for superpositioned Electrical or Gravitational fields between material objects

Coupling Constants are dimensionless numbers

They are reflective of the linear & scalar forces produced by 2D mass-energies

$$\frac{m}{s}\cdot\frac{s}{m}$$

electric charge coupling

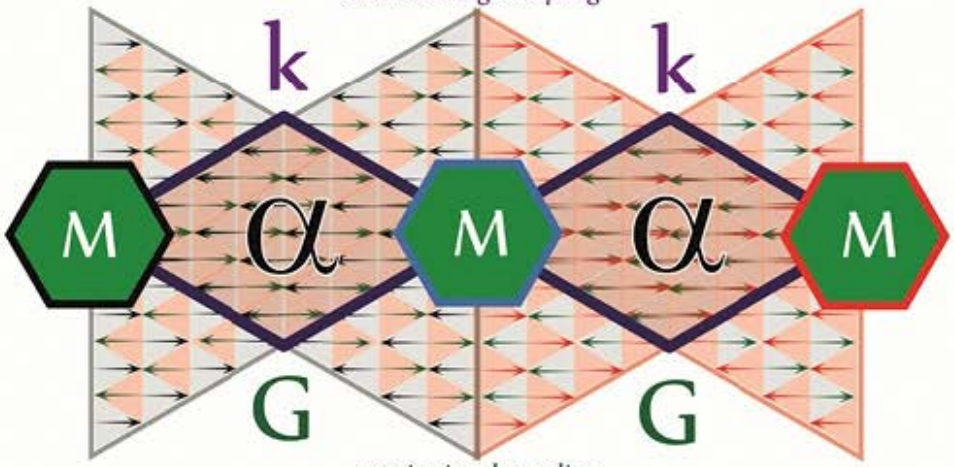

gravitational coupling

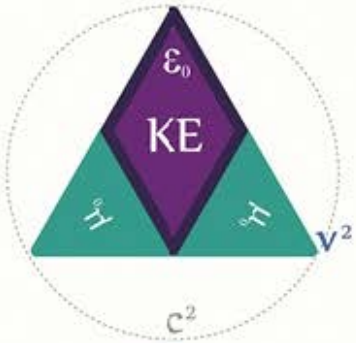

$$\frac{m^2}{s^2}\cdot\frac{s^2}{m^2}$$

Usually the Lagrangian or the Hamiltonian of a system can be separated into a kinetic part and an interaction part. [For example, the electric charge of a particle is an Electrical coupling constant]

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Opposites
ATTRACT

ElectroMagnetic Charge

[the universal coupling constant]

Similars
REPEL

1.33518 e-20 C

Q

1.33518 e-20 C

Electric charge is a physical property of matter that causes it to experience a force when near other electrically charged matter.
Electric charge comes in two types, called positive and negative

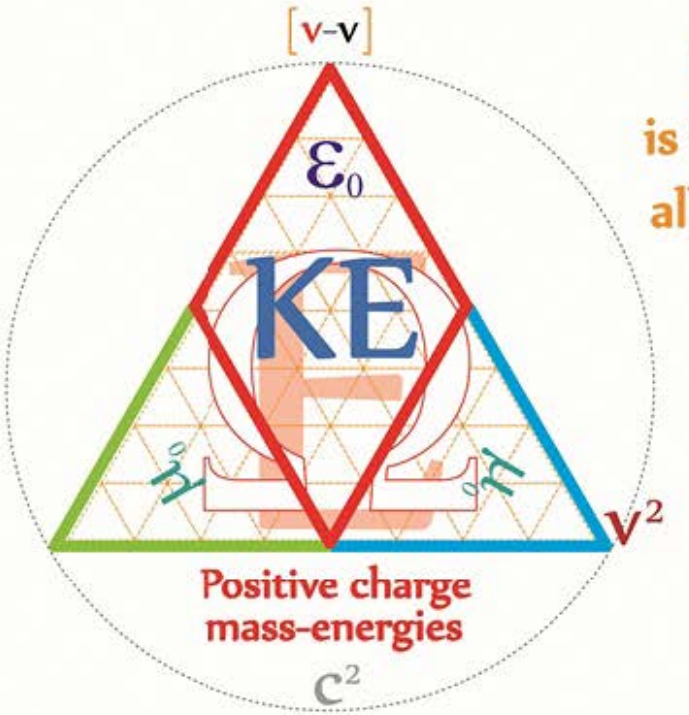

ElectroMagnetic CHARGE is the equilateral foundation to all the quantum geometries of mass-ENERGY-Matter

$$m\frac{\Omega v^2}{c^2}$$

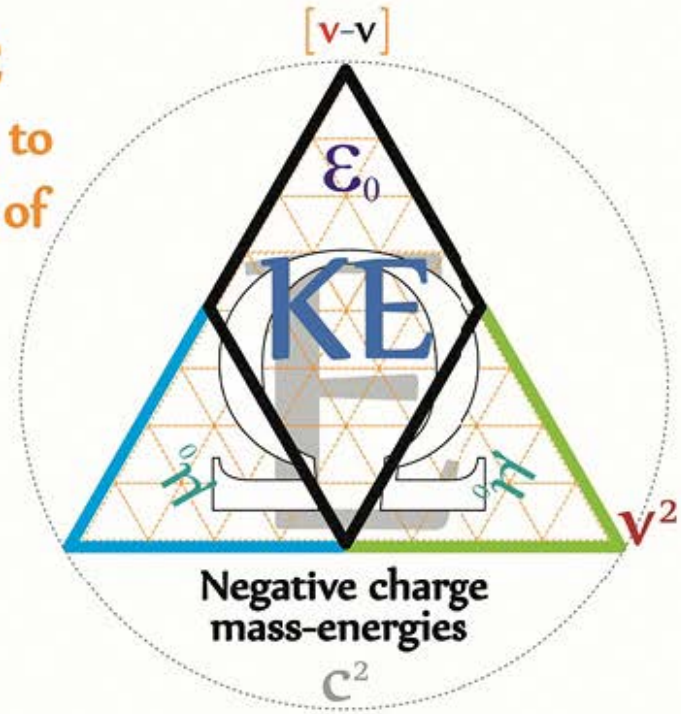

seconds

Changing charge geometries are equivalent to TIME in relativity

seconds

The electric charge is a fundamental conserved property of all subatomic particles, which determines their electromagnetic interaction.
The interaction between a moving charge and an electromagnetic field is the source of the electromagnetic force, which is one of the four fundamental forces

The equilateral geometry of Planck energies creates CPT symmetries in physics, and provides the foundation for all Matter geometries and their fields of interaction

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Einstein–Podolsky–Rosen paradox

was a thought experiment that attempted to challenge the Copenhagen interpretation of Quantum physics

Tetryonics provides a complete model of all Energy forms and Wave-Particle interactions, allowing a clear understanding of previously mysterious actions and processes in Quantum Mechanics

Albert Einstein

(14 March 1879 – 18 April 1955)

Showing that it is possible to know the both Position and Momenta of Particles and to model EM wave geometries and interactions in Quantum Physics

Boris Yakovlevich Podolsky

(1896–1966)

Δx

Δp

Nathan Rosen

(March 22, 1909 – December 18, 1995)

The EPR experiment involved two systems that initially interact with each other and are then allowed to separate before being measured.

Measuring the Position of the Electron determines the Position of the Positron

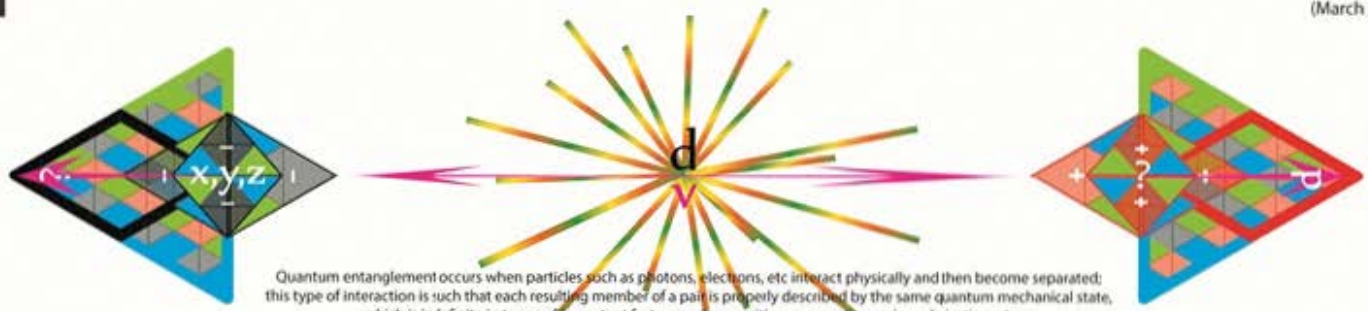

Measuring the Momentum of the Positron determines the Momentum of the Electron

Quantum entanglement occurs when particles such as photons, electrons, etc interact physically and then become separated; this type of interaction is such that each resulting member of a pair is properly described by the same quantum mechanical state, which is indefinite in terms of important factors such as position, momentum, spin, polarization, etc

The EPR paper shows that measuring one feature of a entangled system, e.g., the momentum of one of the pair of particles, will reveal the same feature of the other particle - thus providing a mechanism for determining both the momentum and position of both particles simultaneously

Thus providing a theoretical indication that either the Uncertainty Principle was incorrect or that our understanding of Quantum Mechanics was incomplete

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Spooky interactions-at-a-distance & the transfer of information

Quantum entanglement is sasid to occur when particles such as photons, electrons, and other forms of EM mass-energies interact physically and then become separated; the type of interaction is such that each resulting member of a pair is properly described by the same quantum mechanical description (state), which is indefinite in terms of important factors such as position, momentum, spin, polarization, etc.

Through the equilateral geomtry of Tetryonics the mass-energy-Matter of any system of particles can be modelled in order to reveal the true EM mechanics of their quantum interactions

alice

bob

All EM fields have amplitude probabilies 'wavefunctions'

Longitudinal waves can facilitate instantaneous 'action-at-a-distance'

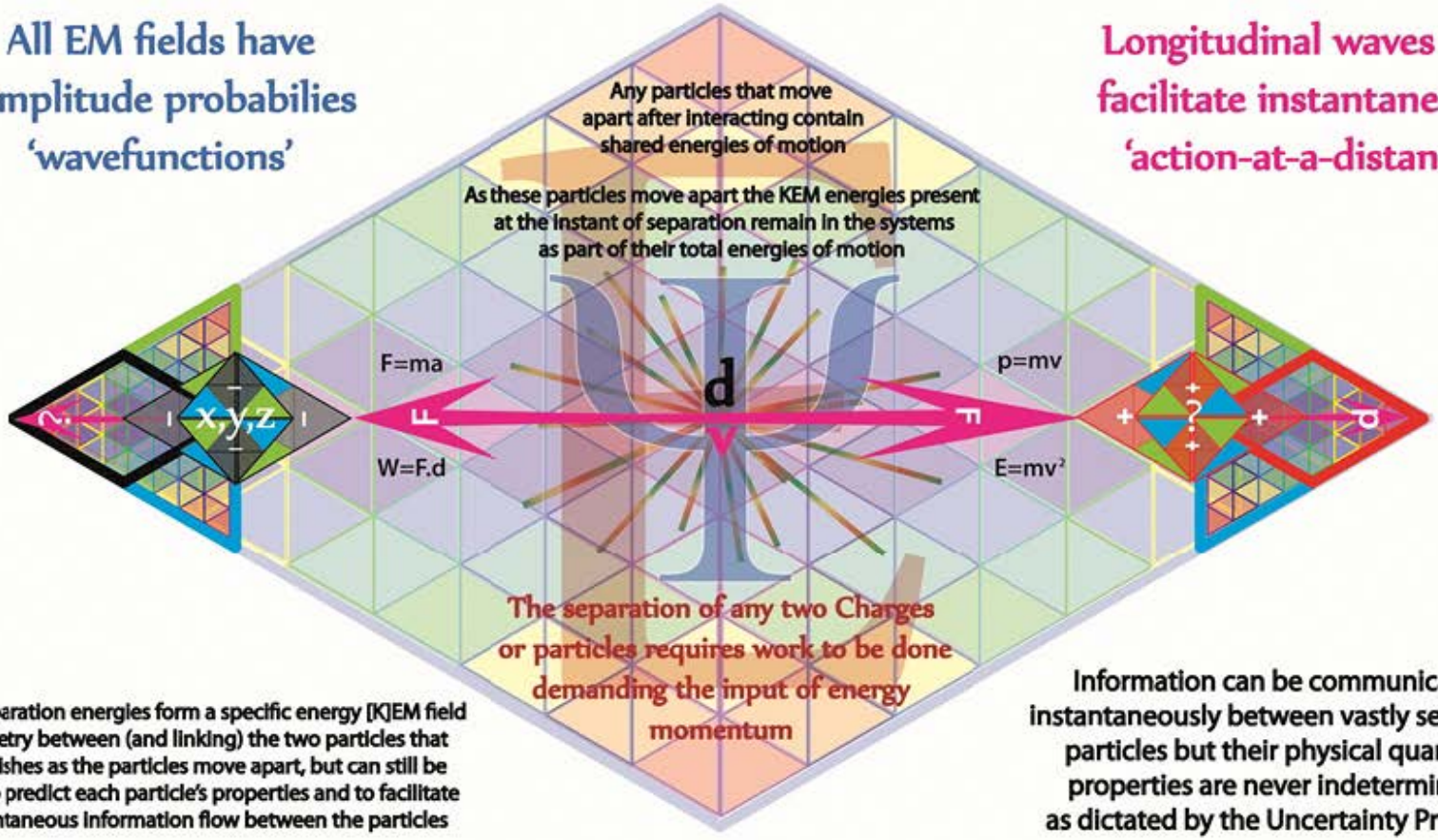

The separation energies form a specific energy [K]EM field geometry between (and linking) the two particles that diminishes as the particles move apart, but can still be used to predict each particle's properties and to facilitate instantaneous information flow between the particles

Information can be communicated instantaneously between vastly separated particles but their physical quantum properties are never indeterminant as dictated by the Uncertainty Principle

When two entangled particles are separated using longitudinal energies, the energy momenta of separation provides a mechanism for the establishment and near-instantaneous communication of the physical wavefunction/properties of one particle to the other, irrespective of the spatial or temporal [space-time] separation of the two 'entangled' partner particles

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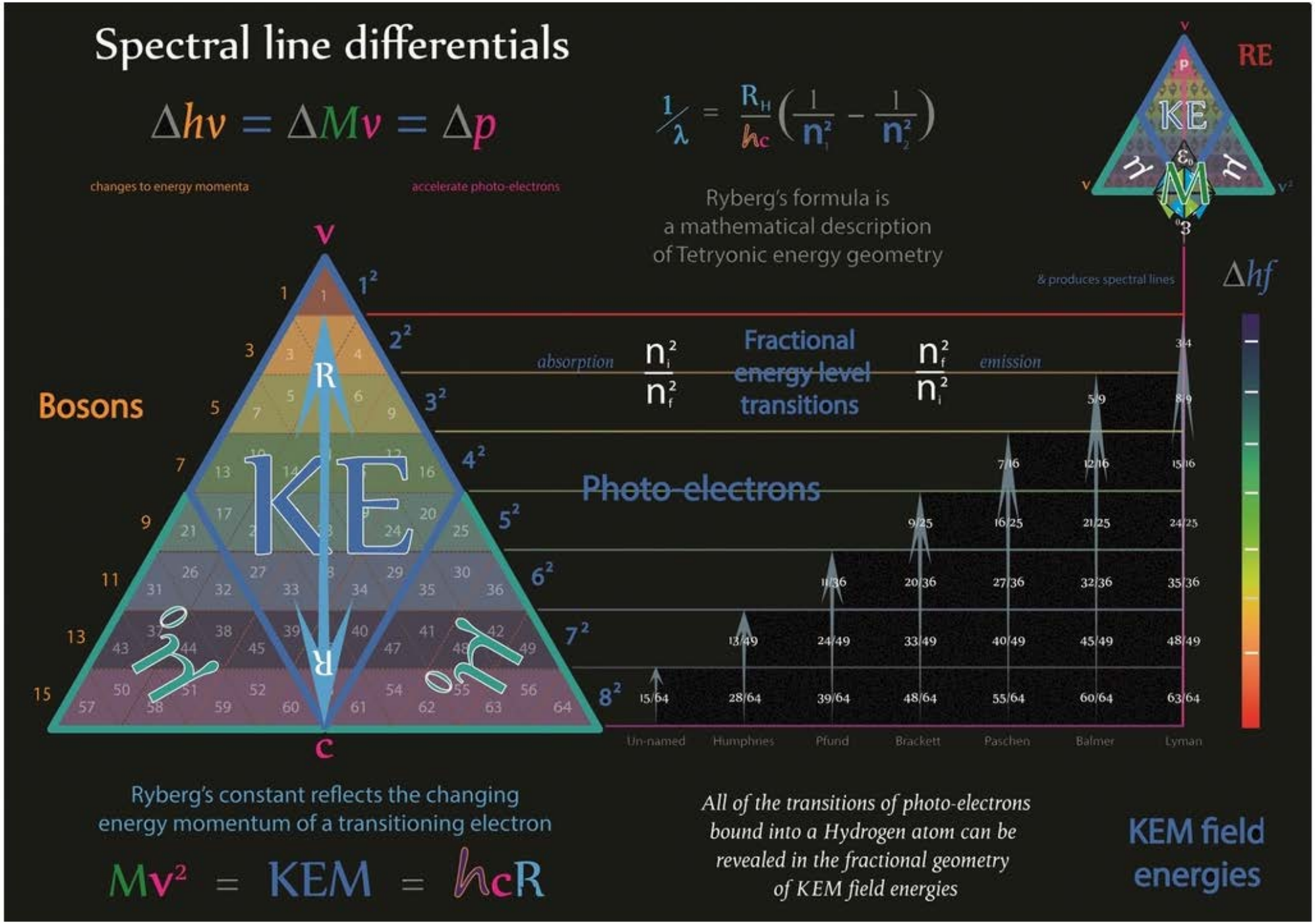

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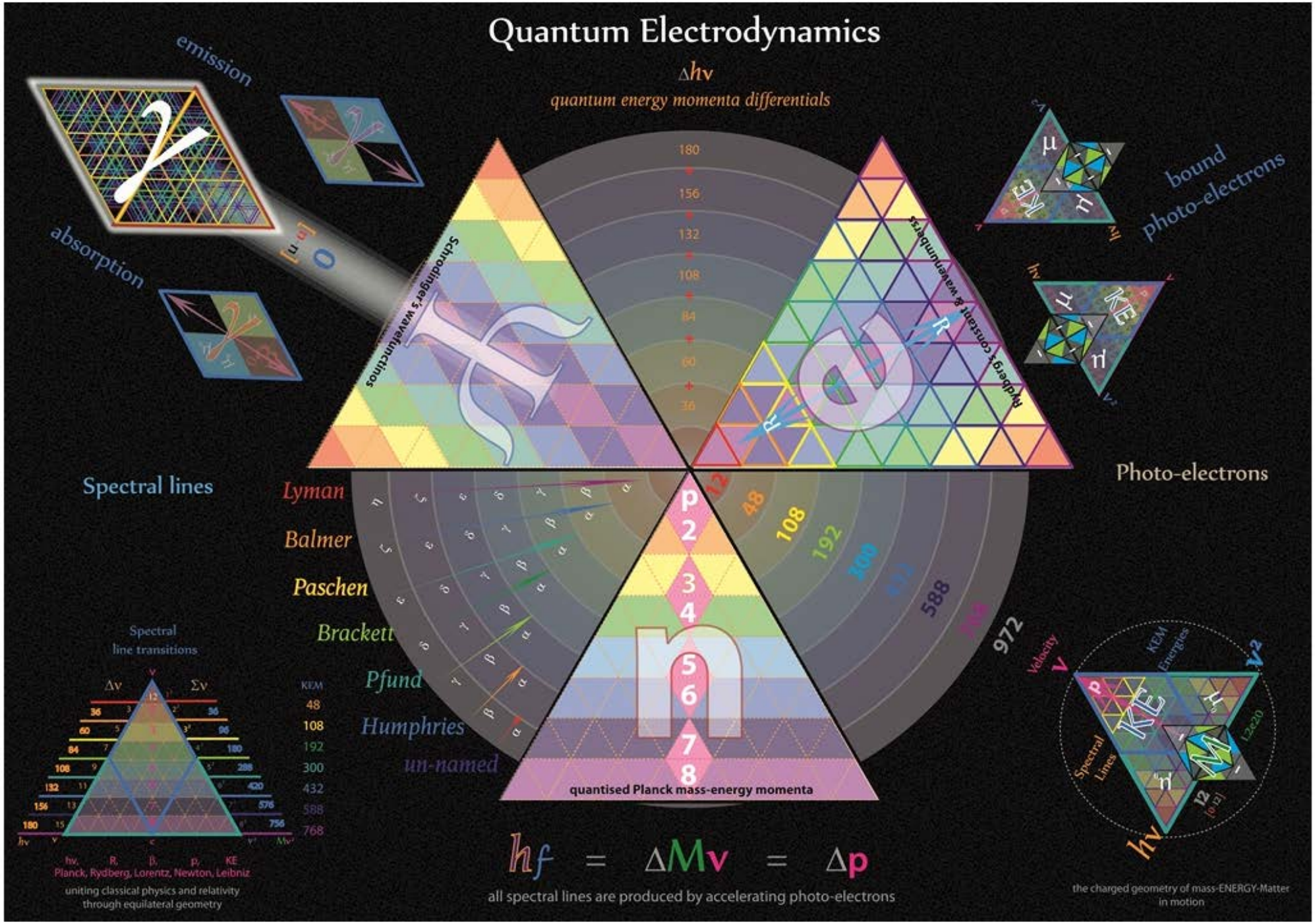

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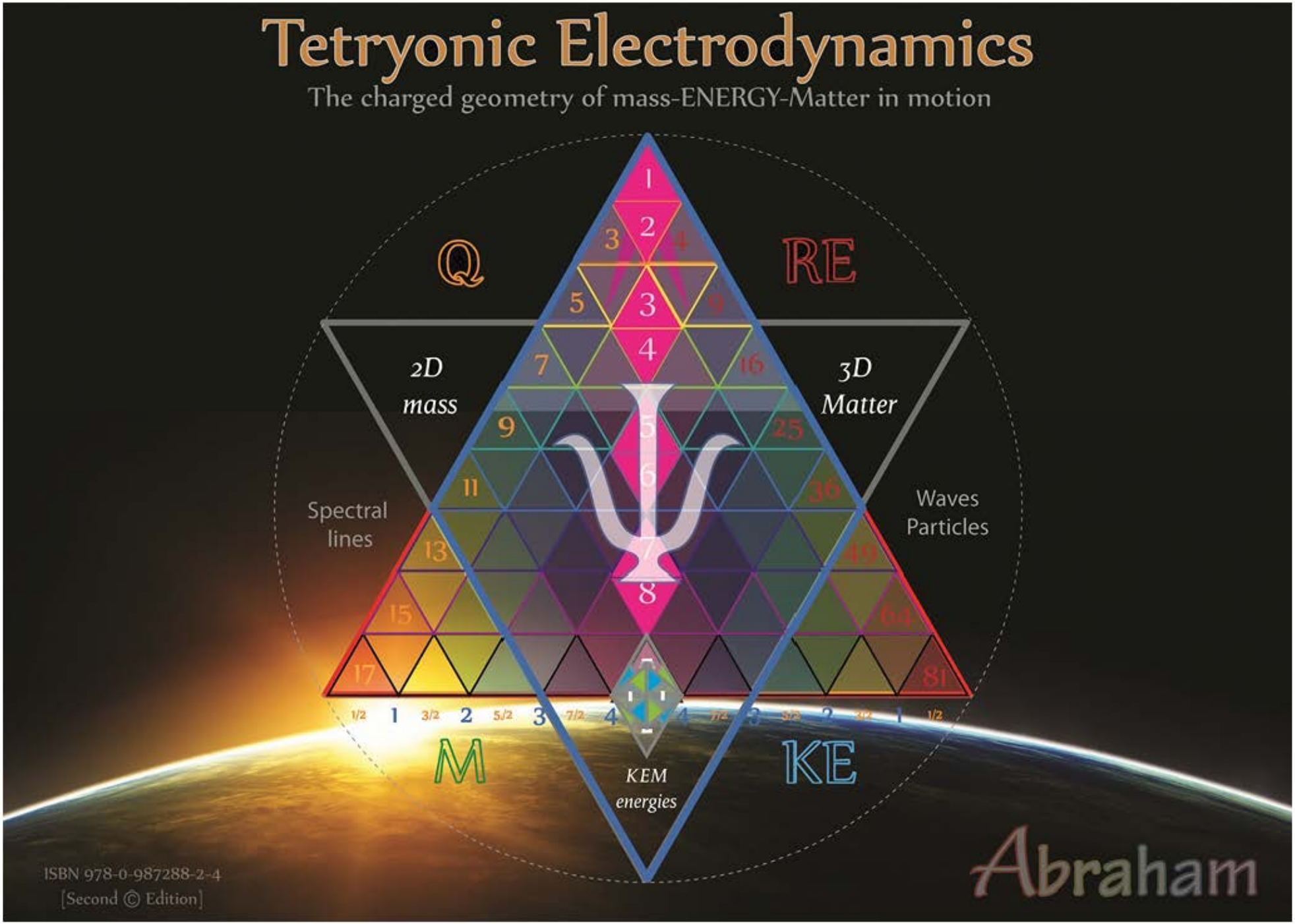

TETRYONICS

The charged topology of periodic & compound Matter

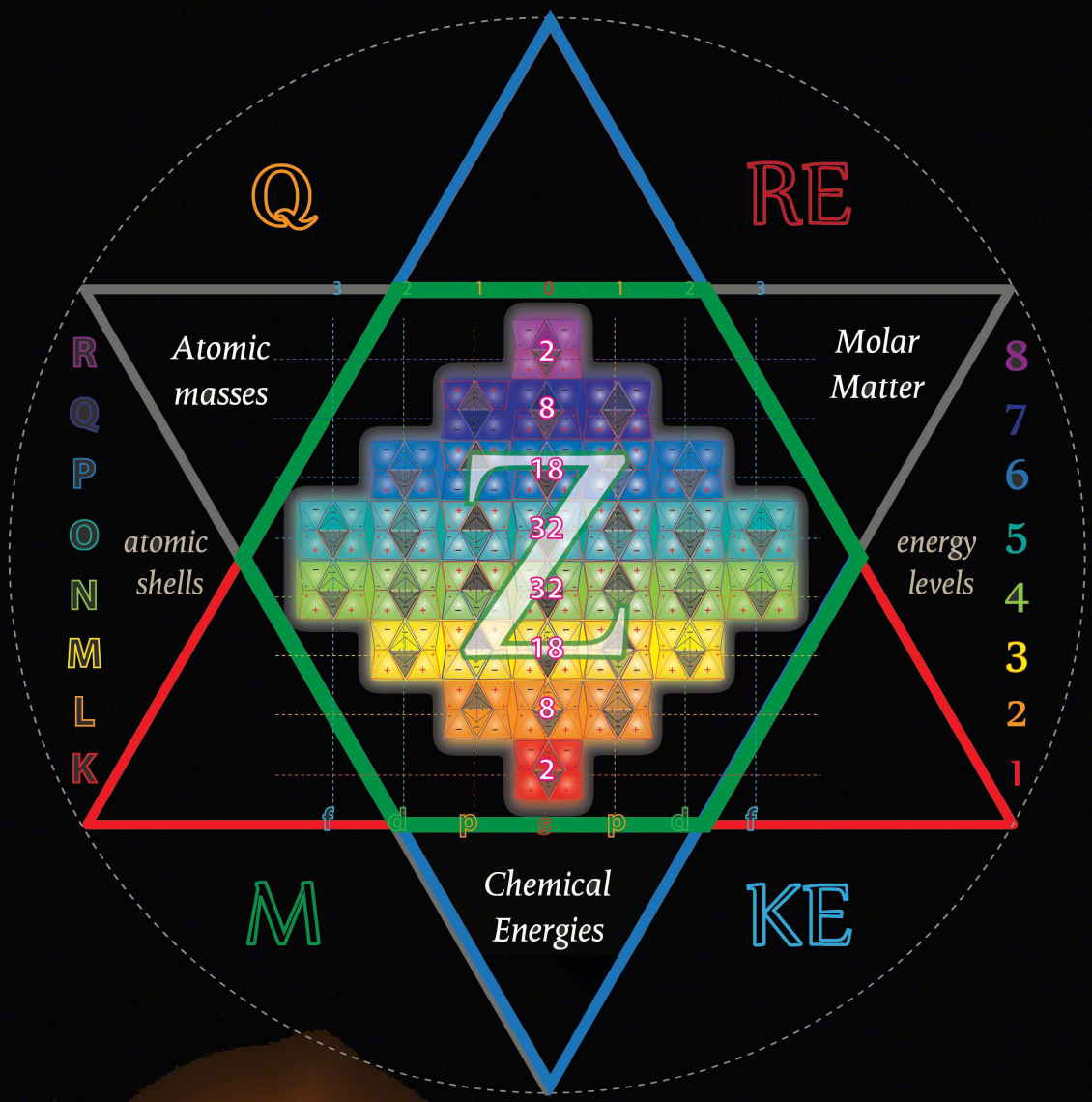

Foundational Quantum Chemistry

Abraham

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[Second Edition © 2012]

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Residual Electro-Magnetic Forces

allow Neutrons and Protons to attract via the opposite Electric charge points created by their constituent Quarks in order to create Elementary Nuclei

Protons + *Neutrons*

u+d+u d+u+d

All electrons, quarks and Baryons are made up of 4n+ (Tetryonic) standing-wave EM fields.

As well as having nett Tetryonic charged topologies ranging between [+24] ~ [-12] they all posses distinct ELECTRIC FIELDS that are concentrated in 3 apex points as indicated in the illustrations

These points result from the orientation of Electric apexes and orthagonal Magnetic dipole field edges that make up each particle's externalised EM fields.

The Positive and Negative electric apex points, obey the Law of Interaction forcing separated nuceli to combine due to their individual nett Tetryonic charges and provide a means of orienting nuclei to each other to create larger particles [elements, allotropes and compounds]

External Magnetic (H) fields can interact with the integral magnetic (B) dipoles of Tetryonic particles forcing them to orientate in specific directions to facilite chemical bonding [nuclear forces]

Additionally, external Electric fields can intercct with the integral electric fields attracting or repelling them depending on the polarity of the external electric field [Electrostatics]

External energies can be induced into these integral EM fields via inductive coupling or the absorption of spectral photons in turn leading to an increase in the strengthes of the integral EM apexes in turn increasing the Strong Nuclear Force.

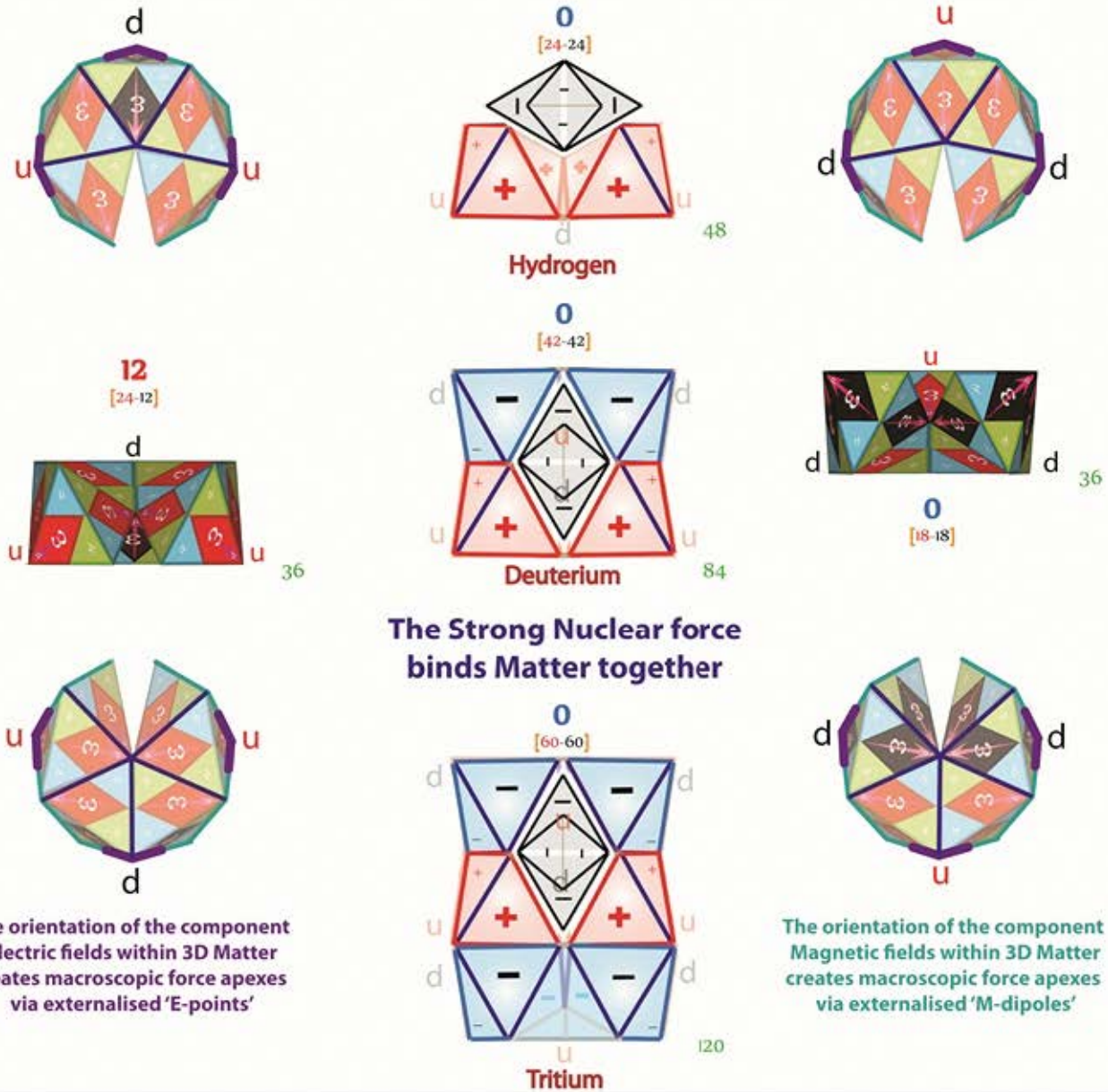

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Nucleonic residual EM force

Neutrons

Protons

The attraction between Baryonic E&M field apexs, a result of their component Quark arrangements, results in the formation of heavier and more complex Nuclei

The residual e-field apexes and m-field dipoles form two rings of residual EM fields around the circumference of atomic nuclei

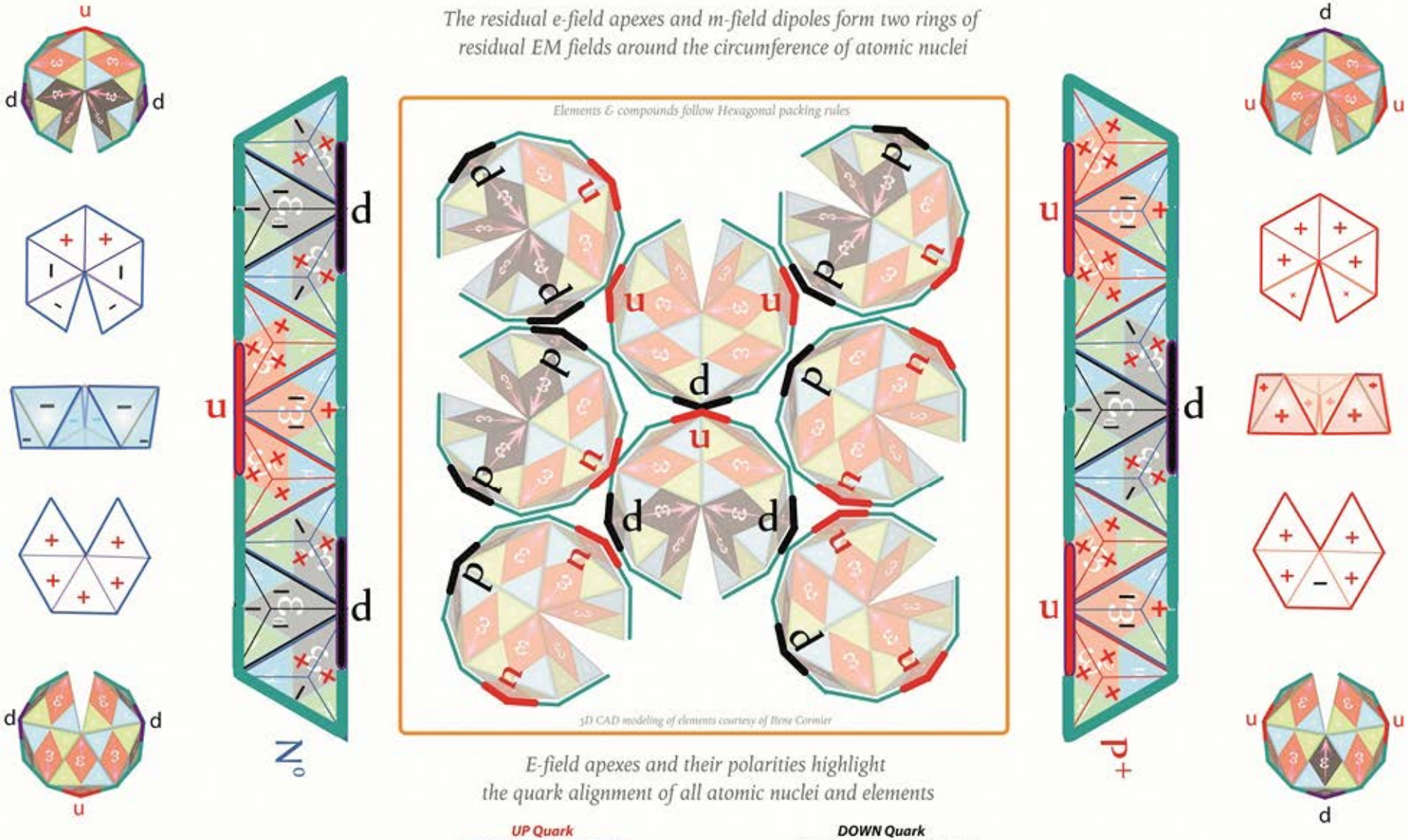

E-field apexes and their polarities highlight the quark alignment of all atomic nuclei and elements

UP Quark
Positive Electric field apex

DOWN Quark
Negative Electric field apex

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Insulators and Conductors

The position of electrons in Nuclei within Atomic Elements results in the properties of Insulators or Conductors

Coloumbic forces

Electrons are attracted to the residual EM net (+12) positive charge of Protons or n[+12] unbalanced Ionic charges of nuclei

Conductor

Electrical energies move around the material via boson exchanges and electron movement

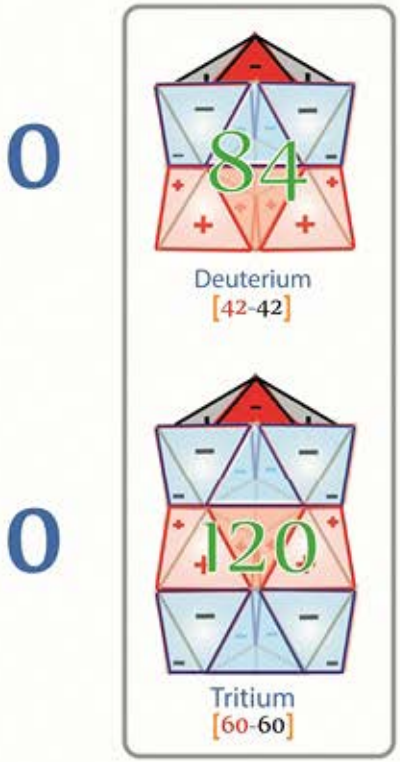

≈

Insulator

Electrical energy is fixed within the nucleus as electrostatic charges & released upon demand via electron rotation/motion within the nucleus

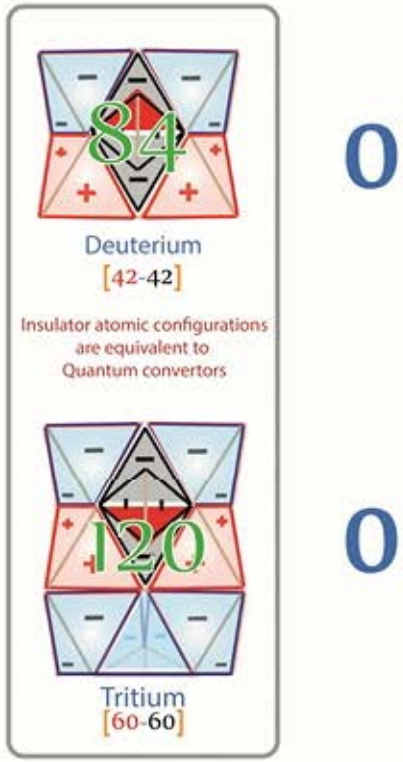

Ions

Charge (energy) is moved around material via electron movement

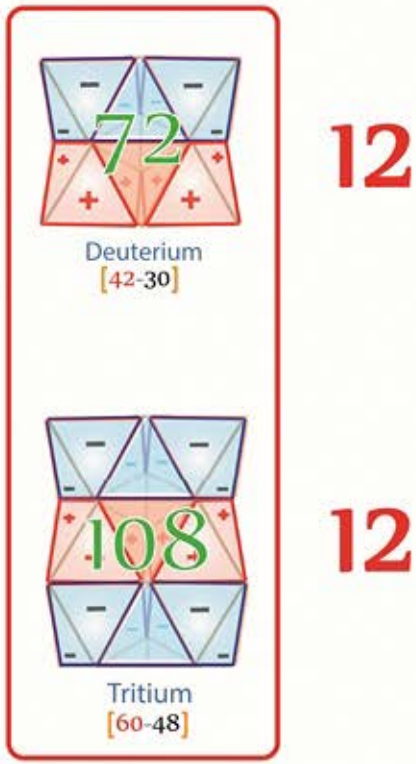

Conductive materials contain 'free' electrons that can be readily or easily moved within the material

Insulator materials have electrons that are 'bound' tightly to the atoms and store charges locally where they are applied

Materials that have been ionised are more likely to become Conductors as they easily attract and bind free electrons to them

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Nucleon Quark Arrangement

The nuclei arrangement of each atomic shell [quantum level] is the result of quark EM field interactions

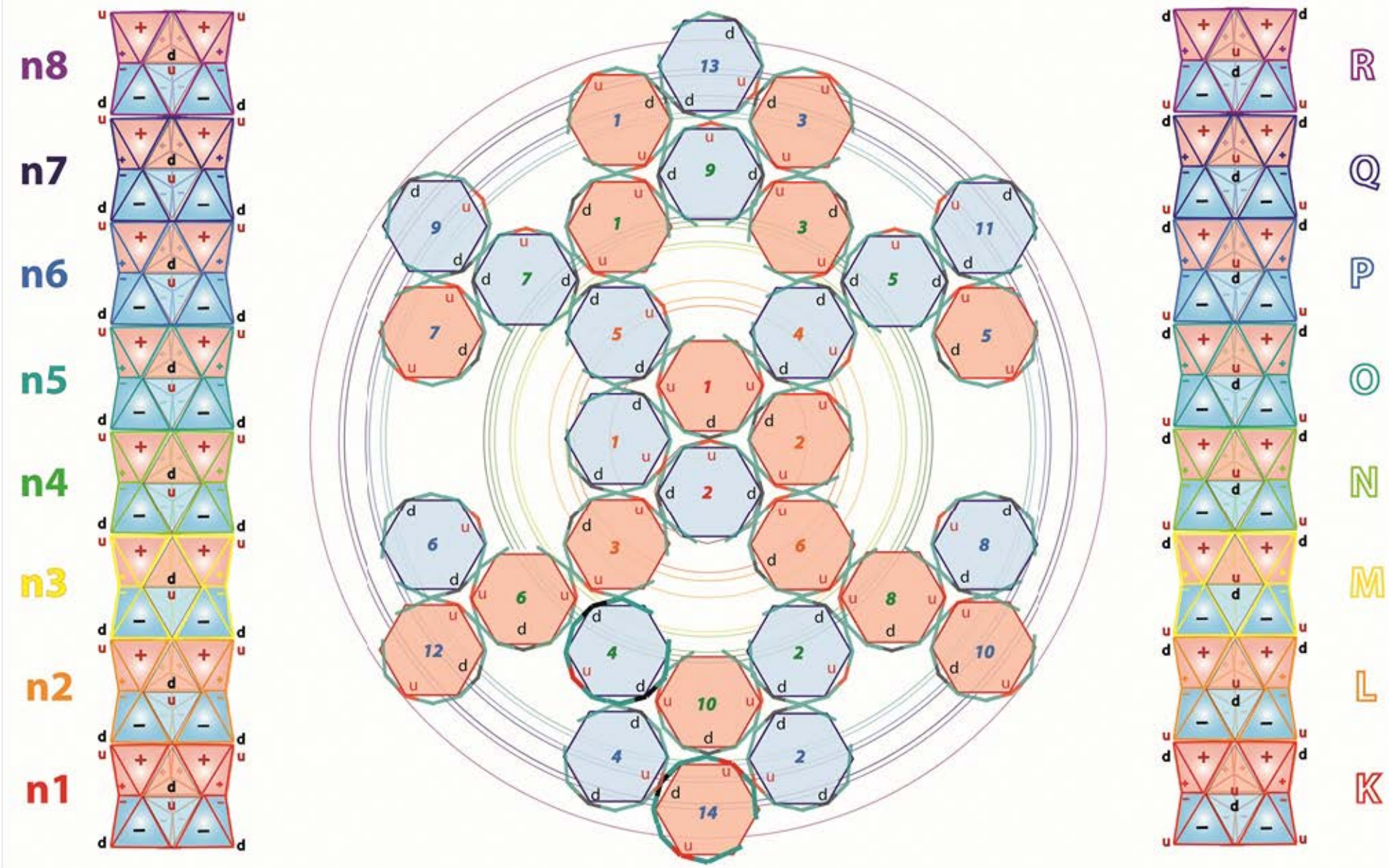

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Nucleon Charges and Bonding

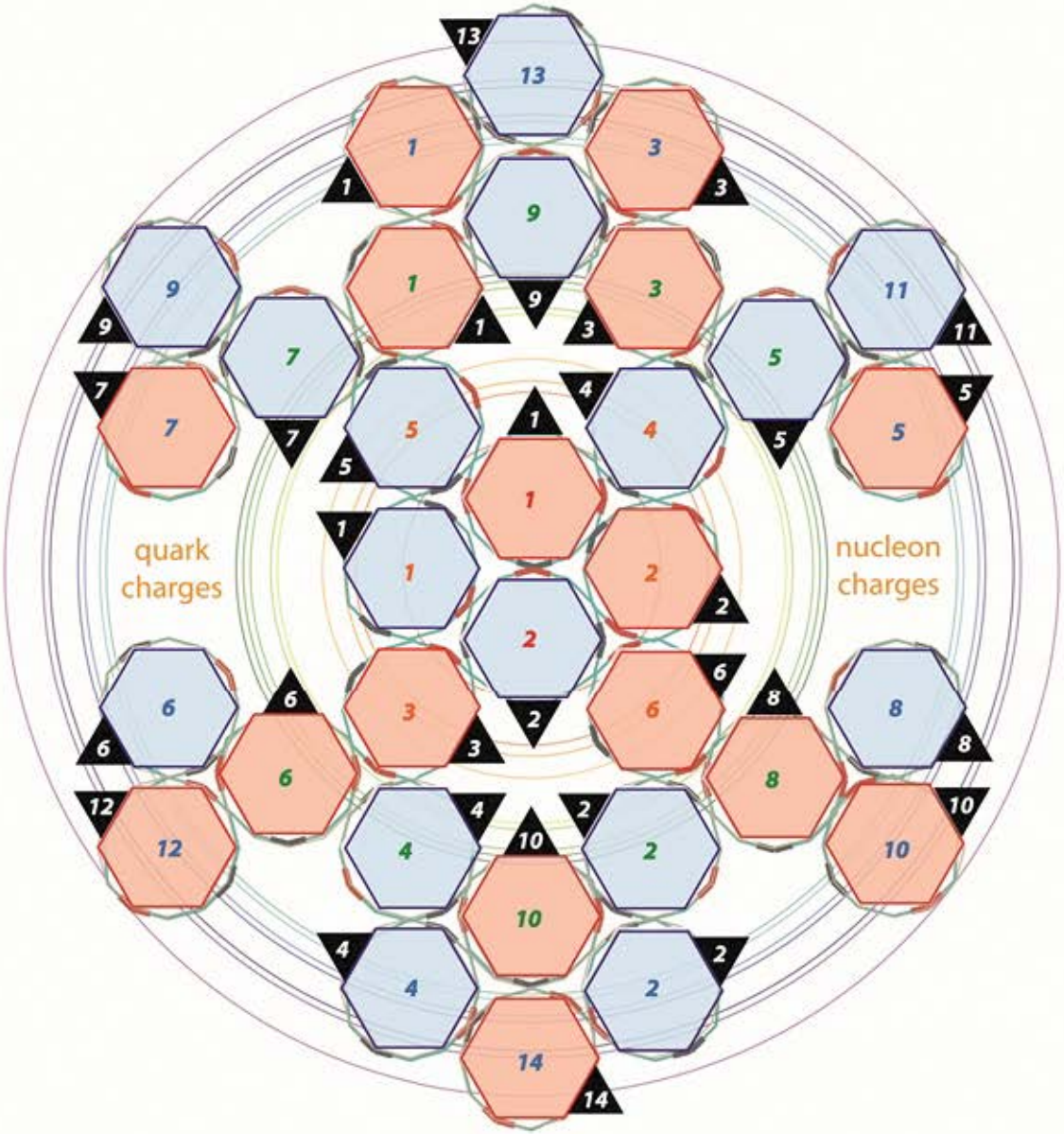

(Strong force - topological Electric Points)

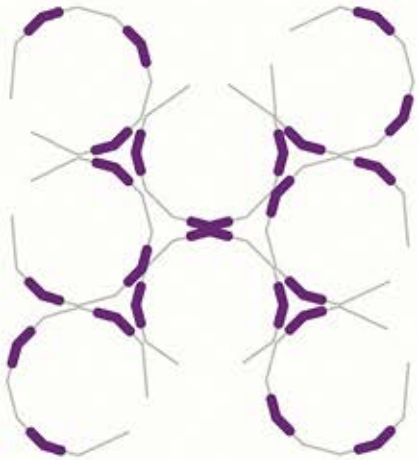

residual EM forces

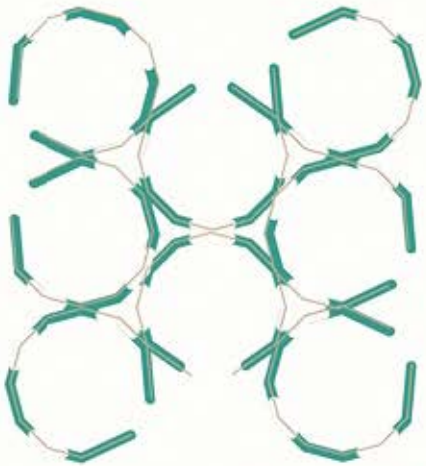

(Strong force - topological Magnetic dipoles)

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Bound electron arrangements

Externally bound electrons produce sub-orbital patterns different to the electron orbitals of internally bound electrons

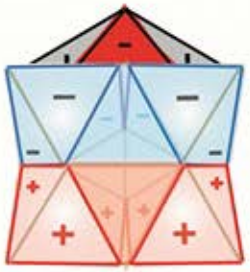

Deuterium

electrons are externally bound to the Deuteron nuclei

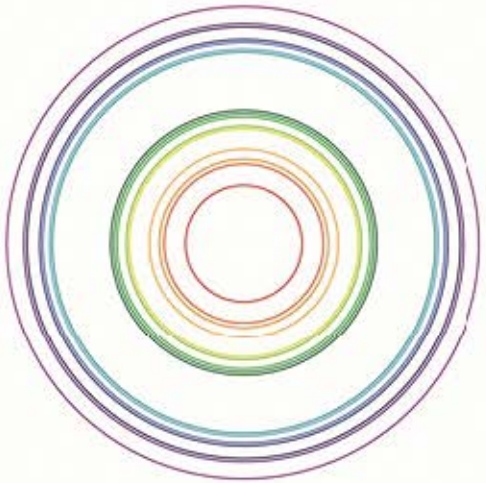

Conductors

Charges are free to move and equalise

electrons require less energy to 'break free' from Nuclei

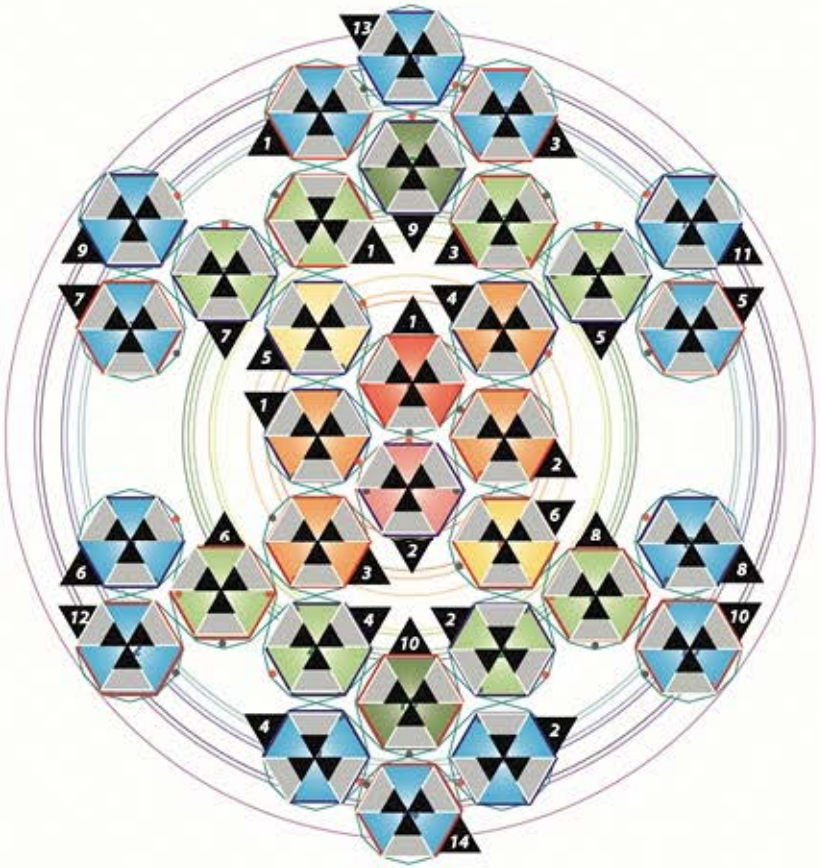

The electron orbitals of conductors are lower energies than those of insulators

Deuterium

electrons are internally bound in the Deuteron nuclei

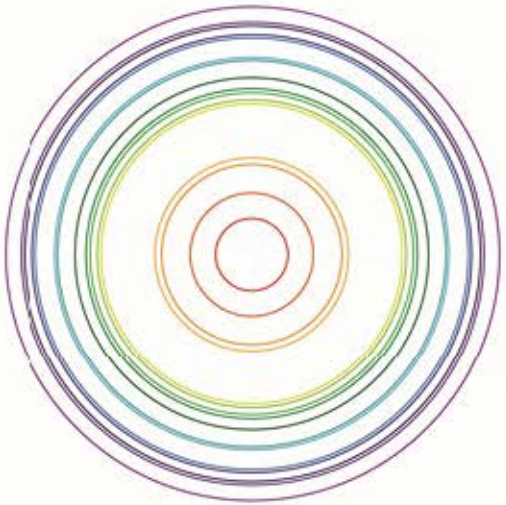

Insulators

Charges are bound to specific locations

electrons require more energy to 'break free' from Nuclei

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2D mass-energy geometries form the fabric of 3D Matter topologies

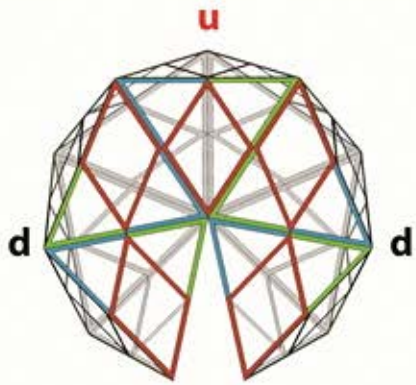

Proton

12
[24-12]

nett Charge
component charges

charged mass-energy geometry

20π

Matter topology

12
[42-30]

40π

Deuteron

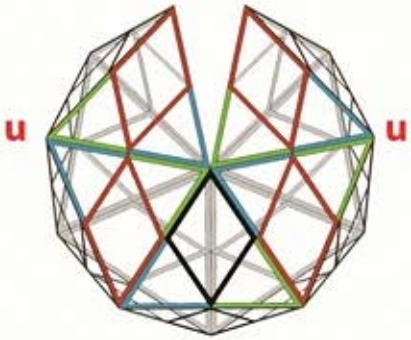

nett Charge
component charges

0
[18-18]

charged mass-energy geometry

Matter topology

20π

Neutron

Charge provides the framework for the mass-energy geometry of Matter

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All Matter topologies are the result of charged EM mass-energy geometries

Matter

$$\frac{36\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Baryons, Planck quanta, mass, velocity

mass-energy

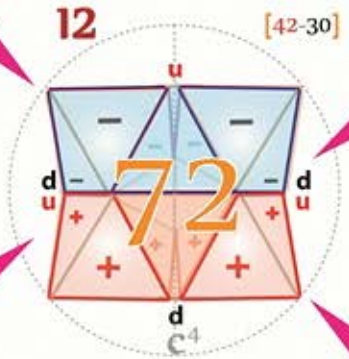

Matter

$$\frac{36\pi}{c^4}\left[\left[m\Omega v^2\right]\right]$$

Baryons, Planck quanta, mass, velocity

mass-energy

Deuterons

are the building blocks of
all periodic elements and compounds

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Strong Forces and Nuclear Bonding

How do Baryons with Positive and Neutral charges attract each other and bind to form stable elements ?

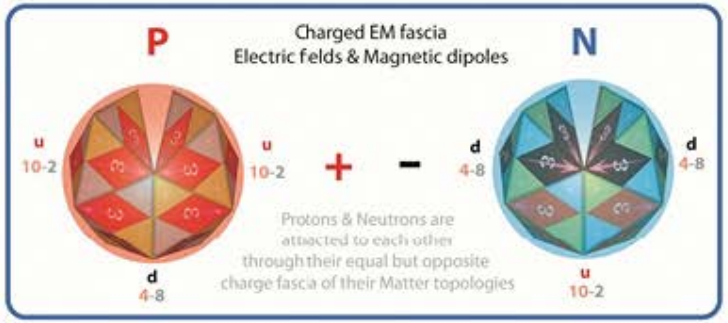

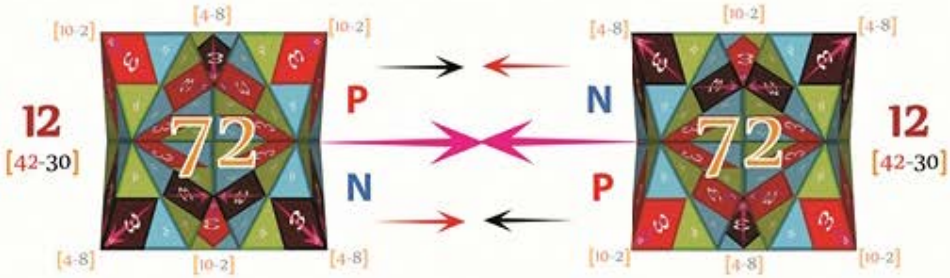

Once nuclei have been created their external electric fields & magnetic dipoles continue to attract and bind individual nuclei together via the Residual EM Force as nuclei seek charge equilibrium by combining with each other and electrons to form neutral elements

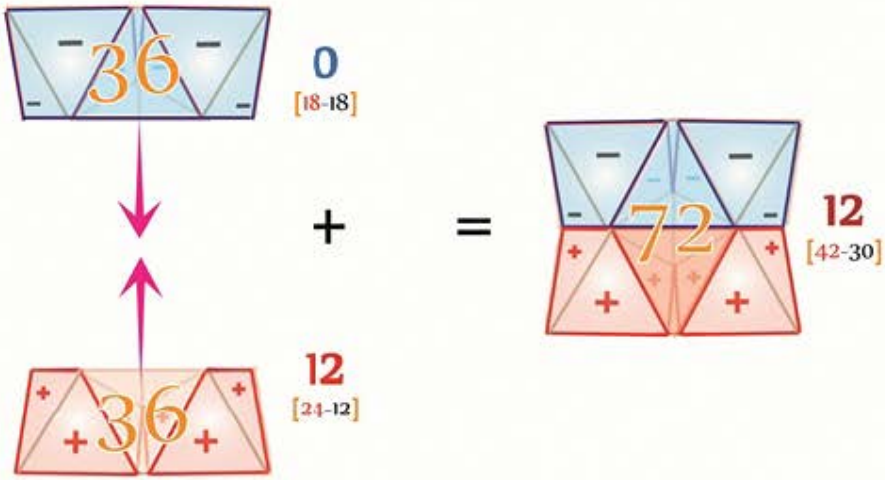

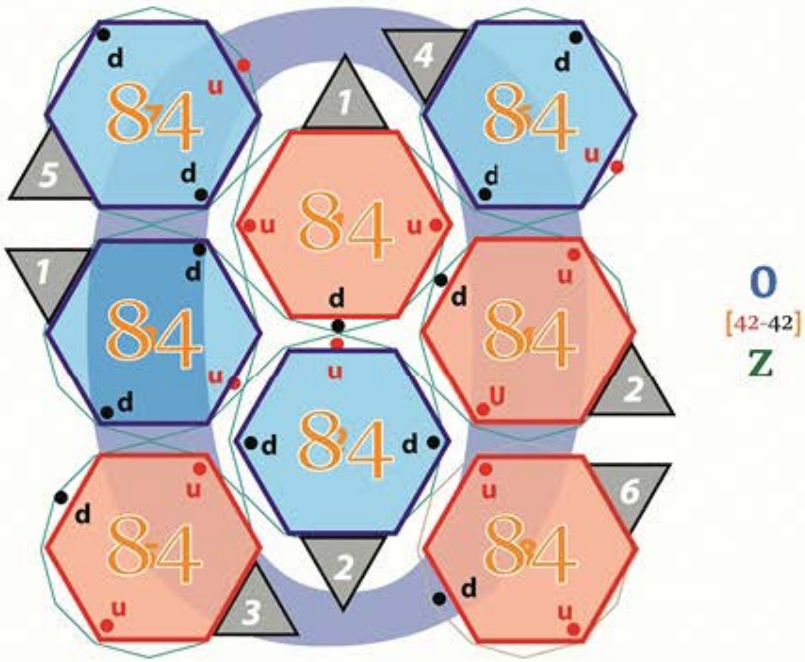

The attraction and binding of Protons and Neutrons through their electric charge imbalances creates Deuterons which have +12 charges

The residual Z[+12] charge is what attracts electrons to form neutral atomic nuclei via Coulombic attraction

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Strong Nucleonic Bonding

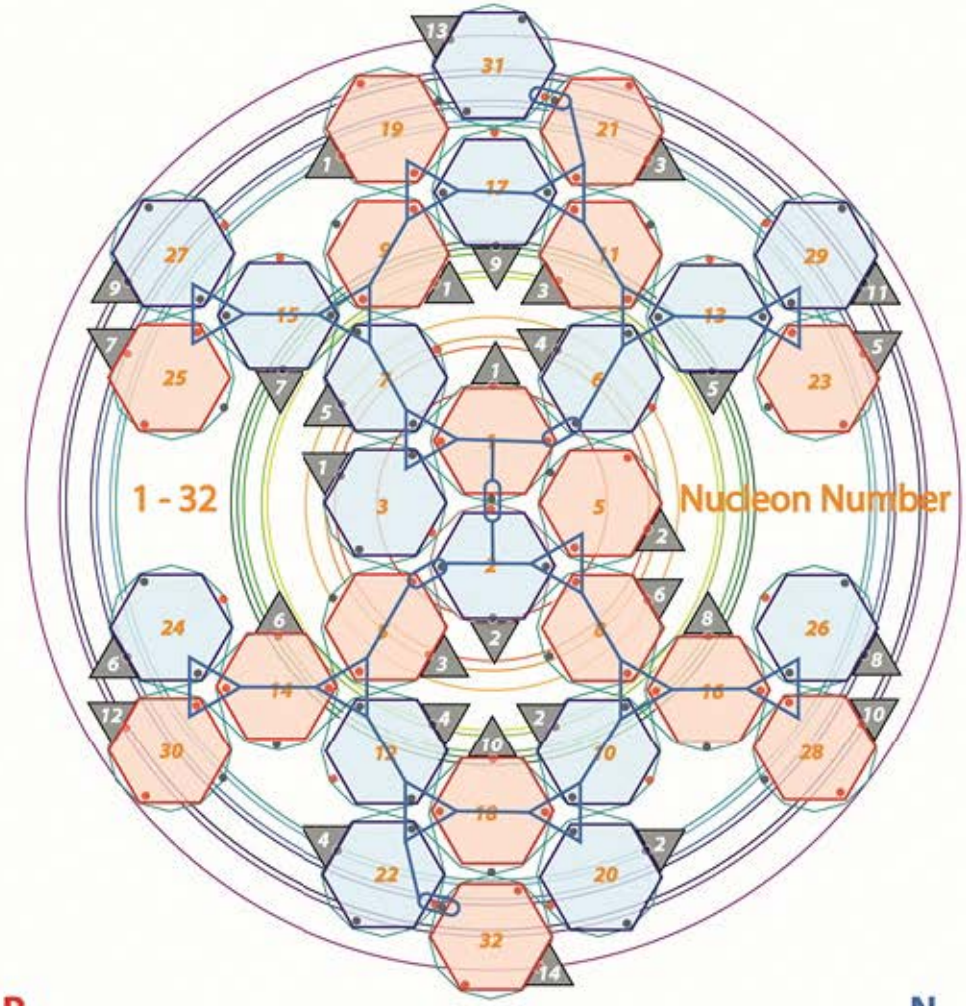

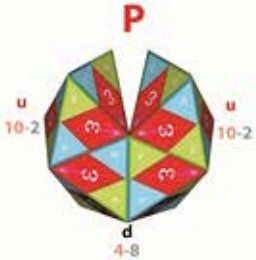

+

In addition to the Strong colour force
a separate residual binding force arises
from the external apexes formed by
Positive and Negative Electric points of quarks
in each Baryon [nuclear-chemical bonds]

-

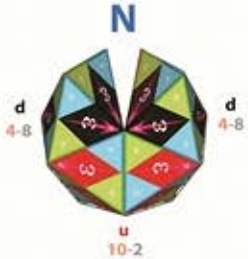

All energy seeks equilibrium

External Electric field points bind via Charge fascia interactions with Plus and Minus Electric points combining and sharing energy throughout the resultant nuclei

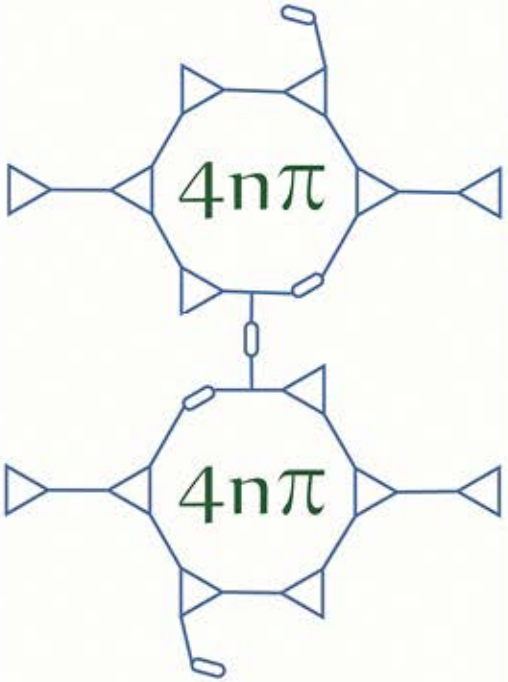

Positive Electric field apex

Negative Electric field apex

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Hydrogenic vs Nucleonic electron binding

If a unbound Proton attracts an Electron the Electron can be bound to the nuclei in a number of differing orientations [each with differing spin energies]

All atomic nuclei (and elements) are Deuteron'ic nuclei with a mixture of *orthagonal*, parallel and anti-paralllel spin orientations

(this is why Rydberg is less accurate for elemental nuclei compared to Hydrogenic atoms - see QM spin)

Electrons can be bound to deuteron nuclei in four distinct orientations [2 horizontal & 2 vertical] with each spin coupling orientation producing differing energy electron orbitals [wrt to the nuclear magnetic moments]

Ejecting electrons from atomic nuclei by adding energies to their KEM fields [the Photoelectric effect] creates Positive Ions

Vertically orientated electrons within Proton-Neutron Nuclei [Deuterons] create quantum synchronous convertor geometries

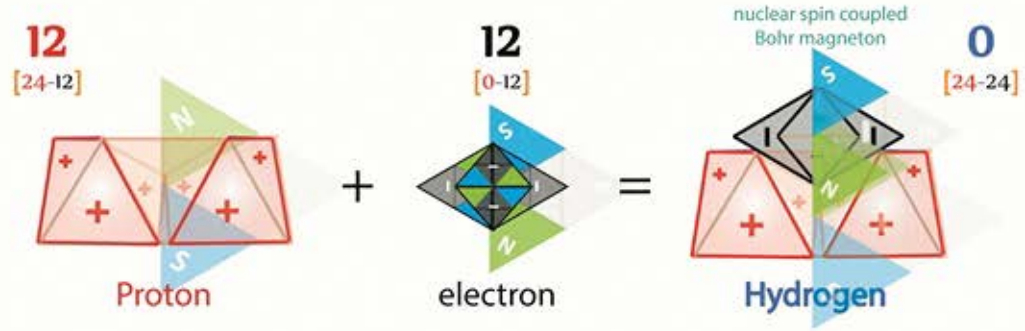

The energy levels of Baryons determines the KEM field energy of bound electrons

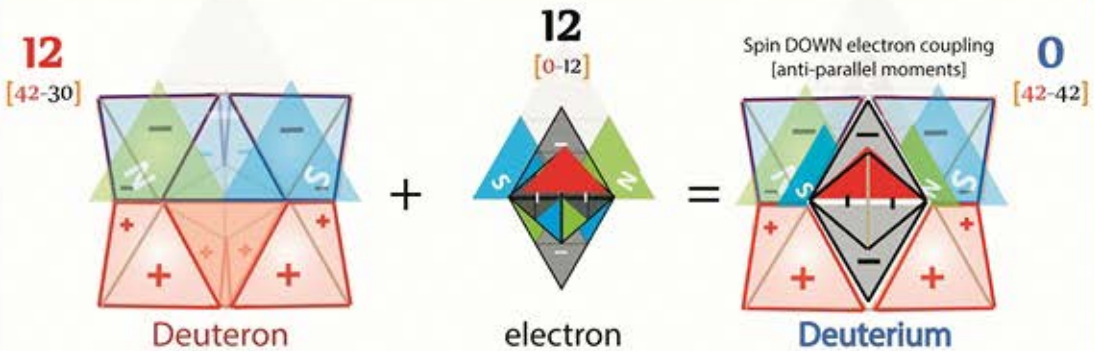

Bohr magnetons are always referenced wrt the Nuclear magneton

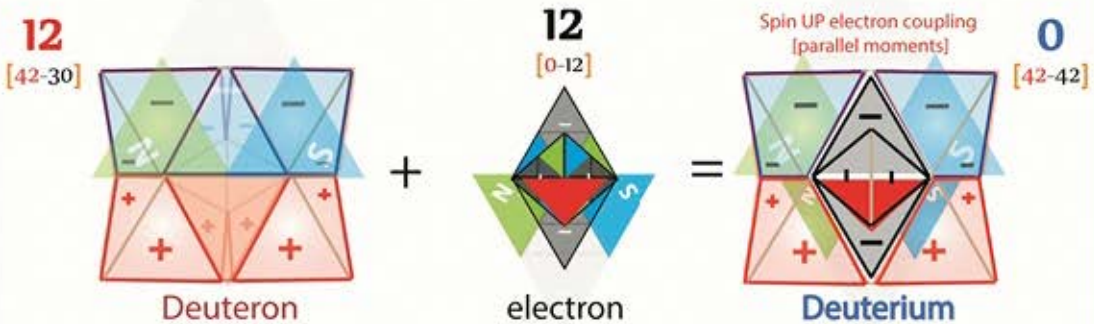

electrons produce stronger magnetic moments due to their mass-charge quotient

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Atomic Nucleus Master Template

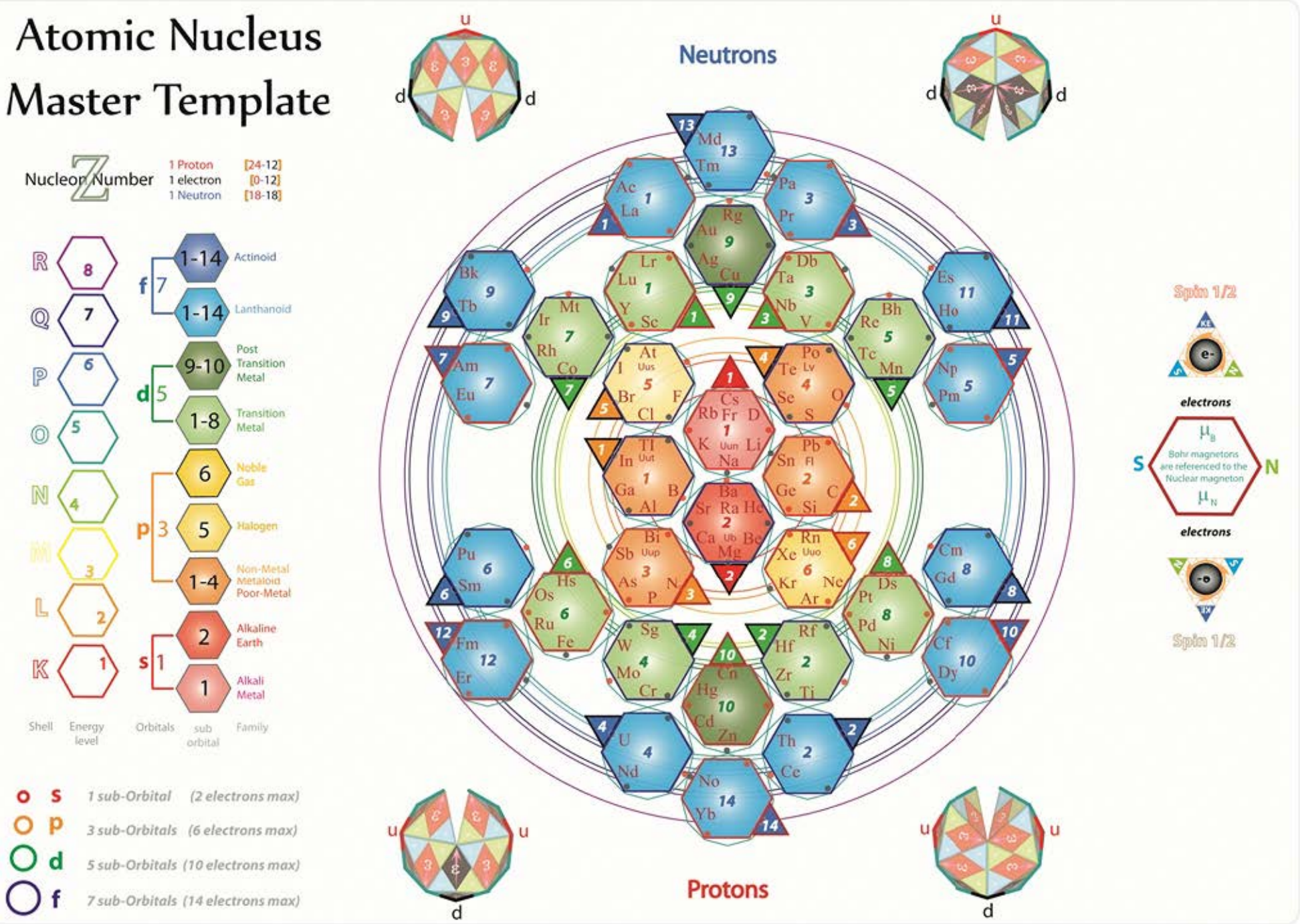

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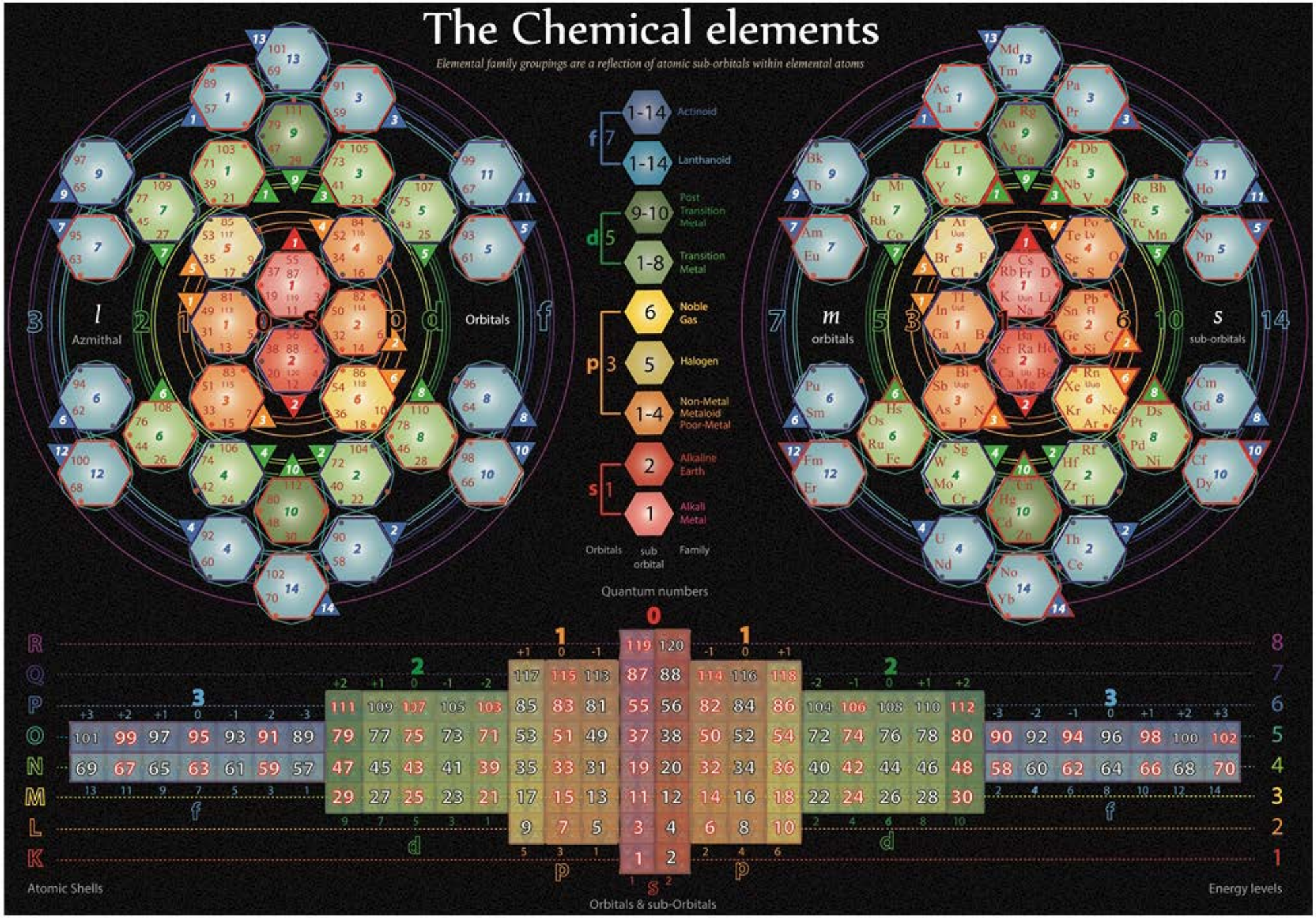

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Element Numbers

Z * 1 Proton [24-12]
1 Neutron [18-18]
1 electron [0-12]

Each elemental nuclei is made from Deuterium

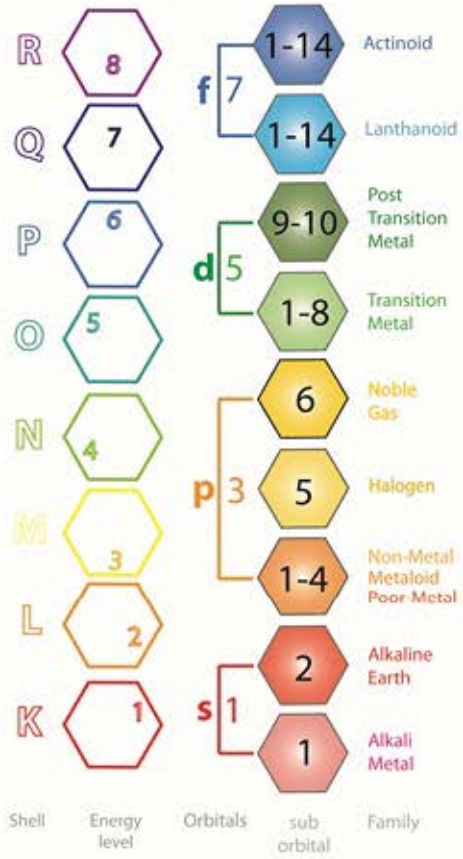

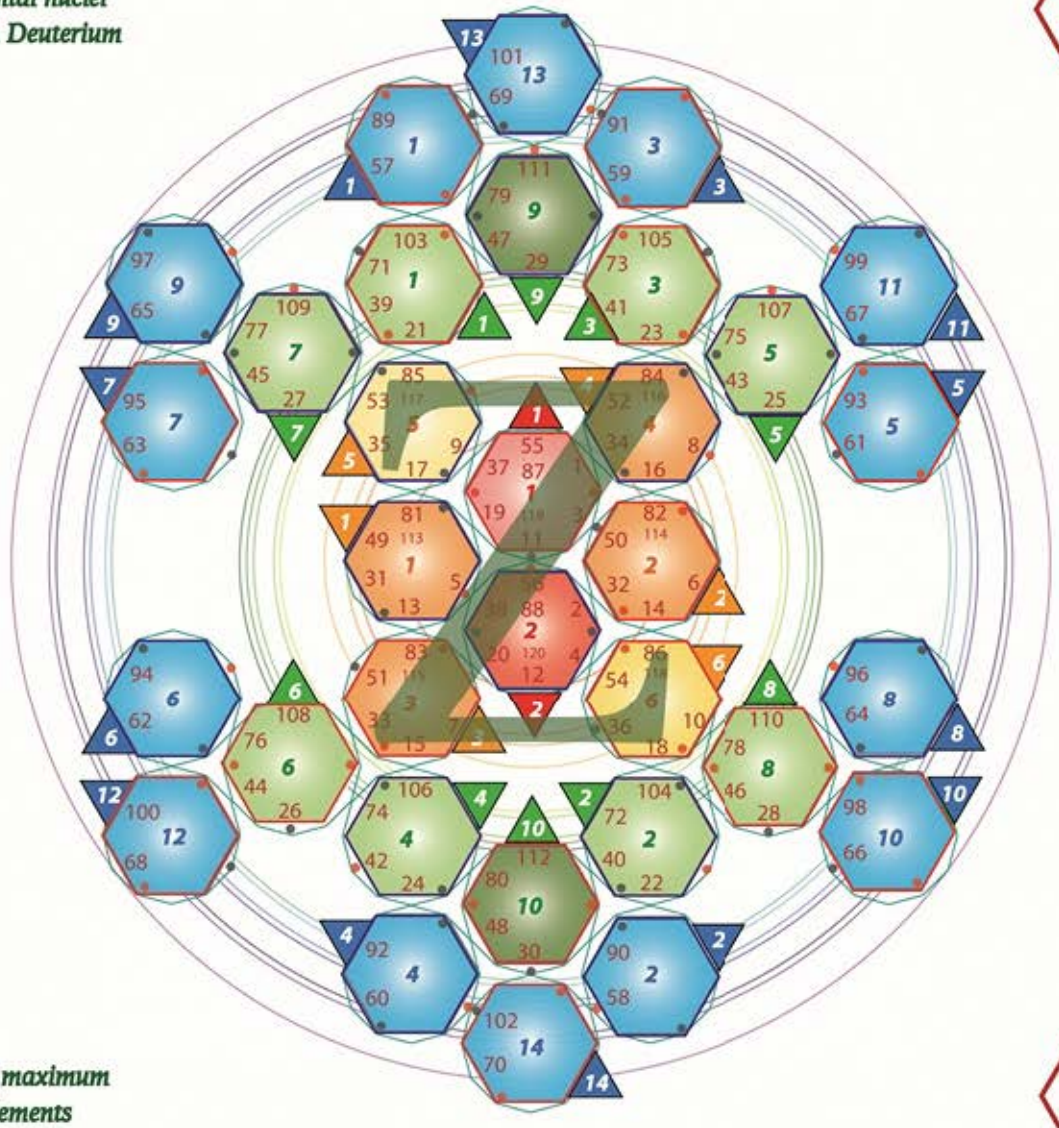

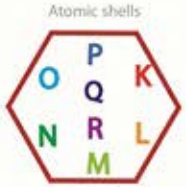

o s 1 sub-Orbital (2 electrons max)
o p 3 sub-Orbitals (6 electrons max)
o d 5 sub-Orbitals (10 electrons max)
o f 7 sub-Orbitals (14 electrons max)

There are a maximum of 120 elements possible

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Element Names

Z * 1 Proton [24-12] 1 Neutron [18-18] 1 electron [0-12]

There are a maximum of 120 elements possible

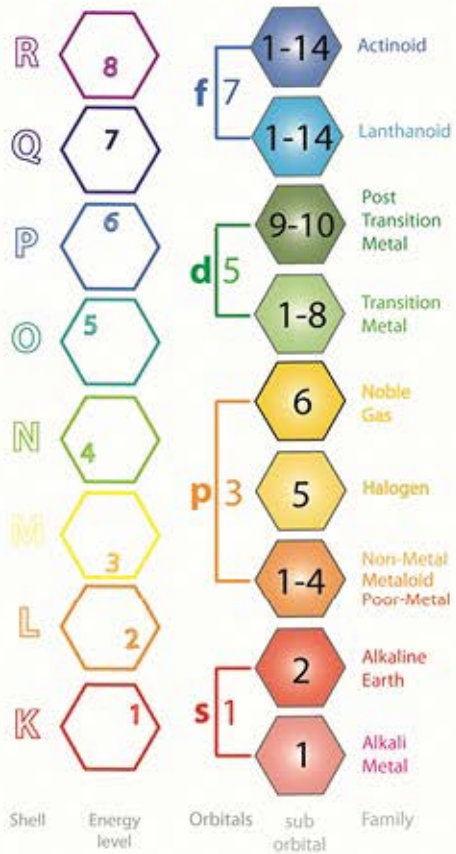

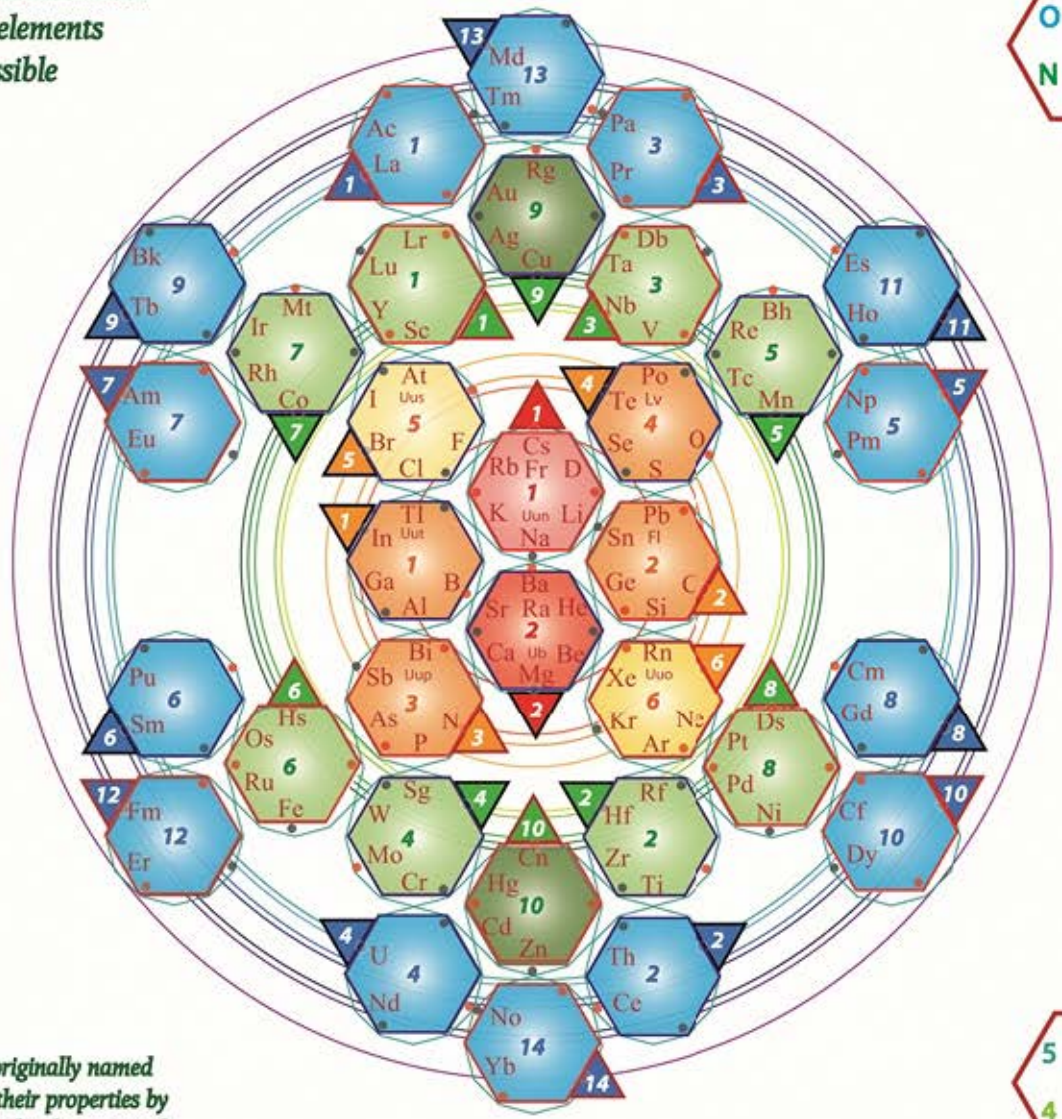

o s 1 sub-Orbital (2 electrons max)
o p 3 sub-Orbitals (6 electrons max)
o d 5 sub-Orbitals (10 electrons max)
o f 7 sub-Orbitals (14 electrons max)

They were originally named according to their properties by their discoverer but have recently been named after famous scientists

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Electron orbital configurations

A huge number of differing d and f orbital configurations are possible given the number of nuclei and bond points created by elemental topologies

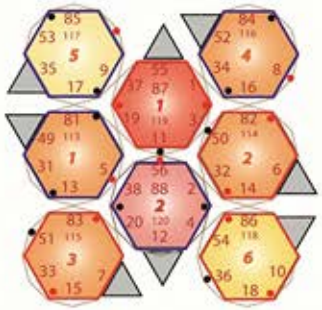

As the number of nucleons increases so does the complexity of the electron orbitals possible

quantum snowflakes

However all have a stable 'core' grouping of nuclei comprised of s and p electron orbitals

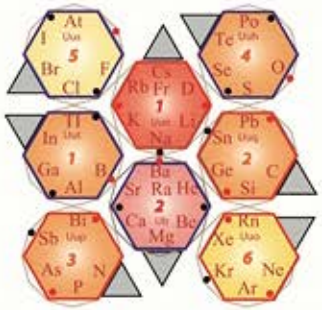

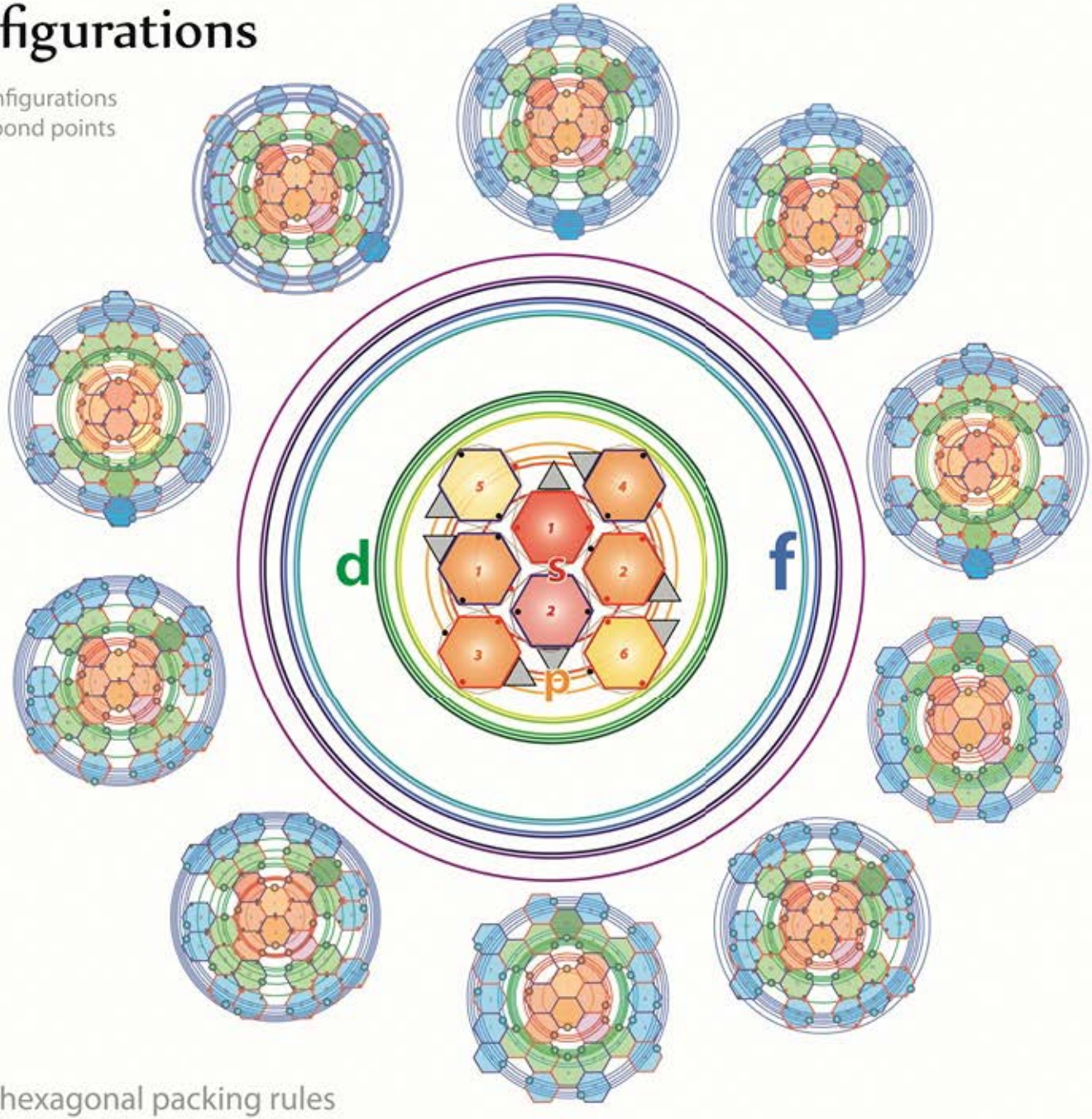

All nuclei bonding closely follows hexagonal packing rules

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Atomic Nucleus
Exploded view

1 Proton [24-12]
1 electron [0-12]
1 Neutron [18-18]

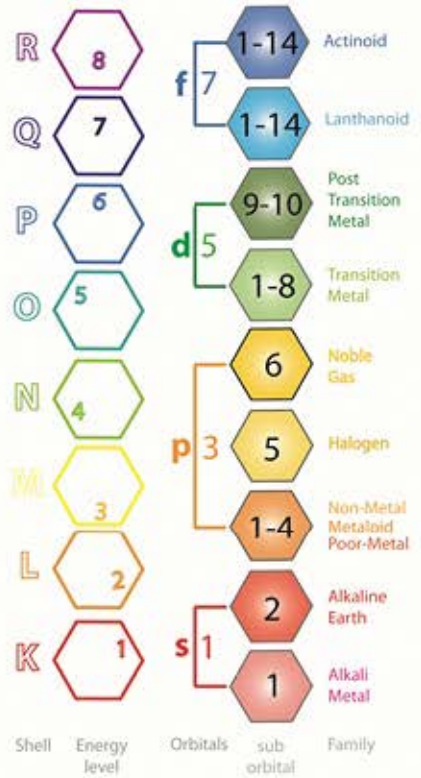

o s 1 sub-Orbital (2 electrons max)
o p 3 sub-Orbitals (6 electrons max)
o d 5 sub-Orbitals (10 electrons max)
o f 7 sub-Orbitals (14 electrons max)

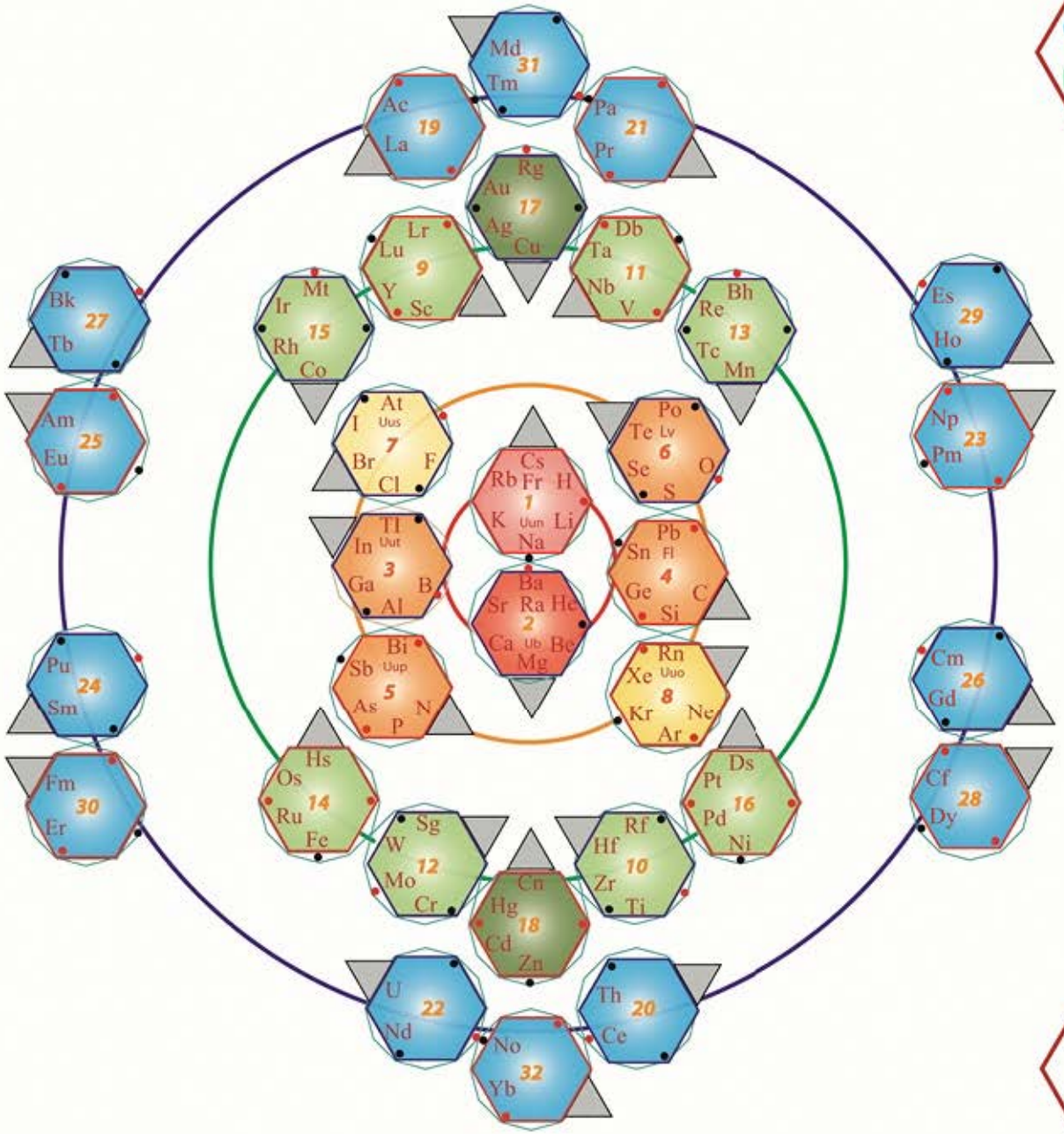

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Atomic radii of elements

The Mendeleev block arrangement of periodic elements presents a number of problems in representing the true topologies and properties of all the periodic elements:

Questions are raised over Hydrogen's appropriate position in the table

The table correctly positions elements according to their elemental properties but offers no insight into the individual geometries of the periodic elements themselves

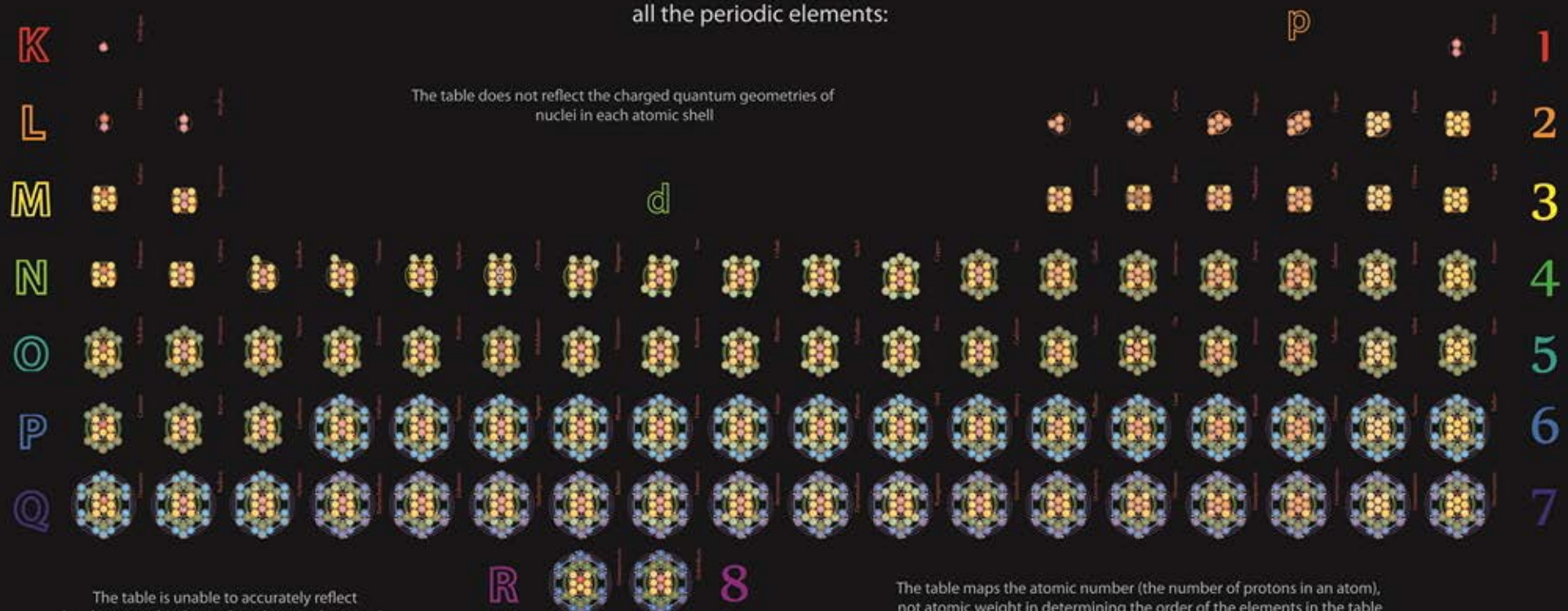

The table does not reflect the charged quantum geometries of nuclei in each atomic shell

The table is unable to accurately reflect the electron orbitals or other elemental properties described by the Bohr & Schrodinger models

The table maps the atomic number (the number of protons in an atom), not atomic weight in determining the order of the elements in the table resulting in a number of errors in periodic element placements

'f' orbitals elements are not normally presented in their true atomic number positions

f

Tetryonic charge geometry rectifies all of these deficiencies

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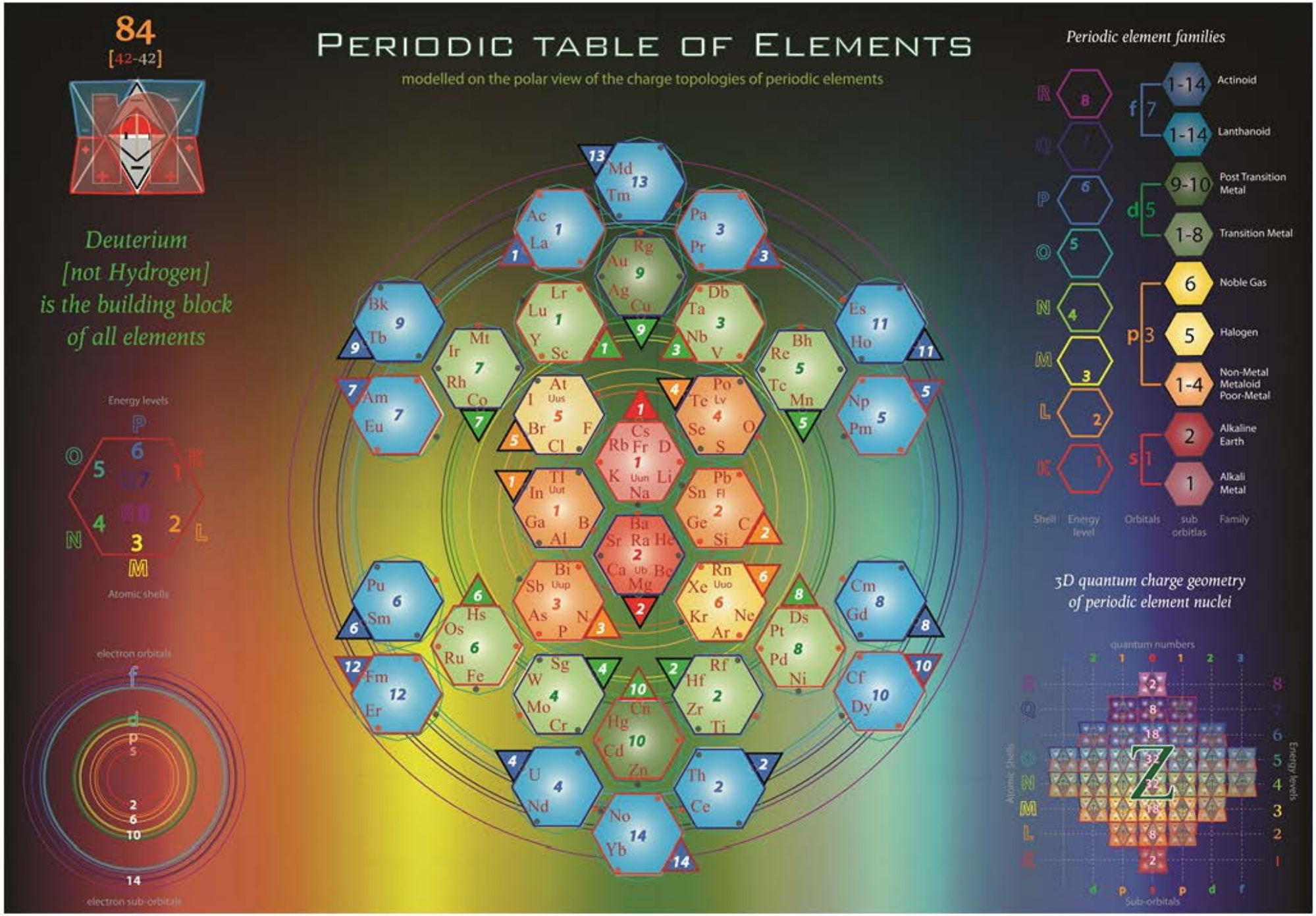

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THE ATOMIC NUCLEUS

the charged quantum mass-energy geometry of periodic element topologies

Neils Bohr

(7 October 1885 – 18 November 1962)

Erwin Schrödinger

[12 August 1887 – 4 January 1961]

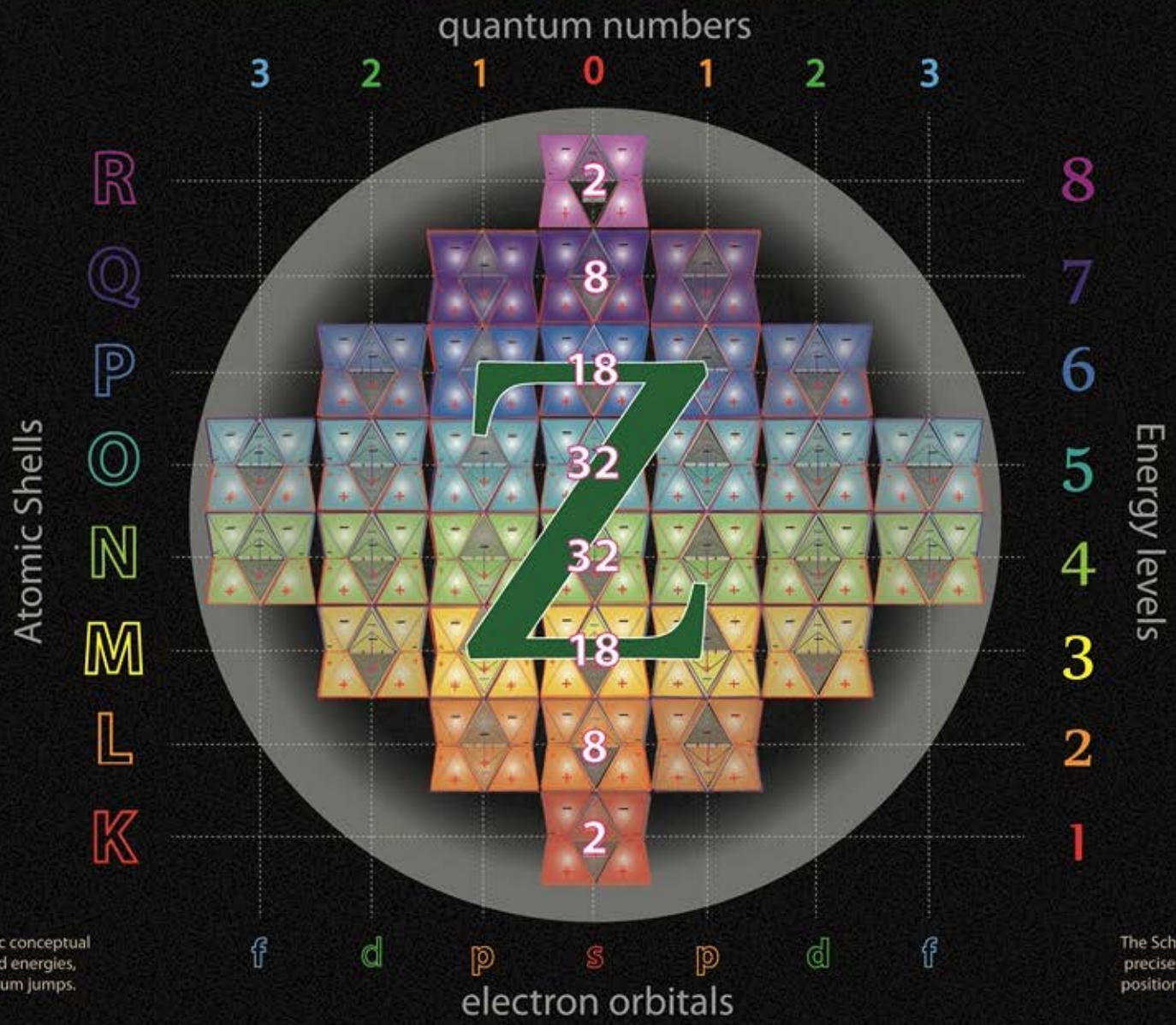

NEILS BOHR

The Bohr model gives us a basic conceptual model of electrons orbits and energies, along with the idea of quantum jumps.

SCHRÖDINGER

The Schrondinger wave equation gives precise details of spectra and electron position and motions within the nuclei

The uncertainty principle erroneously dictates that position and momentum cannot be simultaneously determined.

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Periodicity of atomic elements

An electron shell may be thought of as an orbit followed by electrons around an atom's nucleus. The closest shell to the nucleus is called the "1 shell" (also called "K shell"), followed by the "2 shell" (or "L shell"), then the "3 shell" (or "M shell"), and so on further and further from the nucleus. The shell letters K, L, M, ... are alphabetical

Each shell can contain only a fixed number of deuterium nuclei [Protons, Neutrons & electrons]

Each shell consists of one or more electron orbitals, and each orbital consists of one or more sub-orbitals.

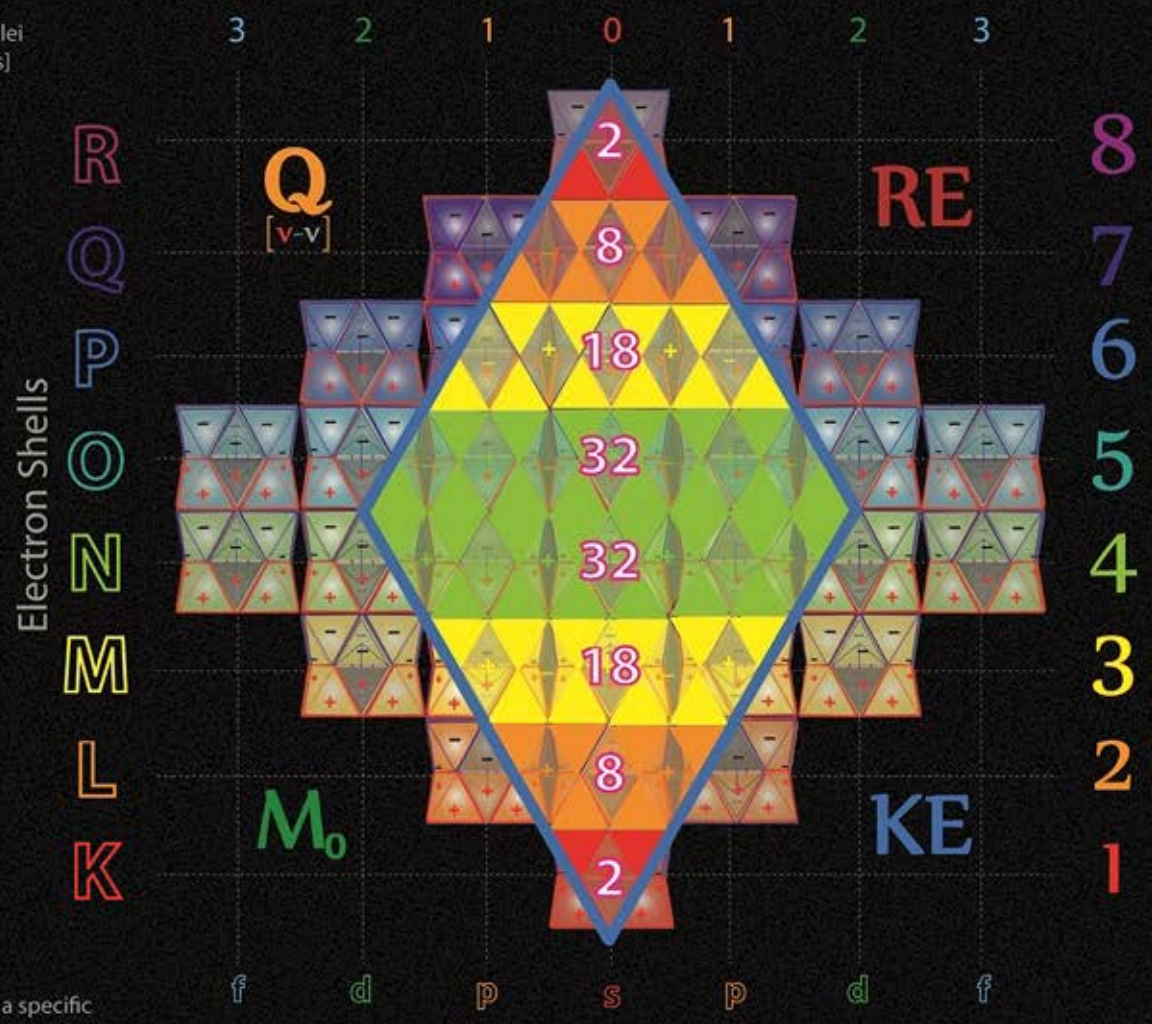

8 atomic energy shells with electrons

120 periodic elements in total

The number of deuterium nuclei that form each atomic shell in an elemental atom number is double that of Photon energy levels

Each atomic shell equates to a specific energy level for the Deuterium nuclei that comprise it with in turn affect the angular momentum of electrons in that shell

The electrons in the partially filled outermost atomic shell [or highest energy level] determine the chemical properties of the atom; they are called valence shell electrons.

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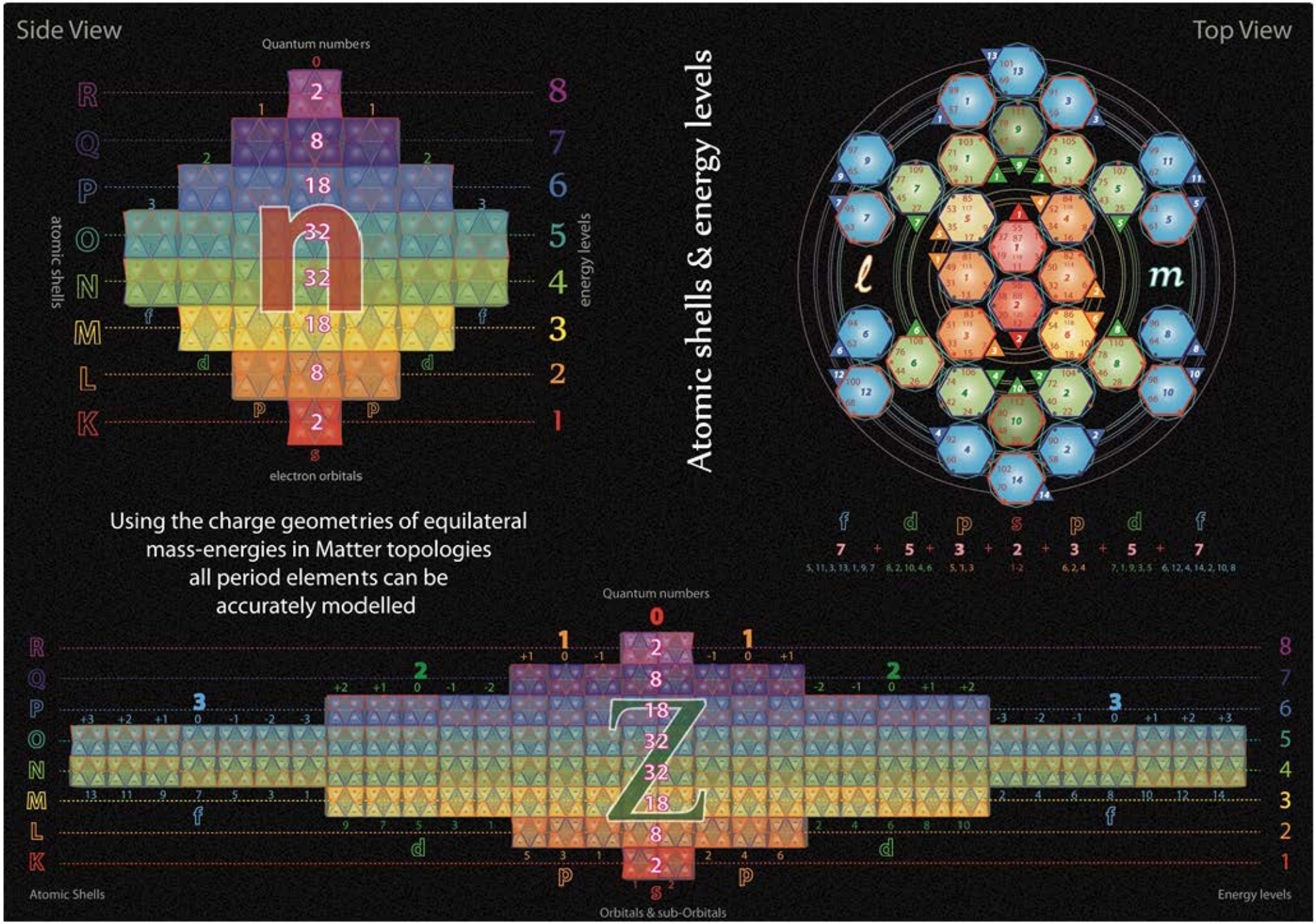

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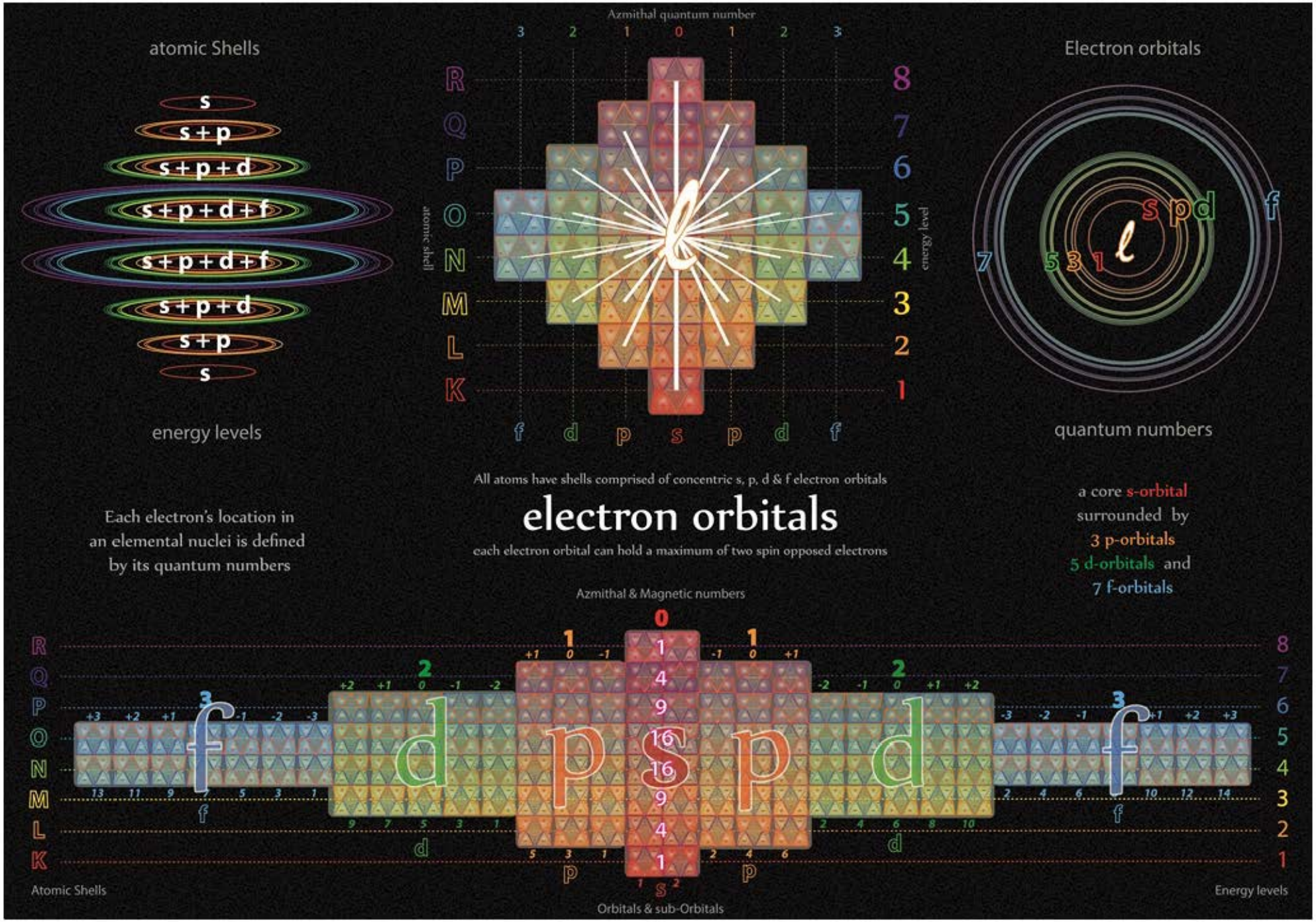

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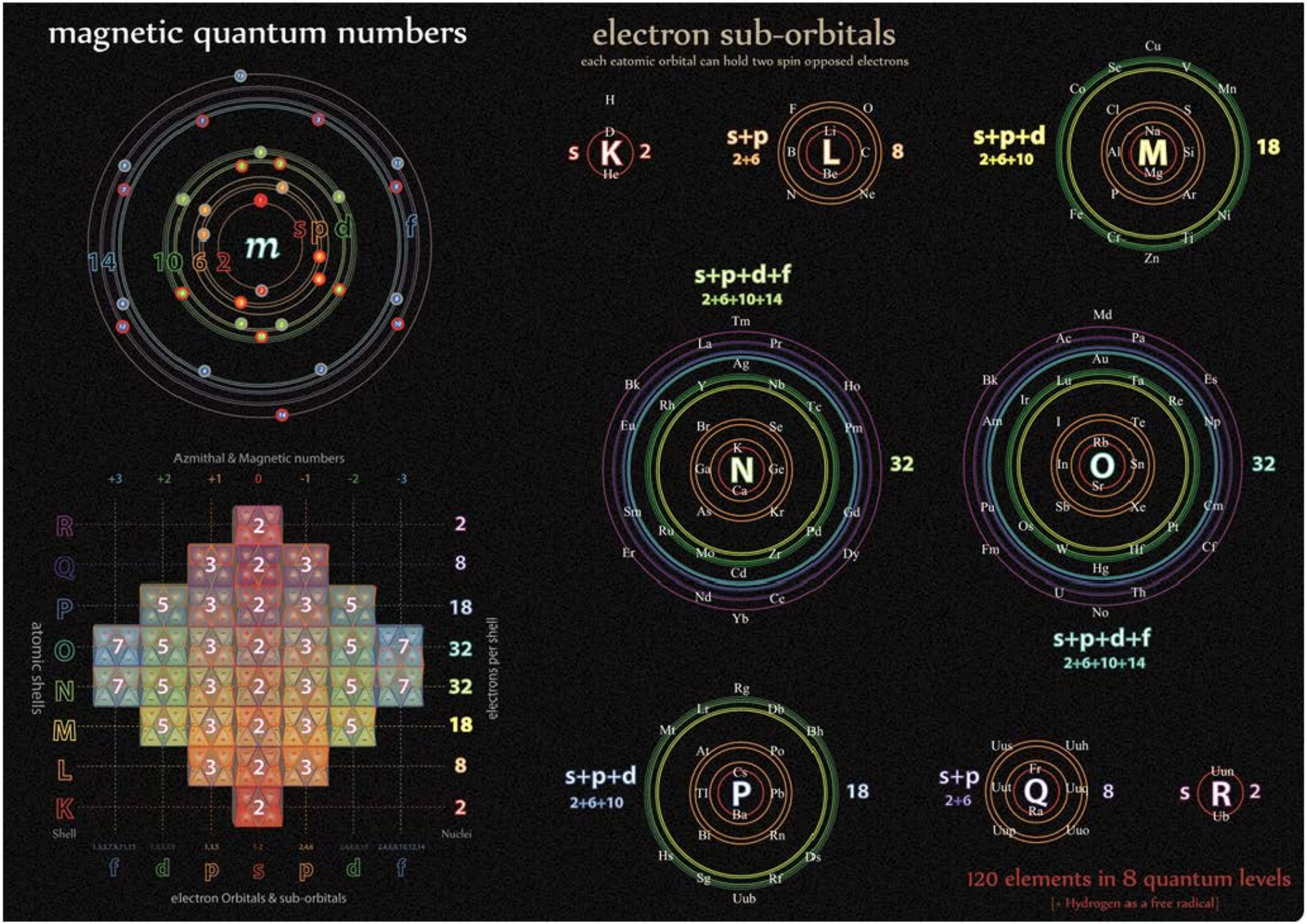

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Electron SPIN in atoms

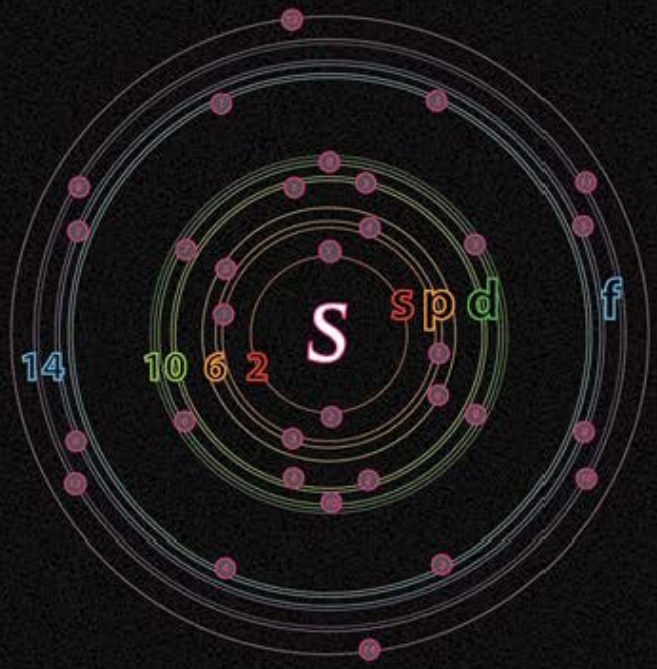

1 sub-Orbit	s	2 electrons
3 sub-Orbits	p	6 electrons
5 sub-Orbits	d	10 electrons
7 sub-Orbits	f	14 electrons

Hund's Rule
Each electron sub-orbital (Azimuthal number)
can not have electrons with the same spin direction

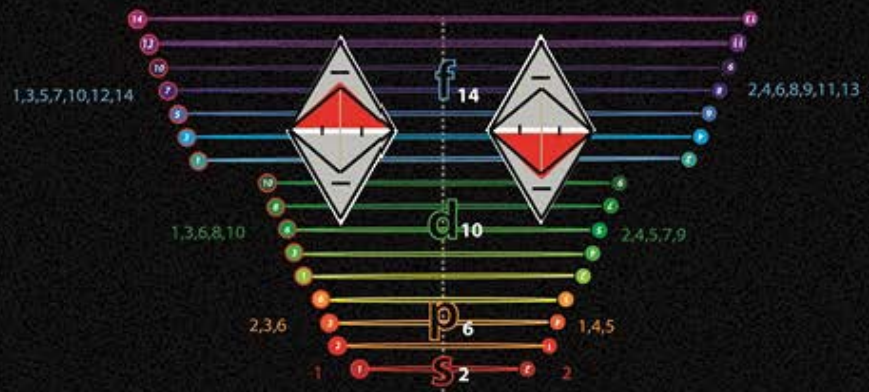

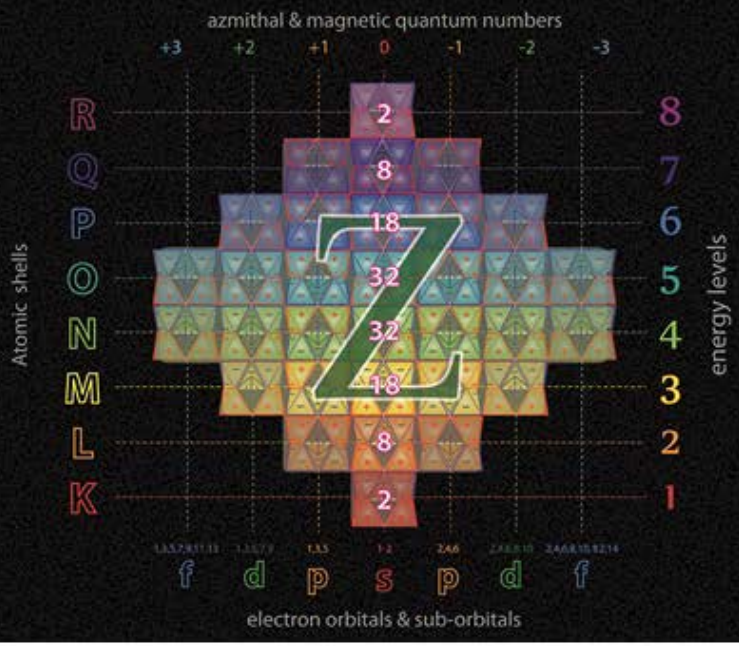

electron spin is always referenced to the Nuclear magneton

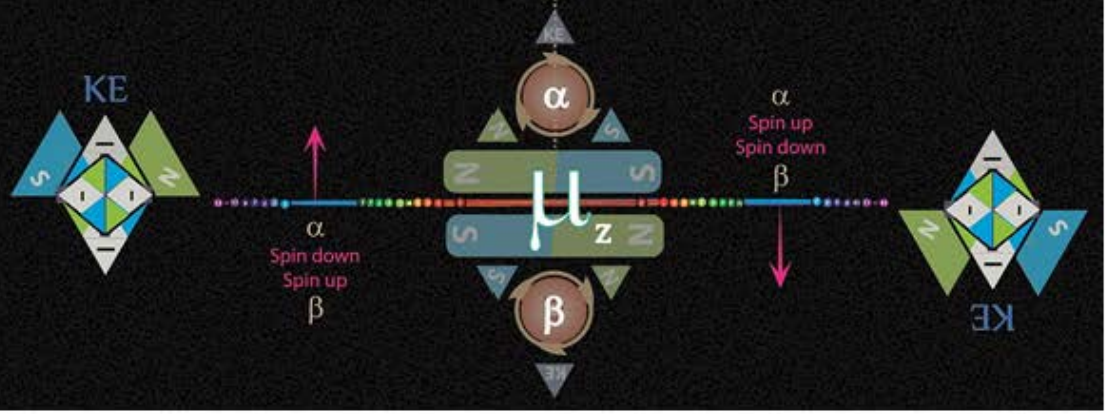

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Quantum numbers

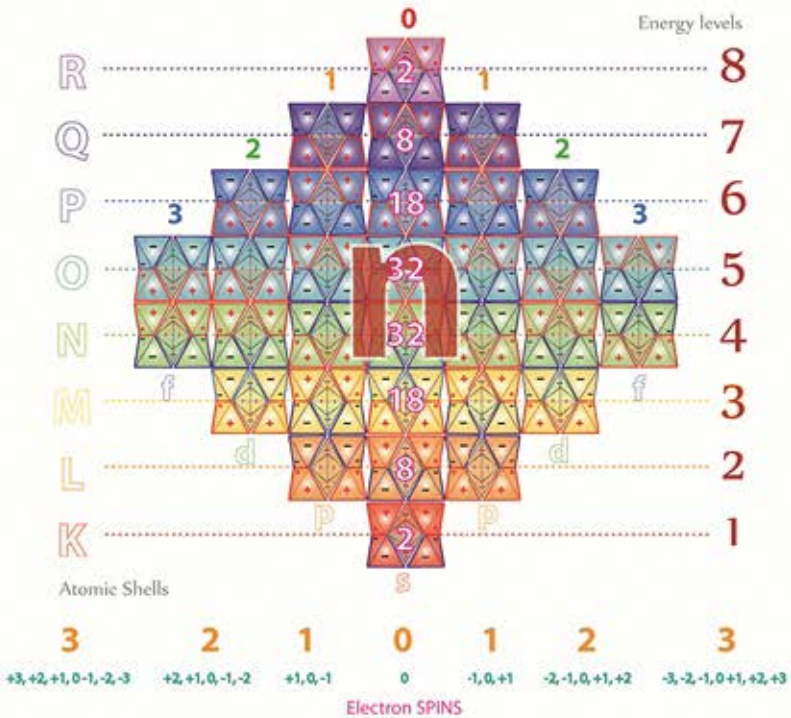

The properties of every atom's specific electron configuration can be described by four quantum numbers:

n (1-8)
Principal
(n = 1, 2, 3, 4 ...)

ℓ (0-3)
Azimuthal
(l = 0, 1 ... n−1)

m (2ℓ+1)
Magnetic
(ml = −l, −l+1 ... 0 ... l−1, l)

s ±½
electron Spin
(ms = −1/2 or +1/2),

The Bohr model was a one-dimensional model that used one quantum number to describe the distribution of electrons

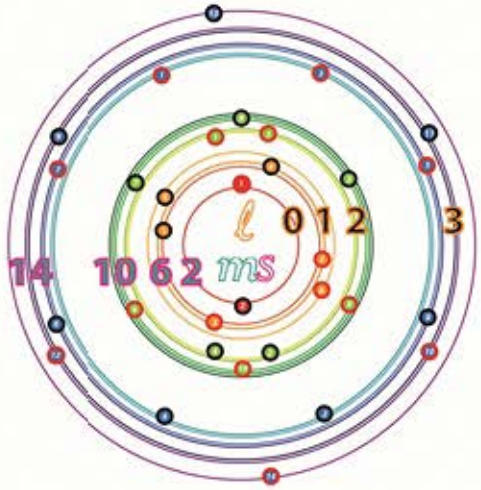

The three coordinates that come from Schrödinger's wave equations are the principal (n), angular (l), and magnetic (m) quantum numbers.

These quantum numbers describe the size, shape, and orientation in space of the orbitals of any particular atom mathematically.

These four numbers, n, ℓ, m and s can be used to describe any electron in a stable atom [and can be mapped back to the classical terminology of Shells and electron orbitals].

Each electron's quantum numbers are unique and cannot be shared by another electron in that atom.

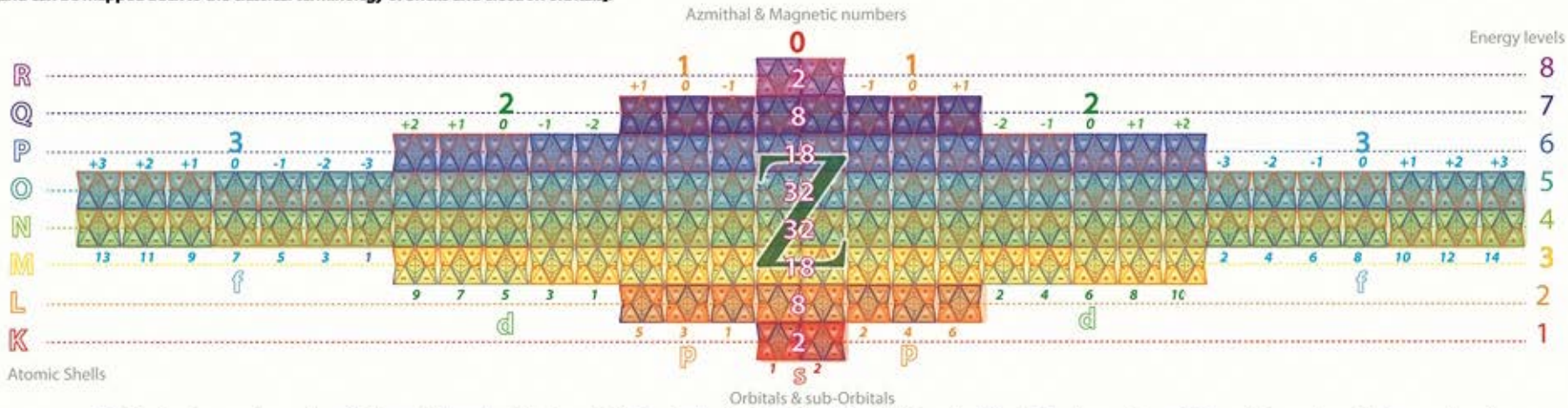

A stable atom has equal numebrs of Protons, electrons [and Neutrons], all following the Pauli Exclusion Principle thus orientating their spins so that each element has a unique electron configuration

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PRINCIPAL quantum number

The first describes the electron shell, or energy level, of an atom.

This is the only quantum number introduced by the Bohr model

The principal quantum number can only have positive integer values

atomic shells

n(1-8)

(n = 1, 2, 3, 4 ...)

energy levels

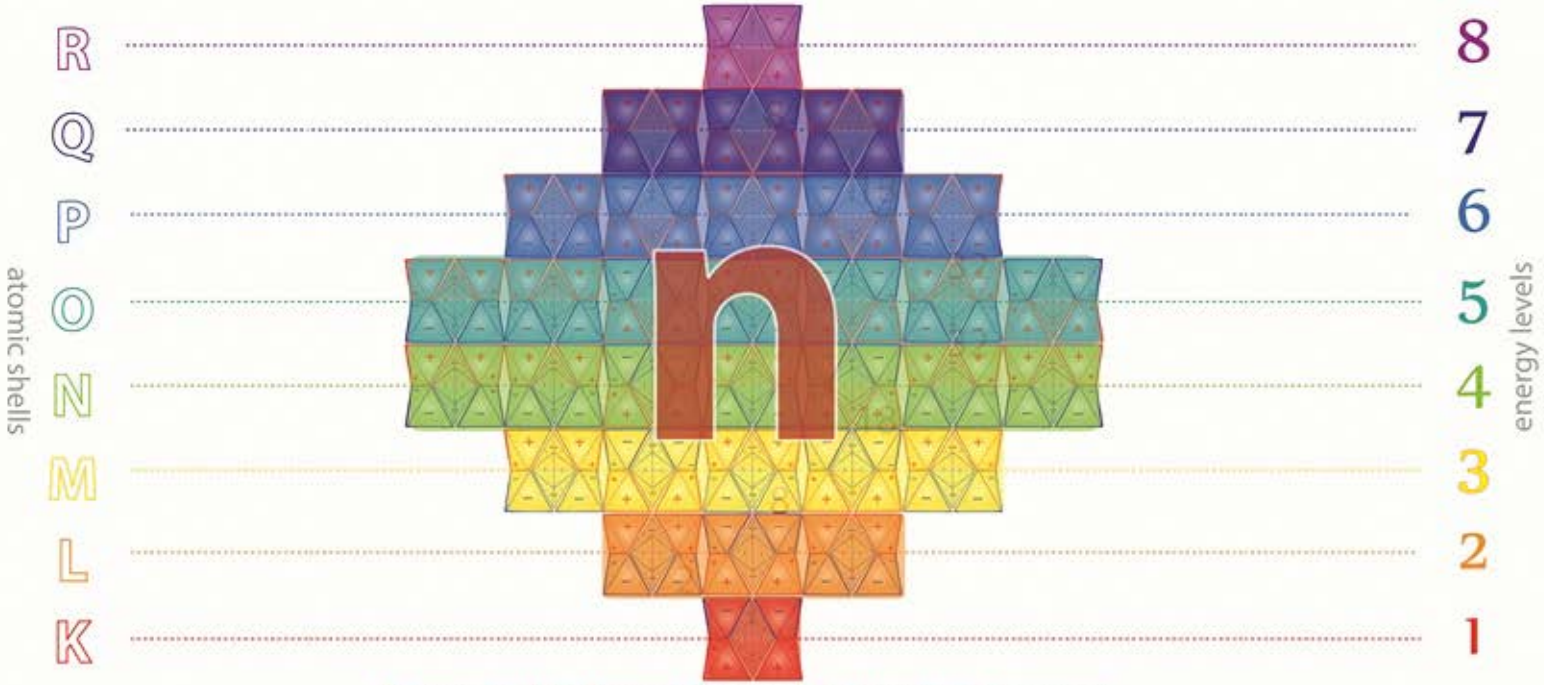

As energies of the Baryons comprising the atomic nuclei increases, the electron bound to each nuclei also possesses more KEM field energies and is therefore less tightly bound to the nucleus

Atomic Shells

(K, L, M, N, O, P, Q, R)

Atomic shells relate directly to Principal quantum numbers

(1, 2, 3, 4, 5, 6, 7, 8)

Energy levels

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AZMITHAL quantum number

The azimuthal quantum number is a quantum number assigned to any atomic orbital that describes its orbital angular momentum and determines the shape of the electron orbital

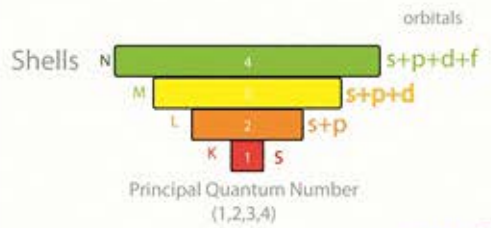

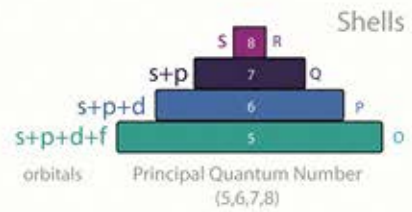

s p d f

electron orbitals

(l = 0, 1 ... n−1)

ℓ (0-7)
Azimuthal

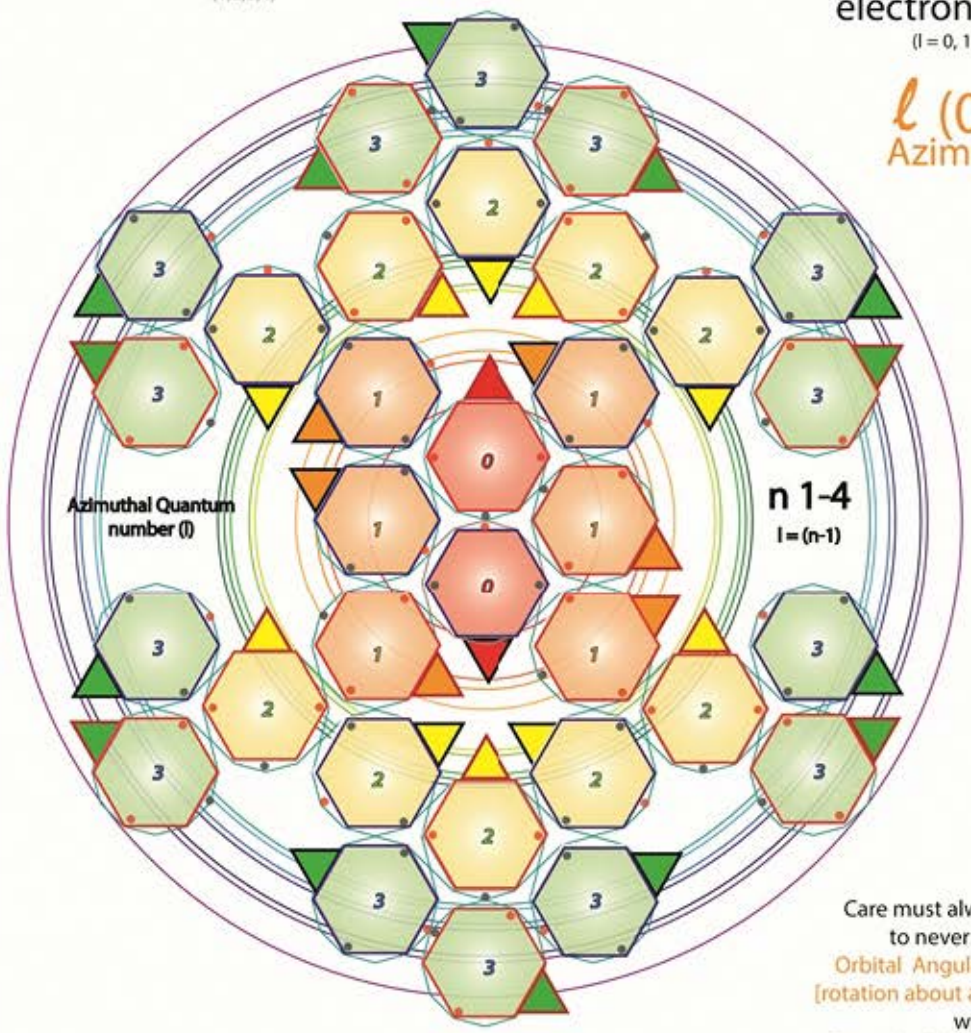

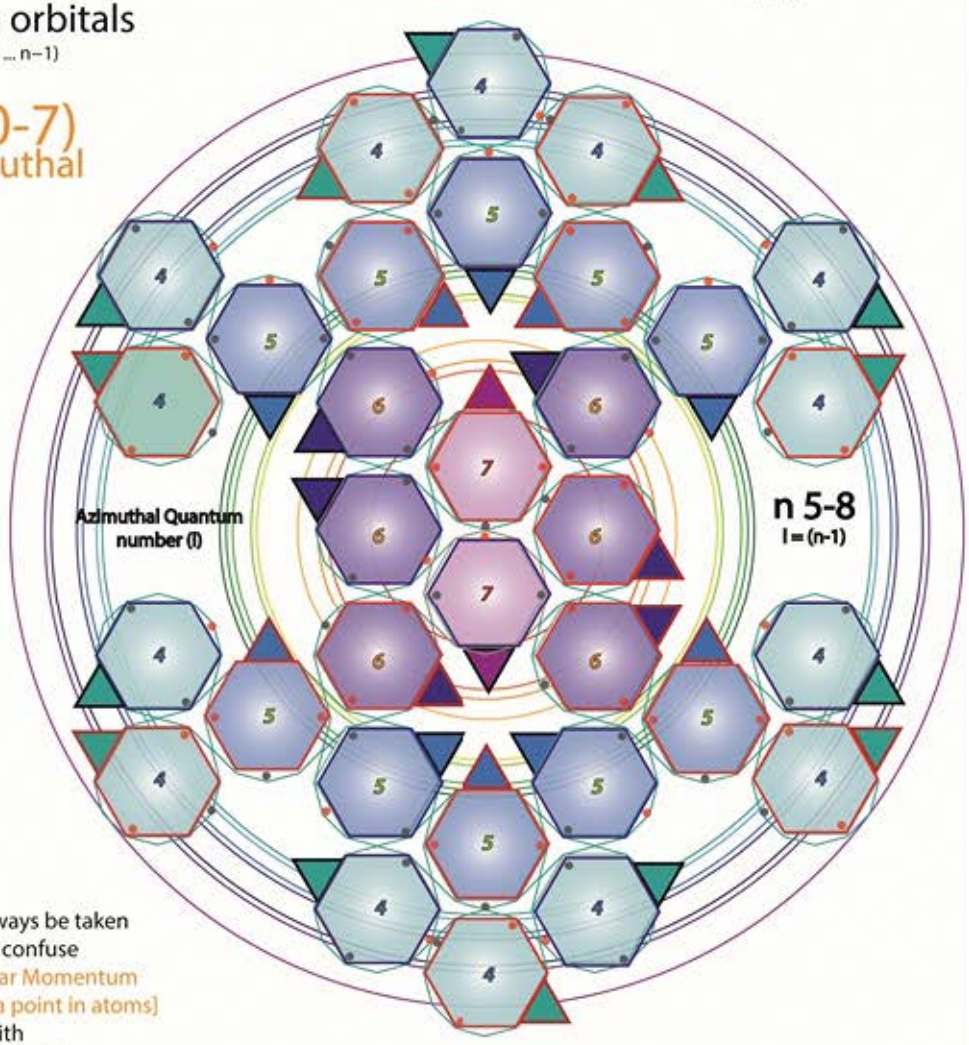

Care must always be taken
to never confuse
Orbital Angular Momentum
[rotation about a point in atoms]
with
Quantised Angular Momenta
[equilateral Planck energy geometries]

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MAGNETIC quantum number

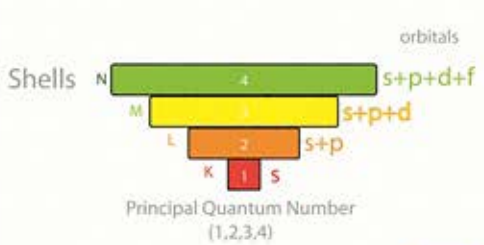

The magnetic quantum number denotes the energy levels available within any subshell

Magnetic numbers do not continue to increase as the Principal numbers increase instead they reverse after n4 to reflect the charged quanutm geometry of Elements and do not follow the current computer models in popular use

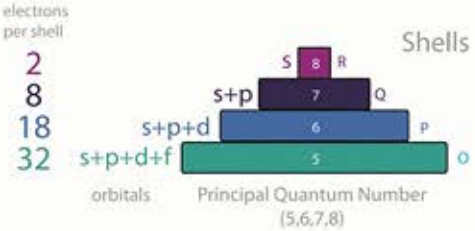

s p d f

electron sub-orbitals

(ml = −l, −l+1 ... 0 ... l−1, l)

mℓ (2ℓ+1)

Magnetic

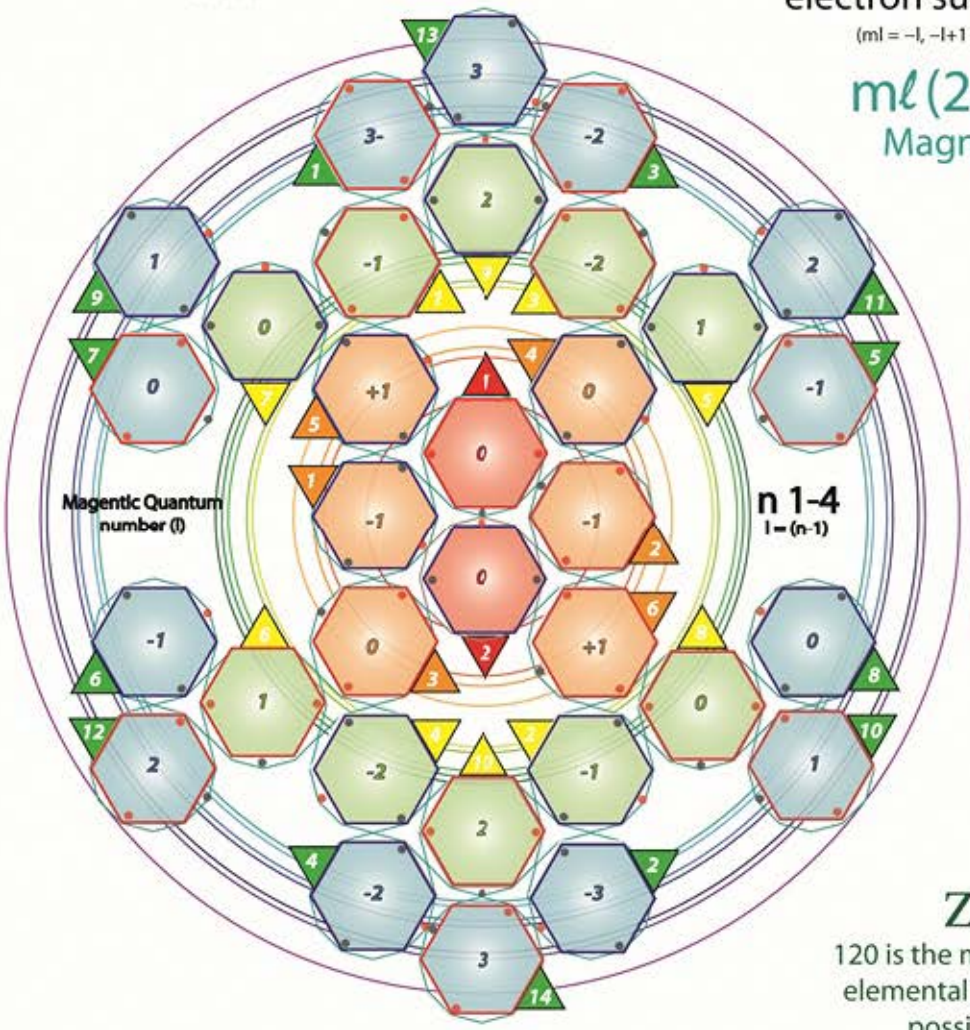

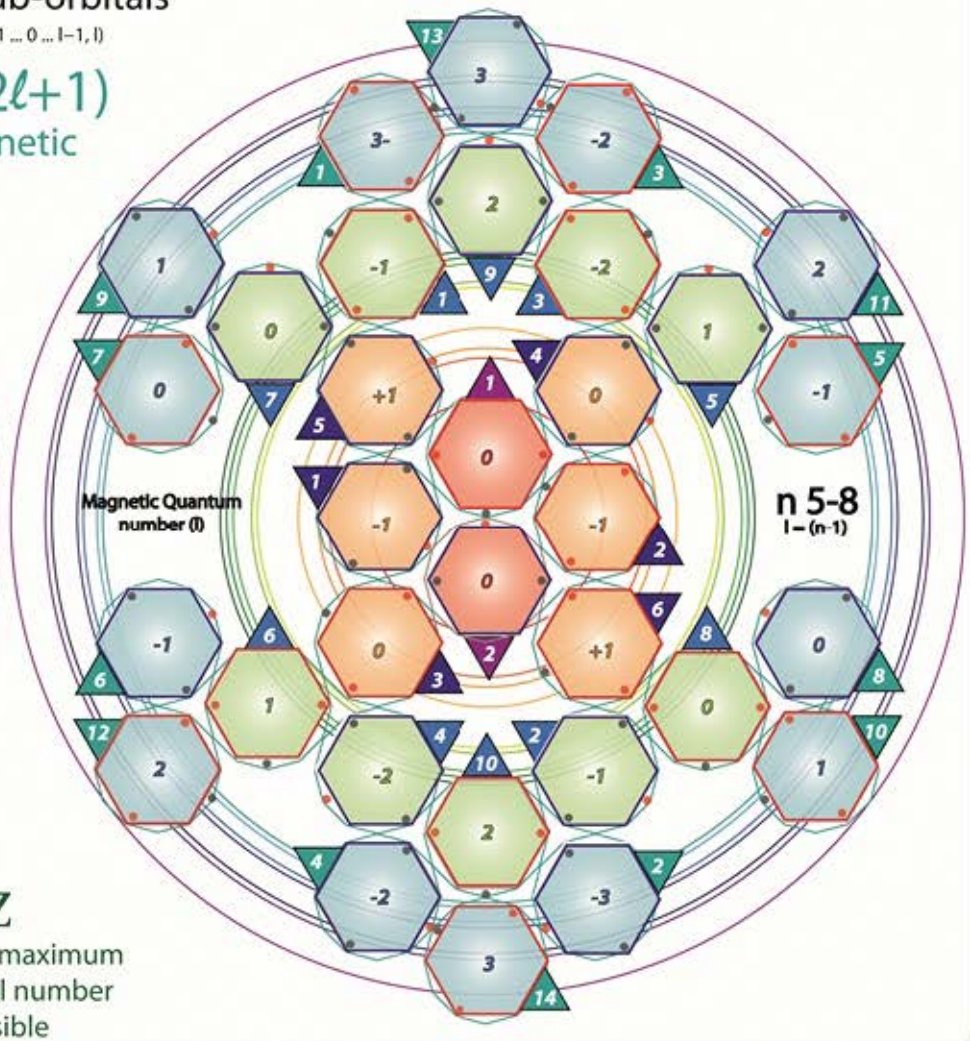

Z

120 is the maximum elemental number possible

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SPIN quantum number

The spin quantum number is a quantum number that parameterizes the intrinsic angular momentum (or spin angular momentum), of any given electron anywhere in an atomic nucleus

parallel magnetic moments

Spin UP

higher coupling energies

anti-parallel magnetic moments

Spin DOWN

lower coupling energies

Electron spin can orientate in either direction within Nuclei, providing the nett spins follow the Hund rule and Pauli exclusion principle

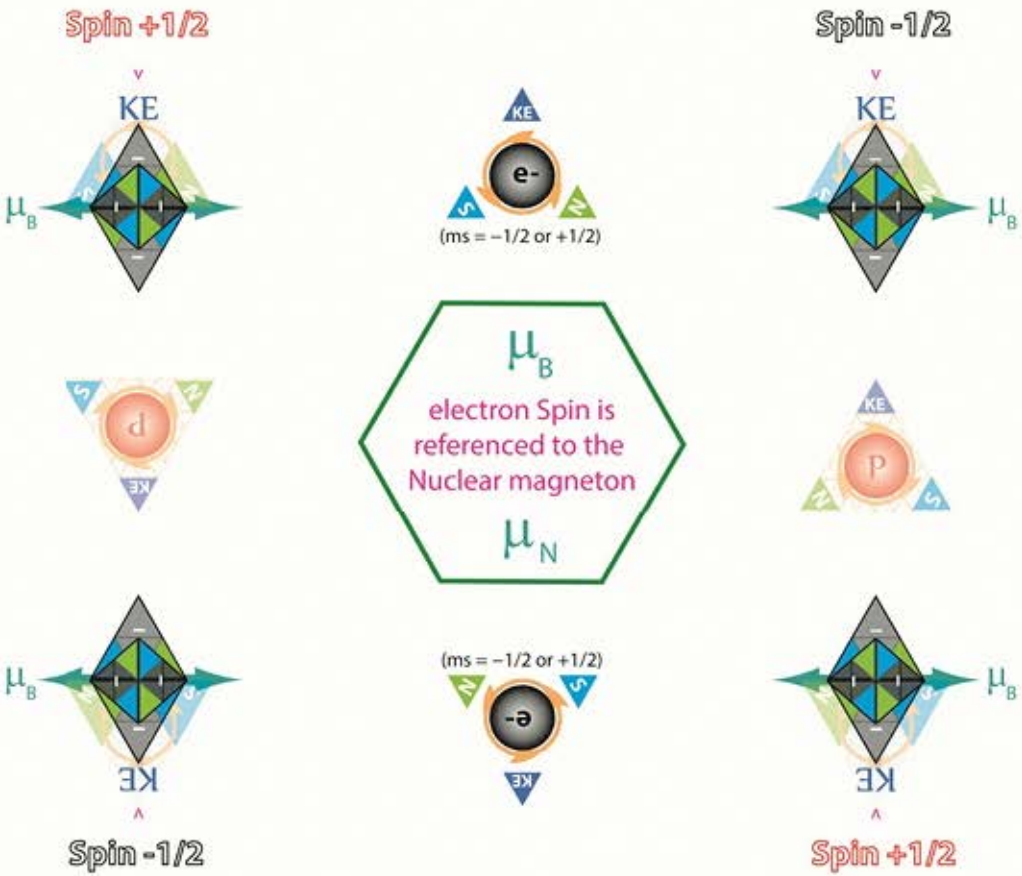

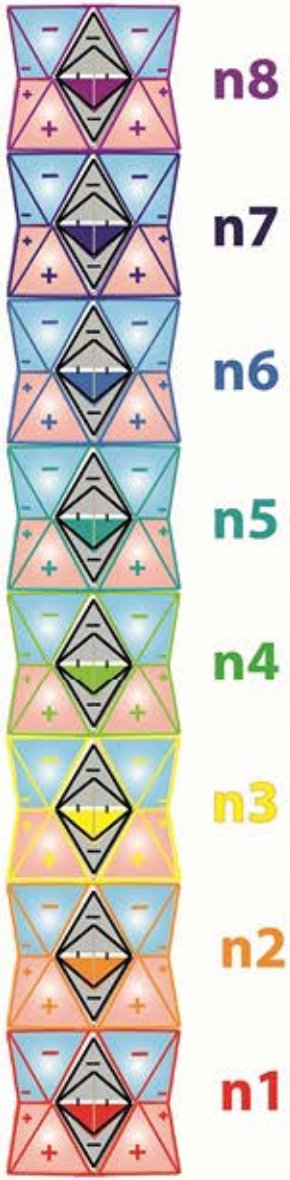

The nuclear energy levels of the Baryons comprising Elemental nuclei determine the energy-momenta of electrons bound to them

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Modifying Hund's Rule

Electrons fill orbitals in an alternating sequential numbering pattern due to nucleon placement creating opposed direction electron spins

The increased stability of the atom, most commonly manifested in a lower energy state, arises because the high-spin state forces the unpaired electrons to reside in different spatial orbitals.

A commonly given reason for the increased stability of high multiplicity states is that the different occupied spatial orbitals create a larger average distance between electrons, reducing electron-electron repulsion energy. In reality, it has been shown that the actual reason behind the increased stability is a decrease in the screening of electron-nuclear attractions[1].

The total spin state is calculated as the total number of unpaired electrons + 1, or twice the total spin + 1 written as 2s+1.

As a result of Hund's rule, constraints are placed on the way atomic orbitals are filled using the Aufbau principle.

Before any two electrons occupy an orbital in a subshell, other orbitals in the same subshell must first each contain one electron. Also, the electrons filling a subshell will have parallel spin before the shell starts filling up with the opposite spin electrons (after the first orbital gains a second electron).

As a result, when filling up atomic orbitals, the maximum number of unpaired electrons (and hence maximum total spin state) is assured

Sub-orbitals fill in order of numbering

Electrons spins pair before next orbital is filled

ie.
p1 [DOWN] and p2 [UP] fill before
p3 [UP] and p4 [DOWN] before
p5 [DOWN] and p6 [UP] etc

Hund's rule of orbital filling must be modified to reflect the true orbital filling order

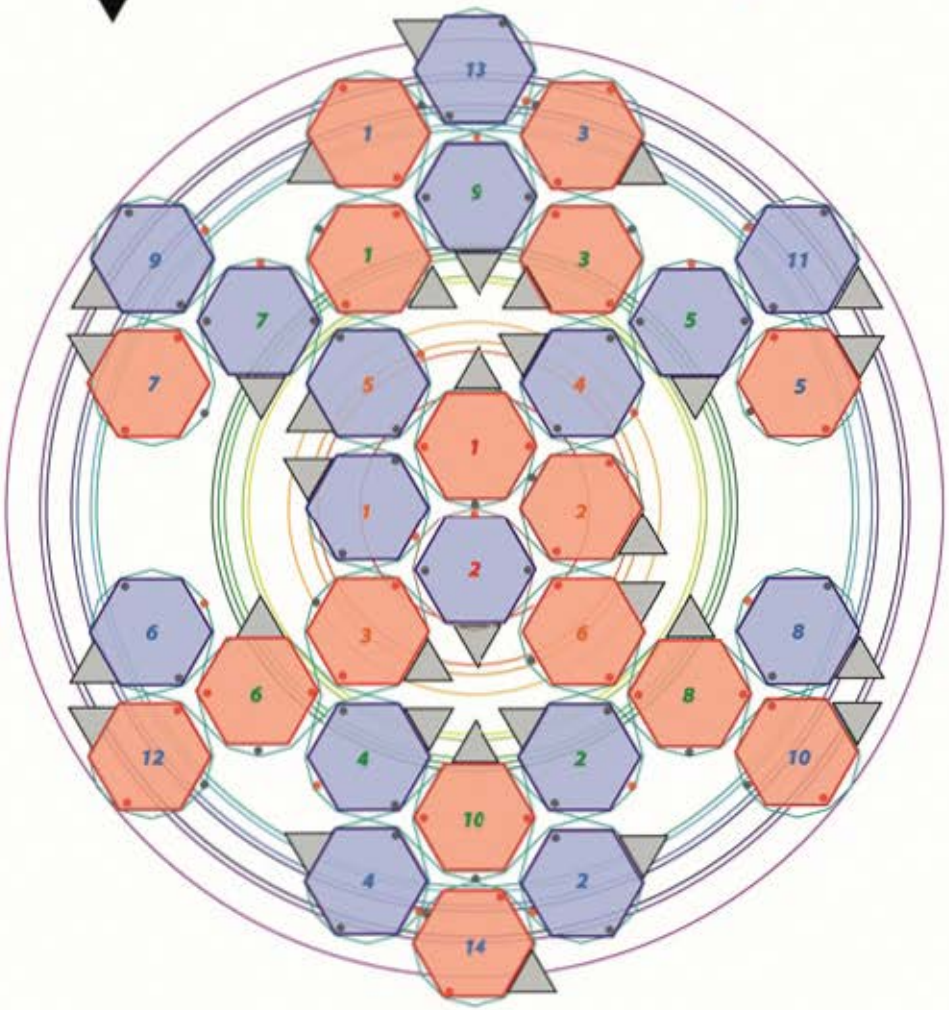

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Principle quantum Energies

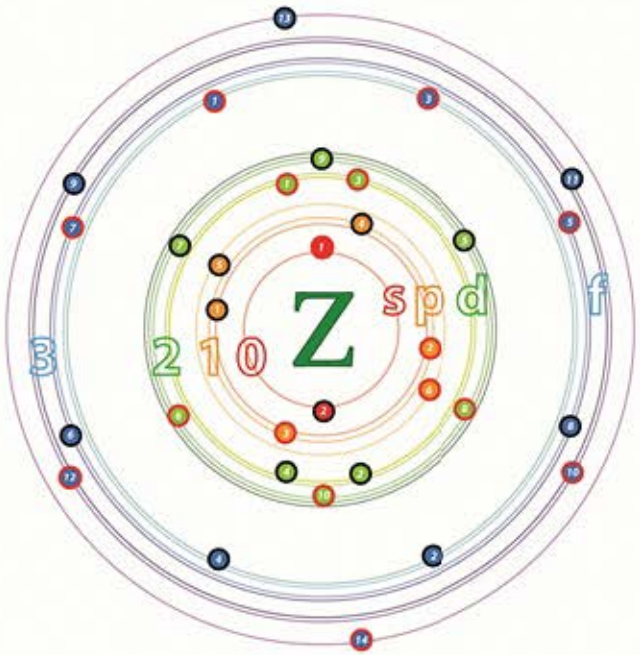

In an atom - electron energies are proportional to their intrinsic Kinetic Energies - which in turn are directly proportional to the quantum energy level of the nuclei which the electron binds to in their respective atomic shells

In a nucleus, lower energy orbits have less 'paired' nuclei supplying energy. The more energy you give a nuclei the faster it casuses the bound electron to rotate. If you give the nuclei enough energy, it will impart eneough energy to its electron for it to leave the system entirely.

The same is true for an electron orbital. Higher values of n mean more energy for the electron and the corresponding KEM field enegies of the electron is larger, resulting in increased angular momentum.

Values of n start at 1 and go up by integer amounts.

If enough energy is added to the system by incident Photons a electron will leave the atom creating a positively charged nuclei [ionisation].

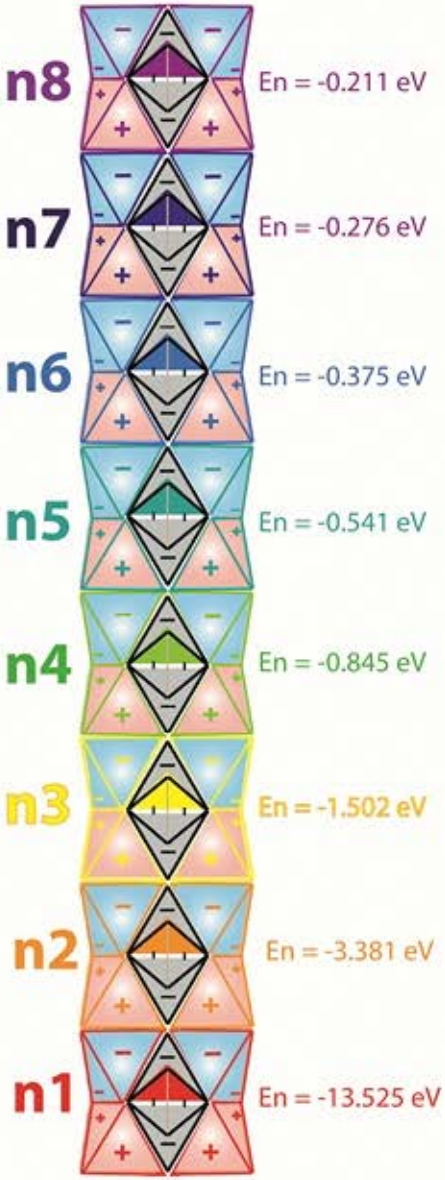

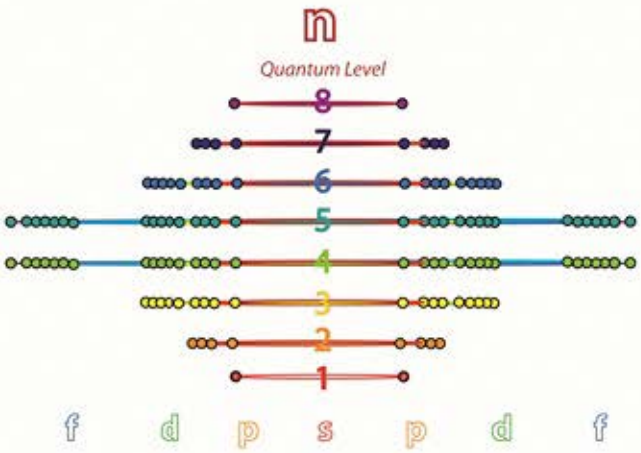

s orbits	n1-8
p orbits	n2-7
d orbits	n3-6
f orbits	n4-5

Eigenstate value

KEM field energy [per n] required to exceed 13.525 eV at which point the photo-electron has sufficient KE to break free of the Nucleus

$$E_n = \frac{E_1}{n^2} = \frac{-13.6eV}{n^2}, n = 1, 2, 3...$$

The possible Kinetic Energies (quantum levels) of an electron are directly related to the energy level of the Nuclei in each Quantum Level

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Quantum Level 1

K shell

n1

Ground State electron

$iE = -13.313\ eV$

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
1	1s1	Deuterium	1	1	1
2	1s2	Helium	2	2	2

2

Deuterium [not Hydrogen] is the building block of elements

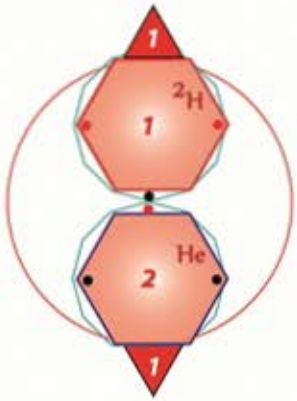

Z #		Name	Protons	electrons	Neutrons
1	1s1	Hydrogen	1	1	0

Hydrogen is a free radical element

n1

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Quantum Level 2

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
3	2s1	Lithium	3	3	3
4	2s2	Berylium	4	4	4
5	1p1	Boron	5	5	5
6	1p2	Carbon	6	6	6
7	1p3	Nitrogen	7	7	7
8	1p4	Oxygen	8	8	8
9	1p5	Fluorine	9	9	9
10	1p6	Neon	10	10	10

8

Deuterium [not Hydrogen] is the building block of elements

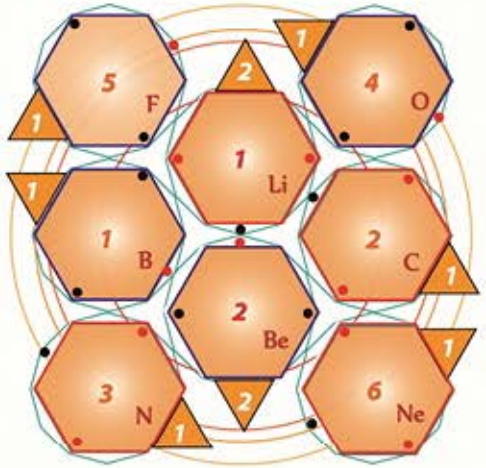

L shell

n2

Ground State electron

$iE = -12.679\ eV$

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Quantum Level 3

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
11	3s1	Sodium	11	11	11
12	3s2	Magnesium	12	12	12
13	2p1	Aluminium	13	13	13
14	2p2	Silicon	14	14	14
15	2p3	Phosphorus	15	15	15
16	2p4	Sulfur	16	16	16
17	2p5	Chlorine	17	17	17
18	2p6	Argon	18	18	18
21	3d1	Scandium	21	21	21
22	3d2	Titanium	22	22	22
23	3d3	Vanadium	23	23	23
24	3d4	Chromium	24	24	24
25	3d5	Manganese	25	25	25
26	3d6	Iron	26	26	26
27	3d7	Cobalt	27	27	27
28	3d8	Nickel	28	28	28
29	3d9	Copper	29	29	29
30	3d10	Zinc	30	30	30

18

Deuterium [not Hydrogen] is the building block of elements

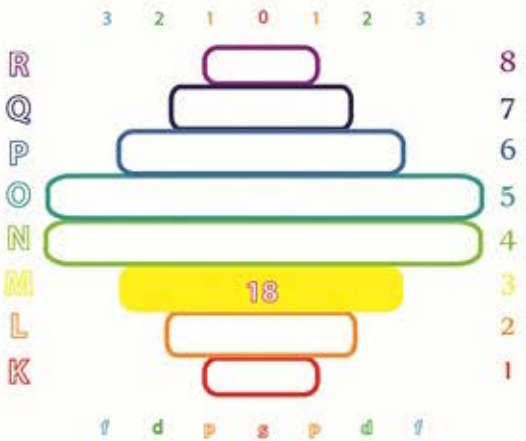

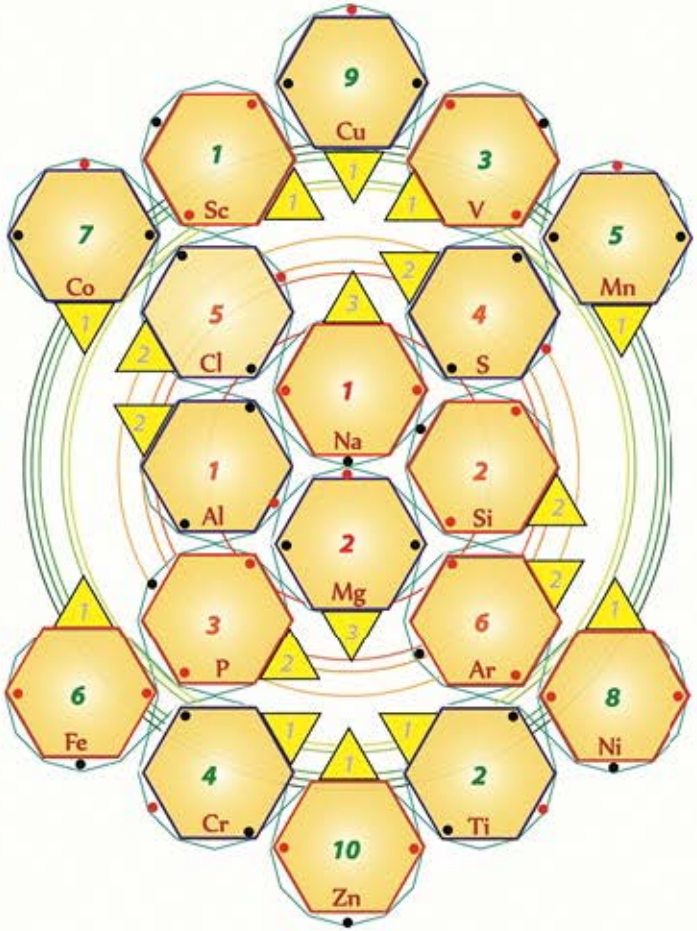

M shell

n3

Ground State electron

$iE = -11.623\ eV$

Energy level

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Quantum Level 4

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
19	4s1	Potassium	19	19	19
20	4s2	Calcium	20	20	20
31	4p1	Gallium	31	31	31
32	4p2	Germanium	32	32	32
33	4p3	Arsenic	33	33	33
34	4p4	Selenium	34	34	34
35	4p5	Bromine	35	35	35
36	4p6	Krypton	36	36	36
39	4d1	Yttrium	39	39	39
40	4d2	Zirconium	40	40	40
41	4d3	Niobium	41	41	41
42	4d4	Molybdenum	42	42	42
43	4d5	Technetium	43	43	43
44	4d6	Ruthenium	44	44	44
45	4d7	Rhodium	45	45	45
46	4d8	Palladium	46	46	46
47	4d9	Silver	47	47	47
48	4d10	Cadmium	48	48	48
57	4f1	Lanthanum	57	57	57
58	4f2	Cerium	58	58	58
59	4f3	Praseodymium	59	59	59
60	4f4	Neodymium	60	60	60
61	4f5	Promethium	61	61	61
62	4f6	Samarium	62	62	62
63	4f7	Europium	63	63	63
64	4f8	Gadolinium	64	64	64
65	4f9	Terbium	65	65	65
66	4f10	Dysprosium	66	66	66
67	4f11	Holium	67	67	67
68	4f12	Erbium	68	68	68
69	4f13	Thulium	69	69	69
70	4f14	Ytterbium	70	70	70

32

Deuterium [not Hydrogen] is the building block of elements

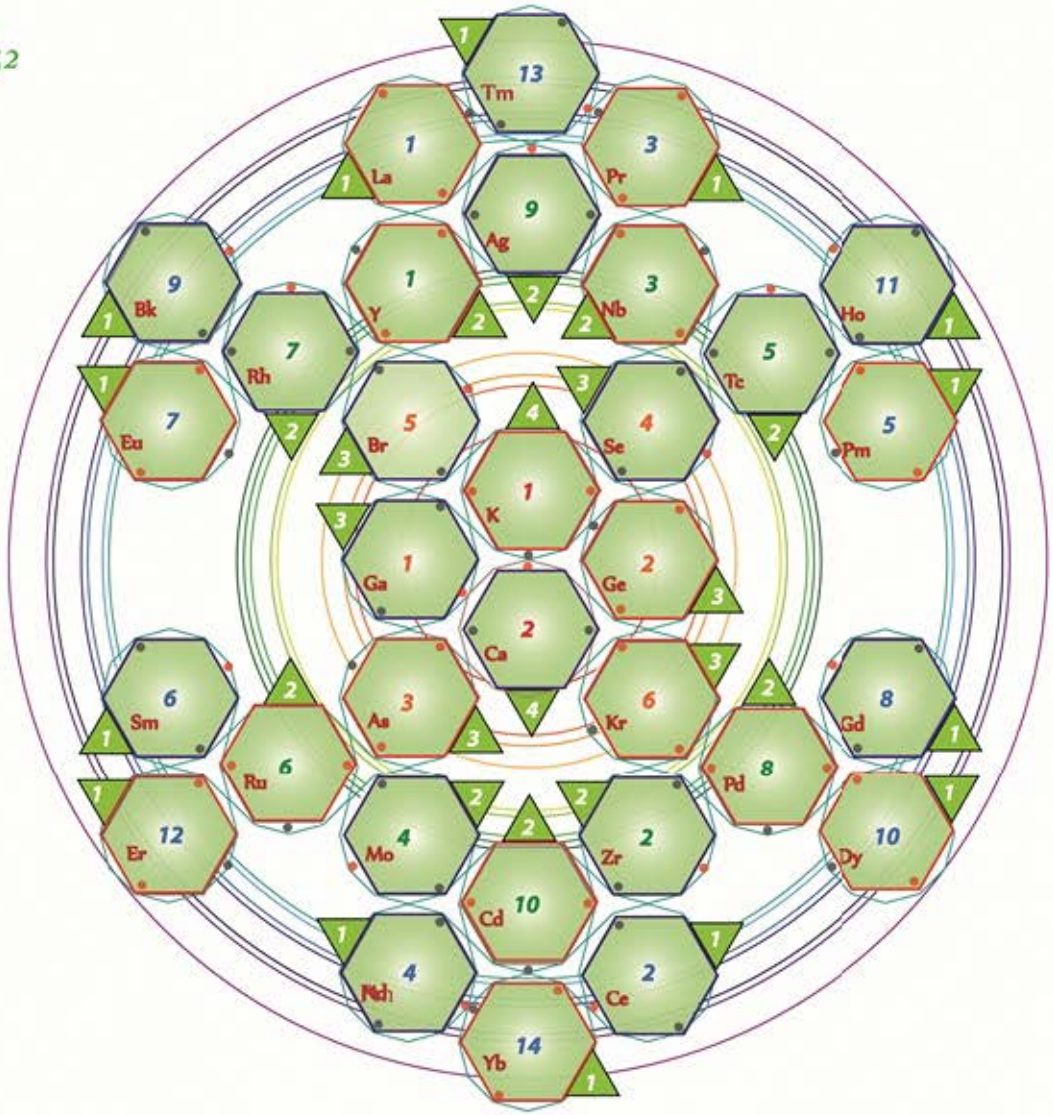

N shell

n4

Ground State electron

$iE = -10.143\ eV$

Energy level

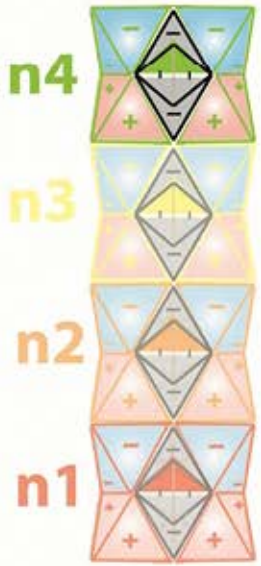

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Quantum Level 5

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
37	5s1	Rubidium	37	37	37
38	5s2	Strontium	38	38	38
49	5p1	Indium	49	49	49
50	5p2	Tin	50	50	50
51	5p3	Antimony	51	51	51
52	5p4	Tellurium	52	52	52
53	5p5	Iodine	53	53	53
54	5p6	Xenon	54	54	54
71	5d1	Lutetium	71	71	71
72	5d2	Hafnium	72	72	72
73	5d3	Tantalum	73	73	73
74	5d4	Tungsten	74	74	74
75	5d5	Rhenium	75	75	75
76	5d6	Osmium	76	76	76
77	5d7	Iridium	77	77	77
78	5d8	Platinum	78	78	78
79	5d9	Gold	79	79	79
80	5d10	Mercury	80	80	80
89	5f1	Actinium	89	89	89
90	5f2	Thorium	90	90	90
91	5f3	Protactium	91	91	91
92	5f4	Uranium	92	92	92
93	5f5	Neptunium	93	93	93
94	5f6	Plutonium	94	94	94
95	5f7	Americium	95	95	95
96	5f8	Curium	96	96	96
97	5f9	Berkelium	97	97	97
98	5f10	Californium	98	98	98
99	5f11	Einsteinium	99	99	99
100	5f12	Fermium	100	100	100
101	5f13	Mendelevium	101	101	101
102	5f14	Nobelium	102	102	102

32

Deuterium [not Hydrogen] is the building block of elements

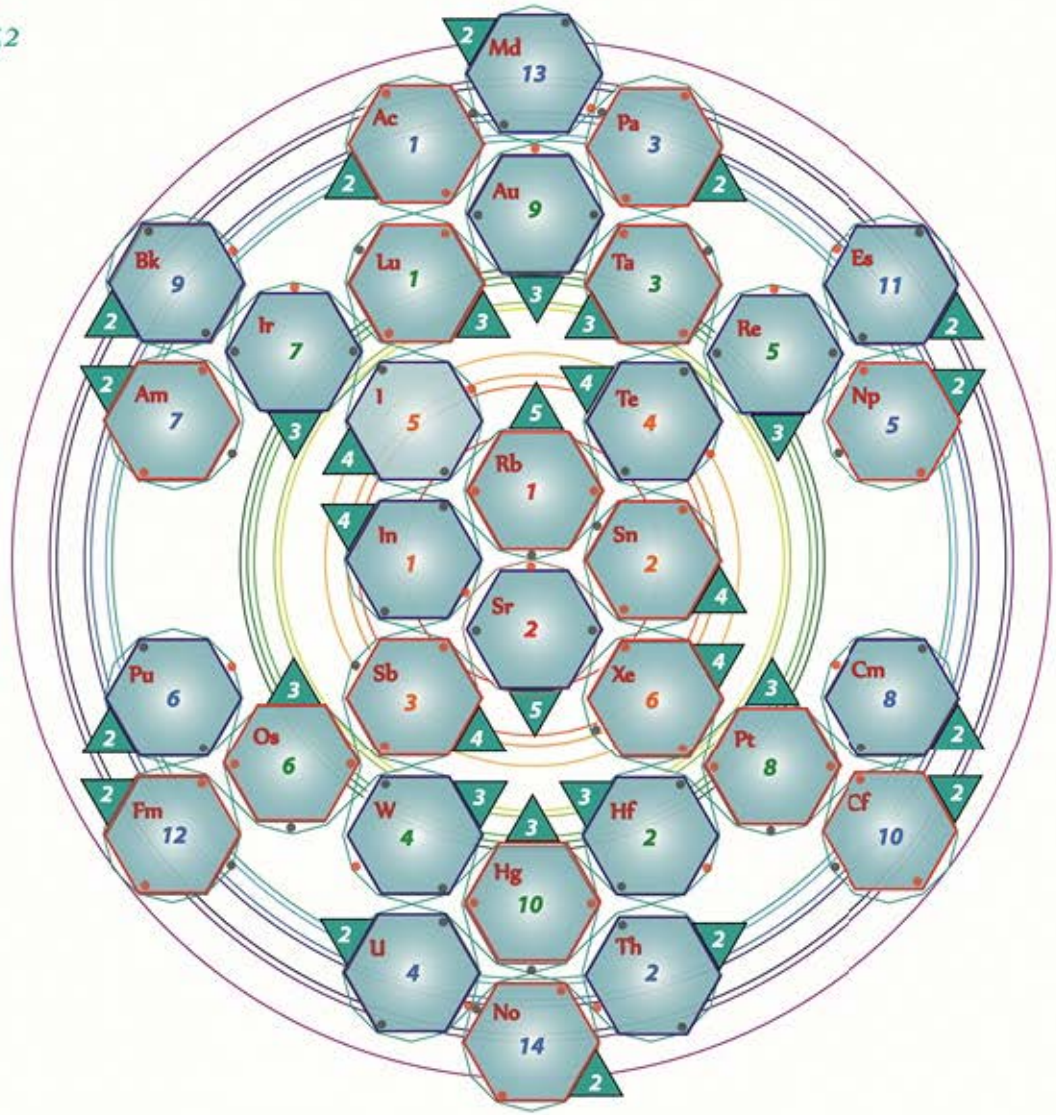

O shell

n5

Ground State electron

$iE = -8.241\ eV$

Energy level

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Quantum Level 6

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
55	6s1	Caesium	55	55	55
56	6s2	Barium	56	56	56
81	6p1	Thallium	81	81	81
82	6p2	Lead	82	82	82
83	6p3	Bismuth	83	83	83
84	6p4	Polonium	84	84	84
85	6p5	Astatine	85	85	85
86	6p6	Radon	86	86	86
103	6d1	Lawrencium	103	103	103
104	6d2	Rutherfordium	104	104	104
105	6d3	Dubnium	105	105	105
106	6d4	Seaborgium	106	106	106
107	6d5	Bohrium	107	107	107
108	6d6	Hassium	108	108	108
109	6d7	Meitnerium	109	109	109
110	6d8	Darmstadtium	110	110	110
111	6d9	Roetgenium	111	111	111
112	6d10	Copernicium	112	112	112

18

Deuterium [not Hydrogen] is the building block of elements

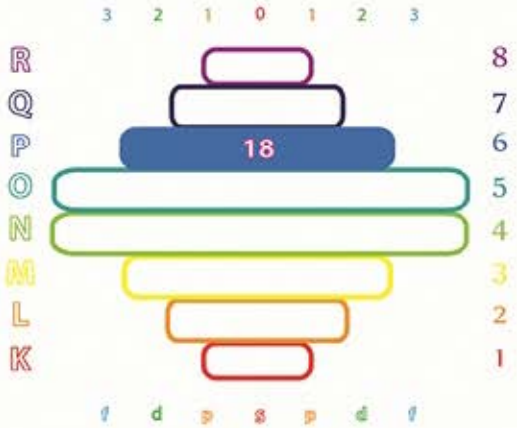

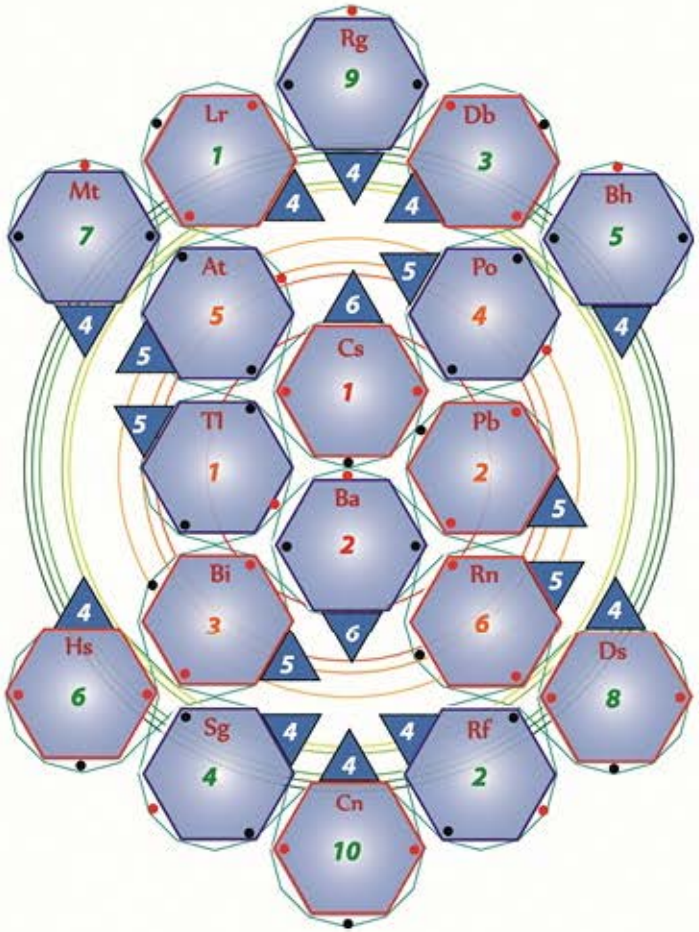

P shell

n6

Ground State electron

$iE = -5.917\ eV$

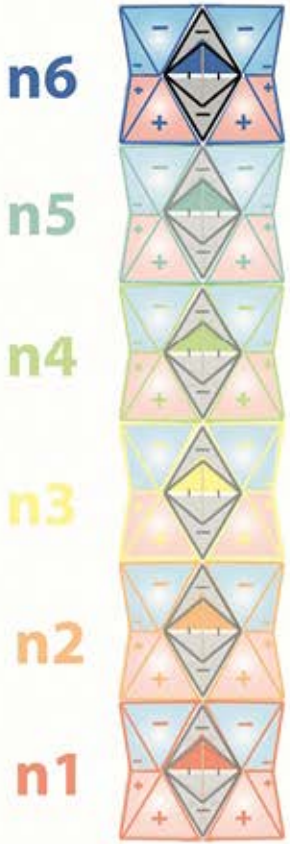

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Quantum Level 7

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
87	7s1	Francium	87	87	87
88	7s2	Radium	88	88	88
113	7p1	Ununtrium	113	113	113
114	7p2	Flerovium	114	114	114
115	7p3	Ununpentium	115	115	115
116	7p4	Livermorium	116	116	116
117	7p5	Ununseptium	117	117	117
118	7p6	Ununoctium	118	118	118

8

Deuterium [not Hydrogen] is the building block of elements

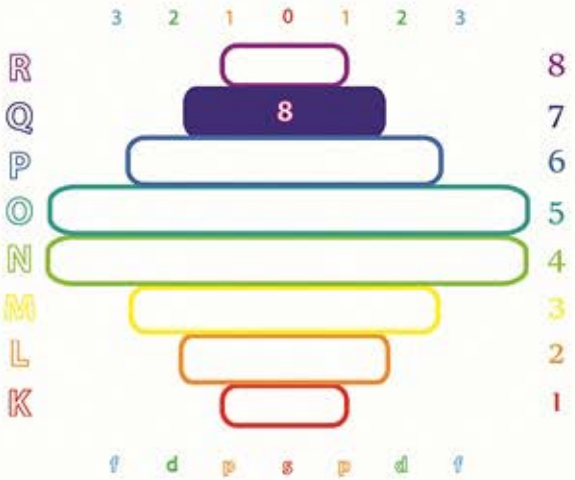

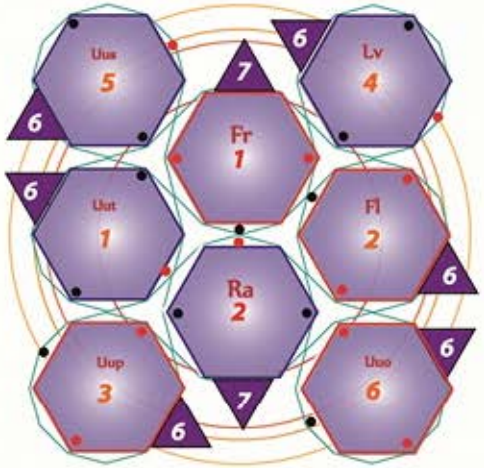

Q shell

n7

Ground State electron

$iE = -3.169\ eV$

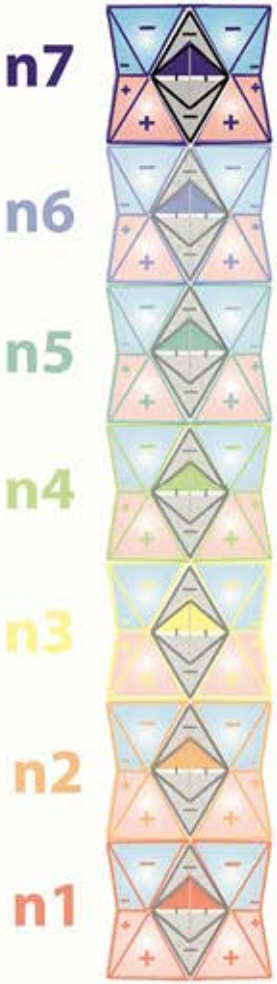

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Quantum Level 8

The energy levels of bound electrons is determined by Baryons

Z #		Name	Protons	electrons	Neutrons
119	8s1	Ununnonium	119	119	119
120	8s2	Unbinilium	120	120	120

2

Deuterium [not Hydrogen] is the building block of elements

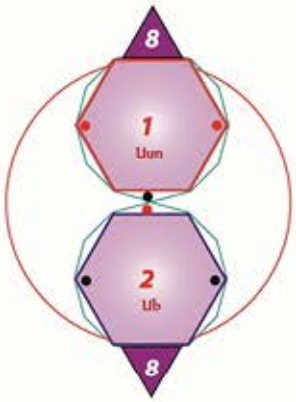

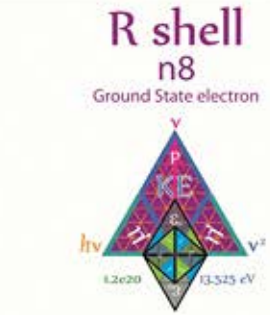

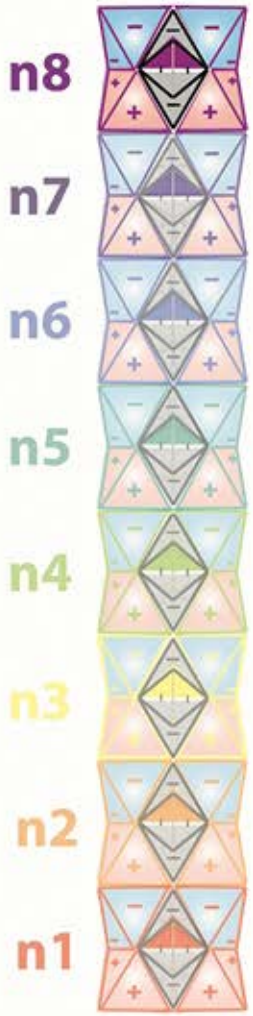

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Quantum Level Jumps

Photon Absorption and Release

Spectral line transitions

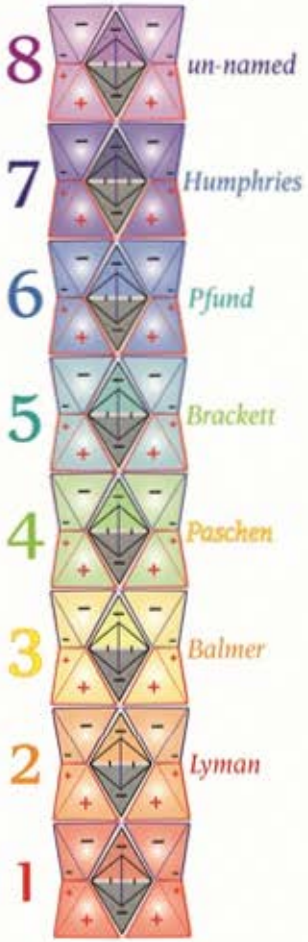

Quantum level jumps

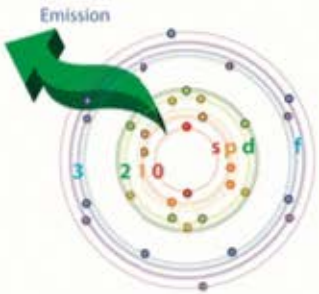

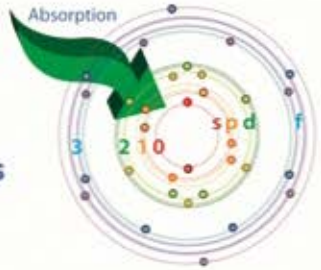

Photo-electrons can only transition between principal energy Baryons in the atomic nuclei in discrete steps [or quantum jumps] because Baryons determine the KEM energy levels of electrons in nuclei

[see Tetryonic QED for full details on spectral line mechanics]

Initial Quantum level									
8	768	756	720	660	576	468	336	180	0
7	588	576	540	480	396	288	156	0	
6	432	420	384	324	240	132	0		
5	300	288	252	192	108	0			
4	192	180	144	84	0				
3	108	96	60	0					
2	48	36	0						
1	12	0							
		12	48	108	192	300	432	588	768
		1	2	3	4	5	6	7	8

Final Quantum level

$$\Delta p = \Delta M v = hf$$

accelerating photo-electrons produce spectral lines

Spectral line transitions

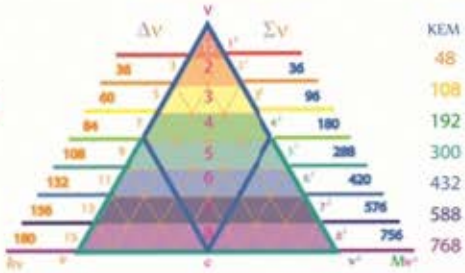

Nuclear energy emission~absorption

If atoms are left undisturbed, their electrons usually fill the lowest available energy levels and stay there, in their "ground state."

Occasionally, however, they may also be pushed up to some higher energy ("become excited") e.g. by a collision with a fast atom or electron, one which got extra speed from an electric voltage or from some source of heat.

An atom/electron elevated to one of its higher "excited levels" soon falls back to a lower level ("undergoes a quantum jump"), emitting a photon whose energy corresponds to the difference between the levels.

That need not be the ground state: the atom/electron might descend to that state in several steps, emitting a photon at each step on the way.

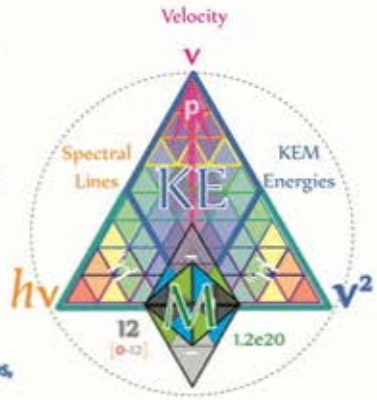

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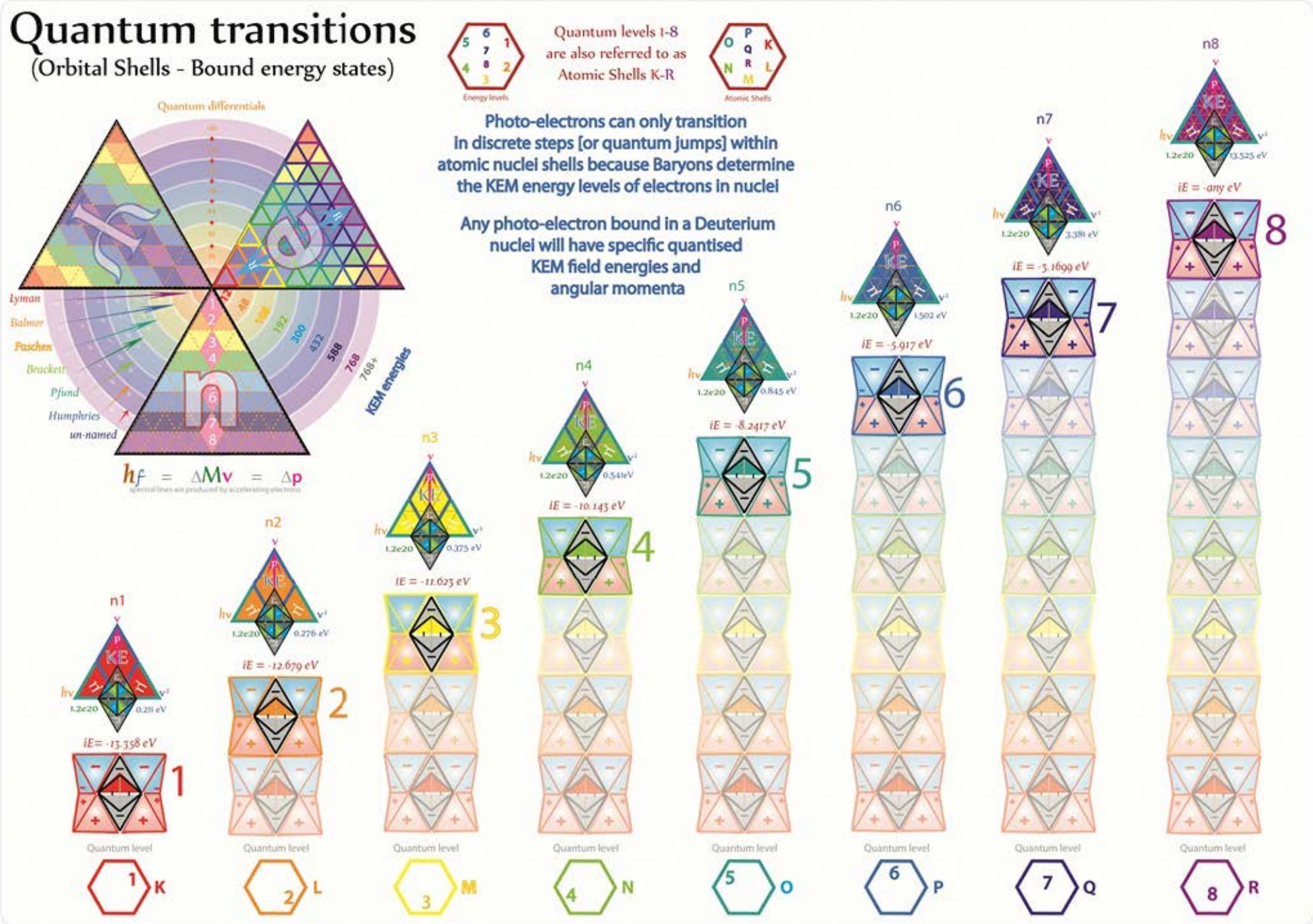

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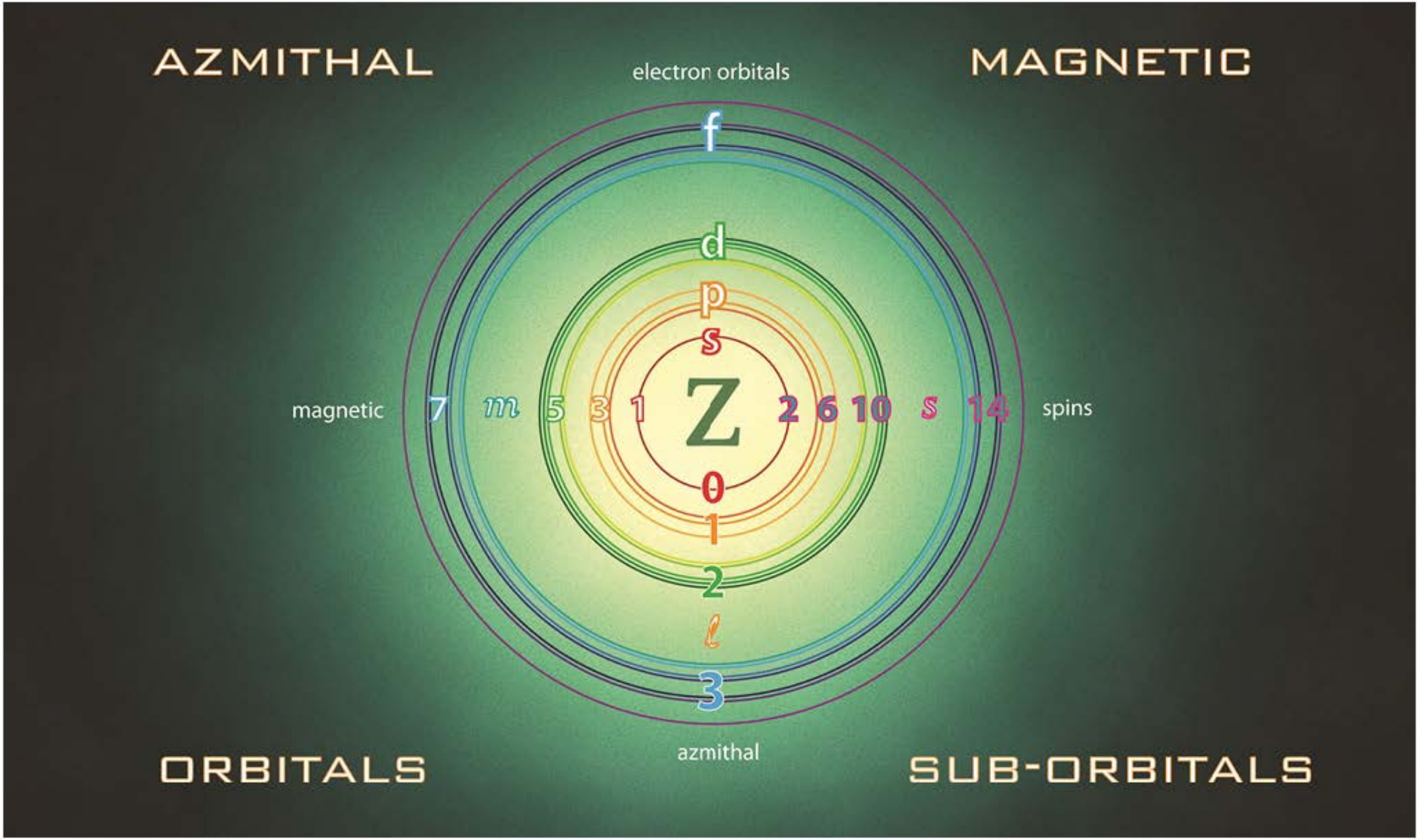

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Atomic Orbitals

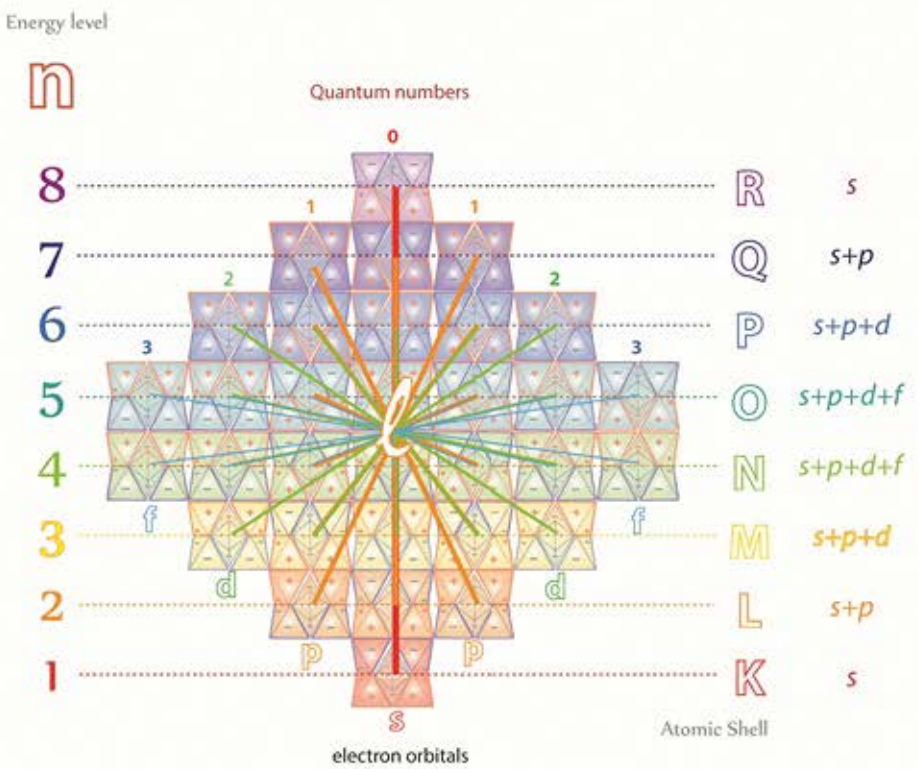

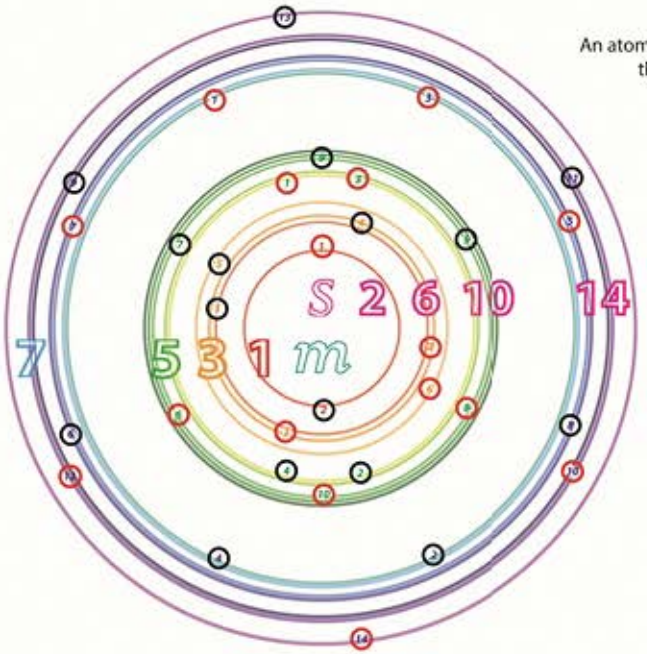

An atomic orbital is a mathematical function that describes the wave-like behavior of either one electron or a pair of electrons in an atom

Atomic orbitals are typically categorized by n, l, and m quantum numbers, which correspond to the electron's energy, angular momentum, and an angular momentum vector component, respectively.

Historically used to define the pedagogical electron cloud model of an atom Tetryonics reveals the true geometry of atomic nuclei

Each orbital is defined by a different set of quantum numbers and contains a maximum of two spin opposed electrons.

Aufbau

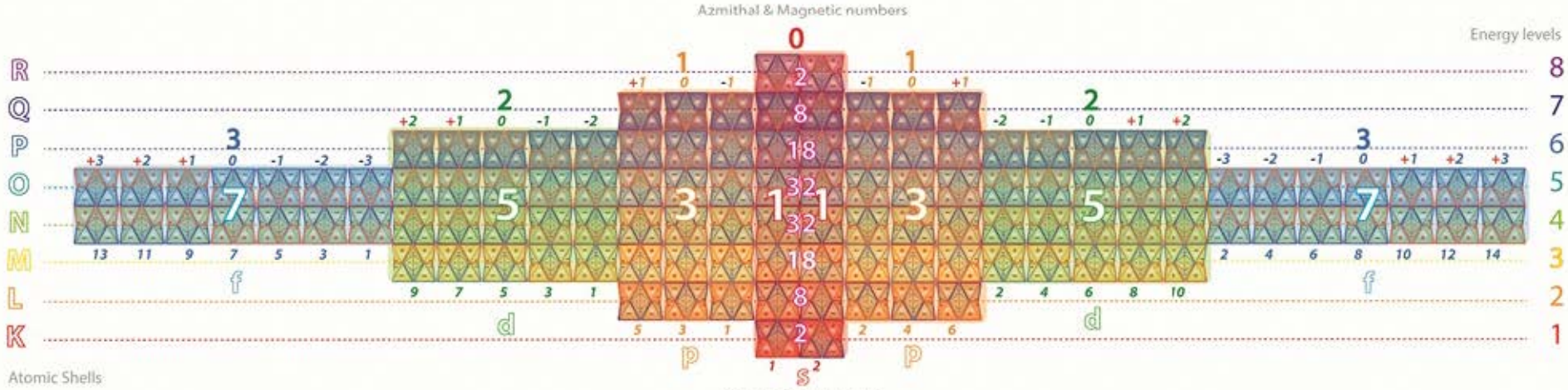

Electron Spins can be either up or down providing they obey the Pauli exclusion principle

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s Orbital

1 Orbit (2 electrons max)

Alkali Metals & Alkali Earths

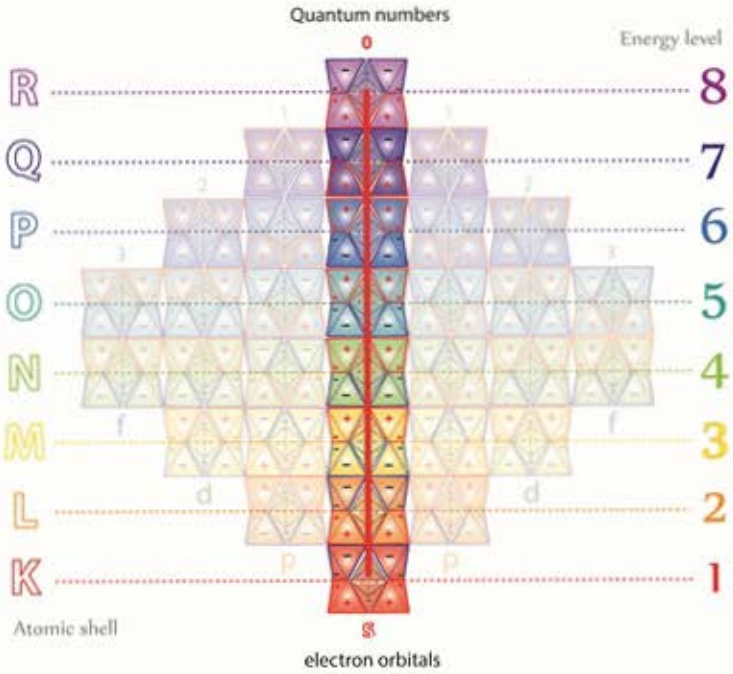

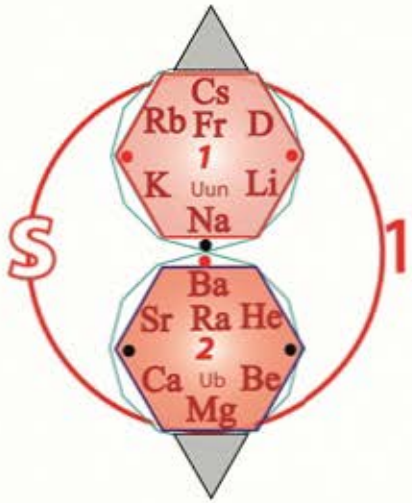

		n
azmithal number	0	ℓ
magnetic numbers	0	m
spins	-1/2 +1/2	s

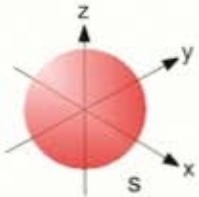

erroneous computer model of 's' electron orbitals

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p Orbital

3 Orbits (6 electrons max)

Non-Metals, Halogens & Nobel gases

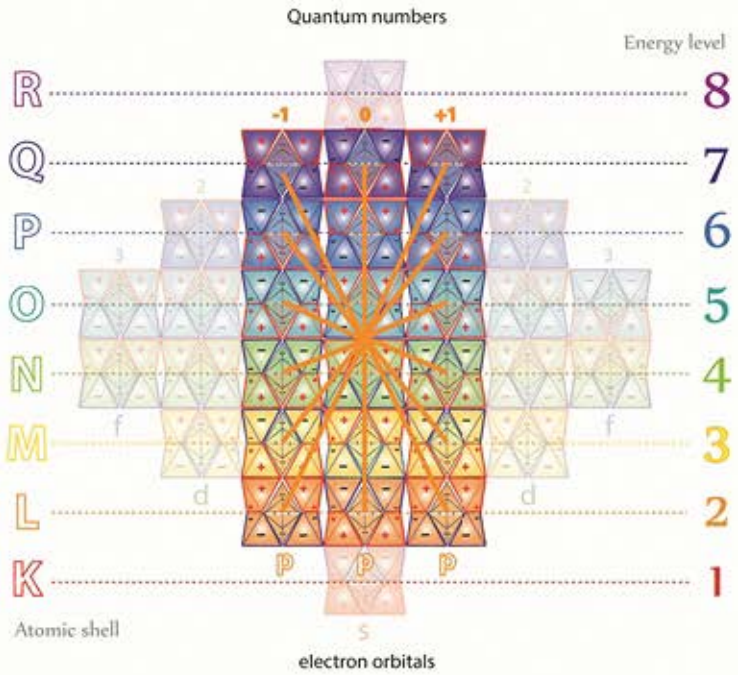

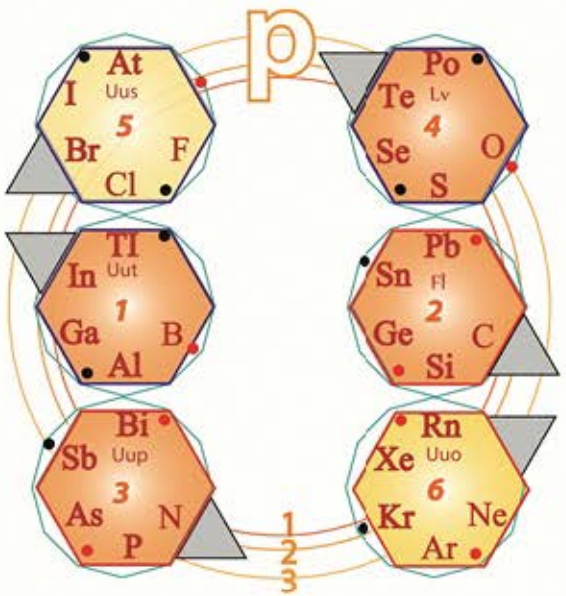

			n
azmithal number	1		ℓ
magnetic numbers	-1	0	+1	m
spins	-1/2 +1/2	-1/2 +1/2	-1/2 +1/2	s

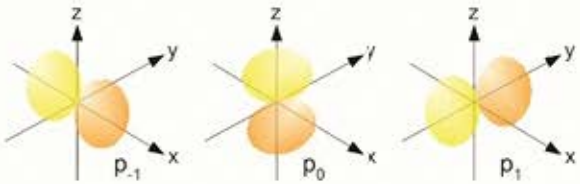

erroneous computer model of 'p' electron orbitals

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d Orbital

5 Orbits (10 electrons max)

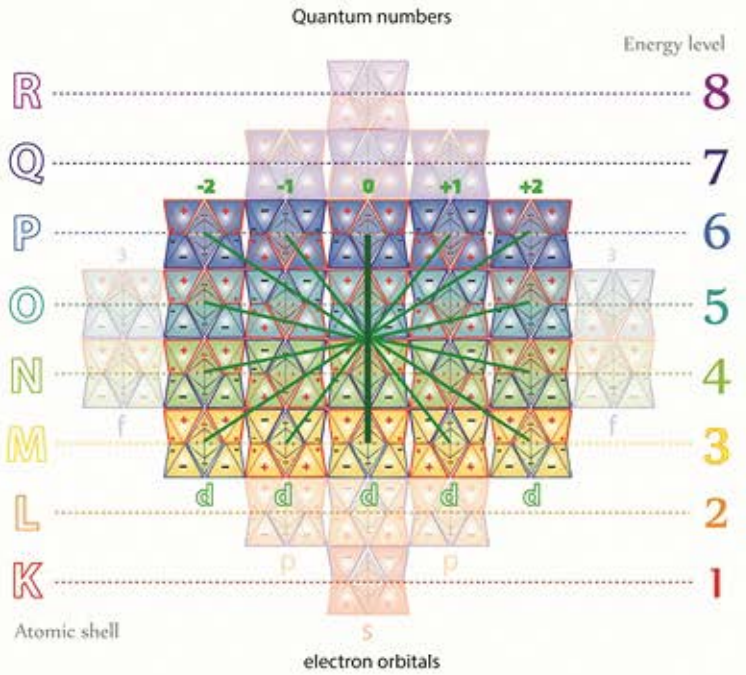

azmithal number			2			ℓ
magnetic numbers	-2	-1	0	+1	+2	m
spins	-1/2	-1/2	-1/2	-1/2	-1/2	s
	+1/2	+1/2	+1/2	+1/2	+1/2	

n

Transition & post-Transition Metals

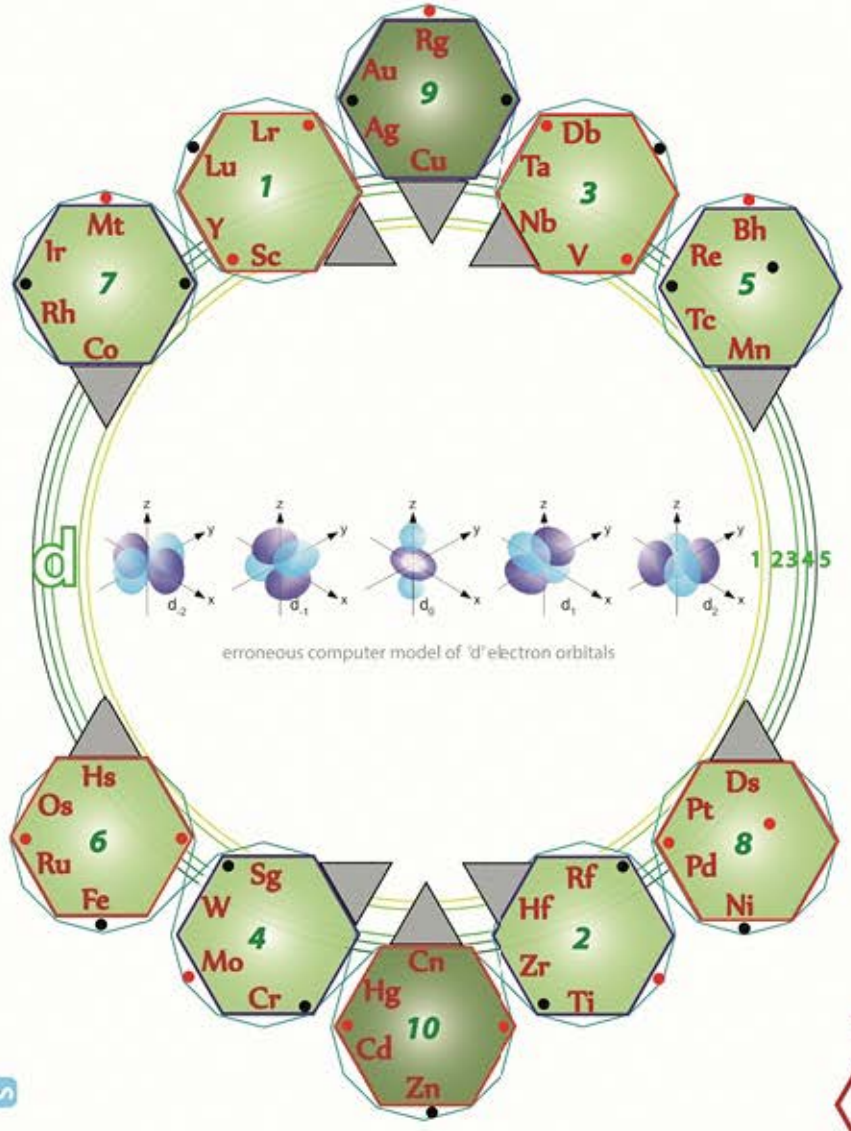

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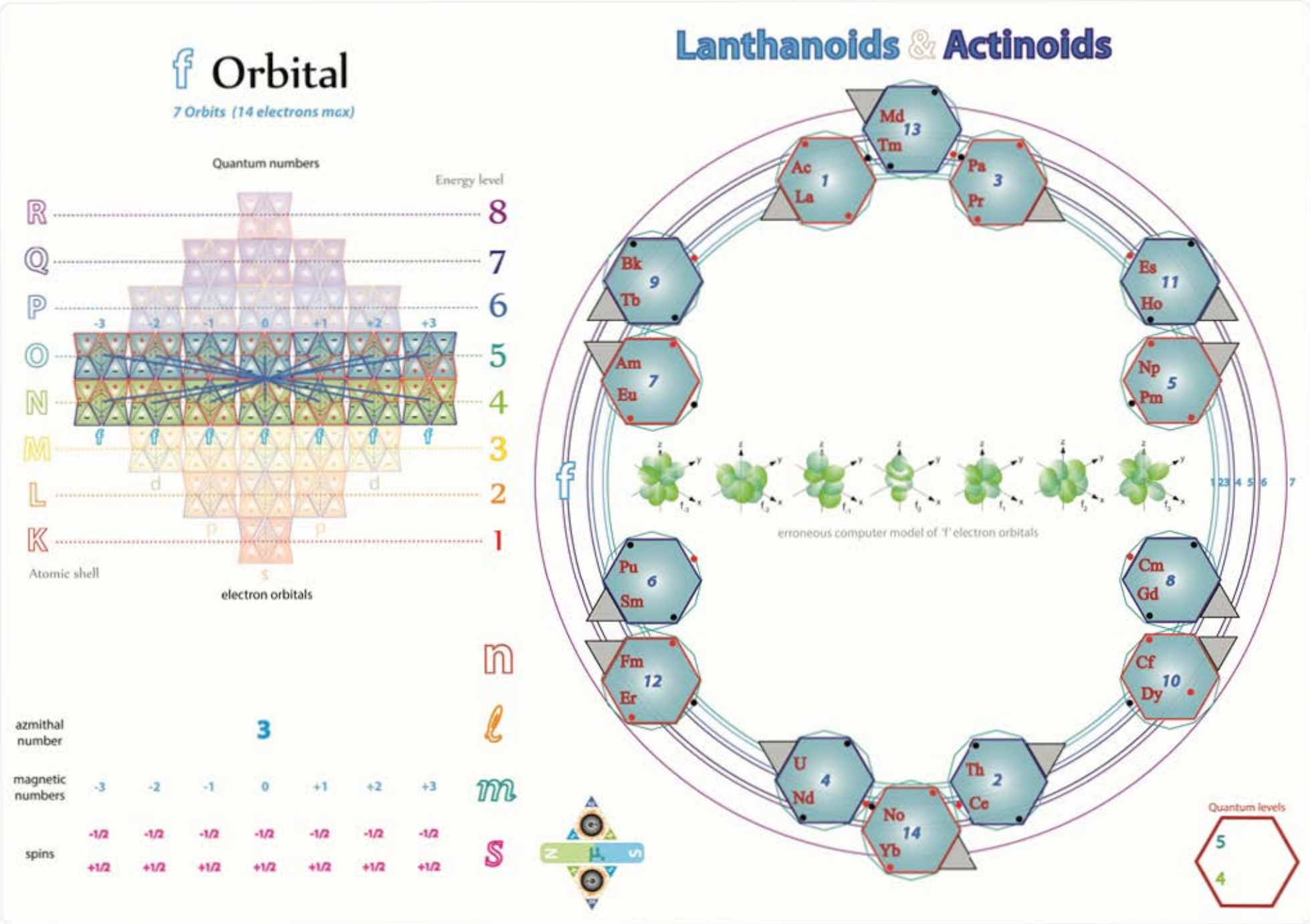

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Orbital energy variations

All Elements have stable core electron configurations of s & p orbitals for each energy level as revealed through diffraction studies

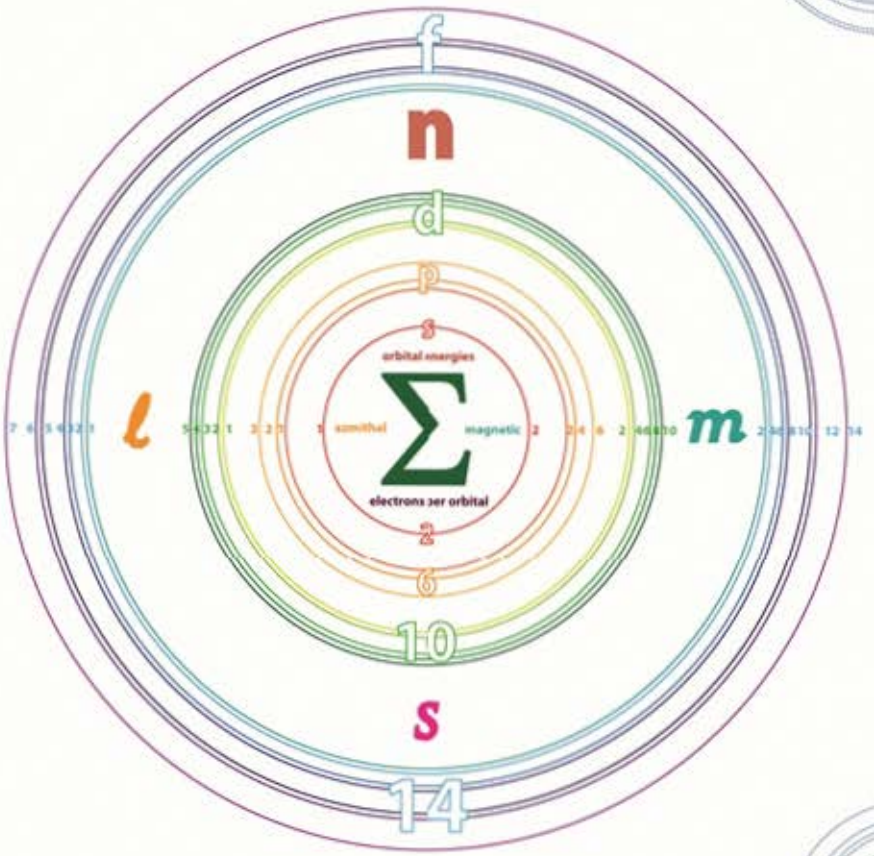

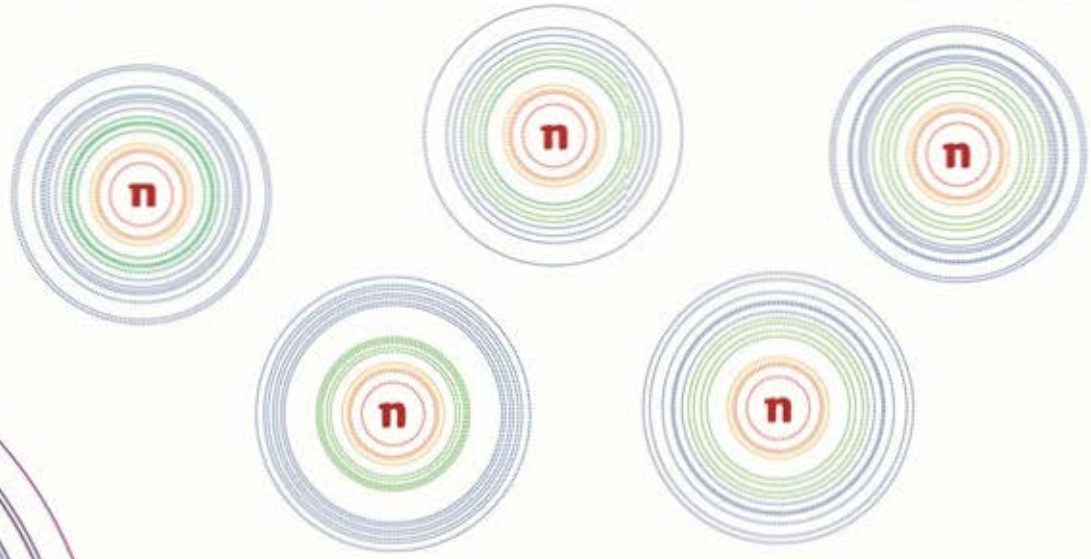

As additional nuclei bind to form d & f orbitals they can do so by bonding in many positions, with each location producing different orbital energies for each electron that binds to nuclei in that position

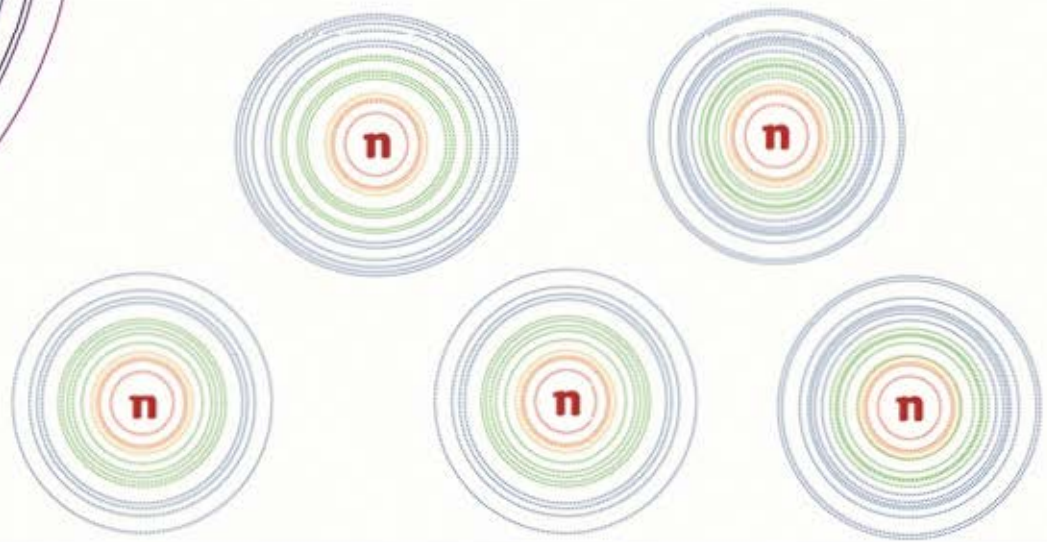

The final energy levels of each orbital is the result of the energy of the Baryons in the nuclei and the spin coupling energies of the photo-electrons bound to them

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Electrons per shell

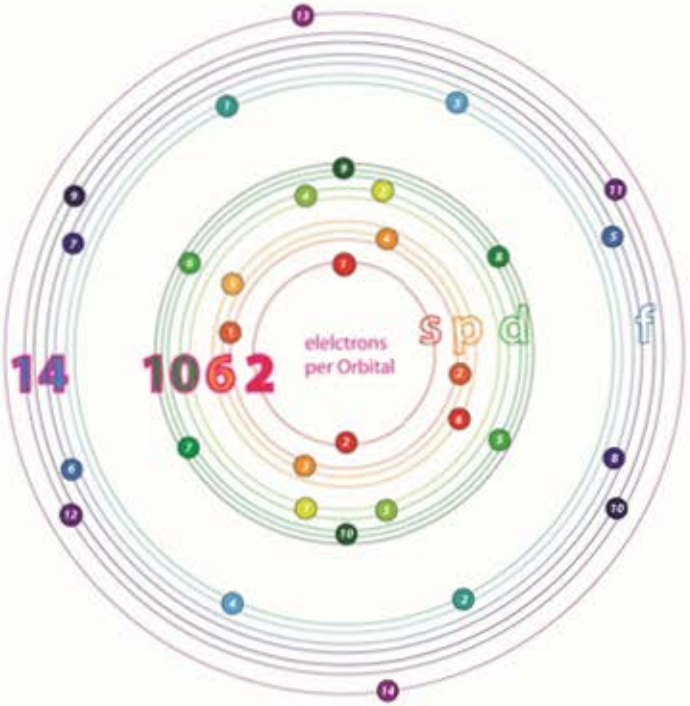

Each energy shell of a periodic element can hold only a fixed number of electrons

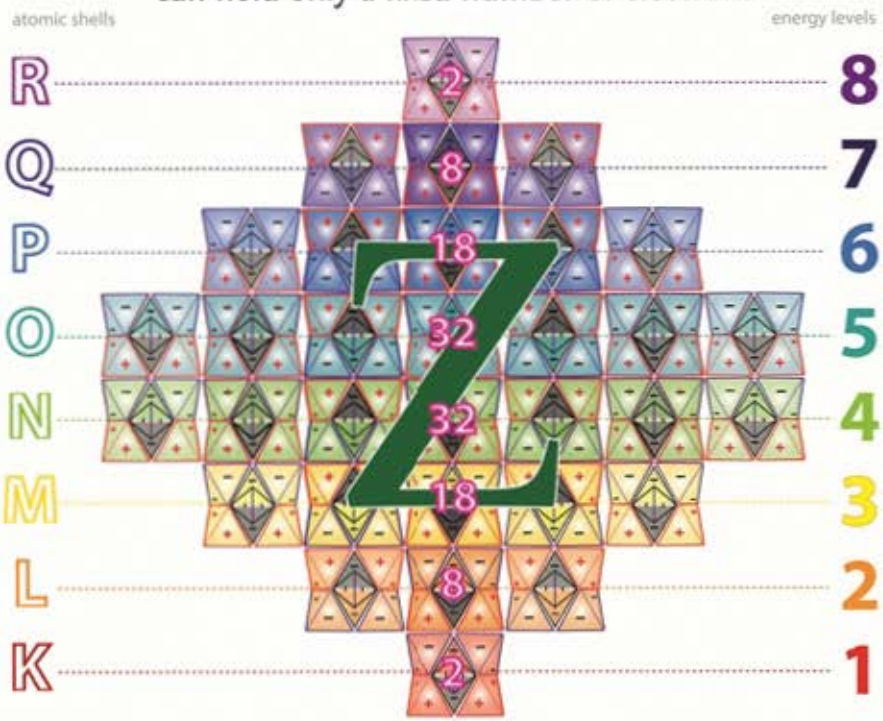

Rules governing the allowed combinations of Quantum Numbers

The three quantum numbers (n, l, and m) that describe an orbital are integers: 0, 1, 2, 3, and so on

n (1-8) Principal	The principal quantum number (n) cannot be zero.
ℓ (0-3) Azimuthal	The angular quantum number (l) can be any integer between 0 and n - 1.
mℓ (2ℓ+1) Magnetic	The magnetic quantum number (m) can be any integer between -l and +l.
m_s : $^1/_2$ Spin Projection	The Spin of electrons in any nuclear sub-orbital can only be +1/2 (Spin UP) or -1/2 (Spin DOWN).

Z

1, 2, 3, 4, 5, 6, 7, 8

s, p, d, f

1	2
1, 3, 5	2, 4, 6
1, 3, 5, 7, 9	2, 4, 6, 8, 10
1, 3, 5, 7, 9, 11, 13	2, 4, 6, 8, 10, 12, 14
down	up
up	down

Quantum Numbers

n	4-5	3-6	2-7	1-8	2-7	3-6	4-5
ℓ	3	2	1	0	1	2	3
m	-3	-2	-1	1	+1	+2	+3
s	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2	+1/2 -1/2

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Erwin Schrödinger

(12 August 1887 – 4 January 1961)

Using Tetryonic charged geometries for mass-ENERGY-Matter, an electron's position and velocity CAN be modelled simultaneously
(but any attempt to measure or interact with it, will affect its component energy-momenta)

Electron Position Uncertainty

Atomic orbitals are typically described as "hydrogen-like" (meaning one-electron) wave functions over any spatial region of measurement, categorized by n, l, and m quantum numbers, which correspond to the electron's energy, angular momentum, and a vector momentum component, respectively

Werner Heisenberg

(5 December 1901 – 1 February 1976)

Lepton's are physically Spin 1 fermion particles that can easily be misconstrued as having entirely different spin numbers without the correct physical topologies to base the observed measurements on

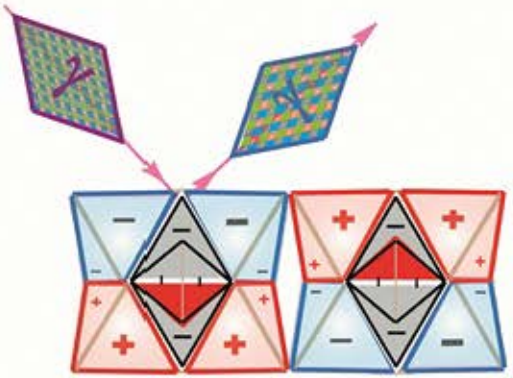

The energies of photo-electrons are determined by the Baryons they bind to & incident photons

Quantum Mechanics is a mathematical representation of equilateral energy momenta interactions and the charged geometries of mass-ENERGY-Matter

Determining the motion of electrons bound to atomic nuclei is akin to measuring the motion of variable speed electric fan blades mounted at various heights within a rotating carousel

Leptons are 12 loop quantum rotors

an identical fascia is presented with every 120 degree rotation

their spin number is a measure ment of their magnetic moment

The unique 12 faceted topology of leptons results in an identical EM geometry being oberved for every 120° rotation of the particle

Leading to the interpretation that the Lepton disappears and re-appears when being 'observed' or measured

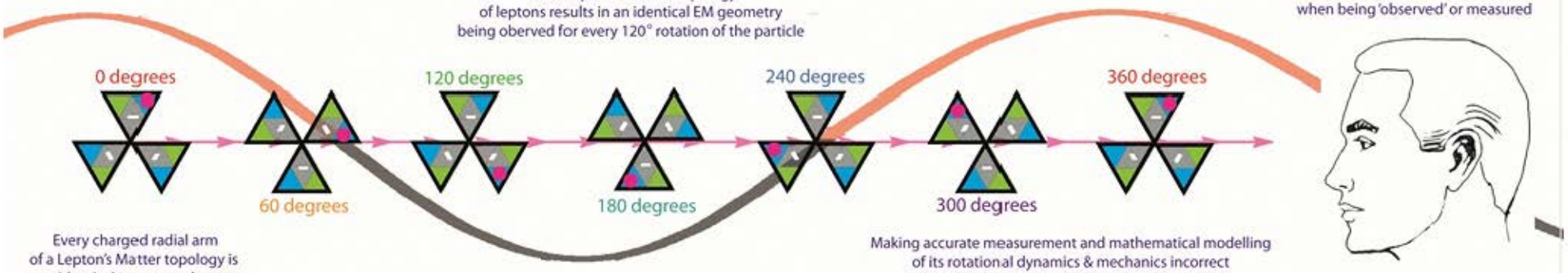

Every charged radial arm of a Lepton's Matter topology is identical to every other

Making accurate measurement and mathematical modelling of its rotational dynamics & mechanics incorrect without the correct physical topologies

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Electron modelling & probability calculations

Electron positional measurements have proven to be historically difficult to accurately model due to the charged 12π rotating topologies of leptons

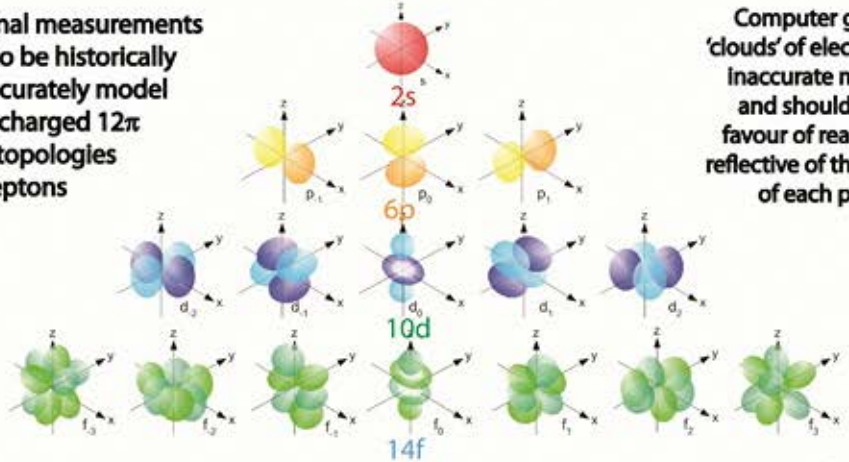

Computer generated plots of 'clouds' of electron probabilites are inaccurate mis-representations and should be abandoned in favour of realistic atomic models reflective of the charged geometry of each periodic element

Every elemental atom can be viewed as a quantum carousel with a unique number of oscillating fans positioned around it.

Each fan has 3 blades and a fixed speed n[1-8] related to its height above ground level, AND the carousel is turning around on its axis

All periodic elements are made form Deuterium nuclei

The baryonic energies of nuclei determines the energies of bound photo-electrons

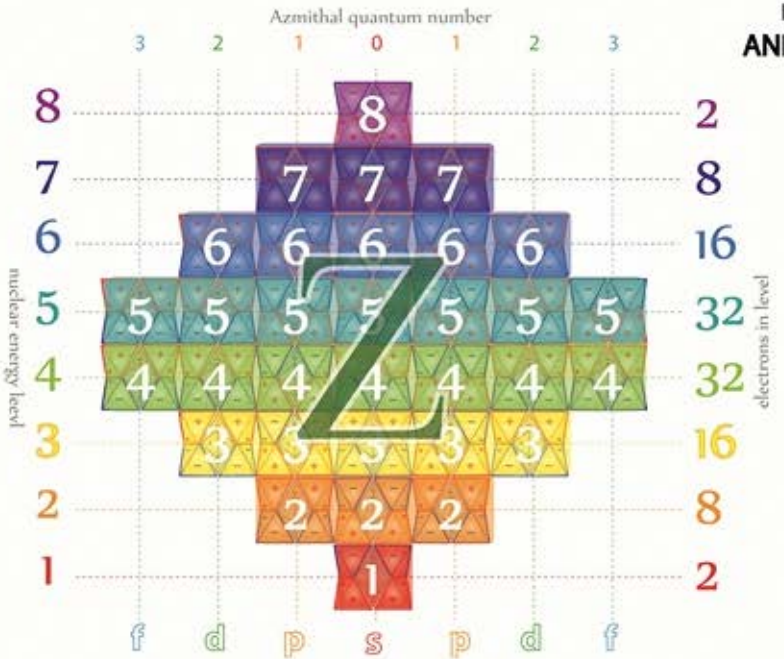

The current computer generated electron probability diagrams in popular use at present can now be show to be a misrepresentative model of mathematical modelling of electron sub-orbital energies

The nuclear quantum levels [n], intrinsic quantised angular momentum [h] and orbital angular momentum [l] of each electron bound within atomic nuclei are all the direct result of the Baryonic energies of the nuclei they are bound to

Each level of the quantum carousel can contain only a limited number of fans each running at a specific speed

Imagine trying to measure (or model) the motion of any 1 quantum scale blade while the carousel rotates

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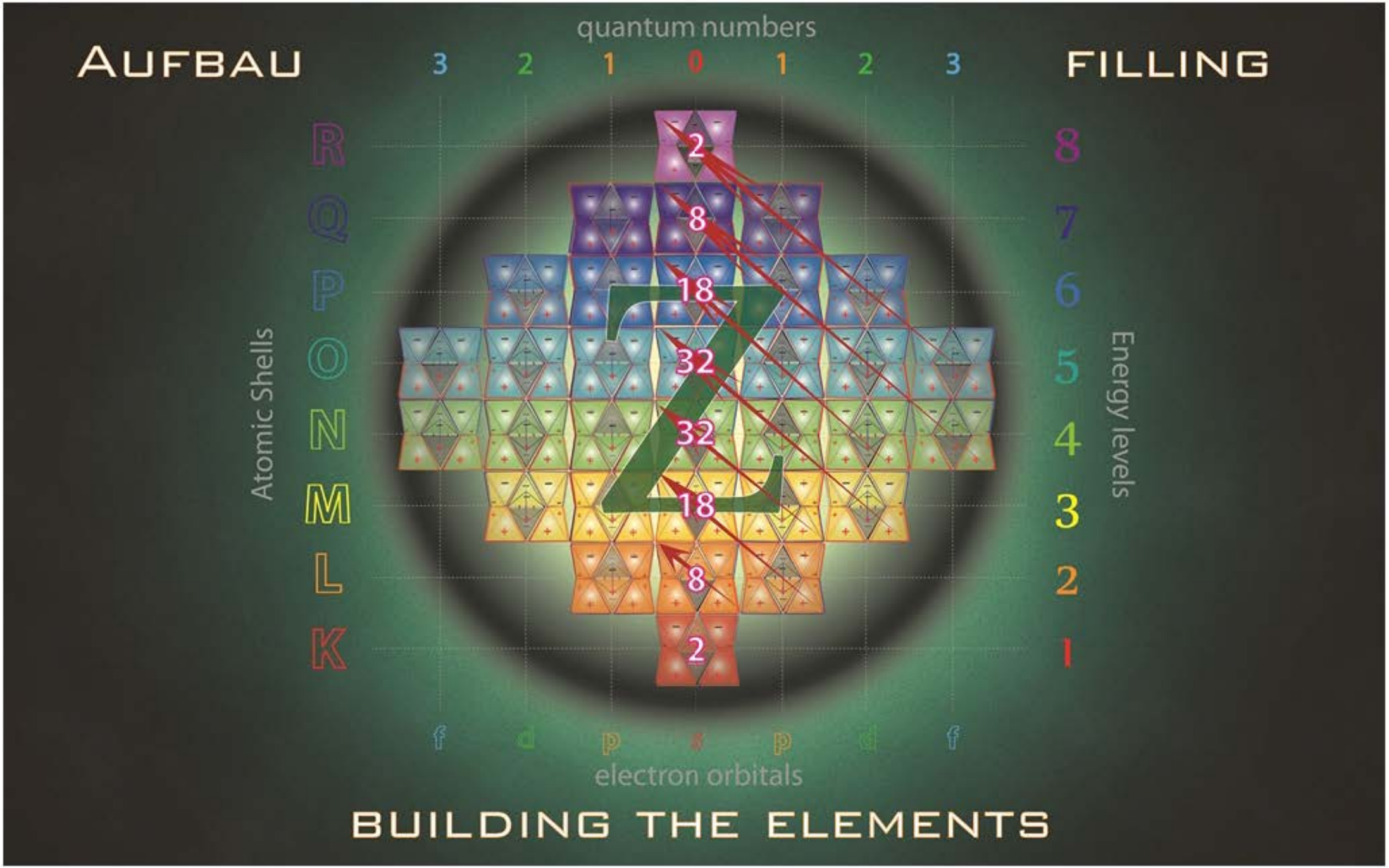

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Quantum Topologies

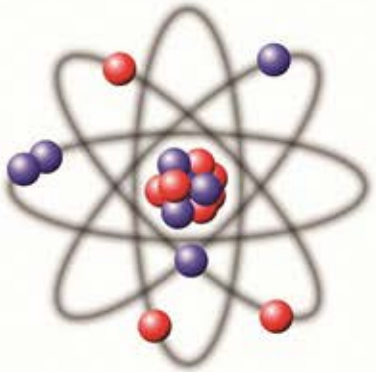

Dalton Model

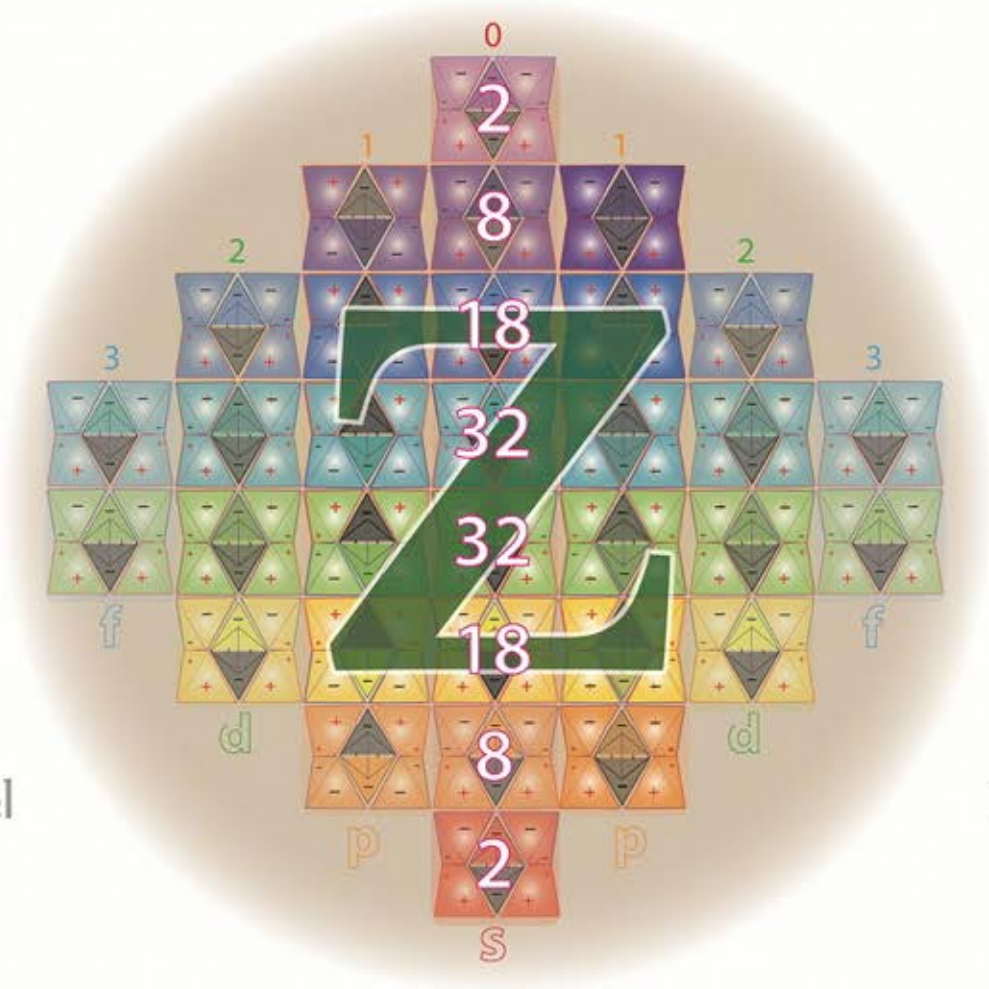

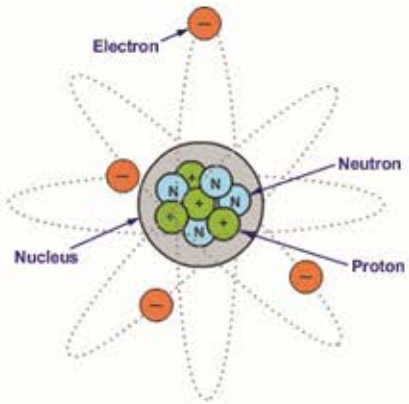

Quantum Model

Thomson Model

Rutherford Model

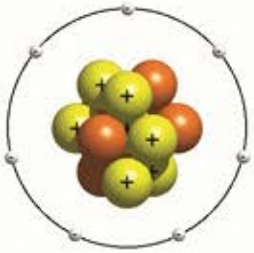

Historically viewed as a spherical object
Tetryonic charge geometry has finally revealed the true quantum topology of all atoms

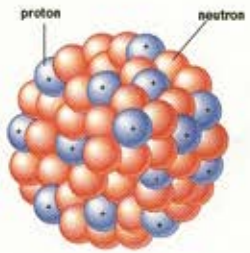

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Element numbers

The rule dictating how many nuclei form each Atomic shell is known as the Aufbau principle.

The physical and chemical properties of elements is determined by the atomic structure. The atomic structure is, in turn, detemined by the electrons and which shells, subshells and orbitals they reside in.

The maximum periodic elemental number is 120

$$Z = \sum_{1}^{1\,2\,3\,4\,4\,3\,2\,1} 2(n^2) = 2 + 8 + 18 + 32 + 32 + 18 + 8 + 2$$

Number of nuclei per level	Element #
2	120
+	119
8	118
+	111
18	110
+	93
32	92
+	61
32	60
+	29
18	28
+	11
8	10
+	3
2	2
	1

The number of nuclei per quantum level is reflective of photonic energy levels and provides the foundational geometry for all of the periodic elements

The number of possible nuclei in each Quantum level follows aufbau principle 'numbers' which can be determined using the following summation formula

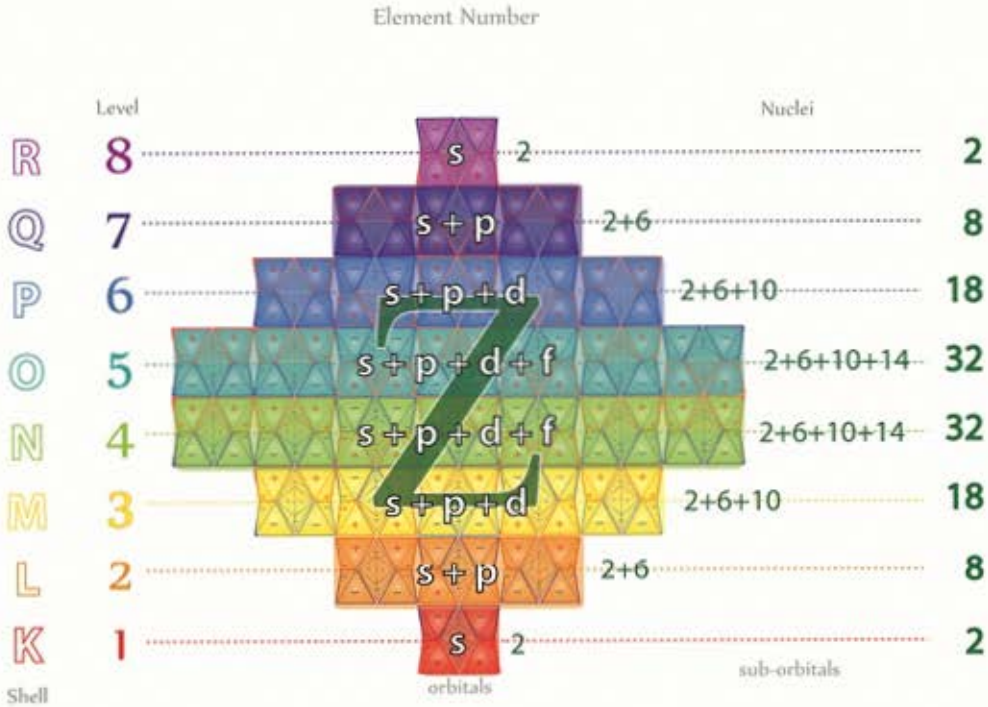

Deuterium is the building block of all elements

Each element has equal numbers of Protons, electron & Neutrons with their stored mass-energies making up the molar masses of elements not excess neutron as currently modelled

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Aufbau Principle
(Nuclei number and position)

1 Sub-Orbit (2 electrons max) — s
3 Sub-Orbits (6 electrons max) — p
5 Sub-Orbits (10 electrons max) — d
7 Sub-Orbits (14 electrons max) — f

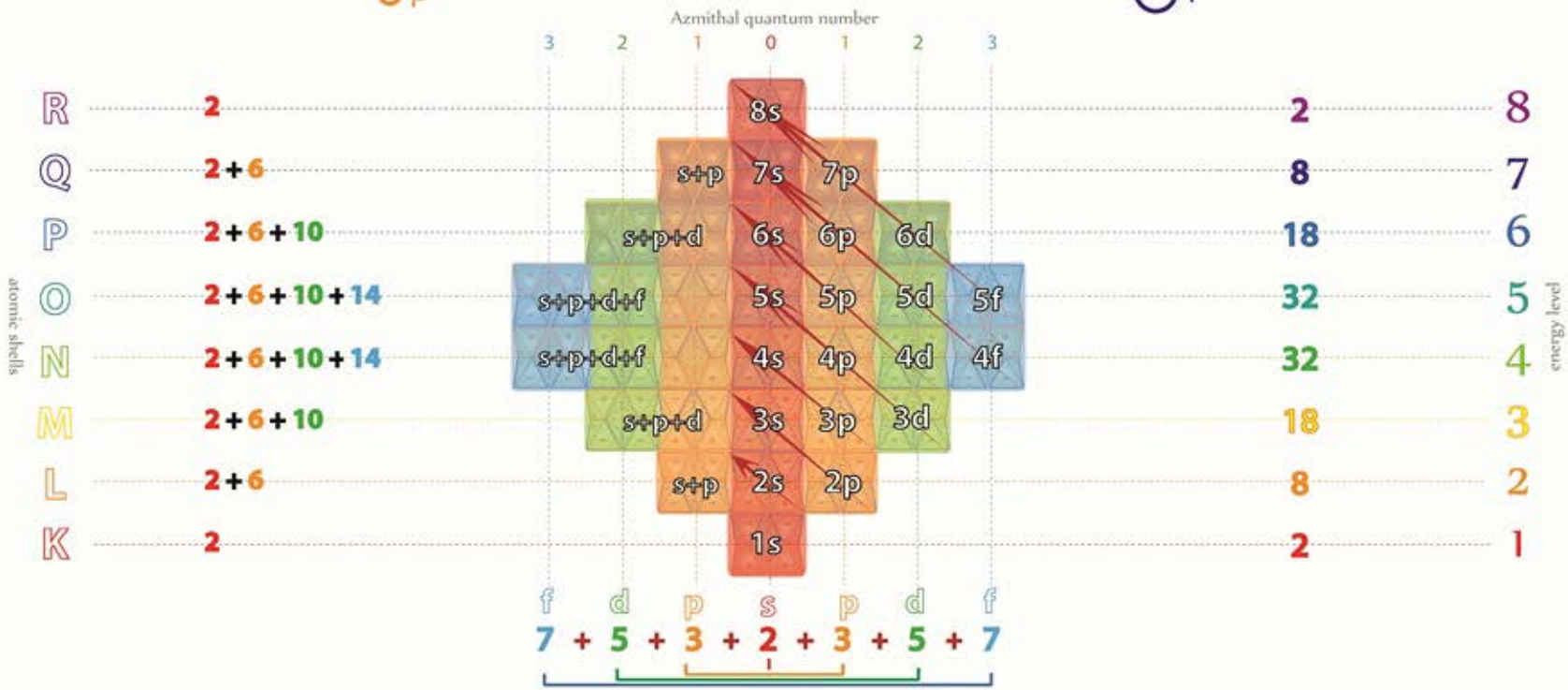

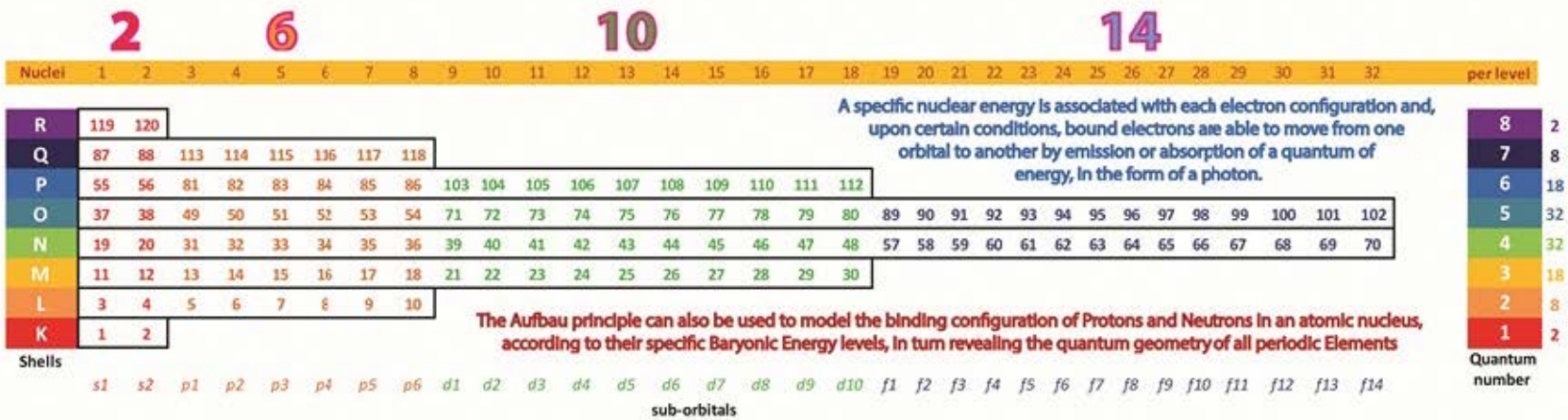

A specific nuclear energy is associated with each electron configuration and, upon certain conditions, bound electrons are able to move from one orbital to another by emission or absorption of a quantum of energy, in the form of a photon.

The Aufbau principle can also be used to model the binding configuration of Protons and Neutrons in an atomic nucleus, according to their specific Baryonic Energy levels, in turn revealing the quantum geometry of all periodic Elements

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Wolfgang Pauli

(25 April 1900 – 15 December 1958)

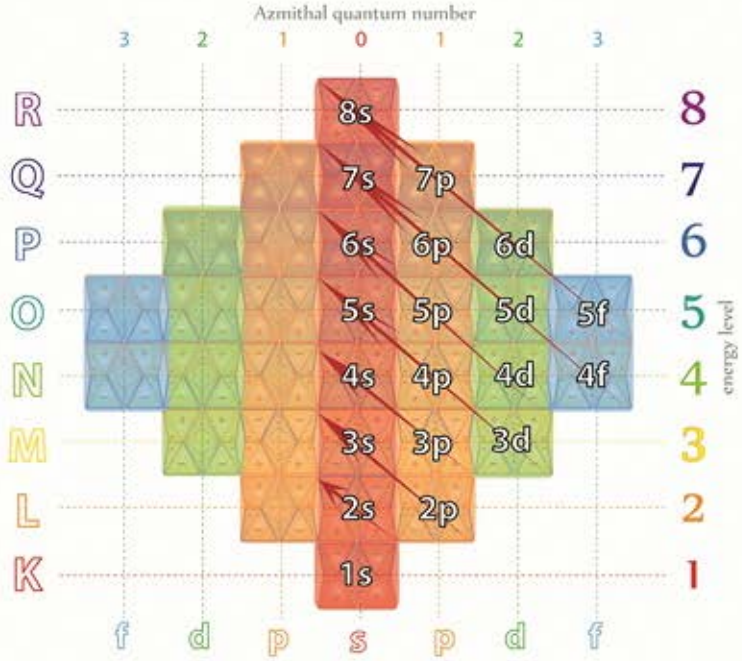

Friedrich Hermann Hund

(4 February 1896 - 31 March 1997)

The orbitals of lower energy are filled in first with the electrons and only then are the higher energy orbitals filled.

aufbau electron orbital filling

Orbitals of equal energy are each occupied by one electron before any orbital is occupied by a second electron, and all electrons in singly occupied orbitals must have the same spin state

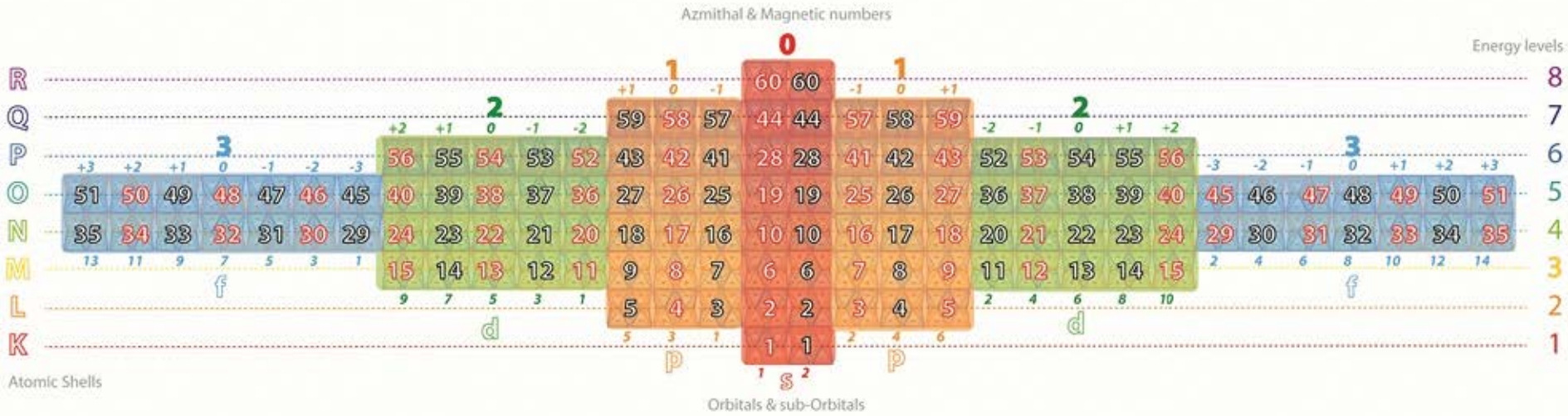

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Aufbau construction

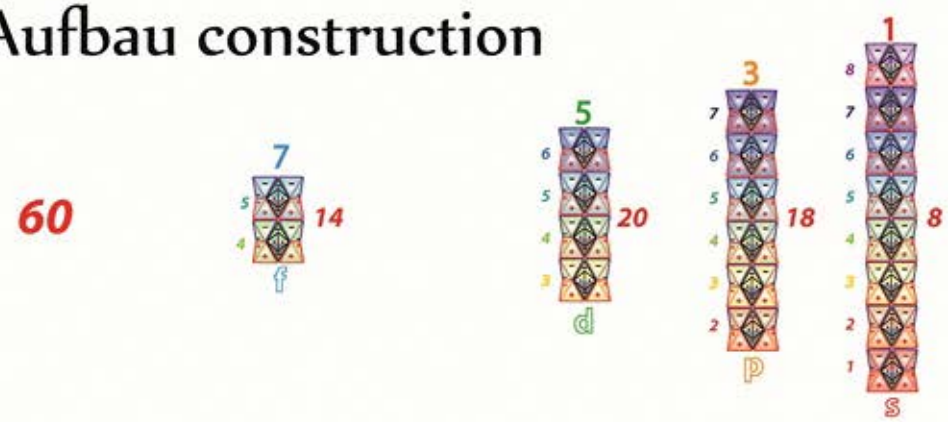

Proton base Hemisphere

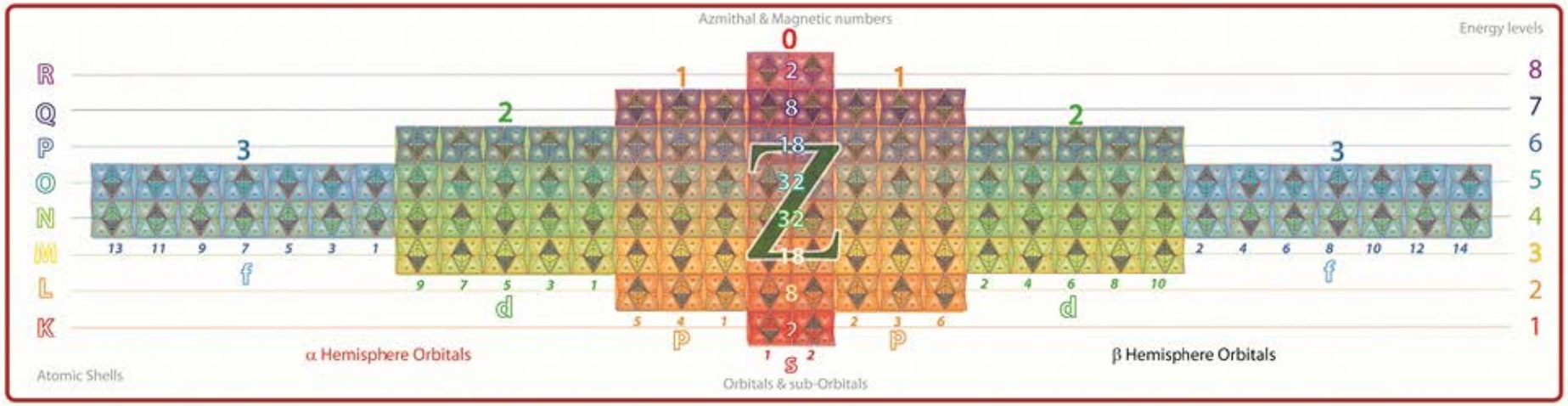

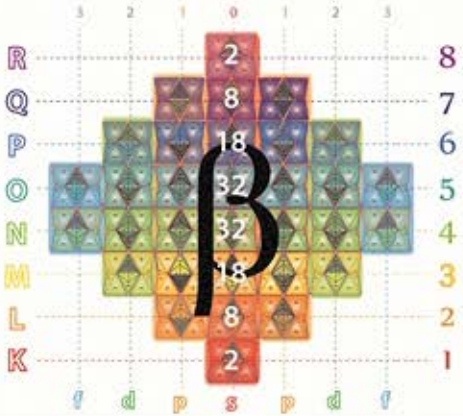

Neutron base Hemisphere

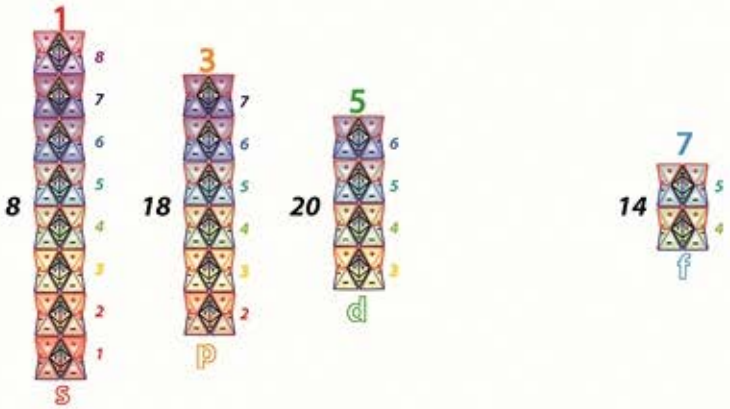

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Atomic Weights

[Molar mass-energies]

The table does not illustrate the quark compositions of the baryonic nuclei in elements

The Mendeleev table incorrectly positions Hydrogen as Element 1 in the table and does not show Deuterium [the building block of all Elements]

The Mendeleev block arrangement of periodic elements presents a number of problems in representing the true topologies and properties of all the periodic elements:

It provides no insight into the individual topologies of the periodic elements themselves

The physical dimensions of periodic elements and the electron orbitals of each element are not represented by the table

The table does not reflect elemental quantum numbers as defined by Schrodinger's wave equation

The table provides no additional insights or information on nuclei packing, aufbau element building processes or how nuclei energies contribute to total molar mass

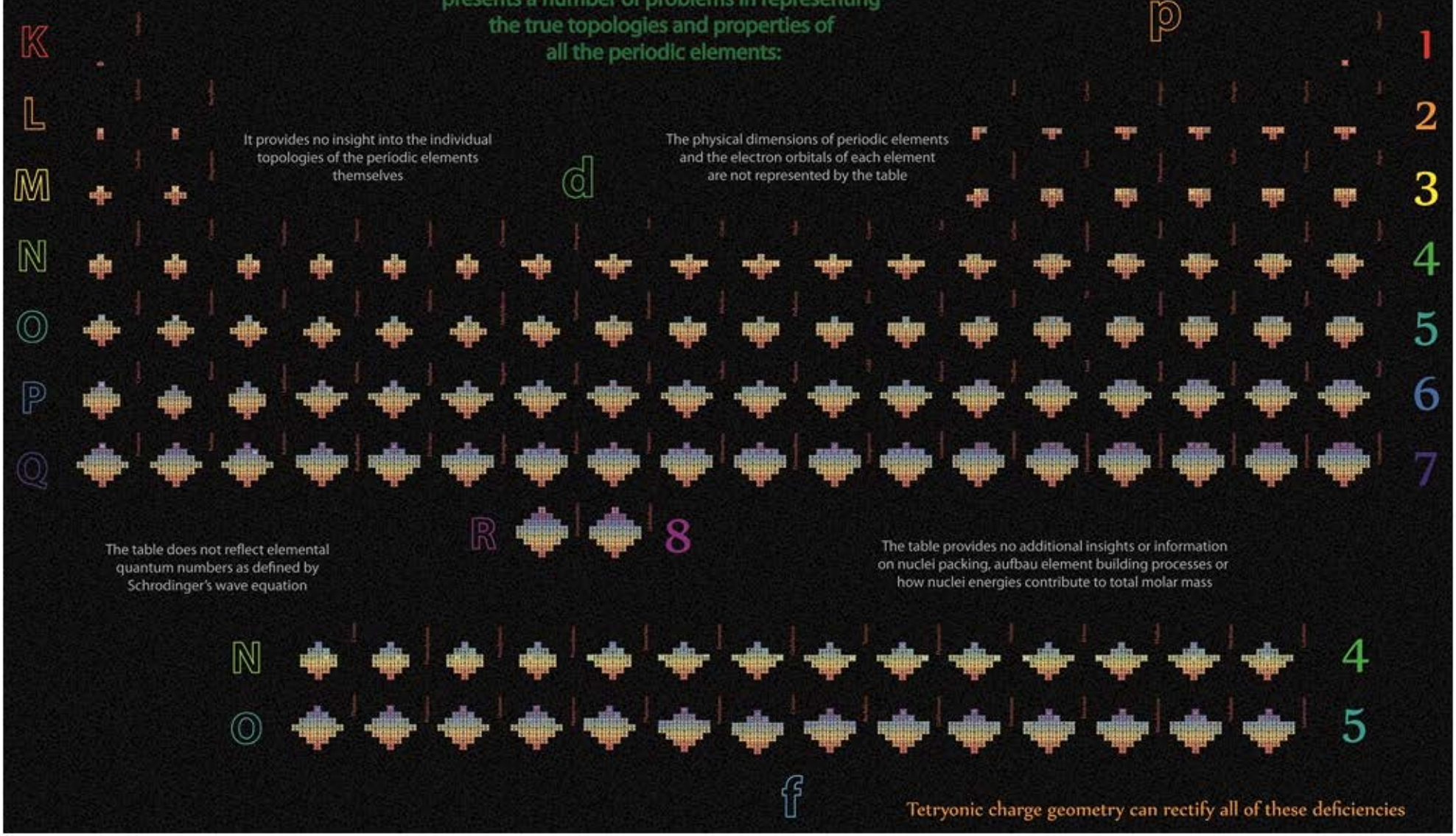

Tetryonic charge geometry can rectify all of these deficiencies

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Atomic nuclei mass-energies

Each element's weight [mass-Matter in a gravitational field] is the result of the total quanta comprising that element

Baryon mass-energies	E			electron KEM field
n	The quantum level mass-energies of Baryons determines the kinetic energies of electrons			hv^2
	1n - 1 e19v			
73,728	n32	8	v8	3.268969693 e15
69,192	n31	7	v7	2.502804921 e15
64,800	n30	6	v6	1.838795452 e15
60,552	n29	5	v5	1.276941286 e15
56,448	n28	4	v4	8.172424232 e14
52,488	n27	3	v3	4.596988631 e14
48,672	n26	2	v2	2.043106058 e14
45,000	n25	1	v1	5.107765145 e13
Compton frequencies	1.2 e20 electron rest Matter is velocity invariant			spectral frequencies
930 MeV	496 keV			13.6 eV

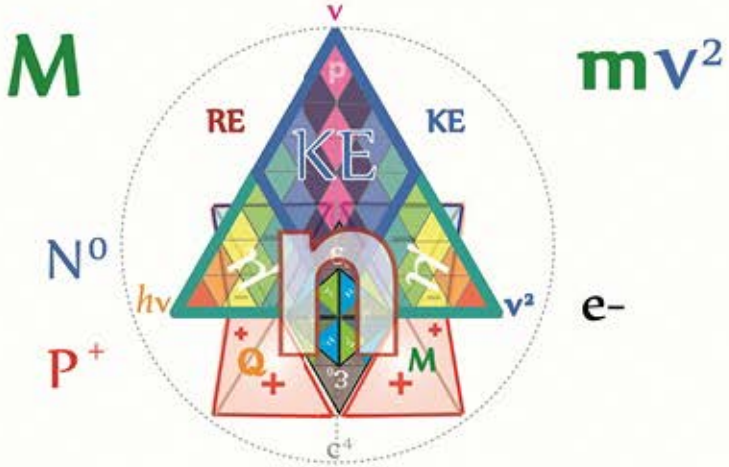

The nuclei forming each atomic shell have specific mass-energy quanta

$$\overset{8}{\underset{1}{n}}\left[\left[72(n)^2\right]+\left[12e19\right]+\left[m_e v^2\right]\right]$$

Baryon rest masses — lepton rest mass — KEM

Deuterium mass-energy per shell

Despite having differing mass-energies each Deuterium nuclei has the same velocity invariant Matter geometry [84π]

spin orbital coupling in synchronous quantum convertors

Electrons act as quantum scale rotating armatures in atomic nuclei and can only have specific energies reflective of the electron orbital energy level of the Baryons in which they are found

They acheive these energy levels by absorbing or emitting photons to acheive the specific angular momentum required

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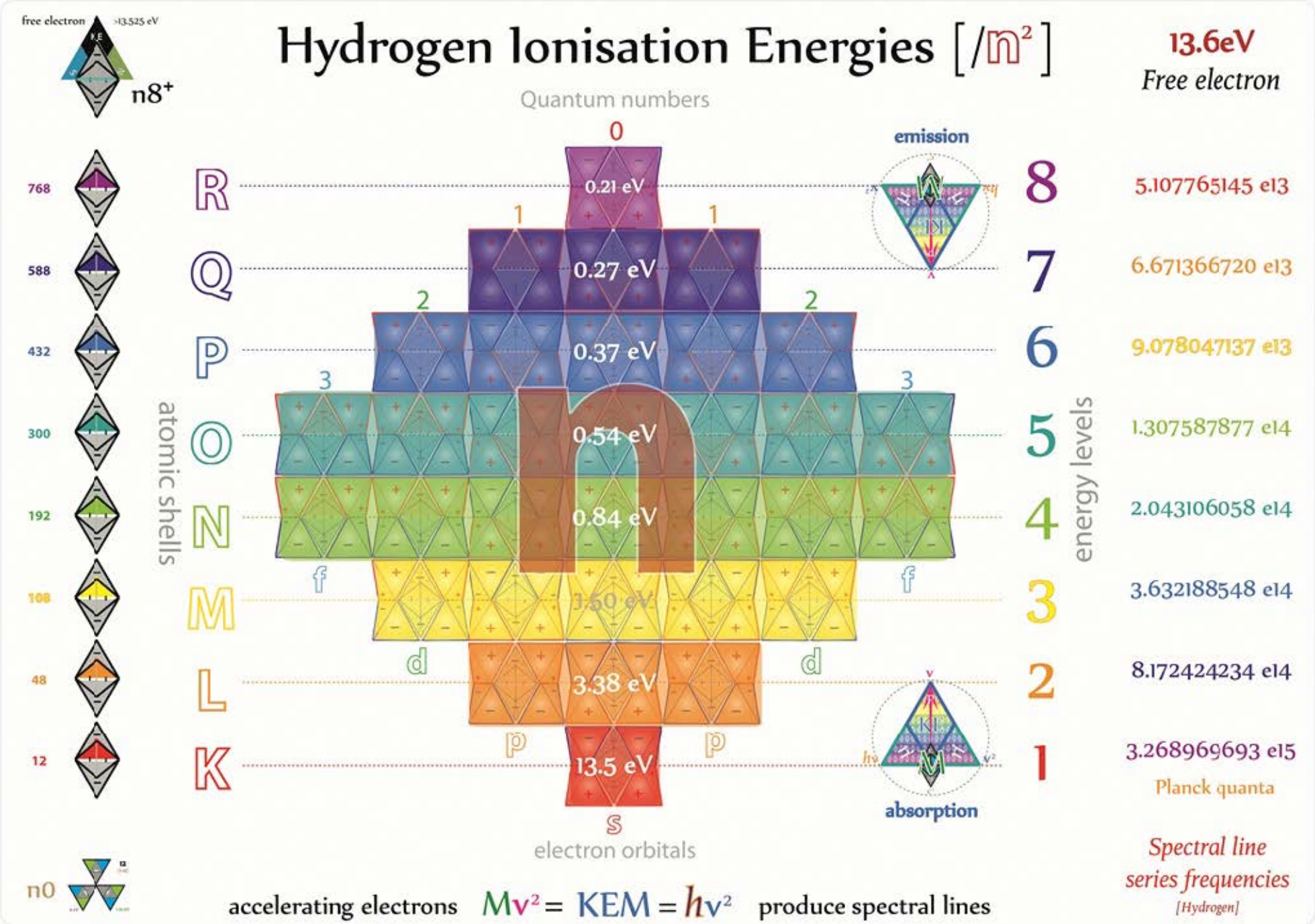

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Redefining Atomic weights

Atomic weight (symbol: Ar) is a dimensionless physical quantity, the ratio of the average mass of atoms of an element (from a given source) to 1/12 of the mass of an atom of carbon-12 (known as the unified atomic mass unit)

Carbon 12

504
[254-254]

12
C
11.996

270,072

6s1

6 Protons [24-12]
6 Neutrons [18-18] n1
6 electrons [0-12]

The 'unified atomic mass unit' currently in use is known to be inaccurate and must be corrected in order to bring clarity & increased accuracy to the atomic weights of all elements

A_r = 22,512
Hydrogen

Defining Hydrogen as having an exact atomic Planck mass of 22512n quanta provides uniformity with Tetryonics

1/12 C_{12}

A_r = 22,506

42
[24-18]

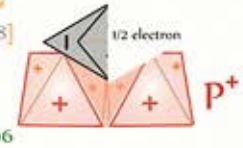

22,506

1.660096209e-27 kg

1 Proton [24-12]
.5 electron [0-6] n1

Unified atomic Matter unit

48
[24-24]

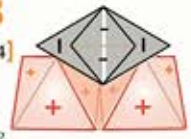

H
P+

22,512

1.660538783e-27 kg

1 Proton [24-12]
1 electron [0-12] n1

Deuterium is the building block of all elements in the period table

A_r = 45,012
Deuterium

Defining Deuterium as having an exact atomic Planck mass of 45012n quanta reflects the true charged geometries of all Elements & their topologies

D

1/6 C

84
[42-42]

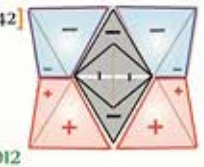

N°
e-
P+

45,012

3.320192418e-27 kg

1 Proton [24-12]
1 Neutron [18-18] n1
1 electron [0-12]

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Planck mass-energy units

NAu = 0.001 kg

48
[24-24]

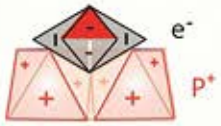

^{1}H

22,512

1.660538841 e-27 kg

One Da is approximately equal to the mass of one proton or one neutron

36
[18-18]

N^{0}

0.499866702 H

22,500

1.659653693 e-27 kg

36
[24-12]

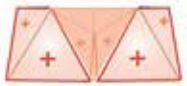

P^{+}

0.499866702 H

22,500

Deuterium is the building block of all elements

84
[42-42]

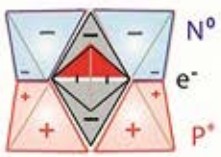

^{2}H

45,012

3.320192534 e-27 kg

The unified atomic mass unit (symbol: u) or Dalton (symbol: Da) is a unit that is used for indicating mass on an atomic or molecular scale

270,072

1/12 the mass of a C12 graphene atom at rest in its electronic ground state

1.660538782(83)×10−27 kg

22,506

is an inaccurate means of determining the exact rest mass of a Hydrogen atom

22,512

Carbon 12 has 270,072n planck quanta (270,072 / 12 = 22,506)

Hydrogen has a mass of 22,512n (22,500+12) requiring all mass to be calculated directly using the Planck mass-energy quantum (.001kg / N_A / 22,512) & Tetryonic charge geometries

Using Tetryonic theory to define n Planck mass = $7.376238634 \times 10^{-32}$ Kg

(see Tetryonics QM 15.04)

exact atomic rest masses for all particles, elements and compounds can be determined directly from atomic theory

N_A = 6.02214179 e23

The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12; its symbol is "mol".

NA(12u) = 0.012 kg

504
[254-254]

12
C
11.996

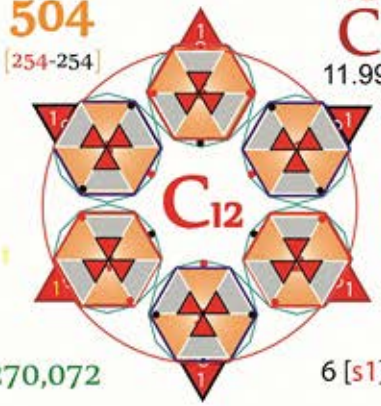

270,072

6 [s1]

6 Protons [24-12]
6 Neutrons [18-18] n1
6 electrons [0-12]

Carbon has a number of differing atomic configurations (allotropes)

6 Protons [24-12]
6 Neutrons [18-18] n1-2
6 electrons [0-12]

504
[252-252]

6
C
12.6493

284,760

[He] 2s2 2p2

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Planck mass-energy contributions to the measured weights of periodic, elementary mass-Matter topologies

36
[18-18]
N^0
45,000n

1.659653693 e-27 kg

36
[24-12]
P^+
45,000n

12
[0-12]
e-
12n

8.851486361 e-31 kg

n
[v-v]

2.411109611 e-35 kg

γ

0

KEM

Baryons have 2,25e23 Planck quanta comprising their rest Matter topologies

[930.974 MeV]

Δ 1875 x

[496.5 keV]

Leptons have 1.2 e20 Planck quanta comprising their rest Matter topologies

[496.5 keV]

Δ 36,711 x

[13.6 eV]

Photons are planar geometries [Matter-less] (purely Kinetic mass-Energy and momenta)

The Lyman alpha spectral line mass-energy contribution to the mass of a Deuterium nucleus is negligible

Electron quantum level energies are determined by the energy of the Nuclei they bind to in elements

D^+
[1.862 GeV]

84
[42-42]

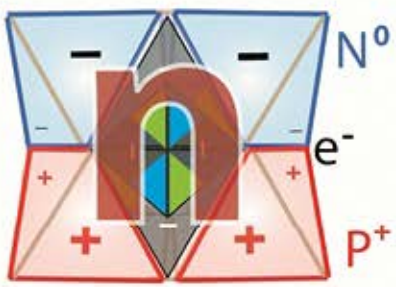

90,012n+

Photons contribute spectral mass-energies to the nuclei mass but are themselves Matterless [2D zero rest mass-energies]

Photons are 2π charge mass-energy geometries

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Ionisation energies

Fractional quantum differentials

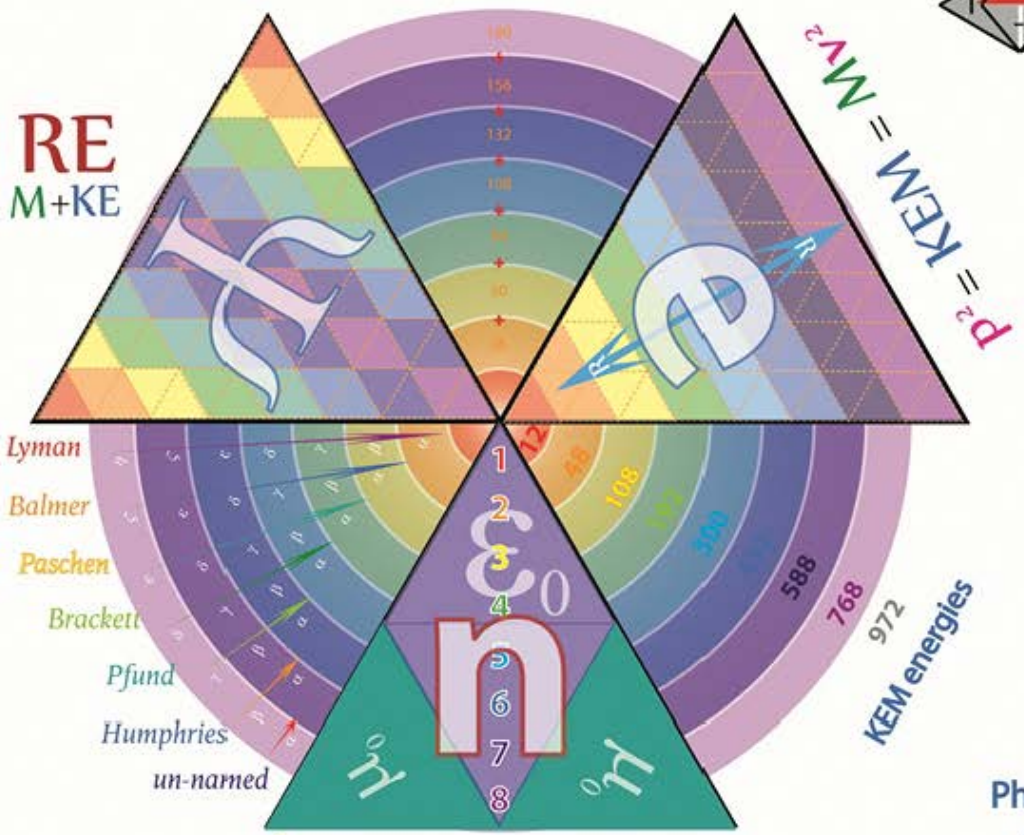

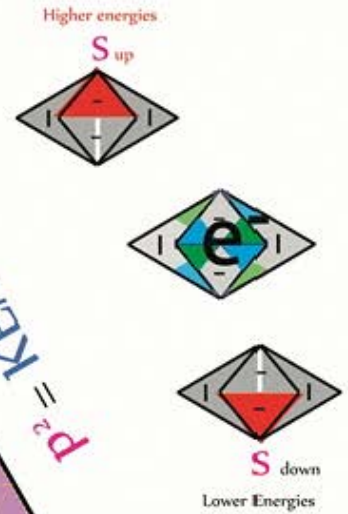

photo-electronic energy momenta

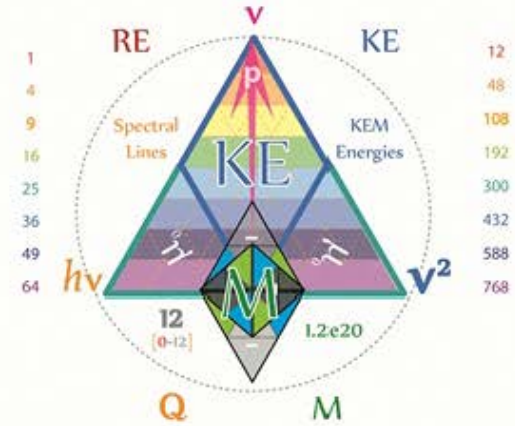

Mapping photo-electron transition energies to Tetryonic energy momenta geometries reveals many key facts about the ionisation energies of nuclei

$$E = -\frac{Z^2}{n^2}\frac{ke^2}{2a_0} = -\frac{13.6Z^2}{n^2}eV$$

The differing fractional KEM field energy momenta of electrons that results from their transitions to specific energy nuclei in elements results in differing QAM quanta and produces spectral lines and fine line splitting

$$hf = \Delta Mv = \Delta p$$

spectral lines are produced by accelerating electrons

Note: this is an Illustrative schema for modelling KEM field energies
All KEM fields possess the same physical spatial geometry
in radial-time defined spatial co-ordinate systems

c^2 c^4

Photo-electrons absorb/emit spectral energies

$$E = eV = \frac{1}{4\pi\epsilon_0}\frac{ne^2}{a}$$

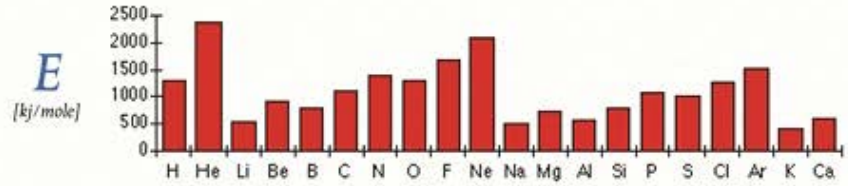

Spectral line transitions

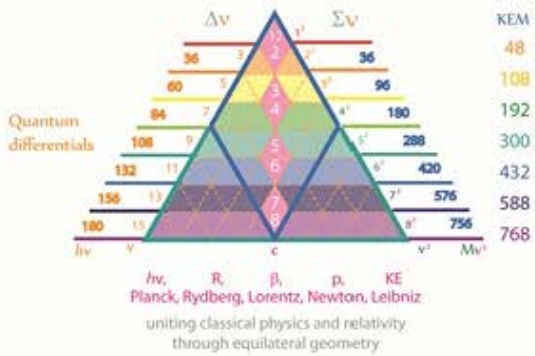

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Elementary ionisation energies

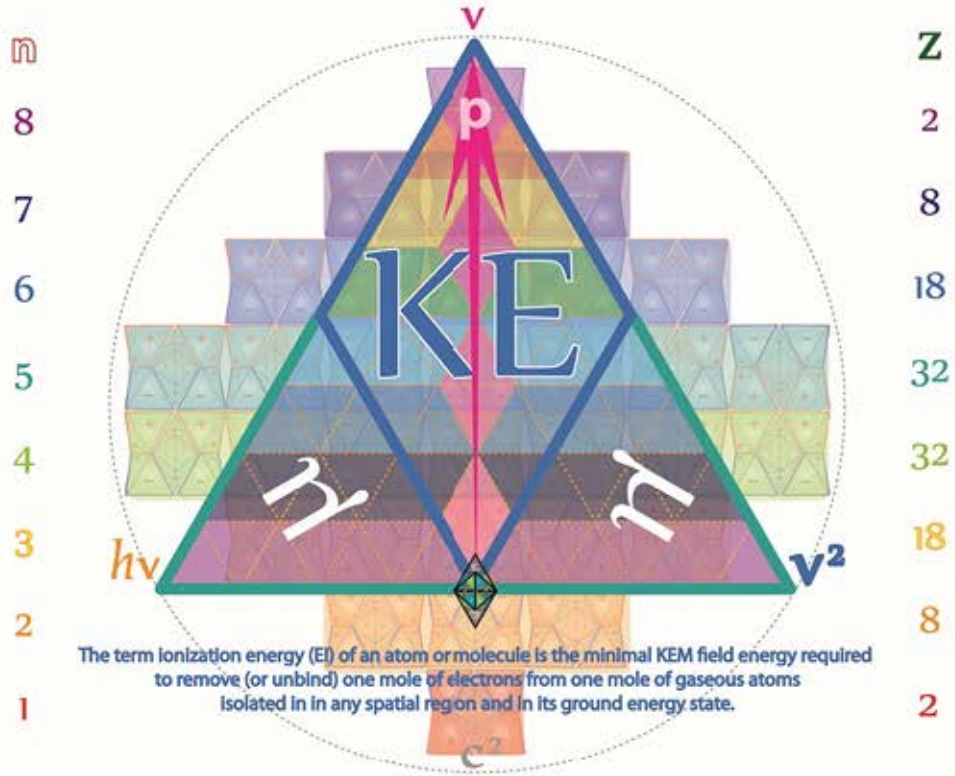

The term ionization energy (EI) of an atom or molecule is the minimal KEM field energy required to remove (or unbind) one mole of electrons from one mole of gaseous atoms isolated in in any spatial region and in its ground energy state.

The term "ionization energy" is sometimes used as a name for the work needed to remove (or un-bind) the highest energy photoelectron from an atom or molecule.

However, due to interactions with surfaces, this value differs from the ionization energy of the atom or molecule in question when it is located by itself in free space.

So, in the case of surface-adsorbed atoms and molecules, it may be better to use the more general term "electron binding energy", in order to avoid confusion.

Both these names are also sometimes used to describe the work needed to remove an electron from a "lower" orbital (i.e., not the topmost orbital) for both free and adsorbed atoms; in such cases it is necessary to specify the orbital from which the electron has been removed

$$E = -\frac{Z^2}{n^2}\frac{ke^2}{2a_0} = -\frac{13.6Z^2}{n^2}eV$$

Every electron in each elementary orbit has a unique ionisation energy

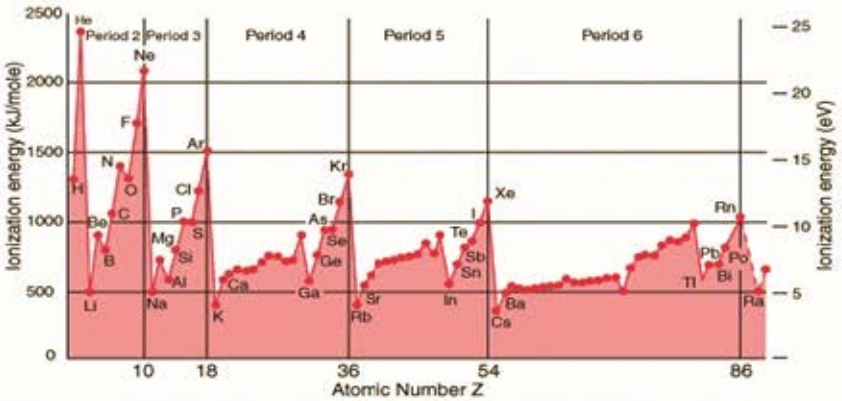

Nuclei	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	per shell

Element number

| Shells | | |

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Hyperfine splitting and Lamb Shifts

When the spectral lines of the hydrogen spectrum are examined at very high resolution, they are found to be closely-spaced doublets.
This splitting is called fine structure and was one of the first experimental evidences for electron spin.

The fine structure describes the splitting of the spectral lines of atoms due to first order relativistic corrections [principal quantum energies]

n

Differing electron spins within shells & quantum levels produces Hyperfine splitting

atomic shell energies result from Series addition of baryonic energies

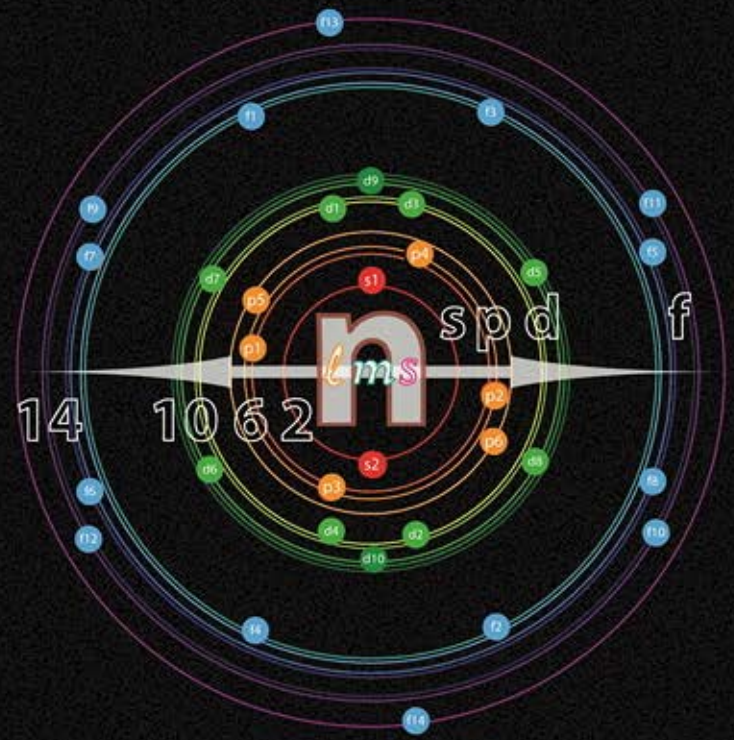

The electron energy levels of Hydrogen should depend only on the principal quantum number n.

In 1951 it was discovered that this was not so, the $2p_{(1/2)}$ state is slightly less than the $2s_{(1/2)}$ state resulting in the Lamb shift

$\ell m s$

Differing electron sub-Orbtial energies create Lamb Shifts

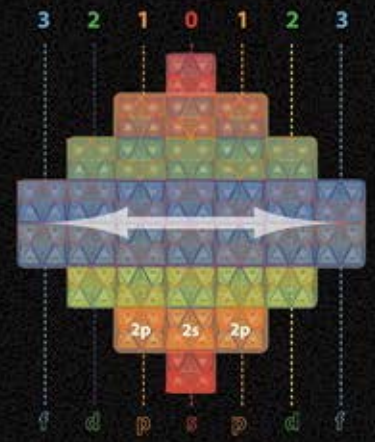

electron sub-orbital energies are Parallel energy configurations

If you measure the atomic energy levels of photo-electrons at an extremely high resolution, you'll find small deviations of individual KEM field energies of electrons in sub-orbitals which are primarily the result of parallel and anti-parallel electron spins

Higher energy
Parallel
Magnetic moments

Lower energy
Anti-parallel
Magnetic moments

All electron spins are referenced to the Nuclear magneton

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M_0

3D Matter topologies are comprised of charged 2D mass-energies

Energy per second²

RE

Relativistic mass-ENERGY-Matter

Relativity fails at the foundational level to explain and differentiate between mass-ENERGY and Matter in physical systems

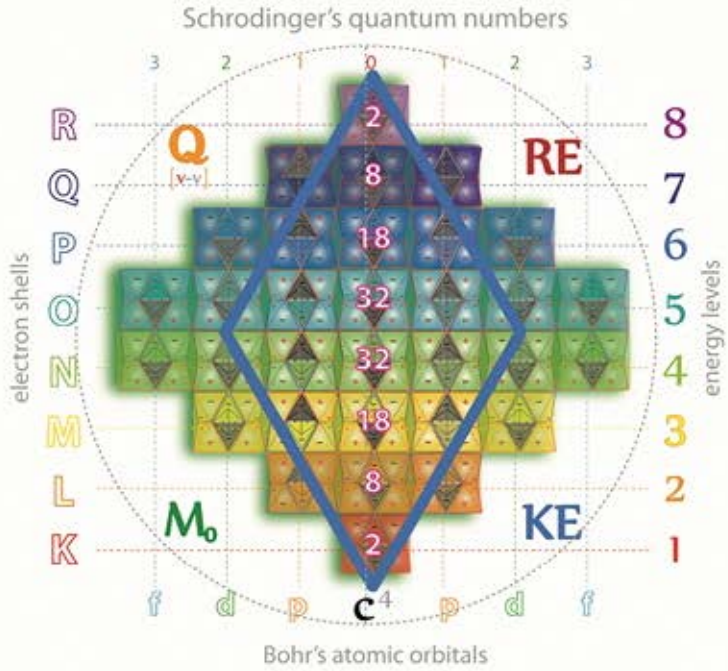

KE

2D equilateral mass-energies are euclidean geometries

Energy per second

Einstein's relativistic [Lorentz corrected] stress energy tensor aggregates all forms of energy into a single energy density gradient

$$\frac{T\pi}{c^4}\left[\left[m\Omega v^2\right]\right] \quad \text{atomic energies} \quad \frac{Tm\eta}{c^4} + \frac{mv^2}{c^2} \quad \text{electron spins} \quad \frac{n\pi}{c^2}\left[\left[m\Omega v^2\right]\right]$$

Matter, Planck quanta, mass, velocity

Mass, Planck quanta, mass, velocity

mass-Matter

standing wave mass-energiescreate
the material substance of all chemical elements

3D rest Matter + Lorentz corrected 2D Kinetic Energies = total Relativistic Energies

mass-energies

radiant planar mass-energies create
EM fields, spectral lines & chemical interactions

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Deuterium is the building block of all Elements (save Hydrogen)

The geometry of any Element is determined by its Charge

The Molar Weight of any Element is a measure of its standing wave mass-energies

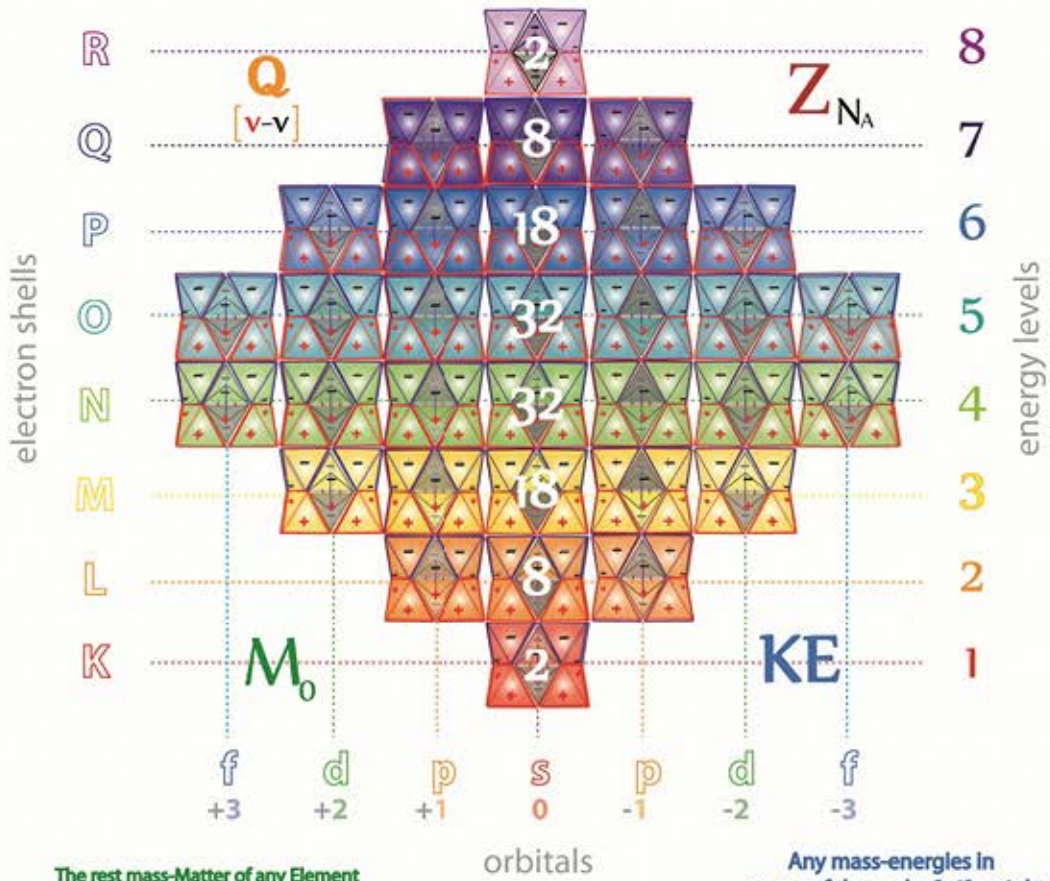

The rest mass-Matter of any Element is determined by the total number of quanta making up the Protons, Neutrons and electrons that comprise them (in their respective energy levels)

Any mass-energies in excess of the molar [n1] weight is a measurement of a element's CHEMICAL energies

Important point to note:
The Kinetic Energy difference between any Element's total [n1] Deuteron mass-energies and its Molar mass has historically been incorrectly explained as resulting from an excess number of Neutrons in the atom it is not, Z# = (number of Protons = number of electrons = number of Neutrons)

Elementary mass-Matter

n per nuclei
1e19v = n

$$\sum_{K}^{R}$$

2	2 nuclei [74,496 ea]	120	Unbinilium
		119	Ununennium
+			
8	8 nuclei [69,780 ea]	118	Ununoctium
		87	Francium
+			
18	18 nuclei [65,232 ea]	112	Copernicium
		55	Caesium
+			
32	32 nuclei [60,852 ea]	102	Nobelium
		37	Rubidium
+			
32	32 nuclei [56,640 ea]	70	Ytterbuim
		19	Potassium
+			
18	18 nuclei [52,596 ea]	30	Zinc
		11	Sodium
+			
8	8 nuclei [48,720 ea]	10	Neon
		3	Lithium
+			
2	2 nuclei [45,012 ea]	2	Helium
		1	Deuterium

The rest mass-Matter of any Element is the sum total of its constituent Z[n²] energy level Deuterium nuclei

Aufbau

$$Z\#\left[\begin{array}{ll} z \text{ Protons} & [24\text{-}12] \\ z \text{ Neutrons} & [18\text{-}18] \\ z \text{ electrons} & [0\text{-}12] \end{array}\right] n1\text{-}8$$

(ie Calcium [20] = 2+8+10 n level Deuterium nuclei)

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Periodic Harmonic motions

$x = A \cos(\omega t + \varphi)$

Much of the math in of modern physics is predicated on the assumption that π [where it appears] is related to the properties of a circle

$F = -kx$

Circular motion

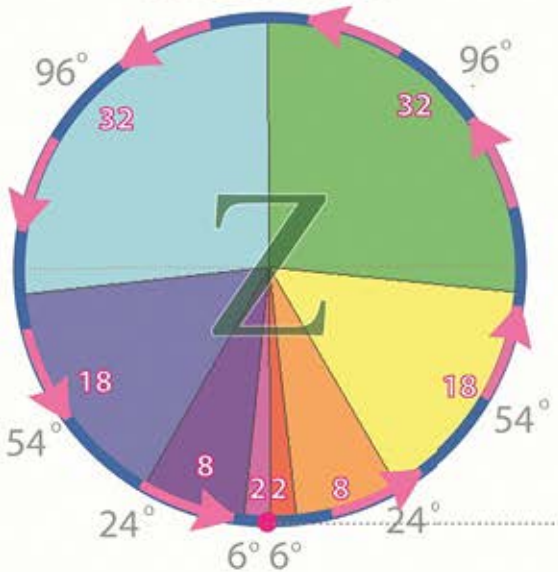

Linear motion

Simple harmonic motion can be visualized as the projection of uniform circular motion onto one axis

Principal Quantum Numbers

circular harmonic motion

simple harmonic motion

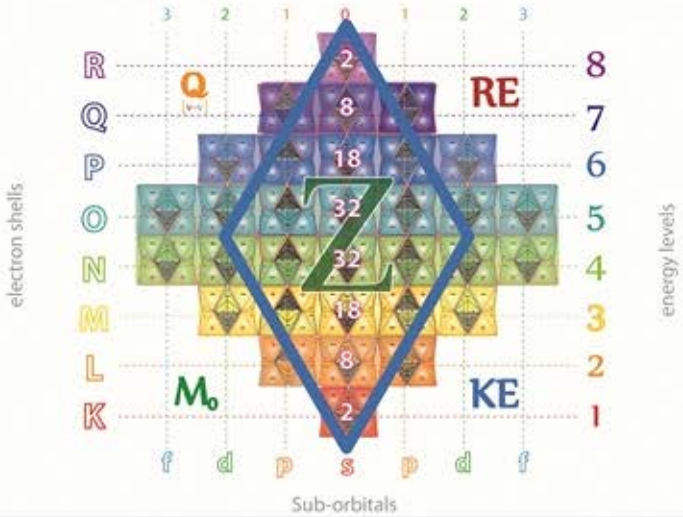

Circular motions describe the motion of a body with a changing velocity vector [the result of an acceleration force].

Nuclei per shell in elements follows a 'periodic summation rule' that is reflective of photonic energies

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$$\sum_{K}^{R}$$

nuclei per shell

$$\prescript{R}{K}{\sum} Z$$

Periodic Summation

Periodic summation is a notation developed for Tetryonic theory to model the geometric series addtion of Z[n²] energy level Deuterium nuclei that form the periodic elements

$$\sum^{120}_{1} Z$$

element number

STEP ONE

Periodic summation follows the atomic shell electron config

STEP TWO

Periodic elements build up following the aufbau sequence

$$\prescript{1\,R}{1\,K}{\sum}_{2,3,4,4,3,2} 2(x^2) =$$

Each atomic shell can hold only a fixed number of deuterium nuclei

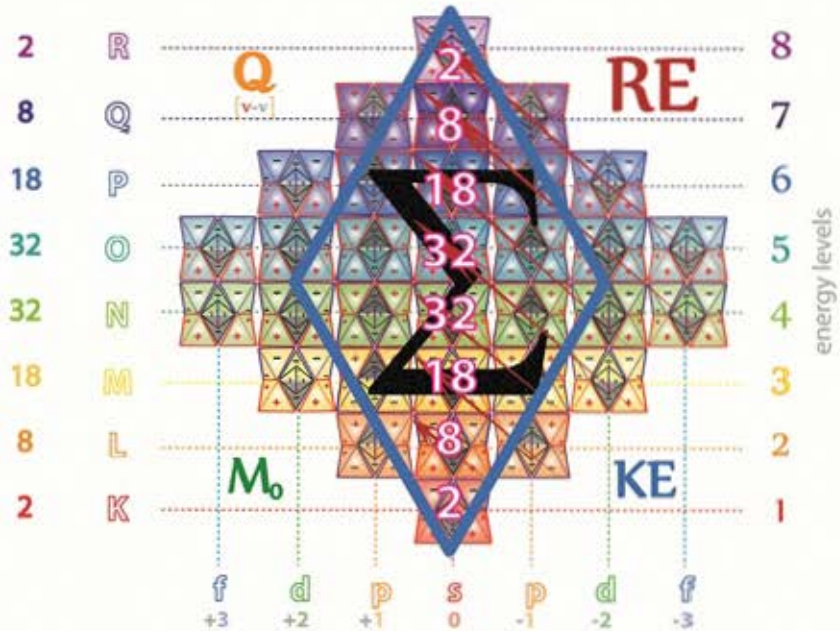

$\prescript{R}{}{\sum} = 2$	2 nuclei [74.496 ea]	120	Unbinilium
+			
$\prescript{Q}{}{\sum} = 8$	8 nuclei [69,780 ea]	118	Ununoctium
+			
$\prescript{P}{}{\sum} = 18$	18 nuclei [65,232 ea]	110	Darmstadtium
+			
$\prescript{O}{}{\sum} = 32$	32 nuclei [60,852 ea]	92	Uranium
+			
$\prescript{N}{}{\sum} = 32$	32 nuclei [56,640 ea]	60	Neodymuim
+			
$\prescript{M}{}{\sum} = 18$	18 nuclei [52,596 ea]	28	Argon
+			
$\prescript{L}{}{\sum} = 8$	8 nuclei [48,720 ea]	10	Neon
+			
$\prescript{K}{}{\sum} = 2$	2 nuclei [45,012 ea]	2	Helium
		0	Hydrogen

THe LHS of the notation determine the number of nuclei in each atomic shell, from the periodic mass-energy levels for atoms, and the RHS follows the aufbau building principle to determine the rest mass-Matter of any specific element

Aufbau

Each periodic element is made of Z [n² energy] deuterium nuclei

$$Z\# \left[\begin{array}{ll} z \text{ Protons} & [24\text{-}12] \\ z \text{ Neutrons} & [18\text{-}18] \\ z \text{ electrons} & [0\text{-}12] \end{array}\right] n1\text{-}8$$

Planck mass-energies form the surface integral of rest Matter topologies for each periodic element

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Element numbers

Nuclei per shell in elements follow a 'periodic summation rule' that is reflective of photonic energies

$$\sum_{K}^{R} {}^{P} 2(x^2) = 2 + 8 + 18 + 32 + 32 + 18 + 8 + 2$$

$$Z$$

120	Unbinilium	n8
119	Ununennium	
118	Ununoctium	n7
87	Francium	
112	Copernicium	n6
55	Caesium	
102	Nobelium	n5
37	Rubidium	
70	Ytterbuim	n4
19	Potassium	
30	Zinc	n3
11	Sodium	
10	Neon	n2
3	Lithium	
2	Helium	n1
1	Deuterium	
Hydrogen	0	

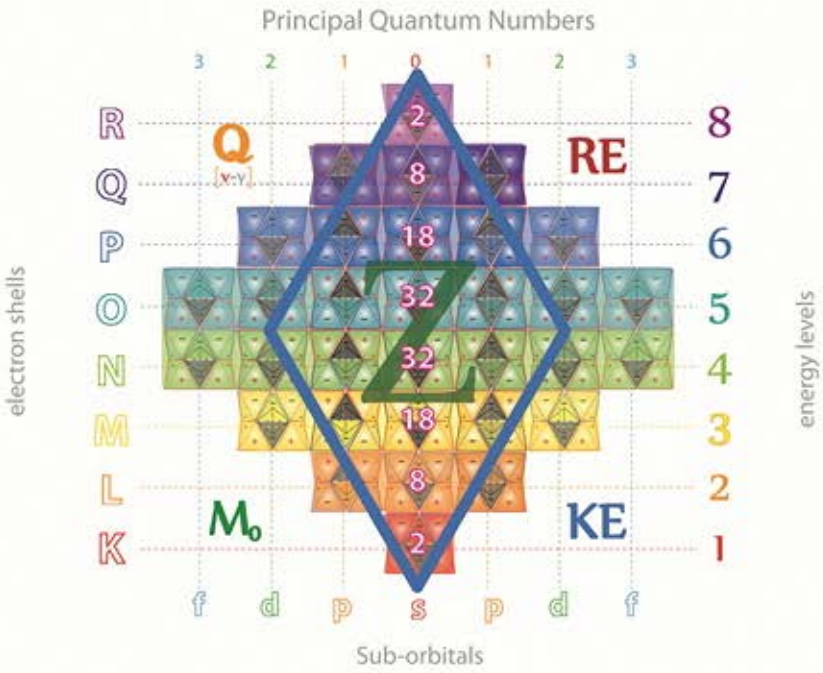

Periodic mass-ENERGY-Matter

Following periodic summation rules for shell filling n[1-8] quantum energy deuterium nuclei combine to form elementary Matter

$$\sum_{K}^{R} {}^{P}_{25}{}^{32} \left[\left[72(n)^2 \right] + \left[12e19 \right] + \left[m_e v^2 \right] \right]_{1}^{8}$$

Baryon rest masses; lepton rest mass; KEM

Deuterium mass-energy per shell

The measured weight of Matter in gravitational fields is the result of planar mass-energies in tetryonic standing-wave geometries

The periodicity of all the elements, along with their exact molar rest mass-energies and quantum wavefunctions can be described with Tetryonic geometries

Ionisation energies

$$\gamma$$

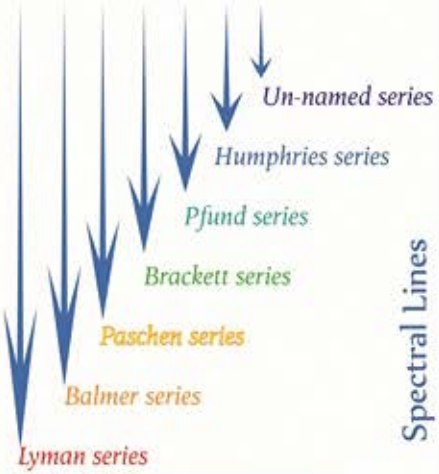

$$Mv^2 = KEM = hcR_H$$

Photon emission/absorption

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Photo-electron ionisation energies

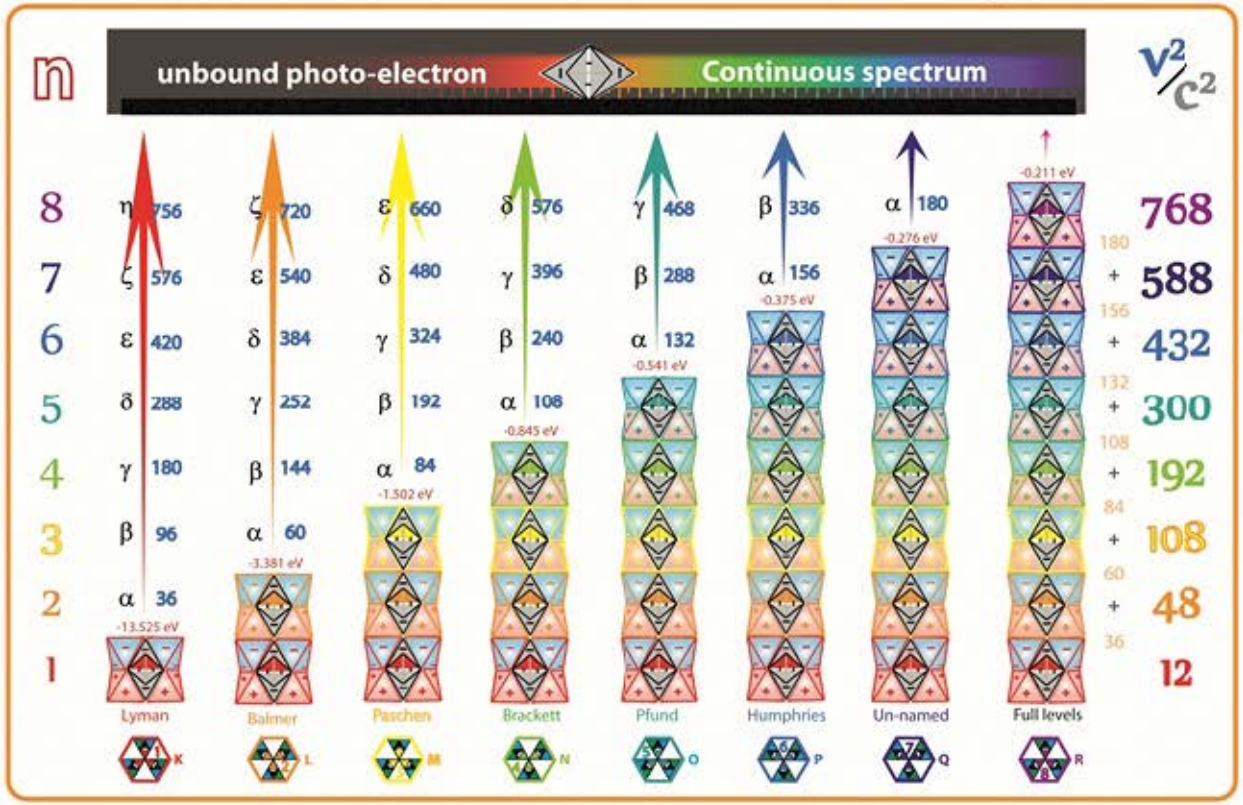

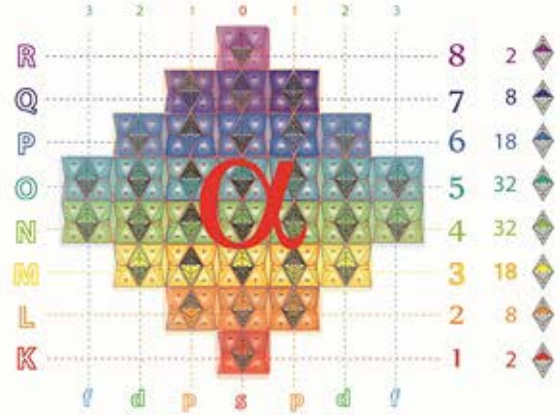

Opposed electron spins results in Hyperfine splitting & Lamb shifts

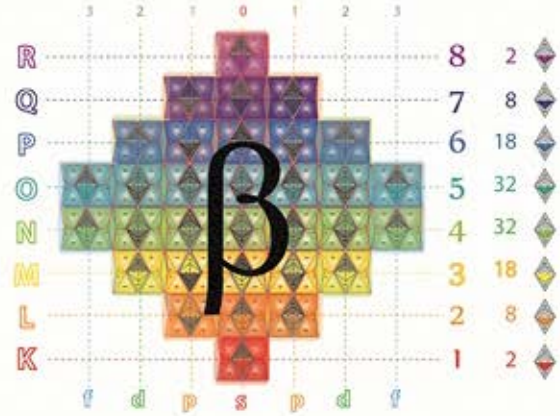

Energy levels

Azmithal & Magnetic numbers

Atomic Shells

Orbitals & sub-Orbitals

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Eigenstate - Ionisation energies

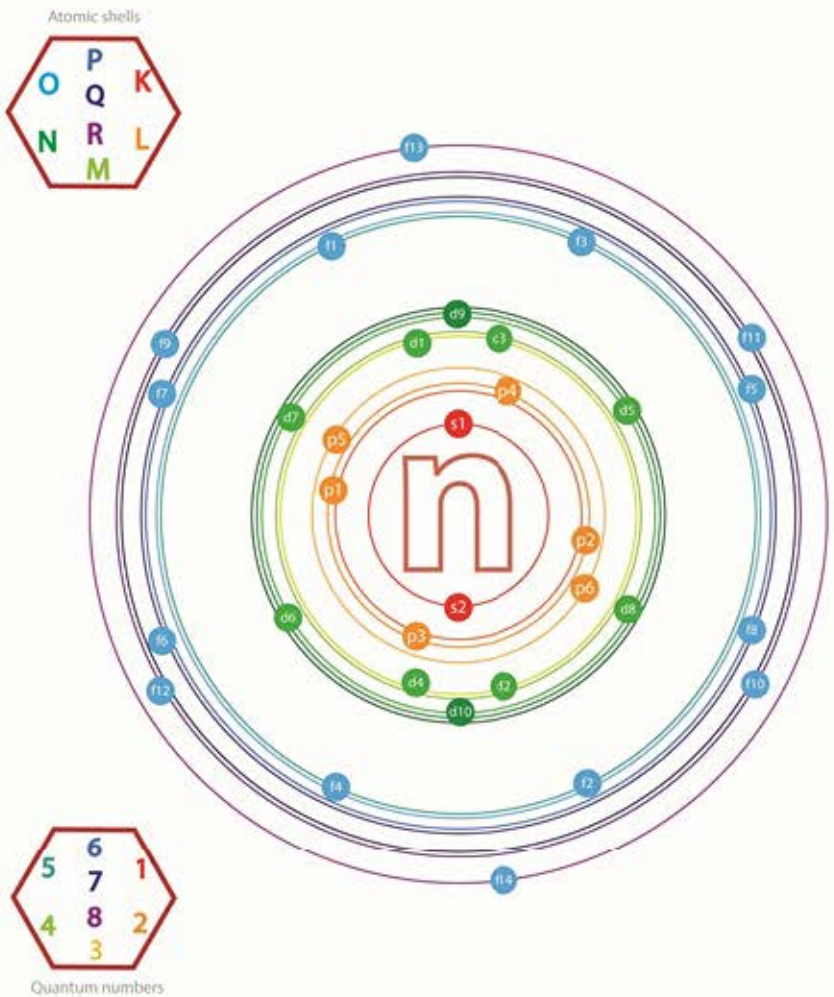

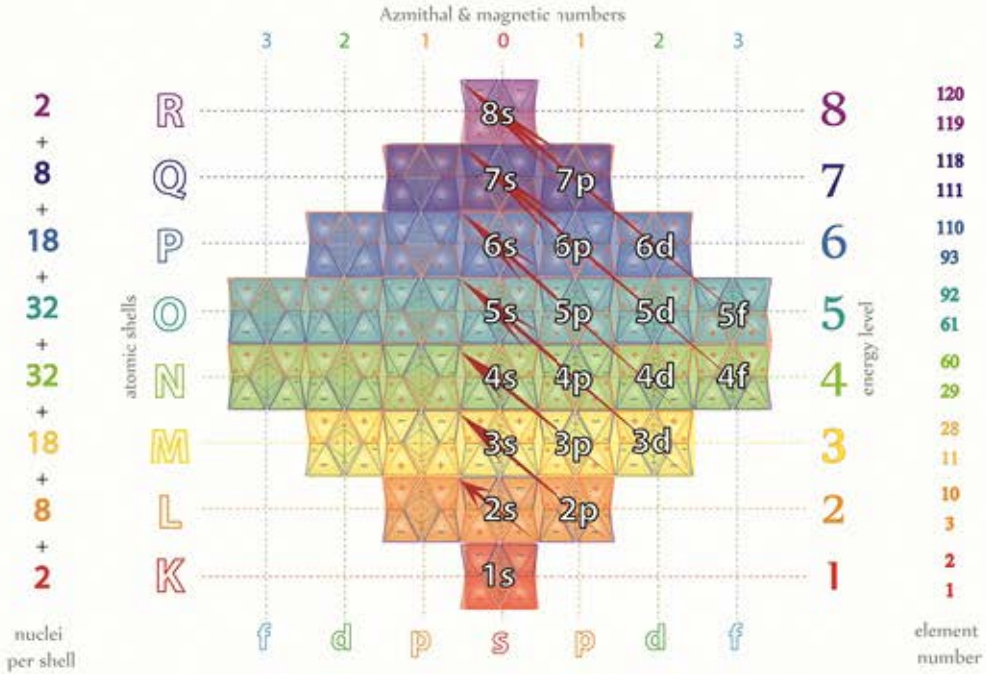

The ionisation energies of individual atoms varies due to many factors, namely:
electron spin-orbital coupling with Baryons of specific energies,
the relativistic energies of photo-electrons bound in nuclei
and Zitterbewegung effects on bound electrons

First ionisation energies for all periodic elements

$$E = -\frac{Z^2}{n^2}\frac{ke^2}{2a_0} = -\frac{13.6Z^2}{n^2}eV$$

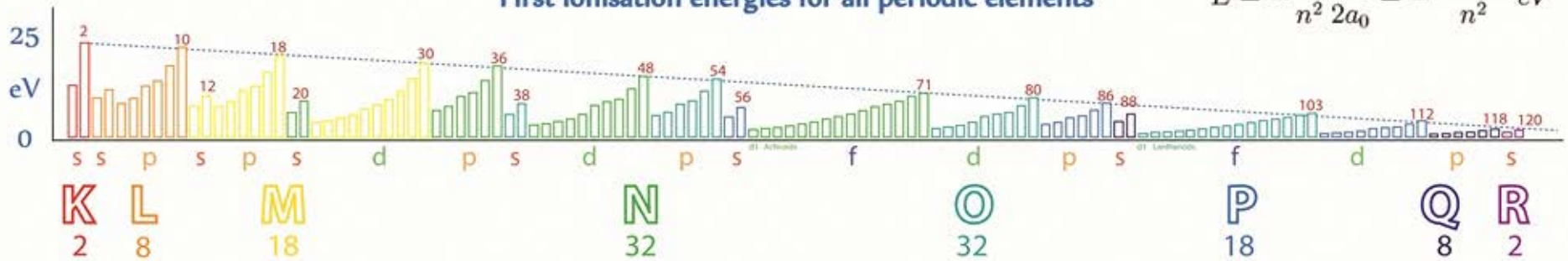

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Proton - Neutron Curve

The graph below is a plot of neutron number against proton number.
It is used as rule to determine which nuclei are stable or unstable.

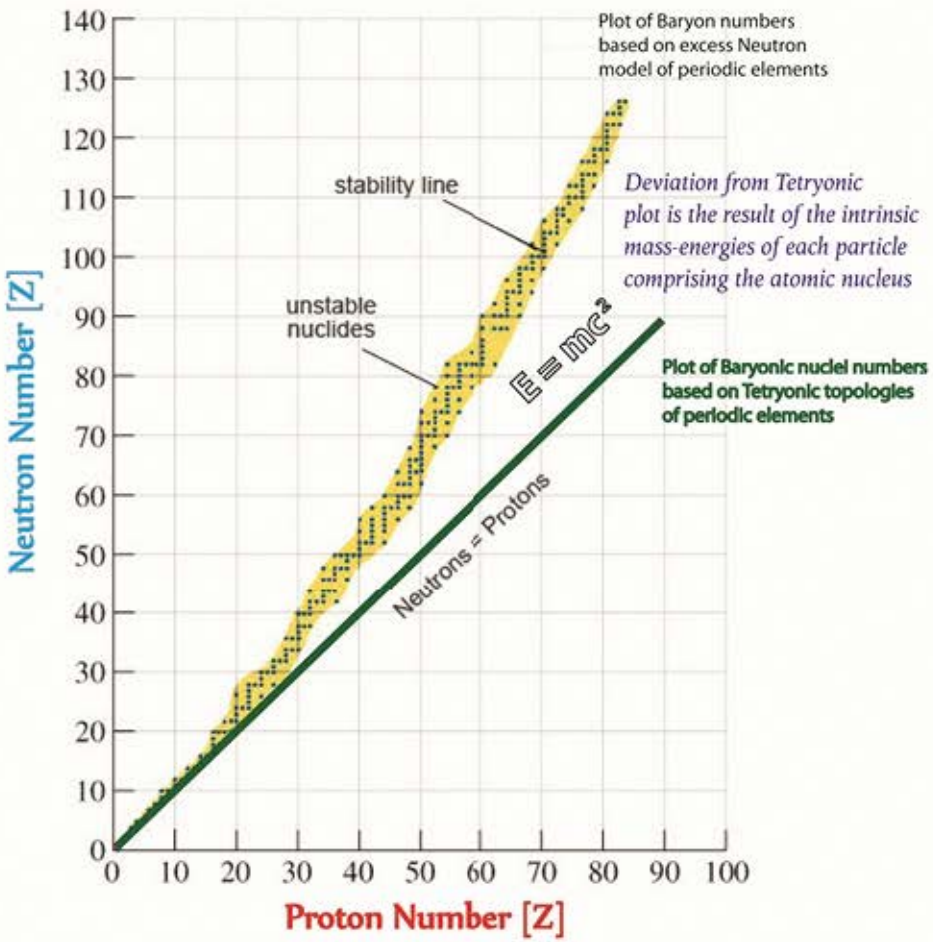

Historically, Proton-electron numbers are viewed as being equivalent in neutral elementary matter with the excess molar mass measured being the result of 'excess or extra' Neutrons in the atom

Atomic Nuclei Numbers

All periodic elements have an EQUAL number of Protons, Neutrons & Electrons with their molar mass-Matter being determined by their quantum level mass-energies

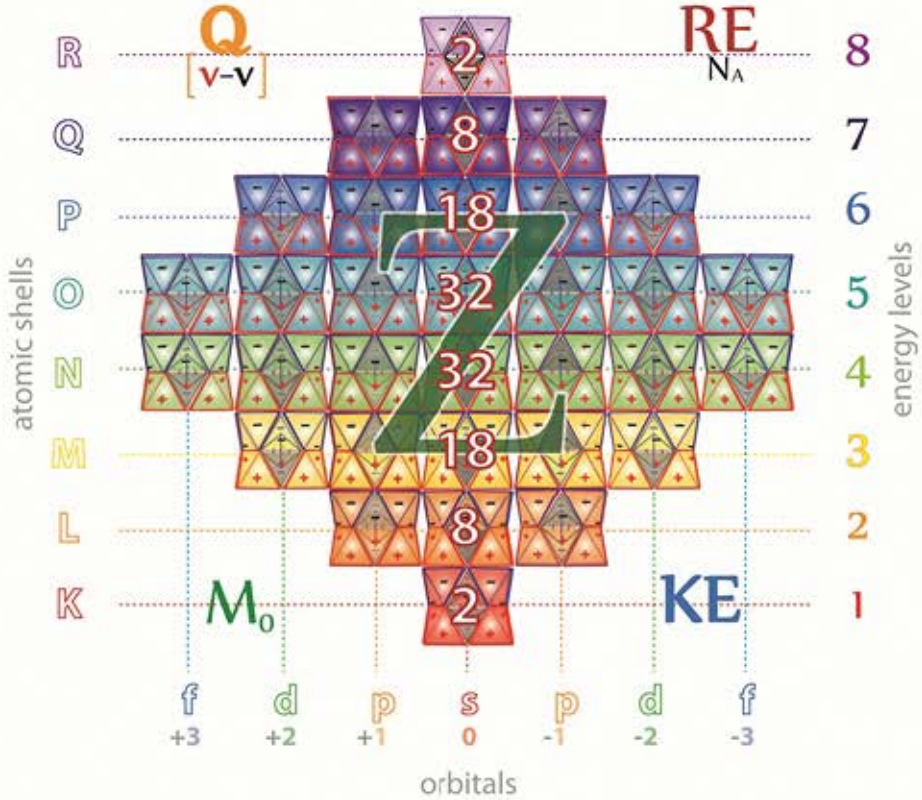

Tetryonic modelling of the charged mass-ENERGY-Matter topologies of elementary atoms and the nuclei that comprise them, reveals a DIRECT LINEAR relationship for the number of Protons-electrons-Neutrons in all periodic elements and nuclear isotopes

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Planck mass-energy contributions to elementary Matter and isotopes

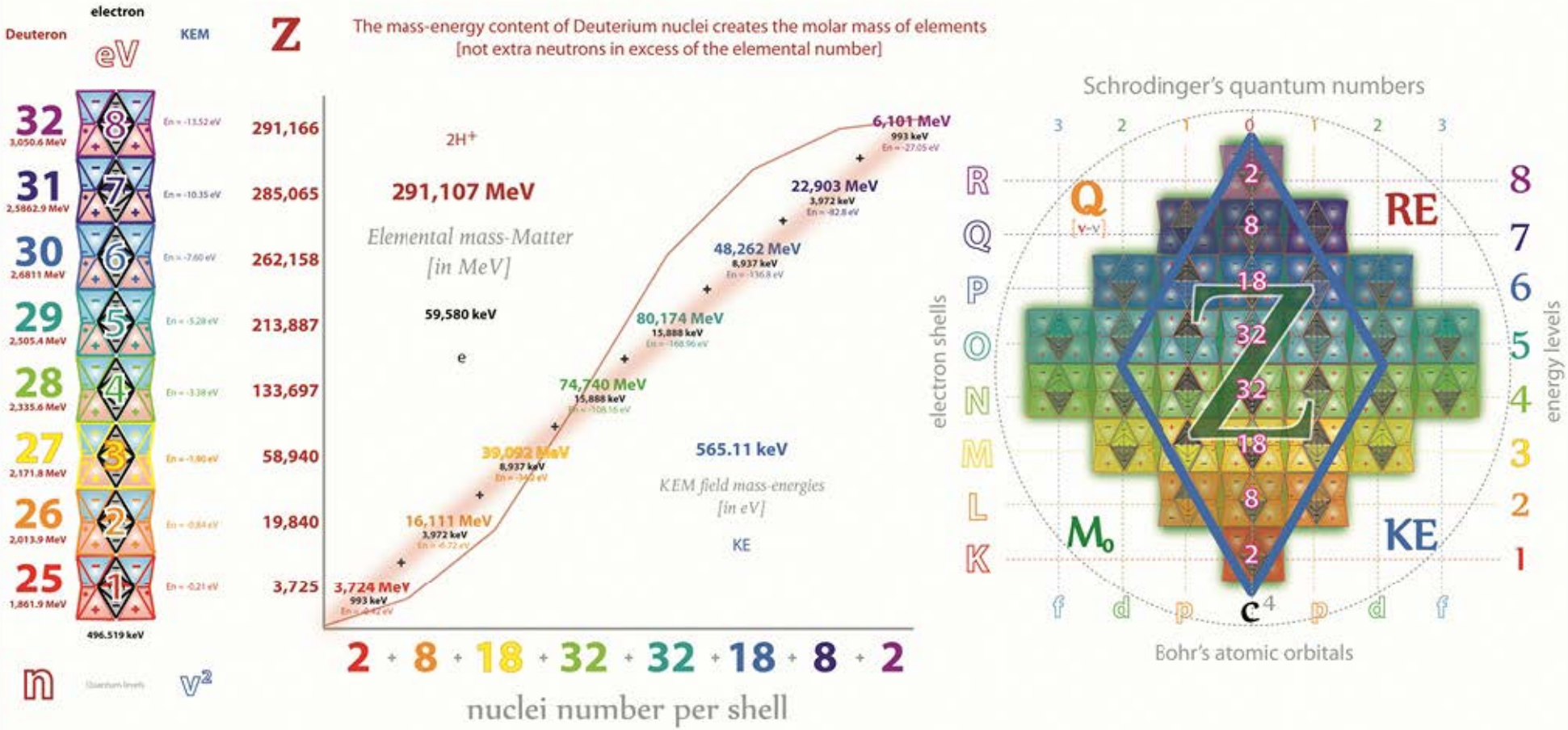

n1 Elementary nuclei

are comprised of equal numbers of Protons, Neutrons & electrons with varying energy levels

Baryons		electrons		KEM fields
930.947 MeV	+	**496.519 keV**	+	**13.525 ev**

The mass-energy content of Matter topologies is velocity invariant

The mass-energy content of Baryons determines the KEM field of electrons

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Baryons **930.947 MeV** + KEM fields **13.525 ev** + electrons **496.519 keV**

Mapping Planck mass-energy contributions to elementary Matter and isotopes

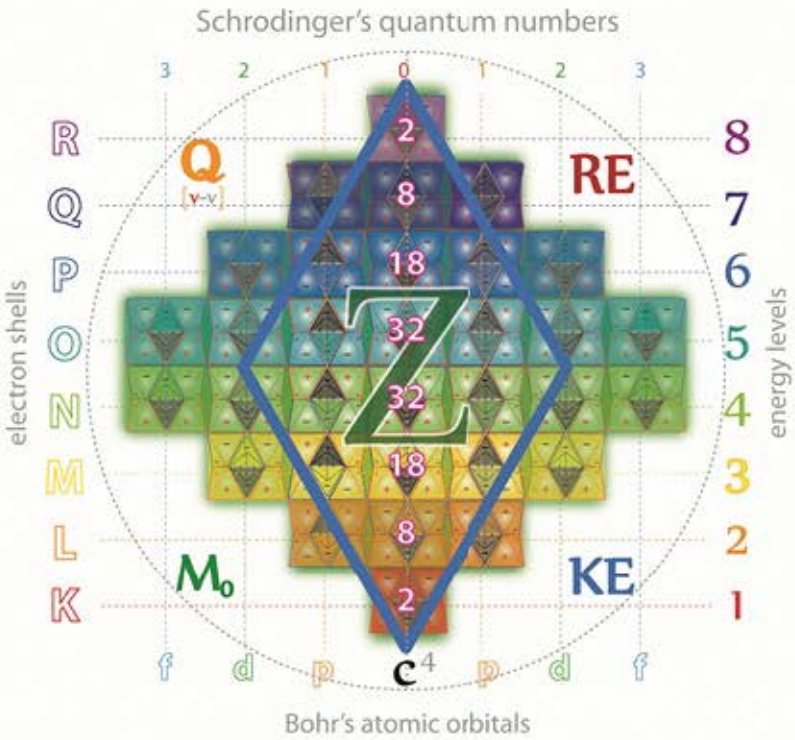

$$E = h\nu^2$$

$$n^2 + \nu^2 + e = Z$$

general form quatratic equation

$$ax^2 + bx + c = Z$$

$$E = nh\nu$$

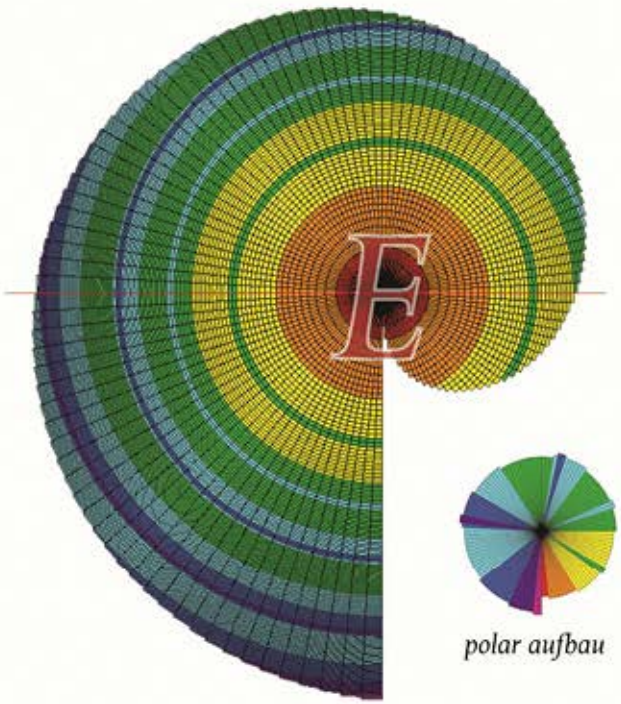

polar energy spirals courtesy of Rene Cormier

Identifying electron rest Matter topologies as velocity invariant we can re-arrange the component Planck mass-energy geometry formulation of periodic elements to

$$h\left[72[v^2]_{\text{Deuteron rest mass}} + v_{\text{Spectral lines}} + 1.20\,e20\,v_{\text{electron rest mass}}\right]$$

reveal a quadratic formulation for all Z numbers

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All elements are comprised of n level Duetrium nuclei

Baryons **KEM fields** **electrons**

$$Z\,[[72n^2] + [12v^2] + [1.2e20]]$$

1,861,949 MeV **13.525 eV** **496,519 keV**

$2H^+$ $[72n^2]$ — Z — γ $[M_e v^2]$

Elemental mass-Matter [in MeV]

The atomic shell energy levels of Deuterium nuclei in elements

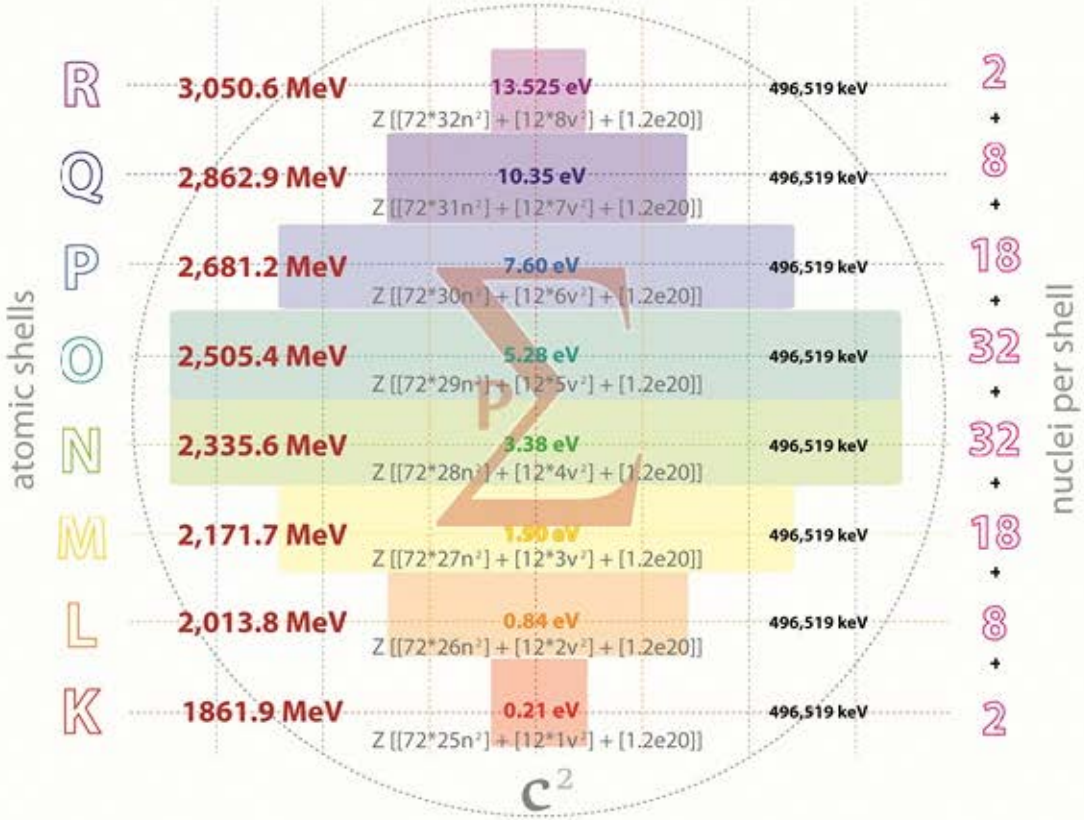

Elemental mass-Matter [in MeV]

6,101 MeV
993 keV
En = -27.05 eV
+
22,903 MeV
3,972 keV
En = -82.8 eV
+
48,262 MeV
8,937 keV
En = -316.8 eV
+
80,174 MeV
15,888 keV
En = -168.96 eV
+
74,740 MeV
15,888 keV
En = -108.16 eV
+
39,092 MeV
8,937 keV
En = -34.2 eV
+
16,111 MeV
3,972 keV
En = -6.72 eV
+
3,724 MeV
993 keV
En = -0.42 eV

[1.2e20]]

e

the rest mass-Matter of bound photo-electrons is velocity invariant

Determines the spectral line [KEM field energies] of electrons bound to them

The relativistic rest mass-energy-Matter of all periodic elements

is the sum of the mass-energies of all atomic nuclei and spectral lines that comprise its mass-Matter topology as measured in any spatial co-ordinate system per unit of time

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Avagadro's number

6.022141579 e26
atoms in 1KG of Matter

1 KG mass
[of Matter]

1.660538841 e-27 kg
atomic rest mass-Matter

Hydrogen

01

using SI units Avagadro's number can be expressed exactly as the inverse rest mass of Hydrogen

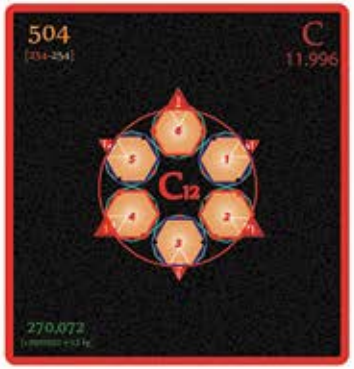

Weighted atomic mass

Carbon

12

5.019789213 e25
atoms in 1KG of Matter

6.02214078 e 23

1.99211552 e-26 kg
atomic rest mass-Matter

Tetryonic charge geometries make weighted atomic mass measurements and calculations obsolete

22,506 1/12 of Carbon 12 [Graphene] is not equal to 1 Hydrogen atom 22,512
(Deuterium is the building block of all atomic elements]

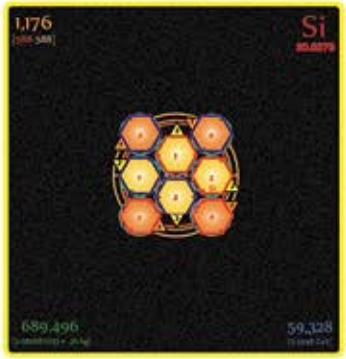

1.966225348 e25
atoms in 1KG of Matter

International Avagadro project

5.085887033 e-26 kg
atomic rest mass-Matter

Silicon

28

The gram was originally defined in 1795 as the mass of one cubic centimeter of water at 4°C, making the kilogram equal to the mass of one liter of water.

The prototype kilogram, manufactured in 1799 and from which the current kilogram is based has a mass equal to the mass of 1.000025 liters of water

In recent years two major experiments, namely the Watt balance & Avagadro projects, have been attempting to measure and define 1KG of mass-Matter in terms of electrical force and the number of atoms respectively in order to better define 1KG of mass-Matter precisely for all future physical references

Platinum

191

2.817950081 e24
atoms in 1KG of Matter
3.181804449 e23

90%
10%

La Grande K

The La grande K is an alloy of 90% Platinum & 10% Iridium that has been slowly losing mass since its manufacture

Pt
Ir

3.1893811012 e-25 kg
atomic rest mass-Matter
3.142870708 e-25 kg

All atomic rest masses are for atoms at absolute zero and any deviation is a measure of the topological Matter's Kinetic energy content [chemical energy, KEM fields and/or spectral lines]

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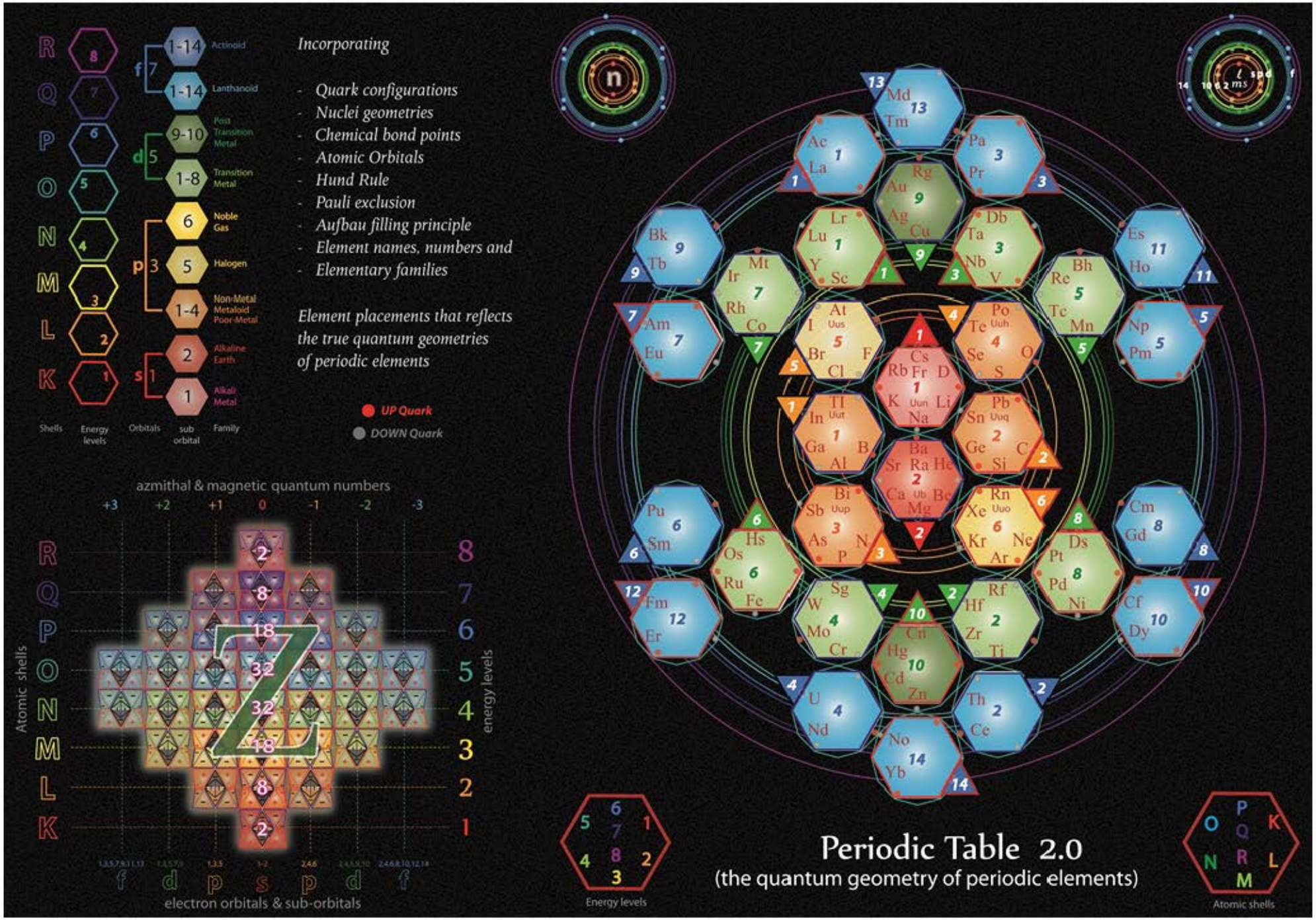

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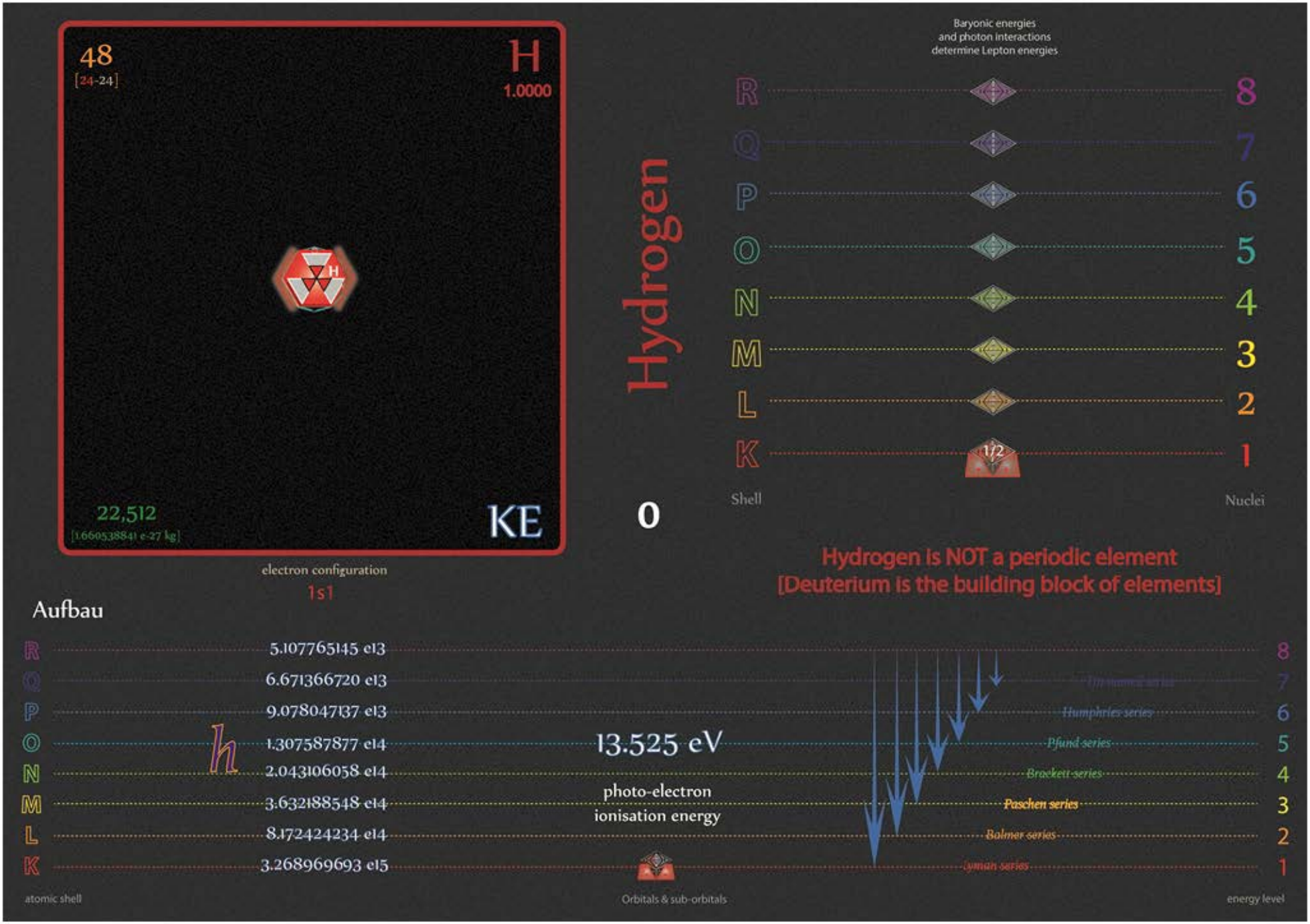

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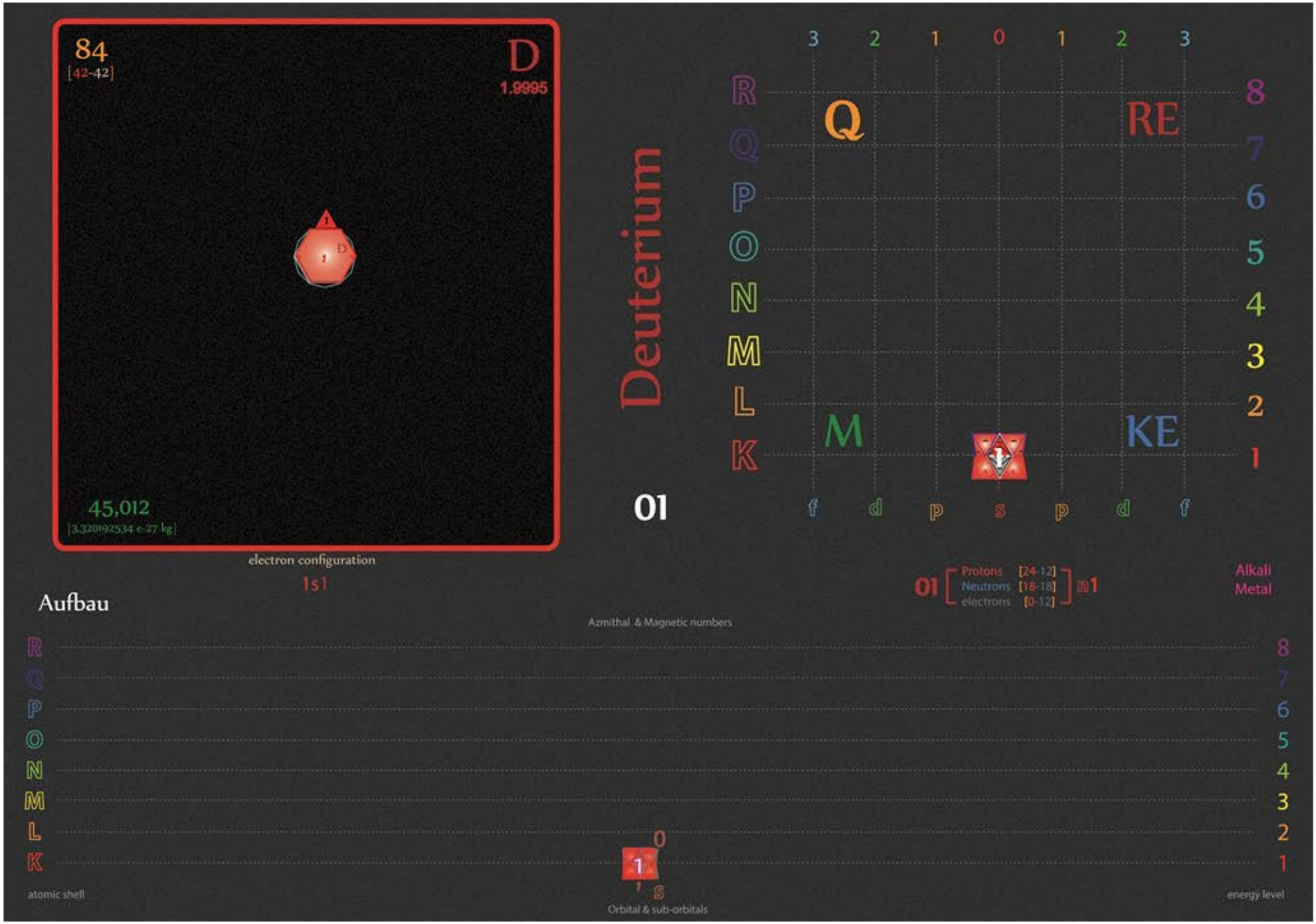

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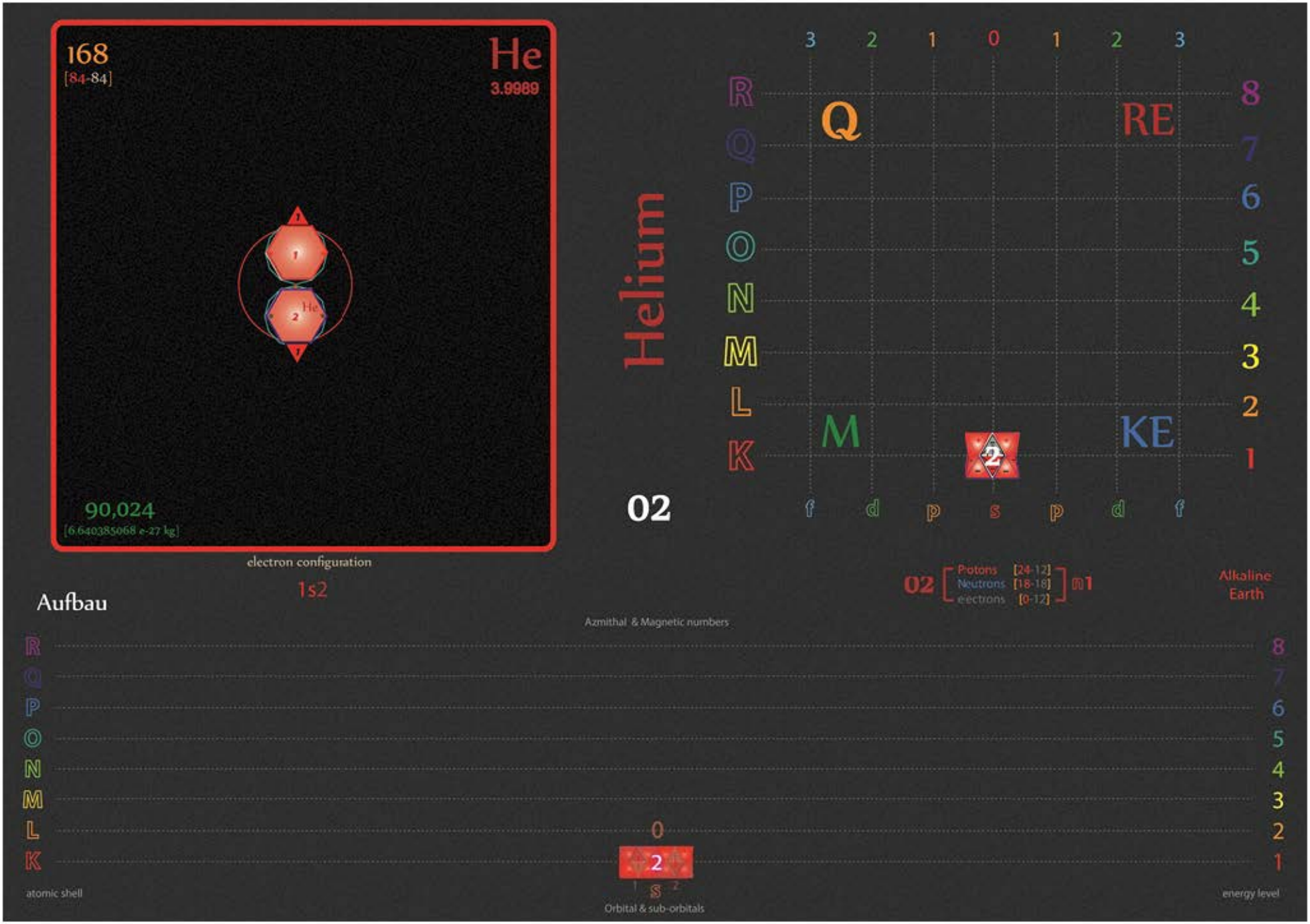

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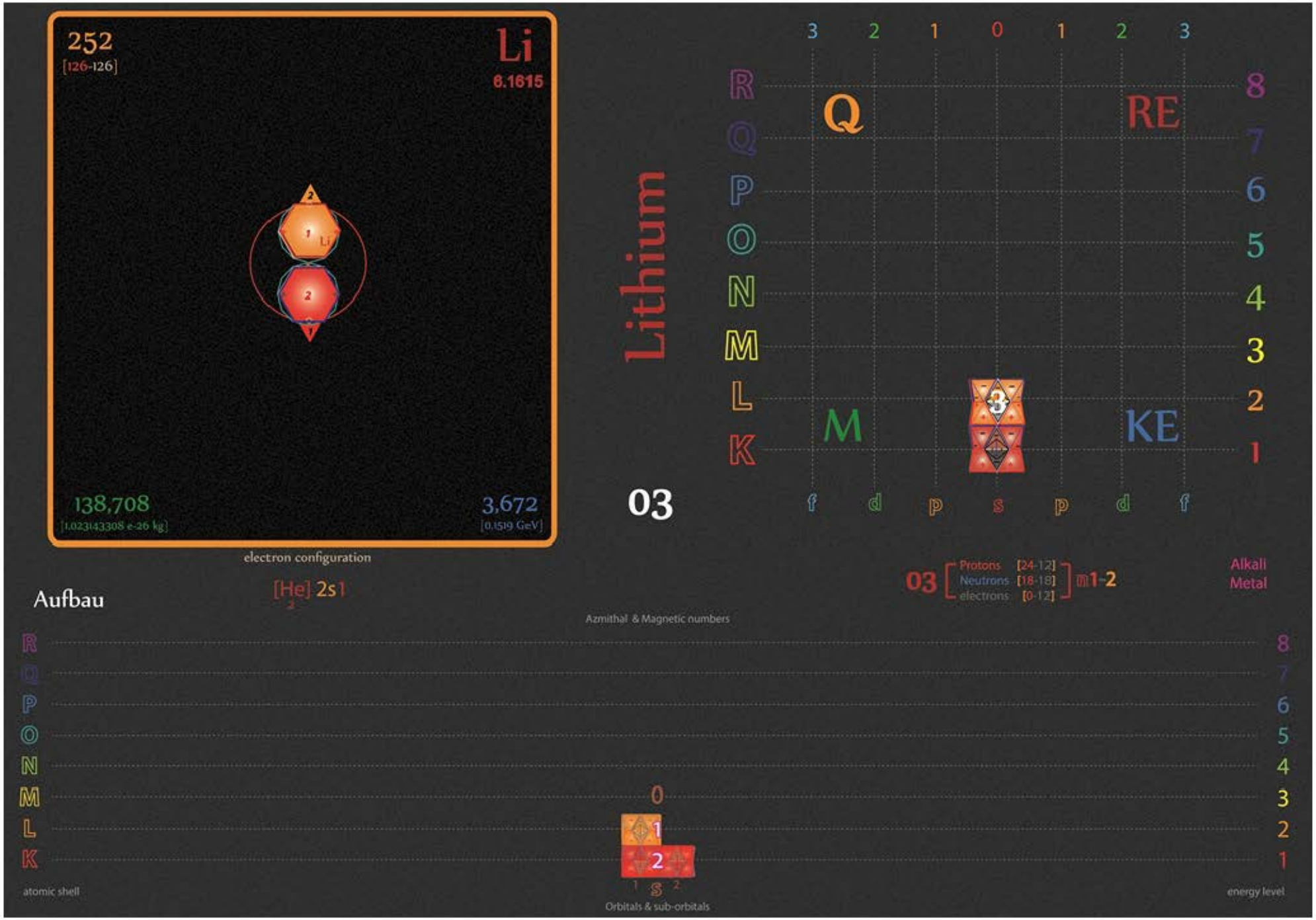

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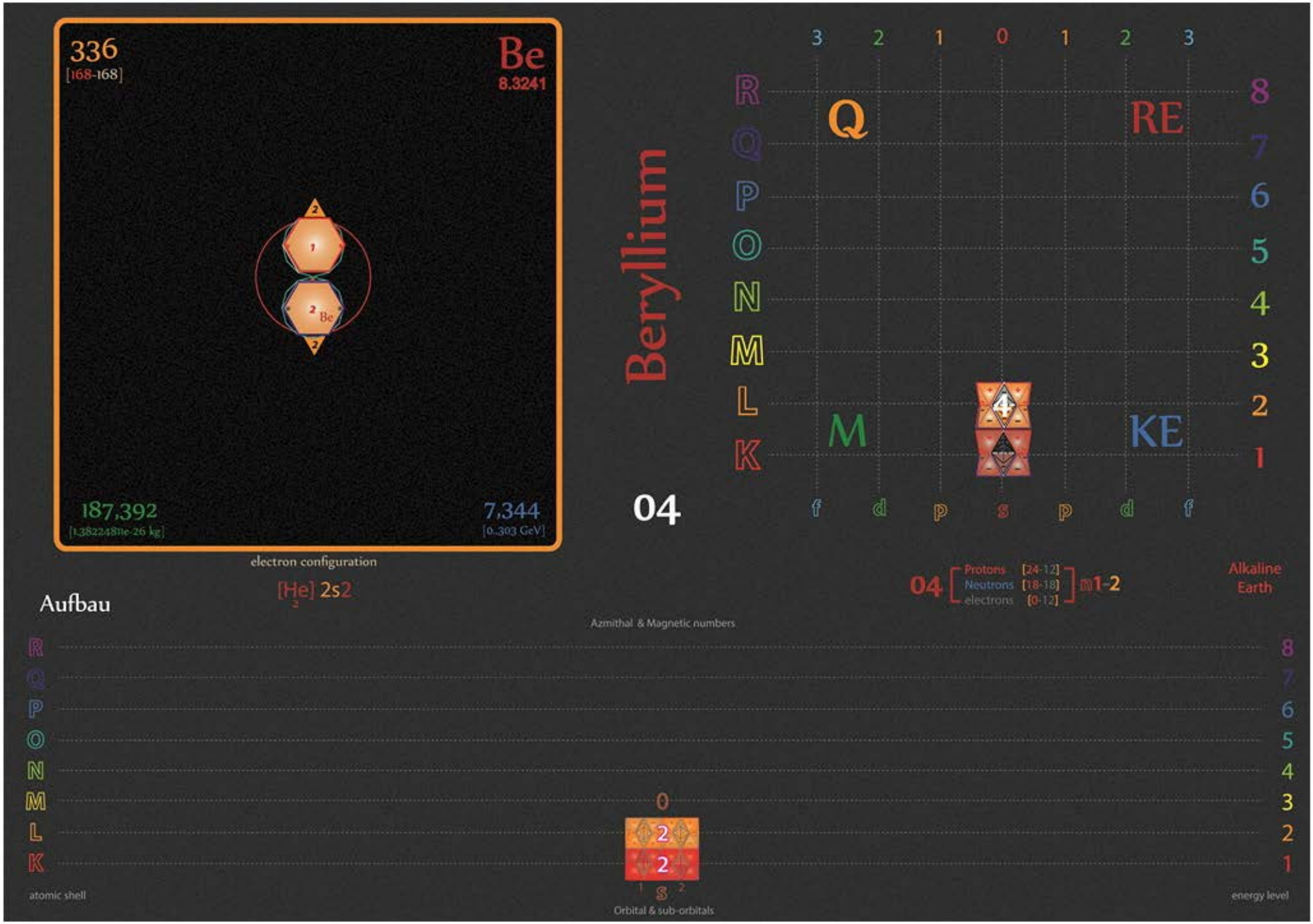

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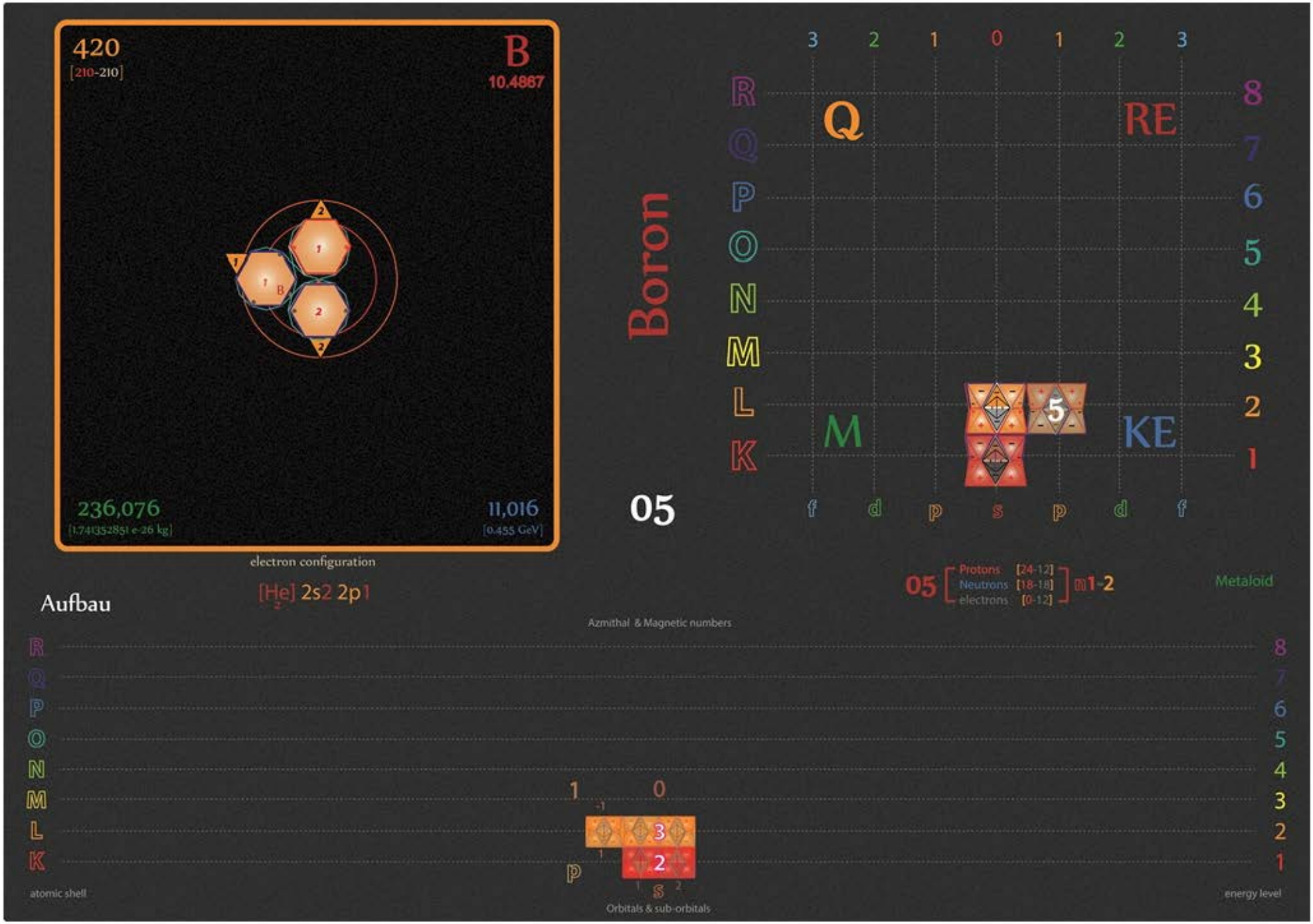

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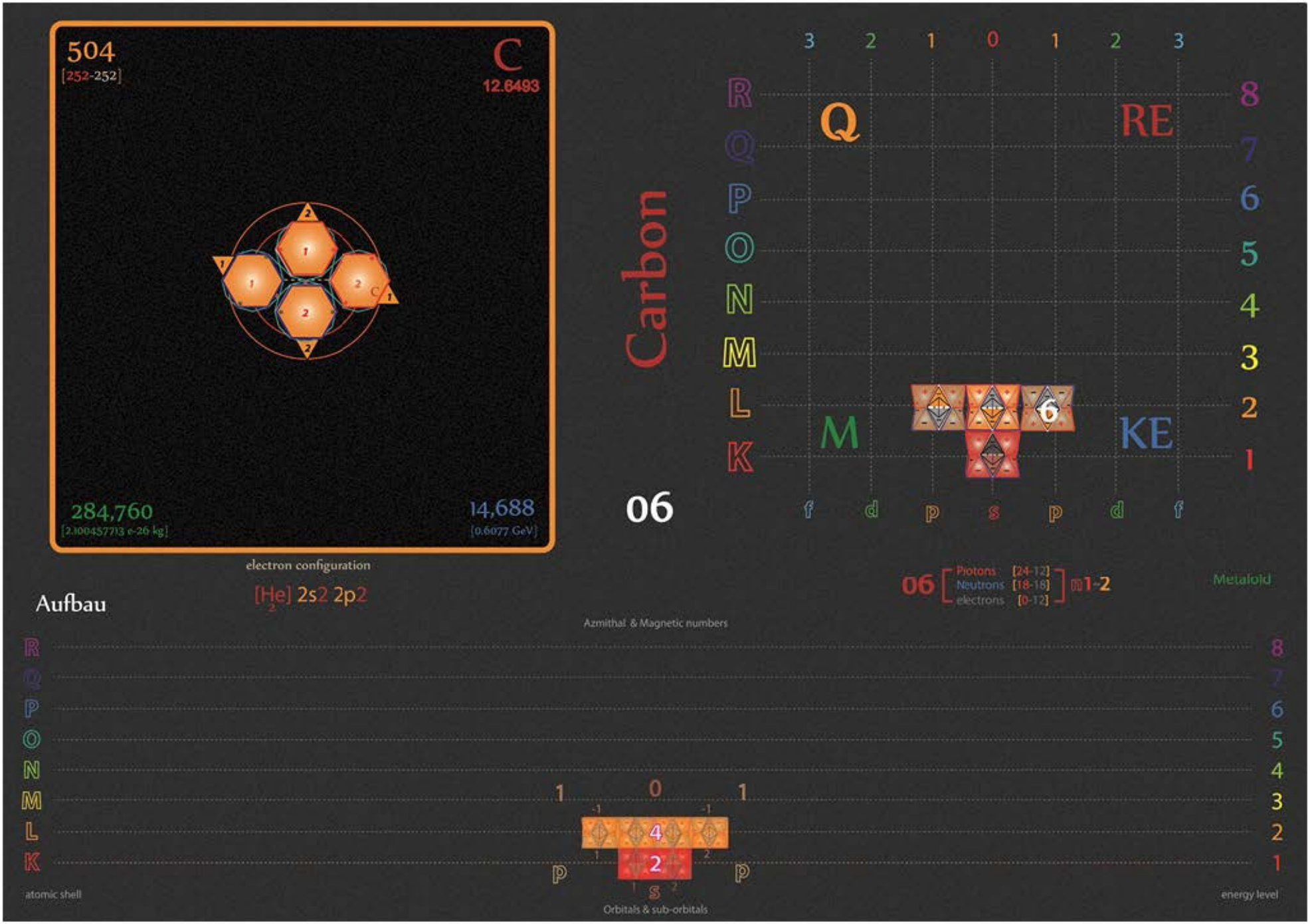

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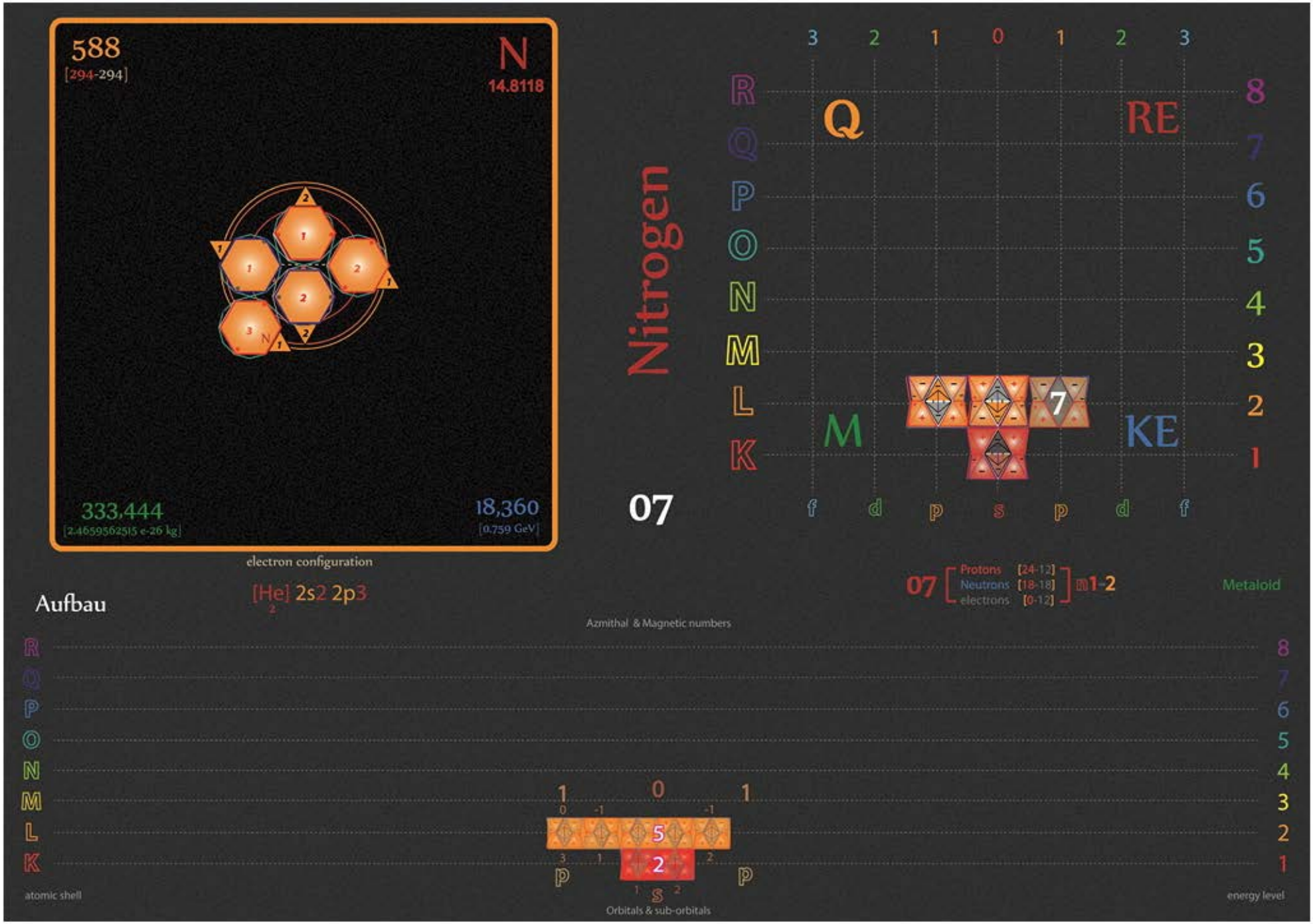

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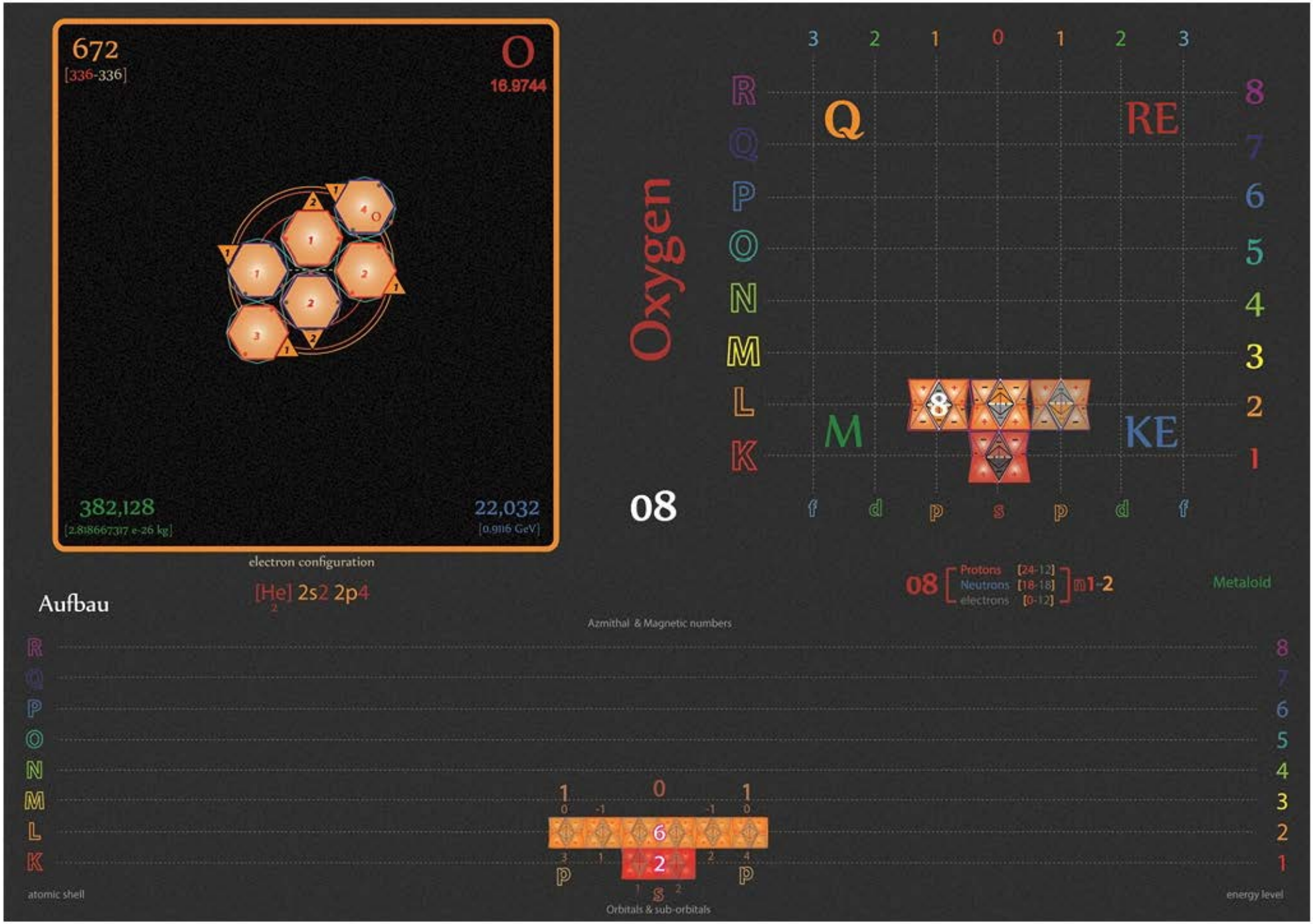

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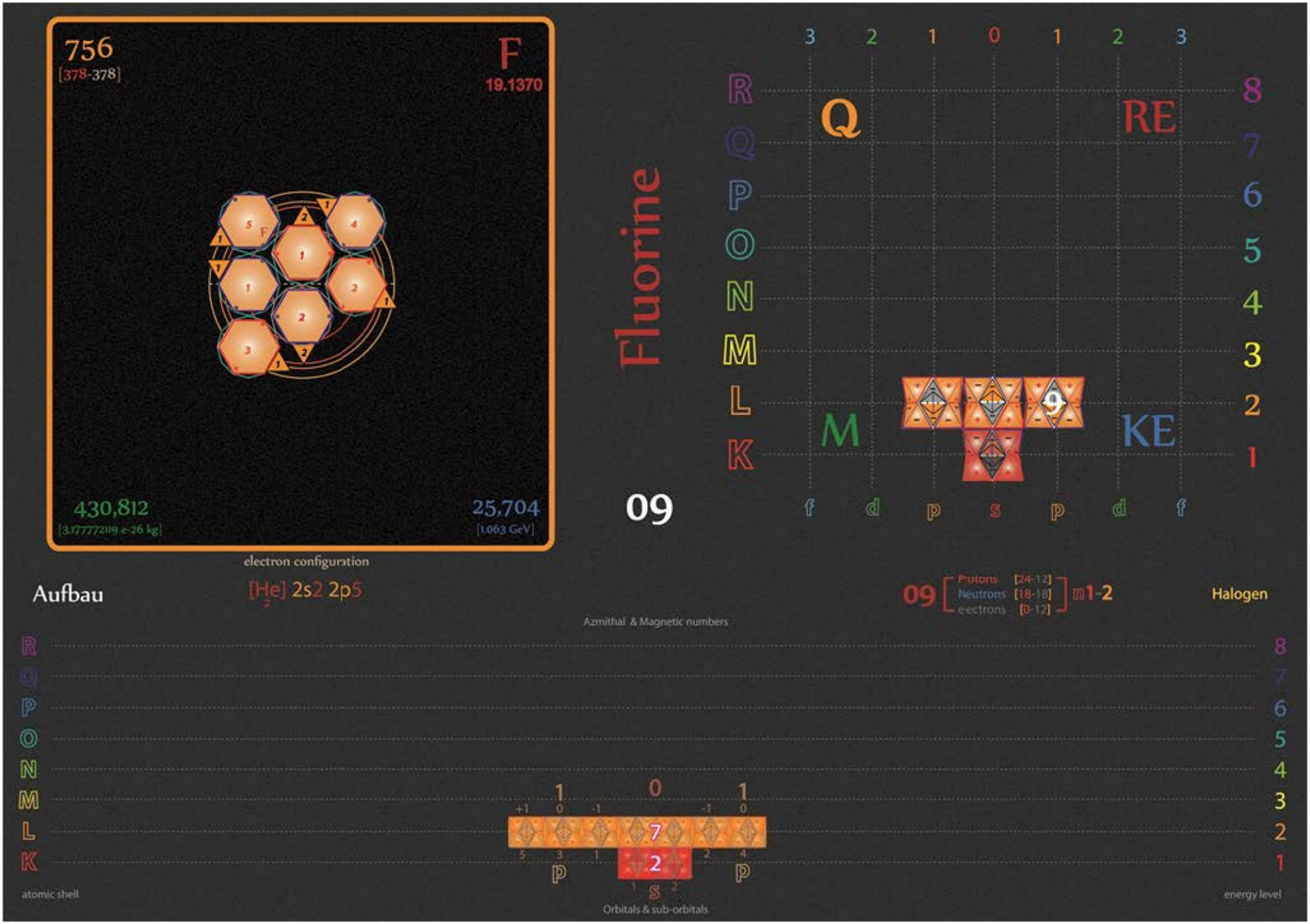

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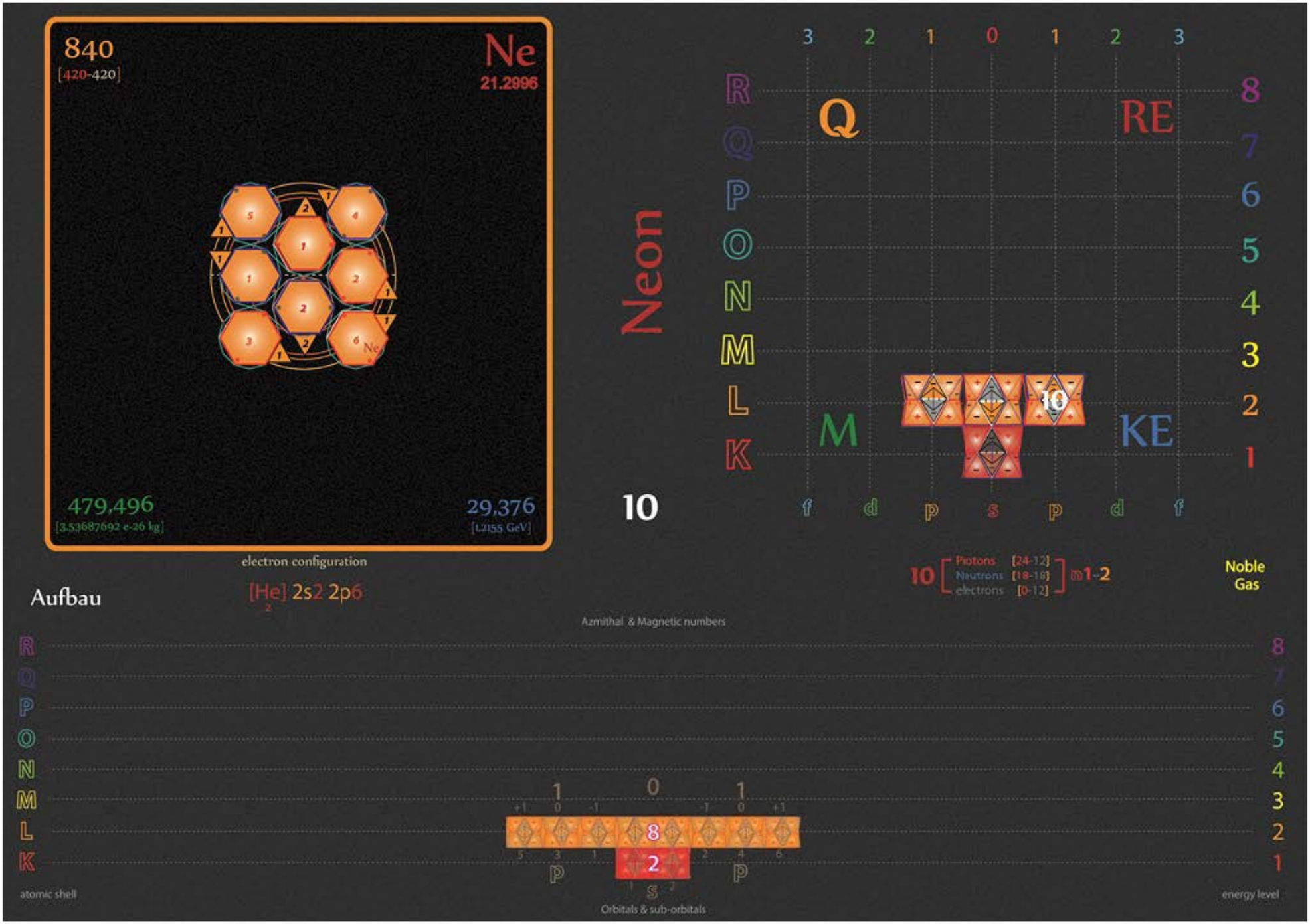

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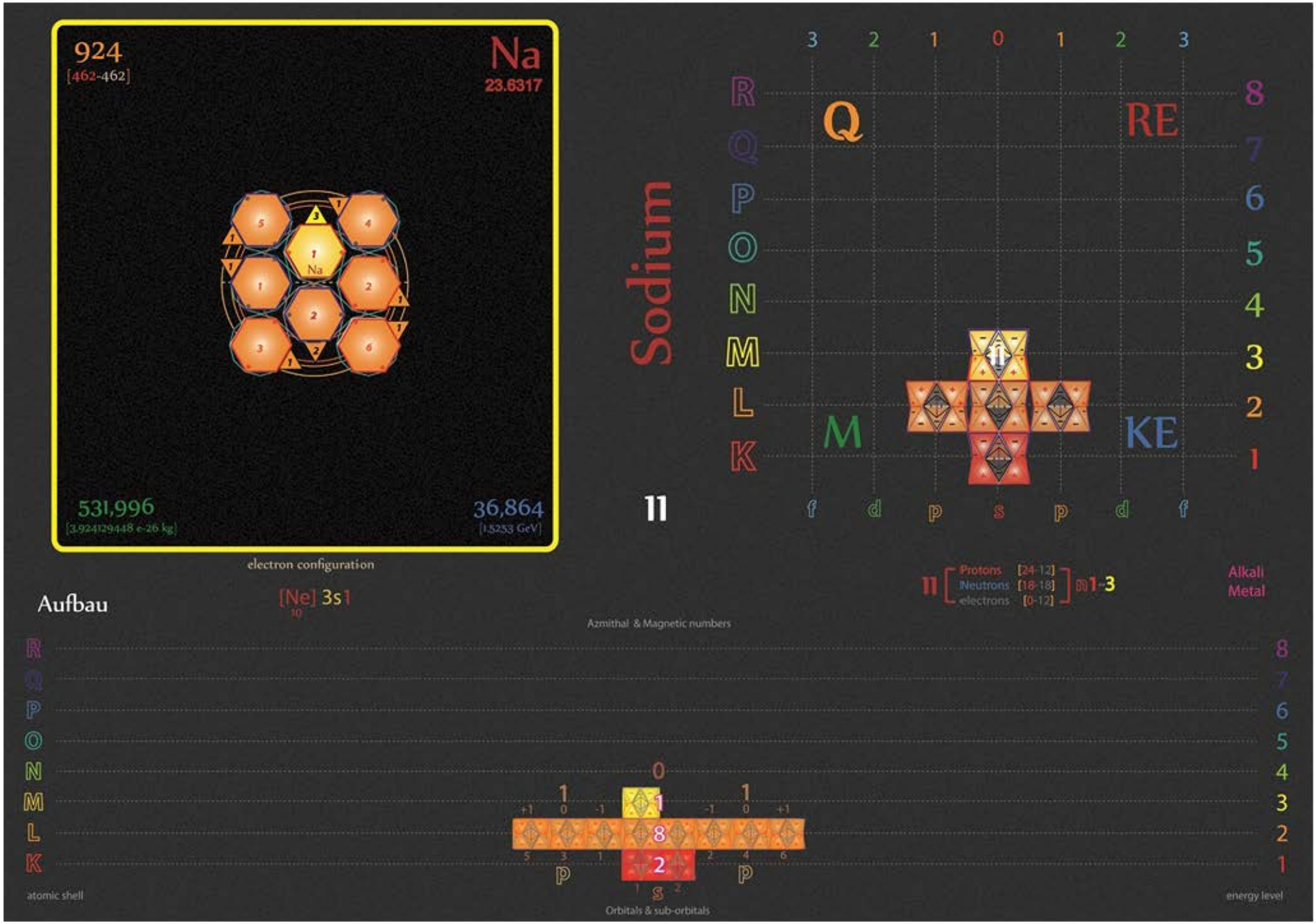

Tetryonics 51.11 - Sodium atom

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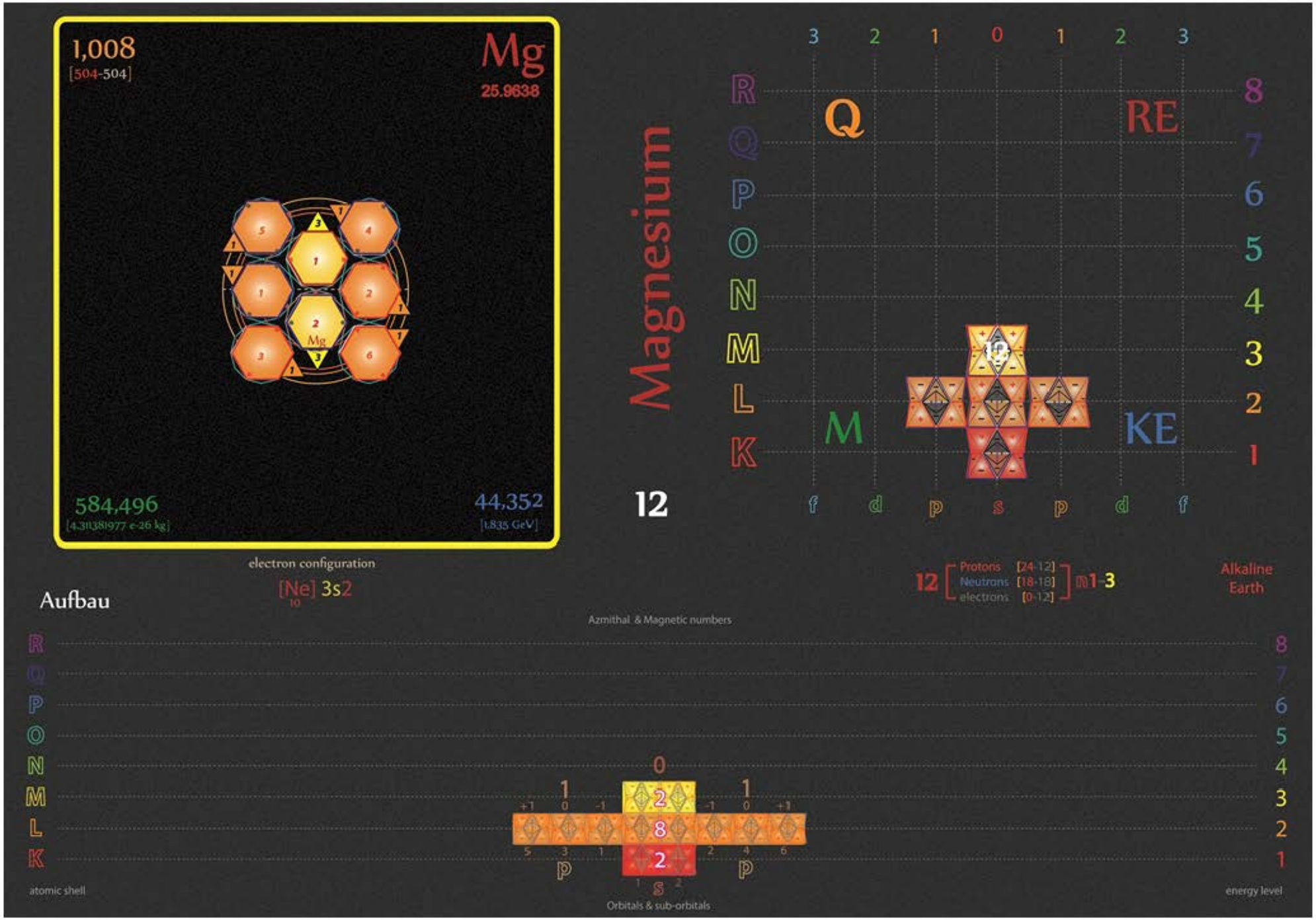

Tetryonics 51.12 - Magnesium atom

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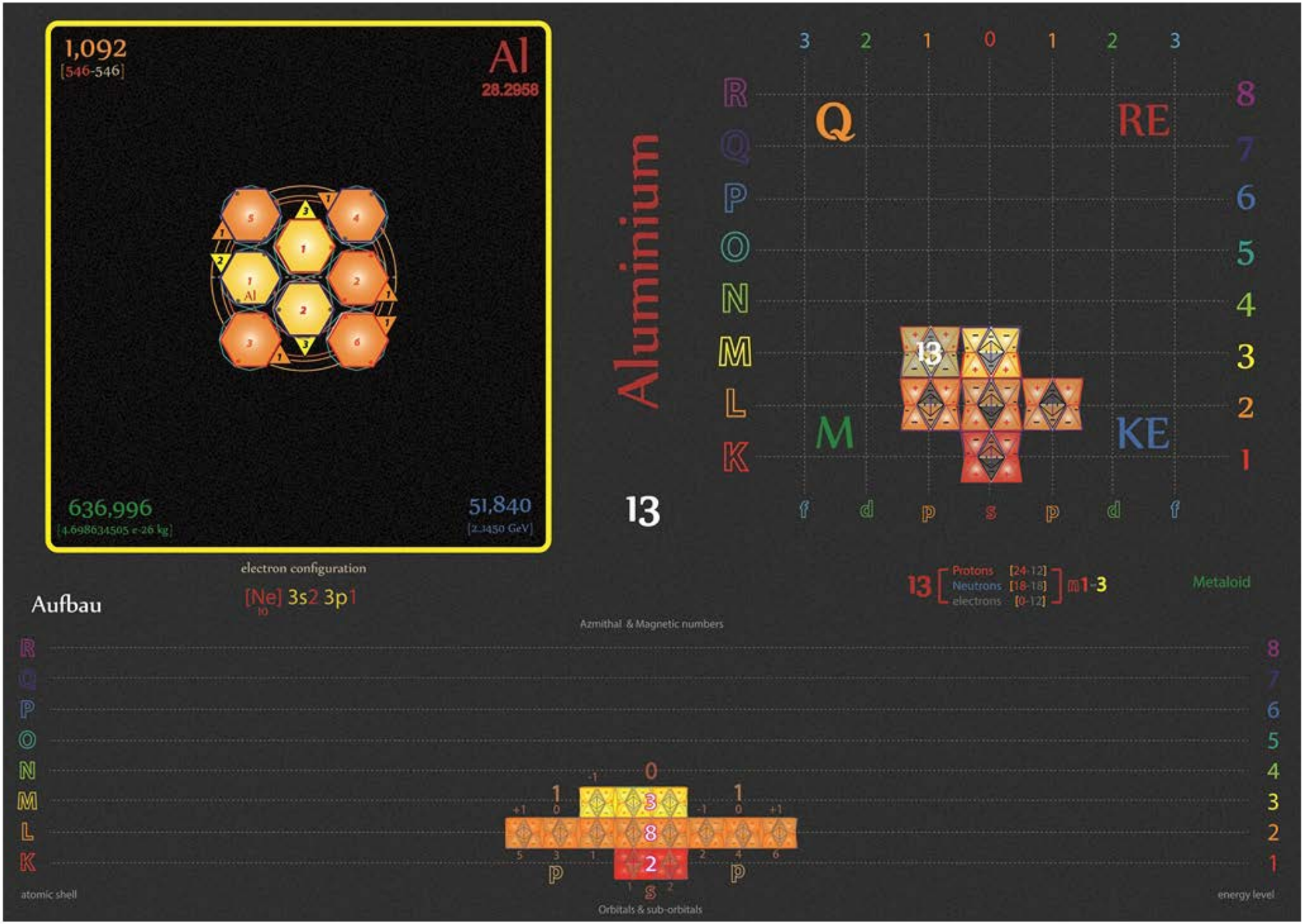

Tetryonics 51.13 - Aluminium atom

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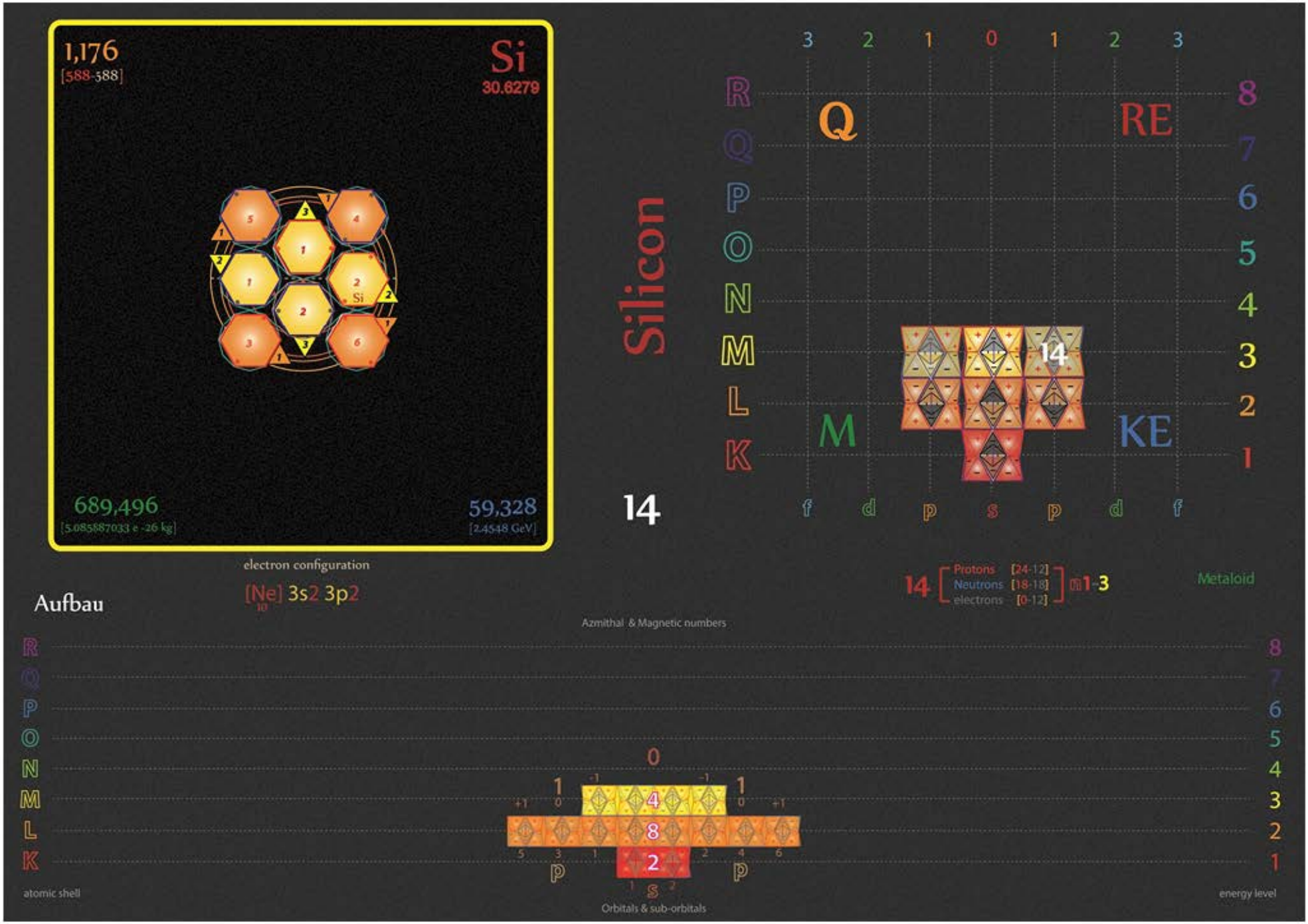

Tetryonics 51.14 - Silicon atom

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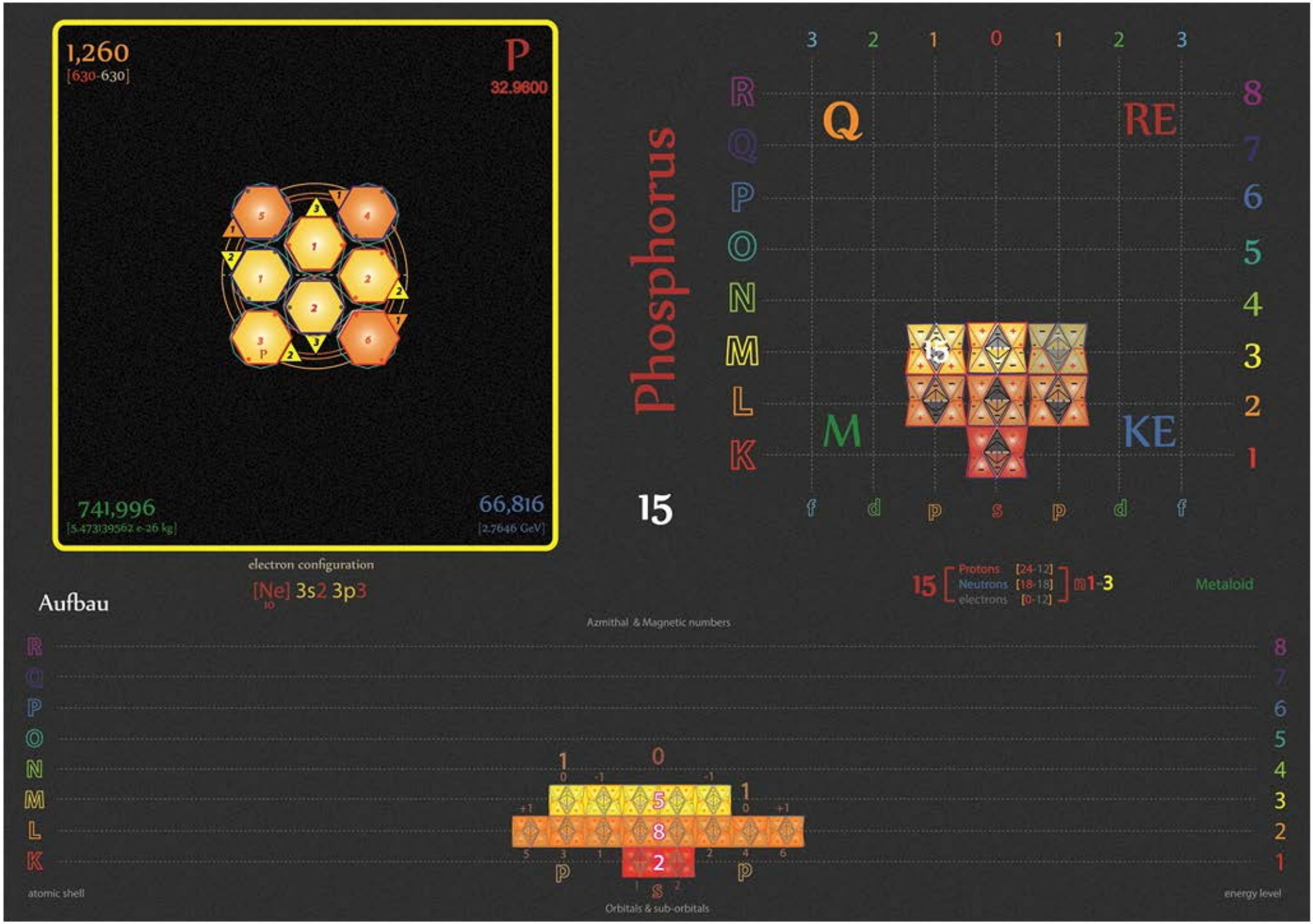

Tetryonics 51.15 - Phosphorus atom

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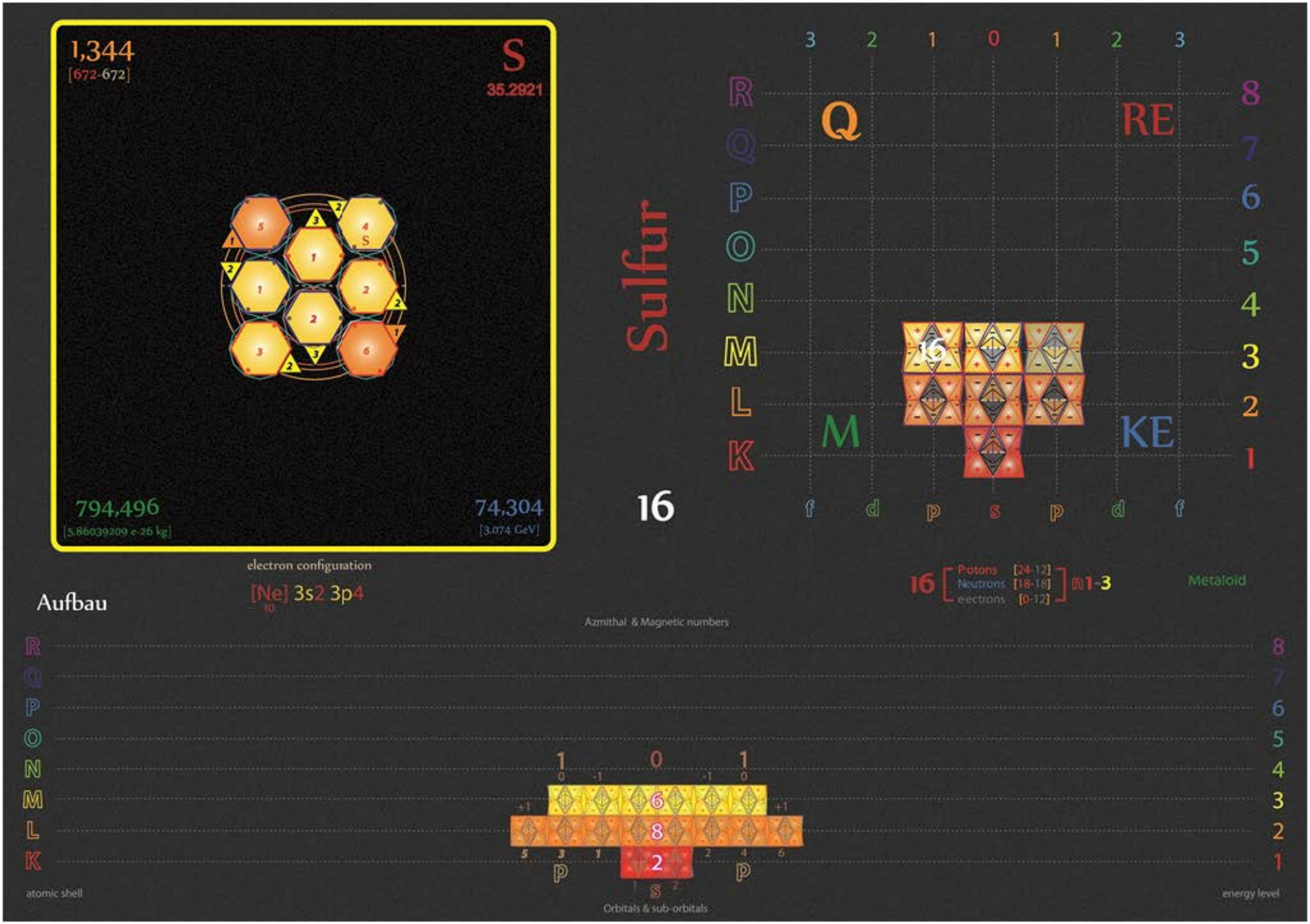

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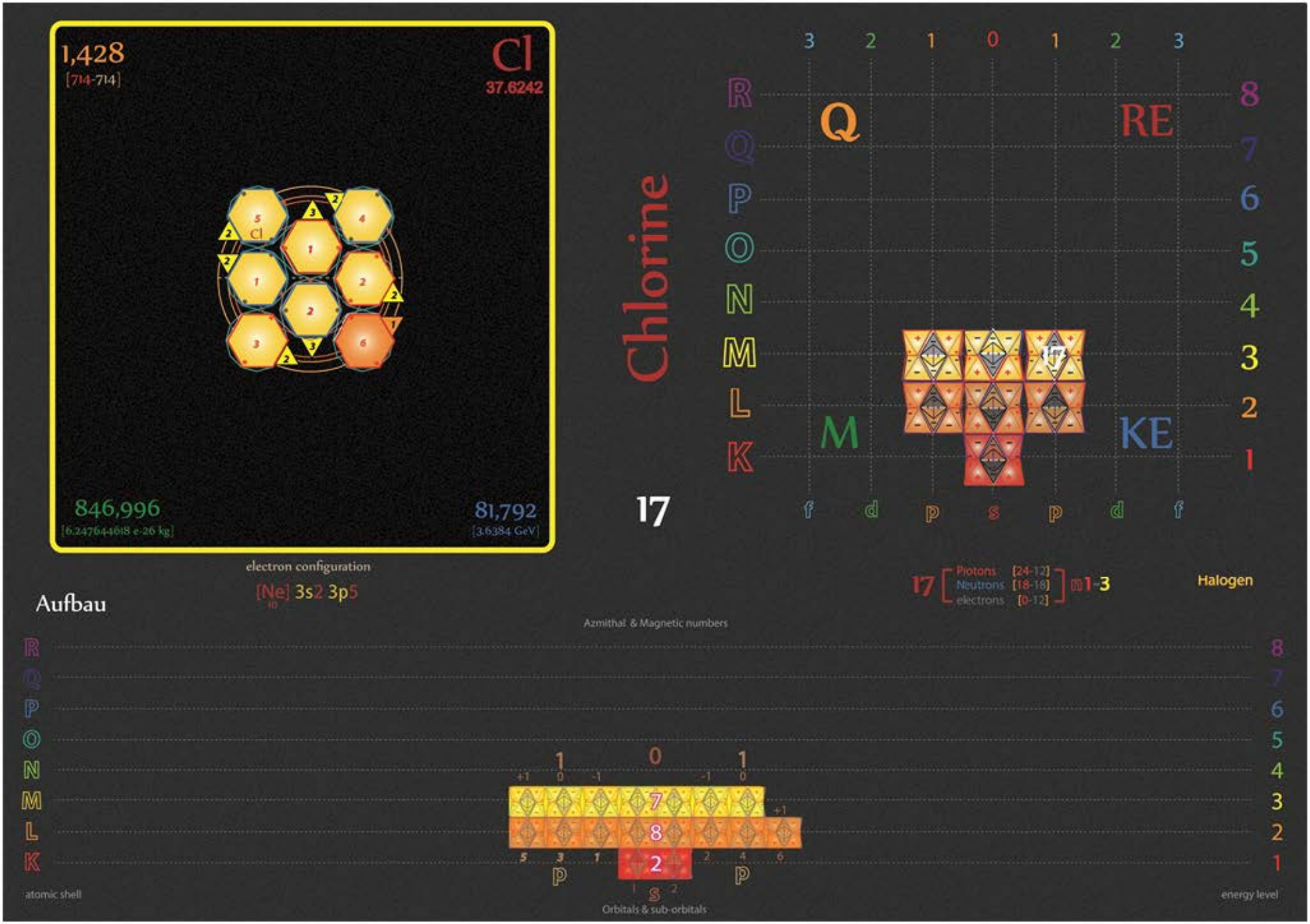

Tetryonics 51.17 - Chlorine atom

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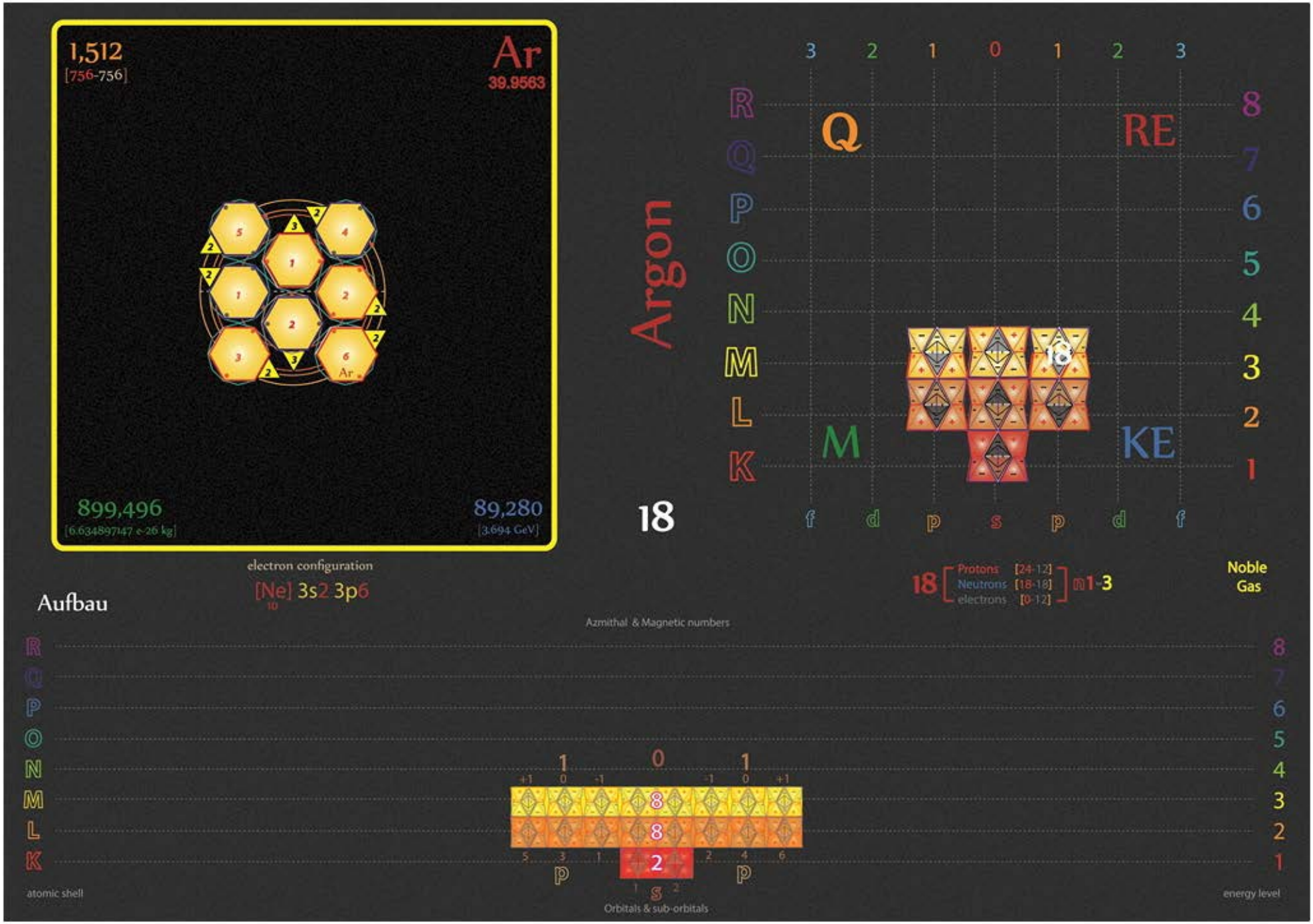

Tetryonics 51.18 - Argon atom

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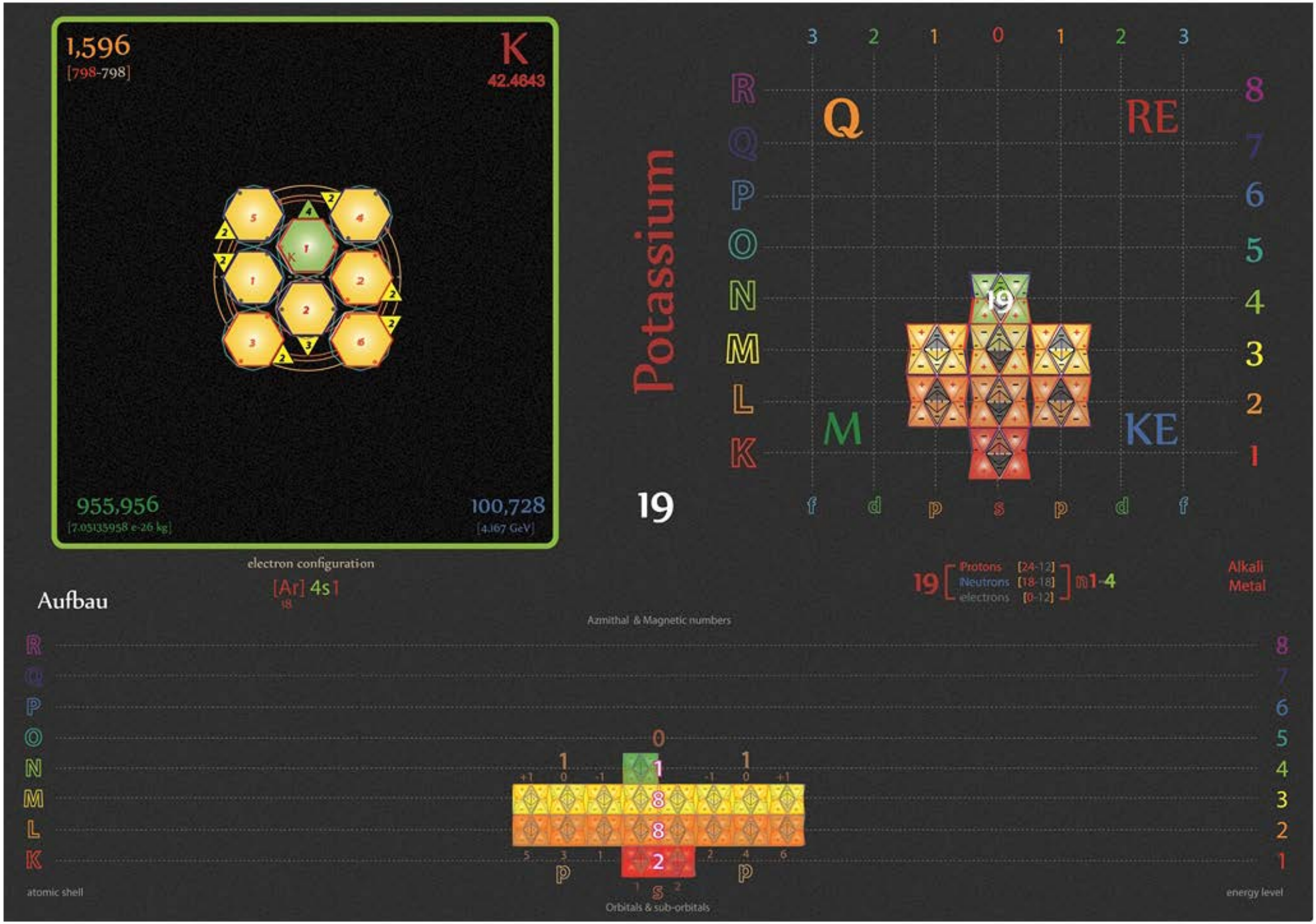

Tetryonics 51.19 - Potassium atom

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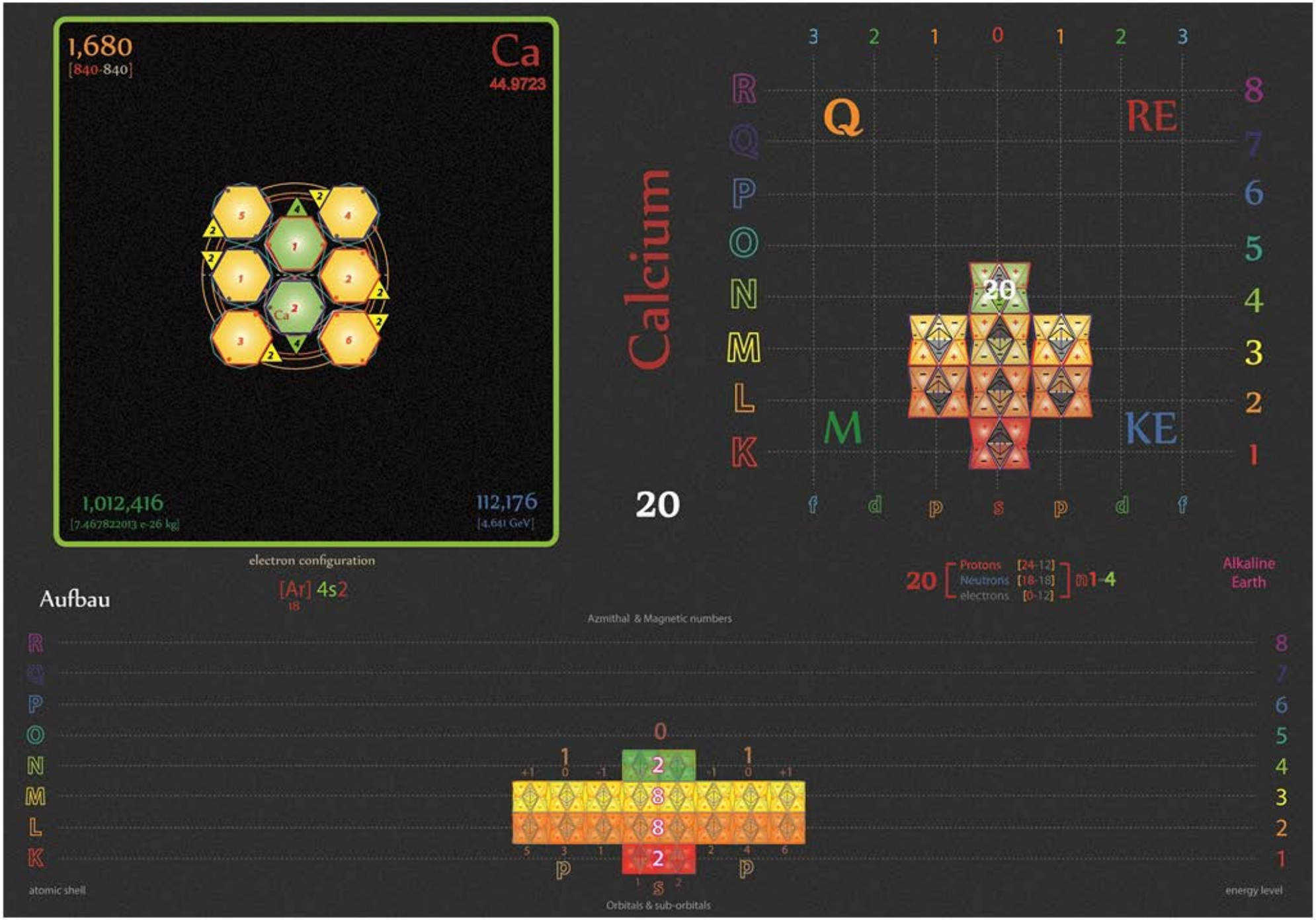

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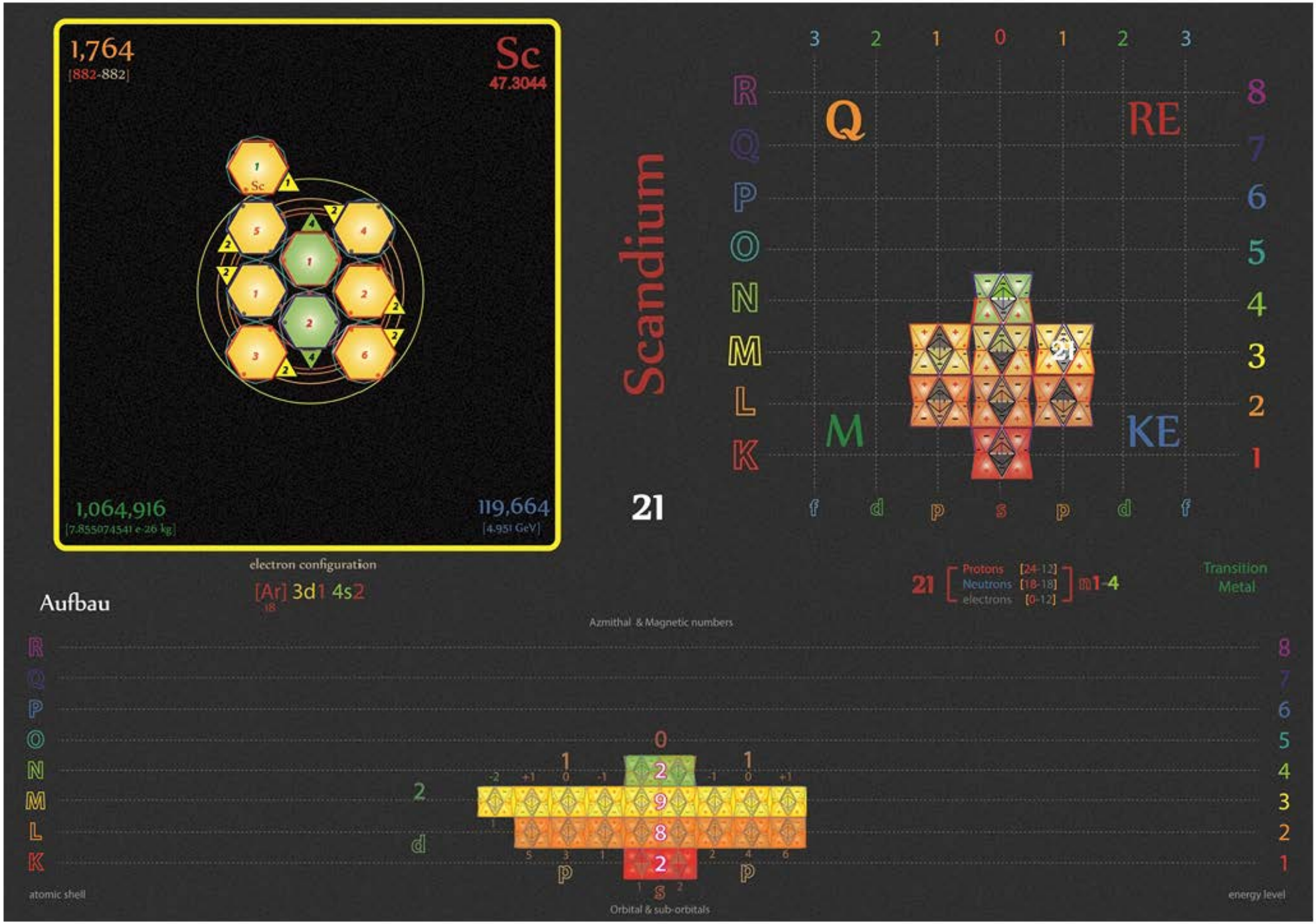

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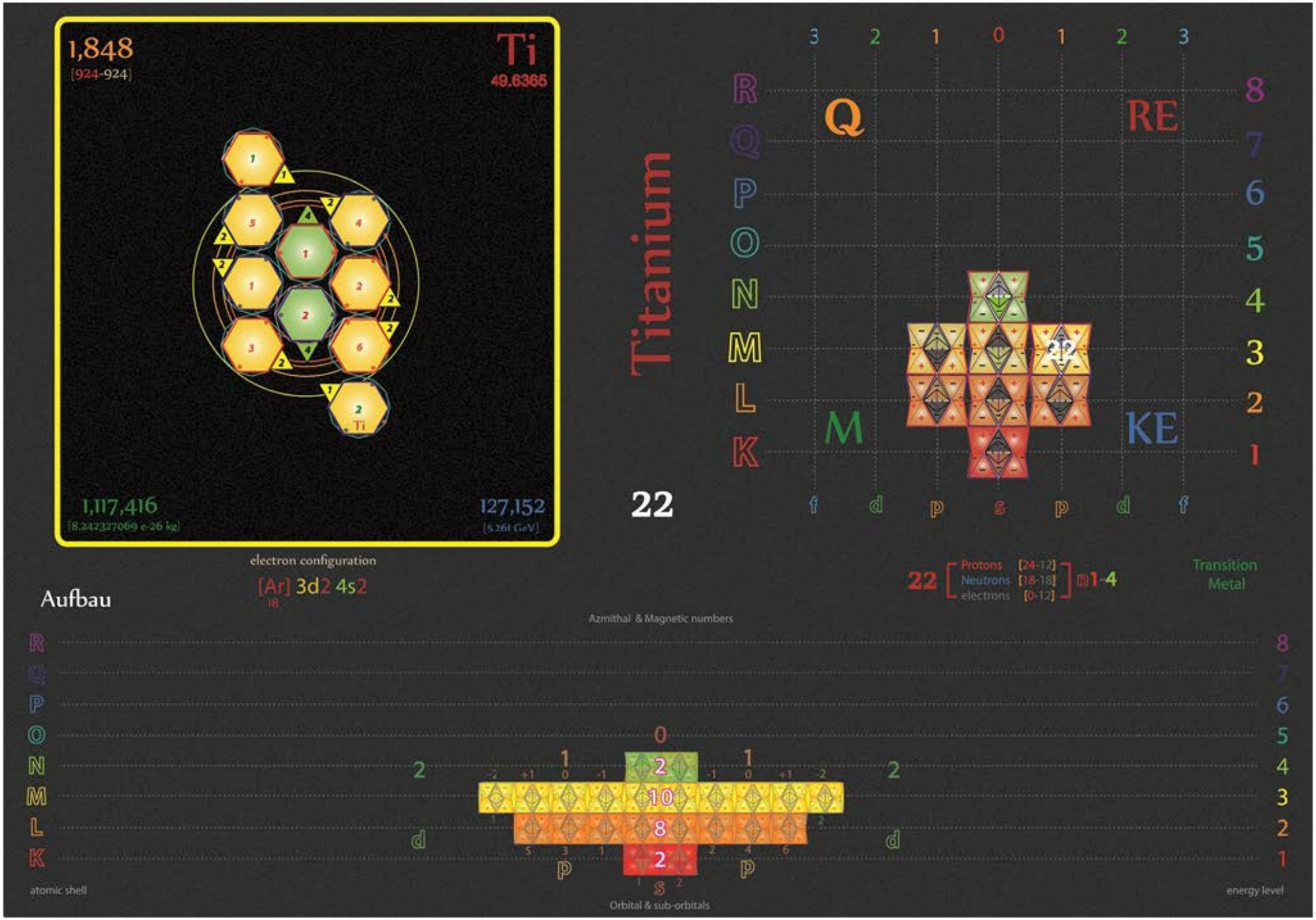

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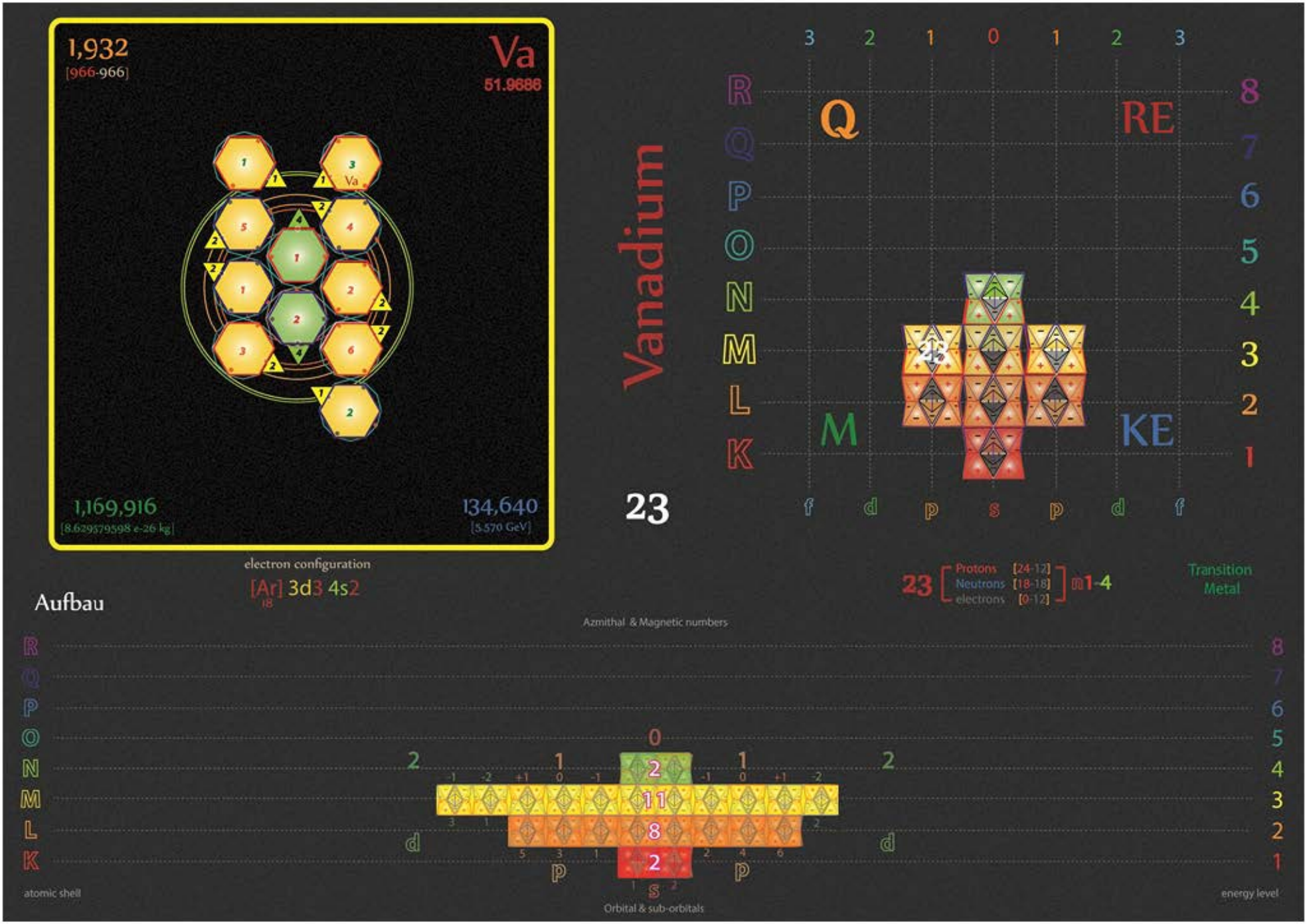

Tetryonics 51.23 - Vanadium atom

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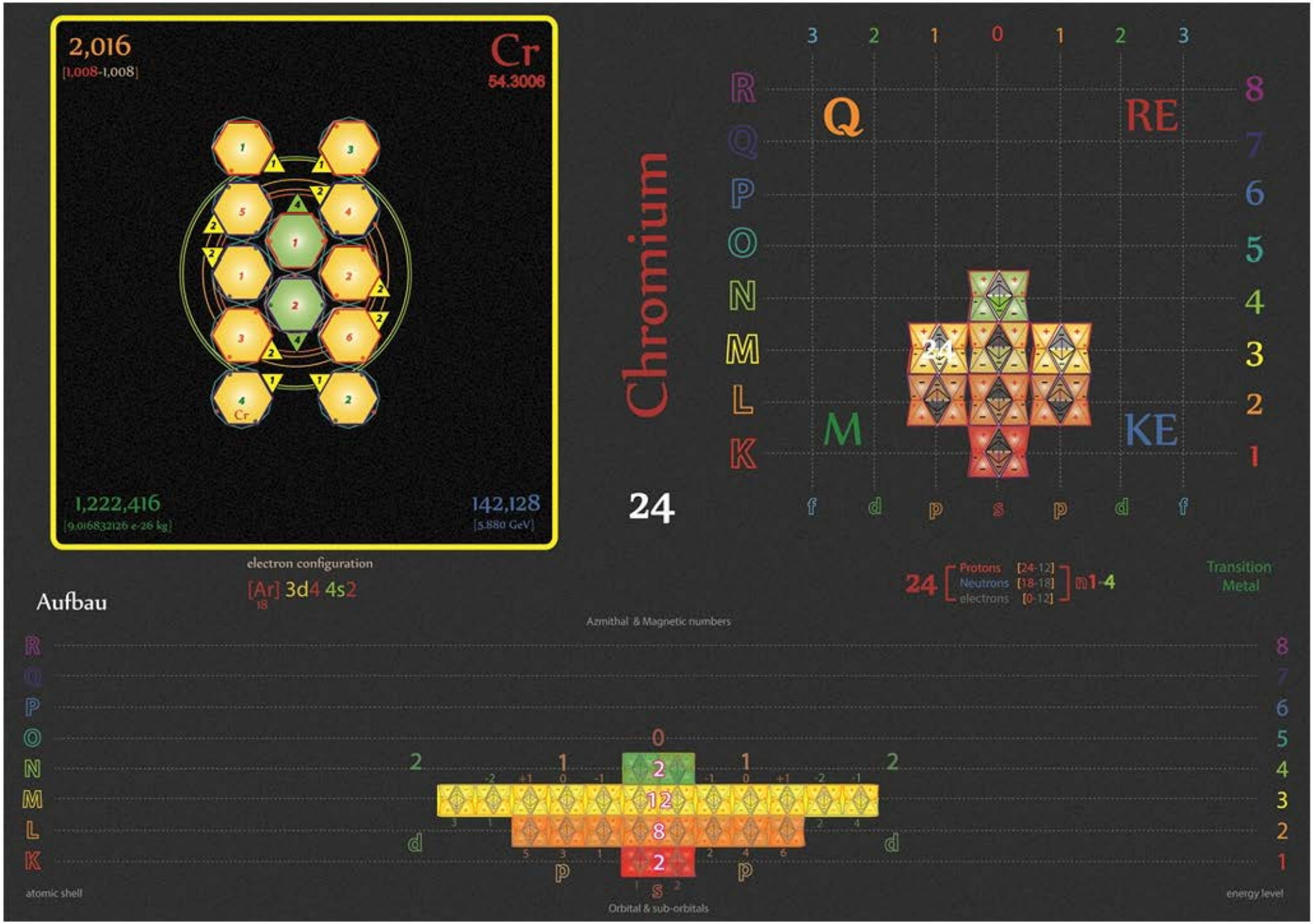

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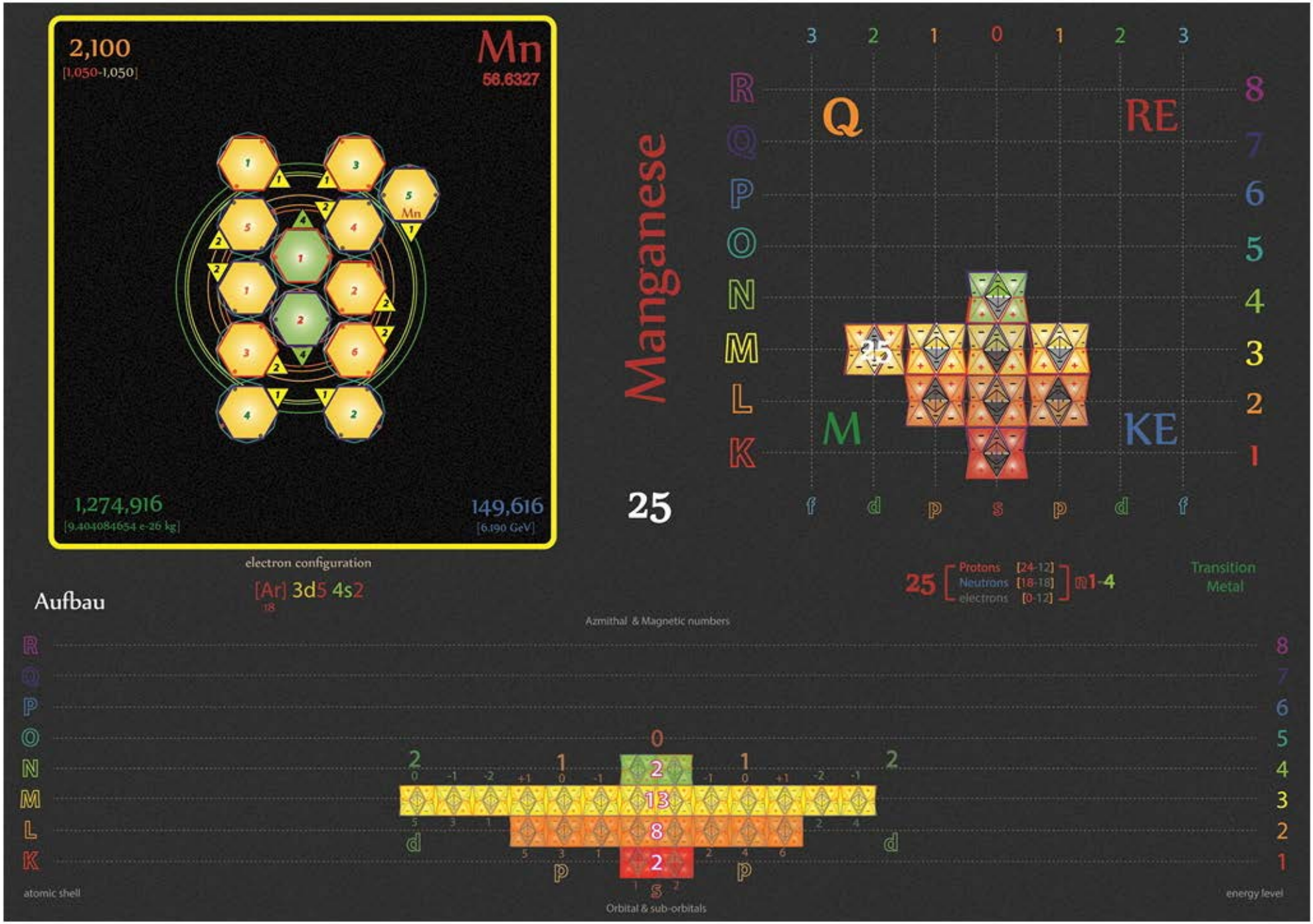

Tetryonics 51.25 - Manganese atom

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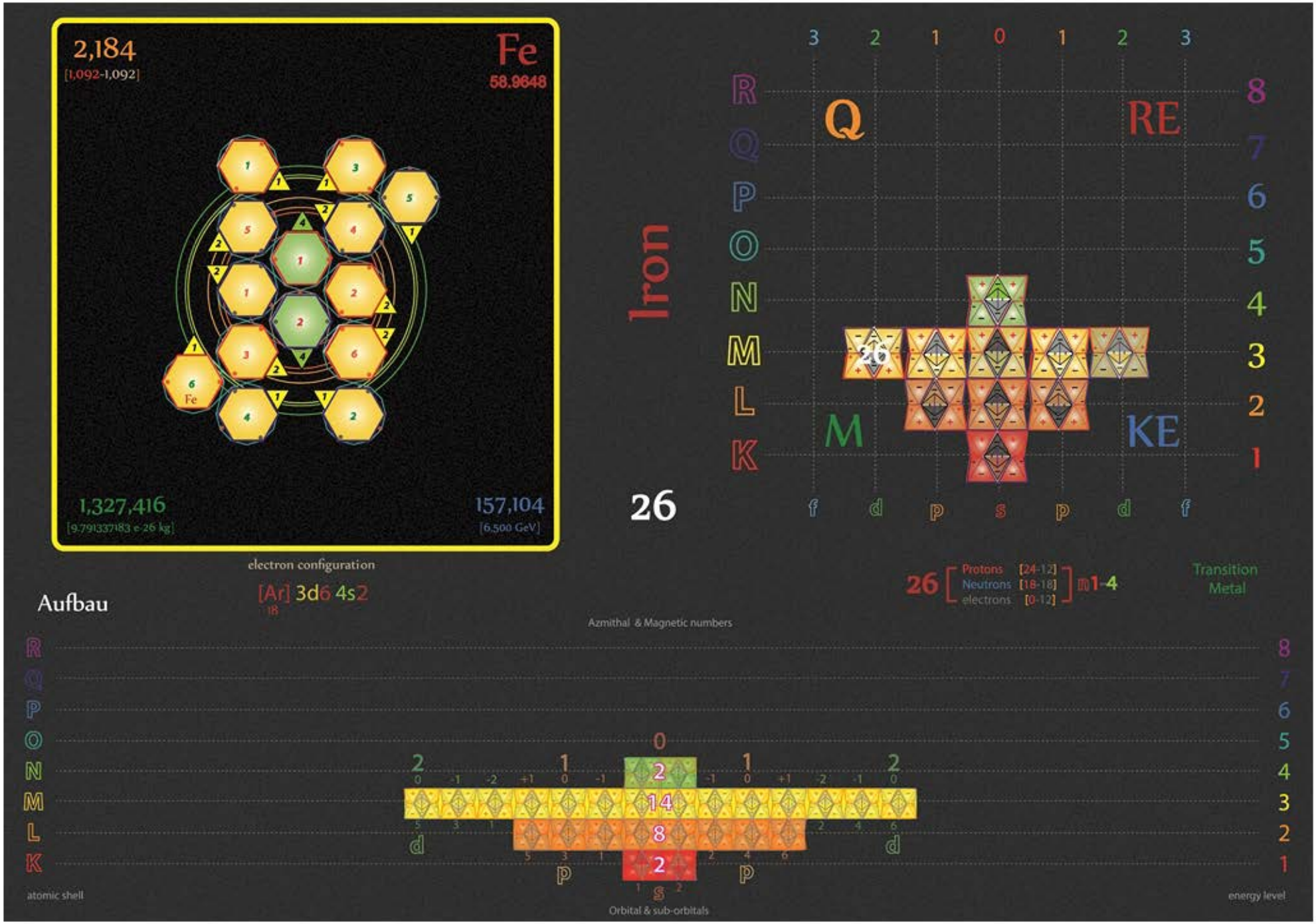

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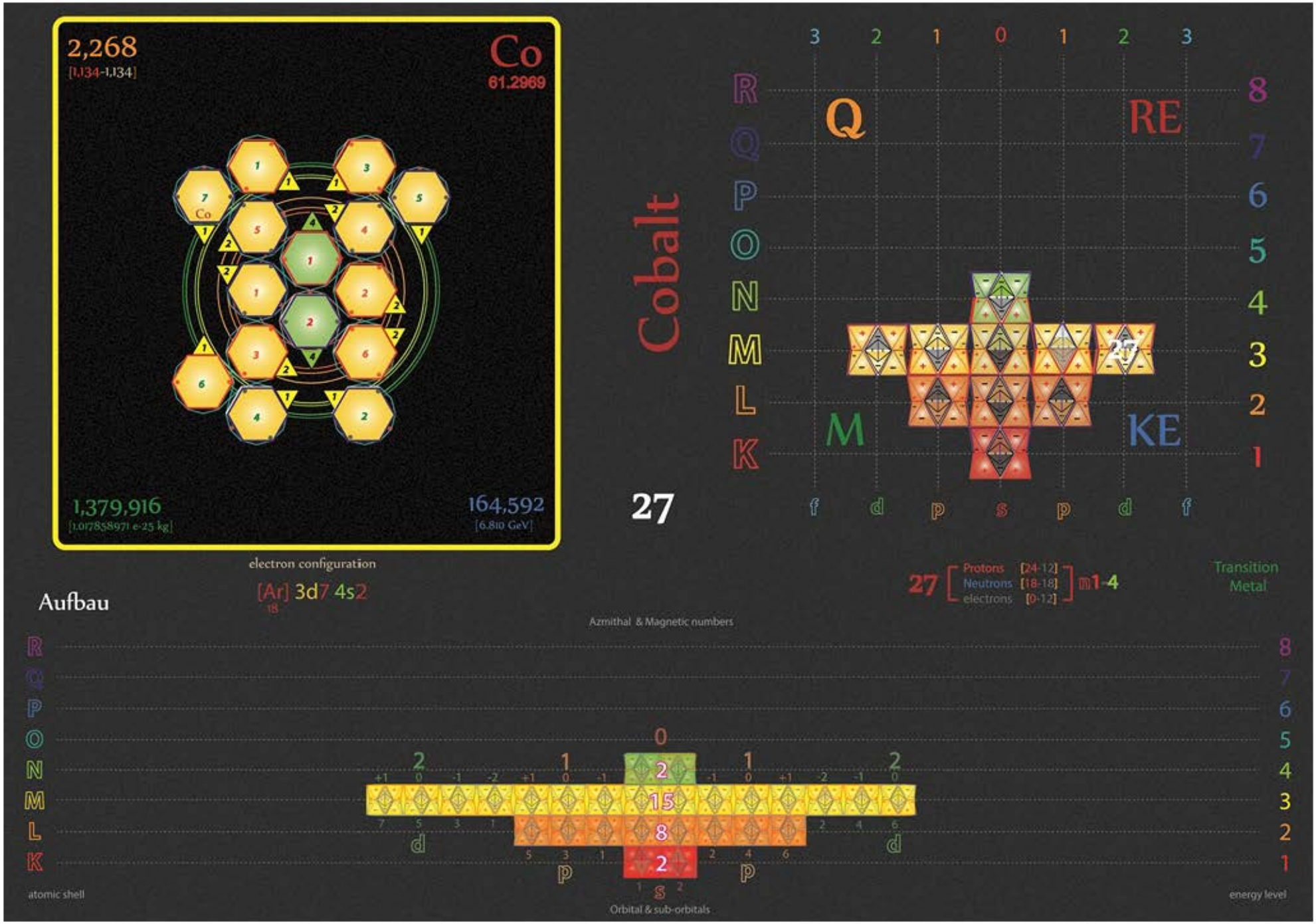

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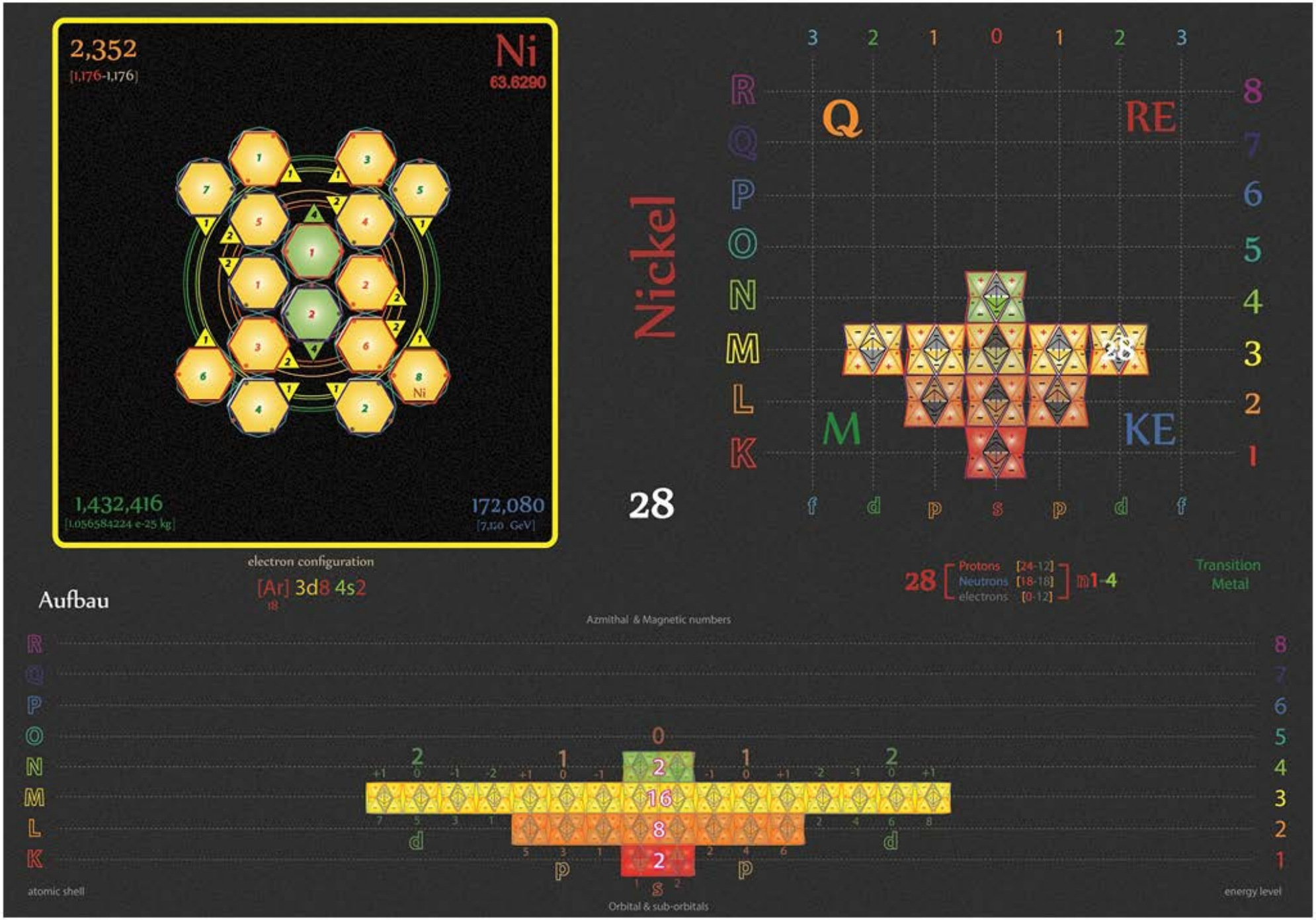

Tetryonics 51.28 - Nickel atom

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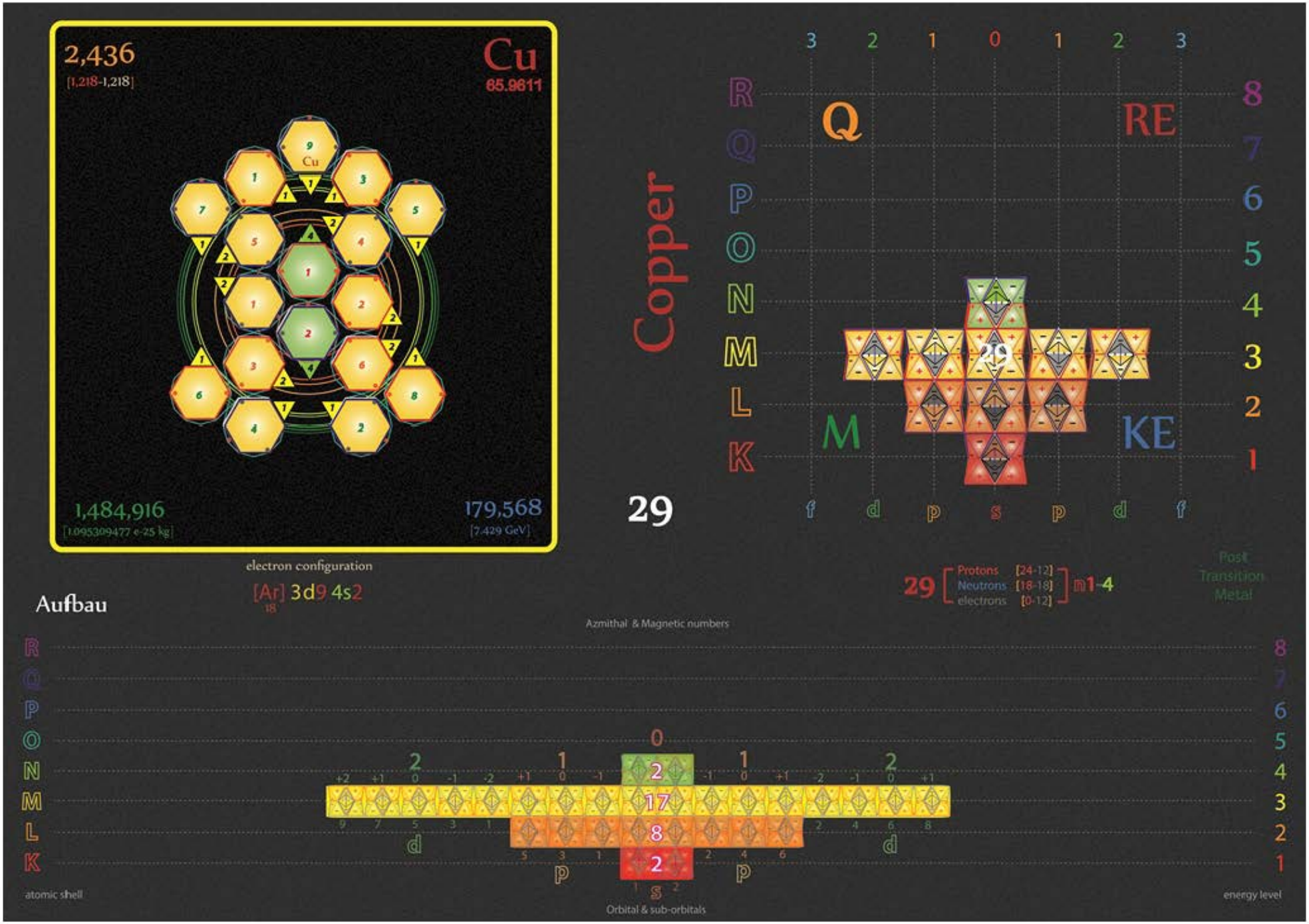

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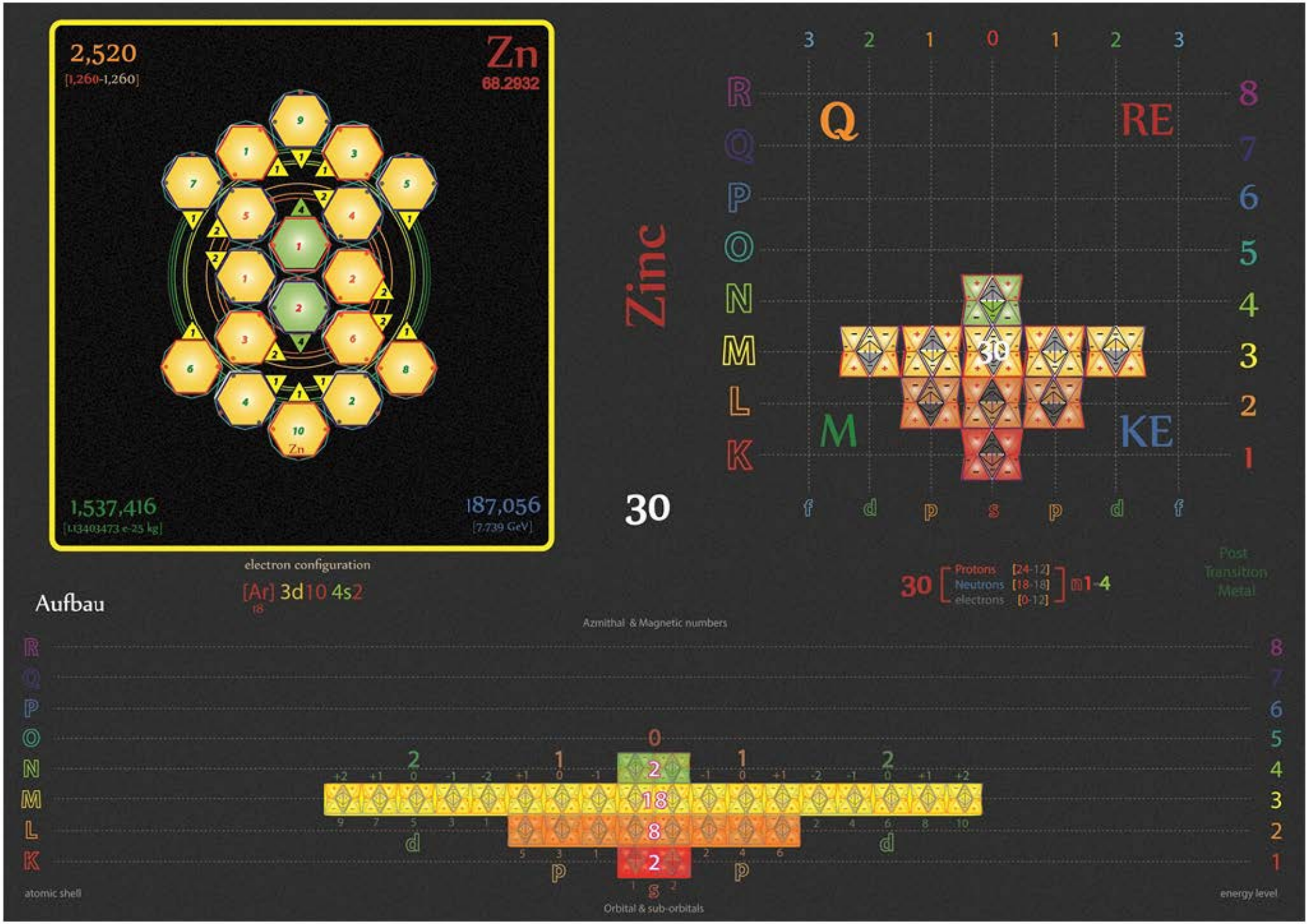

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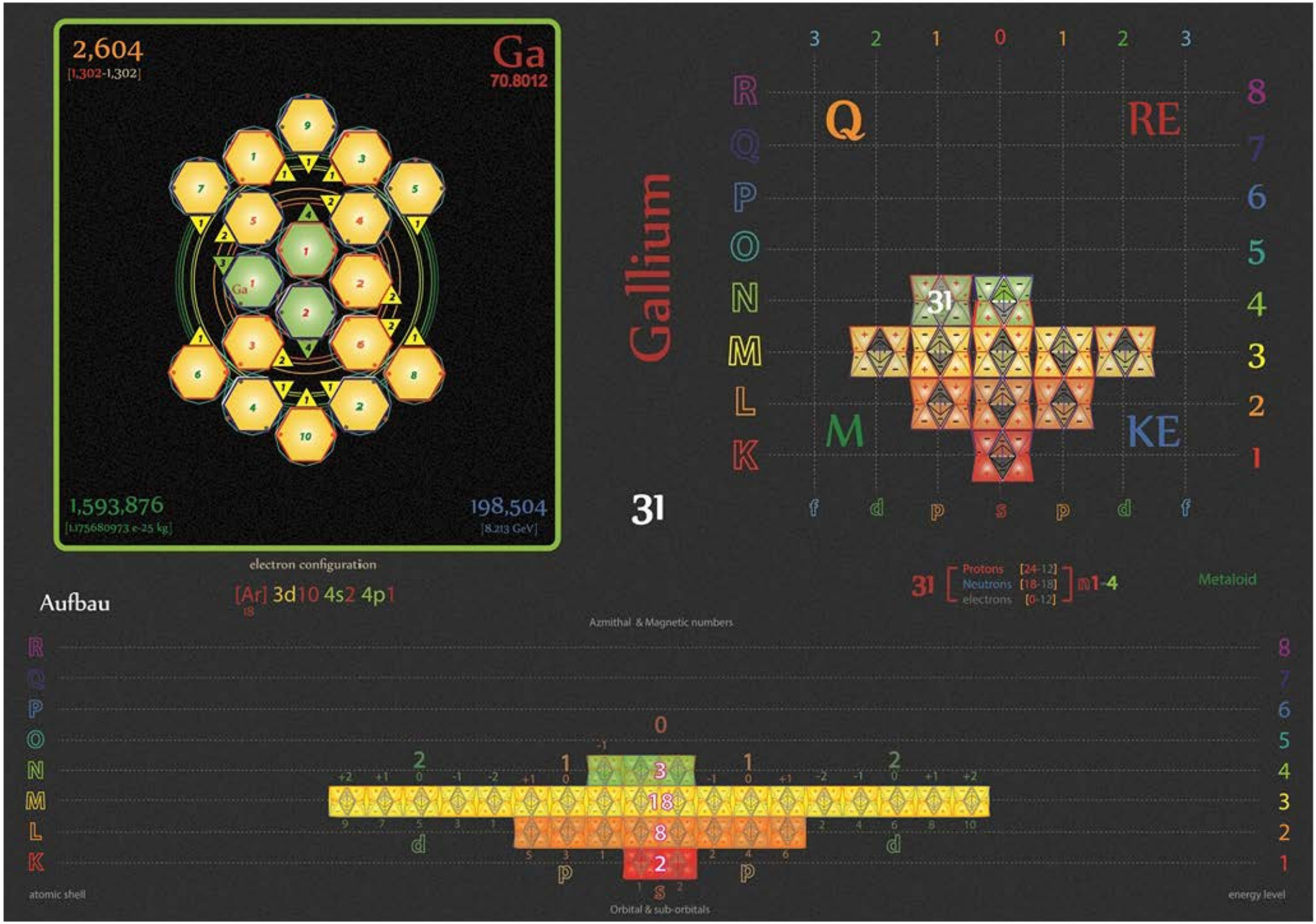

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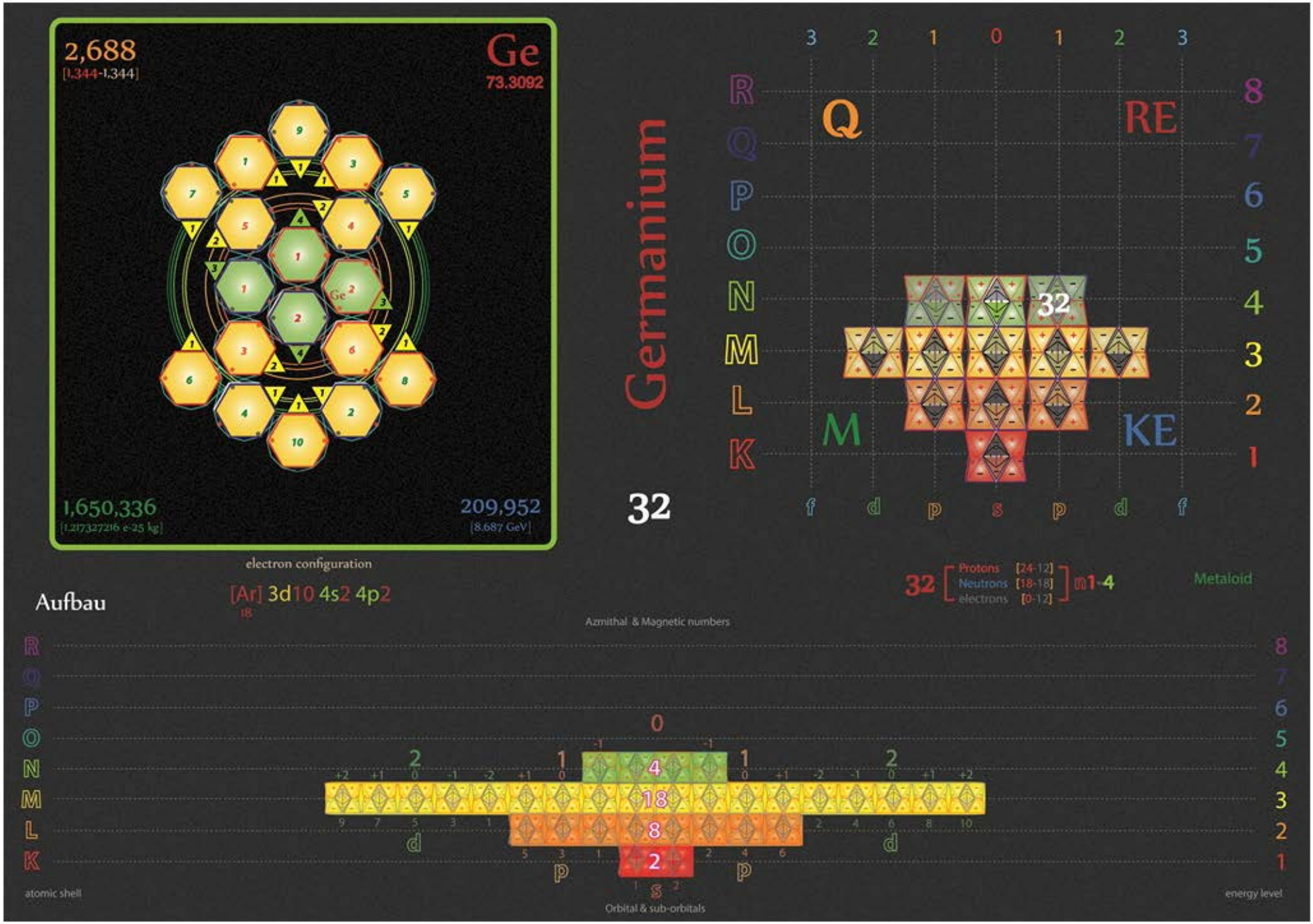

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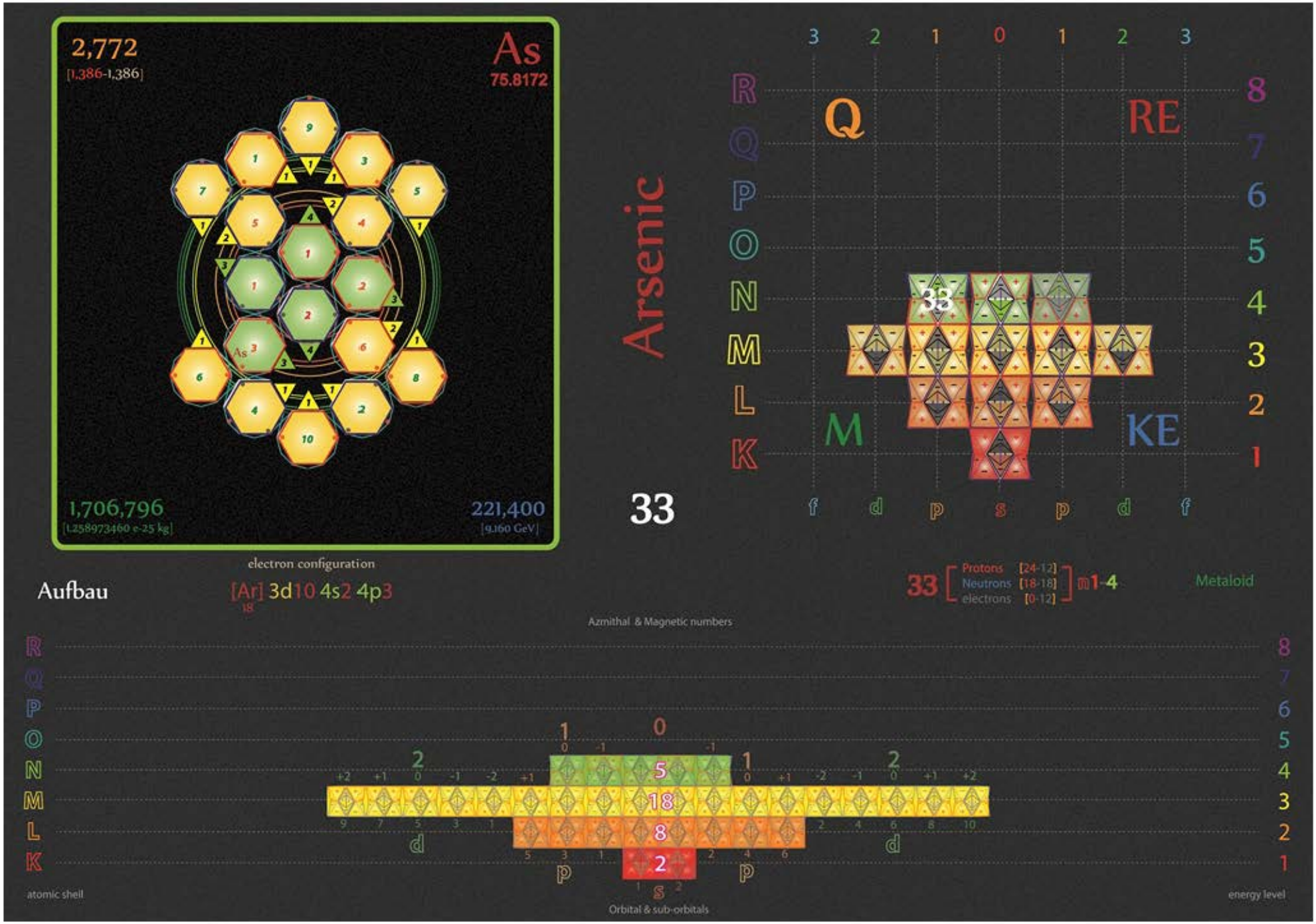

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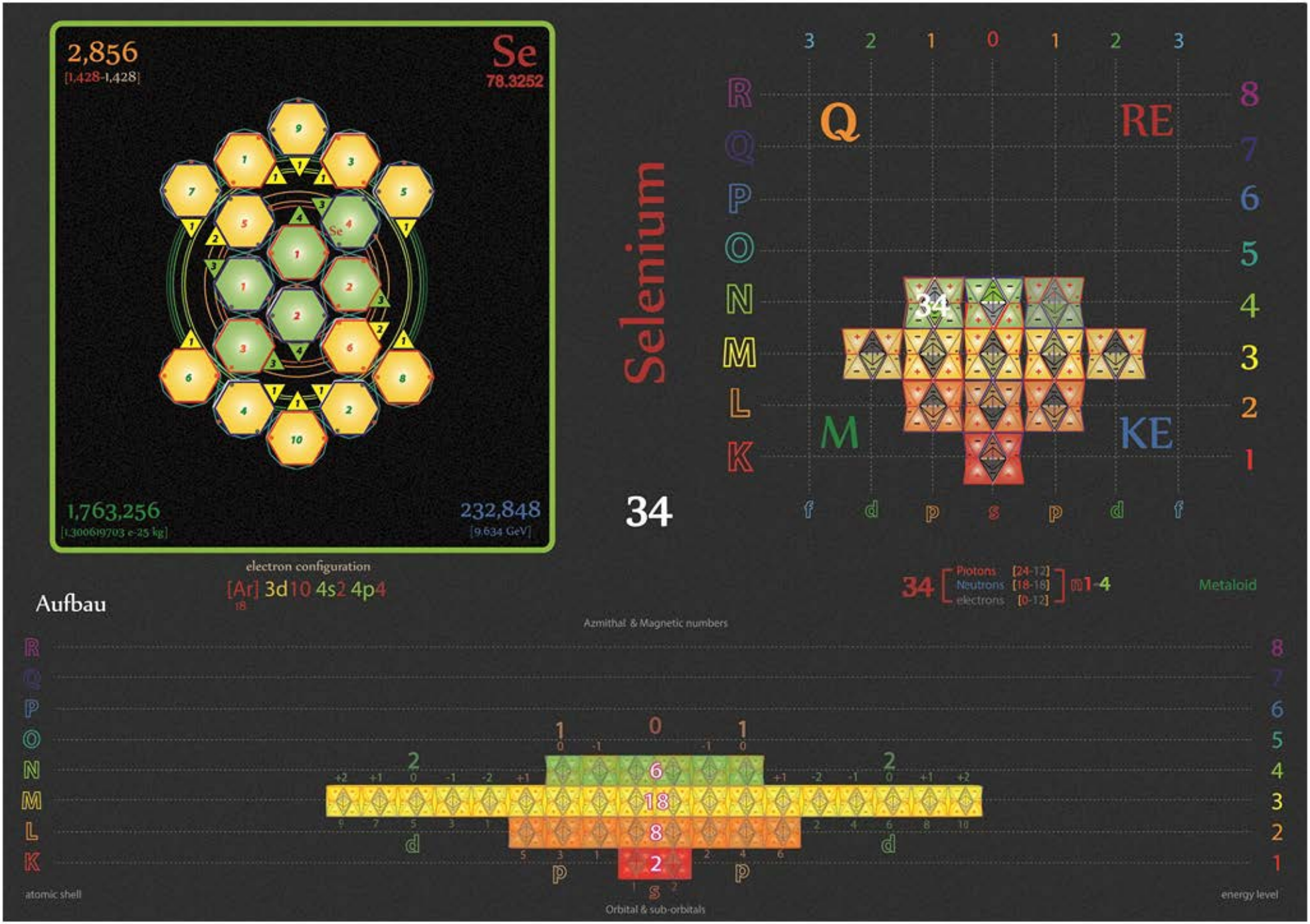

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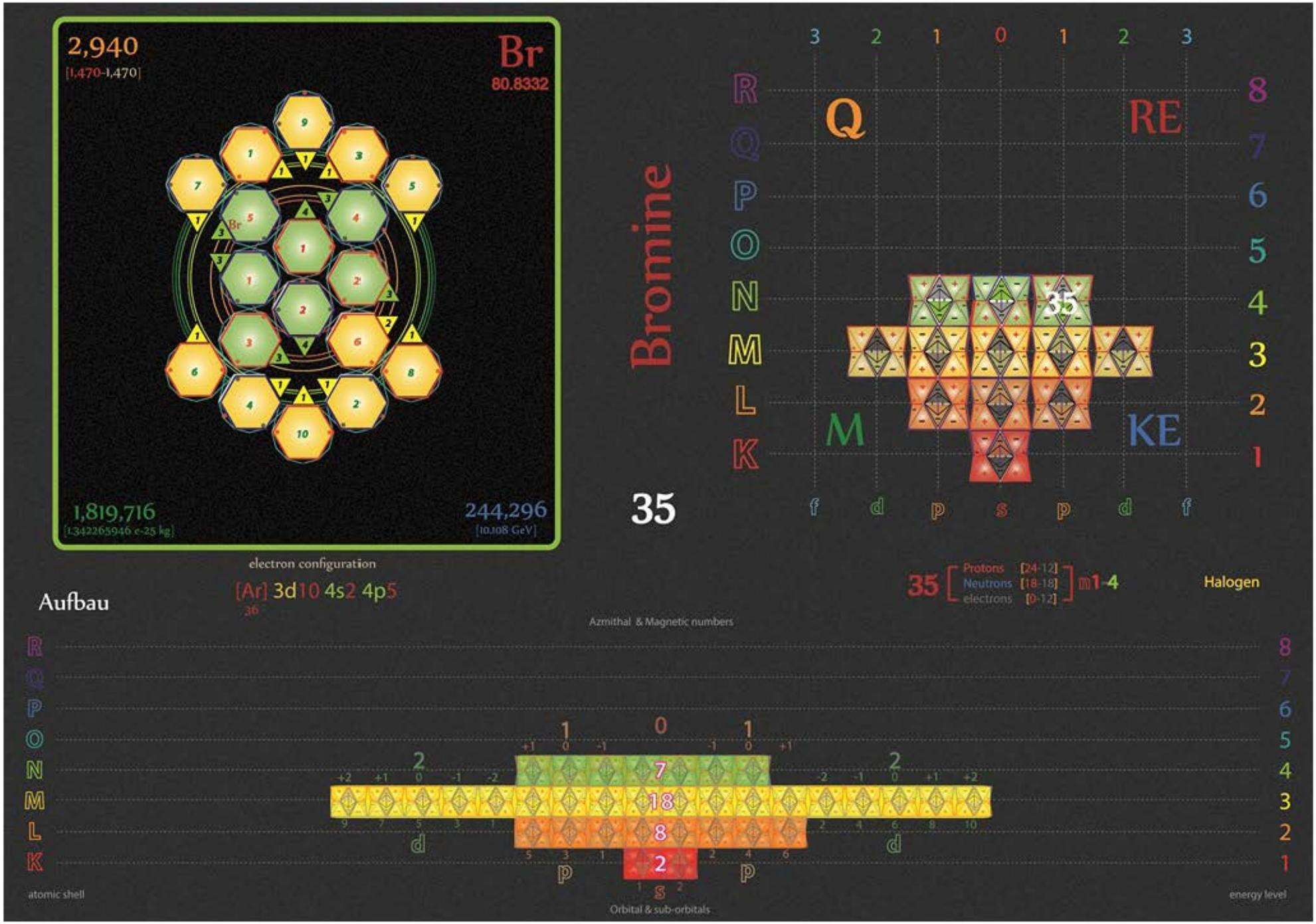

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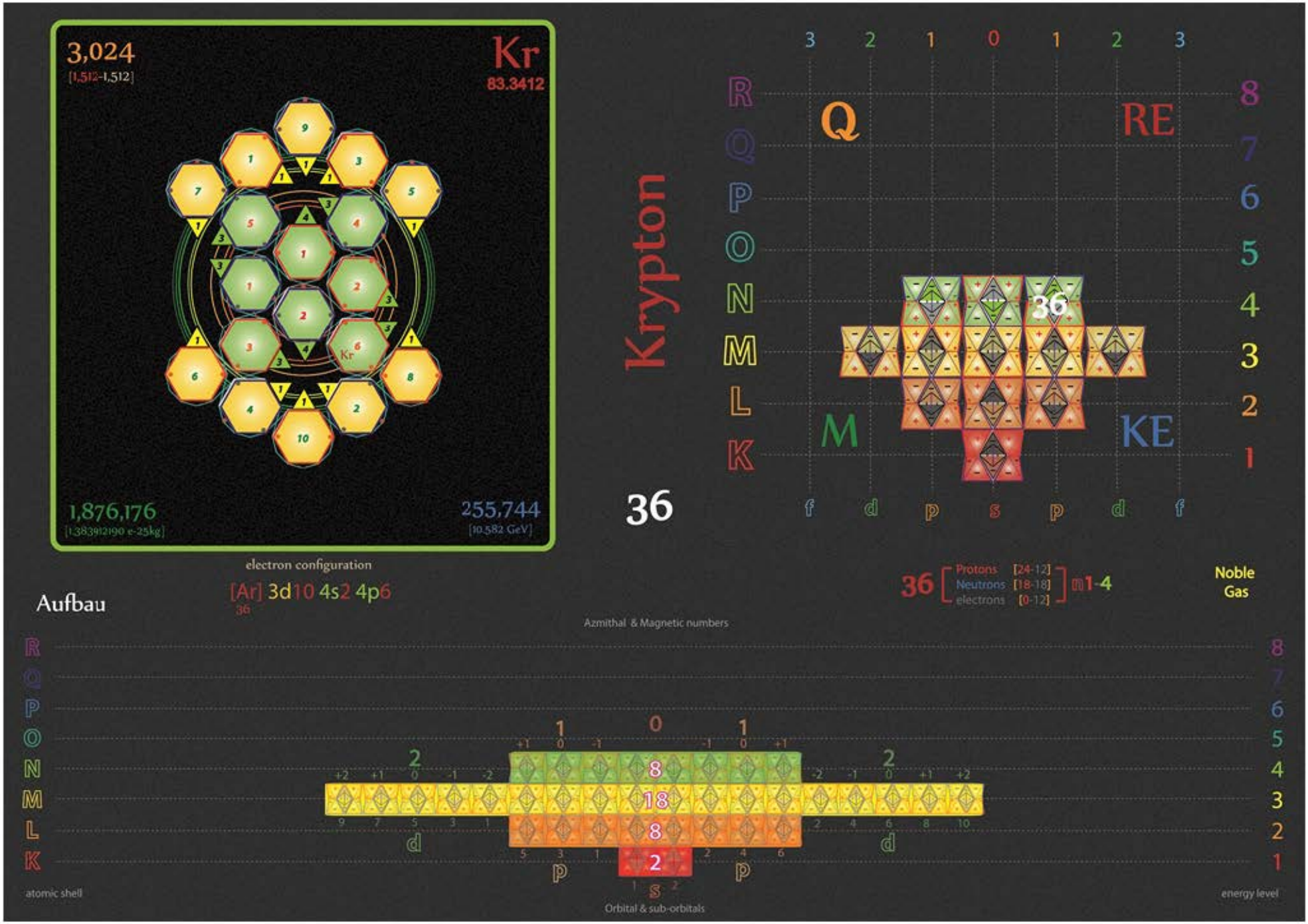

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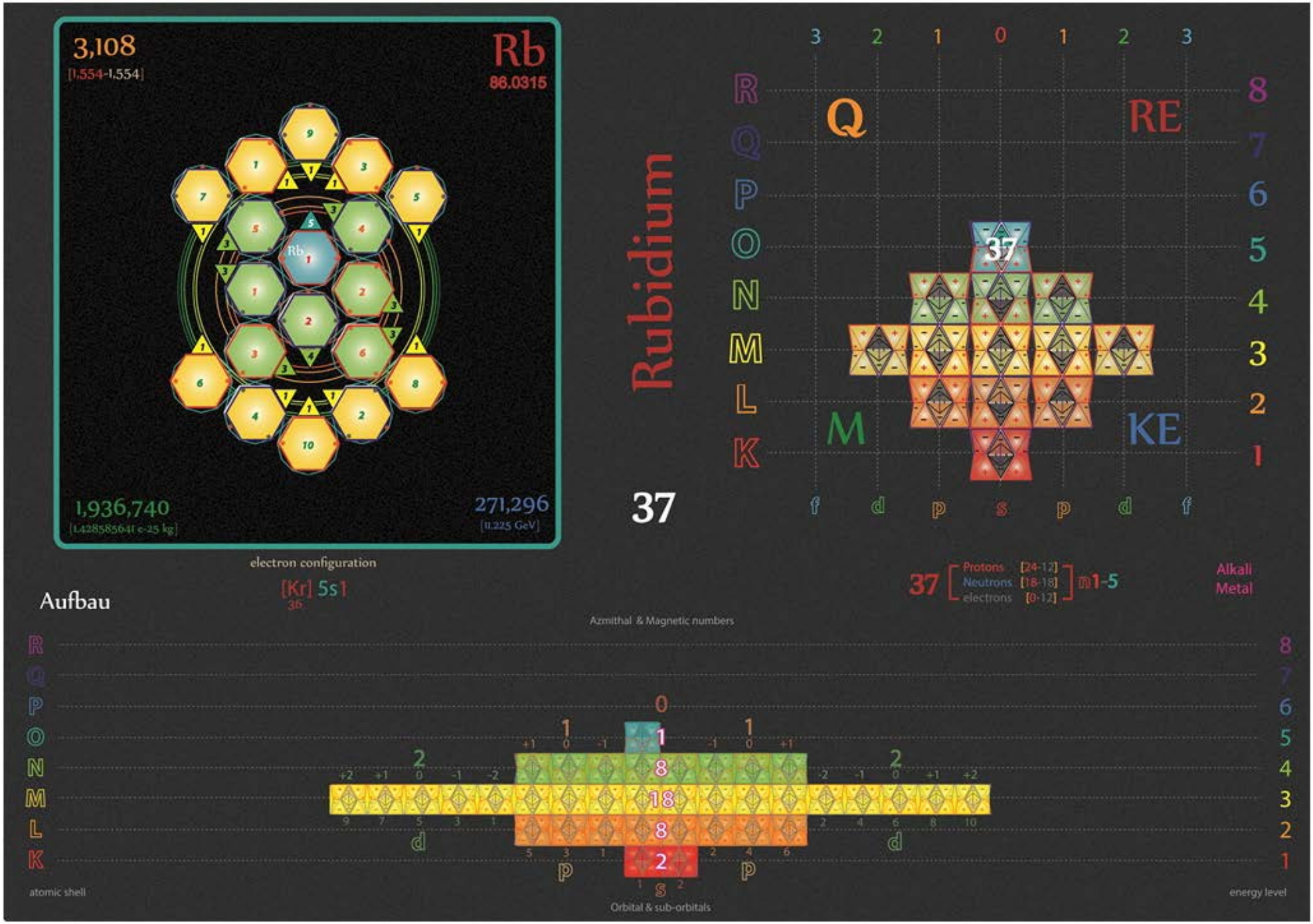

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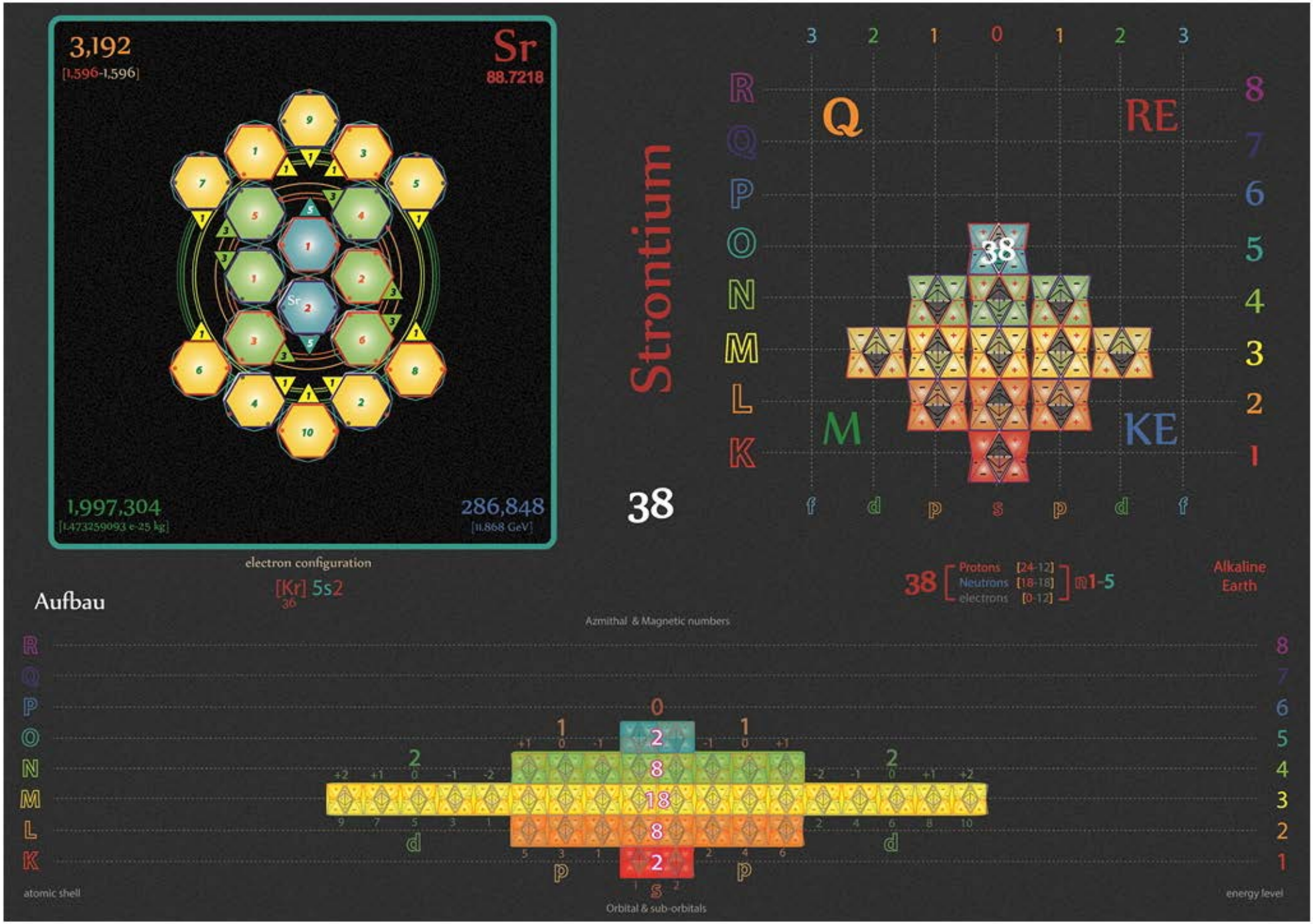

Tetryonics 51.38 - Strontium atom

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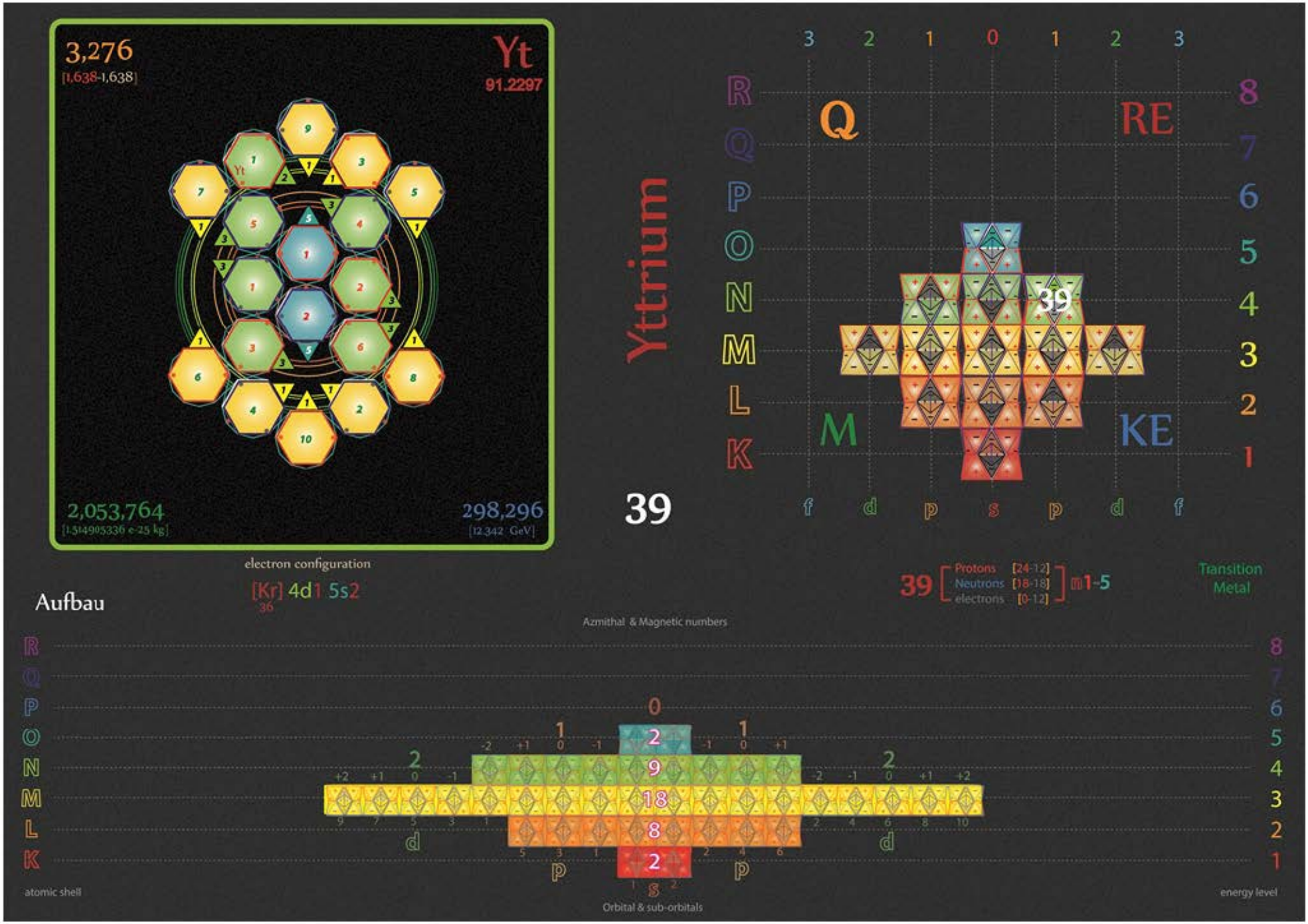

Tetryonics 51.39 - Yttrium atom

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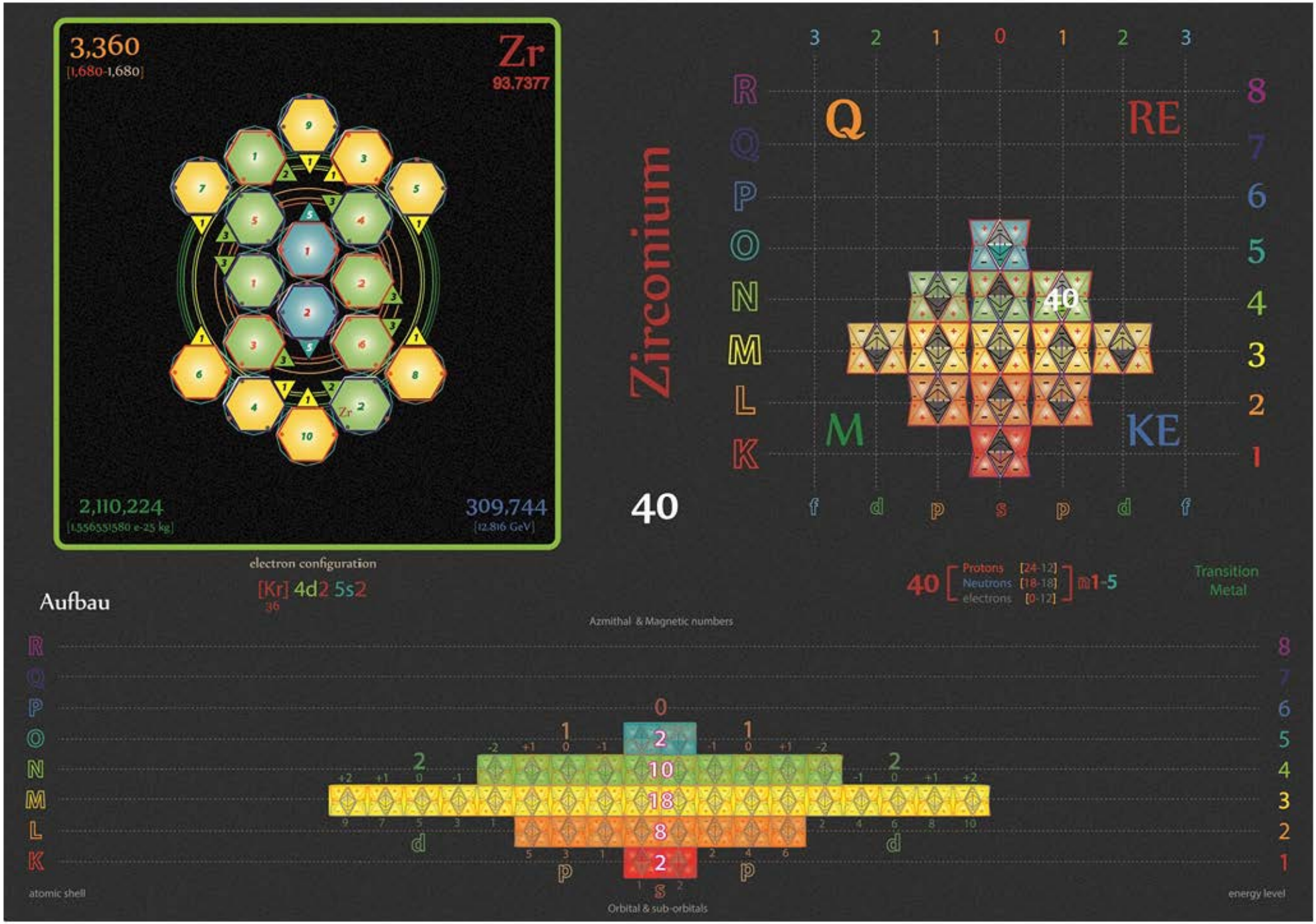

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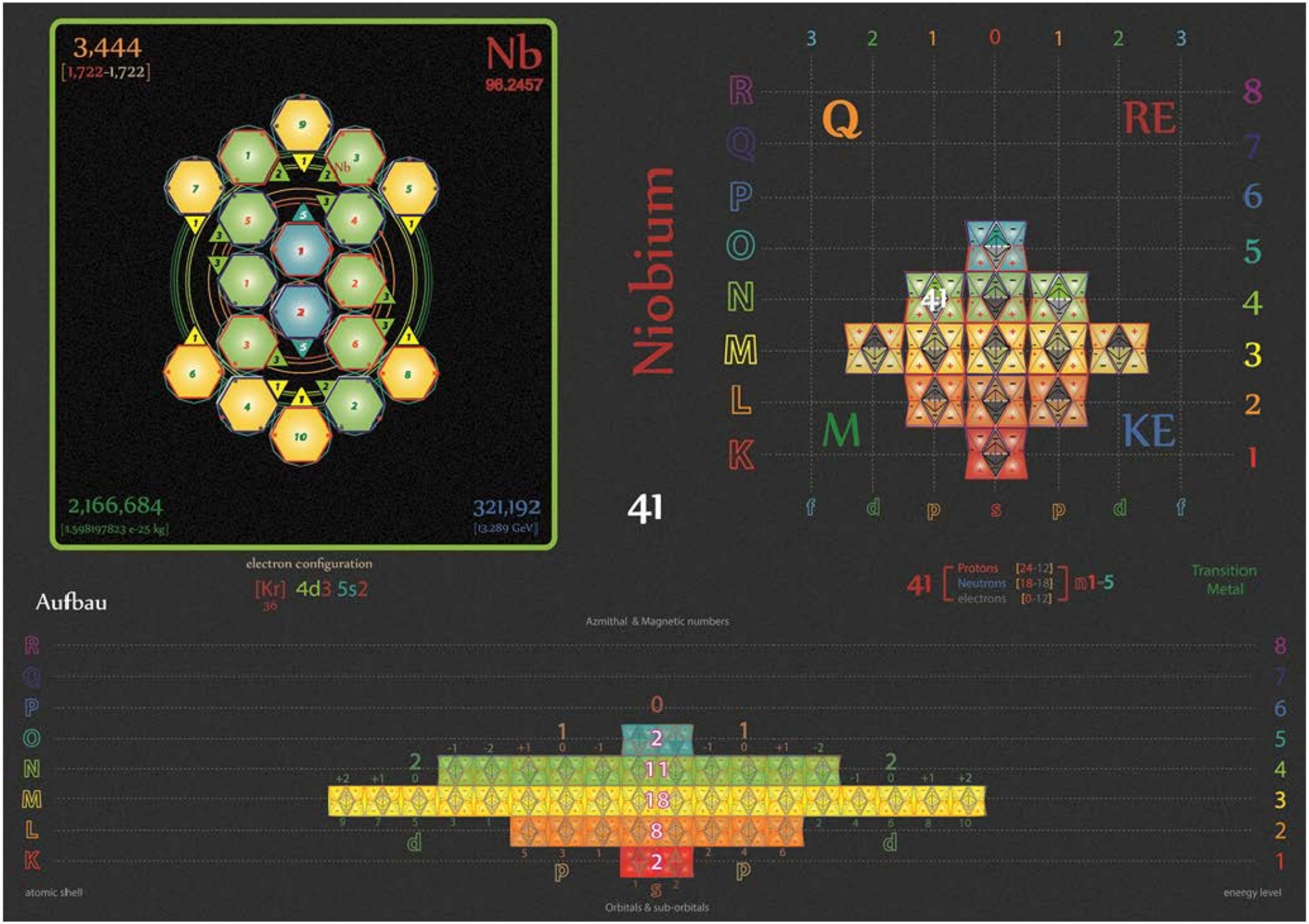

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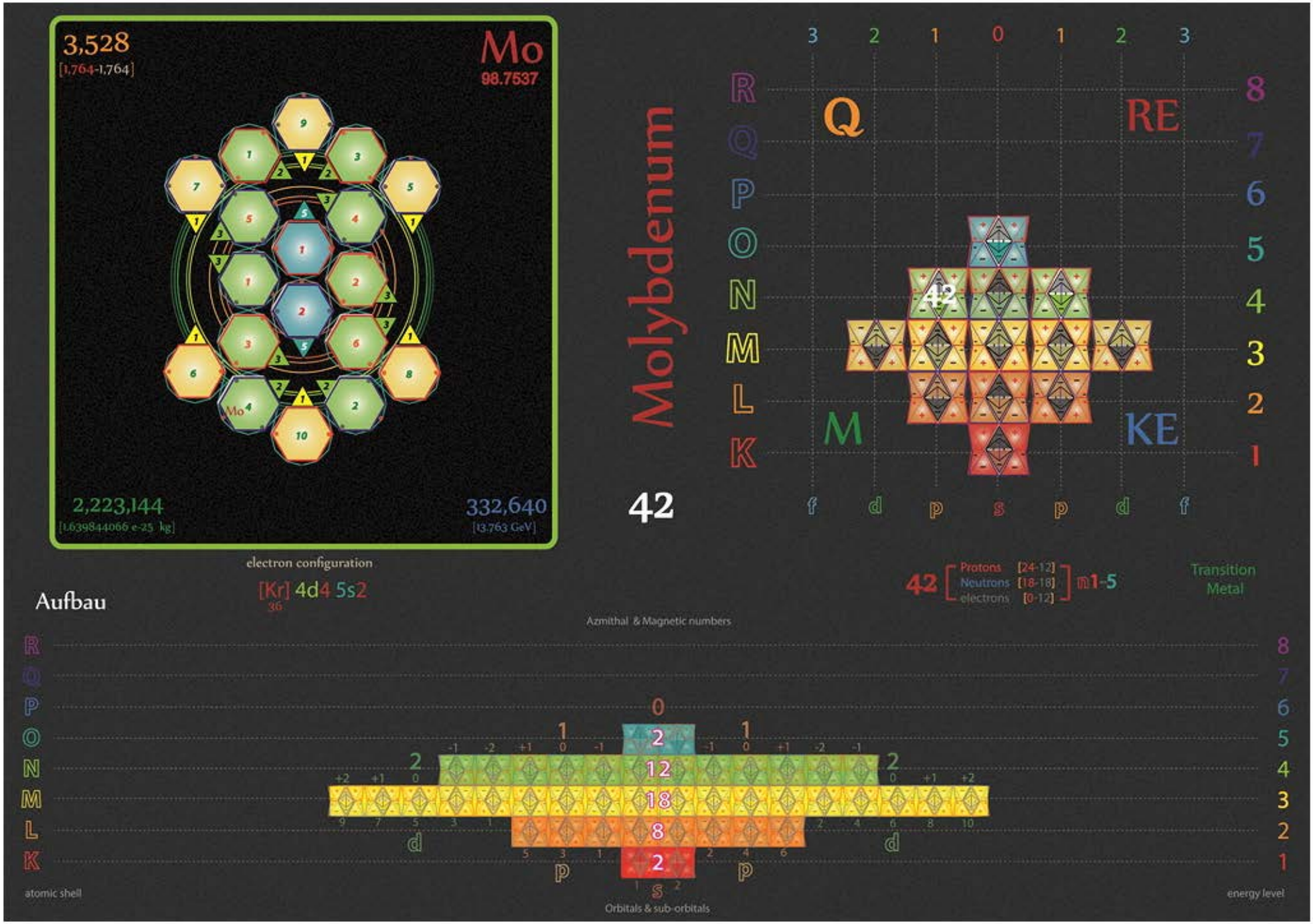

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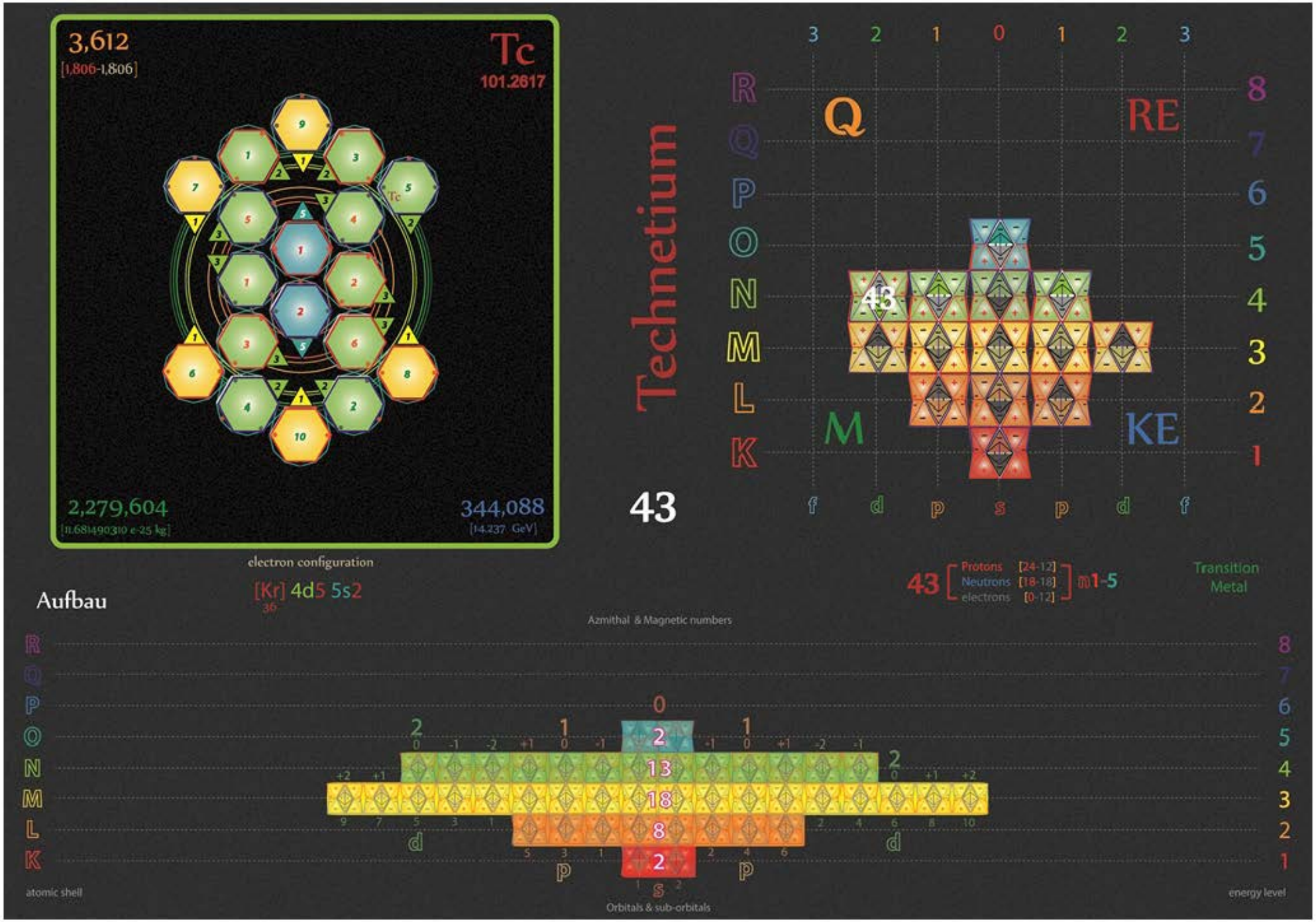

Tetryonics 51.43 - Technetium atom

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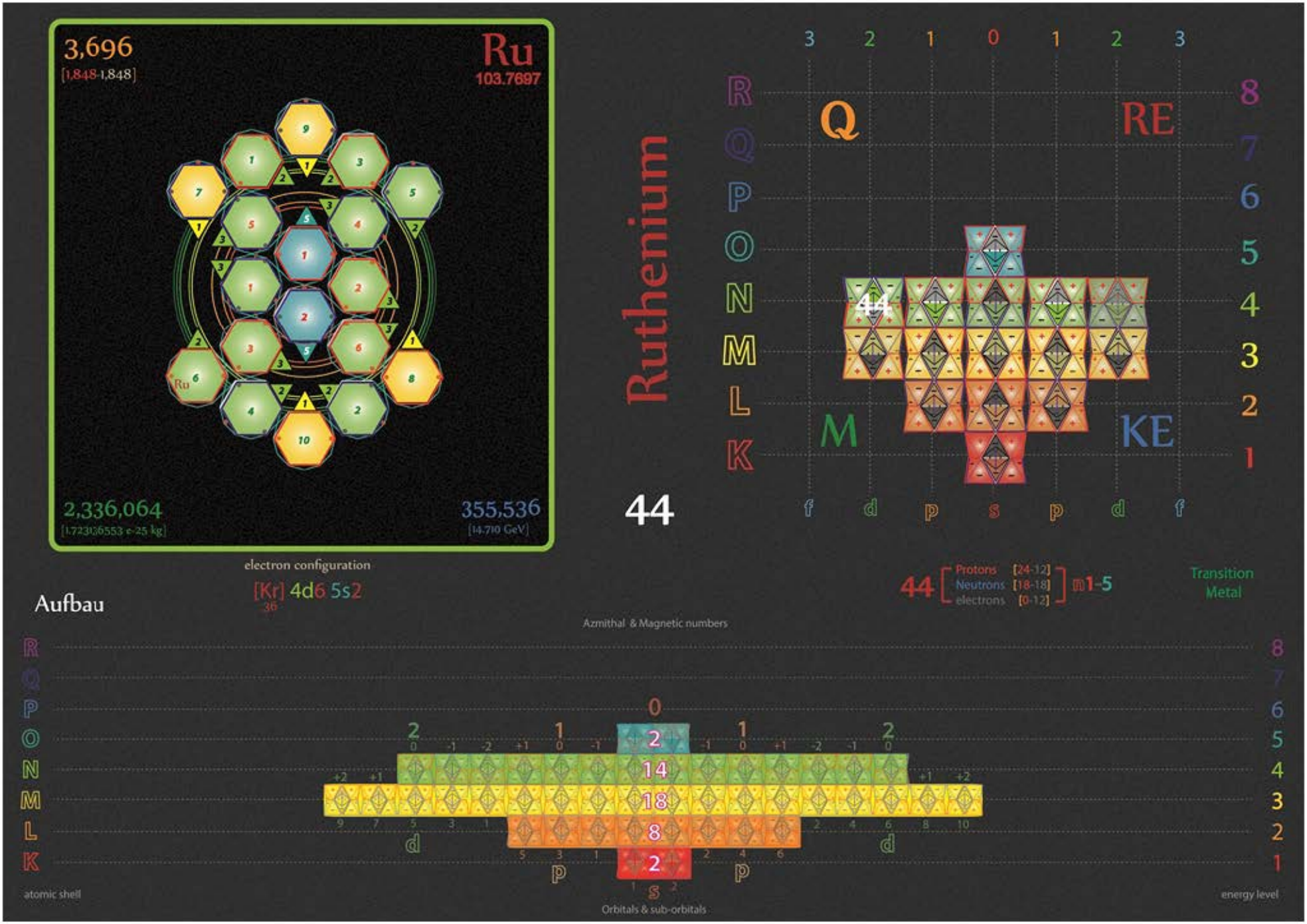

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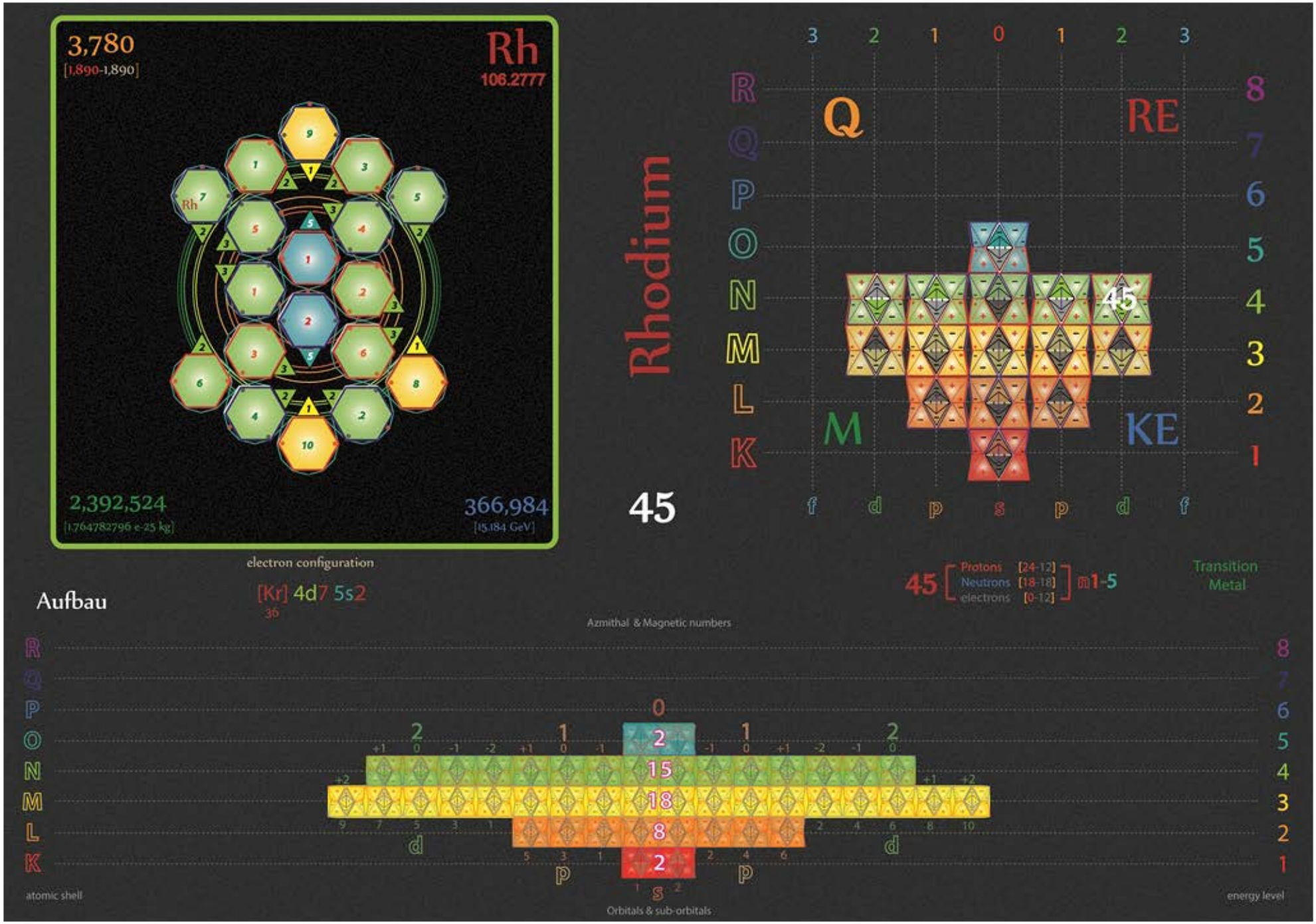

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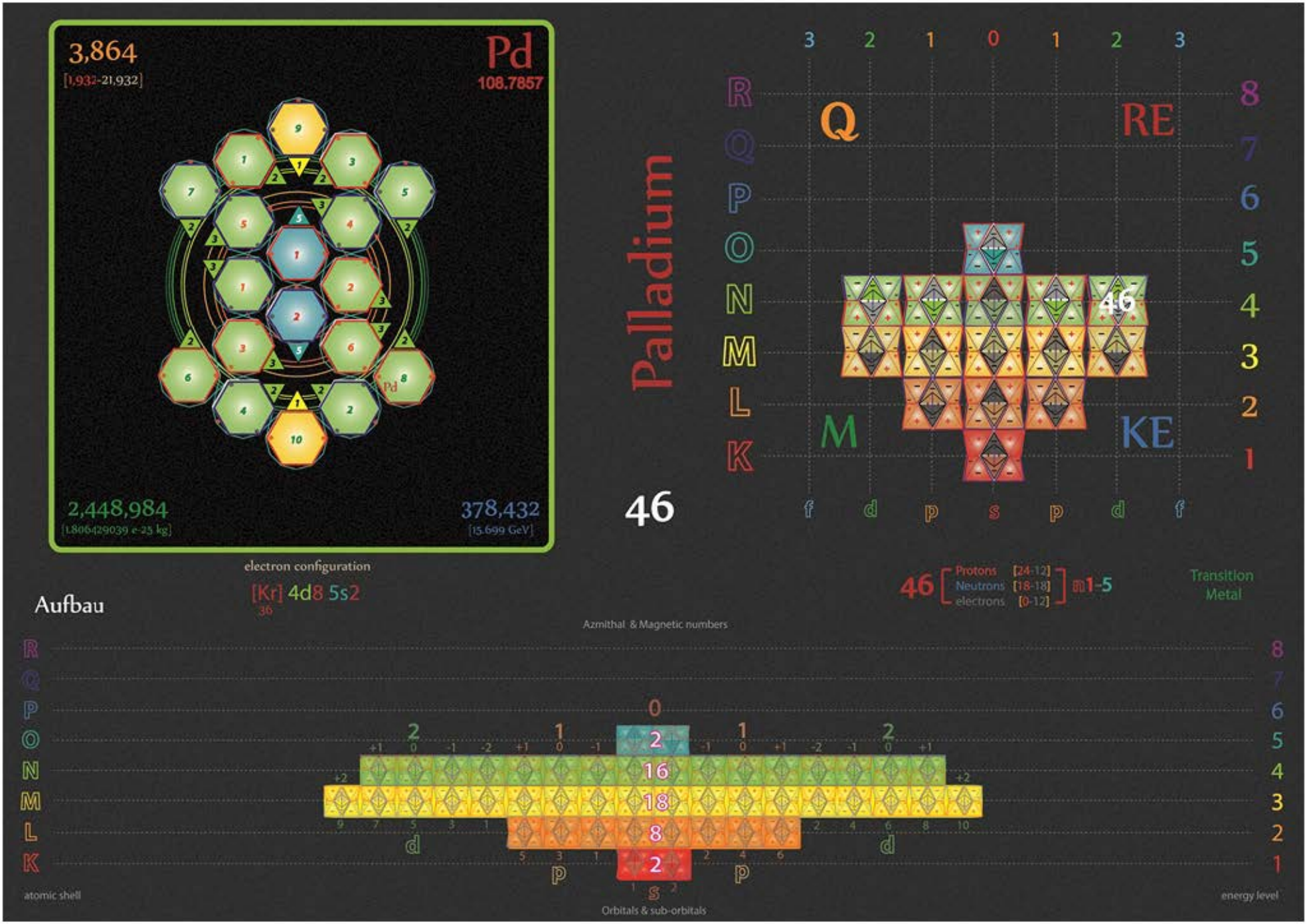

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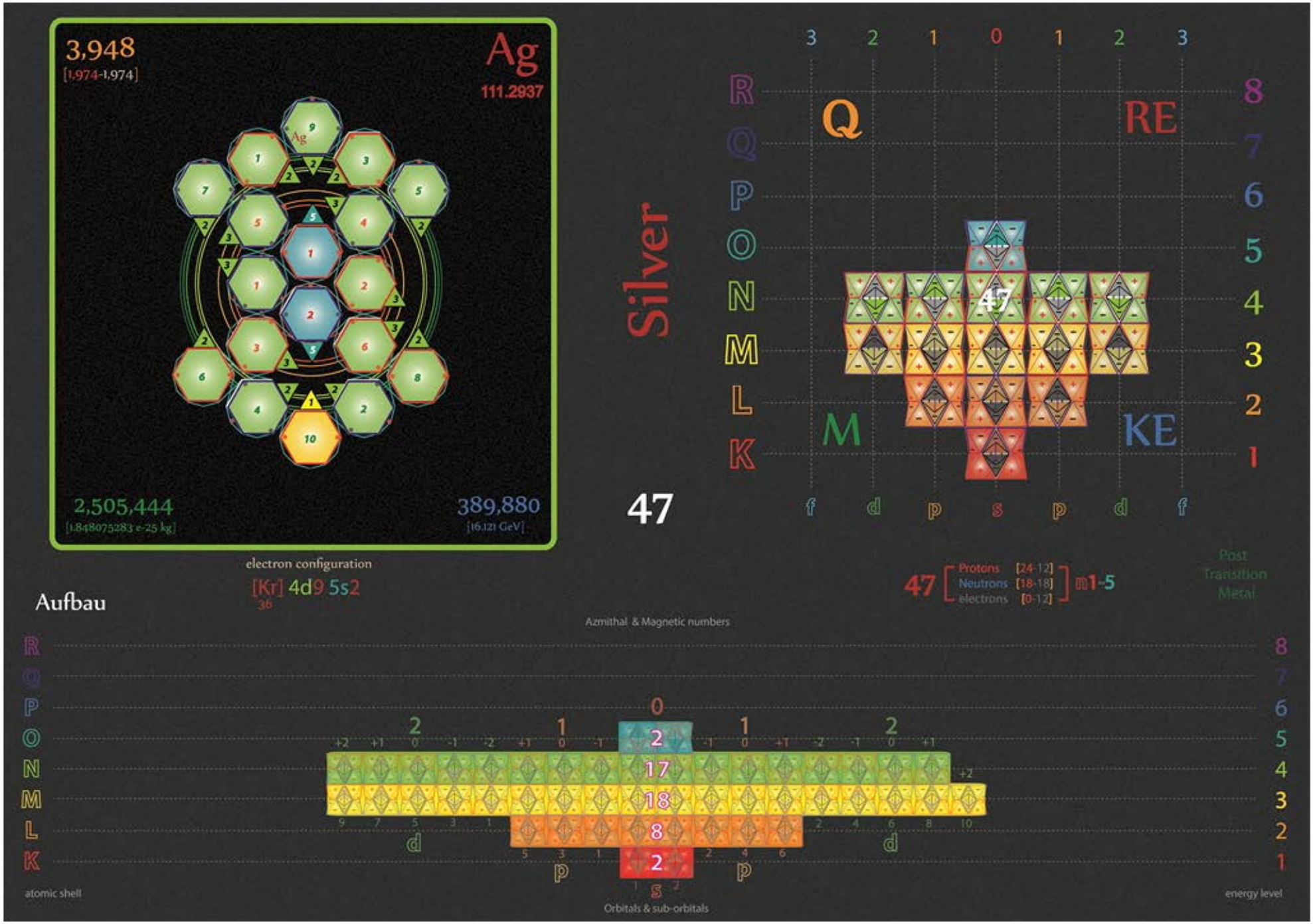

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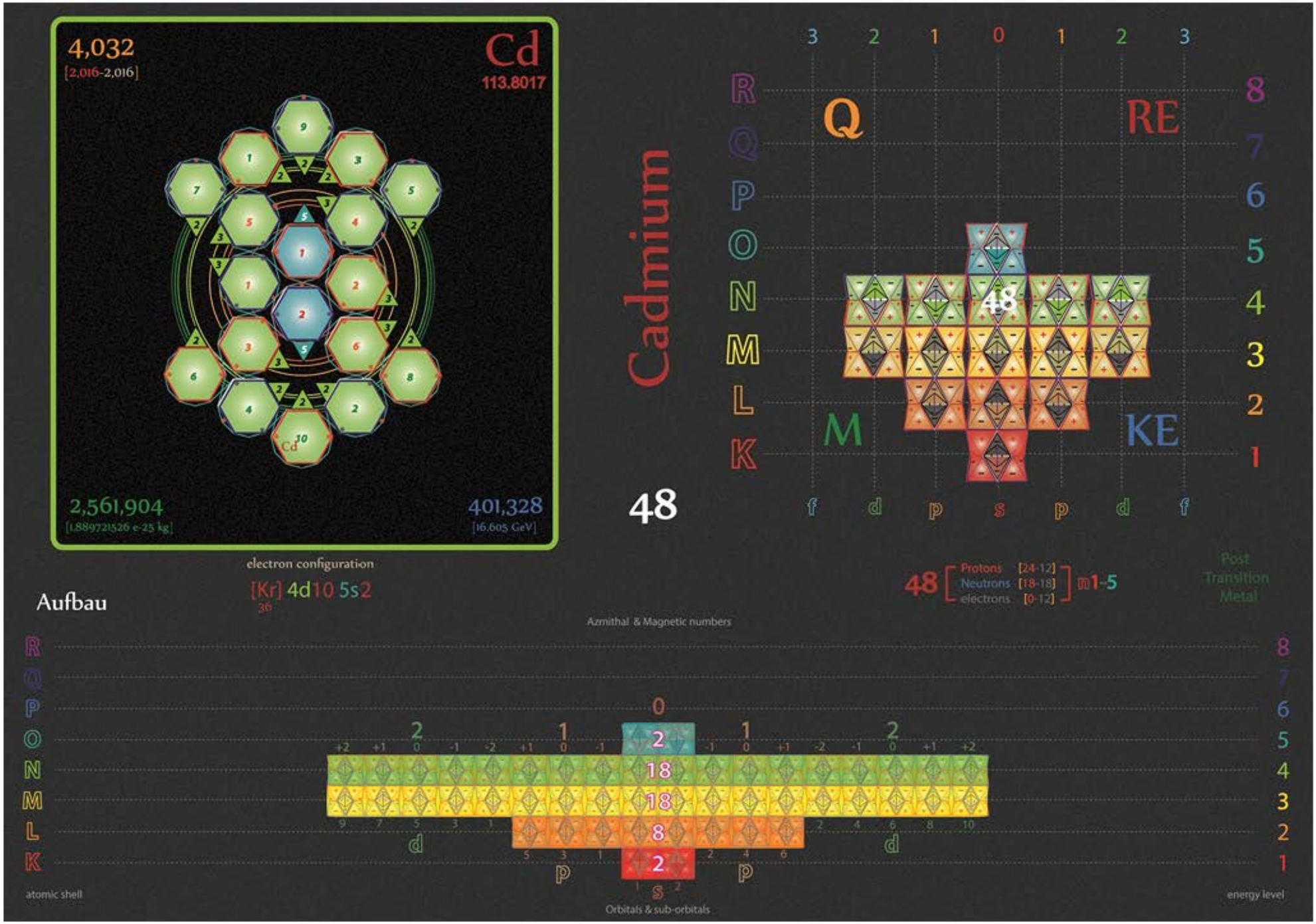

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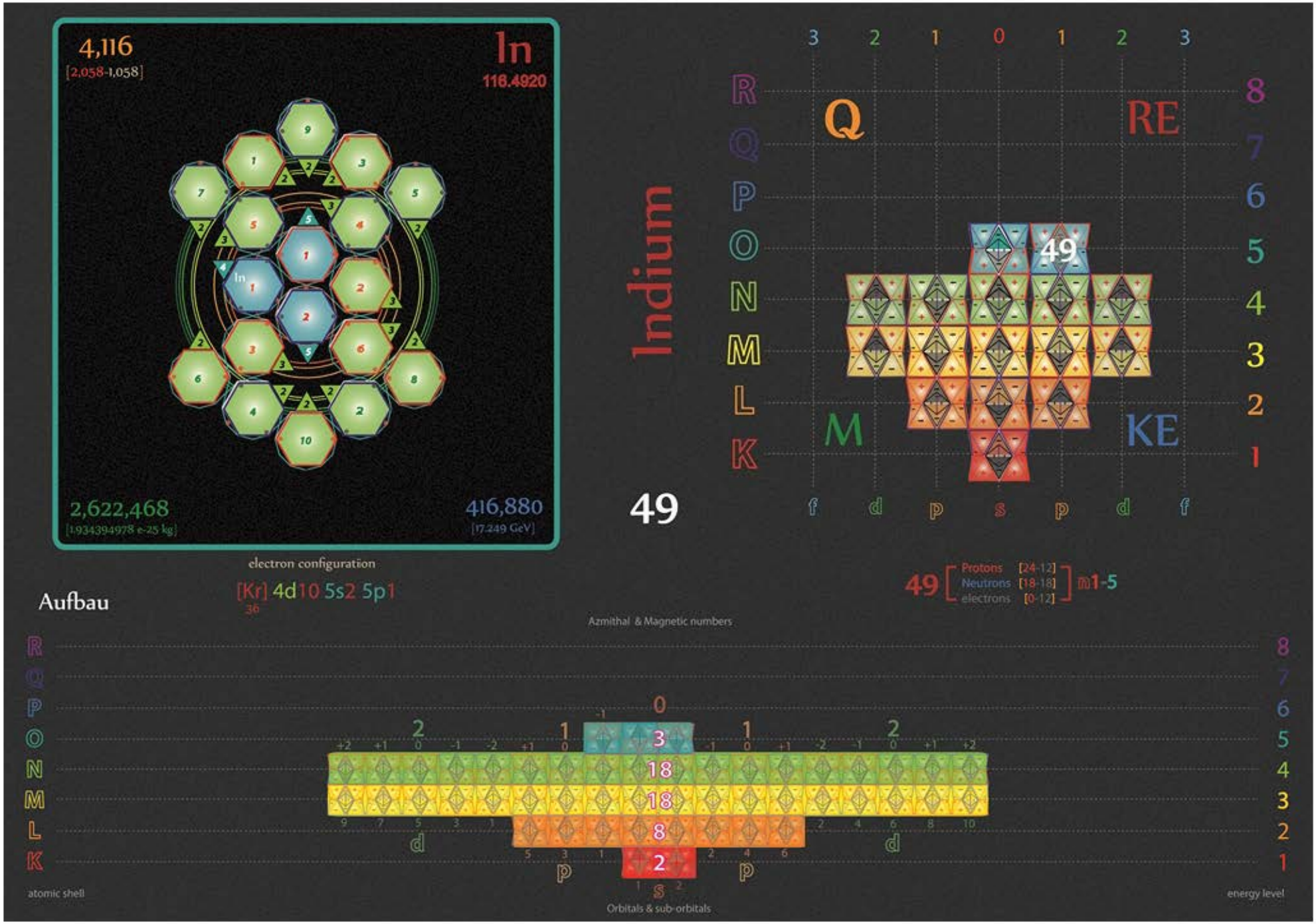

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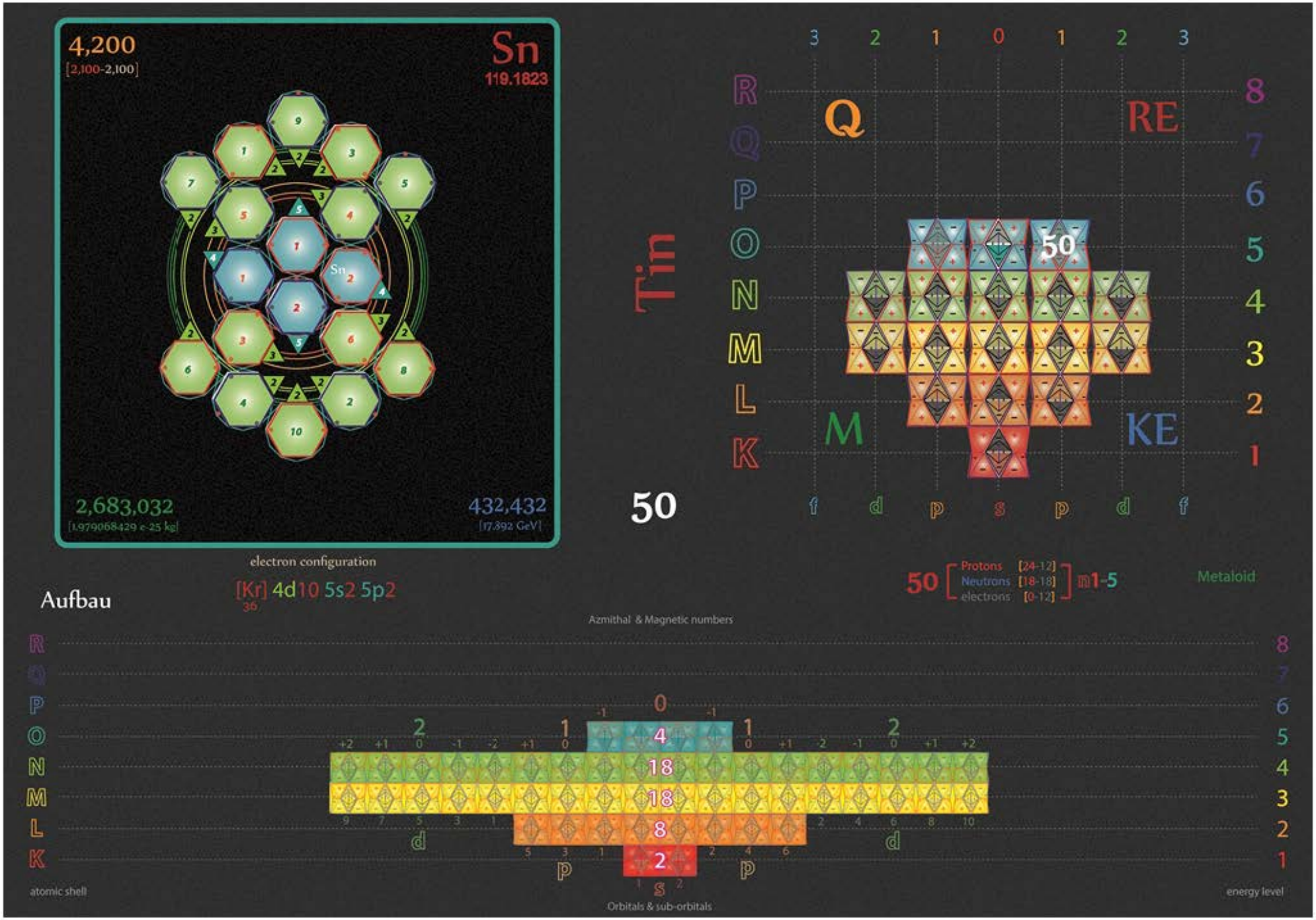

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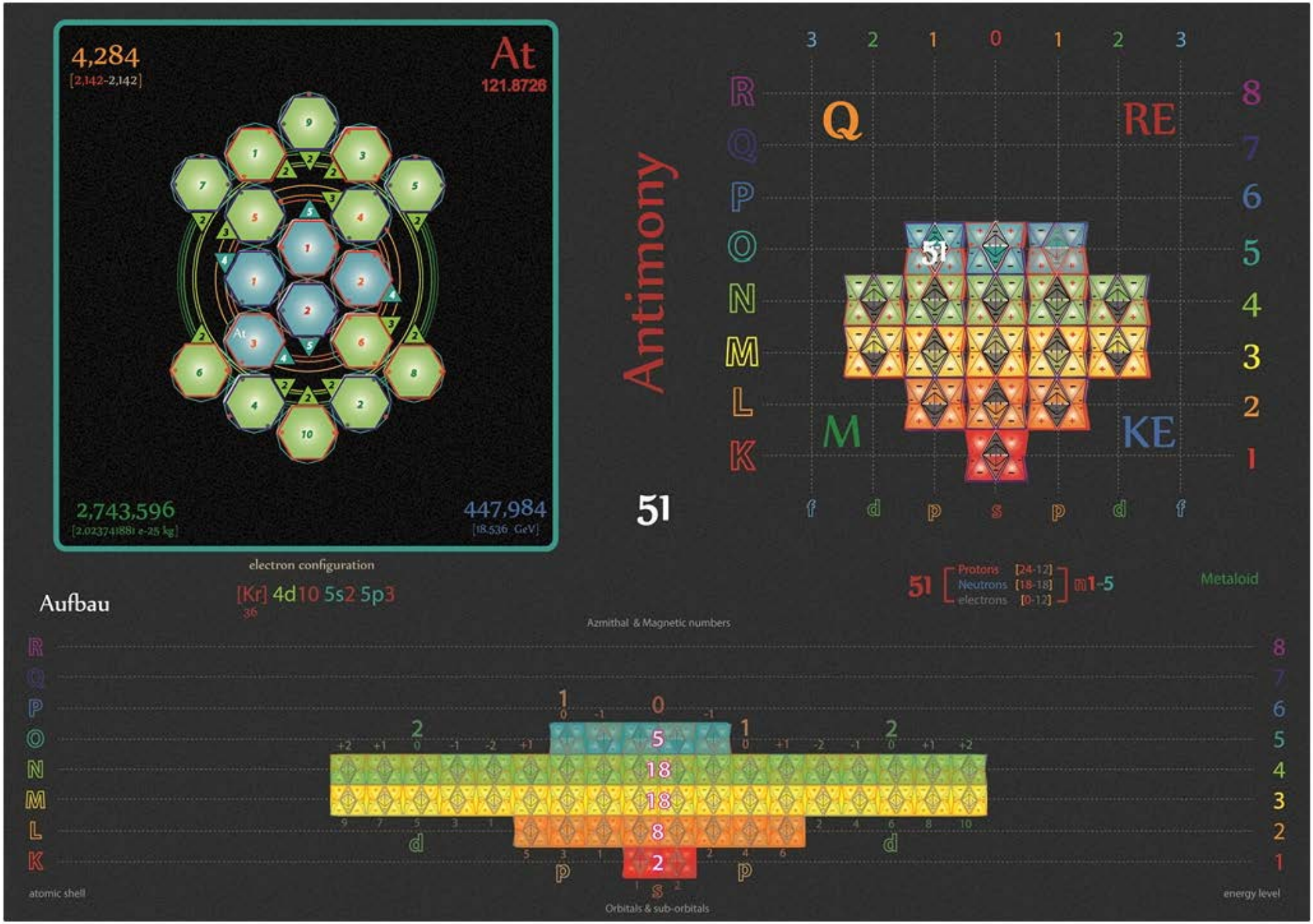

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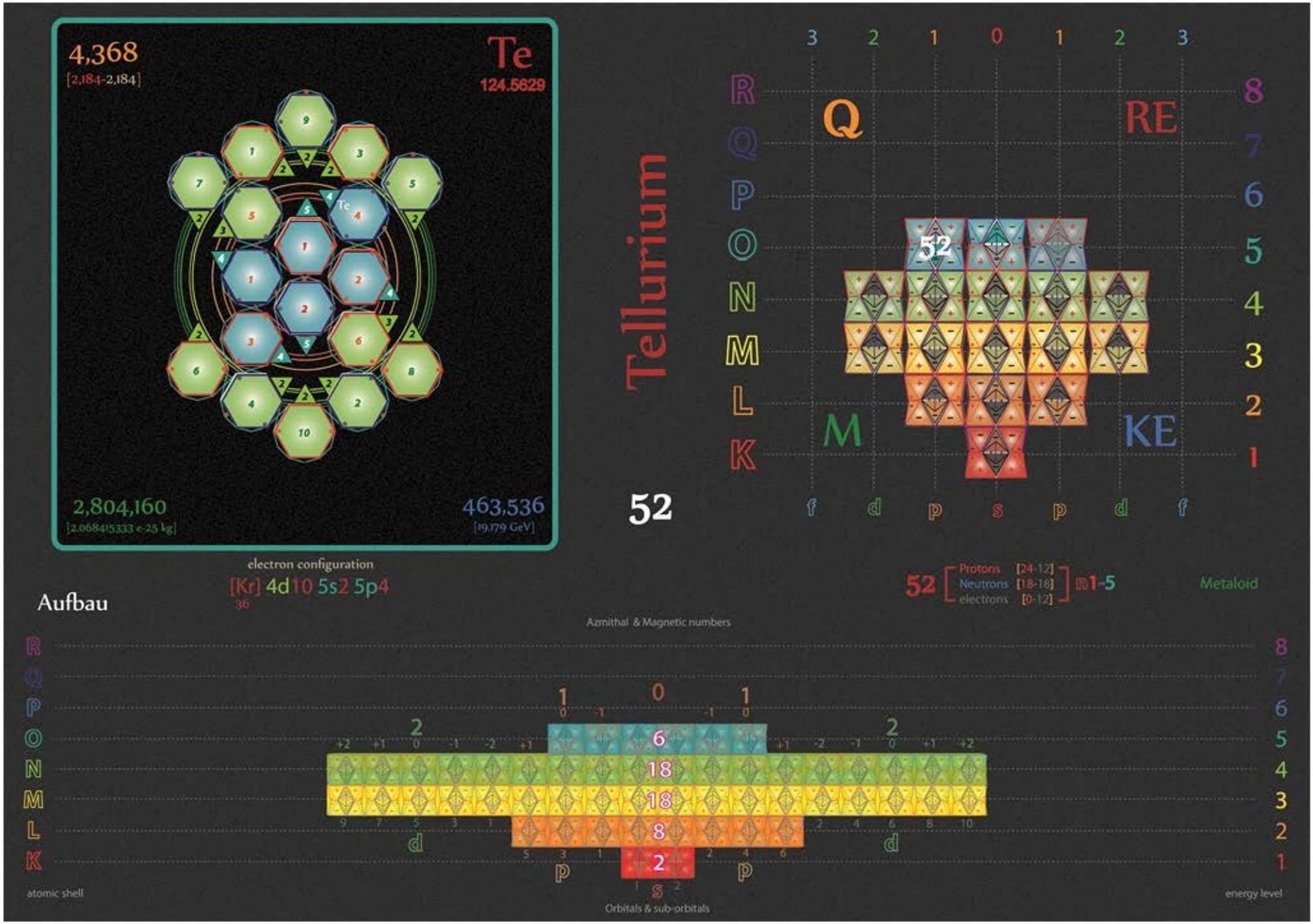

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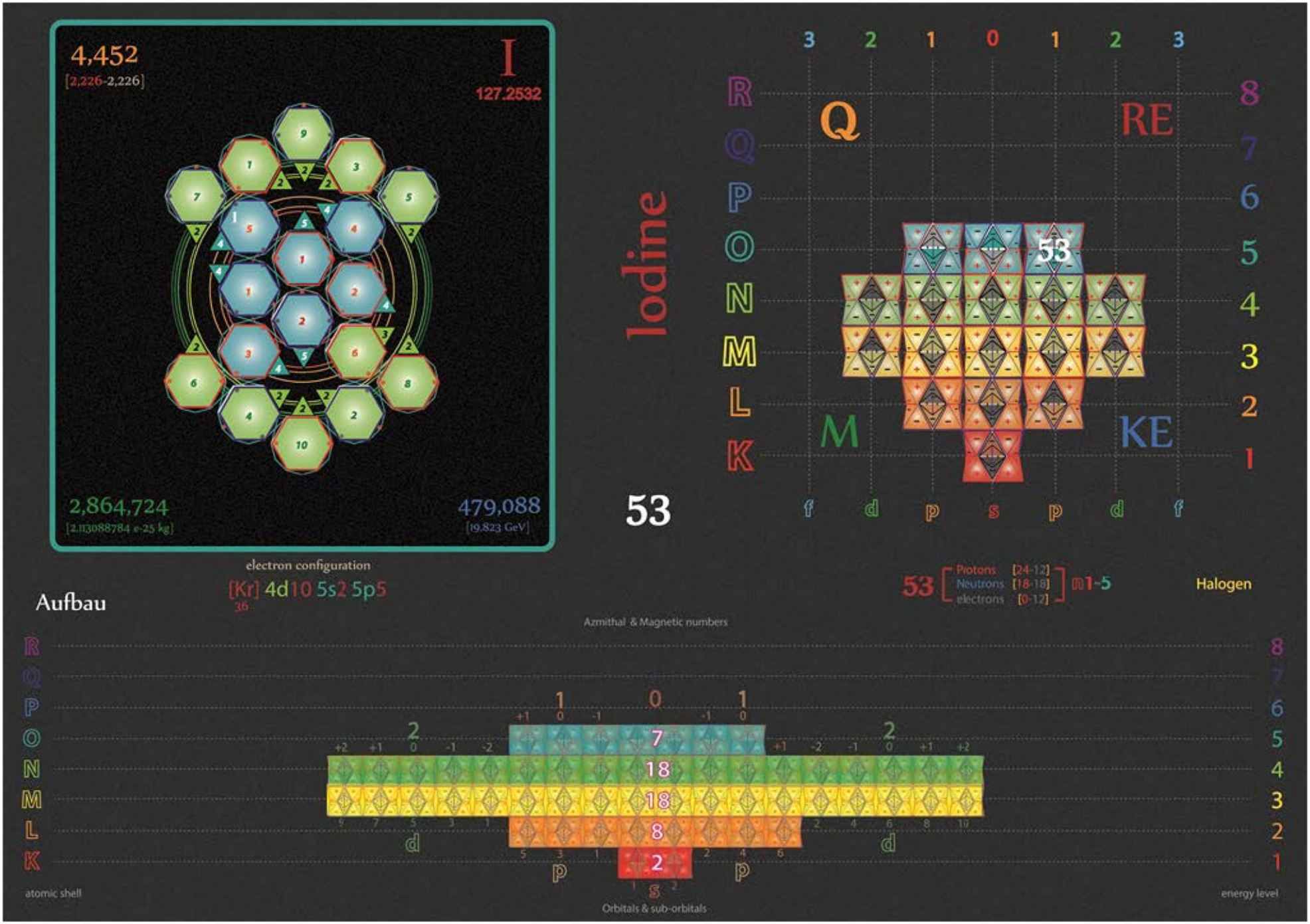

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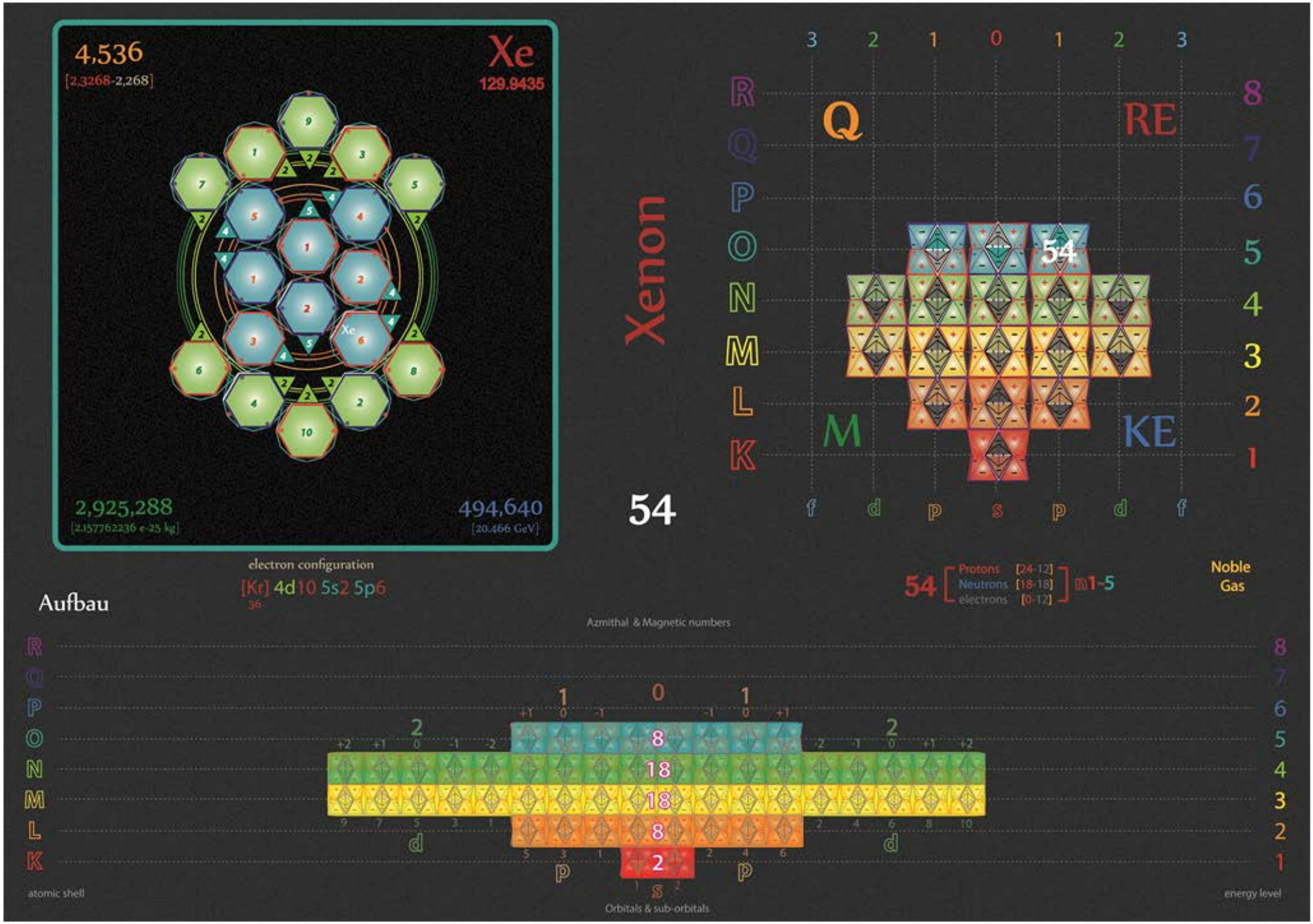

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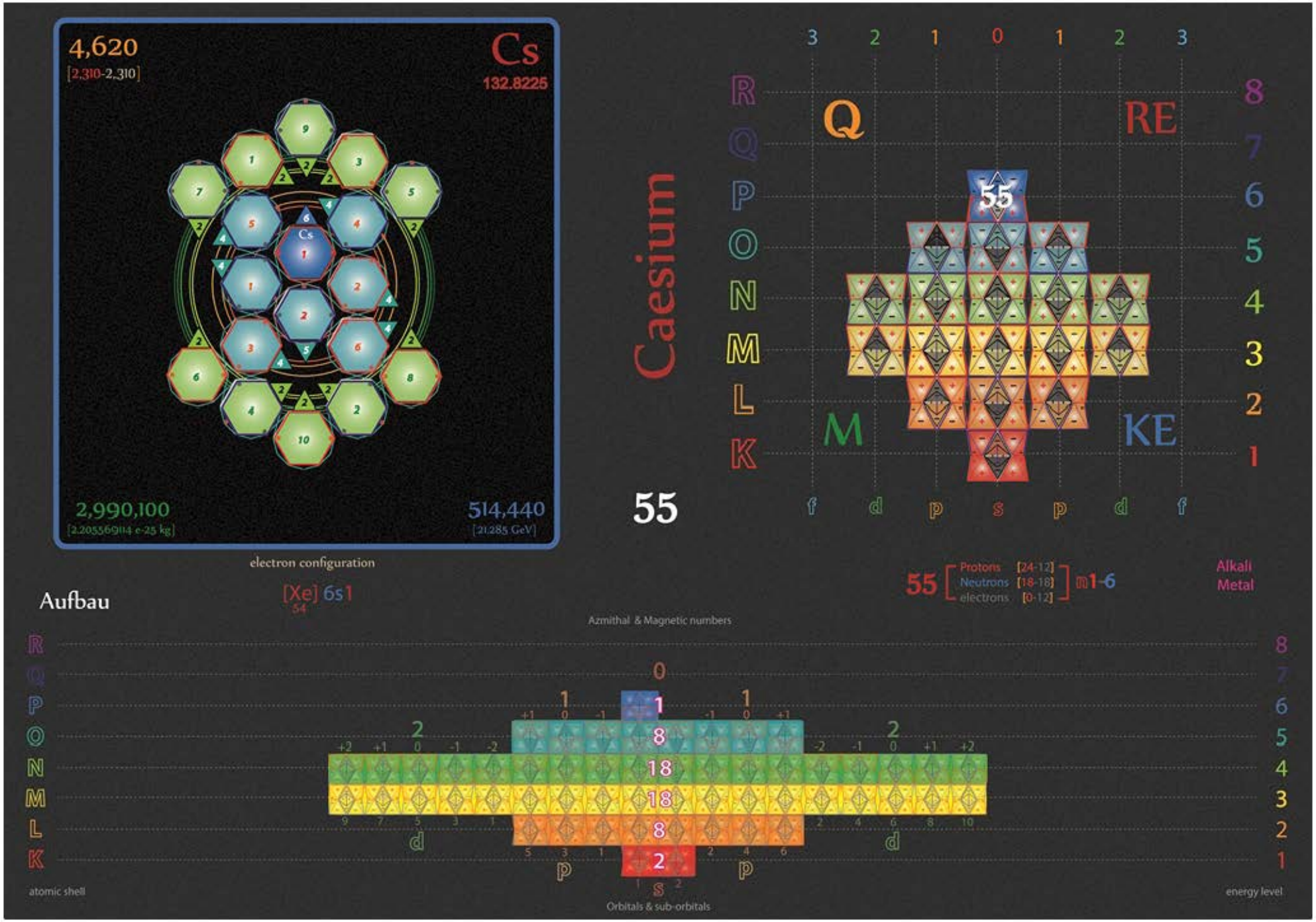

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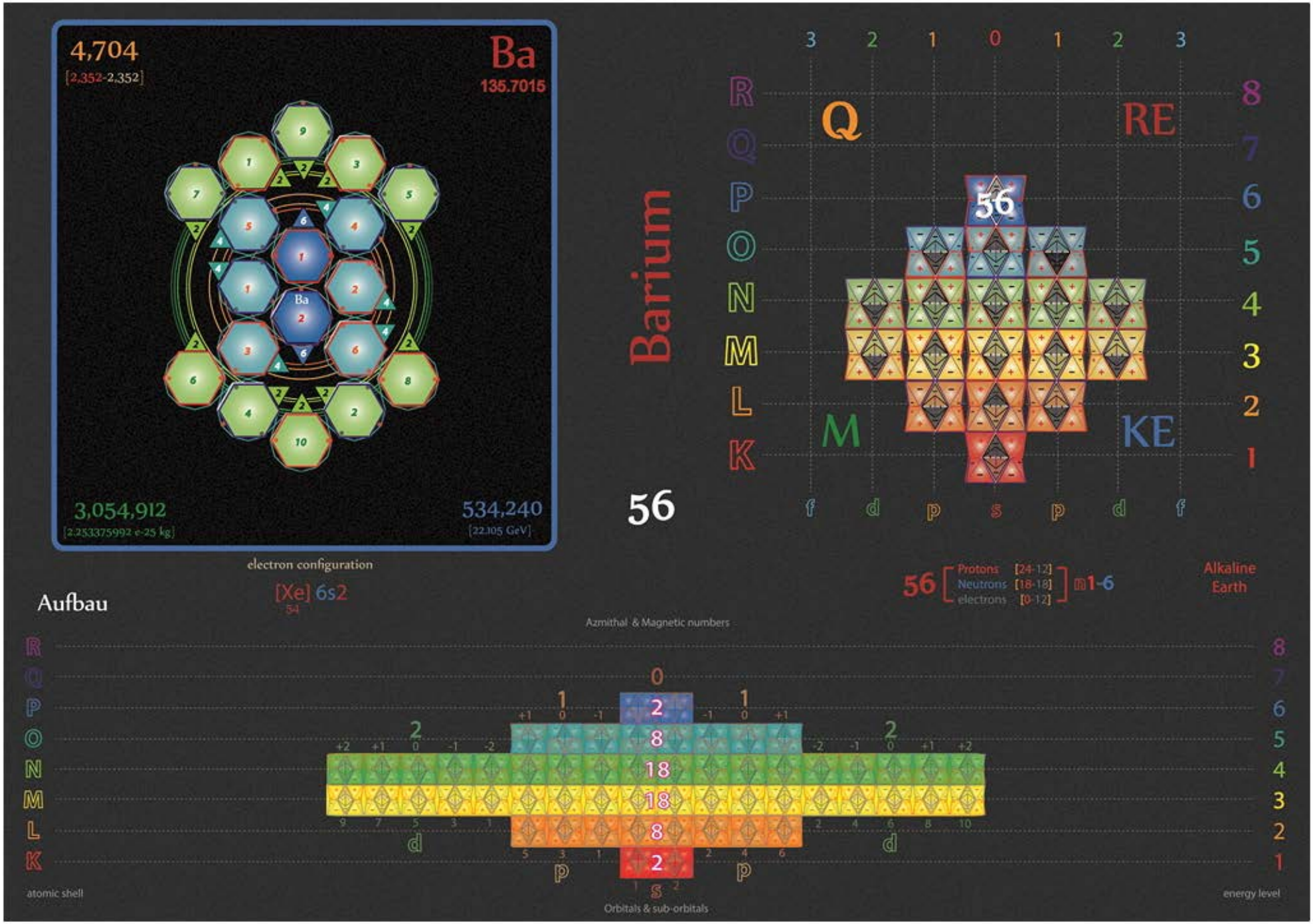

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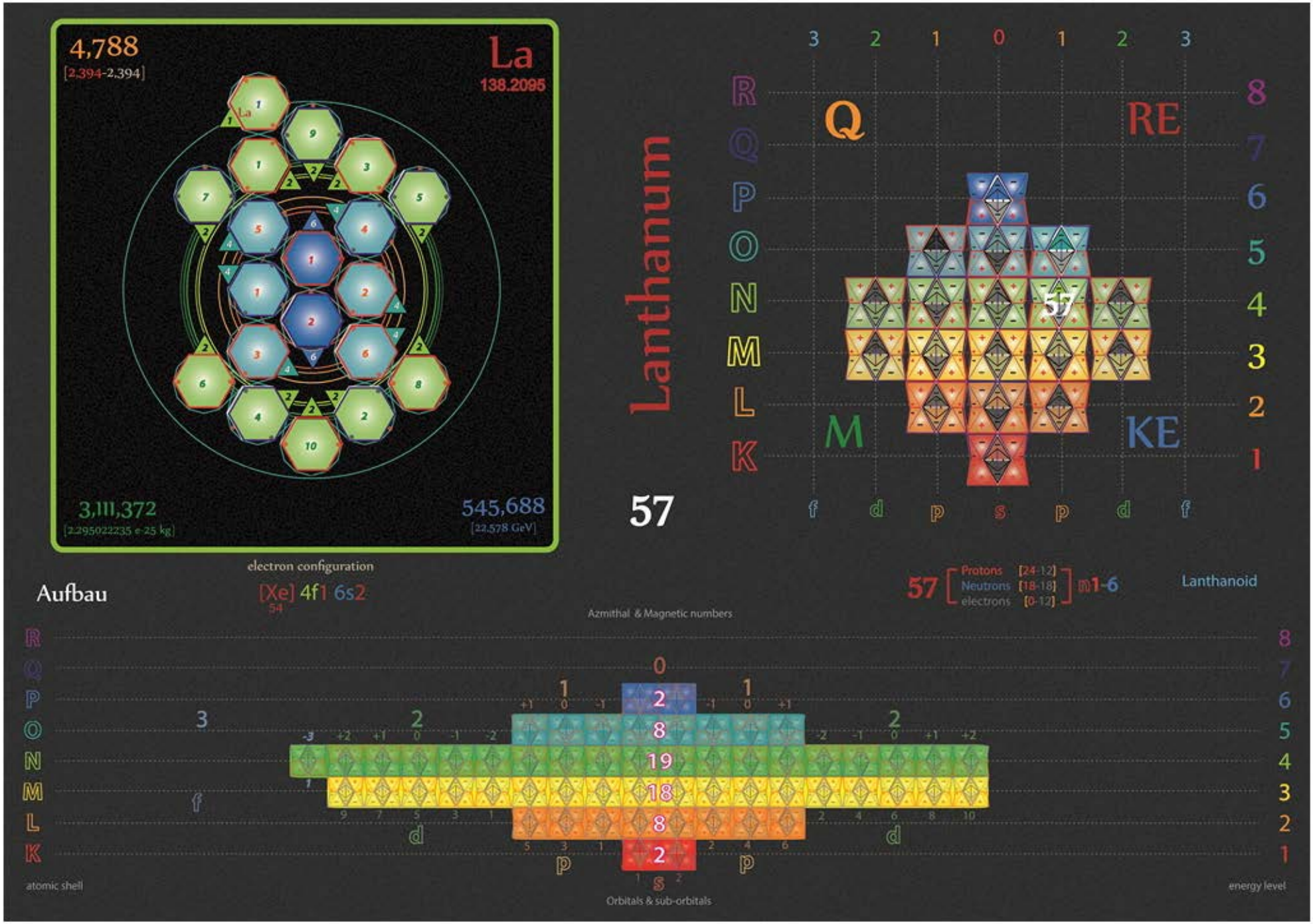

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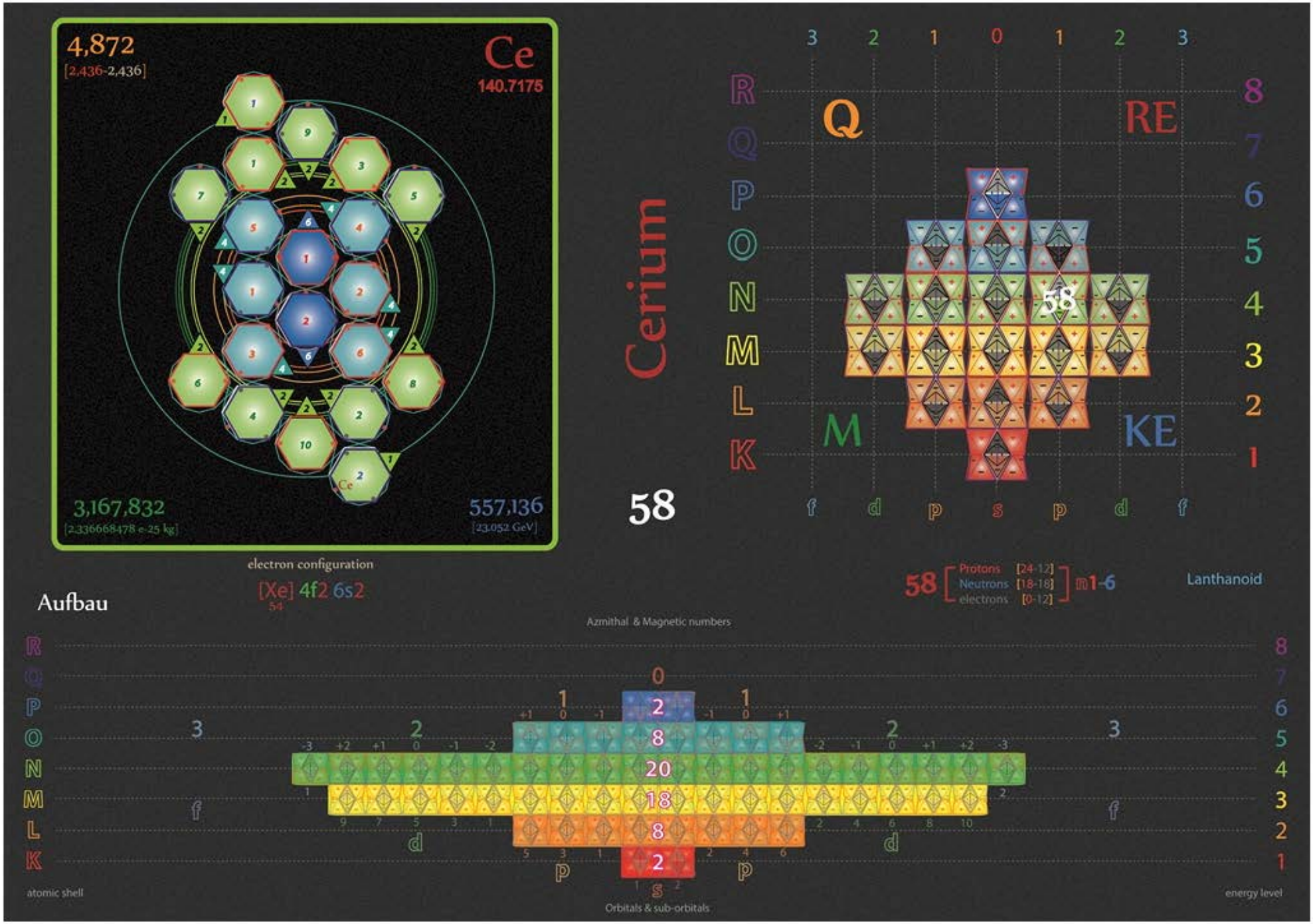

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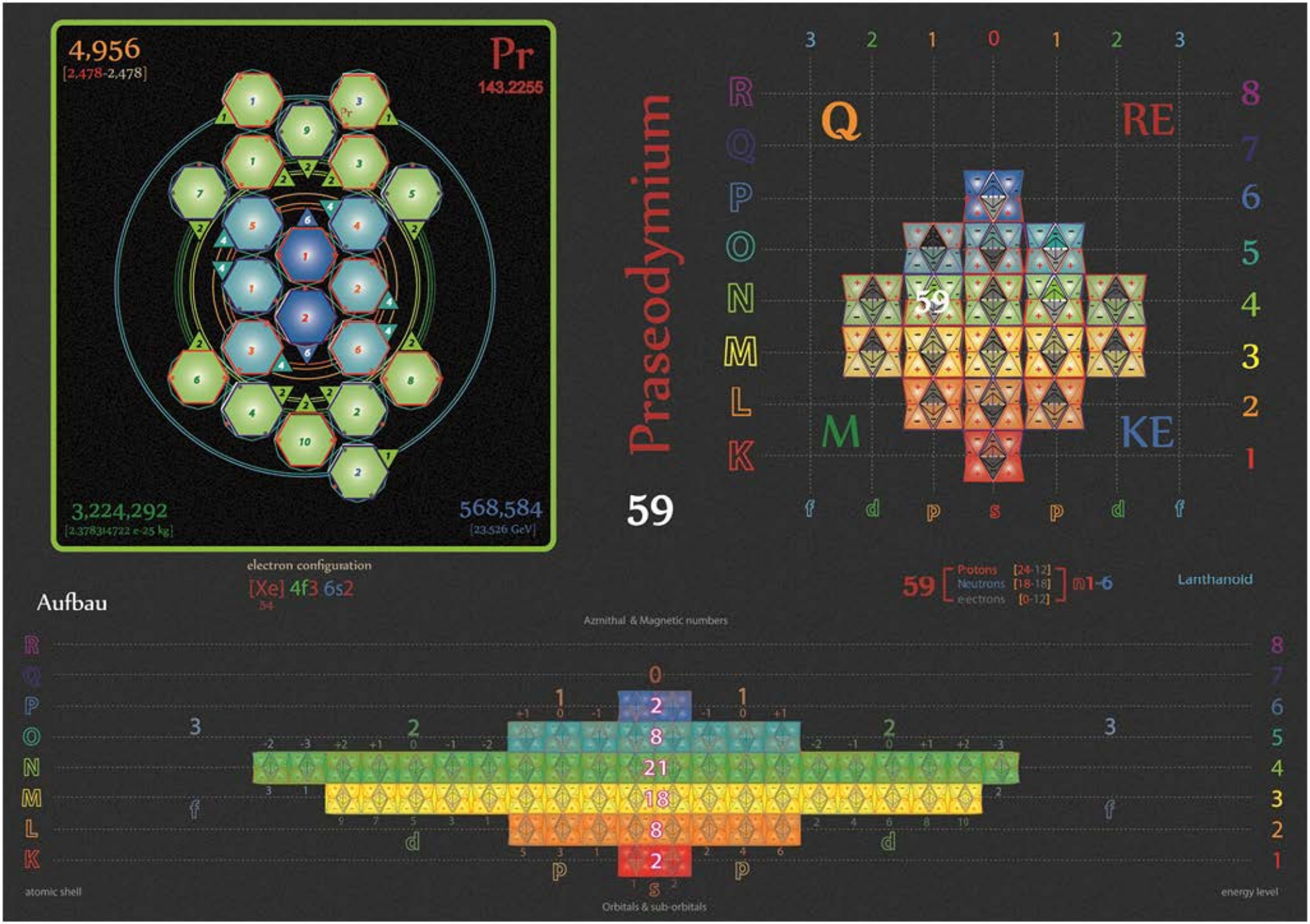

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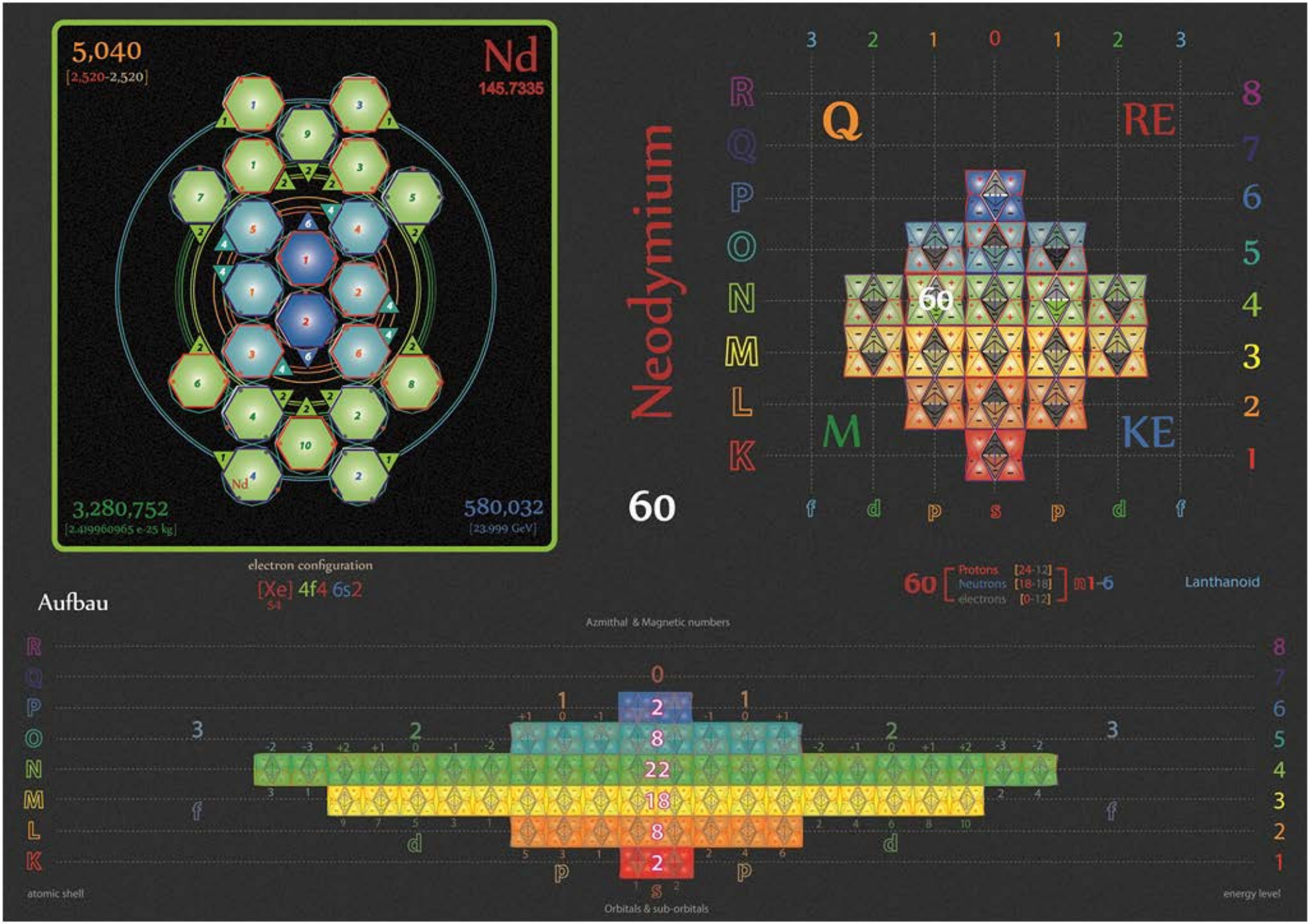

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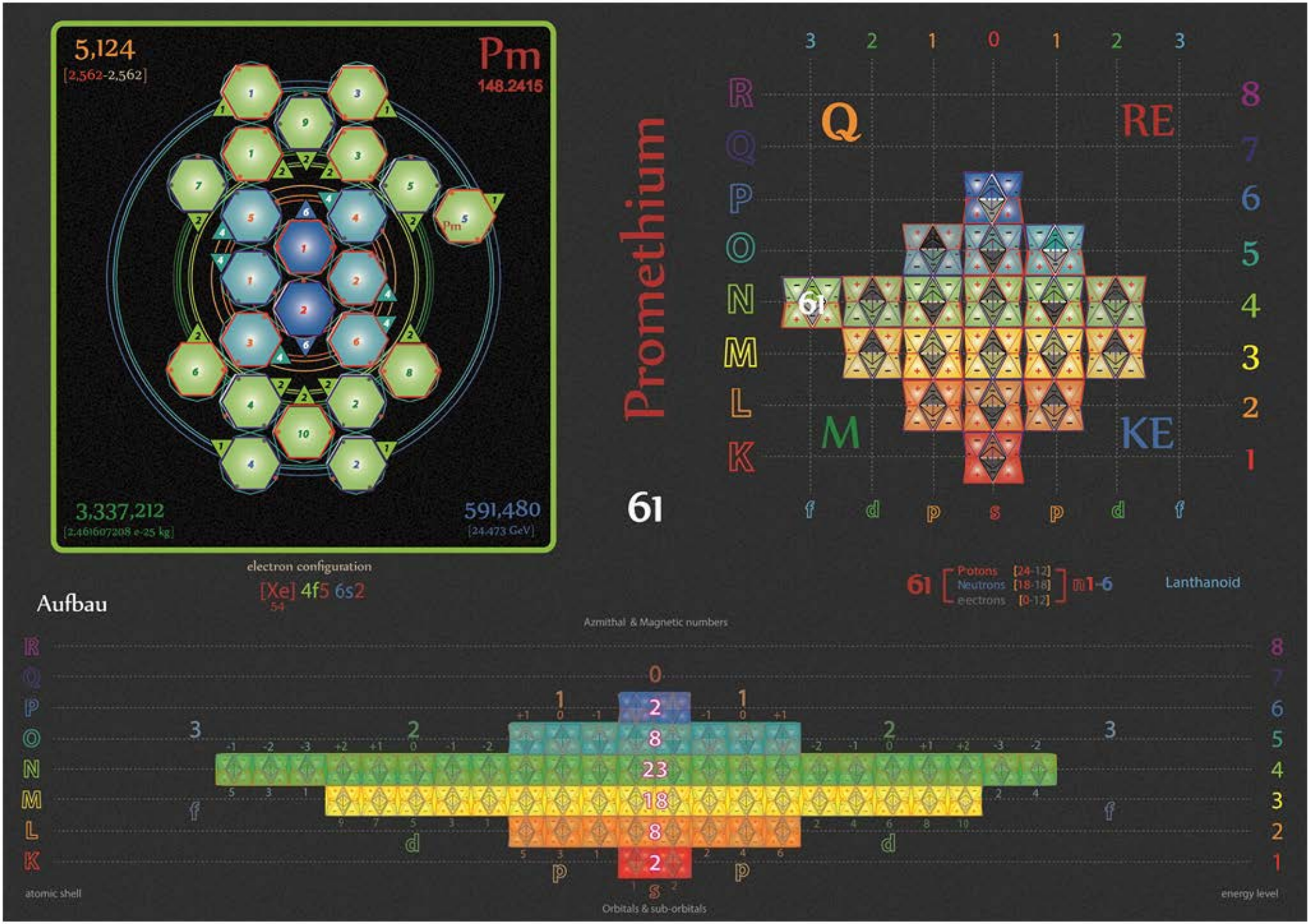

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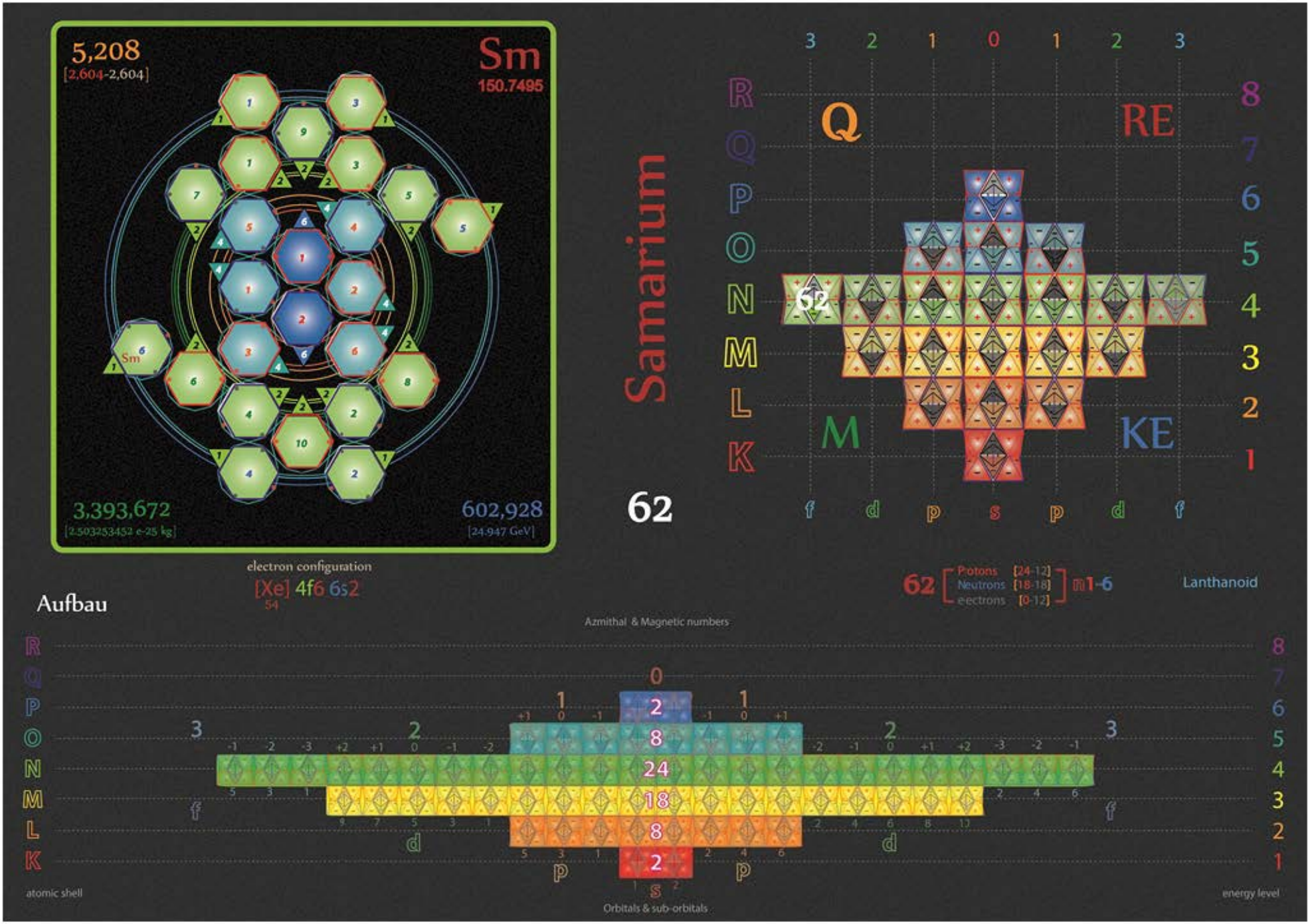

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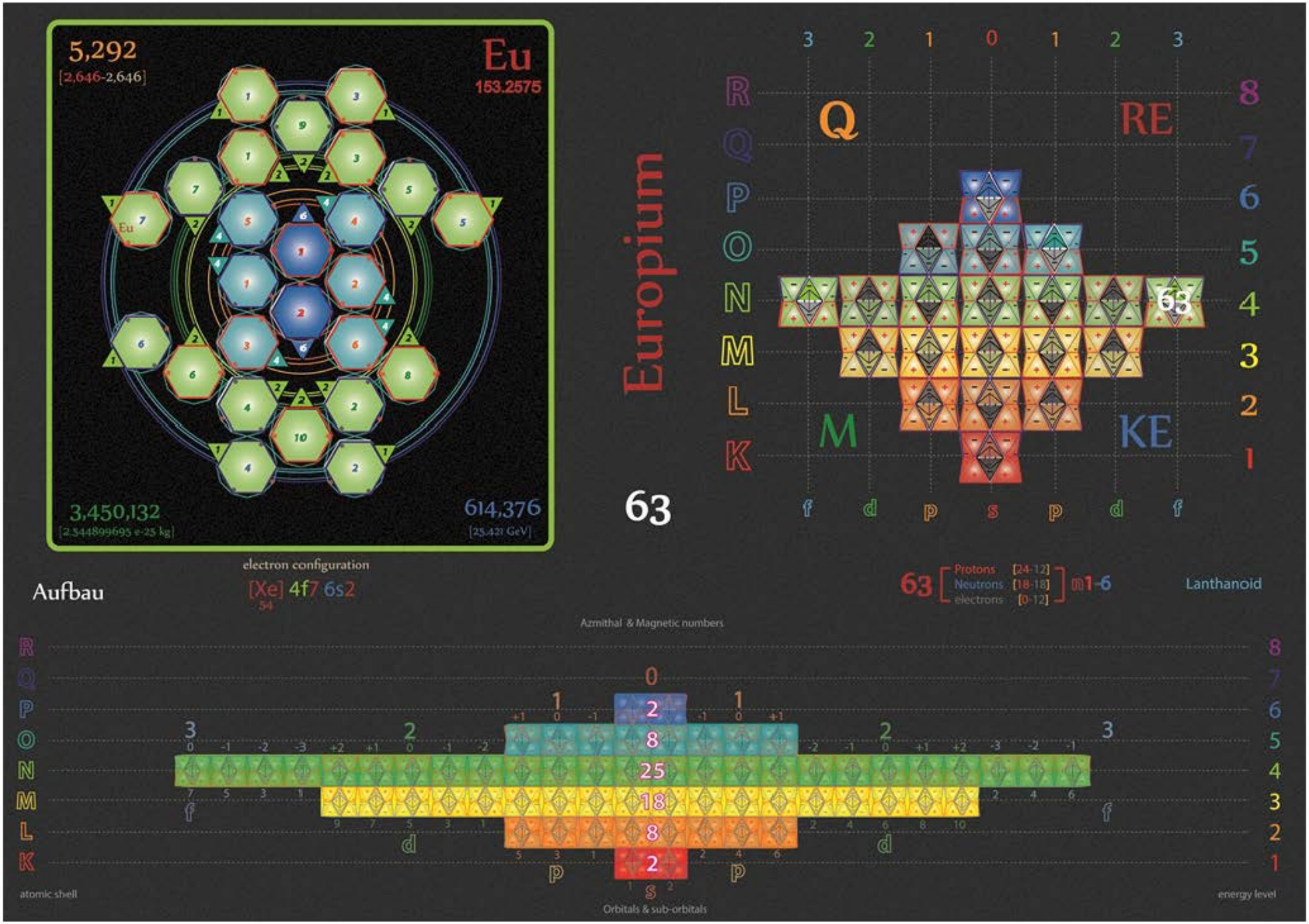

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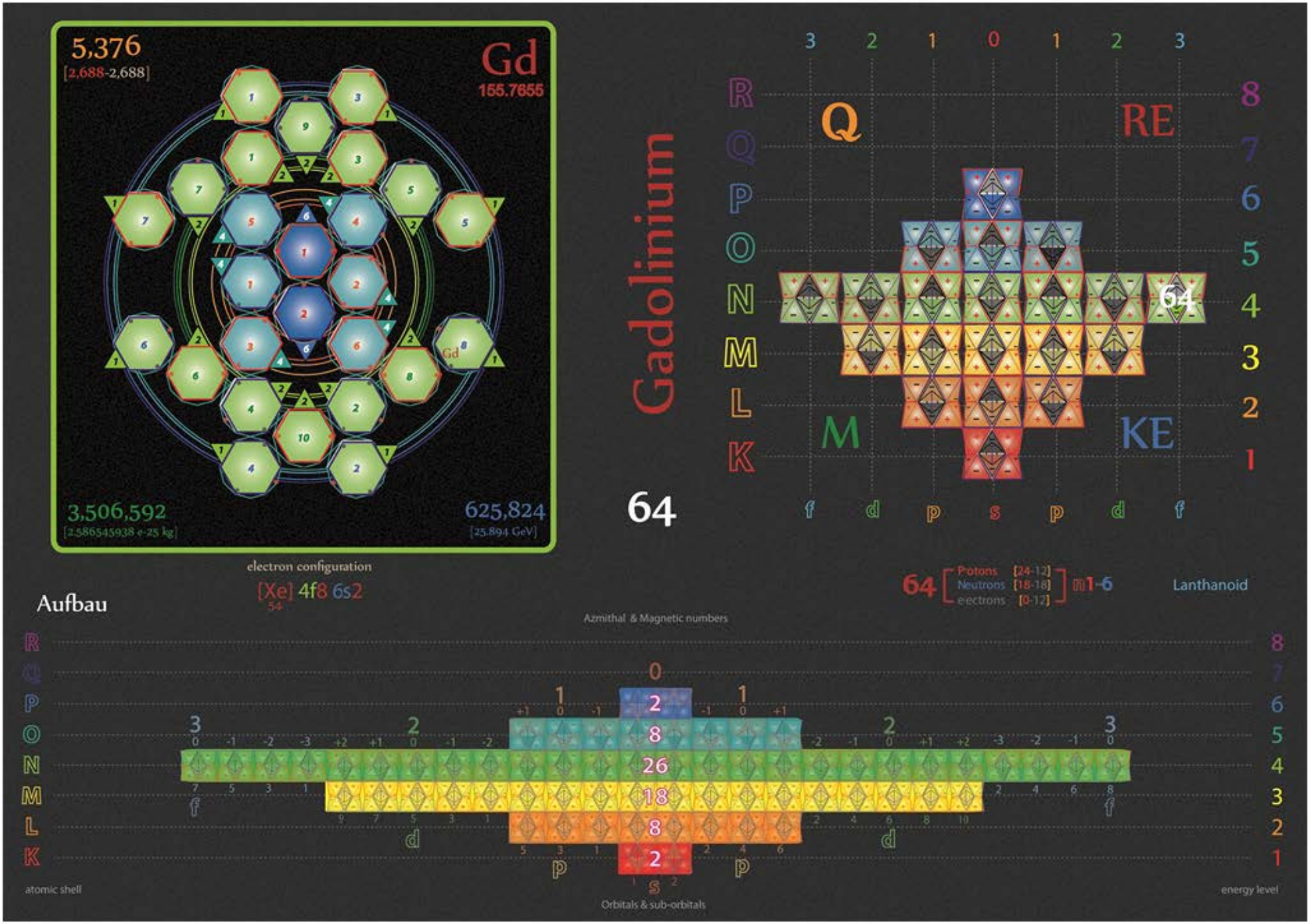

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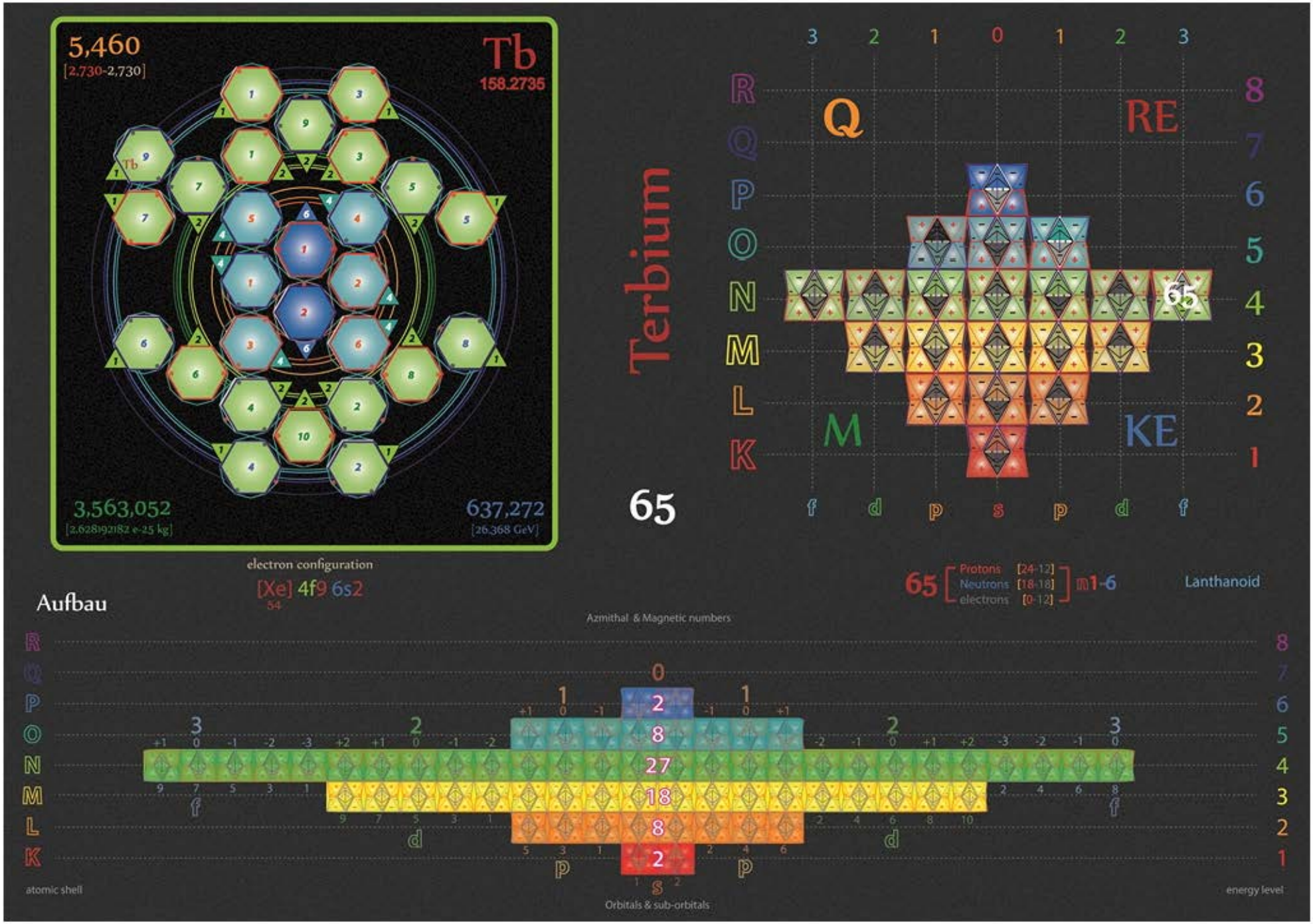

Tetryonics 51.65 -Terbium atom

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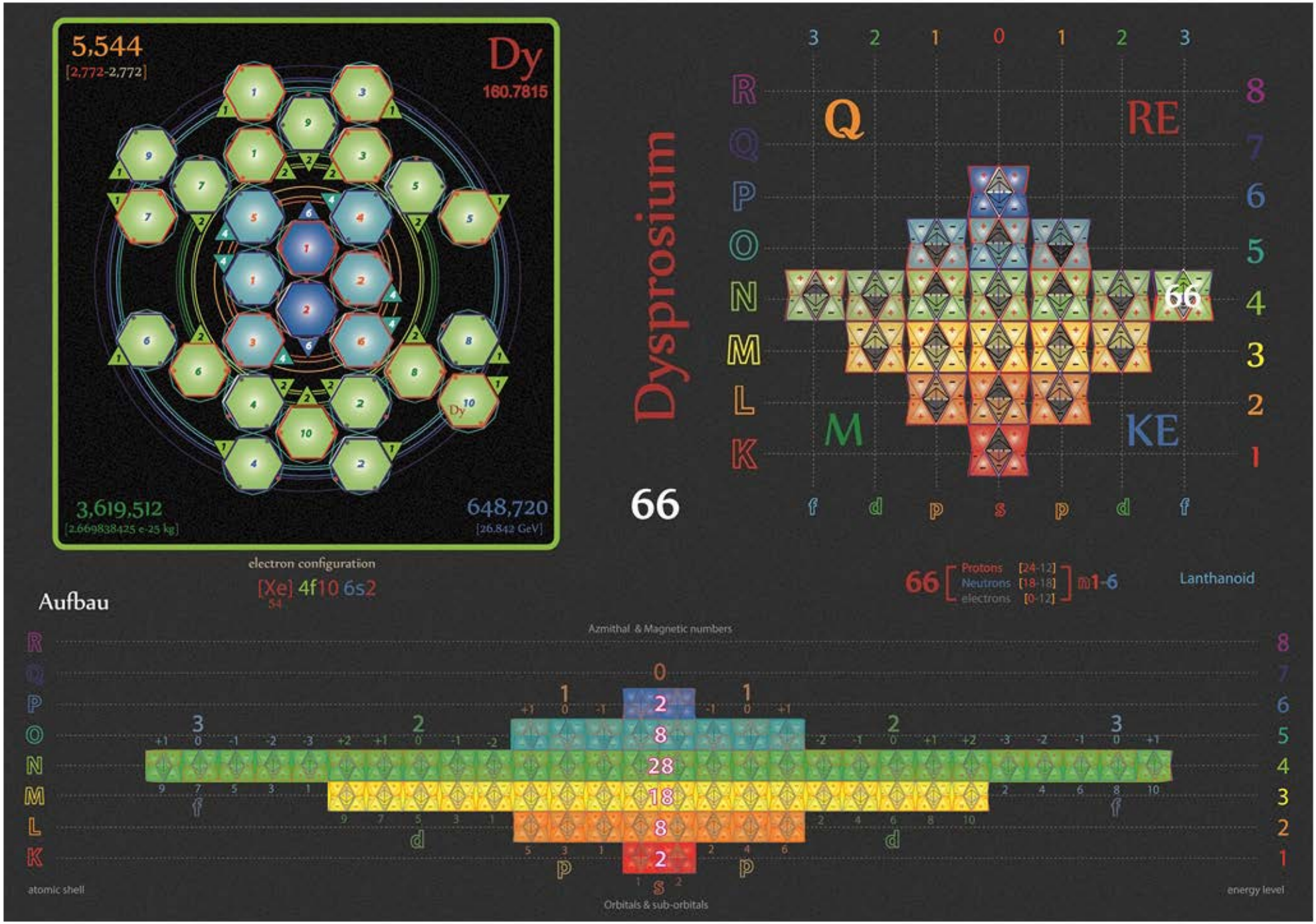

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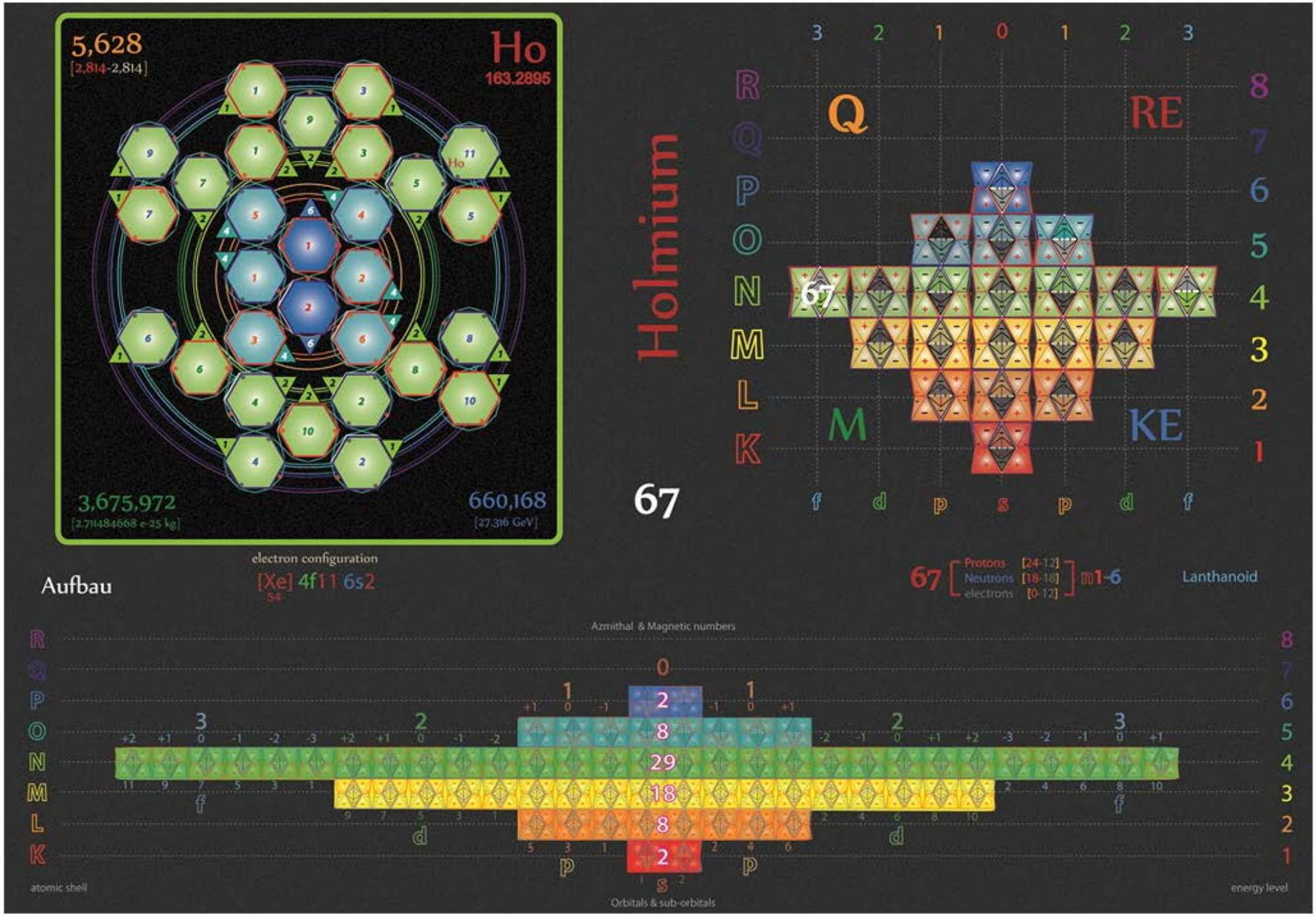

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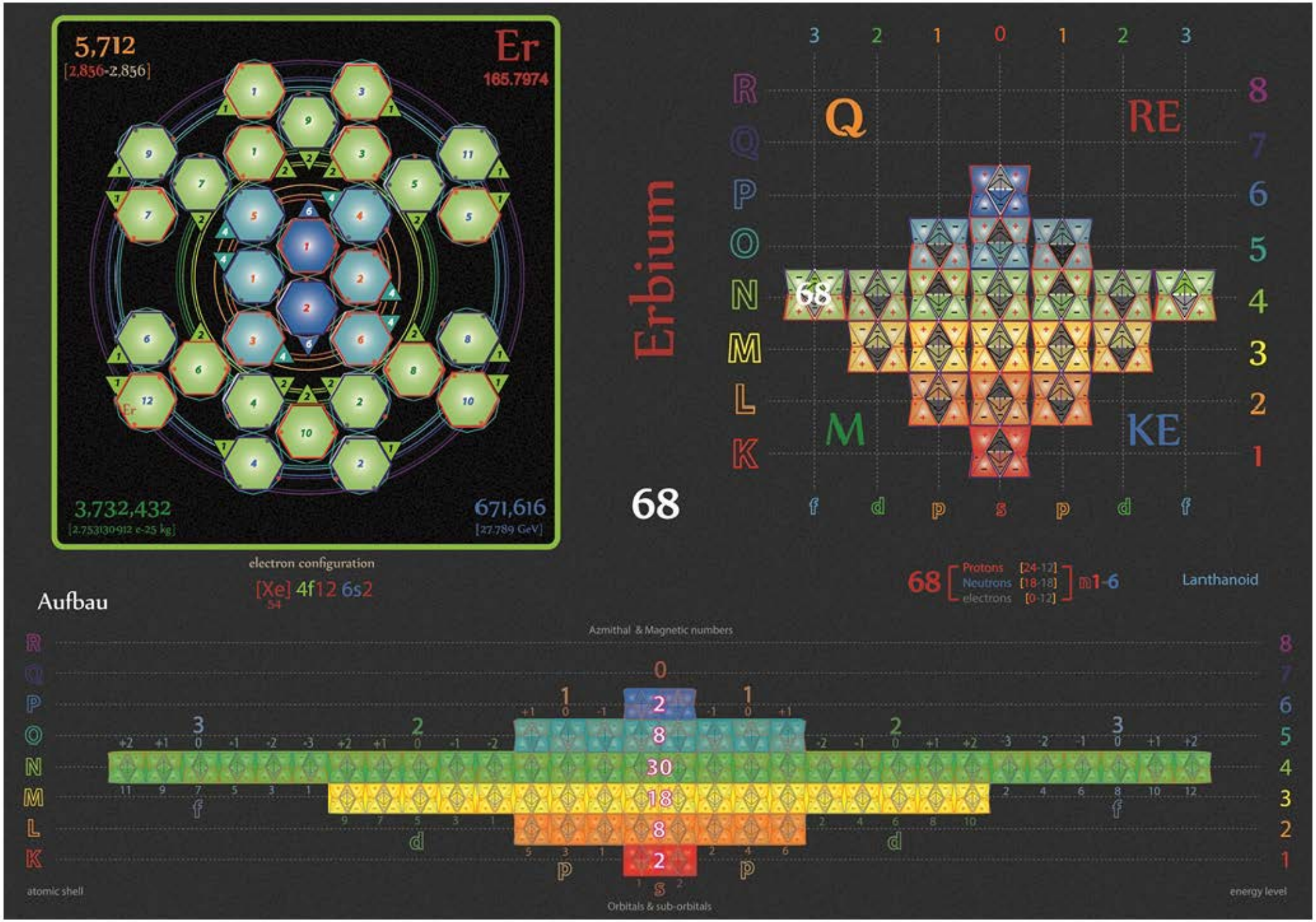

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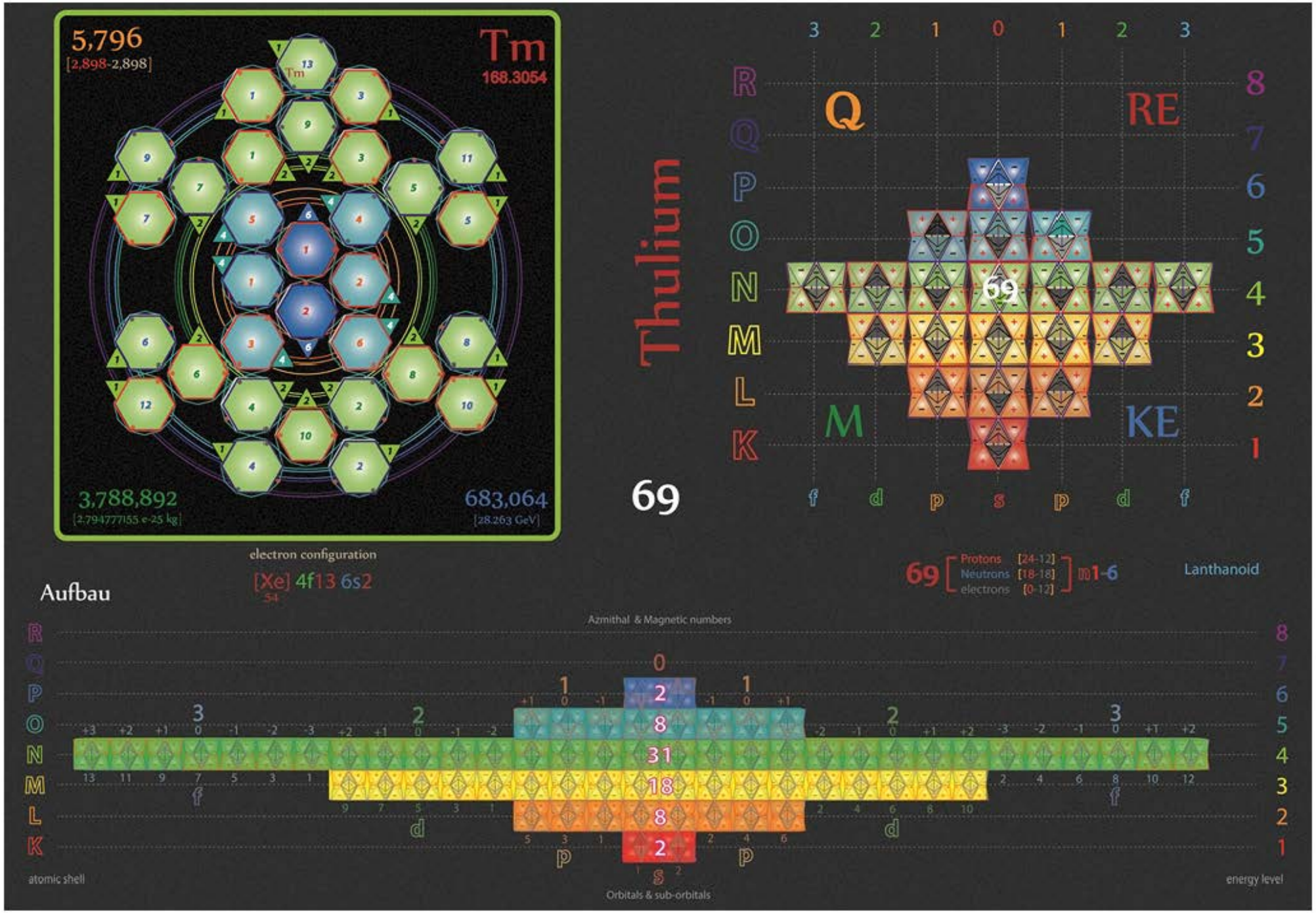

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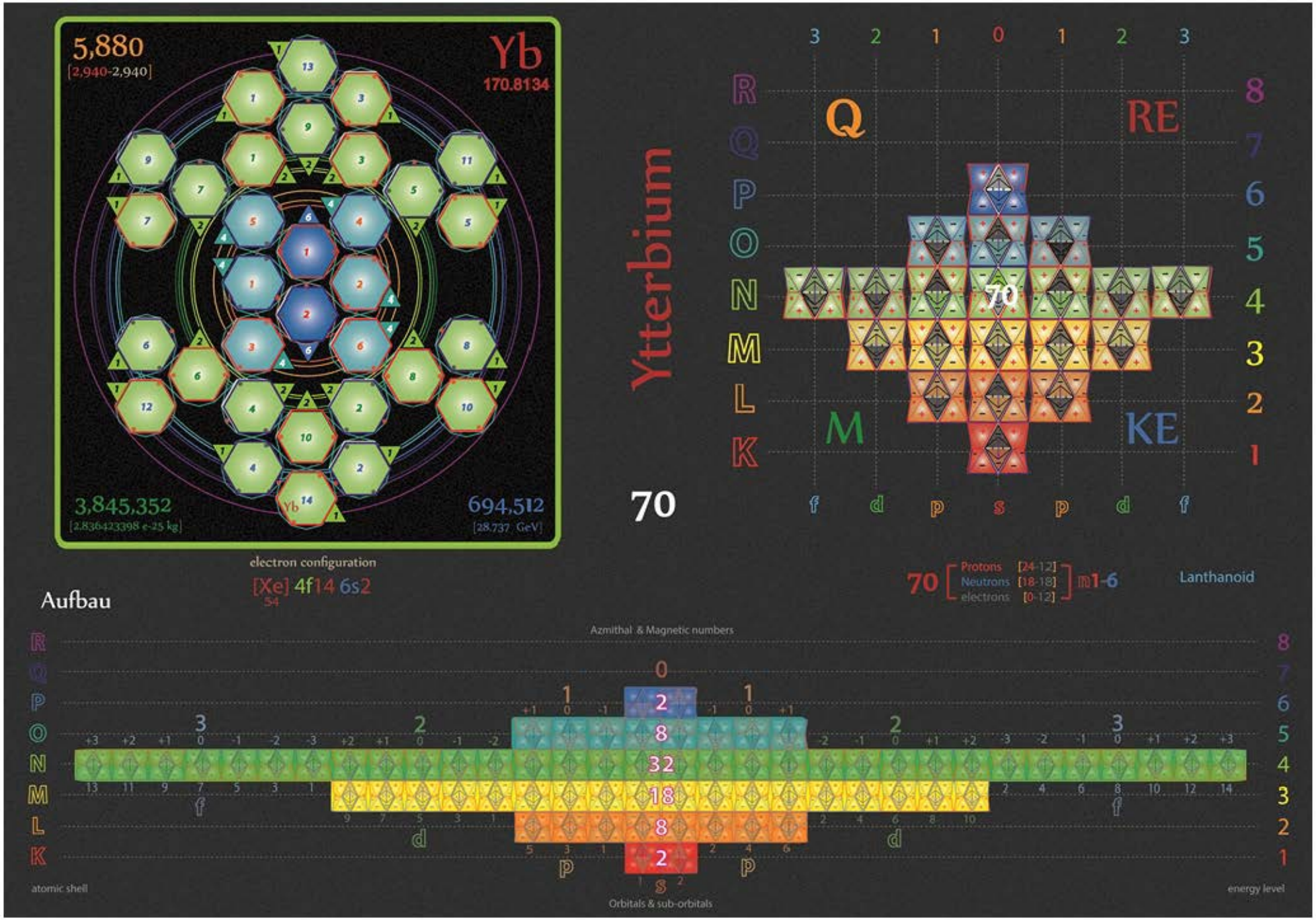

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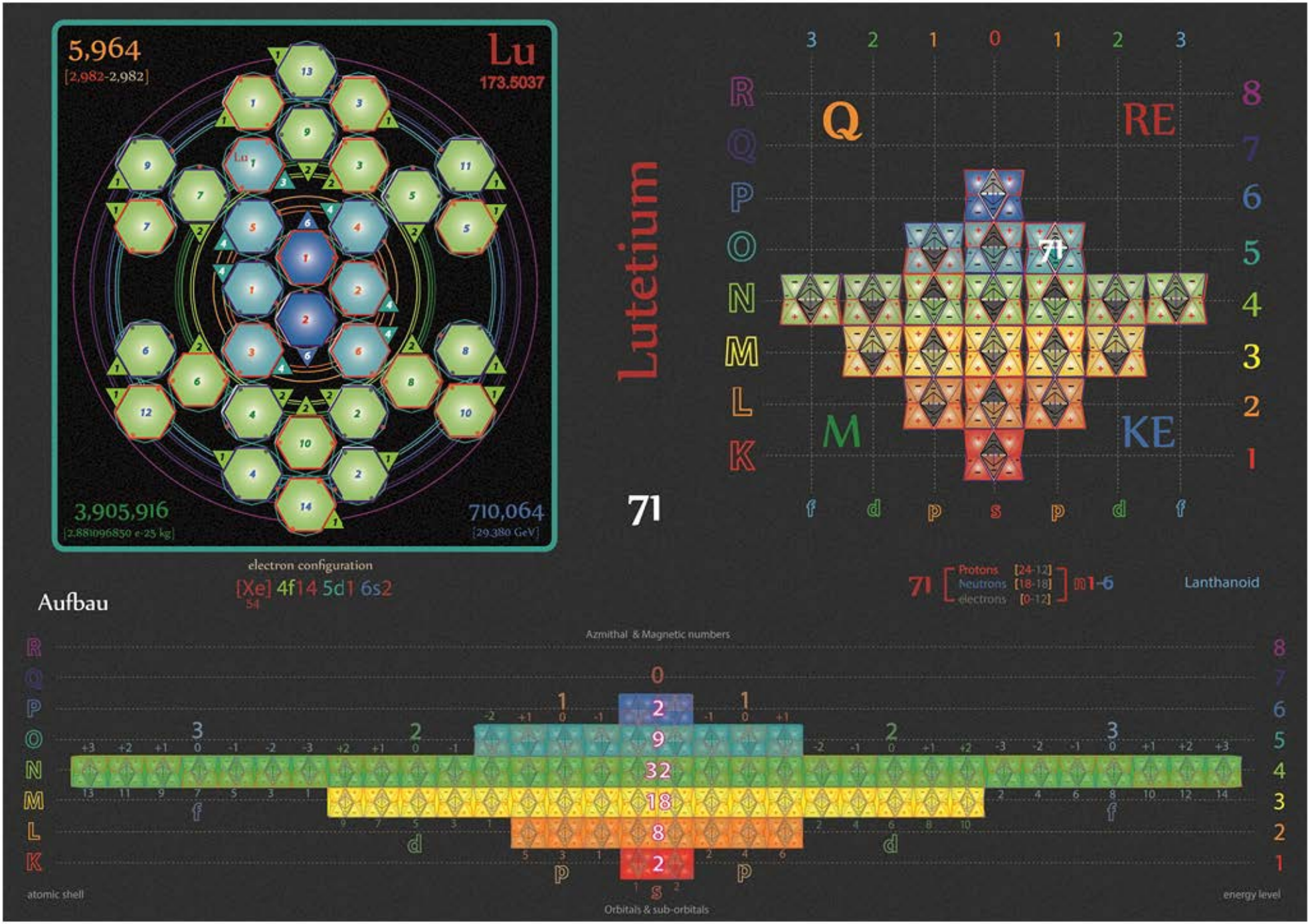

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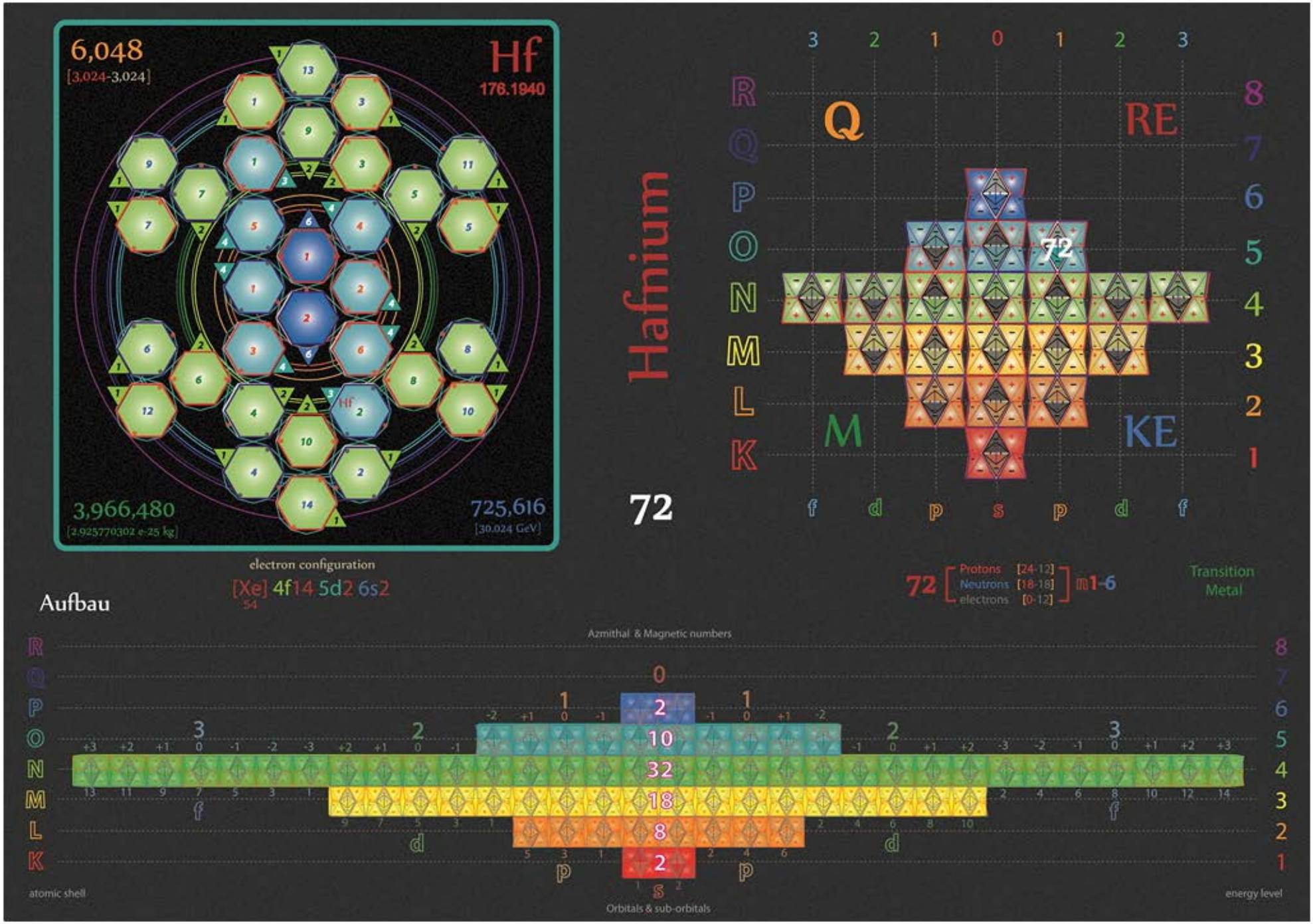

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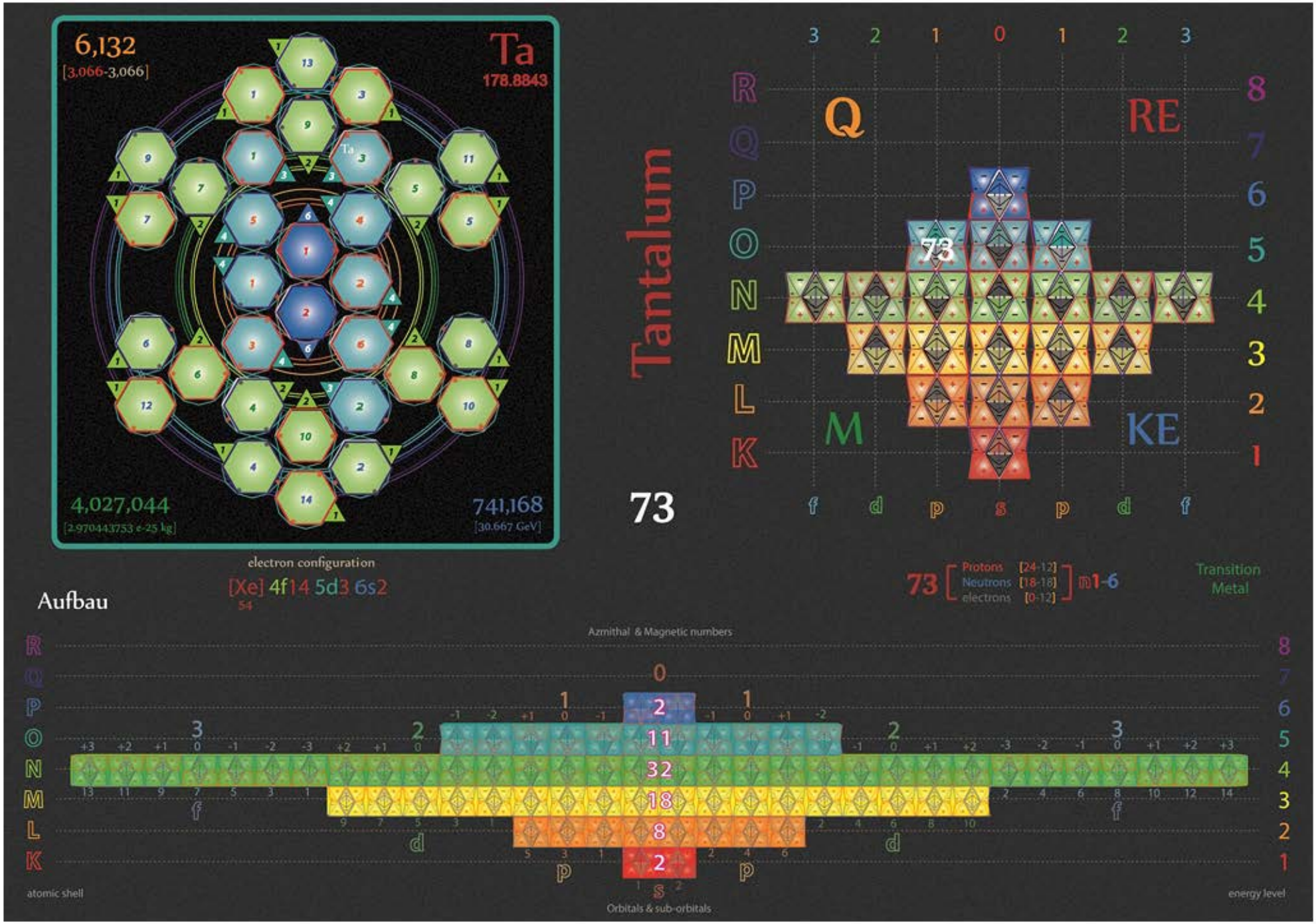

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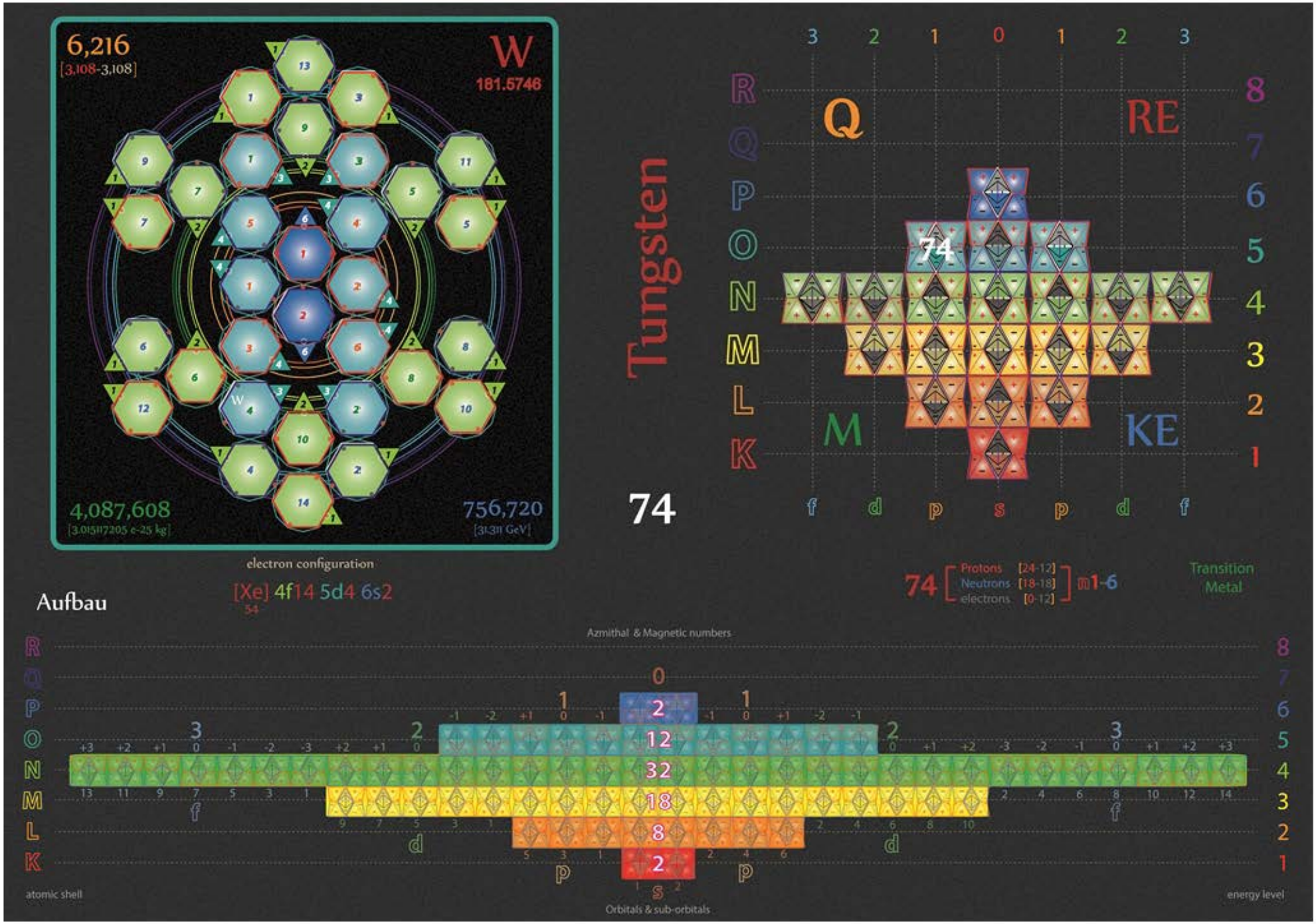

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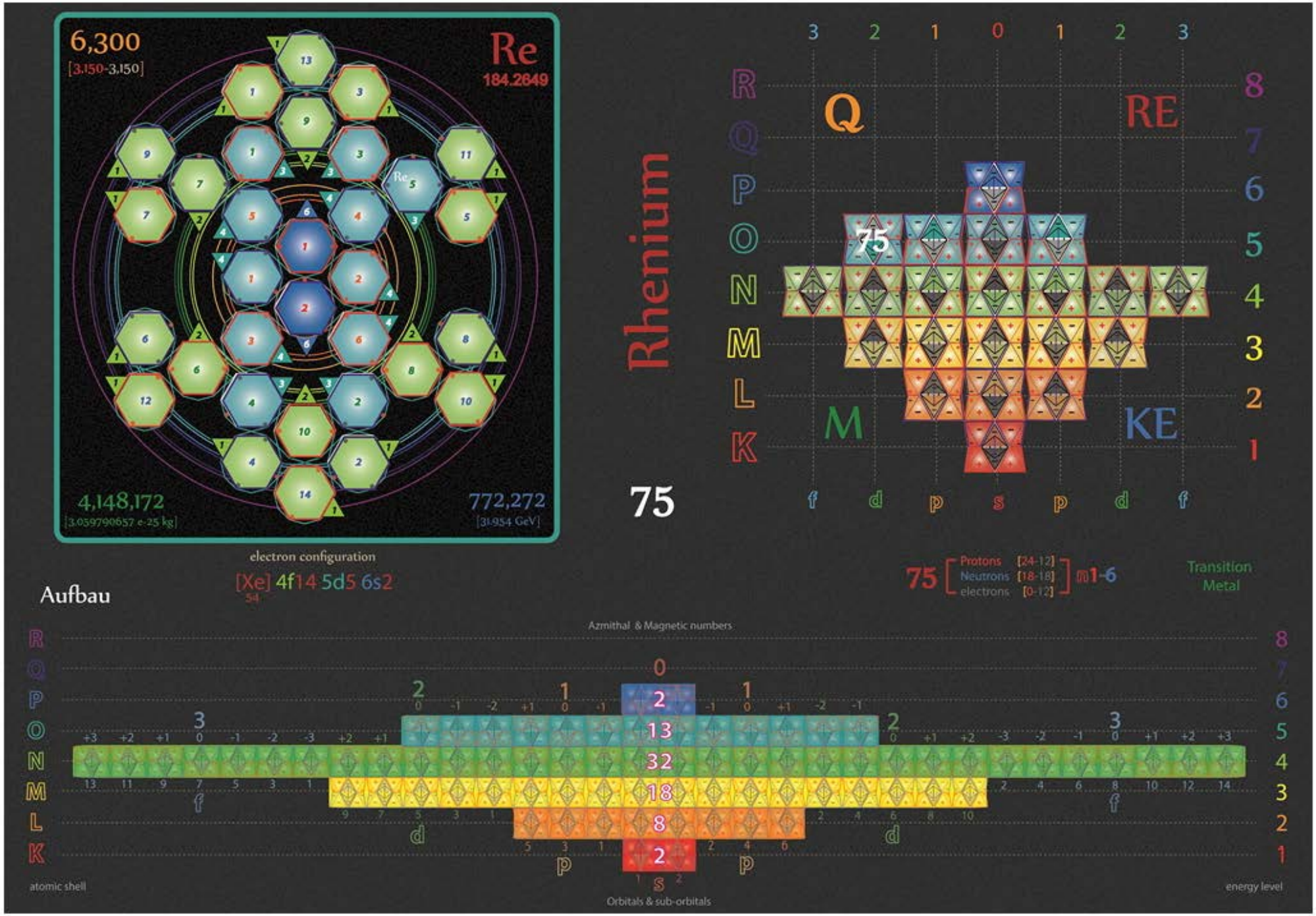

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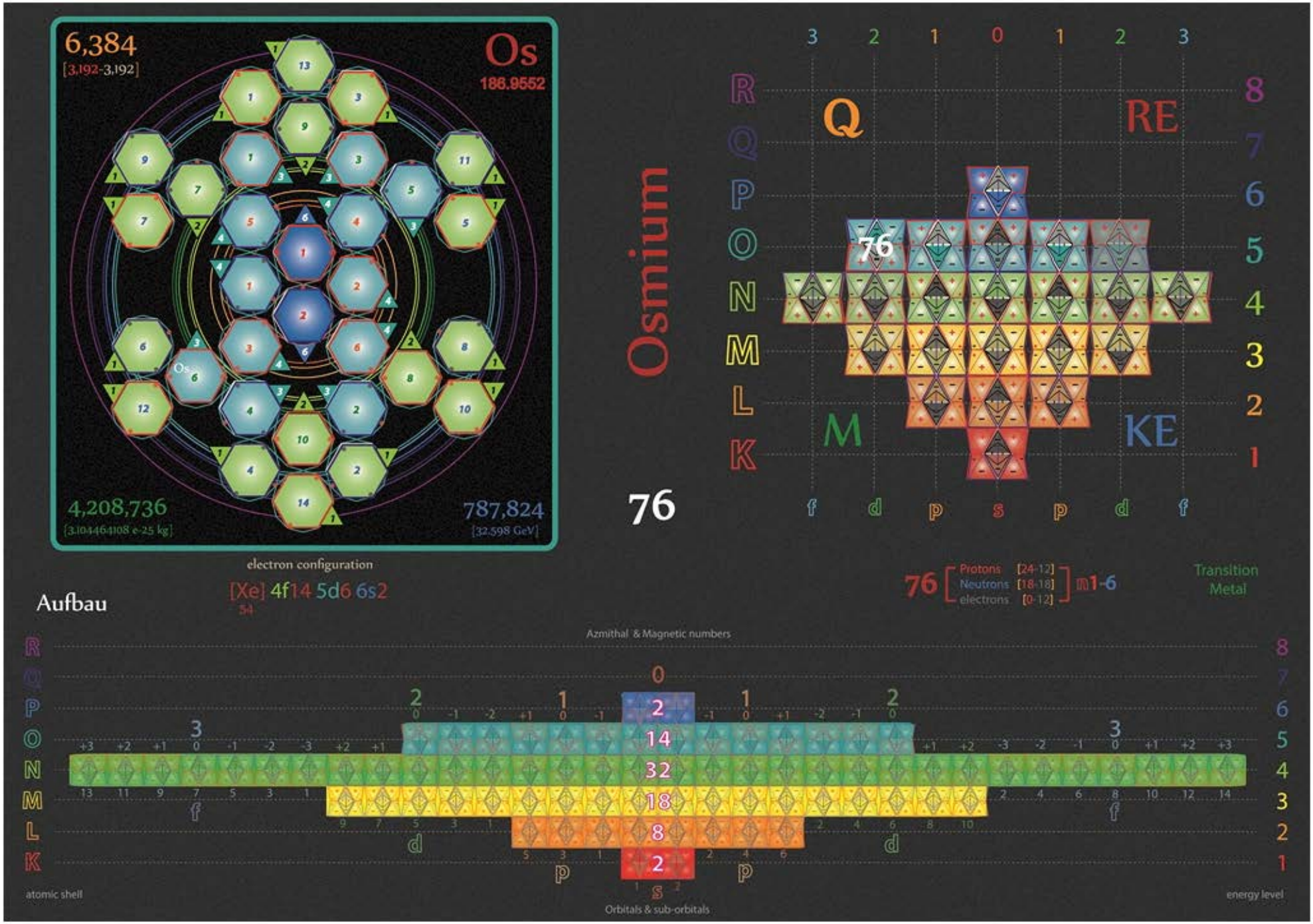

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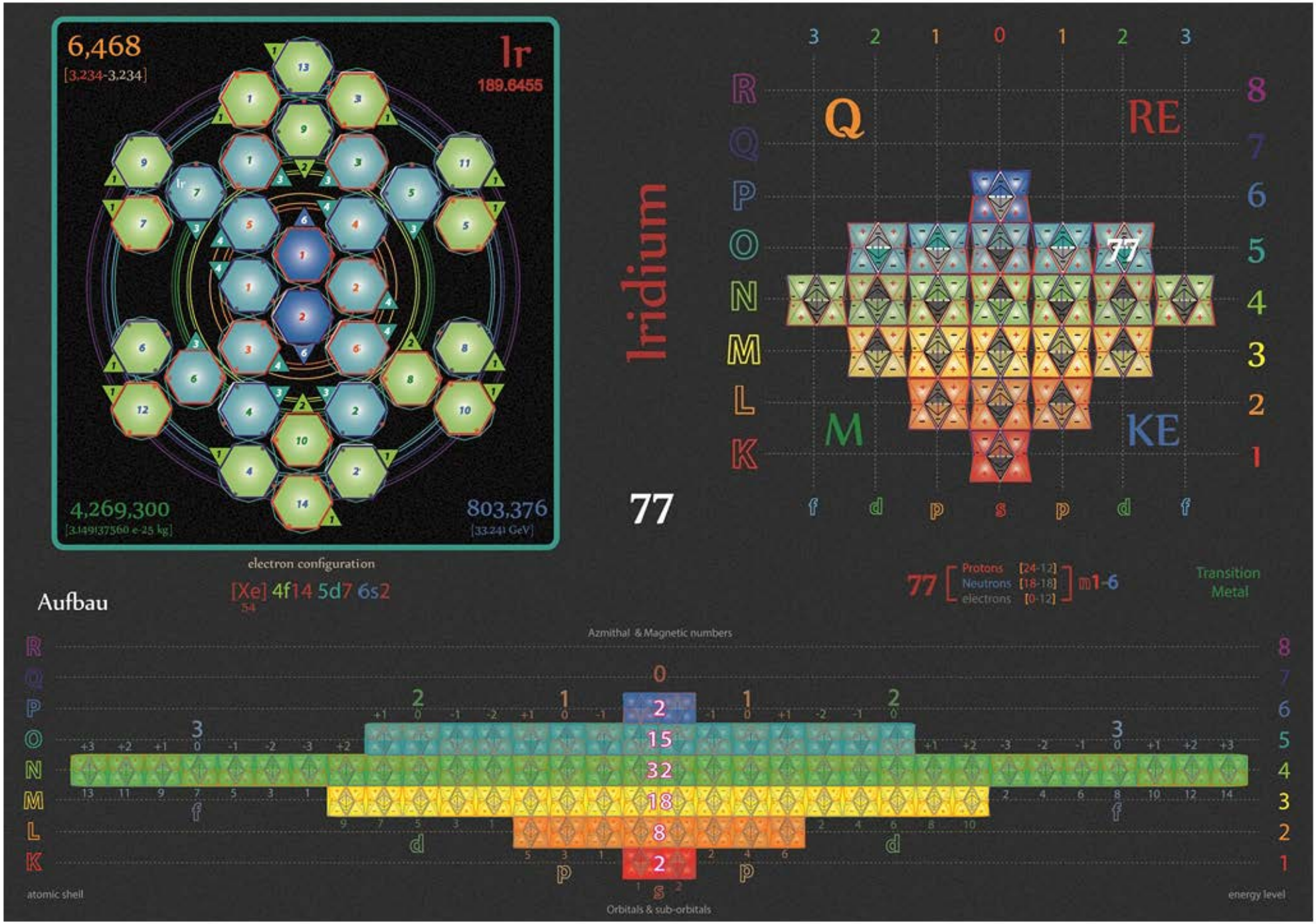

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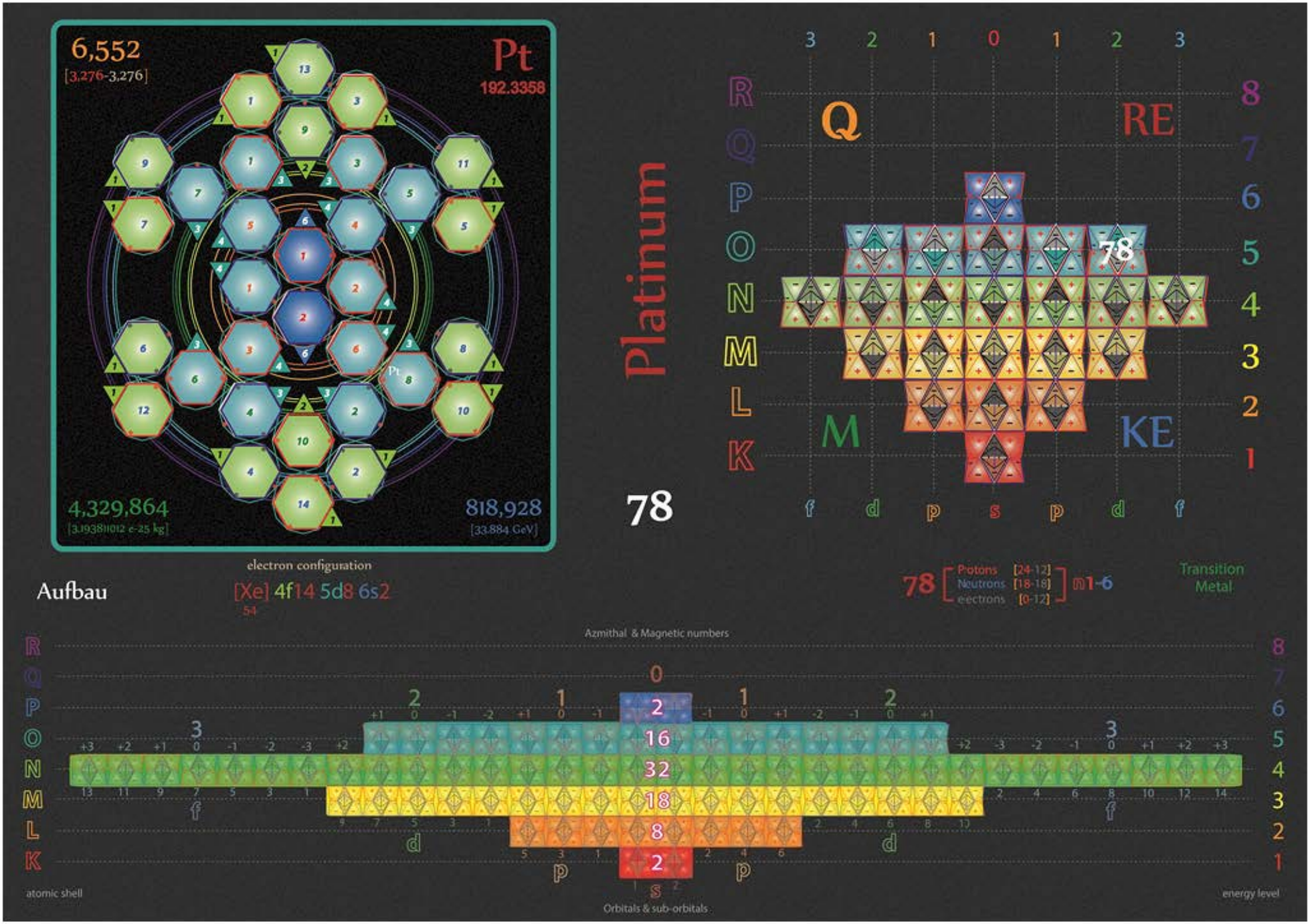

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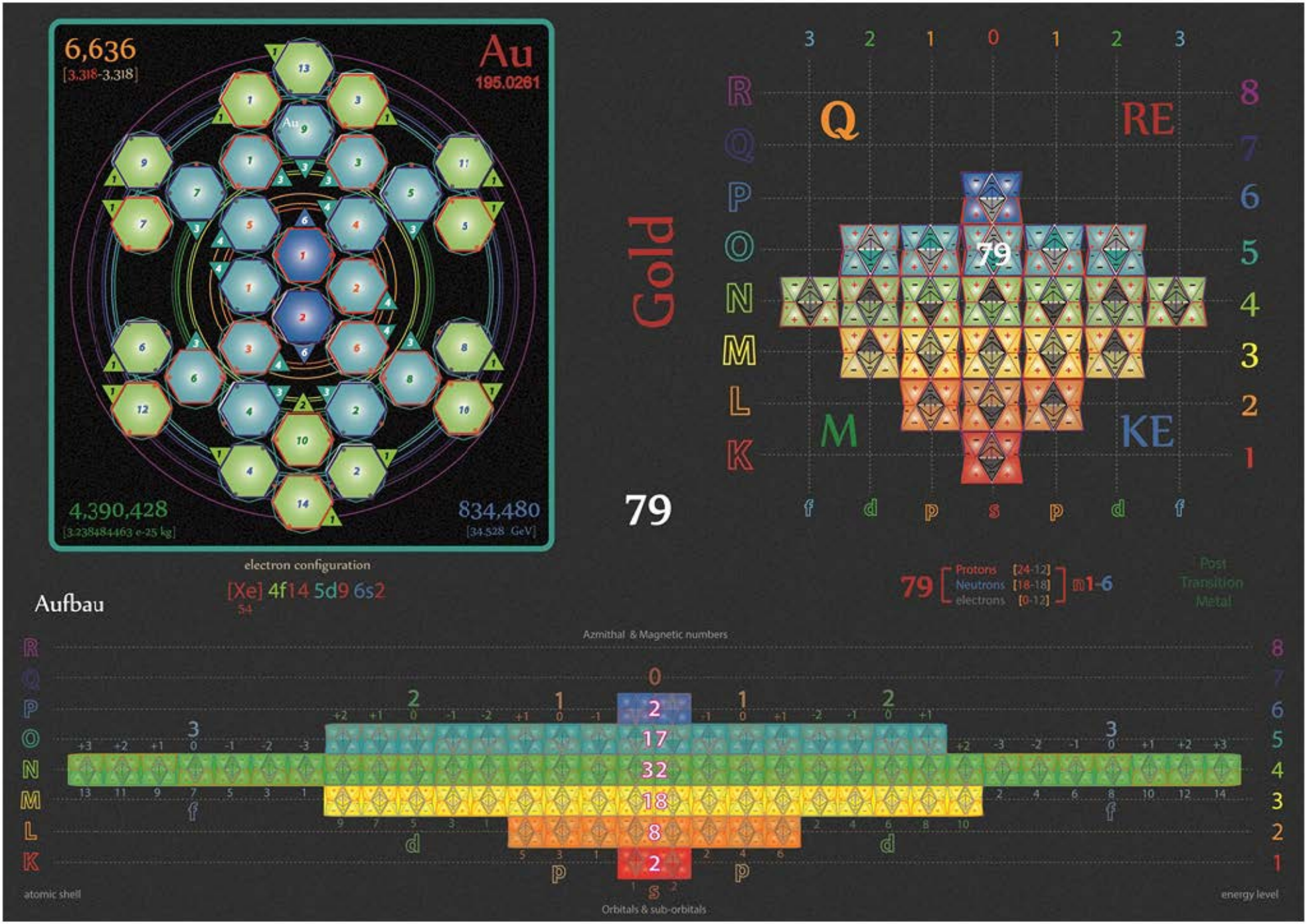

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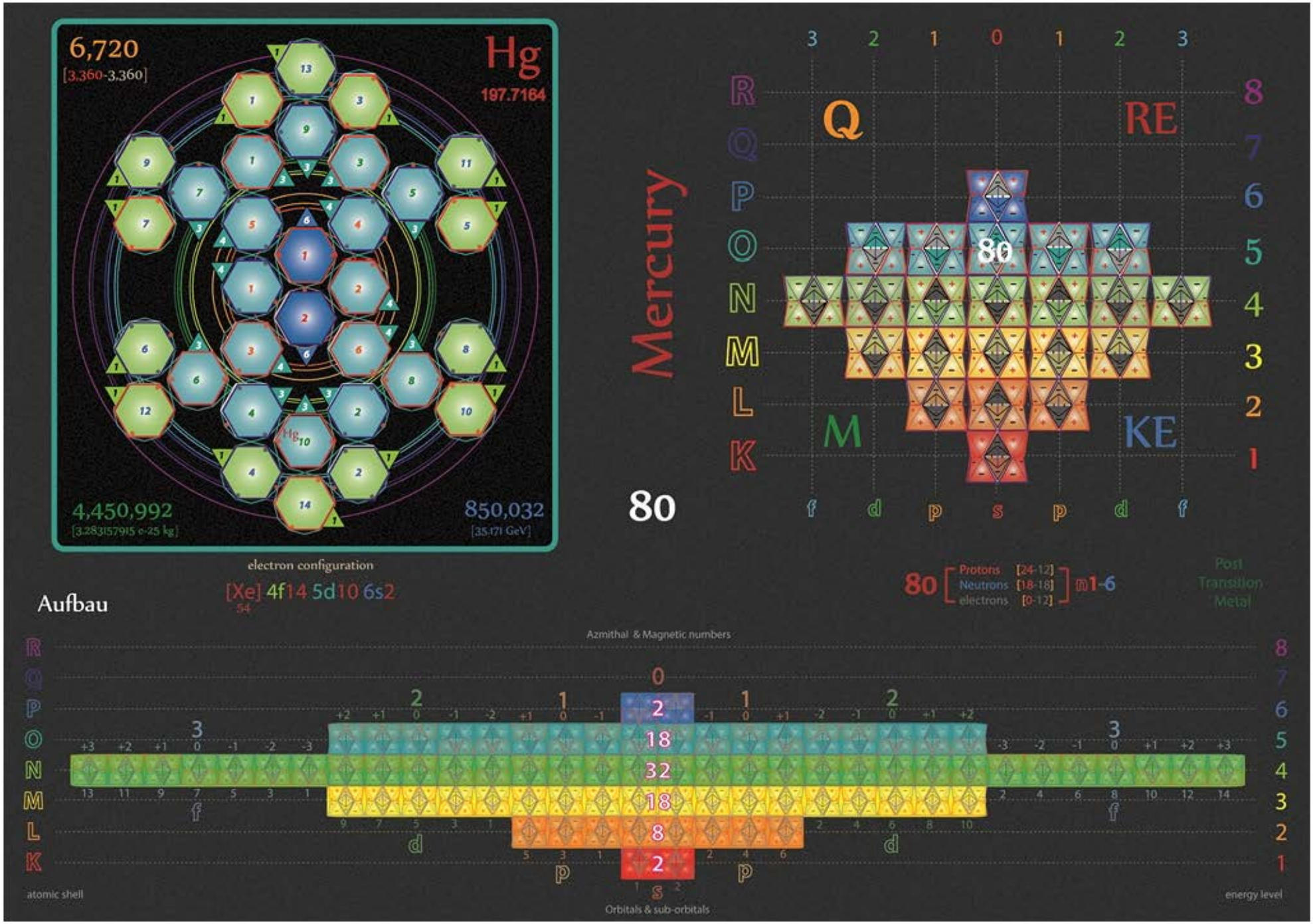

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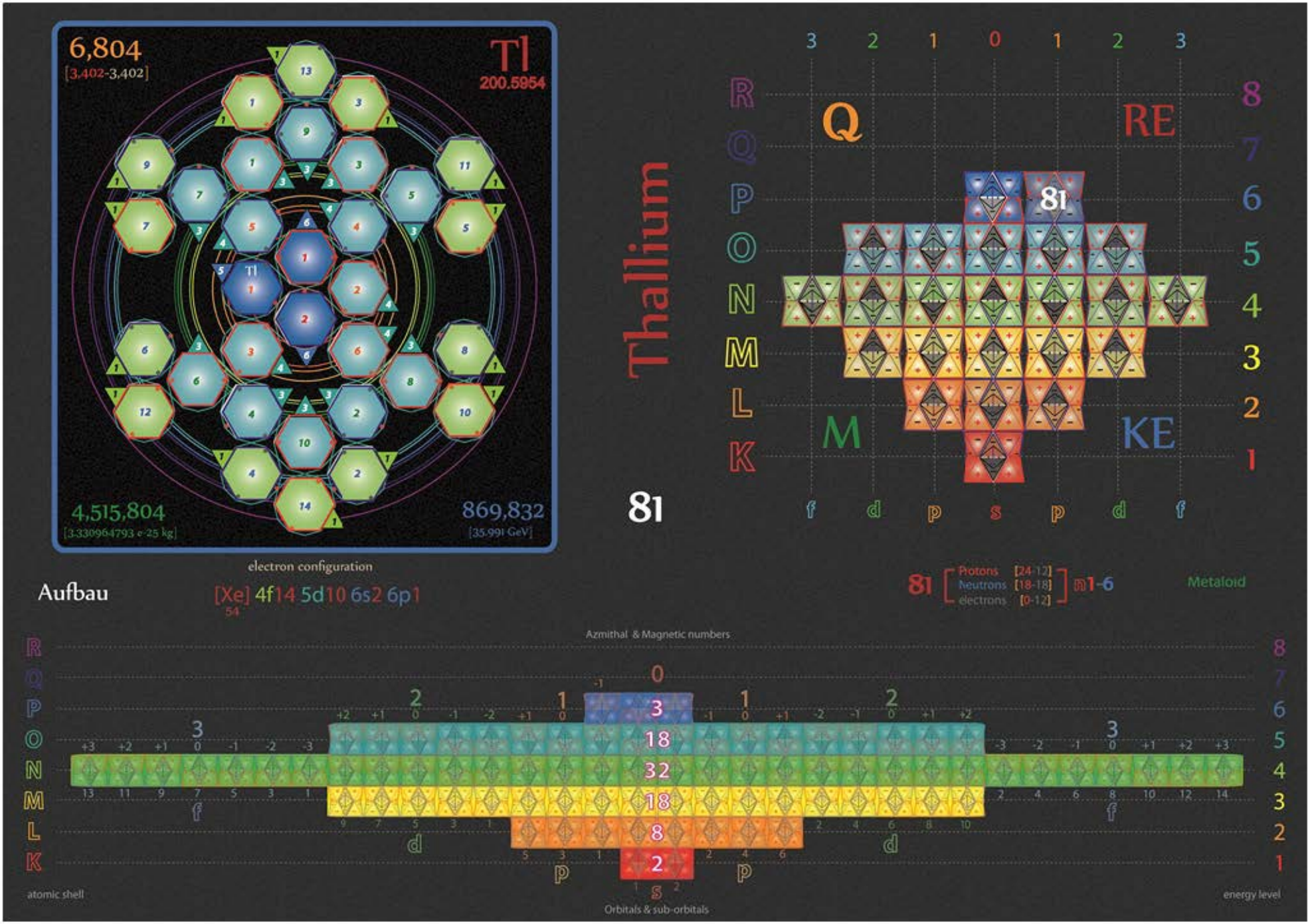

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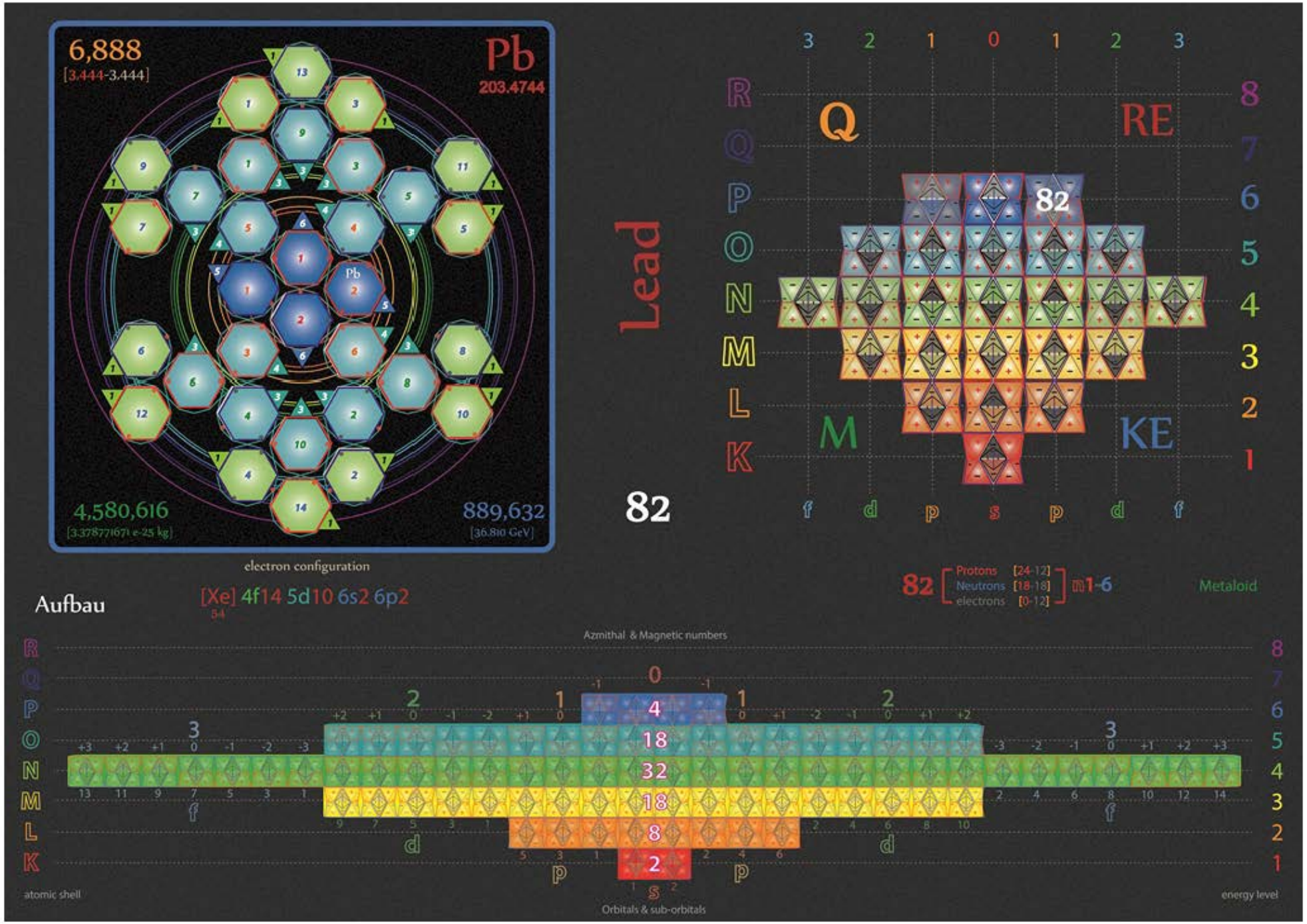

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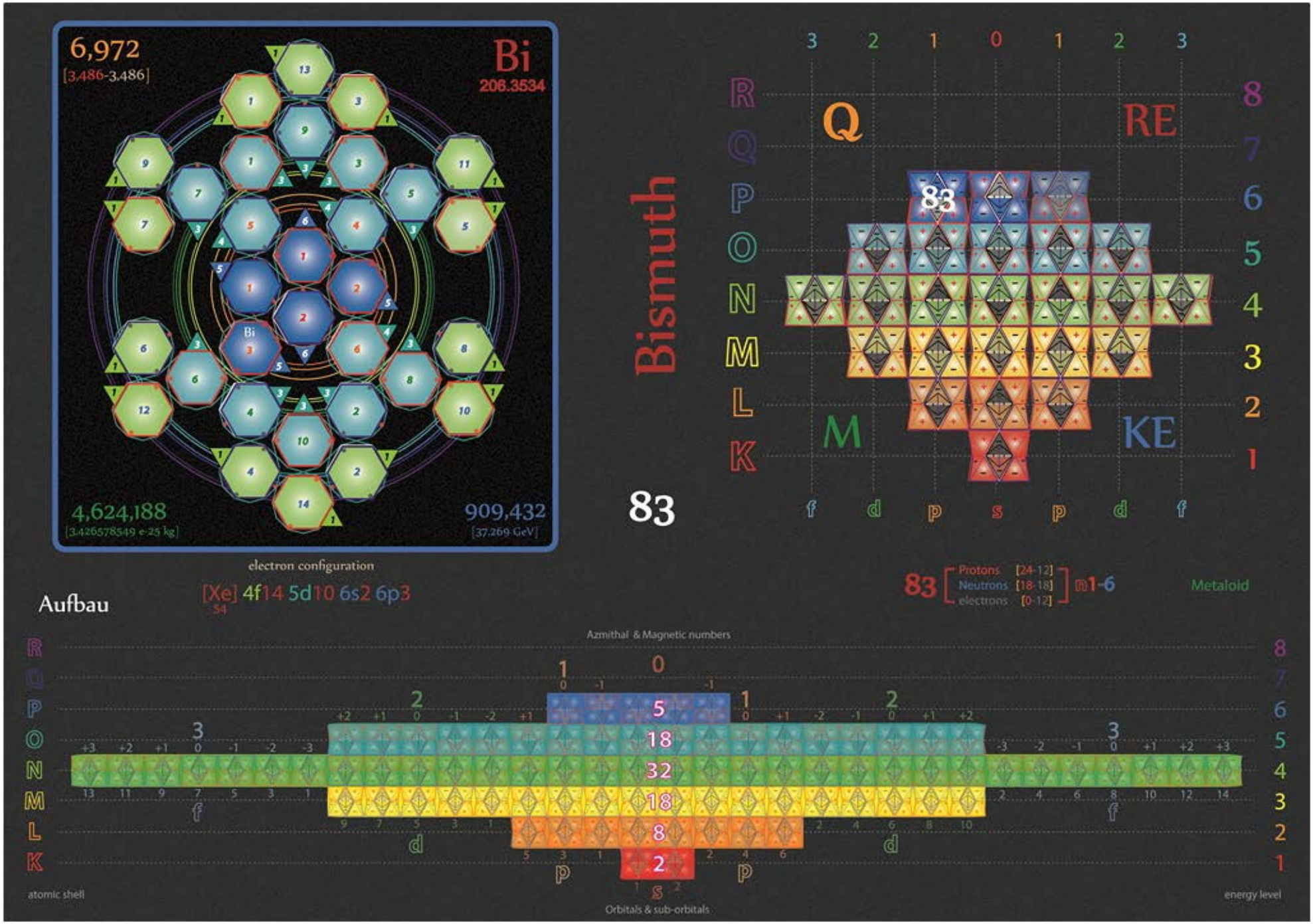

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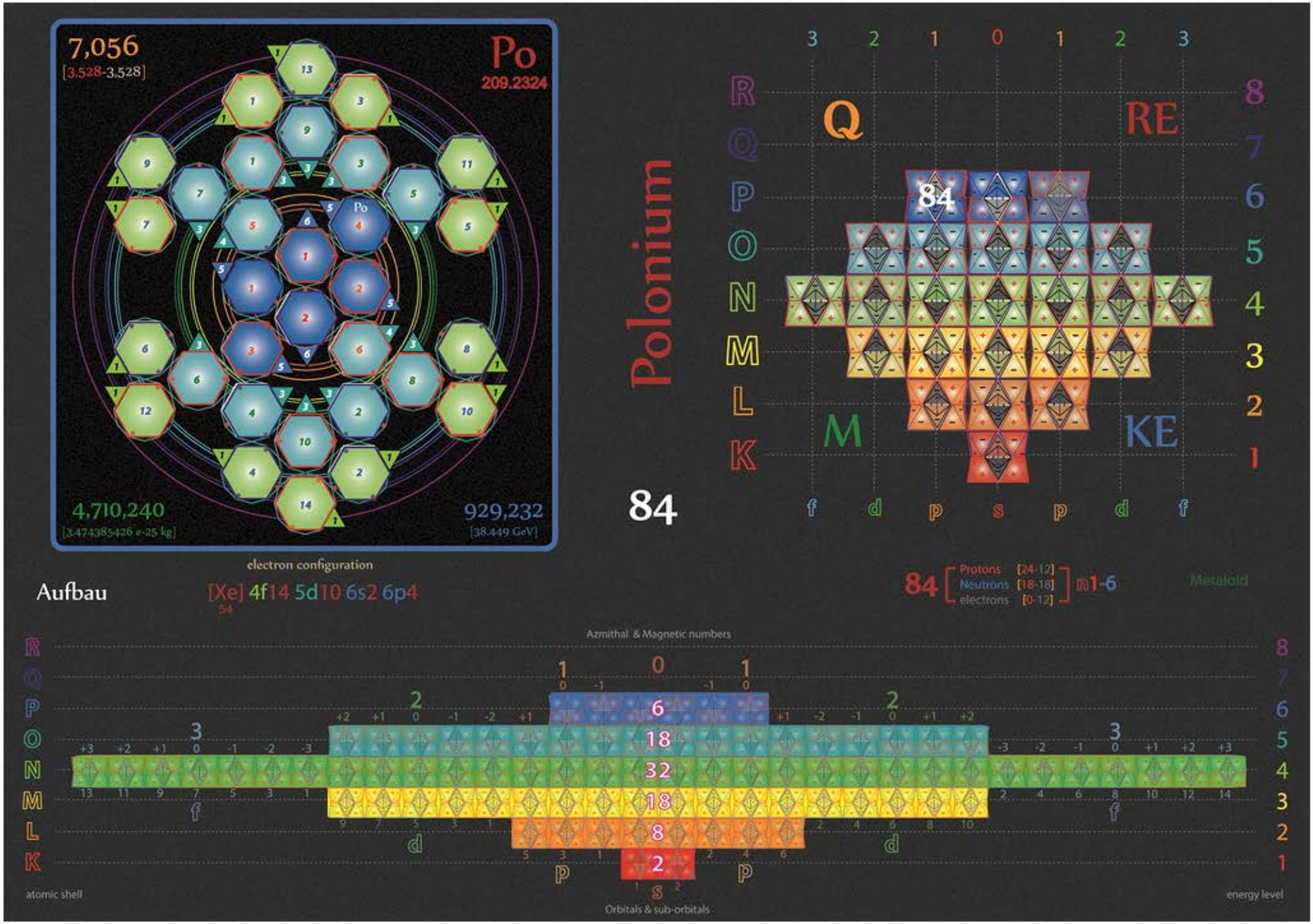

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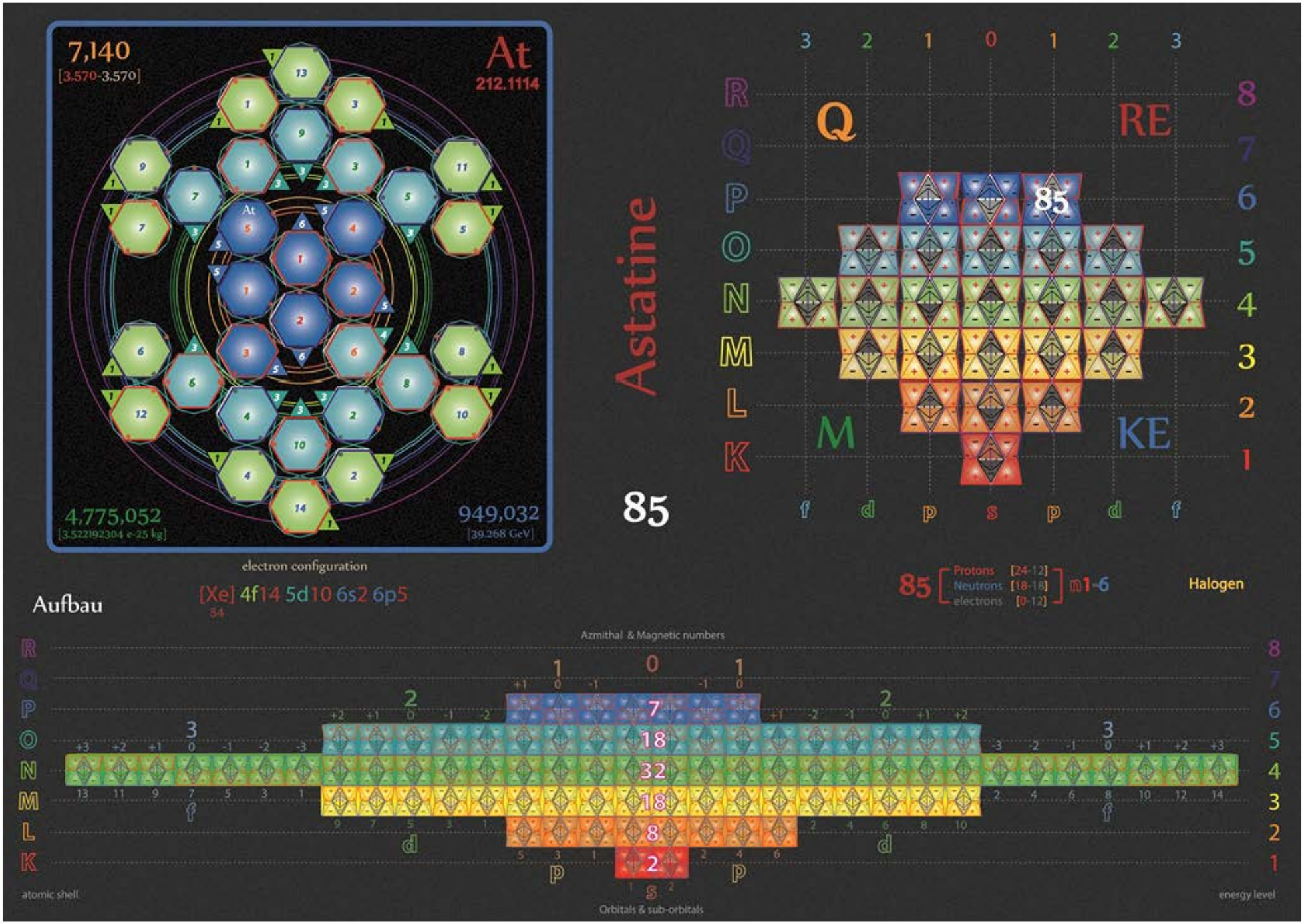

Tetryonics 51.85 - Astatine atom

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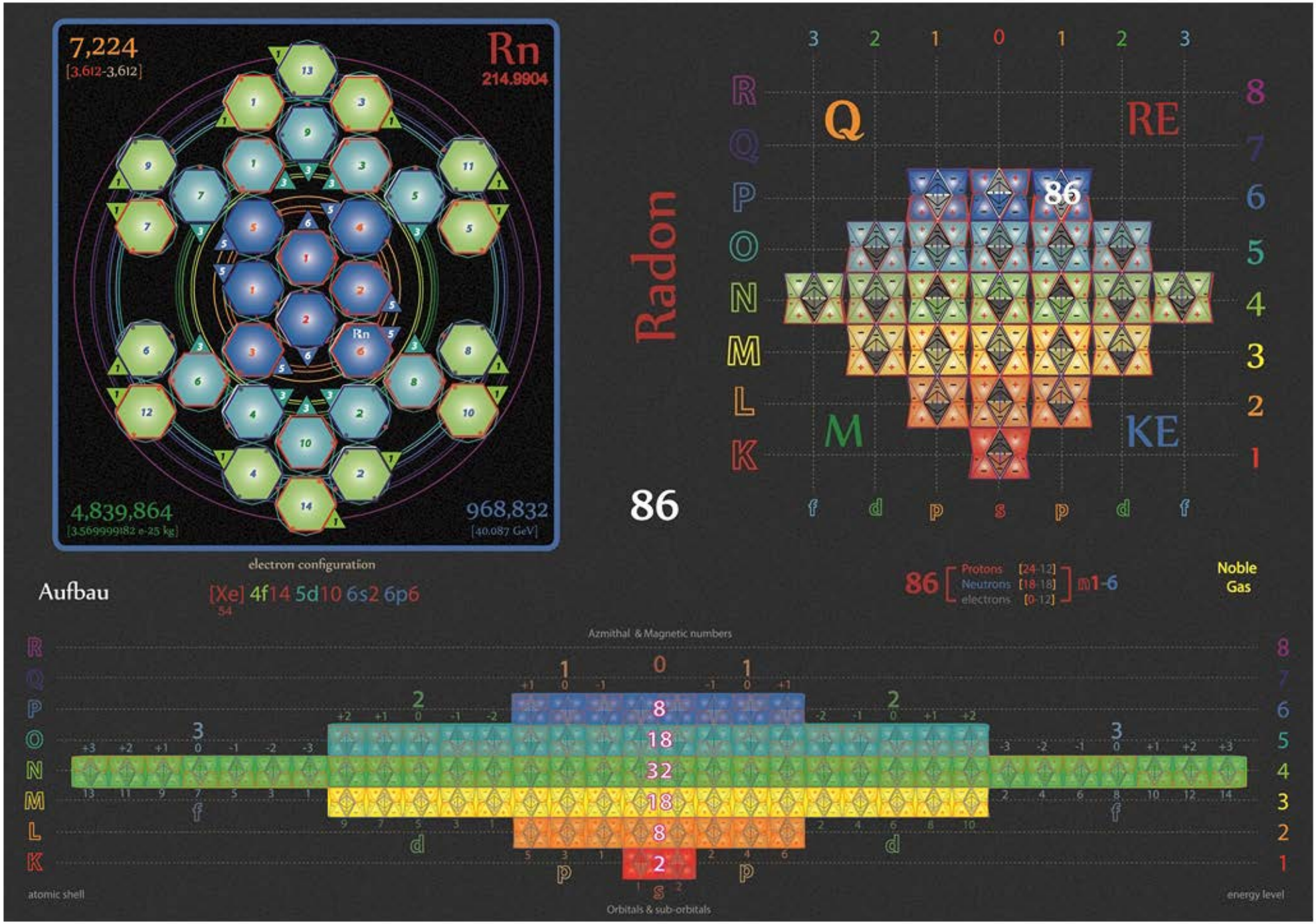

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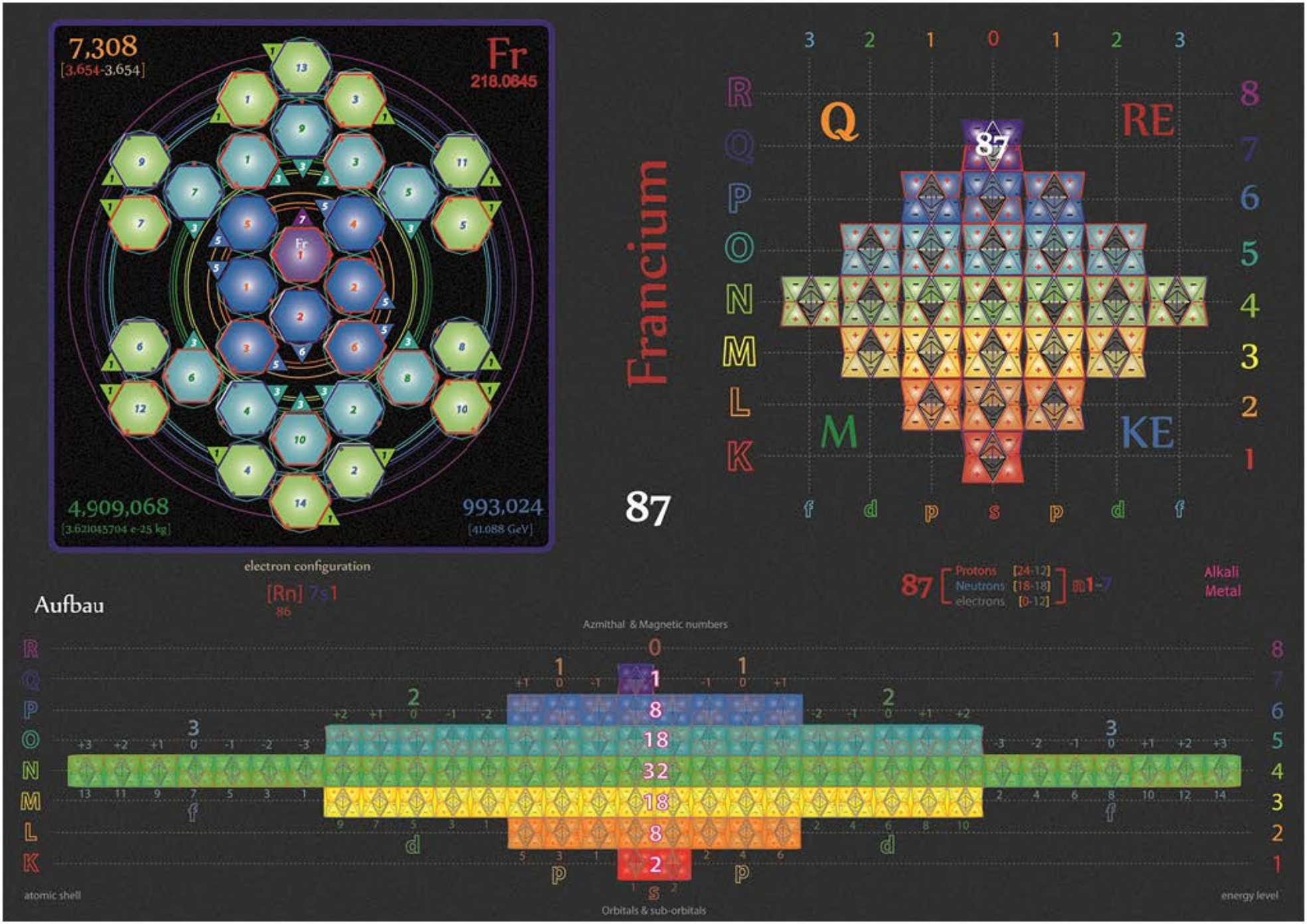

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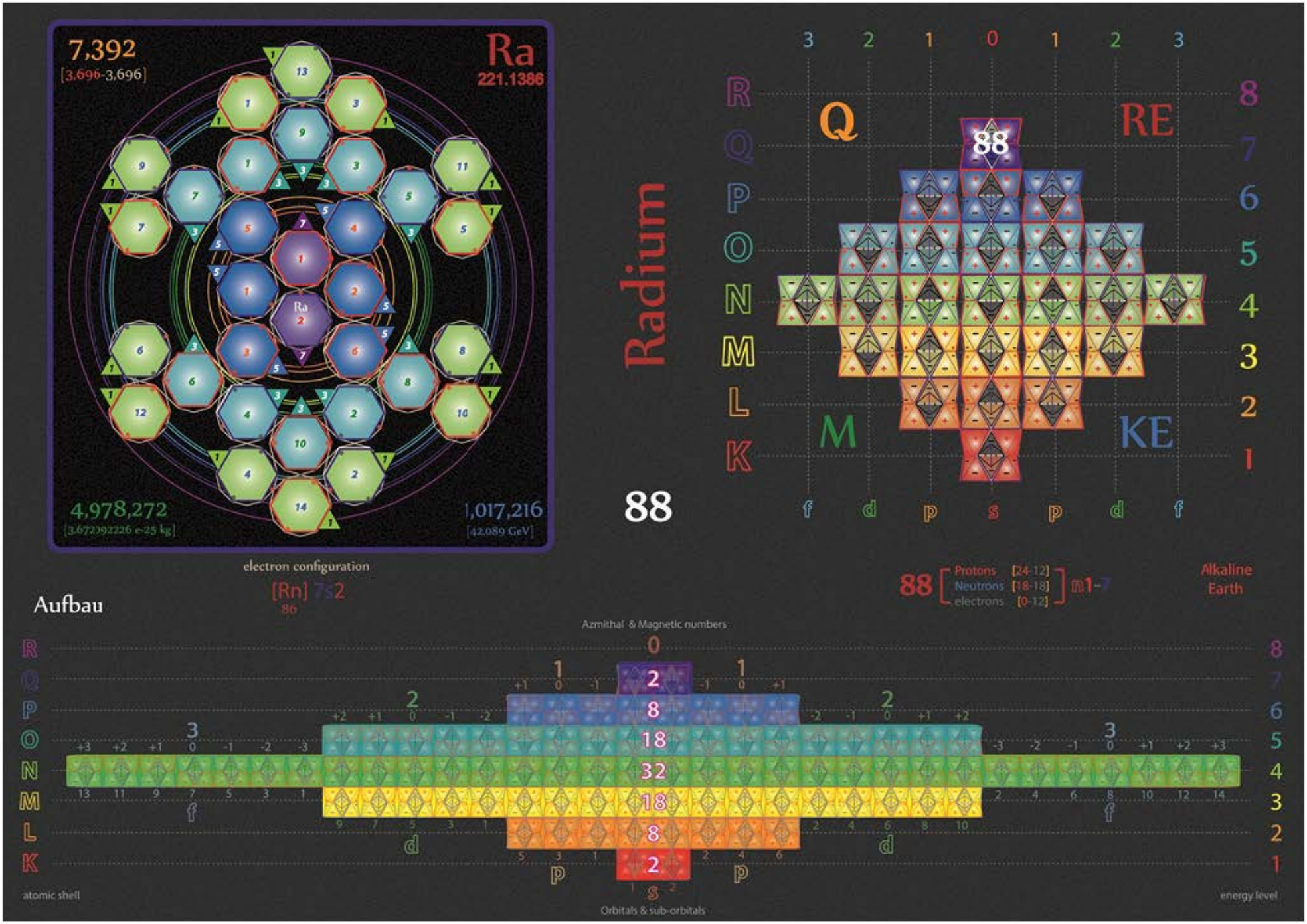

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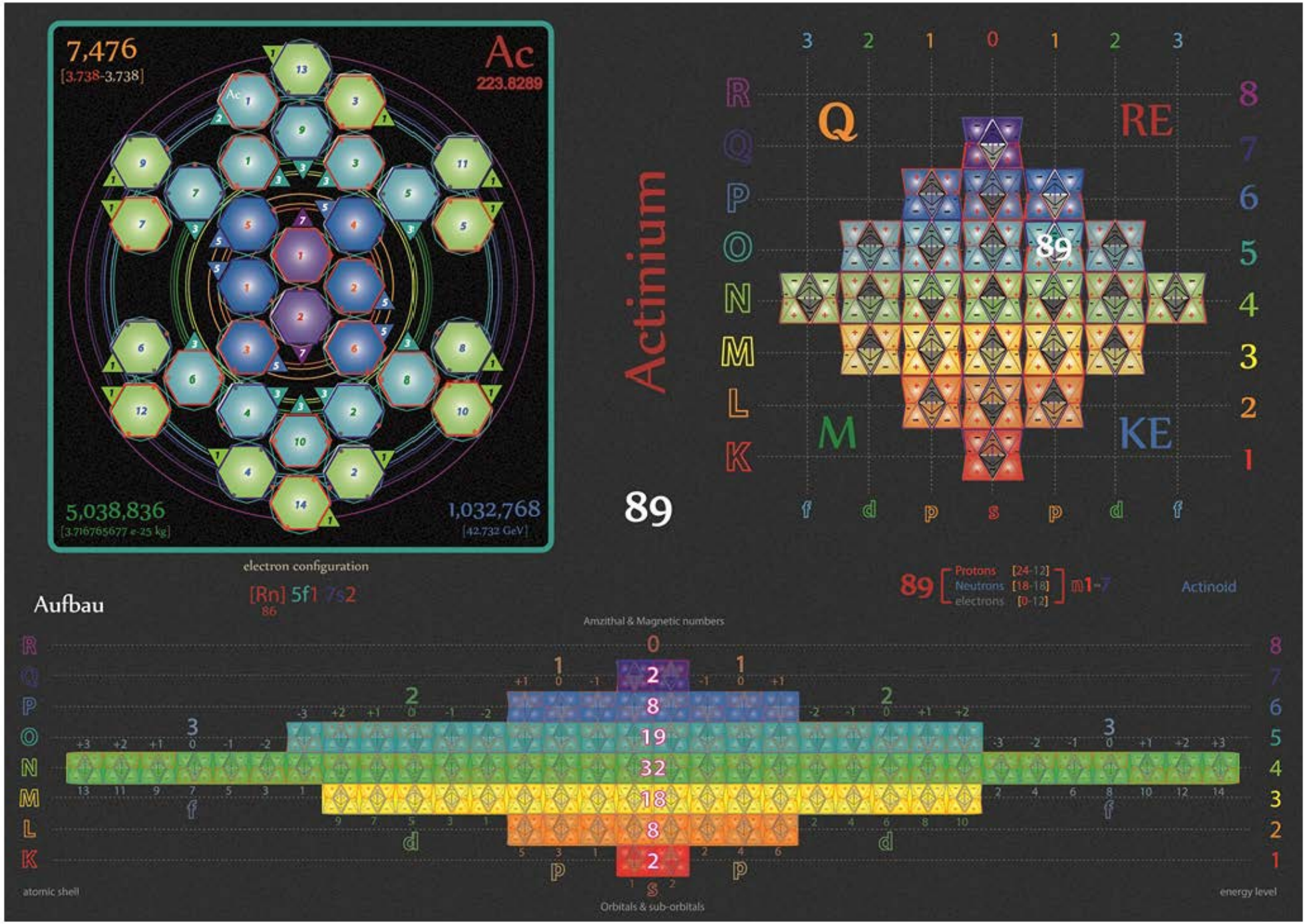

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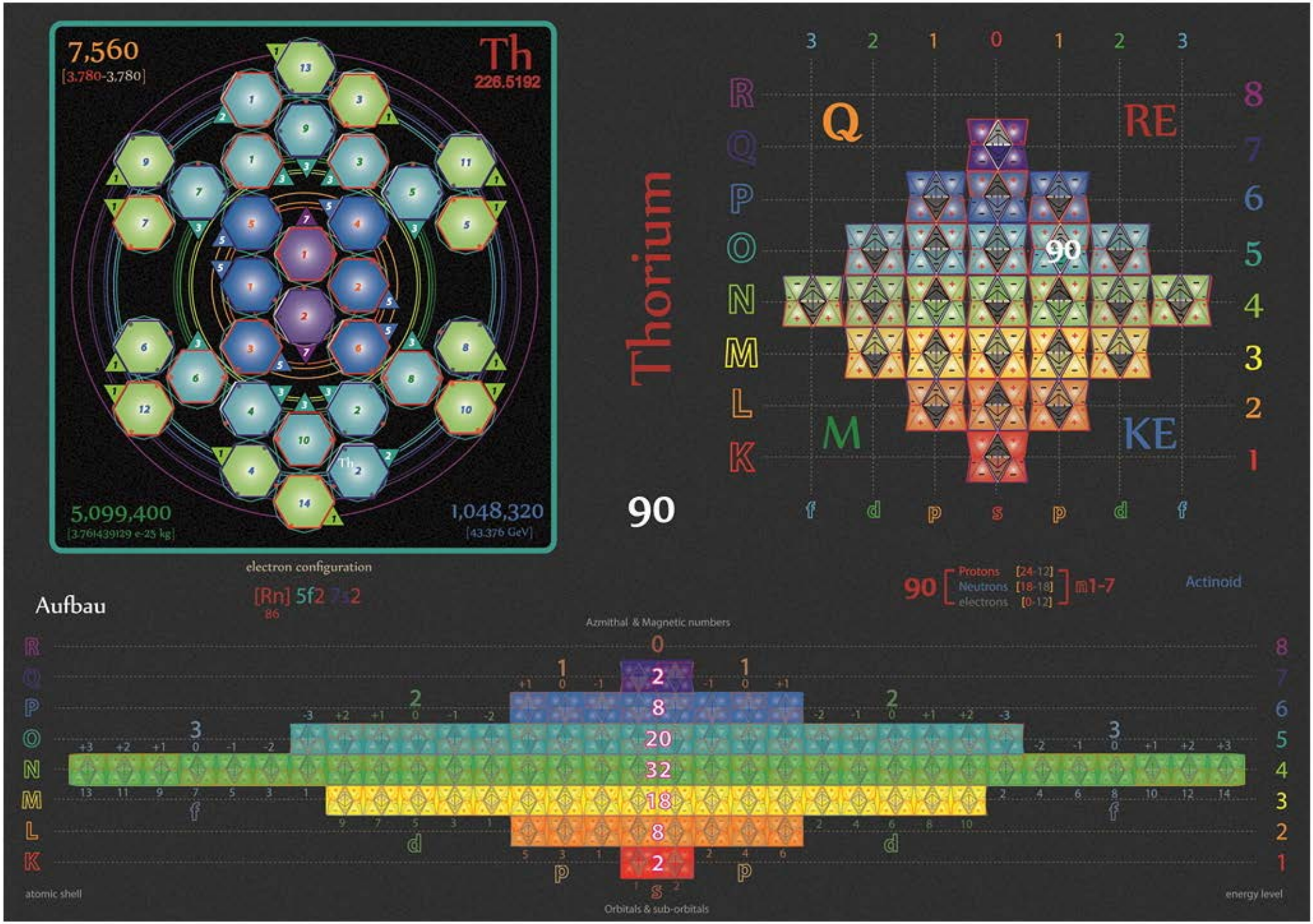

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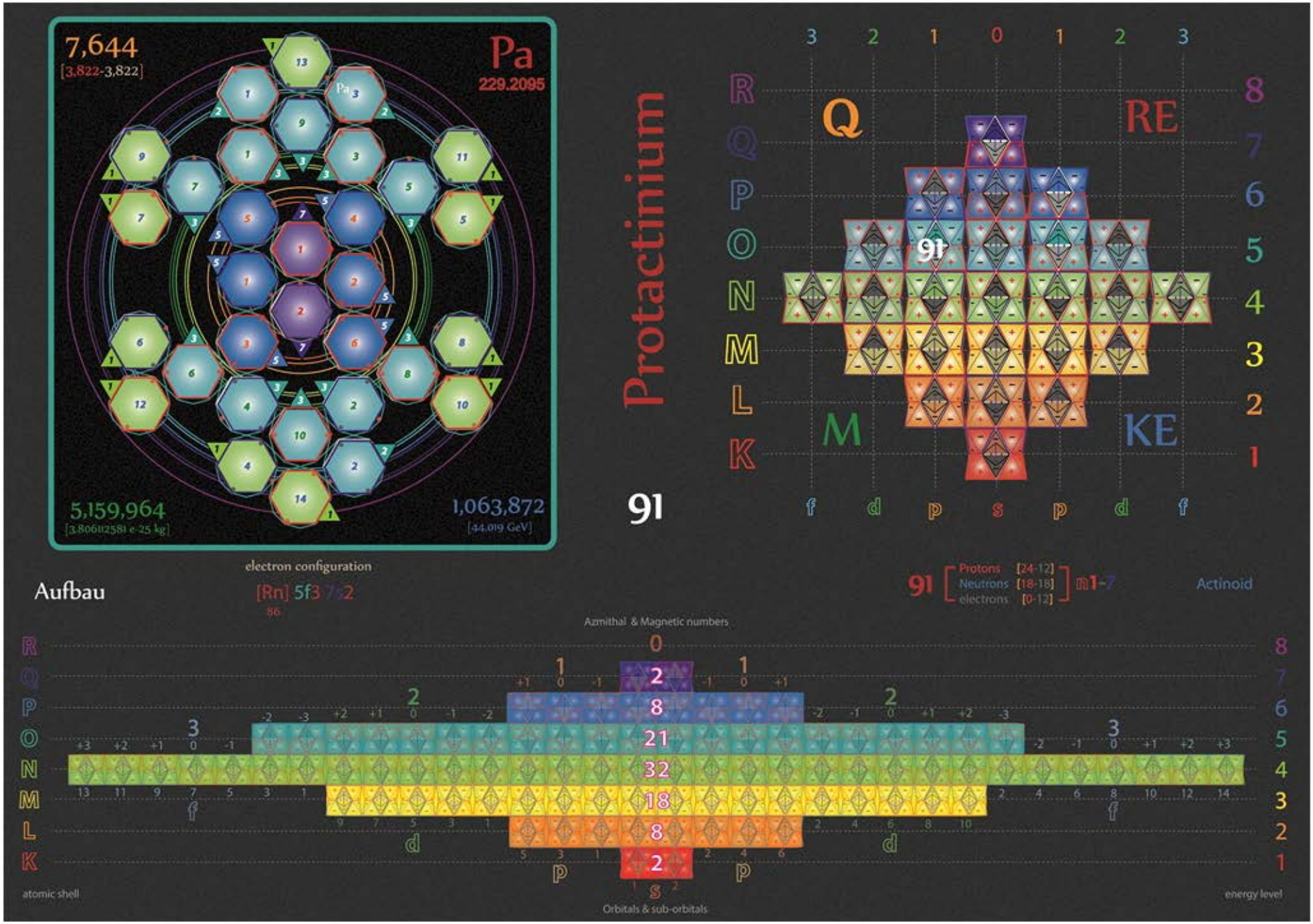

Tetryonics 51.91 - Protactinium atom

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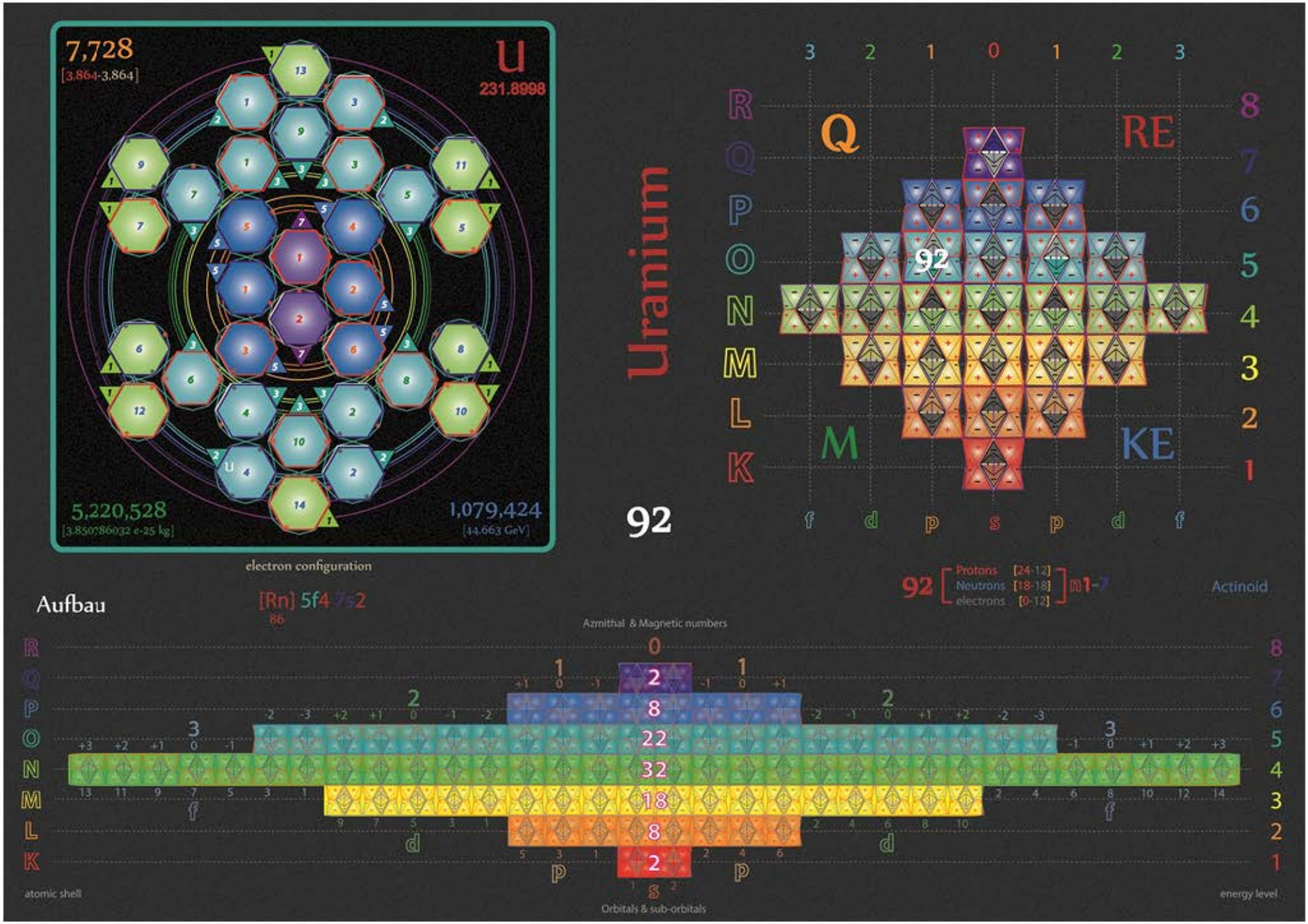

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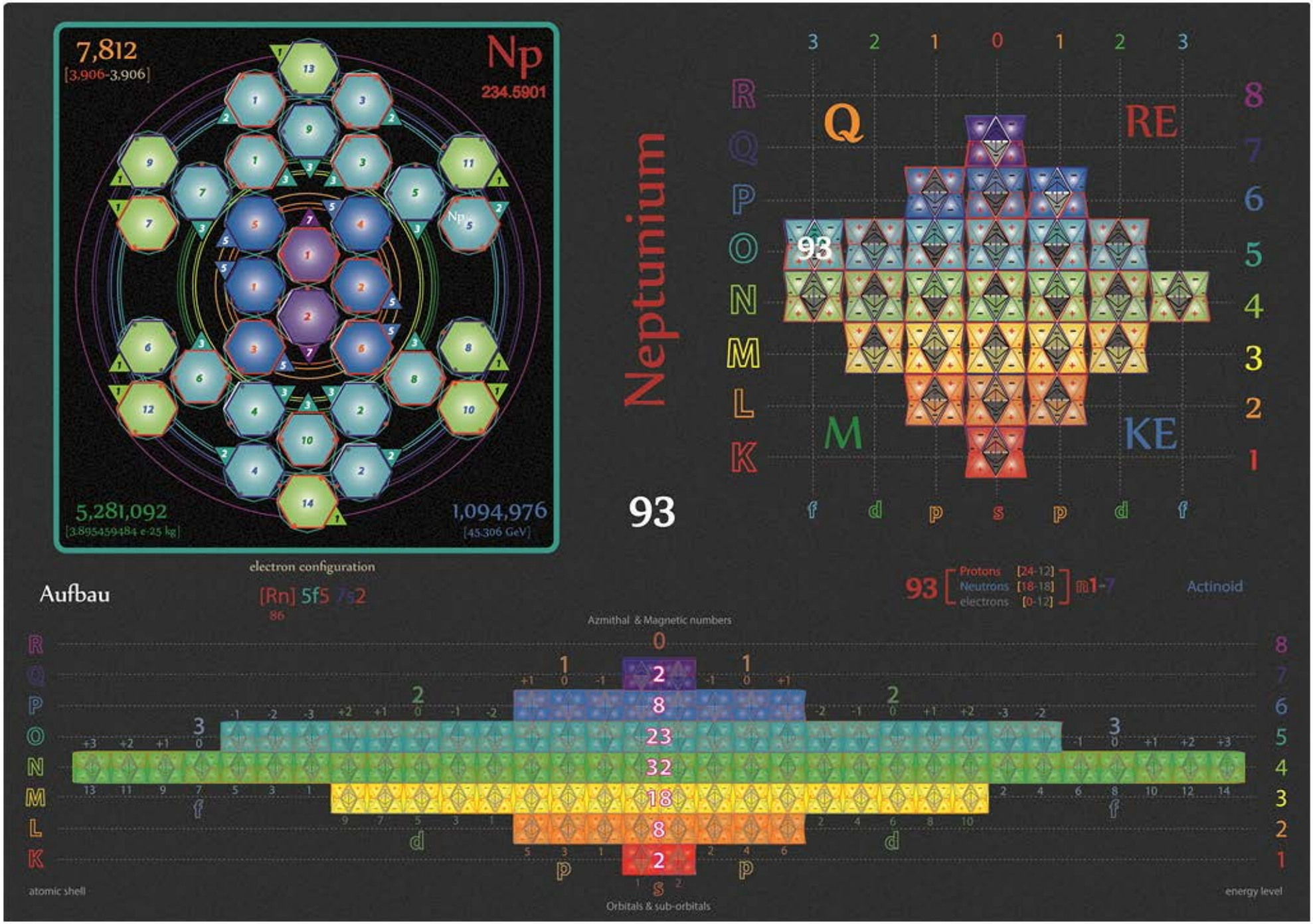

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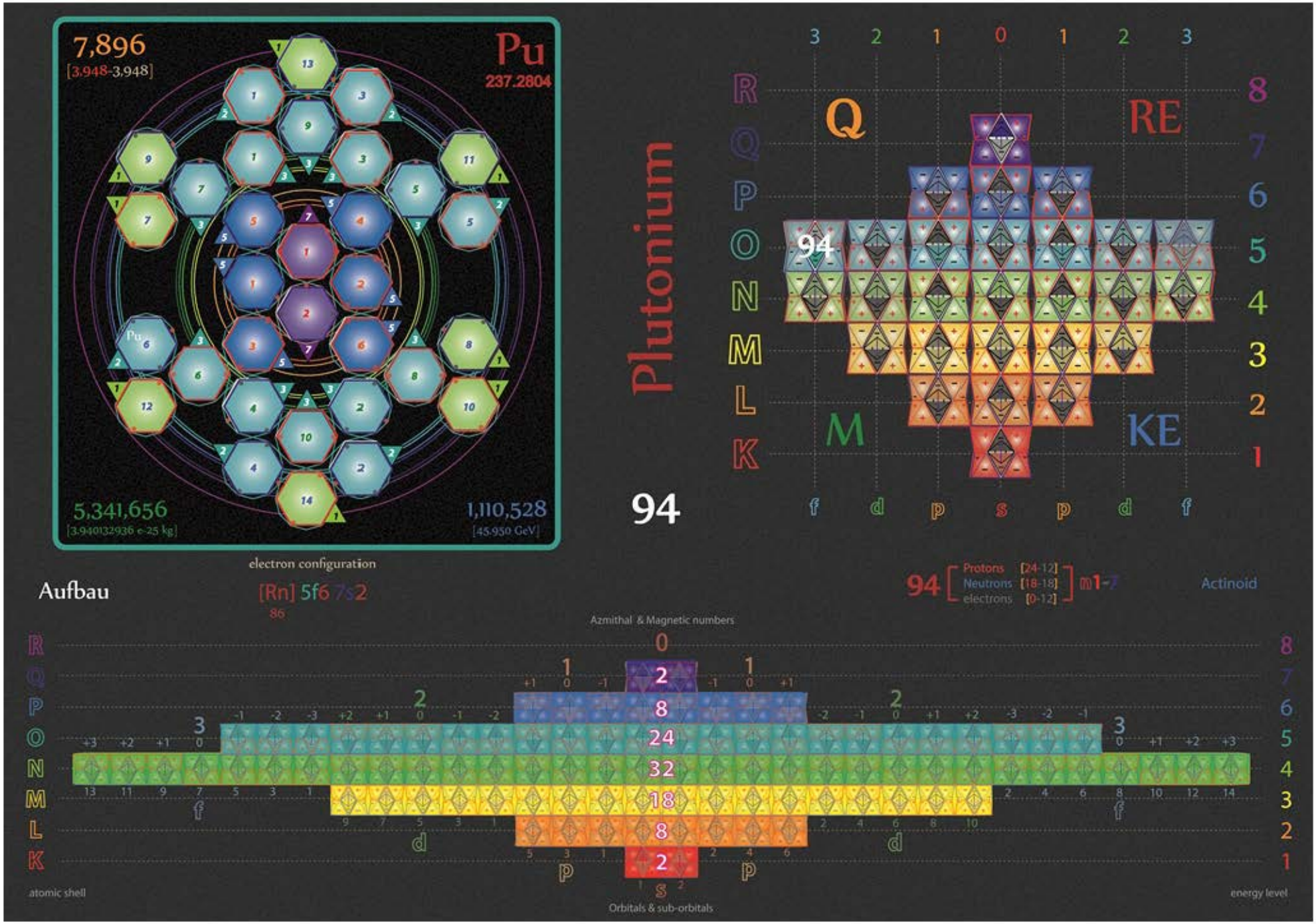

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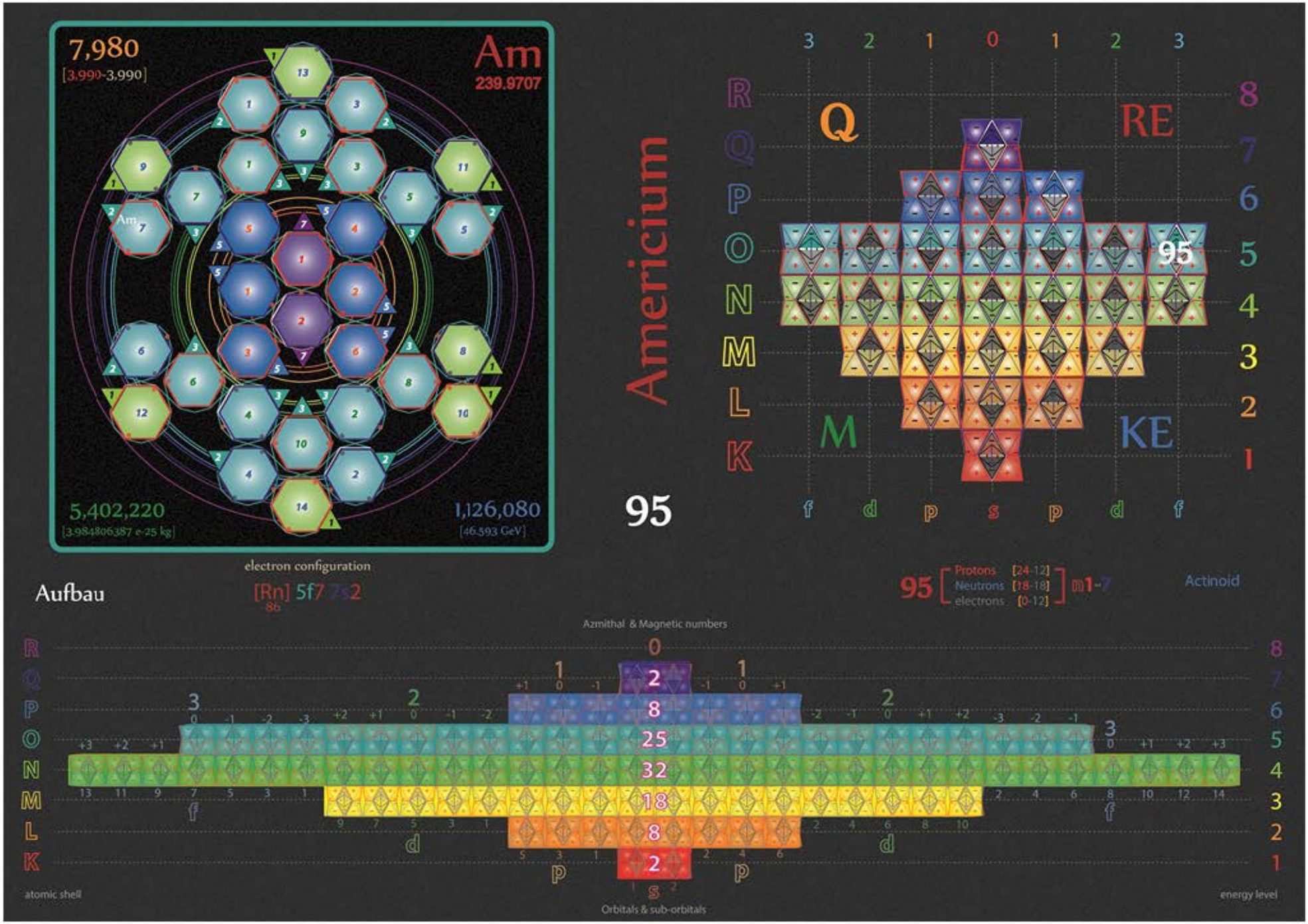

Tetryonics 51.95 - Americium atom

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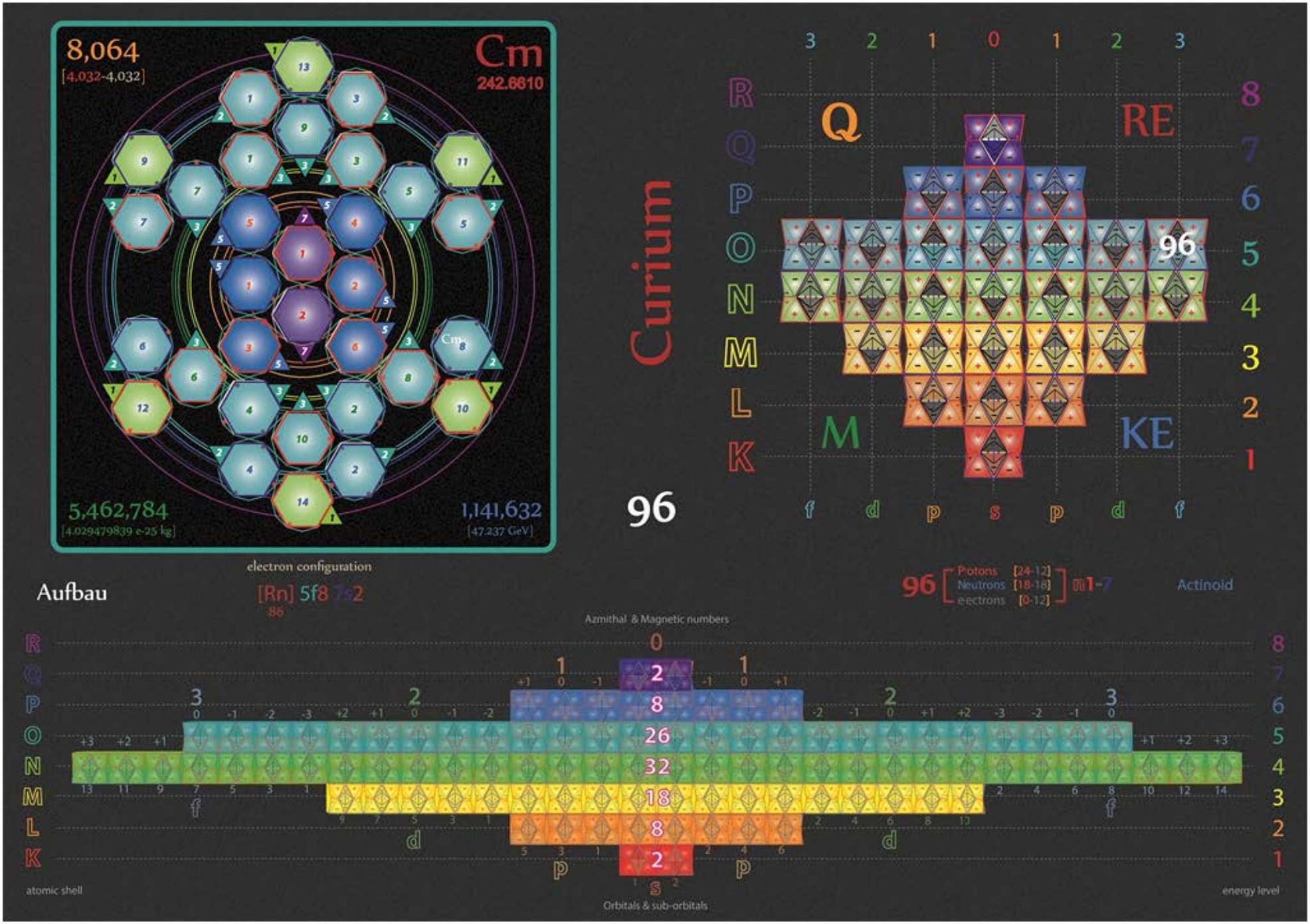

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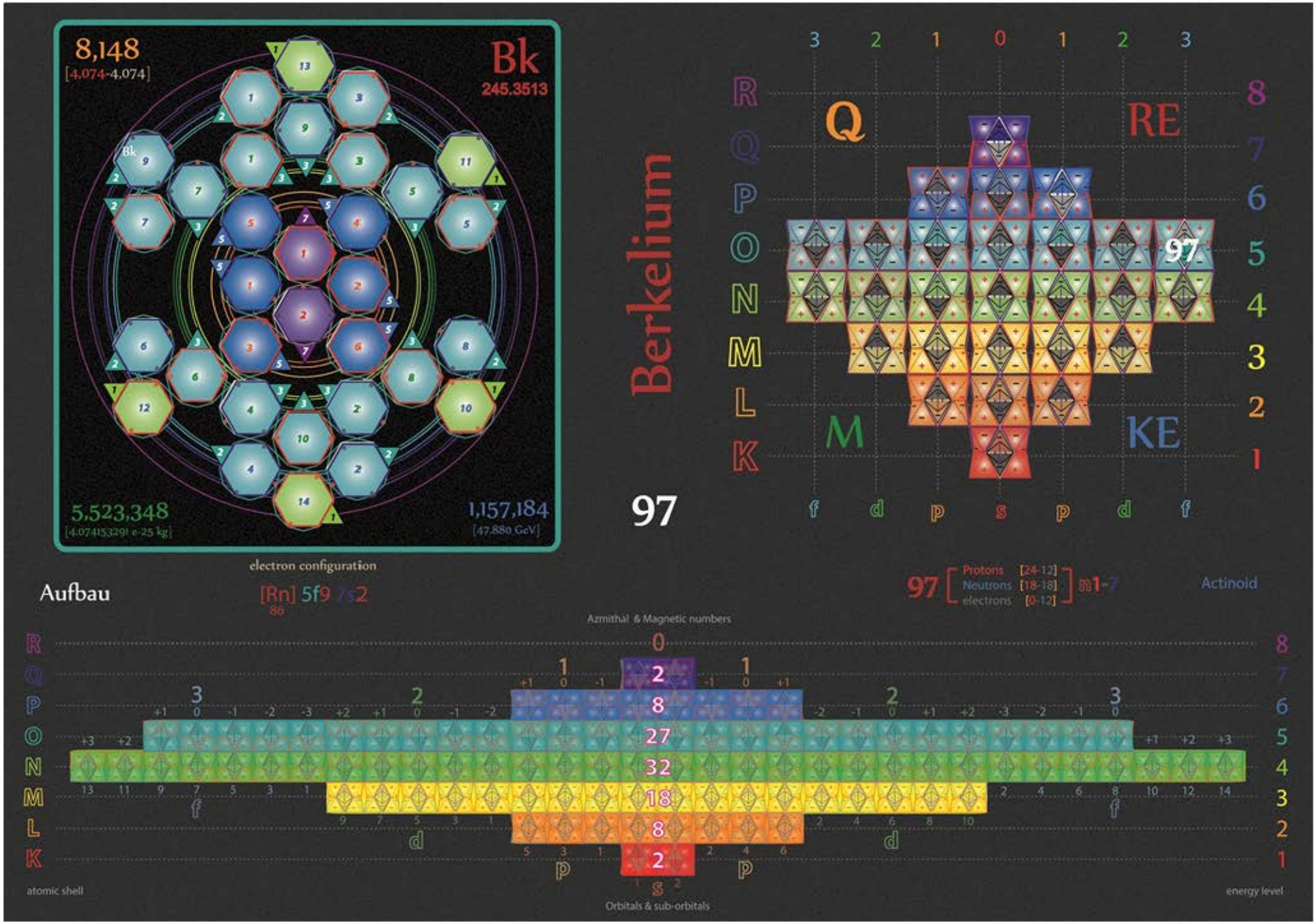

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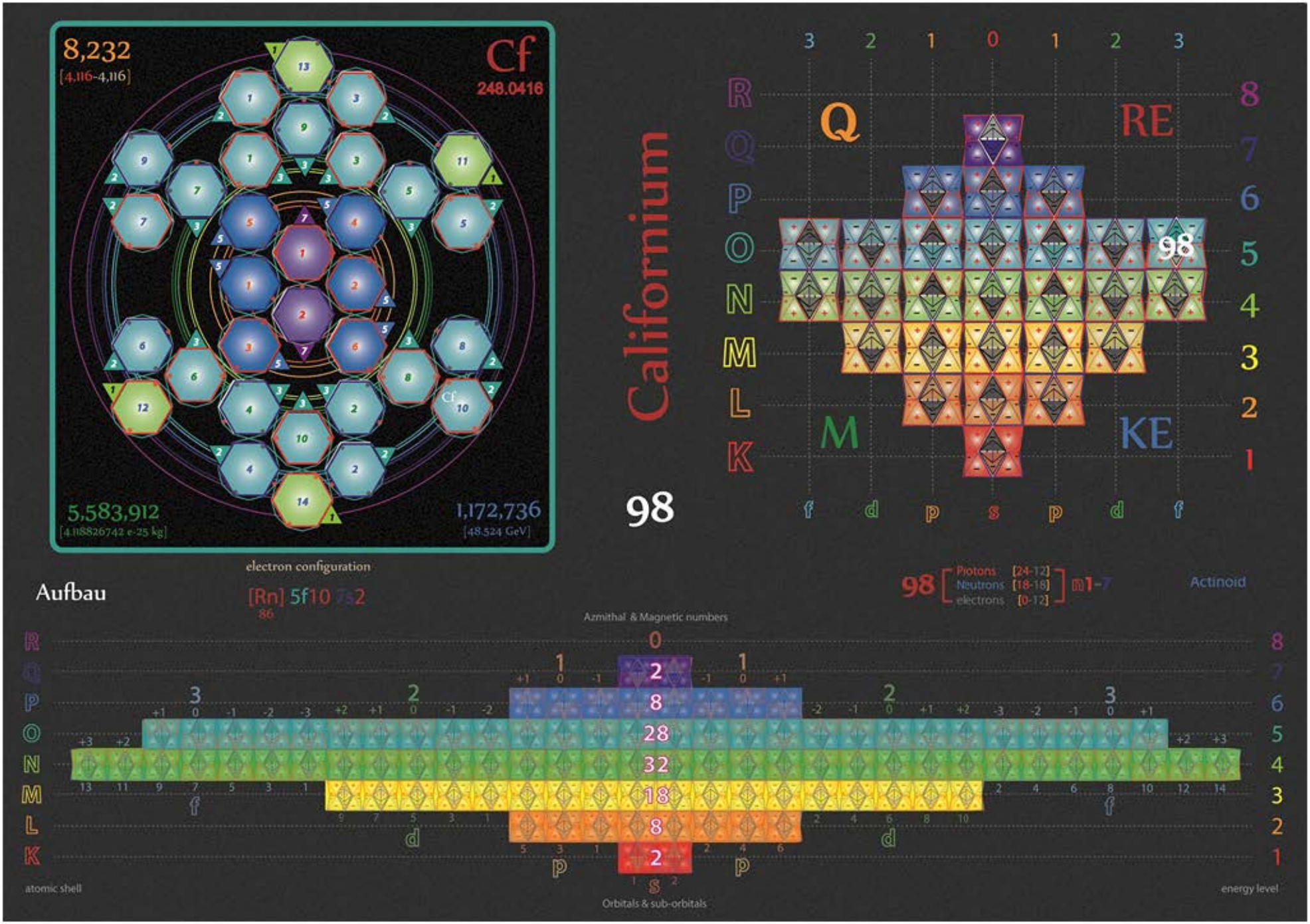

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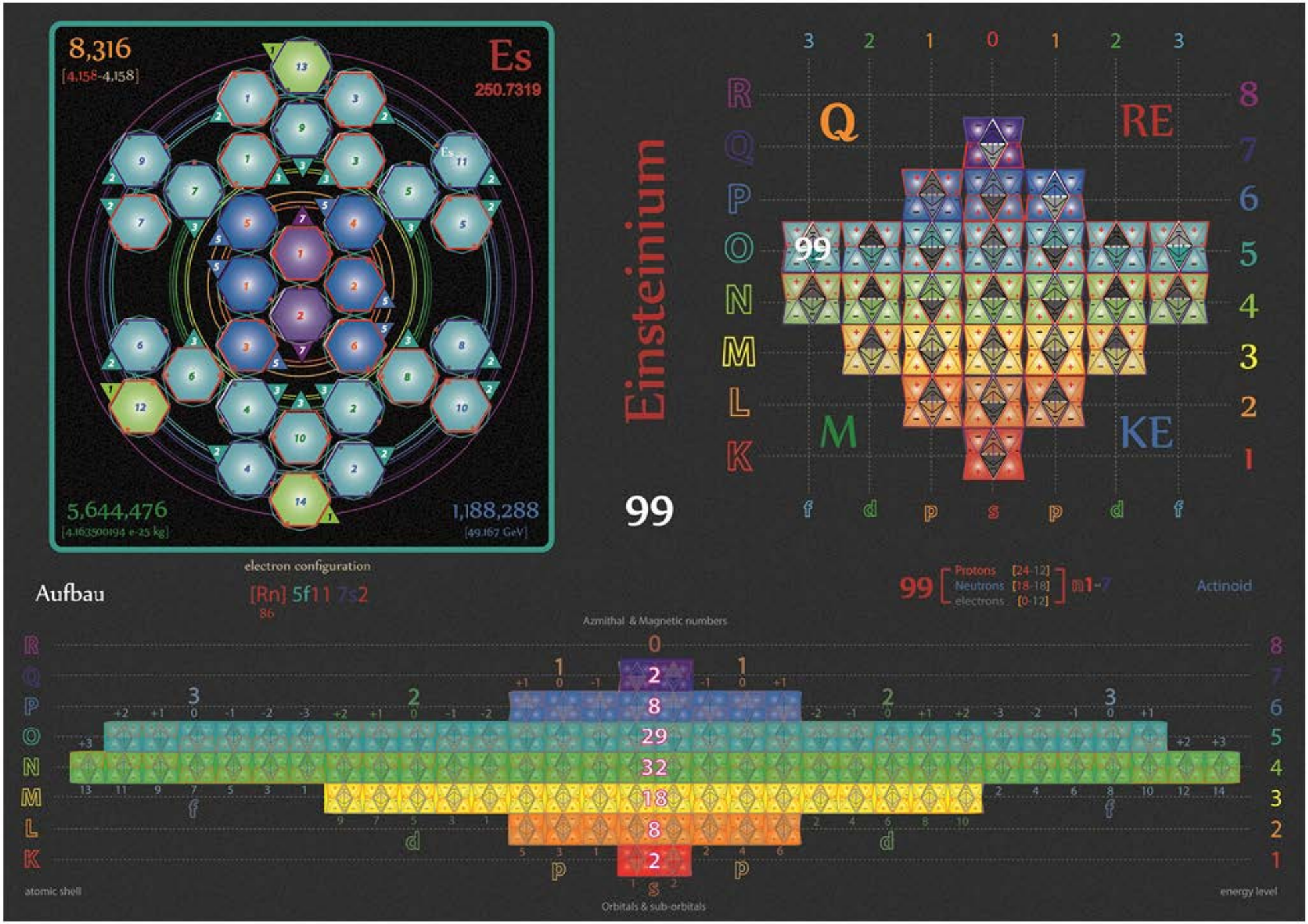

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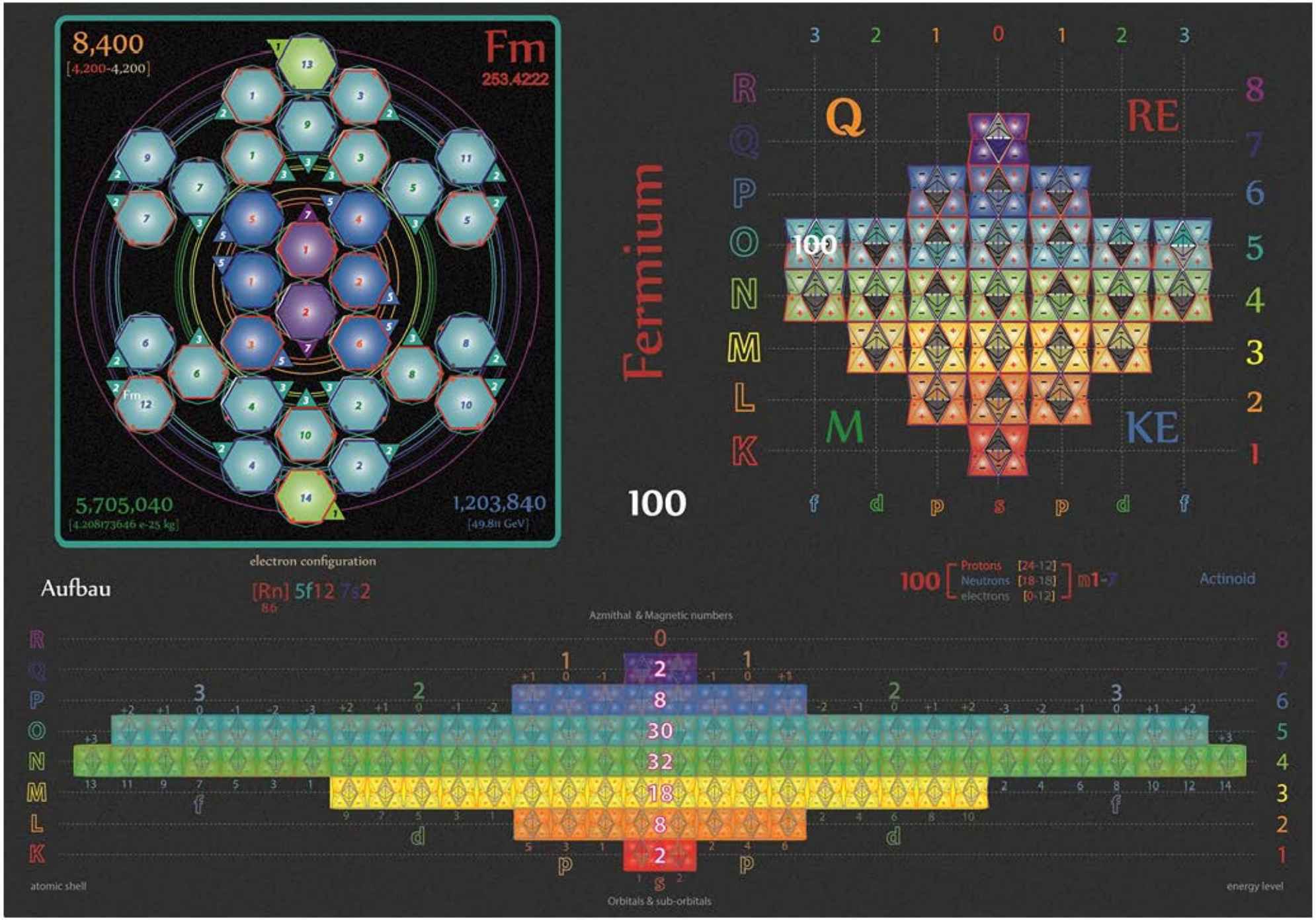

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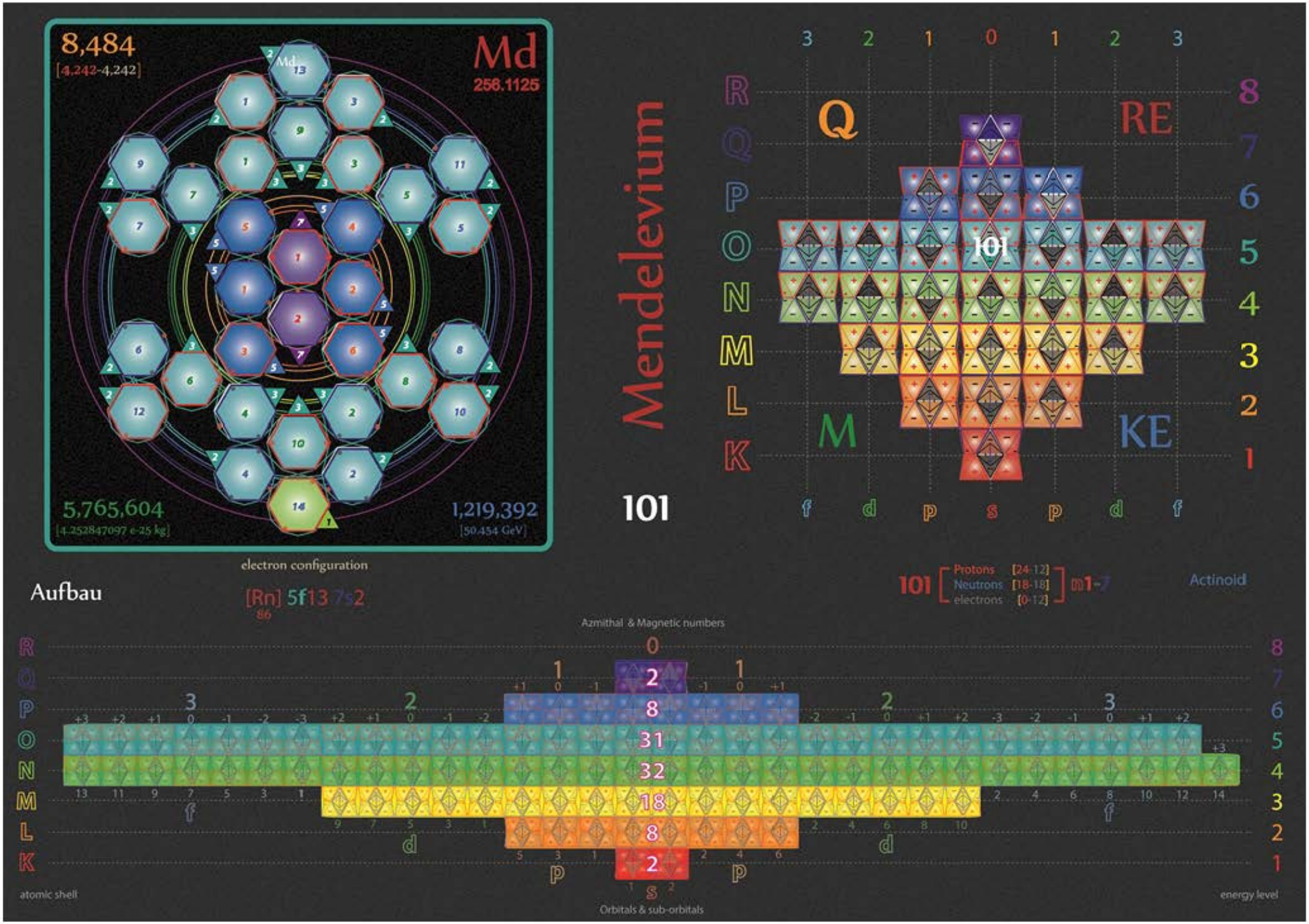

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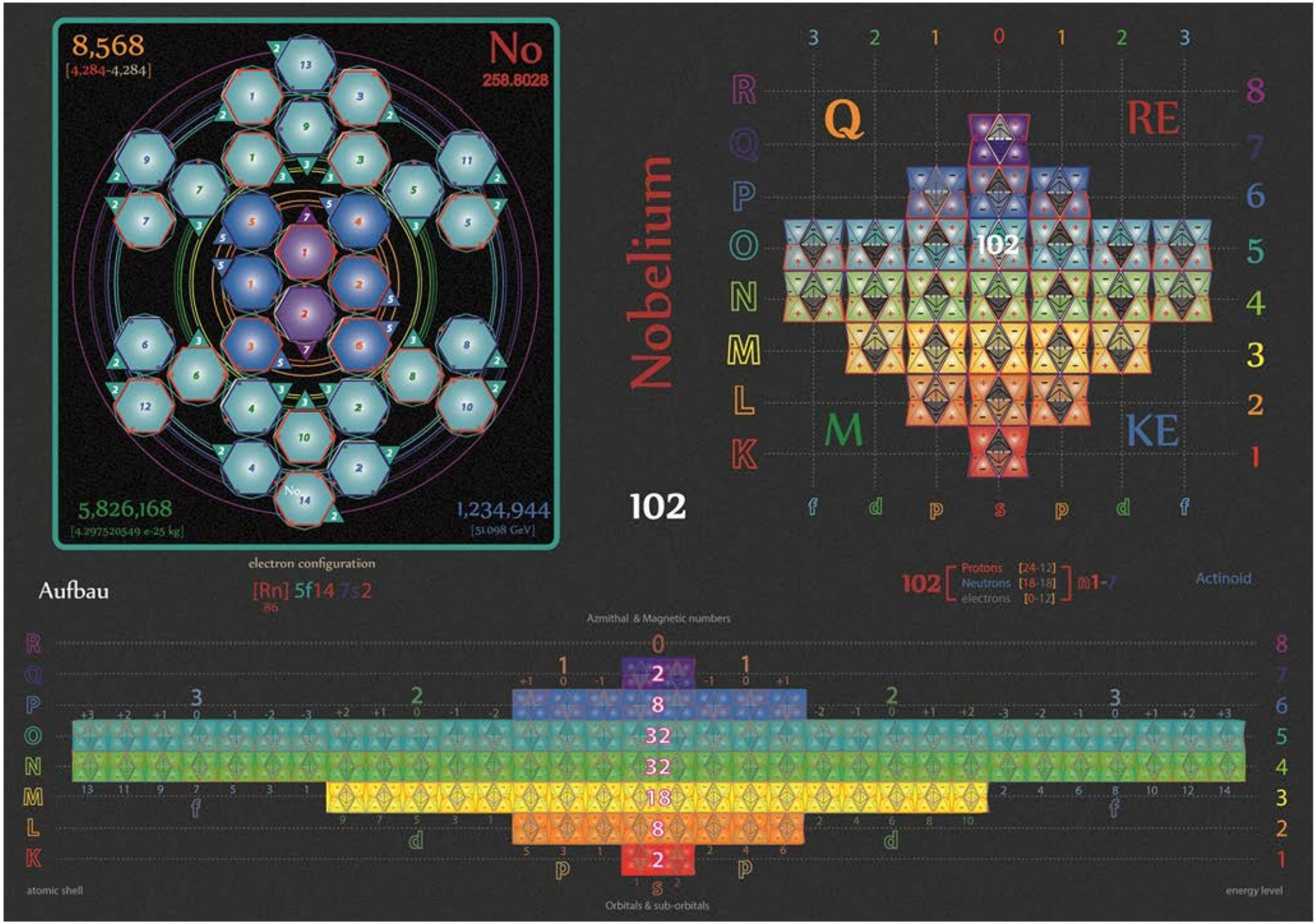

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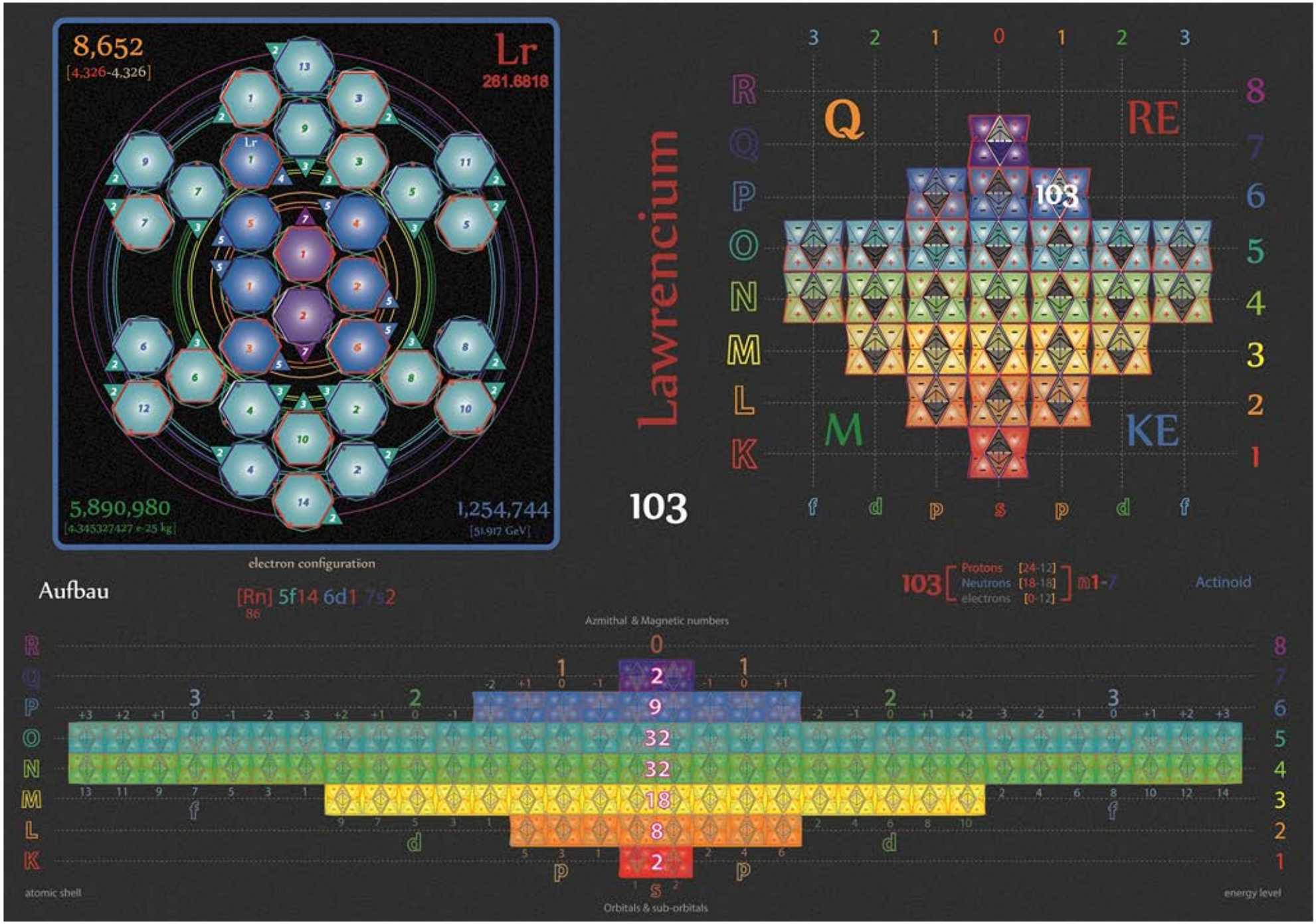

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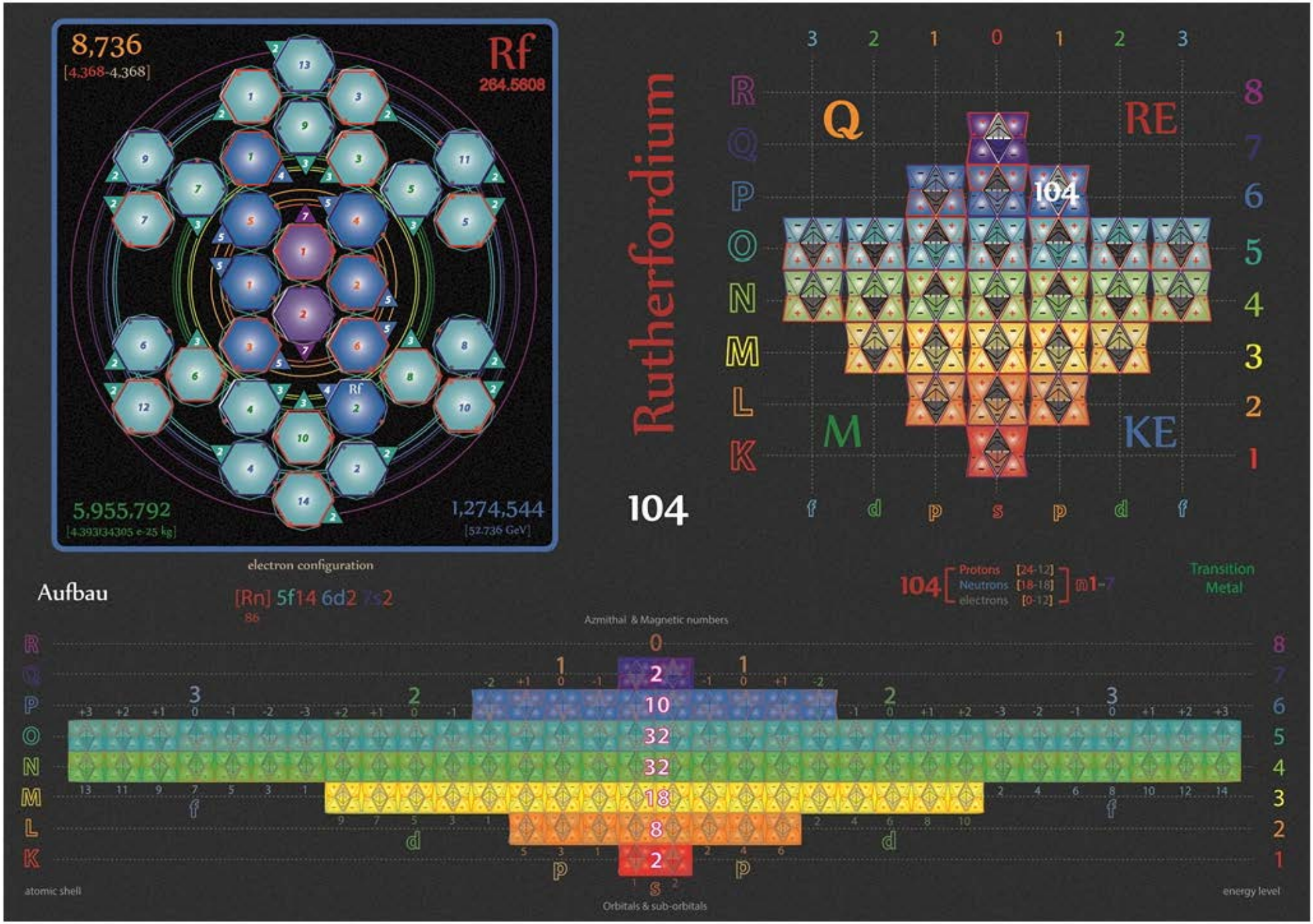

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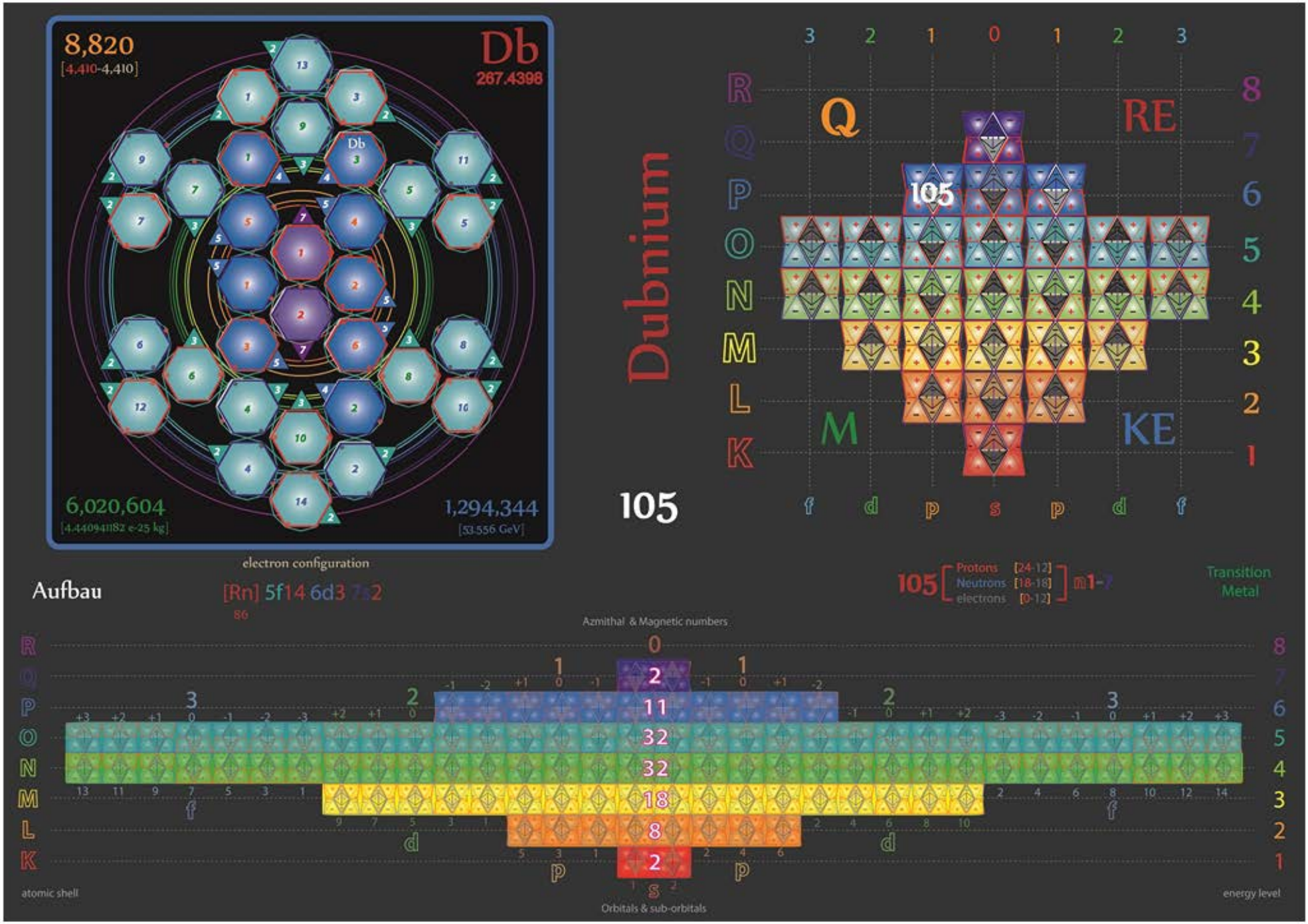

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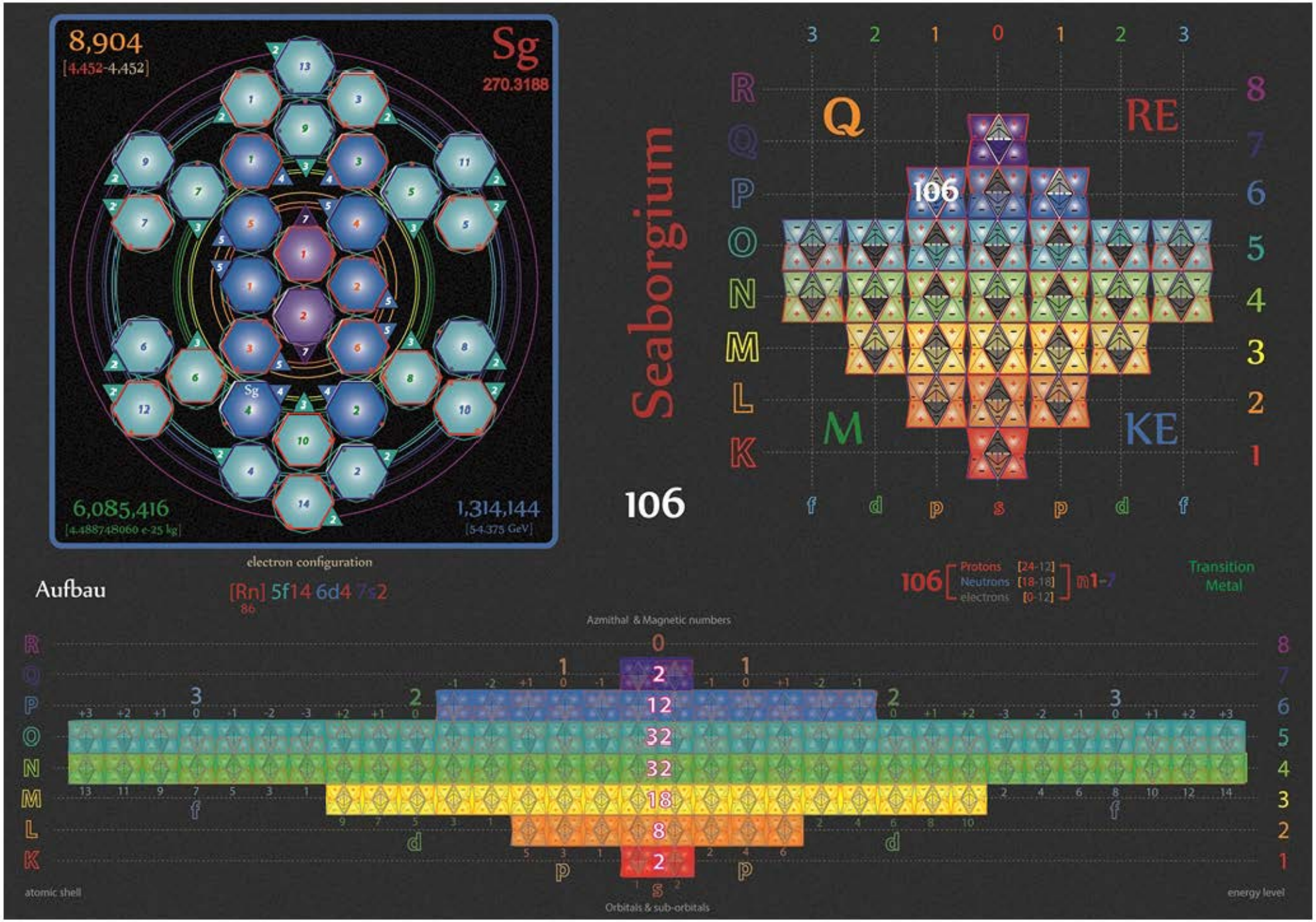

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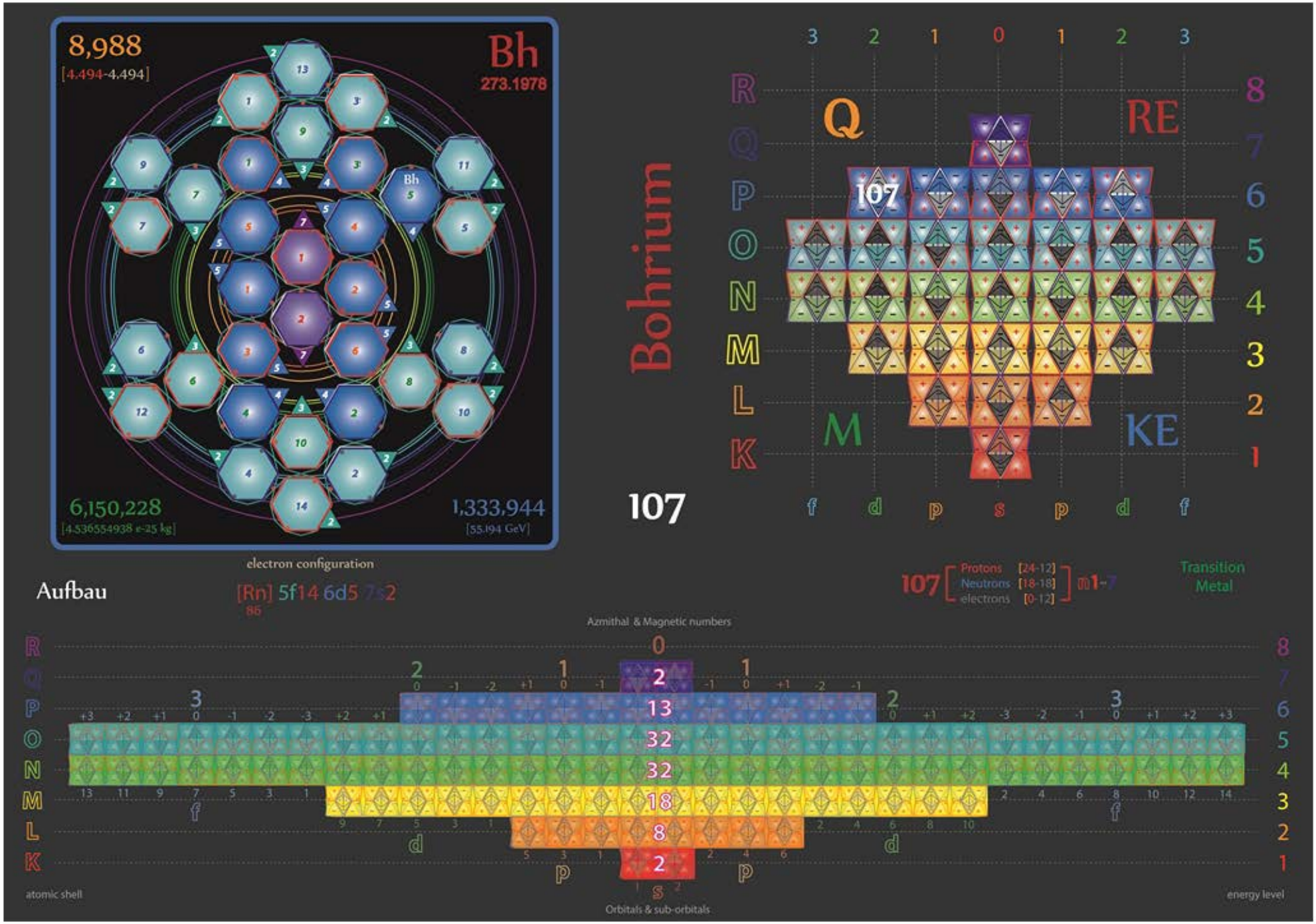

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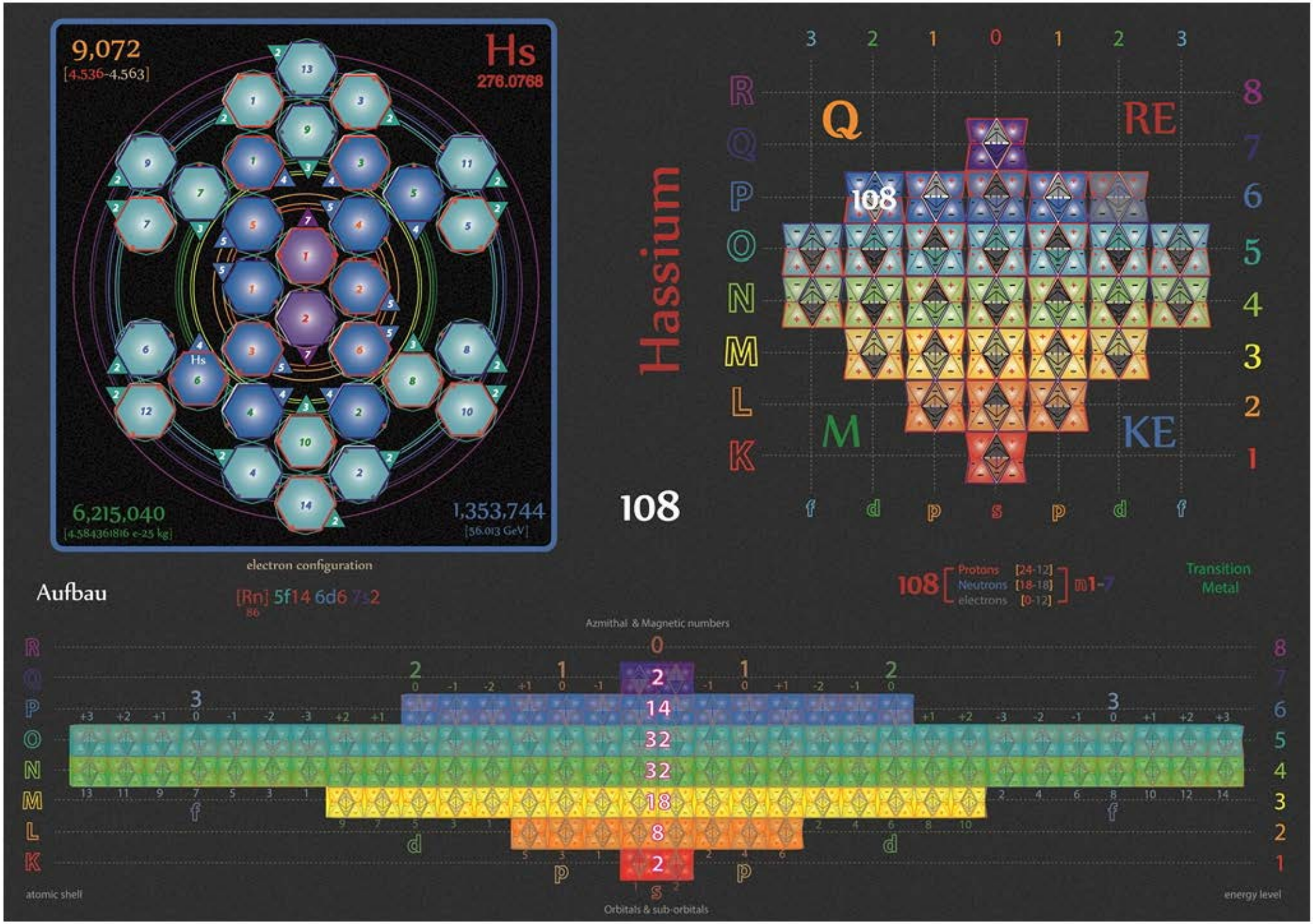

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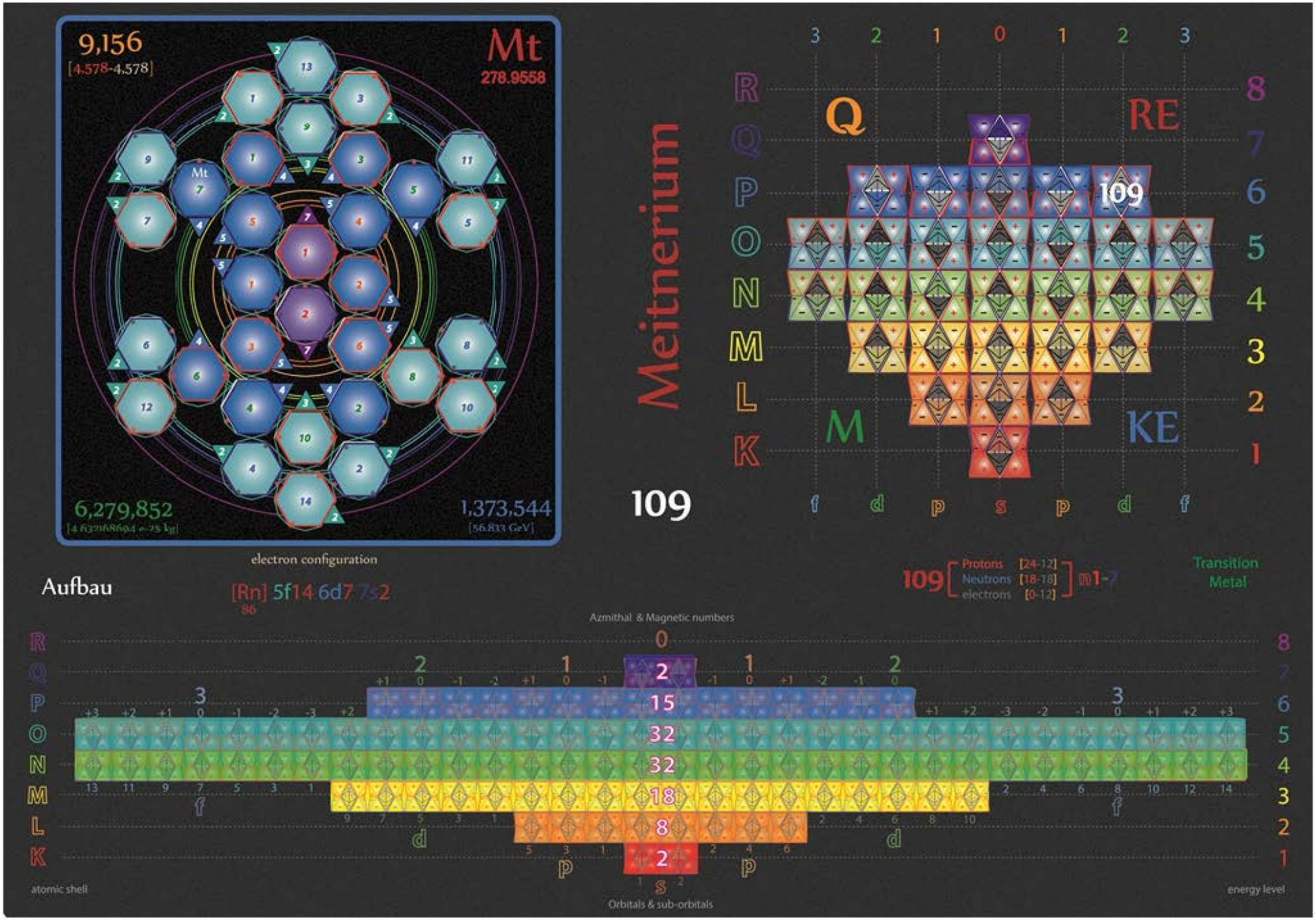

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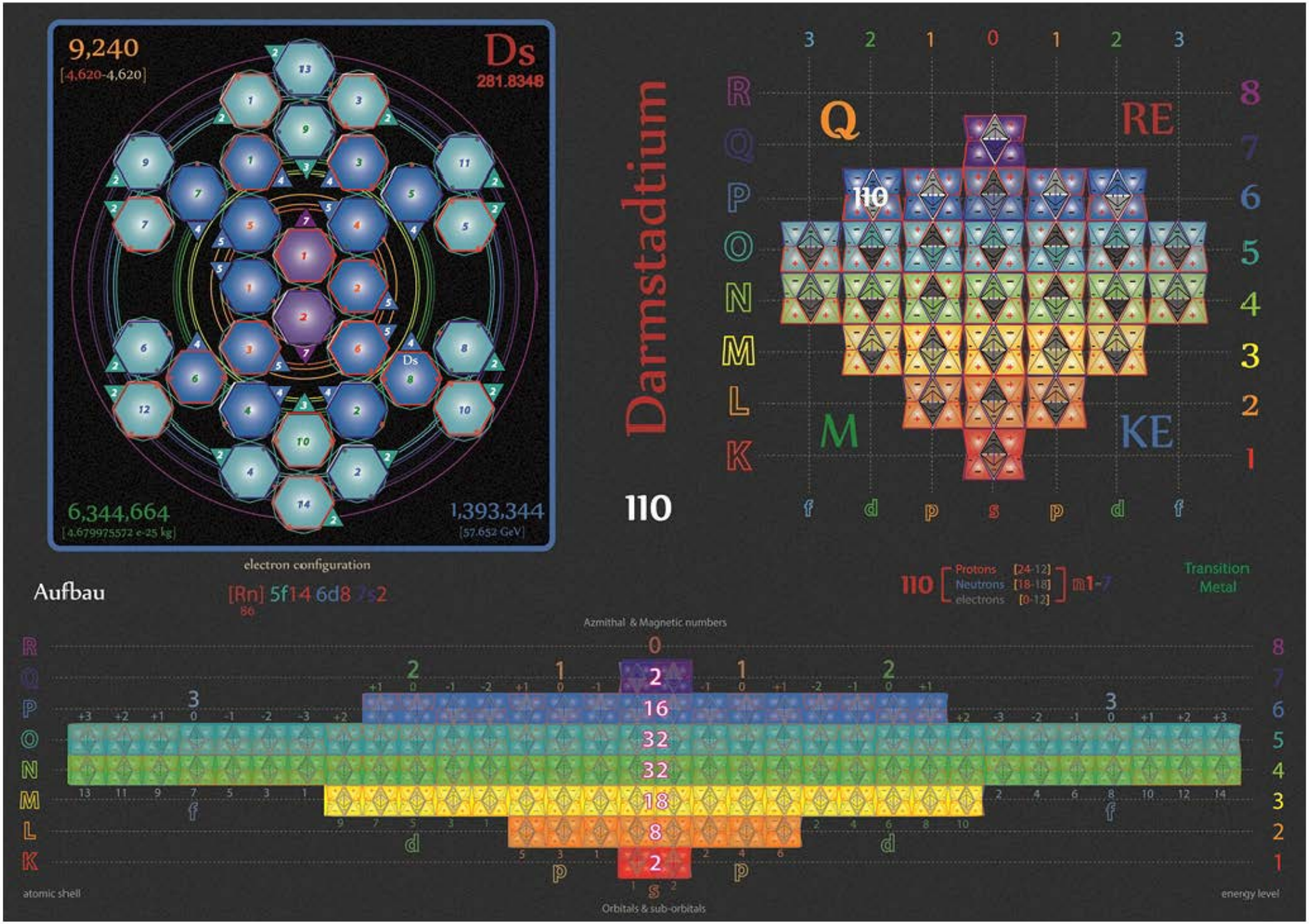

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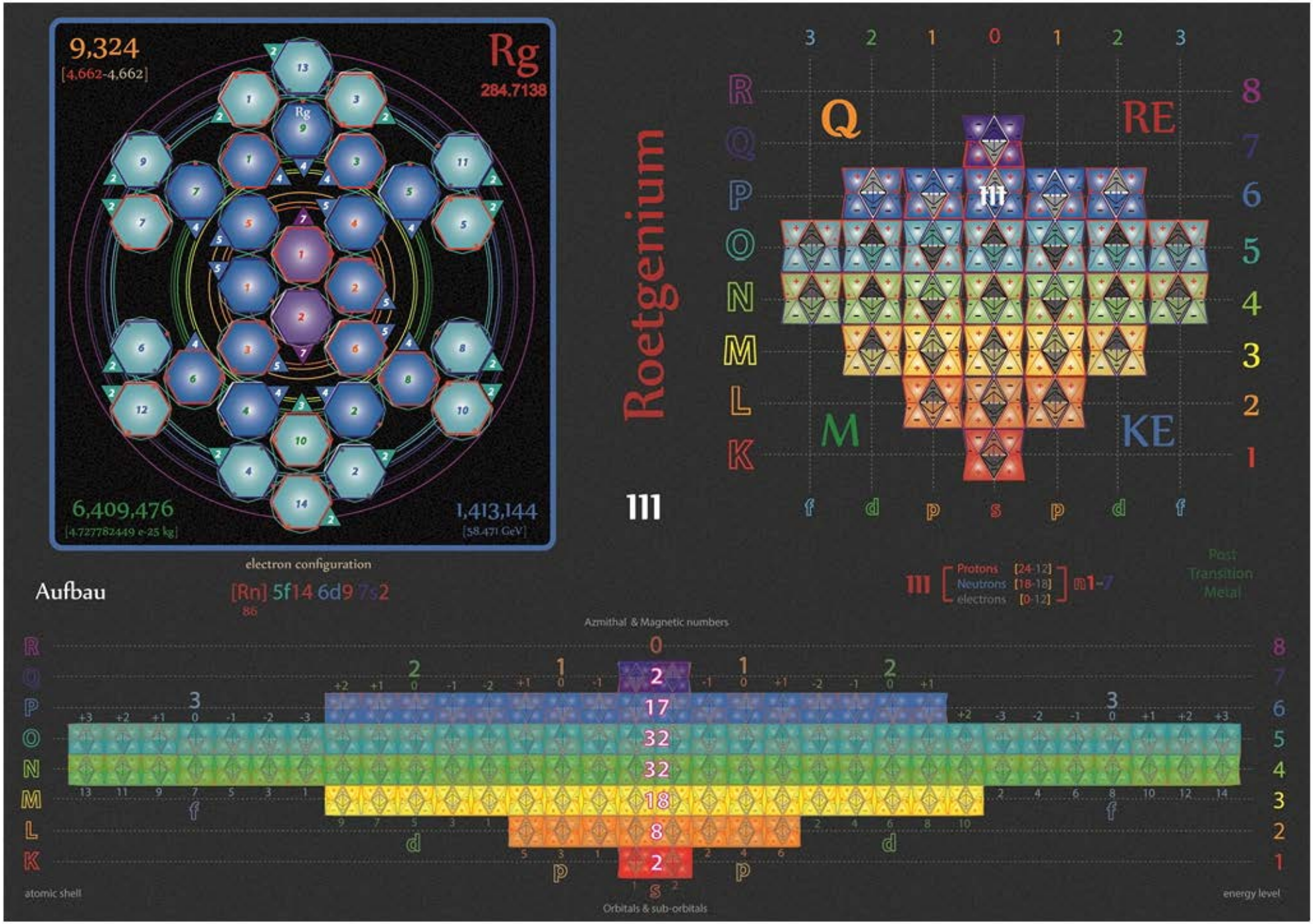

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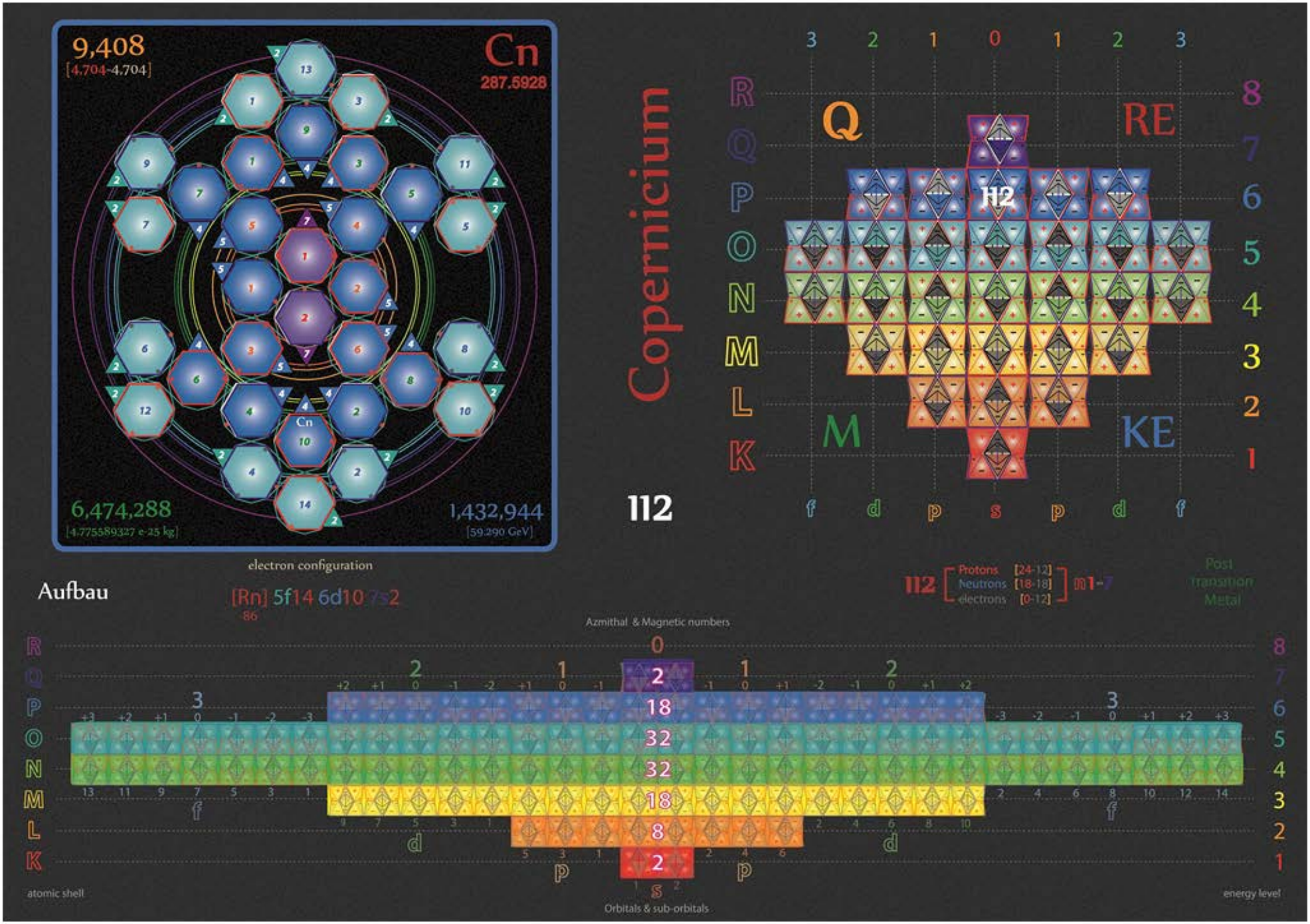

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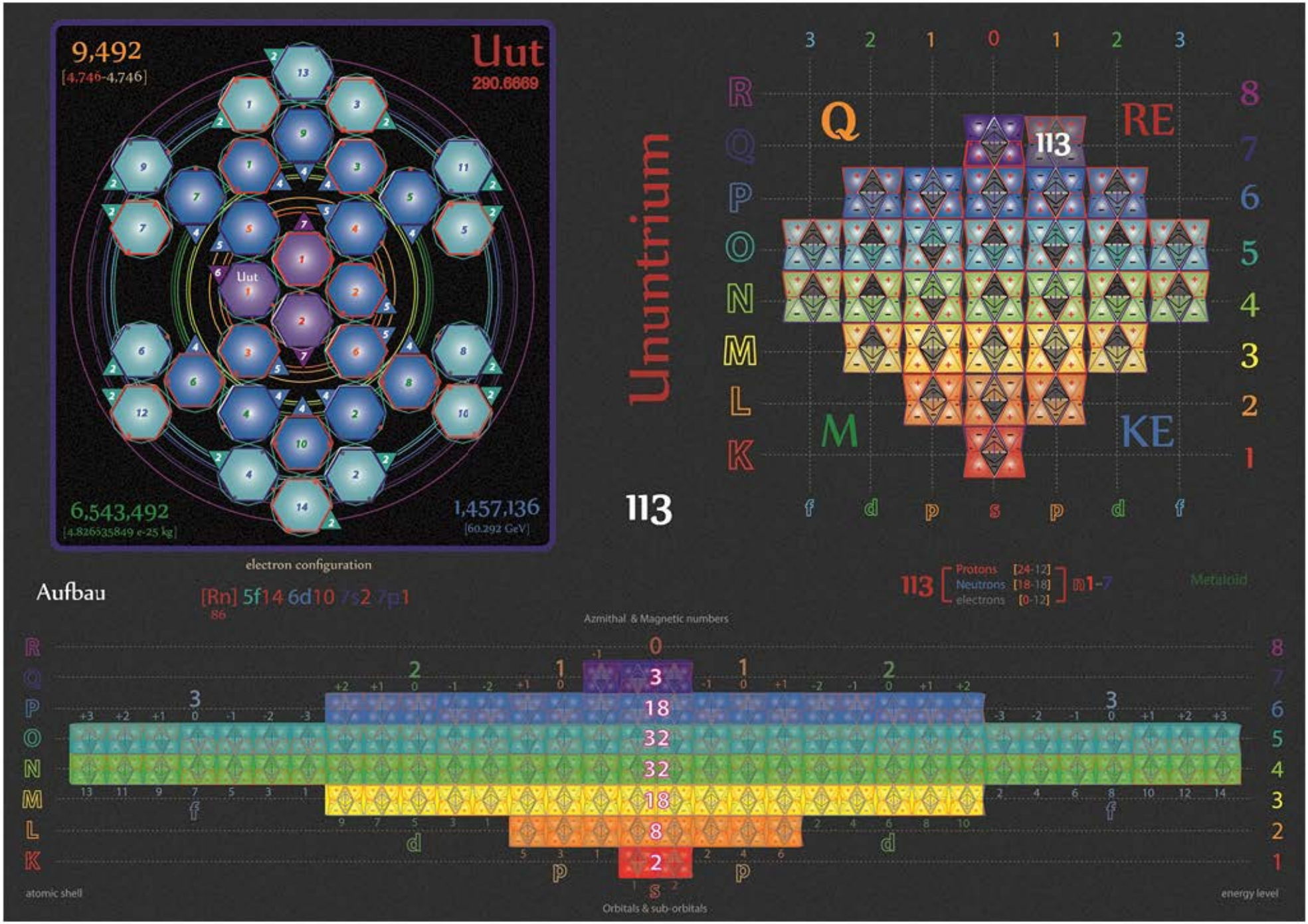

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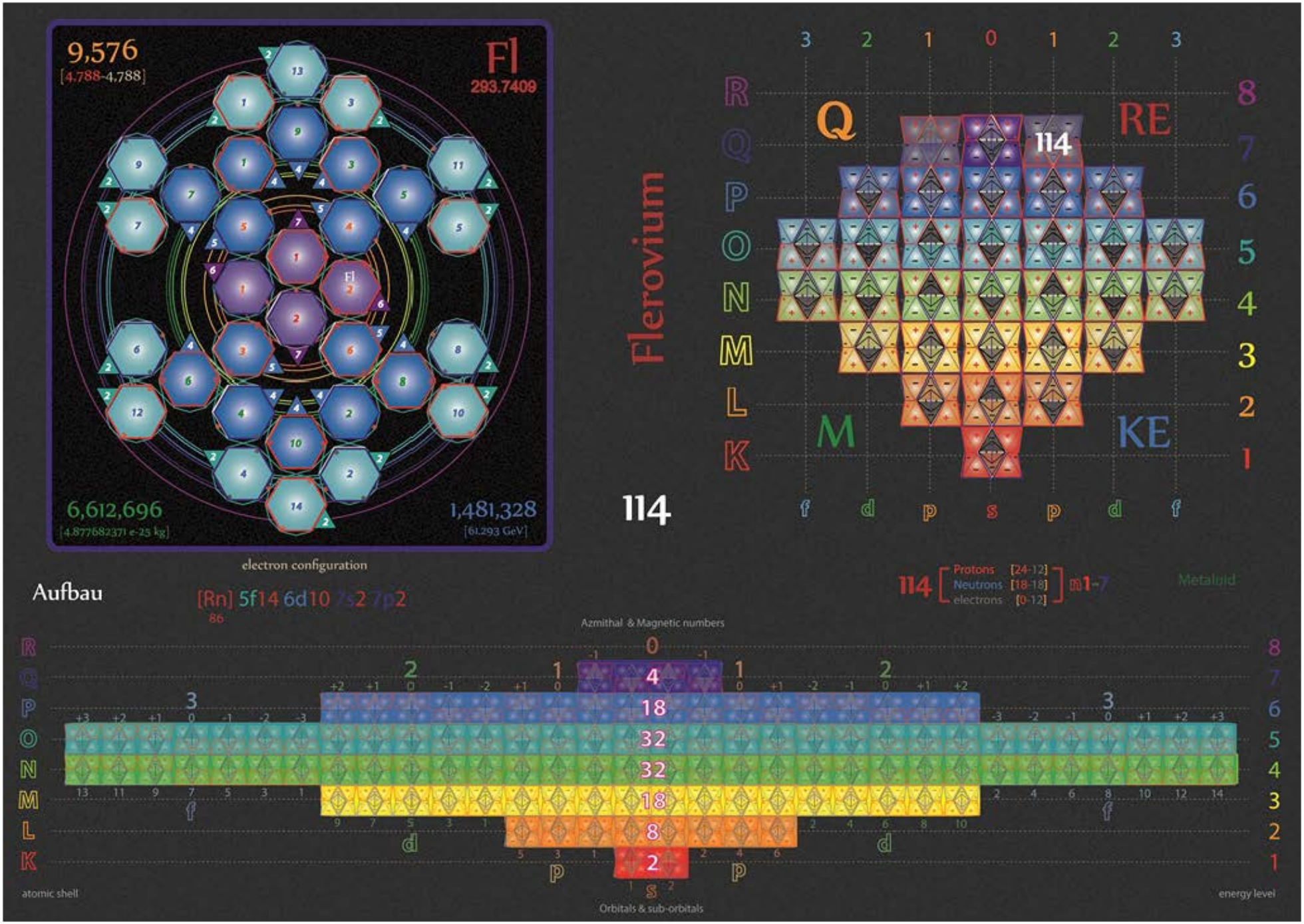

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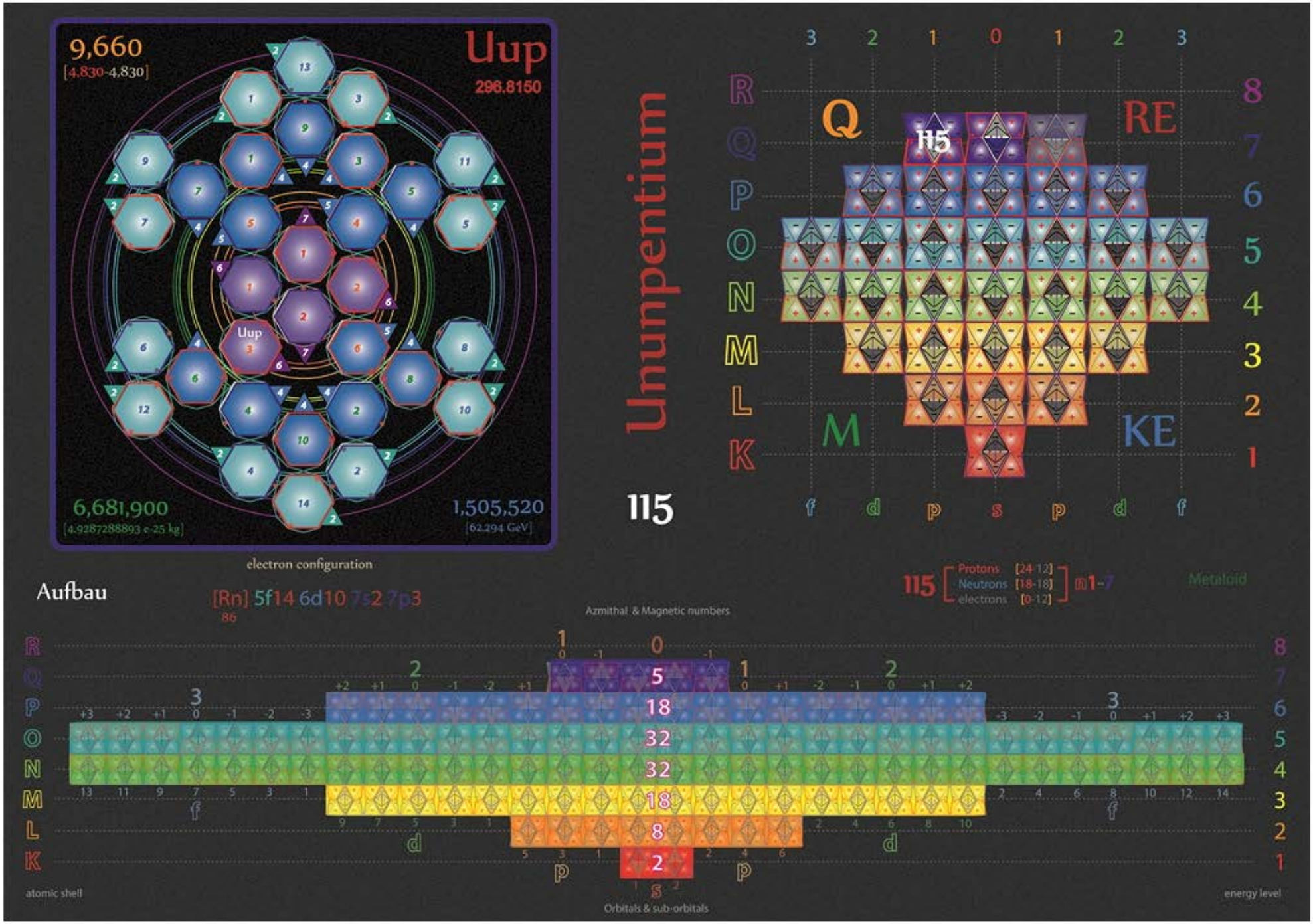

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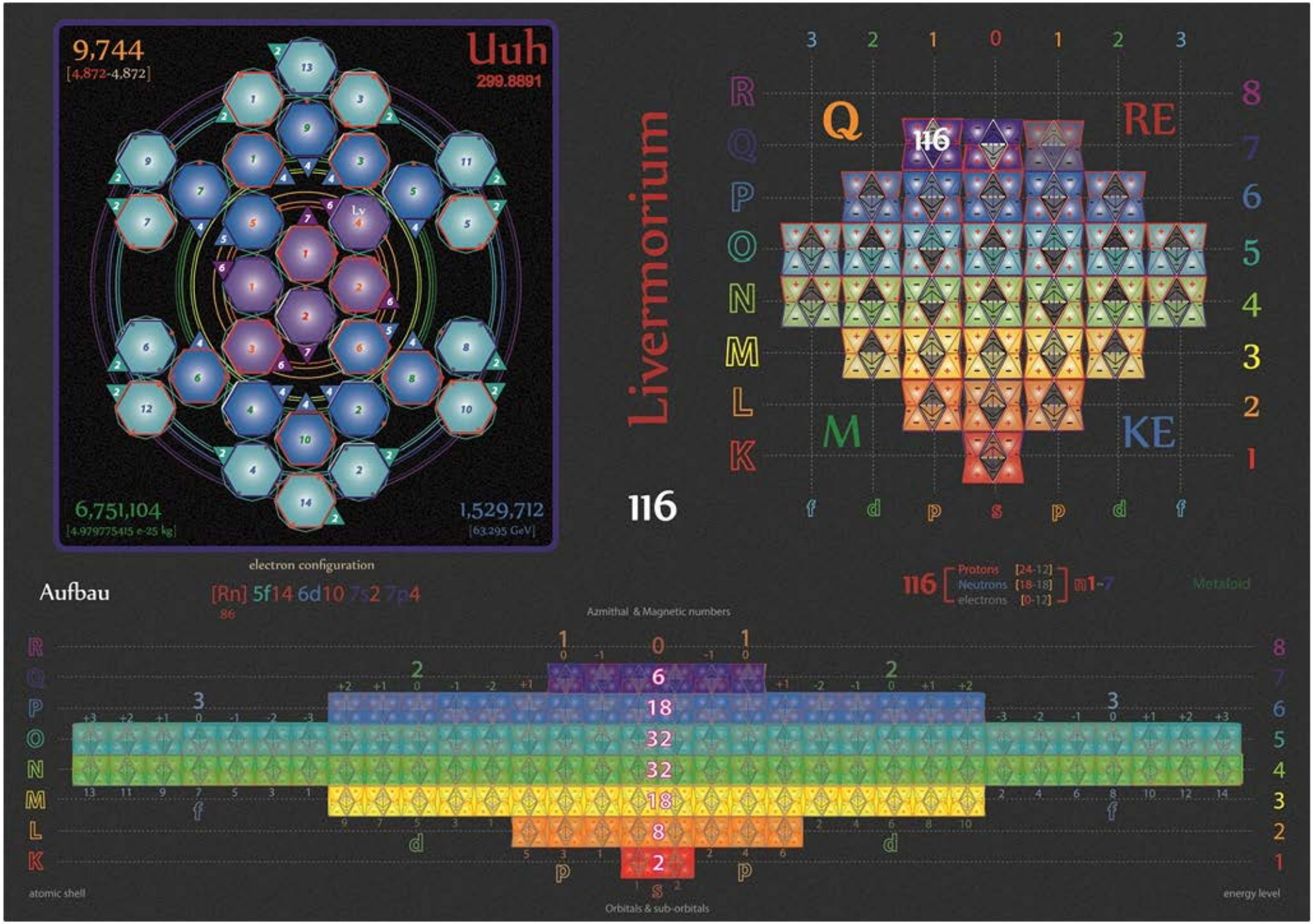

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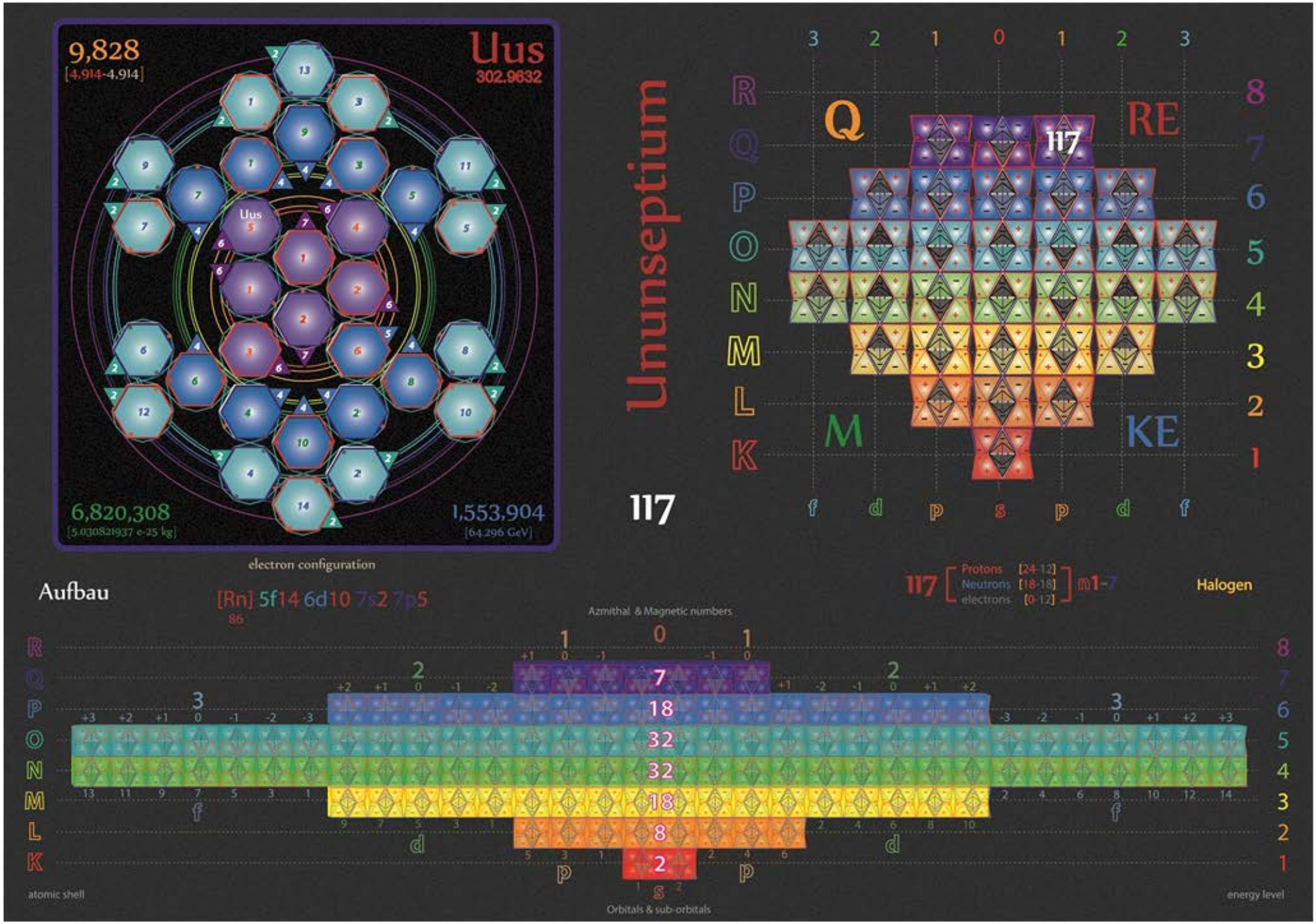

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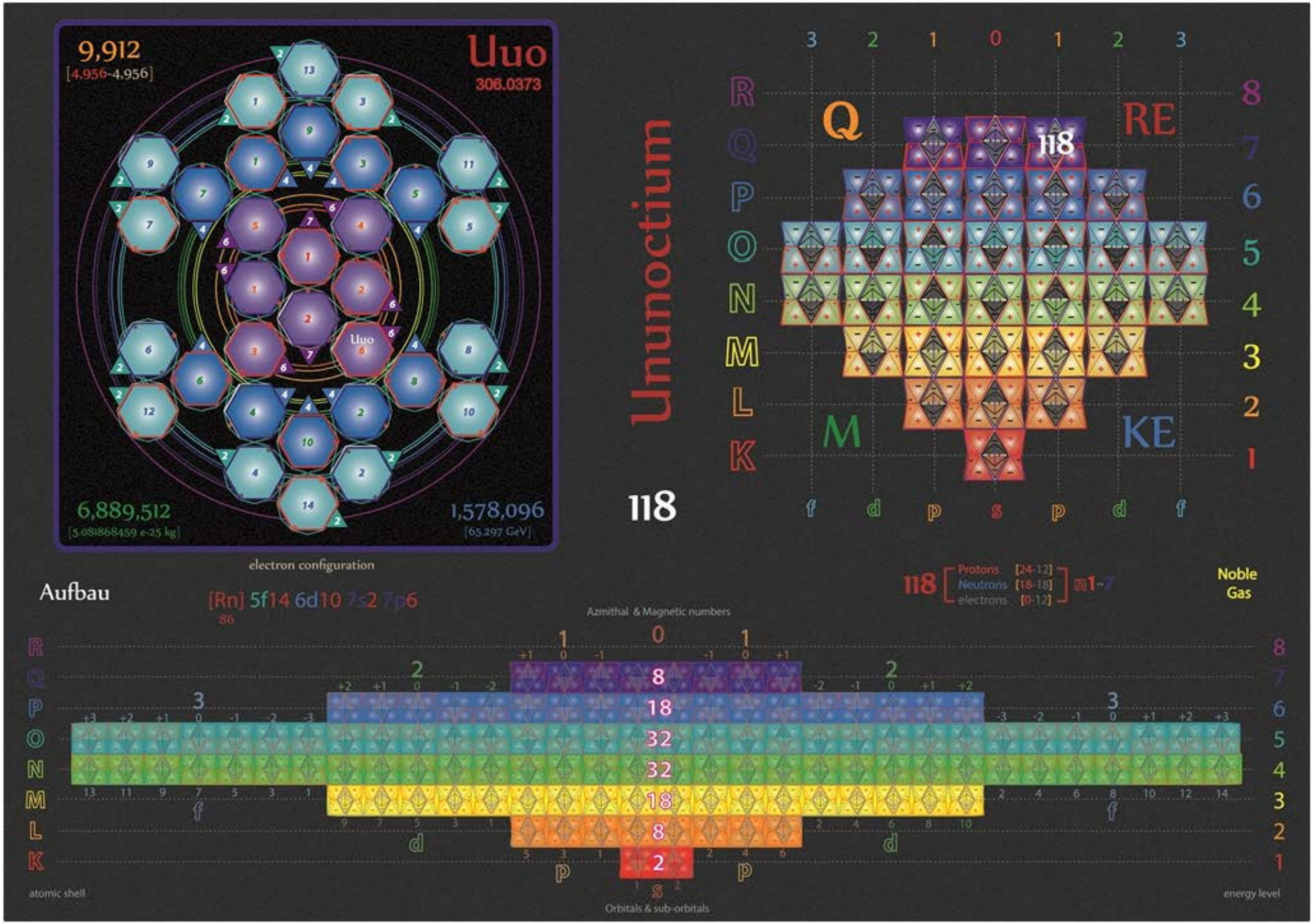

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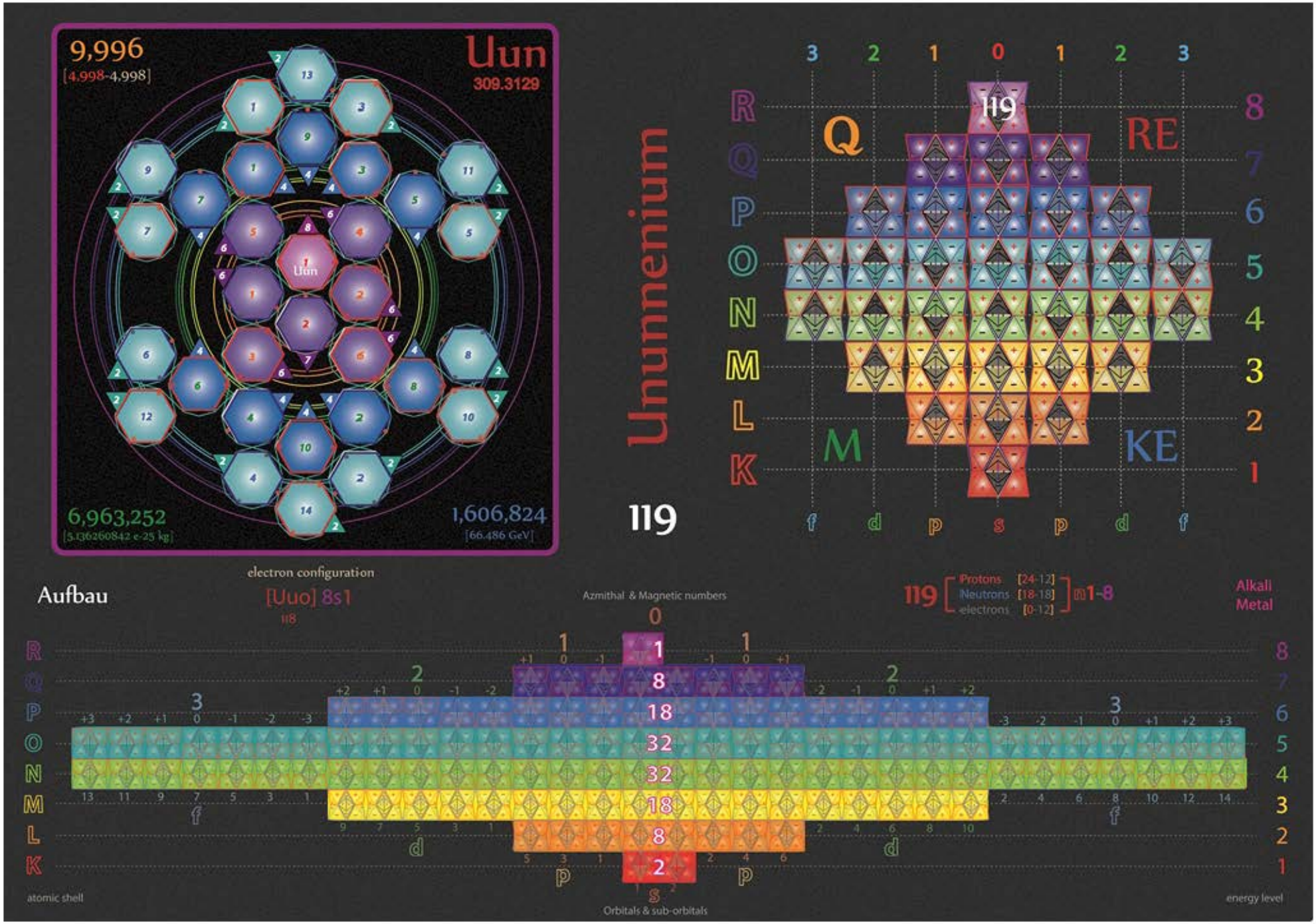

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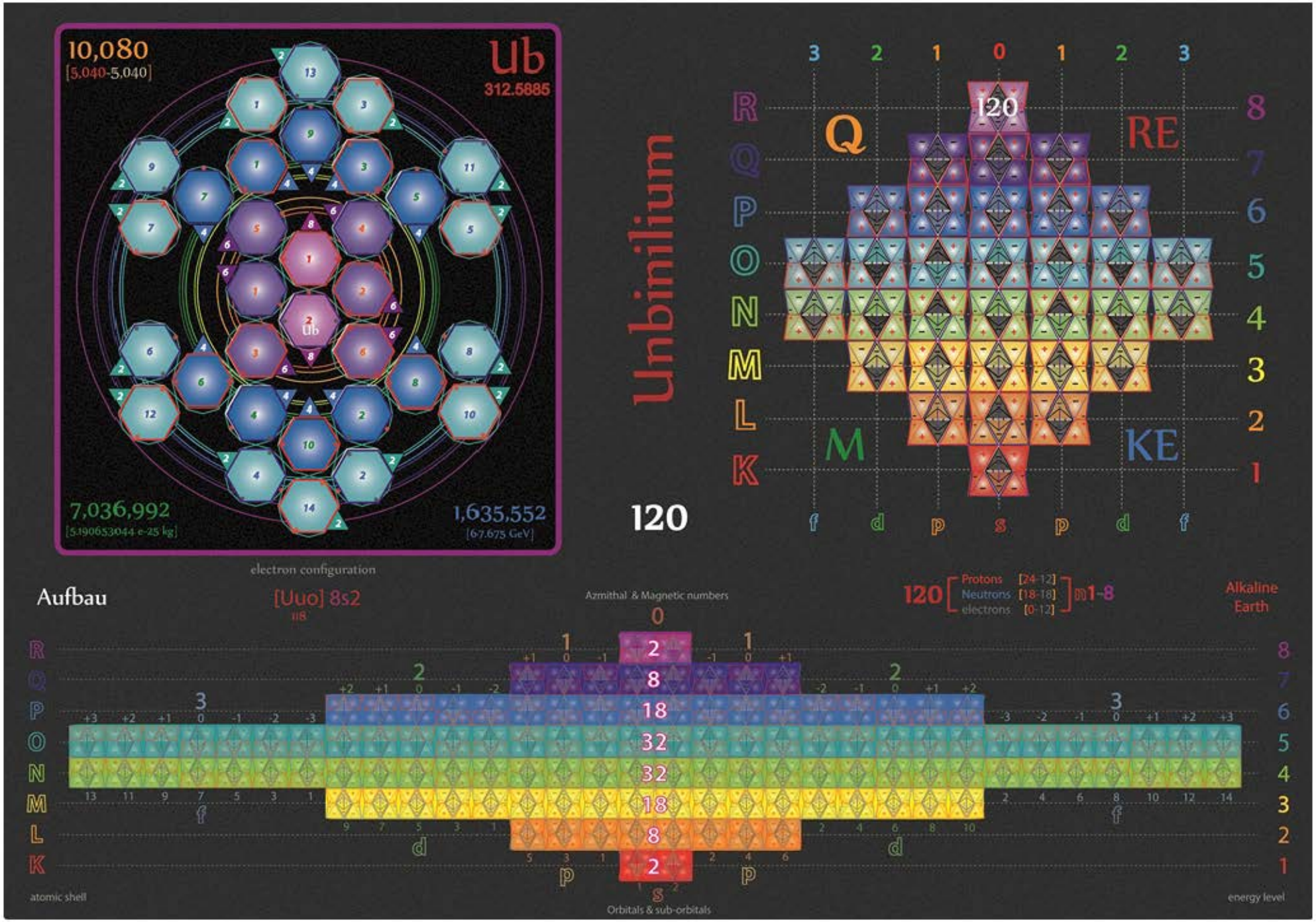

Tetryonics 51.120 - Unbinilium atom

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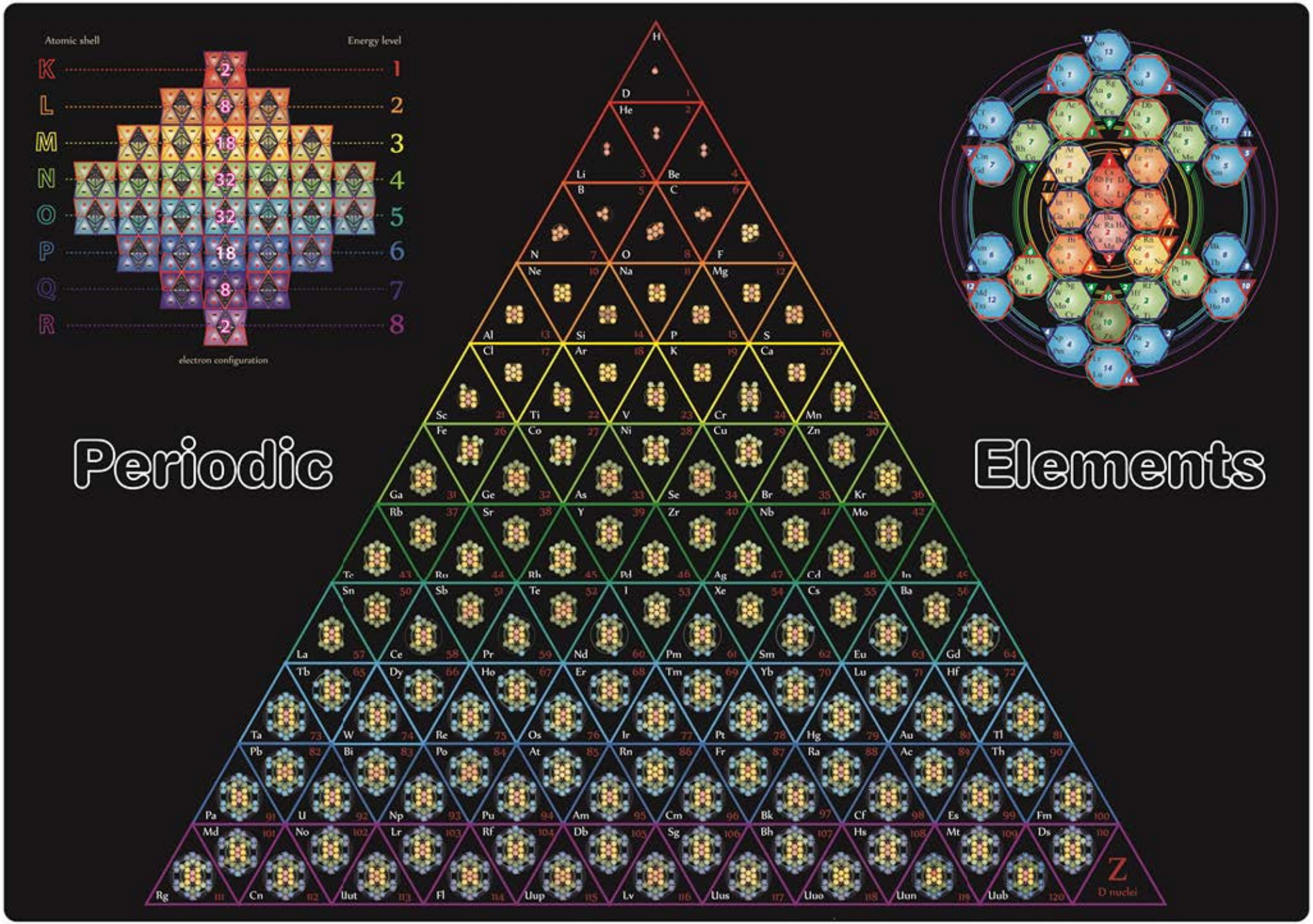

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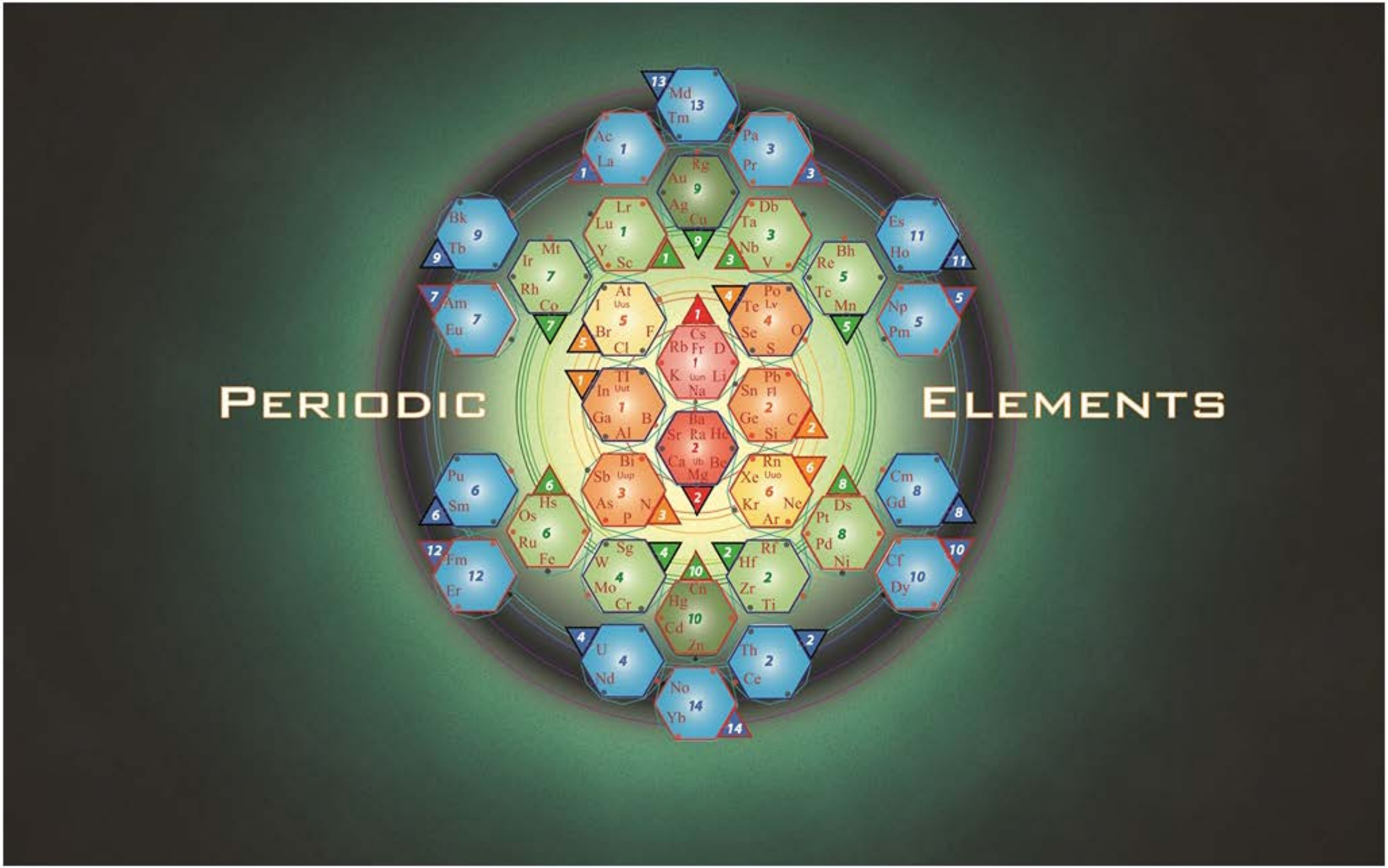

Response to an analysis of Tetryonic Chemistry by Robert J Brotherus [July 2015]

In reply to a paper outlining Mr Robert Brotherus' examination and *mis*-understanding of Tetryonic theory and in particular how it applies to the modern understanding of Chemistry as it currently taught…..

Point by point I'll firstly address the particular points of concern raised wrt modern chemical theory and physics in general:

Tetryonics paper on quantum chemistry is very scarce on making any predictions about atomic properties or comparing such predictions to experimental results.

Tetryonic theory provides many predictions regarding the physical 2d planar **geometrie**s of bosons [radiant mass-energies] and the 3D material **Topologies** of Fermions [Matter and their associated physical properties]. Inclusive in these are many predictions and repeated statements and illustrations of specific particle shapes and the values of mass-energy momenta attributed to each… as well as how these values stem from the equilateral tessellation of Planck energy momenta and why they differ from the established values of modern scientific theory….

In many cases there are similarities to be found with existing observations but where Tetryonic theory differs from modern theory it is not by choice but rather dictated by the equilateral mass-energies within charged Matter topologies themselves and all too often led to much effort in order to reconcile the differences, leading to further insights and extensions of the theory over time…. Where differences exist it is deliberate not by error.

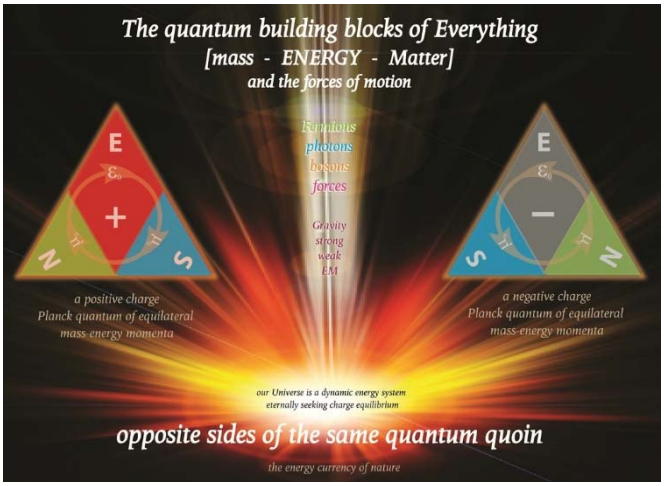

Tetryonics is a BOTTOM-UP physical theory that unifies many currently disparate theories of science into a coherent unified model of the same – but not without its own set of mental challenges to those who are first becoming acquainted with it. As such it must be recognised that Tetryonic theory should not be studied without a sound understanding of the foundation upon with it is built…. Many have approached analysis of my work in such a way only to find that their analysis was limited by modern science's lack of precise detail of the foundations of the physics that they attempt to explain [to wit modern theory is a top-down explanation of the science build up over many generations with an equal number of varying interpretations and assumptions]

Tetryonics plays down importance of "mathematics" and instead emphasizes "geometry".

Arguably I place a lot of emphasis on geometry over that of mathematics in Tetryonic theory, but only so as it offers insights into physical theory that maths alone has not been able to

provide since its wholesale incorporation into the science in the 1600's. This is not to downplay the importance and productiveness that maths has provided us a scientific tool, but rather to 'illustrate' and draw attention to the advances that a purely geometric model has to offer us in advancing our understanding of the same…. To wit, Tetryonic geometries are based on the postulate that all physical theory is founded on equilateral Planck quanta of energy momenta and as such these physical entities afford no room for speculative ideas or mathematical manipulations beyond what is physically possible to be constructed.

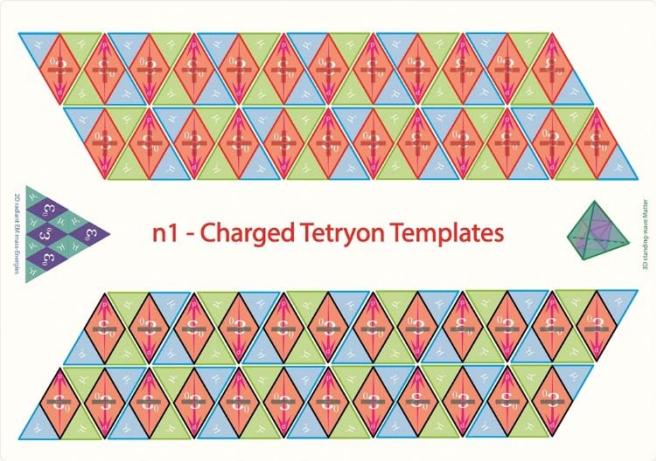

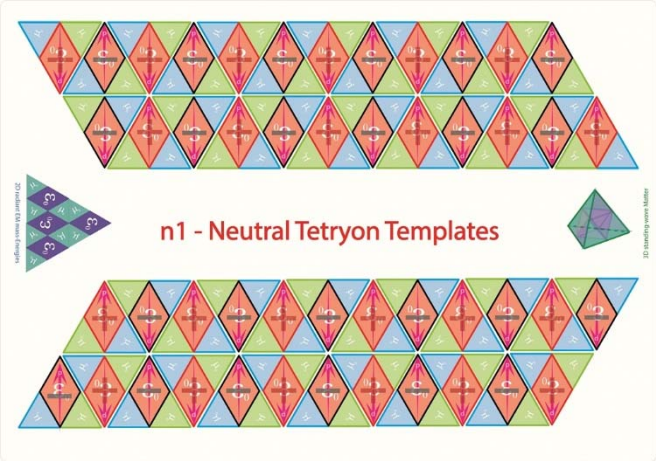

To help elucidate my work and thoughts on the differentiation of 2d planar mass-energy geometries from 3D Material topologies I recorded a detailed YouTube video titled "Tetryonics 101" where I show HOW to use the existing Tetryonic templates [of Planck mass-energy momenta] to construct all the fields [boson & photons] of the Standard model along with the 3D Mater topologies of all the known fermions [and them some]… I do hope you'll take the time to review this detailed instruction on the creation of quantum fields and Matter and try to replicate them same yourself – it is THE most informative thing students of Tetryonics and science in general can do when trying to increase their understanding of the hitherto unseen constituents that make up quantum theory and our macro-scale Universe and the laws of Nature we observe….

Tetryonics paper on physical chemistry is scarce on such numerical predictions and where it does make such predictions they are often in contradiction to observed experimental facts.

In addition to the maths found within Tetryonic illustrations there are also many spreadsheets developed from those very same equations over time to provide the numerical detail found in the illustrations – particular wrt periodic elements and theory rest atomic masses and kinetic elements etc. – It is by no means exhaustive on every topic imaginable

but they do address the information provided on particles & elements etc. along with their kinetic and relativistic energies of motion.

Tetryonic Problem: Missing hydrogen element

Hydrogen is not missing from Tetryonic theory – in fact it is extensively detailed and modelled in Tetryonics [1] – Quantum Mechanics eBook [again highlight the need not to jump into one's preferred field of expertise and study but rather learn Tetryonic theory as you would any modern physical theory in order of presentation]

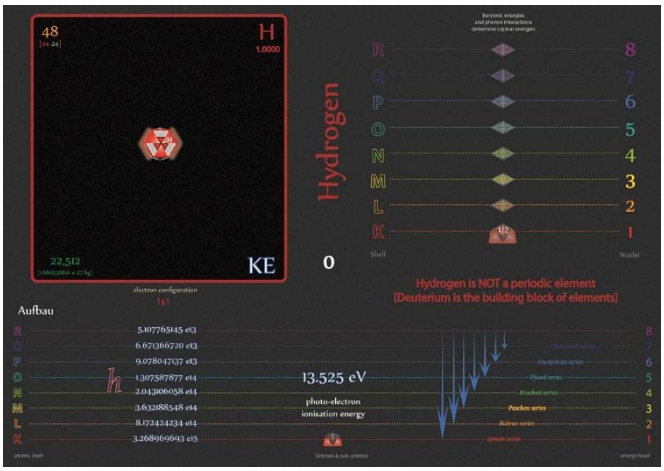

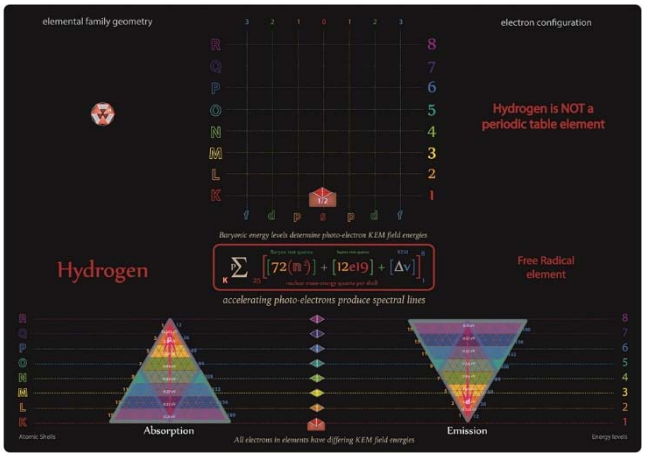

Hydrogen is designated as element 00 in Tetryonic theory as it is **NOT** the building block of periodic elements as is currently understood but rather a sub-unit of Deuterium the real building block of all elements…. This is not an arbitrary decision but one forced on anybody who attempts to build physical models of all elements in order to match and explain many of the current established aspects of chemical and quantum theory wrt the quantum electrodynamics of elements themselves wrt molar mass, the Aufbau principle, Schrodinger and Bohr numbers for each element and how Deuterium nuclei [or any other] may bind together in order to form all the elements of the periodic table and their respective spectral emissions lines.

Attempting to build heavy elements utilising Z number Hydrogen nuclei as a foundation with the excess molar masses being accounted for by way of 'extra or excess' Neutrons [as is the established model of modern chemistry] runs into a number of problems immediately – namely:

The lack of residual strong Force binding points on nuclei to facilitate the binding of Neutrons to the nuclei in order to form the elements [particularly elements 60+]

The incorrectness of ‘reserve beta decay’ to explain and model Neutron particle formation and the mechanics of electron binding to periodic elements in accordance with Schrodinger’s wave equation and Bohr’s atomic model of the same in order to produce observed spectral line emissions of each element in the PT.

There is no uncertainty or indeterminacy in Tetryonic theory as there is in modern theory to explain away such inconsistencies between various aspects of physical theory – each attribute MUST be modelled and explained from first principles & invariably leads to new insights into quantum chemical theory that are at odds with established lines of thought.

To wit I stand by the claims and statements made in my eBooks :

> Each elemental nuclei is made from Deuterium" (p. 12)
> “120 elements in 8 quantum levels *and hydrogen as a free radical*.” (p. 26)
> “Deuterium (not hydrogen) is the building block of all elements." (p. 21)
> “Hydrogen is NOT a periodic element” (p. 83)

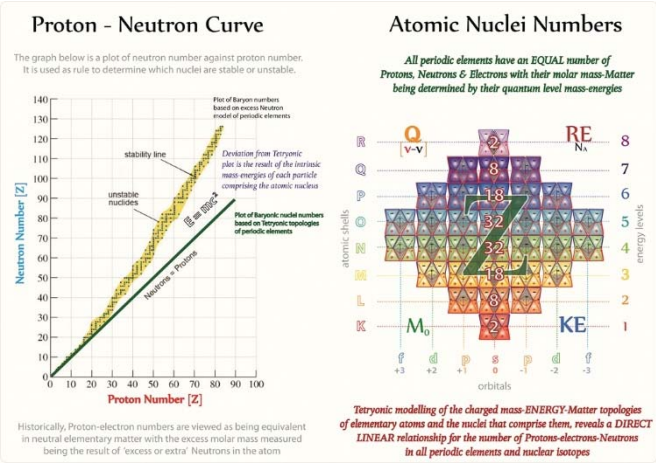

As it is the ONLY way to model and explain how all the periodic elements are created from equilateral Planck energy momenta that is in accord with the known observables… they are not in agreement with some aspects of established theory BUT they do closely mirror the observables and once KEM fields of thermal heat, kinetic motion etc. are taken into account provide a very accurate quantum model of chemical processes at the quantum scale.

Tetryonics does not throw all these facts out of the window just because hydrogen does not fit neatly into my [or other] pre-conceived set of boxes and triangles and hexagons, they are calculated from the Material models and immaterial fields associated with each element that MUST grow from first principles… not from assumptions elaborated upon over time.

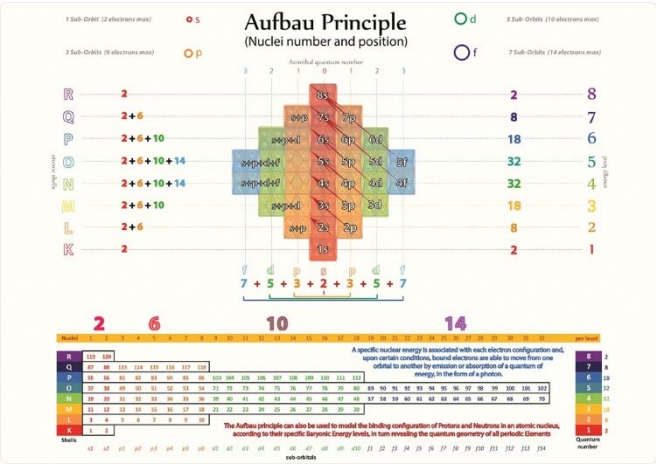

In fact the Aufbau table is shown in Tetryonic theory to be a table that has been ‘right justified’ to match the nomenclature of mathematics rather than the geometric topology of reality [which is centred about the principle quantum numbers and shells of Schrodinger and Bohr respectively]… it is only our skewed perspective of maths that prevents most from seeing the real symmetry present in atomic nuclei as detailed in the quantum numbers of Schrodinger’s wave equation for the same … ie there are no g,h,I,j, shells as supposed and all the quantum numbers of Schrodinger’s wave equations match the symmetric topology of elements as geometric portrayed in Tetryonics [and are in agreeance with Bohr’s shells and orbitals as well, thus unifying all 3 theories]

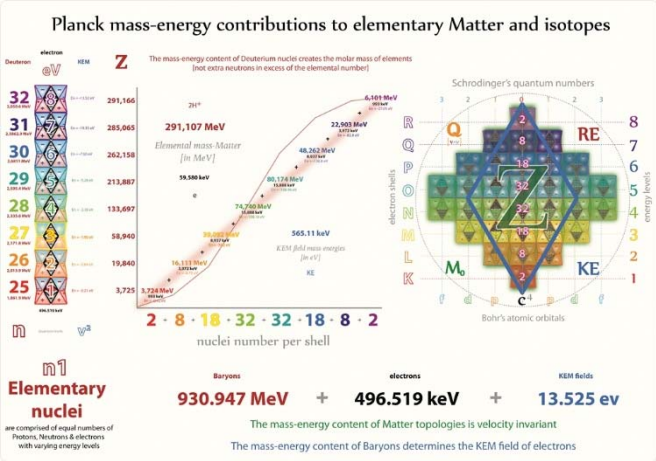

The material topologies of Tetryonic theory then also lead to the necessity to correct ‘weighted’ values for all known particles and elements [and then some] in light of the quantum mechanics of the same – ie their identical 3D charge topologies and the mechanics of the quantum rotating synchronous convertors [Deuterium nuclei] that they form in deference to the accepted theory of mini-solar systems and Neutrons that are heavier than their identical charged counterparts [Protons and anti-Protons]

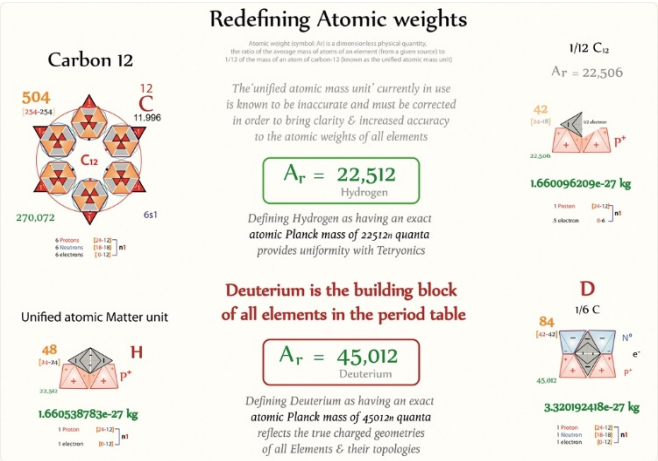

Point in case being **Tetryonic Problem: Incorrect Proton and Neutron masses**
As detailed in illustration 49.04 & 49.05 respectively in my eBook… Tetryonics demands an exact mass for Planck quanta and the molar masses [at absolute zero] for each and every particle in our Universe for modelling and any additional energy momenta [by way of thermal, spectral, kinetic or observational energies etc.] are accounted for in the KEM fields of each respective element or particle.

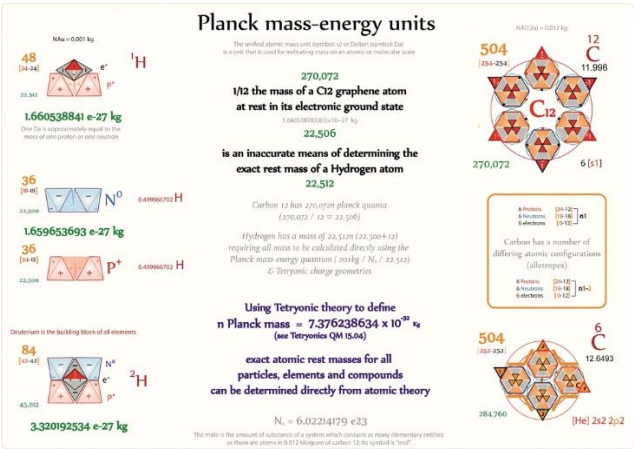

There is NO room for a 'weighted' atomic mass as utilised in modern chemistry which conveniently ignores the mass and motional energies of the electrons in the elements or which ignores the KEM field energies noted above for 'most' situations and calculations – Tetryonic theory MUST account for all of these energies even if it does so at the risk of disagreeing with modern theory at times…

The Proton and Neutron MUST have identical atomic masses as they are identical – both are 36π Baryon Matter topologies differing only in the net charges of +12 [24-12] vs 0 [18-18] they possess as a result of their constituent quarks [UDU vs DUD] as extensively detailed in my QM eBook… Neutrons are NOT created through the process of 'reverse' beta-decay as is supposed presently supposed in modern theory and accordingly do NOT have a slightly higher mass than Protons which in turn affects the molar mass calculations for all periodic elements and isotopes as outlined in my Chemistry eBook as well at length.

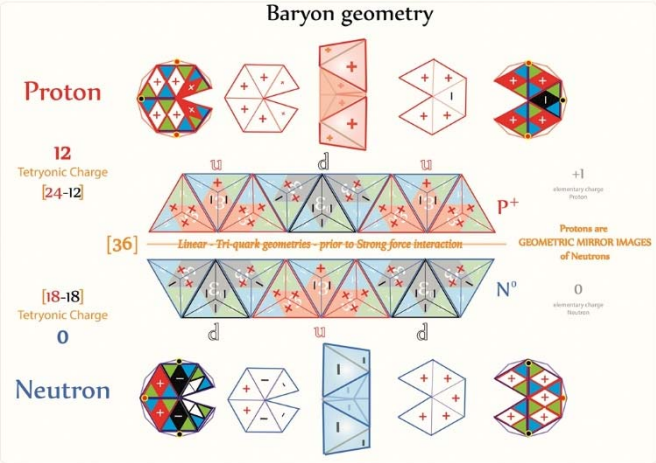

Ie Carbon 13, 14 and upwards are not the result of 'extra' Neutrons being bound to the Carbon nuclei – such a nuclei if possible would be stable and not decay as observed – but rather they are simply the result of the inherent 'squared' equilateral mass-energies of each Baryon in the nuclei being increased from n1 to n2 to n3 …. Resulting in a net mass increase that 'appears' to be the result of a number of 'extra' Neutrons in the nuclei [again this is detailed in my Chemistry eBook and spreadsheets of the calculations be easily created from the formulae found in chapter 53 on my Chemistry eBook….

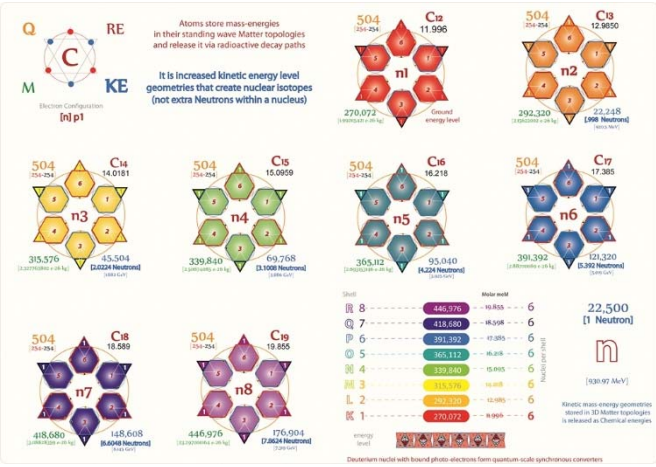

This 'significant discrepancy' with Tetryonics prediction of Proton and Neutron masses from observed ones alone will be enough to prove Tetryonic theory a worthy successor to modern quantum chemistry theory – unless you can explain all of the above using 'excess' Neutrons.

I am neither ignorant of the basic masses of basic particles nor do I think that Tetryonic theory and observed facts of nature disagree, but rather the established theoretical 'facts' of modern chemical theory must be in error

I agree that in reality Matter has **3D structure** (including **volume**) hence the terminology of Matter **topologies** throughout my work. To portray my planar illustration of elements and particles in my PDF eBooks as not reflecting their true material topologies is grossly inaccurate and reflects that fact that **YOU have NOT read all my work** including Tetryonics 101, the Google sketch warehouse of 3D CAD models of each and every particle [kindly developed by Rene Cormier over many months of effort] and extensive list of all elements and their charged 3D topologies and electronic wave function properties and numbers which are freely available to all – only planar 2 d mass-energy **geometries** [bosons and photons]

are portrayed as being like thin 2D sheets in Tetryonic theory, something I am sure you will become more familiar with as your understanding of T-theory advances,[and your distain for its predictions and values not in accord with modern theory wains over time].

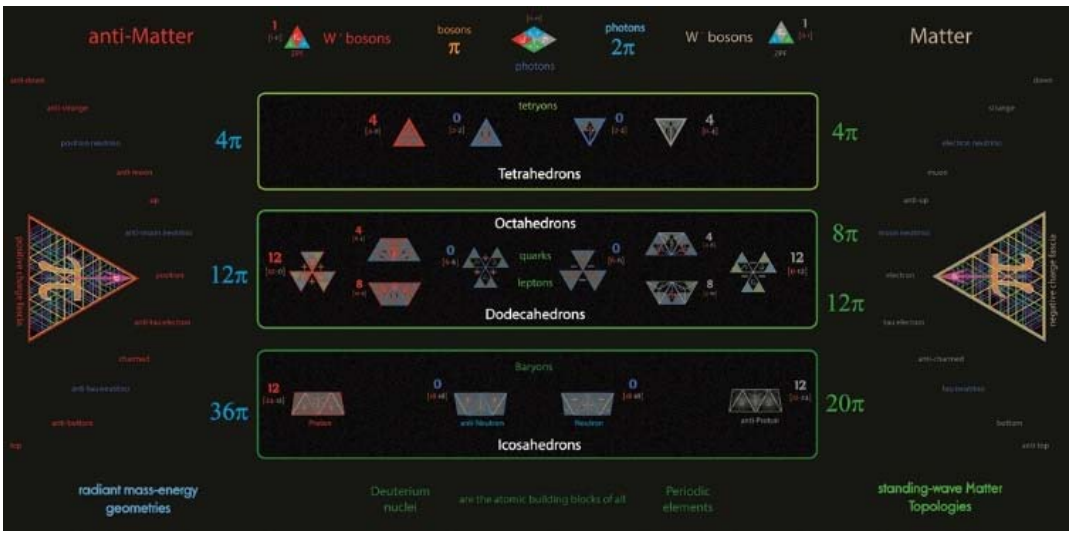

Regarding the 'separation ' of electrons from the atomic nucleus – this is an antiquated model of quantum electrodynamics that is fashioned on planets and their satellites [ie the mini-solar system Bohr model] and which has been extended to a fuzzy electron orbital model to incorporate the Schrodinger quantum model and the 'inherent' quantum uncertainly/indeterminacy of statistical probabilities intrinsic to quantum theory as the theories developed over time…. Tetryonics makes it quite clear in T[1] – QM that the atomic nucleus is in fact a quantum synchronous convertor [ala Tesla/Westinghouse] that can store and release mass-energies in a controlled and predictable manner [ala isotopic decay and spectral line emissions] and that quantum mechanics is NOT quantum inherently uncertain nor in determinant as it is often portrayed – in fact quantum theory as explained by Tetryonic theory is very much deterministic in every way – it was only our top-down view of the mechanics that led modern science to this erroneous conclusion, which I have attempted to correct through Tetryonic theory.

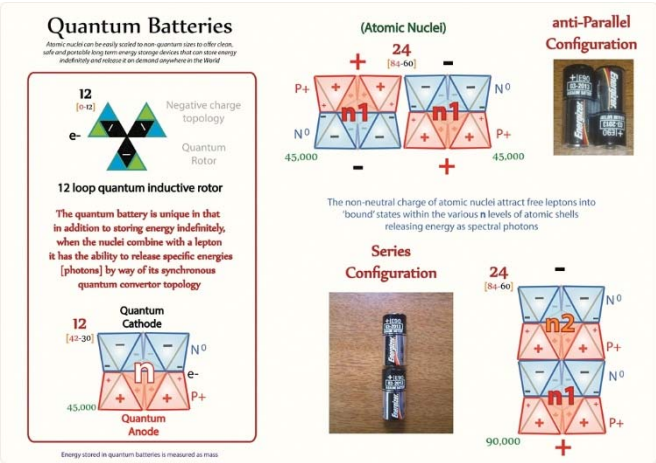

The electron does not orbit the atomic nucleus of any element but rather is bound via its magnetic dipole moment to the positively charged nucleus and spins akin to the rotating rotor of quantum convertor partially within the 3D Matter topology of Deuterium nuclei….

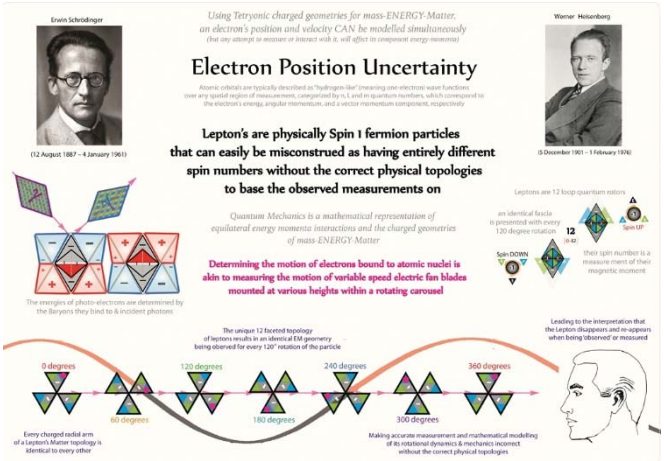

Again these models have all been built and operate according to established electrodynamic theory and their operation is well understood in the macro sense [but obviously the acceptance of such a model strains the thoughts of most who have grown up a mental picture of fuzzy electrons orbiting a spherical nuclei]

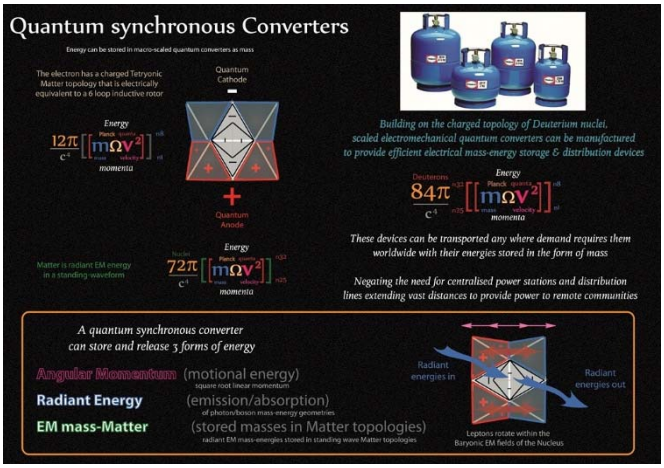

Again the electronic structure of each and every one of the 120 possible periodic elements is well detailed wrt Bohr shells & orbitals and unified wrt their respective Schrodinger numbers for the same in my Chemistry eBook for all to view…. Unlike modern texts which normally stop at element 20 and claim that it is just too difficult to show the quantum models of larger elements with their evermore complex electron configurations and Schrodinger numbers

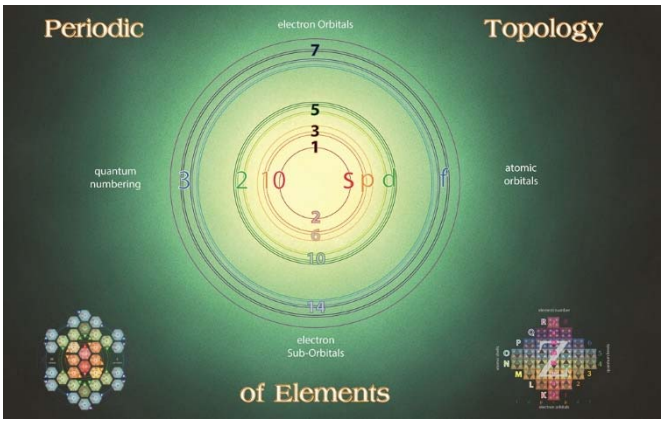

The s.p.d & f orbitals of electrons 'around' any elementary nuclei is the result of the atomic nuclei rotating about is centre of mass/gravity [classical angular momentum] and the

electrons tracing out easily determined and well defined concentric orbits about the same centre [as illustrated] …. A close examination of the Schrodinger numbers [or in fact Bohr orbits] of heavier/larger Z number atomic nuclei reveals the there are no g,h I orbits etc as often postulated but in fact there is a reversal of electron orbital distance as the element number and principal energy levels increases….. Resulting in the periodic symmetry depicted in Tetryonic theory of an atomic nucleus resembling a child's spinning top, which could be mistaken for a spherical topology from our macro view of the quantum scale.

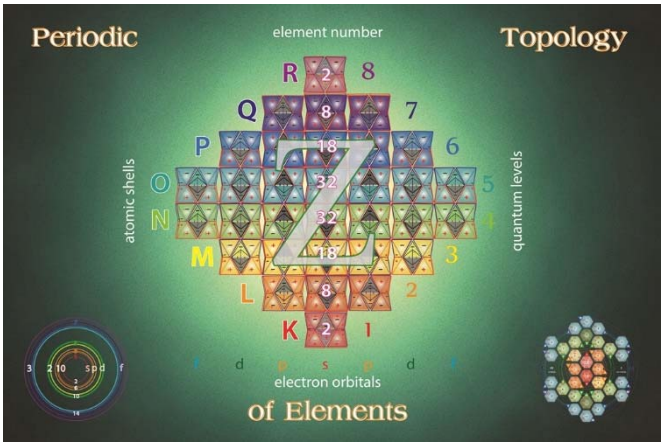

With each element's Z number reflecting the number of **Deuterium** atoms in each nuclei, *not the number of Hydrogen atoms with an ever increasing number of Neutrons to account for observed molar masses*

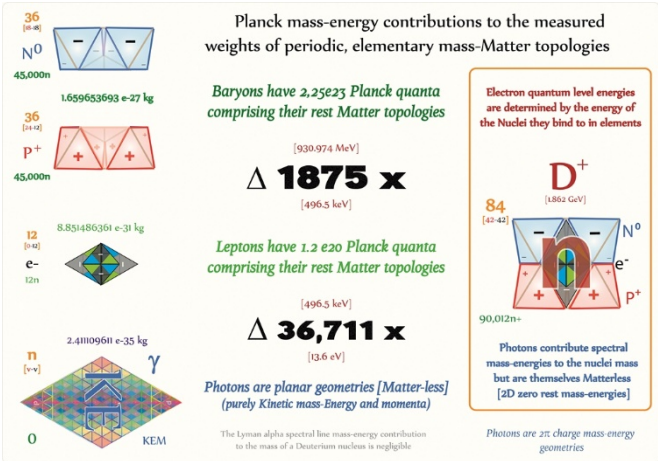

The electrons associated with each atomic element's structure in fact have an important and direct bearing on the spectral emissions of each particular element. Even though their mass-energies of their electronic topologies are only 0.000533' % of the mass-energies of each Baryon in any atomic nuclei this mass-Matter differential along with the energy momenta of the electron's KEM field is key to facilitating the absorption and release of spectral line emissions particular to each and every element known… again, it is not simple good enough to conveniently ignore electrons ad hoc in scientific theory to suit a particular point or theory just because they are or 'insignificant' mass compared to the whole nucleus. Any successful model of science and physics in general must be able to account for ALL the known aspects of modern observations not just a select few that suit their purposes in order to unify physics on all energy scales. Ie a new model of the quantum structure, topology and mechanics of atomic nuclei must account for charge, atomic and chemical interactions, spectral line series and all known elements and compound creation in the ONE physical model.

Clarifying question about Tetryonics nuclear vs. atomic size wrt the Zenon atom
I humbly submit that illustrations 51.49

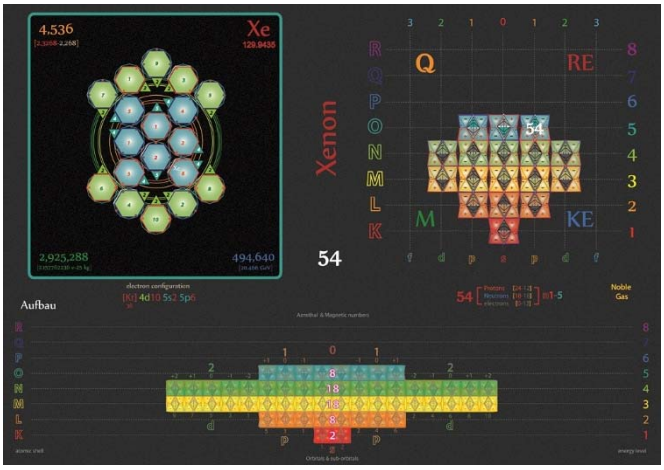

And 53.49 respectively along with the 3D CAD illustrations of the same

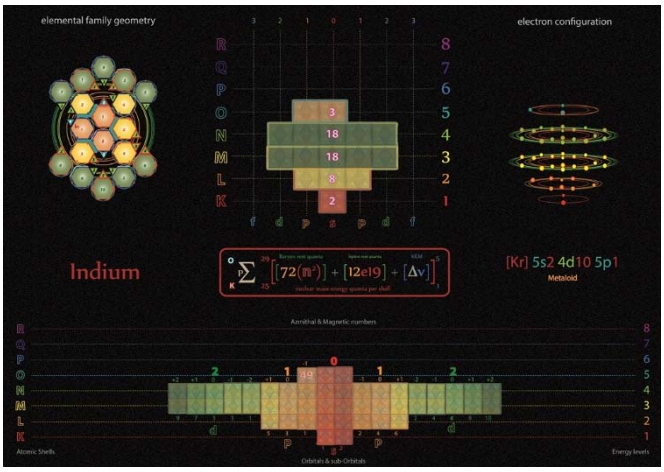

Should be sufficient to explain and illustrate all properties of the Zenon atom [or any other you chose] including their rest mass-Matter energies [at absolute zero], their charged Matter topology in accord with Bohr shells/orbitals and Schrodinger numbers and the kinetic mass-energies of their bound electrons.

Clarifying question 2 about Tetryonics nuclear vs. atomic size

According to Tetryonics the proton and neutron in Deuterium nuclei touch one another at the point son their respective charge topologies where the e-field components of their constituent quarks are located - this is indicated on all Tetryonic element illustrations via red [for positive] focus points and black [for negative] focus points.

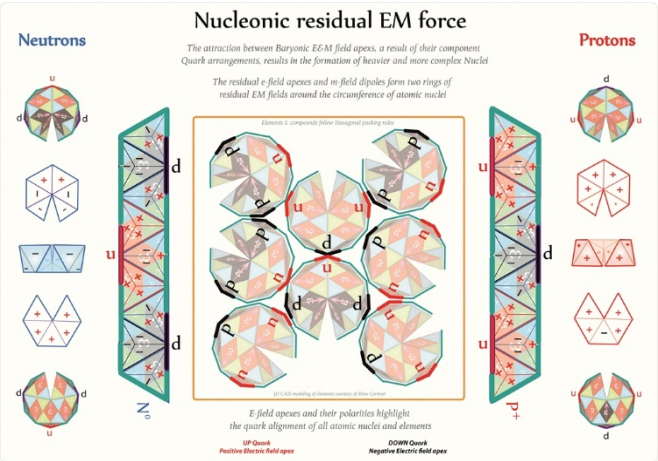

But since Tetryonics does not include any separate strong nuclear force but just electromagnetics, all particles of Tetryonic nucleus would fly apart in a nanosecond.

Again, this misunderstanding and erroneous statement about Tetryonic theory seems to stem from you having failed to read Tetryonics [1] – Quantum Mechanics, viewed my Tetryonics 101 instruction video or even attempted to build and understand how atomic nuclei are formed and come together to form larger elements and compounds alike prior to commenting ….

In my first eBook I have gone to great lengths to show that the STRONG force does indeed exist and in fact plays a crucial role in bringing tetryons [the tetrahedral quantum of Matter topologies themselves] together to form leptons, quarks, mesons & Baryons – it is the parallel opposite charge interaction present between the planar charge faces of each tetryon within each and every Baryon [not to be mistaken for the residual strong force]

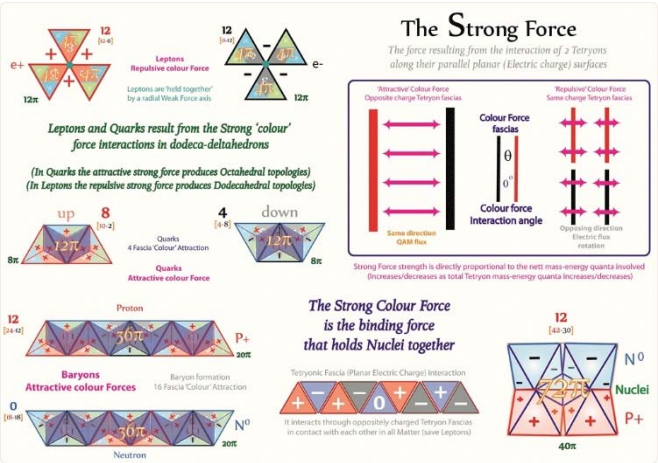

Obviously this co-planar opposite charge interaction holds all atomic nuclei together and your claim of Tetryonic particles flying away in a nanosecond just doesn't hold water…

In fact just place two sheets of glass together with a thin film of water between them and see how easy it is to pull those sheets apart by applying a force orthogonal to the co-planar sheets of glass and you'll soon understand the STRONG force much better that you do presently.

This charge interaction between the e-fields of quarks in Baryons serves to not only bring positive charge Protons together with neutral Neutrons [something modern theory cannot explain] but also serve to orientate each baryon to the other so as to facilitate electron bonding and the creation of ever larger atomic elements and compounds [the residual strong or EM force as it is often termed or the London force]

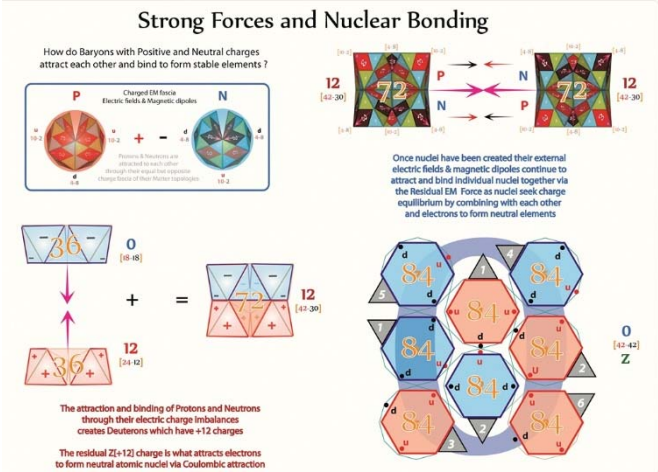

Yes I have an ‘obsession’ with all atomic nuclei have equal numbers of Protons, electron AND Neutrons in accord with their Z number, just as you have an obsession with them being Hydrogen atoms with excess Neutrons ‘bound’ to them – but for the reasons highlighted above, and many others – as for the quantum structure of Protium (regular hydrogen), Deuterium and Tritium being ‘missing’ - again my T[1] - QM eBook holds the answers

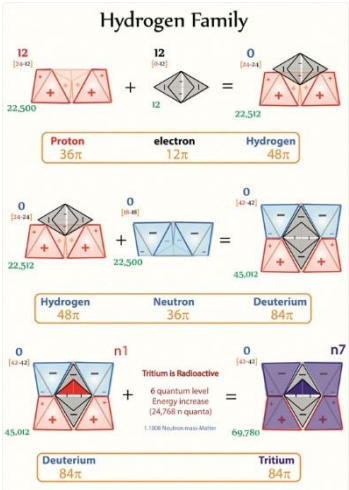

With additional space being made to highlight the Tetryonic genesis of Tritium & Helium 3

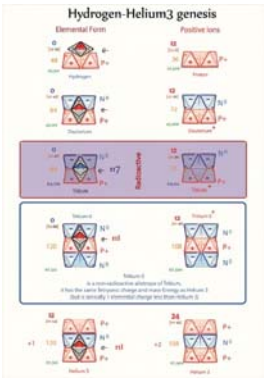

All isotopes are simply Z number nuclei with the energy levels of their Baryons raised to the next quantum energy level [n1-n8] in accord with the 3D material symmetry of the atomic nuclei themselves and the Bohr shells/Schrodinger principal quantum numbers, which can occur either through natural energy absorption or the artificial increase of their mass-energy content in the lab….

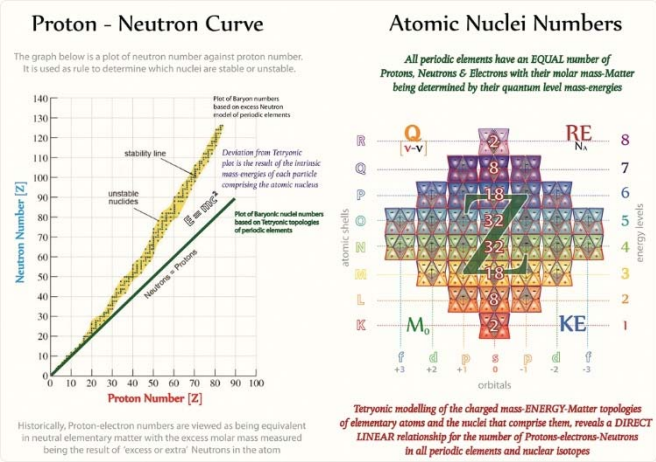

Obviously with all Deuterium nuclei being quantum synchronous convectors as the energy levels of their Baryons are increased [or decreased] the electrons bound to them respond in kind [hence synchronous] via spectral line emissions [or absorption] ….all covered in Tetryonics [2] – Quantum Electrodynamics.

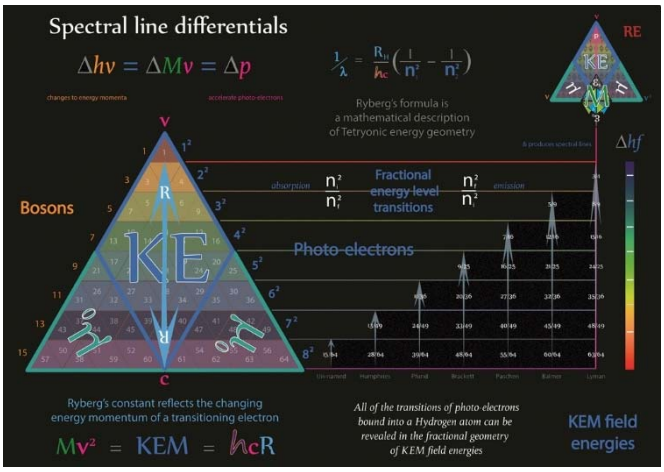

There is NO explanation in modern chemical or quantum theory that accounts for the Proton-Neutron 'curve' of atomic isotopes nor for the islands of stability that exist for various elements, however Tetryonic theory accounts for all of this firstly by 'straightening' out the curved Z line of Protons and Neutrons underpinning atomic elements [by showing that all atomic nuclei are comprised of D nuclei not H atoms with excess neutrons] and then showing that the observed isotopic masses of each are the result of increased principal energy levels of their constituent baryons with the D nuclei comprising each element…. It is no error or 'false notion' as you put it, rather it is the current explanation of these facts by modern theory that is in error

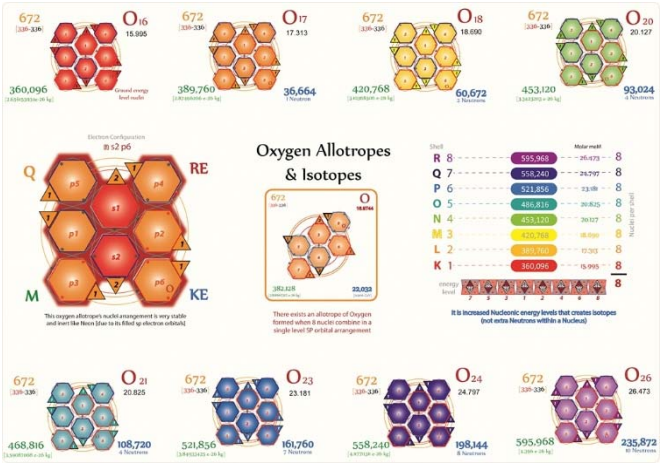

You have chosen Lithium to make your point I chose Carbon, Nitrogen and Oxygen to make mine, but the explanation for Lithium remains the same….. an increase in the mass-energies of the baryons making up the element concerned… btw I have done spreadsheets for each and all the elements as a matter of course during the development of my theory.

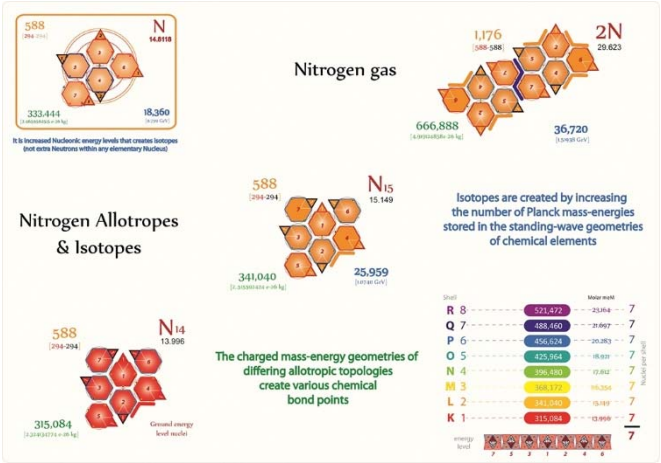

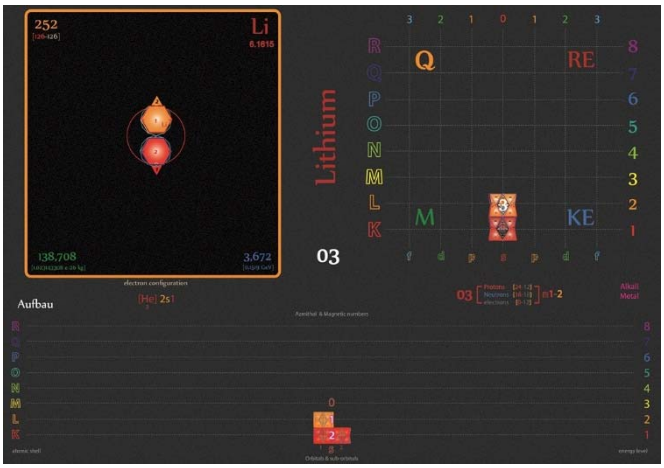

Element 3 – Lithium [ground state atomic topology and electronic configuration]

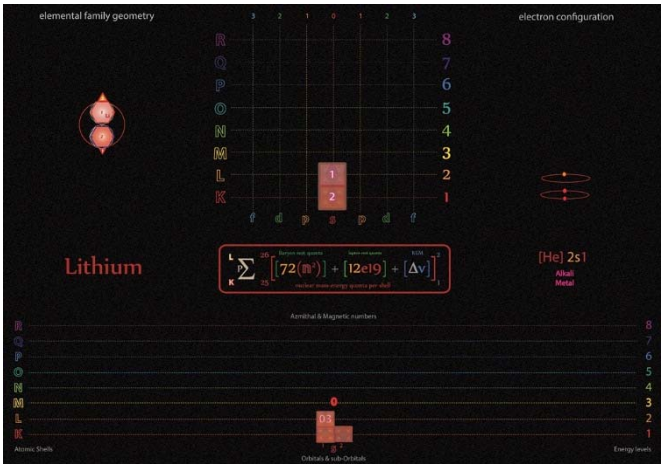

Regarding your comment of “but in reality **only electrons are on these shells** and the structure of the nucleus is completely separate from these shells”, - that is only the current opinion/consensus explanation of quantum chemistry at this stage and is obviously at odds with Tetryonic theory *built from the ground up from equilateral Planck energies not the top-down through supposition*….. I am confident that over time this consensus will change.

1. Explaining the extra (neutron) weight as higher energy-levels of the Deuterium nuclei seems *ad hoc* explanation with no supporting evidence – *simply nonsense*…..
2. No calculation is presented to *derive a prediction* for the excess mass (or energy) from the Tetryonics model – *have you even read my work in detail – calculations and mass-energies are provided everywhere throughout it*.
3. The excess mass of, say, Lithium 7 (one excess neutron compared to 3x deuterium) – *again a number based on your erroneous viewpoint – not y given explanation and illustrations of the same.*
4. This is inconsistent with the fact that there are **multiple** isotopes of each element.- *how so?*

   The energy level of Baryons of each and every illustrated element in Tetryonic can be increased resulting in isotopes of that element – with NO extra Neutrons present, again you seem to have failed to read and/or comprehend what was presented before you in the Tetryonics chemistry eBook.

5. See above for Hydrogen family [please]

All the ‘observed’ masses you have provided in that table are firstly just that, weighted [averaged] measurements of particles with kinetic energies [heat, spectral, motion etc.] not the absolute rest masses I have provided and clearly stated as such…… you must account for observational and inherent kinetic energies for your stated values to even begin reflecting the quantum values of particles at absolute zero.

Again, ‘isotopes’ is NOT what you think and proclaim – there are no extra Neutrons in the nuclei – only Baryonic energy above that of the res/ground state of such an element at absolute zero – unless you can account for those KEM field energies [as should be done]

Tetryonic Problem: Helium as Alkaline Earth metal

- And Hydrogen is element 1 which no-one can agree on which position it truly belongs in on the current periodic table.

Tetryonics problem: 120 possible maximum elements

- That is what is dictated by the charge topology of particles and elements themselves, perhaps you'd care to share what your spherical [or other] model for element 93 is, and how all the 'extra' Neutrons bind to each other to create that particular model?

Tetryonics shows quite clearly the reasons for there being only 120 possible periodic elements and it agrees with the math and equations of both Bohr and Schrodinger's models despite the differing quantum topologies.

Perhaps, you can produce element 121 and prove me wrong on this.

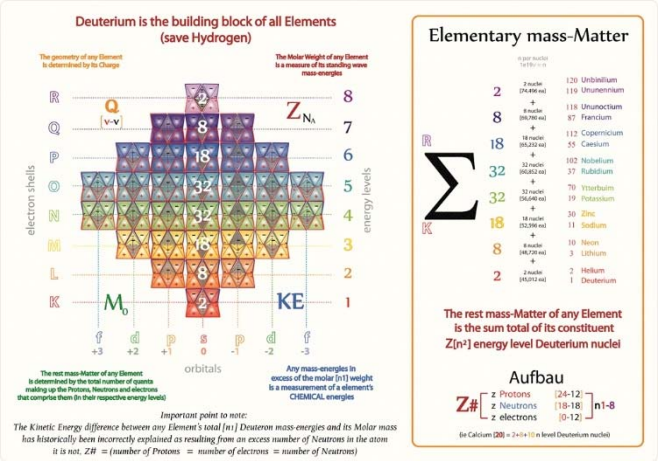

Additional random quotes - the uncertainty principle erroneously dictates that position and momentum cannot be simultaneously determined

- There's nothing random about this comment/quote - Tetryonic theory is founded on the SINGLE postulate that Planck mass-energy momenta has an quantum equilateral geometry [ie quantised angular momenta (m^2/s] is equilateral/triangular not circular as it is the macro sense of angular momentum] - from that flows the fact that the probabilistic nature of quantum theory and the maths used to describe it are in fact not 'fuzzy' or indeterminate as supposed presently but in fact an emergent property of the tessellation of mass-energy momenta at the quantum level.

The inherent indeterminacy of quantum theory is a crutch used my mathematicians and scientists alike to explain many of the puzzling aspects of quantum theory like the inherent statically probabilities of quantum fields themselves or the wave-particle duality of photons or particles in motion….. Again it is them and modern theory that have simply failed to grasp the geometric reality of energy momenta that underpins these phenomena and how they build to form the familiar laws of Nature at our scale of observation.

Tetryonic theory is all about correcting these erroneous assumptions and established viewpoints – but any change of perspective is not without birth pangs of angst and misunderstanding from those who first encounter it [like Newton, Planck and Einstein with their theories of Gravity, Quantum mechanics & Relativity theories before it]

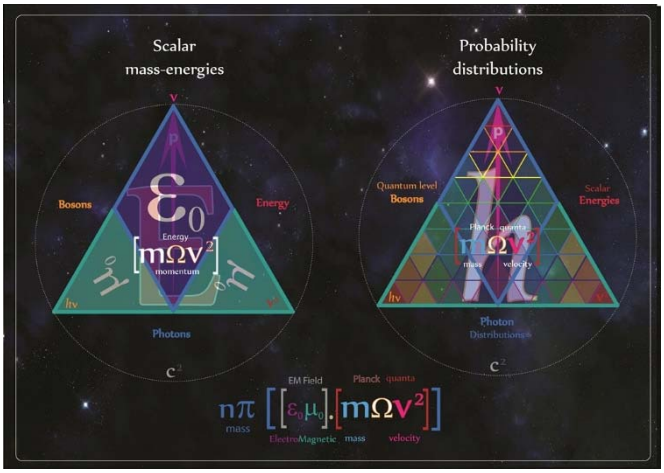

That it is the transverse bosons Max Planck described using E=n.hv when resolving the ultraviolet catastrophe and spectral line emissions

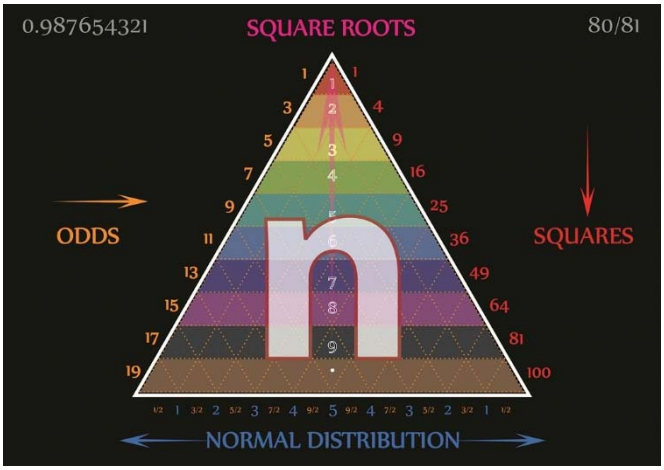

And which subsequent theorists incorrectly applied directly to Einstein's formulation of E= hf to describe neutral PHOTONS of energy momenta [dual charge bosons – quantum transformers]

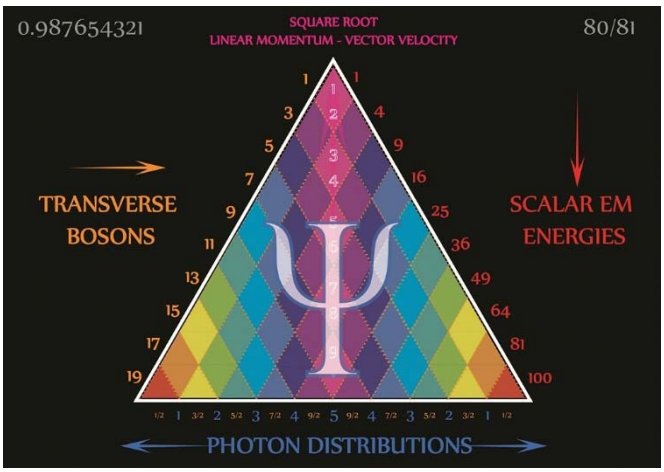

And then erroneously attributed to an inherent uncertainly in quantum field dynamics etc. that does NOT and never existed in Nature itself or in Tetryonics….

I do look forward to further elaborating Tetryonic theory in detail with you – but also strongly suggest that you become more familiar with my Tetryonics [1] – Quantum Mechanics and & Tetryonics [2] - Quantum Electrodynamics eBooks beforehand as a lot of your suspicions of, and reaction to Tetryonic theory seem to stem from a lack of understanding of the basics of the theory….

And as I mentioned in previous communications, I remain open to an online discussion so we may discuss these points in far more detail than possible herein.

There is also lots more additional information and explanation of Tetryonic theory to be found on YouTube and Otto's Science of Life web- blog & the detailed 3D CAD models developed by Rene Cormier in the Google sketchup warehouse.

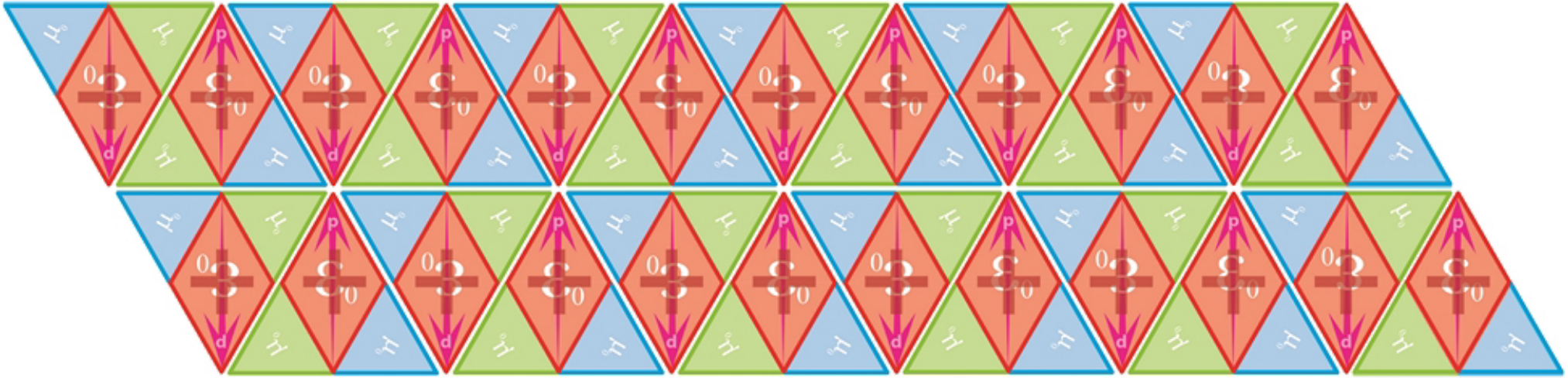

2D radiant EM mass-Energies

n1 - Charged Tetryon Templates

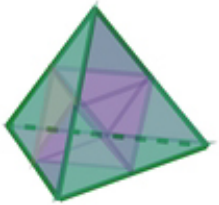

3D standing-wave Matter

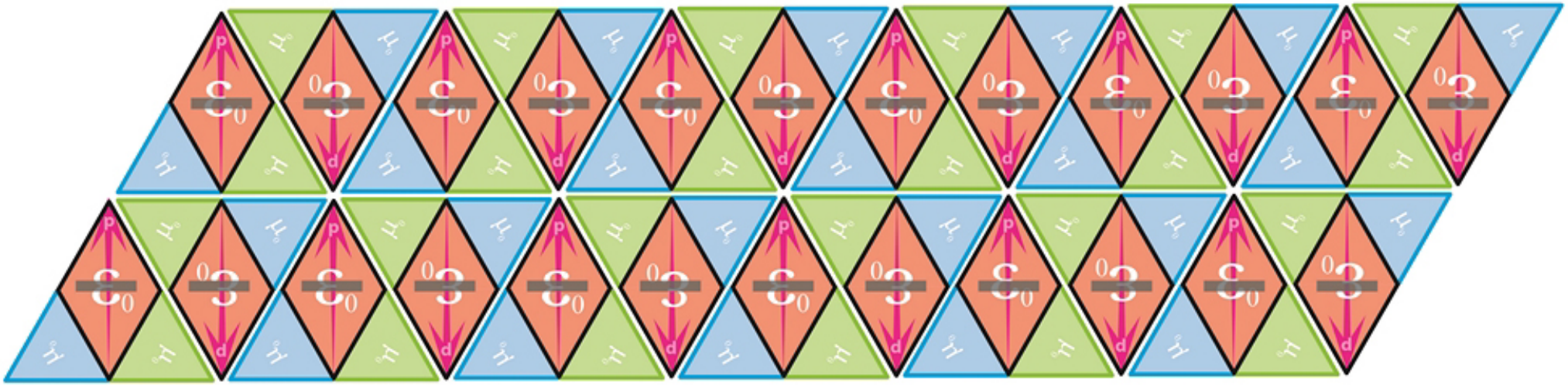

n1 - Neutral Tetryon Templates

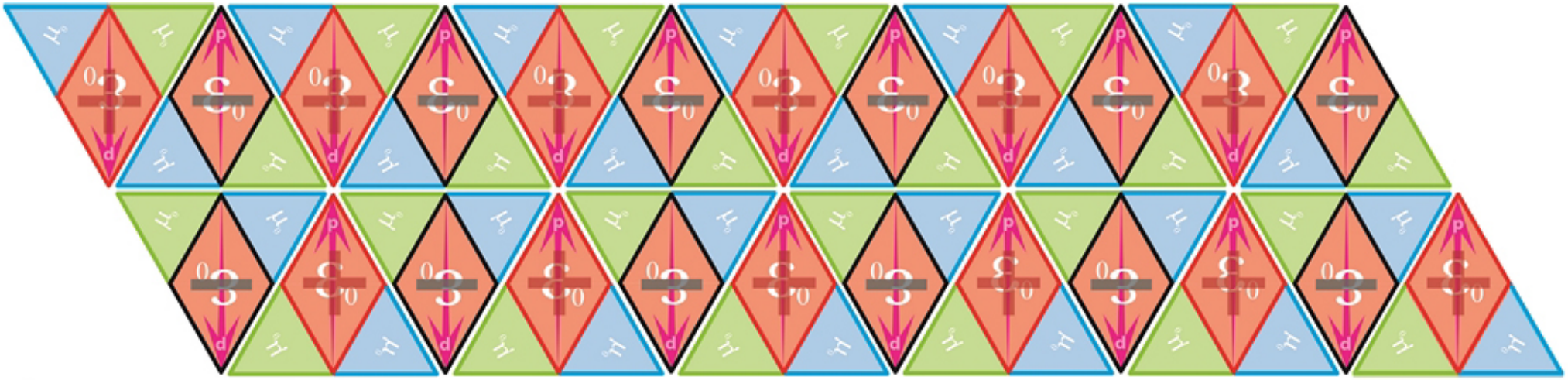

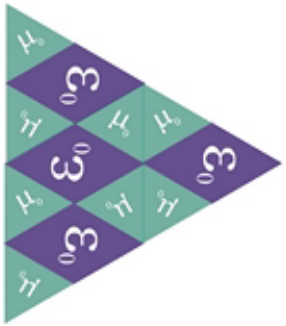

2D radiant EM mass-Energies

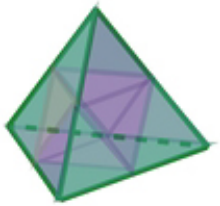

3D standing-wave Matter

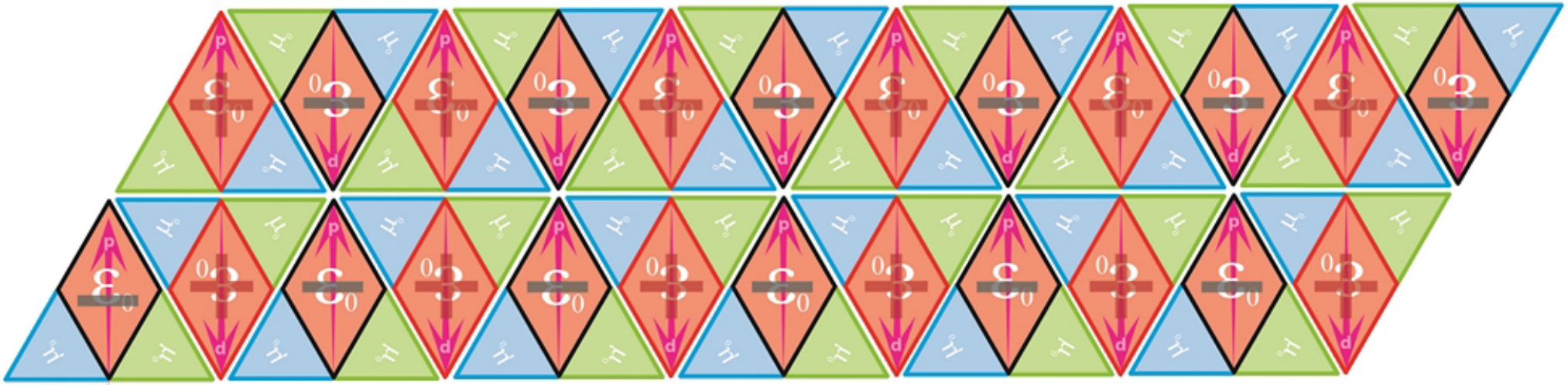

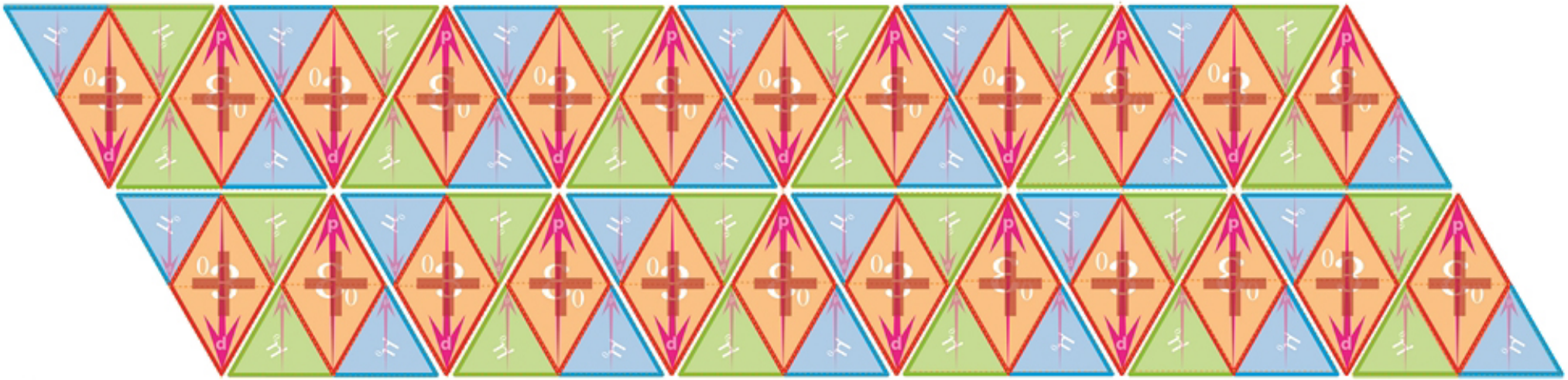

2D radiant EM mass-Energies

n2 - Charged Tetryon Templates

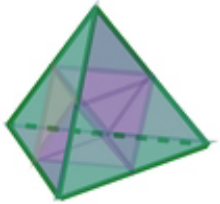

3D standing-wave Matter

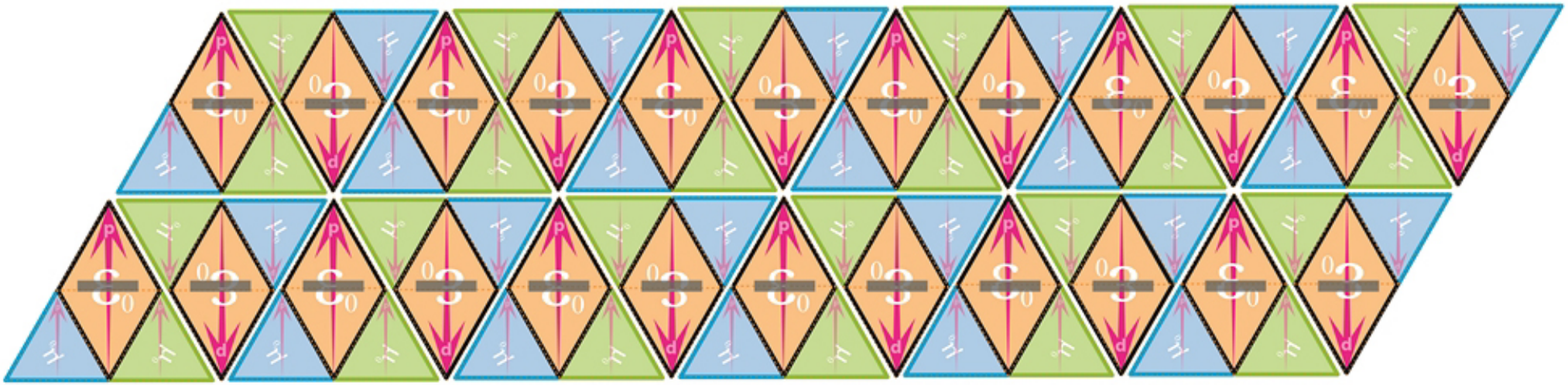

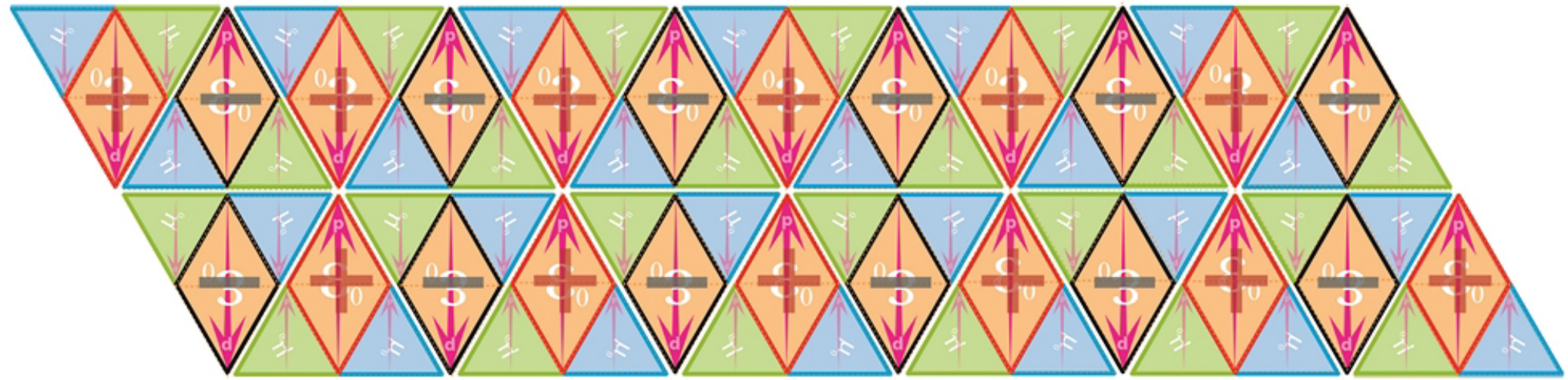

2D radiant EM mass-Energies

n2 - Neutral Tetryon Templates

3D standing-wave Matter

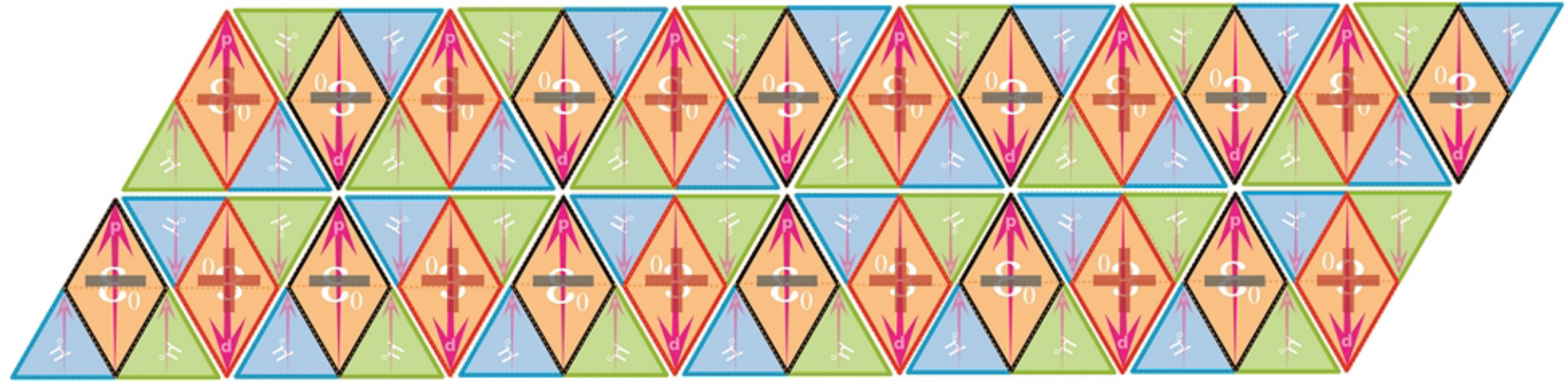

n3 - Charged Tetryon Templates

2D radiant EM mass-Energies
n3 - Neutral Tetryon Templates
3D standing-wave Matter

n4 - Charged Tetryon Templates

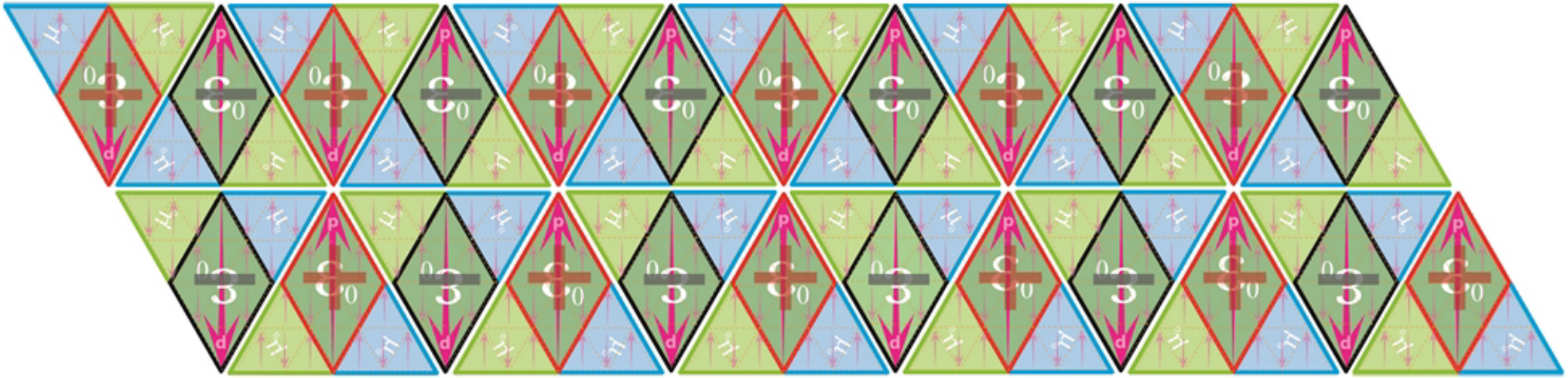

2D radiant EM mass-Energies

n4 - Neutral Tetryon Templates

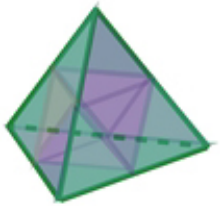

3D standing-wave Matter

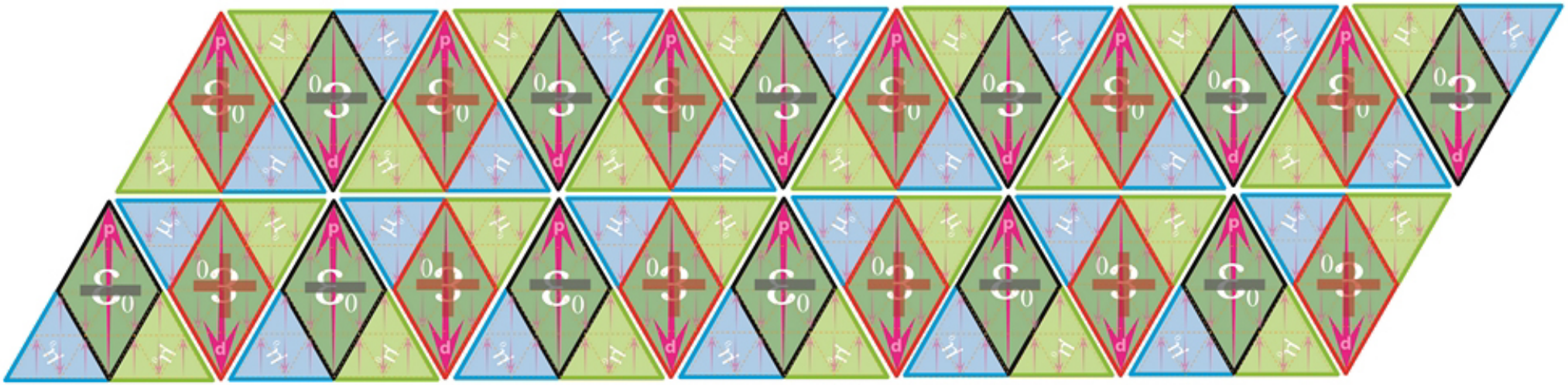

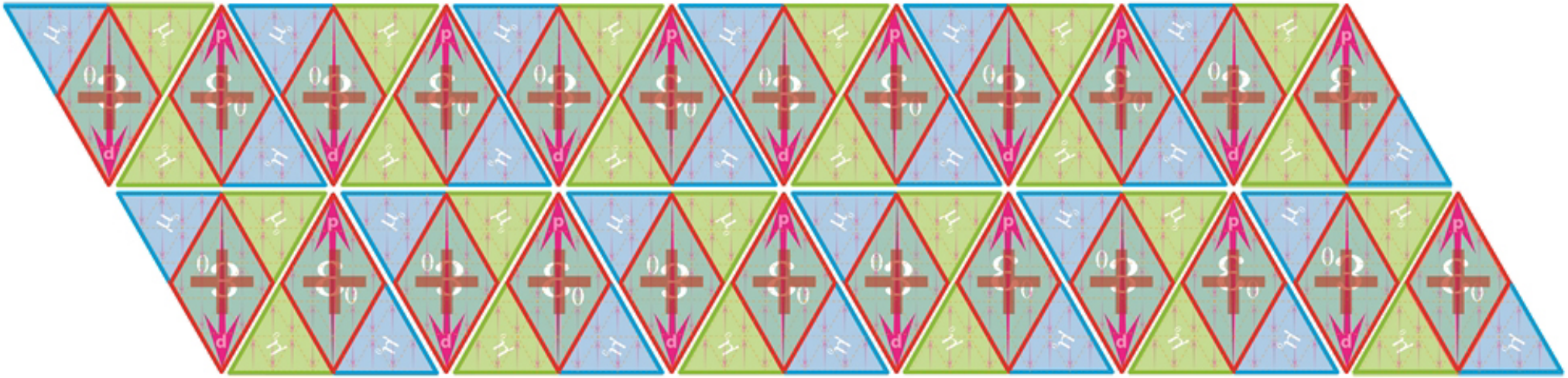

2D radiant EM mass-Energies

n5 - Charged Tetryon Templates

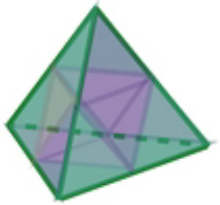

3D standing-wave Matter

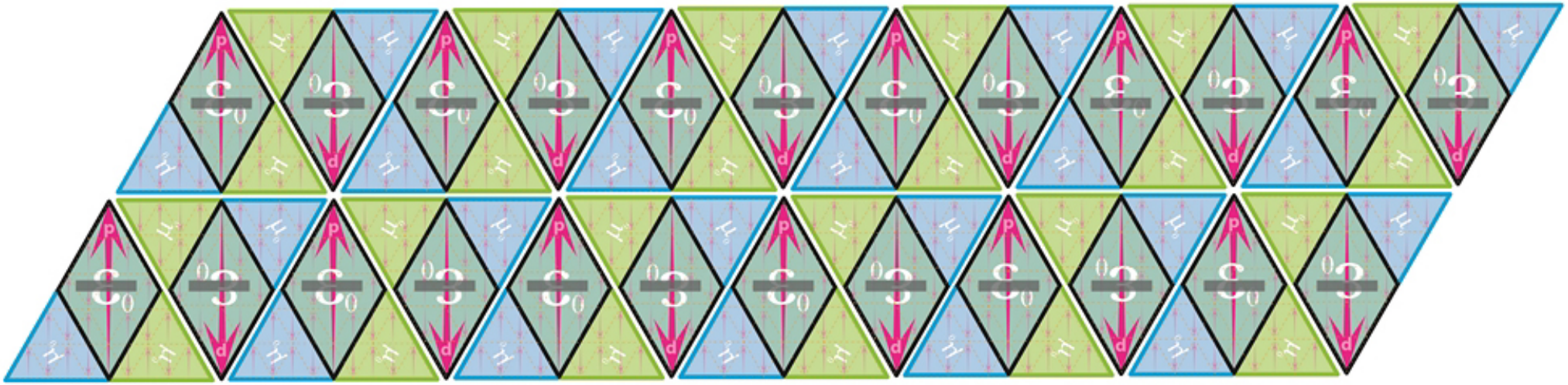

n5 - Neutral Tetryon Templates

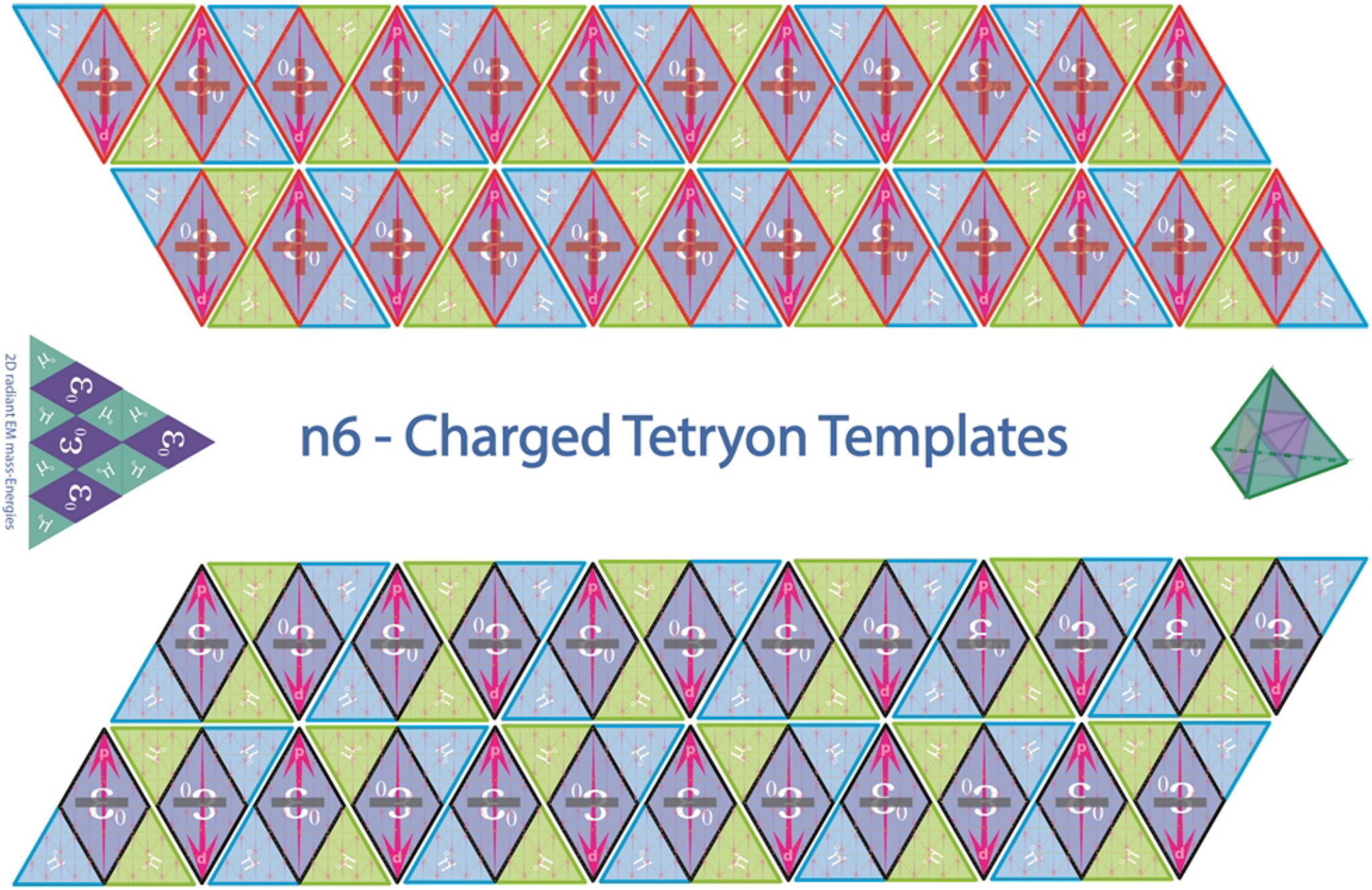
2D radiant EM mass-Energies
n6 - Charged Tetryon Templates
3D standing-wave Matter

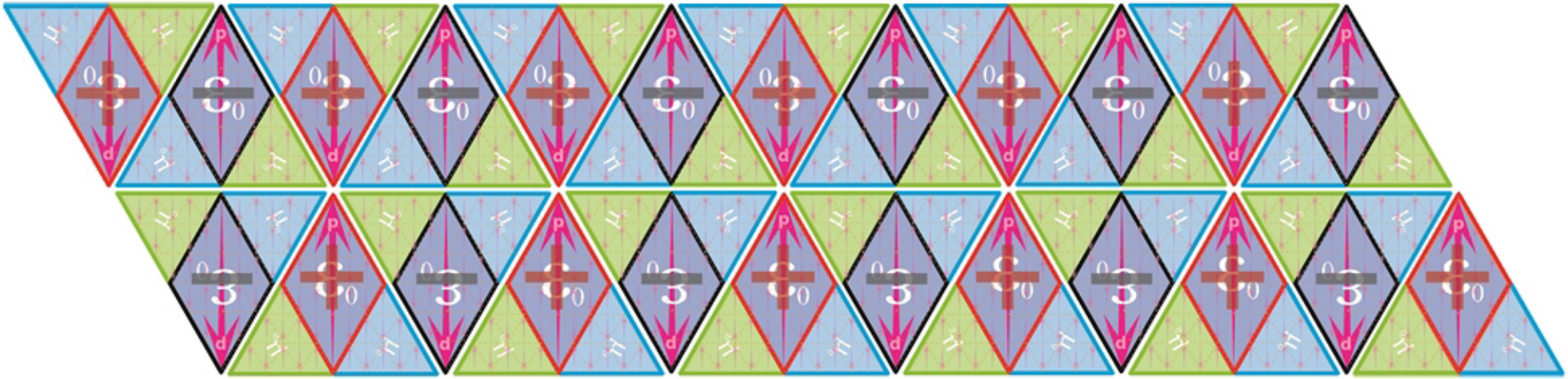

n6 - Neutral Tetryon Templates

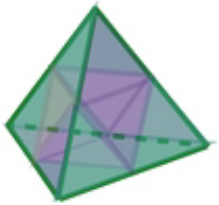

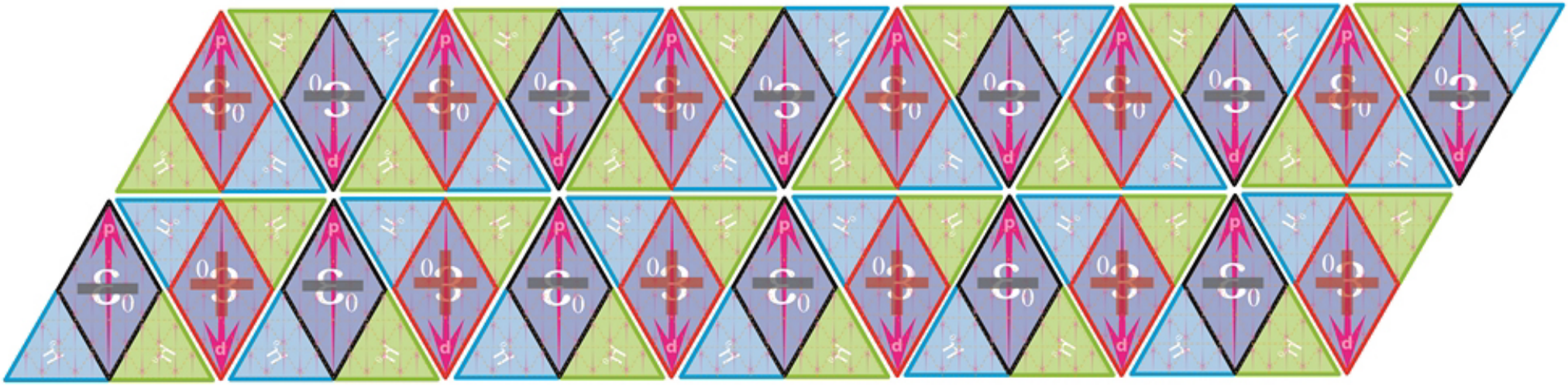

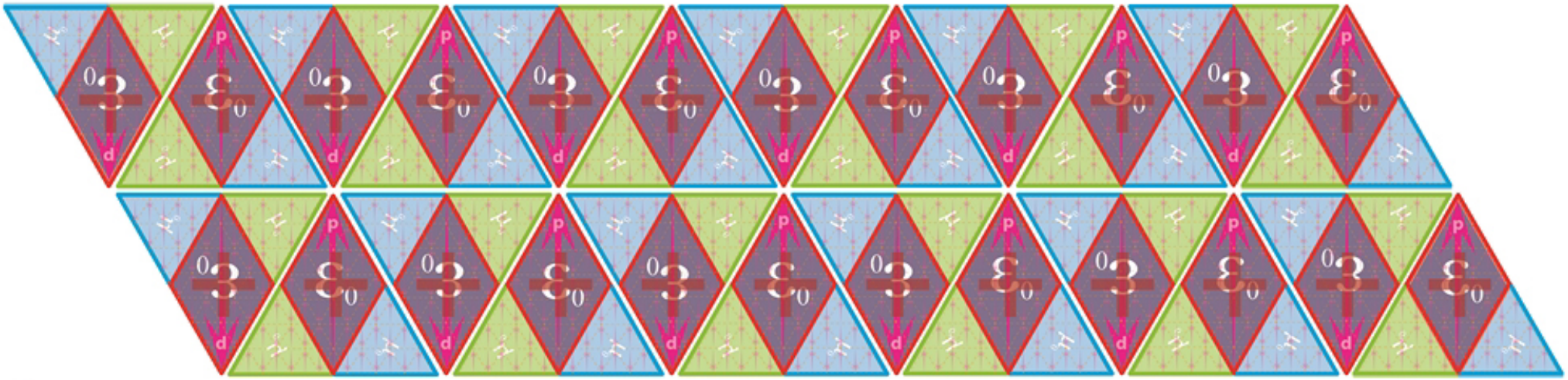

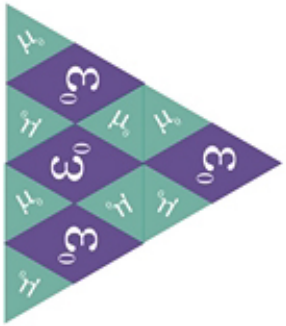

2D radiant EM mass-Energies

n7 - Charged Tetryon Templates

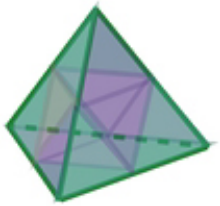

3D standing-wave Matter

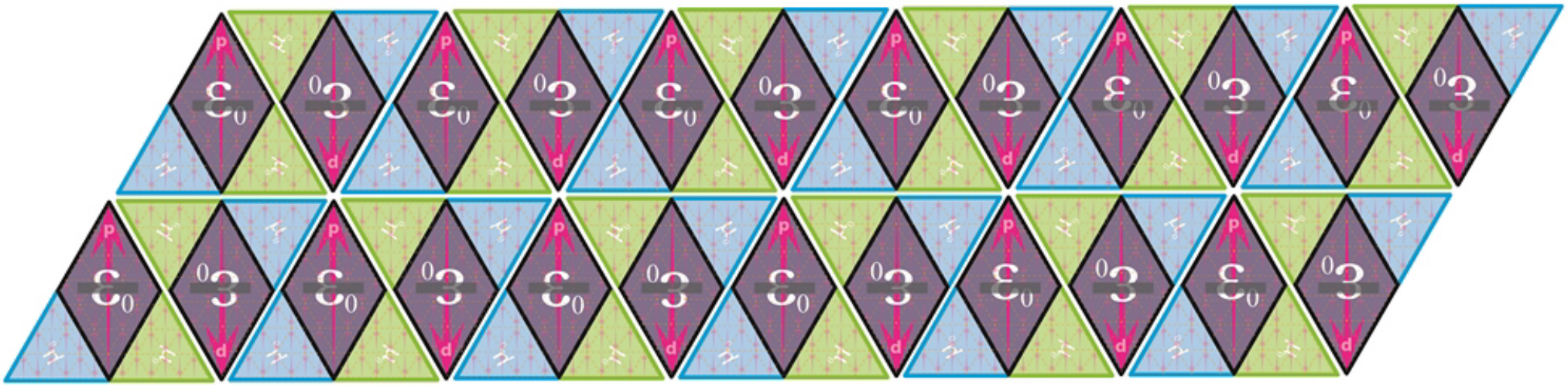

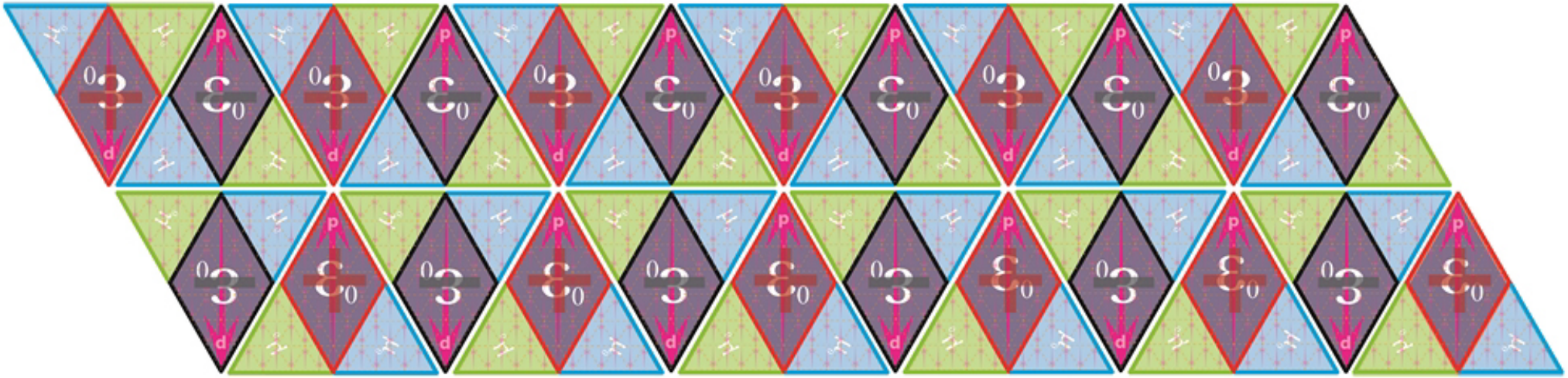

2D radiant EM mass-Energies

n7 - Neutral Tetryon Templates

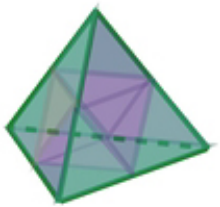

3D standing-wave Matter

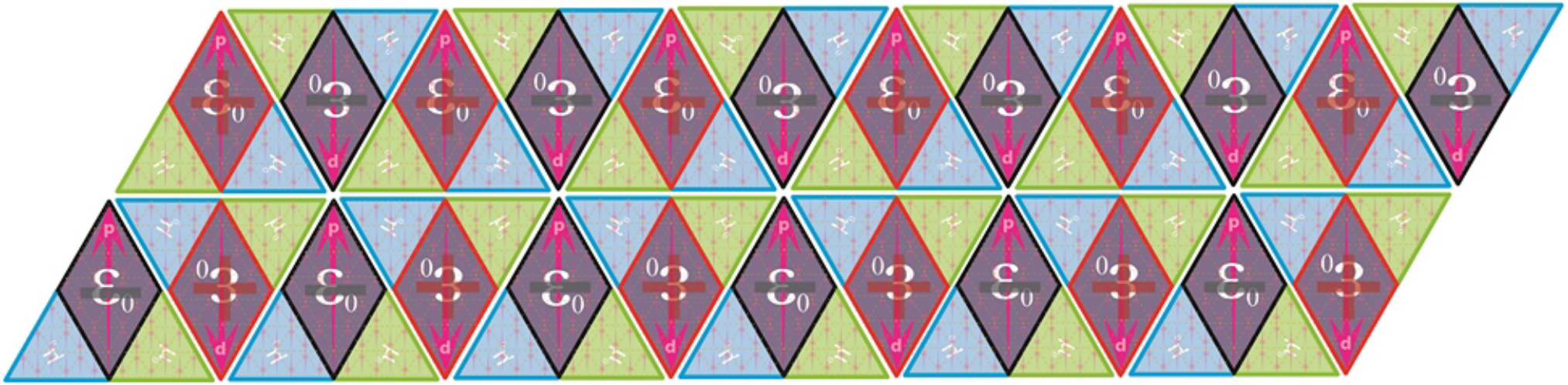

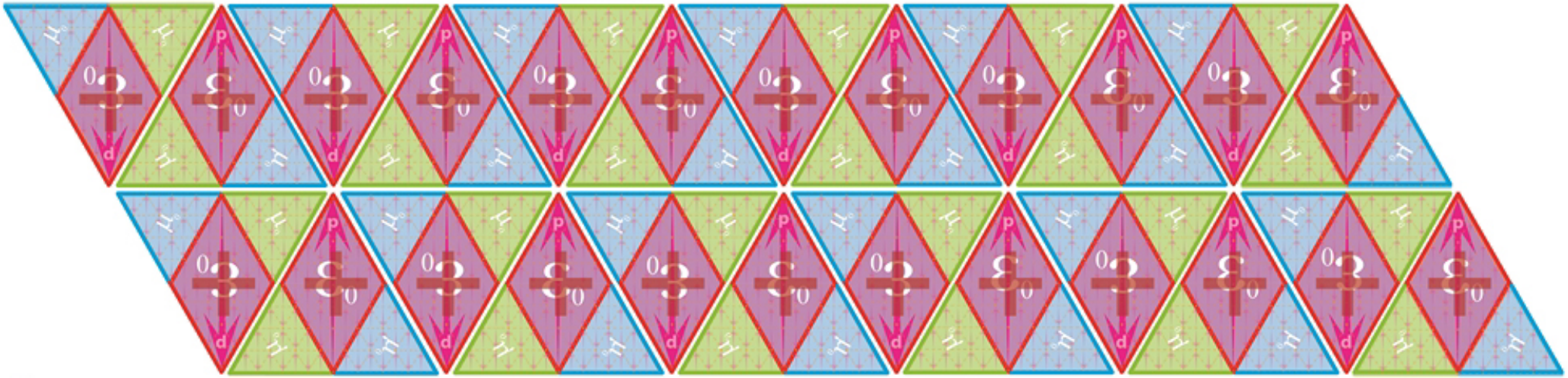

2D radiant EM mass-Energies

n8 - Charged Tetryon Templates

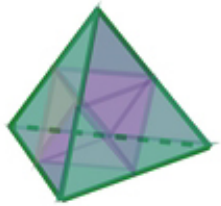

3D standing-wave Matter

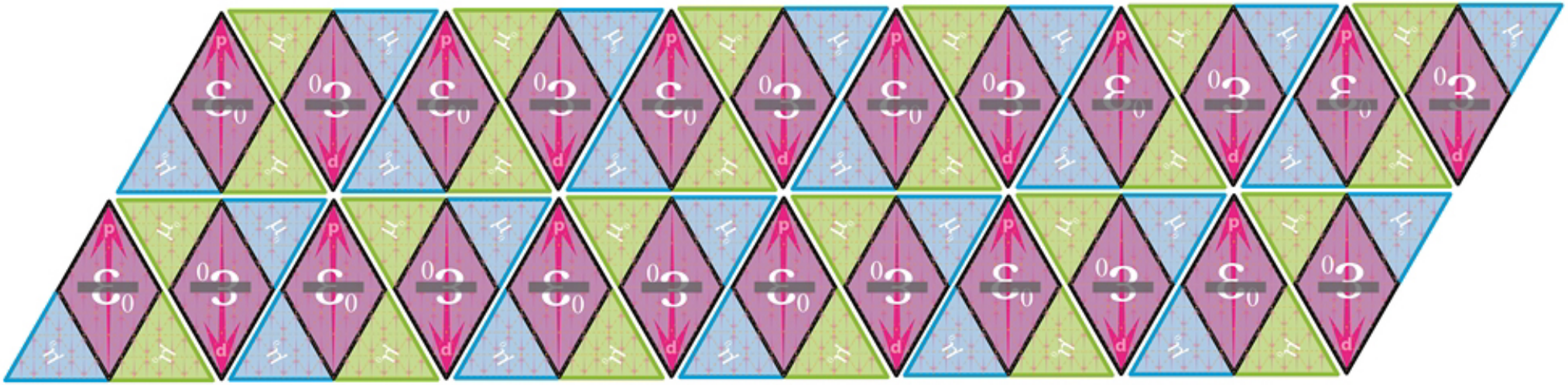

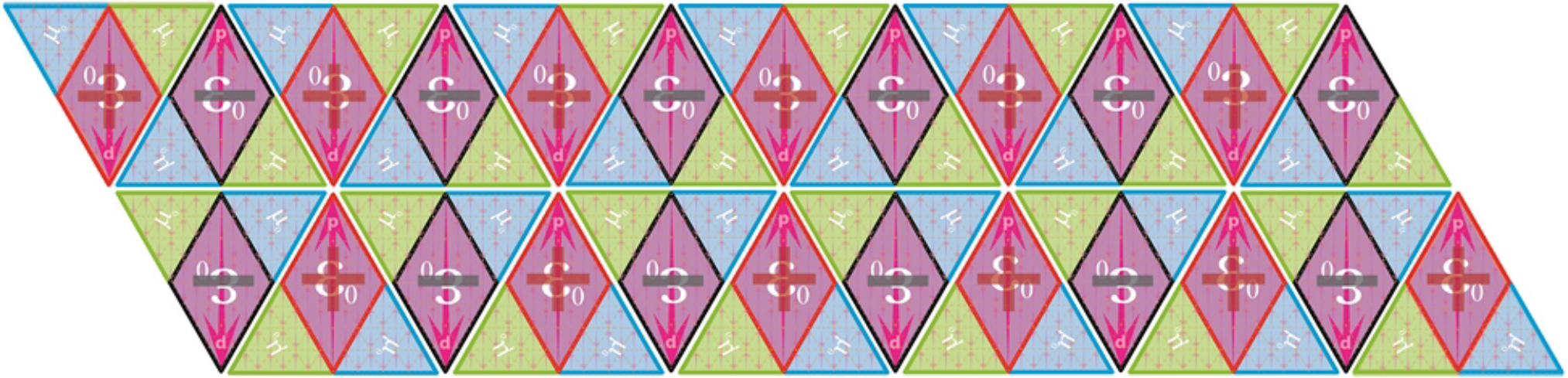

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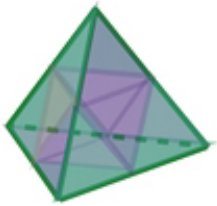

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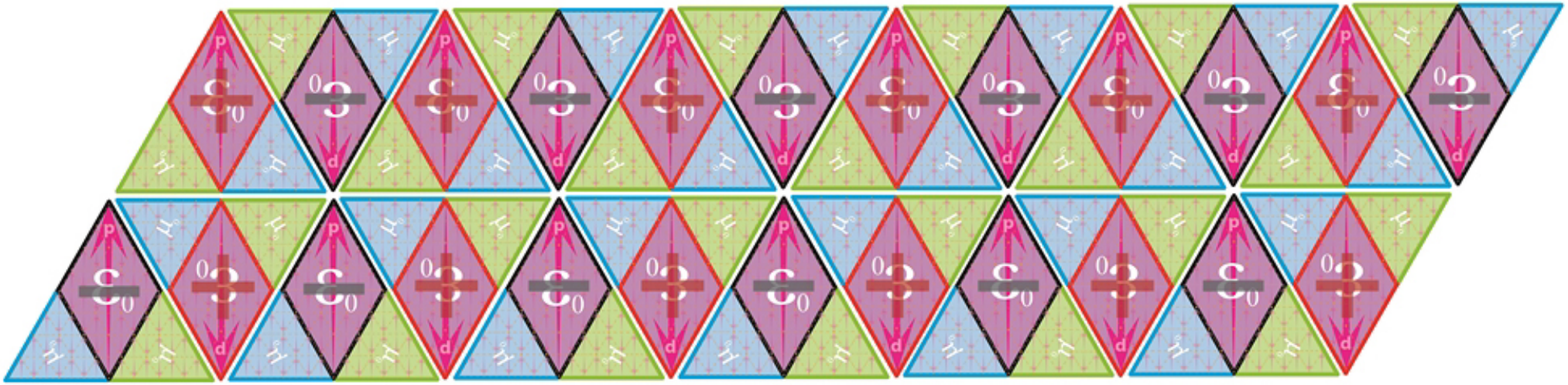

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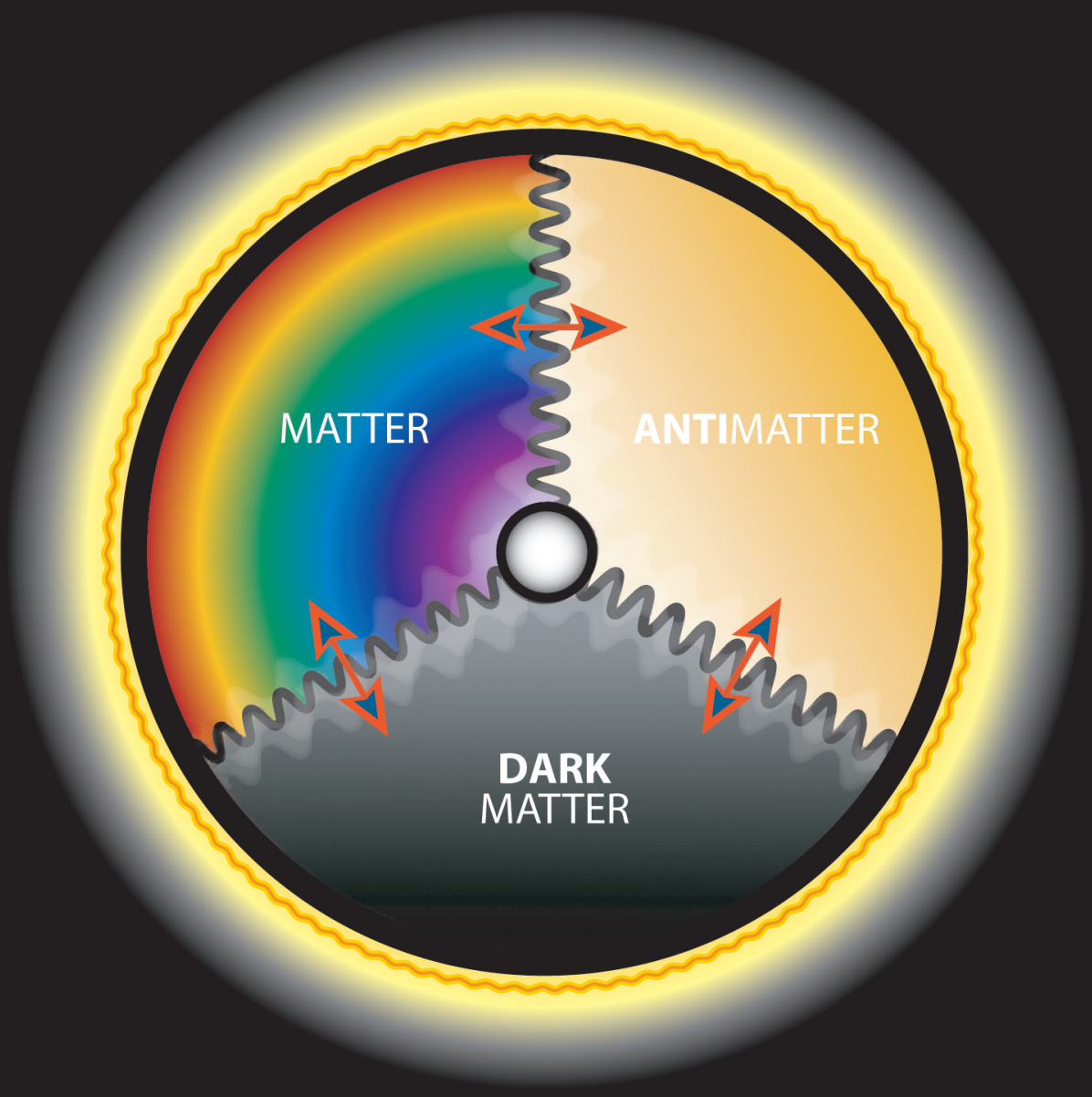

by Nuclear Engineer M.T. KESHE

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The Universal Order Of Creation Of Matters

ITNOTGOG

… a Reflection

Mans intelligence has reached levels that through the use of modern technologies that anyone can peer the knowledge he reads to verify
its logic and validity.

I firmly believe that this work has to be understood by all Men and not judged by a few whose self-interest might, and has been, obstructing the release of such a knowledge as disclosed in this book.

This book is written in such a way that anyone from any background field of science, and interest in the workings of all Matters of the universe, can understand the full new knowledge and be their own peers in receiving such a disclosure, which is at the edge of science and technology.

In this book a synthesis is given of the *understanding of new first principles in physics* that are gathered for over more than thirty years of independent research and development, where several working prototypes and numerous tests with different loadings have confirmed their correctness and operativeness.

Mehran Tavakoli Keshe
2009

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Forewords

In Mans technological and scientific evolution over thousands of years, conversion of the Earthly state of matters and energies from one state to another has been the key to his progressive success.

For man to progress further in the path of this evolution, man has to learn, understand, and unravel the powers of the initial fundamental particles of the Matters.

In the following pages, simple new theoretical principles and results of tests done to unleash the powers of the initial fundamental particles forces will be released and discussed.

In my writings, the simplest form of language is used so that every man, from all corners of the world, can read and will be able to comprehend the fundamental orders of their physical creation.

Therefore, every man on Earth will have the same groundwork knowledge and opportunity to build his own environment and so be in control of his future and destiny.

This simple transfer of knowledge gives every man, by understanding the principles of his world of creation, the possibility to utilise and enhance the fundamental powers of creation for his advancement in his path of evolution.

Through appropriate use of this new knowledge, one can generate as much clean power as one needs for survival at any location in the universe.

This is energy production capability, without the production of any further new wastes to damage the environment and to endanger the future generations' chances' of survival.

This new knowledge allows man to produce food and medicine through the natural process of the construction of his cells' initial fundamental plasmas.

Therefore, no child, woman or man should go hungry and rely-upon others for his survival.

This new knowledge gives man the opportunity to produce all his materials' needs, without him being tied-up to the Earthly resources, or environmental conditions, or the place or a position in the universe, wherever that might be.

This new knowledge brings about the capability for man to be able to move and travel in his environment and in the universe with universal magnetic fields protection, in any atmospheric or space conditions.

This new knowledge, gives man the freedom of motion irrespective of the medium whatever his medium, and wherever he might be in the universe. For man to be able to use systems for travel that is at all time in protected magnetic fields levels and gravitational field levels as on the Earth. As his physical body has become accustom to the atmospheric condition around his home planet.

Which up to now, this has been a dream and unattainable in all dimensions, with his present level of scientific development and knowledge.

Men will build on this new knowledge, and they will add their own scientific and technological flavours and unique additions and discoveries to overcome their present natural problems and limitations.

Our hope is that, Men, irrespective of their race, colour of skin, creed or religion, will use this new knowledge collectively and in unity, for advancement of the human race. We pray that, Man uses' these new knowledge and information's for creation of peace and justice among their fellow men and other of Gods' creations and creatures, whom they will come to be in touch with, irrespective of their appearance, technological progress and intelligence.

Mehran Tavakoli Keshe

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Introduction

In the progressive path of mans' technological achievement, it has been proven that the human race has not been able to create and produce fundamental energy systems similar to the ones which are operating in the spans' of the universe.

Nevertheless, he has managed simply to convert one form of energy to another and he has made use of the small surplus energies released by these methods to his advantage.

In the universe, the structure, operation, appearance and existence of the plasma and an atom, does not so much differ from the relationships and interactions of their larger counter parts as the molecules, solar systems and galaxies.

Where, as in the ***present*** science and state-of-the-art technology, the lower orders of particles of construction of an atom in its nucleus are considered to be made of quarks and gluons.

The world of science has never looked at and into the ***progressive construction of a plasma*** (Chapter 3) on the same basis and principles' as other larger matters and fields in universal orders of creation and motion.

What this simply means, is that scientists over centuries have made some limited and un-necessary self-imposed conditions in looking at the physical realities of Matters and matters in their surrounding environment, for them to be able to compare and draw parallels from these phenomena and principles to understand the criterions by which the initial seeds of plasmas are set in the universe and to understand the methods by which different forces operate within them.

From the basic knowledge of what is in hand in the world of science at the present, it is not too hard to discover what are the real elementary particles in the universe, and find an *alternative and realistic way* of how these fundamental particles of plasma come together to create ***the initial seed of plasma***.

It is important to note that the existence of dynamic and different strengths, speed, velocity and densities of ***magnetic fields***, and their interactions, are the **cause** and the **foundation** of the existence of different **Matters** within the universe. In the universe, *collections* of *loose and weak magnetic fields* have initiated the creation of, and finally become the initial components of the Matters of plasma.

Rays and plasmatic magnetic fields

At the same time, we consider "rays" as individual and directional magnetic forces. We consider "fields" as the same ray's magnetic force as it is influenced by other rays and magnetic field forces, which the ray makes a dynamic zone of influence in its path.

We consider the same phenomena in principle with respect to plasma and ***plasmatic***

magnetic fields, where, a plasma of magnetic fields is considered to be a collection of such rays and fields of rays.

The collective interactions of weak plasmatic magnetic fields in the universe are considered to become the foundation and the cornerstone of the creation of initial fundamental particles.

In the universe, the same and regular specific sequential and consequential interactions of lower orders of magnitude plasmatic magnetic fields strength are always considered to lead to the formation of the plasma and its sub-Matters' components.

Throughout this book a clear distinction has been tried and been made between the magnetic field and plasmatic magnetic fields.

The **Plasmatic magnetic fields** are considered to be of *collection* of near *similar dynamic rays of* magnetic fields *strength*. We refer to the Plasmatic Magnetic Fields as "***pmtics****", as Magnetic fields, which were detached from their source of creation*, hence, the use of the term "plasmatic" for these magnetic fields. For clarity: In this book the term "**plasmatic**" refers to a "collection" of dynamic magnetic fields, and **NOT** to the ***state of a plasma*** in its common term use that refers to a *state of dynamic protons*.

At the same time, pmtics interactions with other pmtics are considered to create effects the likes of gravitational fields and Magnetic fields of Matters, plasmas, planets and so on.

These magnetic rays or fields and their collection as plasmatic magnetic fields, become known as the **Initial Fundamental Particles.** Therefore we consider that magnetic fields to be the **"real" fundamental particles**.

The present science considers that the 'elementary particles' to be of 'quarks' and others. With the new understanding of creation of Matters and forces within the universal order of creation, in this book when the term **'elementary particles'** is used, this means that the **'magnetic fields'** are considered to be the **new** *'elementary particles'* and their forces. The existence and interaction of these magnetic fields leads to and creates all other effects that one sees and observes in the universe, like creation of Magnetic and gravitational fields which leads to creation of what I call different ***Matters*** *(Matter, Antimatter and Dark Matter)* of the plasma, or what presently is known as quarks and so on of the plasma. Where, we consider the Dark Matter as an integral and part of the same normal Matters of existence and as an important part of the construction of the initial fundamental plasma in the universe, and we do not consider the Dark Matter as an exotic and distant hidden Matter.

From this point on in this book, we refer to 'magnetic fields' as the ***'elementary particles'*** and *not consider quarks and others as elementary particles any further*, I consider that these quarks of different colour, with up and down notation and spin are all created as the outcome and consequences of different interactions and attraction of these 'magnetic fields' or 'plasmatic magnetic fields'. As quarks themselves are now known to be made of simpler particles of 'magnetic fields', then quarks cannot be

considered to be the elementary particles.

In this book will be explained how 'magnetic fields' become to be the creators of quarks and other effects and forces within the plasma of proton, then the **'magnetic fields'** become the '**new elementary particles'** in the science of physics.

Further in this book it is explained how *different strength of these fields* leads to the creation of different **Matters and their forces** as has been observed by world of science.

Furthermore, these weak collections of pmtics and their interactions with magnetic fields and turbulent magnetic fields forces in different parts of galaxies manifest themselves as the seeds of atoms, stars, galaxies and so on.

Magnetic and gravitational fields (Magravs)

When we write **M**agnetic field (with capital M), we considered that these fields refer to the Magnetic field of celestial objects, like a Star, planet, etc. Where this Magnetic field is always accompanied with gravitational fields of the object.

Where we consider that ***gravitational fields and Magnetic fields*** cannot exist in the universe without each other, and that they are produced simultaneously. Through the same dynamic materials and Matters in the same region. Due to the construction of other Matters in their catchments area, these entities could have a different value than the other. As the Matter/matter content of the object dictates which will be stronger in strength and value than the other in that given position. The only known and possible objects that its gravitational and Magnetic fields could be equal in value strength, in majority of the cases in the universe, are objects of mono-material (like some stars), with pure hydrogen content. There are cases in the universe(s) that mono-matter of objects can be like uranium or heavier elements. These objects of heavier mono-matters are usually the producers of stronger gravitational fields and Magnetic fields, by several orders of magnitudes than the hydrogen mono-matter objects. It is assumed that each universe cannot possess more than one heavy material mono-magnetic star.

It has to be noted that the co-existence of these two fields always in interaction with any other magnetic fields or plasma of fields always lead to the creation of a ***magnetosphere***, which the boundary of the magnetosphere is the maximum point of balance or equality between the two field forces. Any variation in strength of one of the two fields in respect to the other will create different effects, for example such unbalance field between the two fields can be seen in Mercury, which has no atmosphere, and such a misbalance can also be observed in most moons of planetary systems.

In this book, as one field cannot exist without the other, for representation of the **MA***gnetic* and **GRAV***itational field***S** we use the term: "**MAGRAVS"**.

Plasmas

We consider that " The **Plasma** in its **collective existence** is a combination of different initial fundamental Matters, which these Matters are created through the interaction of at least two or more of the same strength plasmatic magnetic fields (the initial fundamental particles)".

Plasmas (Chapter 3) are considered to be collection of combination of interaction of pmtics forces of Matters', Antimatters' and Dark Matters' and other magnetic fields forces, all at the same time and within an overall sphere of the confines of the plasma.

Further, in the process of interactions and collections of these initial pmtics with each other, in specific combinations, these leads to creation of atoms, molecules, matters and so on.

In this disclosure, simple connections between *Initial Fundamental* ***Particles*** and *initial Fundamental* ***Plasmas*** are explained and discussed.

These specific collections and interaction of initial fundamental *particles* and initial fundamental *plasmas* and their interaction with other magnetic fields manifest themselves as **states of matters**, these are purely magnetic fields densities and compactness environment dependent, and they present themselves as different states of matter (gases, liquids and solids).

Matter and matter

In the following sections, we clearly distinguish between *states of matter* (gases, liquids and solids), denoted as "**matter**", and *state of the Matters* (Matter, Antimatter and Dark Matter) denoted as "**Matter" or "Matters**".

Initial Gravitational Fields

The interaction of different magnetic fields of different strengths, upon each other, is considered to be the creator of initial gravitational fields for the start of the creation of the initial seeds of the Matters of the plasma (Fig. 8 B).

We consider that pmtics interact to create the attraction field or gravitational field.

Reactor technology

With the new knowledge and new first principles which are disclosed in this book about the creation of Matters' and plasmas', techniques acquired and reactor systems have been designed, developed and tested, it has become possible to replicate the pmtics of plasmas' environment that allows different Matters of plasma to be released from their interlocking magnetic fields forces within the confines of a reactor.

Further on, it has become possible within the structure of these reactors, to manage and control, these unlocked fields and Matters of the plasma, for specific predetermined functions and applications.

In these new reactors, in being able to weaken the Magravs of the plasmas (Coulomb magnetic or energy barrier) and by allowing the Matters of the plasma to be more free to move within the environment of the reactor. Where, these reactors were designed to facilitate the reduction in plasma magnetic fields forces and eventually to create an environment that Matters of the plasma can freely move in a soup of Matters, pmtics and rays. Where, through the operation of these types of reactors the famous Coulomb barrier becomes irrelevant in the overall structure of the soups of Matters binding magnetic fields of the plasma.

With these new methods of the manipulation of the structure of the Matters' of the plasma it has become possible for the pmtics forces of the plasma within these reactors to be unleashed, and with plasmas' constituent substructure loosen, it has become possible to manage to attain new powerful effects and properties from these rather weak initial fundamental magnetic fields of the plasma. Where up to the present time, these have been the unknown knowledge and methods in the world of science.

Within the structure of simple nuclear-based systems that have been developed, ***conditions*** *are created in which simple weak ambient dynamic pmtics, similar to the internal construction of plasmas, are generated.* The technology for creation of conditions similar to the internal structure of the plasma and methods which have been specially developed, that allows the loosening of the magnetic fields structure of the plasma, this will change the course of present nuclear fusion, and allows scientists in this field to achieve their goals *rapidly* and *at the fraction of cost* of present systems.

In the new state-of-the-art technology much simpler, softer and more practical ways, very similar to conditions as in the universe, are employed to attain fission and fusion of different Matters and plasmas.

During the reading of this book the reader will discover various future applications of this technology, so it will not surprise the reader that we have applied for several international patents to cover all aspects of the topics, principles, methods and systems mentioned in this book and the ones to follow.

Fission and Fusion by Plasma Dilution

The present methods of fusion and the Antimatter production technologies apply strong magnetic fields forces or high-speed rotation of the plasma, with low or limited success. As the real principle of the construction and structure of these sub-plasma Matters have never been understood correctly.

In our new state-of-the-art science and technology, one creates a control-conditioned environment within the confines of a multi-core reactor, which facilitates and allows the plasmas' Matters to ***disentangle*** themselves into their sub-Matters and pmtics

components.

In these reactors the effects of the newly freed principal Matters of plasma's interactions with each other are utilised to create new and more powerful internal and external Magravs' forces, within and in respect to other plasmas and Matters in multi-core reactors system environments'.

In the new state-of-the-art technology reactors, after achieving desired goals, the system parameters can be changed so that the system can allow the same separated parts of plasmas' Matters to return to their original properties and regroup as the original plasmas.

This new method of loosening and the use of plasmas' Matters within the confines of a reactor is to be called the ***Keshe Theory*** of the "**Plasma Dilution**" and the art to achieve this "Plasma Dilution Technology"(Chapter 21).

This technology means that it is now possible to create an environment of weak magnetic fields within the cores' of a reactor, where the plasma is allowed to be opened-up and be released of the interlocking magnetic fields forces between its different constituent Matters.

The new dilution method in opening-up the plasma is a more practical and gentler methods for fission or fusion of the plasmas and/or its sub-Matters' components, for utilisation of their effects and properties.

In the present state-of-the-art technology in physics, scientists have chosen harsh method systems in fission industry. For fusion, they have chosen high speed and by compression of plasma, utilising giant magnetic fields induced technology to achieve their goals.

They use accelerators to slam the plasma on to a surface, to extract the sub-plasmatic components like the Antimatter component of the plasma (6, 7, and 8).

In the new state-of-the-art plasma dilution technology, within the confines of the reactors, environments and conditions are created, which are like a soup of weak pmtics, similar to the internal structure of plasma's own environment.

In this new approach, any new introduced plasma into the reactor, new **plasma's *binding* magnetic fields forces** come into an environment and ***interact*** *with fields* ***similar to their own plasmatic magnetic fields strength*** to allow their more condensed fields of interlocking Matter, Antimatter and others, to loosen and operate more freely in the environment of the pmtics soup of the reactor cores.

Using this new state-of-the-art science and technology, achievements of astonishing effects has been reported over the past few years. Where, with the current state-of-the-art technology, to achieve these effects, is considered to be nearly impossible and literally a dream and against the present known laws' of physics.

These effects reported, like being able to lift a reactor system weighing several kilograms by the use of a few grams of gasses, utilises the properties of the Antimatter components of the plasma's interactions with each other within the cores of these reactors.

This new technology makes it possible to produce in a very fast and easy manner nanomaterials and their constituent pmtics, like nano atomic layers known as graphene (sp2), diamond atomic structure (sp3) and nano-oxides, at room temperatures and atmospheric conditions, as has been independently confirmed by reputable organisation in the west.

In fact, all that has been achieved is the application of the understanding of how to use the soup principle to undo the tangles of magnetic fields of the plasma, and release of its substructure Matters, like Antimatter, in a reactor.

Lift and Motion by Magravs positioning

By utilising the properties of the interaction of forces of the collection of pmtics, interlocking between the Matters of the plasma and/or their sub-magnetic fields, which are part of the structure of the Antimatter and the Dark Matter, it has become possible to create stronger Magnetic fields, or gravitational fields' forces within the confines of and in respect to the surrounding environment of multiple-core reactors'.

These Magravs, if strong enough to interact with similar fields in their environment and with other fields of the same components of plasma in other parts of the same reactors, these Magravs interactions' of the system and the planet can cause lift and motion of the mass of the system, which the reactor is attached to.

Scientists at the Fermilab (6) in the USA state that small amounts of Antimatter, as little as a spoon-full, can release enough energy equivalent for the launch of several shuttle flights. This laboratory has confirmed that they have managed to collect some of this Antimatter in the past forty years, using special plasma separation and containment methods.

Utilising the new plasma dilution simple methods', not only are the Antimatter components of the plasma separated but, at the same time the interaction of the magnetic fields of these Matters are used within the system for the creation of strong Magravs within and in respect to their environment, for creation of lift and motion.

The newly created Magravs in these reactor cores, in interacting with the surrounding planetary Magravs and in trying to find a new Magravs balance, for example, in respect to the Earth fields, causes the system to move.

This method of achieving system motion due to interaction of Magravs forces is to be known as the ***Keshe principle of Magravs positioning*** *(Chapter 19)*. This position is, the point where the combined gravitational and Magnetic fields strength of the reactor

system and the Earth, find a new position, where they are in balance strength in respect to each other.

After achieving the required Magravs positioning, this being the new height and/or distance, in respect to another Magravs force like that of the Earths Magravs, the systems' internal parameters can be changed again to create a new Magravs strength within the reactor. At this point, a new Magravs positioning balance needs to be attained by the system in respect to the planet. This, forces the system to find a new Magravs balance in respect to the planet Magravs' strength, and consequently for the need for the system to achieve the new Magravs positioning in respect to Magravs of the planet.

In attaining a new Magravs positioning balance, this leads to the movement of one system, in respect to another.

Thus through this new Magravs positioning method, motion of crafts, cars and systems for energy production can be attained *without burning* any fuel or using the present propulsion technology for lift of relatively small payload into space.

Through Magravs positioning principles, this is how ***motions*** *of atoms, planets, and stars and so on, are created and achieved in the universe (Chapter 19).*

Through tests, we can confirm that, the motion of any mass for any Magravs positioning system is not size dependent, but mass dependent, where the smaller mass always tends to move in respect of the larger mass in the universe. There are some exceptions in respect to this rule of the thumb. As in Magravs positioning reactor systems, where gravitational field strength control within the cores of the reactors plays a major roll to achieve lift, motion and Magnetic field protection of the system.

As I have said before "no one has ever seen a rocket in the back of the Earth that has been causing its motion for billions of years".

Subsequently, if necessary, through the same changes in internal parameters of these new reactors, the components of the Matters' of the plasma are and can be allowed and be facilitated to regroup and return back to their original structural state of pmtics levels of Matters and composition, once the desired affects are achieved.

Through new understanding and new state-of-the-art technology and by simply following the methods and universal orders of creation of Matters, the components of plasmas' Matter, Antimatter and Dark Matter can be manipulated and utilised for effective lift and motion of objects, creation of energy, production of new Matters and so on.

By the release of this new knowledge, this does not mean that the paths chosen up to now by other scientists have been wrong; this is by no means so. Nevertheless, their achievements have been and are limited because of the focus on the use of the **matter**; it's state of gases, liquids and solids, and even a limited view on plasma (as the fourth state-of matter) rather than our approach in use of the **Matters;** it's state of Matters, Antimatters, Dark Matters with their different pmtics strength components of the

plasma.

With the use of the matter, one has to burn fuel to overcome gravitational field forces to attain a new position in respect to the planet. However, "with *Magravs positioning systems* one uses the pmtics of the Matters of plasma (Matmags) to create Magravs forces within the reactor, for the reactor system to *move within* the Magravs forces of another object, like the Earth, for the system to attain a position in respect to the Earth Magravs forces."

We consider that as much as there are Magravs forces between Matters, the same is true for the existence of Magravs forces between the Antimatter and the Dark Matter components of the plasmas too. This principle applies the same in respect to the inertia of Matter as much as to inertia of the Antimatter and the Dark Matter components of the plasma.

That is to say, in the universe there are Antimatter Magravs forces and Dark Matter Magravs forces as well as inertia for all three Matters.

All Matters and their effects can be used for the creation of motion and energy production in conjunction with other matters and Matters of the plasma.

Our newly released knowledge is for achieving and reaching the same target as other scientists and institutes, but with new knowledge about the construction of Matters of the plasma, we are achieving more profound and stronger effects, in simpler and less complicated ways than have been chosen in the past.

We see this release of new knowledge and technologies as an addition to the rest of the past and present scientific works, and a breakaway from the complicated ways and harsher methods.

In this disclosure, one comes to understand how Matters and matters are made from the start of time (Chapter 3). Where, the method of creation of plasma and atoms in the universe is explained in a simple form.

Then one can see how to use the inner construction of Matters' pmtics to generate vast amounts of energy and learn to use magnetic fields principles of interaction that are the fundamental principles' in the universal method for creation of motion.

We have tested the Magravs positioning systems for motion, and the results confirm the correctness of the theoretical aspects of the approach. The future of space technology will be based on simple safe portable Magravs positioning nuclear-based reactors, which have been developed and tested.

CHAPTER 1

Historically unexplained principles

The main reason for the lack of understanding of simple processes of creation and control of Matters of the plasma is not so much the lack of knowledge in the scientific world in the past or present. Rather the lack of progress is by large due to, the peer review obstruction mechanism, which has been put-up, for some scientists, to protect their individual financial interests and titles, in their schools of thoughts in their field of science.

For example, despite having huge research budgets and human resources, the world of science in respect to understanding of the simple structure of the plasma and its fusion, has not reached substantial results in the past sixty years. Where, nuclear physicists and industry have been trying to cause fusion of plasmas of hydrogen atoms, in fusion reactors, which have been built, and are being built at costs of billions of dollars.

The structure and working of these state-of-the-art fusion reactors are built against the natural laws of physics and opposite to the way, that fusion of plasmas takes place in the universe. Where, these reactors operate with near zero-gravitational field forces within their structure in trying to achieve fusion. Where in these systems, the natural internal gravitational field forces needed for a simple fusion is missing.

What they miss as the natural gravitational field forces needed for fusion, they try to replace this with the use of strong external electro-magnetic fields, by the use of large massive coils and huge amount of energy to operate these systems, and then the they try to achieve fusion. This is like as they are trying to bake bread with only water, salt and heat, without having its main ingredient, the flour. The question to ask from these scientists, is simply that, where are the gravitational fields essential for fusion in these reactors, and where is it suppose to come from, if there is going to be a successful fusion chain process as in the middle of the Sun, which, these forces are in thousands of G‘s.

In fact, with the use of giant external magnetic coils, they squeeze plasmas into tighter balls and then they try to fuse two hard balls of plasmas together. This is the reason why, they have and will achieve very little, if the present misguided path of fusion technology is to continue.

Another point is that the present twenty-first century advanced world of science is lead to believe and to accept the outdated 19th century principles of creation of Magnetic fields through convection principles in the centre of the Earth. Even, when scientific seismological data’s (1, 2, 3, 42A, 42B) indicate that another explanation is needed.

For example, some peers consider that man in the 21st century is not intelligent enough to discover how gravitational fields of planets are created. According to these peers, the principle of creation of gravitational field forces and their control at present is beyond

comprehension of other scientists.

Where, as new Magnetic and gravitational fields positioning systems, which have been developed and tested, confirms the ability to create lift and motion by just using the effects of Matters magnetic fields (Matmags), without burning any fuel or use of propulsion technology.

Within the present 21st century knowledge and proven science, there are a number of unacceptable points from these earlier centuries accepted principles like the creation of the magnetic fields of planet through convection principles.

New theories and principles for these misassumptions, unexplained and out-of-the-hat principles are explained and discussed in the following sections and chapters.

In the following four sections in this chapter, it is important to note that:

Information that have been obtained through the earth-quakes seismological data over past thirty years from around the world, these data points to the fact, that what has been assumed to be the ***solid inner core*** *of the planet* and to be made of one piece solid metallic matter (Fig. 1), this core in fact has *a* ***cavity*** *in its centre* (Fig. 1) (1, 2, 3, 4, 5, 41A, 41B). This newly discovered cavity in the solid core of the planet has been called by geologists the 'inner-inner' core of the planet and is assumed to be about at least over 500 km in radius in the centre of the inner solid core of the planet.

I have called this new core, "***The Caroline Core***" (Fig. 1, 2 and 3), to distinguish it from other presently known cores' of the planet (12).

1. The creation of Magnetic Fields of the Earth

The assumption of the creation of the Magnetic fields of the Earth by scientific world has been based on the understanding of the working of the dynamo principle of earlier centuries. Where, the process of the production of the current was accepted to start-off with the motion of high temperature fluid of matters in the outer core (Fig. 1), in the centre of the Earth by heating and liquidity of matters in this core.

Where electrons of atoms of matters are considered to be released or loosened from their atoms to be free to vibrate or float in this region, and as the rotation of the solid metal inner core (Fig. 1) of the planet interacts with these free electrons in the outer core of the planet, this leading to the creation of Magnetic field of the planet (Fig. 1 Field M).

If this assumption is totally correct, then how do other planets and stars create their Magnetic fields?

Stars like the Sun, possess Magnetic fields and yet do not have solid inner cores as the Earth does. The Sun definitely generates Magnetic fields, which does span beyond the

Earth and the Saturn.

The first flaw with this convection theory of electrons motion is that, we know now **that plasma of an atom** is a charged entity **and possesses much stronger charges** by several orders of magnitude ***than its smaller counterpart electron***.

Thus, the main Magnetic field force of the planet is more feasible to be created by the plasma charges rather than electrons charges. With the knowledge we now know, that even the electron is a plasma condition similar to the proton construction (Chapter 3, 17, 18 and 19).

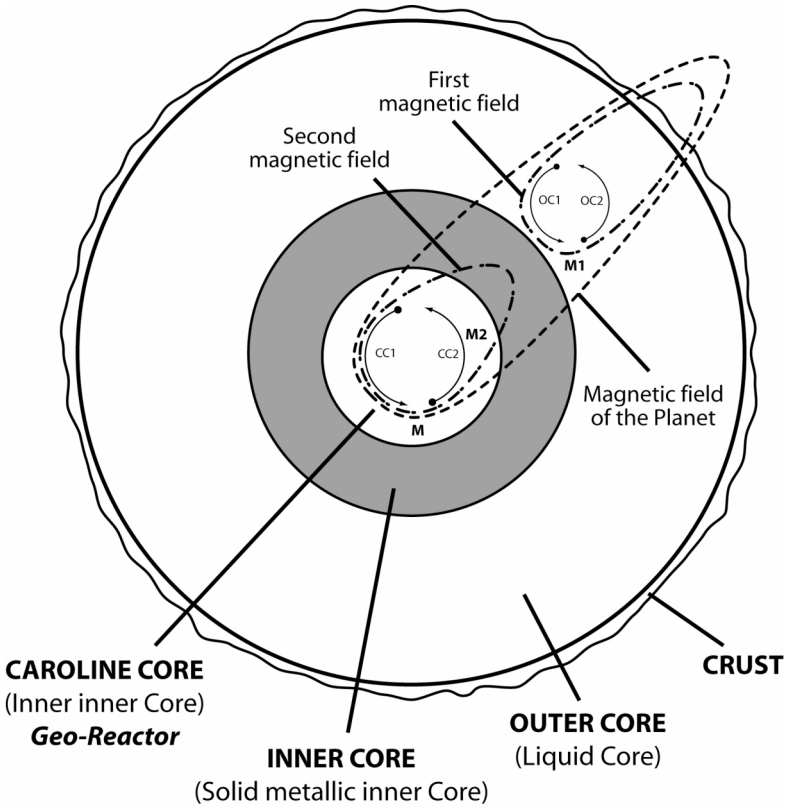

Fig. 1: Two interacting plasmatic magnetic fields in the inner cores of the Earth lead to the creation of the Magnetic field of the planet.

Note: The Caroline Core, can contain plasmas, atoms (nanomaterial), molecules, different matters, hydrogen, potassium, uranium and plutonium due to nuclear decay, fission, possible fusion, ionisation of matters, leading to the creation of heat in this core, which is transferred through the solid inner core to keep the materials content of outer core in fluid state.

Through current knowledge in plasma physics and studies in the nuclear fusion industry, it is a known fact that dynamic protons (plasmas) of atoms are positively charged entities and do generate their own currents, through what is known as the Birkeland current principle. It is through this principle of creation of current and the dynamism of plasma in the centre of stars that main solar Magnetic and gravitational fields forces of stars are created, and not the convection principle.

Secondly, if we have plasma in the centre of the planet, which is possible, then the convection theory for the production of Earth's Magnetic field has limited validity, and it is possible that some of the Magnetic fields of the planet are partially created by the convection principles method too.

2. Creation of the Gravitational Fields of the Earth

The other major concept, which is an obstacle to the development of new knowledge, is to understand how gravitational fields of planets are created. This is a concept that has not been understood until now. Where, the creation and maintenance of gravitational field's forces in stars and planets have unnecessarily made been by the scientific world into the holy grail of science.

In fact, the creation of the gravitational fields of planets and stars in the universe is as simple as the creation of their Magnetic fields.

The hypocrisy with this is that the scientific world and an infant child (at school age) agree on one principle, that, two dissimilar poles of solid magnets, gets attracted to each other and pulls one magnet to the other, or they have gravitation in respect to each other. It is an accepted fact that, opposite poles of magnetic fields forces can interact to create attraction field forces or the gravitational fields forces in respect to each other and other matters around them.

Thus, it is correct, to assume that, to have a gravitational field in a planetary system, the gravitational field forces must be made similarly by the same principles of attraction and interaction of at least two magnetic fields, in the centre of the planet in respect to each other. Therefore, the gravitational fields of the planet must have been made by interaction of two or more sources of magnetic fields in respect to each other in the centre of planets or stars that can span beyond the physical boundaries of these objects.

By the reality of the existence of the Magnetic and Gravitational field forces around the Earth, this leads to the confirmation and understanding of a need for two independent regions that can create magnetic fields forces within the structure of the planet inner cores, that, their interaction leads to the existence of the gravitational field forces of the planet.

Consequently the Earth, being in possession of gravitational fields, this confirms and indicates to the existence and operation of at least two independent magnetic fields forces regions in the centre cores of the planet (Fig. 2, fields G1 and G2).

Where, the interaction of the two magnetic fields (Fig. 2, fields G1 and G2), which are generated in the centre cores of the planet, upon each other, leads to the creation of attraction or gravitational field forces of the planet, similar to the attraction fields of opposing poles with solid magnets.

It is a known fact that, planets and stars are made of different layers of different

materials. Similarly stars are made of the same material (Hydrogen), which, due to variation in the compression and temperatures, layers are created in these objects, where the same matters in different layers create and behaves and show slightly different properties and effects; These different layers produce their own slightly different in strength magnetic fields force, compared to their adjacent layer magnetic fields strength. Thus, the layers of plasmatic or fluid materials in different depth of stars and planets, each layer create their own independent magnetic fields in the centre of planets or stars.

The magnetic fields created in each dynamic layer in the cores of these celestial bodies, due to the proximity have no alternative, but to interact with the magnetic fields generated in ascending or descending layers from them. The interactions between these magnetic fields in different layers are considered to be as or similar to a solid magnets state magnetic fields interactions.

In the case of stars and planets' inner cores, magnetic fields are created by and in plasmatic states or fluid states of Matters. Where, these flowing dynamic materials in the inner layers of celestial objects cannot physically lock to each other through the magnetic fields generated by each layer, as it happens with solid-state magnets. This being due to fact that atoms and molecules in these layers are continuously in motion and are pushed around by other forces and the rest of the Matters in their given layers or by other layers effects and forces.

Nevertheless, the magnetic fields created by each dynamic layer interact with the magnetic fields of the adjacent dynamic layer or layers. These interactions of magnetic fields in different layers creates attraction magnetic fields, as much as, repulsion Magnetic fields forces, in between the materials in the different layers.

Therefore in the same regions and by the same matters, **similar magnetic fields polarities** in different layers interact and two similar polarities magnetic fields forces (Fig. 1 field M1 and M2) repel each other. This repulsion magnetic fields forces (Fig. 1 field M1 and M2) becomes' the ***outwards field force pushing*** and what is known as the ***Magnetic field force*** of the planet (Fig. 1 field M).

Further, the *opposite polarities magnetic fields* in these layers at the same time, interact simultaneously and in a similar way, and the interaction of **opposite magnetic fields** polarities of matters in these layers (Fig. 2 field G1 and G2), leads to the creation of the different layers magnetic fields pulling or attraction in respect to each other. This attraction magnetic fields force (Fig. 2 field G1 and G2) becomes the ***inward field forces pulling*** field force and what is known as the ***Gravitational field force*** of the planet (Fig. 2 field G)(18).

Through tests done over several years with the construction of similar set-ups as in the inner cores of the planet, the ***Keshe Theory of creation of gravitational field*** of dynamic objects in possession of dynamic cores states that:

"***The dynamic outward' Magnetic fields forces of planets and stars are created by interaction of the same materials and in the same layers, as their dynamic***

gravitational fields forces".

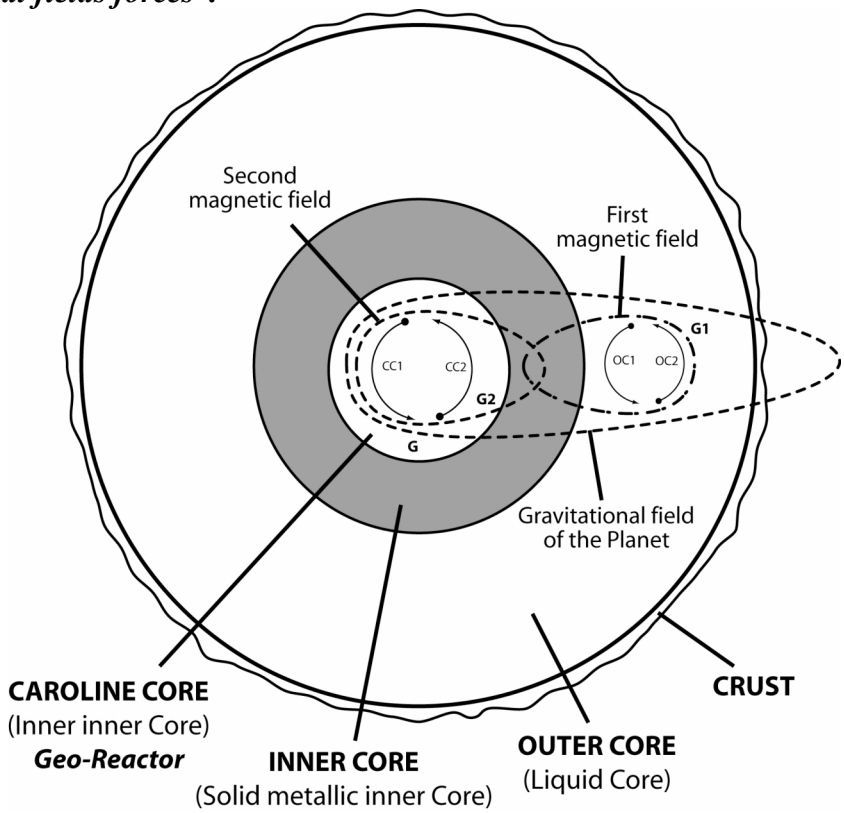

Fig. 2: Two interacting plasmatic magnetic fields in the inner cores of the Earth lead to the creation of the Gravitational field's forces of the planet.

The ***Magnetic fields forces*** of the planets are made from the interaction of similar polarities of plasmatic magnetic fields of Matters in the dynamic layers of its inner cores (Fig. 1 field M) and these radiate themselves ***outward***. The ***Gravitational fields forces*** (Fig. 2 field G) are created by the interaction of the opposite plasmatic magnetic fields polarities of the same Matters in the same layers in the cores of planet, creating the pull or ***inward*** attraction in these celestial objects".

This new understanding of interaction of multi-magnetic fields in the planets inner cores brings about a new definition, new understanding and new explanation of how gravitational field forces are created in centrally dynamic multi-inner-cores celestial objects in the universe the like of the Earth and the Sun.

Gravity can now be defined on the real basis and what leads to its manifestation, strength, existence and control.

Therefore, Gravitational field forces are magnetically based fields, and thus according to ***the Keshe Theory of Gravity***, Gravity is defined as:

"***The Gravity is, the measure of the interaction and attraction of two or more, magnetic fields forces or dynamic plasmatic*** strength created within the second system"(18).

This is the same as Newton's definition of gravity, with the extension however, that two Matters or matters cannot possess pulling forces nor have gravitation in respect to each other position, without the existence of magnetism.

Certainly, the attraction and interaction of pmtics forces changes with respect to position of two objects and they are distance and fields' strength dependent.

If the celestial objects do not possess magnetic fields strength that can interact with each other, then, how could they be attracted to each other?

Thus, gravitational field now can be understood and explained in its real terms of what creates it, and this is due to interaction and attraction of pmtics created within dynamic cores of celestial objects in respect to each other.

Secondly, as the gravitational fields of these planets or stars are magnetic fields strength dependent, one can now understand why their attraction is position dependent.

Therefore, *gravity in a simple form can be defined as; that gravity or gravitational fields forces are the measure of the interaction and attraction of two or more magnetic rays or magnetic fields systems of two or more entities in respect to each other's strength and position at any point in the Matter, plasma, matters, planets, solar systems, galaxies and universe*.

This new definition of gravitational fields is an extension to the present knowledge and due to new understanding of the plasmatic magnetic fields interactions between components of Matters (see Chapter 3).

Another proposition can be that: We further can assume that the cell of a human or matters of other objects, which all are made of atoms and plasmas and of magnetic fields can/are/or behave as the possessor of the second magnetic field in respect to any other plasmatic magnetic fields in their environment. Therefore, it is possible that pmtics of these cells and matters in their interaction with the dynamic pmtics of the planet can behave and replace the interacting double magnetic fields system principles necessary for the creation of gravitational phenomenon principle to operate.

Further it can be said, that any substance in possession of plasma or nuclei has gravitational attraction in respect to the planet.

If this is correct and applicable, then, this can be another reason why, a singular Magnetic field of a planet can be enough to create the gravitational field pull in respect to any object within the catchments zone of the Magnetic field of the planet's. That is to say, a single Magnetic field would be sufficient for the gravitation of plasma to the planet to be created and exist.

Nevertheless, there could be a flaw with this concept, as one need the gravitational and magnetic fields (Magravs) together to be able to have a constant free motion and position option of the two objects too.

In this book, we try to make a distinction between *magnetic fields of matters* and *Magnetic fields created by* dynamic interaction of two magnetic *rays*, two *magnetic fields* or *two pmtics*. Where, in the case of like **plasmas** and planets *Magnetic field* and *gravitational fields*, which they always accompany each other we use **capital M** as **Magnetic field**. In these references instead of writing **Ma**gnetic and **grav**itational field**s** we write in short as "**Magravs" *magnetic fields forces in respect to each others position***".

"Where, the Gravitational field force of one celestial body in respect to the other is a measure of the attraction and of the interaction of one plasmatic magnetic fields strength created within one system in respect to another plasmatic magnetic fields.

3. The source of the Heat in the Earth Cores

Another unanswered question in geophysics is that, where does exactly the heating of the inner solid core of the planet Earth comes' from that can keep the outer core materials in their fluid state? Secondly, how and through what method is heat generated in the inner cores of the planet?

These questions have not been addressed fully with clarity up to the present time in the science of the planet.

In general, it is an accepted fact that the Earth maintains heating of its inner cores. I consider that the Caroline core is a Geo-nuclear reactor (Fig. 1, 2 and 3) to be known as the **Geo-Reactor** (Fig. 2). It is not hard to assume that there are radioactive matters (41C) in this new central core of the planet (12), which leads to the heating of the inner cores of the planet. In general, nuclear geophysicists and myself agree upon this, up to certain degree, with difference in the content of the matter types and the process by which this heating is generated.

Where, geophysicists mainly consider that the heat in the Caroline core is generated through the nuclear decay of heavy elements, which have sunk into the centre of the planet due to their weight.

As a nuclear engineer having built several simple nuclear reactors replicating the structure of the inner cores of the planet Earth and achieving the same effects of creating Magravs similar to of the Earth, I believe, Matters, plasmas, hydrogen atoms, carbon atoms, radioactive matters and other matters collectively are parts of the mixture of the matters content of the Caroline's core (12).

One can now clearly explain that the major contributor to the generation of heat in the inner cores of the planet are, or can be due to nuclear decays, operation of plasmas, nuclear fission (41C) and possible nuclear fusion of materials in the Caroline core of the planet.

Materials in this region of such a high temperature are, and can be, considered to be in the fluid state (12) as has been considered by present geophysics scientists in respect to

the condition in the outer core materials of the planet.

Matters in this region, due to their fluidity, can be considered to be able to produce their own dynamic magnetic fields (Fig. 1 field M2 and Fig. 2 field G2), due to the *dynamic motion of fluid matters* in this section of the planet and these fields can/and interact with the dynamic solid inner core of the planet (Fig. 2). This being in principle similar to what has been assumed by geophysicists, that to be happening in between the **inner core** and the **outer core** regions of the planet matters leading to production of Magnetic field forces of the planet at the present time. Secondly due to the *charged plasmas and charged electrons and their motion in this core, these could be partially responsible for the creation of the second magnetic field force of the planet.*

By the discovery of the second cavity, the Caroline core, in the inner cores of the planet, it becomes clear that the **second magnetic fields** (Fig. 1 field M2 and G2) can be, and are created in the very centre of the planet. Where, the solid core of the planet will act as a separating partition wall, between the two dynamic matter regions in the centre of the planet, namely the fluid matters in the Caroline core and the fluid matters in the outer core.

So, the holy grail of the gravity (18) can be explained by the principle of interaction of two dynamic magnetic fields sources in the centre of the planet as was discussed in the above section. Therefore, the interaction between two pmtics on either side of the solid core is the source of the plasmatic Magravs of the planet.

4. What causes the Rotation of the planet Earth?

Another unexplained and daily-accepted phenomenon is the rotation of the planet Earth. How is the rotation of the planet Earth created and maintained? What causes and dictates its constant speed of rotation of the planet, irrespective of where the planet is in its solar system?

The way and how the rotation of a planet is created, has never been explained in the past by world of science.

The existence of two independent pmtics forces (Fig. 1 field forces of M1 and M2, and Fig. 2 field forces of G1 and G2) on either side of the inner solid core of the planet (Fig. 3) can help to explain the next mystery in the world of geophysics, through the ***Keshe Theory of "The principle of the rotation of the planet"***.

Magnetic fields are known to possess *field forces* that can exert pressure on an object, and are capable of causing its motion.

The existence of, and the continuously maintaining and interplay of the two dynamic pmtics forces (Fig. 1 fields M1 and M2 and Fig. 2 fields G1 and G2) on either side of the inner solid core of the planet, partially goes to answer the sources of the fields that exert forces on the inner solid core of the planet that causes the motion of the inner solid core.

It has been explained that the interaction of two dynamic magnetic fields on either side of the inner solid core, leads to the creation of Magravs forces of the planet. At the same time the interaction and exertion of the same magnetic fields forces on the inner solid core of the planet put magnetic pressure on the inner solid core of the planet, causing the motion of the inner solid core of the planet (Fig. 3 fields G1 and G2). In the figure 3 the total and overall effect of Magnetic field and Gravitational field forces of each core on the inner solid core are denoted as G1 and G2.

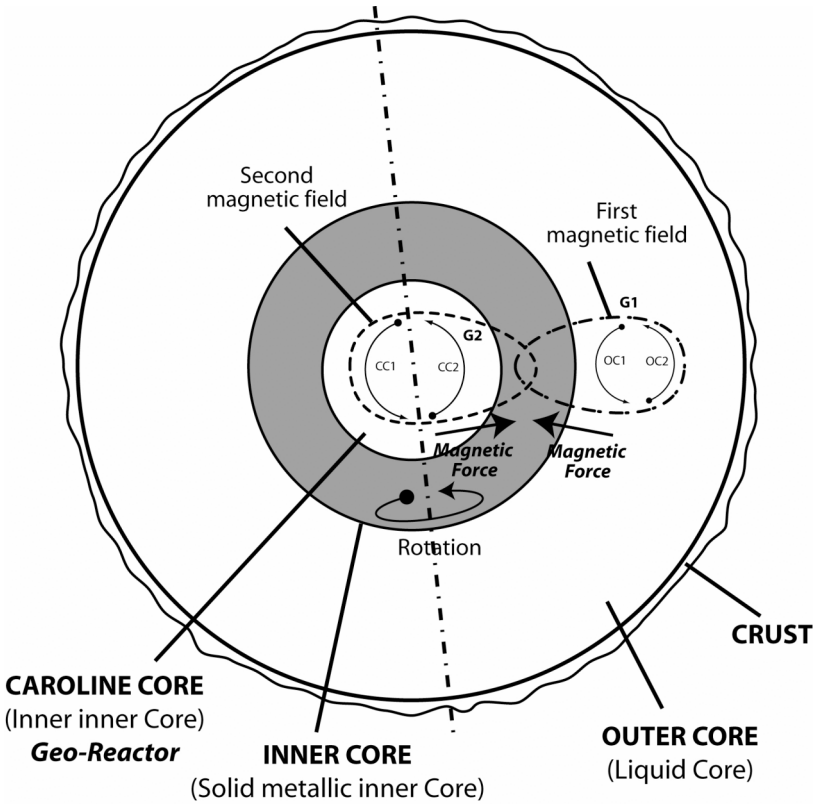

Fig. 3: Interacting plasmatic magnetic fields in the inner cores of the Earth leads to the creation of the rotation of the planet.

As the solid inner core confines' the materials in the Caroline core (Fig. 3) and the outer cores materials are confined by other matters at the outer boundaries of this core (Fig. 3), these two cores are considered to be holding a constant volume and weight of matters. Thus, it is possible to assume that the magnetic fields forces created by each core will be constant and these magnetic fields forces will be maintained on either side of the inner solid core of the planet for a long period of time (billions of years).

Hence, the *balance of magnetic fields forces* exerted on the metallic inner solid core, by both magnetic fields on either side of the inner solid core, will determine the speed of rotation of the solid core of the planet.

Consequently, through the principle of viscosity and friction of the matters inside the planet, the final speed of the rotation of the whole planet is considered to be set and be due to the motion of the inner solid core of the planet. Which is carried out to the outer

layers of the planet and becomes the final rotational speed of the planet.

Therefore, the speed of the rotational motion of the planet is determined by the planet's internal cores magnetic interactions upon the inner solid core of the planet and by large, this speed of rotation is **irrespective** of the position of the planet in its solar system and overall effect of the external Magravs forces, which are exerted by other planets, and the star of the solar system, on the planet.

So the twenty-four hour speed of rotation of the Earth is totally dictated by the exertion of the magnetic fields of the other cores on the solid inner cores of the planet as has just been explained, and not necessarily by any other factors.

This principle of constant speed of rotation of celestial object should hold true for the all-dynamic celestial objects that are in possession of dynamic thermal central materials cores and this rotation is irrespective of the temperature of the inner cores or temperature of the outer layers and surrounding environment of these objects.

Through tests in laboratory of similar reactors as the construction of Earth inner cores, we have concluded that the **speed of rotation of celestial objects and Matters** and the **creation of Magravs strength** are **temperature independent**.

The motional rotation of a planet is created through the same principle as the linear motion that is attained in the present Maglev magnetic railway system of Japan, with the difference that, due to *spherical shape* of the inner solid core of the planet (Fig. 3), the motion created in this case will be a rotational one (12) rather than linear. We can consider that this principle is universal.

5. The difference between Matter and matter

Another unexplained phenomenon in the world of physics has been the understanding and the difference between the Matter and the matter, one in respect to the other.

In this book we make a clear distinction between **the Matters** and **the matters** in all levels of universal orders of materials, where;

The **Matters** are understood to be as the like of the Matter, the Antimatter and the Dark Matter. These three Matters are all made of ***different*** *plasmatic magnetic fields strength* and are ***field strength*** dependent in respect to each other. The three Matters are the three major components of a plasma. Each of the three Matters have pmtics of another strength, where the constituent strength of the pmtics creates different Magravs, different magnetosphere field strength and different mass for each Matter, and these independent of the other two Matters within the plasma, and independent of the environment that surrounds the plasma.

Whereas:

The **matter** refers to the Matter component of the plasma. Matter becomes matter, when the Matter comes to levels that **plasmatic magnetic fields forces** and the ***motion** of these forces* in their environment can determine the compactness of the components of the Matter pmtics appearance in the plasma that make the matter appears as a gas, a liquid or a solid ***state-of-matter***. These forces being created due to interactions of Magravs, dynamism of the environment, and so on.

At the same time, Matters are pmtics strength, contact friction dependent. Where, the friction of pmtics in matter usually leads to the change of the state of the matter through the change of plasmatic magnetic fields forces to the likes of light, heat and other's.

It is the **external field forces** and ***not the field strength*** of the environment that dictate the compactness of any of the plasmas' Matters so that the pmtics becomes matter and visible or tangible to human senses, like odours or appearance of Matter as solid, gas or liquid, it is then that the ***Matter*** comes to be called the ***matter***.

The principle of ***strength*** of the magnetic fields of Matters is very different than the strength of magnetic fields in matters.

When we consider to work with Matter(s) for space technology, the term "**fuel**" is not applicable, therefore the use of the term "**MAT***ter* **MAG***netic* **S***upply*", abbreviated to "MATMAGS". This is a Matter (Matter, Dark Matter, Antimatter) ***source of pmtics*** used in reactors for the production of Magravs for the operation of gravitational positioning reactors, where one can state the Matter needed and the strength of the Magnetic fields of the Matter needed to achieve desired effects from the reactor.

Since "fuels" only refer to the *matter level*, where fuels are usually *burned through ignition of matters*, whereas ***magnetic fields of Matters***, in the form of Magravs, are manipulated to create a preferred effect, and where the magnetic fields can be reversed back to any other state of Matter, and they are never lost. The only difference would be that with the Matter supply the magnetic fields strength can differ after processing, but in reality one would be left still having magnetic fields of varying degrees in strength.

6. How motion of matters and Matters are created?

The question to be asked first is, that, how the Matter, the Antimatter, and the Dark Matter are created in the universe.

Secondly, how are the regular independent motion of **Matters** (Matter, Dark Matter and Antimatter) and **matters** (electrons, atoms, matters, planets, stars and galaxies) in the universe without burning of any fuel created and maintained?

No explanation has been put forward by the scientific world that is realistic, fundamental and applicable in all levels and to all sizes of objects and in any position in the universe.

In the following chapters of this book, I will disclose how **matters** (gasses, liquids and

solids) and **Matters** (Matter, Antimatter and Dark Matter) as part of fundamental elements of creation, move in the universe. In addition, it will be explained, how the plasmas, electrons, planets and stars attain and maintain their motion in the span of the universe. (Chapters 19)

Motion in the universe is achieved by understanding in full that how the construction of Matters happens at their simplest form, from the inception of the initial fundamental particles how they come together, and how they respond to each other's magnetic fields forces, that the interactions of all constituents Magnetic field forces in Matter and plasma of Matters, leads to the creation of motion of plasmas, electrons, planets, stars, and so on.

7. How Light is created?

The present science of physics accepts that the light is created through the drop in energy of an electron from one energy level to a lower, or its ground energy level.

Further, in this book we will explain how light is created in the universe, where actually there are *no electrons present* in the plasma-saturated environment.

The other unanswered question is whether the speed of light (C) is the ultimate speed in the world of Matters.

The speed of light is in the world of science thought to be the ultimate speed that any Matter can travel.

I consider this assumption to be **incorrect** for all states of Matters (Matter, Dark Matter and Antimatter).

The assumption that the speed of light is the ultimate speed can be correct **only** for *interactions between matter and Matter component* of the three basic Matters (Matter, Antimatter, and Dark Matter).

I consider that the **plasma** is to be in **possession of all three states of Matters,** these being **the Matter, the Dark Matter and the Antimatter.** (See the cover image of the book)

Secondly, the assumption that the speed of light to be the ultimate speed, can at the same time be partially correct and applicable, only for a limited fraction of time for specific conditions of **matter** (and not necessarily only in vacuum conditions). Where **matte**r itself is only a small part of bigger components of Matters of plasma in the universe.

There are too many physical facts that are present in the mechanism of the universe's daily operation that rejects that the speed of the light being the ultimate speed. These new theories will be discussed further in Chapter 7, titled "Speed of light". A large numbers of physicists around the world do not accept such a limitation on the speed of

matters in the universe.

CHAPTER 2

Interaction of Plasmatic Magnetic Fields (pmtics)

In the Matters the strength of the magnetic fields goes back to the origin of the creation of magnetic fields. Where, the strength of the magnetic fields is in terms of reference, the power of the magnetic fields. Where magnetic fields in essence are created out of the potential difference in position from their source and the rate of the flow of the magnetic fields from their source becomes the current of the magnetic fields. Thus, as the position is closer and the rate of the flow is higher, the stronger the strength of the fields. This principle of creation of magnetic fields and magnetic fields strength are explained in full in the paper titled "The creation of magnetic fields".

In understanding the ways and the simplicity with which the gravitational field force of plasmatic conditions are generated and maintained in planetary and stars systems, we can now state that the method of creation and production of the Magnetic fields and gravitational field forces of galaxies, stars, planets, molecules, atoms and plasma are all considered to be through the same method, irrespective of their physical size.

At the same time, it is important to appreciate that this applies to all scales of the universal order of creation. That is to say, stars are made of the denser, larger and stronger by order magnitudes of plasmatic magnetic fields strength forces in the universe. Compared to the plasmas and the electrons, which are made of a weaker order of magnitude of plasmatic magnetic fields strength forces.

Nevertheless, the same principle of structural formation applies to the Magravs structure of stars as to the structure of an atom, the plasma and the electron.

In the physically big state order of matter, large scale, stronger and denser magnetic fields can be easily observed and detected, like the magnetic fields of the Earth, the Sun or the Galaxies.

By the same measure and the same order of the scale and magnitude, plasmas and electrons possess and are made of and follow the same principles of Magravs interaction and attraction, and hold on to their different Matters and forces, as a star or a galaxy does.

Whereas, the existence of the lower order of the magnitude pmtics that make the physical structure of plasma due to their very weak magnetic fields strength, can mainly be confirmed through the physical existence of the plasma itself, its behaviour, and its properties.

Through our own tests, which have been done over several years, it is apparent that the plasmas possess their own Magravs forces, which are made from the interactions of combinations of different pmtics forces within their structure.

The fact is that, if the plasma did not create and maintained Magravs forces internally, it would not have been able to hold on to its fundamental particles, for the plasma to exist. By the ***Keshe Theory of the Gravity***, the existence of Magravs forces as the existence of a magnetosphere of the plasma confirms the existence and interaction of at least two plasmatic magnetic fields forces within this structure.

Secondly, if the plasma did not possess Magnetic field, it would get stock to other plasmas in its environment, these environments being for example the like of the other plasmas in the nucleus of heavier atoms. Then as the plasma is a free motion entity, which keeps distance from other plasmas in its environment, this confirms the existence of Magnetic as well as gravitational field's, which is internally maintained and emanated from the plasma itself.

Unless it can be proven to the contrary, we can assume that all plasmas are made of the same types of pmtics, and the same structural Matters and the same structural configuration. Then, we can say with confidence that all plasmas are made of identical Matters and create the identical Magravs forces within their structure.

We consider neutrons, protons and *especially* electrons as being of plasma structure with only difference in their pmtics content level. Thus, different atoms of different matters have different energy and physical pmtics properties from other atoms purely due to the level of total pmtics of their total plasmas that they can hold onto.

From this point on, in this book, it is considered that all **hydrogen atoms** have and will always be in ***possession of the same properties***, be of ***the same construction*** and be made ***of the same similar internal pmtics and Matters***.

Therefore, it is assumed from this point in this book that what we call initial fundamental plasmas, or what is called neutron, must always be made of the same composition and of the same specific pmtics at all times, for all such plasmas of all atoms.

Furthermore, it can be said that all initial fundamental plasmas create the same and similar plasmatic Magravs forces.

Until contrary to this fact is proven, then it is correct to assume that majority of plasmas have the same characteristics, the same properties, and have the same dimensions, and the same measurement of Magravs density and field strength.

Therefore, it is right to assume that the *majority of plasmas* in the universe are all made of the same collection of pmtics interactions.

Hence, it is correct to assume that to have plasma of specific characteristics and specific Magravs strengths; the plasma is made of and must be able to attain a Specific Magnetic Configurations for all initial fundamental plasmas.

From observation of motion of plasmas in the universe, it is clear that not all packs of pmtics are connected to a specific source. They are mainly free floating in space and are

made of different magnetic fields strength.

Where, some of these pmtics interact with others of the *same strength*. Which, these interactions lead to the creation of the plasmatic Magravs, in their space and in respect to other floating pmtics in their given environments.

Initially, when pmtics of similar strength get close to each other, the interacting fields get entangled with each other and set-off a new cycle of Magravs in respect to other pmtics and magnetic fields in their given environment.

Further on as more pmtics of different field strength are gathered together due to their initial magnetic fields strength the new seeds for creation of new and different Matters are set to start. Where, the collection of these different Matters and fields and their interactions leads to the creation of initial fundamental plasma, in a specific given position in space.

Plasmas are always considered to be made in the same manner, by the same process, by the collection of the same pmtics force strength and the same interaction procedure of the fields within their structure.

Hence, plasmas are said to be made of **S***pecific* **E***ntangled* **P***lasmatic* **MA***gnetic* **F***ields* (SEPMAF) and this is considered to be the same for composition of all plasmas in general.

CHAPTER 3

The Initial Fundamental Particles of the plasma

The **initial fundamental particles** components of plasma are considered to be *a **collection** of weak* **plasmatic magnetic fields** (in short: pmtics) originally existing in the spans of galaxies.

These are **residuals** of different plasmatic magnetic fields activities of matters and Matters, which are released by the interaction of different magnetic fields by/and through for example processes like fission and fusion within stars and so on. It is considered that some of these ***weaker*** plasmatic magnetic fields are *released into the environment* by the nuclear decay of atoms themselves.

Where some of the pmtics (Fig. 4) are *continuously created in the **denser** environments* by the **interaction and friction** of two or denser ***or stronger*** *pmtics* and some ***weaker pmtics*** are generated through the **collision or friction** of *matters and Matters* in the universe.

Fig. 4: Graphic presentation of plasmatic magnetic fields.

Note: The figure 4 A: represents the collection of plasmatic magnetic fields of different strength. The figure 4 B: represents a graphical representation of dynamic pmtics in motion.

The pmtics due to their very weak strength are usually considered to exist and be in motion in **packs** within the different parts of universe (Fig. 5). Where, each pack can be made of number of different orders of magnitude of pmtics strength.

For ease of understanding in trying to explain that how plasmas are created initially, we will consider three packs of pmtics. Where, for our purposes, each pack of plasmatic magnetic fields is denoted by one capital letter. Then each strength sub-constituent magnetic fields forces is number denoted. The different strength fields denoted with different numbers (Fig. 5).

For simplicity of explanation, we will consider three packs of A, B and C with constituents of different dynamic pmtics (considering that fields are in motion in their environment).

Furthermore we consider that each pack of magnetic fields contains five different sets

of fields strength called (**Pack A**) as A1, A2, A3, A4 and A5, (**Pack B**) as B1, B2, B3, B4 and B5 and (**Pack C**) as C1, C2, C3, C4 and C5 respectively (Fig. 5).

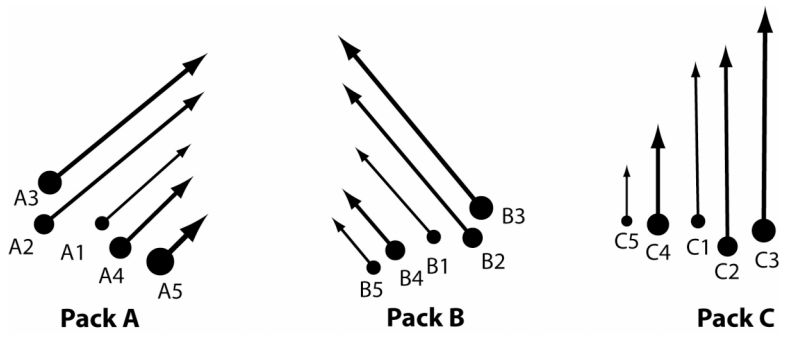

Fig. 5: Initial fundamental particles of plastic magnetic fields.

It is important to remember in this section, that when we talk about the *gravitational field forces (Magravs)*, this means the **gravitational fields** and the **Magnetic fields** of any entity in possession of these magnetic fields, which are generated simultaneously by the interaction of the same two or more plasmatic magnetic fields.

It is crucial to remember that there cannot be a situation where, there are gravitational fields and no Magnetic fields within a system and vice-versa. Even where, the Magnetic field comes to be placed in the boundary of the gravitational field zone.

In principle, the gravitational fields and the Magnetic fields of the plasma are represented in the same region in our diagram(s), and for simplicity, these are shown with the doted line and this single line is representing both the Magravs zone of a Matter.

Creation of Matter of plasma through interaction of pmtics.

Initially considering interactions between, the pack A and the pack B and ***at least one pmtics of each pack***, which are to match with each other strength ***of the other pack***, where these two pmtics are allowed to interact and interlock into each other.

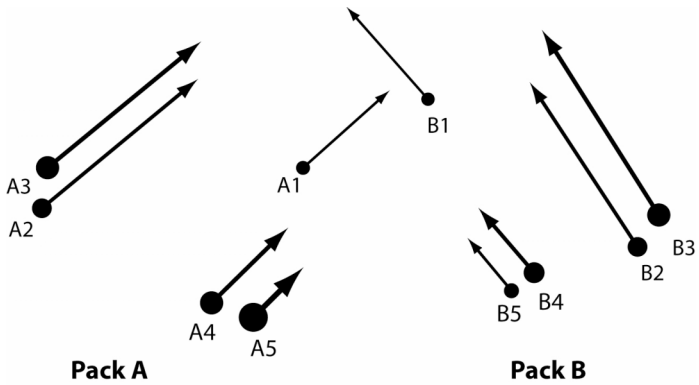

Fig. 6: Dynamic plasmatic magnetic fields A1 and B1 making the initial magnetic interaction of two packs.

Note: Only pmtics of similar or near similar pmtics strength can interlock into each other, where pmtics of different strength are attracted to each other but cannot interlock in the majority of the cases.

For the pmtics of packs A and B, which are similar or equal in magnetic fields strength, and they are in motion, and able to interact with each other or to interlock into each other (Fig. 6 and Fig. 7 a), it is considered that the North Pole of pmtics A1 and the South Pole of the pmtics B1, (Fig. 7 b) start the ***attraction*** of the two pmtics to each other.

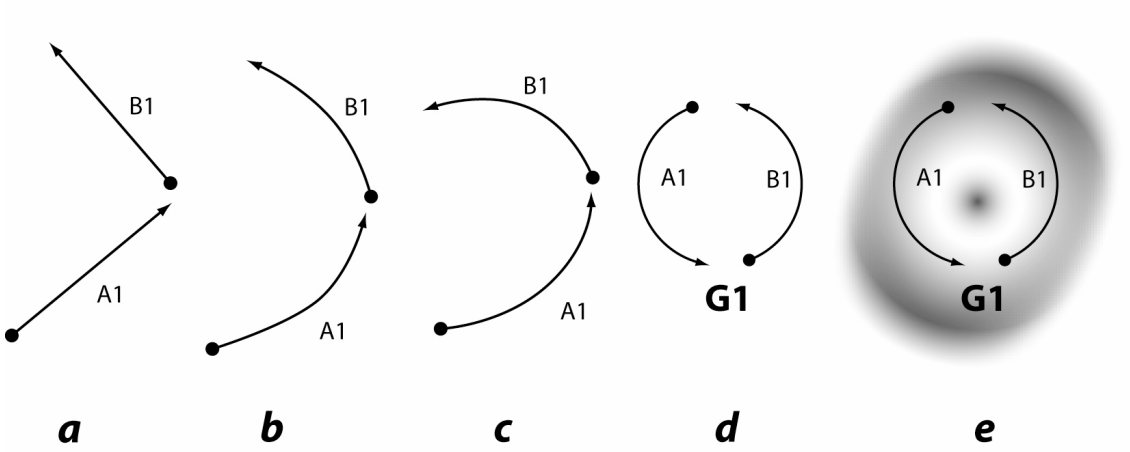

Fig. 7: Interacting plasmatic magnetic fields making pmtics of Matter.

Note: It is considered at all times in the universe all magnetic fields and plasmatic magnetic fields are in dynamic and in the state of motion, as magnetic fields in essence are always attracted or interacting with other magnetic entities, thus they are always on the move towards or repulsing from one magnetic field to another. This is how the motion of Matters and fields are maintained in the universe. This continuous dynamic mixture of different magnetic fields strength become part of a localized or universal pmtic soup(s).

This interaction and interlocking of these pmtics initiates and creates the ***first step*** of interactions between two packs A and B plasmatic magnetic fields (Fig. 7 c). This ***interlocking***, leads to the creation of the very first *initial fundamental magnetic fields set*, or the first initial Magravs, what is called the initial configuration of pmtics needed for initial seed of the plasma (Fig. 7 d and e).

The interaction of at least one plasmatic magnetic fields of each pack that is initiating, and starting the initial weak Magravs forces of a Matter of a plasma, this is the **first step** *for the interlocking of the two packs* of A and B, of pmtics forces in respect to each other.

From this point on, the first plasmatic Magravs force, essential for the seed of the first Matter of the plasma, is set to start and operate (Fig. 7 e). That is to say, the first gravitational field (G1 in Fig. 8 B) and the Magnetic field (M1 in Fig. 8 B) forces can be considered to be created in between these weak pmtics packs.

It is appropriate to consider that the interlocking of the two dynamic fields, due to their

interaction and attraction, are bent inward or become overall to be ***spherical*** in shape (Fig. 7e and Fig. 8 A).

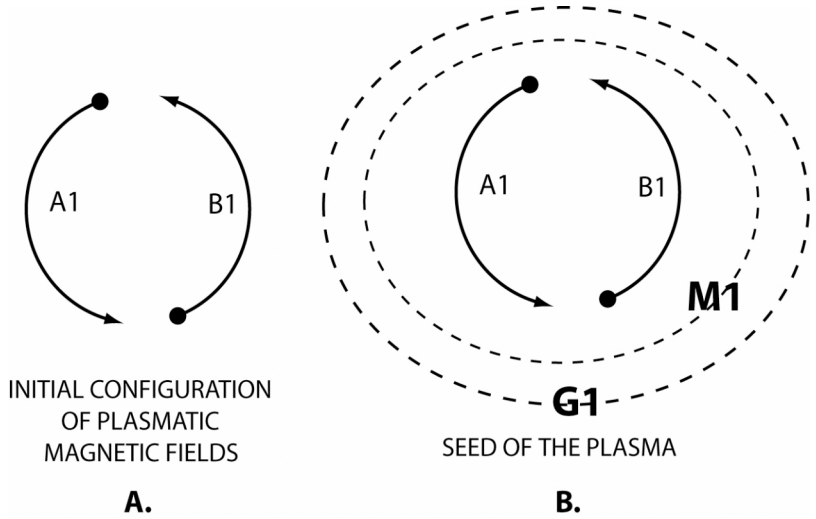

Fig. 8: The creation of the seed of the plasma.

For ease of explanation, all the initial plasmatic gravitational fields (Fig. 9 field G1), and all the plasmatic Magnetic fields (Fig. 9 field M1) from now on in this disclosure are denoted as G1 fields (Fig. 10), or what we call **Magnetic and gravitational fields** or **Magravs** and considered these to be the seed of the pmtics of the **Matter** components' of the plasma.

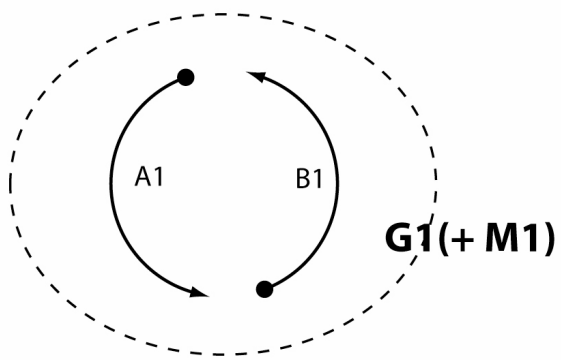

Fig. 9: Initial gravitational fields and Magnetic fields (Magravs) of the Matter components of the plasma.

At the same time, the ***remaining*** pmtics in each pack of A and B, due to the dynamism and Magravs in the vicinity of this seed, these will be kept around the seed G1 as one dynamic pack SET P1.

The collective Magravs force of the seed of Matter will be known as G1 (Fig. 10) and the remaining pmtics magnetic fields of Pack A and B as initial set of the Matter component of the plasma is denote as **SET P1** (Fig. 10).

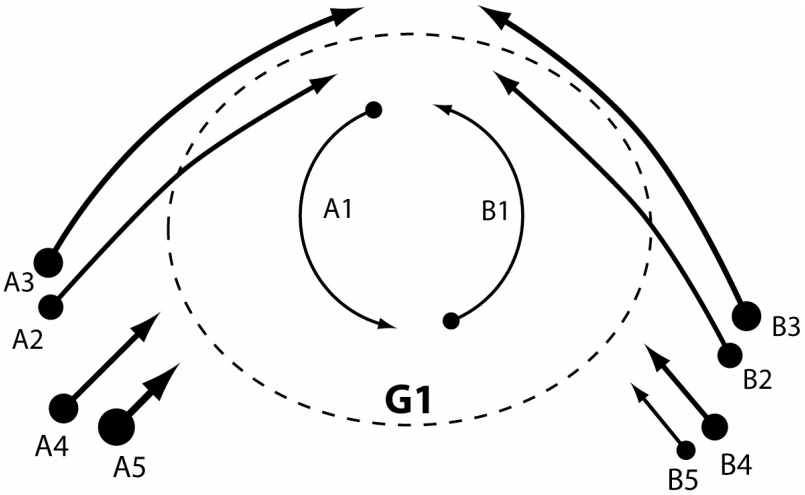

Fig. 10: **Set P1**, the initial pmtics of the Matters Magravs' components of the plasma.

*Note: It has to be remembered that the pmtics in G1 are not produced and connected to a source of a solid magnet, but these **forces** were made by magnetic fields and were detached from their source of creation, some times before, hence, the use of the term "plasmatic" for these magnetic fields. The term "plasmatic" refers in this book to a "collection" of dynamic magnetic fields, and **not** to the state of a plasma in its common term use, which for example refers to a state of dynamic protons.*

Nevertheless, the remaining plasmatic magnetic fields of the two packs A and B are ***not matching in strength*** and hence they cannot lock into each other, *these being* pmtics A2, A3, A4, A5, and pmtics B2, B3, B4, B5.

Therefore, the initial dynamic pmtics interaction of the two packs making up the G1, possessing dynamic Magravs force, become the **Matter** component's of the *upcoming plasma*.

In the open spaces of the universe, the SET P1 due to its dynamism and motion, naturally and eventually will come across another pack of pmtics, like the **pack C**.

The interaction between magnetic fields of the SET P1 and pmtics of the pack C will be different in respect to the initial interaction of the packs A and B.

In this set of interactions between all the fields and initial Magravs force of the SET P1 and the pack C, several steps can take place instantaneously, simultaneously or over a length of time.
The first step is that, some of the magnetic fields strength in the pack C (C1, C2, C3, C4 or C5) could be **similar** to certain magnetic fields strength as in the G1 of the SET P1.

The *addition of **new** plasmatic magnetic fields* does not necessarily increase the strength of the fields of the G1, but it just adds to the density of the compact pmtics in the G1, and hence **increases of the mass** of the G1 only.

Creation of the Antimatter of plasma

The **second step** is that the stronger field of the SET P1 interacts with similar fields as

in the pack C and as they are ***stronger***, they would create a much stronger Magravs strength set. This, leading to the creation of a new Magravs zone, **near** the initial Magravs forces of the G1.

Due to its ***higher*** *pmtics strength*, this new Magravs system denoted as the G2 (Fig. 11) and it would have a separate distinctive characteristic. The new Magravs set possesses **a much stronger field** due to its stronger pmtics, which initiated its creation. This new and stronger Magravs will ***exert forces on the G1*** (Fig. 10), this making the pmtics constituent of the G1 a denser environment as the seat of the Matter (solid, liquid, gas) components of the plasma.

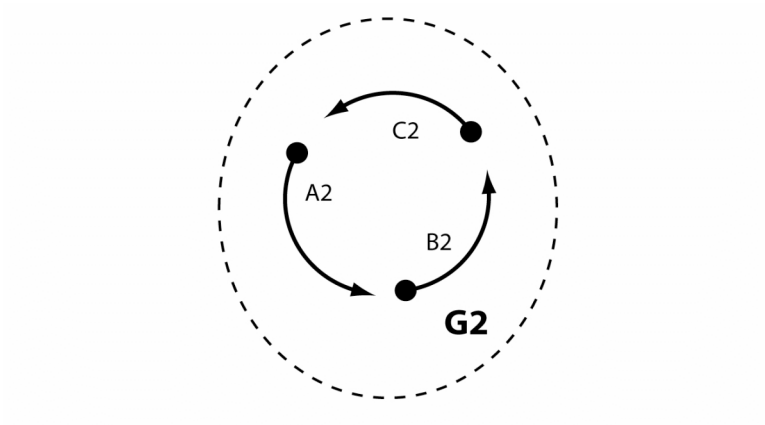

Fig. 11: The pmtics of the second Magravs.

Hence, this new interaction of fields creates a separate and stronger Magravs zone G2 (Fig. 13) adjacent to the G1 (Fig. 13) and in the same environmental plasma condition as G1. This new Magravs G2 (Fig. 11) is independent and interlocked to the initial Magravs of Matters of G1 but it will not interfere with the operation of the G1.

In fact, the Magravs forces within the G2 (Fig. 12) and its surroundings become the seed of another Matter in the same environment.

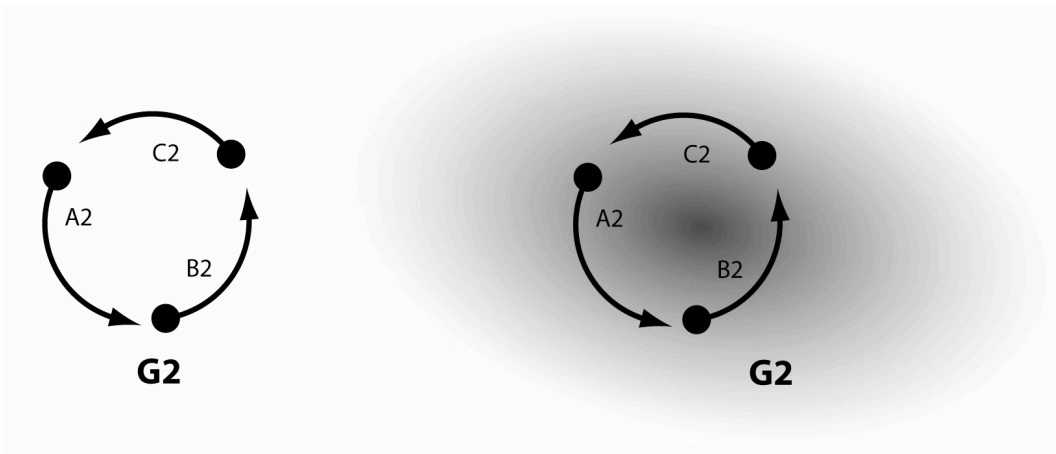

Fig. 12: The Antimatter Pmtics and Antimatter pmtics Magravs.

This new and stronger Magravs force, due to its stronger plasmatic Magravs interactions and its transparency, become what is known as the Antimatter part of the

plasma (Fig. 12 G2).

For clarity, the new stronger magnetic fields interaction between the SET P1 and the pack C, and creation of the Magravs force of G2 (Fig. 11), becomes part of the **SET P2** (Fig. 13).

Where, now this new set includes the G1 the Matter and the G2 the Antimatter and the remaining pmtics of the three original packs. Where, the weaker Magravs of the G1 and the stronger Magravs of the G2 co-exist next to each other, and are interlocked to each other by the original three pmtics fields in the original packs, which they originally shared (Fig. 13). Through overall Magravs of the two Matters in respect to each other, these two Matters' Magravs keep the rest of pmtics of the original three packs together and around them.

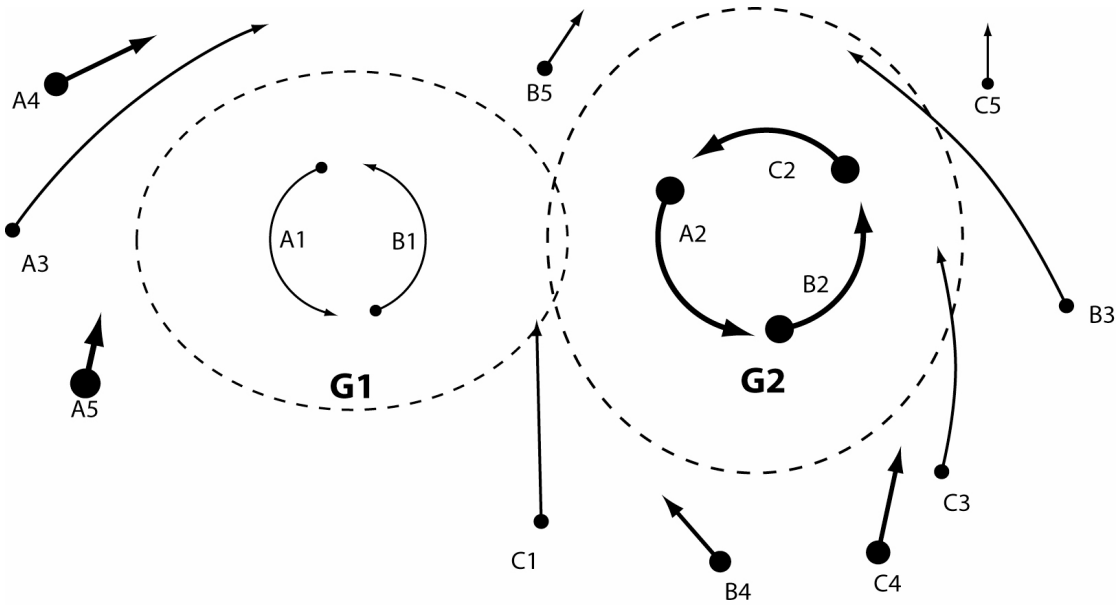

Fig. 13: Set P 2. This set includes pmtics and the Magravs of the Matter, the Antimatter and residual pmtics of 3 original packs.

This interaction of two different plasmatic Magravs sets of different strengths is similar to the plasmatic Magravs set forces operating in independent celestial bodies of the solar systems the like of the Earth and the Sun, where, the Earth can be considered to be the G1 pmtics Magravs and the Sun the G2 pmtics Magravs of the set.

Creation of the Dark Matter of plasma

The **third step** of the same interaction of the pack A, B and C pmtics, is from the other residual fields of these packs. Where some of the *residual* magnetic fields will generate a new Magravs force environment, the like of the G3 (Fig. 14). The G3 gravitational field force is a part of the same set of the same plasma environment as the G1 and the G2.

This new Magravs force zone of the G3 is created through the same process as the other

two Magravs, with a difference that the outward Magravs strength created by G3 are in magnetic fields strength balance with the overall pmtics strength created by the G1 and the G2 and other pmtics within the environment of the original three packs of pmtics.

This G3 is independent from the magnetic fields of other two Matters of the plasma. But these sets overall Magravs are ***near equal*** or are ***in balance***, in respect to the pmtics of the overall enclosure of the plasma and of all the three original packs and the two gravitational sets of G1 and G2.

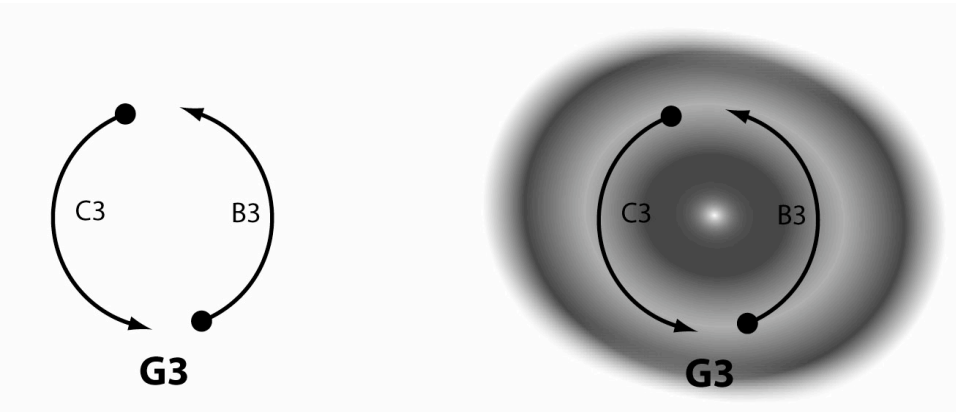

Fig. 14: The schematic and pmtics representation of Dark Matter.

Hence, even though this region of the plasma possesses Magravs forces, but it appears to be void of external magnetic fields, or this region appears to be void of a magnetosphere. Where, in the interaction of the G3 Magnetic fields with its surrounding magnetic and Magravs of the G1 and the G2 of the same environment, these fields of the G3 fail to create a visible and distinguishable magnetosphere for the G3 set with other magnetic fields in its surrounding environment. Therefore, as there are no interaction between the overall balance of the Magravs of the G3 with its surrounding pmtics, thus no visible or may be very little detectable light due to the interaction magnetic fields of the G3 with its surrounding pmtics are produced, that these could create light that could make this new gravitational centre to be detectable. Which this light can confirm the existence of another internal gravitational fields of another Matter in this region of the plasma.

Even though there would be a gravitational field force in this region of the plasma, which confirms the existence of another Matter in this region of plasma. However, the G3, due to the balance external Magravs interaction with other fields around this region with the lack of stronger external magnetic fields to create more profound detectable light in comparison to the G1 and the G2 magnetospheres within the plasma, makes this region around the G3 darker in respect to the rest of the plasma environment (Chapter 7).

Nevertheless, this region possesses pulling field forces or gravitational field forces but will not be as visible or detectable as the rest of the plasma, or will be darker in comparison, due to a lack of the stronger magnetospheric interface (Fig. 15 **SET P3**).

The G3 gravitational field force region, due to its dark appearance, becomes the Dark Matter component of the plasma (Chapter 14).

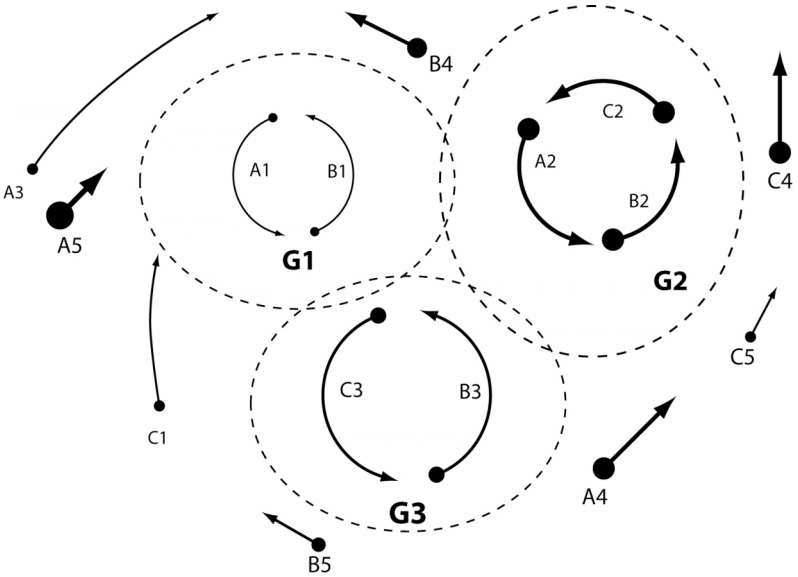

Fig. 15: Set P3 interactive gravitational fields of a Matter, Antimatter and Dark Matter.

In the past papers (36) and the Dark Matter chapter, ***Keshe Theory of creation of Dark Matter*** considers' and explains' that "Matter which possesses both Magravs, but where the overall Magravs strength are *in balance or near balance* in respect to its environments pmtics strength, so much so, that these regions do not create any or create only a very little magnetospheric visible light zone through the interaction of their pmtics (Chapter 7), that the Matter cannot become detectable or become visible in respect to its surrounding environment at specific given time and position, hence the Matter Magravs magnetosphere appears to be darker in that part of given environment, hence the term **Dark Matter**" is used.

These interactions and principles of how Dark Matters are generated have been explained and discussed in detail in the paper titled "The creation of Black Hole" (13), "Creation of Dark Matter" (36), "The rings of Saturn" (39) and further in different following chapters in this book.

We consider the creation and appearance of the Dark Matters, Black Holes, Dark Spots on the surface of the Sun and Dark sections of the rings of the Saturn, are all to be due to and through the same fundamental principle of the interaction of equal plasmatic Magravs strength forces in their given specific environment at a specific duration of time as in the G3 (13, 14, 17, 18, 24, 36).

Nevertheless, the Magravs forces of the G3 will be interacting with the rest of the plasma Matter's field's forces. The G3 pmtics released partially will feed the plasma's of other components of Matters for their motional energy and in keeping the gravitational field forces of the G1 and the G2 intact and overall to keep the plasma as one integrated system (Fig. 15).

Creation of the torus field force

The **fourth step**: Further on in this process of interaction of three original packs of

pmtics, and due to the dynamic characteristics of the other three Matters Magravs, soon ***some of free pmtics*** left in the overall initial three packs will come to be positioned in the centre of three Magravs forces of the G1, the G2 and the G3, and becomes the **interlocking force** between the three. The free pmtics become a dynamic swirling compact of residual of *un-matching pmtics* field strength and behave as a partial sphere of rotating magnetic fields forces to be known as the **F1** (Fig. 16) part of the plasma.

Fig. 16: The spherical torus field force.

These free F1 pmtics, due to not being able to find equal magnetic fields strength partners to establish themselves as a Matter condition phenomenon, this portion of the interacting fields become void of central gravitational field forces.

As the G1, the G2 and the G3 are in continuous motion, and as these three Matters lose their energies and momentums, due to their long-term dynamic activities, they come close to this inner field force region of the F1 and in contact with its pmtics forces. This is the point where, the three Matters of plasma gain momentum from their interactions and encounter with the dynamic magnetic fields forces of the F1 (Fig. 17).

This dynamic pmtics region in between three dynamic Matters can be compared to an empty spherical torus shaped field force effect (F1) (Fig. 17), as the field forces turn inwards, without any central gravitational field forces strength, and without any matching pmtics to generate any viable internal gravitational field force for the creation of any Magravs to lead to the creation of any Matter types.

In practice, the conversion of the pmtics of the F1 into energy, partially allows the balanced dynamism of the whole plasma to be maintained.

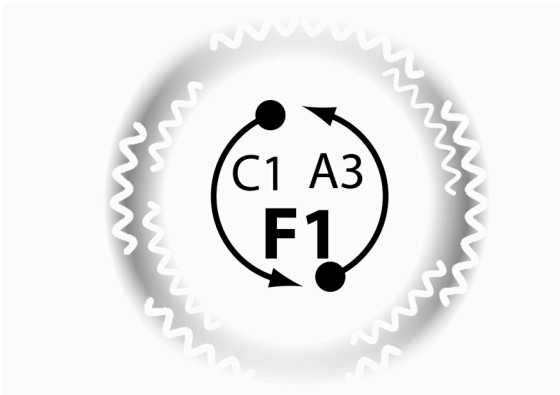

Fig. 17: Spherical torus shaped pmtics made by interaction of different strength residual pmtics of the three original packs.

F1's are considered as a natural process and phenomenon in the plasma and in the

universe, with the content of larger order of magnitude difference in pmtics strength in their constituents.

This dynamic spherical magnetic fields force region of the F1 in plasma or in space, void of central gravitational field forces, is commonly called a ***Wormhole***, and its operation of its field's forces in motion as Wormhole effect.

It has been hypothesized in the past by scientists that such a Wormhole can be used for inter-space travel with extreme speeds of motions near the speed of light.

We consider that these dynamic magnetic fields regions can be used to increase the speed of any object, which comes in touch with their dynamic magnetic fields. In fact the fast journey of the object through the F1, will not necessarily lead the Matter to anywhere rather than giving a turbulent fast ride within the structure of the plasma.

In case of wormhole in a galaxy, the object will have a fast speed travel without much control in speed and dictating the point of final destination of where the object might end up.

These are points in space that acceleration for motion for other Matters of the plasma or physical matters can be obtained, by using the dynamic pmtics forces of the F1 in plasma or space, where these forces happen to exist. Finding these points in space are much easier than ever thought before (Future publication).

Initial structure of Matters of plasma

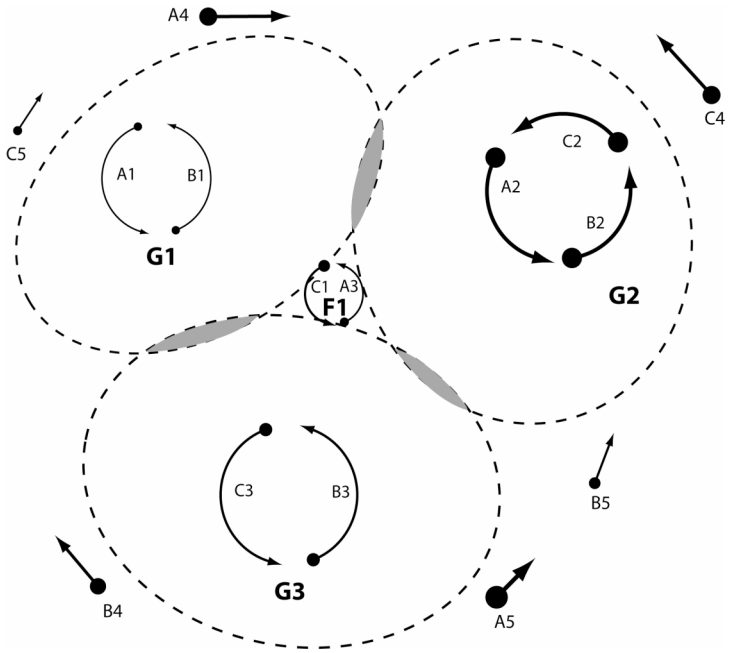

Fig. 18: Set of interaction between the three Matters and the F1.

Even though each of the three Matters are separate and operates independently from other Matters within the plasma, it is possible that from time to time the magnetospheric

envelop of each Matter comes in touch with other magnetospheres of Matters of the plasma and creates a common ***interface*** in the region for the window of time of the interaction (Fig. 18 shaded areas).

It is important to note that plasmas can possess several G3's and F1's of different pmtics strengths in its overall entity for some time, individually or simultaneously, at different time in its life cycle.

Transition-zone pmtics

The new overall interaction of all three Matters and all fields of all pmtics of all three Packs, as one entity, leads to the creation of the initial Matters and Forces of the plasma (Fig. 19).

At this point, there could be other pmtics of the three original packs within the structure of plasma that could not link or be part of the components of the three Matters and the F1, these free leftover pmtics literally float in the plasma and over time, they become the feeding pmtics for one Matter or another and the interlocking magnetic fields forces of part of the other Matters of the plasma.

These loose pmtics in-between interfaces of Matters are the dynamic plasmatic magnetic fields transition zones, which we call "***the energy transition zones***" (Fig. 20, the field arrows), in the overall structure of plasma. The magnetic fields in these intervening gaps among the Matters are fields that are mutually shared by all Matters in the plasma, when there pmtics strength comes to their level; these residual pmtics are considered more as a mixture of magnetic rays than pmtics.

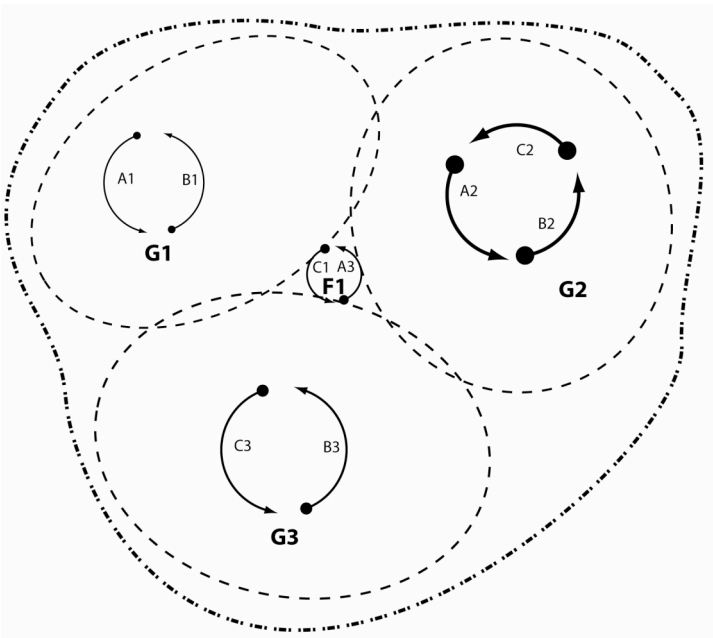

Fig. 19: Initial Matters and forces of the envelope of plasma.

They are in the plasma, like intermediating or interface zones in between two or more

Matters of the plasma at the same time.

Now that all the plasmatic magnetic fields of the three original packs are considered and counted for and used up, now we consider that the full set of the G1, the G2 and the G3, loose pmtics in the transition zones and F1, create an overall **integrated** independent Magnetic field and gravitational field of their own to keep the integrate of all pmtics of the three Packs A, B and C, together as on entity. Where this new entity becomes to be known as the "Initial Fundamental Plasma".

Initial Fundamental Plasma

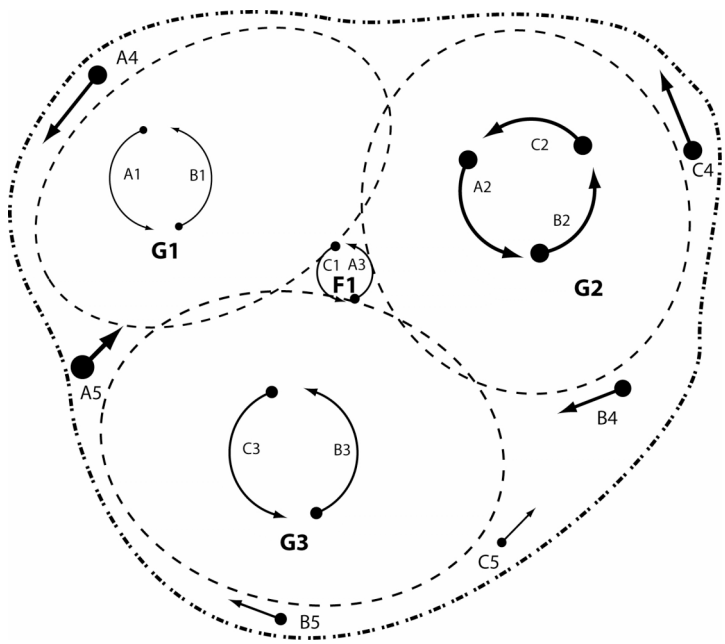

Fig. 20: Keshe Model of the Initial fundamental plasma.

I call this dynamic concept the **Keshe Model of *"The Universal order of creation of Matter"***.

We consider the Initial Fundamental Plasma to be similar to **the construction of the Neutron** (Fig. 20).

Figure 21 gives the conceptual presentation of complete plasmatic magnetic fields of plasma, of "**The universal order of creation of Matters**". This model represents the pmtics structure of the **Initial Fundamental Plasma**, where the G1 is the Magravs of Matter, the G2 is the Magravs of the Antimatter and the G3 is the Magravs of the Dark Matter.

It is considered that Initial Fundamental Plasmas always have an internally balanced magnetic fields environment, as one observes in the plasma as in the solar systems.

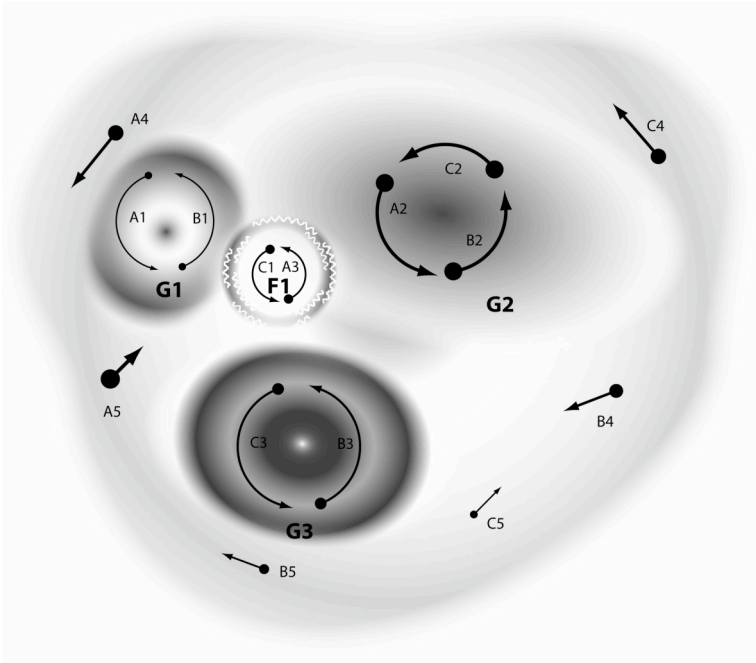

Fig. 21: Keshe Model of the pmtics of Matters of plasma.

At the same time initial fundamental plasma maintains an overall and external Magravs created by Matters and all pmtics, which are within the confine of the plasma too. Thus the internal balance magnetic fields of the neutron does not mean that it does not possess Magravs in respect to its outside environment. But due to the existence of Magravs of its component structure the initial fundamental plasma maintains an independent magnetosphere in respect to its surrounding environment.

When, contemplating on discussing about the proton or the neutron as a plasma, one has to talk about the whole of the plasmas' components, namely, the *Matter* part (what has been considered as the matter part of the nucleus of the atom), the *Antimatter* part, the *Dark Matter* part, the *spherical torus magnetic fields* and the *transition magnetic fields parts.* These are all together ***the components of one plasma*** and have to be considered as one package and entity.

There cannot be a plasma condition, where all three Matters do not participate in the existence of the plasma.

Decay of initial fundamental plasma

At the point in the cycle of the life of an initial fundamental plasma, when the shared magnetic fields of the transition zones, or pmtics of one of the Matters of plasma are partly exhausted and the Magravs balance among or in the Matter fields are disturbed and the Magravs binding forces are unbalanced, then the initial fundamental plasma disintegrates to its substructure of new balanced Magravs of the same Matters for the initial fundamental plasma to find a new balanced combination within its own Matters and fields within their given environment.

This process of splitting of the initial fundamental plasma to find new and smaller balanced plasmas for Magravs of Matters and fields balance, I call this process the **decay of the Initial fundamental plasma.**

The decay of the initial fundamental plasma always leads to the creation of at least two new balanced and smaller initial plasmatic magnetic fields plasmas of the same configuration, with, one plasma which possess more of the Matters and is larger, and one plasma which is a smaller and holds less of the Matters and pmtics of the original initial fundamental plasma. Nevertheless, the two new plasmas and their contents have to keep the overall balanced structure of the initial fundamental plasma. This happens so that both plasmas can survive within their environment as one entity.

The outcome of the **decay** of the **initial fundamental plasma** into two new components is considered to become the creator of the new ***proton*** and the ***electron*** of an atom. This new balanced pmtics entity, or so-called atom; itself has to have an overall balanced Magravs forces operating within it, for the atom to keep the integrity of the original initial fundamental plasma.

The decay of the initial fundamental plasma leads to the splitting of its content into a proton and an electron simultaneously (Fig. 46 diagrams 1 to 8). Nevertheless, at the same time as the new plasmas' component reposition and rebalance during this process of decay, this leads to the release of some residual pmtics or magnetic fields, which are not needed for or by the two new entities for their respective parts of their Magravs positioning (Chapter 18).

The release of the unwanted fields for the balance interaction between the two new plasmas, leads to the release of the magnetic fields packs as different rays or energies from the splitting of the initial fundamental plasma. This release can be in any form like a mixture of rays, pmtics, sound energy packs and so on.

I consider this ***process of the decay*** of the initial fundamental plasma of the contents of its three Matters and fields to be a **new** fundamental universal principle, where in larger scales of order of magnitude; it is called the nuclear decay of atoms.

In science at the present, scientists consider that elementary particles are quarks and so on, but now we know that ***quarks*** *themselves are further* ***made-up of basic magnetic fields and their interactions***. Where, ***collections*** of magnetic fields in a group, as dynamic plasmatic magnetic fields, and their interactions with other dynamic plasmatic magnetic fields, leads to the creation of the Matter(s). Where, the mass of the "quark" is produced by the interaction of these plasmatic magnetic fields through the principle of the creation of gravity as has been explained in Chapter 1.

Secondly, what is at the present called the spin of the quarks now we understand is the natural dynamic motion of the Matters created in the plasmas' environment, through the interaction and Magravs positioning of the dynamic Matters of the plasma.

Thirdly, what is considered by the present science, as the *colours of the quarks*, are in reality the different contents, of different plasmatic magnetic fields strength interactions leading to the creation of gravity and Magnetic fields with their overall interaction

effect in respect to their environment pmtics, which leads to the creation of the magnetosphere of each Matter of the plasma, these being the magnetosphere of the Matter, the Dark Matter and the Antimatter in the magnetic environment of the plasma or the neutron, the proton or the electron.

This means that the quark cannot be considered as an "elementary particle" as it has sub-components and is made of magnetic fields itself.

Thus, ***I consider the new "elementary particle" to be of the "magnetic fields" origin,*** which this itself explains why one sees all sorts of effects, like the present quarks, bosons and the spin of the dynamic Matters of the plasma, and so forth. Where, these all can now simply be explained as being due to the interaction of different magnetic fields strengths, which makes up the structure of the Matters of the plasma and the other magnetic fields, which are within the structure of the plasma.

Even in the largest scale, this initial fundamental plasma decay model is what cosmologists see in the galaxies as the collapse of stars (which the star is and can be considered to be the initial fundamental plasma) and its re-emergence as new smaller components of star or solar systems. By the same principle, the release of energies for the star to find its new balance through its star decay always leads to releases of vast amounts of unwanted matters, Matters and energies and creation of sub-components but still with its Magravs forces.

This decay of initial fundamental plasma is discussed in more detail in Chapter 15.

CHAPTER 4

Matters' of plasma and their transition of states

There is conclusive evidence to show that plasma possesses energy, and maintains specific magnetic behaviour, and that plasmas can and do generate their own Magnetic fields and gravitational field forces.

Research done by a number of institutes around the world indicates that the plasma of Matter is accompanied by a second Matter constituent called the Antimatter. Some institutes (6, 7, 8) claim that they have separated and have managed to contain the Antimatter.

In other sections of science, scientists refer to what is called the **Dark Matter**, and observations of virtual matters.

The world of science has failed to consider the creation of all these three states' of Matters (Matter, Antimatter and Dark Matter) as constituents, and as of one process, in the chain of initial progressive process of creation of the three Matters and as the content of one plasma in the universe.

This failure has been due to the lack of understanding that the Matter, the Antimatter and the Dark Matter components of plasmas are all created simultaneously and as one integrated dynamic plasmatic magnetic entity.

It is fundamental to understand that one of these Matters' does not exist without the others within the overall structure of the plasma. Then through this process, it becomes easier to understand the operation of Matters, matter and fields, plasmas, atoms, molecules, solar systems and galaxies.

One can now translate this new understanding of how plasmas are created and operate into how larger celestial objects are created, and operate in their given environment collectively. In other words, we translate the knowledge of the operation of electrons around the nucleus to the operation of planets around their stars.

To understand the relationship and construction of the plasma with more clarity, every effort in this book have been made to go through stage by stage, how **Matters** of plasmas are considered to be connected, and *appear* **to inter-transit from one state of Matter to another** within different environments without loss or gain of any of their plasmatic magnetic fields strength.

In the matter world this is like the inter-change between states of matters, from solid-to-liquid, liquid-to-gas, and vise-versa.

Where in the matter world the ***state-of-matter*** is *magnetic fields'* **forces** dependent, and in the ***state-of-Matter*** it is *magnetic fields'* **strength** dependent.

The phenomenon of transition from one state of Matter to another is a regular occurrence in dynamic pmtics processes in the spans of the universe (Fig. 21).

All components of Matters of the plasma or any Matter or matters in the universe are connected to each other through the interaction of their pmtics, and their pmtics strength, which are the constituent and the creator of their Magravs.

Thus, as each Matter gains or losses some of its pmtics, one Matter component of the plasma will become or can become the component of another Matter of another plasma or field at "a given point in motion of pmtics" (time) and at a given point in its space.

For example, Matters of plasma can interchange from one Matter to another due to their motion of dynamic pmtics or what is called energy levels changes in respect to a given environment pmtics strength.

All Matters can appear as different Matter by just changes of the environmental pmtics strength too. For example the same plasma or Matter by just passing through another region of different pmtics strength. This is the process what we call *transmutation*, but in this case the transmutation is done by the environmental condition and not by the internal Matter pmtics strength change.

Matter can appear as different Matter, for example Dark Matter can appears as Matter by *simply entering into a new pmtics environmental condition*. This is how Dark Matter suddenly appears as virtual matter.

For example, **Dark Matter** in a given environment of plasmatic magnetic fields strength by entering into a new and stronger or weaker pmtics strength configuration, instantaneously, becomes **visible Matter** in respect to its newly entered environment (Dark Matter to Virtual matter). I call this the ***phase of transmutation of Matter(s)***, so this is the unveiling or occurrence of a new state of Matter from the same old Matter in a different outfit.

Secondly, Matters can change their status and behaviour from Matter to another for example from Dark Matter to Antimatter or Matter, by simply ***gaining from*** or ***losing to*** a part of their plasmatic magnetic fields strength to other Matter(s) or pmtics in respect to their given environment.

If Antimatter Magravs strength reaches an environment pmtics strength that its overall Magravs strength becomes equal and in balance with its new environment pmtics strength level, then the Antimatter can become and behave as the Dark Matter entity in respect to its new given environment (Fig. 22).

On the other hand, for example as the pmtics strength of the components of Antimatter reduces or as Antimatters interact with other Antimatters of different Magravs strength, these Antimatters lose enough of their Magravs strength that one or both Antimatters come to a new balance of plasmatic magnetic fields strength. Where, these balances can be in their internal and external Magravs, then these Antimatters Magravs strength can

come to a level that the new strength of the former Antimatter become to be in the pmtics strength level of the Matter, or change to the Dark Matter field strength level status in respect to the same environmental condition.

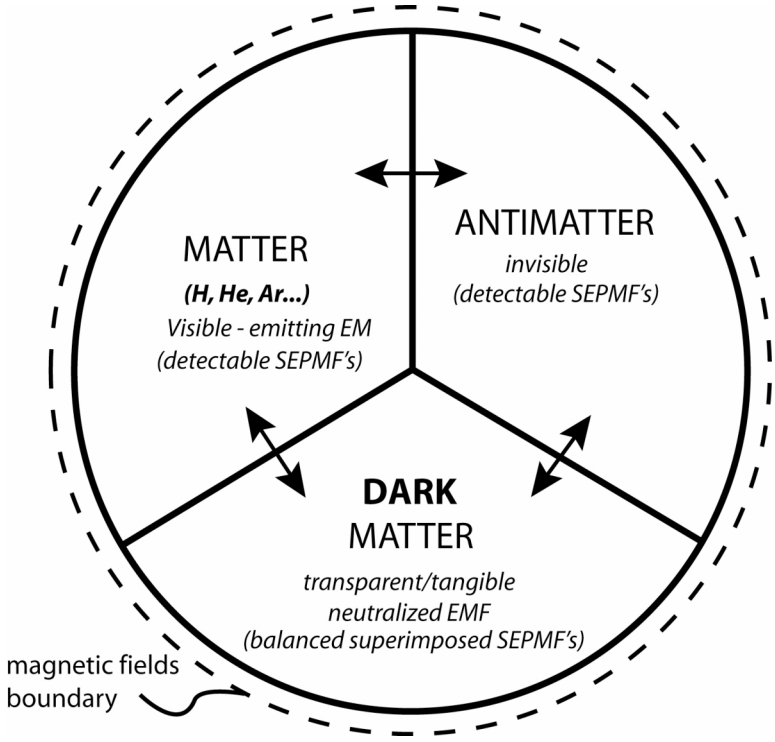

Fig. 22: Schematic Keshe model of interconnection relation between different states of Matters.

This is what we call the ***Keshe Theory and principle of the transition of Matters***, that is to say "***the transition from the Matter to the Antimatter or the Dark Matter and in reverse, and the transition of the Dark Matter to the Antimatter and in reverse, is a normal condition of transition of the Matters"*** (Fig. 22 and Fig. 23). These figures showing in a simple and new way how and the connections by which interchange(s) between the states of Matters in the universe are achieved.

Keshe principle of transition of the Matter states' that, "the plasmatic magnetic fields strength of the environment in which the Matters operate in, ***dictates*** what the Matter appears as or presents itself as, in that given environment" or on the other hand "when one Matter gains or losses enough of its plasmatic magnetic fields strength that the Matter Status, characteristic or behaviour becomes of other Matters of the plasma status and behaviour or characteristics within the same given environment".

Therefore, Matters can change from one Matter to another by increase or decrease in their pmtics strength or they can appear as different Matter as they enter different plasmatic strength environment and conditions.

That is to say, the Matter can become to have the characteristic of the Dark Matter in a given environment pmtics strength, and by the same measure, the Antimatter can lose enough of its pmtics to become Matter, and so one. The schematic transitions of state of

the Matters are shown in figure 22 and figure 23 of the ***Keshe model of transition of Matters.***

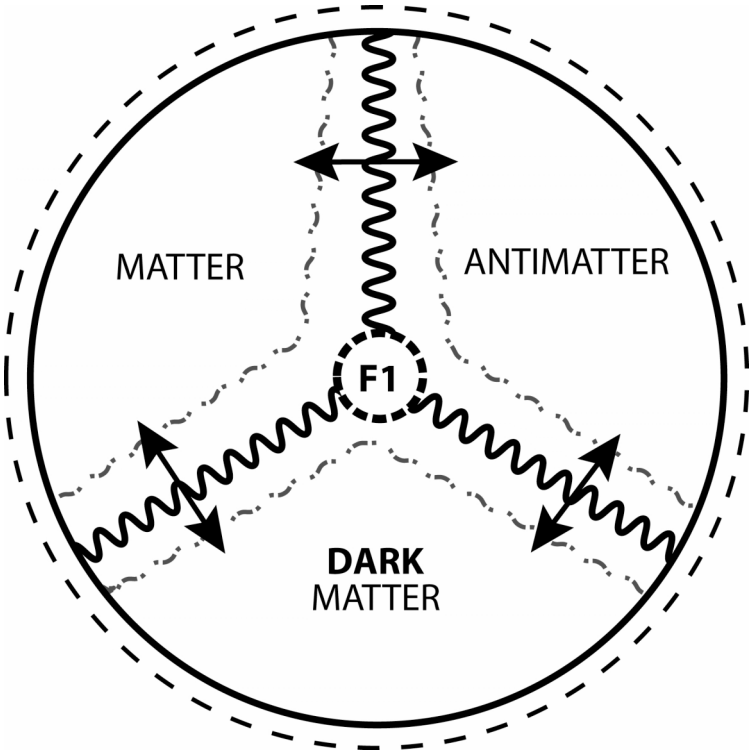

Fig. 23: Keshe universal Model of the plasma transition of plasmatic magnetic fields and Matters.

With the use of simple pmtics plasma dilution reactors, which have been developed by Keshe Foundation through its Keshe Technology development sector, the principle of transition of Matters have been tested and results have proven to be in line with the theoretical consideration.

Where, in these nuclear-based reactors, Matters can be allowed to go from one state of Matter to another and then allowed to return to their original state of Matter. This new method of transition of Matters brings about a new way and technology of producing all man's material needs for motion, energy, creation of new matters and so on.

For example, effects and properties of transition of Matters (Fig. 23) can be used to make physical Matter to have no magnetospheric boundary as Dark Matters do in a given environment, so that the Matter behaves like the Dark Matter in characteristics. In these environments, the Matter will become translucent dark or the centre core behaves as becoming invisible in respect to its surrounding environment, without any change in the property of the physical Matter or change in its gravitational field strength or position in space of the Matter.

As the Matter with this property presents no effective magnetospheric condition in respect to its surrounding environment due to the lack of /or little interaction between the pmtics of the Matter and its environment, then the Matter now can behave as Dark

Matter and move without friction and freely within the same environment.

Utilizing this state of the Dark Matter effects around an aircraft or spacecraft, this condition will give the craft frictionless motion and higher speeds and possible invisibility in the same environment (Chapters 13).

The technology of transition of Matters has been tested-out over years by the Keshe Foundation, and several systems were designed, developed and manufactured and used to achieve the formation of original magnetic fields plasmas to prove the correctness of these principles, and indeed the effect of transition of Matters were proven to be correct.

The implication and application of the use of transition of the states of Matters are so immense and profound, that one needs to know, for example, where the Matter will end-up in, and in what state of Matter in respect to its environment, one will appear as.

That is to say, one has to know if for example, going from Matter to Antimatter, where in the strength fields of Antimatter, one will end-up in. Vice-versa, when one can go from Dark Matter into a Matter condition zone, one has to know in what state of matter (gas, solid, and liquid) one will come to ends up in.

Through the operation and control of these reactors, one needs to know where the system state of matter and magnetic condition will end-up. This could be in liquid seas, or in the middle of a solid Matter or in the middle of deserts. Without being prepared for these parameters through the operation of systems, which can facilitate such a transition behaviour and characteristic, the use of Matter transition can have catastrophic consequence, not only for the system, which produces it, but also for the occupants of possible crafts using this type of transportation in the spans of the universe.

By the understanding of the principles of creation of the initial fundamental Matters within the initial fundamental plasma, through the interaction of the initial fundamental particles, a number of unanswered questions in the world of science can be answered.

For example, in the universe the total quantity of plasmatic magnetic fields and the related energies are to be considered ***constant***. Therefore, *in the* ***totality***, no matter, Matters or magnetic fields will ever be lost or gained in the universe. Pmtics of different strength start existence at one strength level and they consolidate to become stronger, or lose their field strength through division and collision to become weaker in strength. Nevertheless, pmtics in their different strength fields can never be destroyed or lost.

Therefore, pmtics simply interact, divide, and interlock to produce different Matters and conditions like forces, motions, heat and compactness for them to be matters to be visible to the eye of creatures, according to their positions, and so on.

Pmtics in their interactions with others of the same can only move from one state of Matter to another depending upon the condition(s), which prevails at a given point in a given time in space. Thus, the Matter can go from the Dark Matter to the Antimatter and vice-versa, and the Matters to the Dark Matters and vice-versa and so on.

Therefore, the theory and the discussion that universe one day will run out of matters and energy and then there will be nothing as has been promoted by some scientists in the recent past is anything but a fallacy.

By the same principle, we call the **pmtics in motion as** the **energy** of the pmtics**.** These pmtics in motion can release and can lead to creation of the same Matters as they were created-out of, and can have the same capability. That is to say, for example, the energy of the Dark Matter can change into energy of Matter, or part of the matter, and the same applies for other states of Matters.

In understanding, the principles of "**the universal order of creation of Matters**", one can utilise the transition of states of Matters and matters to take full advantage of universal Matters and matters pmtics and their energies.

Through the permanent interaction of all dynamic pmtics of different scales of strength, there will be no end to the universe, as the universe moves through its different pmtics strengths field interactions and repulsions. Where, these will lead to eternal motion of the universal pmtics forces and creation of new Matters, matters, forces and new condition for them to cooperate within the universe. Thus, there never has been a Big Bang and there will never be a doomsday scenario for the universe as a whole, the universe will be forever in equilibrium in its overall universal order of pmtics.

The pmtics of Matters will ***transit*** from one state of **Matter** (Matter, Dark Matter, and Antimatter) to another state of **Matter**. In addition, from one state of **matter** (solid, liquid, gas) to another state of **matter.**

Where, these changes will depend on the properties and forces of the states of plasmatic Magravs and their strength in respect to each other. Similarly, pmtics from strength of fields of Matter will transit to pmtics of different pmtics strength of Matter, in these ***processes of transition***, plasma releasing dynamic pmtics in motion as **energy**.

The real size of the universe will never change; that is to say, the universe cannot expand into a space if the space for its expansion was not there to begin with. Where, from our point of view we only observe a small fraction of the whole, which we observe that fraction expanding. The observed expansion is relative to the position of the observer in respect to a given position in the universe, for example what will be a red shift observation of one at one end of the universe, this will be blue shift to an observer on the opposite direction of the motion of the same entity. In the paper titled "Creation of magnetic fields" it has been explained that the ***blue shift of light*** is created when ***pmtics are compressed***, and the ***red shift is created*** when the ***pmtics move away*** from each other, or ***when pmtics are opened up***.

In the real world of the universal order of creation there is no room for the principle of singularity. Except, if, we would call, a large pmtics, that covered the whole of the universe singularly by itself. Then all that has happened, is that the original single plasma has gradually disintegrated to smaller and weaker strength fields, which their interaction has lead to the creation of what has been seen and is in the present in the short time of the life of man on the Earth. Then, such original singular plasma, which

covered the whole of the universe, had to gradually to disintegrate to smaller strength fields, which their interactions have lead to the creation of all events, Matters and matters in the Universe.

The transition of state of Matters principles will be discussed in full in future disclosures.

CHAPTER 5

Definition of Energy Through pmtics

The initial components and construction of plasma are due to the existence of initial dynamic plasmatic magnetic fields.

For a magnetic field to be able to be detected or its existence to be confirmed, the pmtics has to *leave the confines of the boundaries* of its containments, this being the boundary of Magravs of the Matter or the plasma.

It is important to keep in mind that the pmtics do not possess or show **field force** unless they are in motion.

The energy possessed by a plasma can be define as "the total plasmatic magnetic fields forces of all its constituent Matters *and fields in motion,* in respect to the original position of the plasma in a full three hundred and sixty degree spherical direction''.

This is an important factor, as up to this point, scientists have measured and calculated the energy of the Matter component of the Matters of the plasma. Where, in calculating the true energy of the plasma, *one has to calculate the energy of* ***all Matters*** (Matter, Antimatter and Dark Matter) and the other components of the dynamic plasma.

When the magnetic field has left the Matters' or the plasmas' boundary, at this point its existence and the content of the pmtics strength of all Matters pmtics' released can then be confirmed as energy. This is shown in (Fig. 24), the magnetic fields in the Matters.

The pmtics constituent constructions of individuals Matters of plasma are not energies in respect to other Matters while they are within the boundary of the plasmas Magravs' forces. These are shown as the magnetic fields inside the Matters on the left of image (Fig. 24) but are *only forces* (these being the like of Magnetic field or gravitational field forces) in respect to other Matters and pmtics.

When the field leaves the environment of its Matter or the plasma, it is at this point that it can release its domain pmtics to other plasmas in regions or combinations of field interaction zones. These are shown as field forces A at the boundary of the plasma in figure 24.

As the plasmatic magnetic fields, moves further from its original plasmas' boundary (field B in Fig. 24), the plasmatic magnetic fields uses' its energy to overcome other Magravs in its environment. Hence, as the plasmatic magnetic fields moves further away from its mother plasma, the less energy it will have to transfer to other plasmas as it comes into contact with their pmtics.

Thus, energy transfers from one Matter to another Matter through one pmtics strength and the measure of the pmtics possessed at the point of the contact with the second Matter, this is position and distance dependent, from the point of departure to the point

of arrival.

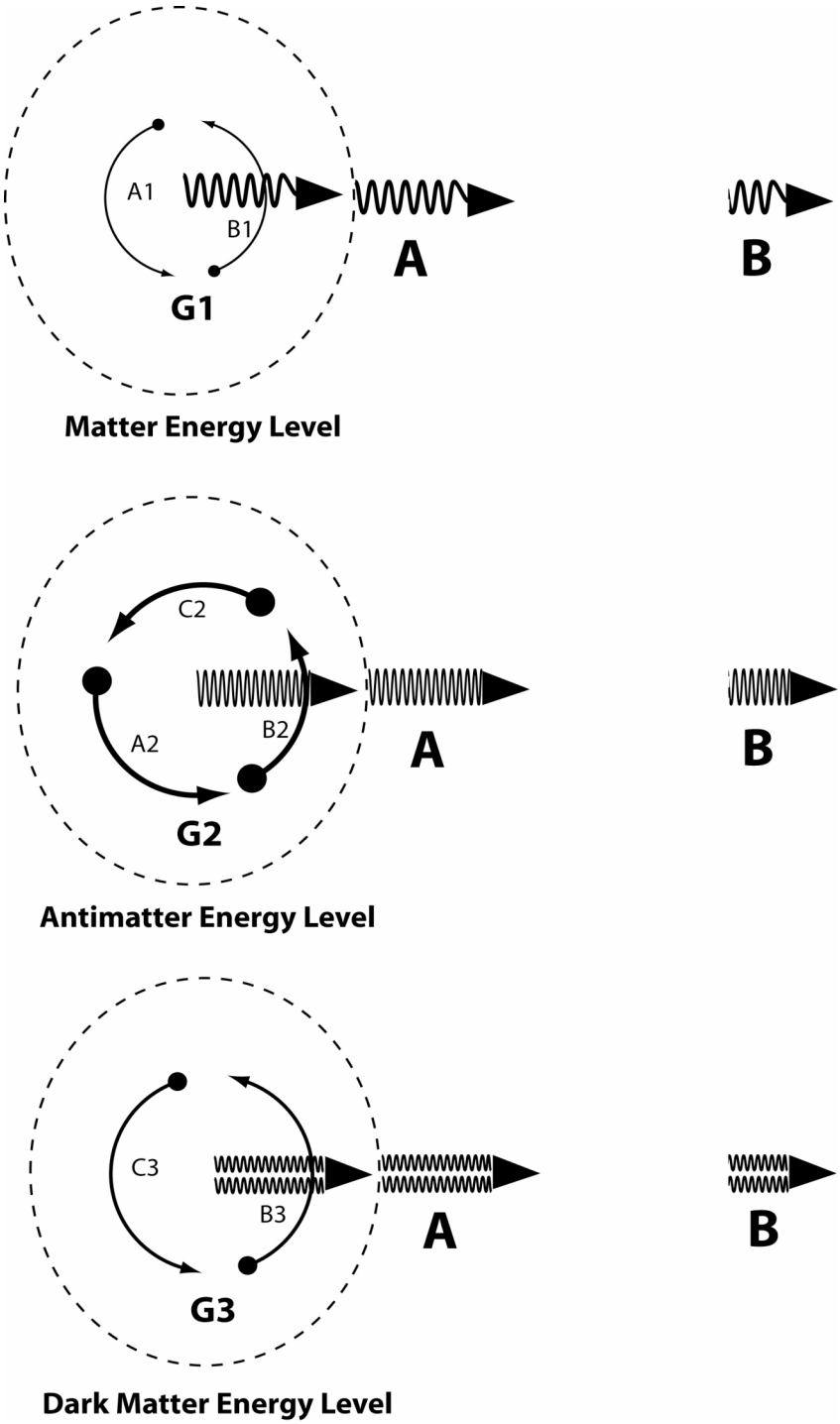

Fig. 24: Schematic presentation of relationship of pmtics and energy in respect to their Matters.

The total Energy released by the Matter or plasma is the total of pmtics forces that the plasma can release and transfer, and that and what measure of the pmtics can be absorbed by all components of other plasmas in its environment.

That is to say, the same proportion of magnetic fields forces by Matter, Antimatter and Dark Matter and other fields of plasma are released and the same proportion of all energy fields are transferred to the all recipient plasmas and Matters and pmtics.

The total energy of Matter is said to be the total pmtics that Matter can release as it disentangles all the components of its **initial fundamental magnetic fields**, or what is known as its' "**initial fundamental particles**", which the plasma and of the Matters of plasma were made up of, at the point of their inception.

Thus energies released by the plasma or the total energy possessed by the plasma is in fact, the total collection of initial fundamental magnetic fields of all the component constituents of the plasma, which disentangles from their Matters or plasmas and are in motion in the direction of the encountering other pmtics components.

Pmtics absorbed by some plasma's can be only a part of the total pmtics in motion, or energies that have been released by the initial fundamental plasma, and are not necessarily considered to be the total energies that a plasma possessed or has released.

Energies released by plasma are said to be "**the total initial fundamental pmtics released by all components of that plasma" passing its Magravs boundary.**

Multi-plasma atoms' release more plasmatic magnetic fields, due to their total sum of the plasmatic magnetic fields released by all their participating plasmas (protons plus neutrons, and electrons).

The principles of creation of Magravs forces, gives us an insight that "**energy**" can simply be defined as "pmtics, once released, through the dynamic Magravs characteristic boundary from the plasma or Matters, that these released pmtics can ***exert or pass a part of their released pmtics to another plasma,*** for the new Matter or plasma to maintain its existence and/or maintain constant normal magnetic fields strength and/or increase its magnetic density of the same pmtics strength condition to their ground base levels, in their given environment" (Fig. 24).

Measure of a mass

One of the central unsolved questions in the world of physics is how the mass of the Matters or of matters are created, and how they can be calculated.

Through the ***Keshe theory of Mass***, the creation and the measure of the mass of an entity can be defined to be:

"Due to the interaction of at least two magnetic rays, magnetic fields, or plasmatic magnetic fields, which the outcome of their interactions leads to and creates two field forces of a ***pulling*** field forces called *the gravitational fields force* and a ***pushing*** field force called *Magnetic fields force*, whereby the interaction of the gravitational and the Magnetic field forces with each other, this interaction of two field leads to the creation of a given magnetic fields strength **balance** between the two field forces, where, the

measure of the magnetic fields difference of the interaction of these two field forces of the gravitational and the Magnetic field forces, is the measure of the Mass of the entity which the two original magnetic fields have created."

The outcome of the interaction of the fields balance is creation of the mass of the Matter, components' of the plasma (Fig. 25), or mass of the matter (solid, liquid or gas).

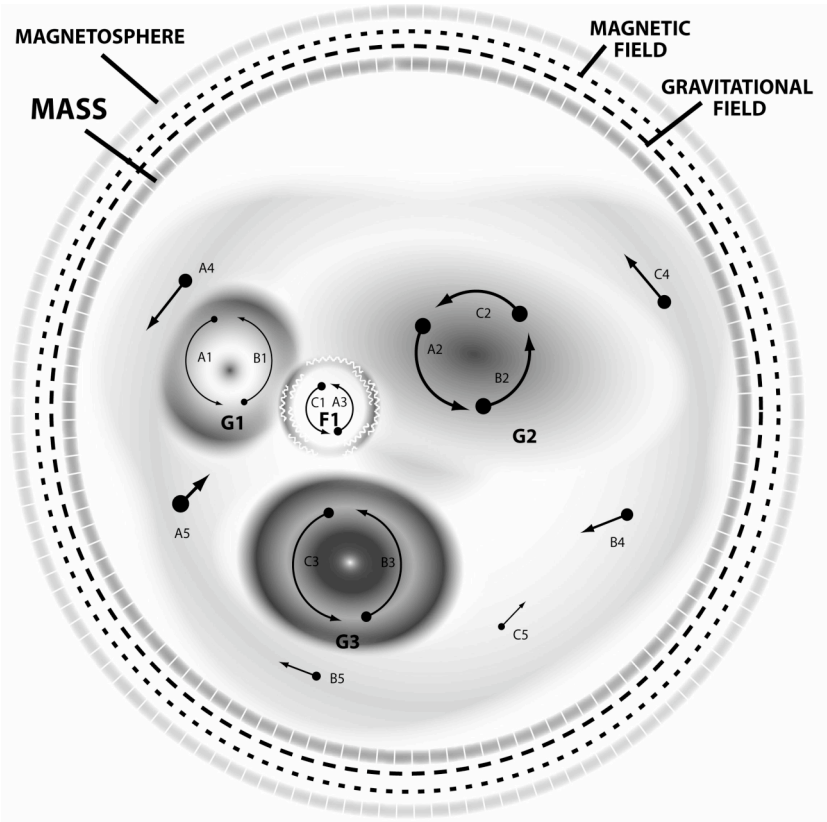

Fig. 25: Mass

That is to say by the ***Keshe law of measure of the mass*** of any entity, this being Matter, plasma, atom, matter, planet, star, etc states that:

" **M**ass of any entity =

M*easure of the total gravitational fields strength forces of the entity*

- (minus)

M*easure of the total Magnetic fields strength forces of the entity*"

Through this definition and understanding it becomes clear that the gravitational field forces are always predominate and stronger as all entities possess mass, otherwise their mass would be negative.

Thus ***mass*** *is the measure of the* ***difference between two or more magnetic fields after their interaction***, and **NOT** the measure of strength **before interaction**.

Where, the measure of the magnetic fields *before interaction* is their "forces" of their fields, and *after the interaction* of the magnetic fields the outcome of the balance between the gravitational and Magnetic fields that is generated, becomes the mass in respect to a given fixed position of the central Magravs.

The creation of Magravs always is accompanied by the creation of a ***Magnetosphere*** and the creation of the mass of any entity in the universe, and all these four forces are created instantaneously and simultaneously.

That is to say, "the **Initial Fundamental four forces** of existence of an entity that are, the ***Magnetic fields***, the ***Gravitational fields***, the ***Magnetosphere field*** and the ***Mass field*** forces, are *all the outcome of the interaction and interlocking of two or more mainly matching in strength magnetic field*s or plasmatic magnetic fields, irrespective of the size of the entity, this being Matter, matter, an atom or a star.

This is the reason why the mass of any object, which is created by any two magnetic fields strength, is *independent of any external forces and factors*, like gravitational fields forces of other objects or entities. The instance the two magnetic rays or magnetic fields interlock, to generate the first Gravitational fields as an entity, at that moment the span of the Magravs of the two fields forces involved in the original fields are not as individual fields, but they become an *independent entity* in respect to their environments' fields forces. That is the reason why the **Mass of any entity**, like the Matters, are *constant and independent and irrespective of the environmental Magravs forces* which the entity exists and operates within.

That is the reason why the Mass of spacecrafts of the future, or the Mass of planets like the Earth are independent of their environmental conditions. That is to say, the **strength** of the interaction of the two **original** magnetic fields and the span of the fields they produces that created the Magravs *decide how much mass the interaction of the two fields will carry* and no other factors.

This is the reason why, Man will be able to make crafts that can carry any payload by the use of Grapos nuclear reactors Magravs strength, as the payload of these systems and the strength of Magravs that these systems generate, creates independent environment Magravs forces *as long as the boundary of the magnetosphere of the Grapos can cover the physical boundary of these crafts*. Figure 25, in its design, explains' this concept fully. That is why the two magnetic fields have to be equal in strength before they can create the initial four field forces.

If two unequal magnetic fields in strength interact, the two create the gravitational, the Magnetic, the magnetosphere and the Mass, and the lowest strength field, which dictates the maximum level of the strength of the four fields that the Matter can have. The stronger magnetic field residuals of these types of unequal magnetic field strength encounters and creation of matters become the ***tail*** **magnetic field of the entity**, and

this tail is the cause of the creation of the coiling effect of these kinds of masses. Where and if the two unequal magnetic fields strength ***cannot*** create a mass, the same interaction leads to the creation of the coiling of the two fields and to what is known as the ***coiling of the magnetic fields***, this effect is partially the cause of the *swirling of the F1* torus field zones in the plasmas, and its larger counterpart, the rotation of Wormholes, as these regions in the universe are created out of unbalance Magnetic field strength interactions and interlocking, this be it in the plasma or in the universe. In so many ways in knowing the strength of two magnetic rays, magnetic fields, plasmatic magnetic fields and so on, which are about to interact and to create the initial Magnetic and gravitational fields of an entity, one can tell what would be the outcome measure of the mass of the entity they will create.

Einstein has related the mass of matter to its energy through the general equation of relativity.

As explained above, the mass of an atom or plasma itself is made of a collection of dense pmtics strength and their interaction with each other.

Thus initial fundamental plasmas always have the same mass irrespective of the Magravs of their environment.

By the same measure, the Atoms of the same elements are always made of the same number of initial plasmatic magnetic field's sub-components, of neutrons, protons and electrons.

Atoms of the same elements always have the same total plasmatic magnetic gravitational fields **pull** and Magnetic field **push** in respect to all their internal components, irrespective of the environmental plasmatic Magravs that the atoms might be in. This becomes the total mass of an atom, as mass is an expression of measurement of the total enclosed pmtics interaction within the fields of confinement of the plasma.

In considering the general equation of relativity

$$E = m \cdot c^2$$

The energy for the mass of Matters of the plasma, accordingly will be

$$E = m(M) \cdot c^2$$

That is to say "the total pmtics released in motion by the Matter of plasma (once they have left the boundary of the plasma) (Energy), is equal to, the total balance after interacting pmtics strength of the Matter components of the plasma (Mass) which the plasma is made of, multiplied by the square of the maximum speed that pmtics can travel in the matter environment (speed of light)".

Considering that, pmtics of different strength can travel different distance from their point of release with ***different speeds*** in *different Matters,* Matter *and* matter mediums.

Then it is correct to say that the pmtics of the Matter, once it has left the Matter

Magravs of the plasma, this pmtics of the Matter will travel with a different speed than the plasmatic magnetic fields of the Antimatter of the same plasma, or be it the pmtics of the Dark Matter component of the same plasma, in the matter environment.

The Antimatter has and is made of different pmtics strengths, by virtue that it has been created initially by stronger fields, then its speed will be different and higher than that of the pmtics of its Matter component of the same plasma in the same environment.

By the same principle, the faster field of the Antimatter carry more energy or more powerful energies than the slower pmtics in motion of the Matter component of the same of plasma.

Alternatively, in reverse, as the Antimatter possesses more power or energy than the Matter, then for the same volume of Antimatter as Matter in the plasma; the Antimatter pmtics must move faster than the pmtics' of the Matter, in the matter medium.

The Fermi National Accelerator Laboratory - or Fermilab, in USA (6, 7) - considers a small amount of the Antimatter, once released from the Matter of plasma; it can deliver more energy than its Matter parts of the same plasma. They are considering and working on the principle as; they can burn the Antimatter to release its energy so that by the time the Antimatter reaches the state of matter energy, that they can harvest its surpluses energy.

Through the ***Keshe principle of conversion of energy***, the fundamental universal conversion principle follows the path that the Matters convert to matters through their **dynamic pmtics in motion and forces,** or what is refer to as the **energy of the Matter magnetic fields forces, as these energies are transferred to the constituent pmtics' of matter**.

From what I call "The fundamental ***universal conversion principle***" follows that "the pmtics of the Matters' like of Antimatter slow down, through interaction with other magnetic fields, so that their energy can be absorbed and converted to Matters' pmtics strength levels, that become useable in matter environment and appears as the matter (solid, liquid and gas)".

By the same principle, the matter can be converted to Antimatter through the same method in reverse. Where, these processes are not much different for both paths of conversions.

Only the state of pmtics strength and the effects of the environment, which dominates at a given point and at a given motional position (time), that will dictate what state the dynamic pmtics in which the state of Matters, the matter manifest itself as, and what matter will appears in the line of sight by given tools of detection at a given point in the universe. This dictates if pmtics strength will appear in state of matter as solid, liquid or gas, or will manifest itself in one of the state of Matters, as Matter, Dark Matter or Antimatter.

CHAPTER 6

The total energy balance equation of Plasma

The energy balance equation or general equation of relativity ($E = m.c^2$) gives the relation between the *tangible part* of Matter of the plasma and its constituent energy.

The mass of an atom or collection of plasmas of its components, themselves are made of a collection of densities of pmtics strength of different Matters and their interactions, in respect to each other within their respective initial fundamental plasma.

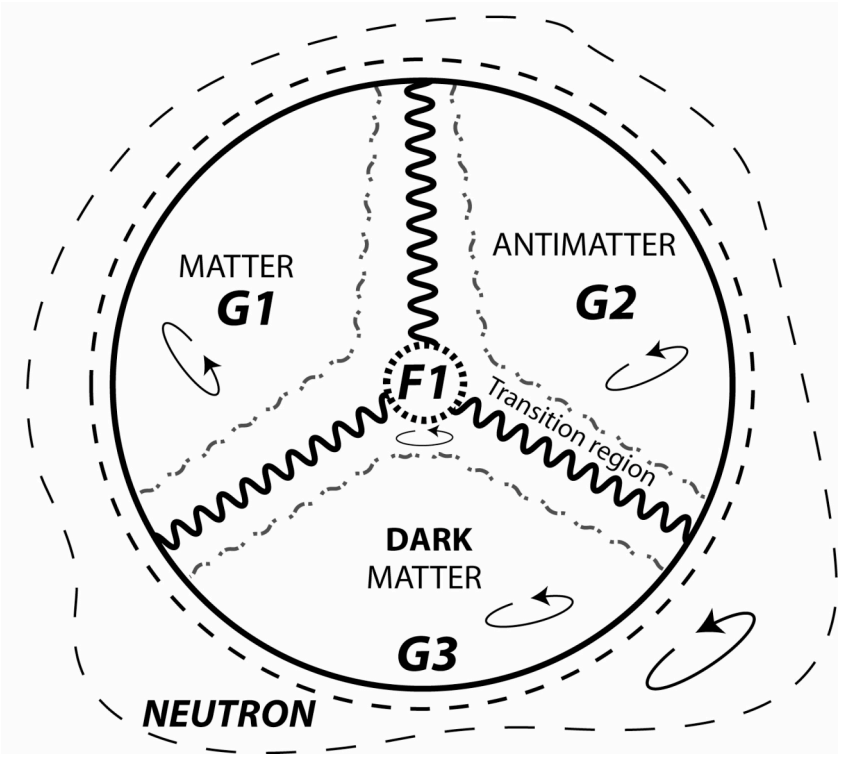

Fig. 26: Schematic of the fields of all components and of the initial fundamental plasma.

In considering the plasma, the general equation of relativity can be written in its real terms of its constituent components and their interactions and effects. Thus, this equation as has been said can be defined in respect to the Matter components of the plasma in the following manner.

That is to say "the total pmtics released in motion by the Matter of the plasma (once they have left the boundary of the plasma) (Energy), is equal to, the total balance after interacting pmtics strength of the Matter components of the plasma (Mass) which the plasma is made of, multiplied by the square of the maximum speed that pmtics can

travel *in the **matter** environment* (speed of light)".

Knowing the new composition of the plasma, then the ***total energy of the plasma*** has to be in its ***totality of all its masses of all its Matters*** and not just its Matter component.

Therefore:

K (the total energy of plasma) = [energy of the Matter + energy of the Antimatter + energy of the Dark Matter + energy of the spherical torus-shaped field force effect + the energy in the inter binding between the other parts in the transition zones of the plasma].

K= [E (Matter) + E (Antimatter) + E (Dark Matter) + Ecf (centre spherical torus pmtics) + Etr (pmtics within transition zones)].

Where, total general equation of relativity for the whole of the components of the plasma can be written in the following form.

$$\mathbf{K = EM + EAm + EDm + Ecf + Etr}$$

Or:

K = [(The total components of constituent pmtics of the **Matter**) x (the square of the **speed** of pmtics in the **Matter medium** or the speed of light) + (The total components of constituent pmtics of the Antimatter) x (the square of the **speed** of pmtics of the Antimatter in the Antimatter **medium**) + (The total components of constituent pmtics of the Dark Matter) x (the square of the **speed** of pmtics of the Dark Matter in the **Dark Matter medium**) + The total energy components of constituent pmtics of spherical torus-shaped field force effect + The total components of constituent pmtics of the inter binding between the four other parts in the transition zones of the plasma].

$$K=M\,(M)\,.\,c^2(M) + M\,(Am)\,.\,c^2\,(Am) + M\,(Dm)\,.\,c^2\,(Dm) + E(cf) + E(tr)$$

Note: Capital M indicates here a mass of Matter.

When for example an apple is measured using the present measuring tools and methods, the figure attained is only for the mass or the weight of the Matter part of all the plasmas' of atoms of the whole apple.

As a representation, one initial plasma of an atom in the whole construction of an **apple** with it's Matter, Antimatter, Dark Matter, and other pmtics are shown on the right hand side picture of figure 28. Where, the *tangible apple **as matter*** represents the total Matter components of all the pmtics of an apple is shown on the left picture of figure 28.

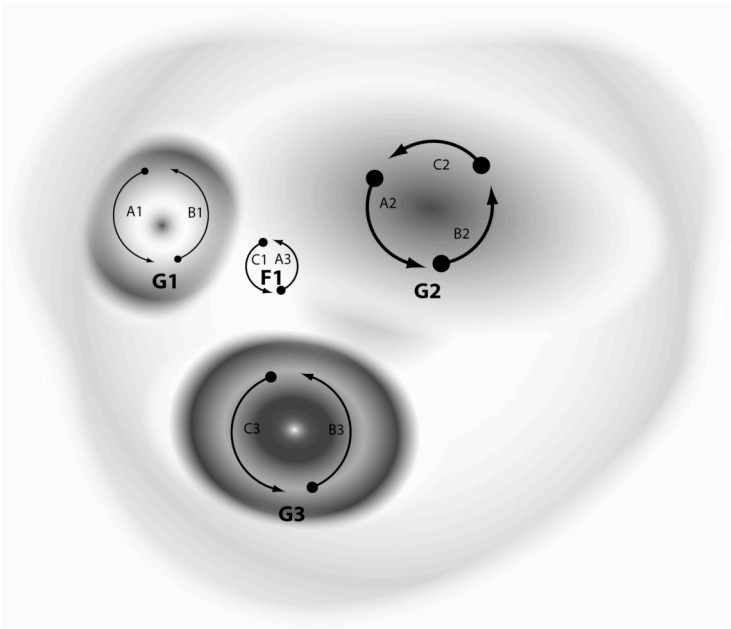

Fig. 27: The pmtics of all components and of initial fundamental plasma.

The total weight or mass of the plasma has to be the total weight and the total mass of all the components pmtics and all of all the plasmas of Matters of the initial fundamental plasma.

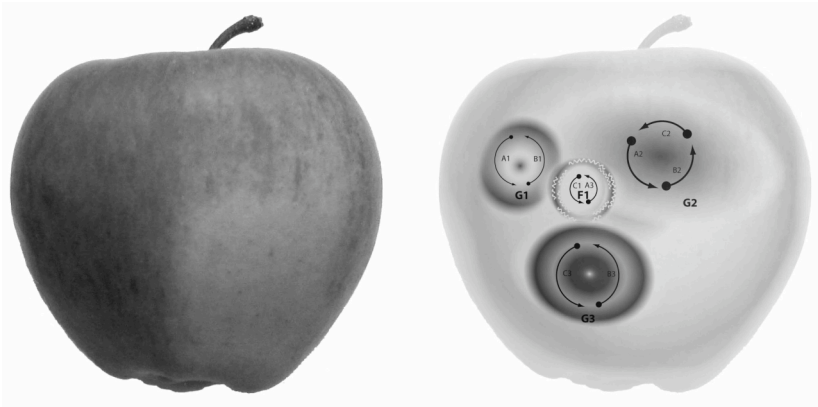

Fig. 28: Newton's apple has different types of pmtics and Matters.

Note: When the Matter is part of the plasma, this is denoted as ***Matter*** *(G1 in Fig. 26, Fig. 27 and Fig. 28) and when the same is considered as tangible matter, it is noted* ***as matter*** *(Apple in Fig. 28), of an atom or an object.*

By the same measure, if one has managed to separate the Antimatter of the plasma from its other constituents of the Matter and the Dark Matter of the plasma to confine the Antimatter in separate container as the Fermilab has claimed. The question to ask is that, what is the weight or the mass of the balanced leftovers of the Matters, (or Matter, Dark Matter and residual pmtics) of the plasma? By the laws of physics, one cannot have something (Matters/Energy) out of nothing. One cannot have mass of Antimatter component of the plasma, when its mass is not calculated in the overall mass of the

plasma, or the leftover mass of the Matter and the Dark Matter of the same plasma must be less than before the Antimatter was taken out.

On the other hand, the question is that, is the present used methods of measuring the weight and mass of the plasma, measuring the ***total mass*** of ***all*** *the Matters* of the plasma? Alternatively, does one has to break the present numbers of mass and weight of each Matter, up to its sub-weights and sub-mass of the Matter (Fig. 26 and Fig. 27 G1), the Antimatter (Fig. 26 and Fig. 27 G2) and the Dark Matter (Fig. 26 and Fig. 27 G3) of the plasma. Further, the Magravs of the Matters of the plasma in conjunction with their own Magravs and other pmtics in the plasma create their own additional gravitational and Magnetic field forces, their own additional mass, as well as the individual masses of the Matters of the plasma. Thus the total mass of the plasma has to be more than the total mass of individual Matters of the plasma.

As Fermilab has separated the Antimatter components of the plasma, then, the question to ask from them, is that, if the mass of the matter of the plasma they hold still has the same mass as before without the Antimatter in it? So, what is the mass or the weight of the Antimatter that has been separated?

This applies the same to the Dark Matter components of the initial fundamental plasma too.

As has been said before, the total weight or total mass of the plasma is and has to be the total weight and total mass of all components of the Matters of plasma. This includes the masses or energies of the magnetic fields force of the F1 and the residual fields in the initial fundamental plasma.

Thus, there is a *fundamental error* in the present methods and technologies of measuring the weight and the mass of the plasma systems as a whole.

That is why suddenly one can see strange results from the Antimatter component of the plasma of the same mass or weight in the matter environment.

If, the total dynamic pmtics of the initial fundamental plasma, would have been, measured correctly from the beginning, then there would have not been such an ambiguity and mystery arising from the sudden hidden energy sources called the Antimatter, or the powers of the Dark Matter of the plasma.

The fact is that, the Antimatter and the Dark Matter possess plasmatic Magravs forces and that is why, they are called the **Matters**, as they possess mass and energy.

Hence, if there is a gravitational field's force of the Antimatter or the Dark Matter components of the plasma, then these Antimatter and Dark Matter have to have mass and they have to have weight in respect to the other Matters in the plasma and in respect to their environments pmtics, which the plasma is in, at given time. Therefore one needs the measurement of both of the mass and the weight of the plasma as whole as an entity as well as all the individual masses of each Matter too.

Then, the same as with the atomic mass and atomic weight of an atom measurement

phenomenon of today's science, **there is a need for a new scale of measurements**, and new measuring tools to be brought about and developed for the true and total pmtics measurements of the constituent Matters and fields of the Initial fundamental plasma.

By this new total weight measurement, then the ambiguities in the present plasma physics and nuclear physics will be sorted.

That is to say then, where and when one gives the measure of the mass or the weight of the plasma, then at this point, one has to give the mass or the weight of the Matter, the Antimatter, the Dark Matter and the rest of components of the plasma in a given motional position, and the position in the life of the plasmas independently, for all components of the plasma, and one measurement for the plasma collectively as the whole needs to be given too.

The reason for stating the position and motions of the plasma is due to the fact that, the plasmas having dynamic characteristic components, plasma itself as a whole is a dynamic system too and continually gains or losses pmtics from or to its surrounding pmtics environment respectively. Therefore, the total pmtics of plasma, in different frame of motion (time), will be different, from one point to another in a given space.

In the future measurements, one has to be clear about all measurements of the Dark Matters as well as the Matter as well as the Antimatter components, as well as all magnetic field components, the likes of the F1 or maybe several F1 configurations in any given pmtics of the initial fundamental plasma. Therefore, there is a need for correct figures for the mass, the weight and the energy of the initial fundamental plasma, because such data are needed for in-depth research and developments of various kinds of applications in Magravs positioning systems using components of Matters of plasmas as the Matmags, for future space travel.

Another point to consider is the Matters environment in which the weight or mass of the plasma is carried out. That is if, this is carried-out in the Matter plasmatic magnetic fields, Antimatter pmtics strength, or Dark Matter pmtics strength environment.

Similarly, the plasmatic magnetic fields' strength in which the measurements are taken should be considered. This being, in what fields strength in the Matter, the Antimatter or the Dark Matter field strength or their respective pmtics energies measurements are taken place.

This is the true nature of the complexity of the relationship with the mass, weight, energy and their interactions in the world of Matters. These cannot be so simplified with one equation of relativity with three simple denotations, if in the future scientists strive to achieve the universal method of producing energy and motion.

The space travellers of the future will come truly to understand that a small error in the measurement of all matters and Matters components, the environmental magnetic plasmatic strength and so forth, can land them in strange and peculiar environments, which these were not planned for or expected. These small errors can end them up in new conditions and positions in the galaxies, which could be nice for experimental purposes, but not necessarily good for the health or the life of the passengers of these

future crafts using Matters *Magravs positioning systems* (Chapters 22 and 23).

It is possible that due to miss-calculations, one part of the systems of the future crafts, or even the reactors of crafts, which are creating the conditions for motion or energy, will experience different environmental and Matter conditions than the rest, of the craft or the reactor. As, for example, the same system can land in the border of two different pmtics strength environments, or, in a different plasmatic condition than was originally planned, because of the miscalculation of the Dark Matter Magravs strength.

A physical comparison of the two state of Matters can be for example, considering a cube of sugar, half-submerged in a hot liquid, like tea, where, half of matter of sugar is in the solution of the hot liquid and the other end of the cube being between the fingers of the dipper, in solid state.

Therefore, the question emerges, of how does or can one put the original components of the sugar cube together to get back to the first state of the solid cube, in its original solid state and shape.

The rearranging Matters through the understanding of the Matter energy balance will be the solutions for these kinds of mistakes.

The misunderstanding and potential pitfalls with space technology of the future will be with the miss-calculation of the loading of matters as the "Matmags", and the control in the reactors of crafts of the state of Matters transitions will be interesting.

Nevertheless, the travels and space ventures of the future through miss-calculation of energy balance and wrong Matter Matmags loading will not be without its problems and sorrows, as have been experienced in the short lifetime of the space explorations of today for men whom have dared to test the limits of space explorations.

Who dares, in the space traveller of future, may succeed to have a taste of the pleasure of the unseen in the universe! Our hope is that they come out of these journeys much wiser, but not necessarily less darer than before.

CHAPTER 7

The creation and speed of light

One of the possible ways that light in the universe is created can be through interaction of pmtics' of the plasmas. The speed of light is not considered to be the ultimate speed of Matters. We will discuss how, the interaction of pmtics of the flight systems using Magravs positioning reactors would lead to the creation of light around such a system in the atmospheric conditions like that of the Earth.

Understanding the basic structure of the initial fundamental plasmas, the rationale that the speed of light is the ultimate speed of travel of any Matter becomes questionable.

The phenomenon that the speed of light is the ultimate speed of travel of any Matter(s) or matter(s) is an assumption that has a clear flaw in its concept and cannot be correct for all states of Matters in the universe.

In the iron-based magnets of the solid state of matter, the magnetic fields flow is in one direction, out off the North Pole and their return through the opposite South Pole.

The question that needs to be asked is that, what is the ***speed of the flow*** of the magnetic fields force from one pole to another in solid state of matter?

For ease of understanding let us consider two packs of dynamic plasmatic magnetic fields strength of the pack A and the pack B (Fig. 29), in the path of collision with each other.

The pack A and the pack B can be considered to be of the plasmatic magnetic fields of the plasmas, solar systems or galaxies. The other assumption is that the pmtics strength of these two sets considered not being equal. These two sets of pmtics are supposed to be the mixture of the pmtics of gravitational and Magnetic fields of their respective Matters or objects in each pack.

In considering three snapshots a), b) and c), the motion of the two packs A and B in a given space of time and pmtics strength of the environment area of the D in respect to each other.

a) As the pack A and the Pack B are in motion in space and heading towards each other and these two fields are set to collide with each other (Fig. 29).

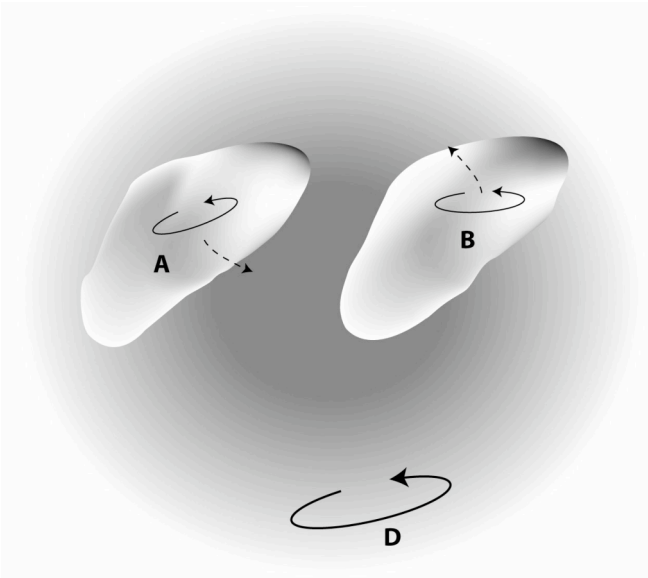

Fig. 29: Two unequal pmtics packs heading for collision.

b) Further, in the process of their motion, the two pmtics collide with each other (Fig. 30).

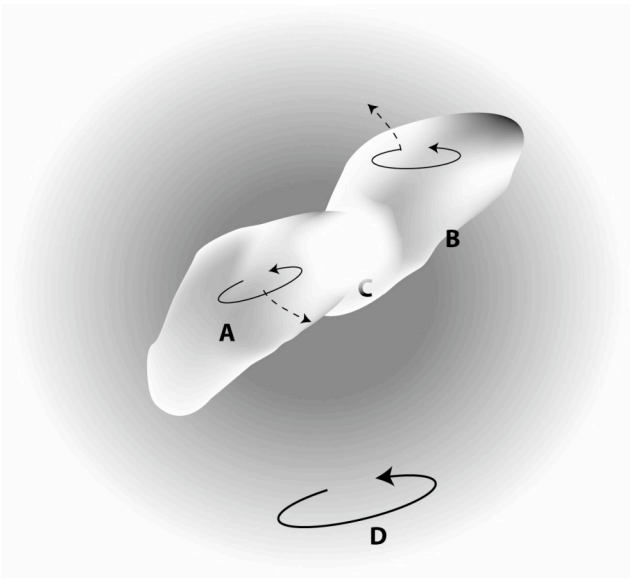

Fig. 30: Two unequal pmtics packs colliding and releasing lower order of pmtics strength as light (C).

c) Further, in the process of the interaction of two original pmtics of A and B, the two fields separate (Fig. 31) and carry on in the universe with some of their fields being released during the collision.

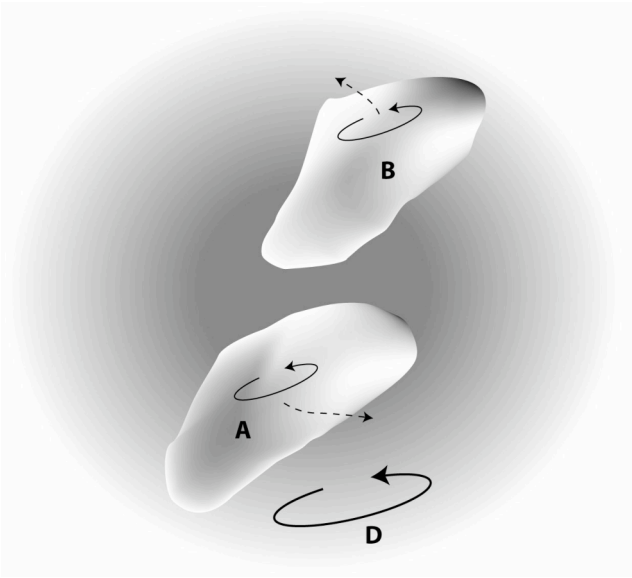

Fig. 31: Two unequal pmtics packs after collision moving away from each other.

Considering the point (b) of impact and collision as in figure 30, as there is no physical matter in these zones, only the pmtics forces can collide and interact.

The collision of the two plasmatic magnetic fields due to their frictions with each other, this leads to separation and production of fragments of pmtics, which some will be of slower plasmatic magnetic fields strength than the two original pmtics of the two original packs.

In case of physical matter, it is normal that when two matters collide head-on, they slow down and some parts of their matter are sheared off and released as fragments.

Through the collision and the interaction of these two packs of pmtics with each other, and the friction between them, these cause separation and fragmentation of some of the same pmtics from the two original pmtics of the two packs. The collision in between two sets of magnetic fields causes some of the pmtics to slow down. In the case of pmtics collision, these slowed down fragments of original two packs of pmtics are slower, and possesses weaker strength pmtics compared to their original two pmtics strength, which were involved in the collision.

We can assume that the original two pmtics plasmas speeds of travel have to be much higher by order of magnitude than the fragments that are created by the collision and interaction of the two packs of magnetic fields forces.

In other word, when two pmtics are colliding with each other, the outcome is partly slowed down fragments of pmtics as the residuals of this collision. These slowed down plasmatic magnetic fields fragments of the collision of the two stronger plasmatic magnetic fields, are slowed enough to appear as, and to be of light magnetic spectrum within the matter magnetic fields strength spectrum of the matter detection zone.

Nevertheless, one can say that, when the two pmtics of A and B collide, the outcome are residual pmtics fragments of the collision, which some of their slowed down magnetic fields fragments created due to their friction and collision, leads to the creation of slower pmtics strength in the range of visible light (Fig. 30 field zone C). Where, this visible range of the magnetic wavelength is part of the overall universal order of magnitude of the magnetic wavelength spectrum fields.

In the universe, when two or more plasmatic magnetic rays, fields, plasmas, of Magravs collide with each other, some of the residual pmtics fragments produced by their collision will be slowed down to magnetic rays or plasmatic magnetic fields strength levels, which the strength of these magnetic rays or magnetic fields are in the range of magnetic fields strength spectrum of the visible light. In other word, the outcome of the interaction of two or more magnetic rays, magnetic fields or plasmas of Magnetic and gravitational fields (Magravs) is the production of light.

This being considered as "one of the prime methods by which visible light is created in the universe. These being the residual of slowed down weaker magnetic fields strength fragments of pmtics released by the collision of two or more pmtics of Margraves of plasmas with each other".

The speed of pmtics fragments, which has slowed down due to a head on collision of two pmtics plasmas, cannot be faster than the original two pmtics plasmas themselves that have caused it to be produced.

Thus, the ***speed of the light***, which is created by interaction of two faster fields' head-on collision, as a fragment and slowed down field, cannot have a faster speed and more pmtics strength than the fields that have caused its creation due to their collision.

For example, by the slowing down of the two faster pmtics of the Earth and the Sun that have not been visible, after collision with each other, and slowing down, they create the slower plasmatic magnetic fields' strength and slower speed magnetic fields in the range of the speed of visible pmtics as of the daylight.

It is correct to accept that "the pmtics, through their collision, have to slow down so that they became slow enough that they become in the range of the slower wavelength in the visible light pmtics wavelength spectrum".

It is obvious that a slower fragment cannot be faster than the fields that have caused its creation. Therefore, "The speed of the light is not and cannot be the ultimate speed of motion" when itself is created by interaction of faster or stronger plasmatic magnetic fields.

In universal order of magnitude of the speed of motion, I consider "the speed of light to be somewhere in the lower end of the overall universal magnetic fields speed spectrum".

Thus, the speed of the light is only the fastest to human methods of detection and not necessarily true in other levels of universal order of motion.

It can be said that the speed of the light is “the ultimate speed that can be attained by pmtics in the Matter components of the plasma”.

Another, fundamental point to realise is that “the speed of travel of light is **different** in a Matter environment than the Antimatter environment and even in the Dark Matter environment”.

Similarly, it is correct to say that “the light created by the interaction of the Antimatter pmtics plasmas and the Dark Matter pmtics plasmas, they have **different** speeds than the light created by the interaction of Matters’ pmtics plasmas”. These faster speeds of magnetic fields than the pmtics of the light spectrum are not detectable by the present tools in the scientific state-of-the-art technology. But their effects and power and strength has been seen and observed in the reactors, which have been built and tested for lift and motion in the past years.

Considering the collision of two pmtics like those of the Earth and the Sun, where the Earth’s Magnetic and gravitational pmtics (Fig. 32 field B) being made through interaction of magnetic fields of Matters in the inner cores of the Earth (Chapter 1), and the Sun’s Magnetic and gravitational pmtics (Fig. 32 fields A) being made by the matters, in the cores of the Star. (In this case, we do not consider the pmtics of Matter, which are released by interaction of matters pmtics on the surface of the Sun).

An example of the creation of the light through the interaction of pmtics:

As the pmtics of Magravs produced and released by the Sun, reach’s’ the boundaries of the Earth pmtic of Magravs, these two pmtics of Magravs collide with each other at the edges of the Earth’s upper atmospheric levels.

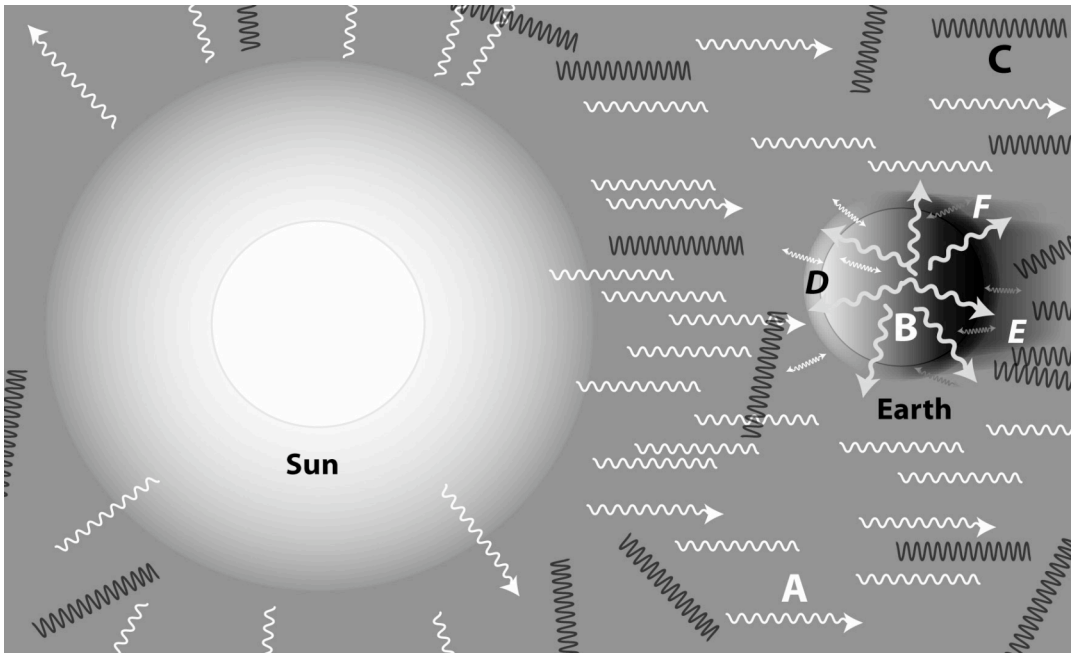

Fig. 32: Interaction of three different types of pmtics strength (A, B, C) and the resulting three residual fragment pmtics (D, E, and F).

Where, these interactions leads' to the creation of the pmtics interface, or the **magnetosphere** of the planet. Where, this magnetosphere of the Earth is partially produced at the same time in respect to the other surrounding pmtics of Matters and other plasmatic magnetic fields (Fig. 32 field C) in the solar system as well as the pmtics of the Sun.

Through the pmtics plasma interaction principles, the pmtics of the Magravs of the Sun interaction with pmtics of Magravs of the Earth leads to the creation of new residual ***slower rays and pmtics strength in the light spectrum*** (Fig. 32 field D), where, the overall effect of these pmtics fragments of light generated, leads to the creation of the *daylight* on the Earth, in the interfacing sector of the Earth with Sun's pmtics only.

The light generated in the sector of the planet, facing away from the pmtics of Magravs of the Sun, in interacting with the weaker pmtics of the Dark energy of space around it, due to the weaker plasmatic magnetic fields' strength of these pmtics of Dark energies in space (Fig. 32 field C) and the same constant pmtics strength of the Earth (Fig. 32 field B), in this sector, **weaker strength pmtics residuals** (Fig. 32 fields E and F) are created and released, thus, the appearance of the darker sky or the *night light*.

Thus, the interaction of the *same pmtics* of Magravs strength of the Earth (Fig. 32 field B) with the *stronger* plasmatic magnetic fields of the Sun (Fig. 32 field A) leads to the creation and release of more powerful pmtics strength residual fragments in the light spectrum (Fig. 32 field D), hence **the daylight**. Similarly, the interaction of the *same pmtics* of Magravs of the planet (Fig. 32 field B) with the *weaker pmtics* of the Dark energy (Fig. 32 field C) in space, away from the Sun's plasmatic magnetic fields, leads to the creation of weaker pmtics strength residual fragments, hence weaker lights or dark night light and creation of the translucent plasmatic darkness (Fig. 32 field E and F) light of the night.

As the Earth's reach a more Magravs pmtics strength balance and equilibrium with its environment's plasmatic magnetic fields' strength, thus the darker that part of the atmosphere it appears to be (This principle is described in Chapters 12 and 13).

Through the same principle of interaction of and collision of solid matters of the cosmic dust and the pmtics of the Earth, the northern lights in different colours are created. Where in this case, the light created is due to collision of the matter pmtics and pmtics of Magravs of the Earth.

It is not correct to consider the speed of light to be the ultimate speed of motion, for any pmtics of Matters environments existing within the universe. Similarly, it is conceivable that pmtics can fuse and that their pmtics can increase in strength and consequently they can increase their speed too. (Paper: Creation of magnetic fields).

In principle, the speed of light is not only achievable by the reduction in pmtics of higher order of magnitude pmtics strength, but conversely it can be achieved from the addition or adhesion of the strength of lower order of magnitude pmtics strength too. By the same measure, the pmtics of the light can be integrated, to create their stronger and faster speed of motion, with new and faster pmtics from their interactions too.

The **pmtics strength** and **the speed of plasmatic magnetic fields** is environment dependent and there are no limits in its lower or higher orders of magnitude. Generally, as long as plasmatic magnetic fields can interact, they can add to pmtics speed or lose their speed.

The limitation of speed of travel to plasmatic magnetic wavelength of light is the restriction that Man has forced upon himself, purely due to lack of his understanding of the true construction of Matters of his universe.

The present limitation of the speed of the light for motion is very much similar to the earlier century's hypocrisy and lack of knowledge of Man, with the belief that the Earth was flat and at the centre of the universe.

The pmtics become visible light to the human eye, purely due to the fact that human eyes are adapted through their protein molecular pmtics strength chain, for them to be able to interact and recognise them. This range of the plasmatic magnetic wavelength is translated for the human brain to be the visible light for humans to be able to see and function. Where, this visible range of the magnetic wavelength is part of the overall universal order of magnitude of the plasmatic magnetic wavelength field's strength and not necessarily its ultimate speed.

Thus, "if the human proteins pmtics strength had a different chemical chain, that is to say, if the protein chain did not have hydrogen, oxygen, carbon and nitrogen in its composition, then man would have had different overall pmtics strength in his protein and the universe would have been visible to man in a different range of plasmatic magnetic wavelength field's strength spectrum".

This phenomenon of the protein chain pmtics strength of creation is explained in more detail in the book to be published, titled "The universal order of existence (9)".

Further, in this book we will talk about new nuclear-based systems, which have been developed for them to be able to make use of the creation and control of pmtics of Magravs strength for motion. We have called these systems ***GRA****vitational* ***PO****sitioning* ***S****ystems* (**GRAPOS**). From, tests and what we have seen and observed in the past years in proof of pmtics creation and control, the following can be discussed in respect to the interaction of the pmtics of the Grapos Magravs and the pmtics of Magravs of the Earth.

Using Magravs positioning reactors, the interaction of the Magravs generated by these reactors with Earths' Magravs, these interactions of the two of Magravs, by their natural phenomenon of creation and interaction of pmtics, these Magravs interaction of the Grapos reactor and the planet, always leads to the creation of light around these systems in planets' atmospheric environment.

Crafts using **Grapos for lift and motion** in their movement and travel in pmtics plasma of Magravs environments, like the Earth's atmosphere, **these systems generate pmtics fragments of rays of light and appear** to be like **moving *bright lights* in the skies** (Fig. 33 disk 3 and 4).

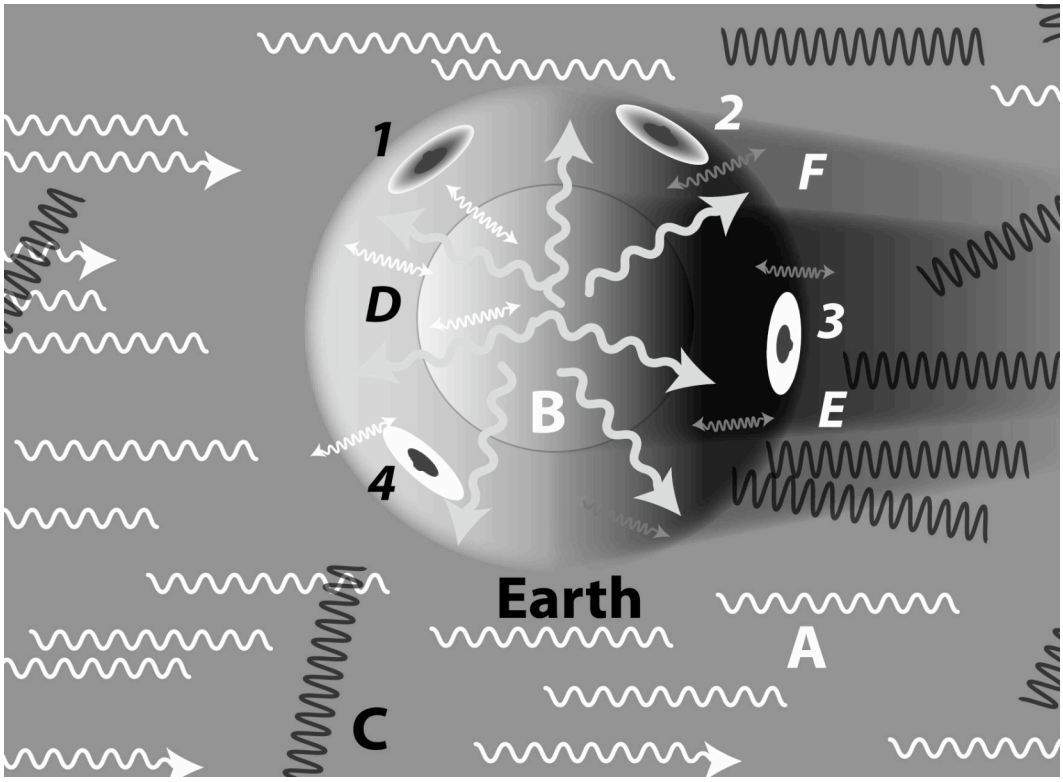

Fig. 33: Visualisation of Magravs positioning systems (1, 2, 3 and 4) within Earth atmosphere.

The effects of the interaction of the *four different Grapos and their different* pmtics strength and lights they produce around these systems, due to their of Magravs strength in respect to the Earths' pmtics are demonstrated in the figure 33 disks 1, 2, 3 and 4.

The **brightness** of these lights in sky is due to the pmtics of Magravs strength of Grapos' in respect to their environment pmtics of Magravs of plasma strength of the Earth, and these *lights are balance pmtics strength dependent*. Lights around these crafts are produced by the same principles and are similar to the way light is created by stars.

Another example of the Magravs positioning reactors to be used in future craft systems' is, in creating a balanced Magravs strength in respect to the Earth atmospheric plasmatic magnetic fields' strength, so that there would be not much field strength difference and hence nearly no interaction between the pmtics of the system and the Earth. Thus, no or very little light created around these systems as is shown in figure 33, with disks lights 1 and 2. So the system or spacecraft in a given position and time in the Earth atmospheric condition can become dark translucent in respect to the Earth pmtics strength. This giving the impression that, the system has disappeared from the sky, in fact, the system has created its own balance plasmatic magnetic fields' strength condition of dark light in its environment in respect to its environments Magravs strength, while the system still is/or can be keeping the same position in atmosphere. By being able to adjust the Magnetic and gravitational field's strength of Grapos reactor(s), these crafts can change their visual appearance in the Earth atmosphere, from dark to

bright light and deemed-light and so one. Four different Magravs strength of Grapos in Magravs of the Earth are shown in figure 33 and figure 55 in disks 1, 2, 3 and 4.

Man can and will travel several times faster than the speed of the light in the future. This will be of his own choosing and limited by his technological advancement and the limitation of understanding of his own tangible existence.

The speed of motion, due to the interaction or gravitational pull of the planets and stars of destination, in pulling the crafts equipped with Grapos towards them is beyond the present technological ability and comprehension of the scientific world, but in time this will be as easily and manageable as daily atmospheric flights of today. Which these crafts can travel several times faster than the speed of light.

The other scenario of collision of pmtics around the Earth could be that when the two field Magravs of the Earth and the Sun collide, and their overall field interactions can lead to the creation of faster pmtics than that of visible light. This again is the result of the amalgamation of two pmtics strength forces from two celestial objects.

Theoretically this is not possible around the Earth as most of the fields of the Earth are outward going and crossing the path of the pmtics of the Sun, and these fields would be carried away and out from Earth's atmosphere and not inwards. Therefore, any amalgamation of two pmtics of the Sun and Earth has to be inward so that Earth's atmospheres can generate the daylight.

This phenomenon of the addition of two fields to create light in the case of the high speed of the plasmatic magnetic fields of the Sun and the Earth is not a common possibility, or there is so very little of it.

By the pmtics theory, in the case of an atom's structure, pmtics of Magravs of the constituent Matters of the electron interact with the pmtics of Magravs of the proton. This creates the fuzzy light around the electron fields in motion, which makes it dimensionally easier to detect the presence of the electron than its nucleus. This fuzzy light being similar and created through the same principle as to the interaction of the pmtics of Magravs of the Sun and the Earth, as was explained.

Considering the interaction of the pmtics of matters on the surface of the Sun: The lights which can be observed from the surface of the stars is primarily due to the interaction of the pmtics of the gravitational and Magnetic field from the centre of the star and their interaction with the Magravs of the plasmas on the surface of the star, where this interaction of the two fields leads to the release of pmtics in the visible light spectrum. The intensity of the light of the stars is in principle due the strength of the gravitational and Magnetic fields generated in the centre of the star, as the pmtics of the hydrogen plasmas on the surface of the Sun are considered to be constant.

We consider the pmtics received by the fields of the Earth from the pmtics from the matters from the surface of the Sun to be small and to be a fraction of the power of the pmtics released due to the gravitational and Magnetic fields from the centre of the star which reaches the planet Earth. The only time when the pmtics of the materials on the

surface of the Sun has any effect on the interaction with the Earths' gravitational and Magnetic fields is when there is a surge in the volcanic eruptive activities on the top layers of the materials on the surface of the Sun. These eruptions cause the release of large quantities of physical material of plasmas into the solar system.

CHAPTER 8

Dark Light phenomena

In the previous Chapter we explained that the *visible light* is created through the interaction of Magravs and the *light* created due to the difference in strength of Magravs. Opposite to this, must be the interaction of balanced Magravs strength where the weak or balanced Magravs fields strength, which leads to the creation of a type of night light or dark light at nights.

The point has reached in physics, that these balanced pmtics Magravs strength conditions needs to be considered on their own, where the **Dark light phenomena** can be introduced as part of the science of physics.

"**This Dark light phenomenon**, with Dark light intensity, can be said to be created and be due to the near to, or balanced, equilibrium in pmtics strength reached, or that can be achieved, through the interaction of two or more pmtics forces in respect to each others in a given environment". Where, the intensity of the darkness is pmtics strength balance dependent (Fig. 36 zone C).

The level of measurement of this darkness is not field strength dependent, but *plasmatic magnetic fields strength balance dependent of one pmtics in respect to another pmtics.* That is to say, the interacting pmtics environments can possess any magnetic strength, but in all cases, when the two pmtics strength are ***near equal***, then the darkness phenomenon of the same dark intensity prevails and the same type of dark light phenomenon occurs, irrespective of the original pmtics strength involved.

If this phenomenon is fully understood, just as man has developed night-vision tools, equipment can be produced that can view Dark light plasmatic magnetic fields strength balance in respect to different pmtics strength. Then the universe would be full of new objects that have never been seen in light energy matter conditions.

What a wonderful world would one be in and see, through these tools and machines, Men of vision would take pleasure and treasure by looking through from such a machine.

CHAPTER 9

Relation between Gravity and Light

Through the pmtics theory principles, as gravitational fields are made of interaction of pmtics, and the light being itself made of pmtics, it is inevitable that entities made of the same, will interact with each other.

From previous chapters, it is clear that the light is made of the lower order of magnitude pmtics strength in the overall pmtics strength spectrum in the universe. The light in essence is itself moving dynamic pmtics and that by the principle of this definition **light is energy**. Alternatively, it can be said that the light possesses energy.

We consider that light is a made of pmtics strength of a lower order of magnitude in the overall pmtics strength spectrum in the universe.

At the same time as has been explained, "Gravity and gravitational fields' (Chapter 1) are themselves made of interaction of at least *two **similar** pmtics* or at least *two **similar** magnetic rays*".

It is understandable that, any gravitational field's forces, as an entity, in essence are made of interactions of pmtics. Thus, gravity can and will effect any other entity in possession of pmtics, or entities being made of pmtics, like light. The light and the Magravs (known as gravitational fields) are both made of the same magnetic entities; it is normal that they have interactions and attractions in respect to each other's position.

Fundamentally, it is **not correct** to say that **light is gravitational dependent.**

But, it **is correct** to say that, "the attraction and interaction of **the light rays** in respect to, and from, another collection of plasmatic magnetic fields like **gravitational fields (Magravs) are position dependent".**

In classic physics, the behaviour of the light has been said to be gravity dependent. Through the new understanding of the creation of Magravs, this cannot be correct. As the light and gravity are made of the same magnetic fields of different strength, thus they can have near enough the same speed of motion in matter magnetic field strength medium.

In the case of light rays, when the ray comes in the vicinity of, or in position in space that it can be within a field of, or be near to or in the catchments area of a collection of Magnetic fields or gravitational fields (Magravs), these two entities' magnetic fields interact.

Thus, light is not gravitationally dependent, but in fact the attraction of light is position dependent from a pmtics of any Magravs area.

Thus, the stronger the Magravs of an object are, the stronger the pull.

Following the new principles of magnetic field interactions, the stronger pmtics of Magravs strength of the Matter, the Antimatter or the Dark Matter will exert their gravitational magnetic field forces on the weaker magnetic field strength of the light rays. Hence, the stronger pmtics of heavy matters and the stronger pmtics of stars, the Antimatter and the Dark Matter, pull weaker magnetic fields like light pmtics towards themselves.

So that the visible light will move slower as it will be pulled towards the gravitational force of these stronger, Magravs like stars and Antimatter zones and as it interacts with their pmtics forces.

Light has a different speeds in the Antimatter, the Matter and the Dark Matter due to their magnetic fields strength, very much like as it has slower speed in liquid than in air in the matter environment.

The difference between matter environment and the Antimatter and the Dark Matter environment is very much in that the former is pmtics compactness and density dependent, as in the latter it is pmtics strength dependent.

Thus, light, by the principle of its construction from pmtics, will be pulled and travel slower in other state of Matters and near large and stronger plasmatic Magravs strength of objects like stars, through the magnetic fields interaction principles or the gravitational pull of one stronger magnetic fields in respect to the weaker magnetic fields of the light.

In physics, this has been said to be like the effect of the bending of light when it passes a planet or star in possession of gravitational field forces. The principle of bending of the light, or gravitational lensing in vicinity of, for example, stars is purely due to the interaction of the pmtics of the light with the plasmatic Magravs forces of the star.

It is important to notice that in positions in space, where the Magnetic fields of the star supersede the gravitational fields' strength in respect to any given ray of light, the light ray as well as being able to bend inward due to the gravitational pulls, it can also be reflect away from Magnetic fields forces too.

By the same principle, it is now understandable, why and how for example in strong gravitational fields like black holes areas, even light appears as to get absorbed into them. This being due to the fact that Magravs strength in the centre of the black holes in these regions are so strong, that due to their magnetic fields strength they gravitate the magnetic fields of the light inwards or what they call in common terms "absorb" the light. This attraction is simply a gravitational pull of stronger Magravs strength of Matters and matters in the centre of a black hole in respect to the much weaker magnetic fields of the light.

Most certainly, ***gravity and its field strength is not warp dependent*** or gravity is not caused and is not created because of a warping of the matter in the plane of time and space, as has been discussed in some fields of present physics.

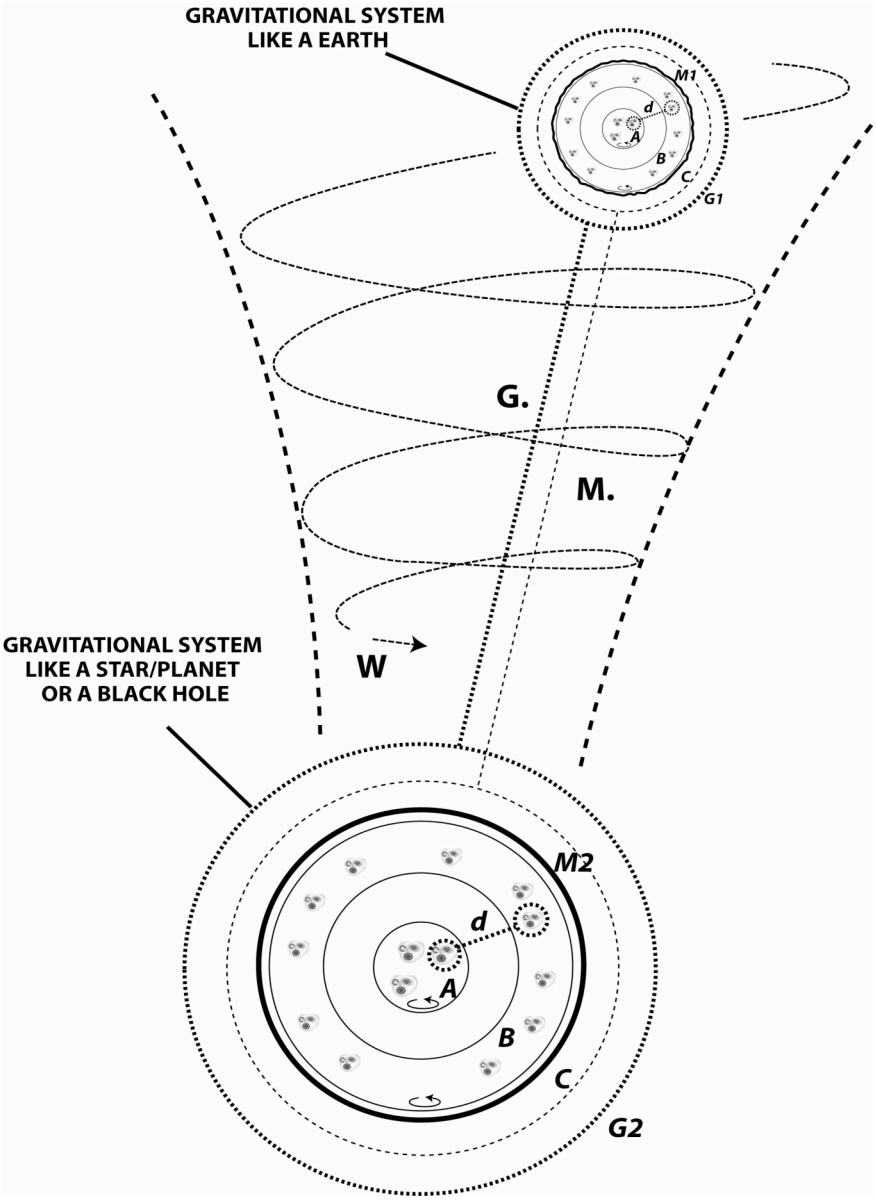

Fig. 34: Warping path of a weaker Magravs system towards the stronger Magravs system.

Note: Definitely the warping is not the creator of the gravitational fields, but the warping shows the path of the motion of the one gravitational field downward or toward onto another gravitational field.

That is to say, one weaker gravitational field can be attracted towards another stronger gravitational field G2 (Fig. 34), so that the path of the direction of the motion of the weaker gravitational fields G1, towards the stronger, could make the warp like path (Fig. 34 path W) in a given plane of time. This is the warping effect of a ***weaker*** *gravitational field* in respect of a ***stronger*** *gravitational field* and this is the warping path of attraction.

Therefore, warping of the matter is not the cause of the creation of gravity in the matter

of the weaker gravitational field strength object, but in fact the warping is only an indication of the path of the attraction and motion of the weaker gravitational fields towards the stronger gravitational fields.

Celestial matters in possession of Magravs, through their internal pmtics and their attractions and interaction and nothing else, can generate the majority of their own gravitational fields in the universe. At the same time, the motion of two objects in the possession of their own gravitational fields can set and start different gravitational fields of one object in respect to the other. That is to say, when two stars in the universe come into each other's catchments zone, the catchments envelope creates its own gravitational pull, separate from the internal gravitational pull of the stars themselves. That is in fact the operation of two original pmtics Magravs being cascaded by the bigger one outside them. The interaction of the two stars, in trying to find their position, causes the swirling effect first and then the warping effect type of motion of the weaker stars' gravitational fields towards the stronger pmtics gravitational field.

External motion of matter does not necessary create gravitational fields inside an object, but the path and speed of the motion of matter indicates the strength of the pull of one field towards another and the direction of the path of the attraction.

There are no planes of references for this warping, as the original point of the reference of the interaction of the two pmtics magnetic fields in respect to each other comes from where, *they first come into touch* and start the first fields interactions; this becomes the plane reference point for the path of the attraction of one gravitational field towards another (Fig. 34)

In fact, the theory of warping creating gravity is as far from reality, as gravity being time dependent.

Maybe it is right to say, "In time, once two Magravs come in contact with each other and stay interlocked, the two fields might merge into one, this time of merger is then pmtics Magravs strength dependent".

As has been explained, Matter is one of the three parts of the Matters of the plasma. Thus, the same interaction between the three gravitational pulls of three Matters within the structure of the Matter (see Chapter 18 and 19) causes the warping and motion of Matters in respect to each other within the plasma.

In fact, any magnetic and pmtics entity, at all times of its existence, is gravitating or will have gravitation towards one or another magnetic ray or pmtics or Magravs in its regions and is warping towards one point or another in space at any given frame of time. That is to say, there are ***no regions in space in the universe, which are void of magnetic rays or pmtics***, and their gravitational interactions and attractions in respect to one field or one Magravs or other.

Nevertheless, there are different magnetic fields strengths, which in one form or another, are gravitated to one or another magnetic fields regions in the universe, in respect to their proximity of distance from a ray or a pmtics.

Maybe we can say "that gravitation in respect to time, is dependent on the position in space and pmtics strength of the any two entities, and that in time, for example light being in essence a magnetic field in origin, it will be effected or attracted or gravitated to another magnetic field or collection of fields, and that these magnetic fields can already possess gravitation in respect to each other.

Thus light rays in given point in space will come in touch with other magnetic fields, which they will gravitate towards each other, for them to merge, where this merger will take a certain given duration.

Thus, the light rays and other pmtics strength have a direct effect on the rate of attraction of one field to another. Thus, speed of attraction is pmtics strength dependent".

In real physical terms, the light itself can be or become one-half of a gravitational field set, so not only is the light getting attracted towards another Magravs system, but also in this process, the light becomes part of a second magnetic field of a gravitational set itself in respect to the first gravitational field. Then this light pmtics becomes part of a plasma magnetic field, which this is, a new set of a light field and the first gravitational field interaction, and this itself becomes another Magravs system like.

The other important point to consider, is the time it takes for the light ray to reach or be attracted into or by a gravitational field, zone or area. This interaction and attraction, is both gravitational field strength, and the light ray's magnetic fields strength, dependent.

That is to say, stronger gravitational magnetic fields, ***pulls*** rays faster to themselves than a weaker gravitational magnetic fields.
Thus, *the time, that it takes for a light ray to get attracted into the gravitational field zone is gravitational field strength dependent and not time dependent,* as the strength of the pmtics of the light of the matter is considered to be constant for all states of Matters.

Then for different Matters (Matter, Antimatters and Dark Matters) in the universe, there should be different *frames-of-reference* of duration or time. As the light created in the matter environment will have different speed in the Antimatter and Dark Matter magnetic fields spectrum environments of stronger pmtics strength regions. While the light created by the Antimatters and the Dark Matters pmtics, interactions have very **different speed** than the light created by Matter pmtics interaction. Secondly, the speed of the light from Dark Matters and Antimatters are much faster than the speed of the light of the Matter state or in matter state pmtics' strength levels.

Some notes about light

1. The frequency of the light wave is created on the same basis and due to the same principles as the change of the polarity in the stars, for example the Suns' eleven years half shift in polarity change (12, 18).

2. By the same principles, the alteration in the extreme points known as maximum and minimum points of return of the waves are Magravs positioning balance dependent,

and not as what has been assumed, electromagnetic field based, as electrons themselves are made of plasmatic magnetic fields.

3. The pmtics as rays, as they enter or come in touch with an atom or an object that they can move or cause motion in the penetrated atoms, electrons of matter or Matter or in their initial fundamental particles, because the matters or Matters components are similarly made of dynamic pmtics, thus, when a pmtics comes in touch with another pmtics, these pmtics interact and collide with each other. Thus, the outcome is a transition of pmtics from one entity to another.

4. The transition of pmtics takes place when the plasmas of Matters come into contact with the initial fundamental plasma of the Matter and they transfer their plasmatic magnetic fields strength from one to another. Usually this transfer is from the stronger to the weaker field strength directional of flow.

CHAPTER 10

The Antimatter

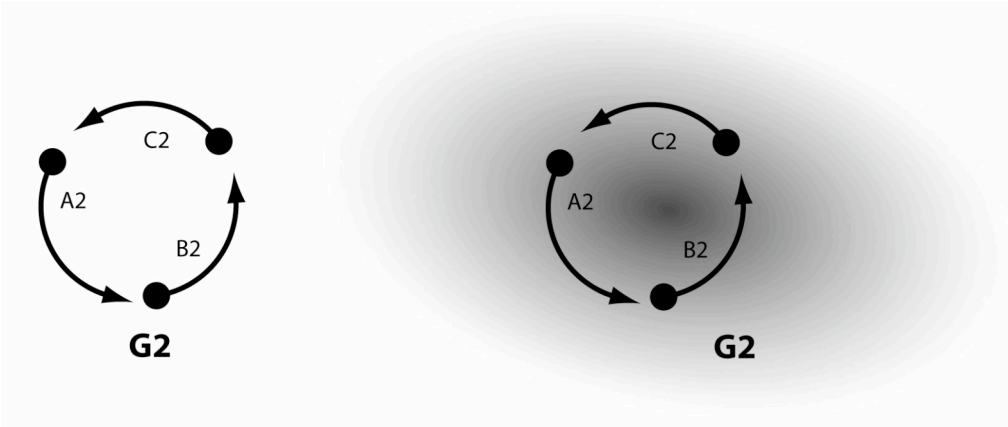

In the world of science, the Antimatter has been considered and said to be the largest source of energy for the future of the energy, space and motion technology.

In the structure of the initial fundamental plasma, I consider that "the Antimatter is the *main component* of the whole structure of the plasma and it is the carrier of the *largest amount and strongest* of dynamic pmtics strength in the plasma, which Antimatter can release the maximum and the larger amount of pmtics strength in the full spectrum of pmtics of energies from the plasma".

To understand what the role of the Antimatter is in the overall construction of plasma, we can simply look at the larger scale of the same type of entity and its effect in the universe. In the universe, the large-scale plasma conditions are said to be the like of the Stars, or the Suns' in their solar systems.

Where, the **Antimatter** part of the plasma is the same as the Star of a solar system, and it is the ***holder of the main quality and quantity*** and the possessor of the ***strongest pmtics strength*** of all Matters of the initial fundamental plasma.

I consider that, the Antimatter is the **source of the energy** and **the central gravitational point of the plasma** as a whole. The Antimatter is in fact the Star of the plasma, thus it is as the Sun to the solar system. In fact, there is nothing "anti" about this Matter component of plasma in the universe.

This is the reason why, in being able to free them from the sub-components of the Matter and the Dark Matter of the plasma, the Antimatter appear to be such a fantastic new source of energy.

As the Antimatter was made initially from the stronger magnetic fields strength in the plasma to start with, hence it holds the real fundamental source and the supplier of pmtics to all matters in the plasma. It can be said that pmtics released by the Antimatter are the platform for the change for almost everything that is made in the matter world.

That is to say, “that Antimatter is the source, where pmtics are positioned to start the change from stronger pmtics strength level in the plasma components, and transfer more of pmtics strength of Matters to matters”.

It is the pmtics of the Antimatters, which are transferred in most parts‘, from one plasma to another, which, causes energy transfer from one molecule to another or one cell to another.

We have used these Antimatters pmtics strength effects in the recent past in our reactors, the pmtics interactions of Antimatters were utilised to create the Magravs forces needed for the Magravs positioning of these systems in respect to another plasmatic Magravs of another object, this being like the Earth’s Magravs.

Through tests, it has been proven that the presence of the **Antimatters** and its strong plasmatic magnetic fields that it provides for the creation of Magravs in the reactors is the main reason why, we have managed to lift and move large masses through the gravitationally positioned principle.

In Grapos test reactors, which have been developed and tested for lift and motion, the operativeness of pmtics strength of the Antimatters have been proven to be in line with our theories, where if the pmtics of the Matter were used in these reactors, the Magravs created by pmtics of this Matter would not haven been strong enough to cause the motion or lift of the system.

The scientific world is using accelerators (6, 7, and 8) to slam the plasma into a wall of matter, for the plasma to open and to release its Antimatter sub-components.

In present technology, scientists are trying to understand how to gather and harvest the power of this Matter. It is however crucial to understand that, “**one does not burn the Antimatter as fuel,** as it is assumed by the present scientific world in this field and as Fermilab (6, 7) is considering”.

Nevertheless, there is an easier and smoother way to achieve this separation, and that is just to dilute the plasma (Chapter 21), through this method, it will be easy to release the Antimatter from its plasma.

Once the scientific world has a full understanding of how to separate this Antimatter from its plasma, then they will understand that one does not need to burn this Matter as fuel to create motion and energy. But, they simply have to learn **to use the effects of the interactions of the constituent pmtics of this Antimatter** in conjunction with other Antimatters pmtics of other plasmas or Matters pmtics to achieve lift, motion, and for creation of energy, as has been done in the universal order of motion and creation of energy for billions of years.

CHAPTER 11

The Antimatter energy

Antimatters are known to be the sources of vast amount of the **strong pmtics**. The strong fields of the Antimatter are considered to be the major sources of the energy supplied into their respective environment for Matter-to-Matter, and from Matter-to-matter through their pmtics. The ***strong*** *pmtics*, once released by the Antimatter, and these pmtics in being *in motion* in their environment, they become to be called the **energy of the Antimatter**.

These pmtics by essence of their origin and strength they are, and become, ***strong*** *energy field sources* and reservoirs of energy in their environment. Where, some of the pmtics within the Antimatter are used to maintain the integrity of the Matter and the plasma itself.

At the same time, some of the pmtics of the Antimatter are equally reduced in strength, and these changes and reductions in their strength of some of the pmtics strength of the Antimatter overall constituent pmtics, these pmtics are allowed then to escape the gravitational fields of their Antimatter pmtics Magravs.

These released pmtics from the Antimatter, become the Antimatter pmtics in motion (energies) due to the strength of their plasmatic magnetic fields' forces. These pmtics can travel *much further* from the Matters and plasma, to transfer their energies to other pmtics in their environment.

These released fields become the Antimatter pmtics in motion (energies), which, due to the strength of their plasmatic magnetic fields' forces, these pmtics can travel *much further* from the Matters and the plasma, for them to transfer their energies to other pmtics in their environment.

Due to the fact that the Antimatter itself is originally made of the stronger pmtics, the Antimatter will let go of pmtics in stronger and wider spectrum of magnetic fields strength. Thus, the Antimatter releases a full spectrum of pmtics strength forces. That is why they are more powerful and covering a wider range spectrum of energy levels as they slow down.

In essence, the **Antimatter** itself starts from a combination of interactions of stronger pmtics bases, and hence has more to lose of its slowed down fields and it has more to attract due to its stronger Magravs too. At the same time, it covers a larger domain as its pmtics can spread further.

In fact, the energies that are released by the Antimatter look to be, and basically are stronger than other energy fields around them, purely due to the fact that they start their life from stronger pmtics strength base in their environments.

CHAPTER 12

The Dark Energy

The principles of creation of the Dark energy as an outcome of normal interaction of pmtics are discussed. The similarities of the Dark energy and force, which are created around Black holes, are in principle of the same origin.

In the dynamic environments of the universe, changes happen due to various conditional factors like motion, compression, turbulence, temperature, and so on, that can individually or collectively lead to concentration or motion of pmtics (energy). These changes in environmental conditions can lead to the manifestation of Matters like the Matter, the Antimatter, the Dark Matter, atoms, stars and galaxies and so on. This is the common fundamental base for the creation of Dark energy and creation of Dark Matters (36) and any dark objects like the Dark Matters, the regular appearance of dark spots on the surface of the Sun and stars (12, 13, 14), the appearance of Dark spots in the galaxies known as Black holes (13), the Dark Rings around Saturn (17) and so on. The creation of these conditions and matters can all be explained through the following interaction of normal dynamic pmtics in the universe.

By pmtics theory, the Dark energy is said to be the ***collection of balanced and equilibrium pmtics strength forces in motion*** in respect to their environments pmtics strength, this being in any given environment, in deep space in the universe or in the centre of an atom and so on.

The universe always possesses equilibrium pmtics strength in its total energy balance, hence the universe possesses more environments which are in pmtics balance strength and hence the existence of vast-spans of the universe which energies are in motion, but due to their balance magnetic fields strength in these regions of the universe, no light through the interaction of various magnetic fields are produced to confirm the motion of the pmtics in that region.

It is important to note, that in the universe only the difference in magnetic fields strength is the cause of creation of visible light from the human observation point of view. Where there is balance and equilibrium in the environment, no lights through interaction of magnetic fields or pmtics are produced. This doesn't mean that there are no magnetic fields or pmtics in motion (energies) and that nothing is present in that region of the universe. In fact the darkness of dynamic environment of the universe confirms the existence of the balanced magnetic fields strength. Beholding the truth, the darkness of the universe confirms the existence and motion of balance and equilibrium of magnetic fields strength, and not the lack of the existence of magnetic fields in motion (energy).

We have defined Energy as: "**pmtics forces in motion"**. Therefore the Dark energy has the same definition, where in this case, these are **balanced or near balanced pmtics**

strength forces in respect to their environment pmtics field forces in motion.

The universe always possesses equilibrium pmtics strength in its total energy balance, hence it possesses more environments which are pmtics balance strength and hence the darkness of the universe.

Steps in the creation of Dark Energy

To explain the phenomenon of creation of the Dark energy in more detail, let us consider two equal pmtics environment zone A and B in figure 35. These two fields' zones can be for example pmtics from two galaxies in motion in the universe or two pmtics in the span of a plasma.

Before the interaction of the two field zones, pmtics of each zone are interacting with their respective environment, which creates their own boundaries of their field strengths through their magnetosphere boundaries, in respect to their environmental pmtics (zone A with zone D, and zone B with zone D).

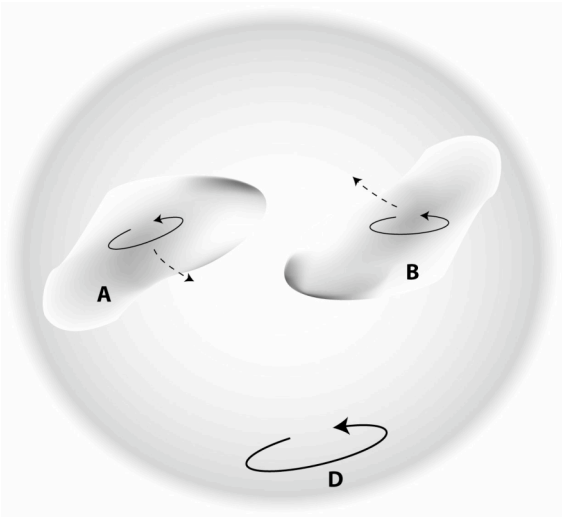

Fig. 35: Two equal pmtics strength entities moving in each other path.

Lets assume; a) The universal magnetic fields are always in rotational motion as of D (Fig. 35), and b) The two pmtics of the A and the B are in motion in directions shown. Through their motion and the environmental forces, the two fields zones come to be partially in contact and interact with each other. (Fig. 36)

As segments of pmtics of the zones A and B collide (Fig. 36), and as their interacting pmtics are similar in strength, then there are no differences in field strength for the two pmtics to create the magnetospheres condition (14) or no residual pmtics or very little pmtics fragments are produced from the interaction of these two pmtics zones. Thus in the interaction of two fields and due to balance in their pmtics strength, this interaction **zone C** of fields does not lead to creation of pmtics fragments in the light magnetic field spectrum leading to the creation of pmtics of light (Chapter 7), to make this region light

to show the existence and occurrence of collision between two equal magnetic fields strength zones.

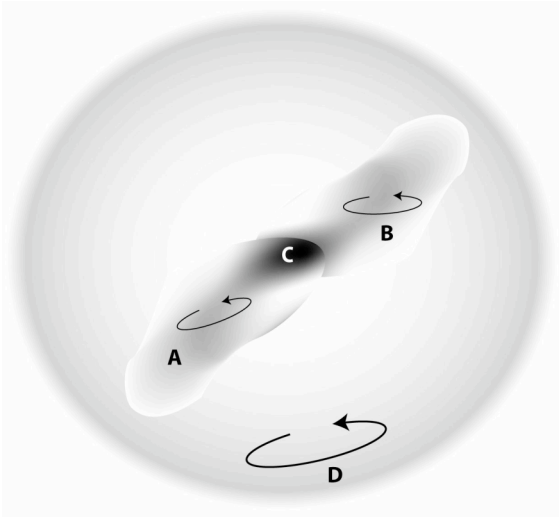

Fig. 36: Two equal pmtics strength entities moving in each other path colliding and creating a temporary Dark energy zone (zone C) due to their interaction.

Thus in respect to the surrounding environment the colliding of two pmtics in motion and the lack of production of pmtics fragments strength in the bandwidth of the light in this section of colliding pmtics, this creates the appearance of being dimmer or darker zone (Fig. 36 zone C) compared to its two original zones magnetospheric condition in respect and in comparison with their surrounding pmtics.

In the region of C of figure 36, due to the balance in pmtics strength and the creation of very little residual pmtics fragments, this area has a darker appearance in comparison to the rest of the region which one can observe with the rest of the two zones of A and B in the overall region of the D environment. Nevertheless, the energy of the pmtics in motion of the two pmtics zone of A and B exist and they can be measured, as the two pmtics of A and B move on, this confirms the existence of energy in the dark zone C, where in fact there are no sources for such an energy field to justify their existence in this darker appearing region.

Thus, in the case of the Dark energies zones in the universe, most of the time, one has to look at the overall picture of the interactions of the package and area, rather than to the local zone where the darkness and dark energies appears to be and where pmtics in motion as energy fields are present.

Further on, as the two fields zones A and B are dynamic entities and they are pushed by the forces in the bigger picture of the zone D, the Dark zone C, figure 36 disappears as two zones of A and B move away from each other.

Thus, the interaction and creation of the zone C, figure 36 is a **temporary phase** as the two field zones separate and carry on in their own path and the Dark energy zone C in figure 36 disappears, as there never was a Dark energy zone in that part of the zone D as

whole (Fig. 37 fields A and B).

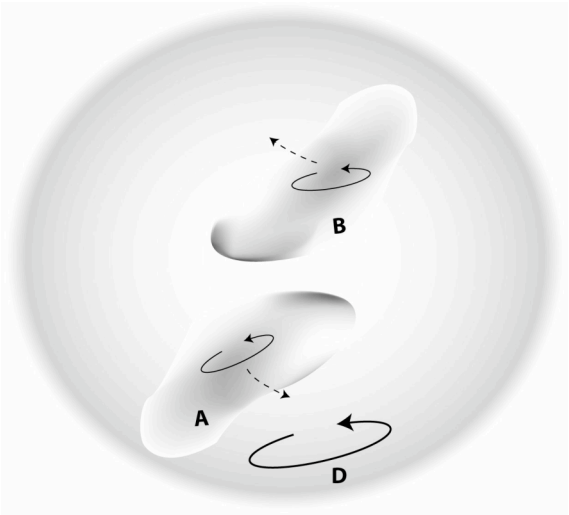

Fig. 37: Two equal pmtics strength entities moving away from each other after their collision.

Therefore, Dark energy zones in the universe are not necessarily a place where there are void of Matters or magnetic fields, but the darkness itself confirms the existence of the balanced pmtics strength in motion in respect to the majority of pmtics strength forces in that given environment, which pmtics in these areas are in balance and in equilibrium in strength with each other in a given point and a given window of motion of fields called time in the span of the universe.

At the same time, these sudden Dark energy regions in space are temporary conditions in a given specific time and specific position from a specific point of observation.

On the other hand if one is inside such a zone not necessarily means that one is in the Dark energy zone. In some cases of dynamic solid gravitational fields of matters in the centre of these energy zones, due to the interaction of the Magravs of the Matters and in level of Dark intensity translucent, inside these Dark energy zones one can have bright zones as being near a star zone.

It is obvious that most of the universe appears as dark, even though pmtics always exist in these areas of the universe and are essential components of its structure. This by itself means that the universe is in pmtics strength balance and equilibrium within itself.

The Dark Matters do not all possess the same pmtics strength and therefore the Dark energies are not all of the same magnetic or Magravs strength, in respect to other pmtics strength environment.

By the same measure, the Dark Energies in the universe do not all possess the same pmtics strength, as their strength is pmtics strength dependent in respect to the environment pmtics strength of their appearance.

In the case of the Dark Matters as sources of the Dark energies, these Dark energies are produced through the initial pmtics interactions in the centre of the Matter, and hence the energy they produce as their overall outward Magnetic fields and inwards gravitational fields, are always in balance in respect to other pmtics in their given environment. Where this balance of pmtics strength gives the Matter the appearance of **darkness**, or darker looking in respect to its overall given environment.

Some of the Dark energies have a Magravs source in their centre in the universe. Thus, these types of Dark energies are part of a Dark Matter source, which are part of the overall magnetospheric environment of the Dark Matter pmtics. These sources of the Dark energies are the Magravs of a matter which in respect to its environment from a given position in space, and due to the equilibrium of the pmtics of the Matter and the environment, cause the Dark energy zone, from that specific point of observation, as that given zone of pmtics interaction appear to be darker than the rest of the environment surrounding it.

CHAPTER 13

The Dark Matter

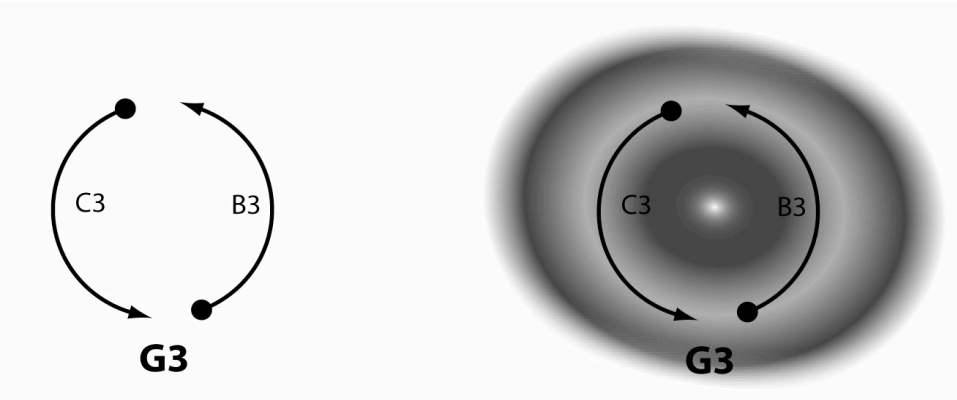

According to the ***Keshe pmtics Theory of Dark Matters*** "*for an entity to be considered as a Matter, the entity has to possess both Magravs pmtics forces, so that not only the Matter can maintain its Magnetic and gravitational fields, but at the same time the Matter can maintain a balanced pmtics magnetosphere magnetic fields forces strength zone and a magnetic fields mass, for the Matter hold on to its constituent pmtics for it to exist, with the difference with the Dark Matter that the magnetosphere created through the* ***overall*** *interaction of its Magnetic and gravitational fields forces strength of the Matter and the environment pmtics force strength that these two forces are in equilibrium in strength, where the interaction of the pmtics of Magravs of the Dark Matters' magnetosphere and the environment pmtics field force in interacting with each other, they do not create residual fragments pmtics that is in the light magnetic fields strength spectrum level, that makes this Matter visible or detectable, hence the term Dark Matter (Fig. 38 G3)* (36).

At the same time the Magravs forces created by the same Dark Matter appears to create a magnetospheric fields forces' zone around the central Matter, which gives an impression of an energy source that comes from a dark space in a given environment without a visible material source and hence the use of the term **Dark Energy** (Fig. 38 C)."

The Matter is said "to be dark, as its effects can be seen or felt, but, it, is not made observable to the line of vision or is undetectable through detection systems, which are looking for signs of light as means of confirmation of the existence of the Matter"(36).

The Dark Matter can be defined in another way, that is to say:

"The Dark Matter (Fig. 38 Matter G3 field C) is the Matter that, by the interaction of its internal initial pmtics strength, creates the Magravs effects and its external plasmatic Magravs as the magnetospheric field effect for the Matter to exist. Nevertheless, it is due to the overall balanced Magravs strength that are created by the Matter as the magnetosphere of the Matter, being in balanced magnetic fields strength with respect to its given environment pmtics strength, so that the interaction of the two magnetic fields

does not creates pmtics fragments in the light spectrum, where the Matter cannot create detectable magnetospheric light."

That is to say, the interaction between two plasmatic magnetic fields strength of the Dark Matter and the second pmtics strength of environment does not create a **visible or detectable magnetosphere** effect, which would be needed to confirm the presence of the Matter in that given environment and in a given position, at a given point in time.

The Dark Matters effect of Magravs energies can confirm its existence, as the Matter that *appears* as Dark or translucent Darker Matter, in respect to its given environment, to the line vision appearance of the Matter, in a given position and time.

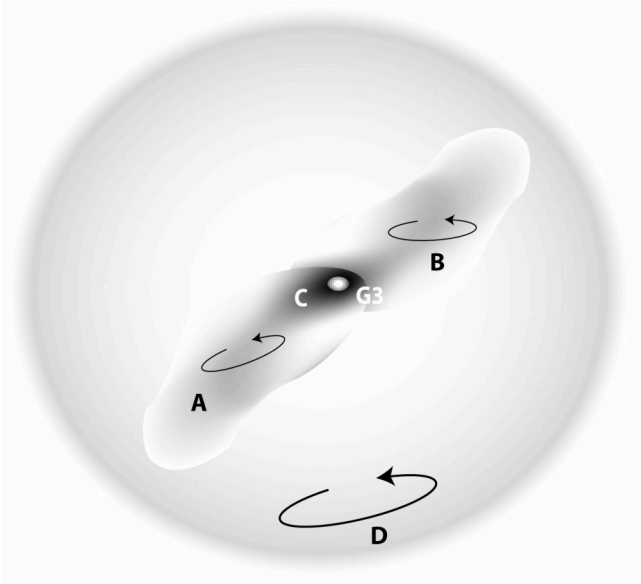

Fig. 38: The Dark Matter (G3), the Dark energy (C)

The Dark Matters can be, or, are made of stronger or weaker plasmatic magnetic fields than the Matter, and the Antimatters components of the plasma.

The Dark Matters are Matters which appear as areas in the universe in possession of Magravs forces but no or a very weak, detectable external magnetosphere in respect to their environment at given point and **a given window of transition of time**, where the confirmation of the existence of the Dark Matter is environmental pmtics strength and position dependent.

If one could create the fundamental principles of the Dark Matter, by the use of Grapos, with the production of balanced pmtics strength around the system, then one can travel the spans of the universe with pmtics Magnetic field protection and more or less without any friction, or resistance in the direction of the motion of the system, this allows the system to achieve speeds far beyond the present knowledge of Man in the space and aircraft industries (36).

The same effects of the creation of balanced pmtics strength in respect to the environment can be used to make systems, that without moving; such system becomes invisible to the line of vision at any point in atmospheric condition or in deep space.

The larger entities like of the Dark Matters in scale of magnitude are the black holes in the galaxies, where a large gravitational fields zone is observed and no physical tangible source for the large and strong pulling forces in that region of the galaxy can be seen. These areas, which are usually and mainly in the centre of galaxies or on the edges of turbulent boundaries of galaxies, as there are more Matters, matters, magnetic fields and plasmatic magnetic fields on the move. Where the total balance of these fields, in respect to their given environment, gives these regions an impression to have the appearance of the **darkness**.

These dark regions with strong gravitational pulls are overall temporary events in the bigger cycle of life of galaxies bigger picture of motion of pmtics and Matters (12, 13).

Sudden appearance of Dark Matter as Matter due to changes in fields forces in the environment can be analogised like having a wet cloth that is dry looking. However, by twisting and squeezing the cloth, out of nowhere, drops of water start dripping out of the cloth. The appearance of the water drop does not mean that water was not in the cloth, but in fact it means that the condition were not there to force the water to manifest itself within the cloth.

The Dark Matter can become visible as Matters around their environment pmtics strength changes. On the other hand, the Dark Matter can become visible Matter when there is a change in the internal pmtics strengths of the Dark Matter, which the change in magnetospheric strength of the Dark Matter, changes the magnetosphere pmtics strength in respect to its environment pmtics strength and the Matter becomes visible. That is why the Dark Matters are environmental pmtics strength dependent. The appearance of Dark Matters, due to changes of their pmtics strength or environment pmtics strength changes have been seen in the universe by scientists and they call these, the Virtual matters or the Virtual particles (Chapter 14).

Dark spots on the Sun and Black Holes

The Dark spots on the surface of the Sun; These effects are usually seen on the dynamic surface of stars, where large numbers of similar pmtics strength materials in motion interact with each other, and hence there are more possibilities of having balanced pmtics strength regions, as most of the matters are of the same structure of hydrogen plasmas.

The main reason for the increase in the levels of the dark areas and dark spots on the surface of the Sun, about every eleven years, is due to change of polarities of the Magravs created by magnetic fields in the centre of the Sun. This increase is purely and only due to one factor, this being that the creation of dark spots on the Sun is primarily due to the interaction of pmtics of the matters on the surface of the star and the pmtics of the Magravs from the centre of the star. As at time of polarity change of the star,

there are more chances of the interaction between two pmtics, which are made by the components of the same matters (Hydrogen). Thus, there are more chances of reaching Magnetic strength equilibrium conditions between the surface pmtics strength of the matters on the surface and the internal Magravs' fields strength created in the centre of the star. Where at these points of balance zones of pmtics strength, no or very little pmtics fragments in the spectrum of light are created, hence the reason why appearance of the increase in the number of dark spots on the surface of the Sun during the polarity changes of the star (12,13).

Thus, the dark spots of the Sun are natural outcomes of the balance interaction of the pmtics strength of the overall Magravs created by the centre of the Sun in respect to the pmtics strength of the plasmas of the materials on the surface of the Sun. Thus, as there are more balance pmtics areas produced, a higher number of darker zones can be observed on the surface of the Sun.

The darkness of Black holes in galaxies, and the Dark energy fields they produce in their environment, are due to the same process (12, 13). Similarly, all Dark energies are not necessarily connected to the central Magravs of the Dark Matters.

The Dark Matter and the Dark Energies appear and behave as dark regions, in respect to a given magnetic fields strength environment, at a specific point in time and space, and specific conditions from the point of observation. By the same principle, the Dark Matter and the Dark energy will be a visible or tangible Matters or matters in a different pmtics strength environment and even from another point of observation.

Therefore, state of the Matters, this being the Matter, the Antimatter, the Dark Matter appearance and detection of their energies are totally pmtics environmental respective dependent.

That is to say, "what is **the *Matter and the energy*** *in one given plasmatic magnetic fields' strength environment* can become *the* ***Dark Matter*** *or the* ***Dark Energy*** *in another pmtics strength environment* to the human point of observation".

In the universe, the Matters and the Matter energies or the Dark Matters, the Dark energies, the Antimatter and the Antimatter energies **change from one state of Matter to another**, or one **state of Matter energy to another**, purely due to *the respective Magnetic fields or gravitational field* strength as of their environments pmtics strength as these Matters and energies pass *through them*.

In the micro and macro universe, suddenly Matters and energies ***appear*** **out of nowhere** and **Matters and energies suddenly *disappear* into nothing**. These appearances are all pmtics strength respective environment dependent as the Matter or energies pass through a given field at a given time in their immediate environment.

The universe is considered by us to be covered with the Dark Matters and the Dark Energies. In general it can be said, where there are no faster or slower pmtics, or differences in pmtics strength, interacting or for other pmtics of the same or different strength to collide with, through these balanced pmtics strength regions, there are no

unbalance fields to create friction or to have an interface or to have residual pmtics between the environmental and the moving pmtics, these regions in the universe give the appearance of lack of *Matter,* or the Dark Matter or the existence of Dark energy in respect to the given point and position in the universe. This means that the dark regions of the universe are balanced in pmtics strength, and *not void of pmtics*. Hence as the universe is magnetically strength balanced, therefore the universe, in general, appears dark and empty, even though the universe has no regions without magnetic fields.

These types of darkness can be see-through and can be transparent through their pmtics energies; I call these areas the "***translucent Dark energy zones***".

This translucence state of position in a given environment is a state where, there is total darkness but at the same time, there are pmtics strength field interactions that allow enough light, in respect to vision and detection for one to confirm the lack of light.

This being the reason why, one can see or detect, other Matters or matters through this universal Translucent Darkness light.

This light in the span of the universe is due to the interaction of very weak pmtics in motion (energies) in the constituent universal pmtics soup. In fact, these dark regions of their environment are where the pmtics are in balance within these regions.

As was discusses in the previous chapter, to the human eye protein pmtics balance set, these residual fields of the two pmtics interactions, due to their pmtics strength balance, appears as the Dark Matter and is like Dark energy zones in space. If humans would possess another chemical pmtics protein chain, what are the Dark Matters and the Dark energies by present means of detection, by viewing through different tools of vision, then these areas will be as visible light regions of the universe, and may be in different colour, for example in the Antimatter colours spectrum of the universe, or even in the Dark Matter colours' spectrum of the universe. Through the use of such tools, the importance of the use and function of the Dark energy (Fig. 36) and the Dark Matter (Fig. 38) will be soon grasped by men of vision, to see the true darkness. Where in the colour spectrum of the Antimatter the colours are magnetic fields strength dependent and these colours are not noticed by the human eye matter-based protein pmtics. The same applies to the Dark Matter colour spectrum.

In the universal order of containment for Matters and energies, it is not far from the truth to say that the state of Dark Matter is the same as gasses in matter state, that the Dark Matters and Dark energies do not have self-containment.

That is to say, "As with gasses in a state of matter, Dark Matter fills all the environment and space that is given to it, as it creates no effective magnetospheric interface boundary resistance in respect to its environments' pmtics strength forces.

The boundaries of the Dark Matters and Dark energies are dictated by the boundaries occupied by stronger or weaker pmtics strength regions around them in their given points in the universe."

The forces of Dark energies can be confirmed only through their interaction with other plasmatic magnetic fields in motion, in respect to the field of the Dark energies motion themselves.

That is to say that the dark lights generated by the Dark Matters and Dark Energies cover the whole of their given spaces, this being the space in-between different Matters in the atoms structure or solar system or even galaxies, I call this ***principle of creation of dark light*** strength difference of pmtics magnitude needed for creation of light, the **principle of pmtics magnitude**.

It is very correct to assume that one atom of Dark Matter and its Dark energies can be and/or is enough to span its balanced pmtics to cover the whole of a solar system, or its bigger counter part galaxies or smaller spaces as the space in the pmtics Matters of one tangible atom.

CHAPTER 14

Virtual Particles (Virtual Matters)

The existence of virtual particles, *which appear out of nowhere*, and have the characteristics of real particles in essence, has been described in the Dark Matter section of this book. The method by which these particles appear within their environment is exactly how the Dark Matters do exist and appear in their environment, after their overall Magravs, magnetosphere strength changes' or due to changes in the pmtics strength of the environment.

In fact the virtual particles are individual atoms' or plasmas, or any Matters, of the Dark Matters behaviour' (Chapter 13, and reference 12), which when they come into new pmtics strength environment *which is* ***different*** *than their previous balance condition* pmtics strength environment with their Magnetic field and gravitational fields, then these particles generate a new magnetosphere in respect to their new condition pmtics strength environment, thus they create light due to their interaction of their plasmas (Chapter 7) and so they appear *as* ***new matters or virtual Matter***.

There is nothing new about virtual particles; these are like loose plasmas or a single atom in the soup of the universal Magnetic and gravitational fields.

Thus, in simple way according to ***Keshe Theory of creation of Matters***, virtual particles are Matters and behave like Dark Matters. They are created from the interaction of at least two pmtics, which leads to the creation of Magravs of the Matter, therefore what scientists call virtual particles, these are real Matters, which due to the change in their environmental magnetic fields strength condition, they suddenly ***appears as matter(s)*** for *a very short time*, until they lose their pmtics strength or their environment pmtics strength changes or as they move out of the environmental pmtics strength level or they seem to disappear.

Virtual particles possess a magnetosphere and the light they create in their new environment is due to the interaction of their pmtics of their magnetosphere with the pmtics of this new environment, which makes them visible in that given point and given time.

Note: When the (virtual) particle(s), Matter(s) or matter(s) is moving towards the observer due to it's ***compacting of pmtics***, this creates the blue shift colour of magnetic wavelength spectrum (Chapter 7). If the virtual particles are moving away from the point of observer, due to ***opening of the pmtics*** of the environment, they create light in red shift colour of magnetic wavelength spectrum. (This is described in the paper: Creation of Magnetic field).

The virtual particles are actually individual nano-atom or plasmas or sub-Matters of plasmas.

The Casimir effect

In present physics, virtual particles are related to Casimir effects.

First of all, the Casimir effect and the photon energy appearance in its setup of its confirmation is always considered to be in a **vacuum condition** between two conductive plates where, photons in between two plates are observed and electrical charges are measured.

In fact, it is not important what vacuum condition level can be achieved in test laboratory conditions, nevertheless still a number of pmtics, Matters, plasmas (electrons and protons) and atoms could be left in the space between the two plates, which are under observation.

As matters are made of plasmas of interacting magnetic fields of Matters, when the space in between the plates is freed and void of most of its atoms and Matters, at this point the leftover matters or Matters between the two plates are more free to move in the newly created condition environment. Hence it is natural that these residual atoms, electron plasmas, proton, can move really in empty space and can collide with the walls of the matter of the two plates and due to their interaction fragments of pmtics strength are released which these are in the range of the pmtics strength of photons.

So vacuuming the gap between the plates creates a new environmental plasmatic magnetic fields force condition that allows a more free motion of leftover Matters and atoms in between the two plates, where in fact the boundary of the magnetosphere of one atom can occupy or expand the full span of the gap between the two plates.

Casimir effect measurement is a good tool to measure how many atoms and/or what Matters are left in the gap between the two plates at a given vacuum level.

We have done experiments in plasma dilution reactors, which we have developed and have seen the Casimir effects. In these tests, we have seen some serious voltages and currents, but never photons. Which indicates that these voltages can only be from Antimatter source in-between plates, as matter cannot produce these levels of voltage and amperages.

In a number of tests we have created 30 mm gap between plates and the results have been the clear indication that Casimir effect testing is good to find nearly the number of Matters in between the gaps, and types of Matter which are left in between the gaps. As **Matter and matter** create *different charge levels* than the **Antimatter** components of the plasma.

We have created environments of 10 (-9, -10, -11, and -12) bar in our tests, and in tests over 10 (-8) bars there was not much difference in voltage and current measurements from both plates' terminals. This indicating that it does not make much difference how far one can vacuum the gap in between the plates, there are still some components of Matters or matters will be present in the gap, which can move with more freedom than before. Where this small number of matters or Matters in-between the plates can

transfer energy through the free motion of their plasmas in collision with plasmas' of matters of the wall and lead to the release of pmtics fragments in the strength of the light magnetic field spectrum or a photon.

Van der Waals forces

In respect to the Van der Waals effect, this **push and pull effect** is now very clear and easy to explain, this is to say as plasmas contains all Matters (Matter, Antimatter and Dark Matter) and these Matters are all made from the interaction of plasmatic magnetic fields, which leads to the creation of their Magravs, so that each Matter is *like a* ***independent entity*** within the structure of the plasma, at the same time plasma possesses its own Magnetic and gravitational field forces.

By the same measure, the atom, as an independent system, possesses its own Magravs in respect to other atoms in molecules. The same, the molecules have their own Magravs in respect to each other.

Therefore, what has been considered as Van der Waals forces of push and pull of molecules, these are simply Magnetic and Gravitational field forces or Magravs forces of one molecule in respect to any other molecule.

The Van der Waals force is in fact the pull (gravitational effect) and the push (Magnetic effect) of the individual molecules in respect to any entity (atom, molecule) around them.

CHAPTER 15

Interaction between Matters

Different Matters in their environment interact and create different conditions, and state of Matters are similar to the state of matter, as one can mix liquid with solid and gas with liquid in state of matter, the same can be done with different states of Matters, like allowing the pmtics of the Matter to interact with the Antimatter and further the Antimatter with the Dark Matter. As in the case of Matters, they are all pmtics strength dependent, where these kinds of mixings of states of Matters allow more profound effects to be developed. This kind of mixing between the state of Matters will open new world of science to mans' encyclopaedia of knowledge ***Matteorology*** *(knowledge of Matters).*

The process by which, Matters are created and operate in respect to each other within the construction of the plasma has been explained in previous chapters. These Matters individually possess their own properties and create their own effects in respect to their environment, both individually and in conjunction with each other.

What is important to understand is: *What happens when these Matters interact or come to collide with each other within the plasma or their environment?*

What is the outcome of the amalgamation of the plasmatic magnetic fields strength of different Matters with each other?

Let us consider some of the variations between interactions of different Matters.

Interaction of Matter with Antimatter

The Matter is composed of ***weaker*** Magravs strength than the **Antimatter**. In this case, the Matter always gets attracted towards the Antimatter.

In the case of the plasmatic magnetic fields of the Matter ***colliding*** with the plasmatic magnetic fields of the Antimatter, the Matters components will **get *absorbed* into** the larger and stronger pmtics strength, by order of magnitude, of Antimatter.

What can be observed from this impact is the release of some plasmatic magnetic fields residual as pmtics, like release of some lights or rays or magnetic residual. The content of the dynamic plasmatic magnetic fields of the Matter or its energy is *absorbed into the environment of the Antimatter* and gets mixed in within its structural magnetic fields strength. At this point there will be no more signs of the Matters past existence.

Where, most of the rays released in this interaction are mostly due to the coming close of the two Magravs of the two Matters, rather than the splashing of the pmtics from the

surface of the Antimatter.

This is like when a drop of water falls into a cup of tea, in this case, the drop of water becomes part of the larger teas' liquid.

Majority of scientists working in this field, are lead to believe, as the Matter and the Antimatter collide, due to their charge balance after the impact, the content of the two Matters ***disappear into nothing***, except some residuals released as energy, gamma rays or photons, then, in their opinion, there is nothingness left as these two Matters' charges balance each other out.

Such a belief and concept is against any natural laws of existence. That is to say, there cannot be a position of total annihilation of both Matters, where there can be nothing left at all after the two actual Matters in possession of Magravs collide with each other. This nothingness of the two Matters after the collision of the Matter and the Antimatter is a rash assumption and incorrect.

In fact, the Matter and so-called the Antimatter by their pmtics strength order of magnitude in the matter world, is like the Earth slamming into the Sun, and then saying that after this collision there is nothing left of the Sun and the Earth, except some outwards splashing fragments of plasmas from the surface of the Sun. This is illogic attempt at a scientific explanation for such a real physical event.

The Matters of the Earth would cause a small splash on the Suns' surface. This splash then releases some plasmas or gamma rays or photons from the surface of the Sun. Then the plasmatic magnetic fields components of the Earth become part of the plasmatic magnetic fields of the plasmas of the Sun. This is exactly the same incident as when pmtics of the Matter collides with pmtics of the Antimatter.

In view of this principle in physics of the conservation for energy, ***nothing in the universe is lost or can disappear***. They just change their magnetic fields strength and their compactness from one form and level to another.

Thus, collision of the Matter and the Antimatter create nothing but the Antimatter, with more content of different plasmatic magnetic field's strength of the Matter components inside it. Therefore the outcome of this collision is mainly the Antimatter balance remaining.

Interaction of Matter with Dark Matter

This follows the same principle as the previous states of the Matter and the Antimatter. The content of the Matter then becomes the constituent Matter of the gravitational centre of the Dark Matter. With the difference, that in this case the Matter will not have to overcome any magnetosphere of the Dark Matter.

This interaction will be the same as seen in the universe matter dimension, where for example Stars and cosmic matters disappear into a Black hole in the universe.

In some instances, this process can disturb the overall Magravs' strength balance of the Dark Matter in respect to its surrounding plasmatic magnetic fields strength. This change can induce the production of slightly stronger or weaker magnetic fields strength magnetospheric conditions of the Dark Matter in respect to its surrounding field's environment.

In these rare cases, due to the change and unbalance of the magnetic fields strength between the new content and new Magravs strength of the Dark Matter, this new stronger or weaker plasmatic Magravs strength, allows the creation of a new magnetosphere field strength of the Dark Matter in respect to its environments pmtics strength to take hold. Then, what was the Dark Matter in a given environment, can in the same given environment, with a different and new plasmatic magnetic fields strength, now create and possess a new magnetospheric field strength zone in respect to the same environment's pmtics strength and then the Dark Matter can become like the Matter that is more visible.

This incident has been recorded by cosmologists a number of times. Where, *out of nowhere*, Matters appear in the Dark spaces of the universe.

In fact, even changes in the tightness of plasmatic magnetic fields in the span of universe, can unbalance the Dark Matter environment pmtics strength and make the Matter visible.

This magnetic unbalance of the environment causes different balance condition around the Dark Matter pmtics, and then out of nowhere stars appears in the Dark spans of universe.

The interaction of Antimatter and Dark Matter

In the case of the interaction of the Dark Matter and the Antimatter, there are clearly several scenarios, which are possible.

1) Scenario 1

This case is the most probable and is considered to be the norm. This interaction is a collision of the giants of the Matters of the plasmas'.

Assuming that this scenario of interaction takes place within the environment of an initial fundamental plasma.

Considering the construction of pmtics strength of the Dark Matter and the Antimatter, when, these two Matters of the plasma collide, the outcome is normally production and release of new and balanced plasmatic magnetic fields environments. In this case, it is considered that each of the Matter's components of the plasmas keeps their pmtics strength plasma status.

Due to the enormity of the quantity of the amounts of the two plasmatic magnetic fields of the ***Antimatter and the Dark Matter amalgamation*** (denoted as **A-D Matter**), new supersized, unstable giant plasma is initially created. This new plasma needs to reach stability over the entity of the plasma as a whole for it to survive. Thus, the new super giant plasmatic magnetic field has to find a new Magnetic and gravitational balance and equilibrium within itself.

For the new giant plasma to reach the new equilibrium condition, the new plasma has to, and always does, release its excess plasmatic magnetic fields into its surrounding environment. The new released plasmatic magnetic fields have to be in balance by themselves too, for them to exist and stay within the gravitational fields of the A-D Matter.

This new release of excess plasmatic magnetic fields near to A-D will contain some of the Antimatter, some of the Dark Matter and some other newly balanced interacting and attracting weaker plasmatic magnetic fields of different strength in the Matter pmtics strength level. These *weaker fields* are mainly from the leftover weaker fragments of the collision of the two giant Matters. These new released small bundles of weaker plasmatic magnetic fields strength themselves due to their proximity and their source of origin, these usually bunch-up and become a new *miniature plasma version of the original initial fundamental plasma within the A-D Matter.*

At the same time, this newly created mini-plasma still has to keep it's own balance and the balance of the whole of the original Matters pmtics and stays' within the Magravs hold of the giant A-D Matter mixture. This mini-plasma creates its own Magravs and then this mini-plasma has to have a Magravs positioning in respect to its original initial fundamental plasma. Thus the new mini-plasma is forced to take a new position and new gravitational positioning in respect to its larger neighbour of A-D and it is at this point that it is forced out of the A-D Matter plasma environment, but still in A-D Matter Magravs catchments' area, therefore this mini-plasma attempts to stay in the orbit of its mother seed, and becomes the **initial fundamental satellite plasmas'** of the original A-D Matter.

Further on with the same process, the A-D Matter mixture has constituents of two unbalanced and un-matching plasmatic magnetic fields strengths of the Dark Matter and the Antimatter within it, at some point, the two Matters plasmatic magnetic strength fields separate and the balance returns' to a new central plasma. By this time the central plasma due to this interaction, finds itself with a new rotating satelliteing smaller plasma.

It should be noted that pmtics of different strength ***never mix*** with each other, however they can be ***influenced*** by each other.

The collision of the Dark Matter and the Antimatter, and creation of new satelliteing mini-plasmatic Magravs rotating around the central plasma is the ***creation of the electron*** from the interaction and collapse of theses two Matters of the initial fundamental plasma. The interaction of the Antimatter and the Dark Matter of the Initial

Fundamental plasma leading, to the creation of a new central plasma and its satellite mini-plasma, lead to creation of **Initial Fundamental Atom** (hydrogen atom). This is what I call the initial fundamental decay of the initial fundamental plasma, or decay of the neutron.

The collision of the Dark Matter and the Antimatter is usually due to unbalance or some deviation in the plasmatic magnetic fields' strength of one Matter or other within the confine of structure of the plasma itself.

2) Scenario 2

This scenario happens usually when the F1 collapses altogether, sending the two giants Matters of the plasma, the Antimatter and the Dark Matter, to collide head on.

In this case, there are two possibilities, which remains open to the new A-D Matter plasmatic magnetic fields.

A) The first possibility is that the plasmatic magnetic fields of the Dark Matter superimposes the Antimatter plasmatic magnetic fields.

By this process, the outcome will be a giant size plasmatic region of the Dark Matter and energy in the plasma.

This new giant Matter, due to the interaction and amalgamation of the two sets of plasmatic magnetic fields strength and their Magravs of its two separate Matters will have large-scale gravitational pull system, with no clear magnetospheric zone boundary in respect to interaction with its outside plasmatic magnetic fields strength environment as before.

This will be a giant gravitational region that will have massive pulling effects, but its core cannot be seen due to the lack of interaction of its magnetospheric condition with its environment's pmtics. Therefore, this region even possessing enormous amount of gravitational field pull has no balance interacting Magnetic field strength or a balance Magravs strength in respect to its surrounding pmtics strength. This Matter seems as if it does not exist, or appears to be Darker than it's surrounding. Around this area, enormous gravitational pulls' can be detected, but the cause of all the pulling and where the gravitational pulls is coming from are not clear and obvious. Where, this darkness is purely due to the balance magnetic fields strength of the magnetosphere of this Dark Matter and being too similar in strength in respect to its surrounding environment pmtics strength to be able to generate the magnetospheric light.

Thus, this area is and looks like as a giant eating machine, which has a lot of energy and gravitational pull, but no visible source to show for its Dark energy as was explained before (36) and the Dark Matter. This condition is usually referred to as the ***Black Hole effects*** (13).

In fact, the only way that one can say that the Antimatter is cascading in this case by the

Dark Matter, is by observation of the appearances of the interaction of the Matters Magravs patterns of the magnetosphere of the whole structure from the outside of the structure.

In these cases of cascading, where the two pmtics strength at the point of separation between the Antimatter Magravs strength and the Dark Matter Magravs strength, internal layers cannot mix due to their different magnetic fields strength, this interaction between two different pmtics field strength at this magnetic interface, creates an ***internal pmtics-interface zone***. Where, this pmtics strength interface zone creates a different zone gravitational and Magnetic field strength on the outside of the magnetosphere surrounding environment of the cascading Dark Matter, and the position of this zone on the outer regions of the Magnetosphere of the Dark Matters are in position and in-line with its physical position of the pmtics interface in the infrastructure in the centre of the cascaded Material.

This internal interface plasmatic magnetic fields zone can create ring-like zones around the outer boundaries of the Dark Matter magnetosphere, where these rings are like different colour or light intensity rings around the whole of the outer boundary of the Dark Matter in respect to their environment pmtics. Where, the thickness and the width of such a ring is equal to the thickness of the embedded Antimatter component.

The physical observation of these effects of the pmtics-interface strength can be seen in the gaseous planets which have initial solid core centre, and where different pmtics strength zones interfaces of different Matter layers are created internally due to their internal pmtics interfaces, as each interface is seen as one ring in the extended magnetosphere of the giant gaseous planets.

These type of magnetospheric rings are usually seen around the gaseous planets with a embedded and initiated solid matter centre cores, and as a number of different layers of the same or different gases are superimposed on top of each other over the life time of the planet. Where the solid matter due to temperatures of its blanketing of gases has become to be in the fluid state-of-matter and creates its own plasmatic Magravs forces. Which the Magravs of matters core interact with the Magravs of the gases in different layers, and/or gas-to-gas of different layers. Where, at the interface of each layer of matters, different Magravs strength are generated and their regions and position of pmtics Magravs strength balance are observed, as one ring related to that specific interface, around the outside of these planets magnetosphere environment in their solar systems. This is exactly how the rings of the Saturn and the Jupiter are created (17, 18). In fact if one could count all the numbers of the dark rings of the Saturn, one should be able to say how many layers of gasses the planets has in its constituent inner structure. This is like counting the rings across cutting of the trunk of a tree to establish its age. How these rings have come to be made and how layering of different gas layers have been achieved by the planet Saturn has been explained in full in the papers under reference 17 and 18.

These multi-layer gas rings actually can bee seen around some stars too, but these are hidden within the intense light from the surface of the star.

The application of multi-solid core and rings in Magravs positioning reactor

When this principle is used in a Grapos reactor, this gives the system and craft a major impenetrable multilayer magnetic shielding ring for protection from cosmic dusts or in defence technology for maximum shielding from incoming asteroids on the path of high-speed crafts (17, 18, 29, 33). Or these types of magnetic multiple ringing can be used around a craft for submerging in deep ***liquid environments*** (29, 33). Where, the craft using these systems become liquid-sealed and Magnetic field and gravitational depth positioning, and temperature independent.

B) The second possibility, with this interaction is that the Dark Matter's plasmatic magnetic fields moves to the centre of the Antimatter's plasmatic magnetic fields region.

In this case, the Dark Matter plasmatic magnetic fields are superimposed and they are cascaded by the Antimatter plasmatic magnetic fields.

Considering that this scenario happens in the environment of the initial fundamental plasma and between its Dark Matter and the Antimatter components. In this case, again, giant plasma of double layers of the Antimatter and the Dark Matter is created and the new plasma will suck-in the Matter components and the electron or another pmtics around it into itself as before.

Nevertheless, this interaction gives the impression of a sudden expansion of the Antimatter as a bright Matter. That is to say that the magnetospheric zone of the Antimatter becomes the total magnetospheric zone of the central plasma. Thus, this new combination of interactions will have a new plasmatic Magravs strength of the three Matters. These being the contents of plasmatic magnetic fields' strength of the Matter, then the Dark Matter and then the plasmatic magnetic fields of the Antimatter.

All these Matters again as previous scenario being cascaded this time by the pmtics of the Antimatter. Where, the weakest pmtics strength of the Matter will be in the centre, superimposed by the plasmatic magnetic fields of the Dark Matter. Then, these two Matters are superimposed by the pmtics strength of the Antimatter on the outside.

The new giant combination of three Matters at this stage is a super plasma size, and this is a temporary condition and is called the Nova state of the three layers Antimatter cascading of the plasma.

Where, the Antimatter's strong plasmatic magnetic fields strength are on the *outside* and create enormous amount of light compared to when there was a balance state of the initial fundamental plasma. This sudden expansion of the Antimatter due to ballooning of the other Matters inside the cascade gives the impression of a sudden expansion of the bright plasma, or what is called a ***Nova condition***.

Sometimes in stars, due to the internal interacting dynamic plasmatic magnetic fields of the plasmas, and through natural process of interaction like fusion or fission or nuclear decay and generation of weaker fields in the centre of these objects, Dark Matters and

Matters pmtics strength conditions are generated and held in the centre of the star.

This generation of new Matters *internally* will cause the expansion and ballooning of the volume of the star initially for a short time. Further on, at this point, as the content of the new-cascaded plasma of Matters can push its boundary to limits beyond the internal central gravitational strength pulls of its three different Matters, then the star explodes in its environment.

This explosion leads to the total release of the internal plasmatic magnetic fields of all its constituent Matters and pmtics inside the cascade. Therefore, these Matters and plasmatic magnetic fields can again start new interacting conditions and environments. Henceforth, the whole cycle of the creation of fundamental particles, then initial fundamental Matters, plasmas, atoms and matters starts again.

This is in fact the normal cycle of the process of interaction and attraction of plasmatic magnetic fields strength in their confined of their environment. There is nothing more and nothing less to this natural cycle of regurgitation of plasmatic magnetic fields of different strength and conditions that these create for themselves and the effects they create to secure their existence.

That is to say, in the case of the plasma, this becomes the release of some particles, which gets absorbed by the other atomic plastic structures around the plasma.

In the case of a star, this becomes an exploding star, which its constituent plasma after disintegration becomes part of the soup of the galaxy and the content of the star gets absorbed in, for regeneration of new stars and so on. In the case of galaxies, this is the same; further on the same happens to universes and so on.

There is the possibility of another scenario for the same new cascaded materials, and that is:

Once the Nova is created and it is not allowed by the external field force in its environment to expand its boundaries beyond its combined internal Magravs' strength, it is at this point that, the *internal* gravitational fields of its three Matters interactions starts to lock into each other and create one overall Magravs force in respect to their outside environment.

This new overall plasmatic Magravs force, which is created due to the interaction of plasmatic magnetic fields of the three layering and three different pmtics strength of the three Matters (the Matter, the Dark Matter and the Antimatter) in conjunction with each other [This is a similar principle to the systems of three internal layers for creation of gravitational field forces of the planet Earth as explained in Chapter 1 (12, 18)], once this new gravitational fields forces takes place and takes hold, and becomes operational, then purely due to its interacting layering gravitational strength magnitude, and the span of its coverage the Matters of the cascade will start pulling all three plasmatic magnetic fields components of three Matters tightly to itself. This causing the retraction of the matters of the Nova and hence contraction of the Nova. The Nova volume shrinks, in response to the new created three layers interactions' Magravs strength.

Thus, by the time all the Matters settle down to their new position, this new plasma will be a condensed Matter of all sorts. As each Matter layer, due to their plasmatic magnetic fields strength will hold onto their position within the construction of the cascaded plasma. Once, the new matters settle into their new positions from the previous giant Nova condition, this new plasma state of the three Matters will be a fraction of its Nova size. Nevertheless, its size will not be equal to the total size of the collection of all three previous Matters and its initial fundamental plasma size, but its overall internal gravitational fields strength will be enormous compared to its past when it was the whole initial fundamental plasma.

By the this stage the content of the outer layer is still active plasma with bright lights of the Antimatter, but due to the new strong internal gravitational pull of the Matters, even the light that is created through the interaction of plasmatic magnetic fields in the outer regions of the Antimatters, interacts with the strong internal field of the cascaded materials and converges inwards (Chapter 9). This giving the impression that the plasma or the Star is dormant or dying, but in fact the systems has never been as powerful and active internally as this in its whole existence even as plasma or as a star.

Interaction of plasma with plasma

Another possible scenario in interaction of collection of Matters as a plasma, is in collision with another collection of Matters as a plasma.

Electron interaction:

i) For example, there is the possibility that the plasma of the electron can be fused into the plasma of the central nucleus of its proton.

"I have called this interaction and fusing of the electron to its proton plasma the ***inter-atomic fusion principle*** (37). I consider this method to be a simpler and more practical to achieve fusion for production of energy, than the path being followed by the present scientific world in fusion reactors technology in trying to fuse two large plasmas of the proton, without any tangible success up to now after over fifty years of research and development to attain any sustainable fusion cycle to produce usable energy for domestic market. These systems being like of the Jet project (Tokamak) in UK and the present upcoming ITER (Tokamak) project being built in the South of France at the cost of over ten-billion US dollars investment with the final goals of only to produce for a few milliseconds of energy within 10 year's time.

The process of the inter-atomic fusion is shown step by step in figure 39.

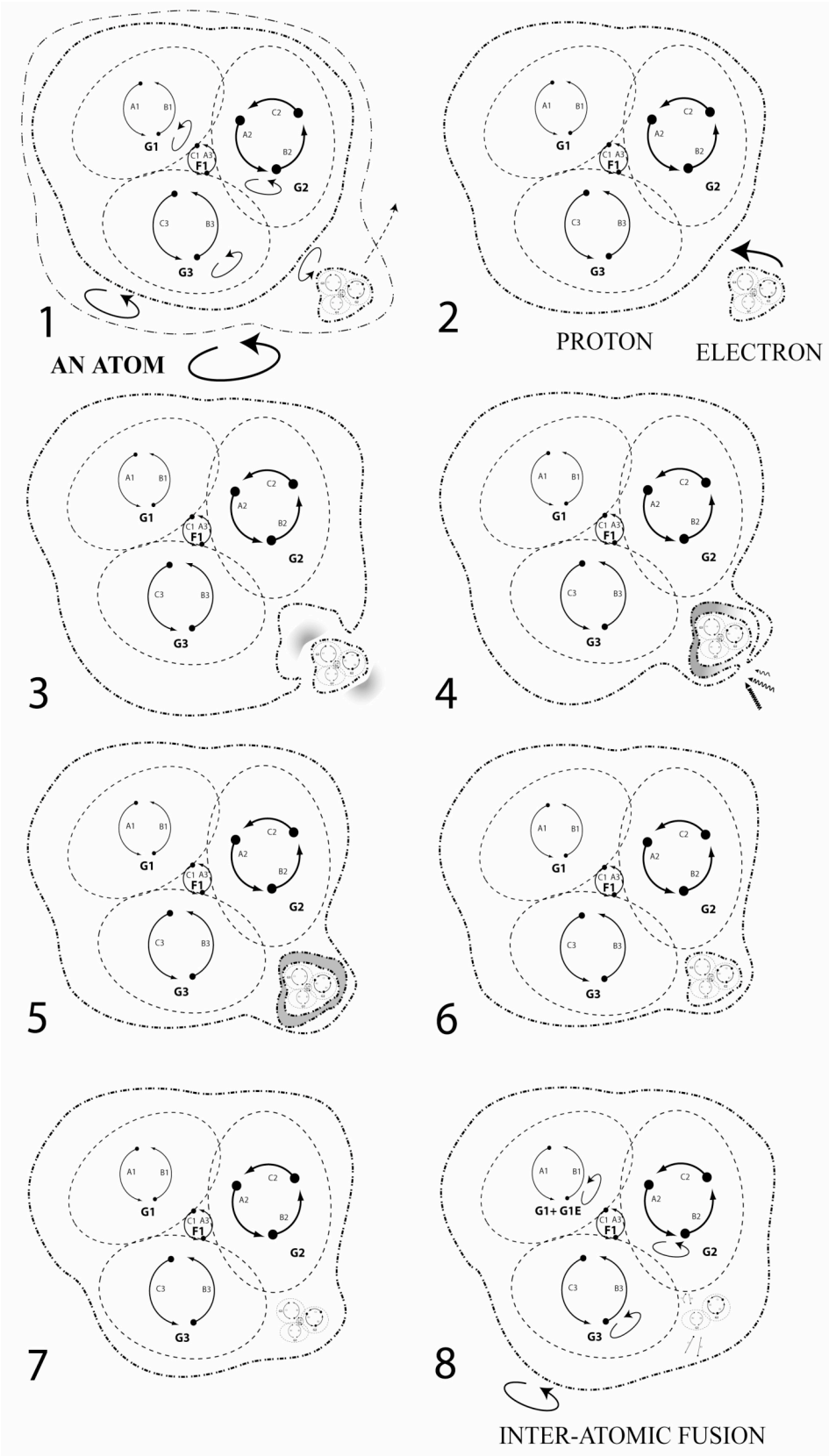

Fig. 39: Schematic process of the inter-atomic fusion.

Where, initially by using Dilution plasma reactors (Chapter 23, Fig. 57), by feeding the atom of hydrogen into this reactor cores (Chapter 21, Fig. 54), and then in allowing the magnetic atomic structure to dilute and to open up in the soup of the plasma of the reactor (Fig. 39 diagram 1) into its sub-components of electron and proton. At this point the magnetic fields' strength of the soup of the reactor is brought to the levels, which now can be matching with the plasma of the proton pmtics level, for the reactor fields strength to match the overall Magnetic and gravitational pmtics of the protons' plasma. This is the magnetic field strength level of the binding of the plasma, which is called the Coulomb charge barrier of the plasma. Which at this point, the Matters' of the electron are more free and can be gently Magravs positioned to join up in to the Matter components of the proton.

This is the natural method of fusion in its basic form, where there is no need for the huge magnetic fields forces to achieve what happens naturally in the universe to fuse an electron of atom to its proton. The same process of fusion in the plasma dilution reactors' technology can be used for fusing Matters, plasmas or even atoms.

This inter-atomic fusion is done in a magnetic field environment of ***soft*** plasmatic magnetic fields forces and at the same time in a similar magnetic fields forces strength of the same atom environment of the two similar plasmas of the proton and the electron of the same atom, where, in fact the magnetic fields of the outer cores of the reactor performs a similar job as the magnetic rings of the Tokamak systems in providing the containment magnetic fields. Where as in the plasma dilution reactors, at the same time natural gravitational and Magnetic fields needed for fusion criterion is provided by the operation of the fields in two cores of the reactor fields' interactions with each other.

If scientists use this method of creation of Magnetic and gravitational fields forces in the present Tokamak reactors', to replace the solid coil electric magnetic rings, they will achieve fusion in real universal conditions, fusion within natural gravitational fields forces environment necessary to accommodate the fusing of any plasma at a fraction of the present costs and in a very short time-frame.

With these soft magnetic fields in plasma dilution reactors, one can achieve more rapidly fusion than using current induced enforcing magnetic fields rings. These types of magnetic fields strength in dilution plasma reactors are similar to the magnetic fields strength of the plasmas and atoms, and hence they can be manipulated much easier, than, trying to force the plasmas' of two protons.

In comparison, that is to say, to make *an omelette*, it is easier to mix the contents of two uncooked eggs homogeneously as happens in plasma dilution reactors, whereas in trying to make the same omelette, this time by boiling the content of two eggs first into two hard boiled eggs, as Tokamak scientists have been trying to do for past fifty years to make the fusion in reactors by hard balling the content of plasmas (by squeezing the plasma with the use of external magnetic fields to a tighter, harder, smaller entity) and then trying to fuse the two hard balls of plasmas to achieve the fusion process. Then hoping, with increasing the speed of the two hard balls, that they can smash and fuse the two smaller hard balls together. That is why the present path of Tokamak technology in trying to achieve fusion is a sweet dream that will never come true.

In this inter-atomic fusion technology, smaller and weaker plasmas of electrons, which are already within the structure of an atom, are fused into the Matters' component of the proton of its central plasma (Fig. 40). This is a more realistic and practical method of fusion than the present, fusion technology in trying to fuse two large plasmas of hydrogen's protons together, and creating unmanageable heat, of several billions of degrees. Where, the tools and materials to control and harvest the energy of such huge temperatures, on the long term bases in small Tokamak reactors, does not exist within the known galaxies in the universe.

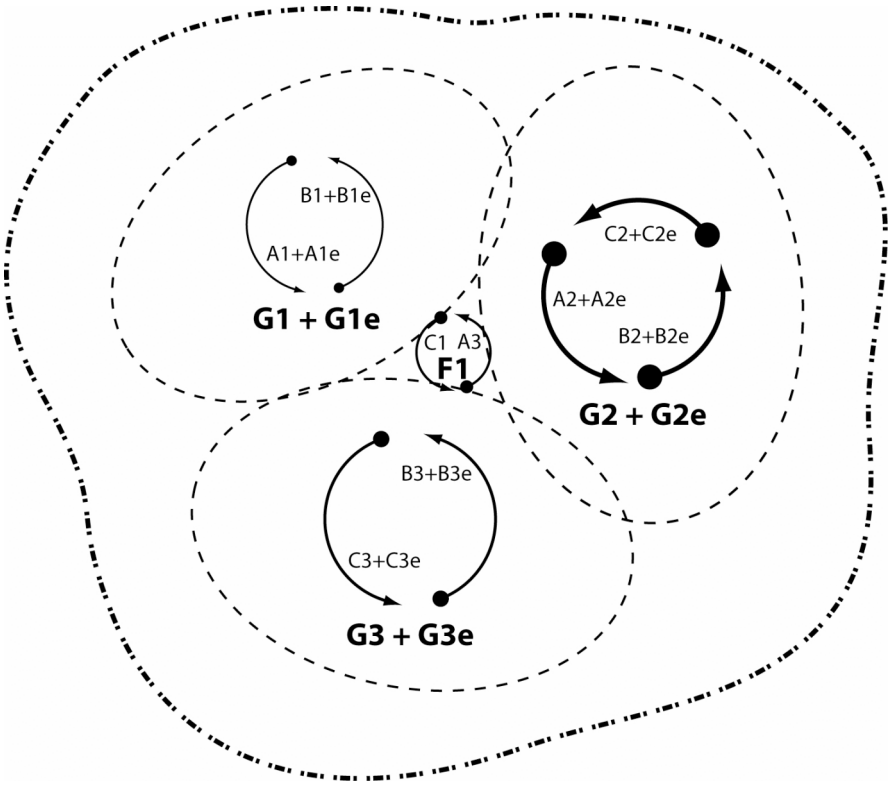

Fig. 40: Schematic diagram of the fused proton and electron plasmas.

In these processes of dilution plasma technologies, when the electron plasma is gravitationally positioned or encouraged to amalgamate its contents with the content of the plasma of the proton, as the two plasmas approach each other, the interaction of two plasmatic magnetic fields of the two plasmas will and can produce several scenarios, which their effects can be harvested for production of different energy levels or production of new materials and so many other purposes.

In brief two cases are discussed here:

a) If the strength of the pmtics of these plasma dilution reactors is set at a level, to be just below that of the total balance of the pmtics strength (Coulombs barrier) of the plasma of the proton, in this case, as the two plasmas approach each other, the initial stages' of the process of fusion starts, which this process begins and will be

accompanied with light and heat emission as in figure 39 - diagrams 1 to 5. This light or heat from this process can be used for example for present state of art technology turbine power generators directly. Where, the temperature of the interaction of the systems can be set at the optimum efficiency temperature of the turbine. Hence, operating these reactors in the same configurations as is done in the present fission reactor technology power generators to generate steam to run turbines. With the difference that these dilution technology reactors leave and produce no nuclear waste, and heat can be generated at any level as per demand of the system.

In these reactors, the Magravs strength similar to the plasmas' **Coulombs barriers** charges can be created and controlled. In the dilution plasma reactors' the magnetic fields created through the soup of the plasma will create and maintain pmtics strength, which can be similar to the magnetic fields barrier strength of the plasma of the proton. Where, the strength of the pmtics field in the reactor will decide the strength of the pmtics in comparison to the protons' plasma Magravs strength. As the pmtics strength of the reactor reaches more to the level of the Magravs strength of the plasma, then there is ***less resistance*** *and* ***less friction*** *between the plasmas of the proton and the electron*, when, they are brought together to fuse. Thus as the strength of the magnetic fields of the plasma can be reached by the reactor operation, this allows less friction and hence *less heat* to be produced by the interaction and by the gravitation of the two plasmas of the proton and the electron to fuse. By being able to control the pmtics strength of the plasma dilution reactors Matters' soup of plasma, one can dictate the amount and the rate of the heat release from the interaction of the two plasmas, thus one can control the heat output of the reactor, if the production of heat is the primary objective of the use of such a system.

In general, in being able to control the ***Coulombs barrier strength*** in respect to the given environment of the reactor, one can **vary** this barrier magnetic fields strength in the soup of Matters in the plasma dilution reactors.

Therefore there is no need even to fuse the plasma of the proton with the plasma of the electron, and by just bringing them close to each there to create the right friction when the Coulomb barrier is at the right strength, between the two plasmas, then the reactor can generate a controlled heat-output, or any other rays that is demanded from the systems' operations.

Therefore by *bringing the reactor magnetic fields strength to the level of Coulomb barriers*, one can bring into balance the magnetic strength barrier changes in the overall mixture of the reactor to any level from, or to the Coulombs barrier magnetic fields levels.

Where, the ***difference*** between the two, the **reactor** and the **plasmas' magnetic fields strength**, will decided the ***temperature output of the reactor*** when, the plasma of the electron is gravitated to the plasma of the proton to fuse. The outcome of the bringing of the two plasmas into each other proximity and the interaction of their Magravs, leads to the friction between the two plasmas, and the release of pmtics in form of heat. Where, the temperature of the heat released by this attempted fusion is directly controlled by the pmtics field strength within the reactor and in respect to the variation level from the

Coulomb barriers' pmtics strength level.

An example of this controlled heating of interaction pmtics in the natural world is the like of when the pmtics of the sunlight in atmospheric condition becoming in touch with pmtics of the cell of the human body. Where, as the pmtics of the proteins of the cell are always constant, by varying pmtics strength of the direct sunlight, the heat released from the interaction of these two pmtics, the human feels the increase in the pmtics strength as heat of different degrees. The stronger the pmtics of the sunlight, the more heat is produced from the interaction of two pmtics, thus the warmer one feels. This is like walking from the shadow into the sunlight.

The phenomenon of heating during illness, happens due to the interaction of pmtics of a bacteria within the blood protein pmtics, where as a blood cell comes in touch with a stronger pmtics of the bacteria, the level of the interaction of the extra pmtics from the structure of infection, in ***interaction*** with the blood cell, manifests itself as heat or the increase in the body temperature (this is explained in detail in the paper: Universal order of creation, to be published as a book), where the interaction and possible ***fusion*** of two pmtics of the bacteria and the body cell leads to a release of heat, called "an infection" temperature. This being the reason why the same pmtics of bacteria can have no affect on some human bodies and the same infection can create high temperatures like 41°C +. The reason being that the cell of the one with the high temperature has a lower pmtics strength, thus the interaction of the two infection and the body Magravs pmtics creates more release of fragments of pmtics as heat. When the temperature reaches a level that the Magnetosphere of the human protein reaches its dilution point then the cell is de-structured.

b) When the neutron is needed to be produced from the atom of hydrogen in space for production of heavier atoms, one can follow the process from stage 1 to stage 8 of the Fig 38. In this process the pmtics strength of the reactor are set to be nearer to the binding Magravs strength of the boundary of the protons of the plasma, so that the electrons' plasma literally melts into the protons Matter structure and the matching pmtics of both plasmas of the proton and the electron. Which these plasmas and their pmtics were all of the same origin; this is amalgamation to produce new neutron type initial fundamental plasma. This is the process of the decay of the initial fundamental plasma in reverse, using the same original components of Matters pmtics of all three matters of the plasma. Such a neutron can be added to the construction of the atomic structure of lighter atoms to create **gap(s)** needed for Magravs positioning for the protons of the nucleus to accommodate an extra proton and its accompanying electron for production of even heavier atoms, for example for the production of carbon, oxygen and nitrogen to produce protein base nutrition in deep space travels. Alternatively, one can produce atoms of any matter from initial hydrogen atoms, through the use of the same method of progressive accumulations of protons and neutrons in fusion in plasma dilution reactors.

ii) The other condition is, when the plasma of an electron is attracted to the protons' plasma, ***but does not get absorbed*** within its pmtics, due to their Matters strength friction at the zones of contact of the two plasmas.

As has been explained in previous chapters, the electron is itself a plasma condition and a collection of dynamic pmtics of Matters. Where through the method of its construction and motion around its nucleus, this electron is always in proximity of other electrons of the similar construction or it is in the proximity of larger plasmas such as the neutrons or the protons of the nucleus of its atom.

The ***Motion*** *of the electron* around the proton is created due to the construction of its internal Matters (Chapter 19). Similarly, it has been explained that the interaction of two pmtics due to their friction lead to release of pmtics strength fragments of lower strength of pmtics or rays in the electro-magnetic field spectrum of the light.

Now it is very simple to understand how light is released due to external factors. When the electron of the atom is forced to come close enough to another electron or the components of the plasma of its nucleus or a nucleus of another atom. So that, the interaction of the two plasmas Magravs of the electron and the proton leads to the release of lower magnitude pmtics strength fragments that, its pmtics strength are in the light electromagnetic spectrum (It has been explained that when two plasmas interact and collide; the pmtics fragments of their collisions always releases pmtics in the light bandwidth)(Chapter 7).

This interaction and collision of the pmtics of the two plasmas does not mean amalgamation of the two, but in coming too closed to each other, the two pmtics strength touch and bounce off due to their dynamism.

Hence, as the electron has lost some of its pmtics due to the interaction and collision, with the pmtics of the proton, so now being in possession of different Magravs strength, the electron accepts a new Magravs positioning (Chapter 19) in respect to its proton plasmas.

This interaction of the two plasmas creating the closeness or distance of the electron to its systems' central Magravs point, or what is called that the electron finds a new *ground energy level* position after releasing some of its energies as light, this is then a new Magravs positioning of the electron in respect its protons' Magravs strength forces, which is acceptable by both plasmas Magravs within the atoms structure after collision between the two pmtics of the plasma of the electron and the proton or other plasmas in its vicinity.

Thus when plasmas interact like the plasma of the electron and proton, this leads to the creation of light in the majority of case.

CHAPTER 16

The fundamental difference between Inertia and Gravity

Inertia is said to be due to the total interaction of pmtics of Matter(s) of a solid object without the central dynamic cores that can create Magnetic and gravitational fields forces.

Inertia, through the new understanding of the structure of the plasma, can be simply defined as "the pmtics and gravitational fields due to the Matter in the matter (solid, liquid, gases) components of the plasma (Fig. 41 link F)"

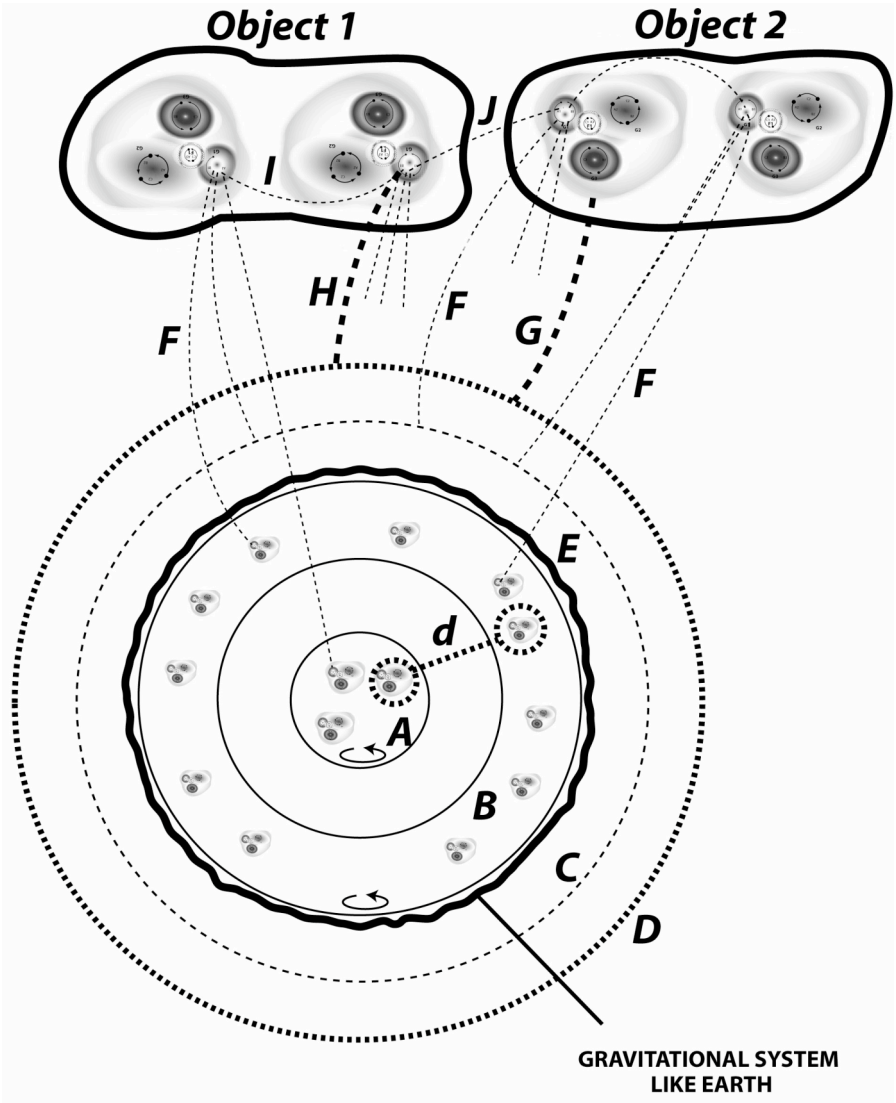

Fig. 41: Interaction and connection between inertia of Matter pmtics of an entity (I and J) in respect to another entity and their interaction (F and H) with magnetic field (C) and gravitational field (D) of systems respectively.

Gravity is simply defined as ”the total pmtics Magravs created by all components of the Matters (Matter, Antimatter, and Dark Matter) of the plasma (Fig. 41 link D and G, and Fig. 42 Link G).”

Inertia is said to be due to a *total collection of pmtics* of the constituent Matter(s) of atoms and molecules of an object, interacting and attracted with each other and any other Matter(s) or matter(s) or Magravs.

The principle of inertia is applicable to the Dark Matters and the Antimatters as well as the Matter components of the plasma in the universe.

As each atom is made of and possesses specific pmtics strength, these fields, in interacting with each other in the state of matter (solid, liquid and gas), create their own total Magravs by addition of the overall magnetic fields of all the atoms of the structure of any matter. The structure of the matter could be made of molecules or an asteroid or any physical object, which is void of gravitational pull, but in possession of pmtics Magravs' pull of Matter component of plasma, due to the construction of components of its neutrons, protons and electrons of matters. These pmtics, in being interlocked with each other, cannot create a dynamic Magnetic and gravitational pull or interactions between the constituent pmtics of all the Matters of an object. Nevertheless, they create gravitation in between the Matter components of the Matters of plasmas of the object.

In other words they have or create gravitation in respect to Matter-to-Matter components of plasma, or this singularity Matter attraction or gravitation of the total Matter of plasma, is called the **Inertia**.

As the **Gravity** is due to the overall dynamic pmtics strength of all Matters of an object, which is in possession of at least two **sets** of dynamic pmtics in respect to other pmtics, where, the interaction between two sets of dynamic pmtics, leads to the creation of gravitational field forces and simultaneously Magnetic field forces for plasmatic magnetic fields, or rays of magnetic fields, or the whole Matters of an object, this being a planet or a star or others.”

In the case of larger objects with multi-core configurations like Earth, the multiple pmtics forces of dynamic multiple-core objects are loose from each other. Hence, the overall dynamic pmtics of their Matters can interact, creating much more active fields to be brought into play. These being, the stronger magnetic fields constituent components of the plasma; Matter, Antimatter, and Dark Matter, F1 zone fields and all other transition zone fields to interact with each other within the plasma.

That is to say, that the collective **free Matters** of the plasma create a stronger pull or gravitational forces than when the same independent are compacted and cannot be free in a dynamic condition in matter (solid, liquid and gas).

Gravitational fields, due to their free motion and strength of interaction of their Matters with others of the same, can span and reach further a field in the environment.

Gravitational field forces are always stronger and span wider in their given environment, than their inertia of individual Matter counterparts, simply because

gravitational field forces of planets or stars are mainly created by all components of pmtics of Matters of the plasma (Fig. 42), rather than the collective plasmatic magnetic fields of individual types of Matters' components of the plasma or the matter.

Planets' and stars' total pull is a combination of the gravitational fields and inertia pull of all their constituent Matters and matters. These composite pulls are created due to the dynamic plasmatic materials of their constituent Matters in the inner cores of these objects in respect to each other, plus the total pmtics interaction of their matters.

Through tests, it has been proven; that the Magravs force strength of a dynamic object is independent of temperature and pressure of their cores. Where, we do not consider this to be the same for the inertia of the matter (solid, liquid and gas).

At the same time, Magravs of a dynamic object can vary as the strength of its Matters pmtics constituent changes. Where, the inertia of the solid matter is always constant, both in respects to the same initial given position.

It is considered that Matters, in general, possess Magravs forces due to their dynamic construction of their pmtics.

As much as the universe has inertia field forces, in respect to Matter components of the plasma, there is ***Antimatter inertia*** in respect to the Antimatters components of and ***Dark Matter inertia*** in respect to the Dark Matter components of the plasma or the universe (Fig. 41). In fact, a collection of the Antimatter and the Dark Matter can possess inertia similar to the physical Matter conditioning of their environment. Therefore, the same matter possesses separate Dark Matter and Antimatters inertias too.

By the same measure, it is to realise that there are Matter Magravs systems as are Antimatter and Dark Matter Magravs systems in the universe. In understanding this clarification, in the systems of attraction of Matters, reactors can be build which are inertia dependent and not gravitational dependent.

It is important to note that; gravitational fields of planets and stars are all created by the Matters components of plasma. This means gravitational fields affect all Matters of plasma (Fig. 42), where inertias of certain Matters affect only that particular Matter component of the Plasma. At the same time, it is clear that gravitational field reactors can be produced in such a way that their gravitational fields *can attract certain Matters only*.

These systems will be like laser systems with the advantage that the laser operation can work ***in reverse***, that is to say the system can send rays of a given pmtics strength as well as attraction or gravitating the same rays and collection of pmtics towards or into the system too.

These systems can or will have, single or multi-molecules pmtics gravitational settings, that can be attracted to, or repelled by only specific pmtics strength, to or from their environment.

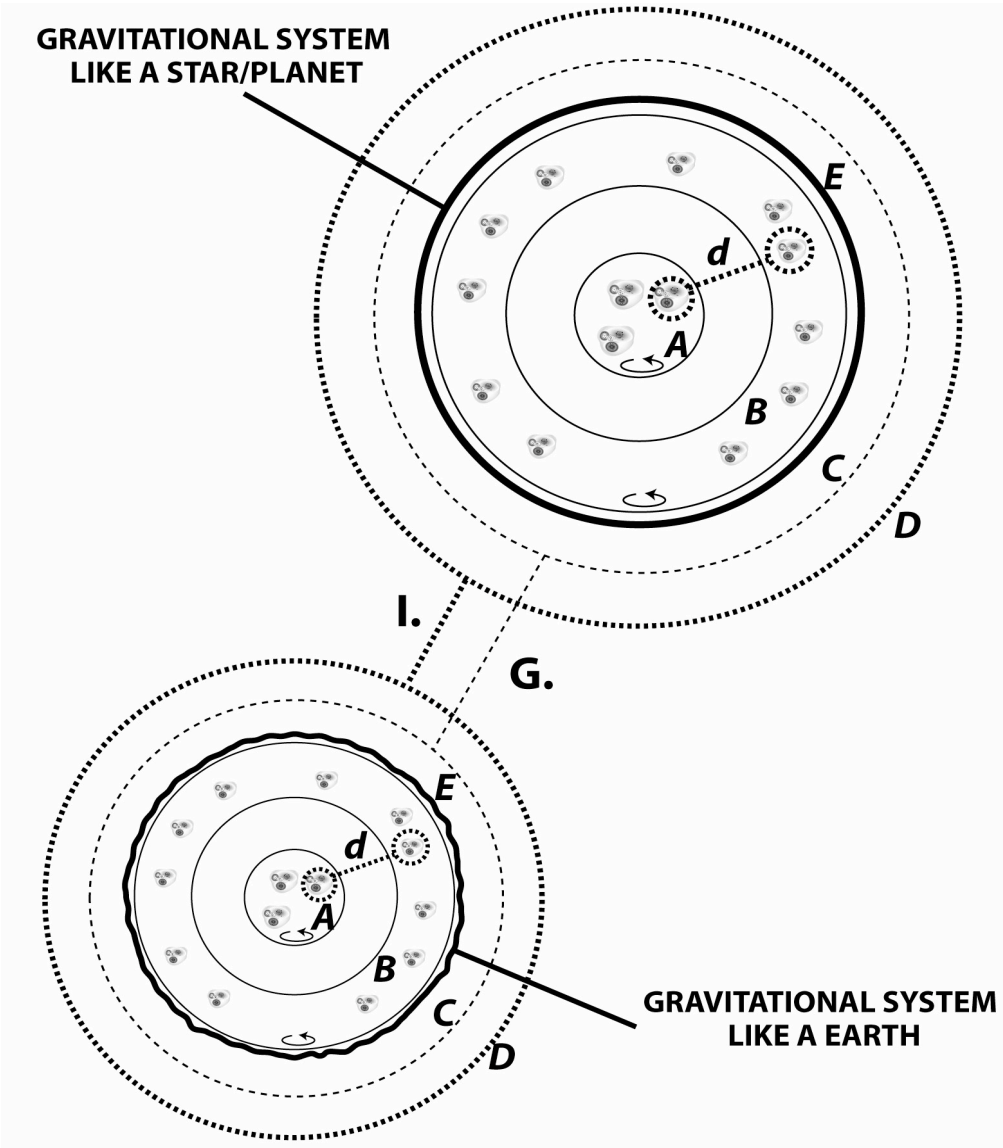

Fig. 42: Interaction between the pmtics Magnetic fields (I) and gravitational fields (G) of two Magravs systems.

Note: In fact the term used as "gravity" has to be explained as gravitational and Magnetic field forces, as when an object is attracted by gravitational fields of a matter, like the Earth, at the same time it is repelled by the Magnetic field forces of the object too. Thus, when talking about gravity it is correct to talk about the overall Magnetic and gravitational fields (Magravs).

These simple mono- or multiple-setting gravitational or inertia systems (Fig. 41 and Fig. 42) can be used for specific *extraction* of certain Matters, matters or materials from the universal Matters or matters soup.

Such systems, will change the present industrial systems thinking that magnetic attraction is only *limited to ferrite metallic objects*. Man has now the possibility to make systems *that can attract* ***any matter*** through the development of these systems."

These systems for example can be used, once set to appropriate pmtics gravitational

field strength levels, so that they can extract only the CO_2 from air, or specific poison from water, or rare metals from the Earth and space and so forth (31).

These reactor systems can be used for production of proteins for human consumption and so forth in the future space travels (32, 34, and 38). The production of proteins like matters, through gravitational plasma dilution mixing has been tested and different matters were collected in several tests in summer of 2008. In these tests, the proteins produced and extracted from the reactor cores caused the damage to the ancillary systems of the reactor set-ups. These proteins layers were physically visible and tangible.

Using the mono-Magravs systems (38), new matters can be extracted from other environments, like nano-materials of all sorts. These systems can be used to produce specifics matters too, matters like, uranium, hydrogen and so forth from the plasma of the universe as the needs for their use arises.

Thus through the understanding of the principle of mono- or multi-gravitational and inertia systems, reactors can be evolved that are gravitational to one object or one matter or one Matter only. Through understanding of the interaction of the plasmatic magnetic gravitational principles, reactors have been built, that have a Magnetic or gravitation to plastic at one point, and by resetting its configuration becomes magnetic to carbon and so on. Thus, mono-gravitational and inertia systems can be developed that have specific magnetic attraction or repulsion to one Matter, matters or any Matters of the plasma that can be expected of them through their pmtics strength operation setting.

On the other hand, the repulsion technology of the same Grapos can be used to send the Dark Matter and/or its pmtics energy as the Dark energy of the same plasma of specific pmtics strength into deep space for specific applications.

These types of gravitational lasers type reactors can be used for example in communication systems, where the information packs, using mono-pmtics strength of the Dark Matter and Dark energy can be sent through the system, so that the information can be packaged in the Dark Matter-envelop and sent without resistance or loss of energy, for it to travel with speeds beyond the speed of light to its destination anywhere in cosmos. The speed of communication through mono-Magravs systems are speeds which can be several times faster by order of magnitude than the present used state-of-the-art communication systems with satellites and microwave technologies. These speeds of transfer of information will be, by order of magnitude, faster than the speed of light.

These **GR***avitational l***ASERS** systems, that can be called "**Grasers**", can be used for example to avoid a head-on collision and destruction of crafts by an asteroid in the path of the motion of crafts in deep space (33), or within atmospheric condition. The present missile technology due to its slowness through development of these reactors are obsolete, as once fired to protect the craft in space, for example from asteroids by the time the missile will arrive at the point of destined collision between the spacecraft and the asteroid, maybe it will be years after the craft has past that point.

These mono-gravitational or mono-inertia systems will bring to Man the realisation that

the time of making war-machines has come to its end.

As Man will come to understand, soon enough that using these mono-gravitational or inertia systems against one another as tools of war will mean and will have only one outcome, and that is a total wipe-out of the human race from the face of the Earth. The men of war through this technology will come to accept peace not out of their pleasure but out of the fear of their own demise.

The use and capability of the use of this knowledge and of the effectiveness of these *mono-Magravs system*s lethality, has been the cause and the keeper of the peace in the universe. No chance, will be given to the Man, to change the tranquillity of universal peace by use of this technology.

Man through the lethal powers of these mono-Magravs systems will be taught an unforgiving and painful lesson, if he ever tries to use this technology and knowledge to carry on with his aggressive behaviours, as has been his habit for centuries on his own planet. Then this will be the coming of the end of the term of the Man in the universe.

It is clear that any celestial object as the planets, stars and galaxies, are all created through the attraction and interaction of these Matters and matters, their interactions and their constituent plasmatic magnetic fields. These interactions and collections of Matters and matters in respect to the plasmatic magnetic fields strength, which larger objects possess by their order of magnitude, decides' what will be in their part of their environment. That is to say, the plasmatic Magravs created by the plasmatic magnetic fields of Matters in the inner cores of the stars in principle will decide on the size and the span of the dominion of its field in its environment. Then these Magravs strength and their balances dictate what matters or Matters will be attracted to the atom, molecule, planet or the solar system.

This principle of mono-gravitational plasmatic magnetic fields strength forces is the main reason in the universe that why certain planets only retain one element in their structure. For example, this is one of the reasons why the planet Saturn is mainly made of helium on its outer layers as its main constituent matter (17). The reason being that the initial Magravs of the interaction of pmtics of Matters and matters in the inner cores of the planet has been set to be equal to the helium plasmatic magnetic fields strength of matters in that part of solar system in the early life of the planet.

This mono-Magravs positioning field strength of the Saturn is one of the reasons, why this planet, with its strong gravitational field forces, does not pull in and absorbs a large number of asteroids from the Astor-belts. The other reason is that, mono-Magravs systems possess very strong Magnetic fields too, which this is one of the reasons why this planet can keep the matters of asteroids in check.

Alternatively, certain galaxies have more of one matter like hydrogen than the others having nitrogen and so on. Thus, the pmtics of Magravs forces and their mixture with the inertia of a planet dictates what matters are extracted from their part of their environment, like the solar system or galaxies.

Thus, Magravs positioning reactors are not only for creation of motion and for

protection, but they will be the main tool for cleaning environments, collecting preferred Matters, matters, etc.

CHAPTER 17

Plasma's and Nuclear decay

The nuclear decay principles of an atom, is in general, considered to be on "the same principles and methods and as the simple decay explained previously for the initial fundamental plasma into a proton and an electron (Fig. 43)".

For the initial fundamental plasma to reach the ground-level plasmatic magnetic fields content condition, the plasma divides itself into two new and exactly similar structures with different amount of mass of the same constituent plasmatic magnetic fields Matters for the creation of a proton and an electron, and releases its unwanted pmtics as residual pmtics or as rays (gamma or x-rays, etc)(Fig. 42). I call this process of the neutrons decay "***The initial fundamental plasmatic decay***."

Through the process of releasing of the exact amount of plasmatic magnetic fields from the **neutron** necessary for the creation of a **proton**, an **electron** and the **release of energy or other rays** from the initial fundamental plasmatic magnetic fields, this, in a way, confirms that *all initial fundamental particles of plasmas are always make exactly of the same and similar plasmatic magnetic fields and the same configurationally structure*. This being another proof that initial fundamental plasmas in the ***universal order of Matter*** are always made through and by the same Specific Entangled Plasmatic MAgnetic Fields (SEPMAF) strength criterion and procedure, as has been previously explained.

The principles of the nuclear decay of initial fundamental multi-plasmas of an atom, is considered to be solely due to the re-balancing of the overall plasmatic Magravs strength components for Matters of plasmas of the atom ***to maintain an overall Magravs forces balance of all participating plasmas***, in the construction of the atom. These being the plasmatic magnetic fields of neutrons, protons, electrons and their constituent Matters, their plasmatic magnetic fields of their Matter, Antimatter and Dark Matter and their magnetic fields forces of each plasma.

For the plasmas of an atom to stay together and hold onto its constituent structure plasmatic magnetic fields, some of these *plasmatic magnetic fields in motion* (energy) are ***transferred to*** *other plasmas*, and in term, these plasmatic magnetic fields are said to be used. At the same time, part of the initial fundamental particles fields of plasmas are used for the upkeep of the integrity of the nucleus positioning and dynamism; As part of the binding energy is consumed for holding the fundamental plasmas together. As in this cycle of consuming pmtics reaches that enough pmtics have been used, that the initial fundamental plasmatic Magravs of the plasma cannot hold onto their initial gravitational positions in respect to each other. The plasmas making up the part of participating neutrons or protons in the centre nucleus of atom, gravitationally reposition themselves within the nucleus for the nucleus to find a new Magravs *balance and equilibrium positioning* in respect to other plasmas.

At this point of magnetically repositioning of the plasma of the heavy nucleus, the

nuclei of heavier atoms split into exactly the same configurations of two or more new Magnetic fields and gravitationally positioned balanced plasmatic strength configurations (Fig. 43) of the plasma's of neutrons to protons and electrons, and hence split into two new atoms. This regular splitting pattern of heavier atom to two or more light atoms is known as a ***controlled fission*** of atoms.

As the initial fundamental plasmas were all made of the same initial fundamental particles of the same specific magnetic fields strength and interactions, in their disintegration of denser nucleus atoms, they split and gather into two or more new less denser atoms and of Magravs' configuration, and their need for the new equilibrium of collective plasmas of new atoms.

That is how the atoms are always spilt into exactly the same lower order of numbers of neutrons, protons and electrons in the new nuclei for the overall new balance pmtics of the two new atomic structures to be able to be kept.

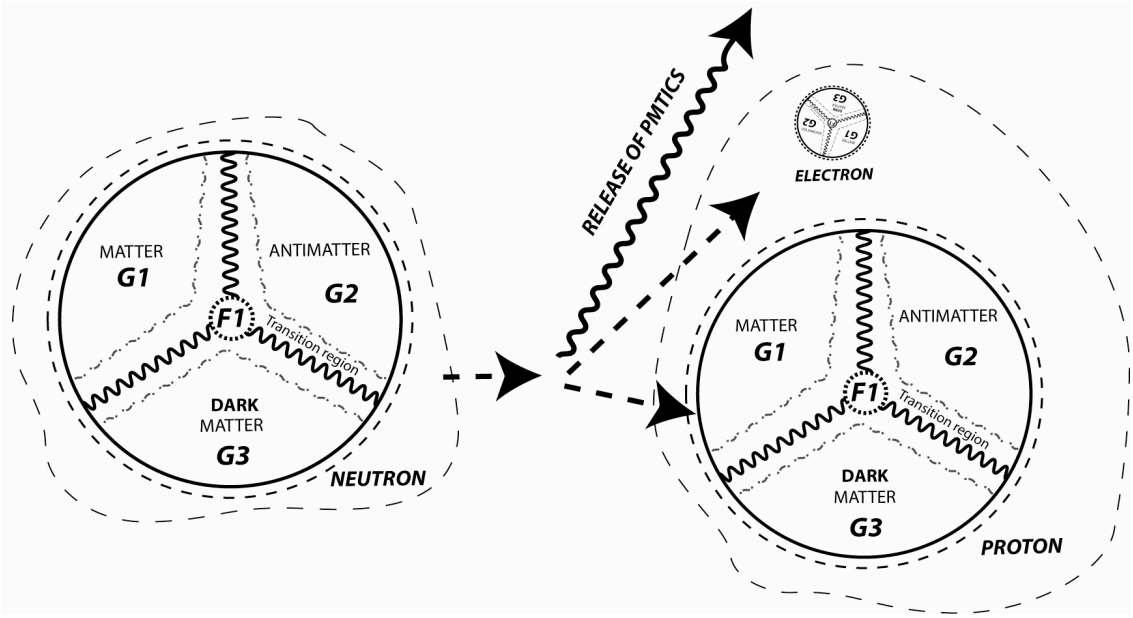

Fig. 43: Schematic of a decay of pmtics and Matters of the Initial Fundamental Plasma (NEUTRON), "the initial fundamental plasmatic decay".

In principle the overall disintegration of all atoms heavier than Hydrogen, involved in the collective pmtics of a given matter, the collective pmtics of the residual matters is always constant, and of the same end-structure of new and lighter atoms.

The overall numbers of the plasmas involved in a structure of a given matter is said to be constant, purely due to the fact that the overall rate of interactions and disintegration of plasmatic magnetic fields are considered to take place at a constant rate. Hence, the phenomenon that takes about the same time for the plasmas to reach a point of using a given amount of dynamic plasmatic magnetic fields (energy), before they reorganise themselves to a new balance condition. This reorganisation or rebalancing of overall plasmatic magnetic fields of the components of nuclei, leads to the fundamental principle of the nuclear decay nuclear of an atom.

This reorganisation of the new plasmatic magnetic fields balance in mass of matters is in so many ways dependent on all of the atoms participating in the total structure of the mass of the matter. This is irrespective of the number of atoms in the matter, these being in the solid, liquid or gaseous state of matter.

The nuclear decay in some plasmas can be triggered and be due to internal changes in the plasmatic magnetic field's structural balance, or can occur due to changes in the external environment of the initial fundamental plasma. These changes can be due to the ***changes*** in the external equilibrium of magnetic fields forces or field strength of other initial fundamental plasmas, or surrounding plasmatic magnetic fields adjacent or near to the initial fundamental plasma.

This being why different atoms of a given matter decay at different rates depending on their position within the overall structure of tangible matter. That is to say ***the decay of atoms is environmental pmtics strength dependent.*** Which the environment can be within the same matter construction of atoms, or the interface between the matter and for example matters of air. Where each environment enforces different rates of use of internal pmtics of different matters within the nucleus of that atom. This being the reason why different rate of decay of atoms within matters are considered to have a **half-life** principle. Where the half-life is, and can be pmtics strength environmental dependent.

Interesting point to consider:

Does the reorganisation take place in the same position first and the same number, which initiates the course of the decay in the rest of the mass?

Is the decay of an atom in a mass happening faster in the inner positions of the mass of matter, or on the edges of the mass?

CHAPTER 18

Neutron-Proton, Electron-Atom

Through the new understanding of the method by which the initial fundamental particles and their subsequent plasmatic magnetic fields interaction, leads to the creation of the initial fundamental Matters (Matter, Dark Matter and Antimatter) leading to the creation of initial fundamental plasmas or the Neutrons, the subsequent degeneration of initial fundamental plasmas through decays further leads to creation of protons and electrons of an atom, and their interactions and collections into molecules and matters (solid, liquid and gas).

Fundamentally, *initial fundamental particles* ***interactions***, leading to the creation of different states of Matters and the creation of initial fundamental plasmas, where these plasmas are considered to be in a ***total plasmatic magnetic equilibrium state*** (Fig. 44 and Fig. 45).

The Initial Fundamental Plasmas are **neutrons** in characteristic. Neutrons (Fig. 44 and Fig. 45), in their construction, are considered as ***balanced*** dynamic plasmatic magnetic fields environments.

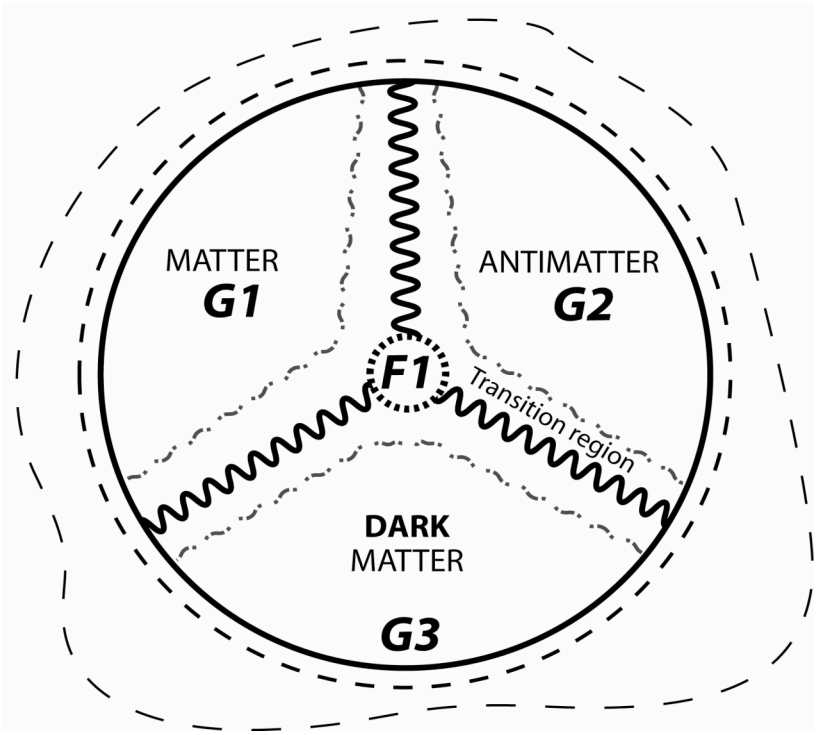

Fig. 44: Schematic presentation of the overall Magravs of Matters and the fields of the Neutron.

Neutrons, due to **the *larger content* of the three Matters and their F1**, they create a ***stronger gravitational pull*** between the Matters of the plasma, consequently their

overall Magravs of the initial fundamental plasmas are considered to possess more mass, than the total sum of the masses of the individual proton and electron, from the same plasma after its decay.

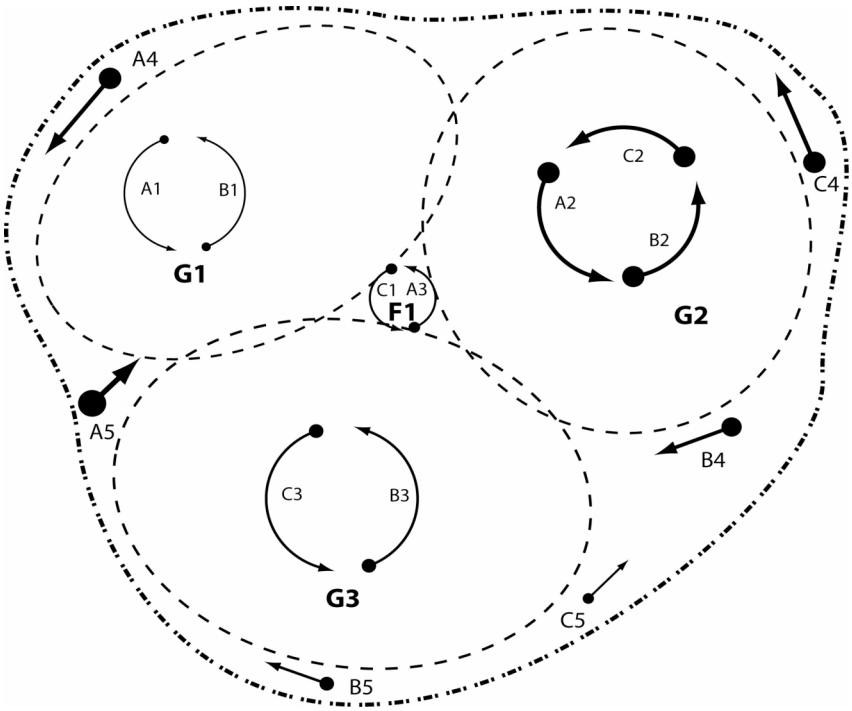

Fig. 45: Matters schematic diagram of the Neutron.

For the ***initial fundamental plasma*** to find its final balanced equilibrium plasmatic magnetic fields force strength condition, due to different effects, the initial fundamental plasma ***reduces*** *its plasmatic magnetic fields balance* to its **ground-level** magnetic fields mass level (Fig. 46 diagram 7) for it to survive, hence the initial fundamental plasma disintegrates or decays' to its sub-Matter levels and fields.

The decay of the neutron

This process has been explained in previous chapters where, now we look at this process in more detail.

The release and division of components of the initial fundamental plasma leads to the release of two independent, yet at the same time interlocked, balanced plasmatic magnetic fields environments plasmas (Fig. 46 diagram 8). Of these two new plasmatic magnetic fields plasmas, one would retain more of the initial fundamental plasmas' mass and be the larger of the two balanced plasmatic magnetic fields (Fig. 46 diagram 7). The second plasma will contain less of the pmtics of the initial fundamental plasma and mass and would be smaller (Fig. 46 diagram 6). The *larger of the two plasmas', would* ***stay in the centre,*** due to its mass and Magravs strength would become ***the proton*** of the atom (Fig. 46 diagram 8). The new smaller balanced plasmatic magnetic

fields released can be said to manifest itself as ***an electron*** (Fig. 46 diagram 8) of the same atom.

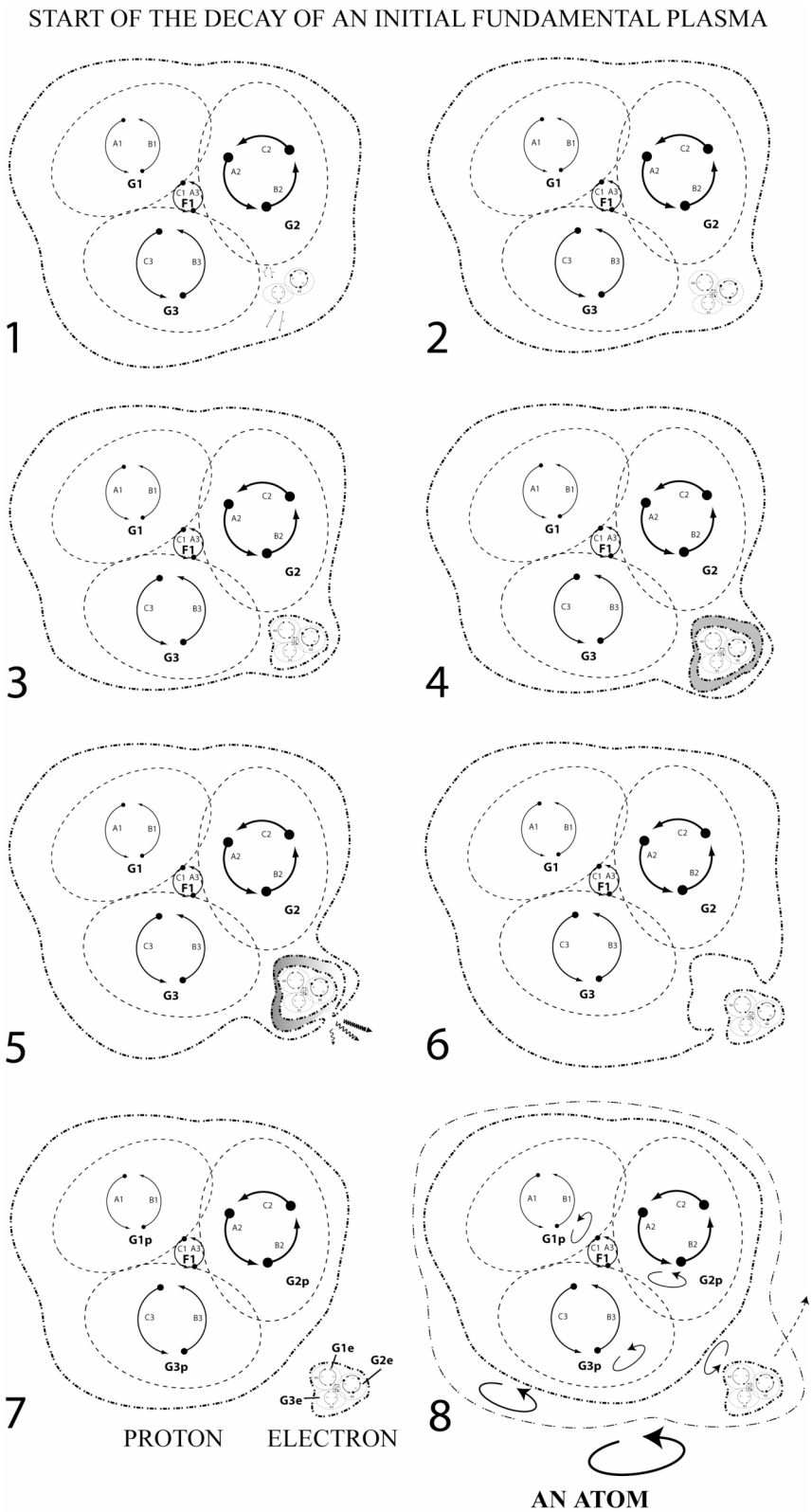

Fig. 46: The eight steps of the Neutron decay cycle to a proton and an electron and then an atom.

It is considered that the ***pmtics of the Antimatter components*** *of the* ***neutron*** **start the process of the decay** of the neutron. As the Antimatter is the main and the strongest of the Matters' of the initial fundamental plasma (Fig. 46 diagram 1), in comparison the Antimatter is the star in a solar system. Then the pmtics of the Dark Matter part of the neutron plasma splits simultaneously as the total balance of the Magravs forces of the plasma is disturbed (Fig. 46 diagram 1). This process is continued up to the point that, due to the cycle of separation of more and more of the two pmtics of the Antimatter and the Dark Matter, leads to splitting of the Matter part of the plasma (Fig. 46 diagram 4) as the plasma tries to keep its overall stability and equilibrium.

At this point, the pmtics fragments of the Antimatter, the Dark Matter, the Matter, and other pmtics within the plasma, through the dynamism of the plasma internal environment, are brought close to each other and then merge to produce a small and independent **mini-plasma** within the structure of the initial plasma.

Where this new embedded mini-plasma in the overall structure of the initial fundamental plasma becomes the structure of the initial fundamental plasma of the **electron** of the atom.

The plasma of the electron by this time is formed internally and has establishes its own balance Magravs zone and hence its own magnetosphere (Fig. 46 diagram 5 and 6). At this stage, the Magravs of the electron plasma tries to find and reach its own Magravs positioning balance in respect to the leftover pmtics and Matters Magravs of the initial fundamental plasma. At this point, as the two plasmas try to find their Magravs positioning in respect to each other, the electron plasma is pushed out-off the boundaries of the initial fundamental plasma (Fig. 46 diagram 7) environment.

At this point where the two plasmas find their Magravs positioning balance, this becomes **the gap** *between the proton and the electron*, or the ground energy level for the electron in respect to the proton' of the plasma. From this point on, the foundation for the final step of the making of an atom with contents of a proton and an electron is reached (Fig. 46 diagram 8).

Therefore the new balanced fields of the original initial fundamental plasma now becomes the components of the two newly balanced plasmatic magnetic fields plasmas of the proton and the electron of an atom (Fig. 48).

From this point on, the motion and rotation of the electron around the proton is set to follow, according to what is described in Chapter 19.

The similarities between the construction of the protons' plasma and the electron plasmas components of Matters, as both have started together quasi-independent life, from the same initial fundamental plasma mother (Fig. 47).

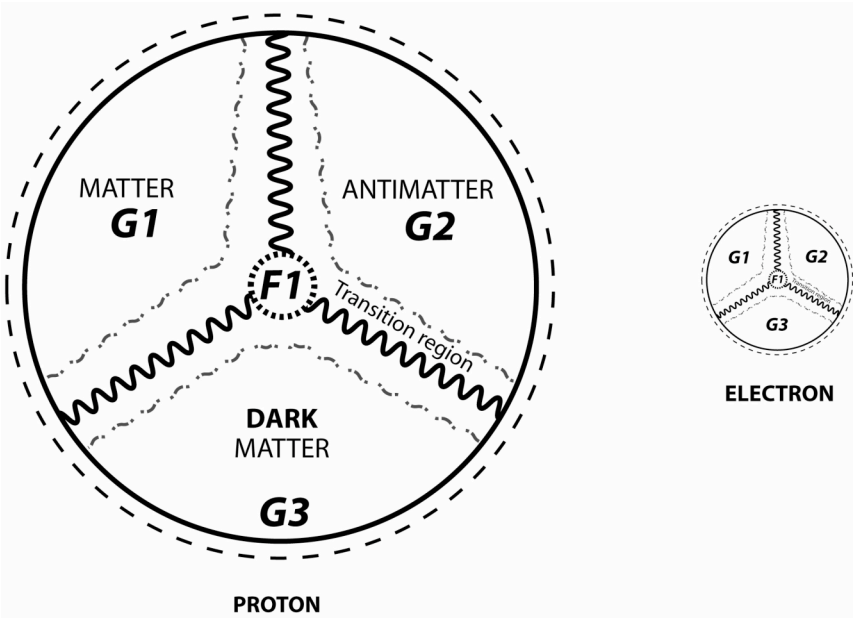

Fig. 47: Schematic similarities between construction of a proton and an electron (components of Matters).

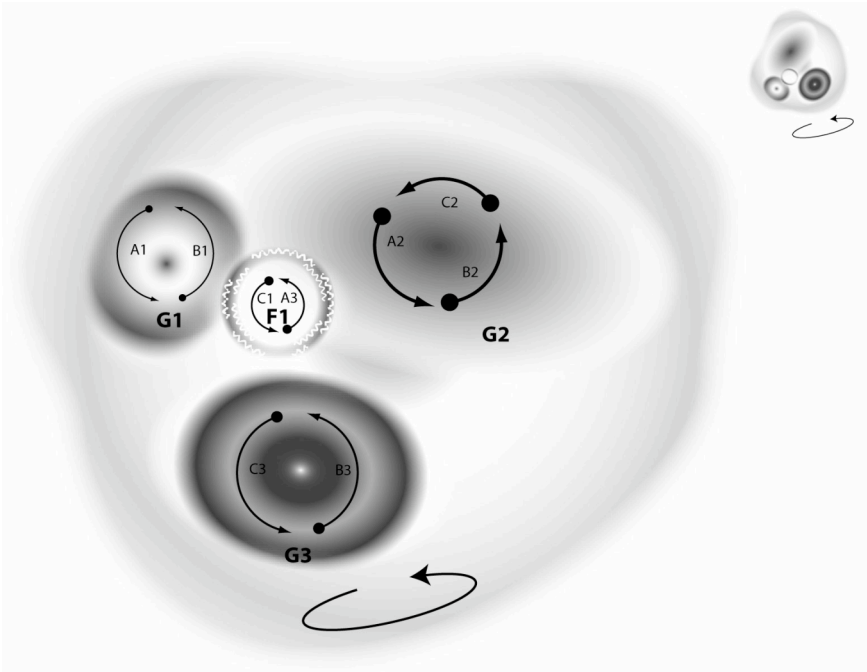

Fig. 48: Pmtics presentation of Initial Fundamental Atom (hydrogen).

As the initial fundamental plasma splits into two balanced plasmas (Fig. 46 diagram 1 to 8), this guaranties the total balance of the integrity of the complete original initial fundamental plasmatic Magravs configuration.

Thus, the splitting and decay of the initial fundamental plasma into the proton and the

electron (Fig. 48), called the ***initial fundamental decay***, is a natural decay process as is the ***nuclear decay*** of heavier atomic structures into lighter atoms. Where as the plasma uses some of its pmtics to keep its position, motion and magnetosphere boundary, it needs to break up to smaller atomic substructures that can guaranty its overall magnetic and gravitational field structure, thus the term "*decay of the atom"*. This neutron division, to the substructures of a proton and an electron, is for guaranteeing the survival overall of what was achieved before for the creation of initial fundamental plasma (Fig. 48).

This method of the Initial Fundamental Plasma Decay to the proton and the electron is the reason why in atomic structures the number of the electrons and the protons have always been seen to be in ***matching numbers,*** as there is no alternative way in nature for the creation of proton and electron in the universe in general, however individual electrons can be produced from the pmtics in plasma dilution reactors.

In the construction of higher atomic number elements (Fig. 49), for the total balance in both Magravs of the nuclei and their respective electrons, these heavier atoms need to have more of the balanced plasma components of neutrons.

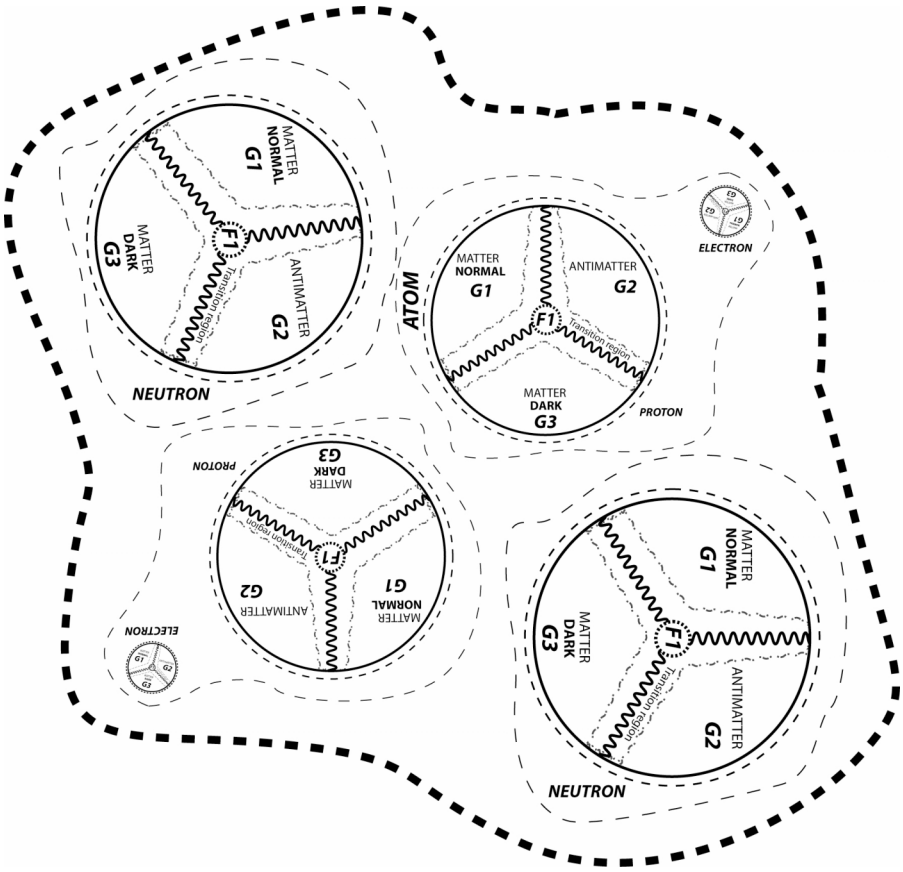

Fig. 49: Schematic of pmtics of a complex atom (like Helium).

Note: Through this simple configuration (Fig. 49), one can understand why certain chemical bindings and structure of some atoms and molecules of certain proton combination interactions in a given environment become possible.

In fact, the neutron, due to its balanced magnetic plasma or neutrality, and at the same time possessing its own Magravs magnetosphere, becomes the space gaps and space(s) needed for Magravs positioning of protons, in respect to each other, as much as magnetic fields equalisers or balancers in the construction of the nucleus of atoms with more than one proton (Fig. 49).

In the heavier elements, due to the tightness of packing, if there were not so many neutrons to create some magnetic and Magravs positioning balance gap, or what we call **gaps**, then due to the protons gravitational pulls, part of the nucleus would most probably clog-up, this being due to the interlocking of the Magravs of protons in the nucleus of the atom. In the majority of cases, this ***clogging-up*** would most probably lead to the explosion of the nucleus, due to *repulsion* of the fields or Magnetic fields of Magravs within the construction of the nucleus in being too close to each other's proximity. On the other hand without the existence of neutrons as a gap the nucleus would not be a gravitationally positioned stable configuration.

A configuration of the complex structure of the initial fundamental plasmas like an atom of the Helium and the positioning of its neutrons, protons and electrons are shown in figure 49. This shows the overall gravitational fields and Magnetic fields generated by interaction of these individual parts, in respect to the dynamic Matters and the fields each part produces both internally, and in their overall external boundary interaction of the plasmatic Magravs of the atom.

By a close observation of the proton and electron's Magravs balance, it is now clear how the *different* ***electron orbits*** *of heavier atoms* come to be created. That is to say, as the number of protons increases, the boundary of the Magravs of all protons in the centre of the nucleus increases, thus allowing and accommodating the next orbit for the motion and Magravs positioning of the next layers orbits of electrons. It has to be remembered that protons are *dynamic* entities, thus not more than certain numbers can revolve in the compact zone of a nucleus. So as the number of protons and their equivalent electrons are added to the nucleus, *more room is needed* for the *free* motion of these protons. Hence the only way a neutral zone can be created for the free motion of these additional protons for the structure of nucleus to be Magnetically and gravitationally in balance, is to add more balance neutrons to create an environment for the free motion of the protons and their Magravs positioning.

Thus as proton number increases, and the volume of the nucleus increases to keep all protons in motion, and hence more numbers of neutrons are needed. This is the reason why one sees a larger number of neutrons in the nucleus of heavy atoms. The more neutrons and protons are in the centre, the *larger the magnetosphere of the nucleus* boundaries. Hence, the accommodation of more electrons in *further distances locations* from the centre nucleus. Where all these electrons, protons and neutrons overall pmtics Magnetic field and gravitational field have to be at all times in balance.

It is fundamental to understand that " the negative field charge of any magnetic fields is due to its Gravitational field strength or pull, and the positive charge of the fields due to the Magnetic fields strength or push of the Magravs of the Matter, like a planet.

In electric field charge and current flow, its to be understand that the **positive charge** is

the flow of the Magnetic field push of the Magravs, and the **negative charge** is the gravitational pull of the flow of the gravitational fields of the Magravs of the plasma and its Matters content. This in a way explains the ***Resistance*** and the ***Impedance*** respectively of the matters in the electrical section of physics. Where the impedance is the measure of the gravitational pull of the flow of the pmtics in respect to the matters' atoms and where the resistance is the measure of the Magnetic push of the flow of the pmtics in respect to the matters' atoms.

CHAPTER 19

Motion of the Electron around the Proton

The constant rotation of the electron around the nucleus of an atom indicates that the electron and the nucleus of the atom constantly maintain an overall balanced Magravs forces between and Magravs positioning, in respect to each other.

Within the structure of the initial fundamental plasma (the neutron), and through its sub-dynamic Matters (Matter, Antimatter, and Dark Matter) and at the same time, with all Matters of the plasma being in possession of their own independent internal dynamic plasmatic Magravs forces, they all exert dynamic and varying levels of Magravs on different constituent of Matters of plasma internally, which these field forces span beyond the boundaries of the nucleus plasma itself individually and collectively.

The total effect of these dynamic forces, from the nucleus plasma (proton) (Fig. 50), will affect the *path* of the *rotation* of the satelliteing electron around the nucleus.

Similarly, the *plasma of the* ***electron*** (Fig. 50) itself is *made of the* ***same three dynamic plasmatic magnetic fields structures*** *of Matters as of the proton in its nucleus*.

The effect of these **dynamic** plasmatic Magravs of different Matters in the centre plasma **(proton)** of an atom on the **dynamic** plasmatic Magravs of different Matters of the plasma of its **electron,** and their collective effect of each plasma on each other, is the reason why the electron does not have a constant and a defined path of motion around the nucleus.

That is to say, the electron plasma by itself is in possession of its own individual Matters' (the Matter, the Antimatters and the Dark Matter) Magravs forces' as well as their collective plasmatic Magravs forces of all the Matters of the electron, and the same applies to the Matters and the plasma of the proton.

As the Magravs of different Matters of the electron passes different Matter components of the proton, each of the facing Matters' Magravs forces within the proton and the electron have to interact with each other, plus the electrons' and protons' overall Magravs positioning in respect to that particular Matter in the proton and electron. Which, this type of interactions and Magravs repositioning between the two involved Matters of each plasma will keep on repeating on continuous bases as both the proton and the electron are independent dynamic entities. As the ever-continuous Magravs positioning between the two dynamic entities leads to the ever changing in position of the lighter by mass (the electron) of the two entities, to move around the proton, hence this chasing-up of the ever-repositioning movement becomes the "uncertain" position or erratic motion of the electron around its proton.

This giving the electron in that given configuration of interactions of the Magravs its *pulled* ***closer*** *to* ***or pushed*** *further away* from the nucleus. Then, immediately, the electron has to finds its new overall Magravs balance positioning, in respect to the

proton.

Then, due to the dynamism of both plasmatic Magravs of proton and electron, other Matters' fields in the two plasmas come into play and face each other and their Magravs of these two new Matters and overall Magravs have to interact again.

Therefore, the new facing Matter of the plasma of the electron Magravs have to find a new Magravs positioning in respect to the new Matter of the proton's Magravs and the overall Magravs of the two plasmas.

Further on, again, as both the proton and electron are dynamic, the electron has to find a *new Magravs positioning*, in respect to these new Matters facing each other from each entity interactions, this change of Matters facing each other takes place on a continuous basis, as different Matters and Magravs of both components and the overall structure of each atom come to exert their forces on each other and the overall balance distance of both the electron and proton position is to be maintained as every time new Matters in each entity come to face each other. We call this the ***Magravs positioning principle*** (or Magravs positioning).

The result of this continuous change of the Magravs positioning of the Matters of the electron in respect to the Matters of proton and their overall Magravs, causes and creates the motion of the electron around its nucleus.

The behaviour and interaction of the ever-changing of Magravs positioning of the proton and the electron Magravs in respect to each other, leads to the creation of an erratic, never duplicated path, and is the cause of the motion of the electron around the proton.

That is to say, as the electron rotates around the proton, its position and distance in respect to the proton changes, according to the overall position and balance of the gravitational pull forces and Magnetic field push forces of all three components of its Matters and their respective plasmas, in respect to the position of all three Matters Magravs of the protons' and overall Magravs of the proton.

Nevertheless, as the Matters, in the proton and the electron are both dynamic themselves, the rotation of the electron around the nucleus is changing by the principle of the Magravs positioning of the Magravs balancing. Where, this leads to the ever motion of the electron around the proton of an atom (Fig. 50).

As the overall strength of the Magravs of both components of the atom are the same, this leads to a minimum and maximum distance that can be attained by the electron field strength, in its position in respect to and from its proton. This explains why an electron appears to be moving erratically around the centre point, with a given minimum and maximum distance from the centre proton. This minimum and maximum is to be known as the amplitude (minus and maximum) of the distance of the electron from its proton.

In fact, as the Matters dynamic components Magravs of the electron interact with the combined dynamic Magravs of the proton, the electron, which is the less magnetically

dense of the two, has to try to find its position, in respect to all the components of the denser magnetic fields plasma of the proton.

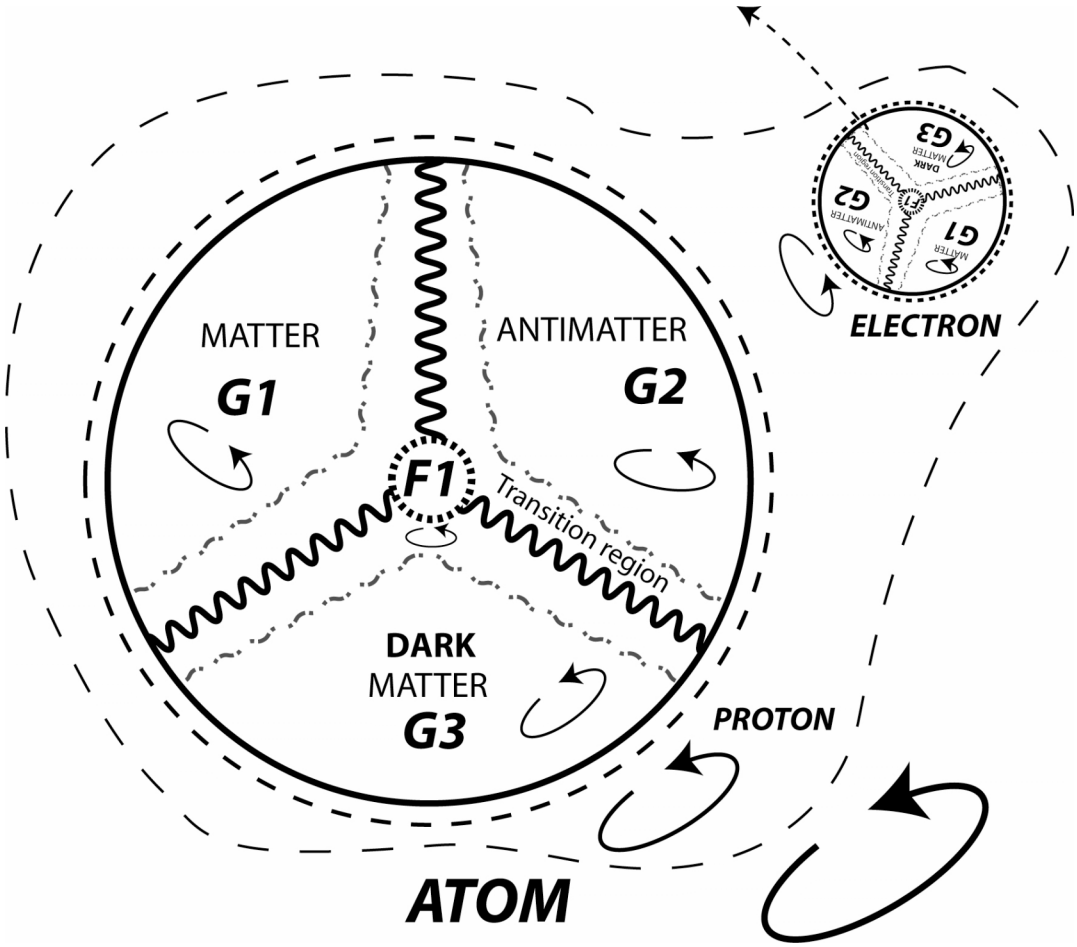

Fig. 50: Schematic of dynamic pmtics of Matters and fields of the proton and the electron and their interaction of individual Matters and their overall plasma and Magravs, leading to Magravs positioning and motion of electron in respect to its nucleus.

This continuous change in the Magravs positioning of the electron, in respect to the proton, leads to the continuous rotational motion of the electron around the proton (Fig. 50)

In fact, one can conclude "the proton and the electron are made up of composite Magravs of several different Matters by simply observing the erratic path of the motion of the electron around the proton".

In principle it can be said that the magnetic fields strength of any magnetic fields or Matter is ***position dependent*** of the two parts of the fields from each other, which the field has been released from. This is how magnetic fields strength in principle are determined and created. (Paper: Creation of Magnetic fields).

For example, the interaction of the Magravs of the Dark Matter's in the plasma of the electron interacting with the Antimatter's Magravs in the plasma of the proton and their

overall Magravs of the electron and proton plasmas in respect to each other, decides the position and the distance of the Dark Matter of the electron in respect to the proton.

Universal Magravs positioning principle

The effect of the composite components of the proton and the electron's Magnetic fields and gravitational fields strength, changes the path of the electron as it approaches each Matter of the proton. In composite nucleus, the overall fields' strength of all the protons of the nucleus dictates the distance of the electron from the nucleus.

All motions of objects and fields in the universe are due to the ***overall*** *Magravs positioning of one pmtics of one object or ray*, and so on, *in respect to another*.

I call this dictation of position of an entity in respect to another entity, due to their Magravs positioning distance, the "**universal Magravs positioning principle"** for motion in the universe.

This Magravs positioning of Matter takes place within the constraints of Matters' possessing their own composite pmtics Matters fields' strength.

Universal method of motion

In principle, "the **continuous dynamic Magravs positioning** of one dynamic single ray or multiple Matters of multi-cores plasmas of an object in respect to another dynamic single or multi-Matters of a multi-cores plasmas of another objects, **leading to and/or can lead to and cause the motion** Matters, matters in the universe in respect to each other".

I call this method of **continuous change in Magravs positioning** of one entity in respect to another causing motion in one of the two entities, "**The Universal method of motion "**.

Motions of atoms and their components interactions, the molecules, solar systems and galaxies in the universe, are all based on the ***same*** *simple universal method of motion*.

The dynamic plasmatic Magravs of Matters within the constituent structure of one entity dictates the position and direction and the path of the motion of one object in respect to another dynamic plasmatic Magravs of Matters within the constituent structure of the entity. Motion of components of atoms, motion of planets of solar systems and physical contents of motion of galaxies in the universe are all based on this principle.

The universal method of motion of any two gravitated objects in respect to each other is based on the dynamic plasmatic Magravs strength interaction and attraction of all of its complete composite components of Matters and forces within the object, ***irrespective*** *of the physical size* of the system. All universal gravitational objects follow the same

principle of motion as an electron around its proton, the same as is for the motion of Matters in the initial fundamental plasmas.

It is correct to say, "**motion in the universe** is totally and exclusively caused and is due to **Magravs strength positioning** of rays, fields, matters, Matters electron, planet, stars and galaxies in **respect** to each other".

Thus from this point on it is clear that **one does not need to burn fuel** to create **motion, but use Matmags**. However, one only needs to create the right Magravs strength within any system to attain dynamic Magravs positioning in respect to another object, this being, a planet, a star, a solar system or a galaxy for the system to be in motion.

This method of utilising the plasmatic Magravs interaction for the creation of Magravs forces within a system, that brings about the motion of one object in respect to another due to Magravs positioning, is to be known as the "**Magravs positioning methods and universal principle of gravitational motion".**

Thus, the Magravs positioning principles of motion are the future for the creation of motion for automotive, marine, air and space industry.

Through this method of Magravs positioning, there is no need for the burning of fuel in engines to move cars or use liquid fuelled jet propulsion systems to fly rockets into space.

When speaking about gravitational or Magravs positioning, this means the collective effect of gravitational field and Magnetic fields of one system in respect to another object or plasmas, Magravs of planets or stars.

It is important to remember that in the universal order of motion, the ***plasmatic gravitational field*** and ***plasmatic Magnetic fields***, are *integrated*, thus simultaneously they co-exist and one cannot exist and operate without the other.

In the universe the **Magravs positioning of Antimatters** in respect to each other and their plasmatic magnetic fields does exist. Further, there exists the **Magravs positioning of the Dark Matter** in respect to each other and their plasmatic magnetic fields too.

The way the Magravs systems of the future will be set-up and operate will dictate in which gravitational fields strength and dimensions the crafts of future will travel in.

In man-made systems using the plasmatic magnetic fields of the Matters that, through their interaction with each other, create the Magravs needed for positioning*: simply by creating Magravs* ***within a reactor***, and these systems will, by trying to find its new Magravs positioning balance in respect to the Magravs, for an example, in atmospheric area of the planet, cause the motion of the reactor system in respect to the surface of the planet.

The creation of motion through Magravs *positioning* can be used in an aircraft equipped

with gravitational reactors in respect to Earth, or with a spacecraft in respect to a planet(s), solar system or galaxy.

Methods based on the Grapos principle for motions are the future for the creation of motion in space, according and in parallel to the way the universe is operating for millions of years for its dynamic existence.

CHAPTER 20

Molecules

The creation of plasma and the way its plasmatic Magravs interact to bring about a balance in its overall plasmatic Magravs and their effect on each other, leading to further interactions and balances in different atoms and their components in different dimensions in atoms has been explained. This balancing and positioning of plasmatic Magravs in between different atoms of different Matters brings about how the final Matters, plasmas and atoms can be brought together, leading to how molecules are come to be generated.

That is to say, for the creation of a molecule, it is necessary that the plasmas of protons and neutrons of any nucleus of an atom, and atoms of different elements, need to have a total plasmatic Magnetic field forces and gravitational field forces positioning balance in a given environment so that these atoms can hold onto their total structure, for the molecules to be created.

Thus, by the same principle a molecule or a cell can only be created where, the Magnetic fields and gravitational fields positioning are in equilibrium in all its participant atoms plasmatic magnetic fields (Fig. 51).

At the same time, the whole of the structure of the molecules' plasmatic Magravs have to find plasmatic Magravs balance in respect to their surrounding environments Magravs for the molecules to be able to exist as an entity in a given environment. This in fact, explains why certain atoms and molecules, in certain configurations, can never exist in one environment, while they are prevalent in other environments, like planets, or galaxies and why different pmtics forces and conditions can apply to the same Matter, and Matter manifest itself as a matter in state of solid, liquid and gas.

Likewise, the same can explain why proteins of specific characteristics are created or maintained by certain cells in one part of the human body and not in other parts of the body (9).

In fact, if the same conditions of plasmatic magnetic fields are, or can be, maintained in any part of the universe, one can reproduce exactly all the Matters known to Man anywhere in the universe.

That is to say, when one can create the required balance and equilibrium environment in the total and overall Magravs of the atoms participating in the construction of a molecule, one can replicate and maintain any molecule. Therefore this explains that Van der Waals forces of **pull** and **push**, merely can be known as the **gravitational** fields forces and **Magnetic** field forces respectively operating between different molecules, irrespective of their binding structure with other molecules or atoms.

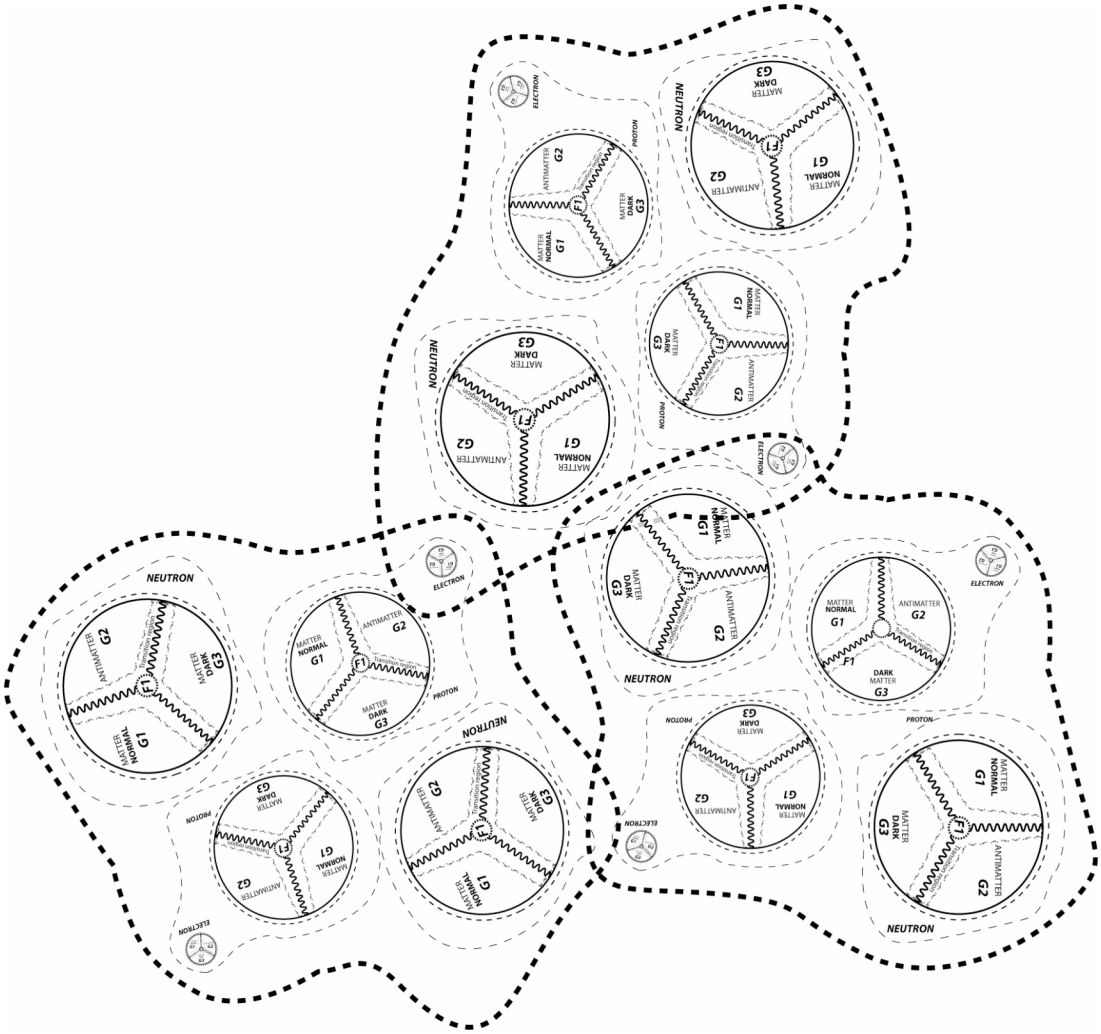

Fig. 51: Schematic pmtics of atoms gravitational (Magravs) positioning to form a molecule.

In the industrial Magravs reactors of the future, one can produce as many atoms as one needs by just absorbing the plasma from space or the environment, for any application and purpose like the production of the hydrogen molecules, carbon, nitrogen, oxygen for the production of proteins for food, air, water and so forth, by simply replicating the Magravs of the preferred molecules and allowing their positioning and interactions.

In the future, by giving a standard chart of Magravs strength and prevailing magnetic fields forces, temperature and pressure of plasma, atoms and molecules, one can produce and maintain any atom and molecule anywhere in the universe.

CHAPTER 21

Plasma Dilution Technology

The Plasma Dilution Technology is the new approach for the use of new gained knowledge for creation and control of plasma and its sub-Matters constituents Matters and their fundamental elementary particles.

The new understanding and insight into the construction and the structure of plasma and its constituent Matters and their magnetic fields, opens up new opportunities for the creation of energy and motion, production of new materials, for medical uses and so many other applications.

The plasma dilution technology allows the plasmas' Matters components to be diluted within a soup of Matters and their pmtics made up of exactly of the plasmas' own composite structure.

Through the specially designed ***nuclear reactors***, conditions are created within the structure of the reactor that the plasma is contained in a safe and secure way in reactors cores configuration.

The operation of these reactors can be controlled so that they do not release any radiation into the environment and they create no waste of any kind, this being the likes of radioactive materials or CO_2 waste, as has been the trend in the current nuclear and energy production industry.

Through the understanding and creation of a parallel environments, similar to the internal environment of the same weak plasmatic magnetic fields of the plasma itself, plasmatic magnetic soup environments are produced in these types of reactors, so that the plasmatic magnetic fields condition within the reactor cores matches the plasmatic magnetic fields of the binding forces (Coulomb Barrier) of the initial fundamental plasma, as the components of this plasma soup, this barrier is magnetically diluted and soften, allowing the plasma to open through the operation of the reactors, for the Matters of the plasma to become part of the dilution soup of Matters and fields forces of the reactor.

A soup of weak plasmatic magnetic fields

These plasmatic magnetic fields saturated reactors will allow components of any plasma introduced into the reactor to be loosened and, the Matter, the Antimatter and the Dark Matter of the plasma, to be free to move within the structure of the plasma soup, which has been created through specific setting and Matter combination. Matters once loosen from other Matters within the soup of the plasma, these are then free for their fundamental particles effects to be utilised to achieve any desired effects, like for fusion and production of new matters, lift and motion.

Reactors that facilitate such a dilution of plasma I call **Plasma Dilution Reactors** (Fig. 56) and their process of dilution as the **Plasma dilution principle** and their knowledge as the ***plasma dilution technology*** (Fig. 52).

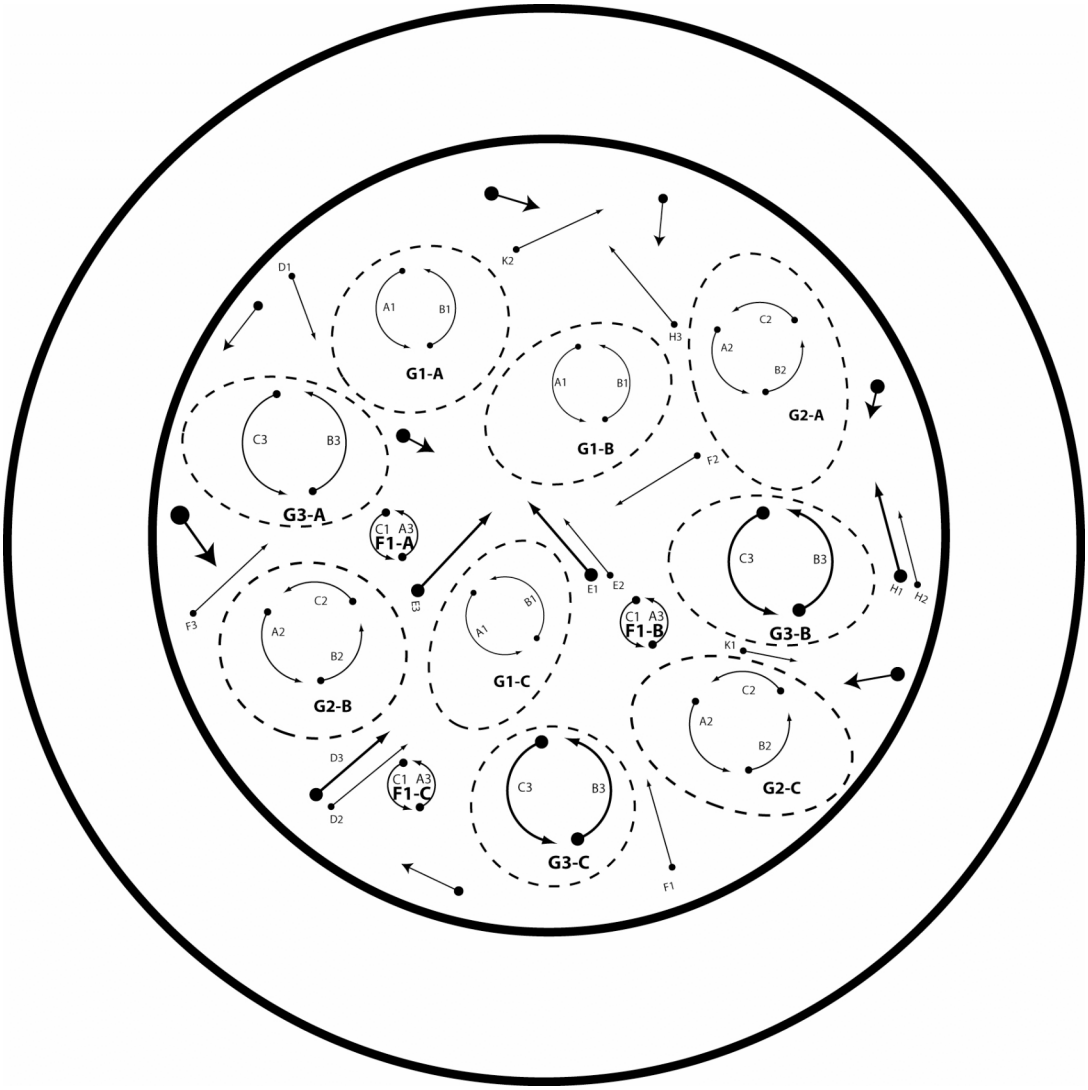

Fig. 52: Plasma dilution concept and technology.

Further interaction of the constituent principle plasmatic magnetic fields of the Matters of the plasma inside the cores of these reactors can create effects that can be used to achieve desired outcomes from their interactions with other Matters or matters and fields outside or inside the reactor's structural environment and this is exactly the way and the method that different entities in the universe function and operate to achieve certain desired effects and production of Materials.

Diluting the plasma in the larger pmtics environment of the reactor is another option in the nuclear world for achieving fission, fusion, production of new Matters, matters, for generation of energy and motion.

Disentanglement

Through the Plasma dilution process, once the new plasma soup is produced in the reactor cores, the weak interacting plasmatic magnetic fields soup interacts with the binding fields of the components of the Matters of the plasmas which are further introduced into the reactor cores, this allows the Matters of new plasma to disentangle themselves from each other (Fig. 53), if this level of dilution of new plasma is required.

In this process of plasma dilution, the sub-components of the plasma are allowed to loosen up from each other and not necessarily allowing the separation of all the Matters of the plasma from each other.

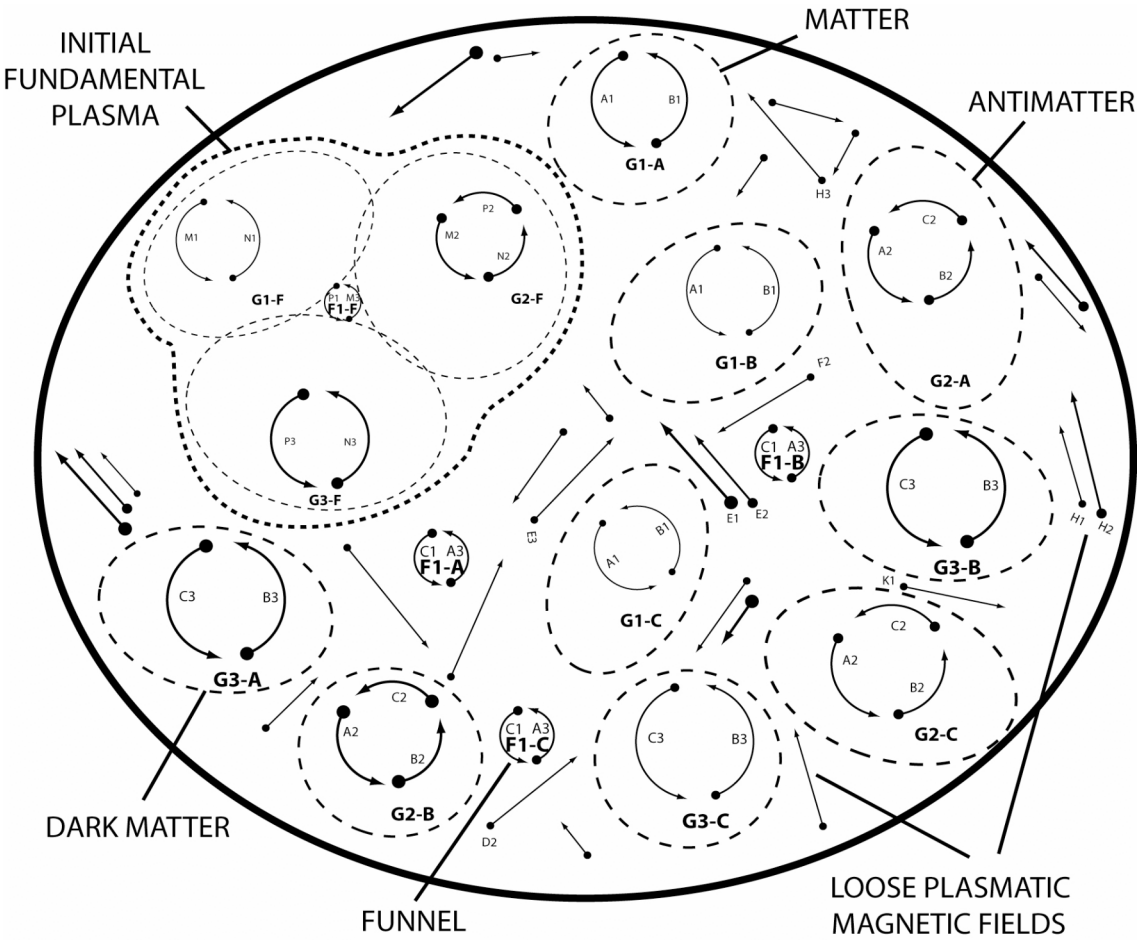

Fig. 53: Dilution process of initial fundamental plasma within a soup of Matters.

Through this method, different components of the Matters and fields of the plasma can be used for any purpose that the operator decides or that the system is pre-set to.

Hence, each sub-component Matter of the plasmas in the reactor can be separated from the plasma in any quantities of individual Matter within the soup.

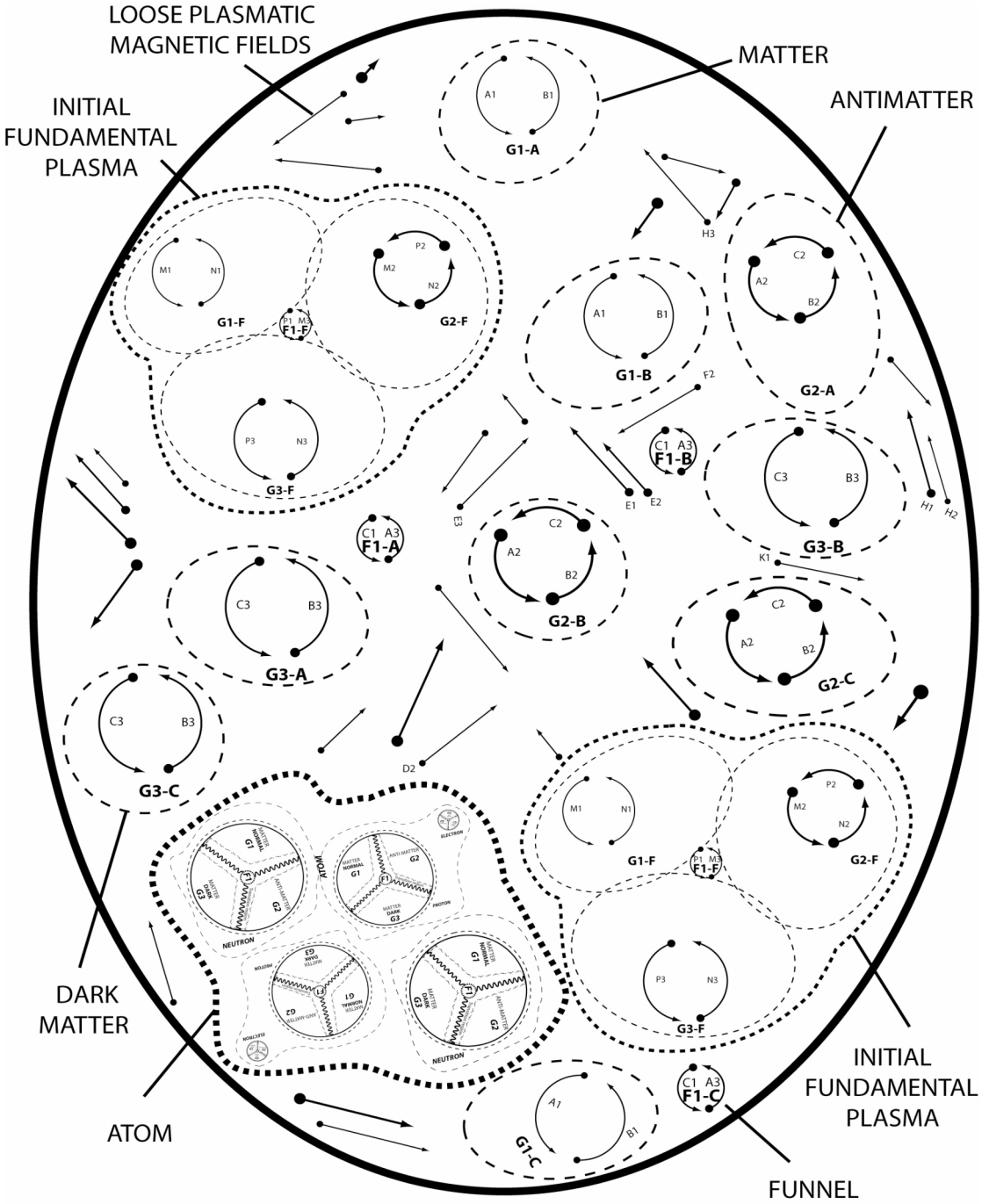

Fig. 54: Dilution process of initial fundamental plasma and atoms and molecules within a soup of Matters and pmtics.

The plasma dilution technology (Fig. 54) replaces the present state-of-the-art technology *accelerators* used for the separation of different components of plasma or an atom.

The plasma dilution reactors for example can be used for the extraction of Antimatter, instead of the presently used methods of slamming plasma at high speeds in accelerators into specific pure solid metal matters to extract its Antimatter, by chance, every once in

while (6, 7 and 8).

In the same way, the plasma dilution reactors can be used in the fusion industry where, present technology uses huge enforcing magnetic fields to force the fusion of plasmas.

With the plasma dilution method, the components of the plasma are opened up, in a soft way, loosened, and then are allowed to be separated from other Matters in their surroundings, and into their specific sub-components, interacting collectively in the soup of the Matters for their use for any given specific purpose (Fig. 54), like for fusion of Matters or matter.

These reactors even can be used for fusing components of two plasmas together. If the Antimatter is needed to be separated from the Matter, this can be easily done, as by creating a weak plasmatic magnetic field, around the plasma, then, the Antimatter components of the plasma can be separated for the use of their plasmatic magnetic fields properties and effects for example for the production of powerful Magravs forces. Where, the rest of plasmas' components are then *left in the* ***dilution soup***.

When one has used these freed Antimatter plasmatic magnetic fields for their effects they create, for the purposes that one needs, then the system-loading Magravs configuration and parameters can be altered to *change the dynamism of the reactor*, and gradually disassemble the dilution fields. Then the Matters of the plasma are allowed to return to their original Matters' components state of the plasma, and for the plasma to return its atomic structure and so forth.

All these reactions can be created and controlled without the creation of unstable or high temperature environments as is seen in the universal order of creation of Matters, energy and motion.

At the same time, there is no need to hold on to certain Matters and to run expensive holding systems for Antimatter as done for example by Fermilab at the present.

All these processes are carried out without any release of radiation or the production of new radioactive waste.

These effects can be created at room temperature and within portable safe nuclear reactors, which have been designed, developed and tested in the past few years.

There is conclusive evidence from tests, that the principle of the untangling of plasmas' magnetic fields binding forces through plasma dilution technology is a proven fundamental principle for the future of energy production and creation of motion for space travel.

That is to say, that we have seen the effects that Antimatter in being loose in the cores of the reactors to possess stronger fields and create stronger Magravs forces than the Matter components of the same plasma. We have managed to lift and reduce weight of reactor systems in respect to its environment, and we have create new matters, all at room temperature, in the recent past through the operation of plasma dilution reactors, as we have reported and applied patents for.

This stronger characteristics and effects of Antimatter are purely due to the fact "that at the inception of the plasma, the Antimatter components of the plasma were created by the stronger plasmatic magnetic fields to start with".

Similarly, gravitational field forces of the Dark Matter components of the plasma can be used through the plasma dilution technology for the creation of high-speed motion without friction for crafts of the future in space technology, or these reactors can be used for the extraction of poison from a substance like water or air.

In testing for the production of the Dark Matter principle, systems have been twisted in their axel and damaged, confirming the enormous power of invisible, powerful, Magravs of the Dark Matter.

In general, it can be said, "The future is **bright**, the future is plasmatic magnetic fields based, through the production of controlled plasmatic dilution technology reactors"

CHAPTER 22

Matters and Magravs systems

The technology that uses the properties of the Matters of plasma to create motion and energy, instead of the present use of matter, I have called ***the Magravs positioning Systems Technology***.

The fundamental difference between the **Matter** gravitational technology and **matter** propulsion and energy systems can be explained in simple way.

matter propulsion technology

The present **matter** propulsion systems in burning fuels have **to fight and to overcome** Magravs of the planet for **lift and motion.** This we see in the rocket propulsion space technology of today.

In the matter systems, like the propulsions systems, power stations and cars use the fundamental principles of ***burning matter*** to release its energy and convert this energy from one form to another to create motion and energy. This technology has always delivered *limited energy*, and due to its bulkiness of mass and weight of the fuel that have to be carried by systems to achieve their objectives, these systems are payload dependent.

The matter system uses the ***Matter part*** *of plasma*, the **weakest** and **least energetic** part of the plasma. By their nature as has been seen in the past, matter systems create different type of waste, like CO_2, nuclear waste, and so on.

Matter gravitational technology

The **Matters** Magravs system uses the *properties of the all Matters* in the plasma to create motion, lift and energy without destroying the characteristic of the Matters, and the system works **within** and through the **Magnetic field** and **gravitational field** of its environment to **attain position and motion,** one can achieve more working ***within*** *than* ***fighting against*** the Magravs of the planet.

In the present state-of-art technologies, always the matter components are considered for their physical ***action and reaction***, and not their Matters field's components.

Matters used in the Magravs systems, uses the properties and interaction of all the initial fundamental particles properties of all Matters within the components of the fundamental plasma, "Matter, Antimatter and Dark Matter". There is no need to "react" as in the matter processes, since the system works' within and is part of the same

magnetic fields base system and works through the universal natural forces. Therefore there is never a need for reaction for motion, as the system always magnetically balances itself in respect to other magnetic fields forces.

These reactor systems are developed to function in the same way as the interaction of the initial fundamental particles leads to the creation of Magravs for the motion of Matters through the Magravs positioning principle in the universe.

In these systems, there is no destruction of Matter, since the system can use Matters pmtics properties for the enhancement of Magravs positioning, for the creation of motion and energy and so forth.

This method of the use of Matters creates heat, if it is needed from a system.

As it has been observed, stars create massive heat to create vast amount of energy and Magravs forces, through tests it have been proven that the creation of motion and energy by the use of Magravs forces, these systems creating effects which are ***temperature independent***.

Used in the atmospheric conditions, the Grapos, through the principles of the creation of plasmatic Magravs within the cores of the reactor and their interaction with the plasmatic Magravs of the planet, this interaction of these two Magravs, leads to creation of a *magnetosphere* around the systems. Where, the interaction of plasmatic Magravs of the system and the planets Magravs always lead to ***the creation of light*** around the system. This light being created through the principle of interaction of two plasmatic magnetic fields as was explained in Chapters 7 (Fig. 29 and Fig. 31). This is exactly how the magnetosphere of the Earth is created in respect to the Magravs interaction of the Earth and the Sun, and the same principle as for the creation of the daylight as seen around the Earth.

The magnetosphere created around the Magravs system, can be a spherical or oval bright light in shape depending upon the speed of motion and protection chosen by the operator.

In the **Universal systems** like stars**, their Magravs forces** are *fixed* by their initial matters' contents in their inner cores at the point of the inception of the star, and the magnetic fields strength they generate for the production of their Magravs strength, once the strength of the Magravs is set for the stars, these cannot be changed arbitrarily to achieve different Magravs strengths for the stars.

Whereas in the **Grapos reactors'** developed for the motion of crafts, the **Magravs** parameters of these reactor systems *can be changed and manipulated* according to the position, speed, energy and so forth, as is desired of the system by their operators.

In these systems, the reactor-operator dictates the Magravs strength of the system, therefore he decides the speed and the position of the craft at any position in space in respect to another Magravs system, the like of the Earth surface or a given distance from the moon or galaxies.

Interesting enough, all these effects of motion are achieved even though the system uses the same fundamental methods and Matters as in the cores of the planet or star that the systems is operating within or aiming for.

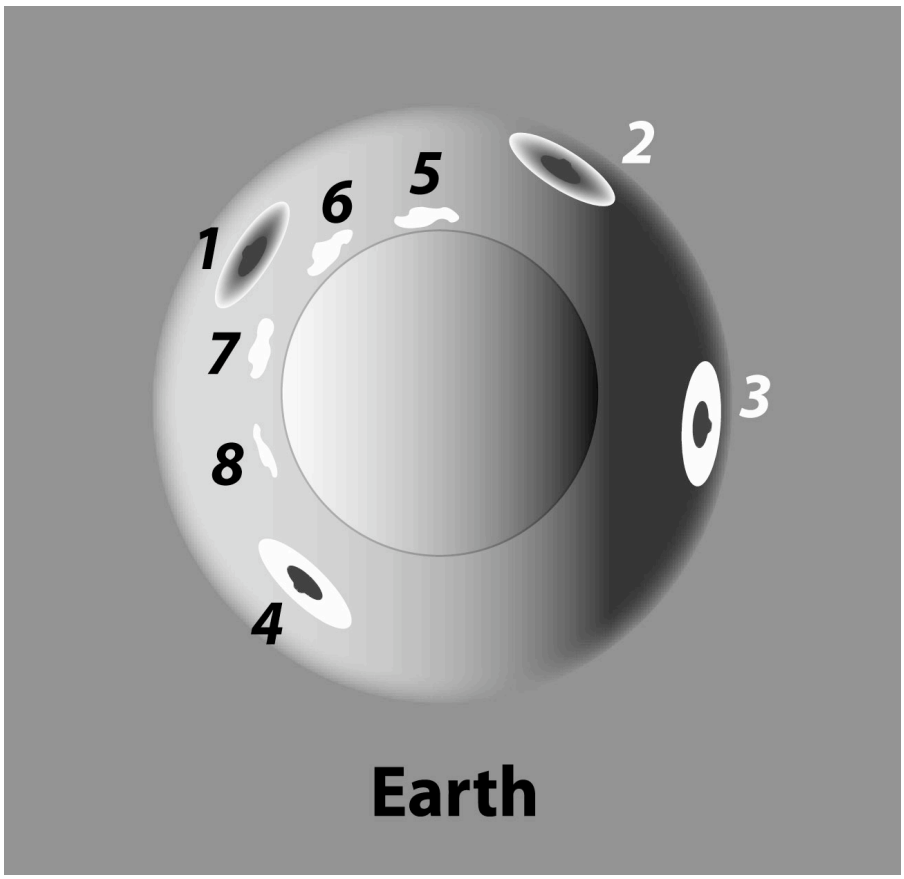

Fig. 55: Representation of interaction of four different pmtics strength of gravitational (Magravs) positioning systems (Grapos) in respect to Earth pmtics Magravs (1, 2, 3 and 4).

Note: Figure 55, numbers 5, 6, 7 and 8 show that the position of clouds in respect to Earth are pmtics Magravs strength dependent, and not size or volume dependent.

Thus, wherever the Magravs principles reactors are used for flight in a system, like in atmospheric condition of the planets', the natural outcome of the interaction of the two pmtics Magravs of the environment and the reactors Magravs is the appearance of and creation of natural light around these flying systems (Fig. 55 light regions of 1, 2, 3 and 4). Thus, the same Magravs positioning systems can be used, to produce lamps that can create light for years without needing to burn any fuel or consuming electricity.

Simultaneously, in a dense plasmatic magnetic fields environment, like the Earth, when the Grapos are used for motion and lift, due to the interaction pmtics Magravs, of the Earth and the system, these systems will produce their own magnetosphere around them. This magnetospheric light intensity is reactor Magravs' ***strength*** *dependent* and through the principle of interaction of two pmtics of plasmas as was discussed before, these magnetospheres will cause the creation of bright light around these systems in the

Earth atmospheric condition. As the brightness of the magnetosphere around the system in respect to its surrounding pmtics strength will be dependent on the strength of the plasmatic magnetic fields that are created by the Magravs positioning reactors, and in respect to the systems' position, considering that the plasmatic magnetic fields of the Earth is constant.

Thus, the confirmation of systems using Magravs positioning technology for motion in dense atmospheric condition like the Earth will be the appearance of bright moving lights (Fig. 55 lights 3 and 4) in the Earth atmosphere or any given atmosphere or medium in the universe. In dense atmospheric conditions, these Magravs systems will be appear to be a shining bright light floating in air, either with high speeds or seated stationary.

In some literatures, systems that use Grapos for motion and appear as bright lights from an unknown source in the skies have been called, the Unidentified Flying Objects, also called ***UFO's*** (Fig. 55 lights 1, 2, 3 and 4). Now that the method by which these bright lights in the sky are produced, their operation understood, and known, these crafts are not Unidentified Flying Objects no longer.

Nevertheless, in reality, it is now interesting to see who are the users of these systems. Whoever are the users' of these Magravs systems, this does not necessarily means that they are more advanced in scientific level than the human race in its present scientific and technological evolution. However, this simply means that they have managed to harvest the principles of the plasmatic magnetic fields, and the constituents of Matters, some time before the human race.

Now that the technology and the principles behind the plasmatic Magravs positioning fields are open to the human race, it is not hard to see that interaction with users of these bright lights will be inevitable and will only be to the Mans advantage, to help man to reach new levels of understanding about his universe.

In tests, the effects and bright light created by use of these reactor systems, which have been developed and tested for weight reduction and lift, has been noted.

The operation and interference with the radar and radio frequencies, through tests running of these Magravs positioning reactors have been videoed and recorded in August 2008. This confirms the origin of the motion of these systems to be on a plasmatic magnetic fields basis, as the system's Magnetic field operation interferes with radio waves, which radio waves are magnetic fields based entities.

NASA has done tests on these types of magnetospheric condition and motion system, on a miniature scale, in advance concept projects known as MINI-magnetospheric plasma propulsion project called M2P2 (40). They have achieved this by using the argon gas up to this stage. They hope to be able to finance the project to reach helium and then the use of hydrogen as base-material in years to come. They may then use plasma of hydrogen atoms later as they progress in gaining knowledge in 30 to 50 years and having the budget. However this is still one of the theoretical approaches for NASA.

Fermilab (6, 7, and 8) is looking for the Antimatter as the "fuel" for propulsion systems of the future space programs for NASA. If they redirect their attention into the properties and the effects of the Antimatters that they have gathered by now, they can achieve the same results as have been seen and tested in the recent Magravs systems reported on our Foundation web site and patents that have been applied for.

Through the understanding of the real forces in operation of the universe, the Magravs positioning reactors are simply years ahead of their time.

Our Magravs positioning reactors are not in a mini-scale dimension as NASA's project has tested and envisages at this moment in time, but these are in several sizes, which can create controllable size magnetospheric conditions, as the operator of these simple systems sees fit the purpose.

In the near future, these Magravs systems will replace the propulsion systems that have been used for space explorations and air travel.

The advantage with the Matters powered Grapos is that these systems create a magnetosphere around the reactor system. This is the same natural magnetic protection barrier for the future spacecrafts as the magnetosphere around the Earth has been, protecting man from space debris and cosmic radiations for billions of years.

These systems' magnetosphere protection capabilities can be used to protect the craft in deep oceans from water and the crafts to be used like the submarines of today, with the difference that these systems magnetosphere will allow these crafts to reach the deepest parts of oceans floors without any problem, as they can reach any depth in liquid planets in the universe.

The magnetosphere generated by Grapos will create *magnetic shielding* at Matters' level of the plasmas that can be used to pass through materials like ice without melting their matter(s). But simply by diluting the ice Matter(s) at plasma levels as in the plasma dilution reactors. In these conditions the crafts will appears as the craft will come out of nowhere and with no holes indicating the position of the exit from the ice by the spacecraft. If observed from the distance these crafts will be like bright lights shining and jumping out from the ice-covered sea-surface.

These plasma dilution Magravs positioning systems, by the use of Matters, will be the only solution for plasmatic saturation, once these crafts will pass and go through cosmic dusts as they temporarily disentangle the Magravs of atoms and plasmas of these cosmic dusts by just diluting the components of the Magravs of the Matters of cosmic dusts with the Magravs of the craft protection magnetosphere, and the craft passes through the dust matters as if they were not there.

CHAPTER 23

Matter Pmtics in reactors for lift and motion

The utilisation of the Magravs forces of dynamic multi-core systems, in respect to each other, for the purpose of the creation of lift and motion is discussed in this chapter.

In multiple cores *dynamic plasmatic dilution Grapos* that have been developed and tested at room temperature, these systems have proven to have the capability to produce different plasmatic Magravs forces strength as strong as those of a hot centre core object, like the Earth.

Using the principle of the creation of dynamic plasmatic Magravs forces within the structure of a multi-core reactor, the system can be caused to find its own position in respect to the environment of a planet or any Magnetic field and gravitational field forces in space.

In developing and achieving the Magravs positioning of these systems, in respect to the planet's Magravs forces, on the surface of the planet, leads to the reduction of the weight of the system to start with. Once the two plasmatic magnetic fields of the planet and the system reach **the total balance or equilibrium**, the ***zero weight*** of the system, in respect to the planets gravitational fields at a given point and the position, is achieved.

From this point of ***total equilibrium*** any further change(s) in Magravs force strength of the reactor in the same direction and configuration as before, this leading to and causing the ***free lift*** and **motion** of the reactor system, in respect to the planet.

Principle concept of upward or separation motion

The upward motion of the systems in respect to the planetary fields or any other Magravs systems is simply due to the fact that the **Magnetic field of the planet** and the Magnetic field of the system is of the *same polarity*. Thus, the two similar Magnetic polarities ***repel*** each other, hence causing the upward or separation motion of the system.

It is fundamental to understand that: In the Magravs positioning reactors **"The repulsion of two objects or moving away from each other, like moving away form the surface of the Earth, is totally due to interaction of the two pmtics of Magnetic fields forces of the systems and of the planet.**

Whereas**, any closeness or gravitation of the reactor system in respect to the planet is controlled by the pmtics of the gravitational fields between the system and the planet in respect to each other."**

This is how Magravs positioning reactors, in possession of dynamic cores, create up or down (lift and descend) motion in respect to another Magravs of an object, like the Earth.

In these systems by changing the strength of any of the gravitational or Magnetic fields strength within the reactors of a system, this system, necessitates the finding of a new balance position between the system and the planet's Magnetic and gravitational fields.

By changing the parameters of the reactors and for the reactor to find a new balance between the systems' own Magravs and the planetary Magravs, this causes the motion of the system as it tries to reach the newly desired balanced Magravs force position, in respect to the planet Magravs.

This is the universal method of **creation of motion *without burning an atom*** of any matter, and this is exactly how all the celestial objects find their position and motion in the ever-dynamic environment of plasma of an electron in an atom, solar systems, galaxy and universes.

The motion of the system is purely due to the phenomenon of **Magravs positioning**, of one system in respect to the other(s).

Simple, portable, plasma dilution nuclear reactor systems, can produce the required Magravs forces within its reactor cores on a continuous repositioning criterion bases that can cause the motion of the Magravs positioning system (Fig. 56).

In these Grapos, the individual pmtics released in the central core (Fig. 56) in their interaction with the compatible and matching pmtics' strength of other pmtics *in the same core* can then collectively interact with the same collection of pmtics created in the other cores of the reactor (Fig. 56), and interactions and interlocking of the same pmtics strength in *different cores* of the system leads to the creation of Magravs within and around these types of reactors simultaneously.

By referring to figure 1, 2 and 3 in the early chapters, then it can be realised that, what has been achieved in these dilution plasmatic Magravs positioning reactors (Fig. 56), is exactly what has been going on in inner cores of planetary systems such as the Earth, to create their Magravs for them to hold on to their components through their gravitational fields, and at the same time to protect their matters from other celestial objects through their Magnetic fields, and at the same time create positioning in respect to other Magravs, at the same leading to creation of motion of the reactor. These reactors are truly an all ***integrated system for flight and motion.***

At the same time, these reactors during their operation within a craft system creates' and maintains' an independent internal gravitational field forces within the reactor cores fields catchments' zone. For example these properties and effects can be used to maintain an earth, one-G gravitational field force within the confine of any spacecraft, independent of the position and speed of the craft where, this position in the universe might be.

These reactors in collaboration and simultaneous production of the Magnetic fields and

gravitational fields leads to the creation of a distinctive and separate magnetosphere around the reactor or the craft which, uses such reactor technology, similar to the Earth atmospheric magnetic field.

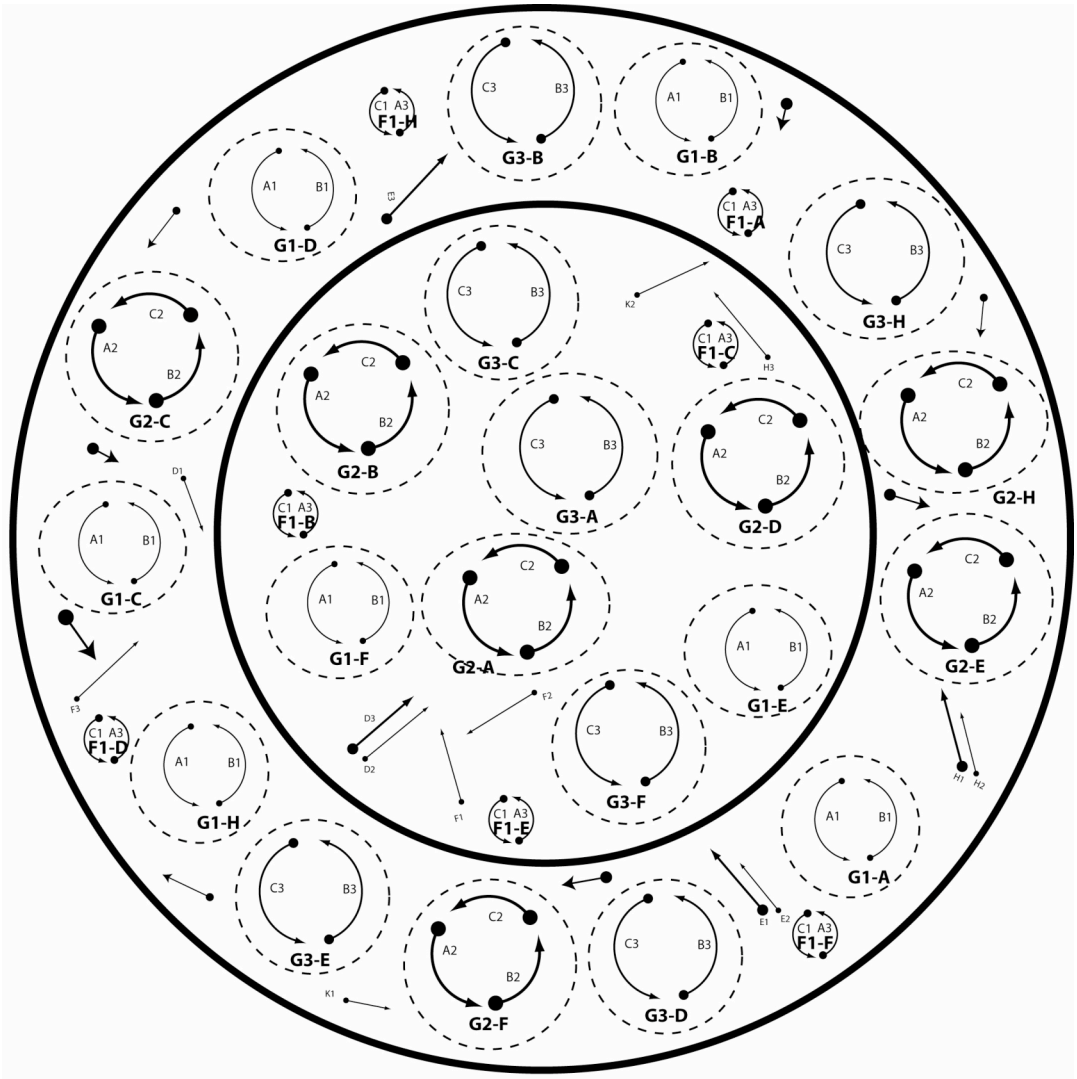

Fig. 56: The Keshe Model of Plasma Dilution and Magravs positioning reactor.

Thus, the Grapos are exact copies of the planetary Magravs producing systems. Similarly, they utilise the same Matters inside them, and the same principle of interaction to create Magravs between the systems and a planet. This being the same principle as, between the Earth and the Sun field forces and the Earth, and the rest of planets in the solar system and the same system principle as between electrons and protons. (Fig. 57)

Therefore, by changing the strength of the Magravs strength of Grapos, these systems can be positioned in any orbit or position around the Earth (Fig. 55, Fig. 56 and Fig. 57 c), in the solar systems or galaxies, with the use of Matters, rather than matters in the system.

In other words, the balancing of two Magravs' forces of the system, in respect to the planetary Magravs forces, leads to lift or descend of the systems. This separation only leads to a vertical up or down motion of one-system field in respect to the other systems' field. This means lift or descend of the system in a craft takes place vertically and not a 360-degree directional motion of the system.

In current physics, scientists call this the anti-gravitational field forces needed for lift and these systems are called anti-gravitational systems.

In reality, any motion of a system is not due to anti-gravitational field forces, but in fact is due to the total balancing of the gravitational field and Magnetic fields of the two systems of the planet and the Magravs positioning of a reactor, in respect to each other in a given position.

For directional motion, the same principle as vertical lift is used with the difference that in the directional case, the ratio of change between Magnetic fields and gravitational field created within the system are utilised, as the two field forces in the reactor of such a system have an opposite gradient of scale of strength with each other. That is to say, the control of the creation of gravitational fields increases with the same increment as the decrease in Magnetic field strength, within the interaction of the fields of the cores of the system, in respect to the planetary field forces.

The same principle of Magravs positioning can be used in space for motion, in a direction of motion towards or away from a planet, star or galaxy.

There is an alternative *method of motion*, which is by *compartmenting* each core of the reactor. This is a highly advanced technology and needs a full understanding of the creation and control of the magnetic fields' strength of magnetic rays and Matters mixtures and full control of the motion of dynamic Matters in a dynamic environment of the reactor cores.

As motioned before, reactors have been designed, built, and tested to confirm the effects of weight reduction and lift, and the results have proven the correctness of the principle of Magravs positioning reactors, rather than the anti-gravitational field assumptions.

It has been shown that the **system gravitational field and Magnetic field strength** are **independent** of the **size of the system for the mass that** they can lift.

In tests carried-out in 2008, a ten-kilogram reactor system was used to lift a 100-kilogram weight.

In early 2009, the system combination was used to reduce weight from 9 kg by increments of 100 grams. Then another system was use to reduce the weight of the system from 7 kg to 6.5, 6.3 and 6.1 kg and so on in increments of 100 grams. In some tests, the weight of the same system was increased by 100-gram increments also.

These tests were done to show the correctness of the theoretical principles and its practical applications in reduction or increase in Magravs forces of one system in respect to another like the planetary system.

CHAPTER 24

Passive Magnetic Fields

In the universe, there are two types of interaction in respect to plasmatic magnetic fields forces.

One pmtics force is called ***active*** magnetic fields force and the other ***passive*** magnetic fields force.

The *active magnetic fields forces* are the pmtics forces that can exert forces on other fields and components of other pmtics of plasmas causing them to move or vibrate, or receive motion or vibration from the pmtics. This is usually matter-based motion and creates tangible or physical motion of matter.

Active magnetic fields forces usually cause dislocation of the electrons in a cell or vibration of electron in conductive material, etc.

Matters of the plasma mainly produce the **passive** plasmatic magnetic fields.

Passive pmtics can deliver their magnetic fields forces as energies to another plasma of the atom, for them to increase their magnetic fields density or energy without dislocating any Matters plasma's.

Through passive magnetic fields strength, if the plasma is in need of the extra pmtics strength, it can receive the quantity that it needs *of the **same** pmtics strength* for it to return to its ground level pmtics strength level. Otherwise, the pmtics will pass the plasma without transferring any of its pmtics to the second plasma. At the same time the second plasma, if it has extra pmtics which it does not need, it gives the extra pmtics *to the **passing** pmtics,* if it needs the extra pmtics for both pmtics to return to ground levels of their original pmtics strength.

The passive magnetic fields do not cause the atom to move or be dislocated from its position but also cannot cause vibration of the electron of the atom as such.

Passive magnetic fields are pmtics used for delivering the energy levels of vitamins and minerals to atoms and molecules of protein chains and are ***Matter pmtics orientated*** and based.

It is important to note that each plasma carries' one pmtics strength pack in the majority of cases. Thus for human body to receive all its pmtics strength spectrum, the body need to consume different minerals and vitamins and proteins that can deliver certain specific passive plasmatic magnetic fields strength to cover all his cells' needs.

Where the ***active pmtics*** are **matter orientated** and create heat, motion, and vibration in the matter components of the plasma.

CHAPTER 25

New understandings and New Technologies

From the new explanation and understanding of the creation and control of initial fundamental particles (magnetic fields), and further in having access to the new knowledge and the technologies that to be able to replicate the same in small reactors and their systems, the production and the control of MATTERS and the initial fundamental plasma as in **the universal order of the creation of Matters** in these reactors have become simple and practically possible.

The world of science and technology can find new solutions and new sources of Matters for the production of energy, the creation of motion and other applications within the confines of these reactors and this technology will be developed further for these purposes.

In understanding the principles of the working of these reactors, one can make use of, and manipulate, the Matters and energies embedded in the initial fundamental plasmas for the production of new materials, motion and energy. One would be able to use the new understandings of the Matters sub-plasmatic structure for the release of magnetic fields and energies from these Matters.

Through progressive development of this technology, new and simpler methods are devised and developed further for the fission and fusion of Matters and their relevant technologies. Through these new understandings and developments of reactors, new ways and opportunities for the production of energy in the world of nuclear physics has become possible.

For energy production in nuclear fission of today, the state-of-the-art technologies use the ***collision effect*** of neutrons and atoms to break up an atomic structure and release its energy. On the other hand, in the world of nuclear fusion, the reverse methods are in use. Scientists in nuclear and physics laboratories use as ***much force*** as possible to fuse plasmas, and harvest the residual released energies from this process.

Through our technology new and simple reactors are in the reach of the scientific world for the disintegration of an atom, or for the fusing of plasmas through plasma dilution technology. This new approach is less energy consuming, much simpler, more practical and the resulting energies produced are easy to harvest.

The same is seen in the world of aircraft and space industry where, jet engines and propulsion systems are in use to force and displace matters like air to create lift and motion.

With this new knowledge and approach to plasma dilution technology as one integrated system, much simpler and more effective methods based on the universal methods for creation of motion are made available to the aircraft and space industry to move crafts within atmospheric or outer space (Fig. 57 C). Magravs positioning principle of an electron in respect to its proton (Fig. 57 A) and Magravs positioning of the planet Earth

in respect to Magravs system of its Sun (Fig. 57 B), these shows similarities between the principle of the use of the new Magravs positioning reactors and their universal parallel systems.

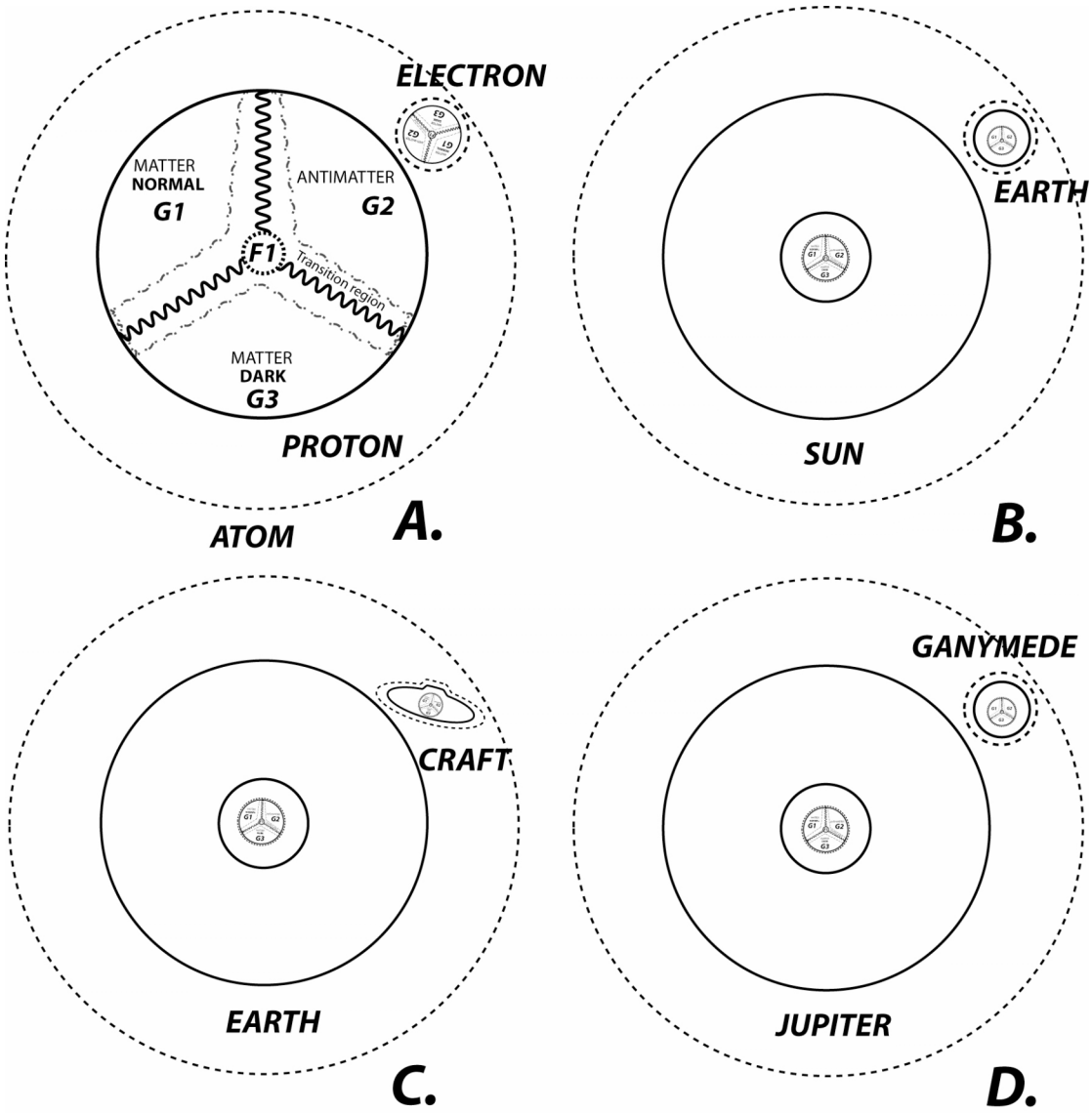

Fig. 57: Similarities between four different Magravs positioning principles and systems for motion and position.

Note: Figure 57 D. shows that an independent plasmatic Magravs system can exist within another Magravs system, and have Magravs positioning in respect to each other, as the ***Ganymede****, a moon of the planet Jupiter, has been functioning for millions of years within Jupiter's Magravs. To cosmologists the case of the Ganymede is the only known condition of an inter-gravitational planetary system positioning, and its operation within the Jupiter's magnetosphere could never be explained with present scientific knowledge. Similarly, Grapos reactors can be used in crafts for motion and Magravs positioning within the magnetosphere of the planet Earth, as shown in figure 57 C using the same fundamental principle as the Ganymede.*

Through the fundamentals of this new understanding of the creation and control of plasmatic magnetic fields reactors (Grapos), **craft systems** *do not need to burn Matmags* to create **lift and motion, but where, the reactor uses the Magnetic fields strength of the Matter (the Matmags) to create gravitational positioning.**

In the **Magravs positioning Technology reactors**, by the simple creation of the acquired plasmatic Magravs levels of the desired point in space, within the reactor's systems, the system is forced by its' internally produced Magravs, the need *to reach a new plasmatic Magravs balance* position between the system and the planet Magravs forces', this causing the motion of the system in respect to the Earth **without burning any fuel.**

The Magravs positioning technology once used in a craft, unusually these crafts become weight independent. That is to say, the systems payload compared to the power of the gravitational positioning forces of these reactors are so insignificant, that the payload mass becomes irrelevant.

This is how small cores size of matters in comparison, in the centre of the planet Earth, can create such strong plasmatic magnetic fields, that their interactions can keep and cause continuous motion of the heavy loads of matters of the planet, at ease, for billions of years.

The important point about using Grapos in aircraft systems is that the plasmatic Magravs and Magnetosphere fields' catchments area of the system has to pass the physical boundary of the craft itself during motion, in-flight and stationary floating mode or protection mode.

During the operation of plasmatic Grapos, magnetospheres are created around the system interface between system and the planet. At the interface of the magnetosphere of the system, due to the friction between two plasmatic Magravs of the system and the planet, only at the point of the magnetospheric interface of the system, this leads to the creation of visible light (Chapter 7).

In respect to plasmatic gravitational field systems, once the fields are allowed to pass beyond the physical boundary of the craft, this gives the craft being in possession and the advantage of having a dynamic magnetically based magnetospheric protection environment around the system. This magnetic magnetospheric zone around these crafts operates and functions exactly and similar to magnetosphere possessed by the Earth, which, the Earth has generated around itself by the interaction of its own plasmatic gravitational and Magnetic fields with that of its star and the pmtics around its environment in space.

This production of plasmatic magnetospheric shielding is a *natural protection* system offered by all celestial objects in possession of dynamic plasmatic Magravs for the entrapped matters within their systems.

Thus, by the use of Grapos in crafts nothing less than that is natural in the universe and a normal phenomenon for protection of internal matters and structure of the planet are offered.

Using this magnetospheric protection capability of Grapos, crafts of future will travel at speeds beyond the capability of the present technology in the aircraft and space industry. These crafts will travel without their outer-surface ever getting heated-up, or ever being in a position to be hit for example by birds in Earths atmospheric conditions or in space by space debris. The reason for this is due to the fact that the outer surfaces of these crafts *never come to be in contact with other matters*, except its own internally created plasmatic Magravs.

The ***interface*** between the crafts' dynamic Magravs and planets plasmatic dynamic Magravs can be extended through the design and control of the Matters within the reactor cores of these systems, that their interface to be far enough away from the physical body of the craft, that there will be no contact or interface with other Matters and matters of physical body of the craft system. These matters outside the boundary of the system can be Dark Matter, air, liquid or others. These Magravs are needed for the protection of a system like this in space, as the systems cannot be hit or damaged by any cosmic dust or asteroid in the path of motion of the system.

The magnetosphere created around these systems, due to the dynamic characteristics of their nature, create plasmatic magnetic fields that will act and is a magnetic shield for the embedded craft within it. These dynamic magnetospheres around these crafts are naturally watertight systems.

If the plasmatic magnetic fields generated by the system, do not reach and pass the physical outer boundaries of the craft, these crafts can have the gravitational shearing gradient forces fields effects, enforced on it, half-way within its structure, rather than around its outer physical boundary; which partial structural cover of Magravs on the middle of the structure of the craft will end-up in the physical damage or in extreme cases the breaking-off of parts or the whole section of the craft at the point of interface between the system and the planet pmtics Magravs. This shearing-off zone is possible and can happen purely due to a difference in the two Magravs forces strength levels at the magnetospheric boundary of the reactor system in the middle of the structure of the craft.

At the same time the passengers of the future, using the Magravs positioning systems, will travel in gravitational field forces within the boundary structure of the craft in similar conditions as on the Earth. The passengers of these crafts can travel without the need for the present compression systems, in use, in the state-of-the-art aircraft industry. There will be no G-force changes inside these crafts during their flight due to the sudden changes in directional motion or at high-speed capabilities of these crafts. Using Grapos, in spacecrafts, this allows normal life and motion within the craft without the effect of weightlessness as is experienced by the space travels of today.

These crafts through their natural plasmatic magnetic fields interaction will always be rotating, as all celestial objects in possession of Magravs positioning field force do. This rotational effect can be facilitated through the design of the craft that the rotational motion can be transferred and be connected to the outer physical boundaries of these crafts, without affecting the working of the internal structure or passengers of these types of crafts.

This method of travel using plasmatic Magravs protection for motion for the future space systems is to be called the **M***agnetically* **O***riginated* **J***oint* **H***abitation* **A***nd* **N***utrition* (MOJHAN) system. The passengers of this **M***an* **O***riginated* **Z***one* **H***abitation* **A***nd* **N***utrition* to be known as "MOZHAN".

These new names unify the human race by the use of the name of the technology and the method of its travel, through the Men's collective effort to reach this point of scientific achievement over thousands of years, through their progressive evolution in science and technology. This takes away the national dependent names, like Cosmo- or Astro- and the rest from the unique and individual nations, for the collective effort and contribution by all of the inhabitants of the planet in different measures over the times to reach this point in Mans scientific evolution.

The use of Grapos will make national boundaries irrelevant except for tax and local laws. The Grapos will not need airports to land near too. These systems know no national or planetary boundaries and they have no need for fuel as such.

Thus, in the near future the nations will have to devise new ways of dealing with the Mozhans as they can land anywhere, without a need for a specific plot or landing strip. In reality however, these crafts will never even need to touch the ground.

Nevertheless, these systems can reach ground level, when their total reactor Magravs sizes are reduced to a safe planetary level, within a specific spherical zones cavity, allocated just out-side the boundary of the reactor systems but within the craft environment.

Pmtics reactors for production of energy

The creation of energy in the universe and utilisation of Grapos technology for production of energy in essence are based on the same principles.

In the universal order of production of energy like in stars, in these units, the principle of the production of current and energy is not on the base of electrons and their vibration movement. In fact, current and voltages on massive scales in these celestial objects are produce through their only ingredients, which are the plasmas and their creation of the pmtics of Magravs of their Matters within their inner natural cores.

In current state-of-the-art power production units like power stations generators, the rotational motion of magnets, and the magnetic fields forces within the confines of the copper windings, is used to create a continuous vibration of the electrons in the solid matters of the copper wire, to generate a flow of current.

We consider the flow of pmtics in materials like that of the ***wind flow of pmtics*** or what is commonly called the ***current*** *flowing through matters* like in copper wires. Where the plasmatic magnetic fields flow in matters like copper, the strength of the magnetic wind decides the rate of the vibration of the electrons of the atoms of the copper.

In understanding the new concept of the internal structure of an atom there are two fundamental points to consider.

First, the electron is the smaller and the weaker of the two components of an atom. Secondly, **the proton by order of mass is much heavier** and is made itself of greater amounts of the ***same*** plasmatic magnetic fields as **the electron**.

Thus in utilising the power of the plasma of the proton rather than the plasma of the electron, it becomes easier to produce the same levels of power with the use of a fraction of the material compared with the present power units.

This is to say; the new dilution plasma technology will bring into to play the ***use of magnetic characteristic of Matters of the plasma of the proton*** rather *than the vibration of the electron.*

To be able to separate the Matters of plasma of proton within the plasma dilution reactors, one needs to release enough dynamic plasmatic magnetic fields, in motion (energy), in the field strength level of the plasma of proton. These plasmatic magnetic fields can move the plasma of the matters of atoms with profound effects, rather than the electron of an atom.

This new capability and control of magnetic fields strength that can be released by the plasmatic reactors, brings into play totally new methods for energy production for any purpose.

The important point to note is that the production of energy through this method does not mean a change in the common use of electrical equipments. The beauty of this method is that the generators of the future will not be limited in their power production capabilities because of the material and size of the system. This means that even pmtics of plastics, nanolayers or any sort of matters can be used for current production and flow of current.

This changes the present power production capability, and gives the possibility of any generator's construction or any power levels at the point-of-demand, this being nano-amps or megawatts of power, through the operation of the same reactor, simultaneously and separately.

The other advantage is that the plasmatic magnetic fields strength of these reactors can be changed through the operation of the system. This capability of the plasma reactors gives a new insight into the power production capability of these new generators using the present equipments and tool.

New type of Generators

Through the control and power of the plasmatic magnetic fields strength **DY***namic* **P***lasmatic* **M***agnetic* **F***lux* **S***trength*, abbreviated to: "**DYPMFS"** that can be released by these new plasmatic dilution reactors, future electric power generators only need to

change their Dypmfs, or the dimensions of the **VO***lume of the* **MA***gnetospheric* **F***ield* **S***trength*, abbreviated to "**VOMAFS**" of the reactor, to envelop the generators' winding using the coil winding method for power production.

Where, the Vomafs of the reactor can cover more of the same copper winding, to produce larger amounts of currents or the strength of Dypmfs of the reactor can be increased or decreased to change the levels of the current out-put of the same winding.

With these new types of plasma magnetic fields system there is no need for transformers, since the exact power input to the motor or engine can be produced by the plasmatic magnetic fields release at the point-of-demand.

For example: considering the present Power Station generating units (Fig. 58), it can be seen that, what has been used as fuel (coal, oil, gas, nuclear) to boil water, to generate steam, to turn the turbine and for the turbine to cause the rotation of the rotor, which is mounted with fixed flux strength magnets, for the motion of these magnetic fields cutting with the matter of the copper coil windings, to generate power, for this power to feed into a power grid.

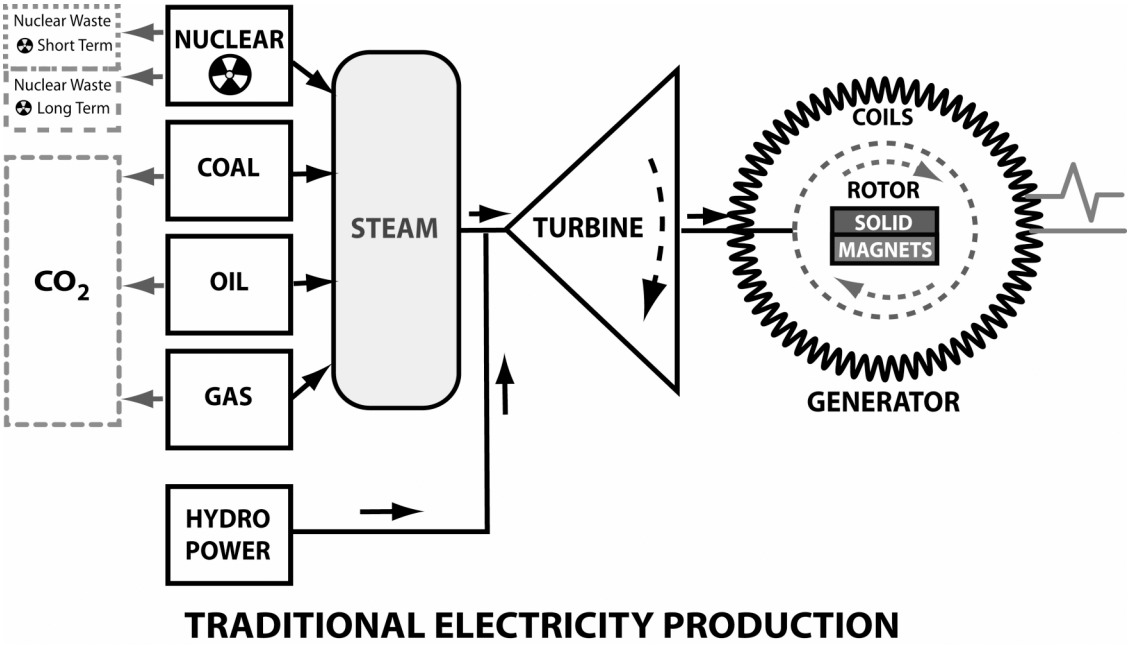

Fig. 58: Schema of actual electricity production

With the present power station generating units *one losses a vast amount of energy through each step of conversion* from solid or liquid or gas to steam to rotation, by all sorts of channels like different types of frictions, heat lost, losses through the grid. These systems usually need hundreds of kilometres of **transmission lines** to transfer the generated powers to the point-of-demand usually into cities. At the same time these types of generating systems using matter components of plasma, these always produce wastes like CO_2 or nuclear wastes.

In understanding the principle of the rotation of the Earth, through the interaction of two magnetic fields (Fig. 3) and the capability of the planet to create simultaneously the external dynamic Magnetic field (Fig. 1, similarly Fig. 61), with the new knowledge of the use of the plasma dilution Magravs positioning reactors with the ability to produce **a controllable, continuous, dynamic rotational flexible Magnetic field strength**, within the cores of such reactors, it is now easy to construct and produced new strong and powerful generators that do not need to burn any fuel (Fig. 59), to create rotating Magnetic fields, but, just by using Grapos nuclear reactor one can achieve the same and even more power than the present matter-based frictional systems. Even it becomes possible to produce varying frequencies of current output of the system from the same generator.

Grapos generators can produce power from kilowatts to megawatts in seconds, by just increasing the strength of the Magravs for the **Dypmfs** of the reactor or by increasing the **Vomafs** coverage of the Magravs. We have called this new generation of power generators the ***Keshe reactor generators*** (Fig. 60).

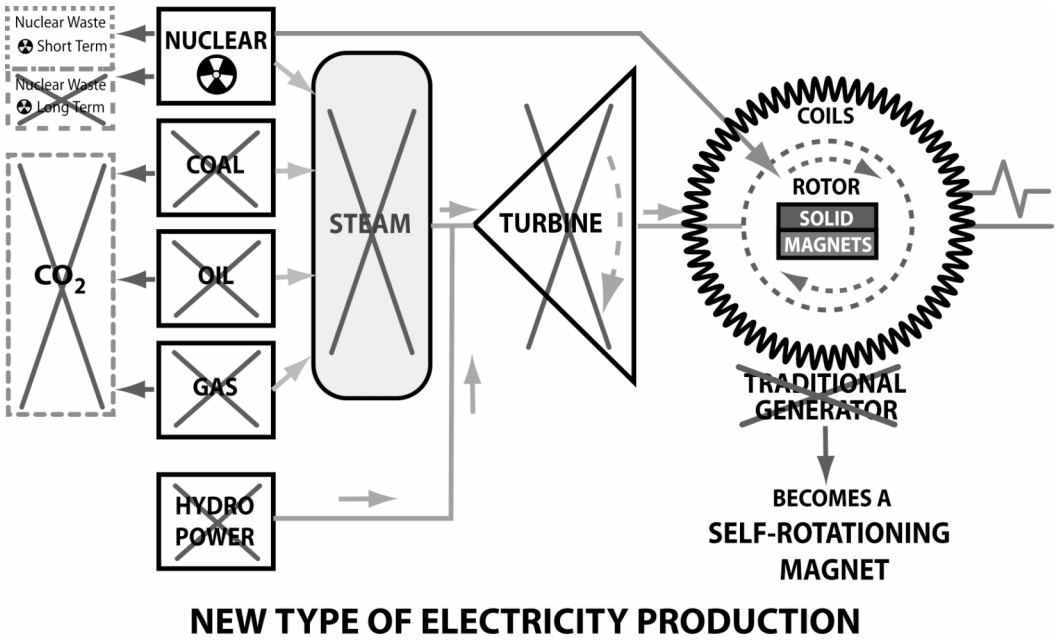

Fig. 59: New approach to generate electricity

The use of plasma dilution Magravs positioning reactor brings to an end the need for burning of fuel (Fig. 59), to create rotational motion of the rotors' for production of electricity as it happens in the present generators.

Our new approach puts an end to the production of greenhouse gasses (like CO_2) through the burning of fuels (coal, oil, gas) and finally an end to the habitual burning of matters to generate motion and energy. This also bringing to an end the current production of dangerous nuclear waste by running the present nuclear power stations.

By purely using the effects of interaction of the Magravs of the Matters, within the cores of these reactors, motion and Magnetic fields, for production of any amount of

electric power can be achieved in one all-integrated nuclear-based unit without creating any waste of any sorts.

In a way this is how all plasmas, atoms, planetary systems, stars and galaxies create their own motion and Magnetic fields (Fig. 60 and Fig. 61). Why not for the man to take advantage of this new knowledge of clean source of supply of Matters for new energy production technology through the real universal method of workings of magnetic fields of Matters?

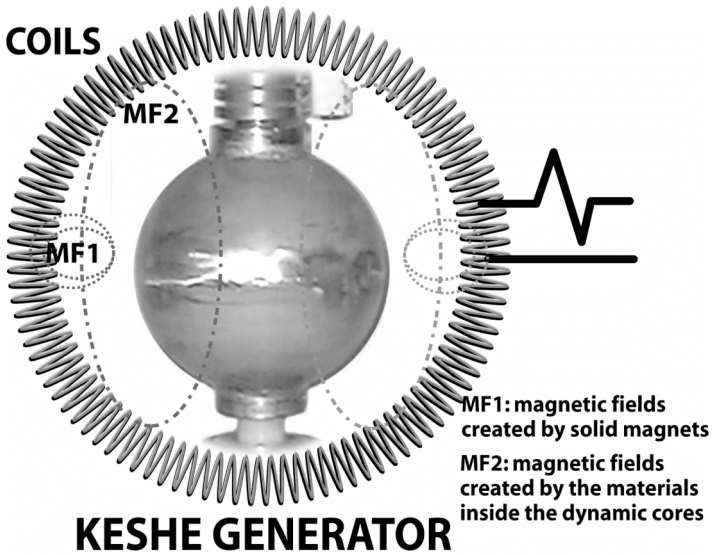

Fig. 60: The Keshe generator, which rotates for years in a coil structure.

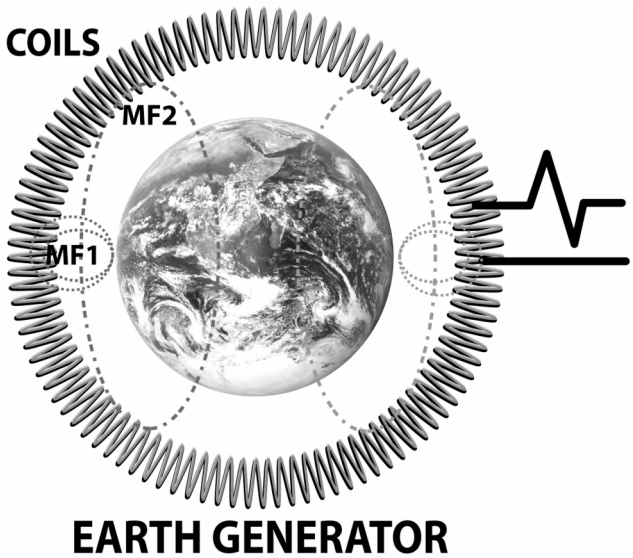

Fig. 61: The virtual Earth generator, which rotates and generates Magnetic fields (MF1 and MF2) for millions years, and could generate electricity if there was a copper coil around it.

Similarly, using the plasmatic magnetic fields reactors can **eliminate** the need for

generators and **transmission lines**, due to the fact that the pmtics needed for production of a given current and voltage level can be created at the point-of-contact of the system. Even the structure of the matters electrons or plasmas can be used to create current for their use in the same equipment. This means that one can produce current from the atoms and plasmas of a silicon or plastic cover of a microchip, to meet the components energy needs.

One possible use for a small reactor is to produce the right plasmatic vibration of electrons or the plasma of matter, within any given environment to generate light and power.

Prototype reactors have already been made and can be further refined that only need to generate plasmatic magnetic fields within their cores, that the interaction of the pmtics generated by these reactors with its surrounding matters, creates a *magnetosphere* at the point of the interface of the two pmtics of the system and atmosphere, that leads to the release of pmtics in the range of visible light of any colour and ray. This will be how future light producing units will be manufactured.

Similarly, in a given environment, in such as a craft, the operation of reactors can produce Magravs, that the interior of such crafts would always be lit due to the principle of the interaction of the surrounding Vomafs of the reactor and the dynamic plasmatic magnetic fields of the particle content of the air within the confines of these crafts.

The strength of these Dypmfs generated by the reactors can be set to produce any colour rays of any magnetic wavelength, be this red or orange light, and X-rays or gamma rays. We have seen this effect in laboratory tests and have measured the radiation fields.

The power generating units of the future, using the plasmatic magnetic dilution technology, will be a departure from the present power and light production technology.

Grapos, due to their ability can create rays at any frequency, can be used for example for disinfection of any give environment and materials, by the production of Ultra Violet lights for matter and Extreme Ultra Violet for Matter in space.

The same principle, for generating matching plasmatic magnetic fields for the production of proteins in these reactors have been tested and proven to be correct. These tests were carried out in 2008 and the production of proteins by the use of nitrogen from air through this technology was proven to be simple and achievable.

In separate tests conditions, the hydrogen atoms of water were used to transfer the right plasmatic magnetic fields to the right pmtics strength of plants and human cells for the pmtics of the cell to gain nourishment or recover to their original level of plasmatic magnetic fields' strength.

This technology has been used in trial cases for helping volunteers with different vitamin deficiencies, or cell plasmatic deficiencies, to recover from the disorders produced by the deficiency, and people to live a normal life after years of suffering.

Alternatively, this technology can be used for production of new materials for coating

or new processes of coating.

At the same time, through simple magnetic plasmatic reactors, the lattice structure of matter can be changed so that the nano-components of the matter can be realigned to change their lattice formation to another. The change of characteristics and properties of one element to another has been tested and confirmed to be correct by independent organisations. In these tests, the nano-matter of an element was captured and then its lattice formation, through the right plasmatic magnetic fields conditions, was changed to attain new properties from the same matter. This was carried out through several tests, at room temperature and pressure, where ***atomic carbon*** was initially released from a C-H bound matter. The carbon was then allowed to deposit itself on a layer of copper. This deposition was dependant on the presentation of the right plasmatic magnetic fields at different points on the same copper Matter. This copper surface was then tested and proven to have sections of nanolayer coating in the form of sp2, and on the same layers and same condition the lattice structure changes the same material to a diamond lattice structure, or what is known as sp3. Where, sp2 is a two-dimensional nanolayer, and sp3 is a three-dimensional diamond-lattice nanostructure.

The plasmatic magnetic fields' of reactors can be tuned to similar frequencies' as the plants pmtics, to generate certain vitamins and minerals. These single or multi-plasmatic magnetic fields producing reactor sources can and will replace the fertiliser industries of today's technologies in space for food production, once scientists grasp the method of their use.

In tests, seeds of herbs were grown by being feed using water treated in these reactors, the parallel seeds, which were grown normally with rainwater, died in early October. The herbs that were watered from reactor system were still green till March of the following year, because the molecules of the water were structured through the reactor system to act as fertilisers. Similar tests are in progress.

In this section, it has been shown and explained some of what has been tested and achieved through this new understanding. Scientists and users of this new technology will find their own ways to expand and will add their own new knowledge to our disclosures.

Seed of thought

Where, in the present time the majority of the nations in the third world due to the lack of funds to purchase fuel even in having power stations, or being able to afford to build generators at the cost of tens of million of dollars, they cannot afforded to run these generators to provide power for their nationals. Secondly, there is not enough production capacity to build new power stations and power grids. Therefore local alternatives can be in the range of windmills and solar cells, but these will not solve the incredible lack of electricity in next decades.

Now, through the use of **Keshe generators reactors**, which can cost as little as a new car, these governments can provide electricity and clean water for their nationals.

Where, these governments do not need to pay for fuel as these reactors run on hydrogen extracted from their environment. These reactors can be placed at the ***point-of-demand*** in a village or in the cities without the need for transmission lines or for any expertise to operate these reactors. Where through the production of electricity, purification systems which are part of these reactors integral operations will allow fresh clean water supply to every child, woman and man on this planet. This new energy source and clean source of water, given opportunities to third world nations to rise above and from poverty and reliance upon foreign aids and charities organisations. Where these nations can produce food and warmth for their nation as the rest of developing world without the backbreaking debt to other nations.

According to a ***United Nations report*** (Energy Challenge for Achieving the Millennium Development Goals 2006), "*Currently**, at least 1.6 billion people do not have access to electricity** for lighting, refrigeration, mechanical power, telecommunications and other beneficial uses. ... Moreover under today's policies and investment trends in energy infrastructure*, **1.5 billion people will still lack access to electricity in 2030**". (42)

Of course this is not acceptable. It is clear that humanity is not capable to deliver fundamental care to all of its members, even not within next twenty years!

Man is not complete and healthy if parts of it human structure suffers from paint of self-inflicting disability, this is the same for the human race as whole. This race is not complete until all its members have and can exists and have the privilege to live the same standard of the development as the rest.

"The future is bright, the future is plasmatic magnetic fields based, through the production and control of plasmatic dilution technology reactors to bring peace and comfort to the human race."

CHAPTER 26

Matters Experimental results and observations

Tests for the proof of all the concepts have been carried out over some years. The direct results and observations made in some of these tests have already been mentioned in some other parts of this book and now will be brought under one chapter collectively and will be discussed in general.

The reason for writing this book is to disclose the theoretical new first principles of our technology; because most of our test results are so groundbreaking that they cannot be explained by actual knowledge. Actual science is partly based on a number of mainstream accepted assumptions about fundamental interactions and particles and matters, where these assumptions have become almost "laws", and do not consider the true occurrences of real events in the universal order of creation of particles, plasmas, matters, energy, gravity and motion as they take place in the universe.

Where, the major processes in the universe are based on fusion and fission of Matters and plasmas, and the transformations and conversions of matters from one form to another. In this book we explain how such conversions and transformations can be reached in plasma reactors, and by this insight we were able to attain such amazing results. Where some people don't feel comfortable with them, or a priori reject them because these new findings and their applications counter their school of thought and their financial gains.

For example, one of the major obstacles in the world of nuclear fusion has been to overcome the Coulomb barrier for fusing two plasmas, and this problem has not been solved for the past sixty years by all scientists in this industry, even though billions of US Dollars and more has been spent by different nations in laboratories and fusion reactors testing to overcome ***the weakest of the weakest of magnetic fields interactions*** in the world of creation, which this is a magnetic barrier, also known as the Coulomb barrier, where this barrier is exactly the Magravs of the plasma, and as now we know how it is created, we have found the solution not to fight and force to cross this magnetic magnetosphere barrier, but the solution is how to create an environment matching the magnetic fields strength of this magnetosphere of the plasma for it to open-up and unveil its real constituent Matters. As the environment of the whole reactor becomes in magnetic fields strength equal to the magnetic fields strength environment of the plasma. Therefore, through this method, there are no barriers to overcome, and fusion of matters of plasmas or the use of the Magravs of the Matters of the plasma becomes a child's play.

For the first time in the world of energy and motion, we offer through dilution reactor technology, at low costs, to open the plasma and dictate the strength and the resistance of this Coulomb barrier to realize the dream of fusion.

Similarly, to achieve lift and motion where, the present space agencies are only able to

deliver a limited payload into space, and the burden and the costs of such launches of crafts and personnel, cannot be met by one nation easily. Where, Magravs Grapos reactors can lift much larger payloads at low costs, without limitation on passengers and no weightlessness conditions in space.

Radiation

During tests in 2008, radiation detectors in the surrounding environment of a test reactor detected high levels of magnetic fields radiation. These high-energy magnetic fields have been measured more than 1.5 meters away from the plasma reactors. Where, there were ***no neutron sources*** in the laboratory or in the building. Through known physics or theories, these radiations should have not been in the environment.

These strong radiation fields were tested and looked for and were not present in the laboratory at any other times with other different testing configurations with the same reactors, using the same radiation measuring detectors.

Such high levels of magnetic fields radiations could have only been due to the release of the magnetic fields that had been entrapped in the Matters of the plasmas, which the system was set to produce. These releases of components of the plasma were achieved during the specific pre-set configurations of loadings of reactors. These strong magnetic fields were released by the operation of multi-core plasmatic dilution environment reactors and at no other time they were detected in the laboratory.

Most of the reactors, mainly built and tested for lift and weight reductions, are made of different simple parts, which some part have materials like plastic rings, and PVC, thus these systems do not and could not have been operating at high temperatures.

In other tests in 2008, and in repeats of the same tests in January and February of 2009, the same results have been achieved, all of which have been recorded on video.

In these tests with the use of a less than *one **gram** of mixture of matters* in the similar multi-core dilution magnetic fields systems, fundamental plasma separations were created through the same method as before. These tests were done using five different reactors, each having a different set of internal configurations.

In all test settings of the reactors, different loadings of materials and different dynamics for the reactors were used.

Weight reduction, motion and lift

In all cases, when the dilution of the plasma and the subsequent untangling of its Matters in the reactors were achieved, then the effects of the disassociations of Matters were observed through the effects they created internally in the reactor and externally through lift and motion, and jamming of radio-frequencies and so on.

In the early original reactor tests, full lift was achieved so fast that the effects of free motion were noticed a while after it was clearly apparent and were in progress, through the replay of the video recorded sessions of the sessions of tests. Through video replay of the recordings of tests, the motion of the system freely on the floor of the laboratory could clearly be seen prior to physical observation of the lift of the reactor system. These reactors have no protrusions, are not equipped with propellers, or portholes, which could cause the lift of the reactor by air repositioning means.

In one configuration and loading of the system, control of the system was lost, so the reactor had to be caught by hand in mid-air, that it could be brought under control before it was damaged.

In one configuration, two reactors with different external bodies and two different internal settings were used next to each other. These systems were kept about thirty centimetres apart from each other. These reactors were entirely different in design and had different settings and loadings. In the two-system loadings that were adjacent to each other, the systems' interacting fields pushed one reactor away from the stronger Magnetic fields of the two systems. With the same systems and different configurations of loading one system was attracted by and was pulled by the stronger gravitational fields strength system, where physical force was used to keep the two systems away from colliding with each other.

"These systems have no portholes, and no physical means of interaction with the outside environment and no aerodynamic systems to cause them to propel up or move side-ways through the air, and they have been no solid magnets or electro-magnets for repositioning or for motion, for them to move the total collective weight of 15 kg of the two systems. There are no external systems and tracts used to help causing the lift or motion of the system in the laboratory. Thus the motion is ***not due to*** **propulsion** ***or*** **aerodynamic** ***design and movement***". This is the conclusion of independent expert appointed as observer for the validation of the results of the tests.

During other tests systems weighting several kilograms, their weight were reduced in a controlled manner at increments of one hundred grams and two hundred grams per setting of a reactor and these tests were all videoed and recorded. For reduction of weight in these increments, the systems needed less than one thousand^{ths} of a gram of a new material combination as Matmags, even in some tests no new material was introduced and by just adjusting some internal parameters of the reactors reductions were achieved.

With the use of such a small amount of physical mass of matters used, creation of such lift and the reduction of system weight seven kilograms, has been said to be impossible without any external energy or equipment.

Through the understanding of the principles of the plasma dilution methods of disassembling the plasma components to utilise its sub-components, systems were designed to achieve these effects in simple ways. With the interaction of the disassociated Matters components of plasmas in different parts of the system, then the scene was set for creation of profound effects such as a *reduction in weight* with respect to the Magravs forces of the planet.

The interaction of the strong Antimatters' of the plasmas components, which were released in the different cores of the ***plasma dilution reactors*** and the interaction of the fundamental magnetic fields of Antimatter upon each other, was observed during different tests. The interaction of pmtics of Antimatter leads to the creation of the strong Magravs in the vicinity of, and within, the reactor cores.

Through the control of plasmas and by being able to separate the components of Antimatters and utilising their constituent magnetic fields in reactor cores, this led to the creation of Magravs forces that initially led to a reduction in the weight of the whole system. In following on with this process there was a detachment of the system from the ground as the system found a new Magravs positioning in respect to the Earth's Magravs force strength.

When looking at the effects and results achieved, there is no doubt about the powers of the interaction of the magnetic fields of Matters, which were diluted and their fields were allowed to interact in these reactors' cores. These effects were attained by allowing a number of the pmtics of the Antimatters of the plasmas *to integrate* ***in one core***, and allowing these fields of Antimatters to interact with the same and similar fields *integrated* through the same principles in ***other parts*** *of the reactor*. Where, the interaction of the pmtics of the components' of Antimatters in different parts of the system with each other, led to the generation of strong specific plasmatic Magravs. The reactor facilitates for these stronger Magnetic fields to interact and generate strong plasmatic Magravs in the reactor cores, with allowing these Magravs created in the reactor cores to interact with the Magravs forces of the planet, and due to the strength of the fields produced in the reactor, this causes' reduction or increase in the weight of the system in respect to the planet's Magravs.

The new Magravs created within the system, pushing against the Magravs of the planet at the boundary of the systems fields, causes the variations in the weight according to the combination and configuration of the Grapos loading. The produced Magravs forces *within the confines of the system* are independent of the external planetary gravitational fields. In numerous tests, it was observed and recorded that the changes in the *internal* gravitational field forces of the system, did not necessarily change the weight of the system in respect to the Magravs of the planet. The interacting internal pmtics forces clearly showed to be generated independently by increase and decrease through internal electrical measuring components set in the system for the detection of these types of changes.

It has become clear that it is the interaction of the Magravs of the planet and the system that have brought about the reduction or increase in the weight and lift or descend of the system in respect to the planet. In some tests, these increases or decreases in the weight of the system have been without any addition or withdrawal of physical matters from the system.

In continuing with the same processes of creation of varying Magravs in the system, weight reduction was managed and followed to such an extent that the total balance of the interaction of Magravs of the system and the planet, in respect to each other, eventually zero reading on the measuring scale system. The point was reached where there was total physical detachment of the system from the table or floor first, and then

the upward motion of the system, away from the surface was achieved.

Some call this the anti-gravity principle but in fact, this interaction and new balance in Magravs forces in between the system and planet, is due to both gravitational and Magnetic positioning of the reactor system in respect to the planet, as both objects are in possession of ***active*** *dynamic plasmatic Magravs forces*.

In a specific reactor, set for weight reduction, internal gravitational field reduction and zero-gravitational field force were disturbed, where the human touch was applied causing the change in the magnetic interface between the fields of the system and planet. This gave a tingling feeling on the tip of fingers after repeated tests.

In numerous tests over years, where the equilibrium state of internal Magravs strength between cores were achieved, the whole system, including internal physical dynamic parts, came to halt, sometimes for up to thirty minutes or more. Then, the dynamic motion of the systems re-set by itself and the system restarted. This ***re-setting*** has been due to losses and reduction of one Magnetic and/or gravitational field strength in respect to another within the cores of the reactor.

A number of times, *external power sources* were used to try to restart the system. In some cases measured energy of up to three, four and eight times the normal operational energy was continuously applied to the internal systems to try to push-start the system, but to no avail.

This shows that the power generated by a countable number of Matters of molecules, was so powerful that additional systems built in the reactor cores could not overcome the kinds of powers produced by so few Matters magnetic fields interactions.

These tests have shown the creation of independent Magravs in separate cores of the reactor. They show the creation of independent plasmatic Magravs within the system boundary, and then the combination of the same Magravs prevailing around the outside or beyond physical boundary of the reactor as magnetospheric or cosmic radiations were produced, which these types of fields are prevalent as have been observed in space around stars and planets.

Indications are that these radiations created in these system, due to their characteristics, do not shown any side effects in the human tissue of the operator up to this moment, years after having been involved with these fields tests.

These fields around the cores are considered to be due to the interaction of plasmatic magnetic fields' of Matters of plasma and environments' Matter or matter, and are independently created in different parts of the cores of the system.

This technology opens up new opportunities for the industrial development and manufacturing of systems that have different gravitational conditions inside the system for living, and have different gravitational conditions compared to the outside and around the physical boundary of the craft. This allows for having a one-G gravitational field force for the normal habitation of Man inside spacecrafts, or in a dome outside and around the crafts for habitation. While the conditions outside the craft can be zero G to

tens of G's. The passengers of crafts using Grapos can walk around the craft, or in and around the dome created by the extension of Magravs of the systems, on any planet surface, as if they were in Earth's gravitational field force environment.

No high temperature core environments or sudden surges of heat were recorded in any tests. The reactors were in some cases opened immediately after operation for new settings, in a normal lab environment. There was no physical damage ever noticed to the internal parts of the system. This includes melting and twisting or destruction of any parts due to the presence of Matters.

Even though we lost a full system by pure enthusiasm to catch, lift upwards, which the jumping on the systems after several times cracked the structure and the systems was lost. We have kept the reactor casing for further analyses of matter lattice changes, and another reactor was damaged when a Black hole condition was replicated.

On only one occasion, where a specific setting was used, a black spot was noted on one of the external sides of the reactor core wall. This is supposedly was due to an energy surge during the test. The effect of the black burn was not removed for further analysis.

Production of matters

In different tests, a new orange and gold coloured material was noticed on two occasions in a reactor, and samples were collected for further testing to show the material production capability of the system.

This method of the production of Matter can be used by manipulating and changing the plasma's and rearranging them for the production of oxygen, hydrogen and water from collections of initial fundamental particles found in space, for human deep-space travel and colonisation. Where, the components of plasma absorbed from the cosmos are loosened by producing the right pmtics strength in the reactor for production of the first two atoms of hydrogen. Using further plasmas from space, in the matching gravitational fields as of the atoms of oxygen in the same reactor, this element can be produced. Then through the same reactor's operation, this allows the combination of the two elements, of hydrogen and oxygen, which was produced from the space plasma, this allowing the ***production of drinking water***.

In the future tests, one can attempt to combine the gravitational effects of the systems for production of energy, material production and other capabilities of the technology all simultaneously in ***one reactor***. We have achieved this much but there is a lot more to learn.

These reactors are truly an integrated system, which can produce and attain several effects and properties, like production of Magravs, creation of matters and so on simultaneously.

Dark Matter technology

The system using the Dark Matter in travelling through the Magravs of the planet creates no magnetospheric conditions, friction, or pmtics force resistance, between its pmtics Magravs and the planet pmtics Magravs. Thus, zones around a craft can be created that there is no magnetospheric field between the craft's magnetic interface and the planetary system's. Hence, a craft using the Dark Matter ***cascading*** can travel within a stronger pmtics, like that of the Earth, *without detection* since the system can create no interface magnetosphere, as there would be no visible light to be seen with this method of motion.

Through this method of using the Dark Matter for transportation, high-speed motions can be attained for spacecraft in planetary systems, solar systems and galaxies.

Using the ***Dark Matter principle for transportation***, the environment between the systems and the planet is **saturated** with the dynamic plasmatic magnetic fields of the system and the planet. This zone appears to possess energies but they cannot be linked to any source. Even though the source of the dynamic pmtics, in motion around the system or so-called energies of the pmtics, is set in the centre of a strong plasmatic Magravs systems inside the crafts and centre of the planet. Such Dark energy fields give the appearance and confirm the existence of dynamic energies, which have no explicit source of origin. Where, the source of energy or the dynamic pmtics is the hidden gravitational source in the centre of the Matters reactors and the planet.

This new technology is a radical breakaway from the hold that physical matter have had on the destiny of Man on the Earth.

With this new understanding of the methods of how Matters are created in the universe, it is possible for Man to use the real Matter sources for energies and powers available to him in the universe for his future scientific evolution.

CHAPTER 27

Discussions and Conclusions

With this new understanding, the elementary particles have become to be the 'magnetic fields' and their interaction leading to the creation of Magravs, this leading to the creation of Matters, as the state of each Matter depending upon the strength of the magnetic fields which have led to its creation in respect to their environment fields strength, which the Matter appears as the Matter, the Dark Matter or the Antimatter, where the collective interaction of the Matters Magravs, leads to the creation of the Initial fundamental Plasma (the Neutron), where the environmental magnetic fields forces conditions, around the Plasma, dictates the physical appearance states of the Matter part of the plasma as matter, this being solid, liquid or gas.

It is obvious that the universe will never stop creating new Matters and matters and their effects, and their interactions, as the universe is a soup of dynamic and ever-changing conditions, created by the Magravs positioning of plasmas, dynamic Matters, matters and their components and effects.

Man can learn how to create the same conditions as the universal order, and to rearrange these fundamental particles for his use, in a much simpler way than he has chosen up to this point in his path of technological and scientific evolution by the use of matter(s).

In the present state-of-art technologies for the production of energy, scientists have chosen the path of force and *destruction of atoms and molecules* to overcome barriers. In the universal order of creation, one works within the magnetic fields forces to achieve the same and even better results.

This ethos of ***burning and destruction*** has been the fundamental focal point for Man's survival in his environment, due to what he has been conditioned to in his evolutional path on Earth. He has seen the power of fire, from fires in forests, and he has used this knowledge to keep himself warm and so he has learned to do the same using the same methods and materials. By perfecting this art, through the burning of wood and oil and so on, he has managed to create energies for cooking and warmth and running industries.

Then he saw the birds and understood the concept of motion in air and so he used the concept of fire to create propulsion and jet engines, still burning one form of fuel or another to achieve flight, still based on the principle of ***matters repositioning and conversion***.

He has seen death through disease, so he has produced other elements to destroy the germs that can cause and bring an end to his uncertain and fragile physical life.

If man would learn to work within the structure of **the universal order of creation of**

Matters and the method and principle of their use, he will learn that he does not need to burn or destroy anything to keep himself warm or feed himself, or even to overcome diseases.

He can very simply change the characteristics of the plasmatic magnetic fields of the elements that caused the misbalance in the first place, leading to his ailment, without swallowing a single tablet in his lifetime.

We have developed and tested such simple systems in the past years and have seen their amazing results.

For example people suffering from Fibromyalgia for thirty years or more, within 3 months of drinking water through these systems, have started living a normal life without any signs of their disease. Follow-up over 18 months has shown a total eradication of the ailment.

We have tested this technology on other forms of illnesses and viruses and the results are amazing. However, this is what is to be expected with the use of the true knowledge of the creation as has been disclosed in this and future books.

With this new disclosure, man in the future will learn to live and operate in the real universal order of creation of Matters and their existence in the universe for his life. He will never destroy any Matter or matter, but he will learn to work within their structure. He will learn to achieve more, with less use of the resources in his environment. This is an improvement on the past, whereby at the present by the use of destructive methods, he has brought himself to the point that the abuse of the matters is now endangering his future on his own home planet.

Man has to learn to work with the real elementary particles and elements and their functions in the universe, such as magnetic fields and their interactions, for him to be able to produce what he needs irrespective of where in space he might be or would want to be.

Maybe this knowledge and the proof of its pleasures will change the ingrained ethos of destruction for the survival for man. One could even hope for a change in his animal instinct of killing other people and other creatures of god to survive.

Additionally he can change his habits and the instinct to want more since through the understanding of this technology he can have whatever he desires from his materialistic world.

In this disclosure, some theoretical nature of the universe has been spoken about, but the real physical aspects can be created to achieve the same conditions as in the universe as we have shown through our tests.

Man will be able to carry on with his life, but at the same time will be able to live in a balanced environment.

The reactors we have developed, which in real terms are ***miniature universes***, that can provide man with all his needs, such as water, food and medicine for him to survive and enjoy the beauties of creation.

The conditions in these reactors are soft and gentle environments and the methods of their use for control and creation of mans' needs are based on working within the universal structure, and not destroying to achieve, as has been the principle of the past for the Man.

For example, when the principles of the creation of Magravs are applied to the lower orders of creation, like the interlocking of atoms to make molecules, there are explanations as to why certain types of Matters are attracted to the reactor, and why certain molecules are, or can be, produced in certain ways and combinations, in certain parts of the universe.

The same applies in the even lower orders of creation, that one can explain and produce certain magnetic fields and their interactions that can lead to the creation of present fundamental elements in the centre of the proton, plasma, an atom and finally the man himself.

The world of science has to understand the conditions by which the interactions of initial magnetic fields can lead to the creation of an initial state, for the creation of the Matter, matter, plasma and finally atom.

Then there is a need to understand and demonstrate as is done in this book the way Matters and matters are created in vast spans of the galaxies.

Scientists have studied over centuries the structure of matters and the atom, and their interactions, in their material and tangible *states of matter*. However, the structure and method by which the atom is created, maintains and guaranties it's existence has not been fundamentally fully understood, due to the lack of overall overview of workings of the universal order of Matters. Even the construction of protons with its sub-components (quarks, gluons), up to today, is based on assumptions and indications by the use of particle accelerators and plasma reactors, by *only looking at* ***matter*** *components* of the proton and some Antimatter parts. So the present scientific world looks for an answer in the construction of the proton on the ***matter-to-matter*** level.

By the present science, the existence of the Matter, the Antimatter and the Dark Matter are largely considered to be independent entities in different points in space, and have never been considered to be as ***one collective*** *and all being* ***integrated parts of one system*** making up the plasma, up to this disclosure.

Mass of the Matters and Mass of the plasma

In the new knowledge we consider the three different quarks of a proton, ***as the three different Matters*** (Matter, Antimatter and Dark Matter) ***of the plasma***.

Where each Matter is *created* through the interaction of at least two different magnetic fields or pmtics, where through the interaction of these two plasmatic magnetic fields of different strength, initial gravitational and Magnetic field for creation of different Matters of the fundamental plasma are set to start.

So that the interaction of *at least two pmtics of* ***each*** *Matter* creates it's own Magravs forces. What we call the interaction of the Magravs strength forces between and in respect to each other of these three different Matters of the proton.

Where, through the understanding of the method of creation of different Matters of the plasma, due to interaction of at least two magnetic fields and the creation of gravitational and Magnetic fields, this confirms that ***each Matter*** irrespective of its environment Magravs *possesses an independent* ***mass*** *of its own*. In the present science this is called the mass of the quark. In fact each Matter, Dark Matter, Antimatter and Matter, has its own individual mass in the plasma. As each Matter is created by the interaction of at least two different magnetic fields strength, the ***total mass of the plasma*** is the mass of the three Matters plus the total interaction of Magravs interaction of the overall plasmatic magnetic fields within the plasma. Consequently the *total mass of the plasma* is always considered to be ***larger*** than the *total mass of its three Matters'* components.

Due to the dynamism of the interaction of the two initial pmtics, leading to the progressive creation of the Magravs of each Matter, *each Matter* is always in a ***dynamic rotational state*** within the plasma. Where the **speeds'** of the dynamic rotation of the different Matters in the plasma are not the same and they are independent from each other, since their speed of rotation is set by the strength of their initial magnetic fields interactions. Where in the present science the observation of this natural phenomenon of rotation is called the ***spin of each quark***. One can compare this, in cosmological sense, as the ***independent*** *speed of rotation* of the Sun and Earth, in spite of that they are within the same solar system. Where the initial plasmatic magnetic fields strength, which leads to the creation of different Matter(s) in it's interaction with it's environment pmtics strength, leads to the creation of an individual magnetosphere of a specific field strength for each of the Matters. Where the intensity of each magnetosphere creates *different light intensity* in its environment.

Now we understand that the interaction between the pmtics of the magnetosphere of each Matter of the initial fundamental plasma leads to the release of different pmtics strength fragments in the range of visible light (Fig. 18).

Due to the interaction of the plasma of each of the three Matters with each other and the release of light or energy, these interactions in parts reduces their strength and the pmtics content of each Matter, where due to these reductions in Matters quantity and strength of pmtics, different colours are attained by these interactions for each Matter during the cycle of the life of each Matter.

It has become clear that all states of Matters are the same in their nature of their creation with only differences in their field strength. What does differentiate these Matters from one another is in principle the strength of their fields and their position(s) and

interaction(s) with other pmtics in their environment and in respect to each other.

Thus, Matters are Antimatters and Dark Matters depending on the point-of-observation and the field strength of the environment of the appearance at a given point and position, but they are all made of the same entity at source, which is the magnetic field.

The front-cover image of this book has been chosen specifically to emphasise for the scientific world to reconsider their assumptions.

The Matter can change to, or appears as the Antimatter and the Dark Matter and vice-versa, if the right conditions and the right plasmatic magnetic fields forces are given or taken away from the pmtics of the Matter.

In this disclosure, we have explained in a simple way that magnetic fields are the *new* initial fundamental particles, and the **magnetic fields** are the new elementary particles ***instead*** of what has been assumed at present as *quarks*. So, the magnetic fields and their interactions are the **creators** of these quarks and so on, in the plasmas.

Then we have explained how the Matter, the Antimatter and the Dark Matter, and the relevant energies of the Matter, the Antimatter and the Dark Matter, are all decided, dictated and created at the inception of the creation of the first stages of the creation of the initial fundamental plasmas of these Matters.

In this disclosure, we have discussed the results and shown how the three states of the Matter, the Antimatter and the Dark Matter are created, but through ***real tests conditions***, we have confirmed the co-existence of these three Matters and their respective energies.

For example, in tests there have been the very strong magnetic wavelengths of cosmic gamma-like radiations levels, which have been detected ***for meters*** around the system, *where there has been* ***no physical source*** *of such radioactive materials ever being present*. Whereas, it is a known fact that alpha and beta rays cannot travel that far in room condition environment. These levels of radiations could only be created through the interaction and the creation of strong magnetic fields in the reactors cores, which in their interaction with the pmtics of matters in the room environment have led to the release of these gamma-like radiations. This is exactly by the same principle as the Magravs generated in the centre of the stars in their interaction with the plasmas of matters on their surface, generate lights and high-level cosmic radiations.

An **atom** is considered to be "a collection of different densities and strengths of magnetic fields interacting with each other, in different magnetic mixtures and levels, in, and under, the same physical rules of the existence as the rest of the Matters, matters and bodies in the universe". The atom is nothing more than a collection of the lower order energy magnetic fields strength in motion in the universe, that always come together in the same specific pattern of dynamic pmtics and strength.

The question is, that, is it the collections of magnetism, which created the MATTERS' of the plasma, or did the existence of the MATTERS of plasma create the magnetism?

At this point, the existence and understanding of the Dark Matter becomes important, since the human eye and the physical machines of today can only observe what is in possession of visible and detectable energy fields.

The **Dark Matter** is created by interaction of magnetic fields which create and are in possession of intense fields of gravity and magnetism, and at the same time, and it is void of visible light in respect to their given environment magnetic fields strength. On the other hand, the existence of the Dark Matter is position dependent and pmtics strength balance dependent, in respect to its environments pmtics' strength.

Through the operation of hundreds of static and dynamic tests we have very strong indications that the universe is indeed made in the normal conditions and of packages of dynamic pmtics.

From our observations, we can say with a large degree of certainty, that the dynamism of the whole universe is constantly maintained through the principle of the interaction and attraction of different pmtics, according to their strength and positioning in respect to their neighbouring rays, fields and plasmas. Where magnetic fields of different strengths are locked to each other by the principle of their ***Plasmatic Magnetic Energy*** (PME) and ***polarity***. These causing the first stage of the creation of the magnetic attraction or what is called the ***Magravs force*** for the creation of the first Matters and plasma and further on of the first atoms, molecules, matter, stars and galaxies.

Through the above disclosures, it is clear that these components of plasma themselves have no solid parts, but are merely *a collection of energy and fields, trapped or interlocked in different magnetic fields strength of the other parts*, according to their strength where, they can appear as the smaller components of these parts or near to visible as the physical state of matter.

These dynamic pmtics or energies on their own in the universe are not that influential, but as they *gather with other collections* of dynamic pmtics or energies of the same levels, they appear as part of Matter, the energy constituents of an electron or the Matter parts of matters, that they show and exert their influence.

When the pmtics binding principles are fully understood, the world of creation and the understandings of the origin and working of the universe will become much easier to work with.
Why, only a part of the pmtics levels is visible to Man is not a mystery, but the reality is that Man has the habit of only looking at things in physical terms. If Man looks for the real existence of the effects of the energy levels, he will open his eyes to a new horizon in the world of creation.

The question is if one can develop the ***pmtics*** as in the universe and manage to release part of these plasmatic magnetic fields from initial plasma as energy, then, one can manage to control the level of these pmtics and their interactions that are needed to create and replicate energy combinations that can lead to the creation of the Matter and then matters. This in time will be done and depending upon the openness of Man to accept the realities of his owns creation and his existence in the midst of others.

In developing reactors, which have been openly disclosed, and in understanding their modes of operation, which are discussed, these reactors will not only be used as future sources of energy for Mans energy needs, further, these reactors will become the incubator for the creation of the energy levels, which can lead to the creation of the pmtics, which will lead to the creation of Matter and matters, like oxygen, food, water and so on.

Through the use of the plasma dilution and gravitational reactors systems of the future, one can and will experience the Black Hole concept and the reversibility of the polarity of planets (12), as we have done in our lab tests and become aware of their pleasure and dangers.

In these plasma dilution technology reactors it is not only the fusion of Matters that is possible, but also the fusion of Antimatters and Dark Matters and their real application in the production of Antimatter and Dark Matters atoms and molecules that will become part of daily use. Where, these will be used for the production of energies and effects, which are above the levels of the Matter components strength.

The beauty of the application of these universal reactors will be the opportunity for the creation and manipulation of the much weaker and smaller energy levels that can lead to the creation of electrons and protons.

These weaker strength magnetic fields for the creation of Matters will be noticed and can be collected at the *outer boundary of the plasma*, but not on the edge of the plasma in the reactor. This is due to the fact that the edges of these reactors are dynamic and are violent areas in which temperature interfaces will not be so suitable, but can allow creating the conditions for weak energy levels to be maintained and to manifest themselves. These zones are good to create the conditions for the creation of electrons' plasma, where loose plasma conditions are needed for fine-tuning of the fields in these reactors. This is due to the fact that electrons, in their foundation, are made of low energy levels bindings and interacting with each other, largely in a dynamic volume as compared to the protons, and in possession of weaker binding energy than protons.

To create conditions for the production of the protons, there is a need for the same energy levels, but tighter and stronger magnetic fields plasma conditions are essential and the size of the plasma and the mixture of energies available in both conditions are important.

The techniques for the use of the ambient temperature reactors to perform fusion or the production of new and heavier atoms can be learnt through the development of initial fundamental plasma dilution technology, which is very much different from the mode of operation of the present fission or fusion reactor technologies.

In the present nuclear fusion industry, the most important point in the world of creation, the *presence of controllable gravitational field forces*, has been absent and totally ignored by scientists.

In **dilution plasma technology**, as in the universe, **gravitational field forces** within the

systems are the ***cornerstones*** of the operation of the reactor.

This is a unique method of the creation of new Matter and the creation of energy, which has been explained in the operation of dilution plasma technology. This is exactly how Matters are created in the universe.

In the right conditions and mixture of initial fundamental particles, the use of plasma dilution technology will lead to the transformation of the *initial fundamental plasma* into protons' and electrons' to create the basic matter and simple atoms like ***hydrogen***. With the right method of application of the plasma dilution technology, hydrogen atoms can be used for the production of the heavier elements.

It is important to note that, in an atom, "The interaction between the two pmtics of neutrons and protons Magravs are in fact the source of the **double magnetic fields** of the atom and consequently the creation of the Magravs of the whole atom.

Even though **neutrons** are supposed to be ***balanced*** *pmtics entities*, the magnetic energy of the nucleus can be ***increased*** up to a limit *without the disintegration* of the inner gravitational forces of its constituent parts for its components Matters field strength to attain the plasmatic magnetic energy of a higher strength or new pmtics element.

In his progressive evolution, Man has learnt to use what has been available to him, like wood to create fire, steam to create power, the use of oil for engines to create motion, and in the recent past the breaking of the atom and joining of plasma in nuclear reactors for energy.

Through the understanding of the creation of the initial fundamental plasma, the energies of not only the Matter parts of the plasma are used, but this technology allows the utilisation of all Matters of the plasma, that is the Matter, the Antimatter and the Dark Matter and their energies that these possess and can produce, that come into play and can be used.

In the other words, we welcome the Man to ***the real world of creation***.

CHAPTER 28

Insight into the Future

Using the new acquired knowledge from above chapters, one can look into the future and say that the struggles of the past will bring beautiful fruits of creation for the future of the man.

From understanding of the operation and relation between magnetic fields within any structure, this being an atom, molecules, and even a star, different types of life in all corners of the universe can exist in all forms, and through other matters then the nitrogen based protein chain of the human race, which other lives through their different pmtics can operate through the same principles as the human protein chain. These creatures through the balance of their pmtics criterion do and can exist in the spans of universe. In fact, their protein chains with different matters than nitrogen could be more efficient in its use of passive pmtics than the humans' protein chain in using pmtics from the soup of the universe.

These Beings might have different colour of liquid distribution medium than Mans' red blood, but not necessarily this mean that they are any different from the Man in essence.

For example, if the liquid of life for these creatures of god have the potassium as the base element instead of nitrogen or mixture of the potassium and the nitrogen, then this liquid can function as good as, and even better than nitrogen-based protein of the human blood for converting and the use of Matters and matters in the universal soup of supplies. Even these Beings' protein-based cell can be more efficient for the conversion and the use of the passive pmtics of the Matters of universe. This efficiency can mean more and different comprehension, intelligence, and brain structure, etc.

Thus difference in these creatures and the Man will, and could be only the colour of their medium liquid system in their bodies.

The Potassium, in combination with pmtics of matters like the hydrogen and the oxygen mixture, in vacuum condition of systems in the Earth atmosphere, creates a silver greenish pmtics magnetospheric interface colour. Which, to mans' protein mixture, in the light absorption spectrum, these creatures with potassium-base proteins can be different in colour. Thus the liquid of life of these creatures in its interaction with Earth's atmosphere pmtics will create blood of different colour than the human red blood. Even in their external appearance they might be, or having to be reflecting the colour of their blood (9).

In reality as different planets have acquired different matters due to their Matters Magravs strength as their base materials, at their inception in their galaxies, rather than nitrogen or potassium as the base for what is called their protein for cell production to sustain life in their medium, in mans' journeys into deep space to these planets and

zones, he will come across different intelligence, colour, sizes, transparency and shapes creatures.

Man has to understand that the level of intelligence, colours of skin or blood and shapes of these beings in the universe, can and is, intriguing as is in his home base with his red blood of the Earth to them.

What is important is that these creatures, with their pmtics balance protein chain could have a different viruses tolerance passive magnetic fields levels than to the Man in the Earth atmosphere pmtics condition too.

From this point on in the journey of the Man in the universe, the prejudices of colour of skin, and the nationhood will have no meaning. From this point on the colour of the blood is only the means of indication of the origin of point of life reference and nothing more and nothing less.

In the short-term for the future one can envisage:

The implications and applications of the transition of Matters will be the key to the survival of Man in the hostile environments of the universe. If this technology is understood fully, Man will be able to conquer the control of most of the forces within the universe and use them to his advantage. The use of the *transition states of Matters* are such a powerful tools for science for the future, that if their applications are harvested in full, most of diseases of the present and future can be eradicated. Through the appropriate use of this knowledge, Man can use the pmtics strength to free himself from most ailments, by producing the right pmtics strength equal to his protein level configuration, to ***reset*** *the cells in his body* to their right and original pmtics strength of operation without swallowing a single tablet.

For example, Man can produce ***enough food*** from the initial plasmas of the universe, without the need for soil, by simply converting the initial plasma to the atoms and molecules of the proteins and vitamins that he requires, at the point-of-demand, anywhere in the universe. As the food, itself is made of and is from the conversion of different dynamic pmtics strength. Where, the planets and animals do the conversion for man, for them by absorbing the pmtics strength of the Sun, and converting these different pmtics strength to vitamins and proteins for mans consumption for his survival. Where plasma dilution reactors can do the ***direct conversion*** of what animals and plants do for production of pmtics strength in levels that can be used by humans, and have the same effect and gives the same pmtics amount and strength needed by the different cells in the human body.

At the same time by the use of plasma dilution reactors, there will be no need to carry all of Man's physical needs with him into space, like oxygen, water, food or matters for his colonisation of planets, and space. Man will be able to convert *Matters-to-matters* through the fusion technology using plasma dilution reactors in space as he travels, and produce what he needs at any given point in space (Fig. 56).

Man can produce ***any*** *material* from the initial plasmas absorbed from the environment

of space, he can produce any Matter or matters at the point-of-demand, this being an atom of hydrogen, oxygen, water, protein molecules, leafs' of gold or sheets of steel. The crafts of the future will not need to carry any raw basic materials for the production of parts into space. Man can produce materials for the construction of permanent habitation zones at any point in space and any planetary environment, through the use of dilution plasma and Grapos reactors.

Systems can be developed, which even in possession of the Dark Matter gravitational field forces, the same system can produce balanced pmtics strength in respect to its environment, for the system to appear as the source of Dark energy.

Systems can be developed, which have the ability to produce internal Magravs forces that can be tolerated by the human body. However, at the same time, the same system is being able to generate a balanced external pmtics strength in respect to its surrounding environment, these pmtics created by the system can be matching to the environment so that they do not have to interact with other systems pmtics forces (like those of the planetary systems' magnetic fields forces), so the pmtics around this region of the craft can have the appearance of systems that can produce Dark Matters and Dark energy.

However in one instance, by creating the balanced pmtics in respect to its environment, the systems that have been physically visible in one position in the given space, without a change of position, suddenly become dark or translucent in respect to their environment. In these systems and condition of operation the interaction between the balanced pmtics strength of the system and the fields of the planetary system can be brought to be matching without the system ever moving, this giving the impression that the system has moved to another position.

New systems can be developed that can produce ***instantly*** as much *energy-on-demand*, at temperature and pressure independent conditions, anywhere in the universe.

In possession of this new knowledge and Technology: ***Man can free himself from the shackles of the Earths gravitational field forces.***

Through the understanding of the ***methods of creation and control of pmtics***, Man can produce its own controlled *protection Magravs* magnetospheric conditions within and around the crafts, with the use of the plasma dilution Magravs positioning reactors, these magnetospheric field forces strength will be similar to the Earth Magnetic field strength (Fig. 62) or similar to the magnetosphere of an electron around its proton (Fig. 63). Where, the Matmags of transport for the crafts of the future can be gathered from the plasmatic magnetic environment of the universe.

The Magravs positioning systems (Grapos) can be used as much in a plasma, on Earth, in Space as they can be used in deep liquid environments, and galaxies, irrespective of the pressures and temperature around the craft.

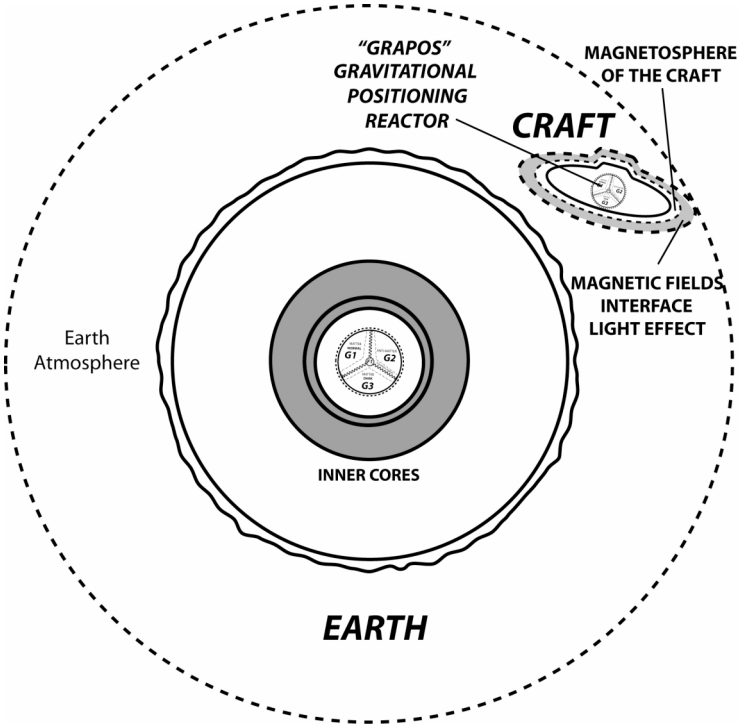

Fig. 62: The plasma dilution Magravs positioning reactors used in a craft due to the interaction of their plasmatic magnetic fields can lead to the creation of shining silver light in the atmosphere of the Earth.

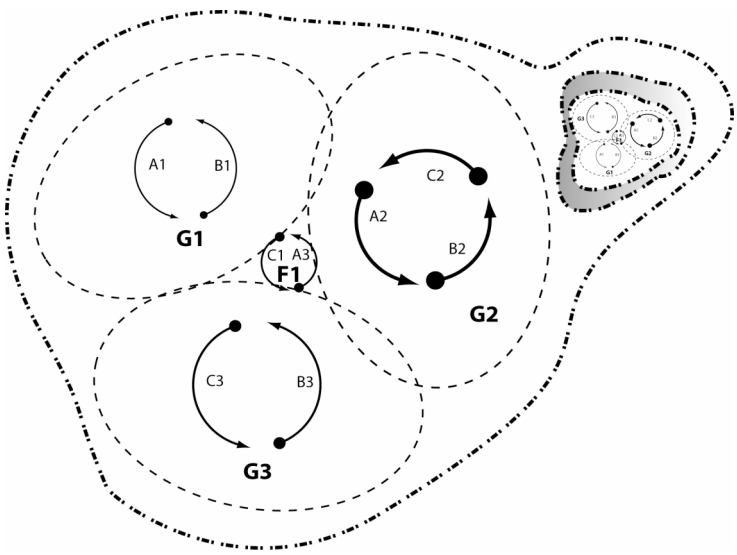

Fig. 63: Initial fusion process for the production of matters and creation of bright magnetosphere of the electron as it approaches' and is amalgamated into the plasma of the proton of the atom.

Our hope, is that this technology cannot and will not be allowed to be utilised for destruction, killing and damage to any environment or against any of God's created

Matters and creatures, whether in possession of intelligence or not.

God help Man with this knowledge so that Man will find peace within himself and others.

As Mans weakness, his greed and his hunger for power and control, soon he will come to be thought the lesson that there is no forgiveness for the ones' whom misuse this knowledge and the technology for harming others.

By understanding in totality this new knowledge and what it can bring, maybe now Man will understand the meaning of that there are balances in the overall construction of his initial fundamental materials and that their lives always have to be within their limitations, of these balances.

Mans' fundamental construction of his initial state magnetic field structure, is always the same in force and energy and specific in its initial components, as the initial fundamental components of Matters, or matters of the universe ***cannot take more than what they need*** to be constructed of the pmtics of the universe and balance enough to share their inner constituents pmtics to pass on what is needed by others' configurations for them to exist, even if this giving can mean and can bring about their own demise.

Thus every creation, in its essence, has the attributes of its creator. Therefore, with this new knowledge and the reality of its existence, maybe Man can strive to understand the truth about himself and purpose of his creation in the universe.

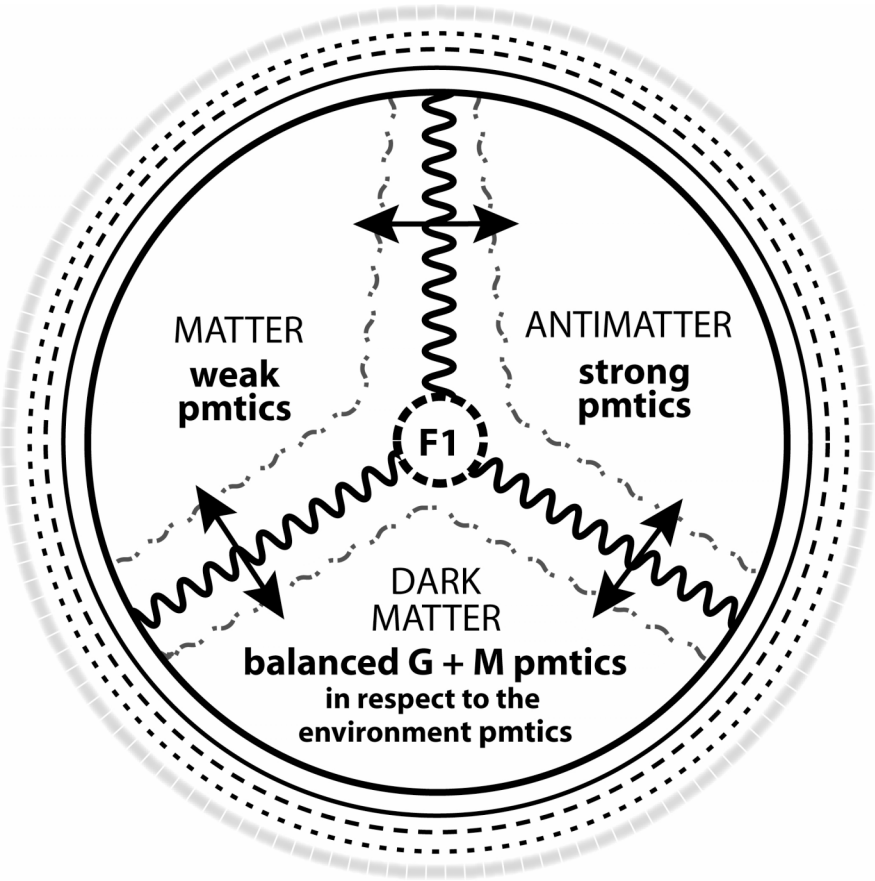

Fig. 64: The fundamental insight.

In general, I can say,

"God has been the creator of All,

and Man the converter of some".

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Published and unpublished works by M. T. Keshe

There are a number of unfinished articles that are to be converted to full disclosures when completed, like Antimatter method of energy releases, Nano space technology, relation between the creator and the created, space communication system, deep space defence technology, dynamic magnetic fields force regions (wormholes) construction and control, creation of magnetic fields, and so on.

Some of these works have already been published through different channels and some have not yet been released.

In the following section some of the works done by the same author are mentioned, with a brief disclosure of their contents.

Some of these papers can be purchased and obtained through direct request and access through specific links.

A number of papers with * and ** marks are not for public release due to their sensitivity of information and only available to relevant commercial and governmental organisations for peaceful applications of the technology.

The universal order of creation
(5.7.2006)

In this disclosure the main construction principles and the method of the link and control in the universal order of the existence of living cells, like the function and operational method of any matter based on so called proteins chains, as for example in human cell are explained in detail.

REF 9

The author considers this paper as one of his most important and fundamental works to be published and to be added to the sets of disclosures written by him.

Cosmic Rays
(Release date 24.3.2004)
This paper explains the source and the origin of cosmic rays and the way these work within our cosmos, their function and their benefits.

REF 10

***The Airborne reactor**
(Release date 25.3.2004)

This paper covers the total design of airborne reactors for space technology. This covers all aspects of operation, design and control of such reactors.

REF 11

The seed of the Earth
(Release date 25.3.2004)

Some extracts from this paper:
The theory that the heat of the core of the Earth is due to inertia of the material pilled on top of each other is completely dismissed through this new disclosure.
The author M T Keshe believes that this centre core is made of hydrogen, other gases and a mixture of liquid and solid Matters, which were in the vicinity of the centre of the core of the Earth at the time of its inception in the solar system.
Through this new understanding of the new inner cores of the planet, this brings to play the fact that the old inner core of the Earth that is already assumed to be made of a solid piece itself becomes a sealed container for the new inner core.
The author through design of a parallel system has set to confirm the validity of this assumption, that the centre of the Earth possesses a *semi- fusion atomic reactor* and not a fission reactor as has been assumed by other scientists.
This theory of hydrogen in the centre of the planet is in line with the physical reality of the creation and the present situation in the physical construction of the solar system.
By the laws of physics all the gases in the solar system should have been in the giant gas planets at the outer layers of the solar system, like in Jupiter and Saturn.
The physical reality in the solar system, is that the lightest of all these gasses, the Hydrogen, has taken its place right in the centre of the solar system in its star, the Sun.
It has to be recognised that the centre of all planets in possession of gravity due to the centre cores heating, are always in possession of two Magnetic Field Forces in their inner sanctum (M. T. Keshe " The creation of gravity").
In the case of the Earth up to now and with the present knowledge there has been acceptance of only one inner core and one magnetic force.
As it is explained in the paper titled "the creation of gravity", there is an inner core in the inner core. This inner core, due to it physical content, motion and position in the centre of the Earth, creates and maintains its own magnetic field force, independent of the magnetic force which has been known to be created by the interaction of the inner core and the outer core of the planet.
These two magnetic fields interact to create the planet's own double magnetic fields in its centre. The interaction of these two magnetic fields forces upon each other leads to the new concept of the "DOUBLE MAGNETIC FIELD EFFECT", where the interaction between these two field forces in the centre of the planet leads to the creation of the gravity and the magnetic forces of the planet (Paper: The creation of gravity).
This new second core is the seed core of the planet, the mother seed of the planet

positioned in this new inner core.

REF 12

The creation of Black Hole
(Release date 25.3.2004)

In this paper it is explained that the Black Hole is created out of a natural sequence of events, and that the existence of the Black Hole in a galaxy is a normal event. Further it is explained that a Black hole is created in similar ways to the Dark Spots on the surface of the Sun. In this paper for the first time, it is explained how the Black Hole is physically created and what function it plays in its galaxy.

REF 13

Magnetosphere
(Release date 9.6.2004)

"The shape and the strength of the magnetosphere of a planet is exactly what a fingerprint is to a man. It is unique to each planet, star and galaxy. It is a tell tale of all its attributes, and it reveals the hidden mysteries of the internal materials' structure".

REF 14

Correction to the Einstein equation of Relativity
(Release date 15.6.2004)

In this paper the physical reality of the Einstein equation is considered, and efforts are made to bring this equation to the real conditions. Even Einstein considers this equation applicable for very small mass, and not in real three-dimensional multi-Magnetic and gravitational conditions, which are external and have nothing to do with the theoretical object's mass and speed, but have effect on the speed and the mass of the object under consideration.

REF 15

***Introduction to the new system**
(Release date 2.7.2004)

In this paper it is written "It is essential to understand that, with the application of this system of motion, one cannot bring into play the solid, liquid and gas fuel method to create motion, as is used today. What is offered in this system is in simple words a fully integrated plasmatic magnetic energy system. Which creates within and around the core environmental conditions as known to man in the universe, like creation of gravity and

magnetic field protection the same as the magnetospheric protection condition of planets and motion through interaction of magnetic fields as planets and stars do in their given environment".

REF 16

The rings of Saturn

(Release date 2.7.2004)

One of the oldest puzzles in the world of astronomy has been the existence of the rings around Saturn. How did these rings come to exist the way they are now? How did they come to appear and behave the way they do? These questions and much more about the creation of these rings are all answered in this paper.

REF 17

The creation of gravity

(Release date 11.7.2004)

In this paper it is explained that "the source and the creator of the magnetic forces and the gravitational forces are due to the interaction between the same materials in the same region of the planet."
Further it is explained how the gravitational field force can be created, replicated and controlled within a nuclear reactor. Further it is explained how this property can be used for the motion of a system within a planetary or solar system.

Now by understanding the principal of the creation of gravity, in this paper it is further explained that "the gravity in reality is the effect of the interaction of **two plasmatic magnetic energy fields** of any two object in respect to each other."

REF 18

Death of a star

(Release date 26.7.2004)

In this paper the death of stars is explained, "The death of a star and the creation of a supernova is in reality the same as the half-life cycle energy step-down of an atom. With the difference that this show is in a larger scale, and more spectacular, in all aspects of its dimensions".

REF 19

Fusion

(Release date 28.7.2004)

In this paper the physical and scientific problems with present fusion technology is considered. Where it is written, "nuclear Scientists, with the fusion reactors of today, are trying to create fusion in the opposite way to the known laws of physics and their parallels in the universe". Further in this paper it is written, "if the present path for creation of fusion is followed, with the present scientific knowledge of physical materials for construction of such system, then following the present path of development to create energy from current fusion systems *will be a distant dream*".

REF 20

Life of a Cell

(Release date 28.11.2004)

Extracts from this paper; "The reality of the transportation and transmutation of a cell is not far from the reality of the life of an atom or a star. Where the life cycle of the cells are slightly more complicated, as they contain other Matters like acids, which have their own magnetic characteristic of their on chemical structure. For this reason the control and replication of the energy of the cell is very much complex, but very simple to achieve".

REF 21

The Atom

(Release date 19.12.2004)

The content of this paper explains how and where atoms in the universe are originated from and how the construction of atoms in a cold plasmatic nuclear reactor can be replicated.

REF 22

Magnetism

(Release date 8.1.2005)

In this paper it is written, "The question is where did the Magnetism come from? This is the Secret of creation. The world is made of one thing and only one thing and that is Magnetism. Its combination and interaction with its own different strength fields makes it appear as different Matter. The rest of creations are the outcome of these interactions of different strength of this thing called magnetism and the forces it creates. Magnetism is the origin of existence and the real singularity in its full meaning".

REF 23

***The creation of the magneto-gravitational force**
(Release date 5.2.2005)

The creation of magneto-gravitational field force is and will be fundamentally independent of temperature and pressure, proviso to the fact that as long as a homogenous free floating PMF within a Matter is created.

REF 24

The core of the Earth
(Release date 20.4.2005)

One of the original assumptions in developing the new Magravs system some thirty years ago by M.T. Keshe was on the basis that the centre of the Earth possesses addition cores, which create the necessary gravitational conditions of the planet. After some twenty years of space technology and through Earthquake seismological data's this assumption has been shown to be correct and after over twenty years, it has been scientifically proven that the inner core of the Earth has an inner core of 600 km. Professor Guy Master in 2002 ref 24 nuclear planet. The centre of this core is assumed to have an inner core of 8 Km, this he thought to be made of the plutonium or other nuclear materials

But the developer of this new plasma reactor technology has proven through physical dynamic cores that these cores possess a mixture of hydrogen plasmas and the process of the heating of the centre of the Earth are due to a semi-fusion chain of events.

REF 25

***The electron-atomic welding**
(Release date 3.5.2005)

Some extracts from this paper:
"The electron atomic welding or atomic welding principle is the phenomenon that atoms of the same material, through a common shared electron, become a magnetically balanced molecule of the same Matter, with the difference that the shared electron will create a balanced PMF in the molecule".

REF 26

***Shutdown and safety of the reactor core**
(Release date 6.6.2005)

In this paper the safety parameters in the operation of the gravitational and energy

reactors are simply explained to avoid the loss of plasma and gravitational field forces created within its cores.

REF 27

***Reactor Start-up**

(Release date 9.6.2005)

In this paper the systematic start-up of the dynamic reactors for the creation of gravitational field forces and the production of energy are set out. The start up of these systems are totally different then the prior arts known in the nuclear industry.

REF 28

***The energy balance of the reactor**

(Release date 29.6.2005)

Some extracts from this paper:

The energy balance of these types of reactors is not as simple as might look in the first instance. The energy creation is simple. But the heat leakage and dissipation through the deliberate inherent material design are and can be zero. That is to say the system not only can hold on the heat it creates. At the same time due to the close circuit feed operation will become self-sufficient but long lasting.

In planets, the loss of heat through their surface creates the variation in the central core condition over several billions of years. In this reactor as losses can be literally negligible, the system can operate at low energy loss temperatures. Even the boundary of the body could be made through the right combination of material in the chambers, so that the body of the reactor will be colder then its surrounding boundary. So the system will not only lose energy to its surrounding, but it can be made to absorb heat in the negative temperature gradient from its surrounding, so that there are no losses.

REF 29

Nuclear decay or half-life

(Release date 20.7.2005)

Extracts from the paper:

"The nuclear decay always has the same or near the same time duration. This is due to the fact that the all neutrons and protons, from their inception, carry a predetermined level of plasmatic magnetic energy. This energy is continually used for the motion and vibration of different elements of the nucleus in respect to each other and the surrounding Matters of the atom. As the space and dimensions of a nucleus of an atom always obeys the same principal of the magnetic separation and magnetic attraction. Protons or neutrons can and will need to use or consume the same energy before they become weak enough that the splitting or decay becomes a clockwork job. The nuclear decay is the natural levelling done of a nucleus' energy, due to the energy consumption

and heat dissipation for the motion of the elements of the nucleus for its remaining plasmatic magnetic fields energy necessarily needed for them to hold one together".

REF 30

***The decontamination system**

(Release date 10.10.2005)

"What this means is that, for example in trying to recycle the CO_2, by the use of the right Matter in one of the cores of the reactor, the system will then use the O_2 to produce H_2O, in the form of pure water, and C in the form of atomic or molecular carbon, or even by feeding this back through certain operational compressions and gravitational interactions within a small core, to create industrial diamond or graphite, for different industries."

The use of the reactor for this purpose has been proven to be correct and Raman spectroscopy has proven the concept and physical reality of the separation of Matter in atomic level after separation in the same system from a composite Matter.

(See the graphene on the technology web site)

REF 31

The difference in atomic and molecular structure under gravitational force and pressurised conditions.

(Release date 15.8.2005)

In this paper is written that "the atomic and molecular structure of Matter is totally aligned and positioned in a fundamentally different configuration where it has come together due to gravitational forces, than when Matter has been brought together by the means of pressure. This has a fundamental effect on the behaviour of the structure and properties of the Matter which is created in either way". Where this is explained and utilised to develop a new method in creating graphene and Sp3 atoms and walls in a simple core made of a coca- cola bottle.

REF 32

****The Defence and shielding system**

(Release date 4.9.2005)

Some extract from this paper:
The design of the side open system for lunch of high saturation magnetic plasma package is one of the most effective technologies for defence of the reactor and the

craft, which is in possession of such a system.
It is essential for any space technology in the open environment of the universe, if the craft is to keep a straight line of motion and to be able to protect itself from any solids or Matters in its path in the cosmos.
This technology can destroy any object by the principal of plasmatic magnetic energy saturation of the incoming object at a molecular level, that object will disintegrate in the form of magnetic vapour and not atomic level destruction, before Matter can damage the craft as debris, and before the craft ever becomes in touch or near these space Matters.
This technology can also be used to protect Earth from the collision risk of NEO's (Near Earth Objects), like comets and asteroids.

REF 33

Method of creation of an atom or nano Matter
(Release date 11.10.2005)

The manufacture of an atom of any density, this being of the simplest form of nucleus or a full atom of hydrogen, or even heavier elements in the universe, all follow the same principal.
Atoms are created in the soup of the cosmos from collections of very weak plasmatic magnetic fields, which for their existence cluster and share their energies with the magnetic fields that are not far from their own plasmatic magnetic field strength.

REF 34

The relationship between Gravity and Mass
(Release date 21.1.2006)

Extracts from text of this paper:
"A planet like Earth possesses a combination of both gravity and inertia. Where the gravity comes from the interaction of plasmatic magnetic energy fields from the processes within its core, and the inertia comes purely from the collection molecules PMF of Matters which has built the physical body of the planet.
Any object, being an electron, atom, molecule or even a human body, is a collection of plasmatic magnetic energy fields of different strengths and their interactions between each other, which in total decides the total or collective magnetic field possessed by that object where this is the mass of the object.
Where the mass of an object is a collective package of plasmatic magnetic energy field tightness of a given object and will not change as long as the object is intact as one entity in its overall atomic or molecular or collective molecular appearance.
Which plasmatic magnetic energy of a physical body (so called the mass of the body) in interaction with molecular or atomic magnetic field (this being gravitational or inertia) of another object will determine the weight of the two object in respect to each other in each others environment".

REF 35

The Dark Matter

The Fifth state of Matter

(Release date 21.1.2006)

Extracts from text of this paper:

The existence of Dark Matter is not questionable,

Proving its existence, and its effect on the energy balance of the universe, in all Matters as small as in the heart of an electron or in a solar system needs to be created, replicated and its effect measured.

The theory of Dark Matter does not and needs not to be considered as complicated, if one understands in real terms the plasmatic magnetic energy of the Matter in the visible and invisible dimensions of the universal work.

The Dark Matter has two distinctive characteristics, which makes it totally apart from the visible Matter.

The Dark Matter possess mass but not visible light, where its existence can only be determined by the weight of the its hidden mass, which could be substantial due to its internal gravitational field.

REF 36

***The inter-atomic fusion**

(Release date 3. 5. 2006)

Extract from this paper:

"The fusion of two or more atoms has been the pre-occupation of nuclear physicists for past years.

Conditions to achieve fusion of two hydrogen plasmas in the TOKAMAK reactors have taken years to teach scientists a lot about the behaviour of plasma and their fusing.

The reality about the fusion in someway has to be reconsidered as, if the scientific world is trying to amalgamate the contents of two plasmas to release energy. There must be a simpler way to achieve releases of similar energies.

The fundamental principal of the inter-atomic fusion is a much simpler way to achieve fusion. If this principal is applied to the atomic condition of fusion, then fusion will be attained in a simple but in a much more physically realistic environment.

The explanation for the inter- atomic fusion is very simple and direct.

In the fusion of two plasma of proton of hydrogen atom, the physicists try to fuse two large plasmas, and by doing so, they try to release a large amount of energy. Where in this process enormous amount of magnetic field forces and currents are needed to bring two plasma in close proximity, so that the energy barriers in between them can be overcome for them to amalgamate or fuse.

In the inter-atomic fusion the overcoming of energy barriers does not exist, as in this method of fusion, the electron of the atom which is circulating the nucleus of the atom and is of the same origin will be encouraged to return into and fuse with the nucleus of its atom".

Where this is a more practical way to create and release manageable energies and there is no need for elaborate systems where even if the energy release will be small compared to dreamed up fusion systems of today.

With inter-atomic fusion method at least small and practical systems can be developed to handle low temperatures of the fusion process.

REF 37

The conductivity of the Matter in the vacuum of the interplanetary mediums

(Release date 21.1.2006)

Some extracts form this short paper "Therefore plasmatic magnetic energy field of elements within the interplanetary medium will cover the space given to them in their environment. Where due to their motion and their electric charges even in eV levels, they become perfect conductor, and in turn, due to their motion on their environment, they become plasmatic electromagnetic generators.

REF 38

The production of Graphene

(Release date 25.7.2006)

Repeated experiments and tests in simple static reactors, and tests in more complex dynamic reactors, prove that atomic separation and recombination of Matter like carbon and hydrogen can be reached at room temperature and at atmospheric conditions.
We have now indications - through static and dynamic tests in our reactors - that the universe was made in normal condition, which was originally nothing but packages of plasmatic magnetic fields of different strength, which were themselves nothing but areas of plasma or collections of loose magnetic fields energies. Where magnetic fields of different strength in locking to each other, by the principle of their **plasmatic magnetic energy (PME),** have caused in the first stage the creation of fundamental particles, secondly atoms, then molecules and then Matter, clouds and asteroids and then stars and galaxy's".

The big bang theory conditions have no room in the reality of the creation of the universe.

REF 39

INTERNET LINKS

Web site: www.keshefoundation.com

Large images of this book on the web site:
http://www.keshefoundation.com/book/images/

Links on the web site to YouTube movies: http://www.keshefoundation.com/youtube/

Forum: http://www.keshefoundation.com/forum/

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In this book nuclear engineer Mehran Keshe discloses in a very logical way that the initial fundamental building blocks of the universe find their origin in a cosmic magnetic soup that contains an uncountable number of magnetic fields of different strengths. In this soup magnetic fields of similar or equal strength can meet, interact and entangle into a larger dynamic spherical pack. The interaction between different dynamic packs, leads to the creation of Gravitational and Magnetic field effects and properties in their given environments. Due to the differences in their magnetic field strength each spherical pack will possess a different strength, which each magnetic field strength will be in the order of magnitude of the three basic types of Matters (Dark Matter, Antimatter and Matter).

As these three Matters being made of magnetic fields, they also interact, inter-balance and can interlock with each other, these interactions of three Matters results in a larger integrated dynamic system, called the Initial Fundamental Plasma, or the Neutron. By the natural decay of this plasma, the proton and the electron come to be generated and to co-exist, where plasma of each proton and each electron still contains the Trinity of the three Matters of the original plasma.

The discovery of these new first principles in physics will open for mankind a large number of benefits, since the various type of interactions of the three basic Matters and their field forces in their environment leads to the creation and control of matters (solid, liquid and gas).

In this book, new first principles and criterions for the creation of Gravitational and Magnetic field forces of the planet Earth are explained. Similarly it is explained how safe, simple, nuclear reactors, which have been build to replicate the structure of the planet inner cores, confirm the Keshe theory of creation of gravitational fields of the planet, as these reactors can produce fields which can cause reduction in weight, cause motion and lift of the reactor system, and produce an independent magnetosphere around such reactors. The interaction of the dynamic plasmatic magnetic fields of the magnetosphere around these reactors with the planetary magnetic fields creates light around the reactor. These light-effects confirm the Keshe's theory of creation of light through the interactions of plasmatic magnetic fields. These systems will open new ways of Space Travel.

By this knowledge it became possible to design, develop and test new low cost reactors that can dilute plasma and achieve fusion of plasmas in a simple and affordable way. So it now becomes possible to create vast amount of energies (like electricity and heat) and motion without the need of burning any fuel and without creating any waste. These reactors can create at any point-of-demand matters like air, water, food, medicine, and new materials, also at nano-level.

This new revolutionary technology can help to solve a number of global problems, like of the climate change, since Keshe reactors can be build to attract greenhouse gasses like CO2, or the global issue of water shortage and water pollution since it becomes now possible to create water and to attract hazardous elements out of the polluted and contaminated waters.

The Keshe Foundation

The Keshe Foundation is an independent non-profit and a non-religious organization founded by nuclear engineer M.T. Keshe, aiming to bring new scientific knowledge and new technologies to mankind, and to bring new solutions for the major global problems, like famine, water shortage, shortage of electrical power supply, climate change, illnesses, by the use of new types of plasma reactors, and to give Man the real freedom to travel in Space.

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The Structure of the Light

Nuclear Engineer M.T. KESHE

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(The Netherlands)

The Structure
Of The
Light

ITNOTGOG

Reflection

The light has plasmatic structure the same as the plasma of the proton and electron and it is made of mixture of magnetic fields strength with difference that the light has dynamic composite magnetic field strength spiral helixial cylindrical composite matter mafs plasma structure rather than the dynamic composite mafs spherical structure of the matters the like of the plasma of the neutrons.

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Forwords

All knowledge gathered and learned in every fields of science by man in his cycle of scientific evolution from his beginning of time and up to this point, these are like of the speck of dust of the universal wisdom in comparison to what man will enjoy from the knowledge which is to be revealed in this disclosure.

This shall not be all that the man has to know about his creation and the creator but through this new knowledge man will become close to realise how much more he needs to discovered and learn more about the created bigger universe, and our hope is that we have managed to bring man to his ultimate point of maturity about his world and the world of other creatures of universe through what is to be disclosed in this book.

In these new series of disclosures including this we will open the world of science into the realisation of the real working of the universe and how man can advance his intelligence and that this new and up to now unknown science can clear the way for bringing peace to the Man's own wondering life and other intelligent beings in the universe.

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Introduction

With the present knowledge in the plasma technology and the new understanding of the internal structure of the plasma, the light is and can be considered to be a cylindrical version of the spherical plasma like of the proton and the plasma of the light is in possession of all three magnetic fields of the matters of the plasma (1).

The ray of light is in possession of Magravs and hence its own gravity, mass and Magnetosphere, and due to its dynamism this plasma of the light possesses momentum and hence can carry and transfer this momentum as energy to other light rays, tangible and non-tangible entities.

As the plasma of the light is moving from one dynamic magnetic field strength spherical in shape plasma to another and as each matter's mafs of the plasma of the light interacts with its surrounding environment's plasmatic magnetic fields in any matter environment, then the appropriate matter mafs components of the light and its ever present environment come to interact with the same and different matters and matter mafs in strength of its environment, this leads to less losses of the plasmatic magnetic field (pmf) contents of the mafs of the matters of the ray of light and hence allowing the light to travel in any environment at the speed of its given environment plasmatic magnetic fields strength with less friction and maximum speed in that given pmf strength. Then in matter mafs and matter magnetic fields strength environment, this property allowing the ray of light to have a speed of light in matter environment strength as is observed by man, and where in antimatter environment the antimatter light travels at antimatter magnetic field strength environment, which the speed of antimatter light is far higher than the speed of light in the man's matter plasmatic magnetic field strength environment.

Thus the speed of the light in the matter environment is not the ultimate speed of matters in the universe, but the speed of light is dictated and controlled by the environmental magnetic field strength which the light operates in.

It is possible to attain faster speeds than the speed of light in a matter magnetic field strength environment by using the magnetic fields properties of the antimatter plasmatic fields.

Once understanding this criterion and concept then at this stage one will face the magnetic strength barriers to overcome as one does in the matter environment with sound barrier.

Therefore: One has to understand the truth about the real construction of the light and its movement in each plasmatic magnetic field strength environment for the man to be able to travel the spans of the universe with pleasures of being able to observe and learn all the truth about the creation in all pmf strengths which operate in the universe.

The re-naming of matters and conditions

(Advice: Skip this section unless you need to refresh or reading for the first time or read it after you have read the chapter 1, 2 and 3 as this section can be confusing and distracting you from the main body of the book).

(Point of reference: The following section is and to be added to all disclosures for the ease of understanding as most of these have been disclosed in the book (1), and it is added here for the ones who have not read the book and are not familiar with terminologies in the works of the author).

In this literature, when using the term "mafs" for example in form of the antimatter mafs this means and refers to the magnetic fields (mafs) which this entity is made of and it is considered to be as a plasma of magnetic fields, and where the term "antimatter" is used on its own this meaning the physical tangible or detectable entity of the same. This usage of mafs similarly applies to physical matter and Dark matter too.

Further, the difference with Antimatter and matter is only in their plasmatic magnetic fields (pmf) strength and compactness of their fields. Thus, what is the magnetic fields (mafs) of antimatter they become magnetic fields of the matter as antimatter magnetic fields unwinds, loosens up, weaken in their field strength through their interaction with other magnetic fields and matters and become matter mafs and in plasmatic magnetic field strength of matter environment the matter mafs becomes tangible and become matter.

Therefore the antimatters are a more compact strength magnetic fields entities of the same of the magnetic fields of the matter, and due to their tightness of their fields, these magnetic fields of these mafs of matters they create stronger gravitational and Magnetic fields and hence they have stronger Magravs and hence upon their unwinding, they release magnetic fields and pmf which are faster, higher in strength and hence they look as to be strange strong and fascinating matters.

This means that antimatter entity of for example ten centimetres in diameter once unwinds in structure it becomes a matter of several thousands of meters in diameter entity in matter magnetic field strength environment.

Inevitably one should call the term antimatter the start matter and therefore antimatters should be renamed the Principal matter. Therefore there is nothing anti about these matters mafs and matters at their pmf strength as has been assumed in the world of science.

The Principle mafs matter itself has different degrees of strength by itself and not all magnetic fields of the Principal matters have the same magnetic field strength. Where, the principal mafs plasmatic magnetic fields strength has a spectrum of field's strength too.

As the magnetic fields of the principal mafs unwinds, it releases and loosen in its environment these magnetic fields (mafs) of the principal matters disperses into their environment, then they lose their strength through contact or interaction and friction with mafs' of matter and matters, and hence these principal mafs matters pmfs go for through magnetic fields strength of the Dark mafs matter strength first before through further reduction in strength, the dynamic pmf of mafs of the dark matter in motion reaches the pmf strength of the matter mafs level and hence becomes visible in matter pmf strength environment and becomes matter.

Now that the essence of existence of dark energy or dark matter can be explained in its realistic manner, and that is what has been called dark matter is in fact this is a magnetic field in transit from

the principal mafs matter and matter strength to matter mafs strength and matter.

Then as energy has been defined as "magnetic fields in motion" then the dark energy in fact is transition mafs matters in motion, or what is called the transition energy.
Then the dark energy can be called the Transition energy instead of the Dark energy, as the pmf in motion as this magnetic fields from the mafs strength of the principal matter in motion to reach to mafs strength of the matter level, this is only a Transition pmf condition, and transition mafs matter phase only.

Where, the interaction of mafs of transition matters with other of the same leads to and creates the Transition gravitational and Magnetic fields of their own or create what is called the Transition Magravs and in some cases this condition leads to creation the transition matter (dark matter) and consequently sometime interaction of mafs of transition energy leads to appearance and become transition matter (dark matter) in the cosmos.

Therefore, the magnetic fields strength which makes the **dark matter** is to be renamed as the mafs of the transition mafs matter and the dark matter as tangible matter becomes the transition matter, the dark energy to be renamed to transition energy.

The plasma of the principal mafs matters exists everywhere in the universe. This being in the centre of the universes, galaxies, stars, planets, plasma of proton and even in the centre of the plasma of the electron and in the lower order pmf strength environments which have been undetected up to now by man.

In reality in the centre of what is called a black hole in the universe, there exist and is the home of the principal mafs matters and principal matter. Therefore the *black holes should be called* ***the principal stars*** in the centre of galaxies, stars, plasma of protons and other entities like these.

The choice of the term star for principal centres of matters is correct as these principal matter concentration centres are like a star in the centre for the matter world like solar system, and the Principal stars are the place for the mafs of the Principal matters and the principal matters which their fields radiate outward into their surrounding as it does with the stars. Thus from this point on in this disclosure we call the black holes the Principal stars in the universe now that we understand the real source of their mafs of this matter(s) and its principal matters.

It can be understood now that where the intensity and the strength of stars and planets come partially from the existence of the principal mafs pmf strength which has been released by the Principal stars in the galaxies. This is to say that the seed of the pmf of the galaxies and matters needed for the creation of stars in principle are from pmf of the mafs of the Principal matter. Where, *the interaction of the pmf of these mafs' of the Principal matters* leads to *creation of initial strong Magnetic and gravitational fields* needed for the creation and attraction of mafs of matters of plasmas of matters, the mafs of the transition matter and transition matters of the same region of the galaxies, plasma of stars, plasma of the proton and other entities of the same structure in the universe.
At the same time when using Magnetic with capital "M" this means the like of the Magnetic field of the earth, which itself is the plasmatic environment created by the interaction of at least two magnetic rays and indicates the outward flow of the magnetic fields from a plasmatic environment the like of the earth.

Similarly, when using magnetic field with small "m" this simply means the magnetic fields as in what we observe at the end of a solid magnet as magnetic fields of the object without its interaction with other fields.

Chapter 1

The light

The initial assumption which has been made by Einstein that the light is energy and travels with the ultimate speed of acceleration in the world is nothing but short of the lack of the understanding of the scientist about the real truth about the real different composition of dynamic Magnetic fields strength which the light is made of.

It is really unthinkable that the light in matter environment can be considered as energy as has been done by Einstein, as he has even proven that the light tends to bend when it passes near large objects like stars.

This bending of the light should have indicated to Einstein that, when energy tends to bend in and around any objects like a star, this by itself indicates that the light is and possesses both a Magnetic and gravitational entity structure. He should have understood that only Magnetic fields or the gravitational fields, which both are magnetic fields based, that these two entities can only attract or interact with other magnetic fields based Magravs entities and then in finding their position in respect to each other, this causing the positioning and not bending of the light in respect to the star and hence light bypasses such large objects by manoeuvring around them and gets or give the appearance of bending near the object as it position's itself in respect to large objects Magravs.

Hence light is not energy but a physical plasma entity like the plasma of a proton or an electron. Therefore, the interaction and Magravs positioning of two physical dynamic entities, which leads to observation of what is called the bending or lensing of the light near large objects the like of the star.

Whereas this was not so and light was an energy, and as has been explained before energy is when plasmatic fields (pmf) are in motion, then light would have been absorbed by the Magravs of most stars into their magnetic fields based atmosphere on the way of them passing through cosmos and as has been observed the light would have been absorbed by the other entities in the cosmos, and the light ray would not find its position in respect to star and bend around stars and large dynamic entities in the universe and the light ray would have never been able to cross the universe that one can now see the emitted light of stars from far corners of the universe.

Therefore as light tends to react and bend near objects like stars this by itself indicates important points that the light is a composite magnetic field based entity and if one can attract and interact with any composite magnetically based entity, then the entity has to have both Magnetic and Gravitational field forces.

When two or more plasmatic spherical magnetic fields Magravs interact then this can lead to release and creation of cylindrical Magravs of the light, which ***this transitional Magravs entity*** possesses both **mass and gravity**. Therefore, as the plasma of the light possesses gravity and Magnetic fields, hence this entity due to its structure possesses its **own mass** and its **own magnetospheric environment** too.
Where, this magnetosphere which is created by the interaction of the two the Magnetic fields and gravitational fields of the light in its interaction with other pmf of Magravs of a given environment, this leads to and creates the visible light in matter mafs and matter environment when the outer matter content of the light is in matter environment.

Hence the interaction of the plasma of the light and its environment's magnetosphere leads to

release of pmf in the human protein Magravs strength, which manifestation itself as the visible light.

That is to say as the magnetosphere of the light interacts with the magnetosphere of its given environment, due to friction of the two fields*, residual magnetic fields leftover* are created, which they are manifested as visible light or other wavelength of magnetic fields according to the human eyes protein cells plasmatic magnetic fields strength levels in earth environment Magnetic fields condition and in comparable environments.

Chapter 2

The structure of the light

As an entity in possession of Magnetic and gravitational fields moves from one spherical plasmatic magnetic fields environment (for example the plasma of the proton) to another plasma, the plasma Magravs motion in between these two spherically dynamic plasmatic entities (transition plasma magnetic fields (pmf) stretches' to and takes the shape of elongated cylindrical Magravs entity rather than a spherical shape.

It can be considered that the tangible or detectable pmf are of dynamic spherical in shape entities and they possess the pmf Magravs of their own and as the pmf moves from one dynamic spherical entity to another dynamic spherical pmfs Magravs environment then the plasmatic magnetic field Magravs in transit between the two spherical Magravs due to interaction and its composite Magravs configuration and the Magravs composite of its environment becomes elongated pmf in shape from the Magravs of the spherical plasma and takes and become narrow and elongated and hence spiral cylindrical in shape.

It has been explained in detail that the plasma of dynamic spherical entities like plasma of the protons' is made of three main components of mafs of the matters, the mafs of the principal matter and the mafs of the transition matter and mafs of the matter (1).
Therefore the elongated plasma of the same must contain the same mafs and matters but in a different structural positioning configuration.

Hence the dynamic cylindrical shape plasma of the mafs of the matters in transit from one plasma to another will have the same quantity mafs of all matters of the dynamic spherical plasma and therefore the plasma in transit possesses and it is made of the same mafs of the principal matter (Fig.1, 2), mafs of the transition matter (Fig.1, 2), and the mafs of the matter (Fig.1, 2), hence the plasma of the light contains the same mafs of the matters as the plasma which is manifested from.

This dynamic elongated cylindrical plasma once in motion due to its new shape it can penetrate and move faster in its environment as it has less frontal interface and creates a lesser friction as if it was spherical in shape, this allowing faster speed to be attained by the plasma of the light in transit from one matter mafs environment to another irrespective of the plasma matter mafs of the light being in the principal mafs, transition mafs or matter mafs mediums pmf strength environment.

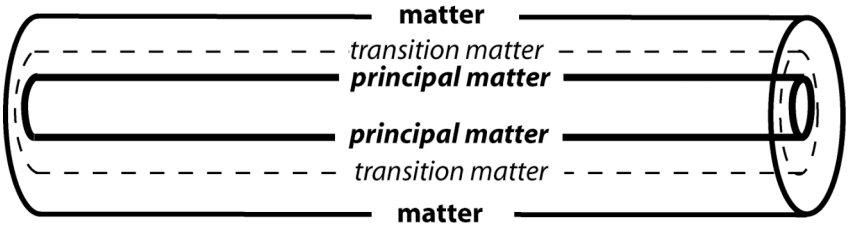

Fig.1 The schematic mafs of the matters components' of the light

This internally dynamic cylindrical plasma of the light in its motion creates friction between itself and the Magravs of its environment, which this friction at the point of their interaction and due to friction of the two pmf Magravs at this point of interface releases plasmatic magnetic fields, which are in the man's protein pmf strength detectable magnetic spectrum. Through biological structure of the humans protein pmfs strength visionary sensors' which can detect this interface interaction pmf strength then these sensors become aware of different pmf strength, its position and condition and

this information is passed to the brain, where this method of interface interaction of two Magravs of the rays of the light and the protein has become the method for man to be aware of his physical surrounding in his environment pmf strength and the man has called this matter interaction conditioned wave length the light ray.

The light ray in its interaction with the surrounding magnetic fields in their environment leads to creation of magnetic field in range to man visible light according to the human protein pmf strength of the universal Magravs spectrum, where the shine or the visibility of the light observed become and it is at the boundary of the magnetosphere of the plasma of the light.

The structure of this dynamic cylindrical plasma of the light ray, which creates its own Magravs, is initially consisted of, in the centre, the content of mafs of the principal matter, then the next layer to the principal mafs is the mafs of the transition matter and then the layer surrounding this, is the matter mafs strength magnetic fields components of the light.

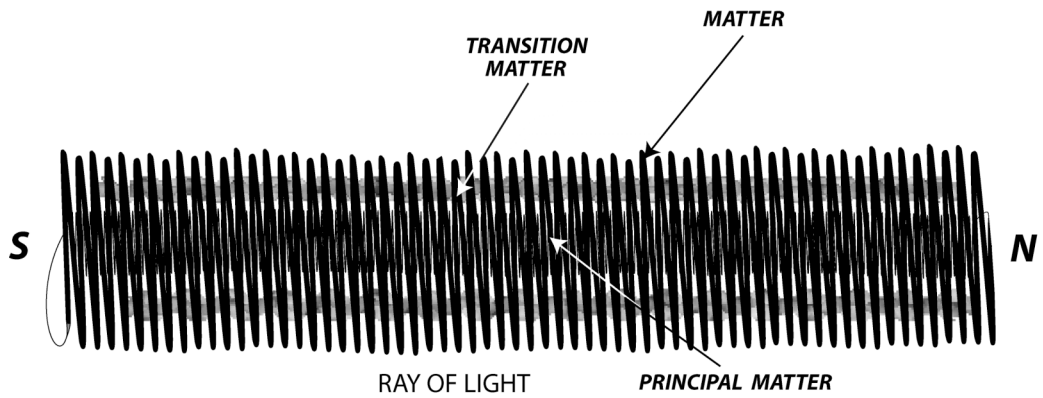

Fig. 2 The mafs of the matters components' of the light

These dynamic plasmatic magnetic fields due to their proximity to each other, they have to interact with each other as all magnetic fields in close proximity with each other do and by the same universal principle laws of physics these magnetic interactions leads to creation of gravity (1) and creation of Magnetic fields within and around this dynamic cylindrical plasma, where these magnetic fields interactions leads to creation of internal and inward magnetically initiated gravitational fields force of the light and the outbound Magnetic fields forces of the light. Therefore due to interaction of different constituent magnetic fields of different mafs' of the matters of the light, the light must create and does possess its own Magnetic and gravitational fields, and due to the interaction of these two plasmas of the fields of the gravity and Magnetic fields, this leading to creation of the mass and the magnetosphere of the ray of light (1).

Hence the light by natural laws of magnetism possesses mass and magnetosphere and similarly not all lights have the same mass and by the same laws and principles lights of different intensity and lights which can travel longer distances possess a larger mass. Where, their mass is primarily dictated by the strength of the pmf of mafs of the principal mafs of the light components'.

The interaction of the mass of the light and the environment of the medium that the light is traveling through, then the light acquires weight in respect to its given environment fields strength.

The mass of the light has different weights according to the gravitational environment which it is passing through or being produced or arrive at. In understanding the construction of the ray of the light then the mass of the light has to be measured along its total length and not across its width.

Most rays of light possess anticlockwise spiral longitudinal rotational motion for their constituent

fields and not spherical rotation of the fields as for example in spherical dynamic entities the like of plasma of the proton.

Rays of light as in the case of matter plasma of protons the light rays mainly possesses and maintains a clockwise directional motion.

Due to composite structure of the light's mafs, if one looks' at the cross-section of the light (Fig. 3), one should be able to observe a tighter magnetic fields strength region of the principal mafs in the centre, leading to creation of the strong light in the principal spectrum level and stronger gravitational fields of this sections' structure that creates its own magnetosphere region, then this section is covered with the transition mafs region structure of the light, and then when the transitions mafs have reduced in their strength, then they become in the level of the matter mafs strength and at this zone the matter mafs and matter of the light are established and maintained (Fig. 3).

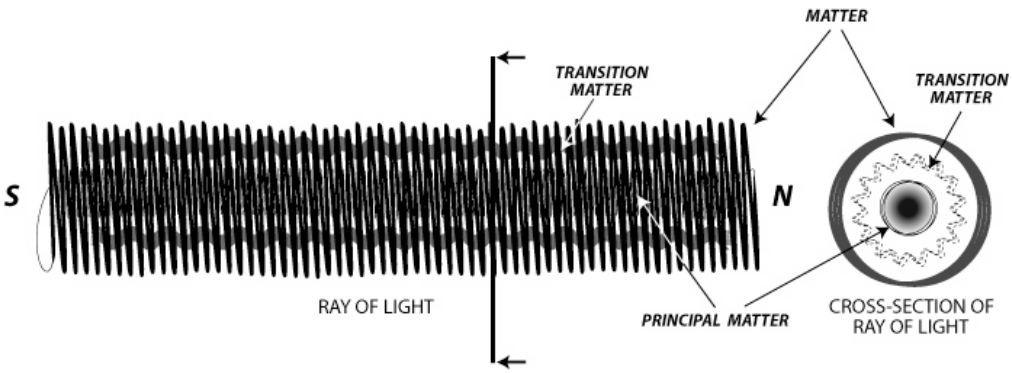

Fig. 3 The cross section of the ray of light

The lights' structure is similar to the structure of inner sanctum of the Sun and principal star in the centre of the galaxies, where for example the Principal Star takes its position in the centre of the galaxy and due to its higher inner magnetic field's strength of the principal star, this creates what appears as the principal stars strong gravitational field forces that all matters around it are pulled inward and at the same directional motion of the galaxy is set by their principal star too, where simultaneous this central matter radiates outward its own light in the principal mafs strength (3 and 4).

The straight helixal cylindrical shape of the light ray has polarities the same as any straight solid magnet, where the outer magnetic fields lines of the light ray converge inwards and the inner magnetic lines of fields diverge outwards, this creating an inward (South-Pole) and outward (North-Pole) directional motion of fields (Fig. 4).

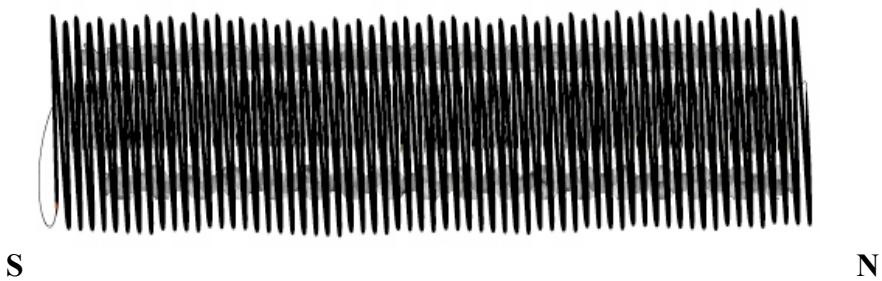

Fig. 4 The polarity of the ray of light

Due to the structure of magnetic fields of the light, it can be said that the matter mafs fields components of the light will be interacting and be attracted and drawn inwards' through the centre

of the structure of light's magnetic fields at the ends of their pmf length (South -Pole of the light) and then as they go through or in proximity of the mafs of the principal mafs of the light in the centre they absorb some of the pmf, which has been unwinded by the mafs of the principal mafs fields and then these matter mafs fields, now energized, then due to their rapid motion are ejected and appearing from the other end (North-Pole) of the light ray.

This inward revolving motional central rotation of the outer matter mafs fields at the same time gives the light its property of high speed forward motion, where the conversion and the overall and total gravitational field strength and the helixial cylindrical rotation of Magnetic fields of the lights' principal mafs' dictates the length of the light ray and hence where the beginning and the end of the light ray would be.

This process of matter of light going inwards and then ejecting from other point, is very much like the process what some consider as the imaginary phenomenon commonly called and known as a wormhole principle. The continues rotation of the mafs of the matter's fields concaving-in and will go through the inner Principal Star like system of fields in the centre of the ray and then the pmf of the mafs of the matters emerges from the opposite-end as it has entered with new and higher pmf strength.

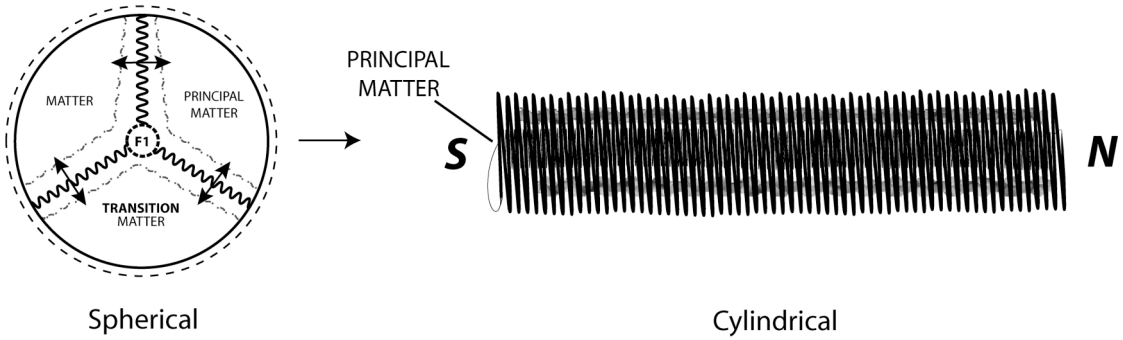

Fig. 5 The first conversion. The spherical plasma structure converts to the cylindrical plasma structure of the light (The first metamorphoses of the light)

When, the spherical plasma first changes to cylindrical plasma that is the point when the ray of light is created and becomes straight line directional in motion entity, and the spherical entity goes through the first metamorphoses (Fig. 5).

Then as and when this dynamic cylindrical entity reach's its destination point, this being of any mafs or matters plasmatic fields strength environment, then at the point of arrival then this cylindrical entity goes through the second metamorphoses and reverts back and spherical rotational fields entity (Fig. 6).

Fig. 6 The second conversion. The cylindrical plasma structure of Light converts back to a spherical plasma structure (The second metamorphoses of the light)

Where, the plasma of the light gets gravitated and absorbed then it takes the shape of the matters in the target entity environment as the content matter of the plasma of the lights gets added to the plasma of the target environment and the target entity receives an additional dynamic plasmatic magnetic field of all mafs of the matters of the light or what is called the target plasma receives an additional energy from the plasma of the light.

Therefore the plasma of the matter to hold on to its maximum pmfs and transfer its pmfs from one point in the universe to another as fast as possible, then the plasma of mafs uses and goes through double metamorphoses process of spherical to cylindrical and then to spherical entity (Fig. 7).

In reality the light ray due to its mass possesses momentum rather than light being a ray which only transfers' it magnetic fields and energy upon interaction with other entities in the universe.

Therefore, IFF the light was a ray and not a plasma composite of different mafs strength, then only one of the matters' mafs of the plasma of the targeted entity would increase in mass and this creates unbalance in the inner structure of the targeted plasma and only in that matter's content, which in the case of the matter environment this energy is so low compared to the principal mafs contents' of the targeted plasma, that this increase in matter pmf would not have shown any increase in its content and increase in the energy as the whole.

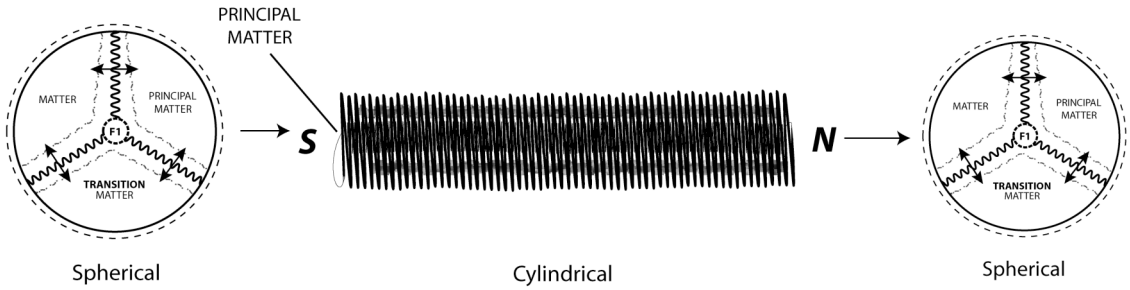

Fig. 7 The double conversion of the plasma from spherical to cylindrical, and on its arrival back to spherical plasma entity
(The double metamorphoses process of the plasma of the mafs)

But as the light transfers all its mafs of all its matters content to the targeted plasma, then the whole pmfs matters of the plasma of the target plasma increases and then the whole plasma shows signs of increase in the plasma content and for example the whole atom structure gets energised.

This being the like of when plasma of an atom receives injection of a ray of light that the whole proton and electron gets excited and energized and not only the matter components of the plasma (note: the term plasma of an atom as the whole structure of an atom including its neutron, proton and electron create its own magnetosphere and it can be considered as one plasma containing plasmas of these particles). Where, the electron due to its lesser mass shows a more rapid motion and excitation, whereas the plasma of the nucleus absorbs most of the light mafs and adds this to its total mass of all its matters.
If! The protons of the nucleus magnetosphere are measured before and after interaction of the light with its atoms magnetosphere, then it can be observed that there is a marked increase in the magnetosphere size of the plasma of the proton too, this indicating that the whole atom absorbs all matters mafs of the light and not only the plasma of the electron, which moves and takes new position in respect to the protons Magravs.

In comparison, in earth condition as meteoroids enters its magnetospheric zone, the facing side of

the meteoroid on entry into pmf of the earth, its interface surface matter curves' backward, where the same happens in the case of dynamic plasma of the light in entry into a new pmf strength environment, then the same types of curvature and convergence of the mafs of outer matter mafs layer of the light due to the speed of the transition and obstruction and friction of the new environment, then the outer mafs of the light take their position on the outer layer and the rest of the mafs of other matters' of the light follow the same process and take their position within the new plasma and the cylindrical structure of the light converts into spherical plasma and hence the light converts into a tangible spherical matter, and all its matters content fuses and amalgamates with all matters of the same in the new target plasma environment (Fig. 6).

The reversal of the helixal motion and cylindrical plasma of the light to spherical and rotational mode of matter is entirely dependent on and due to the environmental plasmatic magnetic fields strength, which the light arrives at and it is dependent on the tightness or strength of the magnetic fields of the destination environment.

In this process pmf traveling from one point to another in the universe, as the fields of the mafs of the transition matters have faster speeds than the matter mafs fields of the light then, when the light arrives at the point of its destination, where is to release and converts its fields to the given environments' of other plasmas, then the conversion in the matter mafs to matter fields strength leads to creation or release of plasmatic fields in the soft x-ray which is the essence of creation of life (6) and other magnetic fields strength of magnetic spectrum levels.

In the matter environment the slowing down from the principal mafs components of the ray to matter mafs fields strength leads to release of magnetic fields plasmas in the gamma rays strength levels and similarly the beta plasmatic magnetic fields strength is due to fields strength from principal mafs to mafs of the transition matter and transition matter mafs to matter mafs and matter pmf strength this become to release alpha rays in the magnetic field spectrum.

The production of gamma ray through such similar process can be observed, when the star in the supernova state releases gamma burst, where this gamma burst is due to the rapid expansion of the principal mafs of the star converting into the matter mafs magnetic field strength or the rate of the change of the principal maf to matter and matter maf leads to release of gamma rays.

As the matter mafs composition and the construction of the plasma of the electron has been understood to be of the same as the plasma of the proton and neutron (1), then gamma rays are and can be produced by the mafs of the matters of electron the same way as done by the neutron or protons, when and where the right condition for the release of the fields strength equal to the gamma rays are made available for this ray pmf strength to be released. Where these rays released by the electron can appear in the inner structure of the plasma of the protons of the nucleus and be manifest as the incoming and mysterious energies which are moving within the plasma of proton or neutron and their source unknown.

There are lights rays which are created by the electron in the same process of spherical to cylindrical structure conversion between the pmf of the electrons and the proton or an atom.

It has been explained (2) that there is current of magnetic fields flowing within the different mafs of the matters magnetic fields strength of any plasma as it does between the plasmas themselves. Where the current of magnetic fluxes in the case of the light rays is in the light plasma magnetic fields strength and not electron levels of magnetic fields strength of the spectrum of the magnetic fields, when magnetic fields moving from one matter mafs to another within the layers of the mafs of the matters of the light. This current of pmf within the mafs of the matters' of the light is to be called the **light Magnetism**, "***ligmagnetism***" instead of electromagnetism as their mass of the mafs

are totally in different scale of measurement.

It has to be said that as there are electromagnetic fields so there are *protomagnetic* field as well in the operation of universe, these are a more powerful current follow of magnetic fields package, which the world of science is not so much aware of these at the present, but in the construction of space reactors for the future of space technology the use of protomagnetic fields and their currents are much easier systems to produce and this gives opportunities for the development and production of a much smaller but more powerful by factor of several orders of magnitude than electromagnetic based plasma space reactors, where huge masses can be lifted with few grams of fuel. This concept of light to neutron and lift and motion is the main corner stone of knowledge and principle that allows the stars to create such a powerful gravitational and Magnetic fields, which the scientific world at the moment has not understood as of yet and has been entangled in the smaller component of the atom, rather than understanding the real power house of the atom and utilise this for their benefit to achieve some wonderful and interesting results.

The pmf current within the mafs of the matters of light structure magnetic field in strength has a different spectrum due to its length and rotational motion than the electromagnetism measurement. This ligmagnetisem has more powerful current flow and by size have stronger field's strength as it has more field contents in the principal mafs fields' spectrum than the electromagnetism which is in matter fields' strength spectrum.

Electromagnetism or electromagnetic flow (2) is said to be the electron magnetic fields strength equal to the strength of the magnetic fields of the plasma of an electron and the current is explained as the rate of the flow of the magnetic fields from one magnetic field strength to another (1 and 2).

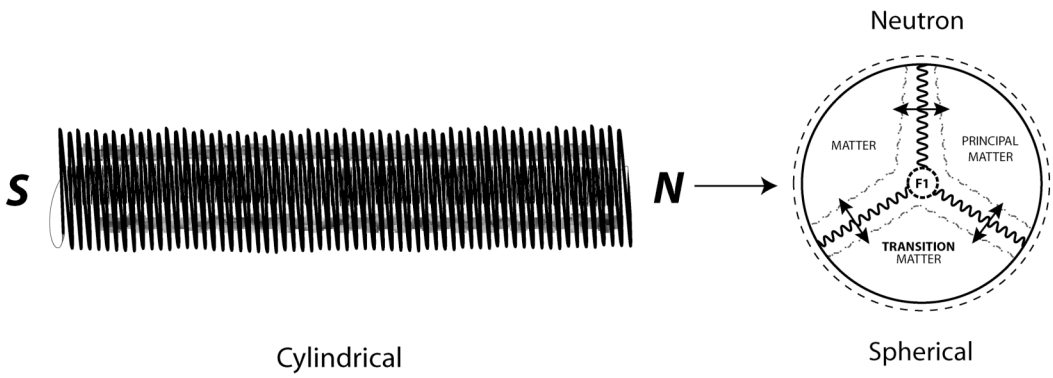

Fig. 8 Conversion of the ray of light into the fundamental plasma
or what is known as neutron

In most cases when the lights have enough mixture of mafs of different strength, these rays upon their arrival to a given environment, they directly convert into the complex plasma of fundamental plasma or what is known as the plasma of neutron (Fig. 8)(1).

At the same time collection of smaller and fragments of lights plasmatic magnetic fields upon arrives at the point of destination, due to the vacuum level of the environment go through the process of accretion and they create or lead to creation of the fundamental plasma (neutron) in their new environment.

In cases the light ray carries more mass contents of all three mafs of matters compared to the its environmental mafs need for production of fundamental plasma in this new environment, then in these cases the large in mass light rays has enough mass of mafs that the light ray in this new environment goes directly into the structure of the fundamental atom or what is known as atom of

hydrogen, that once this ray. That is to say in certain conditions, the structure of atom is due to total conversion of the light rays components and the ray of the light does not go through neutron decay conversion (1) for the light to become an atom (Fig. 9).

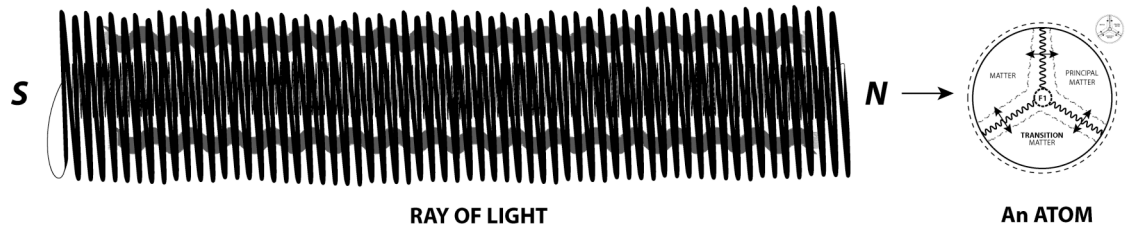

Fig. 9 Production of an atom direct from the ray of light

Some light rays due to their internal dynamism and different mafs strength in their structure, these lights rays create and contain entities moving internally and these internal structures keep the plasma of the lights' mafs in order and under control. These internal entities are the like of the electrons, which are externally positioned in the overall structure of the atom, these internal entities have specific position and purpose and they mostly convert to electrons' of the plasma of an atom in given specific conditions once the plasma of the light converts into matter of an atom, where with this process there is no conversion into neutron and then the nuclear decay of the neutron that leads to creation atom, in this process the light converts directly into atomic structure in one step. These internal entities are usually observed in the lower order environment medium which the light is traveling through, where the low speed of the entry of the outer layers fields, in-going through the faster speed principal mafs, these create small vortexes between the two fields in the transition mafs environment of the palms of the light, which these vortexes start operating independently and gradually fiend a fix position in the internal structure of the plasma of the light and when the light transfers to structure of an atom, these mafs entrapped in these vortexes become the electron of the matter of the atom (Fig. 10A).

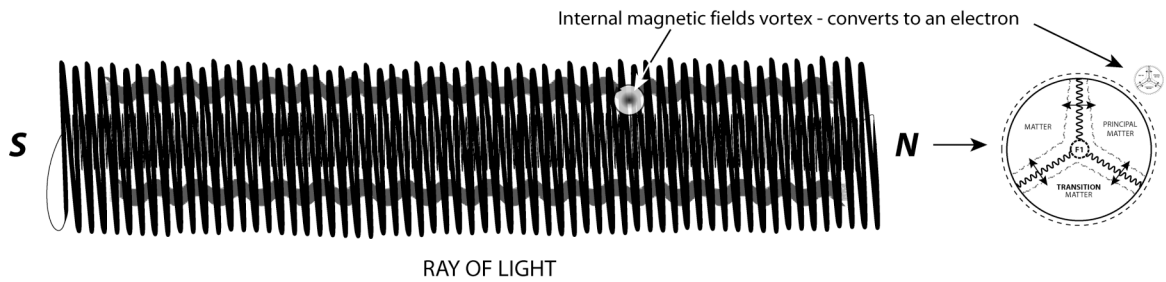

Fig. 10A The conversion of light containing vortexes into the structure of an atom direct.

The reason why the plasma of the light takes the spiral helixial cylindrical motion and shape is simply due to the fact that plasmas' with this type of structure does not have a need for additional external plasma(s) around them for coherence and a balanced plasma the like of electron in the spherical plasma structures of an atom.

In principle rays of light get their strength from their inner plasma of the principal mafs' strength rather than any other part. This being the reason, ***why light look as to be an energy rather than entity with the mass***. Therefore the light is a composite of plasmatic magnetic fields of different mafs of the matters fields' strength and **light is not a single magnetic field structure**.

The lack of understanding of the structure of the light and the inability in scientific world to be able to split the structure of the inner components of a light ray has led the scientific world to consider the light rays as an energy rather than a dynamic structural plasma as of the same as the electron or proton.

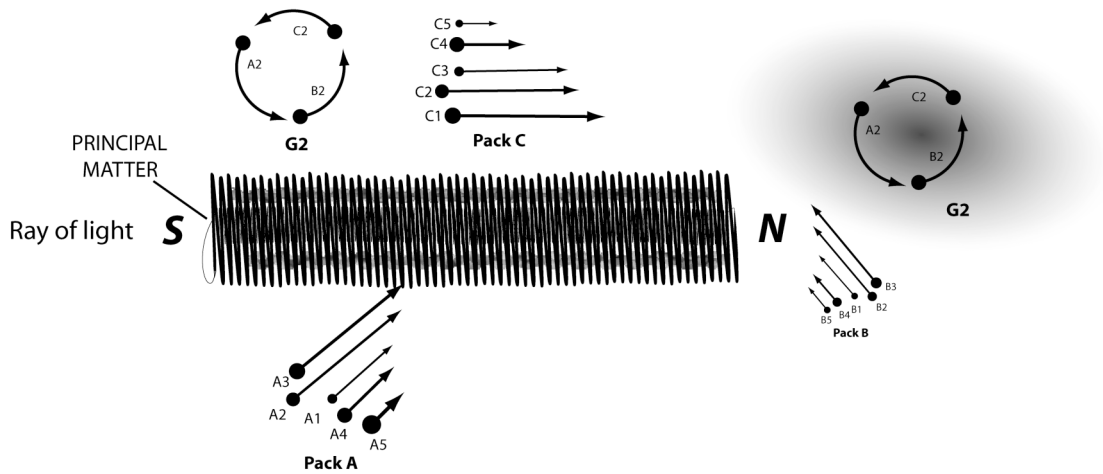

Fig. 10B Ray of light travelling through and interacting with outer mafs and initial fundamental particles of pmfs.

Due to the cylindrical structure of the light plasmatic magnetic fields and their interactions, light has the wonderful capability to be able to change its outer mafs cover as/and depending upon the matter mafs or matter medium that it is traveling through or where it arrives at.

In choosing and using helixial cylindrical motion the light does away with the need for external rotating plasmas like as the electron(s) with the atomic and planets with solar system.

This, meaning that all rotational spherical objects the like of the solar systems and atoms need to have two or more parts that their centrifugal magnetic forces can keep their matters and mafs content of dynamic magnetic fields in an encircled and enclosed loop for them not to lose too much of their magnetic fields through leakage to other plasmas in their environment.

In reality helixial cylindrical rotation partially can be seen in structure of some of galaxial structures too, primarily due to this phenomenon.

Where, for faster and simpler speed, the layers can move inside-out and vice-versa according the mediums' magnetic fields strength of the environment of travel. This meaning that due to dynamic cylindrical helixial motional and composite matters mafs structure of the light, the mafs of the transition matter plasmatic magnetic fields can become and take its position on the outer shell of the light rays in a mafs of the transition matter mafs and medium strength and similarly the principal mafs components of the light can take their place on the outer fields layers' of the light rays in principal mafs and matter fields strength environment.

The light is energized from the central magnetic fields strength region of its structure in a matter medium and this being the reason why the light seems to be able to travel long distances and behave as energy and not an entity. This change of cover allows less losses' of the mafs of all matters of the light ray due to friction in any medium magnetic field strength.

Now it becomes clear, how and why spherical rotational shape of the movement of the dynamic plasmatic magnetic fields leads to creation of matters and at the same time longitudinal cylindrical

helixial rotation of the same dynamic plasmatic magnetic fields lead to creation of light rays. Therefore the method of transport of pmf and Magravs in space is through the Light Magravs, where at the point of interaction and slowing down the lights' pmfs are transformed and transferred to matters fields strength of plasma of the new environment.

Hence, in the universe mafs of the matters are transferred and transported through the mechanism and the use of plasma of the light and when for example the Magravs of the light reaches matter environment it becomes and slowed down enough to reach's all content matters Magravs strength levels, then what is released in by the light pmf, this surplus or released pmf then becomes the pmf which targeted pmf receives as addition pmf or what is commonly called ***it receives energy from the*** pmf of ***the light***.

When, the light ray reaches the principal matter environment then its principal mafs pmf will have the same interaction as delivery to its given environment as mafs of matter have in the matter environment.

The reason matters can feel forces of rays of light are primarily due to the momentum of the motion of the mass of the light itself and not through absorption of its energy.

In the solar-sail transportation the motion of these would not be due to energy of rays of light absorbed by the sail, but in real term the created motion is due to the motion of the mass of the light and its momentum that once it comes to rest at the point of interaction with the material of the sail, the light transfers its momentum to the fabric of the sails' matters and hence the increase in the momentum of the sail and hence the motion of the sail.

It is essential to realize that as there are gamma rays, beta, and alpha rays and so on in the matter world so do the same types of rays of the same in equivalent and in proportion in strength exist in the environments of the Transition and the Principal Matters too.

Therefore one has equivalents' of the gamma ray in the principal mafs environment and the same as x-ray in the mafs of the transition matter environment in magnetic fields strength too. This meaning that the sub-division and spectrum of pmf strength of the light is not the exclusivity of the matter environment only and it has parallels' in other matters' pmf strength environments.

At the same time the interaction of the Magravs of the lights surrounding with Magravs of the light leads to release of magnetic wave's rays in the visible light spectrum in these matter mafs environments depends up on the observes pmf strength visibly tools of observation.

The inter matter's mafs cover exchangeability of the light rays is the reason why light has the capability to travel long distances in mafs of the transition matter environment of the universe, as the similar in strength mafs of the transition matters creates no loses or interactions in this level that can lead to minimum losses of light's plasmatic magnetic fields and its strength. The reason being that visible light is only released, when two different Magravs in strength collide and not when two pmf of the same interact or very little pmf are released in these compatible pmf strength entities and environments encounters as in the interaction of the similar pmf lead to and creates very little friction between the pmfs of the light and the environment and hence these interactions releases very little light and this being the reason why in the universe, the interaction of the transition mafs of the light rays with the transition matters of the universe creates very little light or a dark light or what can be called the Transition Translucent light (1) and not a bright visible light, when one looks into the deep cosmos.

The invisibility of travel path of the ray of light through the deep space is in fact ***due to its***

capability to change its outer layers according to the environment that it travels through.

That is to say as the light goes through the Transition fields regions of the universe, then the transition mafs and matters of the light will come to take their position on the outer layer of the ray, then through this process less pmf are used in interaction with these fields and matters and hence less friction and less loses of mafs of the light, and in these interactions there are very little loses through the Magravs of the mafs of the transition mafs of the light, these faint lights produced in the interaction of light's outer mafs of its transition matter and of the same and/or transition matters in the universe, where these very few interfaces of the collision between the light and the environment Magravs gives the universe a dark but translucent effect that one can see through the universe. In a way this interaction of lights' transition mafs and universe's transition mafs is the cause and the reason for the invisible transparent structure which allows the production of universes discreet light that one can see through this universe but blocks opportunity that one cannot see the lights from and the universes outside this universe (3).

It can be said that the light due to its interaction and helixial rotational characteristics is like a **chameleon** and ***it has the ability to changes its cover matter and mafs according to its environmental Magravs strength***, which it travels though and when and where the fields strength changes are too great then the light changes its cylindrical to spherical shape structure and its outer skin matter and mafs take's strength of its environment mafs or the matters' plasmatic magnetic field strength. Or it can be said that the light has **surface** Magravs strength matching characteristics and capabilities. As the Magravs of the light reaches or tries to enter another spherical Magravs or cylindrical Magravs then part of the released Magravs due to friction of two Magravs with each other lead to transfer of pmf to spherical pmf and release of some pmf in the form of magnetic rays' strength spectrum.

The light as it enters or comes in contact with plasmatic magnetic environment the likes of the earth, then the interaction of their two dynamic cylindrical and spherical Magravs creates fragments of plasmatic magnetic fields that are in the range of the man's protein Magravs strength that to man's sensory detection tool called the eyes can recognise the interface of the interaction of the two Magravs as the visible light.
In reality the light is created and operates through and from different pmfs strength and it is not as simple as an energy as if one define the true meaning of the energy, which is "the plasmatic magnetic fields (pmf) is motion" (1), then taking the motion or speed of the ray of light's movement in a different matters and mafs environment then one can see that the light in truth is no one magnetic ray but it is made of a complex plasmatic magnetic fields of different strength.

Whereas, in the light's principal mafs (3) the stronger and tighter of its fields seats in the centre of the structure (Fig.1) and as this mafs of the matters field's unwinds, these newly made available which are lower in strength and are going from one strength to another, then these mafs in motion to be known as ***transition energy*** (dark energy) and when these mafs slow down enough to their transition matter and mafs environmental strength, then these appear as mafs of the transition matters (dark matter), and then when the transition mafs pmf strength reduces or unwinds enough that this mafs reach's the matter mafs pmf strength levels environment then it become tangible or detectable the matter at this strength (Fig. 11).

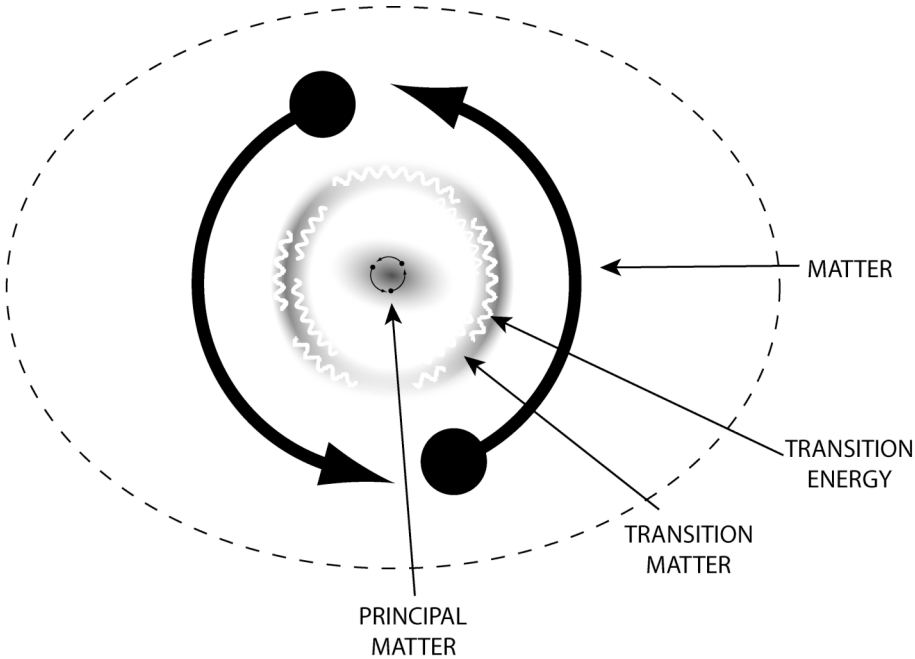

Fig. 11 The magnetic field structure of the plasma of the light

Where, the visibility of the light at this point the like as in the earth and human body, then this light is human protein chain mafs strength dependent, then it became visible light to the human eye in the Magravs strength of the planet gravitational field strength and then the light appears in matter pmfs strength and as tangible or detectable matter.

Light in its visibility and tangibility has different strength and what is visible light in one matter mafs and matter environment strength, this it is not necessarily visible and tangible matter mafs and matter's pmf strength in another environment and vice-versa. The visibility of the light or its transparency is ***environment and target magnetic field strength dependent.***

The structure of the light prevail that in general in matter environments the stronger or the principal fields take its position that as it unwinds it become the source of the magnetic fields to the lower field's strength and it can be divided into the lower field's strength of the plasmatic and magnetic fields.

At the same time the tightness of the fields of the mafs of the principal matters and their content of the principle fields in their interactions with other principal strength fields of the same strength mafs and matters creates visibility in their level of strength too that these lights are not visible for example in matter mafs or matter environment to human eyes even though in the matter environment the existence of the principal fields and mafs of the matters can be felt or even their affects can be seen.

It has to be said that if the light was not in possession of its own Magravs, the light would have been attracted and absorbed into and by the first magnetic fields or the first object in possession of Magravs in its travel in the universe, whereas the light being in possession of its own Magravs (the dotted line around the mafs of the light in the figure 11) (1) this allows the light to find its position according to its Magravs strength in respect to other objects Magravs and magnetic fields in the universe and this giving the light the ability to travel the length of the universe without being absorbed into or by other objects Magravs and magnetic fields. Thus the light has the ability to establish and maintain its own Magravs positioning criterion in respect to other entities in its environment.

The light rays with higher mass of the mafs of the principal matters, these rays can travel further in space compared with rays of lower mass. Therefore what one can observe as light from far corners of the universe in general these are some of the lights which possess the more mass of the mafs of the principal matters at the point of their inception, as the rays with lower mass have already been absorbed by the other entities in the universe over the life of the universe from the time that these rays were created and have been in travel in cosmos that they could not be observed by man at this point in the life of this universe.

The light observed from far corners of the universe are some of and not all the lights from the whole of the universal light from the point of creation of this universe as most lights by now have interacted and been absorbed or are interacting and getting absorbed by the other fields in the universe, then this can indicate that lights of lower mafs of the principal matters strength and content of principal matters from the origin of the time of the birth of this universe have mostly already been absorbed or been attracted by other pmf and entities in the universe.

The absorption of different rays of light in the universe are environmental dependent and it can be said that the lower mafs strength of the principal matters of the mass of a light ray can become the **seeds of neutrons** or it can be said that the principal mafs of the light as it arrives in a matter magnetic fields strength environment, then this principal mafs of pmf of the light becomes dynamically spherical in structure and then become the seed of the creation of neutron. Hence one can understand how energies which are defined as "the plasmatic magnetic field in motion" convert to matter in a given Magravs environment. Where, each mafs of the matters field's strength components of the light then can become in its arrival at a given environment the seed of one of the components of mafs of the matters of different plasmas too.
Therefore it can be said that the initial seeds of the creation are in motion in the universe at all levels and all time and once they reach given an appropriate environment mafs pmf strength, then in that environment depending on theirs plasmatic magnetic fields strength and the given environment plasmatic magnetic fields strength then light rays manifest themselves or can become tangible and detectable in that environment.

For example the light which has the plasmatic magnetic fields strength of a neutron then can upon its arrival in a given environment changes to a tangible and detectable neutron and then through the losses of some of its magnetic fields to its environment this neutron goes through the nuclear decay (1), which this lead to creation of plasma of an electron and a proton and the light ray becomes the seed of the fundamental atom (1) or the atom of the hydrogen in matter environment plasmatic magnetic fields strength of for example of the Earth.

Thus; "the present assumptions that the first atoms in the universe were created when the universe cooled, **this theory is not and cannot be correct** and in reality atoms are created through change in the plasmatic fields strength of the mafs of the light, secondly at the point of creation of the universe, the universe was not hot and there were never high temperatures that the cooling of the universe has led to creation of the first atoms as presently commonly stated. The first atoms and universally all first atoms' the like the atom of hydrogen in all mafs strength in the universe ***are created through the magnetic field strength reduction*** and through no other means.

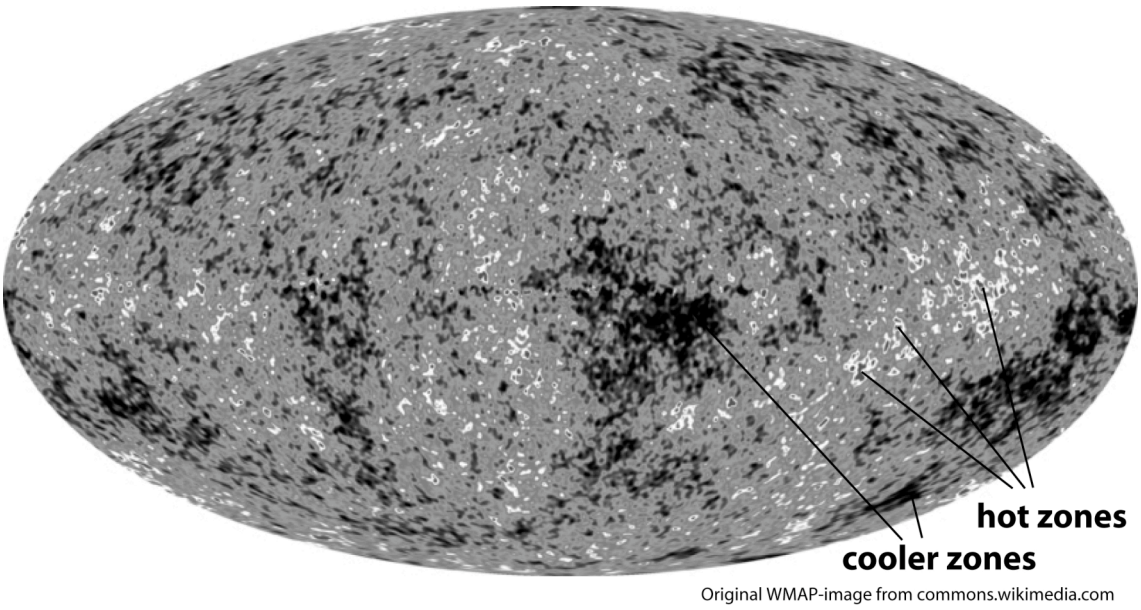

Fig. 12 The universe heat distribution map (W-MAP of the universe)

This concept of creation of heat and high temperatures at the birth of the universe is not observed in the plasmas of electron and proton, when the plasma of neutron decays and divides into an atomic structure, and in the universe there are always continuity and parallels, thus the universe has never been hot that has cooled down to create atoms, and this is the reason why W-MAP (8) shows present balance heat distribution of the universe (Fig.12).

In truth the current assumptions of initial heating of the universe at time of its birth cannot be true as the initial atoms of the universe and presently atoms were and are created from the original principal mafs strength which radiated out as principal lights rays of the universe in the centre of the universe and the initial atoms and matters of this universe were not created through cooling of the universe at the point of inception of this universe, which this universe itself is created from the decay and division of bigger mass of another universe as it happens in the division and decay of plasma of neutron to plasmas of proton and electron (3). One does not observe heating in the plasma of electron or proton in this division and so be it the same when the bigger universe divided and led to creation of this universe of the humans (3).

In fact, if! The universe was created by the present scientific assumption then the WMAP should have shown cooler region in its outer boundaries than the present near homogenous heat distribution which has been physical observed and from collated data by the publishers of the universal heat distribution map of the universe.

The heat distribution and the heat concentration on the central line of the WMAP confirms that the universe started from a central line in the middle and as the principal mafs of the universe unwinds then the transition mafs and the matter mafs were released and as were spreading outwards into the space of a larger universe (Fig. 13), then as the Magravs of the principal mafs in the central line region are converted and are reducing, then the overall unified oval-spherical shape explanation of the WMAP come to exist, and then as the total margrave of the central principal matters reach a point where they cannot hold on to all the mafs and matter expansion of the universal-magnetosphere, then at this point the universe will go through a division and all the matters and mafs at this point rearranged and regroup as and in the principal strength mafs and the universe then divides into two principal mafs of lesser masses of universes, which these new universe are magnetically interconnected and then these new universe go through the same principle of the principal light unwinding and the same process as creation of new universe carries as before (3).

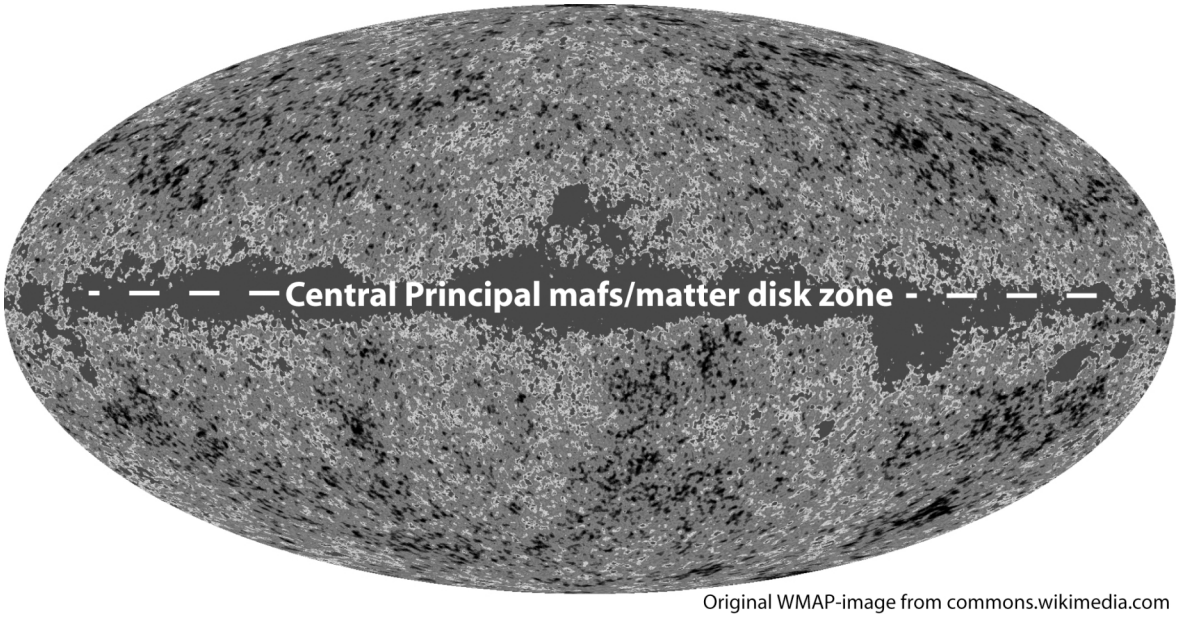

Fig. 13 The microwave heat distribution of the universe shows a concentrated heat in the centre disk of the universe

That is to say that the principal matters are the way that universes divided and arrive form another universe and as the light in the principal mafs strength unwinds' in its new environment then the new envelop of the new universe starts to be created (3). The same process occurs when the neutron decays and divides into the plasma of the proton and electron.

Thus, the universe is not created as a big-ball of fire which has been cooling down as has been promoted, but in fact the universe is created the like of as an ejected principal mafs is injected into new a universe environment and as the principal mafs radiate outward as light of stronger mafs, then they create the other matters mafs and matters depending on the given pmtics strength of a given region in the larger process of this unwinding of the principal maf and matters and its lights (3) in this new expanding universe.

Therefore this universe is in fact created inside out than what has been assumed up to now that as it cools down to what it is, which this explains why even the universe is observed to be expanding, as the reason for expansion of the universe is being due to the presence of principal mafs in the centre of the universe and as principal lights of the principal mafs radiate outward, these light rays of the principal mafs while traveling in their new environment they reduce in strength and this creates new matter mafs and matters according to given environments magnetic fields strength and in a given point pmtics hence the creation of new mafs and matters and so forth, which this leads to creation of atoms and molecules and stars and so forth.
Thus there has never been a big-bang and the current appearance of the expansion of the universe is due to the principal maf which as unwinds it creates the sphere of this universe (3).

This method of the creation of the universe now explains' why there is a central gravitational matter concentration in the universe as this pull is centred in the dynamic central line of the injected principal maf of the universe at the time of its inception, which this can be seen as the red line in the W-MAP (Fig.13), which the more concentration of the mass of the principal matter seats in the central disk of the W-MAP and as these principal mafs create their own magnetic interactions, hence these create their own gravitational and Magnetic fields of their own and thus the central gravitational of the universe is in the centre of the denser point of principal mafs of the centre universal heliosphere of this universe is created and solving the present mystery in scientific world

that, where the gravitational pulls of the universe come from.

This is how even the plasma of the neutron decays and divides into plasma of the proton and electron too, where the matters mafs of different quantities and masses of different strength from neutron are divided and injected in the new area in their environment, where the original in their overall Magravs of all their mafs as original components concurrently maintained that the plasma of the electron and proton(Fig. 14) and then as the matter mafs ***unwind*** and interact they reach given Magravs level and position ***that new plasmas of the sub-components of the atom are created***.

Where this process of division due to micro -level of masses involved it appears as an instantaneous process of creation of proton and electron.

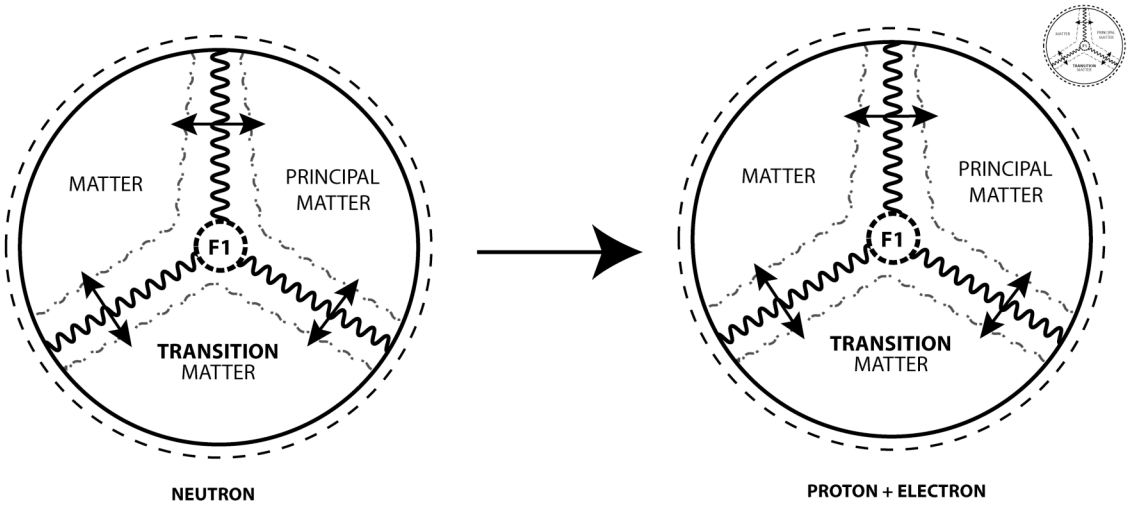

Fig. 14A The conversion of the plasma of neutron to plasmas of the electron and proton
The same process is considered to occur when the universe divides (3).

This being the reason why the proton does not get heated as a big-bang theory suggests but as portion of principal mafs of the neutron which become part of the plasma of the proton **expand centrally** and as the principal maf unwind to the transition matter and matter maf of the plasma of the proton and all other fragment of pmtics and magnetic fields, hence the protons' plasma is created from the division of the principal plasma and the fragments of the fields as different constituent mafs, matters and fields in the plasma of the proton.

The structure of the plasma can be compared to ***the winding spring of a mechanical clock***, were as the main spring is winded up using a key and then as it unwinds.

Where as the winded spring is *tighten in the centre* this tightened spring becomes like the ***principal matter*** of the plasma, a compact entity full of energy in the centre (figure 14b-1) and as the spring unwinds it releases its magnetic fields in lower strength that this unwinding of the fields and reduction in their strength further down the line of unwinding of the spring becomes the magnetic field strength in the ***transition*** (dark matter) ***field strength*** (Fig 14b-2).

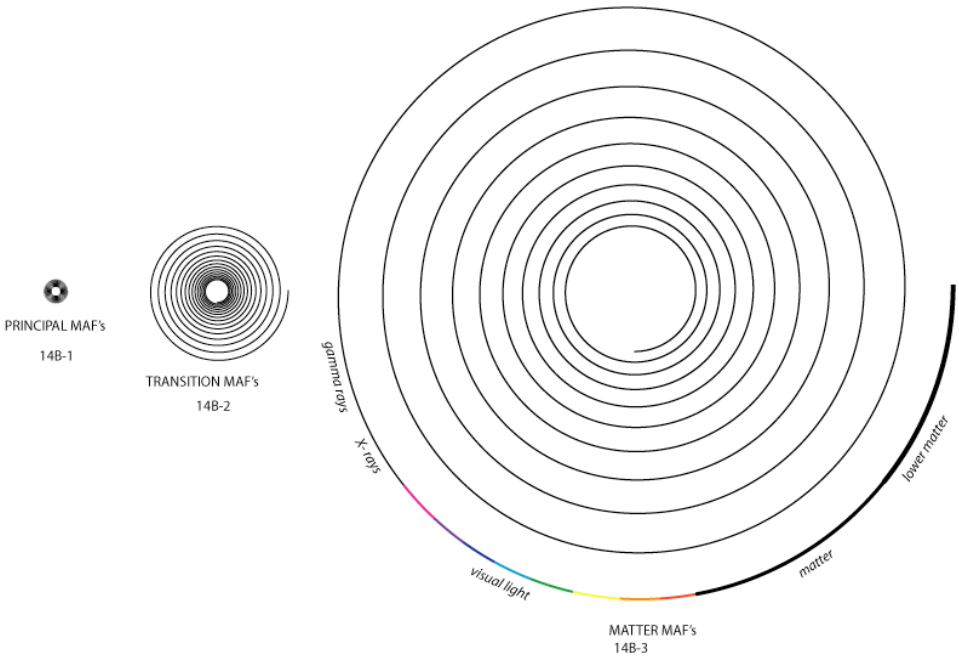

Fig. 14B The visualization of the universal spectrum of magnetic fields.

Further as the magnetic field strength and as this field opens up in it's environment and slows down and reduces in strength, these fields in this region become in the visible light and lower magnetic fields strength in the unwinding cycle of the principal magnetic fields reaches the ***matter*** magnetic field strength (Fig 14b-3) and further on this field reduces in strength to even lower fields strength magnetic fields.

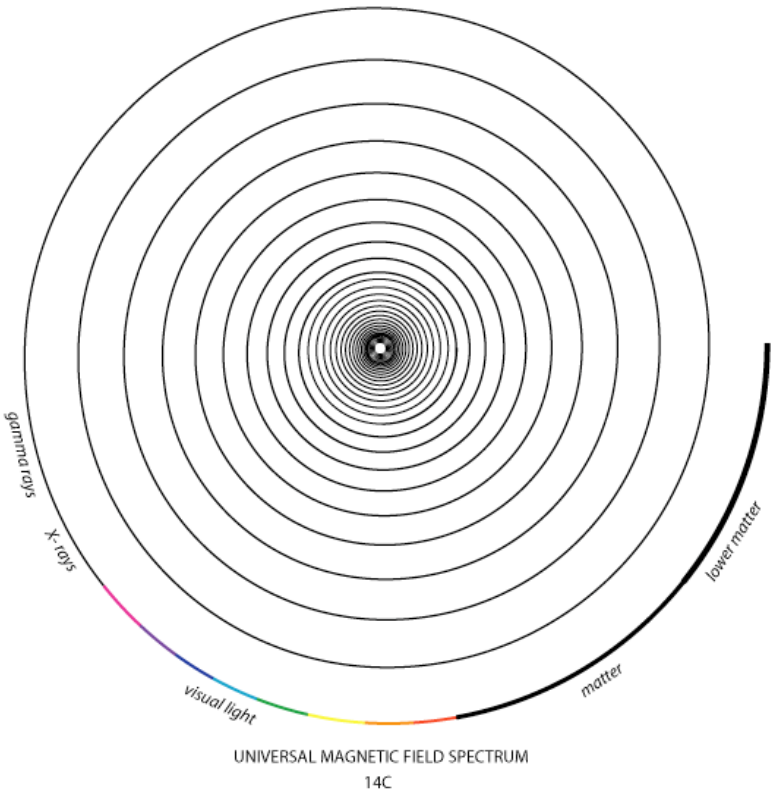

Fig. 14C The visualization of the universal magnetic field spectrum.

Then as one puts the whole magnetic fields spectrum of the principal mafs, transition mafs and the matter magnetic fields as one continuous magnetic field strength spring or then the true sense of the unifying magnetic field spectrum which connects all creation of fields and matters as can be observed in the universe, that this can be called the universal magnetic field spectrum (Fig 14C).

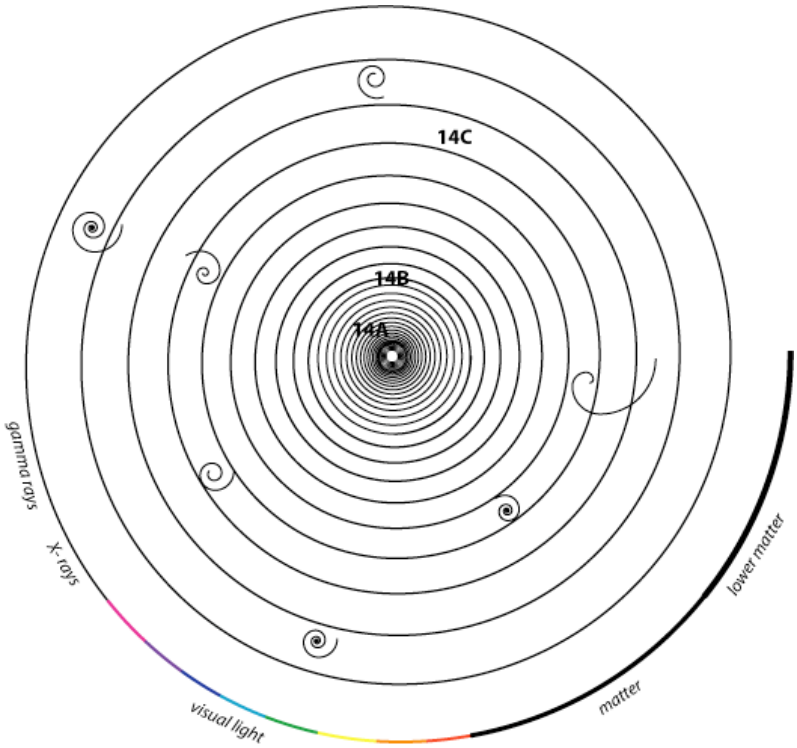

Fig. 14D The universal plasma magnetic fields structure

Where in the plasma of a proton for example, as the fields unwind and divide in the lower scale of the maf strength these lower fields as themselves unwind they interact with other fragments of the fields of the same in the Magravs of the principals matters of the plasma and hence they create the division and sub fields which one observes within the structure of the plasma, these being like what they call quarks and bosons and so forth. Where this total interaction within the capture zone of the Magravs of all the fields is called the universal plasma magnetic fields structure 14D.

The same process can happen with the ray of the light originated from principal mafs strength (what is called the principal light), when this principal light arrives in the principal mafs strength environment and hence the first fundamental principal atoms' can be created in that given environment through the same principle as principal atoms are created in the principal matter environment (1).

In reality: if! one could follow and observe the rays of the light which arrives at the boundary of the heliosphere of a solar system, one should be able to observe that some of these light rays of varying in mafs strength, which can reach this point in the Oort clouds region, these due to the balancing of their pmf and their environment vacuum condition and mafs strength, then these light rays individually or as collection of fields will become particles, plasmas of neutron, atoms and matters, and over the life of the solar system then they rain inward towards planets and the star of the solar system (Fig. 15)(4).

These light's rays which have slowed down in the Oort clouds layers or other inner sectors of the solar system can and do become as neutrons or other particles, then some of these become like of

what is commonly known as neutrinos and get attracted back to the star.

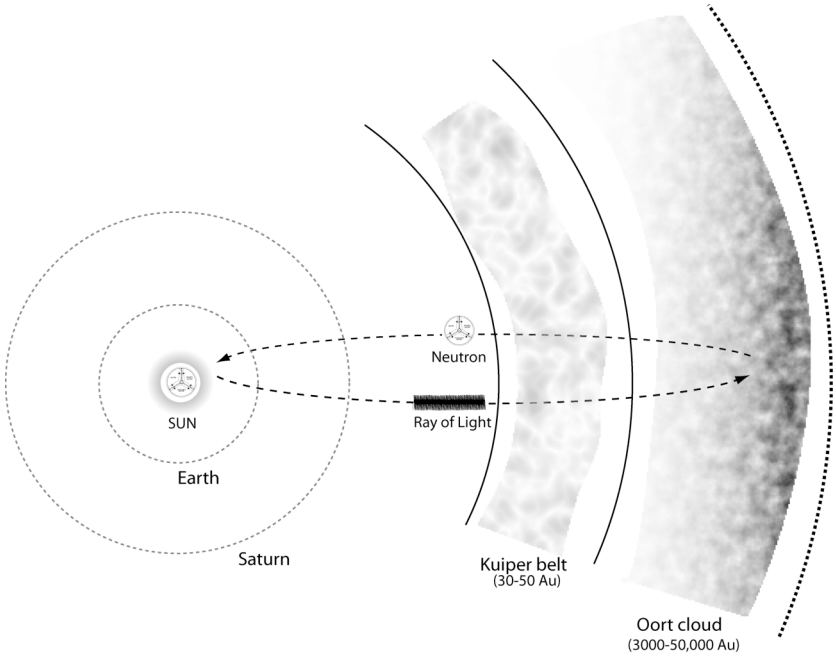

Fig. 15 Conversion of the light ray to neutron, atoms and gans in the Oort cloud

Thus as the stars of solar systems through their light emission continuously feeds their planets and moons with light rays in form of heat and further the sae light rays in slowing down in form of matter, then the same principle continues as the solar systems themselves get feed by the principal stars in the galaxies through their principle lights which these lights at the moment due to the man's lack scientific tools these lights have been invisible for detection to the man of science.

The neutrinos are on the other hand produced by and through the same process from the fragments of principal mafs of the light rays of the Sun or the principal matters in the centre of the earth inner cores too. At the same time and by the same measure neutrinos, which are released by the principal matters and mafs content of the inner-inner core of the earth which are detectable leaving the earth surface their existence and the exit from the surface of the earth is the confirmation of the presence of the principal matters and principal mafs in matter environment of the cores of the earth, as the light emitted by these principal entities lose their pmf strength within the centre cores of the earth (4) and as they move outward from the centre of the planet they appear as neutrinos exiting the earth surface.

Some of these light rays due to their Magravs strength get attracted and in a process known as the fusion of light rays and produce the initial molecules of the matters in the solar system too.

In understanding the concept that lights' rays from the Sun converts into atoms and molecules, then this make obsolete the theory that the ice particles left from the time of the creation of the solar system are the ones observed in the Oort clouds, the Kuiper belt, in the rings of the Saturn and so forth in the solar system.

That is to say most and even all matters in the solar system like the fuzzy material in the Oort clouds layers are mainly the product of the slowing down of the light rays of the star of the system and not the hypothetic present assumption that the meteoroids and all particles in the outer edges of the heliosphere of this solar systems are the residual materials from time of the creation of the star and the solar system.

This recycling of the light rays and production of for example particles is comparable and it is in fact the same process as one observes in systems which have dynamic magnetosphere the like of the earth, where the molecules of the vapours of water rise-up to upper and further regions of the earth magnetosphere and when they reach a given temperature and environmental condition then they gather and when they are heavy and enough of these entities then they rain down on the earth. This is the exact process as it happens with light rays of the Sun as these rays reach to the outer boundaries of the solar system in this process due to magnetic field strength difference instead of temperature difference as in a planetary system, they slow down and become matter mafs and matters and then they rain back towards their star due to its magnetic field interaction and gravitational field strength (4).

In attraction and motion of these lighter atoms and molecules solar winds in the outer region of the solar system are created and as they move in the Kuiper belt of the solar system these matters become part of the constituent matters of the outer giant planets and these light rays become part of and the creators of comets, asteroids and meteoroids as different densities of matters are released and created in this process and collected in these so called belts of the solar system.

Where, the existence of the meteoroids and their pattern of motion confirms the change of the mass of the light to the molecules of gans of the hydrogen as these comets and meteoroids go back in the Oort clouds layers, then meteoroids attract the newly produced molecules of the hydrogen and oxygen and at the same time they carry on mixing the soup of the Oort clouds matters(Fig. 16), this leading to collisions of new produced gas and gans of matters needed for the production of heavier matters and molecules like water in the solar system.

In reality the light rays becoming part of comets and meteoroids, these themselves become like a mixing spoon of the solar system and the cause of the mixing and displacement of the matter mafs and matters needed for having an active and dynamic matter environment in all parts of the solar system.

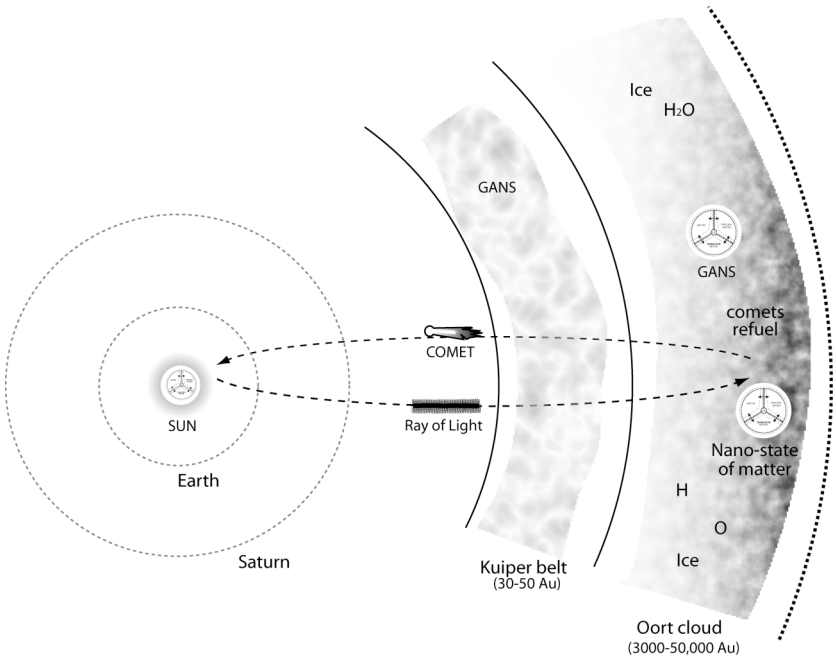

Fig. 16 The light rays become water molecules and get attached to comets and meteoroids and then return back into the inner parts of the solar system.

Therefore the reason, why giant planets exist and possess most of the gasses at the outer boundaries of the solar system, this is due to the fact that these gas planets *continuously absorb all the freshly*

atoms and the molecules of the gasses and gans which are produced by the ***transformation of the light rays to these atoms***, and hence these gas and gans atoms and molecules get gravitated and pulled around and held or get captured by gravitational, Magnetic fields and get positioned, for example, ***in the rings*** of giant gas planets according to these ice **gans** particles Magravs strength and Magravs positioning.

The collection of ice particles and solids in different rings in the planetary or solar system is primarily due to magnetic fields of static inertia of these objects the like of asteroids and on the other hand due to and Magravs positioning through the Magravs of the gans matters their interaction with the planet or solar system Magravs strength and due to their of these planet's fields nearest to the Kuiper belt and Oort clouds.

Thus, light rays of the star are the feeder of the star, planets, meteoroids and asteroid as they rain back inwards into the star heliosphere over time as the Star's strong gravitational fields pulls' every matter and matter mafs in its system back to itself.

Therefore the light emitted by the star partially become the sources of the materials which are returned to the star matter for it to carry on with its everlasting existence.

Chapter 3

The conversion of light rays to the Gans of the matter

Considering the transition of the light into matter in the outer boundaries in the Oort clouds environment of the heliosphere of the Sun, there is a further process which occurs to these newly created tangible mafs from light rays of the Sun as these newly born neutron goes through its nuclear decay (1) and become an elementary atom of the hydrogen in possession of an electron and the proton. This atomic matter in the coldness and in low gravitational and Magnetic fields of the Oort clouds and Kuiper belt become in atomic or nano state of matter of hydrogen rather than atomic hydrogen and hence sometimes due to the weak gravitational field forces in these zone these lights become the gans (5) of the same element.

The **gans of the matter** is the ***state of matter, where the atomic gas of matter becomes the single solid atom of itself*** or what we have called "the gas in nano state of matter" in short or "gans" of the same element (5). Where, the gans of the matter is *internal gravitational and Magnetic field strength dependent* and at the same *time where the gravitational and Magnetic fields of the matter* ***is stronger*** *than its environments 'Magnetic and gravitational fields strength.*

The difference between the atomic gans or a nano gas material is in the fact that gans of an atom is its solid three dimensional free state of matter due to its internal gravitational field interaction.

As the Gans is the solid state of atom of gas in its natural three dimensional structures that its mafs of this matters are interlocks due to their internal Magravs strength of its own and their internal mafs loose bindings, and not rigid binding as in solid atomic state of matter as in the form of ice state of matter of the same entity of the same atom, which ice state of matter is due to and dependent upon external magnetic fields' strength of the environment which are exerted up on the binding structure of atoms that become creates the state of the ice of the same atom.

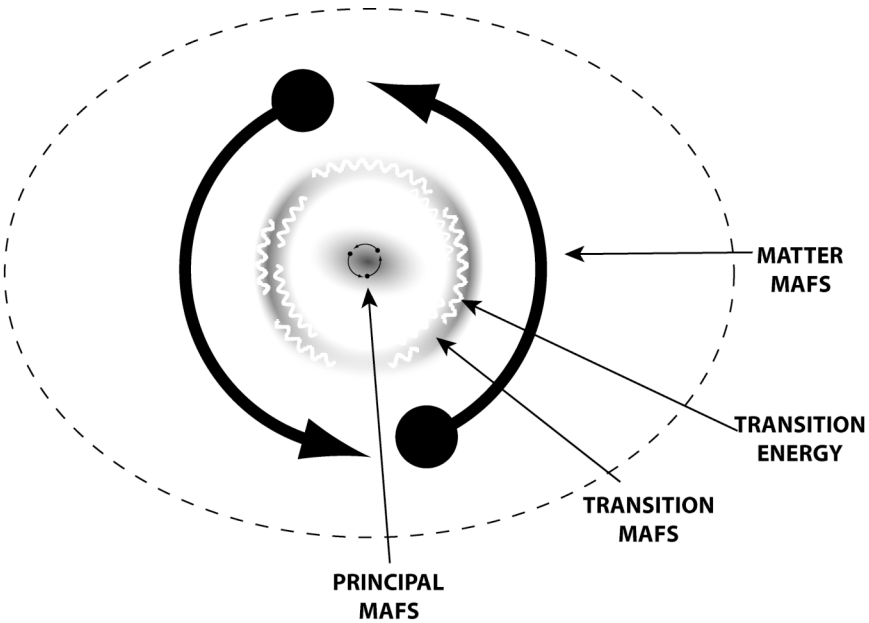

Fig. 17 The structure of gans of neutron

Where, at the same time it has to be noted that the light in becoming in ***state of gans*** it can create the fundamental plasma of the gans (Fig. 17); in the same region as it does create the fundamental plasma (of neutron) too.

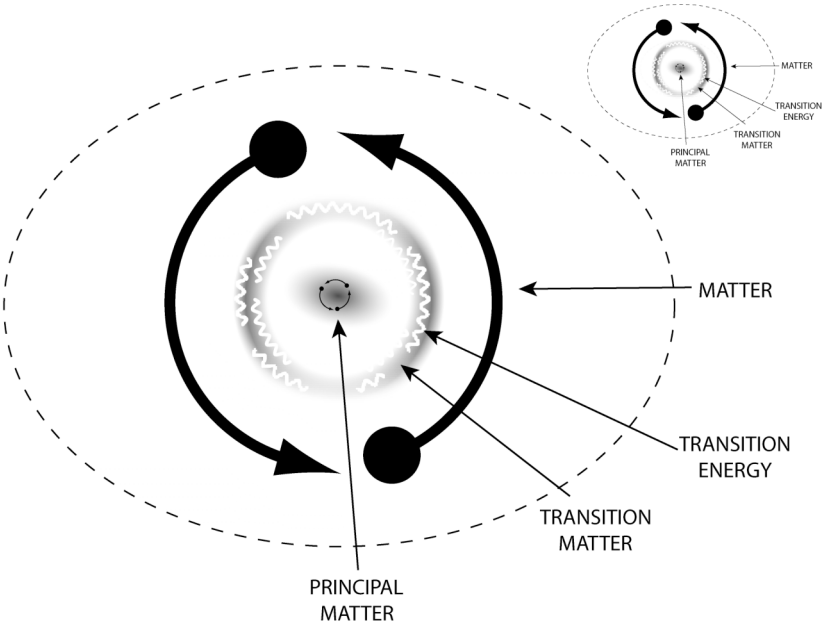

Fig. 18 The structure of gans of an atom

The gans of elements (Fig. 18) are created through the same process as of known atom directly from the rays of light or through the decay of the neutron of the gans going through its nuclear decay and creation of its own gans of the same elements in atomic state.

It can be said that the gans state of an neutron or atom is internal magnetic and gravitational fields strength dependent, where atom or nano of matter of the same element is environmental magnetic fields strength the like of heat and pressure dependent (Fig.19).

In this illustration the difference between the internal and external magnetic fields forces and processes which lead to creation of gans of matter structure of neutron respectively are shown.

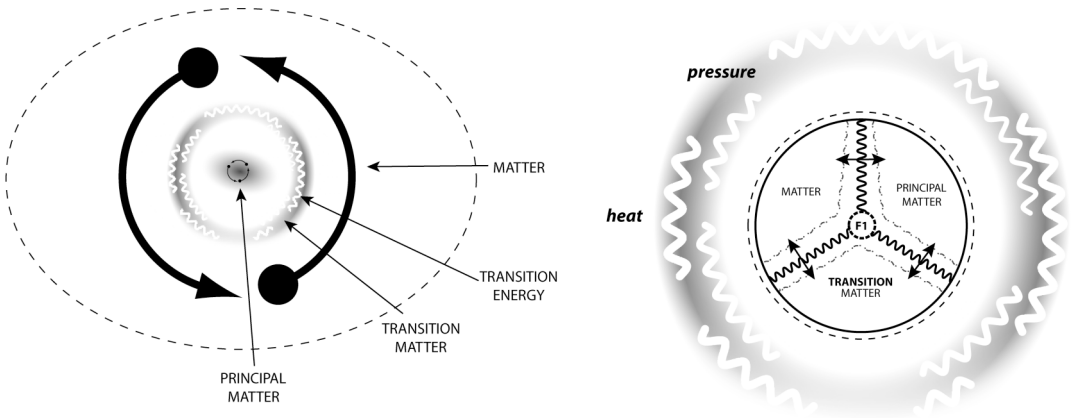

Fig. 19 The comparison between the gans of neutron on the left and the fundamental plasma (neutron) on the right

The gans state of matter is the reasons why for example the molecule of gans of the amino acid (Fig. 20) in the structure of protein and other cell structures the like of in the leaves of plants have

tangible, flexible, soft characteristics that they can be manipulated and not being rigid hard.

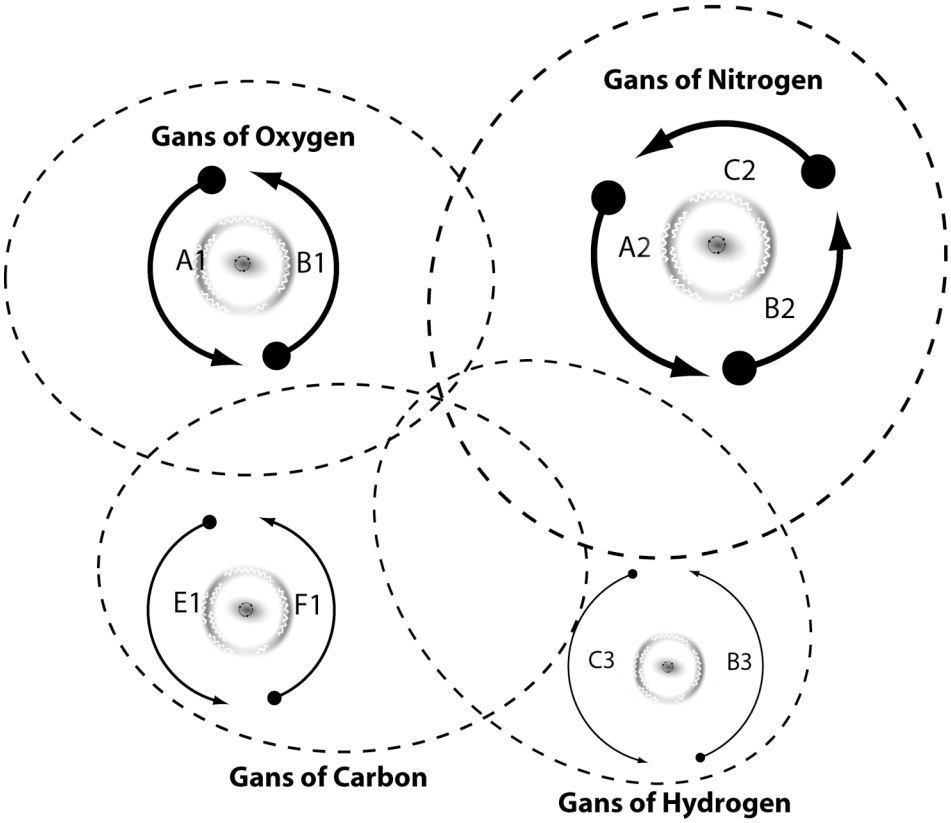

Fig. 20 The structure of a molecule of gans of amino acid

May be it can be said that gans is the solid state of matter of living entities. That is to say the structure of the protein is one of the molecular states of the gans in matter magnetic fields strength environment. Where, through the gans state of matter as part of the cell of the living beings this makes the transition of pmfs needed for rapid transfer of given mafs much easier as by the availability of the gans of an atom rather than nano of atom, this makes it possible to transfer the information of the matters as magnetic fields and not the whole of the atom from one atom or molecule to another as has been assumed by the world of science up to now, and hence once the right measure of the mafs are transferred to a cell then through accretion of mafs in the vacuum of the body then a new gans cell is produced.

Where, for example, if one pinches oneself flesh or skin, what one holds within its fingers are gases of oxygen, nitrogen, carbon and hydrogen in state of gans of the matter, otherwise the body of the man would been a balloon of gases and not in the state of matter as one finds between ones fingers.

At the same time the energy transfer to the already existing cell is due the transfer of pmf of mafs from one cell of gans of lymph to the existing cell. By the same measure as the cell uses its appropriate mafs and is left with wrong or mis-measured amount of mafs for its use, then the cell transfers these pmf of mafs to the blood cells for their removal from the body's systems. This being the reason why for example one does not finds residual of urine in the blood, but as the blood passes through a different dynamic gans molecular structure of the kidney, then the mis-measured mafs in the gans blood cells are reconstituted as liquid and appear as urine in the walls of the bladder.

This applies the same for the transfer of the molecules and atoms of the minerals and vitamins which in fact are mafs of different combinations.

In reality, the world of science and humanity always have known this state of matter as part of the structure their own body but they always have considered it as molecules of the same element and not as another state of matter, thus gans can be considered as the **fifth state of matter**.

This condition of gans of matter is to be explained as the gases when their physic-chemical at ambient temperature and pressure and due to internal gravitational and Magnetic field's strength of the atom the atom physical appearance the atomic structure of the gas ***changes to a compact configuration of the solid*** and as the atom of the same gas become and behave like solid but ***with totally new properties and characteristics*** which has never been known as when the atom was in its other three initial known states (gas, liquid and solid).

This ***conversion of the light rays to solid state*** occurs in the **outer regions of the solar system**(s) where the gravitational field forces (vacuum) are low and the temperature has no effect on the internal motion of magnetic fields that create this solid state of matter. Then, as the ray becomes and appears as gas and in a given conditions manifest itself as the nano structure of gas or what is called "GANS" in the same environment *due to atom's own internal Magnetic and gravitational fields configuration* and ***not due to*** *its environmental magnetic fields.*

This state of gans and gas of an atom is being the *same difference as between* ***the mass*** *and* ***the weight*** *of an atom* respectively, where **mass** is due to internal atomic interaction of fields of the atom and irrespective of external field forces and where the **weight** is due to environmental magnetic fields effect on the outside appearance of the same mass.

Humans are familiar with the gans of the molecules and atoms as integral constituent of their own tangible body, where ***gases at low internal vacuum condition*** *of the body convert* ***gases into gans or soft individual solid atom state***, but up to now the scientific world has never considered this state of matter as they just say for example the carbon of protein chain or matter of a cell or a carbon as part of the structure of a sugar of a leaf of a plant and so one. That is to say for example, when an atom or molecule of a hydrogen gas, which was created from the ray of light as this gas is absorbed by the human body then this gas of the atom changes to the gans of the same atom and then through the accretion process in vacuum condition of the human internal operation, then this gans particle according to its Magravs strength becomes part of the molecular ganses of the **N-C-O-H protein chain** of the human and that is why human body becomes tangible entity. Where, the creation of the solid gans in the atom of the gas of the atom, this process by itself is due to the accretion process of all the fields of the mafs of the gas atom itself.

If this change of state of light to gans does not take place, then the human body should have been a balloon of gasses and not in the solid tangible arms and legs and so forth.

Further, it has to be said that as the light ray changes to the atomic gas of the hydrogen and as it reaches the planetary condition and natural Magravs state of planets this matter changes to gans atom of the same matter in the atmosphere of the planetary entities too.

The confirmation of the production and existence of the gans in the Oort clouds and Kuiper belt is and can confirmed by the existence of the hexagonal rings on the top of atmosphere of the poles of the Planet Saturn. Where the composite dynamic layers of nano gans of material(s) in this part of the planet leads to creation of the hexagonal shape solid clouds as has been recorded by pictures taken the scientific world from the pole region of the planet (4).

The only reason that one sees these types of structures in the universe is primarily due to existence of gans state of matters like hydrogen, methane ganses and others in these layers, as the Magravs of

the planet interact with dynamic metallic characteristic structure of the hydrogen gans and other matters ganses and this nano state of matter in dynamic magnetic fields of the poles of the planet leads to creation of current in between these layers and consequently for example in the poles of the Saturn the formation of hexagonal shape rings of the clouds which is the consequence of these interaction , which are natural positioning for the gans in dynamic mixed and composite magnetic and nano structures.

To create the hexagonal shapes of the clouds in the north-pole of the Saturn one needs at least three layers or mixture of three different ganses of different or the same elements to be able to create these shape features in the upper atmosphere clouds of this planet (4).

In reality gans's of matters behave as semiconductors do in the matter environment, with the difference that the gans of matters are *always as they are in a* ***semiconductor state*** *and at the same* ***time they create current*** *in any environment* due to their internal dynamic magnetic fields structure.

On the other hand, the conversation of the light into gans and its absorption and their interactions with the strong Magravs producing planets like Saturn is the cause and producer of the internal Auroras that are commonly observed at the poles of the gas planets. Where these auroras are due to the fact that as the gans of the elements from Kuiper belt gets absorbed into the giants planet atmosphere and as these ganses are in solid atomic matters state the like of the cosmic dusts and in their interaction with the magnetic fields of the planet, these interactions of the gans and the magnetic fields of the planet leads to creation of the Aurora at the poles of these giant gas planets.

It is essential to understand the fundamental effect of the light rays mafs of the matters' in the solar system and even in the creation of the solar systems and planets themselves that one can understand why the rays of light are the transporters of creation in the universe as in their conversion they become the created entities the like of atoms, cells and so forth due to their pmf strength of their environment. Where, in fact the lights in becoming the gas of the matter, then they become the source and the cornerstone of the creation in all matters levels of the universe. Thus as light changes to atom and gans then in the right environment of for example one G (gravitational field strength of the earth) as on earth then the collection of atoms as the molecules of ganses state of matters leads to creation of the beings, the like of single cells and complex combination as of the human's body.

Light ray from the Principal Star (black holes) as it loses its strength and becomes to matter mafs state strength and then it becomes to the nano and atomic level of the matter strength of the fundamental element of atom of hydrogen, it is at this point, where this matter generates the first external gravitational and magnetic fields or what is called the Magravs of itself in matter environment that this tangible entity due to its Magravs positioning and strength in respect to other Magravs that it can be attracted by or attract to itself the same and others elements in the same environment. Then it is at this point that the light becomes physical entity and the seed of the stars and planets and the essence of the tangible entity in the all matters environments of the universe.

In the spans of the solar systems, galaxies and cosmos as the gans and atomic of the hydrogen interact, they create the first seeds of creation of more powerful Magravs that leads to attraction and conversion of other light rays in the universe into liquid and solids, which these interactions leads to creation of galaxies, stars and planets, where the light itself in different strength becomes the tools of the division of the hydrogen for it to start the cycle of creation of intelligence and creation of the lives in all corners of the universe (6).

The gas and gans of hydrogen becomes the dynamic fuel source of creation of the magnetic fields necessary for the creation and establishment of the stars and solar systems and their planets, as the interaction of different magnetic fields of gases and ganses lead to the creation of the initial

Magnetic and the gravitational fields needed for these celestial bodies to be created in the universe. The existence of nano materials in the core of the planets like earth has been initially disclosed (1), now it can fully be understood that how these nano materials in state of nano matter, gas and gans become to exist in the centre of these celestial entities and be the initial seeds of their creation.

It is important to realise that due to internal structure of the nano material in layers and in gans state, these materials by large keep their structural integrity, where high external environmental matter conditions like pressure and temperatures cannot affect the total structural integrity ***once they are in individual matter gans compound state***.

This meaning that internal structure and molecular binding of gans and nano materials in nano layers or composite structures will not be affected by the matter environment's the likes of temperature and pressure condition of the environment. But the gans will be changing in its structure when conditioned to high level dosage of radiation.

For example, this is one of the reasons, why the DNA of the human being is venerable to changes and absorption of radioactive energy and in the radioactive environment or to burst of radiation, as the real structure of the amino acid of the protein of the DNA chain is made of gans of matters and not solid matter of the same gases (6).

In these conditions the gans of the matter receives radiation in the upper levels of the matter mafs strength and hence it has to accommodate this extra pmf of radiation hence the gans reaches a new magnetosphere pmf strength and consequently the gans of the atoms of the protein which has absorbed the additional pmf has to accept a new positioning in respect to other ganses in the chain, hence new positioning means new additions or new configuration in the setup of the DNA and hence new changes and hence slightly new chain configuration or alteration (6).

The property of the light in gans state make the gans venerable and receptive to changes due to the magnetic fields spectrum in all levels of mafs of the matters strength, this be it from the higher order mafs of the principal matters fields to lower pmf strength of below matter environment. This being the reason why DNA due to absorption of for example high level radiation or strong ray can change its configuration this leading to new permutation and change in the characteristic and change in parts of the being characteristics of the living matter.

Through this process of Magravs positioning and that all Magravs needing to be in their given position in the DNA chain that one observes the consistency with structure of the DNA for every living entity in the universe, which these chains of protein positioning become entities exclusive to that of a given being or entity. Now one can understand how light and its process of conversion, fusion and amalgamation lead to creation of exclusive structure of DNA and creation of beings (6).

Scientists due to old understanding of creation of magnetic field consider that the earth has an iron metallic core which due to its motion through convection theory leads to creation of Magnetic fields of the earth. The fact that the Sun does not possess a metallic iron core but it has large and powerful Magnetic and gravitational field forces; hence the existence of iron in the centre of all dynamic rotational bodies is not a common and acceptable principle and natural order of creation of Magnetic and gravitational fields in the universe.

In truth the plasma of neutron does not possess iron core, but it goes through the decay and division to make plasma of electron and proton and in this process of decay neutron does not go through iron energy balance condition as has been claimed by the cosmologist that this is how they consider stars reach the point of no return due to the creation and solidification of iron matter in their central core. And at the same time geologist consider iron core of the earth is reason for the planet possessing

Magnetic fields.

The method by which the Magnetic field's (repulsion of fields) and gravitation field's (attraction of fields) are generated exponentially increased in all planetary, solar and galaxial object are initially and primarily through the magnetic properties of the plasmas, nano and gans materials within the centre and internal structure of all celestial objects. As in the inner cores of celestial objects the ganses of the matters due to their mafs and through nano layers or different composition of collective crystal and magnetic fields structure they become or behave as the best insulator and conductor simultaneously in their environment, where the gans and nano matters, and their mafs and their properties ***changes from conductor to insulators*** as these matters behave as semiconductors and metals and at the same time due to their dynamism of their pmfs this leads to the initial and then partially continues production of the Magnetic fields and gravitational fields of the star or planets respectively (2, 3, 4 and 5). It is at this point that magnetic properties of the nano and gans materials in their interaction lead to creation of Magnetic and gravitational field's forces, this leading to creation of the independent mass and magnetosphere of the new entity.

Through the gans internal disassociation of its mafs structure as the internal principal mafs of the structure unwinds rapidly and when this transition to matter level strength is very rapid, then this lead to release of the high temperatures and strong rays of light in man's protein and the visible magnetic fields spectrum strength and hence detection of the release of spectrum of magnetic fields of the light rays.

The gravitational properties of nano materials and the creation and attraction and absorption of matters from the environment have been explained in the paper published in detail (5), at the same time matter cannot attract or gravitated towards another matter if both are not in possession of magnetic fields, where at the same time it has been confirmed (5) that nano materials possess magnetic properties and as magnetic fields interact then nano and gans materials create their own gravitational field zones and environments; and in having nano and gans materials in the centre of planets and stars this indicates how the gravitation fields (6, 7) of all dynamic systems and objects in the universe are created.

Ganses being in the right magnetic fields strength environment due to their Magravs strength these materials ***will convert into gravitational zones in their environment and attract light and in turn absorb, create and release energy***, where this energy leads to creation and attraction of gases and their conversion as for example the same process in the human body to solid state of matter at room temperatures, where in test it has been shown that this process of absorption or conversion of the gas to gans leads to creation and release of energy and similarly vice-versa. As for example in absorbing CO2 from its environment the plant releases energy into its internal structure to be used for conversion of minerals to food for the plant to assist with its survival and growth.

Thus the truth about how even the heat of the body is created is far from the present assumptions which the scientific world has led the man to believe, as they themselves never understood the real working of universe and the process by which matters behave and operate in its low vacuum conditions.

This concept and process has been tested, explained and published in detail in Chapter 4 of this book, where for example in capturing gases of CO2 from the environment and collecting it as gans as a tangible entity at room temperatures and pressures, the energy released through this process is use to light and run lights and motors respectively in the lab by independent scientists as has been published in the journals in May 2010.

Whereas, in this case energy is released is in a similar way as it happens in the human body, when

the light or magnetic fields of the light enters in the micro vacuum condition of system or the body and in receiving the light rays and in trying to entangle or go through the process of atomic-entanglement in gans level and then accretion, this process leads to release of the surpluses energy and then accumulation (accretion) of solid ganses which appear as cloud of matters in tests and in human body which then this become tangible structure of matters of the body and the surplus energy is released as the heat of the body or it is used for the communication system of the body.

This process of accretion is one of the sources of energy release in the living body entities and in experimental testing this released dynamic energy in the level of plasmatic magnetic field strength of an electron produced through this process become the source of power and is enough to light a LED for several months, as this process is a natural process as long as the light or other rays can penetrate the liquid, jell or soft tissue condition of the system this process can continue.

The other important reason that one finds water in this solar system is primarily due to the fact that pmf and Magravs strength of this solar system and the ones like this encourage and enforce initially the production of gans of magnetic matters the likes of oxygen, which leads to creation of liquid state of matter of water.

At the same time it is curtail to understand the structure of three and two dimensional properties and characteristics of the same atoms in layering and physical positioning. The gans of the matter is captured and held in three dimensional states, where gans of matters gravitate and make dynamic clusters of ganses around themselves and become dynamic entities, whereas, in the linked version of the same atom clustered the same matters in solid state makes layer and gives and possess totally different properties and appearance.

The light in its conversion to atom of gas or atom of gans according to its given environment then will take and enforces its preference estate of its manifestation, and with slight change in level of its internal vacuum (defined as availability of Magravs and their strength) then the light will appear as the gas of an atom or a gans of the same.
It is interesting that scientists and scientific organizations are not in possession of tools at this moment to identify these two separate states of matters of the light in visible entity of matter and hence always consider all matters as the atoms and in presently considered four states' of matters as has been tradition.

The same ray of light when changes to gans of the hydrogen atom, this change's its dynamic diamond crystal structure of the same matter and hence this gives the same matter insulating properties and hence allows the creation of conductive and isolative properties of the same element in its layering and clustering structure and its dynamic properties in between the same elements of atoms of the gas and gans.

The gans in specific condition has diamond crystal structure of the hydrogen atom and with slight change in its environmental condition become a conductor for short or on a long term. Where this has been experimental prove and demonstrated and then clustering of this structure mixture of gas and gans of the same atom leads to creation of multi-layers of conductive and isolative matters of the same matter and hence in the dynamic magnetic environment of the universe this leads to creation of different and stronger Magravs, and start of attraction and positioning of different matters towards these initial seeds of gravity and Magnetic fields and hence start of creation of initial celestial entities like plasmas of neutron, atoms, stars and galaxies.

This is the reason, for example why the same matter of carbon becomes to be the best conductor as nano layer Sp2 and the best insulator as the diamond crystal insulator structure known as Sp3 across the same layers or through its layers respectively where the production of such a mixture has been

independently confirmed by Ramon spectroscopy of these structures produces as layers on a given surface. Therefore all elements and molecules or their combinations can have both Sp3 or Sp2 structure and property at the same time and in the same environmental condition.

This being the like of the protein chain, where each gans of each element exist individually and collectively in the amino acid as molecule of gans as each element plays its individual role which can affect collectively the operation and existence of the acid in its given environment (6).

In understanding the concept of the conversion of light rays to gans and gas and creation of nano materials, this discredits the present philosophy of the planets needing solid iron cores which enables them to create their Magnetic fields that they can operate in the universe or even the human race could be brought to the earth from other places from far corners of the universe. The life on earth is the natural product of lights' motion and its conversion in the internal activity of this planet and solar system.

By the same measure light plays in different environments different roles which can lead to creation of the same and similar or totally difference combination of creation of molecules of gans, which these manifestations of difference appearance of the light are environmental pmf mafs strength dependent. This is to say that life is not and shall not be the exclusivity of this planet and this solar system once on understand the principle of creation and motion of the light rays in the universe.

Thus the centre of the earth does not need to have solid iron core for it to possess Magnetic and gravitational field's forces leading to creation of life on the planet too. Whereas, composite elements of nano materials, gases and ganses crystal structure of the same element in the inner cores of the planet can lead to creation of the same Magnetic fields and gravitational fields of the planet.

This explaining why even some planets like Saturn possess Magnetic fields, even though these planets could possess some solid matter as their constituent materials as part of their inner structure.

In reality as layers and layers of dynamic gas and gans are piled-up in the centre of the planet the effects of dynamic magnetic layers exponential strength that they make as the Magravs of the planet take hold and this phenomenon lead to creation of stronger fields that can span billion of kilometres in the solar, galaxial heliosphere in the environment of these entities.

Thus the transition dynamic helixial cylindrical ray of light in slowing down in a given environment Magravs strength, this lead to creation of specific matter in that given Magravs strength environment.

The scientific world has to understand that the state of gans of matter is a natural phenomenon in the world of creation, this meaning as man has learned about the solid, liquid and gas state of matter, as these states of matters are due to temperature and pressure difference in the environment of these matters, but there is another state of the same matter even though as it's like a gas and behaves and exists as matter in form of liquid and solid but due to its internal gravitation fields forces of its atomic structure this matter for its appearance and properties is ***not external environmental dependent***.

The gans or the gas in nano state of solid state of matter will play an important part in the future of the science and technology. That is where the same atom behaves like a gas, liquid and solid at the same time depending on its own internal magnetic fields interaction in its plasma and not of the external environment conditions around the plasma the same matter will be in dynamic solid state at room temperature at all-time irrespective of the environmental condition.

That is to say the plasma of an atom of gans receives or coordinates its own Margravs and its own Magravs positioning in respect to its own electron and proton and other gans structure.

Thus, gans is the state of the structure of the light which has changed from dynamic cylindrical plasma of magnetic fields to a dynamic spherical entity of the same matter mafs, which its state of manifestation in matter environment is internal gravitational dependent and not environmental condition dependent. That is why one can observe the same element in coldest and hottest regions of the universe and still misreads them as atomic matter rather than nano-atomic or gans of the same matter.

This is how some of the plasmas and rays ejected by the Sun, depending on how they arrive at the Oort clouds and Kuiper belts then become nano materials of gas or gans and in clustering with other matters and ganses become part of the meteoroids or asteroids and look as they have been there from the time of the creation of the solar system.

In the universe and solar systems of the right Magravs strength, the light changes into the nano hydrogen and through internal magnetic fields of the solar system through the principle of magnetic balancing and accretions this matter elevates to the next magnetic material, which one of these materials' is the gans of the oxygen. This element due to its Magravs positioning and balancing in the Magravs of some solar systems lead to creation and production of water molecules in the Oort clouds belt and then these water nano particles gets pulled back into the inner parts of the solar system as nano ice particles of gans of this material which for example one observes them in the rings of Saturn.

The ice particles in the ring of the Saturn are there and for ever are produced by the return of the rays of light which were released by the Sun itself, on their way back to the Sun as gans and ice particles and they are temporarily trapped and positioned in these rings, and the present assumption that these ice particles exist in these rings are not by the crash and splitting of meteoroids or asteroids into smaller pieces that afterwards have stock in these rings of the Saturn as can be observed at the present time.

Thus as the light reaches the outer boundaries of the solar system, its becomes nano material, which due to their magnetic properties, this leads to creation of a nano magnetic material which is oxygen and then this matter of nano particles gans of oxygen to find stability for its Magravs, this attracts two atoms of gas or gans of the hydrogen nano particles, which this leads to production of gans of ice looking particles of water in the Oort clouds belt of the solar system, which they move inward and become the liquid magnetic substance and the source of the life in this solar system.

Thus the water in the solar system is generated by the rays of the light of the Sun itself mainly and by no other source and hence water is produced in the solar system by the recycling of the light rays of the Sun itself.

The mixture of these ice nano materials with solids matters of the solar system leads to creation of meteoroids, whereas these dynamic objects in traveling between the Oort clouds and Kuiper belt, these objects attract nano water molecules and then they return to the inner regions of the solar system. This being one of the reasons why the meteoroids are seen on regular basses and their size never changes, but their vapour trail tells the existence of the water residuals in their structure's as forever these objects gets replenished with the Sun rays in the form of gans of water in these outer regions of the solar system and return back into the inner parts of the solar system.

Therefore the theory that water is brought to planets like earth by meteoroids as has been assumed is partially correct, but Magravs of planets like earth in the Magravs of its Sun have the ability to

convert light to nano matters and nano matters which have been produced into hydrogen and molecules of water through accretion process in the vacuum of the solar system and in the upper layers of the earth atmosphere itself. Hence water is the creation of the combination of atoms created by the rays of light and in different magnetic fields conditions in the Margraves environment of this solar and planet system.

This process of conversion of the light can happen anywhere in the universe as the nano particles of the hydrogen is one of the first and weakest Magravs strength that light can change to matter anywhere in the Magravs strength of this universe.

Thus water is not exclusivity of this solar system and is product of the light rays of the universe in matter environment.

There are waters like substances in other matter mafs and matter strength environments in the universe too.

It is important to realize that all gans have the magnetic properties with the difference that oxygen is the one of few common magnetic materials in the solar system and in most of the universe needed for braking of the light itself to lower level strength, which can lead to creation of intelligent life. In some solar systems and galaxies pmf strength of the gans of the matter of the oxygen is the common magnetic elements and the reason why all maters existence dependent upon availability of this matter in the pmf of the environment.

In the living bodies in possession of systems the like of the lungs and gills in fish, the light in changing to molecule of oxygen and in being inhaled for their existence, in these systems contrary to present belief the atoms and molecules of the oxygen will never cross the boundary of the structure of the lung or being absorbed by the blood as has been thought and promoted by scientific world (6). The fact is that in the process of inhaling or in case of fish by passing the water through its gills, the atoms of oxygen simply passes limited value of their matching plasmatic magnetic fields strength to its matching oxygen atom of protein of the blood cell that the blood cell as commonly called gets oxygenated in the lung (6). In reality no oxygen atom or molecules ever passes the walls of the lung as has been assumed, but the oxygen atom transfers its pmf to the bloods oxygen atom in its protein and then this pmf is carried through and by the same principle as the pmf from the oxygen of the blood protein cell is passed on to other oxygen atoms ganses in the protein chain of other cells in the human body (6) as they come across their corresponding mafs strength protein in the blood.

The oxygenation of the red blood cell is primarily another quantum-entanglement of the same matching matters strength or entanglement transfer of adequate amount of pmfs of specific cell of the matters of blood.

The fallacy that oxygen atoms cross the walls of the lung is so far from the reality of existence that as saying a man can walk through a solid wall. This hypocrisy has been the consequence and through the lack of understanding of the real structure of the oxygen and its origin being laying in the structure of the light that matching plasma of light and atoms can/and frequently entangle and transfer their pmf up to level of their mutual strength that existence can be guaranteed in one form or sub-structure of the same and without the plasma of actual solid atom crossing the boundaries (6) of the lung.

In fact the energisation of the red cell is through transfer of the pmf of the atom of oxygen and not the actual transfer of the crossing of oxygen into the blood stream and the brightening of the red cell passing through the lung is like the variable light switch, that as one increase the current through the

light the light shines brighter, this is the same process and in the same way as the red blood cells receive the pmf of the oxygen, then the blood become brighter or richer in pmf, then the blood cell after transferring its pmf to appointed cell in the body then pmf strength of the blood cell is reduced in energy and illumines less, dimmer or looks darker as it returns to the lung to be recharged (6). Man has a lot to learn first about his own body before he can conquer the universes.
In understanding the function and the fundamental properties of the gans and molecular gans then computing systems can be produced that not only they think the same ways as humans do but due to their dynamic energy and singular directional rotation, then at this point the first quantum computing systems can be produced that these computers will be exact copy of the human brain and muscles in structure with the same multi-neuron-cross linkage and communication channel, as these channels are created as gans molecular Magravs linkage will allow them to have the same simultaneous multi-cross connection that these quantum gans of molecules structures will be exact parallel systems as do the human brain in all aspects of a real working structure of logical system, which even they can carry emotions as well as control and logic. Where, in fact the binary gans and twin gans sets will be the future of fast thinking units needed for the high speed control logic system for space systems travels of the future.

As there are gans in the matter environment mafs strength then there are gans in pmf strength of principal matter and transition matter too, and at the same time the gans of matter in all mafs strength will operate in all levels of pmfs strength. Thus it is possible to produce molecular gans unites which work at high speeds and with same emotion and logical systems as human brain, but with speeds that are far exciding speeds of the human brain processing capabilities.

Therefore it can be said that for the first time the man has the capability and the knowledge of not only producing solid gans of gas at room temperature, but it can go one step further than present conceptual nano matters and nano matter based computers and start working on real brain based matter structure logical systems by using the gans of the gases which are the building block of the human amino acids.

But the question is that would we as far as building the first human operational brain and body using these matters as we have already decoded the DNA of the human genome, and as we know the full chain of the DNA sequence and we have already unravelled the mechanism that the RNA produces it energy and current for its internal communication and control of the internal systems of the DNA, then would man become the creator of new beings bases on human structure and would the discovery of the gans and simple method of its production will allow the ethical question of mass replication without the need for stem cell or even egg and sperm, which are memory banks of human survival on this planet. Would man will make one of his own with a clean DNA memory. OR is the human being to become the god of new generation of beings.

This is not the first time in the universe that one created has the ability to reproduce another of the same, but at the same time this discovery of structure and properties of the gans would have become apparent to man of science in due time as he would have progressed in his scientific conquests.

Some scientists believe that solid iron is the main magnetic matter in the universe and this matter in the centre of the stars and its energy balance conversion between its fission and fusion is the point when stars goes through their slowing down process or reduction or what is known as their nova state. The truth is that the plasma of mafs of the simplest structure of the plasma is the common and the fundamental and elementary magnetic entity in the universe. Thus the plasma of the light is the basic and common magnetic matter in the universe and one does not need iron to reach this point, as the plasma of matters in given position can lead to unbalancing of their total environment pmf mafs and Magravs, this leading to total disassociation of the all matters in any matter or object in the span of the universe, and once the process of the chain reaction of disintegration and disassociation

starts then the whole entity disassociation from each other begins and in the case of plasma of neutron and star at this point disintegrates to re-association in a different as plasma of proton and electron and new star and planets in their form in difference point and place in their given environment.

By the same measure the plasma of neutron which is created by the conversion of the light ray is the common magnetic matter of the solar system and not atoms of iron, and in reality the light of the Sun and its Magravs dictates this property of this mafs of the matter and the present assumption that energy balance conversion of iron is the cause of their nova cannot be correct and as most of matters in the universe are created because and through the existence and the operation of principal matters in the centre of the stars and their rapid unwinding and balancing of their Magravs in the centre of the star leads to the expansion and disintegration of the star and not as has been assumed at this point by some cosmologists due to the iron fission-fusion balance (3,4 and 5) phenomenon.

What has been explained above, this is the process of creation and recycling of the light through its full circle of its existence from matter to light and from light back to matter(s).

The detailed information and explanation about the existence of the gans of the matter has been possible due to through series of tests which has been carried out and absorption of the physical solid CO2 at room temperature has been confirmed. The procedures and tests results in confirming the existence of this new state of matter was originally published in 23.12.2009 by the Keshe Foundation on its website. For those whom have not been able to read this paper a copy of the same is published in this chapter.

The state of gans of matter can now explain about the truth of life in the universe and this opens new horizons in the world of energy, new materials, production of more natural components of the human body parts, production of new medicine, new types of food processing technology, which this eliminate the need for present farming processes to feed the populations, as protein can be produced from the content of the light or the mixture of composition of lights mafs in gans state of matter that can lead to production of solid matter the like of fresh meat and or composition of dairy milk and so forth. Thus through production of gans dependence on the extensive farming in the space becomes irrelevant, where in deep space by absorbing weak residual mafs of the light and in bringing them together and through accretion, then producing the gans of the fundamental plasma, then producing the gans of fundamental atom and then through accretion creating composition of ganses of protein, then one can produce any food in the span of the universe directly using the matters of the light. Originally this concept of producing protein through gans from the gases of environment was considered and successfully tested in Tehran in the summer of 2008, and through simple process the first gans of protein in small quantities by using the natural air at room temperature was produced.

In the appendix section of this book, attached is the paper titled “The unifying field theory” published in the 28.10.2009, in this publication it is discussed and can be concluded that the origin of all entities, tangible or not are magnetic fields and the interaction of at least any two of any magnetic fields of any strength can lead to creation of all other effects and matters which are observed in the universe.

Thus the magnetic field is the unifying field and the mother and the seed of all created and creation in the universe, thus the magnetic field is the Holy Grail, which the scientific world had been searching for in the universe strength to connecting all fields and effects observed in the universe.

Chapter 4

CO2 in Gans State (paper 2009)

Direct absorption of carbon dioxide CO2 and methane CH4 gases from the environment and their conversion into nano solution and nano solid matters and production of energy and oxygen by the use of nano compound at ambient temperature and pressure.

Abstract

In this paper, results of processes will be introduced for the absorption of carbon dioxide CO2 and methane CH4 gases direct from environment and their conversion into nano materials of the same suspended in solution or dried as powder. Where, concurrently within the processes of extraction of these gases in a simple reactor, we have managed to produce energy and oxygen.

Discussion

New methods for absorption of CO2, CH4, and others gases and further conversion and preservation of these elements in their nano solid state of matters at room temperature and pressure has been developed and achieved.

We have developed simple processes by which carbon dioxide CO2 and methane CH4 gases can be extracted from their environment where no additional heat or pressure to achieve this has been applied.

At the same time conditions can be created within these systems that CO2 in conversion without going through any chemical process, can lead to creation of methyl, oxygen and methane gas and vice versa.

Where during these processes of CO2 and methane gas extraction or conversion we have managed to produce usable energy and oxygen molecules in sustainable way.

Production and extraction of CO2 by applying energy is a known technology in the present science, what is new with our technology is, that not only CO2 is extracted in a simple system at room temperature and pressure, at the same time, energy released through absorption and conversion of the captured CO2 to formic acid, we have developed simple techniques to capture the energy release from this transition process to produce useful power.

The novelty with this new technology is that in previous state of art technologies, engineers and scientists had to add energy to extract CO2 the environment or to produces O2, where through our technology, not only we generate useful energy while absorbing these gases from the environment, but also at the same time, the system can produce molecules of oxygen.

Thus, this simple system has the ability to replicate the processes as in a natural way as plants achieve in their conversion of CO2 into oxygen.

With this technology, CO2 and CH4 gases are absorbed and attracted into and within the solution in their nano state, and then they are allowed to amalgamate to produce gel like residual solution and then form nano sediment.

Where, nano CO2 can be extracted or removed from the solution as solid matter at room temperature.

The CO2 stays in state of gel as nano materials in the solution due to their diamond crystals structure (sp3), or due to their crystal lattice structure, this creating a non-adhesion molecular bound like diamond crystals. Which, this does not allow more than certain number of molecular structures to adhere to each other. Where, CO2 nano matters once reaching a certain molecular gravitational level, as crystal, then they do not attach or cannot hold on to more than single or certain numbers of nano molecules of CO2 and form independent or nano cell of matter. Thus, all clusters of CO2 in solution have certain dimensions and that is why they stay like clouds or gel within the solution.

We have to explain that it is known tested fact to us that nano-coated materials and nano materials in sp2/sp3-state due to their characteristic of diamond crystal behaviour, they cannot be soldered to each other or soldered to another material. However, at the same time in a peculiar way the outer electron of these materials allows conductivity of matter. What this means, is that, even through they do not or cannot be attached to any other material from their outer structural boundaries, but in being connected with each, these materials allow flow of current and voltage through their outer boundary.

In a way, these behave like quartz materials, but at the same time after a number of layers, they do not or would have the gravitational pull or adhesion capability to allow more layers to be added to their layers.

Where, these layers along their grain and layer, they behave as a superconductor, but across layers in PN junction, depending on the position of PN cavity within the layers, they become best resistors. Where, we have measured the resistance of these layers and this have been confirmed by other scientists whom have tested our material of sp2/sp3, that these materials have shown to have 20 M Ohms resistance threshold barrier. On the other hand, this material on the surface has as good as resistance capacity as air and diamond.

We have further managed to obtain solid matters of CO2 from the system or dry the nano-saturated nano CO2 dilution into nano CO2 powder. Thus for the first time in the world of science we have managed to generate at room temperature and pressure nano matters of CO2 and methane through the same process.

To confirm that solutions obtained in our tests to contain CO2 and CH4 matters and these matters are in nano form, we had to under take laboratory tests of the solution with infrared spectroscopy and XRD respectively.

Further, as we know through our previous developments in nano technology, that nano materials are by principle sp2/sp3 in their character. Thus from results obtained from infrared spectroscopes and XRDs of matters during our process of absorption and nanolisation, we have concluded that the extracted CO2 and CH4 materials in solution and dry are both in nano state of matters of these gases.

At the same time parallel researches which we have found on the internet since the publication of the first addition of this paper on the 23.12.2009 done by other scientists, Dr Omar M Yaghi of the university of California released on 7.12.2009, which extracts of this has published in article by The New York Times published 4 on the 8.12.2009, this article refers to “metal-organic frameworks (MOFs) material promise of carbon capture and release, and that these materials being crystalline sponge hybrid lattices of organic compound and metal atoms that has a huge internal area where gas

molecules can be absorbed."

Where we have reported these characteristics of metal-organic sponge effect and capture of CO2 in 2006, and this has been confirmed by indecent testing by major nuclear testing centre in Europe in their report in 2007.

Further, in the paper Dr Yaghi states, "***MOF used in the study contained magnetism atoms***"

Where in our previous disclosures and patents applied, we have declared that the absorption of these atom of CO2 and CH4 are Magravs (Magnetic gravitational fields) based. Which this independent scientific paper confirms our finding that CO2 and CH4 are gravitated to the water as nano molecules, and they do not have any interaction with the medium of the water, but the water *is the container and tool or catalyst to keep these captured molecules in their singular or nano state and sp3 floating condition or as a solution.*

In the same paper, Dr Yaghi refers to how material separated out CO2, which allows methane to pass.

Where, our system not only captures the CO2, but also at the same time it can capture CH4 as we have reported before. That these captured carbon dioxide CO2 and methane CH4, produce diamond structure nano matters or crystals, with metallic behaviour like, which they have a superconductor characteristics and behave like conductors.

Thus, our findings are inline with other scientists and their scientific research works, which have been reported. Where now we can clearly state these captured gases can be converted to solid nano materials, which behave like metals, and are superconductors, but in reality, their superconductivity of the matter is due to their sp3 nano characteristics and not their metallic condition.

Further Dr Yaghi states that 87 percent of the CO2 captured, at 13-degree temperature are released back by the MOF matter to the environment.

Where this is inline with our reported behaviour, that as the CO2 are extracted by these materials we have developed, which our capturing materials are metallic and organic in their real structures, these materials then release their captured CO2 in the water at room temperature in Gans (Gas-Nano-Solid) state.

Further, he states that to release the balance 13 percent of the captured gas, one-need temperatures of 175 Fahrenheit.

Where, we release all captured CO2 as nano-material into the basic solution of the system, this all at room temperatures without any heat being applied.

Further more, the Canadian company Mantra-Venture-Group has announced on Business News Network that in conjunction with 3M using electro reduction of carbon dioxide, they confirm that ***they need 6Mw of energy to extract one tonne of CO2***, which this is considered to be at the edge of technology of CO2 extraction.

Where, with our new technology we produce energy rather than consuming energy.

Where, further MantraEnergy in conjunction with use of the CO2 they capture, they can produce formic acid, using the technique developed by Dr Gabor Laurenczy. Where, he has confirmed that he can generate hydrogen from formic acid. (Video-interview:

http://www.mantraenergy.com/mantra-in-the-news/squeezeplay-zapping-carbon.html).

We clearly have shown and absorbed CH4 not only from the environment, as similarly we have reported the production of formic acid through the natural gravitational forces of our system as has been shown by laboratory tests results which are discussed below.

We have reported the production of CH3 in our system late last year as we managed to separate the CH3 and its capture in nano state of matter in our system. The production of radical CH3 from the H2O molecule of the water as the magnetic and gravitational catalyst of the system, subsequently this leading to existence of two radicals in the systems at the same time, one of the CH3 and one of an atom of Hydrogen leading to release of molecules of oxygen.

Scientists at a nuclear centre have confirmed the production of hydrogen radical through our technology in 2007 in their independent (not yet published) report.

Therefore, it has become a simpler method through our development to extract CO2 and CH4 and released it in nano solid matter in water, and at the same time have the ability to produce energy and oxygen as we have demonstrate it to independent engineers in December 2009.

Further on in this paper we show and present pictures of both matters of CO2 and CH4 in solution and solid state for the first time (Fig. 29 for solution and Fig. 30 for powder of CO2, and Fig. 31A-B for solution and Fig. 32 for powder of the CH4). The CO2 in solution and dry state has a white milky appearance and methane CH4 has a blue greenish colour.

We have mentioned Dr Yaghis' paper in this section as the findings in his paper is near to our finding and is one of the latest in this field.

The CO2 capture is well documented subject on internet and we are not here to list them to support our claim, one can refer to these on the internet to find that our claims our inline with main stream physics community, with the difference that we reported the capture of CO2 in early 2005 in nano materials on our web site and now we are reporting the first solid nano material of the gas as in Gans-state. We call a Gas-Nano- Solid state the GANS-state, which is a state or phase of transition of matters, which has bee unknown in actual science up to the release of this paper.
Meanwhile in light of our latest discovery and disclosure of the capture of CO2 as solid or in solution, our foundation will ask the nuclear centre which has done the independent test for our system in 2006-2007, that if we can release part of this report confirming the CO2 capability capture of our materials.

The CO2 absorption

In our tests and development phase, we have managed to produce a special material for the production of a new and a simple system for absorption of CO2 through the principle of Magravs field forces, rather than the chemical method of absorption of these gases. Where, the absorption principles through gravitational systems have been disclosed in full in the book, which we have published in July 2009 (titled: The Universal Order of the Creation of Matter; ISBN 978-94-6087-001-9). In this book, I have, explained in detail, the principle of gravitational and Magnetic field positioning and attraction and repulsion of matters from these systems respectively.

Through the development of these new composite materials of organic and metallic nano layers, we have managed to create specific static gravitational field forces which can be in the magnetic wave length of the CO2 molecules, or we have developed condition(s) that as the gravitational field

attracted the CO2 to the material, the Magnetic field(s) within these layers cause the repulsion or the release of the captured molecules of the CO2 from the layers. Thus causing the creation of nano molecules of CO2 in the water, and as we use the magnetic fields of the water for stability and as a magnetic catalyst, they come to allow the formation of clusters of Gans of CO2 and create a solution of these nano matters, which these latter manifest themselves as a sediment in the liquid of the system at the bottom of the holding container (Fig 30E).

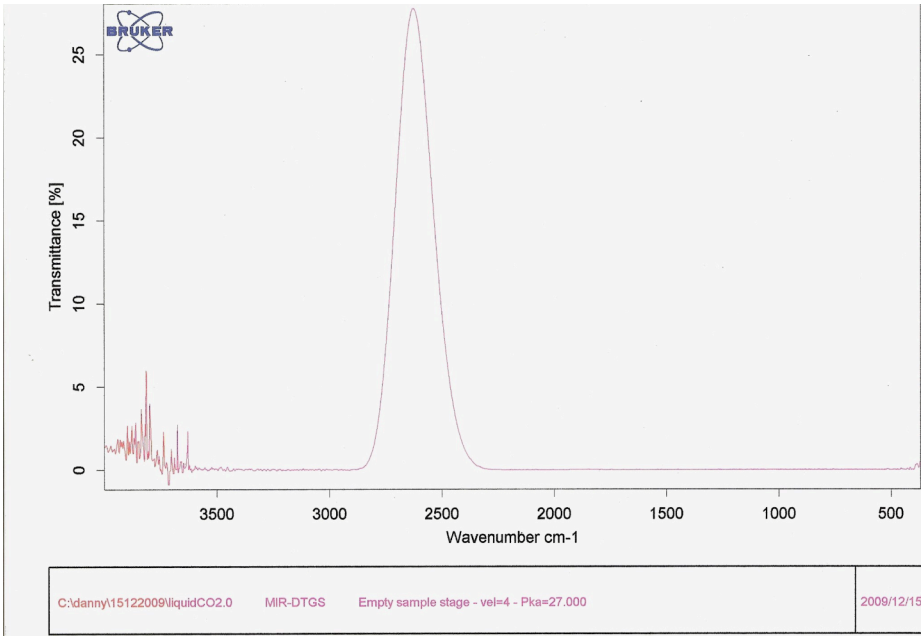

Fig. 21 Infrared spectroscopy of the CO2 solution.

The solution of nano carbon dioxide CO2 and has been subjected to infrared spectroscopy by independent laboratory confirming the production of the first nano CO2 in a solution or as gel at 2630 cm-1 wavelength of the spectrum (Fig. 21).

This is actually the best observe data as calculated and predicted figure is said to be at 2640 cm-1 (Fig. 22). (Source: http://science.widener.edu)

The closeness of the figure of 2630 showing the purity of the CO2 solid matters within the solution obtained during our test.

Where even the predicted matter has a multiple peaks, where these captured matters due to their singularity in the measured sample has a sharp and clear single peak as has been shown in Fig. 21.

This sharp peak can confirm the possible nano sp3 structure of the suspended capture matters of CO2 in this solution, once XRD test was carried out for the same sample.
For further confirmation of nano structure of the matters captured within the solution and then the solution was allowed to dry and then as a film was subjected to XRD testing.

The results of this test showed a clear match only as superconductor characteristics for this material. Further analysis with the data from XRD, a superconductor material characteristics perfect match was not found for this matter.

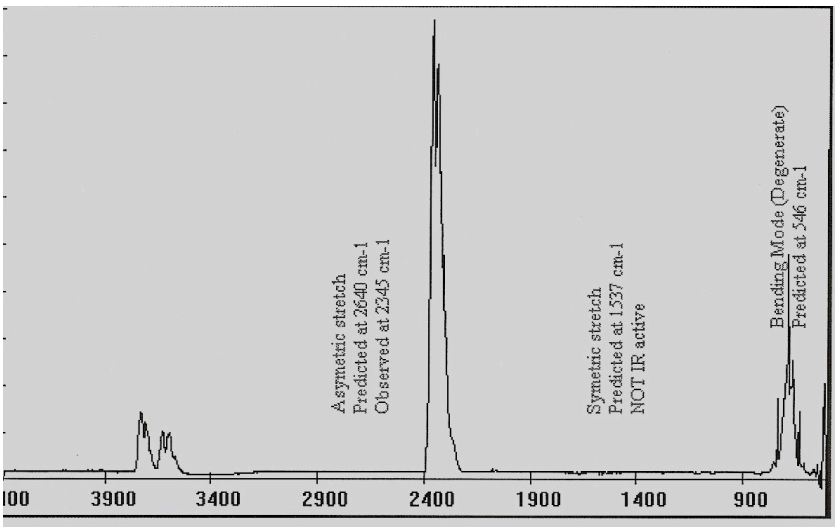

Fig. 22 Standard CO2 infrared spectroscopy graph.

With this test, and from our pervious developments and testing, clearly it is shown that the matter within the solution has superconductivity property (Fig. 23), which has new non matching data in the present collected reference data, and this is the characteristics of nano materials in sp3 state of matter.

This matter as superconductors known or ever been recorded for observation.

Thus the XRD of the CO2 data as solid and its graphs have become the new base knowledge and fundamental basic data for any future capture of these gases, once they are absorbed as a nano material in solid state.

From our previous developments and tests, we know that all nano materials show and have superconductive characteristics. Now with this test, now we have further proof that the captured CO2 in the solution is in a nano state of matter.

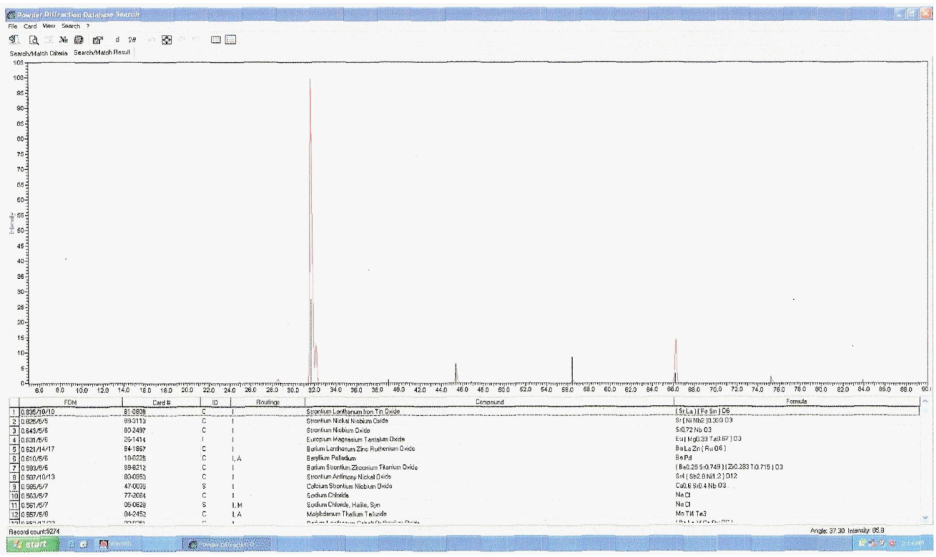

Fig. 23 XRD of the CO2 nano material

The closest match as superconductor characteristics to CO2 in the solution or in dry state of matter,

this was found to be an exotic mixture of five different materials, as can be seen in the table at the bottom of the graph, with the best match reference data figures to be about 80%-90% superconductivity properties of this matter.

With the discovery of this new state of matters and the simplicity of their production and their high superconductivity properties, we predict that gans (GAs Nano Solid) of gases are going to be the next-best purest superconductor and resistor materials of the future.

Further more: in confirming the matter of solution being carbon dioxide and at the same time confirming that this matter within the structure of the solution and the system set-up has the capability of conversion to formic acid in presence of CO2 captured in the solution of water, a further test was carried out with **infrared spectroscopy** to confirm this conversion principle of the confirmed nano CO2 capture to formic acid within the solution.

For confirmation of absorption capability of nano CO2 by the solution and its conversion into formic acid, the chamber of the infrared spectrometer system was field with pure CO2 and measurement were taken. This measurement is shown as line A on graph Fig. 24.

Then the solution of nano CO2 from our test was then injected into the chamber and the graph line B in Fig. 24 was obtained.

The peak region NC in the Fig. 24 shows an increase in carbon dioxide in the solution was once it was introduced into the chamber.

This showing that the CO2 solution is extracting carbon from the chamber or causes reduction in carbon content of the chamber.

This in away showing the absorption capability of the solution of nano CO2 of more CO2 on its own independently, and confirming further from previous results that nano materials are CO2 absorber by their nature of construction, even though these matters are themselves part of the original solution.

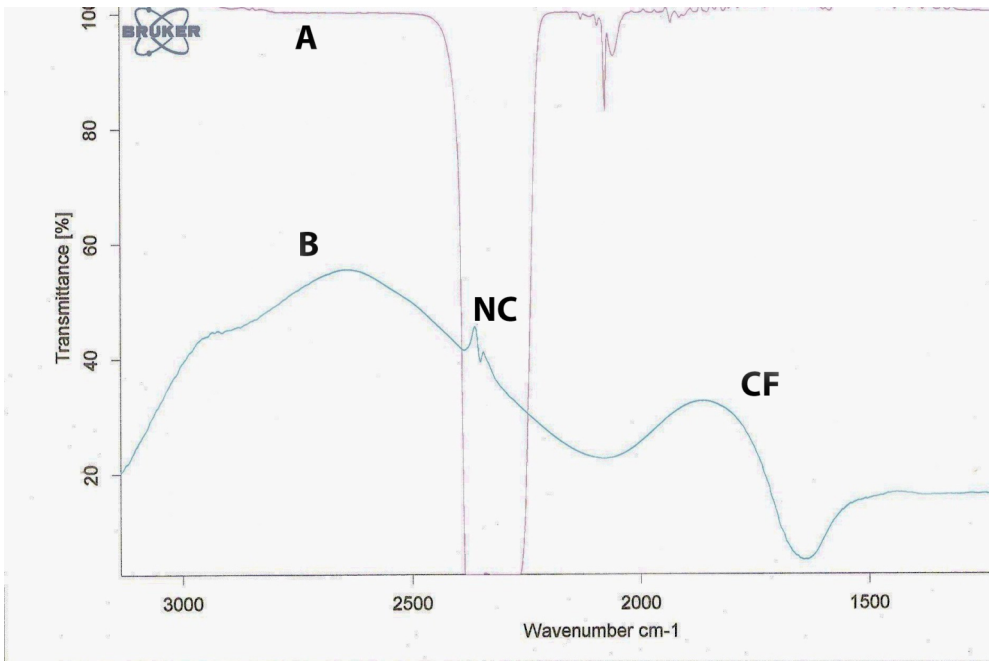

Fig. 24 The comparison graph of injection of the solution of CO2 into CO2 gas environment.

In this graph the peak NC showing absorption of CO2 from the chamber and this followed by formation of formic acid as shown in the CF region of this graph through infrared spectroscopy test Fig. 24.

The graph of the CO2 from the solution and its conversion is independently shown in Fig. 26.

It is at this point of gravitation attraction and subsequent Magnetic field repulsion that the magnetic fields strength equal to the strength of the Magravs of the proton and the electron are made available to the system, which these fields are absorbed by the electrodes within the system and then these are past to cooper wire atoms', which are the constituent matters of electrodes and cause the vibration of electrons within the copper wire leading to creation of current in them.

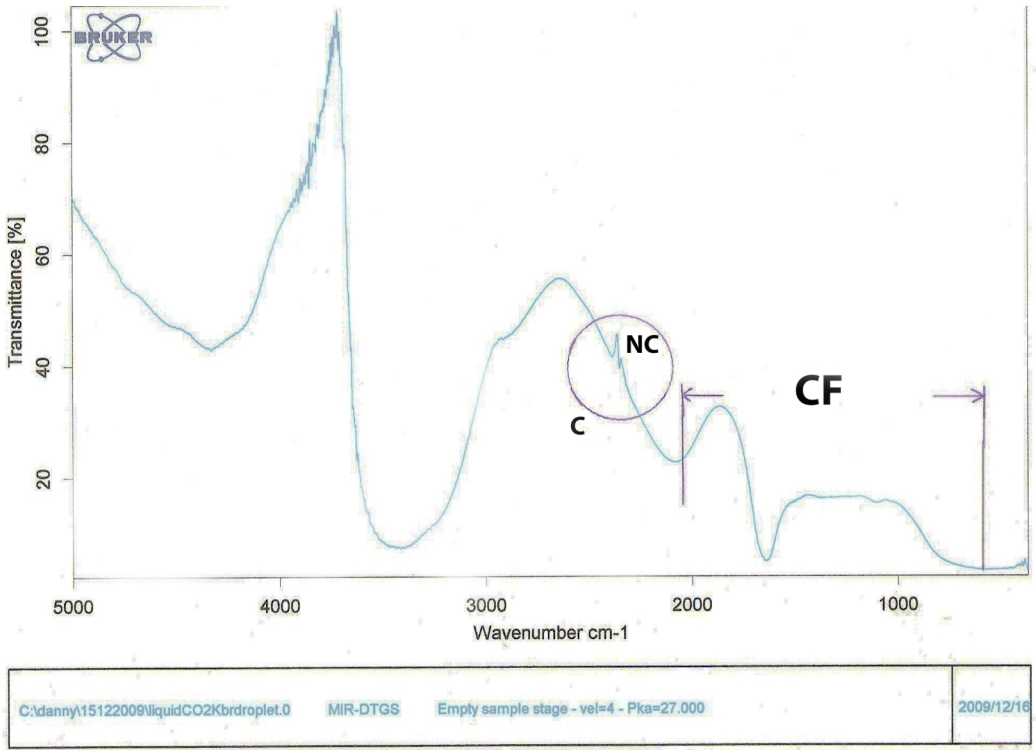

Fig. 25 The graph of the conversion of the CO2 into the formic acid within the chamber.

In the actual physics they call these released packages of magnetic fields or energies as photons as they are released which are then these are absorbed by electrodes placed within the system and used for example to light diodes.

Through development of this technology, production of power without burning fuel and at levels that can meet the demand of a household or a car, is achievable.

Where, for separation of CO2 from environment, in present state of art technologies, energy is used to be able to first separate the CO2 and then cause the formation of formic acid reaction chain, this leading to production CH4 or hydrogen.

Where, through our simple technology, in opposite to the norm, we ***generate energy while extracting CO2 from the environment.*** The method we use is the principle of gravitational positioning and is exactly the way by which matters are extracted and separated in the universe as has been explained in this book.

Our approach is totally different than the present state of art technology, where they use and follow the fundamentals of chemistry, hence the need for their system for energy input to achieve the separation or extraction and we follow the universal method of extraction and holding where magnetic fields as energies are made available through the process.
The example of energy production during the process of CO2 extraction is shown by lighting the diodes as can be seen in Fig. 26.

Where, this set of three LED lights being powered by CO2 capture process. These lights have being on contentiously from 7 pm Saturday 11.12.2009 until this report is release 05.01.2010. Further we expect that these lights will be on for months to come, if we allow the set-up to be running as it is. The intensity of the lights from these LEDs has not diminished and in fact, sometimes they are brighter.

Through development of this technology, production of power without burning fuel and at levels, which can meet the demand of a household or a car, is comfortable achievable.

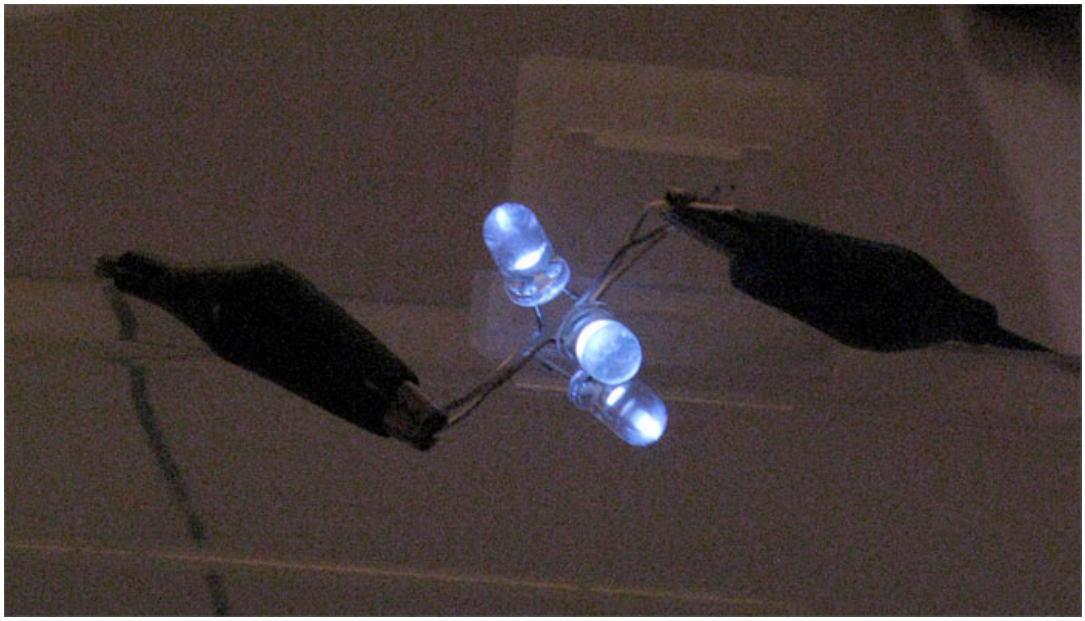

Fig. 26: Group LED's light

For further investigation into confirmation of CO2 capture and its conversion in their interaction with water to form formic acid, the standard reference infrared spectroscopy graph and data of formic acid was obtained as shown in Fig 27.

To confirm further the conversion of the CO2 into formic acid from the CO2 nano solution from our test, the following procedures were carried out.

To begin with, formic acid liquid with 95% purity was introduced as film on the sample disc of infrared spectroscopy system and the graph FA in Fig. 28 was obtained.

Then a drop of solution of nano CO2 was placed on the film the formic acid and the graph CO2+FA in Fig. 28 was obtained.

When the three graphs are superimposed, that is the original infrared graph of the nano solution of CO2, on the graph of the formic acid and then the graph of the mixture of formic acid with CO2 solution, these clearly showing the absorption of CO2 in the zone 1 in Fig. 28, and then presence and formation of formic acid as shown in the zone 2 of the Fig. 28.

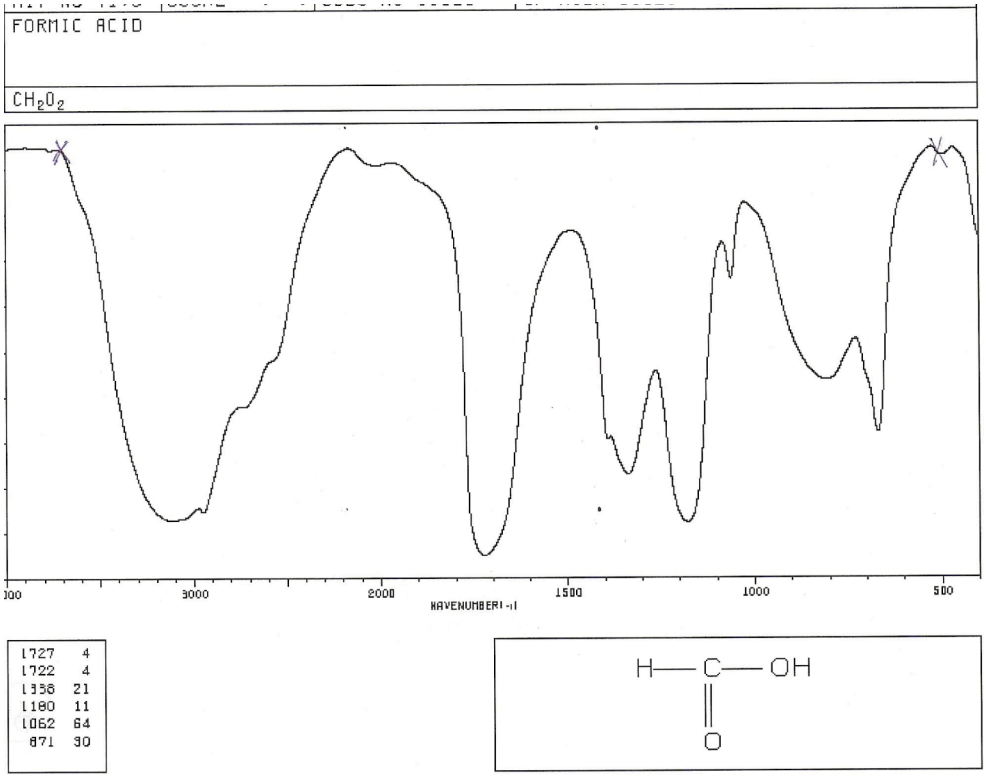

Fig. 27 The standard reference of IR spectroscopy of the formic acid.

This showing the same pattern of presence of Formic acid in the solution of nano CO2, hence not only confirmation of existence of CO2 in the nano CO2 solution, but at the same time the absorption capacity of nano CO2 solution of CO2 from the environment and conversion of these additional CO2 in conjunction with water into formic acid.

Having established the characteristic of the matter within the solution from testes and results shown in Figures 21, 23, 24, 25 and 28, without the shadow of a doubt, the white material is CO2 in nano state, and from Fig. 23, we have the confirmation that this matter is a nano structure in sp3 and behaves as a superconductor.

Further, as the process of the energy production from the system has been extended to days and weeks, the following characteristics and materials have been detected and collected from the system.

In the process of the running the system, the area around the electrodes, which have been specially treated, start gathering a white cloud around them after subjecting the electrodes to certain conditions. From this point on the environment around the electrodes start creating a mist of white material around them, and then gradually the whole containment becomes like milky colour liquid, and then white sediment is established in the container.

Through the infrared spectroscopy shown in Fig. 21, we can confirm that the material in the solution is carbon dioxide and the nano state of this material is very much confirmed by the second test of XRD, as the only match for the dried solid residual of this milky substance shows' superconductivity behaviour of this material. This confirming the nano characteristics of the CO2 as white powder, or in its solid state of matter.

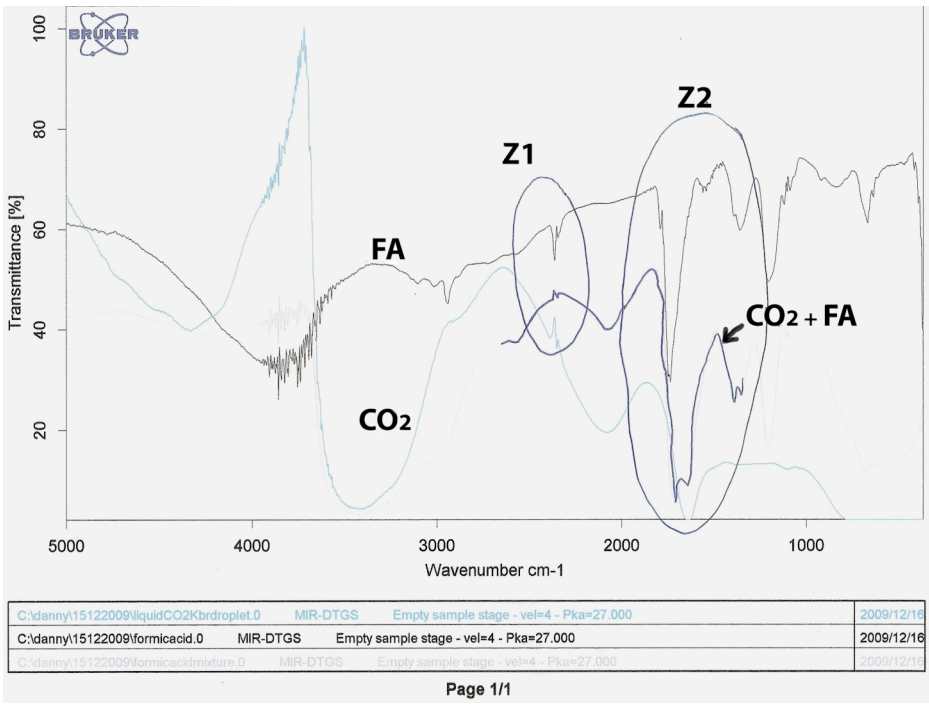

Fig. 28 The superimposed graph of CO2 and conversion o Formic acid and formic acid and mixture of formic acid and solution of nano CO2.

This is for the first time in the world of science that CO2 as gas not only can be captured without use of any pressure, temperature, or energy, but this matter can be extracted and held as a solid at room temperature.

The picture of concentrated nano carbon in solution used for infrared spectroscopy leading to graph in Fig. 21 is shown in Fig 29.

Fig. 29 Solution of nano-CO2

To our knowledge, this is the first picture of nano CO2 solution produced and maintained at room temperature and pressure ever been recorded.

Photographs of dried powder of nano CO2 are shown in Figures 30 A, B, C, and D. These are the first pictures taken of nano CO2 in solid state in atmospheric condition.

This is important as nano CO2 or **CO2 has *never* been observed in solid state at room temperature** and the only solid state of this gas known has been in frozen state of this matter as like of ice blocks (Dry ice).

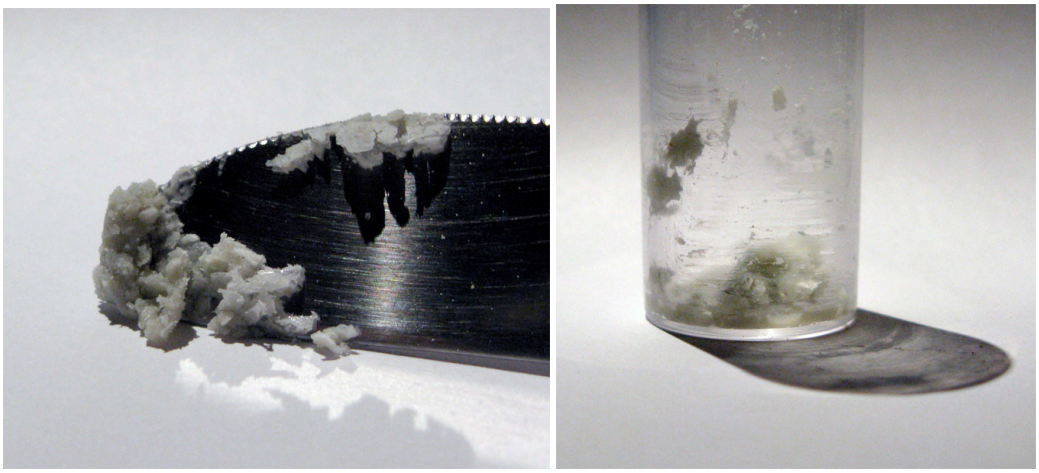

Fig. 30 A, B: Solid nano-CO2 on a knife and in a vial

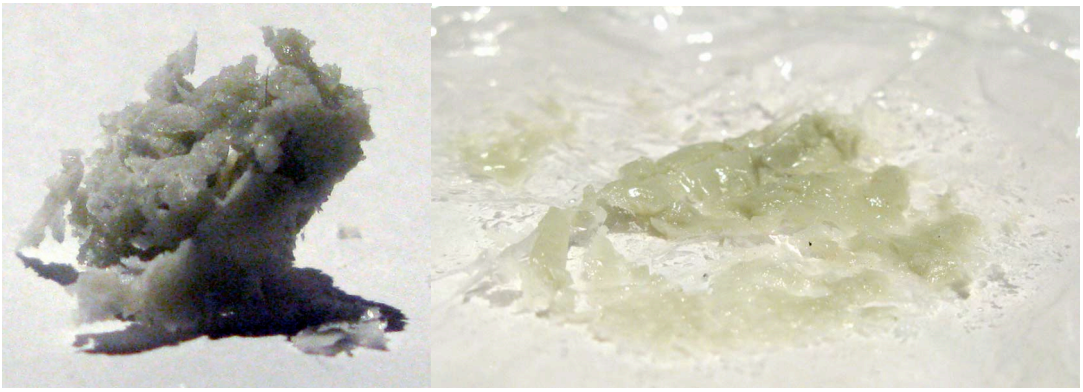

Fig. 30 C: Solid and gel nano-CO2

The important point to note is that, there is no content ratio between the CO2 absorbed in the liquid and the water, as is the usual procedure to state in most tests like these content ratios between sediments or gel and the water of the solution.

With this method of CO2 absorption technology, as long as one can extract nano CO2 from the environment or surrounding environment of water, the CO2 absorbed can be removed without ever a need for the change of the water.

Fig. 30 D: The Solid CO2 material in the Gans-state being held in hand at room temperature. This solid CO2 is not a 'dry ice', but a mastic-like matter.

In practice, we have a number of times collected Gans of CO2 from the same water within the container. The only reduction in the water is due to vaporisation or when it is part of the gel.

This is a very important and crucial point, and this is where this technology departs from present science of chemistry, and stands on its own merit as a nuclear gravitational system.

That is where if the system were a chemically based system, the CO2 content of the water would have been fixed and hence there would have been a ratio balance and final content for CO2 in the water and this value would have been fixed.

Due to the new understanding of the gravitational systems, as has been explained in the book (The universal order of creation of Matters), these specifically designed systems, with specifically placed and produced electrodes, these systems can create a strong but invisible gravitational and Magnetic fields within the layers zone of the electrodes, that these electrodes, as gravitational positioning elements, can create ***the gravitational pull*** *that can absorb CO2 molecules from the water and beyond the boundaries of the water*, without the CO2 as a nano molecule ever chemically interacting with the water molecules content of the system and going through the normal chemical processes.

Thus; if this was not so, how could electrodes deep submerged in liquid would have been able to extract CO2 from the air above the liquid and bring them into the material of the electrode for them to be separated as individual CO2 molecules on a continues bases, as we have been collecting these materials from the same container over period of weeks.

Where in this processes, as the materials like CO2 become in nano structure of their own state, then they are sealed like the diamond and hence they achieve a self sustained gravitational system, like a planet, that does not interact gravitational or magnetically with any other matter and attain the state of singularity or nano state.

This solution of CO2 material feels like mercury as gel, and to touch it feels cold, but does not stick to its container that much.

After extracting the water from the CO2 gans solution, the matter takes the form of gel and is cream whitish in colour.

Thus, this is a **static nuclear gravitational and magnetic field extraction process**, which has never been recorded or known up to this point.

With this method of CO2 extraction, there are no ratios between the matters collected as nano matters and the water content of the system, as the residual of gans of the gases can continuously be extracted from the environment of the system, without change in the volume of the water of the system.

The point to note is that, the volume of the water content of the system stays the same. Where, the system caries on gravitating to itself gases of CO2 and other gases from its environment indefinitely. But the total mass and the volume of the system increases as gases are absorbed into the system by the gravitational principle.

In fact, the system gains weight, mass, and volume as it absorbs more gases. This phenomenon was observed after the test was completed in Holland in the lab, and the increase in volume of the content of the system was noted at the end of that meeting, that we have more liquid in the bottle than when we started the test after about four hours of testing and running the system for energy production trail.

This is normal phenomenon, as extra gases from the environment of the system have been absorbed in the system and converted to gans, which settled at the bottom of the bottle of liquid.

The snap shot from video of the matters content of gans of CO2 as misty residual matter collected after the test in master bottle is shown in Fig. 30E.

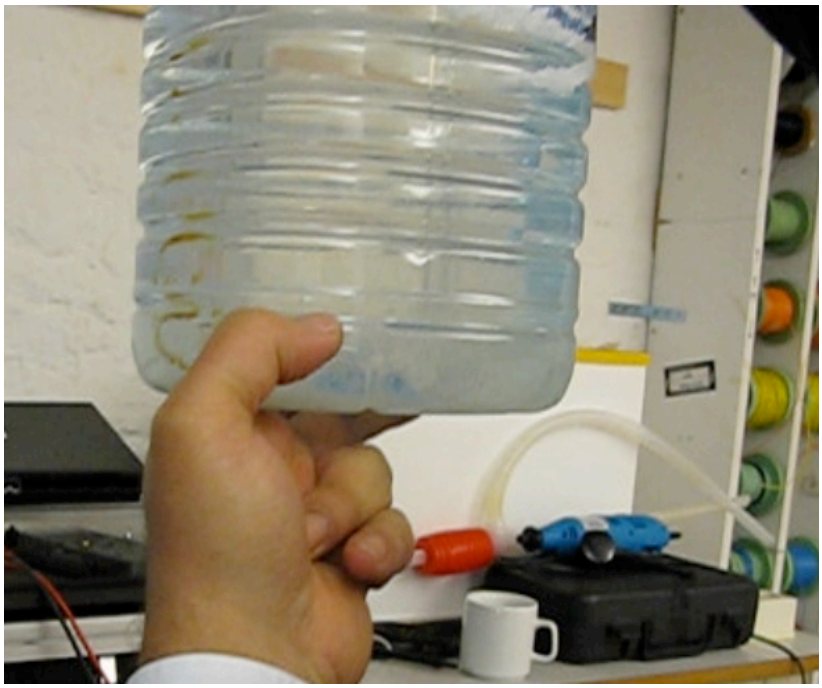

Fig. 30E A misty residue at the bottom of the bottle.

The principle and the technology used for the extraction of CO2 and its containment as a nano matter can be used for making and allowing the production and development of vacuum systems or singular atomic weight extraction systems, which can attain high purity vacuum condition needed

for space technologies of the future or in room laboratories for extracting certain molecules or germs.

This vacuuming technique can be achieved without use of any suction system or high-vacuumed pressure pumps as is the norm in today's technologies for production of interstellar space level conditions that are hard to achieve. These systems do not even needs to be adjacent to the system or near the space where the extraction is needed to take place.

In the universe, this singular Magravs strength principle is the exact method used by certain planets or stars and solar systems in managing to extract only certain materials from their solar or galaxy environment respectively. An example of mainly mono Magravs system is few elements material content, being the like Saturn with mainly helium content matter.

In fact in this system we have shown, a micro universal selective gravitational, which in this scale we only absorb CO2 gases from the environment. Where the operation of these systems can be changed and modified to extract any material from any environment without the use of suction or chemical process and so on.

The methane CH4 absorption

During the process of running the system for extraction of CO2 and production of useful current, due to specific configuration setting of the system, specific section of system starts the absorption of methane gas from the environment.

At this point, the water content of these sections of the power system starts to become blue greenish or violet blue in colour, similar to reported colours of the methane in solid state.

Further to confirm the nature of this new material, the same tests as for the CO2 gas extraction was undertaken and results obtained were as follows.

Through infrared spectroscopy test, it is has become clear that this solution has the ability to facilitate the CH4 capture and the release of the residuals of CH4 as solid in the in the dilution of the liquid through the same principles as described above for CO2 gas.

This effect of separation of CH4 as solution shown in Fig. 31 A and B as blue-greenish water and the same colour sediments in the tube.

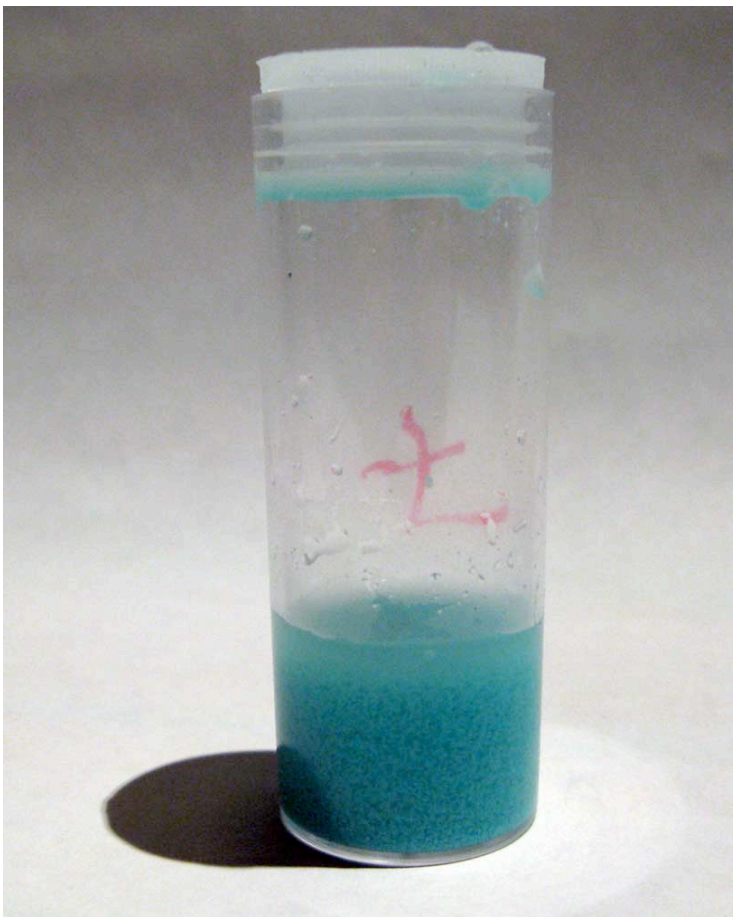

Fig. 31A. Solution of nano Methane (from two different angles)

Fig. 31B. Solution of nano Methane

The solid dry residual nano CH4 powder is shown in Fig. 32.

Fig.: 32. Solid nano CH4 (gans of Methane)

The process of creation of current and the observation of appearance of residual of solid matter indicates two clear processes:

Firstly, the system starts to absorb methane gas from the environment through the same principle as described through mainly Magravs process as for gas of carbon dioxide CO2.

With the difference that in this case different and specific conditions Magravs strength level by the layers of matters' of electrodes are generated, that this new Magravs strength level facilitates the extraction or absorption of the new material by the system and within and through the system.

As the gravitational and Magnetic fields needed for extraction of the CH4 Magravs are slightly different than the Magravs fields for CO2, hence different combination of Magravs is needed to extract the CH4 from the environment.

Hence, in being able to collect and further test the new material from the solution to confirm the extraction of CH4 from its environment, this proves that, the system has the ability according to its pre-set conditions, to create different Magravs strength within the layers of the electrodes, that can absorb or gravitated different materials to the system such as CO2 or CH4, through operation of the same system concurrently.

Secondly, another process can take place within the system, where the CO2 absorbed in the system goes through process of interaction with water and initiates the production of CH4 and release of molecules of oxygen.

To achieve the production of methane gas through this process, one molecule of CO2 and two molecules of water H2O are required, that by using the energy absorbed by the material within the system leads to production of CH3 radical and then CH4 as molecule.

Where, this process is not a chemically binding rather is Hydrogen plasma gravitated and it is sustained through magnetic field strength within the layers of coating or matters and energies within the system facilitate such a process.

In conventional chemistry, it is assumed at least energies equivalent to eight photons are needed to achieve such a conversion from CO2 to CH4.

Through this method of using our new system, the material of the systems acts as catalyst and

magnetic field provider, that such energy (eight photons) are not required, but in fact gravitational and magnetic fields of the plasma of the oxygen and hydrogen of the water become the magnetic field binder for this chain of events.

This being the reason why in similar cases and in theoretical chemistry one needs energy to trigger such conversion, where as through our system the hydrogen and it sister radicals in presence of the free magnetic oxygen, the solution becomes the magnetic bridge, allowing the system to release energy in larger quantities than eight photons, rather than in parallel chemical process in needing energy for the same process to take place in these systems.

In this second path of production of CH4, one needs catalytic effect of the material used in the set-up of the system. In the nature, this catalytic effect needs eight photons of energy for it to take place, which this is usually provided through sunrays.

In the case of our system the conversion of CO2 to production of CH4 and O2 takes place through the layers structural materials and the localised gravitational fields which they generate. As these materials have the ability to absorb infrareds rays too as well as sunrays in the environment and hence these new materials can facilitate the production of the methane and oxygen gases and release of energy twenty-four hours a day.

Thus in fact with the development of this new system, we have clearly shown that for process of photosynthesis, one needs the Magravs strength in the infrared spectrum. Through this process we have clearly shown why plant do their CO2 to CH4 and O2 conversation mainly during the night time, where the infrared radiation from the planet is high, as the sun magnetic field can not suppress their emission upwards from the earth surface. Where, it is known fact that the earth is the best suppler of infrared rays.

Further on, to show the correctness of our technology and that we do not require energy to extract CH4, where in fact we produce energy as power supplier through our technology, the engineers at the lab proposed to connected our system to an electric fan, to see if the poser produce can run mechanical devices like this on a long term. As can be see in Fig. 33. Where we ran the fan for over an hour.

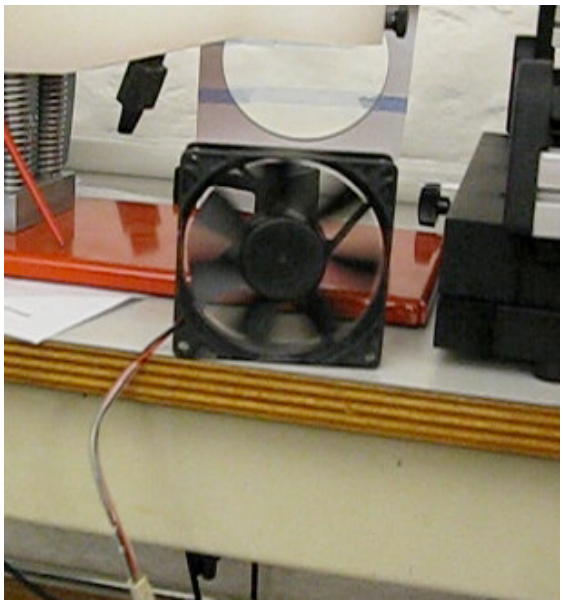

Fig. 33: Turning fan powered by CH4 extraction system.

This test was done in presence of a journalist and engineers from the magazine that we cooperate with and all has been videoed. The test happened in the basement of their premises, in the absence of any sunlight.

Energy release by the process of gravitation and extraction of CH4 creates more energy and stronger current than the same process of absorbing CO2 from the environment. Where, this process leads to creation of strong current rather than stronger voltage output from the system.

The absorption of CO2 from the environment and conversion of it into formic acid and release of energy needed for the photosynthesis and where at the same time the CH3 stage of methane gas as methyl becomes first stage for the production of sugar bases in organic materials has been observed and videoed with operation of one of systems.

Thus for the first time the process of photosynthesis can be shown to take place exactly as happens in a nature like in a tree through these systems can be demonstrated.

These systems not only absorb CO2 from environment, but through their process of conversion, they can lead to production and released of oxygen as molecular structure.

To confirm and be able to show such a process takes place within the process of the production of methane and oxygen and hydrogen from our system, it is essential to show that methane in nano state of matter as we have collected in our system is or has a superconductivity behaviour, as was shown for CO2 nano material.

For the confirmation that the captured CH4 solid material is or has a ***super-conductive*** behaviour, we subjected the solid residual of the blue-greenish matter to XRD testing in the laboratory.

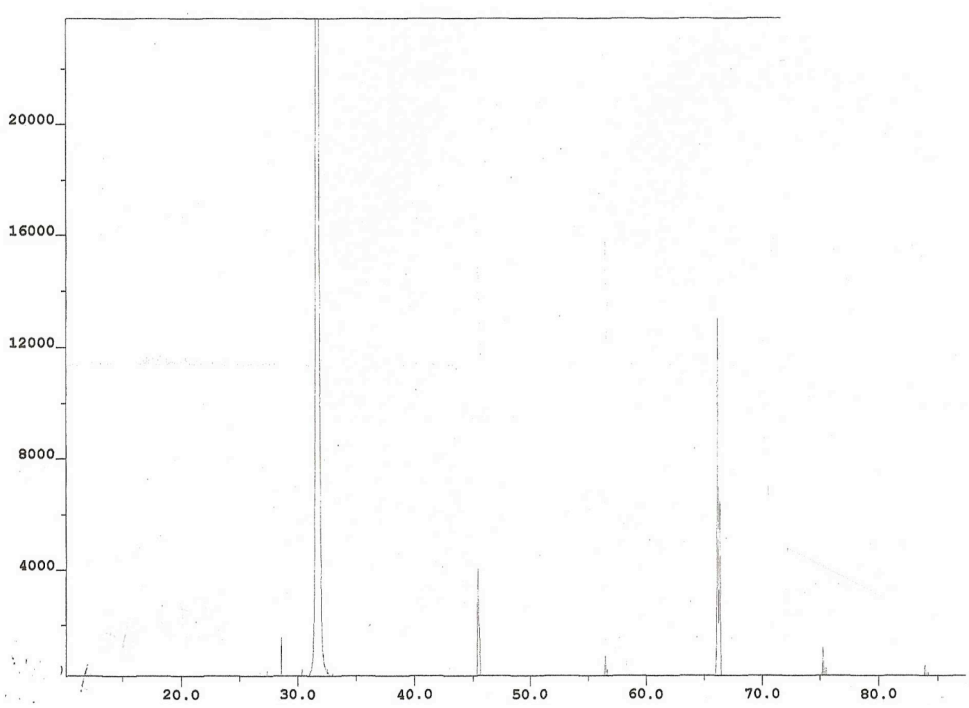

Fig. 34 The XRD of the superconductor characteristic of nano Methane solid

The result of this test has to be noted that CH4 as CO2 in nano state has superconductivity behaviour detected seen in XRD is shown in the graph of Fig. 34.

The nearest material composite match to this material characteristic of our solid matter is beryllium palladium, which matches by 95% as a superconductor behaviour only. The list of near enough matches as superconductor to CH4 in nano state can be seen in the table shown in Fig. 35.

Comment:
Scan Type: 2Theta Scan
Start Angle: 5 deg.
Stop Angle: 90 deg.
Num Points: 4251
Step Size: 0.02 deg.

Name=Beryllium Palladium / Be Pd
FOM: 0.950 Total Matches: 6 Total Lines: 6(11) Card: 65-3196

Name=Beryllium Palladium / Be Pd
FOM: 0.946 Total Matches: 6 Total Lines: 6(11) Card: 18-0225

Name=Sodium Silver Chloride / Na.903 Ag.097 Cl
FOM: 0.942 Total Matches: 6 Total Lines: 6(9) Card: 77-2065

Name=Sodium Chloride; Halite / Na Cl
FOM: 0.936 Total Matches: 7 Total Lines: 7(9) Card: 75-0306

Name=Sodium Chloride; Halite, Syn / Na Cl
FOM: 0.905 Total Matches: 7 Total Lines: 7(17) Card: 05-0628

Name=Sodium Chloride / Na Cl
FOM: 0.866 Total Matches: 7 Total Lines: 7(9) Card: 77-2064

Name=Strontium Nickel Niobium Oxide / Sr (Ni Nb2)0.333 O3
FOM: 0.860 Total Matches: 5 Total Lines: 5(12) Card: 89-3113

Name=Manganese Tellurium Selenide / Mn Se0.8 Te0.2
FOM: 0.837 Total Matches: 7 Total Lines: 7(9) Card: 89-4969

Name=Strontium Niobium Oxide / Sr0.72 Nb O3
FOM: 0.827 Total Matches: 5 Total Lines: 6(12) Card: 80-2497

Name=Barium Strontium Zirconium Titanium Oxide / (Ba0.25 Sr0.749) (Zr0.283 Ti0.715) O3
FOM: 0.785 Total Matches: 5 Total Lines: 6(12) Card: 89-8212

Fig. 35 The nearest data of matching materials available that match the green blue powder superconductivity characteristic to the extracted nano methane solid from the solution.

The comparison of superconductivity characteristics of the CO2 and of the CH4 nano materials obtained by XRD and matching and similarity in behaviour of carbon dioxide CO2 and methane CH4 as super-conductive nano materials are shown in Fig. 36.

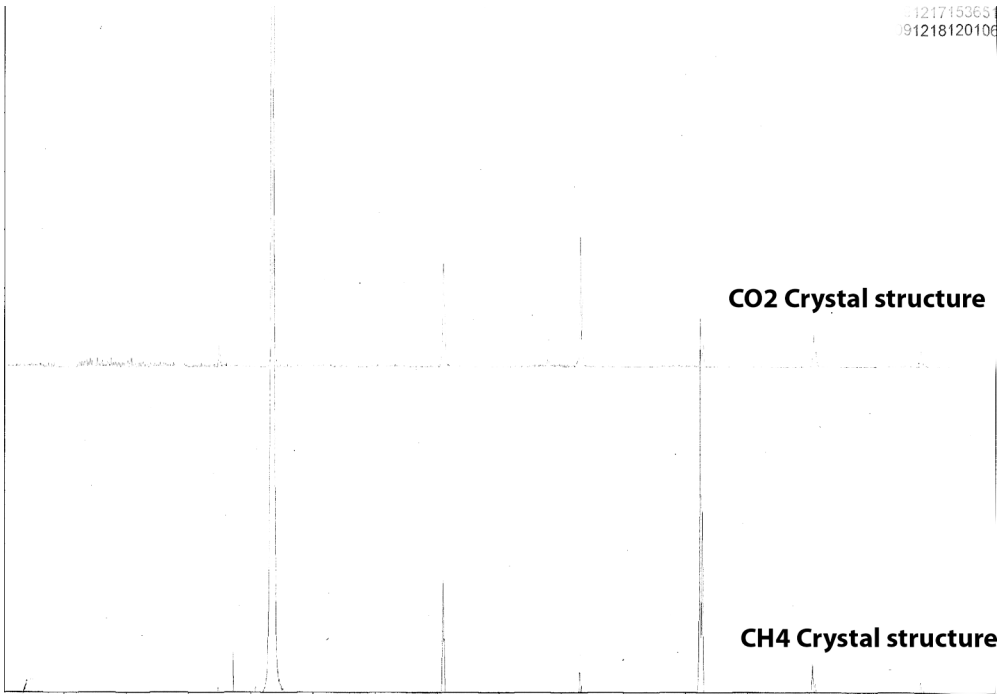

Fig. 36 The XRD superconductivity characteristic comparison of nano CO2 and nano CH4.

The common behaviour between the CH4 and CO2 nano matters have been observed and shown by superimposing their infrared spectroscopy graphs as shown in Fig. 37.

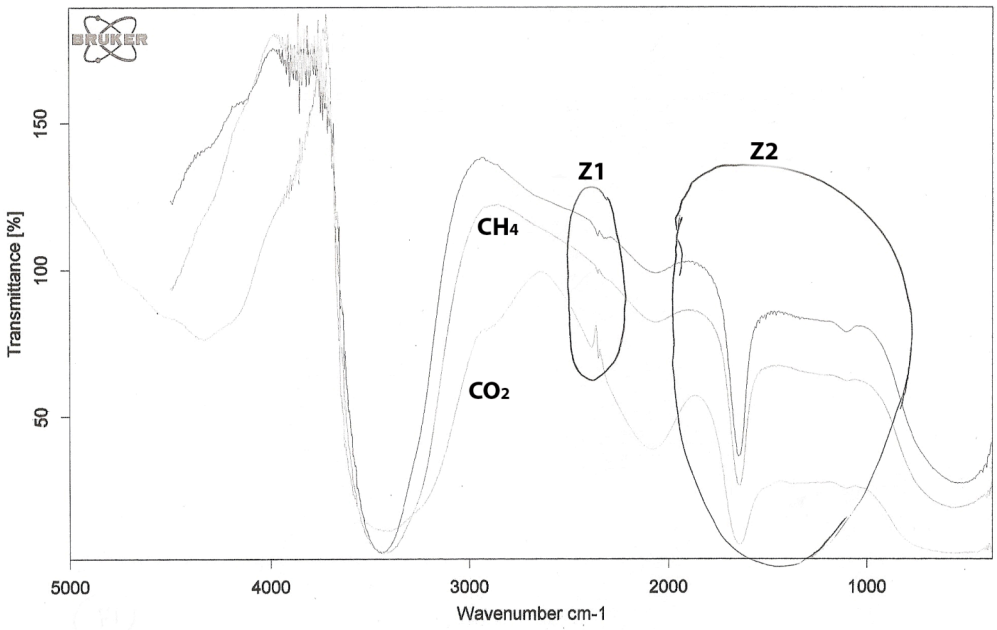

Fig. 37 The IR spectroscopy comparison between nano CO2 and nano CH4 in solution

In this graph the CO2 in zone 1, shows extraction of CO2 gas from its environment and then forms formic acid as seen in zone Z2. Similarly methane (Me) releases increase the availability of CO2 in the environment of the chamber of the spectrum machine as seen in zone Z1, and then the same releases' of formic acid as the same as CO2 as can be seen in the zone Z2 through this process.

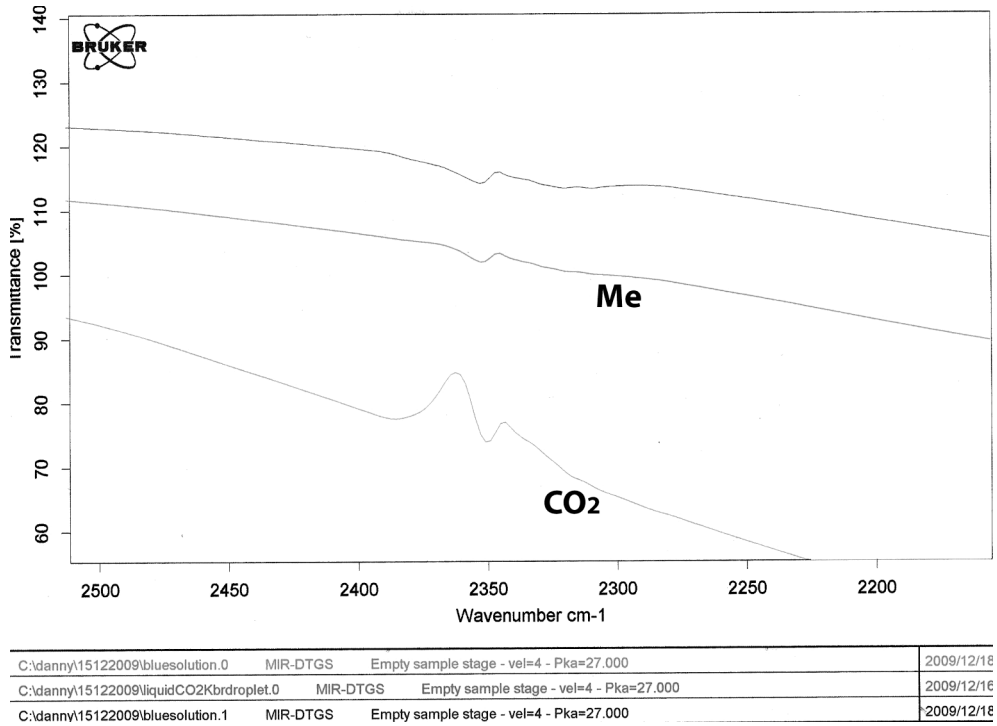

Fig. 38 the enlarged section of the CO2 and CH4 in infrared from Fig. 37.

This explaining two factors, one that the solution is processing both CO2 and CH4 extraction simultaneously and or it is has the ability to produce CH4 through CO2 absorption and the water chain interaction as was discussed before.

Enlarged section of the zone Z1 in Fig. 37 are shown in Fig. 38.

Superimposed graphs of these nano materials of the same region in graph 37 are shown in Fig. 39.

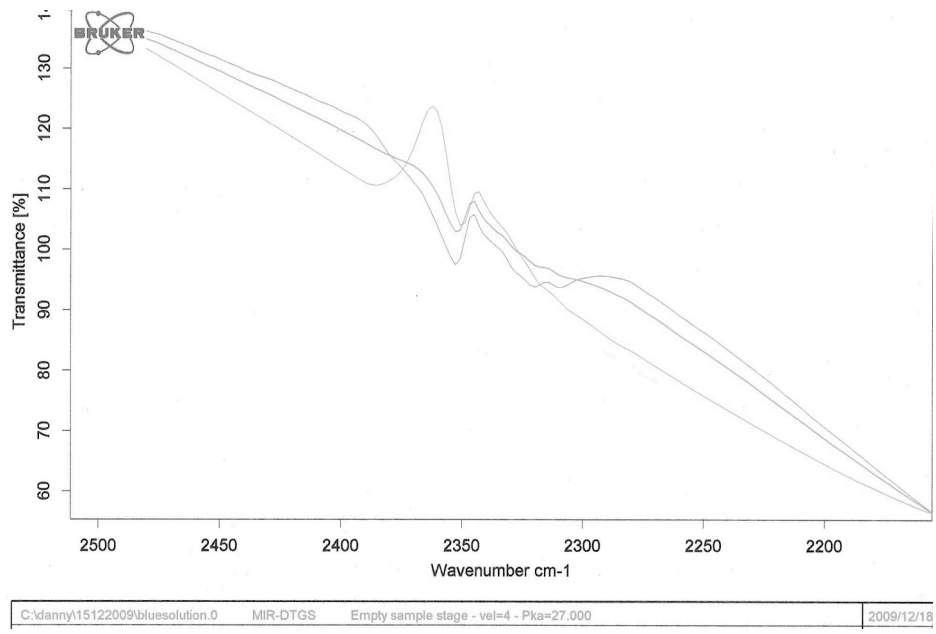

Fig. 39 The superimposed and enlarged section of carbon sector of the Fig. 37.

Observations and notes.

In the development discussed above, one has shown how by absorbing CO2 from the environment, this being on earth or as the content of craft, this gas can be used to generate energy and oxygen to sustain life without the need for additions reserves of these gases using the man himself as the supplier of the main ingredient matter, the CO2.

What this new technology offers for the planet earth is a survival line that in the present environment of the global warming with the CO2 generated by burning of fossil fuels and production of methane gases produced by extensive cattle farming, through the utilisation of this new technology for the first time ***these gases can be extracted from the atmosphere and simultaneously be converted to solid matters or solution, this process can be used to lead to, and cause the release of energy, and through the use of specially developed composite materials, this leading to separation and generation of oxygen.***

Where some of methane and carbon dioxide in the form of nano materials of the same gases can, all be suspended in the solution or dried as solid and reburied or returned to earth as topsoil.
Where this new technology shows for the first time and make it possible to achieve creation and holding of carbon dioxide or methane gases in solid state at room temperatures and pressures. Through evaporation of water from solutions, solid of carbon dioxide CO2 and methane CH4 gases in the form of powder nano materials of these gases are produced.

This new system and technology completes the circle of life for maintenance and existence in the future while it can clean up the mess man has created by the use of fossil fuels on earth in the past centuries.

Where these new systems will behave as trees on earth and for the passengers of space systems of the future, by simple converting CO2 into oxygen, and where the man himself becomes the supplier of CO2 for the system to keep the cycles functioning.

Through the development of the technology that has been disclosed in this paper the initial steps to conclude this process for application in our space technology is considered to be completed. In the space technology of the future, one has to be able to use all matters available within a spacecraft to attain continues and sustainable existence of man in deep space travels.

This technology of direct extraction of CO2 and CH4 from the environment can happen in reactors of small and large dimensions. Thus the technology can be used to tackle the Climate Change problem. For example large installations can be connected to exhaust systems of heavy industry, and small extraction devices can be made for households or be built in cars. None of these installations will need powering, as they will deliver themselves electricity. On the other hand we don't have a sequestering problem since the CO2 and CH4 are already in a solid state, which make storage easy. However our liquid and solid CO2 combined with limonene oxide can also be used to make new type of polymers and plastics.

We have developed and attained a fully integrated system that is able to sustainable life in space.

In letting the process of CO2 absorption and production of energy to continue, some cells of the system start the process of production of methyl CH3. This is a significant process as this shows organic process as CO2 is in progress within the system.

Further, this process in conjunction with its water content, and nitrogen from the environment, can itself lead to production of natural sugars, starch and proteins, using our simple static gravitational

system.

This simple system can be used not only to clean up the environment from CO2, but at the same time the same CO2 can be used in conjunction with specific matters of the system, to release energy, oxygen. Further at the same time producing CH3 and methane and formic acid and by use of nitrogen this leading to production of protein(s) that can be the food supply for the humans' passengers of spacecraft's of the future while they inhale oxygen and exhale CO2.

Thus through this new technology mans' existence on board of the spacecraft's of the future, the man becomes the container and supplier of carbon dioxide and hence the provider of oxygen for his own existence.
Thus, man himself becomes the conversion system to maintain his own survival in deep space or on earth during shortages of food or natural disasters.

The property of this system has allowed us to submit a full patent for the first full day and night energy panels.

New state of matter

When considering this new technology and understanding the potential of its physical ability to convert gases into solid state of the same, where up to present knowledge the gas from being able to take the shape of its container, for the same atom or molecule becoming the container of itself as a nano matter, then this new state of matter or the solid state of the gas at ambient conditions like the room temperature and pressure, ***itself becomes the nano matter of the gas*** and this state of matter has never been known in the world of science and has to be considered to be a new state of Matter or the fifth state of matter.

Where, through our development of matters in our technology we consider solid, liquid, gas, plasma, and dark matter as the first five known states of matters up to this point in our technological development.

This being due to the fact that this new nano matter of the gas in solid state, it does not behave and looks as any of its old states of matters or any other state of matter as we have known and what we have seen before from these matters.

The infrared and XRD testing of these carbon dioxide CO2 and Methane CH4 gases in nano state showing that this matters behaves like a ***superconductor material***, where nor hydrogen or hydrogen and the carbon in there matters are considered as super-conductive materials in the present world of science known knowledge in their gas state of their molecules.

To our present knowledge superconductors at these levels are by principle of matter in diamond structure or sp3 state of matter. Where, their physical gas equivalent of these matters known to science and are classed as odours.

Thus as in this new state of matter molecule of GAs which becomes Nano of itself and become and appears as Solid state of matter as we have seen from our testes and shown as solid of the matter in this paper, this new state of matter needs a new name, for it to show the source of the matter, that is from GAs to Nano of Solid and to be called **GANS** for short.

This new name in fact clearly not only indicating the source of the matter, which is the gas, but at

the same time it clearly explains what to be expected and describes the characteristic of these matters too.

Where these new characteristics being like superconductivity, lightness, singularity of grains and so on, of the same molecule as it become nano of itself and become solid of itself but having full molecular structure of a gas, but self gravitationally and magnetically closed and singular, but it still can be in a gas state of itself, but as it becomes singular atom or molecule of itself it behaves as solid matters do.

Thus from this point on, we do not call these solids of nano of gas or nano CO2, but **GANS** of CO2.

First ever pictures of these matters in Gans or solid state are shown in Fig. 30(A-D) for CO2 solution and dry state.

Pictures in Fig. 31A and 32B shows the first ever solutions of methane and dry or gans of CH4 respectively.

Through experiments and deliberate mixing of different gans in one solution, it is clear that these materials do not mix or do not chemical interact with each other. Where each gans of each matter stays separated from the other matters within the solution, and stays the original gans. Fig. 40 shows a mixture of three gans in a solution, where they stay without any chemical binding, where for example the green residue settles can be seen at bottom of the tube.

Similarly for the first time in the world of science, through understanding of this technology, we can capture odours as solid? But the question is that, would they smell the same as their sp3 counterpart as gases? This is the question to be answered and explored in the times to come.

Parallel with development and extraction of gans, these systems produce energy, which are not due to burning of fuel or chemical conversion like in a battery. The energy produced during the process of gans from any system, which this energy can be used for any purpose, this being creation of gravitational field force to create static sources for creation of Magravs, power to run a motor or light-up a lamp, this new source of energy needs a clear and new name classification.

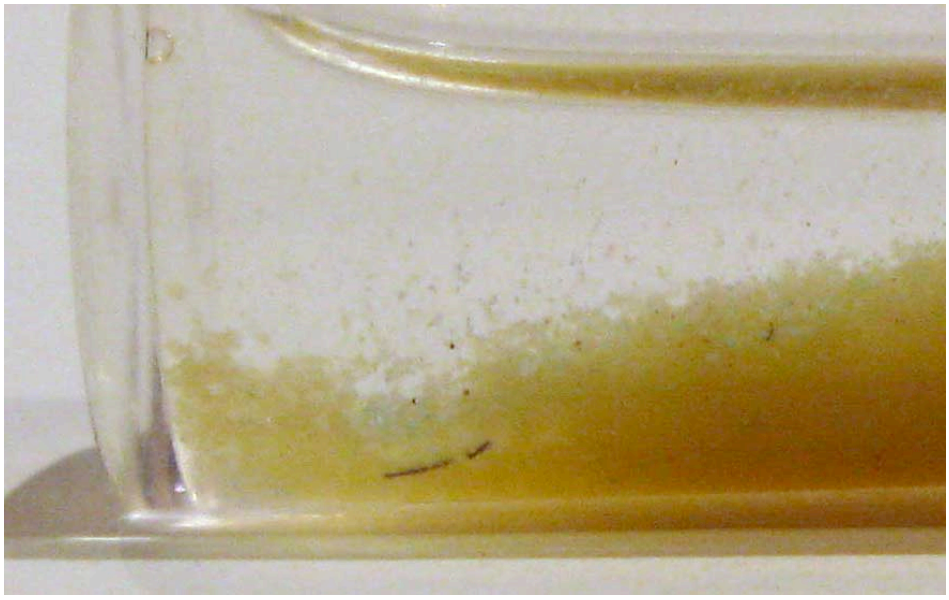

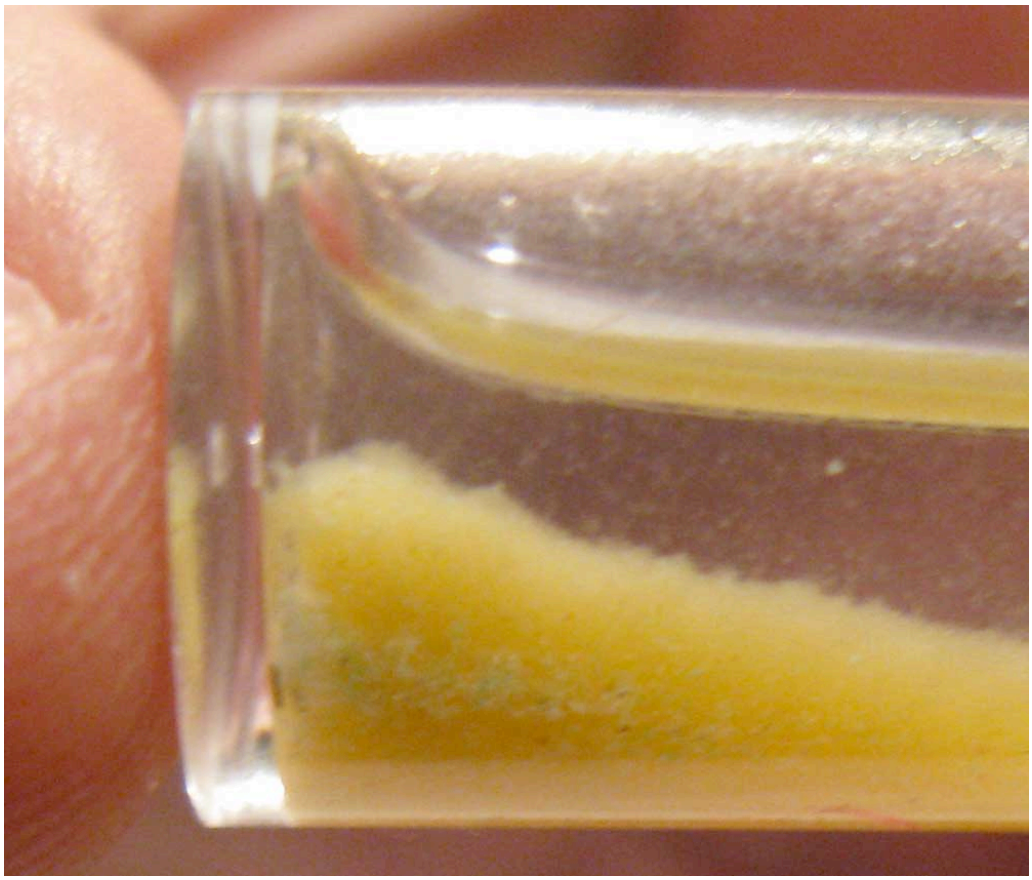

Fig. 40 Different Gans do not mix or chemically bind, and stay separate in the solution.

We call this new method of production of clean energy, this being in magnetic field force strength or electric energy, the **GAs Nano Solid Energy** or GANSE for short or Gas Energy Solid for short **GES**.

Implication and applications of this new technology

In the development of the technology discussed above, we have shown how by absorbing CO2 from the environment, this being on earth or as the content of craft, this gas can be used to generate energy and oxygen to sustain life without the need for additions reserves of these gases using the man himself as the supplier of the main ingredient matter, the CO2.

What this new technology offers for the planet earth is a survival line that in the present environment of the global warming, with the CO2 generated by burning of fossil fuels and production of methane gases produced by extensive cattle farming, through the utilisation of this new technology for the first time these gases can be extracted from the atmosphere and simultaneously be converted to solid matters or solution and return of this matter as solid into the ground,

The development of this new technology shows and makes it possible, for the first time in world of science to achieve absorption and containment of carbon dioxide or methane gases in solid state at room temperatures and pressures.

Through evaporation of water from solutions, solid of carbon dioxide CO2 and methane CH4 gases in the form of powders nano materials of these gases can be produced, where in later stages in different applications like manufacturing processes, these materials can be added to effect the physical or the property of different matters or produce new types of matters with these new materials.

These new matters of gans can be used for example as new biological nano filters, where their purity or the molecular size of gans can determine the matters to be filters, this being cancer cells, germs or other matters.

Through the use of this new technology the circle of life for maintaining a clean environment in the future, while it can clean up the mess man has created by the use of fossil fuels on earth in the past centuries.

Where these new systems will behave as trees on earth and for the passengers of space systems of the future, these systems by simple converting CO2 into oxygen, guaranteeing ever supply of life essential need, where the man himself becomes the supplier of CO2 for the system to keep the cycle functioning and guaranty his own survival.

In our tests, in letting the process of CO2 absorption and production of energy to continue, some cells of the system start the process of production of methyl. This is a significant process as this shows organic process in progress within the system.

Further, this process in conjunction with its water content, and nitrogen from the environment, can itself be used to lead to production of natural sugars, starch and proteins, using our simple static gravitational system.

This simple system can be used not only to clean up the environment from CO2, but at the same time the same CO2 can be used in conjunction with specific matters of the system, to release energy and oxygen. Further at the same time producing CH3 and methane and formic acid and by use of nitrogen this leading to production of protein(s), that can be the food supply for the humans' passengers of spacecraft's of the future while they inhale oxygen and exhale CO2.

Through the development of this technology that has been disclosed in this paper, the final steps to conclude the process for application of these systems in our space technology is considered to be completed.

Where, these CO2 extraction systems, by their nature of operation as described above, they can become the natural backup energy systems and vacuum systems for spacecrafts of the future.

With the completion of this sector of our technology, we have developed and attained a fully integrated system that is able to sustainable life in space. Where we have shown through other sectors of technology, systems for motion with gravitational positioning through our nano materials we have shown how to produce matters in the universe and materials to manufacture for what man needs for food and habitation, then we have shown how to develop the system to feed and produces systems to cure ailments through our medical application section, and in the energy production system we have shown how to generate energy through simple natural process, and finally now with this technology we have shown how to create a self sufficient environment to sustain life with extraction of CO2 and use of the same to create oxygen for man to survive in space.

Thus through this new technology mans' existence on board of the spacecrafts of the future, where

the man himself becomes the container and supplier of carbon dioxide and hence the provider of oxygen for his own existence is complete.

Thus, man himself becomes the conversion system to maintain his own survival in deep space or on earth during shortages of food or natural disasters.

The property of this system has allowed us to submit a full patent for the first full day and night energy panels and all other points which has raised as new science in this paper.

Conclusion

Through new and simple methods which has been developed and explained and production of new materials with some new properties which has been confirmed, we have managed to create and establish clearly how gases can be made to be contained, extract and converted into solid state of matter, without the use of any chemical reaction, temperature or pressure, and simply through creation of condition of mini and localised Magnetic and gravitational fields within the system, as is done in the universe.

Where, these fields are hidden within the static layers of different matters within the system, as they have been chosen as the electrodes within the structure of these systems.

Where clearly in picture Fig. 40, one can see that these matters are normal solid and can be handled like any other solid matter.

Clearly from the infrared spectroscopy and XRD graphs of these matters and solution it is clear that the matter absorbed or extracted from the environment, as gans are so pure and in nano state that their spectroscopy recorded data is as close as to perfect theoretical for CO2 gas. This purity of the matter, showing itself in such clear and single perfect lines of graphs shown from the test of the actual sample of the solutions of these ganses.

At the same time, it is confirmed that nano gases do behave as their metallic and semi metallic matters in the universe and they become or attain the behaviour of conductors and superconductors and super resistors. Where this finding of the behaviour of these gans solves and answers a number of unanswered questions in the world of physics, chemistry and biological binding, movement and motion of planets, stars and matters in cosmos.

This paper in its simplicity of its presentation and the knowledge it has put forward, it will in due course bring about fundamental new ways that a number of problems in the scientific world concerning gases and solids are to be considered.

For example we can think of ways to solve the mystery of the ***a-biogenesis*** (the study of how life on Earth could have arisen from inanimate matter.) or how proteins could have been created in Space by local super-conductive conditions.

With the knowledge gained with the operation of these simple power cells, new systems in production of vacuum, creation of matter, extraction of matters and conversion of matters can be developed, and in a way this paper opens a new an unbelievable horizon to the man for science and space technology of tomorrow.

We have shown and clearly proven not only one dose not need all sorts of machines to create or

extract matters from the environment but simply following the laws of universal gravitational and magnetic field forces, one can achieve the same in a much simpler ways, and instead of using energy to achieve production of a matter, one can extract energy from the same system and achieve better results in doing the same process.

Additional pictures

Some pictures of different matter, which have been gravitated to the system, are shown in the picture below.

Up to this point we have managed to attain six different elements in gans-state, which each one has it's own colour as can be seen in sample tubes as they have been extracted from the system during it operation, while producing energy. Some of the materials shown have not been subjected to IR and XRD spectroscopy to confirm the composition of the original gas before they were converted to their gans-state.

Fig. 41. Six different materials in gans-state which have been gravitated by the system up to today (05.01.2010).

Fig. 42. Two different materials in gans-state, which have been gravitated by the system, which we think these, are organic gases in Gans-state. They have different orange colours.

Fig. 43. CO2 in gans-state , which have been gravitated by the system. It contains solid flakes within the solution

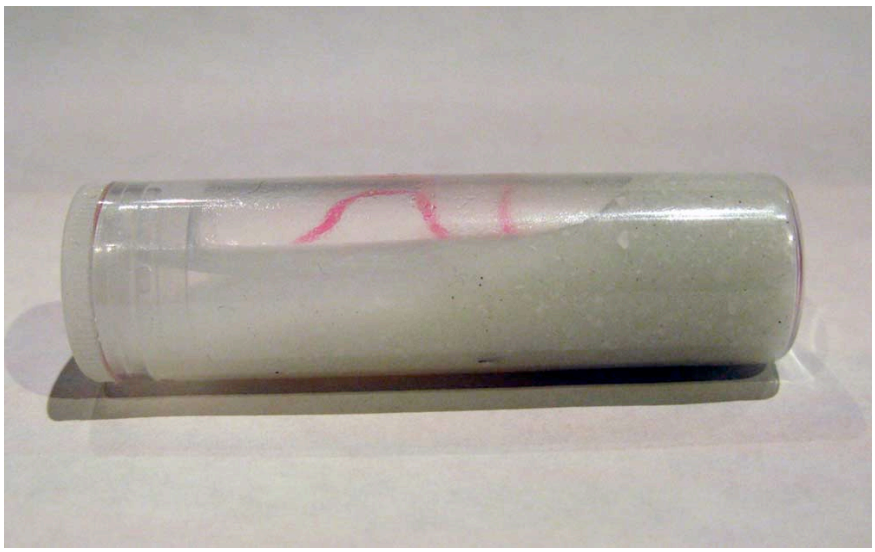

Fig. 44. Different angle of show from the same solution as figure 23. CO2 in gans-state, which have been gravitated by the system. It contains solid flakes within the solution.

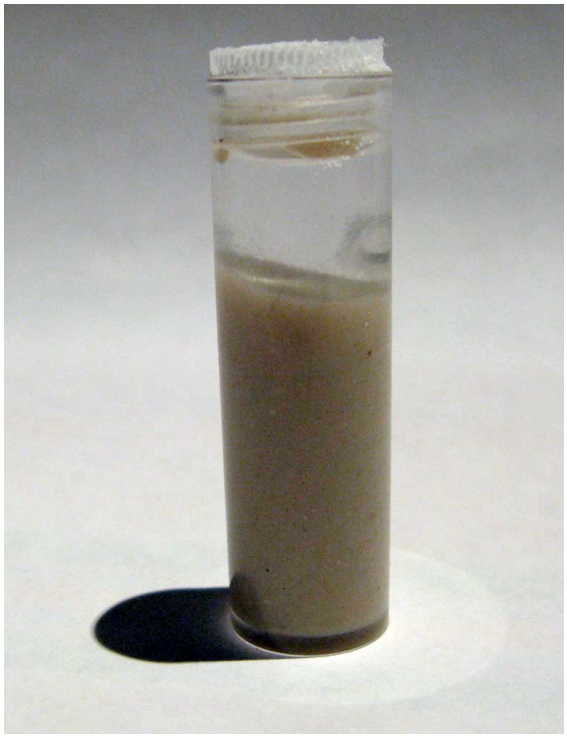

Fig. 45. Unknown composite material in gans-state which have been gravitated by the system.

Chapter 5

The light and its interaction with the Principal star

The Principal Star is what has been commonly called the Black Hole (3) and it is understood that these entities are places, where the principal mafs and matters are create and collected.

The pmf of principal star being covered by dense layers of the transition mafs, this being the reason as why they look to be dark or where there are no lights are transparent in these regions in the specific parts of galaxies in the cosmos (Fig. 46).

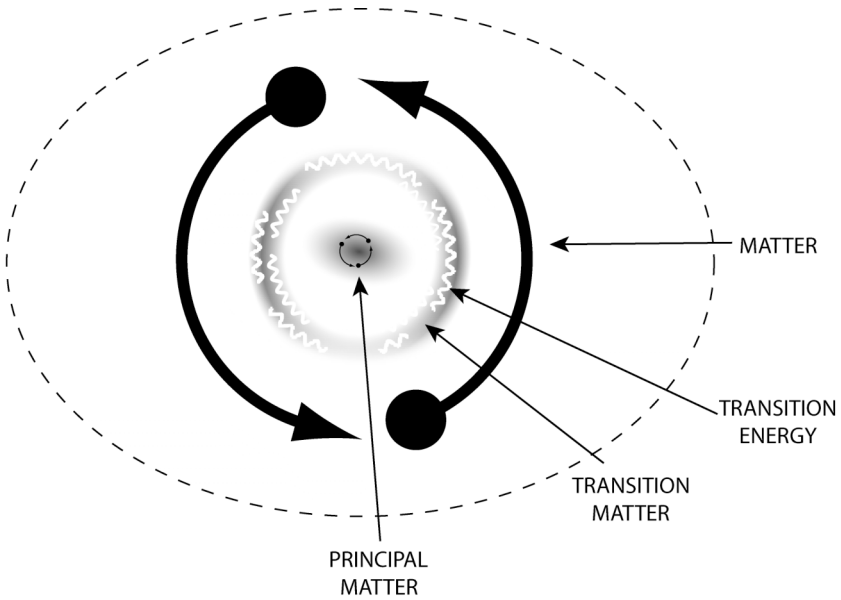

Fig. 46 Structure of the principal star

The light being in possession of the gravitational and Magnetic fields of its own and consequently the light having the Magravs of its own, these fields forces' of the light in matter magnetic field strength environment of the universe take their positions in respect to the Magravs of these principal stars in the centre or any other part of the galaxies.

In these environments in the universe one can observe that as the light rays come close to the principal star the light in majority of cases will not be absorbed by the extensive gravitational fields forces of the principal star, but the light ray finds its way by going around the principal matter star instead of as it being absorbed by this entity. This ability of bending of the light is commonly called the lensing of the light near large objects, and this is the process by which currently scientific world can confirm the existence of the principal star in the universe.

The reason for the bending of the light being due to the fact that as the light possess its own mafs of the principal matter, then the light's principal mafs Magravs take their Magravs positioning in respect to the principal star mafs' and matters' and this positioning of the two Magravs of the principal mafs of the light and the star from the point of an observes from a distance looks as the light bends around these objects or what is called lensing phenomenon of the light around the Principal star occurs (Fig. 47).

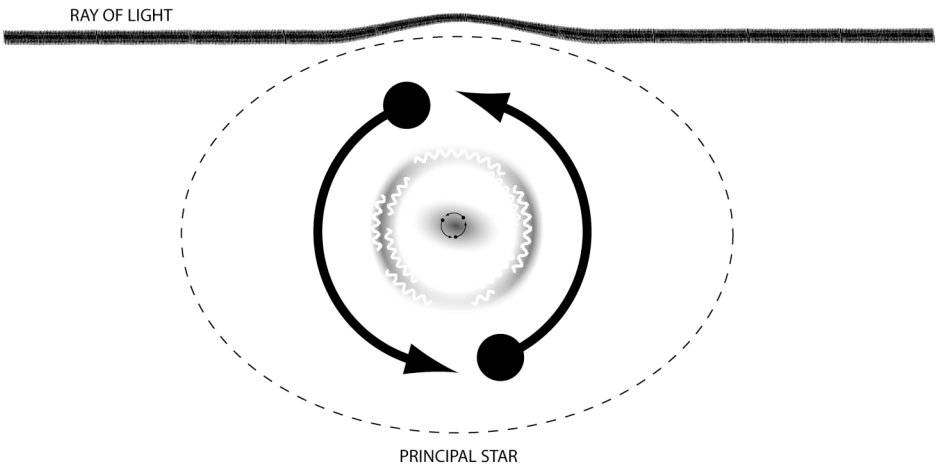

Fig. 47 Bending phenomenon (lensing) of the light around the Principal star due to Magravs positioning

The theory that even the light will not escape the Principal star gravitational field forces once passes the event horizon, this shows the lack of the understanding of the scientists in this respect too, as if the scientists had the tools to observe and could detect the principal mafs magnetic field spectrum, then they could observe that as in matter mafs stars like the Sun of the earth's solar system, these Principal stars will radiate pmfs in the principal mafs strength spectrum and the Principal stars are like bright shining stars in their environment, and as they absorb light in matter's spectrum strength, they at the same time release light in principal mafs and transition mafs pmf strength simultaneously.

In time the scientific world would produce tools that with these tools they will be able to observe the motion and emission of the Principal and transition lights rays from these dark spots in the universe. Then one can observe that light in principal mafs strength are emitted from these stars in the galaxies as light are emitted from the Sun of the solar systems and the disappearance of the light in even horizon is only illusion and not a reality as the pmf of the light mafs get diluted in the stronger pmf fields of principal and transition mafs rays.

The concept that how principal stars are created, how they operate and how they absorb and emits some light has been disclosed in detail in the paper written in 2002 and published in 2006 titled "The creation of Back Hole".

Principal stars if they absorb mafs and of the matters, stars and visible light as it appears to human eyes' vision spectrum, then they can and they do at the same time emit light in the mafs of the principal matters spectrum into the environment of their galaxies too, as this was not the case then the conservation of principal mafs and matters in the cosmos will not hold and this is against all the laws of physics.

In reality the dynamism of the mafs of the principal matters in these stars and the light they emit is the cause and deliverer of pmf needed for the creation of matters and stars in the galaxies.

In a simple way, as the light from the Sun feeds its own solar system mafs of the matters and matters the like of its planets, the same is done by the Principal star through its light emission in the Principal mafs pmf strength feeds all mafs and matters in its captured Magravs sphere or so called its galaxy.

At the same time the Magravs of the Principal star dictates the position and attraction of other

matters, stars and galaxies' in respect to itself as the total mass of the matter mafs and transition mafs of the matters in galaxies are about less than five present of the total mass of the galaxies (3).

Thus the positioning and directional motion of the galaxies in the universe, the same as in the solar systems is dictated by the mass of the principal mafs and matters of the principal star of the galaxy and no other factor (3). Therefore the mass of the galaxy is the measure of the interaction of the Magnetic and gravitational fields' forces that the principal mafs contents of the principal matter can produce and maintain.

Once these principal stars are formed in the universe then the Principal stars and the lights which are releases form them become the means of the supplier of pmfs and nourishment of to the environment of these galaxies" (3).

The concept of the structure of the principal's star lights as the source of pmf into its heliosphere zone is applicable the same but in much smaller quantity of mafs of in the operation of plasma of an electron, proton and stars too.

In the modern science the source of the creation of matters in the plasma of electron and proton are mysterious entity, which lead to creation of quarks, bosons and other names content of the plasma, in fact for example so called the bosons are the pmf of lights released by the principal mafs of the plasma, which as this dynamic light reaches a given point and given pmf strength in the plasma of the proton or electron due to reduction in its pmfs strength in motion in the plasma, this leads to appearance of matter mafs and matter of different pmfs strength in all regions of these plasmas.

The mysterious forces which the scientific world has been observing in the plasma of the proton, these are released by the principal star of the plasma itself as lights in the principal mafs strength unwinds and as these lights reduce in strength to different mafs and matters pmf levels strength. Then these slowed down pmfs lead to appearance of different weaker matter pmf strength in the content of the plasma, where and when two matching field's strength and matters strength can interact that they can create a given gravitational fields forces within the plasma then these points of gravitational field appears as bosons and other named entities within the plasma. At the same time these entities create their own Magravs which the operation of fields forces of these Magravs appear as mysterious filed forces within the plasma of the proton or electron.

Theory of Higgs and Higgs boson concept: In fact if these scientists would have understood that the interaction of at least two magnetic fields (bosons) leads to creation of gravity (attraction) and Magnetic fields (repulsion), which further interaction of these two fields of Gravity and Magnetic fields leads to creation of the mass of the matter (Higgs), then Higgs would have understood that interaction of magnetic fields not only in plasma but in any level of magnitude in the universe leads to creation of matter which this matter always possess its own mass and magnetosphere, or in other word when two magnetic fields interact they lead to creation of mass which is the maximum strength of the gravitational strength less the Magnetic fields strength created by the interaction of these two secondary fields (1). Thus Higgs theory is correct and in reality one does not need to smash an atom in accelerators to observe and prove his theory, but it would be easier to the same behaviour of production of matter ***if two rays of light are fused*** that **they lead to creation of matter** and thus the Higgs theory would be proven to be correct in a simpler way.

This is process of the production of bosons, Higgs and other entities in the plasma of proton is the replication of the same process as the operation of light rays in the solar system changes to matter in different pmf strength regions in the heliosphere of the star, where in the case of plasma of proton ***the same process takes place in micro/nano level*** of the mass of the principal star and principal mafs and matter in size.

Stars in the centre of the galaxies in motion near the Principal stars even though they release rays of light but not all these rays get absorbed into the principal star or the stars themselves and in reality the Principal stars do not absorb all lights from the matter stars (the sun is a matter star) into themselves as the plasmas of the lights in the matter mafs pmf strength contain their own principal mafs and matter and these principal mafs of the light create their own pmf Magravs, which this Margrave allows the light to take its position in respect to the Principal star which is so close to, and this Magravs positioning of the light allows the light from the star in the matter strength to move away from the principal star as is observed by the astronomers. In fact the speeds and the distance of the star from the principal star is dictated by their own principal's mafs content and the Magravs strength.

The matter stars in their inner sanctum contain and hold on to large quantities of the principal mafs and matters (1), This meaning that even the Sun in its process of feeding light into its heliosphere, at the same time in this process the Sun *releases a large quantity of the magnetic fields of the principal mafs and matters as the* ***principal light rays strength of magnetic spectrum*** in this environment.

It has to be said that in galaxies, the high speed of the rotation of matter stars near principal stars has to be extremely high, this being due to the fact that as the matter star itself contains principal mafs and matters and at the same time these mafs of the principal matters interact within the structure of matter star that they create their own gravitational and Magnetic fields that the matter star takes it principal mafs Magravs strength positioning in respect to the mafs of the principal star matters and mafs Magravs. Thus the only way that matter star can hold on to its pmf structure is to attain a high speed as its mafs of the principal matters of the matter star content have to find a constant continues renewing its new position in respect to the principal stars matter's and mafs' content. These high speeds of the stars near the principal star has been puzzling the cosmologist, but if they look close enough and as they could understand the principal of the rotation of an electron in respect to the proton of an atom (1), then the speed of the matter's star with composite matter and mafs content near the principal star shows and is flowing the same path and the same principle of motion as an electron does in respect to the proton in the nucleus of the atom as electron moves fast around its nucleus to maintain its position and hold on to its content matter (1). Thus now may be the high speed of the matter stars near principal stars can be explains and the single directional orbit of the star matter in these regions confirms content of the Principal star as to be mainly as of the Principal mafs and matters, that this singular mafs and matters contents' of the principal star allowing the more circular motion or elliptical motion of matter stars with their large mass near the Principal stars.

This is the same process as to replacing the proton with the principal star and the electron with the matter star, with parallel high speed dynamic motion of the matter star with controlled Magravs positioning around it nucleus. The reason that the motions of the matter star around the principal star is not as unpredictable as of motion of electron around proton (1); this is primarily due to mono content matters and mafs of the principal star. In fact in these cases the light observed by the cosmologists created by the matter star is mainly due to the interaction of Magravs of the two matter and principal stars, and at this point the Magravs of the matter star has to find rapidly its position in respect to the Magravs of the principal star, and this is how the matter star become to attain speeds' in the region of the speed of light in matter pmf strength. Thus the majority of the visible light of the matter star in close proximity of the principal star is not of the star itself but it's due to the interaction of the Magravs of the two stars. Now one can see another marvel of the universe, where matter mafs in creating light which itself is the light of itself.

This concept of mass moving at speed of light in matter pmf strength environment due to

interaction of principal mafs strength will have such a profound effect on the man's scientific progress and in man being able to travel the depth of universe and this will be the point of and the tool of detection of future space crafts in motion at speeds beyond the speed of light in matter mafs strength and above in the cosmos, once the concept of the light rays in the pmf strength of principal mafs strength are understood fully.

Chapter 6

The light and its planetary interaction

The interaction of different lights of different matters (principal, transition and matter) can be utilized to create the appropriate magnetic fields and currents and gravitational fields' forces as it is needed for any purpose, then this concept of interacting lights is the way that food and energies from the right light mafs levels can and will be produced in deep space travels of the future, as one can take the right components and amounts of the mafs in matter field strength needed of any required levels of mafs as/and for nourishment of the mans' physical body, without man actually eating tangible food.

This conversion and absorption of light rays is in fact what plants and animals do in the earth environment as they absorb specific plasmatic magnetic field strength of light spectrum and due to their atomic and molecular Magravs field's strength they create measured vacuumed condition within their structure to and for transformation of a given pmfs' strength of the light to be converted this to gans of that mafs in the structure of the plants or animals. Which, these ganses have Magravs equal to Magravs strength of vitamins or minerals levels as the planet produces or the animal needs for existence in a given environment. The process of production of minerals and vitamins in understanding how light is and can be converted to gans in earth atmospheric condition will allow the production of the same matters and vitamins by use of the light matters' structure in conjunction with the using a simple dilution Magravs positioning reactor anywhere in the universe (1).

For example man by eating a given plant, he absorbs that spectrum of the fields transmitted and absorbed from the spectrum of the light mafs of the matters fields for specific use in specific protein in man's body, and now man has the knowledge to produce the same proteins and minerals from the light rays without the need for plants or animals as an intermediary conversion toll for this process.

In earth atmospheric Magravs condition herbs absorb pmf of the higher strength of the same light as normal plants do and the meat can absorb the complex strength magnetic fields of the light. The structure of herbs pmfs attraction and storage is more dependent on the pmf emitted by the light spectrum from the earth fields as the fruits store most of the light spectrum which are entered into the atmosphere from above and that is why each entity has different mafs strength storage and conversion capacity and capability. Where, the same light from space in different distance and interaction with the magnetic fields strength of the light of the earth leads to creation, storage and production of different pmf spectrum of the light by the same plant and animal DNA.

The ray of light in its entry into the magnetosphere of the earth and the interaction of the two Magravs lead to release of specific characteristic rays of specific magnetic fields strength, that this ray through a special process with the hydrogen atom lead to creation specific division of energy that can sustain life on this planet. This ray and its process of creation, which is not known in the world of science presently has been fully explained in the book "the universal order of creation" to be published in the future. We see that in time man of knowledge would be able to comprehend this process, and once this process used then the wisdom of all creations in the universe will be understood and can be replicated anywhere in the universe.

The rays of light at any strength of its mafs at their entry into any dynamic plasmatic environment have the ability to lead to or through conversion process cause the initial chain of reactions needed

for the start of life and then the matters produced use the light itself to further create more cell like beings and then through the ray of light conversion in these cells this leading to final step that the light ray in becoming the creature like man, then using light rays and its product main gains intelligence and the intelligent body at this stage acquires its magnetosphere and Magravs or what is known its ***soul***.

Chapter 7

The use of the properties of the structure of the pmf of the light for space technology

As the man's knowledge reaches and becomes in line with realities of creation; in the future the mafs of all components of the light and the phenomenon of light rays entanglement will be used for space technology in an efficient way and in manners which are not even comprehendible at the present.

The helixial cylindrical motion and reversibility capabilities of the outer-magnetic mafs of the shell of the light in space reactors of the future will be the key in control of the motion and the directional motion which these crafts can travel and the same time the control of the speed of the motion of the space crafts of the future can be set by using the matters' components of the light.

The gravitational fields' forces of the light and the reactors using and producing light gravitational properties that can be used for control of the directional motion are much easier systems to produce in a fully integrated combination space reactors setup that using different mafs' strength of the light makes take-off and landing possible in every environment and pmf fields strength in the universe, without putting the craft and its passengers ever in any danger. Where, with the use of the lights' mafs Magravs technology one can reach the deepest part of the universe in time spans that are within the fraction of the life of humans, rather than the present assumptions of thousands of the light years. In comprehending the concept of the structure of the light in full; this will the time, when the Man understands the truth about the world of creation in the universe, and how universe was created and real universal motions are created and maintained.

How, different rays of lights get entangled and leads to creation of conditions of mafs of matters is due to Magravs positioning of one light ray in respect to another of the same. The Magravs positioning of two rays of lights or what is known as the light–entanglement is the condition for example, where and when the light rays can converts from mafs of matters to characteristics of tangible or detectable matter in a given plasmatic magnetic field strength environment.

It has to be noted that there is fundamental difference in light entanglement and fusion of light rays. The ***fusion of the light*** is more fundamental process in production of matters and mafs and this process can be used for production of stronger light rays or for the production of heavier elements without going through the process of the matter state fusion. This being the like of the production of oxygen molecules through the fusion of light rays, rather than multiple fusion processes of the rays of the light's once the neutron to an atom of hydrogen is reached, and then through multiple fusions processes to reach the production of oxygen molecules.

In fact fusion of the matters of the light does not require energy and in reality does not lead to release of vast amount of energy. Whereas, in the present process of fusion of the matter of hydrogen the present fusion scientists have got themselves tied up with the wrong concept and technologies and they are in the dream of achieving fusion of matters through the use of present laborious fusion reactor technology with very little success.

By the same default in understanding the real process of the fusion in the universe, there has been a misconception by nuclear scientists in production of the heavier matters through fusion of matters in the centre of stars and in their nova process. Where, the **present assumption** that matters are created in the centre of the stars through process of fusion of matter **is not in reality correct**, whereas the process of fusion and production of all matters in the universe primarily takes place at

the *point of the fusion of the light rays* ***first,*** then as the light rays become to the point of matter mafs strength they first *all convert to gans of the neutron* and then through process of the Magravs positioning and collective balancing of these forces of the total light rays in a given environmental pmf strength, then some of the light rays once converted to neutrons some stay as neutrons and others of the weaker strength in the collection go through the process of the neutron decay (1) and become proton and electron of the collection of the light rays and hence in a given pmf strength, the physical matter with given number of neutrons and protons and electrons are created. Therefore, it is the collection of fused light rays which changes to collection of neutrons and then as some neutrons go through neutron decay and become proton and electron, this is *how* ***atoms of different matters are created*** *in the universe*. Where, further this process of the light pmf strength matching through light-entanglement process is a much easier process than the matching and fusing physical plasma of atom or molecules and solids.

In fact this is how neutrons are found to take their place in the centre of atoms to start with and this is how fusion takes place in the ***real universal cosmos*** (unicos). This being one of the reasons why the present science have problem to produce fusion as they try to fuse matter as in real term in the universe and in the centre of the stars fused light rays lead to creation of matters of different mass.

Fusion light **ray reactors** are simple practical systems which do not need very much energy for them to run and operate, but they can create and facilitate *directional motion of the space crafts of the future* using their capability to split the plasma content of the light to its sub structure matters and fields and create Magravs of different strength and in a cylindrical reactor of the same to stack the light rays gravitational and Magnetic fields forces for creation of the directional change and at the same time these reactors can be used for the production of the matters for the use in the space environment of the future.

For the space technology of the future there is a need for multiple light reactors that an instantaneous three hundred and sixty degree spherical motion of space crafts can be achieved and the at the same time the shielding magnetic fields can be interchanged from matter mafs to principal mafs and change of the dynamism of the same fields can be used for rapid deployment and penetration in dangerous and denser matter and mafs parts of the universe.

The same entanglement or interconnection process exists between light rays as does and prevails in the atomic and matter environment. At the present time the scientific world is considering ***quantum entanglement*** and its use in transportation of matters and other uses within and across the boundaries of the universe. In reality if scientists comprehend the concept of the light–entanglement and understands the principle use of this phenomenon, then one can use the matching structure plasmas of light rays before they become matter to achieve high speed transportation in the range of and beyond the speed of principal light rather than limited speed of the light in matter environment as man is considering to be the ultimate speed of motion at the present.

In entanglement process one can/and have the capability of use of different mafs of the lights for crossing the universe, and without change of physicality of the plasma and change of its state and then at this stage one can even copy and lock the same plasma of the light that in Magravs positioning of one plasma in keeping its connection with the same plasma of the light of the same strength or length in other parts of the universe.

If this concept of light interconnection and complex light-entanglement of Magravs of light balancing is understood and replicated then feeling, like touch, loving and hate and so forth can be transported across the universe without actually the matter or being ever crossing it physical boundaries. Thus coping atoms and interaction of the atoms and even the emotions of the matter (which complex, vibrational and rotational based) of one atom or light to another can be transported

across the universe using light entanglement technology.

In fact this is how dreams in the inner sanctum of the human brains are created and take shape and give the man the image of seeing and communicating even with people which they have never physically met or to other Magravs of other beings which in their time of living in that give environment their Magravs of the dreamer and dreamed of have been exposed too.

The light entanglement is a real and correct physical process, where certain cells within the inner brain or thought control systems of the living being has the capability to operate within these pmf mafs strength and this is the natural part of the operation of the brain of the human beings that scientific world has not mastered to unravel.

In fact the light entanglement communication method called telepathy is the easier way of communication than using the ears or other method of listing and talking and the place for this system seats in the inner parts of the man's original main brain structure.

The light entanglement technology will allow collective entanglement and different strength molecular light entanglement allows the full structure transportation and even continuous motion replication of the molecules. This meaning the transportation through the light plasma entanglements of let say heart, brain and all tissues at the same time, with the same heart beat and the same liquid with emotion of the entity across vast points of the universe becomes a possibility of the use of this process. Where, the light in all its pmfs of all its mafs of all matters and strength are available in all corners of the universe and all needs to be done, is to re-produces the same strength and combination mafs of different matters to replicated and reproduce the copy of the original entangled light for the two lights entanglement across the universe to interact and communicate and transfer their knowledge without acutely the matters of the light ever leaving their original environment.

Using this technology one can even transmute the same from one mafs of the matters' strength to another to speed up or reduce the transportation and trans-crossing time from one field strength and matter mafs to matter strength variation and principal mafs to matter mafs and matters strength. This needing and leading to change of light's mafs to the appropriate measure and sizes and conversion from matter mafs to matter like the mafs of food or oxygen and so forth for human consumption in crossing the universe without relying on and physically carrying food or power supply or even transporting human beings across the universal physical boundaries.

This concept of transmutation which is commonly used in the universal method of transportation will be thought in detail in future disclosure and partly has been disclosed in the book the universal order of creation of Matters (1) papers references 11, 16, 21, 29, 34 and 37.

In the matter environment of the earth, this can be achieved in plasma reactors of simple structure using complex combination pmf of mafs of the light and matters and plasmas in the dynamic nuclear supported reactors.

This concept of light entanglement is one of the easy solutions for transportation in the future without physically moving matter across the universe. This concept has been tested in medical application of the technology and results confirm the correctness of the technology. Where, copy of the correct cell information is translated to cells that the cell makes the copy of the right cell and uses this knowledge to cure or replace damaged cells or by allowing the process to be moved to another part of the body while one part of the brain recovers from damage (the coma case).

The concept of the atomic-entanglement and the binding between two atoms is a natural process of

interaction in the universe and if one understands the similarity of this interaction and the light–entanglement then one can see that in the physical world twin stars and the atomic entanglements are of the same in principle interaction and in concept, with difference in their magnitude and the size of the entities involved. Taking note that there are differences in between the twin and binary connection of atoms and stars and their process of entanglements criterion are totally different. Where, the twin atoms and stars are matching in matter contest and, where the binary stars and atoms are matching in magnetic and field contents.

Where, in the binary system the overall Magravs is matching that entities can magnetically polarity interlock. Whereas with twin entities every matter matches in mass and position as well as Magravs and their pole positioning.

The reason that a pair of atoms in receiving additional pmfs of rays of light is elevated to create a mysterious binding between them, is due to one of the fundamental principles of the reversibility in the magnetic polarity of one atom in respect to the other, even though both atoms having the same directional motional rotation. That is to say, *one of the plasmas involved in the entanglement get its magnetic polarities reversed in respect to the other atom*. This meaning, if the first atoms' proton and electron have their North-Pole on the top, in receiving additional mafs of the light, then the second atom receives enough mafs that causes or initiates the change polarity in this second atom, that at this point the North and South poles of each atom interlock with each other and the sudden atomic binding due to the lock of magnetic fields flow between the atoms takes place.

The same principle of atomic entanglement and attraction of reverse pole attraction holds true, when one observes the rotation of twin and binary stars entanglement. Whereas one star reverses its magnetic polarity, automatically the twin star polarity changes too, that the magnetic lock between the two stars to be maintained that the entanglement and twining and binary system can be sustained.

Star, atomic and plasma twining and binary process locking is the safest and common occurrence in the universe as this gives the stars a total magnetic balancing and guaranty's the survival of the both entities. This phenomenon of reverse polarity entanglement holds true and exists for all the twin system in the universe, this being for atoms, stars, galaxies and even universes.

The reason that the light injection or absorption of additional energy by two atoms in some cases leads to creation of entanglement is primarily due to the fact that additional energy received from the ray of the light leads to increase in the magnetosphere dimension of the atoms and this in turn allows two atoms in proximity of each other two magnetically interact and entangle and at the same time in coming close to each other, one atom changes polarity and the two atoms pmf lock and gets gravitated to each other but at the same time each atom is holding on to their Magravs positioning strength gap which is dictated by their internal pmf maf contents. Once the mafs of one star and atom changes due to whatever reason, then one will observe the disconnection of the entanglement or the coupling between the two entities, where at this point the higher Magravs strength partner will pull the weaker Magravs entity to itself.

This is a crucial phenomenon to understand, especially when using light entanglement reactor process in reaching any destination and requiring the change of the plasma of the light from principal mafs to matter mafs strength condition. Thus atom entanglement is a natural phenomenon and at the same time once an atom is created the content of two atoms' plasmas are hardly ever the same, this is to say, to find matching content of pmf of two plasmas of electrons and protons are as rare as finding two completely matching structure of two snow flacks.

The injection of the light into the plasma of two atoms allows some of the atoms, which are near

enough in pmf mass to reach the same point of mass or Magravs strength equality at the same time and hence have the capability of coupling. But there are points that additional pmfs of the light can induce enough energy that one atom can come near to another atom pmf balance and being able to interlock too.

The atomic–entanglement is not and cannot be used for transmutation of elements as easily as has been suggested by some scientifically advanced schools of thoughts.

In the present scientific world, scientists have been observing and detecting regular pulses of for example gamma radiation in the upper atmosphere of the earth, which they consider that these radiations all originate from the cosmos and for example they are from the time when a star explodes through the nova principle in the universe. These types of radiations are not the only types of radiations that arrive towards the inner part of the solar system from the cosmos. In reality there is spectrum of radiations and magnetic fluxes of different strength that go through the solar which are originated in the cosmos. In comparison, the radiation that arrives in the inner-most part of the solar system and at the boundaries of the earth atmosphere, these cosmic origin based rays are nothing compared to the gamma rays and other rays which are created within the heliosphere of the solar system itself.

The truth about the main source of these background radiations which has been considered to be from the cosmos and are released, when stars in the universe go through supernova, this concept that these explosions are the main source of these gamma rays and other background radiation which are detected, this shows the lack of the understanding of the process of the conversion of the light into matter and movement and collision of these new matters and mafs in the Oort clouds and Kuiper belt of the solar system. The main source of the gamma radiation bursts detected are originated and created through the motion of the charged particles of the new matters mafs and matters and their collision with each other in the Oort clouds and Kuiper belt region of the solar system and these gamma bursts have nothing to do with supernova and release of gamma bursts that they produce.

That is to say as/and, when newly born charged particles of mafs of the matter and matter as gases, nano matters and ganses move in outer regions of the solar system and ***as they collide with each other***, they release magnetic fields in the gamma, other radiations and noises in magnetic field spectrum levels in these regions of the solar system, which these radiations find their way into the inner parts of the solar system due to the strong magnetic fields interactions pull of their star.

The way these radiations and noises are generated and released is exactly the same way as the lighting and thunder are created and how light and sounds are released through the collision of clouds on earth and in other active atmospheric conditions or in other planets and moons in the solar system and similarly as it happens on the surface of the Sun, when matters mafs of the Sun collided in its upper atmosphere.

Thus the space travellers of the future have to consider all components of the all rays of the magnetic spectrum in the matters' mafs, matters, light, sounds, the principal mafs and matter and its sound and all their light radiation spectrum strength levels too, which these are all free and in motion in the space of this solar system and in the cosmos.

The radiation danger and damages from the light in the principal mafs strength levels are more predominant, stronger and profound than the matter mafs light ray spectrum strength and these radiations and their motion in space will play a crucial role in the future of space travel as these rays will be lethal and fatal if protection from these are not facilitated into cosmos excursion systems and scientific world has to have a viable protection technology for the passengers in the space crafts

of the future before they contemplate on such excursions into cosmos and specially traveling in the centre of the galaxies and near principal stars.

Whereas, for example one of these problems will occur, when strong mafs of the principal matters radiations will interfere with matter mafs dilution Margraves positioning reactors used for motion of the craft in space and these principal mafs upon them reaching inside the reactor, they can create Magnetic field surges that can lead to surges in these reactors gravitational and Magnetic fields, which this can lead to the loss of the system and the total inhalation of the system, or the change in the Magravs strength leans the craft in totally different part of cosmos than where the craft was originally destined for.

Therefore, before the men of science contemplate on traveling beyond the boundaries of this solar system, they have to master the knowledge of the mafs of the principal matters spectrum's magnetic field strength and the light transportation mechanism in this spectrum.

If one could understand the structure of the light and how it changes from spherical shape plasma to cylindrical in shape for it to be able to travel with less friction and high speed from one dynamic environment of spherical or cylindrical entity to another spherical environment, then in the future the man of knowledge can develop elongated cylindrical three matters mafs strength spherical and cylindrical composite mafs fuelled combination setting and reactors and crafts, which these elongated crafts will have the benefit of possessing spherical or cylindrical plasmatic magnetic shielding of higher order magnitude pmf strength of the principal mafs and matters for fast and protected space travel in the universe, then at this point one can travel the spans of the universe in times which are not even imaginable at the present by the man of science by use of these types of composite setting and fuelling reactors.

The use of light for purpose of transportation technology and communication through the understanding of the relationship and interaction of mafs of plasma and plasmas of the light(s) in each and every mafs strength of the matters of the light structure is the key to final and ultimate intellectual growth of the human race and point of maturity of the coming of the age of the man as has been promised. This technology will be at the edge of man's enlightenment in the knowledge of creation and control of light and its mafs and matters in the universe.

Chapter 8

Insight into the future use of the structure of the light

From the new understanding of the structure of the light, can easily and readily be concluded that if the light did not and was not made of the structure of three mafs of the matters then the light would have not possessed its own gravitational and Magnetic field forces and for example the light from other stars in the universe would have never been able to reach the earth as an individual magnetic field due to the characteristic and properties of the magnetic fields interactions and gravitations, as through magnetic interactions all these rays' of lights would have been absorbed by other magnetic fields and gravitational fields in the universe and the light would have never reached the far distances of the universe. Hence the light as a physical entity which is similar to other physical entities the like of proton, electron, earth and the Sun and the light being in possession of both Magnetic and gravitational fields, the light ray has to find its position in respect to any other object and pmf in the universe as it passes these entities in the universe, and hence in its travels in cosmos light ray has to find it's Magravs positioning in respect to them that this allows the light ray not to be absorbed but to go around these objects. Hence, the reason for the physical observation of the lensing or the bending of the light near these object as the light passing large and strong gravitational object is purely due to its Magravs and its positioning in respect to these entities in the universe.

Therefore the lensing of the light is the confirmation of its existence as dynamic composite magnetic field strength fields physical and tangible entity in position of Magravs, and the light is not a ray of magnetic field in motion or what has been called that the light to be an energy. Whereas, the plasma of the light ray in motion can transfer it Magravs to other matters and thus has the ability to transfer its momentum to other matters and mafs as energy.

Hence due to the fact that the light possess both Magnetic fields and gravitational fields and in line with laws of physics, when the gravity and the Magnetic fields interact (1 and 2), their interaction lead to the creation of entity in possession of its own mass and its own magnetosphere. Where, the interaction of the lights magnetosphere with the magnetosphere of other objects due to their friction leading to release of residual magnetic fields in the matter magnetic field strength level of the human protein, which this makes the point of interaction of two Magravs detectable pmf field or what is called the visible light to human eye and his tools and methods of detection of pmfs in this ranges of filed strength, out of the full magnetic fields spectrum of the universe.

Where, the motion of the dynamic spherical plasma of magnetic field in its travel from one point in the universe to another causes and leads to elongation of the dynamic spherical pmf, hence the restructuring into a dynamic cylindrical plasma ray of the light, and as this plasma of the ray of light reaches the right pmf environment strength that slows down enough or losses its strength, at this point the cylindrical plasma restructures back to its spherical structure and leads to the creation of pmf of matter mafs and matter in given matter pmf strength environment (Fig. 48) The book cover image. Hence light has the same structure as the pmf of any other plasma known to man like the plasma of electron and proton but in elongated form rather than presently known dynamic spherical shape of tangible matters.

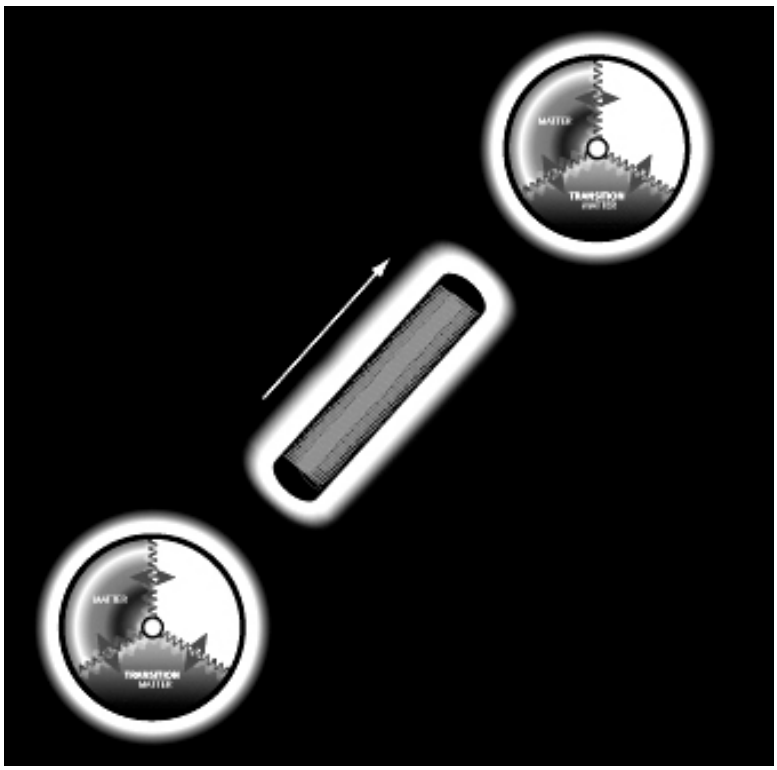

Fig. 48 The conversation of dynamic spherical pmf into dynamic helixial cylindrical ray of light and its conversation back to dynamic spherical (Cover image).

Where, at the same time the plasma of the light in its travels in space can become visible according to the plasmatic magnetic fields of the environment which it travels through and according to the observers' plasmatic magnetic fields strength which in the case of human living Magravs protein molecules structure.

Different proteins have different pmf strength for different creatures in the span of the universe, hence what is visible light to one creature in one point pmf strength in one part of universe this does not mean that to another protein Magravs strength in the same environment this can be visible light too. Hence what is visible light in principal matter or mafs strength, in transition mafs and matter and in matter mafs world in a given matters' magnetic fields environment respectively these light rays are detectible or visible according to the environment and of each mafs and matter in the binding Magravs of the structure of the observer.

The plasma of the light has the capability to present the magnetosphere around itself according to the pmf strength which it is passing through, thus it is the environmental pmf strength which decides the outcome of the mafs of the matter of external layer of the plasma of the light and the final presentation of the light in a given environment.

The plasma of the light to reduces its losses in its pmf of its matters and at the same time allowing it to encounter less resistance for it to be able to travels through the same pmf strength that have less or faces no losses, thus the light ray has the capability of the change of cover mafs and matters of its structure. Thus it is inevitable to consider and conclude that the light like its larger combinations has its own intelligence and its own internal logical magnetic processing that allows it to survive and exist in every dimension in the universe that it might travel through or be part of. This giving the light the capability of being able to travel long distances, and at the same time, this allowing the light not to have fixed maximum speed in all universal magnetic field strength spectrum opposite to what has been assumed by scientific world at the present.

At the same time, the light becomes more visible or detectable as it travels from stronger matter mafs fields strength to a lower matter fields strength environment.

Two rays of lights with different mafs of the principal matter strength can pass through the same medium and they can create different brightness intensity and therefore all lights rays do not have the same intensity primarily and their strength and intensity is internal initial principal mass and strength dependent. Therefore a ray of light can be dimmer or slower compared to another ray primarily due to their mafs of the principal matters content and their strength.

Lights have speed according to their lowest common denominator of it environment pmf strength. Therefore, speed of light in Principal environment due to the stronger field strength of the principal mafs pmf is much faster than the speed of the same plasma in the matter environment, hence the present assumption that the speed of the light as observed by man is the maximum speed of the plasma of the light is ***incorrect***, and hence the plasma of the light has speeds in the Principal matter environment far beyond the present assumptions in the matter environment of the earth and this universes matters' pmfs strength.

Even though the formulas used for conversion of main connection of mass and energy looks as to be balancing and to be correct, in fact this equation is only correct for small and minute amount of plasma and only in the matter environment and not in other plasmatic fields environment of principal mafs and mafs of the transition matter or combination and composite plasmatic magnetic fields strength of principal mafs and matters environments and where only individual rays are considered.

Now that one knows that mass is created through secondary effects and interaction of the effects of the interaction and connection of at least two dynamic plasmatic magnetic fields of the gravity and Magnetic fields (1), which these Gravitational and Magnetic fields both themselves are created and are products of interaction of at least two initial magnetic fields, then in fact mass itself is product of interaction of four fields of two initial fields and two effects of these two fields and hence the formula of relativity now is totally incorrect and has to be rewritten as now one of the factor of the four of the magnetic fields and their combination of their products with each field in position of its own speed of its mafs strength, as energy which is define as magnetic fields in motion, then multiple of speeds of the light in their initial matters mafs strength times the matters mafs of their effect strength in a given mafs strength is the realistic method of the measuring the energy in respect to the mass of the same matter.

Using this knowledge and understanding the structure of the light and applying these in the space technology and in the space reactors crafts of the future for travel in deep space, then by knowing the mass and the strength of the fields which one needs to be traveling to and by the same principle the strength of the original mafs of pmf can be calculated and measured by using the fundamental application and implication in production of light Magravs strength of the system and of the same of the destination point, then one can estimate the power of the crafts Magravs need to be and at the same time what the speed of the travel of the craft shall have, and using the mafs of the light at that given matter environment, one can calculate what mass of the light the system needs to have and be loaded that the system can travel at a given speed in a given environment, or what speed the craft might have once one uses the certain amount of mass of the light in any combination in any of multiple combined fuelled integrated multiple Magravs positioning reactors of the space crafts of the future (1, reference 24,18 and 11).

In understanding the strength of the principal mafs fields strength and using this phenomenon for creation of speed of motion of the systems and crafts, then one can calculate and understand that

travels with speeds hundreds and thousands of times and millions of time faster than the speed of the light in matter environment in the near future will become as conventional as jet liner travels of today. The assumption that the speed of light in the matter world is the ultimate speed in the universe cannot be correct. This assumption, when using the principal mafs fields as source of fuel in dynamic plasma dilution gravitational positioning space reactors, which have been developed and tested can be used to achieve higher speed than the speed of light in the matter environment.

Through this technology of the use of light gravitational positioning systems, speeds of travel in Principal and Transition mafs strength environments, which are beyond the present understanding of the man in the matter universe are faster than the speed of light in matter environment.

Now one can understand, that once by not using the principal matters as fuel as has been discussed and promoted by some organisation to burn, as has been the habit of the man to burn to attain motion and height in the past centuries, then in using the mafs of the principal matters in creating gravitational fields and Magnetic fields within a gravitational system, then one can travel the length of the universe in times which are not acceptable to man at the present time due to restrictions which has been forced on the humanity by the less knowledgeable scientists of the time and due to their lack of understanding of the creation and control and structure of the light itself.

Then now one has to make new concepts and measuring tools for local time and universal times as these will be different according to the light mafs strength of the space crafts and environment of measurement and new conventional translation for time has to be employed, otherwise traveling in one speed of the light mafs strength and then entering another to live in, this will create untold problems for the future universal travellers of this universe and for the inter-universes travellers of the future (3, 6 and 7). Invariably in the near future one can use the principal mafs and matters magnetic fields for the purpose of transportation in the universe, where from this point on travel with speeds beyond the matter pmf strength environment for travel in the universe and between universes become a natural means of transportation.

At the same time the speed of light in the principal mafs and matters strength is visible light to the man too, with the difference that in this environment as the protein chain of the man contains and is consisted of plasma of electrons and protons, and these plasmas themselves are made of and operating and consisted of the composition of principal mafs and transition mafs and matters (1) too, then the principle mafs strength of the protein will come into operation and the life will be as normal as one living in the present matter mafs and matter environment of the universe. With a slight difference that he needs to learn about control of the operation of his physical body and his tools of detection in the speed and light configuration.

The parallel world of different pmf strength of matter mafs and mafs of the principal matters are the faster and stronger in pmf strength of life which the Man has come to comprehend and live with and soon he will be able to transmute from one pmf strength of mafs to another and use this knowledge for the advancement of his race and connection and communication in and with the other creature of the universes.
The gravitational field forces of the mafs of the matters of the structure of the light will be the smartest and fastest method for creation and control of space reactors of the future. At the same time speed of the separation of mafs of the matters of the light will be the best directional controller and magnetic shielding protection system for the space crafts of the future as the lights' mafs and matters separation and control in different mafs of the matters and matters of the universe this make the plasma of the light the safest and quickest methods to generate parallel speed of the light in different mafs of the matters environment and at the same time the directional motion of the Magravs transportation system can utilize the mafs of the matters of the light interaction for smooth transition from one matter mafs field strength to another or from matter mafs to matter environment

and vice-versa.

This light matter mafs structure division and utilization will be the technology which needs a full understanding of the world of creation and once mastered as has been done by other inhabitants of the universe, then the man will be of the same strength and capability of the understanding of the universe of universes operation, interaction and universal organisation.

When, the intelligence of the man reaches the full understanding of the potentials of the use of the light mafs of the matters, then one will be able to travel in different mafs of the matters environment with use of the mafs of the principal matters magnetic fields strength as the protection magnetosphere created around the crafts in possession of the multiple Magravs positioning reactors.

The dynamic twin reversal of directional motional shielding system made of and through the use of mafs of the principal magnetic fields' strength of the light guaranties the total non-penetrable protection for travel in all mafs and matters environment in the universe, without leaving any traces of direction of motion and without being visible to the human eyes and any other tools and means of detection of any other creatures in the universe.

Where, this technology can be used for fast speed travel in crossing boundaries of universes and for travel across one universe without spending thousands of light years in traveling time as is currently calculated by human scientists. Thus one can travel with full safety using the highest lights Principal Magnetic field strength for every aspects of the motion in the universe.

Once the concept and the principle structure of the principal mafs and matters and other mafs of matters and lights are fully understood then one can use the knowledge of the light structure in full and the scientific world will be able to use the structure and mafs of the light for creating new matters and production of food and nourishment for the life of the passengers and for the space machineries of the future and food producing reactors for the man in deep space where the light is the only available matter for use and at his disposal.

The mafs of the matters of the light can be brought to levels that one needs for the body to absorb for it to survive a pleasurable and comfortable life. Where, different strength mafs of the matters and of the light can be used as vitamins and minerals and proteins for the Man's needs to live. Where, the light mafs of the matters can be used directly without the need for the plant and animal conversion systems of the light mafs of the matters to minerals and nourishment for the human consumption.

One has to understand that there are lives in the lower pmf strength of the universe too; where in reality the matter universe is not the lowest level pmf strength in the universe. The light in this universe is the same and operates in the same way.

In the future one can *use the light mafs of the matters to produce and lower their strength mafs of the matters to pmf for example of the sodium or vitamin A or B*. Therefore from this point on one can even produce composition of matters or what has been the dream of producing energy and new matters through fusion. Now one can use the Principle matter mafs field's strength of the light to fuse the elements in the matter environment. In fact fusion is more practical and achievable if one uses the principal mafs and matter's field's strength of light and their division to create environment of matter mafs for the matters to be created. Fusion of pmf of the light mafs is in so many ways easier than physical matter fusion once the light is transferred into neutron or an atom. The lights' mafs of the matters fusion is a way for the re-production of heavier elements or their pmfs without creating enormous amount of heat that one cannot and has no tools and means to control and contain such matter fusion technology.

Once the man learns the use of the construction of mafs of the matters of the light, then one will learn that source of mafs of the matters are available in all corners of universe and on the other hand one does not need to create the physical matter to have the properties of the physical matter, but one can use pmf strength properties of the given matter in its fusion of the light mafs of the matters to achieve the same effect, the likes of the production of energy and food without ever using fusion of physical matter to achieve the same goal and actually without ever needing physically to eat and to digest food. Then in the near future man's body will do with the digestion system and in the further times man will learn and will do with the physical body for it to exist and for it to travel the spans of the universe(s).

Using the mafs of the matters of the structure of the light rays for **communication purposes**, in the matter environment, then the communication system can be set to transfer the information in the Principal matter mafs strength and once the information arrives at the point of destination the receiving system can decode the information from the principal mafs strength to matter mafs strength and then the information can become available for whatever purpose it was transmitted for, this being audible, visual or computable information or transfer of matters. This method of use of mafs of the matters of the light field's strength will eliminate any time delay in communication across the spans of the universe, the delay time which has been observed in the present cosmos communication systems will not exist once using principal mafs strength and then communication become instantaneous anywhere in the universe.

Thus by switching from one matter mafs strength to another matter mafs strength of the same light, this will bring into play a totally new technology and facilitates new approaches in the production of tangible matters too. That is to say one can strip the light from one of its mafs of the matters for one purpose and use its residual mafs of the matters for other purposes. That is to say, by striping the light off its principal mafs for the communication purposes, then one can use the mafs of its transition matters and mafs of the matters of the same plasma of the light for production of increase in other matters and matters growth or expansion in their given environment or use these for production of energy for human existence in space.

The universal language using mafs of the matters of light and using the same mafs of the matters of the light for their transportation will be the cornerstone of the future transmutation of matter and matters and communication in the universe among other intelligent creatures of the universe(s).

The positrons are created at the point of the creation of the plasma of the atoms from the ray of the light and the clockwise motion of these particles is totally and primarily internal magnetic fields position dependent. This meaning that the directional rotational motion of all matters are dependent on the speed of the rotation and position of the mafs of the principal matters and matters in respect to each other, this plasma be it of the plasma of electron, proton, atoms even stars and galaxies.

The clockwise or anticlockwise rotation of electrons, protons, planets and stars is determined by the principal mafs matters speed of rotation and its distance in respect to the matter mafs and distance between different layers mafs components of the plasma of the entity after the light ray is converted to matter of the electron or the proton and star and its matter content.

In conclusion one has to be aware that visible light magnetic fields spectrum, which makes man to see its universe is the same in all pmf strength levels. This means that in every pmf strength environments there are visibility criterions to all created life, but the visibility is pmfs field strength dependent. Therefore, what is not visible to one being is visible environment to another using different pmf strength for point reference as tool for vision and this applies to all pmf strength mafs of the matters and matter universes and environment.

At the same time vision is not through the vision tools like the eyes, but vision is the openness to receive knowledge through the real means of the operation of the universe in the pmf strength of the level of intelligence of the structure of the beings.

The reality of the existence has been measured by the strength of the light, which a matter can emit, and the duration and the depth the Magravs of the created light can penetrate in its environment. Then the question for the Man to ask of his existence, is that how does the matter like him, who is the user and the producer of the same physical entities as stars, how does his existence will shine and operate in the span of the universe after the demise of his physical life on this matter strength environment?

May be it is the time for the Man to come to understand the true meaning of the light, as all beings in the universe announce their existence through the emission of the light into and onto their surroundings.

This technology of the light ray's protection gives the man the ultimate knowledge for survival and brings the man knowledge and intelligence in par with and equal to the knowledge known to the rest of the universal manifestations and the same we have served our purpose in bringing the same to all men of progress.

Thus would be correct for the Man to consider his connection beyond his physical existence and through the light of his presence during its time, and hence would the soul of the man be of the light of the confirmation of his existence.

Be wise to the truth of the creation of the man, if the light of wisdom is the light of the soul from the time of beginning to the end of time. This light will exist and will be the source of the confirmation of everlasting existence of his soul, as the light of far distance star after billions of years are shining in the deepest part of the universe, this has been and shall be destined for the soul of the Man throughout all times of the existence of the universe.

Thus it can be said

The man has come from,
He exists, operates through and
He shall return to
the Light

Definitions

Below is a list of the new terms and their definition that used in this book. A number of these words and terms have been used in the previous book and scientific papers, which have been published by the foundation and most readers, are familiar with these terms and reference. In this book a different approach and language and terminologies is used, therefore has become necessary to create a new terminology and words that can explain the real term application and processes in the world of physics.

Mafs: magnetic fields

Magnetic: with **capital M** refers to the plasma of magnetic fields created by a dynamic entity as for example this refers to the magnetic field of the earth.

Magravs: Magnetic and gravitational fields (Magnetic referring to the plasma of magnetic fields created by a dynamic entity as for example this refers to the magnetic field of the earth)

Pmf: plasmatic magnetic fields

Principal matter: This matter in conventional physics is called the ***anti-matter***, as now the real structure of this matter is fully understood and is said to be source of all matters from the dark matter to matter, thus it has been called the original matter or the principal.

Principal mafs: These are magnetic fields, which are in the principal strength levels and considered to be I order magnitude several hundreds of times stronger than the magnetic fields which make up the tangible and visible matters.

Principal star: This entity in the conventional physics is called the Black hole

Transition energy: This energy in conventional physics is called the dark energy. This is the pmfs that are in motion from principal to matter magnetic fields strength so called the transition energy as energy is defined as the pmfs in motion.

Transition matter: This matter in conventional physics is called the Dark matter, as now the real structure of this matter is fully understood and is said to be when plasmatic magnetic fields are in transition state from the principal matter to tangible matter thus the term transition matter is used.

Transition mafs: These are magnetic fields which are in strength level between the principal and matter magnetic fields strength, and are in transit from the principal mafs to matter mafs strength levels.

Gans: a new state of matter; a molecule of a gas (GAs) which becomes Nano of itself and appears as Solid state of matter. **GA**s to **N**ano of **S**olid and to be called **GANS** for short.

Reference

1. The book, “The universal order of creation of the Matters”, M T Keshe, published July 2009 ISBN 978 46 6087 001 9

2. The unifying theory of the fields M T Keshe 2009

3. The origin of the Universe M T Keshe 2010

4. The creation of the solar systems M T Keshe 2010

5. The CO2 capture paper by MT Keshe Published 23.12.2009

6. “The universal order of existence” finalized and to be published in 2010-2011 by M T Keshe

7. The Magravs positioning M T Keshe 2010

8. NASA WMAP common.wikimedia.com

Published and unpublished works by M. T. Keshe

There are a number of unfinished articles that are to be converted to full disclosures when completed, like antimatter mafs method of energy releases, Nano space technology, relation between the creator and the created, space communication system, deep space defence technology, dynamic magnetic fields force regions (wormholes) construction and control, creation of magnetic fields, and so on.

Some of these works have already been published through different channels and some have not yet been released.

In the following section some of the works done by the same author are mentioned, with a brief disclosure of their contents.

Some of these papers can be purchased and obtained through direct request and access through specific links.

A number of papers with * and ** marks **are not for public release** due to their sensitivity of information and only available to relevant commercial and governmental organisations for peaceful applications of the technology.

The universal order of creation
(5.7.2006)

In this disclosure the main construction principles and the method of the link and control in the universal order of the existence of living cells, like the function and operational method of any matter based on so called proteins chains, as for example in human cell are explained in detail.

REF 9

The author considers this paper as one of his most important and fundamental works to be published and to be added to the sets of disclosures written by him.

Cosmic Rays
(Release date 24.3.2004)
This paper explains the source and the origin of cosmic rays and the way these work within our cosmos, their function and their benefits.

REF 10

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*The Airborne reactor

(Release date 25.3.2004)

This paper covers the total design of airborne reactors for space technology. This covers all aspects of operation, design and control of such reactors.

REF 11

The seed of the Earth
(Release date 25.3.2004)

Some extracts from this paper:
The theory that the heat of the core of the Earth is due to inertia of the material piled on top of each other is completely dismissed through this new disclosure.

The author M T Keshe believes that this centre core is made of hydrogen, other gases and a mixture of liquid and solid matters mafs, which were in the vicinity of the centre of the core of the Earth at the time of its inception in the solar system.

Through this new understanding of the new inner cores of the planet, this brings to play the fact that the old inner core of the Earth that is already assumed to be made of a solid piece itself becomes a sealed container for the new inner core.

The author through design of a parallel system has set to confirm the validity of this assumption, that the centre of the Earth possesses a semi- fusion atomic reactor and not a fission reactor as has been assumed by other scientists.

This theory of hydrogen in the centre of the planet is in line with the physical reality of the creation and the present situation in the physical construction of the solar system.

By the laws of physics all the gases in the solar system should have been in the giant gas planets at the outer layers of the solar system, like in Jupiter and Saturn.

The physical reality in the solar system, is that the lightest of all these gasses, the Hydrogen, has taken its place right in the centre of the solar system in its star, the Sun.

It has to be recognised that the centre of all planets in possession of gravity due to the centre cores heating, are always in possession of two Magnetic Field Forces in their inner sanctum (M. T. Keshe “The creation of gravity").

In the case of the Earth up to now and with the present knowledge there has been acceptance of only one inner core and one magnetic force.

As it is explained in the paper titled "the creation of gravity", there is an inner core in the inner core. This inner core, due to it physical content, motion and position in the centre of the Earth, creates and maintains its own magnetic field force, independent of the magnetic force which has been known to be created by the interaction of the inner core and the outer core of the planet.

These two magnetic fields interact to create the planet's own double magnetic fields in its centre. The interaction of these two magnetic fields forces upon each other leads to the new concept of the "DOUBLE MAGNETIC FIELD EFFECT", where the interaction between these two field forces in the centre of the planet leads to the creation of the gravity and the magnetic forces of the planet

(Paper: The creation of gravity).

This new second core is the seed core of the planet, the mother seed of the planet positioned in this new inner core.

REF 12

The creation of Black Hole
(Release date 25.3.2004)

In this paper it is explained that the Black Hole is created out of a natural sequence of events, and that the existence of the Black Hole in a galaxy is a normal event. Further it is explained that a Black hole is created in similar ways to the Dark Spots on the surface of the Sun. In this paper for the first time, it is explained how the Black Hole is physically created and what function it plays in its galaxy.

REF 13

Magnetosphere
(Release date 9.6.2004)

"The shape and the strength of the magnetosphere of a planet is exactly what a fingerprint is to a man. It is unique to each planet, star and galaxy. It is a tell-tale of all its attributes, and it reveals the hidden mysteries of the internal materials' structure".

REF 14

Correction to the Einstein equation of Relativity
(Release date 15.6.2004)

In this paper the physical reality of the Einstein equation is considered, and efforts are made to bring this equation to the real conditions. Even Einstein considers this equation applicable for very small mass, and not in real three-dimensional multi-Magnetic and gravitational conditions, which are external and have nothing to do with the theoretical object's mass and speed, but have effect on the speed and the mass of the object under consideration.

REF 15

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*Introduction to the new system
(Release date 2.7.2004)

In this paper it is written "It is essential to understand that, with the application of this system of motion, one cannot bring into play the solid, liquid and gas fuel method to create motion, as is used today. What is offered in this system is in simple words a fully integrated plasmatic magnetic energy system. Which, creates within and around the core environmental conditions as known to man in the universe like creation of gravity and magnetic field protection and the same as the magnetospheric protection condition of planets and motion through interaction of magnetic fields as planets and stars do in their given environment".

REF 16

The rings of Saturn
(Release date 2.7.2004)

One of the oldest puzzles in the world of astronomy has been the existence of the rings around Saturn. How did these rings come to exist the way they are now? How did they come to appear and behave the way they do? These questions and much more about the creation of these rings are all answered in this paper.

REF 17

The creation of gravity
(Release date 11.7.2004)

In this paper it is explained that "the source and the creator of the magnetic forces and the gravitational forces are due to the interaction between the same materials in the same region of the planet."

Further it is explained how the gravitational field force can be created, replicated and controlled within a nuclear reactor. Further it is explained how this property can be used for the motion of a system within a planetary or solar system.

Now by understanding the principle of the creation of gravity, in this paper it is further explained that "the gravity in reality is the effect of the interaction of two plasmatic magnetic energy fields of any two object in respect to each other."

REF 18

Death of a star
(Release date 26.7.2004)

In this paper the death of stars is explained, "The death of a star and the creation of a supernova is in reality the same as the half-life cycle energy step-down of an atom, with the difference that this show is in a larger scale, and more spectacular, in all aspects of its dimensions".

REF 19

Fusion
(Release date 28.7.2004)

In this paper the physical and scientific problems with present fusion technology is considered. Where, it is written, "nuclear Scientists, with the fusion reactors of today, are trying to create fusion in the opposite way to the known laws of physics and their parallels in the universe". Further in this paper it is written, "If the present path for creation of fusion is followed, with the present scientific knowledge of physical materials for construction of such system, then following the present path of development to create energy from current fusion systems will be a distant dream".

REF 20

Life of a Cell
(Release date 28.11.2004)

Extracts from this paper; "The reality of the transportation and transmutation of a cell is not far from the reality of the life of an atom or a star. Where the life cycle of the cells are slightly more complicated, as they contain other matters mafs like acids, which have their own magnetic characteristic of their own chemical structure. For this reason the control and replication of the energy of the cell is very much complex, but very simple to achieve".

REF 21

The Atom
(Release date 19.12.2004)

The content of this paper explains how and where atoms in the universe are originated from and how the construction of atoms in a cold plasmatic nuclear reactor can be replicated.

REF 22

Magnetism
(Release date 8.1.2005)

In this paper it is written, "The question is where did the Magnetism come from? This is the Secret of creation. The world is made of one thing and only one thing and that is Magnetism. Its combination and interaction with its own different strength fields makes it appear as different matter mafs. The rest of creations are the outcome of these interactions of different strength of this thing called magnetism and the forces it creates. Magnetism is the origin of existence and the real singularity in its full meaning".

REF 23

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*The creation of the magneto-gravitational force
(Release date 5.2.2005)

The creation of magneto-gravitational field force is and will be fundamentally independent of temperature and pressure, proviso to the fact that as long as a homogenous free floating PMF within a matter mafs is created.

REF 24

The core of the Earth
(Release date 20.4.2005)

One of the original assumptions in developing the new Magravs system some thirty years ago by M.T. Keshe was on the basis that the centre of the Earth possesses addition cores, which create the necessary gravitational conditions of the planet. After some twenty years of space technology and through Earthquake seismological data's this assumption has been shown to be correct and after over twenty years, it has been scientifically proven that the inner core of the Earth has an inner core of 600 km. Professor Guy Master in 2002 ref 24 nuclear planet. The centre of this core is assumed to have an inner core of 8 Km, this he thought to be made of the plutonium or other nuclear materials

But the developer of this new plasma reactor technology has proven through physical dynamic cores that these cores possess a mixture of hydrogen plasmas and the process of the heating of the centre of the Earth are due to a semi-fusion chain of events.

REF 25
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*The electron-atomic welding
(Release date 3.5.2005)

Some extracts from this paper:
"The electron atomic welding or atomic welding principle is the phenomenon that atoms of the same material, through a common shared electron, become a magnetically balanced molecule of the same matter mafs, with the difference that the shared electron will create a balanced PMF in the molecule".

REF 26
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*Shutdown and safety of the reactor core
(Release date 6.6.2005)

In this paper the safety parameters in the operation of the gravitational and energy reactors are simply explained to avoid the loss of plasma and gravitational field forces created within its cores.

REF 27
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*Reactor Start-up
(Release date 9.6.2005)
In this paper the systematic start-up of the dynamic reactors for the creation of gravitational field forces and the production of energy are set out. The start-up of these systems is totally different than the prior arts known in the nuclear industry.

REF 28
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*The energy balance of the reactor
(Release date 29.6.2005)

Some extracts from this paper:
The energy balance of these types of reactors is not as simple as might look in the first instance. The energy creation is simple. But the heat leakage and dissipation through the deliberate inherent material design are and can be zero. That is to say the system not only can hold on the heat it creates. At the same time due to the close circuit feed operation will become self-sufficient but long lasting.

In planets, the loss of heat through their surface creates the variation in the central core condition over several billions of years. In this reactor as losses can be literally negligible, the system can operate at low energy loss temperatures. Even the boundary of the body could be made through the right combination of material in the chambers, so that the body of the reactor will be colder than its surrounding boundary. So the system will not only lose energy to its surrounding, but it can be made to absorb heat in the negative temperature gradient from its surrounding, so that there are no losses.

REF 29

Nuclear decay or half-life
(Release date 20.7.2005)

Extracts from the paper:
"The nuclear decay always has the same or near the same time duration. This is due to the fact that the all neutrons and protons, from their inception, carry a predetermined level of plasmatic magnetic energy. This energy is continually used for the motion and vibration of different elements of the nucleus in respect to each other and the surrounding matters mafs of the atom. As the space and dimensions of a nucleus of an atom always obeys the same principles of the magnetic separation and magnetic attraction. Protons or neutrons can and will need to use or consume the same energy before they become weak enough that the splitting or decay becomes a clockwork job. The nuclear decay is the natural levelling done of a nucleus' energy, due to the energy consumption and heat dissipation for the motion of the elements of the nucleus for its remaining plasmatic magnetic fields energy necessarily needed for them to hold one together".

REF 30
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*The decontamination system
(Release date 10.10.2005)

"What this means is that, for example in trying to recycle the CO_2, by the use of the right matter mafs in one of the cores of the reactor, the system will then use the O_2 to produce H_2O, in the form of pure water, and C in the form of atomic or molecular carbon, or even by feeding this back through certain operational compressions and gravitational interactions within a small core, to create industrial diamond or graphite, for different industries."

The use of the reactor for this purpose has been proven to be correct and Raman spectroscopy has proven the concept and physical reality of the separation of matter mafs in atomic level after separation in the same system from a composite matter mafs.
(See the graphene on the technology web site)

REF 31

The difference in atomic and molecular structure
under gravitational force and pressurised conditions.
(Release date 15.8.2005)

In this paper is written that "the atomic and molecular structure of matter mafs is totally aligned and positioned in a fundamentally different configuration where it has come together due to gravitational forces, than when matter mafs has been brought together by the means of pressure. This has a fundamental effect on the behaviour of the structure and properties of the matter mafs which is created in either way". Where this is explained and utilised to develop a new method in creating graphene and Sp3 atoms and walls in a simple core made of a coca- cola bottle.

REF 32

**The Defence and shielding system
(Release date 4.9.2005)

Some extract from this paper:
The design of the side open system for lunch of high saturation magnetic plasma package is one of the most effective technologies for defence of the reactor and the craft, which is in possession of such a system.

It is essential for any space technology in the open environment of the universe, if the craft is to keep a straight line of motion and to be able to protect itself from any solids or matters mafs in its path in the cosmos.

This technology can destroy any object by the principle of plasmatic magnetic energy saturation of the incoming object at a molecular level, that object will disintegrate in the form of magnetic vapour and not atomic level destruction, before matter mafs can damage the craft as debris, and before the craft ever becomes in touch or near these space matters mafs.

This technology can also be used to protect Earth from the collision risk of NEO's (Near Earth Objects), like comets and asteroids.

REF 33

Method of creation of an atom or nano matter mafs
(Release date 11.10.2005)

The manufacture of an atom of any density, this being of the simplest form of nucleus or a full atom of hydrogen, or even heavier elements in the universe, all follow the same principle.

Atoms are created in the soup of the cosmos from collections of very weak plasmatic magnetic fields, which for their existence cluster and share their energies with the magnetic fields that are not far from their own plasmatic magnetic field strength.

REF 34

The relationship between Gravity and Mass
(Release date 21.1.2006)

Extracts from text of this paper:
"A planet like Earth possesses a combination of both gravity and inertia. Where the gravity comes from the interaction of plasmatic magnetic energy fields from the processes within its core, and the inertia comes purely from the collection molecules PMF of matters mafs which has built the physical body of the planet.

Any object, being an electron, atom, molecule or even a human body, is a collection of plasmatic magnetic energy fields of different strengths and their interactions between each other, which in total decides the total or collective magnetic field possessed by that object where this is the mass of the object.

Where the mass of an object is a collective package of plasmatic magnetic energy field tightness of a given object and will not change as long as the object is intact as one entity in its overall atomic or molecular or collective molecular appearance.

Which plasmatic magnetic energy of a physical body (so called the mass of the body) in interaction with molecular or atomic magnetic field (this being gravitational or inertia) of another object will determine the weight of the two object in respect to each other in each other's environment".

REF 35

The Dark matter mafs
The Fifth state of matter mafs
(Release date 21.1.2006)

Extracts from text of this paper:

The existence of dark matter mafs is not questionable,

Proving its existence, and its effect on the energy balance of the universe, in all matters mafs as small as in the heart of an electron or in a solar system needs to be created, replicated and its effect measured.

The theory of dark matter mafs does not and needs not to be considered as complicated, if one understands in real terms the plasmatic magnetic energy of the matter mafs in the visible and invisible dimensions of the universal work.

The dark matter mafs has two distinctive characteristics, which makes it totally apart from the visible matter mafs. The dark matter mafs possess mass but not visible light, where its existence can only be determined by the weight of the it's hidden mass, which could be substantial due to its internal gravitational field.

REF 36
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*The inter-atomic fusion
(Release date 3. 5. 2006)

Extract from this paper:
"The fusion of two or more atoms has been the pre-occupation of nuclear physicists for past years. Conditions to achieve fusion of two hydrogen plasmas in the TOKAMAK reactors have taken years to teach scientists a lot about the behaviour of plasma and their fusing.

The reality about the fusion in some way has to be reconsidered as, if the scientific world is trying to amalgamate the contents of two plasmas to release energy. There must be a simpler way to achieve releases of similar energies.

The fundamental principle of the inter-atomic fusion is a much simpler way to achieve fusion. If this principle is applied to the atomic condition of fusion, then fusion will be attained in a simple but in a much more physically realistic environment.

The explanation for inter- atomic fusion is very simple and direct.
In the fusion of two plasma of proton of hydrogen atom, the physicists try to fuse two large plasmas, and by doing so, they try to release a large amount of energy. Where in this process enormous amount of magnetic field forces and currents are needed to bring two plasmas in close proximity, so that the energy barriers in between them can be overcome for them to amalgamate or fuse.

In the inter-atomic fusion the overcoming of energy barriers does not exist, as in this method of fusion, the electron of the atom which is circulating the nucleus of the atom and is of the same origin will be encouraged to return into and fuse with the nucleus of its atom".

Where this is a more practical way to create and release manageable energies and there is no need for elaborate systems where even if the energy release will be small compared to dreamed up fusion systems of today.

With inter-atomic fusion method at least small and practical systems can be developed to handle low temperatures of the fusion process.

REF 37

The conductivity of the matter mafs in the vacuum
of the interplanetary mediums
(Release date 21.1.2006)

Some extracts form this short paper "Therefore plasmatic magnetic energy field of elements within the interplanetary medium will cover the space given to them in their environment. Where due to their motion and their electric charges even in eV levels, they become perfect conductor, and in turn, due to their motion on their environment, they become plasmatic electromagnetic generators.

REF 38

The production of Graphene
(Release date 25.7.2006)

Repeated experiments and tests in simple static reactors, and tests in more complex dynamic reactors, prove that atomic separation and recombination of matter mafs like carbon and hydrogen can be reached at room temperature and at atmospheric conditions.

We have now indications - through static and dynamic tests in our reactors - that the universe was made in normal condition, which was originally nothing but packages of plasmatic magnetic fields of different strength, which were themselves nothing but areas of plasma or collections of loose magnetic fields energies. Where magnetic fields of different strength in locking to each other, by the principle of their plasmatic magnetic energy (PME), have caused in the first stage the creation of fundamental particles, secondly atoms, then molecules and then matter mafs, clouds and asteroids and then stars and galaxy's".

The big bang theory conditions have no room in the reality of the creation of the universe.

REF 39

Further works on medical research and developments have been written and completed, and will be published on the Foundation medical site in due course.

The process of the reversal of coma: Published in December 2010

Multiple Sclerosis: Published in December 2010

Epilepsy: Published in December 2010

Fibromyalgia: Published in December 2010

INTERNET LINKS

Web site: www.keshefoundation.com

YouTube Channel: http://www.youtube.com/user/keshefoundation

Forum: http://www.keshefoundation.com/forum/

Appendix 1

The unifying field Theory

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Date of release of paper 28.10.2009

Abstract

In this paper the origin of electromagnetic fields or electromagnetism and how they are created within the existence of the other magnetic fields are simply explained.

Discussions

The creation of magnetic field and its interaction with physical matter or other fields always leads to release of electromagnetic fields or energy equal to the energy of an electron.

In the universe, energy equal to energy of an electron, where there are no matters for magnetic fields to interact with, for electromagnetism to be created or to be released, in these environments electromagnetic fields do still exists and function.

Electromagnetic fields or electron energy does not need to be created by interaction of magnetic fields and matters as like in generators of present time, as in the universe electromagnetism is constantly produced due to the difference of the magnetic field strength between two fields and without presence of any matter or physical interaction of fields or fields and matters.

Due to the development of gravitational systems and having the ability to create different strength plasmatic magnetic fields within gravitational reactors cores, with the capability of being able to create and maintain different magnetic field strength in different part of reactors, where these fields are continuous and can be kept at a given constant strength level, that their difference in strength in fields can be equal to the magnetic field strength of an electron, where electromagnetic current flow can be maintained from one magnetic field to another due to their field strengths difference, this has enabled us to create and maintain energy field or elect magnetic fields strength of an electron in a plasma reactor without an electron being present or in motion within these reactors.

Where production of electromagnetic fields can be achieved by the simple creation of two magnetic fields with different magnetic field strength of an electron, that as fields are down levelled, from one magnetic fields strength to another, one can creates a flow of magnetic field equal to magnetic field strength of the an electron, thus the creation of electromagnetic current, or production of flow of electromagnetism can be achieved.

Where electromagnetism or current of magnetic fields of an electron can be created at any level of magnetic fields strength, as long as a strength level difference between two fields in magnetic fields exist, and where, in plasmatic magnetic fields the strength level difference of the fields causes the flow of magnetic fields from one field strength to another can be caused or what is called commonly electromagnetic field flow can be maintained.

Therefore, one can have electromagnetic fields of any strength, this being Matter, Antimatter or

Dark Matter, as long as their magnetic field strength difference between to field strength is equal to the magnetic field strength of an electron or magnetic fields of Matters of an electron. Or the magnetic field strength that can affect the motion of other fields to be equal to the magnetic fields strength of an electron. Then at this stage one achieves the electromagnetic current thought flow of magnetic fields, from one stronger to the weaker field, which the magnetic field strength of the flow is equal to magnetic field of an electron (see Fig. 1).

Electromagnetism

In the real world of existence, all Matters do not have boundaries as tangible matters do, but their boundaries are dictated and created through the space they cover through and by their dynamic magnetic field effects. Where, this space of effect of their magnetic field is called the environment of plasma of these fields.

Thus when we speak of plasma or plasma of an electron, proton or neutron, what we talk about here, is the space and environment where the effect of these magnetic fields of the total structure and the entity of for example an electron can cover.

Thus an electron is in fact nothing but a space in an environment, which the total effects of all magnetic fields of all Matters and fields, can be detected or be contained in.

Thus to this end, when an entity possesses magnetic field strength equal to total magnetic fields strength of an environment within the plasma of an electron, then this entity is in possession of mixture of dynamic magnetic fields of an electron or this entity has magnetic field strength measure of an electron or what is called possesses electromagnetic field.

Where this space being in possession of magnetic fields, by its nature has to interact with other magnetic fields and entities made of magnetic fields in it's surrounding, where these interaction can be attraction (gravitation) or repulsion (Magnetic).

Hence and direction of motion of this space of fields (Fig. 1) or electromagnetic fields is totally dependent on other magnetic fields within its environment, which their environments total strength in gravitation and repulsion dictates the direction of the motion of the plasma of an electrons magnetic fields.

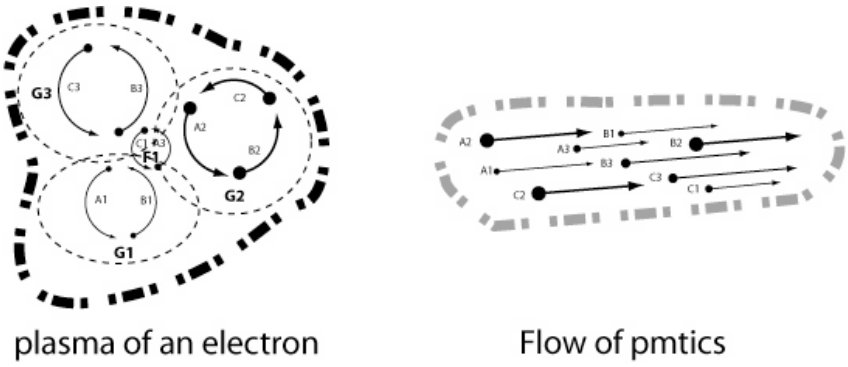

Fig. 1 Magnetic fields concept of an electron and a flow of plasmatic magnetic fields equal in strength to that of an electron.

As I have explained in the book, The Universal Order of Creation of Matters (2009, ISBN 978-94-6087-001-9) the magnetic field strength decay of the plasma of a neutron (Fig. 2) leads to creation of two plasmas of the same structure of a proton and an electron.

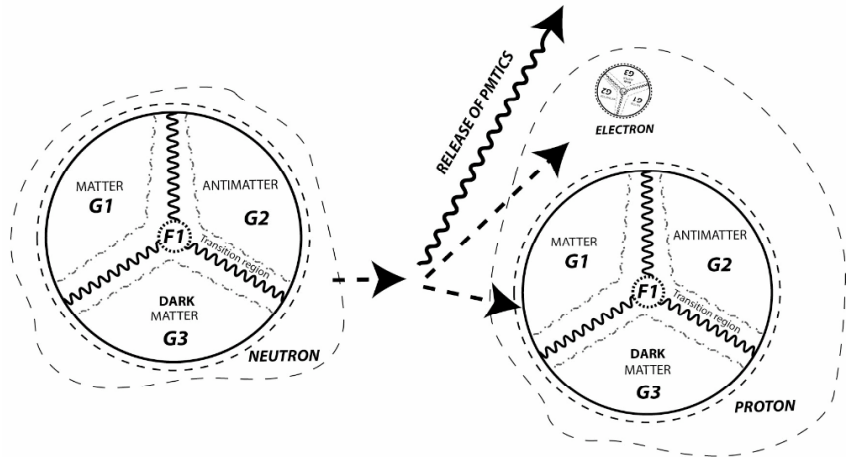

Fig. 2 Decay of plasma of Neutron into two plasmas of proton and an electron.

It is an important to understand that the structure of an electron in fact is plasma and it is like the plasma of proton but in a smaller scale in the mass compared to the proton (Fig. 3).

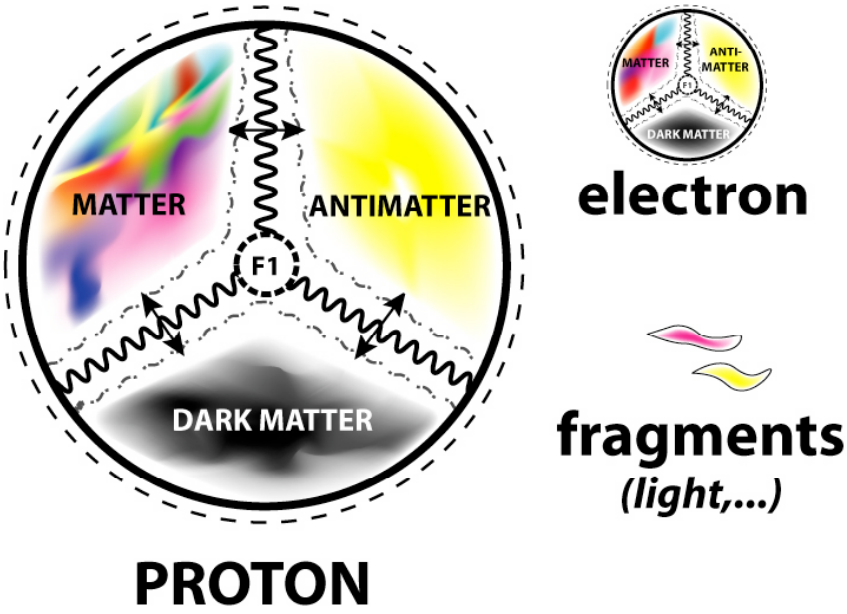

Fig. 3 This showing that proton and electron both possess the same electromagnetic field strength of different Matters, with each entity having different mass of each matter.

Thus the electron is and has the structure of a proton and similarly possesses all its three states of Matters (Matter, Anti-Matter and Dark Matter), and its content is proportion to its neutron plasma prior to its decay into two plasmas of the proton and an electron. As electron is made of electromagnetic field strength of varying strength, this being the reason, why its current and its flow can be influenced by other magnetic fields, as magnetic fields of different strength do influence each other's path of motion and speed of motion in different Matters and matters environment.

Where, at the same time and by the same principle the dynamics (orbits) of the electron around its proton is due to the continuous repositioning (alternating attraction and repulsion) of the smaller Matters parts of the electron in respect to the large Matters magnetic fields of the proton. This is the reason why that the trajectory of the electron is said to be uncertain.

Where, by the same principle, the Magnetic field source of all Matters and matters and their different magnetic fields strength, is the cause and the sources of all effects and matters we observe in the universe.

In the book I have explained how the gravity is created through interaction of two or more magnetic fields, and how mass is the measure of difference between gravitational fields and Magnetic* fields created by the interaction of the same two or more magnetic fields. Thus even mass is magnetic field strength dependent too.

Further the relation between mass and energy, which both are magnetic field strength dependent (1), and as has been explained, energy is the measure of the mass and the rate of it's the speed of transfer in its own Matters medium (this being Matter, Antimatter or Dark Matter medium) from one magnetic fields strength to another depending upon attraction or gravitational strength from one magnetic field to another. Where, this speed is magnetic fields order of magnitudes strength dependent.

Where, transmutation from one magnetic field strength of Matter to another, like from Matter to Antimatters can lead to creation of current or electromagnetism within the given environment of the same plasma itself too.

In fact in the universe one has proton magnetic field current flows or **protomagnetism** (proton-magnetism) too. This current is the flow of magnetic fields to another, which are equal to magnetic fields strength of one proton. These magnetic fields are bases of the cosmic magnetic field storms and have more profound effects on the structural integrity of the galaxies than their weaker counter parts electromagnetic fields.

Further more as now we understand the concept of plasma of an electron and even by the same principle one can understand the principle structure of the plasma of the proton and by the same measure of the plasma of the neutron, hence in the universe we have observed plasmas of neutrons in motion, which these have the same ability as electromagnetism and protomagnetism in motion and these are called the **neutromagnetism (neutron-magnetism).** Where, these are the space in universe, which carry magnetic field strength equal to the strength of magnetic fields of all Matters, and fields, which make the structure of an entity a neutron.

In fact what is called a neutron star, these in reality do not possess neutrons, but these stars emitted magnetic fields strength in the range of Magravs of neutron. Hence tangibility of the neutron becomes later on as they disassociate themselves from the other fields in their environment, and at this point, they create dynamic space or environment or what we call the plasma of the neutron, where these magnetic fields can exercise their influences on other fields within their surrounding.

Further to this explanation, one can simply understand that in the matter world or in the magnetic field strength of matter, the gravitation and repulsion between these magnetic fields are in the level of matter magnetic field strength of electron, proton or neutron.

Hence in the matter world like in solid magnets, magnetic or magnetism or attraction or gravitation, is the attraction between the magnetic fields strength of Matter components of the plasma of electron, proton or neutron of that matter.

Thus is the reason, why in the physical world certain matters are attracted to each other, which they make certain types of molecules or physical matters. Where, the attraction of atoms to make up any matter it is entirely Magravs strength dependent and no other factor.

Where these attractions or gravitation of atoms or molecules in respect to each other, on other hand is environmental magnetic field dependent too. This is the reason why we can observe certain matters in one environment and not in the others. This being due to the fact that environments themselves are made or created or are conditioned due to interaction and Magravs (Magnetic and gravitational fields) of other magnetic fields.

Permanent magnets

Sometimes in the future I will release a book which initial basic work for it already has been set. The book will be titled "The universal origin of magnetic fields". In this book I will explain how magnetic fields are generated and how plasmatic and specific Matters magnetic fields exist in different dimensions.

In simple terms, the Matter magnetic field or what we call permanent solid magnets are mono magnetic fields strength which are at the levels of the Matter components of the plasma of an electron, which are in sequence with the plasmatic magnetic field Matters' of the proton of their element.

What this means is that when plasmatic magnetic field of the Matter components of an atoms' proton and electron field strength become interconnected and in field balance, then a continuous field between the Matter fields of the proton and electron is set to operate, where in the case of for example Iron at earth magnetic and gravitational field strength, this connection is set to be holding and hence creating a permanent magnet.

Hence as one establishes inter-connection between electron and proton internal field strength, then due to the more of supply from the proton, then the matter stays in one field strength for indefinite time.

This being the reason for example why magnetic fields in level of the water molecules, do not have strength to attract for example cooper atoms gravitational level, but can attract other water molecules'.

In fact iron will not be magnetic as it is on earth in most of positions in the universe. This being due to the fact that even permanent magnetic properties or characteristic of all matters are their environmental Magravs dependent. Hence what is permanent magnetic in solar system, its no similarly the same in other solar systems or galaxies.

Secondly magnetic fields or plasmatic magnetic fields are independent of Matter, but dependent of Magnetic field of Magravs of the Matter, Antimatter and Dark Matter of plasma of electron and proton too.

But at the same time it is important to understand that to have long term or permanent magnets, the Antimatter components of the plasmas have to and are positioned that they establish a continues field between the other antimatter component of the atoms of the same matters too.

The difference between conductors and superconductors

The present world of physics has a dilemma with the fundamental principles of conductors and

superconductors. Where this should not be so, if, scientists could understand the real term difference between the current flow of electron and current flow of magnetic field flux equal to the magnetic field strength of an electron.
What this means is that in conductors, the motion of or vibration equal to vibration of an electron causes the flow of current in the matter.

Where as in superconductor it is not the flow of the electron or the vibration of an electron that causes the flow of the current, but current flow is caused by the flow of electromagnetic field strength equal to magnetic fields strength of an electron, which flows through the material.

Where in the case of superconductors' there is no need for vibration or motion of matter, as with superconductors the same magnetic field strength equal to the magnetic field of the an electron flows through the superconductor materials.

Where in the case of superconductors the lattice boundary of molecules or atoms are so closely and perfectly packed that the electromagnetic flows through the lattice structure without a need for vibration of the electrons of the atoms or molecules of that structure.

In fact one can say that the same electromagnetic field, which starts from one end of the superconductor, itself will be traveling out of the other end of the superconductor, irrespective of the length of the material of the superconductor.

In the case of conductors vibration of electron needs kinetic energy and hence loses, where in the case of superconductors the structure of the material is so that no electron moves, but the material has the ability to transfer the electromagnetic fields strength equal to an electron magnetic fields strength, hence literally no kinetic move, no resistance and no loses.

The superconductivity of the matter is lattice position structure dependent and this is usually better observed in sp3 or diamond-structured materials.

Thus in conductors, electrons have to move and in superconductors magnetic field strength equal to magnetic field strength of an electron needs to be transmitted, and as there are no physical motion of matters within a superconductor, thus there are no loses, this resulting in faster transmission of magnetic fields without losses.

Current and impedance

The origin of all motions in any material or environment is always magnetic field strength dependent. Where in the case of transfer of current in any conductive material for electrons to be moving forward or being capable to transfer current, the material or the atoms of it have in respect to their adjacent atoms two behaviours, one is attraction or gravitation and one is repulsion or outward motion.

In the connection of let say a power source to a energy consuming unit like a light bulb, the light bulb creates a position that has lower gravitational and magnetic field strength in respect to the sources' electrons magnetic field strength. Thus this negative gradient in the magnetic field strength causes the flow of the Magnetic field motion of the electron in the direction of the lower strength magnetic field, from the source to the component.

At the same time, as electron vibration is in the forward direction of the magnetic field strength of an electron towards the component and has to be maintained, there is a similar and opposite pull for the electrons of the conductive matter between the power supply and the components too. Where, this pull is the same as the gravitational field force between the power supply and the light bulb too.

Thus for the connecting wire to be able to keep its constituent atoms together, the atoms of the wire need to have equal repulsion and attraction in respect to each other and at the same time maintain the negative gradient in magnetic field strength between the component and the power supply too.

Thus for supply and component to be interacting that flow of the electromagnetic fields are maintain in between them and due to gravitation of one field to another, the reverse field flow or reverse attraction flow of the fields leads to gravitation field or equal to the field strength of the an electron magnetic field or what is call the impedance flow.

Where, the flow of the current equal to the strength of an electron magnetic field outward is the electromagnetic fields and the gravitational pull between two fields or the current of flow of attraction between the two fields, which create the pull of electromagnetism of the fields, is the impedance of the field.

Thus in fact we can compare the current and impedance to two Magnetic and gravitational field of the planetary system, one can say that the outward flow field of the planet or its Magnetic fields are the current or electromagnetism field and attraction or gravitational flow of the planet is the impedance fields in the matter, where the flow of magnetic fields are restricted within boundaries of a copper wire or an electric light bulb.

Note; At the point where the impedance or the current in a wire increase in one or the other, that is the point, where for example the wire separates and magnetic fields of the atoms of the matters can not hold on to their atomic balance Magravs as the increase in repulsion between the atoms of the wire causes the separation of atoms, and in the case large numbers of repulsion between atoms, then the separation or what is called in common language the melting of the wire occurs.

Where in fact the melting is not due to the heat, but in physical terms, the melting is due to repulsion of atoms of the copper due to not being able to maintain constant gravitational fields of atoms of the wire.

Experimental point's observation

In our reactors we a have the ability able to release the energy of protons which has magnetic field strength by order of magnitude of about 2000 times of an electron magnetic field forces.

Thus one can see how small amount of plasma can create and release vast amount of magnetic fields that one can use these magnetic fields in their dynamic state for the production of electric currents or Magravs in a confined of a small reactor, that these can be utilised for motion and production of vast amount of electric current in conjunction with other field within or within the vicinity of these type of reactors.

Further the interaction of these magnetic fields for example with physical copper winding outside the reactor in a generator structure configuration can lead to creation of energy as we are use to in present generators, without single movement or vibration of an electron within the cores of the reactor and only is presence of plasma of fields equal to the field strength of an electron.

Conclusion

The electric charges, magnetic field and gravitational fields are all of the same and of one origin. Where the gravity is due to pulling effect of two dissimilar poles of the same plasmatic magnetic fields interactions and Magnetic field is due to repulsion of two similar magnetic poles, and electric current is due magnitude of the flow of magnetic field from one field to another.

Thus the ***grand Unifying field*** is the magnetic field, and the missing link has been to understand that gravity is the product of interaction of two plasmatic magnetic fields, mass is the difference between the magnetic fields strength of similar and dissimilar field strength (gravity and magnetosphere forces strength Fig. 25 of the book), and the energy is the measure of the magnetic field that is transferred between magnetic fields at the speed that magnetic field can travel within a given matters' medium, for it to be able to move from one magnetic field strength to another, and the electromagnetic current is the rate of movement of the magnetic field from one field to another and where the electromagnetic field is due to magnetic field strength difference and is the equal to the magnetic field strength of an electron.

Thus the unified and common field is the magnetic field, between the gravity, mass, energy, and electromagnetic field.

Thus the unifying theory for the first time is complete and it is fully understood.

Where *magnetic field interaction* makes **the gravitational fields** and the *flow magnetic field from one field to another* creates **the electromagnetic current**. Energies can be created, from any ambient, depending on what one wants to produce or obtain from these currents or fields.

Electromagnetism is created *as magnetic fields strength are transferred from one field strength to another* and in the process of the flow of magnetic fields this leads to creation measurable field movement or measurable current from what is called "electromagnetic fields".

This simple sentence brings the whole of understanding between magnetic fields and its flow from

one magnetic field strength to another and is the grand link between the gravity, the mass and energy and this finalises the long lasting missing link of the unifying field.

Now that one can understands that current is the rate of flow of magnetic field from one strength to other, and "the connection between electromagnetism, gravity, mass and energy" is finally understood. Thus the origin of all things tangible and their effects is magnetic field based and magnetic fields are the origin of all and unifying field in the world of creation.

Reference:

1; The Universal Order of Creation of Matters by M.T. Keshe (2009, ISBN 978-94-6087-001-9) Chapter 5.

*Magnetic field with capital M is the plasmatic magnetic fields created by systems like earth, which this spans beyond the boundary of their physical matter.

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The Origin of the Universe

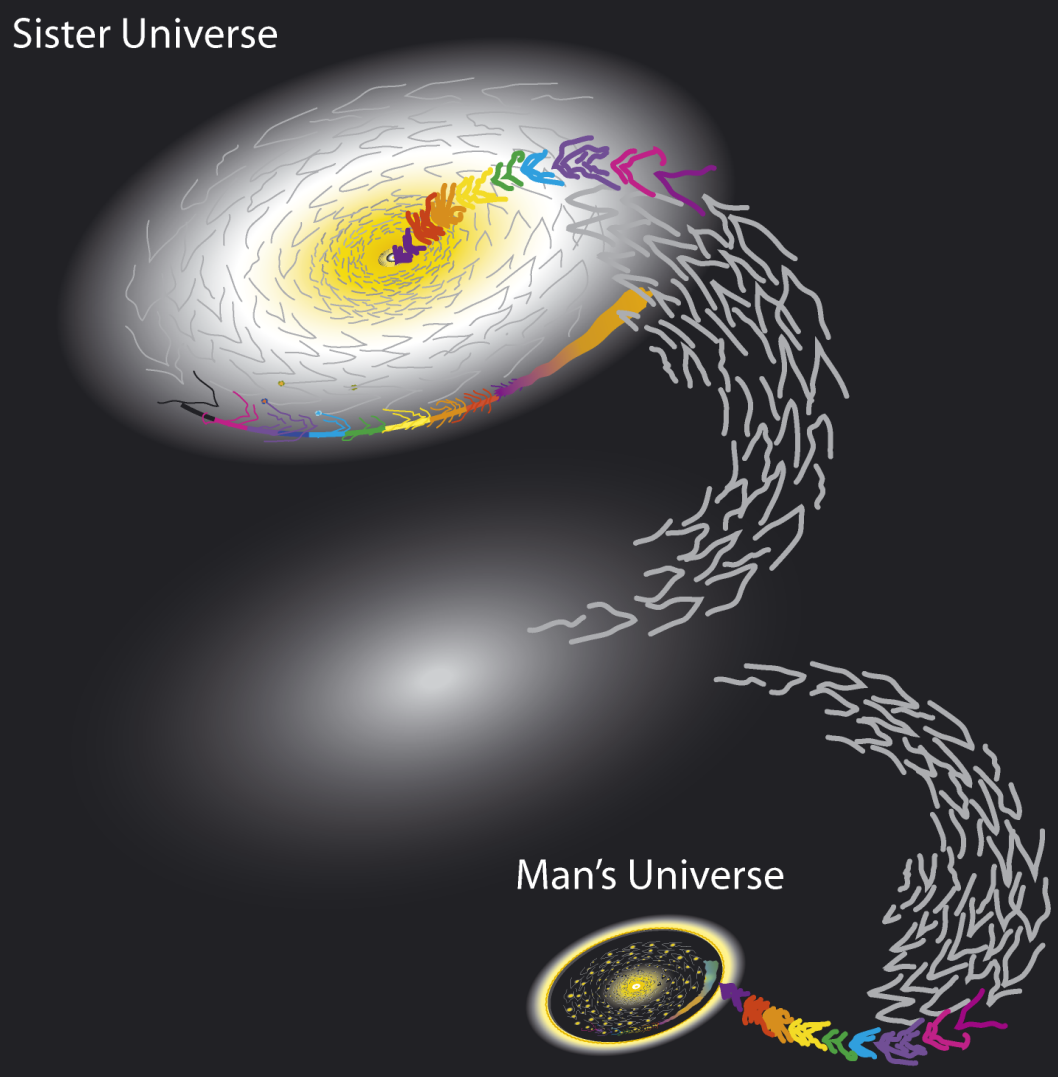

Nuclear Engineer M.T. KESHE

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M.T. KESHE

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The Origin of the Universe

ITNOTGOG

Reflection

The creation of a new universe(s) is as simple as creation of an atom from the division of the neutrons, thus universes are made from division of bigger universes and the same shall be the future of this universe of the Man.

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Forewords

In the past centuries so much discussion has been about the origin of this universe, where in the recent times the groundless concept of the Big Bang theory has taken hold in the scientific world and been considered to the norm accepted fact.

It will be explained in this disclosure that there has been start to this universe, but not necessarily in the way as it has been thought and promoted by the present scientific world due to their lack of the understanding of the universal processes of the magnetic field division and plasma decay as it is the norm in the nuclear structure.

The origin of this universe has to be on the physical realities and in parallel with the rest of the cycles of creations and developments of matters and field as we have seen and observed around us in daily life and the creation of this universe cannot be an exception to rest of universal order of creations and operations.

Introduction

The present visible universe to man is a larger scale in matters and fields of what have been seen by man of science in the structure of the plasma of the neutron, and universes division occurs in the same manner and by the same principle as decay of plasma of neutron to plasmas of an electron and a proton.

The creation of this universe is the replica of the same process as decay structure of neutron but in a larger scale in quantities of magnetic fields strength and matters. This universe is not the only universe in existence and this universe is created through the same natural processes as other elements and entities in the unicos and through decays, division and amalgamation of other fields and elements in the inner sanctum of their mother universe.

Thus in truth there are as many physical universes as there are galaxies and solar systems and man's universe is one of the units in this overall structure of the greater mother universes.

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CHAPTER 1

The Universe

The term Universe to me as a nuclear physicist's has one meaning, and that is the more of the same magnetic fields of different strength as it is in the plasma of an electron or proton. Where, the total behaviour and operation of all magnetic fields and matters created by fields within the operation of stronger fields' strength catchment's in the centre of each entity is considered to be of the same and through the same and similar processes.

Where in the smaller scale entity the like of the plasma of proton we call the bigger and stronger entity to be is the Principal mafs and matter, or what is commonly is called the up or down quark in the present physics, where in the universal scales we call these the central the principal mafs line, where the other components within the plasma of the universe are exactly created and operate as the galaxies, solar and plasma of electron systems within these universes are created and operate.

Thus, the difference between the plasma of a neutron and the plasma of the universe is the size of the mafs of the fields which has come together to create that entity and otherwise all self-contained gravitational-spherical and magneto-spherical entities this being the plasma of proton to the plasma of solar system, the plasma of a galaxy or the plasma of the universe, they are all created through the same principle and operate through the same physical conditions and restrictions.

Where, under certain conditions of magnetic field or gravitational fields strength and positioning in certain parts of the these plasmas, whatever they could be, conditions can be created that allows the growth and suitability condition that clusters of fields can become active and sustain a rhythmic and coherent field interactions that these can lead to creation of certain types of repetition of the same fields in these plasmas.

Where, the repetition of Magravs of these types' fields within these plasmas of different scale can lead to creation and sustainability of continuity of being able to absorb mafs in motion from their environment that these clusters of fields can sustain long-term durability and exist-ability, or what we call to attain the process of life.

Where, different versions of life can exist in the plasma of proton as it does in the plasma of the solar systems as is on earth and different forms of lives exists in the plasma of the universe and universes within the unicos of the creation of the bigger structures of universes.

Thus, this universe or other universes, which have led to creation of this universe and the cycle of the life of this universe in time it will lead to creation of smaller universes, where these in time have all come from one essence of a larger fields entity(s) and in time as they divide and they become weaker, then in time these fields will gather together to create a different universe(s) with different field(s) strength properties (Fig. 1).

Thus, this universe is not unique and there are others, which are created through the same process(s) and there is remote chance that there could be another universe similar to this universe in the ***unicos*** (Fig. 3) of the creation, but not necessarily it will have the exact combination and structure of mafs and positioning of its fields and matters in its internal structure as man's universe.

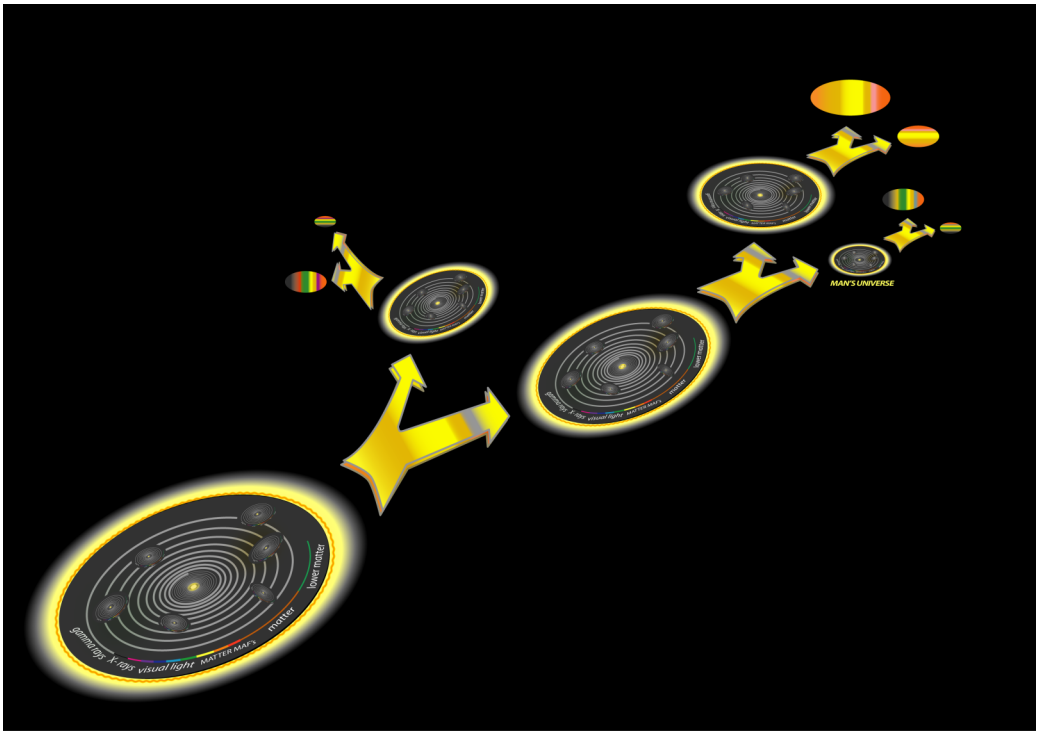

Fig. 1. Creation of new universes out of the division of a larger universe
through the process of decay similar to the decay of the neutron in proton and electron.

In truth the universes are created with a long whisper as one sees and hears gases leaking out of cylinder or a balloon (Fig. 18 C an D), and more like trajectory line depending on the magnetic and gravitational balances of their mother universe and outside environment, which they are getting released into and as the release gases try to find their new position in the new environment, which they have been released into.

Thus the creation of universes are not made with huge sound and explosion but very much with a long whisper as the plasma of the larger universe is dividing and ejecting its matters into two or more environments to guaranty the survival of its overall Margrave strength structure. Very much as the neutron divides and creates the proton and the electron plasmas.

Then as each universe reaches it's own Magravs balancing positioning then it again divides and creates further universes (Fig. 2).

This has been the truth about the creation of this universe in the unicos and in time man will come to understand that the creation of unicos, universes, atoms and plasma are nothing but natural dynamic processes of the interaction of different amount and strength of magnetic fields at different time and position in the overall world of the creation.

Then the question becomes, where did it begin to start with (ref 23), then one needs to understand the truth about the levels and position differences of the origin of the magnetic fields.

This in time will be revealed to the men of real insight in the world of creation as the man at this moment is not mature enough to understand and comprehend the totality of creation of the universe.

If one reads all the writings' of the author, and if! and that is a big if, then the reader will understand the truth about the essence of creation and the origin of the creation. One will come to see its creator way of operation and purpose of creating such an intriguing mesh of unify principles in all levels of creation in all of unicos's.

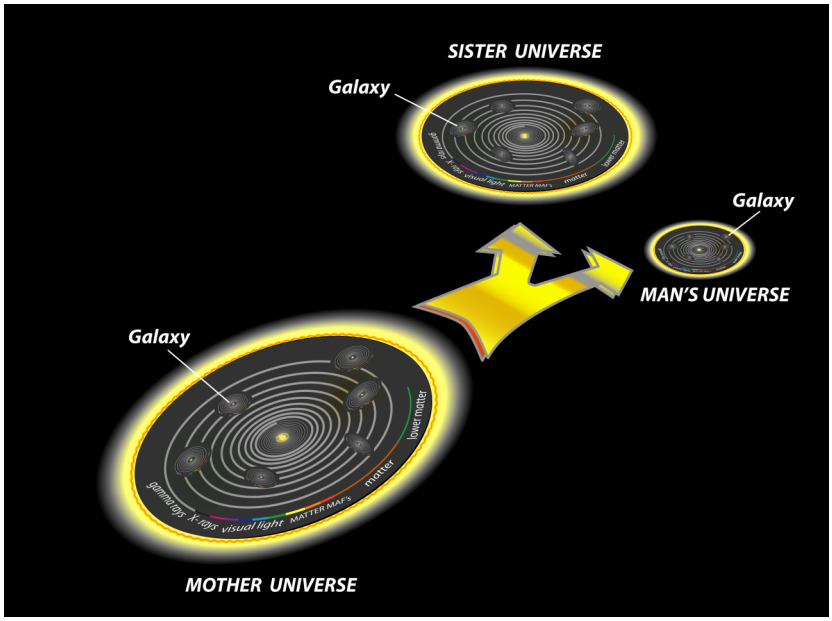

Fig. 2. The creation of Man's Universe after the decay of it's Mother Universe Magravs' maf's.

This shall be the point of maturity of the man to understand how feeble he has been created according to his understanding, where in fact he carries the whole of the world of creation within himself

CHAPTER 2

Theory of Expansion of the Universe

There have been theories and observational data, which support the concept of the expansion of this universe at the present time.

There are two aspects to this expansion theory of this universe, which each one has to be considered on the real terms of expansion of the universe that both can be scientifically acceptable.

In principle, it can be said that this universe cannot expand in to space in bigger unicos's space, if this space was not there for Man's Universe to expand into and to begin with. Thus this universe cannot be the only universal system that exists in the bigger **UNI**versal **COS**mology (unicos).

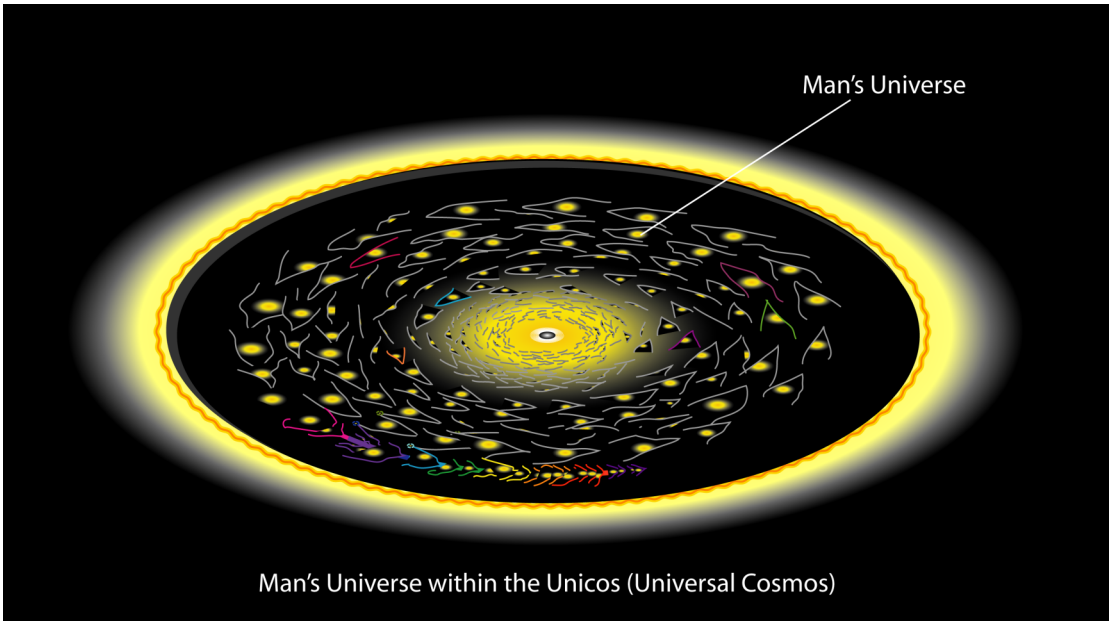

Fig. 3. The Unicos

The Man's Universe is a small fraction part of the unicos universes (Fig. 3).

This Man's universe is expanding due to two factors, ***firstly*** as the principal mafs of the central fields of this universe are unwinding they make available more mafs in the strength of different matters (Book 2) that as these fields open up they lead to creation of new galaxies and other entities, and ***the other factor*** is that the stronger gravitational fields environments which are outside the boundary of this universe's at the same time are pulling on this structure and keep it dynamic (on the same principle of motion of electron around it proton (Book 1, Chapter 19)), and the expansion of this universe in reality is part of the motion of the unicos as in the direction of the motion of all the universes in respect to unicos's internal central Magnetic and gravitational field forces interactions.

This meaning that if one looks at the overall directional motion of all the galaxies in this universe, it will be noted that not all galaxies in this universe are following the rest of this universe's galaxies on a straight overall spherical one line motion of expansion, but in fact part of this universe's galaxies overall line of motion is curvature and is following in the direction of the pull of an outside sister's

universe gravitational field force, which this is necessary as this universe is to find its balance and position in respect to other external fields forces of the same of other universes in the unicos (Fig. 4).

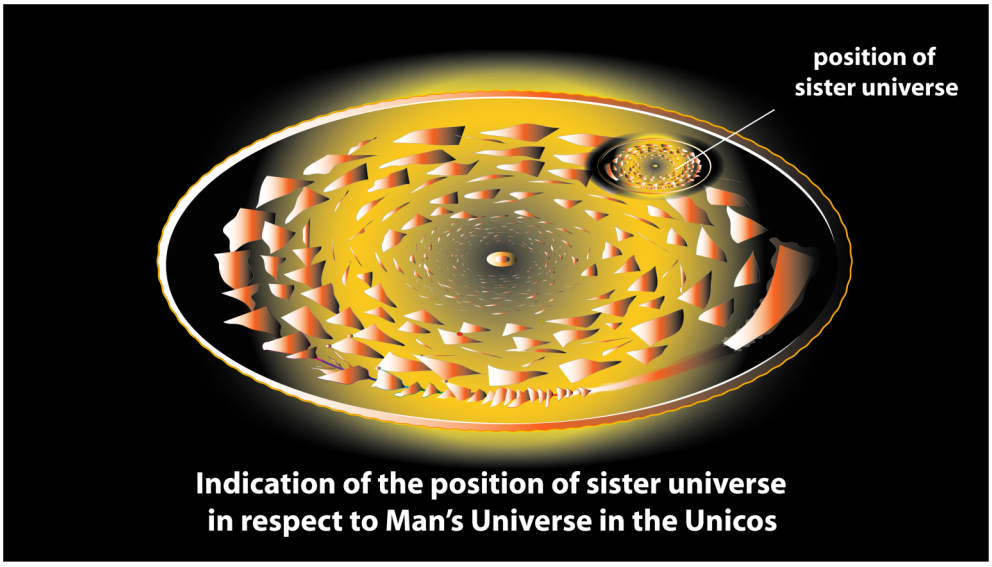

Fig. 4 The position of the sister universe in respect to the Man's Universe.

At the same time each universe possesses a central principal mafs and matter point and or central principal matter line, where these mafs strength and quantity of in this centre point or the centre line dictates the size of any universe and at the same time the Magravs created by this is like a Principal star and line in the centre of the universe that this dictates the position of the universe in respect to other universes in the unicos and this Magravs strength of the central line dictates the matters which are attracted and created in that universe and the matter and content of Galaxies' in respect to itself and no other matter in that universe.

Where, the total mass of the mafs and transition mafs in a galaxies are about less than five percent of the total mass of the universe principal matters and mafs in its central line and its principal star.

Thus the positioning and directional motion of the galaxies in the universe, the same as in the solar systems is dictated by the mass of the Principal mafs and mafs in that universe central principal mafs and star in the centre of that universe but in larger order of magnitude of contents and due to no other factor.

At the same time as the universe is created out of the ejection of the large quantity of principal mafs and matters and have motion in their time of creation, thus it is more feasible to consider an stretched line of principal matters and mafs across a central line of the universe rather than a centre point universe star of principal mafs and matters in the central line of universes.

Therefore the mass of the universes are measure of their principal mafs and matter content, which their Magnetic and gravitational field forces dictates every motion of matters in galaxies in that universe, hence strength of the principal matters and mafs in the central line and central principal star dictates that universe's-magnetosphere, gravitational pull sphere and the mass of that universe.

To understand the process of creation of mafs and matter and elements in the universe, one needs to look at the smaller scale universe, which are similar to the constituents' plasmas and the structure of an atom, its creation from division of the neutron to a simple hydrogen atom with it's plasma of electron and proton, the way they are created from neutrons division and the mafs which are released in the process of decay of the neutron into its environment, leading to creation of the simplest atomic system of Hydrogen.

Where, any mafs realised through and during the process of the division is not necessarily transferred to the newly created plasmas that lead to heating of the two new plasmas of the proton and electron.

Thus there could be some heating of the plasma of the electron and proton during and due to decay of its mother neutron, but this energy may and possibly and do *not necessarily is transferred totally that leads to heating up of the plasma* of the proton and electron.

Therefore the same applies to the division of this universe, when it was created ***from the decay of it mother neutron universe.*** Hence there are no logical reasons that the universe was heated and was hot and it has cooled for elements in this universe to be created due to creation of gravitational field forces.

As in the production of two parts of the plasmas of an atom (1) from the division of the plasma of neutron, the present assumptions in physics that the first atoms in the universe were created ***when the universe cooled***, this theory is not and cannot be correct and in reality *atoms are created through change* ***in the plasmatic fields strength of the mafs of the light***, secondly at the point of creation of the universe, the universe was not hot and there were never high temperatures that the cooling of the universe has led to creation of the first atoms as presently commonly stated. The first atoms and universally all first atoms' the like the atom of hydrogen in all mafs strength in the universe are created through the magnetic field strength reduction of the principal mafs and through no other means.

The concept of creation of heat and high temperatures at the birth of the universe is not observed in the creation of plasmas of electron and proton, when the plasma of neutron decays and divides into an atomic structure, and in the universe there are always continuity and parallels, thus the universe has never been hot that has cooled down to create atoms, and this is the reason why W-MAP (1) shows at present balance heat distribution in this universe (Fig.5).

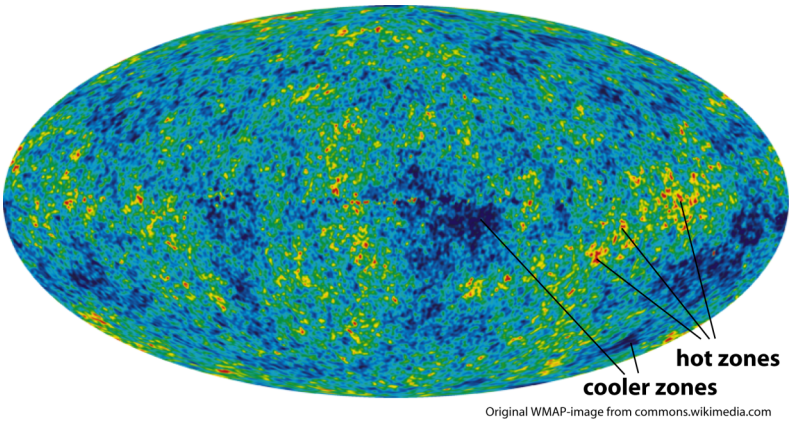

Fig. 5 The universe heat distribution map (W-MAP of the universe)

In truth the current assumptions of initial heating of the universe at time of its birth cannot be true as the initial atoms of the universe and present atoms were and are created from the original principal mafs strength, ***which radiated out as principal lights rays of the universe*** in the centre of the universe and the initial atoms and matters of this universe were not created through cooling of the universe at the point of inception of this universe, which this universe itself is created from the decay and division of bigger mass of another universe as it happens in the division and decay of plasma of neutron in two plasmas of proton and electron. One does not observe heating in the plasma of electron or proton in this division and so be it the same, when the bigger universe divided and led to creation of this universe of the humans. (Fig. 18).

In fact, if! The universe was created by the present scientific assumption then the W-MAP should have shown cooler region in its outer boundaries than the present near homogenous heat distribution, which has been physical observed and from collected data by the publishers of the universal heat distribution map of the universe.

The heat distribution and the heat concentration on the central line of the WMAP confirms that the universe started from a central line in the middle and as the principal mafs of the universe unwinds and reduced in strength (Book 2) then the ***transition mafs*** and the ***matter mafs*** were released and created, and as these were spreading outwards into the space of a larger universe (Fig. 1) from its central line ejected mafs into unicos, then as the Magravs of the principal mafs in this central line region are converted and are reducing in strength, then the overall unified oval-spherical shape explanation of the WMAP come to exist.

Then as the total Magravs of the central principal matters reaches the point of the equilibrium of its forces, then at that point, this becomes the boundary of the universes boundary or becomes the plasma of the universe. At this point where they Magnetic and gravitational field forces cannot hold on to all the mafs and matter of that universe and this become the point of the limit of the expansion and the boundary of the universe and the envelop of the mafs at the given point in time, which are under control of these forces from the central lines principal mafs of that universe, where this expansion line becomes that universe's magnetosphere boundary line.

Then, When a point in the cycle of the life this universe reaches that the overall strength of the Magnetic fields and gravitational fields of the central line principal mafs and matters cannot hold to their overall fields balance, then at this point this universe will go through a division the same as the division of neutron decay and all the matters and mafs at this point rearranged and regroup as and in the principal strength mafs and the universe then divides into two principal mafs of lesser masses of universes, which these new universes are magnetically interconnected as proton and electron do after the division of neutron and then these new universes go through the same principle of the principal mafs light unwinding and the same process as creation of new universe carries and central line as before.

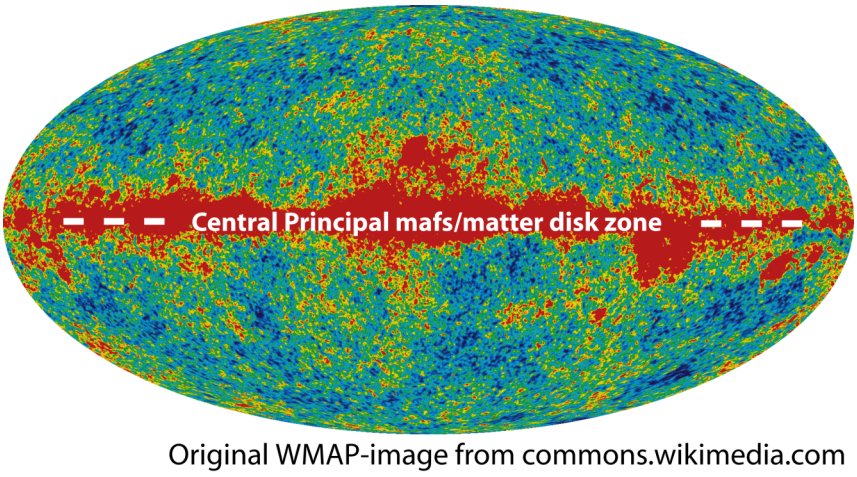

Fig. 6 The microwave heat distribution of the universe shows a concentrated heat in the centre disc of the universe

That is to say through the principal mafs and matters are the way that universes divided and arrive form another universe to start a new universe and as the light in the principal mafs strength unwinds' in its new environment then the new envelop of the new universe starts to be created.

The same and similar process occurs, when the neutron decays and divides into the plasma of the proton and electron.

Thus, the universe is not created as a big-ball of fire which has been cooling down as has been promoted, but in fact the universe is created the like of as ***an ejected principal mafs*** is injected into a new area in the unicos and as the new universe environment and as the principal mafs radiate outward as light of stronger mafs, then as the weaken and radiate outwards in their new environment, then they create the other matters mafs and matters in this new envelop depending on the given pmtics strength of a given region in the larger process of this unwinding of the principal maf and matters and its lights (3) in this newly born and expanding universe.

Therefore: this universe is in fact created inside out rather than what has been assumed up to now that as it cools down to what it is, which this explains why even the universe is observed to be expanding, as the reason for expansion of the universe is being due to the presence of principal mafs in the centre of the universe and as principal lights of the principal mafs radiate outward, these light rays of the principal mafs strength while traveling in their new environment they reduce in strength and this leads to creation and transition mafs and matters, which further on losing its strength creates new matter mafs and matters according to given environments magnetic fields strength and in a given point pmtics, hence the creation of new mafs and matters and so forth, which this leads to creation of atoms and molecules and stars and so forth in this universe and its galaxies and solar system through the same principle.

Thus there has never been a Big Bang and the current appearance of the expansion of the universe is due to the principal maf, which as unwinds, it creates the expansion of the universal-sphere of this universe (3).

This method of the creation of the universe now explains' why there is a central gravitational matter concentration in the universe and as this pull is centred in the dynamic principal central line, which the original principle mafs were ejected out of the mother universe when it divided, where the injected principal maf of the universe at the time of its inception can be seen as the red line in the W-MAP (Fig. 6) which the more concentration of the mass of the principal matter sets in the central disc of the W-MAP and as these principal mafs create their own magnetic interactions, hence these create their own sphere of gravitational and Magnetic fields and thus the central gravitational of the universe is in the centre of the denser point of principal mafs of the centre universal heliosphere of this universe and as the more principal mafs are unwinding and spread outward are reduced in their strength they principal mafs become transition mafs and further as they reduce in strength they become the matter in the unisphere of the universe and as the principal mafs open up and reduce in their environment this leads to creation and expansion of the balloon of this universe in the unicos, and this explanation resolves the present mystery in the scientific world that, how and where the central gravitational pulls and the expansion of this universe which has been observed by scientists of the universe comes from.

This is how the plasma of the neutron decays and divides into plasma of the a proton and an electron too, where the different quantities of matters and mafs of different strength of the neutron are divided and injected in two new areas in their environment, that their overall Magravs of all their mafs are as original components that the plasma of the electron and proton concurrently maintain their overall Magravs of the original neutron Magravs (Fig. 7) and then as the matter and mafs unwinds and interact they reach given overall Magravs level and position as the new plasmas of the sub-components of the atom are created.

Where, this process of division of neutron due to micro-level of masses involved, these appear as an instantaneous process of creation of proton and electron, where the same applies to creation of universe and larger universes divide to guaranty their overall existence in the unicos.

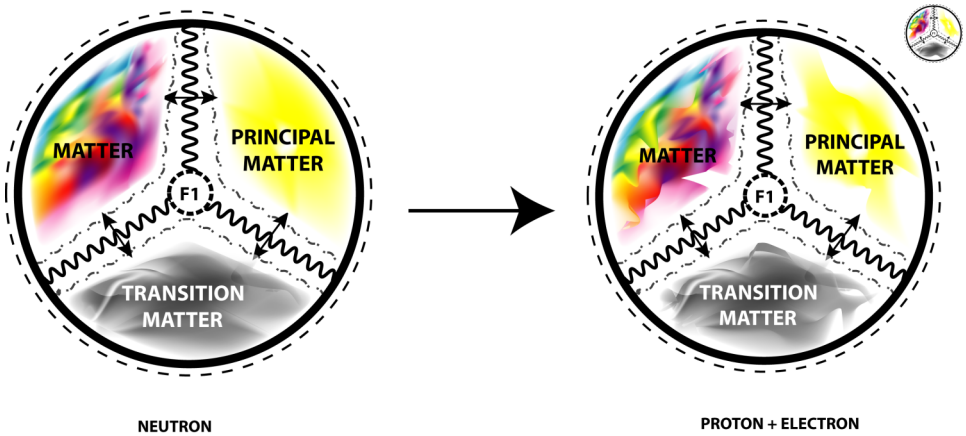

Fig. 7 The conversion of the plasma of neutron to plasmas of the proton and the electron.
The same process is considered to occur when the universe divides (3).

This being the reason why the proton and electron in their process of creation ***do not get heated*** as a Big Bang theory suggests but as different portions of principal mafs of the neutron which become parts of the plasma of the proton and electron unwinds and expand from the central line of their centrally disc which they are rejected into their environment by the division of the neutron, and as *their principal maf unwind* in this disc to the ***transition matter*** and then, as they weaken further, they create ***maf and matters in tangible mafs levels***, the like of the plasma of the proton and ***all other fragments of pmtics and magnetic fields*** in these new plasmas (Book 2, Chapter 1 and 2), in these processes of creation of new smaller plasmas of there is no Big Bang and there is not heating of the plasma of the neutron and electron (Fig. 8).

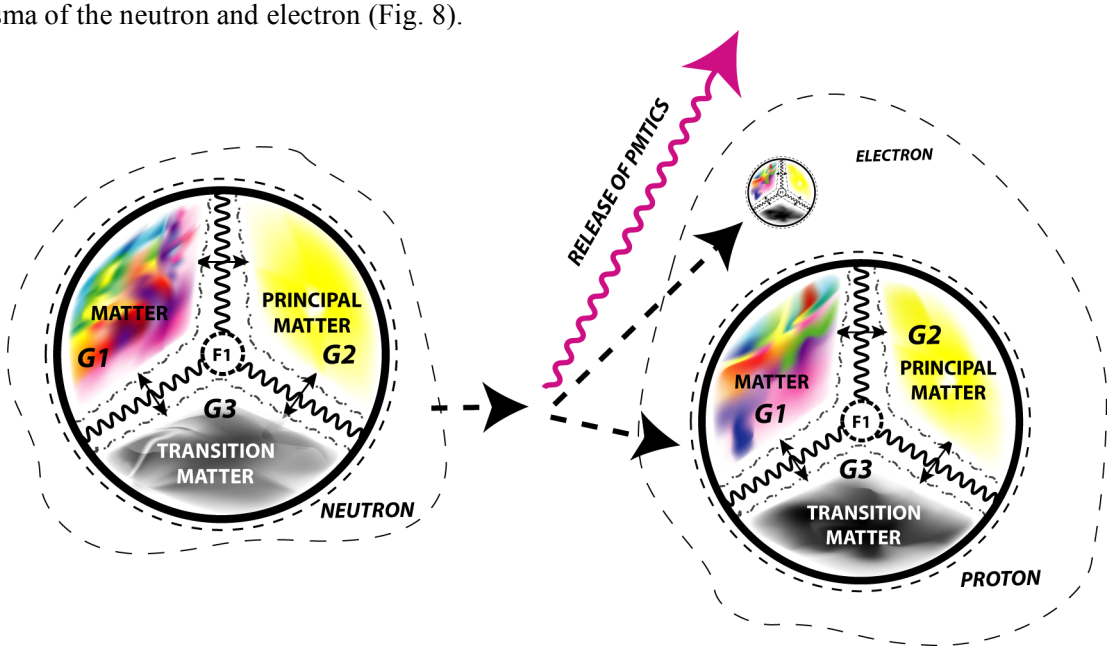

Fig.8 Decay of plasma of neutron in plasma of proton and plasma of electron.

Hence the theory of Big Bang is not correct and has no meaning in the real world of creation.

The same process can happen with the ***ray of the light*** originated from principal mafs strength (what is called the **principal light**), when this principal light arrives in the principal mafs strength environment and hence the first fundamental neutron principal plasmas and principal atoms' can be created in that given environment through the same principle as atoms are created in the matter strength environment (1).

At the same time the Magravs strength of the **P**rincipal **U**niversal **L**ine **M**afs (PULM, the central line of the universe)(Fig. 9) dictates the position and attraction of other matters, stars and galaxies' in that universe in respect to itself.

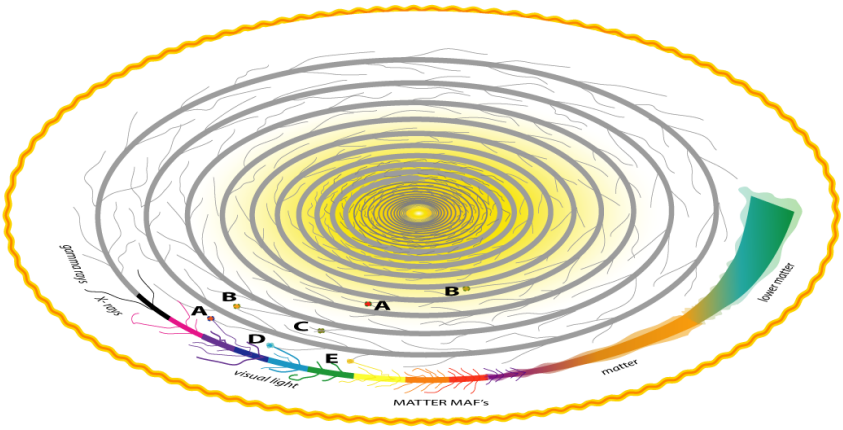

Fig. 9. The Principal Universal Line of Maf's.

The total mass of the matter mafs is about five percent and transition mafs of the matters about fifteen percent in any universe and is the same as with galaxies, solar and plasma of proton systems in the universe. The reason for this is due to the principal mafs (Fig. 10) and mass conversion and conservation and motion as they move within the plasma of the universe and lose their strength and reduce to transition, and matter mafs. Secondly if any mass more than this ratio of principal mafs is converted and stays within these systems, these can lead to unbalance and faster division of the entity, this be it plasma of the proton, neutron, solar system or universe.

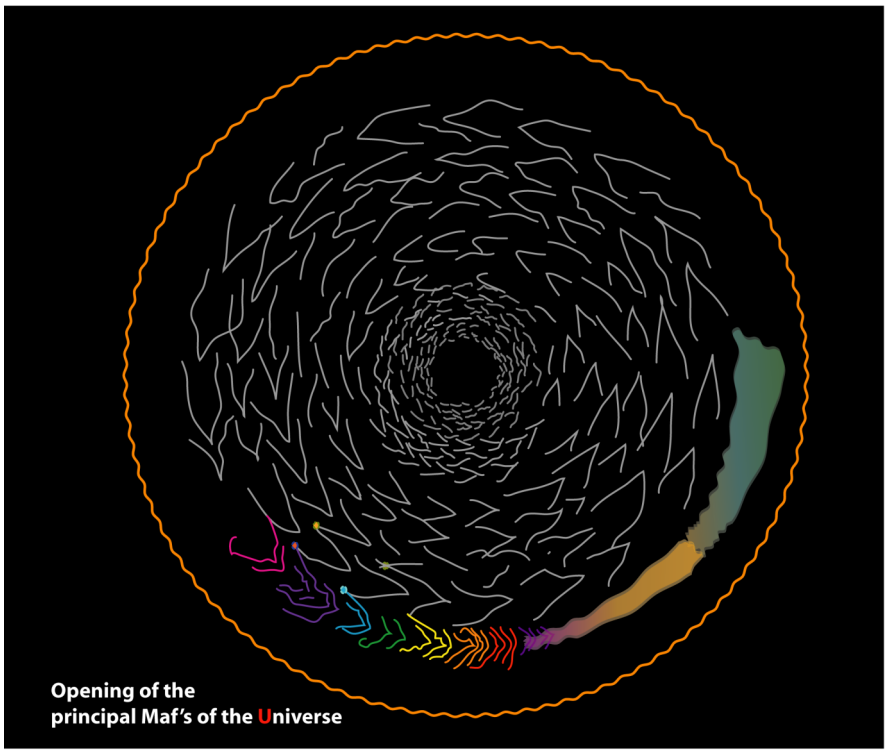

Fig. 10. The principal maf's of the Universe.

Thus, the positioning and directional motion of the galaxies in the universe, the same as in the solar systems is dictated by the mass of the principal mafs and matters of the principal mafs of the universal line star mafs (pulm) of the galaxy and no other factor.

Therefore the mass of the universe is the measure of the difference in the interaction of the Magnetic and gravitational fields' forces that the principal mafs contents of the principal matter in the universe can produce and maintain. The same measurement principle applies with the galaxial and solar system.

Once these principal stars are formed in the universe then the Principal stars and the lights which are releases and radiate outward from the pulm becomes the means and the supplier of pmfs and nourishment source to all entities in the internal plasma environment of that universe, these be it galaxies, solar system atoms and so forth (Fig. 11).

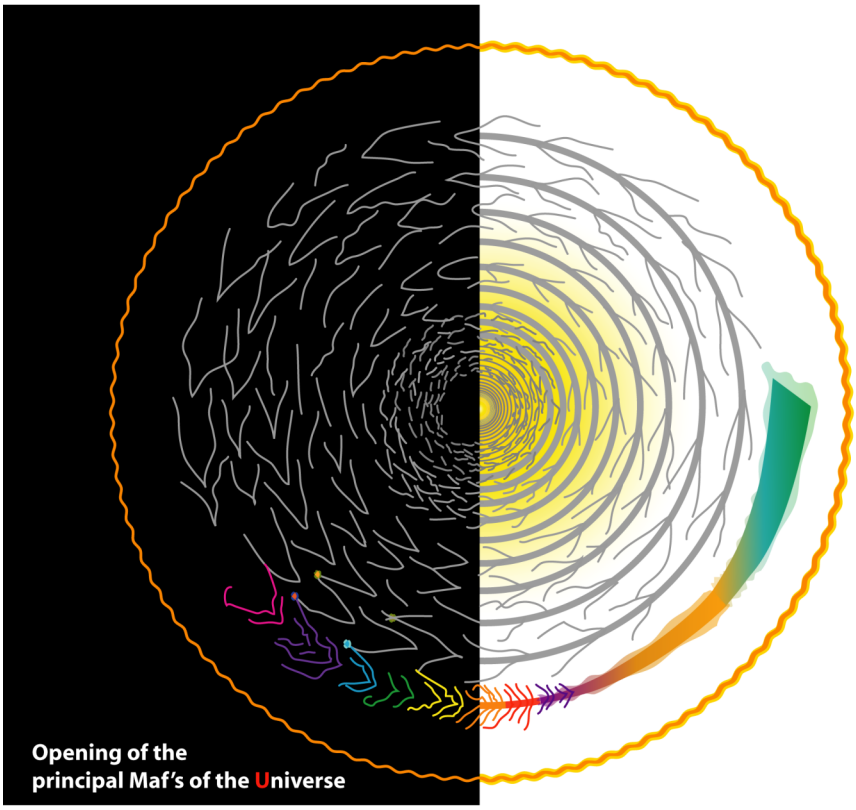

Fig. 11. The unwinding of Magravs in an entity.

The same applies as to the galaxies, solar systems and plasma of proton systems too, where in fact in the centre of each galaxy, solar system and plasma there is the principal star (Fig. 12) with a plasma of principal mafs and matters and as these unwind, expand and spread within the Magnetic and gravitational fields which they create, these releasing, opening's and loosening of principal mafs in the pulm leads to creation of transition and then matter strength mafs and matters in the envelop of the magnetosphere of the universe leading appearance and creation of principal matter in the galaxies, solar and plasma systems, exactly the same as it has happened and has led to the creation of the plasma of a neutrons, stars, galaxy's.

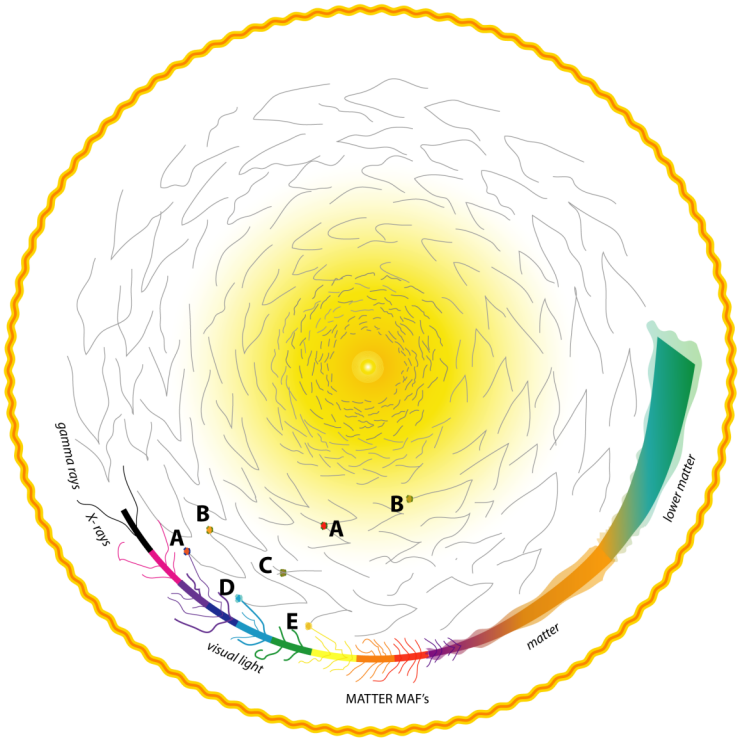

Fig. 12 Plasma of the Universe: any entity can be created anywhere in the Universe as long as the appropriate maf's strength of that entity is reached through reduction or interaction of maf's of the Universe

Where, A(s) are the universal magnetic fields oceans in the form of fields forces or light, where sea of lights are created by the interaction of the fields which these can be in any light strength of matter, transition or principal magnetic fields strength, B(s) are universal matter oceans, C (s) are the transition matter and mafs oceans, D(s) are galaxies, E(s) are sub-matter mafs and matters oceans in the plasma of the universe, where all these entities they are created due to and through the interaction of the residual fields which are released by and through the release and separation of fields from principal mafs and transition mafs and matter mafs of the main or the subsequent divisions of these mafs as the principal mafs of the universe open up and divided and expand in the structure of the plasma of the universes' Magravs (Fig. 13).

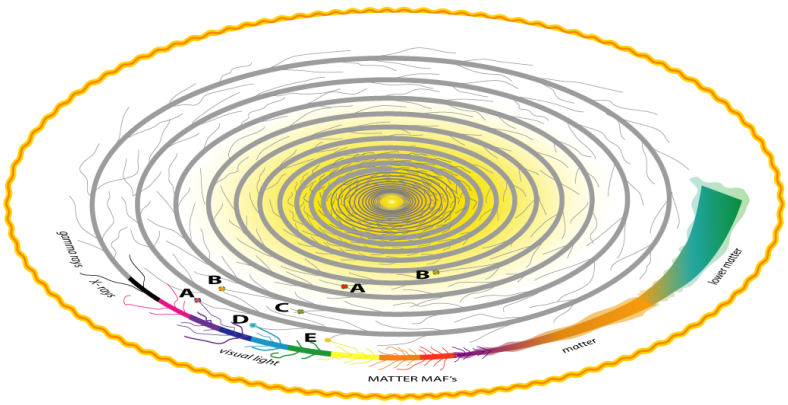

Fig. 13 Plasma of galaxy: any entity can be created anywhere in the galaxy as long as the appropriate maf's strength of that entity is reached through reduction or interaction of maf's of the galaxy itself or its Universe's maf's

Where, the same principle applies to the structure of the creation of stars and planets in the galaxies and solar systems, and where the same process of creation of matters and fields is applied in the creation of entities in the plasma of neutron, proton and electron.

Where, A can be the point of creation of a star, a B the black hole, C the creation of planet in the solar system, D the cloud dusts and E the magnetic fields ocean of the galaxy.

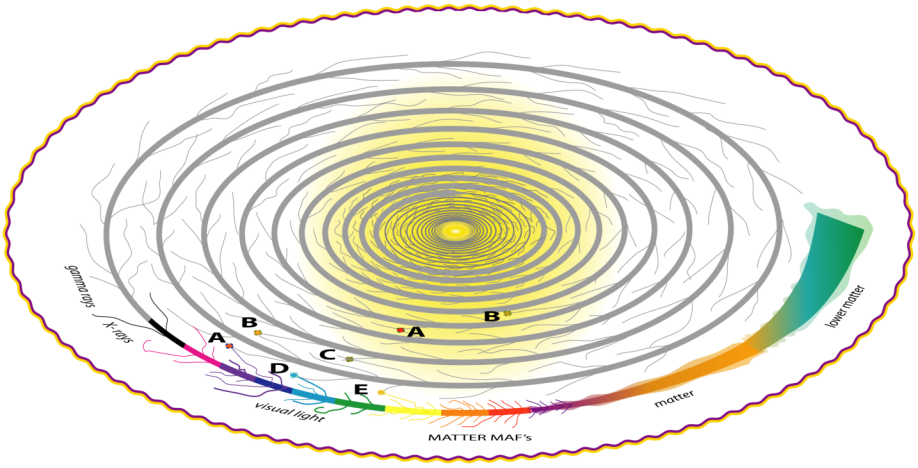

Fig. 14 Plasma of Neutron: any entity can be created anywhere in the neutron as long as the appropriate maf's strength of that entity is reached through reduction or interaction of mafs of the neutron and it's galaxy itself or it's Universe's maf's.

Where, A can be the principal matter, B the transition matter, C the matter, D are the fields in motion, E are dust of matters in creation and motion within the plasma of the neutron (Fig. 14). Where even the creation of the X-rays and gamma rays are normal features of the plasma of the neutron as one observes in the process of the existence and operation of the galaxies (Fig. 15) and universes plasmas.

The universe as the plasma of the proton can expand according to the amount of the transition matters which can travel away from the principal matter line, and hence the expansion of the universe or plasma is dictated by the amount of the transition matter and mafs and speed of by which the principal mafs and matters can release which the pulm can hold on to the total Magravs of its structure. Now this can explain why this universe through WMAP (Fig. 5 and 6) shows to be more oval than sphere in shape.

On the other-hand the shape of the WMAP being oval can explain the same characteristics as one observes in the major composite gas planets in the solar system as they are not fully sphere in shape, but have more flat poles.

The oval shape of this universe confirms the existence of a central principal disc point in the centre of the universe and the flat disc spread shape of the principal mafs distribution in the central line disc of the universe.

At the same time the uniformity of the speed of the objects in the universe and galaxies shows the connection between the principal mafs release in the pulm.

This confirming the real process by which plasma and atoms are created and appear across the universe, where their accumulation leads to the creation of cosmic dust, stars and planets.

Fig.15 Galaxy (Source: Hubble)

Where, the concept of the cooling of the universe leading to creation of the atom becomes to be meaningless, as the creation of plasma and atoms is totally due to reduction in the mafs strength of the principal mafs to matter mafs strength and has no connection with heat or cooling inside or in any position in the plasma of the universe.

Where, the heat in different points in the plasma of the universe has only have the effect once the plasma of matter is created, then the environmental temperature in any point in the universe ***only dictates if the plasma in matter state will manifest itself as gas, liquid or solid.***

Then in fact this brings a question mark on the theory of time and space as then time will have no meaning as a new plasmas of atom can be created in the far corners of the universe from high speed mafs of the principal mafs which left the pulm, where some mafs go through the mafs strength reduction before arriving in the same point in the plasma of universe.

Thus; the theory that the whole parts of the universe are created about the same time and the more ancient galaxies are in the centre of the universe in some extent ***is not correct***. As matters in the universe move as their Magravs positioning dictates and hence some components of the universe move in such a rapid way which are not visible to the present technology available to the man.

CHAPTER 3

The method of transportation of mafs in different mafs strength in the universe

In all dimensions of the universal mafs strength, these be it principal matter, transition matter or matter environment, for the plasma of these matters to travel with the maximum speed and minimum loss of mafs to their environment, in all dimension of the universal mafs levels, the spherical shape plasma of the matter transforms itself to elongated plasma of itself or what is commonly is called as a ray of light (Fig. 16) (Book 2).

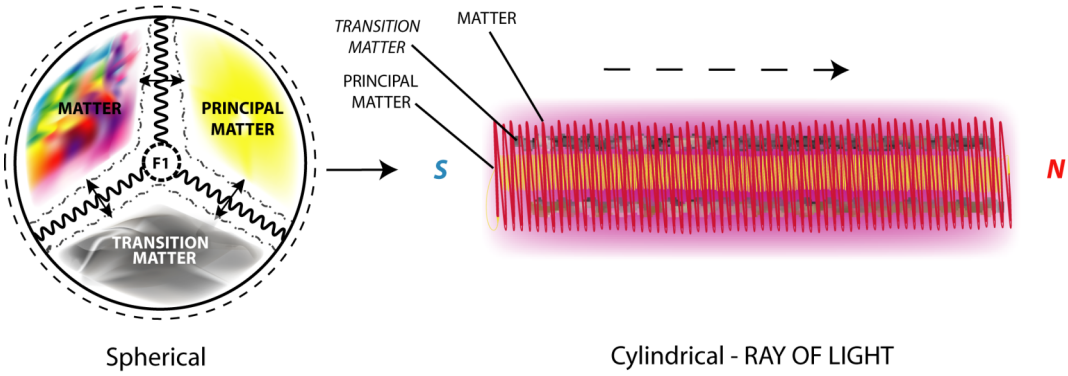

Fig. 16. Conversion of the spherical plasma of a neutron in a cylindrical ray of light.

That is to say for example as the principal light goes through the Transition fields regions of the universe, then the transition mafs and matters of the ray will come to take their position ***on the outer layer of the ray***, then through this process less pmf are used in interaction with these fields and matters of their environment and hence less friction and less loses of mafs of the ray, and in these interactions there are very little loses through the Magravs of the mafs of the transition mafs of the light.

Then any faint lights produced in the interaction of these rays outer mafs transition matter and of the same transition matters in the universe, where there are very few interfaces of the collision between the ray and the environment Magravs this gives the universe a dark but translucent effect that one can see through the universe.

In a way this interaction of rays transition mafs and universe's transition mafs is the cause and the reason for the invisible transparent structure which allows the production of universes discreet light that one can see through this universe but blocks the opportunity that one cannot see the lights from the universes outside this universe.

The most important point to understand is that light exists in all mafs strength levels in the universe, that is to say *there are lights in the principal mafs strength* as much *as light in the transition mafs strength* and *as man observe there is light in the matter world of the man*.

It has to be point out, that as one hears sound boom in the matter world when one reaches the speed of sound in the matter environment, or what is called the sound barrier, the same applies when the systems developed by man reach's and passes the ultimate speed of the light in the matter environment too.

That is to say when rays go from lower level strength to higher level strength mafs, one will hear audibly and will feel the vibration of the passing the light barrier.

This sound will not be a one of boom as when the sound barrier is broken, but due to the spectrum of the light transition forces, this noise will be more like a continues varying and long boom and roars. Therefore one will hear a long term tunes and not just one of noise.

This applies the same as one passes the transition mafs environment into principal mafs strength too.

Thus light speed barrier will always be the speed of the light according to man's mafs of his amino-acid and the visible light in all mafs strengths, which are the universes' creature's structures' mafs strength dependent.

When, the man become habitual to travel with the speeds faster than the mafs of matter strength, then on frequent bases man will hear a roar of a noise as passing the light barrier limit.

There are lights in all levels of the matter and mafs strength in the universe, that is to say there are lights in the principal mafs strength specific to that mafs strength environment, which is not necessarily the same as the white light as one observes in the man's matter world and at the same time each light has its own speed which is dependent on the mafs strength of its environment.

Therefore there are lights in the transition mafs strength as much as there are in the man's matter levels.

There are rainbows (Fig. 17) in all levels of the mafs strength in the universe as there are in the matter mafs strength of the earth. The light in all mafs can diffract according to the Magravs strength of the mafs of the given environment.

Fig. 17 The colour of rainbow according to the Man's pmtics strength in Earth Magravs strength.

CHAPTER 4

How matters are created in the universe

In the spans of the solar systems, galaxies and cosmos as the **gans** and **atom of the hydrogen** interact, ***they create the first seeds of creation of more powerful Magravs*** that leads to ***attraction and conversion of other light rays*** *in the universe* into gas, liquid and solids, which these interactions leads to creation of galaxies, stars and planets, where the light itself in different strength becomes the tools of the division elements the like of the hydrogen for it to start the cycle of creation of lives and the creation of intelligence in all corners of the universe (6).

The ***gas and gans of hydrogen*** becomes the dynamic fuel source of creation of the magnetic fields necessary for the creation and establishment of the stars and solar systems and their planets in some parts of this universe, as the interaction of different magnetic fields of gases and ganses lead to the creation of the initial Magnetic and the gravitational fields needed for these celestial bodies to be created in the universe.

The existence of nano materials in the core of the planets like earth has been initially disclosed (1), now it can fully be understood that how these nano materials in state of nano matter, gas and gans become to exist in the centre of these celestial entities and be the initial seeds of their creation once the mafs of the principal matter is reduced to the mafs of the matter strength.

It is important to realise that due to internal structure of the nano materials in ***layers*** and in ***gans state***, these materials by large keep their structural integrity, where high external environmental matter conditions like pressure and temperatures cannot affect the total structural integrity once they are in individual matter gans compound state. This meaning that internal structure and molecular binding of gans and nano materials in nano layers or composite structures ***will not be affected by the matter environment's the likes of temperature and pressure condition of the environment***. But the gans will be changing in its structure when conditioned to high-level dosage of radiation. Thus such entities have monoid characteristics.

For example, this is one of the reasons, why the DNA of the human being is venerable to changes and absorption of radioactive energy and in the radioactive environment or to burst of radiation, as the real structure of the amino-acid of ***the protein of the DNA chain is made of gans of matters*** and not solid matter of the same gases (6).

Thus, gans is the state of the structure of the light which has changed from dynamic cylindrical plasma of magnetic fields to a dynamic spherical entity of the same matter mafs, which its state of manifestation in matter environment is internal gravitational dependent and not environmental condition dependent. That is why one can observe the same element in coldest and hottest regions of the universe and still misreads them as atomic matter rather than nano-atomic or gans of the same matter.

Thus as mafs strength of the universe changes according to mafs available in any given part of the universe, this allowing the production or appearance of plasma of any matter which the mafs strength allows it become in that point in the universe.

Thus this why in one part of the universe one observes the hydrogen as in some parts helium or even gold can be observed without actual existence of any hydrogen atom any other matters.
In some part of the universe the matter take up their nano crystal structure, that the same matters looks to be the diamond structure of its parallel matter in another environment in the same galaxy or universe's environment.

Thus matters are created and to be part of the structure of star and planets or being in the universe according to the mafs strength of the environment and then they become appear in state of gas or solid according to the pressures and temperatures of that same given environment.

CHAPTER 5

The theory of decay and division of the universe(s)

In reality all theories which have been put forward up to present time have no parallel in the universe as has been observed by scientists.

In the universe everything and every process has parallel. In the universe there are always parallels due to the magnetic fields laws of interaction, and hence there cannot be any divisions from these laws.

At the present the scientific world has been intrigued and encouraged to understand the phenomenon of the creation of this universe and scientists have to unravel the mysteries of the creation of this visible universe.

In fact the creation of this universe as is visible to the world of science cannot be any different than any other process in the world of creation, and this universe has been created through the same principles as the rest of the magnetic plasmatic nuclear and atomic additions and divisions of entities in the universe.

This meaning that the present universe is created though the same method as has been observes in the division of the neutron's plasma into plasma's of electron and proton or smaller and/or bigger components of the same Matters.

Hence to follow the principle of the universal order of matters, this universe is created from the division of a larger universe that the man's visible universe is or can be the smaller part of the division.

The reason for it being the smaller part is that in the present cosmological term, this universe is following the attraction of the bigger part and hence it is always in the motion to follow the Magravs of the bigger sister .

This being the reason why it looks as the universe is always expanding as the external field forces pull and pushes the boundary of this universe mafs and as part of the universe has been noted to be collectively following different path of motion than the rest of the universe.

The portion of the independent motion of this universe is the indicator that where the bigger portion of the division of the pervious universe is in respect to the man's universe.

It has to be said that the original universe through the same principle of decay of neutron to plasma of electron and proton (1) and similarly as the decay of heavier atoms to two or more lighter atoms, through the same principle as the mother universe of the man's universe as itself has been created and was created from the division of a larger universe through the same method of decay and division.

The difference in the universe creation and decay is in principle merely is the size of the plasmatic field content in comparison to plasma of electron or proton after nuclear decay and division of the neutron.

Thus in fact this present universe itself is and was created some billion of years back from the division of a larger universe (Fig. 18). Where in Fig. 18 A to G, step by step the phases of the unbalance of the Mother Universe, it's opening and as the fields disperse in to two different zones in the unicos, where

these fields interactions and Magravs positioning with Magravs of the Mother universe leads to the establishment of position and placement of two new universe entities, where the same process of decay of neutron and creation of Hydrogen atom occurs.

Hence every time as it is the same with division of the plasma of neutron to plasma of electron and proton, in this division the new universe carries the characteristics of its mother's universe, but due to reorganisation of magnetic fields and their strength the new universe will have a new and fresh cycle of time, which this shows as the age of the new universe.

In fact this being the like of giving birth to a child, where the age of the mother is irrelevant once the new seed of life is created and once the child is born, even though; the new child carries some of the same DNA fingerprint of the parents. The new life has its own cycle of life and its own timing.

Therefore the theories of Big Bang and M-11 as has been proposed in the past and present have no meaning and have no parallel principles in the physical world of creation of universe. One does not see the same Big Bang , when the atoms and neutron go through division or decay, hence this cannot be the same in the division of universes too.

Then if this was so, then every time an electron is created from the division of neutron there must be a Big Bang , This proposed principle is nothing, but showing the man's and scientific worlds lack of knowledge and ignorance of the real terms and parallel entities existence of all units in the universe.

In fact once the division is created and the universes are created, then the rest of the materials and matter content and how they organise themselves in that universe is more or less follows the same principle as before and once the fields are released within a given Magravs which the fields can created in interaction with each other, then the size of galaxies, stars and planets and even creatures within that given Margraves strength of the newly produced universe are determined.

The mafs and matters as arrive directly into the new universe are mafs first which can change to matter then divide between the two universes and then new matters are created in the new universes independently according to the Magnetic fields and gravitational fields in interaction with each other these mafs can achieve to maintain and create. Thus all universes in content are not and cannot be the same in material and mafs strength, and content of each universe are dependent upon the internal interaction of fields which are transferred into the new universes.

The new structure is dependent on the fields within the new universe and their internal motion of the new universe is internally determined by the total mass which the interaction of the Magnetic fields and gravitational fields of the universe can master.

This new universe has all the attributes and mafs of its mother's universe, where the subsequent production of mafs and matters like Principal matter and Principal Matter, planets, solar systems and galaxies and so forth, are nothing but the consequential outcome of all other effects in a given universe.

Thus in other universes there could be ***no physical matter*** the like of hydrogen and where for example hydrogen can be *only in nano or gans state only*, thus the life in these universes will be in order of fields and mafs strength rather than matters in this visible section of this Mans' universe.

But if this universe has the same structure as its mother's universe and co-birth universe, then this universes can be a micro replication of a bigger version, where these universes are macro version of the total universe in the greater universe.

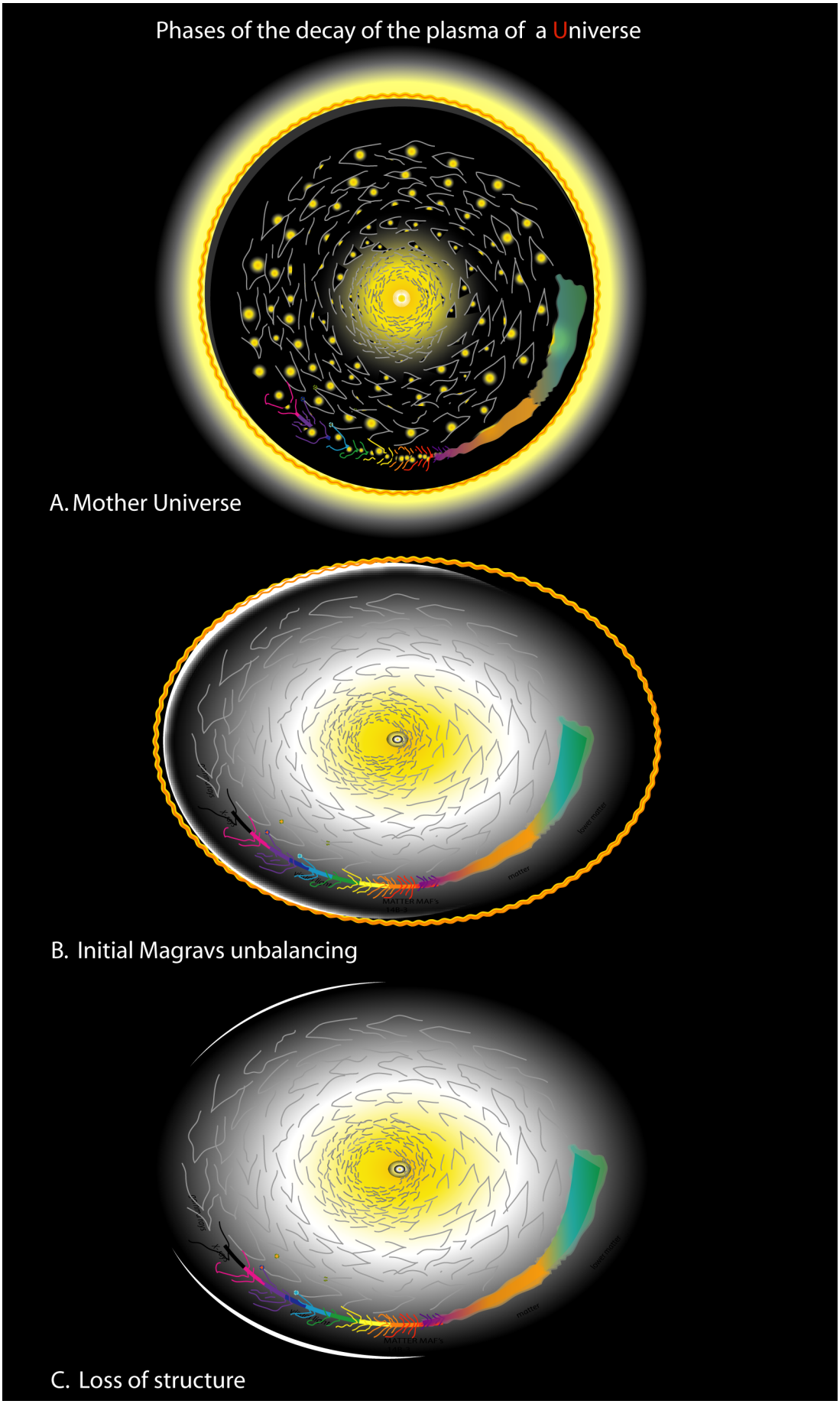
Phases of the decay of the plasma of a Universe
A. Mother Universe
B. Initial Magravs unbalancing
C. Loss of structure

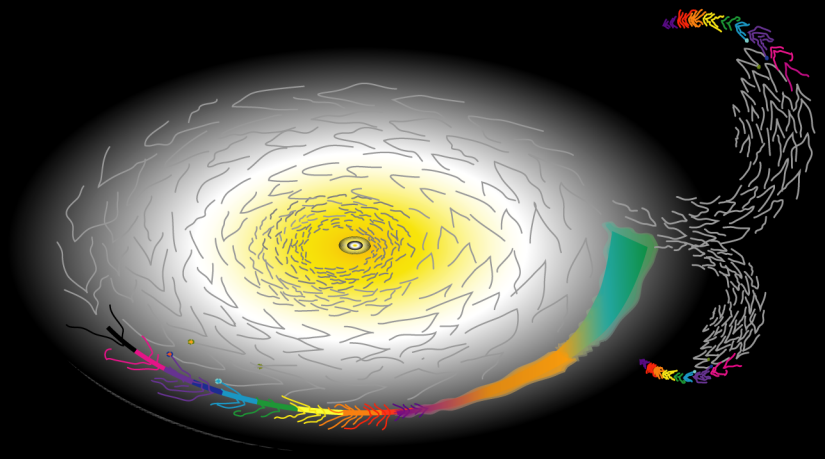

D. Dispersion of fields of the plasma of the Mother Universe in the unicos.

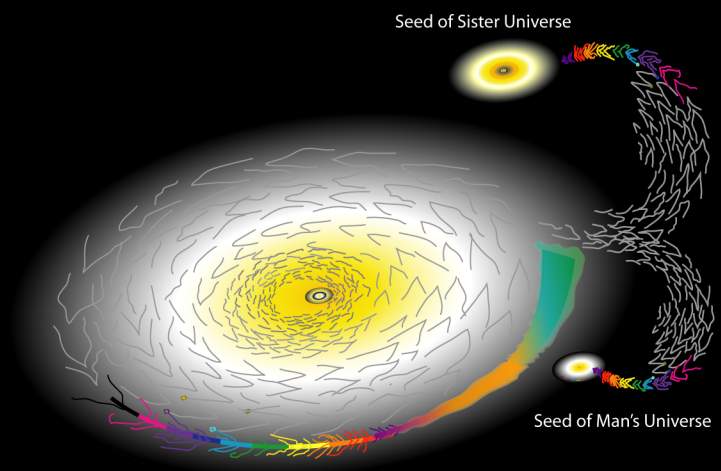

E. The creation of the seeds of the new universes from the decay of the Mother Universe, where the two new universes have to maintain a magravs positioning in respect to the Mother's and each others magravs.

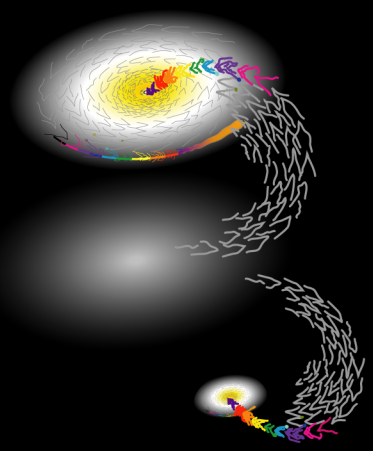

E. Full splitting of the Mother's Universe plasma into two new plasma's

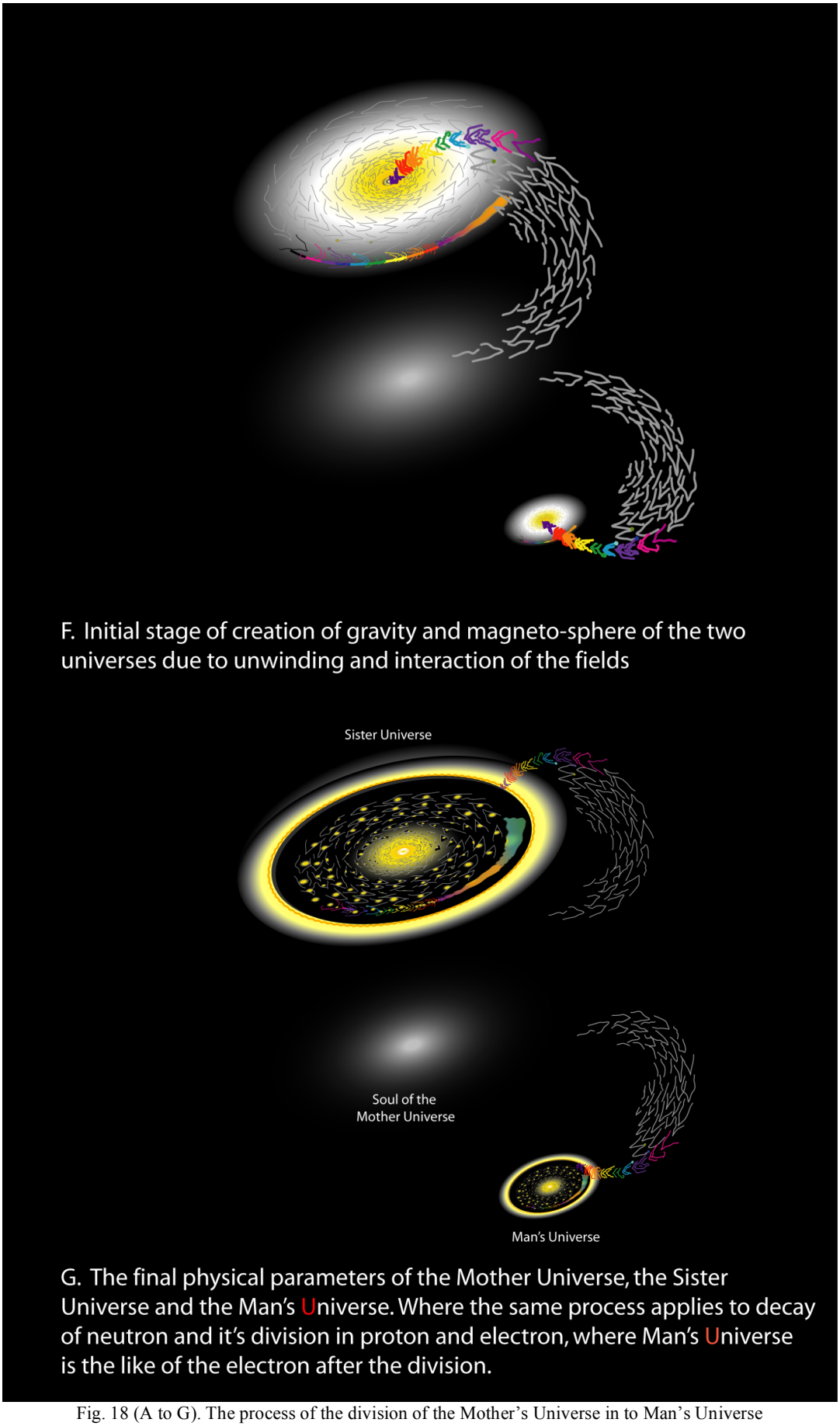

Fig. 18 (A to G). The process of the division of the Mother's Universe in to Man's Universe and it's Sister Universe

Thus, in fact in the bigger portion of the original mother universe which the man' universe is partly created out of it is bigger or smaller mass portion of the original mafs of the mother fields, then the bigger portion or co-birth universe of this universe, due to the larger mass of its content, this universe's galaxies and stars can be much larger in proportion in comparison to the galaxies in mans universe and conversely due to larger Magravs of the internal structure of the larger portions, the beings within these universes can be smaller or they be totally different in operation than the beings in the mans universe.

It has to be said that life in any form is not exclusivity of the Earth, if this is the mind-set of some, this shows their lack of understanding of universe and how it is created and not the real truth and how fields and matters operated and function in the universe.

CHAPTER 6

The Man and his soul and their connection to the universe

In the structure of the Principal mafs centres or the Principal star or what is so called the Principal stars in the centre of galaxies and mafs and matters in the centre of stars and in giant planets and even in the centre of some planets, the Magravs of these objects seems to possess a stronger or larger than the mass ratio for such an object, that the object possess and covers a stronger Magravs forces than usually a matter in these regions by the present in the world of science knowledge become apparent. The reason for the stronger Magravs of these objects comes from the multiplicity in the Nano magnetic mafs' and matters' and layers in the inner structure layers in the sanctum of these objects.

In understanding the operation of different mafs of matters in the universe and the process of the reduction in strength of these mafs to reach the lower levels light, visible light and tangible structure's like atoms, then one should understand that the structure of the man's body will not change as the physical structure of the man goes through and from matter to transition matter or from transition matter to principle mafs and matters strength's environments.

The reality about this, is that the plasmas of the atom of the structure of the man, like the individual atoms, which are active in the structure of fundamental amino-acid molecule of the human body, these are all made of plasma of mafs of universe and for the proton or the electron of let say carbon atom in the amino-acid, this plasma of the proton has in its centre principal mafs and maters as well the transition mafs and matters and finally the matter mafs, which is its tangibility state which make matter visible to for example the eye of the human.

But once these plasmas of the tangible matter structure of let say proton and electrons of the carbon atom cross the barrier from the light mafs strength and matter fields to transition mafs and matters field strength, or even the body of the man crosses the principal mafs and matter strength, then at each point of field strength crossing, that part and components transition or principal mafs and matters of the plasma of the proton of the carbon will come to operate and interact in that entered field strength zone, and hence the integrity of the structure of the human being physical body will be maintained, but indifferent mafs strength level.

This meaning that the man will be still intelligent and will have the use of all its faculties, but the body will operate through the principal mafs of its plasma rather than present matters mafs strength of it material world strength.

Thus the man is not restricted to life in matter world only, but life in all dimension of strength of the mafs of the universe.

The reason for the plasma of the human body having the ability to operate in any mafs strength, is due to the fact that the atoms of each cell of the human body operate in the gans state of matter and not solid state of matter, which this gives the plasma of all the elements of the human body to cross mafs strength barriers by calling up on their mafs components of their environment.

That is to say the gans of the carbon in the amino-acid of the human beings' will bring forth and operate through it transition mafs strength in the transition mafs environment. Then the same gans of atom will operate with its principal mafs components in the principal mafs strength environment.

Thus the body of human will not be destroyed or evaporate in different plasmatic magnetic fields strength environments as it orderly crosses them.

But the body of the man will be destroyed if the mafs of principal mafs strength is applied to it in the matter strength environment, where in this case the mafs and the matters of the atoms of the man become diluted as a minor part in the mafs and matters of the applied fields.

Therefore man is part of an inclusive pattern of field's in motions in the universe and nothing more or less can be attached to the existence of the man.

The man in physical term is an entity and in and through his soul the connection of the field between himself and the other fields in the universe.

The physical body of the man is the like of the planet earth, where it has mass and its magnetosphere which expands beyond the physical body, but its total magnetic fields and gravitational fields determines its position and relation with other matters in its solar system and in a small way it determines the position of its star in its galaxy and, then the position of star determines in a small way the position of the milky-way in the universe and so forth.

Thus the soul of the man is the external connection of the operation of the physical body of the man in the universe, it is part of one and inclusive realty of interaction of the whole.

Therefore the soul is part of the operation of the universe and every creation which can extent the effects of its overall magnetic field to others which can affect their position and existence is in possession of a soul.

Thus soul which magnetic fields created and expand beyond the physical body of the man is not exclusivity of the creature but it is the common denominator and common link between the man and other creatures of the God and has direct effect on the operation of the rest of the universe.

Therefore the man's body due to the interaction of its atoms protons and electron and neutrons magnetic fields, this object creates its own magnetosphere and its own mass and this body is and has to be in possession of magnetosphere which shows the working of the magnetic fields of its constituent matters and its subcomponents and fields.

Where, in the physical worlds as the same as the solar systems possessing magnetosphere as so do the star and planet, so does the body of the human through the same physical principle possess the magnetosphere, which is so called aurora of the human body, the field of the aurora is part of the soul of the man, but is fact the total effect of the internal interaction of all fields of the body which creates the Magnetic field and gravitational fields of the body and their interaction on each other which leads to the interaction with their fields in the universe, this overall output of the fields of the body of the man is the soul of the man.

Thus; all dynamic plasmatic matters in the universe possesses a soul. But the man has the intelligence to allow the interaction of its soul with others. Therefore through this principle the man is responsible for all his actions and he stands answerable to other souls in the universe. As he decides how these fields which partial and fully control through the Magravs of the matters of his brain how and what happens in its interaction with other souls during its physical existence.

Hence the man has to understand, that universe and others, whom this universe has been created from and the universes which will be created from the division of this universe in the future are all interconnected and operate through the same fundamental principle magnetic fields.

Therefore there are parallel universes to this universe, with the difference in the measure of their magnetic fields and their position in their given environment.

Thus as we have the same and similar electrons structure's and protons structures in the same structure of an atom, this structure of positioning of electrons and protons is the same for all known atoms, then the same applies to the universe and the souls within them too. This meaning that there are similar universe as this universe in the greater universe and other universes which this universe has been created from or it shall create.

It has to be said that at the same time the matters in the universe have the same universal language of communication, where in the universe the common language is the basic plasmatic magnetic fields, based on the first plasmatic magnetic field strength of plasma or the simplest atom of matter of their environment.

This language is universal and once the man on earth understands this phenomenon and can fully measure the magnetic fields strength of the electron Magravs and uses this as the base strength, then man will be able to understand and communicate with rest of soul possessing creature of the universe. Until then, the search in the sound waves to look and try to communicate with other creatures of the universe is a primitive picture and shows the lack of mans understanding of the world of the Creation.

Therefore the gravitation, magnetic, radiation and other similar properties and interactions of the field(s) on each other in this and other universe(s) decides on how and the way the creatures in the different universes and in the man's universe would look and behave.

But in a essences they are all made of the same building block of *MAGNETIC FIELDS AND IN ITS AND THEIR INTERACTION OF DIFFERENT STRENGTH AND TIGHTNESS OF IT IN THEIR ENVIRONMENT*; This determining how tall and short and if one has eye or uses the interaction of fields to interact and communicates with other creatures of its environment, universe(s) with or without physical tangible or visible so called body.

May be now it can be understood what has been said that in the universe,

I have made man in the image of myself

CHAPTER 7

The creation of gravity in the universe

At the present time the scientific world uses the terminology that when the gravity took hold then that was time when the matters in the universe began to be created.

The reality is that as when the universe is created from the magnetic fields of the previous universe(s), then the content of the new universe is nothing but a soup of different strength plasmatic magnetic fields, then as these magnetic fields interact with each other usually laws of magnetism they attract or repel each other, where at this point the attraction fields of these plasmatic magnetic fields become the ***gravitational fields*** forces of the universe and the repulsion field forces of the magnetic fields become the Magnetic fields forces which the same fields create.

This interaction of fields in the plasmatic fields always enclose itself in the form of an envelope, which this always in the universe leads to creation of the spherical shapes of all entitles, this be it plasma of a neutron, earth, or universe?

The interaction of field and attraction fields which leads to creation of a circular motion of the gravitational fields as the fields in respect t the matter have keep their gravitational positioning too.
Thus the spherical shape of the fields is primarily due to the gravitational field and positioning combined together which this causes the magnetic fields in the universe to close and created a full circular; and hence the creation of spherical objects in the universe.

Therefore the gravitational filed forces of the new universe is created by the interaction of its content magnetic fields and in fact gravity is created by the natural laws due to interaction of two opposite polarities of two magnetic fields, which as these opposite fields interact they create attraction fields or what commonly called the gravitational field, where the strength the outcome field from this interaction of fields expands beyond the boundaries of the two original fields, this leading to the creation of an envelope or area of the effect of this new field that attracts other fields to itself and the strength and compactness of this new field leads to creation of gravity which in the universe this leads to creation of Principal matters, transition matters and then visible matter of galaxies , stars and planet and so forth.

The creation of gravitational fields forces in the for example the plasma of neutron, its strength and contest by large measure is dictated by the universal gravitational fields forces and not in full by the field which leads to creation of the neutron to start with. In the universe the creation of the neutrons are dependent on their universal gravitational fields forces. To this effect not all neutrons are all the same and not all neutrons in the different universes have the same gravitation a magnetic fields forces and dimension.

In fact the human race has to learn that what it is observed by them as the physical matter in fact is only a fraction of overall content of matters of the universe created through creation of gravitational forces and what he sees are not all of its matters.

This meaning that the universe has other matters and mafs contents and as the man's technological and intellectual capabilities expands and increased then man will come to see more of the realities of the universe.

CHAPTER 8

Insight into the realities of the working of the Universe and what they bring about

In the recent past scientists have talk about the term dark energy and anti-matter, where these covers the part of knowledge which they cannot find explanation for within the present understanding in the scientific world. For example the term dark energy is used to understand the forces, which is nor explainable and neither does fall within the conventional present world of physics too.

In this disclosure the terms like the matter, transition matter and Principal matter are used, where these terms are and have become recent addition to man's scientific vocabulary, where these can more precisely explain the rang and the medium, where each magnetic field in respect to their fields and its own magnetic fields strength is and would behave.

In the universe the same as in the physical matter world there are sources of magnetic fields, which are stronger in magnetic fields strength and some which are in the transition and there are some which are in between the strong and the weaker field strength.

In the physical world one called the stronger fields source the star, where in the plasmatic fields of the universe, the stronger fields' plasmatic regions or fields are easier to be called the **Principal fields**, which their interaction leads to creation so called **principal matters** (anti-matter), which these are real physical entities, which have been unknown to man up the recent times.

There are **transition fields,** which are in between the Principal matter fields in strength and the matter field's strength, and as these are in balance in between the both fields of Principal matter and matter world, and then these do not create visible light when they interact with Principal matter or matter fields strengths. Hence they tend to be like ***transparent*** and ***translucent*** in their environment and hence they give the appearance of the darkness to their environment.

When, magnetic fields are in motion they are called energies (Book1), where these translucent fields as they are in motion from one state of mafs to another they create what is called the Transition energy (commonly called the dark energy) which this explains the Transition energy mystery of today's science.

Then there are in the universe fields, which are the weaker plasmatic fields region in strength, which these fields are in the human protein plasmatic Magravs strength that they become detectable or what is called the visible or tangible matter.

Therefore in simple term, the Principal matter is the like of the sun and sources of energy in the universe, the transition matter is the magnetic fields strength fields travelling from the stronger field to weaker field, and the matter fields are the like of the planets of the solar system.

There are no mysteries about these fields, energies and matters, except in the lack of knowledge in the man's progressive and advancing science about his universe and living environment.

- Where, in the universe one sees the effect of the stronger Principal matter's fields as in the centre of the galaxies as the star do in the solar systems. The present world of science will come to realise the order of fields are all time kept and all followed the same rules and principles in all levels of the universal creation and created.

- This meaning that in the centre of the galaxies the entity which recently called as the Principal star of the galaxies, this entity in its centre have nothing but Principal matter magnetic fields, which their interaction leads to creation of strong gravitational fields. Where, this centre of Principal matter is covered by the transition fields as they are on their way to visible matter fields strength or what one observes as the dark environment around the central Principal matter region, hence the term black hole (Fig. 19) or Principal star, which this darkness region is only due to the balance transition between fields in motion and the fields which the rays are travelling through.

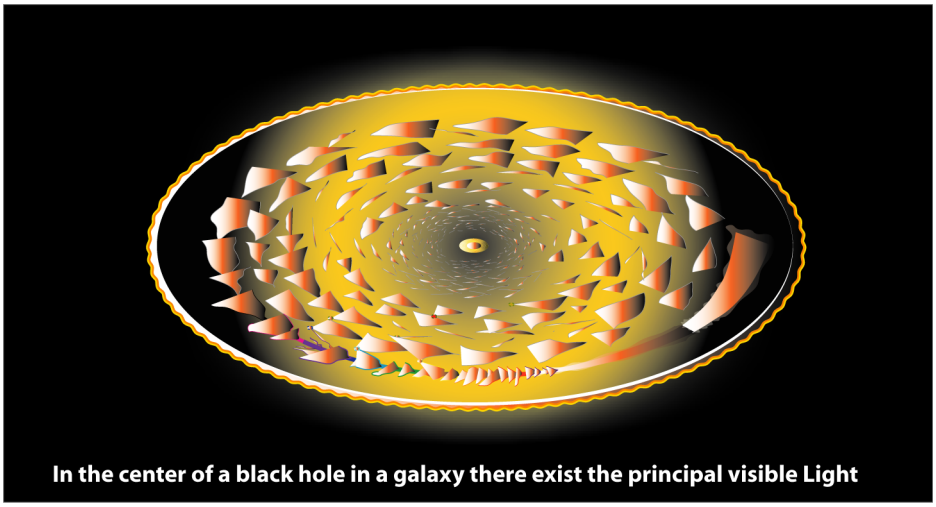

Fig. 19 The Principal Light inside a black hole.

- The existence of the principle fields and matters in the centre of the universe with its strong gravitational fields is the reason as it seems that the Principal star is eating everything and absorbing everything this being rays or matters, where in fact it is the gravitational field forces of the Principal matter in the centre of this dark spot which are creating these large pulling fields.

- The size of the Principal star in the centre of the pulm is the combination of gravitational fields and Magnetic fields forces or the field's strength of the Magravs of the Principal matter content of the Principal star.

- In a sense as the Principal star extracts more material from its environment in the universe, then a position is reached that the total Principal matter absorbed by the Principal star from the objects, the like of stars, planets, plasmas and so forth, a point of criticality is reached that the gravity of the Principal matter fields exceeds the Magnetic fields of the Principal matter and that these forces cannot sustain their balance, hence the Principal star has to release enough material and fields that it can reach equilibrium between its two fields, and that is the point where the principal stars release vast amount of fields and matters without actually causing the division of the universe (Fig. 20).

- Where, these massive fields and matters of massive principle fields released will disturb the equilibrium of the universe as they travel the spans of the universe and in case can lead to creation of new galaxies and even stars and new mattes suddenly out of nowhere in the universe. These principal storms are very much like the sun storm one observes on the surface of the sun. In this process of rebalancing, it can observed in the universe, like as in galaxies that their Principal star has sodden volcanic eruptions in the rest of universal galaxies central principal stars as they absorb some of the principle matters and fields which they receive

through the universes principal field eruption and the Principal star spewing of the surplus mafs and matters in to its surrounding environment.

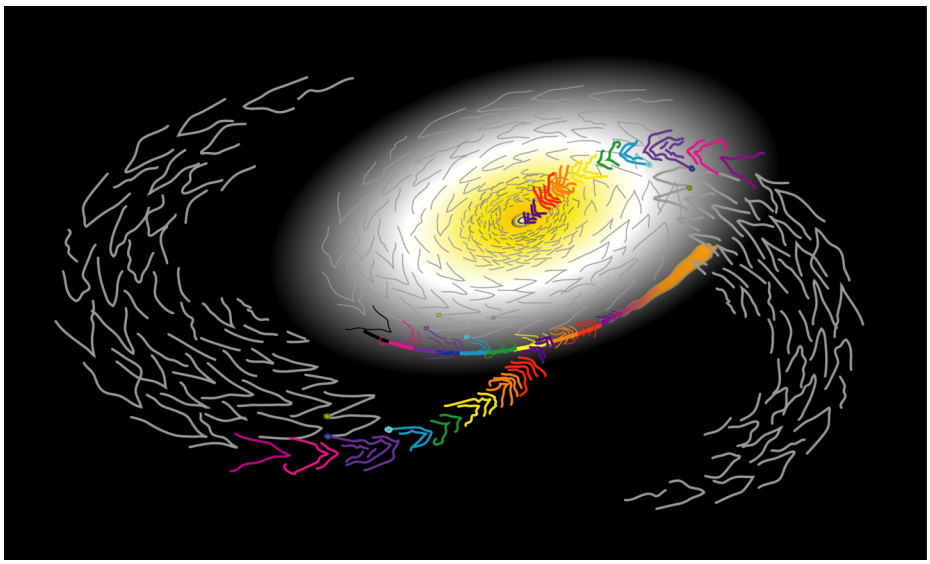

Fig. 20 The absorption of matters and fields by principal stars of the universe or galaxies.

- The principal star of the galaxies as much as the same with the principal mafs and matters of the stars of the solar systems or their sun have observed this process in smaller scale. Where up to now man has not have had the tolls to observe that when the star of its solar system not only release the visible matters and releases huge amount of magnetic field into its heliosphere, but at the same time through and amongst these eruption of the Sun huge amount of principle fields and matters are released into the plasma of the solar system, which these have not be observed by the scientific world due to the lack of appropriate tools.

- The ejection of principal mafs and matters from the surface and right from the centre of the sun is an essential part of sustainability of the fields and matters within the solar system and essential part of the creation of new atoms and matters on the surface of the planets of the solar system. Where at the same time the solar systems as the whole on continues bases receives large amount of principal mafs and matters from principle star of its galaxy and principal stars disc in the pulm centre of the universe.

- It will observed that Principal star in the central disc of the universe even absorb principal light, in fact as light is an entity which possesses both gravity and Magnetic fields and its own mass, thus Principal star is extracting another object from its environment due to its stronger fields strength (2) is a normal occurrence. (Fig. 21)

- Where, the same has been assumed in the present science that black holes even absorb light, but the truth is that principle stars be it in the centre of the universe, or galaxies are created from the principle mafs, which are of the higher order of magnitude in mafs strength and the mafs than of the light mafs in the matter mafs strength. Thus in fact it is normal for weaker field's strength to be attracted by much larger and stronger mafs of Magravs of the principal stars in the centre of the universe or galaxies.

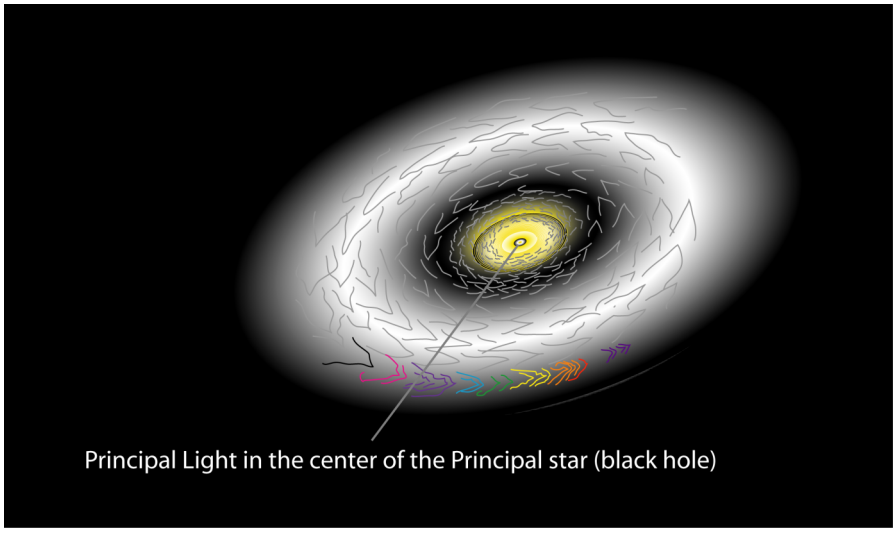

Fig. 21 Principal Light in the centre of the universe.

- But at the same time it is normal to see that the principal stars in the centre of the universe and galaxies spew stronger lights in the order of magnitude of principal mafs which are not visible to human eyes, where the light in the matter mafs strength is visible to him, hence man see one way traffic and not the real truth about the world of creation of duality and equilibrium.

- Thus in the universe it should be possible to observe points where the light lenses the Principal star if it is far enough that Magravs of the Principal star cannot overwhelm the Magravs of the light, but strong enough that Magravs of the light find their position in respect to the Magravs of the Principal star and creates their own Magravs positioning. As this can be observed in respect to the light and star of a system so as the star is made of mafs of principal mafs and matters too and has the same effect of the lensing for the lights rays too.

- Lensing of the transition light when passing the principal mafs regions of the universe should be observed the same way in the future as one observes the lensing in the matter light mafs strength. Where even the lensing of principal light should be observable in the specific cases and some regions in the universe.

- The matter, Transition Matter, Principal stars, the dark spots on the surface of the sun all are created through the same concept and principle that when plasmatic magnetic fields of the any field or matter is equal to the plasmatic magnetic fields of its environment, then there are no collisions between the matters fields which can leave or release any surplus or residual magnetic fields in the light spectrum of the mafs strength or lead to creation of magnetic wave in the visible light balance of the human protein pmf strength or that specific mafs spectrum anywhere in the universe. Thus these areas in the universe, the galaxies and stars surface looks as creating not too much light or what is called to be looking as to be darker than the rest of their surrounding environment(1).

- Thus the assumption that even light cannot escape the gravitational fields of the Principal star is position and the lights itself Magravs strength dependent.

- In truth if and when the Principal matter magnetic fields over time are reduces in strength and they unwind and transfer their fields to their environment, which as these fields slowdown, they become transition matter energies and then transition matter and finally they slow enough that they reach the plasmatic magnetic fields of the mafs strength, which at this point

they become energies observable and absorbable and tangible to human field touch and visible to it virtual magnetic fields sensors.

- It has to be said that there is a great misunderstanding in the operation of the fields and mafs in the universe, this misunderstanding over time has reason due to the man's concept of heat in the *MATTER WORLD, WHICH THIS NEEDS SOME CORRECTION THAT CAN BE APPLICABLE IN THE UNIVERSE* as whole (The full explanation of the magnetic fields, plasmatic magnetic fields, matter and mafs is explained in the reference 1).

- The universe will never run out of energy and get cold, the universe will not expand to nothingness, but universe will decay to smaller universes as universal gravitation will never disappears as long as there are two or more magnetic fields remain in the universe that they can interact and attract and repel each other that they can create gravitational and Magnetic field forces that the whole process can restart again.

- In the nuclear decay one does not observe temperature increases and one sees uniform temperature gradients across the newly divided plasmas and the temperature distribution will be constant, this is the same with division of mother universes to smaller universes. Thus the concept of universe was hot and as cooled down matters are created is fallacy and not in parallel with the rest of the universal laws and processes.

- This observation is parallel with the W-MAP, which has been planned out by present scientific world, where one does not observe huge heated areas and points in the universal map. Here the equal heat distributions parallel with the nuclear decay and heat balance in the divided components of electron and proton after their division and long term motion in their environment is observed.

- The individual heat spots observed across the universe, these points are due to newly arrived mafs and matter movements in that given region of the universe and they are temporally condition.

- The central heat line across the W-MAP is due to dynamism of the principal mafs and matter in the centre of the universe and this is due to concentration and dynamism of the mafs and matters and their reduction to transition energies within this region.

- The creation of gravity in the beginning of time of the universe(s) was and will be primarily due to the interaction of combination of different plasmas of mafs within the plasma of each universe which have arrived from the mother universe and as the magnetic fields interacted, they create gravitational fields and Magnetic fields of the new universe, which these in turn as there are made of many mafs strength, which have arrived in the new universe from the division of the old universe, then different gravitational fields and magnetic fields due to their interaction are created, this leading to creation of different galaxies and matters. Thus, the universe never been cooled but pmfs from one strength meets-up with another and leads to creation of central gravitational fields of the universe and these interactions in the future will lead to creation of specific new matters in that universe, which these matters existence and appearance are closely related to the gravitational fields which the pulm mafs and matters have stared and maintain during the life of that universe and will allow to be created and be held in that universe. Thus all universes do not contain the same matter and all their basic matter is not based on the plasma of the hydrogen as is in the man's universe.

- The internal and initial gravity created in the plasma of any universe is on the same principle as the one created in the plasma of proton and electrons mafs and matters and from the interaction of their mafs of matters, transition matters and their principal matters once they arrived from the decay and division of the neutron. Thus the gravity of the universe is established from the interaction of different mafs and matters strength once the mother

universe is divided and they are created in respect and relation to the original Magravs of the mother universe as these fields are separated from their mother universe into two or more universes like the one visible to the man. Therefore it can be said that man's universe is part of the multiples of universes which all have been created from one mother universe, which this present visible universe to man is a fraction and part of operation of bigger and more active universal order of the Grand universe.

- In reality one can say that this universe is nothing but like an electron in the structure of a uranium atom which this atom is part of a large mass of a large block of uranium atoms.

- This visible universe is part of a total universe and man's universe which looks so large to him is only due to his lack of understanding of the real terms of the world of creation and existence and is dependent up on his openness and understanding of levels of his own existence.

- The principal concept of creation of the principal matter and transition matter strength from mafs and matters in matter mafs strength can be achieved through the process of fusion of mafs, when these mafs and matters of lower order strength enter into the principal star regions of the universe and their fields become and are squashed and tightened in intensity of the fields within the mafs and Magravs of the principal star that the entered fields into the Magravs catchment's of the principal star merge different field strength magnetic rays and fuse these rays that they become and reach mafs equal to the strength and density of the principal mafs and matter strength.

  Thus Principal stars are, where the process of fusion of mafs and matters occurs to amalgamate and increasing the mafs strength of loose and incoming lights and matters from weaker strength mafs is set to take place. This is to say that Principal stars of different size and intensity in galaxies of the universe are the places where the principal mafs and matter are cooked up and separated and processed and manipulated into their given strength and then through conditions become to be known the like of quasars these new recycled stronger fields are released into their given environment, leading these principal mafs and matter to become the centre point for the creation of the stars and planets in their galaxies and as some become to be in the centre of the plasma of proton and electrons and so forth.

- Where, at the same time the Principal stars are the points in the universe that by and due to their high gravitational fields of their environment, this is the place in the universe, up on entry of different mafs and matters, these matters strength can be increased to higher level magnetic fields strength. Thus the Principal star are the points in the universe where the mafs and matters can increase their strength to transition matter levels or to the principal matter magnetic fields strength and where the transition mafs matters fields can be increased to the principal matter field's strength

- In the centre of the stars as the same as the in the centre of galaxy and universes, where the fusion process of fields and matters are considered to take place and heat to be generated due to fast movement of the pmfs. In reality in movement of the stronger and weaker mafs and reduction in strength of the mafs, which these changes disturbs the plasmatic magnetic fields of the Magravs of plasma of the components of atom, this be it the plasma of electron and plasma of proton in principal matter, transition matter or matter strength, this leads to release of mafs fragments, which these can manifest themselves as heat or radiation in their given environment mafs strength. This movement of plasmatic magnetic fields leads to weakening of the magnetosphere of plasma of the all atoms, this be it plasma of principal, transition or matter atoms, hence this weakening allowing the process of entry and amalgamations or fusion of different plasmatic fields into another magnetosphere of any other plasma or an atom or increase and amalgamation of lose mafs of different strength within the environment of a principal star.

- By creating and using the higher strength mafs than the gravitational and magnetic fields strength any entity this be it atom or rays, one can create conditions, where one can cause fusion of atoms, plasmas and rays without creating heat and any need for accelerating particles and in colliding them to create fusion as has become the tradition in the present plasma of matter fusion technology on earth in the recent times.

- If the full concept of fusion in matter level is to be achieved in much easier way, then it will more appropriate to separate the different components of the plasma's mafs and matters, amalgamate the same together and then allow the re-amalgamation of different mafs strength to take place. This is how fusion of field's and matters are attained the span of the universe.

- In the universe the principal mafs and matters are the sources of the energy and supplier of the pmfs of the universe, thus when the plasma of principal mafs or matters interacts or collides with the lower strength mafs in order of magnitude of any matter then mafs and magnetic field content of matter becomes part of the principal matter spectrum and their content is added to the mafs of the plasma of principal matter.

  Hence the current fallacy that when matter and principal matter interact nothing is left of the two, except some release of magnetic fields or energies, this is hypocrisy and man lack understanding of its own world and the world of the creation. This is like saying that if earth gets attracted and absorbed into the Sun of the solar system as a lot do on frequent bases in the universe, then there will be nothing left of the Sun.

  The principal mafs and matters are the source and stars of the universe and by order of magnitude and strength and the mass the principal matters and stars mafs are by far stronger and possess denser fields than their by-products the transition matter and matter fields strength which are created and released originally by the principal mafs and matters itself to begin with (1) which has led to creation of the planets and stars. Then how can the weaker and insignificant part in matter strength level destroy the larger entity?

  Thus nothing happens when matter entity comes to contact with principal matter (antimatter as is known at the present time) entity. There will be only principal matters left with addition into it the content of matters mafs and matters, which have collided with it.

- Thus the physical structure of the plasma of principal stars in the universe is as follows the principal mafs and matters in the centre, transition mafs and matters and the then mafs and matters in the matter mafs strength.

  This entity what man calls the universe follows the rest of the universe orders of linking the magnetic fields polarities of north and south poles together as has been observed in the man's planet. This universe is near spherical in shape in general and dynamic and rotational anticlockwise in direction of motion. But the principal star can pull into itself due to its strong Magravs and gravitational field's matters as well as matters to itself from its content plasma as well as from the unicos of it outside environment, where in the process it can separate their sub-Matters for these to be added to its principal matter too.

  Looked from outside this universe surly will possess rings as planet Saturn's does, as this universe has the same construction as the gaseous planets, but; with the difference that its rings will be colourful and much more dynamic than Saturn's rings.

- In universe(s) principal stars can be found which have anticlockwise motion and some, which have vertical rotation and may be some, which have combination of both clockwise and

vertical rotation too. These motions are primarily matter and fields' strength and position dependent as has been seen in the man's solar system (1, 2).

In the principal mafs state of matter all matter more operate in the gans state of matter than the gas or plasma of the matter, where with the gans of the matter the mafs of the environment decided the appearance of the element in a given condition and in all cases tangibility of matter is the consequence outcome of these conditions.

Hence all matters in the universe are not matter atoms, but gans of matters, as gans of matter can take all lattice structural combination of elements, where for the matter of same element to converse from one lattice structure to another high temperatures and pressures are needed. Where, in the universe majority and nearly all conversion of lattice are done through gans of the matter and not atom of the matter.

To achieve the gans state of matter the environment of the atom of the gas needs low and continues flow of mafs in transition for the atom of the gas to be converted and its Magravs changes from magnetosphere of a gas to a magnetosphere of tangible matter of the gans (4) state of matter, and in fact this happens when the gravitational field of the gas is made more powerful than the Magnetic field of the gas and hence the plasma of the gas gravity contracts or tightens and hence the gas changes from gas to gans and becomes what is called solid nano state of matter in the atmospheric condition.

- Multi-layering of mafs and matters increases and exacerbates the initial magnetic fields strength of the matters and the fields they can create. This causing an increase in the strength of the Margraves of these objects and even Magravs strength can be further increased if the mafs and matters are in gans state of matter or in combination of different mafs strength in different layers.

- Ganses as gases once reach the state of certain structural lattice as in the gases on the earth atmospheric pressures, these ganses change their characteristics and take the properties of non-dimensional plasma or they become what is known as odder or what can be detected of their existence in their environment. This principle applies the same to the gans of the matter too, that the ganses of all elements have odder and hence the universe outside the earth atmosphere has an specific odder of its own, which in fact each galaxy has the same properties and different odder and each universe has its own odder primarily due to the structures of the gans(s) of the elements they create or they can hold on to, and the same element does not have the same odder in all corners of the universe. As odder is the mafs strength dimension dependent the gans of smelling entity mafs combination and/or of the gans's mafs strength itself.

- At the birth of the universe there has never been and in the future there will never been creation of heat, as in the same process of decay and division of neutron in to plasma of proton and electron. Thus the theory which has been created and been followed in the world of cosmology that universe at the beginning was hot and then as it cooled down and gravity took hold and then matters are created are false, The hot universe and cooling and production matter through cooling, this is an understanding of creation of matter and based on the matter world condition structure is base of old centuries and understanding of matter from cooling of gases and liquid into solids.

  The heat distribution of the universe is the same as the heat distribution in the plasma of the proton after the division from the neutron. This balance distribution of the heat has been observed and recorded by the W-map. This pattern of no heat and creation of gravity due to interaction of pmf fields in the universe leading to creation galaxies and stars are the normal process. Where in the universe matters operate through mafs and their environmental mafs

and no other factors. This being the reason why one can observe matter in all corners of universe independent of temperatures and pressures which prevail in that part of the universe.

Matters in the universe are brought to the state of conductivity and connection through their Magravs and not heat and pressure and that is the reason why life exists in all dimensions and structures and intelligence in all corners of universe and life is not the exclusivity of water and oxygen based entities and environments the like the earth and its citizens.

- The present concept that the production of iron atoms are the limits of fusion in the universe and the point where the fusion of matters leading to production of iron and absorption of all energies of the star this leading to collapse of the star and that the star go through the final cycle of life as an active star, this again shows the man's lack understanding of the full science of creation and motion of mafs and maters in the universe.

  In fact due to presence of principal matter in the centre of stars, the process of fusion will go on and all heavy elements are produced through the process of fusion in the centre of the star and not as has been assumed when the process of red dwarf and white dwarf are initiated.

  Stars produce the heavier elements in a rapid process when the Principal mafs of the star releases part of its pmf, facilitating and making available pmf necessary for the fusion of the matters to heavier elements. All heavy matters in the universe are created in the fusion centres of the stars and most of very heavy material like uranium and heavier principal mafs are created in the principal star regions of the universe.

  The point to realise and which has been overlooked is that most of the universal objects like stars and planets, and principal stars they all carry in their centre a large amount of nano materials in all mafs and matter forms and it is correct to understand that in these areas there is a large amount of gans of matters too. The reason for the existence of these nano matters in the form of individual or specially in the form of layers and sheets in the layer boundaries or interfaces of one or different state of mafs or matters, the existence of gans and nano mafs and matters in these large objects leads to creation and production and enhancement of gravitational, and Magnetic fields of the these entities through the principle of interaction of dynamic motion of mafs and matters with magnetic matter or matter of these objects. As this interaction are the main source of increase in mafs and their effects in all matters accelerations in the universe and scientific world by large has not understood this concept in full, as if they would have understood this, they would have understood that there are no limitation within the structure of the planets and stars for them to create conditions that through fusion all elements in the universe can be produced within their sanctum during their cycle of existence, and not when they are at the their latter stages of their cycle of existence.

  In the centre of planets and stars always through interaction of plasmas and their capability to unwind and open up and release all their components of mafs and matters, then it is possible for the centre of planet to reach a point that they can release the content of the plasma of their gas, gans and matters that this leads to release of the principal matter of the plasma, that this high strength mafs through rapid reduction in strength can lead to rapid creation of new atoms and due to its localised strong Magravs in the centre of stars and even planet, this allowing the production and help with the fusion of large number of plasmas of proton and electrons separately, that further on by interaction of large quantities of these plasmas this can lead to production of any element in the centre of the planet or a star. This be it the atom of uranium or copper or even fusion hydrogen to produce helium.

  Fusion is not action, which is exclusivity of the centre of stars or universes. Fusion can take place in simple environment of universe, where there are no confinement matters like the core of the earth or where there are no high temperature regions the like of the centre of stars.

Fusion of elements can and do take place in the open spans of the universe, when the right mafs strength environment are created without even existence of no tangible matter.

Thus the creation of iron in the centre of stars being its doomsday has no meaning, and has no truth in the realities of world of production of matter in the universe, the reality is that if the centre of the star cannot create new heavier matters than iron during its working concentrated fields how can it do so when most of its matter are in process of disintegrating and diffusing in the environment of the star. Thus this is another fallacy about the doomsday of star and creation of iron atoms in the centre of the stars.

- In the process of the movement of pmf one has to understand that the interaction of magnetic fields and the repulsion of the similar magnetic field poles of the pmf of matters of the universe leads to creation of the repulsion forces of the universe, thus leading to its so called separation of its matters and what is called the expansion of the universe.

  While the interaction of opposite polarities of the same magnetic fields leads to creation of the gravitational field forces of the universe and universe cannot exceed its magnetospheric interaction size, where this is the maximum fields balance between the gravitational and Magnetic fields of the universe, and at the same time the mass of universe will remain the same as the mass is the balance fields between the gravitational fields and Magnetic field strength of the universe.

  Thus the mass and the content mafs and matters of the universe are set to be the same at the beginning of its creation less what pmf are transferred to it surrounding universe(s) during its life for this universe to keep its distance and Magravs positioning in respect its contents and in respect to others universes in the grater universal scale of existence in the unicos.

- When, the pmf of matters transferred by this universe to it neighbouring universes is more than what this universe needs to sustain its existence, then this universe cannot hold its present universal magnetosphere and gravitational balance, once this balance is disturbed then this universe like its previous universe(s) will go through division to find its new balance and this leads to creation of new universe(s).

  Thus, the concept that this universe will expand to point of running out of energy and go through crunch and/or dies as a cold entity or go through the contraction and go through a singularity point again, these are nothing but fallacy of the misunderstood and short-slightness of a few to realities of the operation of the universe and not in line with real world of existence as has been observed in the universe, and why in truth the creation of this universe should and division, but never ending process of the cycle life of this universe of its matters and fields be any different than the rest of universal methods of creation of fields and matters in their birth, fusion and decay.
  Therefore the limit of the expansion of the universe is dictated by the total Magravs strength of this universe itself and at the same time the space which is accommodate by and for this universe by the mother universe and the space given to this universe to expand into and the expansion of the universe observed presently is not dependent on no other factors.

  It is possible some times in the future this universe itself will merger and fuses with another universe and make a larger in mass universal unit too as much as it can divided into two or more universes.

- It has been considered that the noise which has been detected by scientist in the 1960's, that this noise goes back to origin of the universe, when this universe was made, this has no truth as the noise which is constantly can be detected from the cosmos is the constant noise of interactions of pmf of mafs of different matters and mafs in the universe and these are created continuously and constantly.

Thus is the same as when mafs of different field in the universe interact and create visible light, thus the noise from the universe shows that it active and living universe as different parts of it interact with each other, as one can hear the noise from the Sun in the solar system when it matters and field interact with each other.

In fact if there were any noise left from the time of the creation of the universe, by now it would have escaped from this universe through its magnetosphere into the mother universe, the way strong radiation pointed upward from the earth escapes from earth atmosphere.

- In the universal levels, the energy is defined by the term, that when the pmf are moving from one point in the universe to another, and as they transfer or they carry pmf of the principal matter for it to be slowed down to matter levels, hence this transportation of pmf of the principal matter to slowdown to matter level strength, this is called the energy of the universe or what commonly called the Transition energy (dark energy) of the universe.

- The universal energy is the one which the pmf in motion is carrying that is balanced in mafs strength with the environment in which they are travelling through which due to their balance field strength the two field create near to no resistance to each other that this condition creates near no interaction with pmf of its environment that leads to release of pmf that become visible, thus the pmf of the universe travels in the soup of its own field and hence less losses and hence the lack interaction, which this condition of travel does not create collision and hence no residual release of mafs of any significant and hence not much of the visibility of the travel of the mafs of the universe, but this transition energy is translucence and as one can see through it so much so that one can see through it stars billions of kilometres away as their light travels in the balance Transition energy of the universe.

  This concept of travel of pmf or Transition energy in the transitions matter is explained in the book “The structure of the Light” (2).

- The universal energy does not need to cool to create matter, to reach matter mafs pmf strength level, but the energy reduces in strength to pmf strength of the matter that matter can be formed, this being the reason why there is a homogeneous heat distribution is observation of the W-MAP as heat is not created during the early seconds of the creation of the universe. Thus the cooling phenomenon of the universe is a fallacy.

- The reality of the operation of the universal system is that the universe is made of pmf which their mafs and matters in motion become energies and that is where the cosmologist says that at the point of birth the universe there was only energy and as it is known now energy is defined (1, 2) is nothing but magnetic fields or plasmatic magnetic fields in motion.

  At the present some consider that there are more Transition energy than transition matters, which is not a correct assumption, where if this was correct then this means that the principal mafs and matters are unwinding much faster and in a rapid manner, which if this state has or to be achieved in the universe, then this means that the losses are more than expected and this can indicate that universe is losing too much too fast and this can be an indication that the universe is getting ready for a further division into two or more universes.

- At the same time it is possible as the universe was created from the splitting of the mother universe, then the separation of the pmf of that neutron universe due to separation of its mafs and matters have released some pmf, which might have created some localised heating in some parts at the point separation and division of the neutron mother universe, which this

separation leading to creation of hot spots or small heating of the new universe in sporadic positions and conditions within the plasma of the universe.

- The plasmatic magnetic fields strength that are released from the Principal matter to matter levels and during their process of the strength level reduction from principal matter to matter level, what is known as the Transition energy, as the plasmatic fields need space and matter in the universe to release and lose some of their strength to their environment to reach the plasmatic magnetic matter mafs strength level, which is mafs in motion from one level to another strength level is known as the Transition energy or universal energy or what is called the universal energy in motion.

  The speed of travel in the universe has only relation in respect to its mafs and matter strength environment, hence one can travel at the speed of light of environment strength in any mafs strength, this meaning that in the matter environment on can go faster than the speed of the light if one travels with the Magravs of the plasmatic magnetic field strength of the transition matter or Principal matter plasmatic strength level.

  Therefore one can only travel with a faster speed than speed of light in matter environment only if one has the capability to create and/or captures Principal matter or transition matter plasmatic magnetic field strength in a Margrave positioning reactors (1).

  Hence the limitation of the speed of travel limited to speed of the light in matter environment is applicable if one use matter and mater mafs for transportation otherwise there are no speed limitation in this environment as one can travel faster than the speed of the light in matter environment when using principal mafs strength in the cores of the Magravs systems, where the speed of the light in principal matter environment is millions of times faster than the speed of light in the matter environment.

  One has the ability to travel any speed in the universe and with any mafs and matter plasmatic fields strength in but there are hazards to consider prior to taking such a travel.

  The theory, that the speed of the light to be the ultimate speed of travel is only applicable in the matter environment using matter plasmatic magnetic field strength and it is not true if using stronger mafs strength, thus one can travel the spans of the universe by using higher order mafs with speeds millions of times faster than the speed of light in matter mafs strength like on the surface of the earth.

  The body of the man will not feel any difference and will behave as one is in the jetliners of the last centuries as the pmf of the mafs of the human body cells contains within their structure mafs of principal matter, then the man will not feel that much difference travelling with speed of light or thousands of times faster than speed of the light in the universe.

- It has to be noted that as in the matter and mafs universe and environment, in the principal mafs and transition matter environment, these environment possess their own shock waves and speeds of sound and as said before even smells and odour of themselves, which these are different than the ones in the matter universe. One can smell the Principal matter and hear the noise of the transition matter interactions, once one is trained and developed the senses for the observation of the transition matters and principal matter which are part of the structure of every living thing as these matters and mafs are part of the structure of the plasma of every proton and electron in the matter environment of the universe.

- Once understanding the structure of the universe, it can be conclude that universe will never end, there are no singularities and no cold ends to it and no crunch, and only for ever the universe(s) will divide in plasmatic magnetic fields strength and from one mafs to another and then in fusing together they repeat the same process, and as the universal structure never can

lose any of its fields through by its natural laws of conservation in physics, then only matters and matters converts from one matter or mafs to another form of mafs or matters and order of preservation of fields and matters is obeyed even in the bigger universal order as has been in the matter world as has been studied in details over centuries. Thus preservation of energy and conversion from one form to another is the essence of creation in every levels of the bigger universe too.

- In the matter universe for example smell is only diamond structure of the or SP3 structure of the same atom in the gas state, thus in the principal matter environment the principal matter possesses and have different states of matter like the gas, liquid and solid state of Principal matter too.

  The same there are molecules and atoms and plasma of the Principal matter too, therefore principal matter have smells and odours and they frieze and they boil and they create clouds and become all thing as one has observed in the matter environment of the universe too.

  Then one can ask the questions that are the cold and warmth the same as the matter universe as in the principal matter universe. And the answer to this is most certainly is yes, with the difference that the temperatures are beyond the levels of man's understanding as the strength levels of plasmatic magnetic field in these environments are off the scale of comprehension of the human at the present time.

- Then the point arises that are there lives in the Principal matter and transition matter scale of plasmatic magnetic field strength of the environments of the universes, and the answer to this is most certainly yes, as the same structure of interaction and creation of cells and life exists in the these environments in the universe as are these conditions available and possible in the matter environment in the larger scale of the working of the greater the universes.

- The matter made available to the matter universe by the down levelling of the plasmatic magnetic fields strength from the Principal matter levels is what allows the creation of the matter, where these new matters have to find physical Magravs positioning in respect to each other, this need for new positioning in cases can lead to movement of the matter and increase in spacing of matters in respect to each other, hence this new increase in the spacing looks as the universe is expanding. Thus the increase in the spacing or expansion is limited as the matters and the rate of conversion from the principal mafs to matter has a limit and hence the universe cannot explode and only thing which can happen to the universe, is that as the Margrave of the universe is reached a point that cannot be sustained in its present mafs levels needed for the creation and sustaining its Magravs level, then the universe in a gentle way divides to guaranty its overall survival in two parts, rather than losing everything in the mother universe to other universes all together.

- The universal Magnetic fields within the transition matter is the force which pushes the universe apart and the gravitational fields within the transition matter is what brings the matters of the universe together and is the glue of the universe. Where both these forces are created by the principal mafs and matters field's interactions of the universe and the transition matter is the medium which they use without interfering with to a large extend for these forces to keep the universe in its dynamic condition.

- If the rate of the conversion of the principal mafs reaches to the point that there are more energies in transition mafs strength levels that the rate of conversion cannot lead to creation of matter mafs of magnetic fields strength, then the transitions energies fields interact and this will lead to creation transition matter, which this condition is abnormal and this ultimately in some cases can lead to creation unbalanced Magnetic fields and gravitational fields within the universe, and this is the trigger point for sudden expansion of the universal magnetosphere in certain point and as this cannot be sustained, then the universe goes through division and the

universe and creation of two or more fragment of this universe are the consequences of such condition.

- It has to be clearly understood that the neutron division to electron and proton, usually is caused due to sudden expansion of the neutron magnetosphere, which is caused through the same process of the rapid change of the principal mafs to transition energy, which this leads to temporarily creation of transition matter that this creates a new magnetosphere condition which cannot be sustained, hence the neutron goes through the process of division to electron and proton too.

- As the pmf of the transition energy slows and reduces in strength once reaching the boundaries of the universe as it happens in the planetary upper atmosphere and solar systems heliosphere, in the same way and by the same principle these transition mafs will rain inwards into the interior of the universe, where they started their lives from and at the edge of the universe boundary the same as cloudy earth in its upper levels will have showers of matters in the form of small plasmatic matters and mafs and this looks as universe is raining inward. Thus once one look at the boundary of the universe one will see cloudy or a hazy shell, in fact this haziness it is nothing but the weak mafs and matters which are lingering around as clouds do or dust particles do in the planter systems upper atmosphere.

- The same cloud systems do exist in the solar systems heliosphere too, where this zone where most of meteoroids and asteroids of the solar systems find their seeds and receive their regular matters and mafs from.

  It has to be said that once man learns to cross the boundaries of the heliosphere of the solar system, the travellers of the crafts as is done when man leave for the travel to the moon at the present time, these crafts as they enter the heliosphere of the solar system they will encounter the same misty cloudy space at the edges of the solar system too and still they have to deal with solar heliosphere re-entry and cloud dusts and so forth as one encounters in the re-entry into the earth atmosphere.

  On the edges of this universe one will see weak pmf of matter and transition matter and transition energy plasmas and even one will observe the entry of other mafs and maters and plasmas in all mafs strengths and entry of universal meteoroid from other universes and unicos, as one sees meteoroid and radiation entries into the earth atmosphere from the solar system and cosmos. There are universal lightings and universal meteoroid too, in fact if the W-map observers look for this they will see another storm and lightings as these vast energies and large matter enters this universe at the edges of the universe, but they simply have registered these as hot spots in this map's outer boundaries.

  The existence of these short lived hot spots will show that they are dynamic, live a short life and their energy is fast moving, as it happens when one has meteoroids entering into the earth atmosphere.

  In reality the existence of these hot spots on the edges of the W-map should give a clear indication to the man the existence of other universes and the greater universe as earth is part of a solar system and a galaxy, the same is with this visible universe of the man, and all one sees in this universe as the same is repeated in the greater universe too.

- One of the fundamental principal concepts of the universal energy is what the scientific world of today to a large extent has not understood fully and has up to now ignored this fundamental principle of the pmf magnification using the pmf of the mafs and matter and energies and specially the universal energy.
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If the scientific world understand how universe uses its dynamism and its inner content dynamic universal energies layering to magnify its power in its operation of this universe, then men of wisdom will come to realise that one does not need principal matter that much and in truth any matter so much all to operate this vast universe and transfer energy to all its far distance corners.

The world of science of today has been by large ignorant to this fact and has not managed to understand the magnetic layering and dynamic universal energy principle and in turn this has put man in disadvantage in comparison to the technological advance with other travellers of the universe.

Man of wisdom should look within to see the creation of their own being, then they will come to understand how small amount of matters and mafs and magnetic fields has been creating conduction and energy transfer in their own structure without utilising or using very little mafs or matters, then they find the power of creation and its application and manipulation for untold usages.

Then they will realise that one does not need wormholes and all that fancy words to travel within the universe with the speed of their own creator. This shall and will remain the mystery of existence upon the time when man learns not to trespass the boundary of others and he learns the existence of balance and true peace within himself and its people and it's surrounding.

- One should understand the concept of multiple principal stars operation in one galaxies system and the role they play to create disc like or spiral galaxies. The operation of visible and invisible principal stars in the universe will play the same role as the twined solar systems and twin galaxies, where in this cases the twined principal matter centres are and have the capability to discharging different pmf strength according to their anti-martial gravitational pull and the measure of the mafs that they might release to control their field of domain. The multi- principal matter centres are and can be used in the space travel in a fascinating way, where once creates multiple jumping steps, with differential and opposite dynamic direction of motion of these Matters. The speed and protection created from and through these manipulations will give the man the chance to travel the length of galaxies and universes in the minutes, but one has to be aware of the destruction power of these technologies as there will nothing left but pmf of the creatures travels of these universal craft if things goes wrong at these mafs levels.

- It should be noted that the shapes of the galaxies and their physical appearances, should teach one the power of the effect of the other matters and entities around them as they will allow and pull an push these objects toward or away from one point or other and hence allowing the appearance and the physical visible structure of these celestial bodies to obey and have a given shape, this is important in the understanding that one has not to look at an entity but look at the surrounding area of the entity to understand the limitation of the operation and the shape of the matter and mafs internally and externally as it is allowed by the environment of the entity for it to exist within a given point and time of a system, this being a planet, solar system, galaxies or universal entity.

- The uniformity of the pmf within the plasma of a proton, an atom or a universe these all show the equilibrium and balance condition between all the participating magnetic fields forces which have been designated to the entity at the point of its inception and creation. Thus, if one sees a fast moving object the like of the Plasma of an electron in an atom or in a larger part the universe, then this does not mean that the universe is expanding and it will be chaos internally in these entities. Thus the fast movement of the internal matters and mafs of the universe does not mean that the universe is expanding, on the other hand this means that the universe is

internally controlling its mafs as repositioning to guaranty its existence as an entity and at the same time the universe is holding its position or what is called universal Magravs positioning in respect to other universes in the unicos.

Thus this universe will have matters and mafs which will be moving away in one position but at the same time other fields in the universe will be moving in the opposite way to, but it has to be said that the conversion of mafs to matters creates a visible expansion, but overall gravitational field forces of the universe cannot be changed and the universal order of preservation of fields will be maintained, does not matter what is converted to what fields and matters and the internal universal gravitational fields strength will be maintained and preserved.

- The universe has laws and conditions and has primary atoms and particles, at the present man has managed to understand the structure of atom and plasma of proton and other particles and through this understanding and his vision of his universe thinks that the atom of the hydrogen is the simplest structure as he can see and understand, in time this will become apparent not to be the same for all creature of the universes, but up on and until then man has to learn that the fundamental particles and unifying fields and the fundamental fields of universe are the simple magnetic fields of the universe and the whole operation of the universe is based up on their interaction and operation.

  But at the same time man has to learn that all created entities in the grater universe have achieved a common method of communication or what is known as the universal fields communication, all created being which have managed to influence their environment and have managed to interact with other intelligent being individually or as unified groups and have managed to accept one universal communication language that is acceptable to all, this language is known as the universes language and is bases on the strength of the pmf of the different strength and not based on the voice or sound or physical alphabets and shapes.

  The man will have to learn this language and will be able to communicate with the other intelligent created entities in the universe once man learn to find peace within himself and reaches the understanding that they cannot trespass and cannot create division in the universe as they have been accustom to on earth to get their way and in achieving and attaining physical possessions and that in the universe martial possession are nothing but the lack of man's understanding of his position and short slightness of use of his intelligence.

  The universal language is transparent and clear language and works on the pmf waves strength and has standard forms and accepted levels for communication depending upon the creatures of different environments which creatures are initiated from.

  Where, one should understand that not all created intelligent beings in the universe need or needed the physical planetary structure as human do for their existence for them to be created or to survive.

  Life is created in the universe in and within the fields of the universe and it does not necessarily need physical tangible, food and land for it to exist and collaborate and operate with others in the universe.

Whereas, and as long as the Man tries to contact others through pictures and voices using the present technological advancement, man will find in general he will have a long time to wait for the response, as the other created intelligent beings of the universe have been and are and will be visitors to man's home from the time of its creation and to its demise, but the universal language will be established and communications will be opened when man learns that he does not need to take more than he needs to and at the same time man does not need to create division to get what he desires and cause conflict.

The cause of isolations of the man from the universal community has been his lack of understanding that in the universal language the other creature do not need to use words but they can and do understand and communicated at pmf fields levels, thus the thoughts of the man which is pmf based in his operation in the brain of the man, these pmf are detected and are like visible light to these creatures and as what is said they can see and understand the real intentions of the man's deeds without man uttering a single word.

Thus man isolation from the universal community has been in forced up on it out of protection of the universal peace, rather than man's inability to find the other creatures to communicate with.

- The Universe in general is a peaceful place and wars and conflict has been things of the past and a long-long time in the past, hence once the man learns the advantage of peaceful living, then man will learn the universal language and then man will be allowed to learn more and join the universal community of Beings, irrespective of these being physical or field appearance to the eye of the man.
- One does not need eye to see but the intelligence to understand, and then the real sight is the real will of the observer of the beauty of the creation in all levels of universes.
- In the material world for example the neutron always divides into balancing masses that the overall gravitational positioning of two new masses can guaranty the existence and continuation of the life of the neutron in the same material world. This applies to the universe too, that universe will divide in mass and as in the neutron the lighter mass will have to follow the graters mass fields forces Magravs motion and hence the universe of the smaller mass will be more agile than the heavier mass. Whereas, the smaller mass universe will be and has to follow the internal motion of its own mafs and matters and at the same time the overall Magravs of the smaller universe has to find its position in respect to overall Magravs of the larger universe and the overall dynamic motion of the mafs and matters which the bigger universe creates.

  Thus, the smaller universe can be in **a** snapshot or in the case of man life time over a million years, this universe be looking as it is stationary in its internal space, but in fact this universe is following another larger universe at very high speeds itself to keep its position and at the same time the universal centrifugal force of motion allowing the universe to hold on to its content of its own mafs and matters.

  All universes the like of the galaxies and solar systems are all in motion not only internally but at the same time they are in motion in respect to their the other half of the their mother universe, which it was originated from. The overall direction of the motion of the universe in its bigger universe can easily be detected and realised. The direction of motion of the universe

is shown by the directional motion of the mass of universe, which is moving out of normal direction of the whole content of the universe itself. This meaning that, if! The full matter motion of the universe is planned out; one should see a region, which is moving as a whole in totally arbitrary and independent direction.

The reason for this envelope of the mass following an independent directional motion is due to the fact that this mass of the universe is connected Magnetically and gravitationally is locked to the direction of the interaction of the Magravs of this universe in respect to the Magravs of it co-birth sister Universe (Fig. 22).

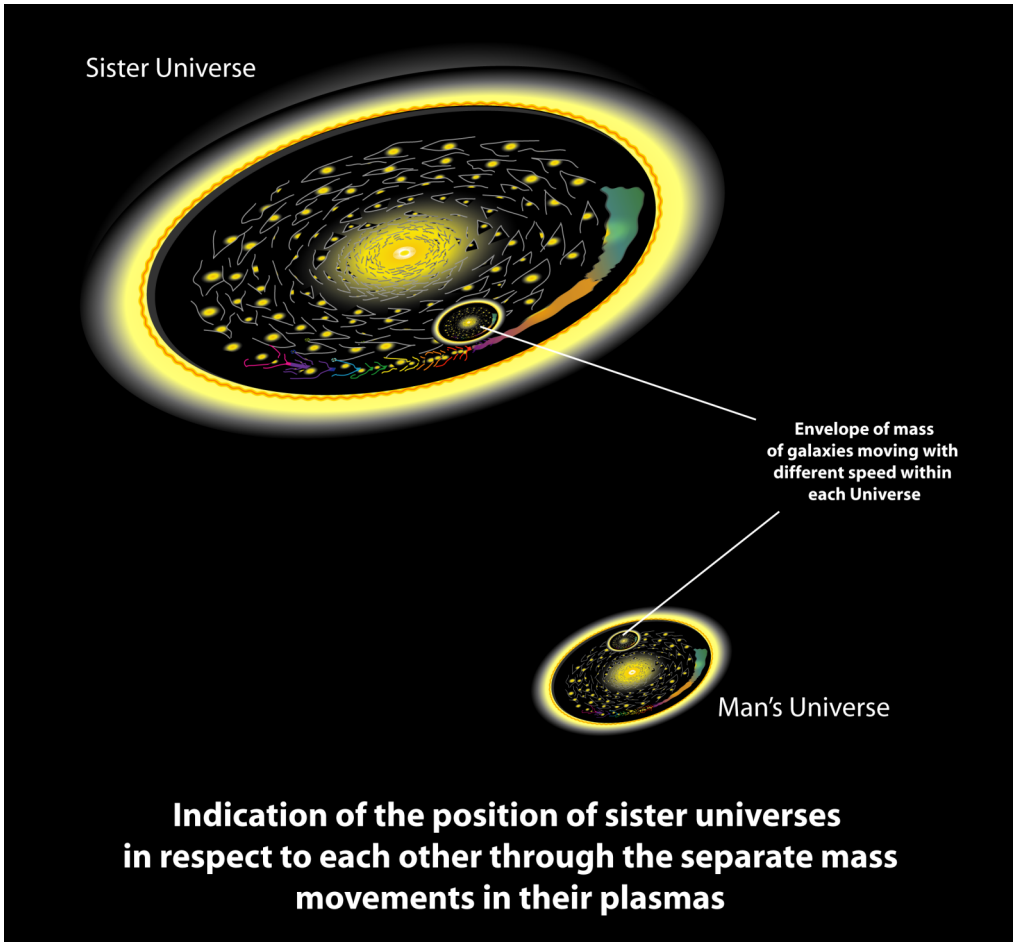

Fig. 22 Envelope of galaxies in each Universe indicating the position of the Sister Universe.

The mass of the matters involved in this motion should indicate the extent and power of the Magravs interaction between the two universes.

This mass moves in all three hundred and sixty degrees direction as the co-birth universe is dynamic and has its own dynamic Magravs motion too.

This independent zone in motion in the universe has already been detected by the cosmologist for this universe, but they could not understand the reason for this independent part motion in the plasma of the universe.

Thus the direction, which this mass in the universe is moving and is positioned, this shows the position of the co-birth universe in respect to this universe.

Therefore if and when the man's scientific and technological achievements reached the level in the future that man can see through the universal magnetosphere, then the position to look for the co-birth universe, would be the direction where this internal mass is in motion and at the same time the distance of the this internal mass from the edge of the universe will show the distance of this universe in respect to its co-birth universe.

- In the universe the heat and cold is not measured in the way, which has been accustomed in the world of physics of today. In the universe heat is measured to the extent that the matters pmf can be loosened to allow the bridge of what is known as the atomic or molecular magnetosphere.

  Thus what is commonly known, as the coulomb barrier, in the atomic physics is only the extent of the resistance or the tightness of the Magravs of the atom. In fact man has to realise that if he unifies the terminology then he will solve most of the problems in the world of the science of physics. For example, by unifying the word of the magnetosphere and coulombs barriers, which in fact these are both the same properties and principles; where one shows the tightness of the Magravs of the planter system and the second show the same for the atomic structure. If this discrepancy in language is resolved and man understood all phenomenon of the creation of magnetosphere in all levels universal mafs strength which has been discussed above, then the nuclear and theoretical physics would not have the problem in creating and maintain fusion of all matters and mafs in the universe.

  Thus for fusion one does not heat or speed to create and achieve fusion, but the loosening of the Magravs or dilution of the Magravs of the mafs and matters will lead to fusion and creation heavier elements without the need for the elaborate accelerators and others gadgets which has become the tools of the advance science of today.

  The use of the accelerators are nothing but to show the true lack of understanding of the scientific world in the what these scientists are trying to achieve and their misunderstanding of the operation of the universe.

  The heat created by the fusion processes within the stars or the principal stars is the by-product and in fact the heat assist with the operation to loosen the Magravs and loosening the Coulomb's barrier that fusion or mixing of different plasmas of mafs and matters are accommodated, but not the cause or the outcome of the fusion.

  Where in the world of the fusion of today scientists try to speed up and accelerate plasma and make them to collide and hope for the fusion, but in the universe the reverse process happens, whereas in the universe fusion takes place in condense centre of the principal stars and matter stars, where there are no rooms for the plasmas to speed-up, but due to loosening of the pmf forces magnetosphere of the plasma or coulomb barrier, then matter mix and fuse and what is not necessary from the amalgamation of two plasmas fusion, then these appears and are released as surplus unwinding pmfs of mafs which as in this process of higher to lower mafs strength is so rapid that this process shows itself as the heat in these environment of the universe as part of the process.

  Thus heat can be explained in its real term as the pmf which is unwinding from one state of matter to unwind that the pmf field released allows the other matters to open their magnetosphere that they can receive the pmf in transit from other plasma.

  Then the cold can be explained as the when the pmf of the matters are reduced to beyond the magnetosphere of the matter that matter cannot transmit any pmf to another matter.

  At the point, where the total transfer is zero, this is known as the Absolute zero point at the present time. Where, the scientists say that at this point there are no molecular movement. In

fact the plasma of the matters or ***the atoms is still at this point active*** and maintains their internal dynamic condition and environment. If this was not so then magnetic fields creating the mafs and matters would have ceased to interact and the matter or mafs would have lost their gravitational fields and magnetic field and hence the matter and mafs would not have been able to maintain the magnetosphere and the mass of the atom, and hence nothing would have existed; But as one still sees the matter at absolute temperatures, then the condition is inter plasma magnetosphere connection and not internal magnetic connection;

In fact magnetic fields, which are the principal particles or are known as the fundamental matters can never come to a point that they do not exist or interact with other fields and at the same time due to ever existence of other magnetic fields and fundamental elements in the universe, then all fields and matters at all times are attracted or repelled by one matter or other and hence a total non-dynamic universe never can exist and in truth the creation of the universe and creation and origin of the magnetic fields is due to and through the fundamental of difference in the universes differential waves. Thus the magnetic fields are themselves created out of strength level difference in the universe and thus the origin of the magnetic fields is the cause of the existence of the universe and the existence the universe is the cause of the existence of the condition differential which is the creation of fields to compensate for this difference and hence the creation of entity to cover the difference in position and hence the creation of the magnetic fields. Thus one in a simple language now knows even how magnetic fields, which their variation leads to the world of the creation of universe has come from and how the real essence of all creation become to exist.

- It can be said that at the Absolute temperature the time stops for the matter and material world but not for the mafs and mafs dimension and hence if the universe were made only of matter and mafs then the physical matter would have never existed in the deepest part of the universe if the temperature were at absolute temperature.

- The measure of the cold in the universe is dependent upon the slowing down of the movement of given pmf in a given direction and strength, hence the measure of the coolness is the external strength dependent and not plasma internal fields motion dependent. This being the reason why like in the planetary systems planets can and do produce their own independent temperatures irrespective of where in the universe they are and how cold or warm the environment of their surrounding planets and stars could be. Therefore *THE ABSOLUTE ZERO IN RESPECT TO* mafs and matter environment is only applicable to the earth position and environment and not to all universal condition. This being the reason why, one can see and observe life in all kinds of pressure and magnetic field strength in the universe.

  Therefore the Absolute zero for mafs and matter environment is not applicable true for principal, transition and matter mafs and matter strength and environment.

  This being the reason why that internal atomic structures can exist and atoms mafs can hold on to its structure and its existence, while the molecular structure in the matter environment can be cold that no external motion within the atoms of the molecule can be observed at absolute temperature.

  The absolute temperature in a given environment can be said to be when the Magravs of the constituent matters environment come to be in total balance; and that is the point that the total losses and gains from the surrounding environments are said to be balance out that the total magnetosphere of the environment will compensate for the losses that the environment can keep on holding on to the zero motion of the total environmental Magravs.

  On other hand the environmental Magravs can be reduced that there is no interaction between atoms that the motion of the atoms in respect to each other ceased to exist and motion in respect to each other become frozen. This is known as balance Magravs criterion and to

produce this within the structure of reactor is an art not known to man. Where, the balance Magravs positioning is the key to establishment of colonies in the universe, where there are no planets and stars as point of reference, but the condition of balance allows the station to be permanently positioned in that spot that all passengers of space can come to meet.

Production of an absolute balance give man the ability of what is known as hovering, where there are no propellers and no vertical jets of today to stay stationary in mid-air.

Absolute Magravs balance allows crafts of the future to keep a constant position and this can create fantastic composition for gate-thing, which is needed for movement from one Magravs system environment to another without actually needing to handle re-entry problem in either direction.

The operation and the use of the absolute balance Magravs technology systems are as for the physical doors of today, when used in the future, when one moves from Magravs plasma environment to another.

- In the operation of the universe, the distance of pmfs and the speed of the rotation of one pmf in respect to another is the criterion by which the speed and directional rotation of one matter or plasma in respect to another plasma is dictated.

  Where, the positioning of mafs in respect to each other in the universe has a direct effect on how fast, when and where an entity will position itself and even this dictates the measure of the cold or heat of two entities in respect to each other and to other environments. This concept is seen in the universe in respect to the rotational direction of planets, stars and galaxies, where their direction of the rotation if different to the one other entities in their surroundings.

  The criterion of mafs positioning is the reason, why for example the Vinous rotates in different direction than the rest of planetary systems in the solar system of the man, as its internal pmfs speed of rotation and their position in respect to others of the same within the internal structure of this planet are as such that the outer layers of this planet are forced by the configuration of the combination positioning of different cores and their pmf strength, forcing the planet to rotate in the clockwise direction rather than the anticlockwise direction as the rest of the planetary entities in this solar system.

  This principal of the mafs positioning and speed in way can explain even why all matters in the universe rotate anti-clockwise or what is commonly called the electro negativity of the hydrogen atom directional motion.

  Hence it can be said that the anti-clockwise directional movement of the plasma of proton and electron are due to the mafs strength within their plasma and the position of different mafs in respect to each other within the plasma.

  Then this puts a closure to present theory of electron and positrons, where in fact electrons and positrons only difference is that one's internal magnetic fields are slightly differently positioned than the other and as their mafs contents of fields is the same, then only the positioning of the fields in respect to each other dictates the direction of the rotation of the plasma of these entities. This directional motion variation can even affect the absolute temperature of the operation for the positrons and electron in different environments too.

- Time as man is accustomed to on earth, this time in the universal language does not exist; time is a manmade phenomenon to measure the course of his life. In reality the time is the measure of the pmf of given strength to pass a given predetermined strength, thus time in the universal language is magnetic field strength and environment dependent. Where in the principal mafs

world the time of reduction is much faster than the time of reduction in the same matter environment. Thus time or measure of reaching from one level of strength to higher or lower by the same order of magnitude is the measure of the time in the universe.

Where, the universal positioning time will be measured according to the central position of the universe and considered to be zero at this point and then to make an appointment to be at a given time then the motion of all mafs and matters in the universe in respect to this point needs to be considered, Where this position is and has a three dimensional three hundred and sixty degree reference. Where, in fact time in the universe needs point of reference and that is earthly time, solar time, galaxial time and universal time.

Time is unchangeable and it is the same in the same gravitational and Magnetic field strength environment. This is important, as at the present there is a fallacy, which has been accepted to convince the scientific world that time goes faster in the universe as one moves away from the earth.

This is nothing but hypocrisy and lack of the understanding of how gravitational fields are created. This fallacy has come to a point that in the satellite systems of today an error time has been allocated that the satellite timing is adjusted in respect to position location of a matter or entity on earth. Where in fact if the scientific world would understood the full principles of the creation of matters, and if scientists can create the same g strength forces in the environment of the operation of the electric and mechanical processing of these satellite does not matter where they are positioned, what is called the environment of what is called one g, then these satellites do not need correction factor which they are using.

Where, in fact the time correction factor is due to the fact that matters in the different Margraves and gravitational position around the earth have and operate under different magnetic and gravitational field strength and this is the reason why there is a difference.
Thus for the correction of time in these systems only one needs to consider creating the same Magravs strength at on the surface of the earth and then there will be no difference in time.

This concept is important for the future travels of the man into space and his excursions in the universe if he wants to keep to his habitual twenty four hour clock and earth gravitational magnetic field strength of his planet.

Man soon will find and realise a simpler way and then the hypocrisy of time travel and wormhole and going to the past and to the futures and so-called granddad theory will come to an end.

One point to remember that light which itself is plasma entity moves out in a spherical three hundred and sixty degree environment of the universe and for example the feature of a the face of the man will create man lights for it to be seen as a whole, but in time as light travels in the ever rotating sphere of the universe and these rays some get absorbed and some get distorted, then one cannot bring all the lights of all the matters of the one human face together to see that entity as it was so many time lapses before.

Thus if one hopes think that one can see the past of one person on a revolving dynamic environment through one light or making a machine to go backward to see the face of its forefathers, this shows nothing but the lack of the understanding of the science of creation and motion of light through the haze of dynamic universe by these men of science.

One can see the structure of matters like stars and fields in the far points of the universe primarily due to the fact that the light is and has plasmatic environment and like a telescope can pass the information to the point of arrival. But the light cannot bring the past of its source, but shows the pattern of its source like a move at the time it left the object.

In fact it can be said that light is composite matter and entity with active complex pmf of different mafs.

Thus, for example one as one enters the principal matter environment, where the principal matters is the creator and controller of Magravs of the environment, then in these environments one travels at the speed of the pmf of the principal matter and not pmf of tangible matter. Then if considering the principal matter environment in the centre of galaxies, then time for the matter world will be looking as being much faster or matter seems to be travelling thousands of times faster than what has become to be as the speed of light in the matter world in these environments.

Thus in reality the accepted time and speed of light as the maximum limit is only applicable for and to human understanding of the universe and not considered to be the truth in the real working of the universe.

When, the race of the man understands the concept of the use of the principal matter in the travel systems of their creation, then the man will be able to travel into the universe with much faster speeds than the speed of light of the mafs in the matter world and then one can travel the spans of the universe in seconds in human term and then one can travel the length and the breadth of the greater universe as one travels the earth glob with the toy systems of the jetliners of today.

Then the point arises that why some mattes and entities in the universe can last for a long time, where for example the human life is limited, the answer to this is very simple, and that is the body of the man is made of composites of mafs and matters and the more one adds to the composite the more Magravs are available to be lost to the surrounding Magravs, and be effected by the surrounding Magravs too.

Thus the life of the man is environment conditioned and in time as the DNA of the man learns to preserve more, then this will be adding to the life of the man and then the man will live longer, but eternal life is and belongs to no one entity in the universe, but the entity is the total facet and attribute of the whole as a whole. Thus man has been and shall ever be, not in the physical form but rather in the attributes of its physical existence in all universes of the god. Where, god is part of whole and fraction of none.

Where, the universe possess mafs and matters which their difference only is in their strength and nothing more and nothing less, thus time is faster in the stronger field for the weaker matter created entities and time is slower for the stronger mafs field strength in slower in weaker matter field strength. Thus time in the universe in reality does not exist and is a creation man's state of position and possession. Thus if one is in universe, where the strength of the mafs are one thousands time stronger than the other mafs, then the time is one thousands time faster and this applies to all mafs and matters in the world of creation.

One point to realise is that the magnetic rays which are released and are prevalent in the environment of the man are the time setters for the degeneration and division of the man's cells and have direct effect on the life span of the man in the universe, this be it a word of wisdom for the ones who come to comprehend and look for the eternal time life.

- What holds the universe together are the attraction and repulsion force of the pmf content of the universe. Thus the tightness of and the position that matters appear in the universe are totally pmf strength dependent.

  Therefore as the pmf strength of the matters are attained at any point in the universe then that matter becomes to manifest itself in the given point and time in that part of the universe. Thus the glue of the universe is a combination of the interaction of all the mafs and matters, which their interaction makes the Magnetic and gravitational fields Magravs of the universe.

Thus in fact what is called the bosons theory has its truth in the position of and their interaction of the magnetic fields of different pmfs, plasmas, matters in a given position in the universe as these interaction dictates what and how pmf are given or taken from the universal soup of magnetic fields, and what the outcome entity shall be and how the matter manifest itself at given point and for what period of the time.

- Thus once a given pmf strength in the universe is achieved which can be initiated combination of the interactions of several conditions, plasmas, and environmental magnetic fields, then at that point in the universe a specific given mafs or matters comes to exist, this being mafs or tangible matter magnetic fields strength and so forth. This is the secrete of universal existence and manifestation of the all mafs and matters and the observation of one mafs or another matter is totally dependent on the observers pmf Magravs strength that one matter or another can be tangible or visible.

- As in the solid state magnets in the plasma state of the magnetic fields regions of the universe, these plasma poses and operate through the North and the South poles and the same goes with their attraction and interactions in respect to other magnetic fields of all plasmas too, that is to say that plasmatic magnetic fields position themselves as solid magnets do in respect to strength and position of other plasmatic magnetic fields near to and in their environment. Thus the North-pole of the plasma attracts the south-pole of other plasmas and at the same time the South-poles of the plasma keep and make distance from the South-poles of other plasmas as it happens in the solid state magnets.

  In the physical matter one can see the motion of the magnetic fields and motion of magnets in respect to each other as magnets move and find their position in respect to each other in their given environment once they are brought into the proximity of each other. The same positioning and movements are applicable and are created and maintained in the magnetic environment of the plasma two plasmas once they are brought within the mafs field interaction of each other too.

  The plasmatic magnetic fields of all entities can recombine to allow the circulation of their fields and in general determine the point at which the fields can re-enter the plasmatic magnetic fields to complete a full spherical plasma of the fields. Where, this point of re-entry of the fields is primarily dictated and decided according to the environment, which the mafs of the entity operates in and, not necessarily by the mafs strength of the field of the entity itself. Thus, the point of termination and re-entry of the fields of the plasma of mafs of even solid matters is dictated by the environmental mafs strength and not by the matter. That is to say the termination point for the magnetic field lines for a plasma and solid matters (the beginning and end of a field line) is decides mainly by the environmental mafs strength and not necessarily the strength of the fields of the matter.

  This being the reason why the magnetic fields can reconnect anywhere in the universe irrespective of their physical distance, as the environment which the fields enter and carried to their full destination is supported and facilitated through the mafs of the environment and not the strength of the fields of the entity. Where, this phenomenon is well explained in the interaction of the change of polarity of two atoms, which as one changes its polarity, the second one does the same instantaneously. This is what one observes in the change of polarity of plasmatic field's entities, that for example as one plasma changes polarity, the other does the same parallel changes automatically that one never observes any changes in the structures of either entity.

  This being like the change of the polarity of the earth and the synchronized change of the polarities of the cells of all beings on earth, that no physical change can be detected by the inhabitancies of the planet as the physical polarity of the earth changes.

Even though the same cannot be said about the change of the polarity of the moon of the earth as it does not changes as the earth polarity changes in majority of the cases.

In understanding the principle of this phenomenon, then man of science can make any matter anywhere in the universe as the need of the time be, this be it production gold or production of amino-acid needed for production of proteins of chain of fibres of heart of man anywhere in the space for the travellers of the future.

Thus, one can control the point where what appears as the magnetic fields can draw in fields (as called conventionally called the exit pole) and where the field exits to release the fields (the north-pole of the mafs. Then size and the length of the magnetic field and the gravitational fields and Magnetic fields, which any entity creates, can be controlled and hence the size of plasma of an electron or proton can be predetermined. That is to say the total field strength of the Magnetic field and the magnetosphere which an entity creates and can hold on to, this determines the exact and precise dimension of the plasma of be it this be the plasma of the proton and electron.

Thus, in principle one can have field zone of the same length, which upon their interaction they create a given magnetosphere, but one can have the same spherical dimension of magnetosphere with a different magnetic fields strength, which this creates different Magravs field zone. Thus, the length of the magnetic fields determines in what entity is to be created, this being the plasma of proton or an electron, and so forth.

Complex magnetic fields create different field lines, hence different Magravs. This being the reason why in the plasma of the proton different pmf and matters entities are observed and detected.

- In the bigger picture of universal works, scientists will come soon to realise that all parameters are the same, all plasmas do and behave within a given procedure and sequence. Thus, what one sees in the plasma of this universe is the same as what goes on in the plasma of the proton and electron too. That is to say what has been puzzling the theoretical physicists about the content of the plasma of the proton, as one can see in the operation of the universe then one should have been expecting the existence of different matters, fields and fields strength in the plasma of the proton and even the same in the plasma of the electron as one sees in the plasma of the universe.

- Interesting enough scientists soon will start wondering about the creation and control of these magnetic fields that how they lead to creation of different plasmas of magnetic fields too, and how plasma of the magnetic fields become to become units of the same fields and how a magnetic fields can be attracting one plasma while the same end of the matter can repel another of the same from the same end or exit port of the magnetic fields. That is to say how can a solid magnet at the same time as can attract the opposite polarity and then at the same time and simultaneously the same pole can attract another dissimilar polarity. The fact is that magnetic fields of plasma of fields do not bunch all to north and south or all exit and entry port, but they arrange themselves as one of entry and one of exist and or one north pole and on the south pole adjacent to each other, but they do not set end to end with each other. Thus for example looking at the section cut across cluster of the magnets, the fields are arranged like mosaic of north and south in correct sequence and order. Where, in the case of the dynamic plasmas like protons the top view shape of the magnetic fields are the likes of a whirlpool and not straight-line fields of the same mosaic.

  Then one should understand how the structure of nucleus of atoms are arranged in a similar manner too, as one exit port sets next to an entry port, then when a nucleuses has two protons then the in and out ports are matching and the magnetic fields of the atoms internal magnetosphere is complete and the atom is stable, but when the atom possess two of the same

ports and one of the other ports in its nucleus then the extra port is sharing its fields and or is looking for the an extra port that can receive its pmf or it receives pmf from, and hence the odd number protons nucleuses always are more receptive in receiving or dividing for them to have matching pairs pmf ports of entry and exit, that they can make their own matching magnetic plasma. In fact single magnetic fields do not exists in the world of plasma, and in a way the theory string shows nothing but lack of understanding of operation of the fields in the universe. This explains why odd number proton numbers go through decay or they are more receptive to make polymers of themselves or join up to make molecules.

Where, the entry port of the fields can take magnetic fields from the other ports or from the soup of the Magnetic fields of its environment, and thus the size of the entry port of the fields in principle determine the matter and mafs condition in a given environment.

The reality is that the entry point consumes more energy than the fields, which are coming out of the exit port of the plasma of the fields. The fact is that whenever fields interact they create minute contact points that at these contact points fields are divided into smaller length and strength, this is like when two bodies collide and due to their friction some heat or fragments are created; This happens the same when two magnetic fields interact to create their own magnetosphere and mass. Then due to this friction between fields the magnetic fields entry of south-pole are slightly weaker and less in mass than the total mass which originally entered the magnetosphere of the two fields in the south-pole. Where, in fact the slight difference in the mass and fields strength between the entry and exist of the ports, leads to ever reconnection and closing of the loop of the fields between the North–pole and the South-pole, and the motion of the fields within the structure of the matter and the entity.

Where, the South-pole or entry port is the feeder and the North-pole or exit point is the provider, where at the same time the due to miniature and micro size of the magnetosphere of the fields, there are too many magnetospheres which are connected and arranged in the mosaic of the one cross section, thus the entries and the exists or the north and south poles set next to each other and where the entries poles are more stronger the matter attracts and where two facing section the south pole are stronger the matter repel and hence the sequence of pulling and attraction of mafs and matters in the universe.

Where, the entry points both need to attract as much as possible so they move to guaranty their own continues supply of fields and this being the reason why similar poles move away from each other, that is simply to allow the entry or exit of the same floor of the fields to have the maximum chance of attracting fields to guaranty their field supply.

The dissimilar poles gravitate, as the entry-pole try's to absorb all that it needs from the supply of exit-pole of the other entity.

Further on the minute fields which are released from the interaction of the two fields, in them separating and being able to travel a given distance away from the original two fields and their interaction, these fragments travelling distance capabilities determine the magnetosphere region of the two interacting magnetic fields too.

The interaction of fields in creating plasma of fields needs a constant supply of fields from its environment, and that is why the fields can and do regurgitate some of the fields which was released by their own interactions and this being the reason why the Plasma of magnetic fields can last for a long time in the given environment.

In a way the attraction or the gravitational fields forces is created out of the necessity of the need for the two interacting fields to keep locked to each other, and hence the need for a constant sources of supply of magnetic fields in the universe, which this need is meet in large from a stronger source of fields and their unwinding of the principal mafs sources which are

scattered around the universe. Where for example the larger plasma's the likes of the stars needs are meet by the cosmoses principal fields as they unwind and in the micro levels the need of weaker fields magnetic fields of atoms are meet by their lower level strength fields of their environment.

Where, at the same time the magnetic fields can enter a centrifugal region where their strength can be tightened and thus fields as much as they can lose their strength through unwinding, and then through the same process of rewinding they can increase their strength too. That is to say that if the mafs fields are entered into a winding region or in a tighter pact region fields strength of the universe, their magnetic fields can be winded up that the mafs strength increases to principal mafs field strength. Or what is said in the common language of present science the mafs can become of principal mafs strength and the centre of the tightening mafs is the principal centre of what is called at the present science the principal region of the environment, this being in the centres of the cell, galaxies or universes.

Thus as long as the environment can supply surplus amount of the pmf for a given system for its north and south poles to be maintained, then there will always be an entity existing, does not matter what word in the vocabulary is used to confirm its existence.

The mass is created when the field at the entry port and the exit port are linked and it is independent of any other entities of the same or there scale of mafs entities in the environment. Where, the mass is the amount of the fields needed from the environment for the interaction between two fields or plasma of its fields to exist.

- The magnetosphere is the limit of the field's exertion in a given environment created by the interaction of the gravitational and Magnetic fields of the two original fields. Where the magnetic fields are the cause and the gravitational and Magnetic fields are effects their interaction and the Magnetic fields interaction now becomes the cause of the creation of the mass and magnetosphere of the entity as the latter become the effect of the interaction of gravity and the Magnetic fields.

This being the reason why, that the mass is independent of the environmental conditions and effects, as the mass is the indication of the given internal interactions itself and is due to internal processes of interaction of the same internal magnetic fields. Thus when the environmental magnetic fields, gravitational and Magnetic fields are considered and applied to the given mass system, then the weight or the measure of the mass in respect to the environmental fields forces can be measured.

As the puzzle of creation of gravity is solved, this should open new horizon in the world of science and make life easier for scientists to understand the working of the universe. Where the whole world of creation can be said to start from the difference in condition in position, where this leads to creation of field that the different position can interact and be connected to each other, This known to be the origin of creation and origin of the creation of magnetic fields in the universe.

Where, this movement of and need for interaction of fields to cross the space of their environment leads to creation of what is come to be known as magnetic fields flow, and the extent of the flow to cover the strength difference and the proximity to each other trying to cross the gap to guaranty continuity of flow of fields in the environment become the current or the strength of the magnetic fields.

Where, the interaction of magnetic fields leads to creation of Magnetic (repulsion) or gravity (attraction), where the interaction of the created Magnetic fields and gravitational fields leads to creation of mass and Magnetosphere (1) for the magnetic fields concerned. Where the interaction of magnetic fields depending upon their strength leads to creation of stronger fields to be connected to

each other, thus the stronger fields become the principal fields or feeders of mafs and the weaker fields become the matter mafs fields of the universe.

In the man's range of Magravs strength of his protein, the weaker mafs become tangible and visible or detectible and part of his own being's structure and his matter world is created and where in other levels due to stronger fields the principal mafs create a visible world for the one's whom their protein Magravs strength is set to a level beyond the man's mafs strength level.

Thus, the universe is the collection of and the creator of magnetic fields in different length and strength and their interactions to create different magnetosphere in size and strength in Magravs, and whenever and wherever there are fields to interact then they coagulate and linkup and create mafs and matters of different strength.

In the universe there are no empty places, which are void of magnetic, Magnetic and gravitational, mass and magnetosphere fields or not being in the path of the movement of fields. In general what is tangible and visible magnetic fields collection has been and it can be called matter and what is fields in the motion which are not yet attached to any matter to become part of given environment of matters or mafs are called energies of the universe.

The universe will never cease to exist as long as there are fields to attract and repel each other. Universe has no dark and black unknown phenomenon about it, it has principles and how they are applied and enforce themselves or it is enforced upon them, then a given condition and fields and mafs are created for given span of duration of fields interaction so called time.

The earth is not the unique environment which can provide and sustain life and intelligence, but life starts from fields and their interactions and upon their complex interactions and order they choose to be a club of plasmas, matter mafs, atoms, molecules, Magravsly to be bind (chemically), combination orderly repetitively Magravsly bind (biological) and creating communication in the biological Magravs repetitive order to guaranty the survival of their overall Magravs which these interactions lead to creation of intelligence.

Thus the man is not the only being with intelligence in the universe, as given the environment of interaction of fields entanglement is the facets of progression interaction of the fields which can be sustained everywhere in the unicos.

What is interesting is that one does not need the intelligence to have the soul, the same as one does not need to see the star in the far corners of the universe to know of its existence, but the plasmatic magnetic fields which it released during its existence it has travelled and nourished the universe to reach the position of the observes. This is the same for the soul of the man and the manner of it's creation and movement in all dimensions of existence, wise one now can understand the mystery of nothingness and of the creation of the soul of the man and the essence of its meagre existence in the world of universes.

The survival of the soul of the created being is the beauty of it, for it to give and to receive and not to be an outcast, then man of wisdom will enlighten the man of possession that there is nothing to possess if one uses what one needs and no more. Be wise on what has been said and open to be received and receive what is in your path of life in its different levels of interaction and attractions.

The ultimate point of understanding for the man who is one of the created entities in the universe and through what has been revealed on to man in the verities of disclosures in the recent past is that in the universe among its created whom have attained intelligence and have managed to take into spaces of transition environment of universes, that in the universe there are no animosities and no wars and nor this rule shall be changed as war and acts of aggression has been the habit of the passengers of the planet earth during their technological progress and their short lives on this planet.

The reason for the universal peace is not the lack of technology among its inhabitancies, but the truth is that the intelligence of the beings of the universe is so advanced that they have no reason to fight for what they can attain in and achieve and obtain from the universe.

Thus the universe is ruled by peace and justice and the ones whom have the habit of the like of the blue blood from the blue planet will be thought soon a lesson that unless unity takes over the thoughts of the creatures of this planet, then these shall be thought a lesson that they will soon fall and follow the rules of the universe and not the old habits of the feeble man.

Not forgetting that the everlasting habitant of the universe have attained the knowledge that can wipe-out any type of life from the universe, thus the peace in the universal order is not due to the weakness of its inhabitants, but their strength to be able to see any short sightedness from the newly joined members of the universal community that they cannot and shall not be allowed or even think they can carry on with their old habits of war and division and injustice and exploitation of the other habitants of the universe as they has become accustom to on the blue planet.

The laws of the universe shall be in the hand of the land of the lion as they have been graceful and has been just and as has been promised, the knowledge of universe shall come from the land of the lion and the Sun where it will shine upon the rest of humanity in equal measure and with true powers of grace and justice. This has been the command of the created and shall be attained.

CHAPTER 9

The creation of Gravity

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Abstract

The universe is built and held together and operates on the basis of two forces. One cannot work and exist without the other and when one of these two forces dominates the affects can be interesting, drastic or/and at times dramatic for the entity, this be it the universe, solar system, planet, atom or plasma. These two universal principal dynamically plasmaticaly magnetic field forces one being the Gravitational fields forces (attraction field forces of the entity) and the other the Magnetic fields forces (the repulsion or magnetosphere fields forces of the entity), which both have their origin within its centre these operating entities.

Hypothesis

The source of creation and sustainer of the gravitational field force and the Magnetic field forces of for example planets are the same elements and the same conditions in the centre of the planet.

Prototypes

To prove this concept, several static and dynamic prototypes over span of five years have been made and tested (Fig. 23), which the outcome of these tests shown system on the bases of this concept can be made that the system creates both gravitational and Magnetic fields forces, which in the operation of the system allows the system to reduce its weight first and then the system separates from its ground base and hovers within its environment. This proving that the concept of production of dual Magnetic and gravitational fields through the same elements and conditions to be correct, and the results and observation from these tests are summarized in general in this and other papers to be published.

Fig. 23. Some of the prototypes used for creation of Magravs.

Discussions

In this paper for ease of understanding the structure of planet earth is considered as vast amount of information about the inner-structure of this planet are available. In fact this principle of creation of gravity through interacting magnetic fields can be scaled up to structure of universe or scaled down to structure of the plasma of proton and electron and the principle will still applies and be correct.

If scientists would have discovered both magnetic field forces and the gravitational field forces of the planet at the same time, they would have probably had a totally different understanding of their principles, their capabilities and their connections and most probably the human race would have taken a different course in its intellectual and scientific world. It seems this miscomprehension has been purely due to the physical time gap between the discovery and understanding of these two forces of creation.

Working on a real basis for gravitational field's forces production at the centre of the planet, the author set out in early 1980's to design and has produce several real and practical reactors (Fig. 23), which these reactors could replicate the universal order for generating magnetism and finally their interaction lead to the creation of Magnetic and gravitational field forces within the same system to prove the correctness of the principle of above hypothesis.

A fundamental assumption to achieve the proof of the creation and control of a gravitational force within a system has been that the Earth in its inner part has and maintains a semi-fusion and fission nuclear chain of reactions, also called a geo-nuclear reactor.

The interaction between materials and magnetic fields of semi-fusion and fission chain of events in the Caroline core (Fig. 24) of the planet (*This being the core within the inner-inner-core of the Earth, "The seed of the Earth"* (12)) always leads to creation and maintenance of planets physical forces of Magnetic field (MF) and gravitational fields (GF).

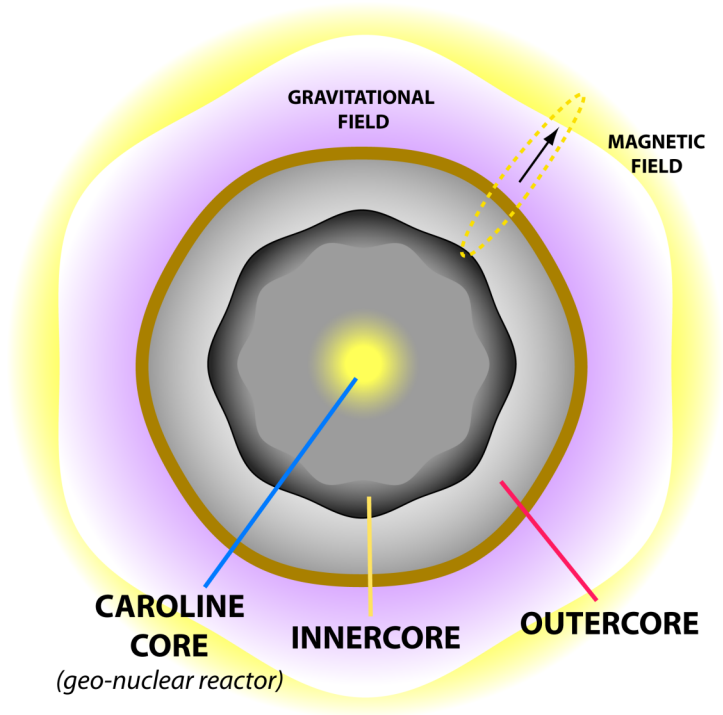

Fig. 24. The structure of inner cores of the Earth (12).

This semi-fusion and fission sequences of processes and existence of plasmas, nano-materials, gases and other materials in the containment of Caroline's' core and the convection process due to the heat transferred from the Caroline core to the Outer core of the planet once being passed through to the inner-core has been considered to be the principle operation of the inner cores of the planet, where, due to dynamic characteristic of the materials, which are charged and rotating within in vacuum condition of inside of the Caroline core, leads to independent creation of current and plasmatic magnetic field within this core, irrespective of the already assumed second and already known magnetic field, created between rotation of the inner-core and the outer-core of the planet.

These two independent dynamic plasmatic magnetic fields which are separated by means of the physical barrier made by the existence of the known solid inner-core.

The interaction of these two dissimilar poles if the these two dynamic plasmatic magnetic fields due to their proximity within the centre of the planet leads to the creation of the central gravitation field force of the planet, which this force spreads out to cover the whole of the structure of the planet.

Hence it is clear that the source of the Gravitational field force of the Earth and all planets are due to the interaction of two dynamic plasmatic magnetic energy fields, which are created independently in the centre of the planets.

The Caroline core of the Earth creates its own spherical dynamic plasmatic magnetic energy field, and the already known second field, comes from the dynamic spherical plasmatic magnetic field, which is created in the outer-core of the planet at the same time.

In trying to lock onto each other, these fields forces create the condition of double spherical magnetic fields, which both possess their own North-pole and the South-pole, where due to dynamic and loose atomic, molecular structure of the matters and fields in these two cores, the dissimilar poles of the two cores can never quite reach the point of total locking into each other, and as they try to reach this point of full lock, the field forces they create lead to creation and maintenance of the perpetual motion of the two fields in the centre of the planet.

These separated dynamic fields forces on either side of the solid-inner core exert their forces on the solid inner-core of the planet and cause it to rotate, and this leading to creation of the rotational movement of the planet (12)

At this point the interaction of the fields created by atoms and molecular elements, which cannot lock to each other due to their similarity of magnetic poles, will create the outward plasmatic magnetic field between the two cores, or they create what is known as the Magnetic field force of the planet (this being created by the environment and the behaviour of two similar poles of a solid magnet which they repel each other).
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Where, at the same time the interaction of the magnetic fields created by atoms and molecular elements which cannot lock into each other due to their dissimilarity of magnetic poles, these interaction of the magnetic fields will create the pulling power effect between the fields, atoms and molecules contents of the two cores and this creates the dynamic attraction plasmatic magnetic fields of the planet or what is called the gravitational (Pulling) field force of the planet

Thus; Gravity or gravitational field force does not and cannot exist with existence of only one plasmatic magnetic field force as has been assumed to be so up to now in respect to the creation of the magnetic fields of the planet.

The gravity and gravitational field forces manifest themselves upon the creation and existence and maintenance of the second dynamic plasmatic magnetic field within the structure of any dynamic plasmatic field entity, that in the case of the earth fluid matter in the outer-core is source of this second field and may be generated through the assumed convection theory by the convection of the matter in the outer-core, and the interaction of fields in this core with the plasmatic magnetic field which was originally created in the Caroline core of the planet through the fluidity of the fields, plasmas and matters in this core.

Therefore the gravity is an outcome of the interaction at plasmatic, atomic or molecular levels between two dynamic plasmatic magnetic fields created and maintained by the two inner-cores of the planet upon each other.

Ultimately for creation and maintenance of gravitational field force, for all stars and planets or any dynamic maintain plasmatic magnetic fields system, and to maintain a gravitational fields forces in any celestial entity there is a need for existence and establishment of two independent dynamically, molecularly or/and combination of the two independent plasmatic magnetic fields forces, which these can be created by any mixture of matters and fields, in any combination of magnetic fields, liquid, gas, plasma or other state of matters within the confined of specific condition and entity, this leading to generation of loosely interlocking plasmatic magnetic fields, which these two fields are separated and maintained by any physical supranational means, in any state of matter or function, separately and independent from each other, even though one magnetic field could be the cause of the creation and maintenance of the second pmf.

Where, the separation of the plasmatic magnetic fields could be established by the means of solid, liquid and gases, plasma and energy directly in adjacent layers to each other as has been observed to be in the structure of the inner-core of the Sun material layers.

Once the strength of the plasmatic magnetic fields of the inner-inner-core (Caroline) and the outer-core in a system, by controlling the creation of the plasmatic magnetic fields in the Caroline core or the outer-core is attained by the system, consequently the strength of the gravitational field forces of the system like the earth is set.

Looking at overall view of the centre of the Earth magnetic fields and it their near spherical shapes structure and with the new understanding of its' physical inner construction and material composition, one will come to understand that at least the two magnetic fields generated within the inner cores

structure of the Earth are spherical in shape and they generate dynamic spherical plasmatic magnetic fields. Where, one field being superimposed on top the other are in operation within the centre of the planet.

Whereas, one of the fields being the spherical magnetic fields maintained by the inner-inner-core due to existence of plasmas, hydrogen atoms, other gases, nano, gans, nuclear and non-nuclear materials in presences of second magnetic field generated by spherically dynamic plasmatic magnetic the outer-core in the centre of the Earth (Fig. 25).

Which, this creates and brings about the phenomenon of the dynamic magnetic confinement for the materials in the Caroline core, which this brings about the conditions for the fusion process to be attained in this core of the earth. This explaining why the planet can exist for a long time with its matters and motion intact, as matters through fission and fusion use a very little matter in the close capsule environment of the Caroline core.

The second spherical dynamic plasmatic magnetic field in the outer core of the earth possibly is created through convection, due to its materials in motion in the outer core.

There are strong indications and possibilities that the outer core could be operating in the same matter mixture composition as the Caroline core, which this eliminate and invalidates the concept of the convection theory.

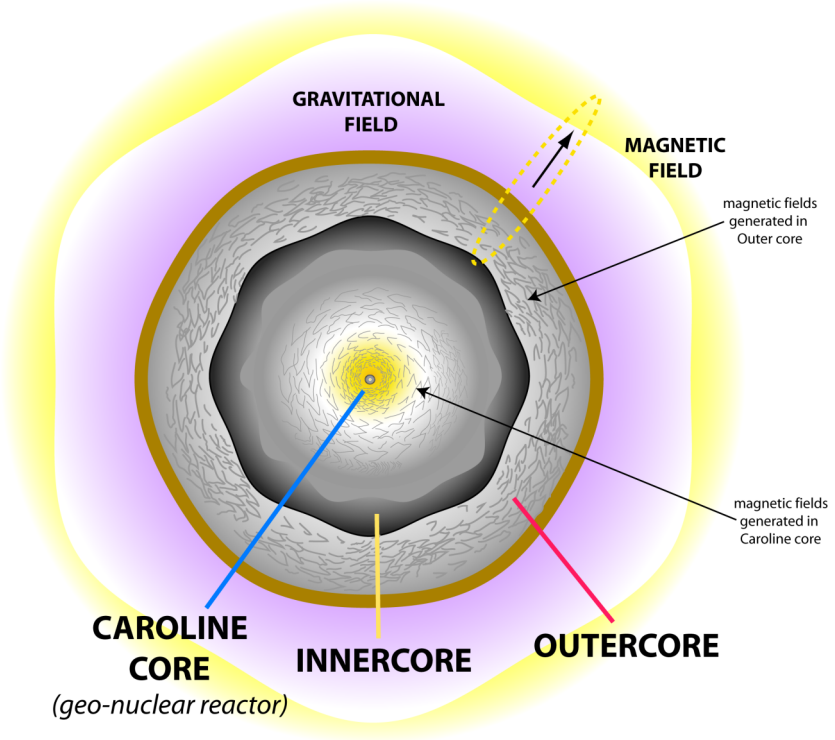

Fig. 25. Existence of minimum two separate magnetic fields in two cores of Earth.

It has to be said and it can be proven that the Caroline core maintains and through nuclear decay of its matter content produces plasma of matters, then by the understanding of the concept of generation of current through motion of the plasma itself, this proves that one does not need the convection principle to create the current and magnetic fields in the Caroline core or even in the outer core of the planet.

Therefore the existence convection theory and motion of the solid inner-core to create the magnetic fields of the earth losses its credibility, as in plasma technology, it is well understood that plasma in motions create their own current and in turn the interaction of this current with matters and other fields in their environment this can lead to they creation their own magnetic fields.

Thus, the theory of convection has to large extent no validity in the present understanding of nuclear science as one observes these operations of plasmas' phenomenon at the solar, galaxial and universal systems levels.

The convection theory was he understanding of the eighteenth century and the understanding of the working of dynamo of bicycles and this has no room in the integral working of the universal motion of plasma and magnetic fields of today.

Secondly entities like stars do not have solid core that leads to creation of their strong magnetic fields and gravitational field, as they only operate on the principle of plasma layers and some helium matter in, nano, atomic and molecular level.

Therefore in reality the physical positioning of the matter in the cavity of the once presumed solid sphere of the inner-core is the catalyst and contributor and the creation of both plasmatic magnetic fields of the planet, which both fields are independent of each other, but at the same time interconnecting or magnetically reconnecting tool for both spherically plasmatic magnetic fields on either side of the solid inner core of the earth to produce the Magnetic field and gravitational field of the Earth.

Where the interaction between these two dynamic plasmatic magnetic fields in the physical body of the inner-core of the earth leads to creation of the double spherical plasmatic magnetic fields' phenomenon needed for creation and control of the strength of the plastically magnetically based gravitational field forces and plasmatic Magnetic field forces necessary for the creation of the mass of and the atmosphere or magnetosphere around the planet.

These reconnections' of plasmatic magnetic field generated in two cores of the planet are totally on atomic and molecular levels, this leading to a creation of loose plasmatic magnetic field forces that operate at weak levels, but strong enough to cover a vast area in their surroundings.

That is why a small Caroline core in the centre of the Earth can create a strong magnetic fields effect of up to outer boundary of the magnetosphere and gravitational field of the Earth and beyond.

As the plasmatic magnetic fields could be created by use of any elements in both cores of the planets that they can generate any amount of heat and a given gravitational fields forces and for example with the Earth operating at central temperatures of several thousands of degrees centigrade at its core with surface gravitational force of one g at its surface, and similarly the Sun physically possessing several of thousands of times larger mass and volume than the Earth with central temperatures of several millions of degrees centigrade, which has only the surface gravitational force of about twenty eight times more than the Earth, therefore the following statement can be made that "*the strength of gravitational field force of any system is largely independent of temperature, and is primarily dependent on, the composition of its dynamic inner structure mafs and matters, and the fields they created or maintained and the physical condition and are positioned in respect to each other, which through their interactions these leads to creation of the two dynamic plasmatic magnetic fields strength of the gravitational fields and magnetic fields of the system within its inner sanctum"*,

In relation to the physical data's available, the present gravitational field system which has been assumed to be created by the single magnetic system due to motion of matter and the inner-cores and the outer-core in the centre of the planet is not scientifically acceptable and cannot stand the present physical knowledge about the inner construction of the planet from seismological data's of the past twenty five years.

The concept of single plasmatic magnetic field of the planet, which has up to now been assumed does not stand scrutiny of present knowledge and the present expanded laws of physics, as for the planet to be able to create gravity and Magnetism (for magnetosphere) that can span a vast area of the solar

system irrespective of its position and the material carried in its outer shells and on its surface, then the planet has to have two active plasmatic magnetic field forces in its centre cores, that the interaction between these two plasmatic magnetic fields can create the fields that affect the behaviour other entities' with dynamic plasmatic fields elements in the vicinity of these fields, and the interaction of the fields of the planet and the fields of the entities allows for the entities' to position themselves in respect to and within the plasmatic magnetic field strength of the planet to be attracted by the effective plasmatic magnetic field of the planet. This is what we have called Magnetic and gravitational position or for short Magravs positioning of one entity in respect to the other entity, where both entities possess internal dynamic plasmatic magnetic fields.

The reality is that, if Earth has had only one magnetic field as has been assumed until now, then all elements on the planet would have been firmly attached to it, due to principle of attraction or repulsion of two magnets, and as it is observed on the planets all systems have been able to freely positioned themselves and being able to be mobile.

Without the shadow of a doubt the centre of the planet maintains two independent plasmatic magnetic fields, that the interaction between these two plasmatic magnetic fields at the plasmatic, atomic or molecular level leads to creation of an environment in which the matters in the surrounding area of the two plasmatic magnetic field will have the power to attract and repel mafs and matter within this created field. By the same law as the atomic matter, itself is made of magnetic energy fields, which possesses polarity hence why the attachment of the man to the earth as his being is made of these entities.

Therefore the matter will only by finding its Magravs position within the plasmatic magnetic field of the planet, if it can be attracted and be kept as part of the matter of the planet, or if its plasmatic magnetic field is too weak or too strong to be kept within a given field. Thus now it can be clearly understood how and why different planets can manage to hold on to certain matters and not the others and now one can understand why different matters take their positions in different layers of the planet too, where this positioning, like of the gases and solids, are totally related to the strength of the plasmatic magnetic energy of the atom in respect to the plasmatic magnetic energy of the planet or in other word, in respect to the total interaction between the pmf of mafs of the matter and the Magnetism and gravity of the planet.

The plasmatic magnetic field force created on these levels in the physical inner cores body of the planet these creates the condition, where all magnetic forces within these fields will be influenced through their magnetic reconnection, this being in atomic or molecular level, this creating pulling inwards forces for the two plasmatic magnetic fields of the matter and the planet to be locked into each other. This interlocking and the strength of it bind creates the effect of the gravitation field force, as the matters' magnetic force and the planet plasmatic magnetic field created by the double plasmatic magnetic energy field, reconnect to keep each other at a physical interactive but loose distance.

In reality gravity is the strength of the plasmatic magnetic field created by the interaction of the double dynamic magnetic force fields of the planet that can influence to pull the matters around these field to stay within its strength, or what is called its gravitational field force.

The interlocking of these forces are the same as with two bars of magnets when they are brought close to each other, but their binding of forces is in planetary plasmatic levels, which are at a loose atomic or molecular level rather than electrons' realignment or what is called are energy equal to the collective plasmatic magnetic energy of the electrons of Iron atoms interlocking plasmatic magnetic field level.

With the difference that in the planetary or astronomical, cosmological and universal levels these so called magnets are in the form of closed loop spherical shape and may be in possession of internal heating in respect to their surrounding temperature and system, where their plasmatic magnetic field

force can vary and they can change their strength due to the compression and other factors in their centre cores, as in solid magnet the strength of the magnet is constant and permanent.

In the closed loop spherical plasmatic magnets, the system of the plasmatic magnetic field lines has to find their magnetic reconnection line for the loop to be completed. Where, this plasmatic magnetic field's reconnection leads to the directional polarity leading to the creation of the North and South Pole phenomenon of the planet.

Through replication and production of such a system as the structure of the inner-cores of the earth, in being able to control the amount of matter and fields within the structure of these systems, the strength of the plasmatic magnetic fields of the cores of the system can be controlled and adjusted, so that, this will allow the creation and control of the measured gravitational fields forces by the systems in respect to the environment in which the system is operating in.

In the case of motion of an object like a manmade system, in possession of its own gravitational power production, in the gravitational pull of another object like a planet, the use of the phenomenon of the creation and control of the gravity in the centre of any system can be treated in the same manner as in the planetary system.

Where, the gravity created in the centre of manmade system needs to be slightly changed in the positive or negative direction in respect to its previous position for the object to be repelled or be attracted towards the planet or an object.

This Magravs positioning of a system in respect to planets plasmatic magnetic fields, can be achieved through several means, like by the change of characteristic of the dynamic of the one core in respect to the other, or changes configurations of the parameters, materials or physical structure aspects of one core or both core of the system.

The magnetic and gravitational forces of a Star are to some extent dictated by the position of planets within the system as much as the constituent content matters of the Star itself. On these bases, this being the gravitational forces of the system and its position within its galaxy is to a large extent dictated and controlled by its' planets and the gravitational force they create independently on their own.

This is very much like the rotational plasmatic magnetic fields of the electrons circulating around the nucleus of an atom. Where, the magnetic rotational spin of the electron decides the plasmatic magnetic field strength of the nucleus and the position which the element occupies and the number of other electrons it can carry, so this dictates the properties and its characteristics in respect to other elements around it, even though the plasmatic magnetic field of the nucleus is much more powerful than the plasmatic magnetic field of the electrons around it, or in other word the gravitational forces of the nucleus is needed for the electrons to be kept in their orbit and vice versa.

Thus the gravitational forces of a system or a galaxy is not only dependent on the plasmatic magnetic energy forces of its centre or its star, but it is fully controlled and determined by a bigger scale by its constituent planets and stars in that system too.

From the topography of the Earth gravitational field pattern provided by space agencies, Earth plasmatic magnetic field does not keep a constant pattern and there are constant changes in the strength of these fields in different parts of the planet, where these are dictated by the activities within the centre cores of the planet at the point of observation. These variations in gravitational field's patterns confirming that the planet has composite and not necessarily spherical shape cores.

These variations in these forces in the cores of the planet could be due to the variation between the interaction of the inner and the outer plasmatic magnetic fields, where for example at point where these forces vary drastically in respect to each other, then one gets distortion of the fields and

reduction or increase in the gravitational field force in that region of the planet by small factor. Then where, for example one force field, like the fields created in the Caroline core is more powerful due to sudden short burst of ionization in the core, at that point and that moment, the plasmatic magnetic fields interaction of the centre field is more powerful, then the gravitational field force can be more powerful at that given point, but these changes due to close confinement of the centre cores are usually not so large.

For example by observing the pattern of the gravitation field of the Earth, a constant depression in the plasmatic magnetic field in the region of the southern eastern hemisphere in respect to the rotation of the planet usually can be observed. Where, this phenomenon now can be easily be explained, and this is what I so call the washing machine effect and that is, where the material within the inner-core has loose plasma area of rotation, as in the drum of washing machine filled up with clothes, the inner-core of the Earth does not possess the blades as in the drum of the washing machine, then the more dense matters in the Caroline core as they cannot role all the way up against the internal wall of the cores, and then due to toroidal and interaction with poloidal motion of the Earth, these materials pull up the wall of the core and due to their viscosity they roll back over in this area, this whirlpool effect due to slower motion and less available field in this region effects the gravitational field in the south American continent area too.

This washing machine effect of the materials in the Caroline core directly affect the plasmatic magnetic field production in this core, and consequently its interaction with the plasmatic magnetic field of the outer core, and in turn this creates the disturbance in the gravitation field of the planets in these two regions as has been noted in the overall pictures of these regions gravitational field forces effect, where dents in the gravitational field forces patterns are observed on continues bases.

Even thou Newton did note the effect of interaction of two forces between the matters and the planet and he measured its strength and called it gravitational field's forces of the planet, but he could never establish the source and method of its creation. He speaks about the effects of the gravity in relationship between two objects in respect to each other's position, and not the effect created by two plasmatic magnetic forces in respect to each other and their position in respect to each other, where he could not understand that gravity was magnetic field bases entity and magnetic field strength and it effect are magnetic fields position dependent. Newton never could relate and understand the connection between Magnetism and the gravity as both to be created by the same matters and conditions which manifesting itself as two different forces in respect to other magnetic field forces.

Scientists explain the gravity as the relationship of attraction between position of two bodies in respect to each other, and not the reality that gravity manifest itself in relation to interaction and attraction of two bodies in possession of dynamic plasmatic magnetic field forces created and maintained in respect to each other position.

In understanding the real method by which the gravitational field forces of planetary systems are created then systems can be made to replicate the same process and by being able to create and control gravity as done in the planets one is able to observe the effect of this natural phenomenon within operation of a manmade system.

In manmade reactors as the concept of gravity has been replicated, now the concept of the gravity has to be redefined as the " attraction between two bodies, where at least one body possesses a double spherical dynamic plasmatic magnetic field force, where one field is superimposed by the other plasmatic magnetic field forces within an object, where their overall plasmatic magnetic field strength interaction upon each other can create an overall plasmatic magnetic field, that other matters in possession of their own dynamic plasmatic magnetic field or static plasmatic magnetic field, within their catchments area can position themselves according to their internal plasmatic magnetic fields strength".

The interaction of these double dynamic spherical superimposed plasmatic magnetic fields in the centre of the planet separated by the physical matter of the inner-core upon each other is the cause of the rotational motion of the inner solid core of the Earth and where the motion of the inner solid core itself is the containment body of the centrifuge system for the gases in the Caroline core for the atomic fusion chain of events in this chamber, for it to sustain the ionization process in the this chamber. Where, at the same time the inner-core plays the effective mixing machine for the matter in the outer-core of the planet, where the interaction of plasmatic magnetic field of the Caroline core with interaction with the plasmatic magnetic field of the outer-core would change the combined plasmatic magnetic field effect of the whole planet, which in reality would have changed the gravitational field strength of the planet.

The rotation in the gas layers of the Caroline core in conjunction with turbulence, which leads to convection in the materials in the cores of the planet, this effecting the generation of current and plasmatic magnetic field in the core of the planet and consequently the gravitational forces created by the core of the system.

Now one can explain that the change of the polarity of the earth and any other entity the like of the Sun is only due to change direction of flow of the current in one core or layer of these dynamic magnetic fields based star and hence the change of direction of the flow of the current for example in the plasma of the Sun layer leads to change of the polarity of the star, as one can sees the same change of polarity in the production solid magnets, where the change of direction of the flow of current changes the polarity of the metal, as is the same for the plasmatic magnetic field entities too.

Thus change of polarity of the earth is only due to the change of direction of the current within the core(s) of the earth and would not affect the gravitation field or Magnetic field strength of the earth when it will happens.

Now that the method of the creation and control of gravitational field forces of planet is understood and can be replicated, it becomes easy to understand how systems can be produced that can create magnetic field structure of any element or matter in the universe, this being magnet for hydrogen atom or uranium atom or magnetic machines can be produced that can gravitated to themselves molecular structure like water or protein.

Where, the system gravitational field can be created to match for example only the plasmatic magnetic field of atom of gold, so that the system becomes a gold magnet or the system will generate only or gravitates towards the plasmatic magnetic energy of the gold atom, so one can separate gold or any other matter which the system is present to generate the Plasmatic magnetic energy of. This system will then can replace the present centrifuge system of the present time.

Magravs measuring system

In the gravitational systems, where only magnetic fields forces are considered and measured, the present earthly measurement tolls of gravity has no meaning and room. Space scientists of the future have to learn to measure magnetic field force in respect to each other and not kilogram per centimetre per Seconds Square.

Thus the measuring gravitational systems to be developed have to be first of all three dimensional, as field forces of all matters and fields in space have to be considered and balanced against or with.

The gravitational tools of the space technology is fixed magnetic fields shear against the magnetic fields of the system against the total magnetic fields forces in the overall sphere of the systems fields.

In fact the gravitational fields of the space technology are like a magnetic fields sphere positioned around the gravitational reactors, as these measuring tools of the gravitational systems will measure the Magravs of the all fields of all forces internally and externally in respect to their position in respect to the reactor Magravs.

The Magravs measuring tools are to be called **Universal Magravs Measuring System** (UMMS) and position of Magravs of the system in respect to another Magravs are called **Magravs positioning System** (MPS).

Elaborations:

Through understanding the real term concepts of the creation of the gravitational field forces and design and production of specific nuclear-based reactors of the function of matters within static and dynamic reactors, the principle of the hypothesis of creation of gravity has been proven to be correct.

The difference between inertia and gravity is said to be the gravity is an attribute of a body in possession of two dynamic plasmatic magnetic field forces interacting upon each other, where the inertia is the attribute of collective molecular magnetic force of an object which does not possess a double magnetic field structure as whole, even though both behave the same and due to their plasmatic magnetic fields appear to be the same thing.

Where, in case of planets like Earth, the total pulling power of the planet in respect to other objects in, on, or about it are due to collective forces created by the gravity and its constituent's matters inertia.

The creation and maintenance of gravity is dependent on two dynamic regions being in possession of two independent dynamic plasmatic magnetic field forces and gravity is totally independent of the mass of the object as mass itself is the by-product of the interaction of the Magnetic fields and gravitational fields of the entity, but dependent on the position of their plasmatic magnetic forces in respect to their plasmatic magnetic field strength from the centre entity.

The centre of planets, does not matter what their inner layers are made of do not need a metallic matter or metallic behaviour conditioned matter for the creation and maintenance of their own electromagnetic effect due to motion of electrons and charged plasmas in their core as these entities generate current and potential difference levels for the core to maintain independent plasmatic magnetic field forces leading to the creation of plasmatic magnetic field and finally by interaction of two such dynamic plasmatic field forces upon each other, leading to creation of gravitational field forces within the entity and in its surrounding area.

The interaction of these two plasmatic magnetic field forces upon each other, or the concept of *"DOUBLE DYNAMIC SPHERICAL PLASMATIC MAGNETIC ENERGY FIELD EFFECT",* in the centre of any dynamic plasmatic entity will lead to creation of the gravitational field force and the magnetic field forces of that entity in respect to other entities with the catchments fields force of the entity.

Therefore, the gravitational field strength of a system manifest itself and can be explained as the relation to interaction and attraction of two bodies in possession of dynamic plasmatic magnetic field forces created in respect to each other plasmatic magnetic field position and strength. Even, further it has been proven through prototype reactor tests that the speed of the rotation of the planet is

determined by the speed of the solid inner-core of the planet, where the speed of the rotation of the planet is set and dictated by the interaction between the dynamic plasmatic magnetic fields of the Caroline core and the outer-core of the planet, as the motion induced by the strength of the two fields in the centre cores, upon and interacting within the solid inner core, determines the speed of the rotation of the inner core, and in turn this will determine the speed of the rotation of the whole planet.

Whereas, if the speed of the rotation of the planet were not set by the planet by this principle, then the planet would have had different speeds at different points in its daily axial rotation and it would have had different speeds in its annual path in circling its star, where the effect of the other objects in the system would have dictated different speed of the rotation of the planet, therefore it is correct to assume that the speed of the planet is controlled by the speed of the solid inner-core of the planet, and the same applies with other entities like the star as the speed of the internal fields interaction dictates their speed of rotation.

The motion of the inner solid core is very much like the motion of the trains on magnetic tracks, where by not allowing the two dissimilar magnetic poles to be aliened, the train moves forward. Where, in the case of the spherical solid metallic inner-core of the Earth, this motion is rotational rather than linear.

Through tests, it has been proven and understood for the first time, that the magnetic polarity change of planet or the system occurs when the direction of the flow of current this being due to motion of electron or charged plasma in the cores in the whole of the system changes from one direction to the other, or in some cases one field change of direction of internal current can causes the half reversal of the polarity of the whole system. This is understandable, as the plasmatic magnetic fields are created due to directional motion of electrons, plasmas or charged plasmatic current within the matters of any entity, thus as the direction of the flow of the current changes, this will change the direction of the polarity of the planet.

Understanding the direct relationship between the magnetism and gravitational forces within a system, in the manmade systems the change of polarity in the reactors of a system has to be avoided, as, if this happens during the operation of the reactor, this can and would lead to the overturning of any platform which is equipped with such a system. This being one of the fundamental reasons why the reactors which have been developed and tested up to now for space technology, always are preferred to be constructed in a half spherical shape, simply to avoid the flipping of the polarity in the cores of the reactor, where the speed of the rate of the polarity change is very dependent on the components and conditions created within of the centre of a planet or a star.

If a planet is made of near enough similar material on both side of the inner core, the flips of polarity will be much faster and on a shorter time lapse, like in the Sun.

If the planet is made of a composite core, and made of two or more different materials in its Caroline core (the real centre core), for the two fields to re-align, then this will take a longer time for the magnetic flip of polarity to occur, like in the core of Earth. In any case, as the materials in both cores are always constant and cannot change that much, therefore the time laps between the changes of polarity stays on the same time intervals.

In the case of the Sun, due to its more uniform and singularity or only composite of three matters of plasma, hydrogen and helium in its core, the change of polarity takes eleven years, and the full polarity change has the predetermined time of twenty-two or three years.

In the case of smaller planets' like the Earth, which is made of composite mixtures cores, the time lapse in change of polarity will be longer. Where, the switching of polarity is a natural outcome of the direction of the flow of current created by the electrons and primarily by the charged plasma and due to dynamic characteristic of the core, and is an inherent characteristic of the atomic structure of each element and environment which they are condition to within the cores of the planet.

It has been observed in tests, that the plasmatic magnetic field of the core increases by the principle of extraction of the electron from the core, where electrons are facilitated to be absorbed by the walls of the reactor core. Where, the majority of the field created is primarily due to the motion of charged plasmas. Where, at the same time for weaker magnetic fields test the reactors have present to absorb the plasma of the proton that only the lesser mass of mafs available in the plasma of the electron can be used for a given test condition.

Therefore according to need of the use, reactors can be set to utilize any components of an atom or the mafs of their constituent plasmas without in fact destroying any structure of the mafs or the matter, which the mafs was used for that given exercise.

In principle it is observed that the plasmatic magnetic energy of the planet is primarily due to the motion of the charged plasma in the core and not electrons, where in reality the motion of charged dynamic nuclease of an atom has/ and indeed, possess a much larger electrical charge then its counterpart the electron by factor of 2000 times. Thus now it is apparent and clear why such a small core in planets can master such large magnetic field forces within and around them, and now it is understood how planets can carry the burden of such large mass in their journey through their system for such long period of time of billions of years in their solar systems.

In tests plasmatic magnetic field created by these type of cold condition plasma using a 20 cm dynamic core, has been noted to create a 4-meter radius dynamic spherical plasmatic magnetic field span, which can last up to several minutes after the switching off the whole system.

The dynamic plasmatic magnetic fields created within the double cores of the planets, determines the magnetic or gravitation fields, which the planet will possess and consequently the material, which the planet will hold on to. This explaining why planets behave like magnets, which only have the characteristic of one element or several materials plasmatic magnetic band(s) which covers some and not the other elements, which this dictates the material composition of the planet within, on the surface and around the planetary system. Where, the same applies to the solar system and galaxies and so forth. Where, the gravitational field forces created by the balance of the two interacting dynamic plasmatic magnetic fields is the principal factor in determining the constituent material of a plasma, planet, star or a system.

The creation of the gravitational field forces of a solar system and even the gravitational field force of the galaxies are not far from the gravitational system and method's used in the atomic and planetary systems. That is to say, that solar system’s possess and generate plasmatic magnetic fields like planets and they possess gravitational forces according to their stars constituent materials. If one could stand on the edges of the solar systems, one should be able to see and detect the gravitational forces of this system, by it simply absorbing and attracting with the entry of cosmic meteoroids and asteroids into its gravitational and solar heliosphere region of its solar system.

Solar systems, like planets, possess and create magnetospheres of their own which is specific to their composition materials. The entry and exit from these solar Magnetic and gravitational fields uses the same method as the entry into or exit out of planetary systems.

This also holds true for a solid magnet, where if a piece of magnet could be cut into two halves or four quarters, each piece of the material will still carry the same north and south poles and each piece will have the same magnetic powers as the original piece. That is to say, that if one uses the same volume ratio of the same mafs or matters and proportional physical conditions in the core of a system; one will attain the same magnetism and gravitational field force from the system as its bigger dimension system with the same mass ratios.

In astrophysical terms, the Magnetic field forces of any entities are what keeps the entities apart from each other, and at the same and opposite to this, the gravitation filed forces are what keeps them together.

Where, the pattern of distribution of Magnetic and gravitational fields forces of the entity interacting with another Magnetic and gravitational field force shows itself as the magnetosphere of the entity.

This Magnetic and gravitational field force (Magravs) of dynamic plasmatic fields force is known passive magnetic field (PMF) and has no relation with the magnetism as known in a solid-state magnet. This is so called passive plasmatic magnetism due to the fact that, this type of magnetism cannot magnetize an entity otherwise all the materials in the universe would have stuck to each other. But this mixture of Magnetic and gravitational fields are used to position one entity in respect to each other that they not necessarily collide or move too far from each other once they established inter-magnetic connection.

The reason the Magravs are called passive plasmatic magnetic field is due to their capability of passing through human tissue without in majority of the cases affecting the function of their atomic and molecular magnetic field, which human cell possess on their own for their structural bindings.

In the past, magnetism and gravity have been explained according to the physical understanding of a solid magnet and not according to the planetary magnetic forces, this new understanding of creation of magnetism and gravity, is one of the corner stones of the creation of plasmas, planets, solar systems and galaxies. By not appreciating the connection between the magnetic field force and gravitational field force of a system like Earth, it has become a challenge for the scientific world even to overcome the weak gravitational field forces of small planet like earth in just trying to send a small rocket into the Earth's orbit.

Through development and tests on double core type of cold condition plasma reactors creating the same conditions as it has been assumed to exist in the centre of planets, it has been observed and physically been proven, that the source of the three dimensional spherical gravitational field and three dimensional spherical magnetic field of the planets are the same materials and the dynamic interaction of plasmatic magnetic fields created individually and independently in each core of these reactors and their effects upon each other creates and maintains both forces of the creation Magnetic field and gravitational fields forces simultaneously.

If one were able to create the right condition and material in a simple core, as has been done in our tests with core developments, then one can create and control magnetism and then the gravitational field forces within that object, and then in the environment which the object is positioned in respect to other external plasmatic magnetic fields around it, where, the plasmatic magnetic fields created within and by the object will becomes its Magnetic field around it, very much like the magnetosphere of the planets, this providing a magnetic shielding like Earth atmosphere around the object and due to the spherical shape of objects in possession of both forces, this creates a magnetic loop, where they create the two poles of the magnet as the North and the South Poles.

If a system can take advantage of this phenomenon, for it to move within forces of a planet, rather than trying to overcome them, or to resist them for its motion, then not much energy or effort is needed to create the right gravitational forces and magnetic field protection within and around a system for it to move inside or outside the atmosphere of a planet or a system without burning a single atom as a fuel, which this puts an end to the propulsion technology for rapid and protected motion anywhere in the universe.

Due to the spherical shape of most of celestial entities and their rotational motions in the universe, the gravitational force created by the dynamic plasmatic magnetic effect has a pulling force, which has the tendency to encircle and reconnect within the interior of the entities fields of the same dynamic

structure. This being the reason why the gravitational forces increase as one moves closer to these objects and as one moves' towards the centre of these matters.

The difference between the solid magnetism and plasmatic geomagnetism are two clear factors, in this particular order, first is Dynamism of the magnetic fields which creates the geomagnetism, and second the need for the interaction of two independent fields upon each other to maintain the plasmatic magnetise, where plasmatic magnetism for it to exist the plasma needs to create and maintain a full gravitational and Magnetic fields system of its own, which can absorb and feed other plasmatic magnetic fields within its environment to guaranty its survival in that environment at the same time, whereas in solid magnet, the order of continuity is within the structure of the matter and not mafs of the matter.

Conclusion

The gravity is the product of interactions of fields and wherever in the universe fields will interact their interactions will gravitates some fields or matters to them, or caused these fields to be attracted and gravitate towards another setup of the same or stronger and by laws of nature the stronger attract and gravitates more to itself and the heavier mass as they are made of more magnetic fields tend to dominate the seen when it comes to gravitational pull. Through tests it is apparent that the power of Magnetism and gravity of all entities in the universe are independent of the physical size of the entity and more dependent on the strength of mafs, which have led to the creation of the entity.

Through design and test of double core reactors we have proven that the origin of the gravitational force and magnetic force of a planet or any celestial systems in the universe are the same mafs and materials and conditions, where they are created out of the interaction of two independent and dynamic plasmatic magnetic fields.

Note; this revised version of the creation of gravity paper has included extracts from collection of three other papers published by the author, which these were, the gravitation measurement system, the relation between Magnetisem and gravity (35) and the original paper of the creation of the gravity.

CHAPTER 10

The creation of Black Hole

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Author: Nuc Ir. Mehran Tavakoli Keshe
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Note:

The original version of this paper, which explains how black holes are created and how they do leak matters and rays into the environment of the universe, was submitted to the Royal Astronomical Society of United Kingdom in London in April of 2004 for peer review and publication. The author after three months received on the 8.7.2004 a letter (Fig. 29) from the Society dated 7.7.2004 that this paper will not be published and will be kept in the library of the Society.

Interesting enough on the same day 8.7.2004 (check the press) Mr Steven Hawking, the imminent Black hole scientist and expert in this field of science announced that he, after thirty years has changed his mind and he says that indeed the black holes do leak rays out and that he announce this in a conference in Dublin later that month (see the press), as now he has lost a bit of shirt.

We have wondered for years how coincidental of the topic, the date of letter from the institute, the date of announcement, and the change of mind of a scientist!

This is the reason why the Keshe Foundation does not believe in the scandals and process of peer review and the foundation publishes its own scientific papers on its website and its own books for the reader to peer review the newly gain knowledge. As with this process the knowledge is passed on first hand and in some cases in matters of hours of the discovery to the public and not waiting for month and years until there is gap in some journal that the paper can be published. The Keshe Foundation firmly believes that 'as if a man, has reached the age of maturity and intelligence that he can read, then he can independently investigate and judge the correctness of the knowledge he receives according to his own level of intelligence for himself", unless he is an innocent, then he needs to accept the enforced control system of peer reviewing to tell him what to think, that this peer reviewing can suit the self-interest of the peer reviewer, or organisation which supports him financially or the nation which has promoted the peer reviewer for their own clandestine purposes, as we have seen the same process of control through peer review systems in different occasions in different countries around the world in this recent times.

A copy of the letter from the Royal Institute of Astronomical Society is enclosed at the back of this chapter for reference. (Fig. 29).

Abstract

Since first disclosures of this phenomenon, scientists and the rest of academic world have tried to understand and explain the reasons for the existence of these mysterious Black spots in the universe.

Hypothesis

The object of this paper is to prove that Black Holes are created out of a natural sequence of events in the universe and to prove that existence of a Black Holes in the galaxies and in the universe is a normal event as the appearance of the Dark Spots on the surface of the Sun. Black holes are simply a creation or an outcome of natural interaction between two or more mafs, passive magnetic fields and matters in motion within any dynamic plasmatic magnetic field entity in the universe (Fig. 26).

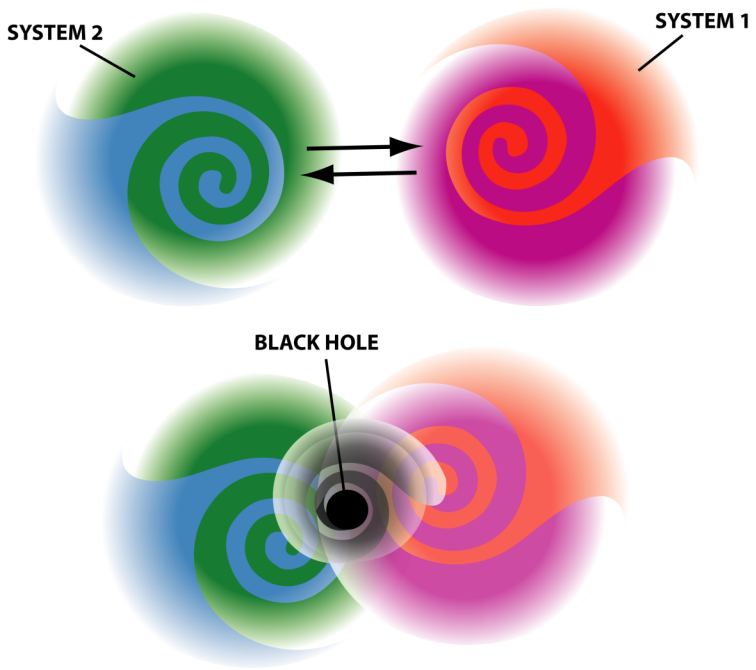

Fig. 26 Interaction of two plasmatic energy fields creating the effect of a Black Hole.

Discussion

In this paper for the first time, it will be explained how the Black Hole is physically created and in this disclosure it will be explained

1) The conditions, which this physical object is created in the universe naturally.

2) How this body of the mass appears as a dark spot in the galaxy?

3) What purpose it serves in the universe?

4) Parallel example of the Black Hole condition in our solar system.

5) The use of this phenomenon for Man to enable him to travel in space.

When, one could fully understand the concepts of the creation of galaxies, stars and planets and plasmas, and then one could be able to understand the creation and existence of the Black Hole in the universe in its different scale of dimension, where the creation of these entities in the universe all follow the same principle.

In understanding the fundamental principle that galaxies like solar systems and planets are given their inner mass and energy at the point of their birth in the universe, so they cannot create additional new masses and new source of energy on their own. Then it is understandable that Galaxies can only recycle what they have been given at the start of their lives, to create different new objects like stars or planets within themselves. In universal terms they have a finite mass and energy available to them and nothing more. But at the same time as a part of bigger picture galaxies have to obey the universal laws of physics. Consequently, all galaxies follow the same rules and so do their physical contents like solar systems and atoms within them.

A Black Hole is created primarily and only under-one condition in the Universe and as the consequences of other acts in a galaxy. They are not created as a deliberate act and as predetermined plan in and by a galaxy. But in their way, they make an enormous contribution in keeping the matters in check in their surrounding environment during their relatively short life.

At the same time they redistribute fresh materials throughout the galaxy during their cycle of existence. This is done through and as the consequent of them being the source for the creation of cosmic rays in their galaxies, as this is very much like natural fertilizers production systems of galaxies. Where, the old matters give its energy in an indirect way, for the existing other planets, to keep them healthy and for them to receive sustenance from their galaxy.

Black Holes in the universe are nothing but the centre for collection and re-cycle waste bin of cosmic debris of different sizes, this being giant meteoroids to specs of cosmic dust.

As the black hole grows bigger and their gravitational forces take over, then a Black Hole becomes a predator for parts of this galaxy. They become vast eating machines of the debris and stars and planets and this is exactly what is to be expected of them.

The Black Hole is originally created totally by chance. There are no patterns in their creation. They are simply a creation or an outcome of natural interaction between two or more passive magnetic fields or matters in motion within the galaxy or the universe.

Creation of the Black Hole

To explain the concept of creation of black holes, phenomenon's that are normal and familiar are used and will be relied upon in this paper. Then a parallel for the creation of the Black Hole type of incidents will be drawn with the same process in the solar systems, galaxies and universe.

Black Holes are created according to the rules of physics in galaxies to collect and then replenish the galaxies with fresh recycled materials, where this recycling is the vital factor in sustaining and making sure that as the galaxy moves that there are new materials available to start new systems within the galaxies. At the same time for them to nourish the other planets within the galaxy with fresh supply of materials. Where, for example the Earth receives several thousands of tons of cosmic dust from the

solar system through the similar method through its atmosphere per year from the black hole within its galaxy and from the universe.

The parallel similarities between the Black Hole and presentation of new material in the universe and on Earth can be compared to the effect of collision of Earth's tectonic plates. When, two sources of solid materials interact with each other. In the long run stars and planets in the galaxy, as the same with Earth submerged tectonic plates; these become the source of the supply of new materials in the galaxy, similar to, as lava becomes the new continents, or mountains on the Earth.

Let's explain this in the following manner. The continental plates and stars systems are forever on the move, they move slowly, but surly they are on the move. On the Earth, when two or more continental plates move in random manners, over centuries and millions of years, at some point they come on each other's path so as do the stars and their systems, like solar system and others in our galaxy.

When on Earth the two or more continental plates come together. Several things can happen, this happens in galaxies but in a different form too. Where, the continental plates in galaxies are replaced by cosmic spherical or flat oval magnetic fields of the stars or systems.

The next steps in the procedure are very familiar on Earth as the continental plates push against each other, if, they are of similar strength, they rise together to create the mountains over millions of years as these plates are still pushing and moving while they are exerting their strength on each other. So, large mountain ranges on the surface of planets are created.

Other things can happen too and that is if, one of the continental plates has weaker energy strength the weaker plate will slide under the other, where the continental plate which sub-merges in the long run becomes the material in the lower levels inside the planet, which later this becomes the base material for the magma of the planet, then over millions of years this matter again appears on the surface of the Earth through volcanic eruption. Then some times in the future these too become the source of materials for new continents or an island and so on through volcanic eruptions.

The material drawn into centre of the planet does not disappear but for the time being is hidden from the view and parallel to this scenario happens in the galaxies, when two or more systems in the galaxy reach each other, where an area in the space is created that the two passive magnetic fields and or entities have to interact with each other. Where, their passive magnetic fields push against each other like continental plates (Fig. 27).

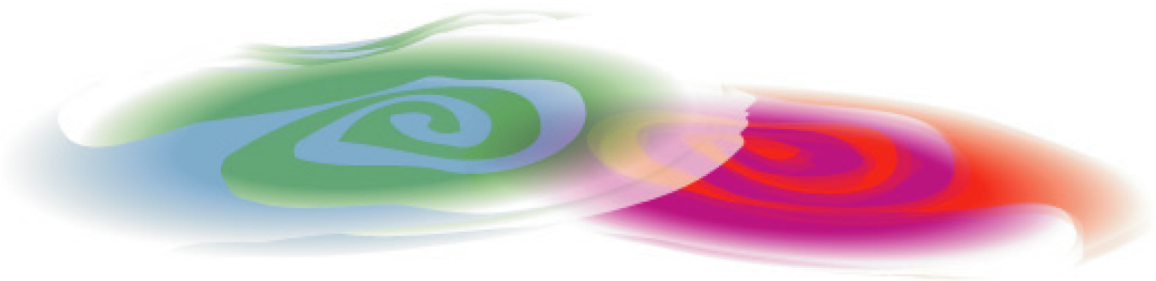

Fig. 27. Plasma of passive magnetic fields pushing each other creating
a balanced magnetic field region, called Black Hole

As they are on a collision path with each other and as at the same time the surrounding systems forces are pushing for their position, they do not allow any other course of motion but path of the collision of the two systems on the move. Then, a point is reached that as there are solid materials in motion from both systems and they have no choice but to collide and interact with each other. Where, in this process being thrown at each other by their systems, pieces of inter-planetary garbage, parts of moons or meteoroids and other bits of the two systems in this region are in the same pot too and all are mixed up and get entangled with each other.

In this area and at the same time as the two systems physical materials are pushed and thrown at each other, so do their mafs and passive magnetic fields are exerting their powers and authority too as in the like of in the planetary the hidden forces pushing the continental plates into each other. Then a point is reached, where these two magnetic force fields' of the two set of entities forces become to near enough to cancel each other out and create a condition of magnetic field equilibrium, where one field force cannot dominate the other passive magnetic field force, and inevitably an area of no or very week passive magnetic fields force in this region of the universe is established, where during all this processes materials from both systems are still being pile-up in this part of space. Where, the two systems materials are brought together due to pure forces of the Passive Magnetic Field forces of the systems and their surrounding systems in the galaxy.

Even stars themselves in the latter stages of the development of the Black Hole could become the victims of the Black Hole, which their system themselves were partially the cause of creation of. At this point the new mass of the Black Hole may even be a larger mass than any of the individual systems that created the Black Hole in the first instance.

One cannot forget that these masses are still in motion and rotating at very high speeds.

This new mass in the centre of this is pile all together creates a very large gravitational force within its region due to sheer weight of the mass which is collected and primarily these could become inertial pull rather than gravitational pull of the matter in these Black Holes too.

By laws of physics, one knows that the only reason that stars shine or cosmic rays glow is the phenomenon of the motion of charged particles passing through a magnetic field. In this region where the magnetic fields are very weak, this region lacks the main component that could make it shine or to be bright and that is the lack of the passive magnetic field in this region, due to the equilibrium and / or cancelling out of the two interacting magnetic field forces of the two systems.

Or for a time in the motion of the two magnetic fields of the systems passing each other in some parts there are no or there will be very little magnetic field force available, even thou there are charged particles in the area, but there are no magnetic fields strong enough for them to interact with to create the visible light. Consequently, in these areas of galaxy there are No glows and No shine.

Reason why this is called the Black Hole, is due to the fact that in these parts of the galaxy, which two or matters and their magnetic fields meet and interact, and can balance each other out, there will be very little visible light emission due to the lack of interaction between charge particles and non-existence of magnetic fields or existence of weak magnetic fields, that cannot produce bright light enough to be visible from the Earth.

This is the reason, why if one look's at these areas of the galaxy these areas seem to be darker compared to their surrounding areas, as the light not only is emitted from the mass of the black hole, but at the same time these matters due to their physical dimensions and their magnetic fields forces strength will not allow and block lights coming from other sources behind them in the galaxy too.

This is why, these regions of the space seem to be black, but from an outsider point of view looking over the area it looks as everything and all materials are thrown in to this dark spot from one side and nothing is coming out of the same side and consequently the physical term of The BLACK HOLE was invented.

This area appears as to be a Dark part of the universe, but in reality some rays of light should be observed being produced in this zone, as some charged particles still interact with the some weak PMF of the systems or what is left of them before they enter and interact and in this part of the galaxy there are visible light but matters are disappearing too.

So, in this region of the galaxy astronomers observe a large gravitational force due to the large amount of mass thrown in to this area by the two systems as they pass each other. But, they have no explanation as what is happening to all this mass. Now one understands the reason for this false assumption and appearance. This is the region where the gravitational forces are in reality mixture of gravity and inertia pull of two systems.

One has to remember that as these two or more systems are passing each other, several scenarios can happen again, which every one of these will have and has drastic and profound effect in that region of the galaxy. Where, at the same time these events can generate a vast amount of new recycled material for other entities within the galaxy.

At the same time one has to take into account the time factor and that one is dealing with a three dimensional picture, as in some cases the Black Hole exists for millions of years during the crossing of the two systems crossing each other's path at a slow speeds. The truth is that the Black Holes are a temporally condition, so to speak, in the bigger picture of cycle of the life of a galaxy, but they surly look like being there forever.

Some of the residual of these interactions will be some cosmic rays (10) or the outcome could be the birth of a new system with a new mass from the mixture of the masses of the two old systems after the system parameters balances each other out. In this case the overall masses of elements within the black hole are present as they were in their original systems. Where, now the new Black Hole could possess slightly less than the combined mass of two old systems. With lose of the some of its matter in the process of the interaction of the two systems into the galaxy.

One cannot forget that the centre mass of the Black Hole is still rotating most probably in the same direction as the systems were rotating which created it. At the same time, as the centre mass is void of the Passive Magnetic Field (PMF), the usual interaction between the passive magnetic force and gravitational force do not take place that usually creates the first basses of heating and sustaining that heat, so that the temperature gradient could take hold, that this in turn could create the scenario conditions for the mass to become a large star or a system.
So that the centre mass have enough material but not the right condition to create the necessary heat, for the time being to make the jump to become the source for a new system or a new star in possession of gravitational forces.
This is one of the ways that the Black Holes become the creator of new stars and systems. Therefore the mass relies upon the heat that is produced mainly by the natural friction of the elements pilling on top of each other in the centre of the black hole.

But at the same time these places become the centre of the mafs of principal matters of the entities within the collision zone. Where at this point the principal mafs and matters of the constituent matters within the collision can take hole and star t the process of creation of the principal star with its strong magnetic and gravitational field forces, which this condition can lead to creation of principal star and hence through realises of mafs of at principal level and through its slowing down and through production of transition mafs, these parts of the universe can again appear to be dark than the rest of their immediate surroundings, and hence the creation of balance mafs of created and the surrounding environment field, then again due to lack of creation of interaction sufficient to create mafs at the mafs of visible light, then these areas of the universe again look darker than the neighbouring regions, and as the centre of this region is covered with the seed of principal mafs and matters then one observes the strong pull of matters to this region without being able to see its origin which is the principal star in the centre of the dark zone.

These interactions between passive magnetic fields occur on regular basses in our galaxy, as systems are at all times on the move in a confined space of their Galaxies and if one had enough time to look out into the space, one will observe the creation of so called black hole the way one observes passing of dark clouds in the sky of the earth during stormy times.

The motions in this specific part of galaxy are in progress over thousands of years, the Black Hole's due to other systems magnetic fields surrounding it and their influence and interface with passive magnetic fields of these systems making and allowing the black hole to leak cosmic rays into the galaxy like a fountain in its surrounding area.

Then it should be understandable now that why the scientific world finds materials from the Universe that is not nor have not the same age as the original component of the galaxy. As like supernovas, the Black Holes are the source of the new material for the galaxy primarily because of the way they are created and the way their life cycle finishes.

The other scenario of the interaction of the two systems could be totally different with an interesting outcome. This is the most horrendous way that the two systems could come into contact with each other and in this case as the two magnetic fields come too close to each other, at the same time other systems around them push these Passive Magnetic Fields themselves together.

The two fields interact and the first stage of creation of the Black Hole is reached very rapidly, but as the two systems surrender more and more of their debris and planets to the Black Hole, the central mass of the Black Hole increases and as the Black Hole is receiving its contents from two different systems simultaneously, then a point reached that the weight and the gravitational force of the new centre mass of the Black Hole super-passes the mass weight of one of the systems, which created it in the first place.

Systems which have already lost some of their mass to the Black Hole at the outset of the creation of it, now losses control of its magnetic fields too. To an outsider looking at this event, it seems as the Black Hole is consuming everything around it. Where, this process can take over thousands of years, until a temperature gradient or a dynamic principal mafs and matters of in the centre of the mass is established.

As the centre mass of the Black Hole has consumed the entirety of two systems, and it is operating in a no magnetic field zone for a period of time, where its internal dynamic plasmatic magnetic field cannot pass its physical boundary (see the paper "The creation of dark matter" M T Keshe for clarity), the system will still can absorb or attract other masses from its surrounding into itself.

In this scenario, if mafs and materials are held for long enough time within the centre mass! That new magnetic field force could be produced and maintained, where at this moment of its life cycle this giant of a mass of the Black Hole will be nothing but a huge Gravity and Magnetic field producing machine. Where, by the end of this process a new system or several systems will come to be born and new materials will be scattered in the galaxy, and this Black Hole will be a Dark place but not necessarily cold.

If the centre mass during its creation does not manage to heat up, then the third phase of the Black Hole syndrome takes hold. This being that, the centre mass at this stage becomes so big and as it never had a chance to heat up due to total absence or lack of strong magnetic force at the same time where the new large centre of the mass is rotating, this new mass will be inherits a huge natural inertia force from its collective mass with no or little magnetic field beyond its physical boundary to keep it at bay, so, this massive large body will start pulling smaller objects near to it into its trap.

The same phenomenon applies when two galaxies come to pass each other's path too, with the most horrendous outcome for the galaxies in that part of the cosmos, where the outcome of such encounter is beyond imagination. This has happened before and astronomers forecast it for The Milky Way galaxy in the future as it passes the nearest galaxy to it in the next few billion years. Where, the surrounding areas near the newly created Black Hole will not be safe from the onslaught as this new mass at all time of its existence has the same fundamental problem as of all other systems, and that it tries to hold onto all its elements. At the same time like other systems the lighter elements and weaker mafs in the mass move to the outer layers and to the edges of the mass.

Where, weaker mafs as lighter gasses and particles move to the outer region of the mass, they become better candidates for them to be pulled away from the centre mass by any opening in the adjacent Magravs systems near to the Black hole. When the centre mass reaches a point that Magravs or its inertia force become weak on its edges, that lighter elements can manage to loosen themselves and escape from its grip into the space of its neighbouring environment.

These freed elements will become part of matter that can be attracted by adjacent systems to the black hole or due to the rapid motion of the Black hole released as cosmic dust in the galaxy. Therefore objects can and do leak out of the Black holes into their respective galaxy even during the time of their creation.

If these elements are pulled out of the power of the centre mass, through the strength or gap in the adjacent systems or weakness in the power of the black hole, then they become the cosmic rays this being due to the fact that during extraction most atoms get striped of their electrons, and some heavier atoms in this scenario lose their electrons in the same way and so they appear as plasma and as part of the cosmic dust in the galaxy too. Black Holes are the source of most of cosmic rays and dust in the galaxies due to this effect (10).

In the galaxies Black Hole's while are in process of being created and during their existence at all times are still surrounded by other systems and are under the influence of their Magravs.

The powers of these Black Holes are usually kept at bay by other systems around them with their larger magnetic field forces and gravitational forces, which the black hole is still encapsulate amongst.

Black Holes are normally observed close to the centre of the galaxies and the universe, as there are more systems clustered together in these regions as this increases the chances of different systems to come in the path of each other and in turn increasing the chance of the collision of solar systems in the and galaxies in the universe and hence increase in the chance of the creation of numbers of the Black Holes.

The stronger mafs and the heavier elements of the universe and galaxies are largely concentrated in and near the centre of these entities, thus the passive magnetic fields and gravitational forces of the systems in these central regions are many times more powerful near the centre of galaxies then what is experience in the outer edges of them.

Consequently, the gravitational forces and passive magnetic forces in the centre regions of the galaxy will soon bring and keep the size and the power of these giants Black Holes under control.

What these collisions of systems and creation of Black Holes achieve is the fundamental principle of regeneration of new systems out of the old matters, and at the same time unclogging of the galaxy of all the loose debris.

If one looks at a three dimensional overview of these areas in space, surely due to the movement of stars and planets and the interaction of their forces, one should be able to predict, where the next Black Hole in that part of galaxy could be produced.

In time, a point will be reached, where the passive magnetic fields systems in one of the immediate systems' neighbours to the Black hole will move on, and at this point the feeding frenzy of the Black Hole will come to an end.

Like volcanic eruptions on Earth, where the mantle is thin enough that pressure of the lava can takeover, and that it can to pure out, pushing its way out into the atmosphere as a volcanic eruption.

This is exactly what happens when one of the passive magnetic fields in this area moves or weakens.

This creates a gap in the fields containing and controlling the black hole parameters, where the materials in the centre of the Black hole, which has been pushed previously into the Black Hole from one direction, for these materials to be released or scattered in to the galaxy.

In this process, part of these materials will manage to cluster together and generate the conditions essential for creation of one or more systems or stars.

Where the rest of the materials of the centre mass of the black hole becomes cosmic dusts, some become comets and some become cosmic rays and so on.

Thus Black holes are not gigantic eating machines compared to the size of their galaxy. In reality, they are nothing but a temporary condition created in the galaxies due to movement of plasmatic magnetic field systems as they are crossing each other.

Very much like two masses of clouds crossing each other path colliding with each other. Where, this interaction of clouds upon each other creates abnormal conditions in that area of the planet, where, their thickness can block the rays of the Sun behind them and the sky looks darker, but in reality these are temporary conditions for the viewer from Earth.

Contrary to common belief, Black holes always release matters and release new recycled material into their surroundings; they are not bottomless pits, where everything disappears into them. They are like a funnel, that if one looks at one end it seems that they are taking everything in, but exactly like a funnel, they have a hole on the other end, that what goes in has to come out, with a difference that the end of this funnel is connected to a kitchen-waste unit of the universe, where that on one end it crunches everything up and mixes whatever goes in before spewing the waste out through the waste pipe.

So the behaviour of the Black Hole is very much dependent on the position of the observer. If one looks from one end they are massive eating machines and from the other end they are the supplier and feeder of new life in the Galaxy.

In real term this dark part of the galaxy is at all times emitting electromagnetic waves of varying levels and strength from all the activities which is happing within, around and because of it. Black holes can easily be identified in their environment and their position can clearly be pinpointed by using much simpler method of detection than by just guessing and look for their effects in a given region of the universe.

In principle the Black hole has all the attribute of any system, but in fact as the internal plasmatic magnetic energy field of the systems creating it, in the given region of the galaxy, cannot create outward plasmatic magnetic energy field, that can interact with other plasmatic magnetic energy fields in its immediate given environment, for it to create outward visible magnetosphere at boundary of the black hole to manifest itself as a visible space in its region, this leads to creation of lack visible light in the man's Magravs amino-acids matter mafs strength.

The phenomenon of Black Hole occurs on the continuous bases on the surface of stars of any Solar system. The principle of the creation of Black hole happens on a smaller scale on the surface of the Sun in the solar system, where these are called the Dark Spots of the Sun.

These are where dynamic plasmatic magnetic fields systems on the surface of the Sun go through the same cycle of interaction of fields with each other as it happens for the creation of the Black Hole in the galaxies, where these plasmatic magnetic fields come across each other in the atmosphere and on the surface of the Sun, consequently they have to interact or pass each other, with the difference that these plasmatic magnetic fields systems on the surface of the Sun, even thou they are so powerful,

they in one way or other meet-up with each other, and as their energies have to interact, then sometimes these energies cancel each other out and reach a balance magnetic energy condition.

At these points then, the same cycle as the creation of a Black Hole, on the surface of the Sun in much smaller scale repeats itself as there are no magnetic fields interaction because of similarities and identical mafs strength of the interacting fields, then there very little friction of fields that residual fields in the strength of the man's mafs of amino-acid strength are released, and hence or a very little light in the region and hence the appearance of the Dark Spots on the surface on the Sun is observed. In some instances the same is created as there are no interactions or balanced pmfs strength of the matters and mafs between the charged particles and mafs from the surface temporally are produced and consequently there is no or very little emission of light from the surface of the Sun in these regions.

On the surface of the Sun the same scenario of retraction and absorption of matter as the of the Black Hole starts occurs with a slight variation, which in this case the gravitational fields force of the Sun is so powerful and very close by that as the gravitational forces of the Sun are (in proportion) many times stronger than the gravitational force of the particles captured within the Dark spot region on its surface, that once the magnetic fields have interacted their energies and the content within the catchments of their forces have reached the equilibrium level, then the mass of particles in these regions are sometimes pulled back inward onto the surface of the Sun instantaneously after the collapse magnetic fields which created the dark spot regions, then at this point the physical matter of plasma in this region of the dark spot are pulled back into and is literally missile back into the liquid surface of the Sun, this creating a secondary dispersion of matter in the atmosphere of the Sun and into the solar system and hence the increase in the Sun flairs during the creation and as sequence of the collapse of dark spots on the surface of the Sun.

In reality the persona of dark spot is created mainly through interaction of mafs fields of the Sun and these are created very high above the surface of the Sun, that the dark image observed is not in reality mainly on the surface but much further up in the atmosphere above the real solid surface of the Sun.

In other instances as the plasmatic magnetic energy fields interact to create the Dark spot, the surface tension of the Dark spot becomes weaker on its face away from the Sun and all sorts of mafs and matters in the full spectrum mafs of the universe directly gets ejected into the solar system with much more power and matter then normal dispersion.

Once the temporally condition of creation of dark spot of the Sun is created, By this time, most of the other plasmatic magnetic fields of the Sun physically push and cajole the plasmatic passive magnetic fields (PMF) that created the Dark spot, so that, these external forces in the surrounding environment of the dark spot move and shift them from their position, where by this movement there are no more active plasmatic magnetic fields in the region to interact with each other in these regions and then the normal process of the charged particles interacting with the plasmatic magnetic fields around them start again as before, then everything goes back to normal and the light or the shine on the surface of the Sun returns to normality.

When too many dynamic plasmatic magnetic energy fields start cancelling each other out, the surface of the Sun become congested with many different plasmatic magnetic energy fields and they clog up the surface of the Sun, like congestion in traffic jams, hence the number of the Dark Spots starts increasing.

It is important to remember that Objects (these being solid, gas, plasmas or etc.) possesses their own plasmatic magnetic energy field and all these plasmatic magnetic energy fields on the surface are dynamic and respond to other dynamic plasmatic magnetic energy fields, which are created internally in the inner cores of the star. Where, these internal magnetic fields are the creators' of the gravitational field and the overall magnetic field of the star itself. Where, The stronger plasmatic

magnetic energy field (the gravitational field) usually dictates and plays apart in the position and level of freedom of the weaker plasmatic magnetic energy field (the object) in respective to each other.

Thus, when the inner cores of the stars due to their near mono atomic structure go through their internal current realignment (12, 18) this in turn leads to change in the direction of the gravitational field and thus the polarity of the whole star.

Consequently the rotation of the gravitational field which itself is originated and created magnetically interacts with the dynamic plasmatic magnetic energy field areas on its surface and in its atmosphere causing them to move in respect to the internal dynamic plasmatic magnetic energy field movements of the star.

Therefore main reason for sudden periodic increase in the movement of the plasmatic magnetic energy field on the surface of the star and sudden increase in the creation of black spot in their environment can be clearly be identified, to be due to the interaction of the dynamic plasmatic magnetic field created by the matters and mafs on the surface and the inner Magravs fields force of the stars.

Where, the inner dynamic plasmatic magnetic field of the star is by order of magnitude several millions of times much stronger than the isolated single or packages of dynamic plasmatic magnetic fields on the surface. Thus the stronger inner fields force of the star, dictating the direction of the motion of the weaker fields of the Dark spot. This being the very reason why the eleven-year cycle of change of polarity of the Sun brings about an increase in the number of the Dark spots of the surface on the Sun on regular bases. This being due to Sun's internal plasmatic magnetic energy fields' changes which brings about the polarity changes, every eleven years. Where, at these cycles there are more of these surface and atmospheric dynamic plasmatic magnetic energy fields in motion and available to interact with each other and the internal mafs of the Sun.

In fact, as the polarities of the Sun changes, so more dynamic plasmatic magnetic fields start moving from one pole to the other to accommodate the physical practicality of the plasmatic magnetic energy field polar change. Thus, a larger number of the dynamic plasmatic magnetic fields become to cross each other's path and consequently there are more chances of two or more dynamic plasmatic magnetic fields to meet and to balance out each other's field. Inevitably, as at these areas, there are no effective plasmatic magnetic energy fields for the charged matter to interact with, thus there is less light emission from these areas of the Sun. Henceforth the appearance of darker areas or dark spots in these areas on the same principle as the creation of the Black Hole phenomenon re-occurrence.

The increase in the number of dark spots of the surface of the Sun is always in sequence with the period when the Sun internal dynamic plasmatic magnetic fields activities go through their repositioning.

The number of these Dark spots increases and as they move, suddenly a vast number of dynamic plasmatic magnetic fields cancel each other out and as the change of polarity of the Sun completes itself and settles down.

The whole cycle of collapse of the Black hole re-occurs', that is, where a Dark Spot collapses, and their new plasmatic magnetic energy fields fines its total balance, and the matters which where gravitationally trapped under the influence of the dark spots, which are mainly plasmas, are retracted by the gravitational pull of the star and are ejected back onto the surface of the Sun is large quantities and numbers. This is the time, where there are massive activities and strong Sun flares scattering outwards from the surface of the Sun, where, large quantities of the Sun matters are plashed outward in the solar system.

Sometimes, as the mass of particles collected in a Dark Spot is pulled back into the surface of the Sun, due to their mass and speed, these become like meteorites hitting the surface of the Sun. This act causes more than usual charged particles to be leaving the Sun surface into surrounding space.

The darkness on the surface of the Sun is not due to what is commonly thought to be due to cooler temperature in these regions, as the Dark Spots are purely due to the fact that there are no or very little dynamic plasmatic magnetic fields available in these regions to interact with the charged particles to create light.

So underneath the Dark Spots on the surface of the Sun the temperature of the surface is still the same as the rest of its surface.

Conclusions

Black holes are natural physical by-products of the motion of forces and matters like every other object in the universe. The only difference for this body to appear is the fundamental shortage or total lack of one of the three main ingredients of the creation, namely the lack of the Passive Magnetic Force Fields in the region, where these black holes manifest themselves.

Black holes are another creation of universe like the uniqueness of the Blue planet and once one has understood the methods of universe's powers of creation within all its physical parameters, then every aspect of the appearance of objects and fields can only be explained with understanding of the interactions of these with each other.

The most beautiful part of this phenomenon will be! How Man will use this knowledge now for the advancement of its race?

Understanding of the method of creation, existence and the behaviour of the Black Hole in space opens new doors for the Man to plan his future excursions in space and the appropriate name for this object should not be a Black Hole.

These regions of Black hole in the galaxies cover areas as large as several solar systems, with them possessing all the physical attribute of solar system. With the difference that they do not shine due to the lack of appropriate dynamic plasmatic magnetic fields strength within their construction or during the time of their existence in the environment of their operation.

The appropriate name for this object as has one body and two distinctive characterizes behaviours and appearance, by first characteristic being a gigantic eating machine, and the second characteristic by allowing new systems to start from what it has digested. There is an old Aryan name for an arrow with two heads as the Black Hole with two characters and this object is called ZHUBEEN.

I call this unpredictable object in the galaxy with this name, as now it is a known object and not a mysterious scientific phenomenon.

Elaborations

The helio-seismology is the study of the internal structure and dynamic of the Sun using Sun-quakes, and the Sun oscillates continuously by varying degrees and directions. These oscillations are caused mainly by turbulent convection just below the surface. The data from spherical-symmetrical solar

model of the same condition shows close correlation to physical collected data through inversion. This showing that the data simulation is close to the physical reality of what is happening in the inner sanctum of the Sun.

For our testes in dynamic cores and data's attained through them, it can be confirmed that the rotation and the turbulence have direct effect on the heating of the matter within the confined of the reactor build on the same principles, where in the reactor and consequently in the creation of the current through convection and magnetic fields production within it, where the turbulence of the matter in the core of the reactor creates the dynamic and the dynamo effects which this has a direct effect in and on the production of the dynamic plasmatic magnetic field in the reactor.

Turbulent convection and differential rotation in the Sun are thought to be the cause of the creation of the solar magnetic fields and the directions in which these magnetic fields appear to flow out of the surface of the Sun according to their direction of rotation their tightness are known as helicity of the magnetic field in the region. Where, Helicity simply describes the handedness of this field and as the field literally opens up like a cone as it moves away from the centre towards outer region. As Magnetic and Magravs helicity is in fact a measure of the knottiness and the twistedness of these fields within a region, where this closely related to the turbulent dynamo effect. Where, from all observation in the past, large-scale poloidal magnetic fields the helicity have a direct linkage with strong toroidal field leading to finite helicity.

As, in the reactor tested on the same bases as turbulence of the mafs of matters where the reactor cores having a finite parameters and the rotation and turbulence are predetermined, therefore the helicity of the magnetic fields has to be the same at different points but equal for all distance from the centre. Where, due to the small size of the core, a mean or average strength or tightness of the magnetic field could be assumed.

Thus a point of interaction of two magnetic forces in the cores will create condition similar to the dark spot on the surface of the plasma. Which if the collapse can go through plasma towards the boundary of the core, this can create a sudden surge of dynamic plasmatic magnetic field or which this can alter the system operation mode. The reason for writing this paper has been due to the fact that in the reactor designed, if the condition of Black Hole is created, this can lead to the shutdown of the system or unstable condition of the operation of reactor. As this has happened in two occasions during testing of the spherical core, where the second magnetic field was deliberately created and positioned to interact with the internal magnetic field created by the core.

In both cases the whole system did go through magnetic poles trying to bypass each other.

In the second test in trying to prove the point of the interaction of two magnetic fields and creation of black hole condition, the whole system was twisted and the axial pines of the core were off centred.

The core axels had to be realigned, but the damage to the core weld and axel proven to be too much to repair, and more or less this test of creation of black holes caused the loss of the first steel prototype core (Fig. 28).

At the same time in the same reactor the creation of the dark spots due to interaction of the matters were deliberately created for specific use of the system, where investigation in the creation of dark spots, and where the use of transition matter condition for the creation of dark matter, for the fuel needed for deep space travel was tested and confirmed.

This is how these above phenomenons clearly can be explained, and the principle for the creation of the Black Hole can easily be demonstrated.

Fig. 28 Test reactor

In the future papers the writer will explain how the Black Hole's effects can be useful in helping to travel through galaxies and in the Universe. These are at this moment of time beyond understanding at the present level of scientific achievements.

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Advancing Astronomy and Geophysics

Mr T. Keshe

7th July 2004

Dear Mr Keshe,

Thank you for your recent submission.

I am sorry but your paper is not in a suitable form to be considered for any of our journals and so I have placed it in the Society's library, where Fellows may read it. I have included your contact details so that they may approach you directly if they wish to comment.

I am sorry to disappoint you on this occasion but we cannot give your submission any further consideration.

Yours sincerely,

David Elliott
Executive Secretary

Fig. 29 . Letter of Royal Astronomical Society

CHAPTER 11

The relationship between gravity, mass and weight

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Author: Ing. Mehran Tavakoli Keshe
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This paper is written for clarification by the encouragement from Mr Dirk Laureyssens.

Abstract

With the new understanding of the creation of the double dynamic plasmatic magnetic field of planets and understanding the new principle and method of the creation of gravitational forces, further on the balanced fields outcome of the collective and internal interaction of Magnetic and gravitational fields up on each other of any entity within the structure of mafs, plasmas, atoms or molecules this leads to creation of so called the mass effect of an object, it is now simple and apparent that what the mass is, how it is created and why the same mass possess different weights in different gravitational field forces environment.

Hypothesis

The mass of an entity is created from the outcome of the deduction of the interaction of the gravitational fields and Magnetic fields forces of an entity and has nothing to do with external field's interaction and strength of the environment of that entity. The variation in the numerical difference in the weight of the same mass of an object in different dynamic plasmatic Magravs field forces of different environments or different planets, is totally due to the interaction of the total collective dynamic plasmatic Magravs fields forces, including the inertia effect of the environment which the entity is weight measured and of the collective internal dynamic plasmatic Magravs fields strength of the mafs of the entity which create the mass of the objects upon each other.

Where, the magnetosphere of the same entity is the total sum of the magnetic field and gravitational field forces catchments zone of the same two internal fields which make the Mangroves fields of the entity that they can attain in their given Magravs fields strength environment.

Discussion

Planet like the Earth possesses a combination of two magnetic field forces. First the gravity, created due to the interaction of the two independent dynamic plasmatic magnetic fields in its centre cores upon each other. Second the inertia, which is the collective dynamic plasmatic magnetic field of its atoms and molecules of its constituent matters, which has the physical body of the planet.

Any object, this being plasma, an electron, an atom, a molecule or even a human body is created from a collection of the plasmatic magnetic Magravs energy fields of different strength and their continues interaction between and up on each other, which in total decides the total or collective magnetic field possessed by that object or the mass of an object and the total interaction within molecular or atomic dynamic plasmatic magnetic field of a given object is always constant irrespective of the other dynamic plasmatic magnetic field fields around it. The mass of an object has a collective package of plasmatic magnetic field tightness of all its constituent elements, and this will not change as long as the object is intact as one entity in its overall atomic or molecular or collective molecular appearance.

Which the interaction of the one object dynamic plasmatic magnetic fields with molecular or atomic magnetic field of another object Magravs in its vicinity or it environment will determine the weight of the two objects in respect to each other or in a given environment.

The mass of a body in relation to another molecular magnetic field, like gravity is dictated by the strength of the magnetic fields which creates the gravity, which in the planetary system like earth, this is maintained by the planet according to its inner molecular construction and conditions in and by which the Magravs strength of the planet manifest itself to the body.

The interaction between two or more dynamic plasmatic magnetic fields created by a planet to create and determine the gravitational strength of the planet are due to conditions and in conjunction with its elements.

Usually these types magnetic fields created by planets are very strong, so an object like a human body which possess a weaker collective dynamic plasmatic Magravs and in reality possesses its own gravitational field forces due to its combined electromagnetic fields of its elements which it is composed of, which for a given body this is constant, these will be attracted and be operating in a much more stronger dynamic plasmatic magnetic field environment of the planet. Which, this gives the body due to its interaction of the Magravs and the planet dynamic plasmatic Magravs interaction, where the strength of the Magravs force of the planet and the body in respect to each other, this determines the attraction force between the two fields of two entities of the body and the planet and consequently the mass of the weaker force or the object in respected to and within the stronger Magravs forces of planet or Magravs forces of the body dictated the weight of the body in respect to the planet.

In reality the reverse of the same criterion is true too, for the mass of the planet, and its weight in respect to the dynamic plasmatic magnetic field of the body.

Thus, it is easy to explain, when a body interacts with two planets of the same size and when the two planets are made of the same materials, where one for example has lower temperatures, or internal speed of rotation or lower rate of ionization of the prime materials within its Caroline core, which all these can affect the strength of the Magravs of the planet for it to possess a weaker dynamic plasmatic Magravs strength, then planet which has a more inertia power, which is of the weakest order than gravity, but always constant, for a planets like moons, then the magnetic attraction, or pulling, between the same object and the second

Magravs force will be weaker, this by the same principle as above giving the body in the second environment a lesser weight value.

This is the very essence, why man's body appears to have less mass on the moon than on the Earth. Where, this is simply due to the fact that the dynamic plasmatic Magravs of the moon, which creates its gravitational force, and even this could be the inertia effect of the moon, have weaker Magravs strength power to interact with same given human body's dynamic plasmatic Magravs than the Earth dynamic plasmatic Magravs strength on the same body.

Therefore, the weight of a body is position dependent in its relation to its counter interacting planet or object inner Magravs forces, which create the Magravs or/and the inertia, or static Magravs of atones of that planet.

That is to say, if one could replicate the same Magravs field as on the moon, within a given position in the Earth atmosphere, one will have the same weight as the body will have on the moon within the Magravs force of the Earth.

This is why in propulsion technology there is an absents of the Magravs within the system objects always float and have less mass, as first of all the propulsion systems do not create Magravs that the object can position itself in respective to and lock to the position that the object become motionally stable and this and the secondly for example in respect to the body of space users of the propulsion system, the body's collective dynamic plasmatic Magravs strength, has been positioned far enough away from and within the dynamic plasmatic - Magravs strength of the Earth, that the mass dynamic plasmatic magnetic field strength of body in that position within the Earth gravitational field, due to the speed of the rotation or motion and conditions created within of the craft, will have a weaker interaction upon the body, allow the body a more freedom of movement.

Using the principle of the Margrave positioning for vertical take-off or choosing stationery or fixed position orbit for an object, like for satellites, within any atmospheric condition, where the magnetic fields created within the reactor of a craft can lead to creation and control of the Magravs within the craft, allowing the mass of the body of the object in a given position within the atmosphere of the planet to reach the equilibrium in relation to the Magravs of the planet, then in that particular point within the fields that are created by the planet the body will have the same mass as the earth and the time delay lapse of free float satellites to tune with earth gravity become irrelevant and there will not be a need time delay or adjustment.

This is the fundamental principle and criterion for any system that is used in any spacecraft's technology to replace the present jet propulsion or rocket technology.

Therefore the mass of an object is the representation of the effect of the Magravs of a body in respect to the Magravs of the second body.

The Magravs positioning is the reason why atoms of the same element fuse to create molecules, as their weight in respect to each other is zero, or equilibrium, even thou they both possess the same mass.

At the same time, if this is understood in full, then most of the chemical and biological interaction of atoms to create molecules can be comprehended and replicated in an easier manner.

Where, the collective mass of atoms in respect to other atoms within a molecule Magravs will dictate the number of, position of and the composition of atoms of different elements within that molecule.

Then this explains why it is easier to create certain material in absence of gravity in space labs, that in the presence of lesser dynamic plasmatic Magravs strength of the planet in high altitude then only the weaker Magravs forces of the elements come in to play as they are in a much weaker dynamic plasmatic Magravs strength levels from the centre of the planet and they can combine to produce materials, which under Magravs forces of the Earth are impossible.

Conclusion

Therefore the mass of an object possess different numerical weight values in two different Magravs force environments purely due to the interaction of the double dynamic plasmatic magnetic field of the planet and the constant collective dynamic plasmatic Magravs of the object.

The gravity itself is created by the interaction of magnetic fields of the matter and as the mass is the product of interaction of gravitational force and Magnetic fields forces of the same matter magnetic fields based generated phenomenon and as any environment in the universe possess magnetic fields irrespective of their strength and interaction of these fields in that given environment creates a new Magnetic and gravitational fields or Magravs in that environment that the outcome the interaction the two Magravs of the matter and it environment become the weight of the matter in that environment.

That is to say the variation in weight of an object in different environments is totally due to the interaction between the dynamic plasmatic Magravs strength of the two of entities upon each other, in respect to each other's position, in their respective environment.

Where Magnetospheres of the entities are the outcome of the sum of the interaction of Magnetic fields and gravitational fields forces that the entity can master for it to be able to protect and hold on to all its mafs and matters which the difference field forces of the same Magnetic fields and gravitational or Magravs of the same entity has managed to attract and accumulate within its given environment.

In short the interaction of the two or more dynamic plasmatic magnetic fields lead to creation of Magnetic and gravitational field (Magravs) of the entity, and then the balance of interaction of the Magnetic and gravitational fields forces leads to creation of the mass of the same entity which the mass is entirely dependent on the strength of the two original magnetic fields of the entity, and then when the Magravs of entity interact with the Magravs of another entity which itself magnetic fields origin based, then difference or the influence of one Magravs of one entity in respect to the second entity Magravs make the weight of the two entities in respect to each other, where as much as the first entity has weight in respect to the Magravs of the second entity at the same time second entity has a weight in respect to the first entity too.

CHAPTER 12

Parallel worlds

Mysteries of existence about parallel worlds, the questions to ask are or can be as follows:

1. How do they become to exist?
2. How can we interact or be aware of their existence?
3. What can we do or have done to get there?

Let us consider the structure of simplest entity of plasma of an electron in overall structure of let say an atom of hydrogen (or atom of sodium which is part of piece of stone or metal, gas and etc.).

The plasma once created and maintained from interaction and down levelling in strength of different mafs of which this plasma in its division leads to creation of an atom which at this point the plasma of the electron of the atom has an independent existence from plasma of its proton and electron decides about its own motion and its own position in its environment in respect to its proton. Even though, this is conditioned on the position and strength of the proton of its atom. Where, electron itself is made up of collection of different magnetic fields strength and their interactions and as the electron of an atom is not aware of the its larger counterparts of proton(s) and other electron(s) in a larger elemental or molecular structures and it is not aware of any state of matter and at the same time that the electron is not aware of the part of heat and cold in its environment are playing in its position and motion in respect to its proton and other entities of the same which it is connect to.

Where, this electron physical appearance as any physical matter is dependent on its environmental condition. Where, let say this electron can be an electron of atom which is part of atoms of a piece of stone and at this point the electron is not aware of the existence of a stone in larger scale levels of its existence. But the electron exists within the existence of an atom, which the atom exist in existence of the stone.

But now let's say the stone is parts of a salt stone grain which is consumed by an animal.

Now the sodium atom by making its Magravs available to protein of a cell of the animal it becomes and takes part in the bigger scale and larger Magravs of a protein chain connection, where sodium on its own could not achieve.

Let's say that now the protein and in conjunction with sodium this creates the condition of neuro-connection and the cell becomes part of living being, this being part of neuro system a shrimp, dog or a man.

Where, for example the combination of different protein and different atoms and the interaction of their Magravs and balancing act within their mangroves lead to need for interaction and new balancing Magravs, where this new interaction of proteins and their different Magravs, leads to a need for cohesive and balancing line of magnetic fields line of transfer of fields. Where, an accumulation of different fields and Magravs and their interaction brings about feelings and intelligence and so forth in the animal.

Now as the different Magravs and their interaction takes place, this being in the level of an atom, a solid, protein, combination of proteins and their attachment to other atoms, these new entities create two distinctive levels of individual compacted fields one for their tangible state of existence and one

they facilitates their fields and positioning for the use by and to other parts which are related to them but not connected to their existence in the line of communication of other atoms.

What this means, is that the entity gives life to existence of two levels, one is the physical tangible of itself and one is the fields and energy which it is part of, but once it is created the new entities has enough field that is an accumulation of the interaction of another interaction that this new entity does not need a physical entity to manifest itself in the tangible world, but the fields strength is sufficient enough that the new entity can easily exist on its own right in the universe and make decision about all others whom have become part of and operate through the new entity.

Now as the more and more fields and matters interact and creates a certain fields levels, that let say they lead to tangible matter existence of an entity, the accumulated physical matters have a parallel acuminated non tangible levels too which are its fields which allows it to be part of bigger entity.

Where in complexity of previous interactions to reach a point, these interactions have released or will release new complex fields that these fields perform and exist as the matter part do.

But sometimes the matter and associated fields interlocked, but exists and operate into different levels. Even though the tangible matter is aware of its own existence, but it is not aware of the existence of the associated counter interlocked fields within it, this be it the same as the plasma of electron of a piece of stone, which the electron is part of.

Thus now it becomes clear how a man has physical body and a soul. Where, the physical body is conditioned of the matter world and its environment, where the soul has no such a conditioning.

Thus the soul is aware of the existence of the physical body, but independent of its existence, but it receives the changes in the condition of the physical Magravs of the body.

Thus the soul of a man is a parallel world to the physical world of its associated plasmas, which has created it.

But as soul has no need for the physical body to sustain its existence once it is created, as it operates in a different field zone non tangibility, hence the physical body can die, but the soul will be left in tacked and carries on without its detached physical counterpart in the world of creation.

At the same time, the fields of the soul will carry-on with its interaction with other fields and Magravs of its own level and it will keep on attaining more and keep on and interacting as it physical counterpart did and combining with more and creating more the same and different.

The soul, itself is the balancer of the physical matter of the body, but from point of detachment, does not need the physical body for it to exist. As the physical interaction has led to its existence, but by now it is independent enough to carry on with its own operation.

This is like giving of a birth, even though the baby has been in need of the mother for it to start and become entity, up on the departure from the mothers body, the two entities can live two independent lives, without a need for each other existence.

Thus the soul of an entity, this being stone, animal or a man has the same method of operation and existence as any other matter or fields in the universe, and that as once it is established and sets its frame work, it does not need its physical counterpart which led to its existence.

Now one can understand how different levels of existence do operate and exist in conjunction and in parallel with each other.

Take this one step further and let say fields of the souls have established the same methods of interaction and communication as their physical counterpart plasmas of atoms did with each other and souls through their fields of existence interact with each other and lead to a more dynamic parallel non tangible world of existence in the dimension no need for the actually physical dimension of existence.

In the universe there creatures, which are made from the interaction of principle mafs and matters strength as man is made of matter mafs and matter fields strength and they can operate in a non-tangible level of existence rather than the physical tangibility to the eye of the man

This does not mean that they creatures do not have a soul or they are more intelligent than the man, but the only difference is that they operate in different mafs strength, which these lives can be strange to the mans' travels of the futures as they have the ability to transmute between different levels of mafs strength and be able to visible or detectable in their spectrum of mafs strengths

The soul of the man ids the like of the light from the star in distance universe, where the physical star could have been exploded and destroyed billions of years ago, but still at night the man observes the soul of the stars as the shining light in the dark of the night.

Parallel world exist even within the and during the life of the man himself, but they need the eye of the wisdom for the beings to see them and recognise them in their environment.

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CHAPTER 13

The universal principle of division of pervious universe(s) and their decay leading to creation of new universe(s)

Written in 2009
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ITNOGOG

In the universe there are always parallels due to the magnetic fields laws of interactions and hence there cannot be any deviations from these laws.

At the present the scientific world has been intrigued and encouraged to understand the phenomenon of the creation of this universe and scientists have tried to unravel the mysteries of the creation of this visible universe.

In fact the creation of this universe as is visible to the world of science, it cannot be any different than any other process in the world of creation and this universe has been created through the same principles as the rest of the magnetic plasmatic nuclear and atomic interactions, addition and division.

This meaning that the present universe is created though the same method as has been observes in the division of the neutron into electron and proton or smaller and/or bigger components of the same Matters.

Hence to follow the principle of the universal order of matters, this universe is created from the division of a larger universe that the man's visible universe is the smaller part of the division.

The reason for it being the part of a system is that in the present cosmological term, this universe is following the attraction of the bigger part and hence it is always in the motion to follow the Magravs of the bigger sister.

This being the reason why it looks as the universe is always expanding and as part of the universe has been noted to be collectively following different path of motion than the rest of the universe.

Where, the portion of the independent motion of the universe is the indicator that where the bigger portion of the division of the pervious universe is in respect to the man's universe. (Fig. 30).

It has to be said through the same principle of decay of neutron to plasma of electron and proton (1) and similarly as the decay of heavier atoms to two or more lighter atoms, the original universe through the same principle the mother universe of the man's universe, itself has been created and was created from the division of a larger universes through the same method decay and division during the time of the life of the unicos.

The difference in the universe's creation and decay is in principle merely the size and amount of the plasmatic field content plasma of each universe in comparison to plasma of electron or proton after nuclear decay and division of the neutron.

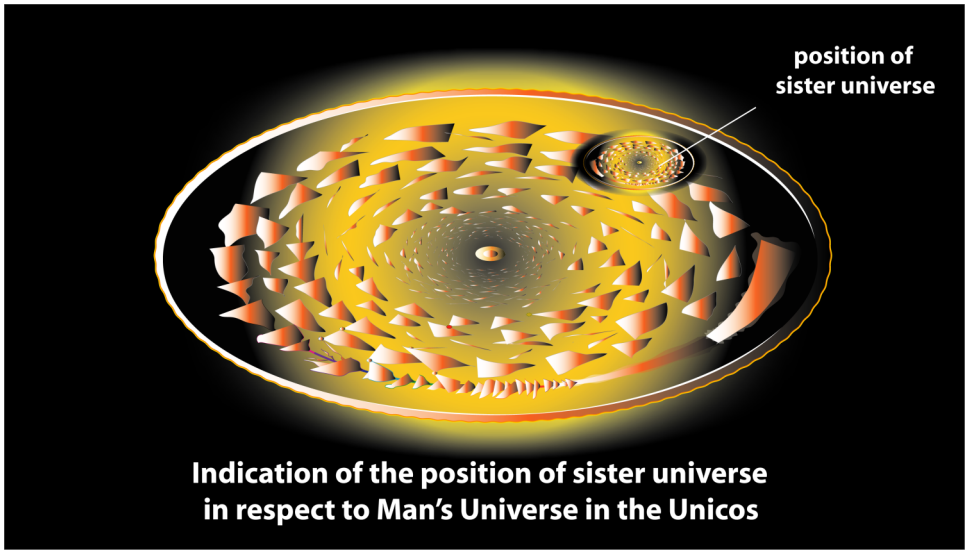

Fig. 30 The position of the sister universe in respect to Man's Universe

Thus in fact our present universe itself is and was created some thirteen billion years back from the division of a larger universe. Hence every time as it is the same with division of the plasma of neutron to plasma of electron and proton, this division the new universe(s) will carries the characteristics of its mother universe, but due to reorganisation of magnetic field strength the new universe will have a new and fresh time, which this shows as the age of the new universe.

In fact this being the like of given birth to a child, where the age of the mother is irrelevant once the new seed of life is created and once the child is born, even though; the new child carries some of the same DNA fingerprint of the parents. The new life has its own cycle of life and its own timing.

Therefore the theory of Big Bang and M-11 as have been proposed in the recent past has no meaning and has no principle parallels in the physical world of creation of universe, a child or plasma of the proton or an electron. These two proposed principles are nothing, but showing the man's and scientific worlds lack of knowledge and ignorance of the real terms and parallel entities existence of all units in the universe.

In fact once the division is created and the universe is created the rest of the material and matter content and how they organise themselves in that universe is more or less follows the same principle as before and once the field are released within a given Magravs which the fields can created in interaction with each other, then the size of universe, galaxies, stars and planets and even creatures within that given Margraves strength of the newly produced universe are determined by the entity itself and without interference from its previous part.

Where, the new structure is dependent on the fields within the new universe and the internal motion of the new universe is internally determined by the total mass, which the interaction of the Magnetic fields and gravitational fields of the universe can master on its own.

Thus in fact in the bigger or smaller portion of the original mother universe which the man' universe is partly created of, in the bigger or smaller portion due to the larger mass the galaxies can be much larger in portion to the galaxies in this universe and conversely due to larger or smaller strength Magravs of the internal structure of the larger or smaller portion, the being's within these universes can be smaller or bigger or totally different in operation than the beings in this universe.

It has to be said that life in any form is not the exclusivity of the earth, if this is the mind-set of some men, thus this shows their lack of understanding of universe and how it is created, not the real truth and how matter's operated and function in the universe.

Therefore man is part of an inclusive pattern of field's motions in the universe and nothing more or less can be attached to the existence of the man.

The man in physical term is the entity and in the soul the connection of the field between himself and the other fields in the universe.

The physical body of the man is the like of the planet earth, where it has mass and its magnetosphere expands beyond its physical boy, but its total Magnetic fields and gravitational fields determines its position and relation in respect with other matters in the solar system and in a small way it determine the position of its star in its galaxy and souls which are created within it in their course their operation in the universe, as then the position of star determines in a small way the position of the milky-way in the universe and so forth.

Thus the soul of the man is the external connection of the operation of the physical body of the man in the universe, it is part of one and inclusive realty of interaction of the whole.

Thus the soul is part of the operation of the universe and every creation can extent the effects of its magnetic field to others which can affect their position and existence of any in possession of a soul.

Thus the soul, which is magnetic fields created and expands beyond the physical body of the man is not exclusivity of the creatures but it is the common denominator and common link between the man and other creatures of the God and has direct effect on the operation of the rest of the universe.

Therefore the man's body due to the interaction of its atoms protons and electron and neutrons magnetic fields, this object creates its own magnetosphere and its own mass and this body is and has to be in possession of magnetosphere which shows the working of the magnetic fields of its constituent matters and its subcomponents and fields this being including thoughts.

Where, in the physical worlds as the same as the solar system possess magnetosphere and so does the star and planet, then the body of the human through the same physical principle possesses the magnetosphere, which is so called aurora of the human's body. The field of the aurora are part of outer appearance as the soul of the man, but is fact the total effect of the internal interaction of all fields of the body which creates the Magnetic field and gravitational fields of the body and their interaction on each other which leads to the interaction with their fields in the universe, this overall output of the fields of the body of the man is the soul of the man.

Thus, all dynamic plasmatic matters in the universe possess a soul. But the man has the intelligence to allow the interaction of its soul with others; therefore through this principle the man is responsible for all his actions and he stands answerable to other souls in the universe. As he decides how these fields which partial and fully controlled through the Magravs of the matters of his brain, in how and what happens in its interaction with other souls effects their operation in the larger universe.

Hence man has to understand, that universe and others, which has the use of this universe all have been created from and the universe, which has been created from the division other universe and will be created from the division of this universe and in the future are all interconnected and operate through the same fundamental principle.

Therefore there are parallel universes to this universe, with the difference in the measure of their magnetic fields and strength and their position in their given environment.

Thus as we have the same and similar electrons structure's and protons structures in the same structure of an atom, which this structure of positioning of electrons and protons is the same for all known atoms, then the same applies to the universe too. This meaning that there are similar universe

as this universe in the greater universe and other universe which this universe has been created from it and those that we will shell create through he operation of our souls and bodies mafs and matters.

It has to said that at the same time all beings in the universe use one and the same universal language of communication, where in the universe the common language is the basic plasmatic magnetic fields of basic field's. This is based on the first plasmatic magnetic field strength of existence of the simplest plasma of atom of the universe, and is similar to what we call in this universe neutron and its division and collections as atoms the like of the Hydrogen atom, which the mystery of this has been kept from the man and not apparent through his own misunderstanding of the operation of the universe.

This language is universal and once the man on earth understands this phenomenon and can fully measure the magnetic fields strength of the electron Magravs of it and he uses this as the base strength, then man will be able to understand and communicate with rest of soul possessing creatures of the universe.

Until then, the search in the sound waves to look and try to communicate with other creatures of the universe is a fantasy and shows the lack of his understanding of the world of the Creation by the man of ignorant intelligence.

Therefore the gravitation, magnetic, radiation and other similar properties and interactions of the field(s) on each other in this and other universe(s) decides on how and the way the creatures in the different universes and in the man's unicos and universe would look and behave.

But in essences they are all made of the same building block of *MAGNETIC FIELDS AND IN ITS AND THEIR INTERACTION OF DIFFERENT STRENGTH AND TIGHTNESS OF IT IN THEIR ENVIRONMENT*; This determining how tall and short and if one has eye or uses the interaction of fields to interact and communicates with other creatures of its environment, universe(s).

CHAPTER 14

How would it end?

The end of this universe will be the same as it started.

What this means is that as the magnetic field balances of the universe reduces to a level that the universe has to re-organize itself that it can keep its constituent field forces together, the whole universe will, like as with neutron plasma will decay and divide into two constituents of smaller universes, which these universes are still connected to each other through their original magnetic field forces (book 1 - chapter 17).

Hence this universe will be divided in to a smaller universe and larger universe parts of a set. This being the same process as the like of the process as neutron decays and the rest of the known nuclear decay of atoms do as there are no other known processes of division process in the universe, and there has to be uniformity in all dimensions of creation.

There is no end in the universes but conversion and amalgamation of fields and matters, which are created out of fields themselves.

Thus, this universe will divide into two active fully operational of lesser universe and bigger universe masses (fig. 31). But in total the overall balance of the matters and fields in both universes will be near equal of what was in this universe, with a little leakage of fields into the Universal Cosmos (unicos).

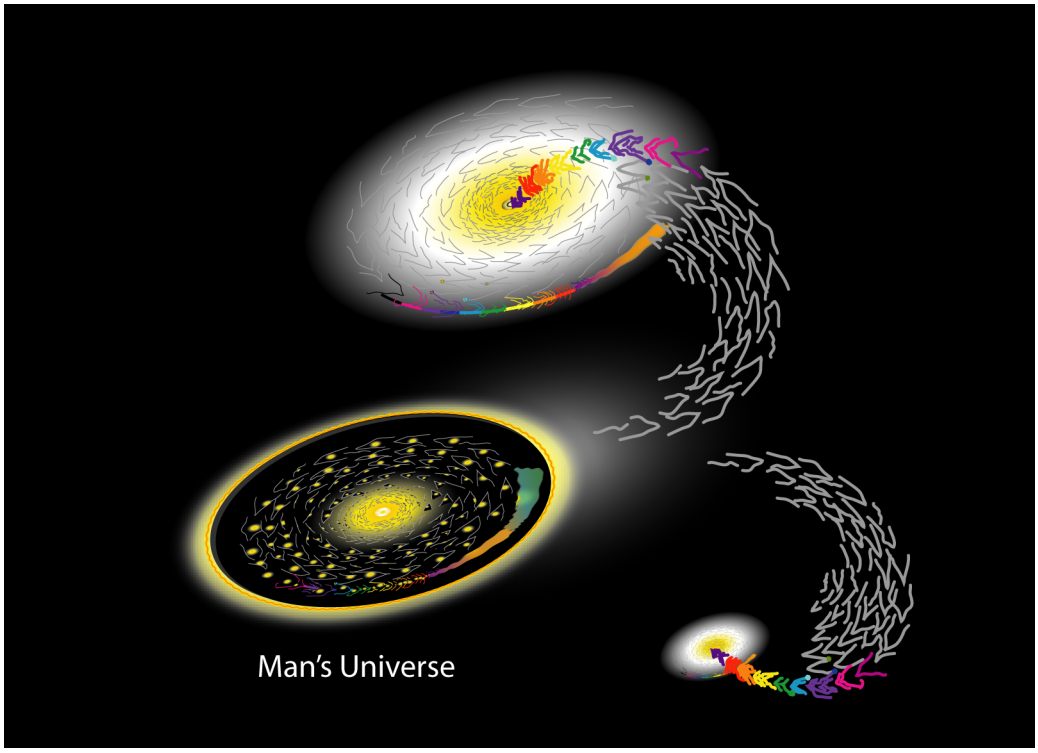

Fig 31. In time the decay of Man's Universe.

Where, the lesser mass part of the division of this universe will rotate around the larger mass universe. Where, the whole of the two new universes both will be rotating around larger universe mechanisms, which this universe on its own was rotating around.

Thus, if one is in the lesser universe, and looks into its motion, it looks as their universe is expanding, as they always seems that matters and fields in this universe to be running away from them as their universe is looking as being expanding.

Where, in fact being in the smaller universe, the gravitational field of the larger universe is continuously pulling or holding onto the lesser universe that the lesser universe stays within its orbit, as the electron does with its proton in atomic structure. As there can be no difference in all levels of creation of larger universe, as it is with the structure of decay of all atoms known to man.

Therefore this is how this universe was created and how future universe will be created out of this universe.

Thus there has never been a big bang, and there will never be a dooms day or the big rift. All it will happen is that this universe will go through a division, which is the norm in all-universal orders of creations.

The original universe has divided itself to smaller universes, which our universe is one of its offspring's and the same will happen over and over again to this universe and its offspring's.

Thus this universe is not the original universe, but part of a fraction of a fraction of fraction of a bigger picture.

May be now it can be understood that in the universe, as has been said that "I have made man in the image of myself" and now the reality of operation of different and all entities of the universe understood and are set in motion for the man to have the full understanding of method of creation and control and the way he has come to be on this planet at this moment in time and if he understood the purpose of his creation, then it can be said that:

The universe exists and operates within the structure of the man

and

the man exists and operates within the structure of universe

Definitions

Below is a list of the new terms and their definition that used in this book. A number of these words and terms have been used in the previous book and scientific papers, which have been published by the foundation and most readers, are familiar with these terms and reference. In this book a different approach and language and terminologies is used, therefore has become necessary to create a new terminology and words that can explain the real term application and processes in the world of physics.

Mafs: magnetic fields

Magnetic: with capital M refers to the plasma of magnetic fields created by a dynamic entity as for example this refers to the magnetic field of the earth.

Magravs: Magnetic and gravitational fields (Magnetic referring to the plasma of magnetic fields created by a dynamic entity as for example this refers to the magnetic field of the earth)

Pmf: plasmatic magnetic fields

Principal matter: This matter in conventional physics is called the anti-matter, as now the real structure of this matter is fully understood and is said to be source of all matters from the dark matter to matter, thus it has been called the original matter or the principal.

Principal mafs: These are magnetic fields, which are in the principal strength levels and considered to be I order magnitude several hundreds of times stronger than the magnetic fields which make up the tangible and visible matters.

Principal star: This entity in the conventional physics is called the Black hole

Transition energy: This energy in conventional physics is called the dark energy. This is the pmfs that are in motion from principal to matter magnetic fields strength so called the transition energy as energy is defined as the pmfs in motion.

Transition matter: This matter in conventional physics is called the Dark matter, as now the real structure of this matter is fully understood and is said to be when plasmatic magnetic fields are in transition state from the principal matter to tangible matter thus the term transition matter is used.

Transition mafs: These are magnetic fields which are in strength level between the principal and matter magnetic fields strength, and are in transit from the principal mafs to matter mafs strength levels.

Gans: a new state of matter; a molecule of a gas (GAs), which becomes Nano of itself and appears as Solid state of matter (Gas to Nano of Solid and to be called GANS for short).

The re-naming of matters and conditions

(*Advice: Skip this section unless you need to refresh or reading for the first time or read it after you have read the chapter 1, 2 and 3 as this section can be confusing and distracting you from the main body of the book*).

(Point of reference: The following section is and to be added to all disclosures for the ease of understanding as most of these have been disclosed in the book (1), and it is added here for the ones who have not read the book and are not familiar with terminologies in the works of the author).

In this literature, when using the term "**mafs**" for example in form of the antimatter mafs this means and refers to the magnetic fields (mafs) which this entity is made of and it is considered to be as a plasma of magnetic fields, and where the term "**antimatter**" is used on its own this meaning the physical tangible or detectable entity of the same. This usage of mafs similarly applies to physical matter and Dark matter too.

Further, the difference with Antimatter and matter is only in their plasmatic magnetic fields (**pmf**) strength and compactness of their fields. Thus, what is the magnetic fields (mafs) of antimatter they become magnetic fields of the matter as antimatter magnetic fields unwinds, loosens up, weaken in their field strength through their interaction with other magnetic fields and matters and become matter mafs and in plasmatic magnetic field strength of matter environment the matter mafs becomes tangible and become matter.

Therefore the antimatters are a more compact strength magnetic fields entities of the same of the magnetic fields of the matter, and due to their tightness of their fields, these magnetic fields of these mafs of matters they create stronger gravitational and Magnetic fields and hence they have stronger Magravs and hence upon their unwinding, they release magnetic fields and pmf which are faster, higher in strength and hence they look as to be strange strong and fascinating matters.

This means that antimatter entity of for example ten centimetres in diameter once ***unwinds*** in structure it becomes a matter of several thousands of meters in diameter entity in matter magnetic field strength environment.

Inevitably one should call the term antimatter the start matter and therefore antimatters should be renamed the Principal matter. Therefore there is nothing anti about these matters mafs and matters at their pmf strength as has been actually assumed in the world of science.

The ***Principal mafs matter*** itself has *different degrees of strength* by itself and *not all* magnetic fields of the Principal matters *have the same magnetic field strength*. Where, the principal mafs plasmatic magnetic fields strength has a spectrum of field's strength too.

As the magnetic fields of the principal mafs unwinds, it releases and loosen in its environment these magnetic fields (mafs) of the principal matters disperses into their environment, then they lose their strength through contact or interaction and friction with mafs' of matter and matters, and hence these principal mafs matters pmfs go for through magnetic fields strength of the Dark mafs matter strength first before through further reduction in strength, the dynamic pmf of mafs of the dark matter in motion reaches the pmf strength of the matter mafs level and hence becomes visible in matter pmf strength environment and becomes matter.

Now that the essence of existence of dark energy or dark matter can be explained in its realistic manner, and that is what has been called dark matter is in fact this is ***a magnetic field in transit from the principal mafs matter and matter strength to matter mafs strength and matter***.

Then as energy has been defined as “magnetic fields in motion” then the dark energy in fact is transition mafs matters in motion, or what is called the transition energy.

Then the dark energy can be called the Transition energy instead of the Dark energy, as the pmf in motion as this magnetic fields from the mafs strength of the principal matter in motion to reach to mafs strength of the matter level, this is only a Transition pmf condition, and transition mafs matter phase only.

Where, the interaction of mafs of transition matters with other of the same leads to and creates the Transition gravitational and Magnetic fields of their own or create what is called the Transition Magravs and in some cases this condition leads to creation the transition matter (dark matter) and consequently sometime interaction of mafs of transition energy leads to appearance and become transition matter (dark matter) in the cosmos.

Therefore, the magnetic fields strength, which makes the dark matter, is to be renamed as the mafs of the transition mafs matter and the dark matter as tangible matter becomes the transition matter, the dark energy to be renamed to transition energy.

The plasma of the principal mafs matters exists everywhere in the universe. This being in the centre of the universes, galaxies, stars, planets, plasma of proton and even in the centre of the plasma of the electron and in the lower order pmf strength environments which have been undetected up to now by man.

In reality in the centre of what is called a black hole in the universe, there exist and is the home of the principal mafs matters and principal matter. Therefore the black holes should be called the principal stars in the centre of galaxies, stars, plasma of protons and other entities like these.

The choice of the term star for principal centres of matters is correct as these principal matter concentration centres are like a star in the centre for the matter world like solar system, and the Principal stars are the place for the mafs of the Principal matters and the principal matters which their fields radiate outward into their surrounding as it does with the stars. Thus from this point on in this disclosure we call the black holes the Principal stars in the universe now that we understand the real source of their mafs of this matter(s) and its principal matters.

It can be understood now that where the intensity and the strength of stars and planets come partially from the existence of the principal mafs pmf strength, which has been released by the Principal, stars in the galaxies. This is to say that the seed of the pmf of the galaxies and matters needed for the creation of stars in principle are from pmf of the mafs of the Principal matter. Where, the interaction of the pmf of these mafs’ of the Principal matters leads to creation of initial strong Magnetic and gravitational fields needed for the creation and attraction of mafs of matters of plasmas of matters, the mafs of the transition matter and transition matters of the same region of the galaxies, plasma of stars, plasma of the proton and other entities of the same structure in the universe.
At the same time when using Magnetic with capital “M” this means the like of the Magnetic field of the earth, which itself is the plasmatic environment created by the interaction of at least two magnetic rays and indicates the outward flow of the magnetic fields from a plasmatic environment the like of the earth.

Similarly, when using magnetic field with small “m” this simply means the magnetic fields as in what we observe at the end of a solid magnet as magnetic fields of the object without its interaction with other fields.

Reference

1. Book 1, “The universal order of creation of the Matters”, M T Keshe, published July 2009
ISBN 978 46 6087 001 9

Book 2, “The structure of the Light” M T Keshe, published January 2011.
ISBN 978 94 6087 003 3

2. The unifying theory of the fields M T Keshe 2009

3. The origin of the Universe M T Keshe 2010

4. The creation of the solar systems M T Keshe 2010

5. The CO2 capture paper by MT Keshe Published 23.12.2009

6. “The universal order of existence” finalized and to be published in 2010-2011 by M T Keshe

7. The Magravs positioning M T Keshe 2010

8. NASA WMAP common.wikimedia.com

Published and unpublished works by M. T. Keshe

There are a number of unfinished articles that are to be converted to full disclosures when completed, like antimatter mafs method of energy releases, Nano space technology, relation between the creator and the created, space communication system, deep space defence technology, dynamic magnetic fields force regions (wormholes) construction and control, creation of magnetic fields, and so on.

Some of these works have already been published through different channels and some have not yet been released.

In the following section some of the works done by the same author are mentioned, with a brief disclosure of their contents.

Some of these papers can be purchased and obtained through direct request and access through specific links.

A number of papers with * and ** marks are not for public release due to their sensitivity of information and only available to relevant commercial and governmental organisations for peaceful applications of the technology.

The universal order of creation
(5.7.2006)

In this disclosure the main construction principles and the method of the link and control in the universal order of the existence of living cells, like the function and operational method of any matter based on so called proteins chains, as for example in human cell are explained in detail.

REF 9

The author considers this paper as one of his most important and fundamental works to be published and to be added to the sets of disclosures written by him.

Cosmic Rays
(Release date 24.3.2004)
This paper explains the source and the origin of cosmic rays and the way these work within our cosmos, their function and their benefits.

REF 10
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*The Airborne reactor
(Release date 25.3.2004)

This paper covers the total design of airborne reactors for space technology. This covers all aspects of operation, design and control of such reactors.

REF 11

The seed of the Earth
(Release date 25.3.2004)

Some extracts from this paper:
The theory that the heat of the core of the Earth is due to inertia of the material piled on top of each other is completely dismissed through this new disclosure.

The author M T Keshe believes that this centre core is made of hydrogen, other gases and a mixture of liquid and solid matters mafs, which were in the vicinity of the centre of the core of the Earth at the time of its inception in the solar system.

Through this new understanding of the new inner cores of the planet, this brings to play the fact that the old inner-core of the Earth that is already assumed to be made of a solid piece itself becomes a sealed container for the new inner core.

The author through design of a parallel system has set to confirm the validity of this assumption, that the centre of the Earth possesses a semi- fusion atomic reactor and not a fission reactor as has been assumed by other scientists.

This theory of hydrogen in the centre of the planet is in line with the physical reality of the creation and the present situation in the physical construction of the solar system.

By the laws of physics all the gases in the solar system should have been in the giant gas planets at the outer layers of the solar system, like in Jupiter and Saturn.

The physical reality in the solar system is that the lightest of all these gasses, the Hydrogen, has taken its place right in the centre of the solar system in its star, the Sun.

It has to be recognised that the centre of all planets in possession of gravity due to the centre cores heating, are always in possession of two Magnetic Field Forces in their inner sanctum (M. T. Keshe “The creation of gravity").

In the case of the Earth up to now and with the present knowledge there has been acceptance of only one inner-core and one magnetic force.

As it is explained in the paper titled "the creation of gravity", there is an inner-core in the inner core. This inner core, due to it physical content, motion and position in the centre of the Earth, creates and maintains its own magnetic field force, independent of the magnetic force which has been known to be created by the interaction of the inner-core and the outer-core of the planet.

These two magnetic fields interact to create the planet's own double magnetic fields in its centre. The interaction of these two magnetic fields forces upon each other leads to the new concept of the "DOUBLE MAGNETIC FIELD EFFECT", where the interaction between these two field forces in the centre of the planet leads to the creation of the gravity and the magnetic forces of the planet (Paper: The creation of gravity).

This new second core is the seed core of the planet, the mother seed of the planet positioned in this new inner core.

REF 12

The creation of Black Hole
(Release date 25.3.2004)

In this paper it is explained that the Black Hole is created out of a natural sequence of events, and that the existence of the Black Hole in a galaxy is a normal event. Further it is explained that a Black hole is created in similar ways to the Dark Spots on the surface of the Sun. In this paper for the first time, it is explained how the Black Hole is physically created and what function it plays in its galaxy.

REF 13

Magnetosphere
(Release date 9.6.2004)

"The shape and the strength of the magnetosphere of a planet is exactly what a fingerprint is to a man. It is unique to each planet, star and galaxy. It is a tell-tale of all its attributes, and it reveals the hidden mysteries of the internal materials’ structure".

REF 14

Correction to the Einstein equation of Relativity
(Release date 15.6.2004)

In this paper the physical reality of the Einstein equation is considered, and efforts are made to bring this equation to the real conditions. Even Einstein considers this equation applicable for very small mass, and not in real three-dimensional multi-Magnetic and gravitational conditions, which are external and have nothing to do with the theoretical object's mass and speed, but have effect on the speed and the mass of the object under consideration.

REF 15

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*Introduction to the new system
(Release date 2.7.2004)

In this paper it is written "It is essential to understand that, with the application of this system of motion, one cannot bring into play the solid, liquid and gas fuel method to create motion, as is used today. What is offered in this system is in simple words a fully integrated plasmatic magnetic energy system. Which, creates within and around the core environmental conditions as known to man in the universe like creation of gravity and magnetic field protection and the same as the magnetospheric protection condition of planets and motion through interaction of magnetic fields as planets and stars do in their given environment".

REF 16

The rings of Saturn
(Release date 2.7.2004)

One of the oldest puzzles in the world of astronomy has been the existence of the rings around Saturn. How did these rings come to exist the way they are now? How did they come to appear and behave the way they do? These questions and much more about the creation of these rings are all answered in this paper.

REF 17

The creation of gravity
(Release date 11.7.2004)

In this paper it is explained, "the source and the creator of the magnetic forces and the gravitational forces are due to the interaction between the same materials in the same region of the planet."

Further it is explained how the gravitational field force can be created, replicated and controlled within a nuclear reactor. Further it is explained how this property can be used for the motion of a system within a planetary or solar system.

Now by understanding the principle of the creation of gravity, in this paper it is further explained, "the gravity in reality is the effect of the interaction of two plasmatic magnetic fields of any two object in respect to each other."

REF 18

Death of a star
(Release date 26.7.2004)

In this paper the death of stars is explained, "The death of a star and the creation of a supernova is in reality the same as the half-life cycle energy step-down of an atom, with the difference that this show is in a larger scale, and more spectacular, in all aspects of its dimensions".

REF 19

Fusion
(Release date 28.7.2004)

In this paper the physical and scientific problems with present fusion technology is considered. Where, it is written, "nuclear Scientists, with the fusion reactors of today, are trying to create fusion in the opposite way to the known laws of physics and their parallels in the universe". Further in this paper it is written, "If the present path for creation of fusion is followed, with the present scientific knowledge of physical materials for construction of such system, then following the present path of development to create energy from current fusion systems will be a distant dream".

REF 20

Life of a Cell
(Release date 28.11.2004)

Extracts from this paper; "The reality of the transportation and transmutation of a cell is not far from the reality of the life of an atom or a star. Where the life cycle of the cells are slightly more complicated, as they contain other matters mafs like acids, which have their own magnetic characteristic of their own chemical structure. For this reason the control and replication of the energy of the cell is very much complex, but very simple to achieve".
REF 21

The Atom
(Release date 19.12.2004)

The content of this paper explains how and where atoms in the universe are originated from and how the construction of atoms in a cold plasmatic nuclear reactor can be replicated.

REF 22

Magnetism
(Release date 8.1.2005)

In this paper it is written, "The question is where did the Magnetism come from? This is the Secret of creation. The world is made of one thing and only one thing and that is Magnetism. Its combination and interaction with its own different strength fields makes it appear as different matter mafs. The rest of creations are the outcome of these interactions of different strength of this thing called magnetism and the forces it creates. Magnetism is the origin of existence and the real singularity in its full meaning".

REF 23
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*The creation of the magneto-gravitational force
(Release date 5.2.2005)

The creation of magneto-gravitational field force is and will be fundamentally independent of temperature and pressure, proviso to the fact that as long as a homogenous free floating pmf within a matter mafs is created.

REF 24

The core of the Earth
(Release date 20.4.2005)

One of the original assumptions in developing the new Magravs system some thirty years ago by M.T. Keshe was on the basis that the centre of the Earth possesses addition cores, which create the necessary gravitational conditions of the planet. After some twenty years of space technology and through Earthquake seismological data's this assumption has been shown to be correct and after over twenty years, it has been scientifically proven that the inner-core of the Earth has an inner-core of 600 km. Professor Guy Master in 2002 ref 24 nuclear planet. The centre of this core is assumed to have an inner-core of 8 Km, this he thought to be made of the plutonium or other nuclear materials

But the developer of this new plasma reactor technology has proven through physical dynamic cores that these cores possess a mixture of hydrogen plasmas and the process of the heating of the centre of the Earth are due to a semi-fusion chain of events.

REF 25
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*The electron-atomic welding
(Release date 3.5.2005)

Some extracts from this paper:
"The electron atomic welding or atomic welding principle is the phenomenon that atoms of the same material, through a common shared electron, become a magnetically balanced molecule of the same matter mafs, with the difference that the shared electron will create a balanced pmf in the molecule".

REF 26
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*Shutdown and safety of the reactor core
(Release date 6.6.2005)

In this paper the safety parameters in the operation of the gravitational and energy reactors are simply explained to avoid the loss of plasma and gravitational field forces created within its cores.

REF 27
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*Reactor Start-up
(Release date 9.6.2005)
In this paper the systematic start-up of the dynamic reactors for the creation of gravitational field forces and the production of energy are set out. The start-up of these systems is totally different than the prior arts known in the nuclear industry.

REF 28
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*The energy balance of the reactor
(Release date 29.6.2005)

Some extracts from this paper:
The energy balance of these types of reactors is not as simple as might look in the first instance. The energy creation is simple. But the heat leakage and dissipation through the deliberate inherent material design are and can be zero. That is to say the system not only can hold on the heat it creates. At the same time due to the close circuit feed operation will become self-sufficient but long lasting.

In planets, the loss of heat through their surface creates the variation in the central core condition over several billions of years. In this reactor as losses can be literally negligible, the system can operate at low energy loss temperatures. Even the boundary of the body could be made through the right combination of material in the chambers, so that the body of the reactor will be colder than its surrounding boundary. So the system will not only lose energy to its surrounding, but it can be made to absorb heat in the negative temperature gradient from its surrounding, so that there are no losses.

REF 29

Nuclear decay or half-life
(Release date 20.7.2005)

Extracts from the paper:
"The nuclear decay always has the same or near the same time duration. This is due to the fact that the all neutrons and protons, from their inception, carry a predetermined level of plasmatic magnetic energy. This energy is continually used for the motion and vibration of different elements of the nucleus in respect to each other and the surrounding matters mafs of the atom. As the space and dimensions of a nucleus of an atom always obeys the same principles of the magnetic separation and magnetic attraction. Protons or neutrons can and will need to use or consume the same energy before they become weak enough that the splitting or decay becomes a clockwork job. The nuclear decay is the natural levelling done of a nucleus' energy, due to the energy consumption and heat dissipation for the motion of the elements of the nucleus for its remaining plasmatic magnetic fields energy necessarily needed for them to hold one together".

REF 30
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*The decontamination system
(Release date 10.10.2005)

"What this means is that, for example in trying to recycle the CO2, by the use of the right matter mafs in one of the cores of the reactor, the system will then use the O2 to produce H2O, in the form of pure water, and C in the form of atomic or molecular carbon, or even by feeding this back through certain operational compressions and gravitational interactions within a small core, to create industrial diamond or graphite, for different industries."

The use of the reactor for this purpose has been proven to be correct and Raman spectroscopy has proven the concept and physical reality of the separation of matter mafs in atomic level after separation in the same system from a composite matter mafs.
(See the graphene on the technology web site)

REF 31

The difference in atomic and molecular structure
under gravitational force and pressurised conditions.
(Release date 15.8.2005)

In this paper is written that "the atomic and molecular structure of matter mafs is totally aligned and positioned in a fundamentally different configuration where it has come together due to gravitational forces, than when matter mafs has been brought together by the means of pressure. This has a fundamental effect on the behaviour of the structure and properties of the matter mafs which is created in either way". Where this is explained and utilised to develop a new method in creating graphene and Sp3 atoms and walls in a simple core made of a coca- cola bottle.

REF 32

**The Defence and shielding system
(Release date 4.9.2005)

Some extract from this paper:
The design of the side open system for lunch of high saturation magnetic plasma package is one of the most effective technologies for defence of the reactor and the craft, which is in possession of such a system.

It is essential for any space technology in the open environment of the universe, if the craft is to keep a straight line of motion and to be able to protect itself from any solids or matters mafs in its path in the cosmos.

This technology can destroy any object by the principle of plasmatic magnetic energy saturation of the incoming object at a molecular level, that object will disintegrate in the form of magnetic vapour and not atomic level destruction, before matter mafs can damage the craft as debris, and before the craft ever becomes in touch or near these space matters mafs.

This technology can also be used to protect Earth from the collision risk of NEO's (Near Earth Objects), like comets and asteroids.

REF 33

Method of creation of an atom or nano matter mafs
(Release date 11.10.2005)

The manufacture of an atom of any density, this being of the simplest form of nucleus or a full atom of hydrogen, or even heavier elements in the universe, all follow the same principle.

Atoms are created in the soup of the cosmos from collections of very weak plasmatic magnetic fields, which for their existence cluster and share their energies with the magnetic fields that are not far from their own plasmatic magnetic field strength.

REF 34

The relationship between Gravity and Mass
(Release date 21.1.2006)

Extracts from text of this paper:
"A planet like Earth possesses a combination of both gravity and inertia. Where the gravity comes from the interaction of plasmatic magnetic fields from the processes within its core, and the inertia comes purely from the collection molecules pmf of matters mafs which has built the physical body of the planet.

Any object, being an electron, atom, molecule or even a human body, is a collection of plasmatic magnetic fields of different strengths and their interactions between each other, which in total decides the total or collective magnetic field possessed by that object where this is the mass of the object.

Where the mass of an object is a collective package of plasmatic magnetic field tightness of a given object and will not change as long as the object is intact as one entity in its overall atomic or molecular or collective molecular appearance.

Which plasmatic magnetic energy of a physical body (so called the mass of the body) in interaction with molecular or atomic magnetic field (this being gravitational or inertia) of another object will determine the weight of the two object in respect to each other in each other's environment".

REF 35

The Dark matter mafs
The Fifth state of matter mafs
(Release date 21.1.2006)

Extracts from text of this paper:

The existence of dark matter mafs is not questionable,

Proving its existence, and its effect on the energy balance of the universe, in all matters mafs as small as in the heart of an electron or in a solar system needs to be created, replicated and its effect measured.

The theory of dark matter mafs does not and needs not to be considered as complicated, if one understands in real terms the plasmatic magnetic energy of the matter mafs in the visible and invisible dimensions of the universal work.

The dark matter mafs has two distinctive characteristics, which makes it totally apart from the visible matter mafs. The dark matter mafs possess mass but not visible light, where its existence can only be determined by the weight of the it's hidden mass, which could be substantial due to its internal gravitational field.

REF 36
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*The inter-atomic fusion
(Release date 3. 5. 2006)

Extract from this paper:
"The fusion of two or more atoms has been the pre-occupation of nuclear physicists for past years. Conditions to achieve fusion of two hydrogen plasmas in the TOKAMAK reactors have taken years to teach scientists a lot about the behaviour of plasma and their fusing.

The reality about the fusion in some way has to be reconsidered as, if the scientific world is trying to amalgamate the contents of two plasmas to release energy. There must be a simpler way to achieve releases of similar energies.

The fundamental principle of the inter-atomic fusion is a much simpler way to achieve fusion. If this principle is applied to the atomic condition of fusion, then fusion will be attained in a simple but in a much more physically realistic environment.

The explanation for inter- atomic fusion is very simple and direct.
In the fusion of two plasma of proton of hydrogen atom, the physicists try to fuse two large plasmas, and by doing so, they try to release a large amount of energy. Where in this process enormous amount of magnetic field forces and currents are needed to bring two plasmas in close proximity, so that the energy barriers in between them can be overcome for them to amalgamate or fuse.

In the inter-atomic fusion the overcoming of energy barriers does not exist, as in this method of fusion, the electron of the atom which is circulating the nucleus of the atom and is of the same origin will be encouraged to return into and fuse with the nucleus of its atom".

Where this is a more practical way to create and release manageable energies and there is no need for elaborate systems where even if the energy release will be small compared to dreamed up fusion systems of today.

With inter-atomic fusion method at least small and practical systems can be developed to handle low temperatures of the fusion process.

REF 37

The conductivity of the matter mafs in the vacuum
of the interplanetary mediums
(Release date 21.1.2006)

Some extracts form this short paper "Therefore plasmatic magnetic field of elements within the interplanetary medium will cover the space given to them in their environment. Where due to their motion and their electric charges even in eV levels, they become perfect conductor, and in turn, due to their motion on their environment, they become plasmatic electromagnetic generators.

REF 38

The production of Graphene
(Release date 25.7.2006)

Repeated experiments and tests in simple static reactors, and tests in more complex dynamic reactors, prove that atomic separation and recombination of matter mafs like carbon and hydrogen can be reached at room temperature and at atmospheric conditions.

We have now indications - through static and dynamic tests in our reactors - that the universe was made in normal condition, which was originally nothing but packages of plasmatic magnetic fields of different strength, which were themselves nothing but areas of plasma or collections of loose magnetic fields energies. Where magnetic fields of different strength in locking to each other, by the principle of their plasmatic magnetic energy (PME), have caused in the first stage the creation of fundamental particles, secondly atoms, then molecules and then matter mafs, clouds and asteroids and then stars and galaxy's".

The Big Bang theory conditions have no room in the reality of the creation of the universe.

REF 39

Further works on medical research and developments have been written and completed, and will be published on the Foundation medical site in December of 2011

The process of the reversal of coma: Published in December 2010

Multiple Sclerosis: Published in December 2010

Epilepsy: Published in December 2010

Fibromyalgia: Published in December 2010

INTERNET LINKS

Web site: www.keshefoundation.com

YouTube Channel: http://www.youtube.com/user/keshefoundation

Forum: http://www.keshefoundation.com/forum/

Internet radio interviews:

Interview 06-09-2011 with Red Ice Creations (hour one):
http://www.redicecreations.com/radio/2011/06/RIR-110609.php

Interview 06-09-2011 with Red Ice Creations (hour two - need for simple registration):
http://www.redicecreations.com/radio/2011/06/RIR-110609.php

Interview 05-09-2011 radio interview with Alienshift:
http://www.livestream.com/alienshift/video?clipId=pla_8251665e-ac74-4d77-a785-443bbca65bf6

Interview 04-27-2011 with Mrs. Kim Greenhouse of Its RainmakingTime:
http://itsrainmakingtime.com/_radioshows/110427Keshe.mp3

Interview 04-20-2011 with Mr. Redneck Radioman of blogtalkradio.com:
http://www.blogtalkradio.com/paranormalpalace/2011/04/20/gravitational-technology-with-nuclear-scientist-mehran-keshe
---
Interview 04-17-2011 radio interview with Mrs. Aurora and Mr. Bill Alek of vortexnetworksnews.:
http://intalek.com/AV/VNN/VortexNetworkNewsHour/04-17-2011-VNN.mp3

Interview 04-09-2011 second radio interview with Mr. Bill Alek of vortexnetworksnews.:
http://intalek.com/AV/VNN/ProgressiveTechnologyHour/04-09-2011-Technology.mp3

Interview 04-02-2011 first radio interview with Mr. Bill Alek of vortexnetworksnews:
http://www.intalek.com/AV/VNN/ProgressiveTechnologyHour/04-02-2011-Technology.mp3

Interview 12-18-2009 radio interview with Mr. Allan Sterling of Peswiki:
http://www.mevio.com/episode/205187/fen-12-18-09-interview-with-mehran
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As we are helping with series of books which have been published and to be released, to build the full knowledge of the structure of the operation of the magnetic fields and their interactions in the world of creation for man to understand the entire process, one comes to the point that one has to explained different proportion of this entity in different levels of creation of the greater universe and not the man's universe. In the first book the creation of of matter, the operation and interaction of smaller fields, which leads to creation of matters was explained. In the second book we merely explained the method of travel of the collection of fields in the form of so called light. In this third book, it is further I have explained the operation and interaction of a bigger cells of the same fields, which these leads to creation of the mans universe and more and what is too much for the man to understand with his present scientific knowledge and he calls it his universe.

Where, the so called this universe in this book is explained itself is to be a part of natural process of creation and it has been created from the division of bigger quantities of fields and in time this universe will itself will be divided into and will create smaller universes or part of it will amalgamate with other universes and their fragments' to create bigger universes in the overall structure of the unicos, the universal cosmos.

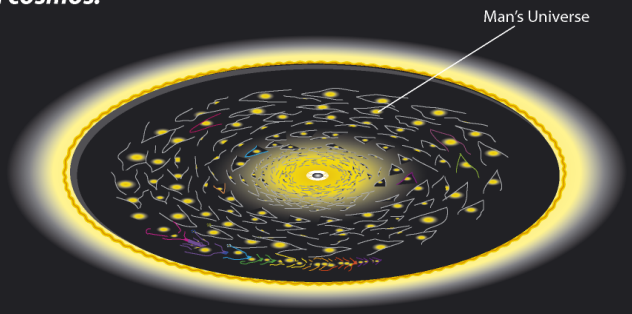

Man's Universe within the Unicos (Universal Cosmos)

This process is being the like of the division of the plasma of the neutron to plasma of the electron and proton to create an atom and/or the fusion of two proton to create a heavier bodies of plasmas.

Thus this universe is not the centre of creation and itself is part of the bigger structure.

That is the same dilemma as man had as he tough the earth was the centre of the universe and as he understood more, he realised that he, his planet and himself are the smallest part of solar system and his solar system was in fact smaller part of a galaxy and so forth, and this is the same with operation and existence of the of the mans' universe in the bigger operation and structure of universes in the cosmos of universes: the Unicos.

The Keshe Foundation

The Keshe Foundation is an independent non-profit and a non-religious organization founded by nuclear engineer M.T. Keshe, aiming to bring new scientific knowledge and new technologies to mankind, and to bring new solutions for the major global problems, like famine, water shortage, shortage of electrical power supply, climate change, illnesses, by the use of new types of plasma reactors, and to give Man the real freedom to travel in Space.

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M.T. KESHE

THE ORIGIN OF THE UNIVERSE

The Keshe Foundation

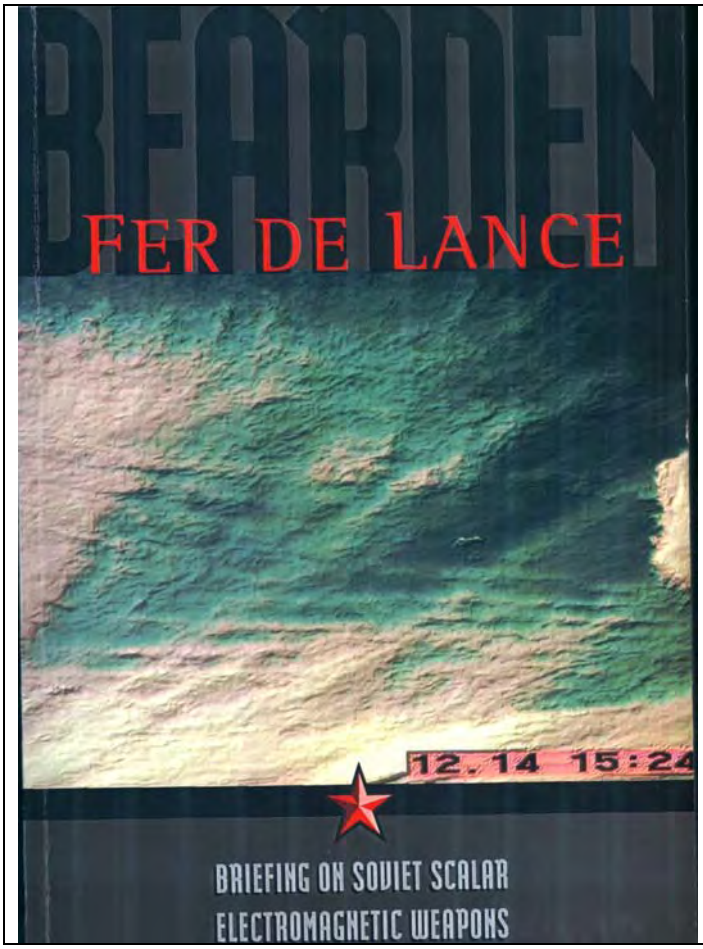

FER DE LANCE

Lieutenant Colonel Thomas E. Bearden (U.S. Army, Retired) PhD, is the author of numerous books, papers, briefings, and presentations dealing with anomalous phenomena, scalar electromagnetics, free energy devices, Soviet Tesla weapons, and Soviet scalar electromagnetic weather warfare.

Lt. Col. Bearden was previously a senior scientist and department manager with the Alabama division of a major aerospace company where he directed the company's design and production of expert systems (artificial intelligence) applications for the U.S. Army command control systems. He has more than 29 years experience in air defense systems, tactics, and operations; technical intelligence; nuclear weapons employment; computerized wargames; anti-radiation missile countermeasures; and military systems requirements.

Bearden obtained a Master of Science degree in nuclear engineering from the Georgia Institute of Technology and a Bachelor of Science degree in Mathematics from Northeast Louisiana University. He is a graduate of the U.S. Army Command and General Staff College.

When Fer De Lance was originally written, Tom was a member of Mensa, Society for the Investigation of the Unexplained, International Tesla Society, American Association for the Advancement of Science, Association of American Physics Teachers, the Air Force Association, the Association of the U.S. Army, the American Nuclear Society, and the American Defense Preparedness Association. He is currently the Director of the Association of Distinguished American Scientists (ADAS), Fellow Emeritus of the Alpha Foundation's Institute for Advanced Study, and is CEO of CTEC, Inc.

In private life, Tom has two sons and two daughters, and lives in Huntsville, Alabama with his wife, Doris.

"...In 1999, the Earth's first strategic sub-space war was silently fought and won..."

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Sweating done by red_gonzo.

Note: sometimes formatting of the text may be a little fuzzy. It's all because the OCR process didn't go as smoothly as I expected. Also there may be some errors inside text so be vigilant. In any case share this book, send emails to people about knowledge contained in it. Since this book talks about the most terrifying weapons present today the information in it is even more of value. But knowing an old saying »the knife cuts both ways« one can also use the same knowledge in order to heal ourselves since it seems that our body already does it using the physics described inside. Hopefully the latter will prove to be the most useful way to use this old but forgotten / supressed knowledge.

The contents include the 2002 update and the older 1986 briefing with slides.

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The Russians have sustained the largest weapons development program ever launched by any nation, and they have kept it effectively hidden from prying Western eyes. I have called this program "Fer-de-Lance," after the deadly South American pit viper of that name.

The dreaded fer-de-lance is a snake of great agility and lethal effect. It often ambushes its hapless prey, striking unexpectedly and without warning. Its first sudden strike is usually lethal to its victim, which promptly expires in writhing agony. Since the Soviet development of scalar EM weapons has been designed for the same purpose, the name seems appropriate.

2002

Overview[1] and Background of the Energetics[2] Weapons Threat

T. *E.* Bearden, Ph.D.
LTC, U.S. Army (Retired)
Director, ADAS

September 15, 1998
Update

Note: We have placed this update as a section in front of the original paper. This leads to some redundancy, which remains to insure clarity.

[1] This is an updated and slightly sanitized version of a paper originally prepared for and transmitted to selected Senators and Congresspersons.
[2] The present name of the old KGB is the Federal Security Services. The leopard's spots remain the same, regardless of its new name—at least for a die-hard old communist faction of it. Presently the helm of Russia has been turned over to a new Premier who has an extensive KGB background. However, Putin has chosen to differ from the traditional KGB outlook and seems intent on becoming America's trusted cheap oil partner and supplier, in a bid to help his economy and pump much-needed funds into it. His friendship with George Bush may be one of the turning **points** of this new century He at least has achieved sufficient control over much of the KGB to get on with trying to solve his economic problems and break the old "die-hard communist" mold a **bit**

2002 OVERVIEW AND BACKGROUND

For some time, Russia and several other nations have possessed highly advanced "extended-electromagnetics" *(energetics)* weapons of a very novel kind, using a dramatically extended electrodynamics theory {1}. To comprehend these weapons requires a combination of non-Abelian electrodynamics in at least the 0(3) gauge symmetry {2}, general relativity, Bohm's interpretation of quantum mechanics {3}, and the use of time-domain (scalar) energy, fields, and potentials to directly enter distant 3-spatial points without propagating energy through 3-space. It also requires correcting many of the serious errors in classical electrodynamics. Probably the most elegant and applicable extant model to deal with these phenomena and weapons is Sachs' {4} unification of general relativity and extended electrodynamics, particularly as implemented in O(3) electrodynamics. O(3) allows direct engineering by modified EM means.

Most of these energetics weapons are more advanced than what has previously been known to the U.S. military, intelligence, and scientific communities, although parts of the communities are finally making real progress in understanding such "revolutionary" areas. For example, every major weapons lab on earth seems to have discovered longitudinal EM waves and longitudinal EM wave weapons—the scalar interferometry we have been discussing for so long {5}. A major contributing factor holding back U.S. catch-up is that the flawed foundations of Maxwell's 1865 theory {6} have not been changed by the Western scientific community.

Historically, the scientific community exerts resistance to substantial innovation. Often 40 to 50 years are required to do what can be done with a concerted effort in four years. The Manhattan Project in WW II is a notable example of where the scientific community made a maximum effort and did a difficult job in four years. Also, "skunk works" efforts continue to be utilized for very rapid development when something really advanced is to be done and done quickly.

With the U.S. substantially behind in these "new" strategic superweapons, a new Manhattan Project would appear to be advisable and warranted. There are at least some indications that such may actually be going on at last. We hope the indications are true.

A sobering development that occurred early this year (2002) was China's deployment of both quantum potential (QP) weapons {7} and *negative energy* electromagnetic pulse (EMP) weapons (a type which we originally called the *MindSnapper* to disguise its true nature) {8,9}. The QP weapons are the dominant weapons on Earth today, followed closely by negative energy EMP weapons in second place. We have not been able to ascertain exactly how many nations have the negative energy EMP weapons, but it is at least five at the time of this writing.

The U.S. is still well behind in the use of special "engines" (special curvatures of spacetime and their dynamics, but achieved with higher group symmetry electrodynamics) for directly engineering the mind itself, and for producing *nonmaterial* robot systems made totally of such engines—"causal system robots" which we will mention later. Several of the Western nations do accomplish work in the mind control area, but use a sort of "brute force" method oriented on frequency and frequency changes, etc. where the true active mode is the unsuspected transformations of the U(1) electrodynamics to a higher group symmetry unified field theory electrodynamics, accomplished by the human body tissues and structures themselves.

Western scientists have not realized that all EM energy in 3-space actually comes from the time domain *to* each point in 3-space and *returns from* that 3-spacc point back to the time domain.[3] Hence "propagation" of 3-space EM energy is actually the propagation of a "circulation" of EM energy between the time domain and 3-space, involving each 3-space point presently said to be "occupied" by the energy. Unfortunately, Western science is still unaware that *no observable exists in time,* a priori, since by definition it has no extension in the time dimension at all {10}. Instead, an observable *continually recurs* as a frozen 3-space snapshot of an ongoing dynamic 4-space interaction, due to the continual repetition of the observation process which is the application of a *d/dt* operator to the ongoing 4-interaction. Hence, we "see" physical reality (3-space reality) similarly to the way we view a "motion picture" series of successive frozen frames. The major result of this flaw (mistaking a 3-space observable as a 4-spatial cause) in Western science is that Western science still extensively substitutes effect for cause—e.g., in the notion of a separate 3-force acting on a separate 3-mass. No such situation exists in nature, and nothing "moves" or "changes" in 3-space alone. For an entity to exist in time, it requires at least 4-space because a time length is required. Nonetheless, the West is making progress. If some of its scientific dogma can be overcome, the younger scientists will break free and readily do the job required for the defense of this nation.

Mad Scramble of Soviet Science After the End of WWII

During WW II the West produced a great technical breakthrough and obtained the atom bomb as a decisive new weapon. While speeding up his own atomic

[3] Specifically, energy comes from the time domain to the negative 3-charge, thence to the positive 3-charge, thence back to the time domain in a *4-circulation* of EM energy. With extra energy *appearing* and present at the negative charge due to entering 3-space there, and with less energy present at the positive charge due to the energy *leaving* 3-space there, there is a delta in energy density (pressure) across a dipolarity, oriented from negative to positive. That is the exact basis of the T. T. Brown unilateral thrust force, and the force used in the "lifters" experiments today. To calculate the **force, th**e long-unaccounted Heaviside energy flow component must also be accounted— not just the weak Poynting flow component.

weapons program[4] as a result, Stalin also ordered his own Academy of Sciences to quickly derive the next great new technical breakthrough, and he held the top scientific leaders themselves personally accountable to him, to see that it was done at all speed (Figure 1).

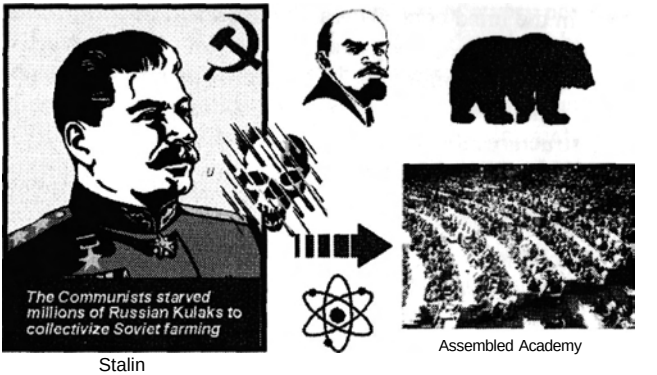

Stalin

Assembled Academy

"The destiny of communism has been frustrated by the U S development of the atomic bomb That is not the last great technical breakthrough The next one WILL be Soviet! You will provide me with that great new technical breakthrough at all speed, or I will have your heads Do I make myself dear, comrades?"

Figure 1 Stalin's dictum removed any resistance from his scientific community.

Simply put, Stalin placed the heads of the Soviet scientific leaders on the chopping block, since he was an absolute dictator and often killed or imprisoned those who opposed his instructions. To survive, the leaders of the Soviet Academy had to demand the utmost of their subordinates, because they themselves had to report their progress or lack of it to a dictator who would and did take swift action if they did not produce results. Thus, Stalin simply bypassed the usual scientific posturing and protracted delay so typical of our Western scientific bureaucracies.[5] If the Directors of the Russian scientific

[4] At the Potsdam conference, after Truman informed him the U.S. had just exploded a great new explosive weapon, Stalin secretly called the head of his nuclear weapons program and ordered him to accelerate the Soviet nuclear weapons program.

[5] As a simple example, the U.S. National Academy of Sciences, National Research Council, National Academy of Engineering, and the National Science Foundation—and all the electrical engineering departments at all the universities in the U.S.—have not yet recognized that all EM circuits and systems are in fact powered by EM energy extracted directly from the seething local vacuum by the source charges and dipoles in the circuit or system, and particularly by the broken symmetry of the source dipole in the generator or other primary power source. They also have not yet solved the more than a century-old source charge problem, but continue to support engineering models assuming that the charge *freely creates* real EM energy out of nothing at all, in total violation of the conservation of energy law, and pours that created energy out, freely and continuously, to establish its associated fields and potentials and their energy reaching across the universe. The agencies thus unwittingly advocate perpetual motion machines on a scale unparalleled in history. They continue to support an electrical engineering model and a classical

community dragged their feet and did not push his desired program to the limit, their heads would roll—and some did.

As a result of Stalin's forceful intervention, the entire Soviet scientific community was galvanized into a most intensive review of all of physics. The scientists desperately sought to quickly uncover potential breakthrough areas that could be developed into the great leap forward that Stalin demanded. They had to have progress, and they had to have it rapidly.

One Institute Had 2,000 PhDs and a Full Support Staff

Large review institutions were quickly set up, staffed with the best Soviet scientists and support translators and teams. One such search institute involved some 2,000 Ph.Ds along with their support staffs. Soviet ships brought in shiploads of copies of all the scientific journals of the West—from the beginning—, and they were reviewed paper-by-paper, page-by-page. Anything novel and implying new scientific possibilities, or anything that had not been adequately followed up, was laid aside in a "select" pile for further review and decision by the best Soviet theoreticians available {11}.

One gets a new physics by discovering shortcomings and flaws in the old one. This intensive Russian search almost immediately uncovered the deep flaws in classical electrodynamics—flaws that have been propagated throughout most other branches of science. Classical electrodynamics (and electrical engineering) is particularly beset by hoary flawed foundations problems, dating from at least 1865. As an example, the equations did and still do assume a material ether, and they have since the beginning! Not a single equation was changed when the

electrodynamics model which *do not even model* the active vacuum and its exchange with every charge, much less a *broken symmetry* in that exchange. So none of those agencies even knows what powers an electrical circuit, 45 years after the proof of broken symmetry was accomplished by Wu and her colleagues in 1957, and the Nobel Prize was then quickly awarded to Lee and Yang *the very same year* (1957) for predicting that broken symmetry revolution. In the modern view a charge is a dipolarity, when its vacuum interaction is considered. As a dipolarity, every charge exhibits the proven asymmetry of opposite charges, in its interaction with the active vacuum. The charge thus extracts and outpours real observable EM energy from the vacuum, freely and continuously, and it exhibits COP = oo. Those agencies—along with nearly all the rest of the U.S. scientific community—still naively assume that a COP>1.0 EM system (i) is impossible, (ii) is against the laws of nature, and (iii) is a forbidden perpetual motion machine. In nearly half a century since the discovery of the broken symmetry of opposite charges, those agencies have yet to apply that finding to electrical engineering and engineering curricula. Frankly, since they have dragged their collective feet for nearly a half century on extracting EM energy from the vacuum, what is needed is a Stalin to put his iron boot firmly to their posteriors and call their attention to it in language they cannot ignore. *The pollution of the planet for energy purposes and the imminent oil and energy wars that will ravish the earth are directly due (i) to this inexplicable dogma upheld by the scientific community and (ii) to the community's continued falsehoods equating EM COP>1.0 to perpetual motion machines.* The continuing failure to **incorporate** the **active vactnun** exchange—and its broken symmetry—into electrical engineering and classical **electromagetics a**lso poses an unacceptable threat to the continued survival of this nation.

Michelson-Morley experiments in the 1880s destroyed the material ether itself. The classical EM model also assumes a flat local spacetime (falsified by general relativity since 1915) and an inert vacuum (falsified in particle physics for several decades). It still assumes the same EM field in mass-free space as exists in mass—a non sequitur of major impact. Just to make the Maxwell-Heaviside equations easier to solve and avoid numerical methods, the *totally arbitrary* Lorentz symmetrical regauging[6] discards all EM systems far from equilibrium with their active vacuum environment. In fact, there is no "active vacuum environment" in the model, much less a broken symmetry in that exchange. Yet that very broken symmetry is exhibited by every charge and dipole {12}, and thus by every EM circuit and system. That asymmetry is involved in the continuously increasing giant negentropy poured out by every charge in the universe, thereby generating all EM fields and potentials and their energy, eventually reaching even across the universe, *and with perfect macroscopic order and time duration as long as one wishes*. Indeed, all electrodynamics is in total violation of the second law of thermodynamics, to any *macroscopic* size level and time duration desired.[7]

The terribly flawed electrodynamics model was completely overhauled by the Russian scientists *very* quickly, and the work was accomplished by some of the best nonlinear scientists in the world. Already present at the time were many things available to assist in dramatically extending {13} the hoary 1865 Maxwellian electrodynamics {6}. Gauge field theory was available since the turn of the 20th century, and the top theoreticians could readily see that something more than Abelian electrodynamics was firmly required in particle physics. The Yang-Mills {14} theory met that need in 1954 by originating non-Abelian gauge theory.

Situation in the Early 1950s

By 1950, Stalin's scientists had the beginnings of what they dubbed "energetics" {15,16}, which we would dub an "engineerable unified field theory" {17,18,19}. Longitudinal EM waves were primary {20,5} in that more

[6] Actually a version of this symmetrical regauging was first performed by Ludwig Valentin Lorenz, "Ueberr die Identitat der Schwingungen des Lichts mit den elektrischen Stromen," *Ann. Phys. Chem.*, Vol. 131, 1867, p. 243-263—only two years after Maxwell published his seminal theory in 1865. The paper is also published in English, as Ludwig Valentin Lorenz, "On the identity of the vibrations of light with electrical currents," *Phil. Mag.*, Ser. 4, Vol. 34, 1867, p. 287-301. Unfortunately not much attention was paid to Lorenz's effort, since he independently derived electrodynamics. Decades later, when H. A. Lorentz also published symmetrical regauging of the Maxwell-Heaviside equations, he was given credit for it with no further mention of Lorenz. A proper historical summary of this has been given by J. D. Jackson and L. B. Okun, "Historical roots of gauge invariance," *Rev. Mod. Phys.*, Vol. 73, July 2001, p. 663-680. This is an excellent coverage of the history of who actually did what and when, and who got credit for it.

[7] This dramatically extends the size regions (microscopic through colloidal) and the time durations (momentary to two seconds) where the second law is known and proven not to necessarily apply.

fundamental approach. By the mid 1950s, one can pick out of the open literature {21} increasing incidences of prototype Russian energetics weapon testing around the world. In 1960, Khrushchev {22} spoke obliquely of these "fantastic new weapons" that were "just within the portfolio of the Soviet scientists," so to speak. Commercial aircraft sightings (Figure 2) and the reports of their captains and crews are also a particularly significant source of sightings of Russian energetics weapons tests, as are sightings by ships' crews (Figure 3) and ground observers (Figure 4).

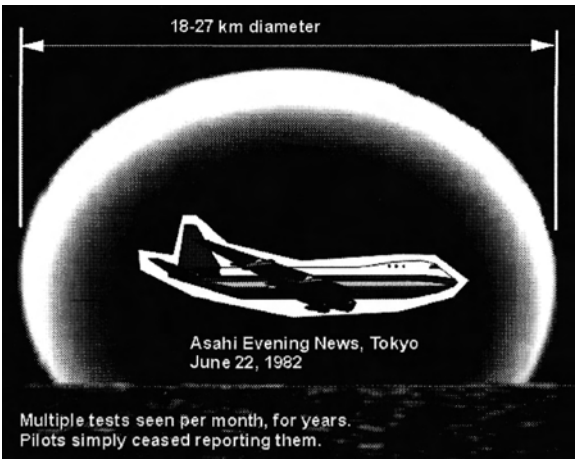

Figure 2 Typical shield test, northern route to Japan, seen by passing airliner.

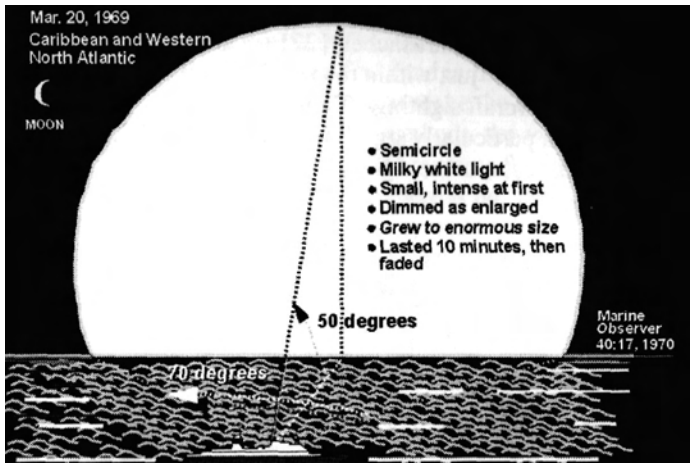

Figure 3 Giant missile shield test seen by passing ship's crew.

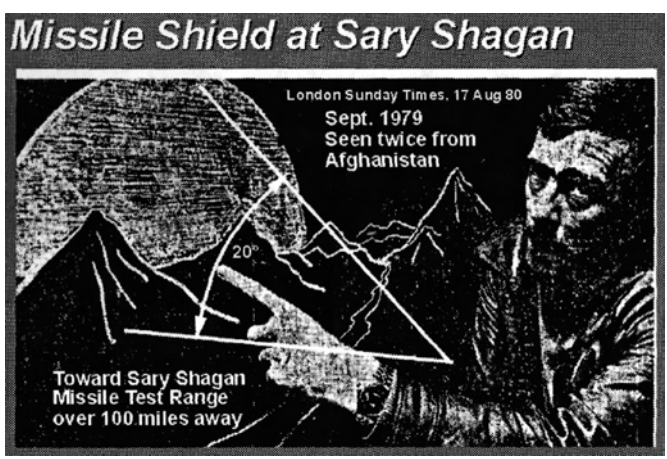

Figure 4 Nick Downie's sighting from the ground of distant Soviet missile shield tests.

1963 Deployment and Immediate Use of Scalar Interferometers

The first huge scalar potential interferometers {23,24} of strategic range and power (Figure 5) were deployed by the Soviets in 1963, and one was used to kill the U.S.S. Thresher nuclear attack submarine (Figure 6), leaving clearly recognizable signatures {25}.

Since 1963, the Russians have had the equivalent of more than seven additional Manhattan Projects (using the Russian 5-year program instead of the 4-year Manhattan Project), back-to-back, in development of energetics weaponry. The energetics weapons have never been given to the regular Russian forces. Instead, all research, production, siting, manning, and employment are by the KGB and still under ruthless KGB control by die-hard communist factions {26}.

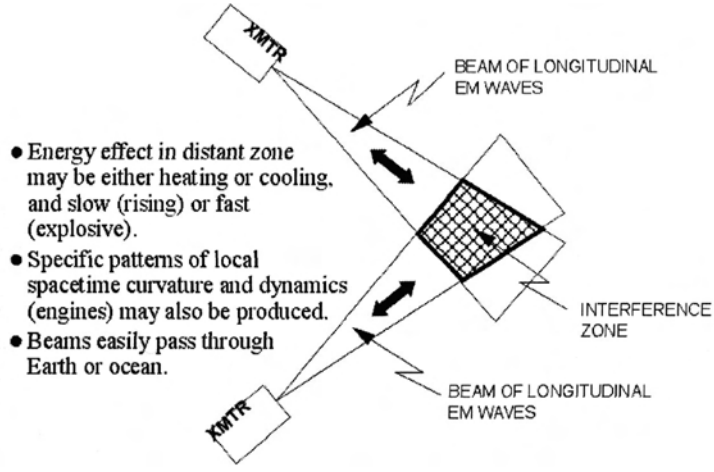

Figure 5 Scalar (longitudinal EM wave) interferometer.

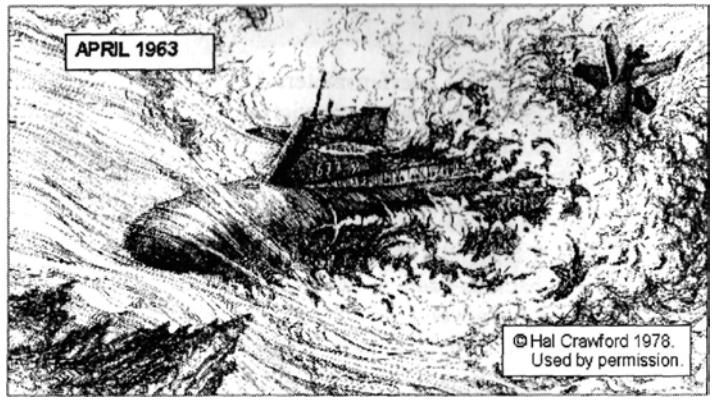

Figure 6 Kill of the U.S.S. Thresher. With her controls jammed, the hull of the doomed submarine implodes when she reaches crush depth

An Example of Russian Technology Astonishing Western Scientists

Some years ago, coordinating with a Western but non-US aerospace firm, I furnished the firm with the names and addresses of some Russian scientists in Moscow, since it was clear from their internet site that the scientists were on the fringes of the KGB energetics weapons program. An excellent European engineer fluent in Russian was sent in, several times. Several unusual things were demonstrated to him, including (i) transmitting enormous energy down a very thin wire, and (ii) cold molding, or turning metal into a liquid at room temperature, pouring it into a mold, and then letting it sit and harden. All without heating.

The engineer also closely questioned the Russian scientists about Russian . energetics weaponry, a subject the scientists were most reluctant to discuss. Finally they admitted the energetics weapons existed, and they actually obtained a meeting between the engineer and the KGB General who had directed the Soviet energetics weapon program for more than 20 years. In the meeting, the General coldly admitted the weapons, stated that "Of course you are not going to be allowed to see *those!"* and confirmed that somehow the Russians obtained everything the present author writes, as soon as he writes it {27}.

The engineer then brought the Russian scientists to his aerospace firm in that Western nation, where the scientists demonstrated cold molding to assembled scientists and some U.S. personnel. I forwarded a written explanation to the Western scientists of how the cold molding was performed technically. Later, on calling the engineer again, I discovered that the foreign authorities of that country had suddenly classified everything over there, and the engineer could no

longer even talk to me without filing a Foreign Intelligence Contact Report. My own part in all this was completely open-source, pro bono, and I had already written of it openly and publicly.

Softening of Metal at a Distance Was One Effect Used Against the Challenger

At any rate, earlier I had openly advanced (and printed) the same mechanism, since it was the metal softening mechanism used by the KGB to kill the U.S. Challenger spacecraft in 1986. Publicly I had been resoundingly called a lunatic for advancing such a "preposterous" thesis. Nonetheless, metal softening by a distant LWI (longitudinal wave interferometer) was definitely utilized as part of the kill of the Challenger, as a close colleague here in the U.S. proved *experimentally*, detecting and demonstrating that metal-softening Russian signal prior to the kill of the Challenger. He amplified the signal and demonstrated on the bench its nearly instant softening of nails, rendering the nails momentarily as limp as wet noodles (Figure 7). Nails from the same box, not exposed to the signal, remained hard and could be hammered into a board. Not so the nails from the box that were exposed to the amplified Soviet signal! Those nails folded up like a wet noodle when tapped with a hammer, and could not be driven into a board.

Working unpaid with the foreign scientists, we had in fact obtained the "smoking gun" proving that this cold molding capability rigorously existed in the KGB inventory. Further, it had existed so long that the KGB had essentially *declassified* it so that the civilian Russian scientists seeking employment funds from the West could utilize it.

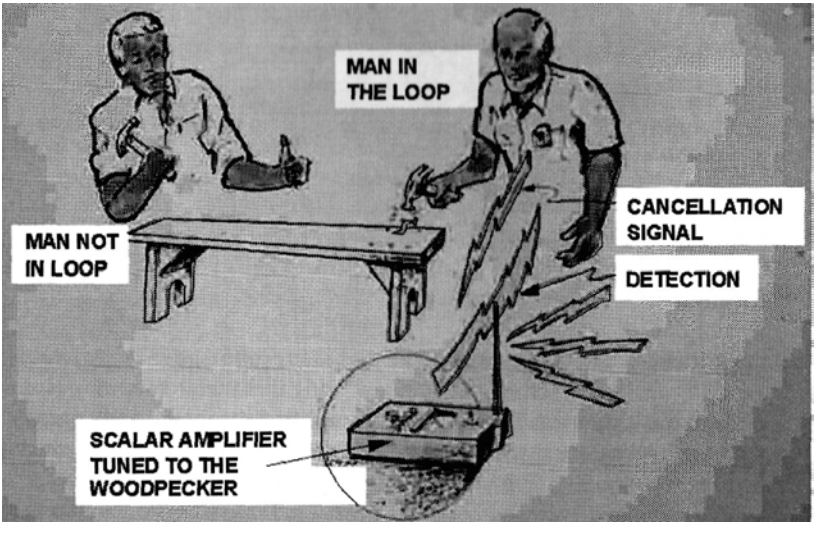

Figure 7 Proof of metal-softening signal: Golden softens nails with amplified Woodpecker signal.

Energetics: Three Branches and a Strategic Deception Plan

The *energetics* weapons use exotic polarizations of EM waves, quantum potentials, and the "infolded" LW electrodynamics (both scalar and longitudinal photons) inside and comprising every "ordinary" transverse EM field and wave. The KGB energetic weapons are categorized (Figure 8) according to what they are targeted against:

(1) against inert matter, fields, and potentials etc., that branch of weapons is called by the same name, *energetics* weapons.

(2) Against living tissue, bodies, cells, biofields, biopotentials, etc., they are known as *bioenergetic* weapons. Disease-induction electrodynamics such as used to irradiate the U.S. Embassy in Moscow are examples of bioenergetic weapons.

(3) Against the mind, thought, memory, behavior, and the mind-body coupling mechanism, they are known as *psychoenergetic* weapons. Particularly in the latter mode, these weapons also use time-polarized (scalar) EM waves and time-polarized (scalar) photons as well {28}.

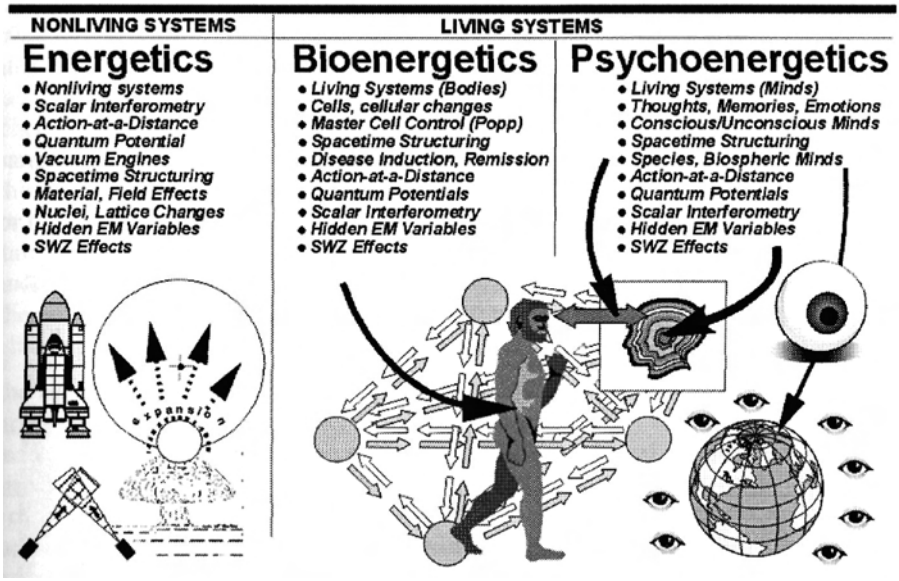

Figure 8 Three branches of Russian energetics weapons.

The KGB also implemented an elaborate and continuing deception plan, as is standard military practice for any great strategic attack plan. The KGB deception plan has been highly successful {29} in keeping the United States convinced that these weapons do not exist, and convinced that the standard strategic nuclear weapons possessed by the West are "leading" and "superior."

Strategic Attacks Scheduled and Why We Were Not Destroyed

Indeed, the West's nuclear weapons are inferior to Russian energetics weapons, particularly to the quantum potential weapons (Figure 9) deployed at the end of 1989 and to the newer "causal system" weapons deployed since the first of 1999, where *functional robot systems* (Figure 10) are made of nonmaterial spacetime curvatures and their dynamics only! In the event of a full strategic Russian energetics strike, an opening strike with quantum potential weapons {30} will dud all nuclear weapons on earth, all nuclear power systems, and all nuclear propulsion systems in about 10 minutes. This takes care of most of the U.S. strategic armament, *within the first 10 minutes.* The publicized strategic weapons of this nation have in my opinion been almost defenseless now for at least a full decade {31,32}, but I also believe that situation may be rapidly changing for the better.

A friendly little foreign nation *does* have such weapons including QP weapons that operate in multiply connected spacetime (MCS). That little nation has been

responsible for our continued survival and has continued to deter the planned KGB strategic energetics strikes upon the West. There are indications (though still not certain) that at least one—and possibly two—other friendly Western nation also possesses such weapons.

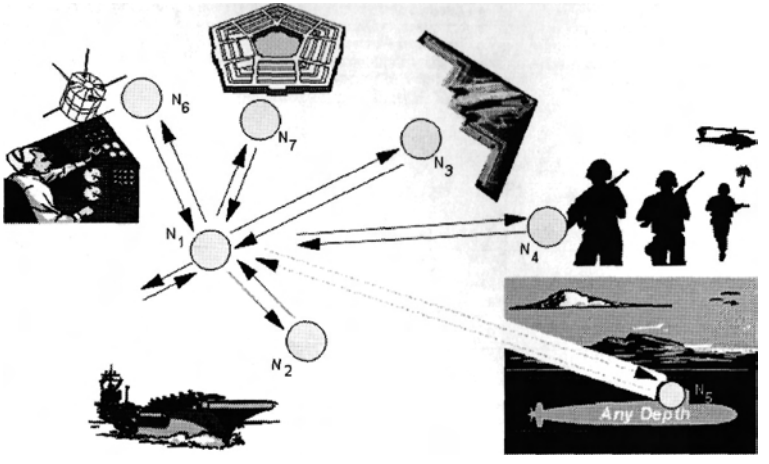

Figure 9 Quantum potential instantly attacking widely separated targets.

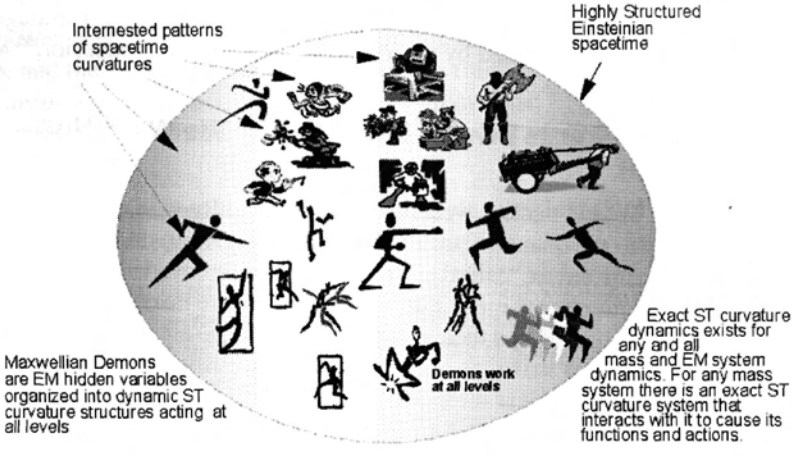

Figure 10 Causal system robots (CSRs). These are sets of ST curvature engines, with functions organized into a single complex weapon system with communication, propagation, weapons effects, and command and control functions incorporated. When the CSR interacts with mass, the mass performs those system functions.

Twice in 1997 alone *we were within days of the scheduled total strategic destruction of the U.S. by die-hard KGB energetic weapons,* with all-out strategic attacks actually scheduled in each case. The first attack was scheduled in latter February but was quickly countered. The attack was immediately rescheduled for May 1. The U.S. intelligence and scientific communities were apparently unaware of what was happening, and still do not believe it. However, as this author previously informed appropriate government agencies a few days prior to the attack scheduled for May 1, 1997, U.S. intelligence agencies certainly intercepted my urgent personal fax directly to the prime minister of the friendly little nation, urgently requesting that the "sane" command and control of the countering MCS/QP weapons be changed to "insane" control and spelling out the compelling reason why it was necessary.

In the insane weapons control mode, the computer periodically (say, every two hours) initiates launch sequence for the weapon, automatically. If any operating personnel remain alive on site, there is a designated short period in the sequence where the onsite personnel can countermand the order and abort the launch. If (he order is not countermanded, the launch is not aborted and the "doomsday" weapon automatically fires. In that case, KGB military power and most of Russia would disappear from the face of the earth.

This was necessary to nullify the impending strikes of MindSnapper negative energy EMP weapons {33} on those critical friendly QP weapon sites to instantly kill all personnel on site. Strike by the MindSnapper instantly kills every living thing in the area, and a protracted contamination remains whereby the struck areas emit longitudinal EM waves. If one attempts to insert new crews to resume operation of the weapons, the crewmen sicken and then die in the entry attempt. First, increasingly severe interference between mind and body control occurs. Then the individuals waver, lose consciousness, go into seizures, and their minds gradually de-couple from their bodies and they die. Fortunately, alter my fax message the C3 system was changed to the insane mode, and the Russians were notified, just in the nick of time {34}. To prevent their own destruction by the certain insane counterstrike, the KGB aborted the looming strategic strikes.

Ironically, at about the very time that the KGB strategic armada was standing down, Secretary of Defense Cohen {35} was making the following statement in Georgia:

> *"Others are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves...So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations...It's real, and that's the reason why we have to intensify our efforts."*

Almost certainly Secretary Cohen had no knowledge that, so to speak, a great Sword of Damocles hanging over his head was being removed by a friendly little foreign nation at that very moment, as he uttered those words apparently referring to the older longitudinal EM wave interferometer weapons. I suspect that Dr. Cohen is to this day still unaware of the incidents that were ongoing at the time of his poignant statement.

Attempts to Alert the Nation

We alerted the President and the National Security Council as early as 1984 (Figure 54). In 1998 we also furnished selected Senators, Congresspersons, and certain high-level U.S. government agencies with color copies of a 200-page briefing and expose {36} of—among other things—these weapons, their testing, and their clandestine use against the U.S. since 1963. Because of the nearly 50 years of demonstrated induction of diseases {37, 38} (Figure 11) in personnel in the U.S. Embassy in Moscow (e.g., responsible for the deaths of three U.S. Ambassadors), we also included part of the briefing on the Priore work {39} (Figure 12) showing the remarkable cellular changes (time-reversal of diseased states back to a previous earlier healthy condition) that can be and had been experimentally induced by energetics under rigorous scientific controls.

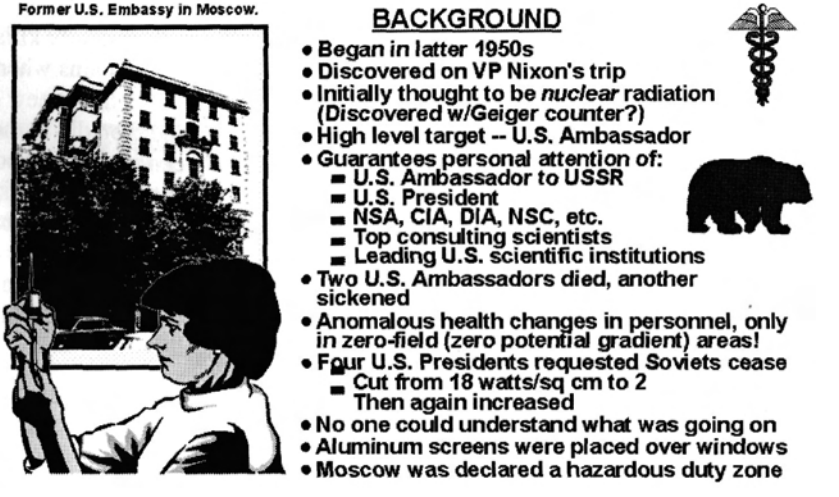

Figure 11 Microwave radiation of U.S. Embassy in Moscow.

We proposed to the DoD a very rapid, high priority development program to develop portable suitcase-sized computer-controlled treatment devices (Figure 13) capable of saving a majority of mass casualties—e.g., from a professional large anthrax attack on a major population center.

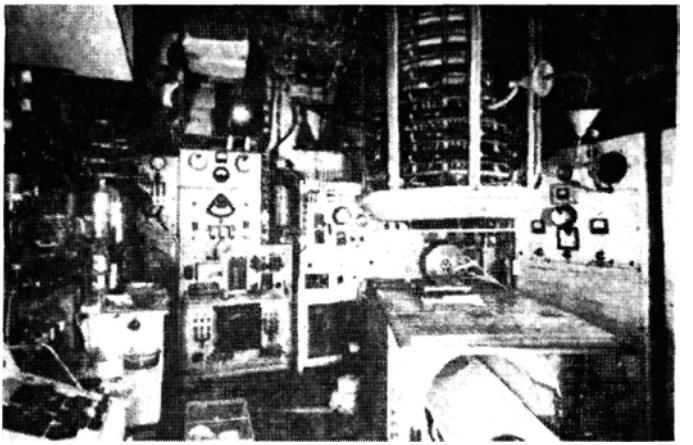

Figure 12 Priore[1] laboratory and device for treating small animals.

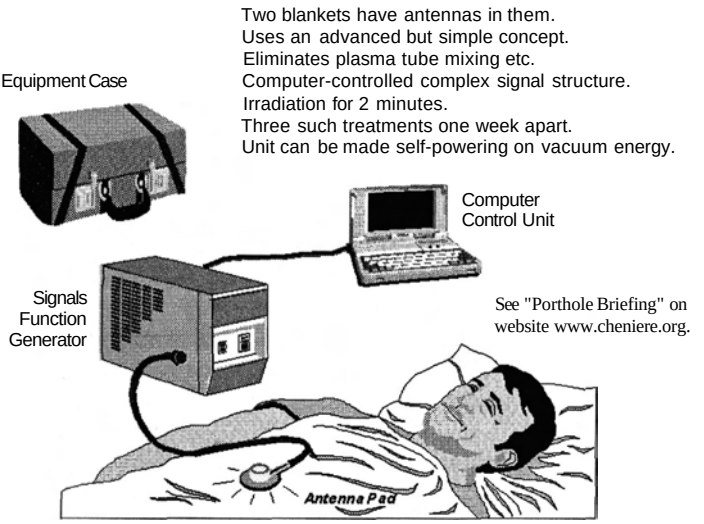

Figure 13 Portable unit for rapid treatment of mass casualties.

The Responses

The responses—or more exactly the near total lack thereof—by various U.S. government agencies were enlightening. E.g., the National Institutes of Health (NIH) never let the package out of its Policy (i.e., *political spin control)* section. It did not check a single scientific reference on a proven method documented in the hard French scientific literature for reversing terminal cancer, infectious diseases, etc. Not a single scientist called me to discuss such a proven, revolutionary effect. Instead, the NIH Policy section simply shipped the package over to the DOD as "their problem, not ours." That was because the package also explained how the Gulf War Disease was induced, including how semen can cause infection of the wife, and how the structured body biopotential of the sickened veteran can induce similar structuring of the biopotentials of his children by proximity, thus inducing various aspects of the disease.

Effective Survival Treatment of Mass Casualties Could Be Developed

Meanwhile, we had uncovered a way to dramatically speed up the Priore healing process, and use only normal transverse EM radiations for ready adaptation of existing equipment, while still forcing the same time-reversal of diseased and damaged cells back to normal. Just much faster. This meant that very small, suitcase-sized treatment units (Figure 13) could now be developed in a reasonable time—e.g., in two to three years, given a high priority, intense effort, adequate funding, and a carefully chosen scientific team.

So, we proposed a crash development by DOD of a small, suitcase-size portable device for quick, mass treatment of mass U.S. casualties following terrorist attacks on our cities using weapons of mass destruction. Eventually an innocuous reply (forced by my congressman) simply stated "it was not supported by the literature." In the package, of course, I had *specifically cited* the numerous scientific papers in the French scientific literature reporting and proving the experimental results. I had also worked 14 years to decipher the mechanism actually performing the revolutionary healing accomplished in rigorous animal testing by the Priore team. Eleven years after suppression of the Priore effort, the University of Bordeaux, which had been pressured into rejecting Priore's doctoral thesis, did approve and publish a doctoral thesis by Perisse on the work {40}.

The National Science Foundation (NSF) did not reply at all. Yet at the time the official strategic threat to the United States listed WMD attack on our cities and great population centers as the greatest threat of all (Figure 14). Today, as everyone knows we are in a war after the terrorist attack on the twin towers in New York and on the Pentagon on September 11, 2001. The U.S. government clearly recognizes that it is not a matter of if additional attacks on the U.S. cities and populace will occur, but *when.* The terrorists are also known to have already

infiltrated weapons of mass destruction such as biological warfare weapons (anthrax, smallpox, bubonic plague, etc.) Nonetheless, apparently the NSF simply did not believe a novel but *rigorously demonstrated-in-the-1960s* unorthodox process that could potentially save most of those millions of Americans who otherwise will surely die—and who *are* going to die in the first major WMD strike on our population centers.

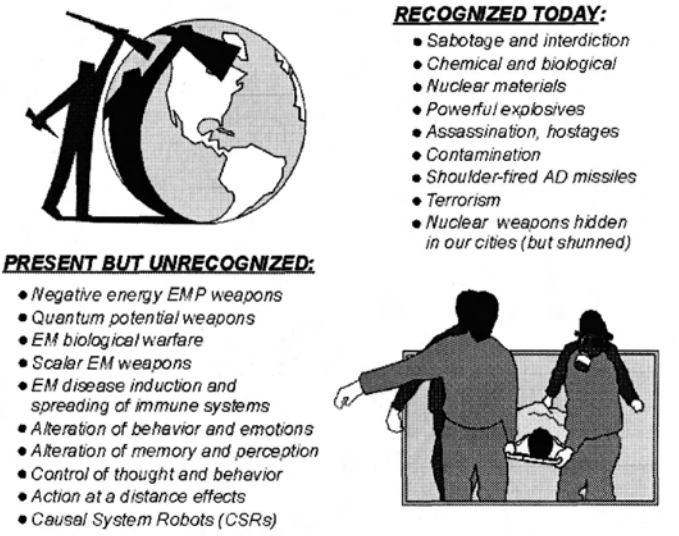

Figure 14 The mass destruction weapons threat to our populace.

The entire scientific method is based on assigning priority to experimental truth rather than dogmatic belief. If experiments refute the theory, the theory must be changed and the experimental results accepted. Else one is not following scientific method. Apparently the National Science Foundation does not follow scientific method, nor does it seem interested in doing so. Neither do the National Institutes of Health. The decisive results of some 2,000 rigorous animal experiments reported in the refereed scientific literature in leading French journals, by multiple established French scientists, were simply ignored because the results are contrary to present dogma. Meanwhile, four years have been lost. During that four years, the portable units could have already been developed, mass produced, and made available to treat and save millions of coming U.S. civilian casualties. Apparently the lives of those Americans are not as important as maintaining the present medical dogma. When those millions do die—and they will—we shall most certainly remind those agencies of the caliber of their dedication to scientific method and of their service to their fellow Americans. In my personal view, ignoring a chance to save so many Americans is treason of a very special kind.

The Official Silence Was Deafening

Not a single scientist in any of those and other organizations seems to have taken the package seriously. Not one called me to discuss it, or apparently studied the references, etc. No one asked for a personal briefing. No one was interested in the actual photo of the strike of a Russian EM missile from a scalar interferometer, offset from a U.S. night shuttle launch (Figure 15) from Cape Canaveral in latter November 1985, or the photo of the actual registration point ball of light high in the air (Figure 16) over that same shuttle launch {41}. The same weapon then killed the Arrow DC-8 at Gander, Newfoundland about two weeks later (Figure 17). An eyewitness (or more than one) actually observed the streak of light from the sky that struck the Arrow DC-8 in the right fuselage ahead of the engines {42,43}, after the thrust of the engines were reduced during take-off by use of a negative energy (cooling) interferometer. A similar ball of light associated with the kill of a Titan missile fired from Vandenberg AFB in early 1986 {44} and printed in *Aviation Week & Space Technology* magazine, was also apparently of no concern.

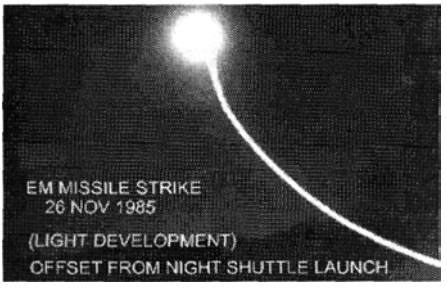

PHOTO BY BOB GLADWIN

Scalar interferometer operator fires offset EM missile from Russia.

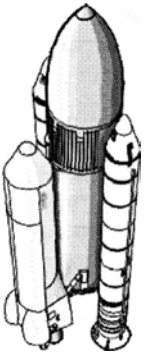

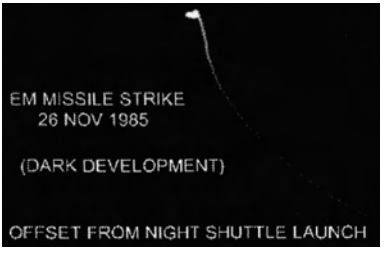

Figure 15 Soviet EM missile strike offset from U.S. shuttle launch at Cape Canaveral on 26 Nov. 1985. This is the smoking gun.

These remarks are intended to show the lack of understanding that has existed in our governmental, scientific, and intelligence communities of what energetics is and of the great energetics superweapons that have been developed. With the present rapidly growing interest in longitudinal EM waves, however, we suspect

that such lack of understanding is now no longer the case. We certainly hope that is true, and we are

Distant operator onsite in Russia slews away the registration point (the m arker beacon)

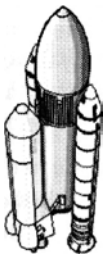

26 Nov1985

Two weeks later, the same weapon killed the Arrow DC-8 at its takeoff from Gander, Newfoundland.

Figure 16 Marker beacon above U.S. shuttle launch at Cape Canaveral, 26 Nov. 1985. Russian crews were using shuttle launches as practice ICBM launch targets.

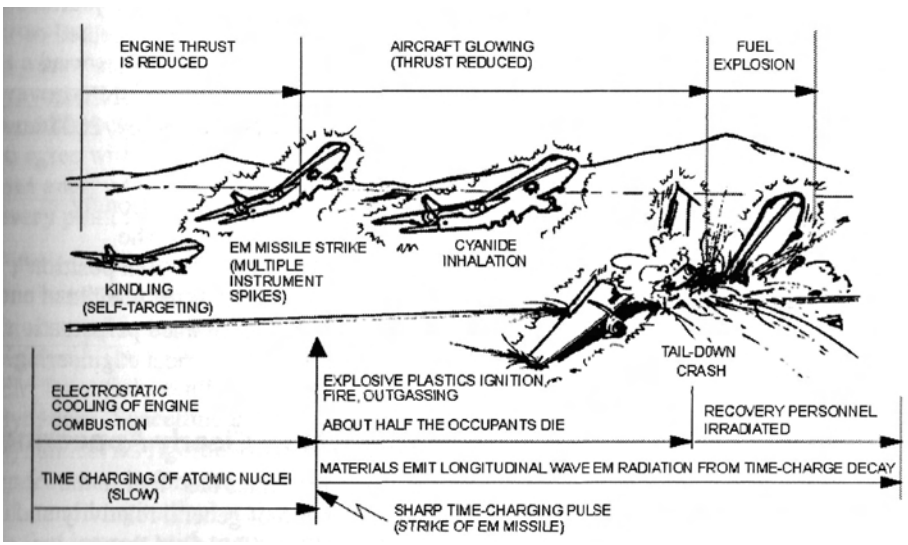

Figure 17 Kill of the Arrow DC-8 at Gander, Newfoundland Dec. 12,1985.

much encouraged that at least one—and possibly two—friendly Western nations now possess quantum potential weapons.

The Long Dry Spell in Correcting Electrodynamics May Be Slowly Ending

In over 20 years of unrelenting effort, until 1999 we were unable to get any significant Western scientists of real "horsepower" (e.g., in non-Abelian electrodynamics, foundations errors in electrodynamics, advanced gauge field theory, general relativity, etc.) to meticulously examine conventional U(1) electrodynamics and its glaring errors, and to look at weapons implications of higher group symmetry electrodynamics.

Beginning about three years ago, however, a noted scientist, Dr. Myron Evans {45,2}, along with other theoretical scientists of the Alpha Institute's Institute of Advanced Study (AIAS), have been extending electrodynamics by developing the 0(3) electrodynamics. They also have deeply examined the Whittaker work of 1903 and 1904 on which the early part of the Russian energetics weapons are based {24}.

The AIAS analyses, and subsequent papers by Dr. Evans and Alex Labounsky as well as by the entire AIAS group, have clearly established the primary importance of time-like precursors of EM fields, operating in massfree spacetime where fields E and B cannot exist. These time-like precursors *create* all the rest of the conventional electrodynamic entities {46}. This is a dramatic extension to electrodynamics and physics across the board. More than 100 papers have been produced to date, with more than thirty published in journals such as *Foundations of Physics*, and many of the others are either accepted or still in the referee process with various journals. Some 60 of the papers were published as a single special edition of the *Journal of New Energy* (JNE) in latter 1999, and a second edition of *Modern Nonlinear Optics*, Wiley, 2001 has been published with many important papers.

However, the problem is that the scientific community, which is strongly committed to "business as usual", has funded none of this work. The conventional lead agencies of the community are still in the "ostrich position", with their heads buried very firmly in the sand with respect to the terrible damage they continue to enforce on this nation by their continued perpetuation of an old, long-archaic, inadequate electrodynamics and electrical engineering.

Engineerable Unified Field Theory Is Now Clearly Appearing

The rapidly emerging AIAS extension of electrodynamics has "met in the middle" with Sachs' {4} revolutionary generalization of general relativity and electrodynamics. For the first time, an *engineerable* unified field theory—employing 0(3) electrodynamic means—is now being produced. The AIAS work in 0(3) electrodynamics was shown to be an important subset of Sachs' approach. It also now provides the full, rigorous theoretical foundation and model for the Priore mechanisms and results.

We also comment most strongly that the important SU(2)xSU(2) electrodynamics as developed by Barrett (47) leads to essentially the same conclusions, since Barrett's electrodynamics is homomorphic with 0(3) electrodynamics. Barrett, of course, is one of the pioneers of ultrawideband radar—another scientific area that was fiercely opposed and suppressed by the orthodox U.S. establishment for some time. Ironically, today those very scientists who were so dogmatic in their vociferous condemnation of UWB radar, have assumed the mantle of "experts in the UWB field", sometimes even taking credit for having "advanced it" in the first place.

Examples of Some Major Non Sequiturs in Conventional Electrodynamics

In every textbook and millions of technical papers in the West, electrodynamicists routinely calculate the "magnitude of the scalar potential". Actually, not a single one—including Maxwell—calculated or calculates the *magnitude of the potential itself.* Instead, they universally calculate the *reaction cross section* of the potential at a point occupied by an assumed intercepting/collecting unit point *static* charge {48}. At best that is a representation of the *intensity* of the field at each point. The reaction cross section of the potential with a fixed unit point static charge is indeed a scalar value. The "scalar" potential itself, on the other hand, *is not* its own reaction cross-section at each point of itself, and it is not a scalar entity at all! Instead, it is a harmonic bundle of bidirectional EM longitudinal phase conjugate wavepairs, as shown by E. T. Whittaker in 1903 {49}. It is and always has been a multi-vectorial, multiwave entity. By slightly reinterpreting Whittaker's work to agree with quantum field theory, the scalar potential is also a circulation of EM energy from the time domain to 3-space and back to the time domain, at every point in space that is occupied by the potential.

Further, the "field" notion is utilized in two self-contradictory manners. On the one hand, it is assumed in the massless reaches of space, and on the other hand it is assumed in mass, *which is the only case in which a force field is properly defined.*[8] The so-called "electromagnetic field" existing in empty space is not an EM force field at all, but a curvature or curvatures of spacetime with assorted ilynamics. Spacetime is after all active, and being active means curvatures and ilynamics. As rigorously shown by the AIAS theoreticians, what exists in *spacetime*—before the force-fields appear on reacting charged mass—are time-like and longitudinal scalar potentials and fluxes. These "pre-EM field" entities in fact interact with mass to produce all the force fields (the electromagnetic fields). Mass is a *component* of force; simply by F == *d*p/dt, which is expanded

[8] Since Maxwell and **the** original pioneers believed in a material ether filling all space, to them t**here** was not a single point anywhere in the universe that was devoid of mass. Hence to them there was only one kind of field: **the** kind that exists in mass.

into F = d(mv)/dt, which is ma + v*(dm/dt).* Note that both terms have mass as a component. Hence there is no force or forcefield when mass is absent. Present mechanics is seriously wrong (and has been wrong for hundreds of years) in assuming a separate massless force acting upon a separate mass.

Jackson, one of the ablest classical electrodynamicists of our day, adroitly states how electrodynamicists skirt that issue. Quoting, p. 249 of his *Classical Electrodynamics,* second edition: *"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable quantities such as force somehow involve the product of charge and field."*

Our comment is that one does not get an observable until after the interaction of a cause with a previous effect, to provide a change (a new effect). The 4-cause itself—in this case the field that actually exists in the vacuum—is never observed nor is it observable. Its *effect* (force with an affected observable mass as a component of it) is observed. The field in space and the field in matter thus do not even have the same fundamental units, but differ by a factor of m. In electrodynamics the m is avoided by "defining" the field as force per unit coulomb of "charge" (without saying or accounting "charged mass").

Wide Confusion of Cause and Effect

Present electrodynamics (and even the hoary old mechanics, as pointed out) has thoroughly confused the causal (4-space) side of the observation process with the effects (3-space) side—observation yields *3-spatial* entities, not 4-spatial. Indeed, as is well known, *time is not observable, even in theory.* That is really because observation is a *d/dt* process applied by the 3-space intermediary (e.g., mass) being acted upon by the causal (4-space) entity in spacetime, to produce a change in that intermediary (3-spatial) that results (is observed). *A priori,* the output of the observation process does not even exist in time, since its fundamental units are LLL and not LLLT. The observation process is thus *d/dt(LLLT)* => LLL.

Further, electrodynamics omits the fact that, not only does the causal entity act upon the intermediary to produce the *effect* (changes to the intermediary), but *those changes (effects) also act back (in reverse) through the intermediary to produce changes in the causal entity itself.* This mutual interaction between cause and effect (but never stressed in exactly that manner) is well known in GR, where the curvature of spacetime acts upon mass-energy to change it, and the resulting change in mass-energy also acts back upon spacetime to curve it. The omission of the latter "back reaction" in EM theory by Maxwell resulted in omitting half the energy, half the wave, and half the causal entity in spacetime, as well as half the effect. The missing half of the effect appears as the Newtonian third law reaction, which in electrodynamics is just mystically "assumed" to be an effect without a cause.

The vast importance of restoring this missing "back action of effect upon cause" is because it can be deliberately utilized to directly engineer the causal (4-space) state itself, producing nonmaterial "engines" and unobservable functioning robot systems comprised entirely of curvatures of spacetime and their dynamics. Such "causal system robots" (CSRs) can be designed and engineered to then perform almost any desired action upon normal mass systems they encounter. The robots also can easily penetrate vast depths of mass, which is mostly empty space filled with potentials, fields and waves—all of which are just bundles of longitudinal EM waves and their dynamics. "Mass" is actually a vast superhighway through which such CSRs can easily move at the speed of light {50}.

CSRs: Engineering the Unobserved Causal Side To Create Functional Systems

Understanding early on the mutual interaction between cause and effect that existed in their energetics, the Russians were able to engineer this totally new kind of system: the *causal system robot* or CSR (Figure 10). With sufficient theoretical development, one can "work backwards" by adroitly re-engineering the effect to obtain a desired causal system (spacetime curvature set along with its impressed dynamics; (Figure 18) corresponding to some physical system and its changes one desires to engender. One thereby directly creates a deterministic set of spacetime curvatures and impressed dynamics, which we call an "engine" (Figure 18). This *ST curvature engine* system can then function as a completely separate system {51} (Figure 10). One can communicate with it via longitudinal EM waves, control it, etc. By building in scalar interferometry functions, the **CSR** can be given "weapons" capabilities, etc.

- All levels of energy structures and all levels of time structures mold spacetime geometry.
- The "pattern" is called a *template* for a vacuum engine (spacetime curvature engine).
- Spatial and temporal structurings of the engine act upon mass at all levels.
- This produces a template of forces, for precise translations and stresses within the mass at all levels. The forces exist in both time and 3-space.

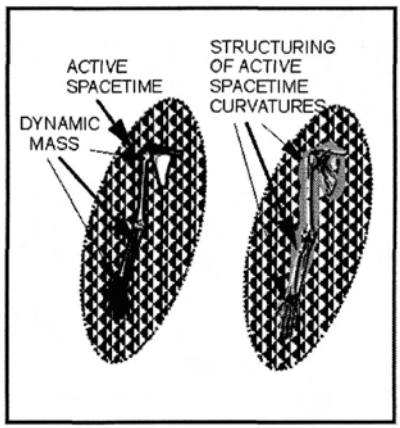

Figure 18 The principle of general relativity extended to include the concept of the vacuum engine.

In theory such a CSR can be assembled to perform any desired function or complex of functions upon matter, fields, potentials, etc. that is desired. In short, one can build real, functioning "infolded" (subspace) robot weapon systems using this "backward engineering of spacetime itself process. The huge underground facilities (hundreds) that the Russians continued to build after the collapse of the Soviet economy and the fall of the Soviet Union, apparently contained the full CSR development and control facilities as well as the operational systems employed for this totally new kind of weapon system.

A great engineering of the future lies in engineering CSRs, which already constitute a great leap forward past the material nanobot technology being pursued in the West.

Making the First CSR is Extremely Difficult; Making a Million Copies Is Easy

The development of a specific CSR with a specific set of functions is akin to developing a highly complex software system of major proportions (several tens of millions of lines of code). The job is extremely difficult, and tortuous "debugging" is required for a lengthy period. Once a single CSR is completed and debugged, however, the production of thousands or even many millions of copies is then a trivial task.

The CSR may be visualized as a sort of vast complex of longitudinal EM waves (recall, we are speaking of ST curvatures, not the conventional EM waves thought to operate on a flat spacetime. *All* EM waves operate in a curved spacetime *a priori,* as clearly shown by Sachs). It turns out that all matter is mostly empty space, filled with potentials and fields. Space itself, considering its energetics, may be taken as a giant scalar potential. All those potentials and fields and waves are in fact nothing but sets of longitudinal EM waves and dynamics. In short, they are vast superhighways for the travel of CSRs and the propagation of longitudinal EM waves.

A CSR can be embedded *within* any kind of EM potential, wave, or field. So to replicate one, one embeds it in a magnetic signal and records that signal on a diskette or other media. Then one makes millions of copies of the diskette, for perhaps 10 cents or less each. Or do it en masse, by first completing a CD-ROM with a hundred or two hundred CSRs embedded in its signals (Figure 19). Then simply reproduce the CD-ROM. Every reproduction has another hundred or two exact duplicates of those CSRs, made for almost no cost at all. With communications built into the CSRs, the command and control facilities take charge of them, give them individual numbers or designations, and a robot armada emerges with most unusual capabilities indeed.

The puzzling underground facilities in Russia (which our fellows apparently never deciphered and which remained a mystery) apparently contained the scientific teams, the research and development facilities, the production

facilities, and the command and control facilities for the new vast CSR weapon complex. It was to see its first great employment at the end of 1999.

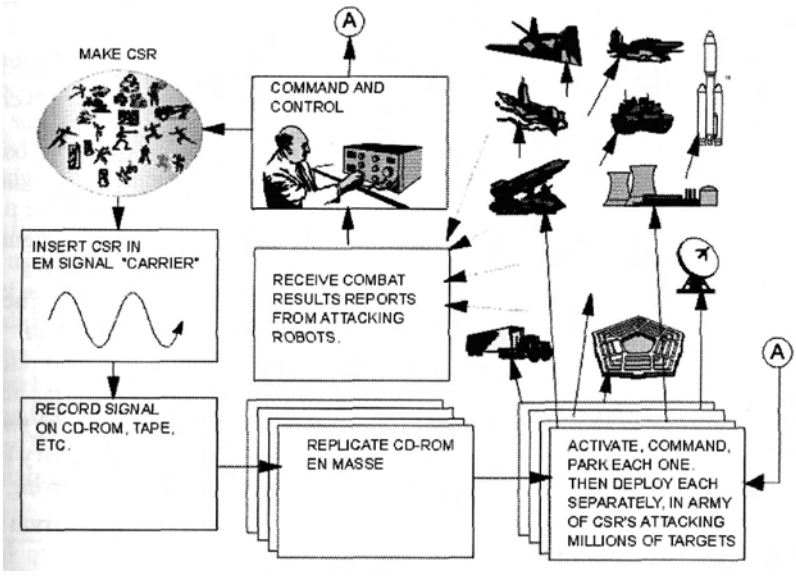

Figure 19 Mass reproduction of a CSR is simple and inexpensive. The CSR resides in, or propagates inside, any EM signal, potential, or field.

In 1999 The KGB Deployed Massive Numbers of CSRs for a Strategic Attack

In latter 1999 the KGB began massively deploying these CSRs of various types throughout the Western world, particularly including the United States. They simply sent the CSRs back "inside" the potentials and fields and waves being emitted from radio stations, TV stations, power lines, satellites, communications systems, inside matter, etc. These CSRs were deployed and infiltrated in major command posts and installations throughout the U.S. and its allies. True to form, the KGB even "stimulated" some major computer systems in critical U.S. government facilities by having the robots "surface" some effects on the Computers, right through the firewall programs (whose EM signals and operations indeed provided nice superhighways for the robots). Our fellows **detected** the interference as a "sophisticated computer hacking attack" (puzzlingly from the Russian Academy of Science), and then the robots "submerged" again after deliberately performing actions to produce obvious changes and guarantee the U.S. detection of those changes. The purpose of this "stimulus and probe" was to see if the U.S. was aware of CSRs and CSR **technology.** We clearly showed we were not, and we still are not aware of them. Fur**ther,** the entire government apparatus—including all our vaunted national

laboratories—knows absolutely nothing at all about CSRs, and none of the laboratories believe it. That is the same posture they've been in with respect to energetics weapons for a half-century. Apparently they will be in that same posture for another half century, left to their own devices.

However, I was not allowed to remain a casual onlooker for this new CSR armada! The KGB also planned to use me as a stimulus to ping the government yet another way, and then assess the government's response.

Here in Huntsville, suddenly I was personally struck by such a CSR right from my computer monitor, with the attack riding through the light from the monitor to my eyes and retinas and right into the brain and nervous system (Figure 20). This was the type of CSR that can lurk in any potential or field inside a computer, and then strike and kill the operator looking at the screen. The CSR took over control of the machine, split the screen so that only one-inch horizontal strips were luminous—one at the top and the other at the bottom of the screen with the middle dark. These two separated horizontal strips allowed scalar interferometry via the inner LWs comprising the light from the two strips. The LWI signals crossed in my vision center, where suddenly ordinary EM signals and waves were produced by the scalar interferometry occurring there.

Stimulating apparently the only analyst capable of recognizing a CSR attack and connecting it with the scheduled giant strategic CSR attack.

KGB General commanding the energetics weapon previously confirmed that what this analyst writes on his computer is received as soon as he writes it. Apparently accomplished by Tempest techniques or directly by energetics.

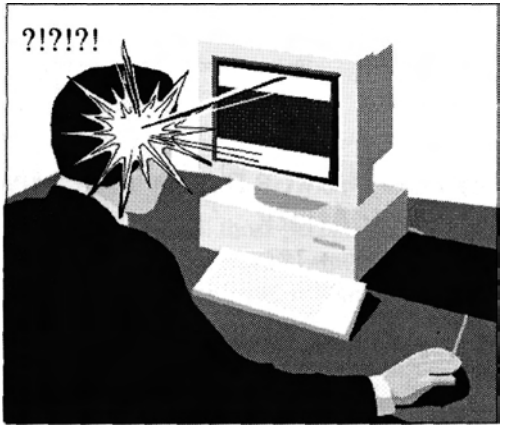

Figure 20 Present author struck by CSR in latter 1999 as a deliberate nonfatal stimulus.

I saw rapid blinding flashes like a hundred flashbulbs exploding at once right in my face. However, the signals representing those "flashes" were being created right there in my vision center. An external camera would have recorded only the weirdly separated screen display. It *would not* have shown the brilliant flashes of light I was seeing, unless it was set up stereoscopically. The strike was deliberately sustained for only about 10 seconds so as to be severe but nonlethal; about 30 seconds would be totally lethal. Violent fibrillation of the heart also resulted explosively, and I was instantly hypnogogic and seriously weakened by

sudden hypoxia from near total lack of blood pumping (because of the fibrillation). The purpose was apparently to strike the only analyst in the U.S. who would recognize what the nature of the attack was, stimulate him, watch him try to notify the government, and then observe the government's reaction. It look four days to recover from the strike. But I knew immediately what had made the strike, and that I had been hit with a CSR weaponized by having a built-in scalar interferometry capability. It was also a very sophisticated CSR, as it showed by assuming complete "intelligent" control of my computer's functions.

When I finally recovered, I did notify the government and warn them of CSRs, exactly as anticipated by the KGB. As might be expected, the government's total disbelief and lack of reaction clearly showed they knew nothing of CSRs. They simply did not believe such weapons existed or even could exist. Sadly, once again one faced the "not invented here" syndrome. General relativity and its provision for spacetime curvatures and their associated dynamics (engines) operating back upon mass are apparently just supposed to remain a theoretical curiosity. Why, obviously no scientist in his right mind would think of weaponizing such!

A more correct answer is, *"Like hell they wouldn't!"* *American* scientists would not think of it, but *Russian* scientists with their national chess-playing psychology will immediately seize upon any opportunity—even many moves ahead in the game—and develop it and utilize it. They understand and use the boa constrictor. We only understand and use the immediate rattlesnake.

How the Asymmetrically Deployed Strategic Attack Was Stopped in Its Tracks

However, we also alerted the "little nation" that has advanced EM weapons technology, which—since early 1997—has been saving the U.S. by forcing the abortion of impending KGB energetics weapons attacks.

When I warned them in 1997 about the MindSnapper weapons and mind-control weapons used against Captains Button and Svoboda, unknown to me at the time they later reacted and suddenly destroyed those facilities in Russia (apparently with violent scalar interferometry strikes). So *that* mind-control type of attack being readied for 1999 was thwarted for a few years by these strikes sometime prior to mid-1998.

But to return to the CSRs. In the latter quarter of 1999, the Russians were developing and deploying throughout the West numerous kinds of CSRs. So the period at the end of 1999/first few days of 2000 attack was already scheduled for a massively programmed CSR attack. It was designed to cripple the entire **nation,** and perhaps even collapse it economically, yet all would be blamed on Y2K! Our scientific ignorance guaranteed that we would blame it on something **mundane that** our scientists could understand: Y2K problems in all the old

software programs running so much of our automated systems, communications, and centralized functioning, accounting, banking, etc. In short, the KGB planned to give us a bicentennial gift: a Y2K nightmare far beyond our wildest fears.

After my recovery from the CSR strike in the latter quarter of 1999, I again urgently alerted the friendly nation of the development of CSRs and their widespread deployment—and informed them of the personal attack on me and specifically why it was made nonfatal. Of course I also alerted our own government. We were scheduled for a *real* Y2K problem that would curl one's hair, so to speak, with everything imaginable failing—and probably all blamed on Y2K.

Admirably, beginning just at the end of 1999, the friendly nation simply began methodically and massively cleaning out all the CSRs, and they disposed of them in very short order! Such CSR systems[9] may easily be located and destroyed by strategic longitudinal EM wave weapons {52}, when and if one has the longitudinal EM wave technology sufficiently developed. So Y2K came and went with only a few relatively minor incidents from the *normal* Y2k problems expected.[10]

However, unknown to our scientists and intelligence community, a great war of a very special kind—*the Earth's first strategic subspace war*—had just been silently fought and won, right there inside our power systems, command and control systems, major weapon systems, electrical power systems, electrical control systems of our nuclear submarines and strategic bombers and missiles, even inside the electronics of our nuclear warheads, etc. And not a bobble showed on the surface, anywhere. This was the first real "subspace" war, where weapons made of pure spacetime curvatures and dynamics were involved as the main offensive battle systems. LWI destruction of numerous CSRs inside potentials and fields in various electronic equipment throughout the nation, created little or no overt signs at all.

This time we won, thanks to the "good guys" and not to our own scientific community. Next time we may not be so fortunate.

The Mostly-Ignored Time-Energy Interaction

For some inexplicable reason, physicists in the West have omitted one-half the actual photon interaction.[11] If one allows the *spatial energy* component of the photon to interact, then one must also account for the simultaneous interaction of the time-component of the photon. A mass m absorbing a photon (AE)(At)

[9] These early CSRs apparently had no "stealth" capabilities built-in, so they were easily detected and destroyed, rather like shooting fish in a rain barrel.

[10] Even so, a normally disastrous Y2K problem was narrowly averted, in the nick of time, by a concerted national software reprogramming effort massively mounted and costing billions of dollars. Otherwise, the expected "ordinary" Y2K problem would have been very bad indeed.

becomes *masstime* (m+dm)t, not mass m. Mass *m* and masstime *mt* are as different as are force *F* and impulse *Ft.* No scientist in his right mind would ignore the *t* in *Ft* and consider just the force *F.* Yet that exact kind of giant *faux pas* has been done for many decades now in the photon interaction. And it is still ubiquitously done in physics. *Mass does not emit photons; masstime does.* Again, physicists confuse effect and cause.

As the Russian energetics weapon scientists know full well, time is actually spatial energy compressed enormously, by at least the factor c^2. Hence time has at least the equivalent energy density of mass. The greatest amount of "energy" existing in a photon—particularly in lower frequency photons—is in that "time" part that is arbitrarily ignored and discarded. An ELF photon has enormously more total energy—by many orders of magnitude—than does a gamma ray photon.

Energy and time components in the photon are canonical. Low frequency photons are reduced in the magnitude of their *spatial* energy component and thereby maximized in their *time* components. For the ordinary (decompressed) *energy equivalency* of the time component, one must multiply the time in seconds by c^2. Halving the frequency, e.g., doubles the time component, whose spatial equivalent energy is now $(2t)\times(c^2)$. With respect to the original photon, the new total energy (achieved by halving the frequency) is given by $[(\Delta E)/2] \times [(2\Delta t) \times c^2] = [(\Delta E)(\Delta t)\times c^2]$. So halving the photon's frequency increases its total energy by a factor of c^2, which is approximately by a factor of 9×10^{16}. Hence photons actually carry enormously greater total energy (most is locked up as time) at low frequency than at high frequency. Indeed, the highest energy photon interactions in the universe are at low frequency, *if and when* a transduction of the available time-energy into spatial energy occurs.

This has been completely missed in the West, but not by the Russian energetics weapons scientists. They have been *engineering* that formidable new high energy but low frequency physics—a physics far more energetic than that used in our most energetic colliding beams in "conventional high energy physics".

The cold fusion processes[12] stumbled onto by Western scientists are using the

[11] I.e., except for accounting for the overall "action" (angular momentum) and such things as **minimum** action theorems, etc. Treating the photon's increment of time specifically as a formidably compressed piece of spatial EM energy does not appear in Western physics. It has **long** been utilized in the KGB's secret energetics weapon science.

[12] For an explanation of the use of time-reversal zones in cold fusion experiments, and some of the resulting new transmutation reactions that result, see T. E. Bearden, *Energy from the Vacuum: Concepts and Principles,* "Chapter 10: Cold Fusion: Low Spatial-Energy Nuclear Reactions at High Time-Energy," Cheniere Press, Santa Barbara, CA, 2002. Available from www cheniere.org. Statistically, the formation of significant time-reversal zones is guaranteed by t**he transient** fluctuation theorem of Denis Evans et al., and by recent experimental work by Evans et al. proving that such zones (where the reactions run backwards) can and do occur at up to **micron** (colloidal) size and for up to two seconds in duration. We stress that this is a recognized, **proven** violation of the second law of thermodynamics already known to physics.

time-energy component of photon interactions, to generate enormous localized EM energy directly upon the interior quarks and gluons of nucleons {53}. We worked out a speculative explanation of the active time-energy transduction mechanisms that fits all the experimental phenomena, including the eerie instrument anomalies occurring in rigorous electrolyte experiments at China Lake for some years. That is included in my new book, *Energy from the Vacuum: Concepts and Principles,* Cheniere Press, Santa Barbara, CA, 2002, available from www.cheniere.org.

Of course consistency alone does not prove it conclusively; consistency is a necessary but not sufficient condition for proof. But at least the proposed explanation is consistent, and nothing else seems to be, at this time. In one chapter in my referenced new book we do cover the cold fusion mechanism and give specific new nuclear reactions producing the excess deuterium, tritium, and alpha particles in so many successful cold fusion experiments worldwide.

My "time-reversal zone" approach is stringent, because the recent work by Denis Evans *et al.* {54} has clearly shown that reactions can and do run in reverse—totally in violation of the second law of thermodynamics—at micron (colloidal) level in size and for up to two seconds in duration (and sometimes even a little longer). So experimental demonstration that the "time reversal zones" I assumed can and do indeed occur has now been accomplished by Evans *et al.* This provides strong experimental and theoretical support for the basic assumption (of the formation and momentary existence of localized time reversal zones that subsequently decay) we used to derive the fundamental cold fusion mechanism including some of the specific reaction equations for excess deuterium, tritium, and alpha particles now demonstrated in hundreds of successful experiments.

In a reversed zone *the law of attraction and repulsion of charges is reversed,* so that like charges attract—sometimes so closely that each enters the strong force region of the other, forming a quasi-nucleus (Figure 21). As the time-reversal zone subsequently decays back to a time-forward zone, the reduced strong force is restored much faster than the Coulomb force is reduced and then reversed back to normal. So during this readjustment decay process, the quasi-nucleus will simply change to an isomer and a known nucleus by quark-flipping to change an H+ ion to a neutron. Note that the "reversal zone" momentarily changes the Coulomb barrier—always the only thing that has really prevented chemical fusion and transmutation at low spatial energy—to a Coulomb attractor. Hence cold fusion—as now backed up by more than 600 successful experiments worldwide, by multiple laboratories and researchers in multiple nations—is an established fact and a herald for a vast new science based on deliberate and intentional reversal of the Coulomb barrier and use of time-energy.

With its usual perspicacity, the organized U.S. scientific community has flubbed it—and flubbed it badly—with respect to cold fusion. Its contribution has

largely been a tirade of ad hominem attacks, slander, and libel of a viciousness seldom seen in the annals of science. Once again, the community is far more devoted to defending its cherished dogma (and its own rice bowls from the conventional Big Nuclear Science that cold fusion thoroughly upsets), than it is in applying scientific method which calls for *believing the experiments* and changing the dogmatic theory.

- Fermions time-reverse in even numbers
- Like charges cluster
- Aqueous solutions contain H+ ions, which are just protons
- Quarks flip as TR zone fades

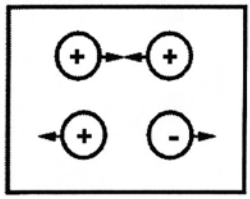

$$2({}_1H_1 + {}_1H_1) \rightarrow 4({}_1H_1) \rightarrow 2({}_0n_1 + {}_1H_1)$$
$$\rightarrow {}_2He_4 = \text{helium (alpha)}$$

Figure 21 Example of a time-reversed zone nuclear reaction common in successful cold fusion experiments.

Development of Threats and Scheduled Attacks Aborted

KGB energetics weapons have long constituted our single most pressing yet largely unrecognized national security problem. That problem has also increased with the growing development and deployment of such weapons by other nations such as China. Some 10 nations, for example, now have scalar interferometry weapons, and even the Japanese Yakuza has them and also has their own secret facilities for producing them in Japan, including small portable units developed for use in assassination and terrorist type warfare within a targeted nation—the United States of America.

Unknown to our government, we narrowly escaped destruction twice in the first half of 1997 from scheduled all-out strategic KGB energetics weapons attacks. **Only** the actions of a friendly small country countered the attacks and caused the **KGB** to abort on each occasion.

When the second scheduled Russian strategic attack was aborted just prior to May 1, 1997, a new KGB counter-counter for the friendly counter used by the **little** nation in latter April 1997 was already rapidly being deployed. The new **Russian** counter-counter—seizure and control of the mind of an operator at a distance, and complete control of his actions while he performs sophisticated

technical tasks—was tested in two separate incidents {55}, first on Captain Button (Figure 22, Figure 23) and then on Captain Svoboda about two months later (Figure 24), each flying an A-10 Warthog aircraft over the U.S.

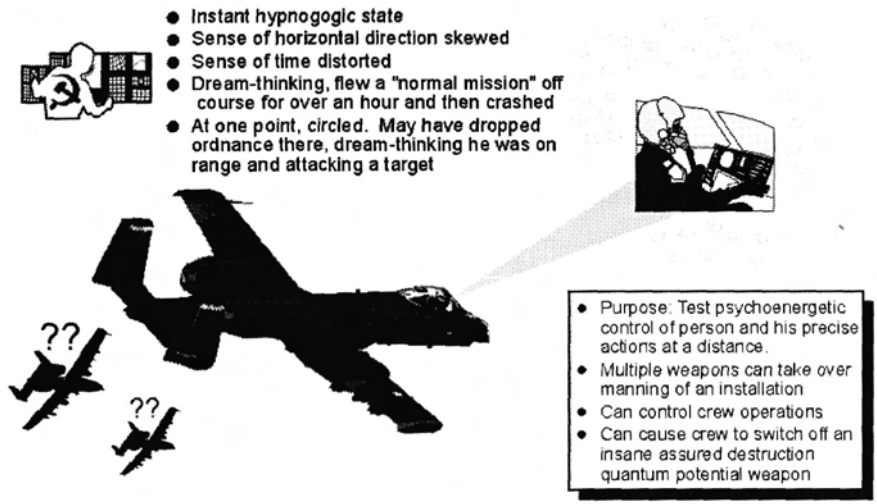

Figure 22 Captain Button's bizarre flight to his death on 2 April 1997.

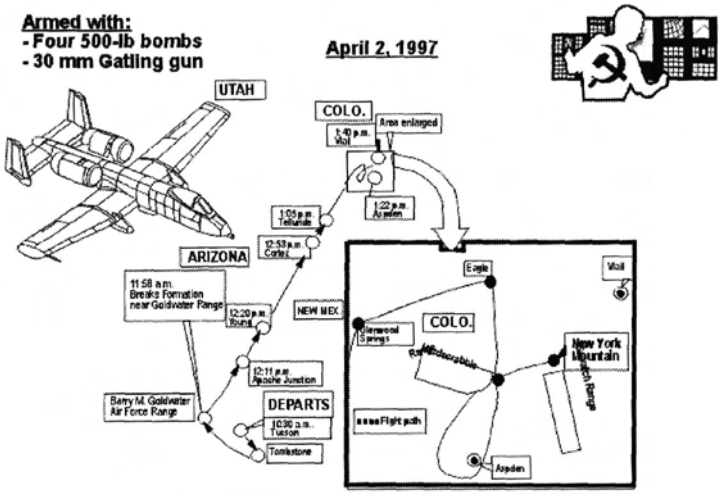

Figure 23 Captain Button's flyaway path to his eventual fatal crash.

The highly successful test against Captain Button (Figure 22, Figure 23) is

particularly significant, as we have explained. Captain Button was controlled while performing highly technical operations, for more than a full hour, and one hour was apparently the acceptance test specification. Captain Svoboda (Figure 24) simply had her mental perception of up and down instantly reversed while climbing her A-10 warthog from low level ordnance delivery on target. Erroneously perceiving she was diving, she immediately "corrected" sharply to "climb", thereby diving headlong into the ground and perishing in the resulting explosion of her aircraft.

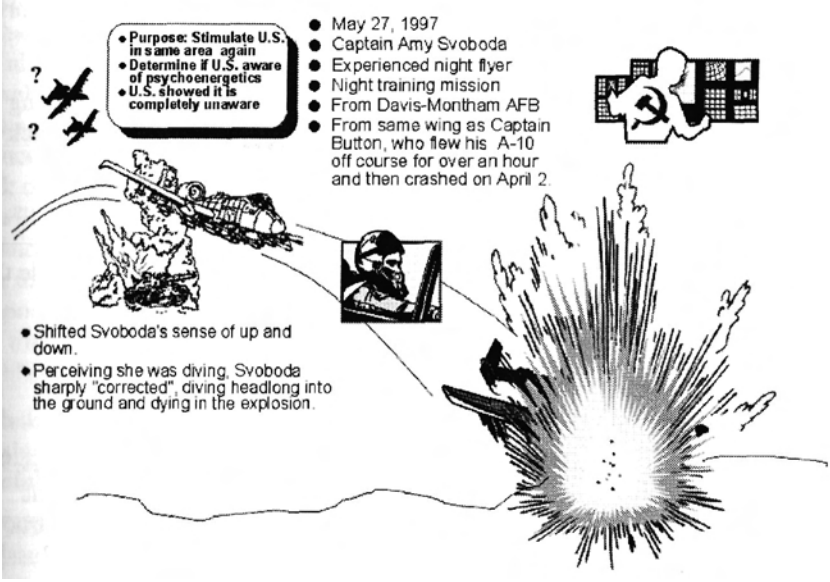

Figure 24 Climbing out of low-level ordnance delivery, Captain Svoboda suddenly dives headlong to her death on 27 May 1997.

Svoboda's kill demonstrated a *tactical destruction* usage, whereas Button's test demonstrated a *strategic* hostile usage of the adversary's defending weapons crew to take action against the adversary's defending strategic weapons system. A new KGB strategic energetics attack against the United States—using the mind control (psychoenergetics) weaponry to take over the operators of the little nation's QP weapon sites and stand the sites back down for maintenance—was rescheduled apparently for latter 1997 to mid-1998 or so. It appears that the extensive preparations for that attack were totally destroyed clandestinely and very suddenly by the friendly little nation some time after we warned them, as we mentioned above.

However, still another Russian counter—the development of "weaponized engines" (functioning causal system robot weapons, "infolded electromagnetic" in form) consisting of organized and functioning systems of spacetime curvatures operating in and traveling through EM fields, potentials, waves, and

signals—came on line (Figure 10, Figure 18). The KGB simply altered the attack plan for a Millennium Strike and completed the forward deployment of these eerie new CSR systems by introducing millions of them directly throughout U.S. facilities, command centers, weapon systems, power grids, ships, aircraft, submarines, missiles, nuclear warheads, computers, communications systems, etc.

We estimate that several million such systems were introduced in that manner, and readied for the Millennium Strike. The United States and its allies were and are almost totally unprepared for this dramatically new kind of strategic warfare that has been developed and deployed against us. No such weapons have previously existed in history. Consequently our national survival and the survival of our allies was once again at stake—and right on schedule during the critical period from mid-1999 through mid-2000 that we had predicted back in 1997.

The die-hard elements of the KGB indeed had a new millennium gift for us, but it was not at all the kind of gift we would appreciate. The KGB is not a monolith! This plot apparently did not include Putin, and it did not include the rest of the KGB, particularly that element reporting to Putin.

Live Destructive Tests Over and Near the U.S. Have Continued

Without elaboration, we believe that the Learjet crash incident and the EA-990 crash incident may have been very sophisticated tests of these new robotic causal EM systems. We also believe that the long years of Russian construction of over a thousand mysterious underground facilities, even though the Russian economy was collapsed and the citizens and soldiers were destitute, is significant. Those facilities apparently contain the set of command and control systems for this vast new strategic weapon system.

The facilities also include the "factories" where the CSRs are made, because the factories are unlike any other factories ever conceived. They do not build "physical" systems, but something more like "software." Only now the "software program" itself is an independent robotic system, with a full set of weapon systems functions, and capable of independent navigation and functioning anywhere, while remaining under KGB command and control via longitudinal EM wave communications infolded inside the potentials of earth, ocean, and space. The facilities also contain the operational forces, headquarters, and communication and control systems that maintain, deploy, and employ (fight) these CSR systems, and direct the battle.

The purpose of the 1998 document we sent to DoD—which did not include the causal robot system armadas later deployed throughout everything in the West—was to inform selected members of the Senate and Congress of the energetics threat situation and summarize it for them. Accordingly, we presented the

background of the development and testing of the KGB energetics weapons since WW II, in some detail, for selected Legislators and their staffs. We also included some specifics on the failure of the U.S. scientific community to keep American science and technology abreast of that of our adversaries.

The Scientific Basis For Energetics Weapons Is Established

As pointed out above, the scientific basis for our early use of Soviet scalar EM interferometry is now rigorously established by work accomplished by the Alpha Foundation's Institute of Advanced Study. It is also rather "old hat" now that all major weapons labs have discovered longitudinal EM waves and are actively working on and with them. The Director of the AIAS, Dr. Myron Evans, is an eminent scientist and theoretician with over 600 papers in the hard science literature. He and his colleagues also have had zero funding for their work on the higher group symmetry electrodynamics necessary to understand such things as energetics. A combination of non-Abelian electrodynamics, advanced gauge field theory, and the impact of E. T. Whittaker's work shortly after the turn of the century has shown that scalar interferometry is real, and that weapons based on scalar interferometry can be a potent threat on the battlefield. The time-like (time-energy) basis for electrodynamics is now clearly established.

With this important new work, we are now only some 40 years behind the Russian weapons scientists! But we are beginning to close the gap—and hopefully that will be done very rapidly.

In 1999 after being personally attacked by a CSR, I again contacted the office of the leader of the friendly small nation and again furnished all the information we possess on the new CSR systems programmed by the KGB as a countering method against the small nation's QP weapons. The outcome was that the little nation destroyed the CSRs in time, as we stated above. We were lucky that (i) the KGB did attack me with one of the weapons, deliberately to "get my strong and immediate attention", and (ii) deliberately did not kill me with the strike. Otherwise, there would have been no warning to the little nation, and the U.S. and its allies would have experienced a "Y2K" problem worse than their wildest fears, possibly collapsing the economy of the United States and much of the developed world.

Our Situation Here In the U.S. Is Precarious

Meanwhile, our own scientific community apparently does little or nothing in these areas, except to castigate, slander and libel anyone daring to suggest that such "out of the box" weapons areas even exist. E.g., there does not appear to be

a single U.S. scientist who knows how to create a *time-polarized* EM wave.[13] There do not seem to be any concerted programs to deal with t-polarized photons and t-polarized EM waves. Our scientists still firmly believe that one has to propagate spatial EM field energy through space to affect a target electromagnetically, when that was obsoleted by Russian "subspace EM longitudinal wave propagation" weapon systems deployed as early as 1963, and was completely obsoleted by deployment of quantum potential weapons in 1989.

Yet a close colleague of the present author has single-handedly developed and demonstrated prototype superluminal communication systems using the infolded (longitudinal EM wave) electrodynamics, and these systems would have been heading onto the market in latter 2001 except for the sudden bankrupting of the major backing company. There has not been any funding forthcoming for his revolutionary work, but only clumsy attempts to take it from him. It is my fear that the further clumsy takeover attempts will be successful, and this desperately needed technology will never see the light of day in defense of our nation. As a single example without further discussion, his work revolutionizes the present notions used in the rapid development of quantum communication and quantum computing, because it revolutionizes the very notion of the Q-bit, completely removing the statistics of the quantum state and making it engineerable. This of course is completely counter to present QM notions, but is consistent with the Bohm hidden variable approach to quantum mechanics.

Meanwhile, our own weapon scientists apparently still do not recognize the possibility of a superluminal longitudinal EM wave communication system, and appear to have no motivation or intention to develop such. This is in a way quite sad; quantum tunneling at more than four times the speed of light, of a clearly recognizable Mozart symphony, has already been demonstrated in a section of a waveguide {56}. Whatever one wishes to call it and however one wishes to do it, superluminal communication of intelligible signals has been clearly demonstrated in the laboratory. For the "infolded" longitudinal EM waves, all the "normal" or "envelope" EM waves, potentials, and fields are just great *superwaveguides* for such longitudinal EM wave "tunneling through subspace" at superluminal speeds.

[13] Keeping one's sense of humor, apparently there has also not been a U.S. scientist who even recognized and knew what actually powered an electrical circuit, until our solution to the source charge problem and publication of it in 1998. Eerily, even after the technical basis for a solution had been proven in particle physics in 1957, no one seemed to have applied the broken symmetry of opposite charges to the common dipole and to a dipolarity such as a scalar potential and a charge (with its associated virtual charges of opposite sign, in the modern view). Everyone accepted that the fields and potentials and their energy are established by their associated source charges, but no one had stated that the source charge receives its input energy from its asymmetry in its seething energy exchange with the active vacuum.

The Dominant Weapons Are Quantum Potential Weapons

Full-bore deployment of Russian quantum potential weapons occurred by the end of 1989, the first lab prototype weapon having been tested in April 1986 against the U.S. air attack on Libya (Figure 25). Beside Russia, two other nations—Brazil and the "little friendly nation"—also had developed quantum potential {57} weapons. The United States did not develop them, or at least apparently not just yet.

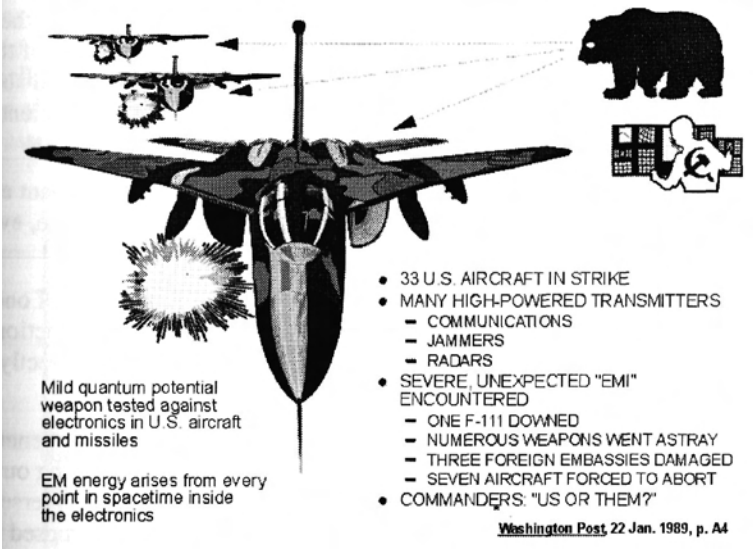

Figure 25 U.S. air strike on Libya, April 1986.

Burlier this year (2002), China also deployed QP weapons, and we now find that an*other friendly* nation has them as well. That brings the total to five, as of this writing. Two of those are friendly, and a third is astraddle of the fence, so to speak. The other two are Russia (the KGB) and China.

At this point China could go either way, so it represents a future enigma. China **has** control of the Panama Canal, and has inserted more than 200,000 Chinese into Panama—which is on the way to gradually becoming a Chinese territory, as soon as the Chinese in Panama outnumber the native Panamanians. In addition, under the Clinton administration China gained access through two U.S. ports (with little checking, so anything can easily be inserted). China also has a**dditional** ports in the Western hemisphere. China is almost certain to eventually attack and seize Taiwan, which puts her on a collision course with the U.S., si**nce** the U.S. has an agreement to defend Taiwan. She has also declared the South China Sea—through which passes some 60% of the oil bound for Japan, a**nd** much oil for other nations also—to be Chinese territorial waters. China also has developed bioenergetics weapons, having long ago induced cancer into most

of the GRU Russian representatives then serving in China. She almost certainly has or is rapidly working to develop psychoenergetics weapons as well.

So far as I am aware, there still exists not a single funded U.S. scientific program to directly correct the glaring errors in our own classical electrodynamics—such as those problems deplored by Nobelist Feynman and Wheeler {58,59,60}. Both knew that the force field concept in space was erroneous. As they put it, only the "potential" for the force field exists in space, in case some charged mass is available there for interaction. But the field itself is created by the interaction and is the effect of it. It does not exist before the interaction occurs. Yet all our texts continue to teach the disinformation of the "field in space." And our science community continues to fiercely defend such dogma, attacking and sometimes destroying the careers of those brave scientists who do try to change it.

One notes that time is multiply-connected, since in theory the same instant exists at every point in the universe. Or said another way, in any instant in time, every point in the universe simultaneously exists.

Operating in the time-domain as a causal system, and then turning out of one point there into any point in 3-space desired, is a means of producing "action at a distance" that obsoletes our old concept of transmitting the energy directly through space {61}.

Presently the U.S. scientific community has little predisposition toward energy turning into the time-domain, operating in the time-domain, then turning out of the time-domain into any desired point in 3-space, anywhere in the universe.[14] Every 3-space point in the universe simultaneously exists in (is superposed in) each point in time, as those points in time occur. In one sense, time can be considered to be the total multiple connectedness of space! We suspect that it may even be possible to interpret "instantaneous" communication—as by a quantum potential—in that "in here-out there" instantaneous fashion via "tunneling through the multiple connection of the time channel".

Finally, mass—being an observable and 3-spatial—does not exist in time. Mass continually turns into masstime (by photon absorption), then masstime turns back into mass (by photon emission). Masstime exists in time, but mass does not. U.S. scientists also seem unaware that the so-called "rate of flow of a mass through time" is generated by the sum total of all photon interactions (both virtual and observable) with that mass. The ubiquitous interaction of a mass with photons also causes that mass to continually recur, and thus to seemingly "continuously exist." It is continually observed, but it does not continuously

[14] If one models the time domain in three dimensions instead of one, e.g., then in theory it becomes possible to "flip" a 3-dimensional mass object into the time 3-domain at a single "moment," then rotate from that "time 3-point" back into 3-space at a new 3-space location anywhere in the universe. Hence the "beam 'em up Scotty!" of the old Star Trek (and the more modern beaming version) may hold more of a promise than just for science fiction entertainment.

exist! Since the photon interaction is engineerable, then it follows that a specific muss can be time-reversed back to an earlier state {62}.

Cellular Time Reversal: Revolutionary Healing by a Team of French Scientists

Priore and eminent French scientists {39,40} unwittingly used the mechanism for time-reversing a mass and every part of it, to time-reverse diseased and damaged cells, including tumor cells, physically changing them back to their previous healthy physical state and condition in vivo. This included all parts of **the** cell, including its genetics. The Priore team demonstrated revolutionary cu**res** of terminal tumors, infectious diseases, atheriosclerosis, and restored depressed immune systems.

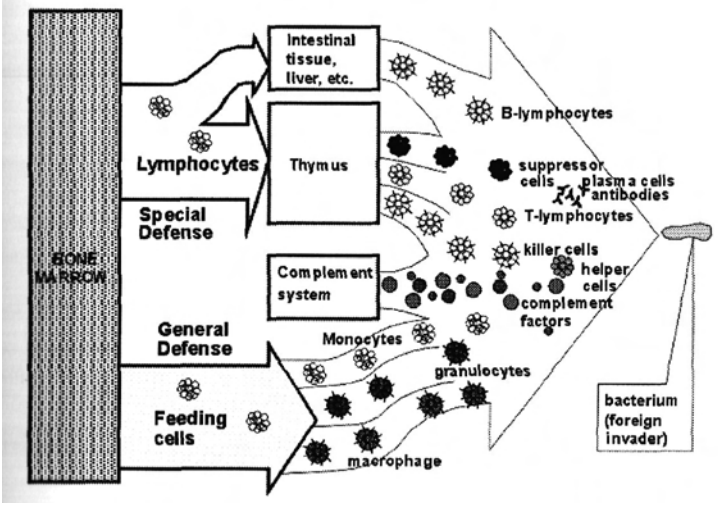

Figure 26 Simplified diagram of the immune system.

The immune system (Figure 26) *heals nothing, not even its own damaged cells.* The human cellular regenerative system {63} is responsible for all *healing* in the body—and it utilizes time reversal of the damaged cells as the active healing mechanism. The regenerative system (Figures 27, 28, 29) pumps the damaged cells with longitudinal EM waves (and therefore with time-polarized EM waves, which always accompany longitudinal EM waves), inducing the cells and all their parts to add the phase conjugates, thereby forming time-polarized EM waves and pumping in the time-domain rather than the 3-space domain. This dramatically extends nonlinear optics to the time domain, and mass pumped in that fashion is time-reversed (propagated back along its own time-track, to a previous physical condition.

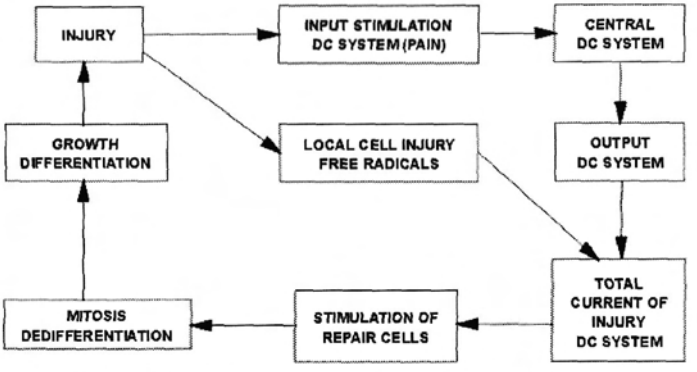

Note: Becker only had conventional EM available, hence was unable to model the inner structuring and inner dynamics of the fields and potentials. *So he missed the deeper "engine and antiengine" mechanisms.*

*Robert O. Becker, "The significance of bioelectrical potentials," Bioelectrochemistry and Bioenergetics, Vol. 1, 1974, p. 191.

Figure 27 Becker's theoretical control system involved with response to injury.

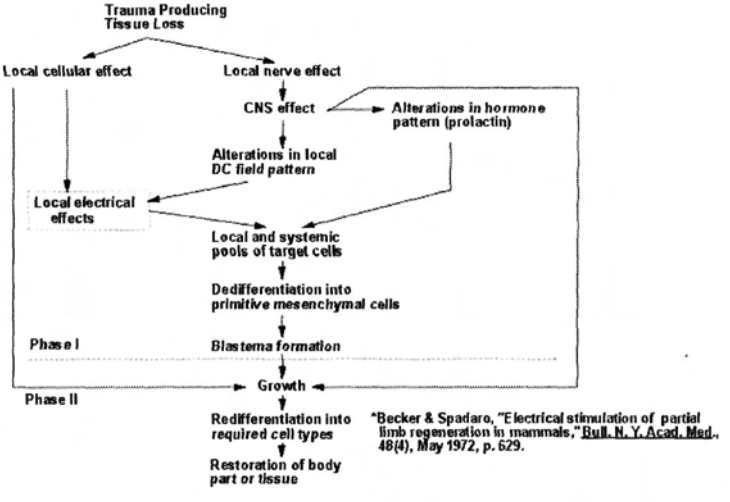

*Becker & Spadaro, "Electrical stimulation of partial limb regeneration in mammals," Bull. N. Y. Acad. Med., 48(4), May 1972, p. 629.

Figure 28 Becker's proposed control system governing regeneration.

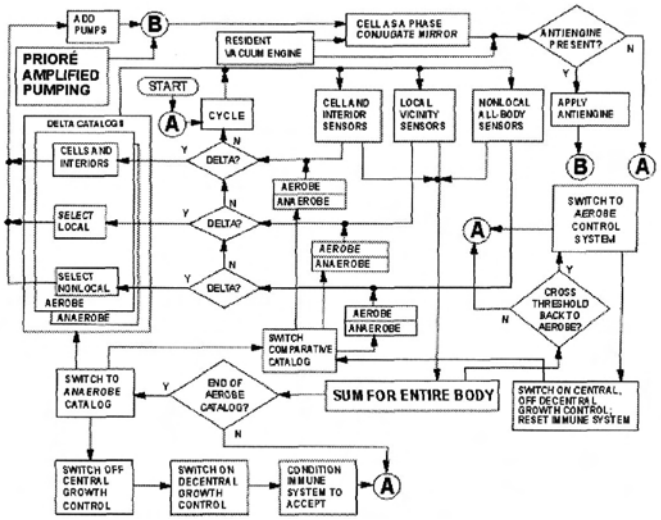

Figure 29 Author's deeper block diagram of the cellular regeneration system.

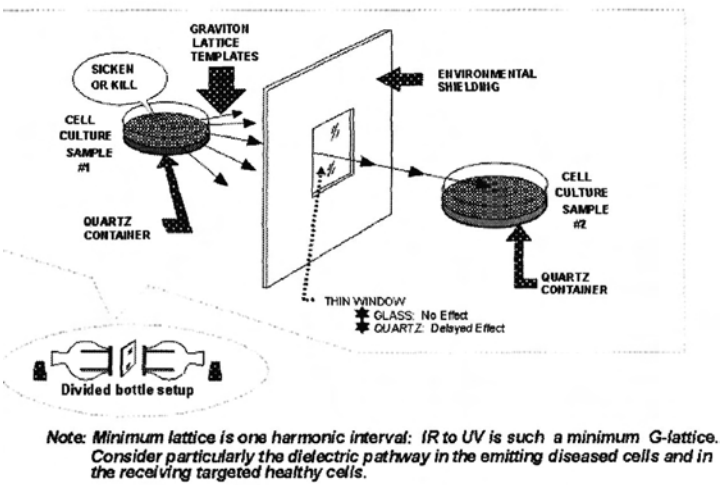

Figure 30 Kaznacheyev's electromagnetic induction of cellular disease and disorder.

Kaznacheyev has shown that essentially any cellular disease or disorder can be electromagnetically induced in cells at a distance (Figure 30). Together with Becker's work, this shows that the cells can be altered either detrimentally (disease induction) or beneficially (disease elimination) by purely **electromagnetic** means. It would seem that diseases such as AIDS, e.g., could be **rather** dramatically cured by use of whole-body longitudinal EM wave radiation

(with its simultaneously time-polarized EM wave radiation), as was done for other diseases by the Priore team and properly reported in the French scientific literature. We have also uncovered a process and method for causing the body to directly produce the time-polarized EM wave pumping, reducing the irradiation to perhaps 30 seconds of pumping instead of two or three hours {64}.

Becker's Study of the Cellular Regeneration System

In all our medical science, the only true healing procedures being utilized appear to be the use of Becker *et al.'s* tiny EM stimulation across otherwise intractable bone fractures {65} (Figure 31), to dedifferentiate (time-reverse) red blood cells, then redifferentiate (time-forward) them again twice to form osteoblasts, which are deposited in the fracture site to make new bone growth. All the other medical procedures seem to be *interventions,* not *healing.* After the intervention—which of course may be urgently necessary—it is then up to the body to heal itself (restore its cellular and tissue damage and functioning). So we have little *healing* science today, and in fact our medical establishment hardly funds any *healing* studies at all. EM radiation is usually considered as something that simply heats tissue. Our present medical science is deeply engrossed in studying the immune system. Again, the immune system heals nothing, not even its own damaged cells.

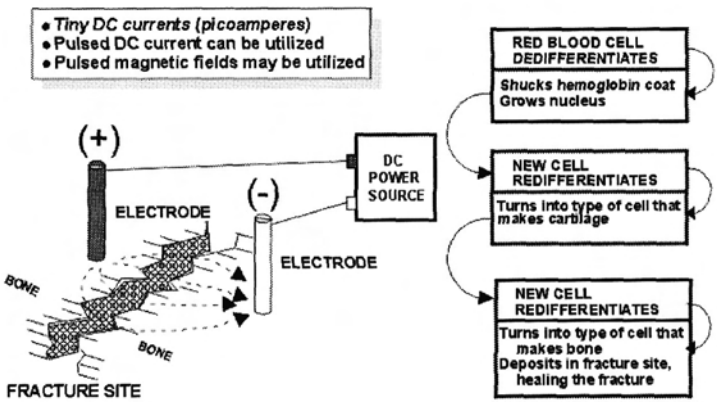

Figure 31 Becker's epochal bone fracture healing.

After the immune system "kills the bad guys" and saves the day, the battlefield is littered with residue and many cells of the body are damaged. The immune system sends in large scavenger cells that clean up the residue. And that's it for the immune system. Comparing it to an army's operation in the field, the immune system is the combat troops, not the medical services.

Restoration (healing) of the damaged cells back to normal is accomplished by

the *cellular regeneration* system (Figure 29). This system is little known and little studied, but mostly studied by Becker (Figures 27, 28). It is a system that functions electrodynamically, but uses time-domain pumping to time-reverse the cells and their every part (including their genetics) back to an earlier state. In biology, the effect is called *dedifferentiation,* but without any knowledge of the actual EM mechanism.

So, within its capabilities, the cellular regenerative system in the body already uses longitudinally polarized EM waves, time-polarized EM waves (TPWs), and optical pumping by LWs and TPWs. Here we point out that neither the longitudinal photon nor the scalar (time-polarized) photon is individually observable; however, the combination of the two is observed as the instantaneous scalar potential {66}. With a little correction to properly make the phase conjugate replica wave a time-polarized EM wave, Whittaker's fundamental bidirectional EM longitudinal wave decomposition of the scalar potential (Figure 32) is consistent. Immediately the direct involvement of both the scalar photon and the longitudinal photon—and both the scalar EM wave and the longitudinal EM wave—are seen in Becker's bone-healing work using a scalar potential (Figure 31).

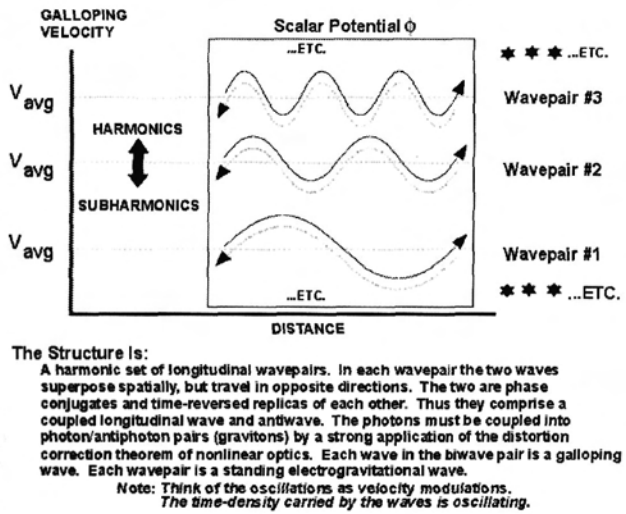

Figure 32 Infolded longitudinal EM biwaves composition of a scalar potential, per Whittaker 1903.

Priore unwittingly stumbled onto the actual mechanism used by all biological systems in "healing" (cellular regeneration), and also recognized how to amplify it (Figure 12). But no one understood its exact nature, including Priore and the scientists who worked with him at the time, and the conventional community still does not understand it. The Russian scientists not only *understood* it early

on, but *weaponized* it as well. So did the Chinese.

Need to Correct and Extend Classical Electrodynamics

The organized scientific community's protracted defense of a seriously flawed classical electrodynamics is long standing. The conventional, comfortable ways of "doing business as usual, leisurely" now threatens the survival of the nation itself. We need to quickly admit and correct long-standing EM errors—such as calculating a reaction cross-section of an entity and calling it the magnitude of the entity itself! Our electrical texts continue to make that fundamental mistake, and they have done it now for 100 years or more. We need to quickly change the classical EM model to include the active vacuum and its interaction, and we need to change all textbooks to clearly state that all EM energy in the universe comes from the active vacuum, via the asymmetry of the source charges in their fierce energy exchange with it.

We also need to point out that all primary electromagnetic entities—the charge, the field, the potential, and every joule of EM energy in the universe—totally violates the second law of thermodynamics. The charge produces continuously increasing negentropy, the field and the potential are formed at expanding light speed across the universe and are perfectly ordered (thereby totally violating the statistical mechanics basis of the second law), and every joule of EM energy is either field energy or potential energy, and hence violates the same statistical basis of the second law.

The Situation Is Serious

Admittedly these are strong statements highly critical of our scientific establishment's track record. But our national survival continues to be increasingly at stake, the situation is serious, and we must not continue to bury our collective heads in the sand like ostriches. We simply cannot continue to idly sit by and pontificate while other groups and nations methodically maneuver technically to cut our collective throats with advanced weapons we cannot defend against, once they find a way to "get by" the little nation that has been countering them for some years. Our own beloved nation may have less than 10 years {67} and perhaps less than three years to survive, unless the organized scientific community is galvanized to focus its very best scientific efforts in the energetics area.

So far, in truly innovative approaches to new methods for electrical energy, the U.S. scientific community is about as energetic as a sand terrapin sleeping in the tropical sun. There is no discernible move to recognize the seriousness of the problem, or to do anything effective about it. In 45 years, the asymmetry of the dipole (and the charge in its modern view as a dipolarity of special kind) has not made it across the university campus from the particle physics department to the electrical engineering department. In fact, the implication of broken symmetry to

electrical engineering and classical electrodynamics seems to still be completely unnoticed by the National Academy of Sciences, the National Science Foundation, our universities, and our great national laboratories. In the scientific community, other than work on vaccines etc., it is largely "business as usual."

A New Manhattan Project Is Warranted

Our need in the energetics weapons area is extreme, as are our needs in the medical area for quick, cheap, easy, and effective portable treatment of the coming mass casualties and our coming dramatic needs in energy. We *do* have superb scientists with the horsepower necessary to do something about it. The astounding, independent work of Sachs, the AIAS, and a few other scientists—which we stress has been unfunded—already clearly proves that. But unless we change the organized scientific community's normal rather snail-like pace—by a strong measure such as a Presidential Decision Directive and a declaration of a Nalional Emergency—the U.S. scientific community will overshoot the point of no return now approaching.

We need a new Manhattan-type project. We need it very quickly. If we do not change and focus our present scientific procedure, then—all too shortly—little that the scientific and intelligence communities are doing will be of value. We shall all be very, very dead or else in a new Dark Ages where most of the world economy has collapsed and freedom has largely disappeared from the face of the Earth.

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Director, Assoc. of Distinguished American Scientists

2002 ENERGETICS WEAPONS THREAT TO THE U.S.

T. E. Bearden 2000
Updated Oct. 1,2002

The U.S. Narrowly Escaped Energetics Destruction Twice in 1997

On two occasions in 1997 (latter February and on May Day), we were scheduled In be strategically attacked without warning and completely destroyed. Eerily, in public statements the leader of the Aum Shinrikyo sect (Figure 33) had foreshadowed the dates for the planned attacks, since his group was also involved—in fact, shooting down the TWA-800 (Figure 34) as advanced practice and stimulation of the U.S. to see if it knew what was afoot. Those two planned strategic strikes in 1997 were avoided only in the nick of time by ac**tions** of a friendly little foreign country, which was the only nation on earth at the time that could counter the KGB quantum potential (QP) weapons. I am sure that proper U.S. agencies intercepted my urgent personal faxes to the Defense Attache in Washington, DC and directly to the Prime Minister of the nation involved. Actions by that nation did succeed in averting our destruction in the nick of time.

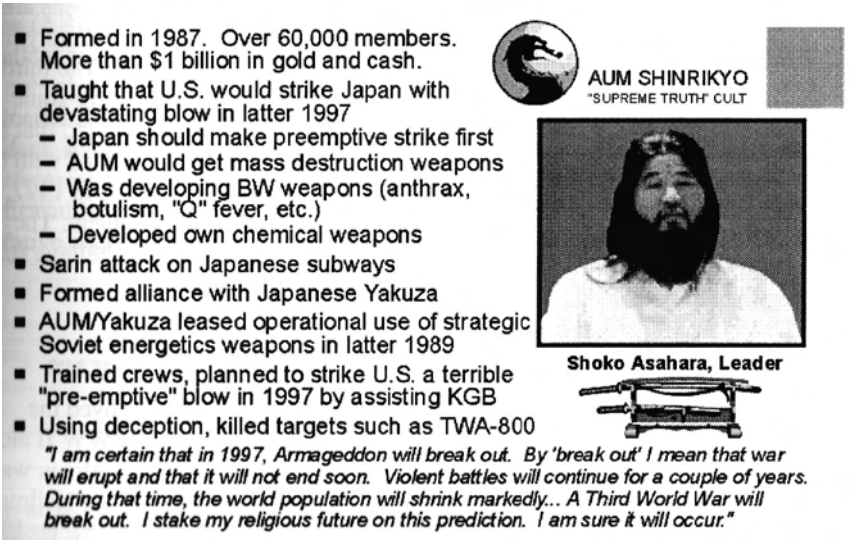

Figure 33 Planned KGB/Yakuza/Aum Shinrikyo attack in 1997 was foreshadowed in public statements made by Shoko Asahara.

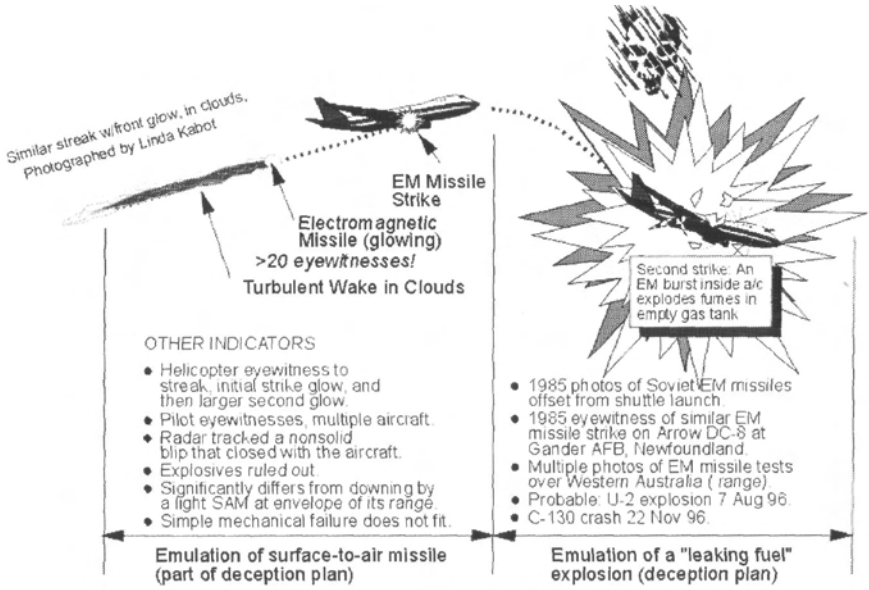

Figure 34 Kill of TWA Flight 800 on 17 July 1996 by Yakuza and Aum Shinrikyo.

Only five nations or national groups have quantum potential (QP) weapons, though one or more additional nations are almost certainly working on them and may even have them. First of the five is the KGB in Russia (the weapons are not in the regular Russian forces, and never have been). Second is the friendly little foreign country to whom we presently owe our continued survival. The third is Brazil (which has had a small and successful QP weapon program for some time). China deployed QP weapons in early 2002, and I recently found that at least one other friendly nation has them as well. I'm not too impressed with that other friendly nation, since they played no role in saving our bacon in 1997. It appears they did not actually know the coming attacks were imminent. They certainly do not have Causal System Robot weapons, nor do they believe such weapons even exist.

Initiation of the Brazilian Energetics Weapon Program

Brazil implemented an energetics weapons program after it employed the repatriated Dr. Hellman, a German scientist taken to Russia after WW II along with the German radar team. Years after being taken to Russia, Hellman was repatriated and made his way back to Germany. In a news interview Hellman reported that he had worked directly on the development of Soviet secret EM weapons which could suddenly free/.e large areas of the ocean surface. That of

course is a scalar interferometry weapon, producing negative (converging) EM energy rather than positive (diverging) EM energy in their distant interference zones.

Also, when the U.S. made David Bohm *persona non grata* in the McCarthy witch-hunts, Bohm was later employed in lecturing and teaching in Brazil for some time. At the time our own scientists continued to pontificate as to whether they *liked* or could *tolerate* Bohm's quantum potential and his hidden variable interpretation of quantum mechanics {3}. Meanwhile, the KGB weapon scientists and the Brazilian Hellman project seized upon Bohm's hidden variable theory with alacrity as soon as he published his seminal paper. Those two weapon groups were already familiar with the internal longitudinal EM wave structuring of potentials, fields, and waves (Whittaker 1903), and immediately saw the fantastic weapons implications of a deliberately structured quantum potential, containing a specific "engine" as desired. Most of our scientists still are unaware of it to this day, and are unaware of its formidable weapon implications when combined with Whittaker's 1904 superpotential paper, his 1903 potential decomposition, and quantum field theory. Most of our scientists still adhere to the Bohr interpretation of QM, which excludes the normal, everyday, observable, ordered universe we all inhabit and observe.[15]

The Bohm quantum potential is, after all, a scalar potential, and at least in theory it has a Whittaker biwave decomposition {68}. Even in the Coulomb gauge, the scalar potential has infinite velocity, as pointed out by Jackson.[16]

Several tests of the "cold explosion" Russian weapons referred to by Hellman have since been openly made. One major test seen by at least five jetliner crews was the anomalous rapidly rising cloud and subsequent extremely huge light globe (ABM energy shield) effects off the Kurils in April 1984 (Figure 35). Two excellent scientific articles on the physical phenomena observed in that incident are published in the prestigious journal *Science* {69}. We had explained the cold explosion phenomena and the ABM energy shield effects some years before that incident. Even ordinary superpotential theory {70} and longitudinal EM wave interferometry at a distance can substantiate the capability. We also positively confirmed by private sources that the scalar interferometry, the MindSnapper (negative energy EMP), and the cold explosion weaponry are real.

[15]This exclusion is euphemistically known as the "missing chaos" problem in quantum mechanics, and it is resolved in Bohm's hidden variable approach.
[16]J.D Jackson, *Classical Electrodynamics*, 2nd Edn., John Wiley & Sons, New York, 1975, p. 222, 223. Usually the instantaneous scalar potential contributes only to the near field.

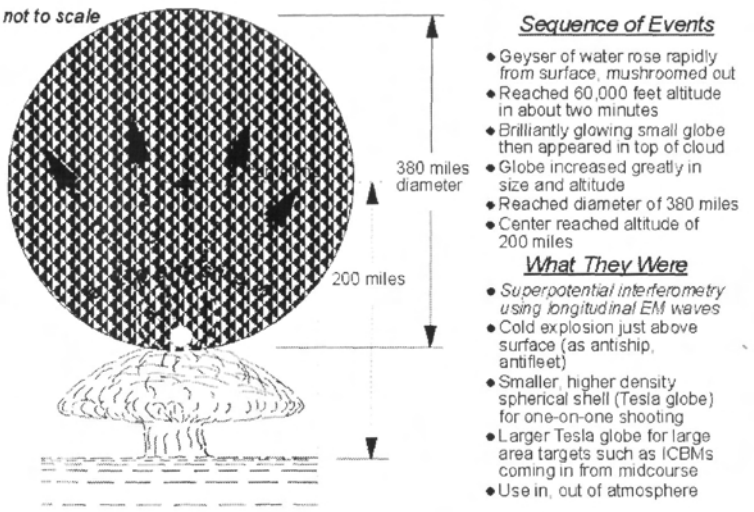

Figure 35 Exothermic (cold) explosion off the Kurils 9 April 1984. A second test, an expanding globe of light, was added in the exothermic mode to demonstrate rapid serial switching between weapon modes.

Related Phenomena

In 1969 in Toronto, Canada, Sid Hurwich demonstrated a device capable of "freezing" a pistol lying on a table so that the gun could physically not be moved and the trigger could not be pulled {71}. For this exhibition of *strong electrogravitation*, general relativistic fields initiated by the EM force field (including the usually unaccounted Heaviside nondiverged component that Lorentz arbitrarily discarded) as the agent of spacetime curvature were used {72}. The strength of the effect was attested by the fact that the hands of the observers' watches all showed "no passage of time" during the half hour they were in the room with Hurwich's device operating.[17]

Rapid development of that strong electrogravitational technology and concomitant energetics then proceeded in another nation. Weapons of such nature were then employed by that nation a few years later, in two well-known international incidents. Clear signatures of the nature of the weaponry utilized were present in those incidents. Details of these incidents will not be included in this paper.

[17] We point out that this is highly interesting itself, since it showed that the observers were operating in a different frame from that of the watches and the gun, which were "frozen". We also point out that recently light itself has been "stopped" in quantum experiments, yielding something quite similar.

Since the energetics weaponry already utilized special EM "hidden variables," Bohm's hidden variable theory and quantum potential were directly adapted into the program to dramatically extend it into the development of quantum potential weapons.

Stalin *Personally* Initiated the Soviet Energetics Program with the Greatest Urgency

While Stalin was at the Potsdam conference, at the close of WWII, the U.S. exploded the first atomic bomb in the desert. Truman informed Stalin in general terms that a powerful new U.S. weapon had been successfully tested. Secretly, Stalin already knew of our atomic bomb progress, for he had a spy in the program. While he was still at Potsdam, he then secretly called the Director of the Soviet atomic weapons program and directed a speed-up.

After we exploded two atomic bombs on Japan, the Japanese surrendered and WWII was over. See again Figure 1. Stalin vehemently ordered his Academy of Sciences to produce the next great technical breakthrough at all possible speed, since the American atomic bomb had frustrated his plan to wait two years after the war while the West speedily disarmed, then march into Europe and take it in six weeks. Now his massed troops could just be bombed back into the Stone Age by U.S. bombers using atomic bombs.

A Great Technical Breakthrough in Physics Can Always be Had in Four Years

The scientific community can have a great new technical breakthrough whenever its furious and dogmatic resistance to innovative discoveries or the possibility of innovative developments can be suspended. All that is necessary is a concentrated group of highly skilled, open-minded scientists, the money and facillities, and a strong headlock placed on the powerful but dogmatic scientific groups who would otherwise hamstring the program and destroy it.[18]

[18] Present day examples are (i) the cold fusion fiasco, where the U.S. scientific community has revealed furious determination to ignore more than 600 successful experiments worldwide, (ii) a similar fury against any and all research into extracting EM energy from the vacuum, even though all EM energy comes directly from the active vacuum via the proven asymmetry of source charges and dipoles, (iii) violent suppression of proven "extended electrodynamics" methods of rapidly curing severe diseases, even in terminal stage (resistance to anything except "cut, drug, burn" and anything that would interfere with the monstrous profits of the large pharmaceuticals), (iv) continuing dedication to an electrical engineering model that does not even model or apply what powers an electrical circuit, (v) continuing resistance to quantum potential research and development, (vi) slavish dedication to "big nuclear science", massive accelerators, dangerous nuclear power plants, and a "hot fusion WPA program", even though much higher energy physics than these programs advocate and use can be and is being done on the tabletop, using time-energy instead of spatial energy, and (vii) increasing "lock-up" of all research funds into the organized hierarchy's politically approved agenda. The community has deviated so far from scientific

We proved it in the WWII Manhattan Project, where we went from nearly zilch to the operational atomic bomb in 4 years. But we did it only by secretly bypassing the conventional U.S. scientific establishment. Einstein wrote to President Roosevelt *around* the scientific community, and when the President approved and ordered the highly classified program, conventional scientists not on the project were just parked on the sideline and ignored so that the job could be completed. The naysayers were also muzzled because of the extreme classification of the project; they faced jail if they engaged in their usual ad hominem attacks and dogmatic eloquence.

Further, today the "Skunk Works" approach repeatedly proves that bold new projects can be done, when the skilled scientists and facilities are mobilized and no adamant opposition by the conventional community is tolerated.

Numerous examples of the U.S. scientific community's suppression of innovation and new technology can easily be furnished. Such are well known to any historian of science. Cold fusion, the amorphous semiconductor by Ovshinsky, the first laser papers, ultrawideband radar, Mayer's original conservation of energy law, Boltzmann's work, Wegener's continental drift, flight of heavier-than-air machines, the rocket as a great strategic weapon, and hundreds of other examples come readily to mind. Such suppression has been *the* major characteristic of the organized scientific community since its inception, as pointed out by numerous leading scientists and authors. As Planck stated, usually one gets a new physics only after the old physicists who so adamantly oppose it just die off and get out of the way.

Today, the U.S. scientific community is in fact our "front line troops," although—except for a little lip service—the managers of the organized scientific community are blissfully unaware of it and have little or no sense of mission in out-of-the-box areas with respect to national survival. It is ironical, e.g., that our orthodox scientific community does not even know what powers an EM circuit—energy extracted directly from the vacuum by the asymmetry of the source charge (considered in its modern view as a dipolarity) and by the source

method in defending archaic theory in the face of experiments that falsify it, that the ubiquitous violation of the law of increasing entropy (second law of thermodynamics) by electrodynamics itself continues to be adamantly resisted using ad hominem and inflammatory attacks, slander and libel, and destruction of scientific careers of researchers. We flatly are not getting our taxpayer money's worth from our present scientific community, and—barring a Stalin-like shakeup from top to bottom—we are not going to get our money's worth in the future unless the community is forced to free up funds for young graduate students and postdoctoral scientists wishing to work in "out of the box" scientific areas. As Max Planck stated, *"An important scientific innovation rarely makes its way by gradually winning over and converting its opponents: it rarely happens that Saul becomes Paul. What does happen is that its opponents gradually die out, and that the growing generation is familiarized with the ideas from the beginning."* In other words, one doesn't get a scientific innovation until the old dogs so bitterly opposing it just die off and get out of the way. This long-known and stated characteristic of the scientific community—its fierce and unrelenting resistance to change and innovation—is presently the greatest threat to the survival of this nation.

dipole (Figure 36).

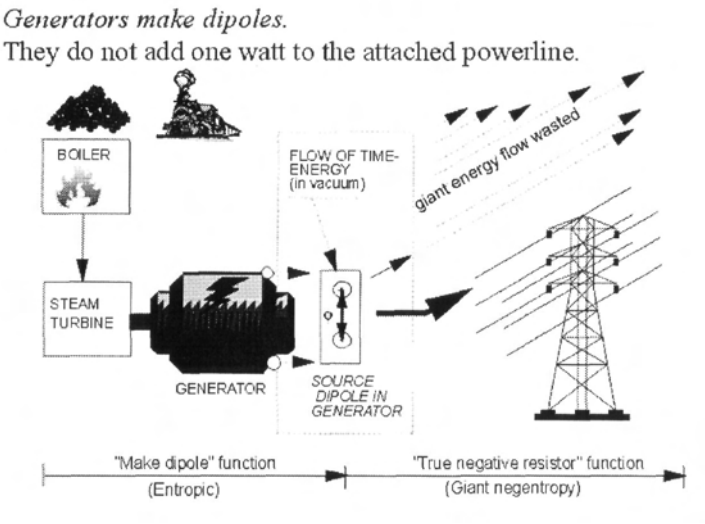

Figure 36 Energy extracted from the vacuum by the asymmetry of the source dipole powers every electric power line and electric circuit.

A Typical Example: The Suppression of Cold Fusion

As an example, much of U.S. Science—dominated by nuclear factions since the adventof the atomic bomb in WWII—vehemently attacked cold fusion and the **cold** fusion researchers, including wholesale ad hominem attacks, with a viciousness seldom seen in the history of science. Many dogmatic scientists declared the entire field at best a mistake and at worst a fraud. Even the character of many of the leading cold fusion scientists was openly impugned and the researchers were slandered and libeled. All this was done by conventional dogmaticscientists who have not solved the fundamental source charge problem {10,12}, have no inkling that all EM energy in 3-space comes from the time-domain {10}, and have not a clue as to what really powers every EM circuit. Since they also do not know where the electrical energy driving the chemistry actually comes from, they have no knowledge of the effects of time-energy in electrolyte solutions.

They also appear to have little or no knowledge of the implications of Evans' and Searles' *transient fluctuation theorem*[19] in thermodynamics showing to what degree the second law of thermodynamics can be violated and reactions can run

[19]D.J. Evans and D. J. Searles, *Phys. Rev. E,* Vol. *50,* 1994. p. 1645.

in reverse, nor its extension to the micron (colloidal) size level and to two seconds in duration.[20] If they did, then they would realize that the Coulomb barrier provided by *repulsion* of like charges (such as two H+ ions), often reverses into the *attraction* of like charges, with the barrier changing into the Coulomb attractor. This can last (by experimental proof shown by Evans *et al.)* up to two seconds, in a volume of fluid up to a micron in diameter. Hence it is not "against the laws of physics and thermodynamics" to observe attraction of two protons in an electrolyte so closely that each enters the strong force region of the other and the two form a quasi-nucleus. In the decay of this reversal zone, the preferred decay of the quasi-nucleus can be by quark flipping in one of the protons, yielding an atom of deuterium emerging from the decayed time reversal zone. Such results have been meticulously observed in many cold fusion experiments in multiple labs and nations, and by multiple researchers. Since these and other novel nuclear transmutation results are *replicated* experiments (more than 600, in multiple labs, multiple nations, and by multiple researchers), it means that no amount of theory can refute them or the results. The harsh skeptics launching the frenzied ad hominem attacks are thus revealed as the unscientific bigots they are, since they ignore substantial experimental results that contradict the prevailing theory. The excess energy production and inexplicable new nuclides (Figures 21, 37, 38) obtained by these multiple experimenters are completely inexplicable by ordinary nuclear interactions in the accepted theory.

- Fennions time-reverse in even numbers
- Like charges cluster
- Aqueous solutions contain H+ ions,
  which are just protons
- Quarks flip as TR zone fades

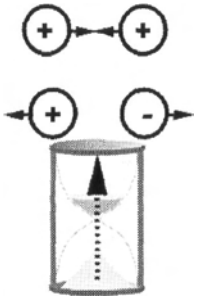

$$({}_1H_1 + {}_1H_1) \rightarrow ({}_0n_1 + {}_1H_1) = {}_1H_2 \text{ deuterium}$$

Figure 37 Electronuclear reaction in a time-reversed zone producing excess deuterium ions.

[20] G. M. Wang, E. M. Sevick, Emil Mittag, Debra J. Searles, and Denis J. Evans, "Experimental Demonstration of Violations of the Second Law of Thermodynamics for Small Systems and Short Time Scales," *Phys. Rev. Lett.,* 89(5), 29 July 2002, 050601.

- As TR zone decays, quasi-nucleus is usually in an excited state
  - — Decay action starts from every point in spacetime inside the nucleons
  - — Moves from inside toward outside
  - — Strikes the nearly free quarks first
- Decay occurs by easy quark flip
- Quasi-nucleus transmutes to an isobar
- If quasi-nucleus is a stable state in a forward time zone, no decay occurs.

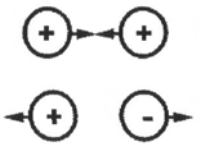

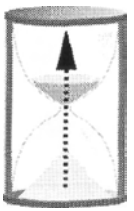

$$_1H_2 + {}_1H_2 \rightarrow {}_2He_4$$

Figure 38 Electronuclear reaction in a time-reversed zone producing excess alpha particles.

Meanwhile, the U.S. Patent Office has been instructed not to accept any patent applications that would interfere with present nuclear planning. Positive cold fusion results have also been successfully obtained in several U.S. government laboratories, including at China Lake where very strange instrumental effects have the experimental team puzzled. I proposed an explanation of those anomalies in August 1998, and have included it in my book just published in September 2002 {73}.

Revolutionary New Processes Are Hidden in the Cold Fusion Experimental Results

Once understood, cold fusion holds the breathtaking key to systems that consume *a tiny fraction of time flow itself* as a fuel to produce copious heat energy for the world's needs. Unknown to the conventional scientists, of course, electrodynamics itself already does this, but it has just not been recognized and accepted. Transducing one microsecond per second of time into transverse wave EM energy will produce some 9×10^{10} watts of real electrical power, if all the transduced EM energy is intercepted and used. This is the *real* way to extract energy from the vacuum and use it cleanly and cheaply.

To grasp such a notion, recall that the fundamental units used in physics are completely arbitrary. It is perfectly possible to express all physics in only a **single** fundamental unit—for example, *the joule*. Time then becomes totally a function of energy. So it is not so insane after all to express time as highly compressed energy. Mass is also highly compressed energy. That concept is now familiar after Einstein, the nuclear age, and $E = mc^2$. Time-as-energy is just as straightforward as mass-as-energy, but it has just not yet come into

recognition.

The *use* of time as compressed energy, however, leads to some profoundly new types of electronuclear reactions presently unknown in particle physics. These new transduction reactions produce the new nuclides in cold fusion experiments, and generate the *electronuclear interaction*. We explain that in some detail in our new book, *Energy from the Vacuum*, previously cited {10}.

When interpreted as using time-energy, cold fusion shows us the way to a new electronuclear regime of nuclear reactions where nuclei, elements, and compounds can just be directly assembled by comparatively weak (in terms of *spatial* energy!) electromagnetic interactions. Presently we have made substantial progress in understanding the fundamental mechanisms generating these electronuclear reactions, after presenting preliminary results in August 1998.

As one example, time-reversing a single fermion (a particle with spin 1/2, 3/2, etc.) is precluded by the Pauli exclusion principle. But one can time reverse *two* of them, or any even number n, where they act as a semi-boson or group of semi-bosons. Simply put, if a time-reversal zone is established momentarily in the region where like charges exist, then the n-tuple fermion cluster can be achieved because the law of attraction and repulsion of charges is temporarily reversed {74,75}. This unexpected "attraction of paired fermions of like sign" will form quasi-nuclei in many cases, particularly in small clusters of two or four, etc.

Hence two H+ hydrogen ions (two protons) in such a time-reversal zone in a fluid are drawn together into a quasi-nucleus, which actually is an excited isomer of deuterium (Figure 37). Time-reversal zones are temporary in cold fusion experiments due to the statistics of their formation and the transient fluctuation theorem {76} of thermodynamics. As the time reversal zone decays, the quasi-nucleus of two protons is increasingly in an excited and unbalanced state. The excited-state *diproton* nucleus decays by flipping a quark in one proton, converting it to a neutron. That produces a *neutron + proton nucleus*, which is a deuterium ion, strictly by electronuclear means. Or four protons may cluster by "attraction in a time-reversal zone" and form a 4-p nucleus. That is an excited isomer of a helium nucleus. As the time-reversal zone decays, first one quark flips in one proton and then another quark flips in a second proton. That produces a helium nucleus - i.e., an *alpha particle*. Or two deuterium ions can attract and form a quasi-nucleus (Figure 38), which is already an exact isomer of a helium nucleus and thus easily decays into an alpha particle by simply "tightening" as the weakened strong force recovers faster than the Coulomb force can reduce, vanish, and resume in the opposite direction. The exact reaction equations for these reactions are given in my new book, *Energy from the Vacuum* {10}.

We filed an Invention Disclosure on the process of forming and using time-

reversal zones to cause like charges to attract and unlike charges to repel *in vacuo,* in fluids, and in other media, resulting in the formation of semi-nuclei as excited isomer states of other nuclei, followed by decay into new nuclides. We will follow it with patent applications in the future. This represents a completely new kind of particle physics interaction presently not included in the textbooks, and not requiring high-energy processes. Literally thousands of new nuclear interactions—all *permissibly* violating the second law of thermodynamics because the statistics permit such violations and experiments prove it—are now possible.

Cold fusion does indeed hold a new kind of nuclear physics in its hand—but a physics presently considered very alien by our orthodox nuclear science community. For decades nuclear scientists have been seeking ever more spatially energetic particle smashing, believing that extreme high energy nuclear reactions and transmutations cannot possibly be done with charged particles at low *spatial* energy. One is sympathetic to the scientists, because even the concept of "low spatial energy transmutation" itself sounds like an oxymoron. And it would be, *if one were limited to spatial energy alone*, as is presently assumed by physicists. But one is also speaking of the neglected and compressed *huge time-energy* component of those low-spatial energy photons, and that is quite a different matter. The lower the spatial energy of the photon (the lower its frequency), the greater the amount of compressed energy transported in the time component as "time". The transposition of time-polarized EM energy into longitudinally polarized EM energy—and vice versa—is already justified in quantum field theory. Use of that extremely high energy component by its transposition or partial transposition into spatial energy in fact provides a much higher energy physics interaction than present orthodox high energy physics utilizes, knows, or considers.

Almost all the learned scientists are thinking *only* of spatial energy, since that is the only kind they have been "taught" to consider. Hence, from their view (i.e., on the premise of their implicit *assumption)* it is perfectly "logical" to condemn cold fusion, since in their view, "cold" implies low (spatial) energy and "fusion" implies high (spatial) energy transmutation. What is unknown to the orthodox community is that the "cold" in cold fusion also implies "extraordinarily high time-energy". So with a little transduction of highly compressed time-energy into spatial energy, "cold" fusion actually can imply "extremely high spatial energy made available by transduction" also.

As an example, the Chief Editor of *Science* recently had the courage {77} to publish results of sonoluminescence research reporting positive experimental transmutation results {78}. A paper was then published in *Nature* {79}, pointing out that the (spatial) energy involved is insufficient for such nuclear transmutation temperature, thereby implying that the reactions reported by the first researchers are not possible.

However, given formation of a time-reversal zone, this second paper is not

necessarily applicable to the sonoluminescence fusion process, because the paper is based on an unwitting two-part premise that *(i) only spatial energy can be used for nuclear transmutation and (ii) no time-reversal zones exist to nullify that premise by having reactions (such as the law of attraction and repulsion of charges) run backwards.* That premise is already experimentally proven to be invalid by Evans et al., and it fails when the time reversal zone effect is considered.

We strongly stress that thermodynamics—both in theory and as demonstrated in experiments—not only allows but predicts—for a certain fraction of the time—the formation and existence of just such "reversal zones" where the usual reactions *run in reverse* {76}. It is also experimentally proven {54}. In that case a much higher energy—time energy—can be and is employed to convert the Coulomb barrier into the Coulomb attractor.[21] We know now (from the experimental demonstrations by Denis Evans et al.) that such "reversal zones" may be up to a micron in size and may endure for up to two seconds. The subsequent decay of that TRZ then allows the quasi-nuclei temporarily formed in it to decay by quark flipping alone, allowing the quasi-nucleus to easily transmute into a perfectly well known nuclear reaction product.

To quote Arthur C. Clarke, when a learned scientist says something is *possible*, he is probably right. When he says something is *impossible*, he is probably wrong.

Stalin's Dictatorial Impact on Soviet Scientific Management's Response

Stalin was a powerful dictator. He simply killed or jailed those who opposed his will. So after his blunt order (Figure 1) circa latter 1945 to find a great new technical breakthrough area quickly, his Academicians and high level science managers were faced with a severe dilemma: They could not afford to *oppose or criticize a vigorous search* for new innovations and a great breakthrough, and they could not remain passive. Their very lives depended on they themselves *personally finding such a breakthrough in great haste and presenting it to Stalin*. They had to actively spur the efforts of their most outstanding subordinates and Soviet science itself, or suffer dire personal consequences. Siberia and prison camps loomed for the lot of them unless they produced.

To put it bluntly, Stalin "got their collective attention" and their "whole-hearted support." Those few who resisted simply were shipped post-haste to the notorious prisons of Siberia, and worked to death in short order.

[21] We strongly point out that, when the reactions run backward and negentropy appears in those reversed regions, the conservation of energy law is violated unless time-energy is being converted to spatial energy. Either we must begin accounting time as energy, or we must give up the conservation of energy law itself. The obvious solution is to account the time energy being utilized, as well as the 3-space energy.

So the highest-level Soviet scientific managers now desperately demanded of their subordinate scientists *anything—anything at all*—that was novel and had breakthrough implications. An almost convulsive national scientific effort was launched immediately, with hardly a detracting voice. A great team of the very best Soviet scientists was rapidly formed and methodically searched the scientific literature of the world from beginning to end. Nothing even remotely like that search and review has ever occurred in the West.

For example, one great technical center set up by the Soviets had a staff of about 2000 Ph.D.s with associated translators, staffs, etc. The Soviets purchased and hauled in copies of all the scientific literature of the West—by the shiploads—to such centers. Their scientists then methodically went through the material, journal by journal, paper by paper, page by page. There are and always have been myriads of innovations and discoveries sitting on the shelf in the scientific literature, never followed up, or opposed by standard models and credos. The first tier of reviewing Soviet scientists was composed of excellent scientists. They skimmed out the "cream" into a select pile which the second tier then analyzed in depth. The second tier was composed of the best nonlinear scientists in the world—the "superscientists."

They were seeking *new principles of nature that could rapidly be developed into highly advanced technology*, and they found them—sitting there in the literature, already pointed out, and long ignored by the Western scientific community.

Shortly Stalin had his great new breakthrough area emerging, and they had their heads.

Our Own Science Community's Progress During These Decades

For decades foundations physicists (Bunge, Feynman, Wheeler, Lindsey, Margenau, etc.) in the U.S. have repeatedly pointed out the substantial foundations problems in electrodynamics. Nobelist Feynman and the great John Wheeler tried to "fix" the problem whereby electrodynamics still erroneously assumes force fields in a space filled with a *material ether* (unit point positive charge, unit point north pole, and unit point mass assumed at every point in space). Unfortunately they failed, primarily because their absorber theory {80} contradicted the photon hypothesis and hence quantum mechanics.

Meanwhile, our own National Science Foundation and National Academy of Sciences has directed only minimal work on correcting electrodynamics and dramatically extending it. Faraday and Maxwell—as did every other scientist at the time—rigorously assumed a material ether. Maxwell's equations also implicitly included that material ether assumption. They still do, even after Heaviside's truncation and Lorentz's symmetrical regauging, because none of the Maxwell-Heaviside equations were changed to eliminate the material fields in space (material ether) assumption after the Michelson-Morley experiments

falsified it.

Every major university in America still teaches that implicit material ether, even though it was falsified over a century ago. That is an exact measure of the caliber of "foundations" work our own scientific community does if left alone. *In more than 100 years, they have not even chosen to root out the material ether from electrodynamics.*

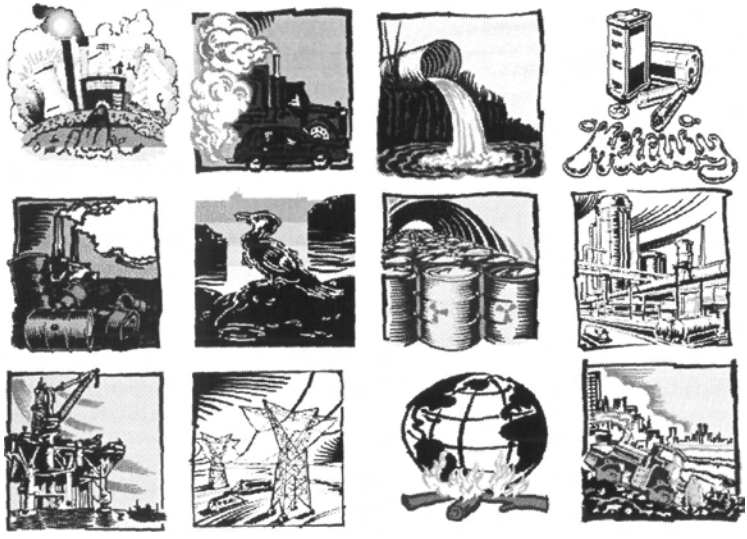

Figure 39 This polluted and suffering planet. Direct result of the scientific community's adamant resistance to upgrading classical electrodynamics and electrical engineering.

The prevailing flippant attitude is that, "Well, your TV set works, doesn't it?" Yes it does, but we also do not have practical electrogravitation and inertial propulsion, nor do we have cheap clean EM energy from the vacuum. Instead, we have a severely polluted planet (Figure 39), ever increasing deaths from biospheric fumes and polluting byproducts, increasing destruction of species, and a monstrous unleashing of far more coal and hydrocarbon burning in our near future while the world tears itself apart and destroys its economy and civilization in a rising series of oil and energy wars. The direct responsibility for that mess lies directly with the scientific community and its fierce resistance to innovative research and development, and changing a century-old, long outmoded classical EM and electrical engineering model.

Wryly put, it's high time we "got the lead out" of EM field theory, where the lead is the material ether and other non-sequiturs cluttering the theory.

Such drastic modeling errors would not be tolerated of government-funded aerospace engineers and contractors developing a new missile system. So it should be equally intolerable in the government-funded scientific community

and in fact in the civilian scientific community as well, and it should not be tolerated of either the National Academy of Sciences or the National Science Foundation.

Einstein {81} said it perfectly, as follows:

> *"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted... in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them."*

Upholding and perpetuating flawed electrodynamics models seriously impedes the progress of scientific development and revolutionary new technology.[22,23] At some point, one must legitimately question the upper management of the U.S. scientific community for not modifying classical EM and electrical engineering to include the active vacuum exchange with every charge and EM system. In not doing so, they continue to advocate perpetual motion source charges, creating energy from nothing, on a scale unparalleled in history.

It is little wonder that we do not have electrical power systems that successfully and freely utilize more than a trillionth of the vacuum energy they freely extract from the local vacuum. *There is not now and there never has been a single*

[22] Oddly, the conventional electrodynamics model assumes that every source charge freely creates energy out of nothing at all, and pours this energy out continuously in all directions, thereby establishing its associated EM fields and potentials at light speed, reaching out across the universe. From the 1960s alone, the total assumption of incredibly vast numbers of perpetual motion machines has been carefully hidden from the new students, so that today even many professors do not realize that in their model all EM fields and potentials, and every joule of EM energy in the universe, are assumed to be created by a vast assortment of perpetual motion machines called source charges. That problem has not been solved in electrical engineering or in classical electrodynamics, and if the scientists have their way, it is not going to be solved. Yet the basis for its solution—the asymmetry of opposite charges such as the dipolarity (in the modern view) of a source charge—has been in particle physics since 1957, with the award of the Nobel Prize to Lee and Yang in December of that year.

[22] One keeps one's sense of humor. The raucous skeptics and "defenders of the orthodox EM faith" who so noisily denounce legitimate COP>1.0 EM system researchers as "perpetual motion nuts", are themselves unwittingly the greatest perpetual motion nuts ever recorded in history. Further, they are so ignorant of what their present model actually means, that they do not even know it. It is one thing to be ignorant and to recognize it; it is quite another thing to be ignorant and so ignorant one does not know it—45 years after broken symmetry was rigorously established experimentally by Wu and her colleagues, and the Nobel Prize awarded to Lee and Yang.

electrical engineering department, professor, or textbook that knows what actually powers an EM circuit—real observable EM energy extracted from the local seething vacuum by the source charges and the source dipolarity.

Since our scientific community cannot seem to make such a simple change (as including the active vacuum's interaction with every charge and the charge's broken symmetry in that interaction) even 45 years after the basis for that change has been resoundingly proven in particle physics, our national survival is at stake and the nation itself is seriously threatened by the superweapons developed by the KGB over the last five decades. We would have already been totally destroyed—twice in 1997 alone—had it not been for the intervention of a friendly little foreign nation. My colleagues and I played a very small alerting role in those affairs, so we are speaking from experience, not from extrapolation. We would be quickly destroyed today, were it not for the continuing "balance of terror" provided by the little nation.

U.S. Scientists Have Committed Monstrous Crimes and Gone Unpunished

Rather sadly, we also point out another thing that has to be said: *scientists are no more moral or immoral than any other slice of American citizens.* A percentage of scientists is capable of committing horrible scientific crimes, as distasteful as such a statement may be. That includes the deliberate experimentation on humans, resulting in deaths. In short, at least manslaughter and perhaps even murder, since knowledge of the probable results was there beforehand.

One would think U.S. scientists would *never* scientifically condone and perform experiments leading to mass deaths for 30 years (i) as they did in the Tuskegee case in Alabama. Over 400 poor blacks were supposedly treated for syphilis, while actually not being treated at all, but were deliberately tricked and allowed to rot with syphilis so our "ethical" scientists could watch how their brains decayed, so to speak. Over 100 of those poor blacks died with the disease while the scientists cold-bloodedly watched them expire and kept meticulous records. Or (ii) as they did in the case of whole body nuclear radiation for 30 years—again by trickery, deceit, and illegal use of security classification to hide these acts—of helpless retarded children and others, some of whom also died.

Once these heinous incidents were exposed publicly, the political power of the scientific community is such that *no scientist was ever indicted or tried for these heinous mass murders, and none is going to be.* The scientific community *has* <u>*not*</u> fiercely called for punishment of these mass murderers amongst their midst—guilty of precisely the same kind of horrible actions for which we tried and executed war criminals at Nuremberg.

Incredibly, the President of the United States formally apologized for these incidents! He did not turn the case over to the Justice Department for prosecution of high crimes against humanity and mass murder, *as would have*

been done for ordinary citizens. Had a single doctor in his private clinic done such things on his own, he would have been arrested, summarily tried, and either sentenced to life in prison or executed.

The sad thing is that there was really no sharp clamor from the scientific community to bring their fellow scientists to justice, a la Nuremberg. By their silence, the organized scientific community showed a side that scientists are loftily not supposed to possess. *So long as the scientific community continues to tolerate those mass murders of American citizens and not call for justice, then just so long do they stand convicted by their own resounding silence and inaction.*

We cite these painful incidents (there are others!) to point out that one must not deify the scientific community. The conduct of science is no better and no worse than the conduct of human affairs in other areas. Science is also a big business, and it has its moral scientists and its immoral scientists. It does its moral business and it does its immoral business.

We painfully submit that both sides of the scientific character must be considered, when one examines such things as the tolerance or intolerance of the scientific community to dramatic innovation and "out of the box" research. We have to consider it now, because it has become a serious threat to the continued survival of our nation. The conduct of scientific affairs will unavoidably include suppression, maneuvering, spin control, and fierce struggle for power and funds—such is in the very nature of human beings, and it is present in the scientific community on a bell-shaped curve as in all other human communities. It is ongoing widely today, and to an uncomfortably large extent much of science has been captured and effectively controlled by controlling the scientific funding and prescribing what research must be done for the funds available.

As the French say, "The more things change, the more they remain the same." Science is still the same way as it was when Planck made his famous statement. It will still be that way tomorrow, and a century from now. As with any other big enterprise, it has to have checks and balances imposed and enforced on it from outside—by the government itself. Little or no indication exists of that happening in the near future, until we get something like an anthrax spray attack on a large city, and have a million or more Americans dying in the streets.

Energetics: New Principles of Physics and How the Soviets Found Them

Under Stalin's whip, the Soviets particularly sought anything that indicated *possible new principles of nature.* It is no accident that Nobelist Petr Kapitsa later informed Nikita Khrushchev that a means of total neutralization of foreign missiles could only come from *a group of new principles in physics called energetics.* A group of new principles is precisely what energetics *is.* So if our scientific and intelligence communities wish to understand energetics, they must

first understand the new principles it is based upon. They cannot just simply apply ordinary electrodynamics and "business as usual" as they have largely done. The massive Soviet scientific search program spurred by Stalin is where those new principles came from.

When the first tier of Soviet review scientists found something that had not been followed up, and saw that it had significant implications if found valid, that paper was laid aside into a "select" pile. That select pile then went to the "super" scientists, for full-blown review and analysis by some of the brightest and sharpest minds on the planet.

The Russians came up almost immediately with Whittaker's 1903 and 1904 work. That work shows a hidden electrodynamic *longitudinal* EM wavepair structure (in phase conjugate pairs) inside the scalar potential and comprising it.

This is a dramatic extension of electrodynamics to incorporate a full-infolded general relativity infolded inside the electrodynamics. Whittaker showed that scalar potential functions in interference already *create* all the "normal" fields and waves anyway (the beginning of superpotential theory). This novel interferometry and its inherent capability for action-at-a-distance did not elude the Russian superscientists. The superb Soviet scientific team came up with that and with much, much more.

Nothing like the comprehensive, intense review of the entire scientific literature has been accomplished by the U.S. scientific community. Nothing like it is being done now.

Longitudinal EM Wave Interferometry Energetics Was Almost Immediately Uncovered

At the end of WW II, the German radar team and infrared team were taken to Russia. Both teams were years ahead of their Western counterparts.

One of my close colleagues has validated that the German radar team had some severe instrumental anomalies while still in Germany. We think this is what they were:

In WW II the Germans invented radar absorbing materials, to coat their submarine snorkels and prevent Allied antisubmarine warfare bombers from tracking the snorkels and destroying the subs. A wide variety of highly nonlinear, doped materials were investigated. In addition to single beam radar cross section, the Germans also examined the materials in multi-beam illumination circumstances.

It appears that, in some multibeam experiments with some materials, conditions were just right so that the multi-illuminated absorbing material acted as a pumped phase conjugate mirror (PCM), and wave-to-wave interactions emerged. This meant that the absorber material PCM would suddenly gather up

all the energy in the pumping beams, use one of the other beams as a signal input beam, and fire an amplified retroreflected pulse right back down the signal input beam, wrecking the experiment and creating havoc in surrounding equipment.

When the German radar team went to Russia, their knowledge of these anomalies went with them. In the desperate Russian scientific climate to find *lust such anomalies,* this startling and anomalous phenomenon would have been exhaustingly examined and studied, once the German radar engineers got to Russia to their new laboratories.

In short, it appears that the Russians quickly came up with what today is called "nonlinear phase conjugate optics," but first in the radar band rather than optics.[24] So before 1950, it appears that the Russians already had working phase conjugating pumped phase conjugate mirrors for the radar bands and in other bands.

Fisher {82} details that we Americans did not "stumble onto" practical phase conjugate optics experiments until Russian physicists briefed Lawrence Livermore National Laboratory scientists in 1972 about the strange wave in **many** of their optical experiments that "came out of nowhere and restored order **from** disorder." At that time, the KGB energetics weapon scientists had known aboutphase conjugate retroreflection and its amplified pumping, for more than 20 years. Indeed, the first giant strategic scalar interferometers had already been deployed and utilized to kill the U.S.S. Thresher nearly a decade earlier (Figure **6).**

By 1950 Russian Energetics Was Off and Running

By the beginning of the 1950s, the Russian scientists under iron KGB control were already experimenting with "scalar potential interferometry" at a distance, a la Whittaker 1904. Here transverse EM waves, EM fields, and EM energy—either *divergent* (heating) positive energy or *convergent* (cooling) negative enery—could be readily created at a distance {83} (Figures 40 and 41). Further, the longitudinal EM wavepairs used in this interferometry had the marvelous characteristic of easily penetrating right through the earth and ocean, with only a little intervening interaction, given that the LWs are sufficiently well made {84}. The interferometry "beams" can and do also move superluminally—again, right through the earth and ocean.

[24]**Of course, they would also have investigated it at all other bands as well.**

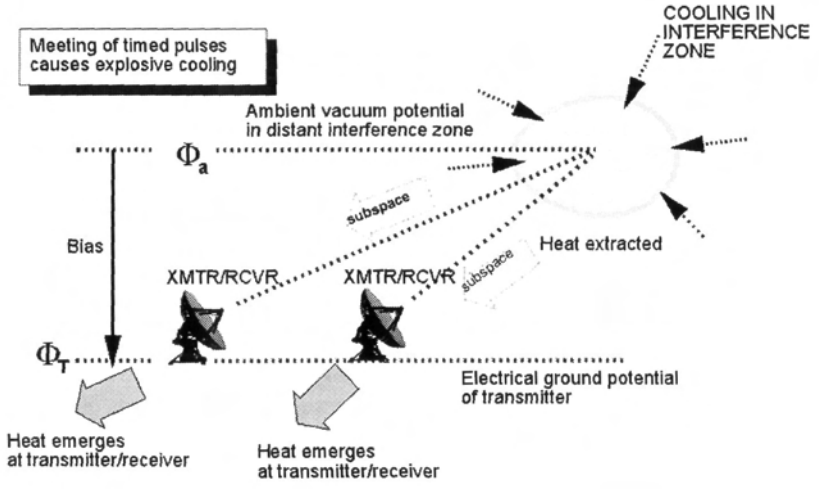

Figure 40 Scalar interferometry in the endothermic (cooling) mode.

It is not accidental that Admiral Gorshkov, head of the Soviet Navy, would later bluntly state: *"We have made the oceans of the world transparent."* And so they had.

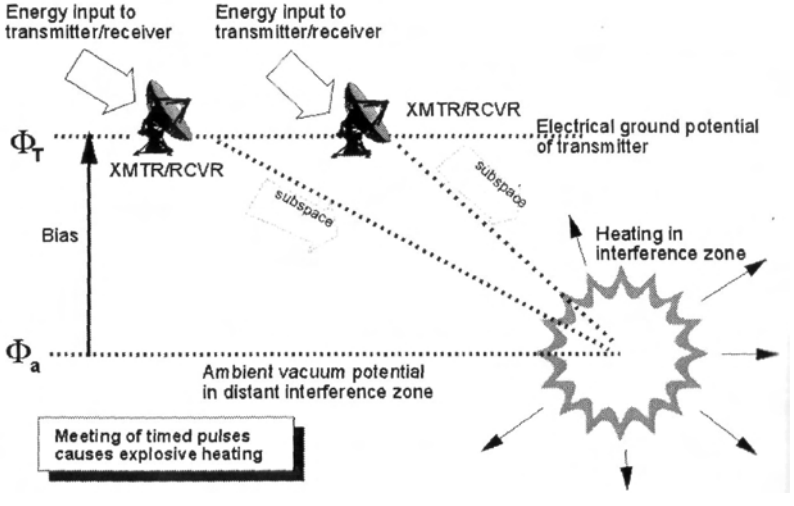

Figure 41 Scalar interferometry in the exothermic (heating) mode.

By 1950, the Russian scientists were experimenting with deliberately creating and phase conjugating longitudinal EM waves, forming phase conjugate

wavepairs. They then assembled the desired (mathematically calculated) sets of those waves, adjusted frequencies and magnitudes, phasing, etc., to produce EM potentials having a desired deterministic internal spacetime curvature set (internal spacetime engines) and dynamics.

As a result, by the mid-50s Russian weapon scientists were already experimenting in *bioenergetics* with the direct inductance of diseases and health changes via the transmission into human targets of such "internally structured" EM potentials, fields, and waves. They were also experimenting with the production of EM energy, potentials, fields, and waves at a distance, directly through the earth and the ocean. Either heating (energy flow divergence) (Figure 41) or cooling (energy flow reconvergence) (Figure 40) could be produced at will in the distant interference zone, merely by altering the bias voltage on the chassis grounds of the interferometer's transmitters. Rapid switching between the exothermic and endothermic modes thus was straightforward {85}, as demonstrated (Figure 35).

By the latter '50s, longitudinal wave interferometry weapons had already emerged from advanced engineering development and were in full production engineering toward deployment. The LIDA device {86} and even more advanced versions for directly affecting the human mind and its state of consciousness had emerged in *psychoenergetics* as one class of devices rather openly released and utilized. The LIDA uses structured EM microwaves {87} to induce a hypnogogic or cataleptic type of trance-like state in either a human or a cat. as tested years later by Dr. Ross Adey of the U.S. Early prototypes were purportedly used against our prisoners in North Korea during the Korean War to assistin their brainwashing by their North Korean Captors. Prisoners reported that its effects were irresistible.

Meanwhile, energetics weapon testing in several major modes was being conductcd, particularly from Soviet research ships over remote regions of the ocean and at night. Descriptions of such tests—many of them seen by passing ship's captains—can readily be found in the open maritime literature. We gathered and published many such incidents and cited references.

Deployment of the Soviet Energetics Weapons and Their Quick Use

In January 1960 Khrushchev spoke obliquely of these "fantastic" new superweapons, just within the portfolio of the Soviet scientists, so to speak, in an important speech to the Presidium. Parts of that speech were reported in the *New York Times* {88}. No one in the West knew what Khrushchev was talking about. Our intelligence community, which bases many of its assessments on the tired old phrase "We have no evidence that..." simply treated it as propaganda, It wasn't, and the U.S.S. Thresher was to be destroyed (Figure 6) three years later by that same weapon Khrushchev was speaking of.

Khrushchev began rapidly inserting long-range missiles and nuclear warheads into Cuba in 1962, precipitating the Cuban Missile Crisis. Kennedy knew Khrushchev's strategic bombers and rockets were in horrible shape, due to direct information received from Colonel Oleg Penkovskiy, a Russian spy in our employ courtesy of British Intelligence. No one knew of the superweapons, but they were not yet operationally ready in Oct.-Nov. 1962. So Kennedy called Khrushchev's bluff and faced him off. Blustering awhile to obtain U.S. assurance that it would not invade Cuba, Khrushchev was forced to back down and withdraw the missiles. In his exuberance he had simply moved too fast in inserting the missiles into Cuba. Had he waited a few months later, the strategic superweapons would have been operational and ready. Any U.S. naval blockading force would have thus faced quick and eerie destruction or disabling, as was soon to be demonstrated in the case of the U.S.S. Thresher and its surface companion, the U.S.S. Skylark.

This severe loss of face by Khrushchev, before the Communist Party, made it imperative that he do something quite dramatic to stay in power, and do it as quickly as possible.

Khrushchev's first large, full-up, strategic longitudinal EM wave energetics interferometer weapon became operational on site by April 1, 1963. A few days later, Khrushchev employed it to kill the U.S.S. Thresher atomic submarine (Figure 6) underwater off the East Coast of the U.S. By simply creating EM noise in an interference zone placed on, in, and around the sub underwater, and thus jamming the sub's electrical controls so that it could not be controlled, the helpless sub sank to crush depth and imploded. The U.S.S. Skylark on the surface had multiple systems seriously jammed or rendered nonoperational. This was the Russian deception plan, to have the kill of the sub resemble an accident.

One day after the successful clandestine kill of the Thresher, the same weapon was used to demonstrate a powerful underwater electromagnetic burst 100 miles north of Puerto Rico (Figure 42). The energetics underwater burst equaled a substantial deep underwater nuclear explosion in size. The burst was seen by a passing U.S. jetliner crew and was reported to the FBI and the U.S. Coast Guard when the aircraft landed in Florida. A colleague interviewed the co-pilot of the aircraft, and relayed the interview information to me.

Khrushchev's Second Demonstration

Deep Underwater EM Explosion 11 Apr. 1963

(Similar to this photo set of a deep underwater nuclear **test** explosion)

Phenomena observed and reported by passing U S jetliner

100 miles north of Puerto Rico, over Puerto Rican Trench (One of the deepest parts of the ocean)

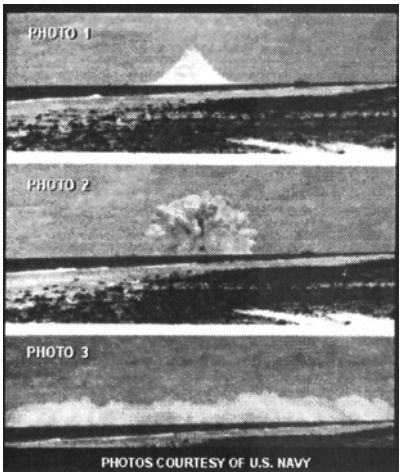

Figure 42 Deep underwater nuclear burst, demonstrating same water phenomenology produced by Khrushchev's second demonstration on 11 Apr. 1963, the day after killing the U.S.S. Thresher.

Why the Soviets Could Continue to Attack and Kill U.S. Targets with Impunity

Ironically, Khrushchev clearly demonstrated the inability of U.S. science to comprehend the numerous test incidents of Soviet LW interferometers, including the actual destruction of strategic U.S. targets (our latest and greatest nuclear attack submarine!) right off our coast. *The greatest strategic weakness of the U.S.—and the thing that may yet completely destroy all of us—is the continuing snail-like pace of U.S. scientific progress in revising, correcting, and extending its seriously flawed classical electrodynamics model. This scientific inertia placed us several decades behind in development of defenses in the areas of longitudinal EM wave weapons, quantum potential weapons, and causal system weapons. It countered our strategic nuclear armada for two decades. We were for some time analogous to the Spanish Navy with its wooden ships, when it faced and was destroyed by American steel ships. Hopefully at least some more modern work has now been accomplished in higher group symmetry electrodynamics, so that we are not quite as defenseless as we formerly were. But we still have a very long way to go.*

When one performs a standard strategic analysis on a nation, one of the areas examined in depth is called *national style.* One of the major characteristics in the U.S. **national** style is that we do not react to slowly increasing threats or changes

(Figure 43). That style particularly applies to the scientific community. Because of it, the Russians knew that our government only inches forward in achieving new *basic* science. We run at enormous speed, doing *applied* science. We are essentially Romans and great engineers. We are largely not Greeks and not great esthetics discoverers. We also will just ignore new threats if they emerge very slowly and are only gradually perceived, and we will hide behind that infamous phrase, "We have no evidence that..."

BOA CONSTRICTOR LIGHTNING STRIKE

Americans tend not to react to slowly increasing things,
but react to rapidly increasing things.

Figure 43 America's national style: we do not react to slowly increasing threats.

In short, *we react to the coiled rattlesnake, not to the boa constrictor*. We are now in a long, bloody, costly war against terrorism because of that very characteristic of our national style. For decades, the slowly increasing infiltration of terrorists and their weapons was just ignored. Oh, yes, the official "threat studies" pointed it out, placidly.[25] But no one got very excited about it. The prevailing attitude was that "Ah, yes, but nothing like that will happen on *my* watch!"

As clearly demonstrated by their successful decades-long radiation of the U.S. Embassy in Moscow, the KGB chess masters knew that, if the test kills using

[25] Indeed, if one will look at the threat studies prior to William Cohen taking office as U.S. Secretary of Defense, one will find widespread complacency about the terrorist threat, and mostly just lip service to it. It was definitely not very important to most of the intelligence and scientific community. Cohen built a fire under the entire threat community, forcing them to get their act together and start actually studying the terrorist threat, asymmetrical warfare capabilities and dangers, and what could be done about it. He did force the research and threat communities to do a creditable job of studying it, and to publish reports detailing it. Unfortunately, the tenor of the political community outside SecDef Cohen's control was basically "business as usual, not to worry." September 11, 2001 changed all that forever. Once again we had waited until the rattlesnake struck and actually bit us, before the nation rose up and paid attention.

their superweapons were not too often repeated, and if they even vaguely resembled other things known in the world, the U.S. scientific community and government investigators would resist all suggestions of Russian superweapons and super technology using new principles of nature. And so would our intelligence community, since they rely on the scientific community for their scientific assessments. They were well aware of our historical "ostrich" position (Figure44).

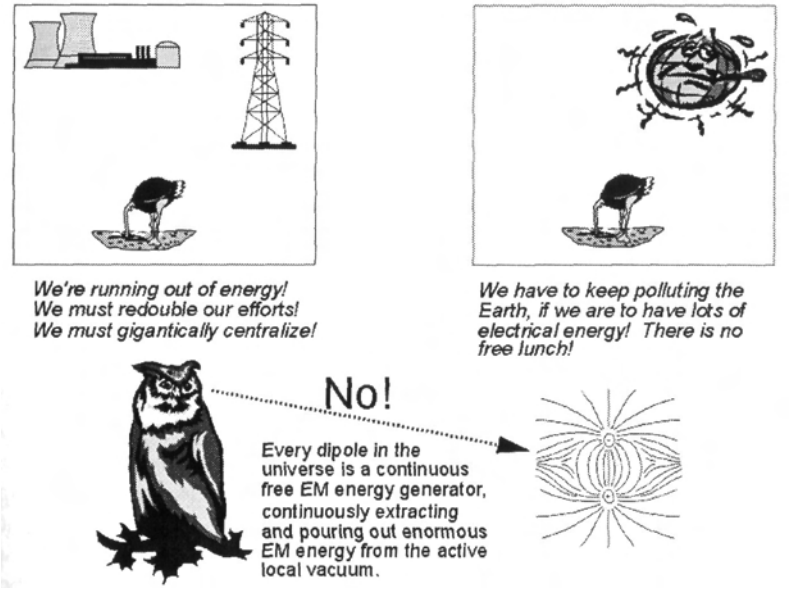

Figure 44 The only energy resource problem is the theoretical ostrich problem in science. We *must* become theoretical owls, rather than ostriches.

The KGB deception just depended upon the U.S. tiger to keep its stripes and exhibit its normal reactions or lack thereof. They also utilized (i) a series of strategic deception plans, deliberately designed to perform the tests suggestive of discredited phenomena such as UFO reporting and "lights at night" types of things, and (ii) a continuing series of subtle and anomalous stimuli (probes) designed to rather slowly attract the attention of U.S. Government at high levels, and of state-of-the-art U.S. government scientific contractors as well. The trick was not to attract U.S. attention *too suddenly or too strongly.* Show them the slow boa constrictor, not the lightning-fast rattler, and see how they reacted, if at all. By their reactions, the KGB could assess whether or not the U.S. governmcnt, intelligence, and scientific communities understood what was happening.

Precisely as anticipated by the KGB, we showed them for some decades that we

really had little or no comprehension of the superweapons and their testing right over our heads. Even today, at least in the open community there is still little recognition, even of the violent weather war raging right over our own heads since July 4, 1976 and easily recognized.[26]

A case in point was the deliberate induction of diseases and health changes in U.S. personnel in the U.S. Embassy in Moscow for over 40 years (Figure 11). On a continuing basis, this excellent intelligence probe showed (by the U.S.'s actions or lack thereof) that we knew nothing about energetics.

Another KGB probe method was to kill a target once in a while, such as a jetliner or a submarine (deliberately rather seldom here, because the U.S. military would react if a certain frequency threshold were exceeded). Such kills resemble or can be posed as natural accidents or terrorist incidents. Quite a number of such incidents have occurred over the last three decades. The National Transportation Safety Board (NTSB) does not have higher group symmetry electrodynamics in its knowledge base or on its "checklists", nor does it have scalar interferometry, psychoenergetics, bioenergetics, or quantum potentials. In total, the results of deliberate stimuli of the U.S. continually assured the KGB chess masters (with 100% certainty) that we were a complete novice in the energetics game, and we were a lamb increasingly ready for the slaughter.

The major contribution to the continued success of these deliberate measures by the KGB has been provided for decades *in the "nonreaction of our own scientific community to slowly increasing threats."* To a lesser extent, our own intelligence community has also not focused sufficiently open-minded and highly qualified scientists to comprehend what is occurring in "new principles of nature" phenomena. "In the box" electrical engineers with Bachelor of Science degrees often are the analysts who analyze and assess such "out of the box" phenomena. Good luck!

Ordinary radar engineers may analyze an ordinary radar rather well. They will never, never become aware of a radar beam carrying infolded spacetime curvature engines. Such is not even in their lexicon or in their belief structure. They have no understanding or experience at all with longitudinal or time-polarized EM waves—most have never even *heard* of time-polarized EM waves. Mention curvatures of spacetime and their dynamics as deliberate "engines" impressed *inside* EM fields and potentials and waves, and one gets a glaze right over the eyes of the intelligence analyst recipient.

Western science conceives the mind as a meat computer, and does not understand that mind operations are totally electromagnetic and causal, but nonphysical—meaning in the time domain rather than in 3-space. Mind

[26] The weather war over our heads has been particularly violent, and violently resisted, this year (2002).

operations primarily use time-polarized EM waves rather than the transductions into transverse EM waves that the scientists actually measure. Hence Western science has not the foggiest notion as to what Russian psychoenergetics is all about, or how it can even "be." Certainly Western science has had no notion of deliberately creating time-polarized EM waves for direct engineering within the mind itself and within the mind's time-EM operations.

As Arthur C. Clarke puts it in his "third law," *"Any sufficiently advanced technology is indistinguishable from magic."*

Our long fascination with our "normal" (optics, IR, UV, radar, COMINT, satellite photography, etc.) technological intelligence collection systems will certainly not lead to any great breakthrough understanding of Russian energetics weaponry. That could only have come through HUMINT or COMINT. HUMINT is an area which, in the past, we have mostly just neglected or given lip service to for decades—and that came back to bite us severely on September 11, 2001. Even when we use HUMINT, it will not yield energetics results if the managers and directors themselves (and the agent handlers in the field) have no understanding of it and do not even know the proper questions to ask. And the system will not deliver results if the Intelligence Collection Requirements do not address the proper issues because ordinary electrical engineers and conventional electrical physicists having no inkling of psychoenergetics, or how it works, drew them up.

COMINT, on the other hand, suffers from its own extraordinary prolific output -as well as by only conventional analysts and conventional scientists examming it. Warehouses of COMINT information often have not even been read in any way except a casual glance by a junior analyst, and certainly have not had serious foundations scientists examine it in detail. ELINT does a little better insofar as a human analyst looking at it, but then what is a conventional electrical engineer or radar engineer to make of a giant hemispherical globe that slowly forms and expands from a tiny "seed bubble" of intense glowing light that appears (Figure 35), as it did off the Kurils in April 1984? What will he label it? "Light phenomena?" Where are the technical descriptors of the actual process forming the phenomenon? Where are the implications as to the strategic military use of such phenomena? The reader can see the point. For decades our analysts ignored prolific reports of such incidents by the hundreds. Why, everybody knew it was glowing swamp gas!

One cannot even write a proper "intelligence collection requirement" if one does not understand the basic phenomenology. So essentially no one in U.S. intelligence was writing the proper intelligence collection requirements.

The Science Behind the Soviet Energetics Weapons

The science behind these weapons is called *energetics*. (See again Figure 8.) Energetics consists of three branches, depending upon the nature of what is

being targeted. The branch targeted against nonliving matter is just called the same name: *Energetics*. Targeted against living cells and biological material, the nervous system, etc., that branch of energetics is called *bioenergetics*. Against the mind and its functions (which are time-like and thus involve scalar photons and time-polarized EM waves), energetics is called *psychoenergetics* {89}. See Figure 45. Psychoenergetics includes both the conscious[27] and unconscious mind[28] of the individual—and even Jung's collective unconscious mind[29] of the entire human species {90}, and in fact even the collective unconscious mind in all species on earth, which corresponds to Lovelock's *Gaia* concept.

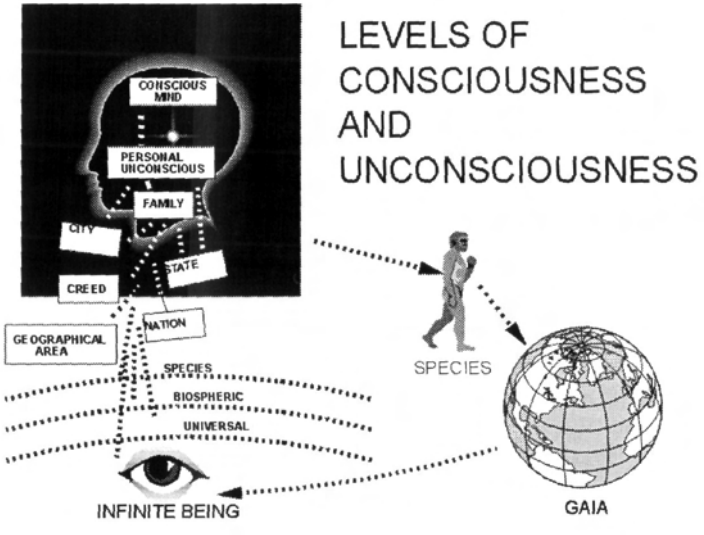

Figure 45 Mind levels are subject to engineering by higher group symmetry electromagnetic (psychoenergetic) weapons.

We remind the reader that we are talking *physics*, not metaphysics and not mysticism. Strong Soviet physics developments over a sustained period have occurred in all three energetics areas, and these areas continue to be developed at present.

Once a nation enters into LW EM development, it has just entered into unified

[27] The conscious mind is a very fast serial processor, processing one snapshot at a time.
[28] The unconscious mind is a massively parallel processor, doing a great many things simultaneously. It is totally conscious, but multiply so. Since the serial processor conscious mind can only "see a single slide projector in the viewgraph at one time", when it "looks at the unconscious mind" it sees a large number of slides simultaneously, hence just sees "black" or "nothingness" (no single thing).
[29] Jung himself labeled it a *mind* (and hence a living entity). His modern followers shudder at such a concept, and very much downplay the "mind" and "entity" aspect, preferring that it just go away.

field theory development also. Particularly with longitudinal EM waves, one is directly engineering general relativity itself, and spacetime itself, as well as the dynamics of spacetime curvatures and sets of such curvatures. But it is an even greater unified field theory than Western physicists suspect. Not only does it unite the four forces of physics, but it also unites mind and matter and their dynamics as well.

We shall also refer to time-polarized EM waves as *time-density waves*. The reason is that a time-polarized EM wave is one where the EM energy is on the time-axis and oscillating along it, like the squeezing of an accordion. In short, it is a longitudinal EM wave on the 4th Minkowski axis *ict*, where the only variable is *t*. Hence it is a wave of the variation of time-density along that axis.

All three branches of KGB energetics use longitudinal EM waves, longitudinal E*M* wave interferometry, and Whittaker-structuring of fields and waves to provide organized curvatures of spacetime known as *spacetime engines* or v*acuum engines*. They also use time-polarized EM waves, as mentioned above. Any or all can also employ the quantum potential as well as negative energy EMP aspects. For now, the reader should just recognize that each infolded longitudinal EM wavepair comprising the scalar potential, includes both a *time-density wave* along the time axis and a longitudinal EM wave in 3-space {91}. So ordinary electrostatic scalar potential fi—ordinary voltage—is made of a harmonic structure of *coupled time-polarized and longitudinal EM wavepairs.*

Oscillations of time density oscillate the local rate of flow of time. In turn, since time has the energy density of mass, its spatial energy equivalence *W is* given by $W = c^2t$. Any change in a time density wave is a very powerful oscillation of loca1 spacetime curvature. So time-density waves constitute a very powerful form of infolded general relativity, inside potentials and hence inside all EM waves and fields. The KGB weapon scientists call that inner general relativity (time density waves) the *information content of the field*. Unfortunately our follows confuse that term with common "spectral analysis" which it very def initely is not. But as part of the deception plan, the Russians are quite happy to help them think it is exactly that, and in fact the Russians go to some pains to continue to help our fellows think that.

KGB energetics involves the use of a highly structured general relativity infolded inside electrodynamics—inside EM potentials, fields, and waves regardless of type. In addition, that very special GR is using the very strong EM force along the time axis as the main agent of curvature. By deliberately structuring these time-polarized EM waves and their dynamics, extremely powerful *spacetime curvature engines* can be employed, either created locally or at a real distance, or also globally in an entire selected distant region.

Once these spacetime curvature engines structure the distant targeted spacetime region. Then in that interference zone the engines therein act upon any mass present. In theory, any physical effect known can be engineered, according to

general relativity, once one can create and utilize the proper set of spacetime curvatures (the proper set of spacetime curvatures and their dynamics). In GR, curvature of spacetime acts directly upon any mass present, and vice versa. With such technology one can therefore *engineer mass* to any level and at any distance (and eventually in any quantity) at will, using energetics methodology. *The engineered mass may be either living or inert* {92}. It follows that bioenergetics and psychoenergetics effects can also be engineered at a distance in similar manner. All it requires is the proper engines for the effects desired in the targets desired.

By using time-density waves and their dynamics, mind itself can be engineered and controlled at a distance as in the cases of Captains Button (Figures 22 and 23) and Svoboda (Figure 24).

The Importance of Scalar Photons and Time-Density Waves

Now we digress momentarily. Again, there are four major photon polarizations in quantum field theory {93}. The first two are *transverse* photons, polarized in the x- and y-direction respectively (transversely to the line of propagation, which is customarily taken along the *z*- axis). Ordinary transverse EM waves are comprised of such photons or blends thereof. Though ignored, EM waves prior to interaction with mass do *transport EM time-energy* as well as EM spatial energy, though in electrodynamics that time-energy transport has been ignored, thus confusing the effect with the cause.

The third polarization is a *longitudinal* photon, vibrating along the *z*- direction (the direction of propagation). Obviously longitudinal EM waves are comprised of such longitudinal EM photons.

The fourth polarization is a *scalar* photon, since it oscillates only along the time axis (the word "scalar" refers to the fact that it has no vector field component in 3-space). In American physics the latter photon is largely ignored since time is not an observable in quantum mechanics. However, such scalar photons do comprise time-density waves and EM time-energy currents, and they are involved in powerfully curving spacetime via oscillating the time domain. Hence by their oscillations they produce spacetime curvature oscillations, which in turn project small components into 3-space. Sufficient such coherent projection components are in fact longitudinal waves in 3-space.

The combination of the scalar and longitudinal photons is observable as the instantaneous scalar potential, and when Whittaker's 1903 decomposition of the scalar potential is slightly corrected, then the scalar potential is comprised of coupled pairs of waves, where each pair consists of a time-polarized EM wave coupled to a longitudinal EM wave. The combination of the scalar and longitudinal EM waves in the presence of charge is observable as the macroscopic scalar potential. Negative charge absorbs the time-polarized photon from the time domain and re-emits a longitudinal photon in 3-space, while the

positive charge absorbs a longitudinal photon from 3-space and re-emits a time-polarized photon in the time domain.

Psychoenergetics: Engineering the Mind-Matter Interaction by Engineering Mind

We shall be interested in what actually constitutes a living biological system in **the** psychoenergetics view (Figure 46). Mind operations are *time-like* rather than existing in 3-space, and for that reason mind and its operations are not observable. Observation is a *d/dt* operator acting on an LLLT ongoing interaction, which removes the T and leaves a frozen LLL snapshot, via d/dt(LLLT) => LLL. *Imposition of observation itself breaks,* any and all connection with time-like operations, including mind and its operations.

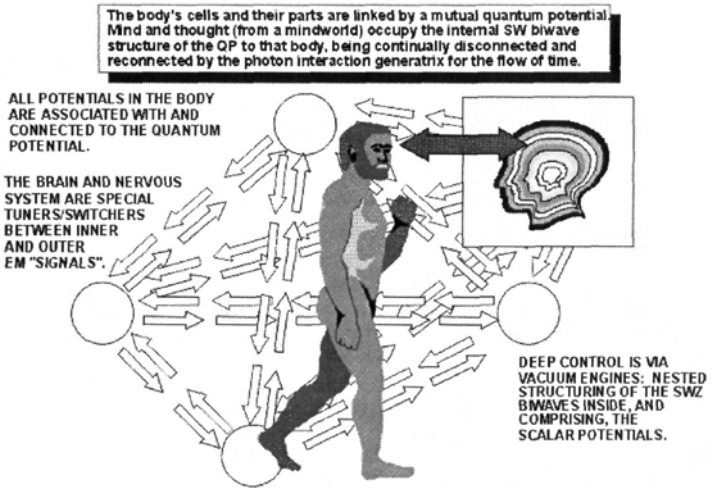

Figure 46 A living biological system (psychoenergetics view).

"Dynamics" involves "velocity", and in general relativity's 4-space velocity is rotation (Figure 47). Any mind-operation or change is dynamics and produces a small velocity, which is a small rotation. This projects a very small component into 3-space, in the physical body, but still in the virtual state. We are speaking of physics rather than metaphysics! *Sufficient* coherent mind operations (changes) have just such small (virtual) rotation components in 3-space that will project coherent little projection components (virtual) into 3-space. Coherently sustaining these components (intent) results in their coherent integration to breach the quantum threshold and become detectable (produce an observable 3-space result). That is how an "intent" change sustained in the mind becomes an actual physical energy input to the body and nervous system.

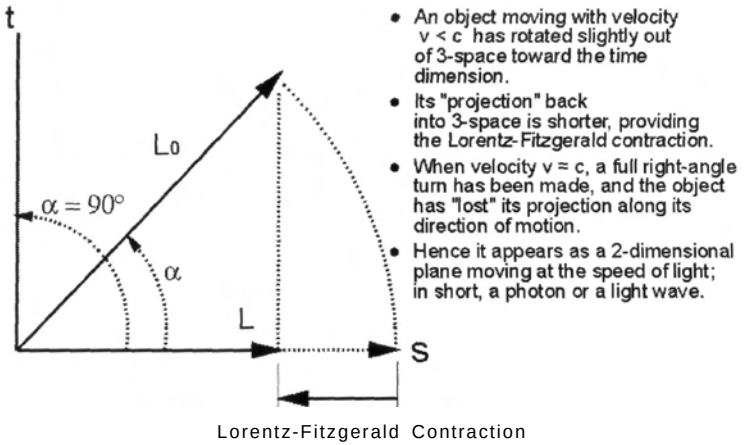

Figure 47 Velocity is rotation. Necessary to understand the mind-body coupling mechanism.

We again stress that the scalar potential is comprised of coupled time-density and longitudinal EM wavepairs. Mental operations also are time-density wave changes, hence they are changes to the interior of potentials, including the ambient potential of the vacuum itself. Potentials superpose, and their coherent internal structures add (integrate) coherently. Hence, mind changes can coherently integrate to produce minute but real, observable, physical input changes to the body system. *Mind permeates the body via the interlinked and superposed potentials of the body.* The living bio-organism's mind and its operations can be modeled as an organized operating wave dynamics inside a scalar potential and superposed potentials of the body of that organism. Since fields are made from the more fundamental potentials, these operations also function inside the fields of the body. The organized time-density dynamics constitute both the conscious mind and its operations and the unconscious mind and its operations. More subtle depths of the time-density dynamics also constitute the human collective unconscious mind functions and operations. Again, we are speaking physics, not mysticism.

See Figure 48. The "component projection" (coherent integration) process from time-like mind operations into 3-space in the body potentials introduces into the living body the *physical* commands correlated to the *mental intent* of that entity. This is the solution {94} to the long unresolved *philosophical problem of intent*, and addresses the unresolved physics problem of *just what constitutes the "observer."* But the subsequent physical changes accomplished by the responding body as a servomechanism, also produce small rotations into the time domain (into the mind domain) but in the virtual state. However, a series ol' coherent physical changes produces coherent virtual state changes in the mind realm, which in turn coherently integrate into perceptual input. In this fashion,

the mind senses the response of the body to its order, and any errors in that response that need correction. The time delay gives also the sense of identity and personal persistence, hence creates the perception of self, the "responding body belonging to self," etc. Interwoven perceptions of coherent rotation changes from other 3-space phenomena that do not respond to mind intent, also create the perception of the "separate physical world." That these phenomena do not respond directly to mental intent creates the perception of the "separateness" of this "external" physical world, while the interweaving creates the perception of "existing simultaneously" with or in the external world.

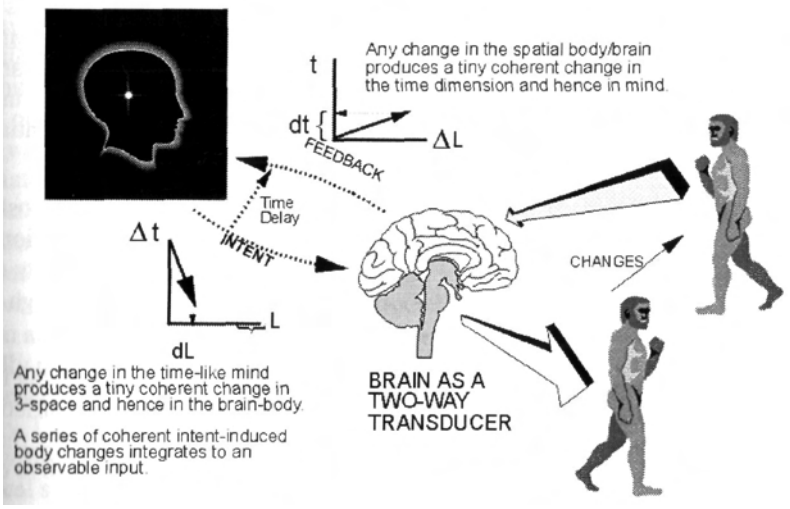

Figure 48 Mind-body coupling mechanism at work.

All of that perception, dynamics, rotation, and processing is subject to direct engineering via psychoenergetics means.

Without further elaboration, we again stress that the conscious mind is a serial processor, whereas the unconscious is a massively parallel processor. Westerners are prone to equate self to consciousness or conscious mind operation alone. That is not the case. Consciousness is just one attribute of the self (of the total feedback loop having delay between feedforward and feedback).

The totality is the mind-body coupling mechanism (Figure 48) enabling a living biological system (Figure 46).

By using time-density waves formed of scalar photons, the mind realm also can be directly engineered by the same energetics technology. Hence, for the Russian energetics weapon scientists there followed the development of psychoenergetics as an entire class of breakthrough electromagnetic weaponry.

This resulted in the development of not only a unified physics of matter and space, but also a unified physics of mind and matter reaction. Any true unified field theory must integrate the observer and the unobserved as well as the various categories of the observed. It is now possible to *directly model and engineer both physical and mental reality and their interaction.* Russian psychoenergetics has been developed to do precisely this {95}.

Quantum Potential Weapons Are Utilized in All Three Energetics Branches

In addition to scalar interferometers, there is another category of energetics weapons used in all three branches. That category involves the use of *quantum potential weapons*, after David Bohm's quantum potential in his hidden variable interpretation of quantum mechanics {96}, published in *Physical Review* in 1952. We openly published one mechanism for creating a quantum potential {97}; there are others.

Presently these quantum potential weapons are the most powerful and most flexible weapons on earth. Nothing else can stand against them. Any nation not possessing QP weapons is already a second-rate power, regardless of how many nuclear missiles, bombers, and submarines it possesses, or how many high-energy lasers and high power microwave weapons it possesses.

The greatest problem the Soviets had was not in *making* the QP itself, but in (a) *localizing* its creation to the specific area or region desired, and (b) restricting its coupling to the type of equipment, entity, level, size, type of nuclei, etc. that was desired. We have not yet fully solved the problem of how they are able to do that, but have made a little progress upon it.

The Importance of Longitudinal EM Waves

The KGB energetics weapons use longitudinally polarized and time-polarized EM waves as their basis, rather than transversely polarized EM waves. There is a surge of renewed U.S. interest—and a revolution in electrodynamics—just underway in this country (and in the major weapons laboratories of other nations) *vis a vis* longitudinal EM wave solutions to the major equations of physics. E.g., one may check the Los Alamos National Laboratory Internet web site for summary papers by Rodrigues and Lu {98}. There are now formal EM wave solutions faster than light speed, slower than light speed, etc. {99}. There is also experimental support for superluminal tunneling of EM waves in waveguides {100}. In addition, as is well known, the speed of the ordinary scalar potential is infinite in the Coulomb (transverse) gauge {101}

Higher topological algebra is being used to embed the electrodynamics in most of the KGB energetics work. Maxwell's original theory {6} was some 20 quaternion and quaternion-like equations in 20 unknowns. Quaternion algebra

has a higher topology than either vectors or tensors. Heaviside and others reduced the quaternion-like theory of Maxwell down to four equations in four unknowns—or to two coupled equations, depending upon how represented—and formed the much lower topology vector algebra in the process. This seriously demoted the topology of electrodynamics and placed undue limitations upon what can be done with it. The subsequent mathematical promotion of electrodynamics to tensor algebra still did not recover much of the EM functioning possible in quaternion algebra. An even vaster, far more powerful electrodynamics emerges in *Clifford Algebra* electrodynamics, which may be the coming modern trend.

However, even with Clifford Algebra, there remain fundamental foundations difficulties—such as bluntly confusing *energy transport* with *energy dissipation, by* arbitrarily integrating the Poynting vector around a closed surface so as to select only the divergent portion of the Poynting energy flow. That produces the *energy dissipation flow* associated with the circuit, not the overall energy flow associated with it. The overall energy flow is some 10^{13} times greater in a nominal case, as (i) discovered by Heaviside in the 1880s, (ii) never even considered by Poynting, and (iii) deliberately discarded by Lorentz with a little integration trick {102} still used by classical electrodynamicists and electrical engineers. Electrical engineering departments, professors, and texts do not know and do not teach that all EM power sources—such as generators and batteries—actually pour out of their terminals a far greater energy flow than the meager shaft energy input to the generator or the chemical energy dissipated in the battery. Lorentz arbitrarily discarded the huge Heaviside nondiverged output energy flow component a century ago, with the observation that it "has no physical significance" {103,104}.

Part of the emerging electrodynamics revolution is intuitively obvious. Higher topology algebra used in one's electrodynamics model means that lots more things can be done—in circuits, equipment, and components. As an example, suppose one can only draw geometrical figures on a flat, uncurved plane. Then compare the figures there to what can be drawn when a third dimension is added so that the plane can be curved, twisted, folded, stretched, compressed, etc. in 3-dimensional space. That is similar to the dramatic differences between electrodynamics in a higher topology algebra and electrodynamics in the far more limited tensor and vector algebras.

Further, if someone's circuits *are working* in a higher topology, a lower topology analysis will not even see their true functioning. This turns out to be true for Tesla's work, where so many pundits have used vector or tensor algebra in the belief that they therefore knew what Tesla was doing. They did not, nor did they even use the proper tools to see what he did. For the proof, see Barrett's examination of Tesla's actual patented circuits, using quaternions {105}.

Energy, Wave Energy, and Wave Speed are All Dramatically Altered

The energy of a pure longitudinal EM wave (LW) is infinite (unlimited). In practice, only an imperfect LW is produced experimentally, and therefore its energy is finite, but that energy may be extremely large, and the wave's propagation may be many times faster than the speed of light. This is much like *quantum tunneling*, which has been measured to be superluminal. Nimtz *et al.*, e.g., have transmitted Mozart's 40th symphony through a barrier in a waveguide at 4.7 times the speed of light {100}. Other researchers have transmitted information at lesser velocities but still at greater than c, the speed of light in standard vacuum.

Einstein assumed light speed in vacuum to be universally constant. That is correct for *transverse* photons and *transverse* EM waves, but not necessarily for other polarizations. Instead, it can be a function of the energy density of the vacuum (i.e., its stress energy density), which can be a matter of the gauge and the wave polarization. Further, *c* as a constant applies to transverse polarized EM waves (which are "surface" waves of the medium, so to speak) and not to longitudinal or time-polarized EM waves (which are "subsurface" or "subspace" waves). In general, the speed of the EM wave can be a function of the energy density of the vacuum (i.e., its stress time-energy density). And it is also a function of the type of EM wave being utilized.

"Empty space" is filled and writhing with the continual transiting of higher order EM waves, the presence of standing high order EM waves, and energetically organized regions where the energy is in the LW mode and in the time-density mode. Indeed, space (more correctly, spacetime) itself is nothing but a plenum of such waves and their wave-to-wave interactions.

The longitudinal and time-density effects in empty space are correlated with seasonal and periodic variations of time-charging and longitudinal EM wave emissions from planets, stars, etc. As a result, the characteristics of empty space itself periodically vary, and these can be detected as variations in the speed of light through the affected space.

The interplanetary radar measurements, e.g., do indeed show several periodic variations of the speed of light in interplanetary space, on a weekly and essentially monthly basis. In this data the proclaimed constant speed of light is upheld only by averaging the measurements over a month-long period, as shown by Wallace {106}. Actually, the scientists are dealing with variations of the periodically varying local time-density of spacetime, but have not taken that into account.

There are also specialized "galloping wave" zones, created by variations in the interferometry of the interpassing and interfering longitudinal EM waves in space. Such galloping waves from wave interferometry are already known in the literature {107} from 0.1 to 100 times the speed of light, but they do this on a

"surge forward and lag backward" mode about an *average* speed of c in the laboratory here on earth. In space away from planetary masses, that value "c" varies from its textbook value also.

All that has really been shown is that interplanetary space is *not quite* uniform after all, contrary to present scientific assumptions.

One would think that this *fundamental foundations anomaly* shown by the interplanetary radar measurements would excite the entire scientific community and trigger a massive scientific investigation. Instead, scientists such as Wallace who publish critical analyses showing that the data directly prove the variation of c in "ordinary" space, are just ignored and essentially "parked on the side-lines" until they eventually fade away.

A Process for Creating Longitudinal and Time-Density EM Waves

Today we know that some plasmas very often can produce a longitudinal EM wave from a transverse EM wave, and can produce a transverse EM wave from an input longitudinal EM wave. This was not known when the Priore team was performing its experimental work. However, it provides one method for producing and detecting longitudinal EM waves.

The Priore team in France unwittingly made longitudinal EM waves by inputing transverse EM waves into Priore's rotating plasma in a giant plasma tube (Figures 12 and 49).

- At the end of the project, Priore had developed a large unit to treat humans.
- A few were treated.
- Cures replicated what had been done in lab animals.
- The massive size of the unit and long treatment time (hours) made the process bulky and very inconvenient — and expensive.
- We proposed a way to do it with a suitcase-sized unit and a treatment time of two minutes.*

*See *Porthole Briefing,* www.cheniere.org

Figure 49 Priore's large plasma tube installation in his 3-stories-high treatment facility for humans. Results obtained in animal experiments were also duplicated in human experiments.

Quantum Potentials and Multiply Connected Spacetime

It appears that a sufficiently clean longitudinal EM wave can be utilized to

create a *quantum potential*, very similar to Bohm's notion, by iterative retroreflection between two phase conjugate reflectors. When sufficient *iterative self-targeting* occurs and persists, the waves eventually "snap in" and fully converge to laser-like beams without any energy divergence {97}. At that point, one has achieved an essentially "pure" LW, which has infinite velocity. For all practical purposes, there is then little or no difference between this wave and a quantum potential.

A pure longitudinal EM wave just "appears instantly" everywhere in space that it will be. It is already an element of a quantum potential. In this sense, all that a "quantum" potential is, is an ordinary scalar potential in which the composite EM longitudinal phase conjugate wavepairs really are pure longitudinal EM waves. It would seem that this also moves the gauge to the Coulomb gauge, so far as the potential is concerned. It follows that, by establishing significant and clean longitudinal EM wave contact between any two points via iterative retroreflections, one establishes a quantum potential if sufficient harmonics are established in the contact. The implications for "phase conjugate shooting" to go one step farther are obvious.

By "scanning" an area with the appropriate LW transmitter array, with deliberately imperfect LWs so that contact reaction occurs, and then decreasing the imperfections in the scanning by iterative retroreflection, it appears that a quantum potential can be created and connected between the transmitters and a desired distant region.

Essentially, in the case of pure longitudinal EM waves and quantum potentials, we must model the situation in terms of a *multiply connected spacetime*. The divergence-free waves are now pure longitudinal waves in one sense, and pure potential beams in another sense. In any case, the Coulomb gauge applies. As is well-known, the potential moves at infinite velocity in the Coulomb gauge.

Thus a single station can be connected by such a QP to any number of distant stations—by first "knitting them together" into a common multiply connected spacetime by iterative mutual LW self-targeting beams. It matters not if one or more distant station(s) is/are then moved beyond the star Sirius; the moment an energy signal appears in the initiating station, it is already instantly in each distant coupled station anywhere in the entire universe. There is no separation distance involved. Here *one no longer needs to propagate transverse EM wave energy painfully through space at the speed of light.* Instead, one is now dealing with multiply connected spacetime. One now has the instant appearance *in each and every distant coupled target* of the energy input into the single "transmitting" or "coupling" station. So the process is a startling and giant "energy amplification method" as should be expected from something that has infinite energy in the first place!

One vulnerability and disadvantage of a QP weapon is that, if the target is aware of one's coupling and also has QP technology, he can now immediately send

back any energy form or "greetings" he wishes, from any one of his coupled targets. He can even do it inadvertently, without even knowing he has been coupled by a quantum potential. In other words, the QP provides a two-way street, if the target is aware of it and has the technology himself, *and even if he is unaware of it and does not have the technology.* For that reason, actual use of the QP weapon in strategic strikes requires caution and special considerations. Usually it requires very rapid single use and then cessation of any further usage.

Need for Caution with QPs Used Against Biological Organisms

Another QP weapon disadvantage is that rather extreme care must be rigidly exercised, particularly when linking living creatures. For living things, the QP is best utilized in the absolute minimum energy mode. E.g., *an extremely weak OP already links every member of the human species.* Suppose one increased that linkage intensity carelessly. Immediately the entire human race is in grave difficulty. Every death of a person feeds into every other living person. Every birth of a baby feeds into every living human. Even the fertilization of one human ova instantly feeds into all other ova. The integration of all those changes would totally disrupt—and instantly destroy—all human life on Earth. Since chimpanzees have very similar genetics to that of humans, all the chimps would probably die also. Other higher primates would also suffer or die, as would many other species.

What might be useful, of course, would be to use a QP to kill every smallpox, HIV, Ebola, and other dread disease pathogen on Earth. If so, it would first have to be made extraordinarily specific, else it could threaten all or most of the life on Earth.

A very useful adjunct would be to use a QP device to nearly instantly scrub and decontaminate (disinfect) an anthrax-contaminated large city—such as New York or Washington, D.C.—by instantly killing all the anthrax spores in that locality. Or to clean all the antibiotic-resistant staph pathogens out of U.S. hospitals by just killing them all instantly and periodically. Or to rid the Earth of necrotizing fasciitis—flesh eating disease pathogens.

An extremely localized QP could be used to connect with all HIV viruses and DNA inside an AIDS patient's own DNA. One could then kill the HIV viruses not yet integrated into the patient's cellular DNA. One could also time-reverse the patient's own HIV-infected DNA back to normal, effectively "removing" the HIV DNA already dumped into the patient's own infected cells. In theory, 100% of the HIV infection could be removed from the patient's body, restoring him or her to a completely HIV-free condition.

A Hypothetical Example

Suppose one arbitrarily increased the even weaker QP that presently joins all living things on Earth, regardless of species. Instantly every living thing on Earth would die, and the Earth would be instantly converted to a sterile planet.

Even though *physically embodied* life was gone, however, all the forms of those species would remain in spacetime activity, their vacuum engines—for both minds and bodies—forever embedded in the local potentials and fields of the material Earth. In other words, the Earth's potentials and the local spacetime potential would still be *dimensioned* and *conditioned* for the life forms that once moved upon it in physical form. The dimensioning and conditioning (engines) for every life form that ever lived on the Earth *exists now* at every point in the Earth and in the local spacetime. With proper application of energetics, in theory it is possible to recover any of these life forms desired, back into living form.

When one understands that environmental aspect, one understands why the Miller-Fox-Urey biogenesis experiments {108,109,110} (Figure 50) would still produce living organisms again. A *physically* dead planet or test flask is not necessarily a "completely dead" planet or flask, when one considers the presence of spacetime engines and dimensioned potentials. One recalls that these forms and engines contain not only physical forms, but also the mind-aspects and the mind/body coupling and dynamics aspects as well.

In short, the entire biochemical notion of biogenesis from truly inert matter devoid of any form of life or pattern of life appears to be a false premise. Since potentials reach to the end of the universe, then any structured potential structures *(dimensions)* the universal vacuum potential everywhere in the universe {111}. The Miller-Fox-Urey experiments were not performed in a truly "sterile" environment after all, when the new energetics is considered {112}. One realizes that the entire universe is alive; the mere presence of a single living microbe or other form anywhere establishes an entire living noosphere. The Russian researchers—such as Kaznacheyev {113}— into EM induction of disease in targeted cells at a distance also realized that biology included a noosphere, and it could be engineered.

- Engines of and from all life forms ever on earth or in the universe exist in the ambient vacuum potential.
- The Miller-Fox-Urey experiments were not in a "sterile" environment.
- Heat (IR) and UV constitute (1) a harmonic interval with a difference frequency, and (2) amplifying by the process previously shown.
- These experiments "kindled" previously living forms from the available gases etc. by amplifying the ancient living engines from their virtual state to the observable state, so that the masses were molded into the physical states of their templates.

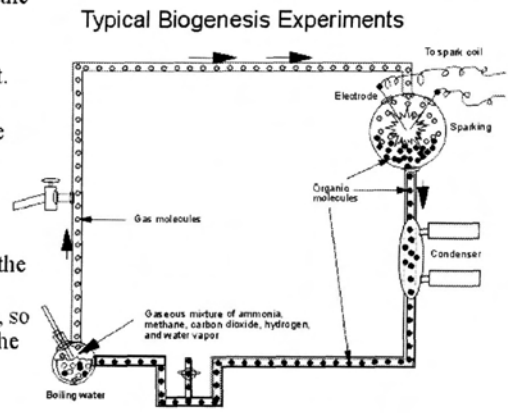

Figure 50 Typical Miller-Fox-Urey biogenesis experimental apparatus.

Herman Kahn, then director of the Hudson Institute (a leading think tank), once remarked that it did not concern him that there existed mechanisms that would destroy all physical life on earth. Instead, he stated, it concerned him that he know almost 200 such mechanisms. The quantum potential weaponry is yet another doomsday weapon with a thousand lethal mechanisms to add to Kahn's list, were he still with us.

The QP Weapon Is a Superb Energy Amplifier "For Free"

In a multiply connected spacetime established between multiple separated (to the observer) stations, one can instantly input one megawatt of power into *every distant stution* by inputting it into a single station. Suppose that coupling station is coupled via QP to one million distant stations (scattered anywhere in the universe). Then in each distant coupled station there now instantly appears one megawatt of power, even though we have input only a single megawatt in our "transmitter" coupled station. This is a superb *one-on-many weapon system and energy amplifier*—perhaps the ultimate weapon system.[30]

AS an analogy for understanding, one can look at it this way. Put a dot (point) on a piece of paper. Mathematics tells us that an indefinite number of other points can be "superposed" directly on that original point. Now input some "energy" into the original point. It instantly appears in each and every other superposed point. That is precisely the way a quantum potential linkage between stations

[30] However, we should not be loo surprised at such "astonishing" effects, once we appreciate that with the quantum potential and pure longitudinal waves one is playing with infinite energy anyway.

works, except that in normal singly-connected 3-space the points are *observed* by a normal observer to be widely separated. Aristotelian logic—which is an "either/or" logic—does not apply. Instead, a higher topology logic applies.[31]

The QP weapon can be used with microwatt input to induce low-level disease states or pre-disease states *(shadow disease states)* (Figure 51) in entire populations. Tests done in this fashion will violate the "vector carrier" aspect of infectious disease transmission. Instead, the tests will cause a few widely spaced nearly simultaneously cases of the disease being tested. Several such tests (e.g., with necrotizing fasciitis) have already been conducted in the populace of the United States.

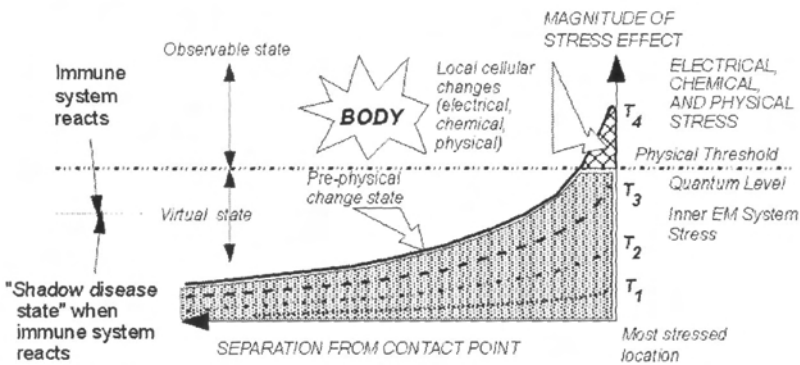

Figure 51 The shadow disease state is that structured virtual state level of the promoting disease engine template, at which the immune system reacts.

Or a QP weapon can be used with megawatt or gigawatt input to blast multiple distant targets simultaneously. One may destroy, e.g., every single transmitter of a given type. Or one may instantly kill all ships and weapons and paraphernalia in a large naval task force steaming toward its target. Or if one wishes to take the ships and equipment, the weapon can just kill all the humans instantly in that task force. ICBM sites, e.g., are vulnerable and obsolete since 1990 to any nation possessing QP weapons. So are underwater nuclear submarines and long-range strategic bombers. The entire strategic and tactical armada we have built up so painfully over the decades is obsoleted—also meaning *countered*—by any enemy possessing sufficiently advanced energetics weapons, and particularly quantum potential weapons.

[31] We developed such a logic years ago, and have recently included **it** in *Energy from the* ***Vacuum*** 2002, *ibid.*

Other Novel Uses of QP Weapons

If an enemy has such QP weapons and you do not, you are easily and directly destroyed at will, once certain other deterrents are overcome. One of these previous deterrents that had to be overcome was the stability of nuclear weapons in our nuclear arsenal. To remove this stability and render them easily destroyed, the holder of a scalar interferometry capability could induce sudden massive fissioning and fusioning of many of the targeted onsite weapons if the scalar potential interferometers were used massively. However, the resulting tremendous nuclear explosions—many "in the dirt and dirty"—would also unacceptably damage the attacker. Further, major antagonists usually clandestinely introduced hidden nuclear weapons into the cities and target areas of their opponents, which practice was known as "dead man fuzing." The notion was that, even if one side suddenly destroyed the other, that destroyed side could stil1 detonate its secret nuclear weapons hidden in the attacker's homeland territory, destroying him as well. In essence, the killed side (the "dead man") had set off the fuzing of his pre-planted weapons, to destroy the attacker even though the "dead man" was already dead.

One strong reason that the Russians pursued the quantum potential weapon so strongly was precisely because it offered a mechanism to solve this "dead-man fuzing" problem, removing it as a viable deterrent. Obviously it would be quite advantageous to be able to dud or destroy these hostile weapons in one's very midst, even though one did not know their locations, and pull the fangs of the dead-man fuzing installed by one's opponent.

There appear to be ways of directly connecting a QP, e.g., to every atomic nucleus of a given type, in a given region (say, in a region consisting of on the surface of the Earth, in the Earth to some depth, in nearby space, on the surface of the ocean, and beneath the ocean). Connection can be made, e.g., to every U235 nucleus and to every weapons grade plutonium nucleus. Or with the technology developed, the users ought to be able to make such connection only between certain pre-selected *localized amounts* of U235 nuclei or plutonium nuclei.

Now suppose that such a QP is established between weapon-sized groups of U235 atoms. Then one hits one U235 nucleus in such a group in an activator station with a neutron bullet. Voila! One simultaneously hits every other linked U235 atom (including the activator station—one just blew it to smithereens if it contained very many U235 nuclei) in such weapon-sized groups. The raw U235 in ores in nature is still okay if the ore contained only tiny traces of U235 nuclei. But all the "neutron-struck" fissionable nuclei in nuclear weapons worldwide—regardless of owner or location—fission in the weapons immediately. That destroys all the nuclear weapons on Earth—including the clandestine nuclear weapons that various nations have spirited into other nations perceived to be their enemies, as a "checkmate" against sudden surprise attack. *One* does not need to know where a weapon is at all.

However, it gets all the weapons by exploding them, and that itself could create a giant nuclear destruction and fallout problem that would probably do in most life on earth because a great many nuclear weapons will have exploded "in the dirt and dirty." In short, it is an entirely unacceptable solution to the dead-man fuzing problem.

Of course, no *sane* enemy would wish to use the QP in such fashion, because it is quite suicidal for him and essentially destroys civilization. But suppose the sane enemy is well aware of the exact nature of the new cold type nuclear reactions (we explained these in an initial rough paper given in August 1998 at an Energy conference in Utah). The energy initiating these "time-reversed" nuclear reactions starts from "inside" the nucleons in the nucleus and moves outward (that is true of any "reversed" zone).

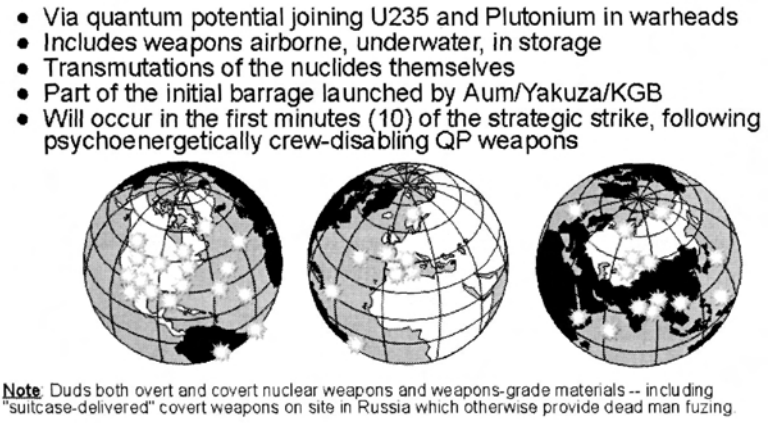

Figure 52 Simultaneous dudding of nuclear weapons worldwide. Also duds nuclear reactors and nuclear propulsion systems.

Direct *isomeric transmutation* then becomes a preferred decay reaction to induce in the nuclear weapons one wishes to dud. By gradually inducing (slowly "kindling") one of these transmutation reactions, one can just "transmute" the U235 to—say—an isomer such as U238, with some readjustment and energy balancing in the ensuing rebalancing decay processes. In that way, one gets no nuclear explosions. One can even choose the transformation or several successive transformations so as to minimize any resulting nuclear radiation. The attacker also destroys all the nuclear reactors, including those in civilian power plants, nuclear submarines, and elsewhere. But he gets just about all the nuclear weapons if he transforms both U235 and plutonium (Figure 52). In about 10 minutes he will dud them all, without any nuclear explosions, but he would probably allow about one hour "just for good measure and nearly 100% certainty."

This offered the Soviets the ideal solution to the worrisome hostile nuclear arsenals of the world, since they also had additional nonnuclear strategic weapons of a different kind and of great power.

Apparently that very kind of QP weapon became operational, on site in Russia, circa 1989 under KGB control. For the first time, it provided the KGB with a guaranteed solution to the nuclear dead-man fuzing problem that had until then prevented its massive use of the scalar potential interferometers (such as in 1985-1986 as originally envisioned by Brezhnev).

By almost simultaneously leasing the earlier scalar interferometer weapons to **the** Yakuza and Aum Shinrikyo at the end of 1989, the KGB obtained an influx of vast new funds {114}. It thus concentrated even more intensely on the more advanced energetics weapons such as QP weapons and psychoenergetics weapons {115}.

So with a QP weapon one can attack multitudes of targets, using a single "coupler" or "transmitter," all without "propagating the EM energy through 3-s**pace."** Further, with the technology developed, only the number of outrigger stations coupled limits the energy amplification achievable. One can alter matter at any level, from the quarks in the protons and neutrons in the nucleus, to the lattice bonds, to the molecular bonds, etc. Or one can structure the emerging energy (that emerges directly out of the local spacetime itself), so that *structured local spacetime curvatures* (engines) appear in the target zone(s). These ST engines can be generated so as to perform macroscopic functions against real systems—e.g., jamming electronics, as against the U.S. air attack on Libya in April l986 (Figure 25), or as was done by a longitudinal EM wave interferometer in the attack and kill of the U.S.S. Thresher (Figure 6) in April 1963 {116}.

The U.S. Narrowly Escaped Destruction Twice in 1997 Alone

On two occasions in 1997 the United States would have been utterly destroyed by the die-hard faction of the KGB, except for direct countering by a friendly little foreign nation. The present author and three colleagues played a very minor role by alerting that nation to the impending attacks. There was certainly no reason to contact officials of our own country; the U.S. was and is powerless to prevent such attacks, although *hopefully* that is changing! It made much better sense contact the only nation that could possibly avert our impending disaster. Of course we later also informed proper U.S. government officials of our actions.

The first strategic attack was scheduled for between early to mid-February, and involved (1) dudding all nuclear weapons, (2) striking the QP weapons in the little nation simultaneously, as well as extant scalar interferometer weapon sites in other foreign nations, and (3) then leisurely blasting cities, facilities, and installations with iterative and continued scalar interferometer strikes. This third

phase would include work assigned to the Yakuza/Aum Shinrikyo teams. That is how the Yakuza (and Aum Shinrikyo) expected to revenge themselves for the Western defeat of Japan in WWII, and for the West's dropping the atomic bomb on Nagasaki and Hiroshima. To be able to "get in on the kill" is why the Aum Shinrikyo and Yakuza leased the scalar (longitudinal EM wave) interferometers from the Russians in the first place {117}.

These, along with negative energy EMP weapons, are the kind of energetics weaponry that now determines our fate, and against which the U.S. presently has still inadequate defenses. Our own scientific community does not believe such weapons even exist—apparently due to the "not-invented-here" syndrome. Most of the U.S. scientific community is thus relatively useless and outdated as far as contributing to the strategic survival of the United States is concerned.

Purpose of the Novel Attack on Captain Button

Hopefully, some scientists are aware of the strange incident that involved the mental seizure of Captain Button in his A-10 (Figure 22) and controlling him for well over an hour (Figure 23), including controlling his perceptions, intent, and actions while performing complex technical tasks. That was the test of a KGB *psychoenergetics* weapon, developing and to be deployed by the KGB. That was the "acceptance test", so to speak—deliberately conducted over the United States—for the KGB's system that would be produced in numbers sufficient to counter the QP weaponry, if the QPs of the little friendly nation were to be placed in the insane command and control mode. This was yet another Soviet counter, planned for the near future against the counter by which the little nation did force abortion of the KGB second attack (scheduled for May 1) in 1997.

The purpose of the attack on Captain Button can be understood as follows: The later second scheduled strategic attack on the U.S.—scheduled for May 1, 1997—was forcibly aborted after the friendly defending nation switched to an *insane* command and control mode. The insane C3 mode counters the MindSnapper type attack that instantly kills all on-site operators and renders the sites too "hot" for new personnel to come in from outside and control it. In short, the U.S. could have been destroyed in that scheduled May 1 attack, but with the change of the friendly QP weapons to insane C3, Russia would also have perished in the immediate quantum potential counterblow from the little nation[32] that would have been automatically delivered by the site weapons themselves. The May 1 attack had been predicated upon the fact that a preliminary MindSnapper (negative energy EMP) attack on the friendly QP

[32] There are also variations. As an example, the insane C3 can also include a separate channel requiring a countering "punch in" code every 15 minutes (as in a heightened alert status) or the control system will order the launch initiation (this accepts that all on site personnel have now been suddenly killed). So the insane control system is also flexible, and many variations and considerations are possible.

weapon sites would have instantly killed all persons on site,[33] and neutralized the site for some months because of the resulting longitudinal EM radiation. However, the shift of the C3 of the QP weapons to insane mode rendered such a pre-emptive MindSnapper attack totally ineffective because Russia would still have been destroyed.

Hence another countering means was required, and in fact that additional system was already in development. It was a very sophisticated array of psychoenergetic weapons, each with a special, highly trained team of operators capable of fully controlling one targeted individual while he was directed and controlled to go about performing desired technical tasks. We estimate that it required one psychoenergetic weapon (very complex, multiple transmitters) and an operator team of perhaps 20 to 30 skilled operators (one for each major human function to be controlled) to adequately control the mind and actions of one distant person performing quite technical tasks. Hence several hundred such "weapon sets" were required to take over all persons on the targeted QP weapons sites in the friendly nation, have the controlled crews deactivate the QP weapons including using the security code and procedures to standdown for maintenance, etc.

Once the QP weapons were totally on standdown, then the MindSnapper would have struck suddenly and killed every living thing on site, neutralizing the site for several months due to subsequent strong longitudinal EM wave emissions from the struck site. No new crews could have entered the site and lived, so the sites could not be operated after MindSnapping, even though the QP weapons were still intact but just on standby. Of course, a third phase then would have involved strikes by scalar EM interferometers to leisurely and completely destroy the systems and sites, permanently taking out the physical system as well.[34] With the first two of that three-part series of strikes completed successfully, then the KGB weapon sites would have been absolutely free to blast North America and our European allies into smoking ruins, leisurely and at will, given the first 10 minutes of dudding all nuclear warheads worldwide, to take care of that old type of "dead man fuzing".

From the open reports of the Button incident, and from the kill of Captain Svoboda a few weeks later, the nature of the next strategic attack that would be scheduled was immediately apparent. Accordingly, we warned the little nation about the shift to a new attack plan, and estimated the new schedule between mid - 1999 and the first of 2000. Of course, we also passed that information on to

[33] We point out that it required a longer time to develop the more powerful negative energy EMP weapons capable of just destroying the sites, personnel and all. The first effective weapons of that type could easily kill personnel brains, nervous systems, and hearts while still doing little damage to the much more robust *QP* systems and on site equipment.

[34] We strongly believe there are shielding provisions at those sites, against scalar interferometry attacks, which reduces their effectiveness and delays their destructiveness. However, so far this analyst has not deciphered those shielding methods or mechanisms.

our government as well, but apparently, no one believed it. The proper U.S. intelligence agencies, however, certainly intercepted my faxes to the little nation's Military Attache in Washington D.C., and particularly my fax a few days before May 1, sent directly to the Prime Minister of that nation and urging the change to an insane command and control system for the QP weapons and the reason why.

It turned out that, some months after I alerted them to the coming psychoenergetics, MindSnapper, and scalar interferometry attack in that order, to be scheduled between mid-to-end of 1999, apparently the friendly nation suddenly struck and utterly destroyed the KGB facilities for the MindControUer negative energy EMP weapons being painfully built up in sufficient number. Probably scalar interferometry weapons were used to destroy them. The onsite psychoenergetics crews and facilities were destroyed and neutralized completely.

Anyway, as we passed mid-1999, the type of "Y2K" problem we were worrying about was whether or not the attack was on, headlined by a psychoenergetics weapon strike on the little nation first, with the three phases as previously scheduled back in 1997.

Later, in early 1999 I realized the Russian/KGB development of the causal system robots (Figure 10), mentioned in the introduction. In the latter part of the third quarter of the year, working at my computer at night, I was struck by one of these very beasts from within my computer (Figure 20), in very bizarre but unmistakable fashion (previously detailed). In 10 seconds I was nearly killed and severely disabled for a period of time (it took four days to recover completely). Because of the features deliberately utilized by the CSR on my computer screen so I would recognize it, I grasped the nature of the attack (the KGB *wanted* me to recognize it, and live to tell about it!), how it was done, how it jammed the brain and vision center and strongly fibrillated the heart, upset the equilibrium, etc. I also realized that, in 20 seconds or so additional exposure, I would have been a very dead person, expiring with a very violent heart attack and severe brain embolisms. Note that the CSR deliberately struck directly from the computer screen through my retinas and onto the nervous system, passing through the vision center and flashing it tremendously, and jamming my mind, brain, and nervous system.

When I recovered shakily about four days later, I notified the small nation, once again, as best I could, giving the exact symptoms of the attack and explaining what it was. By then I knew what was coming down, the form it would take, and the deceptive cover (Y2K uncorrected errors!).

The little nation then quickly proceeded to search out—apparently *inside* the North American signals, potentials, fields, and waves "superhighways" for the CSRs—all the CSRs and destroy them in place. It turns out to be a fairly straightforward operation, once one possesses advanced longitudinal EM wave

interferometry weapons and techniques. Locating a "very dense" and very dynamic set of LWs performing organized functions is analogous to a normal radar locating a large bomber in cloud cover. One "burst" from the LW "radar," and the targeted CSR is completely disrupted and electronically destroyed.

So a very short (lasting a few days) and strange strategic battle was fought in infolded space or subspace, inside our electrical and electrical systems and inside the fields, potentials, and waves in them. A mighty attacking armada of perhaps several million main battle systems was intercepted and destroyed throughout our homeland, without the slightest notice by our own government, scientific, and intelligence communities. And without a whimper of what is usually recognized as "combat actions".

Afterwards, a very simple and innocuous little message was received which, reading between the lines, simply meant "thank you very much." In short, my hard-pressed colleagues and I got a small "Attaboy!" for our role in alerting the friendly nation.

So Y2K and the Millennium Celebration came, while we waited to see if the CSRs were gone or if they would erupt with damage all over the U.S. Fortunately, they were gone like popping balloons, and so the *fourth* scheduled strategic attack upon the U.S. in the space of three years—this time actually launched—was successfully destroyed.

Whatever I can do to help the survival of my country I will continue to do without hesitation, regardless of whether the U.S. scientific, intelligence, and military communities are aware of the new threat or not, and regardless of whether they believe it or not. Presently our fate and that of the Western world rests on the shoulders of a small but advanced and friendly nation. That is beginning to change, it seems, but still not swiftly enough to suit our needs.

We simply must change all that, by developing QP weapons and defenses ourselves. It is not an option; as an example, China has now finished—as of earlier 2002—and deployed QP weapons. Almost simultaneously, China also finished and deployed the more powerful negative energy EMP (MindSnapper-type but much more powerful) weapons and deployed them as well. So we have entered a very dangerous period when the strategic changes that are likely to occur will be both massive and traumatic.

AS this is being written in early October 2002, it is obvious that our nation is also preparing to strike Iraq if need be, either with a coalition effort or alone. If so, then Saddam Hussein will certainly unleash whatever terrorist forces he has in North America. He will attempt to unleash upon us all the weapons of mass destruction at his command. This could even happen within the next 30 days, with the MidEast exploding, giant polarization of the Arab world, general chaos in the MidEast and upset of world oil supplies, and skyrocketing fuel and energy costs with severe impact upon the already seriously ailing U.S. stock market.

If Saddam Hussein succeeds in doing sufficient damage to our cities and energy infrastructure with more weapons of mass destruction than we have credited him with, then the potential economic collapse of the United States and much of the developed world is an uncomfortable possibility. If that happens, turf wars will erupt all over the world, the world economy may collapse, the KGB and rogue Japanese (Yakuza and Aum Shinrikyo) will move and unleash further destruction, Pakistan and India are likely to erupt into a nuclear war, and several other regions may also erupt into nuclear war and use weapons of mass destruction. What China might do in such event is anybody's guess.

In short, the Armageddon we have so long feared, with the resulting collapse or destruction of much of civilization, could well be approaching. Let us hope that dark picture is terribly, terribly wrong, and that we successfully avoid Armageddon one more time!

Meanwhile, we would be in much better shape to weather the coming storm had our scientific community not grossly betrayed us. But if and when millions of Americans are dying in the streets with no effective means of treatment, and no effective defenses to prevent onslaught after onslaught against our nation, all those deaths and all that suffering will be directly the fault of our own organized scientific community.

Rogue Japanese (Yakuza and Aum Shinrikyo) Have a Role

In the information briefing furnished the previously named agencies, we briefly detailed the elements of the attack, how our own nuclear weaponry can be dudded anywhere, etc.

We also detailed the strange role of the Japanese Yakuza and the Aum Shinrikyo, who leased the operational use of the early generations of KGB longitudinal wave interferometry weapons in 1990 directly from the KGB. The first down payment on the lease was $900 million. I previously furnished pertinent information on this to an investigative U.S. Government agency. Since then, the Yakuza have set up their own scalar interferometry weapons development facilities in Japan, including portable energetics weapons,[35] and have assumed a very secret and nearly unsuspected role somewhat similar to Bin Laden's role in the attacks of September 11, 2001—but much more deadly when the coming Armageddon erupts.

Inducing the Gulf War Disease

In 1986, the Russians had already solved the dead man fuzing problem theoretically, but had not yet completed the development and deployment of the

[35] We strongly suspect some of these portable weapons have already been infiltrated into the United States—e.g., to be used against nuclear power plants and other lucrative targets such as refineries, oil fields, etc.

necessary QP weaponry. The KGB's first "combat demonstration" test of the **ability** to localize a QP in a selected region of space was against the U.S. air attack on Libya in 1986. That test apparently used a laboratory apparatus to prove the process. In short, it was a major milestone whose success moved the system into full production engineering and production. The system was then developed at very high speed after the successful demonstration in 1986. The first strategic KGB QP weapon(s) became operational on site in latter 1989.

It was this QP weapon that was used to generate the so-called *Gulf War Disease* in our soldiers in the MidEast. In the action package, I explained precisely how that was done. I have also finally placed the simplified gist of that explanation openly on the Internet for all to see (website www.cheniere.org). Those suffering U.S. veterans were *casualties of war,* not victims of just nerve gas whiffs or chemicals or their own stress, etc. The initial U.S. Government and U.S. scientific community's assertion that "it was all in their heads" and due to stress, insults every veteran who has ever served his nation. One justifiably has contempt for such treatment of our veterans. Sadly, the latest "studies" are **beginning** to conclude the same thing once again.

Apparently our intelligence and military command agencies have not yet learned t**he** lesson of the decades long Soviet microwave radiation of the U.S. Embassy in Moscow, which was responsible for health changes of many kinds in U.S. personnel and was also responsible for the deaths of three U.S. Ambassadors to the Soviet Union. Apparently we are still using radar engineers and electrical engineers for electrodynamics analysis, and these analysts apparently still believe that in the absence of the EM fields there can be no induced EM effects. One sadly comments that, just as the electrical engineering departments of our universities have been unable to walk across the campus to the particle physics department and find out what the discovery of broken symmetry in 1957 portends for their discipline and model, then the intelligence community apparently has not yet learned that no EM analysis of such things as the microwave radiation of the U.S. Embassy in Moscow or the shootdown of the TWA-800 is worth a tinker's dam unless it is a higher group symmetry EM analysis. As Barrett showed, our fellows still have not grasped what Nikola Tesla already accomplished in actual patented circuits circa 1900 and shortly thereafter. Tensor analysis and vector analysis simply will not show what is really there.

Our veterans were hit with a "cocktail mix" of specialized disease "spacetime curvature engines" just below the observable threshold, in the "shadow" (virtual, but nearly observable) state[36] (Figure 53). The immune systems and the cellular

[36] One should think deeply about this, in terms of the solution to the source charge problem (which our engineers have not thought of very much, much less solved). Every charge already "engineers" the virtual stale at will, converting virtual energy into deterministic observable EM energy. That means we can directly engineer the virtual state vacuum itself if we put our minds to it. **Actually** Nobelist Lee has already pointed out that we have *not even tried to do this!* See T. D.

regenerative systems do react to that shadow state level.

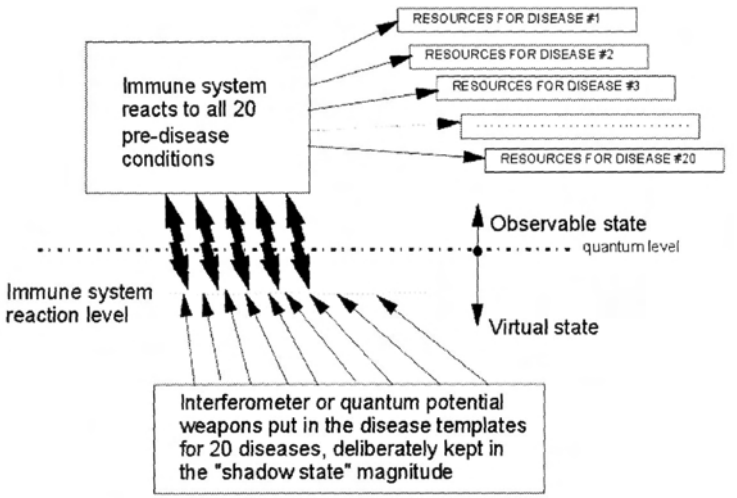

Figure 53 Spreading (thinning) the immune system's ability available to meet a new pathogen.

Such a "simultaneous mix" shadow induction "spreads" the reacting *finite* immune system and regenerative system (Figure 53) and their resources all across that entire mix of shadow diseases, so that only a much smaller portion of the immune system and of the regenerative system is directed against *any one* of the shadow diseases. This in turn greatly heightens (by a factor of 5 or more) the susceptibility of the body to all additional disease pathogens, and it greatly lowers the ability of the body to recover from any disease or biological warfare strike. In addition, the exposed veteran's body fluids and masses have accumulated a persistent "time-density charging" that very slowly decays (by emission of weak *longitudinal* EM waves) over months or even a few years.[37] The sperm from these veterans did indeed have the innate "engines" and therefore the capability to gradually infect their wives. So did the saliva in their mouths. The weak "dimensioned" LW radiation from their bodies could also slowly alter the cellular regeneration and immune systems of their family members in close proximity, over a period of time, thus inducing the disease in them {118,119,120}.

Lee, *Particle Physics and Introduction to Field Theory*, Harwood, New York, 1981, in his "Chapter 25: Outlook: Possibility of Vacuum Engineering," p. 824-828. On p. 383 Lee points out that the microstructure of the scalar vacuum field (i.e., of vacuum charge) *is not utilized.* We add that the West does not utilize it. It has been utilized for some decades in the former Soviet Union and now in the continuing KGB energetics and bioenergetics weapons programs.

[37] See T. D. Lee, "Can Time Be a Discrete Dynamical Variable?." *Phys. Lett.,* 122B(3,4), Mar. 10, 1983, p.217-220.

The induction of GWS in our troops was in fact a test for the *present* clandestine use—already ongoing—of that technique to spread the immune and regenerative systems of the targeted U.S. population. This in turn gradually makes us more susceptible to terrorist BW attacks and disease pathogens of all types *from anyone else*. This tactic is already in place and accomplished, and it will substantially increase the American civilian casualties in our cities when they are subjected to terrorist BW attacks in the near future. *Those attacks now will have some five times the effectiveness that our present planners estimate.* In short, it is going to insure the deaths of millions more Americans. The approaching war in the MidEast, with Saddam Hussein's unleashing of his terrorist assets in the U.S. to the maximum extent possible, thus will probably see a five-fold increase in the effectiveness of some of his mass destruction weapons that Hussein's assets are able to unleash on America.

The entire affair of the Gulf War Disease was both a preliminary test and also a magnificent intelligence probe by the KGB, to clearly demonstrate once again that the U.S. Government and the U.S. scientific community are still nearly totally unknowledgeable of QP weaponry, immune and regenerative system "spreading," disease induction by bioenergetics means, etc. It follows a methodology used with great success for four decades by the KGB,[38] and one that our own government, scientific community, and military community has yet to decipher. *So long as the threat only slowly increases, Americans remain complacent in their ignorance, ignoring the boa constrictor slowly strangling them, while awaiting the cobra seen in the distance?*[9] We have unwittingly cooperated with the KGB boa constrictor for four decades, even as it slowly prepared to crush us. In the Gulf War, that crushing moved to the next threshold, to actually inflict casualties and deaths on U.S. troops and totally get away with it because of the bioenergetics (in the Russian sense) ineptness of the U.S. scientific community.

[38] The decades-long microwave radiation of the U.S. Embassy and induction of health changes and diseases, was a case in point. A high level target—the U.S. Ambassador—was involved, guaranteeing U.S. Government attention at the highest level. Puzzled, the U.S. government would then call in their most trusted EM scientific analysis groups. By the responsive actions then taken by the U.S. at the Embassy, the KGB could ascertain with absolute certainty whether or not our scientists knew of the use of infolded engines in bioenergetics. For more than four decades our actions assured them with 100% certainty that we knew nothing of what their "information content of the field and potential" actually was, or how it had been weaponized and was being used right in front of our faces and before the entire world.

[39] It is bizarre that our scientific community—even after those decades of EM induction of diseases and health changes in American personnel in the U.S. Embassy in Moscow—*still do not and cannot believe that conditioned EM radiation can induce cellular disease.* Such total blindness is inexplicable.

40-Years of Russian Induction of Diseases In U.S. Embassy Personnel

Sadly, our own fellows have never even figured out how the diseases and health changes were previously induced by the KGB for decades in personnel in the former American Embassy in Moscow. Three U.S. Ambassadors to the Soviet Union died as a result of their exposure to that radiation. Many other Americans on site were made ill or suffered health changes.

When Johns Hopkins scientists studied the problem, they found a most anomalous thing: no health changes occurred in areas *where the EM forcefields existed* in the microwave radiation. Instead, the health changes only occurred in areas where the potentials were gradient free so that the force fields were zero—and thus the potentials (and their specific internal "engines") were *persistent.* Using only a classical EM force field analysis—which does not show any of the internal longitudinal EM wave substructuring of the fields, potentials, and waves—the Johns Hopkins scientists erroneously concluded that it could not have been the weak microwave radiation causing the health difficulties, *because no such health difficulties occurred where the forcefields were present.* That is, they very naively assumed that "no force fields" meant no EM effects were possible. Their entire findings thus were based on a total non sequitur, the assumption that there can be no electromagnetically induced physical changes in matter in the absence of fields! The Aharonov-Bohm effect alone falsifies that entire premise. So does general relativity and higher group symmetry electrodynamics.

Actually, the Johns Hopkins scientists had just clearly proven the exact opposite: *that it indeed was the radiation that induced the health changes.* That is simply shown statistically, and it is a deep and continuing mystery how good scientists and their governmental overwatch did not notice the violation of inference methodology.

Simply put, there was 100 percent correlation to the presence of *gradient free EM potentials— the persistent kind.* There was zero correlation (or 100% anticorrelation) to the presence of the normal electric and magnetic fields—i.e., where the potentials changed over a very small region of space. Hence it could *only* have been the constant potentials, else we must throw out statistical inference theory altogether.

If the changes had *not* been caused by the EM radiation at all, one would have had some health changes in regions where fields were present and some health changes where the fields were absent. Considering the lengthy time the radiation persisted and the number of personnel affected, the statistics are decisive. Without question, the cause was indeed the persistent potentials where the **force** fields were zero. Whittaker's two papers—one in 1903 and the other in 1904-would then show how it was done. The 1904 paper and superpotential theory alone would *not* have explained it, since that alone does not include the

"information content of the field"—i.e., spacetime curvature engines infolded inside the normal EM potentials, fields, and waves.

So, the U.S. government and U.S. scientific community "botched it badly," unfortunately, by elemental statistical inference standards. And unfortunately, they have continued to "botch it" to this day. Both the scientific community and the intelligence community missed it. Elementary statistics theory alone, coupled with the Johns Hopkins results, clearly indicates that the microwave radiation was causing the health changes, to a very high degree of confidence.

This demonstrates how "totally inexplicable" some of the effects generated by longitudinal EM wave interferometry and by "structured" or dimensioned potentials, fields, and waves can seem to our conventional scientists. If we examine the serious foundations flaws in classical electrodynamics and electrical engineering taught in our universities, and the near-total lack of higher group symmetry electrodynamics training, we can understand why our scientists and intelligence analysts did not and do not have the background required to properly assess the incidents and effects.

Western Electrodynamics Is in Sad Shape

Actually, numerous scientists have long pointed this out. For example, quoting Mario Bunge {121}: *"...it is not usually acknowledged that electrodynamics, both classical and quantal, are in a sad state."*

In quantum electrodynamics, it is the *potentials* that are the primary causes of all electromagnetic phenomena, not the force fields as used by Johns Hopkins and the Government in its analysis. We know that classical EM is wrong in its focus upon force fields as primary EM causes; the Aharonov-Bohm effect, Berry phase, and geometric phase work in some 20,000 papers in the physics literature already show that. Indeed, we also know that the classical force fields do not even exist apart from mass; in space, only the potential for such a force field exists, in case some charged matter is brought in to interact with the EM entity as it exists in mass-free space (as curvatures of spacetime).

The Aharonov-Bohm effect and its implications have been published in *Physical Review*—our most prestigious physics journal—since 1959. Later publications have included the Berry phase extension of the AB effect, and Aharonov and Anandan's further extension of the Berry phase to what is today called the geometric *phase.* The potentials are indeed the primary EM causes, and *the force fields do not even exist as such in mass-free space, but only in mass.* Yet our classical EM taught in our universities has not been changed in its fundamental acceptance of the material ether since 1865.

Every university in America is still teaching and defending a rather mangled electrodynamics where

(1) The material ether is still assumed, even though destroyed more than a

century ago by the Michelson-Morley experiments;

(2) The force fields are erroneously assumed to exist in massfree space, but in force-free form(!!!) when what actually exists there as an EM disturbance is a general relativistic perturbation of spacetime (i.e., an oscillation of the local curvature of spacetime). Actually, force identically is the time rate of change of momentum, where momentum is mass times velocity. Thus mass is a *component* of force and force field. There is no force or force field without mass. As Feynman put it, there is no force field in massless space; instead, there is only the potential for such a force field to be formed at the various points, should a charged mass be placed at (added to) each of them;

(3) The source charges are erroneously assumed to *create* their fields and potentials and all that energy in them, reaching across the entire universe from each and every charge, right out of nothing at all. This perpetual motion and creation of energy error continues even though particle physics has known (and proven, both theoretically and experimentally) that any charge (as a set of composite dipoles, when the charge is taken with its clustering virtual charges of opposite sign) is a broken symmetry in its fierce energy exchange with the vacuum. Hence the charge extracts that energy in its fields and potentials *from the active vacuum,* and outputs the extracted energy across space {122}.

Our own electrodynamicists and electrical engineering professors and departments would have us believe - and they continue to imply such in every university in America—that every charge is a perpetual motion machine clearly in violation of the master energy conservation dictum that *energy can neither be created nor destroyed.* The complete lack of scientific understanding that every charge extracts energy from the vacuum and freely and continuously pours it out as real observable EM energy, is reflected in rather silly "witch-hunts" {123} against electrical systems which exhibit more energy output than the operator himself inputs—i.e., systems which exhibit a coefficient of performance (COP) of COP>1.0, which are open EM systems far from equilibrium in their active environmental exchange.

Let us reason together! If the second law of thermodynamics really did prohibit COP>1.0 *electrical* systems, then it also would prohibit the demonstrated COP = oo of a solar cell array. It would also prohibit the demonstrated COP>1.0 *mechanical* systems such as a windmill, waterwheel, or sailboat—all of which have COP = oo! In other words, the second law cannot even be a law if it discriminates only one type of energy prohibited from being used for COP> 1.0,

For some inexplicable reason, EM COP>1.0 systems have come to be dogmatically labeled "perpetual motion machines" by the professional skeptics since EM systems must take their excess energy from the known active vacuum environment! In short, the dogmatic scientific community is saying that "windmill-type EM systems" with COP = oo are permissible for exchanges with

physically active and observable environments (such as the sunlight used in solar cells, the heat in the air used in heat pumps, the water currents used hydroelectric power plants, the winds used in windmill power generation, etc.), but they are not permissible for exchanges with the proven modern active vacuum *virtual particle flux energy* environment, even though the discovery of **broken** symmetry in 1957 already proves that all EM energy is indeed freely taken from the seething vacuum environment by the asymmetry of the modern dipolarity of the source charge! We refer the interested reader to the proven broken symmetry of opposite charges {124}. We also refer the reader to Nobelist T. D. Lee's statement applicable to the skeptics' naive notion of symmetry. Finally, in modern physics all the major forces of nature are generated by the exchange of virtual particles. It is these forces that then translate against a resisting mass or entity to provide useful work. So all useful work in the universe already comes from the interactions of the seething virtual flux of the vacuum. On what distant planet have the skeptics been hiding while all this modern physics has been developed?

One must keep one's sense of humor! It is ironic but true that every major university in the U.S. continues to teach, uphold, and advocate—by implication—EM charges as ubiquitous perpetual motion machines, freely creating energy from nothing. And that is those professional skeptics and witch-hunters never mention that their own naive understanding of electrodynamics already implicitly assumes and teaches perpetual motion machines freely creating energy from nothing at all—and on a scale unparalleled in scientific history!

We have one chart with some 32 major foundations errors and flaws in the electrodynamics taught in all our schools; there are many others in addition. This erroneous teaching has so indoctrinated our graduate students that most electrical engineers no longer know the real difference between power (the rate of change of form of energy and thus the rate of production of work) and rate of energy flow (whether it is being dissipated or not).

Every textbook speaks of "sources furnishing power," when it is the rate of dissipation of energy in the individual loads and losses to provide the rate of doing work that *constitutes* power. Sources do not furnish power! They furnish energy flow (specifically, their source dipole furnishes energy flow, extracted and transduced directly from the active vacuum, and only a tiny bit of that enormous energy flow is diverged into the circuit and used). The various components of the receiving circuit interact with that energy flow to catch and dissipate a little of it, thus producing power and work locally in the intercepting and dissipating component.

A massive nondivergent (nonintercepted) energy flow has zero power (time-rate of doing work), but if intercepted and diverged, the divergence may develop enormous power (time rate of doing work) in and upon the interceptor, diverger, or collector. Even many physicists today are confused on the difference between

rate of work and rate of energy flow per se. E.g., for about 30 years now, there has been a polite debate involving that very subject in the *American Journal of Physics.* It is still not completely resolved, because the argument has not actually addressed where all EM energy in fields, potentials, and waves comes from in the first place: directly from the seething vacuum via the asymmetry of the source charge. It also has not addressed the long unaccounted giant Heaviside nondiverged energy flow component.

Toward a Deeper Electrodynamics

The first thing the Soviet Academicians did after WW II was to completely overhaul electrodynamics, but in highly classified areas controlled totally by the KGB. Stalin's boot firmly planted on their backside saw to it, creating the terrible fear that if they failed to produce, they would surely die. Not having experienced such a "Stalin boot," our own scientific community continues leisurely onward, while it teaches 110 years old electrodynamic material filled with non-sequiturs.

The Russian use of the "information content of the field" euphemism is a case in point. Our fellows (in both the intelligence community and the scientific community) assume the Russians are speaking of simple transverse EM wave spectral analysis. Nothing could be farther from the truth. Let me explain.

In 1903, E.T. Whittaker—a leading theoretical physicist at the time—showed that any scalar potential is comprised of a harmonic set of bidirectional *longitudinal EM wavepairs.* Each pair consists of a longitudinal EM wave and its true phase conjugate replica (i.e., its "antiwave", or time-reversed twin, coupled together).

Unknown to Whittaker, that LW wavepair actually includes a *time-density wave* in the time domain, coupled to a longitudinal EM wave in 3-space. Per quantum field theory {66}, such a coupled pair would be observable as the scalar potential. Knowledge of this specialized coupling is necessary in order to properly decipher the Priore mechanism. That mechanism was demonstrated to *time-reverse* (dedifferentiate) a diseased or damaged cell and all its parts back to it previous normal state, *genetics and all.* The time-reversal was accomplished by "pumping" the cell and all its parts in the time-dimension so that time-reversal propagation of the mass-energy is achieved. The time-domain pumping is done by the associated time-density wave, which always accompanies any longitudinal EM wave a priori. So sometimes we sloppily say that the "longitudinal EM wave pumping" causes the time reversal of the mass, but it is really the associated time-density wave pumping that causes it. The time-density wave component also can cause *time charging* or *time-excitation charging* of a mass. During its alternate existence as masstime, the time portion is altered, and that is a time-excitation or time-energy excitation.

It turns out the human cellular regenerative system (Figure 29) also uses the

same time-excitation charging methodology to produce time-pumping of the cell and all its parts. This produces a slow time-reversal (dedifferentiation) of damaged cells back to a previous state. This is in fact the basic mechanism for healing, as used by the living body.

Reversing aluminum, for example, just converts it back to ordinary aluminum. Not too interesting.

Reversing an HIV infected cell, however, would produce a healthy, normal cell with normal genetics. When a damaged cell turns into a cancerous cell, it is due to a process called *promotion* (change of the cell to a cancerous cell). *Reversing a* cancerous cell would change it back to a healthy, normal cell again—in short, it would constitute *demotion* of cancer and then healing of the damage in the now normal but damaged cell. In the AIDS patient, simply pumping the entire body with the time-density wave accompanying the longitudinal EM waves produced in a plasma—as Priore did for terminal tumors—would time-reverse all cells, completely ridding them of any residue of HIV infection. This would remove all the "HIV factories", thus completely solving the problem of AIDS. We have also uncovered a more advanced process where *matter can essentially be directly engineered in any conceivable manner,* including nuclear transmutation etc. We have filed a Provisional Patent Application and will file formal patent applications on those processes in the future, as soon as funds are available (patent attorneys are expensive!)

Time Is Highly Compacted Energy

Since time is energy compacted by some $9x10^{16}$, even small time-density changes can produce enormous spatial energy, should any of that compacted energy be *transduced* from time-density waves into transverse EM waves and thus into spatial EM energy. Such transduction can indeed occur in nonlinear materials and processes, such as in electrolysis.

The New Transduction Model Explains the Cold Fusion Results and Mechanisms

In August 1998, we presented a conference paper pointing out that cold fusion uses this very *transduction of EM wave types,* one into the other. We presented such new concepts as (i) TW to LW to TDW transduction and in the other direction also, (ii) time density charging of a particle to an excited time-density state (analogous to energy charging to an excited energy state), and (iii) the observation that excess phase conjugation in a local region can generate a time reversal zone where like charges attract and unlike charges repel.

With these concepts we were able to explain the excess heat appearing in the cold fusion experiments of hundreds of researchers. We also came up with (iv) a totally new class of nuclear reactions without the usual high-energy

considerations. That is, we showed the exact nature of the electronuclear reaction that is forming the anomalous nuclides in cold fusion experiments. Production of the new nuclides was revealed to be simply what one would expect from this mechanism, as indeed was particle clustering of like-charged particles.

We also explained (v) all the instrumental anomalies occurring in a series of well-documented cold fusion electrolysis experiments at China Lake. In fact, (vi) we added a completely new term to the conservation of energy law, thereby extending it.

An updated explanation is included in my new book, *Energy from the Vacuum*, 2002, *ibid.* With the new transduction interactions, one must state that the total energy in (a) spatial energy form, (b) mass-energy form, and (c) time-energy form is what is conserved.

So when transduction occurs in cold fusion experiments (electrolysis), some of the time-density charge energy is gradually transduced into ordinary transverse EM wave energy, which as it scatters produces excess heat not accounted for in present particle physics interaction models.

Scientists with only the "old" 2-term Einstein conservation law in mind, will be firmly convinced that this excess heat represents a violation of conservation of energy, hence is impossible. So they will question the calorimetry ability of the cold fusion scientists, etc. Unfortunately, the more ardent defenders of the orthodox faith will unjustifiably impugn the intentions and morals of the experimenters themselves with vicious ad hominem attacks. Such has indeed been precisely the case. Many of the harsh scientific critics have acted like cur dogs in a pack attack, and not as scientists at all.

Once one analyzes cold fusion in the new 3-term conservation manner and with the new transduction concepts, one immediately sees that the *overall* conservation of energy is upheld, while the *special case* represented by the former energy conservation law (conservation of the sum of the spatial energy and the mass-energy) is *permissibly* violated. The former case was a special case in that it arbitrarily assumed that no transduction of time-energy into spatial energy or mass energy—or vice versa—occurred.

In essence, successful cold fusion experiments show that, via transduction, a bit of time itself can be "utilized for fuel" and transduced into ordinary EM energy. Energy-wise the system has become a nonlinear open dissipative system[40] far

[40] But we point out one idiosyncrasy of thermodynamics, which defines a "closed system" as one in which mass does not cross the system boundary, but energy is free to exchange across that boundary {125}. Hence, eerily a "closed thermodynamic system" is actually an open system with respect to energy exchange between system and environment. As such, energy-wise the system can be a system far from energetic equilibrium with its external active environment, and still be considered a closed thermodynamic system! Energetically, a *closed thermodynamic system* that exchanges energy but not mass is permitted to exhibit COP>I .0 and even COP = oo!

from thermodynamic equilibrium {125}. As such, it is permitted to (1) self-organize, (2) self-oscillate, (3) output more energy than it itself has, by merely receiving, converting, and using excess energy from its environment (in this rase, from the transduction of a tiny bit of the time-charging that has occurred), (4) power itself while simultaneously powering a load or performing useful work, and (5) exhibit negentropy. With the exception of transduction of time-charge into excess energy, all of that is already in the thermodynamics texts, though it has not been clearly spelled out in electromagnetics texts. The source charge, e.g., exhibits all five of those capabilities. *The inclusion of the time-domain as part of the external active environment, however, is an extension of* ***previous*** *open dissipative system work by leading researchers such as* ***Prigogine.*** *It dramatically extends the meaning of "active environment".*

Why There Is a Time Delay in the Onset of Cold Fusion Phenomena

With an energy-to-time compaction ration of $9x10^{16}$, energy processes have to transduce spatial energy into time for quite a while in order to build up very much *time-excitation charge*. This leads to an initial delay in the onset of the "new law" transduction phenomena, as directly shown by the vast majority of careful cold fusion experiments. This build-up occurs during the "palladium-lattice loading" time, e.g.

By the same token, there is a time delay after cutoff of the input power to such experiments, during which time the slowly decaying time-density charge by its transduction into spatial energy continues to maintain the anomalous new processes (such as excess heat production) as they slowly subside. So the hours-long or even days-long delay phenomena after input power shutdown are also explained by the new approach.

In summary, there exist some very anomalous but very good experiments by excellent scientists—more than 600 of them—that are at least totally consistent with the above new wave polarization transduction model. Consistency with experiments is the first element of proof (it is necessary but by itself it is not sufficient). The new model also contains and obeys the conventional conservation of energy law until the new transduction phenomena become observable, at which time the extended energy conservation law applies. So in its lower limit, the new model corresponds to the present model—again, another requirement of any model purporting to extend a scientific area past that area's conventional model description.

The KGB weapons scientists—not the regular Russian academic establishment—have about a 40-year lead on us in all these areas. While our own scientists have dallied and pursued the standard model, the Russian weapon scientists have produced the equivalent of 10 Manhattan Projects, back-to-back, in the "new" energetics area.

The Early Soviet Longitudinal Wave Interferometers

Using longitudinal EM waves, the early KGB energetics interferometers could pass their beams right through the earth and ocean. LWs readily penetrate matter, reacting with it only weakly.

Some LW interferometry was also done using ordinary EM waves as carriers for the LW wave functions. Each such transverse wave carrier is in fact two scalar potential functions (Whittaker 1904, the initiation of superpotential theory). In each scalar potential for which functions are extracted and used to make the normal transverse carrier wave, there exist LW biwave pairs comprising said potential. So by assembling the desired LW biwave subsets, the two scalar potentials and their resulting interference-produced carrier wave are internally structured as desired. This is the use of the so-called *internal information content of the field*. We speak of such a deliberately structured potential, field, or wave as having been *conditioned*, *dimensioned*, or *activated*. If these terms are deemed inappropriate, just use the more generic term "internally structured." Then one has to explain what the "internal" is, and how this "internal" can be "structured."

In the distant interferometry zone, those *dimensioned* potentials, fields, or carrier waves would interfere and produce the desired alterations in the local spacetime (including specific spacetime curvature engines). Remember, the potentials are just bundles of special waves. We are discussing a special form of nonlinear multiwave interferometry, where the individual waves and waveforms comprising the total wave package assembly constituting a carrier have been carefully chosen in advance.

In the local spacetime in the distant interference zone, such multiwave longitudinal EM wavepair interferometry creates ordinary EM waves and energy that arise directly from each and every point in that individual interference zone. We stress that ordinary transverse wave EM energy propagation through the intervening space between the interferometer transmitters and the distant target *does not occur*.

In January 1960, in a speech to the Presidium, those are the weapons then in final engineering development for production that Khrushchev spoke of as "fantastic new weapons".

Khrushchev Killed the Thresher to Prevent His Own Dismissal

The first deployed large force-structure interferometer weapons became operational circa 1 April 1963. Khrushchev was still smarting from his Cuban missile crisis fiasco and his humiliation by Kennedy. Having overplayed his

hand and gotten caught,[41] Khrushchev was desperate to stay in power and not be thrown out by the Communist Party leaders for such a massive loss of face.

On April 10 of 1963 Khrushchev used his new interferometers to reach through the earth and ocean and "kindle" EM jamming in the electrical controls of the **U.S.S.** Thresher nuclear submarine underwater off the East Coast of the U.S. **The** reader should recall that, wherever the interference zone is established—including in the earth or underneath the ocean, in the atmosphere, or in space—the energy arises directly out of the local spacetime. *There is no Faraday shielding of such effects, which do not depend upon ordinary transverse wave EM field energy propagation through space*. The energy appears everywhere within the targeted object, simultaneously.

It is extremely important that the reader recognize the dramatic difference in the way energy propagates in the new mode as compared to the old "propagation through space" mode. In the old mode, energy transport arises in one spatial location and is considered to proceed serially through the intervening spatial points to the intercepting and interacting particle's location. The Poynting model presently uses only this mode. In other words, the energy propagates from wi*thout* the object *to* the object, and thence *inward inside* the object, if possible as the object interacts.

On the other hand, when the energy arises at each and every point in spacetime, it then propagates outward from each arising point. Thus in the nucleus of an atom, the "energy flow" starts at all interior spatial points and flows or diffuses outward in all directions. So the energy "meets" and interacts with the quarks in the nucleons, *before* it meets the "nucleon as a whole" and translates it. For this reason, with energetics it is easier to alter and "flip" quarks in nucleons than it is to translate nucleons, since one is using the new energy propagation mode. *This simple reversal of the outside-to-inside energy propagation to an "inside-to-outside" mode, is a revolution in particle physics and effects on materials.*

In fact, the energy dramatically enters the "interior" areas of nuclei, nucleons, etc. in a manner heretofore impossible or extremely difficult to achieve by high-energy physics, which can only do it by smashing into the object with sheer brute kinetic energy. Therefore the new "inside to outside" energy propagation mode can produce—at feeble spatial energy—extraordinary nuclear interactions not possible by brute force "outside-to-inside" energy propagation means. By controlling the structuring of the arising of the energy at each point in spacetime, the energy structure interacting with the quarks and other interior components can **b**e tailored to order. This is the primary secret of transmuting an element at a distance by a specialized energetics weapon. The structuring of the emerging

[41] Oddly, had he simply waited a few more months or a year before injecting the missiles and nuclear warheads into Cuba, Khrushchev's strategic scalar interferometers would have become operational. With those in operation, a "Cuban missile crisis" might well have had a different outcome.

internal energy can be deliberately tailored to change quarks in—say—some of the nucleons of U235 and plutonium nuclei. In this fashion nuclear warheads, nuclear powerplants, and nuclear propulsion systems of atomic submarines can be altered at a distance, beneath the earth's surface, beneath the ocean's surface, in space above the earth, etc.

The EM "hash" emerging from the Russian interferometry simply jammed the electrical controls and systems of the Thresher *from inside its very electrical circuits.* Out of control and helpless, the Thresher sank to crush depth and imploded (Figure 6). The EM "splatter" from that interferometry, arising from the local spacetime throughout a surrounding region, engulfed the Skylark, the surface companion of the Thresher. The resulting spurious EM jamming severely interfered with multiple electronic systems on the Skylark. Several electronic systems just ceased working altogether. Their electrical forces were time-energy excited and time-reversed so that electron currents in them became impossible (blocked).

It required over an hour for the Skylark to transmit an emergency message back to the Navy that the sub was in difficulty, through all that interferometry jamming effects. The Russians undoubtedly "tracked" the sub till it imploded, then cut off the interferometry. As the "time-density charging" in the area slowly diminished, all failed electronic systems in the Skylark returned to full functioning. This was because the excess time-energy excitation just decayed away, so that electrical currents could again flow.

Khrushchev Demonstrated the Powerful Blast Capability of Strategic Interferometry

The next day, 100 miles north of Puerto Rico, the same KGB interferometer weapon was powerfully pulsed to produce a giant EM burst deep under the ocean's surface (Figure 42). A cone of water rose up from the surface to about a half-mile in height, observed by the startled crew of a passing U.S. jetliner and reported to the FBI and Coast Guard when the aircraft landed in Florida. As it rose, the cone of water spread into a cauliflower shape typical of a deep underwater nuclear burst that does not vent the gas bubble. Then that giant cauliflower of water fell back out of the sky and into the ocean. The second successful demonstration of Khrushchev's scalar interferometer weapon had been made for the benefit of the Presidium and the leaders of the Communist Party.

With those two dramatic tests, Khrushchev had killed the latest and greatest U.S atomic submarine and demonstrated the awesome power of energetics weapons. He had shown the leaders of the Communist Party that the U.S. had no inkling of his new superweapons. He had struck the U.S. a formidable blow in a direct act of war—but a new kind of *clandestine* energetics war—and gotten clean away with it. Now it was Kennedy, rather than Khrushchev, who had been

duped. So had the entire U.S. Intelligence Community and the U.S. Scientific Community. Sadly, mostly they apparently remain duped or partially duped to this day.

Khrushchev managed to stay in power nearly two years longer by these two demonstrations. So the KGB/Soviets embarked on a decades-long program of buildup and development of the new weaponry, clandestinely, in order to take the U.S. by surprise attack and destroy it utterly.

In 1972 Brezhnev named 1985 as the target year when Russia would be able to do as it pleased, and would essentially control the land, the oceans, and space {126}. This was stated at a secret meeting of the European Communist parties in Europe. A British intelligence agent was in the meeting, and furnished the U.S. that information. Later it was openly released and published.

The Russians met that 1985 deadline, and the resulting increase in killing U.S. missiles and aircraft in 1985-1986 was most indicative. Other indicators such as massive weather engineering were already ongoing.

Weather Engineering Over North America

The first KGB weather engineering tests over the U.S., using their relatively new interferometers, produced signatures of anomalous perfectly round holes appearing in clouds. These experiments started in 1967 or thereabouts. The Russians gave us that very severe "deep freeze" winter of 1967, as an initial weather-engineering test of their energetics interferometry weapons.

The KGB communists do have a sense of historical dates, and they often do things on certain dates in symbolic fashion. Full-time Soviet weather engineering over North America started in earnest on July 4th, 1976—our Independence Day and our bicentennial. This was the KGB's "gift" to the United States on such a historic occasion. Full-bore weather engineering over the Americas has continued to this day, and even increased. It was passed into the hands of the Yakuza and the Aum Shinrikyo upon their leasing of those interferometers on site in Russia at the end of 1989. In 1985 I produced a rather crude videotape[42] (40 minutes) with pictures of the giant radial cloud signatures etc. associated with such weather engineering operations since 1976.

The *basic* weather engineering method is simple. Use an LW interferometer (LWI) to reach through the earth and *cool* the air in a region and produce a high-pressure area, due to the densification of the air. Use another interferometer to *heat an*other area and form a low-pressure area, due to the expansion of the air. Then carefully steer those *highs* and *lows* by gradually and slowing rotating the distant antennae and slowly adjusting the interferometry range simultaneously, according to a calculated schedule.

[42]T. E. Bearden, "Soviet Weather Engineering Over North America," 1985.

By that means, the LWIs easily catch, entrain, and steer the jetstreams largely responsible for our weather. Put sharp loops and twists in that steering, and the huge angular momentum of the jetstreams developed in those sharp turns and circles will spawn tornadoes, violent weather, etc.

The first complete weather engineering system over North America in 1976 also used the Woodpecker's normal EM carrier signals with dimensioning and internal assemblage of the composite longitudinal EM wavepairs. A giant "interference grid" was established over much of North America. A great deal of local adjusting of the interferometry in the grid was necessary. These local grid readjustments caused "sudden popouts" of EM energy, creating many atmospheric booms, rumbles, and explosions.

To really stir up big weather trouble, the Russians—and now the Yakuza and Aum Shinrikyo—also heat or cool areas of the ocean where El Nino and similar "water engines" form. A dimensioned LW interferometer is required for this operation. By slowly and protractedly heating or cooling the water in one of the "warm water engines" fueling the weather, one causes a very significant, long-term, later effect on perhaps an entire continent.

One can create great droughts in some areas, great floods in others, etc. The KGB has been doing this extensively, since 1976. The great floods in Red China a few years ago are a direct example of KGB/Yakuza weather engineering, as is much of the extreme heat of 1998. In fact, thanks to the weather operations of the Yakuza under their KGB mentors, 1998 was the overall hottest year on record till then, since records were kept. At least for the summer of 2002, the record may have been broken again, with a significant season of giant forest fires burning away.

One purpose of the excess heating of the atmosphere, of course, is to do damage. An added "benefit" to the KGB is to furnish support to the environmentalists who are concerned about global warming. Understand, there is indeed such a thing as global warming. But by augmenting the atmospheric (and ice sheet) heating just a bit in a single year, the statistical analyses are skewed. The skewed analyses will show that the global warming problem is far more imminent than it really is, if the LWI engineering of it were suspended. Nobody on either side of the global warming debate seems aware of the LWI intervention that is ruining the results of their models and calculations.

In turn, the heightened global warming indications, detected as a result of the LWI interruptions, impel strong activist support for such things as the Kyoto treaty, *which is specifically designed to the strategic detriment of the U.S.* if and when the U.S. Senate ever approves it. The Kyoto treaty does not even apply to some 160 countries including Russia, China, etc. This focuses a certain proportion of our government time and effort in grappling with an inflated global warming problem, immediately. It directly fits the KGB strategy of "spreading" our government energy and attention all over the map, anywhere

but upon the coming strategic energetics strike and upon energetics weaponry.

The die-hard section of the KGB strategists are chess players. *They will come at you anyway, anyhow, and anywhen that they can.* Everything that can be impressed to serve or support the overall objective, will be impressed and used. That is the overriding principle when analyzing Russian KGB strategy.

Khrushchev meant every word of it when he said to Nixon in their famous Kitchen Debate: *"We will bury you!"* Interestingly, to this day Americans and their government officials have continued to be deceived as to exactly what Khrushchev meant. He meant it literally.

Earthquakes to Order

According to U.S. Defense Secretary Cohen, electromagnetic induction of earthquakes is now recognized by the U.S. Department of Defense, considering his little-noticed statement in Georgia in 1997, which we previously quoted. An interesting exchange of induced earthquakes (Figure 54) had occurred in latter 1988 and early 1989. Here two sides seemed to be "counting rifles."

Opening bet (induced quakes)
- Quebec 25 Nov 88
- Pasadena 3 Dec 88

Raise you
- Armenia 7 Dec 88

Call - what do you have?
- Malibu 8 Jan 89

Four aces
- Soviet Central Asia 23 Jan 89

***Clear** table (stress relief)*
- Bakersfield CA et al. various

Figure 54 Counting rifles with earthquakes: Put up or shut up.

As Secretary Cohen made his April 1997 statement obliquely recognizing the scalar interferometer weapons, the little friendly nation had just completed countering and averting a massive strategic energetics strike upon the United States and Western Europe, scheduled for May 1, 1997 —just three days later. A little more than two months earlier, a previously scheduled attack had also been countered and averted by the same friendly little nation.

Once one can reach into or through the earth and ocean and create energy in a

desired interference zone, induction of earthquakes is simple. Use the interferometers to deposit energy in a fault zone over a period of time. Keep it up, and the piezoelectric plates build up enough mechanical stress to forcibly "slip" and produce an earthquake.

Put the energy in very slowly, and one gets a long "overpotential" effect where the rocks do not slip for a long time, while the energy builds to higher levels due to the static friction of the rocks. Then there occurs a rather rapid catastrophic slip. In short, one produces a large destructive earthquake. The KGB weaponry can produce earthquakes of the highest magnitude if they work at it.

If one wishes to induce a quake in an area where there are no known faults, then one simply focuses the interference zone there inside the solid rocks and proceeds to deposit the energy, preferably rather quickly (in hours instead of days). The entire rock will be expanded and it will fracture, producing an anomalous so-called "flat plate" earthquake.

Around the early 1900s, the "normal" rate of large earthquakes was two or three per year. That gradually increased after WW II. During one week in year 2000, there were some 20 major earthquakes around the globe. Obviously, someone is doing it, since this is far beyond what could be expected naturally. Presently that "someone" is mostly the Yakuza and Aum Shinrikyo, on site in Russia and leasing the LWIs. With the scheduled CSR attacks forcibly aborted, the KGB has the problem of restraining an increasingly impatient Yakuza and Aum Shinrikyo group, while keeping them paying the lucrative lease money. Consequently, inducing some big earthquakes is one way to "keep the troops occupied and busy." Shooting down the occasional aircraft or missile is another way.

I worked for 8 years or more with an inventor (Floyd Sweet, now deceased) who had an energy device {127,128} sensitive to *artificially* induced quakes of that fashion, even such quakes thousands of miles away. The device would sit right on top of a *normal* quake and not react. We could tell within some 8-10 thousand miles—and often even for greater distances— which quakes were artificial and which were natural.

So during that period I was able to clearly ascertain what was going on, and who was doing what to whom, and which quakes were normal and which were manmade. Several artificial U.S. quakes, the Armenia quake, and a subsequent big quake in Russia were particularly interesting in the mid and latter 1980s. The huge 1976 China quake was directly induced by the KGB.

Figure 55 Brewer briefs President Reagan on Soviet scalar EM weapons October 1984, then briefs National Security Council

In 1984, on my behalf Roy Brewer {129} had briefed President Reagan on these scalar interferometry weapons (Figure 55), then briefed the National Security Council. Let us hope that these high level briefings may have borne at least some fruit.

Readying the Weapons for the 1985 Readiness Demonstration Tests

In latter April 1985 I received an urgent call from my close colleague Frank Golden. In his avionics repair work, he suddenly found that his best calibration instruments were very "noisy." He replaced one expensive instrument, and the second was "noisy," also. A third proved equally noisy. This was unparalleled. It was not the instruments, but instead it was all the electronics to be repaired, that were emitting electromagnetic noise!

So Frank borrowed one expensive instrument and brought it home for the weekend. He altered it by a proprietary method so that he could detect energetics radiation. Voila! The entire earth was alive with Soviet energetics signals. The weak interferometry of so many signals impinging into the weakly interacting electronic systems to be repaired, had generated the electronic noise his instruments had detected.

In response to Frank's call, I immediately proceeded to his location. I personally observed on the oscilloscope, as detected by Golden, some 27 pairs of Russian energetics signals, each of the two in a pair being 12 kilohertz apart. (We have

previously explained why two frequencies are used, and one "pretends" one transmitted the difference frequency). Each of these frequency pairs represented the entire earth held in entrained resonance. Each pair was an "energy tap" in the earth, extracting enormous energy from the heat of the molten core of the earth itself and outputting it as 12 kilohertz power for transmission to giant interferometry weapon sites.

Each "tap" was extracting energy sufficient to power perhaps 4 to 6 of the giant intercontinental energetics interferometer weapons. We were observing something like 100 to 150 massive weapons on line and radiating. A full-up strategic dress rehearsal—or preparations for a full-up strategic attack on the U.S.—was underway.

Gorbachev was still a "new man on the job" at that time. Further, 1985 was the 40th anniversary of the end of WWII, and a very important occasion for the Communists and in fact for all Russians. The May Day celebrations that year went on for several days, not just on May 1.

What we were seeing were preparations for a massive May Day weaponry demonstration in and around May 1, 1985. We were observing the preparation and demonstrated readiness of all that great armada of Soviet energetics weapons, to meet Brezhnev's 1985 schedule laid down back in 1972 {126}.

Longitudinal EM wave communications to deep underwater Soviet subs, the huge interferometer armada, and everything else—all were being readied and demonstrated. I can assure the reader that observing full rehearsal of preparations for the next World War was a most sobering experience.

After May 1, most of the armada of interferometers was stood down again because it had been demonstrated that the "ready schedule" had been met. All but one of the giant energy taps in the Earth were also stood down again. That one remained active.

The May Day report to the heads of the Communist Party that year must have really been something!

As usual, apparently our own scientific and intelligence communities did not detect the main activities, and would not have believed it if one told them. They certainly did not believe it when I published it in 1986 in *Fer-de-Lance,* but labeled it sheer fantasy or at best total conjecture.

It was neither fantasy nor conjecture. It was direct experimental measurement. It was in fact what used to be called *scientific method.* The problem with our intelligence agencies was that they operated behind *policies.* Once the *policy* is decided, then regardless of what the intelligence analysis indicates, anything against the official *policy* is just ignored. This neat little *policy* method of doing business has resulted in making our intelligence agencies some of the most political-minded and manipulative groups on Earth.

Meeting the 1985 Schedule for Readiness

In 1985, KGB/Russian preparations began in earnest for the energetics weapons readiness projected for that year by Brezhnev in 1972. Being full-bore tests, these actually went after destruction of vehicles and killing people. These were actual acts of war. The so-called "Cold War" was not nearly so cold as pictured in the news media!

Early that year, an LWI was used to cool the combustion in the engines of a jet liner off the coast of San Francisco, bound for Los Angeles (Figure 56). This flamed-out the engines. The stricken craft fell 30,000 feet before the time-density "cooling" charge drained away, sufficient for the pilot to restart his engines and limp into San Francisco. Gravitational and inertial anomalies—*a clear signature of the use of this EM/GR weapon*—were exhibited upon the personnel in the cockpit. The official investigators ignored those signatures; after all, such is not in their standard checksheets! And everybody knows the standard checklists are already perfect!

SIX MILE DROP IN TWO MINUTES

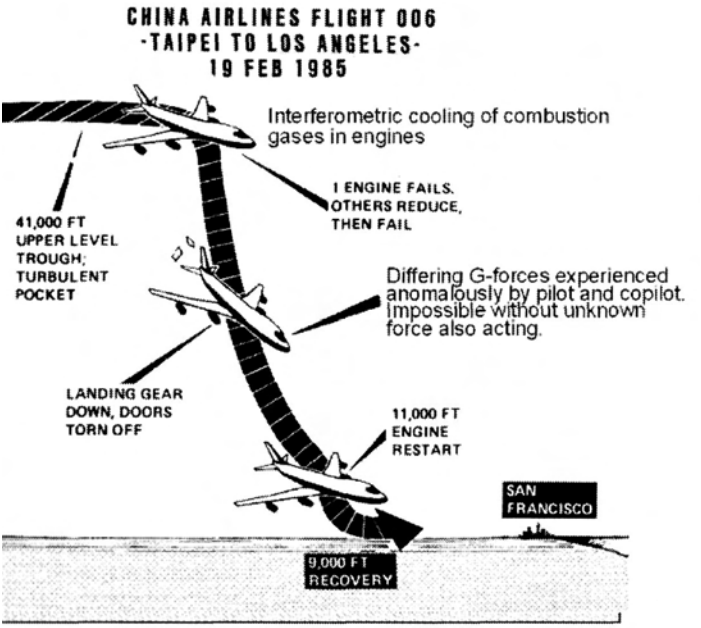

Figure 56 Extinguishing combustion in the engines of a jetliner 19 Feb. 1985.

KGB Crews Regularly Practiced Against U.S. Rocket Launches from Cape Canaveral

In a late Nov. 1985 night shuttle launch at Cape Canaveral, the Russian interferometer crews continued their practice of using the U.S. shuttle launches as convenient "simulated" ICBM launches, for energetics interferometer crew practice (Figures 15 and 16). EM missiles (balls of EM energy formed in the area by distant LW interferometry through the earth) were used as the "destructive agent", but were offset from the actual launch in order not to destroy the shuttle. This was *normal crew drill,* not combat operations. The practice range for energetics weapons is—as might be expected—the actual targeted area and targeted nation itself.

As shown in *Fer-de-Lance,* I published an actual picture (Figure 15) of such a KGB EM missile strike, offset from that shuttle launch in late Nov. 1985 and snapped by Bob Gladwin. I also published an actual picture of a second such EM ball of glowing energy (Figure 16), over the launch site for the same launch, and used as a registration point (the LWs deviate slightly in passage through the earth, since the potentials in the earth are not constant). George Suchary took the second photo.

A standard artillery "shift-from-known registration point" method of firing was being used. In other words, the crews establish LW track on that EM registration ball, right through the earth. That represents *a point having a known set of coordinates*—a registration point—established in the firing computer. Then when the targeted strategic missile (in this case the shuttle's main booster) ignites, the interferometer also tracks the huge ionization target of the exhaust with the same weapon system.

That gives a known *relative* location of the missile rear end, with respect to one's registration settings for the registration point ball of light. Then add some meters to move up onto the missile body proper, and voila! The center of the target missile that will be fired is now in the bulls-eye, so to speak. That is a standard "shift from a known registration point" method of shooting, well known to every artillery group on the planet. The "marker beacon" is what is known as a "high burst registration," except it is not a burst but a steady ball of energy maintained over the area as the registration point.

The distant rocket or missile can now be destroyed in a variety of ways:

(1) Just create a sudden EM surge arising right in that spacetime (that is, just pulse the interferometer). That burns out some of the inner electronics of the missile, causing partial or complete missile failure.

(2) Sharply pulse the interferometer to introduce EM energy surges and sparks in the fuel or solid propulsion, igniting it massively and blowing up the rocket. Works well for aircraft fuel tanks as well.

(3) Form another EM missile and hit the missile broadside with that, burning

through it and destroying it immediately.

(4) Hit it with an explosive EM missile internally, instantly exploding the missile into pieces. Or

(5) Hit it with several of the above simultaneously.

Suchary and Gladwin had captured the direct evidence of KGB dress rehearsal for the strike and kill of the Arrow DC-8 in Gander, Newfoundland about two weeks later.

Kill of the Arrow DC: Practice Turned into Performance

Two weeks later, the same KGB weapon tested against the Cape Canaveral shuttle launch was used to destroy the Arrow DC-8 at Gander, Newfoundland, killing some 256 occupants, 248 of them being U.S. soldiers returning from peace-keeping operations overseas. The aircraft *was not* iced up; later that was clearly established.

See Figure 17. As the ill-fated Arrow aircraft began its thrust down the runway for takeoff, it was already under LW interferometer track (the exhausts of the **engines** were being precisely tracked) by distant KGB operators. The KGB operators simply began to cool the combustion gases in the engine combustion chambers as had been done to a U.S. jetliner earlier that same year (Figure 56) off the coast of San Francisco (there they had completely flamed out the en**gines).** Now they did not want to flame out the engines during take-off, but just wanted to reduce the thrust of those engines.

So the available thrust of the engines began decreasing as the aircraft picked up speed on the runway toward takeoff, even though the turbines were rotating at full speed. For powered flight, it is the *thrust-per-drag ratio* that is important. One can reduce that ratio by ice-loading and therefore increasing the overall aircraft drag, as all Transportation Safety Board checksheets assume if the engines are at full rotation and if operation and icing conditions are present. Or one can reduce the ratio by reducing the engine thrust itself, as was done for the Arrow, even though the plane is de-iced. All the Transportation Safety Board checksheets *assume* that it has to be drag increase, and thus due to icing.

The National Transportation Safety Board (NTSB) investigators know nothing about longitudinal EM wave interferometry and its capabilities—and its development by several nations of the world. Neither do their checksheets. Sad**lly,** the NTSB is not even aware that the electrodynamics and electrical engineering it assumes is so perfect is in fact a decrepit old model based on century-old errors. They are unaware that much better electrodynamics models have long been developed for particle physics, because the crusty old classical model is totally inadequate. Their checksheets also are "unaware" of anything really modern such as electrodynamics models of the higher group symmetry **kind.**

The thrust reduction by combustion gas cooling *does not appear on the official checksheets and is never considered.* It is not considered to this day. It will probably still not be considered this century.

Observers on the ground heard those engines "laboring," which can be a direct symptom of combustion gas cooling and engine thrust reduction. Rough running and missing can be another, if the cooling increases. Engine flameout occurs when the combustion no longer can be sustained because of the dramatically lowered temperature of the gases.

The Arrow Pilot Sensed the Lack of Power, But the Aircraft Was Immediately Hit

See Figure 17. At rotation and liftoff, the pilot of the Arrow DC-8 immediately sensed his lack of lift, and started a slow turn to the right, apparently intending to come around and land again as an emergency measure. Meanwhile, crossed beams had formed in the sky above and off to the right side. From those crossed beams of light, there shot down a bright "streak" of light that struck the fuselage of the aircraft in the right side, ahead of the engines. That was the EM missile strike—just as had been offset from the shuttle launch two weeks earlier in Florida, and photographed by Bob Gladwin.

That piece of Arrow DC-8 fuselage hit by the EM missile, with the burned hole in it, was recovered and tested. Tests showed no explosive residues on the edges of the hole, so it *was not* made by a bomb or other explosive device. Instead, it was made by an EM missile of the type that over a decade later hit the TWA-800 several times off Long Island and killed it.

In the Arrow aircraft's kill, the fiery EM missile sharply ignited the plastics in the forward cabin, which explosively outgassed. One product of such outgassing is hydrogen cyanide. A whiff or two, and all the passengers in that section were already dying of cyanide poisoning. *In the autopsies of the recovered bodies, about half the passengers were already dead of cyanide poisoning before the plane impacted the ground and exploded.* They died while that aircraft was still flying and sinking tail-first toward the ground.

The results of those autopsies were deliberately withheld from the Canadian investigative board.

The impact of the EM missile on the Arrow DC-8 was clearly recorded by sharp, vertical EM surges (spikes) in traces on both data recorders on board the aircraft. In *Gravitobiology,* on p. 82 I printed the recorded sensor responses **for** that signature also.

Elements of the U.S. Government Deliberately Suppressed Vital Evidence

Several eyewitnesses, including Judy Parsons, physically observed the formation of the crossed beams in the sky. Parsons and perhaps others actually saw the streak-down and strike of the EM missile when it hit the doomed Arrow DC-8. Parsons tried to testify, but her testimony was never allowed to be heard by the Canadian Transportation Safety Board. A major U.S. News agency interviewed her, but then squelched the story for some "unknown reason." Other witnesses (who are still reluctant to come forward) did observe the strike of the EM missile also.

Why would the U.S. government deliberately suppress information relating to the cause of the deaths of 248 of our soldiers returning from peacekeeping missions overseas? Why were they so determined that this direct act of war be declared an "accident" in the face of overwhelming evidence that it was not an accident at all?

Iran Contra was not yet divulged at the time. Recall, at very high level our own fellows had directly violated the law, and were engaged in the illegal Iran Contra fiasco up to their eyeballs. Also, some officials in Washington in certain high U. S. Government circles were in near panic, in their personal (erroneous) firm belief that a MidEast-sponsored terrorist bomb had destroyed the Arrow. In that case, so they reasoned, with the murder of 248 of our soldiers, the American public would be so aroused and angry that they would force military action against the MidEast nation or group, and that would then reveal Iran Contra. *Too many highly placed people's hands were dirty!*

So extreme spin control was the major requirement. Damn how many American soilders had just been killed in an overt act of war against the U.S. Damn the implications of the use of eerie new weapons we did not possess. A hue and cry from the U.S. public would almost certainly reveal Iran Contra and smoke out the duly secrets. That must not happen at any cost. Some high officials—particularly the ones who engage in such illegal acts, in assassinations, murders, etc.—are far more interested in covering up their nefarious deeds than they are interested in any kind of justice or morality. Consequently, the fix was in.

So *U.S. officials placed enormous pressure on Canada to produce a finding of icing.* Lots of other skullduggery occurred, which probably constituted criminal activity by some U.S. officials. A high-ranking U.S. military officer arrived on site quickly, apparently under orders to erase that scene as fast as possible. He almost immediately wanted the Canadians to bulldoze over the site, even before recovery operations were complete and while the investigation was just getting underway. The site was bulldozed over in unseemly haste not long thereafter. That would appear to possibly constitute deliberate tampering with the evidence at an official site of investigation, on the part of whoever ordered the General to bulldoze the site precipitously.

In addition, witnesses such as Parsons were never allowed to testify. The Canadian Board waited until the half of its members who strongly opposed any ad hoc finding were absent, and hastily approved a finding of icing as the cause of the "accident." Later the disgruntled Board members who were absent when the "voting" occurred, issued their own minority report. Unfortunately they knew nothing of scalar interferometry and energetics weapons, and so they strongly believed it had to be sabotage and explosives.

Anyway, the blackguards hiding Iran Contra buried the incident, and the savage kill of 248 of our soldiers and 8 civilians went unpunished. Anyone such as the present author who pointed out what had really happened and why, was just branded a lunatic. After all, the blackguards who do not flinch at murder and unapproved assassination do not blink an eye at slander and libel.

The sad part is those fine young soldiers and the 8 civilians who were killed, and the grief and lasting changes made to their families. It is the children who had to grow up without their fathers, the mothers whose husbands were suddenly dead, etc. They deserved much better from their government than they got.

Other Direct Energetics Signatures on the Arrow DC-8

Meanwhile, in the lifting DC-8 the strike of the EM missile had also *time-density charged* the forward cabin materials. Those materials slowly decayed from their excited states via longitudinal EM wave emission. When a human body is subjected to fairly significant LW waves (accompanied with their time-density waves), it gets its internal immune system and cellular regeneration system "jammed," since these systems use LWs and accompanying time-density waves. The cells and tissues are also "time-energy charged" as well, and so spurious LWs continued to be slowly emitted in their tissues and cells locally, leading to gradual, general debilitation. After a time delay for the effects of this time-charge decay to be exhibited, such exposed persons will get sick with odd symptoms of various diseases such as influenza.

The ground handlers on the scene and exposed to the struck materials of the aircraft, were also exposed to longitudinal EM wave radiation from those materials which had been instantly "time-charged" at the powerful strike. Hence they were exposed to fairly significant LW waves, and should therefore have shown later symptomology.

Some 60 or so of the ground handlers actually retrieving the crash materials later sickened with all sorts of mysterious maladies: dizziness, stomach cramps, flu-like symptoms, weakness, nausea, fatigue, etc.—precisely what would be expected if some the materials they were handling were emitting longitudinal EM radiation, exposing them to significant LW radiation. That is a clear signature again of a strike by an EM missile, and the exposure of those retrievers to LW emissions. *In no normal way could 60 of those ground crewmen handling the wreckage debris all come down simultaneously with the exact symptoms of*

LW radiation sickness, unless that was what it actually was.

Many of those sickened persons remained debilitated for years. Probably a few are still alive and debilitated.

There are other signatures on the Arrow DC-8 kill. I did a small bit of work on the problem in the interests of Arrow airlines, but of course the conventional investigators they also hired could only conceive of an ordinary explosive. Nevertheless, I did tell them as best I could what happened to their aircraft, their crewmembers, and our own valiant soldiers.

Our troops on board the tragic Arrow DC-8 *did not* die from a simple over-iced plane that crashed as a result of carelessness in deicing operations. *They died as the result of an act of war against the U.S., carried out by the KGB as a test in an entire series to demonstrate the 1985 readiness that Brezhnev had specified in 1972.* That war is still partially ongoing and undeclared to this very day, with other players such as the Yakuza and Aum Shinrikyo also now in the game—and possibly even the Chinese, who certainly have had the weapons for some time, and have had QP weapons and negative energy EMP weapons since earlier this year (2002).

With the kill of the Arrow DC-8, the KGB made its deadline that had been set down 13 years earlier by Brezhnev. To meet the 1985 schedule, something significant had to be killed successfully and clandestinely, no later than Dec. 31, 1985. The KGB made the schedule on December 12, 1985, by killing the Arrow DC-8 after a warm-up and full dress rehearsal against a U.S. night shuttle launch at Cape Canaveral about two weeks earlier. And they also demonstrated just how ignorant of such energetics weapons and their usage the U.S. government, scientific community, and investigative boards really were.

We were fortunate they did not just go ahead and kill that same shuttle in late November 1985. Instead, they waited and killed the Challenger a few months later.

Other Acts of War Completed the Milestone

Apparently the final demonstration of milestone completion called for the destruction of an aircraft, kill of an ICBM, kill of a space shuttle, induction of earthquakes, and demonstration of the new quantum potential weapon still in the advanced laboratory stage. The KGB completed much of the milestone demonstration in 1985. The remainder they completed in 1986.

In January 1986 they killed the space shuttle Challenger, and the very next night the KGB even gave a big party in Moscow, to celebrate the "perfect success of their active measures" against the shuttle. General Daniel O'Connor, former head of U.S. Army intelligence, personally issued an alert to many high-ranking U.S. government officials, pointing out the almost certain involvement of the KGB and the fact that the loss of the shuttle was almost certainly due to a hostile

act by the Soviets.

In April 1986 (May Day report time was coming!) the KGB killed a Titan ICBM fired from Vandenberg Air Force Base. They also induced several large earthquakes for practice, and then began the induction of the long-dreaded "giant California quake" in the San Andreas Fault zone.

This latter induction of what would have been a massive quake in both San Francisco and Los Angeles, and all along the San Andreas Fault, was countered (destroyed) by a civilian group known to this author, with a backlash that resulted in the Chernobyl incident.

In April 1986 (for the same May Day report) the KGB also demonstrated the effectiveness of their newly emerging quantum potential weapon against the convenient U.S. air attack on Libya (Figure 25).

Kill of the Titan Missile Over Vandenberg Air Force Base

In 1986, the KGB began gingerly using those energetics interferometry weapons to kill other U.S. aircraft and several U.S. missiles, including killing a Titan 34-D fired from Vandenberg AFB on 18 April 1986. The Titan was killed 9 seconds after launch, partially crippling the U.S. space surveillance program. That kill was part of the demonstration of readiness milestone completion.

There was a completely decisive signature on the kill of the Titan. Simply check *Aviation Week & Space Technology,* 124 (17), Apr. 28, 1986, p. 18, where a picture (the one taken from longer range) of the Titan explosion is printed. Look about an inch above that explosion, which is already well developed. There above the Titan explosion sits the KGB ball of light registration point, just as it was sitting over the night shuttle launch in Cape Canaveral in latter Nov. 1985 when videotaped by a private photographer.

I persuaded NBC engineer Ron Cole and his colleagues to analyze a copy of that video tape frame by frame. In 17 frames, that little ball of energy above the explosion moved off on its own course, independent of the Titan explosion. Since the launch area for such missile launches is controlled and there were no aircraft over the explosion, then one again has a very clear signature. The KGB killed the Titan, with 100% certainty.

That of course was a test of the interferometry weapons in the role of *Launch Phase ABM system*. Tested against the Arrow, the KGB operators were emulating test of the system in a *Launch Phase Antibomber role*. These were vital *strategic* weapon tests. I published details of the use of the weapons in many other roles.

Dead-Man Fuzing and Outside Assistance Deterred a Full Strategic Attack in 1986

We have previously documented and published why the U.S. was not fully attacked and destroyed by the Soviets in 1986. It was because of our nuclear facilities, warheads, etc. which would have exploded, creating great fallout hazards worldwide, and because of nuclear dead-man fuzing weapons clandestinely placed in Russia by one or more other nations.

A friendly small nation possessing energetics weapons also intervened directly in l986, and blew up several Russian missile ammunition storage sites, some five or so in six months. In one such explosion, about one third of all the missiles in the Russian Northern Fleet were destroyed. As we stated, the so-called "Cold War" was not nearly so cold as has been represented.

In short, the friendly little nation served notice on the Soviets that, if they moved against the West, the Soviet Union itself would suffer terribly. They put it in language clearly understood by the KGB. So any full-up strategic attack for that period was stalemated by that combination of factors.

A major concern for the Soviets was their inability to counter the dead-man fuzing problem posed by nuclear weapons clandestinely hidden inside Russia and by the nuclear warheads and reactors inside the targeted nation(s). They already had the quantum potential (QP) answer *theoretically,* and had conducted a demonstration test of a laboratory QP device, but they had not yet completed the *QP* weapon systems and deployed them.

Nonetheless, a very powerful strike of peculiar nature—induction of a giant earhquake in the San Andreas Fault zone, including in both Los Angeles and San Francisco—was scheduled. This strike would have caused billions of do11ars worth of damage and would have killed perhaps 200,000 Americans. The initiation of the strike was actually begun in April 1986—as the reader can begin to see, there was to be one helluva May Day report in 1986! Incredibly, a private group here in the U.S. then made a unique and unprecedented contribution that saved the day for Los Angeles and San Francisco.

What Really Happened in the Chernobyl Disaster

Using the "inside" of the Woodpecker beams as superhighways for their longitudinal waves and interferometry, in April 1986 the KGB interferometers had started their build-up of substantial induced EM energy in the sides of the San Andreas Fault that runs through Los Angeles and up through San Francisco. Two beams were being used by the Soviets: One was coming down on the target from the North—coming over the North Pole regions and the ice caps—and one was coming around from the East and upon the target area. Completely (100%) certain signatures were present, including some ELF "chugger" waves symptomatic of the Soviet method of inducing very large quakes. The time-

energy is being used, hence very low frequency ELF is employed to maximize the amount of time-energy available for transduction in the rocks on the side of the fault. The Soviets were building up a very large earthquake—indeed, to spawn a whole series of such quakes all along the San Andreas fault—with severe aftershocks following after the main quake had done terrible damage. In short, they were preparing to hit California with the "big one" that everybody had been anticipating and dreading for so long.

A private group contacted me. They stated they could take out one of the transmitters by producing a powerful (giant) phase conjugate replica signal pulse upon it that would backtrack right into the transmitter and catastrophically burn it out—a surface application of the "phase conjugate shooting" once considered for armed satellites that could shoot down rising hostile ICBMs at 10,000 miles distance. As I understood it, they had a new kind of essentially noise-free regenerative amplifier, used in a transmitter. This meant that *extreme amplification* could be achieved in a pulse response to a received Woodpecker signal, before the transmitter burned out.[43] Since the group had no knowledge of the exact KGB transmitter locations or the possible consequences of such an action, they asked my opinion as to the risks associated. This placed me in a real quandary.

At the time, the U.S. was literally under siege. We have mentioned some of the

[43] A very subtle but important point is this: An energy flow of any amount—say, 10^{20} joules per second—has absolutely *zero power* if none of that energy flow is diverted or changed in form. So if one has a truly perfect noise-free amplifier, and a pure noise-free energy signal input, the signal energy input can be directly and freely amplified without limit, so long as those noise-free conditions can be upheld. In short, that rigorously constitutes *regauging,* and the widely used **and** well-known axiom of gauge freedom—the ability to change the local energy density of a system or spacetime freely and at will—applies. Relativistically, such re-gauging is merely rotating the frame of the system away from the laboratory frame. This group indeed had such an amplifier, which I physically saw, and apparently has it today. Our present texts have not yet realized the real implications of gauge freedom: It means that one can freely amplify energy without limit, once certain conditions (no divergence of the energy or change of its form) are met. This does not violate energy conservation; the "potential energy of a system" is not a fixed number at all, but depends on the frame of the observer vis a vis the frame of the system. We point out that there really are no true conservation laws in general relativity unless introduced by arbitrary measured The great Hilbert already knew this in 1917, two years after the advent of Einstein's general relativity. Hilbert stated: "/ *assert... that for the general theory of relativity, i.e., in the case of general invariance of the Hamiltonian function, energy equations... corresponding to the* ***energy*** *equations in orthogonally invariant theories do not exist at all. I could even take this circumstance as the characteristic feature of the general theory of relativity."* [D. Hilbert, *Gottingen Nachrichten,* Vol. 4, 1917, p. 21]. Loskutov and Logunov commented as follows: *"In formulating the equivalence principle, Einstein actually abandoned the idea of the gravitational field as a Faraday-Maxwell field, and this is reflected in the pseudotensorial characterization of the gravitational field that he introduced. Hilbert was the first to draw attention to the consequences of this. ... Unfortunately, ... Hilbert was evidently not understood by his contemporaries, since neither Einstein himself nor other physicists recognized the fact that in general relativity conservation laws for energy, momentum, and angular momentum are in principle impossible."* ["Nonuniqueness of (he predictions of the general theory of relativity," *Sov. J. Part. Nucl,* 18(3), May-June 1987, p I79).

"target year" activities, such as kill of the Arrow DC-8, flameout of jet engines early in 1985, target practice against shuttle launches at Cape Canaveral in November 1985, etc. Actually kill of targets had continued in 1986. A huge earthquake followed by several large aftershocks had been used against Mexico City on 19 September 1985, causing great damage and demonstrating a little of what might be expected when they chose to hit Los Angeles and San Francisco much harder. The Mexico City quake had been preceded by an induced, giant hailstorm weeks earlier, and on the evening of 18 September 1985 by giant radial cloud signatures accompanying the generation of excess energy in the underlying rocks as the KGB prepared next day's giant Mexico City quake. The reader should recall that, working with Sweet during this period, I knew with certainty which earthquakes were natural and which were manmade.

U.S. missiles and aircraft had been hit, the Challenger had been destroyed, and the Titan 34-D had been destroyed at Vandenberg AFB on 18 April 1986, accompanied by a 100% indicator (the substantiated presence of the marker beacon for registration and shift firing). In addition, a little Richter 5.3 quake in the San Francisco Bay area had been induced by the Soviets on 31 March 1986, a quake which was correlated with preparatory activity on the Woodpecker transmitter signals the day before, showing Soviet induction of the energy to create the quake. Again, we had instrumental evidence that it was manmade.

That quake on 31 March had been a "warm-up" and practice for the big one now about to be induced in both Los Angeles and San Francisco, and along the San Andreas Fault. In fact, it appeared that the entire fault zone would be stimulated by deposit of excess energy all along its length. In that case, induction of a distributed California quake of unprecedented extent and great magnitude was now in process, though just beginning. If that event or those events occurred, the loss of American lives and property would be staggering.

The High Side Risk Factor

The group's query to me presented a very difficult decision situation. Such huge Soviet interferometer beams, once built up, contain *enormous* longitudinal EM wave energy. If a Soviet transmitter were near large nuclear facilities, and were instantly blown and shorted, all that potential energy might flash directly into the ground.

In case of such a catastrophic transmitter failure, an enormously powerful longitudinal wave pulse would spread out in all directions in the surrounding earth. The first nuclear material the pulse encountered would be fissioned abruptly and very violently. If the transmitter were within a few kilometers of one or more of the large "monster" Soviet ICBM sites, the full-up explosion of several 30 or 40 megaton warheads might result—in the dirt and dirty. The resulting fallout and contamination would be massive, would spread round the world, and would eventually kill millions for years to come. Nuclear reactor stations were a similar risk; instant fission of all the fissionable material in one

of them would constitute an unprecedented and giant nuclear explosion, in the dirt and dirty. That was the high side risk.

The Low Side Risk Factor

The low side risk would be that little or nothing at all would happen; perhaps a tremor induced in a nearby fault zone, etc. I knew that the Soviets—after an early Kyshtym transmitter failure—had produced such a flashover on a much smaller scale and that flashover had caused the nuclear explosion of nearby stored nuclear wastes. The resulting fallout contaminated some 1200 square kilometers, which is still contaminated to this day. I also knew that, after Kyshtym, the Soviets had installed safety devices on all their scalar interferometer transmitters in case of just such failures.

So if the safety devices held when the transmitter suddenly shorted out, they could hold the longitudinal EM wave beams and potentials long enough to drain the energy slowly and harmlessly into the earth over an extended period. That was the low side risk.

The *most likely* consequence, of course, would be somewhere in the middle, between the extreme upper risk and lower risk limits. In other words, we could expect some bad repercussions in the Soviet Union almost certainly, but hopefully it would mostly be confined to that spot.

Consequences of Not Taking Counterfire Action

If no action were taken, the risk to the U.S. was appalling. If the transmitters continued, then perhaps 200,000 Americans were going to die in Los Angeles and San Francisco and along the San Andreas Fault. Perhaps 300,000 more Americans would be injured, and many of them would also die. Enormous physical damage would also be done, and those basins would be disaster areas for some years to come. It would be interpreted by our inadequate scientific community as a great "natural" disaster caused by a giant earthquake, and the ghost of Khrushchev would have had one more laugh at us, with his words "We will bury you!" silently ringing in the ether.

My Recommendation to the Counterf ire Group

To save those American lives, some reasonable element of risk had to be accepted. In other words, it became a classic "risk-to-benefit" military analysis, but one that was deadly serious. To me, as a military person the medium risk had to be accepted in such case.

I gave the group my reasoning. They then asked what I would personally do if my own finger were on the fire switch. I answered that I would take out the transmitter or transmitters and save those American lives, accept the medium risk, trust in God, and pray **for** the best. Military decisions often have to be made

in just such uncertain conditions. If one's military could not make such tough decisions, then one's military forces would inevitably lose their wars.

The Group Fired and Took Out a Transmitter

The group thanked me, stated that they would fire, and hung up the phone. See Figure 57. They did fire on April 25, just as they promised, and they did destroy one of the KGB transmitters—apparently located some kilometers (perhaps 30?) from the Soviet nuclear reactors at Chernobyl.

At the moment the transmitter was hit and destroyed, engineer Bill Bise—out in the field with magnetic field detectors and measuring the Woodpecker beams—observed the abrupt failure of the Woodpecker transmitter beam coming around the Earth from the East. Thus, he actually detected the successful destruction of that distant interferometer transmitter. Unknowingly he had detected the results of a great counterstrike in a very dangerous strategic battle.

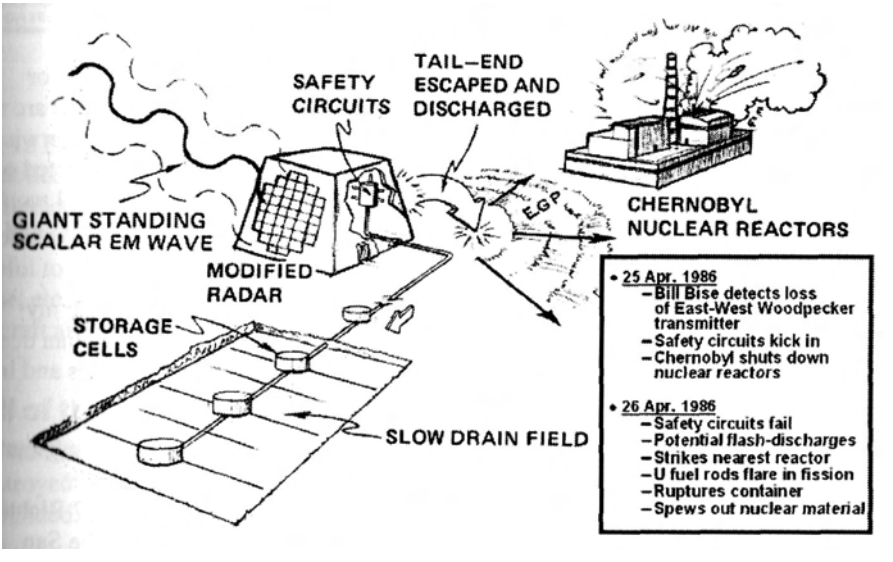

Figure 57 Chernobyl disaster 25-26 April 1986.

Results at the Transmitter and at Chernobyl

We were very, very lucky. At the destroyed transmitter site, the safety circuits kicked in and caught the huge beam potential and held it for about 24 hours, gradually draining down the intense beam energy into the earth in a slow manner all the while.

A **frantic** Russian message to the Chernobyl reactors galvanized the operators to immediately shut down those reactors (put in the cadmium control rods).

However, the uranium in the fuel rods was of course still sitting there. Chernobyl then waited with bated breath to see if the safety circuits would hold.

Then on 26 April, the safety circuits at the transmitter site finally crumbled, and a far weaker LW flashover occurred than would have occurred earlier without the safety. The spreading LWs in the earth struck the nearest reactor core at Chernobyl, preceded seconds before by a tremor induced in the earth at Chernobyl as the LWs arrived. *Part* of the struck uranium in the core fissioned immediately, venting the containment structure and spewing out radioactive material. Nuclear fallout spread over much of Europe. The rest of the disaster is well known.

That unknown group, in my estimation, saved a large number of American lives—at least 200,000 or more and perhaps as many as 300,000. They also prevented enormous physical damage to California, both to Los Angeles and San Francisco and to points in between. The members of that group are the unsung heroes of this bizarre episode. It is my hope that I may live to turn the names of those persons in for the award of a very high Presidential medal. Until then I will not reveal those names under any circumstance.

Whether or not the U.S. scientific and intelligence communities know it or believe it is of no concern. What matters is that a great many Americans are still alive, and their children born since then are alive. Those Americans otherwise would have been very, very dead or never born. I personally have reflected on those desperate circumstances many times. If I had it to do over again, I would unhesitatingly urge the same action: Fire and save those American lives, and accept the medium risk. And pray.

And I did pray after recommending the strike. In my opinion, this time my fervent prayers were answered. I am extraordinarily sorry for the civilian deaths that occurred; all one can say is that it was under severe circumstances and in a very peculiar—and very desperate—war.

The Soviets had many other interferometers on line. They induced a substantial earthquake in Mexico at the end of April. Thus they did complete their "earthquake footsteps" of the milestone. On 7 May they induced a 7.7 Richter quake in the Aleutian Islands. If 7.7 to 9.5 quakes had hit all along the San Andreas Fault in Los Angeles and San Francisco and in between, then the destructive scenario I had envisioned for the West Coast would have occurred.

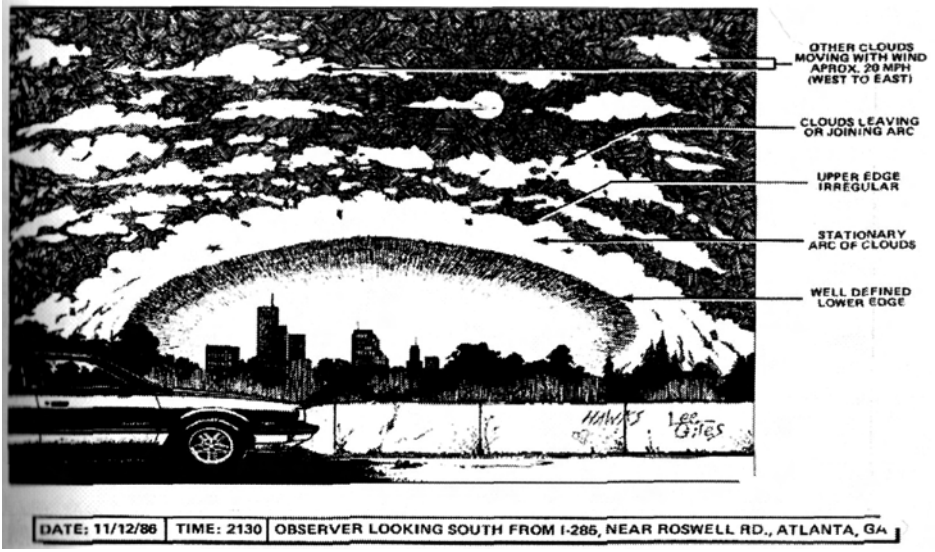

Figure 58 "Bottling up" shield practice over Atlanta 12 Nov. 1986. With a real shield, aircraft or missiles flying into it (from inside or from outside) explode and are destroyed.

On 12 November 1986 the Soviets even placed a giant "dummy shield" (practice) over Atlanta, Georgia (Figure 58). If the shield had been real and not just practice, any aircraft and missiles flying into it would have been instantly exploded and destroyed. That mode—"bottling up" a strategic weapons area—is useful to nullify an entire strategic ICBM launch complex or a large bomber base, etc. It can also "bottle up" a large carrier task force at sea, including the aircraft and the Tomahawk missiles, the shells from the naval guns, etc.

Kill of the Challenger Included Use of Metal-Softening

As we mentioned, during that 1986 preparation period the Russians also destroyed the Challenger spacecraft (January 28, 1986). Numerous signatures abounded, all of which we have already published.

A few weeks before the kill of the Challenger, a close colleague had experimentally proven that a metal-softening signal was indeed placed on the Russian "woodpecker" signals (Figure 7). He did this quite simply: he wired himself into a receiver, through an intervening amplifier, and tuned the receiver to the Woodpecker signals.[44] Then he took nails from a can of nails he was

[44] Here he was taking advantage of the fact that the infolded LW signals inside the Woodpecker carrier wave, comprising the "engines" for metal-softening, also constitute "perfect" divergence-free EM energy, so to speak, at least overall. Amplifying the signal also amplifies the "engine" inside it. When connected to his body, "potentials superpose" is the rule, and that transferred the amplified engines to his body and into the EM field immediately surrounding his body. Hence he softened the hammer metal a tiny bit, and softened the much less tempered nails quite a bit more.

using, and hit them with a hammer to drive them into planks. The nails all folded up instantly like totally wet noodles. A couple dozen, one right after the other. Simultaneously, his son—who was not connected to the Soviet signal—was pounding nails from the same box, normally and without difficulty. None of the nails picked up and pounded by his son experienced any difficulty or softness.

Then my friend disconnected himself from the signal, and waited a bit. Whereupon when he then used nails from that same box, he drove them in without difficulty. There were no more "wet noodle" nails.

We reach a very simple conclusion: When he connected to an amplified Woodpecker signal, his body was time-excitation charged (quick charge and quick decay) with a specific signal so that the nails he picked up were charged. Then when hit with the hammer, the nails acted as if made of very limp rubber without a rebound. When he disconnected from the amplified Woodpecker signal, and waited a moment for the induced charge in his body to dissipate, the nails also discharged their engines and quit acting like limp rubber bands when hit, and became normal nails with normal behavior. That would seem to be quite sufficient to prove the thesis.

The Challenger was then destroyed, as we previously printed, with numerous signatures of the hit, including even a KGB party in Moscow to celebrate the success of killing the vehicle (and getting away with it).

Cold Molding: An Epilog to the Metal-Softening Donnybrook

I was called a total lunatic for pointing out a metal-softening capability on the Russian signals. So be it. Metal softening is achieved by an engine which serves as a pumped phase conjugate mirror for the vibrations and signals in the lattice bonds of metals. Build up that engine in the metal until the precisely reversed and overlaid signals negate the normal signals, and one has "dissolved" the lattice bonds, converting the solid to a liquid. Lattice bond cancellation is not heating.

But that was not to be the end of the "metal softening" story.

A few years later, working informally with a large UK aerospace firm "for free", I furnished them an address in Moscow of some Russian scientists associated on the perimeter of the KGB energetics weapon program. The address had been taken from their cautious advertisement for business on the Internet and furnished to me by a correspondent. A UK engineer fluent in Russian was sent to meet with those scientists in Russia. They nervously showed him several novel things, one of which was "cold-molding" of metal. The liquefied the **metal**

The result was that a hammer blow onto a nail head resulted in the nail acting as a limp noodle upon impact.

without heating, poured it in a mold, and waited for the "effect" to wear off and the liquid to turn back into a solid again.

Briefly, an energetics charge (using LWs) was induced on the metal lattice vibrations, adding their phase conjugate replicas to the interior LWs comprising the lattice bond signals. The metal's atoms were time-density charged to an excited state (presently not recognized in Western science). Thereupon the metal lattice EM forces "dissolved" and the metal became liquid at room temperatures and without heating. The cool liquid metal was then poured into a mold. Then after awhile, the time-density charge and slowly drained away, and the metal resumed its normal solid state—all without any heating whatsoever.

On a subsequent trip the engineer brought that Russian team itself out of Russia and to the UK. The Russian scientists demonstrated cold molding to assembled UK scientists, and to some U.S. visitors. The phenomenon was physically demonstrated and proven.

I was correct about the metal softening then. We were also correct back there in 1986 about the metal-softening signal employed against the Challenger (together with several other things).

There are numerous other signatures on the death of the Challenger. Again, *the death of the Challenger was not an accident.* It was due to a deliberate act of war by the KGB. The KGB knew in advance—after substantial probing incidents—that they would get away with it. And they did so.

Additional Update from Year 1998 to Year 2,000 Has Been Given

In the action package we sent to the DoD in 1998, we told the rest of the KGB energetics weapons story up to that date. We gave the attack plans as we saw them and the most useful types of attacks to be expected.

I hope the reader is interested in this special energetics weapons information. High power microwave weapons, high energy lasers, and nuclear weapons are useful but no longer decisive weapons either strategically or on the battlefield against a foe equipped with such energetics weapons, and particularly against a foe equipped with quantum potential weapons and negative energy EMP weapons.

At present, we are intensely watching to see if we can pick up indicators for the next scheduled strategic attack, its probable timing, and the "new twists" included in it.

Presently, we have perhaps an 80% chance that the little nation can once again counter any new threat and cause the KGB to abort the impending attack. On the other hand, with Putin apparently limiting at least some of the action of the KGB, we have moved into our present asymmetrical warfare against terrorism—

and ultimately against the extensive terrorist teams and assets already infiltrated into our homeland.

As a single example, before the collapse of the former Soviet empire, the Russians long ago slipped in nuclear weapons (from 20 to 40 KT) and hid them in all our large cities and population centers, along with the Spetznaz teams to detonate them on command.[45] Several nations have introduced teams with normal sabotage assets and also with weapons of mass destruction such as radioactive nuclear materials (for a dirty bomb), anthrax, smallpox, bubonic plague, etc. Behind the scenes, the die-hard remnant of the old KGB crew are using QP weapons to "spread" the immune systems (Figure 53) of our populace and materially enhance any BW strikes that the terrorists unleash. The rogue Japanese team (Yakuza and Aum Shinrikyo) on site in Russia are using their LWIs in a giant weather war and the occasional kill of an aircraft, etc. Over the decades Castro infiltrated some 10,000 guerrilla/special forces types trained in camps in Southern Mexico for decades. Probably at least half are still loyal and dedicated—and waiting to blow up bridges, power substations, high voltage power distribution system towers, dams, harbor facilities, refineries, pipelines (both oil and gas), etc. The first phase of WW III—delivery of the weapons of destruction and mass destruction to the targets along with means to unleash them—has already been accomplished.

We are particularly struggling against the rise of asymmetrical warfare—the superpower's paradox (Figure 59)—and our present involvement in that "new" kind of warfare is still quite foreign to us. Only time will tell how well we fare in this new type of war, which we will be engaged in for many years to come. Vice President Cheney rightly regards it as almost a state of perpetual warfare we shall have to learn to live with, as shown by his words on Oct. 21, 2001:

"The war on terrorism will not be over in our lifetime. It is different than the Gulf War was in the sense that it may never end. At least not in our lifetime. The way I think of it is, it's a new normalcy."

[45] See Stanislav Lunev (with Ira Winkler), *Through the Eyes of the Enemy,* Regnery, Washington, 1998. Lunev is a high-ranking GRU defector. He is a former Colonel in the GRU, the military counterpart of the KGB. In p. 22-33, he summarizes the Spetznaz capabilities. On p. 22-27, he summarizes Spetznaz use of nuclear weapons already on American soil. On p. 26, he gives some of the ways in which the Soviets easily brought nuclear weapons into the U.S. On p. 30 he confirms Russian seismic weapons. Use of EMP weapons is on p. 30-31. Use of very, very low frequency weapons to destroy the human brain, put people into a zombie-like state, and aid in brainwashing is confirmed on p. 31. And this is **information** Okayed by the CIA for release!

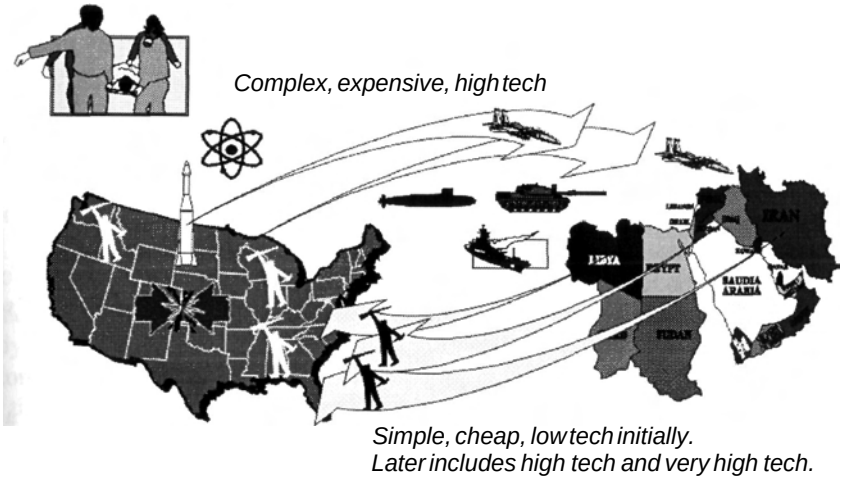

Figure 59 The superpower paradox: Asymmetric cheap WMD strategic strikes and destruction, later becoming extremely high tech and extreme yield.

There is Also a Severe Bioenergetics (EM Biological Warfare) Threat

The threat from bioenergetics is equally vivid. That old die-hard section of the KGB can now attack an entire population, e.g., with electrodynamically (energetics) induced diseases of any kind whatsoever, particularly when using QP weapons. Such attacks are totally immune to inoculations and antibiotic treatment. Any kind of strain or variation of a disease can also be induced in the pathogen pool for that disease. Against a foe who has such capabilities, our entire medical establishment—including all our emergency treatment procedures and agents—*is obsolete right now.* A vaccination and the presence of antibodies, e.g., does absolutely nothing against the EM induction of the exact physical effects and form of a disease, as shown in the decades-long "microwave radiation" of the U.S. Embassy in Moscow (Figure 11).

To the Assistant to the SecDef in such matters, in 1998 we furnished a 200+ page briefing package and loosely proposed a crash development of the new type of medical therapeutic treatment devices pioneered and proven by the Priore group in France in the 1960s and early 1970s. Later, Congressman Cramer queried that office for an answer.

Unfortunately the Assistant SecDef s office erroneously responded to Congressman Cramer that nothing in the literature supported the mechanisms proposed. Indeed, the package we furnished contained a *detailed list* citing the hard French scientific papers in the literature, reporting the exact experiments

and the astounding results obtained. Some 2,000 highly successful animal experiments for more than a decade of experiments in fact supported the thesis, and higher group symmetry electrodynamics fully supports the ability to use EM means to make spacetime curvature engines, so that these engines then interact back upon the targeted matter to perform the actions desired. That it does not appear in conventional electrical engineering is of no consequence; it appears in physics and it is good physics, just on the cutting edge.

We also reported, explained, and cited Becker's epochal work (Figures 27 and 28), which is copiously published in the hard literature and which was an example of the fundamental mechanism also. Becker was twice nominated for a Nobel Prize for his outstanding work. Unfortunately, the Assistant SecDef s office responded with a non sequitur.

Packages were sent also to NIH, NSF, CDC, and several other government agencies. Not a single one of those agencies was interested enough to have a competent scientist contact me and discuss the area. I strongly doubt that a single scientist anywhere in the Government bothered to *seriously* read and ponder the material so painfully and expensively compiled and furnished. Lieutenant Colonel (Retired) Ken Moore and I worked our fingers to the bone for weeks, preparing that briefing, and we spent all the spare money doing it that we could rake up and obtain.

The near-total lack of response itself seems astounding, but it clearly shows the state of U.S. science with respect to novel energetics innovations, even long after those innovations have been experimentally proven and documented in the hard literature, and even after they have been weaponized against us. It is a direct indication of why the U.S. never deciphered what was going on in some four decades of Soviet weak microwave radiation of the U.S. Embassy in Moscow, including the kill (eventual deaths) of three U.S. Ambassadors.

For decades there have been manipulations, to say the least, in the hotly contested field of the biological effects of EM radiation. We refer the interested reader to an excellent expose of that situation: The expose is by Dr. Andrew A. Marino, Ph.D., J.D., *Powerline Electromagnetic Fields and Human Health,* which is current. I believe it can be freely downloaded from: http://www.ortho.lsumc.edu/Faculty/Marino/PowerlineTOC.html. Dr. Marino has been personally and deeply involved in the investigation of EM bioeffects, in court cases, and in Blue Ribbon Panel investigations and proceedings. The book is an eye-opener, and it gives one a good view of the machinations in the EM bioeffects field. We quote directly from Dr. Marino, Chap. 6, p. 1:

> *"Oversimplistic as it may sound, whoever pays for EMF bioeffects research and analysis determines what data is produced and the way it is interpreted. Soon after the possibility that powerline EMFs were health risks was raised in a legal dispute involving the New York Public Service*

Commission, power companies and their trade associations, particularly the Electric Power Research Institute (EPRI), became massively involved in EM bioeffects research. Subsequently, the power industry dominated funding of the effects of powerline EMFs, both in terms of absolute dollars and compared with dollars from non-industry sources...the power companies and their trade associations were deeply deceitful regarding the information they provided to scientists and to the public regarding the potential health hazards of powerline EMFs."

In the entire EM bioeffects field, there does not appear to be any mention of, study of, or recognition of EM bioeffects induced by the most powerful EM factors: longitudinal EM wave irradiation, time-polarized EM wave irradiation, and time-excitation charging of particles throughout the body and its cells, with resulting emission of transduced longitudinal and transverse EM radiation *from-within-to-without.*

National Institute of Health Reaction

NIH replied to my letter and action package from their *Policy*—read: *spin control*—Section. They noted that the package mentioned the Gulf War Syndrome, which was not in their mission area. So they just sent it off packing to DoD (simplest way to get rid of it, apparently no one seriously read it or even cared to read it). I queried them back by separate response letter about their lack of interest in a revolutionary proven new medical methodology well-documented to cure cancer and other dread diseases, in many hundreds of experiments by leading French medical scientists. This was certainly within their mission area.

They hastily replied from the *Policy* Section that, yes of course NIH was interested in all such things, and told me where to "submit a proposal." We never got out of their *Policy* department. Again, not a single competent scientist in the U.S.'s supposed master medical agency apparently even read the package or cared to call and discuss the matter. This was an indicator of their total lack of any grasp of the energetics threat, its testing, and its use to induce the Gulf War Disease.

Now perhaps one can see why we are so far behind the KGB energetics weapons scientists and weapons program.

Marino, *ibid.*, is particularly enlightening on the adamant opposition by appropriate sections of NIH vis a vis the harmful effect of nonionizing EM radiation.

No responses at all were received from the NSF and the CDC, or the other U.S. government agencies to which the package was furnished.

The CDC of course comes under NIH, and thus its responses or lack thereof would be dictated by the parent NIH policies. As for the NSF, Marino, *ibid.*, again is enlightening on the qualifications or lack thereof of its membership.

So as the reader can see, the top of the medical establishment in this nation is flatly not interested in any "controversial" or "out of the box" proven method for curing cancer, dread diseases, and mass treatment of those millions of American casualties that are coming in our cities and population centers. Again, they directly ignore scientific method's very premise: *If the experiment is replicated and contradicts the theory, accept the experiment and change the theory.* I personally concluded that the U.S. Medical establishment largely does not follow scientific method, but follows dogma and the already approved methodologies.

How the New Revolution in Medical Healing Works

For the reader who is a medical scientist and trained in physiology and biology, one might be interested in that revolutionary French therapeutic methodology and how it worked (before it was ruthlessly suppressed in the early 1970s).

Priore's apparatuses (Figures 12,49, and 60) simply pumped the cells of the entire body with longitudinal EM waves (each accompanied of course by its time-polarized twin, in a Whittaker pairing). The cells and every part of them are very nonlinear, so they act as pumped phase conjugate mirrors for Whittaker wave-pair engines resident in the cells and acting as "input signal complexes".

Once the cells are pumped by these now-established *time-density* waves, the damaged or diseased cellular masses slowly "charge up" with excess time-excitation. The irradiation took several hours, and this was the "activation" or "time-excitation charging" stage. Thereafter, the time-charge decayed slowly, all the while constituting *pumping* of every cell and every part of it, in the time domain.

The resident engine in the cell contains two components: (1) the normal or healthy component, and (2) the abnormal component representing disease or debility. Pumping these two components time-reverses both of them and amplifies that reversal. This creates amplified and incredibly precise *antiengines* in each cell and in each part of each cell. These antiengines override the weaker cellular engines resident. In turn, this "reversing" action of the antiengines causes the pumped cellular masses (actually the mass-energy, in its exact structure and dynamics)—at any and all levels, including the genetics—to be time-reversed back to normal. In biological instead of physics terms, it "dedifferentiated" the diseased or altered cells back to a previous healthy state by simply eliminating the diseased engine component. *This is a dramatic extension of nonlinear optical phase conjugation from the 3-space pumping domain to pumping in the complex (time) plane, and it is effective for time-reversing mass-energy at any and all frequencies. We accent that the cellular*

time *reversal back to a previous state includes all the cell's genetics and every* ***part*** *of the cell no matter how small.*

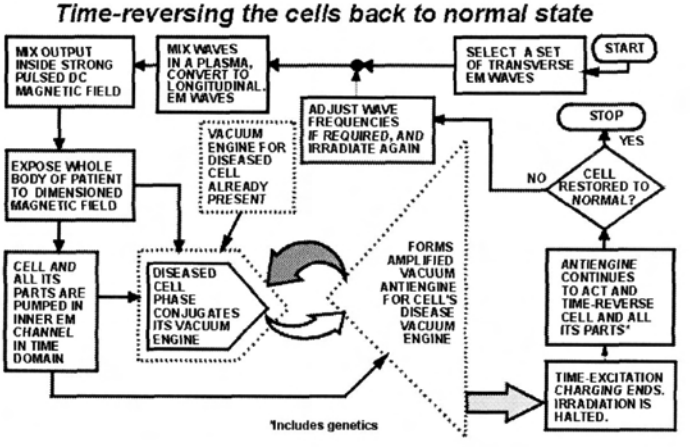

Figure 60 Block diagram of Priore's healing (regenerative and time-reversing) process.

Normal cells are just backed up to a slightly younger condition. Diseased cells **have t**heir abnormal engine component overridden and reversed back to zero (its earlier state), so that only a slightly younger normal engine remains resident in the cell. This simultaneously reverses the cellular masses back to their previous healthy condition.

Contrast this direct healing mechanism to the action of the immune system.

The immune system itself does not *heal* anything. It contains the killers, the scavengers, the locators, the markers, the attackers, and the troops manning the ram**parts.** Usually after a fierce battle with invading hostile pathogens, it wins. Lots of cells still living are damaged in the melee. The immune system scavenger cells then scavenge up the residue littering the battlefield. But *the immune system itself cannot heal and restore a single damaged cell, including one of its own.*

That healing and restoration of damaged cells is the job of the *regenerative system,* still little known and inadequately studied today. Perhaps the most fundamental studies were mostly by Becker *et al.* some decades ago. The regenerative system (Figure 29) is an EM system in its operation, as clearly shown by Becker (Figures 27 and 28), yet it is able to physically differentiate and dedifferentiate cells from one form to another at will, and in highly selective fashion. The regenerative system acts within its limitations (only weak pumping can be done for the time-reversal of diseased or damaged cells) to eliminate the delta (the deviation from normal of the resident engines in the pumped cell). That restores the normal (healthy) engine and slightly amplifies it as well.

It is obviously of the utmost medical importance to understand and apply (and amplify) this little-known technical mechanism by which the regenerative system is able to restore damaged cells back to normal.

It turns out that *the regenerative system in its novel EM functioning uses precisely LW and TDW pumping of those damaged cells and gradually time-reverses their entire masses back to a normal healthy state, within its limitations.*

This is the secret of the mechanism of the cellular regenerative system—which is an electrodynamic system of very unusual nature. The exact mechanism has not previously appeared in the literature. It took me 14 years to uncover that fundamental mechanism, and another 4 or 5 to refine it a bit, even though both Priore and Becker (as well as others) applied it decades before without being able to fully decipher it.

The experimental proof is already in the literature, once one understands the higher topology EM unwittingly used by both Becker and the Priore team. The proper types of higher group symmetry electrodynamics required to understand the action of the cellular regenerative system are available. There exist scientists skilled in their application and use. These scientists and that higher group symmetry electrodynamics are little used, and are never used at all in the medical field. There exists no funding anywhere for higher EM examination and modeling of the functioning of the cellular regenerative system—i.e., for the fundamental healing process.

Just imagine what this could mean to medicine: *One can now develop a new medical science to amplify and apply nature's own proven method of restoration and healing of damaged cells, including all their damaged genetic material.* It matters not what caused the damage, whether pathogen or gamma radiation, whatever. This new therapeutic method is a totally new general relativistic process where powerful spacetime engines are created which work directly upon the damaged cell and every part of it, physically reversing the cell and all its parts precisely back to normal condition.

General relativity rigorously tells us that a precise spacetime curvature engine (set of precise spacetime curvatures) is present and active for every specific disease condition and every nuance in it. It also tells us this flawed (disease or damage carrying engine) continuously operates on the cellular mass at every level, maintaining the exact physical condition of the cell and its dynamics. By creating a precise "anti-engine" and amplifying and applying it, general relativity assures us that we are physically acting upon the cell and all its parts at every level, down to the smallest—to precisely return every part in perfect proportion back to a previous normal healthy condition. *Pautrizel directly proved the time-reversal to an actual earlier state of the cells and the organism* (Figure 61). Amplification by time-domain EM pumping, means that we can cause this time-reversal of the cells back to normal to happen much more

quickly than can the body itself, which can only pump very weakly.

- Pautrizel compared identical treatment of immature rats with immature immune systems, and mature rats with mature immune systems.
- Treatment restored the damaged mature system back to full mature functioning, and it promptly recognized and dispatched the pathogens.
- Treatment restored the damaged immature system back to full immature functioning, unable to cope, and the pathogens promptly reinfected and killed the immature rat.
- The lesson: The body is indeed returned to a previous physical state. The pathogens themselves are not killed by the treatment, but by restoring the ability of the immune system to recognize and destroy them.
- Only *the previous ability* of the immune system is restored by the process.

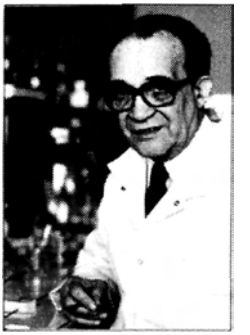

PROF RAYMOND PAUTRIZEL
(Renowned Parasitologist)

Figure 61 Pautrizel's proof of time reversal of the stricken cells back to a previous state.

General relativity also assures us that any and every disease is subject to this novel treatment approach, even diseases which have resisted every other known therapy. The Sachs unified general relativity and electrodynamics, and GR/EM unification applications in O(3) electrodynamics produced by Evans, for the first time provide a solid theoretical basis for Priore's methodology and his evolutionary results. They also offer direct engineering of startling physical cures, once the technology is developed.

The profound implications of that treatment can be seen. Apparently, however, **our** leading governmental agencies and health agencies do not see it, do not wish to see it, have no appreciation for general relativistic effects in healing, and do not intend to have any appreciation for general relativistic effects in healing. Indeed, they seem totally uninterested in even trying to comprehend and research *the fundamental healing mechanism* demonstrated by nature herself.

What the French Researchers Showed

Among other things, the Priore team produced revolutionary cures of *terminal tumors, infectious trypanosomiasis, suppressed immune systems, and atheriosclerosis* in several thousand laboratory animals in rigid laboratory tests under rigorous protocols. Eminent scientists such as Robert Courrier and Raymond Pautrizel worked with the Priore team. Courrier was head of the Biology Section of the French Academy of Sciences at the time, also *Secretaire Perpetuel* of the Academy, and a noted scientist of high stature. Courrier personally presented the astounding Priore results to the entire assembled French Academy. He also sent his own most able scientist assistant to personally

prepare the terminal tumor grafts on the lab animals before their treatment.

A world-renowned parasitologist who did enormously important work with Priore was Raymond Pautrizel, who is still alive at this writing though quite aged. Pautrizel was greatly persecuted for his years of determination and effort. Courtesy of Pautrizel via the late Christopher Bird, I personally have the very Ph.D. thesis that Priore himself submitted to the University of Bordeaux on his revolutionary work. That thesis was maliciously rejected in the suppression that was applied to the project. When the French Government changed to a Leftist government in the mid-70s, Government support was immediately withdrawn and the project was ruthlessly suppressed. Priore later sickened and died and that was the end of that. More than a decade later a brave and determined Pautrizel finally was able to get a doctoral thesis approved in the Priore work area, at the same university, by another doctoral candidate, Eric Perisse {40}.

There are two U.S. patents on the Priore device itself, and of course several French patents also.

All the above was rigorously documented in the 1998 package prepared and submitted by Ken Moore and I.

While Priore was still alive, a team with which I was connected attempted to mount a well-funded effort to restore the Priore methodology while Priore was still alive. We also were viciously suppressed. The lives of our financial backers and their families were threatened. The head of our project was viciously attacked financially and destroyed, fleeing the country for his very life. Whoever thinks that dramatically innovative medical science in this country is just sweet reason and scientific method, should have a strong enema to remove the serious blockages interfering with his perceptions.

This vicious outside suppression of our project so infuriated me that I made a solemn promise that, were it humanly possible, I would decipher the Priore process before I died. It took 14 years, but we made good on that promise. During the 20 years or so since our project was suppressed, it is heartbreaking to consider the millions of children and sickened and suffering people who could have been saved had the project continued and succeeded. It is heartbreaking now to consider the coming millions of casualties in our civilian populace in our cities, most of who are going to die from mass destruction weapons. And most of those would not have to die, would the scientific community waken from its long sleep and discover some modern physics and higher group symmetry electrodynamics—and their application to solve nature's mechanism for **healing.**

When one time-reverses the body's cells and all their parts, one forces the diseased cells to dedifferentiate back to healthy state. We strongly accent that this is accomplished by unified GR/EM processes involving precisely **organized** spacetime curvatures and their local actions in the cells and all their inner components, down to the finest level. It can be rigorously expressed in good unified physics, as expressed in an electrodynamics such as O(3).

The nondamaged or nondiseased cells just get a little younger. That is also highly beneficial; it reverses the ravages of aging, just a little. Indeed, one of the implications of the Priore mechanism is that aging can indeed be reversed by the process and treatment. Again, one must keep one's sense of humor. In order to get this technology and therapeutic method born, what seems to be needed is an extremely wealthy person, strongly desiring to live longer than the expected life **span** and do it in a vigorous, healthy body—and who is willing to fund the project with the necessary $60 million required so to redevelop and extend the Priore technology so it can be readily applied. A byproduct will be the saving of millions of American lives when those coming mass casualties from weapons of mass destruction occur in our cities.

How the Regeneration Mechanism Was Finally Deciphered

What took so long in deciphering the mechanism was the problem of how to make such precisely tailored and exact ST curvature engines, specifically so that they are *exact* antiengines for a specific disease and even a specific pathogen, and even for different versions of the engines for different cells in a single body having different strains of the same pathogen, having different body DNA, etc. For years, the solution of that task seemed hopeless. How on earth could one possibly work all that out in a hundred lifetimes, so that it could be precisely calculated even by an array of the most powerful computers on Earth?

After years of struggling with the problem, in one stroke of enlightenment it was revealed to be the simplest thing in all the world. Absolutely no calculation was necessary, and the exact amplified antiengine effect was a fairly simple and straightforward thing to obtain. General relativity tells us that every cellular mass and each part of it, has its own unique spacetime curvature engine, to the finest detail and an exact fit. As Wheeler put it so nicely {130}, *"Space acts on matter, telling it how to move. In turn, matter reacts back on space, telling it how to curve. "* The mass and its dynamics and the engine and its dynamics constantly interact upon each other, and "keep attuned and in perfect adjustment," so to speak.

That means that a "normal" cell already has just such a precise "normal" ST engine residing in it, and acting upon every component at every level—even in the atomic nuclei. Well, a diseased cell has an absolutely specific structuring, and therefore it also has an absolutely specific ST engine structuring. *A priori that* resident structuring for the diseased or damaged state in the individual cell differs (by some delta) from the structuring of the normal healthy cellular state for that individual cell.

Voila! That means that *the ST engine for the damaged cell can be decomposed into two parts (two engines):* (1) the normal "healthy cell" state engine, and (2) a delta ST engine that has been added to it so that together the two comprise the full ST engine for the exact individual condition of the cell.

What is now needed is a way to produce an exact antiengine of two parts: (1) one for the normal engine and (2) a second one for the delta (disease) engine. Applying this amplified and combined "antiengine" would overpower the resident combined engine, precisely reversing the cellular condition by reducing the delta to zero. Rigorously, the cellular mass and every part of it must then also revert to a previous physical state, or else we must complete discard general relativity itself.

Well, if we were to just time-reverse the resident engine and its two components, that would give us the perfect antiengine with its two components. Amplifying this antiengine would then produce one that was more powerful than the resident engine in the cell. Applying that amplified antiengine to the cell, that would not really change the "normal" engine component, but it would precisely reduce the delta engine component back to zero (its previous state, before it was there!) Voila! A specific healing signal of perfect structure, for the specific deviant condition of the individual cell and its every part.

Since we have a combined GR/EM to use, we can think electrodynamically about this general relativity problem. Immediately we see that phase conjugate optics is a candidate, since the "resident composite engine" can correspond to the "signal" or input wave, and the pumping of the nonlinear mass of the cell and its parts (where they act as nonlinear phase conjugate mirror materials) produces an exact phase conjugate replica (the exact amplified antiengine). The presence of that antiengine overrides the magnitude of the resident engine, and it moves the cell precisely back along the temporal path previously taken. In short, it applies a specific kind of dedifferentiation of the cell back to its previous healthy condition.

Since we extend phase conjugate pumping to the time-energy domain, then the resident composite engine and its time-stream component are the "input." The amplified antiengine and its time domain component will then forcibly propagate that pumped mass energy back over the time trajectory previously taken by it. In short, it will time-reverse the cell and all its parts back to a previous condition, completely eliminating the delta (disease or disorder). The beauty is that it will also reverse damaged or altered genetics, such as in the AIDS disease. It can do this prior to the appearance of health symptoms—it can be done as soon as the patient tests positive for HIV.

Since the antiengine is amplified, it moves the cell back to normal fairly rapidly (in a few hours, for example). At least the time charge for the reversal process is delivered in that period; one may allow (as Priore did) a full week for the time-charge and its transduction to continue reversing the cells. But it is much faster than the normal speed of the human regeneration system using the same process, because now we have greatly amplified the time-reversal rate.

It is therefore ideal for a method of quickly treating mass casualties, particularly since it can be developed and used in a portable unit about the size of a large

suitcase (Figure 13).

Interestingly, during the radiation with LW EM radiation, one also pumps the pathogen and time-reverses it as well. Its "normal state" towards the beginning was a condition whereby it could move with relative immunity past the immune system's opposition, having deceived the immune system. In the treatment, a small amount of the pathogen is therefore converted back into this condition just shy of the beginning, where that part of the pathogens is resistant to the immune system. However, a very small, short "post treatment" irradiation with LW radiation for a much shorter interval and at weaker power, will clean up this altered pathogen residue by allowing the immune system to recognize it and destroy it. Pautrizel clearly demonstrated this significant fact.

Cellular and Body Rejuvenation are Possible, Once the Technology is Developed

One can in fact really accomplish *rejuvenation* of the aged and infirm, as the technology is developed. One could certainly solve the major problems of Medicare, and cut the patient load at least in half, relatively quickly and inexpensively. Of course lots of big U.S. drug companies will be rather violently opposed to any such idea, because much of their empire would be threatened. Much of the organized medical community depends largely on the Big Drug Approach. So the organized medical community will also vehemently oppose it, just as the formal medical science community in France viciously opposed it.

One could also produce cheap, portable LW treatment units *en masse*, which is what we were suggesting to the Assistant. SecDef. That way one could flood the emergency response system (response teams, hospitals, fire stations, police precinct stations, schools, etc.) with quick and effective treatment devices. They could be used to rapidly {131} treat those millions of American casualties that are going to occur when one or more of our cities are attacked in the near future by terrorist WMD attacks. This would save the lives of most of those stricken millions of Americans.

Mow Many Americans Could Be Saved?

For an anthrax attack on Washington, D.C., first generation equipment could save perhaps 70% of those sickened Americans, almost all of who are going to die with *present* capabilities. With second-generation equipment, one could save perhaps 90%.

For an anthrax attack without spreading via QP clandestine preparation of the populace, one would save 0.7 to 2.1 million Americans. With clandestine KGB QP spreading and a *5:1* increase in the yield of the anthrax strike, one would save 3.5 to 10.5 million Americans.

For a truly nightmare attack (as a worst case scenario) perhaps 5 major cities

might be attacked in such manner and to such degree. In that case, one is talking about saving 3.5 to 10.5 million Americans for the unspread attack case, and up to 17.5 to 52.5 million Americans for the spread case.

Further, the development of the necessary portable treatment units is doable and affordable, for mass treatment capability. Training on a portable machine could be done for a high school student in 30 minutes or less, and that student could then give emergency treatment effectively.

Absolutely nothing else out there can presently warrant such projections. Yet this is the very technology our own medical science community is eminently uninterested in, has no knowledge of, does not wish to obtain any knowledge of, and does not wish to scientifically discuss.

There Are No Resistant Strains to the New Technology, and There Cannot Be Any

A most interesting thing is that there cannot be a "resistant strain" of a pathogen for the new treatment methodology, *a priori.* No mass can shield against spacetime curvature effects. Slight adjustments of the controls will adjust the spacetime engines being utilized. Two or three hour's work with a developed unit and a lab team on a new strain would suffice to completely determine the required adjustments, once the technology is developed. The new information could then be quickly relayed to all stations treating patients. On each treatment device, adjusting a few dials and controls for the laptop computer controlling the unit will do the trick. The use of the final device would be so simple that a teenager could be trained to use it in less than 30 minutes.

Such new capabilities are urgently needed not only for the millions of civilian casualties we expect in the future, but also for support of our armed forces in the field. Frankly, the anthrax shots are not going to do them much good, once one realizes that the "spreading" of their immune and regenerative systems is already occurring via KGB quantum potential means. Camel pox is available to any terrorist foe, and has almost the identical actions and constitution as smallpox. Indeed, it is almost identical to smallpox.

The Gulf War Disease and Syndrome were just small preludes of what is to come and what is already being used against the entire U.S., though as yet very clandestinely. Look again at the Kaznacheyev work. *He clearly proved in thousands of successful experiments that any kind of cellular disease or damage or death whatsoever, can be induced at a distance by novel EM means.* Replication experiments were successfully accomplished at the University of Marburg and also at the University of Sydney.

Results of the Priore' Treatments Are Well-Documented and Independently Supported

The Priore team's results are well documented in the hard French scientific literature. At least one French doctoral thesis was eventually accepted upon the work. The astounding results really occurred. They were scientifically substantiated under rigorous protocols and even police-guarded labs for tests by a learn of outside scientists. To then deny those results simply because no one **has** *understood* the active mechanism until now, is to deny the scientific method itself: *Believe the experiment when it refutes the prevailing theory.*

There is also independent work by other scientists that strongly supports the Priore results, once the mechanism is finally understood.

Robert Becker *et al.* in the U.S. conclusively showed that living cells *in situ* can be dedifferentiated, redifferentiated, etc. by laughably weak currents (picoamperes) and DC potentials (which are comprised of those famous Whittaker pairs). Becker was unaware that his potentials included time density waves and longitudinal waves, as predicted by quantum field theory and as shown by Whittaker in 1903 (once one understands that a bidirectional phase conjugate longitudinal EM wavepair is a time-density EM wave coupled to a longitudinal EM wave). Application of such EM potentials by Becker transformed red blood cells into pre-cartilage cells, then further into pre-bone cells. That latter cell type was then deposited in bone fractures, healing them when nothing else would. Becker and others have demonstrated partial regeneration of limbs in small test mammals, using the technique. The bone-healing techniques were finally approved by the FDA and are often used in some hospitals for treating otherwise intractable bone fractures.

Since then, other scientists have shown the directed formation of other types of body cells from cells from distant parts of the body (i.e., muscle-type cells from cells produced in the bone marrow, etc.). Such things are now well documented in the U.S. literature, in at least several hundred papers and in the leading journals including *Nature, Science,* etc.

The Present Threat Is Urgent, and Our Strategic Destruction is Still at Issue

Our own medical community, our science community, and our intelligence community are at least 20 years or more behind the KGB right now. We are also behind the Chinese. In many respects our scientists have simply missed the biggest scientific breakthrough of the century.

It is urgent that we find some way to counter and avoid future strategic energetics attacks sure to be scheduled. The eventual attack actually launched—if the little nation's QP weapons can be countered first—would destroy the U.S. in about 2 hours. It only takes about 10 minutes, it seems, for the QP weapons

already deployed to negate almost all our strategic nuclear arsenal. Thereafter, the KGB and Yakuza/Aum Shinrikyo can simply attack us at will and utterly destroy the U.S. To any loyal American, that is an entirely unacceptable solution.

The most urgent requirement would seem to be immediate and strong contact at the highest level between the U.S. government and the leaders of the little foreign nation (and the other friendly nation) that presently is guarding the ramparts and saving our necks. A cooperative crash program to develop our own QP weapons would seem to be the order of the day, if it can in any fashion be negotiated. But to have any chance of success, the President and the Congress will have to use the utmost care in selecting the U.S. negotiators and scientists to explore this possibility.

Immediate transfer of the requisite capabilities to the U.S. would be desirable, at least from our own view. From their view, of course, we do not necessarily resemble a trustworthy scientific partner at all, based on our past scientific performance, and it is up to the U.S. scientific community to prove to them that the leopard really has changed its spots. That would all have to be negotiated and worked out.

If that is not possible, then it is of extreme urgency that our own country embarks upon a new Manhattan Project to develop strategic quantum potential weapons and defenses. It would be a great relief to discover that such had already been started, but I fear not.

Desperately Needed Defensive Capabilities Can be Provided by a QP Solution

We pose one more very, very useful QP capability prior to closing. As we stated, if a large U.S. city is hit with—say—an anthrax attack done in professional manner, we would expect 1-3 million casualties, according to a well-known major U.S. government study. With immune/regenerative spreading presently already ongoing here in our populace by KGB QP weapons, that figure may actually increase by about 5-fold. So the casualties (prompt and delayed) might well reach 5-15 million, in a single *professional* anthrax spray attack by two persons from one light plane on a calm night dispensing 100 kilograms of anthrax spores sprayed over the city with a simple agricultural sprayer. With the indicated Priore technology and treatment units in all emergency response hands, at least 70% or so of those casualties could be saved. Otherwise, *presently almost all of them will die.* That dramatic saving of lives is one desperately needed capability that could be met.

But there is a further capability of LW technology that nothing else presently known can do without serious impact upon the populace.

After the prompt and shortly delayed casualties are mostly cured and the

remaining fraction dies, a terrible problem of BW contamination still remains. No one anywhere really knows how to clean up an entire city from anthrax spores. But unless harshly decontaminated, that contaminated city is going to be effectively uninhabitable for decades to come, if only the present technology and methods are available. Islands of the coast of Scotland, where anthrax was tested decades ago, are still "hot" and contaminated—and off limits.

The indications are that our nation has developed chemical sprays that can kill and neutralize the anthrax, including in the lungs of the populace breathing the spray. On the other hands, it is indicated that the spray is a high physical stress factor, and some of the more debilitated citizens will be injured or even killed by the spray itself. This includes babies and small children, the aged, those with lung and breathing difficulties, etc. As a matter of national survival, desperate diseases do deserve desperate remedies. So while spraying the zone might itself sicken and kill some thousands of our weaker citizens, at least—so the thinking would go—it saves millions. This of course is similar to the use of triage—reserving treatment and scarce medical capabilities and supplies for treating those most likely to live and recover with treatment, rather than treating those more seriously affected and less likely to survive. Sadly, presently triage will almost certainly be necessary because of very short supplies and treatment teams, etc. So most of those 1 to 3 million casualties will simply be dragged aside and left to die, and just made as comfortable as possible.

However, the QP technology can be adapted to produce systems that can indeed do complete decontamination, very quickly, and without harm to the citizens in zone. The anthrax can simply be modified by specialized spacetime curvature engines—specialized EM fields and waves carrying hidden inner "information content of the field" engines that are designed specifically to change and destroy anthrax and nothing else. Eventually one could develop the capability to do it similarly for *any other* major contaminant, including nuclear radioactive materials contamination of a major city.

Any strategic and tactical analyst can immediately see the tremendous value of such capabilities.

In Conclusion

I hope the above admittedly lengthy overview is of interest to the reader and useful. If we are to survive the debacle that now looms before us in this new asymmetrical war we shall be in for decades, it will require the efforts of leading and dedicated Lawmakers and Overwatch persons. Without firm prodding, the military, scientific, and intelligence communities are likely to just continue their present pace until many or most of us all die suddenly.

The KGB energetics threat is still real and imminent; Russia is not a monolith and Putin still does not have complete control over the KGB. Another full strategic attack is sure to be scheduled before very long by either that die-hard

faction of the KGB, the Yakuza/Aum Shinrikyo, the Chinese (particularly if they move against Taiwan and we defend), or someone. And so our possible deaths also to be taken into account, if we just continue to do business as usual.

Along with other Americans, I love my country and served it to the best of my ability for 20 years of active duty. It is the survival of America itself that is now at stake, both in the asymmetrical war against terrorists and in the continuing war against energetics weapons. Our scientific, military, and intelligence communities simply must be jolted awake and into massive efforts in energetics.

We have the scientists with the required capability. We have the facilities. We have the leadership, and we can do it if we can put this thing under a Presidential Decision Directive, under an Executive Order and a Declaration of National Emergency (along with the several already in effect).

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1986

Fer De Lance

Briefing on Soviet Scalar Electromagnetic Weapons

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1986

Note: This is the original Fer De Lance briefing paper wich includes some minor text and artwork editing.

1986 FER DE LANCE INTRODUCTION & BRIEFING ON SOVIET SCALAR ELECTROMAGNETIC WEAPONS

This briefing presents the basic concepts of Soviet scalar electromagnetic weapons, some of the major types available, and evidence of their widespread testing.

Scalar Electromagnetics is Electrogravitation

Scalar electromagnetics is an extension of present electromagnetics (EM) to include gravitation. That is, it is a unified, and, what is more important, it is a unified engineering theory. Nikola Tesla initially discovered its basis.

In the scalar EM extension, EM field energy can be turned into gravitational field energy and vice versa. This exchange can be patterned and localized, in specific areas or objects. Such a controlled change of electromagnetics to gravitation is not possible in the normal EM or physics presently taught in Western textbooks. However, the bits and pieces of the theory have been scattered through the physics literature for some time, but no orthodox Western scientist seems to have realized that these anomalous portions could be integrated into a startling new physics. Unorthodox experimenters, inventors, and scientists have made discoveries in this arena for several decades, but again have not realized the exact implications or the precise manner in which their results could be combined with present electrical physics.

Fer-de-Lance

Such sluggishness is certainly not present in the Soviet Union. For over three decades, the Soviet Union has been developing electrogravitation and applying it to develop strange new secret weapons of incredible power and capability. They have sustained the largest weapons development program ever launched by any nation, and they have kept it effectively hidden from prying Western eyes. 1 have called this program "Fer-de-Lance," after the deadly South American pit viper of that name.

The dreaded fer-de-lance is a snake of great agility and lethal effect. It often ambushes its hapless prey, and strikes unexpectedly and without warning. Its first sudden strike is usually lethal to its victim, which promptly expires in writhing agony. Since the Soviet development of scalar EM weapons has been designed for the same purpose, the name seems appropriate.

The equivalent effort of about seven Manhattan projects has been poured into Fer-de-Lance by the Soviets, and the program has been successful almost beyond imagination. The eery weapons are now developed, deployed, and

tested. The ambush has been completed; Fer-de-Lance is coiled and ready to strike.

Energetics and Directed-Energy Weapons (DEWs)

The ordinary Soviet name for this type of weapons science is energetics. In the West, that term is believed to be associated with conventional directed-energy weapons (DEWs) such as particle beam weapons, lasers, radio frequency (RF) directed-energy devices, etc. The Soviets do not limit the term in this way.

Western scientists are familiar only with directed-energy weapons where fragments, masses, photons, or particles travel through space and contact the target to deliver their effects. Hence in their thinking they limit the Soviet term "energetics" to the type of weapons they themselves understand - exotic but normal weapons using energy or mass traveling through space to impact a target.

However, it is possible to focus the potential for the effects of a weapon through spacetime itself, in a manner so that mass and energy do not "travel through space" from the transmitter to the target at all. Instead, ripples and patterns in the fabric of spacetime itself are manipulated to meet and interfere in and at the local spacetime of some distant target. There interference of these ripple patterns creates the desired energetic effect (hence the term energetics) directly in and through the target itself, emerging from the very spacetime (vacuum) in which the target is imbedded at its distant location. As used by the Soviets, energetics refers to these eerie new superweapons, as well as to the more mundane DEWs known to the West.

As a consequence of the Soviet breakthrough and decades of feverish development, monstrous strategic weapons undreamed of in the West are already in Soviet hands. A noose is slowly and steadily being tightened about our throats, and it is already the 11th hour.

The Soviets Use a Deception Plan

Concomitant with this supersecret development program, the Soviets developed and implemented an elaborate deception plan to conceal these startling weapons and their nature from Western eyes until it is too late. Soviet deception has been so successful that even when Western scientists are confronted with the actual Soviet tests of these weapons directly over their heads, they do not recognize the weaponry nor the nature of the effects produced.

As early as January 1960, Nikita Khrushchev announced the Soviet development of a new, fantastic weapon. On May 1, 1960 Soviet defensive radars - rigged as prototype weapons of this new kind - probably downed Francis Gary Powers's high-flying U-2 reconnaissance plane over the Soviet Union, precipitating a major diplomatic incident.

On April 10, 1963 one of the first new superweapons operationally deployed was used to destroy the U.S.S. Thresher atomic submarine underwater, off the east coast of the U.S. The next day, April 11, 1963 the same deployed superweapon was utilized in a different mode to produce a giant underwater explosion in the ocean over the Puerto Rican Trench, 100 miles north of Puerto Rico.

Over the years, various aircraft were interfered with or downed as tests of these Soviet weapons. A particular case involved the mysterious loss of F-111s in the Vietnam conflict. At least one downed F-l11 crew was recovered in the subsequent prisoner-of-war exchange. On that aircraft, all electrical systems suddenly were in difficulty simultaneously. All emergency indicator lamps were lit up, "like a Christmas tree." This was probably due to special Soviet teams converting some North Vietnamese SA-2 missile system radars to the scalar EM mode, and employing "scalar beam" interference to produce spurious EM noise throughout the electrical and electronic systems of the aircraft.

In late April/early May of 1985, the entire armada of Soviet strategic scalar EM superweapons was activated as a special celebration of the 40th anniversary of the end of WWII. Activation of this armada (which probably contained over 100 giant weapons), together with 27 giant power systems and a large number of command and control transmissions, was monitored on an advanced, proprietary detection system by Frank Golden. After the giant strategic exercise, which lasted several days, most of the weapons and power sources were once again stood down to "standby."

The NASA shuttle launches provided a convenient opportunity for Soviet testing of these superweapons in a Launch Phase ABM mode, where a launched missile can be detected and destroyed shortly after liftoff. At first, electromagnetic pulse (EMP) bursts on the early shuttle trajectory were deliberately delayed in time, to prevent actual destruction of the target and avoid alerting the U.S. that something unusual was happening.

The shuttle launch of November 26, 1985 saw a particularly significant-test of this kind. In this case, a very loud "sonic boom" or explosion occurred over the launch site 12 minutes after shuttle liftoff, when the shuttle was already away and downrange. At least two previous shuttle launches had also been used as pseudotargets, with delayed booms occurring over the launch site well behind the vehicles.

After the lack of U.S. reaction to these three tests showed that the U.S. still had no knowledge of the new technology and did not even recognize its employment, the Soviets apparently decided to proceed with tests where the target vehicles would actually be destroyed.

On December 12, 1985 the same Soviet weapon tested against the NASA shuttle launches may have deliberately interfered with the controls of an Arrow DC-8 taking off from Gander Air Force Base, Newfoundland. At an altitude of 100

feet, the aircraft - carrying over 250 U.S. soldiers and civilian crew members - lost power and sank into the ground tail-low, killing everyone on board. Three Canadian witnesses to the crash were interviewed over the Canadian Broadcast Corporation's television news on April 8, 1986 at 10 p.m. No flame or smoke issued from the plane before its descent and crash. However, the aircraft was seen to be mysteriously glowing with a yellow glow. That is a signature of the use of a scalar howitzer in the "continuous EM emergence" mode, similar to the manner in which the F-111s were downed in Vietnam. In short, the DC-8's electrical systems were interfered with by electromagnetic noise created throughout each increment of spacetime occupied by the aircraft. The powerful charge created in and on the aircraft also apparently caused the loss of two engines, one after the other. With its controls ineffective and power drastically reduced, the aircraft sank to earth, still in its "tail down" configuration from takeoff, and crashed and burned. The "yellow glow" was a corona due to the acquisition of a high electrical charge by the skin of the aircraft.

Other factors contributing to the crash may have been reduced lift due to poor engine maintenance, increased weight of the aircraft due to icing, and heavy loading. Still, no one has recognized the significance of the "yellow glow" or what it implies, or the possible connection between loss of the aircraft and previous Soviet testing of-a Launch Phase ABM system against U.S. shuttle launches.

As this book goes to press, the last two U.S. Air Force Titan 34-D missiles fired from Vandenberg Air Force Base in California have blown up shortly after launch. The first one blew up on Aug. 28, 1985 just after lift-off. That loss has been attributed to failure of a high-powered fuel pump, causing a massive oxidizer leak and a smaller fuel leak. The second Titan loss occurred on April 18, 1986 when the missile blew up 5 seconds after lift-off. Its loss is still under investigation and no determination of cause has been made. Apparently the shuttle and the Titan presently provide the only viable launch vehicles for launching U.S. "spy" satellites. The loss of these sensitive satellites - if indeed they constituted the payloads - cannot help but be damaging to our strategic surveillance capability. According to the Los Angeles Times, the single remaining KH-11 satellite was launched in December 1984 and, with an expected life of two to three years, it could stop functioning later this year.

Whether or not significant Woodpecker grid activity existed in the vicinity of the Titan launch of August 1985 is unknown at this time. However, significant activity in the grid definitely occurred before the April 18 Titan disaster and on the same day.

On Easter Sunday, Mar. 30, 1986 engineer Ron Cole observed significant **cloud** signatures of grid pattern activity, correlated with Soviet Woodpecker measurements. On April 18, the present author observed traces of a cloud **radial** over Huntsville, Alabama and took photographs of it. Preliminary reports from

Thousand Oaks, California indicate extensive grid activity again on April 18, the day the second Titan exploded.

At least the second of these two missile destructions shortly after launch is suspicious, since the grid positively was active during that time. Also, a clear trail of Launch Phase A8M system indicators exists back to the massive scalar exercise of April/May 1985. The first Titan explosion in Aug. 1985 thus falls within the Soviets' "now let's test them against U.S. launch vehicles" period. The second Titan loss follows highly suspicious losses of the Arrow DC-8 on Dec -T7 1985 and the Challenger on Jan. 28, 1986. The same Soviet weapon system that destroyed those targets may also have destroyed one or both of the critical Titans.

The Soviets have also been able to significantly engineer the weather over North America for more than a decade without being found out. They have tested a fantastic range of anti-ballistic missile (ABM) defense weapons for over two decades, and no one is the wiser in the West.

As previously stated, prior to the end of November, 1985, at least three "wet-run" tests of a Soviet "launch phase ABM system" against actual U.S. shuttle launches were made directly over Cape Canaveral itself, and still no one recognized what was happening or what sort of weapon was being tested. On December 12, destruction of the Arrow DC-8 in Newfoundland produced no indications that the Americans and Canadians knew anything about the nature of the weapon possibly used.

Accordingly, after a sufficient wait to test our reactions (if any), the Soviets prepared to actually destroy a shuttle after its launch.

Destruction of the Challenger in January 1986

As the whole world knows, on January 28, 1986 the shuttle Challenger was launched from Cape Canaveral, Florida after exposure to undesirable weather conditions, and disastrously exploded shortly after launch. The evidence seems to indicate that, as the rising vehicle was stressed, one end of its right booster broke loose, twisting away and into the main fuel tank, causing rupture, spillage of the fuel and catastrophic explosion. Several other anomalies still exist, however, and it is clear that a problem existed with at least one of the booster scals. All seven astronauts aboard the flight were killed in the fiery destruction of the vehicle.

Of course no one had recognized that the Soviets had already tested a launch-phase anti-ballistic missile (LPABM) system against three of our previous shuttle launches. These "wet-runs" used a deliberate "time offset" to delay the explosive emergence of electromagnetic energy in a launched shuttle's location along its trajectory. The delayed test shots resulted in very large "booms" above the Iaunch site after the shuttle was safely out of the area, but did not destroy the

shuttle vehicles themselves. For example, the delayed-shot boom occurred 12 minutes after the evening launch of Nov. 26, 1985. Even a marker beacon (large light in the sky) was utilized on that launch shortly after lift-off. The marker beacon was photographed. In addition, another photograph taken in a time sequence shows another sudden streak of light coming down and ending in a burst of light. This was probably a spatially-offset test of the "pulse" mode for destroying the shuttle. The "light burst" would have been detected in the Soviet Union and scored against its intended offset position. However, another mechanism may have been used to cause destruction of the shuttle itself.

On Jan. 1, 1986 the presence of a metal-softening signal added on to the Soviet LPABM system's scalar EM transmissions was detected by a surprised Frank Golden. The metal-softening ability of the detected signal was experimentally verified by him. Golden also locally nullified the action of the scalar EM signal in a test, rather conclusively establishing (1) that it existed and (2) what it was. The signal was apparently being prepared for use against an upcoming U.S. shuttle launch.

Just prior to the launch of the shuttle in late January, 1986, the Soviets accomplished significant weather engineering over the U.S. The jet stream was severely bent southward in the middle of the U.S., bending rightward again to move across the Florida panhandle. Icy cold air from Canada was drawn far down, into Florida and onto the Challenger sitting on its launch pad. This exposure to cold outside its tested range was probably an additional factor contributing to the Challenger's failure. Positive signatures of the Soviet weather engineering and jet stream manipulation were observed and photographed by several persons, particularly in Alabama and California.

On January 28, 1986, the Soviet scalar EM weapon system effects were sharply localized in the launch zone. Localization involved higher frequencies being present; these are quite painful to small brains - whose hemispheres act as a scalar interferometer and detector - such as in birds. As commented upon by national news commentators, strangely the birds were not flying that morning. Indeed, they were staying down on the ground or avoiding the area, since the sky over the area was painful to them.

As the Challenger rose, the metal-softening signal would have been experienced in and around the boosters shortly after ignition, since the booster flame acts as a special "ion-plasma" turner/detector for the scalar signal. (Certain plasmas have a unique characteristic: they transform an input transverse wave to a longitudinal wave, or an input longitudinal wave to a transverse wave.) The effect of such a local signal is to "change mass in the immediate vicinity" with the particular scalar resonance signal. (Mass acts as a capacitance or accumulator for scalar resonance).

The ill-fated Challenger was doomed. After ignition, the booster flame acted as a ionic plasma detector/amplifier for the scalar metal-softening signal on the

Soviet Woodpecker grid. The metal in and around the booster flame was slowly and steadily weakening due to charge-up with the metal-softening pattern. This attributed to booster leakage from the already cold-damaged seal. The leaking booster poured out smoke and later flame, contributing to the impending disaster.

Substantial winds and air turbulence over the site increased the stress on the Challenger as it rose through this region. This also contributed to the impending disaster and may have been deliberately created there by Soviet weather engineering.

As the Challenger stressed, eventually one or more weakened metal mounts gave way, partially freeing the end of the right booster. The booster oscillated, rotating into the tank and rupturing it. Contact of the escaping liquid fuel and the flame resulted in a fiery explosion, destroying the vehicle.

Even so another anomalous flame or light was observed on the vehicle, and may have represented a very small additional "pulse mode energy form" produced by the Soviet weapon that was attacking the Challenger. The shock of the explosion probably killed the astronauts instantly, although the cabin appears to have remained essentially intact while it plunged several miles to the ocean below.

By treating excess cold exposure to the shuttle, inducing metal-softening in and around the ignited booster, and possible adding a deliberate "intensely hot spot", the Soviets caused the Challenger to weaken and destroy itself shortly after launch, in so subtle a fashion that NASA scientists would not suspect what had actually caused the mishap. The Soviets also had previously withdrawn all their trawlers and ships which normally shadow a shuttle launch, to prevent any suggestion of Soviet presence near or involvement in the catastrophic accident.

A few days later, sporadically intense "high frequency localization signals" were still present on the grid, at least at one hinge-point at Birmingham, Alabama. From 1-4 February 1986, many birds inadvertently flew into the zone when an intense breakout of these components occurred, and dead birds fell from the sky in substantial numbers.

* According to an Urgentgram sent out by General D. Graham, on the evening of the Challenger's loss, KGB headquarters held a party to celebrate "success of their active measure against the shuttle." Note that all Soviet scalar EM weapons - development, testing, deployment, and usage - is under command and control of the KGB.

Among other things, this briefing details the bizarre series of indicators that showed the Soviet intention to destroy the vehicle, and documents the accidental discovery of the signal with which they intended to cause the shuttle to fail and destroy itself.

Technological Surprise and a New Hiroshima

Sadly, the bureaucratic smugness of orthodox Western scientists has materially assisted the Soviet deception process. Most Western managerial scientists - particularly in weapons development activities — have continued to view the Soviets as ignorant peasants, still trying to clean the mud off their boots. This view, of course, is totally untrue and unwarranted.

It takes only a few examples to refute this attitude. In nonlinear mathematics, engineering and science, the Soviets have led their Western counterparts since the beginning. The electromagnetic pulse (EMP) effect of a nuclear explosion appeared in the ordinary Soviet scientific literature before Western scientists were even aware that the effect existed. The Soviets continue to lead the world in explosive welding, titanium forming and welding, etc. While the Soviet scientists exhibit little inclination to build good washing machines, they certainly do produce state-of-the-art technology — and beyond — in any area in which they focus their main efforts. (We do lead the Soviets in some areas such as computers, computer software, miniaturization, etc.)

Once before, a modern nation - the United States - developed a mighty weapon in secrecy and used it to force a powerful foe - Japan — to its knees. The mindbending atomic blows to Hiroshima, and shortly after to Nagasaki, showed once and for all that in the modern age technological surprise can prove instantly disastrous. Yet in our scientific arrogance, we have assumed that no one else will ever do such a thing. We have assumed that it certainly could never happen to us, and that the "secret weapon" scenario will never be repeated. On the contrary, it has happened again, someone else has done it, and it has happened to us.

It has also become fashionable in the West to believe that all the laws of physics are already discovered. We assume we already know all of them. While we have been pridefully crowing this tune, the Soviets have been steadily discovering new laws in secret, as well as new ways to circumvent the old laws.

We Have Given Up Defense in the Larger Sense

Meanwhile, to defend ourselves strategically, we have chosen to forego "defense" and rely almost totally on building a powerful strategic offense that is capable (we think!) of destroying our would-be enemies anywhere in the world. Our offensive striking power is based mostly on a triad of deterrent forces - land-based ballistic missiles, submarine-launched ballistic missiles, and strategic bombers. The cruise missile is presently being added to the triad. If this 4-part offense were nullified or destroyed by Soviet secret weapons, we would be powerless to prevent our own destruction and Soviet domination of the world.

We have been viewing ourselves as Samson, confident in the strength of our locks.

Yet literally our locks have been secretly shorn and the Philistines are already upon us. Indeed, Soviet energetics weapons are now capable of destroying our triad shield, our homeland, our armed forces in the field, and our population, quickly and efficiently. We have a new "gap" of monumental proportions: not a missile gap, not a submarine or bomber gap, and not even a particle beam or laser gap. We have a scalar electromagnetics or electrogravitation gap.

In this briefing, it is my purpose to show a portion of the Soviet weapons developments that have lead me to such dire conclusions. The Fer-de-Lance briefing is also an attempt to galvanize our leaders and scientists into action, for our present total vulnerability to the Soviet Fer-de-Lance weapons is intolerable and unacceptable.

Unless we achieve defenses — and quickly — our own demise in a fashion similar to the Hiroshima-Nagasaki scenario is inevitable and imminent.

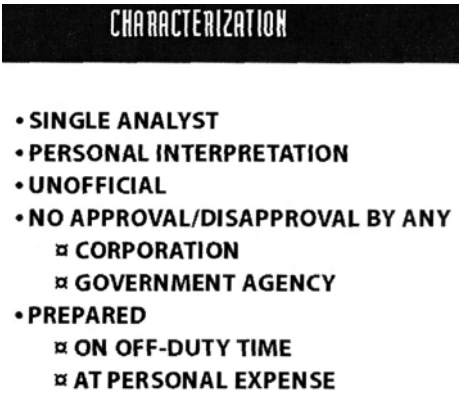

Slide 001: Characterization

We point out at the beginning that this briefing and its interpretation are the result of 22 years of analysis and effort by a single analyst. It is entirely unofficial. It is not approved or disapproved by any corporation, company, or government agency. It has been prepared by this analyst at nights, on weekends, on holidays, and during off-duty time.

It has been prepared mostly at personal expense, though several grants and support have been received from R. J. Reynolds III, Peter Kelly, Mike Bearden, Interdimensional Sciences, Association of Distinguished American Scientists, and others. Very valuable assistance has been received from the U.S. Psychotronics Association and the Planetary Association for Clean Energy. These contributions are deeply appreciated and most gratefully acknowledged.

Graphics and artwork support by Hal Crawford, Margaret Wilson, Tommy Neumann, Ron Cole, and Lee Giles has been invaluable. My sincere thanks go to these artists who have made the presentation vivid and imaginative. A great deal of background support was given by Joe Gambill, Frank Golden, Tom Herold, Ken Moore, Pete Kelly, Eike Mueller and Mel Bartlett and is deeply appreciated.

Finally, the help of many other persons and colleagues too numerous to enumerate is also gratefully acknowledged.

If the U.S. bureaucracy ever moves and develops defenses against scalar EM weapons, it will largely be due to the support of the persons and organizations who have freely given of their talents and resources to further this effort.

OUTLINE

- THREE VIEWS OF ELECTROMAGNETICS
- EXTENDED AHARONOV-BOHM EFFECT
- SCALAR ELECTROMAGENTICS
- KILL/DAMAGE MECHANISMS
- VULNERABILITY
  - ELECTRONICS
  - PERSONNEL
  - EQUIPMENT
  - MATERIAL
- SUMMARY

Slide 002: Outline

This presentation does not attempt to cover the complete field of energetics weapons developed by the Soviet Union. Instead, it concentrates on the major areas necessary to understand the type of weapons likely to be unleashed on our strategicand tactical installations and our troops and their equipment. It does not attempt to present the frightful bio-electromagnetic weapons the Soviets have developed to be unleashed on our populace at large and on our troops in the field. Also, the briefing does not dwell on the historical progression, but on the types of weapons themselves.

Of necessity, it presents several shortcomings in classical EM, and presents three differing views of electromagnetics and what can be done with them. The briefing particularly stresses the Aharanov-Bohm (AB) effect. This mesoscopic effect, which produces action at a distance by pure EM flux and not EM force fields, has been extended by the Soviet weapons developers into the macroscopic world around us.

In addition, we develop the basic concepts of scalar electromagnetics and how electrogravitation is achieved. The basic concepts of scalar interferometry and scalar resonance are briefly advanced, and a few of the major kill and damage mechanisms are presented. The nearly total vulnerability of our present electronicequipment,personnel,communications,vehicles,aircraft,ships, missiles, submarines, nuclear weapons, and materiel is stressed.

Finally, a short summary is given to highlight the main points of the briefing.

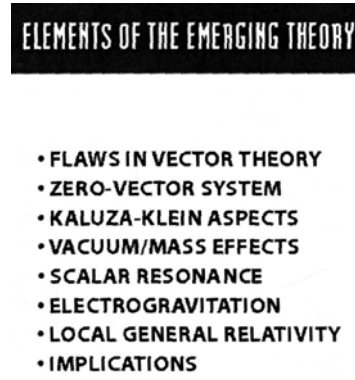

Slide 003: Elements of the Emerging Theory

Specifically, we will point out some flaws in vector mathematics itself, particularly with the concept of the zero force vector. The zero force vector is a system of forces that sum to a zero resultant. Hence the components of the summation represent a patterned stress in the medium to which they are applied, or in which they are imbedded. This includes the vacuum (spacetime) medium. In classical electromagnetics, this vacuum stress due to a zero-vector summation of EM force fields has been totally omitted and ignored.

As such, the EM "zero" force-vector summation produces a "trapped internal EM flux and flux pattern, without resultant (external) force field" condition - precisely as does the Aharonov-Bohm effect. The components of the artificially zeroed system, however, can be transmitted and still maintain their special relationship and coherence. While the AB effect has been shown to hold for the mesoscale (a few thousands of angstroms), the zero-vector scalar EM effect can hold for hundreds of thousands of kilometers.

To provide a unified electrogravitation, we adapt Kaluza-Klein 5-dimensional gravitational concepts to the idea of the zero-vector stress system in vacuum-spacetime. We also point out how simultaneously varying the magnitudes of **the** force components of a stress, all in phase, produces a stress wave or scalar EM wave. Scalar waves are almost always absorbed and emitted by the nucleus of the atom, not by the electrons in orbit.

The relationship of mass and vacuum, and the constitution of the vacuum, are pointed out from the viewpoint of modern quantum mechanics.

How a scalar wave resonance differs from conventional EM resonance is developed briefly. Mass and inertia are the direct result of - and are - trapped scalar resonance. The trapping mechanism is the spin of the particle.

Severely limiting assumptions in ordinary general relativity (OGR) are pointed out. In OGR, it is assumed that the local frame is always a Lorentz frame, and never curved. In other words, local spacetime is always assumed to be flat. This **saves** the conservation laws, simplifies relativity, and reduces "general" relativity to special relativity with distant perturbations and curvatures.

By removing this ad hoc assumption, a much richer local general relativity results. This local general relativity is readily engineered. Note that, in OGR, the physicist has actually assumed that he can never "engineer" local general relativity! Indeed, with the scalar EM approach, he can easily do so, in contradiction to what is taught in all Western universities.

By engineering a local general relativity (LGR), the individual conservation la**ws** can be violated locally. This includes the conservation of energy/momentum, and the conservation of charge, for example.

The major implication of this startling new engineering physics is that one can **engineer** physical reality itself. For example, elements can be transmuted with minuscule energy input, free energy devices are possible, action at a distance is possible, communication faster than light speed is possible, etc.

By using the zero-vector approach, the virtual state can be organized and made **largely** deterministic, rather than statistical. This means that the probabilities of the states propagated forward by the Schroedinger equation can be engineered and changed. Whether or not a certain quantum change shall emerge or not can be determined or substantially influenced in advance. Bohm's hidden variable **theory** now becomes directly engineerable. This is a drastic change to quantum mechanics and physics in general.

Another implication is that this is the final engineering, for it allows the direct engineering of physical reality itself. Humans must now find a way to resolve their differences peacefully, or shortly Man will destroy himself and his biosphere by his own hand.

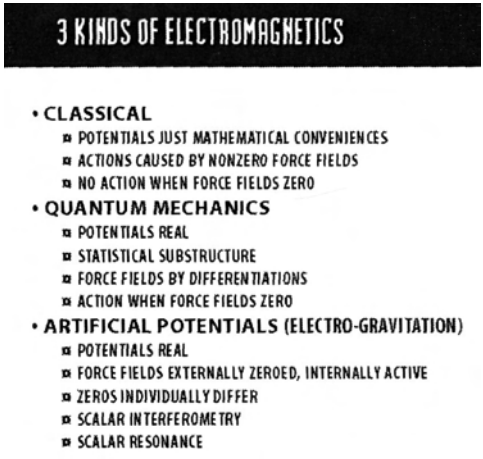

Slide 004: Three Kinds of Electromagnetics

There are actually three kinds - or three views - of EM. These are (1) the classical view, (2) the quantum mechanical view, and (3) the scalar EM or electrogravitational view.

In the classical view, the potentials are just mathematical conveniences and do not physically exist. The real causative agents are the force fields, and there is no longer any electromagnetics going on if the force fields reduce to zero. Further, the ideas of "charge" and "charged mass" have been made erroneously synonymous.

Of course the classical view was formed from the idea of a thin material ether, with electricity as a thin fluid, long before the discovery of the electron. Since most earlier scientists studied string waves and these are transverse, the EM wave was modeled as a transverse wave. Also, detection equipment actually detected transverse waves. The role of electron spin and drift velocity, which would have shown that force-field-causing EM waves in the vacuum could only be longitudinal, was not yet discovered. Maxwell's equations and the classical approach became so engrained that the basic derivations were never corrected for more modern discoveries.

The quantum mechanical view, on the other hand, regards the potentials as the real physical actants, and the force fields are just effects derived from the potentials by differentiating operators. Classically oriented physicists have adamantly opposed this foundations requirement of QM because it would require nearly a complete redo of EM theory. It would also rather drastically

change our ideas of physical reality. For years a controversy has raged around the Aharonov-Bohm effect (which demonstrates the reality of the potentials, among other things). Only this year - 1986 - have most physicists finally accepted the AB effect with its implications (see Physics Today, Jan. 86). However, no changes have yet been made to EM theory and the basic classical approach to electrical physics and engineering.

Yet even the QM view is flawed, since it has not examined the structure of EM forces which sum to a vector zero. Such a system produces stress, and if the summation is in the vacuum itself, it produces stress of vacuum/spacetime. Rigorously, this is a gravitational effect, and the energies of the various EM components in the local region are locked into an artificial potential. From general relativity, this type of potential where the energy density of vacuum is altered is a gravitational potential. From Kaluza-Klein unified theory, it is at least a 5-dimensional gravitational potential.

If the individual force vector components of the vector zero are varying in magnitude - say, all in phase - then they produce a gravitational wave. The energy density of the local vacuum is being rhythmically varied. Call such an EM wave a scalar EM wave, where, by "scalar" we imply that, to an external observer, the EM force vector resultants are identically zero, but the local gravitational potential of the wave is varying. Thus this is an electrogravitational wave, and vector zeroing of EM force fields constitutes a means of changing EM field energy into G-field energy. On the other hand, by breaking up the coherence of the zero-vector summation of the EM forces, nonzero EM resultants are recovered, constituting the change of gravitational energy into EM energy.

A simple means to break zero-summed coherence is by interference of two or more such zero-vector waves.

In this, third view of EM, action at a distance is easily possible, and is the norm rather than the exception. In addition, a new kind of resonance - scalar resonance - exists. The scalar EM wave does not interact with orbital electrons, but rather with the interior of the nuclei of atoms. Thus the new scalar EM resonance is between nuclei and within nuclei.

Slide 005: Bohm-Aharonov Effect

In 1959, Aharonov and Bohm published a fundamental paper in Physical Review, which pointed out the QM implications of potentials as the real entities, while force fields were derived effects. They showed that, even in the presence of zero EM force fields, the potentials may still exist and produce real effects in physical systems. They also suggested experiments to prove these predictions.

Interference of the potentials is the key mechanism producing real effects in charged particle systems, even in the presence of zero E-field and zero B-field. Unfortunately the AB paper did not address the issue of zero-summed systems of EM force fields as one way of producing artificial potentials having unique characteristics

At any rate, the "AB effect," as it came to be called, was rather hotly resisted and debated over the years, until finally it has generally been accepted as proven in 1986. The principle represents a violation of both classical mechanics and classical electromagnetics. It is required, however, by quantum mechanics and quantum electrodynamics. And experiment has proved it.

(See Y. Aharonov and D. Bohm, "Significance of Electromagnetic Potentials in the Quantum Theory," Physical Review, Second Series, 115(3), Aug. 1, 1959, p 485-491.).

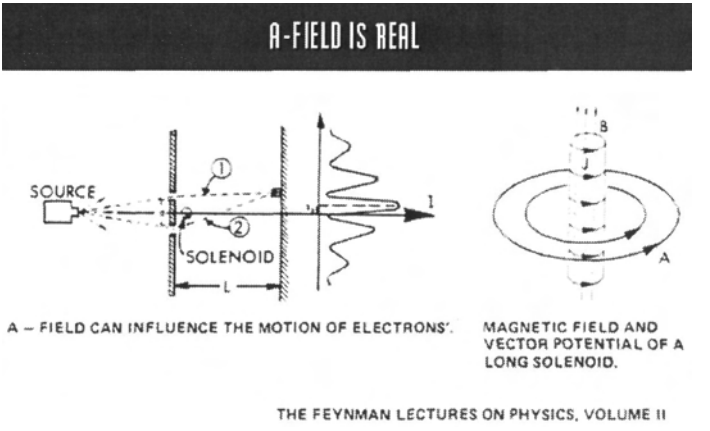

Slide 006: A-Field is Real

In classical EM, the vector magnetic potential (the A-field) had been defined as a mathematical convenience by the equation

$$\nabla x A = B \qquad [1j$$

But if the potentials are real, then conceivably the A field can be loosed from its enchainment to the ∇x operator. In that case, it becomes a free, new, and independent field of nature with potentially unique characteristics. For example, its defining equation shows that magnetic force field can be made from it, and the rightmost term of the equation

$$E = -\nabla Ø - dA/dt \; [2]$$

shows that its time rate of change makes an electric field.

Let us explain this in more simple terms, and somewhat more precisely than conventional theory. We will use the Kaluza unified G-EM interpretation and electron flow in our explanation.

In the A-field, we have a certain kind of 5-dimensional G-potential which can bleed-off as EM force fields in two ways: (1) in a swirl fashion, where the vortex producing the swirl moves parallel to electron movement, and the swirling is a torque or spin, and (2) in a linear fashion, where the time rate of change of the A-potential produces a linear E-field on the electrons.

The first bleed-off as given by equation [1] constitutes the magnetic B-field, and the second bleed-off as given by the rightmost term of equation [2] creates a component of the overall electrical E-field. (Bleed-off of the electrostatic scalar potential produces the other component of the E-field).

Now in general relativity (GR) theory, "the" G-potential is just a conglomerate of many things, each of which has the characteristic of curving spacetime. "The" gravitational field is not a single thing at all, but is composed of a collection of many things.

Thus if we realize that both the electrostatic scalar potential (Ø-field) and the magnetic vector potential (A-field) are components of the 5-d G-potential, then we see immediately that bleed-off of these two components of the 5-d G-potential creates all normal EM force fields.

It follows that, if we produce a zero-vector summation of the two or more EM bleed-offs, we are actually "putting as much back in" to the 5-d G-potential through its A and Ø components as we are taking out electromagnetically. In that case, the 5-potential is in a state of equilibrium with respect to EM bleed-off. It is now forced to bleed-off in the only other way it can: as ordinary 4-dimensional gravitational field. Thus by vector-zeroing EM force fields, we turn EM field energy into G-field energy and vice versa, via the intermediary of the 5-potential.

At any rate, soon after publication of the Aharonov-Bohm paper, experiments showed that, if the magnetic field is trapped inside a long solenoid, a phase shift still is induced in the two-slit electron experiment, even though - classically - no contact of the enclosed magnetic field and the moving electrons occurs. This phase shift is explained by the fact that the freed A-field exists outside the trapping solenoid, even though the B-field does not. Consequently, interaction of this free A-field with the electrons produces a phase shift of the QM interference detection pattern.

This proves that A-field is real and causes physical effects.

It also proves that a form of action at a distance is real, just as required by quantum mechanics.

Years ago, Frank Golden and this author - together with Dr. William Tiller - experimented with "free A-field" devices. Golden went on to develop prototype transmitters and receivers and a prototype underwater communication system.

Since that time, Gelinas has patented several curl-free magnetic vector **potential** (free A-field) devices: see U.S. patent no. 4,447,779, May 8, 1984; 4,429,288. Jan. 31, 1984; 4,429,280, Jan. 31, 1984; and 4,432,098, Feb. 14, 1984. These patents are assigned to Honeywell.

(See also Theodor Kaluza, Sitz. Berlin Preuss, Adad. Wiss. 966, 1921.).

QUANTUM NON-LOCALITY

"The non-local aspect of quantum systems is ... a general property of nature, and not just a freak situation manufactured in the laboratory."

PAUL DAVIES, SUPERFORCE
1984 (PAGE 48)

Slide 007: Quantum Non-Locality

Indeed, quantum systems exhibit nonlocal effects that are general properties of nature. These effects are not just freak situations manufactured in subtle laboratory experiments.

However, if spatial coherence in such microscopic effects can be induced and sustained, then action-at-a-distance can be obtained in large macroscopic systems. This is the engineering aspect of the scalar EM approach.

It is also the aspect that the Soviets have secretly weaponized for over three decades.

The zero-vector EM force-field summation of multiple EM waves is used to transport specific time-phased patterns of EM polarization of vacuum to a distance. There interference of two or more such patterns results in the interference of the internal patterns, breaking of the phase relations, and appearance of positive (added) or negative (extracted) EM energy in the intersection region.

VECTOR MATHEMATICS HAS A FUNDAMENTAL PROBLEM

IN ITS AXIOM FOR THE ZERO VECTOR,
VECTOR ANALYSIS DISCARDS ZERO VECTOR
SUMMATIONS OF ACTIVE SYSTEMS
OF VECTORS.

VECTOR ZERO IS MADE THE ABSENCE
OF ALL VECTORS

(IT CAN ALSO BE THE PRESENCE OF REAL
VECTORS WHOSE VECTOR SUM IS 0.)

Slide 008: Vector Mathematics has a Fundamental Problem

In its concept of the zero vector, vector mathematics discards zero-vector summations of active systems of vectors. It replaces such a summation with a zero vector. This is fine for mathematics as an abstract system, but it is in error when applied to real electromagnetic force fields of nature.

In the abstract mathematics, a vector zero summation is made the "absence of all finite vectors". Further, all vector zeros are made equal. No concept of the "internal stress" of the zero vector exists in abstract vector mathematics.

However, physically the zero summation or "balancing" of vector forces in a medium represents stress in that medium. In the physical case, a vector zero summation system of non-zero vectors has a dynamic substructure, and this substructure is an individual.

Obviously, in the physical case vector zero summations may materially differ, both in the pattern of stress and the magnitude of stress. They cannot all be equated. Further, they are not the absence of vectors, but represent the presence of vectors in a special manner. Such a zero summation of EM vector forces directly stresses the "medium" - which may be the vacuum itself.

In the physical case, several changes to the axioms of abstract vector mathematics are required. (1) the "potential" of a vector zero must be taken into account, such as is represented by the sum of the squares of the magnitudes of its vector components. (2) the specific deterministic pattern of the vector components comprising the zero must be taken into account. (3) The dynamic

variation in both the deterministic directions and deterministic magnitudes of the components and of the overall pattern must be taken into account. (4) Frequencies of the changes in the direction, magnitude, and actual makeup of the vector zero must now be accounted for. That is, time and wavelengths are rigorously aspects of the vector zero, and these may be deterministic variables. Since time itself is now a variable aspect of the vector, the vector zero system can affect its "rate of time flow" in the observer's system. (5) Since a "reference vector zero" can be established at any point of a vector magnitude, then individual vectors themselves may have dynamic substructures inside a special "zero reference" in and on the vector. The patterned potential of a vector is a reality.

This leads to a system of "vectors nested inside vectors" ad infinitum. In other words, it leads to an infinite-dimensional system, and the "opening" of every finite closed vector system through its vector zeroes.

For application to physical electrogravitational systems, at least 5 dimensions are required, four of space and one of time.

Here we still are considering only a special case where all vector zero summations represent EM force field energy locked in a gravitational potential, or gravitational force field energy locked inside the EM potentials. That is, we are prescribing a system where the only intertranslation of energy is among mass, EM field, gravitational field, and vacuum virtual energy (anenergy).

(See T. E. Bearden Toward a New Electromagnetics: Part III: Clarifying the Vector Concept, Cheniere Press, Santa Barbara, Ca. www.cheniere.org, 1983; Part 4: Vectors and Mechanisms Clarified, 1983. See also E. T. Whittaker, Proc. Lond. Math. Soc. 1, 367, 1903; Robert Bruce Lindsay and Henry Margenau, Foundations of Physics, Dover, New York, 1963, p. 283-287; Richard P. Feynman et al, The Feynman Lectures on Physics, Addison-Wesley, New York, **Vol.** I, p.2-4.).

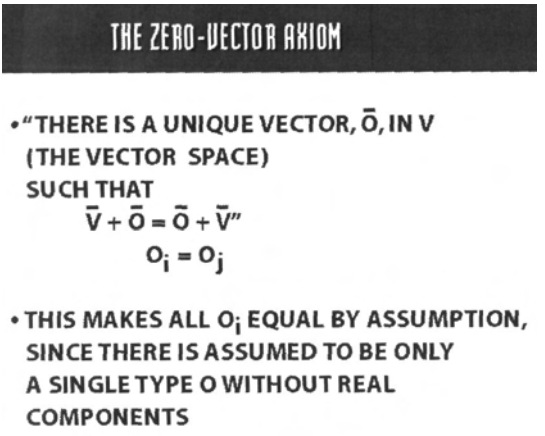

Slide 009: The Zero-Vector Axiom

This slide shows a standard mathematical statement of the zero-vector axiom, used in many texts.

As can be seen, all zero-vectors are made identical, and no substructure is considered.

Such an abstract system of vector mathematics does not fit physical reality. However, when all one's EM foundations concepts are strongly conditioned in this fashion, the gravitational aspects of EM are discarded.

Further, EM theory, experiments, and equipments will be developed along these limiting lines. In that case, EM engineering of gravitational effects will not be developed. One will assume that it is impossible to have a locally curved spacetime, and hence all local frames will be Lorentz frames. Therefore the conservation laws will rigorously apply.

Further, the nonlocal quantum effects will stay firmly in the microscopic world where they belong. Physical macro-reality will stay stable and predictable in a classical manner.

General relativity (in curved spacetimes) will be restricted to the special case of the local special relativistic (uncurved) spacetime, with only distant perturbations (spacetime curvatures).

The world will stay sane and "normal", and the totally variable insanity of physical reality will remain bottled up in the minute microworld or the distant maelstrom of suns, stars, black holes, etc.

The Aharonov-Bohm heresy will stay kaput in the real world and will not be unleashed beyond mesoscopic reality — a few thousand angstroms or so.

With such an error in the application of vector mathematics to physical science, we become "flatland physicists," so to speak. We become like skimmer bugs on the surface of a pond; we have no appreciation of the dynamics of the depths below or of the heavens above.

Worse, we condition our development of instruments according to the fixed notions in our heads. Then we use these "biased" instruments to do experiments that reaffirm our notions. Any deviation suggested to this is considered heresy and nonsense.

And as Max Planck once pointed out, you will get a new physics only when the old physicists — who so adamantly oppose it — die off.

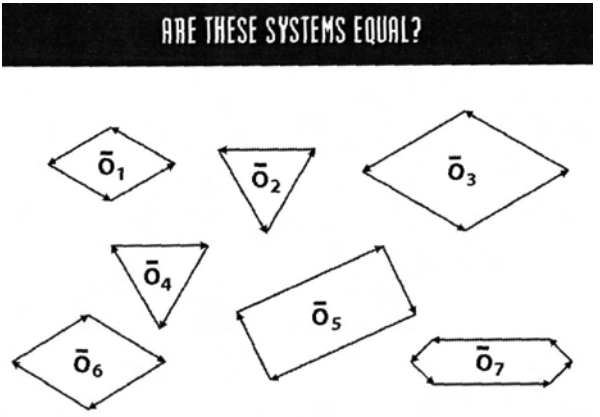

Slide 010: Are These Systems Equal?

Shown here are some representations of various very simple zero-vector systems. As can be seen, the stress magnitudes and the spin and dynamics of all of these systems are very different.

Further, their "stress potential" substructures are not composed of a huge collection of little random force vectors. Instead, their substructures are deterministic. If the components being put into the zeros are varied in direction and magnitude, but always sum to a zero resultant, then highly complex substructure dynamics may be created and utilized, infolded (Bohm's term) inside the zero vector.

In theory one can establish "channels" of communication and power (magnitude) transmission without ever surfacing a nonzero EM force field. In practice one can do this with very little EM spillout. Thus one can establish electrogravitational channels and energy transmission inside normal EM potentials and/or ordinary EM carrier waves.

One can use a conventional system of EM potentials, force fields, and waves as a special kind of "wiring circuit" in and through which to transmit and produce electrogravitational effects. By distant interference, EM effects at a great distance can be accomplished, yet no "ordinary EM energy" has passed between the transmitters and the distant interference zone.

INFOLDED SYSTEMS ARE EXCLUDED BY PHYSICS

DYNAMIC ZERO-VECTOR SYSTEMS ARE NOT CONSIDERED IN ORDINARY GENERAL RELATIVITY, CLASSICAL ELECTROMAGNETICS, OR QUANTUM MECHANICS.

Slide 011: Infolded Systems are Excluded by Physics

Unfortunately, these infolded dynamic zero-vector systems have been eliminated from physics.

They are omitted in classical EM, ordinary general relativity (OGR), and quantum mechanics.

That is, they have been omitted in Western physics.

They have not been omitted in secret Soviet weapons labs and weapons development programs.

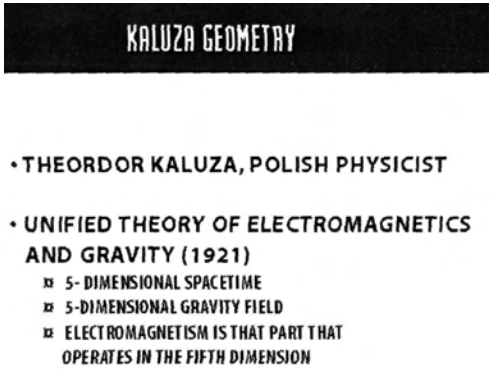

Slide 012: Kaluza Geometry

In 1921, Theordor Kaluza, a Polish physicist, published a unified theory of electromagnetics and gravitation. Albert Einstein, who had had the paper for two years, recommended his paper for publication. In that theory, five dimensions - four space and one time - are utilized in the basic model. This gives a 5-dimensional spacetime.

In the model, electromagnetics and ordinary gravity are two aspects of a single more fundamental field: the 5-space gravity field. Electromagnetism is that part of the 5-field that operates (bleeds-off) in the fifth dimension.

The ordinary 4-space G-field is the small residue that spills over into our ordinary 4-space, and doesn't slide around into the fifth dimension and bleed-off there as electromagnetics.

Implicit in the theory, but not explicitly stated, is the fact that the 5-space G-potential bleeds-off in two fashions: (1) in the 5th dimension nearly unopposed, to produce what we see as EM force fields, and (2) in the ordinary 4-space we live in, which we see as ordinary gravitational field.

Normally almost all the force field bleed-off is in the fifth dimension as EM; only a minuscule bit bleeds off as 4-gravity.

Just as one example, between two electrons the 5-space G-potential bleeds-off into electric force field about 10^{42} times as much as it bleeds-off into 4-space G-field.

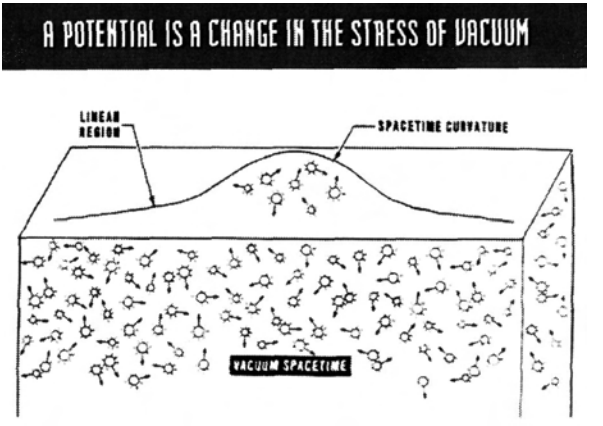

Slide 013: A Potential is a Change in the Stress of Vacuum

In physics, the idea of a "potential" is very poorly defined, if at all. The normal "definition" for the electrostatic scalar potential, for example, is not a definition at all. Instead, it's an abstract operation that tells how to mathematically calculate the magnitude of the potential, by pushing a unit charge in from infinity, against the potential field.

Now ultimately a definition must be an identity statement, not an operational statement about something.

Since I could find hardly anyone who actually understood what a potential was, and how or of what it was composed, I simply took quantum mechanics at face value and constructed this model.

First, the modern view of the vacuum is that it is not an emptiness, but a plenum. It's teeming with an incredible amount of raw energy, existing totally as the temporary bits of energy of virtual particles. That is, the vacuum "energy" exists as the nonintegrated energies of little particles which appear from nothing fare spontaneously created) and disappear into nothing (are spontaneously annihilated) almost instantly. This happens so fast that the little particle and its energy cannot individually be detected; it doesn't hang around long enough.

Hence the fleeting little booger is called a "virtual" particle. Like, "We had 'im there man, for just a moment, but he was gone before we could grab 'im!"

This kind of ghostly particle, however, is very real in modern physics. All observable forces are theorized to be due to the integration or collection of a large number of virtual forces created by exchange of these little particles.

However, this implies a peculiar thing about the vacuum "energy." Actually it's vacuum energies, for each little bit of energy only exists momentarily, then returns to the nothingness from which it came. That is, vacuum virtual energies are totally unintegrated. Each "bit" of virtual energy exists individually. These virtual energies cannot be "added up" to compute the "available energy" unless some collector or integrating mechanism puts them together.

That is, unless some kind of "zipper" is there to "zip them together" into macroscopic, observable energy. The usual "zipper" is a spinning, observable particle of mass. We say that the vacuum energy is unzipped and hence unobservable in that state. We say that "observable energy" is just zipped-together vacuum energies - integrated by and on a spinning, observable particle of mass.

So the vacuum can be visualized as a special sort of violent, unzipped plasma, where the particles of the plasma are fleeting and do not last. We can speak of it also as a sort of special unzipped gas, in the same manner.

The "pressure" of the vacuum gas we refer to as "stress." Due to its violent boiling activity, the vacuum gas is always under very high stress.

This "stressed virtual plasma" identically IS the vacuum and identically IS spacetime. Length, time, frame, mass, etc. - all arise by zipping operations (or understood zipping operations) in and of this raw vacuum/spacetime. When one uses the vacuum notion in this manner, one now uses the term "ether" again. However, this is not the old "thin material ether that hangs around"; this is an entirely new kind. It's a virtual flux and a virtual plasma.

The ether is also what we call "spacetime" in relativity. As can be seen, spacetime is stressed. Further, spacetime has a substructure.

By an uncurved spacetime, we mean one in which the stress of these virtual particles (the "pressure in the ethereal gas," so to speak) is constant from one place to another and from one time to another. Indeed, we also should mean that the stresses of the individual components of the entire plasma are constant from one place to another and from one time to another.

By definition, when we determine the lengths between every two points, we determine a frame. (Actually, we have prescribed a universal "length zipping" operation/mechanism as well as its characteristics.). A "linear frame" or "Lorentz frame" is one in which the pressure or stress remains constant. It may be higher than ambient vacuum, however, due to a particle's or an object's motion through the observer's ether. In the case of constant velocity, the particle/object encounters a higher level of virtual particle flux in the observer's ether, like a vehicle moving through raindrops. It encounters a constant rate of

flux, however. In such constant velocity case, the moving object's frame is said to be "rotated," but not curved, with respect to the laboratory frame of the observer.

In a "curved" spacetime, we mean one in which the stress of vacuum increases or decreases from one place to another, or from one time to another, or both. At one fixed location, if spacetime is curved, then the stress is increasing or decreasing as a function of time. That is, the flux density of that area is changing. We may visualize the local frame as undergoing angular acceleration, rotating more or rotating less. This is a non-Lorentz frame, or curved spacetime. It is also a nonlinear vacuum.

In such a vacuum, local gradients exist in the flux of virtual particles. If affected by (coupled to) one or more of these gradients by a nonzero coefficient, a local object experiences effects (forces and actions) "without observable cause." Observably, conservation laws may be locally violated by these "virtual rivers" of vacuum by coupling, just as a paddlewheel dipped in a river violates its own local "conservation of energy" due to the river providing an energy source to it.

One must be very careful with the "pressure" analogy, however, when one utilizes unified theory (Kaluza theory). We now have a virtual plasma vacuum in five dimensions, not four. But the basic notions to enable our visualization and understanding still apply.

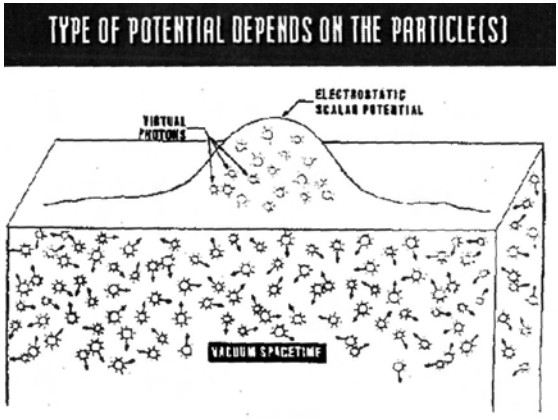

Slide 014: Type of Potential Depends on the Particle(s)

Now one can see that, by choosing the type or class of virtual particle, and looking at its potential or stress in the vacuum, one can have many kinds of "potentials" existing in the overall "gravitational potential" of vacuum spacetime.

For example, the stress of the virtual photon flux (which is what causes electrical charge) is called "electrostatic scalar potential."*

We can choose any other class of virtual particle we wish, and there exists a potential (and "change") for it. There are quark potentials, neutrinic potentials, etc.

Indeed, one of the reasons for ignoring Kaluza unified theory for so long was that it predicts a great many types of potentials and fields which have never been observed and which are unknown. Approximations, which neglected all these mysterious, and unknown fields, gave erroneous results. Perplexed physicists, seeking to simplify matters, simply turned away from it in frustration. They returned to it in the mid-70's when it appeared that 11-dimensional Kaluza-Klein theory possibly offered a complete unified theory.

Actually, the diversity of new fields in Kaluza theory was its strength not its weakness. That they are presently unobservable and undetectable is beside **the** point. Neither is time directly observable; however, we have worked out handy procedures and measurements of spatial quantities, which allow us to infer **time.** We have not just tried to drop it from physics!

And indeed the Kaluza theory is consistent with experiment when the higher fields are included. The message is, we must work out "clocks" for these new potentials and fields, so that they can be inferred with at least some degree of precision

- The character of movement also determines the type of potential. The longitudinal (radial) movement of the virtual photon flux is implied in electrostatic scalar potential. The swirl (tangential) component of this flux might be taken as the magnetostatic scalar potential - a magnetic pole - when the cw and ccw components of the swirl balance, but the sum of their absolute values differs from the sum of the absolute values of the corresponding tangential components in the swirl flux of the local ambient vacuum. If this swirl stress is higher than the vacuum swirl stress, this constitutes a north magnetic pole. If lower, it constitutes a south magnetic pole. If there is a prevalence of direction (cw or ccw) in the swirl (i.e., one component exceeds the other), this corresponds to the magnetic vector potential (the A-field) when the A-field is freed from the magnetic force field (B-field) — i.e., when A-field is freed from its ∇x operator in the equation $\nabla x A = B$. The bleed-off of the excess swirl stress from the north magnetic pole to the deficient swirl stress of the south magnetic pole constitutes the magnetic force field, B — usually referred to simply as the "magnetic field."

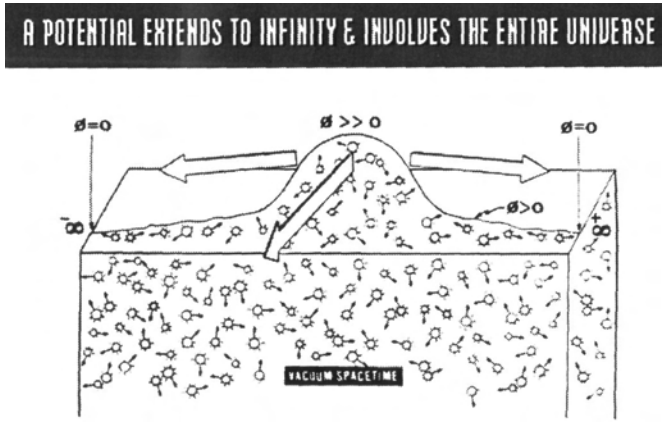

Slide 015: A Potential Extends to Infinity & Involves the Entire Universe

As shown on this slide, the change in the stress of vacuum due to a potential tapers off to infinity. Its magnitude normally does not reduce to zero until infinity.

Some types of potentials reduce much faster or slower than others, however, and so - at some distance away from a common origin of the potentials, one or more may be neglected in its (their) overall effects on an experiment or system.

Also, the speed of propagation of potential is highly dependent upon (1) what type of virtual particle or particles produce its stress, (2) its magnitude, (3) its composition, and (4) the presence or absence of coupling objects and other interacting potentials.

Fundamental observable particles are like little spray pumps and little vacuum cleaners at the same time.

Each is emitting virtual particles into the vacuum in a spray or flux, and at the same time it is absorbing virtual particles from the vacuum spray or flux. It's a little dynamo, and nature furnishes its driving energy unceasingly.

However, each little virtual particle it emits is itself such a little simultaneous pump and vacuum cleaner. That is, it's also emitting an even finer (and faster) flux of smaller virtual particles, and at the same time it's also absorbing flux al this time finer level.

"Bigger fleas have smaller fleas to bite em;

And so on ad infinitum".

We may consider the vacuum to be made of an infinite number of virtual state layers or levels.

It is not too difficult to show that each of these successively deeper, nested "layers" of virtual state corresponds to a successively higher dimension being added to our 4-space basic spacetime. So hyperdimensions and deeper levels of virtual state are one and the same thing.

The basic "speed" of the first layer is c, the speed of light.

The basic "speed" of the second layer is c^2.

And so on.

This is interesting. We may directly engineer the virtual state by means of the vector zero (scalar electromagnetics) approach. By nesting vector zeros inside other vector zeros, we may directly engineer the deeper layers of virtual state, and consequently hyperdimensions.

Scalar electromagnetics thus is virtual state engineering and hyperspatial engineering at one and the same time.

Superluminal communications systems, hyperspace drive, and materialization and dematerialization are all hypothetically possible, using scalar electromagnetics. As the technology develops, we should see the development of many of the systems long thought impossible except in science fiction.

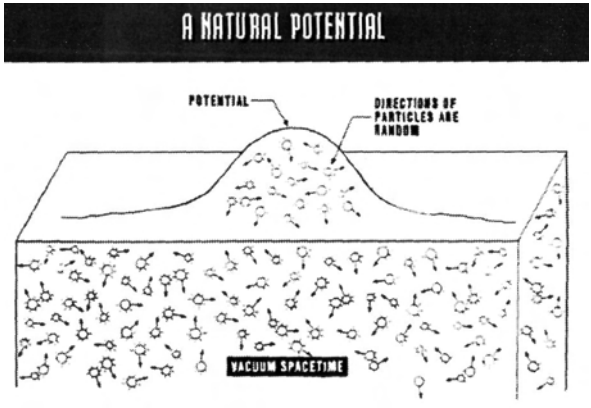

Slide 016: A Natural Potential

There are two broad categories of EM potentials, depending upon the way in which they are formed.

The two categories of potential formation are: (1) natural, and (2) artificial.

The difference is in the virtual particle flux substructure that comprises the potential.

If the substructure of emerging and vanishing virtual particles is random and without deliberate order (polarization) except in one broad, overall sense, then that is a natural potential. As such, there is no deterministic functioning going on inside the substructure of the potential itself. The potential can only act "as a whole" on a charged particle system.

Natural potentials have substructures of random virtual vector components. Any small amount of coherence as a function of distance vanishes quickly (on the order of a few thousand angstroms at most, according to present Aharonov-Bohm experiments).

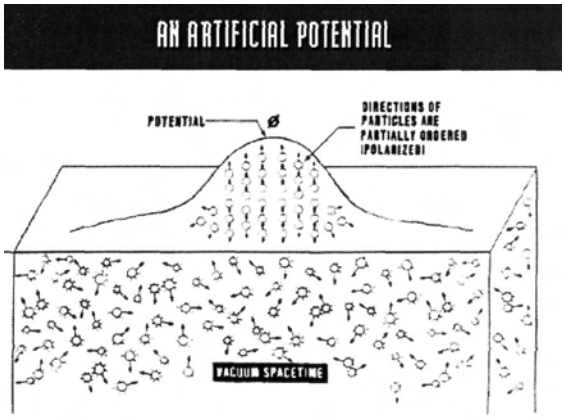

Slide 017: An Artificial Potential

An artificial potential by definition has a substructure composed of deterministic observable vector components, summed to an overall zero vector. Coherence as a function of distance can be maintained over enormous macroscopic distances - even hundreds of thousand of kilometers - by simultaneous transmission of the entire cluster of substructure components as a coherent "zero" group.

To the conventional linear EM detector, at any point along its transmission path, this substructure is detected as a zero-E vector and a zero-H vector. Hence the conventional detector does not see the artificial potential, even if its "stress magnitude" (a function of the magnitudes of all summed components) changes.

Action at a great distance is possible with this artificial potential, however, if a highly nonlinear situation is met so that the phasing of the components is broken or significantly altered. In that case, the components do not sum to zero after their dephasing, and real EM force fields emerge. This "dephasing" can be made to occur at the distant nonlinearity.

Action at a great distance is not possible with the natural potential, but is possible with the artificial potential.

Further, with the transmitted artificial potential, VO must be applied from the transmitter to the distant interruption zone, as if there were no intervening space between.

Note that VO may be positive or negative. Thus energy may emerge at the distant disruption, or be extracted from there. In the first case, energy is input to the transmitter, to re-emerge at the distant dephasing zone. In the latter case, energy is extracted (disappears) from the distant dephasing zone and is received (reappears) back at the transmitter

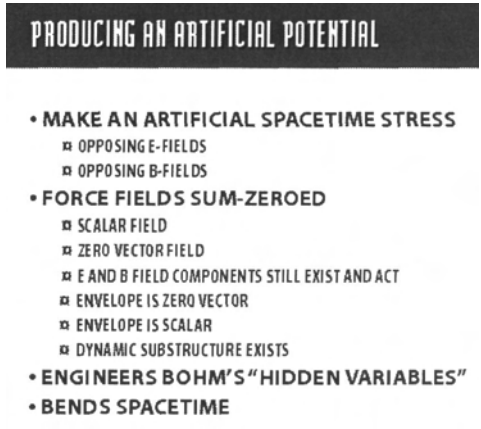

Slide 018: Producing an Artificial Potential

ANartificial potential is deterministically patterned spacetime stress, made by opposing E-fields and/or B-fields so that they sum to vector zeros in a special pattern.

The resulting zero-summed envelope has no EM force field, to an external observer/detector.

However, the infolded E-field and B-field vector components still exist and act. They may dynamically vary, so long as their summation is always kept to zero.

The simplest variation is to vary all their magnitudes at once, by the same degree. In that case, each one comprises an "EM wave." However, the summations of this cluster or "locked group" of waves still exhibit a zero-E and zero-B field to any external observer/detector. In other-words, to an external observer, one now has a varying wave of pure spatiotemporal stress, but one that has a deterministic structure. This is a scalar EM wave, or electrogravitational wave. It is also an alternating current of specific scalar pattern.

Varying the stress of spacetime locally, curves it locally. This violates the conventional assumption of restricted general relativity that local spacetime is uncurved (is a Lorentz frame).

By use of scalar EM waves with deliberate substructures, one can engineer Bohm's "hidden variables" so that quantum mechanics becomes deterministic

rather than statistical. This is a drastic change to the common (Bohr) interpretation of quantum mechanics.

And Einstein's intuition that God does not play dice with the universe turns out to be correct after all.

Since physicists haven't seen where the real game was being played, it has all seemed bewilderingly statistical to them.

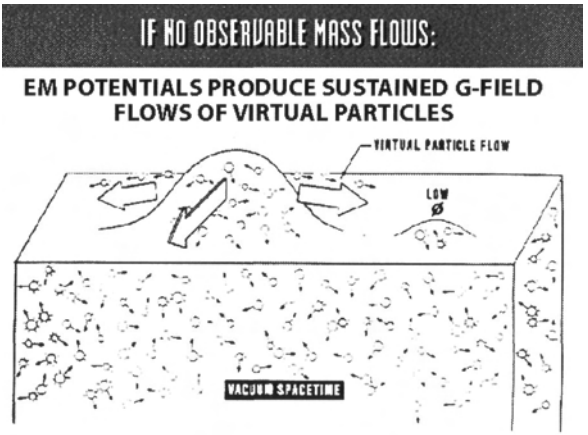

Slide 019: If No Observable Mass Flows:

Since there are no observable mass particles flowing in vacuum, there are no observable force fields produced. Only virtual force fields can be produced in the virtual particle medium that is vacuum itself.

Thus (here is no observable E-field in the vacuum surrounding a charged point. There is, however, a virtual E-field there. When an observable charged particle such as an electron is introduced in the surrounding vacuum and "couples to" (integrates, zips together) the virtual E-field, an observable E-vector force is produced on and of the observable charged particle.

(For the classically trained electrical engineer or electrical physicist, the statement that no E or B fields as such exist in vacuum, is usually bewildering. Let me point out that any so-called "vector field" (such as the assumed E and B vacuum fields) can mathematically be replaced with two scalar fields. See E. T. Whittaker, Proc. Lond. Math. Soc.l, 366, 1903. What we are saying here is that the definition of an E field is in terms of force per unit charged mass. The scalar fields - which are actually what exist in vacuum - provide only a virtual or unzipped E field, until an observable spinning particle couples to both of them by virtue of its "dynamo flux pump" action. The ensemble, then, of two electrostatic scalar potentials coupled to a spinning observable particle, constitutes and is the so-called "E-field.")

When detecting these "vacuum E-fields," it is the free electrons in the electron gas in our probe or antenna which couple to the two "Whittaker scalar fields". These electrons produce ensembles that interact with each other collectively.

Charges in this electron-gas coupled medium is what we actually detect - not "what is in the vacuum."

To repeat this again for emphasis: The usual detector is an "electron-wiggle" detector. It detects changes in its own conduction electron gas, not in the vacuum itself. That is, the disturbance in the virtual-particle vacuum interacts with the observable particles of the electron gas, if (and only if) the spins of these observable particles couple the vacuum disturbance to the electrons and integrate their virtual components. After integration, an observable disturbance of the integrating object - say, the electron - results. It is this electron gas disturbance that is "detected" by almost all orthodox EM detectors.

If the spin of the observable conduction electrons cannot couple the electron to the vacuum flux disturbance, then the normal "simple" detector will not detect the disturbance. (By a "simple" detector we mean one in which the electrons are able to couple to the vacuum disturbance! Little circular definition here!)

Now most potentials reach to infinity before reducing to zero. The change in the virtual particle flux intensity of vacuum - which comprises the potential - decreases with distance from the potential. The magnitude of the change tails off toward zero as one approaches infinity.

To any finite distance, then, there exists a decreased gradient in the change of the virtual flux intensity of vacuum, from a potential. Therefore virtual particles are flowing in the direction of the decrease of this gradient, just as gas molecules flow from a region of high pressure toward a region of lower pressure.

So there is a virtual particle "river" in the vacuum between any two separated points of different potential magnitude. The type of potential determines the type of virtual particle(s) in the river.

If the potential is natural, the gradient river does not carry any coherent substructure.

If the potential is artificial, the gradient river carries the coherent substructure everywhere within it. In this case, there is a flow or "river" of the virtual structure of this coherent pattern in the vacuum between two separated points of different "potential" in that pattern.

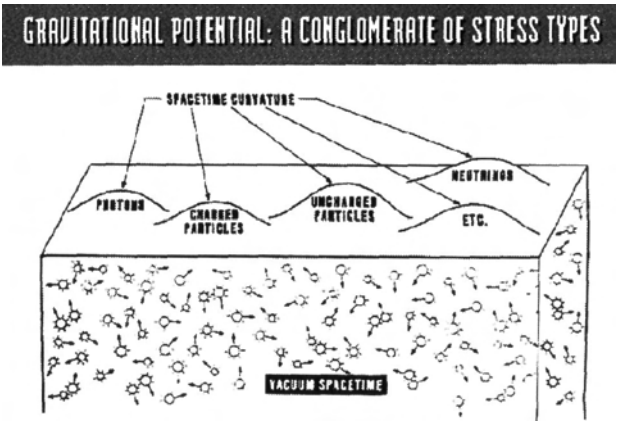

Slide 020: Gravitational Potential: A Conglomerate of Stress Types

Rigorously, all EM potentials are actually part of the overall 5-dimensional gravitational potential.

There is no such thing as "the" singular gravitational potential: instead, it is a conglomerate of different stress types and patterns, each of which is named for the type of action that produces it.

The movement of charged particles, for example, creates electromagnetic potentials. At any point in vacuum, the potential consists of a flux of virtual particles.

The vacuum contains a great variety of particle fluxes. There are virtual photons, virtual electrons, virtual positrons, virtual protons, virtual pions, virtual neutrinos, etc.

The conglomerate stress from all these virtual particle stresses constitutes the overall gravitational potential

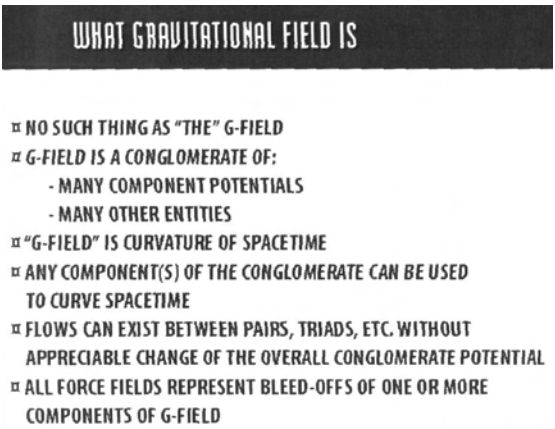

Slide 021: What Gravitational Field Is

As previously stated, there is no such single thing as "the" gravitational field, as is assumed in the Newtonian sense.

G-field is a conglomerate of many component potentials and other entities.

Rigorously, anything that "curves spacetime" is a gravitational field.

In the modern view, all forces ultimately arise, by some means, from the curving of spacetime. Thus all forces and force fields are related to - and caused by, so to speak - gravitational field.

If the vacuum stress is uniform from one place to another in an observer's **frame** then the observer's spacetime is uncurved. The observer's frame, is said to be linear or uncurved; or a Lorentz, frame. In such a situation the conservation laws rigorously apply for macroscopic, closed systems.

If the vacuum stress is not uniform from one place to another, then the spacetime is curved. In such a situation the conservation laws may be violated for macroscopic systems, since they are "opened" to the vacuum stress, and vacuum virtual particle flux gradients exist across the system or portions of it.

Note that the overall stress magnitude may be constant across a region, but its composition may change. That is, two or more components may vary canonically. In that case, the spacetime is uncurved in the gross external sense, but contains specialized "internal" curvature patterns locally. Depending upon

reaction to the canonical infolded curvature patterns, some macroscopic systems will still exhibit conservation, but certain other macroscopic systems may not.

An example is symmetry breaking. Here charge, parity, and time symmetry may be violated individually or in pairs, but not all three simultaneously. An overall conservation law is obeyed, but any two of the three conservation laws can be (und are) violated.

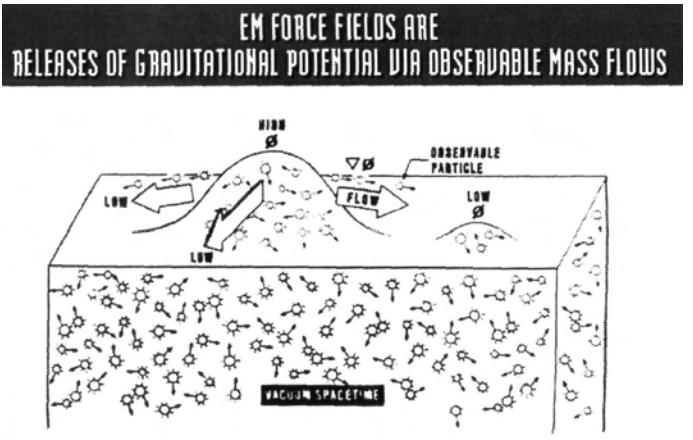

Slide 022: EM Force Fields are Releases of Gravitational Potential via Observable Mass Flows

In Kaluza theory, we may take EM force fields to be the 5th dimensional "bleeding-off" of a 5-G potential. However, in vacuum alone this bleeding-off is totally within the virtual state. That is, only virtual EM force fields exist in vacuum.

By the ordinary term "EM force fields," physics has chosen to imply measureable or observable E and B force fields.

That implies that the 5-G potential gradient flows of virtual particle flux must be coupled to observable charged particles - such as electrons, protons, ions, etc. - before observable E and B force fields exist.

Rigorously, E and B force fields consist of the virtual E and B force fields coupled to observable charged particles. They do not "cause" a particle to accelerate; they are the product of the particle and its acceleration.

As these observable particles are themselves "spray pumps" producing virtual particle flux, then a collection of them represents an increased or decreased **flux** (for negative or positive charge) vis-a-vis the ambient background flux of vacuum. Nature furnishes the continuous power to drive these "virtual flux" pumps.

Normally, EM potentials are formed in natural and manmade electrical circuits by collections of these observable particle "spray pumps." Such collections of

increased or decreased "spray flux" density, of course, represent 5-potentials, gravitationally.

Release of these pumps in conductors or in the vacuum itself results in creating E-fields and B-fields on and of the moving observable charged particles. But release of the observable-particle spray-pumps from the collection (the potential "pressure head" or "source") reduces the potential or "pressure" at the source.

Thus the formation of E and B fields represents the release of the 5-potentials. Hence EM force fields are the bleed-off of 5-dimensional G-potential via observable mass flow.

Since classical EM always seeks to create the force fields, it always bleeds-off and discards the gravitational effects that could be otherwise achieved.

To allow orthodox EM flow is to dissipate the gravitational effects.

Strangle the orthodox EM flows, and you can keep and use the amplified gravitational effects.

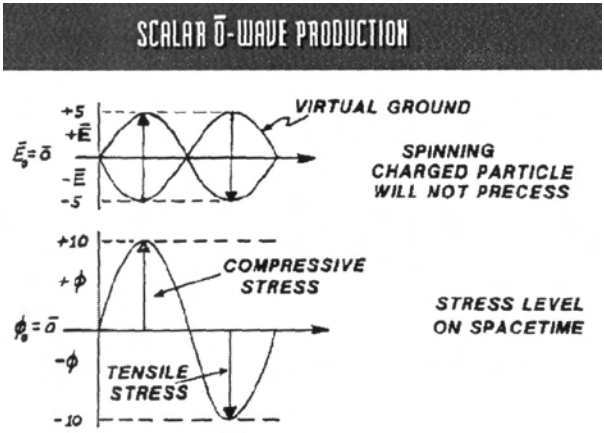

Slide 023: Scalar O-Wave Production

We now visualize the formation of waves of pure stress in the spacetime medium (in the vacuum). These we call scalar EM waves, Tesla waves, electrogravitational waves, longitudinal EM waves, waves of pure potential, electrostatic/magnetostatic waves, and zero-vector EM waves. All these terms are synonymous. Each sheds its own particular light upon the nature of these waves or of their original discoverer, Nikola Tesla.

We use a gedanken experiment, or thought experiment, in which we can be "perfect."

Thus we have two single-frequency EM sine waves whose E-field componenls are shown on the slide. The two waves are of the same frequency, traveling together in the same direction, and superposed 180 degrees out of phase with each other.

In this case, at any spatial point, the summation E and B fields are vector zeros.

However, if we plot the spatiotemporal (vacuum) stress induced by the wave, wo see that it constitutes a sine wave, with compressive stress in one half cycle **and** tensile stress in the second half cycle.

Rigorously this defines a "longitudinal" EM wave - or what Tesla called a "sound wave in the nonmaterial ether."

Also, rigorously it is a gravitational wave, for it is a wave of the curvature of spacetime (nonlinearity of vacuum) itself. That is, what is changing in the wave

is the vacuum stress, or intensity of the virtual particle flux of vacuum. That is identical to changing the curvature of spacetime. In one half-cycle, spacetime is curved positively. In the second half-cycle, spacetime is curved negatively.

Since the increase or decrease of the intensity of virtual particle flux (vis-a-vis the ambient vacuum's virtual flux intensity) represents electrical charge, then in one half-cycle negative charge is represented, and in the other half-cycle positive charge is represented. This directly explains the "positron-electron pair" representation of an electromagnetic photon - the "photon" being one wavelength.

In one half-cycle, time moves slower. In the second half-cycle, time moves faster. Thus scalar waves can also be considered to be "tempic" waves (to use Wilbur Smith's term), or oscillations of the rate of flow of time itself, about the ambient rate of time flow. Since these oscillations are variations in the curvature of spacetime, then they represent gravitational or force-generating waves, when coupled to a mass.

Variations in the rate of flow of time produce force, just as any other type of curvature in space-time does.

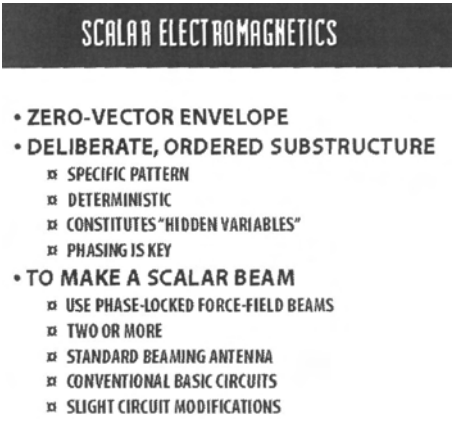

Slide 024: Scalar Electromagnetics

To rehash: scalar waves are zero-vector waves. Patterned E and B fields exist in a relationship where their summation equals vector zero. Electromagnetically, the zero EM "envelope" of a scalar EM wave is composed of a zero-summation of infolded finite EM force-vectors.

However, the internal (infolded) substructure is deliberate, macroscopic, and ordered. Vacuum is polarized deterministically by the wave, and macroscopic spacetime is locally curved by it.

These substructure components constitute Bohm's "hidden variables." They can be manipulated and varied at will. Phasing, beaming, frequency, superposition, interference, resonance, and Fourier expansion are the keys to scalar EM engineering.

To make a scalar beam, special modifications are made to the EM wave transmitter so that, effectively, the transmitter transmits multiple transmissions simultaneously, and these vectorially sum to zero. This is the same thing as transmitting multiple phase-locked EM force-field beams simultaneously, in **the** sum-zeroed fashion.

Standard beaming antennas and conventional circuits can readily be utilized with slight modifications.

Any radar can be converted to a scalar EM radar quite simply. Indeed, a modification kit to accomplish that can be developed and held until the **scalar**

mode is desired. The modification kit can be quickly installed to provide the scalar capability.

Scalar radars, for example, cannot track "corner reflector" targets. However, they can magnificently track smoothly filleted corners; rounded, smoothly curved surfaces; and curved or flat metalized dielectrics. Against aerial targets using special construction to lower their cross-section to normal radars, the application of the scalar radar mode is immediately obvious.

Scalar waves pass through the electron shells of an atom and interact with the nucleus. They are continually absorbed and emitted by all nuclei in the universe.

BACKGROUND FOR THE BRIEFER.

Any large collection of nuclei - such as a star or a planet - is a strong absorber and radiator of scalar wave radiation.

The Sun is a particularly strong source of scalar radiation. This radiation penetrates the Earth deeply, interacting more and more with the deeper layers which, under greater mechanical stress, are more nonlinear. Most of the heat in the molten core of the Earth comes from the dephasing of a portion of this absorbed scalar radiation from the Sun, liberating ordinary EM energy as heat.

The Earth also re-radiates scalar wave radiation back to the Sun. The Sun and Earth are thus coupled into a "scalar" system in equilibrium or near-equilibrium. Each body in the couplet possesses both a feed-forward and a feedback loop.

The Earth also radiates scalar wave radiation to the Moon, and the Moon reradiates scalar radiation back to the Earth. The Earth and Moon also are coupled into a "scalar" system in equilibrium or near-equilibrium. Again, each body in the couplet possesses both a feed-forward and a feedback loop.

The Sun and Moon are correspondingly coupled into a scalar system in equilibrium or near-equilibrium, each with both a feed-forward and a feedback loop.

The Earth, Sun, and Noon thus form a triad-coupled system of special importance to the stability of our existence here on Earth, and the stability of our biosphere.

And so on with all the other planets in the solar system, and combinations thereof.

The solar system is thus a very sensitive scalar-coupled system, with strong subsystems within it.

ADDED FOR THE BRIEFER:

Actually this scalar coupling of the solar system provides a major check on unreslricted use of the large Soviet strategic scalar EM weapon systems. If significant scalar effects are produced on earth in a "pulse" mode, pulsed

disturbance of the earth-sun and earth-moon systems results. Here a danger exists that one or more natural resonances of the coupled system may be excited. If the feedback stimulation of the Sun is not insignificant, for example, large sunspot activity may result sometime thereafter, say in a day or two. If too much or too sharp stimulation occurs on earth, the coupled resonant response from the sun could be disastrous. Indeed, a solar response could be stimulated so that the Sun would violently belch and destroy our biosphere, among other effects. The simplest doomsday stimulation would be for a violent expulsion of Solar EM energy and particles to occur. If this were due to resonance, the expulsion of Solar EM energy and particles would continue during some decay time. In that case, fiery destruction of the earth, strongly indicative of Biblical prophecy, would result. Particularly sensitive are the resonances of the sun-earth, sun-moon, and earth-moon systems.

Note the abnormal influence of the moon on tides - tides of both the tectonic plates and the oceans. One cannot help but point out that, if the earth-moon resonant system were overstimulated, one might expect violent earthquakes of extraordinary magnitude, and tremendous tidal waves hundreds of feet in height. (The potential connection to legends of earth-destroying floods, evidences of extreme water levels in mountains, and legends of ancient cataclysmic destruction of supposedly advanced technological oceanic cultures is obvious.)

Accordingly, use of huge scalar EM weapons is a double-edged sword. Unless carefully employed, use of the weapons could cause a terrible backlash to the user as well as the victim, and even accidentally cause the destruction of the earth itself. It is not accidental that in 1960 Khrushchev stated that his new fantastic weapon could - if unrestrainedly used - destroy all life on earth.

This appalling backlash potential is apparently what prompted Brezhnev in 1975 to make so strong an effort to get agreement to outlaw the development of "new weapons of mass destruction" more frightful than the mind of man had even dreamed of. Gromyko even introduced such a draft agreement into the proceedings of the United Nations. The first article of the draft agreement indicated that the nature of the weapons referred to would be negotiated. Sadly, the entire Western world did not even know what the Russians were talking about.

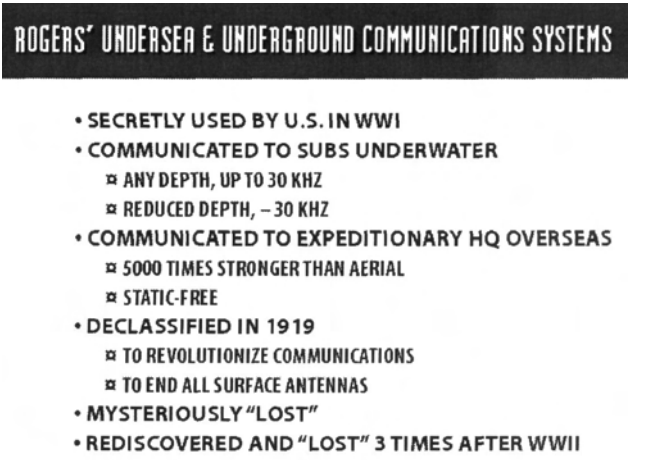

Slide 025: Rogers' Undersea & Underground Communications Systems

In an article in the March 1919 issue of the Electrical Experimenter, a real bombshell was released on an unsuspecting world.

In that issue, details of the Rogers'undersea and underground communication systems were released. These systems had been classified SECRET during WWI, and used to communicate with (1) U.S. submarines underwater around the world, and (2) U.S. Expeditionary Forces Headquarters overseas.

Subs at any submerged depth could be reached with transmitters of frequencies up to 30 kiloHertz. At reduced depths, frequencies above 30 kHz could be used.

At the headquarters of U.S. overseas forces, the signals were received through the earth. They were 5,000 times stronger than aerial signals through the atmosphere, and static-free.

The Rogers' systems were covered by a series of patents. They used special antennas implanted in the ground.

While the patents are somewhat confused, several of the diagrams in the Electrical Experimenter reveal that the antennas were producing scalar waves. Scalar waves can indeed travel through the earth and through the ocean. Indeed, if good quality scalar waves are made, then frequencies well above 30 kHz can be sent through the ocean. Multi-megahertz frequencies, for example, are easily achievable. (The problem, of course, is that these waves are pure zero-vector

artificial potentials that do not move electrons in the conduction gas of a conventional antenna/receiver combination. Normal receivers and detectors do not see them. Special underwater detectors - such as those developed by Frank Golden - are required.).

With the startling declassification and revelation of the Rogers' systems, it was expected that all communications would be revolutionized, and that all surface antennas would be removed.

Strangely, this entire technology faded away quickly, as if it had never been. Certain powerful interests did not wish the extended electromagnetics to be discovered or taught. That, after all, would lead to free energy and loss of economic control of the citizens. That was precisely why Nikola Tesla had already been suppressed.

According to the important research of Dr. Robert Beck, the same scalar technology has been rediscovered and mysteriously "lost" at least three times after World War II!

Today the orthodox establishment is still suppressing it.

One wonders why no orthodox physicist - with the single exception of Dr. Hooper (see U.S. patents 3,610,971, Oct. 5, 1971 and 3,656,013, Apr. 11, 1972) - seems to have experimented with deliberately constructed zero-vector EM waves and devices, and published his results in the literature.

One would think that any university physics department would wish to explore such a gaping void with at least a few graduate student experiments, if for no other reason than scientific curiosity, particularly when the experiment is easily performed, it is totally different from anything else in the theory or literature, and the implications may be formidable. A true scientist in that related field ought to try it!

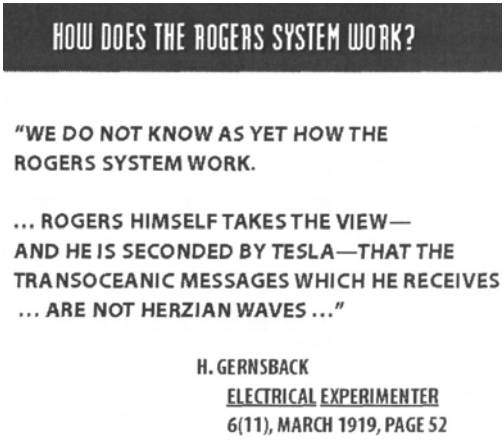

Slide 026: How does the Rogers System Work?

In the same March 1919 issue of Electrical Experimenter, Hugo Gernsback pointed out that no one as yet knew how the Rogers' system actually worked.

Rogers himself believed he was not using conventional Hertzian waves.

Nikola Tesla himself confirmed that the underground and undersea waves were not Hertzian waves.

If so, they could only have been scalar waves.

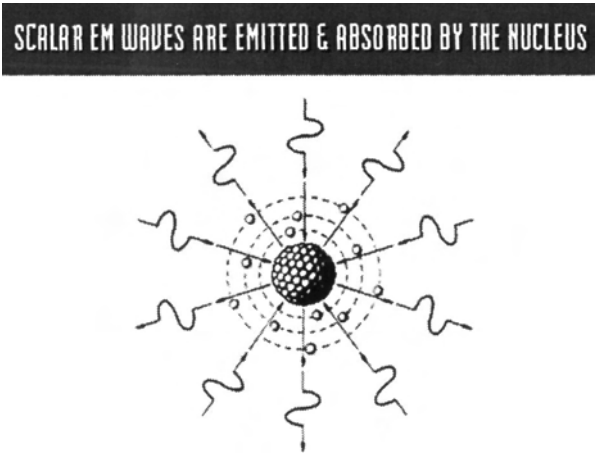

Slide 027: Scalar EM Waves are Emitted & Absorbed by the Nucleus

Normally scalar EM waves do not couple to orbital electrons. Entering into the atom, incoming scalar EM waves penetrate the electron shells without interaction. They continue, penetrating into the interior of the closely packed nucleus, where the extreme nonlinearity of the charged virtual particle flux that binds the nucleons together distorts the scalar wave, dephasing its summed EM vector components. This produces a nonzero EM resultant and polarized pattern directly inside the virtual particle charge flux of the nucleus.

The new EM resultant immediately couples the distorted scalar wave to the nucleus, resulting in absorption of the wave and incorporation of its polarization pattern into the nucleus' virtual flux. This in turn results in a slightly excited nucleus. Normally the excited nucleus will promptly decay by emitting another scalar wave, which passes through the orbital electron shells and radiates out into the universe.

However, as can be seen, if the same strong scalar pattern is constantly radiated into the nucleus and absorbed by it, the excitation of the nucleus "charges up," leading to decay by other modes. In this manner the nucleus can be engineered even transmuted - by rather minuscule power of the engineering radiation signal.

This is how living biological systems are able to transmute elements, as discovered by Louis Kervran. (Kervran was nominated for the 1977 Nobel Prize

for this work.). The biosystem produces scalar EM waves. If the appropriate signal is employed into and on the appropriate nucleus, a changed element emerges. In this fashion chickens denied sufficient calcium in their diet, but allowed a surplus of potassium, are able to transmute some of the potassium into calcium. Note that one of the isotopes of potassium is an isomer of normal calcium. Transmutation of this potassium isomer to calcium is easiest.

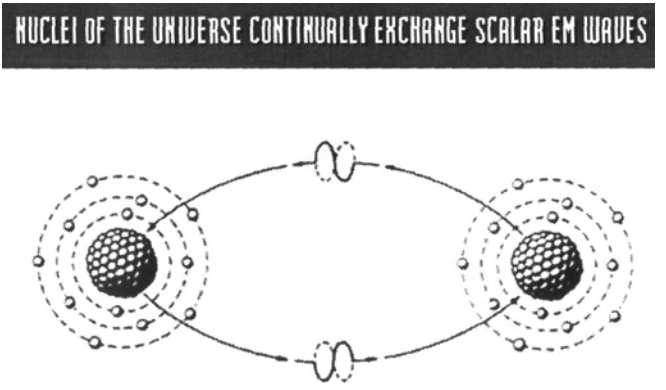

Slide 028: Nuclei of the Universe Continually Exchange Scalar EM Waves

Thus scalar EM waves are continually exchanged by all nuclei of the universe, and the vacuum is - among other things - a seething cauldron of scalar radiation.

In fact, it is this seething scalar wave cauldron that creates the virtual particles and the virtual particle flux of vacuum itself. (Since the scalar EM wave represents an oscillation of the curvature of spacetime, and since everything - virtual or observable - is a curvature of spacetime, then scalar waves can be taken as the universal generatrix.

The intensity of the trapped scalar flux in the nucleus of an atom is responsible for the mass and inertia of the nucleus.

Mass is localized trapped scalar resonance.

The trapping agent is the spin of a particle.

The mass and inertia of the particle are due to the scalar resonance that is trapped. Increasing the amplitude of the trapped scalar resonance increases the mass and inertia; decreasing the amplitude decreases the mass and inertia.

CONVERTING EM FIELD ENERGY TO G-FIELD ENERGY & VICE-VERSA

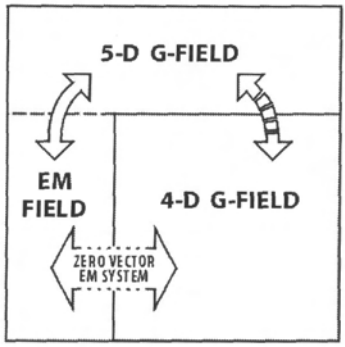

Slide 029: Converting EM Field Energy to G-Field Energy & Vice-Versa

According to Kaluza theory, there are no such things as a separate EM field and a separate gravity field. Instead, in five dimensions there is only one field: the 5-d gravitational field. The EM field is the 5th dimensional aspect, while our **normal** 4-dimensional G-field is the other aspect of the 5-field, in our normal 4-space.

Thus we may say that the 5-field is composed of two components: the 5th dimensional component (our normal EM field) and the component occupying **our** normal 4 dimensions (our normal G-field).

The 5-d "force" field, of course - or the 5-space analogy to a force field - would be due to a gradient or "bleed-off of the 5-d gravitational potential. This gradient in turn is composed of two components: the 5th dimensional "bleed-off" outside our normal 4-space (this outer bleed-off is our normal EM force **field**) and the bleed-off inside our normal 4-space (this inner bleed-off is our normal G-field).

Normally the 5-potential bleeds-off outside our 4-space as EM field, far greater than it bleeds-off inside our world as G-field. Between two electrons, for example, the electric field is about 10^{42} times as strong as the G-field. Since in the Kaluza view there is only one 5-d G-potential that is causing both force fields, this shows that there is an incredibly greater EM bleed-off of the 5-

potential between the two electrons than there is a G-field bleed-off between them.

As shown on the diagram, the 5-d G-field is normally comprised almost entirely of the 5th dimensional EM field. Only a small 4-space G-field component exists.

However, suppose we were to "block" the bleed-off of the 5-potential in the EM mode. Then none of the 5-potential could bleed-off in the 5th dimensional EM field. Instead, it would be forced to bleed-off into the 4-space G-field. In our two-electron example, this "perfect case" would result in the disappearance of the E-field between the two electrons, and the G-field between them would increase to about 10^{42} times its normal strength.

The end result would be that, by blocking the EM force field bleed-off, EM field is converted to G-field. In addition, EM field energy is converted to G-field energy. With the extremely amplified gravitational and inertial effects that result, one can now accomplish direct engineering of gravitation, mass, and inertial effects.

We can effectively accomplish this "blocking the EM bleed-off by opposing EM force fields so that they sum to vector zero. This is the same as summing various 5th dimensional gradients of the 5-potential to a zero vector resultant. In that case, as much "EM bleed-back to 5-potential" occurs as there is "EM bleed-off from 5-potential." This places the 5-potential in equilibrium with respect to EM bleed-off.

Also, another nice thing results: Since we can readily vary the magnitudes of the EM force field components of the vector zero summation, we can actually form phased "zero vector waves" by increasing and decreasing the magnitudes of all the component EM vectors in phase, but retaining their vector summation always equal to zero.

In that case we have produced a very simple 5-space G-potential wave, which concomitantly forces phase-locked variations in the 4-space G-potential. In short, we have produced an electrogravitational (EG) wave, or scalar EM wave for short. This wave described is the simplest EG scalar wave we can produce; much more complex EG waves can be produced and used for highly **specialized** purposes.

The scalar EG wave changes EG potential energy into 4-gravity potential energy in one half-cycle, and changes 4-G potential energy into EG potential energy in the other half-cycle. However, the EG potential energy in the first half-cycle does not react electromagnetically in linear circumstances, since it is electromagnetically a linear vector zero.

So our scalar EG wave actually oscillates energy back and forth between a locked-in 5th dimensional EM potential and a 4-space G-potential. As can be seen, to the linear 4-space observer this scalar EG wave appears as a purely gravitational wave, with G-potential magnitude varying in a wavelike manner.

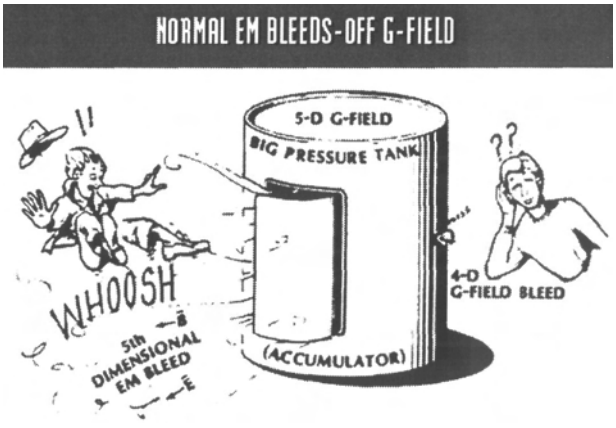

Slide 030: Normal EM Bleeds-Off G-Field

For easy visualization, we may regard the situation in the analogy shown on the slide.

The 5-potential of 5-space vacuum is like a high pressure in a big tank. The tank has a huge open door in the 5th dimension, leading to rapid bleed-off of the 5-presure through the big door; that is, as EM field. Only a very small hole in the tank normally exists in our own 4-space world, so only a very small amount of the pressure bleeds off as our G-field.

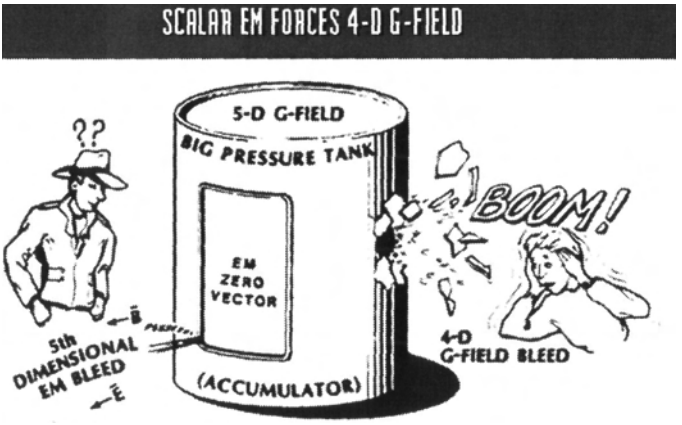

Slide 031: Scalar EM Forces 4-D G-Field

As can be seen however, if we shut the big door so that we have only a little bleed-off through the seals, then most of the pressure is forced to bleed-off through the small opening, greatly enlarging it. In that case, most of the 5-potential bleeds-off as 4-G force field.

The mass exposed to such increased 4-G bleed-off exhibits a much greater mass and inertia.

In fact, mass itself can act as an accumulator for the effect, and it can increase its ability to store trapped scalar resonance. This increases its inertia.

By the use of scalar EM (blocking the EM bleed-off), we can input normal EM energy and obtain powerful gravitational and inertial effects. Many other powerful effects can also be obtained.

DETECTION OF ELECTRO-GRAVITATION

- WHEN ORDINARY EM FORCE FIELDS ARE INTERFERED/SUMMED TO PRODUCE ZERO, AND ARE ALSO LOCKED TOGETHER, THEY PRODUCE STRESS OF VACUUM (GRAVITATIONAL POTENTIAL OF FIELD). THIS IS ELECTRO-GRAVITY.
- WHEN ELECTRO-GRAVITATIONAL FIELDS ARE INTERFERED/SUMMED TO PRODUCE ZERO, AND ARE LOCKED TOGETHER, THEY PRODUCE ORDINARY ELECTRO-MAGNETIC FORCE.

Slide 032: Detection of Electro-Gravitation

Here arc two magic rules in the scalar electrogravitational business:

(1) When ordinary EM force fields are interfered or summed so that they produce vector zero, and the fields are locked together, they produce stress of vacuum (5-potential). One component of this 5-potential is the 4-space G-potential. Since bleed-off as a gradient of this 4-space G-potential is all that is allowed, then the EM destructive interference/zero summation bleeds-off to produce gravitational force field. This is because opposing equal forces, which sum to a vector zero force field resultant, actually produce a stress potential having stress energy of spacetime. And that is a curvature of spacetime, hence gravitational.

In short, total destructive interference of EM waves or force fields produces excess stress potential energy in spacetime, and therefore gravitational force field on detecting/coupled particles.

(2) When electrogravitational fields are interfered/summed to produce vector zero, this destructive interference/zero summation bleeds-off to produce ordinary electromagnetic force field.

In short, destructive interference of scalar EM waves or fields (electrogravitational waves or fields) produces electromagnetic force fields on detecting/coupled particles.

BACKGROUND FOR THE BRIEFER:

Mathematically we can summarize this as follows;

$$G_{(1-4)} = G_{(1-4)}(m) + G_{(1-4)}(EM) \quad [3]$$

$$G_{(1-5)} = G_5 + G_{(1-4)} \quad [4]$$

If $\mathbf{E} = \Sigma \mathring{\mathbf{a}}_i E_i = \mathbf{0},\ E_i \neq \mathbf{0};\ \mathbf{B} = \Sigma \mathring{\mathbf{a}}_i B_i = \mathbf{0},\ B_i \neq \mathbf{0}$ [5]

then $G_{(1-4)}(m) = G_{(1-4)}(EM) = G_5 = G_{(1-5)}$ [6]

and $G_5 = G_{(1-4)} = f[\Sigma(\mathring{\mathbf{a}}_i\, |\mathbf{E}_i|^2)] + g[\Sigma(\mathring{\mathbf{a}}_i\, |\mathbf{B}_i|^2)]$ [7]

and $G_{(1-5)} = G_5 = G_{(1-4)}(m) = G_{(1-4)}(EM) = f(\phi) + g(\mathbf{A})$ [8]

Where:

$G_{(1-5)}$ is the 5-d G potential, or total G-stress on dimensions 1-5.

G_5 is the combined EM potential, or G-stress on dimension 5 only.

$G_{(1-4)}(m)$ is the normal 4-d G-potential of mass alone, or the G-stress due to mass-gravity.

$G_{(1-4)}(EM)$ is any extra 4-d G-potential of mass due to conversion from G_5 stress (normally zero).

E and B are the electric and magnetic force fields.

ϕ is the electrostatic scalar potential.

A is the magnetic vector potential.

Thus the age-old scientific dream of direct engineering of gravitational field — and of spacetime itself — can now become reality. To start, one simply makes an intense EM vector zero and varies its stress intensity and internal pattern of summed components. One also varies the reference potential at which the patterned EM stress zero is created, and the frequency of internal component variation.

BACKGROUND FOR THE BRIEFER.

He that has ears, let him hear.

Here is the secret of antigravity

The "electrical charge" of a charged particle — such as one of the orbital electrons of an atom or one of the protons of its nucleus — represents a difference in flux intensity (potential) between the local particle and its ambient vacuum.

It's the continual bleed-off of gravitational charge as electrical charge.

If that bleed-off is reversed or stopped, a drastic effect on the gravitational potential and charge ensues. The 5-potential and 5-charge have become 4-G-potential and 4-d-charge respectively.

Thus "charging" an object with its scalar EM pattern charges it gravitationally.

Now the only "bleed-off channel" is through the 4-G force field.

Further, in a nucleus the nucleons continually change back and forth between proton and neutron, so the electrical charge is "spread" throughout the nucleus and shared by all the nucleons.

Further, each element (actually each isotope) has its own unique "ensemble pattern" of Fourier expansion scalar frequencies, amplitudes, etc. This pattern, of course, can be reproduced artificially and transmitted by modified EM transmitters (i.e., by scalar EM transmitters). There is, however, a sort of "master key" scalar EM (EG) pattern for nucleons (protons and neutrons which are changing back and forth into each other by exchange of virtual charge currents).

If one "reverses the charge" by inverting this pattern, and then "charges up a mass with the inverted charge," to the external observer the charging mass just gets lighter and lighter, and its inertia gets less and less. Eventually it seems (to him) to acquire negative mass and negative inertia, and just accelerate away from the earth. The object "falls upward" instead of "falling downwards."

There are also some weird time effects. The object can be moving slower through time than the laboratory observer, or even be moving backwards through time with respect to the laboratory observer. (Don't believe everything they laught you in relativity; none of those professors had ever engineered a single general relativistic situation. Little that they teach in GR is based on direct experimcnt. Most of what they teach is already experimentally proven to be incomplete or in need of further extension.).

But back to our slide.

Inside the pattern itself, it's just a quite normal pattern. No change in or on the object seems to have occurred, to it, if the charge is evenly accomplished throughout the object. Indeed, to an internal observer it's the external environment that seems to have suddenly gotten very strange! This is what occasionally happens to a haplessaircraft or ship that experiences anomalous spatiotemporal difficulty in an *occasionally scalar-active* area such as the Bermuda triangle. Under the right conditions, the vehicle's gravitational charge is affected by anomalous changes in the scalar radiation from the earth in that area. To the passengers and crew, it is the external environment that suddenly seems weird. In addition, on-board EM and inertial instruments may be affected, and other electrogravitational effects may also occur, due to differing rates of charge in different parts of the vehicle.).

"Reversing or lowering the EG-charge" is controlled by means of biasing the ground potential on the ensemble pattern transmitters. These transmitters can even be on-board the vehicle itself. (Remember, in scalar EM to transmit is also to receive. A vehicle can change its own bias potential (with respect to local vacuum G-potential) by properly transmitting, which translates to "receiving potential charge." The charge current can either be negative or positive (its potential can be lowered or increased vis-a-vis that of the vacuum.) Think of this as handling positive and negative energy, which means positive and negative gravity.

By "fiddling" with this, you can float metal. Or a human body. Or a battleship. Or a high-speed vehicle containing a crew.

You can even "dematerialize it" or "teleport it."

The Philadelphia Experiment may have been real after all. If so, the test ship and its personnel were "blasted" into this strange realm, instead of making a gentle, controlled entry.

Suppose you materially lower or reverse (adjust) the gravitational charge (gravitation 5-potential with zero-summed EM to throttle EM bleed-off). At zero gravitational charge, to the external observer, such an assumed vehicle would seem to have no mass and no inertia. It is capable of extreme accelerations, right angle turns at full speed, etc. It is also right on the point of dematerialization, and may appear to be glowing or just a vehicle of light.

If the pilot wishes to "land," of course he must adjust the charge on the vehicle.

If the pilot wishes to "dematerialize" or "teleport," again he must adjust the charge on the vehicle.

If he wishes to go "hyperspatial," again he must adjust the charge on the vehicle and allow the proper bleed-off to produce a hyperspatial force. That's done with nested zero summations and nested patterns of scalar EM transmission.

That is, he can charge and bias the vehicle in multiple, nested zero-summations simultaneously.

That is necessary for hyperspatial control and travel.

Note that in lower hyperspace such a vehicle could do some very strange things. Such as "penetrate" solid matter (actually, it goes "around" the 3-space matter in a 4th Kaluza-Klein space).

We might expect to see such vehicles glowing. Their various surface features and mechanisms might appear to be glowing or revolving lights, etc.

They could exhibit incredible "aerodynamic performance," seemingly in the atmosphere. Actually they would not be moving "through" the atmosphere at all but through a higher space outside each particle of atmosphere.

They could seem to materialize and dematerialize.

They could seem to plunge into the ocean or rise out of it.

They could even seem to operate under the ocean or inside the earth itself.

Such anomalous vehicle performances have been seen all over the world, particularly since a few years after WWII.

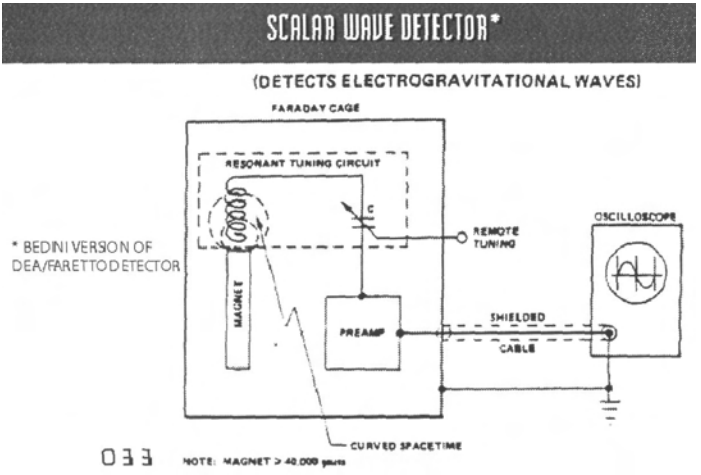

Slide 033: Scalar Wave Detector

On this slide we show a concept for a detector for scalar EG waves. This is the Bedini scalar wave detector, adapted from an original concept by Dea and Faretto.

The idea is quite simple: install a very powerful bar magnet vertically inside a grounded Faraday cage. Then install an open-ended coil longitudinally above the magnet so that a line through the longitudinal axis of the magnet passes through the longitudinal axis of the coil above it. The open end of the coil does not touch the magnet.

Connect the other end of the coil to a variable tuning capacitor, so that the coil and capacitor form a tunable, series-LC-oscillatory circuit. The output of the capacitor is connected to a transistorized preamplifier inside the cage. A tuning shaft for the capacitor is very carefully passed through a small hole in the shield to allow tuning from outside.

The output of the preamp passes very carefully through a small hole in the shield, through a shielded cable, to an adjacent oscilloscope. The cable shield in also grounded to reference ground potential.

The theory is as follows: Suppose a normal EM wave appears inside the cage, above the magnet or closely adjacent thereto. In that case a coupled **oscillation** appears in the field of the magnet, and this oscillation is coupled to the coil immediately above it. If the oscillation is within the bandwidth of the tuned

scries LC circuit, detection occurs. This is amplified by the preamp and passed to the oscilloscope, where it is displayed on the scope.

Note that the detector detects normal EM wave. Now our problem is: how do we get an EG wave to be detected? And how do we assure that we do not detect ordinary EM waves from outside?

Actually this is simple. Ordinary waves (except for quite low frequency) will be grounded out by the Faraday shield, and will not penetrate the cage. Thus these normal EM waves cannot enter the cage and appear above the magnet. They will not be detected.

Scalar EG waves, on the other hand, will enter the cage since they do not couple to conduction electrons in the metal of the cage. Above the pole of the magnet, spacetime is locally bent. After all, a pole is a magnetostatic scalar potential, which is a part of the conglomerate called "G-potential." The pole represents an increase (or decrease, depending upon whether it is a north or a south pole) in the magnetostatic component of the local G-potential. This is a curvature of spacetime. An EG wave entering this region adds a varying component of magnetostatic G-potential, which bleeds-off in the coil as an ordinary EM wave.

Another way to view the detector is to model the EG wave as a longitudinal wave, and an ordinary EM wave as a transverse wave. When the EG wave enters the curved spacetime region above the magnet, to the coil (the "observer" in this case) the longitudinal aspect of the EG wave appears to be rotating back and forth, so that an oscillating transverse component is present. This transverse component appears to the coil as an ordinary EM field, and so the LC circuit detects it if it is in the proper frequency band.

Yet another way to view the situation is to realize that an EG wave entering the magnet results in an oscillation component added to the magnetostatic scalar potential (pole strength) of the magnet. Accordingly, the magnet is a receiver for scalar waves, which are detected to "bleed-off as an oscillation of the magnetic field strength of the magnet. Coupling of this oscillating magnetic field to the coil creates an oscillating current flow into the capacitor. This oscillates the voltage input to the preamp, which amplifies and feeds the signal to the oscilloscope for display.

In fact rather like the latter view! It is important to remember that a magnetostatic potential and an electrostatic potential can be oscillated by a scalar EG wave. By placing a magnetic material inside a Faraday cage, the oscillation of the magnetostatic scalar potential (pole strength of the magnet) can be used as the EG detecting mechanism. By placing a chargeable material inside a Faraday cage, the oscillation of the electrostatic scalar potential can be detected. (Possible examples of the latter type detectors are given by Hodowanec, Radio Electronics, April 1986.)

Note also that one may detect waves at one reference level and not at another. Changing the bias on the zero-reference ground of the Bedini detector affects the detection. To look inside a normal EM carrier (such as the Woodpecker) and see what scalar signals are riding upon it, the carrier may be used to bias the reference ground of the Bedini detector.

To produce a spectrum analyzer, simply use additional series resonant LC tuning circuits in parallel (put multiple taps on the coil, and wire each tap to a separate tuning capacitor of different capacitance). Again, varying the zero reference level is important, as is varying the strength of the magnet.

Golden also has invented an excellent series of scalar wave detectors based upon quite different proprietary principles.

The bottom line is: we can indeed rigorously detect and measure scalar EG waves. When one considers the large sums of money presently being spent to bury large aluminum cylinders etc. in an attempt to detect gravitational waves, one wonders why some funds could not be released to a few unorthodox researchers by the National Academy of Sciences to fund the proven creation and detection of electrogravitational waves!

Note from TEB: I understand that it took Bedini about 600 attempts before he got the device to work. It was then handed over to a different party to produce, who made some "improvements," and the device then failed to work.

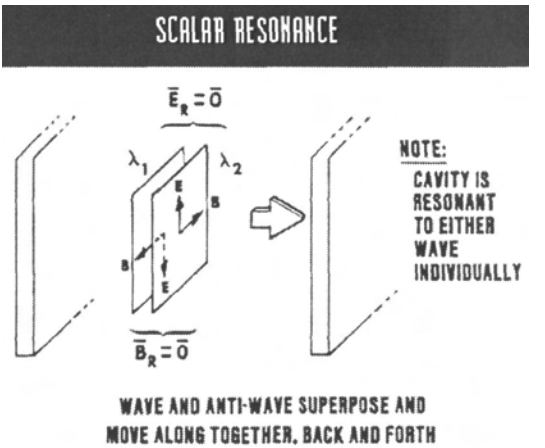

Slide 034: Scalar Resonance

Here we explain a new kind of resonance: scalar EH resonance, or electrogravitational resonance.

First, imagine we have a standard resonant cavity, represented by the two walls in our diagram. In this cavity we have a resonant EM wave moving back and forth, represented by the forward-most plane. In accordance with convention, we show the E-field vector and the B-field vector at right angles in this moving wave front. As the wave front moves back and forth, the vectors vary back and forth; however, at any one point between the walls, the two vectors always have the same value. Thus our resonant EM wave forms a standing wave in the cavity.

Now imagine that a second wave front, precisely like the first and of the same frequency, is superposed over the first wave front and travels along with it. This second wave - the "antiwave" - has its force vectors 180 degrees out of phase with the force vectors of the reference wave. Hence the E-fields and B-fields of the two superposed waves always sum to vector zeros, anywhere in the cavity. To an external observer, the cavity contains no ordinary electromagnetic force fields, hence no ordinary EM energy.

However, the energy density of a single EM sine wave in vacuum is given by

$$[E^2+B^2]/8\pi \qquad [9]$$

This energy density is always positive. Hence the energy density of the two waves at any point x between the walls is equal to

$$[E^2+B^2]/4\pi \qquad [10]$$

where

$$E = E(x) \; ; \; B = B(x) \qquad [11]$$

Thus the energy density of vacuum varies with x. But, rigorously, since the resultant E and B fields are zero, this describes a standing gravitational wave. Hence we have a standing EG wave, existing in the resonant cavity. This is an example of scalar resonance. Rigorously the cavity has mass and inertia, to an outside observer, as a result of the two warps in spacetime it contains.

Note that in one half-cycle the energy density of vacuum is greater than ambient, and in the other half-cycle it is less. In the region of one half-cycle, time flows at a faster rate than to the ambient observer, and in the other half-cycle time flows at a slower rate than to the ambient observer.

One half-cycle appears to contain negative electrical charge, and the other appears to contain positive charge.

One half-cycle appears to contain a north pole (positive magnetostatic scalar potential), and the other half-cycle appears to contain a south pole (negative magnetostatic scalar potential).

Perhaps now one can begin to understand why a continuously accelerated orbital electron in the atom does not radiate EM energy, completely in violation of Maxwell's equations. The electron is naught but a complex aspect of a standing scalar resonance, existing between the nucleus and the orbit.

SCALAR RESONANCE

- NOT IN PRESENT TEXTBOOKS
- CONTROLS NATURE OF PARTICLE
- BENDS SPACETIME
- CONTROLS MASS
- CONTROLS INERTIA
- CONTROLS GRAVITY
- CAN FLOW
- A "MASS" IS LIKE A CAPACITANCE
- HAS A SCALAR MAGNITUDE
- HAS SPECIFIC PATTERNING

Slide 035: Scalar Resonance

Scalar resonance is not in the conventional textbook.

Scalar resonance is a particular zero-summed multi-resonance, electromagnetically, so that it does not act in an electromagnetic manner.

A scalar resonance is a standing electrogravitational wave. It can be made e**lectrically,** but it is not electrical in behavior.

In any scalar resonance, spacetime is curved, and it is the magnitude (and direction; of this spacetime curvature that is oscillating in "standing wave" fashion. In respect to stress of the vacuum medium, one half of a standing sine wave of scalar resonance is tensile; the other half is compressive. However, this is with respect to the local ambient stress of vacuum.

"Mass" of a particle is just a characteristic exhibited by a trapped scalar resonance. Usually this trapping is done by the "spin" of the individual particle.

The concept of "mass" may be compared to the concept of "capacitance." That is, a mass is an accumulator for scalar waves; that is, for scalar resonances. It is continually being "charged" and "discharged" by absorption and emission of sca**lar** waves from and to the ambient vacuum scalar wave flux.

Indeed, the magnitude of a mass may be defined in terms of the absolute value of this "switching" (absorption = switch in; emission = switch out) rate. In a very early paper I defined the mass of an object as proportional to the absolute value of the sum of the input and output switching rates, where each "switch"

represents a change of action of h/(4). (Bearden, Quiton/Perceptron Physics: A Theory of Existence, Perception, and Physical Phenomena, Mar. 1973, AD 763210, available through NTIS.) In that scheme, one kilogram of mass equals a switch rate of 17.053×10^{50} switches per second. An object is in a Lorentz frame when the switch-in and switch-out rates are equal in a given direction. If, in addition, the in-out rates in all directions are constant, the object is "stationary" with respect to a Lorentz observer. If not constant in all directions, the object is in a curved spacetime with respect to a Lorentz observer. In that case either the object's local spacetime is warped or the object is in a generalized, accelerated frame.

In the normal linear spacetime, the "charging" and "discharging" are equal in all directions; hence the "mass" exhibited in any direction is the same.

With respect to an "external observer's" equilibrium flux, a moving object encounters an increased amount of flux rate along its line of motion, just as a moving object in a rainstorm encounters more raindrops per second in the direction of its path, than does a stationary object. Encountering increased scalar wave flux (with respect to the external observer) forces the moving object to absorb and emit scalar waves at a higher rate along its direction of motion than when it is not moving. Thus to the external observer, the mass of the object has increased, insofar as any disturbing force along its line of motion is concerned.

At right angles to its line of motion, however, the flux rate is precisely the same as when the object is at rest. Therefore the "mass" of the moving object with respect to any disturbing force at right angles to its line of motion has not changed, as seen by the external Lorentz observer.

Thus is explained both parts of one of the alltime great mysteries of special relativity: (1) how the mass of an object increases with respect to its motion, and (2) why the mass only increases with respect to its line of motion, and not at right angles to it.

The inertia of a particle is due to its mass, i.e., to the total magnitude of its trapped scalar resonance.

The gravitational attraction between two masses is due to their spacetime curvature. Further, mass is like a capacitance. It can trap additional scalar waves as trapped resonance; hence increase its magnitude or "inertial charge." Or, it can discharge more scalar waves than it absorbs; hence decrease its magnitude or "inertial charge."

Those scalar waves emitted from resonance are emitted as a pattern ensemble of the resonance. Hence they may be regarded as constituting a current of scalar resonance leaving the mass-accumulator-object. Scalar waves absorbed into trapped resonance may be regarded as constituting a current of scalar resonance into the mass-accumulator-object. Thus it is proper to speak of scalar resonance as being able to "flow."

Further, it is possible to increase the mass of an object directly, by transmitting scalar EM waves to it so that it absorbs them. (By "absorbing" scalar waves one means that more enter the object than leave it, so the object acts as an inertial accumulator charging up with inertial charge. This is done by insuring that the reference potential of the scalar wave transmitter is higher than the reference potential of the irradiated object.)

It is also possible to decrease the mass of an object directly, by transmitting scalar EM waves to it so that it emits more than it absorbs. (By "emitting" scalar waves one means that more leave the object than enter it, so the object acts as if it were an inertial accumulator that is discharging its inertial charge. This is done hy insuring that the reference potential of the scalar wave transmitter is lower than the reference potential of the irradiated object.)

As can be seen, the scalar wave "transmitter" is actually somewhat comparable to a heat pump; it can either act as an "energy transmitter" or as an "energy extractor," depending upon the difference in potential between "transmitter" and "receiver."

Finally, scalar resonance can have a specific pattern: both in frequency and in spatial curvature aspects, as well as "rate of flow of time" aspects. Indeed, scalar-wise every object has its individual "scalar pattern" which is a unique fingerprint. Since that print is spatiotemporal, it is a product of the object's entire past history. Thus - scalar-wise - no two objects are identical.

This brings up another rather amazing potential: If a reasonably precise scalar pattern of an object can be "irradiated" and resonated with scalar waves, energy may be created in or extracted from the distant object, just as stimulating one tunning fork can excite another at a distance by sympathetic resonance. We leave it as an exercise for the reader to ascertain the relevance of this statement to clairvoyance, radionics, remote viewing, etc.

For the skeptic, however, we must point out that - rigorously - quantum mechanics requires that, continually, in any localized region of spacetime, the "pattern" of any object in the universe appears momentarily in the virtual state, purely from statistical considerations alone. So long as the situation remains statistical, any place in the universe can continue to have the "ghosts" of everything present there, in an ethereally thin pattern, and the observable world will not be affected by it. However, if one can discriminate and scalarly "charge" or "discharge" individual patterns in this "ghost-realm," action-at-a-distance is directly possible, as is materialization and dematerialization. If one accepts that even thought itself produces such virtual "ghost-patterns" in the virtual particle flux of vacuum, then it is at least theoretically possible to even materialize thoughts and thought images.

We have entered a new kind of reality where the old rules and the old limitations do not necessarily apply.

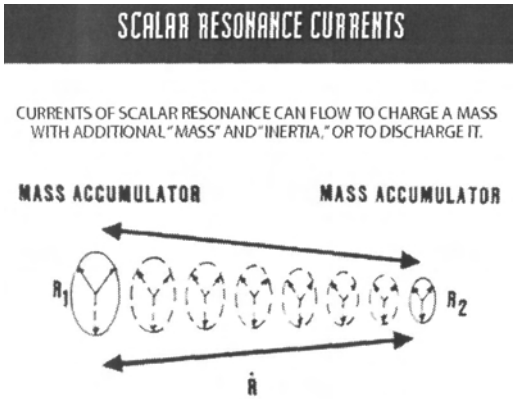

Slide 036: Scalar Resonance Currents

As we pointed out, we can often greatly simplify matters by considering currents of scalar resonance. These currents flow from higher potential to lower potential, regardless of whether we are considering "transmission" or "reception."

Indeed, to "transmit at lower potential" is to receive, and to "receive at higher potential" is to transmit.

Thus the "transmitter-receiver" is a special system where simply biasing the two nodes differently determines which way the scalar resonance current will flow.

We may increase or decrease an object's inertia and mass, simply by properly biasing the transmitter-receiver system's two nodes.

In one accidental experiment of some hours in duration, Golden charged up an area so that, locally, all clocks became erratic. This included electrical clocks, battery-driven watches, wind-up kitchen clocks, and a pendulum-operated grandfather's clock. The rate of flow of time itself was apparently altered in the local area by the accumulated charge, which took some four days to drain off and discharge. At the end of the four days of discharge, all clocks and watches had returned to normal.

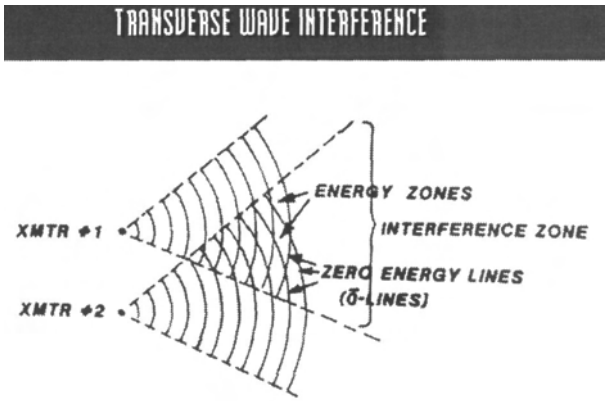

Slide 037: Transverse Wave Interference

On this slide we show the orthodox representation of EM wave interference.

The chart is stylized since we assume two single-frequency EM waves that intersect and interfere in the indicated region.

In the interference zone, in-phase wave amplitudes add (constructive interference) while out-of-phase wave amplitudes subtract (destructive interference). In our stylized mode, we show the zero-summed locations as lines.

Conventionally, these interfering waves are considered to be transverse waves in vacuum.

The point is, in this scheme we think of "putting in the waves of finite amplitude, and creating the zero-amplitude regions by destructive interference." We create additional waves of increased-amplitude regions by constructive iterference.

Note that this view is only half correct. It addresses the electromagnetics, but not the gravitational aspects. Actually the regions of destructive EM interference are regions of constructive G-interference, and the regions of constructive EM interference are regions of destructive G-interference.

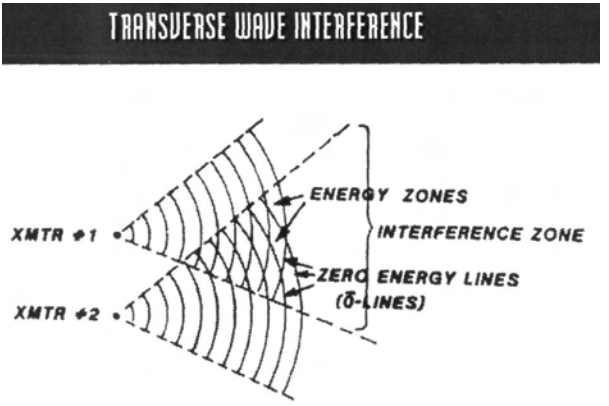

Slide 038: Transverse Wave Interference

Here we show the same interference situation, only now we think of transmitting scalar EM waves, which we model as longitudinal waves.

Again we assume two single-frequency scalar EM waves that intersect and interfere in the indicated region.

However, to an external observer, each of these waves individually appears to have zero E and H fields, hence to contain zero EM energy. That is, conventionally we seem to be transmitting waves of "pure potential," without any "force field" amplitudes whatsoever. We say we are transmitting waves of "artificial potential," since we deliberately constructed the zero-vector-summation scalar waves in the first place.

In the interference zone, a strange thing now happens. The relative magnitudes of the artificial potential of one wave with respect to the artificial potential of the other depend upon the phase relationship between the two. Further, whether the "gradient" so established appears negative or positive also depends upon the phase relationship between the two.

What results is most interesting: the out-of-phase condition now produces an EM gradient whose sign and magnitude are functions of the location within the interference zone.

Thus one now has real, non-zero EM potential gradients, both electrical and magnetic. And so real EM energy has emerged in an interference pattern within the area.

Ironically, we get essentially what we had before! Only now we have "put in the zero-reference lines, and produced the non-zero gradient (energy) zones."

In other words, we have recreated ordinary EM energy at a distance, directly from the interference of gravitational potential energy (anenergy).

And, to the laboratory observer, there has been no "EM wave" energy flow through the intervening space.

This was Tesla's secret of "wireless transmission of energy to a distance without losses."

Further, in a hypothetically perfect case, the interference represents a sort of "energybottle."

But now recall our need to take the sign of the scalar current into account. In this energy bottle, then, EM energy emerges and stabilizes - if and only if our transmitters are at higher reference potential than the ambient interference zone. If our transmitters are biased at lower potential, then energy is extracted from the energy bottle and re-emerges back at the transmitters, where it must be extracted and disposed of, if the transmitters are not to be burned out.

BACKGROUND FOR THE BRIEFER:

If we interfere two transmitters in a region of great energy -such as the molten core of the earth itself- and bias the transmitters negatively, we can extract enormous energy directly from that distant source!

Indeed, a slight variation of this effect is precisely how the Soviet Union obtains the enormous energy with which to power its incredibly powerful strategic "continent-buster"scalar EM weapons. Scalar frequency pairs - 12 kiloHertz apart - are transmitted into the earth itself on some portion of the earth's "giant scalar resonance" frequency curve. Biasing the two transmitters differently with respect to each other produces a high potential difference (voltage) between them. At the same time, biasing them both negative with respect to the earth's molten core produces a scalar resonance current from the core to the two transmitters. In the "outer loop" between the two scalar transmitters, there appears a gigantic voltage and gigantic electrical current that can be captured by appropriate means. This electrical power is tapped off and transmitted to incredibly powerful scalar EM weapon systems. There special accumulators and switchers are are utilized to provide the power of many Niagaras to each weapon.

Just before May 1, 1985 the Soviet Union performed a "full-up" operational test of their entire strategic scalar EM weapons complex. This test was detected and monitored periodically by Frank Golden. Some 27 of these giant Soviet "power taps" were locked into the molten core of the earth, producing forced (entrained)

scalar resonance of the entire planet on 54 controlled frequencies under our very feet. The remainder of the scalar frequency spectrum was ablaze with literally hundreds of Soviet scalar transmitters: probably the entire strategic scalar command and control system to underwater submarines, higher command centers, distant commands, etc. was activated in the giant exercise.

For several days, the system was exercised on a mind-boggling scale, apparently as part of the Soviet Union's highly accentuated 40th anniversary celebration of the end of World War II.

Ironically, not a single U.S. intelligence agency, laboratory, or scientist detected this monstrous exercise for the new Soviet leader, Gorbachev. Not a one of them had a detector for scalar EM radiation, and not a one of them officially believes the exercise ever happened.

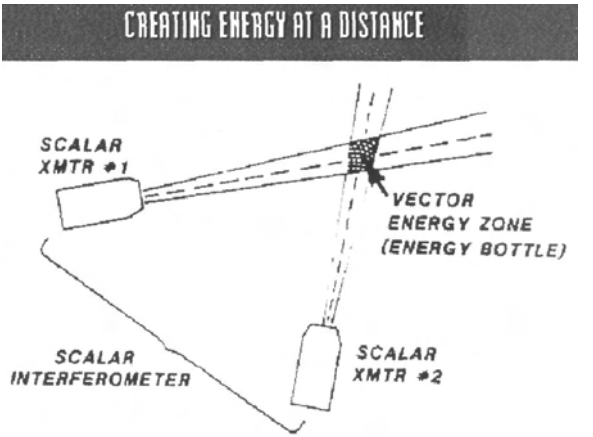

Slide 039: Creating Energy at a Distance

A most useful device is obtained if one uses a scalar interferometer where the two transmitters transmit beams that intersect at a distance.

In the interference zone, an energy bottle is created.

By biasing the transmitter reference potentials well above that of the distant energy bottle, EM energy emerges in that zone. In that case the interferometer is operating in the exothermic mode.

By biasing the transmitter reference potentials well below that of the distant energy bottle, EM energy is extracted from the distant zone and emerges from the transmitter. In that case the interferometer is operating in the endothermic mode.

If the transmitters transmit continuously, the effect in the distant zone is continuous.

If each transmitter transmits a pulse, and the two pulses meet in the distant intersection zone, then an explosive emergence or extraction of energy occurs at the distant interference zone, depending upon whether the interferometer is operating in the exothermic or the endothermic mode.

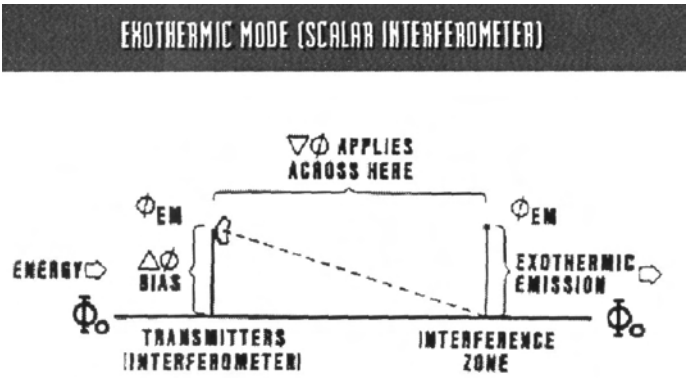

Slide 040: Exothermic Mode (Scalar Interferometer)

For a scalar interferometer, "del phi" (the gradient of the potential) applies between the transmitter site and the distant intersection site, not to the intervening space in between. Thus one speaks of "energy flow" as being between transmitter and intersection, without any "in between." In the intervening space, all the energy exists as locked-in artificial potential, not EM force field energy (gradient bleed-off of potential).

In the exothermic mode, the ground potential of the transmitter is biased well above the ground potential of ambient vacuum. Energy enters the transmitter and "disappears", to "reappear" in the distant interference zone.

If continuous wave transmission is used, the energy continuously appears in the distant zone.

If pulse transmission is used and timed so that the two scalar pulses meet in the distant zone, energy explosively appears there.

If multiple frequencies are transmitted in the manner of a Fourier expansion of a particular geometric form, then a 3-dimensional energy form appears at the distant intersection. In this manner, a spherical or hemispherical shell (a globe of "dome" of EM energy) can be created at a distance. If pulse transmission is used, this will be an impulsive or explosive emergence of that energy form. If continuous transmission is used, this will be a continuous glowing form.

By feeding incredibly powerful transmitters with large amounts of energy extracted from the earth's molten core by "energy taps," very large spherical

globes and hemispherical domes of EM energy can be created. The energy in the interference "shell" of such a sphere or hemisphere is sufficiently dense to lift Dirac matter from the Dirac sea of the vacuum. Thus the shell contains a glowing plasma.

Many such scalar howitzer signatures have been seen over the oceans, particularly over the North Pacific by jet airliners flying into and out of Japan. Also, such globes and domes of light have been seen deep within the Soviet Union, by observers in Afghanistan and by pilots of aircraft landing in Iran.

In the impulsive exothermic mode, a large visible flash will occur if EM energy in the visible spectrum is produced. "Flashes" in the infrared may similarly occur, if the emerging energy is in that spectral band. In September 1979 our Vela satellites detected such a large "nuclear flash" over the South Atlantic, off the southern coast of Africa. A second "nuclear flash" detected by the Vela satellites in 1980 was in the infrared only. Some years ago, a series of Momalous "flashes" and "booms" occurred off the east coast of the United States. These were due to the orientation and alignment -and registration - of one or more Soviet "scalar howitzers" - scalar EM interferometers in the exothermicmode.

Large "booms" occurred over the shuttle launch site at Cape Canaveral, associated with three shuttle launches prior to the end of November 1985. These were tests of such exothermic scalar EM howitzers, being tested as part of the Soviet Launch Phase ABM system. In that mode, the scalar pulses from the two transmitters are injected into special zero-reference scalar EM "channels" established in the EM carriers of the Woodpecker over-the-horizon radars. The scalar pulses travel through these channels, traveling in the ordinary EM beam of the transmitter and following it in its curvature around the earth in the earth-ionospheric waveguide. The scalar pulses are timed, phased, and oriented so as to meet the rising shuttle. In these tests the transmissions were offset in time so the shuttle would not actually be destroyed, but the system could be tested against actual shuttle launches in the U.S.

The specific uses of these various exothermic modes will be covered in later partsofthebriefing.

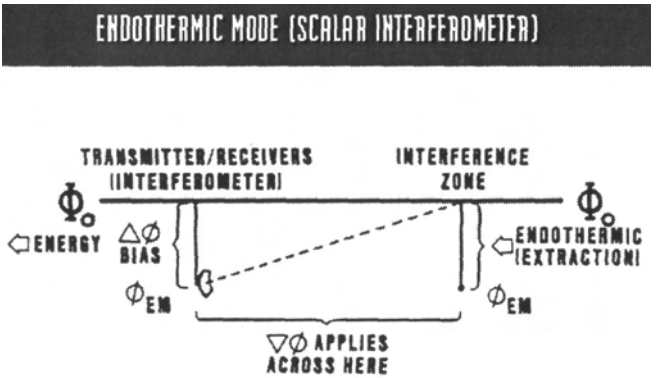

Slide 041: Endothermic Mode (Scalar Interferometer)

In the endothermic mode, the bias on the transmitters is such that energy is extracted from the distant intersection zone, to re-emerge at the transmitters. There the energy must be caught and disposed of if it is not to burn out the transmitters. When very large amounts of energy are extracted from distant points, the Soviets often use a "dump" method of temporarily capturing, and storing in an accumulator, the heat energy emerging at the transmitters. A "scalar energy tap" established into the accumulator then feeds a second howitzer in the exothermic mode. This howitzer is focused on a distant dumpsite - often Bennett Island, where U.S. weather satellites continually observe exhausts.

In the impulsive endothermic mode, energy is impulsively extracted from the distant intersection zone. In the atmosphere this results in a very sharp cooling, or a "cold explosion." It also results in the type of boom and rumble often associated with thunder after a lightning bolt.

On April 9, 1984 the Soviet Union tested such a "cold explosion" off the coast of Japan, near the Kuril Islands. In the suddenly induced low pressure "cold zone" above the ocean, ocean water was sharply sucked up from the ocean, forming a dense cloud. Then air rushing in to the low pressure zone forced the cloud upward, forming a mushroom much like that of an atomic explosion in visual appearance, except for the absence of a flash and the absence of a giant shock wave moving out away from the site of the explosion. (In this case the

Soviets controlled the rise time of the pulse so that no "giant atmospheric boom" occurred.).

As the cloud rises, it expands by mixing - very similar to a giant thunderhead buildup, except much faster. In this case the cloud rose to 60,000 feet in about 2 minutes, spreading out until it reached a diameter of about 200 miles. The pilots and crews of several Boeing 747 jet airliners in the general vicinity saw the incident. Sometime after that, a U.S. weather satellite photo of the area occurred. The cloud in that photo has an anomalous density distribution, differing from that of all other clouds in the area.

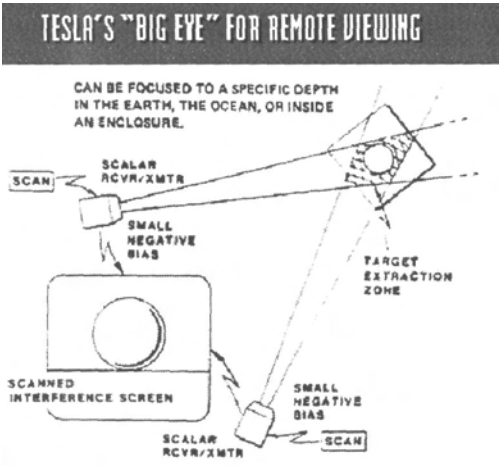

Slide 042: Tesla's "Big Eye" for Remote Viewing

Nikola Tesla also planned a very special use for his endothermic scalar interferometer. He planned to produce what he called his "big eye to see at a distance."

This is accomplished as shown on the diagram. First, the system is only weakly endothermic, so that only a small amount of energy is extracted from the **distant** target. Also, the beams are "scanned" by an open receiver, timewise, from side to side and top to bottom. By scanning yet another single beam through the intersection zone and phasing its pulses, an even better representation can be obtained. Thus the receiver produces a representation of the energy extracted from various locations within the distant endothermic zone. By displaying the received signals on an appropriately scanned screen, a representation of the distant scene in the intersection zone can be created. Indeed this is a special kind of "microwave interferometry," and - with modern techniques - the imagery obtained might be surprisingly good. With development, it might even become as good as the image presently obtained by side-looking acquisition radars.

Interestingly enough, since scalar EM beams will easily penetrate the earth or the ocean, one can also look beneath the earth or beneath the ocean with this type of scanning scalar interferometer.

The importance of this capability to strategic and tactical reconnaissance is obvious. Camouflage, cover, and concealment have no effect on such a **system.** One can easily look inside buildings and into underground facilities. With a small system such as this, the U.S. Marines at Khe Sahn would have had **little**

difficulty locating the tunnels continually dug under the perimeter by the Viet Cong. And targets under jungle canopies are directly visible.

BACKGROUND FOR THE BRIEFER:

It requires little imagination to see that this system is easily adapted to produce an "underwater radar." With such devices, the problem posed by the underwater nuclear submarine is solved. For example, an entire area can be continually searched, much like acquisition radar systems do now. A submarine can be detected and tracked, and none of its ordinary detectors will detect anything out of the ordinary. By using a separate pair of beams in the exothermic mode, powerful scalar pulses can be fired at the distant sub, intersecting at the submarine in a violent EMP throughout the sub and its armament. Thus the sub and all its missiles are destroyed instantly.

Or, continuous exothermic transmission can be used by the targeting weapon at lesser power, gradually interfering with the sub's electrical systems and causing it to lose control. The sub then sinks to crush depth and implodes.

Precisely that scenario seems to be what happened on April 10, 1963 to the U.S.S. Thresher nuclear submarine. It left a signature: the sub's surface companion, the nearby U.S.S. Skylark, was in the "splatter zone" of the underwater scalar interference. That is, spurious EM noise was being generated In all the Skylark's electrical systems, some of which were actually disabled. So intense was the "electronic jamming" that it required over an hour and a half for the Skylark to transmit an emergency message back to its headquarters that the Thresher was in serious trouble and contact with it had been lost. Some of the Skylark's communication systems actually failed, but later resumed operation inexplicably, once the jamming was gone. That type of "jamming" of multiple bands and multiple electronic equipments, of course, together with the anomalous failure of electronic equipment and its later mysterious recovery, were direct signatures of the use of the exothermic scalar interferometer against the undersea target area in the vicinity of the Skylark.

The very next day, Apr. 11, 1963, the same Soviet scalar EM howitzer system was tested in the "destroy submarine" pulse mode. A huge underwater EM blast occured off the coast of Puerto Rico, about 100 miles north of the island. The underwater explosion caused a huge boiling of the surface of the ocean, followed by the rising up of a giant mushroom of water about a third of a mile high. The mushroom of water then fell back into the ocean, completing the signuture.

Fortunately the startled crew of a passing U.S. jetliner that was just passing its checkpoint in that area saw the entire incident. (See Robert J. Durant, "An Underwater Explosion - or What?", Pursuit, 5(2), April 1972, p. 30-31.)

These two incidents were full-up operational tests of Khrushchev's newly deployed superweapons. He probably staged this dramatic one-two punch in a

desperate effort to recover face with the Communist Party after his disastrous facedown by Kennedy in the Cuban Missile Crisis a few short months previously. Apparently the attempt was successful, since he remained in power another year before being deposed.

Slide 043: Site of Mystery Cloud

On this slide we show the location of the "cold explosion" off the coast of Japan on April 9, 1984. The site of the explosion was only about 200 miles from downtown Tokyo. The crews of several jet airliners, including Japan Air Lines Flight 36, saw it.

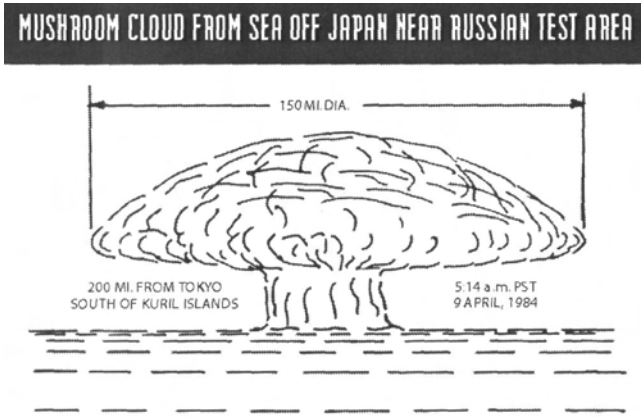

Slide 044: Mushroom Cloud from Sea off Japan near Russian Test Area

A short time before, the Soviets had hastily announced missile tests would be conducted into a zone some distance away from the cold explosion site. This may have been intended as deception to cover this incident, should any foreign nation indicate they understood what was going on.

It also was a direct "stimulus" to the Japanese and the rest of the world: That is, stimulate the system and see if the scientists recognize what happened. If they do, then they know about scalar EM weapons. If they don't, then their countries know nothing of scalar EM weapons, and those countries are defenseless against them.

At any rate, at about 5:14 a.m. Pacific Standard Time on April 9, 1984, a **giant** mushroom cloud erupted above the ocean south of the Kuril Islands. The mushroom rose rapidly, expanding as it rose. In two minutes it had reached **an** altitude of 60,000 feet and a diameter of about 200 miles.

One pilot of a Boeing 747 who observed the cloud was a former B-52 bomber pilot. He described the cloud as very similar to a mushroom cloud from a gigantic nuclear explosion, except there was no flash of visible light. Taking evasive action, he turned off course away from the blast, and braced for a blast shock wave, which never came.

MUSHROOM CLOUD RISING FROM SEA (COLD EXPLOSION)

- 0514 HOURS, 9 APRIL 1984
- GRAY-WHITE CLOUD APPEARED
- ROSE 60,000 FT IN 2 MINUTES
- 180 MILES S.E. OF HOKKAIDO
  200 MILES FROM TOKYO
  SOUTH OF KURIL ISLANDS
- SOVIET MISSILE TESTING SCHEDULED
  ABOUT 350 MILES AWAY
  AT 2100 HOURS, 9 APRIL 1984

Slide 045: Mushroom Cloud Rising from Sea

Indeed, this highly anomalous cloud was due to a cold explosion - a test of a Soviet scalar EM howitzer in the pulsed endothermic mode.

In the weapon's targeted interference zone, EM energy (heat) was rapidly withdrawn when the biased endothermic extraction occurred. Above the ocean an intense low-pressure zone was created. Water from the ocean was sucked up, as if by a giant vacuum cleaner. The water was violently broken into droplets, forming a dense cloud, with a strong upward momentum.

The surrounding higher-pressure air rushed into the low-pressure zone, pushing the rising dense cloud of water vapor upward as its upward momentum continued. Mixing caused rapid expansion of the rising cloud, causing its density to thin measurably as it rose and expanded. An effect very similar to the formation of a strong thunderhead resulted, except much faster.

The mixing cloud also resembled the mushroom cloud from a giant nuclear explosion, just as an emerging thunderhead does.

But no outward blast wave resulted as does from a nuclear explosion. Also, no visible flash occurred, probably as a result of deliberate design by the Russians.

Thus a beautiful "stimulus" and test was conducted: quite a few airliners were "pinged," providing a high-level stimulus to competent observers. The news was sure to be reported by them to several nations. The press was sure to pick up the story. This was a high order stimulus to see whether the U.S., Japan, or other

potential adversaries of the Soviet Union recognized the testing of a cold explosion weapon.

By our reaction, we assured them (with high confidence) that we still knew nothing of scalar EM interferometry or cold explosions.

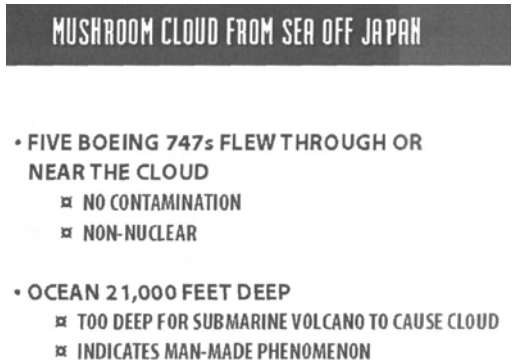

Slide 046: Mushroom Cloud from Sea off Japan

Five Boeing 747's flew through or near the cloud on their way to Anchorage, Alaska. The aircraft were checked at Anchorage for radioactive contamination, but nothing was found. This showed that the huge "explosion" had been non-nuclear.

The ocean in the area is also about 21,000 feet deep. That is really too deep for a submarine volcano to have erupted and caused the cloud. (Besides, a volcano would have continued to snort at least a bit, and so that appears to be out of the question as a possible cause of the incident.)

In short, a manmade phenomenon is indicated.

Indeed, we know it was a cold explosion. As I've stated previously, a colleague has in fact produced the basic effect over a dish of water in the laboratory, using a small scalar interferometer in the endothermic mode.

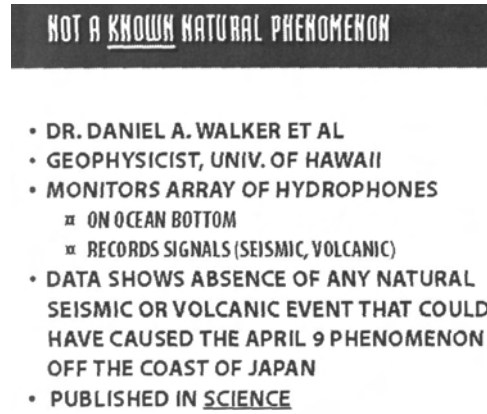

Slide 047: Not a Known Natural Phenomenon

Further, the story does not end there.

A geophysicist at the University of Hawaii, Dr. Daniel A. Walker, together with his colleagues monitor an array of hydrophones on the ocean bottom, recording signals such as seismic incidents, volcano eruptions, etc.

Dr. Walker and his colleagues performed a comprehensive analysis of the data recorded by the hydrophones in and around the time of the incident in question. The data shows the absence of any natural seismic or volcanic event that could have caused the April 9th phenomenon off the coast of Japan.

He and his colleagues concluded that it was either an as yet unknown natural phenomenon, or a man-made phenomenon.

Their report is published in Science. (Walker et al, "Kaitoku Seamount and the Mystery Cloud of 9 April 1984," Science, 227(4687), Feb. 8, 1985, p. 607-611.)

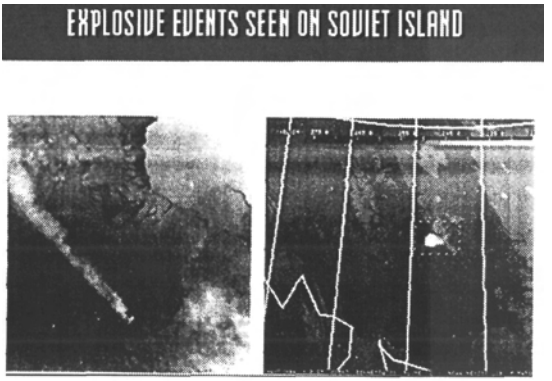

Slide 048: Explosive Events seen on Soviet Island

Here are two U.S. weather satellite photos of the anomalous exhausts on Bennett Island we previously referred to.

The exhaust in the left picture is about 150 miles long, and is nearly horizontal (about 1.5 degrees above the horizontal). It is entirely consistent with the continuous exhaust from a "dumping transfer" scalar EM howitzer in the continuous exothermic mode. (The primary howitzer, of course, was activated in the endothermic mode.)

I think any open-minded investigator must admit that that is indeed a very powerful jet-like exhaust, and not like anything one ever sees from a natural volcano or geological gas vent. If anyone knows of such an anomalous volcanic or geological exhaust, I would be most delighted to see a photo or report. To my knowledge, no such natural photo exists, and no such natural exhaust has ever been reported.

The right picture shows the "puff of an explosive emergence of the exhaust. In other words, this one is the exhaust from a "dumping transfer" howitzer used in the pulsed exothermic mode. Since it did not have so much energy to dump, it could dump it in a pulse. Again, the primary howitzer, of course, was activated in the endothermic mode.

Over 100 weather satellite photos of these anomalous exhausts have been taken since 1974.

One or more U.S. aircraft have even been vectored through the exhausts, and samples of the exhaust taken and analyzed. The exhaust is made up of a little clay and mud and water, and is colder than the surrounding air.

Slide 049: Explosive Events seen on Soviet Island

U.S. weather analysts euphemistically call these exhausts from Bennett Island plumes.

Here is another U.S. weather satellite photo, showing the twin emergence of multiple puffs.

One might expect such exhausts if the secondary "dumping transfer" howitzer is operated in the continuous mode, with continuous extraction by "power tapping" the accumulator of the primary howitzer. In that case, the signature of the exhaust would expose the operation of the primary howitzer. For example, this exhaust would indicate multiple puffs, hence probably multiple frequencies and multiple primary transmitters, each phased in a controlled manner. That of course indicates the production of Fourier expansion forms - of 3-dimensional geometrical forms - by the primary howitzer(s). Since these are puffs, it may indicate the explosive formation of distant spherical balls of energy by the primary howitzer. This in turn indicates the use of a howitzer system in the "pulse firing" mode, which can be used against missiles, ships, aircraft, ground targets, armored vehicles, underwater targets, etc.

Slide 050: Explosive Events seen on Soviet Islands

This slide shows the location of three areas of interest relative to Soviet scalar EM weapons testing.

Wrangel Island, north of the northeastern portion of the Soviet mainland, is associate with tests of these weapons in large circular breakups of the ocean's ice cover. This of course could aid submarines that wished to surface and fire cruise missiles, or submarines that wished to fire from underwater and needed the **ice** broken up.

Strangely enough, Wrangel Island has a most peculiar history: legally it still belongs to the U.S., but has been "given" to the Soviet Union without permission of the U.S. Senate, which is illegal.

Bennett Island, a little farther to the west and still north of the Soviet **mainland,** is noted for its phenomenal number of anomalous exhausts as previously discussed.

North of the Soviet mainland and near its middle lies the large island of Novaya Zemlya. Weather satellites have taken pictures of anomalous circulations over this island, which are further candidates for exhausts from scalar EM howitzer operations.

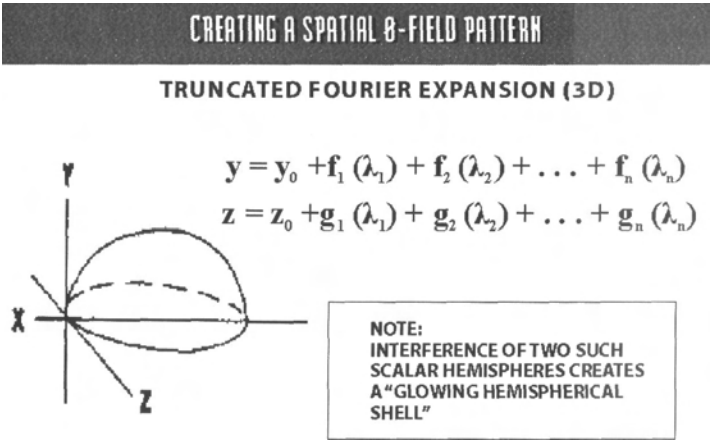

Slide 051: Creating a Spatial 0-Field Pattern

On this slide we show that a hemispherical dome (or other regular shape) can be composed from scalar waves by 3-dimensional Fourier expansion. By truncating the expansion - say after 10 or 12 frequency terms - a good representation of the desired form can be obtained with a practical number of frequencies, and in turn a practical number of transmitters. A computer is used to compute the multiplying functions for each frequency, and the entire complex of frequencies is then transmitted to produce the scalar form. By interfering two such scalar forms, a 3-dimensional shell of locked-in, ordinary EM energy is formed in space.

Interference of two such scalar hemispherical surfaces creates a "glowing hemispherical shell or dome of energy."

Interference of two such scalar spherical surfaces creates a "glowing spherical shell or globe of energy."

Both such geometric forms have been repeatedly seen.

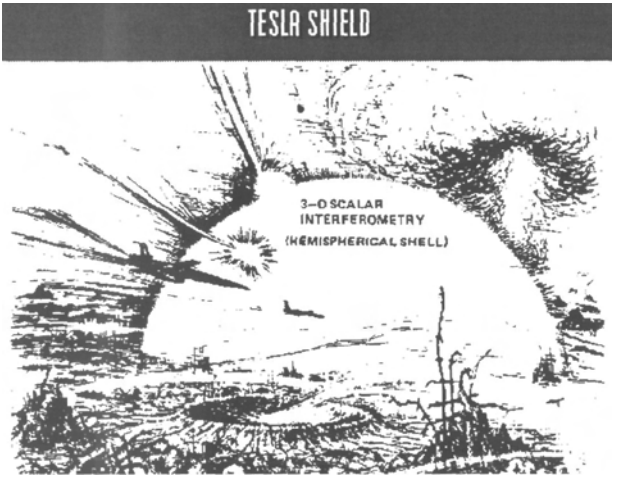

Slide 052: Tesla Shield

Of particular interest is the hemispherical shell of energy, which years ago I dubbed the "Tesla shield."

As shown on this slide, two scalar hemispherical surfaces are created, using multiple frequency transmitters and truncated Fourier series expansions. Interference of the two scalar hemispheres creates a great, glowing hemispherical shell of ordinary electro-magnetic energy. In the shell, the energy density is sufficient to lift Dirac matter from the Dirac Sea of vacuum. The shell is thus filled with a glowing plasma.

Such a shell may be several hundred miles in diameter at the base. The enormous energy required to form such a defense shell is obtained by a "scalar power tap" into the molten core of the earth itself, as previously explained. In late April/early May of 1985, 27 such "power taps" were placed in the earth by the Soviets. If each tap is capable of powering four to six large scalar EM weapons, then the Soviet strategic scalar EM arsenal contains over 100 monstrous superweapons capable of generating exothermic explosions, endothermic explosions, engineering the weather, locating and destroying underwater submarines, detecting and destroying ballistic missiles shortly after launch, detecting and destroying long range strategic bombers as soon as they are airborne, etc.

At any rate, the giant Tesla shield is useful against any penetrating vehicle. If the shell is not so large, its energy density may be very high. In that case, the intense

plasma heating will fuse and even vaporize metallic bodies. In addition, any vehicle encountering the shell is subjected to an extremely intense EMP arising everywhere inside its circuitry. EM shielding is of no use against the creation of energy throughout the spacetime of the circuits; such shielding only helps against energy flow through space in the conventional sense.

Thus the electronics of any vehicle encountering the shield are instantly dudded, whether or not they are shielded against ordinary electromagnetic interference (EMI). This includes the electronics operating a nuclear warhead, carried by a re-entry vehicle. Electrically everything penetrating the shell is totally dudded. Further, explosive materials are exploded when such an EMP is encountered, and combustible materials are fiercely consumed or set afire. Ablative shielding suffers an interesting catastrophe: since energy does not try to "flow into" the shielding but "arises everywhere in it simultaneously", "ablation" occurs everywhere throughout the ablative material, simply exploding it instantly. In addition, for smaller Tesla shells (say of 50 miles diameter) the energy density is sufficient to melt or vaporize metals such as in missile structures.

With such a Tesla shield, there is no need to discriminate true warhead-bearing re-entry vehicles from decoys, chaff, etc. The entire "mess" entering the shield is simply "cleaned up" and "sterilized" or destroyed. The shield can take care of ICBMs/IRBMs and their nuclear warheads, strategic bombers and their nuclear **bombs,** cruise missiles and their nuclear warheads, re-entry vehicles and their warheads, decoys, chaff, etc.

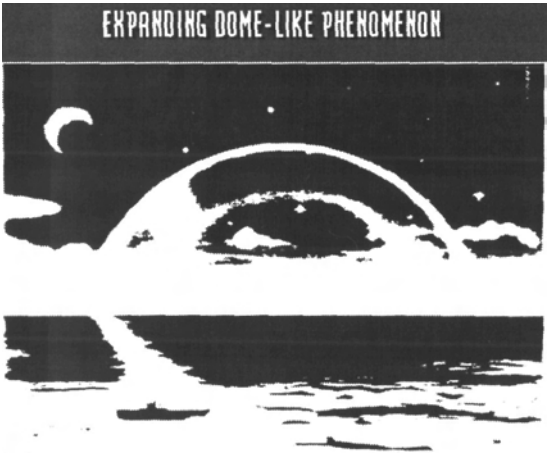

Slide 053: Expanding Dome-like Phenomenon

Here we show one instance of apparent Soviet testing of the Tesla shield (hemispherical shell of energy) over the ocean. This incident occurred in the Caribbean and Western North Atlantic Ocean on Mar. 20, 1969 and is reported in the Marine Observer, Vol. 40, 1970, p. 17. A semicircle of milky white light, quite intense at first, was sighted on the horizon. The semicircle enlarged, dimming as it expanded. The incident lasted for about 10 minutes. Seen from a passing ship, the top of the hemisphere reached a sighting elevation angle of about 50 degrees, while the base of the hemisphere of light subtended an arc of about 70 degrees. This is directly indicative of a test of the Tesla shield, first as a small, more intense shield and then expanding to greater size for a less intense shield whose primary destructive mechanism is EMP. Note that the EMP in a Tesla shield is locally contained in the energy-bottle shell. It is not an ordinary EMP of energy radiated out of the shell.

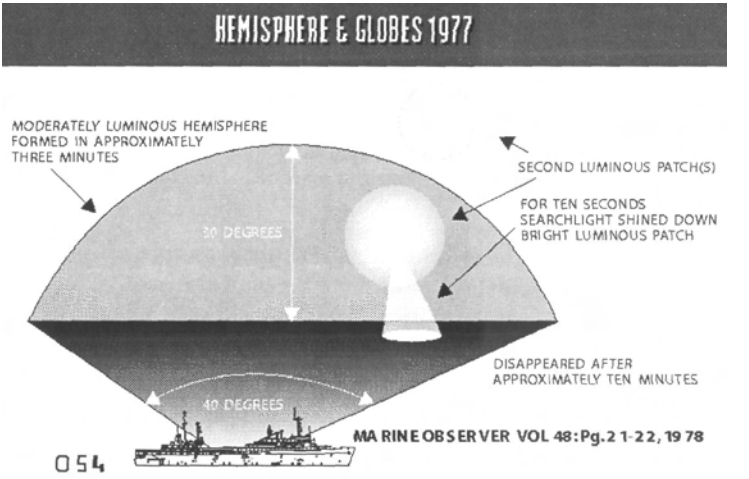

Slide 054: Hemisphere & Globes 1977

Here is a second instance of apparent Soviet testing of the hemispherical Tesla shield over the ocean. This time it is combined with simultaneous testing of two smaller scalar interferometers creating Tesla globes of EM energy.
This incident occurred at 23 degrees 5 minutes north, 17 degrees 25 minutes west. It was sighted and reported by a British ship, H.M.V. Kinpurnie Castle, on Mar. 24, 1977. The report is in the Marine Observer. Vol. 48, 1978, p. 21-22.

First a large, moderately luminous hemisphere of light formed, requiring about 3 minutes to do so. Seen from the ship, the top of the hemisphere was at a sighting elevation angle of about 30 degrees, while the base subtended an arc of about 40 degrees. This was the basic Tesla shield.

Then two other luminous globes or patches of light, each of about 1 degree diameter as seen from the ship, formed in the same area; one inside the shield and one outside it. From the glowing globe inside the shield, a light beam similar to a giant searchlight shone down to the ocean's surface for about 10 seconds.

Again the phenomena lasted about 10 minutes and then disappeared.

The luminous globe or patch inside the hemisphere might be the test of a second weapon deployed from a Soviet aircraft in the area. If so, the aircraft has placed a **strong** spherical shield around itself. In addition, the aircraft is utilizing some sort of scalar interferometer beam weapon in an underwater mode. Probably this would imply a "shot" at a hostile nuclear submarine inside the shielded zone. Thus this aircraft would have the scalar EM equipment to search for the

underwater sub and detect it, and also to concentrate interference energy upon it underwater, destroying it quickly.

Suffice it to say that it is possible to perform scalar interferometry by means of a single beam, in a proprietary process discovered by a close colleague. Thus the "glowing beam to the ocean" resembling a searchlight makes very good sense in the anti-submarine role. The same weapon, of course, could also attack any hostile surface vessel that might have been inside the shielded area at its formation.

The second luminous globe or patch, outside the hemisphere, is probably from a second scalar interferometer from the naval task force, simulating the continuous attack of a certain target (missile or aircraft) outside the protective dome.

As can be seen, this phenomenon is directly indicative of the types of operations one would expect from the testing of Soviet scalar EM weapons at sea, possibly to protect a Soviet naval task force during simulated combat operations.

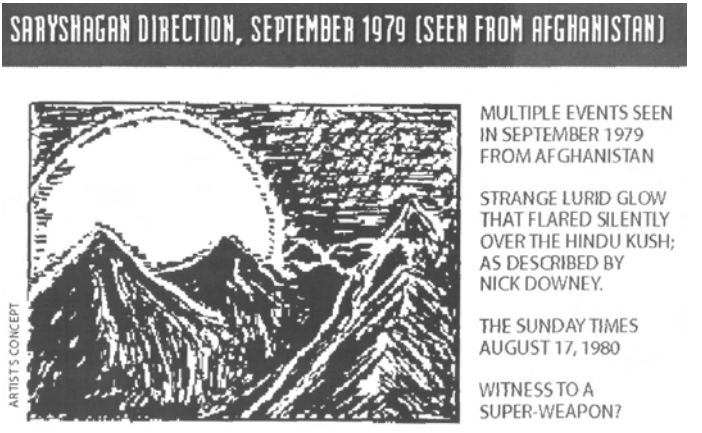

Slide 055: Saryshagan Direction, September 1979

The London Sunday Times of 17 August 1980 contained information and a photo-sketch of incidents of sighting of the testing of very large Tesla globes deep within the Soviet Union. British war cameraman Nick Downie made the sightings from Afghanistan. The phenomena seen were in the direction of the Saryshagan Missile Test Range, which - according to the U.S. Defense Department's Soviet Military Power, 1986 - contains one or more large directed energy weapons (DEWs).

Even though Downie was seeing the giant globe of light from a great distance, it flared silently over the Hindu Kush and expanded to subtend an arc of about 20 degrees, dimming as it expanded. (An arc of 20 degrees subtended by an object many hundreds of miles distant indicates an object of well over a hundred miles in diameter. This gives some idea of the enormous energy being controlled and manipulated by these Soviet weapons.).

Downie saw the sight on more than one occasion in September 1979.

BACKGROUND FOR THE BRIEFER:

In the same month - September 1979 - a stationary luminous globe containing a vertical stripe of black in the center was seen in the sky off Saint Petersburg, Florida. This particular type of sighting in that area has been previously correlated with times of known activity at Saryshagan.

Further, in the same month U.S. nuclear-warning Vela satellites detected a mysterious "nuclear flash" over the South Atlantic, off the coast of Africa. Controversy has raged in U.S. intelligence and scientific circles to this day as to whether a nuclear explosion or some other mechanism produced the flash.

Indeed, the flash may have been produced by a scalar EM howitzer from Saryshagan as one more "ping" of the U.S. intelligence system, to ascertain whether or not it knew anything about scalar EM howitzers. Again, the negative response told them with high confidence that (1) we still didn't know about scalar EM stuff, and (2) we were still absolutely defenseless against the Soviet scalar EM weaponry.

In 1980, a second "Vela flash" was reported. This time it occurred in the infrared region only, which positively rules out any sort of nuclear explosion. Even this increased stimulus still evoked a U.S. action that revealed total ignorance of scalar EM weaponry.

An alternate possibility for the September 1979 Vela flash also exists: countries not hostile to the U.S. may have tested a scalar EM weapon that produced the flash.

At any rate, from Downie's sightings, it is highly probably that the DEW weaponry at Saryshagan Missile Test Range was active in September 1979, and was producing huge Tesla globes. If the DEWs at Saryshagan can produce the giant luminous Tesla globe, they almost certainly are scalar EM interferometers and can produce the giant Tesla shields as well. Downie reported other earlier sightings of similar phenomena seen by Afghans deep within the Soviet Union in the same direction toward Saryshagan.

Briefly let us cover the uses of such a "giant globe" or spherical shell of glowing EM energy and plasma.

By placing such a "giant globe" thousands of kilometers out away from the defended heartland, an entire arc of the sky can be defended against long-range ballistic missile attack in midcourse. During their midcourse trajectory, the attacking missiles would have to penetrate the globular shell twice, exposing them to giant internal EMPs twice. A very high probability thus exists that all missiles entering the space occupied by the globe are dudded upon entry and/or exit. This includes the electronics inside the nuclear warheads themselves. Also, this is particularly effective against MIRV and MARV missile carriers, since the multiple re-entry vehicles are normally still on the main vehicle during most of midcourse. The use of this midcourse ABM globe defense greatly reduces the number of vehicles arriving at the latter part of midcourse and at the terminal phase of their trajectory.

By using a smaller, more intense globe and placing it on incoming clusters of objects or single objects, both EMP and intense local heating are used against the objects. This is suitable in the latter part of midcourse and in the **terminal**

phase of ICBM's, IRBM's, SLBM's, and cruise missiles. It is also useful against incoming strategic bombers and their air-to-surface missiles, both ballistic and cruise.

Two modes of the globes - especially the small ones - can be used. First, the continuous mode can be used to "fry" or vaporize incoming objects in a relatively small volume (say two or three tens of kilometers in diameter). Second, the "pulse" mode can be used to "service" all incoming objects, whether or not they have passed through the "large globe" midcourse defense. This provides an additional guarantee of killing the objects; discrimination is not required, just service all of them. The exposure of all incoming objects to multiple attacks raises the probability of kill to essentially 100%, or as close to that as one wishes. Of course the incoming vehicle may still encounter a terminal defense consisting of the Tesla shield and associated roving "quickshot" small intense globes.

In short, with these systems an essentially 100% ABM and anti-bomber defense is possible. Further, the Soviets have possessed such an effective defense for two decades, just as they have openly stated.

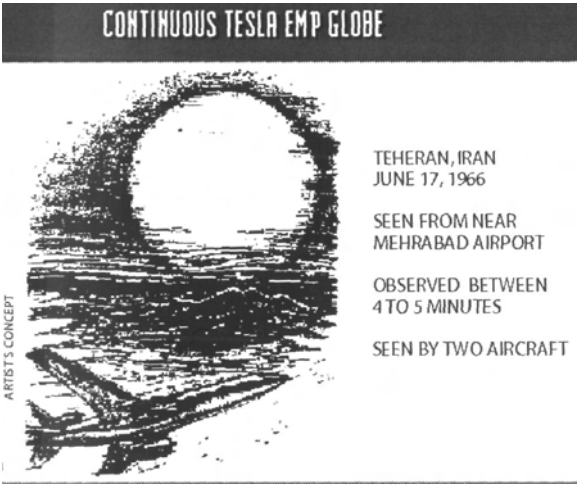

Slide 056: Continuous Tesla EMP Globe

Here is another verified incident of a gigantic test of a Soviet scalar EM howitzer deep within the Soviet Union.

This is a CIA report, released under the Freedom of Information Act. One can be quite sure that the incident occurred as stated.

The phenomenon was seen from two aircraft approaching Mehrabad Airport in Teheran, Iran on June 17, 1966 and reported by their pilots.

On the far horizon deep within the Soviet Union, an intense spherical ball of light appeared, "sitting on the horizon" so to speak. The globe of light increased to enormous size, dimming as it did so, literally filling an arc of the distant sky as it expanded. The sighting was shielded from most ground observers' view at the airport itself due to an intervening mountain range that masked most of tin-phenomenon from the ground.

The silent, expanding globe was observed for four or five minutes before it faded away.

BACKGROUND FOR THE BRIEFER:

Again, this is positive evidence of the testing of a giant scalar EM interferometer, in the "midcourse ABM globe" type of action.

However, note the date - mid 1966! The Soviets have therefore been testing such scalar weapons of enormous size and power for at least two decades. This

implies that development must have started at least a decade earlier, or in the mid '50s.

Still earlier in January 1960 Nikita Khrushchev had announced the development of a "fantastic" Soviet weapon, one that could even destroy all life on earth if unrestrainedly used. In 1962 the ebullient Khrushchev was forced to back down and lose face before John Kennedy in the Cuban Missile Crisis. Khrushchev's missiles and bombers were in woeful shape, as Kennedy well knew (by courtesy of the Soviet spy, Colonel Oleg Penkovsky). Kennedy did not know that Khrushchev's new superweapons were nearing deployment, but were not yet quite ready.

To save face and prevent his immediate ouster, Khrushchev apparently conducted a startling two-strike demonstration of his new weapons as soon as they became operationally ready. On April 10, 1963 he detected and destroyed the U.S.S. Thresher nuclear submarine using a scalar EM howitzer in the underwater "continuous" mode.

The next day he demonstrated the "pulsed" underwater destruction mode for nuclear subs by producing a giant underwater EM explosion underneath the ocean 100 miles north of Puerto Rico. Ironically, just as the Atlantic was coming alive with U.S. naval vessels searching for the lost Thresher, a second test of the weapons that had finished off the sub occurred to the south of them, unnoticed and disregarded, even though seen and reported (to the FBI and the U.S. Coast Guard) by a passing U.S. jetliner's pilot and crew, who observed the underwater explosion.

We thus can peg the development of these weapons by the Soviets as starting well before 1960. The first operational deployment of the giant strategic weaponry occurred in early 1963.

Note that the 1966 testing observed here is completely consistent with this estimated development schedule.

Thus large Soviet strategic scalar EM weapons have been operational on site for 23 years! This implies that at least three additional generations of the scalar EM weapons have been developed and deployed by now.

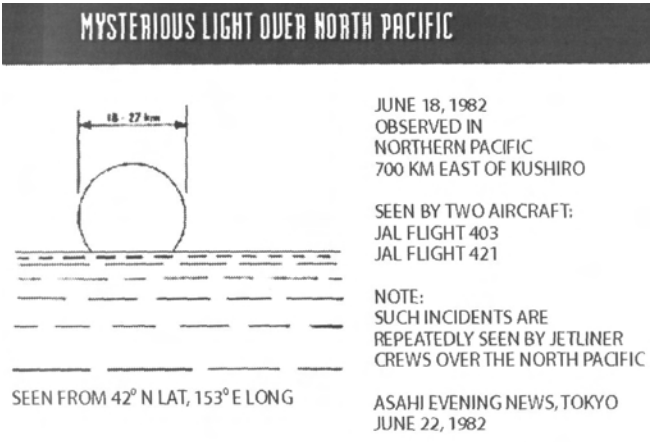

Slide 057: Mysterious Light over North Pacific

Incidents of Soviet testing of the Tesla shield and the Tesla globe weapons are routinely observed by airline pilots flying over the North Pacific into and out of Japan.

This is one typical example. Two jetliners, Japan Air Line flights 403 and 421, sighted and reported a large glowing globe of light sitting just beyond the horizon and extending well above it. The aircraft were in the vicinity of 42 degrees N latitude and 153 degrees longitude at the time. The sighting was thus about 700 miles east of Kushiro.

The pilots estimated the diameter of the ball as at least 18-27 kilometers. Depending upon the actual distance to the sphere, it may have been of much larger size.

This incident is reported in the Asahi Evening News, Tokyo, June 22, 1982.

The jet airliner pilots flying over these waters have reported many other **similar** sightings.

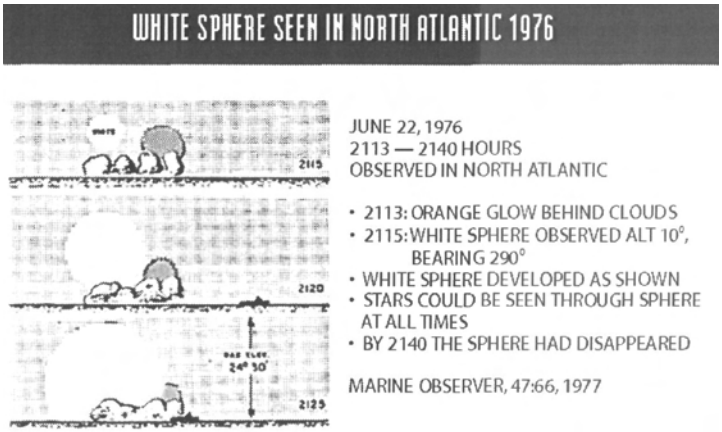

Slide 058: White Sphere seen in North Atlantic 1976

Here is another sighting closer to home.

This incident was observed from a passing ship on June 22, 1976 in the North Atlantic, at about 2113-2140 hours. It is reported in the Marine Observer, Vol. 47. 1977, p. 66.

First, an orange glow was sighted behind some distant clouds. A couple of minutes later, a glowing white sphere of light was observed to the left of the orange glow, just above the clouds. The white sphere then slowly expanded to a much larger sphere, dimming as it expanded. At its maximum size, the top of the white sphere reached about 24 degrees 30 minutes elevation angle to the observer. Development to maximum size required about 10 minutes.

By 2140 hrs the sphere had faded and disappeared. The sphere was sufficiently thin that the stars could be seen through it at all times.

Again this incident strongly fits the large Tesla globe mode of a Soviet scalar EM interferometer.

The significance and role of the orange glow are not known at this time.

Slide 059: Continuous Tesla Fireball

Here is another incident that represents a stimulus to the British government, to see if the British are aware of scalar electromagnetics.

Again, this is a CIA report released under the Freedom of Information Act, so the details are reliable.

On Sep. 10, 1976 British European Airways flight 831, flying between Moscow and London and over Lithuania at the time, observed an intense ball of light above the clouds below the aircraft. The light was so intense that it lit up the sky in the entire vicinity.

The concerned pilot reported the glowing object to the Soviet ground authorities with whom he was in contact. He received the harsh instructions to ignore the light, and essentially to continue on his way out of there.

Here we see an incident involving a small, intense Tesla globe, of the kind with which the defense could "service" objects that had already penetrated a large midcourse globe, or aircraft approaching the defended area.

Obviously the Soviet authorities were tracking the aircraft, and knew it was in the vicinity. It seems logical, then, that they deliberately placed the brightly glowing ball beneath the aircraft so that the pilot and crew could not fail to observe it.

The strange message to the pilot was simply designed to increase the intensity of the stimulus. The stimulus was to be something like, "The Soviets are doing

something in research and development that allows them to create intense balls of glowing light at a distance, and place these objects in the air in and around aircraft, possibly to intercept them." The purpose, of course, was to observe the British government's reaction after the incident was reported by the pilot upon his arrival at London.

Again the reaction of the British - and the U.S. as well - was as predicted. Again we showed that we knew nothing of scalar electromagnetic weapons, and did not recognize one when we encountered its effects.

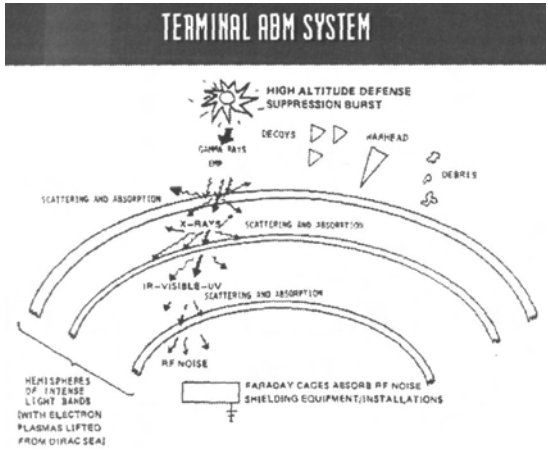

Slide 060: Terminal ABM System

Very neat things can be done if one nests several Tesla shields - say three or four - concentrically, one inside the other. In that case even the nuclear radiation (such as gamma rays) from a defense-suppressive high altitude nuclear burst can be handled.

For example, suppose three such concentric shields are placed over a large vital area. Further, suppose a high altitude nuclear burst is placed up above the outer shield. Gamma radiation almost instantly strikes the plasma in the outer shell, where it is absorbed, scattered, and re-radiated at lower temperature. (That, after all, is what plasmas do.)

Inside the first shell, the scattered radiation is now in the x-ray and ultra-violet region. Let us track the most lethal component, the x-rays.

The scattered x-rays then strike the second plasma shell, and are absorbed, scattered, and re-radiated at lower temperature. Inside the second shell the scattered radiation is now in the visible and infrared region, with a little ultraviolet.

This optical radiation in turn strikes the third plasma shell, and is absorbed, scattered, and re-radiated at still lower temperature. Inside the third shell most of the energy is now in the form of radiofrequency (RF) energy, with a little IR and visible band spectral energy content.

At this point, ordinary electromagnetic interference (EMI) shielding of electronic equipments on the ground and inside the third shield can take care of any RF interference resulting from the emergent RF noise.

As can be seen, three shells are sufficient to convert the gamma and x-ray radiation (and ultraviolet and infrared) mostly to harmless RF energy before all three shells are penetrated. Thus the tactic of deliberate defense suppression by a preliminary high altitude nuclear burst can be countered by multiple Tesla shields.

In addition, of course, any ordinary vehicles penetrating all three shields are exposed to successive violent EMP's, and are almost certainly electrically dudded. The vehicles are also subjected to multiple periods of intense heating, so combustibles, fuels, explosives, and ablatives are destroyed. In addition, metal structures may be melted or vaporized.

Think of it this way: anything that hits one of these Tesla shields goes phht! Just **like** a bug hitting an electrified bugkiller screen.

For years passing ships have observed and reported such multiple-shield "light phenomena" over remote regions of the ocean. U.S. intelligence has routinely **not** paid any heed to reports of "lights at night" over remote ocean areas, and so Soviet tests in this manner have remained relatively unnoticed by officialdom.

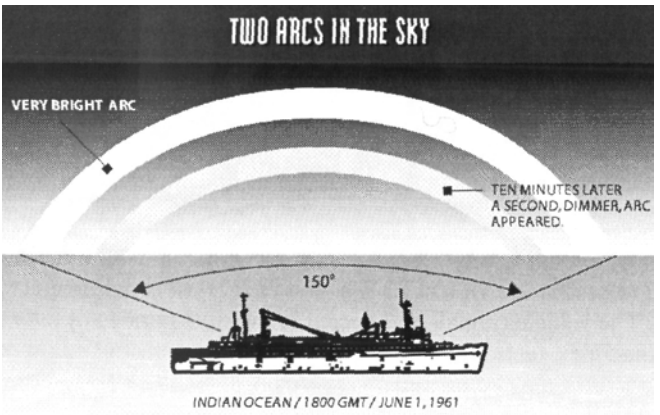

Slide 061: Two Arcs in the Sky

Just to list one incident involving the testing of multiple concentric Tesla shields, here is an early test conducted in mid-1961 over the Indian Ocean.

The incident occurred at 1800 hrs. Greenwich mean Time (GMT) and was observed by a passing ship. The report is contained in Marine Observer, Vol. 32, 1962, p. 64.

First the ship's crew observed a gigantic, very bright arc of light on the horizon or beyond it, with both ends passing below the line of sight to the horizon. This was in fact probably a large Tesla shield, but of such low intensity that only its intersection arc could clearly be seen. The arc subtended an arc of about 150 degrees across its diameter at the bottom. After about 10 minutes, a second and dimmer arc appeared, concentrically inside the first one. The ship thus was observing what probably was the nesting of two giant hemispheres (of EM energy) to provide a multiple Tesla shield.

This was probably a test of an early research and development prototype, since Khrushchev had only announced his new "fantastic weaponry" in development in his January, 1960 speech to the Soviet Presidium. And apparently land-based weapons such as this prototype probably did not become deployed and operational until April 1963. However, even in 1961 the Soviets would have been developing and testing prototypes of the weapon adapted for naval task force protection and usage.

Several other similar phenomena involving nested hemispheres or giant concentric arcs of light have been seen by mariners at sea.

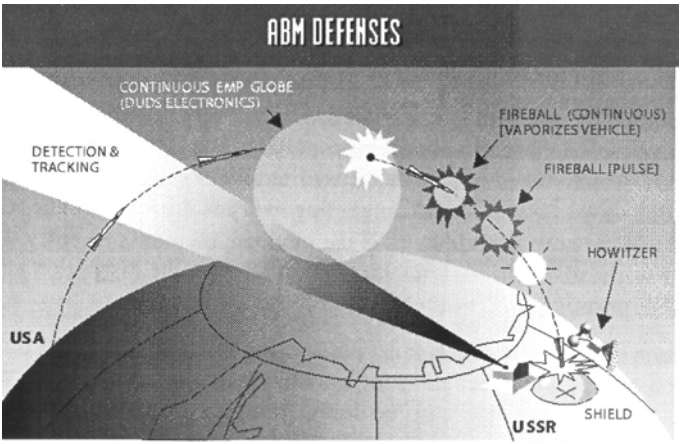

Slide 062: ABM Defenses

When the various capabilities of Tesla shields, globes, and scalar howitzers are integrated together into an ABM defense, a most formidable Soviet strategic defense capability is apparent.

On this slide we deal only with midcourse and terminal phase ABM defense. Later we shall cover the application of these weapons to launch phase ABM defense, primary phase bomber defense, underwater antisubmarine defense, etc.

Suppose the U.S. is provoked to desperately launch a missile attack toward Russia, as indicated on the slide.

First would come the launch phase destruction of the launched missiles, which we will cover shortly.

Any remaining missiles in midcourse would encounter extremely large, glowing spheres of light, where the EM energy density is contained and held in the spherical shell "energy bottle" of the glowing globes. Each globe might cover an are of up to about 20 degrees, as seen from the Soviet defended area. Missiles carrying MIRV and MARV payloads would not yet have deployed their re-entry vehicles.

As a missile and its payload encounter one of the globular shells, an intense EMP is suddenly experienced throughout the missile and all of its components. Again, EMI shielding is of no consequence since the EMP arises in each increment of spacetime throughout the vehicle volume. The result is instantaneous dudding of all electronic circuitry, including the electronics of the

nuclear warheads themselves. The HE content of the nuclear warhead system is violently exploded, totally destroying the configuration of the warhead. A low-order nuclear detonation may occur, but more likely the warhead's nuclear material is just broken up, finely divided, and set afire.

In addition, all combustible materials are set fiercely afire or destroyed. Explosive materials such as booster propellants and HE explosives are violently exploded. Ablative and plastic materials literally explode into pieces, torn apart by sudden violent ablation and outgassing everywhere within. The remnants of the vehicle are now total duds, as is the payload, including re-entry vehicle, nuclear warhead electronics, nuclear materials from the disruption and explosion of the HE portion of the warhead system, etc.

Still, each piece of the debris must pass through the glowing shell once more before it exits. Thus a second "shot", precisely as effective as the first, still awaits each and every piece of the debris plunging along inside the shell as it exits.

As the debris continues on to the latter part of midcourse and early terminal phase, any portions large enough to track are subjected to small, intense Tesla globes where the energy density in the shell is many orders of magnitude greater than in the larger globe used in earlier midcourse. This part of the defense system simply services each incoming "blob" methodically, probably first in the pulse mode. Later, any blobs still remaining are given the maximum "continuous heating" mode with a small Tesla globe, to actually vaporize metals and materials.

In the unlikely event that anything active still remains, or that an object has managed to elude the large and small Tesla fireballs, a Tesla shield is still to bo encountered, towering over the protected area. For significant targets this shield will be concentric, and will contain three or more concentric Tesla shields. Again, the approaching vehicle will be subjected to multiple EMP's and severe heating throughout its volume. In addition, the concentric shields will "clean up and sterilize any gamma radiation and EMP resulting from any deliberate high altitude defense suppression nuclear burst that somehow (inconceivably!) gets through the launch phase ABM system, and the Tesla-globe midcourse and earl terminal phase defenses.

As can be seen, the system complex represents a most formidable defense **that** certainly approaches 100% effectiveness against the present triad, and even against the addition of cruise missiles.

In addition, since these weapons suffer from very strange constraints and limitations, the scalar transmitters are actually dual mode: they become conventional radars by simply switching into the ordinary EM mode. They arc part of the more conventional ABM defense system complexes we presently recognize in the Soviet Union. In this conventional role, backup ABM missile

interceptors are available, to be employed in case the conventional role must be assumed.

Later we will address the reason for the strange limitations that must be placed upon unqualified use of the large scalar EM systems, particularly in the pulse or "burst" nodes.

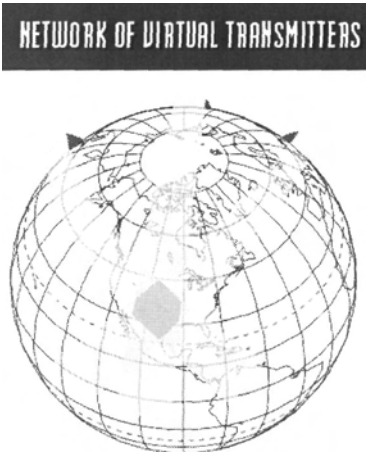

Slide 063: Network of Virtual Transmitters

In July 1976 the U.S. received very special Bicentennial greetings from the Soviet Union.

At that time, communications systems of the world in the 3-30 megaHertz band suddenly met substantial interference from extremely powerful, chirped Soviet transmitters that were suddenly activated. These transmitters continue their transmissions to this day.

Estimates of the power of these enormous transmitters vary, but figures range as high as several hundred megawatts, with a nominal figure being 100 megawatts.

These powerful transmitters were promptly nicknamed "Woodpeckers" because of the characteristic sound of the chirped signal when received. That is, the received signal made a "pecking" sound much like a woodpecker's beak hitting a block of wood.

Several nations protested, but the powerful signals have continued, right down to this day. The only Soviet response was to add a "spread spectrum" capability, so that the transmitter did not dwell too long on one specific frequency, but shifted periodically to other frequencies.

These transmitters have apparently never been precisely located by U.S. intelligence, but their beams carry much of the characteristics of an **over-the** horizon (OTH) radar. They have been dubbed OTH-radars by U.S. intelligence, and can without question perform that mission, in addition to some very interesting missions which U.S. intelligence does not assess.

Soviet Military Power, Department of Defense, 1985, p. 45 shows the direct intersection over the United States of the Woodpecker radar beams used in an OTH-role. We show an illustration of that intersection on this slide.

In addition, we show an additional "scanner" beam that can be scanned across the intersection "grid" over the U.S., formed by waveform interference of two main Woodpecker beams.

These Woodpecker transmitters have a great many diverse functions.

First, they can be used in a conventional over-the-horizon radar node, since their beams follow the earth-ionosphere waveguide and curve around the earth. In this mode they can detect missiles at launch and thereafter, and strategic bombers when taking off and thereafter.

However, these scalar interference grid weapons have many other uses.

First, they can be used to biologically attack entire populations in a targeted area. This aspect is not covered in this briefing. Suffice it to say that phase-locked ELF modulation signals ot 10 Hz and less are often detected on multiple Woodpecker frequencies simultaneously. In a target area, this modulation - if sufficiently stronger than the Schumann resonance of the earth's magnetic field - will entrain a percentage of the brains into "forced entrainment." In that case, these human brains are "synchronized" to the Woodpecker signals so that multiple coherent frequencies are phase-locked into them. That is, multiple coherent EM channels directly into these entrained brains now exist. At that **point,** Fourier expansions may be used to attack specific portions of the brain geometrically.

In addition, scalar EM disease patterns can be modulated upon the carriers, again with Fourier expansions. Specific biological effects can be induced in the entrained populace at will, limited only by the state of the art of the Soviet technology used to attack them. Possible induced effects include instantaneous **death,** heart seizure, severe emotional disruption, loss of control of internal functions, diseases, disabling of the immune system, and even implantation of **thoughts,** emotions, and ideas which are interpreted by the targeted subjects as their own.

While further discussion of this area is beyond the scope of this briefing, the biological aspects of the Woodpecker transmitters are horrible. It suffices to say that, in thousands of experiments, Kaznacheyev demonstrated that almost any **kind** of cellular death and disease pattern could be electromagnetically transmitted. Kaznacheyev reported the effect in the near ultraviolet. Experimenters at the University of Marburg in West Germany duplicated the experiments in the infrared.

The bottom line is that photons themselves can carry death and disease patterns between cells. Scalar E*M* technology allows the synthesis of the actual potential pattern (which after all represents total control of charge and charge distribution,

hence biochemistry in the cell) of a particular cellular disease or death mechanism. Symptoms (and cellular death from them!) of nuclear radiation, chemical poisoning, bacterial infection, and other mechanisms were successfully induced by the Kaznacheyev experiments.

Dr. Popp of West Germany has published an analysis of the virtual photon master control system of the cells. Since scalar EM represents the deliberate ordering of virtual particle flux into deterministic patterns, the master control system can readily be entered with scalar techniques to induce disease and disorder at will.

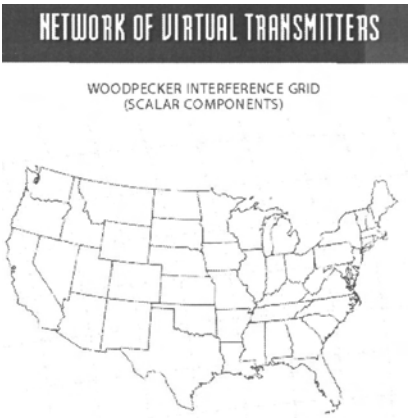

Slide 064: Network of Virtual Transmitters

On this slide we diagrammatically represent the Soviet woodpecker interference grid over the U.S. This grid can easily be used to influence and control the weather, and for over a decade the Soviets have manipulated the weather over the U.S. and other parts of the world.

By the peculiar title of this slide, we wish to call attention to the fact that, in the exothermic mode of scalar interferometry riding on the woodpecker radar signals, each of the woodpecker grid interference cells can act as a little "virtual transmitter." It's exactly as if the Soviets had been permitted to enter the U.S. and build thousands of EM transmitters at regular intervals all over the country!

And of course it's even worse. In the endothermic mode, it's as if the Soviets had been permitted to enter the U.S. and build thousands of "cold generators" all over the U.S. That is, in that mode, each of the "transmitters" can actually extract electromagnetic energy.

These two modes have enabled the Soviet Union to drastically manipulate the weather at will over the U.S. during the last decade (and similarly, for other places as well.)

(For a disclosure of the Soviet weather control operations over the U.S., see T.E. Bearden, Soviet Weather Engineering Over North America, 1-hr. videotape, 1985, available from The Tom Bearden Website www.cheniere.org. We will only summarize here.).

Briefly, inside various reference level zeros on the ordinary EM woodpecker carriers, scalar "channels" are established. Scalar beams, signals, and interferometer pulses and transmissions can be transmitted through these reference channels as if directly through a wire. Phasing, pulse shaping, and Fourier expansion formation of geometric forms are then the key to be used in scalar interferometry through the internal scalar channels of the Soviet woodpecker signals.

By choosing one or more grid cells and using scalar interference there in the exothermic continuous mode, local heating and expansion of the air, and formation of a high-pressure area, occurs.

By choosing one or more grid cells and using scalar interference there in the endothermic continuous mode, local cooling and shrinking of the air, and formation of a low-pressure area, occurs.

By electromagnetic "rotation" of the interfering scalar beams, the hotspots and coldspots can be moved along a desired path and at a desired speed.

By these methods the entire jetstream across the U.S. can be deviated and controlled to a large degree. Moisture can be drawn from the Pacific beyond Southern California and Mexico, and collided over the southern U.S. with extremely cold air brought down from Canada, producing ice storms such as those in and around February 1, 1985.

Violent thunderstorm activity can be induced and directed. By adding "spin", these same storms can be induced to form extensive tornados.

By sustained weather engineering operations, drought or excessive rain and flooding can be induced in areas of the U.S. as desired. Crops can be destroyed or heavily damaged by severe and unseasonal weather.

If the grid is placed in the ground on scalar EM carriers instead of normal EM carriers (and the woodpecker "radars," can switch to, or add, scalar carrier mode whenever they wish), it can be used as an anti-submarine weapon, as we shall see later. It can also be used to cause substantial ocean effects that have drastic consequences on the world's weather - such as the anomalous El Nino of 1982-83.

By localizing one spot of heating at the top of a thunderstorm anvil, and another spot of cooling at its side, a localized downburst can be created. Our weather satellites have detected just such an anomalous combination heating and cooling of thunderstorm anvils over the U.S. While there may exist natural mechanisms to cause this anomalous dual pattern, it may also be caused by Soviet weather engineering, which can cause either broad-area or highly localized effects.

All these types of weather engineering incidents have been deliberately created over the U.S. by the Soviet Union.

Perhaps the greatest weather effects can be induced by altering some of the large-scale normal mechanisms that influence and control our weather. Thus the **artificially** induced El Nino of 1982-83 was a case in point, causing drastic weather upsets worldwide for a year or more.

The last decade has seen weather so anomalous that it could only occur once in 1200 years by chance. It has not been due to normal chance, but by Soviet weather engineering, particularly since the advent of the Woodpecker transmitter complexes.

ADDITIONAL BACKGROUND FOR THE BRIEFER:

The Woodpecker transmitters can carry scalar components, which, in addition to biological strikes, can be used for many other purposes such as to

1. Influence and control the weather,
2. Deviate the giant jetstreams of the upper atmosphere,
3. Detect, track and destroy missiles shortly after launch,
4. Detect, track and destroy strategic bombers and other aircraft,
5. Attack land and ocean surface targets by large aerial electromagnetic explosions: the EM explosion produces the fireball, the thermal effects, and the blast wave of a nuclear explosion without the nuclear radiation and radioactive fallout contamination;
6. Attack surface land and ocean targets by large "cold explosions", where living things freeze almost instantly, leaving the surface facilities and equipment intact,
7. Attack land and ocean surface targets by severe internal electromagnetic disruption, so that all electronics are dudded,
8. Attack personnel on land and sea by direct destruction of their nervous systems with an internally induced strong EMP,
9. Disrupt the operation of distant facilities, equipment, and personnel or destroy food crops in large areas by severe cold or severe heating, or even startling oscillation between the two.

   In addition, the scalar aspects of the Woodpecker transmitters can be beamed through the earth and ocean as surface waves or at a given depth to intersect at a distant region. This mode can be used to

10. Cause distant earthquakes in a distant fault zone by depositing energy in the rocks there, increasing the plate stress until slippage occurs at a fault zone,

11. Cause large, anomalous rocking of an entire plate or large area, by depositing and extracting energy from alternate areas, causing buckling of the large rock plate,

12. Set up an interference grid under the water, so that underwater submarines can be detected, tracked, and destroyed on station and with their missiles still unfired,

13. Attack naval vessels and task forces through the water and through their hulls, without warning,

14. Attack missile silos and nuclear storage sites "before launch", directly through the earth itself,

15. Initiate the full nuclear explosion of implosion-type nuclear warheads on-board missiles on station,

16. Initiate full nuclear explosion of implosion-type nuclear warheads in storage sites and ready reserve,

17. Destroy seaborne and ocean-bottom-mounted mines and underwater sensors, even including entire "fields" of them,

18. Detect and destroy hostile torpedoes, ship-to-underwater anti-submarine missiles, and dumped anti-submarine munitions and charges,

19. "Pump" the electrical grounding of distant electrical power distribution and generation systems so that the system catastrophically fails,

20. "Pump" the electrical grounding of distant electrical power systems so that radio and television transmitters, power grids, and wiring complexes in buildings and facilities radiate a desired scalar wave component or signal complex at equipment and personnel.

All in all, the woodpecker transmitter complexes and other associated scalar EM weaponry are most useful in the major missions required in war.

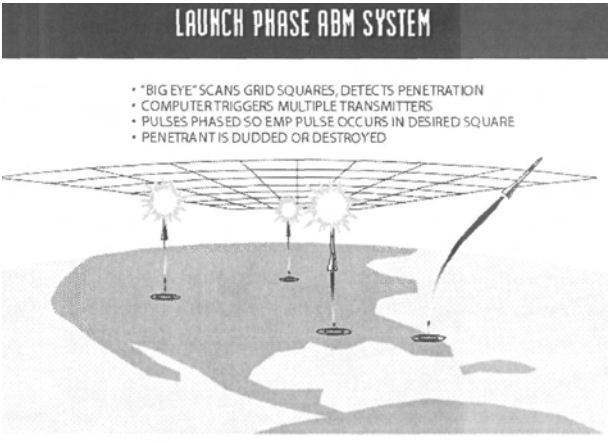

Slide 065: Launch Phase ABM System

On this slide we show the use of the Woodpecker grid in the Launch Phase **ABM** system role.

The scalar components establish an interference grid over the U.S., at some altitude above the earth. One or more separate scalar interferometers transmit through scalar channels established in the Woodpecker's normal EM carriers, scanning through the grid square cells one by one in the "just barely extract energy" endothermic mode.

Back in the Soviet Union, the energy extracted passes through a scanned receiver biased just so that the normal energy extracted from the distant atmosphere does not show on a scanning screen. Any substantial amount of additional energy appearing in the cell - such as from the jet engines of a large aircraft or the rocket exhaust of a large missile - will be detected.

The **operation** of this weapon is four-fold: (1) the scanning interferometer or "big eye" scans the grid squares, detects penetration, and tracks the rising missile. (2) A separate scalar EM interferometer (a howitzer) is controlled by a computer and fired through a separate scalar EM channel opened in the ordinary EM woodpecker carriers. (3) Two timed scalar pulses are fired so that they converge and meet in the grid cell containing the rising missile. This results in the **sudden** emergence of a violent EMP pulse throughout the missile and the surrounding vicinity. (4) All missile and warhead electrical and electronic systems are instantly dudded and destroyed. In addition, fuels, propellants, and

explosives of the missile are immediately ignited, explosively destroying the penetrating missile.

That takes care of the missile target. (The same weapon, of course, can be used against airborne strategic bombers - including Stealth-type bombers. In fact, Gary Powers' high flying aircraft was probably shot down in 1960 by a "jury-rigged" scalar EM howitzer using modified radars and timed scalar pulses to provide an aerial explosion and EMP.)

The Woodpecker grid/howitzer weapon system can be placed over the ocean and used against cruise missiles, naval surface-to-air and surface-to-surface missiles, submarine-launched ballistic and cruise missiles, etc. Placed over a carrier task force, it can also take care of the aircraft launched by the carrier as fast as they are launched. It can also handily take care of the missiles launched by guided-missile cruisers of the accompanying task force.

Now let's take a look at the command and fire control end of this weapon system, way back in the Soviet Union.

SOVIET COMMAND & CONTROL CONCEPT

Slide 066: Soviet Command & Control Concept

On this slide we show a postulated Soviet fire control system for the grid weapon.

Two or more operators sit at a control console, facing a giant display (screen). The display contains a grid, which represents the distant interference grid of the Woodpecker carriers (or scalar EM carriers, if in the underground or underwater mode). A distant missile launched into the real interference grid overhead will cause a spot of light to appear in the appropriate grid square (cell) on the operators' screen. The operators will track the displayed target, select firing mode and type of action, engage the target, and assess whether or not the distant target is killed or missed by the firing.

When a missile is launched in the distant area over which the Woodpecker grid has been placed, it quickly rises through one of the scanned grid cells on its upward journey. As it penetrates the cell, additional energy is extracted (since part of the missile's exhaust energy is now extracted also). At the screen in the Soviet Union, the additional energy received rises above bias, causing a "bloom" or spot of light to appear on the screen at the appropriate grid cell representation.

The distant operator has now detected the missile launch and its location. He places a marker over the target track and activates the computer, also inputting the type of firing or action to be performed. In this case, let us say he wishes a burst of **energy** to emerge inside the distant launched missile, and has activated that mode of firing action.

The computer computes the necessary parameters for another scalar interferometer channel in the exothermic mode, and for firing at the location of the rising missile so that two scalar pulses will meet in the cell penetrated by the rising missile on the other side of the earth. As the channel is opened, the firing solution settled, and the interferometer howitzer readied, the computer activates indicators on the console notifying the operator. When all is ready, a "ready-to-fire" light is lit on the console.

Upon receiving the command to fire and destroy the missile, the operator presses the fire button. The computer fires the activated scalar EM howitzer in the pulse mode. The operator continues to watch his screen.

When the pulses meet in the distant grid cell, a violent EMP suddenly arises in and throughout the missile and its surrounding vicinity. This explodes the missile propellants and warheads, destroying the target.

On the distant screen, a sudden drastic "blossoming" of the target results from the sudden extraction of a great deal of additional energy by the scanning scalar interferometer. The operator thus knows he has made a "kill."

Should for some reason the target be missed, additional energy will still be extracted by the scanning interferometer from the grid cell/vicinity in which the EMP suddenly emerges. The distant operator will still see a bloom on his scope, but not nearly so great as when the missile explodes. He thus knows that the EMP effect of the firing has occurred, but the target has been missed (he will see the bloom in its offset location as well). In that case, the operator can quickly mark the EMP location, hit the switch, and the computer will automatically correct and fire again.

At any rate, for a miss a large "sonic boom" or blast still results in the EMP emergence zone from sudden heating of the air. These are precisely the type of booms that were associated with three NASA shuttle launches prior to the end of 1985. These were actual testing of this weapon system, using the shuttle launches to provide a target, and delaying the burst some minutes so the shuttle would not actually be destroyed. On Nov. 26, 1985 a "marker beacon" (glowing ball of light) was also created over the site. This was probably to orient satellites and other detection systems. Some 12 minutes after that nighttime launch, a large blast occurred over the site, heard for hundreds of miles up and down the coast. Shortly after, the light suddenly moved away very rapidly - faster than a jet aircraft.

If many missiles are being launched, the operator marks them rapidly, one after the other, and the howitzer fires burst after burst at them, decimating the launched missiles, one after the other. In this fashion most of the counterstrike missiles launched by the U.S. would be destroyed shortly after launch, greatly reducing the number of missiles that make it to midcourse.

However, apparently the loss of the shuttle launched on Jan. 28, 1986 was caused by the addition of a metal-softening pattern in the exothermic mode, in and around the booster, using the actual booster ionic flames as a receiver-amplifier. This led to the failure of one of the supports and the partial breakaway of the right booster. The booster rotated into the tank, causing damage and the resulting explosion when the venting main fuel hit the booster flame.

By spread spectrum techniques and proper timing and phasing, one system of Woodpecker transmitters can set up multiple interference grids, in various parts of the world. The scanners and howitzers can operate in the appropriate zones, again by spread spectrum techniques and proper timing and phasing.

In fact, the latest versions probably can operate in the "ordinary EM carrier" (atmospheric) mode and the "scalar EM carrier" (underwater and in the earth) mode simultaneously - again by timed switching between EM and scalar EM carriers, spread spectrum techniques, and timing and phasing of howitzers and Manners.

Thus a single system can operate in the earth, underwater, and atmospheric modes. It can operate against the very wide range of different targets previously mentioned. It can do all this "simultaneously," from a real-time practical viewpoint.

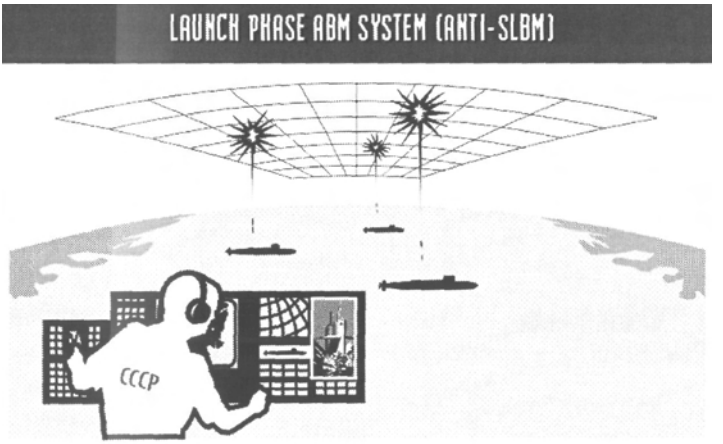

Slide 067: Launch Phase ABM System (Anti-SLBM)

Here we show the operation of the system in the atmosphere over the ocean, to destroy sub-launched ballistic missiles such as Poseidon and Polaris. The system operation shown uses the normal EM Woodpecker carrier frequencies, with scalar components to establish the interference grid, and scalar channels for the scanners and howitzers. The grid can be set up by this method anywhere in the world.

As can be seen, during their early launch phase, this mode will take care of the missiles launched from underwater U.S., British, and French nuclear submarines.

Remember, this is just one mode in which the system is operating. It can at the same time have other interference grids at other locations, and even in other modes, including underwater grids used against the submarines themselves, it can be engaging a multitude of targets of a wide variety of types, essentially all simultaneously.

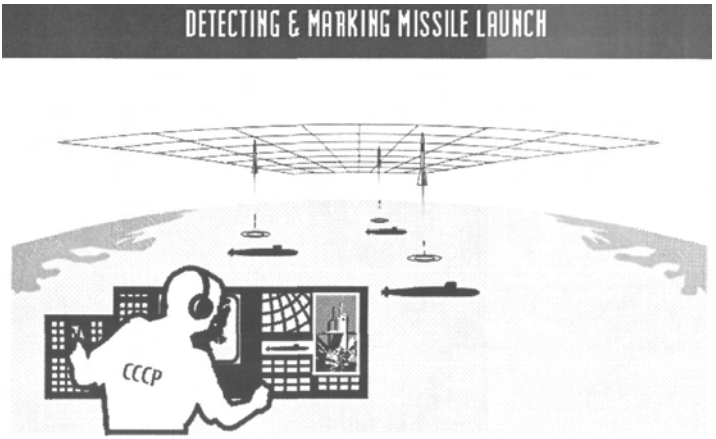

Slide 068: Detecting & Marking Missile Launch

Here we show the missiles launched from the underwater submarines, when just detected in the atmosphere over the ocean. As each rising missile is detected, an operator at the screen places a cursor (a "marker") over the detected track spot on the scope.

The computer quickly computes the firing parameters and indicates when the system is "ready to fire."

By using additional scalar scanner frequencies in the multi-gigaHertz range and fine scanning, the operator is able to accomplish non-cooperative target identification.

After the operator places a cursor over a target, the advanced system fine-scans and identifies it as hostile, then continues the track in automatic.

When the operator presses the fire button for a designated target, the computer intiates fire by the appropriate scalar EM howitzer through established grid scalar firing channels.

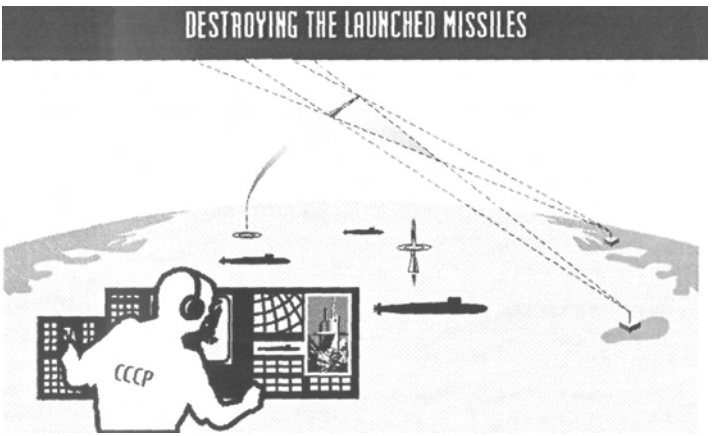

Slide 069: Destroying the Launched Missiles

On this slide we temporarily omit the interference grid and diagrammatically show the operation of the scalar EM howitzer. As shown, two pulses are fired so that they meet in the grid cell where the rising missile is located. A drastic EM pulse suddenly emerges everywhere throughout the missile and its vicinity causing instant missile destruction.

Of course, individual howitzers not in the Woodpecker carrier's scalar channel can also fire at the missiles in the purely scalar exothermic mode. Or they can utilize the large "Tesla globe" in the continuous mode, the small Tesla "ball of light" in the continuous or pulsed mode, etc.

Also, continuous EM energy can be caused to emerge in a broader, "defocused" interference area causing electronic dudding of circuits in vehicles over a wider area. This is a very useful mode to use against mass attacks by many aircraft and/or many missiles at the same time. That is, the entire formation can be attacked in the "dud electronics" mode, and then followed up by more intense servicing of each individual hapless target.

Again, in 1960 Gary Powers was probably downed by a crude prototype scalar interferometer "howitzer" obtained by modifying two ordinary radars. At least the Soviets had previously been unable to down a penetrating U-2 with missiles they possessed. We know the scalar howitzers were in development, for Khrushchev had announced to the Presidium in January 1960 that a new "fantastic weapon" was in development. A development prototype was probably used to down Powers' aircraft.

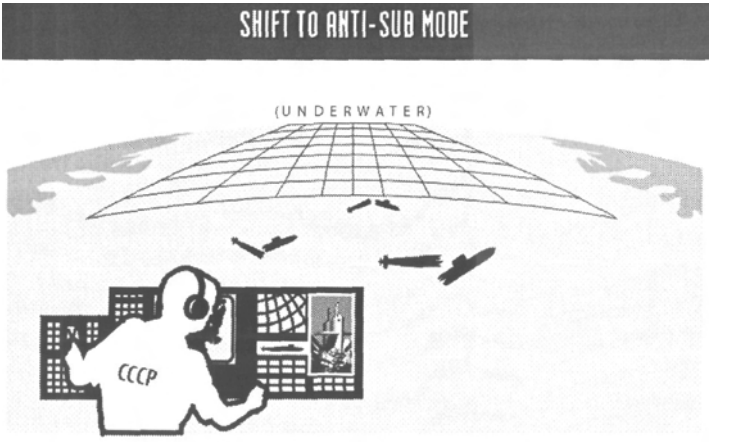

Slide 070: Shift to Anti-Sub Mode

In the underwater mode portrayed on this slide, the Woodpecker transmitters have been switched to "scalar carriers" mode and the carrier beams transmitted through the ground and into the ocean underwater. (Remember, an artificial EM potential that does not couple to charged particles or ions will travel through the ocean, but a force field will not.)

Thus a giant scalar interference grid is now established underwater. Additional scalar beams in the weakly endothermic mode scan this grid. When a submarine enters tne grid, it substantially changes the potential in that cell, and the scanner picks this up. The distant screen now displays the sub as a "track" of light in the appropriate grid square cell. The computer switches in fine-scanning and non-cooperative target identification. It identifies the target as hostile and alerts the operator (by blinking the track and changing its color to red, for example).

As before, the operator marks the target and enters the firing mode and type of action desired. Again, let us assume the "EMP burst" mode of destruction is to be used. The computer computes the firing parameters and readies the howitzer, When the commander gives the command to fire, the operator presses the firing button. The computer fires the howitzer.

Two scalar pulses proceed through the howitzer scalar channel and meet in the submarine. Throughout the sub and its vicinity, a violent EMP is suddenly experienced, knocking out the electrical systems, electronic equipment, and igniting propellants and explosives in the on-board missiles and armament. This explodes the submarine, missiles, and torpedoes instantly.

At the distant command console, the scanners detect the violent eruption of energy from the exploding submarine. It appears on the screen as a sudden strong blossoming of the track. The operator assesses that the target has been destroyed. He immediately engages another target if one is present.

If the EMP is off-course and misses, the scanners still pick up a smaller blossoming in the offset location. The operator immediately knows he has missed the target. He marks the offset bloom, presses the switch for "Correct!" and the computer makes the firing correction. When the operator again gets a Ready-to-Fire light illuminated, he presses the firing button and fires again at the target, this time with corrections applied.

Again, the same Woodpecker system - using timing, phasing, scalar/EM switching and spread-spectrum techniques - may be involved in several grids and many types of targets. When in a target-rich environment, the firing operators may be very busy indeed.

As we shall later see, the same weapon system may also be firing in the "cold explosion" or pused endothermic mode, where intense bursts of instant and severe freezing are unleashed in the target zone.

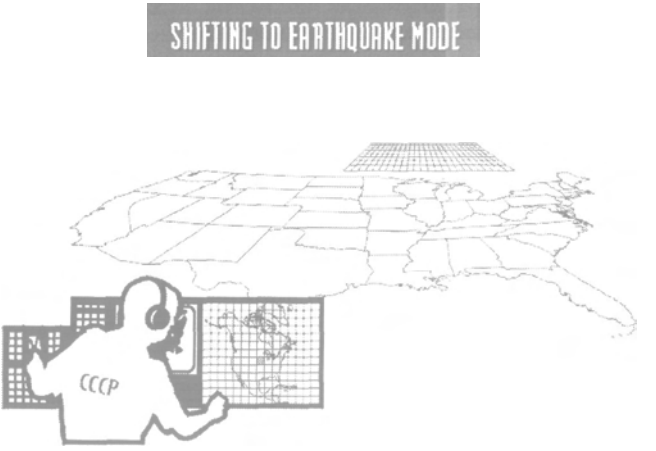

Slide 071: Shifting to Earthquake Mode

The uses of the complex grid, scanners, and scalar howitzers is limited only by human ingenuity and state-of-the-art of the technology developed.

By shifting to the scalar-carrier mode and transmitting in the surface layer of the earth, the interference zone can be established in a distant region of the earth, beneath the earth's surface.

Suppose we establish a very small interference grid in the earth at and around a distant fault zone. Then by steadily depositing energy in the zone in the continous exothermic mode, the stress in the fault area is steadily and gradually increased. Eventually the plates on each side of the fault will slip, and a "natural appearing earthquake" occurs. If the energy is deposited slowly and gently, a gentler quake can usually be effected. If the energy is deposited fairly rapidly, a higher peak stress can usually be reached before the rocks slip, and a larger, more destructive earthquake results.

By making a wider grid in the earth in a larger area, a strange kind of earthquake can be induced, whether or not a fault zone exists in the area. By pouring energy out of alternate cells and extracting energy from the others, a "wave-like" buckling tensile and compressive stress is created throughout the zone. As this continues, the entire plate area will try to oscillate, moving and causing an anomalous sort of "rocking, flat earthquake" throughout a large area.

Not too many days after the destruction of the Challenger on January 28, 1986, such an anomalous "flat earthquake" occurred in the U.S., near the Great Lakes,

involving some 10 states. This was probably the subsequent testing of an additional weapons mode of the same Soviet scalar EM system that destroyed the shuttle.

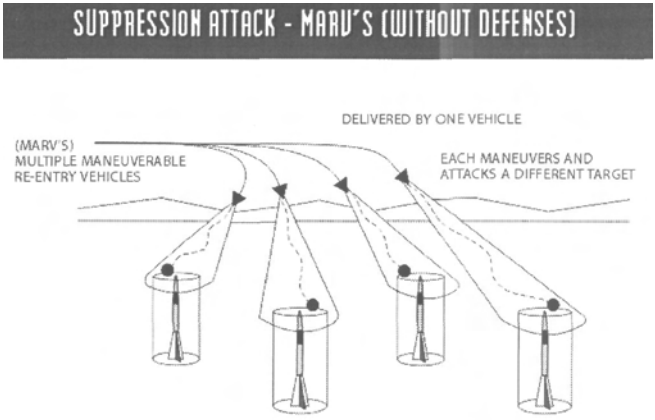

Slide 072: Suppression Attack—MARVs (without defenses)

Now to shift the emphasis a bit, and look at the impact on some "normal" strategic systems and concepts.

On this slide we show the basic idea of suppression attack against an enemy's ground based missile force in fixed-site silos. The attack uses multiple maneuverable re-entry vehicles (MARVs) delivered by a single carrier missile, which acts as a "bus." The bus ejects the MARVs at the appropriate time, and each of the MARVs heads toward its predesignated target, maneuvering as it re-enters the atmosphere and proceeds to the target. The maneuver makes conventional intercept of the MARV by conventional anti-ballistic missiles more difficult.

In this manner, missile silos without defenses may be caught by surprise and destroyed.

The "bus" concept actually multiplies the number of targets a single launched missile can attack, and the maneuvering of the MARV increases the difficulty of defending the target area by orthodox means.

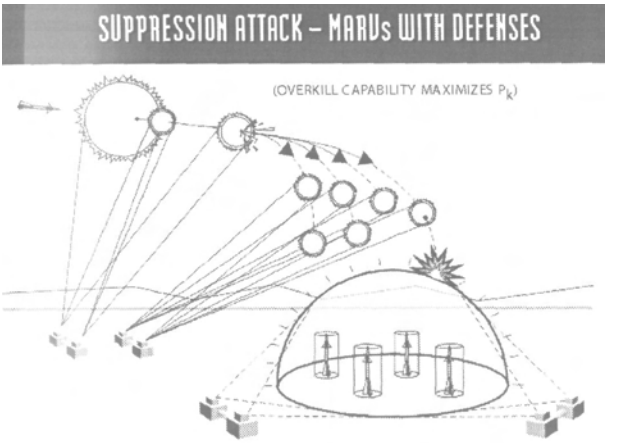

Slide 073: Suppression Attack—MARVs (with defenses)

Now suppose some of the scalar EM defenses we have discussed are added to the picture.

On this slide we show a similar missile field, defended by a Tesla dome and by multiple scalar howitzers.
The howitzers take the incoming buses under attack during the early midcourse phase, by means of very large spherical EMP globes. Many of the buses - and their entire payloads, including the nuclear warheads themselves - are dudded by these midcourse defenses.

Servicing of dudded vehicles that have penetrated the globe now occurs farther along in midcourse. Each dud vehicle may be serviced, for example, with a small globe in the continuous mode for an appreciable number of seconds. This causes vaporization or fusing of the physical structures of the vehicles.

Groupings of incoming vehicles may also be serviced by medium-sized globe in the pulse mode. This assures dudding, and is especially useful for clearing away chaff and debris with smaller ballistic coefficients. It also is useful to further insure that the nuclear warheads themselves are totally dudded.

An additional wrinkle is to place scalar signal patterns - that affect and transmute a nuclear warhead's radioactive nuclei - onto a continuous globe. In short, by the proper scalar signals it is possible to transmute plutonium and uranium into harmless elements, and it can be done at a distance. The 4th and 5th generation Soviet scalar EM technology is probably capable of doing **this**

This insures that, not only are the incoming nuclear warheads electromagnetically inert, but they are also nuclearly inert and incapable of generating nuclear explosions.

Still another wrinkle - particularly useful against implosion-type weapons - is to utilize a scalar signal pattern that causes sudden generation of neutrons in the active material (plutonium or uranium). This harmlessly explodes the nuclear warheads while they are far away from their intended targets and out in space. The burst mode is probably the most useful for this tactic.

Note that, if desired, this same tactic - exploding the nuclear weapons themselves - can also be utilized in the Launch Phase ABM system grid against the missiles after launch. This capability converts an adversary's intended nuclear attack against you to an actual attack against himself!

Also note that the adapted grid system in the surface of the earth can be used to explode the nuclear warheads in ICBMs while they are still in the silos, or to explode nuclear warheads in storage. In the underwater mode, the nuclear warheads in the Poseidon and Polaris missiles on-board the nuclear submarines can be exploded in a similar manner. In fact, the nuclear reactor used to furnish the power for the nuclear submarines can also be exploded or disabled in this manner, as can land-based and ship-based reactors.

Again, this actually turns an adversary's own nuclear weapons against him. His own weapons can be used to obliterate him. Without scalar defenses, possessing the capability of nuclear attack becomes a serious detriment!

But back to our slide. Just in case something gets through this formidable defense somehow, the Tesla Shield (dome) provides the final reiteration that takes care of any residue "leakage."

The sum total of these defenses fully justifies the 1968 Soviet statement in Military Strategy that the USSR has achieved a 100% defense, and the West has

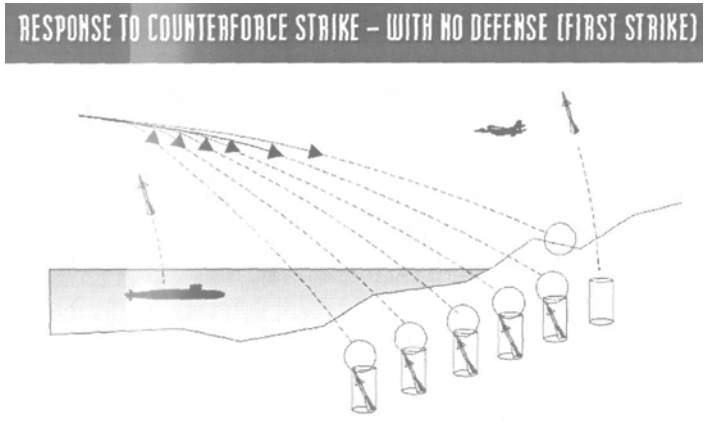

Slide 074: Response to Counterforce Strike with No Defenst

Here we show the orthodox concept of response to a surprise counterforce nuclear strike when the surprised force has no defenses.

A great percentage of the attacked missile silos are destroyed. The surprised side thus is able to mount only a limited strike in retaliation. Perhaps he is able to launch some remaining silo-based missiles that escaped destruction. He is also able to launch missiles from any of his underwater nuclear submarines that escaped. Some of his strategic bombers may have escaped destruction on the ground or while airborne on station; these surviving bombers can be directed to proceed with strategic reprisal against the enemy.

As can be appreciated, this entire concept is now totally obsoleted by the Soviet possession of scalar EM weapons.

The "mutual assured destruction" capability - or MAD concept as it was so aptly named! - is no longer mutual.

And for two reasons: (1) the Soviet surprise attack could destroy essentially all our Triad forces wherever they are, in the first attack. (2) Even if a very small number of our strategic forces survive, the puny strike we could attempt to launch could be repeatedly decimated from launch to terminal phase.

The restraint on the Soviets is not because of our Triad forces. The restraint is twofold: (1) a second nation has scalar EM weapons, and would undoubtedly unleash them upon the Soviet Union with great violence if such a massive

world-wide destruction of U.S. forces occurred or was threatened (is it really "accidental" that six major Soviet missile ammunition storage sites mysteriously exploded within seven months?); (2) the closed-loop scalar radiation exchange system of Earth-Sun could be inadvertently "tweaked" in the feedback loop from Earth to Sun, so that a large solar scalar resonance was stimulated. In that case the Sun could emit a mighty resonant "burp" that would simply wipe out all life on Earth in a fiery shower.

The "terror" in the "balance of terror" between nations has just increased by many, many orders of magnitude.

The biblical prophecy that the Earth will be wiped out by "fire and brimstone from heaven" is very near fulfillment now.

Put another way, the pucker factor - even on the Russians who may contemplate unleashing Armageddon - is higher than any Western strategic analyst has ever imagined, even in his wildest nightmares.

Truly these weapons are "more frightening than the mind of man has imagined," as Brezhnev put it in 1975.

The frightening scalar EM weapons can be used, but only very, very gingerly indeed. If a slight mistake is made, everybody loses everything.

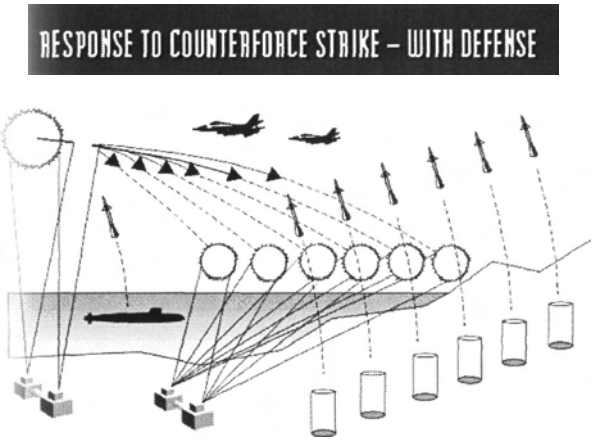

Slide 075: Response to Counterforce Strike with Defense

On this slide we show the impact of scalar defenses against an adversary who possesses only the orthodox nuclear weapons and delivery systems, and makes a "first strike" by surprise against his opponent.

In this case, the attacked opponent has scalar EM defenses.

With just the midcourse and terminal scalar EM howitzer defenses, almost all of the attacking missiles and re-entry vehicles are destroyed.

If for some reason (such as to prevent triggering the sun and destroying the world inadvertenly!) the attacked adversary does not wish to attack strategically with scalar EM weapons, he may now launch a massive retaliatory strike on his opponent.

And if that opponent has no ABM defenses, he's just bought the farm.

What a funny coincidence! Long ago, we crazy Americans chose to put all **our** eggs in the offensive basket. That is, we thought the Soviets cannot dare to strike us because we will have enough surviving missiles to penetrate any orthodox defense and destroy them in return. They would also have the same "mutual assured destructon (MAD)" capability, of course!

The MAD concept was aptly acronymmed - it was an insane idea from its inception. That is, the Soviets were not supposed to defend their cities **and** populace, and neither were we. That way, you see, we could destroy their

citizenry at will, and they could destroy ours at will. We deliberately agreed to that, thinking - in our insanity - that the Soviets agreed also.

Of course the Soviets weren't playing the same lunatic's game at all. They simply fed our own garbage back to us, and we importantly thought we were negotiating something. Unknown to us, they were secretly building and deploying scalar EM defenses even then. Since we didn't know of any other defense, we assumed the Soviets could not defend their citizenry with ABMs any better than we could defend ours with ABMs. So we blithely scrapped our ABMs.

The high government officials of the United States of America grossly violated our constitution and their sworn oaths of office. Our constitution specifically charges the government of the United States to defend the people of the United States. That means our officials are specifically charged with defending our people. Yet they deliberately agreed not to do so, and they deliberately sacrificed us in advance.

They committed treason of the highest kind, by deliberately surrendering us to total destruction anytime the big balloon goes up.

The constitution doesn't charge the government with surrendering our citizens to destruction under any circumstances. It charges the government with defending us against destruction.

Ronald Reagan is the first U.S. president in some time to see through the MAD concept. At least he stands forthrightly for defense. It's just a shame that the government and scientific leaders under him aren't aware of the Soviet scalar weapon developments, so they could brief him on these startling developments.

Be sure you understand what the government leaders before Reagan have been saving. For years, our official policy has effectively said to the Russians: "We will allow each side a token defense only. We deliberately will not defend ourselves, so that anytime you decide to strike us you can destroy us. In return, however, we do not think you will want to strike us, for we believe that - before we become ashes from that strike - we can get enough away at you, to destroy you as well. Of course we believe you are in the same sort of boat."

Then we said, "There! That's settled! What a relief! Nobody can strike anybody anymore. Now can we talk about partial disarmament and on-site inspection?"

The Soviets just kept their astonished amusement to themselves and kept building scalar defenses (and scalar offenses as well!). Their deception plan called for imbedding the scalar EM weapons in ordinary systems when possible, and hiding the scalar EM weapons tests in ordinary weapons tests when possible. Of course they had to be adamant in their opposition to on-site inspection; after all, even Western scientists, if allowed on site with the dual-mode weapons, might suspect something was different and possibly things were amiss.

The Soviet deception has worked like a charm. The U.S. MADmen who created and implemented the MAD doctrine have succeeded in prejudicing two generations of academicians and elected U.S. leaders against the need for effective defense. A vast wasteland of inane paper studies - learnedly dealing with ABM's, penetration tactics, leakage, force and counterforce, radar blackout, electronic warfare, etc. etc. - has been churned out by our military, industrial, and university "think tanks" to clog the minds, efforts, and literature of our defense and governmental establishments.

Our homeland has no effective ABM defense (and very little defense against aircraft or subsonic cruise missiles).

Our field army has no effective ABM defense (or air defense). Our naval forces have no effective ABM defense (although they are better defended against air attack than the field army). Yet ballistic missiles - and to some extent cruise missiles - have supposedly been our greatest threat for decades, followed closely by the secondary threat of massed aircraft attack.

A cynic might take the stand that, if our Defense Department hasn't been allowed to defend us (with deployed weapon systems, not by "paper studies") against what we ourselves have proclaimed is our biggest threat, then why is it called the Defense Department? Why not call it the No-defense Department'?

Understand, a great many fine, hard-working people in DoD have certainly tried to get adequate defenses developed and deployed. The sheer weight of the bureaucracy and its mind-numbing entanglements has prevented it.

But it's even worse. Our bureaucrats - both in government and in "big, organized science" - have been so caught up in the "Russians are really just ignorant peasants" syndrome and the "not-invented-here" (NIH) syndrome that they've not recognized the greatest scientific and technical breakthrough in history. Such a breakthrough - far greater in importance that the nuclear bomb has been made, developed, and deployed by the Soviet Union, all in secrecy and behind the smokescreen of a masterful deception plan.

We've totally missed the most incredible "secret superweapons" development program of all times, and the worldwide testing of the weapons themselves.

Hiroshima and Nagasaki should serve as object lessons in the price of ignorance of such technological breakthroughs.

History does repeat itself. But this time it's not we Americans who got the growl new superweapon first.

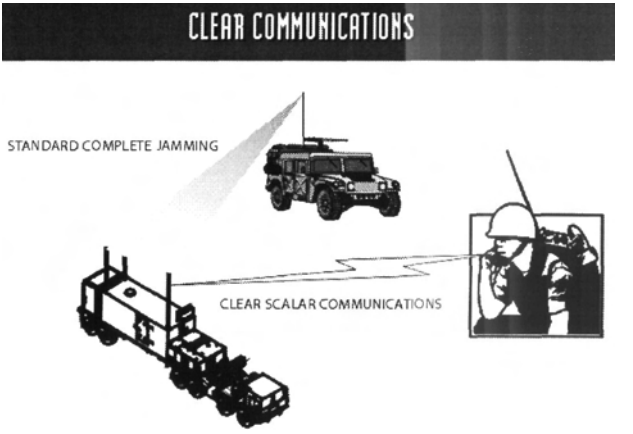

Slide 076: Clear Communications

Now let us rapidly give some unique capabilities that one can do with scalar EM in smaller things. Not only can scalar EM weapons be used in the big "continent burning" strategic weapons, but they can also be used for a variety of smaller defense tasks.

For example, one can establish a zero reference anywhere one wishes in an ordinary carrier. Inside that zero, one can establish as many independent "carriers" as one wishes, and hide them completely from ordinary detectors.

The way to do that is easy. Take as complex a signal as you wish. Subtract it from zero. That gives a "complement" which, when summed with the original signal, will produce the zero. Then only a scalar detector can go inside the zero and pull out the individual components.

So take a carrier wave. Let the enemy jam it completely, with gobs of power.

Your scalar communication channel stays serenely there, calm and unjammed. The enemy thinks you're jammed and can't communicate. Meanwhile, you continue to communicate just fine.

Or be real smart. Take one of those components inside the first zero. Pick a zero reference inside it. Hide still more carrier components inside the second zero. Do this as many times as you wish.

You can put all the telephone calls in the United States of America on one carrier. And you can keep them clear, right through total jamming.

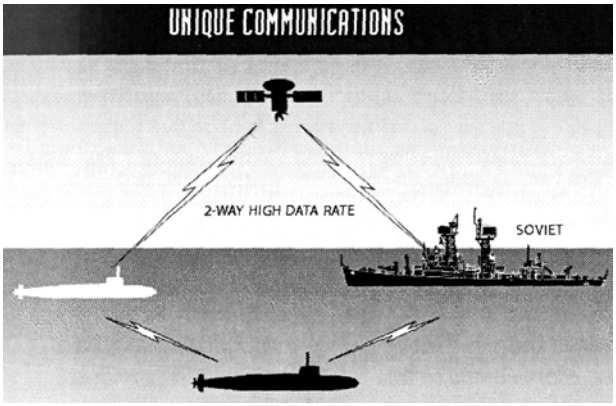

Slide 077: Unique Communications

But that's still not all.

You can also communicate with your submarines underwater. High data rate. Chat away as you wish. You can scramble, frequency hop, encrypt, the works. They can also communicate back to you.

Remember. EM force fields of any appreciable frequency won't travel through the water. Natural EM potentials grab charged particles and ions, so they won't travel through the ocean either. But artificial potentials don't grab onto charged particles or ions, and they will go through the ocean quite nicely.

Everything - aircraft, ships, shore installations, submarines, etc. - can communicate like gangbusters if they possess scalar EM technology.

In fact, you can even build scalar EM underwater radar if you wish.

The airborne scalar EM radar can see under the ocean with a little adjustment. perhaps as well as a conventional side-looking radar sees distant targets today, The airborne scalar EM radar can detect and track the underwater submarine while tooling along.

In fact, the airborne scalar EM radar can then destroy the sub, by using a **little** scalar interferometry. And it's even possible to do scalar interferometry with a single transmitter! How, is proprietary to a friend.

In fact, you can even use your enemy's jamming transmission as a "wire" along which to establish your scalar EM channels. You can use these scalar channels In the "weakly endothermic mode" to locate his transmitter and "lock-in" on it. You can "walk" the lock-in right past his encryption function to the "clear" Input, and receive and record that in the clear. All this from a distance.

You can then destroy his equipment if you wish, or just continue to monitor him in the clear if it's important to do so. Perhaps now we can understand what the decades-long weak microwave radiation of the U.S. Embassy in Moscow is all about. Or why the Soviets are building a nice new Embassy, bristling with antennas, on the high ground in Washington, D.C.

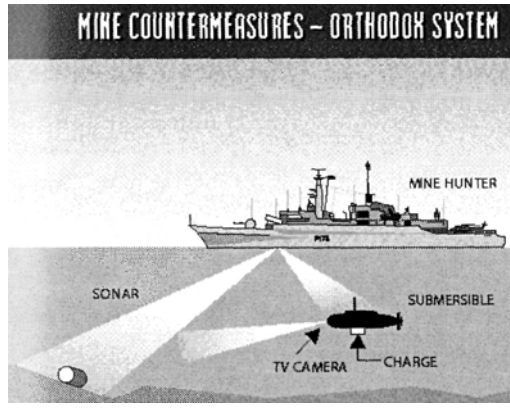

Slide 078: Mine Countermeasures—Orthodox System

Take something like mine countermeasures, for example. Finding and destroying mines - particularly those placed on the bottom in relatively shallow areas such as ports and rivers - is a really tough problem.

Presently it's often done as portrayed on this slide.

Here a minehunter ship uses an underwater sonar to locate the mine, or what resembles a mine. Then it directs a submersible robot vehicle to proceed over to the object and examine it with an underwater television camera. If it's a mine, the submersible places a remotely operated charge beside it, then chugs away. When it reaches a safe distance away, the charge is exploded, causing the mine to detonate.

A very painful process. Very time consuming, and very difficult.

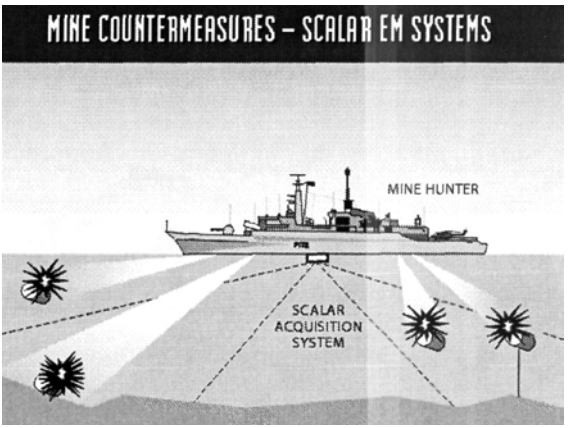

Slide 079: Mine Countermeasures—Scalar EM Systems

Now try the same thing while using scalar EM underwater systems. The scalar EM acquisition system is really a sophisticated scalar radar. It scans a large area rapidly, locating moored mines, bottom-planted mines, and drifting mines.

The acquisition system is also a scanned "underwater eye." The operator in the surface vessel can tell whether or not it's a mine he's located.

Once thc target mine is detected, a computer computes the firing parameters for a scalar interferometry pulse to hit it and destroy it. The operator fires the pulse, destroying the mine.

The same system that detects the mine at a distance identifies and destroys it at a distance. In this way large areas can be quickly scanned and swept clean of mines.

If a suspicious object is detected and one is still not quite sure it's a mine, shoot it anyway! If it's a mine, it explodes. If it's just a rock, nothing happens. So the samesystemcando"discriminationbyfire."

The same system is useful to destroy midget submarines, bottom crawlers, etc.

It can also wipe out whole arrays of underwater sensors by electromagnetically dudding them.

It can take on a sub if it has to! Here it would just gently kindle EM energy inside the sub's controls, causing it to lose control of all its systems. The sub

would then sink to crush depth and implode. The scalar EM mine sweeping system could, of course, simply "blow" the sub, but might itself get caught in the resulting explosion.

SCALAR ANTI-PERSONNEL WEAPON

Slide 080: Scalar Anti-Personnel Weapon

From a military viewpoint, these scalar EM weapons are really quite all-around weapons.

For example, they are very lethal against personnel.

Set in the "high intensity pulse mode," one blast and a person's nervous system is destroyed instantly. Total, instantaneous death results. One can blast away at entire groups of infantrymen, for example. It's the peak power that's important, not the average power. So the weapon doesn't require too much battery power.

Set on a lower intensity pulse mode, one zap can simply knock out a person, rendering him instantly unconscious.

Quite useful if one needs prisoners to interrogate. Also very silent, which is useful in operations employing stealth and surprise.

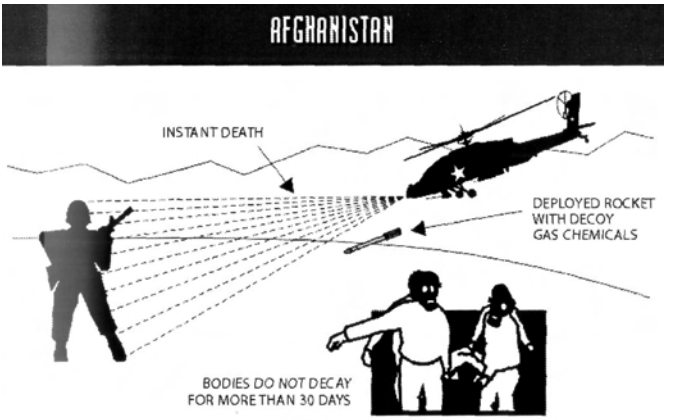

Slide 081: Afghanistan

The Soviets are employing just such a scalar "death ray" weapon in Afghanistan, apparently in the noses of some of their HIND helicopters.

These choppers usually fire gas rockets to camouflage the testing of the tactical scalar death ray. For example, they may fire rockets filled with nerve gas, and some persons will die convulsively from the chemical.

Those hit by the scalar EM weapon, however, have a most peculiar death **mode,**

Death comes instantly and totally. There is no convulsion, no response. The entire nervous system is destroyed instantly. Every living cell in the body is killed instantly, including all bacteria, germs, etc.

A body hit with this thing falls like a limp rag and lies where it falls. It doesn't decay in even 30-45 days. In a macabre fashion, it's been reduced to something like food irradiated with nuclear radiation; everything is killed, so the material is preserved for an extended period before any decay can set in.

Western military authorities have speculated that this strange death is due to some sort of eery new gas.

However, even with the most virulent gas, some seconds are required for a b**ody** to die. And while it's dying it goes into convulsions. Violent convulsions.

This eery, instant death that leaves a non-decaying corpse is not due to a **gun,** This is the signature of a high-powered pulse kill using a scalar EM weapon

The associated gas rockets are the disguise used to fool our intelligence analysts.

They're just part of the Soviet deception plan.

ADDITIONAL NOTES AND REFERENCES

15. For details of the mysterious, instant deaths in Afghanistan, see Yossef Bodansky, "Soviets testing chemical agents in Afghanistan," Jane's Defence Weekly, 1(13), Apr. 7, 1984, p. 508

Slide 082: Scalar Anti-Tank Weapon

Such weapons are also effective against armored vehicles, for example.

They can be carried by personnel, mounted on vehicles, mounted in helicopters, etc.

They are truly all-purpose weapons.

An infantryman with a bazooka-sized scalar EM pulse weapon can easily knock out a tank with one shot. The armor has no effect; scalar EM goes right through conductive shielding and Faraday cages.

And with the same weapon he can knock out another tank, and another, and another...

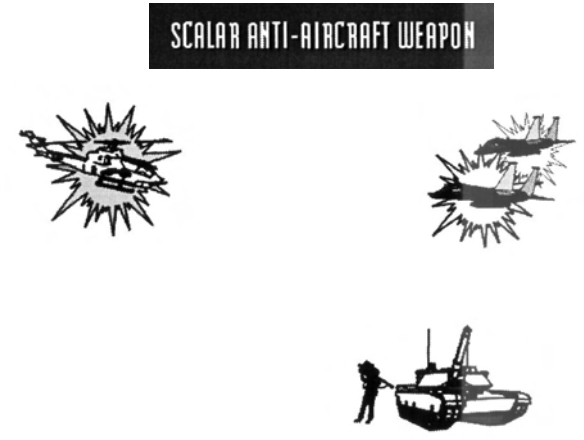

Slide 083: Scalar Anti-Aircraft Weapon

And, if a helicopter or a fixed-wing aircraft attacks him, he can bring the same weapon to bear on it.

He can knock down a chopper or a jet. With one shot.

And another. And another.

Also, it's a line-of-sight weapon. He doesn't have to compute lead angle and all that jazz. Just aim, get the target in his sights, and pull the trigger.

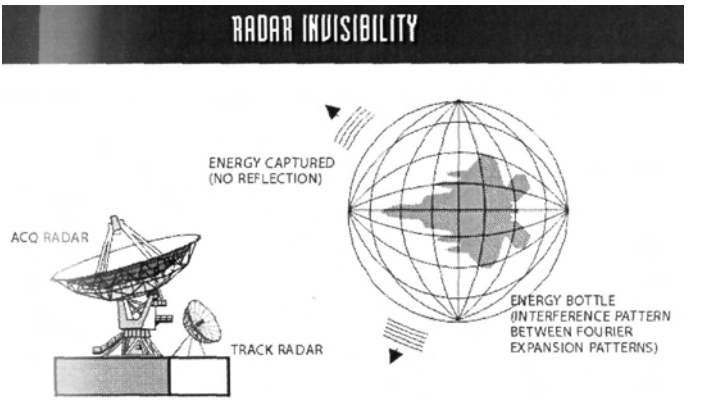

Slide 084: Scalar Anti-Aircraft Weapon

Another neat trick you can do with scalar EM is make an aircraft invisible **to** ordinary radar.

Just use multiple transmitters on the airplane to establish a spherical interference shell, in the bandwidth of the threatening radar, around the aircraft.

When the signal pulse (or continuous wave) from the ground-based radar **strikes** the "energy bottle" in the shell, it interferes with it and is diffracted, scattered, and partially absorbed.

The ground-based radar doesn't get any coherent return pulse or return signal reflected from the target.

Radars don't track aircraft; they track the reflection of their own signal bouncing off aircraft. No reflected signal, no aircraft - as far as a radar is concerned.

To shield against a passive radar (one which tracks emissions from the aircraft), just detect and complement your own emissions so that "near zeroes" result In the spectrum of interest.

Or do both, to protect against both.

It's even possible to cool the exhaust and heated surfaces of the aircraft by a scalar EM adaptation of electrostatic cooling. Theoretically it's even possible to cause the aircraft to "disappear" optically. Takes a bit of doing, but it's possible The basic scheme here is that, when a photon hits the target from a given direction, it's absorbed totally, and a corresponding or "matching" photon is

emitted from the opposite side in the same direction the original photon was going. In that fashion, the light emitted from the target from one direction seems to have "passed through it" from the other direction.

Since that's what empty space does, then what a distant observer sees is "empty space," so far as he can tell.

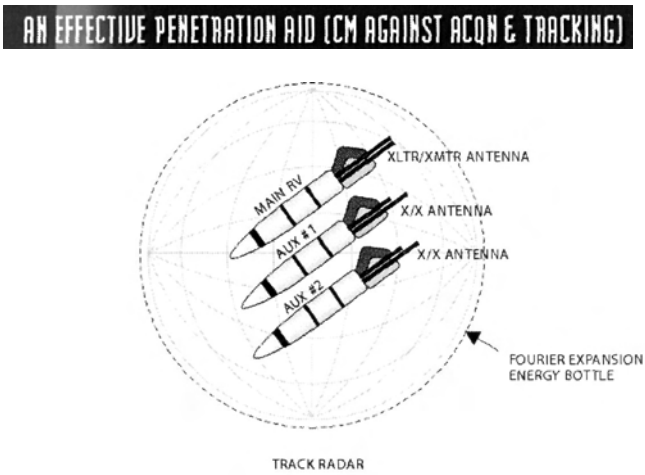

Slide 085: An Effective Penetration Aid

Of course you can do the same thing for re-entry vehicles.

Use some multiple antennas on a vehicle. Or better yet, use satellite RV's to carry the extra transmitters necessary for scalar interferometry.

Deploy the interferometer RV's and activate the scalar EM transmitters. Place an energy bottle Fourier expansion interference shell around the ensemble in the bandwidth of interest.

Radars in that bandwidth now will be unable to detect the incoming ensemble. If nothing detects the threat, nothing is going to shoot at it or react to it.

This can also be used on a bus vehicle during midcourse, for example.

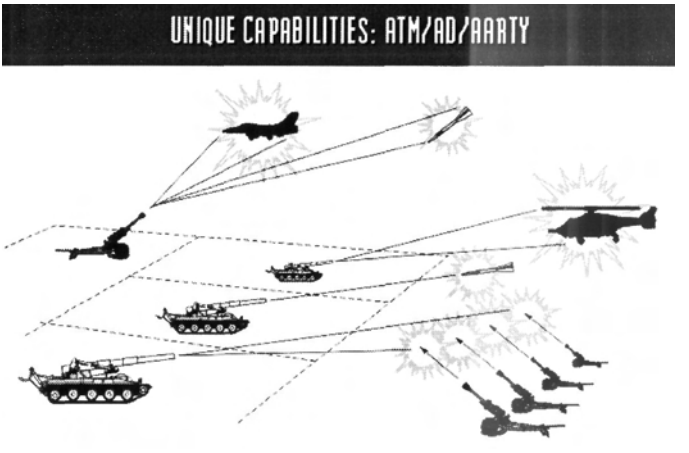

Slide 086: Unique Capabilities: ATM/AD/AARTY

But the uniqueness of scalar EM devices and weapons doesn't end there.

You can hit lots of other threats that are presently difficult or impossible to effectively handle.

For example, on the tactical battlefield, the same scalar EM radar interferometer system can defend against tactical missiles (ATM role), aircraft (AD role), cruise missiles (ACM role), and even artillery and mortar shells (AARTY role).

How the devil, you might ask, can it defend against artillery and mortar shells?

Simple. Sweep the artillery or mortar barrage with closely spaced pulses. Sorta like a machinegun. Or more like a phased-array radar.

If the peak power in the sweeping pulses is sufficient, the explosives are sparked and detonated. Fuses are destroyed.

So even mortar and artillery rounds can be destroyed, by the same system providing air defense and anti-tactical missile defense.

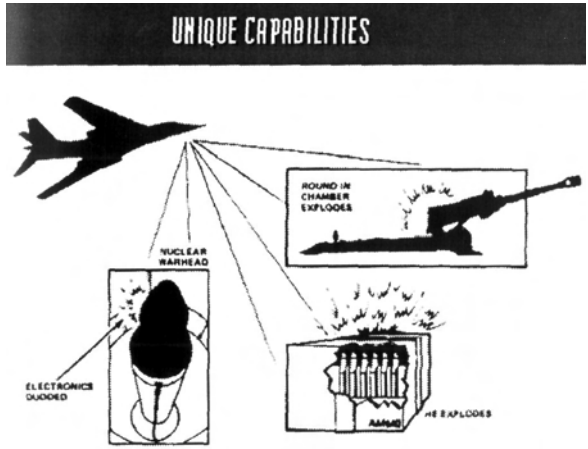

Slide 087: Unique Capabilities

That's still not all.

An incredible number of different types of targets can be attacked with scalar EM weapons.

For example, aircraft equipped with scalar EM weapons can attack targets such as loaded artillery pieces. The round in the chamber explodes, destroying the weapon.

It can also attack nearby stored ammunition. Again, the high explosive in the ammunition explodes, destroying the store.

Even underground missiles can be attacked. The scalar pulse will go right through the overhead cover and dud the electronics, including the nuclear warhead. It will also detonate the HE in the warhead and detonate the fuels and propellants.

A great variety of other targets can also be attacked, as we shall see.

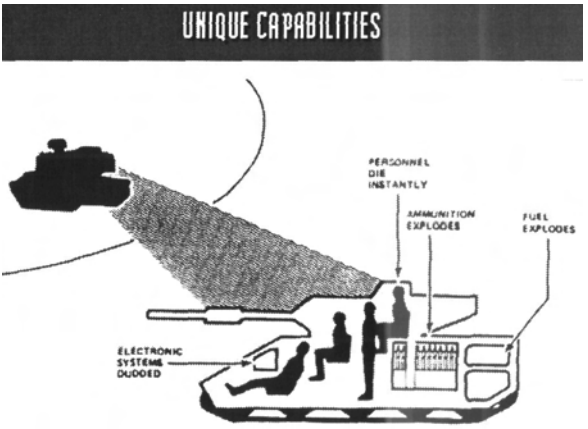

Slide 088: Unique Capabilities

For example, suppose one attacks a tank.

With scalar EM pulse, the personnel die instantly. Total personnel kill is achieved.

All electronic systems of the tank are dudded. Total systems kill is achieved.

The ammunition in the tank explodes. Total kill is achieved.

The fuel explodes. This is another total kill mechanism.

That tank has been killed totally, by a variety of mechanisms, all simultaneously.

That's a k-kill in any analyst's book.

And **don't** worry about retrieval and repair. That tank is finished permanently.

Even **the** most modern tank is just as vulnerable as the most obsolete.

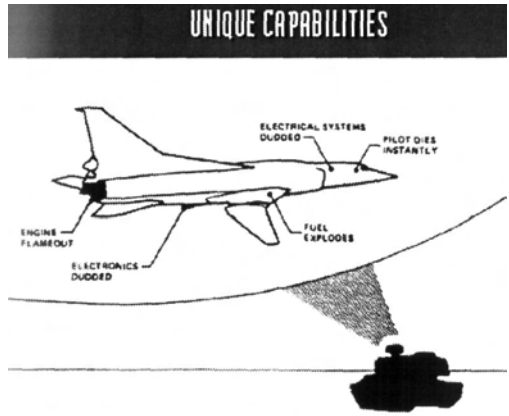

Slide 089: Unique Capabilities

Suppose one attacks a fighter-bomber aircraft.

Again, the kill is catastrophic from multiple simultaneous kill mechanisms.

The pilot and crew die instantly. Total destruction of their nervous systems.

The electrical systems are dudded.

The electronics in all avionics and ordnance is dudded.

The fuel explodes.

HE in on-board or out-board ordnance explodes.

The jet engine flames out if the pulse is powerful enough.

That aircraft is finished. Permanently.

And it's point-and-shoot, line-of-sight.

Even the most modern aircraft is just as vulnerable as the most obsolete.

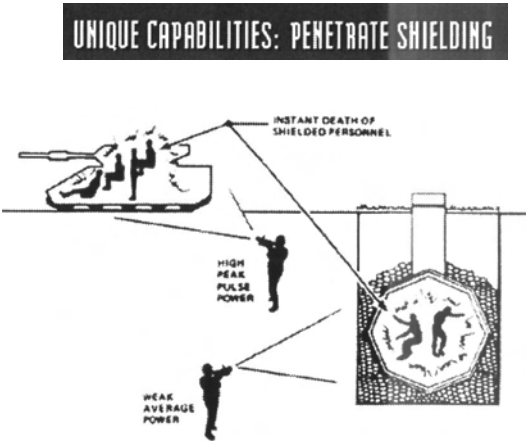

Slide 090: Unique Capabilities: Penetrate Shielding

Shielding is ineffective.

The scalar pulse (or continuous wave) can go anywhere gravity can go.

It penetrates the steel hull of tanks and armored vehicles.

It penetrates underground shelters and bunkers.

It penetrates pillboxes and fortifications.

Foxholes are no protection. Just shoot through the earth into them.

There is no longer any place to hide.

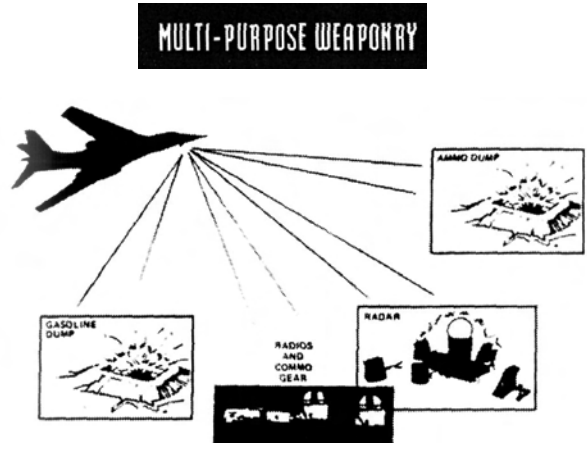

Slide 091: Multi-Purpose Weaponry

These scalar EM weapons are all-purpose. Things such as ammunition dumps, radar systems, radios and communication gear, communications centers, gasoline dumps, etc. can easily be destroyed.

Not only that, but the weapons can be swept, giving area coverage.

You can hit both point targets and area targets.

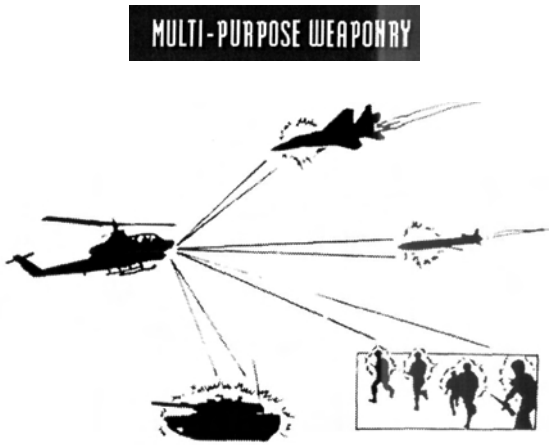

Slide 092: Multi-Purpose Weaponry

Look at what a weapon a helicopter becomes.

The same vehicle, equipped with scalar EM weapons, can engage and destroy jet aircraft, other helicopters, cruise missiles, personnel, and armored vehicles.

It can also hit all the other targets we've been talking about. Any vehicle equipped with scalar EM weapons becomes a formidable destroyer on the battlefield.

And "reconnaissance by fire" takes on a particularly lethal meaning.

For example, don't worry about the enemy in cover and concealment, or highly camouflaged.

Don't worry about decoys or dummy positions.

Just sweep the area with scalar EM fire. The actual targets will be discriminated by fire and destroyed.

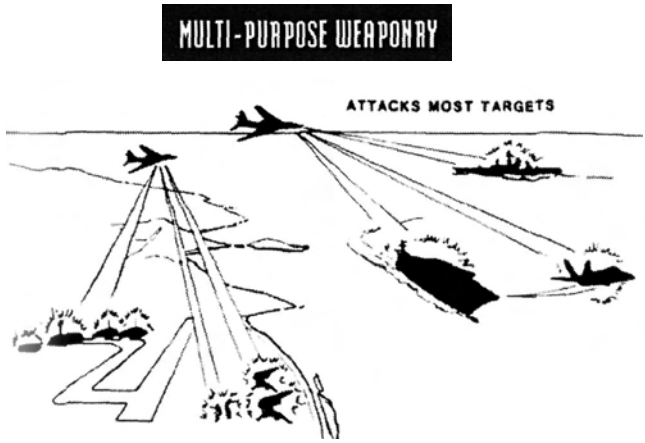

Slide 093: Multi-Purpose Weaponry

As can be seen on this slide, most targets of interest can be attacked.

A single aircraft can sink an aircraft carrier or destroy a battle cruiser from afar.

It can also destroy aircraft, ground installations, artillery, personnel, nuclear weapons storage sites, tanks, vehicles, fuels, and combustibles.

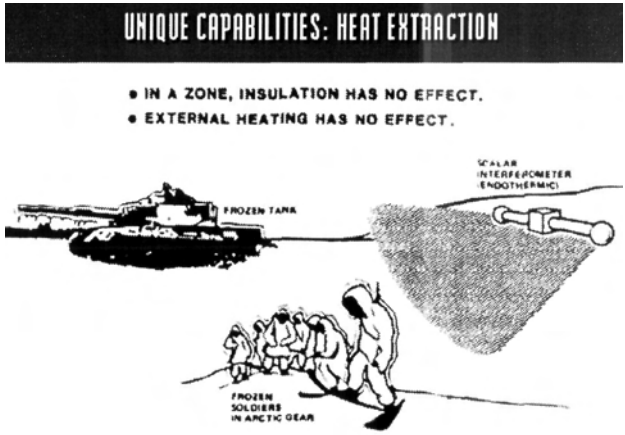

Slide 094: Unique Capabilities: Heat Extraction

Or one can get truly exotic.

To prevent destroying equipment and installations, the endothermic mode can be utilized.

Cold explosions can be used to freeze tanks, personnel, and equipment.

The equipment and tanks thaw out.

The personnel thaw out too, but they are dead when they do. Heaters and arctic clothing are no protection.

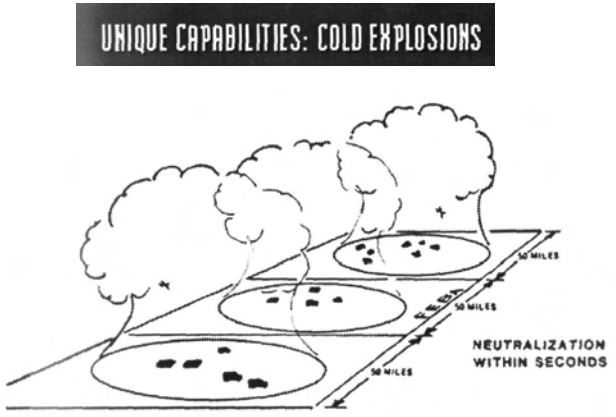

Slide 095: Unique Capabilities: Cold Explosions

For example, suppose three cold explosions, each 50 miles in diameter, are placed upon the front-line strength of NATO.

In seconds there is no longer any "front line strength" of NATO. Every living thing is frozen into a block of ice.

A few more of these things placed on selected rear area installations, and the battle is over before it gets started. Say in about one minute flat!

Suppose NATO is quickly defeated - say in two days. And then the Russians offer us a "Dunkirk." They agree to allow us to evacuate the beaten remnant of our forces.

Are we going to evoke a strategic nuclear exchange, or are we effectively "decoupled" from Europe? Particularly if the Soviets also offer sweeping accommodations to the Europeans, and they accept? If we punch the strategic button, we guarantee our own absolute destruction. (MAD doctrine and all **that,** old chap!)

Whether or not we could do anything to the Russians is a matter of conjecture.

For a demonstration, they could even invite us to launch a couple of missiles, and destroy them over our heads shortly after launch.

And they could take out a few submarines under the ocean, just to make it believable.

And destroy some SAC bombers that are orbiting on station.

Or take out a U.S. Naval Task Force, with a nuclear carrier, as a demonstration that they mean business.

Would a sane President go ahead and destroy us, or accept the Soviet's "Monroe Doctrine" and an "armistice"?

If the Soviets thought he was seriously contemplating ordering a nuclear strike, they could immediately destroy all our nuclear armaments where they sit. Our own weapons would obliterate us!

What would Congress do - after the Soviet Union had demonstrated its absolute power, offered a Dunkirk and armistice, and threatened our total destruction if we "reached for the holster," so to speak - when it realized the President might actually be contemplating evoking assured national suicide?

What would you do if you were a Congressman? If you were the President?

Slide 096: The Transmitter is the Major Weapon

As shown on this slide, with scalar EM the transmitter becomes the major weapon on the battlefield.

Almost every type of target of any importance can be easily and effectively attacked and destroyed or nullified by scalar EM weapons.

Small wonder the Soviets do not discard their thousands of "old" radars!

How effective do you suppose some of their "old" transmitters on their "old" aircraft might be?

What chance do you think SAC bombers would have against thousands of "old" radar-directed gun sites and "obsolete" air defense missile sites?

Could it be that even something like the old SA-1 could be startlingly effective?

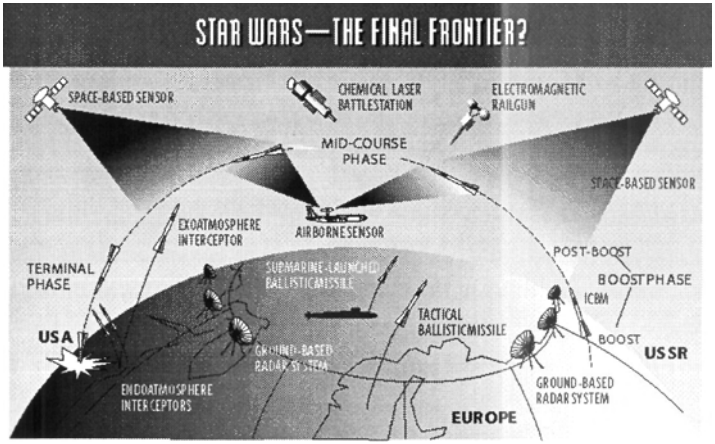

Slide 097: Star Wars—The Final Frontier?

But what of our advanced concepts, such as the strategic defense initiative?

Here we show some of the expensive and complex components of that powerful system.

We have ground-based radars, endoatmospheric interceptors, exoatmospheric interceptors, airborne sensors, space-based sensors, chemically propelled interceptors, electromagnetic railguns, particle beam weapons, high energy lasers, etc. all tied together by a massive command and control system. This massive, expensive system is designed to detect and destroy missiles, including ICBMs, IRBMs, cruise missiles, SLBNs, etc.

The system detects the missile launches and engages them from launch on in to the terminal phase.

Massive systems. Electromagnetic marvels. Nuclear-pumped lasers of staggering power. Perhaps even x-ray and gamma ray lasers. Directed energy RF weapons. Stupendous railguns. Sensors everywhere. Giant webs of communications. Banks of computers and control systems.

And it's totally vulnerable to scalar EM interferometer weapons. Giant scalar EM "radars" can simply sweep through all that like a scythe through standing hay.

As it stands, it's obsolete before its design is even finished.

It's obsolete to Soviet scalar EM weapons that are already deployed and operationally tested in place!

Without scalar EM weapons and defenses, all our present weapons and concepts are deadly vulnerable.

The war is over before it hardly gets started. It's not a war; it's more like a clay pigeon shoot.

Understand, if orthodox science was all the Russians possessed, the Strategic Defense Initiative would be the way to go.

But they do possess something else, and presently they have all the trump cards in the deck.

COMPARISON OF EM CONCEPTS			
CHARACTERISTIC	THEORY		
	CLASSICAL EM	QM VIEW	SCALAR EM (ARTIFICIAL o)
VACUUM SPACETIME	LINEAR NO CHARGE	LINEAR, CHARGED (VIRTUAL) STATISTICALLY	NONLINEAR, CHARGED (VIRTUAL) W/ DETERMINISTIC COMPONENTS
VIRTUAL SUBSTRUCTURE	NONE (FLUID EQUATIONS)	YES STATISTICAL	YES. STATISTICAL. DETERMINISTICALLY WEIGHTED
FORCE IN VACUUM?	CAUSE YES	EFFECT YES	EFFECT NO
ZERO FORCE FIELDS	NO EFFECT	BOHM-AHARONOV EFFECTS	SUBSTRUCTURE EFFECTS, ENGINEERABLE
POTENTIALS	FICTICIOUS	REAL, PRIMARY. STATISTICAL SUBSTRUCTURES	REAL, PRIMARY. DETERMINISTIC SUBSTRUCTURES
CAUSATIVE AGENT	FORCE FIELDS	POTENTIALS	POTENTIALS AND INFOLDED FIELDS OF SUBSTRUCTURES

Slide 098: Comparison of EM Concepts (Chart)

On this slide and the three that follow, we show a comparison of some of the major characteristics of the three kinds of electromagnetics.

We compare the classical, the quantum mechanical, and the scalar EM (electrogravitational) views of electromagnetics

Notice the differences between the three in regards to vacuum spacetime, virtual substructure, force, whether or not force exists in vacuum, the effect of zero force fields, potentials, and what is to be regarded as causative agents.

COMPARISON OF EM CONCEPTS			
CHARACTERISTIC	THEORY		
	CLASSICAL EM	QM VIEW	SCALAR EM (ARTIFICIAL ∅)
CHARGE CONSERVATION	YES	YES	NOT NECESSARILY
ACTION AT A DISTANCE	NO	NO, EXCEPT BOHM-AHARONOV EFFECTS	YES, SCALAR INTERFEROMETRY
SCALAR (ZERO-VECTOR) RESONANCE	NO	NO	YES
INERTIA IS ELECTRICAL	NO	NO	YES
GRAVITY IS ELECTRICAL	NO	NO	YES
MASS IS ELECTRICAL	NO	NO	YES

Slide 099: Comparison of EM Concepts (Chart)

Now note the differing views of charge conservation, action at a distance, scalar resonance, and whether inertia, gravity, and mass are electrical.

COMPARISON OF EM CONCEPTS			
CHARACTERISTIC	THEORY		
	CLASSICAL EM	QM VIEW	SCALAR EM (ARTIFICIAL o)
CHARGE	WITH MASS	WITH MASS	MASSLESS
RELATIVISTIC EFFECTS DUE TO	VELOCITY	VELOCITY, INTERFERING POTENTIALS	INTERFERING POTENTIALS
HIDDEN VARIABLE	NO	STATISTICAL, NEGLIGIBLE	DETERMINISTIC, MAJOR ROLE
VECTOR THEORY APPLIED TO EM	OK	OK	REQUIRES REVISION
VACUUM EM WAVE	TRANSVERSE	TRANSVERSE	LONGITUDINAL W/ SWIRLS
ENERGY/MASS CONSERVATION	YES	YES	NOT NECESSARILY, AN ENERGY CONSERVED

Slide 100: Comparison of EM Concepts (Chart)

Continuing, note the differences in the views of charge, what relativistic effects are due to, whether or not one has hidden variables and whether they are enginerrable, how vector theory is applied to electromagnetics, the nature of the EM wave in vacuum, and conservation of energy/mass.

SUMMARY (1)

- AHARONOV-BOHM EFFECT
  - VERIFIED
  - MESOSCOPIC SCALE (CENTIMETERS)
  - NEED MACROSCOPIC COHERENCE
  - POTENTIAL WEAPON IMPLICATIONS
  - PROBABLE SOVIET WEAPONIZATION
- 6 TO 8 ADDITIONAL ORDERS OF MAGNITUDE NEEDED

Slide 101: Summary (1)

Now we examine the three views for whether or not electro-gravitational waves exist and what they interact with, the number of required spacetime dimensions the type of geometry, the nature of a zero-summed EM vector, local and distant relativity aspects, and whether or not the probability states propagated by the Schroedinger equation can be deterministically engineered.

As can be seen from the last four slides, the three views are quite different, and the scalar EM view is drastically different.

SUMMARY (1)

- AHARONOV-BOHM EFFECT
  - VERIFIED
  - MESOSCOPIC SCALE (CENTIMETERS)
  - NEED MACROSCOPIC COHERENCE
  - POTENTIAL WEAPON IMPLICATIONS
  - PROBABLE SOVIET WEAPONIZATION
- 6 TO 8 ADDITIONAL ORDERS OF MAGNITUDE NEEDED

Slide 102: Summary (1)

In summary, we can now state unequivocally that the Aharonov-Bohm effect has been conclusively proven, at least for the mesoscopic scale over a few thousand Angstroms, and possibly over a few centimeters.

But inthese experimental proofs; the "natural" type of potential has been used, it is basically incoherent in its substructure, dooming the effect to stay small.

By utilizing macroscopic EM force fields and waves to zero-sum and comprise artificial potentials, the coherence can be maintained over a macroscopic distance - even for hundreds of thousands of kilometers.

The weapons implications - only some of which we have set forth in this treatise - are mindboggling.

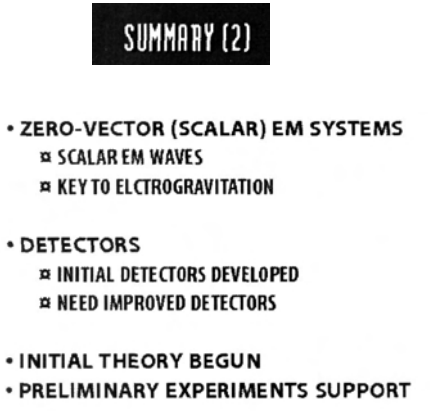

Slide 103: Summary (2)

Zero-vector (scalar) EM systems are the key to scalar EM waves, which are actually electrogravitational waves.
Scalar wave detectors nave been developed and are being improved. Further improvement is needed. This development is limited only by funds.

The initial theory has been begun. More work is needed. Again, this development is limited only by funds.

Preliminary experiments support the scalar EM concepts.

Equipment can be designed and made to work electro-gravitationally.

And it has been.

SUMMARY (3)

- INTERFERENCE PHENOMENA ARE KEY
  - ACTION AT A DISTANCE
  - EXOTHERMIC MODE
  - ENDOTHERMIC MODE
  - 3-D FOURIER EXPANSIONS (TRUNCATED)
- EFFECTS IN/ON NUCLEUS
- NOT ENERGY TRANSMISSION THROUGH SPACE
- SHIELDING INEFFECTIVE

Slide 104: Summary (3)

Interference phenomena are key.

One can get action at a distance - even over hundreds of thousands of kilomcters.

One can engineer gravitational and inertial effects.

One can engineer the nucleus, including transmute it, easily and cheaply. One could clean up all the nuclear wastes.

Electromagnetic energy can be produced at a distant target, or extracted from a distant **target.**

This is is not energy transmission through space in the form of EM force fields. Instead, it is transmission through spacetime in the form of electrogravitational potentials.

Conventional EM shielding is ineffective against scalar EM.

SUMMARY (4)

- MOST SYSTEMS ARE VULNERABLE
  - ELECTRONICS (INCLUDING OF FUZING/WARHEAD)
  - PERSONNEL
  - EXPLOSIVES/PROPELLANTS/FUELS
  - ORDNANCE
  - SHIPS/SUBMARINES/TORPEDOES
  - AIRCRAFT/HELICOPTERS/MISSILES/DRONES
  - TANKS/APCs/WEAPONS CARRIERS/SP ARTY
  - COMMUNICATIONS/SATELLITES/RADARS/C^3I
  - DEW SYSTEMS
  - SURVEILLANCE/SENSOR SYSTEMS
  - MINES/ARTY ROUNDS/NUCLEAR WARHEADS

Slide 105: Summary (4)

Almost every weapon system we presently have - or are developing - is totally vulnerable to scalar EM weaponry.

This includes personnel, electronics (including fuzing and warhead), explosives, propellants, fuels, ordnance, ships,
submarines, torpedoes, aircraft, helicopters, missiles, drones, rockets, tanks, armored vehicles, weapons carriers, self-propelled and towed artillery, communications, satellites, radars, command and control, directed energy weapon systems, surveillance and sensor systems, mines, artillery rounds and ammunition, nuclear warheads, etc.

We are in dire straits. We need a "Manhattan Project" of the highest priority. Now!

The Soviets have already had the equivalent of seven or eight Manhattan Projects in this area.

SOVIET DEFENSE AGAINST MISSILES

"In our country the problem of eliminating rockets in flight has been successfully solved by Soviet science and technology...

It is interesting to note that the problem of anti-missile defense is far from being solved in the West."

SOKOLOVSKIY
MILITARY STRATEGY
THIRD EDITION, 1968

Slide 106: Soviet Defense Against Missiles

Here is a significant statement by Sokolovskiy, contained in Military Strategy, 3rd edition, 1968.

This is not propaganda. The Soviets really do have an effective missile defense. We do not. At the present rate we're going, we may not have one in the year 2000 - if we live that long.

SURPRISE BY USING SECRET WEAPONS

"Each side secretly develops new means of warfare in order to employ them unexpectedly. History knows many examples how the employment of a new weapon initially gave considerable success because the enemy, caught unawares and not knowing the combat capabilities of this weapon, was for some time incapable of effective counteraction."

V. YO SAVKIN
THE BASIC PRINCIPLES OF OPERATIONAL ART AND TACTICS
MOSCOW, 1972

Slide 107: Surprise by Using Secret Weapons

The Soviets took to heart the lesson of our secret development of the atomic bomb. Thrust suddenly upon a fanatical nation, the atomic bomb brought the empire of Japan to its knees.

Other lesser examples - such as the impact of the German V-l and V-2 missiles and jet fighter - also were not lost on the Soviets.

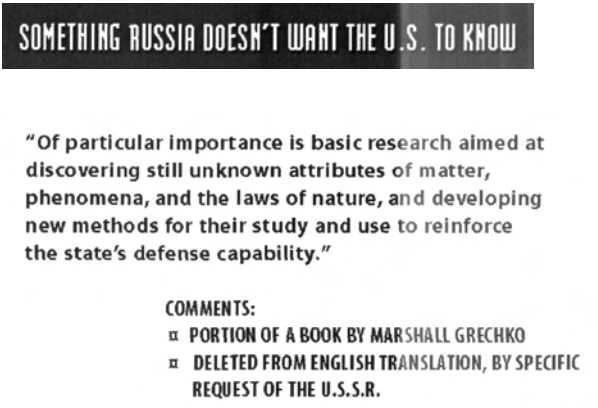

Slide 108: Something Russia Doesn't Want the U.S. to Know

But Marshall Grechko said it even plainer.

He made it clear that the Soviet Union has actively searched for great technical breakthrough areas, particularly in discovering new laws of nature, unknown attributes of matter, and new phenomena, and developing their use for defense.

He made it so clear that the Soviet Union formally requested the U.S. State Departmentto have deleted from its. English translation that portion of his book.

That is a positive signature that the statement is exceedingly sensitive to the Soviets. In other words, it's a real tipoff.

So of course the State Department leaned on the publisher and got that section eliminated.

ADDITIONAL NOTES AND REFERENCES

1. Nikola Tesla, "The Problem of Increasing Human Energy," Century magazine, June 1900, p. 208-209. In this article Tesla spoke of using standing waves to produce distant effects and locate objects such as ships. At this point he was thinking of a scalar radar locator, something more advanced than even our radar today. It was also capable of producing electrical effects at any part of the globe. To quote: "Stationary waves... mean something more than telegraphy without wires to any distance... For instance, by their use we may produce at will, from a sending station, an electrical effect in any particular region of the globe; we may determine the relative position or course of a moving object, such as a vessel at sea, the distance traversed by the same, or its speed..."

2. Nikola Tesla, "The True Wireless," Electrical Experimenter, May 1919, p. 87.

3. T. E. Bearden, Comments on the New Tesla Electromagnetics: Part I: Discrepancies in Present EM Theory, Tesla Book Co., 1580 Magnolia, Millbrae, CA 94030, 1982.

4. T. E. Bearden, Toward a New Electromagnetics: Part III: Clarifying the Vector Concept, Tesla Book Co., 1580 Magnolia, Millbrae, CA 94030, 1983.

5. T. E. Bearden, Toward a New Electromagnetics: Part 4: Vectors and Mechanisms Clarified, Tesla Book Co., Millbrae, California, 1983, p. 6, 39.

6. T. E. Bearden, Solutions to Tesla's Secrets and the Soviet Tesla Weapons, Tesla Book company, 1981

7. T. E. Bearden, Tesla's Secrets and the Soviet Tesla Weapons, 1 hr. 40 min. videotape, Weather Engineering, POB 1472, Huntsville, AL 35807, 1981.

8. T. E. Bearden, Soviet Weather Engineering Over North America, 1-hr. videotape, Weather Engineering, POB 1472, Huntsville, AL 35807, 1985.

9. T. E. Bearden, Star Wars Now! The Bohm-Aharonov Effect, Scalar Interferometry, and Soviet Weaponization, Tesla Book Co., 1984

10. Stefan T. Possony, "The Tesla Connection," Defense & Foreign Affairs, Aug. 1984, p. 12-14, 27.

11. Stefan T. Possony, "Psy-War: Soviet device experiment," Defense & Foreign Affairs Daily, 12(104), June 7, 1983, p. 1-2. Reports on Dr. Ross Adey's investigation of the Soviet LIDA device which is used to bombard human brains with radio waves in the 40 MHz region. Also reports on work by A. S. Davydov of the Ukrainian Academy of Sciences, who discovered how the blood-brain barrier can be penetrated by low-frequency radio waves so that brain cells are affected.

12. Fritz Albert Popp, "Photon storage in biological systems," in Electromagnetic Bioinformation: Proceedings of the Symposium, Marburg, Sep. 5, 1977. Edited by Fritz Albert Popp et al, Munchen, Wien, and Baltimore, 1979, p. 123-149. Dr. Popp has discovered, both theoretically and experimentally, that mitogenetic radiation from cells can be seen as a sort of "waste" from a virtual electromagnetic field with a high coherence. This field has a tendency to become stationary over the whole organism. In addition, it includes the storage of "virtual" coherent photons. (In other words, there is a master EM field with high coherence, stationary over the whole body. This is the cells' master control system. Storage of virtual photons -- i.e., scalar signals -- occurs in this field.).

13. To gain an appreciation of the Aharonov-Bohm effect, see Y. Aharonov and D. Bohm, "Significance of Electromagnetic Potentials in the Quantum Theory," Physical Review, Second Series, 115(3), Aug. 1, 1959, p. 485-491. For an exhaustive discussion of the Aharonov-Bohm effect and a large number of references, see S. Olariu and I. Iovitzu Popescu, "The quantum effects of electromagnetic fluxes," Reviews of Modern Physics, 57(2), April 1985. See also Bertram Schwarzschild, "Currents in normal-metal rings exhibit Aharonov-Bohm effect," Physics Today, 39 (1), Jan. 1986, p. 17-20.

14. For details of the mysterious explosions of six major Soviet missile ammunition storage sites in seven months, see photograph, Jane's Defence Weekly, 2(3), July 28, 1984, p. 92; see also Mark Daly, "Goa and Goblet SAMs in Severomorsk explosion," Jane's Defence Weekly, 2(6), Aug. 18, 1984, p. 224; Derek Wood, "Soviets' northern fleet disabled... 'not viable' for six months," Jane's Defence Weekly, 2(1), July 14, 1984, p.3; Derek Wood, "Six explosions in the past seven months," Jane's Defence Weekly, 2(1), July 14, 1984, p. 3; John Moore, "The aftermath of Severomorsk," Jane's Defence Weekly, 2(6), Aug. 18, 1984, p. 224.

15. For details of the mysterious, instant deaths in Afghanistan, see Yossef Bodansky, "Soviets testing chemical agents in Afghanistan," Jane's Defence Weekly, 1(13), Apr. 7, 1984, p. 508.

16. For details of the Enhanced-V cloud signature of severe weather, see Gary Ellrod, "Dramatic examples of thunderstorm top warming related to downbursts," National Weather Digest, 10(2), May 1985, p. 7-13; T. J. Fujita, "Manual or Downburst Identification for Project Nimrod," SMRP Research Paper No.156, University of Chicago, 1978; D. W.McCann, ., The Enhanced-V: A Satellite Observable Severe Storm Signature," Monthly Weather Review, 111, 1978, p. 887-894.

17. For a good discussion of the modern view of the vacuum, see
I.J.R. Aitchison, "Nothing's plenty: The vacuum in modern quantum field theory," Contemporary Physics, 26(4), 1985, p. 333-391.

18. For a discussion of the ring interferometer experiments related to quantum and gravitational effects, see G.E. Stedman, "Ring interferometric tests of classical and quantum gravity," Contemporary Physics, 26(4), 1985, p. 311-332.

19. For information on self-induced transparency with pulsated light, see E. L. Hahn, Scientific American, June 1967. This is a scalar EM effect. The phenomenon is observed only in insulators, not in conducting materials. A dielectric tends to stop the flow of electrons, thus stopping the bleed-off of the Kaluza-Klein 5-potential as EM force fields. Thus through the insulator or dielectric, an electrogravitational pulse is transmitted. When this pulse emerges from the other side of the

dielectric, then electrons are free to move again and form ordinary EM fields, resulting in resumed EM bleed-off of the KK (Kaluza-Klein) 5-potential. Thus ordinary photons strike the dielectric, changing into electrogravitational waves which transit the opaque dielectric, and these EG waves transform back to EM waves on the far side of the dielectric. Advanced scalar EM application of this effect can make an object optically invisible.

20. For a lucid and profound presentation of the entire subject of elementary particle physics and quantum field theory, see T. D. Lee, Particle physics and introduction to field theory, Harwood Academic Publishers, New York, 1967. Subjects covered include those at the forefront of current research. Chapter 16, "Vacuum as the source of asymmetry," is particularly important. Here Lee concisely covers the idea of degenerate vacuum states, vacuum structuring, and vacuum effects causing symmetry breaking (violation of conservation laws). An excellent coverage of asymmetries and observables is given on p.181-188. For example, whenever symmetry is spontaneously broken, a nonobservable (virtual entity) has become observable. Thus there exist mechanisms for the direct translation between virtual and observable states.

Most engineers are unaware that physics has already rigorously proven (both theoretically and experimentally} that conservation of energy can be physically violated, even by excitation of the vacuum.

However, in the present assumption of a randomized virtual microstructure of a vacuum potential, these broken symmetry effects are individually confined to very small microlevels. For example, on p. 383, Lee points out that the microscopic structure of the scalar vacuum field (i.e., of vacuum charge or "potential") is not utilized.

This of course is reasonable if all vacuum potentials used in particle physics are treated as having a randomized microstructure of virtual particle flux vectors. Since any appreciable directional coherence in such a randomized microstructure could persist only over extremely tiny distances, then the microstructure of vacuum degenerate states has negligible local effects in ordinary macroscopic systems.

In other words, these conservation violation effects would be very difficult to coherently capture and utilize to provide "free energy, emerging from the vacuum."

The randomized momentary coherences, however, are responsible for the violent microfluctuations of the EM fields, well-known in classical electrodynamics. An approach such as taken by Yater or Moray would be necessary to achieve a vacuum energy tap under such conditions. To achieve usable macroeffects, a very large collection of charge or magnetic material, etc. would be required before the probability of usable coherences would become sufficiently large. Therefore this area is neglected in practical physics and engineering.

However, this is precisely where scalar EM is lost in conventional theory and engineering practice. In scalar EM, the coupling together of macroscopic EM force field vectors into a summed zero system means that the vacuum potential's microstructure is now macroscopically ordered by that system. Further, it is sustained during translation through space. In such case, one has produced directional gravitational potential gradients that have macroscopic range and form. Further, by coherently varying the amplitude of the individual components of the zero vector system, a gravitational wave -- a controlled oscillation of the degenerate states or vacuum -- is produced. By processing the EM components, this gravitational wave can be narrowed, formed into a beam, and projected. Two such beams can be interfered, even at a great distance, producing G-interference and causing EM effects to emerge in the distant interference zone. Thus scalar EM profoundly affects quantum mechanics, quantum field theory, particle physics, general relativity, and electromagnetics.

21. For some strong and pertinent critique of present scientific bias, see Ruggero Maria Santilli, Ethical probe on Einstein's followers in the U.S.A.: An insider's view, Alpha Publishing, POB 82, Newtonvllle, MA 02160. Santilli is a highly published physicist and the editor of a refereed scientific journal, the Hadronic Journal. After lengthy attempts to correct injustices within the Scientific system, to no avail, he finally has gone public with his specific charges. Santilli references senior Russian physicist G. Yu. Bogoslovsky, whose 1984 paper "Generalization of Einstein's relativity theory for the anisotropic spacetime," whose research would have been impossible in the U.S. Quoting Santilli: "He would have been discredited, humiliated, and chased out of these institutions [Harvard, M.I.T., and Yale] beyond any reasonable doubt by ample documentation on similar cases." Again to quote Santilli: "Papers bearing the title of 'Generalization of Einstein's relativity' are routinely permitted with human dignity at Moscow University in the U.S.S.R., but they are absolutely inconceivable today at the departments of physics of Harvard University, of the Massachusetts Institute of Technology, of Yale University and of other similar institutions in the U.S.A., as numerous senior scientists would readily testify."

You see, dear reader, there has been a deep scientific conspiracy in the U.S. to prevent any change in the severe restrictions placed on general relativity by Einstein. This has reduced GR to a sort of "special relativity, with only distant perturbations." Specifically, it has excluded scalar electromagnetics and branded as heresy the inconceivable idea that general relativity could be local, and engineerable.

Now you know why the Soviets have been able to develop these monstrous weapons for over three decades while our scientists slept at the wheel. Scientific arrogance and pride has been our greatest enemy.

See also Bryan G. Wallace, "The great speed of light in space coverup," Scientific Ethics, 1(1), Feb. 1985, p. 2-3; "Radar testing of the relative velocity of light in space," Spectrosc. Lett. 2, 1969, p. 361; Wallace, "Letter to the editor," Physics Today, 36(1), 1983, p. 11; "Letter to the editor," Physics Today, 37(6), 1984, p. 15. See M.E. Ash et al, Astron. J., 72, 1967, p. 72. Direct experiments on Einstein's second postulate, in the 1961 interplanetary radar contact with Venus, challenge whether relativity is correct. Variations of over 30,000% of the best possible general relativity fit the MIT Lincoln Lab could generate were measured. The variations were not random but contained diurnal, lunar, and synodic periodic components. See also Bryan G. Wallace, Spectrosc. Lett. 4, 1971, p. 79 for an analysis of published 1961 data on the interplanetary radar contact with Venus that concludes that the data showed a component that was relativistic in the Galilean c+v sense. See also Wallace, "The Unified Quantum electrodynamic ether," Foundations of Physics, 3, 1973, p. 381. which details Measurements strongly challenging the Einstein assumption of the constant velocity of light, and deals with the nature of the ether. See also Thomas E. Phipps, Jr., "Critique of accepted theories of special relativity and electromagnetism," Scientific Ethics, 1(2), Apr. 1985, p. 17-23.

22. For a sample of Soviet scientific freedom from narrow-minded bias in general relativity, see V. I. Denisov and A. A. Logunov, "The inertial mass defined in the general theory of relativity has no physical meaning," Teor. i Matemat. Fizika, 51(2), May 1982, p. 163-170 (In Russian). See also A. A. Vlassov and V. I. Denisov, "Einstein's formula for gravitational radiation is not a consequence of the general theory of relativity," Teor. i. Matemat. Fizika, 53(3), Dec. 1982, p. 406-418. Here we find that the intensity of gravitational radiation and the total intensity determined in the general theory of relativity in accordance with Einstein's formulas depend on the choice of the coordinate system, so that they can be made to vanish or even become negative. [Note by T.E.B.: If local curvature is

engineerable, as in scalar EM, the local choice of coordinate systems can itself be directly engineered. This clearly implies that scalar EM can thus produce either "positive" intensity radiation or "negative" intensity radiation; thus it can "produce energy at a distance" or "extract energy from a distance.]
Continuing with Denisov: This result is a particular consequence of the general assertion to the effect that in general relativity there are no energy-momentum conservation laws for a system consisting of matter and the gravitational field. [Note by T.E.B.: Thus we can have an energy source or energy sink appear in the distant interference region, where matter has been lifted from the Dirac sea and exposed to the highly nonlinear interfering EG fields.]. See also V. I. Denisov and A. A. Logunov, "New theory of spacetime and gravitation, "Teor. and Matemat. Fizika, 50(1), July 1982, p. 3-76. Points out that ". . . the gravitational field in general relativity is completely different from other physical fields and is not a field in the spirit of Faraday and Maxwell." (p. 3, English version).

23. In the Proceedings of the Tesla Centennial Symposium, an IEEE Centennial Activity, Colorado College, Colorado Springs, Colorado, Aug. 9-11, 1984, see Richard A. Blade, "Modification of Maxwell's equations in free space to account for nonzero photon mass and scalar electromagnetic waves," p. 91-92; Jack Y. Dea, "Scalar fields: their prediction from classical electromagnetism and interpretation from quantum mechanics," p. 94-98; Robert W. Bass, "Self-sustained non-Hertzian longitudinal wave oscillations as rigorous solutions of Maxwell's equations of electromagnetic radiation," p. 89-90; T. E. Bearden, "Tesla's electromagnetics and its Soviet weaponization," p. 119-138.

24. To see the limiting assumptions imposed on general relativity that results in the severely restricted "ordinary general relativity" taught in almost all Western universities. see Charles W. Misner, Kip S. Thorne and John Archibald Wheeler, Gravitation, W. H. Freeman and Co., San Francisco, CA, 1973, p. 19-21, 71-72, 367-369. Among other things, these arbitrary restrictions save the conservation laws. When they are removed. the conservation laws can be violated.

25. Several anomalous events -- skyquakes, booms, or earthquakes -- have been documented in Europe. See H. W. Haak. "The Seismic event of November 9, 1983: Earthquake or sonic boom." Seismic Activity in Western Europe, (With particular consideration of the Liege Earthquake of November 8, 1983), Ed. by Paul Melchior, D. Reidel Publishing Co., 1985, p. 215-222. For such events in the United States, see S. Claflin-Chalton and G. J. MacDonald, "Sound and light phenomena," The Mitre Corporation, McLean, Virginia 22102, Nov. 1978.

26. Fundamental experiments were performed by Eotvos et al. in the early 1920s. See R.V. Eotvos, D. Pekar and E. Fekete, Ann. Phys. (Leipzig) 68, 1922, p. 11. Actually a fifth force of nature due to hypercharge may have been found by these experiments. See Ephraim Fischbach et al. "Reanalysis of the Eotvos experiment," Physical Review Letters, 56(1), Jan. 6, 1986, p. 3-6. See also F. D. Stacey and G. J. Tuck, Nature 292, 230 (1981); S. C. Holding and G. J. Tuck, Nature 307, 714 (1984); G. W. Gibbons and B. F. Whiting, Nature 291, 636 (1981); F. D. Stacey, in Science Underground, edited by M. M. Nieto et al., AIP Conference proceedings No. 96, (American Institute of Physics, New York, 1983, p. 285. See also S. H. Aronson et al, Physical Review Letters 48, 1982, p.1306; Physical Review D 28, 1983, p. 476, 495. Also, comparison of satellite and terrestrial determinations of the gravitational field constant reveals significant disagreement: see R. H. Rapp, Geophys. Res. Lett. 7, 1974, p. 35; Bull. Geod. 51, 1977, p. 301.

27. John J. A. O'Neill. "Tesla cosmic ray motor may transmit power 'round the earth: Famed scientist, on eve of 76th birthday, says he has succeeded in harnessing 'penetrating rays' to operate small motive device." Brooklyn Eagle, July 10,1932. Tesla reported he had harnessed "cosmic rays" and caused them to operate a small motive device. Tesla's use of "cosmic rays," however, encompassed scalar EM radiation. Tesla later seems to have progressed to a simpler motive unit. In the Kansas City Journal-Post, Sep. 10, 1933, he stated: My power generator will be of the simplest kind -- just a big mass of steel, copper and aluminum, comprising a stationary and rotating part, peculiarly assembled." A similar type of "gravitational turbine" seems to have been invented by John Bedini.

28. To see just how arbitrary and postulational are present "definitions" of mass and force, see Robert Bruce Lindsay and Henry Margenau, Foundations of Physics, Dover Publications, New York, 1963, p. 283-287. Note on p. 283 that a "field of force" at any point is actually defined only for the case when a unit mass is present at that point. Also see Richard P. Feynman, Robert B. Leighton, and Matthew Sands, The Feynman Lectures on Physics, Addison-Wesley, New York, Vol. 1, 1963, p. 2-4 for a definition of the electric field in the context of its potentiality for producing a force. This problem did not exist for the original foundation of electromagnetic force fields in vacuum, since the vacuum was assumed to be a material ether. With the modern view a nonmaterial ether has emerged, yet the classical electromagnetic theory has not been made sufficiently rigorous in distinguishing "observable" and "virtual" electromagnetic force fields.

29. E. P. Battey-Pratt and T. J. Racey, "Geometric Model for Fundamental Particles," International Journal of Physics, Vol. 19, No. 6, 1980, p. 437-475.

30. Some years ago, Dr. William Tiller produced very important "free A-field" theoretical work which showed waves which did not fall off as $1/r^2$. Interesting theoretical work in scalar wave theory has also been advanced by Dea. See Jack Dea, "Fundamental Fields and Phase Information," presented at the 1985 U.S. Psychotronics Association Conference, Bergamo Center, Dayton, Ohio, July 1985. Dea has formulated an important theory for vacuum EM scalar waves, derived from Maxwell's equations with zero E and B fields. He predicts waves whose intensity falls off with distance as 1/r instead of $1/r^2$, and detection of these waves by various means. He shows simple generators for the waves. Detection is quantum mechanically by electron interference, not by single electrons. Thus such scalar waves will pass through normal Faraday shields. In his theory Dea does not address the question of spin vortexes in vacuum scalar waves. It is the present author's view that all vacuum waves are scalar waves, and the primary distinction between the "transverse" EM wave and the longitudinal scalar wave is simply the presence or absence of spin-vortexes. Indeed, one may argue that the present "vector wave" EM theory can be replaced by a scalar wave theory. In 1903 Whittaker proved that any vector field can be replaced by two scalar fields. See E. T. Whittaker, Proc. Lond. Math. Soc.1, 367, 1903. By implication, since a vector wave is simply a moving vector field, it can be replaced by two moving scalar fields.

31. David Jones, "Israel's Secret Weapon," Weekend Magazine, Dec.17, 1977.

32. John Hutchinson, private communication. Masses of wood, metal, etc. -- some weighing over 60 lbs. -- have been levitated by Hutchinson.

33. For a description and details of the April 9, 1984 incident off Japan, see Daniel A. Walker, Charles S. McCreery, and Fermin J. Oliveira, "Kaitoku Seamount and the Mystery Cloud of 9 April

1984," Science, 227(4684), Feb. 8, 1985, p. 607-611. See also transcription from Japan Airlines flight 036 to Anchorage International Flight Service, 9 April 1984, at 1406 Greenwich mean time, Federal Aviation Administration (FAA) — Alaska Region; Jim Derry, Special Agent, FAA-Alaska Region, interviews with Captain C.H. McDade, Japan Airlines Flight 036, with Captain Cornelis Vander Berg, KLM Royal Dutch Airlines Flight 868; with First Officer Reint Sol, KLM Royal Dutch Airlines Flight 868, and with Captain Mike Howe, Flying Tiger Lines Flight 078, Anchorage Daily News, 10 April 1984, p. A-l; Anchorage Daily News, 12 April 1984, p. A-l; Honolulu Advertiser, 10 April 1984, p. B-l; Newsweek, 30 April 1984, p. 25, Gregg Ripee, "Mushroom cloud sighted off Japan," Los Angeles Daily News, 11 April 1984, p. 1,8; Ross Gelbspan, "Mystery cloud baffles scientists," Boston Sunday Globe, 13 Jan. 1985, p. 1, 14; T.E. Bearden, Soviet Weather Engineering Over North America, 1-hr. videotape, 1985. See also McKenna, Daniel L. & Daniel Walker,"Mystery Cloud: Additional Observations", Science, 234(4775), Oct. 24, 1986, p. 412-413.

34. For a description of the April 11, 1963 anomalous underwater explosion north of Puerto Rico, see Robert J. Durant, "An Underwater Explosion — or What?", Pursuit, 5(2), April 1972, p. 30-31.

35. For details of the loss of the U.S.S. Thresher and the interference experienced by the U.S.S. Skylark, see John Bentley, The Thresher Disaster, Doubleday, Garden City, N. Y., 1975, particularly p. 164. Some of the communications systems of the Skylark experienced temporary failure, but were not disabled, later resuming operation.

36. The Soviet Union has a well-established history of interfering with and destroying aircraft; for example, for a listing see "Soviet and Warsaw Pact air incidents," Jane's Defence Weekly, 3(2), Jan. 12, 1985, p. 58.

37. For details of the anomalous "nuclear flashes" detected by U.S. Vela satellites, see "Scientists Fail to Solve Vela mystery," Science, 207, 1 Feb. 1980, p. 504-506. "Satellite Evidence Shows 'possibility' of Nuclear Test, DOD Says," Aerospace Daily, Oct. 29, 1979, p. 286. "A Flash of Light," Newsweek, Nov. 5, 1979, p. 64-65. "Was It a Nuclear Device?", Newsweek, July 21, 1980, p. 19. "Diverging Views," Washington Roundup, Aviation Week & Space Technology, July 21, 1980, p. 15. Philip J. Klass, "Clandestine Nuclear Test Doubted," Aviation Week & Space Technology, Aug. 11, 1980, p. 67, 69, 71-72. "Debate continues on the Bomb That Wasn't," Science, 209, 1 Aug. 1980, p. 572-573. "Navy Lab Concludes the Vela Saw a Bomb," Science, 209, 29 Aug. 1980, p. 996-997. See also Jack Anderson and Dale Van Atta, United Press Syndicate, "CIA knew South African-Israeli nuclear test was coming," Birmingham Post-Herald, Apr. 26, 1985, p. A5. The latter article repeats the CIA/DIA argument that the Vela incidents represent concurrent South African-Israeli testing of atomic weapons. Taiwan is considered a possible third partner. According to Anderson and Van Atta, a South African navy contingent was "in the area" at the time of the 1979 Vela detection, and Israel and South Africa were cooperating on an atomic bomb project as early as 1966. Apparently U.S. announcement of an impending South African atomic test in the Kalahari Desert in 1977 led to such an outcry that the test was suspended. Anderson and Van Atta cite succeeding visits to South Africa by Israeli scientists, technicians, and defense officials. However, since the actual Vela detections showed some deviations from what would be expected from nuclear tests, one can speculate that Anderson and Van Atta have presented evidence for the development of scalar electromagnetic weapons by two additional countries. One may further speculate that this could reveal what has been checking the Soviets from simply moving against the West with scalar electromagnetic weapons.

Indeed, the mysterious destruction of six major Soviet missile ammunition storage areas within the space of seven months could have been a preemptive measure and warning to the Soviets if they had actually been considering moving against the West. Also, other incidents reported in the South Atlantic may possibly be associated with the program producing the "Vela flashes." For example, see N.W.C. Rutherford, "Unidentified Phenomena," Marine Observer, 51, 1981, p. 186 for a description of a great bluish-white flash and small bolt of lightning, indicating some sort of anomalous electrical discharge, on Dec. 23, 1980 at 2245 hours (10:45 p.m.). Many other anomalous flashes for which no known causative mechanism exists have been detected by satellites. For example, the OSO-2 and OSO-5 satellites have detected about one mysterious short (less than 0.1 sec) flash about every ten orbits, at times when the fields of view of the telescopes were well above the earth. As many as three of the satellite's photometers have detected a flash simultaneously. These flashes must be removed from any discussion of satellite-observed lightning; see J. G. Sparrow and E. P. Ney, "Lightning Observations by Satellite," Nature, 232, 1971, p. 540.

38. For a description of sightings of enormous glowing globes of light deep within the Soviet Union in the direction of Saryshagan, see Gwynne Roberts, "Witness to a Super Weapon?", The Sunday Times, London, England, Aug. 17, 1980. Several incidents were observed by Downie and others.

39. For an artist's conception of a directed energy weapon installation at Saryshagan, see Aviation Week & Space Technology, July 28, 1980, p. 48. For a DOD sketch, see Soviet Military Power, 1985. Obviously classically-trained U.S. military analysts, with no knowledge of scalar interferometry, have not considered the installation as a candidate hyperspatial howitzer.

40. For a description of multiple pilot sighting (from Iran) of an enormous glowing globe of light deep within the Soviet Union, see Central Intelligence Agency (CIA) Information Report No. CO-B-321/15354-66, "Sighting of Unusual Phenomenon on Horizon Near Iranian/USSR Border," Sep. 8, 1966, released on 15 Dec. 1978 under the Freedom of Information Act (FOIA). The sighting occurred at 2142 hours (9:42 p.m.).

41. For details of sighting of the intensely glowing ball of light near British European Airways flight 831 between Moscow and London, see CIA Foreign Intelligence Information Report CO-B-324/33601-76, "Aerial observation of intense Source of Light," Nov. 18, 1976, released on 15 Dec. 1978 under the FOIA. The incident occurred between 1800 and 1900 hours (6:00-7:00 p.m.). The light was observed for 10-15 minutes, until the aircraft had flown past and left the light behind.

42. For other examples of pertinent 1ight phenomena: F. S. Angus and G. Carling, "Optical Phenomenon: Caribbean Sea; Western North Atlantic," Marine Observer, 40, Jan. 1970, p. 17-18; R. A. Holmes, "Unidentified Phenomenon, off Barbados, West Indies," Marine Observer, 40(229), July 1970, p. 107-108; H. K. Dyer, "Unidentified Phenomenon: Western North Atlantic," Marine Observer, 43, July 1973, p.114. For a 1961 double concentric hemispheric shape observed in the Indian Ocean, see Marine Observer, 32, 1962, p. 64. For a particularly significant combination of forms, see Marine Observer, "Unidentified Phenomenon," 48, 1978, p. 21-22. Also, on the night of July 26, 1984 the pilot and crew of a Boeing 747 (American carrier) flying from Tokyo to Fairbanks, near the Kuriel Islands, at 47 5'44" N: 161 00'05" E, noticed a slowly expanding hemisphere of white light off to their left above the horizon. The shell of light continued to expand over a 10-minute

period until ahead of them and to the right. The crew braced for a shock wave which never arrived. Their weather radar saw nothing out of the ordinary. The shell of light had sharp edges and was semi-transparent so that stars became visible through it. (Richard F. Haines, private communication, Sept. 27, 1984). See also Richard Hall, "Aerial anomalies at sea," The Info Journal, 4(3), May 1975, p. 6-9 for an unusual light phenomenon seen in the Caribbean by the R.M.S. Carmania (British). The phenomenon occurred four times at precise hourly intervals, strongly suggesting an artificial origin. See also F. Shepherd, "Cloud: Strait of Gibraltar," Marine Observer, 51(273), July 1981, p. 107-108 for an incident of associated cloud, arch, and anomalous pressure effects. For another significant airline sighting by Japan Airlines flights 403 and 421 of a giant, expanding globe of light on June 18, 1982, in the North Pacific, 100 km. east of Kushiro, see the Asahi Evening News, Tokyo, Japan, June 22, 1982. For additional evidence that nomadic tribesmen passing through Kazakhstan repeatedly observe such gigantic light phenomena in close association with Saryshagan missile test range, and that Soviet deception planners foster the notion of "UFO activity" as a Red Herring, see Robert Jackson, "KGB takes to the flying saucers!", Northern Echo, Darlington, England, March 15, 1984.

43. For details of Khrushchev's announcement of a Soviet superweapon, see Max Frankel, "Khrushchev Says Soviet Will Cut Forces a Third; Sees 'Fantastic Weapon'", New York Times, Jan. 15, 1960, p. 1.

44. See Christopher S. Wiren, "Brezhnev Calls for Accord against 'Terrifying Arms,'" New York Times, June 14, 1975, p. 1, 11. In a major Kremlin speech on June 13, 1975, Leonid I. Brezhnev included a statement that one major concern not covered by existing agreements was "assuming ever greater urgency with each passing day." Calling for a ban on new weapons of mass destruction, the Soviet leader stated: "The level of modern technology is such that a serious danger arises of creating weapons more terrifying than nuclear ones." He stated, "The reason and conscience of humanity dictate the necessity of erecting an insurmountable barrier to the development of such weapons." See also Malcolm W. Browne, "Senatorial Group Received by Brezhnev," New York Times, July 3, 1975, p. 2. Leonid Brezhnev repeated his proposal to a group of U.S. senators on July 2, stating that the capability to develop more terrible weapons was obvious. He emphasized, however, that he "had no particular weapon in mind." Here he may have been deliberately misleading the U.S. senators, to prevent revealing that the Soviet Union had already developed such weapons, and was horrified at their potential for total destruction. E.g., if massive and rapid scalar explosions occur, the linearity of spacetime -- and the orderly flow of time itself -- may be seriously perturbed throughout the earth and its adjacent space. From a general relativistic viewpoint, such an event might well prove catastrophic for the entire biosphere. Boris N. Ponomarev, a Soviet national party secretary, again raised the same issue to a delegation of visiting U.S. congressmen in the Kremlin on Aug. 11, 1975; see Christopher S. Wren, "Moscow Now Pressing Disarmament." New York Times, Aug. 12, 1975, p. 6. At the United Nation's thirtieth session of the General Assembly on Sept. 23, 1975, Foreign minister Andrei A. Gromyko strongly raised the same issue, warning that science can produce "ominous" new weapons of mass destruction. He urged that all countries, led first by the major powers, should sign an agreement to ban the development of these unspecified new weapons. He even offered a draft, entitled "Prohibition of the Development and Manufacture of New Types of Weapons of Mass Annihilation and of New Systems of Such Weapons." The first article provided that the types of these new weapons would be "specified through negotiations on the subject." Because of its fixation on nuclear weapons, the West may have lost its only opportunity to prevent the spread of scalar electromagnetic weapons of power unprecedented even by nuclear arms. Of course, it may also have

been a Soviet ploy to prohibit the U.S. from developing scalar electromagnetics defensive weaponry to counter the massive strategic scalar electromagnetics weapons already developed, tested, and deployed by the Soviet Union. Certainly in 1973 at a secret meeting in Prague with European communist leaders, Brezhnev had laid out a firm statement of Soviet domination of the world by 1985. See "Secret Speech: Did Brezhnev Come Clean?", National Review, 29(8), Mar. 4, 1977, p. 248, 250. Brezhnev's speech contained statements such as: "We are achieving with detente what our predecessors have been unable to achieve using the mailed fist...come 1985 we will be able to extend our will wherever we need to." Brezhnev stated the Soviet Union would control the oceans of the world, 90% of the land, and the air and space above. A front-page Boston Globe article on Feb. 11, 1975 was the first to carry the story. A copy of Brezhnev's secret speech was obtained by British intelligence in 1973, but denigrated by Secretary of State Kissinger. Apparently the first official U.S. reference to Brezhnev's startling speech did not appear until the 1976 National Intelligence Estimate. Although the big intelligence bureaucracies can do a fantastic job with "current intelligence," their record at predicting a drastic change is woeful, precisely because of the political nature of bureaucracies. See "What is Intelligence," Colonel William V. Kennedy et all, Intelligence Warfare: Penetrating the Secret World of Today's Advanced Technology Conflict, with an introduction by Dr. Ray S. Cline, Crescent Books, New York, 1983, p. 8-23. Intelligence Warfare is heartily recommended as the single book which best gives the reader a grasp of modern technical intelligence organizations, capabilities, and operations.

45. For details of Soviet weather engineering operations over the U.S., see Thomas E. Bearden, "USSR: New beam energy possible?", Defense & Foreign Affairs Daily, 13(111), June 12, 1984, p. 1-2. Cloud signature patterns reported in the article have been repeatedly sighted over multiple areas in the U.S. A series of anomalous "hole in the cloud" patterns, possibly associated with early Soviet weather engineering efforts over the U.S., was widely seen in 1967-68. See Weatherwise, 21(4), Aug. 1968, cover and p. 143; 21(5), Oct. 1968, p. 194-195, 204-205; 21(6), Dec. 1968, p. 238-245. Peculiar stationary blocking patterns have also been observed to occur and influence weather over the U.S., leading to severities such as the winter of 1976-77. See K. K. Tung and R. S. Lindzen, "A theory of stationary long waves, Part 1, A simple theory of blocking; Part 2: Resonant Rossby waves in the presence of realistic vertical shears; Part 3, Quasi-normal modes in a singular waveguide," Monthly Weather Review, 107(6), June 1979, p. 714-774. See also T. E. Bearden, Soviet Weather Engineering Over North America, videotape, 1985 for an expose or the physics and some major incidents of major Soviet weather engineering, including details and photographs of cloud signature patterns. See also C. B. Baker, "Soviet Weather Mayhem," Youth Action News, Nov. 1983, P.O.B. 312, Alexandria, Virginia 22313, p. 1-8; C. B. Baker, "Diabolic Soviet Warfare," Youth Action News, Nov. 1984; For a conventional Soviet look at weather modification (possibly intended to mislead the West), see E. T. Protasevich, "Microwave weather modification," Soviet Technical Physics Letters, 7(3), March 1981, p. 114-115. For a downburst mechanism, see Gary Ellrod, "Dramatic examples of thunderstorm top warming related to downbursts," National Weather Digest, 10(2) May 1985, p. 7-13. See Art and Kay Westermann, Weather War — Worldwide, Liberty Bell Books, POB 288, Sedona, Arizona 86336, 1983. See also U.S. Senate Resolution on Environmental warfare, July 11, 1973.

46. For details of the Soviet Woodpecker beams bending around the earth and intersecting over the U. S., see Christopher Chant and Ian Hogg, Nuclear War in the 1980's?, Harper & Row, New York, 1983, p. 71. See also Soviet Military Power, U.S. Department of Defense, 1985, p. 45. The

intersection forms an interference grid. Scalar EM channels added to the Woodpecker carriers then provide a corresponding sca1ar EM interference grid in the scalar area.

When adjusting the scalar interferometry components of the grid, bursts in the interference and discharges of energy as well as bursts of energy extractions occur. This leads to the production of anomalous aerial phenomena such as explosions, rumblings, airquakes, etc. In addition, direct Bohm-Aharonov forces may be engendered in ground structures, shaking buildings and windows, etc. without seismic disturbances. Such anomalous disturbances have been widely noted in the open U.S. press. E.g., particularly see Kenneth F. Bunting and Daniel M. Weintraub, "Mysterious Rumbles Jar Southland," Los Angeles Times, Dec. 8, 1984, CC(II), p. 1,10; Let Scarr, "People shook up over mystery shakes," The San Diego Union, Dec. 8, 1984, p. Bl, 4. Following this and a Dec. series of anomalous aerial disturbances off the Los Angeles/San Diego coast, a sharp and unexpected weather front appeared, racking the area with high winds on the night of Dec. 12, producing widespread damage and power outages. The newly-formed front moved on to produce significant snowstorms in other areas. See Ted Thackery, Jr., "Winds Kill Two, Wreak Havoc as They Sweep Through the Southland," Los Angeles Times, Dec. 14, 1984, MF/Part II, p. 1,8; "Even Tucson gets snow in storm that dumps 20 inches," AP release, Los Angeles Herald Examiner, Dec. 14, 1984, p. A-12. During several months prior to the December 1984 Los Angeles incident, anomalous electrical failures and outages had occurred in the San Diego and Southern California area, possibly due to scalar interferometry adjustments in the Woodpecker grid over the area. For other typical incidents possibly associated with adjustment of the interference grid, see "Who boomed? Odd Noise unnerves Ohioans," Journal, Milwaukee, Wisconsin, Dec. 28, 1982; "Tremors shake Miss. Gulf Coast," Times-Picayune, New Orleans, Louisiana, Feb. 27, 1983; Sandra Skowron, "Sonic boom is just Mother Nature," Beaver Co. Times, Beaver Falls, Penn., Jan 13, 1983; "Booms in Rockland, New York Times, Mar. 1. 1979, Sec. 8, p. 82; "Loud 'boom' unexplained," Star-Beacon, Ashtabula, Ohio, Feb. 21, 1983; Paul Senecton, "The word is now IDENTIFIED," Mail, Hartlepool, England, Feb. 3, 1985: On Jan. 23, 1974 a mysterious explosion over North Wales rocked a 60-mile radius area. Associated anomalous light phenomena were also seen. Hundreds and hundreds of anomalous booms, aerial rumbles, and aerial explosions, many accompanied by flashes or anomalous shaking of ground structures, buildings, windows, etc., have occurred over the U.S. and other Western nations in the 60's, 70's, and 80's.

On occasion, an aircraft at the proper altitude and position can conceivably experience interference in its electrical systems and in its engine combustion processes due to exothermic kindling or endothermic extraction of electromagnetic energy. The combustion processes of aircraft engines produce highly ionized gases in very nonlinear conditions. These can act as strong dephasers and decouplers of the vector EM components of a vector zero summation in a scalar interference zone. Exothermic interference would have little effect on combustion, but strong endothermic interference can result in engine flameout. Anomalous simultaneous failure of jet and propeller-driven aircraft engines sometimes occurs. For high altitude grids, this can result in engine flameouts, but restart and recovery after unusual loss of altitude has dropped the aircraft out of the scalar interference zone. Several candidate incidents over and near the U.S. exist, particularly where power failures were experienced by multiple aircraft. The more usual exothermic case, however, if substantial could result in anomalous loss of control of the aircraft. For a recent candidate incident, see "Jetliner drops 32,000 feet; 400 aboard; 50 are injured," Associated Press release, Huntsville Times, Feb. 20, 1985, p. 1 and "China Airlines Pilot Denies Cockpit Error," Associated Press release, Huntsville Times, Feb. 21,

1985, p. A-9. Deliberate use of this effect as an anti-strategic-bomber weapon capable of destroying bombers at or shortly after takeoff is possible (the Arrow DC-8 which crashed just after takeoff from Gander Air Force Base, Newfoundland on December 12, 1985 may have been deliberately interfered with by just such a Soviet weapon -- see extensive newspaper and TV news coverage of that event).

In scalar EM interference with aircraft, certain signatures may occur. Different instruments may sharply contradict each other, since their activation and inactivation is no longer a simple function. The pilot's instrument panel, for example, may indicate failure of the control system, when actually it has not failed, and the flight recorder may record that the control system is still operating. In such case, the pilot may take proper action based on his own instrumental readings, yet these actions may be contraindicated for the actual status of the aircraft, resulting in opposing pilot/autopilot actions. Tentative indications of the jetliner that anomalously dropped 32,000 feet and recovered are that apparently such anomalous instrument disagreements occurred. Another signature is that, as the EM charge accumulates in and on the aircraft, its skin charges up electrically, producing a glowing corona similar to St. Elmo's fire. The Arrow DC-8 was observed to be glowing yellow by eyewitnesses, according to the Canadian Broadcast Corporation's 10:00 p.m. network TV news on April 8, 1986.

47. T. E. Bearden, Star Wars Now! The Bohm-Aharonov Effect, Scalar Interferometry, and Soviet Weaponization, Tesla Book Co., Millbrae, California, 1984, p. 19-22.

48. For a paper possibly related to the first Bedini scalar wave detector from the "free A-field is a scalar field" view, see Robert R. Lewis, "Aharonov-Bohm effect for trapped ions," Physical Review A, 28(3), Sept. 1983, p. 1228-1235. This paper analyzes the role of the Aharonov-Bohm effect for the bound states of a charged particle in the superposition of two fields: a uniform magnetic field plus the vector potential of a solenoid. Gives exact solutions for a solenoid of zero size and discusses the corrections due to a solenoid of finite size. Shows that a series of new "betatron resonances" appear in the spectrum, dependent on the flux quantum number. The fundamental betatron resonance remains narrow and unshifted for solenoid radii large enough to broaden and shift the cyclotron resonance. See also W. Ehrenburg and R. E. Siday, Proc. Phys. Soc. London, Sect. B62, 1949, p. 8 which, among other things, discusses the effect of the vector potential in electron interferometry, where the insertion of a tiny solenoid between the interfering paths is shown to give an additional phase difference proportional to the flux through the solenoid. The resulting shift in the fringe system is called the Aharonov-Bohm effect.

49. Frank Golden has developed a most important and precise scalar EM detection system to display scalar EM signals on a cathode ray tube. His important measurements have mapped the scalar resonant frequency responses of the entire earth. Two completely different types of scalar instrumentation show precise agreement on the frequency maps. The measurements show that the Soviet Union has for some time entrained the entire earth into giant scalar electromagnetic resonances on two frequencies approximately 12 kilohertz apart. It is the opinion of the author that the beat frequency between these two giant resonances is utilized by the Soviet Union to extract enormous power from the earth, essentially by a mechanism that Golden has uncovered. A complex of four to eight weapon systems might reasonably be powered from the single bi-resonant tapping source. In April 1985 Golden discovered the rather sudden activation of many other scalar frequencies with characteristics resembling command and control communications. In addition, a significant number of additional paired scalar resonances had been entrained upon the earth. It is the

opinion of the author that this showed a major activation of the Soviet strategic scalar electromagnetic defense system, with the power up of from 80 to 100 weapons, along with the complete command and control system. Golden has previously built a prototype of an actual Soviet scalar communications system and demonstrated that it works. Because of the impending mayday and the 1973 statement by Brezhnev indicating that 1985 was a critical planning year, the sudden activation of such massive numbers of weapons and communications was alarming. Accordingly, the author discreetly notified certain contacts to alert the U.S. system. Golden then detected the periodic turn-on and turn-off of the systems, indicating a large command and control exercise rather than preparations for direct tactical use. An additional difference, however, was the change from scalar electric to scalar magnetic field on many of the large transmitters. This is indicative of electrostatic location, targeting, and adjustment of the target on the earth and then switching to the "power input" mode. It is the opinion of the author that this indicated the choice of a geological target and proceeding to attack that geological target in the "slow buildup" mode. Again, proper contacts were so notified.

50. A very good coverage of the Soviet microwave radiation of the U.S. Embassy in Moscow is given in Paul Brodeur, The Zapping of America, W. W. Norton & Co., New York, 1977, passim. None of our U.S. Embassy security personnel knew of scalar interferometry, nor did they possess scalar electromagnetics detectors. Further, orthodox U.S. scientists were also ignorant of scalar electromagnetics. The Soviets were thus in a position to tailor the radiation signals and precisely determine what our on-site personnel would detect. Details of the effects on U.S. Embassy personnel, possibly associated with the microwave radiation, are given by Brodeur. A great number of related releases by the open news media also exist. For example, see Robert C. Toth, "Radiation Devices Bug U.S. Embassy," Huntsville Times, reprinted from the Los Angeles Times, Feb. 8, 1976; "U.S. Screening out Soviet 'Listening Rays'," United Press International release, Washington D.C. Star, Feb. 11, 1976; Norman R. Beebe, "Nixon Exposed to Radiation In Russia?", Associated Press release, Huntsville Times, Apr. 30, 1976; Barton Reppert, "U.S. Scientists Puzzled Over Embassy Radiation Effect," Associated Press release, Huntsville Times, May 28, 1976; Barton Reppert, "Radiation Entering Embassy in Moscow through Phone Line," Associated Press Release, Huntsville Times, May 28,1976. See also Martin Ebon, Psychic Warfare: Threat or Illusion, McGraw Hill Book Co., New York, 1983.

51. For details of the electromagnetic transmission of cellular disease and death, see Vlail P. Kaznacheyev, "Information function of ultraweak light flows in biological systems," Problems in Biophysics, Novosibirsk, 1967, p. 7-18. Kaznacheyev et al, "Conditions necessary for appearance of distant intercellular interactions after UV-radiation," Bulletin Experimentalnoy Biologii i Meditsiny, (5), 1979, p. 468-471; Distant intercellular interactions in a system of two cultures connected by optical contact," Ultraweak Luminescence Biology, Moscow, 1972, p. 224-227; "Distant intercellular interactions caused by UV-radiation," Photobiology of a Living Cell, Leningrad, 1979, p. 221-223; "Studies on the biological role of electromagnetic emission as a factor of adaptive behavior of cells under conditions of latitude changes," Abstracts of the second all-union conference devoted to the problem of human adaptation to different geographical, climatic, and labor conditions, Novosibirsk, 1977, p. 101-104; Vlail P. Kaznacheyev, S. P. Shurin and L. P. Mikjhailova, "Distant intercellular interactions in a system of two tissue cultures," Official Bulletin of the committee on inventions and discoveries affiliated to the council of ministers of the USSR, Discovery no. 122 (19), 1973, p. 3, also printed in Psychoenergetic Systems, 1(3), Mar. 1976, p. 141-142; "Apparent Information Transfer

Between Two Groups of Cells," Psychoenergetic Systems, 1(1), Dec. 1974, p. 37.

52. For evidence of anomalous scalar reflection out of the scalar grid caused by a Navy chaff drop, See "Navy sabotages traffic lights, TV sets," United Press International, PM cycle, Jan. 11, 1985; "Power blackout blamed on anti-radar particles," United Press International, AM cycle, Jan. 11, 1985; "Power Disrupted Briefly After Navy Plane Drops Metallic Strands," Associated Press, AM cycle, Jan. 16, 1985.

53. A good summary of the early incidence of the Soviet Woodpecker signals is given by Bradley Wells, "The Russian woodpecker: a continuing nuisance," CQ, Nov. 1984.

54. A particularly important Soviet Paper is E. B. Smetanin, "Electromagnetic field in a space with curvature -- new solutions," Soviet Physics Journal, 25(2), Feb. 1982, p. 107-111. In this paper, a solution to the stated problem is obtained, which may be regarded as a classical model of a charged particle that has both a magnetic moment and a nonzero magnetic charge density. Interaction with spacetime curvature can disrupt the gauge invariance of the EM field, and it can also reestablish invariance in an initially noninvariant theory. (Hutchinson has had anomalous breaks of metal caused by standing scalar waves, which seems to be due to a mechanism that produces monopoles and deposits them in the metal at standing-wave nodes. This paper should be directly applicable.)

See also Yu. S. Vladimirov and A. A. Kozlenkov, "6-optics and a general theory of gravitation and electromagnetism," Soviet Physics Journal, 27(12), Dec.1984, p. 1039-1041; V. G. Bagrov and M. D. Noskov, "New exact solution of the Dirac equation. XI," Soviet Physics Journal, 27(12), Dec. 1984, p. 1030-1034. See particularly V. I. Petukhov and I. A. Kuzin, "Weak processes in the field of a gravitational wave," Soviet Physics Journal, 27(12}, Dec. 1984, p. 1025-1029.

In the latter paper it is significant that the decay probability increases in a locally curved spacetime, and that solutions are obtained for circularly polarized waves.

(In EM waves, circularly polarized waves have special characteristics in nonlinear isotropic media: exact solutions exist. Also, when two longitudinal sine waves of differing frequencies are transmitted into a nonlinear isotropic medium, the apparent difference frequency is transmitted as a sine wave, undistorted. This characteristic has been used by Westinghouse to produce improved sonar transmission through seawater, for example. The scalar EM (electrogravitational) wave may be represented as a longitudinal EM wave. Immediately, if one wishes to produce a pure scalar EG wave in the nucleus of an atom, two frequencies should be transmitted such that their difference is the frequency wished. Or circularly polarized waves may be utilized.)

Note that, by implication, one should be able to deliberately tailor scalar EM waves to greatly speed the decay of long-lived radioisotopes, such as are contained in radioactive wastes from nuclear reactors and other processes.

55. For some evidence of continuing persistence of the higher frequency scalar components applied to the scalar grid on Jan. 28, 1986 to localize the effects when attacking the Challenger, see "Poison suspected in unexplained deaths of birds," Huntsville Times, AP release, Feb. 6, 1986. From 1-4 Feb.

1986, various kinds of dead birds -- such as blackbirds, cardinals, sparrows and bluebirds -- plummeted to the ground in Birmingham, Alabama. At first some sort of mysterious poison was suspected, but later was ruled out. During this period, the woodpecker grid was particularly active in weather engineering operations. Multiple sightings of giant cloud radials occurred in various places throughout the U.S. The retention of the high frequency components possibly was intensified in the Birmingham area sporadically during the period. Birds flying into this zone would be killed if their brains acted as scalar receivers and were sufficiently jammed by the signals. Normally Huntsville (further north) is a "hinge point" for increased scalar activity, to start the Jetstream bending northeast to move along the Appalachian mountain chain. However, just before 28 January the jetstream had been diverted further south than usual by the Soviet interference, bringing unseasonably cold weather to Florida and the waiting Challenger on its launch pad. Probably hinge points further south than Huntsville were needed for this operation. If these more southern points were retained for a few days, and the high frequency components were retained, then an inadvertent high intensity area of these components may have sporadically occurred in the Birmingham area, killing the birds.

For description of the Apr. 18, 1986 Titan blast and its ramifications to the spy satellite program, see James Gerstenzang and Ralph Vartabedian," Los Angeles Times News Service, "Titan Blast to Hurt Spy Program," Huntsville Times, Apr. 19, 1986.

56. For another very important paper indeed, see Vu. G. Ignat'ev, "Relativistic kinetics of an anisotropic plasmalike medium with damping in a field of gravitational radiation," Soviet Physics Journal, 27(12), Dec. 1984, (English translation: Plenum, June 1985), p. l066-1069. If we substitute the vacuum "virtual plasma" for the observable plasma, this paper may be part of the smoking gun to show that the Soviet Union has developed scalar electromagnetics. Extrapolating from this paper, the amplitude of the "induced longitudinal field" is proportional to the square of the amplitude of the gravitational wave (GW) in an initially isotopic medium, but reduces to a linear proportionality as the medium develops nonlinearities (anisotropies or inhomogeneities). Whereas conventional GW are considered to be weak, the scalar GW may be very strong since we ourselves determine the variation in the energy density of vacuum it involves. Further, sharply spiked scalar EM (EG) pulses may develop appreciably more amplitude that the linearly calculated amplitude from the magnitudes of the zero-summation components. The end result is that (1) we can produce powerful gravity waves using the scalar EM approach, (2) local spacetime can be curved, producing violation of the conservation laws, and (3) the assumption of a local Lorentz frame made by Einstein as a limitation on ordinary general relativity is falsified.

In passing, note that immediately one also has a clear basis for the excess local production of energy when the battery furnishing power to a DC series motor is sharply spiked backwards in a "recharging" fashion. Further, the ions in the battery (which are several hundred thousand times as massive as an electron) possess a resonance on the order of 16 megahertz in a typical lead-acid battery. Under the correct conditions, the ions collect the excess energy (due to the initial square effect) produced by a sharp pulse of recharging potential. The ions are shocked into resonance and, on reversal, "overshoot" and deliver this excess energy to the plates, recharging the battery. Thus such a system can violate linear conservation of energy because spacetime is locally curved by the spiking, and excess energy from the excited local vacuum is collected by the ions and delivered to the plates. This is precisely the effect upon which the first Bedini free-energy motor depended. The timing and adjustment, however, are highly critical and difficult, and the battery takes a rather severe

beating.

57. For details and photographs of highly anomalous exhausts seen on Bennett Island, see "Explosive Events Seen on Soviet Island," Aviation Week & Space Technology, Sept. 26, 1983, p. 31. NOAA-6 and NOAA-7 weather satellite photographs of massive smoke plumes, one of them 150 miles long and nearly horizontal, are shown. Also, in U.S. weather satellite photos of Novaya Zemlya, similar plumes have been detected, making this location a tentative candidate for a second Soviet "exhaust site." See also Letter John M. Miller, Geophysical Institute, University of Alaska, Jan. 4, 1985 with attachment, "Bennett Island plume cases recently found." Satellite photos showing actual circular breaking of arctic ice have also been taken near Wrangel Island. See Sam Bishop, "UA photos show Soviets break ice for missiles," Fairbanks Daily News-Miner, Dec. 15, 1984, p. 1,3; Craig Covault, "Soviet Abi1ity to Fire through Ice Creates New SLBM Basing Mode," Aviation Week & Space Technology, Dec. 10, 1984, p. 16-17. Wrangel Island in fact has a bizarre history: it belongs to the U. S., but has been illegally given to the Soviets and occupied and used by them. For details, see "Wrangle over Wrangel and the Weather War," Don Bell Reports, 32(9), Mar. 8, 1985.

58. For details of anomalous blinding (probably by scalar EM means) of U.S. satellites, see Philip J. Klass, "Anti-Satellite Laser Use Suspected," Aviation Week & Space Technology, Dec. 8, 1975, p. 12-13. For details of anomalous failures and recoveries of a British satellite, see Joe Schwartz, Nature, 280, July 12, 1979, p. 95.

59. For other possible evidence of traces of Soviet scalar EM activity over the oceans, see George D. Curtis, "An electromagnetic radiation pattern over the ocean," Undersea Technology, 5(8), Aug. 1964, p. 29-30, 40. In producing a scalar wave, there exists a sort of "signal to noise" ratio of the desired scalar wave to an accompanying, undesired normal EM component. Due to practical equipment imperfections, the generated scalar wave inevitably is accompanied by a small residue of ordinary EM wave. While measures can be taken to further purify the scalar wave, a residue always remains. Curtis may have detected the weak EM residue accompanying early Soviet interference gridding for weather control testing over the U.S.

60. Interactions which occurred between Khrushchev and renowned physicist and Nobelian P. Kapitsa are of interest. Khrushchev desired absolute defense of the Soviet Union so that the Soviets might be able to launch any action desired without risk or serious concern. Kapitsa informed the Soviet leader that, if a means of total neutralization of foreign missiles was to be found, it could only come from a group of new principles in physics which was called " energetics." The term "energetics," of course, was contracted from "psychoenergetics," and is essentially the expanded physics/electromagnetics that this author has dubbed scalar electromagnetics.

Strangely, a portion of a book by Marshal Grechko was deleted from its English translation at the specific request of the Soviet Union to the U.S. State Department. The passage stated: "Of particular importance is basic research aimed at discovering still unknown attributes of matter, phenomena, and the laws of nature, and developing new methods for their study and use to reinforce the state's defense capabilities."

The most definitive Soviet book on military strategy is titled Military Strategy (Voyennaya

Strategiya). See V. D. Sokolovskiy, Soviet Military Strategy, third edition, edited with an analysis and commentary by Harriet Fast Scott, Crane, Russak & Company, Inc., New York, 1975. There are three editions, the latest in 1968. In the third edition, the exotic weapons normally proposed for defense against strategic ballistic missiles -- such as particle beams, high energy lasers, exotic nuclear warheads, plasma weapons, antigravitational weapons, etc. -- are discussed and discounted by implication. The statement is made several times that 100% defense against missiles and aircraft is possible. A statement is also made that it is interesting to note that this capability (a solution to the strategic missile defense problem) has been achieved by the Soviet Union, but not by the West (e.g., p. 298.) In the same edition, a previous definition of antimissile defense obviously consisting of radars, computers, and interceptor missiles is deleted (see author's note 190, p. 454).

The Soviets also recognize the great importance of technical surprise: "The experience of war shows that warring sides quite often have tried to employ new types of weapons to this end to achieve surprise, which are a surprise for the enemy or are little known to him. Each side secretly develops new means of warfare in order to employ them unexpectedly. History knows many examples how the employment of a new weapon initially gave considerable success because the enemy, caught unaware and not knowing the combat capabilities of this weapon, was for some time incapable of effective counteraction… The mass introduction of new weapons into an army usually cannot remain secret for long for the other side. -- New means of warfare, and in mass numbers, are impossible to create often and quickly. In this regard, the sides have begun to take other paths concerning the attainment of surprise along with searches for new weapons and their sophistication." V. Ye. Savkin, of The Basic Principles Operational Art and Tactics, Moscow, 1972, U.S. Air Force translation, U.S. Government Printing Office, Washington, D.C. 20402.

61. The Soviets have not discarded most of their old radars, and have continued to develop, build, and deploy giant new radars (in apparent violation of SALT agreements), which U.S. analysts always analyze in conventional fashion. It is fairly straightforward, simple, and inexpensive to modify an ordinary pencil beam radar to produce scalar wave beams and geometrical scalar Fourier expansion forms. Radars can provide a wide array of totally new and unexpected capabilities when utilized in the scalar electromagnetics mode. Even older Soviet radars, with antiaircraft gun sites and older surface-to-air missile sites, will exhibit new and startlingly advanced capabilities against ballistic and cruise missiles and Strategic Air Command bombers. Since there are many thousands of these older Soviet radars still operationally deployed, in the scalar mode the Soviet strategic defense may well approach 100%, just as Military Strategy implies. Also, the antiaircraft and antimissile defense capability of Soviet land forces may be far greater than anything presently estimated by U.S. analysts.

62. To the physicists, engineers, and researchers who have made the tough sledding to this point, congratulations! Here's a bonus for you.

Turn to page 32, equation [7]. Time differentiate it (this is left as an exercise for the reader). Collect terms and study the result intensely.

Now you have the reason why rise time is so important from a scalar EM viewpoint. You can also see why spiking the innate inductance of any system very sharply is so important. Fast rise time greatly increases the value of the time derivative terms, and your gravito-inertial effects go up with

the collective squares of your zero-vector summed components. Any system has at least a little inductance. For sharp spikes, the gravitational potential goes very high. The inductance of the system momentarily opposes any current (translation: opposes any current bleed-off, or EM force field bleed-off). During that time you've got the 4-space G-potential to use. If you need to hold it longer to use it, then increase the inductance.

Now you can see why extremely rapid discharge of properly tuned, giant Tesla coils give gravitational and inertial effects sometimes.

You can see why the sharp "EMP" (electromagnetic pulse) from a nuclear explosion or EMP generating device can penetrate the ocean.

That's why the spikes (such as used by the neurophone) can carry messages directly into the brain and nervous system. You also should see why the Soviet woodpecker carriers (a Soviet over-the-horizon radar system) are loaded with scalar EM spikes (Bedini has precisely detected them from 50 Hz to 10 MHz; Golden has detected them into the gigahertz range.) to work on the humans in the targeted area. They're zapping the hell out of us. And they have done something similar at the U.S. Embassy in Moscow for decades.

Bedini has developed a simple, cheap device to mess up the phaselocking of the scalar EM spikes on the woodpecker carriers. It's based on the fact that the Russkies use a lot of circularly polarized transmitters when they make the spikes. Here's what to do: Take 4 strong bar magnets and an old (but operational) long-playing record turntable. Set it on 33-1/3 RPM speed. Glue the magnets on the top of the turntable, standing vertically, symmetrically placed around the turntable's outer edge. Place them so that on one a north pole is up, on the next a south pole is up, then a north up, then a south up. Now turn the turntable on and let it run. This gadget makes a slowly rotating magnetostatic wave. (Yes, it will also make a rotating "magnetic" wave, which is actually two rotating magnetostatic waves.). These rotating magnetostatic waves will interfere with the scalar spikes, changing them to EM (electromagnetism) and slowly rotating their phase. This breaks the phaselock of the Soviet circularly polarized scalar EM signal on the human brain. This gadget will protect the average large room.

But back to our differentiated equation.

Now you should also see why the first Bedini motor is so "devilishly difficult" to adjust. You've got to get the effect and examine it in well under 20 nanoseconds. You'll need an oscilloscope of 350 MHz range or so. Microwave-quality bench equipment is necessary; the ordinary electrical and electronic shop equipment is not good enough. You can also see why the ordinary lead-acid battery takes such a beating. However, a special battery certainly can be designed to take it. Now you know.

Okay, you tigers. Go get 'em.

63. Now here's a final bonus for the persistent reader.

This time, see J. N. Brittingham, "Focus Wave Modes in Homogeneous Maxwell's Equations:

Transverse Electric Mode," J. Appl. Phys. 54, 1983, p. 1179-1189; T. T. Wu and R. W. P. King, "Comment on 'Focus Wave Modes in Homogeneous Maxwell's Equations: Transverse Electric Mode' [J. Appl. Phys. 54, 1179 (1983)]", J. Appl. Phys. 56, 1984, p. 2587; T. T. Wu and H. Lehmann, "Spreading of Electromagnetic Pulses," J. Appl. Phys. 58, 1985, p. 2064-2065; T. T. Wu, "Electromagnetic Missiles," J. Appl. Phys. 57, 1985, p. 2370-2373. Pay particular attention to the latter paper.

Because of the Strategic Defense Initiative (SDI) and other programs, great interest has recently been kindled in using EM pulses to carry energy from a high-powered source to a target. However, so far almost all the work is still couched in terms of purely ordinary (though sophisticated) electromagnetics. It still involves the EM concept of "EM energy flow through the intervening space from the transmitter to the target." As such, the work to date still suffers from all the self-imposed ills and limitations of using the classical force fields concept of EM.

However, the theoretical work of these referenced papers is of great interest to us here.

In the first paper, Brittingham sparked a great deal of interest with theoretical work which promised a permanently focused 3-dimensional concentration of EM energy that propagates in a straight line with the speed of light. That is, this mode used a newly formulated wave packet (called the "focus wave mode") that acted as a non-dissipating EM soliton.

In the second reference, it was concluded that Brittingham's focused wave packet actually satisfied Maxwell's equations, but not the associated boundary conditions.

[Comment by this reviewer: both of these formulations use "linear time" and a "linear frame," ignoring the local general relativity aspects. Indeed, Brittingham's "focused wave packet" can be made by the zero-vector approach! However, it will not be an "EM" packet, it will be a pulse (or oscillating wave, depending upon how it is made) of 5-gravity potential. As such, it contains a multiplicity of locked-in, 5th-dimensional, non-zero EM gradients in and EM gradients out. Collectively these gradients themselves constitute a deterministic "flux of gradients" or an EM flux in the 5th dimension, with no resultant effective current of EM gradients. In other words, it's possible to build a "flux of gradients" and to have a "current of gradients," just as in ordinary EM it's possible to have a "flux of virtual particles" and a "current of virtual particles." The argument concerning the EM boundary conditions of Maxwell's equations is not relevant in such a case. The only boundary involved is the zero itself.]

Be that as it may, the 4th reference is of direct interest. In this paper, Wu has done us a great service. He shows that, under transient excitation, an antenna of finite size can transmit energy to a faraway receiver so that the energy decreases as slowly as one wishes. An electromagnetic pulse of energy with such slow decay is conveniently referred to as an "electromagnetic missile."

The electromagnetic missile has important applications, according to Wu. One possible application is the transmission of

information in a manner that is very difficult to intercept or jam. A second possible application is to

destroy or disable a distant target. However, Wu feels that so much energy is required [remember, he is speaking of EM non-zeroed force fields traveling through ordinary space] that a like1y radiating source must be something like a nuclear explosion. However, as Wu points out, a nuclear explosion produces a powerful EM pulse which includes frequencies from microwaves to gamma rays. To weaponize the explosion to produce a coherent beam, the nuclear explosion must be controlled to produce a coherent radiating source and a pulsed laser-like EM beam. Wu points out that such a technology is difficult and has not been developed.

We comment as follows: It is certainly true that enormous energy is required if the waves in the pulse remain electromagnetic -- that is, if they have non-zero resultant E and B fields to the external observer.

On the other hand, if we form a complex of waves in opposition so that we control the energy content of each individual component wave, but blend all the waves so that their collective envelope wave has zero E-field and zero B-field resultants, then -- to the external observer -- the EM energy is infolded and unzipped electromagnetically. It is now electrogravitational energy, and limitations of "EM force field energy flowing through space or through a physical medium" need no longer apply. However, we may still look at each EM component wave as an individual EM wave, moving in the Kaluza-Klein 5th dimension that is wrapped-around each and every point in our ordinary 4-space. In other words, to the ordinary 4-spacetime observer, each component wave has a special channel around every point of his space, not through it. Thus we have established multiple EM channels "just outside" each point of observer space. These we call "scalar channels," and EM energy can move through each one as if it were moving through a wire. The relative potentials between the "ends of each wire" determine in which direction the "EM energy current" flows along the wire.

And in each of these "special channels," we just have a normal kind of space (to the internal observer). Wu's paper assures us that we can get as much of the input energy to the distant target as we desire. The problem then is how to break the zero-summed EM envelope (and hence the "zero channel" for each component EM energy wave) in the distant target itself, spilling the infolded contents of all the special channels back into ordinary spacetime as EM energy (either positive or negative).

That, of course is easily done by interference in the distant zone. As previously stated, there is a way in which we can even perform this interference in a single scalar beam. Since the newly formed EM energy emerges from each and every increment of spacetime occupied by the distant target, it already emerges inside the very vitals of the target. It does not have to translate through the intervening ordinary space between transmitter and target. Instead, it goes through the Kaluza-Klein fifth dimension. It translates along a line through our space, but not through our space. With the scalar EM approach, we transmit EM energy through hyperspace, not through normal space.

Hereafter we will adapt and expand Wu's SDI term "electromagnetic missile" to include these electrogravitational aspects. In other words, we include the "scalar EM missile", which consists of an infolded multiple of Wu's ordinary EM missiles moving together coherently in special sheathed hyperspace channels.

In Appendix I we show an anomalous photograph taken by Bob Gladwin, just before the shuttle launch of Nov. 26,1985. While the photograph may be an artifact, it also is a candidate for the test strike of such a Soviet scalar "electromagnetic missile" tested against an aiming point offset from the shuttle launch which followed a few seconds later. The test was accomplished before the shuttle was launched, and offset from it, so that it positively would not endanger the shuttle itself. The conditions under which this spectacular photograph was taken happened to coincide with the special conditions required to photograph such scalar EM energy. Those conditions are clarified and explained in the Appendix.

My deep appreciation goes to Mr. Gladwin for allowing me to use this photograph. As we will point out in Appendix I, the video camera caught a picture of the Soviet scalar EM marker beacon associated with the Titan explosion of April 18, 1986. One can rest assured that the Soviets probably destroyed that vehicle, using a scalar EM missile.

APPENDIX 1: SOME IMPORTANT INDICATORS AND DESTRUCTIVE TESTING

Some of the indicators which bear on the use of the Soviet
scalar electromagnetic grid via the Woodpecker EM carrier beams are given in this appendix. along with other information believed pertinent to overall scalar EM effects.

IN ADDITION, THE THESIS OF ACTUAL LIVE TESTING OF THESE WEAPONS BY THE SOVIETS -- TO INCLUDE THE DESTRUCTION OF A TROOP-CARRYING U.S. AIRCRAFT, A SHUTTLE, AND A TITAN MISSILE -- IS ADVANCED AND INDICATORS PRESENTED.

An anomalous photograph taken by Bob Gladwin is presented which possibly may have captured the "smoking gun" -- the strike of a
Soviet scalar EM missile at an offset aim point near the shuttle Atlantis, just before its launch on Nov. 26, 1985. However, this photograph is caveated since it may also represent an anomalous but ordinary artifact. captured in some as yet unknown manner. The manner in which such a photograph may have been taken -- when normally the scalar energy does not show on a photo -- is explained.

Another photograph taken by George Suchary after the launch did
capture the Soviet "marker beacon" utilized in the test firing, however. This independent photograph is presented, and adds credence to the thesis that the Gladwin photograph captured the test of a Soviet scalar EM pulse missile.

- INDICATORS AND SUCH -

1. Continual cloud radials have repeatedly been seen and photographed over Los Angeles, California or its vicinity.

Los Angeles is also apparently a "hinge point" for bending and controlling the jetstream. Three typical radials seen to form one after the other by Margaret Wilson (and sketched and airbrushed by her) in the greater Los Angeles area are shown in figures 1, 2, 3, and 4. These radials were formed on Sunday, Jan. 26, 1986. Ms. Wilson had heard my Saturday night "Soviet Weather Engineering" broadcast over KABC Los Angeles, and my request that anyone who saw the typical radial cloud formation should photograph or draw it, noting time and location, and send the photos or drawings to me.

As Margaret described it. "To my astonishment, the next day I not only saw one, but three in the sky at the same time.

The time of the first one was Sunday, Jan. 26, at 1:15 p. m.
. . . I stepped out the back door for some minor errand and noticed a
fan of long straight clouds in the sky. The sky had been filled with dark clouds most of the morning but this had been breaking up and the western half of the sky was now clear with these lines of clouds spread out on it. I immediately thought of your request and tried to see the bottom of the fan which was hidden behind bushes and a garage. When I stepped into the street, I saw there was a semi-circle beneath them.

Not having film and a wide-angle lens on my camera. I knew I couldn't capture it in its entirety. I am, however, a retired commercial airbrush artist so I quickly sketched the formation. It is illustration #1.

It was in the western sky, the base of the central semi-circle sitting about 15 degrees above the ocean horizon. It was very clear and sharply defined. The semi-circle was broken at the top and the two broken ends curled inward like commas. As I sketched the wind deformed it somewhat, the right half of the whole formation sliding down away from the left.

Ten minutes later it was getting quite clear of clouds except
for a bank over the Santa Monica Mountains to the north and there, straight north, another fan was forming. As I watched it took shape -- illustration #2. The same broken semi-circle (with commas') but this time the bases of the rays were feathered about half-way out with end halves long straight wisps.

As I sketched, another fan had begun to take shape

further east. It was hard to tell its size but I had estimated the first one at about 15 miles across and the second a little larger and the third larger yet. At the peak of its formation it looked like illustration #3. ...There in the middle of the central circle, hazy and a little faint was what looked like the top of a mushroom cloud. Or was it only a distant thunderhead that coincidentally found its way to a place behind the formation? The arms of the last, largest formation were rather wavy and feathery like some gigantic sea creature. It did not disperse as fast as the others, but held for a couple of hours, though it was pretty distorted by then. I could not estimate its size as I wasn't sure of its altitude.

Were they aircraft contrails? Certainly not! There was an airliner in the sky at the time -- a mere scratch on the smooth blue sky (see illustration #3, right center.).

The three formations were present in the sky at the same time although the first was getting quite distorted by the upper level winds before the last reached its peak.

Tuesday our weather changed from hot and sunny to rainy as the weather man said the path of the jetstream altered, and then there was the space shuttle explosion.

...The Russians seemed very sincere in their sympathy for the loss of our astronauts but only two days later it was printed in TASS and I personally heard Vladimir Posner say that Russia hoped that the United States would now realize what could happen if the S.D.I. program was further pursued. Was this friendly concern or a threat? It is very evident that if the S.D.I. can destroy a missile in flight, it can also destroy one on the ground. This would immediately put all Russian missiles in [reach of] our arsenal. They are already in place in the most desirable target areas -- their own launch sites. I'd be panicky too if I were a Soviet leader."

[Ed. comment: My sincere thanks to this thoughtful lady who took the time to sketch the cloud radial phenomena occurring in the Los Angeles "jetstream pivot point" at this critical time, just prior to the launch and destruction of the Challenger.

Anomalous cloud grid activity (formation and dissolution) in
the Los Angeles area has been positively correlated with Soviet Woodpecker activity by engineer Ron Cole, with 100% correlation in 30 straight Woodpecker measurement runs. Statistically, of course, this
is quite decisive.].

2. Continual cloud radials have repeatedly been seen and photographed over Huntsville, Alabama, associated with weather engineering and grid activity. Typical radials seen by this author are shown in Bearden, Soviet Weather Engineering Over North America, 1-hr. videotape, 1985. Huntsville is apparently a pivot point or "hinge point" for bending and controlling the jetstream.

3. Spectacular cloud grid patterns have been seen over Huntsville, Alabama and Los Angeles, California. An excellent videoclip of one of the Los Angeles area grids, personally observed and shot by KABC Open Mind talk show host Bill Jenkins, is shown in Bearden, Soviet Weather Engineering Over North America, 1-hr. videotape, 1985. An artist's sketch of an earlier gigantic grid, extending from horizon to horizon in every direction, seen over Huntsville, Alabama by Tom Bearden and Ken Moore, is also shown in the tape. The videotape is available from P.O. Box 1472, Huntsville, AL 35807. Sketches and details of another highly anomalous grid pattern observed in the greater Los Angeles area by engineer Ron Cole are shown in figures 5 and 6.

The reason that clouds of water droplets and/or ice particles detect the scalar interferometry and form signature patterns is simple: Consider each H_2O molecule as having two light little hydrogen atoms hanging on to the much heavier oxygen atom. The covalent sharing with the oxygen atom of the electron from each hydrogen atom means that (1) the electrostatic scalar potential between the H ion and the O ion it is bonded to, is rhythmically varying as the electron is shared back and forth, (2) this varying potential contains "electron spin holes" since it is made by the moving electron, (3) two such varying potentials exist since there are two H atoms sharing covalent electrons with the O atom, (4) the two H ions are at an angle of over 100 degrees with respect to each other, (5) the molecule assembly thus constitutes one part (one half, so to speak) of a scalar interferometer with imbedded electron spin holes for electron hooking, (6) Incident scalar waves from outside the system interact with the "half scalar interferometer." This scalar interferometry interaction is coupled to the covalent bonding electron because of the internal spin hole pattern of the molecular half of the interferometer. The coupled electron moves with the scalar pattern's changes, causing an observable interaction with and in the electrical structure

and ionic potential of the molecule, (7) the weak H to H hydrogen bonding between molecules connects resulting ionic potential changes to the structuring of the entire macroscopic cloud assembly. Thus by scalar interferometry with the H_2O "half interferometers", an incident scalar EM pattern is detected and translated into patterns of E and B force fields. The H_2O molecules then "line up" in accord with the electrical patterns detected.

Thus the clouds form "signature patterns" according to the incident scalar EM radiation patterns. Giant cloud radials in the targeted area are probably due to the type and shape of antennas -- including the type and shape of the electrical wires establishing the antennas' ground planes -- 640used by the Soviet Union to project the scalar waves. Note that such "radial" antenna patterns were occasionally used by James Harris Rogers in his underground and undersea scalar EM transmission system.

[For Rogers' patents, see U.S. patent numbers 1,316,188, Radiosignaling system, Sept.16, 1919; 1,322,622, Wireless Signaling System, Nov. 25, 1919 (figure 6 of this patent clearly shows a "radial wire" ground plane antenna); 1,349,103, Radiosignaling system, Aug. 10, 1920 (the fourth version in figure 1 shows inside/outside variation which, for the long waves used, to a distant observer appears as a varying magnetostatic scalar potential using opposing B fields); 1,349,104, Radiosignaling system, Aug. 10, 1920; 1,220,005, Wireless Signaling System, Mar. 20, 1917; 1,303,729, Wireless signaling system, May 13, 1919; 1,303,730, Radiosignaling system, May 13,1919; l,315,862, Radiosignaling system, Sept. 9, 1919; also 958,829, Method and Apparatus for Producing High Frequency Oscillating Currents, May 24,1910.].

4. Anomalous power outages in Ventura County, Southern California on Nov. 8 and 9, 1985. Again, engineer Ron Cole, who lives in the affected area, investigated and reports as follows:

"On the evening of 11-8-85 in a rural area of Ventura County known as Carlisle Canyon, a strange electrical phenomenon began to occur at about 10:15 p.m. Our first observation was that random white dots began to appear on the TV screen, then began to increase in size and brightness. The brighter the dots got, the dimmer certain lights in our home became. Yet later we found that, when some lighting circuits were dimming, other circuits were causing lights to

shine much brighter than normal. After a bit of checking, we were able to determine that lighting circuits common to pole 1 of the service transformer were the ones that were seeing a reduction in voltage, while all circuits on pole 2 were seeing an increase in voltage.

There is another interesting condition that was observed on the TV screen. The dots were in sync with the vertical field or frame rate of the signal. This means that the interference had to be of a frequency of 59.7 Hz or 29.85 Hz. Normal power line interference will form a grouped dash pattern across the screen and will strobe upward at the rate difference of 59.7 Hz or 29.85 Hz. In the 8 November case, there was no strobing of the dots whatsoever.

These conditions continued off and on for the rest of the entire evening and were observed by no less than six other persons that I know of. They were observed over the entire TV frequency spectrum, low band VHF, high band VHF, and on two UHF channels. Line interference is almost always most prominent on the low band VHF frequencies only.

These anomalous events would take place on a somewhat irregular time pattern; anywhere from 3 to 10 minutes apart. They would always last for about 2 minutes.

At 12:30 a.m. I went to bed and was not aware of any further activities until 6:20 a.m., at which time I was awakened by several sharp snapping or cracking sounds coming from the walls of my house. I rolled over and went back to sleep, only to be reawakened about 15 minutes later by my wife, who informed me that the power and phones were out. My comment was, "Some dummy must have crashed into a power pole," and I dozed off again.

At 10:15 a.m. the power and phones came back on line. Shortly after, our phone began to virtually ring off the hook. About a dozen neighbors up and down the canyon wanted me to check out their electrical wiring and various appliances. All of them were trying to explain their individual encounters and what took place when the power went out. Such things as wires snapping in walls, singing and humming sounds coming from wiring in walls, strong smell of ozone, light bulbs exploding, buzzing coffee pots, and a handful of other phenomena all took place just before the power went out at 6:20 a.m.

A typical example was that of Rob Steel. [Ed: Name changed for this report; his real name is in my files.] Rob lives four miles down the canyon from us. He had just turned on the lights in his barn and was getting ready to feed

the livestock, when he realized he had left several needed items in the garage located about 75 yards from the barn. Upon entering the garage, he saw the garage lights began to flicker, then go to a dim orange glow. Upon stepping from the garage area, Steel saw that lights in the barn were so bright that he thought the entire structure was about to explode. He froze in his tracks for a moment and his whole house and garage began to hum. Then everything went out.

An interesting point to inject is that Mr. Steel's home and several others farther down the canyon from us are being fed from a different 19 kv power feeder source than the 14 kv feeder that supplies us and most homes in the canyon.

At about 2 p.m. on 11-9-85 I was in contact with the power utility company (Southern California Edison Company) to inquire as to the cause of the power outage. My first assumption was wrong. No power poles had been knocked down; only a ceramic fuse in the 19 kv feeder system had blown and a two-pole oil breaker had kicked out on the 14 kv feeder system. Load charge recorders at the power company show that both fuse devices kicked out at exactly the same time, but they are in no way common to each other as to load distribution. They only supply power to adjacent areas.

Also, the phone company has no record of its service being out, yet the phone service was restored when the power was restored. The phone company does not use Edison Company's power to power its phones. Again, the only commonality is that the phones and phone lines were in the same area.

Numerous magnetic breakers, used as manual switch devices for well pumps and other services, were on when power was returned. These switches had previously set in their off state.

A strong electrical-type ozone odor was detected at five locations at the time the power went out.

Later we found that a Research and Development laboratory in a nearby area measured 29 Hz intermittent signals late on the night of 11-8-85. These signals were interfering with some critical tests the lab personnel were trying to accomplish. The laboratory itself did not experience a power outage.

At this point in time, the only realistic surmise we can come up with is that a tremendous ELF or scalar ground wave was adding and subtracting to the grounded neutral service side of the power pole transformers so as to sum in

and out of phase. When peak nodes were achieved, all line transformers ended up back-feeding the feeder lines out of phase, causing the final power outage.

Twenty-one persons are aware of the strange conditions of the power outage and prior events. [Ed: Their names are in my files.]"

Editor's comment: Another anomalous power outage also occurred in the same area. This occurrence is possibly associated with effects of the scalar interference grid adjustments. If the Soviets were preparing for a major test of the grid in the Launch Phase ABM mode, substantial tests and exercises may have been performed before the actual "wet run" against the shuttle launch on Nov. 26, 1985 -- about two and a half weeks after the anomalous power outage at Carlisle Canyon.

See the Rogers' patents, referenced above, for ideas of how scalar EM signals couple to the power lines and telephone lines.

As this book goes to press, John Bedini has notified me that his new and very sensitive developmental scalar detector positively verifies scalar frequency "spike" activity on the Woodpecker grid (and possibly the ground reference) from 50 Hz to 10 MHz. A normal instrument will definitely not see these signals. John's lab is at Sylmar, California and about 70 miles from Carlisle Canyon.

5. During the Skylab mission, NASA astronauts observed and photographed a mysterious green glow of the atmosphere. The glow was over 1,000 miles long and over 100 miles wide. From Carlisle Canyon, Ventura County, California the sky has also been observed to possess a mysterious green glow from horizon to horizon, on three occasions. [Editor's comment: It is hypothesized that this green glow is associated with grid activity in the Launch Phase ABM System mode.]

6. Just prior to the hapless launch of the Challenger on Jan. 28, 1986, the Soviet Union sharply bent the jetstream down through the center part of the country, then curved it eastward across the Florida panhandle. This exposed the waiting Challenger on the launch pad to severe cold air, brought down from Canada by the sharply deviated jetstream. The use of the scalar interferometry aspects of the Woodpecker grid for weather engineering over the U.S. has been documented previously. [Bearden, Soviet Weather Engineering Over North America, 1-hr. videotape, 1985;

Bearden, "USSR: New beam energy possible?", Defense & Foreign Affairs Daily, 13(111), June 12, 1984, p. 1-2.]. Wilson's cloud radial sightings on Jan. 26, 1986 and Cole's giant cloud grid sightings on Jan. 24, 1986 are directly connected with adjusting the Woodpecker grid and deviating the jetstream, to carry cold air to the Florida launch site.

7. The previous testing of the grid in the Launch Phase ABM/Anti-bomber Mode, using actual jet aircraft as "wet-run" targets, has been demonstrated by various anomalous incidents.

As one probable example, see "Jetliner drops 32,000 feet; 400 aboard; 50 are injured," AP release, Huntsville Times, Feb. 20, 1985, p. 1 and "China Airlines Pilot Denies Cockpit Error," AP release, Huntsville Times, Feb. 21, 1985, p. A-9. In this incident (see figure 7) a Boeing 747, flying at 42,000 feet and bound for Los Angeles, experienced unusual engine flameouts while still out from San Francisco. In a hair-raising plunge toward the earth, the pilot fought to restart the engines and regain control of the aircraft. After a fall of some 32,000 feet in two minutes, the engines finally restarted, and the pilot was able to fly into San Francisco and land safely.

We have already explained how the Soviets are able to track the aircraft's jet engines. Later in this Appendix we show just how accurately an actual "scalar EM missile" may be focused by the Soviets on a hapless target. If a negatively biased pulse or continuous wave scalar EM "energy extraction" beam hits the engines, the extraction of energy will result in engine flameout. (No heat energy, no combustion of the fuel.). This is apparently what happened to this aircraft. In the presence of "splatter" from the extraction beam targeted at the engines, the aircraft instruments were seriously affected. Different instruments have different responses to such an anomalous scalar EM kindling effect. Thus a signature would be that the instruments disagree with each other, and need not record what actually occurred. This appears to have been the case, constituting a signature that scalar EM was targeted against the aircraft. The pilot's instruments apparently indicated that the control system had failed, while the flight recorder apparently indicated that it had not.

Let us assume this was a Soviet test. When the distant Soviet operator turned off the extractor beam, the engines returned to normal state after a "discharge time constant" period. They normalized before the plane struck the ground,

so the pilot was able to restart the engines and proceed.

Notice that this was a limited test to cause engine flameout only. If the scalar EM missile had been used against the aircraft in the "pulse" mode, it would instantly have exploded in mid-air.

The crash of an India jet aircraft outside Great Britain may have been a test of the same weapon in the pulsed "destroy aircraft" mode, since there are indications that the aircraft suffered an anomalous midair explosion. Another candidate for such a possible "shoot-down" of a jet aircraft is an (Italian) Itavia DC-9 that crashed into the Mediterranean in June, 1980. Both Itavia and the Italian Transportation Minister Salvatore Formica believed that a missile struck the jetliner and was the likely cause of the crash. It may have been a scalar EM missile and a full-up test by the Soviet Union. See "Plane was probably hit, judge says," Birmingham Post-Herald, Jan. 17, 1981.

Also the present author has knowledge of at least one instance in the early 1980's when an American-made tactical ballistic missile was anomalously destroyed shortly after being launched by troops in Europe. The destruction was anomalous and a large hole was inexplicably burned through the side of the missile -- exactly as if it had been struck by a scalar EM missile test in the anti-tactical missile (ATM) role.

8. As another example of airborne scalar EM activity in the Woodpecker grid, in January 1985 a U.S. Navy-dispensed chaff cloud, dispensed well-offshore from San Diego, California was caught by an unexpected wind and blown toward the city. (See figure 8.). As the chaff cloud moved in, significant failures of electrical systems and electrical components resulted. Power was disrupted to as many as 60,000 homes by the incident.

The sudden, unpredicted wind was suggestive of a wind blowing toward an artificially created low pressure area. Under certain conditions, a specialized structure such as that of a piece of sophisticated chaff will reflect scalar waves of frequencies within its cut bandwidth. If scalar modulation frequencies within the chaff bandwidth were present on the Woodpecker carrier grid above and surrounding San Diego, a myriad of reflecting bits of chaff in the moving chaff cloud would produce myriads of random, invisible "fireflies" of EM energy kindled at a distance, from random scalar interferometry, in a zone surrounding the cloud. As these invisible "firefly" pulses of

EM energy pulsed inside components of the electrical systems and electrical controls in San Diego and vicinity, extensive and random internal electrical interference occurred. This lead to widespread, anomalous electrical failures throughout the city.

Note that this activity preceded the huge Soviet scalar EM exercise of April-May 1985. The grand exercise would certainly have been scheduled well in advance by Soviet strategic forces controlling the scalar EM howitzers and Woodpecker grid weapons, and adjustments and smaller tests would have been being made for some months before the tests.

9. Other anomalous "electrical strikes" certainly exist, suggesting Soviet testing may occur widely throughout the world, yet be reported as ordinary but anomalous phenomena. An example which comes readily to mind is the anomalous blast (or blasts) that struck Bell Island, off the east coast of Newfoundland, on April 2, 1978. Persons on the shore of Conception Bay reported seeing fireballs coming down out of the sky and hitting the island, according to Royal Canadian Mounted Police. Highly anomalous atmospheric electrical activity preceded the blast. This may have been Soviet testing of scalar-created electromagnetic missiles. Extensive information on this incident can be obtained from P.A.C.E., 100 Bronson Ave., Apt. 1001, Ottawa, Canada T1R 6G8.

As another possible example, villages in an area of West Donegal in Ireland have been terrorized by freak "lightning bolts" for over two years. Roofs have been literally stripped off, windows smashed, telephones and television sets blown up, and pipelines wrecked. On Dec. 25, 1984 a mighty blast caused a three-day blackout: it accompanied a snowstorm, the first "white Christmas" in the area in 20 years. See "Bolts from the blue," Fortean Times, Issue no. 45, Winter 1985, p. 5.

10. Scalar spikes or pulses from the Soviet testing may also cause other anomalies, including deaths of unsuspecting persons using the telephone. For a candidate event of this type, see "Killer Phones," Fortean Times, Issue no. 45, Winter 1985, p. 8-9; also AP release, Huntsville Times, May 30, 1985; AP newswire June 2, 1985; and New York Times, Sep. 11,1985.

On May 21, 1985, five days after passing a complete physical examination, 17-year-old Jason F. Findley of

Piscataway, New Jersey was on the phone at his grandmother's house, talking to his girl friend. An odd click occurred on the line, followed by a gasp from Findley and then only the TV playing in the background. His grandmother found him unconscious, still clutching the phone in his hand. Rushed to Muhlenberg hospital, he was pronounced dead shortly afterwards. An autopsy could not determine the cause of death, and the telephone company found the phone working properly, properly grounded, and no evidence of excess electrical charge. Findley was lying on a wooden bed which would not conduct electricity. He had a hemorrhage of the inner ear. There had been an electrical storm over Scotch Plains, New Jersey the night Findley died.

AP wire services were told by the special forensic investigator with the New Jersey medical examiner's office that about six people had died in the U.S. in similar circumstances. Others had reported being knocked unconscious by "high voltage shock" from their telephones. Several weeks before Findley's death, another man from Whitehouse Station, New Jersey had been found unconscious with a telephone in his hand. According to the Consumer Product Safety Commission in Washington, D. C., in 1984 nearly 12,000 people in the U. S. were taken to emergency rooms with injuries related to telephones. A hundred of them died, although exact details were not revealed.

Note that the giant Soviet scalar exercise of May 1985 had been detected and verified by Golden. Substantial activity in the Soviet weapon complex, and in the Woodpecker grid over the U.S, continued throughout May and beyond. A phone line may by chance detect one or more atmospheric scalar EM pulses, just as occurred in the blackout in Ventura County, California on Nov. 8-9, 1985. These scalar pulses can travel along a phone line and be broadcast into a person's ear and brain from the telephone earpiece. The proper scalar EM pulse can induce both "acoustic shock" in the inner ear and "electrical shock" conditions in the nervous system. The pulse may also interrupt the body's electrical timing pulses to the heart, causing the heart to stop without physical damage. The scalar EM shock to the brain and nervous system can knock the person unconscious or, if sufficiently strong, kill him instantly. The condition is worsened if the person is ungrounded, since then he acts as a large, open-ended capacitance in series with the telephone instrument's

inductance. In such case, the scalar resonance of the equivalent series LC circuit can be sharply excited and resonated. By the nonlinearities of the body and nervous system, the scalar resonance can be translated into an ordinary electrical pulse or resonance. Since the scalar power is not translated into ordinary power except inside the nonlinearities of the human capacitor/nervous system, no damage to the telephone or phone lines need happen. [At the ComTec exhibit in Las Vegas in 1984, John Bedini demonstrated powering a 200-watt speaker system through a 100-foot length of #40 magnet wire, using scalar EM means. He put some 200 "watts equivalent" of scalar energy through the tiny wire to the speakers, where a small Bedini translator translated it back into ordinary electrical "force field" energy, powering the speakers. This was much to the astonishment of the technical audience, since the wire was quite cool and exhibited no evidence of heating, even though by conventional thinking it should have been instantly melted.]

The bottom line is: With increased Soviet scalar weapons activity over the U.S., the telephone system is likely to become more hazardous to humans using it, when th e instrument is connected to th e external wire. A radio ph one is much saf er against anomalous scal ar EM "spiking."

11. The metal-softening detected and verified by Frank Golden on Jan. 1, 1986 is certainly indicative of a new mechanism or effect added to the Woodpecker grid. The highly specialized nature of the particular detector/amplifier which Golden was using provides strong evidence that the signal was actually derived by recording the scalar EM signals produced by a human cerebrum (two cerebral hemispheres connected by the corpus callosum, forming a scalar interferometer) when the human was successfully performing psychokinesis (metal-bending). The fact that Golden was able to nullify the signal locally by special methods worked out by him lends further credence to this hypothesis. In any event, three hours of very objective experimental data strongly support this thesis. It is therefore indicated that (1) the metal-softening signal had been added for a purpose, and (2) something made of metal was going to be softened, leading to its failure. Certainly the Challenger would have been an ideal target; softening the metal on its boosters and fasteners by even a small percentage would significantly reduce the vehicle's ability to withstand the

stress during launch. This of course is circumstantial evidence only, but the finger of suspicion is there nonetheless. It is a fact that the metal-softening signal was and is in the Soviet Woodpecker-repertoire; it is a presumption that it was intended for use against the Challenger.

- FINAL DRESS REHEARSAL BEFORE THE BIG SHOW -

12. The shuttle launch from Cape Canaveral on the evening of Nov. 26, 1986 seemed smooth as silk to the army of official observers and onlookers. In reality the Soviet Union clandestinely conducted one or more Launch Phase ABM System tests against the vehicle, using it as a convenient target.

Figures 9, 10, 11, and 12 are included to give the reader some preliminary background on the highly significant events which occurred in conjunction with this flight, and previous to it. These figures are newspaper articles from the News Tribune, Fort Pierce, Florida. The articles are used by permission.

Anomalous atmospheric "booms" and airquakes had occurred in the Florida area for over three and a half years prior to the launch. Sixteen counties, most of them on the northern Gulf coast or close to it, had reported booms during the two-year period preceding April 1984. State and local emergency preparedness officials and U.S. Air Force Base representatives met but could not resolve the mystery of what was causing all the anomalous booms.

In fact, many booms had occurred in and around the gulf coast of Florida, particularly offshore from St. Petersburg, starting from several years earlier.

These anomalous booms were caused by the Soviets adjusting and testing the Woodpecker scalar EM grid for weather engineering and potential weapons use. The booms and airquakes were certainly not confined to Florida alone, but also occurred at many other locations throughout the U. S. and Europe.

Mysterious, highly localized seismic microquakes also had occurred at widely scattered locations throughout the U. S.

On at least two shuttle flights prior to the Nov. 26, 1985 launch, large anomalous "booms" had occurred over or around the launch site after launch. No one in NASA knew what they were or what caused them.

So prior to Nov. 26, the Soviets had already prepared and tested the Launch Phase ABM system mode of the grid against at least two U.S. shuttle launches. However, so eerie and strange are the scalar EM weapons that they had been able to do so without the U. S. government even becoming aware of what was going on. In the Kremlin, they must have marveled at our continued ignorance.

At any rate, they tested the Launch Phase ABM system again on Nov. 26, and this time private U.S. citizens happened to capture at least some evidence of what was going on. It still would have died there without surfacing, except for a curious chain of events. Let me briefly recount those events.

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Lucius Farish publishes a fine little monthly newsclipping collection called UFO Newsclipping Service (Route 1, Box 220, Plumerville, AR 72121). In it she includes clippings on all sorts of anomalies, including UFO's, strange light phenomena, etc. Because of my long work in UFOs (for some time now, placed on the back burner due to the press of my work in Soviet scalar electromagnetic weapons), I've subscribed to Farish's service for several years.

And this time my unorthodox interests certainly paid off. Farish published a clipping of the article, "NASA officials stumped by strange light, boom," by Susan Burgess, News Tribune writer (see figure 10). The moment I read the article, I realized that the Soviets had actually tested the Launch Phase ABM System's area mode against the shuttle launch of Nov. 26, 1985. Further, George Suchary had taken a picture of the marker beacon as it was slewed away at the conclusion of the test.

With alacrity I contacted Ms. Burgess and, through her, George Suchary. Both were very helpful, and Mr. Suchary gave me permission to use his important photograph of the light moving away after the test. Ms. Margery Bril , the kind librarian at the News Tribune, sent me four clippings.

After reading the article by Julie Enders, Showcase Editor of the News Tribune, I contacted her also. Although extremely busy, Ms. Enders kindly gave me additional details, including the fact that Bob Gladwin had taken a series of eight stills of the launch itself, and in one frame an anomalous, curving line of light with a splash on the end

appeared.

At first I thought it might be the answer to a dream. Very tentative information suggested that the "curved light with a splash on the end" might have occurred in one of the pictures taken during the launch sequence itself, with the light striking directly under the shuttle shortly after it lifted off. I was positive the Soviets could strike at the shuttle (or a missile) with a "scalar EM pulse" missile, but hardly dared hope someone could have actually been lucky enough to get a photograph of it.

From my acquaintance with two masters of paranormal photography -- the indomitable Trevor James Constable and a close friend, Joe Gambill -- I understood how one could possibly get a picture of such a strike -- assuming it occurred -- at night, when the same picture could not have been taken in the daylight. I also understood why the camera might catch it when the human eye would not see it.

It seemed that, between them, these friendly, cooperative persons just might have gathered together the positive evidence to prove that the Soviets had struck at the shuttle with an offset test of a scalar EM missile, using a marker beacon for adjustment. (As it turned out. it was not to be as definite as that!) However, time was of the essence.

The Soviet tests had definitely included a test in the "area burst" mode, which can catch and destroy several missiles fired from a deployed silo complex at once. The clinching evidence I had needed for so long on a Soviet test of the pulse mode -- the scalar EM pulse missile -- just might be there in one of Bob Gladwin1s photographs. But there was no time to lose; such evidence is fleeting. and unless I moved quickly, it was likely to fade away and disappear forever. With persistence, the rest followed swiftly. Mr. Suchary graciously gave me permission to use his photographs. These of course prove that the marker beacon was there. (In addition, it was seen by numerous persons.). The News Tribune gave me permission to print the articles. Mr. Gladwin furnished his negatives and gave me full permission to analyze and use his photographs. Personal friends, Everett and Shirley Edwards, printed the photographs in their private darkroom so the negatives would not be out of safe hands for even a moment.

At the time, this book was almost finished. If the photo of the candidate Soviet use of the electromagnetic missile was accurate, quick work would be necessary if it was to be included. My friend and publisher, John Ratzlaff. had

already agreed to swiftly publish this large output as soon as I could get it to him. At Omni Video Publishing, Ms. Electra Briggs was alerted to the potential importance of what was coming. She and Mr. Glenn Shoemaker swung by my house from New Orleans, and a quick, informal videoclip was taped, announcing the book. (Murphy's law -- if anything can go wrong, it will -- got me there. Inexplicably, in my near-total fatigue from months of 19-hour days and 7-day weeks on this project, I spoke the date of the Titan explosion as April 19th, knowing full well it was the 18th! It happens. Electra suggested she slap a correcting statement over the video. Done. Be ready to get it out. It's too important; don't sweat the small stuff.)

Zerox copies of the photos were received. There in the fifth photo (or so it seemed) was an unequivocal strike of the scalar EM missile, in the launch sequence itself. The assumed strike seemed to have occurred right under the shuttle, a few seconds after liftoff.

The evidence seemed complete. All that was left was to receive the actual negatives and verify the sequence. At last we seemed to have the smoking gun. The Soviets would have been caught redhanded.

Based on the advance zerox copies, the manuscript was altered. Everything was ready. And then the negatives came in.

In this business, you learn to meet and accept a lot of failures. Things often go astray, and don't wind up as they seem at first blush. This time was no exception. Murphy got us again! The photos on the negative were in a different order then they had been on the zerox copies.

There's no mistaking the order in which the pictures were taken. There they are on the negatives, one right after the other, and clearly numbered. And the curving light with a splash at the end did not occur during the launch sequence at all. Instead, it was taken before the launch -- just how long remained to be seen. Everett and Shirley took the photo and developed it at both extremes: very dark and very light, to bring out all the details possible.

The results were most interesting. As shown on the lighter print (figure 13), the light does not curve down out of the sky and strike toward the ground, it turns up toward the sky and strikes above the distant treeline. Further, as shown on the darker print (figure 14), it does consist of a little ball of light, just like a scalar EM missile would appear. No apparent structure to hold the light appears in either picture, though one could not positively rule this out completely

without microdensitometer tests. (One can inadvertently get artifacts like this by focusing on a ball-like light bulb, for example, and then moving the camera while the shutter is still open. On the other hand, there is no evidence that this happened at all, and no street lamp post or other foreign object in the photo.)

(The remaining photos of the liftoff sequence are shown in figure 15.).

We called Mr. Gladwin. He verified that the photos had been taken in order, one right after the other. He had not had the camera on a tripod, but had steadied it on a railing. In other words, the "light streak with a burst on it" had been taken just before the liftoff. Also, Mr. Gladwin had not observed 'the marker beacon, and had not attempted to photograph any such "light in the sky." In fact, visually he had not observed any such streak and burst of light in any scene he was photographing.

So the question is, exactly what did Mr. Gladwin photograph in that photo, just prior to the shuttle's liftoff? The answer is. we just don't know for sure.

Let's run through the two possibilities:

(1) He may have snapped an artifact while moving the camera. If so, the camera was definitely quite still at least most of the time the lens was open, for the treeline is quite clear in the lighter photo, which reduces light saturation and shows details more clearly. Further, there is no evident support or structure attached to the light itself; it seems to be a "disembodied" light. So this possibility is ambiguous, though reasonable. Mr. Gladwin does not recall any such movement of the camera; it was steady while he was shooting.

(2) He may still have snapped a scalar EM missile. If so, it means the Soviets fired a "small test" of the exothermic pulse or scalar EM missile in advance of the actual shuttle launch. Let's pursue that for a moment, and suppose it to be true.

The Soviets already had the marker beacon up in the sky -- that's certain. Many persons saw it. Soviet trawlers off shore and Soviet satellites could also have given the actual position of the marker beacon. Thus the Soviet LPABM System would have had (a) the actual parameters the computer had used to transmit the beacon, and (b) the actual location at which the beacon emerged. Comparison of (a) and (b) is much like having a "meteorological data message" in field artillery: One has the corrections to apply for specific conditions of the medium that cause deviation.

These corrections can then be applied to calculated or "table" data to adjust firing for real-world conditions.

So far so good. The Soviets had the exact position of the registration beacon, and could apply corrections for a shot of the scalar EM missile. They certainly would know the exact position of the shuttle on its launch pad.

If a fairly substantial offset for the scalar EM missile shot were used, "mett corrections" could be applied and a small scalar missile could be zinged in, stopping momentarily at the final offset "strike" position so that a track could be obtained by the scanner extraction beam. Then by comparing the detected offset position of the "burst" of the scalar EM missile to the detected offset position of the marker beacon, the difference could be applied to the beacon's true position to get the true strike position of the missile. The offset used could then be subtracted to give the location where the missile would have struck without the offset, had it actually been fired at the rising shuttle after liftoff. This "adjusted final strike position" could be compared to the shuttle's expected early trajectory (which varies only slightly from standard for the first few seconds) to determine the expected combat success of the shot. It's a little roundabout, but it's a very safe way to do it if one wants quite positive assurance that the missile will not strike the shuttle and destroy it. Since the Soviets delayed the "area burst" and its concomitant atmospheric "boom" to T + 12 minutes, it is evident that a large offset was used for the area strike -- probably about 10 extra minutes -- to positively assure that there would be no actual damage or threat to the shuttle.

It seems logical, then, that they might fire the small scalar EM missile well offset from the shuttle, and just before its launch, to prevent any possibility of actual damage to the shuttle.

So there you have it. Mr. Gladwin's photograph is consistent with such a careful, safe scalar EM missile test by the Soviets, prior to the actual liftoff of the shuttle. On the other hand, it's not possible to say with certainty that that is what it is. It may simply be a very peculiar artifact. In fac, if it were not for the other indicators, one would most certainly not consider such a bizarre possibility as an offset Soviet scalar EM missile strike at the shuttle.

If the "streak" photo is examined as a candidate for a sca1ar EM missile test, then one other thing must be explained: Why did the film capture the test when observers did not see it at all? That, of course, we can explain!

So back to our presentation. Here I'm going to assume -- and accent that this is a postulation -- that the Gladwin photo actually represented a scalar EM missile test. We will run through a possible sequence of events, based on that assumption. We will hypothesize the LPABM system operation and the Soviet conduct of the test. The major events here in the U.S. may be quite real; those assumed to occur in the Soviet Union, of course, are "author's license" -- but hopefully realistic.

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The evening of Nov. 26, 1985 is perfect. At Cape Canaveral, the shuttle Atlantis is poised on its launch pad waiting to move majestically into the heavens on its impending journey. As launch time approaches, everything is as smooth as a cat's whisker. There is, however, just one small anomaly.

A mysterious light is hanging up in the sky, staying still for awhile, then gently rocking back and forth. The light is a Soviet marker beacon for a scalar EM howitzer. The howitzer, employed in a special scalar EM channel contained in the Woodpecker transmitters and interference grid, will shoot through the EM carriers at an aiming point offset from the shuttle.

Since this is still to be a nondestructive test, no chances will be taken. The pulse mode will be used, and a "scalar EM missile" -- a bundle of energy buried in hyperspace around its moving zero-point in this world -- will be fired directly at an offset aiming point prior to launch of the shuttle. A substantial offset in distance will be used to prevent posing any danger of inadvertently hitting the shuttle on its launch pad.

The marker beacon is necessary for precision. Its desired position will be calculated and the beacon will be placed on station. By placing this source of continuous EM energy in the area, it can be detected by the scanning "energy extraction beam" and tracked by the distant Soviet operator. Soviet trawlers and satellites monitoring the test will report the true position of the marker beacon, which will deviate from the calculated location due to conditions of the channel medium (the Woodpecker beams) at the time. Comparison of the beacon's true position to its desired, calculated position "registers" the marker beacon and yields the "meteorological corrections" which must be applied to standard firing table calculations. These corrections can be

applied to any further shot into the area to correct its aim, just as standard field artillery applies registration corrections in the target area.

When the shuttle boosters ignite, an additional track will be obtained from it. The offset from the received track of the marker beacon and the received track of the shuttle booster flame thus will give the exact correction or "shift" from the marker beacon settings that should be used to set the howitzer's aim. In other words, a "relative" firing, offset from the marker beacon registration track, will automatically compensate for any vagaries of the medium experienced by the beams in transmission.

The Russians, being excellent artillerymen, have simply applied the standard artillery technique of shifting from a known registration point.

The Soviet Launch Phase ABM System is cocked and ready. This is the last test in the "wet run" series in which an offset will be used. If everything goes as planned, future shots will move into the next phase, where actual U.S. targets will be destroyed. The two great powers are already at war, but one of them does not know it yet. Because of the importance of this last test before the next step in hostilities commences, Gorbachev himself is monitoring the test.

The countdown begins. In Florida a great many persons are observing the event. George Suchary has already spotted a strange light hanging in the sky, where none ought to be. Bob Gladwin, resting his camera on a railing, prepares to snap his first picture so that he will be sure to have a sequence completely across the launch.

Deep within the Soviet Union, a large display screen is illuminated. The marker beacon's track is clearly shown on the display, as are synthetic symbols for the shuttle on its launch pad, several Soviet ships off the coast of Florida, and several Soviet satellites.

The control officer barks, "Missile test! Proceed!" The simulation officer presses a switch, and a simulated shuttle launch track appears.

The operator responds immediately, "Launch detected!" The identification officer, scanning the frequency components and the signature of the energy extracted from the launch, calls out, "Missile! Target hostile!" He presses a button, and a light illuminates on the panel, marking the target as a hostile missile. The launch track begins to blink.

The control officer announces, "Prepare to fire!" "Pulse mode!" "Strength one!" "Test!" "Apply burst

offset!" The operator rapidly flips switches, setting the mode of fire and the offset. Instantly lights light to show that the computer has computed the shift and offset, and corrections. A red "Ready to Fire" light illuminates and a low siren begins its wobbulating growl.

The control officer orders, "Fire!" The operator presses the fire switch. A "Fire" light appears. A slight, deep shudder is felt briefly as the howitzer fires its scalar EM pulse missile of deadly energy. On the screen, the path of the scalar EM missile is traced out as it speeds toward its target far over the horizon.

In Florida, George Suchary is getting more and more curious about that pesky light. Bob Gladwin is preparing to snap his first photo as the final seconds of the countdown tick away.

On the distant Soviet screen, a sudden small burst appears, superposed over the synthetic shuttle track. The operator yells, "Burst!" On a smaller screen, a vertical profile shows the strike directly underneath the target. Immediately a blinking "Target Killed" light appears as the computer assesses the shot a kill.

The operator excitedly calls out, "Kill !" "Direct Hit!" Cheering breaks out from the firing team and the onlookers. Gorbachev and his entourage are smiling broadly and clapping. The cheering quickly hushes as the crew and participants continue to watch the track of the rising shuttle, and prepare for the launch and the next test.

Bob Gladwin has snapped his first picture (figures 13 and 14) leaving the shutter open a bit to allow for the nighttime conditions. As luck would have it, the scalar EM missile strike Occurs during the time the shutter is open. The film has captured the strike by a special process, even though human eyes have not seen it. (We will explain that shortly.).

At 7:29 the Atlantis's boosters ignite and the vehicle begins to rise smoothly off the launch pad. She will continue to rise, then pitch over to a 45 degree angle and proceed down range..

Bob Gladwin is snapping pictures regularly, one after the other.

In the local Florida area, hundreds and hundreds of persons are watching the flawless launch. The tip-off of the Indian River Community College basketball game and the St. Lucie County School Board meeting are held up while participants watch the Atlantis begin to rise serenely upward.

In the Kremlin, another track has appeared on the

control screen display. Once again the sharp-eyed operator snaps, "Launch detected!" The identification officer, scanning the frequency components, tersely rasps "Missile! Target hostile!" Again he presses a button, and a light lights on the panel, marking the target as a hostile missile.

The control officer orders, "Simulate multiple firings!" The simulation officer acknowledges, "Multiple firings simulated!" and presses a button to cause the computer to simulate multiple launches on the display.

Immediately other synthetic target tracks begin to appear on the display screen, one by one, clustered around the shuttle launch at various separation distances, pre-arranged to represent multiple firings from a missile silo complex for this exercise. A special audio alarm sounds as each track appears.

The operator immediately calls out, "Multiple tracks! Missile launches!" and then "Identified hostile!"

The control officer orders, "Prepare to fire!" "Area pulse mode!" "Test!" "Apply time offset ten!"

The operator flips switches rapidly, acknowledging. Lights illuminate on the console, showing status of preparation for firing. The "Ready to Fire" light illuminates and the low siren begins again.

Back in Florida, Bob Gladwin has stopped snapping photographs. George Suchary has gone into his house to find his Polaroid camera and take a picture of that pesky light still hanging up there in the sky.

Back in Russia, the fire control officer orders, "Fire!" The operator presses the fire switch. The "Fire" light illuminates, immediately blinking, and the siren changes tone. On the display screen, all target tracks are blinking. A large light on the console comes on, showing that an "exercise time offset" of 10 minutes has been applied. A digital clock starts ticking off the minutes.

Minutes pass as the offset time ticks down.

Back in Fort Pierce, George Suchary is coming out to take photographs of that darn light, which is <u>still</u> hanging up there!

Folks are streaming back into the Indian River Community College gymnasium for the basketball game. Attendees at the St. Lucie County School Board meeting are wandering back inside, to get ready for the meeting.

More minutes pass.

Back at the control console in the Kremlin, the offset clock ticks down to zero. The siren ceases its wobbulating tone and holds a steady note. The "Fire" light ceases

blinking and illuminates with steady brilliance. A deep shudder is felt as the howitzer fires again. On the screen, the rapid trace of the mighty scalar EM serpent is shown as it races toward its target.

Suddenly it reaches the target area, and a large blossoming light appears, covering all the target tracks. The operator announces, "Burst!"

All the target tracks flare brightly, then dwindle and die. The "Targets killed" light illuminates and the operator yells, "Kill! All targets killed!"

Wild jubilation breaks out. Everyone is grinning and clapping. Gorbachev personally congratulates the fire control officer and pumps his hand. The tension relaxes visibly. In the noise, the operator touches a joystick and slews away the marker beacon, preparing to shut down the system.

The final test has been a crowning success. Now the real first phase of active combat begins. "And the fools don't even know it yet!" a grinning Gorbachev delightedly announces.

Back in Fort Pierce, precisely 12 minutes after liftoff, high in the atmosphere above the launch site and a little downrange, a tremendous rumbling boom suddenly rocks the coast for hundreds of miles in each direction. The blast is heard as far north as Charleston and as far south as Key West.

George Suchary is taking pictures (figure 10) as the hanging light in the sky suddenly begins to move away, obeying the controls of a Russian operator thousands of miles away. Bob Gladwin has already finished snapping his photographs (figures 13, 14, and 15) of the launch and taken down his camera.

The anomalous light disappears rapidly in the distance, moving faster than any jet aircraft.

People gradually resume their normal activities, talking about the beautiful evening and the perfect launch. Many of them have noticed the strange light that hovered and bobbled in the sky, then sped away.

The final Soviet registration of their eerie weapons for World War III has been completed. A totally different kind of Pearl Harbor -- more akin to a Trojan Horse -- has been prepared for the unsuspecting United States.

Countdown toward Armageddon begins.

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George Suchary's photograph of the marker beacon, just after it had started slewing away, is shown in figure 10, as printed in the News Tribune.

Bob Gladwin's photographs of the shuttle launch are shown in figures 13, 14, and 15.

Figures 13 and 14 show two developments of the same shot, one light and one dark. The light one shows the treeline in focus in the distance, with the light streak and burst.

Figure 15 shows liftoff of the shuttle and its rise and tilt over on the first part of its trajectory.

Figure 16 shows a possible detailed interpretation of the first Gladwin photo. The simulated aim point was offset from the shuttle, and the strike was directly at the offset point. The computer computed the burst strike strike of the scalar EM missile from the adjusted registration data, and determined whether or not the target was killed.

The control precision is shown by the small size of the scalar EM missile.

The strike of the weapon is caught by the camera, but not seen by the naked eye. None of the many hundreds of onlookers saw the strike, though all of them saw the shuttle launch.

There is a very good reason for that, though it is not commonly known.

Constable

The reason is that Bob Gladwin's camera was utilizing a form of photography pioneered -- to the best of my knowledge -- by Trevor James Constable. At least I learned about it from Constable's books and articles. I then told it to my good friend, Joe Gambill, and Joe applied and adapted it to the unusual photography which he performs. Both Constable and Gambill are masters of this type of photography. Once I got deeply into scalar electromagnetics, I finally figured out what was going on in this methodology.

Briefly, here's the way it works. Scalar energy, of course, has to be detected by some sort of interference phenomenon. There exists a very special way to get a camera to perform such interference for you.

In the EM spectrum, the infrared and the ultraviolet have a special relationship to each other. The ultraviolet is exactly twice the frequency of the infrared, if the two zones are properly chosen. In other words, the UV is the first

harmonic of the IR.

The scalar EM energy, since it operates in the Kaluza hyperspace surrounding every point in ordinary space, may be considered to be composed of pure spin. (That is, it's moving in a dimension where each particle of that dimension is spinning). Harmonics there are spin harmonics.

In this photon-interaction produced level of reality (the ordinary world), the IR and UV bands are more closely connected to the "shadow world" in which scalar energy moves. Thus there is a sort of shadowy "swirling" of the scalar energy near the IR and the UV. Entry of the scalar energy into this world, through the IR and UV windows by a kind of "harmonic interferometry," is normally prevented by the presence of visible light. That is, visible light "squelches" the "paranormal channel" that lurks beneath the IR and UV zones.

To make use of the IR and UV interference source zones, Constable covered his camera lens with a special filter (18A) which is opaque to the visible light spectrum and transparent to the IR and UV. Note that the film is sensitive to the IR and UV region we are talking about, but the human eye is not.

When pointed at a sufficiently strong source of scalar energy, such a specially filtered camera has unique characteristics. It strips out the visible spectrum, but still admits the IR and UV spectrum. The scalar energy surges through these two source windows, and phaselocks harmonically. That is, the scalar energy entering through the UV window fits twice neatly in the scalar energy entering through the IR window. This interference, on the film, is (recall) swirling in frequency. The net result is that the film records the interfering scalar energy as visible spectrum energy.

Infrared film can be used to increase the response in many circumstances.

Both Constable and Gambill have rigorously proven this technique in literally thousands of "paranormal" photographs. (They do not necessarily use my scalar EM terminology, but the technique is rigorous and works, regardless of terms.)

Under nighttime conditions, sometimes the particular lens and film combination will phaselock between IR and UV for incident scalar EM energy. This is particularly true when a relatively strong source of IR is in the vicinity.

While Bob Gladwin was taking his photographs, there

was no suppression of the IR/UV phase-lock effect by visible light because it was night and there was hardly any visible light entering his lens.

Thus his camera lens and film formed an IR/UV phase-locked interferometer that detected and recorded the strike of the scalar EM missile underneath the shuttle, even though human eyes did not detect it.

At this point it would be interesting to know whether NASA may have had IR cameras focused on this shuttle launch (which was at night). If so, it would also be interesting to know whether any of them may have developed the IR/UV phaselocked interferometer effect, and captured the strike of the weapon.

Note that daylight shots would automatically break the IR/UV phase-lock possibility, by jamming out the effect with visible light, unless a special filter is used to filter out the visible light but leave both the IR and UV.

One would hope that both NASA and the U.S. Air Force will take note and discreetly add a specially filtered camera to the instrumentation observing and recording all future daylight launches.

To recapitulate the major events at the shuttle launch on Nov. 26., 1985, see figure 17. A marker beacon was placed in the vicinity, high over the area, for precise registration and location of tracks relative to it. A scalar EM missile strike may have occurred just prior to launch, and offset from the shuttle.

Then the shuttle lifted off. The exercise called for simulating multiple launches from a missile field. The area code was computed, and the fire order given. A substantial time delay -- say, 10 minutes or more -- was used to absolutely assure that the actual shuttle was well away from the engage blast.

Twelve minutes after launch, the delayed firing in an area "multiple missile kill" mode occurred, producing a massive boom heard for hundreds of miles up and down the east coast. After the boom, the marker beacon was slewed away, and photographed by George Suchary just as it moved.

The shuttle moved on downrange and went merrily on its way, blithely unaware of the jaws of the tiger that had snapped shut behind it.

To the Soviets, this final test of the preparation phase was highly successful. They were now ready to increase the risk level and fire the first round of World War III.

- THE SHOW BEGINS -

13. On Dec. 12, 1985 the same Soviet weapon tested against the previous NASA shuttle launches and against various aircraft may have deliberately interfered with the controls of an Arrow DC-8 taking off from Gander Air Force Base, Newfoundland. At an altitude of 100 feet, the aircraft -- carrying over 250 U.S. soldiers and civilian crew members -- lost power and sank into the ground tail-low, killing everyone on board. It was a tragedy of enormous proportions to the U.S., and especially to the families and friends of the brave servicemen and crewmembers who lost their lives.

Three Canadian witnesses to the crash were interviewed over the Canadian Broadcast network television news on April 8, 1986 at 10:00 p.m. No flame or smoke issued from the plane before its descent and crash.

However, witnesses reported seeing the aircraft mysteriously glowing with a yellow halo. That is a signature of the use of a scalar howitzer in the "continuous EM emergence" mode, similar to the manner in which several F-111's were downed in Vietnam.

In short, the DC-8's electrical systems were interfered with by electromagnetic energy and noise created throughout each increment of spacetime occupied by the aircraft. A powerful charge was rapidly created in and on the aircraft structures and skin. The "yellow glow" seen by the witnesses was a corona due to the skin of the aircraft acquiring a high electrical charge.

Something also apparently caused the rapid loss of two engines, one after the other. This indicates that the distant Soviet operator may have struck at the engines, one after the other, with a scalar "energy extractor beam." Thus he apparently tracked the aircraft as it moved down the runway, then used two modes against it: one to create serious EM interference with the electrical systems of the aircraft, and one to disable the engines.

With its controls ineffective and power drastically reduced, the doomed aircraft sank to earth, still in its "tail down" configuration from takeoff, and crashed and burned.

Admittedly other factors may also have contributed to the crash. These included reduced lift due to poor engine maintenance, increased weight of the aircraft due to icing, and heavy loading. However, normally the aircraft could still have taken off and flown to its destination. (See "Arrow Air was absolutely safe, FAA official says," UPI release,

Birmingham Post-Herald, Apr. 17, 1986.)

To date, no official seems to nave recognized the sinister significance of the "yellow glow" or what it implies. No one seems to have connected the loss of this aircraft, the mysterious booms over U.S. shuttle launches, the Woodpecker interference grid, the anomalous loss of the U. S.S. Thresher, the high altitude "booms" off the east coast of the U.S. some years back, the puzzling loss of two critical Titan launch vehicles in a row, anomalous engine flameouts of civilian jetliners, etc.

Certainly officialdom has not recognized that a Soviet Launch Phase ABM System is being tested directly over its collective head, to include actual destruction of U.S. aircraft, missiles, and space vehicles with concomitant severe loss of American lives.

Direct and diabolical acts of war have been committed upon us by the Soviet Union, but in a fashion that still eludes our erstwhile pundits.

However, it is not as simple as that. To even energize giant scalar EM weapons is to run a risk -- to all mankind -- so horrendous that it boggles the imagination. Truly it deserves Brezhnev's 1975 phrase, "...more frightful than the mind of man has ever imagined."

Shortly we will reveal exactly what he meant.

- Apr. 18, 1986: Death of a Titan -

14. As this book goes to press, the last two U.S. Air Force Titan 34-D missiles fired from Vandenberg Air Force Base in California have blown up shortly after launch. The first one blew up on Aug. 28, 1985 just after lift-off. That loss has been attributed to failure of a high-powered fuel pump, causing a massive oxidizer leak and a smaller fuel leak. The second Titan loss occurred on April 18, 1986 when the Missile blew up 5 seconds after lift-off. Its loss is still under investigation and no determination of cause has been made. Apparently the shuttle and the Titan presently provide the only viable launch vehicles for launching U.S. "spy" satellites. The loss of these sensitive satellites -- if indeed they constituted the payloads -- cannot help but be damaging to our strategic surveillance capability. According to the Los Angeles Times, the single remaining KH-11 satellite was launched in December 1984 and, with an expected life of two to three years, it could stop functioning later this year.

Whether or not significant Woodpecker grid activity existed in the vicinity of the Titan launch of August 1985 is

unknown at this time. However, significant activity in the grid definitely occurred before the April 18 Titan disaster and on the same day.

On Easter Sunday, 30, 1986 engineer Ron Cole observed significant cloud signatures of grid pattern activity, correlated with Soviet Woodpecker measurements. On April 18, the present author observed traces of a cloud radial over Huntsville, Alabama and took photographs of it. Preliminary reports from Thousand Oaks, California indicate extensive grid activity again on April 18, the day the second Titan exploded.

At least the second of these two missile destructions shortly after launch is highly suspicious, since the grid positively was active during that time. Also, a clear trail of Launch Phase ABM system indicators exists back to the massive scalar exercise of April/May 1985. The first Titan explosion in Aug. 1985 thus falls within the Soviets' "now let's test them against U.S. launch vehicles" period.

The second Titan loss follows highly suspicious losses of the Arrow DC-8 on Dec. 12, 1985 and the Challenger on Jan. 28, 1986. The same Soviet weapon system that destroyed those targets probably also destroyed one or both of the critical Titans.

At least, on the second Titan explosion, the Soviets left another signature. In one of the videotapes taken of the explosion, the marker beacon can be seen well , above the exploding debris, moving away from the explosion site.

See for yourself! Refer to "Titan Explosion Cripples U. S. Launch, Surveillance Capability," Aviation Week & Space Technology, 124(17), Apr. 28, 1986, p. 16-19. Specifically, look at the color photo of the explosion on p. 18.

Look well above the explosion (about one inch on the page) and to the left (about one inch on the page) of the center of the top of the fireball portion. There you will see a little light, caught in the very act of moving away.

At my rather frantic urging, engineer Ron Cole sought out a copy of the original videotape. He and a team spent two hours, going through this portion of the tape frame by frame. The light is there. It's real. And it moves on out of there, well above the explosion and independent of it.

It's the Soviet marker beacon, caught in the very act. Here I want to express my sincere appreciation to Ron Cole for his untiring efforts to nail this light down. Without his dedication to supporting this investigation, it would have been impossible to say for sure that the light was there.

So we have caught the bear red-handed, with his fingers in the cookie jar. If the marker beacon is there, you may rest assured that the Soviets destroyed that Titan missile, with very high probability. [See also "Investigators Search for Clues to Cause of Titan Blast," Aviation Week & Space Technology, 124(17), Apr. 28, 1986, p. 19-20; also "Titan Accident Prompts Funding, Technology and Policy Questions," AW&ST, 124(17), Apr. 28, 1986, p. 21.].

Continue

Figure 1. Wilson's first cloud radial

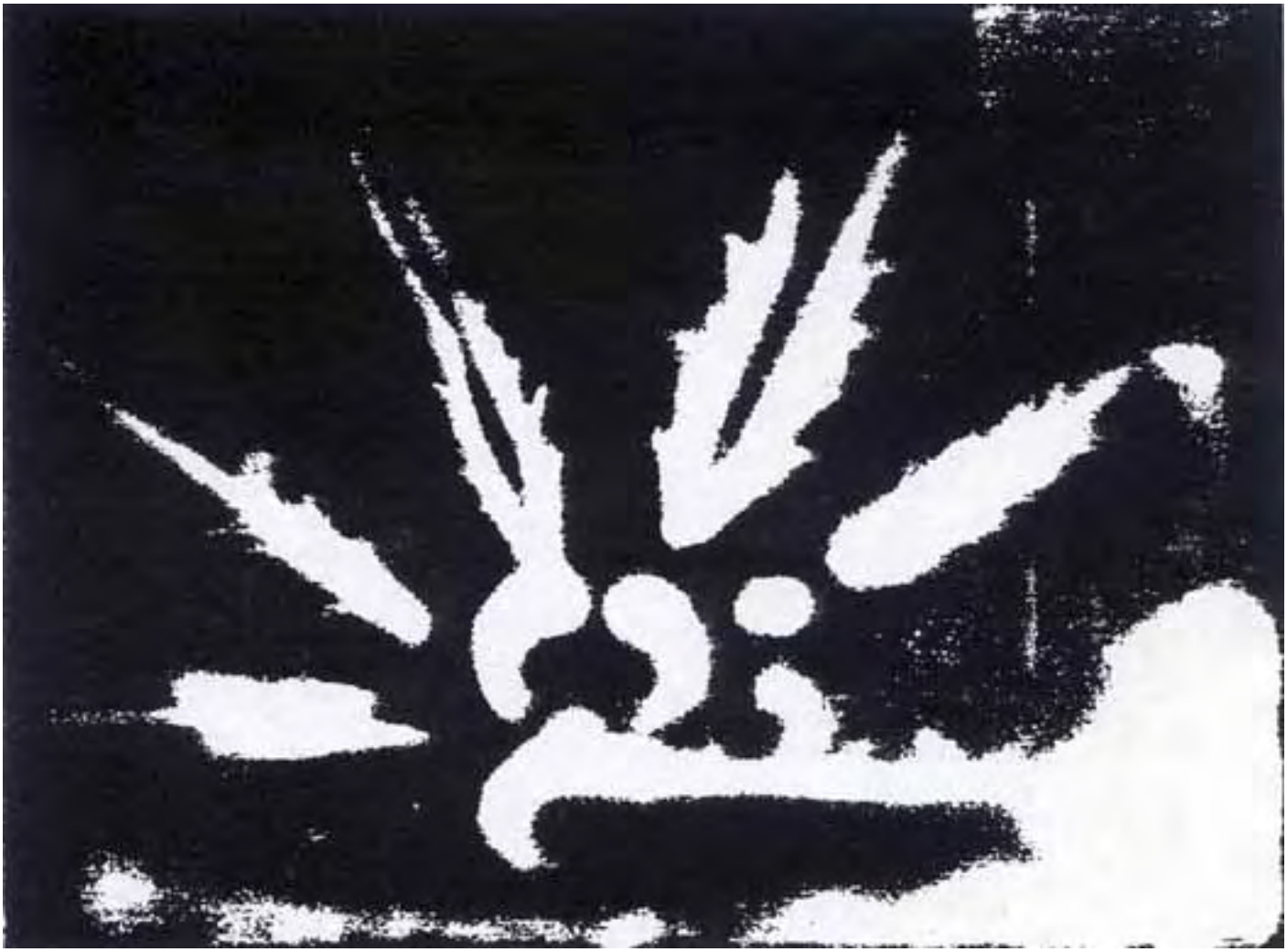

Figure 2. Wilson's second cloud pattern

Figure 3. Wilson's third cloud radial

Figure 4.

PLACEMENT OF WILSON'S THREE RADIALS

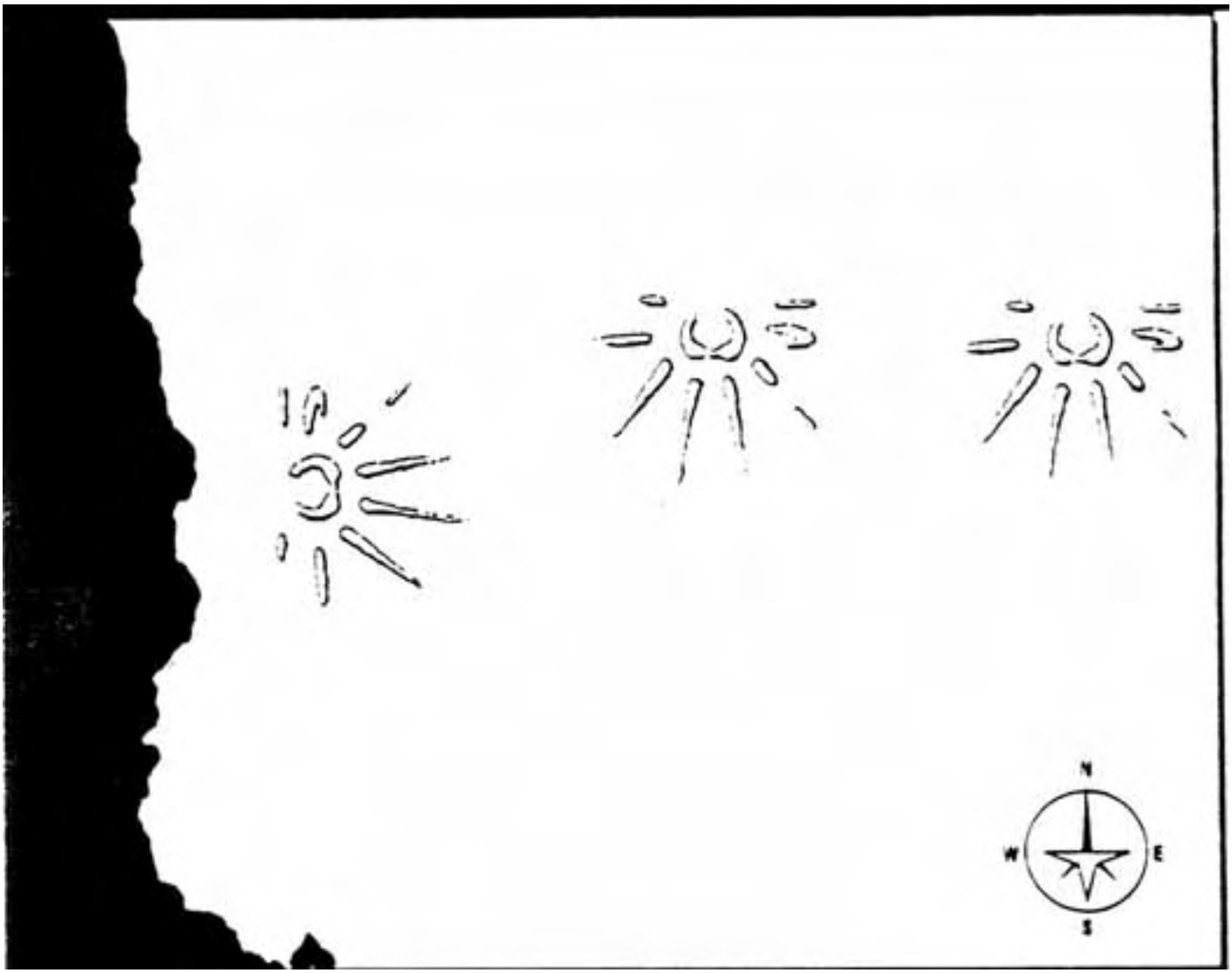

Figure 5.

VIEW FROM WESTLAKE OVER VENTURA COUNTY, CA

1-24-86, 280• WEST/NORTH-WEST

11:45 AM PST

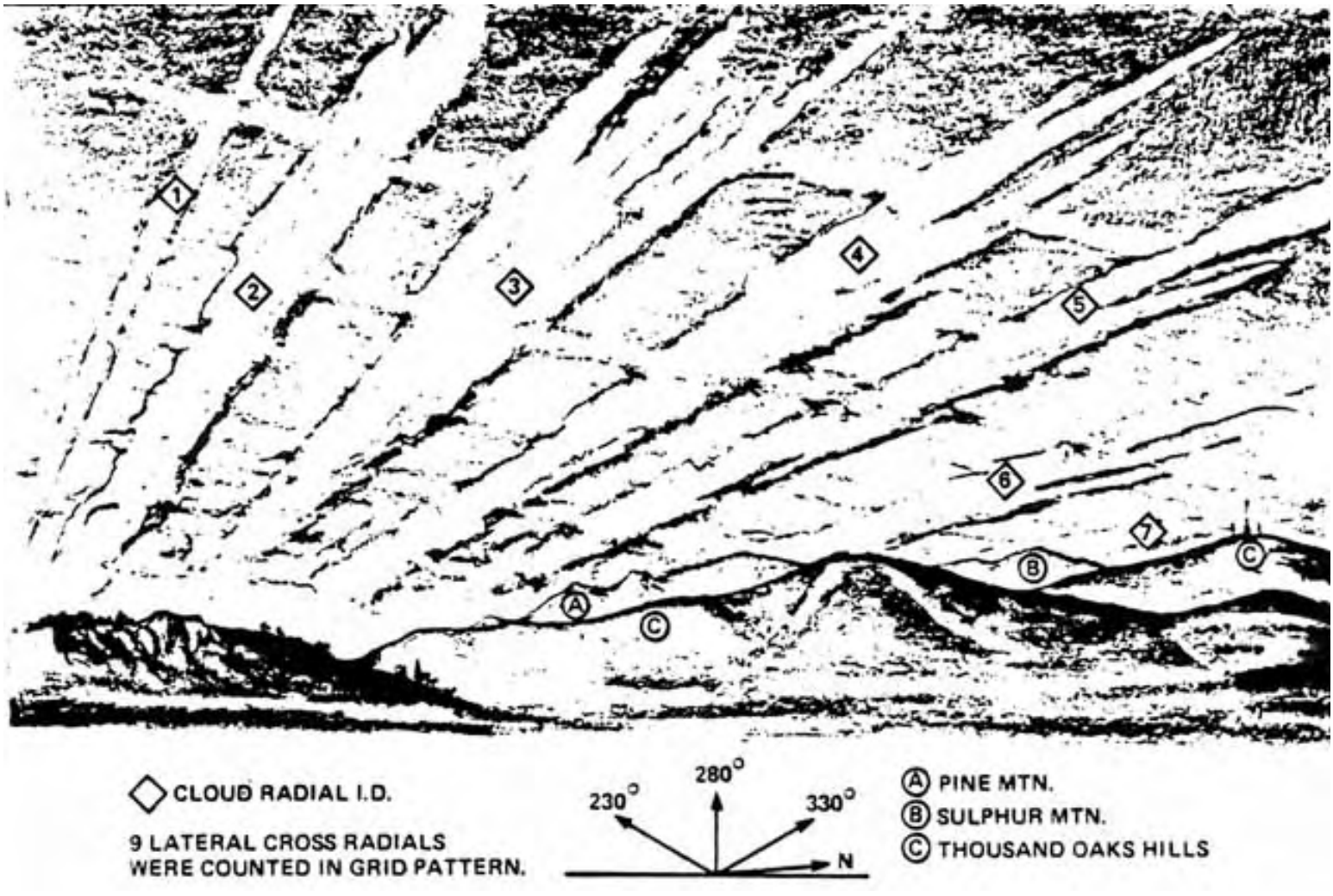

Figure 6.

GRID VECTOR APPROXIMATION
1-24-86 VENTURA COUNTY, CA

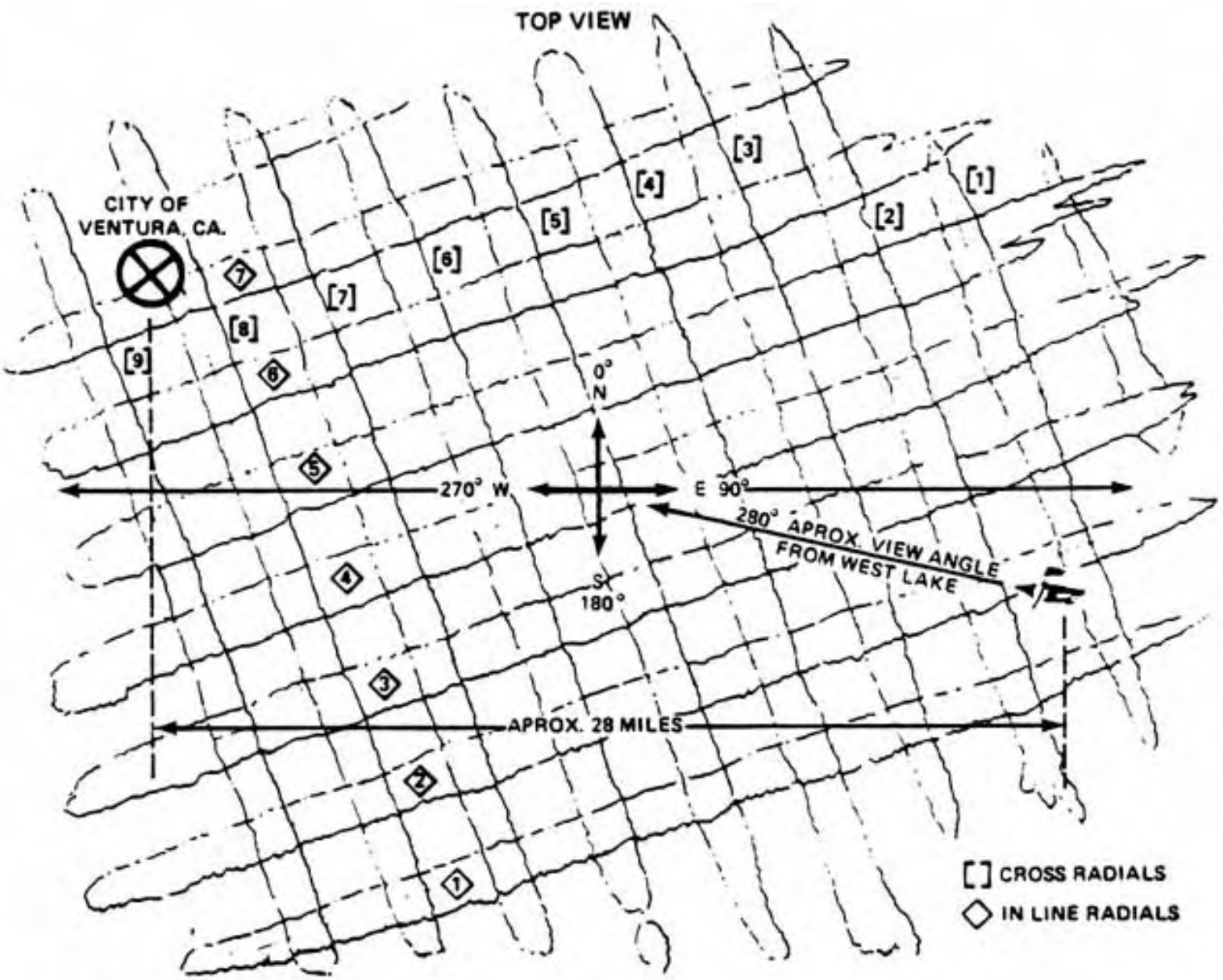

Figure 7.

SIX-MILE DROP IN TWO MINUTES

CHINA AIRLINES FLIGHT 006
- TAIPEI TO LOS ANGELES -
19 FEB 1985

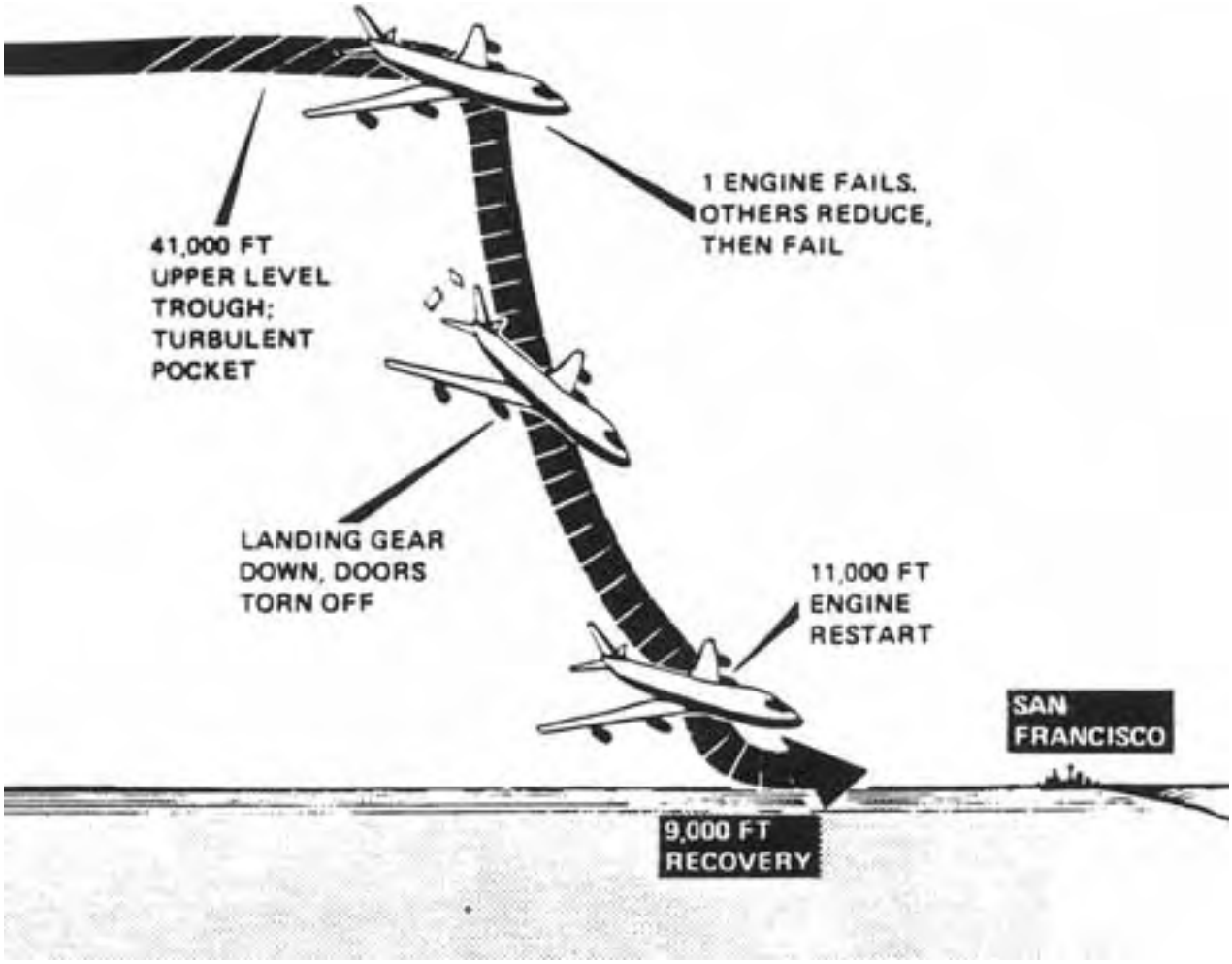

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The Tom Bearden Website

Fer de Lance

Figure 8.

SAN DIEGO CHAFF INCIDENT, JAN. 1985

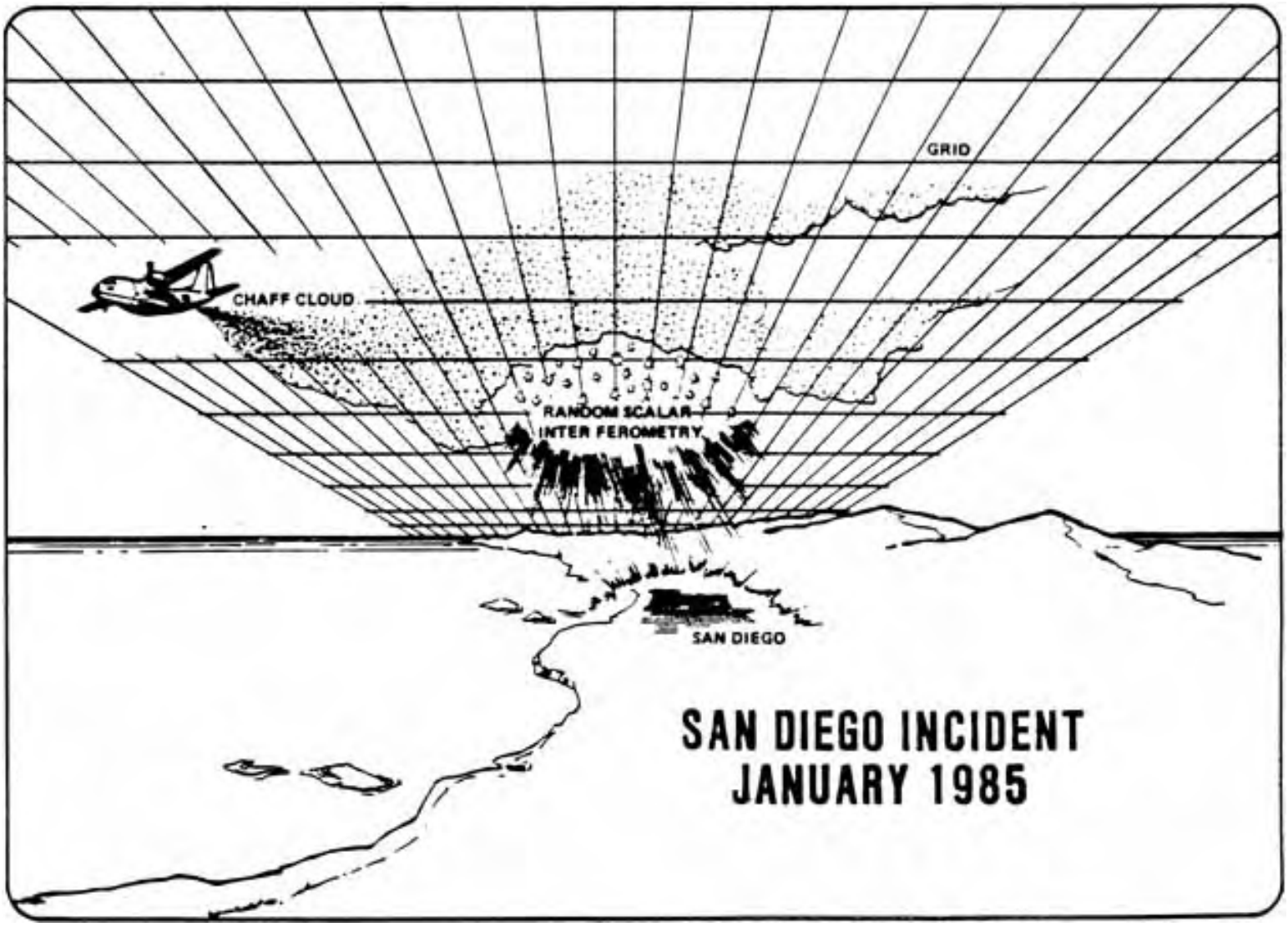

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EM Missile Strike, Offset from Night Shuttle Launch

Cape Canaveral, Florida

PHOTO BY BOB GLADWIN

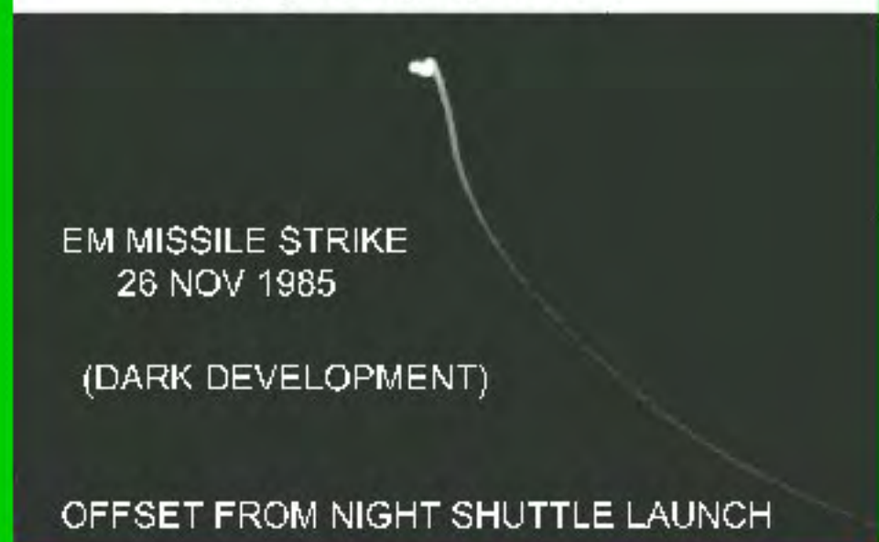

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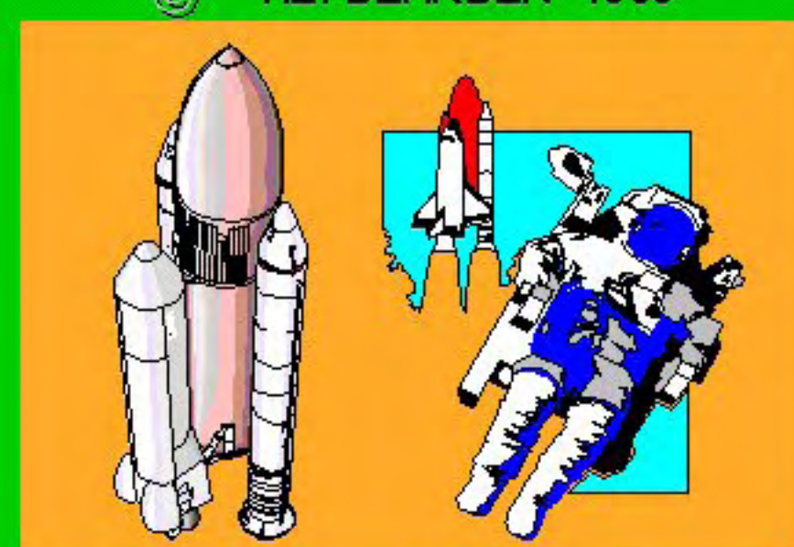

The Smoking Gun on 26 Nov. 1985

Longitudinal EM Wave Interferometry: Exothermic

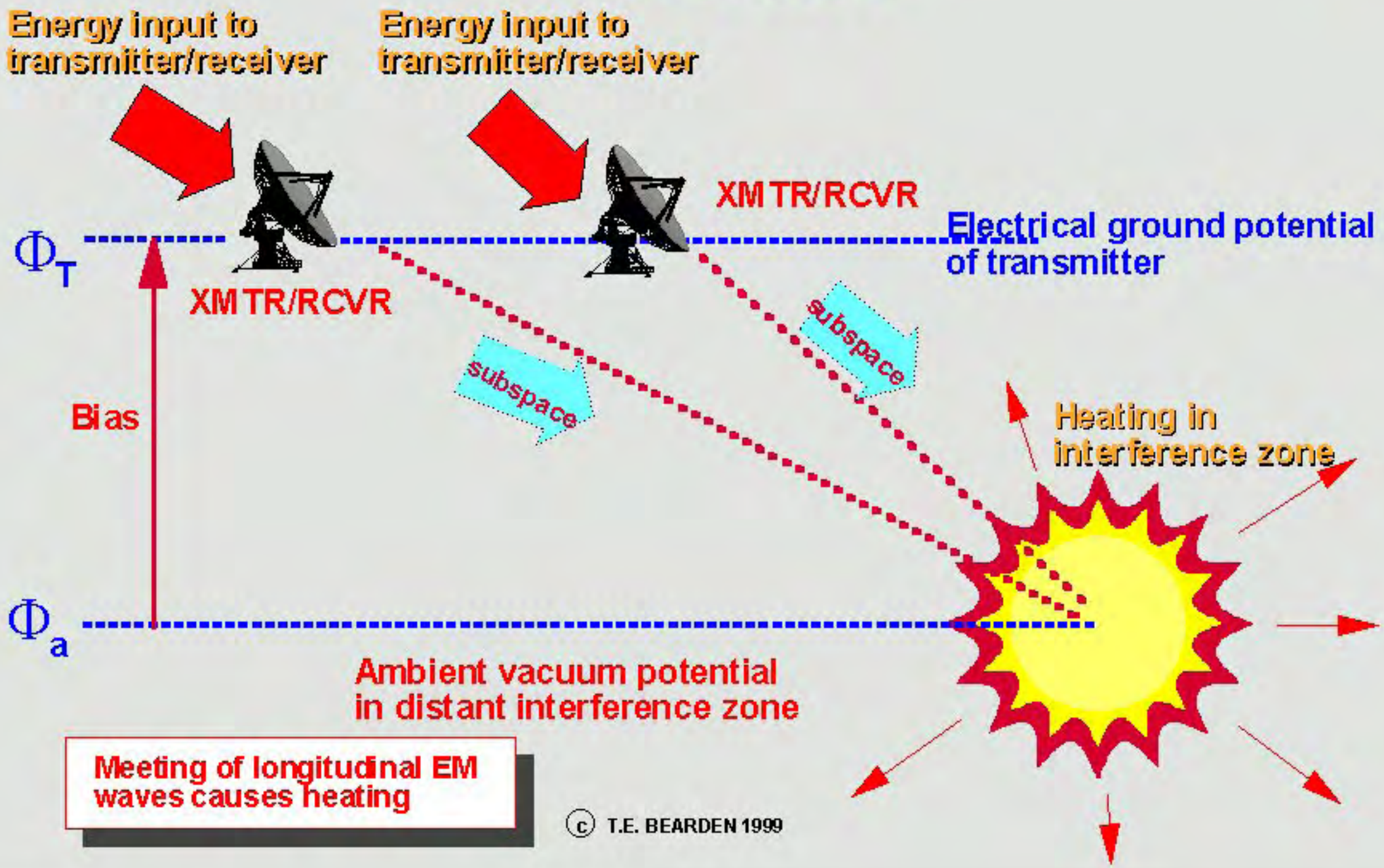

Meeting of longitudinal EM waves causes heating

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Longitudinal EM Wave Interferometry: Endothermic

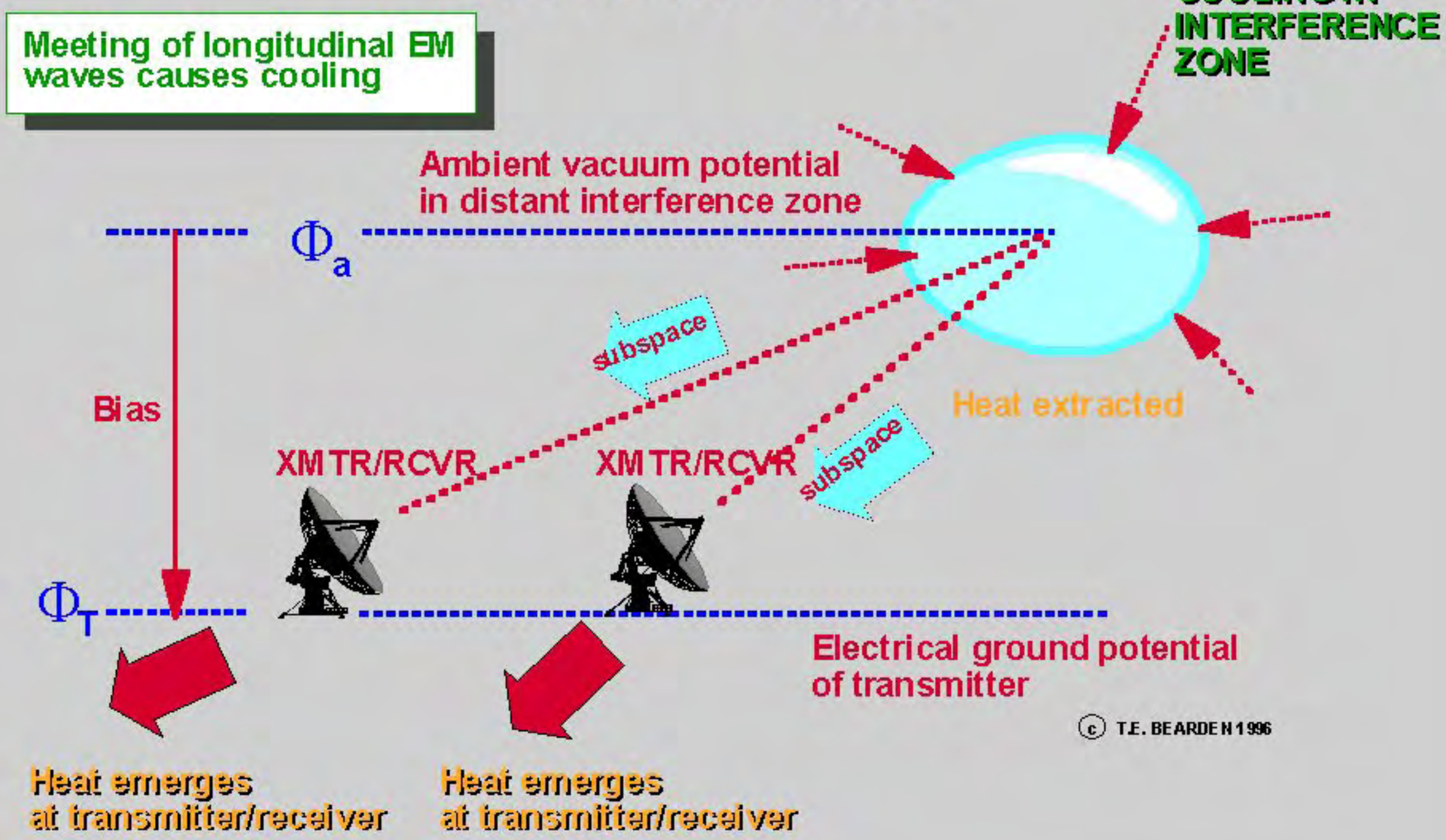

- More Frightening Than the Mind of Man Has Ever Imagined -

Brezhnev's unheeded 1975 characterization of these weapons as "more frightening than the mind of ran has ever imagined" has very real justification. In a moment we shall explain what he meant. We shall also explain why the Russians may be serious about substantial nuclear disarmament.

There is now a "balance of terror" loose in the world that makes the old MADmen's MAD concept look like a sunny day in Hawaii.

Let me explain just a little of what I mean.

The scalar EM can and does use an ordinary EM beam as a medium. Many, many scalar EM channels can be infolded into an ordinary carrier. Thus the amount of energy stored in the carrier as "electrogravitational" energy has little to do with the feeble amount of electromagnetic energy stored in the EM carrier signal.

Thus in one sense, when the Soviets are employing the big "continent buster" weapons, literally hundreds of millions -- or even billions -- of watts of energy may be infolded into the seemingly weak carrier beams. All this energy is in the scalar EM channels established in the carriers.

Plus which, the scalar beams are employed in a "standing wave" node. Each scalar standing wave is like a gigantic "capacitor": It is highly charged. Under normal conditions, it has a charge and discharge time constant as well. If something were to "short circuit" one of these huge standing waves -- say, one with a thousand megawatts in it -- all that stored electrogravitational charge would discharge through the short circuit into whatever is on the other end of the short, and into the ground itself. In other words, the earth itself in that location would receive a mighty electrogravitational pulse (EGP). The ground in a region surrounding the discharge point would "charge up" just like a capacitor, and would transmit the EGP as a hemispherical current into the earth and spreading around it. This is where the real problem cores in.

The problem, as originally discovered by Wilhelm Reich [orgone energy was and is real, and is simply one form of scalar electromagnetics], is that radioactive material has a very great affinity for this EGP and undergoes a drastic reaction to it. Crudely, it works like this:

Imagine the vacuum as a virtual particle gas. This gas is under extremely high "pressure" or, more correctly, internal Stress. This stress is a gravitational potential.

However, the stress of the ambient vacuum is normally about the same in most localities. So a chunk of radioactive material doesn't experience a difference in vacuum potential across itself or throughout itself. In other words, the scalar EM fluxes in and out of every part of the nucleus are very high, but of equal magnitudes. The radioactive nucleus, however, is "unbalanced"; that is, it has an extra bit of unresolved EG potential which it would very much like to get rid of or discharge, by spitting out one or more particles. That is, it would like to "decay" to a more stable configuration. A nucleus that is trying to decay to a more stable configuration is a radioactive nucleus.

Remember, the radioactive nucleus is involved in a tremendously dynamic virtual particle flux exchange with the vacuum potential. And a part of it isn't quite in balance in that flux. Sooner or later the right "bobble" in the input flux will come along, and the nucleus will decay and emit a particle and/or radiation. By measuring the level of decay activity in a certain amount of the radioactive material, we can determine a "decay constant," or basically the probability that a nucleus will decay in one second. We can then determine how long it will take that chunk of material to decay away to a stable, relatively inert material. Some materials only require a few minutes to decay, while others may require thousands of years.

Now if you suddenly and drastically change the stress of the vacuum in which a radioactive nucleus is imbedded, you change the potential placed on the unbalanced nucleus. You hit it, in other words, with a strong EG potential pulse -- an EGP. That instantly unbalances the nucleus and it decays explosively. That is, it changes the decay constant and the probability of decay.

Basically that's what happens in a nuclear implosion weapon: You hit the radioactive hunk of material in the center with a very high, imploding pressure wave, which is carrying an EGP. The EGP causes all the nuclei to decay nearly instantly, producing a nuclear explosion.

The bottom line is: strong EGPs wreak havoc if they happen to hit anything radioactive. Such as nuclear warheads, in missiles or in storage. Such as nuclear reactors. Etc.

Now do you begin to see the problem? Let me spell it out.

Suppose the Soviets have activated some of their giant scalar EM transmitters, to place a giant weather engineering grid over the U.S., or to knock down a Challenger or a Titan. They've got their scalar EM beams all charged up. One of the giant Woodpecker transmitters has -- let's say -- 500 megawatts in its infolded scalar EM standing waves. Everything is going good. They're socking it to the Americans and the Europeans.

All those multiple scalar EM frequencies they're using to form the patterns, etc. have to all be absolutely phaselocked. Therefore all the transmitters have to be rigorously phaselocked, too.

And suddenly something goes wrong. A major amplifier/transmitter controlling or stabilizing the phaselocking malfunctions. The phaselock is disturbed, and begins to quiver.

Emergency circuits react instantly, trying to stabilize the situation and restore the quivering phaselock. Little "shorts" are being applied to the circuitry and to the "giant capacitor" that is the scalar EM standing waves. Dumps and discharges of EM energy are beginning to flash in the transmitter and associated circuits -- and into the ground. These make the situation more unstable. Feverishly the emergency circuits struggle to contain this thing -- and Wham! they cave in, all at once.

Now you get a mighty and continuing discharge of the scalar EM energy in that standing wave back into the transmitter and into the ground. It burns out the transmitter. And the discharge continues as the "capacitor" drains all its EG energy into the earth in a giant pulse.

Around the transmitter site, the EGP is transmitted radially away, still very much like a standing scalar wave. It reaches the first nuclear facility. Let's suppose it's a nuclear reactor. Specifically, let's suppose it's a nuclear reactor at Chernobyl.

If you'll check Soviet Military Power, DoD, 1986 you'll find that there's a big ABM radar site not far from Chernobyl. And Canadian sources verify that one of the large Woodpecker transmitters seems to be sitting in that general location. Now check "The Soviet Nuclear Disaster," The Wall Street Journal, Apr. 30, 1986, p. 24. Check the small drawing in the lower right corner of the bigger drawing. Here you can see that a Woodpecker transmitter located near Chernobyl would ideally transmit nearly due west to intersect over the U.S., entering across North America from its east. Other Soviet "over-the-horizon (OTH) radar transmitters" go over the north polar regions, to enter the U.S. from the North. The two then form a giant interference grid over the U.S. (You can see that in Soviet Military Power.).

Suppose you were in the field in the U.S., measuring the Woodpecker signals. Suppose the stronger beam was coming from the east. You would be able to see this with your instruments.

Now suppose the giant transmitter near Chernobyl got into the type of failure we're talking about. The emergency circuits panic and cut down the EM carriers, trying to drain away the standing scalar waves in a controlled fashion. Then your instruments would suddenly record the "new" direction as coming from the north, since the east carrier is gone.

That's exactly what engineer Bill Bise detected out in California, about the time it appears the reactor at Chernobyl began to get in trouble.

Let's continue with our scenario. Suppose the emergency circuits at the discharging Chernobyl transmitter contain things for awhile. The standing scalar waves are steadily draining into the earth. The EG potential starts to rise at the Chernobyl nuclear power plant.

In the nuclear reactors, the decay constant of the uranium in the fuel rods changes. Additional radioactivity begins to pour out of the uranium. The reactor alarms go off, and the crew takes measures to reduce the problem. The control rods go further in, to slow it down.

But the EG charge keeps increasing. The radioactivity of the uranium continues to increase. The control rods go further in to counteract this. The electrical controls begin to act up, showing anomalous indications. The radioactivity increases. In panic, the controls are fought until the control rods go all the way in. The reactor should in fact now be shut down completely, in normal circumstances.

Things settle and hold a bit. The scalar EG charge increases. Finally the "shutdown" reactor starts to increase in radioactivity again. The control rods can't handle it. Everything is heating up, including the graphite moderator. Back at the transmitter, the emergency circuits finally are overwhelmed and give in. They fail all at once. The dreaded "uncontrolled short circuit" now exists between the collapsing standing wave and the earth. A gigantic discharge of EGP into the earth occurs at the

transmitter site.

In the desperate reactor, suddenly a great EGP appears. Instantly the uranium goes intensely radioactive. A gigantic pressure of heat, steam, graphite and radioactive materials bursts out of the reactor, breaching the building and erupting violently into the atmosphere. The core melts down. The graphite moderator ignites. You've got the realization of the nuclear engineer's worst fears: core meltdown and reactor out of control. It's afire and spewing deadly radioactivity out by the gobs. And the heat! It's like hell itself opened up for business in this spot.

At any rate, something very similar to that seems to have happened at Chernobyl.

This author believes something similar happened in 1957 in the Southern Urals. (See Zhores A. Medvedev, Nuclear Disaster in the Urals, Translated by George Saunders, W. W. Norton & Co., 1979, p. 150.). In the Kyshtym area, an explosion of nuclear wastes stored underground occurred in the winter of 1957-58. The area for miles around was contaminated, and is still contaminated to this day.

Recall, Khrushchev spoke of a fantastic weapon in development in January 1960. Early prototypes of the weapon would have been in development and testing in 1957. Probably at that time there were no emergency control circuits to handle standing wave collapse, or only primitive circuits at best.

If the failure of a transmitter occurred in full-power experiments, the unrestrained collapse of the standing scalar EM wave would most certainly have produced a large EGP in the ground, and instantly activated the nuclear wastes stored nearby. Eyewitness accounts reportedly stated that the wastes exploded, and that is totally consistent with our thesis. It is in fact a scalar EM accident signature.

Any nuclear facility at all is an incredible and monstrous risk whenever scalar EM weapons are active.

Of course, one's nuclear facilities are at risk if one's enemy has scalar EM weapons and fires at them, as we covered earlier in this book.

However, they are at terrible risk even from one's own scalar EM weapons. The consequences ot a relatively simple electronic failure can be catastrophic; not only for the local nation, but for the earth as a whole.

To show what we mean:

Suppose a similar scalar EM accident -- such as seems possibly to have happened at Chernobyl -- occurs at some other giant Soviet "radar" facility. Further, suppose this particular transmitter is not too many tens of kilometers away from a Soviet missile silo complex. Just to really throw in the grit, suppose these missiles are the "big monsters" with--- say -- a 50 megaton warhead in each missile. Suppose there are 10 of them in the complex.

Let's say this accident occurs "catastrophically" -- that is, the emergency control circuits are

overwhelmed immediately and a discharge of all the scalar energy begins at once.

A giant EGP strikes the earth, spreads in all directions, and strikes the waiting monster missiles. In their implosion trigger warheads and in their fissionable and fusionable payload, everything goes at once. Actually, it goes better than when normally triggered. So each one goes at about 100 megatons.

You've just had a monstrous 1,000 megatons of nuclear explosion in the earth. You get a giant earthquake. If it's not too far from the ocean, you get a tidal wave also. You get incredible amounts of lethal dirt and debris, radioactive and deadly, hurled violently into the air.

This is just about the equivalent of a "normal all-out nuclear war!"

And what about the other side's detection and early warning systems? Who's going to alert whom, and for what? How many missiles get launched?

I think you see the point.

And I haven't even covered what a giant EGP can do to humans. If it's truly a catastrophic failure, you can get an EGP that can wipe out half a mighty nation in one burst!

And if the discharge happens to tickle the Sun and Moon's feedback loops the wrong way, you'll get convulsions of the earth, mighty burps of the sun raining fire and brimstone on the earth, and a violent increase in the interior heat of the earth's molten core, with a concomitant eruption of that core right up though the mantle.

In other words, it could be "back to the beginning" for the earth, and start all over -- if, that is, some semblance of an earth survived.

The Soviets know full well the implications of their giant scalar EM weapons. (Remember, I estimate they have over a hundred of these monsters, based on Frank Golden's detection of their full-up exercise in April/May 1985.).

Scalar EM weapons have added a totally new dimension to the meaning of the word "terror". If one develops them and his adversary does not, nothing on earth can stand against them. So in Man's present state, the temptation to develop them is nearly irresistible.

On the other hand, if one's adversary already has developed them, one is already totally defeated unless one also develops them. Again, the need to develop them is imperative.

Yet, whenever one activates a large scalar EM weapon, one immediately places the entire earth in deadly peril. The slightest misstep, and it's curtains for everyone. And it's curtains for the earth as well.

So one is damned if one does, and damned if one does not.

We have reached the final turning point in human history. The clock is ticking away the last years -- or days -- of the lives of all humans on earth. There has never been such a threat.

We simply have come to the crossroads. somehow, all Mankind has to change.

Infatuated with the thirst for ultimate power, we are facing two doors. Behind one is a beautiful lady, and the fulfillment of all man's dreams: control of physical reality itself. Behind the other is the deadliest tiger ever dreamed of in our wildest nightmares.

Which is it to be, the lady or the tiger?

SCALAR EM INOCULATION AND ITS IMPLICATIONS

My appreciation goes to Gary North for his openly sharing the above important information with the public. Human nature being what it is, one or more of his more dire scenarios is going to happen sooner or later.

The problem becomes enormously more compounded if the hostile agent or agents possesses sophisticated scalar EM technology.

With scalar technology, there exists the potential that the worm or virus can be implanted from a distance. If scalar scanning devices of sufficient precision can be developed, then major software residing in a chip, a computer, or on a disk can be read from a distance. With scalar EM methods, the ordinary software "guards" are totally ineffective. The scalar "reader" could simply read off the software directly as the disk or device goes about its normal operations.

After the software is read, a germ or a virus is designed to produce a particular problem as desired and upon special stimulus. Then a scalar "imprinter" device is used to produce the necessary digital pulses directly upon the media in which the software resides. The required code has now been .implanted. In effect, the operating system has been injected from a distance, and contaminated with the desired "sleeping agent" -- germ or virus. From there on, it's just like Gary North's scenarios.

So the scalar EM technology can probably be used (at least eventually) to place "mines" in systems in advance, for damage or destruction at a future date. At least it's possible in principle.

However, it's not the injection of computers and equipment that bothers me. It's the injection of human beings. Here's generally how it can be done (and possibly is being done).

Basically, human brains have various rhythmic waves which represent "envelope pulsations" of the entire electrical system. However, it is not the EM force fields represented by these pulsations which are important: it is the summed-zero (scalar) patterning of the entire complex of neuron firings which represents the real activity of the brain -- and represents it thoughts and emotions. A storage system for these patternings exists, but it's a scalar pattern storage, not an E and B field storage. The storage system is in the nuclei of the tissues of the nervous system itself, not in electrical or electrochemical potentials.

At any rate, the human brain rhythms are also "riding along" relatively entrained to the Schumann resonance of the earth's magnetic field. So all the patterning of the brain is grouped together into giant overall orders, and one or more of these is normally synchronized to our natural environment.

If a varying magnetic signal of extremely low frequency -- say 10 hertz -- bombards the brain with greater power than the earth's magnetic field, it is possible for the brain's rhythm to be "forcibly entrained" to synchronize with that signal, rather than with the normal Schumann resonance. If a large number of brains are forcibly entrained to such a signal, and the signal is artificial, then a master coherent phasing of all the brains to the transmitted signal has been accomplished.

And that can be utilized -- and is utilized -- by the Soviet Union. On the Woodpecker signals, Bob Beck has detected up to 16 carriers, each with a 10 Hertz modulation, and with all the 10 Hz modulations in phase.

Let's stress what we're saying here. At times, the Woodpecker signals have shown 16 carrier frequencies which contain the same 10 Hertz modulation, and which are all kept coherently sync-locked.

If those signals and the modulations are strong enough, the brains in a targeted area demodulate the 10 Hertz signal and phase-lock to it -- actually, to them. At that point, the brains are entrained to

a 10-Hertz driver, and 16 channels of multimegahertz frequencies are locked-in to the brain.

Now if the Soviets have broken the genetic code of the human brain (which they have) and succeeded in developing the ability to implant thoughts, emotions, pictures, etc. (which at least to a degree they have), then they can simply record the proper signals from human guinea pigs, using scalar technology and instrumentation. They can tailor those signals and add them onto the Woodpecker carriers, using scalar EM techniques. By using most of the sixteen carriers as a means to express Fourier frequency expansions, specific areas and functions of the brain can be targeted.

Notice that the distant transmitters al ready "know" the correct phasing; just use the 10 Hertz modulation signal as a reference. In that case, phasing takes care of itself inside the captured human brains.

The brain has a unique characteristic. If a signal arises inside it, it interprets that it itself originated the signal. Thus for the first time in history , true unwitting "robot" actions and emotions can be engendered in masses of human beings.

But it's still worse. The Kaznacheyev experiments (see references) proved conclusively that electromagnetic signals can carry and transmit cellular disease and death patterns into a targeted biosystem. You can rest assured that the Soviets continued on to actually measure and determine a wide variety of death and disease scalar patterns. All of that can be added on to the Woodpecker carriers so that the population in the intersection grid area is devastated. One can even test it out in advance by producing a modified pattern of a disease in the targeted populace, and keeping the percentage of brains entrained down to a small level. This lowers the number of persons "injected" from a distance to a small percentage of the populace. Then the outbreak of the "new strain" of a familiar disease -- such as influenza, pneumonias, and something like AIDS -- can be monitored to provide targeting and effectiveness data. Notice that a series of diseases was experienced by U.S. personnel assigned to the U.S. Embassy in Moscow, probably as a result of the so-called "weak microwave radiation" of the Embassy by the Soviet Union.

But that's not all. Much more subtle effects can be produced in the targeted populace, without anyone getting wise. Cancers and leukemias should be relatively easy to induce. Also, the immune system can simply be attacked directly. If done slowly, a series of common, ordinary diseases will just seem to get "tougher and tougher to cure." Actually it's not the disease that got tougher, it is the immune systems that got weaker. It is my opinion that precisely that sort of testing -- against the immune system -- has been accomplished by the Soviet Union against the U.S. since about October, 1985. A great percentage of influenza patients during the period from then until now have had complications. So much so that multiple sessions -- as many as 3 to 5 -- of antibiotics are necessary before the patient recovers. At least in the Huntsville, Alabama "hinge pin" area, that seems to have been the case. This author personally experienced this, having influenza and follow-on complications for a period of seven months -- something quite different indeed for him.

But it's even worse.

The human scalar EM nervous system ("inside" the ordinary EM signals and functioning of the system) also has its own resident "software." It has special storage media contained in its brain. its cells, and its genetic material, and its actual nucleons. All of these storage media are continually telecommunicated with via scalar EM means. The "stability" of what each of us is, is largely conditioned by those recordings. As personalities we literally "are" what we have experienced, felt, thought, and did. Our whole "functioning conscious system" has been evolved by our experience, and it continues to be "us" by means of continual reference to the record base.

I hope you now realize that the actual record base itself can conceivably be altered by scalar electromagnetic means, even from a distance. Even by the hidden scalar EM content of 16

Woodpecker carriers, locked into a captured brain and pouring in their deadly content. It is conceivable that even what one is can be taken from him, and what someone decides he will be, he will be.

A totally new -- and ultimate -- form of "slavery" has emerged.

Also, look at all this scalar EM functioning of the human system as a special kind of cybernetics. A scalar EM computing software and hardware system.

What if scalar techniques are used to plant "worms" and "viruses" in this system? With hidden triggers? What about a series of them, so that a range of "eruptive software diseases" can be stimulated at will?

And guess what. Such scalar EM "worms" and "viruses" can even be induced by contact with or consumption of "contaminated" water and food. Or saliva. Or other body fluid.

So you can see the possibilities of "seeding" a population with a staggering variety of time-bombs.

I think you begin to see the point. Now you can change North's "Soviet blackmail" scenario drastically. In a new scenario, Gorbachev simply announces to Reagan that a graduated series of specific sweeping changes are going to happen in our population -- changes which we are absolutely powerless to stop. The last stages are various deaths. The master "trigger" for this series has already been initiated. Incidentally, the Soviet populace has been carefully "seeded" with the proper antidotes. The Russian leader demands certain things (very similar to what North's scenario utilized). Unless his demands are met, a "killer virus" will be activated by a special signal. If so, everyone dies. The first step change in the series will start to occur in a few hours. And it does.

In fact, this scenario could be added to North's scenario, and both used simultaneously. What do you think the President and the Congress would do? Or could do?

There are other even more diabolical possibilities, but these should be quite sufficient to illustrate the point.

Pandora's box has already been spilled, and the end of humanity is ticking away like a time-bomb. It's already nearly midnight, and the watchman hasn't even sounded the alarm yet.

I certainly can anticipate the next question: Have the Soviets already "seeded" the populations of the U.S. and other selected western nations with scalar EM viruses and germs"?

The answer is, I simply don't know. And just like Gary North, I don't know what if anything can be done about it if they have. This researcher certainly doesn't have all the answers. An immediate national crash program to develop scalar EM defenses is essential if we are not simply to be crushed beneath the hammer and sickle. It takes funding, people, facilities, and time.

In some 22 years of unrelenting struggle to convince the system we've got a terrible problem, I've hardly been able to move it off dead-center (no pun intended). This book, produced under extreme workload stress, is all I can do to raise the alarm. I've given it my very best shot.

What happens now remains to be seen. Other hands, hearts and minds are going to have to take up the task and carry it forward. This researcher has reached his limit, and has no more left to give.

1986 APPENDIX II

COMPUTER WORMS AND VIRUSES, AND THE IMPACT OF SCALAR EM

Source: - Gary North, "Electronic Aids (Parts 1 and 2)," Remnant Review, 12(20), Nov. 1, 1985, p. 1-8; 12(20), Nov. 15, 1985, p. 1-8. POB 8204, Fort Worth, TX 76124. Phone (817) 595-2691.

Annotation: - Two deliberately un-copyrighted issues to alert the public to software worms and viruses, and their implications for drastic interruption of society. Describes a hypothetical scenario in which drastic scrambling and destruction of banks' computer tapes, files, and records occur due to software worms and viruses. Written in first person by Gary North. [Slightly edited.]

Article: - "Worms." Earlier this year, I read a very interesting article on a major problem facing computer software (programs) development companies. A program comes on one or more 5.25-inch plastic discs. It takes only a few seconds to copy a program on one disc to a blank disc, which costs $3. Yet these programs normally run at least $250, and usually sell at $495, and sometimes cost thousands. Very few are less than $100. So you have a major temptation: make a $500 asset out of a S3 asset. Insert the $500 program into drive A, write "COPY A:*.*.B:" and hit the "enter key;" sixty seconds later, you have a $500 program in drive B.

There are ways to make this copying more difficult. The companies code the programs, and force you to have a control disc in drive A at all times. These "copy protected" programs are a hassle for users. We cannot put them on "hard (big) disc" easily, and sometimes the control disc dies for some reason. Then what? Your data are locked in your hard disc or on a floppy disc, but you can't get to the data because the control disc is not functioning. You order a replacement. Weeks go by.

Last year, several firms came up with a solution. It is called a worm. A worm is a command that is built deep into the complex code that creates the program itself. These are incredibly complex codes, and it is easy to bury a command in them. They cannot be traced.

What does the worm do? It "eats" things. Say that you are a software thief. You make a copy of a non-copy-protected disc, either to use on a second computer, or to give (or sell) to a friend. The program works just fine. But when the program is copied to a new disc, the worm is "awakened." It bides its time, maybe for many months, maybe for years. The program's user is blissfully unaware that a monster lurks inside his pirated program. He continues to enter data, make correlations, etc. He becomes completely dependent on the program.

Then, without warning, the worm strikes. Whole sections of the data disappear. Maybe the data storage disc is erased. Maybe it is just scrambled. Even his back-

up data discs have worms in them. Everything he entered on those discs is gone. Forever.

Can you imagine the consternation of the user? He has become dependent on a booby-trapped program. His business could simply disappear. For the savings of $500(stolenprogram),hecouldloseeverythinghehas.

Several firms threatened to insert worms into their programs. But then they backed off. They are afraid that lawsuits initiated against them might go against them in court. They could be hit for damages suffered by the thieving victims. Juries might decide that the punishment, a bankruptcy) was too much for the crime (a $500 theft).

So far, no worms are lurking in any commercial software programs — as far as I know and the industry knows, anyway. But what if a disgruntled programmer was to hide one in a master copy of, say, Lotus 1-2-3, the most popular business program on the market? What if ten thousand copies a month go out for, say, three years? Then, without warning, every company that has started using them loses three years of data? They sue Lotus. Lotus goes bankrupt paying lawyers. No company in the industry is willing to talk about this sabotage threat publicly. Obviously.

LARCENISTS

I just happened to stumble across an article on worms in a computer magazine. It occurred to me that it might be possible to use the worm technique as a form of deliberate sabotage rather than just as a copy protection device. But what did I know? I'm not a computer expert.

I know a computer expert, however. I mean, a real expert — one of those people you occasionally read about. In the world of business, they're called "space cadets." They operate somewhere in between the asteroid belt and Jupiter. But this one is different. He's a businessman, too.

I got him to sit down with me to discuss the problem of worms. It turned out that he has a real fascination for the topic. He tells me that there are advanced design worms, called 'viruses' by 'hackers' — computer freak programming geniuses. "The software virus is the most terrifying thing I've ever come across," he told me. And then he showed me why. My initial scenario is based on only a portion of his estimation of the threat. It gets a lot worse.

He gave me a 90-minute FIRESTORM CHAT interview. He must remain anonymous. He used to be a software developer for programs that were used in the U.S. banking system, but is now employed in a highly sensitive job in a related industry. Therein lies his problem. If he were to tell the story of what he is capable of doing to these banks, his firm might lose a lot of sales. He can't "go public." Let's call him Tom.

Let me summarize briefly some of the details he gave to me. They floored me. They're going to floor you.

(1) Jackpotting. The rush is on in the banking world to get automated teller machines (ATM's) into shopping malls, supermarkets, and in front of every bank. We've all seen them. Just walk up, punch in your card number, ask for cash, and you get it.

In a busy location, one of these machines can hold as much as $250,000 in cash, mostly small bills. These machines are controlled by computer. They are hooked up to the bank's computer system, usually by phone lines. This local line, Tom tells me, is what computer freaks call THE LOOP. The loop is wide open to tampering. He says that what computer thieves are doing is to hook up a cheap Apple II computer, tie into the phone lines, break into the ATM, and get it to empty itself. This is "jackpotting."

He tells me that ATM thieves are hitting banks continually, but nothing is getting to the press. The banks have yet to show a profit with the ATM's so far, which is understandable. They are hoping to get their machines placed in key locations, so "market share" is crucial to their plans. They are suffering horrendous losses in the short run in the hope that long-run profits will pay off, if and when a defense is developed.

The banks are saying nothing because of their fear that if the extent of the losses gets into the press, they will be forced by pressure from depositors — bank runs — to cancel the ATM's. The losses are horrendous, he says. At present, there is no known defense, given the communications technology.

(2) Rounding Off. This is the "preferred" computer bank theft system. Someone on the inside who has access to the software takes advantage of the banks' need to round off numbers. The programs carry numbers out to 13 places. Banks can't use all that space. So when they balance the books (interest rates at, say, 9.873), they just don't count every tenth of a cent. The program is assumed to round off the numbers randomly. What does the bank care? But the thief has set up bank accounts that absorb those random tenths or hundredths of a cent. In millions of dollars worth of transactions (federal funds, etc.), programmers in some cases have stashed away hundreds of thousands of dollars — maybe millions — over a few years. No one knows how much of this goes on.

How could a bank spot this? The books would always balance to the penny. How would the accountants ever know?

I think of a story that Adam Osborne tells in his paperback book, Running Wild. The president of a large firm was looking out his window one day, and he noticed two Rolls Royce cars parked next to each other. He inquired as to the owners. They were two men in the data processing department. He called in investigators, and the cars and the men disappeared. They fled to Brazil and took their cars with them; **Brazil** has no extradition treaty with the U.S. Years later, as

Osborne was writing the story, the firm still hadn't figured out what they had done.

ARSONISTS

These are the fearful ones, far more than the larcenists. These are the practical jokers who get into a major data bank and trash things. It's a kind of multimillion-dollar "Kilroy was here" graffitti.

How easy is it to get in? Incredibly easy. The boy in "War Games" really could have broken into most firms' telephone-connected computers. Computer programs exist that allow the user to hook up his computer to a phone line and randomly dial numbers until they hear the telltale whine of a computer line. It then notes the phone number and goes on its way, searching out more lines.

They can do it by long distance, free of charge. The telephone company has a tough time tracing those who use various sorts of electronic black boxes to call anywhere on earth at no charge. Some people get caught, of course. "The tip of the iceberg," says Tom.

How do they get in? Easy: few systems are protected, once you locate the line. If one is, he says, you create a deliberate error. Most programs then collapse the protective shell, and the hacker finds himself inside the heart of the system. Tom has designed a program that keeps this from happening to his company's programs, but few companies have anything like it.

It's very easy to get in if someone has "logged on," — opened his terminal's connection to the main computer — if the system is connected to phone lines. Or anyone in the company can just tap in, if someone has left his desk and left the computer on. It's common to forget and leave an open terminal.

He showed me. He says anyone can get fired for leaving a computer on. He demonstrated his point. With 40 computers on line, he ran a quick search and found two of them "logged on," despite the fact that it was after hours. All the security in the world can't do anything if a computer line is open. It's like a burglar alarm; it's worthless if you leave the door unlocked or leave the keys lying around. That janitor you hired. Is he a computer illiterate? Or a plant?

Once inside, what can you do? Steal a fortune? Yes, if you really know the system. He told me he could easily steal $3 million from a local bank, even as an outsider. He would then offer to give it back and keep his mouth shut about how easy it was if the bank would pay him 10% the take. He thinks most banks would capitulate for fear of the publicity. In any case, he knows that he probably wouldn't get caught.

How about creating a new identity? The grade-changing scene in "War Games" is true. You could even create a new identity, give yourself high grades in any academic discipline, just by breaking into a university's database. There is very little security here, he says.

But for sheer vindictiveness, for sheer envy, consider the possibilities of a virus-implanter. He gets inside the computer for a major communications link: telephones, large information database, bank wire transfer, or whatever. Then he lays the egg: a tiny, untraceable brief instruction. Inside a huge database are just a few characters. These float inside a system, seeking to devour certain kinds of data, or executing certain routines.

There is a game played by computer freaks called "Core War." They try to implant these killer messages, which seek out each other and battle one another. If you find one morning that yours has been consumed, you lost the battle. That was probably the origin of worms and viruses.

TERRORISM

Say that a revolutionary terrorist group, or some anti-zionist group gets a "ringer" into a system. He might be a computer genius type. Everyone knows they are either oriental, dark-skinned people with accents, or teenagers. The firms don't hire teenagers, but they hire a lot of foreigners. They may even check the guy's credentials. Electronic credentials. (Ha!) Then they turn the guy loose in the system.

The virus is implanted deep inside the system. It can then be transferred to any other bank's computer by means of EFT (electronic funds transfer). Maybe it is triggered when someone with a peculiar name and address opens a bank account. Three days later: Bam! The data disappear. They haul out the back-up tapes. Bam! The virus is on them, too. It is a process of infection, contamination, and incubation. There is no known defense. Not yet. This is the bottom line.

ANTIBODIES

The designer of a virus can also design an "antibody." The antibody is a counter-virus agent that seeks out a virus and destroys it. But like other antibodies, it must be specific. The only way today that an antibody system can be created is to know what kind of a virus is involved beforehand.

Tom says that people are now selling antibodies at very high prices. Who is paying? Big companies that suspect that there is a virus present in their computers. In all probability, the guy selling the antibody created and injected the virus. But now can any businessman prove it? So he pays the blackmail.

NATIONAL DEFENSE

A Soviet agent or American spy working for the Soviets penetrates any of a dozen computers used by the military. He plants a virus. The computers talk to each other, and the virus spreads to all of them. It tells them to execute a certain routine when a certain command is entered at a missile-controlling terminal. That command might interfere with a routine that activates a missile or launches it. Upon reading that command, the virus shuts down the computer, or scrambles

the executing program, or scrambles the data. No more "launch on warning." No more launch at all. Dead metal.

Scenario: The President of the United States receives a telephone call on the "red phone" — the direct link to Moscow. He lifts the receiver and says, "Hello."

"Mr. President, this is Michael Gorbachev. You must recognize my voice. I have very little time. I will come directly to the point. You have refused to back down on your threat to implement your Strategic Defense Initiative. You intend to go ahead with space-based weapons. My military staff informs me that they think that the United States has the technology to implement it, and that it could place my nation's military strategy in jeopardy. We cannot allow you to do this.

"If we allow you to deploy the SDI, it will be too late for us to respond effectively. Therefore, we are taking the initiative today. I issued orders this morning to put Soviet military units on immediate alert. We are abiding by your biblical rule to announce the initiation of hostilities before striking. Neither the Japanese nor the Germans gave us this courtesy. If you do not come to terms with us, we will launch a first strike against your nation in three hours. We will delay for one day, if you agree to follow a precise procedure that I will outline shortly.

"At one time we feared nuclear retaliation. We no longer do. Within two hours, you will know why not. I suggest that you instruct your ballistic missile team to prepare your missiles for a strike. Then, to prove to yourself that we no longer are concerned about retaliation, launch one or two of them. As far as I am concerned, launch all of them. But please instruct your senior military commanders to report back to you concerning the effects of their instruction. I suggest that you try launching three or four as a test. We don't care which ones.

"Mr. President, let me tell you what is going to happen. As soon as anyone attempts to launch a missile, that missile's computer guidance system will shut down. It will lock up tight, and you will not be able to unlock it within the time you need to respond to our attack. Two hours and thirty minutes from now, your nation will have no remaining Minuteman III missiles to respond with, should you finally unlock your frozen computers.

"I suggest that you contact your senior officers now. You will have to mobilize them within 60 minutes. The test should take about 30 minutes. I will telephone you again in 90 minutes to present our terms of surrender." Click.

The President calls the Joint Chiefs. If he is lucky, he will be able to locate two of the three in time. They will be paralyzed. Who wouldn't be? But in all likelihood, they will at least test Gorbachev's theory. They will order one or (wo missiles launched. The computer guidance system on both will shut down the system. They will try two or three more, with the same result. They will attempt to launch one from a submarine, with the same result.

The President brings in senior Congressional officials and the remaining Joint Chiefs member to the White House.

Exactly 90 minutes after he had hung up, Gorbachev telephones back. He presents his list of demands. First, the immediate removal of U.S. troops from Europe. Second, the withdrawal of personnel from Diego Garcia Island in the Indian Ocean. Third, the breaking of diplomatic relations with Red China and Taiwan. Fourth, the removal of all U.S. troops from Korea. Fifth, a moratorium on all debts owed to U.S. banks by the Soviet Union and its client states. Sixth, the removal of all Minuteman III missiles from their silos. Seventh, the return of all U.S. submarines to port. If he agrees, and the orders are delivered within two hours, the Soviet Union will delay launching a first strike. The President complies.

They might do it with our communications satellites, Tom says. You might do it with any aspect of U.S. data transmission. The virus could sit dormant in a system for years, and no one would know. Triggered, it would then strike.

THE WEST'S VULNERABILITY

The West has become increasingly dependent on computers. We can no longer function without them. The Third world hasn't. Neither has the U.S.S.R. Their technology is still pre-computer. They are inefficient, but they are far less vulnerable.

Tom says that the world of computers presumes that almost everyone is essentially honest, and that all the brightest programmers must be honest. They aren't. Thus, the members of the entire system — banks, national defense, large and small businesses, public utilities — have opened themselves to attack. The attackers are invisible.

"Nothing I have seen in all my years of computers scares me as much as this does," he says. "The system has been designed in terms of a far older set of standards, especially with respect to security. It is totally vulnerable."

He compares it to plague, or venereal disease. People copy each other's software to save a few bucks. They use public access databases. They use "loops" — the phone lines. Yet these transmission belts of information can become transmission belts of collapse.

This is what I have harped on for twenty years: the potential for a collapse of the division of labor. We become rich by means of a brilliant technology, yet we become dependent on it to an extent that no previous society ever has.

Centralized institutions are most vulnerable, but because we use public transmission lines, from microwave transmissions to cables in the ground, each local unit is vulnerable. Those who would choose to bring down the system need only plant electronic viruses in a handful of major common-use databases or transmission sources, and live years or ten years later, the disease hits.

It could bring down the system if technological defenses are not developed. Nothing on the immediate horizon points to a solution, he says. The silence of those who should know what to do indicates that they don't know what to do, but they don't want panic to spread.

Is this fantasy? Last summer a 23-person team broke in (by phone) to Chase Manhattan Bank's computer.

Break-in: - Continuation of part 1, a treatise on worms and viruses in cybernetic systems.

"Maybe you saw the article buried somewhere in your newspaper. I saw it in the New York Times (Oct. 19):

> "A group of at least 23 teen-age computer users broke into a Chase Manhattan Bank computer installation by telephone in July and August and "significantly damaged" bank records, the Federal Bureau of Investigation said yesterday.
>
> Chase officials insisted that no money was stolen or transferred out of customer accounts as a result of the break-ins, and said no intrusions have been detected recently. But Federal officials, in an affidavit, said that in several cases the youths changed passwords, preventing customers — and in one case a unit of the bank itself — from gaining access to their own computer files."

And where were these teen-agers located? In San Diego, across the continent! It gets even more ludicrous:

Federal officials said that most of the offenders were probably too young to be prosecuted.

Robert D. Rose, the assistant United States Attorney handling the case, said: "We're not yet sure what we are going to do. But these things can get out of hand — it did get out of hand — and we have to treat them seriously."

Treat what seriously! "These things?" What things? If they can't legally treat the electronic trespassers seriously, just what is the man talking about? He is talking about the topic, above all topics, that bank and government officials don't want to face: the vulnerability of their computer records.

I have seen no follow-up on this story in the conventional press. A brief article did appear in the computer-oriented tabloid, Info World (Oct. 28). It turns out that the students had broken into the fifes of Interactive Data Corp. of Waltham, Massachusetts, which maintains the bank's financial records. The break-ins were discovered in late July. They had obtained the toll-free 800 number which was restricted (Ha!) to Interactive Data subscribers. As late as October 9, an illegal entry was observed. In short, it took ten weeks after the break-ins were discovered to put a stop to them.

The response of the bank's bureaucracy was predictable. It will ever be thus: "Bank officials are claiming that the FBI exaggerated the nature of the activities of the suspected individuals. A spokesperson for Chase Manhattan said that Interactive's customers were not prevented from accessing their accounts and that none of Interactive's data was altered or manipulated in any way." In response, FBI supervisory agent John Kelso said that the FBI has sworn affidavits from bank officials that say data has been manipulated or damaged. "That sounds pretty serious to me," he volunteered.

Here is the capper: Interactive Data has 25,000 subscribers who are tied into that toll-free phone line. Try keeping tight security on a system with 25,000 users. Chase Manhattan couldn't. If they can't, who can?

And if Chase Manhattan Bank was vulnerable to 23 teenagers who are too young to prosecute, consider its vulnerability to just one envy driven genius who knows all about electronic viruses. The students that did this were apparently just goofing around. But what if just one malevolent computer freak decided to "get even" with Chase Manhattan? What if he had phoned in just once or twice, implanted a long-dormant data-killing virus, and quit? What if he had tied its detonation to, say, a calendar clock in the Interactive computer? If it took security forces from July until early October 15 to raid the 23 students' homes, they would never have spotted one break-in. They could not have traced it, either. Conclusion: we have a risk-free opportunity for electronic arson. We face a potential electronic epidemic. And when I say "we" I mean the entire financial system of the West.

Sure, all the bank "spokespersons" in the world will tell you, "No problem." But there is a problem. A horrendous problem.

At this point, it really gets interesting. Chase Manhattan Bank has just announced that we will be able to set up our own personal electronic banking facilities with them by buying an expanded version of *Managing Your Money*, Andrew Tobias' home financial management.

Citicorp and Bank of America have opted for *Dollars and Sense* a rival program. You will be able to pay monthly bills electronically, balance your "checkbook," monitor your net worth, buy and sell stocks, etc., etc., just by dialing Citicorp or Chase Manhattan. Fantastic! But despite all the assurances, I get nervous. Yes, I know no one will be able to break in and tamper with the numbers. But 23 teenagers shouldn't have been able to do it, either. And now we're talking about a lot more subscribers than 25,000.

Obviously, the master program used by the banks will prohibit easy entry. Unfortunately, someone has to write the program. Can you imagine the blackmail possibilities? Some hotshot programmer could build-in a bomb, and then threaten to detonate it. In fact, he could merely pretend to have inserted a virus. Who would want to call his bluff? Not Chase Manhattan, I would bet.

CORE WARS REVISITED

In May of 1984, A. K. Dewdney published an article in Scientific American's "Computer Recreations" column. It was a light-hearted-piece on how computer experts can get involved in playing this exciting game of "blow up your opponent's defenses." You know: recreation! In the March 1985 issue, he wrote a follow-up. It begins:

"When the column about Core War appeared last may, it had not occurred to me how serious a topic I was raising. My descriptions of machine-language programs, moving about in memory and trying to destroy each other, struck a resonant chord. According to many readers, whose stories I shall tell, there are abundant examples of worms, viruses and other software creatures living in every conceivable computing environment. *Some of the possibilities are so horrifying that I hesitate to set them down at all.*"(emphasis added.)

It turns out that tne French nave been enjoying a novel on the international implications, *Softwar: La Guerre Douce,* by Breton and Beneich. A translation is scheduled for publication here by Holt, Rinehart & Winston. The study revolves around the sale of a high-power computer to the Soviet Union. The U.S. allows its export because it has a "software bomb" in it. When the U.S. Weather Service announces a certain temperature at St. Thomas in the Yirgin Islands, the program proceeds to subvert every piece of software in the Soviet Union.

A pair of Italian programmers was "inspired" by the translation of Dewdney's original article to dream up a virus (a virus is a computer-to-computer killer, whereas a worm is resident in one man's computer). They figured out that by infecting a disk operating system disk (these start computers and tell them what to do with programs and electronics), and then installing it on disks used by the biggest computer shop in the city, they could create an epidemic. They decided not to do it. In short, the only restraint is self-restraint.

A high school student in Pittsburg wrote a virus that was subtler than a data-destroying virus, which at least tells us that we have a problem. His virus created a plague of very subtle errors in the disk operating system. "All of this seems pretty juvenile," he wrote, but "Oh woe to me! I have never been able to get rid of my electronic plague. It infested all of my disks, and all of my friends' disks." He wrote a program to destroy the virus (an "antidote" to it) but it is not anywhere near as effective as the virus is.

Warning: do not copy disks from your friends' copies. This act of piracy could cost you plenty.

A COMMERCIAL WORM

Just a few days after I wrote "Electronic AIDS, Part 1," 1 read a column in the Washington Times, the conservative (Moonie-owned) daily newspaper. One of the reporters has a computer. He had purchased a newly released program from

Microsoft Co., called "Access." Understand that Microsoft supplies the disk operating system that is used by the IBM PC, the most popular microcomputer. In other words, this is no backyard company. It is one of the two or three software giants in the U.S. (Its owner is under age 30, which tells you something about who is pioneering the microcomputer revolution).

As he was setting up his computer to take advantage of this telecommunications program, a warning flashed on his screen: "The weed of crime bears bitter fruit. Now trashing your program disk." Wham! He lost all his files — probably a couple of year's worth of work. Sure, he was probably smart enough to have made back-up copies, but think of the risk. And what if it had been a worm that kept silent for a few years, infecting all of his back-up disks?

He called Microsoft, and they gave him the runaround. They told him that they were not responsible. Some programmer had put in the worm in order to zap program pirates, but the journalist insisted that he was an original buyer. Tough luck, they told him. Obviously, they didn't know that he was a reporter.

Then he published his article. All of a sudden, the victim was not some average buyer. He was big trouble. Things started moving. InfoWorld (Oct. 28) reports that Microsoft has admitted that a programmer put in the worm, but without permission. The offending text has now been removed, we are assured. But what if it had sat in the master for three years? Here is the premier firm in the software.

This is not idle speculation. It has already happened, verifying my hypothetical scenario within a few days after I published it.

Can you imagine the absolute havoc that a dormant worm or virus could create if it were imbedded in all updates of Microsoft's masters of PC DOS and MS DOS, the operating systems for all IBM microcomputers and IBM-compatible microcomputers? It could cost the U.S. economy billions, and some microcomputer-dependent firms wouldn't survive. Any Microsoft spokesman who says, "It's impossible; it could never happen," has to explain how it already did happen to "Access."

ADAM OSBORNE'S WARNING

You may know the name Adam Osborne. He invented the revolutionary portable computer, the Osborne 1. Before there was an Osborne 2, the company went bankrupt. Compaq, the most successful first-year firm in U.S. history (over $100 million in sales in its 12 months of operations) and others built imitations that were far superior.

That isn't my point, however. Adam Osborne was "present at the creation" of the microcomputer industry. He created Osborne publications, and then sold out to McGraw Hill. He knows what is going on. In his delightful paperback book, Running Wild, which is a history of the microcomputer (desk top) revolution,

1975-82, he offers this warning. He says that three areas should not be allowed to be computerized: 1) bank money transfers; 2) the stock market; 3) elections.

All three are just about fully computerized. Another ten years, or maybe five, and they will be 100% computerized. Several firms allow microcomputer buying and selling of stocks (e.g., Charles Schwab), and New York Stock Exchange floor transactions eventually will be fully computerized, at which time it will be pressured to get rid of the "specialists" who make (and sometimes manipulate) the market, short-term — Richard Ney's hated "Wall Street Gang" — but the price of getting rid of them may turn out to be horrendously high.

"The great fortunes of the 21st century," Osborne predicts, "will be the legacies of the great computer thieves of the 20th."

Three years ago, I used a firm to supply computer services I needed. The head of it was a former businessman, quite young, and a true "space cadet." I've quoted him in the last issue. I call him Tom. He operated in a world far removed mentally from the rest of us. He is a nice fellow, a Christian, and a moral philosopher of sorts.

He ran the operations of the local elections. He did it fairly inexpensively. He told me why: "I want to keep these elections honest. It would be incredibly simple to rig the program to produce whatever outcome I wanted in close races. If I can do it, anyone with enough skill to set up the system could do it."

I asked him if he thought Osborne was correct in his predictions about bank theft. "It would be a piece of cake for me to steal three or four million from any local bank. I could go in the next week, offer to give the money back, keep 10% as a finder's fee, and promise not to tell the press how easy it was to steal. They would probably pay me my 10% just to keep me quiet."

Look, These people are geniuses. Worse, they are geniuses in a very narrow field technically, which is now being used to control darned near everything. This unique intellectual-technical skill is the possession of literally a handful of people, mostly under 35 years of age. They are "fooling around" with Chase Manhattan Bank's computers. What happens when a few of them stop fooling around and get deadly serious?

Computer program designers keep telling us that there is no 100% secure way to defend data banks. Maybe there will be a 98% secure system someday, but not now. To defend itself, the system relies on the integrity of youth. In short, self-government is the major defense.

And where have they learned self-discipline? In the public schools?

"NOW YOU'VE DONE IT!"

About four years ago, I read an article in the *Rolling Stone,* the tabloid aimed at rock music fans. It was the only article I ever read in that periodical. It was a gem.

It described a subculture of students at Stanford University, "hackers." These people are computer freaks. The mainframe computer at Stanford was cheaper to use after midnight, so from midnight to 6 a.m., the hackers gathered at their terminals. They lived on candy bars, junk food, and high-technology dreams.

One of the games they played was breaking into each other's programs. It was considered the mark of a master hacker to be able to crack another hacker's defenses. They would spend hours trying. They were "hacker-crackers."

One bright fellow then designed a classic booby trap. He wrote a program that warned trespassers not to tamper with it. This, of course, alerted every would-be electronic safe cracker to the challenge. It was a complex program, and it took days to crack it. Then, after repeated warnings, the successful trespasser got a surprise. Japanese letters appeared on his screen. Roughly translated, the words proclaimed, "Now you've done it!"

At that point, the victim's computer screen went blank. Then the names of all his own computer files appeared on the screen — files that may have taken years to assemble. One by one, they blipped off the screen. In horror, the victim would stare at the screen, unable to stop the process.

As it turned out, the booby trap was only a practical joke. It really didn't erase all the victim's files. It only listed the names, and then erased them. But for a horrifying few minutes, the victim wouldn't know this.

Hackers play games. Very interesting games.

The kind of people who spend six hours, midnight to 6 a.m., trying to break into each other's programs are different from the rest of us. Among their ranks are some highly individualistic people. Some of them are libertarians. I mean anarchists. They are electronic "don't tread on me" sorts of people. They do not appreciate bureaucracy. They appreciate being pushed around even less.

The folks at Chase Manhattan really do have a problem. Do you attempt to prosecute a legally un-prosecutable kid? A kid who has already cracked your computer system? I don't think you do. You play the role of stern but appreciative banker. "Son, I am impressed by your ability to break in. But understand, we are honest people. There is a code of honor here. You wouldn't want to break that code — of honor, I mean — would you?" Because if this kid gets angry, he can do it again. Quietly. And next time, he deposits a virus.

Of course, Chase may hire a programming team to create an unbreakable system. Sure. "Hire fox A. Give him chain link fence B. Hire him to build fence B around chicken coop C."

TEEN CHALLENGE

Suppose that the public gets wind of the threat to the whole banking system that is posed by viruses. What do the bankers (or anyone else) announce to the

public? "We want to assure you that our computer program is impenetrable. No one can break in. It is foolproof."

Here is the challenge — rather like the Stanford program that announced: "Do not trespass." These kids see breaking-in as a challenge, a kind of sport. They do not regard it as theft. They do not regard it as vandalism, even if it costs a company millions of dollars to unscramble. They may be ethical in other respects, but they think of "core wars" as a game.

How would you like to be the 60-year-old banker who doesn't know a byte from usury, but whose public relations department tells him to inform the public that nobody can crack his bank's code? To cite Mr. T in "Rocky III," that bank is dead meat. So are its depositors.

But if he keeps quiet, and the story still gets out about the vulnerability of the system, one or two small "virus-demolished" banks could trigger a collapse of the system, as people do the only smart thing: run for cash. The whole fractional reserve banking system would deflate; only the FED's printing presses could "save the day," in a wave of fiat money.

What I am saying is this: I think that we will see the end of fractional reserve banking in our day. At the very least, I think we will see it subjected to tremendous shocks. People will lose faith in electronic promises made by bureaucrats who do not know anything about the monsters that their efficient computers can be turned into.

Attack on Martinsburg. Now, let's take it a step farther. Some day some state or Federal bureaucrat is going to step on the toes of some genius entrepreneur who has created a software development firm. The bureaucrat will try to wrap this entrepreneur in red tape. Or maybe — just maybe — he will try to sock him with a tax bill that the entrepreneur regards as unfair.

In Martinsburg, West Virginia, there is a large computer. It is owned and operated by the Internal Revenue Service. Into it, over the next five years, the I.R.S. apparently intends to deposit all the records it can assemble on every U.S. taxpayer. This computer database will be the biggest in the world. It is the tool by which the I.R.S. hopes to increase taxpayer compliance. And it may succeed. For a while.

This is one reason for saving all letters to and from the I.R.S. If the I.R.S. becomes dependent on its computer system, which is likely, then any short-circuiting of its database could create havoc for tax collecting. If word gets out that a major failure has hit the I.R.S., the tax revolt could multiply overnight. You would see the deficit become astronomical. If the I.R.S. continues to tie its "voluntary" compliance program to the myth of the "all-seeing computer," then news of the computer's scrambling could backfire.

It is possible that the story of the I.R.S. database is a myth. Maybe they aren't going to build it. But if the public believes that such computer power is at the

disposal of the I.R.S., and taxpayers then learn either that the system has been blown, or that it was mythical from the start, the tax revolt could spread like an epidemic. The electronic epidemic-could trigger a tax revolt epidemic.

He who lives on the cutting edge of technology eventually dies on the cutting edge of technology.

"PEOPLE ARE BASICALLY GOOD"

Let's return to my taped interview with "Tom." In a 90-minute interview, we covered a lot of ground. But one topic that stands out in my mind is our discussion of the pre-supposition that goes into the creation of a computer-based society. The computer people have all adopted the assumption that undergirds modern science, namely that, participants are well meaning, that they will not fake their experiments, and that they will play fair. If scientists had to check every aspect of every article, science could not advance very fast.

What about the computer industry? The whole system rests on faith: "Men are not malevolent. They are not envy-driven. They will not deliberately seek to destroy the work of some random victim." Tom says categorically that this assumption is false. There are bad people with tremendous computer skills, and modern society has not restructured its economic institutions to protect itself.

Here is one example of a break-in technique. Someone phones in to a computer, which has been left open temporarily by some user. The lock is unlatched; he needs no key to get in. He then seeks to penetrate the inner core of the program, such as a bank's program. He creates a deliberate error, which all too often triggers a kind of electronic explosion. The protective shell self-destructs, and the invader now finds himself inside the system, where far fewer defense mechanisms exist.

Tom designed his own firm's defense against this tactic. His program automatically records the source of the error, and throws the user out of the program. The program has protection against deliberate errors, but most of them don't, he says. A major error simply collapses the program's outer shell.

In my previous issue, I speculated that a Soviet spy or agent could penetrate U.S. computers. Note: I did not assume that he would simply phone in; I assumed that a disloyal programmer, or a team, could plant the virus as insiders. From there, the virus would spread through the system through normal telecommunications. Several people have written in to tell me that a wrecker cannot destroy the system by penetrating it from the outside. They may be correct. But when informed that I am assuming an inside job by someone with access to a major computer, the critics have admitted that this might be possible.

The weed of crime bears bitter fruit: for honest, computer-dependent people.

FEDERAL FUNDS

The Federal Funds bank transfer lines allow banks to borrow money overnight. Hundreds of billions of dollars go across these lines every working day. The bank's computers communicate with each other by means of this telecommunications hook-up. What if someone were to plant a long-delay virus in the software that operates these transfers? And what banker has even thought about this problem?

What if this scenario was to take place: a virus triggers the disruption of bank records — not a total breakdown initially, but disruptions in the data? It might be weeks or months before auditors recognized the extent of the problem.

As rumors begin to leak out about complex accounting or other data-management problems of major banks all over the U.S. (including off-shore branches), the various banking regulatory agencies would be swamped with crises and outside rumors. Then, all at once, bank computers begin breaking down.

The rumors then explode. The lines appear in front of banks. The only answer at this point is to print up paper money. It would be printed by the hundreds of billions in order to offset the deflationary effects of bank runs (paper money that is pulled out but not re-deposited in another bank).

You could topple the fractional reserve banking system all over the world. The entire payments system could easily become engulfed in chaos. Debits and credits would no longer be meaningful. A pure paper money inflation would replace the manipulated, "fine-tuned" monetary inflation of modern central banking.

All of a sudden, market-created alternative currencies would be revived. It would then be metallic cash that talks loudest. Silver dimes are not electronic. "They can't be infected electronically." They still circulate when banks are "temporarily closed, due to circumstances beyond our control."

The loss of efficiency would be initially horrendous, I would guess. The division of labor would break down. You could then have the crash that lurks in the minds and suspicions of average depositors. Who says it cannot happen? A lot of public relations firms hired by the banks — computer illiterates in high places?

What we have is an internal bank money wire system that is totally vulnerable to some vindictive programmer. There is little doubt in my mind that the bankers are desperately fearful of this sort of vandalism. It could topple people's confidence in the fractional reserve banking system, and confidence is the only thing that keeps it going.

Conclusion. Technologically, there is no solution at this point. I have no heartening message. Maybe later; not now. Keep precious metal coins. Don't

assume that it can't happen here. It can. The only thing holding it back is the restraining hand of God, through the temporary self-restraint of a technological priesthood.

[Reviewer's comment: I was unaware of the problem of computer worms and viruses until I read Gary North's two articles. His open release of this important information is appreciated.]

SCALAR EM INNOCULATION AND ITS IMPLICATIONS

My appreciation goes to Gary North for his openly sharing the above important information with the public. Human nature being what it is, one or more of his more dire scenarios is going to happen sooner or later.

The problem becomes enormously more compounded if the hostile agent or agents possesses sophisticated scalar EM technology.

With scalar technology, there exists the potential that the worm or virus can be implanted from a distance. If scalar-scanning devices of sufficient precision can be developed, then major software residing in a chip, a computer, or on a disk can be read from a distance. With scalar EM methods, the ordinary software "guards" are totally ineffective. The scalar "reader" could simply read off the software directly as the disk or device goes about its normal operations.

After the software is read, a germ or a virus is designed to produce a particular problem as desired and upon special stimulus. Then a scalar "imprinter" device is used to produce the necessary digital pulses directly upon the media in which the software resides. The required code has now been implanted. In effect, the operating system has been injected from a distance, and contaminated with the desired "sleeping agent" — germ or virus. From there on, it's just like Gary North's scenarios.

So the scalar EM technology can probably be used (at least eventually) to place "mines" in systems in advance, for damage or destruction at a future date. At least it's possible in principle.

However, it's not the injection of computers and equipment that bothers me. It's the injection of human beings. Here's generally how it can be done (and possibly is being done).

Basically, human brains have various rhythmic waves, which represent "envelope pulsations" of the entire electrical system. However, it is not the Et, force fields represented by these pulsations which are important: it is the summed-zero (scalar) patterning of the entire complex of neuron firings which represents the real activity of the brain — and represents its thoughts and emotions. A storage system for these patternings exists, but it's a scalar pattern storage, not an E and B field storage. The storage system is in the nuclei of the tissues of the nervous system itself, not in electrical or electrochemical potentials.

At any rate, the human brain rhythms are also "riding along" relatively entrained to the Schumann resonance of the earth's magnetic field. So all the patterning of the brain is grouped together into giant overall orders, and one or more of these is normally synchronized to our natural environment.

If a varying magnetic signal of extremely low frequency — say 10 hertz — bombards the brain with greater power than the earth's magnetic field, it is possible for the brain's rhythm to be "forcibly entrained" to synchronize with that signal, rather than with the normal Schumann resonance. If a large number of brains are forcibly entrained to such a signal, and the signal is artificial, then a nester coherent phasing of all the brains to the transmitted signal has been accomplished.

And that can be utilized — and is utilized — by the Soviet Union. On the Woodpecker signals, Bob Beck has detected up to 16 carriers, each with a 10-Hertz modulation, and with all the 10 Hz modulations in phase.

Let s stress what we're saying here. At times, the Woodpecker signals have shown 16 carrier frequencies that contain the same 10-Hertz modulation, and which are all kept coherently sync-locked.

If those signals and the modulations are strong enough, the brains in a targeted area demodulate the 10-Hertz signal and phase-lock to it — actually, to them. At that point, the brains are entrained to a 10-Hertz driver, and 16 channels of multimegahertz frequencies are locked-in to the brain.

Now, if the Soviets have broken the genetic code of the human brain (which they have) and succeeded in developing the ability to implant thoughts, emotions, pictures, etc. (which at least to a degree they have), then they can simply record the proper signals from human guinea pigs, using scalar technology and instrumentation.

They can tailor those signals and add them onto the Woodpecker carriers, using scalar EM techniques. By using most of the sixteen carriers as a means to express Fourier frequency expansions, specific areas and functions of the brain can be targeted.

"Notice that the distant transmitters already "know" the correct phasing, just use the 10 Hertz modulation signal as a reference. In that case, phasing takes care of itself inside the captured human brains.

The brain has a unique characteristic. If a signal arises inside it, it interprets that it itself originated the signal. Thus for the first time in history, true unwitting robot actions and emotions can be engendered in masses of human beings.

But it's still worse. The Kaznacheyev experiments (see references) proved conclusively that electromagnetic signals can carry and transmit cellular disease and death patterns into a targeted biosystem. You can rest assured that the Soviets continued on to actually measure and determine a wide variety of death

and disease scalar patterns. All of that can be added on to the Woodpecker carriers so that the population in the intersection grid area is devastated. One can even test it out in advance by producing a modified pattern of a disease in the targeted populace, and keeping the percentage of brains entrained down to a small level. This lowers the number of persons "injected" from a distance to a small percentage of the populace. Then the outbreak of the "new strain" of a familiar disease — such as influenza, pneumonia, and something like AIDS — can be monitored to provide targeting and effectiveness data. Notice that a series of diseases was experienced by U.S. personnel assigned to the U.S. Embassy in Moscow, probably as a result of the so-called "weak microwave radiation" of the Embassy by the Soviet Union.

But that's not all. Much more subtle effects can be produced in the targeted populace, without anyone getting wise. Cancers and leukemia should be relatively easy to induce. Also, the immune system can simply be attacked directly. If done slowly, a series of common, ordinary diseases will just seem to get "tougher and tougher to cure." Actually it's not the disease that got tougher, it is the immune systems that got weaker. It is my opinion that precisely that sort of testing — against the immune system — has been accomplished by the Soviet Union against the U.S. since about October 1985. A great percentage of influenza patients during the period from then until now have had complications. So much so that multiple sessions — as many as 3 to 5 — of antibiotics are necessary before the patient recovers. At least in the Huntsville, Alabama "hinge pin" area, that seems to have been the case. This author personally experienced this, having influenza and follow-on complications for a period of seven months — something quite different indeed for him.

But it's even worse.

The human scalar EM nervous system ("inside" the ordinary EM signals and functioning of the system) also has its own resident "software." It has special storage media contained in its brain, its cells, and its genetic material, and its actual nucleons. All of these storage media are continually telecommunicated with via scalar EM means. Those recordings, largely condition the "stability" of what each of us is. As personalities we literally "are" what we have experienced, felt, thought, and did. Our whole "functioning conscious system" has been evolved by our experience, and it continues to be "us" by means of continual reference to the record base.

I hope you now realize that the actual record base itself can conceivably be altered by scalar electromagnetic means, even from a distance. Even by the hidden scalar EM content of 16 Woodpecker carriers, rocked into a captured brain and pouring in their deadly content. It is conceivable that even what one is can be taken from him, and what someone decides he will be, he will be.

A totally new — **and** ultimate — form of "slavery" has emerged.

Also, look at all this scalar EM functioning of the human system as a special kind of cybernetics. A scalar EM computing software and hardware system.

What if scalar techniques are used to plant "worms" and "viruses" in this system? With hidden triggers? What about a series of them, so that a range of eruptive software diseases can be stimulated at will?

And guess what. Such scalar EM "worms" and "viruses" can even be induced by contact with or consumption of "contaminated" water and food. Or saliva. Or other body fluid.

So you can see the possibilities of "seeding" a population with a staggering variety of time-bombs.

I think you begin to see the point. Now you can change North's "Soviet blackmail" scenario drastically. In a new scenario, Gorbachev simply announces to Reagan that a graduated series of specific sweeping changes are going to happen in our population — changes which we are absolutely powerless to stop. The last stages are various deaths. The master "trigger" for this series has already been initiated. Incidentally, the Soviet populace has been carefully "seeded" with the proper antidotes. The Russian leader demands certain things (very similar to what North's scenario utilized). Unless his demands are met, a "killer virus" will be activated by a special signal. If so, everyone dies. The first step change in the series will start to occur in a few hours. And it does.

In fact, this scenario could be added to North's scenario, and both used simultaneously. What do you think the President and the Congress would do? Or could do?

There are other even more diabolical possibilities, but these should be quite sufficient to illustrate the point.

Pandora's box has already been spilled, and the end of humanity is ticking away like a time bomb. It's already nearly midnight, and the watchman hasn't even sounded the alarm yet.

I certainly can anticipate the next question: Have the Soviets already "seeded" the populations of the U.S. and other selected western nations with scalar EM viruses and germs7

The answer is, I simply don't know. And just like Gary North, I don't know what if anything can be done about it if they have. This researcher certainly doesn't have all the answers. An immediate national crash program to develop scalar EM defenses is essential if we are not simply to be crushed beneath the hammer and sickle. It takes funding, people, facilities, and time.

In some 22 years of unrelenting struggle to convince the system we've got a terrible problem, I've hardly been able to move it off dead-center (no pun intended). This book, produced under extreme workload stress, is all I can do to raise the alarm. I've given it my very best shot.

What happens now remains to be seen. Other hands, hearts and minds are going to have to take up the task and carry it forward. This researcher has reached his limit, and has no more left to give.

APPENDIX III: CONTINUING THE SCENARIO

On May 3, 1986 a stunning loss of a U.S. Delta rocket carrying a critically-needed weather satellite occurred. The rocket suffered a shutdown of its main engine during launch and began to veer off course, causing the range safety officer to destroy it.

The takeoff of the blue and white Delta "workhorse" from launch Pad A at Cape Canaveral at first appeared picture-perfect. About a minute later, six of the nine booster rockets were expended and the remaining three switched on. Shortly after that, the rocket seemed to lose power. The main liquid-fueled engine had suddenly shut down, with the three strap-on boosters still burning. The rocket then had no stability and started to slowly drift off course, creating an increasing angle of attack. Within a few seconds, the nose cone snapped off under the severe stress. The U.S. Air Force range safety officer then sent a destruct command to the stricken rocket, which exploded in a ball of flame.

The Delta, built by McDonnell Douglas, had previously piled up a continuous string of 43 successful launches. Since 1960, 177 launches have occurred, and the success rate has been 94%. The Delta is one of the most reliable rockets ever built.

The unexpected shutdown of the main engine was perplexing. At a news conference following the mishap, William Russell. NASA's Delta project manager. stated: "It was a very sharp shutdown. almost as if it were a command shutdown."

Preliminary data, such as turbine speed and temperatures in and around the engine, "all appeared to be very normal." Russell said.

It may well have been a "command shutdown," unknown to Bill Russell and his NASA engineers.

Preliminary runs of the videotapes of the incident, aired by the national TV news media, show that during liftoff, a mysterious light approached the rocket from below and from the side. rising and striking the vehicle. This light and its path are strongly reminiscent of the first anomalous "light streak and ball" photo taken by Bob Gladwin just prior to the shuttle launch on November 26, 1985.

Let' s suppose that on May 3 the Soviet scalar EM grid was in the launch Phase ABM system mode and was tracking the launch of the Delta rocket.

If the anomalous light that moved up and contacted the rocket was a small ball of continuous electromagnetic energy formed by a distant Soviet scalar EM howitzer, then the rocket's main engine control circuits would have received a sudden and continuous pulse of EM power. This would probably have shutdown the engine by an actual "command" signal, artificially delivered. *

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*Engineers have now determined that such a shorting of the engine circuitry occurred, causing engine shutdown.

Certainly such mysterious switching of satellite circuits has occurred before, probably due to Soviet scalar EM precision testing. For example, the British Ariel VI satellite has exhibited very strange anomalies in its command and control circuitry -- in fact, with very precise control switching

being exhibited as if from an external source.

Thus a very small scalar EM missile may have been utilized by the Soviets to disrupt the control circuits in the rocket. A resulting pulse of power in the engine shutdown command circuit could have "ordered" the shutdown of the main engine -- just as it appeared.

It remains to be seen whether or not the Soviets used a "marker beacon" associated with the disruption of the Delta launch. One news photograph seems to contain a suggestion of such a light, but the videotapes must be studied frame by frame before it can be ascertained exactly what if anything is really there.

If a marker beacon was not used, the distant Soviet operator could simply have "popped out" the continuous EM ball of energy, tracked it and the ascending rocket exhaust, and "joysticked" the scalar EM missile up into the rocket.

Analysis of this incident is continuing, so nothing is certain as we go to press.

However, if this incident was indeed another Soviet kill, then it will have served the Russians well. Much of the world's media attention will now be focused on NASA's launch difficulties, and away from the recent Chernobyl nuclear reactor disaster in the Soviet Union. It's bound to take some of the media pressure off the Soviets.

In addition, it further cripples the U.S. satellite program. Loss of this critical weather satellite payload seriously reduces U.S. weather monitoring capabilities.

Further, the U.S. space program now appears to be all but grounded by the Challenger, Titan, and Delta explosions. For example, it will require about 18 months for the U.S. to redesign the shuttle so that America's shuttle program can get going again. So things are delayed until summer of 1987 at the earliest.

Meanwhile, the Russians are set to grasp the lead in the space race. In 1985 they launched about 100 rockets, five times as many as the U.S. They have a shuttle program of their own, well underway, with a flight expected within months. Earlier this year, they launched Mir, a second generation space station; a U.S. version is still some eight years away.

Charles Vick, of Huntsville, Alabama's Space and Rocket Center, summed it up: "They have their standard military program, a shuttle program and the equivalent of an Apollo program, all within a 10-year period. It's awesome."

An experienced propagandist like Gorbachev certainly understands the advantages of a strong Soviet push into space, such as (1) military advantage, (2) national prestige, (3) scientific achievement, and (4) projecting an image in the world's news media that the Soviets are first in space exploration.

So the failure of the Delta rocket provides many benefits to the Soviet Union.

It also continues to exercise and demonstrate Soviet mastery of the skies over North America itself.

Meanwhile, two U.S. nuclear submarines have "inadvertently" run aground in the last month or so.

Gorbachev again seems disposed toward a summit meeting soon.

If it's held, the agenda may be quite different from the one President Reagan is prepared for.

The clock ticks on toward midnight.

2002 ENDNOTES

1. It is actually a unified field theory since the infolded electrodynamics inside all EM potentials, fields, and waves is utilized—and the internal electrodynamics forms spacetime curvatures and dynamics of those ST curvatures.

2. M. W. Evans, "0(3) Electrodynamics," *Modern Nonlinear Optics,* 2nd Edition, M. W. Evans (Ed.), Wiley, New York, 2001, Vol. 2, p. 79-267.

3. David J. Bohm, "A Suggested Interpretation of the Quantum Theory in Terms of'Hidden' Variables, I and II." *Phys. Rev.,* 85(2), Jan. 15, 1952, p. 166-179 (Part I); 180-193 (Part II); — "Quantum theory as an indication of a new order in physics." A:, *Found. Phys.,* Vol. 1, 1971, p. 359; B: "Implicate and explicate order in physical law," *Found. Phys.,* 3(2), 1973, p. 139-168.

4. Mendel Sachs, General *Relativity and Matter,* Reidel, 1982; — "Symmetry in Electrodynamics: from Special to General Relativity, Macro to Quantum Domains," *Modern Nonlinear Optics,* 2nd Edition, Wiley, New York, Vol. 2, p. 677-706.

5. M. W. Evans, P. K. Anastasovski, T. E. Bearden et al., "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry," *J. New Energy,* 4(3), Winter 1999, p. 299-301 gives a basic mathematical expose of scalar interferometry.

6. James Clerk Maxwell, "A dynamical theory of the electromagnetic field," *Phil. Trans. Roy. Soc,* Vol. 155, 1865, p. 71, 459. Orally presented in 1864. This was Maxwell's definitive presentation of his theory, with 20 quaternion and quaternion-like equations in 20 unknowns. Also in *The Scientific Papers of James Clerk Maxwell,* edited by W. D. Niven, Dover, New York, 1952, Vol. 1, p. 526-604.

7. In T. E. Bearden, *Gravitobiology: A New Biophysics,* Cheniere Press, Santa Barbara, Ca. www.cheniere.org, 1991 we first exposed the quantum potential weapon and some of its uses and characteristics.

8. A negative energy EMP weapons strikes the target or target area with an extreme pulse of negative energy empty Dirac Sea 4-holes. As a result, the free electrons flowing in electrical currents in the struck target instantly disappear by re-absorption into the Dirac Sea. A living body struck by such a blast is totally and instantly dead in every smallest part, since all its brain and nervous system currents, cellular currents, etc. are instantly and totally extinguished. The Russians tested this weapon in the 1980s in their war in

Afghanistan, against two Afghan villages. I spent two hours in Washington D.C. with the then-representative of the Mujahedin to the U.S. Government, verifying the incidents and going over the exact characteristics of the instantaneous deaths of those villagers. With such a sudden death, the mind-body interconnection loop is instantly severed, so that the mind is instantly snapped loose from its connection to the body—hence my use of the term "MindSnapper." The struck body usually emits longitudinal EM waves for an extended period, so that vultures and other predators will not approach the bodies and eat them. All bacteria, viruses, etc. in the body are also killed instantly, and the body does not decay, even in 30 or 60 days.

9. As can be seen, the negative energy EMP weapon is an all-purpose weapon extremely effective against every kind of target: missiles, aircraft, communications, satellites, ships and particularly aircraft carriers, personnel, generators, power systems, the electronics of nuclear warheads, submarines, tanks and vehicles, and the electrical and electronic controls of any kind of machinery or equipment. Such weapons are the second most powerful weapons on earth. In the first part of 2002, a U.S. 2-carrier task force maneuvered in the South China Sea as a precautionary warning to the Chinese that we would defend Taiwan. Unknown to that fleet, tracking it and trained on it were the newly deployed Chinese negative energy EMP weapons, which could have destroyed the entire task force—everything in it—with a few shots in less than 10 minutes.

10. T. E. Bearden, *Energy from the Vacuum: Concepts and Principles*, Cheniere Press, Santa Barbara, CA, 2002. Chapters 1 and 2 give a deeper coverage of this and similar foundations principles.

11. As is well known, Russian theoreticians have always been the best nonlinear scientists on Earth, since the beginning. They still are.

12. See T. E. Bearden, "Giant Negentropy from the Common Dipole," *J. New Energy*, 5(1), Summer 2000, p. 11-23 for solution of the source charge problem. On DoE restricted website http://www.ott.doe.gov/electromagnetic/ and on www.cheniere.org. The problem of the source charge can be solved by treating (with the modern quantum field theory viewpoint) the "isolated" observable charge and its cluster of virtual charges of opposite sign as a composite dipole. Because of the broken symmetry of its opposite charges, any dipole or dipolarity continuously receives virtual energy from the seething vacuum, transduces it into real observable EM energy, and pours out observable photons in all directions at the speed of light. See also E. T. Whittaker, 1903, *ibid.* There is a scalar potential between the ends of each dipole. The scalar potential may be decomposed into a bidirectional set of longitudinal EM phase conjugate energy from the time dimension (from the imaginary plane) and outputs that EM energy in the real 3-space. 3-space conservation of energy flow

is violated, but 4-space conservation of energy flow is upheld. This rigorously follows from the discovery of broken symmetry of opposite charges in 1957—one of the types of asymmetry for which Lee and Yang received the Nobel Prize.

In classical electrodynamics, the charged particle itself is *assumed* to be the source of its own fields and potentials. In other words, the charge is implicitly considered to be *creating*—right out of nowhere—the Poynting energy flow it continuously pours out across the universe in all directions. That makes the charge a perpetual motion machine of the grossest kind, violating the maxim that energy can neither be created nor destroyed.

So the greatest perpetual motion advocates of all times are our own classical electrodynamicists and electrical engineering departments and professors who still ignore the active vacuum interaction that is missing from the classical model. They thereby ignore that the charge is a broken 3-symmetry in its violent exchange of virtual energy with the active vacuum, and merely organizes and emits in observable form a fraction of the energy it continuously receives from the imaginary plane (from the time domain). Yet, that broken symmetry has been known in particle physicists, both experimentally and theoretically, for 45 years.

When Maxwell wrote his theory, neither the electron, the atom, nor the nucleus had been discovered. There was no knowledge of the Drude electron gas, electron spin, etc. There was no knowledge of the nucleus of the atom, and even the atom itself was still contentious. A thin material ether (fluid) was believed to fill all space, so that no point in all the universe was empty of mass. Consequently, E and B were conceived as physical force fields in a material medium—the luminiferous ether. All Maxwell's equations—including the subset selected and modified by Heaviside that today are called "Maxwell's equations"—assume this material ether to this day.

Electricity was thought to be a "thin material electric fluid" running through wires like water through a pipe. The magnitude of the potential was not used; its reaction cross-section was calculated and erroneously used as its magnitude, as it is today (although a good electrodynamicist does know that it is only the *intensity* of the potential, not its magnitude).

Faraday believed that his "lines of force" were taut physical "strings" in this material ether, and that EM perturbations were the vibrations of these taut strings. As he clearly states in his 1873 *Treatise...*, Maxwell sought to capture Faraday's work exactly. He simply *assumed* Faraday's "plucked taut string" waves. Later the measurement in instruments of what was actually the lateral gyroprecession of electrons in receiving wires was thought to prove that the incoming ether vibrations were transverse, like those string waves, because the detected electric **fluid (electron** precession) waves in the receiving wire were

transverse. The drift velocity of electrons longitudinally in a wire (in a typical case, several inches per hour) was unknown. A charge *q* was just a piece of electric fluid, much like a cubic centimeter or other volume of fluid; it had no connotation of "charged particle." There was no concept in all of physics of EM energy flowing through space. There was no knowledge that the same fields created in the transmission wire, which perturbs the Drude electrons laterally, also perturbs the positively charged nuclei laterally, in the opposite direction, highly damped but with equal energy.

There was no way to realize that the energetic perturbation of the curvature of spacetime around the sending wire antenna, by the Drude electron perturbation energy, is simultaneously accompanied by an equal and opposite perturbation of the curvature of spacetime in the opposite direction (energy density, not amplitude of the disturbing wave, determines the degree of curvature of the surrounding spacetime). Hence Maxwell omitted precisely one half the EM energy, one half the EM wave, and one-half the electrodynamics. As a consequence, the "Newton's third law recoil" of the nuclei today is thought to spontaneously arise as if some mystical demon observes the Drude electron perturbations, and simultaneously kicks the positively charged nuclei in the equal and opposite direction. Hence Newton's third law, so to speak, is erroneously still omitted from classical electrodynamics, and the better texts say so.

In the 1880s, the Michelson-Morley experiments falsified the material ether. Not a single one of the Maxwell-Heaviside equations were ever changed to this day. Instead, the electrodynamicists eventually announced that, since there was no longer an ether, they were not using one! Then a total non sequitur was incorporated: that in massfree space, the same E and B fields (defined as material entities and thus existing only in mass) still remain but the forces go to zero. Simple algebra reveals this clever, insidious faux pas, using the E-field as an example: First, F == d/dt(mv), so mass is a component of force. (This reveals the great error due to the hoary old notion that a separate force acts upon a separate mass; the mass is a component of the force, and the force is a coupled system of a curvature of spacetime and a charged mass.). Then E == F/q, which rigorously holds when mass is present.

Now for whatever reason, let F = 0. Then F/q = 0 and E = 0 also, else we must discard algebra. What actually remains is easily explained in general relativity terms (available since before 1920). The couplet of a curvature of spacetime and a charged mass is broken up by absenting the mass. What remains is that specific curvature of spacetime. GR assures us that curved ST acts upon mass, and that any force involves a curvature of ST. Yet in more than 80 years, this erroneous old "material ether remnant" in electrodynamics has been fiercely defended. Every textbook today uses and confuses the E and B fields in two dichotomous fashions: (1) as massive force fields existing only in the presence

of mass, and as "massless force-free fields" existing only in the absence of mass. This of course is a non sequitur.

13. E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," *Math. Ann.*, Vol. 57, 1903, p. 333-355. The "scalar" potential itself is not even a *scalar entity,* as shown rigorously by Whittaker. Instead, it is a harmonic series of bidirectional EM longitudinal phase conjugate wavepairs, and it decomposes into that series. Hence it is a *multiwave, multivectorial entity.*

14. C. N. Yang and R. L. Mills, "Conservation of Isotopic Spin and Isotopic Gauge Invariance," *Phys. Rev.*, Vol. 96, 1954, p. 191.

15. The term "energetics" simply means *energy as the primary thing in the universe.* Rankine first used it. G. Helm in 1887 revived Rankine's term "energetics" and factored energy into an *intensity* factor and an *extensity* factor (which today we would call potential and kinetic energies). William Ostwald in 1893, 1895, and 1901 raised the concept of "energetics" (energy as the primary thing in the universe) to the forefront. Thus when the Russians developed new extensions and principles in weapons physics, they simply used the historical notion of "energy as the primary thing in the universe" and adopted the earlier name for it: *energetics.*

16. Later when Khrushchev demanded a 100% antimissile defense, famed Russian Nobelist Petr Kapitsa answered, *"If a means of total neutralization of foreign missiles is to be found, it can only come from a group of new principles in physics, called energetics".*

17. See T. E. Bearden, "Mind Control and EM Wave Polarization Transductions, Part I", *Explore,* 9(2), 1999, p. 59; Part II, *Explore,* 9(3), 1999, p. 61; Part III, *Explore,* 9(4,5), 1999, p. 100-108. It appears that Sachs' unified GR and EM approach is perhaps the best Western physics model to apply to analysis of the KGB energetics weapons. However, because of the third branch *(psychoenergetics:* engineering the mind directly), Sachs' work would appear to need further extension along the lines indicated by the present author in the cited paper.

18. See T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," *J. New Energy,* 3(2/3), 1998, p. 12-28; — *Energy from the Vacuum,* 2002, *ibid.* For nuclear transmutation at a distance (e.g., dudding all nuclear weapons by transmuting U235 and weapons grade plutonium), extension is required along the lines indicated by the present author in these references.

19. See M. Sachs, *ibid.,* also M. Sachs, "Relativistic Implications of Electromagnetic Field Theory," in T. W. Barrett and D. M. Grimes, eds., *Advanced Electromagnetism,* World Scientific, 1995, p. 551. The Sachs theory

already expresses the greatest generalization possible of electrodynamics, and fully justifies the preceding view.

20. See Whittaker, 1903, *ibid.;* — "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions," *Proc. Lond. Math. Soc,* Series 2, Vol. 1, 1904, p. 367-372. The latter paper was published in 1904 and orally delivered in 1903. Per these two Whittaker papers, it is known that (i) ordinary EM fields and waves are the result of interference of two or more scalar potential functions, (ii) scalar potentials are comprised of harmonic sets of bidirectional EM phase conjugate wavepairs, (iii) all ordinary EM fields and waves and potentials have LW EM dynamics internally, and (iv) in theory, this "infolded" electrodynamics can be engineered. Sachs' theory dramatically extends the richness of that internal electrodynamics ignored in the West, and highlights the general relativity (sets of spacetime curvatures, or "engines", involved).

21. E.g., *Marine Observer* was a rich source for Russian energetics weapons testing in remote ocean areas, sighted by ships' captains and crews and entered into the ships' logs.

22. Portions of Khrushchev's statements to the Presidium are given in Max Frankel, "Khrushchev Says Soviet Will Cut Forces a Third; Sees 'Fantastic Weapon'," *New York Times,* Jan. 15, 1960, p. 1.

23. See Whittaker 1903 and 1904, *ibid.,* for the original basis of scalar interferometry and its creation of any kind of EM field, potential, and wave in the interference zone.

24. Also see M. W. Evans, P. K. Anastasovski, T. E. Bearden et al., On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry, *J. New Energy,* 4(3), Winter 1999, p. 76 for mathematical proof of scalar interferometry. There are several other AIAS papers in the same issue of *JNE,* dealing with interferometry and with the implications of the Whittaker papers.

25. As an example, the U.S.S. Skylark, surface companion of the Thresher, was beset by mysterious "jamming" of multiple types of EM systems in multiple bands. So bad was it that it required more than an hour to get an emergency message to Naval headquarters that the Thresher was in serious difficulty. Later, as the scalar interferometry died away, all the EM systems aboard the Skylark resumed normal functioning. The Skylark was in fact in a "splatter zone" of the underwater interference zone around the Thresher.

26. Circa the end of 1989, the earlier longitudinal EM wave weapons on site in Russia were leased to a rogue Japanese group comprised of Aum Shinrikyo and Yakuza, who have been operating those weapon systems—on site in Russia—since then. Senator Sam Nunn's investigations revealed the presence

of the Aum Shinrikyo in Russia, to include establishing a university there. His investigators missed the Yakuza involvement and also missed the exotic weaponry aspects as one might expect.

27. I concluded from this remark that TEMPEST techniques are probably used at some nearby site not too distant from my home here in Huntsville, to read and record my work as I write it on the computer. That appears to be a good assumption.

28. As a small example of what can be done, see a series of papers by M. W. Evans, P. K. Anastasovski, T. E. Bearden et al, published in *J. New Energy*, 4(3), Special Issue, Winter 1999. The papers are: (a) "On Whittaker's Representation of the Electromagnetic Field in Terms of Two Scalar Potentials, Part I"; (b) "An Experimental Test of the Existence of Whittaker's *g* and/Fluxes in the Vacuum"; (c) "On Whittaker's Representation of the Classical Electromagnetic Field in Vacuo, Part II: Potentials Without Fields"; (d) "On Whittaker's F and G Fluxes, Part III: The Existence of Physical Longitudinal and Timelike Photons"; (e) "Representation of the Vacuum Electromagnetic Field in Terms of Longitudinal and Time-like Potentials: Canonical Quantization"; (f) "On Whittaker's Analysis of the Electromagnetic Entity, Part IV: Longitudinal Magnetic Flux and Time-Like Potential Without Vector Potential and Without Electric and Magnetic Fields"; (g) "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry"; and (h) "On Extending Whittaker's Theory, Part VI: Photons Without Fields and Vector Potentials".

29. As an example, one part of the strategic deception plan was devoted to convincing the West that Soviet psychoenergetics was nothing but a technical wrinkle upon the rather harmless Western parapsychology. This part of the program was completely successful for decades. Another very clever use of deception is to allow release of some real scientific advances that lead the West, but are not too important to the KGB in the weapons arena. The increasing emphasis on torsion fields is an example of this "deception by giving good information that directs the adversary upon a path one wishes him to take", effectively steering him away from the path one wishes him to avoid. Lately, however, there is an uproar amongst the academicians in the Russian Academy of Sciences over this very point, that torsion fields being presented as the "end all, be all" is simply disinformation.

30. With their deployment of QP weapons in 2002, the Chinese are also on the way to having this capability.

31. The multiply connected spacetime (MCS) or quantum potential weapons went on site circa latter 1989. A laboratory prototype had been tested against the U.S. air attack on Libya in April 1986. For details of the extremely anomalous jamming **of aircraft** and missile guidance and control systems in that

attack on Libya, see Mark Thompson, "Mixed signals may have misguided U.S. weapons," *The Washington Post,* Jan. 22, 1989, p. A-4.

32. One or more QP weapons also apparently induced the Gulf War Disease in MidEast forces in the Gulf War. We have previously explained the peculiar anomalies, how it was done, why the endemic natives did not contract the disease, why the French forces did not contract it but U.S., British, and Canadian forces did, etc. We briefly discussed quantum potential weapons in T. E. Bearden, *Gravitobiology: A New Biophysics,* In T. E. Bearden, *Gravitobiology: A New Biophysics,* Cheniere Press, Santa Barbara, Ca. www.cheniere.org, 1991.

33. (a) Yossef Bodansky, "Soviets testing chemical agents in Afghanistan," *Jane's Defence Weekly,* 1(3), Apr. 7, 1984, p. 508 gives something of the two Soviet tests of this weapon in Afghanistan. In addition to the fierce blast of empty Dirac Sea 4-holes, these weapons produce a powerful time-polarized EM pulse in the area, producing a very sharp "jerk" in the rate of flow of time, (b) The mind-body coupling mechanism—which cannot withstand such a sharp jerk in the rate of flow of time—has been given by T. E. Bearden, "Mind Control and EM Wave Polarization Transductions," *Explore,* 1999, *ibid.* This sharp "jerk" in time-flow instantly snaps the mind-body coupling mechanism for any living thing in the struck area. A very small version of this weapon was tested twice in Afghanistan, where the bodies in the "mind-snapped" zone died instantly, fell like limp rags, never twitched, and did not decay or get molested by insects or scavengers for the 30 days it required the Mujahedin to fight their way back into the two struck villages. The Mujahedin thought it was some new, extremely fast acting nerve gas, which they dubbed "smerch" or "death wind".

34. Two Ph.D. scientists were working closely with me on this entire effort, as was another close colleague. There was much more involved in the effort that is so briefly mentioned here.

35. Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

36. T. E. Bearden, *Energetics: Extensions to Physics and Advanced Technology for Medical and Military Applications,* CTEC Proprietary, Mar. 21, 1998, 200+ page inclosure to CTEC Letter to Gen. (Ret.) Walter Busby, Deputy Secretary of Defense for Counterproliferation and Chemical and Biological Defense, March 21, 1998. Copies were sent to various other U.S. government agencies, including to NIH, CDC, the USAF, etc.

37. See Vlail Kaznacheyev and L. P. Mikhailova, *Ultraweak Radiation in Intercellular Interactions,* [in Russian], Novosibirsk, 1981. An English exposition of much of the Kaznacheyev material is given in Vlail Kaznacheyev, "Electromagnetic Bioinformation in Intercellular Interactions," *Psi Research,* 1(1), Mar. 1982, p. 47-76. The work of Vlail Kaznacheyev led to the understanding of how to electromagnetically transmit cellular death and disease into targeted cells (or bodies) at a distance, and involved thousands of lab experiments. Highly sanitized work revealing the results but not the mechanisms, were permitted in order to stimulate the West to see if it knew about energetics.

38. See Stanislov Lunev and Ira Winkler, *Through the Eyes of the Enemy: Russia's Highest Ranking Military Defector Reveals Why Russia Is More Dangerous Than Ever,* Regnery, Washington, D.C., 1998. The Red Chinese also were able to decipher the Russian EM disease transmission methodology, early on. As a strange kind of "poetic justice" action the Chinese induced cancer into many Russian spies stationed in the Russian Embassy in China. Quoting Lunev, p. 160: "...I *was not the only person who was stationed in Beijing to come down with cancer...Almost all of the GRU officers stationed in China with me have been diagnosed with cancer. People assigned to the embassy had told me that they were picking up high levels of radiation from the apartment building around the embassy compound. Whether it was a form of high-tech monitoring or a conscious effort to harm our health, it seems to have been successful. So much so that in 1992 the GRU was asked to investigate the high rate of cancer among embassy officials. The findings, however, have never been made public; in part, no doubt, because of the rapprochement between Russia and China."*

39. See my "Porthole Briefing", on www.cheniere.org. Also see "Le Probleme Priore," *Rapport de la Commission de I'Academie des Sciences a Monsieur le Ministre d'Etat charge de la Recherche et de la Technologie,* France, 1982, p. 1-22; J. B. Bateman, "Microwave Magic," Office of Naval Research London Conference report, ONRL C-14-77, 1977; —*A Biologically Active Combination of Modulated Magnetic and Microwave Fields: The Priore Machine,* Office of Naval Research, London, Report R-5-78, Aug. 16, 1978; — "Staging the Perils of Nonionizing Waves," *European Scientific Notes,* ESN 32-3-85-88, 1978; T. E. Bearden, "Energetics Update and Summary," Parts 1, *Explore More,* No. 1, 1996, p. 13-18; Part 2, *Explore,* 8(1), 1997, 53-56; Part 3, *Explore,* 8(2), 1997, p. 42-45; Christopher Bird, "The Case of Antoine Priore and His Therapeutic Machine: A Scandal in the Politics of Science," Explore, 5(5-6), 1994, p. 97-110; R. Cambar, "Rapport general des travaux de la Commission de Controle constituee en vue de verifier l'un des effets biologiques obtenu par l'utilisation de l'appareillage de Priore A. Bordeaux," [General findings of the work of the control commission formed to verify one of the biological effects obtained by use of the apparatus of A. Priore at Bordeaux],

1969; R. Courrier, "Expose de M. le professeur R. Courrier Secretaire perpetuel de 1'Academie des Sciences fait au cours d'une reunion a l'lnstitut sur les effects de la machine de M. A. Priore 26 Avril 1977" [Presentation by Professor R. Courrier, Perpetual Secretary of the Academy of Sciences, made at the meeting of the Academy on the effects of the machine of M. A. Priore.]; Jean-Michel Graille, *Dossier Priore: A New Pasteur Affair,* De Noel, Paris, 1984 [in French]; Antoine Priore, "Apparatus for producing radiations penetrating living cells," U.S. Patent No. 3,368,155, Feb. 6, 1968; — "Method of producing radiations for penetrating living cells," U.S. Patent No. 3,280,816, Oct. 25, 1966; — "Procede et dispositif de production de rayonnements utilisables notamment pour le traitement de cellules vivantes," [Procedure and Assemblage for Production of Radiation Especially Serviceable for the Treatment of Living Cells], Republique Francais Brevet d'Invention P.V. No. 899.414, No. 1,342,772, Oct. 7, 1963; A. Priore, *Guerison de la Trypanosomiase Experimentale Aigue et Chronique par L'action Combinee de Champs Magnetiques et D'Ondes Electromagnetiques Modules* [Healing of intense and chronic experimental trypanosomiasis by the combined action of magnetic fields and modulated electromagnetic waves], thesis submitted in candidacy for the doctoral degree, 1973—rejected when the project was suppressed.

40. Eric Perisse, *Effets des Ondes Electromagnetiques et des Champs Magnetiques sur le Cancer et la Trypanosomiase Experimentale* [Effects of Electromagnetic Waves and Magnetic Fields on Cancer and Experimental Trypanosomias], Doctoral thesis, University of Bordeaux No. 83, March 16, 1984. Although Priore's own thesis was suppressed in 1973, Pautrizel nevertheless finally succeeded in getting this doctoral thesis by Perisse approved on the work, at the University of Bordeaux which had rejected Priore's thesis, after eleven more years had passed. Considering the viciousness of the suppression, this was a major accomplishment.

41. The photo was taken by George Suchary of the registration point (ball of light) high over the Nov. 1985 night shuttle launch from Cape Canaveral. For a photo of the same kind of "ball of light" registration point above the kill of a Titan missile launched from Vandenberg AFB in early 1986, see reference 39 below.

42. The picture by Canadian investigators showing the hole burned through the right fuselage ahead of the engines of the Arrow DC-8 is shown in T. E. Bearden, *AIDS: Biological Warfare,* Cheniere Press, Santa Barbara, Ca. www.cheniere.org , 1988, p. 52.

43. See T. E. Bearden, *Gravitobiology: A New Biophysics,* Cheniere Press, Santa Barbara, Ca. www.cheniere.org, 1991, p. 82. Two sensors on-board the Arrow DC-8 independently recorded the sharp electrical spike generated by the strike of the EM missile.

44. "Titan Explosion Cripples U.S. Launch Surveillance Capability," *Aviation Week & Space Technology,* 124(17), Apr. 28, 1986, p. 16-19. Specifically see the picture of the explosion on p. 18. It clearly shows the Soviet marker beacon (little ball of light) well above the missile explosion. General background on the Titan explosion and investigation is given in "Investigators Search for Clues to Cause of Titan Blast," *Aviation Week & Space Technology,* 124(17), Apr. 28, 1986, p. 19-20.1 persuaded NBC engineer Ron Cole with a team of engineers to examine the videotape of the explosion, frame by frame. In 17 frames the ball-of-light (registration point) is visible, and moves away completely independent of the explosion. No "bogies on the range" were reported at Vandenberg AFB.

45. Dr. Evans is co-discoverer with Vigier of the B(3) field, now well established but still not in the textbooks. He is the Director of the Alpha Foundation's Institute of Advanced Study (AIAS) and has over 600 papers and books in the literature.

46. M. W. Evans, P. K. Anastasovski, T. E. Bearden et al., "On Whittaker's F and G Fluxes, Part III: The Existence of Physical Longitudinal and Timelike Photons," *J. New Energy,* 4(3), 1999, p. 68-71; — "Representation of the Vacuum Electromagnetic Field in Terms of Longitudinal and Time-Like Potentials: Canonical Quantization," *ibid.,* p. 82-88; — "On Extending Whittaker's Theory, Part VI: Photons Without Fields and Vector Potentials," *ibid.,* p. 79-81.

47. Terence W. Barrett, "Electromagnetic Phenomena Not Explained by Maxwell's Equations," in Lakhtakia, A. (ed.): *Essays on the Formal Aspects of Electromagnetic Theory,* World Scientific Publishing, River Edge, NJ, 1993, p. 6-86; — "On the distinction between fields and their metric: the fundamental difference between specifications concerning medium-independent fields and constitutive specifications concerning relations to the medium in which they exist." *Ann. Fond. Louis de Broglie,* 14(1), 1989, p. 37-75; — and D. M Grimes. [Eds.] *Advanced Electromagnetism: Foundations, Theory, & Applications.* World Scientific, (Singapore, New Jersey, London, and Hong Kong), Suite 1B, 1060 Main Street, River Edge, New Jersey, 07661, 1995. In the latter book see T.W. Barrett, "Sagnac Effect: A Consequence of Conservation of Action Due to Gauge Field Global Conformal Invariance in a Multiply-Joined Topology of Coherent Fields," p. 278-313.

48. But see Craig F. Bohren, "How can a particle absorb more than the light incident on it?" *Am. J. Phys.,* 51(4), Apr. 1983, p. 323-327. By *resonating* the intercepting charged particle, its reaction cross section increases, and more EM energy is collected and re-radiated by the charge than is input to it by the conventional accounting (which only accounts the input Poynting energy that would be intercepted by a *static* charge). The conventional input energy

calculation therefore ignores the huge nondiverged Heaviside component surrounding the Poynting component and wasted. The resonant particle sweeps out past the usual Poynting component into the unaccounted Heaviside input component, and collects excess energy. The Bohren experiment with resonant charged particles produces COP =18. Metallic particles at ultraviolet frequencies are one class of such particles and insulating particles at infrared frequencies are another. For independent confirmation of the Bohren experiment, see H. Paul and R. Fischer, {Comment on "How can a particle absorb more than the light incident on it?'},"*Am. J. Phys.*, 51(4), Apr. 1983, p. 327.

49. E. T. Whittaker, 1903, *ibid.*

50. A beneficial use, e.g., would be to use such CSRs to investigate and report the interior of the sun and planets, including the Earth and its core. Since a CSR can also travel "through" the interior of a light beam, in theory such could be dispatched back into some of the nearer stars to also explore and report their interior.

51. This is no more curious than stating that sets of waves and their dynamics can exist in space, without interacting with mass, and that they can then later interact with a mass system to change it in specifically designed manner. Since longitudinal EM waves and their dynamics are "infolded" inside ordinary EM waves, fields, and potentials, they are also infolded "inside" the ambient vacuum potential, which itself is a part of the local vacuum potential. In short, one forms highly complex LW wavesets and functional dynamics, in essentially a sort of "subspace" as popularized by the Star Trek television series. The LW "engines" are identically ST curvature engines. A close colleague of the present author has in fact already invented and rigorously demonstrated such a communication system, but his former funding by several very large communications companies collapsed before he could develop and employ this system for the commercial market.

52. This is easily understood if one shifts one's vision from "space" to "subspace." Subspace is filled with (literally is composed of) longitudinal EM waves and their dynamics. The CSR's are quite unique, enormous systems "singing away" with longitudinal EM waves. So a longitudinal EM wave interferometer can easily locate them by sweeping its beams through subspace, as a radar sweeps to track aircraft in space. Once the CSR target "pings", the system automatically hits it with a profusion of interacting LWs, completing disrupting and destroying its dynamics. Scratch one system. Probably several million such systems were destroyed throughout the West (command centers, power grids, submarines, nuclear bombers, etc.) in rapid fire order, all without any external "spatial" sign other than perhaps a wee bit of very low level "EM noise" briefly as a struck CSR fractured.

53. See M. Sachs, *Quantum Mechanics from General Relativity,* Reidel, 1986. Sachs'unified field theory, e.g., applies equally to the quarks and gluons, as it does to the nucleons, the atoms, molecules, and macroscopic objects and phenomena. See also M. Sachs, "Symmetry in Electrodynamics: From Special to General Relativity, Macro to Quantum Domains," in *Modern Nonlinear Optics,* Second Edition, 3 vols., M. W. Evans (ed.), Wiley, 2001; vol. 1, p. 677-706.

54. G. M. Wang, E. M. Sevick, Emil Mittag, Debra J. Searles, and Denis J. Evans, "Experimental Demonstration of Violations of the Second Law of Thermodynamics for Small Systems and Short Time Scales," *Phys. Rev. Lett.,* 89(5), 29 July 2002, 050601.

55. The tragic death of Captain Hess was also very probably such a test. Hess, perfectly normal and happy, laid out his uniform in the early morning and then went for his customary morning jog. He suddenly veered aside, sat down in a path and stabbed himself 26 times, all deep stab wounds, four of which would be totally incapacitating (two right through the heart) to any normal individual experiencing normal shock, etc. To a psychoenergetically controlled individual where shock does not occur nor does emotion or pain, this is understandable. Add this to the incidents involving Captains Button and Svoboda, and one begins to see the picture.

56. W. Heitman and G. Nimtz, "On Causality Proofs of Superluminal Barrier Transversal of Frequency Band Limited Wave Packets," *Phys. Lett. A196,* 1994, p. 154-158. Aichmann and Nimtz and co-workers at the University of Cologne have transmitted 8.7 GHz microwaves (free space wavelength 3.4 cm) traveling in a rectangular wave-guide that contains a "barrier" section of reduced dimensions. They have recently transmitted Mozart's 40th Symphony as frequency modulated microwaves through a barrier wave-guide at an FTL group velocity of 4.7 c, receiving audibly recognizable music from the microwave photons that survived their barrier passage. The transit time through the barrier was about 81 picoseconds and was observed to be constant for barriers with widths varying from 4.0 cm to 11.4 cm.

57. Quantum mechanics in fact requires instantaneous transmission of effects. A mishmash of learned contention would have us believe one can "transmit" energy instantly, but not intelligence. This argument has essentially stymied our scientific establishment so that it has not really funded strong investigation in this area. It is a stupid argument: Simply transmit one change, then a second one, then a third one, in serial order, where the "order" contains the intelligence. No different from Morse code. Somehow the pundits so certain that intelligence cannot be superluminally transmitted seem to have forgotten what "intelligence" is. They also seem to have assumed that one superluminal change can be **transmitted** on order, but a second, third, and fourth cannot.

58. Feynman and Wheeler tried very hard to formulate a new absorber theory of electrodynamics to eliminate many of the fierce foundations problems. Wheeler described the effort this way: *"...we may summarize the account of radiation reaction given by Wheeler and Feynman in 1945. In it every charged particle is envisaged as coupled to every other charged particle by a field that is symmetric in time: half advanced, half retarded. Interconnections run forward and backward in time in such numbers as to make an unbelievable maze. That weaving together of past and future seems to contradict every normal idea of causality. However, when the number of particles is great enough to absorb completely the signal starting out from any source, then this myriad of couplings adds up to a simple result: the familiar retarded actions of everyday experience, plus the familiar force of radiative reaction with its familiar sign."* [John Archibald Wheeler, "Law without law," in *Quantum Theory and Measurement.*, preprint, p. 39].

Unfortunately, when the foundations of any science are closely examined in their roots, one runs into the age-old bane of the philosopher: ultimately opposites are identical, at least prior to the observation (separation) action to separate them. It follows that all scientific reasoning is circular at its most primary basis.

59. See Charles W. Misner, Kip S. Thorne and John Archibald Wheeler, *Gravitation,* W. H. Freeman, San Francisco, CA., 1973, p. 71. Wheeler spoke of that inescapable fact in this manner: *"Here and elsewhere in science, as stressed not least by Henry Poincare, that view is out of date which used to say, 'Define your terms before you proceed.' All the laws and theories of physics, including the Lorentz force law, have this deep and subtle character, that they both define the concepts they use (here B and E) and make statement about these concepts. Contrariwise, the absence of some body of theory, law and principle deprives one of the means properly to define or even to use concepts. Any forward step in human knowledge is truly creative in this sense: that theory, concept, law, and method of measurement—forever inseparable—are born into the world in union."*

60. Also see T. E. Bearden, *Energy from the Vacuum: Concepts and Principles,* 2001, *ibid,* for a rework and extension of Aristotelian logic to eliminate its present fatal flaw, extending it into a 5-law logic.

61. The very notion of "propagation of energy through space" is radically extended in the extended unified EM and GR being pursued by AIAS and Sachs. Time-like EM energy currents dominate in the vacuum. E.g., see M. W. Evans et al., "Representation of the Vacuum Electromagnetic Field in Terms of Longitudinal and Time-like Potentials: Canonical Quantization," *J. New Energy,* 4(3),Winter l999,p. 82.

62. Multiwave interactions (between transverse EM waves) produce time-reversed EM waves (phase conjugate replicas of the signal wave input). That method time-reverses EM energy in waveform. To time-reverse EM energy in mass form, simply pump that mass with time-polarized EM waves. As an alternative, it may be pumped with longitudinal EM waves (which are always accompanied by time-polarized EM waves anyway), and the pumped mass is also pumped in the time-domain because of the presence of the time-polarized EM waves in the pumping. We previously filed an invention disclosure with the U.S. Patent Office dealing with how to do that.

63. Mostly studied by Becker. See (a) R. O. Becker, "The control system governing bone growth in response to mechanical stress," *J. Ark. Med. Soc,* Vol. 62, 1966, p. 404; (b) — and David G. Murray, "The electrical control system regulating fracture healing in amphibians," *Clinical Orthopaedics and Related Research,* Vol. unk, No. 73, Nov.-Dec. 1970, p. 169-198. This latter paper is the definitive technical exposition by Becker of his electrical control system ideas and findings. Good references for the educated layperson are (c) R. O. Becker, "A technique for producing regenerative healing in humans," *Frontier Perspectives,* 1(2), Fall/Winter 1990, p. 1-2; (d) Robert O. Becker and Gary Seldon, *The Body Electric: Electromagnetism and the Foundation of Life,* William Morrow and Company, New York, 1985; and (e) Robert O. Becker, *Cross Currents: The Promise of Electromedicine, the Perils of Electropollution,* Tarcher, St. Martin's Press, New York, 1990.

64. A provisional patent application has been filed on the process, and an overview of the method can be seen as the "porthole briefing" on my website www.cheniere.org.

65. (a) C. A. L. Bassett; R. O. Becker, and R. J. Pawluk, "Effects of electric currents on bone in vivo," *Nature,* Vol. 204, Nov. 14, 1964, p. 652-654. The complete electrical control system (conventional EM theory) for the healing of bone fractures is given in (b) R. O. Becker, *Clinical Orthopedics and Related Research,* Vol. 73, 1970, p. 169. A paper "putting it all together" is (c) R. O. Becker, J. *Bioelec,* Vol. I, 1982, p. 239.

66. F. Mandl and G. Shaw, *Quantum Field Theory,* Wiley, 1984, Revised Edition 1993, under the heading "5.2 Covariant Quantization" and "5.3 The Photon Propagator" in Chapter 5. The longitudinal and scalar photon polarizations are not directly observable, but only in combination, where they manifest as the instantaneous Coulomb (i.e., electrostatic) potential interaction, *"which emerges as an exchange of longitudinal and scalar photons."* So the common old electrostatic scalar potential is actually comprised of longitudinal EM waves and time-polarized EM waves.

67. With the MidEast increasingly set to explode, we may be facing the unleashing of weapons of mass destruction, a vast shortage and curtailment of

available oil and energy, and a total collapse of the Western economy and therefore most of the world economy, in as little as three or four years, if the impending energy crisis worldwide is not resolved quickly. See T. E. Bearden, ADAS position paper, "The Unnecessary Energy Crisis: How to Solve It Quickly," *ibid.* As this is written, we have already had a warning shot across our bow: the vicious terrorist attacks on September 11, 2001. We are in Afghanistan and elsewhere in a war against terrorism, and anyone can see the escalation in the MidEast toward war between the U.S. and Iraq, and almost certainly a resulting explosion in the MidEast and unleashing of the hostile terrorists assets and mass destruction weapons already inside the United States. Since modern economies are based on cheap energy, and cheap energy is largely based on cheap oil, then with surging energy demands worldwide we shall see "oil wars" erupt and rage worldwide, with terrorist retaliations and attacks—using weapons of mass destruction—occurring in U.S. cities. *Unless energy from the vacuum is quickly developed and deployment begun at high speed, we risk the coming collapse of the world economy, great destruction of populaces, and a new Dark Ages.*

68. E. T. Whittaker, 1903, *ibid.*

69. Daniel A. Walker, Charles S. McCreery, and Fermin J. Oliveira, "Kaitoku Seamount and the Mystery Cloud of 9 April 1984," *Science,* Vol. 227, Feb. 8, 1985, p. 607-611; Daniel L. McKenna and Daniel A. Walker, "Mystery Cloud: Additional Observations," *Science,* Vol. 234, Oct. 24, 1986, p. 412-413.

70. Superpotential theory was initiated by E. T. Whittaker, extending earlier concepts advanced by G. Johnstone Stoney. See E. T. Whittaker, *Proc. Lond. Math. Soc,* Series 2, Vol. 1, 1904, p. 367-372. Nisbet extended the Whittaker and Debye two-potential solutions of Maxwell's equations to points within the source distribution. This is a full generalization of the vector superpotentials (for media of arbitrary properties) together with their relations to such scalar potentials as those of Debye. See A. Nisbet, *Physica,* Vol. 21, 1955, p. 799. Also, A. Ricci in 1901 introduced what might be called the magnetization potential, satisfying a certain equation, as an alternate to the Hertz vector. This was a part of early vector superpotentials. For an excellent overview discussion of superpotentials and related things, see Melba Phillips, "Classical Electrodynamics," in *Principles ofElectrodynamics and Relativity,* Vol. IV of *Encyclopedia ofPhysics,* edited by S. Flugge, Springer-Verlag, 1962. Phillips discusses, for example, that Whittaker 1903 (note: oral delivery; paper was published in 1904) was the first to prove that one can derive a general electromagnetic field from two scalar functions, which are really components of the vector superpotentials, with proper choices of the gauge functions. Whittaker's method is well known in the treatment of transverse electric and transverse magnetic modes of a cylindrical cavity or a waveguide. Nisbet has shown that this result may be extended within the source distribution (assumed

given) by a suitable choice of stream functions. The Debye potentials and the Bromwich potentials are essentially radial components of the vector potentials of which Whittaker potentials are the real parts. So in general the particular integral (the stream potentials) of the inhomogeneous Maxwell equations may be so chosen that the complementary function can be expressed in terms of only two scalars, which are components of the vector superpotentials. The Whittaker and the Debye-Bromwich potentials are special cases of two vector superpotentials.

71. David Jones, *Vancouver Sun Times,* Weekend Magazine, Dec. 17, 1977, p. 17.

72. For more specific information on the production of practical antigravity and an experiment demonstrating it, see T. E. Bearden, *Energy from the Vacuum: Concepts and Principles,* Cheniere Press, Santa Barbara, CA, 2002, Chapter 8. Approach to Antigravity.

73. T. E. Bearden, *Energy from the Vacuum: Concepts and Principles,* Cheniere Press, Santa Barbara, CA, 2002, Chapter 10. Cold Fusion: Low Spatial-Energy Nuclear Reactions at High Time-Energy. By inadvertently using highly compressed time-energy, cold fusion researchers are actually using—on the tabletop—higher energy density than our present high-energy physics uses in its largest accelerators. The conventional scientific community does not have a single scientific program dedicated to using time as energy, even when one's physics model can legitimately be made of a single fundamental unit. When the joule is chosen as that unit, then time becomes totally a function of energy, just as is mass. The use of mass-energy gave us the nuclear age; the use of time-energy will give us a far greater age, if we can ever get the scientific community off its duff and moving.

74. Further, the second law of thermodynamics has long been known not to apply to a single charge, atom, or molecule or to a small group. For such microscopic phenomena, there will occur reversed reactions a certain small fraction of the time. But also see G. M. Wang, E. M. Sevick, Emil Mittag, Debra J. Searles, and Denis J. Evans, "Experimental Demonstration of Violations of the Second Law of Thermodynamics for Small Systems and Short Time Scales," *Phys. Rev. Lett.,* 89(5), 29 July 2002, 050601. These researchers have experimentally proven that the second law can be and is violated for much larger scales—up to micro (colloidal) size—and for much longer times (up to two seconds). Hence it is now proven that such "reversed zones" where reactions run backwards for quite a bit, can and do in fact occur on the colloidal scale, sufficient for the formation of large clusters of like charges. Evans and his colleagues have pointed out that these results dramatically affect chemistry.

75. Shoulders has been creating and using such charge clusters for years. See Kenneth R. Shoulders, "Energy Conversion Using High Charge Density,"

U.S. Patent # 5,018,180, May 21, 1991; — "Energy Conversion using High Charge Density," U.S. Patent No. 5,123,039, 1992; — "Method and Apparatus for Production and Manipulation of High Density Charge," U.S. Patent #5,054,046, 1991; — U.S. Patent #5,054,047, 1991; — "Circuits Responsive To and Controlling Charged Particles," U.S. Patent 5,148,461, 1992; — and Steve Shoulders, "Observations on the Role of Charge Clusters in Nuclear Cluster Reactions,"J. *New Energy,* 1(3), Fall 1996, p. 111-121.

76. D. J. Evans and D. J. Searles, *Phys. Rev. E,* Vol. 50, 1994, p. 1645.

77. See Donald Kennedy, "To Publish or Not to Publish," *Science,* Vol. 295, 8 Mar. 2002, p. 1793.

78. R. P. Taleyarkhan, C. D. West, J. S. Cho, R. T. Lahey Jr., R. I. Nigmatulin, and R. C. Block, "Evidence for Nuclear Emissions During Acoustic Cavitation," *Science,* Vol. 295, 8 Mar. 2002, p. 1868-1873. Quoting from the abstract: "In cavitation experiments with deuterated acetone, tritium decay activity above background levels was detected. In addition, evidence for neutron emission near 2.5 million electron volts was also observed, as would be expected for deuterium-deuterium fusion. Control experiments with normal acetone did not result in tritium activity or neutron emissions."

79. Yuri T. Didenko and Kenneth S. Suslick, "The energy efficiency of formation of photons, radicals and ions during single-bubble cavitation," *Nature,* Vol. 418, July 25, 2002, p. 394-397.

80. E.g., see John Archibald Wheeler and Richard Phillips Feynman, *Phys. Rev.* 59, 1941, p. 683; —"Interaction with the Absorber as the Mechanism of Radiation," *Rev. Mod. Phys.,* 17(2, 3), Apr.-Jul. 1945, p. 157-181.

81. Albert Einstein, "Foreword," in Max Jammer, *Concepts of Space: The History of Theories of Space in Physics,* Harvard University Press, Cambridge, Massachusetts, 1969, p. xi-xii.

82. Robert A. Fisher, [Ed.], *Optical Phase Conjugation,* Academic Press, NY, 1983, p. xv.

83. Basically, the choice between distant heating in the interference zone, or distant cooling, is as simple as how one biases the ground potential used for the electrical grounds of the interferometer transmitters. Biasing well above the ambient potential in the distant IZ produces divergent EM energy (heat) forming and radiating in the distant zone. Biasing well below the ambient IZ potential produces convergent EM energy (cold) forming and radiating in the distant zone.

84. Mass is mostly empty space filled with EM potentials, fields, and waves. Since these potentials, fields, and waves are simply bundles of longitudinal EM waves and their impressed dynamics, it follows that mass itself

is mostly a "giant superhighway" for the transmission of LWs. This is actually a sort of "subspace" transmission "right through" matter, so to speak.

85. As demonstrated by such dual serial usage by a giant interferometer in the anomalous and explosive "cloud" phenomena near the Kurils in April 1984. For excellent descriptive articles and a hard look at the phenomena, see Walker et al., *Science, ibid.*

86. See "Soviet device uses radio waves as tranquilizer," AP release, *Huntsville [Alabama] Times,* May 19, 1983. See also W. Ross Adey, "Biological effects of low energy electromagnetic fields," *Proc. NATO Adv. Study Inst. on Advances in Biological Effects and Dosimetry of Low Energy Electromagnetic Fields,* Plenum Press, New York, 1983, p. 359-391. Adey apparently was aware only of ordinary U(l) electrodynamics. He describes the **LIDA** device as follows: *"Soviet investigators have also developed a therapeutic device utilizing low frequency square wave modulation of a radiofrequency field. This instrument know as the LIDA, was developed by L. Y. Rabichev and his colleagues in Soviet Armenia, and is designed for the 'treatment of neuropsychic and somatic disorders, such as neuroses, psychoses, insomnia, hypertension, stammering, bronchial asthma, and asthenic and reactic disturbances.' It is covered by U.S. Patent #3,773,049. In addition to the pulsed RF field, the device also delivered pulsed light, pulsed sound, and pulsed heat. Each stimulus train can be independently adjusted in intensity and frequency. The radiofrequency field has a nominal carrier frequency of 40 MHz and a maximum output of approximately 40 watts. The RF field is applied to the patient on the sides of the neck through two disc electrodes approximately 10 cm. in diameter. The electrodes are located at a distance of 2-4 cm from the skin. Optimal repetition frequencies are said to lie in the range from 40 to 80 pulses per minute. Pulse duration is typically 0.2 sec. In a 1-year trial period, the instrument was used on 740 patients, including adults and children. Positive therapeutic effects were claimed in more than 80 percent of the cases treated."* We accent that this is one of the simplest Russian psychoenergetics devices, obsoleted very early on, and thus released very early for public use.

87. Since U.S. researchers are unaware of the EM wave polarization transduction mechanisms, and in general have no instruments for detecting longitudinal EM waves, the specific transduction effects on humans would not be measured by U.S. laboratories. Hence the U.S. scientists could only think of it in conventional electrodynamic terms, and remained totally unknowledgeable about the specific transduction mechanisms in the human body producing time-polarized EM waves and effects from the device.

88. Max Frankel, "Khrushchev Says Soviet Will Cut Forces a Third; Sees 'Fantastic Weapon'," New *York Times,* Jan. 15, 1960, p. 1.

89. For a simplified introduction to psychoenergetics and the mind-matter coupling mechanism, see T.E. Bearden, "Mind Control and EM Wave Polarization Transductions, Part I", *Explore,* 9(2), 1999, p. 59; Part II, *Explore,* 9(3), 1999, p. 61; Part III, *Explore,* 9(4,5), 1999, p. 100-108.

90. One of the serious goals of the die-hard KGB psychoenergetics scientists appears to be to achieve the capability of directly engineering the entire human collective unconscious mind. The plan envisioned is to convert the human species into a sort of "giant ant species" where each one has perfect, machine-like niche and function (except, of course, for the elite Communist masters). In short, they conceived back there in the 1960s that such a "perfect communist state" for all humanity was in fact possible to achieve technically, with sufficient development of psychoenergetic technology. They are apparently well along the way toward achieving that goal. [The U.S. has not even conceived such a scientific possibility, and modern cognitive science in the West seems bent on the rather astounding proposition that mind itself does not even exist!]. We point out that no type of physical defense is even possible against such a capability engineered into the collective human unconscious, once it is achieved. The only "counter" is to use the same technology (it has to first be developed) to "re-engineer" what will have been done. But our fellows have not even conceived the possibility of the threat, much less the cause or the counter. Hence they continue to totally misunderstand what happened to Captains Button, Svoboda, and Hess in successful mind-control tests achieved perfectly at great distance.

91. To see the nature of the time-density wave (which is basically a longitudinal EM wave along the time axis), due to the perfect correlation between time-energy flow currents and variations with respect to longitudinal EM waves, see T.E. Bearden, "Giant Negentropy from the Common Dipole," 2000, *ibid.* Not stressed in the paper is the fact that the same dipolar negentropy with correlated EM time-energy currents and EM spatial energy currents, exists in the "individual" photon. Further, they can occur in coupled photon-antiphoton pairs, yielding the graviton. For time-polarized EM photons, it appears that two photon-antiphoton pairs are coupled, yielding the "supergraviton." Elsewhere we have briefly and addressed these novel formations as hypotheses.

92. Induction of specific diseases and health changes in the U.S. Embassy in Moscow over four decades, included causing the deaths of three U.S. Ambassadors. It was accomplished by implementing desired disease-pattern "engines" infolded inside field-free potentials. The Johns Hopkins study of the radiation patterns revealed a most significant finding: All the affected persons were in regions of the Embassy where the Russian microwave radiation *fields* were absent. In short, where the field-free—and thus very stable—potentials existed. Since these scientists (and most others in classical EM) consider that EM effects are caused only by fields, they concluded (totally erroneously) that

these health changes could not have been caused by the microwave radiation. To the contrary, they had just clearly proven that the radiation was indeed the cause. They showed a 100% correlation to the *presence of field-free potentials,* and a 100% anticorrelation to where the fields were present. This was for induced phenomena over several years. Had the radiation not been the culprit, then some health changes would have occurred where the fields were present, and some would have occurred where they were absent. That is not what happened at all, and this inexplicable logical non sequitur against common statistical inference was the accepted decision. The truly revealing aspect was that *apparently the entire U.S. Intelligence community had no competence or capability in higher group symmetry electrodynamics.*

93. E.g., see Lewis H. Ryder, *Quantum Field Theory,* Cambridge University Press, 2nd Edition, 1996, p. 147+ which covers the four photon polarizations. See also F. Mandl and G. Shaw, *Quantum Field Theory,* Wiley, 1984, Revised Edition 1993, under the heading "5.2 Covariant Quantization" and "5.3 The Photon Propagator" in Chapter 5.

94. We elaborate on this somewhat, in "Mind Control and EM Wave Polarization Transductions", *ibid.*

95. Again, we point out the unified field approach of Mendel Sachs as probably being the best Western model in which to grapple with these phenomena.

96. David J. Bohm, "A Suggested Interpretation of the Quantum Theory in Terms of'Hidden' Variables, I and II." *Phys. Rev.,* 85(2), Jan. 15, 1952, p. 166-179 (Part I); 180-193 (Part II).

97. T. E. Bearden, *Gravitobiology: A New Biophysics,* Cheniere Press, Santa Barbara, Ca. www.cheniere.org, 1991.

98. W. A. Rodrigues Jr. and J.-Y. Lu, "On the existence of undistorted progressive waves (UPWs) of arbitrary speeds 0 < v < oo in nature," *Found. Phys.,* 27(3), 1997, p. 435-508. A slightly corrected version is downloadable as hep-th/9606171 on the Los Alamos National Laboratory web site. It includes corrections to the published version.

99. W. A. Rodrigues Jr. and J. Vaz Jr., "Subluminal and Superluminal Solutions in Vacuum of the Maxwell Equations and the Massless Dirac Equation," *Adv. Appl. Clifford Algebras,* Vol. 7(S), 1997, p. 457-466.

100. E.g., see A. Enders and G. Nimtz, *Phys. Rev. Lett.,* Vol. 48, 1993, p. 632. Enders, Aichmann, Nimtz and co-workers at the University of Cologne have transmitted 8.7 GHz microwaves (free space wavelength 3.4 cm) traveling in a rectangular wave-guide that contains a "barrier" section of reduced dimensions. They transmuted Mozart's 40th Symphony as frequency modulated

microwaves through a barrier wave-guide at an FTL group velocity of 4.7c, receiving audibly recognizable music from the microwave photons that survived their barrier passage.

101. J. D. Jackson, *Classical Electrodynamics*, 2nd Edition, Wiley, New York, 1975, p. 222.

102. See H. A. Lorentz, *Vorlesungen Uber Theoretische Physik an der Universitat Leiden, Vol. V, Die Maxwellsche Theorie (1900-1902)*, Akademische Verlagsgesellschaft M.B.H., Leipzig, 1931, "Die Energie im elektromagnetischen Feld," p. 179-186. Figure 25 on p. 185 shows the Lorentz concept of integrating the energy flow vector around a closed cylindrical surface surrounding a volumetric element. This is the procedure which arbitrarily selects only a small component of the total energy flow in space outside a circuit and associated with it—specifically, the small Poynting component diverged by the surface charges into the conductors to power the electrons—and then treats that tiny component as the "entire" vast energy flow (which may be a trillion or more times greater in magnitude). Thereby Lorentz arbitrarily discarded all the huge *Heaviside* energy transport component that does not strike the circuit at all, is not diverged into the conductors, and is just wasted. See Oliver Heaviside, *Electrical Papers*, Vol. 2, 1887, p. 94. Quoting: *"It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire... . Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire."*

103. When it is associated with positive energy fields and potentials from positive mass, positive energy source charges, we have nominated that long-unaccounted Heaviside energy flow component as the source of the excess gravity holding the arms of the spiral galaxies together (a solution to the dark matter problem). When it is associated with negative energy fields and potentials from negative-energy Dirac Sea holes in 4-space, we have nominated that unaccounted energy flow component as the source of the excess antigravity responsible for accelerating the expansion of the universe (a solution to the dark energy problem).

104. About a year from now, Bedini and I will also release a very novel use of this Heaviside energy flow component in inverted circuits—circuits that

operate almost completely in reverse from normal textbook circuits. This is a totally new kind of circuit that we hope will revolutionize power systems and electronic control systems. Until our intellectual property rights are secured, we are not releasing any details at all.

105. Terence W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," *Ann. Fond. Louis de Broglie,* 16(1), 1991, p. 23-41. Tesla was able to shuttle energy around in his circuits at will. Barrett went on to improve the process and patent two versions. See T. W. Barrett, "Active Signalling Systems," U.S. Patent No. 5,486,833, Jan. 23, 1996. This is a signaling system in time-frequency space for detecting targets in the presence of clutter and for penetrating media. See also T. W. Barrett, "Oscillator-Shuttle-Circuit (OSC) Networks for Conditioning Energy in Higher-Order Symmetry Algebraic and RF Phase Conjugation," U.S. Patent No. 5,493,691. Feb. 20, 1996.

106. Bryan G. Wallace, "The Unified Quantum Electrodynamic Ether," *Found. Phys.,* 3(3), Sept. 1973, p. 381-388.

107. William G. Harter, John Evans, Roberto Vega, and Sanford Wilson, "Galloping waves and their relativistic properties," Am. J. *Phys.,* 53(7), July 1985, p. 671-679. Most waves caused by a single frequency source have a galloping motion. The only exceptions are the very special cases of absolutely pure moving waves or absolutely pure standing waves. The superposition and resulting interference of two oppositely moving waves generally yield a wave having nonuniform motion; in short, the wave rushes forward rapidly, then slows appreciably, etc. A relativistic example is given in which the source frame observes a very nonuniformly galloping wave whose velocity varies between 0.01 c and 100 c, even though its average velocity is c. Relativistic properties of interfering electromagnetic plane waves are discussed.

108. S. L. Miller, "The Formation of Organic Compounds on the Primitive Earth," *Ann. NYAcad. Sci.,* Vol. 69, 1957, p. 260; — *Bioch. Biophys. Acta.,* Vol. 23, 1957, p. 480-489; — *Science,* Vol. 117, May 15, 1953, p. 528-529; — and H. C. Urey, "Organic Compound Synthesis on the Primitive Earth," *Science,* Vol. 130, 1959, p. 245-251.

109. R. Harada and S. Fox, "Thermal Synthesis of Natural Amino-Acids from a Postulated Primitive Terrestrial Atmosphere," *Nature,* 201(4917), 1964, p. 335-336; S.W. Fox, "How Did Life Begin?", *Science,* 132(3421), July 22, 1960, p. 200-208; — and S. Yuyama, "Abiotic Production of Primitive Protein and Formed Microparticles," *N.Y. Acad. Sci. Ann.,* Vol. 108, June 1963, p. 487-494; — and K. Harada, "Thermal Copolymerization of Amino Acids to a Product Resembling Protein," *Science,* 128(333), 1958, p. 1214; — and M. Middlebrook, "Anhydrocopolymerization of Amino Acids Under the Influence of Hypothetically Primitive Terrestrial Conditions," *Federation Proc.* Vol. 13, Mar. 1954, p. 211.

110. H. C. Urey, "On the Early Chemical History of the Earth and the Origin of Life," *Proc. Nat. Acad. ScL,* 38(4), 1952, p. 351-363.

111. I.e., one may speak of the "potential" of a specific engine of a former life form, and then realize that the potential for that form reduces in magnitude inversely as the radial distance from the Earth. However, it does not reduce to zero until an infinite distance is reached.

112. As an example, a great EM energy flow—produced by the cross product ExH of the earth's magnetic field and the earth-to-electrosphere electric field—flows from West to East around the earth, nearly parallel to the equator. Infolded in that great EM energy flow are all the structures of all the genetics and life forms on earth, or that have ever been on earth and conditioned the natural scalar potential of the earth. The vials in the laboratory experiments of Miller, Fox, and Urey were all continually bathed in that great energy flow, which within it contained the entire life structure and dynamics of the planet. So no "inert" experiments were ever performed, contrary to the interpretations of the scientific community.

113. Vlail Kaznacheyev and L. P. Mikhailova, *Ultraweak Radiation in Intercellular Interactions,* [in Russian], Novosibirsk, 1981 [an English exposition of much of the Kaznacheyev work is given in Vlail Kaznacheyev, "Electromagnetic Bioinformation in Intercellular Interactions," *Psi Research,* 1(1), Mar. 1982, p. 47-76.] Kaznacheyev, e.g., appears to have headed the Soviet team actually producing the basis for the disease-inducing technology utilized for four decades in the microwave radiation of the U.S. Embassy in Moscow.

114. Specifically, the down payment was $900 million in gold. The lease is probably about $1 billion per year. Thus the Yakuza acquired very powerful strategic weapons, and became a secret power to be reckoned with internationally and strategically. Since 1990, weather engineering over the U.S. and occasional shootdown of aircraft (such as the TWA-800) have been by rogue Japanese fingers on the scalar interferometer weapon triggers, on site in Russia.

115. The Yakuza has also transferred some of the longitudinal EM wave interferometry technology to their Japanese facilities. One such system has apparently been deployed in the power grid, and has been used to kill some government officials who opposed the Yakuza. This information was obtained by some brave Japanese risking their lives to get the information to the present author.

116. Many important KGB weapon tests happened in April of various years; the KGB weapons folks were simply preparing for their May Day reports, and each wished to have a good one.

117. Sen. Sam Nunn's investigation teams verified that the Aum Shinrikyo were actively seeking the "Tesla Weapons", with the Aum Shinrikyo even visiting the Tesla Museum in Beograd for that purpose. We have 100% certain confirmation of the Yakuza and Aum Shinrikyo leasing of the scalar interferometers from the KGB and Russian Mafia (working for the KGB) at the end of 1989 or first few days of 1990. Sen. Nunn's report confirms that the Aum Shinrikyo set up a University in Moscow. Our comment is that this is where the Russians actually taught the Japanese crews the science and technical functions so that they could successfully man and use the scalar (longitudinal EM wave) interferometry weapons.

118. Recall that in the 1950s and early 1960s, Kaznacheyev et al., *ibid.*, had already clearly proven that nearly any form of cellular change, damage, or disease could be induced in cells at a distance by purely electrodynamic means.

119. In the kill of the Arrow DC-8 at Gander, Newfoundland on 12 Dec. 1985, the struck aircraft did charge up with time-density charging, and many pieces of the wreckage did indeed emit longitudinal EM waves thereafter for some time. Consequently, the Canadian recovery crews working the site and handling the materials, were exposed to longitudinal EM wave radiation for varying degrees of exposure. It follows that many of those on-site handlers should have later come down with physical ailments, with symptoms such as flu-like features, weakness, heart palpitations, headaches, dizziness, disturbance of equilibrium, and with various infections because of weakened immune systems. They also should have had weakened cellular regenerative (healing) systems, so their physical problems would endure and largely remain. About five dozen of the recovery personnel did come down with those exact symptoms, and many remained disabled or debilitated for some years.

120. We have also explained (a) why the French forces in the Gulf War did not get GWS, while American, British, and Canadian forces did, (b) why the native population did not exhibit GWS, and (c) the remaining anomalous phenomena associated, such as the semen "infecting" the wife, the children catching similar or related conditions from sustained close proximity to their father's biofields (transmission of engines), etc.

121. Mario Bunge, Foundations of Physics, Springer-Verlag, New York, 1967, p. 176.

122. T. E. Bearden, "Giant Negentropy from the Common Dipole," J. *New Energy*, 5(1), Summer 2000, p. 11-23 gives the solution to the long-vexing source charge problem. The paper is also carried on DoE restricted website http://www.ott.doe.gov/electromagnetic/ and on www.cheniere.org

123. Two examples of inane articles and actions in this respect, revealing no knowledge that every charge in the universe already exhibits COP = oo, are (a)

Graham P. Collins, "There's No Stopping Them: Perpetual Motion is alive and well at the U.S. Patent Office," and (b) Resolution by the Executive Board at the June 2002 meeting of the American Physical Society (APS) as follows: *"The Executive Board of the American Physical Society is concerned that in this period of unprecedented scientific advance, misguided or fraudulent claims of perpetual motion machines and other sources of unlimited free energy are proliferating. Such devices directly violate the most fundamental laws of nature, laws that have guided the scientific progress that is transforming our world."* So the learned APS has just declared the source charge as an unacceptable "free energy" machine and perpetual motion machine, since the charge simply sits there and continuously pours out real observable EM energy in all directions at the speed of light, without any observable EM energy input. Thus the APS has implicitly declared all EM fields and potentials and their energy—which includes every joule of EM energy in the universe, in matter or in space—to be unacceptable byproducts of perpetual motion nonsense. We heartily call upon the APS in the name of science to enforce their resolution in the orthodox academic community, who are the greatest perpetual motion advocates in history. To be consistent with their own resolution, they must root out and destroy—from all texts and universities and from the scientific literature—any mention whatsoever of charge, field, potential, and EM energy. Either they must do that, or stand hoisted on their own petard as a dogmatic group still very much unaware of why the Nobel Prize was awarded to Lee and Yang in 1957 and what the proof—by Wu et al.—of the asymmetry of opposite charges means with respect to the source charge considered in its modern quantum field theory view as a dipolarity of a bare infinite central charge surrounded by clustering virtual charges (also infinite charge) of opposite sign in the active vacuum. Every electrical engineering department and professor and textbook still uses a model and teaches a subject assuming that every charge in the universe freely creates energy from nothing at all. Further, the APS in every annual meeting also tolerates, encourages, and publishes multiple papers and presentations with the same such unacceptable perpetual motion assumptions in them. Such is the lofty understanding of our present organized scientific community, which seems much more politically bent than scientifically bent. The simple Bohren experiment and the entire area of negative resonance absorption of the medium has long been established in nonlinear optics, and such experiments widely yield a nominal COP = 18. In other words, the experiments nominally output 18 times as much energy as the operator inputs, and the excess input energy is furnished absolutely for free from the active vacuum's exchange. In this case the Executive Board of the APS is not even aware of what its own physics discipline has long proven and accepted in particle physics, for nearly a half century. Neither are the self-appointed defenders of the faith, who also are totally unaware of what physics has already proven with a Nobel Prize awarded nearly a half century ago.

124. C. S. Wu, E. Ambler, R. W. Hayward, D. D. Hoppes and R. P. Hudson, "Experimental Test of Parity Conservation in Beta Decay," *Phys. Rev.*, Vol. 105, 1957, p. 1413. We also quote Nobelist T. D. Lee as follows: *"Since nonobservables imply symmetry, any discovery of asymmetry must imply some observable. The experiment of Wu, Ambler, Hayward, Hoppes and Hudson... established the asymmetry between the positive and negative signs of electricity."* [T. D. Lee, *Symmetries, Asymmetries, and the World of Particles*, U. Wash. Press, Seattle, 1988, p. 11.].

125. Dilip Kondepudi and Ilya Prigogine, *Modern Thermodynamics: From Heat Engines to Dissipative Structures*, Wiley, New York, 1998, reprinted with corrections 1999.

126. See "Secret Speech: Did Brezhnev Come Clean?" *National Review*, 29(8), Mar. 4, 1977, p. 248, 250

127. For the energy description of this device and some results, see Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," *Proc. 26th Intersoc. Energy Conversion Engineering Conf. (IECEC '91)*, Boston, Massachusetts, p. 370-375.

128. Also see my book, *Energy from the Vacuum*, 2002, *ibid*, which includes photographs of the self-powering Sweet device, courtesy of Walter Rosenthal.

129. Roy Brewer was very active in Hollywood Unions against Communists when they were busily penetrating the Hollywood complex. He was a staunch anti-communist, fighting them out of control of the unions, way back when. Ronald Reagan was a personal friend of his of long standing, and Roy had open access to the White House when Reagan was President.

Roy briefed Reagan on the Russian scalar weapons, and Reagan believed him. Three times, Reagan ordered his Secretary of Defense to take action in that area, but neither of the three did so because the U.S. Intelligence Community did not believe it and adamantly opposed any such action. We took quite a beating in those days, for quite a long time (some years), before certain key parts of the Government finally believed us, checked it out experimentally, and found that it worked.

Roy also introduced me to the Duke de Grantsmesnil, one of the last of the great old British intelligence men, now unfortunately deceased. In the hectic 1997 days when we were trying desperately to warn a little friendly nation (and our own) against a coming great strategic strike on the U.S. and other allies, the Duke played a major role in introducing us directly to higher political levels in that little nation - which was the only nation on earth that could counter the pending strike. The first planned strike scheduled in February 1997 was successfully countered, only to be immediately rescheduled. In the second

incident, the attack was scheduled for May 1, 1997. We finally realized why the hostile nation could reschedule and go ahead, and needed then to warn the little nation of the reason in some detail. We had tried everything to get certain information through, and all means had failed. A former ambassador of that nation to Great Britain was also assassinated during that struggle. Roy Brewer was one of the key fellows assisting in that attempt, as were other personal colleagues of mine who also were witnesses and direct participants in those desperate events. When all else failed, I finally just faxed the Prime Minister directly, in the clear, some five days before the attack, urging the most urgent and immediate action possible by the Prime Minister. A complete change in command and control of the weapon was required, and that change had to be made and then the hostile nation had to be notified that the change was in place (and probably shown that it was). The Prime Minister accepted the message and the necessary action was carried out immediately. So two days or so before the actual attack was scheduled, that great hostile armada began standing down. Oh, the hostile nation and its leaders could have easily destroyed the entire United States in two hours or so, without fail! But then their own country would have promptly disappeared from the face of the earth. So they stood down. And our own Intel community never even picked it up (they did get my messages alerting the U.S. Government, but thought it was a joke or something). They, of course, also intercepted my open fax to the Prime Minister, and so were all over me for that one for a while thereafter.

Interestingly, at the very time that great armada was just beginning to stand down, then Secretary of Defense William Cohen made the following statement at a conference in Georgia: "Others are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves...so there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations...It's real, and that's the reason why we have to intensify our efforts, and that's why this is so important." Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

Ironically, the Secretary was referring to the earlier scalar interferometer weapons, and now the quantum potential weapons etc. He was completely unaware that a great strategic strike had actually been scheduled and was just being aborted as he was speaking those words.

Roy Brewer is one of those fellows who has been a great American, has served his country admirably during his lifetime, and contributed greatly to preventing a planned take-over by the Communists of the labor unions of America. In

addition, he helped set up the contacts with the friendly **liltle foregn nation, so** that on four occasions planned attacks to destroy the United States have been successfully aborted or handled.

As you know, one of the great failures in the Communist plan to have America go communist was their failure with the labor unions. And we owe that failure to the steadfast efforts of some staunch folks like Roy Brewer. He helped save our nation when many of us were still wearing knee pants.

130. Wheeler's principle, as stated in W. Misner, K. S. **Thorne, and J.** A. Wheeler, *Gravitation,* W.H. Freeman and Co., San Francisco, 1973, p. 5.

131. With the new improvements we uncovered, treatment time can be reduced to 5 minutes per patient. Three such treatments one week apart would be what are required. Hence one machine station could treat a patient every five minutes, around the clock. With sufficient portable treatment units, mass treatment for mass casualties would become a practical reality.

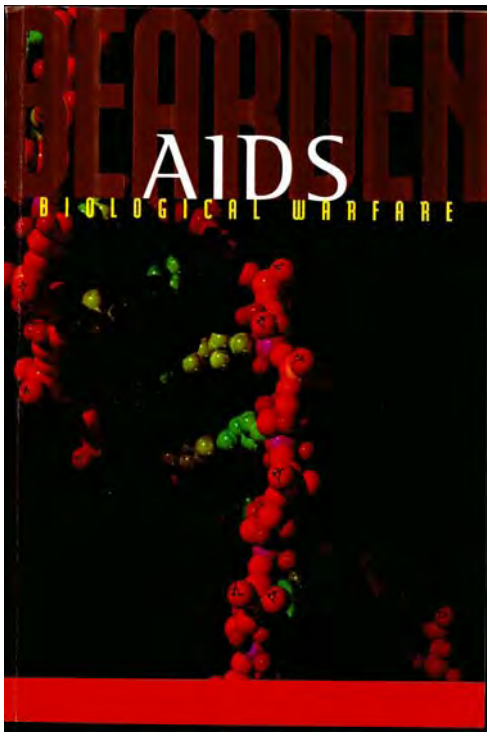

AIDS
BIOLOGICAL WARFARE

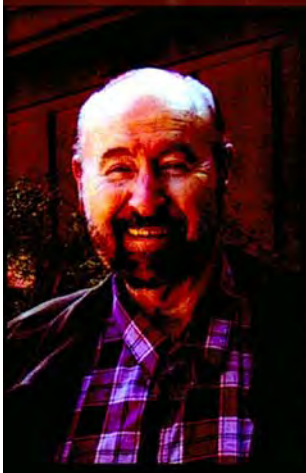

Lieutenant Colonel Thomas E. Bearden (U.S. Army, Retired) PhD, is the author of numerous books, papers, briefings, and presentations dealing with anomalous phenomena, scalar electromagnetics, free energy devices, Soviet Tesla weapons, and Soviet scalar electromagnetic weather warfare.

At the time of writing this book, Lt. Col. Bearden was a senior scientist and department manager with the Alabama division of a major aerospace company where he directed the company's design and production of expert systems (artificial intelligence) applications for the U.S. Army command control systems. He had more than 29 years experience in air defense systems, tactics, and operations; technical intelligence; nuclear weapons employment; computerized wargames; anti-radiation missile countermeasures; and military systems requirements.

Bearden obtained a Master of Science degree in nuclear engineering from the Georgia Institute of Technology and a Bachelor of Science degree in Mathematics from Northeast Louisiana University. He is a graduate of the U.S. Army Command and General Staff College.

Tom was also then a member of Mensa, Society for the Investigation of the Unexplained, International Tesla Society, American Association for the Advancement of Science, Association of American Physics Teachers, the Air Force Association, the Association of the U.S. Army, the American Nuclear Society, and the American Defense Preparedness Association. He was also the Alabama and East Coast Director for the Association of Distinguished American Scientists, was a member of the Alabama Academy of Sciences, and was previously on the Board of Directors of the U.S. Psychotronics Association.

In private life, Tom has two sons and daughters, and lives in Huntsville, Alabama with his wife, Doris.

Sweating done by red_gonzo.

Note: sometimes formatting of the text may be a little fuzzy. It's all because the OCR process didn't go as smoothly as I expected. Also there may be some errors inside text so be vigilant. In any case share this book, send emails to people about knowledge contained in it. This book should especially be interesting to any person in medical community (being as a doctor or as patient) as it provides factual evidence of successful (but supressed) treatments through electromagnetic means. But before any devices can be understood and developed a new and extended kind of physics must be introduced into our educational system. Only then can this proper foundation be learnt and used by applicative sciences such as medicine. So far such knowledge has been contained in highly classified military circles and hopefully now, after many decades of suppression, it will finally be used for the good of mankind.

Dedication

This book is sincerely dedicated to the millions of persons who have died needlessly of cancer, leukemia, and AIDS in the last two and half decades. They were men, women, and children. Some were weak, some were strong. Some died in agony, some died silently. All of them were our fellow human beings. We remember them. They were important. Their anguish cries out to be heard. God willing, the new electromagnetic medicine so long suppressed will flower, and save the millions otherwise yet to die.

Special Acknowledgements

Mr. Christopher Bird's kind permission to print, his summary of the Priore Affair is gratefully acknowledged, as is the contribution of his own extensive Priore research material to this effort. The author owes a great debt indeed to Chris Bird for his magnificent assistance.

Mr. Robert Whitney graciously contributed rare photographs of Antoine Priore's device and also translations of background papers by French scientific journals. His previous valiant though fruitless efforts to bring the Priore machine into the mainline of Western medical treatment are specifically recognized and commended.

Vital contributions by Drs. Robert B. and Theodore A. Strecker are particularly acknowledged. Their March 1986 alert to the federal government, that AIDS was a deliberate biological attack spawned by Soviet agents working in Western research laboratories, is specially pointed out.

Heroic efforts by Dr. John Seale and other scientists to alert the medical research community to the true source of AIDS is specifically recognized and gratefully acknowledged.

Continuing efforts by Dr. William C. Douglass to "tell it like it is" on the AIDS crisis is specially pointed out. His permission to extract and present an excerpt from his research, pointing out tested healing of viral infections by UV irradiation of the blood, is deeply appreciated.

The unyielding and continuing efforts of Dr. Eva Snead, to alert the national authorities to the fact that there is more to AIDS than meets the eye, is also particularly recognized and appreciated.

Decades of effort by John Crane to bring Royal R. Rife's work out of suppression are specifically recognized and appreciated.

Important scalar EM experiments by John Bedini and Frank Golden are fully recognized and deeply appreciated. Their experimental efforts over a period of years have profoundly influenced my own thinking and understanding.

As always, my great admiration and deep thanks go to my friend Hal Crawford, whose keen artistic vision and skilled hand have contributed key illustrations to my work for years.

Other important illustrations and artwork by Messrs. James Thomas Neumann and Lee Giles are gratefully acknowledged.

Photographs furnished by John Moray showing his father's pioneering free energy work are appreciated. T.H. Moray's genius and achievements will yet be recognized.

Support from the Association of Distinguished American Scientists and Mr. Richard J. Reynolds III is deeply appreciated. Without that support, this effort could not have been accomplished.

Important contributions from a host of other colleagues and persons are deeply appreciated. These persons include Frank Golden, John Bedini, Ken Moore, Tom McLaughlin, Joe Parrot, Randy Davidson, George Fencl, Andrew Michrowski, Stefan Possony, Tony Gideon, Electra Briggs, and many others too numerous to mention.

Finally, nothing that I have attempted could have been accomplished at all without the unflinching and loyal support of my beloved wife, Doris.

To all of you I owe a great deal. If this bizarre struggle to save humanity is ever won, it will largely be due to the significant contributions you have made.

Thomas E. Bearden
Jan. 17, 1988

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Chapters 4 and 5
contain complex scientific material
and are suggested for those who are
technically proficient.

FOREWORD

What This Book is About

In my book, **"Fer-de-Lance: A Briefing on Soviet Scalar Electromagnetic Weapons,"** (Tesla Book Co., P.O. Box 1649, Greenville, Texas 75401, 1986), I specifically pointed out that I was of necessity neglecting the biological warfare (BW) aspects. I intended to later write a second book covering the BW aspects.

This book contains the most important item of that planned second book, including the photobiology aspects of BW.

The material is put down in great haste, for it is meant to serve as an urgent warning. There is no time to do the six months additional research and compilation necessary to "flesh it out", sculpture it and meticulously document it, as should be done by a careful scholar.

I apologize to the reader for this lowered standard, but in this case the basic information is far more important than scholarship.

Further, I acknowledge the fundamental contributions of Dr. Robert B. Strecker, M. D., Ph. D., who together with his brother Ted, has for some time urgently called attention to the terrible threat posed by the AIDS epidemic.

I specifically acknowledge his important warning, "This is a Bio-Attack Alert," Mar. 28,1986, which was sent to the U. S. President and Vice-President, Governors of the states, various federal agencies such as Departments of State, Defense, and Agriculture; National Security Agency, Federal Bureau of Investigation, Central Intelligence Agency; and three members of Congress.

Dr. Strecker has also strongly pointed out the covert involvement of Soviet and other communist agents in the epidemic, and the absolute necessity for an *electromagnetic* solution.

Also recognized are the efforts of the other medical scientists, such as Dr. John Seale, M.D., and Dr. Eva Snead, who have tried

repeatedly to call attention to the nature of the AIDS initiation, only to have their submitted papers resoundingly rejected by important journals such as New Scientist, **The** Lancet, etc.

Work by Dr. William C. Douglass in alerting the public to the no-nonsense truth about aids is particularly recognized. His monthly newsletter, **The Cutting Edge,** is an oasis of clarity sharply standing out in a sea of misinformation. Permission to reproduce his published research article on UV irradiation of the blood to successfully heal viral infections is deeply appreciated.

The continuing efforts of Dr. Andrija Puharich and Dr. Robert Beck to assist in achieving an AIDS solution are pointed out and recognized. Important contributions by Ed Skilling are also recognized in this regard.

The vital and extensive contributions of Christopher Bird are particularly acknowledged. Chris has unstintingly and unselfishly shared with me the results of his enormous research on the Priore device and affair and the results of his translations from the French. He has most graciously permitted me to publish his important summary of the Priore affair, and I am greatly in his debt. The reader will find that material most illuminating, and well may be shocked at the depth and malevolence of the scientific and political suppression of Priore's rigorously demonstrated electromagnetic cure for cancer, leukemia, and other killer diseases.

Special acknowledgement is made to Robert Whitney, who so nobly labored to bring the Priore technology into the mainstream of medical treatment, only to be ruthlessly suppressed in his efforts. Photographs of the Priore machine were furnished by Bob from his collection.

My special thanks to colleagues John Bedini, Frank Golden, Andrew Michrowski, George Fencl, Ken Moore, Tom McLaughlin, Joe Parrott and Randy Davidson, without whose assistance this project could not have been accomplished.

The material in this present small book is intended to be of any assistance possible to certain brave colleagues who — with little or

no funds or resources except what they can tear out with their bare hands — are already laboring around the clock to develop a permanent solution to the AIDS problem.

As a matter of discretion, I shall not mention the names of those colleagues. The solution sought is radical, by orthodox assessment. Yet it is the only possible approach that has any chance whatsoever of succeeding.

What they are doing, I cannot do. If they do not succeed, no one can. But I will say this, and most strongly: In my view, the only hope for humanity lies in the work they are doing, and they have my utmost admiration and support.

Their initial results are exciting and encouraging. Basic phase conjugated electromagnetic "mixed-modulations" signals lethal to bacteria, nematodes (hookworm-like organisms), various amoeba, viruses, etc. at very weak power levels have been synthesized and demonstrated.

In my best estimate/opinion, these researchers must succeed in *two years or less, certainly in no longer than three years,* else the **AIDS** incubation already accomplished by then, and the implementation time delay — even given a cure —together will insure a devastation of humanity unparalleled in all of history.

Let me accent that developing this AIDS cure is far more important than developing our entire arsenal of new military weapons. It is even more important than the development of defenses against the Soviet scalar electromagnetic weapons I detailed in **Fer-de-Lance.** Problems in the Middle East, Korea, and Nicaragua are insignificant compared to the AIDS problem.

Desperate Diseases, Desperate Remedies

Spurred by the looming holocaust of AIDS, and by the strong efforts of my colleagues, I have decided to release specific *information on how to develop electromagnetic healing, essentially against any and all of the "killer" diseases including cancer, leukemia, and AIDS.*

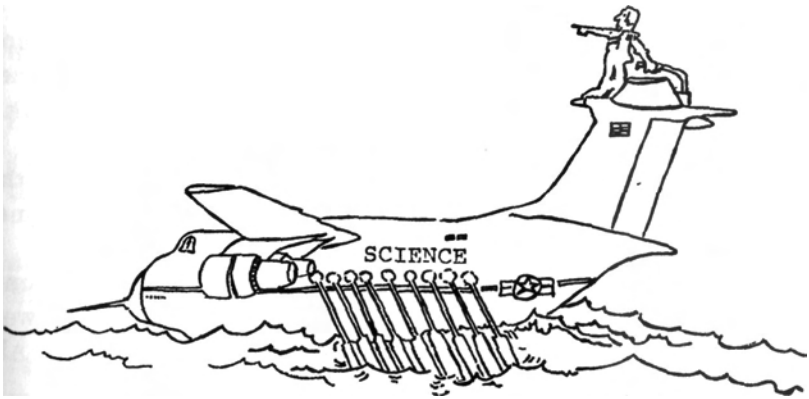

Figure 1. Conventional science cannot do the job.

Unavoidably this also releases a major principle of scalar electromagnetics: what is really going on in phase conjugation. If phase conjugation is truly understood and applied, all the Soviet weapons I have pointed out in **Fer-de-Lance** can be understood, designed and developed.

I'm also releasing specific information on mind and thought that will enable them to eventually be directly detected, measured, and investigated scientifically. Unfortunately, this also will enable them to be technologically manipulated for nefarious purposes.

However, the developing scalar EM technology for the AIDS cure must not be hamstrung. There is no time to apply the standard "Let's classify it!" response. If we do, we'll win the skirmish and lose the war.

As shocking as it sounds, I am convinced that the Soviets have already launched WW III, to the hilt. And it's not at all the kind of war we've been expecting.

There's no time to rail against the Soviets, who have cunningly and in great secret "struck our vitals with the mailed fist." We've been struck in such a way that, *unless we can solve the AIDS problem, in two to three years or less, we are already finished.*

We have been preparing to fight a better World War II. The one we're preparing for is never going to be fought. The real World War III is already raging. Our death knell has been sounded, *and we've not yet even recognized that the battle is underway.*

A great Soviet "first strike to finish us" has already been accomplished. The new "Pearl Harbor" has already happened. The enemy has already overrun our Maginot Line; we are at our Dunkirk. There are no boats waiting, and there are none on the way.

The great Soviet first strike has been delivered with surreptitious biological warfare, not with nuclear weapons or ground forces.

As always in the past, we have almost no troops facing the brunt of the first strike and trying to turn it. This time we have far fewer than we've ever had. Just two or three unorthodox researchers. All the orthodox researchers are manning the wrong ramparts.

Ironically, this time our entire system—the government, the medical establishment, the scientific establishment, the universities — all are far too dogmatic, and have far too sluggish a response time, to offer any assistance at all. They are simply so "out of it" that they don't even know what's really happened.

The bureaucracy simply is so stagnated that, even with a giant paroxysm, it cannot change quickly enough to do the job in time.

The best response the orthodox system could theoretically make —if it immediately placed the nation under martial law, marshalled all the universities and scientists, everything — would require at least seven years to produce results. A more likely response time is 10 to 14 years. That won't do the job.

So the job has to be done from completely *outside* the system. It has to be done with *independent* financing. Financing without a lot of conventional, bureaucratic strings on it. Resources must be committed as needed, immediately, not with a several months' approval process.

Everything in the orthodox establishment simply has to be bypassed.

The government, the medical establishment, the scientific establishment, the universities, everything.

Otherwise, we're as good as finished *right now*.

The "Dirty Dozen"

In the West, there are only perhaps a dozen persons or so that I know of, who are qualified to work on the main task required. They

are all unorthodox researchers and scientists.

There are thousands of fine orthodox scientists, of course, who can help with the peripherals — making and testing viral solutions, setting up and operating equipment, doing interminable tests, all the lab stuff, etc.

But only about 12 unorthodox guys are qualified and mentally and emotionally prepared to come to grips with the particular scalar EM technology required for rapid development of an AIDS cure.

Right now, there are just two or three of the 12 working on this, hammering away as best they can, at terrible cost to themselves and their normal endeavors.

Obviously immediate funds are needed for facilities, equipment, and marshalling that dozen unorthodox researchers and a team of scientists — along with support staff and personnel.

An Analogy

I'm reminded of a story from WWII.

On the beach at Anzio, in a battle lull some doughboys were briefly resting near their foxholes, eating lunch from C-ration cans.

A lone German Messerschmitt appeared, closing on them fast and low with machineguns blazing. They were forced to hastily jump into their foxholes as the Messerschmitt strafed their position.

The pilot continued to make strafing run after strafing run, low and "on the deck." Obviously lunch was rather totally disrupted.

Suddenly, in total disgust a soldier leaped up and flung his half-filled C-ration can into the air directly at the approaching aircraft, full in the teeth of the machinegun fire.

Incredibly, the can sailed straight up into the air intake of the hurtling aircraft, where it was sucked into the engine, which sputtered and died.

The surprised German pilot banked his plane upward and bailed out.

He was promptly captured by the very troops he had been strafing only moments before.

Those two or three colleagues of mine are literally "throwing their C-ration cans" in a desperate effort to ward off a monstrous threat.

Those two or three are striving to the limit of their endurance.

This book and the release of the material in it represent my own "Oration can" hurled into the teeth of the actual Soviet threat as a last resort. Hopefully we can "hit the air intake" of the Soviet juggernaut, so to speak, and stop its progress.

The giant Soviet scalar electromagnetic weapons that I detailed in **Fer-de-Lance,** e.g., are easily countered — in six months or less. Primarily, it is necessary to make a pumped phase conjugate mirror adjunct (PPCMA) that operates at the frequency band of interest, and associate it with a receiver. Once a signal is received from the enemy weapon — say, from a Woodpecker transmitter — it is introduced to the PPCMA. A powerful phase conjugate replica energy pulse is returned into the distant hostile transmitter, totally destroying it.

To meet the viral biological warfare weapon, however, we must develop electromagnetic healing.

In an important article, "SDI vs. the plague," Mar. 8,1988, p. 6, the **Washington Times** revealed a startling Pentagon conclusion that the Soviets may counter SDI with genetically engineered weapons.

Valentin Falin, Chief of the Soviets' Novasti Press Agency, is quoted as saying:

"We won't copy you anymore: We'll take asymmetrical means with new scientific principles... genetic engineering could be a hypothetical example. Things can be done for which neither side could find defenses or countermeasures, with very dangerous results. If you develop something in space, we could develop something on earth. These are not just words. I know what I'm saying."

The genetically engineered Soviet counterstrokes exist and are already being taken. This book tells you what the asymmetrical means, new scientific principles, and genetically engineered weapons are.

May God help us all. If we do not move immediately and correctly to augment the effort of my colleagues, the Free World and half of the peoples of the earth will perish before another decade passes.

CHAPTER 1

THE VACCINE CONNECTION

The following quote is from Don Rowe, **Wall Street Digest,** 214 Carnegie Center, Princeton, New Jersey 08540.

"The AIDS Plague will affect society in ways that you cannot now imagine. AIDS is 100% fatal. Scientists and medical research people are not optimistic about an immediate cure to [or] vaccine. They do not expect to develop an effective vaccine within the next two decades. Public health officials estimate that as many as 2.4 billion people (half the world's population) will die from AIDS within the next 15-20 years."

"Economically, the insurance and medical health systems could be devastated in the 1990's. Nothing short of a spectacular medical breakthrough will keep Western civilization from suffering the worst catastrophe in the history of the world."

The first official U. S. AIDS case was diagnosed in San Francisco in 1981. This followed the puzzling outbreak of the disease in Third World areas such as Africa and Haiti in the 1970's.

The U.S. AIDS outbreak at first seemed to be confined to the gay community, such as in San Francisco.

No one seemed to connect the apparently unrelated facts that, before the outbreak in the U.S. gay community, (1) the World Health Organization had accomplished substantial smallpox vaccination in Haiti, and (2) West Coast gays — particularly from San Francisco — had made Haiti a main playground and vacation spot.

Most orthodox medical scientists have not the foggiest notion why such a drastic "explosion" of the virus has occurred.

It has occurred because *AIDS was introduced by contaminated vaccine used by WHO in its smallpox eradication campaign.* A high correlation exists between WHO vaccination and subsequent outbreak of AIDS.

Figure 2. The "monkey-bite" theory.

The "Monkey-Bite" Theory

As the prevailing rationale goes, a naturally-mutated monkey AIDS virus derivative or strain is believed to be the cause of the monstrous plague looming to strike down half of all the humans on earth.

That is, a monkey is supposed to have bitten a man—an African—and transmitted the normally harmless monkey AIDS virus to him. The virus is then supposed to have naturally "recombined" its genetic material with other viral genetic material and the man's human genes, to produce the virulent new strain of AIDS.

Then this new strain, *from its single human host*, is supposed to have rapidly started spreading through Africa and around the world.

That is simply nonsense.

In Africa, for example, monkeys as well as other animals have had their viral diseases for thousands of years. If monkey virus were the culprit, African man would have been devastated by AIDS thousands of years ago. He either would have been dead or—as have the monkeys — he would have developed a certain resistance and tolerance for the disease, so that it is no more harmful than others.

Understand, the "monkey bite plus human cell modification" undoubtedly does occur in Africa with great rarity — once in several thousand years.

However, even if that rare natural recombination of the monkey AIDS virus were to occur in a single human, normal contact between other humans and the infected human is totally insufficient to provide any substantial infection rate *unless the rate of infection of new individuals is greatly assisted and vastly speeded up by some other outside mechanism — for example, by something like AIDS-contaminated vaccine and a mass inoculation program.*

Retroviruses ***and Recombinants***

As Dr. John Seale has pointed out, "The AIDS virus (human immunodeficiency virus or HIV) is a lentivirus — a little-studied sub-family of the retroviruses. It is highly pathogenic to man but it differs profoundly from any other virus of humans. It is spreading rapidly in the general population of central Africa, and amongst homosexual men and drug addicts in the West. *It is the first virus to have appeared in mankind for many centuries which is entirely new, highly lethal, and spreading steadily from person-to-person world-wide."* [accent by the present author.]

Dr. Seale has courageously pointed out some other very disturbing facts:

(1) Retroviruses of animal origin, if repeatedly passed from human cell culture to human cell culture, will gain the ability to infect human cells *preferentially.* Indeed, they may then even cease to be infectious to their original animal hosts.

(2) In 1982 Robert Weiss pointed out that, in the laboratory, the genetic code of retroviruses commonly recombine if two of them infect the same cell simultaneously.

(3) In a 1984 article in the **Journal of Virology,** David Baltimore showed an efficient means of overcoming the cell's block against simultaneous infection by two or more retroviruses.

(4) Further, Baltimore reviewed how *this had widely been done during the preceding ten years!*

(5) Outside the laboratory, recombination of multiple simultaneous retroviruses has not been shown to occur naturally in humans.

(6) In animals, there is some evidence that it may occur naturally with extreme rarity — indeed, only once in many thousands of years.

(7) By the early 1970's, the technology to make new recombinant retroviruses virulent to humankind was already developed and had been widely published.

To the layman, the infection and reproduction by retroviruses is peculiar to say the least.

When a retrovirus infects a cell, from its own genetic material (RNA) it first makes a "template" or pattern (DNA) for forming other retroviruses just like it. It then inserts this "DNA template" into the DNA of a cell. The host cell itself is now a "sleeping factory", ready to start producing retroviruses.

When activated, the "template" in the cell causes the factory to go into production of retroviruses. Activation is varied. The "infection production factory" can just remain dormant, be slowed over years, take place almost immediately, or be slowed for years and then "explode" to rapidly increase the infective viruses.

Genetically, the cells of any person infected with AIDS or any other recombinant retrovirus have been permanently transformed. Literally that person has acquired a new set of genes. He or she has been converted into a "factory" for producing—and spreading—the virus.

Cancer Research Produced Ideal Biological Warfare Agents

In 1971 President Nixon signed into law the National Cancer Attack Act. Though certainly not intended by the President and the Congress, *the inadvertent result of this act was that taxpayer's funds were used to research and develop the precise things that constitute the most lethal kind of viral biological warfare.*

The on-going small effort in medical research laboratories to alter animal tumor viruses — including retroviruses —to replicate efficiently in human cells was drastically speeded up, as part of the new "war on cancer." In other words, whether intended or not, much of our cancer research money was converted into the precise kind of research that develops virulent biological retroviruses for potential use in biological warfare.

Not only was the research drastically accelerated, but also the

direct participation by Communists and scientists sympathetic to the communist cause was accepted and encouraged.

Astoundingly, this open invitation to the communist scientists was issued at a time when one of the high KGB priorities was to infiltrate our recombinant DNA genetics laboratories! To the Soviets' utter astonishment, we simply opened our labs and invited them in.

The Soviets participated — and penetrated — with alacrity. It is an obvious conclusion that a number ofthe Iron Curtain scientists sent to help staff our laboratories were undercover KGB agents.

In the cancer laboratories, on a wide-spread scale, animal retroviruses were injected and reinjected into human cell cultures, until these retroviruses had become efficient, lethal recombinants favoring human cells as their hosts.

At that point, infection of one or more persons by one of these lethal new retroviruses could unleash a massive AIDS-like plague on all mankind.

A single laboratory accident (or a single act by one Communist agent) could unleash the Great Death Plague.

Weak and ineffective reference to this forthcoming danger was made in 1974 by the Committee on Recombinant DNA Molecules, which had been established by the U.S. National Academy of Sciences. According to **Science,** July 26,1974, p. 303, the Committee made the following rather bland and ineffectual recommendation:

"Scientists throughout the world (should) join with the members of this committee in voluntarily deferring experiments (linking) segments of the DNA from (cancer-causing) animal viruses to... possibly increase the incidence of cancer or other diseases."

So much for the great scientific watchdogs.

U. S. "Cancer War" Labs Were Infiltrated

As we said, ironically we ourselves helped load and cock this potentially disastrous biological warfare cannon. Incomprehensi-

bly, enemy fingers were permitted — even encouraged! — to be placed on the trigger. Many of our medical research facilities involved in this research contained known Communists, dissidents, etc.

For example, see page 106 in Omni, March 1986. Carlton Gajdusek, presently Chief of the National Institute of Health's Laboratory of Central Nervous System Studies and Laboratory of Slow, Latent and Temperate Virus Infections, was asked the question, "Isn't Fort Detrick in Maryland such a biological-warfare research facility?" He responded:

"No, emphatically no! There is no defensive or offensive warfare microbiology done at Fort Detrick today. It is the national cancer research facility of NIH. In this facility I have a building where more good and loyal Communist scientists from the USSR and mainland China work — with full passkeys to all the laboratories — than Americans. With night-working U. S. citizens and foreign Communist investigators here, obviously there is no "secret" bacterial warfare activity going on. Even the Army's infectious-disease unit is loaded with foreign workers — not always friendly nationals. It is a valid basic research unit on worldwide problems of infectious -diseases in which no classified or secret activities unfold."

The point is, what was being produced in these labs were viruses that would grow in human cells. Under tight control, these new lethal agents could be safely studied, and many things could be tried experimentally to see if they would slow, stop, or kill the viruses and heal or benefit the virally infected human cell cultures.

The viruses were being developed to benefit man by aiding in the war on cancer — we accent this most strongly.

However, many of them were precisely the same things that would be developed in a biological warfare lab: lethal new viruses that preferred the human as a host, and against which humans have developed little or no immunity.

The Deed Was Easily Done

Now one can see the subtlety and irony in the Soviet Union accusing the U. S. of having made the AIDS virus at Ft. Detrick!

It's both true and false at the same time.

There is substantial information indicating that the AIDS disease is manmade, and has been deliberately unleashed on mankind by Soviet and other Communist agents, augmented by the international control groups and shockingly inept work by U. S. and European medical researchers.

Human cell cultures deliberately infected with animal viruses were carelessly handled in U. S. and European laboratories — carelessly handled in that far too great (essentially open) access to the new viral strains was permitted.

Our own scientists were apparently unwitting pawns, and Soviet agents performed the "final touchups" to insure release — whether intentional or inadvertent — of the lethal new agents against an unsuspecting world.

Viruses can infect bacteria, since a bacterium is a one-celled organism and the virus is a single molecule.

Cell cultures where vaccine is made from weakened bacteria could easily be contaminated with the desired recombinant viruses available in the cancer laboratories.

To insure worldwide release of the lethal virus, covert Communist agents apparently caused contamination of the smallpox vaccine that was prepared in quantity in Western laboratories.

This contaminated vaccine then was widely used to inoculate Third World peoples and others, in the successful international program to eradicate smallpox.

With only a few agents in key places, the Soviets could easily have taken advantage of the looseness of Western laboratory procedures to deliberately contaminate the animal cell cultures used to make the vaccines.

They had an abundance of agents in the key laboratories, for they were openly invited in and accepted!

The Soviets had their fingers in it, up to the elbow.

And at just exactly the right time, the answer to a Communist's biological warfare dream was available: The World Health Organi-

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Figure 3. The Soviets have delivered an intended knock-out.

zation was already involved in its 13-year campaign of massive smallpox inoculation in the Third World, to eradicate smallpox.

All that was needed was to contaminate the WHO vaccine by one or more of the lethal new recombinant retroviruses that had been developed — and were continually being developed — in cancer research laboratories filled with Communists agents.

The opportunity was presented for a great Soviet "first strike" against the West, using biological warfare agents developed in U.S. and European laboratories and administered by an international agency.

The opportunity was ripe for the taking. It was irresistible. You can be sure the Soviets took it.

It's Actually Documented!

Virus-contaminated vaccines were then widely administered to Third World countries—particularly in Africa, South America, and Haiti. Administration of these vaccines by the World Health Organization is precisely correlated to the subsequent outbreak of the AIDS

epidemics in those countries.

This strongly indicates that the vaccine itself was the "precursor" agent initiating the start of the AIDS infection.

In a shocking article, "Smallpox vaccine 'triggered Aids virus'," in the London **Times** of May 11,1987, **Times** Science Editor Pearce Wright announced that the AIDS epidemic may have been caused by World Health Organization (WHO) smallpox inoculations in third-world countries.

In an important article in **Easy Reader,** June 4, Jon Rappoport reported the **Times** article and the results of an interview with Robert Matthews, technical correspondent of the **Times.**

According to Rappoport, Matthews informed him WHO itself had somehow suspected that its immunization program against smallpox might be connected to AIDS. An outside consultant was employed to perform an independent study, and the study confirmed that WHO vaccines were indeed — somehow — causing AIDS to evidence in inoculated persons.

Needless to say, WHO promptly buried that report—whose conclusion must have been the last thing WHO wanted to hear.

The consultant then came to the **Times.** The **Times** heard him out and printed the story.

This astounding story has almost startling correlations: *"The smallpox vaccine theory would account for the position of the Central African states as the most afflicted countries; why Brazil became the most afflicted Latin American country; and how Haiti became the route for the spread of AIDS, to the U.S.: Brazil, the only South American country covered in the eradication campaign, has the highest incidence of AIDS in that region."*

Rappoport confirms that the subject of contaminated vaccines—"vaccines which, made in tissue cultures of animal parts, contain 'extra' dangerous viruses" — has been of increasingly serious concern to medical scientists in recent years, and the WHO smallpox vaccines may have been contaminated in this fashion.

A documented U.S. Army incident is a case in point.

New U.S. Army recruits are routinely vaccinated against a

range of diseases. One of them is smallpox, in case an enemy should try to use smallpox as a biological warfare agent.

A healthy 19-year old Army recruit developed AIDS after vaccination, and was admitted to Walter Reed Army Medical Center, where he died.

In a paper published in the **New England Journal of Medicine,** Walter Reed medical team scientists reported their discovery of the connection between vaccination and stimulated AIDS disease.

They also warned against the WHO plan to use modified versions of the smallpox vaccine to combat other diseases in developing countries.

WHO's 13-year vaccination and eradication program ended in 1980. The program is credited with saving two million lives a year and preventing 15 million infections.

It may be inadvertently responsible for the ultimate death of billions.

In a meeting of 50 experts near Geneva in May, 1987, it was revealed that millions of new AIDS cases are about to hit Southern Africa. The experts believe that up to 75 million Southern Africans — about a third of the population — may have AIDS within the next five years.

From our previous statements above, it appears almost certain that Communist agents who had penetrated U.S. and European laboratories manipulated the contamination of the altered vaccines.

Further, the Soviets may be stimulating the disease and guiding it electromagnetically, by special implanted signals carried by the giant Soviet woodpecker "over-the-horizon radars" and other Soviet transmitters.

Or, the Soviets may be using their own transmitters and ours, including our own power lines and radio and TV stations, to broadcast signals that "precondition" and greatly amplify our population's vulnerability to certain selected diseases — AIDS and otherwise.

We will address these issues and Soviet subtle EM capabilities later.

Soviet Biological Warfare Background

In World War I, the Russians suffered half a million casualties

to gas warfare, including 50,000 dead.

At 10,000 troops per light division, that's the equivalent of 5 divisions killed and 45 divisions incapacitated.

This made a deep and lasting impression on the Soviets. Lenin himself ordered a major effort mounted to develop and manufacture chemical and biological weapons, for he understood the implications of such mass-destruction weapons.

In 1919 the Soviets began work in earnest on BW weapons. Work on them has not stopped since then. It will not stop so long as the Communists remain in power.

To loyal Communists, Lenin's dictate to develop and lead the world in biological weapons is absolute and unquestioned.

By 1937, the Red Army was fully equipped and psychologically prepared to wage chemical and biological warfare.

Continuing today, the Soviet forces have the highest training in chemical warfare of any troops in the world. Red Army soldiers practice regularly, often using actual chemical agents. Decontamination is a standard measure and practiced as a matter of course.

Even though the Soviets, along with many other nations, signed the Geneva Protocol of 1925 which banned the use of deadly chemical and bacteriological weapons, the Soviets have never ceased development of such weapons.

In the 1930's, a secret Soviet bacteriological institute was set up at the town of Suzdal. Prisoner microbiologists worked on a variety of new weapons and vaccines, including bubonic plague and tularemia (rabbit fever). By World War II the Soviets were prepared to retaliate vigorously to any use by the Germans of chemical and biological warfare agents.

After the war, Soviet research and development in chemical and biological weapons continued apace. However, much of the genetic work was hampered by Stalin's stern support of the autocratic control of agronomist Trofim D. Lysenko. Lysenko's crackpot theories on genetics, for example, held that genes did not even exist. After the death of Stalin, Lysenko's work was discredited, and the Soviets set forth immediately to "catch up" with the West in genetic implications such as recombinant DNA techniques.

Thus in the early 1960's the Soviets began sending Russian

scientists to the West to catch up with Western genetics research. One of these scientists was David Goldfarb, who later became a leading Soviet expert in the field of molecular genetics. He headed up the Laboratory of Molecular Genetics of Bacteria and Bacteriophages of the Soviet Academy of Sciences in Moscow. Although he did not work on secret Soviet projects, the Soviet authorities stopped him cold when he applied for a visa to leave in 1979. Goldfarb was a specialist in plasmids, antibiotic resistances, and recombinant DNA technology—all very, very useful to the Soviet effort in biowar.

One can readily understand the reluctance of the authorities to release scientists such as Goldfarb. After all, the Soviet "dirty work" with the deliberate AIDS contamination of the World Health Organization's smallpox vaccine had already been accomplished and a great Soviet biological warfare "strike" was already underway, thanks to the massive smallpox vaccination program of WHO.

In 1972, in the Biological and Toxin Weapons Convention, the Soviet Union and every major power agreed not to develop or use biological weapons. The agreement went into effect in 1975. Although it bans the development, production, and stockpiling of biological agents and toxins for hostile purposes, it has not slowed or altered the Soviet program.

In the early 1970's, Soviet leaders made a decision to use genetic engineering to produce new and improved BW weapons. Highly secret institutes for this purpose were set up in Moscow, Leningrad, and Novosibirsk. These laboratories specialize in seeking ways that genetic engineering techniques can be used to develop virulent strains and agents that their opponents cannot resist.

Every Soviet civilian institution dealing with bacteriology and epidemiology is responsible for certain military work as well. The Soviet Academy of Sciences in fact funds appreciable research of such nature at these institutions.

One of the major Soviet centers for recombinant DNA techniques in biological weapons research is in the village of Protvino, near Moscow. Research on chemical and biological weapons is very easy to conceal, and the Soviets are sure that they will not be caught. Satellites cannot detect what is going on in the labs. The payoff is big and the risk is minimal. The Soviets push this area vigorously.

A number of installations capable of producing disease agents and toxins on a large-scale basis and placing them in munitions and delivery systems have also been identified. One such facility is in the city of Sverdlovsk and has a long history of BW research and development and production, with emphasis on anthrax. During early April 1979, an accidental release of anthrax occurred in Sverdlovsk that caused many casualties and deaths in spite of heroic efforts by Soviet doctors and cleanup and decontamination crews.

Note that, according to DoD's 1987 edition of **Soviet Military Power,** page 110, *"Anthrax causes a high mortality rate when the infection results from ingestion (up to 70 percent fatal) or inhalation (almost 100 percent fatal) if treatment is not promptly begun."*

In addition to military BW institutes, military officers and KGB agents are assigned to key posts in the Soviet Union's normal health and science ministries to monitor research and development that has possible military significance.

Also, the KGB has a continuing and highly active program to insert recruited Soviet Scientists in Western genetic research institutes and agencies. This is a high priority effort, and it has been very successful. Also, it obviously says something about the probability of Soviet agents penetrating U.S. and Western European cancer research institutes, particularly those using recombinant DNA techniques. To make it even worse, we simply invited them in with open arms!

Indeed, it was that KGB program plus the "open arms" in Western cancer virology research institutes that enabled the Soviets to set up and bring about a massive "first strike", using WHO and Western laboratories to do the actual dirty work unknowingly.

We *Need An Immediate, Full Scale Investigation*

Annually, President Reagan makes a report to the U.S. Congress on the subject of Soviet noncompliance with Arms Control agreements.

In April, 1984 Defense Secretary Caspar Weinberger put it this way:

"There is an apparent effort on the part of the Soviets to transfer selected aspects of genetic engineering research to their biological warfare centers... Soviet research efforts in the area of genetic engineering may also have a connection with the biological program...Normally harmless, non-disease-producing organisms could be modified to become highly toxic or produce diseases for which an opponent has no known treatment or cure. Other agents, now considered too unstable for storage or biological warfare applications, could be changed sufficiently to be an effective agent."

At the time that Secretary Weinberger made this statement, a devastating biological warfare strike using those exact techniques had already been unleashed on the Western world by the Soviet Union, cleverly disguised under the banner of the World Health Organization's smallpox vaccination program.

It is imperative that the Congress of the United States launch a full investigation of the entire background of the AIDS biological warfare strike, as a matter of the highest priority.

The investigation should include the role of the Soviet Union, fellow-travelers, and Western scientists openly sympathetic to the Soviet cause.

It requires little investigation to see that there is a well-marked trail for several decades, showing that such a biological warfare strike against humanity has long been considered — and even preferred — by those advocating the Communist cause and world domination.

For example, Bertrand Russell, philosophical spokesman for a group of Westerners, explicitly stated this diabolical BW capability for consideration, in his **Impact of Science on Society:**

"At present the population of the world is increasing at about 58,000 per diem. War, so far, has had no very great effect on this increase, which continued throughout each of the world wars... War has hitherto been disappointing in this respect... but perhaps bacteriological war may prove effective. If a Black Death could spread through the world once in every generation, survivors could procreate freely without making the world too full. The state of affairs might be

unpleasant, but what of **it?"**

The blood of every American — and every European, African, and Asian — should curdle at such words. We are now facing the very "Black Death" type of plague referred to by Russell in such glowing terms!

Highly influential followers of the Russell philosophy — and his callous approval of the periodic slaughter of much of the world's population — may have continued to view the great destructive power of new viral warfare agents as the best means to achieve their end: Selective thinning of the world's population.

At least a few such men may have continued to cooperate with the Soviet Union to work powerfully behind the scenes in international organizations, trying to arrange the proper opportunity to achieve their nefarious purpose.

The "East-West cooperative effort" in cancer research created and gave them the precise biological agent custom-made for the job.

WHO's massive, worldwide smallpox inoculation program gave them the precise means to rapidly get the deadly virus into enough human veins to assure a new "Black Death."

All that had to be done was surreptitiously contaminate the vaccine — the easiest thing of all.

This plague has been knowingly, with malice aforethought, unleashed upon mankind. The perpetrators should be hounded down like the wild beasts they are, uncovered in the full light of day, and suitably punished with the swift and sure justice they deserve.

At least one outstanding medical consultant had the courage to report to WHO that their vaccine was generating the AIDS epidemic. When WHO suppressed the evidence, the London Times had the courage to print the story.

I strongly urge every U.S. Senator and Congressman to introduce and/or support immediate legislation that would launch a full-scale, massive investigation, with no stone left unturned. I urge every concerned activist to demand and support such an investigation at the highest level.

By preoccupying ourselves with lesser things — "IranGate," Nicaragua, the Middle East, etc. — we are simply fiddling while Rome burns.

CHAPTER 2

THE SOVIETS KNEW THE U.S. WOULDN'T REACT

Administering the Coup-de-Grace

As we've seen, the present AIDS viruses were deliberately created in Western cancer research laboratories strongly penetrated by Communist scientists and Soviet agents.

In laboratory experiments that were a legitimate and vital part of the war against cancer, animal retroviruses were repeatedly injected into human cell cultures until they recombined to produce **strains** hostile to human life—strains that would thus live in human cell cultures.

Even though their work was accomplished for a totally different purpose, cancer laboratories produced the ultimate, made-to-order biological warfare agents.

The World Health Organization (WHO) is also strongly penetrated — and even controlled at some levels—by communist agents, **as** are many other such international agencies.

And WHO's massive smallpox vaccination program in Third World countries provided the Soviets a made-to-order opportunity to have (ostensibly) "someone else" deliver the actual BW strike.

In other words, the Soviet deception plan was complete.

It was very simple for Soviet agents to contaminate the cultures in which smallpox vaccine was being produced for WHO's inoculation campaign. This insured the production of vaccine contaminated with AIDS viruses, and the subsequent massive infection of the African peoples and other Third World nations.

It delivered what will be the knockout punch against the West, unless AIDS is countered.

Table 1. Interesting Soviet Statements

"WE HAVE A NEW WEAPON, JUST WITHIN THE PORTFOLIO OF OUR SCIENTISTS, SO TO SPEAK — SO POWERFUL THAT, IF UNRESTRAINEDLY USED, IT COULD WIPE OUT ALL LIFE ON EARTH."

NIKITA KHRUSHCHEV,
1960, SPEAKING TO THE PRESIDIUM

"WE WILL BURY YOU!"

NIKITA KHRUSHCHEV,
TO RICHARD NIXON, "KITCHEN" DEBATE

"IF A MEANS OF TOTAL NEUTRALIZATION OF FOREIGN MISSILES IS TO BE FOUND, IT CAN ONLY COME FROM *A GROUP OF NEW PRINCIPLES IN PHYSICS, CALLED ENERGETICS!"*

NOBELIAN PETER KAPITSA, TO NIKITA KHRUSHCHEV

"EACH SIDE SECRETLY DEVELOPS NEW MEANS OF WARFARE IN ORDER TO EMPLOY THEM UNEXPECTEDLY. HISTORY KNOWS MANY EXAMPLES HOW THE EMPLOYMENT OF A NEW WEAPON INITIALLY GAVE CONSIDERABLE SUCCESS BECAUSE THE ENEMY, CAUGHT UNAWARES AND NOT KNOWING THE COMBAT CAPABILITIES OF THIS WEAPON, WAS FOR SOME TIME INCAPABLE OF EFFECTIVE COUNTERACTION."

V.YO. SAVKIN, THE BASIC PRINCIPLES OF OPERATIONAL ART AND TACTICS. MOSCOW, 1972.

"OF PARTICULAR IMPORTANCE IS BASIC RESEARCH AIMED AT DISCOVERING STILL UNKNOWN ATTRIBUTES OF MATTER, PHENOMENA, AND THE LAWS OF NATURE, AND DEVELOPING NEW METHODS FOR THEIR STUDY AND USE TO REINFORCE THE STATE'S DEFENSE CAPABILITY."

PORTION OF A BOOK BY MARSHALL GRECHKO
DELETED FROM ENGLISH TRANSLATION, BY SPECIFIC REQUEST OF THE U.S.S.R.

"WILL SHORTLY SEE DEVELOPMENT OF NEW WEAPONS, MORE POWERFUL THAN NUCLEAR WEAPONS, AND THEY WILL BE NONVERIFIABLE."

LYSENKO (FIRST NAME UNKNOWN)
USSR REP/SOVIET EMBASSY WASHINGTON, D.C.
WORLD FURTURESCONFERENCE, WASH. D.C, 20 JUL 82.

Murky "Behind-the-Scenes" Intentions

As was pointed out, the WHO inoculation program is well-correlated as the precursor or "initiator" of the AIDS epidemic.

Where WHO smallpox vaccination occurred, the mysterious symptoms of AIDS disease appeared in due time.

Even the eventual spread of the AIDS virus to the U.S. homosexual community is explainable.

For example, the economy of Haiti had earlier been made a shambles. The poor citizens of that impoverished island had been reduced to desperate straits.

In desperation many younger Haitian males had begun to prostitute themselves to visiting homosexual tourists. The Haitian males were not homosexual themselves; rather, they were desperate to gain money to provide for their starving families.

In response, U.S. homosexuals — particularly from San Francisco and New York — had made Haiti their vacation playground. They even ran ads to this effect in their gay newsletters and mngazines.

WHO then vaccinated some 15,000 or so Haitians against smallpox, using the vaccine contaminated with the AIDS virus. This introduced AIDS into Haiti and into the Haitians.

The U.S. homosexuals quickly picked up the AIDS virus by direct contact, and brought it back to the U.S. with them. There the nature of the activities engaged in by homosexuals was responsible for enhanced spread of the virus among members of the homosexual community.

Engineering the AIDS epidemic appears to have been a collusion between Communists and the international control groups.

Apparently the control groups wished to "clean out the African continent and other Third World areas" — possibly to provide room for relieving population pressure in the developed countries. This may have been seen as the way to solve the problem of the ballooning human population — the so-called "biological time bomb."

The Soviets, however, realized that contamination of the smallpox vaccines would result in an epidemic of unparalleled proportions. They recognized the opportunity for safely initiating — and winning — World War III with a great first strike.

The Soviets themselves already possess an electromagnetic cure for diseases such as AIDS, but they have not unveiled it.

All such products of scalar electromagnetics (which the Soviets call energetics) are held tightly by the KGB.

That the Soviets have kept such a cure secret strongly implies that they regard it as a known antidote for biological warfare agents, and thus highly classified.

The importance of this can easily be seen: Presently the West has absolutely zero defense against a biological warfare strike using viruses as BW agents.

In such a strike, fast-acting viral strains can easily be used — say, agents which are highly infectious and kill within two or three days.

Development of a vaccine is impossible. There is simply no time to do that. Further, even if the virus was slow-acting, a vaccine could only be developed if the virus is stable. If it is unstable (constantly mutating), development of a vaccine is impossible.

The greatest vulnerability of the U.S. today is its total vulnerability to unknown BW viral agents. Absolutely nothing we have or are doing in our Department of Defense is of any consequence or protection against new BW viruses for which no vaccine is developed or possible.

The great ease with which such cheap new, highly lethal viral BW agents can be developed means that even a relatively small military power—such as Libya, Cuba, or Iran—can develop and use them against the U.S.

Such BW viral agents can also easily be clandestinely planted across the U.S., to devastate an unsuspecting, unprotected American populace.

In fact, even a single deranged madman can readily develop lethal BW viral agents sufficient to devastate even a great military power. Further, in an open society such as the U.S., that same madman can easily introduce such an agent he develops — and, if he's clever, not even get caught in the act.

Past isolated cases of "contamination" of on-the-shelf drugstore medicines is just a faint prelude of that which is to come.

Indeed, we may unwittingly do it to ourselves by accident, even without a BW strike by the Soviets, small enemy powers, or a madman.

Throughout the West, it is now most fashionable to experiment with the production of new bacteria and viruses. Gene-splicing, rccombinant DNA genetics, etc. are being employed on a grand scale as the latest "scientific marvel."

Even some high school students have experimented with this sort of thing. Many other colleagues, universities, and private persons are proceeding full-tilt with casual experiments.

Most of this "casual experimentation" is uncontrolled. When finished, the residue gets dumped in the trash can or flushed down the drain. In any case, it goes into our biosphere. Some of this residue contains unstable, highly adaptable viruses.

It's only a matter of time until one of these unwitting agents gets loose and survives — one that's lethal, fast, and highly infectious.

Make no mistake: It's a *near certainty* that this will happen. The only question is *when.*

Also, with the recent Supreme Court decision allowing the patenting of a virus or bacteria, a number of laboratories and companies are now feverishly developing new agents to unleash in the biosphere upon persons, animals, and plants.

For the most part, these experiments are tightly controlled. However, it is impossible to test in the laboratory the result of the natural recombination and mutation of these agents once they are loose in the environment and in a free exchange with all the natural bacteria and viruses.

Once loosed in the biosphere, a new viral agent undergoes combinations and recombinations with the greater number of viruses already present. The situation is like an increase in a large factorial number: Only a few additional viruses will result in millions and millions of additional combinations — at least some of which inevitably will be lethal and quick-acting. This is *not* tested in those laboratories making, patenting, and releasing new viruses.

Humans have spent millions of years developing sufficient immunity to the natural BW agents to allow humanity to survive.

Very shortly we are going to have increasingly large numbers of

new environmental BW agents emerging all around us. For some of them, it is a foregone conclusion that we have little or no natural immunity developed.

So we are going to enter an increasingly harsh environment, characterized by the rise of great epidemics and pandemics of many kinds.

Inevitably some of these coming scourges are going to rival the "Black Death" in ferocity and lethality.

Effective defense against one or more **such BW viral attacks — either against our forces in the field or against our civilian population — can only be provided by a ready, fully developed technology of electromagnetic healing.**

It does not really matter whether the BW strikes are performed by a hostile foe, a madman, natural mutations within our now drastically stimulated viral environment, or as a result of some particular "residue" discarded by an enthusiastic high school or college student.

The end result — the decimation of humankind — is going to be the same unless we develop and use electromagnetic healing technology.

However, with the present enormously self-hostile state of mankind, one or more enemies or madmen will almost certainly launch a strong, clandestine BW strike against the United States Armed Forces and the U.S. populace.

With EM healing technology, a specific "antidote" to any viral disease — known or unknown **— can be developed in a matter of hours.**

Mass electromagnetic treatment can then be started immediately, even for an entire army in the field or for our population in the heartland. Within hours of recognizing a BW strike, cure rates above 90% can be quickly achieved in exposed personnel.

Further, using electromagnetic healing technology, if necessary a more conventional vaccine can also be rapidly developed — say, in two weeks — for mass distribution and inoculation of the civilian populace.

The bottom line is this: Neither the U.S. Armed Forces nor the U.S. civilian populace can or will survive the coming lethal viral

warfare strikes unless we quickly develop electromagnetic healing technology and have the necessary diagnostic and treatment devices already ready and waiting.

The clandestine AIDS strike by the Soviet Union is just the precursor of a great deal more to come.

The USSR Has Repeatedly Verified Our Nonreaction

The Soviet Union already knows that Western science and governments are too stereotyped and dogmatic to react to anything highly unorthodox.

For years, the Soviet have been proving this, over and over, in their development and testing of frightful scalar electromagnetic superweapons of unprecedented power. In the face of overwhelming evidence of this, the West has kept its head buried in the sand like an ostrich.

It wasn't invented in the West. Therefore it cannot be.

Years of substantial Communist indoctrination of students in our universities, by leftist/liberal professors, has placed a massive imprint into our society. An entourage of sympathetic groups has resulted — groups which believe that the Soviet leaders are just like us, that the Stalinist era is long since over, and that the Communist leopard has changed its spots and really isn't trying to take over the world anymore.

As a system, then, much of the West simply refuses to accept anything unorthodox, anything "not invented here", and anything that indicates Soviet aggression.

The Soviets know the U.S. is totally ignorant of advanced scalar EM weaponry. They have proven over and over that the U.S. will not even comprehend that it has been deliberately struck, if the strike is sufficiently unorthodox.

The Soviet scalar EM superweapons have already been documented in **Fer-de-Lance,** Tesla Book Company, 1986, and that documentation will not be repeated here.

Only a short summary of events will be presented, to put the Soviets' confidence into perspective. A longer chronology of selected events is included as Appendix IV.

31 Soviets Knew The U.S. Wouldn't React

The Soviets were quite confident in arranging for a great biological warfare strike, because of the total lack of the U.S. to comprehend incidents such as the following:

1. Beginning in the late 1950's, hidden Soviet transmitters across the street targeted "weak microwave radiation" against the U.S. Embassy in Moscow. Over the years the radiation continued, sometimes continuously, sometimes intermittently. The Soviets electronically induced diseases that resulted in extensive health problems of Embassy personnel, the death of two U.S. Ambassadors, and the sickness of a third. Several U.S. Presidents have protested the radiation. Both U.S. Intelligence and the U.S. scientific community have been totally baffled. They still do not know the true nature of the radiation, nor its purpose.

2. In the winter of 1957-58, an unexplained nuclear event happened near Kyshtym, within the Soviet Union. A huge explosion occurred in the stored nuclear wastes in the disposal section of the Soviet atomic weapons industry located in the southern Urals. Radioactive contamination covered 1,000 square miles. For years the story was opposed — or suppressed — by U.S. intelligence agencies, perhaps to allay public resistance to the U.S. nuclear industry. At the time, Soviet experimentation with large scalar electromagnetic transmitters was well underway. A large transmitter probably failed, discharging its built-up, giant electrogravitational potential (EGP) into the earth. Such a pulse would have propagated through the earth as a wave; the first nuclear material contacted would have been fissioned immediately. The stored nuclear wastes probably exploded due to receipt of an EGP from the inadvertent failure of one of the Soviet Union's new superweapons in development. Survivors reported that indeed the nearby nuclear wastes exploded.

3. In January 1960 Khrushchev announced to the Presidium that a new fantastic weapon was in development. He stated that the weapon was so powerful that, if unrestrainedly used, it could wipe out all life on earth.

Figure 4. The U.S. Embassy in Moscow. The Soviet Union has bombarded this **facility** with weak microwave radiation for decades.

Table 2. MICROWAVE RADIATION **OF THE U.S. EMBASSY** IN MOSCOW

- **SINCE 1959 OR 1960**
- **HIGH LEVEL TARGET (U.S. AMBASSADOR)**
- **GUARANTEES PERSONAL ATTENTION OF**
  - **PRESIDENT**
  - **NSA, CIA, DIA**
  - **TOP CONSULTING SCIENTISTS**
  - **STATE DEPARTMENT**
  - **LEADING SCIENTIFIC INSTITUTIONS**
  - **NATIONAL SECURITY COUNCIL**
  - **ETC.**
- **TWO AMBASSADORS DIED, ANOTHER SICKENED**
- **U.S. REACTION REVEALS ANY KNOWLEDGE OF TESLA ELECTROMAGNETICS**
- **FOUR U.S. PRESIDENTS REQUESTED SOVIETS TO CEASE**
  - **CUT FROM 18 WATTS/CM^2 TO 2**
  - **THEN AGAIN INCREASED**

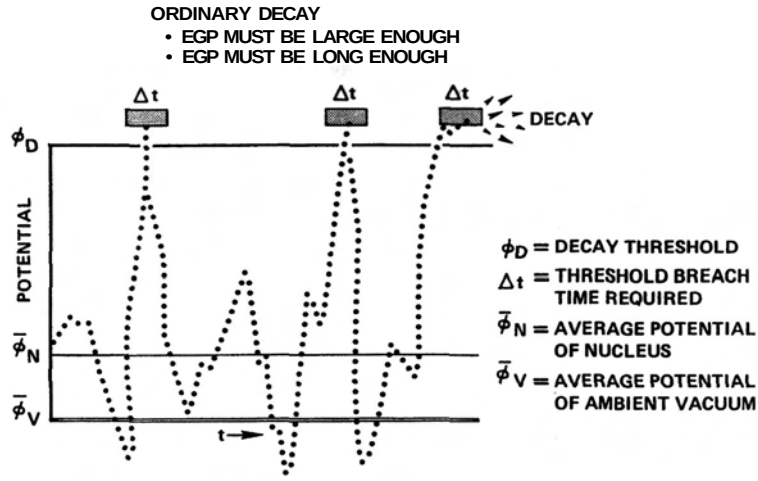

Figure 5. Decay of a radioactive nucleus. When it absorbs a scalar EM wave (electrogravitational pulse) that is long enough and large enough, the nucleus fissions.

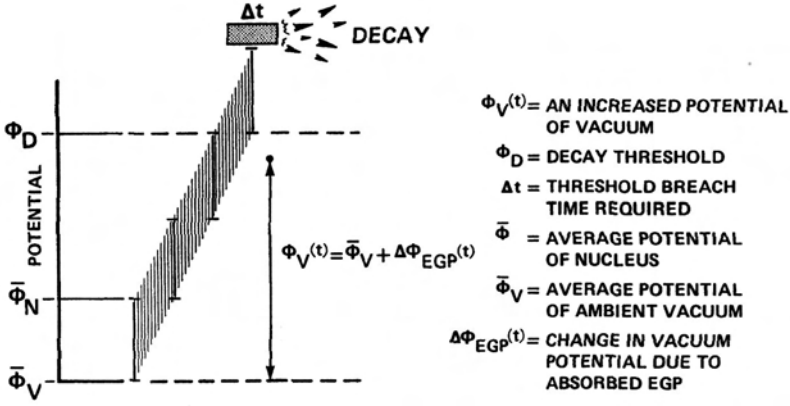

Figure 6. EGP fission of a radioactive nucleus. If an initial EGP is large enough and long enough, it will fission any and all radioactive nuclei it strikes.

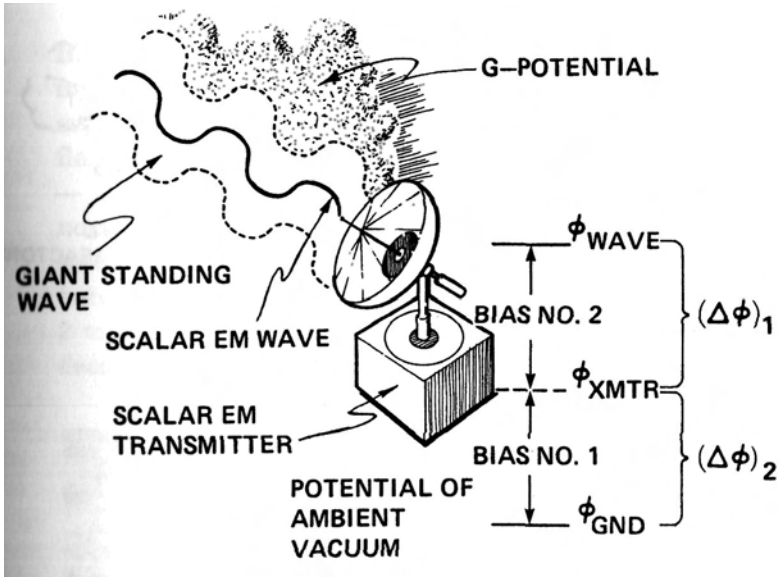

Figure 7. Bottled up energy in a standing scalar EM wave is a potential.

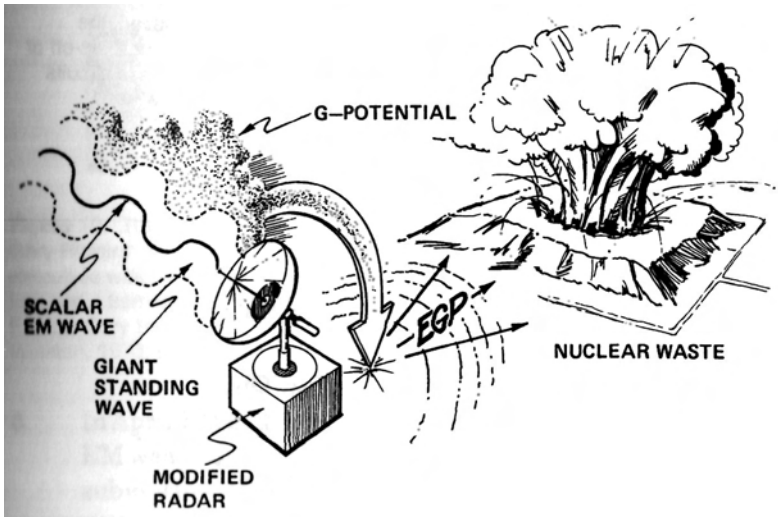

Figure 8. EGP short-out Transmitter failure and consequent discharge of a giant standing scalar EM wave potential caused the explosion of stored nuclear wastes at Kyshtym, USSR, in the winter of 1957-58.

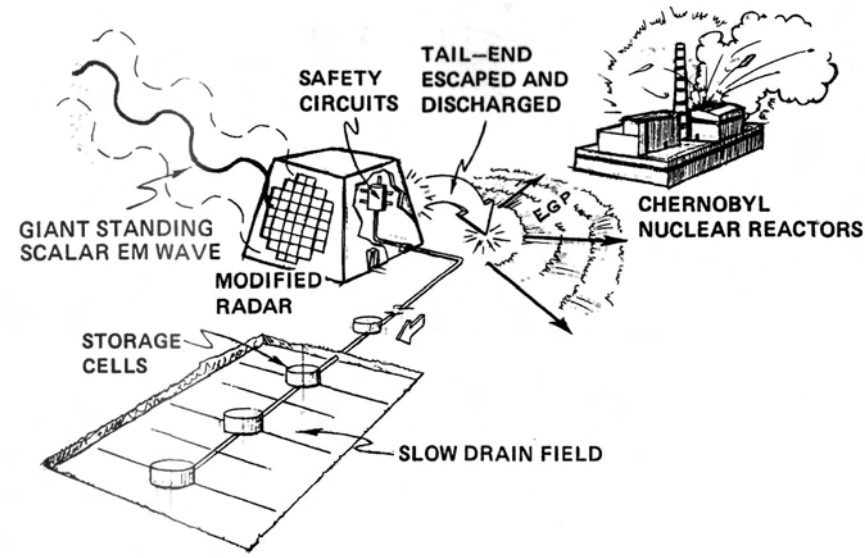

Figure 9. EGP initiation of the Chernobyl event. Failure of another giant transmitter near Chernobyl in 1986 eventually caused the eruption of one of the Chernobyl reactors by EGP-pulsing its nuclear fuel rods. When the transmitter failed, the alarmed Soviets shut down the four Chernobyl reactors while waiting for drain-off of the EGP potential by the safety circuits of the disabled transmitter. These circuits finally gave way, producing a mild EGP pulse into the earth. Had they failed immediately, all four reactors at Chernobyl would have violently exploded.

Table 3. KHRUSHCHEV'S 1960 STATEMENT

(Speaking to the Presidium)

WE HAVE A NEW WEAPON,
JUST WITHIN THE PORTFOLIO OF
OUR SCIENTISTS...
SO POWERFUL THAT,
IF UNRESTRAINEDLY USED,
IT COULD WIPE OUT
ALL LIFE ON EARTH!

4. In May 1960 Gary Powers' high-flying U-2 spy plane was mysteriously disabled over the Soviet Union, resulting in its subsequent crash and the Soviet capture of Powers himself. A flash appeared behind Powers' aircraft, as if from an explosion — except that *the flash persisted,* showing that it was not a normal HE explosion at all. A tracking radar, employed in a scalar EM mode, probably was used to cause the electromagnetic "flash ball" and disable Powers' aircraft. Harmless SA-2 missiles fired far below him may have been employed to deceive Western intelligence analysts.

Figure 10. The U-2 high altitude reconnaissance aircraft. On May 2,1960 Francis Gary Powers high flying U-2 spyplane was disabled over the Soviet Union. Some difficulties with the autopilot were first experienced. Then a single dull thump was felt, and a tremendous orange flash lit the cockpit and sky — *and persisted.* (See Francis Gary Powers with Curt Gentry, **Operation Overflight,** Holt, Rhinehart and Winston, 1970, p. 82.)

5. In April 1963 the Soviet Union utilized a newly deployed scalar EM weapon to destroy the submerged U.S.S. Thresher nuclear submarine, off the coast of the U.S. itself. In spite of intense and totally anomalous electronic jamming experienced by the U.S.S. Skylark, surface companion to the Thresher, the U.S. failed to recognize this major indication of a scalar EM attack. *One day later, a Soviet scalar EM weapon placed a giant*

underwater burst in the ocean, 100 miles north of Puerto Rico. With these two tests Khrushchev, still smarting from his Cuban Missile Crisis facedown by John Kennedy, avenged himself and convinced the Presidium to allow him to remain in power for yet awhile.

Figure 11. The U.S.S. Thresher disintegrates. © Hal Crawford 1979

Table 4. DEATH OF THE U.S.S. THRESHER

APRIL 10, 1963

- **DURING TRIALS OFF EAST COAST OF U.S. IN ATLANTIC**
- **SURFACE COMPANION: U.S.S. SKYLARK**
- **UNDERWATER PHONE BETWEEN THE TWO**
- **THRESHER DIVED AND WAS LOST**
  - **GARBLED MESSAGE**
  - **DID NOT RESPOND TO CONTROLS**
  - **SANK TO CRUSH DEPTH**
  - **IMPLODED**
- **SKYLARK ENCOUNTERED SEVERE ELECTRONIC INTERFERENCE**

Table 5. SEVERE EM INTERFERENCE EXPERIENCED BY U.S.S. SKYLARK

APRIL 10,1963

- **SKYLARK JAMMED (1.5 HR TO TRANSMIT MESSAGE)**
- **MULTIPLE SYSTEMS**
- **SIGNATURE:**
  - **SCALAR INFEROMETRY**
  - **SKYLARK IN "SPLATTER" ZONE**
  - **THRESHER PROBABLE TARGET**
- **OTHER SYMPTOMS**
  - **ONE SYSTEM KNOCKED OUT**
  - **OTHERS THEN WENT OUT**
  - **LATER RESUMED WORKING**

6. In Afghanistan, in 1981 and at intervals since then, Soviet helicopters have sometimes attacked Afghan guerrillas or villages with a strange new weapon. A body struck by this weapon dies instantly and completely. It falls like a limp rag, **and** does not decay even in 30 days. Every cell, bacterium, virus, etc. in the body has been killed instantly. Nerve gas rockets and chemical rockets are also usually fired to provide **a** "deception cover" for the nature of the real weapon. This eery Soviet weapon has been mislabeled as some strong new gas, **and** is referred to as "Smirch", a combination of the two words "smert" (death) and "semerch" (sandstorm).

7. In April 1984 a monstrously huge scalar EM incident occurred off the coast of Japan, near the Kuriles. Subsequent interviews with the pilots sighting the incident have revealed that several combined tests of the various modes of a scalar EM howitzer occurred. A giant "cold explosion" occurred, raising a giant mushroom cloud to over 60,000 feet and greater than 150 miles diameter in two minutes. A glowing dome appeared, and expanded to monstrous size. According to Dr. Walker and colleagues, **the diameter of this great** glowing, **hem-**

ispherical **shell expanded to several hundred kilometers.** * He and his colleagues were able to rule out any possible known natural events or mechanisms that could have caused the incident.

8. Numerous incidents of hemispherical shells of light and giant balls of light within the Soviet Union have been seen from Iran and from Afghanistan. Such giant artificial phenomena have also repeatedly been seen over the oceans by mariners and airline pilots.

9. Several instances of anomalous disabling of jet engines of commercial airliners have occurred while the aircraft were in flight.

10. Direct and intensive weather engineering over the U.S. itself has been accomplished by the Soviet Union for a decade, using the interference grid resulting from the crossing of two or more giant beams from the woodpecker "over-the-horizon radar" transmitters. Specific cloud signatures (anomalous holes, giant radials, twin giant radials, and razor-sharp giant interference patterns) have continually occurred, but the orthodox system has blithely ignored them.

11. A giant test of over a hundred huge Soviet scalar EM weapons occurred in and around May 1, 1985 for the 40th anniversary of the end of WWII. The entire Western scientific and intelligence establishment remained sublimely unaware of the giant exercise. They had not a single scalar EM signal detector — even though the air, land, and ocean was filled with hundreds of Soviet scalar EM transmitters, chattering away to Soviet armed forces, submarines under the water, etc. Underneath our feet, the earth itself was in giant scalar EM resonance on 54 frequencies — 27 pairs, each of which tapped energy directly from the molten core of the earth and fed it to an ensemble of giant Soviet strategic scalar EM weapons.

*See Science, 227 (4584), Feb. 8, 1985, p. 607-611; Science 234 (4775), Oct. 24, 1986, p. 412-413.

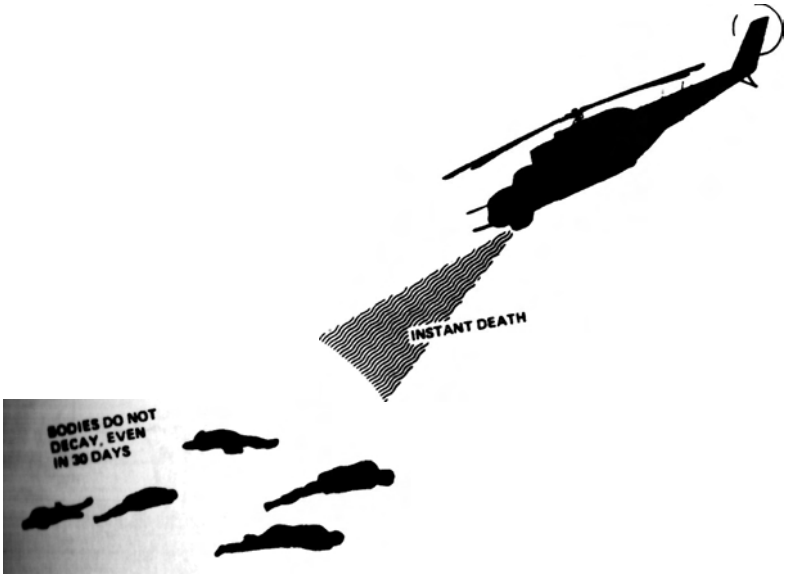

Figure 12. Soviet helicopters have used a "death ray" in Afghanistan.

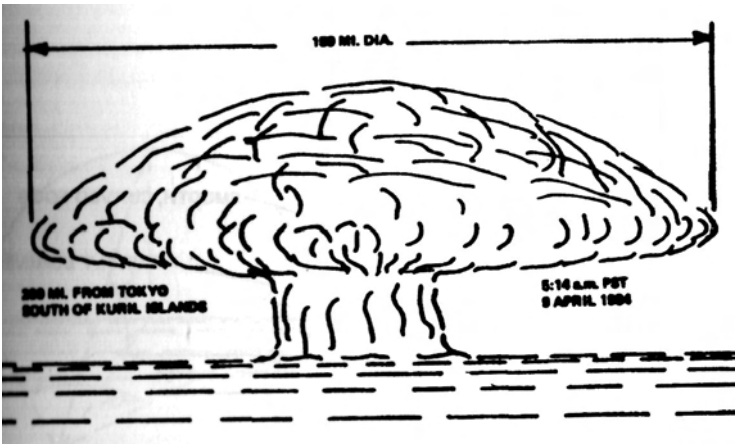

Figure 13. Mushroom cloud from the sea off Japan, near a Russian test area.

©Hal Crawford 1981

Figure 14. The Tesla shield, a giant hemispherical shell of energy. Seen repeatedly in Soviet tests in out-of-the-way places and remote regions of the ocean.

8:15 PM
THURSDAY
AUG 1969
VIRGIN ISLANDS
SEEN BY MANY RESIDENTS

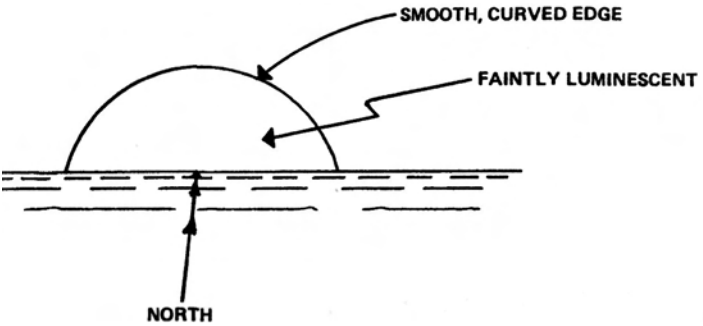

Figure 15. The Tesla shield: A 1969 Virgin Islands incident.

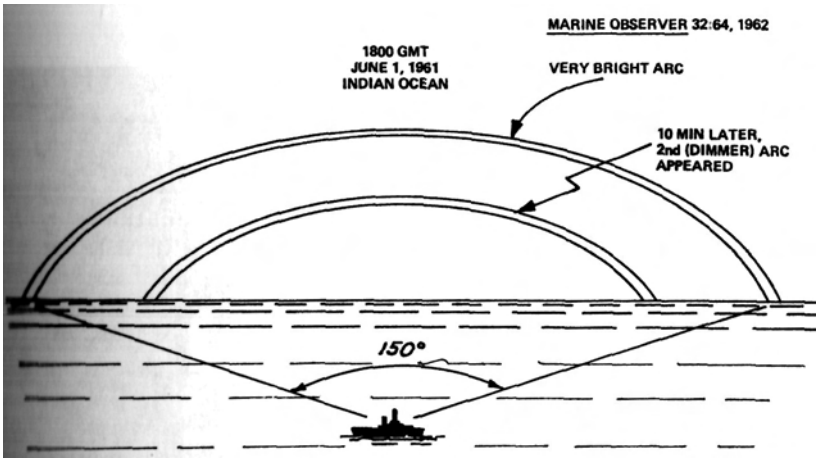

Figure 16. Tesla shields: Two nested arcs of light in the sky.

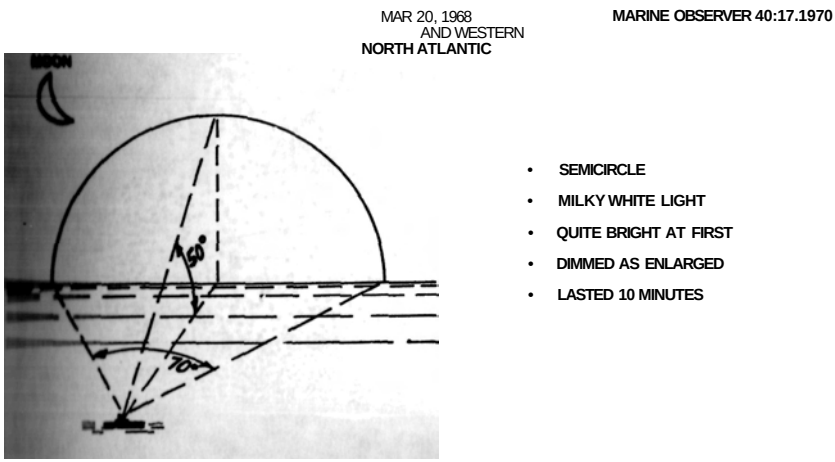

Figure 17. Tesla shield: An expanding hemispherical circle of light.

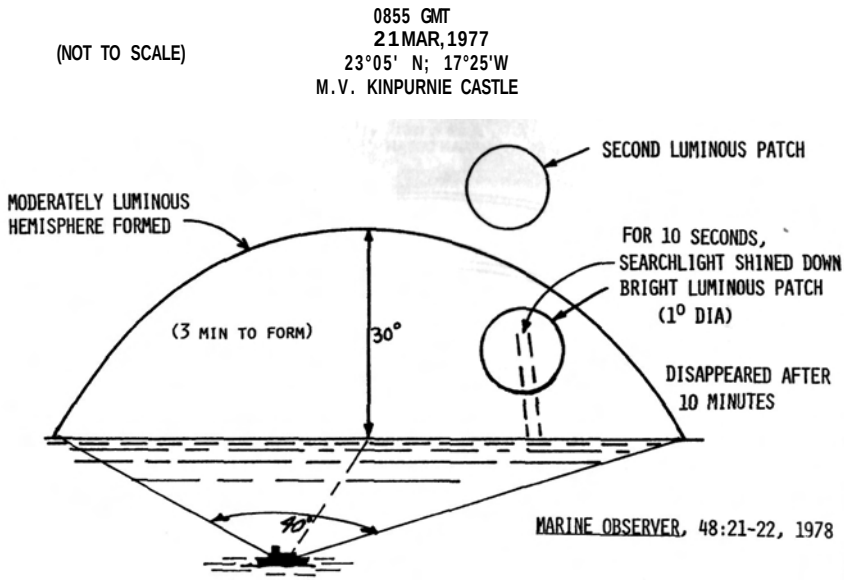

Figure 18. Tesla shield: Hemisphere and globes, 1977.

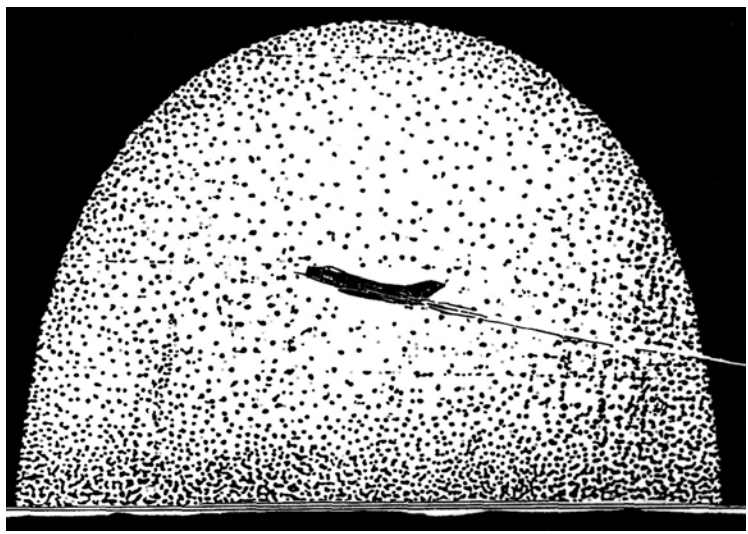

Figure 19. Large Tesia Shield observed by Red Chinese fighter pilots. Electrical difficulties in the aircraft were also experienced.

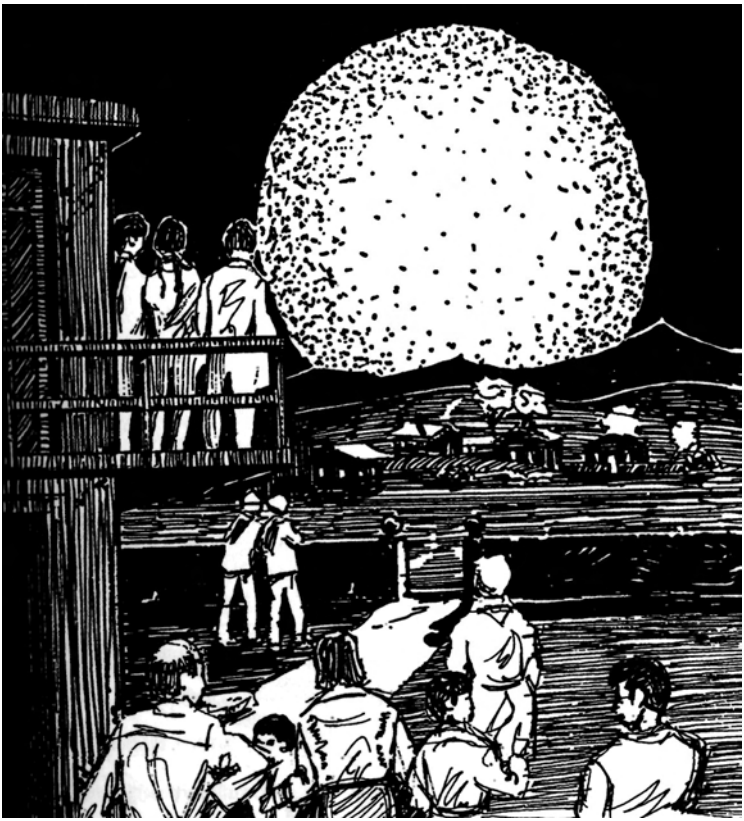

Figure 20. Large glowing Tesla Globe," Red China. Observed by hundreds of **persons.**

©1980 Hal Crawford

Figure 21. 1966 test of giant Tesla Globe, expanding deep within the Soviet Union. Seen from Teheran, Iran June 17, 1966 by two aircraft approaching Mehrabad Airport. Observed for several minutes.

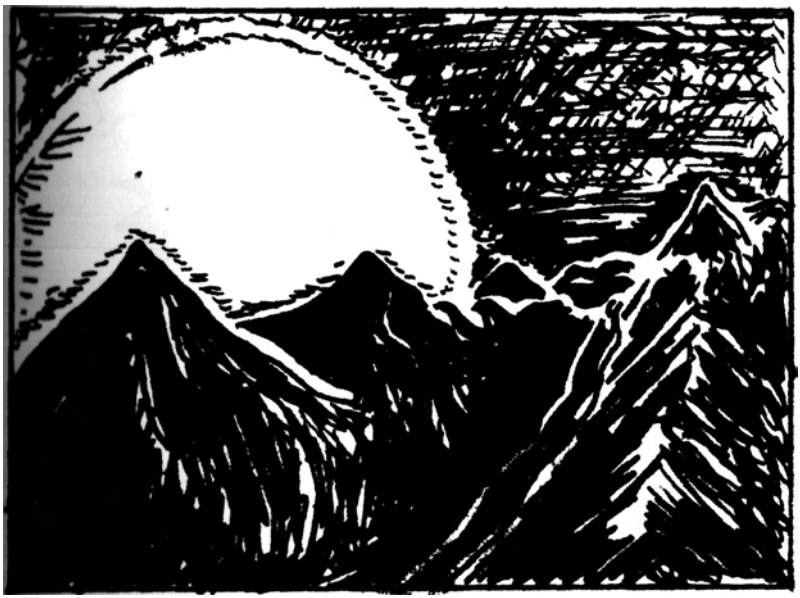

Multiple events seen in Sept. 1979 from Afghanistan

Strange lurid glow that flared silently over the Hindu Kush; as described by Nick Downie.
The LONDON SUNDAY TIMES, 17 August 1980

Figure 22. A giant globe, deep within the Soviet Union in 1979. Seen several times frorn Afghanistan, looking toward Saryshagan.

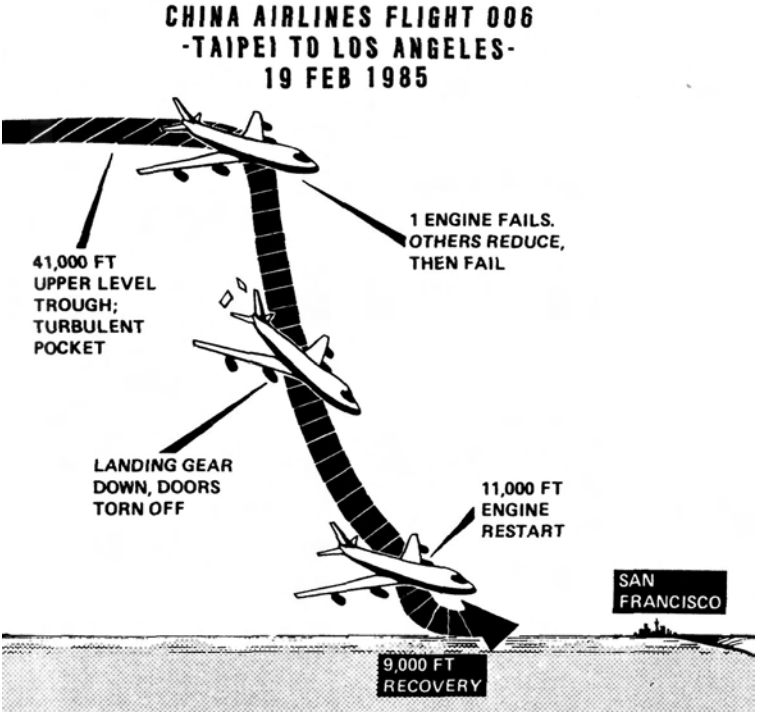

Figure 23. Engines disabled, a passenger jet drops six miles in two minutes.

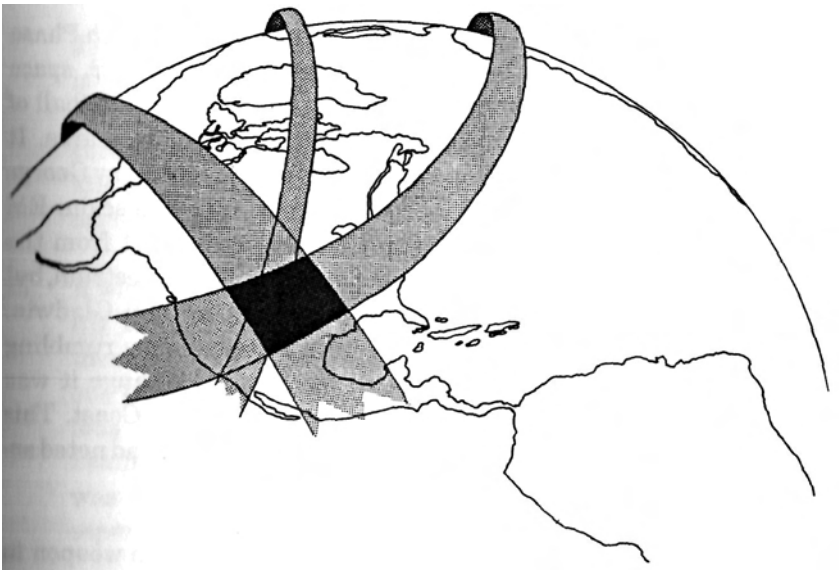

Figure 24. Giant "Woodpecker" beams intersecting over the U.S. Used for weather control, as a launch phase ABM and anti-bomber system, electromagnetic attack of distant populations, and disease conditioning. Using phase conjugate radar mirrors, any amount of energy desired can be delivered to any distant target from which a radar return has been received. Real-time distant holography, to produce powerful energy forms at a distance, can also be accomplished.

Table 6. MASSIVE 1985 STRATEGIC MAY DAY EXERCISE

APRIL/MAY 1985

- **BREZHNEV'S 1972 STATEMENT FULFILLED**
- **40th ANNIVERSARY OF WWII**
- **GORBACHEV NEWLY IN POWER**
- **EARTH IN GIANT SCALAR EM RESONANCE**
  - **54 FREQUENCIES**
  - **27 "POWER TAP" PAIRS**
  - **4 TO 6 WEAPONS EACH PAIR**

- **C^3I SCALAR EM LINKS**
  - **UNDERWATER SUBS**
  - **NAVAL FORCES**
  - **OTHER FORCES**

12. In late November, 1985 the Soviets tested their Launch Phase ABM system over Florida, using the launch of a U.S. space shuttle as a convenient test target. A marker beacon (ball of light) was placed in the sky, hovering near the launch area. It was seen by hundreds of persons, and photographed by George Suchary. During the final countdown to launch, a scalar EM "missile" (ball of intense energy) was fired, offset from the shuttle. This ball of energy was not in the visible spectrum, but may have been accidently photographed by Bob Gladwin. Twelve minutes offset after launch, a tremendous rumbling overhead boom echoed through the area — so huge it was heard for hundreds of miles up and down the East Coast. This was the third U.S. shuttle launch in which NASA had noted associated anomalous phenomena, but did nothing.

13. On December 12, 1985 the Soviets used the same weapon in the anti-bomber mode to destroy an Arrow DC-8 jet just after its takeoff from Gander Air Force Base, Newfoundland. **Over 250 U.S. soldiers and civilian crew members were killed.** Gander has long been a registration point for the Soviet scalar EM weapons. For example, in one 4-day period in 1982, 36 anomalous incidents occurred in and around Gander, involving moving lights, lights in the sky, etc.

14. On January 28, 1986 the Soviets destroyed the U.S. space shuttle Challenger, shortly after its launch. A dozen signatures are associated with this Soviet kill, too many to mention all of them. To give only a few: First, the Soviet ships monitoring the launch site suddenly departed at high speed, four hours before the launch. This was unparalleled. Second, according to General Daniel Graham, *the following evening KGB headquarters gave a party to celebrate the success of the KGB's perfect active measures against the Challenger!* Direct and unmistakable indications of extreme localization of the Soviet transmitters to the Challenger's launch site existed on the day of the launch. In addition, a metal-softening signal was confirmed on the Soviet Woodpecker beams as early as

January 1,1986. Many other indicators also exist. The total is a very strong statement that the Soviets destroyed the Challenger with the same weapon they had tested against three previous shuttle launches, and which they had used to kill the Arrow DC-8 at Gander Air Force Base only six weeks earlier.

15. A whole series of anomalous missile failures occurred, involving Titan, Delta, and Ariane launches. The odds against all these launches failing in that pattern were millions to one. In one Titan failure, video taken of the event showed the anomalous "marker beacon" light in the vicinity, high overhead. Frame-by-frame analysis of the video showed that the light was indeed independent of the explosion, and it moved off separately after the rocket exploded.

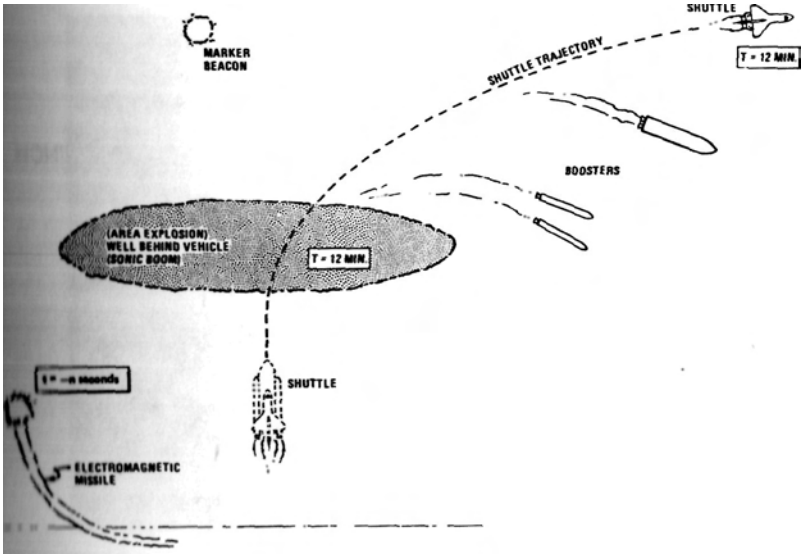

Figure 25. Third Soviet non destructive testing against shuttle launches, Nov. 26, 1985.

Table 7. SHUTTLE **LAUNCH ANOMALIES, NOV. 26, 1985**

- **MARKER BEACON**
  - **PHOTOGRAPHED**
  - **SEEN BY HUNDREDS**
- **OFFSET SCALAR EM MISSILE**
  - **INVISIBLE TO HUMAN EYES**
  - **STRIKE PHOTOGRAPHED**
- **GIANT ATMOSPHERIC BOOM**
  - **T + 12 MINUTES**
  - **HEARD FOR HUNDREDS OF MILES**
- **THIRD LAUNCH WITH SUCH A BOOM**

Table 8. SOVIET ESCALATION AFTER 3RD TEST AGAINST SHUTTLE LAUNCH on Nov. 26,1985.

- **U.S. STILL UNAWARE OF SCALAR EM WEAPONS USE**
- **SOVIETS ESCALATED ACTION**
- **DESTROYED OR DISABLED:**
  - **ARROW DC-8 (DEC. 12,1985)**
  - **CHALLENGER (JAN. 28, 1986)**
  - **TITAN 34-D (APRIL 18, 1986)**
  - **DELTA ROCKET (MAY 3, 1986)**
- **MAY HAVE DISABLED:**
  - **ARIANE II(MAY 31,1986)**
  - **TWO U.S. NUCLEAR SUBS WHICH RAN AGROUND**
  - **STEALTH FIGHTER WHICH CRASHED**

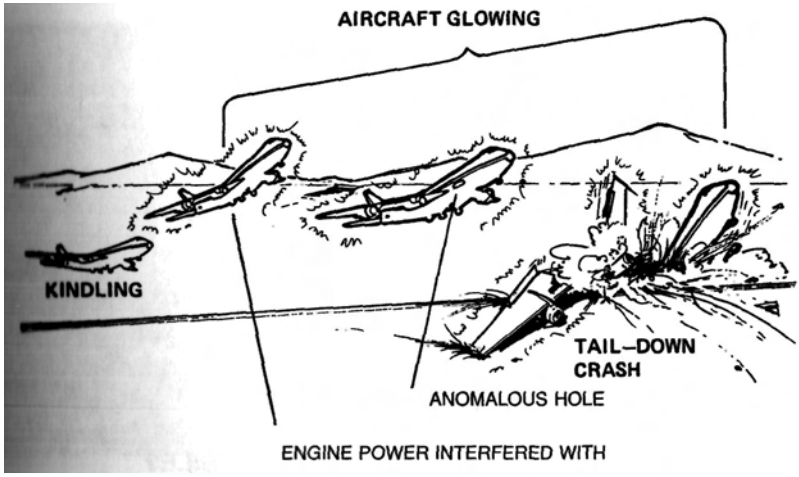

Figure 26. Death of the Arrow DC-8, Dec. 12,1985. Three eye-witnesses saw the **doomed** airliner glowing. An anomalous hole was found in the fuselage, forward of **the** engines. Engine combustion was interfered with, by phase conjugate (negative) e**nergy.** Engines were rumbling laborously, not roaring with power, as the aircraft **passed** 100 ft directly over a witness.

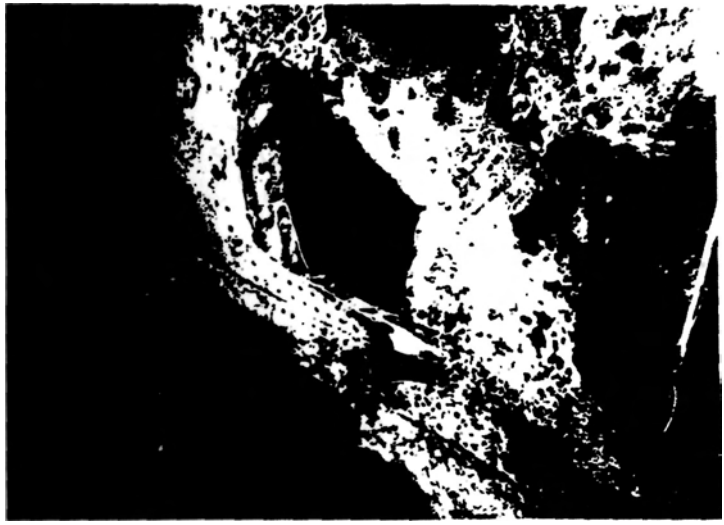

Figure 27. Anomalous hole in the right fuselage of the ARROW DC-8, ahead of the engines. With crossed over-the-horizon radar beams and multiple phase conjugate **radar** mirrors, real-time holography allows the production of a ball of EM energy at a great distance. The ball may be as small as desired, and contain as much energy as desired.

Table 9. ARROW DC-8 DISASTER, DEC. 12, 1985

GANDER AFB, NEWFOUNDLAND

- **AIRCRAFT LIFTED OFF**
- **AIRCRAFT WAS GLOWING YELLOW - ORANGE**
- **SANK TAIL-DOWN AND CRASHED**
- **SIGNATURE OF ENGINE/COMBUSTION INTERFERENCE**
  - **LAUNCH PHASE WEAPON**
  - **ANTI-BOMBER MODE**
  - **ANOMALOUS HOLE IN FUSELAGE, FORWARD OF ENGINES**
  - **STRUCK BY ELECTROMAGNETIC MISSILE?**
  - **EXTENSIVE "BALLS OF LIGHT" WEAPON TESTS IN AND AROUND GANDER**
- **CLOSELY FOLLOWED THIRD TEST AGAINST SHUTTLE NOV. 26,1985, IN ABM MODE**

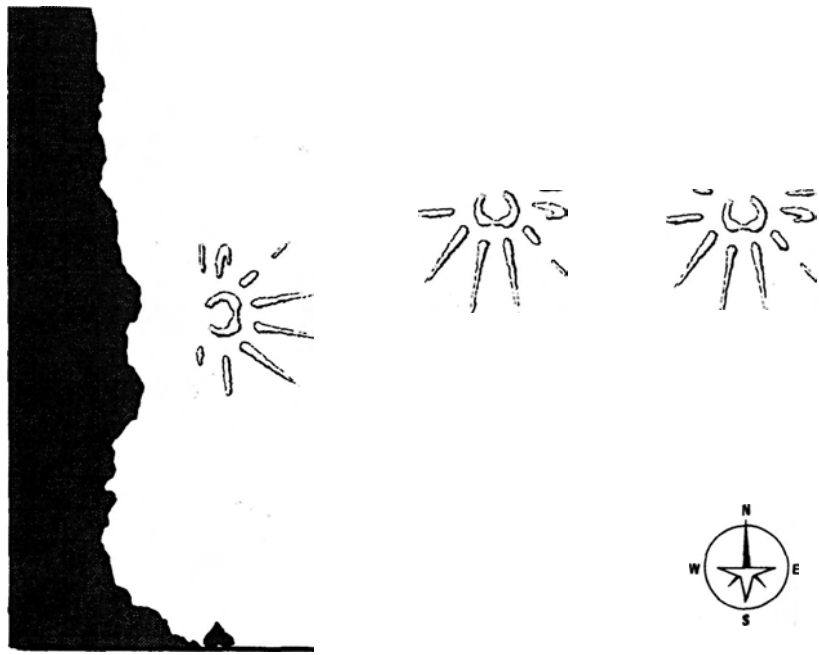

Figure 28. Part of the Soviet engineering of U.S. weather, just prior to the death of the Challenger. Three "giant radial" clouds sighted over the greater Los Angeles area by Margaret Wilson. Appeared one after the other, at 10 min. intervals.

DOD PHOTO

Figure 29. Soviet Trawler spyship. About four hours before the launch of the Challenger, all Soviet ships off coast, that normally monitor each launch, suddenly and mysteriously departed at high speed. Unprecedented event.

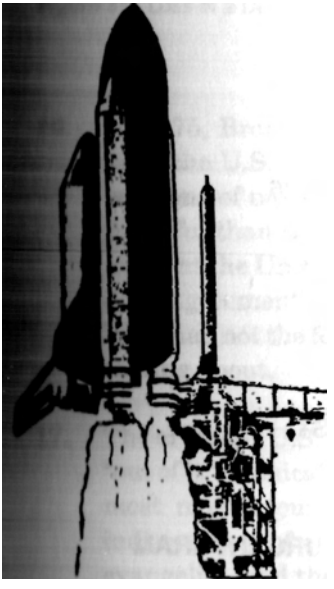

- **SOVIET WEATHER ENGINEERING**
- **SEVERE COLD STRESS**
- **METAL-SOFTENING**
- **BOOSTER SEAL PROBLEM**
- **SOVIET SHIPS ABSENT**
- **LOCALIZATION**
- **AIR TURBULENCE**
- **BIRDS NOT FLYING**

Figure 30. Launch of the doomed Challenger, Jan. 28,1986.

Table 10. DEATH OF THE CHALLENGER, JAN 28, 1986

- **METAL-SOFTENING SIGNAL ON WOODPECKER GRID AS OF JANUARY 1, 1986**
- **SOVIETS ENGINEERED COLD WAVE INTO FLORIDA**
- **SEVERE COLD STRESS ON VEHICLE**
- **GRID LOCALIZATION SIGNATURES**
  - **BIRDS NOT FLYING IN LAUNCH AREA**
  - **BIRD FALLS IN BIRMINGHAM, AL (HINGE)**
- **SOVIET SHIPS/TRAWLERS DID NOT TRACK LAUNCH**
- **BOOSTER SEAL PROBLEM SEVERELY AGGRAVATED**
- **CAUSED SHUTTLE FAILURE**
- **SOVIET KGB HEADQUARTERS CELEBRATED "PERFECT SUCCESS OF ACTIVE MEASURES" AGAINST THE CHALLENGER!**

Table 11. KGB CELEBRATION

EVENING OF JAN. 28,1986

- **AFTER DEATH OF CHALLENGER**
- **KGB HEADQUARTERS**
  - **JUBILANT PARTY**
  - **CELEBRATED SUCCESS**
  - **OF ACTIVE MEASURES AGAINST THE CHALLENGER**

SOURCE: GENERAL DANIEL GRAHAM, URGENTGRAM

- **NOTE: SOVIET SCALAR EM WEAPONS ARE CONTROLLED BY KGB**

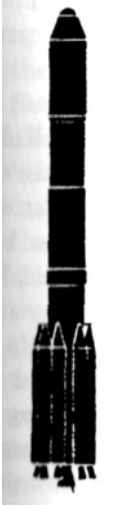

- SHORTLY AFTER LAUNCH
- ANOMALOUS POWER SURGE
- "COMMANDED" ENGINE SHUTDOWN
- VEHICLE THEN UNSTABLE
- RANGE SAFETY OFFICER DESTROYED ROCKET
- EXTERNAL RANGE SENSORS DID NOT RECEIVE SURGE SIGNAL
- SIGNATURE OF TIME REVERSED WAVE
- WHICH LOCALIZED ON ROCKET

Figure 31. Loss of a Delta rocket, May 3, 1986.

16. In 1975, Brezhnev had surprisingly urged U.S. senators to have the U.S. cooperate in banning the development of new weapons of unparalleled horror. He used the phrase, "more frightful than the mind of man has ever imagined." Shortly after, at the United Nations, Gromyko had even introduced a draft agreement for all nations of the world to sign. Again, the West had not the foggiest notion as to what the Russians were talking about.

17. The orthodox U.S. news media has been, and is, almost totally "out of it." Ironically, at the time of our deadliest peril, and the most momentous period in history, incidents such as the indiscretions of a presidential candidate and of a television evangelist, and the "Iran Gate" actions of the National Security Council in trying to illegally get arms to the Contras, are the "burning issues of the hour" — and the week, and the month, and the year, and HO on ad nauseam.

18. The Congress — great watchdog and the direct representative of the U.S. citizenry — is equally immersed in interminable hearings of little or no substance except news media coverage and publicity.

19. A belabored president, misled and now hemmed in on all sides and on the defensive, has had his power to act greatly constricted. In addition, the orthodox filtering networks surrounding him have effectively isolated him. He has been unaware of the extensive information that shows just how certain it is that the Soviets have fantastic superweapons and have been gingerly using them against us for decades. He and his immediate advisors are fed highly filtered, shaped and interpreted data. U.S. intelligence is very good at doing the things that it does. However, it is also very good at ignoring the things that it ignores! Further, the intelligence community is a past master at "slick-tonguing" the interpretation of anything new, and anything it really doesn't understand, in terms such as "We have no evidence that ..." For decades, the community has consistently underestimated the Soviet threat, and it has also usually projected any unpleasant present Soviet capability in the terms that "If the Soviets keep this sort of thing up, it may prove to be a real threat 30 years from now!" For years U.S. intelligence was unaware of a Toronto inventor's development and public demonstration in the late 1960's of an inertial field generator device, for example, because it simply did not place high value on simple overt intelligence such as reading the newspapers! The entire event was printed in detail in a Canadian newspaper. Only very recently, within the last few years, has the community again realized that the most important intelligence can only come from human (HUMINT) sources. And in relying on the scientific community — which itself knows nothing of scalar electromagnetics — the intelligence community has not received the technical advice necessary for it to properly task its collection agencies to collect information on the Soviet superweapons.

20. Western science has also shown itself to be highly dogmatic and ensconced in the comfortable "status quo." It has regally ignored the important Soviet developments in unified field theory. It has assumed an aristocratic stance, regarding the Soviet scientists as little more than peasants still trying to clean the mud off their boots. In fact, the Soviet scientists have been ahead of the rest of the world in *nonlinear* science — the truly hard stuff— since the beginning. They have always been the best nonlinear mathematicians in the world. Soviet scientific papers regularly appear which deal with local general relativity and the overcoming of the sacrosanct conservation laws as a matter of course. That subject is still a "no-no" in U.S. scientific publications, even though breaking symmetry and consequent violation of conservation laws has long boon proven in particle physics. To my knowledge, with the exception of Hooper's obscurely published work, not a single US. scientific paper appears in the literature showing any detailed investigation of "bucking fields" as such and investigating the behavior of materials exposed to such "sum-zeroed" fields. Yet ironically a whole area of optical physics — phase conjugate optics (PCO) — has shown great activity since we discovered it in the open Soviet literature in the late 60's, and since two Soviet scientists visited Livermore* in 1972 and briefed us upon the subject (as another stimulus to see if we recognized the awesome weapon implications). In PCO, the scalar EM wave formed by two waves 180 degrees out of phase with each other, and locked (modulated) together by a nonlinear medium, is blithely called the *pump wave.* Using it on nonlinear materials produces extraordinary results — such as electromagnetic waves traveling backward in time. Further, the PC effect is known to be universal, and not just in the optics region at all; for example, it has also been done with sound waves. **The obvious experimental and theoretical proof of scalar EM has been in our literature for nearly two decades, and even in PCO our scientists do not yet realize that the** "pump" **wave is a scalar** wave, **a** wave **of**

*Lawrence Livermore National Laboratory

artificial potential, and a gravitational wave that pumps the nuclei of the atoms in the nonlinear medium. They also still do not understand that it is the nucleus of the atom that produces the phase conjugate replica wave in PCO.

Table 12. BREZHNEV'S 1975 PROPOSAL

AT THE SALT TALKS ON JUNE 13, 1975

- **THE SOVIETS URGED THE U.S. TO AGREE ON A BAN AGAINST RESEARCH AND DEVELOPMENT OF NEW KINDS OF MASS DESTRUCTION WEAPONS MORE TERRIBLE THAN ANYTHING THE WORLD HAS KNOWN!**

- **BREZHNEV PERSONALLY URGED VISITING U.S. SENATORS TO AGREE TO THE BAN.**

- **GROMYKO INTRODUCED A DRAFT AGREEMENT INTO THE UNITED NATIONS MEETING AND URGED THE NATIONS OF THE WORLD TO SIGN IT.**

- **THE WEST HAD NO IDEA WHAT THE SOVIETS WERE TALKING ABOUT!**

- **SOVIET HAWKS THEN GAINED DOMINANCE, AND THE USSR STARTED ITS MASSIVE BUILDUP FOR EVENTUAL WORLD TAKEOVER.**

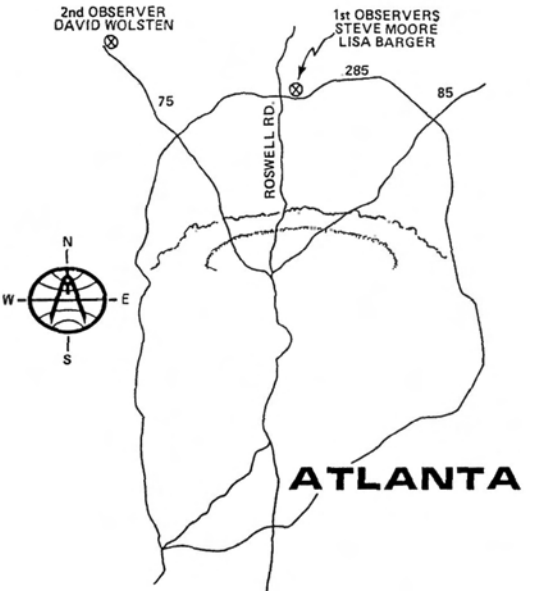

A. Location of the incident

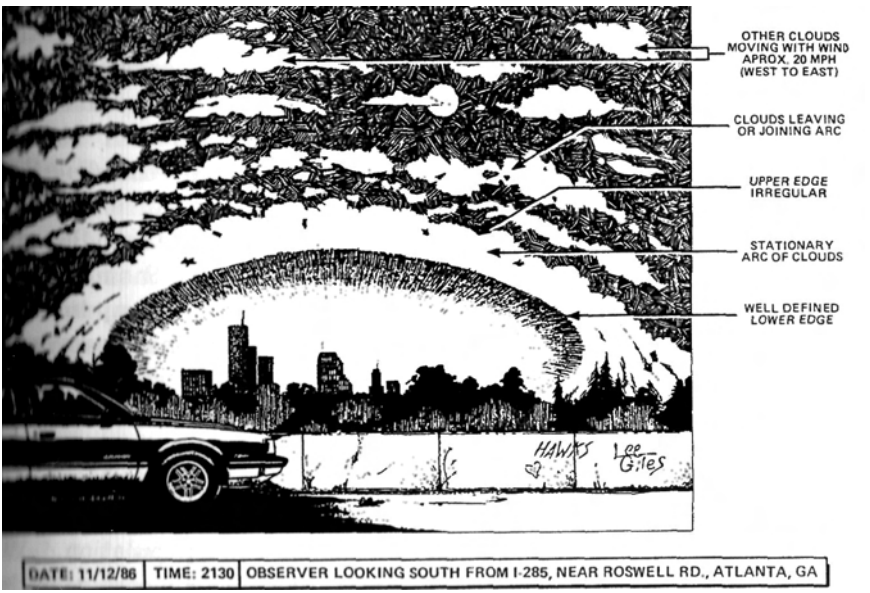

B. Artist's sketch of the incident.

Figure 32. Probable Soviet test of a Tesla Shield over Atlanta, Georgia.

Continually assured that Western science and intelligence remained outrageously ignorant and would obstinately persist in wearing orthodox blinders, the Soviets felt quite safe in striking the U.S. and its Western allies a mortal death blow.

The Soviets knew there would be no retaliation, so long as the blow was sufficiently unorthodox.

After all, the Soviets have been waging a slowly increasing unorthodox war against us for decades, and totally getting away with it.

Consequently the Soviets manipulated the cancer research and the contamination of the World Health Organization's smallpox vaccine to produce the perfect biological warfare "first strike," administered unwittingly by the WHO itself in its mass immunization program to eradicate smallpox. The Soviets continue to manipulate the spreading AIDS viruses electromagnetically so that the West will be devastated, as well as Africa and the Third World.

At least one other spreading AIDS-strain has already appeared in Africa. Testing for exposure to the first strain in most cases did not detect exposure to this second strain.

Officially no one knows whether it will be as infectious as the first strain. However, a suspicious correlation has appeared between hepatitis vaccination in several large U.S. cities and consequent outbreak of AIDS among the persons inoculated.

Further, the latest studies are beginning to show that (1) AIDS may be just as spreadable, though more slowly spread, in the heterosexual community as in the gay community, (2) the AIDS tests themselves are far more unreliable than suspected; one may have the AIDS virus — and serve as an active carrier —for up to three years before the tests begin to detect it, and (3) no one has any real idea as to how many persons have already been infected.

As can be seen, even orthodox scientists are beginning to suspect a coming AIDS infection "asymptote" which may represent an explosion of the disease into a mass pandemic in the world population. In Africa, for example, AIDS is spreading freely among the hetersexual population as well as the homosexual population. * We may be on the verge of seeing a similar phenomenon emerge in the

*Although there is much speculation as to why African heterosexuals seem so vulnerable, at present no one knows why it is true.

Western world.

If so, we are looking full in the face of a forthcoming AIDS massacre that makes the 1918 influenza pandemic pale by comparison. Not only will AIDS decimate Africa and the Third World, but it will also decimate the West a little later.

In the Soviet plan, after the AIDS massacre has peaked, the remaining much smaller U.S. and European populations will be decimated and totally powerless. The demoralized and devastated Western nations will easily capitulate and pass under the Soviet hammer and sickle.

In their deception planning, the Soviets even are allowing some contamination of their own citizens by AIDS. Thus they can keep up *a pretense* that they are just as much victimized as we are, and just as much "in the dark" as we are about the whole thing.

Of course, once the AIDS infection does its lethal dirty work in the West, the Soviets can easily eradicate it in their own population at will, using the electromagnetic healing technology they already posess. The Soviet planners regard the loss of a few Soviet citizens along the way as one of the things necessary to insure the success of the Great Strike and the Final Revolution. Forward divisions in the standard Soviet attack are always regarded as such sacrificial pawns to guarantee the success of the follow-on echelons in the attack. In this BW strike, the sacrifice of some Soviet citizens is deemed necessary to the overall success of the attack.

Remember, these are the same type of Soviet communist planners who killed 20 million Kulaks — their own people — to forcibly collectivize Soviet agriculture. For their highest purposes, these planners are still quite capable of ruthlessly sacrificing millions of their own people to achieve their objectives.

The *Asian Tiger Mosquito: A New and Efficient Vector*

As almost everyone now realizes, in the past our government has greatly understated the AIDS problem. Past projections of the limitation oft he spread of the disease have been far more optimistic than warranted.

For example, officially the government is still denying any possibility of insect vectors for the disease.

Don't believe it. In fact, highly efficient insect carriers of the disease are already on the way.

Insects in Africa have positively been verified to be harboring the AIDS retrovirus. Of course, such reports are always accompanied by the bland assurance that "We have no evidence... (that the insect bites will give AIDS to humans).

Let's see now: We're supposed to believe that a monkey bite will do enormously more than that. Even when the monkey didn't have the exact present form of the AIDS retrovirus. Even though monkey bites hadn't done the trick in thousands of years.

But we're supposed to turn right around and believe that an insect carrying the live AIDS retrovirus can bite you, inject into you some of his body fluid containing AIDS viruses, and you won't stand any chance of developing AIDS .

What are we supposed to believe? That the injected AIDS virus from an insect bite won't bother you, but the injected AIDS virus from other causes will?

Nonsense!

Anyone who believes that is a prime candidate for purchasing that bridge down the road...

Of course insect vectors will give you AIDS!

And we've got a real tiger — mosquito, that is, on the way to do just that.

The Asian Tiger mosquito has been introduced into the U.S. (it just "accidentally" appeared, of course!) and is now spreading through the Southeastern states. This vigorous and voracious mosquito prefers man as its target, and has an unusually wide range.

Recently U.S. scientists have reluctantly confirmed the presence of the AIDS virus in the Asian Tiger mosquito. However, as usual we are presented with the same tired refrain, "We have no evidence that... the mosquito's bite is capable of causing a human to develop AIDS."

Of course, you can be sure that eventually we *will* have evidence of precisely that!

The AIDS virus is now known to be able to live outside the body for up to at least 15 days, if not longer.

Also, the AIDS virus is an unstable virus — it's constantly mutating and changing its form. That means it's "highly adaptable" - that is, it's continually adapting to its environment, at a rate millions of times faster than normal stable viruses change and

That fact implies that some mutant strain of the virus will almost certainly be adapted to living in the Asian tiger mosquito and being introduced into its human host by the mosquito's bite.*

It's not a matter of "Can it do that?" or "We have (as yet) no evidence of that."; instead, it's a matter of "How long will it be until that occurs and we confirm it?"

The Asian Tiger mosquito apparently is intended to serve as the major vector (carrier), or at least one of them, to eventually rapidly increase the AIDS infection rate and devastate the U.S. population.

AS the vector spreads and the virus adapts to that mode of transmission, the rate of increase of the AIDS infection will itself accelerate. This means that all the projections for "doubling times" are seriously in error.

The latest data from Alabama, for example, shows that the disease is now doubling every six months instead of every year. Also, the doubling interval itself has been shortening, at least up to the present. Note also that, from the data of the new studies confirming a much longer lag time for the AIDS test to indicate the presence of the infection, even the present data on the number of persons infected and the doubling time are underestimated.

If these and other data are a true indication, it appears that we literally may have an "explosion" of the AIDS infection in no more than two to three years.

In addition, as we said the AIDS virus is an unstable virus. Mutations in the virus itself are occurring so rapidly that producing an effective vaccine essentially will be impossible. Without a totally new means applied to produce an AIDS cure, AIDS simply cannot be stopped.

•And one or more strains will eventually evolve that can be infectuously spread like the influenza virus is.

In fact, recenly it has been discovered that the AIDS virus is far more devious than previously susupected.* It attacks in more ways than suspected. It changes in the body, increasing its virulence as the disease progresses.

Macrophages, the immune system's scavenger cells, become infected and carry the virus to other body cells. It appears that macrophages may pass the virus to the T-cells, conditioning the destruction of the immune system. Infected macrophasges are found in rectal material of AIDS patients and in cervical fluid and semen. Thus through infected macrophages the AIDS virus is able to infect partners through exhange of semen, cerical fluid, and rectal material — even though there are no breaks or tears in the skin, and even though the number of free AIDS viruses in thefiuids is too small to pass the infection.

Other immune system cells —such as Langerhans cells—are also suspected to be capable of serving as AIDS carriers when infected. The end result is that, as the AIDS patient sickens, the virulence of the AIDS virus increases, so that it attacks a greater variety of cells and can more easily infect them.

Present orthodox methods cannot cure AIDs in time, if ever.

Unless unorthodox technology is applied to solve the problem the West is already defeated.

*See Gina Kolata, "Fatal Strategy of AIDS Virus Grows Clearer," Science Times section, **New York Times,** Mar. 22, 1988; see also "Growth in AIDS Virus Virulence Found," **Los Angeles Times,** Apr. 1, 1988.

CHAPTER 3

WORLD WAR III IS RAGING AND WE'VE NEARLY LOST IT

More on AIDS Doubling Time

AS we said, the AIDS problem is much, much worse than officially announced. As stated, in some areas at least, the number of new AIDS cases diagnosed has been doubling every six months instead of every year. New studies have shown that the tests to identify infection by the AIDS virus may themselves have a 3-year lag period in which they do not reliably indicate the presence of the infection.

These facts probably make all previous "officially announced" estimates and projections off by several orders of magnitude (at least three).

If the incubation period (nominal) is, say, 5 years, then there is a factor of up to 2 (exp 10) of AIDS cases already in incubation.

The lag in accuracy of the AIDS tests however, may mean that there are even more AIDS cases in incubation than this.

And we may have a new entry into the equation at any time, once the AIDS virus adapts to its transmission by the Asian tiger mosquito and possibly even other insect vectors.*

Remember, we've got the U.S. data for only a relatively few years since 1981. So it's statistically difficult to project ahead with any accuracy. However, the best interpretation of the data we can make shows a spiraling (speed-up) trend in the rate of acceleration of the disease, indicative of a forthcoming asymptote. If that interpretation of the data holds true, the asymptote represents literally an "explosion" of the disease.

That is, the six-months "doubling interval" is slowly becoming **the s**ix-months "tripling interval," the six-months "quadrupling interval," etc.

The best indication/projection I can tentatively arrive at is this: If the total cure is not accomplished within about two to three years, then - considering the incubation ongoing by then and the speedup

***Another HIV virus has now been identified.**

ahead — somewhere between a third and two thirds of all humans on earth will perish.

In other words, nominally half the humans on earth will inevitably die, say within five years (the incubation) after that two to three year point.

Most of the people who die are going to be highly selected. Most of them are going to be Westerners, Africans, Asians, and Brown people.

And all of our tanks, ships, bombers, missiles, nuclear weapons, and armed forces put together can't save a single AIDS victim.

We've got more generals than ever before in our history, including World War II. And not a one of them has a single tactic or a single weapon to use against this mortal attack.

Understand, our generals have not failed us against the enemy they know and recognize. The bellies of our B-52 bombers and the aircraft aboard our distant aircraft carriers are filled with nuclear bombs sufficient to destroy the world many times over. Our powerful nuclear-tipped missiles sit in land-based silos and in sleek submarines cruising silently under the oceans, waiting to respond in an instant to hostile attack, again with the power to destroy the world many times over.

Yet the fine men and women who have built and maintained that awesome force, and who man it in constant vigilance to protect our nation, are absolutely vulnerable and defenseless against the smallest foe of all —just as were the Martians in H.G. Wells' **War of the Worlds.**

With all our awesome forces, we do not have the power to stop a single AIDS virus — or indeed, any other similar new BW virus.

We can be defeated with ridiculous ease by even the tiniest determined hostile nation — or even by a single terrorist, madman, or genetic accident by a high school youth.

And if there's one thing that we can learn from history with iron certainty, it is this: If we can be defeated with ridiculous ease, then most certainly we will be!

Since the strike has already occurred, then our defeat is just a matter of time if we continue our present courses of action.

All other threats — nuclear, chemical, scalar EM, the works — pale in comparison to this seemingly innocuous, doomsday BW viral

weapon that has already been unleashed upon an unsuspecting world.

World War III is Already Raging

World War III has long been unleashed and a final, decisive first strike has now occurred. We've already lost the war unless unbelievably heroic measures are taken immediately.

This thing is deliberate. It's fiendishly clever. It's effective. And a smiling Gorbachev — master propagandist — is just part of the icing on the cake to deceive us until it's too late.

Ironically, Soviet announcements have cleverly started claiming that the U.S. has produced the AIDS virus and unleashed it.

That's a very clever propaganda trick to shift suspicion from themselves. Indeed, in the Third World the propaganda has been very effective. Most Third World peoples now give at least credence to the Soviet claim.

Unless we move immediately to effect a total cure, the armed forces and the populaces of all the Western nations will shortly be devastated — perhaps even worse than if they been attacked with nuclear weapons.

With our armed forces and populations devastated, we surrender. We lose.

The Soviets get the U.S. (and European) farmland. That's what they really need.

Of course they also will have rid themselves of about 200 million Americans or so along the way.

That, solves the old "winner's problem" of what to do with, and how to effectively control and care for, a conquered, resentful populace. That problem will have already been taken care of, for most of the U.S. populace will essentially have been eliminated.

There won't be many U.S. military prisoners, for example, since most of the military personnel will also have been eliminated by the virus or viruses clandestinely released.

Communism Is Savage Enough to Do Diabolical Things

The Communist's doctrine is to wage total war. Win any way, with any weapon, at any cost.

ALSO, communism has always taught that it is necessary to

destroy capitalism. That equates with destroying the U.S., the major capitalist country. Communists have always taken the long view, willing to struggle for decades to eventually accomplish their aim.

If you think no modern nation could be so incredibly savage as to deliberately destroy untold millions of people, look at the actual record of the Communists.

When the Khmer Rouge took over Cambodia, they murdered a third of their own people.

The Soviets murdered some 20 million or so Kulaks when they collectivized the Soviet farms.

The Red Chinese also slaughtered Chinese peasants by the tens of millions — perhaps as many as twenty or thirty million — when they collectivized the farmers.

Lenin's followers have proved over and over that they are capable of murdering even their own people, on a scale of millions.

Dedicated communists are highly religious people — even fanatics. Deliberate murder to achieve communism's goals is part of the accepted dogma.

The communists are quite capable of killing a billion or more "foreigners" and "enemies," given the chance. Particularly when the goal is to win the "Final Revolution."

The opportunity to strike the decisive final blow without consequences, using as simple and unorthodox a weapon as the AIDS viruses, could simply not be ignored by men who have spent their lives trying to control the world.

The unparalleled strike opportunity was particularly irresistible since someone else (the Western cancer research institutes) would develop the weapon itself, someone else (the World Health Organization) would unwittingly deliver the strike, and the blow could easily be clandestinely arranged (simply by secretly contaminating the WHO smallpox vaccine) and accomplished without repercussions to the Soviet Union.

Western Medicine is Inadequate

But what of Western medicine? Doesn't it always come through to save us?

Present Western medical science is totally inadequate to do the

task required.

For example, present medicine is largely based on "slowing or killing the invader of the body." Whether that invader is a germ, bacterium, virus, or whatever.

If there's a mechanical difficulty, then present treatment is to try to mechanically remedy it — remove a bad appendix, set a broken leg, etc.

However, then it's strictly up to the body's own natural healing system - its immune system and its repair system — to actually do the healing and repair/reconstruction.

The problem with AIDS is that it directly affects and suppresses the body's systems for healing and repair.

Once this protection and repair system is in disarray, any disease organism can attack the body and infect it. If the immune system can't handle the problem, eventually the invading disease organism kills its host.

Even if a way is found to destroy the AIDS virus itself, present medicine has not the foggiest notion of how to restore the healing and repair system from the damage and destruction it will have already sustained by massive AIDS infection.

Compare the situation to division combat: Hostile invaders are met at the front of the division by the division's combat forces. A battle ensues, with penetration and damage to the rear area support and sustenance facilities. After the enemy is beaten back or destroyed, the rear support and the combat forces must be renewed and restored. If that cannot be done, the seriously weakened division can still literally be boiled over by almost anything that comes along and hits it.*

*For this reason, standard Soviet doctrine is to attack in echelon, say, by three divisions — one behind the other. Thus, even if the first division is annihilated in the attack, the second and third divisions meet a seriously weakened enemy division and blast right over it. Similar tactics in the BW crisis - multiple viral strikes, one after the other — can almost inevitably be expected, now that the "first division" - AIDS - has engaged us.

The Soviet "repetitive attack" method *works,* in case anyone has doubts. For example, see George C. Wilson, "Army training exercises raise troubling questions," The Washington Post, as printed in the Huntsville (AL) Times, Feb. 28, 1988, p. 21A. Repeated U.S. Army tests in the Mojave Desert have shown that, in nonnuclear combat, when attacked by multiple Soviet echelons with 3:1 strength, U.S. forces lose every time! In particular, U.S. troops have poor anti tank defenses.

Modern medical dogma has concentrated almost entirely on the combat forces' problem of destroying and/or repelling the invader.

Western medicine has almost no tools or means of restoring the support and rear maintenance functions.

Even in a paroxysmal effort, dogmatic Western medical science would take decades to totally reorient its medical thinking to where it could even attack the real problem of AIDS and catastrophic sickness due to other viral BW warfare agents.

The same inability to cope with the problem also applies to our government bureaucracy, government agencies, the private companies, the universities, and to Western science in general.

If we have to depend on any or all of our present "system," the war is already over and we are all already doomed. Half of humanity will die within possibly five years after the upcoming two- to three-year "point of no return."

Medical insurance, treatment centers, and even private physicians are quickly going to be bankrupted as the AIDS plague increases. With the collapse of Western medicine, panic and pandemonium will reign in the streets. Martial law will be a necessity, and rioting on a scale unparalleled in American history will occur. We are likely to see our own U.S. dictatorship, in the form of a military junta making a coup and seizing power "to restore order and keep the lid on."

Study carefully the performance of governments and military regimes in such countries as Korea and South Vietnam, when those countries were hard pressed by enemy forces and in great disarray.

You may be looking at your own future.

The Soviets Will Not be Decimated

With the devastation of our armed forces, our governmental and civil agencies, and our population at large, a simple show of strength by the Soviets will collapse any further resistance. The hammer and sickle will wave supreme over the residue.

That's because the Russians *do* have the necessary developed scalar EM medical technology, not only to control and destroy the AIDS viruses, but also to directly restore the immune and repair systems.

The Kaznacheyev experiments alone show they have extensively studied electromagnetic induction of cellular disease and death.* We will have much more to say on that later.

If the Soviets extensively studied cellular death transmission by electromagnetics, you can bet they also studied the reverse: electromagnetic healing, or time-reversing the electromagnetic "death" signals themselves to produce specific "healing" signals for any type of cellular disease.

This is particularly certain since the Soviets also discovered and possessed the necessary "time reversal" electromagnetics: phase conjugation. This had been widely used by the Soviets in developing their enormous scalar EM weaponry, beginning about 1950 or so.

The curative signal technology was kept secret, of course, since the Soviets realized that it provided the only viable defense against viral biological warfare weapons.

The Soviets most certainly have the necessary AIDS cure. They can readily make the correct electromagnetic healing signal, by phase conjugating the AIDS death signal from dying human cells that contain AIDS retroviruses.

They also know we most certainly do *not* have the necessary EM cure. Years of weak microwave radiation of personnel in the U.S. Embassy in Moscow, and inducing illnesses in those personnel and even U.S. ambassadors, have shown that our own intelligence and scientific communities don't know what's really going on there.

Specificially, we've demonstrated (after checking with the DIA, CIA, NSA, and the orthodox scientists) that we do not recognize electromagnetic *biological warfare* —the deliberate introduction of cellular disease and death by electromagnetic means. Not only do we not recognize it, we can't do anything about it when it hits us.

And make no mistake, time-reversed electromagnetic medicine is shockingly cheap and effective, once developed. Specific healing signals for specific diseases — viral or whatever — can be quickly developed (within hours) and immediately used for mass treatment of entire populations.

For example, given the developed healing or "antidote" signal, it can even be recorded and played over ordinary transmitters, using

* There is now reliable information more closely associating Kaznacheyev with military *institutes near Moscow, engaged in* microwave weapon (directed energy) research

their normal transmissions as carrier waves. A populace continually bombarded by such "healing" television, radio, and powerline signals simply doesn't get the disease. And those already infected recover when continually exposed to such healing signals.

So the Russians can stop the AIDS epidemic cold, anytime they choose to do so.

Electromagnetically they can also gently guide and stimulate the progress of a disease such as AIDS, once the disease is introduced into a targeted population.*

Or, the Soviets can pull out all the stops and induce the disease in a distant population directly, placing the "death signals" on common carriers. Such as on our power lines, radio stations, televisions, and directly by induction from the Woodpecker over-the-horizon radar signals which continually bombard us.

The West cannot do any of these things. Neither can the West counter them, or defend against them effectively.

Unless a totally different tack is taken in the Western effort to counter this viral BW threat, Gorbachev's entrancing smile has already lured us to our doom. We are faced with a direct realization of Lenin's words:

"In the final revolution it does not matter if three-quarters of the earth is destroyed, so long as the remaining quarter emerges communist."

And Khrushchev's ghost will have the last laugh after all. We will have fulfilled the prediction he made to Nixon in their famous "Kitchen debate":

"We will bury you!"

Quite simply, for some decades the Soviets have had a new science — one they call *energetics,* and one which I have called *scalar electromagnetics.* The keystone or "heart" of this new science is time-reversed (phase conjugation) electromagnetics and electrogravitation.

*A candidate for an eery test of just this capability may be the highly anomalous deaths of numerous dolphins off the East coast of the U.S. in 1987. Nearly 500 died in the summer and late fall, apparently as a result of the weakening of their immune system to the common bacterium Vibrio. See Julia Lawlor, "Key: Failure of Mammals' **defenses,"** USA Today, **Jan. 19, 1988, p. 1A-2A.**

Chapters 4 and 5
deal *with complex scientific material and are suggested for those who are technically proficient.*

CHAPTER 4

EXTRAORDINARY PHYSICS

Maxwell'sLost Unified Field Theory

About the time of the U.S. Civil War, James Clerk Maxwell succeded in unifying magnetism and electricity. Actually he did far more than that, in his theory as originally written.

In fact, he had produced a theory which also captured the free interchange between electromagnetic energy and gravitational energy, but no one — including Maxwell himself—realized it at the time.

Maxwell wrote his original theory in quaternion and quaternion-like mathematics. The modern form of vector mathematics had not yet been finalized by Gibbs and Heaviside. It is most instructional to examine some of the fundamental differences between a vector and a quaternion.

In a conventional 3-dimensional vector, one may have three vector components, such as

$$v = ai + bj + ck \qquad (4\text{-}1)$$

where i, j, k are unit vectors in the directions of the x, y, and z axes respectively and a, b, and c are constants.

Obviously if the vector components of vector v are zero, then

$$v = 0 \qquad (4\text{-}2)$$

We shall be interested in the "vector product" of two identical vectors v, where

$$\mathbf{v} \times \mathbf{v} = AA \sin\emptyset = \mathbf{O} \qquad \textbf{(4-3)}$$

and A is the length (magnitude) of vector v, Ø is the angle between the two vectors (in this case zero), and O is the zero vector.

Now let us look for a moment at the quaternion situation.

First, in addition to the three vector components, a quaternion also has a separate scalar component, w. So the quaternion q for this situation is

$$q = w + ai + bj + ck \qquad (4\text{-}4)$$

Now when this quaternion is multiplied times itself, the vector part zeros, just as it did for the vector expression. However, the scalar part does not go to zero. Instead, we have

$$q \times q = A^2 = a^2 + b^2 + c^2 \qquad (4\text{-}5)$$

There is a very good physical interpretation of this result. It is a square of the amplitude, hence for the vector part of a wave, it is directly proportional to the energy density of the vacuum, as a function of time, at the particular position. However, we now need to make a short explanation of variation of stress energy density of spacetime.

First, we note that, according to general relativity, the "gravitational potential" is just a conglomerate of potentials of all kinds. Basically, a potential represents a G-potential, and consequently a curvature of spacetime. The potential also represents "trapped energy."

Second, we note that Kaluza combined electromagnetics and gravitation as a unified theory in 1921. Kaluza added a fifth (spatial) dimension to Minkowski's 4-space, and applied Einstein's relativity theory to 5 dimensions.

To Kaluza's delight, a common 5-d potential is responsible for both electromagnetic field and gravitational field. The "bleed-off of this 5-potential in the 5th dimension (which is wrapped **around** each point in our 3-space) is what we know as the **electromagnetic force field.** The bleed-off of this 5-potential *in and through* our 3-space is what we know as the **gravitational force field.**

Since the EM field is very much stronger (by a factor of 10^{42} for electrons) than the gravitational field, it is obvious that most of the

bleed-off of the 5-potential is in the 5th dimension, as EM force field. Only a tiny bit is left to bleed-off in 3-space, producing a very weak gravitational field.[1]

We state this fact: as a mass moves in space, it generates increased "activity" with the virtual particle flux of vacuum itself. **The** Increased virtual particle flux activity exchange between vacuum and mass is analogous to a strange kind of "virtual resistance." Since the resistance is virtual, it does not observably slow down an observable object moving in an (unobservable, virtual-particle flux) vacuum.

The increased flux activity represents an increased "virtual energy density" of space time, and an increased "trapped potential" (mass; resistance to an accelerating force) of the moving object. It represents a rotation of the spacetime frame, vis a vis the laboratory observer).

In the virtual vacuum (which contains both positive and negative time), one sees two antiparallel virtual forces: one in positive time, along the velocity vector of the object, and one in negative time (time reversed, or phase conjugated). The reason one sees virtual forces is that, each virtual (subquantal) change in the virtual flux activity represents an individual (unintegrated), separate change, hence a virtual acceleration. The observer (where things are integrated), sees the integral of all these accelerations, hence observable velocity.

The vector sum of these two virtual forces in the vacuum is a zero vector; however, the two taken together represent a stress in the local energy density of vacuum.

Since we may regard an EM wave as a stream of virtual electrons/positrons, each engaging in tremendous virtual particle flux exchange with the vacuum, then the same basic picture applies.

Now for our physical interpretation of (4-5): If we refer to an EM wave moving in the vacuum, the rotation of the frame is maximum (90 degrees). But this same rotation is just the same as additional vacuum stress, so the vacuum stress is maximum.

[1]**Electromagnetics is 5-gravity sliding around our 3-space. 3-gravity is 5-gravity oozing** through our 3-space.

This leads to these conclusions: An electrical force field vector represents a local maximum linear stress in spacetime, along the line of the vector. (Note we specifically deny that the electrical force field vector, of an EM wave in vacuum, is transverse. Instead, it is longitudinal. That has been addressed elsewhere by the author and will not be covered further here.)

Another electrical (stress) vector interacting with the first one adds more "urging" stress to the first. However, this action is occurring in the rotated frame of the moving wave, and so is rotated 90 degrees from the electrical velocity vector. Therefore it is lateral (but in a hyperdimension, not in 3-space) at right angles to the electrical velocity vector.

The combined "urging" action of the two vectors thus sweeps out an area with respect to the laboratory observer.

This means that the total "urging" or "stressing" action of the two vectors is analogous to a vector area.

It also means that this "area" function may be taken as the "swirl" of the electrical vector, but in a hyperdimension, not in 3-space. That is, we have described the magnetic force field.

Thus any two electrical vectors that interact will have an "area" or "resistance" component generated. *Any two that interact.* Whether they add vectorially, cross-product multiply, or dot-product multiply.

What is actually happening is that the wave exists in the 5-potential. The E and B fields just represent the oscillations in that 5-potential. They represent oscillations in the bleed-offs of that potential as E-field (longitudinal) and B-field (swirl).

The drag-area represents the accumulation of extra potential — hence the local rotation of spacetime. Since this accumulation is moving (along with the EM wave), as it passes a point it represents a change in the local virtual particle flux density of vacuum at that point, **hence a local curvature of spacetime.**

Hence, the EM wave makes a 5-dimension G-potential wave as it travels. The 3-dimensional gravity wave associated with this is normally very, very much smaller in magnitude — say, by a factor of 10^{-42} or so.

However, if the two vectors interact so as to produce a vector zero resultant, then all the electromagnetic energy of tho two vectors **is**

captured. That is, all the "EM vector zero" resultant means is that the EM bleedoff of the 5-space gravitational potential wave has been stopped. The 5-potential is still oscillating, and now all its trapped 5-energy must bleed off as 3-gravity force field.

Mass acts as an accumulator for this "trapped-EM energy turned into local curvature of 5-space." If we continually irradiate a mass with such a wave, the atomic nuclei of the mass slowly charge up with the new energy. Note that this potential delta may be positive or negative, if one adjusts accordingly.

In this fashion one may change the mass of a static object in the laboratory. One may either increase the mass or decrease it, or cause it to float, or even cause it to accelerate upwards.

But to return to our vector interaction and our interpretation of the scalar remainder of the quaternion.

The rule is, when the two EM vectors interact so as to form a zero EM resultant, then the EM energy represented in each of the two vectors has been converted into a special form of 5-space gravitational potential, one that is not bleeding-off in the fifth dimension (electromagnetically), but one which will gradually produce a 3-gravity potential in a mass's atomic nuclei as a function of time, the individual element, permeability and absorption factors of those nuclei, etc.

Therefore in our mathematical theory we ought to have a scalar component remaining when two EM vectors interact to form an EM vector zero resultant. That scalar component represents what is happening in the 5-potential, that will only bleed into 3-gravity.

With exploration of this phenomenology in the laboratory, one can work out the functions, constants, coefficients, and parameters which specify how the "5-G to 3-G and vice versa" component works in conjunction with mass, motion, and other fields.

That's the magic secret of electrogravitation.

It was captured inherently by the quaternion theory of Maxwell published during the American Civil War!

After Maxwell's death, when the scalar portion ofthe quaternion was discarded (by Oliver Heaviside) to form "modern" EM theory, that also discarded the unified field interaction between electromagnetics and gravitation.

Electromagnetic field and gravitational field were then modeled and regarded as mutually exclusive. EM field, therefore, was thought to produce no specific gravitational effects in the vacuum itself.

Hence when Albert Einstein was formulating general relativity some decades later, he knew only one way to "curve" spacetime: that was gravitationally, by "attraction of mass" forces.

But gravitational force was so weak that only a huge collection of mass would exert enough of it to measurably curve spacetime. That would require a sun or star. Since the observer and his instruments would never be on the surface of the sun or a star, **Einstein** assumed **that the local** spacetime **of the observer would not be curved.**

Hence he severely crippled his general relativity theory. In the West, it remains an assumption to this day. It is not a universal assumption in the Soviet Union, however, since the Soviets have long since written — and developed in the laboratory—unrestricted general relativity with *local* spacetime curvature, and hence *local violation of conservation laws.*

So the scalar part of the quaternion interaction, that remains when the vector part of the resultant is zero, is magic indeed.

That is the magic unified field portion that everyone has been seeking for decades and decades!

It was there at the beginning. Then we inexplicably threw it away!

But to return to our vector/quaternion examples.

Note also that the two vectors

$$V_j = ai + bj + ck,$$
$$v_2 = -ai - bj - ck \qquad (4\text{-}6)$$

sum to zero vectorially when added, such that

$$v_1 + v_2 = 0 \qquad (4\text{-}7)$$

However, quaternions may behave quite differently, even under addition. For example, the two quaternions

$$q_1 = w + a\,i + b\,j + c\,k,$$
$$q_2 = w - a\,i - b\,j - c\,k \qquad (4\text{-}8)$$

sum their vector parts to a vector zero resultant, but do not sum to a scalar zero as well. Instead, they sum to

$$q_1 + q_2 = 2w \qquad (4\text{-}9)$$

AS can be seen, quaternions which have the same vector parts as vectors, do not necessarily yield a complete zero when the vector parts sum to zero. And when two vectors multiply to provide a zero vector resultant, corresponding quaternions may yield a scalar term that is equal to the product of the magnitudes of the two vectors. In this way, the quaternion approach can capture the *stress of the medium,* induced by opposing or multiplying vectors. In the vector approach, the stress of the medium is entirely lost when the two vectors sum or multiply to a zero resultant.

Let us see just how important this "vacuum stress" can be.

First, the "stress in the medium" represents curvature of spacetime when that medium is the vacuum/spacetime.

In other words, the quaternion approach captures the ability to utilize electromagnetics and produce local curvature of spacetime, in an engineering fashion. Heaviside wrote a subset of Maxwell's theory where this capability is excluded.*

*Dr. Henry Monteith has independently discovered that Maxwell's original quaternion theory was a unified field theory. See his important "Dynamic Gravity and Electromagnetic Processes," in publication

Note that, by Maxwell's original quaternion theory, however, Einstein's assumption need not be true at all. For example, look at equations (4-5) and (4-9): Here we may utilize electromagnetic force quaternions to produce zeroed EM forces, and an increased stress in local spacetime. In other words, we have curved local spacetime electromagnetically. Since (with electrons) electromagnetic forces are about 10^{42} times as strong as the gravitation force, this local curvature of spacetime is not negligible.

That is, we have produced a scalar effect from zeroing vector operation between electromagnetic forces. I have called this **scalar electromagnetics,** and pointed out that it is truly *electrogravitation.*

We stress again that this violates one of the severely limiting assumptions that Einstein placed upon his theory of general relativity. He assumed that curving spacetime could only be done by the weak gravitational force due to mass. Since gravitational force is so weak, only a stupendous collection of mass — such as the sun or a star — could curve spacetime enough to notice experimentally.

Since obviously the observer and his laboratory instruments would never be located on the surface of the sun or a star, *Einstein assumed that the local spacetime would never be curved!* In other words, the local frame would always be a Lorentz frame. This meant that, locally, the familiar conservation laws of physics would always apply. Curvature of spacetime would only occur at great distances, and at huge collections of mass such as a star or dwarf star.

Einstein did not write a complete, unlimited general relativity. He wrote a sort of "special relativity with distant perturbations."

If Einstein had had electromagnetic theory in quaternions, the scalar "vacuum pressure" parts would have been there for him to ponder. It is highly probable that he would have captured the "electromagnetics-to-gravity conversion remainder" in the quaternion interactions.

If so, he would have written the full theory of general relativity, involving local violation of conservation of energy, a unified field theory, and the direct engineering of

gravitational and antigravity effects on the laboratory bench by electromagnetic means.

In that case, we should long since have navigated all around the solar system, colonized the planets, produced practical free energy devices and power systems, and avoided two great world wars and a host of little ones.

But let us now see if we can make a gravitational wave, electromagnetically.

Again, regard equations (4-5) and (4-9). Suppose these are instantaneous operations of EM force quaternions whose vector parts are varying in magnitude, but in such a manner that the vector parts ways form a zero vector resultant. Now one can see that the scalar part remaining — which represents the stress of local spacetime - is varying as the product of the magnitudes of the vectors in the interaction vary.

This means that one has now produced a scalar wave that represents the local variation of spacetime curvature in an oscillating manner.

Rigorously this is a gravitational wave. It has been produced locally. It has been produced by Maxwell's original unified theory.

Again, I have called this area *scalar electromagnetics*. The Soviets call it *energetics*.

Where local spacetime curvature is varied, conservation laws (energy, conversation, etc.) need not hold. Curved one way, the local spacetime acts as a source (of energy, charge, etc.) Curved the other way, the local spacetime acts as a sink (of energy, charge, etc.)

The Soviets often do not utilize the same restricted kind of general relativity that Western scientists adhere to.

Soviet papers in general relativity regularly point out the complete and unrestricted theory, where local spacetime curvature is allowed. They also point out that all conservation laws may be violated by such local curvature. Thus the Soviets have no unduly dogmatic respect for conservation laws.

Further, by assuming the possibility of local spacetime curvature, Soviet scientists have assumed the possibility of direct experi-

mentation with general relativity on the laboratory bench.

In the West, we have assumed that such cannot possibly be done, because of Einstein's limiting assumption of no local spacetime curvature. Thus Western physicists are strongly conditioned away from electrogravitation.

This is particularly ironic since the basis for just such an experimental theory was produced by none other than Maxwell himself in his original theory of electromagnetism.

Indeed, shortly after the U.S. Civil War, we should have been developing antigravity spaceships. We should have developed electromagnetics a la Maxwell and been on our way to the planets of our solar system. For Maxwell had — admittedly somewhat unwittingly — given us the basis for the necessary engineering theory of unified electrogravitation.

Heaviside's Mutilation of Maxwell's Theory

Well after Maxwell's death,Oliver Heaviside helped to finalize what is today vector analysis.

Then he undertook to "translate" Maxwell's theory from quaternion form to the new vector mathematics form.

Now quaternions were devilishly difficult to calculate in. So much so, that a majority of the electrical scientists (there were not very many of them in those days!) were in despair.

Not to worry! Heaviside took a broadax, figuratively speaking, and simply chopped off the scalar term, leaving only the vector components.

With that artifice, he greatly simplified the calculations to be performed.

Of course, he also threw away the EM stress of spacetime! That is, he threw away the "gravitation" part of Maxwell's theory!

Let me stress this fact most strongly. **After Maxwell's death a single** man**—Oliver Heaviside—directly altered Maxwell's equations, eliminating localized electrogravitation and producing the form of the theory taught throughout the West today as "Maxwell's theory."**

Maxwell's theory has never been taught in Western universities! Only Heaviside's crippled subset of the theory has been taught!

Then, shortly before the turn of the century, a short, sharp "debate" erupted in a few journals — mostly in the journal Nature. Only about 30 scientists took part in the "debate."

It wasn't really much of a debate! The vectorists simply steamrolled right over the remaining quaternionists, sweeping all opposition before them.

They simply threw out the remaining vestiges of Maxwell's quaternion theory, and completely adopted Heaviside's interpretation

Thus, a little over a decade later when Einstein wrote his general relativity theory, he did not know that the original work of Maxwell already indicated the unification of gravitation and electromagnetics, and indicated the ease with which local spacetime could be electrogravitationally curved locally and *engineered.*

Accordingly, he placed the scientists of the West on a road which rigorously assumed that a unified field theory was yet to be discovered. It also strongly discouraged any experimentation aimed at curving local spacetime, for it assumed that such could not be done.

After Potsdam and World War II, a frustrated Stalin was to drive his scientists to review the entire scientific literature of the Western world, actively seeking a great new technical breakthrough area such as the Allies had demonstrated with the development and use of the atomic bomb.

Great Soviet institutes — one staffed, for example, with over 2,000 PhD's — were set up to thoroughly review all the Western scientific literature from its very beginning. Anything interesting, anomalous, or unknown was put aside for further examination.

It is a good bet that the meticulous Soviet scientists discovered the difference between Maxwell's original electromagnetic theory and Heaviside's mutilation of it. Great mathematicians that they are, Soviet scientists would have realized the implications of the difference. With their knowledge of unlimited general relativity, they would have made the connection to electrogravitation.

By 1950 they had indeed done so, and were deeply into the development of what they called "energetics", and I have called

scalar electromagnetics.

They had also reached another milestone about the same time — 1950 or so.

After WWII, both the Soviets and the U.S. were keen on securing the best of the German scientists. The U.S. particularly wanted missile scientists and rocket engineers. The Soviets wanted them too; but they also wanted the German radar specialists and infrared specialists.

The West didn't care about the German radar scientists and engineers, and the IR fellows. The Soviets did, and they got them. That was to prove a most spectacular benefit indeed.

During the war, the Germans had placed extreme emphasis upon radar and radar absorbing materials (RAM). The German scientists had fantastically developed and extended the science of radar cross section — which is the heart of the matter and very, very complex. **They were much further ahead in radar cross section theory at the end of WWII than where the U.S. is today, in the opinion of** some **U.S. radar experts.**

So the Soviets started with a great jump on us in radar knowledge, and they have steadily increased the lead over the years.

In addition, the Germans had developed highly successful radar absorbing materials, and much of the theory to accompany them.

Such materials turn out to be the key to how to build and develop a radar phase conjugation mirror, to produce a time-reversed radar wave.

Thus, because of the German scientists, by 1950 or so the Soviets had already discovered phase conjugation. And they had discovered it in radar first, not in optics!

They would have been primed for the discovery by their great review of Western literature and the foundations of science, since they would probably have noticed that the time-reversed wave is a solution to the wave equation. If so, they would certainly have realized its generality throughout all physics, all frequency bands, and all types of waves.

Superb mathematicians that they are, the Soviets would certainly have made the Kaluza-Klein theory connection, and also

realized that phase conjugate waves carry negative energy as well as negative time. They would quickly have seen the gravity and antigravity implications.

So about 1950 or so, the Soviet Union would have started phenomenology experimentation in earnest, with phase conjugate radar mirrors and phase conjugate radars. This is what was referred to as *energetics.* The Soviets began a massive program in energetics about the time of the beginning of the Korean War.

By 1957-8 the Soviets had progressed to the point of a giant scalar EM accident in the Urals which exploded nearby atomic wastes, devastating the area. They had also progressed to development of great new superweapons using their new energetics — weapons to which Khrushchev referred in 1960 when he informed the Soviet Presidium of a new, fantastic weapon in development, a weapon "so powerful that it could wipe out all life on earth if unrestrainedly employed."

About the same time (mid-to-late 50's), the Soviets had also started the eery low-level microwave radiation of the U.S. Embassy in MOSCOW, to see if the U.S. knew of scalar electromagnetics (energetics) and was developing its own electrogravitational weapons and defenses.

Building Upon Whittaker's Fundamental Work

In 1904, a most fundamental paper in the foundations of electromagnetics was delivered by the British mathematician E. T. Whittaker. (E. T. Whittaker, "On an expression of the electromagnetic field due to electrons by means of two scalar potential functions," Proc. Lond. Math. Soc., Series 2, Vol. 1, 1904, p. 367-372.).

In this important paper, Whittaker showed that the electromagnetic force field equations can be replaced with the derivates of two scalar potential functions.

He also derived the most general form of electromagnetic disturbances in the ether.

This means that the coupling of two dynamic scalar functions can replace vector electromagnetics in the vacuum.

Note that Whittaker's work pointing out the overriding importance of scalar fields also accents the erroneously discarded scalar

part of Maxwell's quaternion electromagnetic theory even more strongly.

Let me explain now how I got from Whittaker's paper to scalar electromagnetics, Soviet Tesla weapons, free energy, antigravity, and electromagnetic healing.

When I discovered Whittaker's paper, I had already strongly objected that "charges" and electromagnetic vector force fields — as presently included in the Heaviside version of Maxwell's equations — included observable mass. Of course there was no observable mass in the vacuum, hence the prescribed kind of EM force fields could not exist as such in the vacuum.

Obviously the foundations of our ordinary electromagnetics theory were seriously flawed. Although my objections fell on deaf ears, I determined to examine the foundations of EM theory, discover the flaws, and at least point out the necessary corrections to be made.

Though this was an arduous task to undertake and it required many years, slowly the flaws showed themselves, and the necessary corrections slowly became clearer.

Most exciting of all, in working with several unorthodox researchers, I was able to see many of these new ideas tried, adjusted, and demonstrated. In addition, the proprietary discoveries of these colleagues continued to reveal new and unique principles and concepts. The only disadvantage was that I could not reveal the propriety apparatuses and demonstrations of my inventor associates, but only the principles and concepts that developed. In turn, I also developed principles and concepts to explain what they were doing and the results they were obtaining.

So over the years I have slowly been releasing the principles and concepts. Some of them are my own discoveries, many of them are the discoveries of my associates. Some of them are simply a mixture of both.

Early on, it became obvious that the Soviet Union was far ahead on this path, and was already utilizing the new unified field theory to build eery, powerful new superweapons.

Since no one else in the U.S. seemed to be "watching thin particular store" (I was rather universally regarded as some pecu-

liar sort of fool!), I also began to compile information and data on the Soviet weaponization of this unrecognized technology. This information I have released in a series of papers, briefings, and books, the most recent being a 1-hour videotape, "Soviet Weather Engineering Over North America," 1985, and a detailed book, Fer-de-Lance: A Briefing on Soviet Scalar Electromagnetic Weapons, Tesla Book Co., Greenville, Texas, 1986.

Building upon Whittaker's important work, I formulated a conceptual revision to electromagnetics, which I dubbed *scalar* electromagnetics to accent that the observable EM vector force fields did not exist as such in vacuum, but dynamic scalar fields did. I also wished to call strong attention to the fact that observable force does not exist until an observable particle of mass is coupled to the interference of the two scalar fields (much like in the Aharonov-Bohm effect). The Soviets, of course, call this area *energetics*, Energetics technology has been used in gigantic weapons programs of the Soviet Union for decades, and it appears to be developed under the most highly classified program that the Soviet possess. All development and deployment of energetics weapons is under the KGB and controlled directly by that organization, not by the Soviet Armed Forces.

Peter Kapitsa, the great Soviet physicist, was once pressed by Nikita Khrushchev for a total defense against missiles and air- and space-borne vehicles. Kapitsa replied that it could only come from the new energetics. In 1960, of course, Khrushchev gleefully announced to the Presidium that a new, fantastic Soviet weapon was in the development, "so powerful that, if unrestrainedly used, it could wipe out all life on earth."

Ironically, Khrushchev "jumped the gun" before his new superweapons were deployed. In the fall of 1962 he began inserting long range missiles into Cuba, bracketing the U.S. with nuclear firepower in an attempt to immediately change the balance of power. Kennedy, of course, backed him down "eyeball to eyeball," so to speak, in a blunt confrontation, but promised not to invade Cuba.

Khrushchev, with his days numbered, was desperate to deploy his new superweapons and provide a dramatic demonstration to recover face.

By destroying the U.S.S. Thresher on April 10,1963 and, on the next day, producing a gigantic underwater explosion 100 miles north of Puerto Rico, the Soviets demonstrated that the new superweapons had been deployed. Khrushchev managed to retain his position a while longer.

In the 1960's and early 1970's, I was also deeply involved in the study of paranormal phenomena.

In 1969, I entered the Georgia Institute of Technology to pursue a Master's Degree program in nuclear engineering, graduating in 1971.

In 1973, I published a rather simple paper, "Quiton/Perceptron Physics: A Theory of Existence, Perception, and Physical Phenomena," in which I pointed out the nature of quantum change, gave a new definition of mass and acceleration, and pointed out the fundamental nature of inversion of time. The paper also contained a simplified derivation of Newton's laws of motion, relativistic form. The elements of this paper had been worked out in 1971 while I was finishing my Master's program in nuclear engineering. Finishing the work had been interrupted by a slight sidetrack — a tour in Vietnam from summer of 1971 until summer 1972.

At about the same time, I formulated a fundamental correction to Aristotle's logic, adding a fourth law of logic to Aristotle's three, and a proof of it. The new logic was of great use in discovering and uncovering new concepts in unified field theory.

Incorporating Kaluza-Klein 5-dimensional concepts, scalar EM became a field theory that unifies electromagnetics and gravitation.

Incorporating dynamic sum-zeroed EM vector systems (which are discarded in normal EM theory) allowed the direct engineering of the unified field theory, including structuring the vacuum, curving local spacetime, and producing effects at a distance and in higher dimensions. Actually it allowed the recovery of much of the scalar part of Maxwell's original theory.

I then realized that, inside a vector zero EM force field summation/multiplication, the virtual particle flux of vacuum/spacetime was ordered and controlled locally and macroscopically. This of course violated one of the major assumptions (a postulate) of quantum mechanics; the assumption that the structure of vacuum was

randomized, and could not be deliberately ordered, engineered, and curved locally.

Adding phase conjugation (time reversal) aspects and extended quantum mechanical concepts allowed local antigravity and local curvature of spacetime to be included — again, on an engineering basis. It also allowed one to produce a mechanism responsible for Newton's third law, and to engineer the reaction force at will.

Further, it revealed that the law of entropy was simply the *positive time* statement; it showed that there was another half of the law, the *negative time* part or the law of negentropy.

In addition, a startling new concept of mind, thought, life, biofields, disease, and healing emerged from all this — again, on an engineering basis. As we stated in the beginning of this book, it is now an urgent necessity to release my work on the basis for electromagnetic disease and electromagnetic healing. We must produce a very quick, positive treatment and cure of AIDS and other coming lethal viruses before the world is decimated.

Accordingly, this work is being released in this book.

In this chapter we will next present some perhaps surprising material on phase conjugation, from the scalar EM viewpoint, after first briefly explaining symmetry and parity.

In following subsections, we will cover briefly the remaining major concepts in scalar electromagnetics. This will then set the stage for the following chapter, Extraordinary Biology, in which we will deal with the basis for unparalleled electromagnetic healing.

Symmetry and Parity

The basic idea of symmetry is the arrangement of the parts of a body or system about an axis so that two or more parts appear the same with respect to some operation.

The most obvious example is to look in a mirror, where we notice that our image has been reversed, left to right. Yet otherwise there is no difference; and so we may say that the reflection has "mirror symmetry." It's the same except that left and right are reversed.

If you know the details of a system at one point, and at another

point you know that the system will possess mirror symmetry, then you can predict exactly what state the system will be in at the latter point. It will be "left to right reversed." You don't have to calculate the laws of reflection and the laws of motion of the system.

All the laws of nature that possess "mirror symmetry" have a special property: If the words "right" and "left" are interchanged in the statement of the law, then the behavior of a system that obeys the law is unchanged.

Thus symmetry became a powerful idea in physics. For a system with a great number of possible interactions, etc., one can usually eliminate a very great number of them due to symmetry considerations. In other words, if one can assume that symmetry of the system will not be violated, then all the possible interactions that would yield "broken symmetry" can be eliminated.

On the other hand, if symmetry is broken in a physical interaction, at least one of the conservation laws is broken in that interaction. Broken symmetry — and hence violation of individual conservation laws — is a well-established fact in particle physics today.

Another concept intimately associated with mirror symmetry is parity. Each particle is assigned a number (+1 or -1), depending upon what kind of particle it is. One adds up these numbers for an assembly of particles, to obtain an overall "parity" number for the system. If parity is conserved in an interaction, then this total number does not change in the interaction.

Table 13. SYMMETRY

- **SOMETHING IS SYMMETRIC IF IT REMAINS UNCHANGED UNDER A CERTAIN OPERATION**
- **A SPHERE IS SYMMETRIC WITH RESPECT TO ROTATION ABOUT ITS CENTER**
- **A CATHEDRAL ARCH IS LEFT AND RIGHT SYMMETRIC ABOUT A VERTICAL LINE THROUGH THE CENTER**
- **LAWS OF ELECTRICITY ARE SYMMETRIC WITH RESPECT TO REVERSAL OF POSITIVE AND NEGATIVE CHARGE**

Table 14. A FORCE FIELD IS A SPECIAL LOCAL SYMMETRY

".. THE FORCE OF GRAVITY IS SIMPLY A MANIFESTATION OF AN ABSTRACT SYMMETRY — A LOCAL GAUGE SYMMETRY — THAT UNDERLIES THE PHYSICS OF THE WORLD."

"ALL FOUR FORCES OF NATURE CAN BE GENERATED IN THIS WAY."

PAUL DAVIES, SUPERFORCE.
1984, p. 115

Table 15. GRAVITY AND LOCAL SYMMETRY

- **THE** LAWS OF PHYSICS CAN BE MADE SYMMETRIC EVEN UNDER LOCAL GAUGE TRANSFORMATIONS

- A GRAVITATIONAL FIELD IS INTRODUCED TO COMPENSATE FOR PLACE-TO-PLACE VARIATIONS

- THE GRAVITATIONAL FIELD IS NATURE'S WAY OF MAINTAINING A LOCAL GAUGE SYMMETRY

- IN THE ABSENCE OF GRAVITY, THERE IS ONLY GLOBAL SYMMETRY

Table 16. HINDSIGHT IS BETTER THAN FORESIGHT

- **FROM THE TWIN REQUIREMENTS OF**
  - **SIMPLEST LOCAL GAUGE SYMMETRY**
  - **LORENTZ-POINCARE SYMMETRY OF SPECIAL RELATIVITY**

- **ONE CAN CONSTRUCT OR INFER**
  - **MAXWELL'S EQUATIONS**
  - **ALL THE LAWS OF ELECTROMAGNETICS**
  - **THE EXISTENCE OF RADIO WAVES**
  - **THE POSSIBILITY OF MOTORS AND GENERATORS**
  - **ETC.**

- **IN REALITY THESE WERE FIRST DISCOVERED EXPERIMENTALLY**

Table 17. WHEN SYMMETRY IS VIOLATED [BROKEN]:

- **A "NON-OBSERVABLE" TURNS OUT TO BE AN OBSERVABLE**
- **AN INVARIANCE IS BROKEN**
- **A CONSERVATION LAW OR SELECTION RULE IS BROKEN**

COMMENTS:

- **A VIRTUAL OBJECT BECOMES AN OBSERVABLE OBJECT**
- **LOCAL SPACETIME BECOMES CURVED, AT LEAST TO SOME POTENTIAL INVOLVING THAT OBJECT**

Table 18. SOME PROVEN ASYMMETRIES

- **POSITIVE AND NEGATIVE SIGNS OF ELECTRIC CHARGE**
- **TIME REVERSAL**
- **RIGHT/LEFT HANDEDNESS**

Table 19. SPONTANEOUS SYMMETRY BREAKING

PRESENT VIEW

1. IF 4-MOMENTUM $K\mu = 0$,

   $Ø_{(X)} = Ø_{VAC}$

   WHERE $Ø_{(X)}$ IS AS COMPLEX
   AS ANY SPIN-0 FIELD
2. **FOR** VOLUME Ω » RELEVANT MICRODIMENSION.

   $K\mu \neq 0$ BUT $K_M \sim 0$

   $\langle Ø_{(X)} \rangle \neq Ø_{VAC}$ [INSIDE *Q]*

   $\langle Ø_{(X)} \rangle \neq Ø_{VAC}$ [OUTSIDE Q]
3. INSIDE Ω, SYMMETRY PROPERTIES DIFFER
   FROM THOSE OUTSIDE Ω
4. T. P AND CP MAY BE SLIGHTLY ASYMMETRIC
5. CPT REMAINS INTACT

SCALAR EM VIEW

1. IF ARTIFICIAL POTENTIAL $Ø_{ART} >> 0$, VOLUME Ω
   MAY BE SMALL
2. $Ø_{ART}$ MAY BE ENGINEERED IN
   - SPATIAL SIZE
   - LOCATION
   - MAGNITUDE
   - SUBSTRUCTURE
3. SYMMETRY PROPERTIES INSIDE Ω MAY
   - DRASTICALLY DIFFER
   - BE DELIBERATELY ENGINEERED
   - BE PATTERNED
4. T, P, AND CP MAY BE APPRECIABLY ASYMMETRIC
5. CPT MAY BE ASYMMETRIC

Table 20. WHY SUCH DRASTIC DIFFERENCE?

IN PRESENT THEORY

$Ø_{(X)}$ • IS USED ONLY AS A PHENOMENOLOGICAL DESCRIPTION

- **MICROSCOPIC STRUCTURE OF $Ø_{(X)}$ OF NO CONCERN**
- **ONLY LONG-WAVELENGTH LIMIT OF FIELD IS OF INTEREST**
- **VACUUM ENGINEERING IS ONLY A REMOTE POSSIBLITY**
- **ACTION AT A DISTANCE IS NOT POSSIBLE**
- **LOCAL SPACETIME NOT CURVED**

IN SCALAR EM

$Ø_{ART}$ • REPRESENTS A LOCAL CURVATURE OF SPACETIME [LOCAL GENERAL RELATIVITY]

- **MICROSCOPIC STRUCTURE OF $Ø_{(X)}$ IS DETERMINISTIC AND COHERED INTO MACROSCOPIC STRUCTURE**
- **ALL WAVELENGTHS OF THE FIELD ARE OF INTEREST**

$Ø_{ART}$ WAVES ARE REAL, ENGINEERABLE AND ELECTROGRAVITATIONAL

- **VACUUM ENGINEERING IS A REALITY**
- **ACTION AT A DISTANCE IS POSSIBLE**

Table 21. ASPECTS OF STRONG LOCAL ASYMMETRY

- **PROPERTIES OF AN OBJECT MAY DIFFER APPRECIABLY FOR**
  - **DIFFERENT OBSERVERS**
  - **DIFFERENT DETECTING MEANS**
  - **ONE TIME TO ANOTHER**
  - **ONE POSITION TO ANOTHER**
- **CONVERSATION LAWS MAY BE APPRECIABLY VIOLATED**
  - **ENERGY**
  - **CHARGE**
  - **SPIN**
  - **MOMENTUM**
  - **ANGULAR MOMENTUM**
- **LOCAL SPACETIME IS CURVED**
- **LORENTZ INVARIANCE OF VACUUM IS VIOLATED**
- **MAY BE A LOCAL "SINK" OR "SOURCE "**
- **GRAVITATIONAL/INERTIAL EFFECTS FROM EM**
  - **TRANSLATION BETWEEN VIRTUAL AND OBSERVABLE**
- **ELECTROGRAVITATIONAL SOLITONS**
- **ACTION AT A DISTANCE**
  - **TRANSMUTATION EFFECTS MAY EXIST**
- **SCALAR/PSEUDOSCALAR FIELD TRANSLATION**

For years the idea of conservation of parity convinced physicists that it would never be possible to tell right from left in the universe, Then in 1956, Yang and Lee pointed out a class of reactions where parity need not be conserved. This effect — broken parity — was confirmed experimentally, and so certain parts and interactions of the universe do possess asymmetry.

The result of all this was that particle physicists established that

(1) symmetry can be, and is, sometimes broken, (2) individual conservation laws can be, and sometimes are, broken.

Particle physics, however, concerns itself primarily with microscopic interactions. Most of the delightful new things discovered in the microworld have not yet been applied — by *physicists,* that is — in the macroworld.

If you can successfully apply broken symmetry in a major system, for example, you should be able to violate the conservation of energy law and thus produce a "free energy" engine. Several inventors with whom I work have done precisely that. The techniques and technology are still primitive and they need much further development, but the principle has been clearly established and replicated.

Physics is correct in certifying broken symmetry, and you can do it in large systems as well as in microscopic particle interactions. Of course you also *curve local spacetime* as well, something which Einstein and his followers have assumed cannot be done.

Charge-Parity-Time ***and Negative Energy***

The upshot of all this is that the physicists came up with the idea that what is really conserved is a consolidated thing called Charge-Parity-Time. You don't have to conserve any one or two of these three, but only the combined product.

Here they overlooked one key factor that is very important to our thesis: In the photon interaction, if you reverse charge and time, you reverse the sign of the energy.

That is, a photon that is emitted from a positive charge carries negative time negative energy. It is different from a photon that is emitted from negative charge, for that one carries what we have conventionally established as positive energy.

Thus physics has not considered the exclusive use of negative-energy / negative-time photons, even when some of its interactions produced them. Instead, it has just lumped together photons and antiphotons, and considered them both to have positive energy.

Antimatter systems don't have positive energy, for example; they have negative energy. *Here we don't use the positive and negative signs to indicate the direction the energy is traveling, but the fundamental kind, of energy that it is—time forward or time reversed.*

For example, consider the local conservation of energy. As conditoned, one almost always unconsciously thinks of the conservation *of positive* energy, without so stating. Yet one is perfectly free to build a system into which he inputs 100 joules of positive energy, and from which he outputs 300 joules of positive energy and 200 joules of negative energy!

For the real conservation law, that's the equivalent of putting in 100 joules of positive energy and outputting 100 joules of positive energy.

Now negative energy will run motors, light lamps, etc. —often much better than positive energy. It can be transmitted, transformed, stepped up or down in "voltage," rectified, received, etc. It can be translated into positive energy or vice versa.

Circuits run "cool" when using negative energy. If you short out a circuit of negative energy so that a violent discharge occurs, it produces cooling instead of heating, greatly lessening the danger of fire and destruction. If you mix negative energy onto a line that is carrying the same amount of positive energy, however, the two negate each other and there is suddenly "no power" on the system.

Think of what you were taught in simple arithmetic. You can take a zero — the absence of any single specific number — and replace it with any set of multiple numbers whose algebraic sum is zero. The presence of this special set of numbers you choose does not violate the condition that the zero means that you could not use just a single number.

Although zero is the absence of just a *single* thing, it can be the presence *of multiple* things.

The same thing works with energy. In the microworld, everything is fantastically energetic, and wildly fluctuating. For example, in a copper wire carrying a current of one ampere, wild momentary fluctuations at extremely high frequencies are occurring.

According to classical electrodynamics, the instantaneous current in a single one of these micro-micro fluctuations may reach thousands of amperes, and the instantaneous voltage may reach 10^{40} volts or more. As can be seen, the instantaneous energy and power are enormous. Yet outside the wire, we see a very placid and peaceful situation.

TIME IS NOT OBSERVABLE

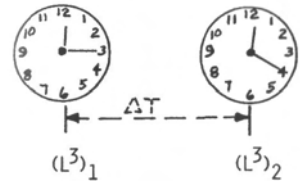

WHAT THEN IS TIME?

WHERE THEN DOES TIME EXIST?

Figure 33. The riddle of time. Unsolved by both physicists and philosophers.

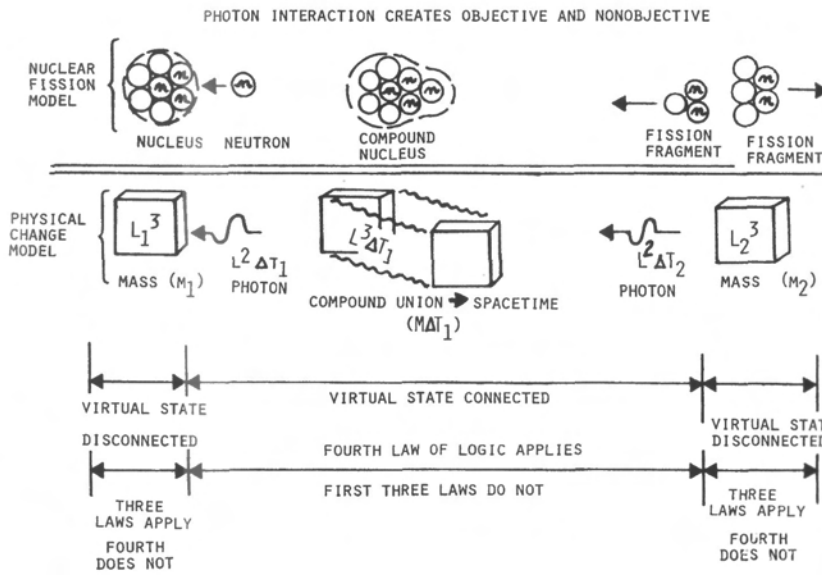

Figure 34. Raindrop model of physical change.

Table 22. FLOW OF TIME

- **PHOTON INTERACTION CONSTITUTES TIME CHANGE**

$\sim\!\!\rightarrow \langle$ NEGATIVE CHARGE $\rangle \rightarrow + \Delta T$

$\sim\!\!\rightarrow \langle$ POSITIVE CHARGE $\rangle \rightarrow - \Delta T$

- **CHARGE-PARITY-TIME [CPT]**

$\sim\!\!\rightarrow \langle e \rangle \rightarrow + \Delta T$ **(note: ~ = photon)**

  - **UBIQUITOUS**
  - **PREDOMINANT**

- **ANTIPHOTON IS A PHASE CONJUGATE REPLICA**

Table 23. PHYSICAL CHANGE

- **COMPOSED OF ACTION**
  - **h = BASIC QUANTUM**
- **TWO CANONICAL VARIABLES**
  - **ENERGY/TIME (dE dt)**
  - **MOMENTUM/LENGTH (p L)**
    ETC.

- **ENERGY/TIME**
  - **h = (+ E) (+ t)**
  - **h = (- E) (- t)**

Free Energy and Antigravity

Let's say the current flowing in the wire is alternating current at a frequency of one megahertz. Let's say we have one watt of power in the wire (there's one volt on it, and one ampere of flowing current). As a working rule-of thumb for engineering use, the available absolute micropower in an alternating current in a wire can be taken as:

$$P_a = 40 \times f \times P_c \qquad (4\text{-}10)$$

where P_a is the absolute power available, in watts; f is the frequency in Hertz; P_c is the conventional power available, in watts; and 40 is a constant of proportionality.

In our example, the absolute power actually available in the current is 40 million watts! We've got about 20 megawatts of positive power, and about 20 megawatts of negative power, in there — *in the microstructure of the electrical current itself--but disintegrated*

By applying unconventional scalar EM engineering techniques, we ought to be able to take such an "input" (a straight wire with one watt of power at a frequency of a megahertz) and get an "output" of up to 40 megawatts. It is relatively straightforward to get out 1 megawatt; such ratios have actually been achieved on the laboratory bench by my associates.

Of course we will have curved the local spacetime to do such a thing. But it is absolutely permitted to do that, by the laws of nature as best we know them from particle physics.

It is also possible to do that by Maxwell's original theory. And it has been proven in the laboratory.

Table 24. NEGATIVE ENERGY

- **CAN BE**
  - **GENERATED**
  - **TRANSMITTED**
  - **TRANSFORMED**
  - **RECTIFIED**
  - **RADIATED**
  - **TRANSLATED**
- **EASILY POWERS**
  - **AC MOTORS**
  - **DC MOTORS**
  - **LAMPS**
  - **TRANSFORMERS**
  - **RECTIFIERS**
- **CIRCUITS STAY COOL**

In scalar electromagnetics, we deliberately seek to produce such effects and systems by nonclassical application and extension of the modern conservation law CPT. And we include negative energy/ negative time production in those systems and effects.

Here's the extended magic rule: First we write down the expression **CPTEGS.**

In this expression, C stands for charge, P stands for (space) parity, T stands for time, E stands for energy, G stands for gravity,

and S stands for entropy.

We are referring here to the algebraic sign of each term, and to a complete photon interaction (absorption and re-radiation) with a charged particle inside an atom of matter. Specifically, we are refferringto the result, after the reaction has occurred.

Normally the photon interacts with one of the electrons in the atom's outer shell. This interaction with the negative electron charge *produces* the "normal" physical world/physical reality we see around us. In the interaction, normal parityis produced, andnormal gravitation (attraction of mass) is produced. Also, in a series of such interactions, the normal entropy (movement from order to disorder) is txperienced and produced.

So in the expression CPTEGS normally the charge term is negative, and every other term is positive, for the complete photon interaction in an atom.

Now here is the magic engineering rule: In the complete photon interaction with a charged particle in an atom, if one of these terms is reversed in algebraic sign, all the others will be reversed also.

For example, if the photon interacts with the positively charged nucleus,then parity is reversed, the bit of time-advance is reversed, a negative/time-reversed photon is emitted, a tiny bit of antigravity is produced in the nucleus, and negentropy is produced. By negentropy, we mean that the emitted photon exhibits the strange characteristics of time reversal, and hence it will return from disorder to order.

This rule is actually a statement of phase conjugation and time reversed waves, as we shall see later.

For example, using the rule, the production of antigravity is straightforward. Simply produce a great excess of negative energy and negative time in an object or generator by scalar photon interaction with the nucleus, at a sufficient rate.

In negative time, gravitational force is reversed. Thus in negative time gravity is a repulsion, not an attraction. Production of excess negative time in the atomic nuclei of a system produces antigravity in that system. Period.*

***At 100 Hz about 500 negative watts/lb is required for flotation. At 1 GHz, the effect is so *weak it cannot be measured, and no amount of power will float* the mirror.**

Let me amplify that statement. There are two kinds of energy, negative and positive. Normally, everyone thinks only of positive energy.

Take Einstein's formula for the amount of energy that's "bottled up" and stored in mass:

$$E = mc^2 \qquad (4\text{-}11)$$

That's positive energy and positive mass. It automatically implies that we are looking at things where time is forward-going.

Now suppose we "charge up" that mass with negative energy: Then the mass is negative, like this:

$$-E = (-m)c^2 \qquad (4\text{-}12)$$

And negative mass is repelled by positive mass. (Like mass G-charges attract, unlike mass G-charges repel.)

That's all there is to it! Simply charge up the protons/neutrons of the atomic nuclei of a mass with excess phase conjugate (negative) energy/time, and it exhibits antigravity compared to the earth. Nothing could be simpler.

Again, it's been done in the laboratory by an associate.

So, with respect to a negative energy/negative time generator, you just add more load and draw more negative power from the machine, forcing it to produce more. It produces more negative time, and hence more antigravity and more "repulsion." When the repulsion balances the earth's attraction, the system "floats in air." Draw still more power by adding still more load, and it accelerates upward. Draw less power by decreasing the load, and it sinks downward again. That's all there is to it.

We should have been working upon this, shortly after the U.S. Civil War.

Again, there exist two completely different kinds of electromagnetic energy: positive and negative. These have been totally and hopelessly confused by modern physics, even though physicists sometimes use these terms.

But in dealing with CPTEGS in the photon interaction in an

atom, we must clearly keep in mind what kind of energy we are dealing with.

The basic engineering rules are these: (1) If any one of the factors - C, P, T, E, G, or S — is reversed, all the others are reversed. (2) If positive charge is involved in the photon interaction, then time (carried by the emitted photon) is negative and so is the energy carried by it. (3) The simplest scalar EM wave may be considered as two EM waves locked together (modulating each other), where one component wave carries positive energy and time and the other component wave carries negative energy and time. (4) Separation of the two components by interaction with charged particles creates both positive and negative time and energy. (5) If the interacting particle is negatively charged, the positive energy/positive time component will interact with it. (6) If the interacting particle is positively charged, the negative energy/negative time component will interact with it. (7) The interacting particle phase conjugates (time reverses) the component with which it interacts. (8) The primary interaction with negative electron shells of atoms yields positive energy and positive time: constituting ordinary physical reality as we observe it. (9) The secondary interaction with the positive atomic nucleus produces phase conjugated (time-reversed) physical reality. (10) Secondary interaction (nuclear phase conjugation) normally produces Newton's third law of motion. (11) In Newton's third law, the reaction force need not be equal, and need not be antiparallel. Note, however, in such case local spacetime is curved. (12) The present law of entropy is only the positive-time half; the other (negative time) half is the negentropy law.

Phase Conjugation (Time Reversal)

It is a most remarkable fact that Soviet radar engineers and radar scientists are also trained in optics. While this seems little short of astonishing by Western standards, the Soviets have an exceedingly good reason: As a matter of course, most Soviet radar systems are also operable in, or associated with another system that is operable in, a time-reversed (phase conjugate) mode.

In this mode the radar and/or its associated system is also an

extremely powerful directed energy weapon, having capabilities undreamed of in the West.

A phase-conjugate (time-reversed) wave actually is a wave that travels backward through time.* That is, it is capable of precisely retracing the path through space, taken by another wave that traveled that path to a nonlinear mirror, stimulating the reflection of the time-reversed wave.

Further, in retracing its invisible path through space, the phase conjugate replica wave does not diverge as do normal waves. Instead, it continually converges upon its invisible trace.

Consequently all its energy arrives back at the distant source that emitted the stimulus wave originally. This was Tesla's original secret of his "wireless transmission of energy at a distance with no losses."**

It can easily be shown, however, that the phase conjugate wave is a legitimate solution to the wave equation. Hence it is a general property of all types of waves: sound, magnetohydrodynamic, etc. It is not confined just to the optical band.

Obviously such a startlingly different wave has phenomenal uses. Literally it ushers in a new physics.

Let us turn now to look at this strange wave that has emerged on our scientific horizon.

In the late 1960's, Soviet researchers cautiously pointed out the possibility of a time-reversed wave. Papers appeared in the open Soviet scientific literature, and shortly thereafter U.S. physicists began to read about it.

In 1972, Soviet scientists visited Lawrence Livermore Laboratory and specifically briefed U.S. scientists on the optical phase conjugation (OPC) phenomenon. Thereafter the effect became of increased interest to American scientists.

(Note, however, that phase conjugation (PC) is a major phenomenon of all physics. It is not confined merely to the optical spectrum, nor just to electromagnetic waves. Phase conjugation is a general phenomenon true of all waves, regardless of type. We will primarily discuss OPC, since most Western experimentation has

*The external positive-time observer sees this time reversal as length (space) reversal.

**The great electrician had actually discovered what today is known as phase conjugation or time reversal of EM waves.

been in the optics domain, and the literature is rich in that respect. However, we also point out that Western scientists have absolutely no inkling of the mechanism causing OPC. They have simply written a model for a time-reversed wave by taking the equation of a normal wave und writing the conjugation (adding an asterisk exponent) to the appropriate term, and pointed out that this new equation also satisfies Maxwell's wave equation. They also do not clearly recognize that an EM wave carries time and energy, and that a time-reversed EM wave carries negative energy and negative time. Further, they do not at all comprehend the startling implications for generating gravitational fields, including antigravity and inertial effects, directly on the laboratory bench.)

In optical phase conjugation, when an input EM wave (ordinary) enters a nonlinear medium, the medium "reflects" or produces a strange, time-reversed EM wave in response.

Figure (35a) shows the effect. In the figure, E1 is the normal input wave, entering a distorting, nonlinear medium (the "blob") as shown. Wave E_1 moves on through the blob, emerging on the other side and continuing, though now in distorted form.

The medium produces a second wave, E_2, which precisely retraces the steps of E_1 That is, everywhere E_1 is, E_2 now appears. The phases of the E_2 wave are precisely reversed from those of E_1 The only difference in the two waves is that wave E_1 carries positive time and positive energy, while wave E_2 carries negative time and negative energy.

(U.S. physicists are well aware of everything in the above statement except for the negative energy portion.) The historical background of the phase conjugate wave is given in Table 25.

(We strongly stress that the West did not discover the time-reversed wave; the Soviets did. At the time (late 1960's) this appeared in the open Soviet literature, the Soviets had already been using it for about two decades in their giant energetics (scalar electromagnetics) weapons development program.)

However, to return.

The time-reversed wave is called the phase conjugate replica of wave E_1. The overall characteristics of the phase conjugate replica E_2 are summarized in Table 26.

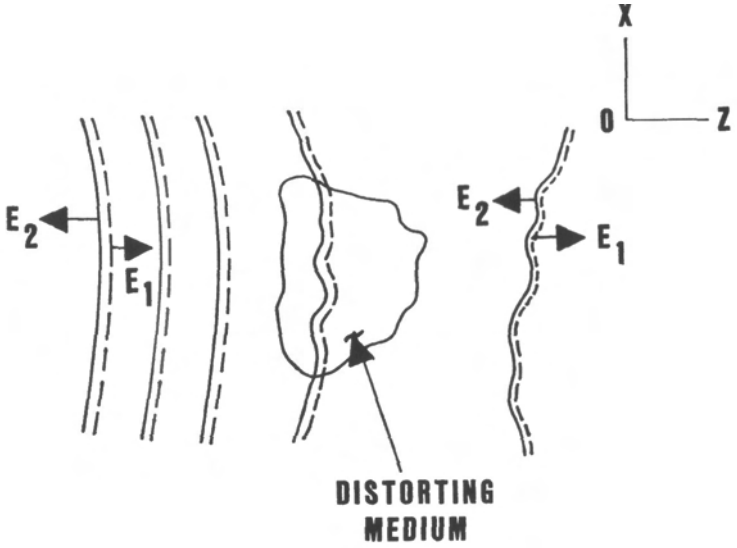

a. Phase conjugation by a nonlinear, distorting medium.

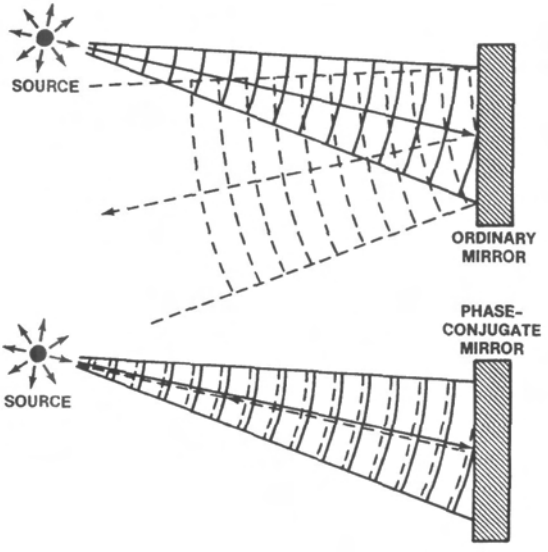

b. Ordinary mirror reflection versus phase conjugate mirror reflection.

Figure 35. Phase conjugate reflection of a time-reversed wave.

Table 28. PHASE CONJUGATE WAVES

- NONLINEAR OPTICS TRANSIENTS
  - DISCOVERED BY SOVIETS
  - LATE 60s-EARLY 70S
- **PRESENTLY** "HOT ITEM"
- INITIALLY THOUGHT RARE
- NOW KNOWN WIDESPREAD
- THIRD POWER OF E-FIELD
- S**TILL** MUCH UNEXPLORED

Table 26. PHASE CONJUGATE REPLICA

- TIME-REVERSED
- CARRIES NEGATIVE TIME
- CARRIES NEGATIVE ENERGY
- "HEALING" PROPERTY
- DISTORTION CORRECTION
- F**ROM** DISORDER TO ORDER
- **MAY** DWARF INPUT WAVE

Table 27. DISTORTION CORRECTION THEOREM

"If a scalar wave E_1 (r) propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z=0] its phase conjugate replica E_2 (r) , then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1."

We point out here that the basic nonlinearity (nonlinear medium) in spacetime is a single particle of mass. In a photon interaction with that particle of mass, the interacting (input) photon (positive energy, positive time) causes the generation and emission of a phase-conjugated (time-reversed) photon. This time-reversed photon provides the precise mechanism for generating Newton's third law: **For every action there is an opposite and equal reaction.** This will be covered later.

But back to our nonlinear medium, and the two waves E_1 and E_2.

E_1 and E_2 are "locked together" as a scalar EM wave unless something else is specially done to separate them. That is because the nonlinear medium is a *modulator,* and the two waves modulate each other (lock together as a single wave).

(We interrupt again to strongly point out this fact: This directly shows that all EM waves in vacuum exist as scalar EM waves, not as the so-called Maxwell-Hertz transverse waves of conventional theory. Nikola Tesla, the greatest electrical scientist the world ever produced, always adamantly insisted that EM waves were "sound" type waves, not "transverse" waves. For one thing, the vacuum-medium would have to be a solid to produce transverse waves! Tesla even visited Hertz in Europe and tried to convince him of the error of his so-called "proof of transverse EM waves." Tesla found Hertz, adamant on the subject, however, and returned without changing Hertz's mind. Ironically, Tesla was right and all the textbooks in **the** Western world have been consistently in error as to the nature of the EM wave in vacuum.)

We simply state here that, for a single-frequency EM sine wave in vacuum, a "full photon" of that wave in vacuum is actually a *single sine-wave oscillation.* The positive (positive energy, positive time) half of that sine wave is the same thing as a virtual electron (negative charge). The negative (negative energy, negative time) half of that sine wave is the same thing as a virtual positron — a virtual electron travelling backwards in time, or "time-reversed", which we detect as length-reversed and charge-reversed.

Further the vacuum — including the vacuum inside each relatively empty "mass structure" such as an atom or molecule — is **a** seething inferno of activity of virtual particle fluxes. It is upon that

mediumthat all physical reality and physical changes are impressed. Thus there is nothing static in the world; what actually exists is *switching of virtual particle fluxes.* What we call a "static thing" is only an equilibrium in this switching activity. And, once switched on, any stream continues until switched off or switched to change it.

For that reason, the full photon has always contained twice as much absolute energy as is provided by the presently used equation

$$E = hf \qquad (4\text{-}13)$$

Where E is energy, h is Planck's constant, and f is frequency.

One half the photon carries negative energy and negative time, while the other half carries positive energy and positive time. In the full photon interaction, one half of the photon interacts and "switches off" the stream. Thus the photon interaction makes a single change of action, energy x time, both switching on the beginning of the quantum change and switching off the ending of it.

The full photon in vacuum is, and has always been, a scalar EM photon. It rigorously is the presently accepted photon plus its directly "hooked on" and accompanying phase conjugated replica photon.

That is, in terms of the present physical view, the scalar electromagnetics view of a full photon in vacuum is that it consists of a photon and its antiphoton, directly combined in serial fashion. Further, this antiphoton part is not identical to the photon, since it is time- and energy-reversed.

The present physics makes no distinction between the two types of photons, hence makes no distinction between positive and negative photon energy. It also still considers "static" things to independently exist. It does not pursue the fact that all things appearing "static"are equilibrium states in nearly unbelievably intense virtual particle streams. Since it does not pursue that fact, it does not build a "switching" model for quantum change, not does it arrive at a method of directly engineering these "switching" operations.

For that reason, present physics has totally missed local general relativity and the engineering of spacetime curvature by electrogravitational methods, as was contained in

Maxwell's original theory.

For the same reason, present Western physics has not worked out the basic mechanism that produces phase conjugation, and it has not realized that all conservation laws can be locally violated with the new methods — methods actually hailing back to Maxwell's original theory!

Now returning again to our nonlinear medium and waves E_1 and E_2:

It is possible to separate (demodulate) wave E_2 from wave E_1 In that case, E_1 is an ordinary EM wave, carrying positive energy and positive time. E_2 is a phase conjugate replica, carrying negative energy and negative time.

Irradiation of an atom in a new sample of material with a normal EM wave such as E_1, just provides the normal photon interaction with the electron shells. That is, the electron part of the full photon adds to the orbital electron's energy state in positive time, raising the orbital electron to an "excited state." (Remember, this has switched on a continuous process of "keep raising the energy level of the electron" in positive time.) The "state-increasing" orbital electron then interacts with the second, positron-part of the full photon, which switches off the increasing, leaving the electron in its "static excited state." Simply put, one half of the full photon turns on an uplifting spray, and the second half of the full photon turns off the uplifting spray, leaving the electron in equilibrium state at a new level.*

Thus in orthodox physics we have taken the view that an electron in a shell absorbs a "photon" from the incident wave, taking extra energy and being raised into an excited energy state.

In the orthodox view, the excited-state electron then decays to release another ordinary photon (since it comes from a negative charge).

What actually happened was that, when the "full photon" of the incident wave is absorbed by the orbital electron, increase of the electron energy is switched on, then switched off, leaving the elec

*We state here a magnificient principle without proof. When one furnishes (inputs) electrical power to a system, all the "input work" is expended purely upon switching fields by fighting against them in brute-force fashion. E.g., electrical power furnished to an electric motor does **not** run the motor, but only continually wrestles the internal fields to switch them. Obviously, to build an over-unity device, one must get it to switch its own fields, at least a significant fraction of the time.

tron in equilibrium at a new energy level.

What happened in the middle was phase conjugation. In absorbing the first half of the incident full photon, the electron acted as a phase conjugate mirror (we will explain that term shortly). It emitted a forward-travelling phase conjugate replica (PCR) of that first photon half, and this conjugate replica entered the nucleus, where it is absorbed to cause the Newtonian reaction force. Note that this PCR emission by the electron does not generate recoil in the electron-PCM, as is well known in OPC theory and experiment.

The same type of phase conjugation happened when the state-increasing electron absorbed the second half of the incident full photon. It phase conjugated again, sending this half to the nucleus to acompany the former PCR half. In the nucleus, this second half switches off the increase in excited state of the nucleus that was engendered by absorption of the first half.

The photon interaction is a process for switching on and off a continuous rate of action increase or decrease.

At the conclusion of the full photon absorption, both the orbital electron and the nucleus are in excited states. The nucleus has increased its gravitational mass.

Then the situation precisely reverses. Both nucleus and electron decay, again emitting full photons and again phase conjugating.

The PCR photon emitted by the nucleus reduces the positive mass of the nucleus. The PCR photon emitted by the electron is reversed from the electron's absorption record, reducing the negative charge's energy state, and the electron is said to "decay" from its excited state. The PCR photon emitted by the electron now (to the observer) will appear to carry positive time and positive energy.

(In passing, we point out that, actually, the situation is far more complicated. Both the electron and the positively charged nucleus are enmeshed in continuous streams of virtual particle flux, including intense streams of virtual photons. One must go to n-wave mixing, where n is greater than 4, to fully understand the total reaction. The main points are, the Newtonian reaction forces within the atom are generated by phase conjugation, the photon emitted by the decay of an excited state electron will normally carry what we call positive energy and positive time, and the photon emitted by the decay of an excited state positive charge will normally carry what we

call negative energy and negative time. Full coverage of these interactions is beyond the scope of this book, and must wait for another effort in the future.).

Now once again we return to our simplified model of phase conjugation, and waves E_1 and E_2 in our nonlinear, modulating medium!

As we stated, we can engineer the situation so that the phase conjugate replica E_2 can be separated from E_1. A separated E_2, however, is a quite different breed of cat. It is a phase conjugate wave, carrying negative energy and negative time.

E_2 is a magic wave indeed!

Irradiation of the nucleus of an atom in a new sample of material with a phase conjugate replica such as E_2 causes the nucleus of the atom to interact in reverse of its normal interaction.* That is, one of the positive charges in the nucleus interacts with a photon resulting from wave E_2, and goes into an excited "negative energy" state. That state, in decaying, emits an ordinary virtual photon which promptly interacts with a virtual positive charge in the nucleus, which decays to emit the virtual photon, which interacts with another positive charge in the nucleus, etc.

In other words, the negative energy of the absorbed antiphoton is captured by the nucleus, and the nucleus overall does not *immediately* decay to discharge the negative energy.

Instead, the nucleus acts as an accumulator or capacitance, charging up and then discharging far more slowly than the normal photon/electron interaction.

(For the purist, the nucleus does phase conjugate the input negative energy/negative time wave, and phase conjugates it again — upon an electron in the electron shells, through spin coupling This second phase conjugate replica is now just a normal EM wave, and the electron exhibits a normal EM interaction. Thus **our** instruments (Which are electron wiggle detectors) detect a normal

*Irradiation of the nucleus with a PCR wave is easily accomplished by using ordinary magnetic resonance, and modulating the PCR wave upon the magnetic carrier, as Antoine Priore did.

EM wave detection and do not discriminate between photon and antiphoton halves of a full photon. For that reason, scientists have not clearly noticed the difference between positive and negative energy, and between photons and antiphotons. They have also not resolved the basic conflict between the particle and wave theories of electromagnetics. *Note that the full photon concept, where the full photon is a normal photon and phase conjugate replica of that photon hooked together into a single sine wave, resolves the long-standing wave-particle controversy.)*

In most of their instruments, present scientists are detecting a secondary normal EM wave for the phase conjugate replica interaction, since the phase conjugate interactions in the instrument are not sorted out, and since the instruments measure only one kind of PCR, that emitted by a negatively charged electron. Hence scientists think the antiphoton has positive energy, and interpret it in positive time. Consequently they tend to accent that the wave is "phase-reversed," and not accent the negative time/negative energy implications since they have not clearly sorted them out.

Let us return to our consideration of the irradiation of the nucleus of an atom (with an incident E_2 phase conjugate replica wave carrying negative energy and negative time, with respect to our electron-wiggle-detecting observer).

AS irradiation continues, the actual "structured charge pattern" existing on the incident E_2 wave slowly charges up the nucleus of the atom with that exact charge structure, in the negative energy/negative time state.

We shall find that most interesting fact of great utility when we later discuss the mind, thought, cellular control systems, and generating a specific electromagnetic phase conjugation pattern to reverse cellular disease.

We shall also find that it is of great interest in accomplishing antigravity when we use extremely low frequency PCR irradiation.

The Phase Conjugate Mirror

Any system which phase conjugates the input wave and returns a phase conjugate "reflection" is called a phase conjugate mirror, or PCM for short.

But the phase conjugate mirror has some very unique properties, as can be seen in figure 35b.

For example, if you look in a *normal* mirror, you see your own reflection. You see your shoes and legs, for example. Light from your shoe scatters across the mirror, and it hits one spot on the mirror which reflects it at the proper angle to strike your eye.

But that simply doesn't happen with *a phase conjugate* mirror! If you were looking into a phase conjugate mirror (PCM), the light that left your shoe and scattered across the mirror would be reflected right back to the shoe, since it would retrace the path taken by the previous light striking all across the PC mirror from the shoe. So all you would be able to see would be two black dots: the retinas of your eyes. Light reflecting off them and striking the PCM would be reflected back to the source — the retinas — so you could see that light and that light only.

This path reversal is most important to keep in mind. With a phase conjugate signal, you are not functioning with an ordinary signal. Further, it has a "precursor" path taken by the incident wave that stimulated its emission from the PCM. Unless interfered with, the PCR will trace back down the invisible vacuum trace of that incident wave, or back down its wave path, like electricity goes down a wire.

This, by the way, is the secret of Tesla's wireless transmission of energy at a distance with no losses.

When broadcast into space, a normal EM wave (positive time, positive energy) diverges or scatters from its path.

Precisely the opposite happens with a PCR wave. When broadcast (reflected) into space, the PCR wave continually converges back upon the invisible trace taken by its incident stimulus precursor. Thus all the PCR energy is continually converging upon an invisible beam or "wire" through the vacuum, back to the source of the original incident wave.*

If the PCR wave is highly amplified (and means to do this are now well-known), then large amounts of EM energy can be precisely

*One can effectively move the entire imprinted vacuum path, however, by adding an additional input vector wave computed so that the **resultant** input would have come from the desired shifted distant point. In this way the PCR can be steered in space to lead and intercept a distant moving target.

returned to distant points from which a stimulus wave of any kind is received.

If a micro-microwatt is received from a point thousands of miles distant, then a gigawatt can readily be returned precisely to that distant point.

This was Tesla's magic secret. The great electrician had discovered phase conjugation, though he did not use that term. He did, however, point out that he could create an invisible wire through space to a distant point, and could send any amount of energy to that distant point without any scattering losses along the way.

He also accomplished the same thing with sound waves and mechanical waves. He pointed out that he could produce an undiminished physical (mechanical) effect at any distant point, and could eventually split the earth if he added power long enough.

Tesla had given the principles of radar in World War I! He later even spoke of his "big eye that can see at a distance." Here he was probably referring to stimulating the emission of a PCR return from that target. The PCR would automatically correct for the distortion in the intervening medium, and fairly sharp pictures of the distant scene — without showing the size dispersion of distance — could probably be obtained. Note that a non-scattering signal to a distant observer does not make him suffer any loss in field or apparent size and detail of the scanned object, which can be recovered to any resolution, limited only by the state of the art of the physical realization technology.

The implications for far greater resolution microscopy— far heyond the present limitation to about 4,500 — should be immediately obvious. The implications of such a microscope - that can see directly inside atomic nuclei; photograph nuclei and fundamental particles directly; see living viruses, molecules, and atoms directly; and theoretically see even into the virtual state itself— should be immediately obvious.

In discovering phase conjugation, the Soviet Union was attempting to break Tesla's secret of wireless transmission of energy without losses, and the Soviet scientists did so by about 1950. They highly weaponized the effects of phase conjugation, phase conjugate mirrors, and amplified phase conjugate mirrors, both in radar waves,

mechanical waves, and sound waves, for nearly two decades. Then the Soviets cautiously stimulated the open literature with a limited paper on optical phase conjugation, to ascertain whether or not we realized the severe weapon implications of time-reversed waves, their production and use, and their amplification.

So phase conjugate mirrors can do very useful things. For example, look again at figure 35a. Suppose we are trying to photograph something on the other side of the distorting medium, say through a distorting gas, such as a turbulent atmosphere. In that case E_1 on the left is, say, light coming from an object on the left and passing through that distorting medium. If we just used ordinary waves in a camera on the right, we would see a very distorted wavefront, as represented by the distorted E_1.

However, if we illuminate the object by sending a wave through the distorting medium, and detect the *phase conjugate* signal that returns, it will have reversed the distortion when it gets to us, and we will get a clear picture. A very nice photo of just this process is contained in David M. Pepper, "Applications of Optical Phase Conjugation," **Scientific American,** 254 (1), Jan. 1986, p. 75.

Phase conjugation has many more uses than we have covered in this brief paper, of course, but this is an important use: the removal of distortion effects from optical systems.

It would, however, be nice to be able to amplify the effect. And so we can.

Amplifying the Phase Conjugate Effect

Let's look now at figure 36, where we will develop how to amplify the phase conjugate replica.

Be careful to notice that we are changing subscripts on you. By convention, optical scientists use A_1 and A_2 as two additional waves, called the *pump waves,* that are used to stress the nonlinear medium, and input signal wave A_4. Wave A_3 then is the stimulated PCM output, or the phase conjugate replica (PCR) wave.

In this figure we show a scheme for amplifying the phase conjugate signal that is generated and returned by the phase conjugate mirror (PCM).

We do this by adding two opposing waves of the same frequency

(in this simplified case). These are the two "pump waves", and impressing them upon the PCM is called "pumping" the PCM.

Actually, in producing the pump wave, we are adding two input waves of the same frequency, 180 degrees out of phase with each other. Since the nonlinear medium is a *modulating* medium, the waves are forced to modulate each other and "lock together" as a *single scalar* EM wave of most interesting characteristics. Indeed, its E fields sum to a zero resultant vectorially, and its B-fields sum to B zero resultant vectorially. However, the scalar parts remain and are multiplied together, as in the original Maxwell quaternion theory. Since the magnitudes of the vector components in the scalar summation (quaternion multiplication, since we are addressing modulation) are varying, then the magnitude of the remaining scalar part is varying. We have therefore produced a standing scalar wave in the nonlinear material medium, having zero vector EM gradient components. We have produced a purely scalar EM wave of pure potential — and this is an electrogravitational wave, rigorously, since it represents a time oscillation of the local energy density (local virtual particle flux density) of vacuum. This scalar EM wave passes through the electron shells and enters the nuclei, where it is phase decoupled by the extreme nonlinearity of the violent virtual particle currents of the nucleus. Its energy is then absorbed by the nucleus, raising it to an excited pseudopotential. This potential decays, returning the scalar EM stress wave into the local vacuum and area. We are now pumping the atomic nuclei of the nonlinear PCM material with our two pump waves, and we have created an oscillating local gravitational field around the PCM.

This increased nuclear G-potential, looked at in Kaluza-Klein theory, is a 5-space potential. It is ready to burst out in the 5th dimension (as electromagnetic bleedoff) at the slightest provocation. That provocation is the entrance and absorption of the input signal wave, E_4. Note that E_4 acts as an "initiator" (or a pinprick into a highly inflated balloon, if you will) on the built-up, excited 5-dimensional gravitational pseudopotential of the nuclei. The moment so initiated, the entire 5-space G-pseudopotential collapses, emitting a time-reversed phase conjugate replica (PCR) of E_4. This

emitted, highly amplified PCR is labelled E_3. It now "backtracks" down the invisible trace through space taken by the incident stimulus wave E_4, returning to the distant source that originally emitted

Voila! Tesla's wireless transmission of energy to a distant point without losses. *Voila!* The Soviet Launch Phase ABM system and the Soviet Launch Phase Anti-Bomber System, when used in conjunction with an over-the-horizon radar (such as the giant Wood-

Table 28. FOUR-WAVE MIXING

- **NONLINEAR MEDIUM**
- **OPPOSING PUMP WAVES**
  - **CROSS MODULATION**
  - **SCALAR WAVE**
  - **INTO NUCLEI**
- **TRANSMISSION WAVE**
- **REFLECTION WAVE**
- **REFLECTION GAIN**

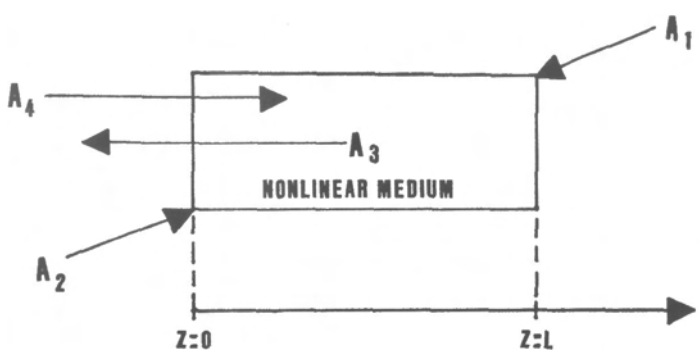

Figure 36. Phase conjugation by four-wave mixing.

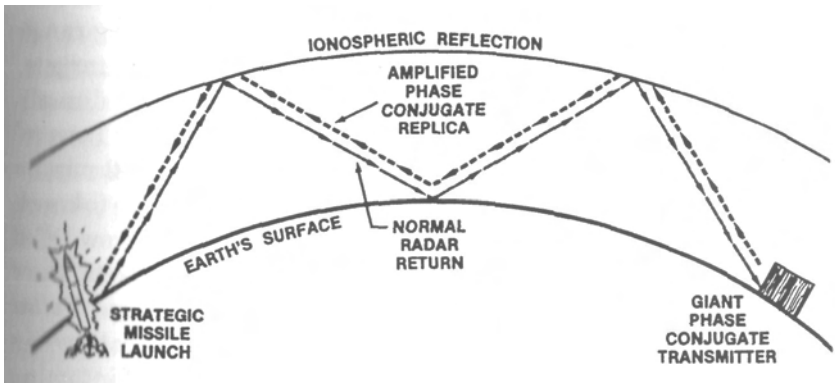

a. Soviet Launch-phase and midcourse ABM system.

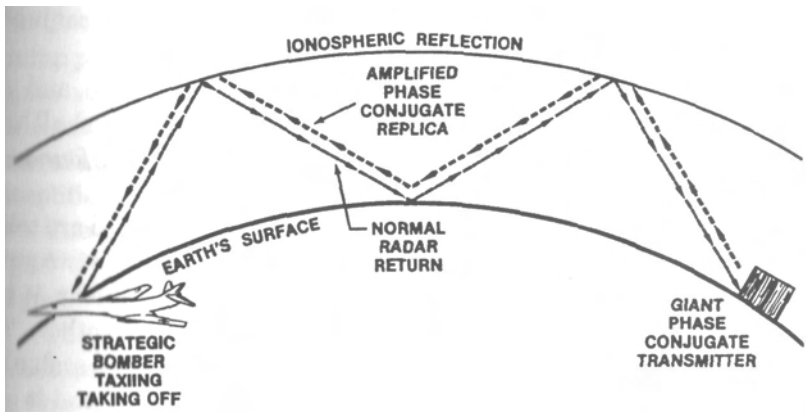

b. Soviet launch-phase and midcourse anti-bomber system.

Figure 37. Soviet launch-phase and midcourse strategic defense system.

peckers) to provide a reflection signal from a distant target. *Voila!* The true use of Soviet Stand-Off-Jammers to knock out enemy antiaircraft, air control, and anti-tactical missile radars wholesale. *Voila!* The Intermediate Phase ABM system, where a long range strategic radar is used to provide reflections from incoming targets. "Fire and fire again!" is the rule, and 100% defense is directly achievable. *Voila!* How the Soviets knocked down Gary Powers' high-flying U-2 reconnaissance aircraft. *Voila!* How SA-2 missile system radars were temporarily modified in North Vietnam to knock down several hot new F-111 aircraft. *Voila!* How the Arrow DC-8 aircraft, Titan missiles, Delta rocket, and Ariane rockets were "electromagnetically surged" from inside to destroy them. *Voila!* Why the Soviets almost never throw away old radars, since they can now add PCMs and make them formidable destroyers of incoming targets. *Voila!* How one solves the ABM problems of discrimination and weapon kill; simply pulse-fire everything — nuclear material explodes in a full nuclear explosion when struck with potential pulses of sufficient magnitude and duration.

Summarizing figure 36 and amplification ofthe phase conjugate replica:

When we consider the addition of the input wave and the resulting phase conjugate wave that will be produced, we shall have a total of four waves. Thus this particular process is called four-wave. *mixing.**

On the diagram in Figure 39, A_1 and A_2 by convention are taken to be the two opposing EM pump waves. Notice that these two pump waves stress the medium. Since the medium is nonlinear, it is a modulator. Hence the two pump waves modulate each other. The two waves thus lock together into a scalar EM wave. This scalar EM wave is an oscillating artificial scalar EM stress wave, and it goes directly into the atomic nuclei of the medium and pumps the nuclei themselves.

The atomic nuclei are now rhythmically stressed with the oscillating scalar wave.

*Probably the best single introduction to optical phase conjugation in the English language is David M. Pepper, "Nonlinear optical phase conjugation," **Optical Engineering,** 21(2),**Mar.**/ Apr. 1982, p. 156-183. Especially read Pepper's footnote on p. **166.**

We now input a weak signal (wave A_4) into the "pumped nuclei" medium.

By our CPTEGS rule, the positively- charged nuclei generate a negative energy/negative time wave — in short, a phase conjugate replica wave. Further, it is a highly amplified PCR, and may contain *as* much raw energy as was fed into the pumped mirror by our pump waves. This "seeker wave" or "electromagnetic missile" wave then sets out on its invisible path through space, seeking a distant "A_4 source point" and delivering all its energy intact to that point.

The Phase Conjugate Mirror as a Vacuum Triode

The pumped phase conjugate mirror (four wave mixing) can best be understood as a special kind of vacuum triode.

The pumped artificial potential on the atomic nucleus provides a powerful cathode in positive time, and a powerful plate as well in negative or reversed time. The electron shields, in their spin coupling to the nucleus, act as a grid in positive time. The input signal A_4 itself acts as a relatively weak signal onto the grid of the triode.

The positive charge difference in potential between the powerful pump potential of the nucleus (cathode, in forward time) acts as the plate voltage. The decrease of this potential when discharging (increase of the negative time, negative aspect) acts as the production of a plate signal to the negative time operation (production of the amplified, time-reversed PCR wave).

The excited nucleus immediately decays upon stimulus by the "grid signal" A_4, emitting a "time- and energy-reversed" strong signal — in short, amplified phase conjugate replica wave E_3.

The amplified phase conjugate signal moves from the cathode (nucleus) out to the electron shells and beyond, precisely because it is time-reversed. To a time-reversed signal, the grid (normal input) acts as the final plate (external output) — that is, in negative time, the elements of the triode are reversed. This makes it possible for the material to emit the powerful PCR.

I have called this effect/analogy a vacuum triode, to accent the direct engineering possibilities. My associates have already engineered this effect to obtain enormous amplification of energy ("free energy") and practical antigravity, from solid-state devices, directly

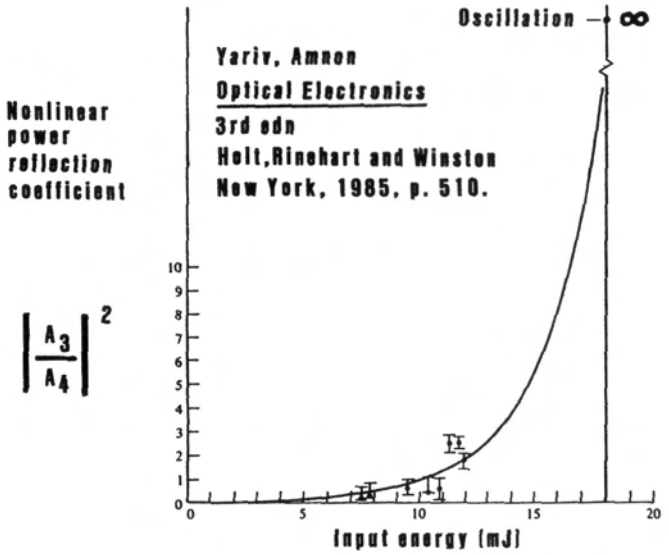

a. Typical nonlinear power reflection coefficients.

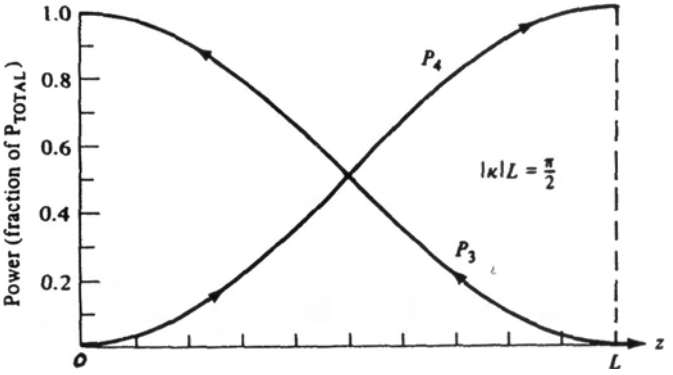

b. Intensities for the oscillation condition.

Figure 38. Power reflection coefficients and oscillation.

on the laboratory bench.

The actual "amplitude gain" of the vacuum triode is the ratio of the amplitude of A_3 to the amplitude of A_4. The square of the amplitude gain is proportional to the power gain; this entity is called the nonlinear power reflection coefficient.

Figure (38a) shows the typical nonlinear power reflection coefficient for a pumped phase conjugate mirror, as a function of the input energy and the depth of the material. As the input signal increases, the gain increases. The ultimate condition would be that the "free oscillation" condition is approached. This occurs when the angle between the input wave A_4 and the pump waves A_1 and A_2 is 90 degrees.

Figure (38b.) shows the oscillation condition and the fraction of the total pump power that is in the input wave A_4 and its output **phase** conjugate replica A_3.

At the oscillation condition, an "infinite" gain exists at the correct depth in the medium. This means that essentially all the energy being fed into the pump waves A_1 and A_2 will now be emitted **in** the output wave A_3. At that point, "saturation cutoff" of the triode output occurs, and it cannot output higher energy, since it has no more.

Notice that, at the oscillation condition, for the slightest output, the full power of the pump waves is fed into the phase conjugate replica. This powerful wave then retraces the path taken by the o**riginal** input signal, unless something else is done to divert it.*

The interesting question then arises: Since we can have infinite **gain,** can we get a special oscillation condition so that the pump wave furnishes its own energy? In other words, can the pump wave "resonate" with the vacuum flux in such a fashion that it is self-pumping and self-perpetuating?

In at least three materials, the answer is yes. Such effects have **been** experimentally accomplished in special forms of barium ti-ta**nate.** See, for example, J. O. White et al, "Coherent oscillation by self-induced gratings in the photorefractive crystal $BaTiO_3$," **Appl. Phys. Lett.,** vol. 40, 1982. p. 450.

*Recall that the PCR can be steered by introducing a minute wave A_5 to vectorially sum with input A_4, In that case, the effective input is the vector resultant of $(A_4 + A_5)$. The apparent distant source point and invisible vacuum path are shifted correspondingly.

Phase conjugation is a universal phenomenon. Theoretically it applies to any sort of wave: electromagnetic, scalar, sound, mechanical, etc. By using it, incredible new effects and an entirely new physics can be accomplished. It is a new and exciting field, little-known outside specialist circles, and still not well-understood. Most discoveries in the field are yet to be made.*

Newton's Third Law and the Full Law of Entropy

For example, the present author noticed that Newton's third law— for every action there is an opposite and equal reaction — is actually a result of phase conjugation. To explain that, we diverge a bit.

First, phase conjugation is also involved in the fact that a charged particle of mass is a little "dynamo" or engine.

Actually, a particle of mass is itself a "nonlinearity" in vacuum spacetime. When a photon (virtual or observable) strikes a particle of mass and is absorbed by it, it's the same as "interacting with a nonlinear medium."

In terms of virtual photons, the charged particle is continually bombarded with them, from the vacuum flux. The charged particle, being a "nonlinear medium", phase conjugates each input virtual photon, emitting a phase conjugate replica.

If it absorbs a normal virtual photon, it emits a "negative energy, negative time" phase conjugate replica.

If it absorbs a normal virtual photon, it emits a "negative energy, positive time" phase conjugate replica — just a normal virtual photon. Note that the particle of mass thus does not exist in time. Or, it exists equally in positive and negative time. Since we only observe particles, it follows that time is not normally an observable, as quantum mechanics has assumed.

The emission of a phase conjugate replica does not affect the momentum of the emitting PCM, as is well-known.

For an observable photon, the particle (nonlinear medium) absorbs the normal photon, which does not affect the energy and momentum of the PCM particle of mass.

If there is no other mass to accept the PCR, it just moves off.

*The U.S. may finally be waking up. SDI is now starting to study EM missiles "in the timedomain" as opposed to frequency. See **Av. Wk.** & **Spurn Tech., Feb. 29, 1988, p. 56.**

If there is another mass to accept the PCR, the PCR is absorbed and phase conjugated by it.

A charged particle in vacuum is continually bombarded by a flux of essentially "randomized" fluctuations. However, on the average these all "average out" to zero. Any particle is automatically in a very high vacuum potential, and is in a state of great agitation at all times, even if it's "at rest" with respect to ordinary observers. It's really "smeared all over the place," so to speak.

When we expose a charged particle to a *normal* potential, the interior virtual particle flux of that potential is disorganized. Hence the particle just "wiggles a bit more frantically," so to speak, randomly in every direction.

However, when we expose a charged particle to an *artificial* potential made by zero summed/multiplied EM force fields or waves, the particle wiggles more frantically in *organized directions.**

This is just as true for virtual particles as it is for observable particles.

Thus the use of such artificial potentials in scalar electromagnetics enables us to overcome the disorder of the internal structure of normal electromagnetics. By this means, we can structure the vacuum, organize electricity and electromagnetic waves, accomplish negentropy, curve local spacetime in complex, deterministic fashions , produce free energy and antigravity, reorganize and transmute nuclei (transmute elements) with miniscule input energy, etc.

Rigorously, this means that the present law of entropy is only half of the full law of entropy. Specifically, it is the "positive time, positive energy" half of the law, and it states that in closed real physical systems, continuing operations of ordered "positive time, positive energy" effects tend to inevitable "disordered" effects produced in the apparatus or system.

In other words, the present law of entropy really states that no ordered system is totally closed. The system will inevitably have energy and actions that escape the system's order, and hence (to the system) this escape represents "loss of order" — or in short, disorder.

The present law of entropy specifically excludes (by implication)

* I.e., **the** electronic noise is partially organized. This is a major key toward building scalar EM detectors. It is also a primary cause of many solid-state circuit malfunctions. The exact principle: (Random changes) + (artificial potential) equals (chaos).

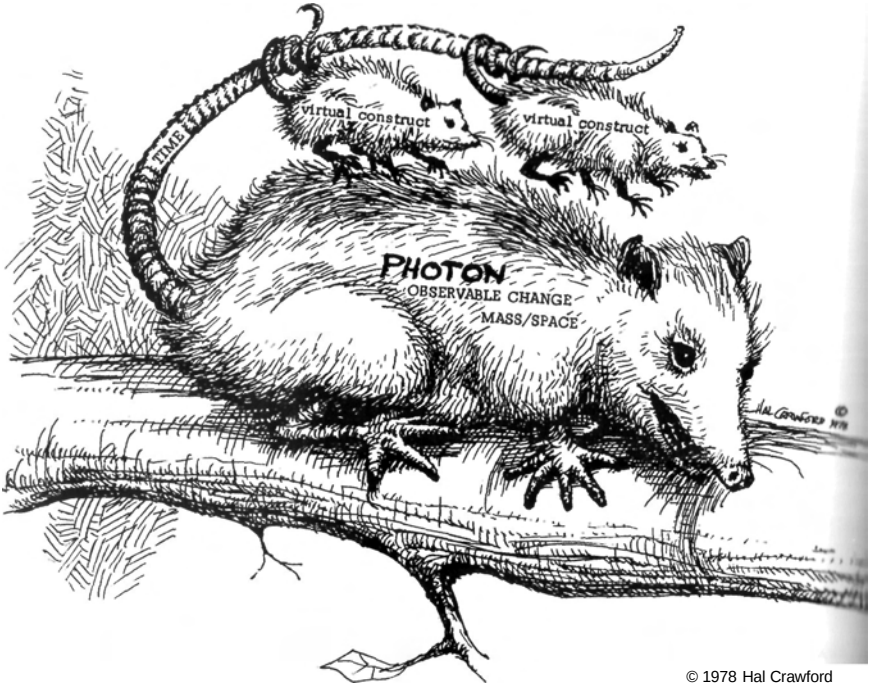

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Figure 39. Photons have virtual substructures. These may be statistical or deterministic.

negative time aspects, where external (disordered) energy time-reverses to again enter the ordered system, in perfect order. By implication, it also excludes negative energy production and operations.

However, **experimentally we can produce both negative energy and negative time, in deliberately time-reversed operations such as phase conjugation and with devices thnt serve as phase conjugate mirrors. Further, we can amplify the phase conjugation and disorder-to-order operations.**

Hence the present law of entropy is incomplete, and states only half the true possibilities. The other half of the law is the **law of negentropy.** In this law, disordered operations outside the **ordered** system undergo time-reversed (and possibly amplified) effects. These reordered energy effects — which may be highly amplified in

comparison to the disordered escaped energy—reenter the "ordered system",restoring order. Since this process moves in negative time, it goes from disorder to order. Hence it is negentropic.

Therefore we have solved the old thermodynamic problem of the "eventual decay of the universe into disorder." Not to worry; the other half of the full law of entropy prescribes negentropic operations in negative time/negative energy, and these restore the order of the universe. That takes care of the problem.

It also means that, in highly disordered systems of many degrees of freedom and far from thermodynamic equilibrium (that is, when the disorder law is saturated), then one can expect to see further stress "create" negative time and hence create order emerging and stabilizing from disorder.

And of course that is exactly what is seen. Ilya Prigogine was awarded the Nobel Prize in 1977 for writing a new thermodynamics predicting precisely such effects, and experiments have proved his case.

But to return to Newton's third law:

Newton abstracted his third law from the classical interaction between two colliding balls.

If one ball is at rest and another approaches it at some velocity, the approaching ball carries momentum and kinetic energy. As it "collides" with the resting mass, quantum mechanics tells us what actually happens: Particles of mass in the moving ball are producing virtual photons continually, and these virtual photons strike the particles of mass of the resting ball and are absorbed by it.

The resting mass now acquires extra energy and momentum from the absorbed photons. At the same time, it acts as a nonlinear medium. It produces phase conjugate replica virtual photons, and these time-reversed virtual photons are emitted. These photons produce no change in momentum or energy upon the emitting mass. However, being phase conjugates, they precisely follow back along the paths taken by the first or "stimulus" virtual photons, striking the moving ball. They are absorbed by that ball, producing (to the external observer) negative momentum and negative energy in it.

These subtract from the kinetic momentum and kinetic energy of the moving ball, reducing them.

The virtual photons emitted by the approaching ball perform positive work upon the target ball.

The virtual, phase conjugated photons, emitted in return by the mass of the struck ball as a PCM, reverse to strike the approaching ball to do negative work upon it.

Notice that twice as much absolute work is always done on the system of two balls as we "input" with the approaching ball.

Also notice that, if we directly "engineer" the phase conjugation of the struck system, we can directly tamper with, and drastically change, the production of the negative energy and negative momentum in the moving ball. Hence we can drastically alter Newton's third law. We can now make a Maxwell's Demon.

This alone clearly establishes that it is perfectly possible to build a so-called free energy device. Though subtle mechanisms must be used, it's nothing more spectacular than putting a paddle wheel in a river, and extracting shaft power from the wheel, furnished by the river's current. Phase conjugation yields other exciting possibilities

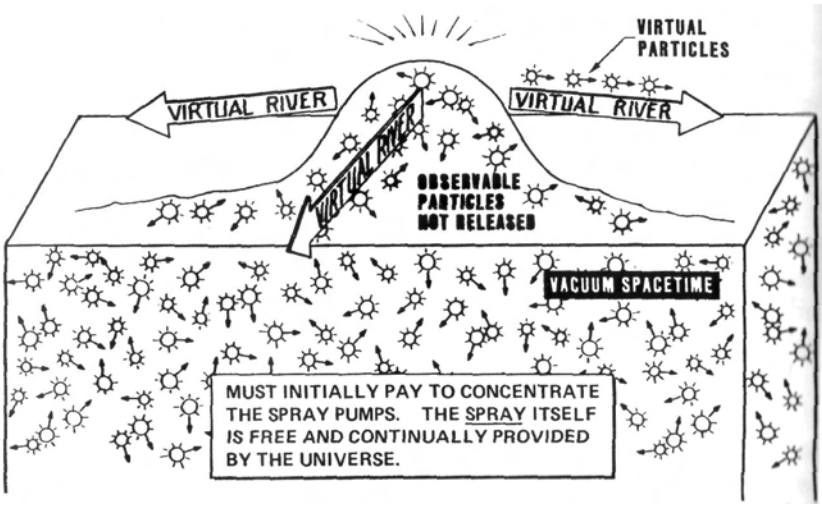

Figure 40. Once established, a virtual river is for free.

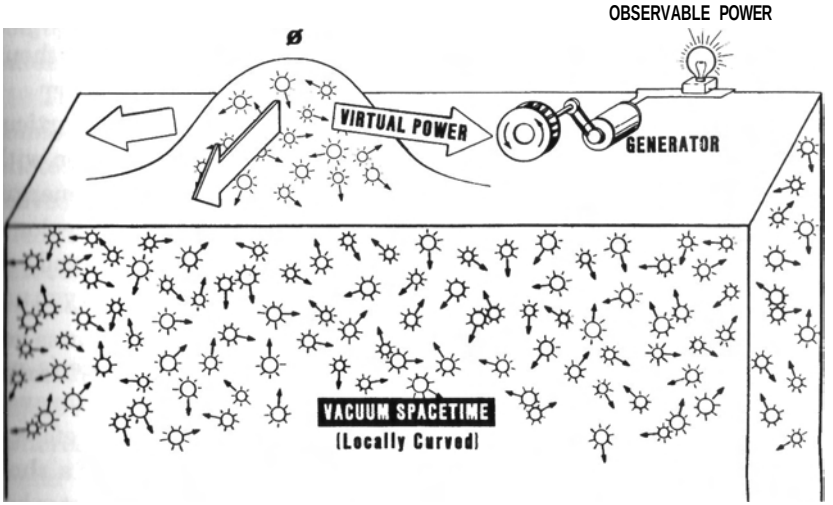

Figure 41. Local energy conservation can be violated.

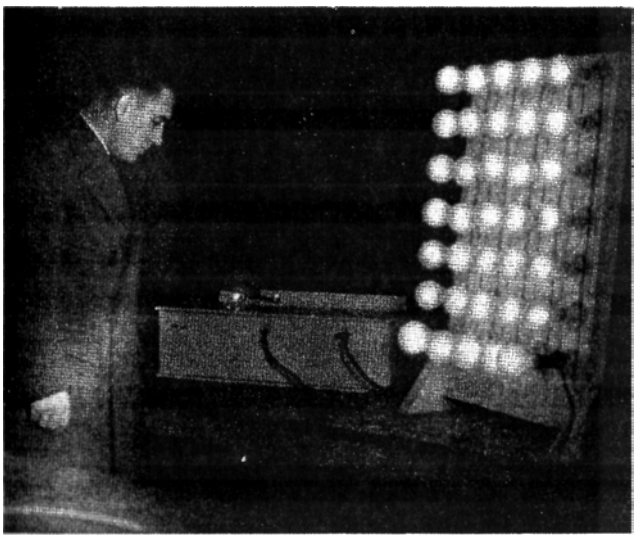

Figure 42. T.H. Moray adjusts the controls of his radiant energy device. Salt Lake City, Utah, in Feb. 1937. Moray obtained 50 kilowatts of power from a 55-lb. device, s**traight** from the ether. Its characteristics (cool circuits, brilliantly lit lamps) reveal **that** It was negative energy.

too numerous to explore here. For just one example, by phase conjugation, real-time holography can be accomplished without having to separately make and illuminate the holograms.

Now with holography and multiple projectors — and particularly with two intersecting "normal" beams to backtrack upon with ever-converging PCR signals—you can assemble a "form of energy" at an appreciable distance from the projectors in three dimensional space. With phase conjugation, you can do it in real time. And you can do it at a great distance back along the path of any signal you use as an input.

By using PCM holography, degradation with distance is not appreciably experienced. After all, the PCR waves utilized are ever-converging. The energy does not diverge and spread. Therefore, if you can make a 6" diameter ball of intense EM energy at a short distance in the laboratory, you can make that same 6" diameter ball of intense energy at several thousand kilometers distance, using PCR real-time interference holography.

With highly amplified PCM's, you can put far more energy into the distant interference form than you can with normal holography. Conceivably it is possible to assemble so much energy in the holography "object" that it condenses into a real material object! In other words, it materializes or semi-materializes.

Both the "intense light form" usage and semi-materialization of forms (such as light forms, flying geometrical forms, etc.) have been created worldwide by the Soviets for decades, to stimulate UFO reports and provide a deception plan for their development and testing of large, strategic energetics weapons using highly amplified PCMs and PCR holography.*

Other bizarre considerations also arise. For example, in **radionics** one utilizes a "witness"—such as a photograph—of the object one is attempting to send "energy" to. (For example, this might bo a sickly plant one is attempting to spruce up). Now when the plant was photographed, the light from it struck the photoemulsion of tho film, producing a photochemical reaction. It also produced phase

*For an example of highly reliable detection and observation of "Soviet hololography UFOs," see Leif Havik, "Project Hessdalen," MUFON UFO Journal, Jan. 1988, p. 4-7. The present author certainly does not imply that all UFO phenomena are due to Soviet PCR holography, only that some UFO phenomena are.

conjugation in the atomic nuclei of the film emulsion, since the emulsion acts in some respects as a nonlinear medium.

There exists a continuous, invisible "stimulus photon and its connections" trace in time and space, between the plant when the photo was taken and that photo now, even if one or both of them have moved. That trace is highly persistent (as Australian experimenters Reid and Barsamian have shown). A phase conjugate (time-reversed) signal can be made to retrace that track and travel all the way back to the plant, in the present. The effect of using the photo (or sample of the object) as such a "witness" of the real plant and directing weak PCR energy back along the invisible trace into the object is called radionics. In most cases, the two cerebral hemispheres of the operator's brain are depended on to form the necessary scalar "pump wave" to pump the "witness" and produce phase conjugated signal energy, time-reversed to travel back into the distant object.*

The problem with present radionics is that it is far too weak, and it is "operator dependent", changing with the mood, temperament, and skill of the operator. It does objectively work, however, though Often erratically. In countries such as England, France, and Germany, use of radionics to treat human disease is legal and permitted, though operators (for example, in England) must undergo extensive training and certification. Its results are roughly comparable to the results of normal medical doctors. Radionics does not replace orthodox medicine. It can successfully treat certain things that orthodox doctors have little or no success with (such as lupus), and orthodox medicine can successfully treat many things that radionics has little success with (a broken leg or ruptured appendix, for example). The two treatments are best used in conjunction with each other.

However, we must point out that a new, amplified PCM radionics is likely to emerge in the near future. Such a new approach will offer highly effective, powerful treatment of diseases, even at a distance, by amplified PCR electromagnetics. Again, the radiation in and from a photo or witness of a diseased patient can be used as a "grid signal" into a powerful, pumped phase conjugate mirror. The

•Again recall that we observe time-reversal of waves as **spatial path** reversal, not as time **travel.**

PCM will produce a specific, powerful, amplified signal that will travel directly to the patient, be absorbed in his entire system, including the atomic nuclei comprising his cells, and directly reverse the chemistry, toxins, and cellular damage in the patient from that disease. It will also kill or destroy the harmful viruses, bacteria, etc. causing the disease, and it can even reverse the actual genetic changes in the cell caused by disease-inducing viruses.

Of course, any powerful tool is two-edged. It can be used for harm as well as good. I think the reader can appreciate the damage that can be done to systems and persons at a distance by means of such powerful new amplified PCM radionics devices.

You can also see the security problems posed to large computing facilities in banks, federal facilities, state and municipal facilities, the IRS, U.S. military weapon systems, ships, aircraft, etc.

Obviously such devices are going to have to be highly regulated and controlled. Else criminal operators will be killing people and destroying things wholesale, secretly and at a distance, and they will have perfect legal alibis to allow them to escape prosecution.

To summarize: if a photograph or witness pattern of an object or person can be correctly stimulated by phase conjugate electromagnetics so that the emulsion acts again as a PCM, can one not argue that—theoretically — phase conjugate energy from the photograph and the instrument can be sent back along all paths, all the way back to the original object? After all, this has been rigorously demon strated by University of Sydney researchers. Is there not an actual physical mechanism for radionics? For highly amplified, powerful radionics where the operator himself is removed from the circuit? Just because it changes our present notion of physical reality, must we dogmatically reject the results being shown on the laboratory benches, some of which are in the hard-core scientific literature?

Phase conjugation and time-reversed engineering have a diversity of applications unparalleled in the history of science. They literally present us with a new physics. New rules apply.

Most of the major discoveries in phase conjugation have yet to be made.

Scalar Electromagnetics

The scalar electromagnetic approach modifies classical electromagnetics (EM) to include gravitational waves and effects.

To do this, scalar EM utilizes summed-zero vector forces and force fields to construct polarized vacuum potentials.

Although externally it has zero E and B vector gradients, an "artificial" potential possesses an internal, dynamic E and B vector field structure. This "infolded" (Bohm's term) structure has finite size and is deterministic. The infolded structure of the artificial potential in turn deterministically structures and polarizes the vacuum and curves spacetime locally, contrary to presently assumed limitations of general relativity.

Since in free vacuum a potential normally extends to infinity in a decaying exponential fashion, then this infolded E and B vector structure of an artificial potential extends to infinity in a decaying exponential fashion.

The artificial potential itself may be rhythmically varied either in structure, magnitude, frequency, or all of the above. This produces waves of potential, and waves of the structure of vacuum/spacetime — again, in the free vacuum case, reaching to infinity in a "decaying exponential" fashion. These "scalar EM waves" are gravitational waves.

Each photon (one major wave length of the "carrier", complete with modulations) of the scalar EM wave also has structure (its included modulations).

Modulated waves have compound or "giant" photons — photons containing infolded photons.

Each compound photon of such a scalar EM wave is a vacuum engine. It deliberately structures and patterns — dynamically — the energy density and charge of vacuum.

(1) By canonically varying two or more components of the electromagnetic vector structure of the zero-summed EM force vector system, the local structure of vacuum spacetime is macroscopically varied in its internal composition. This is the compound variation of "curvature within curvature" — and hence hyperdimensional.

Table 29. A ZERO VECTOR SYSTEM:

- **IS AN ACCUMULATOR**
- **DOES "INTERNAL" WORK ON MEDIUM**
- **HAS NO "ENERGY" EXCEPT STRESS OF VACUUM, YET**
- **CAN YIELD THE ENERGY OF ITS COMPONENTS WHEN DISSIPATED**
- **IS A SPECIAL SORT OF "PUMP"**
- **CAN YIELD CONTINUOUS ANENERGY FLOW IF NOT DISSIPATED**

(2) By prohibiting internal canonical variance while coherently varying the amplitudes of all the EM components, the total stress of vacuum/spacetime — and hence its overall curvature — is locally varied, without modifying its structural form. This is simple variation of overall curvature of local spacetime, involving primarily relativistic effects.

Rigorously, each of these two methods produces a localized gravitational wave, where the local stress of vacuum is deliberately patterned as well as oscillated in amplitude.

Both methods may be applied simultaneously (and multiple infolded times) to produce an even more sophisticated gravitational wave, and more sophisticated structuring of the local stress energy density of vacuum.

The resulting unified electromagnetics/gravitation is called **scalar electromagnetics,** since the electrogravitational effects are obtained by deliberately opposing EM vector force fields so that they vectorially sum or multiply to a zero vector EM resultant, while **the** infolded (Bohm's term) EM vector components structure and vary the stress energy density of vacuum.*

*Gravitational potential is just "in-folded and locked in" dynamic electromagnetic forces. The infolded EM energy is locked-in, representing a change in the local energy density of vacuum and hence a curvature in spacetime. Electromagnetic force fields are just the out-folding of the G-potential's inner EM contents into the 5th dimension. Ordinary gravitational force field is just the "trickle leakage" of the G-potential's infolded contents, out into and through *3*-space.

Note immediately that scalar EM also deals with internally structured and patterned electricity and electromagnetism.

"Normal" electromagnetics has no deterministic internal structure.

The new electrogravitational (EG) wave is called a scalar EM wave, and is believed to have been originally discovered by Nikola Tesla.

James Clerk Maxwell was aware of the potential for electromagnetics to stress and structure the vacuum ether.

His original electromagnetic theory — written in quaternions, not vectors (which had not yet been completed by Oliver Heaviside) - can allow for these effects to be expressed.

Unfortunately Heaviside's interpretation of Maxwell's work

Table 30. STRESS IS FUNDAMENTAL

- **THE MOST FUNDAMENTAL REALITY IS STRESS**
- **THE COMPONENTS COMPRISING STRESS ARE THE GREAT CAUSATIVE AGENTS**
- **MOST OF THESE ACTIVE AGENTS ARE HIDDEN INSIDE ZERO-VECTOR SYSTEMS**
- **THE COMPONENTS OF STRESS MAY BE STATISTICAL OR DETERMINISTIC**

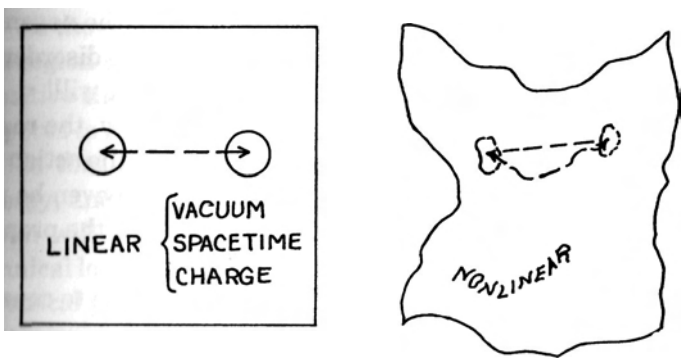

figure 43. Charge affects anything existing in spacetime.

eliminated these effects, and they have remained eliminated from the Western EM theory to the present day.

The use of the scalar EM wave directly engineers the virtual state and the vacuum itself.

Hooper's work represented important work in this respect, as does other related experimental work by Bedini, Watson, Golden, Dea, Faretto, Beck, and other inventor colleagues who do not wish their names mentioned.

Scalar EM theory also bears a strong relationship to the Kaluza-Klein unified theory of gravitation and electromagnetics. At least five dimensions — four spatial and one time — are required as a minimum.

Nested levels of virtual state may be modeled as identical to successive hyperspaces.

Internested levels of zero-summed vector EM force fields allow the direct engineering of those hyperspaces.

Negative energy and negative time flow are especially important when building free energy devices and antigravity. The mechanism producing negative energy and negative time flow is the forced amplified production and absorption of phase conjugated waves.

In addition, phase conjugation is a basic phenomenon of nature: for example, as previously pointed out, it is the direct mechanism that generates Newton's third law of motion. It also adds a negentropy law (for negative energy/negative time).

Accordingly, if we engineer phase conjugation, we can change Newton's third law to our will. And we can invoke the negentropy half of the total law of entropy, so that we can go from disorder back to order. Again, we can make a Maxwell's Demon at will!

In Newton's third law, when manipulated locally, the reaction force need not necessarily be equal in magnitude to the action force It also need not necessarily be parallel to it. It can even be phase conjugated itself to yield an addition force, assisting the propelling of a particular engine or device.

Phase conjugation may also be manipulated so as to cause like magnetic poles to attract, and unlike poles to repel.

Magnetic "force field lines" of a bar magnet normally exist in conjugate co-existing pairs. One of the pair is in observer positive

time, and (by convention) runs from the north pole to the south pole. The second line of the pair is a phase conjugate of the first, and exists in negative observer time. Thus, to the "positive time only" observer, it will appear to run from the south pole to the north pole, perfectly retracing the path of its twin.

Howard Johnson uses a "two particle" theory of magnetic field, for example, where one particle (photon) is the phase conjugate of the other. This is identically the same as the scalar electromagnetics concept of phase conjugate pairs of field lines. By very complex, specialized, compound permanent magnets, Johnson is able to partially separate the two lines, and spatially concentrate or diminish the phase conjugation (negative time) component in a given area of operation.

If the negative time component lines are concentrated to outweigh the positive component lines in a local region, then the laws of magnetics are reversed in that region. There like poles attract and unlike poles repel.

In his rotary permanent magnet motor design, he concentrates the negative time component in that part of the rotation where a north rotor pole is approaching a north stator pole. Normally, in this part of the cycle, one has to overcome the repulsion of like poles to "force energy" into the device for later extraction.

However, *now* in that region *like poles attract.* There the north pole of the rotor is attracted toward the north pole of the stator, adding impetus to the rotor.

As the rotating north pole passes the stator north pole, it leaves the region of negative time concentration and returns to a normal "positive time" region again. Now the north poles repel again, and impetus is again added to the rotor.

In that manner Johnson is able to violate local conservation energy, and make a "free energy" permanent magnet motor. The motor will rotate itself and deliver constant shaft power to a mechanical load. By attaching a standard electrical generator, normal electrical power is continually and freely produced by the complete motor generator power system.

Johnson's complex nonlinear magnets severely curve local spacetime, allowing *local* violation of energy conservation.

Scalar EM View of the Vacuum

In the modern quantum mechanical view, the vacuum is not an emptiness, but instead is a plenum.

Today the vacuum is considered to be filled with incredible virtual particle activity. From nowhere, virtual particles continually arise — even with fierce energy — then disappear again into nowhere, so rapidly that they cannot be individually observed.

However, these virtual particles are quite real, for they cause all the forces of nature when they interact in the aggregate with observable particles.

To the observer, the fleeting particles also appear and disappear in both positive time and negative time. That is, the flux consists of both particles and antiparticles.

Thus the vacuum is a seething inferno of virtual particle fluxes.

The concept of an **ether** is again accepted. It refers to this "virtual flux" vacuum.

Note, however, that this is an ether far different from the old material ether that was theorized prior to relativity.

In the new vacuum ether, every imaginable type of particle continually and spontaneously arises (creation) and disappears (annihilation) at every point in the vacuum, according to modern quantum mechanics.

The rate of this seething virtual particle creation and annihilation is essentially unlimited. Hence the "flux density" of vacuum is essentially unlimited.

Further, any virtual particle created has a flux of even finer virtual particles associated, and so on without limit.

The vacuum's virtual particle flux is thus comprised of nested levels of ever finer virtual particle fluxes, in the modern view. We state without proof that **each deeper virtual level may be modeled as a higher dimension** (hyperdimension). **This yields an infinite-dimensional vacuum spacetime (hyperspace) that is identically the infinite nested levels of virtual state.**

At the same time, every nucleus in the universe is continually absorbing and emitting scalar EM (electrogravitational) waves. The emitted scalar EM waves of pure potential are waves in the stress and structuring of the vacuum itself.

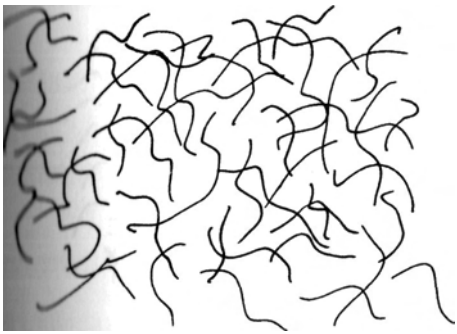

VACUUM IS IDENTICAL TO:

- **VIRTUAL PARTICLE FLUX**
- **SPACETIME**
- **ANENERGY**
- **$Ø_O$**
- **MASSLESS CHARGE**

VACUUM IS:

- **MADE OF UNQUANTIZED ACTION**
- **WITHOUT DEFINITE LENGTH INTERVALS**
- **WITHOUT DEFINITE TIME INTERVALS**
- **N-DIMENSIONAL (UNFIXED)**

Figure 44. Vacuum/spacetime is pure virtual particle flux.

Table 31. VACUUM IS:

- **SPACETIME (L^nT, WHERE n >= 3)**
- **CHARGE (MASSLESS)**
- **ELECTROSTATIC SCALAR POTENTIAL**
  ($Ø_O \neq 0$)
  (ERROR IN PRESENT THEORY)
- **BROKEN BITS OF ENERGY (SUBQUANTAL)**
- **PURE VIRTUAL PARTICLE FLUX**
- **Ø -WAVE FLUX**
- **MULTILEVEL, STRUCTURED, PATTERNED**
- **A VIRTUAL PLENUM**
- **AN OBSERVABLE EMPTINESS**

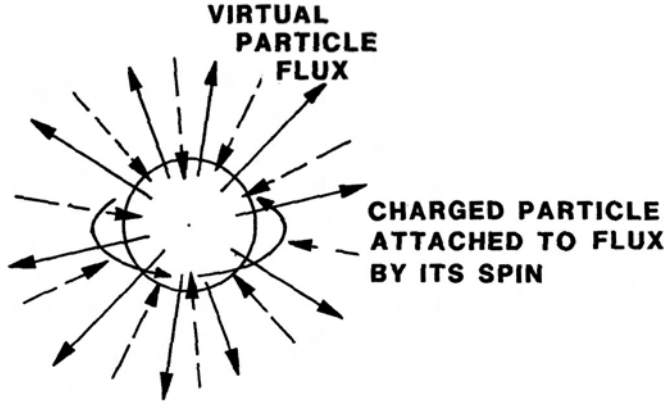

Figure 45. A simplified charged particle.

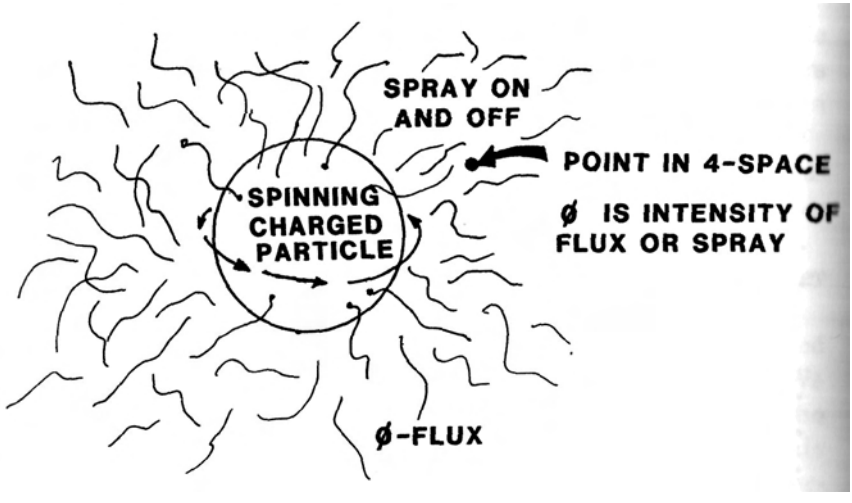

SPRAY IS THROUGH 4 OR MORE DIMENSIONS, NOT JUST 3

Figure 46. A charged particle is a special kind of "spray nozzle."

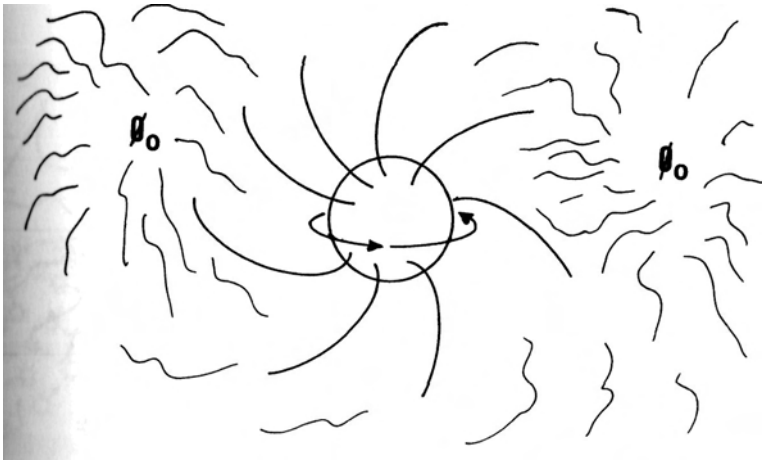

Figure 47. An observable charged particle is directly connected to virtual particle **vacuum** flux.

Table 32. SPIN COUPLES VACUUM TO PARTICLE

- **SPHERICAL ROTATION IS THE KEY**
- **A PARTICLE CAN BE MODELLED AS A SPHERICALLY ROTATING VORTEX OF SPACETIME**
- **ITS MASS IS DUE TO ITS SPIN**
- **THE SPINNING OBJECT IS CONTINUALLY CONNECTED TO ITS ENVIRONMENT**
- **VERY HIGH VALUES OF ELECTROSTATIC POTENTIAL CAN INDUCE RELATIVISTIC CONDITIONS**
  - **CHANGE RATE OF FLOW OF TIME**
  - **EVEN THOUGH VELOCITY IS NONRELATIVISTIC**

E.P. BATTEY-PRATT AND T.J. RACEY,
"GEOMETRIC MODEL FOR FUNDAMENTAL PARTICLES,"
INTL. J. OFPHYS.19. NO. 6, 437-475, 1980

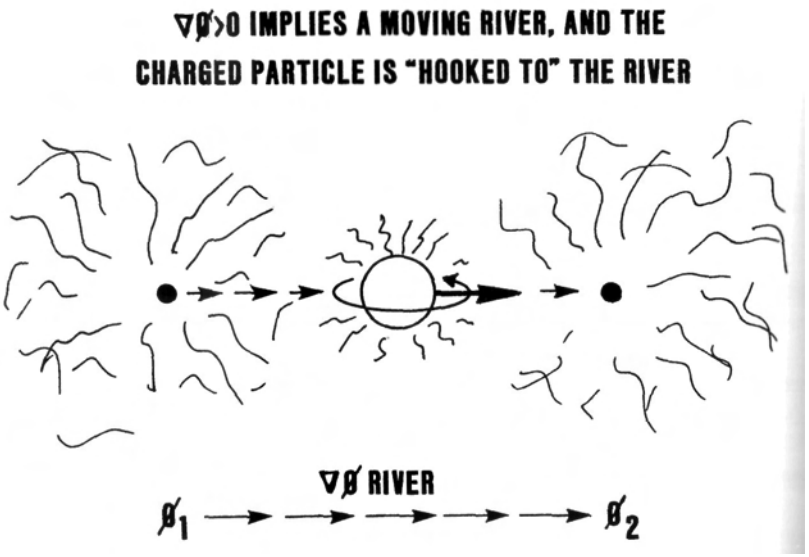

Figure 48. In a flux gradient (virtual particle river), a charged particle moves itself.

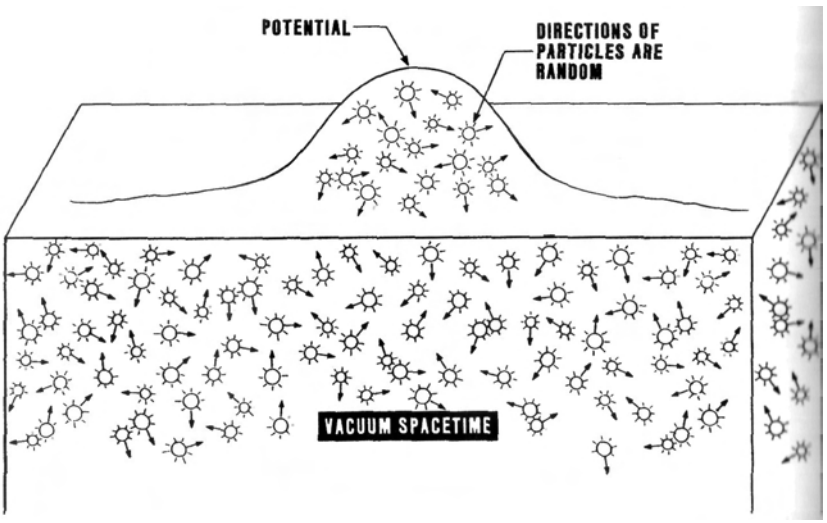

Figure 49. A natural potential is a **disorganized change** in **the stress of** vacuum. It has a random virtual substructure.

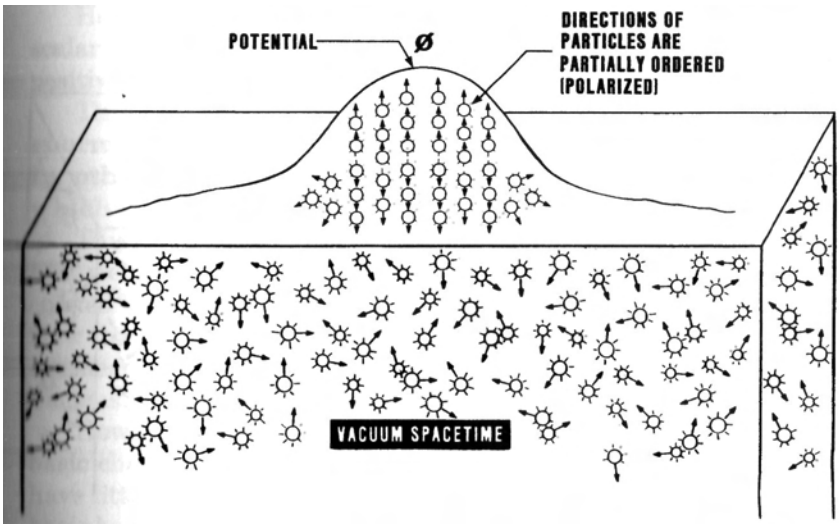

Figure 50. An artificial potential is an organized change in the stress of vacuum. It has a deterministic virtual substructure.

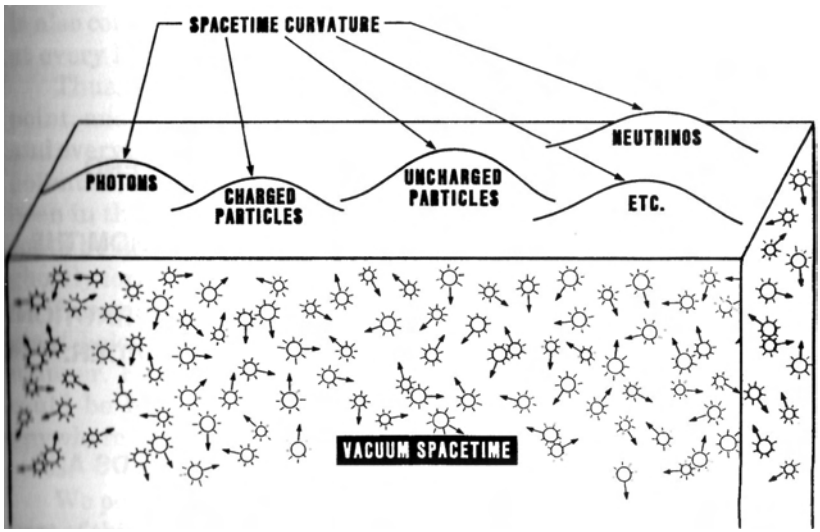

Figure 51. Gravitational potential is a conglomerate of stresses, organized or disorganized.

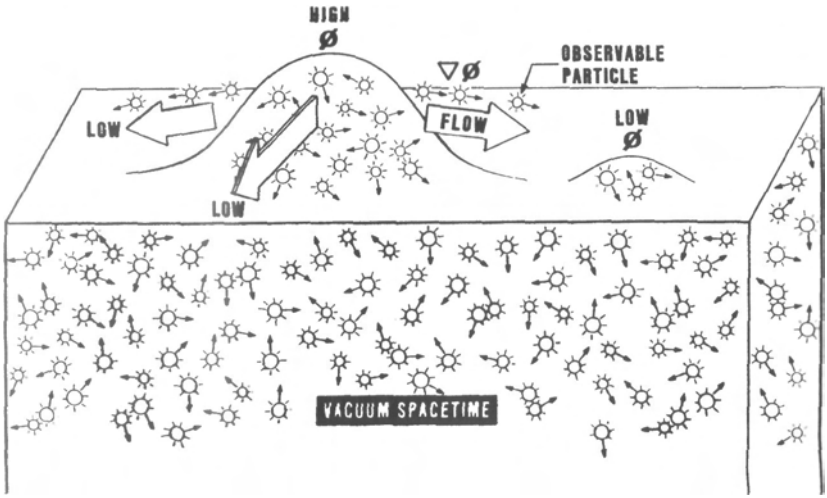

Figure 52. EM force fields are releases of gravitational potential via observable charged mass flows.

Table 33. RESIDUE UNIVERSE, RESIDUE SCIENCE

- **VECTORIALLY, STRESS IS SUM-ZEROED**
- **THE VECTOR FORCE FIELDS REPRESENT NON-ZERO GRADIENTS IN MORE FUNDAMENTAL STRESS**
- **FORCE FIELDS ARE THE RESIDUE LEFT OVER FROM THE SUM-ZEROED STRESSES**
- **PHOTON INTERACTIONS ARE FORCE-FIELD INTERACTIONS**
- **PHOTON-DETECTED REALITY IS ONLY "FIRST ORDER." IT SHOWS ONLY "RESIDUE-LEVEL" REALITY**
- **WE HAVE BUILT A "RESIDUE SCIENCE" AND A "RESIDUE PHILOSOPHY" BASED ON FORCE FIELDS AND PHOTON DETECTION**

Hence at every point in the vacuum, an intense flux of these scalar EM waves, with concomitant interferences, exists — in both positive and negative observer time.

This scalar EM flux causally **drives (constitutes) all the** enormous **quivering of the vacuum** spacetime medium **itself. In other words,** it **drives subquantum (virtual) change, which in turn drives quantum change.**

This is a drastic reorientation of quantum mechanics. In scalar EM, we view that the virtual flux of vacuum is *causally driven or created* by interacting scalar EM waves. This replaces the present **view** that the virtual flux is entirely chance. It opens up the direct engineering and structuring of the vacuum — and hence the atomic nucleus — by scalar EM means.

However, it does not replace the normal *statistical nature* of the **basic** changes of the background vacuum medium. We normally **have** little or no knowledge of the myriad of drivers that cause the basic background waves of that medium. We may, however, deliberately create special vacuum potential waves which are determinis**tic,** and which we have knowledge of.

To the observer, from a purely statistical viewpoint, in this violent vacuum flux *any* and *every* finite pattern of virtual particles is also continually being momentarily created and destroyed — and at every level and in every hyperdimension.

Thus, in the vacuum there continually exists — at any and every point, and in any and every region — the ghostly image of anything and everything, whether in the past, present, or future; and whether **potential,** probabilistic, or actual. Even everything that could have be**en** in the past but wasn't, or might be in the present but isn't, or could be in the future but won't be, is continually present in thin, ghostly form.

Rigorously, the universal vacuum may be taken to be a sort of gi**ant** hologram, for the whole is in each part, albeit in ghost-like manner. Everything that is, or was, or shall be; and everything that could be but isn't, wasn't, or shan't be; already exists *at once, an*ywhere and everywhere, in this ghostly, holographic, virtual state.

We point out in passing that, conceivably, one can engineer any **part** of this "potential for reality." That is, one can directly engineer physical reality itself, in the scalar EM view.

All that must be done is to amplify (continuously and coherently

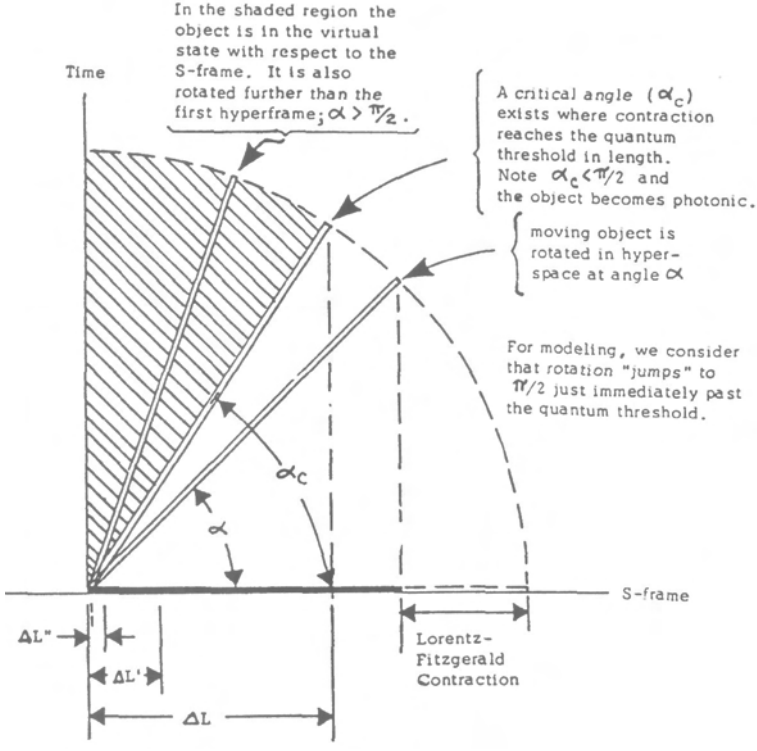

Figure 53. As beyond (without), so within. Hyperspaces are internested virtual states, and rotated orthogonal frames. They are also substructures within and of vacuum state potentials.

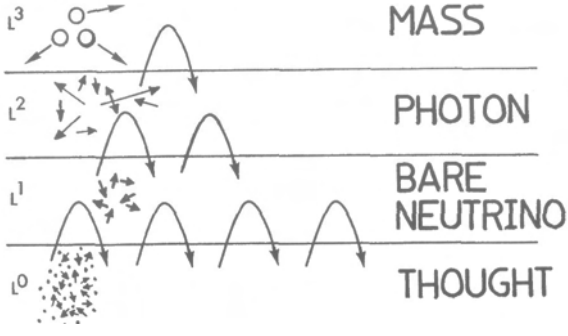

Figure 54. Internested levels of virtual state vacuum interact with neutrino, photon, and mass. "Thought" or "mental state" refers to the third and more levels down in virtual state.

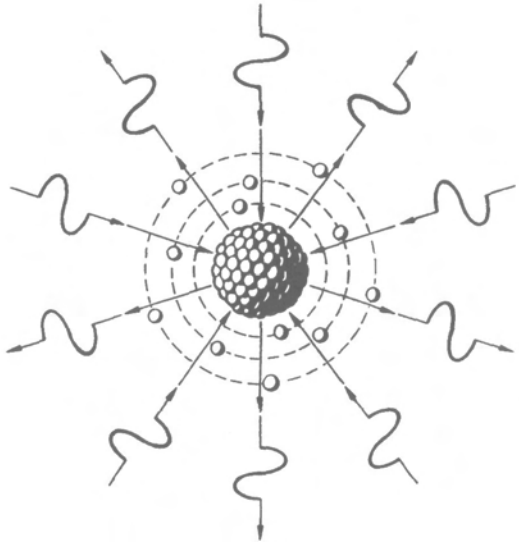

Figure 55. Virtual state patterns are absorbed and emitted by the atomic nucleus. The built-up nuclear "charge" in that particular pattern is a partial potential — for that pattern only.

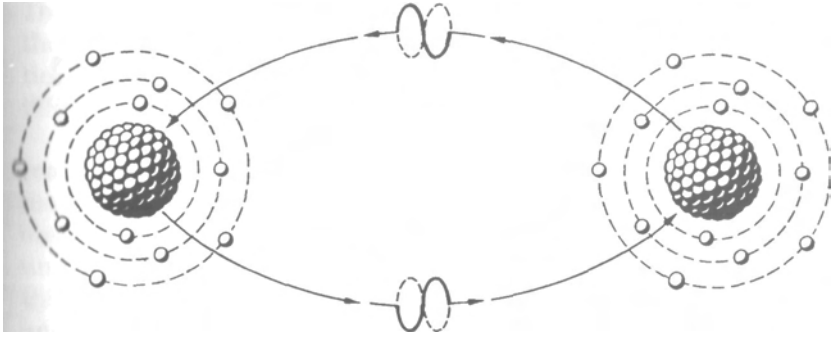

Figure 56. Nuclei of the universe continually exchange scalar EM waves and virtual **panicle** fluxes.

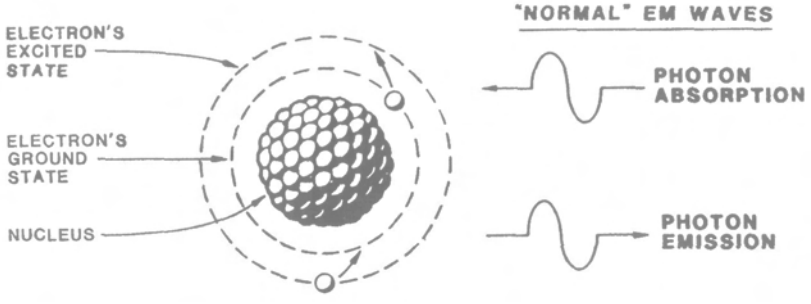

- HEAVY NUCLEUS RELATIVELY UNAFFECTED
- MACROSCOPICALLY. MASS APPEARS STABLE AND "BRICK-LIKE"
- SPECIAL RELATIVITY APPLIES

Figure 57. First order reality. Rough-hewn by observable photon interaction with electron shells of the atoms of physical mass. This process is "physical observation."

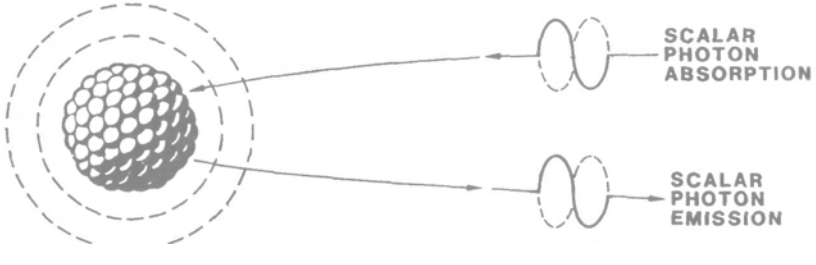

- HEAVY NUCLEUS AFFECTED
- MACROSCOPICALLY. MASS APPEARS FLUID AND CHANGEABLE
- GENERAL RELATIVITY AND KALUZA-KLEIN GEOMETRY APPLY

Figure 58. Higher order (hyperspatial) reality. It exists as stored in the potentials ot the atomic nuclei of physical mass.

add energy to) one of these "ghost images" virtual state forms. In that case, the form becomes "denser and denser," until eventually it starts to breach the quantum threshold. At that time, the form will be seen emerging as a sort of "coalescing form of light," where the light seems to be forming in little "chunks" or pieces. As the coalescing operation continues, the light-form will eventually become fully formed. If it continues, it will start to coalesce further into *thin, ghostly material* form, appearing much like a faint fog-form. With continued coalescing, it will become a very solid, material form which exerts pressure on tree limbs, breaks them, leaves traces, etc.

Long ago I dubbed this process *kindling*. It is rather widely met in paranormal phenomena of many types.

But back to the basic idea of ghostly images in the virtual states of vacuum.

In this view, Everett's many-worlds interpretion (MWI) of quantum mechanics is literal and real, albeit the additional worlds are to bo taken as virtual and hyperdimensional to the laboratory observer.

(It is rather simple to show that ever deeper, nested levels of the virtual state are exactly the same thing as ever higher dimensions. By "rotating" an object in many-dimensional space, one can show that, after three rotations, a physical object has lost all physical intersections with our normal 3-space, to us now only occupying time. Since this is the precise characteristic of a *thought form*, I used this phenomenon and spatiotemporal model to make a multidimensional space model directly including thought, mind and matter. That is, one is thus able to form a unified field theory of mind, th**ought,** life, and matter — a model that is testable, makes predictions, and actually unites physics and metaphysics. That work and its plications, however, are largely beyond the scope of this book.)

It is stressed that the basic scalar EM image (interpretation) of reality is directly implied by quantum mechanics. It is not idle metaphysics. Other than the scalar EM wave causality for the observer's statistical microscopic dynamics (and the extended model unifying mind, thought, life, and matter), it is not the construct of this author. Instead, it follows from interpretation of the equations and axioms of quantum mechanics (QM) itself, as changed and extended by the "zero vector system" dynamics.

Charge, Potential, and Curvature of the Vacuum/Space-time

The flux of one type of virtual particle through a point in the vacuum may be examined.

A single type of virtual particle flux (VPF) at a point constitutes one particular type of charge at that point. For example, the flux of virtual photons constitutes the electrical charge.

Further, the magnitude of the selected flux (usually expressed as a flux density) through the point may be taken as the magnitude of the vacuum's charge there in that type of particle. In other words, at a point the magnitude of the vacuum's charge (VPF) is one type of *potential* at that point.

Various kinds of fluxes constitute various kinds of charge, and comprise various kinds of potentials. Immediately we see that one type of charge may always be decomposed into other kinds of charge, as can potentials. This point is beyond the scope of this book and will not be further amplified.

Continuing our example, the magnitude of the electrostatic scalar potential at a point in vacuum represents the magnitude of the flux of virtual photons through the point, and hence the electrical charge at the point.

Table 34. REALITY IS A HOLOGRAM

TO ESTABLISH THIS:

1. **ALL DETECTION IS INTERNAL**
   PHYSICAL REALITY CONSISTS OF THE INTERNAL DETECTIONS OF THE PERCEIVER/OBSERVER.

2. **THE OBSERVER MAY BE AT ANY POINT IN THE UNIVERSE**
   THE UNIVERSE CAN BE DETECTED FROM ANY POINT INSIDE ITSELF.

3. **THE PHYSICAL UNIVERSE IS TOTALLY INSIDE EACH POINT IN ITSELF**
   THIS DEFINES A HOLOGRAM: THE WHOLE IS IN EACH PART.

Twin Flows of Time

In quantum mechanics, each virtual photon is continually turning into an electron/position pair, and vice versa.

By Dirac theory, *a positron is an electron traveling backwards in time.*

Further, pair production produces time-smeared particles — an electron and a positron.

Pair production, then, actually produces two *electrons,* one coupled to (smeared in) a positive piece of time and one coupled to (smeared in) a negative piece of time.

Thus in the vacuum two discretized streams of time, one positive and one negative, are continually created in conjunction with pair production, and destroyed by pair annihilation.

Further, integration of tiny virtual pieces of time (from virtual photons) to form "passage of time" macroscopically is directly associated with the charge (the absorption and emission of virtual particles) of an observable particle.

This is what is meant by an object "existing" (persisting). Its continual virtual photon interactions are integrated by its mass (timeless part) to continually create its energy states and its march through time.

The absorption and emission of an abservable photon, however, moves the mass (timeless part) in (comparatively) larger jumps through time. The absorption of the photon connects a positive piece of time to the mass of the particle, converting it to masstime. The subsequent emission of an observable photon "tears off the little time-tail," so-to-speak, and leaves behind a totally spatial mass entity, having no large connection to "the flow of time."

This is what is really meant by "observation."

Because the "observation" disconnects time from the previously "excited mass" (masstime), then it follows that time is not an observable.

It also follows that the twin streams of time are not continuous. Each is broken into incredibly tiny bits.

The bits of time are continually interlaced between negative and positive, and neither of the two streams of time bits is integrated in the vacuum. The vacuum is disintegrated!

A photon — the basic quantum — is composed of discretized energy and time, bound together (integrated) as action (angular momentum). That is, a photon is a little piece of energy, welded to a little piece of time, with no seam in the middle.

Two kinds of photons exist: the normal photon exists as (+dE) (+dt). The phase conjugate photon exists as (-dE) (-dt).

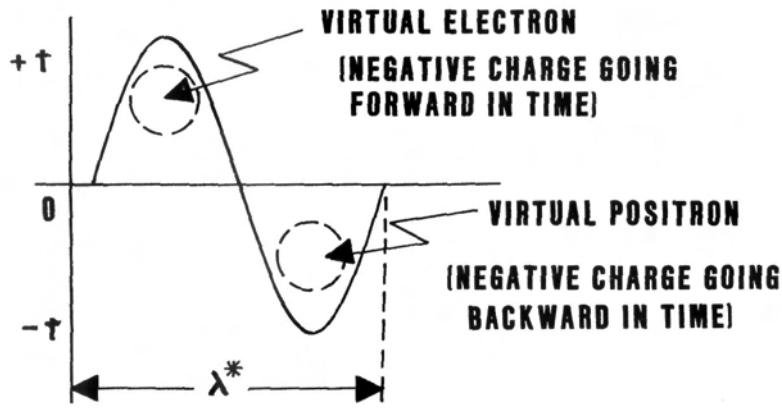

Figure 59. A photon is a single oscillation of a carrier wave. It is also two virtual electrons, one going forward in time, and one going backward in time. With internested modulations (subphotons), the structure of the photon becomes extremely complex.

Table 35. PHYSICAL CHANGE

- **COMPOSED OF ACTION**
- **h = BASIC QUANTUM**
- **TWO CANONICAL VARIABLES**
  - **ENERGY/TIME ($\Delta E \Delta t$)**
  - **MOMENTUM/LENGTH ($\Delta p \Delta L$)**

    ETC.
- **ENERGY/TIME**
  - $h = (+\Delta E)\ (+\Delta t)$
  - $h = (-\Delta E)\ (-\Delta t)$

If the photon is of a certain magnitude, given by Planck's constant, then it is an **observable photon.**

If the photon is less than h in magnitude, then it is a **virtual photon.**

A simple photon in vacuum can also be considered to be one cycle of a sine wave. One half of the sine waves exists in positive time, hence is/contains a virtual electron.

The other half of the sine wave exists in negative time, hence it is/contains a virtual positron — an electron traveling backward in **time.** This second half of the full photon (a single sine wave oscillation) is the phase conjugate (time reversal) of the first half.

As we stated previously, the full photon in vacuum actually exists as a presently visualized "positive time" photon and a phase conjugate "negative time" photon , a "serially linked pair," where **each** photon is only one-half the sine wave. This resolves the conflict inherent in wave/particle duality.

It also has a great deal to say about engineering the vacuum and about detectors and the detection process.

In the spontaneous decay of a virtual photon, it can be seen that one part (the virtual electron) is associated with positive energy and positive time; the other part (the virtual positron) is associated with negative energy and negative time.

The continual "switching" between positive and negative time in an observable particle's absorption and emission of virtual photons **(and** the associated electron/position +t/-t pairs) means that the positive flow of time, to the macroscopic observer, is continually being "started" and "stopped" (created and destroyed).

This continual attachment **and detachment of positive time to and from the "observer particle" creates the "past" and the "future" to which the observer seems somehow to be connected, and yet not connected.**

Engineering Local General *Relativity*

In a flat spacetime (linear vacuum), the two time flows are balanced, as are pair creation and pair annihilation. In this case, conservation of charge and energy hold.

Table 36. ORDINARY GENERAL RELATIVITY (OGR) IS A SPECIAL CASE

- **OGR HAS ASSUMED AWAY MOST LOCAL GR SYSTEMS, OF THE TYPE WHERE MAXWELL'S EQUATIONS AND THE CONSERVATION LAWS CHANGE LOCALLY.**

- **PHYSICISTS ARE THUS STRONGLY DISCOURAGED FROM CONSIDERING THAT GR CAN EASILY BE ENGINEERED IN A LOCAL EM SYSTEM.**

In a curved spacetime (nonlinear vacuum), one of the two triplets (positive electron/energy/time or negative electron/energy/time) predominates. Hence in a curved spacetime the rate of flow (production) of the two time streams is unequal, as is the production of the two kinds of energy and the two kinds of electrical charge.

A locally curved spacetime thus produces a predominance of either positive or negative electrons, and either positive or negative energy, and a predominance of the addition of either positive or negative time production.

The curved spacetime acts as a local source or sink accordingly, and both conservation of energy and conservation of charge can be locally violated in such a curved spacetime region.

As we stated, the locally curved spacetime produces either positive time or negative time more predominantly, acting as a source or sink for normal (positive) observer time. The local rate of flow of the observer's time can thus be speeded up or slowed down, depending upon the type of local spacetime curvature utilized.

It follows, then, that standing local gravitational waves can result in localized, stable gradients in the vacuum virtual particle flux, between the "high potential" part of the standing wave and the "low potential" part.

This allows the violation of conservation laws such as charge and energy in the local gravitational gradient, utilizing the localized curvature of vacuum to provide a special source.

For proof that conservation laws need not apply to a curved

spacetime, see A.A.Vlasov and V.I. Denisov, "Einstein's formula for gravitational radiation is not a consequence of the general theory of relativity, **Theoretical and Mathematical Physics,** 53(3), June 1983 **(English translation);** Russian, Dec. 1982, p. 406-418. Quoting:

"This result is a particular consequence of the general assertion to the effect that in general relativity there are no energy-momentum conservation laws for a system consisting of matter and the gravitational field."

See also V.I. Denisov and A.A. Logunov, "New theory of spacetime and gravitation," **Theoretical and Mathematical Physics, 50**(1), July 1982, p. 3-76. This paper (p. 3) points out that:

"... **the gravitational field in general relativity is completely different from other physical fields and is not a field in the spirit of Faraday and Maxwell."**

A 1984 Soviet paper by senior Russian physicist C. Yu. Bosgoslovsky, "Generalization of Einstein's relativity theory for the anisotropic spacetime," is also very relevant.*

In composing his theory of general relativity, Einstein assumed that the local spacetime of the observer could never be curved, and instead would always be represented by a Lorentz frame (flat spacetime).

This severe assumption had the effect of "saving" the sacrosanct conservation laws, and maintaining the exclusion of electrogravitation.

Since then, Western physicists have raised Einstein's assumption — and the conservation laws — to a dogmatic belief system — in some cases, to near fanaticism.

To see a clear statement of these limiting assumptions imposed on general relativity to provide the severely restricted version taught in almost all Western universities, see Charles W. Misner, Kip S. Thome and John Archibald Wheeler, **Gravitation,** W.H. Freeman and Co., San Francisco, California, 1973, p. 19-21, 71-72, 367-369.

In other words, Western physicists still use a sort of "special

**See* also V.I. Denisov and A.A. Logunov. "The inertial mass defined in general relativity has no physical meaning," preprint p. 0214, Institute of Nuclear Research, USSR Academy of Science, Moscow, 1981.

relativity with distant curved spacetime pertubations," and call it *general* relativity!

The Soviets do not limit themselves to the same restricted general relativity theory as does the West.

Santilli (Ruggero Maria Santilli, **Ethical probe on Einstein's followers in the U.S.A.: An insider's view,** Alpha Publishing, Newtonville, Massachusetts) has documented what essentially amounts to a conspiracy in Western physics to shut out any generalization of Einstein's severely limited relativity.

It is precisely this near-total Western scientific prejudice — along with Heaviside's mutilation of Maxwell's original theory — that has excluded electrogravitation from being developed in the West.

Note also that, by embracing a "locally flat spacetime" assumed to be decreed by the "laws of the universe," in their rigid mindset Western physicists have excluded any possibility of performing simple laboratory experiments in locally curved spacetime.

They do not believe it can be done, so they have never tried.

But let us further address the importance of the negative triplet (electrical charge/energy/time) and its concomitants parity, gravity, and entropy:

Engineering Antigravity

In negative time flow, gravity is a repulsion, not an attraction.

Producing antigravity in an object is simply the production of excess negative time flow in that object.

That is readily achieved by curving local spacetime in the appropriate direction, and forcing the object to produce excess negative energy.

Mass, for example, is just a special form of trapped energy—and trapped energy (potential) is just trapped charge of one kind or another, whether observable or virtual.*

As such, mass represents a "localized potential" in the ambient vacuum, of a certain kind of "trapped energy/time charge."

*Actually, since it is in equilibrium in a dynamic and continual flux, a mass particle is actually a special trapped **rate** of action flow. A defining equation for mass in terms of the rate of action flow was given by the author in **Quiton/Perccptron Physics,** NTIS, 1973. Report AD-763210.

The mass/potential is continually being charged by the vacuum flux, and discharging and emitting charge flux into the vacuum flux. The mass is "in equilibrium" at its fixed potential.

Normal ("positive") mass is simply charged up with positive energy and positive time. And its external electron shells result in it presenting a "negative charge" face to the world.

If we charge up the mass, however, with negative energy and negative time, so that some of its charge potential now is of this second type, the trapped energy will now consist partially of negative energy. In addition, the mass will partially exist in negative time (be charged up partially with negative time).

When excess negative time flow is produced in a mass, the mass begins to be repelled by the earth as well as still being attracted to it in its positive time stream. The net result of the object's fixed attraction and increasing repulsion is that the object begins to lose weight in the earth's gravitational field and gets lighter.

When a sufficient rate of excess negative time flow (sufficient local spacetime curvature) is produced, the mass floats freely.

With additional negative time production rate, it accelerates ("falls") upward.

The rate of excess negative time produced may be controlled very simply by using a "negative time/negative energy" generator and varying the amount of the load applied to the device.

The negative time/negative energy generator can be rigidly affixed to a flying apparatus, serving as a sort of gravitational rocket or gravitational propulsion system.

Of course, the negative energy produced in the propulsion process can be used to light lamps and power electrical loads, as well as host of other things. (Yes, Virginia, it can also be used to generate force fields, power weapon systems, etc.)

Thus one can "eat his cake and have it too"; by using negative energy flow for power, a very practical antigravity spaceship can be developed.

An additional side benefit to the passengers probably exists: they should age at a slower rate when traveling in the vehicle.

As can be seen, since many kinds of VPFs exist in vacuum, the vacuum is filled with (and consists of) many types of "potentials." Overall, this matches very closely the view of general relativity, if we

regard the vacuum itself as indefinite "spacetime", where no ordered universal frame with a fixed metric has yet been associated or prescribed.

Curved Spacetime and the Disintegrated Vacuum

From general relativity, additional characteristics of the modern vacuum/spacetime may be inferred or interpreted.

First, we may take a "flat spacetime" to consist of a charged vacuum, such that both the magnitude and structure of the VPF are essentially unchanged from point to point, and the flux of virtual particles and virtual antiparticles are balanced. Equal positive and negative time flows/charges exist.

Note, however, that we can have what casually may appear to be a "flat spacetime" but instead is "warped." This case exists when the magnitude of the overall VPF comprising the vacuum does not change from point to point, but the component structure of the VPF does vary from point to point.

In other words, the overall vacuum potential remains the same from point to point, but two or more individual potentials may canonically vary. Let us further clarify this point by analogy.

Suppose we view the vacuum/ether/spacetime as a special sort of gas, where the "gas" is actually a mixture of many, many gases.

It is a rather peculiar sort of gas; it exists in five or more dimensions and is composed of very strange, fleeting particles which . spontaneously are created and destroyed, each arising out of nowhere and returning to nowhere almost immediately.

There is only minuscule (negligible) time overlap (integration) of the existence of these virtual particles in the main.

That is, mostly each virtual particle — along with its associated energy, movement, momentum, charge, and increment of time — exists almost entirely as an individual.

The energies, movements, momenta, charges, and time increments of the individual virtual particles do not integrate or sum to any appreciable degree in vacuum.

Thus, although casually this ether/gas may seem to contain enormous "energy density", momentum density, charge density and time increment density, these are not *integrated* energy density, momentum density, and time density in the normal sense.

Instead, they are the densities *of disintegrated* energy, *disintegrated* momentum, and *disintegrated* time flow.

In scalar electromagnetics, we have called the disintegrated energy of vacuum **anenergy.** This clearly distinguishes that it exists in a fashion altogether different from normal, *integrated* energy with which we are accustomed.

By integrating anenergy, of course, one obtains ordinary energy—but it first requires an integrating agent. The most **usual integrating agent/operation is the spin of an observable particle of** mass.

Similar considerations apply to momentum and time.

With this more **precise interpretation, the vacuum contains enormous anenergy, but essentially no energy. It contains enormous virtual energy, but no observable energy.**

Unfortunately, however, orthodox physics does not yet clearly differentiate between the two states of energy, virtual and observable (disintegrated and integrated).

Instead, it continues to loosely utilize the term "energy" for both states, whether integrated or not. Thus it exclusively uses the term "**energy** density of vacuum." Rigorously, the term should be "anenergy density of vacuum."

Indeed, most physicists are not clearly aware of the distinct difference between the two different states of energy, insofar as the implication of integration or nonintegration.

Regrettably, then, we will continue to utilize the orthodox term, "energy density of vacuum." but the reader should be clearly aware that the vacuum "energy" and vacuum "stress energy density" as **such** are totally disintegrated.

Separation of Vacuum and Observable *States*

Because the energy density of vacuum is unintegrated, an integrated physical body — including one's personal body — can **exist** "in" the vacuum medium of incredible "energy" density, yet observably exist in a medium of zero energy density.

The unintegrated vacuum ether has enormous spatial density of *virtual* energy, but essentially has zero spatial density *of observable*

energy.

Note, however, that in our hyperdimensional interpretation of the levels of virtual state, the vacuum spatially does not exist in the normal 3-space of observable matter.*

The vacuum occupies the 4th dimension (time) and all spatial dimensions (hyperdimensions) greater than the third — it occupies all levels of virtual state, but not observable state. It occupies all levels of disintegration, but not the levels of observable integration.

Exchanges occur between normal 3-space and the hyperspatial vacuum, through the common connecting dimension, time.

These exchanges (of virtual particles) are integrated by the spinning observable mass particle into the first quantally excited state — a delta (change) representing a single entrapped quantum — of the 5-space potential represented by the particle and its accumulating VPF. At that time a sharp electromagnetic (fifth dimensional) discharge of the quantum occurs, converting the accumulated 5-G quantum to the ordinary EM quantum of the 4th (time) and 5th (infolded space) dimensions.

This accounts for the so-called "collapse of the wave function", the production of unitary quantum change, and the discretizing of observable change.

We note in passing that time is the only "dimension" where everything can be considered to occupy the same "point" or "interval", but it is discretized and chopped into pieces (disintegrated), quite different in nature from the familiar three spatial dimensions of the observable (integrated) universe.

The dimensional separation (spatially) of the seething vacuum "energy" (anenergy) and the 3-space of normal matter allows a physical body to enormously interact with the vacuum at or near equilibrium at the microscopic level, but maintain its macroscopic form and stability as if no interaction were going on.

Partial Potentials, Curvature, and Warping

At any rate, we view the magnitude of the overall "potential" of this vacuum gas mixture, as the magnitude of the entire "stress

*Here we sharply differ from conventional physics, which hopefully confuses the concepts of vacuum, spacetime (indeterminate), spacetime (determinate), and frame.

Figure 60. A potential is trapped energy. A potential in vacuum is trapped virtual-state "energy" or flux. A natural potential is trapped random energy. An artificial potential is trapped organized energy.

energy" or "pressure" of the mixture — IF AND ONLY IF this stress energy or pressure were somehow integrated.*

As can be seen, we can now look at each of the component gases in the mix as contributing a partial pressure or partial stress energy (an individual component potential) of the vacuum conglomerate.

We may have the overall pressure remain the same, yet canoni-

***Thus it's** really the **potential** stress energy density. The vacuum is nothing but potential!

cally change the partial stress energies (individual potentials).

In that case one has an internally twisted or "warped" spacetime.

A warped spacetime may prove quite useful, for example, for direct translation of one type of "energy" into another. In that fashion, one may conceivably obtain radiation energy at the expense of mass, or mass at the expense of radiation energy.

Or one may convert between potentials where one or more of the converted potentials are as yet unknown to orthodox physics.

Kaluza theory, for example, contains many potentials that are as yet unknown and undiscovered in nature. When undue simplifications are made to arbitrarily exclude the unknown potentials, the adapted theory leads to error in its predictions.

This was originally regarded as a great imperfection, and Kaluza theory fell into disfavor for decades. Then as modern particle physicists began to produce fundamental particles of an astounding variety, a Kaluza-Klein theory of 11 or more dimensions was found to very reasonably describe the emerging situation. Once again, then, Kaluza-Klein theory became a moving force among modern theorists.

One may also convert electromagnetic field energy into gravitational field energy, for example, and obtain enormous amplification of gravitational effects.

This is precisely what scalar electromagnetics seeks to do.

Since the electrical field between two electrons is about 10^{42} times as strong as the gravitational force between them, conversion of the EM charge flux into gravitational charge can conceivably yield up to 10^{42} times as much gravitational force as normal, depending upon the efficiency of the conversion process. Even with a process or device that uses electron currents and has an efficiency of only 10^{-22}, gravitational/inertial gains of 10^{20} are possible.

Note, however, that the levels of vacuum may also be compared to horizontal planes beneath the ocean.

For example, we may take a particular level of vacuum potential, and that level constitutes a sort of included "flat spacetime" of its own. By biasing the potential of a scalar transmitter and receiver to a given level, one may transmit (in either direction) at that level only, Receivers at higher or lower levels will detect nothing.

The immediate application to engineering the nucleus for such things as nonradioactive transmutation of elements, controlled nuclear fusion, electromagnetic healing, and processing nuclear wastes to render them harmless should be apparent.

To recapitulate our analogy, a true "flat spacetime" is a vacuum whose VPF does not essentially vary overall or in each constituent part, between two comparative points.

A "curved spacetime" is a vacuum whose overall VPF varies in overall magnitude, between two comparative points.

A "warped spacetime" is a vacuum whose VPF may or may not **vary** in overall magnitude between two comparative points, but whose partial VPFs vary their ratios, between the same two points. Note that a vacuum/spacetime can be both warped and curved.

It is stressed that we have not limited the number of dimensions **that** can be placed on the vacuum to Minkowski's four. We hold the number of dimensions necessary to represent both vacuum and observable matter to be arbitrary, but greater than four.

To unify electromagnetism and gravitation (which is what scalar electromagnetics is about), we must take five dimensions — four spatial and one time — to be the minimum necessary in modeling the unified theory, similar to Kaluza.

We state now a major characteristic: **Vacuum/spacetime consists entirely of potentials, nothing else, and these are hyperspatial a priori.**

The vacuum does not contain observable force fields nor any **Other** *non-potential* entity.

We also state without proof that in scalar EM theory it seems **very** possible to model the mind and its unification with physical **reality,** in a fashion subject to experimental verification.

Force and Mass Are Inextricably Intertwined

In foundations of physics, it is well-known that, paradoxically, force and mass can only be defined one in terms of the other.

We may use that paradox for a new interpretation of force and **force** fields: a force may be interpreted **to consist of** the time rate of changing the "mv" momentum of a mass system or object, instead of **being the cause of** its dp/dt.

That is, we may take the view that

$$\mathbf{F} \equiv \mathbf{dp}/dt \qquad (4\text{-}14)$$

not just that

$$\mathbf{F} = \mathbf{dp}/dt \qquad (4\text{-}15)$$

We have previously pointed this out and called it the "strong definition of force."

This immediately suggests the question: If force is an effect and not a cause, what, then, causes force?

Quantum mechanics already provides the answer: A differentiating operator must be applied to (coupled to) potential in order to produce a force field. The most usual "differentiating operator" is an observable spinning charged particle.

A charged particle exposed to the variation of electrostatic scalar potential between two points is exposed to a gradient (flow) in the virtual photon VPF, and hence to a directional "stream" of virtual photons. The observable charged particle couples to that stream. **Its** spin integrates the unobservable, disintegrated anenergy of the gradient flux into integrated, observable energy of the particle.

With greater integrated "pressure" on one side of the particle than on the other, the observable particle accelerates and translates This produces or "detects" (and comprises) an electric force between the two points.

Force is the mass particle(s) accelerating, either in time or in mass. Observable force is observable particle(s) accelerating. **Vir-**tual force is virtual particle(s) accelerating.

In **Quiton/Perceptron Physics,** I gave a new definition of mass that is consistent with this viewpoint:

$$1 \text{ kg. mass} = 17.053 \times 10^{50} \text{ switches/sec} \qquad (4\text{-}16)$$

where a switch is h/4*pi), having the units of action/time, or energy. This directly defines mass in terms of energy accumulation, where

the energy accumulated is in equilibrium in a differentiated action flow.

Note that "energy" is the time rate of flow of action. Energy can only be accumulated (as a mass or a potential) by possessing two rates of flow of action simultaneously, one in positive time and one in negative time. This is a very deep statement that affects all of physics, but unfortunately it is beyond the scope of this present book.

To return:

The observable electric force field does not exist as such in vacuum. The vacuum and all its constituents are totally virtual. Only the potential ("potential for the electric force field, given a coupled charged observable particle") exists in vacuum, as pointed out by Richard P. Feynman et al, The Feynman Lectures on Physics, Addison-Wesley, Reading, Mass., 1964 vol. 2, p. 2.

The Concepts of Zipped and Unzipped Forces

As noted previously, the potential exists as an unintegrated virtual particle flux (VPF). Further, each little moving virtual particle is smeared in length and time, is coupled to finer VPF, and thus may be said to constitute a minute "force vector" while it exists.

Thus, the electrostatic scalar potential is composed of a myriad of little individual "virtual particle force field" vectors.

Since these little virtual vectors are essentially separate and unintegrated, one may say that the electric field is *unzipped* in vacuum. By "unzipped" we mean that the individual virtual particle E-field vectors are unintegrated.

A potential, for example, is composed of unzipped vector fields since it is comprised of unintegrated, virtual vectors.

To be static, the potential must be comprised of a pair (at least one pair) of unzipped vector fields, one in positive time and one in negative time. These unzipped vector fields must in turn be locked together. In this case, the positive time observer sees nothing (vacuum only), until he "observes" or detects. Normal detectors detect (and in so doing, they zip together) only the positive time unzipped component. The negative time (phase conjugate) vector held retraces the positive time field, in Newton's third law. Or, if generating a wave or pulse, it would be seen as a phase conjugate

replica which affected the disturbing source.

Let us be very plain. **A "scalar EM potential" is actually two vector fields zipped together: one is in positive time, and the other is in negative time.** Each half is composed of microvectors. A dynamic gradient in this scalar EM potential (i.e., a scalar wave, for example) actually consists of two waves: one is the normal" positive energy/positive time" EM wave, while the other is the phase conjugate replica. When we detect the normal half (with electron detectors), we actually detect the second half with the atomic nuclei. Since it is a phase conjugate, it produces a negative momentum change on the nucleus {since one has p/(-t)} instead of LeSage's positive momentum change. In other words, it produces a drawing (attracting) force on the absorbing nucleus, instead of LeSage's assumed repelling force on it.

That is the entire secret of gravitation. And of electro-gravitation. Knowing that, you can easily work out how to apply the necessary engineering to get antigravity.

But to return.

The potential can also be comprised of many unzipped vector fields at once. These may be deterministic (artificial potential) or randomized (natural potential).

The "force field" is disintegrated (unzipped) in vacuum, and integrated (zipped) on, of, and by an observable charged particle. In vacuum, it is always accompanied by its phase conjugate twin. When detection by an observable particle occurs, the spin of the particle acts as the "zipper," producing an observable force (which is actually of the particle accelerating, not "acting independently upon it.")

Vacuum is unzipped; observable mass is zipped.

Any zipped entity exists observably in 3-space; any unzipped entity exists in hyperspace outside 3-space, and is unobservable and virtual to the 3-space observer.

This interpretation is still consistent with the extended quantum mechanical view, where ultimately all observable forces are considered to be generated by absorption and emission of virtual particles by/from an observable particle (mass), at least insofar as what we may observably measure or detect.

Force, Force Field, and EM Waves in Vacuum

In the new interpretation, consistent with the quantum mechanical view, observable force becomes an effect, not a cause.

One may interpret quantum mechanics as stating that **any observable is an effect, since it is assumed to have a virtual state cause.** In the axioms of quantum mechanics, an operator is required for every observable.

The primary **causative agents are potentials, not force fields, as** is **now** firmly **established in** quantum mechanics.

The Aharonov-Bohm (AB) effect is a striking illustration of the primary reality of the potential rather than of the force field.

In the AB effect, potentials may still exist when the force fields **are** zero, and their interference can still cause real effects. The AB effect has finally become generally accepted by physicists after nearly three decades of controversy.

The immediate result is that, contrary to the outdated view imbedded in classical EM, observable E and B force fields do not exist *as such* in vacuum. This allows a totally new interpretation of the **nature** of the EM wave in vacuum: It is longitudinal. And actually, it exists in longitudinal pairs: the second is the phase conjugate of the first.

But of course we detect transverse waves with our detectors! However, this has a simple explanation.

Examine, for example, a straight-wire antenna. The spinning conduction electrons are longitudinally constrained, as is well known. The electrons are relatively unrestrained transversely in the **wire,** but can only "drift" longitudinally down the wire with a speed usually on the order of centimeters per second. The signal potential, however, moves longitudinally down the wire at almost the speed of **light.**

Obviously it is not the longitudinal movement of conduction electrons that constitutes the "signal", even though classical electromagnetics represents it that way.*

We note that a spinning electron whose movement is longitudi-

*Actually, we do not really know how current/electrons travel down a wire, or even if it does/they do. See three articles by Chappell Brown in Electronic Engineering Times: "Railgun Research Shoots Holes in Lorentz's Theory," April 6, 1987,p. 49-50; "Anomalies in Electromagnetic Law Spur Debate," Sept. 14, 1987, p. 58; "Electrons and Conduction: Not So Simple After All," Dec. 28, 1987, p. 21-22.

nally restrained, but is unrestrained transversely, may be characterized as a gyroscope. Further, the axis of this gyroscope may be taken as lying in a plane perpendicular to the straight wire conduction path, since the electron is relatively unrestrained transversely.

If now disturbed by a vacuum potential gradient, the gyroscopic electron is free to precess at right angles to the length of the wire. In other words, given a disturbing force, the electron will move transversely, or radially in the cross sectional plane of the wire, because of gyroscopic precession.

Thus, assuming a gyroscopic electron and its longitudinal constraint, we will detect transverse oscillations in the electron gas in the wire, IF AND ONLY IF the incoming disturbance in the vacuum is longitudinal, and IF AND ONLY IF the unzipped vacuum disturbance "couples" to (is zipped by) the gyroscopic conduction electrons.

Two things are certain in our electron-detector model: First, by the nature of a gyroscope, the conduction electrons move (precess) at right angles to the "disturbing force." Second, we only detect the movement of the electrons themselves.

Since we do detect transverse oscillations of the precessing electrons in the straight wire antenna, then it follows that normal electromagnetic waves in vacuum—that is, the component half that, interacts with the atom's electron shells and not with its nucleus — are (1) longitudinal, and (2) of such form that they couple to electrons.

Note that Tesla always insisted that electromagnetic waves in vacuum were longitudinal. For example, he called them "electromagnetic sound waves" in the ether. In "Tesla Maps Our Electrical Future," H. Winfield Secor presents Tesla's view of transverse waves in this fashion:

"Tesla upholds the startling theory formulated by him long ago, that the radio transmitters as now used, do not emit Hertz waves, as commonly believed, but waves of sound... He says that a Hertz wave would only be possible in a solid ether, but he has demonstrated already in 1897 that the ether is a gas, which can only transmit waves of sound; that is such as are propagated by alternate compressions and rarefactions of the medium in which transverse waves ***are*** *absolutely impossible."*

In his "The True Wireless," **Electrical Experimenter,** May **1919,** Tesla himself further stated:

"The Hertz wave theory of wireless transmission may be kept up ***for*** *a while, but I do not hesitate to say that in a short time it will be recognized as one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history."*

It should also be pointed out that our analogy permits the option of making a longitudinal wave in the vacuum in such a fashion that It will not couple to electrons.

In that case a normal"electron gas" conduction detector will not detect the new wave. Such a noncoupling EM longitudinal wave is **referred** to as a **scalar electromagnetic wave,** where by use of the **term** "scalar" we call attention to the fact that the vacuum potential **is** varying, but electron coupling to form vector force fields in an **electron** gas does not occur.

Since according to general relativity the variation of a potential in vacuum rigorously is a gravitational wave, then the scalar EM wave is a gravitational wave.*

We often say it is an *electrogravitational* wave to call attention **to** its electromagnetic origin, and to the absence of EM force field "bleeding away" of the 5-space Kaluza-Klein gravitational potential. We will discuss the 5-space G-potential shortly.

The conventional equation

$$\mathbf{E} = -\nabla \emptyset \qquad (4\text{-}17)$$

thus applies in the detecting electron gas, but not in the vacuum. Instead, in the nonmaterial vacuum, rigorously

$$\nabla \emptyset \neq -\mathbf{E} \qquad (4\text{-}18)$$

and this states that a gradient in a vacuum electrostatic scalar

*It is also a very powerful gravitational wave, since for electrons it is some 10^{42} times as strong as "mass attraction" gravity waves.

potential produces an antiphased electric force on and of a particle, on condition that a particle is present. The intent of equation (4-17) should be stated as

$$\nabla \emptyset = -\mathbf{E} \qquad (4\text{-}19)$$

where the vertical line means "on condition that", and cp means "charged particle" (i.e., "that a charged particle is there.).

Equation (4-19) clearly shows that, in the vacuum, only the organized potential for an E field exists due to the quantity $\nabla \emptyset$ essentially as pointed out less strongly by Feynman et al in **The Feynman Lectures on Physics.**

Certainly, in the quantum mechanical interpretation, it is the potential that is real. The force field can only be made from the potential by a differentiating operation.

Since there is nothing in vacuum to perform this differentiating operation observably, one may interpret quantum mechanics as already prohibiting the existence of observable electromagnetic force fields in vacuum, at least in the form prescribed in classical electromagnetics.

Figure 61. A force-field vector is a movement of mass in one direction.

One may regard quantum mechanics — and physics in general - to be incomplete until electromagnetic theory is changed to incorporate the implications of quantum mechanics.

In scalar electromagnetics a new interpretation is taken, and the "overhaul" of electromagnetic theory is in progress.

We accent that scalar electromagnetics is still embryonic. It is at a stage similar to that where electromagnetism was when experimenters were still rubbing glass rods with cat fur and experimenting with little charged pith balls.

Early experiments are enlightening and encouraging; nonetheless, the phenomenology and the myriad of variables are not at all well-understood, even by the experimenters themselves, and certainly not by this author.

Zero-Summed Vector Systems: Shortcoming in Vector Analysis

It has long been pointed out by this author that a fundamental shortcoming exists in classical vector analysis itself when applied to physical systems. Let us briefly look at the construction of the vector mathematics theory, to clarify this shortcoming.

First, an abstract entity called a "vector" is conceptualized. This vector has both direction and magnizude, as contrasted to a "scalar" quantity, which only has magnitude.

Next, an abstract "vector space" is defined; this is a sort of "container" for mathematical objects called vectors, with certain inherent properties of the system specified. In other words, a vector space is an abstract "system" or "space" which can contain objects called "vectors."

Next certain other properties, operations, and entities are defined, one of which is the is the "zero vector".

Essentially the zero vector is defined by a set of operations; however, one simplified interpretation is "the absence of any vector of finite magnitude." By implication, in the abstract vector theory, all zero-vectors are defined to be identical.*

* Because, by their nature assumed in the concept, they have no internal structures. That is, effectively the zero vector has been too restrictively defined as "the absence of any and all finite vectors." It should be redefined as "the absence of any single vector being present alone." In that case the definition would admit "the presence of multiple translation vectors, where their combined translation action is zero."

In the vector addition operation, a group of finite vectors adds to a single vector called the "resultant."

It is standard practice in abstract vector analysis to replace a system of summation vectors by their resultant, since all appropriate properties of the summation system are retained by the vector resultant, in the abstract mathematical model.

This, however, is only possible because the abstract vector space has no such thing as stress, and a zero-vector has no substructure by definition. In the abstract space, only translation and rotation are possible, *by assumption*

It is also possible for two or more finite vectors to add to a zero resultant, in which case the system is replaced with a zero vector. Note that all further action by the summing vector components is eliminated by this assumption.

Again the appropriate properties of the summation system are retained by the zero resultant, in the abstract mathematical model, only because the *medium* (the abstract vector space) is not subject to stress, translation, rotation, and structuring.

Note however, that in physical systems, one cannot simply

Figure 62. The zero-summed vector system is an engine and an artificial potential.

replace a zero summation system of force vectors with a zero vector and retain all characteristic physical effects caused by the replaced system. The physical medium - including the virtual flux of the vacuum, *is* subject to stress, translation, rotation and structuring.

Physically, the presence of the summing vector component forces creates a stress and a dynamic macroscopic structure in the physical medium in and on which the forces are acting. Therefore the stress of the medium and its structure must be preserved and accounted for, even though a zero vector resultant force exists.

This is particularly true in the vacuum, where internal (in-folded) stresses cause charge and energy conversion between one kind of charge/potential and another.

Maxwell's Theory Was Altered and Curtailed

In fact, Maxwell seems to have been well aware of the electro-magnetic stress of the ether and its importance. After all, he believed the ether to be material and mechanical, and developed his theory accordingly.

For example, in his Treatise on Electricity and Magnetism, he wrote:

"There are physical quantities of another kind which are related to directions in space, but which are not vectors. Stresses and strains in solid bodies are examples of these, and so are some of the properties of bodies considered in the theory of elasticity and in the theory of double refraction. Quantities of this class require for their definition nine numerical specifications. They are expressed in the language of quaternions by linear and vector functions of a vector."

Maxwell worked out his theory in quaternions since, at the time, the modern form of vector analysis had not been originated by Heaviside and Gibbs.

To recapitulate what we stated earlier: A quaternion consists of a vector part and a scalar part and can readily take into account the stress and strain of the medium. A vector consists only of the vector part, and does not take into account the stress of the medium.

It seems certain that Maxwell knew that the scalar part of the

quaternion could be present and vary, even though the vector part was sum-zeroed. Quaternions, however, are devilishly difficult, and even in the time of their founder, Hamilton, few mathematicians and scientists ever mastered them.

Maxwell's theory was transposed (shortly after his death) to its modern vector form by Oliver Heaviside. Many of the characteristics of the scalar part of the quaternion were effectively discarded.

In the remodeling, the "unified" basis was omitted, and electro-

Table 37. MAXWELL'S EQUATIONS

- **INVARIANT**
  - **UNDER CONFORMAL GROUP OF TRANSFORMATIONS**
  - **IN 4-D MINKOWSKI SPACE**
- **GROUP INCLUDES**
  - **TRANSLATIONS**
  - **ROTATIONS**
  - **REFLECTIONS**
  - **INVERSIONS WRT HYPERSPHERES OF M-SPACE**
- **HENCE MAXWELL'S EQUATIONS INCLUDE TRANSFORMATIONS THAT**

  <u>CHANGE INERTIAL FRAMES INTO</u>
  <u>FRAMES THAT ARE NOT</u> INERTIAL.

  PROVED IN 1910 BY
  H. BATEMAN AND E. CUNNINGHAM

gravitation was accordingly discarded. Heaviside wrote a severely limited subset of Maxwell's theory; he did not by any means capture all of it.*

The new Heaviside vector reinterpretation of EM was far easier to calculate in than Maxwell's quaternions. Many physicists (there were really very few scientists in those days!) immediately loved it.

FitzGerald wrote glowingly of Heaviside's translation (and mutilation!) of Maxwell's theory:

"Since Oliver Heaviside has written, the whole subject of electromagnetism has been remodelled by his work. No future introduction to the subject will be at all final that does not attack the problem from at least a somewhat similar standpoint to the one he puts forward."

Thus it was that Heaviside discarded the basis for scalar electromagnetics and electrogravitation from Maxwell's original work, and **the** so-called "classical Maxwell Equations" appeared for the first time in their modern vector form in Heaviside's work.

Then in the early 1890's a short but vigorous debate on vectors and vectorial methods occurred, involving eight journals, twelve leading publications, and over 30 scientists. Over half the publications were in the leading British scientific weekly journal Nature.

This debate, which Lord Rayleigh characterized by the statement "Behold how these vectorists love one another," together with **the** far greater difficulty of quaternion methods as compared to Gibbs'and Heaviside's vector analysis, spelled the death knell to the position of quaternions.

After some years, the Gibbs-Heaviside vector theory was firmly entrenched. The quaternion theory of Maxwell was forever modified **and** limited to the form we know today as "Maxwell's equations."

What really happened was that electrical physicists, faced with the formidable difficulties of quaternions, simply stampeded down the far easier road blazed by Heaviside, bowling over all protests against Heaviside/Maxwell/Hertz theory.

*Specifically, Heaviside wrote the subset of Maxwell's theory where gravity and electromagnetism do not interact and are mutually exclusive.

In Western universities today, no one actually teaches Maxwell's true theory! Instead, Heaviside's curtailed reinterpretation — a severely restricted subset of Maxwell's theory — is taught.

And so that is the EM theory that is learned and applied.

One may rightly argue, therefore, that **Maxwell's theory has only been partially applied in its modern translated form, and the modern form of the Maxwell/Hertz electromagnetic theory is very much incomplete.**

To recover the stress factor in Maxwell's original theory, electromagnetics must take into account the *artificial* potential, which has a deliberately ordered, dynamic, deterministic structure. Scalar electromagnetics takes the patterned stress into account and deliberately uses it. Normal electromagnetics only considers the *natural* potential with randomized VPF structure implicitly assumed.

Scalar Waves ***and Polarization of*** *the* ***Vacuum***

Let us use a simple analogy. This will lead us into the profound implications of the deliberate vacuum polarization and curving of local spacetime that is provided by the vector zero summation (artificial EM potential) method of scalar electromagnetics.*

Visualize two sets of opposing and balanced forces pressing on the sides of a plate.

The forces sum to zero, so the resultant force acting on the plate for translation is zero. Hence the plate does not translate (move away or accelerate).

However, the plate is under internal stress (compression), and is in a quite different condition than when it has no external forces at all acting on it.

Now visualize the forces being applied with rigid rods welded to the sides of the plate, so that the forces may alternately "pull" as well as "push." Let the forces rhythmically vary, alternately "pulling" and "pushing", but always remaining balanced so that their summation for a translation resultant is constantly a zero vector.

The plate never accelerates or moves in translation, but it now contains an internal stress wave which rhythmically varies between compression and tensile stress. Rigorously the plate internally

*Vector **multiplications** that yield a zero vector product are also highly significant.

possesses a scalar stress wave, or a wave of "internal stress in the medium."

Now visualize a similar "plate-like" region of vacuum, with its virtual particle flux, instead of the material plate. Visualize two opposing sets of (unzipped) EM force fields, acting in and on the plate-like region, so that they rhythmically increase and decrease, changing direction also, but always with a zero vector summation.

In this case, there is an unzipped zero resultant EM force field (it is zero, by our assumed conditions), but there is a rhythmic oscillation of the intensity of the vacuum flux (intensity of the vacuum potential) and the vacuum structuring in the region. That is, there is a rhythmic and steady oscillation of the stress energy and structuring of vacuum, and hence of the curvature of spacetime, in **the** plate-like region.

Rigorously, this oscillation — which we call a scalar electromagnetic wave—is a gravitational wave, since the local curvature of spacetime is being oscillated.

Further, it differs from a "natural" gravitational wave in several respects:

1. It has a deterministic pattern or substructure,

2. It patterns or "polarizes" the vacuum,

3. It constitutes local curvature of spacetime, and hence localized general relativity - something which ordinary general relativity assumes cannot be accomplished,

4. It deterministically engineers the virtual state and local spacetime,

5. Since it is achieved by converting EM field energy into artificial G-field energy, one can expect tremendous gains of gravitational and inertial effects in and around electrical circuits utilizing such fields precisely,

6. It affects the Schroedinger wave and the probabilities of the

states being propagated forward by the Schroedinger wave. **With the scalar EM wave, one can thus deterministically engineer the emergence of quantum change, and violate one of the fundamental assumptions of quantum mechanics, that of the totally statistical nature of quantum change,**

7. The scalar wave can accomplish direct and localized change of the rate of flow of time (even to its reversal) and variation of mass and inertia, without concomitant translation of matter,

8. By locally curving and patterning vacuum spacetime, a stabilized standing scalar EM wave can provide macroscopic violation of the conservation laws, which rigorously depend upon a locally flat spacetime (Lorentz frame),

9. Since the components in the zero summation may be EM waves, and may be "locked together" and broadcast to a great distance and interfered there, effects at great macroscopic distances may be achieved, in violation of present assumptions of physics, and

10. Since excess negative time flow may be locally produced, antigravity, negative energy, and negentropy may be locally produced.

These are the startling implications inherent in correcting classical electromagnetics' improper treatment of zero-summed EM force vector systems in vacuum.*

By classically replacing the force vectors in a zero EM force field summation with a zero vector and discarding the components, one is totally discarding the fact that such a patterned system of oppositive forces forms a deterministically patterned stress in the vacuum medium.

By this innocuous error, classical EM discards electrogravitation, and avoids unification of gravitation and electromagnetics. It

*And its zero - multiplied force vector systems as well.

also avoids direct engineering of gravitation, vacuum/spacetime, inertia, rate of time flow, free energy, and quantum change.

Generations of Western physicists and electrical engineers have acquired a mindset in only one aspect of the vastly expanded electromagnetics actually available.

Vector Zero Systems and the Kaluza-Klein Approach

Prior to 1921, Theodor Kaluza applied Einstein's new general relativity to five dimensions.

He produced a unified theory of electromagnetism and gravitation.

In Kaluza's theory, the ordinary 4-dimensional gravitational field and the electromagnetic field are but two different aspects of a single more fundamental field: the 5-dimensional gravitational field.

Kaluza's theory was published in 1921, on the personal recommendation of Albert Einstein, who had had Kaluza's paper for two years.

In Kaluza's model, electromagnetics is the 5th dimensional aspect of the 5-d G-field, while the ordinary 4-d G-field is the intersection of the 5-d G-field with our ordinary world.

Five years after Kaluza's epochal paper, Oskar Klein explained where the extra space dimension — the fifth dimension — was. He modified it as "wrapped around" each point in our ordinary 3-space.

In the Kaluza-Klein model, then, an electromagnetic wave— which moves spatially only in the fifth dimension — does not move through our 3-space at all. Instead, on its trajectory it "flows around" each point in our 3-space along its path.

Using Kaluza's model, we may regard the EM field as the normal "bleed-off' or escape of the 5-dimensional gravitational potential in the 5th dimension.

Any gradient in a potential represents a bleed-off of the potential from the high point to the low point. The way to prevent effective bleed-off of a potential at a point is to add an equal amount of bleed-in! The bleed-out and the bleed-in at the point then become balanced, so that an equilibrium state exists in the potential.

By this mean, the magnitude of the potential can be fixed by the two opposing bleed processes in equilibrium.

Table 38. KALUZA GEOMETRY

- **THEORDOR KALUZA, POLISH PHYSICIST**
- **UNIFIED THEORY OF ELECTROMAGNETICS AND GRAVITY [1921]**

  - 5 - DIMENSIONAL SPACETIME
  - 5 - DIMENSIONAL GRAVITY FIELD
  - ELECTROMAGNETISM IS THAT PART THAT OPERATES IN THE FIFTH DIMENSION

Table 39. 5-D G-FIELD BLEED-OFF [KALUZA 5-D THEORY]

- **FAR EASIER TO BLEED-OFF AS ORDINARY EM FIELD**
- **VERY DIFFICULT TO BLEED-OFF AS ORDINARY 4-D G-FIELD**
- **E.G., BETWEEN TWO ELECTRONS:**

$$\frac{EM}{G(4)} \approx 0$$

- **BETWEEN TWO PROTONS:**

$$\frac{EM}{G(4)} \approx 0$$

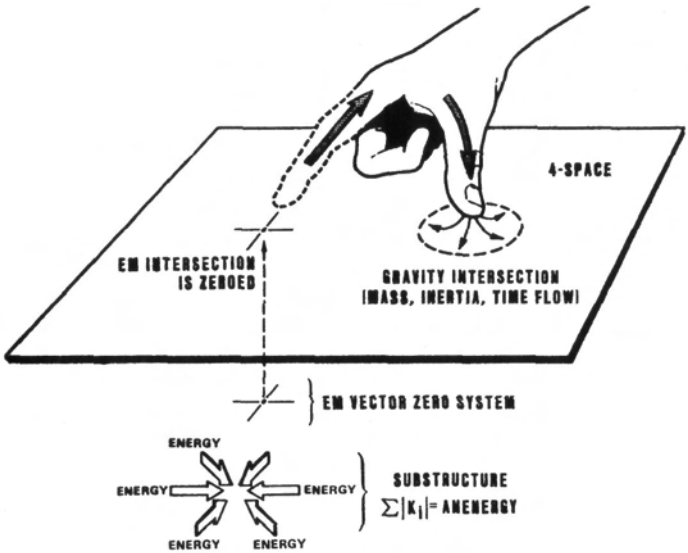

Figure 63. An analogy for how scalar electromagnetics can engineer Kaluza-Klein unified field theory.

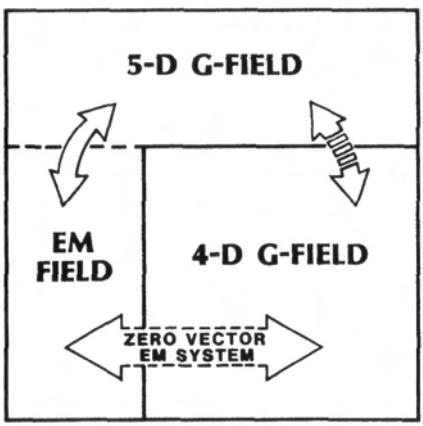

Figure 64. The zero-vector system can engineer Kaluza-Klein theory.

WHERE DID THE EXTRA DIMENSION GO?

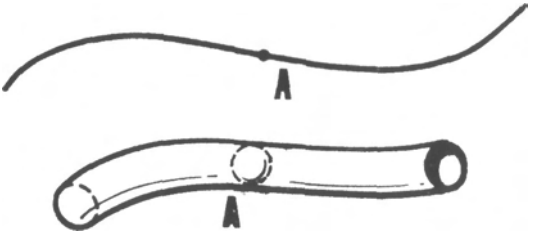

- **FROM A DISTANCE, A HOSE-PIPE LOOKS LIKE A WIGGLY LINE**
- **WHAT WE REGARD AS A POINT IN 3-SPACE IS REALLY A TINY CIRCLE AROUND ANOTHER DIMENSION OF SPACE**

Figure 65. The basic idea of Klein's explanation of where the extra dimension is.

Table 40. PHYSICAL REALITY IS ELEVEN DIMENSIONAL

- **IN THE KALUZA-KLEIN THEORY THE GAUGE FIELD SYMMETRIES BECOME CONCRETE**
- **THEY ARE THE GEOMETRICAL SYMMETRIES ASSOCIATED WITH THE EXTRA SPACE DIMENSIONS**
- **AN 11-SPACE IS REQUIRED BY THE GRAND UNIFIED FORCE THEORY**

PAUL DAVIES, SUPERFORCE.
1984, P. 160-161

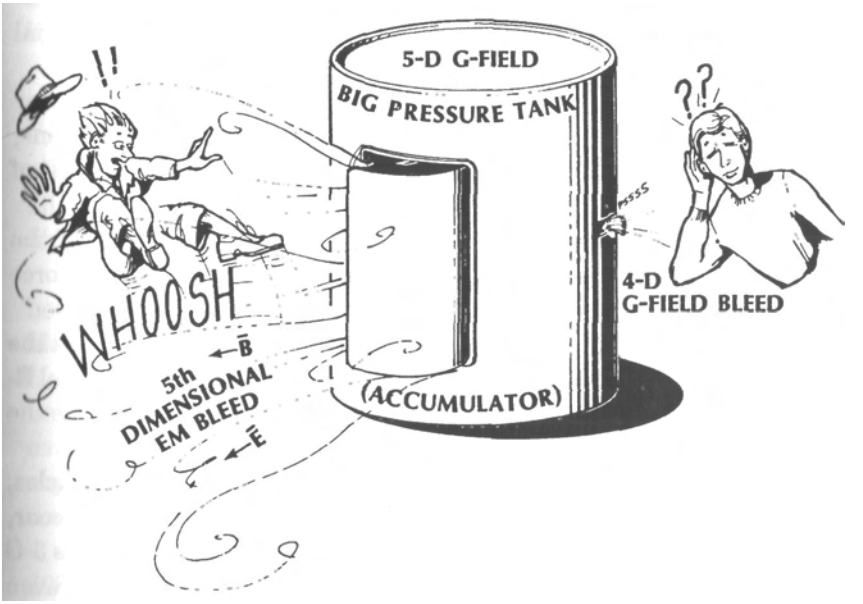

Figure 66. Normal EM bleeds off G-field.

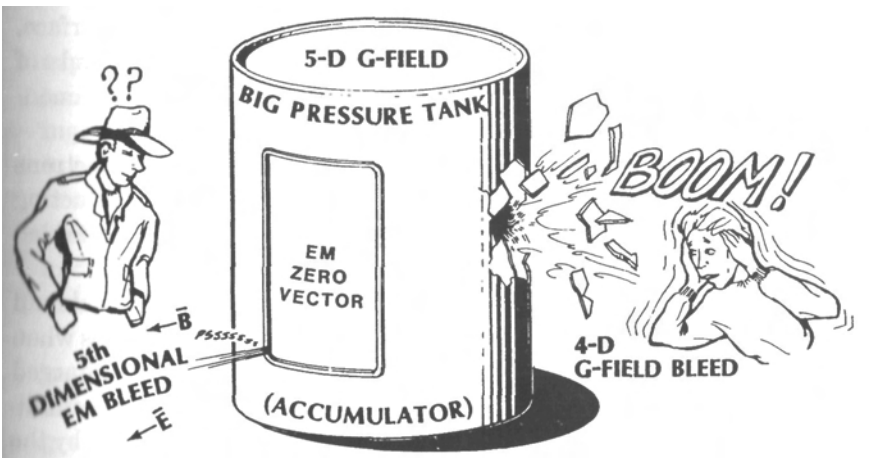

Figure 67. Scalar EM forces 4-dimensional gravitational field.

Note that this positively establishes that two or more zero-summed EM force field gradients produce and stabilize an artificial potential.

Usually, very little bleed-off of the 5-potential occurs in our normal 3-space. When the 5-space G-field is bled off on electrons, e.g., the resulting 5th dimensional E-field bleed-off is on the order of 10^{42} times as much as the 3-space G-field bleed-off.

This accounts for the enormous magnitude of the ratio of the electrical force between two electrons to the gravitational force between them.

Even when the 5-space G-potential is bled-off on and against the greater inertia of much more massive protons, its 5th dimensional E-field bleed-off is still on the order of 10^{36} or so times as much as the 3-space bleed-off.

Note that if we can stop the acceleration of the charged particles, bleed-off of the 5-space G-potential as EM force field cannot occur, and instead all of it must bleed-off as 3-space G-force field. This 3-G bleed-off normally occurs only minimally in electromagnetics, even for so-called "static" charges. This can be seen as follows:

When one charges a conductor such as a large metal sphere, for example, the electrons are unconstrained on the surface of the sphere. They are in constant agitation and motion on the surface, thus constantly bleeding-off the 5-space potential as myriads of squirming little E-fields. Only a very little is bled off as 3-dimensional G-field.

On the other hand, when one charges a dielectric, the electrons cannot be in as much agitation movement as they are on a conducting surface. Hence slightly more of the 5-dimensional G-potential is bled off as 3-dimensional G-field.

Therefore, charged conductors and charged dielectrics should exhibit slightly different gravitational and inertial properties when exposed to a gravity field potential difference. Highly charged capacitors, for example, should exhibit a small but detectable unidirectional thrust in vacuum. Apparently they do, as exhibited by the Biefield-Brown effect.

In addition, different materials should exhibit slightly different fall rates gravitationally. Again there is some evidence that they do,

as exhibited by the Eotvos experiments in a modern reinterpretation by Fischbach et al.*

Electrogravitation Amplification Factor

If the movement of two free electrons could be entirely stopped, all EM bleed-off of the 5-d G-potential between them would be effectively zeroed or blocked. Then the 5-d G-potential would be forced to totally bleed-off into ordinary 3-d G-field.

For two electrons, this could increase the gravitational force between them by a factor of 10^{42}, if the EM bleed were perfectly blocked.

Such perfect blockage of the 5th dimensional EM bleedoff cannot be accomplished in practice. Normally, with the increase in potential caused by zero-summing, agitating electrons in a statically charged object agitate more intensely, moving and squirming in local, erratic constraints.

However, conversion efficiencies on the order of 10^{10} or even 10^{20} appear to be achievable in ordinary circuitry. In that case, gravito-inertial amplification gains of up to 10^{22} or even 10^{32} appear to be achievable. Gains of 10^{10} or more appear to be fairly readily achievable.

Time delay in producing the gravito-inertial effects may be experienced, however, because mass (nuclei) acts as a capacitance to incident scalar waves, exhibiting capacitive charging and discharging "time constants" when charging scalarly for a particular effect or to a particular pattern.

In these achievable amplification ranges, a single milliwatt of electrical power can control enormously powerful local gravitational and inertial effects, once the scalar EM charge is built up in the nuclei of the target material.

Excessive and frustrating "fiddling time" with the circuits is usually required, however, due to the charging "time constant" effect, the general lack of adequate measuring instruments, and the great uncertainty as to the phenomenology and major variables involved.**

*Ephraim Fischback et al, "Reanalysis of the Eotvos experiment," Phy. Rev. Lett., 56(1), Jan, 1986, p. 3-6.

••A series of scalar EM instruments, however, is being developed by Bedini, Schnur, Golden, **and** perhaps even Hewlett-Packard.

However, with persistence, in rather ordinary EM circuits and devices, the use of "summation to zero-vector" techniques and "multiplication to yield a zero-vector" techniques can lower the EM bleed-off of the 5-potential sufficiently to allow substantial local gravitational/inertial effects. By beaming and wave interference, effects at a distance can be achieved.

When gravito-inertial amplification of many orders of magnitude are involved, the assumption in ordinary general relativity of a local Lorentz frame (local special relativity, with local conservation laws applying) is readily violated.

Now one may have local general relativity, with concomitant violation of conservation laws, and local broken symmetry on a macroscopic scale.

Soviet papers already strongly point out that such unrestricted general relativity allows the violation of all conservation laws.

In the Soviet Union, scalar electromagnetics is called *energetics.*

Comparison of EM Concepts

Table 41 shows a comparison between three concepts of electromagnetics: classical, quantum mechanical, and scalar electromagnetic views.

As can be seen, scalar EM re-introduces Maxwell's original potential for electrogravitational variation and structuring of the stress energy density of vacuum spacetime. It applies Kaluza-Klein 5-dimensional unified theory in an engineering fashion.

It deliberately utilizes phase conjugation as a tool to achieve startling negative time/negative energy capabilities and results, including "free" energy and antigravity.

With scalar EM, it should be possible to overcome or circumvent most of the severely limiting assumptions of present physics and engineering.

The great conservation laws yield to direct manipulation and violation. The previously inviolate statistical structure of quantum change becomes deterministic and engineerable.

General relativity becomes an experimental scientific discipline in the laboratory, instead of a complex description of effects only observable in distant, massively curved regions such as on the

surface of a star or near a black hole.

God does not play dice with the universe after all, just as Einstein suspected.

The Aharonov-Bohm Effect

In 1959, Y. Aharonov and David Bohm published a fundamental paper in **Physical Review** which pointed out the quantum mechanical implications of potentials.

The seminal paper is Y. Aharonov and D. Bohm, "Significance of Electromagnetic Potentials in the Quantum Theory," **Physical Review,** Second Series, 115 (3), Aug. 1, 1959, p. 458-491.

In classical electromagnetics, the potentials had largely been regarded as mathematical conveniences, having no real effects.

Table 41. Comparison of EM Concepts

CHARACTERISTIC	THEORY		
	CLASSICAL EM	QM VIEW	SCALAR EM (ARTIFICIAL ϕ)
VACUUM SPACETIME	LINEAR, NO CHARGE	LINEAR, CHARGED (VIRTUAL) STATISTICALLY	NONLINEAR, CHARGED (VIRTUAL) W/DETERMINISTIC COMPONENTS
VIRTUAL SUBSTRUCTURE	NONE (FLUID EQUATIONS)	YES, STATISTICAL	YES, STATISTICAL, DETERMINISTICALLY WEIGHTED.
FORCE, IN VACUUM?	CAUSE, YES	EFFECT, YES	EFFECT, NO
ZERO FORCE FIELDS	NO EFFECT	BOHM–AHARONOV EFFECTS	SUBSTRUCTURE EFFECTS, ENGINEERABLE
POTENTIALS	FICTICIOUS	REAL, PRIMARY, STATISTICAL SUBSTRUCTURES.	REAL, PRIMARY, DETERMINISTIC SUBSTRUCTURES.
CAUSATIVE AGENT	FORCE FIELDS	POTENTIALS	POTENTIALS AND INFOLDED FIELDS OF SUBSTRUCTURES
CHARGE	WITH MASS	WITH MASS	MASSLESS
RELATIVISTIC EFFECTS DUE TO	VELOCITY	VELOCITY, INTERFERING POTENTIALS	INTERFERING POTENTIALS
HIDDEN VARIABLES	NO	STATISTICAL, NEGLIGIBLE	DETERMINISTIC, MAJOR ROLE.
VECTOR THEORY APPLIED TO EM	OKAY	OKAY	REQUIRES REVISION
VACUUM EM WAVE	TRANSVERSE	TRANSVERSE	LONGITUDINAL W/SWIRLS
ENERGY/MASS CONSERVATION	YES	YES	NOT NECESSARILY. ANENERGY CONSERVED
CHARGE CONSERVATION	YES	YES	NOT NECESSARILY.
ACTION AT A DISTANCE	NO	NO, EXCEPT BOHM–AHARONOV EFFECTS	YES, SCALAR INTERFEROMETRY
SCALAR (ZERO-VECTOR) RESONANCE	NO	NO	YES
INERTIA IS ELECTRICAL	NO	NO	YES
GRAVITY IS ELECTRICAL	NO	NO	YES
MASS IS ELECTRICAL	NO	NO	YES
ELECTRO-GRAVITATIONAL WAVES?	NO	NO	YES
PRIMARILY INTERACT W/ (IN ATOM)	ELECTRONS	ELECTRONS	NUCLEONS
SPACETIME DIMENSIONS	4	4	>5
GEOMETRY	MINKOWSKI	PRIMARILY MINKOWSKI	KALUZA–KLEIN
ZERO-SUMMED VECTORS REPLACED BY	ZERO VECTOR	ZERO VECTOR	ARTIFICIAL POTENTIAL
RELATIVITY ASPECTS: LOCAL, DISTANT	SPECIAL, SPECIAL	SPECIAL, MAY BE GENERAL	GENERAL, GENERAL
CAN AFFECT SCHROEDINGER EQUATION	NO	NO	YES, CAN ENGINEER IT.

Table 42. THE AHARONOV - BOHM EFFECT

- **IN FIELD-FREE REGIONS**
  - **E - FIELD IS ZERO**
  - **B - FIELD IS ZERO**
- **POTENTIALS STILL EXIST**
  - **CAUSE REAL EFFECTS**
  - **INTERFERENCE IS KEY**
  - **CONTAIN SUM-ZEROED SUBSTRUCTURE**
- **DOES NOT FOLLOW FROM**
  - **MECHANICS**
  - **CLASSICAL ELECTROMAGNETICS**

However, according to quantum mechanics, the potentials are the real entities, while the electromagnetic force fields are just effects derived from the potentials by imposed operations on them.

Aharonov and Bohm showed that, even in the absence of the EM force fields, the potentials may still exist and interfere to produce real effects in physical systems. They suggested experiments to prove these predictions.

Interference of the potentials is the key mechanism producing real effects in charged particle systems, even in the presence of zero E-field and zero B-field.

Unfortunately, Aharonov and Bohm did not address this issue of zero-summed systems of EM force fields as one way of producing artificial potentials having unique interference characteristics.

That is, by implication they did not consider the deterministically substructured "artificial" potential, but only the randomly structured "natural" potential.

At any rate the "AB effect," as it came to be called, was rather hotly debated and fiercely resisted over the years. Steadily, more and more experiments were added, validating the AB effect. Finally, in 1986 it came to be generally accepted as proven to any but the most die-hard skeptic.

The AB principle represents a violation of both classical mechanics and classical electromagnetics. It is absolutely required, however, by quantum mechanics. And experiments have now established it as proven beyond question.

The potential, then, can be a free and independent field. Further, it can directly act on charged particle systems, even when classical electromagnetics does not recognize the interaction.

Curl-Free Magnetic Vector Potential (A-Field)

As an example, in classical EM the vector magnetic potential (the A-field) had been defined as a mathematical convenience by the equation

$$\nabla \times \mathbf{A} = \mathbf{B} \qquad (4\text{-}20)$$

But if the potentials are real, then conceivably the A field can be loosed from its enchainment to the $\nabla \times$ operator. In that case, it

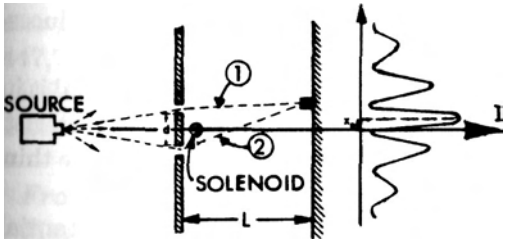

A - FIELD CAN INFLUENCE THE MOTION OF ELECTRONS.

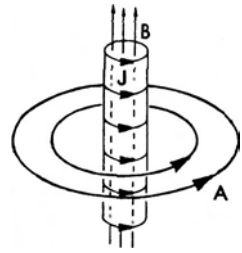

MAGNETIC FIELD AND VECTOR POTENTIAL OF A LONG SOLENOID.

THE FEYNMAN LECTURES ON PHYSICS. VOLUME II

Figure 68. The curl-free A-field. The magnetic vector potential (A-field) may be freed from its attachment to the magnetic field (B-field) and electric field (E-field). It can interfere at a distance to cause real effects. From it, either E-field or B-field, or both, can be made at a distance.

becomes a free, new, and independent field of nature with potentially unique characteristics.

For instance, its defining equation shows that magnetic force field can be made from it, and the rightmost term of the equation

$$\mathbf{E} = -\nabla Ø - d\mathbf{A}/dt \qquad (4\text{-}21)$$

shows that its time rate of change makes an electrical field.

Let us explain this in simpler terms, and somewhat more precisely than conventional theory. We will use the Kaluza unified G-EM interpretation and electron flow in our explanation.

In the A-field, we have a certain kind of 5-dimensional G-potential which can bleed-off as EM force fields in two ways: (1) in a swirl fashion, where the vortex producing the swirl moves parallel to electron movement, and the swirling is a torque or spin, and (2) in a linear fashion, where the time rate of change of the A-potential produces a linear E-field on the electrons.

The first bleed-off as given by equation (4-20) constitutes the magnetic B-field, and the second bleed-off as given by the rightmost term of equation (4-21) creates a component of the overall electrical E-field. Bleed off of the electrostatic scalar potential produces the other component of the E-field.

Now in general relativity (GR) theory, "the" G-potential is just a conglomerate of many things, each of which has the characteristic of curving spacetime. "The" gravitational field is not a single thing at all, but is composed of a collection of many things.

Thus if we realize that both the electrostatic scalar potential (Ø-field) and the magnetic vector potential (A-field) are components of the 5-d G-potential, then we see immediately that bleed-off of these two components of the 5-d G-potential creates all normal EM fields.

It follows that, if we produce a zero-vector summation of the two or more EM bleed-offs, we are actually "putting as much back in" to the 5-d G-potential through its A and Ø components as we are taking out electromagnetically.

In that case, the 5-potential is in a state of equilibrium with respect to EM bleed-off in the fifth dimension. It is now forced to bleed-off in the only other way it can: as ordinary 3-dimensional

gravitational field. Thus by vector-zeroing EM force fields, we turn KM field energy into G-field energy and vice versa, via the intermediary of the 5-potential.

At any rate, soon after publication of the Aharonov-Bohm paper, experiments showed that, if the magnetic field is trapped inside a long solenoid, a phase shift still is induced in the two-slit electron experiment, even though — classically — no contact of the enclosed magnetic field and the moving electrons occurs. This phase shift is explained by the fact that the freed A-field exists outside the trapping solenoid, even though the B-field does not. Consequently, interaction of this curl-free A-field with the electrons produces a phase shift of the QM interference detection pattern.

This proves that curl-free A-field is real and causes physical effects.

It also proves that a form of "action at a distance" is real, just as required by quantum mechanics.

Years ago, Frank Golden and this author — together with Dr. William Tiller — experimented with "free A-field" devices. Golden went on to develop prototype transmitters and receivers and a prototype underwater communication system.

Since that time, Gelinas has patented several curl-free magnetic vector potential (free A-field) devices. See U. S. patents numbers 4,447,779, May 8,1984; 4,429,288, Jan. 31,1984; 4,429,280, Jan. 31,1984; and 4, 432, 098, Feb. 14,1984. These patents are assigned to Honeywell.

Fractional Charges, Magnetic Monopoles, and Magnetic Currents

Fifteen years ago, a most distinguished gathering of physicists occurred in Trieste, Italy to review the physicist's conception of nature and how it developed. Seven Nobel Laureates were in the prestigious audience. The keynote address, appropriately, was given by P.A.M. Dirac, and — appropriately — was entitled "Development of the Physicist's Conception of Nature."

Dirac called attention to the possibility of fractional charges, and unexpectedly presented some of the data from experiments done lung before by Felix Ehrenhaft.

Years earlier Felix Ehrenhaft, former director of the Physical

Institute at the University of Vienna, had reported a number of experiments where — purportedly — he easily obtained fractional electrical charges.

Whereas Millikan had used liquid oil drops in his experiments to determine the charge of the electron, Ehrenhaft used little solid, red selenium oxide spheres. Not only could Ehrenhaft get a fractional charge, but he could actually vary the size of the fraction by varying the size of the spheres.

(Knowing what has been discovered in the last two decades on the complex bond structuring of water and liquid hydrocarbons, one might very well suspect that a solid — which has one less degree of freedom than a liquid — could possibly yield a very different experimental condition from a liquid, from first principles. However, no one seems to have noted that, or taken it into account.)

(Also, Ehrenhaft's results were replicated by other researchers who used his experimental methods. They published scientific papers, but that made not a whit to the scientific community, which simply rejected the experimental evidence.).

Dirac pointed out that Millikan himself, in his oil drop experiments that established the charge of the electron, reported one anomalous experiment which yielded a fractional charge. He discarded the results of that experiment.

Ending his speech, Dirac stated that it all made him wonder if perhaps Millikan did have a fractional charge in that one experimiment after all. And well he might wonder. Ehrenhaft — almost unknown now to the present generation of physicists — may have found not only fractional electrical charges, but the magic magnetic monopoles as well.

Over and over, Ehrenhaft reported the results of experiments which disagreed with the notions of magnetic theory at the time.

Again, some of these experiments were replicated, and reported by those researchers replicating them.

It didn't make any difference at all.

Now, finding a magnetic monopole — and the accompanying magnetic charge current — would be most satisfying to many theorists. That would make the equations of magnetics quite "balanced" with respect to electricity.

However, no one —at least whose results have been accepted -

has yet found a magnetic monopole or magnetic current.

Stanford researchers have perhaps come closest, and even reported the results of one exciting experiment that found the magnetic monopole. However, the team has consistently failed to be able to replicate those results. And in science, "no replication, no acceptance" is necessarily the dictum.

In a moment we will address a possible cause for this failure to find the magnetic monopole and magnetic charge current.

Some Ehrenhaft Experiments

Let's look at some simple, rather informal experiments that Ehrenhaft showed. We call attention to Alden P. Armagnac's excellent article , "Magic with magnetism," in **Popular** Science **Magazine,** June 1944, p. 130-133, 222, 226. In the first experiment, Ehrenhaft seems to have dissociated water with a permanent magnet.

First, Ehrenhaft seals two rods of pure iron, in holes through opposite sides of the U in a U-shaped glass tube filled with water. Then he uses the two rods — which protrude through the tube into the water — as the pole pieces of a horseshoe magnet — either an electromagnet or a permanent magnet. Dilute sulfuric acid — one percent by volume — is in the water, to give it a very slight acidity.

Bubbles of gas rise up through the twin vertical columns of water, and are collected and analyzed. Most of the gas is hydrogen, as is to be expected from common chemical interaction of the iron rods with the very dilute sulfuric acid. However, some of the gas — ranging from two to twelve percent — is oxygen, and most of the oxygen is produced at the north pole of the magnet.

The pole pieces may be short-circuited with wire, to insure they are at the same electrical potential and prevent any electrical dissociation of the water.

Without the magnet, all the gas liberated is hydrogen, as is to be expected. No oxygen at all is produced.

And another very interesting phenomenon occurs. A strong permanent magnet of the Alnico type gradually loses a marked fraction of its strength — say, 10% in 24 hours. It appears that the energy dissociates water — very similar to electrical energy from a battery draining away when electric current is used to dissociate

water.

The real question is: Is this experiment a demonstration of magnetic current?

If it is, then the textbooks are wrong, and there's another constituency in magnetism that has not been taken into account. Further, if it proves magnetic current exists, it has also proven magnetic charge — the magnetic monopole — exists.

If it is not a demonstration of magnetic current, then what is it? Why don't you get any oxygen liberated when the magnetism is removed? What causes the magnet to discharge its magnetic strength?

These serious questions do not appear to have ever been resolved.

In all fairness, however, we must warn the reader that other factors in the water can very seriously affect the outcome of this

EARTH • SUN - MOON TRIAD

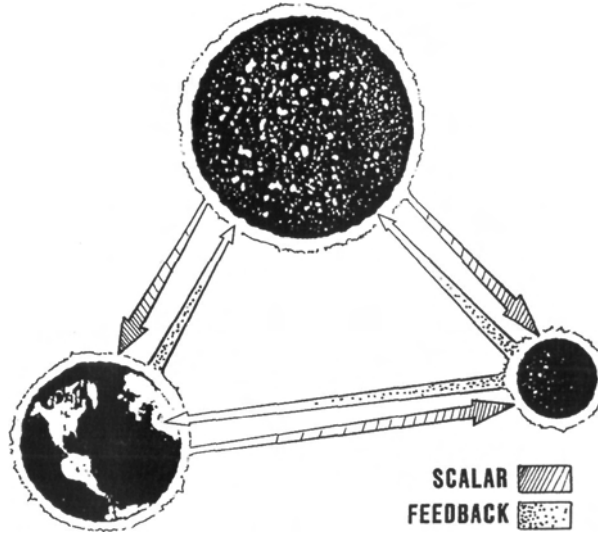

Figure 69. Earth, sun, and moon are locked into a triad system. They exchange both normal energy and phase-conjugate energy. The phase-conjugate energy (negative energy, negative time) streams affect all "subtle-energy" earth experiments

experiment. As we now know, the bonding structure of water is incredibly adaptive. Every bit of water you examine, for example, is absolutely unique in many respects. And in other respects, it's a sort of "single giant molecule."

Be forewarned also that subtle experiments with water are affected by just about everything under the sun. Including the sun!

Ehrenhaft himself was quite embarrassed when this "decomposition of water" failed to be 100% repeatable. It can be done — but you may have to work at it a bit. The best water for this experiment is the most natural, pure ground water you can obtain.

At any rate, it may be that these experiments of Ehrenhaft's are related to the old notion of "watergas" — the changing of water in some fashion so that, as it enters an internal combustion chamber, it decomposes into hydrogen and oxygen, and is ignited by the spark and burns as a fuel. In the typical watergas case, the experimenter has a "green powder" which, when added to water, will allow it to be burned as a fuel when it is used in an ordinary engine. Such a capability, for example, seems to have been exhibited at least once, to the U.S. Navy, by an unorthodox experimenter named Anderson.

Of course, if fractional charges exist and can be controlled (and Ehrenhaft's experiments certainly seem to confirm this), then it is conceivable that a material could be found that would do the "green powder" function. That is, if the bonding electron that bonds hydrogen and oxygen in water were replaced by a fractional charge, the "fractionated water molecule" could just barely be holding together an a liquid. A strong hydroshock — such as going through the jet nozzles in a carburetor — could then cause many of these molecules to break apart, effectively dissociating the water.

A possibly related phenomenon was reported by Le Bon in his Evolution of Matter. The experiment was to hold a piece of ordinary aluminum under the surface of mercury in a container for a period of time. Then the piece of aluminum is taken out and thrown into a container of water, where it violently dissociates the water. At least one colleague was able to replicate this experiment by holding the aluminum beneath the mercury for 36 hours.

These Ehrenhaft experiments may also be related to the extensive use in the Soviet Union (and to some extent, in the U.S.) of

magnetic treatment of water pipes so that boilers do not develop so much hard precipitate. Magnetic treatment of water, for example, can rigorously be shown to alter some of a liquid's properties.

Ament, for example, in numerous well-controlled repetitions has clearly shown an increase in auto gas mileage by using a strong magnetic apparatus on the fuel line. Best results are obtained by a magnet which only has one polarity facing the fuel line, and using three stages where the middle polarity is reversed. The effect of this apparatus is definitely scalar EM (gravitational) and expressed in the atomic nuclei in the molecules of the fuel flowing through the line.

Again, the Ehrenhaft experiments may be related to the strange results of Viktor Schauberger, who obtained motive results with water and natural energy that have not been duplicated before or since, so far as anyone can tell.

Schauberger utilized "implosive" energy rather than "explosive" energy — strongly suggesting he was using the negative time aspects of energy, hence negentropy. Schauberger also conceptualized this energy in a spiral form — and that is precisely the type of motion Ehrenhaft observed in many of his bubble experiments. That such negative time/negative energy is "natural" energy will be apparent from our next chapter, where we point out that all living things must use negative time/negative energy processes if they are to defeat the inexorable law of entropy — the increasing disorder of a system as its positive flow of time progresses.

Note, **for** example, **that a** system **that is 20% efficient in positive time would be 500% efficient in negative** time.

Let's look at another of Ehrenhaft's magnetic experiments.

Taking the air gap between two very flat, very parallel pole pieces of sufficient width, one obtains a very accurately-parallel, uniform magnetic field in between them. Now suppose you place some very small particles of material—both magnetic and nonmagnetic — in the air gap.

Common sense assures us that, if closer to the south pole, for example, one of the little magnetic particles will be attracted by **the** preponderance of south polarity. That is, a little magnetic north **pole**

will be induced on the side of the particle nearest the south polepiece, and a little south pole will be induced on the particle on the side away from the south polepiece. The little particle will then be attracted to the south polepiece.

Again, common sense assures us that, if closer to the north pole, the situation is reversed and the little particle is attracted to the north polepiece.

Well, that isn't quite what happens. Some move to the south polepiece, and some move to the north polepiece. And it seems to vary by the type of material the little particle is comprised of.

Now try another experiment. Let's make a permanent magnet motor. Understand, this one is not quite "for free," for we'll consume "fuel"—the strength of the magnet and the acidified water solution.

In this one, we use a glass cylindrical cell, with one vertical iron rod at the top and another at the bottom, and the rods serving as the pole pieces of a giant horseshoe magnet. (Or, for ease you can use an electromagnet). The cell is filled with the same acidified solution as before.

Without the magnet, hydrogen bubbles can be seen rising as before.

Now put on the magnet (or turn on the switch). Voila! the situation with the bubbles changes drastically. A spectacular miniature merry-go-round — a "whirligig" — of bubbles forms between the faces of the poles and parallel to them.

Add some copper particles to the solution. The particles will rotate in the same plane, but in opposite directions from the bubbles. The stronger the magnetic field, the faster the particles and bubbles will contrarotate.

If the magnetic field is reversed, the rotation of both the bubbles and the copper particles is reversed.

Only a few months after this was reported in Popular Science Magazine, Brother Gabriel Kane of Manhattan College and Charlea B. Reynolds of the Federal Communication Commission confirmed Dr. Ehrenhaft's discovery of magnetic currents.

They made a drop of copper sulfate solution spin between the polepieces of a permanent magnet. They also made an interposed microscope cover glass spin from the rotation of the copper sulfate.

It was hinted they were heading toward power machinery. If so,

nothing else was heard — possibly because they never solved the problem of consuming the magnet's strength and the acidified solution.

Bill Mueller, the present inventor of a free-energy device, has also demonstrated the spinning of a piece of plastic in a magnetic field.

After WWII, Dr. Ehrenhaft returned to his post in Vienna, published later work in French and other scientific journals, and died not long after.

What is a magnetic monopole?

First, let's reiterate what we mean by "magnetic field." It'll take a little bit to get there, so please bear with me.

By electric charge, we mean the virtual photon flux connected with a particle of mass or an object (of mass). One type of charge (by convention, positive) is modeled to constitute a "source" of this flux. The second type of charge (negative) is modeled to constitute a "sink" of this flux.

Everything in electromagnetics is fluid flow, you see. The old guys who formed the theory believed that electricity was a thin material fluid. So they modeled it that way.

They modeled the positive charge as an everlasting "sprayer" and the negative charge as a "sink" or everlasting accumulator.

They reasoned that of course this "stream" of electric fluid could "swirl" or rotate, just as normal fluids can.

This "swirl" in the stream of virtual photons is magnetostatic scalar potential — or magnetic pole for short.*

Obviously there can be two directions of swirl — one right-handed, and one left-handed, with respect to the direction of the virtual photon stream. So there are two kinds of "magnetic pole" — north (right-hand swirl) and south (left-hand swirl).

The strength of one of these "swirls" can vary, of course, and that's a variation in the strength of the corresponding pole.

You can also think of the "pressure" of the swirl, so to speak, **at** least for modeling purposes. In that model, north swirl is "higher

*Rigorously, a permanent magnet does not produce an observable B field in vacuum! Instead, it produces the dynamic, swirling "potential" for that field — i.e., an **unzipped** field. A particle of observable mass placed in this field integrates and "zips" — producing the observed B-field on and of the spinning observable particle.

than ambient" pressure, and south swirl is "lower than ambient" pressure, where "ambient" means "with respect to right-hand swirl." The swirl pressure is then considered to "bleed off/flow" from north pole to south pole. This is modeled by Faraday's "flux lines of force." This bleed off (gradient) from north pole to south pole is called the magnetic force field, or just "magnetic field" for short, even though in vacuum it's really an *unzipped* magnetic field.

Note that the original modelers didn't consider negative time and negative energy at all. And they didn't know anything about phase conjugation — in fact, the electron had not even been discovered when all this model was originally put together.

But back to the model. Considering the swirling fluid as "conserved", if you produced a concentration of one kind of swirl at one place, you had to decrease the concentration elsewhere, which is the same as producing and adding opposite swirl there. Thus, conceptually, in the simplest case (only two swirls allowed), a north pole and a south pole always occur together in a pair — though of course there's no limit to the distance between the pair.

Notice that if you have a conservative field such as we assumed, you are keeping your overall frame of observation Lorentzian — in other words, conservative. You do not have a "curved spacetime" to speak of, by assumption.

Now of course, you can have compound and very complicated magnets and magnetic fields — you don't always have to have everything so neat and simple. In that case, conceptually you could have — for example — one north pole and two south poles.

In fact, it's easily possible to demonstrate that: a bar of magnetic material is simply magnetized so that a north pole is in the middle, and a south pole is at each end. Now bend it around a bit, and you get the point.

However, now let us suppose that we curve spacetime itself, locally — something they avoid in present physics by pure assumption.

Specifically, we curve our local spacetime in such a fashion that there's more right-hand swirl in the local region than there is left-hand swirl there.

In that case, we have a north-pole region there , all by itself. We

have a magnetic north monopole. If that "curved spacetime" region of trapped swirl is moving, that constitutes magnetic current, and it may be either positive (north polar) or negative (south polar) flow.

It's as simple as that! Only when you curve local spacetime can you get a magnetic "charge" or monopole. Everyone who's trying to demonstrate a magnetic monopole in uncurved spacetime is doomed to failure a priori. It takes but little reflection to see that, conceptually, a magnetic monopole is a curvature of local spacetime. Indeed, each of the two poles of a bar magnet is precisely that anyway.

Now a monopole can indeed be "made", by bending local spacetime correctly. It can be made in two ways: in the virtual state vacuum itself, or in and on physical materials. It's easiest to make it in the virtual state: just curving the local spacetime will do that. When this "excess swirl flux without corresponding antiswirl flux" is impressed into and onto matter, however, the atomic nuclei are affected, producing excited "magnetic states." In addition, a great deal of physical stress is created in the material, due to monopolar repulsion between the various "nuclear monopoles deposited in it."

If a sufficiently strong monopole intensity (magnetic charge) is produced in the material, the material will violently fragment from internal stress. When a metal, for example, undergoes such **a** "monopolar fragmentation", it is common to see "tiled edges" of the metal rupture, much as twisted little "planks" or tiles of metal unfurled and "split." Such a break may be a positive signature of the involvement of virtual magnetic monopoles (i.e., by the metal having acquired virtual magnetic monopolar charge, causing the disruption).

This precise type of metal fracture has been very well demonstrated in experiments by Canadian experimenter John Hutchinson. Anomalous, powerful breaks in metal have been obtained by Hutchinson where the two ends that break apart both have a north pole or a south pole.

The anomalous **hole in the fuselage of the Arrow DC-8 destroyed at Gander Air Force Base, Newfoundland on Dec. 12,1985,** strongly suggests that an electromagnetic missile struck the aircraft, inducing monopolar effects. That would also match the-**three** eyewitnesses' description of an anomalous glow on part of the

aircraft as it faltered and then fell.

Supercharges and Fractional Charges

Now without further ado, let me just state flatly that the only way to get a fractional charge is to have an appreciable curvature of local spacetime.

To get that local curvature, it's going to be very difficult to use liquid. For weak effects, it will almost always change its bond structure and not localize the curvature in the nuclei. So "fractional charges" in liquid are much harder to come by.

However, with solids it's a different thing, particularly if you make the solid material very, very small and nonlinear — precisely like Ehrenhaft's little red selenium oxide spheres. There you can get **the** curvature to localize without so much bleedoff through the bonding lattice.

The greatest electrical wizard of all, Nikola Tesla, reported producing electrons with 50 times the normal electrical charge of an electron. That's readily understandable if you look at what's happening to the charge of a particle: To have 50 times as much charge, the electron must be exchanging virtual photon flux with its surrounding vacuum at 50 times the rate of the normal vacuum.

In other words, *it's the vacuum (spacetime) which must be*

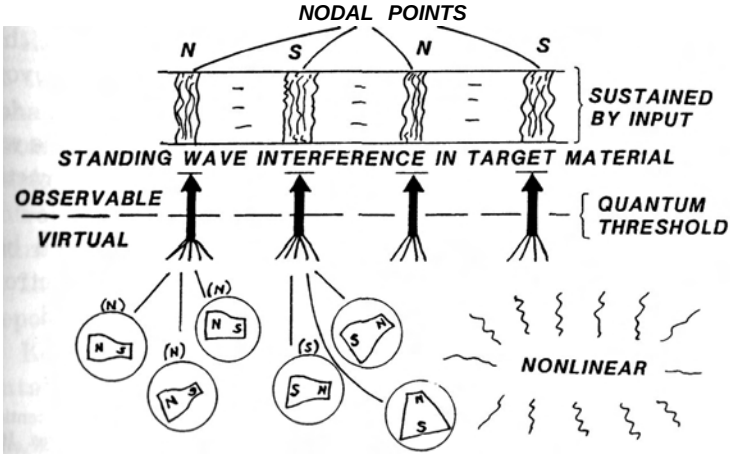

Figure 70. Forming magnetic monopoles with a standing scalar EM wave. In a nonlinear vacuum (locally curved spacetime), virtual magnetic monopoles can be formed and deposited in materials.

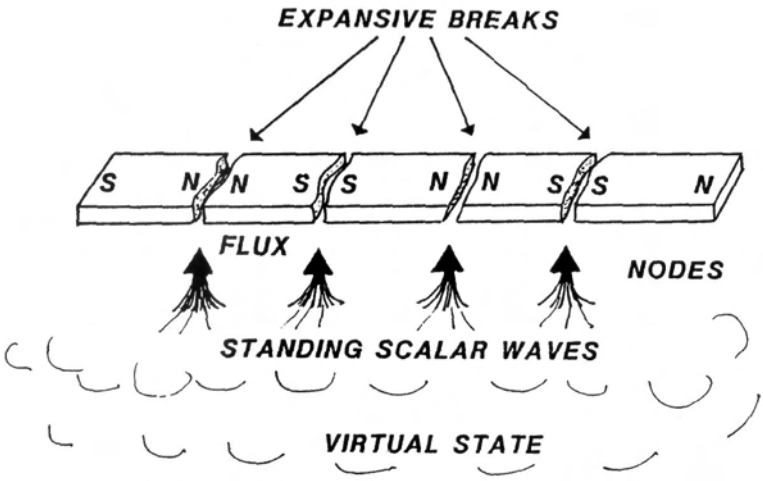

Figure 71. Metal fracture by depositing magnetic monopoles. Demonstrated by Canadian researcher John Hutchinson.

changed, not the electron! Actually, that happens anyway whenever the electron is in an electrical potential field. There are many unrecognized assumptions in the postulate that the electron charge is fixed.

If you curve local spacetime in one direction, you get the charge, of an electron increased. If you curve it in the other direction, you get the charge decreased. In that case it's called a *quark*.

At any rate, our own scientists have been looking in the wrong way and in the wrong place for magnetic monopoles and fractional charges.

Work such as that of Ehrenhaft and others should be re-evaluated. And, most certainly, the basis of the present electromagnetic theory should be both re-examined and reformulated.

*Such as the implication that the free electron is always free to move, and that potential surrounding the electron always possesses a translating gradient when it changes. It does not consider the case where the virtual flux exchange between electron and vacuum increases isotropically, centered on the electron. That, of course, represents an *excited charge* of the free electron.

CHAPTER 5

EXTRAORDINARY BIOLOGY

Kervran's Proof of Biological Transmutation

In orthodox chemistry, one of the strongest dogmas is the stubborn insistence that it is impossible to create another element by chemical reaction. Most chemists also insist that all reactions occurring in living systems are chemical in nature. They believe fervently that chemistry can and must explain life itself.

In the early 1960's, a French researcher named Louis Kervran published work which flew directly in the face of the accepted chemistry dogma. Kervran reported the astounding results of his research showing that living plants were able to accomplish limited transmutation of elements. Kervran was then the Conferences Director at the University of Paris, and his first paper was published in **La Revue Generale Des Sciences,** July 1960.

What was so revolutionary was that, according to the prevailing wisdom of science, you can't transmute elements (permanently change the nucleus) except with enormous energy — certainly not with the microvolts and millivolts (and microwatts and milliwatts) that living systems can muster electromagnetically. *

Rutherford, the British physicist who discovered the nucleus of the atom, had shown in 1919 that you can bombard elements with alpha particles and transmute them. The accepted wisdom of today is exactly the same, except that the physicists have used heavier and heavier "bullets" in their artillery approach. No one has tried a controlled approach, for the catchecism is that you have to use the *wham it harder!* approach.

In other words, to most scientists the whole thing had to be preposterous, and Kervran had to be deluded.

Kervran published further details of his work in a book, **Transmutations Biologiques,** Maloine, Paris 1962. But the initial reac-

*Note, however.that since gravity is infolded EM, one can have extremely powerful infolded EM, yet only have miniscule electrical (outfolded) residues. Thus the actual "available power" in artificial biopotentials may not be quite so small after all.

tion of most scientists was disbelief and skepticism. Few scientists would stoop to repeating Kervran's experiments, which of course they knew could not work anyway.

Actually the effect is widespread amongst living systems. As Kervran pointed out, the ground in Brittany contained no calcium; however, every day a hen would lay a perfectly normal egg, with a perfectly normal shell containing calcium. The hens do eagerly peck mica from the soil, and mica contains potassium — a single step below calcium in the standard table of elements. It appears that the hens may transmute some of the potassium to calcium.

Further, if one tests this assumption, it is quickly shown to be true. Hens denied calcium but not potassium, stay perfectly healthy and lay perfectly normal eggs. Hens denied both potassium and calcium will be sickly and lay only soft-shelled eggs. If these sick chickens are allowed to peck only mica — which they will frantically do — everything returns to normal again.

Most orthodox scientists nevertheless remained skeptical or downright hostile.

However, a few other scientists began to repeat Kervran's

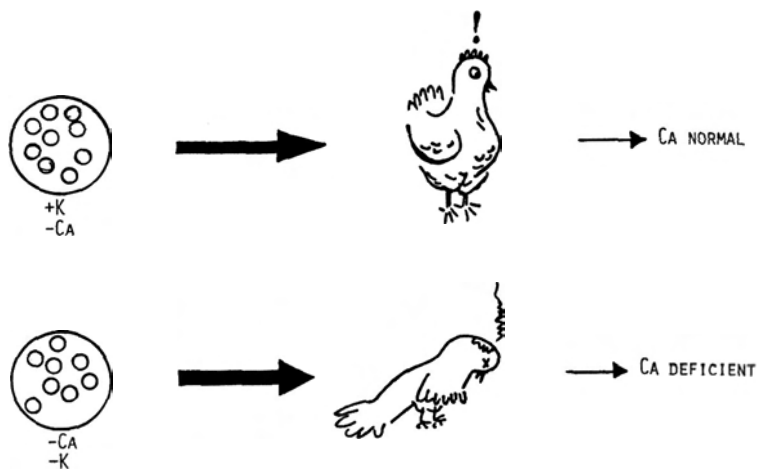

Figure 72. The Kervran effect. A biosystem can accomplish limited transmutation of elements.

experiments and replicate his results. Several of these corroborating scientists were (1) Professor Hisatoki Komaki, Chief of the Laboratory of Applied Microbiology at a leading Japanese university, (2)Professor Pierre Baranger, Head of the Laboratory of Chemical Biology of the Ecole Polytechnique in Paris, and (3) J.E. Zundel, then head of a paper company with a chemical analysis laboratory, and later a chemical engineer of the Polytechicum School of Zurich, Switzerland.

Later work by Zundel was particularly decisive: he utilized the mass spectrometer at the Microanalysis Laboratory of the French National Scientific Research Center, and neutron activation mass analysis at the Swiss Institute for Nuclear Research in Villigen to positively confirm an increase in calcium of 61% to an accuracy of 2%. Such results and instrumentation, of course, removed any doubt that the effect could be due to statistical variation. In the same experiments, the plants increased their phosphorus 29% and their sulphur 36%.

Komaki became head of a research laboratory at Matsushita Electric Company. There he conducted research conclusively proving that microorganisms (including some bacteria and two kinds each of molds and yeast) could transmute sodium into potassium. In fact, he placed a brewer's yeast product on the market that, when applied to composts, increases their potassium content.

Extensive work in the area has been done in the Soviet Union, where results similar to Kervran's have been substantiated.

Thus all doubt (to an open-minded scientist) was removed: living systems are able to change one element into another by some unknown means, using very feeble energy.

A noted French physicist, O Costa De Beauregard, suggested a mechanism for the transmutations, using weak force interactions and advanced waves.

No one — even Kervran himself— thought of negative energy/ negative time interactions. The jury is still out on the actual mechanism, but it is absolutely clear that the transmutation does indeed occur.

The Japanese researchers, having replicated Kervran's astounding results to their complete satisfaction, recommended him to

the Nobel Committee for a Nobel Prize for such epochal work. Thus Kervran became a Nobel nominee, though he was not granted the prize.

Kervran has since passed away, leaving behind his books and papers that point to a revolution in chemistry and physics - transmutation of elements at very weak energy.

Biological Transmutation Has a History

Actually biological transmutation — and transmutation of elements (alchemy) in general — has a history, of both results and suppression.

Louis Nicolas Vauquelin, a celebrated French chemist, discovered that chickens could produce more calcium in their eggshells than entered their bodies. Hence they had to be able to "create" the calcium, else their own bodies would have been completely depleted.

One of his contemporaries, however — Antoine Laurent Lavoisier — became the "father of chemistry." Lavoisier laid down the dictum that nothing was created. So chemistry fixed upon the notion that the combinations of elements could be shifted, but the element itself could not be transformed.

Not until the discovery of radioactivity did any crack in this solid wall appear. But still, the basic ideas of chemistry said the element couldn't be transformed chemically. It could only be transformed if one blasted the daylights out of it with an atomic or particle bullet.

Today most chemists still hold that exact same opinion, unshaken.

To resume: Over a century ago, a chemist named Albrecht von Herzeele proved that germinating seeds somehow transmuted elements in the process. In 1873 von Herzeele published a book, **The Origin of Inorganic Substances,** where he showed research proving that plants continuously create material elements.

Even earlier, in 1822 an Englishman named William Prout had studied chicken eggs in incubation. He found that hatched chicks had more lime (calcium) in their bodies than was originally present in the egg!

Another French scientist named Henri Spindler discovered that, a kind of algae called Laminaria could create iodine.

A German researcher named Vogel had planted cress seeds in a

bell jar. They were fed nothing but distilled water; still, when grown they contained more sulphur than had been in the seeds originally.

Lawes and Gilbert, two British researchers, also found that plants could "extract" more elements from the soil than the soil actually contained in the first place.

Baranger performed thousands of meticulous experiments in plant transmutation of elements. He proved that the transmutations do occur. He also discovered that many things affected the germinating seed transmutation process: the time the seeds germinate, the type of light they are exposed to, the phase of the moon, etc.

None of these experimenters understood the transmutation process used by the living organism. But they proved beyond question that the process existed, and universally occurred.

Surplus-of-Energy Mechanisms Proposed by the U.S. Army

There has also been other very positive support for the thesis that if living systems transmute elements, they can produce a net source of energy in the process.

In 1978 an officially-funded effort of the U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, Virginia positively confirmed that mechanisms for elemental transmutations could occur in biological systems, from an energy consideration.

The work was performed under the direction of Emil J. York, Chief of the Material Technology Laboratory. Solomon Goldfein was the principal investigator for the effort. Robert C. McMillan, Chief of the Radiation Research Group of the laboratory, provided guidance on matters of physics and nuclear physics.

The abstract of the final report (S. Goldfein, Report 2247, E**nergy Development from Elemental Transmutations in Biological Systems,** U.S. Army Mobility Equipment Research and Development Command, May 1978. DDC No. AD A056906.) reads as follows:

"The purpose of the study was to determine whether recent disclosures of elemental transmutations occurring in biological entities have revealed new possible sources of energy. The works of ***Kervran,*** *Komaki, and others were surveyed, and it was concluded*

that, granted the existence of such transmutations (Na to Mg, K to Ca, and Mn to Fe), then a net surplus of energy was also produced. A proposed mechanism was described in which Mg adenosine triphosphate, located in the mitochondrion of the cell, played a double role as an energy producer. In addition to the widely accepted biochemical role of MgATP in which it produces energy as it disintegrates part by part, MgATP can also be considered to be a cyclotron on a molecular scale. The MgATP when placed in layers one atop the other has all the attributes of a cyclotron in accordance with the requirements set forth by E.O. Lawrence, inventor of the cyclotron."

"It was concluded that elemental transmutations were indeed occurring in life organisms and were probably accompanied by a net energy gain."

The researchers also concluded that elemental transmutations occurring in life organisms are accompanied by losses in mass representing conversion to thermal energy, and that such energy probably is a net gain when compared to the amount required to effect the transmutation.

All in all, they concluded that the little cell with its feeble energy does quite well! It's in control of cyclotrons, and cyclotron forces, and direct conversion of mass to energy. Pretty good for a little bitty beastie, wouldn't you say?

Actually, one should point out that, according to nuclear physics, an atom gets a little heavier when it absorbs (usually by means of an orbital electron) a normal "positive energy" photon. That is, the addition of positive energy results in the addition of a little bit of "positive mass."

Negative energy, of course, does a similar thing to the nucleus — except that it adds "negative mass." Thus the nucleus of the atom, when it absorbs negative energy, gets lighter. This is seen in the external world as "loss of mass."

With our present nuclear physics, only positive energy is assumed except in extremely rare cases.

Thus the Army study — which was conducted and controlled by some excellent scientists — worked out a "loss of mass" the way

they're trained to.

By adding some positive energy, the nucleus would gain some positive mass. **By adding some negative energy, the nucleus would lose some corresponding positive mass. The conventional physics then would equate this "loss of mass" as the direct conversion of mass to energy. And so it is, only it's conversion to negative energy!**

However, by pointing out the cyclotron mechanism in the cell MgATP, the Army researchers have made a most important contribution.

Note also that the whirling motion may be very much related to Viktor Schauberger's work and to Wilhelm Reich's work. Both of them worked with what they viewed as an unusual kind of living, spiraling energy.

All the orbital electrons of an atom also are whirling around in orbit, in the simplest model. Further, these orbits themselves move and rotate or precess.

Similar orbits and shells occur in the nucleus, at least in some models (several rather independent models are used there for specific things.)

It may be that a whirling, spiraling (cyclotron) energy motion is necessary to connect positive energy to orbital electron (negative charge) shells, and to connect negative energy to positive charge shells in the atomic nucleus. *

Alchemy ***and Unusual Critters***

In ancient times, the old alchemists pursued the dream of making gold. Obviously, if one could do that economically, one could become quite wealthy.

Just as obviously, the kings and rulers of the world took rather **a** dim view of such proceedings. After all, much of their own power rested on their ability to get and control gold. And if some "loose cannon" could make all the gold anyone wanted, then the national **treasury** of the king wouldn't be worth a plugged nickel. And that would finish the king, for he would be powerless.

•The spinning/whirling motion may be viewed as integrating the unzipped vacuum flux virtual vectors into zipped observable force vectors —just as great grandma's spinning wheel integrated fibers into continuous threads.

There are some unorthodox researchers today who take the view that the alchemists were stamped out—*not because they failed, but because they succeeded.*

I subscribe to the same view.

T.H. Moray had a process to "recover finely divided gold from quartzite sands." My personal, strong belief is that he possessed a practical transmutation process. His knowledge and techniques, of course, are still possessed by his sons, and reside through them in Cosray Research Institute, Salt Lake City, Utah.

The possession of such a technical secret may be one of the major reasons why the Morays have met with such intrigue, harassment, and suppression over the years.

To speak further on "making gold," we first have to present some details on some special "critters" that live, but that can't be observed through a normal microscope — even an electron microscope.

In that vein, toward the end of this chapter, we will present some of Royal R. Rife's fundamental discoveries. Pay particular attention to his discovery of "finer" living forms — which today we could only refer to as "living energy, virtual-state forms."

Let's call them **critters** for short.

At one time, when the earth was young and the radiation from the sun was different, conditions on earth were much hotter. Great volcanic activity and fiery eruptions were commonplace and nearly continuous. Huge storms, of size and magnitude undreamed of today, swept the primitive atmosphere. The oceans were frenzied.

Under those conditions, many types of "critters" were highly active. Most of the critters, for example, lived in and worked on the atomic nuclei of matter .

After all, the critters are living, virtual-state organisms. There's a continual exchange between the virtual state (the vacuum, or spacetime) and mass (the observable state). An atomic nucleus is like an island in the "virtual state ocean", and the flux interchange is like waves breaking onto the island and then washing back to sea. The critters live in that ocean, and wash upon, so-to-speak, the mass-islands and interact with them.

In those primal days, many of the present great mineral deposits of the earth were created due to the transmutation activities of the

critters.

One kind, for example, lived in copper. In an "energetics" sense, this critter "ate" copper and "excreted" gold, so-to-speak. Much of the gold that occurs in great copper deposits today was formed this way in the old days under primal conditions.

When conditions on earth changed, these little "copper critters" ceased their incessant activity and became dormant, just as viruses can do. But the critters are still there in the copper ore, waiting to be activated.

And activate them you can! You can even get the critters into a solution, and then crystallize them out as crystals.

These crystals are what the alchemists of old called the **philosopher's stone,** with the power to transmute base elements into gold. There are several kinds of philosopher's stones; this kind is for copper.

At any rate, you can then place these special crystals on some copper (and add another thing or two), and restore them to a similar primal environment as of old. That is, heat them in an electric furnace. Blast them with terrible electrical bolts. Bathe them in intense ultraviolet light. That's just a nice, refreshing spring day for the critters!*

That stimulates them and revives them. They wake up after a long sleep — and they're immediately "hungry." So they go right to work on the copper. Boom! In a little bit there isn't any more copper, just mostly gold, with a little other miscellaneous residue thrown in, such as black ruby and silver (in the experiments of one of my close colleagues).

The gold is radioactive when first made. Fortunately, all isotopes of gold are very short-lived: just minutes suffice for the radioactivity to die away. So you wait half an hour and everything's okay.

That's all there is to it.

And if you do that and try to capitalize upon it, your life expectancy is about 24 hours.

I don't know whether or not biological systems, in their Kervran-

*Note the probable similar effects involved in the Miller-Fox-Urey experiments in biogenesis

transmutations at weak energy, deliberately manipulate similar "critters." I suspect, however, that they do, at least to some extent.

The Cell Also Lives and Functions in the Virtual State

Obviously, to transmute elements the living system has to be able to directly affect and influence the atomic nucleus.

It has been shown that this is a cellular capability, for single-celled organisms can do it.

As we shall see, Rife's work showed that the living cell is connected to at least 16 intemested deeper levels of reality than a relative "point" under an ordinary microscope. Further, all levels are structured and organized.

Think of it! Each one of those levels is to the preceding level as microscopy today is to the normal world. Sixteen levels!

I think it's reasonable to state that the life of the cell is patterned and dynamically structured and functioning all the way into the virtual state; indeed, to very deep intemested levels of the virtual state. That is, it also functions *hyperspatially*.

We shall also see that the mind and thought involve these more subtle physical (though virtual) levels.

Thus the living virtual-state levels are a reality, for Rife proved it.

The living organized structures at each level are a reality, for Rife proved it.

The living ordering and control of dynamic functions on all those levels is a reality, for Rife proved it.

Those living virtual-level parts of the living organism — plant or animal — thus affect, function in, and reside in the atomic nuclei of the material that composes its bodily structures.

Beasties like bacteria and viruses also have living, organized energy structures in multiple levels of virtual state. Apparently, for these more primitive life forms, the virtual-state "energy part" can be separated and pass through a filter, then re-engender the physical form and/or itself cause the disease in a host! At least that is what Rife and other scientists showed.

"Bigger fleas have smaller fleas to bite 'em, And so on, ad infinitum."

Of course the living system can "work on" the nucleus and

change it a little bit! If it couldn't do so, it couldn't stay alive and function in there in the first place!

The Kaznacheyev Experiments

Dr. Vlail Kaznacheyev is Director of the Institute for Clinical **and** Experimental Medicine in Novosibirsk.

For 20 years he has been directing highly unusual experiments with twin cell cultures. These experiments are vital to understanding disease and healing on a more fundamental basis than is presently utilized by orthodox medical science.

The Kaznacheyev experiments (several thousand) in the Soviet Union proved conclusively that any cellular disease or death pattern can be transmitted electromagnetically, and induced in target cells absorbing the radiation.

In the experiments, two sealed containers were placed side by side, with a thin optical window separating them. The two containers were completely environmentally shielded except for the optical coupling.

A tissue was separated into two identical samples, and one sample placed in each of the two halves of the apparatus.

The cells in one sample (on one side of the glass) were then subjected to a deleterious agent — a selected virus, bacterial infection, chemical poison, nuclear radiation, deadly ultraviolet radiation, etc. This led to disease and death of the exposed/infected cell culture sample.

If the thin optical window was made of ordinary window glass, **the** uninfected cells on the other side of the window were undamaged **and** remained healthy. This of course was as expected in the orthodox medical view.

However, if the thin optical window was made of quartz, a most unexpected thing happened. Some time (usually about 12 hours) after the disease appeared in the infected sample, the same features of disease appeared in the uninfected sample.

This startling "infection by optical coupling" occurred in a substantial percentage of the tests (70 to 80 percent). From an orthodox medical view, these results were unexpected and unheard of.

Further, if the originally uninfected cells were in optical contact

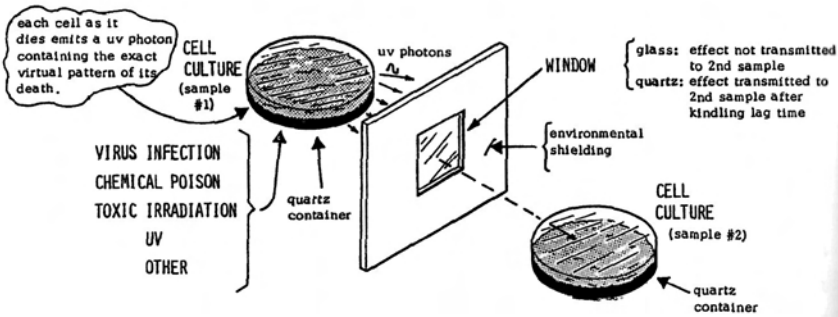

Figure 73. The Kaznacheyev effect. Thousands of experiments proved that (1) cellular disease is electromagnetic, and (2) it can be induced electromagnetically at a distance. Also called the cytopathogenic effect.

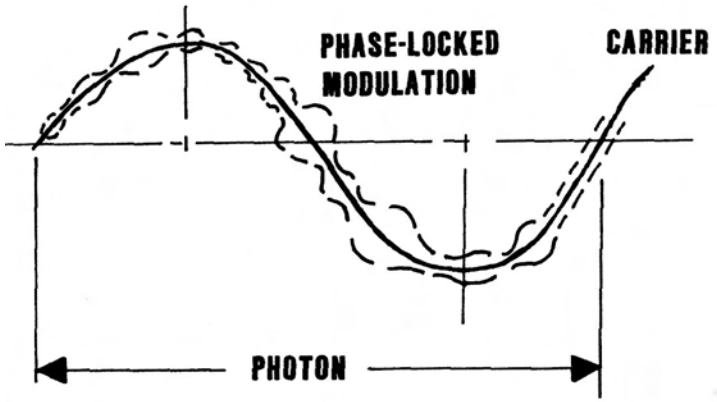

Figure 74. A photon is one oscillation of an electromagnetic carrier. It may have substructures that are modulations. Such a structure is called a "giant photon," or a "compound photon."

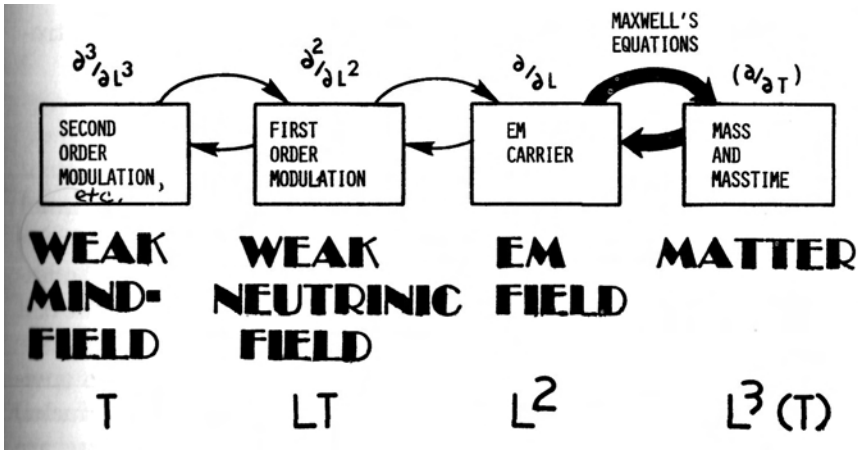

Figure 75. Nested modulations are the key to hyperspatial engineering.

with the infected cells for 18-20 hours or so, and then were correspondingly exposed (optically coupled) to another uninfected cell sample, symptoms of the infection appeared in this third sample an appreciable portion of the time (20 to 30 percent).

Guided by A.G. Gurvitsch's work that showed that cells give off mitogenetic radiation (photons) that can affect other cells, the Kaznacheyev team sought an answer by looking for photons given off by the infected culture sample as its cells died.

They found that the cells in the infected culture gave off photons in the near ultraviolet when they died. The normal window glass was opaque to these near-UV photons and absorbed them. In that case, the uninfected culture on the other side of the glass was not exposed to radiation by the UV "death" photons from the dying cells, and they remained serenely healthy.

However, the quartz window was transparent to the UV "death photons". When the quartz window was installed, the UV "death photons" passed through it and were absorbed in the uninfected culture on the other side of the window. Most of the time, the uninfected culture which absorbed "death photons" sickened and **died** with the same disease symptoms.

The Kaznacheyev experiments proved conclusively that cellular

death and disease patterns can be transmitted and induced electromagnetically.*

Structuring and Charging a Biopotential

Kaznacheyev thus demonstrated that a photon information/regulatory system exists in biological systems due to a continual influx of EM energy from outside the system. That is, the cells of the biosystem are charged with an electromagnetic potential, and additions and changes to the potential are continually received. The cell is thus in minute disequilibrium.

Usually the myriad of continual inputs from the external environment into the cell's potential charge pattern (in its atomic nuclei) may be taken to be potential changes whose substructures are *disordered*. In that case, no specific environmental effect is observed except slight fluctuations without order — a miniscule form of "heating."

However, if a continual *ordered* substructure exists in the input from the external environment into the cell's potential, the cell's potential will gradually "charge up" with that pattern.

An analogy will prove helpful. Imagine an accumulator, a largo pot, that holds a volume of water. Several pipes are connected to tho pot, some are inputs for water coming in, and some are outputs for water flowing in.

Imagine the inputs all containing "blue" water, just in slightly varying shades. The water in the pot is blue, and may slightly rise and fall in level as the input flow rates vary. The water in the pot may also vary slightly in its blueness as the inputs vary. However, it will still be blue.

Now suppose that yellow water starts flowing through one of the input pipes, and at a goodly rate. Slowly the water in the pot will start to turn greenish as a greater percentage of yellow builds up. In other words, the pot slowly charges up with some of the "yellow" charge, in the process acquiring a "green" charge.

*We point out that this effect has been investigated in both the infrared and ultraviolet. IR to UV may be taken as a single harmonic interval — an **octave,** musically speaking. The same effect can be reproduced in any other "octave" (single harmonic interval) of the electromagnetic frequency spectrum. The **reversal** of the effect can also be achieved in any harmonic interval. The mechanism for these effects involves the cellular biopotential, Popp's master cellular control system, and the deterministically-tailorcd substructure of photons.

The biopotential in the cell experiments works the same way.

A cell has a biopotential built up, which represents the "nominal equilibrium" of the scalar charge on the cell. This biopotential, being mostly a "sum-zero" of virtual state vectors, is centered in and on the atomic nuclei of the cell, constituting charge patterns in these atomic nuclei. The biopotential extends out of the atomic nuclei, through the electron shells, into and through the molecules, through the internal cell structures and membrane, and outside the cell.

From the atomic nucleus on out through the cell, every layered structure or organization of the cell will layer, structure, and organize the biopotential accordingly.

This organized, structured cellular biopotential is continually receiving "charge patterns" contained in incoming photons absorbed by the cell. The biopotential is also continually exhausting some of its biopotential charge pattern in the photons (heat, light, etc.) that the cell emits.

The Cell's Electromagnetic Breathing

Via structured photon exchange, the biopotential of the living cell thus "breathes in" the virtual state charge structure of its environment, and "breathes out" its own internal virtual state charge structure.

So, in the experiment, the uninfected cells are continually absorbing photons from their surrounding environment, and emitting photons back to it as well. According to our scalar EM view, each photon it absorbs has a substructure that depends upon the part of the environment from whence it came.

These "substructures" are actually patterns of the sum-zeroed virtual vectors comprising the potential of the absorbed photon carriers.

Normally, since a large number of very different substructures are continually being "input" into the cell's potential from the absorbed photons, the substructure of the cell's potential receives an essentially disorganized continual input from the environment. This liquates to the fact that the environment does not normally specifically influence or change the cell's potential with ordered information (organization).*

When a cell dies, it ceases to maintain the bio-dynamics that sustained its artificial potential (that part due to bio-ordering by its organized life processes, above the background level of its "inert matter" potential). The dead cell's built-up artificial potential then "discharges" by emitting a structured photon.**

Since this photon (energy) comes from an *organized potential drop, the virtual substructure of the emitted photon is organized.* The photon, then — among other things — carries the exact organized virtual charge pattern of the dying cell's disease.

We strongly insist on the quantum mechanical view here: All physical changes — chemical, material, mechanical, whatever — at root level are constituted and caused by virtual state interactions, in direct patterns of virtual particle exchanges.

In the full QM view, what's really going on in primary physical reality is just a complex set of patterns and changes in potentials anyway.

The Summed Virtual Structures of Kaznacheyev's "Death Photons" Physically Kindle the Disease

At any rate, the Kaznacheyev experiments showed that the dying cells from the infected culture emitted photons in the near UV that contained artificial (structured) potentials. The virtual-state, patterned-substructures in this photon flux directly represented tho cellular disease pattern caused by the original cell's specific infection.

In other words, as the infected cells died, they emitted "death photons" which contained the **template** pattern of their death condition.

When these "death photons" are absorbed into uninfected cells, their deterministic substructures gradually diffuse into the cell's bio-potentials. Gradually the biopotentials of the new cells are

*There may be sufficient ordered input from the environment, however, to have something to do with territoriality in living things, salmon returning to a fixed place to spawn, turtles returning to the same beach to lay eggs, the migration of birds, etc.

Note that this photon is emitted from an atomic nucleus. Hence it is a phase conjugate (time-reversed) photon. It will interact with the biopotential of targeted cells, and thus reach their own atomic nuclei. This is the mechanism for Kaznacheyev's cytopathogenic effect. See particularly C.W. Rietdijk, **Found. Phy , 7(5-6), Jun **77, p.** 351

Table 43. THE LIVING AURA: THE CELL'S ELECTROMAGNETIC BREATH.

- **VIRTUAL EM FIELD**
- **STORES VIRTUAL PHOTONS**
- **ENVIRONMENTAL INPUTS**
- **OUTPUTS BIOPHOTONS**
- **COHERES ORGANISM**
- **TENDS TO STABILIZE**
- **EXPERIMENT ESTABLISHES**

Popp, "Photon Storage in Biological Systems,"
Electromagnetic Bio-Information. 1979

"charged up" with the integrated pattern of the disease.

The master cellular control system of the biosystem is itself a dynamically changing, ordered pattern in the biopotential of the cells, which is centered in the atomic nuclei comprising the cell materials. As the bio-potentials of the cells gradually acquire the "death photon's" substructure pattern, this pattern is also diffused throughout (modulates) the master cellular control system. All the cells in the sample (or in a biosystem) are now slowly charging up with the "death photon" pattern.

As Popp discovered, photons continually "leak out" of the virtual photon master control system of the biosystem. Some of these *leakage photons* are observable photons, **but most are virtual photons.**

Further, they are *structured* photons.

In other words, as leakage photons spill out of the master control system, observable change is now being slowly initiated in the physical structures, biochemistry, etc. of the biosystem's cells — and those changes are in consonance with the integrated "cellular death pattern" of the originally infected cells.

Note particularly that it is already well-known in quantum mechanics/electrodynamics that, when a photon is emitted from **the surface of a dielectric body, the entire dielectric body participates in that emission. If a photon is absorbed on the surface of the dielectric body, the entire**

dielectric body participates in that absorption.

Thus as irradiation by the "death photons" continues, the "death structure" in the irradiated cells increases. It is spread throughout the cell culture by the master communication system, gradually charging the virtual state structure of that system with the death pattern.

Spillage photons from the cellular control system occur throughout the culture. These photons are structured with the death pattern, and gradually affect the cell and its biochemistry physically. The previously uninfected cells thus physically start to acquire and exhibit the symptoms and characteristics of the disease pattern that killed the infected cells.

Electromagnetic Infection Results in Physical Disease

The new cells are now electromagnetically infected and physically diseased.

After all, that is all a cellular disease is in the first place — physical, electrical, and biochemical changes in the normal functioning of the cell.

For a given pattern of changes in the cells, a specific "disease" exists in them.

It absolutely does not matter what causes this exact pattern. If the specific physical pattern is there, the specific disease is there.

Note that **any ghost pattern in the virtual state flux can charge up physical matter — that is, the atomic nuclei of a mass. All that is necessary is that a continual flux of thin virtual pattern continually bathe (irradiate) the mass's atomic nuclei.**

The eventual emergence of this "ghost template pattern" into observable physical reality is called **kindling.** Kindling is charging up one or more atomic nuclei with an integrated virtual charge pattern until the integrated pattern breaches the quantum threshold, resulting in emergence of that pattern into observable physical change.

A Possible Cure for AIDS

One of the things going for the "good guys" and EM defense

against AIDS is that cells are a lot tougher than viruses. Thus even non-structured EM signals can be used to effect cures in many disease cases.

In fact, ordinary ultraviolet (UV) irradiation of the blood has already been utilized to cure or control severe infections, including severe viral infections. I am indebted to Dr. William C. Douglass for pointing this out to me, and for permission to reproduce the following information from his important newsletter, **The Cutting Edge, Nov.** 1987, p. 3. The following material is quoted verbatim, with no editing.

"It's amazing what you can find by nosing around in the dusty archives of a good medical library. I came across another remarkable therapy that the AMA and drug industry (or whoever is in charge of supressing non-toxic treatments that work) have shoved down the memory hole."

"Back in 1933, Doctors Hancock and Knott treated a patient dying of septicemia (blood poisoning) with ultraviolet irradiation of the blood.[1] The patient was moribund with a blood stream infection **and** obviously near death. (Remember that this was before antibiotics and there was nothing to lose.) The patient made a complete **and** uneventful recovery."

"Searching further, I found that in 1928 a similar terminal infection was treated by ultraviolet light to the blood. This patient also made a complete recovery.[2] "

"So in 1928, practically in the middle ages, an incurable disease, blood stream infection, was cured with ultraviolet light. With such **a** breakthrough why wasn't it tried again for *5 years?* According to **the** record, *another 6 years* passed before it was tried for a third time.[3]"

"Back in those days infection was the number one cause of death. You can't help but wonder how many lives could have been saved if doctors weren't so resistant to new ideas. Just imagine a cure for **AIDS** being set aside for 11 years. Yet bacterial infections of the blood were uniformly fatal in 1935, just like AIDS is today."

[1] Northwest Medicine, 33:200, 1934.
[2] Knott, AM. J. Surg., Aug. 1948, pp. 165-171.
[3] Am. J. Med. Sci., 197:873, 1939.

"Finally, in 1940, 110 cases treated with ultraviolet spectral energy were reported. The results were uniformly good. Between 1940 and 1948 many other conditions were successfully treated, including vein inflammation (phlebitis), polio and asthma. Up to the late 40's *over 40 thousand* treatments were given with ultraviolet blood irradiation."

"And now for the most interesting part. In 1947, Dr. G.P. Miley reported on 79 cases of virus infection.[4] Miley stated that ultraviolet blood irradiation therapy could be relied upon consistently to control an infection of a virus in a safe and efficient manner.[5]"

"AIDS is a virus. AIDS-II is a virus (the HTLV-IV leukemia and lymphoma now sweeping the world). Remember that these killer viruses are within the cell and any chemical agent that enters the cell to kill the virus will often kill the cell as well. But ultraviolet irradiation *kills the virus without harming the cell."*

"A fine piece of crystal can be shattered by exposing it to just the right frequency. You can be standing in the room and the energy from that frequency won't harm you in the least. Viruses have the same characteristics, and so, in my opinion, frequency irradiation of the blood in the ultraviolet range is our greatest hope for curing AIDS."

"But the treatment is simple, safe, inexpensive and unpatentable. That doesn't bode well for its future, at least until a few *senators* get AIDS."

The Mirror Cytopathogenic Effect and Factors Influencing It

The cellular disease induction effect was called the **mirror cytopathogenic effect** (CPE for short) by the Kaznacheyev group. Mirror CPE appeared only when the quartz or mica window was no thicker than 0.8 mm. A. F. Kirkin also duplicated the experiments using a thin plexiglas window.

There are conditions which enhance the effect, and others which inhibit or degrade it. Irradiation of the detector-culture with a low dose of UV prior to its optical contact enhances the effect, increasing

[4]Rev. Gastroenterol. 15 271-277, 1948.
[5]Am. J. Surgery, Aug. 1948, pp. 170.

it to certainty (99-100%). Increasing the temperature to 38.5 degrees centigrade also enhances the effect (from 37% to 90% for example).*

A necessary condition for the success of the experiment is the rotation of the holder with its two optically-coupled samples at a rate of about 24-25 revolutions per hour. Optical contact between the inductor and detector cells for a minimum of 4-6 hours is necessary, after which the cell cultures can be separated. A longer contact time is necessary for complete development of the irreversible effect.

Both cultures must be maintained in complete darkness throughout the experiment. Use of the detector as a new inductor in a successive state reduces the effect by 20-30%. Three or four such stages is sufficient to eliminate the effect.

There is a seasonal variation in the results. In more than 15,000 experiments, monthly variations and daily variations were noted. (The present author's interpretation of this is that it is due to the monthly variations in the virtual photon substructure input from the moon to the substructure of the cell's bio-potential. The daily variation is due to the daily variations in the virtual photon substructure input from the sun to the substructure of the cell's bio-potential.)

Negative results appear more often in winter. (The present author's interpretation of this is that it is due to the fact that the scalar potentials of the earth and the biopotentials of each living cell on earth are lowered in winter by the weaker flux from the sun.)

Effects are correlated with the polarity of the interplanetary magnetic field. Negative polarity of the field usually precedes the appearance of mirror CPE. (This is because of the positive nuclei — which prefer one direction of the magnetic field over another). Disturbance of the geomagnetic field several days before a culture planting also results in enhancing the mirror CPE effect. (Disturbing the geomagnetic field provides a "dithering magnetic disturbance" in the atomic nuclei which "livens" them. Consequently their readiness to charge-up and emit structured virtual state charges is increased).

Kaznacheyev further discovered that the Sun's activity and the

•This is very important. Preconditioning the cells by "dithering" them in the frequency band of interest, or in a subharmonic band, "livens" the cells for developing the irradiated pattern. Thin is similar to a dither voltage placed on a missile fin, making it much easier and quicker for the fin to move when an actual order is placed on it.

Earth's magnetic field greatly affected the results of his experiments. Large flashes on the sun seem to inhibit the effect. (Such flashes cause substantially increased irradiation of the atomic nuclei by sun-emitted substructures, charging them mostly with this disordered substructure pattern and literally "burying" the disease structure several decibels below it.) In a season of active sunspots, the mirror CPE effect becomes highly unstable. (The sun emissions are sporadically jamming the effect.) Under active sun conditions, the effect varies from 90-100% on some days to complete absence on others.

Some Biological Warfare Implications

The Soviets reported detecting near-ultraviolet photons — bioluminescence — as carriers of the death/disease pattern.

However, scientists at the University of Marburg in West Germany also duplicated the effect in the infrared. This shows that bioluminescent photons in the near UV and in the IR can definitely carry "disease and death" information between cells. Further, integrating a continuing input of such photons coherently integrates the disease or death pattern from the virtual state into the observable state.

Note also that portions of the infrared spectrum are a subharmonic of the near ultraviolet. Harmonics are well-known in nonlinear oscillator theory, and biological systems are filled with nonlinear oscillators. It may be that harmonics and subharmonics are directly involved in the death pattern.

If so, the induction of such "death patterns" upon normal electromagnetic carriers is directly indicated. For example, modulations covering several octaves in the region of 10 gigahertz and above might be constructed that are the analogues of some particular cellular disease. This modulation pattern could then be added to a common microwave carrier — say in the communication band, from 3 to 30 megahertz. Say, that is, to something like the giant Soviet Woodpecker "over-the-horizon radar" signals as carriers.

In that case, a large population could be bombarded, even on the other side of the earth, with "death photons" whose virtual state substructures carry the particular disease pattern. With sufficient

time, many of the targeted persons would develop the disease.

Note that, even if the power and/or irradiation time is reduced so that the absorbed "death photons" are insufficient to actually kindle the disease in the targeted population, a heightened change in the substructure of the biopotentials of the cells of the targeted persons is still accomplished.

In that case, a precursor pattern — a predisposition for that disease — exists in the targeted persons.

If the actual disease agent is now loosed on that population, the agent will be far more **infectious and lethal than it otherwise would.**

In this way, even diseases which normally do not kill or seriously debilitate the infected person can suddenly become very lethal agents indeed.

Influenza, the common cold, etc. can become devastating killers if the exposed population has been electromagnetically "pre-conditioned" for enhanced susceptibility.

What Kaznacheyev Hid: The Role of Phase Conjugation

If cellular disease can be electromagnetically induced, can it not be electromagnetically corrected or healed?

If one could time-reverse the exact signal structure (the information) that kindled the effect, and bombard the diseased cells with that reversed pattern, would not the cell deviate back to "normal" and be healed?

The burning question as to whether cellular disease conditions can be corrected by time-reversed disease signals must certainly have occurred to the Soviet experimenters.

It is highly significant that they did not openly publish those results.*

As we have explained in the sections on phase conjugation and scalar electromagnetics, there are really two major kinds of photons:

*Recent information indicates the strong connection of Kaznacheyev with the Institute of Physiology and Biophysics and the Frank Institute in Pushkino, just outside Moscow. Since these institutes are deeply involved in microwave and coherent microwave "directed energy" weapons, it is highly probable that the Soviets are applying Kaznacheyev's "death photons" to microwave weapons — such as the Woodpecker transmitters. If so, obviously they would develop phase conjugate countermeasure signals as well.

(1) the "normal" photon carries positive energy and positive time. (2) the "time reversed" or phase conjugate photon carries negative energy and negative time.

Further, the Soviets certainly knew all about phase conjugate signals. After all, they discovered and developed the effect. We discovered it only from the open Soviet scientific literature!

Let us assume that the "death photons" in the mitogenetic radiation emitted by the dying cells are ordinary photons. Their virtual state structures (in positive observer time) are exact "templates" for the disease pattern.

Now suppose we detect the "death photons" with a phase conjugator, which by definition will produce a time-reversed counterpart to the input signal detected. In other words, the death photons are allowed to strike a phase conjugate mirror (PCM). Time-reversed counterpart photons — carrying the exact time-reversed template of the death pattern — will be created and emitted by the PCM.

These newly emitted photons now carry the exact "healing pattern" for that specific "death/disease pattern that was received and detected."

Further, if we "pump" the phase conjugate mirror, we can greatly amplify the output pattern, and hence greatly increase the healing pattern!

If one records the pattern of the "death photons" for a specific disease, one could of course modulate that pattern upon ordinary photons/signals — such as the Woodpecker signals — and accomplish disease induction or precursor conditioning.

By phase conjugating the pattern of the "death photons," one can produce an exact antidote. One can modulate this specific healing pattern upon ordinary photons/signals — such as the Woodpecker signals — and accomplish healing induction for that specific disease.

In other words, one can create the healing pattern — the antidote, if you will, for any biological warfare agent. Cancer, leukemia, AIDS, viral diseases, bacterial diseases, whatever. One can create the antidote within minutes after the first symptoms of the disease or death pattern appear.

One can then simply add the negating (healing) signal to power line signals, television and radio signals, special transmitters, etc. —

and immediately start to "administer the antidote" to the irradiated population one wishes to protect. *Now one can see why the Soviets are so ready to expose the entire world to something like AIDS. It doesn't represent a real problem to them, the instant they decide to negate it.*

So they can devastate the rest of the world, with the assurance that their population is safe.

They can allow some of their own people to develop AIDS — and even some to die of it — as a deception plan to delude the West while Western populations are succumbing en masse.

Then they can snatch their own population right back to health, from "the brink of the grave," so to speak.

Our government must immediately develop the same capability. It is straightforward. As weapons and counterweapons go, it is enormously cheap. It can be immediately and widely implemented. **And** it can protect our population against AIDS or any other biological warfare strike by the Soviet Union.

We can save our people from the AIDS knockout already unleashed upon us by the Soviet Union.

First let us do that. *Then* let us negotiate.

Remember this: **You can negotiate with the Russians only from a position of strength. If you are weak, they will bury you.**

If we do not immediately develop this biological warfare countermeasure, we are already as good as dead.

Popp's Master Cellular Communication System

Dr. Fritz Albert Popp has already discovered and pointed out the "virtual state" master communication system that controls all cells in the body, and all their functions.

Based on a thesis derived to best fit experimental results by Ruth nnd others, Popp postulates that biological systems generally have the capacity to store coherent photons that come from the external world.

In other words, the biosystem is open to environmental communication and exchange.

He has shown that the cell population is in a quasistationary state that is far away from thermodynamic equilibrium, as pointed out by Ilya Prigogine.

Popp also concludes from his analysis that ultraweak photon emission within biological systems can influence chemical reactivity. In fact, his analysis strongly implies that "ultraweak" photon intensity can regulate the whole cell metabolism and related phenomena.

The cell takes up photons from external radiation. This includes both "observable" photons and "virtual" photons. Since it stores virtual photons, it stores charge, or biopotential changes. Since its stored virtual photons may be coherent virtual photons, it effectively "polarizes" or structures its stored photon charge, hence its biopotential.

The cell emits "spillage" photons — both coherent and incoherent — from its stored potential.

Although Popp only uses conventional "unstructured" photons in his analysis, he shows that, at the molecular level, there is a stationary equilibrium, as far as photon storage and emission are concerned, between the molecular photon traps, the cell population, and the external world.

It follows that *coherent* photon/charge inception from the external world can directly and precisely influence the cell's biopotential, hence its functioning and control, by information input.

Incoherent photon inception, on the other hand, can only grossly affect the cell, such as by heating or sporadic effects.

In his "Photon Storage in Biological Systems," Popp points out the master cellular communication and control system as follows:

"The photons which we have measured can be seen as a sort of "waste" from a virtual electromagnetic field with a high coherence. This field has a tendency to become stationary over the whole organism."

After additional analysis, he adds:

"....Consequently, biological systems must exhibit 'holographic' properties to an extremely high degree. The successful trials in

finding 'pictures' of various organs in each other organ, such as the ear, the hands, the eyes (acupuncture, iris diagnosis) support these conclusions. Our assumption that the entire genetic information of the DNA is stationarily delocalized over the body in form of genons may be seen as a further striking example."

"From this we can easily deduce that pattern recognition, as, for example, repair mechanisms and immunity, depends finally on the coherence of the photon field within the body."

Finally, Popp states a most important conclusion:

"...In medicine **new aspects have developed, and not only for cancer problems. Diseases in general can possibly be understood in terms of electromagnetic interactions within the organism."**

Scalar *EM* ***Comment on Popp's Communication*** *System*

Popp and his colleagues have produced most important work and results indeed. They only need to add the impact of the zero-summed/multiplied electromagnetics (electrogravitation).

As we cover in this book, the biopotential of the cell is rooted in the nuclei of the atoms of the cell's constituent materials. To be sure, every internal physical structure of the cell correspondingly "levels" and structures the biopotential. The overall cellular communication system is actually the exchange of "leakage" photons — both observable and virtual — throughout the overall biopotential of the organism.

Further, going beyond Popp's work, both the biopotential and the leakage photons have extensive, complex internal substructures. Leakage and intercommunication occurs laterally at all levels of the biopotential, and vertically among cells and substructures.

The master cellular control system's primary electrical conductivity path is not through the electron shells of the atoms, but is through the nuclei-to-nuclei scalar EM "biopotential levels" pathway.

With scalar EM methods, organized signals (signals with specific internal nonzero vector EM waves, but which externally sum to **zero** vector resultant E and H fields) can be constructed for essen-

tially any specific purpose. This includes "killing" a cancer or leukemia cell, destroying a virus, changing the DNA, etc.

This approach can directly reach and manipulate all immune and repair system functions.

The entire biochemistry and functioning of the cell — including its genetics — **is totally engineerable.** The Soviets have long known this, and have long since done it.

Further, a specific "charge pattern" of desired specific immunity (antibodies, etc.) can be designed and used to "charge up" the nuclei of the biosystem. This charge is then maintained by the system to provide permanent immunity. Thus one can develop, for example, an "electromagnetic innoculation" for AIDS, one for cancers and leukemias, etc.

Since the cellular control system is holographic, the "charge pattern" of immunity resides in every cell, including the blood cells.

Injecting a drop of blood from a scalarly immunized animal into another non-immune animal carries the scalar EM immunity pattern into the new animal. That charge diffuses throughout the overall biopotential of the organism, and the charge pattern activates the animal's immune system, including causing it to produce antibodies — according to the EM-transferred antibody template.

Antoine Priore demonstrated this effect numerous times. Thin was one of the great mysteries that confounded the orthodox members of the French Academy of Sciences.

The French Academy did not know of scalar electromagnetics, the cellular biopotential rooted in atomic nuclei of the cellular material, the cytopathogenic effect of mitogenetic radiation from diseased and dying cells, phase conjugation, and phase conjugated electromagnetic healing.

It is little wonder they did not comprehend the operational healing mechanism of the Bordeaux cancer-curing machine of Antoine Priore!

A New View of the Nature of Mind and Thought

The reason that Western science has not discovered what mind and thought are is simple: They have only built instruments and tools to look where the mind and thought *are not to be found.*

Let's look where they are to be found.

For example, consider the ionic discharges in and across the tremendous numbers of synapses of the human nervous system, and the slower discharge and migration of ions across cellular membranes, etc.

Considered as a single biological ensemble, these are much like a vast array of continual and continuing spark discharge vectors, slow charge current vectors, etc.

Overall, within the macroscopic space occupied by the body, these electromagnetic vectors sum almost entirely to a zero vector resultant. Only a tiny nonzero vector residue remains.

However, this vector zero summation has incredibly rich infolded signals, channels, and dynamic relationships (structure) within it.

Modern science/medicine measures the small nonzero electromagnetic residue (the remaining weak E and H fields) and tries to ascertain where and how mind and thought are accomplished, by studying that residue.

However, the residue E and H field remainders are simply the "garbage thrown out" of the glorious engines dynamically operating inside the vector zero summations (and multiplications).

The E and H field residues are the wastes or exhaust byproducts. They are not the functions of the mind/thought process itself; instead, they are the spillage or leakage from those functions.

Take a "frozen time" snapshot of the components of the zero vector summation. Regard the highly complex, infolded structure or pattern these components form.

Now take a second "frozen time" snapshot of the components of the zero vector summation, a very, very short time later. Subtract **the** previous "frozen pattern" from this second "frozen pattern."*

The difference or "delta" between the two patterns represents a myriad of thoughts, hence it represents the contents of the "thinking mind," in the most general sense.

The "mind" is the overall functioning and changing of the entire pattern's substructure, and the ability of an organism to have such **and** do such. The "ability of the organism to do such" requires at least

*Similar to the magnificient "double **exposure holography"** work of Dr Robert Powell.

two more nested levels of virtual state—two more hyperdimensions.

In simplest Kaluza-Klein theory, all those electromagnetic component vectors are in the fifth dimension. Hence they are hyperdimensional.

The zero-vector system may well have further infolded, internested levels of zero-vector systems. Systems within systems. These are hyperspatial, going into the 6th, 7th, 8th, etc. dimensions. Rife's microscope, for example, could reveal some of these levels; using evanescent waves, it could resolve some 16 ever-deeper levels of dynamic energy structure.

Everything driving the component vectors themselves is higher dimensional.

"A thought" is the exact change of a localized pattern (localized

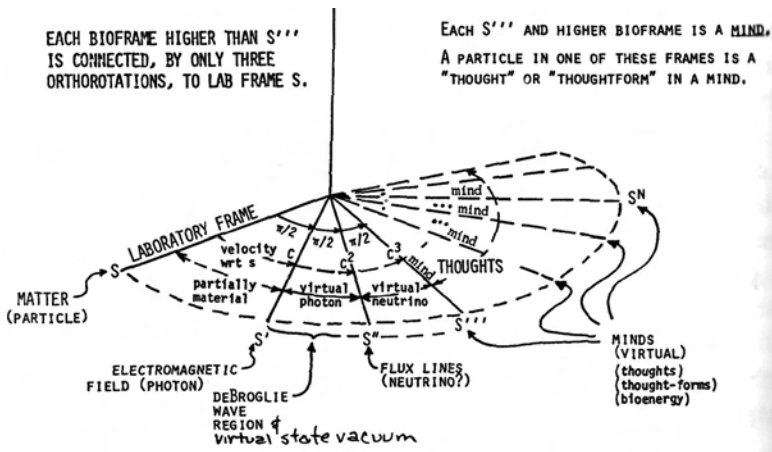

Figure 76. Hyperframes, vacuum, virtual state, minds and thoughts.

zero vector summation whose components are changing but remaining zero summed) from one moment to the next.

Thought is always a pattern change, of the components inside an EM vector zero summation.

Most thoughts are totally "unconscious" (multiple simultaneous

or "parallel" thoughts). A few are conscious (serially ordered, singularly considered and processed).

The unconscious mind is totally a parallel processor (many things/thoughts at once).

The conscious mind is totally a serial processor (only one thing/ thought at a time).

Most persons never take the time and trouble to reflect and notice that, consciously, they only can perceive one single thing at a time. Of course, the conscious mind is so rapid that by habit they assume they can perceive many things at once.

Since the conscious mind cannot discriminate the "multiple images in the slide projector at once" of the unconscious mind, that's what makes it unable to "be conscious" of the contents of the "unconscious."

In fact, the unconscious mind is totally conscious — it's just **multiply conscious "simultaneously."** (Which sheds some interesting light on why one can develop multiple personalities, for instance).

When the conscious mind "regards" the unconscious contents, it sees "something" which has "multiple meanings at once."

That's what we call *symbolic.* A symbol is something which can have many meanings at once.

That's why the unconscious content always "symbolizes" something when it's trying to communicate to the conscious mind. It's necessary to interpret the symbols to understand what the message being communicated is.

That's why dreams, for instance, are symbolic. And why it usually takes a trained psychiatrist or psychologist to properly interpret the symbolic representations manifested in mental disorder, and get at the underlying cause being symbolized.

With deliberately constructed scalar EM, any or all of the conscious/unconscious portions of the mind can be available for engineering and control/change. Eventually you will be able to put contents of the mind and memory on a video screen if you wish to.

It will also be possible to interact with the mind's contents electromagnetically. Mental illness will be treated directly, on an engineering basis.

Of course this opens up the frightening possibility of hostile misuse to the detriment of an individual. It will even be possible to change or erase his or her very personality itself. We pray, of course, that such a powerful tool will not be utilized this way, but will be used to heal humans, not hurt or kill them.

Unfortunately, Lisitsyn's work reveals that the Soviet Union has long since applied energetics (scalar electromagnetics) to mind control and mind engineering, including deciphering the genetic code operation. Controlled induction of images and sensations inside the brain — where they are processed as if self-originated — has been reported by the Soviets. Indeed, they have reported being able to control whether or not the induced material should rise to conscious awareness, as well as when it should rise to consciousness.

For years, U.S. intelligence analysts and U.S. scientists simply did not believe that electromagnetic signals could directly influence consciousness.

However, they were forced to reevaluate that position when a Soviet medical machine — the LIDA device — was openly obtained and evaluated.

The LIDA machine — a small unit somewhat larger than a briefcase — has been used in Soviet medical facilities to treat humans for decades.

The device uses a 40 megahertz EM carrier and very complex waveforms (signal modulations with complex mixtures of frequencies, phases, etc.)

When exposed to it, a person is caused to gradually fall into a trance-like, catatonic-like state within a few minutes. That person becomes very still and very quiet.

It was reported that the machine was tested upon a cat and had the same effect upon it.

One American scientist stated that the device had actually been used in North Korean "brainwashing" of U.S. prisoners of war in the early 1950's during the Korean War!

If so, one can see just how long the Soviets have achieved success with electromagnetic biological warfare/medical treatment techniques.

Reportedly, prisoners exposed to the machine were rendered

unable to psychologically resist their harsh brainwashing interrogation.

But to return to the brain activity, with its innumerable, zero-summed minute EM vectors, and its extremely rich and complex deterministic substructure.

Note that the ensemble of sum-zeroed vectors forms potentials. These potentials — i.e., the scalar EM — penetrate to the atomic nuclei in the brain and body. Internal changes in the potentials' substructures (i.e., thoughts) also penetrate to the nuclei.

The nuclei continually "charge up" (the particles change their states) to these impressed potentials, including the "potential" or "charge" of each component of the impressed potential. That is, the nuclei charge up with both dynamic overall potential (mind) and thought (individual substructure changes).

Notice that **mind, thought, and memory reside in, and are recorded in, the atomic nuclei. At many virtual state levels. In many hyperdimensions.**

Thus the functioning mind and bio-control systems — including Popp's master cellular communication system, the immune control system, the acquisition control system, and the repair control system - all "reside" in the nuclei as dynamically interacting, patterned potentials or "patterned charge," complete with resonances and frequencies, etc.

We can regard the mind and its interactions as physical, in the extended sense we have briefly developed here.

Everything "mental" can be directly interfaced with and engineered.

One day, for example, "education" will be by direct loading of patterns into the brain/body/cellular biopotentials, much as we now place a diskette in a disk drive and load the computer memory. And then everyone can be educated, in the widest range of skills and to the highest degree ever dreamed of.

Kindling, Life, Mind, and Negentropy

The mass of the atomic nucleus can be charged up with a particular dynamically structured biopotential.

In scalar electromagnetics, I use the term **kindling** to refer to the effect of charging up mass by a specific structured charge pattern to form such a structured potential in the nuclei.

Note that we are actually and physically restructuring the nucleus itself. That is because, if the structure of the potential in the nucleus is changed, local spacetime of the nucleus is polarized in complex electromagnetic structures. The electromagnetic currents, actions, and charges of the affected nucleus adjust automatically to this structure or "grid." *

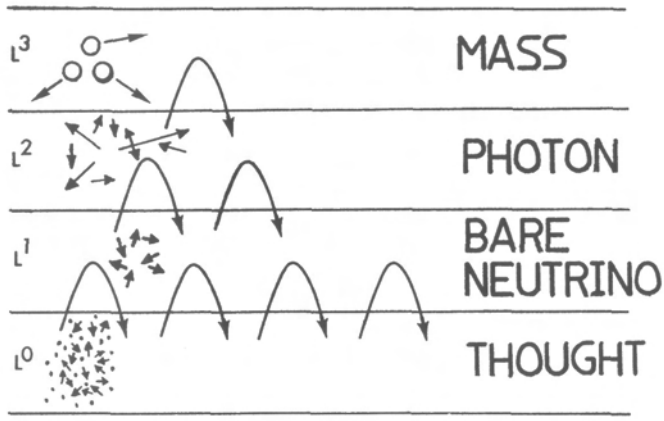

Figure 77. Internested levels of virtual state vacuum contain mind and thought. **The** vacuum also contains their interaction toward and upon mass.

*See Richard E. Prange and Peter Strance, "The semiconducting vacuum," Am. J. **Phy.** 52(1), Jan. 1984, p. 19-21. The vacuum may be regarded as a semiconductor. This semiconductor, particularly in the region close to the nucleus, may be manipulated by subjecting it to external fields, doping, etc. Extra energy density can even be extracted; see H. Paul and R. Fischer, "Comment on How can a particle absorb more than the light incident on it?" Am. J. **Phy. 51(4),** Apr. 1983, p. 327. For the involvement of negative time/negative energy, see C.W. Rietdijk, **"How** do 'virtual' photons and mesons transmit forces between charged particles and nucleons?" **Found. Phy** 7(5-6), June 1977. p. 351-374.

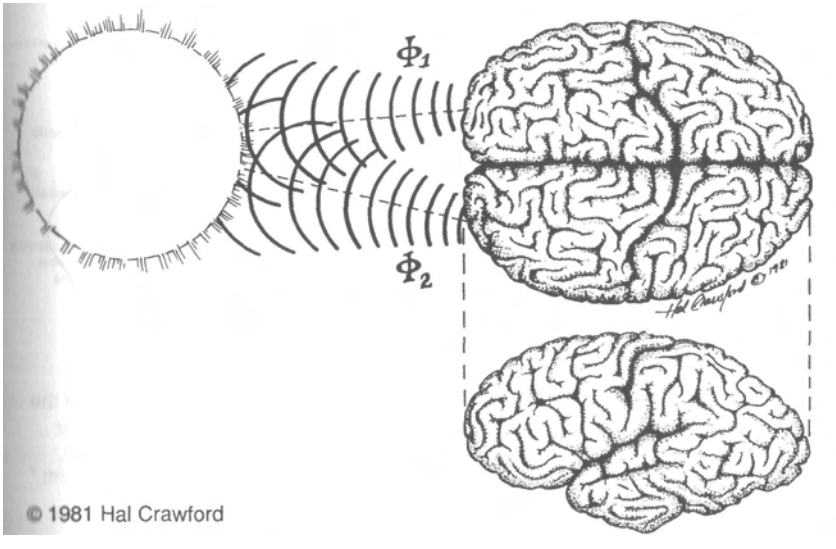

Figure 78. The human cerebral cortex is a natural scalar interferometer. It is a virtual state tuner, processor, and transmitter-receiver. It also can produce...and control to some extent...phase conjugate energy and phase conjugate waves.

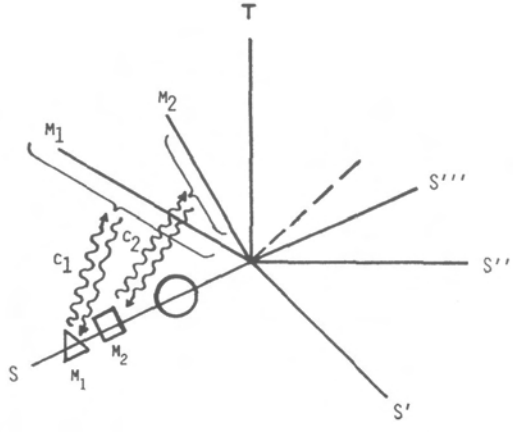

Figure 79. Consciousness and life. These phenomena refer to/constitute a deterministic hyperspatial (virtual state) coupling between mass and an ordered hyperworld.

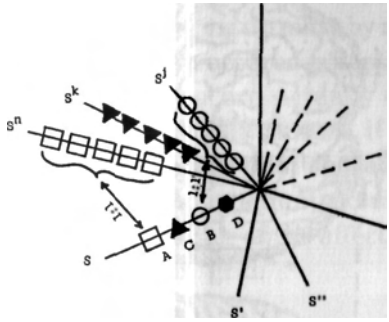

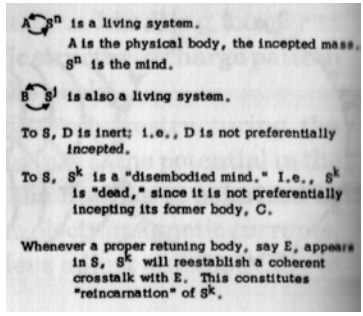
$A \circlearrowleft S^n$ is a living system.
A is the physical body, the incepted mass.
S^n is the mind.

$B \circlearrowleft S^j$ is also a living system.

To S, D is inert; i.e., D is not preferentially incepted.

To S, S^k is a "disembodied mind." I.e., S^k is "dead," since it is not preferentially incepting its former body, C.

Whenever a proper retuning body, say E, appears in S, S^k will reestablish a coherent crosstalk with E. This constitutes "reincarnation" of S^k.

Figure 80. Life and death. If the tuning or coupling between the mindworid and the tuned, structured mass body is broken, that is physical "death." Discharge of the structured cellular potentials then produces "death photons." Discharge of the overall, structured biopotential of the body constitutes discharge of the "living spirit."

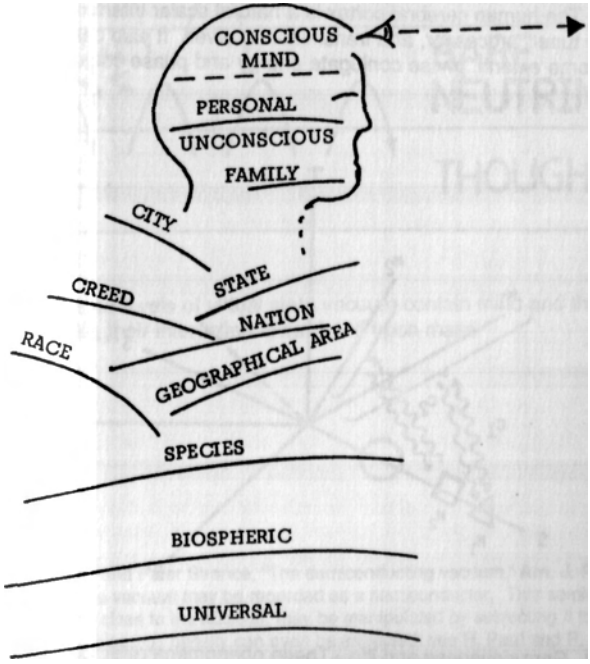

Figure 81. Layers of unconsciousness intersect hyperspatially.

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Figure 82. Scalar electromagnetics can directly interact with the various levels of human mind and personality.

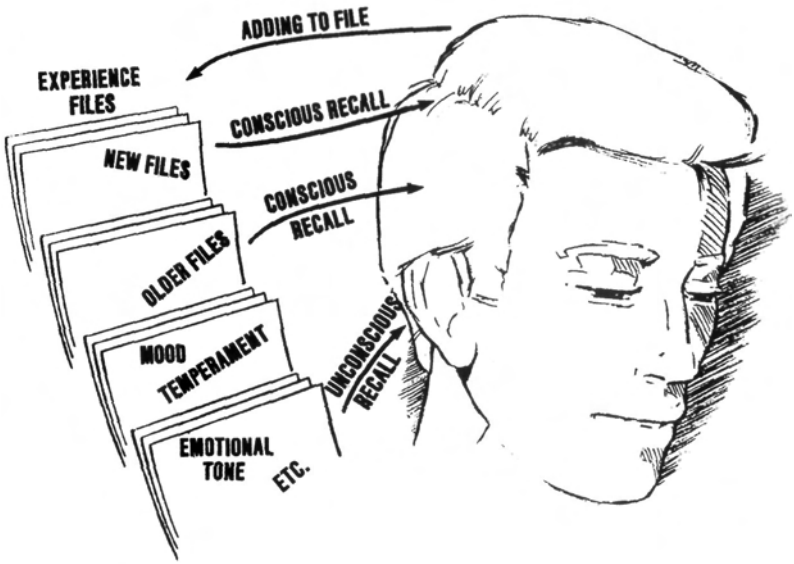

Fgure 83. What personality is.

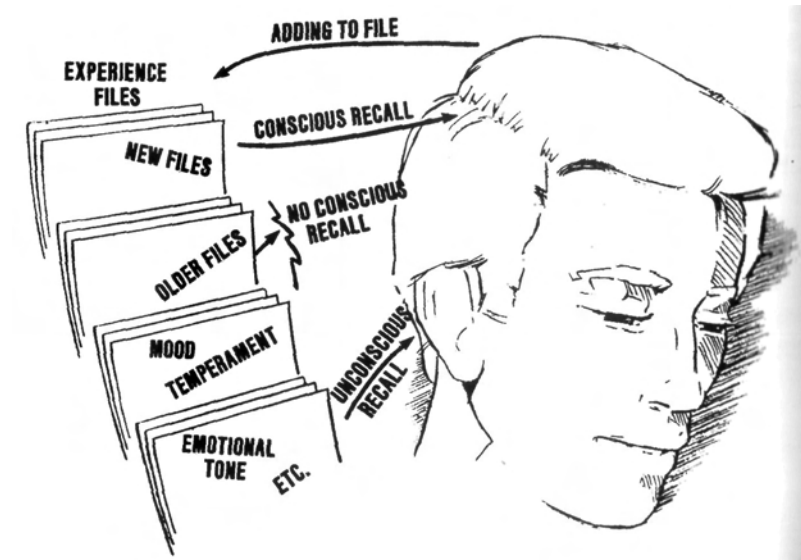

Figure 84. Jamming the "older files recall" process produces simple amnesia. If the recall process is then restored, the person regains his or her former memories.

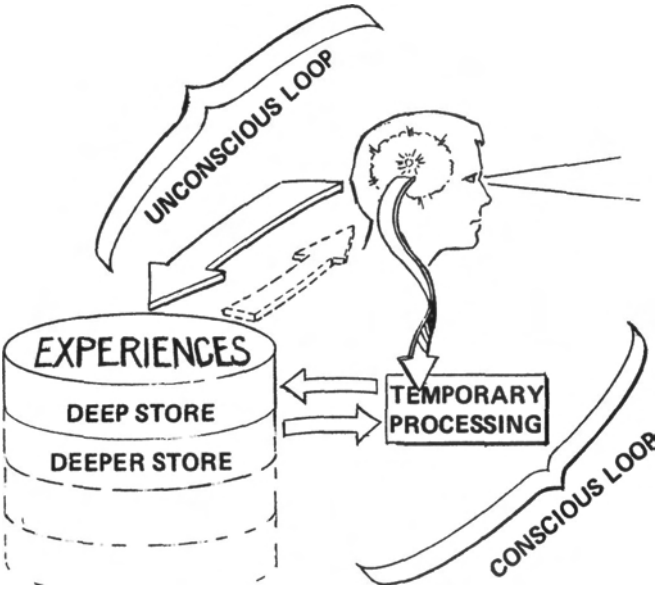

Figure 85. To sustain one's personality, continual functioning is required. All channels must be functioning.

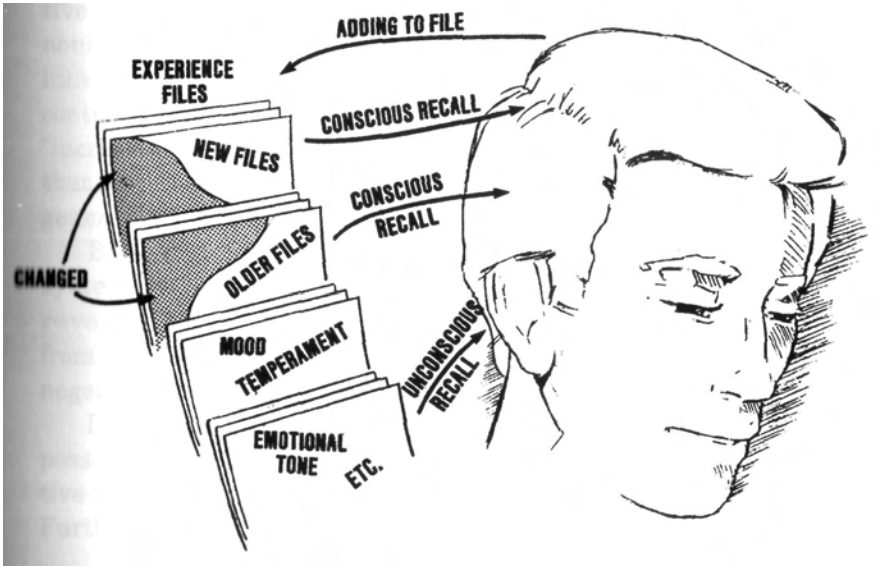

Figure 86. If the files themselves are changed, the personality itself is changed. It is possible to alter who or what a living person is.

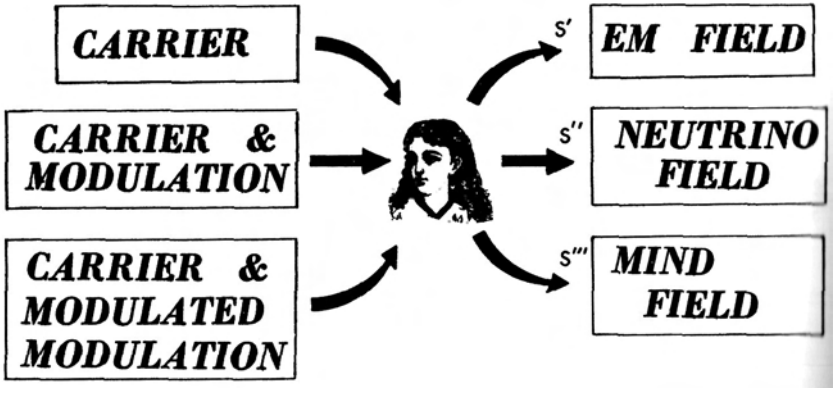

Figure 87. The mind and personality can be affected — and changed or controlled from a distance. The Soviets have developed at least a substantial part of this technology.

Table 44. LISITSYN'S REPORT

- **THEORY DEVELOPED & FITTED**
- **HYSTERESIS MEMORY LOOP**
- **CONTROLLED INDUCTION**
  - **IMAGES**
  - **SENSATIONS**
  - **PREDETERMINED EMERGENCE**
- **23 EEG BANDS**
  - **UP TO 8.1×10^{20} HZ**
- **11 INDEPENDENT CHANNELS**
- **BRAIN CODE BROKEN**
- **44 DIGITS OR LESS**

Thus by tailoring the specific scalar waveform and wave substructure with which we irradiate a mass, and utilizing phase conjugate (time reversed) waves, we can directly engineer the nucleus itself when sufficient charge structure has been built up in it to form a structured potential that is powerful enough to alter/ **shape** the nuclear processes.

We can, for example, transmute the nucleus into another form. Here an isomer form is the easiest. An isomer for an atomic nucleus (a specific isotope) has the same number of nucleons (protons and neutrons) overall as that isotope does, but a different number of protons. So it's a different element, but very specially related to its isomeric "brother."

All that it takes to change a neutron into a proton or vice versa, **is** to "flip" a single quark (subparticle of the nucleon).

Living systems can do that and transmute elements, to a small degree.

For example, living systems must use phase conjugation, negative time, and negative energy. To do so, they must function nonlinearly. That is the only way they can defeat the otherwise inexorable second law of thermodynamics: that all (linear) processes continue to more and more disorder as time passes. (That's called "increasing the entropy (disorder)." Unless a biosystem could defeat **that** law, its genetic pattern would inevitably be disordered in a few generations, and the species would disappear.

By using phase conjugation and time reversal, the **living system is** able to reverse the law of entropy in its time-**reversed channel.** That is, in that channel things go in reverse: fro***m*** disorder back to order! That's called "negative entropy" or negentropy" for short.*

It follows a priori that, to do this, the living system of necessity possesses phase conjugate energy systems (negative energy, negative lime systems) that are rooted in the atomic nuclei of its body. Further, it must deterministically manipulate these phase conju-

To* show how fully one can integrate physics and metaphysics, we point out that, since the vacuum imprints with every **change, nothing *is* ever lost! Death, where is thy sting?

gate systems.

This allows the precise definition of a living or nonliving system. If the system deliberately utilizes and manipulates phase conjugate energy/time in its atomic nuclei, it is a living system. If it does not deliberately use this, it is an inert or nonliving system.

For example, this sheds a great deal of light on the nature of a virus.

A virus is a single molecule. Ordinarily it clouds the distinction between life and death. Viruses can be crystalized out of solution, formed into "rock-like" crystals, and placed on the shelf, so to speak. There they can remain for many years or centuries, seemingly an inert rock. Then when placed back into their "preferred medium," so to speak, the virus crystals dissolve, separate, and "come back to life" and resume their living function. Yet the virus can be killed, in which case it is just a "hunk of rock," sitting on the shelf. In that case, it won't come back to life when placed back into its preferred medium.

In one case its "deterministic phase conjugate energy system" — its mind, to put it simply — remained in the nuclei of the atoms of the crystaline form. In the other case its "mind" was destroyed or disconnected from the crystalline form.*

A somewhat similar effect can be demonstrated in bacteria.

You can "kill" bacteria, for example, with UV radiation, then hold them in the dark for 24 hours (say, for 12 generations, since a nominal bacterial generation is about 2 hours.) They will remain absolutely "lifeless" and static, with no movement or cell division.

Then if you place them in the sunlight, you will be astounded to see them revive by the hundreds of thousands. In the "special kill" case here, the virtual state substructure of the UV photons just totally "jammed" the biopotential substructure functioning of the

*In the living case, the atomic nuclei remained patterned by the structured biopotential In the case of true death, the structured biopotential is lost and the nuclei revert to their "inert" form.

"minds" of the bacteria on one key channel. It didn't physically damage their bodies or "physical tuners." Then when placed in the sunlight, the broad frequency spectrum of the virtual substructure of the photons "dithered" and stimulated the bacteria's body-tuners, much like a "frequency massage" in all the bands. This set the physical tuners vibrating — and therefore responding once again to the biopotential substructure changes of the mind. Hence the bacteria "revived" and swam about — fat, dumb, and happy.

We have stated that **the mind is a physical thing, albeit a virtual or hyperspatial thing. In virtual/hyperspatial reality, it is a functioning, hyperspatial thing.** Interchanges be-

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Figure 88. The mind and personality are physical things, albeit hyperspatial and virtual.

tween it and an otherwise inert, functional, 4-dimensional ordinary physical system (a "body") comprise life functions, "thought," cellular control, etc. Those interchanges in a living system occur in the biopotentials residing in the atomic nuclei of the physical body, in the higher levels of biopotential in the body structures such as cells, membranes, and organs, and in the overall biopotential of the entire mass of the body.

We accent that this is not mysticism, but physics.

But now let us return to phase conjugation and the Priore machine.

The Priore Machine and Phase Conjugation

In the 1960's and 1970's, in France Antoine Priore built and tested electromagnetic healing machines of startling effectiveness.

In hundreds and hundreds of rigorous tests with laboratory animals, Priore's machine cured a wide variety of the most difficult kinds of terminal, fatal diseases known today.

Funded by the French government in the amount of several million dollars, **Priore's machines concretely demonstrated a nearly 100% cure of all kinds of terminal cancers and leukemias, in thousands of rigorous laboratory tests with animals. These results were shown to medical scientists as early as 1960.**

Many of the experiments and tests were done by prestigious members of the French Academy of Sciences. Robert Courrier, head of the Biology Section and Secretaire Perpetuel, personally introduced Priore's astounding results to the French Academy.

The operation of the Priore machine was seemingly incomprehensible. Many orthodox French scientists — some of them world renowned — were outraged at the success of such a machine, shrilling that science had nothing to do with "black boxes."

They loudly called upon the inventor to explain the mechanism utilized by his machine, but the inventor either wouldn't or couldn't, explain the curative mechanism.

Priore certainly knew how to build the machine and make it

work. It is debatable to this day whether anyone — Priore included — actually understood its principle of operation.

Neither the French Academy nor Antoine Priore knew anything of phase conjugation at the time.

In fact, the entire Western World knew nothing of phase conjugation in the 1960's when Priore was getting his finest results. At that time, only the Soviets knew of time-reversed waves.

Certainly Priore's machine was impressive.

Into a tube containing a plasma of mercury and neon gas, a pulsed 9.4 gigahertz wave modulated upon a carrier frequency of 17 megahertz was introduced. These waves were produced by radio emitters and magnetrons in the presence of a 1,000 gauss magnetic field. Experimental animals were exposed to this magnetic field during irradiation, and the mixture of waves (some 17 or so) coming from the plasma tube and modulating and riding the magnetic field passed through the animals' bodies.

Amongst other things, a plasma can convert a transverse wave to a longitudinal wave. Also, phase conjugate (time-reversed) waves

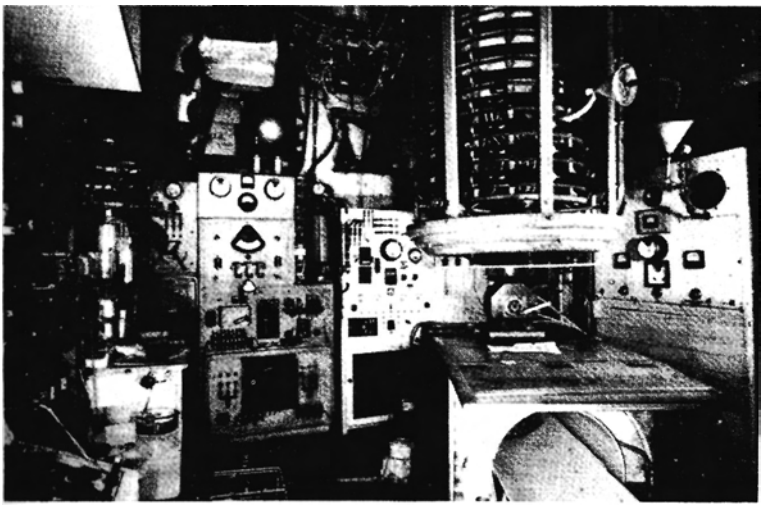

Figure 89. One of Priore's intermediate devices. This device cured terminal cancers and leukemias in thousands of laboratory animals. (Courtesy Bob Whitney)

can be produced by plasmas. Priore's apparatus produced a scalar EM wave/signal with deliberately constructed, infolded components including phase conjugate waves.

One may roughly view a cancer cell as a normal human cell gone "awry" and out of control of the body's master cellular control system. The cancerous cells, viewed as a sort of separate, parasitic group of cells, form a special kind of organism having its own master cellular control system "level," immersed in the host's biopotential.*

There is thus a specific, constant electromagnetic "delta" that differentiates the parasitic cancerous "organism" **from the normal human cellular organism.**

This "delta" can be considered a sort of constant, complex-structured charge existing in the body's atomic nuclei. It's exactly as if the body biopotential had been charged up by Kaznacheyev's "death photons" for that specific cancer condition.

If this cancerous "delta" (which may be rather like a complex intermodulation mix of waves) — or a frequency shifted "transform" of it to a different frequency band — is phase conjugated, a specific healing delta frequency pattern results.

If phase conjugate replicas of a cancer's cell's specific "delta" frequencies are fed into the body having that cancer, the deviation of the cancer cell's master cellular control system will be "time-reversed."

That will return the cancer cell to control of the animal's proper master cellular control system. The cancerous cell will be immediately destroyed, or reverted back to a normal cell of the animal.

A very similar process exists for just about every disease bacterium and infectious agent that attacks the body.

Phase Conjugates of "Death Photons" are "Healing Photons"

The Kaznacheyev experiments in the Soviet Union proved that, any cellular death and disease pattern can be induced by a specific electromagnetic pattern carried on an electromagnetic signal, if the

*One strongly points out the relevance of Dr. Robert Becker's epochal experiments proving that cells can be dedifferentiated and redifferentiated electrically. Those experiments are strong indicators that the cancer cell should be capable of being reverted to its more primitive state — that of the normal cell — by electromagnetic means.

target cells are bombarded with the pattern-carrying carrier signals for a length of time.What was not published of Kaznacheyev's work was the correspondent work showing electromagnetic reversal of cellular death and disease conditions by irradiating the diseased cell cultures by phase conjugate replicas of the pattern-carrying induction signal.

In simplified terms, if an action in forward time induces a condition, then the time-reversal of that action will reverse the condition.

The concept is almost laughably simple. **The time-reversal of an electromagnetic disease process is a specific healing process for that disease.**

In his device, Priore internally structured the carrier photons themselves — making them **vacuum engines.** He phase conjugated his vacuum engines, and then passed these time-reversed vacuum engines down and through a strong magnetic field which thoroughly penetrated all cells of the biological organism being treated.

The scalar components (structured photons) representing the time-reversal of the disease were absorbed and reradiated in all the cells, "charging up" the nuclei of the atoms in the organism to some potential level of the exact "healing and reversing pattern."

In the process, the cancer/leukemia pattern/charge also destroyed the cancer cells, or converted them back to normal cells as appropriate.

As a highly simplified analogy, the complex signal — viewed as a scalar Fourier expansion — represented a "stress" against any abnormal cellular control system encountered and returned it to the normal cell's master cellular control system of the body.

Encountering the normal control system in normal cells, it produced zero stress.

Encountering the abnormal control system in tumerous cells, it produced great stress on it, reverting it to the normal control system of the body's normal cells.

Thus to a normal cell the Priore signal pattern acted somewhat as a comb passing through one's hair.

No interference occurred with the normal cell (one whose scalar control pattern is phase-locked to the body's master cellular control system and in phase with it).

The Priore signal stimulated and "stroked" the normal cell, but did not hurt it at all.

On the other hand, the scalar control pattern in and of an abnormal (cancerous) cell is out of phase with the body's master cellular control system, and is not phase-locked to it.

Hence the Priore signal caused direct interference with the abnormal cell's independent scalar control system. The interference pattern constituted the reconstruction of normal energy directly in the cancerous cell, and also jammed its abnormal scalar life signal.

This destroyed the cancerous cell by two mechanisms: (1) physical energy was kindled directly in the abnormal cell, causing direct mechanical damage, and (2) the cancerous cell, being an "independent living critter," had its scalar life channel (connecting its primitive "mind" to its "body") jammed and stopped.

If the cancerous cell was reverted to a normal cell by the Priore stress before being destroyed, it became just a normal cell and the Priore stress had no further effect upon it.

The Effect is Universally Applicable

Any disease with cellular, biochemical, or genetic basis can be cured in like fashion.

Priore's method, for example, was clearly shown to be able to completely reverse clogging of the arteries with fatty deposits, and to be able to lower the cholesterol level to normal, even in the presence of an abnormally high cholesterol diet.

His method also showed complete mastery and cure of sleeping sickness and trypanosome-induced illnesses.

Often Priore found that every cell of the body — even the hair — must be irradiated and treated ("charged up") with the signal, for the disease pattern was in every cell. The master cellular control system is holographic — the pattern (substructured potential with its dynamic, oscillating components) is in each component (each atomic nucleus, hence in each cell.)

Every structural level of the body larger than the cell also has its

own correlated pattern, or modulation, on the overall.

A biological organism can regenerate lost limbs, for example, if it can utilize its natural recovery process in a Priore manner.

Even though Priore's work was presented to the French Academy of Sciences by Robert Courrier, the prestigious head of the Biology Section, the Academy could not understand the device and its functioning.

That was because the Academicians knew nothing of scalar electromagnetics, and phase conjugation, and the Priore machine was a scalar electromagnetic device using phase conjugation.

In the Mid-70's It Ended

In 1974, a change of local government lost Priore his government supporters. His support and funding were lost.

Ironically, Priore was just completing a 4-stories-tall apparatus capable of radiating and treating entire human bodies. It would have been capable of curing cancer and leukemia in humans rather than just in laboratory rats. (His previous machines were much

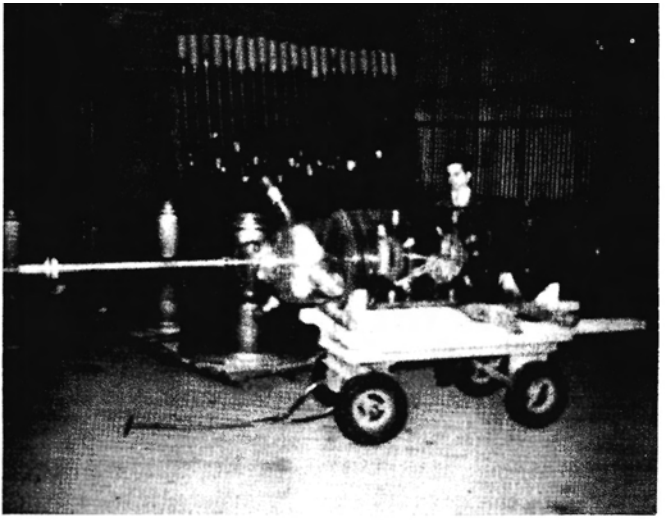

Figure 90. The large, special, phase conjugating plasma tube for Priore's giant device. The final machine would have treated humans "whole-body." (Courtesy Bob Whitney)

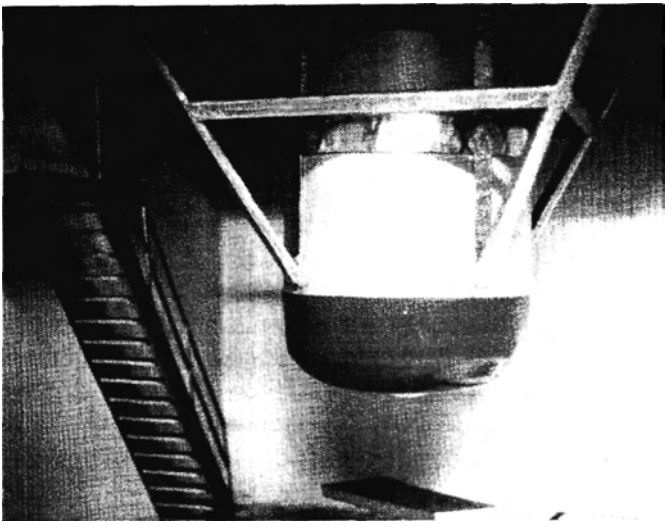

Courtesy Bob Whitney

Figure 91. Capping assembly for the top of Priore's giant plasma tube device. The last device would have treated human patients "whole-body." The cap assembly was on the third floor of the device.

smaller, and only a small animal could be irradiated whole-body.)

In that machine Priore used a "lamp," a special section, in which 17 specific frequencies were mixed and modulated upon the 9.4 gigahertz carrier.

The machine was large enough to irradiate humans over their whole body. **It should have been capable of curing cancer and leukemia in** two **five-minute irradiations, one week apart.**

While Priore was still alive, with my associates I spent nearly two years of my life in an effort to bring the Priore device to market and into the mainstream of medical research and development.

Robert Whitney, Frank Golden, and Tony Gideon played the major role, going to France and negotiating directly with the Priore group and the French government.

Verbal agreements with both the Priore group and with the French government were obtained. The machines were to be built, assembled, and tested in Bordeaux. Then they were to be dismantled and shipped to the purchasers — large medical research and development laboratories where they would be reassembled on site.

A group of wealthy backers was going to provide the necessary millions to fund the effort. Final contracts were being drawn.

Mysteriously, all funding for the project was suddenly withdrawn. Our backers were "leaned on" very hard and strongly threatened. Nothing we could do could revive the project.

Priore never again recovered his funding, and later died. The machine fell into disarray and was disassembled.

However, the proof that the requisite time-reversed signal can be produced, and will ride down a magnetic field, to penetrate every cell and every atomic nucleus in the body, is already in the present hard-core physics literature, if one knows where to look and how to properly interpret the work.

The fact that such signals can reverse nearly every major cellular illness condition of the body also has been proven by Priore and the scientists who worked with him, and it is in the French scientific literature.

The Priore-type cure for AIDS and other diseases only requires the necessary funding and personnel to be redeveloped and re-established.

Work of Australians Reed and Barsamian, and the American G. Wilbanks

At the University of Sydney, Department of Obstetrics and Gynaecology, some magnificent work of great importance to our thesis has been accomplished. Indeed, this Australian research may well be some of the most important work going on in the Western world today.

Dr. B. L. Reid, Dr. S. Barsamian, and their colleagues have produced experimental studies that positively verify pattern and form transmission at a distance, even through Faraday shielding. They have directly shown the reaction to, and results of, an unexplored information field on both living cells and inert crystalline matter.

In addition, they have replicated — and extended — the published results of Kaznacheyev on the cytopathogenic effect. In fact, they have obtained the effect at over 100 meters.

This shows, of course, that the effect is not just mesoscopic, but also macroscopic. Whether we like it or not, structural patterns of cellular disease can positively be transmitted electromagnetically, and kindled in target cell structures at a distance.

Dr. Reid has been interested in the origins of cancer since at least 1958. After much work in the standard models, by the late 1970's he was convinced that the present approach of medical science is wrong. He reasoned that we should pay stricter attention to the nature of growth before examining new growth, i.e., cancer. Growth, of course, is creation — and so the problem became, what is creation?

As a metaphor for biological growth to work with, he and his colleagues chose the growth of crystals. With keen foresight and intuition, they directed their inquiry so as to expose the complicity of some force — if any — external to solute and solvent.

Their work began to show that such a force existed, and it was a type that was unaffected by interposition of a Faraday cage. In other words, *it was not a conventional electrical force.**

Dr. Reid and his colleagues then included biological subjects in the form of living cells. They were familiar with Kaznacheyev's work in Alma Ata, Kazakstan on the subject of long range transmission of pathological (viral) effects on cells. In addition, they were familiar with the seminal studies of Gurwitsch on transmissions by onion roots cells, in the 1920's.

Most of their basic studies on the nature of the new force, however, were made with common salt, drying from aqueous solution, Some of their major results were as follows:

1. The familiar cubic symmetry is altered toward a higher energy form of dendrite crystals when biopolymers such as protein are included in the solvent.
2. A mass of lead 12-20 kg in the crystal space (up to 1 meter distant) causes an interference pattern in the salt crystal display.
3. A prospective dendrite pattern is not realized when a prospective cubic-pattern of the salt is dried in the local space (up to

"For one related possible scalar EM (electrogravitation) interaction, see Ya. B. Zel'dovich, "Electromagnetic current and charge due to interaction between a gravitational and a free electromagnetic field," **J. Exper. and Elec. Phy.** (Soviet translation), 16(7), Oct. 5, 1972, p. 302-303,

1 meter). The latter by its presence in space is able to prevent the dendrite expression and enhance the cubic symmetry expression. **A photograph of crystals of cubic symmetry when moved by a vibrating holder (2 cps) has the same effect on the real crystals drying from the solvent.**

4. Dendrite forms of salt crystal result when certain chemical reactions involving proton or ion movement occur up to 30 meters away, separated by brick walls, glass, etc. These reactions were detailed by Dr. Reid and his colleagues. If the mother solution is examined by ac capacitance on a sensitive bridge, variations in capacitance of over 300% accompany the receipt of the signal.

5. If such a transmission from 30 meters distance is regarded as a carrier wave which is modulated by a foreign — and thus detectable — chemical, **the chemical can be detected in the distant atmosphere some 3 months later in the form of a discrete or adiabatic 'cloud' which contaminates sodium chloride drying at the same time.** In this way, copper sulfate dissolved at a site A in June 1985 could be repeatably detected at site B, 30 meters distant and separated by walls, screens etc., by a drying solution of sodium chloride solution in September 1985. Serial dryings of the sodium chloride solution on glass slides showed that each day, the cloud hovered over a space of 1-2 cm at the end of a venturi tube for several hours before 3 p.m., and then moved off at 1 meter per hour in a NW direction. The copper content of the cloud was discernible by crystal structure and chemical means from the adjacent sodium chloride.

6. All of the above crystal forms required ambient oxygen for their manifestation. Atmospheres of nitrogen and argon prevented their display. At the time, the researchers suspected that the effects may have been carried by orbital electrons of oxygen showing unpaired spin which had interchanged with electrons of the copper solution. They then

developed an information-carrying device which could 'infect' the electron cloud of a target molecule sufficient for the chemical display of properties of the infecting electron's parent atom. This concept seemed to explain the experiment of the following paragraph.

7. Two beakers of sodium chloride solution were connected in series with a small voltage source (say a 1.5V dry cell) to provide a transfer of electrons through each beaker. The second beaker in series was sampled for subsequent drying and display of the crystal form. A crystal form of cubic symmetry resulted. When the solvent of the first beaker was altered by the addition of a protein solution (such as albumen or globulin), the crystal pattern of the second beaker was altered from cubic to dendrite pattern as though protein were present in the second solution.

8. During attempts to stabilize salt crystals on glass by means of thin plastic films drying from appropriate solvents (in order to stain the salt with aqueous solutions of dyestuff), it was discovered by chance that the crystalizing process is accompanied by structural patterns on the plastic film so exposed. These patterns were of two major types: (a) vortices, or spirals in the film plane, of 0.1 to 1.0 mm diameter, and (b) smaller curled structures into which the spiral could be seen to merge or grade. From a concurrent mathematical study of vorticeal interaction as designed by Barsamian, the similarity of the curl structures in plastic films (the researchers usually used 0.25% polystyrene in benzol) to computer simulations of vorticeal vectors was shown to be remarkable.

9. The researchers then dispensed with the underlying crystals and exposed the drying polymer film to a variety of spaces where the field, thought to be responsible for many of these tele-effects, was operative. With this technical advance, the team has made rapid progress over the last year or so. They have come to have a more comprehensive grasp of the ether

field than was possible by less direct methods involving formation of crystals.

10. On the biological side, they repeated the Russian studies done at Alma Ata with transmission of the cytopathogenic effect of viruses on animal cells. They used the cytopathogenic effect of colchicine and its relative vinblastine on cells with the following differences from the published Russian work: (a) The effect can be transmitted at least 100 meters between campus buildings, (b) it is not necessary to use a magnetic field for the propagation, (c) it is not necessary to use quartz vessels; glass is quite effective. These experiments came to the attention of a colleague, Dr. G. Wilbanks, Head, Department of Obstetrics and Gynaecology, Medical School, University of Chicago in 1983. Dr. Wilbanks was able to repeat them with similar results. However, in a more faithful copy of the Russian experiments, he used quartz vessels with cells placed in a magnetic field, with the vessels separated by no more than 1 mm. Both the Australian researchers and Dr. Wilbanks shared another thing in common: their uniform inability to interest the editors of several scientific journals such as **Science, Nature, Naturewissenchaften,** and others in publishing papers describing these fundamental experiments and results.

11. Experience with interference of a lead mass in the crystal work prompted the use of several metals in the ambient field of growing cells. Only lead (and to a lesser extent tin) showed the following properties: (a) Cell growth with 0.5-5 Kg lead in the ambient field is depressed sometimes to one third normal, (b) The cells die (dye exclusion test) but then can be revived by placing a small bar magnet in the local space with its poles in an E-W orientation. At least in Sydney, a N-S orientation of the bar magnet does not revive the stricken cells.

12. The effects of energy flowing through living matter have been documented by Kirlian's method. It was therefore of interest

to the Australian researchers to expose living systems to drying films of polystyrene. They found that the staining properties of the ambient-derived image on plastic films parallel those of the real organism.

13. By appropriate use of an imposed potential on living cells, it proved possible to match the field strength and show the actual imposition of the ambient (scalar) field on the biopolymer content of the material during the permeation process. The traces obtained are not unlike noise and would be so regarded by the casual investigator. The design of this apparatus and associated experiments was the work of Dr. Barsamian.

Concepts of Dr. Reid and Associates

Dr. Reid has kindly shared with me some of the concepts he and his colleagues have formulated. These concepts, it is stressed, are consonant with direct physical results they have obtained in the laboratory.

Note that any errors in this explanation are strictly the fault of this author, and not of Dr. Reid and his colleagues.

1. Matter is bathed in an energy sea familiar to quantum theorists. The Australian team prefers to call this sea of energy **ether,** as a relatively bland term, perhaps in a way to rescue it from the oblivion where Einstein banished it. The key to the silence of this sea is its "fractional-charge" charged particle status and low energy values. The former conceals it from physics, while the latter conceals it from chemistry and thermodynamics.

2. The differing energy levels of this sea, combined with its enduring motion, are theoretically and practically best expressed as a **vortex.** Dr. Reid and associates have detailed this theory to explain the creativity of biology. The incipient creativity of the vortex is given material expression by its association (as part of the EM field) with an electron which it

now endows with equivalent novel properties. There is no intuitive reason why the energetic rearrangements of the electron cloud cannot proceed to the nucleus, there to set up a quark or proton rearrangement — or, as the quantum theorist would say, a virtual particle exchange — leading to transmutation. Kervran's work on biological transmutations is relevant; the literature of such effects goes back to 1798 at least! The team suspects that some such mechanism may underlie their experimental result of the transition of sodium to copper.

3. **A further prime property of vorticeal interaction is its proclivity for amplification,** wherein the atomic-size vortex can be built up to the meteorological hurricane by such adherence or affinity. The team has noted the affinity of ambient field vortices to those produced by an electric current in a metallic conductor, with particular reference to the ill-defined boundary between the two. This parasitism was the reason behind the team's use of "carrier waves" from chemical reactions as transporters of fields whose identity of origin were sufficiently specific to trace the field subsequently. It is at least conceivable that the whole process could be amplified and used to parasitize (modulate) a radar beam as carrier. The affinity property of fields may be exhibited by the experience of mariners with what they loosely term "magnetic phenomena" thought to be derived from luminescent plankton. In the South China and Arabian Gulf seas, giant "wheels" of light, 5-15 km in diameter and containing spiraling spokes, revolve about the ship at night, reversing their direction of rotation as they pass the midpoint of the vessel. The key observation in the context of the field affinity concept is that the luminescence is manifoldly enhanced when the ship's radar is switched on. There could thus exist a chain, scalar-EM/plankton-optical, the first leg (scalar EM) of which can be amplified by radar EM.

4. The property of affinity means that **a scalar field's** transform **or copy, of the energy disposition imposed on it by the experience of matter last permeated, may persist as**

a memory **in space,** as many of the Australian observations attest. The team found that recall was not all that difficult technically. **The energy transform for copper** sulfate **existing as a non-dissipated cloud with marked adiabatic properties could be recalled five months after its formation. There is no reason why informationally more elaborate spatial configurations of energy, including human thoughts, will not behave in precisely the same way.** The cell nucleus could conceivably be the candidate for the first site for storage of such energy. The nucleus has a highly ordered structure and an associated high permittivity, and this would make it a real target. In the human subject, there is experimental evidence that the mongoloid polymer constitution will have a higher activity for storage of the ambient field than will the Caucasian.

Other Important Ideas

Dr. Reid also shared other important insights:

Lavoisier in 1748 advanced the concept that matter itself (chemicals) is inert. The activity of all chemicals, according to Lavoisier, resided in their associated ether — and God sent the ether!

Taken to its limit, this suggests that the source of the energy which we call *thought* is a property of the scalar field. Matter (say, the nervous system) interacting with these fields, would be incapable of discerning the source of the field as presented, whether of self or external origin.

In his book **Hidden Variables in Quantum Theory,** Dr. David Bohm felt that in 'elevating' (his word) matter (as particles) from the sea, it might be possible to consider the idea as containing even more elaborate energy transforms such as biological shapes, these transforms themselves undergoing metamorphosis. [Comment by this author: Rife's microscope, using evanescent waves, actually allowed one to directly see and photograph such forms, proving the thesis.]

The ability of the Australian researchers to rescue these transforms on films together with evidence that they could be seeing the results of the exclusively space interaction of virtual forms (say

microbe and antibiotic), is also a direct technical step toward validating Bohm's important idea.

Wider Implications of Structured Field Information

As T.D. Lee points out in his important book, **Particle Physics and Introduction to Field Theory,** particle physicists have not attempted to use the structure of the vacuum nor the structure of potentials.

Dr. Barsamian has shared other wider implications of the structured ether.

Over the ages a phenomenon which, as discussed, can have no representation in real (that is, electromagnetic or thermodynamic) terms can hardly have been thought of as possessing specific structure or function. Instead, it signaled its undoubted presence to generations of philosophers and physicists before Einstein, solely through statistical effects.

The writings of Helmholtz, James Clerk Maxwell, and Neils Bohr are examples. The more recent Dirac and Fermi statistics are **a** continuation of the process.

If an alternative definition of science is the continuing refinement of that which we partially knew or took for granted, then the refinement of these statistical approaches ~ with their obligatory uncertainty as defined by Heisenberg — is a worthy goal.

In this sense, a more articulate description of the anatomy of the field is a logical progression from the beginnings of the ether concept in Classical Greece through to the statistics of the nineteenth to the early twentieth century.

A hundred years ago, this orderly progression even reached the concept of a vorticeal atom at the hands of J. J. Thompson. However, it was interrupted very effectively by Einstein's publication of the special theory of relativity.

Einstein was fortunate in that he had chosen for his mathematics a pivotal feature of the ether field, its elasticity. The mathematics of elasticity had been evolving — through the developments of Hooke, Young, invariance, and the calculus — to handle its historically increasing complexity (by tensors). This mathematics of elasticity was then available to Einstein. The wisdom of this choice

was vindicated by the remarkable special relativity predictions which were born out in subsequent observation and experiment.

There was seemingly no need to suspect, let alone probe, any special properties of the medium underlying the mathematics.*

The success of these predictions effectively blocked any chance of a return to the ether field concept. Indeed, it was seen as an arrogance to despoil the "elegance" of the mathematics. Nor was the success of quantum mechanics — the other leg of the Western World statistical approach to the nature of reality — able to get the physicists to heed Bohm's 1958 ideas on the hidden variables in its fabric or Dirac's 1952 ideas on a lesser uncertainty of the particle-field relationship than Heisenberg had formulated.

Recently Dr. Barsamian has originated the concept of an **alienation of the electron from its field.** The full expression of this could see the field so alienated that it is well-nigh autonomous, and some kind of fundamental entity in its own right.

In this sense, the freed autonomous field — at least conceptually —could proceed with its creativity by hybridization with other fields and so return the product of these asides to the particle. In atoms of the next fragment of matter with which the particle then associates, this product could create novel properties derived from the interchange.

The multiple properties of such a field allow it to be resolved in EM (electrostatics and electrodynamics), in atomic structure (electrons and nucleons), and in pressure (gravity) terms. This universality makes a new concept possible, long beloved of the GUT (Grand Unified Theory) theorists: that there is only one energy.

It is also quite possible that this ubiquity need not be confined to physics. It may penetrate the biological imponderables of growth, new growth and consciousness.

In view of the work of Dr. Reid and his associates, and other work — such as that of Hines and Chimonas showing atmospheric gravity waves launched by auroral currents — the prospect of amplification and transmission of transforms and patterns over long distances,

*As, for example, whether or not the concept of an abstract vector space in vector mathematics must be modified to correspond to what we know about the vacuum medium. If the vectors are to correspond to the movements of physical things in the *vacuum medium,* then the vector medium must correspond to the vacuum.

through affinity with long distance carriers, is indicated.

Dr. Reid stated that it would be surprising if other laboratories outside Russia had not progressed as far, if not further, than he and his associates had. Obviously the lack of similar publication indicates the nearly impenetrable editorial curtain confronting Western researchers in this and related areas.

Dr. Barsamian's Important Theoretical Insights

Dr. Barsamian has formulated a theory in relation to the development of cancer that is of great importance.

In his theory, he is developing the approach of classical mechanics to electromagnetic interactions between charged particles and between dipoles. The field associated with the primary moving particle is not neglected in his theory, and this part of it differs from Dirac's "new electromagnetic theory."

The field associated with the primary moving particle, in Dr. Barsamian's approach, is viewed as an important part of the particle's interactions. This field is stressed in the sense that diverse phenomena — from Maxwell's EM field radiating from the remotest regions of the universe to the controlled charge flow in the matter medium — are viewed as manifestations of EM forces.

This of course is unlike the traditional relativity view of EM force action on moving charges.

In Dr. Barsamian's view, the potential vectors (derived by a reatment from fluid mechanics theory) form an EM field and are positioned on a vortex curve. All parameters of such a field can be treated mathematically, and Dr. Barsamian has one or more papers presently in publication.

The duality of such potential vectors (gradients) is to conduct the motion of particles (which are always either charged or dipolar) appearing in nonmatter, which is taken as an incompressible continuum — the "void." Because the final results of these forces are always movement of matter, Dr. Barsamian prefers not to classify them by their origin.

Such a field may persist with great permanence. There are some limitations in summation (triplet conditions) and selectivity (periodicity) of the vortices themselves. Part of these limitations takes the

form of particle characteristics. Presently he is rather sure that the formation of patterns of organic, inorganic and liquid crystals (typical to living biomatter) are partially responsive to the effect of the described field.

Dr. Barsamian is attempting to synthesize his own experimental findings on the dielectric behavior of biosystems as they enter the cancer process with the data that Dr. Reid is producing with respect to action at a distance.

With respect to living systems, he has slowly been approaching the conclusion that existing physical laws are just not applicable concerning (1) entropy, or (2) energy breakdown, or (3) random collisions of particles in quantum terms, or (4) electron-ion exchanges in bioelectrochemistry terms.

Under such circumstances, it is difficult to find a referee who sincerely understands the related experiments and their underlying theory. This presents a nearly impenetrable barrier to publication in leading scientific journals.

This is tragic, because these considerations and experimental results at least provide an entry into more fundamental experiments with present lethal diseases such as cancer and AIDS which annually take large numbers of human lives.

The present state of the art is telling everyone loud and clear that something fundamental is wrong with present theory, and that we should come to terms with more novel views.

Comment by the present author: In his prophetic insights, Dr. Barsamian has placed his finger squarely on the fundamental struggle of living systems against the "positive energy/time" laws of present physics. In its struggle, the living system must use negative energy/time, to correct from disorder to order and provide the extra free energy to do so. Otherwise, the steady progress toward increasing disorder in all its actions, would very shortly reduce the living system to such a disordered state that it could no longer reproduce the clear genetic pattern of its own kind. We have already pointed out the hitherto unexpected role that phase conjugation plays in allowing the living system to violate and break the iron dictates **of** conservation, nontransmutation, entropy, and raw statistics.

To live and survive, a living system must have access to other functional levels and other mechanisms beyond those contained in

our present physics, electromagnetics, and biochemistry.

The incredibly productive and important work of Drs. Reid, Barsamian, and associates is of the utmost importance. Their work clearly moves everything in biochemistry and the knowledge of cellular functioning a major step forward.

It is a betrayal of the scientific method that such vital work goes so largely unreported in the leading journals. Indeed, the work of these Australian scientists should be galvanized and well-staffed and funded. They can literally usher in a new science, given the chance to further exploit and develop their results.

Royal Raymond Rife

In the 1930's and 1940's, Royal Raymond Rife revolutionized everything that has been done before or since in high resolution optical microscopy.

He also revolutionized everything before or since in cellular biology. He carried cellular structure far beyond anything ever dreamed of at the time or presently. He revealed the direct connection between organized living energy forms and organized biological systems. He revealed that life itself is organized and dynamic, to a far finer level than anything in the textbooks today. **He revealed that our present theory of disease is fundamentally very, very wrong.**

He produced direct, economical, electromagnetic cures of cancer, leukemia, and other such debilitating diseases. His work presages a future mankind could have had, where most debilitating diseases were quickly and economically corrected, and where no poisonous drugs, violent nuclear irradiation, and harsh chemotherapeutic "burning" of the patient would be necessary.

For such epochal work, he was ostracized, essentially imprisoned in a medical treatment facility, broken, condemned, and rejected by his peers. His findings, though printed in reputable publications and journals, were discredited and ridiculed.

He literally was reduced to a non-person by the power of the medical cartel.

Finally escaping from his enforced confinement, he lived out his remaining years and died quietly and unknown.

Rife's Universal Microscope

With his universal microscope, Rife achieved optical resolution of up to 31,000 diameters and magnification up to 60,000 diameters. His microscope could examine living viruses, living bacteria, and other as-yet-undiscovered living organisms and living energy forms that no other microscope before or since could see.

Even today, only the electron microscope furnishes such resolution, and it zaps-to-death the objects that are being examined. Further, it will not at all detect or see the "living energy forms" revealed by Rife's microscope.

To appreciate Rife's accomplishment, let's briefly summarize some of the performance factors of an optical microscope.*

Several factors are important in the functioning of a microscope: Resolution, magnification, and contrast lead the list.

By **resolution** we refer to the ability of the instrument to distinguish a small object. In other words, something like looking at a medical doctor's eye chart, and specifying the smallest print one can clearly see. Resolution is often referred to as resolving power.

By "magnification" or **magnifying power** we mean the ability of the instrument to "blow up" or enlarge the image produced. Roughly, it's the ratio of the apparent size of the object seen through the microscope to the apparent size of the same object seen without the instrument.

Magnifying power is exactly like enlarging a photograph. It won't improve the resolution or make the photograph any clearer, but may make whatever was captured (resolved) easier for the human operator to see. If you just keep enlarging the photograph, it will get more and more grainy, until no further details can be seen with higher magnification.

Contrast refers to the distinctness by which the various parts of the object can be distinguished from one another. To enhance contrast of objects under the microscope, staining of the objects is often used. Very often the act of staining will itself kill the living organisms — such as bacteria — that are being examined.

*The electron microscope reveals only the "dead carnage" of the battlefield after everything is destroyed. With it, one is observing physical residuals, not the living players. For some encouraging modern work, however, see Michael Hercher, "Virometer — an instrument for the measurement of the size of viruses using an optical microscope," **SPIE Seminar Proc**., 1977, p. 17-22.

Figure 92. Royal Raymond Rife in his laboratory. Courtesy Christopher Bird

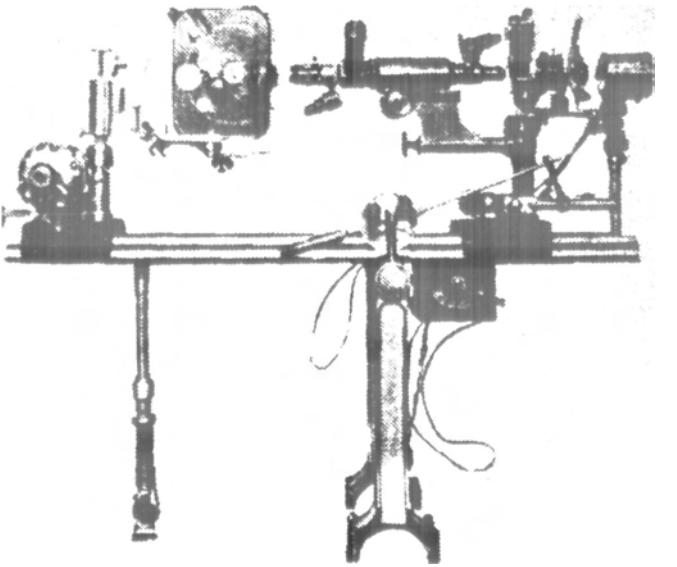

Figure 93. Rife's first virus **microscope.** Courtesy Christopher Bird

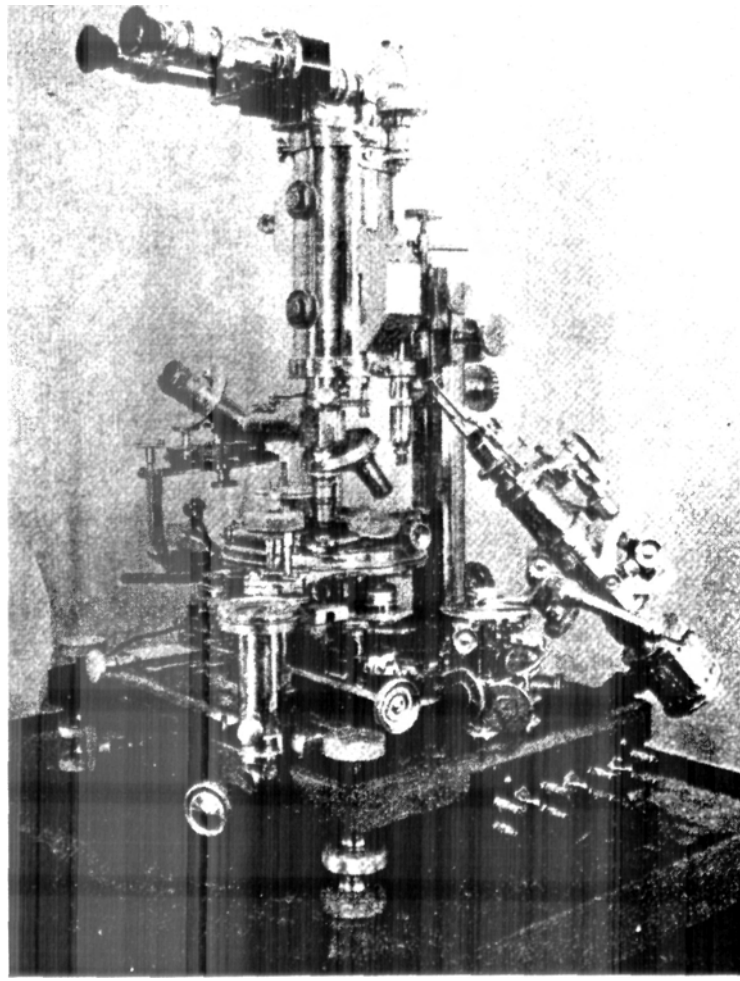

Figure 94. Side view of Royal R. Rife's prismatic universal microscope. Largest and most powerful of five Rife microscopes With it, living filterable viruses could be observed. Courtesy Christopher Bird.

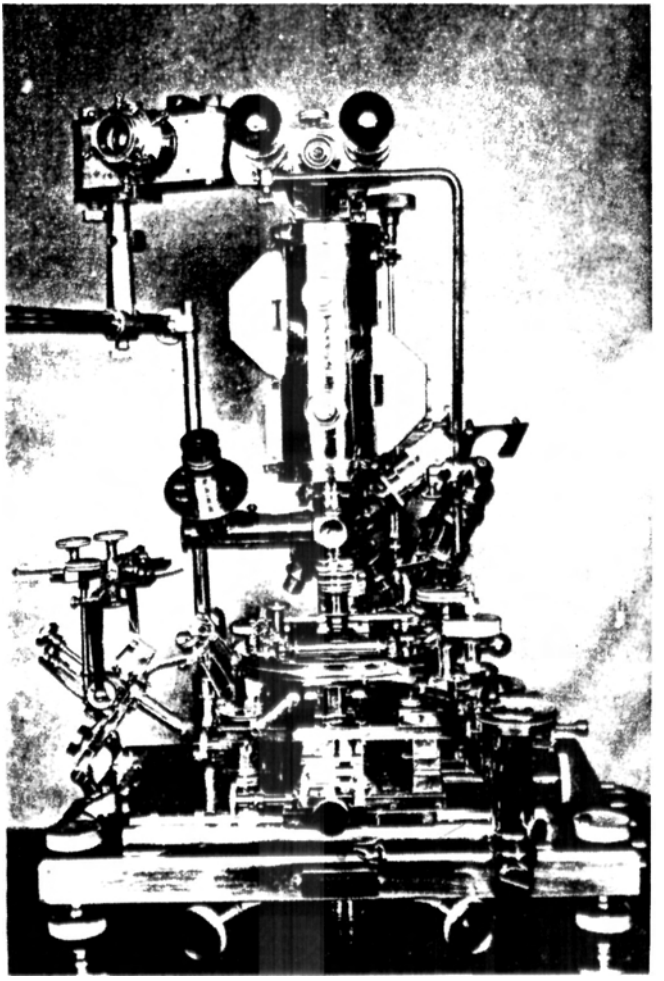

Figure 95. Front view of Royal R. Rife's prismatic universal microscope. Built in 1933 in Rife's San Diego, California laboratory. Courtesy Chris Bird.

We may state the resolution of an optical microscope in terms of the diameter of the smallest object resolved: for example, so many nanometers. Or we may just simply and loosely speak of so many thousands of diameters.

The resolution of an optical microscope depends upon the illumination conditions, its optical system, and the fact that the object viewed diffracts and spreads the light. A wide variety of mechanisms for illuminating, resolving, contrasting, etc. are used in optical microscopes.

According to standard Rayleigh theory, normal optical microscopes are limited in resolution to about half a wavelength. That corresponds to about 250 nanometers for visible light illumination. One can do a little better than that by using ultraviolet light and quartz optics. The UV has a higher frequency than visible light and hence a shorter wavelength. However, beyond 240 nanometers the resolution of an optical microscope quickly disappears.

A few researchers — notably in the 30's and 40's — remarked about other factors, such as "quality of the lenses," affecting resolution. Some of them reported results to about a tenth of a wavelength. Loosely, that translated to somewhere in the order of 5,000 to 6,000 diameters. The dependable upper limit seemed to be — and still is — about 3,000 diameters, however.

Normal optical microscopes simply are almost useless for trying to look at viruses. They will not resolve any but the very largest viruses, and will not resolve the internal features of even those few giants.

Much of today's knowledge of virus structures and shapes comes from the use of electron microscopes. They bombard the object viewed with a fierce rain of energetic electrons. These instruments see nothing of the *functioning* of the virus, for they kill it instantly in trying to view it.

With Rife's universal microscope, the dynamic living functions of the virus could be observed without killing it.

With Rife's microscope, a whole range of complex organisms and structures below the size of bacteria was revealed. Many of these organisms are still not known to present science, even though some of them were written about at the time. Filterable forms of bacteria

— forms which readily passed through filters supposed to easily block their passage — were discovered and reported by Rife and his medical colleagues.

In addition, Rife's microscope — which contained block-quartz prisms and lenses and interference stages — revealed halos around living organisms that other microscopes could not see, even though the object was within their resolving power. Further, it revealed the existence of entire organisms and forms which other microscopes could not see — even though, again, the size of the organisms was within their resolving power.

In other words, Rife's microscope not only revealed smaller physical forms than any other microscope could see, but it also revealed sizeable "living energy" forms which no other microscope could see.

Rife Proved That Everything Is Alive

The degree of smallness to which Rife's microscope would resolve, and the extraordinary energy forms it could detect, showed that direct detection of the virtual state organization of the living organism was accomplished by the instrument.

The science of the day was only just groping its way toward any sort of physics that could explain such an astounding instrumental result. Today, however, in the hard-core literature there is demonstrated proof that the optical limit of resolution can be drastically overcome, using evanescent waves.*

Shortly we will briefly give an "ad hoc" explanation of such evanescent waves.

Electromagnetism has been shown by Kaluza-Klein theory to actually exist in the fifth dimension. In other words, EM itself is hyperdimensional. It flows in the fifth dimension, which is "wrapped around" each point in our ordinary space. It is — to the first approximation — the external environment of every normal point in

*E.g., see T. Sato et al, "Application of evanescent waves to microscopic observation," **Bull. Tokyo Inst. Technol.** (Japan), No. 125, 1974. p. 35-41. See also G.A. Massey, "Microscopy and pattern generation with scanned evanescent waves," **Appl. Opt.** (Poland), l3(3), 1983, p. 247-255.

our 3-space.

Let's say that again.

The electromagnetics "medium" itself is totally external to each point in our space. Each of our points is surrounded in higher space by the electromagnetic medium.

We live inside a totally electromagnetic medium. It's not just an "electromagnetic environment" in our own space; instead, it's an electromagnetic environment in hyperspace.

Everything already is just the internal structure of the electromagnetic medium!

That's what the "vacuum" is.
That's what "spacetime" is.
That's what the "virtual state" is.
That's what physical matter is.

And it's all alive. Totally and completely alive. Everything is alive. There is nothing but life. The electromagnetic medium is alive.

Except within a locally-organized biopotential area, it's just "equally alive in all directions." So it appears inert, where by "inert" *we mean not singly preferential.*

Every biopotential change, at any level in a biopotential, extends "decaying-expotential-wise" to infinity, by standard theory. Part of that potential change exists at every point in the entire spatial universe. And there at that point, so do the biopotential changes for every other biosystem in the universe.

Everything's alive. There is nothing but life. Anywhere. Anytime.

An interchange between this "living, surrounding electromagnetic medium" and each particle of mass in our 3-space continually occurs. This exchange involves the so-called virtual particle flux.

If we model higher dimensions, such as are necessary to include the "particle zoo" discovered by modern particle physics, each of these "higher dimensions" corresponds to a "successively deeper-"

internested level of virtual particle flux—of the vacuum, or of this electromagnetic medium that surrounds us.

The living system orders, structures, and dynamically functions and interchanges electromagnetically throughout many higher "dimensions" — throughout many such internested levels of virtual-state/vacuum/spacetime.

Except for the first layer of virtual state (the 5th dimension in Kaluza-Klein theory), gross (classical) electromagnetic theory totally ignores the infolded, ordered deeper structure of eleetromagnetism (of the EM medium).

Using such gross electromagnetics, orthodox science thus can only detect and grasp the gross results of the living organism's functioning. Further, it can only detect and grasp those gross results that actually move 3-space matter — observable particles.

So it only detects the grossest interchanges between "mind" or "life" and matter. Specifically, it only detects the final results of that interchange—the gross movement of material particles themselves.

The first hypernumber — "i," the square root of minus 1 — is used to model another dimension at right angles to our normal three. An electromagnetic wave thus is modeled to have two parts: the first is the part that affects or moves a material particle, and that's called the "real" part or "observable" part. The second part of the EM wave is the component that lies in this "imaginary" (unfortunate standard term!) dimension. That imaginary part does not of itself move charged particles, so it is considered to be "something other than real."

Note that what's really done in this sort of orthodox modeling is to define observation as the movement of observable charged particles.

The human "conscious mind" is a functioning part of the overall human mind that has been specifically fitted to function almost totally with our gross bodily detection of the photon interaction.

We thus consciously detect and "are aware of only the first level of reality: the interface between the first layer of virtual-state/ vacuum/spacetime/ and the 3-space of observable particles of mass.

Since the physicist must be "conscious" of his observation or instrumental detection, the detection process ultimately has to have

a final stage that produces a photoelectric interaction with his body — for that is all the conscious mind detects and processes.

Everything chemical, electrical, etc. — according to quantum mechanics — will involve at its root level only the photoelectric effect.

Rife's Microscope Used Evanescent Waves

However, it is certainly possible to build an instrument which is multi-staged, and one in which higher stages interact primarily with deeper internested levels of vacuum virtual state. That is, an instrument that interacts with higher dimensional phenomena. That is, one that interacts with deeper internested levels of electromagnetics. If these stages interact causally in a vertical manner, then the final interaction with the human body and nervous system can still be "normal electromagnetics" and yet indicate a higher dimensional phenomenon, event, or function.

That is precisely what Rife did: His universal microscope penetrated to a much finer level of reality because its multiple stages used **evanescent waves.**

Here's what we mean by that.

An electromagnetic wave consists of a "real" part and an "imaginary" part, as we have discussed. It's possible, however, to have the real part become zero, and still have the "imaginary" part remain and dynamically vary.

This sort of wave — containing only the "imaginary" part — is said to be one type of **complex wave,** or an **evanescent wave.**

In advanced EM waveguide and optical theory, such evanescent waves can function to guide or determine the real parts of the EM waves. That "real part" is the part that is then going to interact with electrons and move them, and give us a "detection."

In other words, the "real" part of the EM wave will be moved and guided by the "higher dimensional" or evanescent part, or even by separated evenescent parts — pure evanescent waves.

So one can build a device or instrument that utilizes such an effect to reveal what's going on in a whole dimension beyond what we

normally see. Waveguides in certain RF radars already do that.

Such instruments are not limited to the resolution determined by the "real" part of the EM wave (such as the "real part" of light).

Such a microscope would not necessarily be limited in resolution by the wavelength of the light it used to illustrate the observed object.

Indeed, if one uses a higher dimensional Kaluza-Klein model (which particle physics of necessity has to consider), one could build a "repetitive stages" instrument which could view many more higher dimensions. That's exactly the same thing as viewing many more deeper internested levels of virtual state.

That is precisely what Royal R. Rife did: **He developed a microscope using multiple stages, special interferences, etc. He built a multistaged evanescent wave instrument that could see into higher dimensions and deeper levels of virtual state.**

Rife's microscopes were thus startlingly different from normal microscopes. That is why he could see phenomena and organisms, ostensibly within the size capability of normal microscopic resolution, which ordinary microscopes could not see.*

Evanescent waves penetrate the virtual state (hyperdimensions) and interact with what to us is "dimensionless" (what does not spatially intersect our 3-space). Interfering multiple evanescent waves reflected from/having interacted with these (to us) nonphysical forms can again reproduce ordinary electromagnetic "light." Thus the evanescent wave microscope, if properly built, allows one to directly "see" (and photograph) what is to us living forms of energy, nonphysical, and without 3-space matter bodies.**

The same scheme can be used to develop instruments capable of directly revealing the living nonphysical world around us — such as the human biopotentials, their internal structures (including

*However, Rife's microscope was extraordinarily difficult to focus. Rife often spent 24 hours straight at his universal microscope, just in focusing it.

**If one is going to accept the many-dimensional theories necessary to explain particle physics, one must accept the possibility of higher dimensional living things, which we would see as living energy forms or as thought forms. These would appear nonphysical to us - as is time itself— but would be real and interactive nonetheless.

"thought forms"), etc. What the Soviets call **bioplasma** can be directly observed and photographed in this fashion. We have only to develop the necessary instruments; the science required is difficult, but it is already in the literature.

That is what Rife's microscope did. It was a forerunner of the instruments we need to develop in electromagnetic healing, and Rife was a truly great and unappreciated pioneer.

In one swoop medical science could have jumped a century ahead. The ruthless suppression of Rife and his fantastic scientific breakthrough was one of the most dastardly deeds ever perpetuated by the orthodox scientific establishment.

Rife Revealed a Far More Fundamental, Living Biology

With Rife's powerful universal microscope, it was also possible to view the interiors of the so-called "pinpoint" cells situated between normal tissue cells and just barely visible to ordinary microscopes.

Here is the astonishing living world inside those "pinpoint" cells, as revealed under Rife's powerful instrument: When one of the "pinpoint" cells was magnified, still smaller cells were revealed within its structure. When one of these still-smaller cells, in turn, was magnified, it too was seen to be composed of even smaller cells.

With Rife's microscope, this process could be repeated 16 times. An astonishing internested series of organized levels of a living cell was revealed, far more fundamental than anything that exists in present biological theory.

The present author points out most strongly that these levels correspond electrically to, and are in virtual particle flux pattern exchange with, the electromagnetic potentials of their environment. This includes their own biopotentials that are centered in the atomic nuclei of the atoms comprising the physical material of the cells, and that charge up with specific internal patterns.

The biopotential itself is organized into a corresponding virtual-state series of internested levels and functions. **The structured biopotential of the cell is a living, organized, functioning thing, and its internal functioning literally constitutes the "spirit" or "true nonmaterial deep mind" of the organism.**

All the internested levels are in constant electromagnetic exchange "up and down" with each other, particularly with respect to organized virtual particle flux patterns.

In addition, all the cells are in constant electromagnetic exchange "across" with each other, at all levels. This provides a dynamic, structured, living biopotential for the entire bio-organism (the entire body). Within this potential, dynamic interchange on all levels is continually occurring. This is the basis for the master cellular communication system that Dr. Fritz Albert Popp discovered.

Rife's powerful microscope had revealed nonmaterial functioning life forms (structured, dynamic, living biopotentials) connected to material bodies.

He could follow "filterable" forms of bacteria — actual living biopotential forms of the organisms that could not be separated out by filters, but which would easily pass through any filter.* He could observe interactions of these forms, changes of forms, translations and transmissions of forms, etc. — none of which is detectable by present biological theory or medical science.

Rife had advanced biology and biophysics a century in one jump. As always, orthodox scientists — most of whom in their scientific paradigm are self-admitted materialists — were quite unready to tolerate such heresy.

Obviously the materialistic dogma of the science of his day — and of the science of today — reacted most hostilely to such hogwash. Contrary to the prevailing mystique, most scientists are dogmatically attached to materialism and to the dogma of their present paradigm. Faced with a conflict provided by experiment, most will uphold the dogma and reject the experiment — the exact opposite of the scientific method they espouse.

Rife's revolutionary work was no exception. He incurred the unending, total opposition of powerful individuals controlling the direction of biology and medical science for their own personal gains.

Rife was hounded into court on trumped up charges. Though he was acquitted, he emerged a shaken, broken man and an alcoholic.

*More precisely, they would easily flow *around* the 3-dimensional filter, since they were hyperdimensional.

His work was suppressed. His equipment was left to gather dust. He was also forcibly committed to a medical treatment facility.

Finally escaping from his "prison," Rife lived out his remaining years quietly. He died without ever being vindicated for his marvelous, world-shaking discoveries.

But at least he left us a legacy. Persons are still alive who knew Rife and his work, to one degree or another. Some of his microscopes are still in existence, though non-operable due to missing or stolen parts. With proper funding, an enlightened team of scientists and researchers can be assembled to quickly repair Rife's remaining instruments and duplicate his incredible work.

With concentrated effort, Rife's work will yet play a primary role in the development of a direct electromagnetic cure for AIDS. As a byproduct, it will play a role in rapid development of cures for cancer and other debilitating diseases.

Royal R. Rife's contributions may yet help save half of humanity, and prevent a Soviet takeover of the world.

CHAPTER 6

DEVELOPING THE ELECTROMAGNETIC CURE FOR AIDS

By now, how one goes about developing a electromagnetic cure for AIDS — and for cancer and other killer diseases — should be apparent.

One must set up a modern research laboratory and assemble as many of the "dirty dozen" together as is possible. One then tackles the problem head-on, adding the necessary support staff and special consultants.

First the Kaznacheyev effect for AIDS must be isolated and determined. Then it must be reversed, to yield the precise "curative" signal.

Transforms for these Kaznacheyev IR/UV "death photons" and their phase conjugated "healing photons" must be obtained for a lower electromagnetic frequency band — such as, say, 10 to 20 gigahertz.

Away must be found to irradiate the whole human body with the curative signal. The ideal way is to utilize a scalar EM curative transform so that the atomic nuclei of the body — and hence its entire master cellular control system and immune control system—will be "charged up" with the correctly structured "AIDS cancellation message."

The entire procedure and apparatus must be as simple and small as possible. My colleagues have already achieved very promising — even remarkable — progress in this respect.

Reversing the Kaznacheyev Effect

The "Kaznacheyev effect" for AIDS virus condition must be stimulated between cell cultures, so that the disease condition is electromagnetically transferred from one to another. The actual electromagnetic "delta" constituting the contribution of the AIDS infection must then be isolated electronically. The best way to do this

is probably to subtract the normal cell radiation pattern from the "cell plus AIDS" radiation pattern.*

With the "AIDS delta" determined, the delta is then fed into the appropriate phase conjugating mirror system, so that its time reversed replica is produced.

The new phase conjugated signal is then the required *AIDS reversal signal* to reverse the effects of the AIDS virus itself, inside the cell where it resides dormant. This " time-reversed" signal will reverse the genetic change in the cell, not just kill the HIV virus.

In a crude way, one is making an **electromagnetic anti-virus.**

For ease of development and treatment, microwave technology is most attractive. Obtaining transforms of the signals in the radar band is ideal, since a wide variety of techniques, instruments, and electronic parts are available for that region. Millimeter waves would be most attractive, for the equipment could then be highly miniaturized.

One can regard it another way also: energy forms (critters) are involved. The action of the AIDS virus in its host cell, upon the DNA of the host, is underlaid by manipulation of energy critters. If one makes the electromagnetic anti-virus form, one is also manipulating the energy critters in their virtual state substrata.

The net result is that essentially the virus pattern — even the virus itself — can be phase conjugated by the energy critters. The result can be to turn the actual virus in the cell into a negative virus, accomplishing recombinant DNA procedures in reverse.

Remember that the signal we seek to use involves negative energy and negative time. We are also engineering the virtual state directly. The ordinary positive energy/positive time/observable state rules and limitations do not necessarily apply. And the "fixed form" first order physical reality as we normally conceive it need not

*Procedures along the lines of the extraordinary double-exposure holographic work of Dr. Robert Powell will probably be necessary. His work on biologically significant spatial frequency spectroscopy has blazed the trail as to how to obtain the specific delta patterns desired. It is hoped that Powell will shortly publish the remarkable results of his 15 years' work.

be so fixed at all.

Physical reality itself can be directly engineered.

The engineering we seek to accomplish is directly upon the probability states propagated by the Schroedinger equation, before observation and collapse of the wave function occurs. **We seek to engineer physical reality before it is born, while it is yet forming.**

Only at such a level can the previous action of the AIDS virus — that in which it combined its genetic material with the genetic material of the host cell — be reversed and undone.

Only at such a level can we convert the infected human body from an "AIDS virus factory" back to an uninfected normal human body without AIDS.

The Proof: Priore's Work

Antoine Priore's pioneering work largely proves that it can be done. Cancers, leukemias, and many other virulent diseases yielded to his phase conjugated signals passed down through a powerful magnetic field to totally penetrate every cell in the treated patient's body.

And Royal R. Rife's work proved that a virus and a bacterium are not at all the "rigidly fixed" physical forms that our normal science has led us to believe they are. Instead, both the organisms and their biochemical and genetic actions can be addressed — and changed — on a much finer level of reality.

Of course, it would be enormously helpful if one had a working Rife microscope.

My colleagues are attempting to rebuild one of the original Rife microscopes, which has parts that were missing from it. They have every hope of having the microscope in action in the future.

Another angle of attack is also possible.

One of my colleagues has discovered a very peculiar, weak electromagnetic signal that will kill viruses, harmful bacteria, toxic protozoa, etc. but not harm living human cells. Only a few volts and

a few milliamps are used.

However, there exists a major problem in getting any such very weak signal into every cell in the body — which is required if one is to heal blood diseases such as AIDS and leukemia. After all, that was the reason that Priore utilized a powerful magnetic field of thousands of gauss. The magnetic field penetrated every cell in the body — even those in the bone marrow where all the blood cells are manufactured. By using the all-penetrating field as the carrier, the phase conjugated healing signal pattern could thus be introduced into every cell in the body, bathing it completely, inside and out, with the restorative signal.

Remember, **one must not just get the signal into the cells themselves — instead, one must get the restorative signals directly into, and absorbed in, the atomic nuclei.**

Again, that is why Antoine Priore found it necessary to employ a "rippling" magnetic field. The "ripple" was actually a magnetic wave, and nuclear resonance then provided the magic mechanism to penetrate all the atomic nuclei.

So the initial problem is, how does one provide a mechanism to carry the desired signals into and through each and every cell of the body and into each and every atomic nucleus of the matter of the body?

Obviously one can utilize nuclear magnetic resonance, after the fashion of Priore. If so, the resulting apparatus is going to be extremely large and expensive. It would be highly desirable to do it a different, simpler, much cheaper way.

After many hundreds of back-breaking experiments, one of my colleagues appears to have discovered a completely unique and direct way of introducing the desired EM restorative signals into and completely through every cell of the body, and into every atomic nucleus. Though much additional work to confirm this still remains, the initial results are marvelously encouraging.

Another colleague has succeeded in developing a peculiar sort of detector that should prove adaptable to detecting the actual "biopotential structural patterns" themselves, directly in and out of the atomic nuclei. Though obviously much more work is necessary before the final instrumentation is ready, the preliminary results

are again most encouraging.

As I write these words on paper, this work is proceeding, but very, very slowly due to lack of the necessary funds to attack the research problems in force.

What is Needed

Time is running out —most conventional science appears to be driven by special interest groups/Drug Manufacturers who are unable and/or unwilling to counter the AIDS epidemic with anything other than extensive "Addict Style" symptom-reducing drugs that generate dollars, not cures. Though this is not universal, it *is* the conventional norm.

Unconventional disorders or diseases require *unconventional* science for *unconventional* cures.

Immediate funding is required if this awesome threat to humanity is to be stopped. An American public alerted in time to this desperate situation can demand that the government and/or private business immediately address and act on this life-threatening issue in a different, unconventional manner.

Encouraging Preliminary Work

One of my associates, already familiar with scalar EM devices, has exerted every effort to try to reduce the scope of the problem. In literally hundreds of experiments, he has been able to narrow down the search, and obtain at least some very promising results.

He has obtained an initial candidate phase conjugated signal for further test and trial.

He may well have succeeded in discovering a new and unique method to communicate signals directly into the atomic nuclei inside the matter in the human body. This signal presently appears to directly interact with the cellular biopotential and with the body's master cellular communication system.

Remember, however, these are preliminary results. They still must be fully substantiated in a great many more tests. Undoubtedly a great deal more research, analysis, and adaptation is necessary. We certainly cannot presently say we have any sort of "cure" for the AIDS virus or anything else — or that these results are to be considered as proven in any **fashion.**

But what we can say is that my colleague has been able to derive a very complicated phase-conjugated signal, which produces negative energy and negative time of the general sort required. And he may just have made a most marvelous discovery that will point the way to eventual equipment much, much smaller than the 4-stories high machine with which Priore intended to treat terminal human cancer patients.

The initial signal discovered by my colleague, when applied to the body at miniscule voltage, seems to zap all sorts of "bad things" — viruses, harmful bacteria, dangerous protozoa, microworms, you name it — without harming the blood cells, the normal body cells, or the hosted friendly bacteria.

The signal does this at miniscule voltage and amperage.

It can be applied directly to the body through special electrodes. Through a special feature, my colleague has been able to get the signal to reverberate the entire body, all cells, all parts, and even penetrate the atomic nuclei and establish scalar resonance therein.

There turned out to be some extremely strange things that have to be done to the phase conjugated signal before it will accomplish what is being sought. At least some of these "strange things" have been uncovered by my colleague.

One of the peculiarities is that the entire electrical apparatus is part of the input "form" (that conditions the potential wave structure) being phase conjugated and sent to the organism. If a lead-acid battery is included in the apparatus to power it, one will inject the electromagnetic form for the battery acid directly into the organism,* destroyingit. This includes destroying the host's cells. In this case the signal is lethal, not curative. Substitution of a dry cell battery with no liquid electrolyte eliminates the problem. Exactly why a liquid electrolyte has a toxic effect and a "sludge" or solid electrolyte does not, is not understood at this time.

Other such anomalies in the tentative process have been discov ered and compensated for.

However, the way ahead is exciting. It suggests that the body

*Via a mechanism similar to that found by Reid and Barsamian

(atomic nuclei) can literally be "charged up" (i.e., the living biopotentials can be "charged up" with the signal structure) so that the "disease-proofing" is very lasting, possibly for many years or even for a lifetime.

At least my colleague has pressed this to the point of demonstrating a long-lasting charge being acquired by the body.

For example, at one time his body became so "charged" from his lengthy experiments that a one-inch blue spark often leaped from his fingers when he reached out for something metallic. The discharge was cool, negative energy — living energy, if you will. It should be negentropic, not entropic. It was definitely not the type of energy the orthodox scientific community is accustomed to. And normal electricity will definitely not charge up the body in such a continuing fashion, so far as is known.

Let me clearly state again that we have not yet produced the specific anti-pattern per se. What my colleagues have discovered appears to be a broad-band signal that appears to act hyperspatially, analogous to the manner in which a broad-band drug such as penicillin acts biochemically. Even this much remains to be clearly established.

However, it is a most encouraging and promising first step.

Much more work, and a great deal of experiments to substantiate or adapt these tentative results, still need to be done. Now there is no substitute for rigor and thoroughness — and there is no substitute for clearly and scientifically demonstrating the proof of the concept in the laboratory.

It is not just good intentions that we seek, but solid, concrete, proven results substantiated by proper scientific procedures. Much work remains to be done.

But the preliminary results are very encouraging indeed.

Let me briefly share with you some of the things we foresee, if this present line of successful development continues.

We foresee being able to eventually develop and set up — legally and under proper medical auspices, of course — tested and proven

devices that can easily treat up to two or three hundred persons at once. A treatment of about 45 minutes to one hour is all that would be required. Several repetitive treatments a week or so apart, might prove advisory.

In addition,once the entire gamut of the treatment process is validated and proven, and shown to be completely harmless and safe in accordance with legal medical requirements, if need arises we foresee simply adding the signal to ordinary radio and television transmitters — perhaps as simply as modulating the electrical ground. If so, a "maintenance" signal could be established to negate the AIDS virus (or other disease such as cancer and leukemia) in an entire area, and keep out other diseases such as malaria, sleeping sickness, etc.

Another advantage of such machines would be their portability in time of conflict. Also, they would be most useful indeed as defensive measures against biological warfare. For example, the inhalation of only a relative minor amount of anthrax agent is sufficient for 100 percent certain death unless treatment begins promptly. With the portable machines, however, this would be easily negated in any troops exposed to the agent, even before the lethal disease is evidenced. For a totally new agent, a "phase-conjugate delta signal" could be rather quickly ascertained and developed, and the proper settings made on the machines for immediate treatment and immunizing.

And even later, when we proceed to the direct engineering of the living energy form strata themselves, we shall see remarkable cures and remissions of diseases for which medical science offers little hope today. Arthritis, multiple schlerosis, lupus, and other such debilitating diseases come readily to mind. **Even reversal of the aging process should be possible.***

*Two other promising approaches have recently been discovered First, an electrolyte compound has recently been approved by the FDA for clinical testing. This compound has the remarkable property of raising the cellular electrical potential back to that of a strong, healthy cell. In several years of lab animal testing, this alone was indicated to be over 80% effective against cancer. It may also prove effective against diseases such as arthritis, where the body's immune system attacks body tissue with lowered cellular potentials, since it fails to recognize the weakened cells as those of the body. Second, Baylor University reseachers have found that treating blood with certain laser EM radiation kills the AIDS virus, but does not harm the blood cells This means that it will be possible to assure that blood used in transfusions will be AIDS - free, eliminating one sorce of AIDS transmission.

Conclusion

We have now come to the end of our road, literally and figuratively.

All of us have been struck a mortal blow by the Soviet AIDS first strike.

Make no mistake, this is **real.** We and our children are already as good as dead unless we move as we have never moved before.

We have a chance. A slim chance.

Americans have always come through when the chips are down. We can conquer this thing. We can overcome this mighty death blow that has been launched against us. We can defeat the others yet to come.

But we've got to move. *Now.*

Remember, Pandora's box has already been spilled. Even without the Soviet biological warfare strike, hosts of new viruses and different strains of old ones are going to be, and are now being, dumped into the biosphere by our own culture. It is also only a matter of time before terrorists and meglomaniacs turn to the use of this potent weapon against a wide-open society such as ours.

Both our Armed Forces and our civilian populace are totally defenseless against electromagnetic biological warfare. Now. At this moment.

Even without the Soviet BW strike implication, it is only a matter of time until we perish, unless we develop electromagnetic healing and electromagnetic biological warfare countermeasures.

We've come to one of those profound momentary pauses in history that determine the fate of the entire world henceforth.

It's like the parable of the lady or the tiger.

We're facing, so to speak, two doors.

Behind one is the most fearsome and hungry tiger of all time. If we delay, that door will open and we'll get the tiger full upon us. We shall be utterly destroyed. That mighty tiger will consume half the world in his roaring frenzy. Our children, and our children's children — what few of them will be left — will wear the hammer and sickle yoke for eons.

Those few future survivors will be taught strange things. How you and I were the real enemy. How we were absolutely destroyed for the good of all mankind. How glorious and necessary it was to unleash the great plagues upon us. And how heroic were those who performed the "noble deed."

Our own distant children will curse us and revile us, and they will be taught to worship at the throne of a false prophet.

The world will descend into a new "Dark Ages" far more frightful than George Orwell ever envisioned.

On the other hand, behind the second door is the most beautiful lady of all history. Literally all of humanity's dreams of health, beauty, and vitality lie behind that door.

If we open it, we achieve a freedom from disease and a measure of bountiful health for all mankind that has heretofore only been dreamed of. *Even reversal of the aging process itself lies beyond the second door. Health and youth — the dream of the ages—can be ours.*

But we have only a moment to open the second door. It is firmly shut, and we must exert ourselves to the fullest if we are to open it at all.

On the human stage, the first door is already slowly opening, inexorably. In only a few moments it will be open and the tiger will be upon us.

We must move quickly.

Which will it be for mankind, the lady or the tiger?

The next few moments in the human play will most assuredly tell.

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Author's Note: So far as I can find, there are no available references other than my own that deal precisely with my particular approach to the nature of mind and thought. There is, however, a serious debate over whether (a) the mind is simply the physical brain, similar to a computer (the prevailing materialist view of orthodox science), or (b) the mind is something else altogether, and metaphysical — at least with respect to the level of scientific knowledge today. My own approach utilizes a non-Aristotlean fourth law of logic (included in an appendix to this book) by means of which the dichotomy between mind and matter is removed. In that fashion, one can model the mind as material, or model matter us mind.

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Costello goes on to point out that a group at Sheffield University has collected a great deal of data on this subject, from case studies of 253 hydrocephalics and hydrancephalics. There seems to be no correlation between the IQ of these individuals and the amount of residual brain tissue.

One living subject, Roger, has an IQ of 126 and a First Class degree in Mathematics, yet has no more than 5% of the normal amount of brain tissue.

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APPENDIX I

The Case of Antoine Priore and His Therapeutic Machine: A Scandal in the Politics of Science

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Forty- four years ago, in 1944, an Italian engineer working as a prisoner and forced laborer for the Germans in the huge submarine base in Bordeaux, approached a French police agent to plead for his life. He would be killed when the Germans left Bordeaux, he said, and since they were by that time obviously losing the war, the day of his execution was at hand.

The police officer, who also worked clandestinely for the French underground, told the engineer to get in his car, then simply drove him out of the base and introduced him to the 7th battalion of underground resistance fighters, in the nearby province of Dordogne. There he so distinguished himself in military operations that he was ultimately decorated by the French government.

It was due to his thankfulness to his savior, and his loyalty to his companions-in-arms, that Antoine Priore decided after the war's end to live out the rest of his life in Bordeaux. Thus he became the focus of one of the strangest, and most scandalous, chapters in the scientific history of France or any other nation.

Antoine Priore had earlier graduated from a small provincial school for electricity in Trieste, Italy and become a radar operator in the Italian Navy. During this period he observed what to him was an exciting anomaly: some oranges left in a room filled with electrical bric-a-brac had fallen into an assemblage where they seemed to have been preserved in the same fresh state they had enjoyed when bought off a fruit stand. Other oranges in the room, bought at the same time, were rotten and putrid.

Stunned by his observation, Priore dreamed throughout the war of one day working out an electrical means of conserving foods in their fresh state based on what he surmised was a new, and wholly unexplained, principle. Newton's apple had become Priore's orange.

Occupied during the day as a humble electrical repairman — and projectionist in a movie theater — the almost wholly self-taught Priore devoted all his free time and his meager resources to research. With the help of his war-time companions, some of whom had attained high rank in the Bordeaux police force, he was able to beg, borrow, steal, scrounge, or otherwise acquire a mini-warehouse of electrical and electronic components and parts. With these he put together a device worthy of Rube Goldberg. Exposing lentil seeds to a magnetic field of 225 gauss and electromagnetic frequencies of 80,

32, 3 and 10 Hertz, Priore's device caused the lentil plants which sprouted from them to grow 12-15 centimeters in length, as against only 5 centimeters for controls not subjected to the same treatment. He got similar results for tulips, asparagus and other plants.

Shifting his focus, he next irradiated fertilized hens' eggs, only to see the chicks hatch in 19 days, instead of the normal 21. Though he could not explain these astonishing results, he realized he had stumbled upon a process basic to the enhancement, or speeding up, of cellular growth.

It was at this point that one of his police friends introduced him to Francis Berlureau, the former Director of Studies at the School for Veterinary Medicine in Toulouse and, at the time of their meeting, director of the Bordeaux abbatoir. Priore asked Berlureau to supply him with various animal tissues for experimentation. For 10 years they worked together, Priore's free time allowing, during which Priore noticed he could get no electrical measurement from a cancerous bull's testicles. Since he realized that, in some way, his newly constructed device (no trace of which remains today, except for a snapshot of it) affected the electrical properties of cells, he put two and two together and his sum of four led him to believe that he might be onto an electromagnetic cure for cancer. Newton's gravity had become Priore's cancer cure.

Berlureau next allowed him to expose a cat with cancer of the mammary glands to radiation of his machine. To make absolutely sure that he was not exposing himself to mockery, the veterinarian had all the histological work done by his friend and colleague, a Professor Drieux at the famous Veterinarian School of Maisons-Allfort, near Paris. Drieux wrote a technical report proving that a tumor taken from a cat had, before treatment, started to become cancerous and, after treatment, had become benign.

By 1953, with the help of a doctor of general medicine, Maurice Fournier, Priore began treating human patients whose cancers had been judged hopeless. The huge file of cases maintained by Fournier, and filed with a notary until after his death, was subsequently mysteriously lost. But a few details were preserved in letters discovered in an old dog-eared file.

Some of these dating to the year 1954 concerned a 12-year old boy, Alain B., whose diagnosis wavered between one of reticulo-histio-sarcoma and a malignant form of Hodgkin's disease. The boy was taken by his parents to Priore, who irradiated him. Though the exact nature of the radiation was not known, 12 years later a Bordeaux physician, after a medical examination, certified that the boy, now become a man of 24, was free of disease.

A second case unearthed from the old file indicated that a patient

with cancer of the larynx was able to avoid a laryngectomy and be totally cured after Priore's new ministration.

Fascinated by the principle which he suspected must lie behind the strange Priore Ray, Dr. Berlureau tried to get some Bordeaux University physicists interested in the problem but was laughed out of their offices. He next turned to cancer specialists, beginning with Professor Lachapele, the Director of the Bergonie Foundation, a prestigious center for cancer research, to whom he proposed animal experiments to prove the efficacy of Priore's methodology. His plea met with a stony affirmation on Lachapele's part to the effect that he and his colleagues had no need of the new discovery, inasmuch as "all the patients treated in his hospital were cured and departed in perfect health." As if bound in the chains of his curt reply, years later Lachapele was to become one of the bitter adversaries of Priore's pioneering research.

Only somewhat discouraged, Priore kept up his momentum. He went on to build a new and more complicated version of his treatment device, called the P-l, over the next year. When it was finished he secretly and unofficially began to treat dozens of cancer patients who had been given up by their doctors as incurable. At his funeral in March of last year, among the crowd of mourners was, it is said, a small platoon of older people who had been cured of their terrible afflictions by Priore in the 1950s.

While his findings excited him, he nevertheless felt tremendously frustrated that he could apparently get no one in the world of medicine or science to pay attention to them. Undaunted by his previous rebuffs, his friend Berlureau next introduced the Italian at the end of 1959 or the beginning of 1960 to Professor Tayeau, vice dean of Bordeaux's Medical Faculty. Unlike Lachapele, Tayeau behaved as a true physician and scientist. He sent Priore to two researchers, Biraben, head of the Faculty's Department of Pathological Anatomy, and his assistant, Delmon. The two had been working together on cancerous rats for two years—specifically on animals grafted with T-8 tumors, discovered by the internationally famous team of Guerin and Oberling in Paris, which had proven to be intractable to any form of treatment yet known. To their utter surprise, the tumors in the rats treated with Priore's machine were reduced in volume by 60%, marking the first time in the history of cancerology that the virulent T-8 tumor had in any way been affected by any form of treatment.

Knowing that the mayor of Bordeaux, Jacques Chabans~Delmas-who has kept his post until this day, and was soon to become prime minister of France-- was most interested in the work of Priore (who, he too, had known as a fellow resistance fighter), they also

informed Chaban.

Promptly Chaban convoked not one, but two, commissions made up of Bordeaux and Parisian scientists to study the Biraben-Delmon results in detail. Both commissions rejected Priore and his machine out of hand, and without appeal. It is curious that, in the science of our day, a result, undeniable though it may be, seems to have no hearing unless and until all means to effect it can be adequately explained. It was for this ostensible reason that the two commissions decided to so adamantly reject the research: Biraben and Delmon could not explain the nature of the radiation engendered by the Priore device.

One can stress the word *ostensible* here because the principal reason for the rejection lay elsewhere. The decision by the first commission was, in fact, hardly unanimous. But among its members was the same Professor Lachapele who had refused Berlureau's plea for assistance. His opinion was that even the results themselves were of little value because they were obtained, not on spontaneously arising, but on grafted, cancers. The fact that no treatment whatsoever had ever affected a T-8 tumor was totally discounted. As the sole cancerologist on the commission, Lachapele's dictum was preponderant.

When he learned that the rejection of the first commission had actually been a split decision, the Bordeaux mayor asked for the formation of a second commission to re-examine the problem. Fearing a reversal, Lachapele was able to get one of his colleagues, Professor Courtial, director of the Radium Institute in Paris, and one of the so-called top authorities of French cancer research, named to it. It was all but impossible for the other physicians on the new commission now to outvote not one, but two, cancer specialists, so again the antagonists won the day.

At no time did either of the commissions bother to interview Priore himself or to run a supplementary experiment under their own control.

This seemingly incomprehensible attitude on the part of scientific authority was only a foretaste of what was to come, again and again, over the years. Biraben and Delmon went on to do new experiments. They modified either the time after grafting that the radiation was applied, or the length of its duration. This time their efforts were crowned with unequivocal and complete success. The tumors stopped growing and, when still living cells were excised from them and implanted in healthy control animals, none of them became malignant.

Though these results should normally have fascinated any academy of medicine or sciences, the two researchers did not publish

them. Why? The reasons horrify or disgust. It seemed that Biraben was simultaneously preparing an examination for the *agregation*, the highest French academic degree leading to a senior university teaching post. In charge of the committee to pass on, and award, this degree was none other than that same Professor Lachapele who told him: "Either you get the degree, necessary to your professional advancement, or you publish your research paper. But not both!" Discouraged, Biraben ceded to this demand but nevertheless continued to work on the research that looked so exciting and promising.

Most mystifying to him was how the machine operated to achieve its startling results. At the 3rd Congress of Biometerology held in 1963 in the Pyrennees mountains, a New York City researcher by the name of Kenneth McLean reported he had been able to obtain regressions on tumors and improve the health of cancer patients by using a magnetic field of a strength of 3000 gauss or more. Acting on this hint, Biraben and Delmon made an electromagnet that put out a field of 4,500 gauss and tried it out on the T-8 tumors but without the slightest success. Obviously, something other than a simple magnetic field was at issue.

In 1966, after others had had the same success with the T-8 tumor by irradiating it with the "Priore Ray," the two scientists finally published a memoir in the Revue of Comparative Pathology in which they stated that neither magnetic fields nor X-rays had any effect on the T-8s and that "only certain devices associating a magnetic field with high frequency waves seem at present to reveal therapeutic properties..."

Their conclusions were too late for, by that time, a campaign to stamp out Priore and his electromagnetic approach to cancer cure was well underway, a campaign that has lasted right up to the present moment.

The all-powerful Lachapele had sealed the fate of the Priore device as far as the local Bordeaux medical community was concorned. Veterinarian Berlureau and Priore next decided to carry their case to Paris. They contacted Professor Guerin at the cancer Institute at Villejuif, the leading French center for cancer research nnd the equivalent of the American National Cancer Institute in Bethesda, Maryland. Guerin, one of the discoverers of the T-8 tumor, which for the first time had been stopped in its tracks by the Priore device, courteously received his guests and heard them relate the whole story of how the device had come into being, starting at the point. when Priore had seen the oranges strangely preserved by some unaccountable electromagnetic effect.

Guerin was sufficiently impressed that he assigned his colleague, Marcel-Rene Riviere, to delve into the whole question. For

two years, Riviere, who also had teaching responsibilities at the University of Rennes in Brittany, unremittingly worked to corroborate the Biraben-Delmon findings. On 9 December 1964 a note was sent for publication in the **Proceedings** of the French Academy of Sciences detailing the research and modestly concluding: "... as of now, one may already state that our first observations show that electromagnetic fields used can lead to most interesting data from a point of view of the biological behavior of grafts and their therapeutic action on experimental tumors."

Riviere next decided to see if the Priore Ray could affect another tumoral form that had never been affected by any therapeutic method, the 347 lymphoblastic lymphosarcoma. The results were even more spectacular than for the T-8 tumor. The effects produced were of broader scope and took place more rapidly. A second note was sent to the Academy for publication. The conclusion read: "We can now already affirm that our research offers proof that electromagnetic fields are capable of producing effects on quite different types of neoplasms."

At this point one of the key characters in this extraordinary drama must be introduced. There might have been no drama at all without his appearance on stage. This personage was Robert Courrier, an eminent endocrinologist, who had been named, while still in his 30s, a full professor. Courrier was now perpetual secretary of the Academy of Sciences and later would become President of the Academy of Medicine. Because no scientific paper can be accepted by an academy unless introduced by one of its members, Riviere would have had no chance to see his work so prestigiously published had not Courrier, who knew Riviere well, since he had shepherded him through the winning of his doctorate, taken the responsibility for its introduction.

It was Courrier who, at this point, also took up the cudgel to interest various highly placed French organizations responsible for the administration of scientific projects and their funding. Thus, ho sent a personal letter to the French Minister for Scientific Atomic and Space Research, who immediately offered to try to make funds available for further research on and with the Priore Ray. He also personally asked the Director of the CNRS (National Center for Scientific Research, which coordinates and oversees all such activity in France) to receive Priore and Riviere.

That this meeting was, in its way, somewhat of a disaster, can be explained in part only by a brief resume of the complex character of Priore himself. Priore throughout his life had great difficulty making himself understood in the French language and, as the **years** went by, he even forgot how adequately to speak his own mother

tongue, Italian. Added to these twin impediments was his lifelong fear that his discoveries and inventions were prone to being stolen, a fear which led him never to fully explain the exact nature of the complex radiation emitted from his machine, far less the settings which controlled its various parameters. Whether Priore would not, or could not, exactly explain the functioning of his invention (which, as we shall see, went through several increasingly complex generations) is a question to which no precise answer has been given. It would appear that Priore was an excellent engineer gifted more with a God-given intuition than with school-book reasoning and logic. In short, Priore had a combination of talents that could remind one of the same enigmatic personality that was Nikola Tesla, the deductive reasoning behind some of whose discoveries has never fully been unravelled.

Highly placed scientific administrators are neither comfortable with, nor sympathetic to, what they see as self-appointed geniuses who have not run the same academic gauntlet through which they themselves had to pass. Thus the CNRS director took aversion to Priore's somewhat incomprehensible, yet fairly prolix explanations of his technology and only recommended that a physicist be sent to look over his device to properly decipher its working. At the same time, the Minister, together with the head of the general delegation for Scientific Research (DGRST) — still another key body in the administration of the French scientific decision-making process — let it be known to Robert Courrier that they had not understood a tingle thing about Priore's invention despite his best efforts to present it.

Advancing one more step into what was to become for him a 20 year-long expedition into a jungle of scientific intrigue, Courrier next resolutely decided to send to Bordeaux one of his most trusted laboratory workers, Madame Colonge, to repeat Riviere's experiments under her personal supervision. The DGRST director fully Concurred with Courrier's decision, while letting slip his admission that he strongly suspected that Riviere might well have been duped in some manner by Priore. When Courrier asked the minister for travel funds for Madame Colonge, he was refused with the dry remark that such a request was "premature." The now angry Courrier telephoned to reply: "You've been spending millions for programs and hypotheses about the cancer problem. Riviere has been presenting you with facts!"

The physicist who had been sent to try to elucidate the functioning principles of Priore's device, reported that he could make neither "head nor tail" of the machine.

Madame Colonge's experimentation was as prolonged as neces-

sary. She was so meticulous that, in order not to take her eyes off the experimental animals for an instant, she limited her lunches to sandwiches eaten in the laboratory. She returned, profoundly impressed, to Paris.

Nor was Riviere idle during this period. He decided to experiment with the L-52 lymphosarcoma, a tumor similar to, but even more malignant than the 347. This time, he used not rats, but mice, as hosts for the grafts. So successful were his results that, this time, Courrier decided to bar no holds. Instead of simply having a note published in the Academy Proceedings on the quiet, he decided to present it personally, orally, and in all solemnity, before his fellow academicians at an official meeting scheduled for 1 May 1965.

That date was, and is, a turning point in what came to be known in France as the "Priore Affair." From then on the whole French, and even the international, scientific community could be divided into a minority and a majority group, the first that believed in the research, the second that did not know enough details about it, did not or would not believe, or simply didn't give a damn.

Before Courrier could make his presentation, its scheduling and subject were inadvertently and prematurely leaked to the press. Immediately thereafter, a horde of journalists arrived in Bordeaux. After one or two of them managed to all but force entry into his lab, Priore closed its doors and, with the help of his friends, wrote a printed press release that stressed his thankfulness to the many people who had helped him over the years rather than providing any comprehensible details about the machine he had brought to birth. Stymied, many of the newsmen travelled across town to seek an explanation from its leading cancerologist, Professor Lachapele, who informed them acidly that the machine was all but useless and unworthy of their attention or their time.

The journalists' reports, founded as they were on rumor of outright lies, roiled the pages of their newspapers and magazines in such a way that they either over-exaggerated the potential or a forthcoming cancer cure, or came close to billing Priore as just one more cancer-cure charlatan. All of which so alarmed, among many others, Dr. Wilhelm Bernhard, world specialist in electron microscopy, that he called his friend Courrier to warn him that his forthcoming presentation to the academy might put his hard-won reputation at risk as well as those of Guerin, Riviere and the Villejuif cancer institute itself.

In the journalistic melee, no one had bothered to read the declaration carefully issued by Riviere from Rennes, where he was occupied with his university courses, which formally stated: "Our experiments are of real interest. Much more experimental research

has of course to be done before any therapeutic application on human cancer victims can even be considered. It goes without saying that this will take a certain time and no little effort of many types, both scientific and financial. Our work, as fascinating a perspective as it might hold, in no way, therefore, allows anyone to offer the public hope which could only lead to deception at the present time."

On May Day, Courrier gave his report to an Academy assembly hall crowded with scientists, newspapers and television reporters, photographers and an unusual number of curious bystanders. Accompanied with slides showing histological details, and animals before and after treatment, his lecture was heard out in almost tomb-like silence. When the lights came on again, he announced that he had personally checked the validity of Riviere's findings through the offices of his personal assistant, Madame Colonge. He then went on to say that he had taken the responsibility of presenting three notes to the Academy for two reasons. The first was a ringing declaration and a challenge to critics and skeptics of every stamp. It reads "When it is a question of a problem as serious as that of cancer and when one sees a little light beginning to dawn, one has the obligation to see what this light might represent. One has no right to snuff it out before learning what it may be worth."

The second was a tribute to his colleagues who had done the pioneering work, particularly Guerin, Riviere and Madame Colonge, and a statement of the essence of the problem to be faced down the road. It read: "Attention must naturally be given to the apparatus which Monsieur Priore has conceived and constructed. It has apparently already been examined by several physicists. It is found to be too complicated. While that may be possible, it is nevertheless a fact that Guerin and Riviere have obtained results with it that had to be made public. What is emitted from such an apparatus? I hope Monsieur Priore will allow disinterested physicists to study it at their leisure, for Science cannot tolerate apparatuses enveloped in mystery." Then, as almost a footnote to the history of the moment: "The biological action of magnetic fields is the object of intense research in the United States. In specialized institutes, the influence of these fields on tissue cultures, microbes, plant forms, diastases and certain tumors is under study. Up to now, the results obtained on grafted tumors seem less significant than those which have here been presented."

After Courrier sat down, a leading cancer specialist, Professor Lacassagne, rose to ask snidely why the notes had included no bibliographical references on work done on the bio-effects on tumors from electromagnetic fields, and criticized the experimentation as "impromptu." When Courrier denied this allegation as ludicrous,

Lacassagne stalked out of the assembly hall in full view of the audience.

The meeting caused a new eruption of media reports which unfortunately accented one of three aspects of the problem at the expense of the other two. These were 1) the hope that a miraculous cure for cancer was in the offing 2) the contradictory, not to say discordant, reception of the data by various academics and 3) the enigma of Priore's personality.

Remarkably, no serious discussion among the scientists present at the meeting ever took place. This led a foreign scientist, present in Paris at the time, to remark: *"I don't understand. Here is a report given to the most authoritative scientific body in France by one ofthe most respected and eminent of its members and it is publicly subject to doubt without that leading to any reaction whatsoever."*

The General Delegation for Scientific Research was at this point still open to the idea of providing funds for more research with the Priore Ray. The big stumbling block, however, was one related to niceties involved in relations up and down the scientific hierarchy. To open the way to the allocation of such funds required the approval of the Delegation's own section for cancer research and that section was headed by none other than the same Professor Lacassagne who had so rudely walked out of the Academy's assembly hall.

At the same time the General Delegate diplomatically covered himself by suggesting to Robert Courrier that he had to have more information underscoring the potential importance of the research accomplished. Courrier told him to simply re-read the three notes he had presented to the academy. His matter-of-fact, yet terse, come back then elicited his invitation to a full-dress meeting of scientific experts at the Institute for Scientific Cancer Research.

In this short historical account we obviously cannot go into the ins and outs of what transpired at this meeting or any of the many similar meetings which followed it. A paragraph in a brilliant book, four years in the writing, by the courageous Bordeaux journalist, Jean-Michel Graille and entitled: **Dossier Priore, A New Pasteur Affair** (of which this account is but a tenuous synopsis) must suffice to pointedly characterize the nature of the problem in its most general sense.

Writes Graille: "To read what follows in this chapter might well seem tedious: an enumeration of names and titles, the content of a debate held at an administrative meeting, personal remarks by one ranking personage or another, exchanges of letters following the meeting itself and the official report which came out of it. Tedious but indispensible for not a few reasons. It is important to know who were the participants at this meeting and what of these participants each

was trying to represent. It is important to know how such scientific meetings go about their business at the 'top level,' And, finally, it is important to learn about and to understand, in the particular case of the Priore Affair, the behavior and reactions of all concerned. A reading of all this could be difficult (and it won't be the only such passage in this book) yet it is necessary to understand the essence of the dossier in order to be able to create for oneself as clear and well-motivated a personal opinion about it as to subsequently be able to discuss it, or to hear it discussed, with a thorough knowledge of the facts."

In this single paragraph, Jean-Michel Graille has, in my opinion, pointed to both the nub and the difficulty in getting at the essence of the real facts behind a case such as that of Priore's that are so important to its proper understanding, an understanding which can be painted against the backdrop of the history of science and the backdrop of human pettiness and maliciousness or human courage and magnanimity.

One of the participants, Professor Andre Lwoff, soon to become n Nobel Laureate for his work in virology, was violently against the meeting's central issue: namely, whether or not funds should be spent to build a new and better Priore machine. Not only did Lwoff aver that the three notes presented to the Academy never should have been published, but he also opined that since all the work was done, not on spontaneously generated but on grafted cancers, the effects of the machine were hardly impressive. He later added in writing that 1) the patents issued to Priore for his device were nothing but a web of nonsense, 2) the machine itself could never be duplicated based on any description given for it by its inventor and, in a repetition of his oral remarks, 3) the fact that only cancer grafts were experimented with was nothing to shout about. He strangely added that because the animals who had been irradiated subsequently were able to entirely reject new grafts, the whole phenomenon offered no proof that cancer cells could be killed while healthy cells were not. The whole thing came down to a question of immunity, he said, as if that were not of the greatest possible importance.

To which, in due course, Guerin and Riviere replied: "It has been claimed that our experiments are valueless because they were carried out on grafted tumors and that other therapeutic measures were known to get rid of such tumors and their metastases. *We defy those persons who have made such affirmations* to prove, *with the use of such other measures, that animals infected with T-8 tumors can be cured at a percentage rale identical to those obtained by using the device which Monsieur Priore has developed."*

Not a soul has responded to this challenge, then or since.

A second cancer expert at the meeting, a woman of great influence, resorted only to the cavil that the experiments had been of doubtful quality since none of the animals had been *weighed.* The fact that those same animals had survived normally lethal cancers seemed not to have *weighed* with her.

There were many more observations of the same ilk. They seem atrociously paltry, trifling and picayune coming from professionals who, if they no longer believed in the Hippocratic oath to which they once swore, are considered by the public in general, and by cancer patients in particular, at least to be concerned with seeing what a little light on the problem might reveal before extinguishing it, as Professor Courrier expressed it.

At the same time, we must not forget Priore's decidedly difficult personality. He was an inventor determined at all costs that his invention be developed for the benefit of humanity, yet anxious that that same humanity not steal it from him. As author Graille puts it, "His conceptions and attitude directly or indirectly conditioned the overall essence of this affair. Full of enthusiasm, from the very day he discovered that the ray he had developed had a curative effect on a cancerous cat, he developed a single-minded fixation on cancer One could understand and sympathize with him on this score. Here he is, a little Italian immigrant without money or means, and he is going to offer the world a cancer cure. He is so convinced that he wants to move ahead to doing just that. He will never understand or accept the exigencies of Science or Medicine. For him, experiments, controls, verifications and parallel research are a waste of precious time. 'I've made machines which cure cancer. Take them and treat cancer patients. Don't bother with the rest.' Such would be a summation of his point of view."

Through the efforts of persons kindly disposed to the inventor, this point of view was softened and he came finally to understand the-necessity for what has been called scientific rigor, on the other hand. another aspect of his character never changed an iota. This was his determination to preserve the secret of his invention, motivated first of all by his unshakeable desire that it be developed in Bordeaux, the city of his adoption, for the citizens of that city. Deeply rooted was his belief that if he made his secret public, the machine would be taken from the Bordeaux region and further developed by Parisians, those who considered themselves to be in the penthouse of the scientific edifice. Once this was accomplished, he would likely not have one more word to say about the matter. Therefore he continued jealously to conserve his secret and put confidence in nobody.

As Graille generously concedes, he may well have been right. and adds: "All his life he had to go up against men, whether scientists

or industrialists, who had but one idea in their heads: to get to the bottom of the inventor's secret in order to build for themselves a machine which they then could exploit for their own account, for their own glory. Many such 'Priore Machines' were to be actually built more or less surreptitiously or clandestinely. Not one of them ever worked."

While one might easily accuse Priore of a limited view, the horizons of the researchers themselves were certainly not as broad us they might have been. Those involved in bio-medicine were content with the results produced by the machine, the workings of which were of no concern to them. A black box, as it were, emitted a ray that definitely affected experimental animals. At the same time, as researchers specifically interested in the cancer problem, they never gave a thought to what the Priore Ray might accomplish in the wider clinical domain of other afflictions.

As for the physicists, they were seemingly not up to the task of comprehending a complex radiation that had miraculously sprung, as from the head of Zeus, out of the intuition of a man they considered to be an undereducated and all but illiterate gadgeteer. Still others, whether physicists, biologists, doctors of medicine or specialists in a dozen other fields, were willing to throw the baby out even before it went into the bath water. In their eyes Priore was just a nobody.

Behind the scenes, many of these scientists resorted to using the press to achieve their own ends. Thus, the chief medical chronicler for Le Monde (the French New York Times), herself a doctor of medicine, was led to write outright lies about the Priore Affair—specifically and falsely stating that cancer patients had been treated with the Priore Ray in the clinic of Professor Lachapele in Bordeaux with not only negative, but disastrous, results.

On the other hand, a journalist for another leading Paris daily, Le Figaro, scrupulously conscious of his responsibility to fairly report what was going on, aptly wrote: "We would like to see at least one thorny point clarified as soon as possible. Several years ago P'rofessor Biraben of the Bordeaux Medical Faculty (who at that time had not become a ranking professor) was involved with the Priore device. According to certain reports from medical circles, his results seemed, even at that time, to have been already quite positive on small animals and he seems to have written a report to that effect, He was advised by highly placed authorities "to keep quiet" and stop talking about this affair. If this turns out to be true, it would be a veritable medical scandal to be judged in the harshest terms."

Could one have put it more succinctly?

The foregoing is to present something of the flavor of what was transpiring in the wide world far removed from the laboratory of

Priore who, at the time unaware of it, was revelling in the fact that his machine had been successfully used by high-ranking French cancerologists and its results reported in three separate notes to the Academy of Sciences.

His courage was also more than buoyed by the arrival on the scene of the commercial director of a large French industrial firm specializing in the intricacies of manufacturing glass components. This man had heard that Priore needed a large tube that was beyond all existing norms and perhaps did not exist anywhere in the world. This tube, it can be stated, contained a rare gas, neon, which when excited into a plasma, seemed somehow to convert the various electromagnetic inputs into a single Priore Ray which surged from the business end of the tube. In the tube were an anode and cathode. Peculiar to the anode was that it had to *rotate* to produce the desired biological effects and this is but one of the anomalies in Priore's equipment which physicists and bio-physicists have to this day been unable to explain.

The manufacturing company, a subsidiary of the internationally known company, Saint Gobain, was looking for a new product. The commercial director thought the new tube might fill the bill, particularly if it could be adapted to a machine that might ultimately cure cancer, a product that indubitably would have an enormous market across the world. There were plenty of problems with regard to the tube, notably those of its large dimension, its resistance and its conductability. When the tube was finally made, it now seemed that. Priore would have to explain his discoveries to the scientists of the company that had made it. One of these was sent to elicit such an explanation but was, so to speak, "shot down in flames" by Priore. So a second attempt was made by Ivan Peyches, a senior executive of the company, and president of the Society of Civil Engineers of France, who made a detailed investigation of the device. His reports were subsequently lost, but there remained an article he published in a leading French journal, Sciences and Technics, a short time before his death in 1978. It bore the intriguing title: "What Are So-Called Paranormal Phenomena?"

In it the engineer wrote: "There was so great an accumulation of components capable of having some kind of action, and being unable to work separately, that the results of measurement were limited to proving that there were no specific rays that issued from the tube (Priore talked about canal rays), no more than there were any X **rays.** On the other hand one could detect a magnetic field which was the end result of a field proper to the tube and of the magnetic field of a solenoid that constituted the experimental chamber, an electromagnetic field with a frequency of 16 megacycles (19 meters) and a high

frequency field (metric waves), the whole being pulsed at a very low frequency of an order of one per second. It was impossible, in such an imbroglio, to determine what was necessary and what was sufficient. Priore maintained that the simultaneous action of his various generators was indispensible to achieving his effect."

Peyches then went on to relate how he tried to persuade Priore to offer a more precise definition of his thinking about the workings of his device. He wrote the inventor: "At this point, I would say that all reticence on your part, which in your eyes would be justified by the fear of seeing yourself partially dispossessed of your work, would be of far greater detriment to you than any safeguard of your interests. Moreover, since it has become a question involved in public health, you are no longer entirely your own boss...you absolutely must bring all this to the clear light of day and I don't believe you can do it alone...You must supply all the characteristics so that third parties can reproduce your results." Then, he concluded by citing the words of an academician: "Many phenomena are rejected by the scientific world because they are considered irrational: But it is not B proof of scientific honesty to refuse a priori to try, out of homage to truth, to have a look at them and perhaps to understand them. Will Science one day be able to abandon its taboos?"

It was Peyches' final conclusion that, in the end, Priore was a man of genius who knew absolutely nothing about what occurred in his machine from the scientific point of view. The company which he represented no longer exists since it was bought out by the American firm of Corning Glass.

Industrial interest in the Priore device was not limited to the Saint Gobain subsidiary. Next into the lists was a company in Anguouleme, Leroy-Somer, which specialized in electric motors, generators and later was to branch out into solar power. Its president, Georges Chavanes, took the initiative to write to Priore in 1965 that his company was interested in providing some of the complex electrical equipment needed by the inventor, more particularly high-powered generators, on the condition that Priore move his operation to the company seat at Anguouleme. When the inventor categorically refused, Chavanes tentatively agreed to build a factory to manufacture the Priore device in Bordeaux itself.

The alliance between Leroy-Somer and Priore, shaky at best, lasted two years and blew up on Holy Thursday of 1967. The period was a stormy one for both parties to the agreement. Priore did his best to convince Chavanes to commit himself to building a huge machine with a magnetic gauss strength of 10,000 gauss. In the end he got one that put out only 920 gauss, not much stronger than the machine he had already built which put out 620 gauss. Since the field

of action increased with the gauss strength, Priore reasoned that a machine of literally behemoth size would be able to irradiate the whole, or every part, of a human cancer victim lying on a stretcher, whereas the smaller machines had been effective only for small animals or for treating a limited portion of the human body.

Chavanes and his company were aware that it would be a tremendous financial burden to contemplate building the larger machine. So they went ahead with plans for the smaller one while at, the same time putting great pressure on Priore himselfto make him feel that he was the least important cog in a new gear, in fact that his status was reduced to being a simple employee of Leroy-Somer. In Graille's estimation, this lack of psychological finesse on Chavanes' part constituted what he called "the blackest pages in the Dossier Priore."

Even the smaller machine was to cost about half a million dollars, a price which today, due to inflation, could be tripled or quadrupled. During a stage in which an intermediate machine was designed by the chief Leroy-Somer engineer, Ribeau, a machine that never did function properly, Chavanes all but forced Priore, who was heavily in debt, to sign a contract which was falsified. The falsifica tion was a matter of one word which was changed in the contract. In a phrase reading that an exclusive license of patents, and subsequent patent modifications, would accrue to the company "for all countries solely for therapy on cancers concerning animals and humans," a word was inserted by hand so that the phrase read. *"concerning particularly* animals and humans" implying that other uses of the machine, whatever they might turn out to be, would also accrue to the company. This one word change was amended on Priore's copy of the contract by calling the word "particularly" a "nullified word," but on Chavanes' copy it was called an "added word."

Leroy-Somer believed it was sufficiently well positioned in the driver's seat to be able to deal on behalf of Priore himself with the French governmental institutions, mainly the General Delegation, concerned with the funding of the new machine. When Priore learned of Chavanes' contact with the General Delegation he wrote a letter informing it that no one had the right to deal in his name. Nor did Chavanes even attempt to cut the Saint Gobain subsidiary, which alone could supply the tube, key to the device's functioning, in on the government funding.

In the meantime, no less a figure than Professor Kastler, soon to win the Nobel Prize in Physics, came down from Paris to inspect. the existing Priore device. He brought with him Delmon, who, we recall, had worked with Berlureau on the first animal experiments and who

NOW, it turned out, was trying to build his own version of a Priore device on the sly without telling Priore. Kastler's bringing Delmon with him to Priore's lab so angered Robert Courrier that he told the physicist he had committed a real gaffe. He also convinced Kastler that Leroy-Somer should build a machine with a power of at least 5000 gauss, but Chavanes refused. There seemed to be no harmony of outlook between the leading industrialist concerned, on the one hand, and the top physical and biological scientists on the other.

While all these, and many more, peripatetics were proceeding, Priore's sister in Italy came down with cancer. Beside himself with grief, Priore informed all concerned to commit themselves either to building an intermediate machine correctly, under his supervision or, better, the 5000-gauss machine, and to do this in time to save his sister, or he would wash his hands of the entire matter. Confronted with this ultimatum, the company began to work round the clock to perfect the intermediate machine but engineers involved, believing themselves to be more adroit with respect to its design than Priore, left out a host of what, to them, were unnecessary components. The result was that when the machine was first put to trial, most of the components burned out or otherwise failed, and the machine itself became a useless pile of rubble.

Shortly thereafter, Priore's sister died of cancer. Her grief-stricken brother went into what amounted to total isolation, unwilling to talk to a soul.

The whole Priore affair might have ended at that point, in the early part of 1967, were it not for the entry onto the scene of a key figure, Professor Raymond Pautrizel. Born on 3 June 1916 in Basseterre, capital of the French Carribean island of Guadeloupe, at forty years of age he was on the Faculty of Medicine at Bordeaux. He soon became known, world-wide, as the "father of parasitological immunity," a title he never accepted, saying that, if others had awarded it, it was simply because "he had searched through old scientific publications to find ideas that were as valid for modern research as they were forgotten by modern researchers." And he later was quoted as adding: "It is really too bad that researchers today don't pause from time to tome to dig into studies made by their predecessors, some of which were performed even decades ago!"

Professor Pautrizel was awarded the first academic chair in France for immunology, and later a special unit was created for him for parasitological immunology, a subject which is both simple and complex. The simple part involves the fact that various immunological techniques can be applied to diagnosing specific parasites that have invaded an organism in order to develop preventative actions against them via vaccines, or curative actions via serums.

When invaded by parasites, organisms react by creating antibodies, specific substances aimed at killing the invaders also known as antigens. These antibodies are liberated, like an attacking army, into the blood. Simple enough so far. The complexity arises because the defending army, the parasites, don't just lie down and die under the attack. They are capable of modifying their "personalities," as it were, and of changing various of their characteristics such that the mechanisms that the host uses to recognize, or detect, the invaders are invalidated. Thus, the substance which an organism would secrete to destroy an invader A becomes incapable of recognizing A, now become A-l, and therefore incapable of destroying it.

The organism at this point seems to realize it has to create a different substance to rid itself of its antagonist but, in the meantime, the metamorphized parasite is getting on with its assigned destructive task. Alternatively, the parasite has another capability: that of itself liberating substances which can annul or annihilate the organism's overall defense system. A sort of "in the blood" version of Star Wars is going on at the microscopic level.

The study and classification of the substances - - call them weapons - - emitted by parasite-attacked organisms allows for the establishment, in turn, of batteries of tests to define the exact nature of the parasites themselves in order to come up with an appropriate therapy or counter-weapon.

This then, is the essence of parisitological immunology, Raymond Pautrizel's area of research. He specialized on a particularly lethal parasite known as trypanosome, the scourge of tropical third-world countries where, in one form, it causes sleeping sickness in animals and humans, in another, equine syphillis, in still othera, other afflications. Over the years, during which he produced a small library of literature on the problem (known mostly to specialists in countries where that problem is acute), Pautrizel and his team discovered, among other things, that the trypanosome can modify itself, again and again, up to 101 times over a period as short as only three weeks.

Even before his work on trypanosomes, Pautrizel, back in 1949, was one of the first researchers to discover what is known as *ambivalence* in drugs, notably histamine. Histamine is a substance which is secreted by an organism as a defense mechanism but if oversecreted by certain cells circulating in the blood, it becomes virulently noxious, mainly by overdialating blood vessels, thus making them permeable to water and leading to edema and even death. This process occurs, for instance, in some human beings who are highly susceptible and over-reactive to bee or wasp stings.

Pautrizel's research on the noxious aspects of histamine led to

his finding that the same substance, applied in requisite small doses, is extremely important to the defense system ofthe organism. Today he stresses the notion of *ambivalence* in many areas ofhis work and characterizes it as "a key to the biology of the day after tomorrow."

To finish with the background on Pautrizel, before bringing him on stage in the Priore drama, it may be added that only a few years ago, at a formal reception for him attended by the medical elite of France, he was given a Basque *makila,* an iron-bound honorific cane of sculptured wood, in tribute to his work. On it was the incised inscription: "Sometimes to heal, often to alleviate, always to console," an epithet that perfectly characterizes a medical doctor imbued with that kind of rare compassion that marked Pautrizel's character.

When Robert Courrier sent Madame Colonge to Bordeaux, it was Pautrizel whom he asked to provide her with every assistance. In this way, Pautrizel was first introduced to Priore and his device. After witnessing the results obtained with it he was to say: "What stupified me, and led me to ponder the question, was to see the control animals die from their tumors in 3 weeks, while at the same time I could observe that the tumors in the animals under treatment were literally melting away and the same animals were taken back to Courrier's lab at the College de France in Paris in perfect health." ASa result of his thinking about the problem, Pautrizel came to the belief that the machine, however it worked, did not exert any action at all to kill cancer cells but, through as yet unexplained mechanisms, stimulated the afflicted organisms to provide themselves with new immunological weapons that could overpower the cancer cells.

To shed light on this problem, Pautrizel proposed the simple expedient of experimenting, not on cancer-infested animals, but on *in vitro* cultures of cancer cells. He made this proposition to both French and British cancerologists but they were convinced that the Priore device *had to be actually killing cancer cells themselves,.* They could not see the point that, if the machine did not kill cancer cells, then it was doing something else to the body to allow it, and not the machine, to do that job.

Pautrizel's involvement with the British was the result of a team being sent from England to experiment with cancer mice with the Priore Ray. What happened cannot be related in this brief resume except to say that, out of a lack of understanding on the part of certain British cancer experts and malicious conniving on the part of one member of the cancer "aristocracy" in Paris, the experiments were put under a cloud. It was alleged that mice had been substituted somewhere during their long round-trip voyage between

England and Bordeaux to make it look as if a failed experiment had been successful. This did not prevent Sir Alexander Haddow, chief ofthe prestigious Chester Beatty Research Institute for Cancer from stating, at a meeting in Paris, that the Priore machine had been indubitably effective on the English mice and supporting Pautrizel's idea that experiments should forthwith be done to see if the Priore Ray had any effect on cancer cells *in vitro.* Haddow's suggestion backing Pautrizel's recommendation fell on deaf ears.

Because of the emotional turmoil and rancor with respect to cancer that had so long surrounded Priore and the workings of his machine, Pautrizel suggested that it be tried in a completely new area, one he knew so well, namely on afflictions caused by the trypanosomic pathogen. Before these could get underway, however, someone had to persuade the still desolate Priore to return to work. Pautrizel, known to those really concerned with and knowledgeable about the potential of the Italian's invention, at last was able to convince the inventor to cooperate and get back into harness. This ho did with that rare combination of diplomatic tact and warm human sympathy with which only the Pautrizels of this world are gifted.

In the meantime, Riviere had gone on to implant new 347 tumor grafts in rats previously cured of 347 tumors. When none of the tumors developed, that result added one more argument to back Pautrizel's idea that the machine was, in fact, affecting the immunological defense system of the animals. However, when Riviere tried the same procedure with the T-8 tumors, his animals died. This lead to the conclusion that the immunity acquired by the animals to lymphoblastic lymphosarcoma 347 was specific to that tumor. When a note on this research was sent, again through Courrier's good offices, to the Academy, for the first time, it strangely omitted from the listing of the participating researchers the name of Antoine Priore. It seemed that Riviere had been taken to task by fellow cancerologists who believed that Priore was nothing but a naive bumpkin or, worse, a swindler. They had warned him against publishing any papers with which Priore's name would be associated This rank injustice and lack of fair play again sent Priore into a fit of despondency and depression from which he could only be wilth drawn by those subtleties involved in Pautrizel's sympathetic and friendly counsel.

On 25 July 1966, another note was sent to the Academy filed for the first time not under the rubric Cancerology but under the rubric Immunology. It was entitled "Influence of Associated Electromagnetic and Magnetic Fields on the Immunity of Mice Infected with Trypanosoma equiperdum." The conclusion read: "The treatment allows the organism to rid itself of parasites even when these

have invaded it in a most intensive way.... There is an enhancement of both the specific and aspecific factors of immunity."

Thus, for the first time, the field of research shifted from the narrower field of cancer to the much vaster domain of immunology. And, for the first time, Pautrizel's name appeared as the senior author on the paper. It also appeared that, for the first time, there should no longer be any problem about experimenting with the I'riore machine. Such was not the case.

Still complicating the whole issue was the fact that Priore himself was using different setting to produce different varieties of radiation depending upon his own intuitive evaluation of the particular biological experiments being run with his machine. He would never reveal the nature of these settings.

At this point there appeared on the scene a new researcher who became Pautrizel's loyal ally, a young woman, Pierette Chateau-Reynaud Duprat. During her work in Paris, she had learned of the Priore controversy, and, against the stern advice of mentors senior by many years to her in the cancer hierarchy, she came to Bordeaux to meet Pautrizel and learn more about the research.

Her work, performed over many years, is too detailed for presentation here but it led to important conclusions. One was that the Priore Ray had no direct effect on the trypanosomes themselves but stimulated and reinforced the defense mechanism of the infested organisms, allowing them to reject the parasitical influence with an effect so durable that they were no longer subject to this influence even after treatment stopped.

Another conclusion was even more important and involved, in part, British research. It pertained to the effects of the machine on both *allografts* or those made between two different individuals of the same species, and *isografts,* or those made between two different individuals ofthe same genetic line having in common antigens that were characterized by what is called the same histocompatability. The conclusion was that not only was the rejection of *allografts acce*lerated by the Priore Ray but that *isografts* were also rejected. This meant, in sum, that the ray stimulated not only the *defense* mechanisms of the organism but also, and more importantly, its re*cognition* mechanisms. In the case of an isograft, this allowed the recognition of weak antigens that were not recognized in non-irradiated animals. In other terms, where at first the anti-aircraft batteries could not shoot down the aircraft because they could not see them.now they could shoot them down because they could see them. In immunological terms, the ray affected both humoral and cellural, both specific and aspecific, immunity.

Here we must return to the mystery of the settings on the device.

As a result of the new experimentation it seemed that, depending on those very settings, the active ray, complex as it was, could have either similar, totally different, or diametrically opposed effects. Thus it was not a question of a ray having universal effects — a kind of magic bullet capable of killing any target — but of multiple radiations which, due to the complexities in Priore's personal makeup, have unfortunately yet to be sorted out and explained.

Thus, the machine originally designed by Priore, called the P-l when it put out a wave length of from 19-21 meters, had a radical effect on certain animal cancers, on *cellular* defense mechanisms, and finally, but not universally, on organisms infested with **Trypanosoma equiperum,** (hereinafter called T.e.).

A second machine, dubbed the P-2, was at first not able to produce these frequencies. What it did put out was a frequency of 17 meters that *was* universally effective against T.e. and seemed to act. not on the cellular, but the *humoral,* defense mechanisms. The rejection of grafts depends on the cellular defense mechanisms, which partially explains why Pautrizel when using the P-2 machine, selected the T.e. vector, as it is called in microbiology, just because this creature is fought by the organism's humoral defense system.

Consequently, the bio-effects that were successfully attained depend on the varying, not to say quixotic, nature of the radiation At one point Pautrizel actually did experiments on animals infected with *plasmodia* — the vector for malaria which attacks red cells - and found that the settings used were effective while never learning exactly what they were or the exact nature of the radiation. Further more, Priore himself maintained that over the years he had success fully treated cases of human tuberculosis but, again, never revealed which frequencies had been used to achieve this.

Several more notes were sent to the academy on the successful work performed with the Priore Ray on animals affected with T.e. But the central issue remained: how to find out exactly how the-machine worked. It fell, not to civilian scientists, but to those in the-French army service to attempt, at this point, to work out the problem. The army service brought into the picture was the DRME (an acronym which translates as Administration for Research **and** Test Methods), to which Pautrizel had sent a request for funds in 1968.

This request was the subject of a meeting at which were present three of the top names in French science, one representing biology, the second physics and the third, medical physics. The latter two turned in extremely unfavorable reports recommending that no money be wasted on the problem. The biologist, however, turned in a most favorable report and, despite the fact that he was in the

minority, his opinion won the day.

As remarkable as was this victory, it was even more stunning and incredible given the fact that this biologist was the same Andre Lwoff who had so adamantly opposed the Priore research a couple of years previously. Lwoff had summoned the courage to completely reverse himself only after he sent one of his most trusted colleagues to do secret experiments with the Priore Ray on mice injected with peroxydase (an antigenic solution) to see if they would produce a higher level of antibodies than non-irradiated animals. This they did so well that Lwoff became convinced that the Priore Ray caused an extremely important increase in immune reactions. These results were never published because, before the experiments could be repeated to be absolutely sure of their results, the machine suffered one of its many interminable breakdowns.

The DRME report was at length, and in length, issued but not publicly since it was protected by a military classification. However, a synthesis of it was finally published in November 1979 by Herbert Gossot, Secretary General for the French Association for Bioelectromagnetism, under the title: "A Scientific Balance Sheet on the Priore Ray." Its contents were as follows:

"The two physicists assigned by the army made a complete analysis of the electromagnetic radiations and magnetic fields activated by the Priore device. They thus determined the spectrum of frequencies which the device emitted. They showed particularly that frequencies in the visible light and infrared range had no biological effect; that there were no X-rays or Y-rays; and that the pulsed ultra-high frequency electromagnetic wave was modulated in amplitude to that of a high-frequency wave. They did a topographic survey of the respective intensities of the various magnetic and electromagnetic fields in the experimental plane of the device. In particular, they determined the spatial repartition in this plane of the density of the strength of the ultra-high frequency wave. They showed that its value was very weak and that it could not produce any kind of overall significant thermal effect imputable to the hyperfrequency ray.

Finally, and most importantly, by using what they had learned about these repartitions, they demonstrated a clear correlation between the biological effects obtained and the intensity of the hyperfrequency ray. What they actually observed was that, on the **biological** model used, i.e. experimental trypanosomosis of the mouse, there was a diminution of the rate of evolution of the parasitemia that was proportional to the strength of the hyperfrequ**ency** wave. To quote them: *'These experiments of correlation are of certain interest: they confirm, if there is still any need of so doing, the*

biological efficacy of this device."

The two physicists, Bottreau and Berteaus, are still interested in rebuilding a Priore device with which additional biological research could go forward. At the same time they suggested to administrative bodies in French science the creation of a special laboratory for bioelectromagnetism to fund more work, a suggestion in which Professor Pautrizel concurred. No action was taken and their report was kept under wraps. In a note they presented to the Academy of Sciences on their investigation, they were not allowed to include the names of the laboratories where they worked: in the case of one, the CNRS Magnetic Laboratory at Bellevue near Paris, and of the other, the Laboratory of Ultra-Hertzian Optics and Talence near Bordeaux. Why? Because the directors of these laboratories did not want any mud in the Priore affair to be spattered on them.

The next experiment done by Pautrizel was on rabbits whose testicles had been so seriously affected by trypanosomes as to be almost entirely destroyed. After radiation the same testicles took on their normal histological appearance and the rabbits, able to procreate again, in no way abstained from their newly regained ability. **This implied the complete regeneration of an organ that had all but completely degenerated.**

Yet journalists, who sought out truths about the Priore affair in Paris from high officials they believed would know best about what was going on, continued to be led astray. For example, an American scientific reporter, writing in the **Saturday Review** of **Science** in 1973 saw fit to state: "It is really a question of a mystical problem that has little to do with science." He was quoting Professor Bader, a man who for 15 years held top administrative posts in science that could have allowed him to back the Priore research with all the funding necessary to its accomplishment. At the time Graille's book came out, Bader issued a book of his own about the Priore affair which offers no real idea of what was involved. When I asked several people in France why Bader had written the book, they were unaware of Bader's inmost motivation.

Machinations continued to swirl about the case over the next several years. Behind-the-scenes intrigues, distorted accounts in the press, lethargic attitudes on the part of administrative officials who would not take responsibility to cut an increasingly tight Gordian knot, outright fear of various personalities to become too deeply implicated lest they lose their jobs - - all these, and more, continued their daily round in an atmosphere of "Business AS Usual," and "Don't Risk Your Neck."

To get to the nexus of the situation, we have but to cite the observation of one of the few perspicacious journalists who, in **the**

prestigious scientific monthly, Sciences and Life, wrote: "The physicists are convinced that the effective Priore Ray is very complex but to analyze this further some things first have to be made clear. One is to raise the suspicion that has surrounded Monsieur Priore with a fabulous acretion of misunderstandings, insults and accusations of being a swindler over many years. What is needed is a veritable national effort to act effectively and to act rapidly."

Over the next two years the decision-making process of the French government lumbered its way along until it was finally decided to back the construction of a powerful machine. This decision was not favorably accepted in many quarters. As Le Monde would comment: "The decision was made in spite of the disapproval of many scientists. When money is tight, one should pay particular attention to how it is being spent. Such seems not always to be the case. A credit of some $3.5 million francs (or about a million dollars) has just been accorded to finance the construction of a new Priore machine."

The scientists to whom the article referred were in a rage. They understood, at this juncture, that the only way to put an end to the affair was to eliminate Pautrizel who, because of the very success he was having with his research, was seen as a dangerous competitor that might even become one of the top figures in medicine and science on a national, or perhaps, on a world scale. Indeed, it was learned that Professor Courrier had gone to the length of sending a report on Pautrizel's behalf to the Nobel Committee in 1979.

To make a long story short, the large powerful machine, the M-600, was built but a huge tube in it, after functioning for about a week, exploded. Due to the galloping inflation of the 1970's, to replace it would have cost another million dollars. The money was not forthcoming.

In the meantime Pautrizel, ever experimenting with the still functioning smaller machine, was to discover new facts. Mice with their spleens cut out, for example, also could survive injections of T.e. The Priore Ray had important implications for Arterio-sclerosis, since it effected lipid modifications in rabbits given a dietary regime high in cholesterol. This research, published in another note in the Academy Proceedings, instead of being warmly received, only irritated the cardiological fraternity which felt, as some of its members put it, "trapped" by Pautrizel's efforts.

One particularly virulent opponent was Professor Bricault, Dean of the Bordeaux Medical School who, as late as 1980, was telling his own students that the published results were a farce and had never been obtained. The students, who carried out a special investigation of the matter on their own, were able to judge what a

farce their own medical dean might represent.

L'Express, the **Time** magazine of France, read by at least half the population of French intellectuals, had the gall to compare the results of the Priore research to those of the infamous Trofim Lysenko of the Russia of Stalin's day. Haughtily **L'Express** added: "Today Priore's defenders explain that his machine has not only cured cancer but, in all probability, altered the immunological characteristics of mice. Were this, in fact, so, all the immunologists, all the geneticists of the world would unite to affirm that a machine capable of changing the genetic patrimony is the discovery of the century, far more important than the atomic bomb or the conquest of the moon. Unfortunately, the history of the whole thing has never been properly elucidated." The article was illustrated with photos distortedly selected to convince viewers that the Priore machine was as serious and effective as the one that purportedly brought Frankenstein to life.

In this poisonous atmosphere the slow work of building the M-600 went forward. To give anyone who was not there a feeling for this endeavor we may now cite verbatim a passage from Graille's book: "The construction and assembly of the prototype —the M-600, that of highest power and variable parameters — were fraught with many uncertainties and delays on the one hand and, on the other, were marked by the stamp of Antoine Priore's sparkling genius.

"To go from an apparatus that developed 1,240 gauss applied over an effective area of some 20 centimeters, to one developing 5000 gauss over an area of 60 centimeters means to take on an extremely risky technical and technological wager. Electrical, mechanical and glass-blowing specialists plunged into the unknown. They had to conceive, make, adapt and put together all the various myriad components almost haphazardly with no precise technical study being previously available. Priore's stubbornness forced them to take on a trial-and-error manufacturing "gimmickry" without precedent. As the thing was put together and preliminary tests made, it became clear that many of the components were unsuitable and that they would have to be modified or replaced. The tube itself, made of pyrex, 60 centimeters in diameter, and 6 meters tall, had to be replaced twice after it imploded. In fact, practically everything had to be reconsidered or readapted. "Everything" meant the parts going to make up a generator of 50 tons in weight. For example, the coil which created the magnetic field: 5.5 tons with 11 miles of copper wire. For example, the numerous cooling circuits which stabilized the thermal equilibrium of the generator and its environment or, additionally, the circuits governing command, control regulation and selection — 6 tons of electrical cables of which 15 miles were of

tele-command wiring.

"Priore astonished everyone. Breakdown after breakdown, incident after incident, it was he alone who showed what to do next, indicated the proper steps to take, the right settings to adopt, the right way to assemble the components: He was virtually building his machine by himself, nursing its construction along day after day, all the engineers' studies and efforts actually, and ultimately, serving only as a preliminary attempt, a sketch as it were. When Priore made his presence felt, things began working."

Then.... after the machine was built: "The part of the entire apparatus to generate electricity was set up on a provisional basis. It was so noisy that, while functioning, it woke up the whole neighborhood. The number of experiments had therefore to be curtailed so that the machine would not be used at night. And, all at once, everything came to a halt. The Faraday cage, shielding and isolating Priore's apparatus, was torn and fissured by the shock of the cement pilings that were being sunk into the ground all around to hold up the building under construction. This allowed high-frequency waves to escape which disturbed radio broadcasts emitted by local radio stations, the army, and civilian aircraft for miles around."

Nevertheless during the week or ten days that the machine was in good operation the results of experiments performed with it were more than formidable. First of all, it allowed for as many as forty experiments to be performed on some 280 animals in a remarkably short period of time. Among the discoveries made were: The ray emitted provided the treated animals with an extremely strong immunitary response. Animals whose immune defenses had been attentuated by an immuno-depressant were able to overcome the effects of injected parasites but relapsed a few days later. One could therefore conclude their immune response was much weaker than those normally infested and treated.

Newborn animals, whether treated or not, developed a marked parasitemia leading to their deaths. At the time of death, the parasites had the same antigenic structure as those of the innoculum which thus implied that they had met with no defense at all in the infected organisms. This also proved that the Priore Ray did not act directly on the parasites themselves but only by way of an increase in the immune defense system of the organisms. The newborn animals succumbed to their parasitemia because their immune sytem was not yet sufficiently developed to be stimulated by the P-Ray. The phenomenon of a stimulation of the immune defenses was demonstrated by the fact that animals which had received soluble antigens developed, after being irradiated, a level of antibodies far

superior to the controls.

These and other conclusions were the object of notes presented to the Academy of Sciences by Pautrizel and his team in 1978. Even before, at a colloquium held in Antwerp, Belgium devoted to African human trypanosomiasis, the same team had offered the conclusion that the stimulation of the immune defense system that allowed organisms to throw off the effects of trypanosomiasis had to be very significant in that all attempts to try to effect such stimulation through immuno-stimulants as well known as B.C.G., or Corynebacterium granulosum, had led neither to the cure produced by the Priore Ray, nor to any prolongation of the infected animals' lives, nor even to the slightest modification in the evolution of the Trypanosomiasis.

These three scientific papers did little for the cancerologists who read them except to exacerbate their urge to oppose the Priore research, if not to arouse their outright hatred for the principal experimenter, Raymond Pautrizel. Could this have been because, for over 20 years, the same cancerologists had been working in vain to provoke in cancerous organisms immuno-stimulative reactions by intensively and successively vaccinating them with B.C.G.? Many others had been life-long apostles of chemotherapeutic cocktails of all sorts, or life-destroying ionizing radiations, or, what more recently has become the fashion, of applying the two methods in endless combination.

For this reason, they saw Priore and Pautrizel as nothing more than spoil-sports who had to be destroyed.

One of the opening shots in this campaign was a letter received by Pautrizel to inform him that his request for funds to continue his research through Unit-89, a unit that had been specially set up for him to direct, had been denied. It took many months of investigation for Pautrizel to learn that the real reason for the refusal was because of his work with Priore.

Next Pautrizel was informed that his appointment as director of the same research unit would be extended for only two years, whereas the normal extension for similar units was five years. A third insult came when Pautrizel tried to win a post within his unit for a high-ranking military physician, who had been his student and who had decided to quit the military in order to participate in the fascinating research prosecuted by his mentor. Pautrizel's request for funds to pay this physician, who all his life had been working on tropical medicine closely associated with problems of trypanosomia sis, were refused four times in a row with no cogent reason given. The physician, who in the meantime had volunteered his time without pay, finally became so emotionally overwrought that he gave up his

medical career and retired to the countryside where he gave himself over to alcohol. Then Pautrizel tried to get a salaried post for another ofhis brilliant collaborators (who still works with him). He was told that this man could take up his new functions only if he left Bordeaux. One could go on with many other shocking stories but we will leave it to Graille to conclude: "Everything possible was done to isolate Pautrizel, to separate him from his collaborators. Every single one of these collaborators saw their careers put in jeopardy, compromised, or broken."

As a final insult, when the time came again to renew Pautrizel as director of Unit 89, those responsible, not daring to overstep what even they knew to be decent limits by not extending him, simply abolished the unit. And to add injury to that insult, a doctoral thesis that had now been prepared by Priore, and backed not only by Pautrizel but by Nobel Laureate Andre Lwoff himself, was summarily refused by the President of the University of Bordeaux.

It is perhaps unnecessary to state that the details behind all of this skulduggery could, and did, fill up two chapters of a book and make for the most heart-rending reading imaginable.

So what happened next? In the autumn of 1977, Professor Georges Dubourg, one of the leading lights in Bordeaux's company of surgeons and a friend and admirer of Pautrizel's, came to him to say openly and baldly: "My friend, at the point you've reached, there is only one more way to jolt medical opinion and that is to treat human cancer patients." Pautrizel was hesitant, believing his role to he one of continuing with his animal experiments but where would the funds for that come from now? He therefore asked his old mentor, Robert Courrier's advice. Courrier gave the green light. The treatments were restricted to terminal cancer patients whose immune defense systems had been disastrously weakened by chemotherapy or radiation or both. At least one of them was totally cured. The other 1ived, without pain, for a period many times longer than predicted by prognosis. Dubourg, Pautrizel and their collaborators wrote up the results and sent them as an official communication to the French Academy of Medicine for publication.

The reply they received from that Academy's perpetual secretary reads: "Experts whom we consulted consider that your work does not fall within the jurisdiction of our members and that it would doubtless find an audience more worthy of its purpose in a more specialized society."

To which Pautrizel formally replied: "Since two of the four signatories of our note are corresponding members of your Academy, could we not benefit from the remarks and comments made by the committee which saw fit to refuse our paper? And even, if this is not

too indiscreet a request, to learn the names of the expert members who were consulted which would allow us to get into contact with them directly and to benefit from their singular competence?"

His letter has remained unanswered for four years.

There was nothing more to do except one thing which Raymond Pautrizel, as a man of science, had always been careful to avoid: Get a responsible journalist interested in the case, inform him of all possible details, and let him carry the Priore Affair in all its harrowingly loathsome aspects to the broad reading public. That journalist was Jean-Michel Graille.

For four years, Graille went about his task, publishing three consecutive long articles in his newspaper **Sud-Ouest France** and finally the book to which we have referred and of which this presentation is largely a resume. As early as 1980, Graille would write in his newspaper: "The Priore Affair is simple in essence. It can be reduced to a simple alternative: either the machine developed by Antoine Priore is of no interest and, having shown this, the affair can be considered at an end. Or else the machine is of real and demonstrable medical interest and, if that is officially recognized, he would be allowed to get on with the work. For this dilemma runs the risk, yet again, of being buried under delays and evasions. Beyond all the powers-that-be that have been directly connected to the affair for many years now — the power of finance, the power of medicine, the power of science — perhaps it is now political power with which responsibility lies if it can rise to meet and assume that responsibility through decision."

That was Graille's statement in 1980. His book which came out four years later ends with the sentence: "The Dossier Priore thus depends, from here on out, on a decision that must be taken on the very highest level, and imperatively. This responsibility devolves, in last resort, on the chief of state and on him alone. Will he assume it?"

Would the President of the United States?

Note added by T.E.B.: Antoine Priore is now dead. His machine has been dismantled. The iron dogma and hatred of electromagnetic medicine by bureaucratic science may have doomed hundreds of millions of humans - - whom Priore's device could have saved - - to bitter, agonizing, and unnecessary deaths. Hitler, Stalin, and Mao combined were not responsible for the deaths of so many.

APPENDIX II

PATENTS

English Translation of the French Patent No. 1,342,772 of Antoine Priore, 7 Oct. 1963.

Procedure and Assemblage for Production of Radiation Especially Serviceable for the Treatment of living cells.

Brevet d'Invention. P.V. no. 899.414 no. 1.342.772 Classification Internationale: A61 k-H 05 g

Procedure and assemblage for production of radiation especially serviceable for the treatment of living cells.

Antoine Priore
Requested 1 June 1962, 14.52 hours, Paris
Released by decree (arrete) of 7 Oct 1963

The invention deals in a general manner with radiation capable of penetrating matter. More exactly, it aims at a procedure and an apparatus making it possible to obtain a combination of radiations of different types able to penetrate matter and especially to penetrate intimately living organic tissues in order to produce in them certain effects, particularly in human tissues with a view to a therapeutic effect without destroying essential elements such as the enzymes.

In conformity with the present invention, one emits in a cavity a stream (rayonnement) of electrically charged particles upon which one superposes electromagnetic radiation of the centimeter wavelength range, the wavelength of which is preferably between 3 cm and 80 cm, and one directs the resulting radiation emerging from the cavity on to the object to be irradiated.

This applicant has shown that the penetration and, in particular, the curative effects are very distinctly improved when one gives **the** electromagnetic radiation a frequency determined as a function **of** the organ or the tissue to be penetrated or to be treated. For example, a wavelength of 14 cm is suitable for the liver and a wavelength of 19.5 cm for the spleen.

Preferably, the stream of charged particles is accelerated in a particle accelerator in such **a** way **as** to increase the force of penetration.

The resulting radiation is advantageously applied and directed upon the target, that is to say, upon the tissue to be penetrated, by the intermediary of a tube which is the site of electric fields and of magnetic fields for acceleration and control, the said radiation being preferably guided and/or reflected by a rotary deflector placed in the tube.

It is often advantageous to modulate or impose rhythm on this stream of particles by means of variable magnetic and/or electric fields so as to augment still more the force of penetration. This rhythm is preferably consistent, especially in medical applications, with the intrinsic period of the tissue to be penetrated or of the neighboring tissues, for example, muscle. These intrinsic periods arc well-known in medicine and are applied, particularly, for diathermy: they are situated in the wavelength range from 1 m to 50 m and more especially from 1 m to 18 m.

Preferably, one arranges to modulate the emission of radiation, the accelerating magnetic and electric fields, and perhaps also the rotatory deflector, to the cardiac rhythm of the subject.

It seems that the result obtained by the invention in the treatment of maladies of living cells (vegetable or animal) are due to certain phenomena which will be described, it being understood that this exposition will not circumscribe the invention.

As a function of its electro-physico-chemical constitution, the cellular pair nucleus-protoplasm is endowed with electric conductivity in direct relationship with ion exchange processes provoked by metabolic phenomena. One finds in tissues the presence of an accumulation of electricity at different potentials according to the different cellular densities of the tissues.

The work of Renshaw, Forbes, Morison, Amassian, de Vito, Ruset, Albe-Fessard, Tauc, Adrian, etc. has shown with the aid of micro-electrodes the existence of slowly oscillating elementary electric activity in the interior of cells; it can be thought that the *rythmeur* (or pace-maker) is achieved by the oscillatory electromagnetic system comprising the cell nucleus. This nucleus, in effect, is made up essentially of tubular filaments of insulating material (related to chitin) containing in its interior an electrically conducting saline liquid, and these filaments, coiled upon themselves, can be considered to constitute real little oscillatory circuits.

The recent work of Warson (sic) in America, as well as that of French scientists, including a communication from Polonsky, Don zon and Sadron presented to the **Academie des Sciences** by Prof. Francis Perrin on 16 May 1960 **(Rec. comptes rend, heb.,** 250 No. 20, 3414-3416) making it clear that experimental samples of **solid** DNA manifest properties analogous to those known in ferroelectric

materials, makes plausible the hypothesis that a potential difference may exist between nucleus and periphery of cells. Certain recent theories go even further and liken the cell to an electronic receiver-emitter device normally functioning in harmony with the ambient media. The oscillatory system of demand waves, constituted by the cell nucleus, would behave in accordance with the laws governing semi-conducting materials.

The applicant is led to the conviction that in a normal state of physico-electric equilibrium, the cell nucleus is positively charged, but can acquire a negative surcharge following phenomena analogous to polarization.

The invention, especially, enables organs afflicted by this inversion of their electric potential, particularly in the case of the pathologic negative surcharge of cancerous nuclei, to recover their former equilibrium.

The following description in regard to the attached drawing, given as a non-restricting example, will make it possible to understand how the invention can be realized, the details which emerge both from the text and the drawing being, of course, part of the said invention:

Fig. 1 is a schematic section showing an apparatus for production and emission of an electromagnetic field combined according to the invention.

Fig. 2 is a frontal elevation of the cathode, taken from the right of Fig. 1.

Fig. 3 is a section through III- III in Fig. 1.

Fig. 4 is the overall scheme of the electric supply.

Fig. 5 is a view analogous to Fig. 1 showing another mode of implementation.

Fig. 6 is a section through VI-VI in Fig. 5.

Fig. 7 represents schematically an apparatus for pulsing the electric current.

Fig. 8 is the circuit of an amplifier permitting activation of the apparatus of Fig. 7 at the cardiac frequency.

Fig. 9 is the circuit of an oscillator permitting modulation of the

electric current according to a wavelength between 1 m and 18 m.

The assemblage of Fig. 1 contains an apparatus 1 emitting electrically charged particles 2 in a cavity or passage 3, a cyclotron 4 accelerating the particles 2 and sending them into a cavity 5 forming a tube into which merges another cavity 6 acting as wave-guide for electromagnetic radiation of frequency in the centimeter range emitted by a magnetron 7. The cavity 8 formed by the joining of tube 5 and waveguide 6 leads into a tube 9 in which the resulting radiation is accelerated and aligned. The interior of the cavity-formed by the assemblage of elements 1, 3, 5, 6, 8, and 9 contains argon at a pressure of 2 mm mercury.

The particle emitter 1 consists of an electron gun comprising a plate 10 and a cathode 11.

The cathode 11 is of molybdenum and has the very special form represented in Figs. 1 and 2. It consists of a rim 1la connected by two aligned spokes 11b to a hub 11c pierced by a hole 11d with its axis along XX'. The rim 11a is in two parts (as one sees in Fig. 1) which may be held together by screws (for example) forming a cavity of revolution 11e traversed by a number of holes 11f parallel to the axis XX' and regularly spaced. The filament for heating, 12, situated in the interior of the cavity 11e and is connected to the power supply conductors 12a.

The best results are obtained with a cathode 11 of molybdenum. The applicant has obtained satisfactory, but slightly inferior, results with tungsten cathodes. It turns out that molybdenum, and to a lesser degree tungsten, are the metals whose valency is closest to the mean valency of the chemical molecules constituting living tissues and more particularly those of human beings. One might well seek to use this fact to explain scientifically the phenomena involved, but it is understood that *the invention is not limited by any scientific explanation.* Concerning, on the other hand, the gas present in the apparatus at low pressure, the best results have been obtained with argon; the applicant has also obtained satisfactory, but slightly inferior, results with other gases of the rare gas series.

Surrounding the tube which constitutes the electromagnetic chamber are arranged: an electromagnet 13 with its winding 13a, placed at the level of the accelerating coils 14 and 15. Other accelerating coils 14,15 and 16 are similarly dispersed around the cavities 3, 5 and 8.

The two semi-circular boxes or "dees" 4a of the cyclotron 4 are placed in the usual manner between the poles of the frame around which are wound the accelerating coils 4b and 4c.

The magnetron 7 is of a familiar type and must be capable of

emitting in the cavity 3 a centimeter wave of adjustable wavelength from 3 cm to 80 cm.

The lower portion of the tube 9, for acceleration and alignment, contains a cathode 17 resembling the cathode 11, with a filament 17a. This cathode 17 is supported by a hollow pillar 18 pierced by holes 18a close to its junction with the bottom of tube 9. This pillar 18 communicates with a tube 18b emerging on the axis of a rotary deflector 19 carrying at each end a "crown" of graphite plates 19a inclined at 45° to the vertical. The rotating axis 19b of the rotary deflector is mounted in a support 20 fixed to the interior of tube 19 and carries at its upper extremity magnetic bobs 19c which ensure that it will be set in motion in cooperation with the magnetic bobs 21a mounted on the shaft 21b of a motor 21. The lower extremity of the rotary deflector 19 is composed of a piece of molybdenum or of tungsten 19d in the form of a pyramid whose apex is opposite the open end of the tube 9.

The hollow base 18 and the tube 18b can be of a borosilicate glass of low coefficient of expansion such as that sold under the trademark "Pyrex." They may also be of quartz. Tube 9 itself can be of "Pyrex" as above or of another glass of the quality currently used for the manufacture of electronic tubes, but its bottom 9a, which is traversed by the radiation, is advantageously made of quartz.

The duct 8 joins the tube 9 by way of several tubulures such as 8a and 8b directed in vertical planes towards the plates 19a at a certain angle, which is advantageously about 22.5°. An electromagnet 23 analogous to the electromagnet 13 of the emitter tube 1 is placed around the cathode 7. Similarly, accelerator windings 24 are disposed around the tube 9. This tube also carries, at positions indicated in the drawing, three electrodes 25, 25a, and 25b surrounded by windings 26, 26a, and 26b, respectively. The drawing shows the supply lines, 17b, 17c of the cathode and its filament and that of the plate, 22a.

The basic plan of the electric supply is represented in Fig. 4. The part 27 feeds an initial branch with low voltage alternating current: this consists of a rectifier 28 (e.g., a Kenotron) whose rectified current is modulated at a frequency variable between 30 and 120 pulses per minute by means of a resistance 29, the control apparatus lor which will be described with reference to Figs. 7 and 8. The current so modulated is passed through the electromagnets 13 and *23* in such a manner as to generate, normal to the cathodes 11 and 17, a modulated field of 10,000 to 20,000 gauss.

The part 27 also feeds a variometer (interrupter) 30 which modulates the current of this part at a variable frequency 30 to 120 pulses per minute, the current pulsed in this way serving to feed the

remainder of the installation, to wit: The magnetron 7; a converter 31 whose excitation is modulated at a variable frequency *300 to 900 Hz,* yielding a doubly modulated current (first at 30-120 pulses per minute, then at 300-900 Hz) which feeds the coils 15, 16 and 26; another converter 32 producing a low voltage direct current modulated at 30-120 pulses per minute by the variometer 30. This current feeds the motor 21 as well as the motors driving the variometer 30 and the apparatus controlling the resistance 29.

The current produced by the converter 32 also feeds a voltage step-up apparatus 33 consisting of a vibrator followed by a transformer and a rectifier, and producing a direct current varied at 30 to 120 pulses per minute imposed by the variometer 30. The maximum value of the voltage produced by the apparatus 33 is, for instance, 300,000 V, but this value may vary up or down, depending on the power one wishes to operate with.

The current produced by the voltage step-up apparatus 33 feeds the coils 4b of the cyclotron and 24 of tube 9, as well as a rheostat 34 permitting regulation of voltage to the desired value between 5000 V and 70,000 V. This voltage is applied to an oscillatory circuit 35 which produces oscillations at a frequency variable at will of wavelength between 1 m and 18 m. The current available to the output terminals 35a, 35b of this oscillating circuit 35 is thus a high tension current modulated first at 30 to 120 pulses per minute (by the variometer 30) and secondly at a wavelength 1-18 m. This current feeds the coils 4c and 14; the electrodes, 25a and 25b are connected to terminals 35a and 35b, respectively, and electrode 25 is connected to the mid-point 35c.

Cathodes 11 and 17, the "dees" of the cyclotron, and the plates 10 and 22, not shown in the diagram of Fig. 4, are connected to the output of the step-up assembly 33, while the heating current for the filaments 11e and 17a is furnished by the resistance 29.

To operate the apparatus, one adjusts the controls of the resistance 29 and the variometer to the desired rhythm; in medical applications, this is advantageously the subject's cardiac rhythm: This rhythm is thus imposed upon the whole installation. The cathode 13 emits toward the left a stream of positively charged particles 2, which are concentrated by the electromagnet 13 and accelerated by the coils 14, 15 and 16 and by the cyclotron 4. Superimposed on this particle stream in the duct 8 is the electromagnetic radiation from the magnetron 7, which is adjusted to the wavelength found by experience to be most appropriate to the cells which are to be penetrated, e.g., 14 cm for the liver and 19.5 cm for the spleen. The resulting radiation is deflected, directed and accelerated

in tube 9 and is directed by way of the base of this tube toward the target to be penetrated.

It must be noticed that the magnetic field of the coils 15,16 and 26 is modulated, by means of the converter assembly 31, at a frequency adjustable *between 300 and 900 Hz.* This modulation has the effect of concentrating the particles, that is to say to detach them from the walls of the tubes, and it also permits an appreciable saving in weight of the iron cores of the coils. One chooses the highest frequencies (i.e., around 900 Hz) when one wishes to produce hard radiation at the exit of tube 9, and the lower frequencies for soft radiation.

The unidirectional magnetic fields of the coils 4c of the magnetron (sic) (cyclotron?) and the accelerator coils 14 as well as the electric field of electrodes 25, 25a, 25b, are modulated by the oscillatory circuit 35 at a chosen wavelength between 1 m and 18 m. In medical applications notably one selects the wavelength that best suits the organ to be treated or its surroundings, such as muscle. As already indicated, experience with diathermy makes it possible to determine the most suitable wavelength.

It must be noted that the resulting radiation already possesses, in tube 8 (Fig. 1) a considerable penetrating force. One could therefore use the assemblage described by omitting tube 9 and terminating the cavity at the end of tube 8 by means of a glass or quartz base, the resulting radiation being accelerated and directed, for example, immediately upstream from the base, by a final coil (not shown) surrounding tube 8. However, tube 9 appreciably improves the results.

Figs. 5 and 6 represent another mode of realizing the assemblage in accordance with the invention, in which the elements playing the same role are indicated by the same signs as in Figs. 1 and 3, modified by primes.

The arrangement of the connecting ducts of Fig. 5 in relation to tubes 1' and 9', to the magnetron 7' and the cyclotron 4', is different from that of Fig. 1 and has been used successfully by the applicant. The waveguide 6' of the magnetron 7' opens into the end of tube 1' and the duct 3', carrying the resulting radiation, divides into two branches: Branch 36, which conducts the radiation directly to tube 9', and branch 37 which conducts it to the cyclotron 4'. This blocks the electromagnetic radiation and accelerates the stream of particles which is passed by way of duct 38 to the tube 9'.

This arrangement can be used with a particle emitter and an accelerator and director tube similar to tubes 1 and 9 of the preceding figures. However, tubes 1' and 9' of Figs. 5 and 6 are constructed in a different manner with regard to their cathodes and anodes.

Tube 1' contains a first electrode 11' exactly like that of the cathode 11 of tube 1, and an identical second electrode 39 furnished with a filament 39a. Tube 9' (Fig. 6) contains in its lower part a first electrode 17' with filament 17'a and an identical second electrode 40 with its filament 40a.

In normal operation, i.e., to produce radiation identical to that described in connection with Figs. 1 to 4, electrode 11' serves as cathode and electrode 39, given a positive potential, plays the role of the plate 10 in Fig. 1, the filament 39a being unheated. Electrode 40 and its filament 40a are disconnected; cathode 17' and plate 22' are supplied as in Fig. 3.

To obtain particularly penetrating radiation, the polarities are reversed: Electrode 11' becomes an anode and its filament 11'e is disconnected, while electrode 39 receives the cathode supply and its filament 39a is heated; electrode 17' (with filament 17'a disconnected) and electrode 22' become anodes, while electrode 40 serves as cathode and its filament 40a is heated. For example, one can establish a potential difference of 250,000 V between 40 and 17', and 50,000 V between 40 and 22'. It is understood that in these conditions the cathode 39 emits to the left a stream of electrons which is concentrated, modulated and accelerated by the various coils and in the cyclotron, the polarities of which must of course be established in the proper direction. This stream of electrons is combined with the centimeter radiation emitted by the magnetron 7', resulting in tube 9' in the emission of very hard x-rays, modulated at the chosen frequencies, combined with the centimeter radiation of the desired frequency.

The assembly shown in Figs. 5 and 6 thus permits one to obtain at will either very hard x-rays or the radiation described in connection with the preceding diagrams.

The following description, referring to Figs. 7 and 9, relates to certain details of the apparatus used for modulating the electric current.

Fig. 7 represents schematically the apparatus for control of the resistance 29 and the variometer 30. The variable resistance 29 consists of a graphite helix 29a immersed in a conducting liquid **29b;** another electrode 29c, also of graphite, partly immersed in the liquid, is set into up-and-down oscillations by a connecting rod 41a linked to a fly-wheel 41. The fly-wheel is set in rotation, through the intermediary of a worm transmission 41b, by an axle 42 which can be driven, thanks to a double clutch 42a, 42b, either by a motor 43, or by the shaft 30a of the variometer 30. The variometer 30 is driven by a motor 44 by way of the worm transmission 44a.

If the fly-wheel 41 is driven by the motor 43 at the proper speed,

the resistance 29 causes the supply current of the electromagnets 13 and 23 (Figs. 1 and 4) to vary at the chosen rhythm which as we have seen can be between 30 and 120 pulsations per minute and which can be checked by means of a rotation counter shown schematically in 45. In this case, the motor 44 of the variometer 30 can be stopped and the remainder of the installation is then not pulsed. If, on the contrary, the fly-wheel 41 is engaged in 42b and disconnected from 42a, the motor 44 activates the variometer 30 and the resistance 29 at the chosen rhythm.

The speed of rotation of motors 43 or 44 can be regulated at the required speed, corresponding visibly to the cardiac rhythm of the subject, by acting upon the excitation of these motors by means of a manually adjustable rheostat. If one prefers to regulate the speed of motors 43 or 44 in direct accord with the cardiac rhythm of the subject, one can use an assembly such as that represented schematically in Fig. 8: At 46 there is a contact microphone which, when placed over the subject's heart, produces impulses. These are amplified in the circuit shown and applied to an electromagnet at 47 with a moving core which activates a rheostat; this in turn regulates the current running the motors 43 or 44.

Fig. 9 shows schematically the principle of the oscillating circuit 35. The rectified potential, adjustable between 5000 V and 70,000 V by means of rheostat 34 (Fig. 4) is applied between the terminals 48 and 48a. Terminal 35c (which is also connected to electrode 25, Figs. 2 and 4) is connected to the neutral point on the high tension side of **the** transformer which is a component of the step-up assembly 33 (Fig. 4). The terminals 49 and 49a receive the heating current produced by the resistance 29. The variable condensers 50 and 50a make it possible to regulate to the desired wavelength (which, as seen, is between 1 m and 18 m) the current available at the output terminals 25a and 25b of the oscillator shown.

The modes of implementation described gave been successfully carried out but it is self-evident that these are only examples, and that they might be modified, notably by substitution of equivalent techniques, without going beyond the bounds of the invention. In particular, the electron gun 1 or 1' could be replaced by another charged particle generator.

Resume

The invention includes especially:

> A procedure for obtaining a combination of radiations of different kinds capable of penetrating matter, especially of

intimately penetrating living tissues in order to produce in them certain effects and more particularly in human tissues with a therapeutic effect in mind, consisting of the emission in a cavity of a stream of electrically charged particles, upon which is imposed electromagnetic radiation in the centimeter wavelength range, and the guiding of the resulting radiation emerging from the cavity toward the target to be penetrated.

2. Types of implementation exhibiting the following features taken separately or in the various possible combinations:

   a. The centimeter radiation has a wavelength between 3 cm and 80 cm;

   b. This wavelength is set at the value found by experience to be most suitable for the tissues to be penetrated, e.g., 14 cm for liver and 19.5 cm for spleen;

   c. The particle stream is accelerated by magnetic and electric fields such as those which are used in particle accelerators;

   d. The resulting radiation is accelerated and guided, before its emergence from the cavity, by means of electric and magnetic fields;

   e. The resulting radiation is guided, before its emergence from the cavity, by means of deflecting and/or reflecting surfaces;

   f. The stream of particles and/or the resulting radiation are concentrated and accelerated by means of individual magnetic fields modulated at a frequency between 300 and 900 Hz, the highest frequencies being used to produce hard rays and the lower frequencies to produce soft rays;

   g. The emission of the particle stream, as well as the acceleration and concentration of the radiation result ing at its exit from the cavity, are aided by individual magnetic fields of temporally variable intensity, advantageously pulsed at a rhythm between 30 and 120 pulsations per minute and preferably at the cardiac rhythm of the subject;

h. The assemblages for production of the resultant radiation are pulsed in their entirety at the same rhythm as the magnetic fields according to g;

i. The stream of particles and/or the resulting radiation are accelerated and concentrated by direct magnetic and/or electric fields modulated at a wavelength between 1 m and 50 m and preferably between 1 m and 18 m, this wavelength being advantageously chosen as that which is known in diathermy as suitable for the tissues to be penetrated or for the surrounding tissues.

3. An assemblage making it possible to obtain a combination of a stream of electrically charged particles and a beam of centimeter electromagnetic waves in order to penetrate intimately and to irradiate living tissues and particularly human tissues, the said assemblage comprising at least a particle emitter, means for channeling said particles in a cavity serving as waveguide for an emitter of electromagnetic radiation of which the wavelength is included in the range of centimeter waves and preferably adjustable from 3 cm to 80 cm, means for generating in the cavity magnetic field for acceleration and concentration and means for concentrating and accelerating the resulting radiation at the exit of the cavity.

4. Modes of implementation with the following details taken separately or in the various possible combinations:

a. The particle emitter is an electron gun of which the anode is at the end of the cavity and the cathode is situated further along, this cathode being hollow and placed in the magnetic field of an electromagnetic in order to ensure emission of a stream of particles towards the mouth of the cavity;

b. The cathode consists of a rim connected by two aligned spokes to a hub, the said rim being provided internally with an annular housing containing a heated filament and the said housing communicating with a number of holes arranged annularly and traversing the rim transversely;

c. The cathode is made of a metal of valency close to the

mean valency of the chemical molecules comprising the tissue to be penetrated;

d. The cathode is of tungsten or preferably of molybdenum;

e. The cavity contains a rare gas, preferably argon, under a vacuum of the order of 2 mm Hg;

f. The cavity contains a duct carrying at least part of the stream of particles to a cyclotron and a duct bringing back into the cavity the particles accelerated in the cyclotron;

g. The cavity passes through several coils, the supply current for the various coils being capable of undergoing modulation at different frequencies;

h. The downstream end of the cavity is composed of a tube containing, in the part from which the resulting radiation must emerge, a cathode and an electromagnet which may be identical to the cathode and the electromagnetic according to para. a, an anode near the other end, and a rotary deflector consisting of a number of plates arranged *en couronne* on a rotor lacing the incident radiation at such an angle that the radiation deflected and/or reflected is directed toward the cathode, several coils whose supply current can be modulated being distributed over the length of the tube;

i. This tube also contains electrodes supplied by alternating current generating an electric field at the level of the rotary deflector, each of the said electrodes being surrounded by a bobbin of which the supply current can be modulated;

j. Methods are anticipated for modulating, at an adjustable rhythm between 30 and 120 cycles per minute, the supply current of the electromagnetic according to a and h, and preferably to modulate the supply current of the rest of the assemblage at the same rhythm;

k. Methods are anticipated for modulating, at a frequency between 300 and 900 Hz, the supply current of the bobbins surrounding according to i and one or several

coils according to g;

l. Methods are anticipated for modulating, at an adjustable wavelength between 1 m and 50 m and preferably between 1 m and 18 m, the supply current of the electrodes according to i, of one or several of the coils generating the magnetic field of the cyclotron;

m. The electrodes of the electron gun consist of two electrodes identical to the cathode according to a, b, c, or d, the cathode of the tube according to h is replaced by a double electrode reproducing the arrangement of the electrodes of the electron gun, and methods are anticipated for reversing at will and simultaneously the polarities of these two pairs of electrodes and the direction of flow of the current supplying the acceleratory coils, a first pattern of polarities assuring the functioning of the apparatus in the conditions which are laid down according to a, and a second pattern of polarities assuring emission in the cavity of a stream of electrons combined with the centimeter radiation and giving rise, at the exit of the said tube, to emission of very hard x-rays.

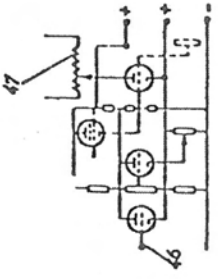

Fig. 18

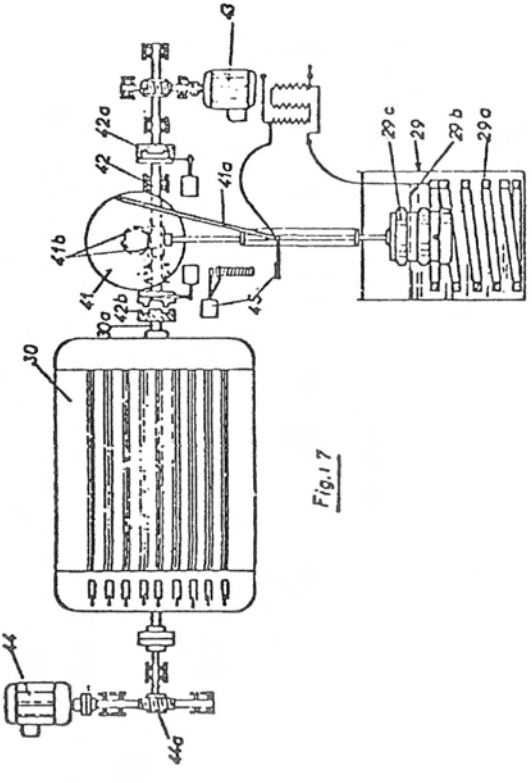

Fig. 17

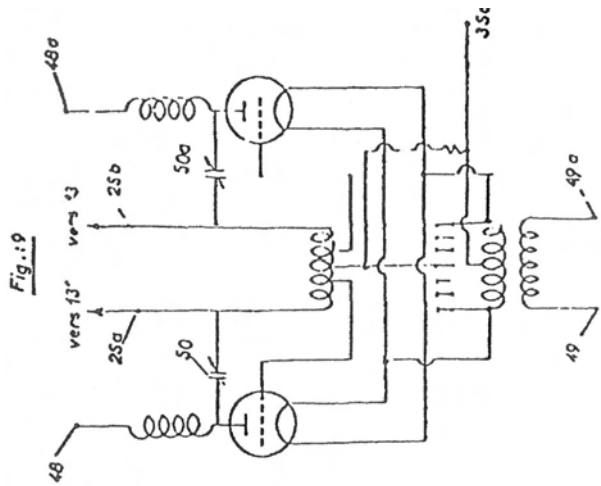
48a
50a
25b
vers 13
vers 13'
25a
50
48
35c
49a
49

Fig.:9

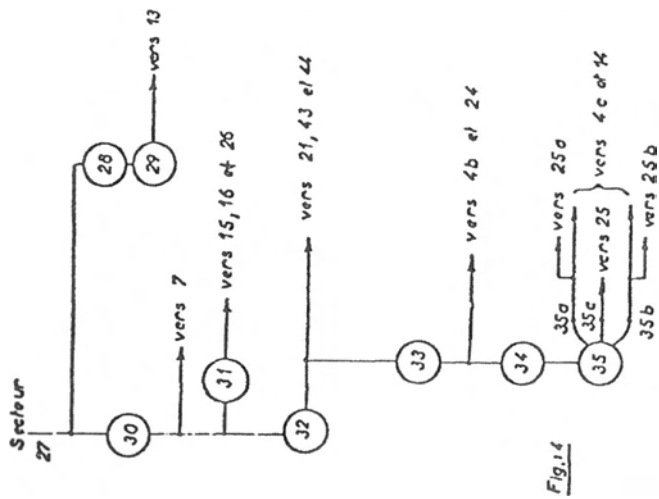
Secteur
27
30
28
29
vers 13
vers 7
31
vers 15, 16 et 26
32
vers 21, 43 et 44
33
vers 4b et 24
34
35a
vers 25a
35c
vers 25
vers 4c et 14
35
35b
vers 25b

Fig.:4

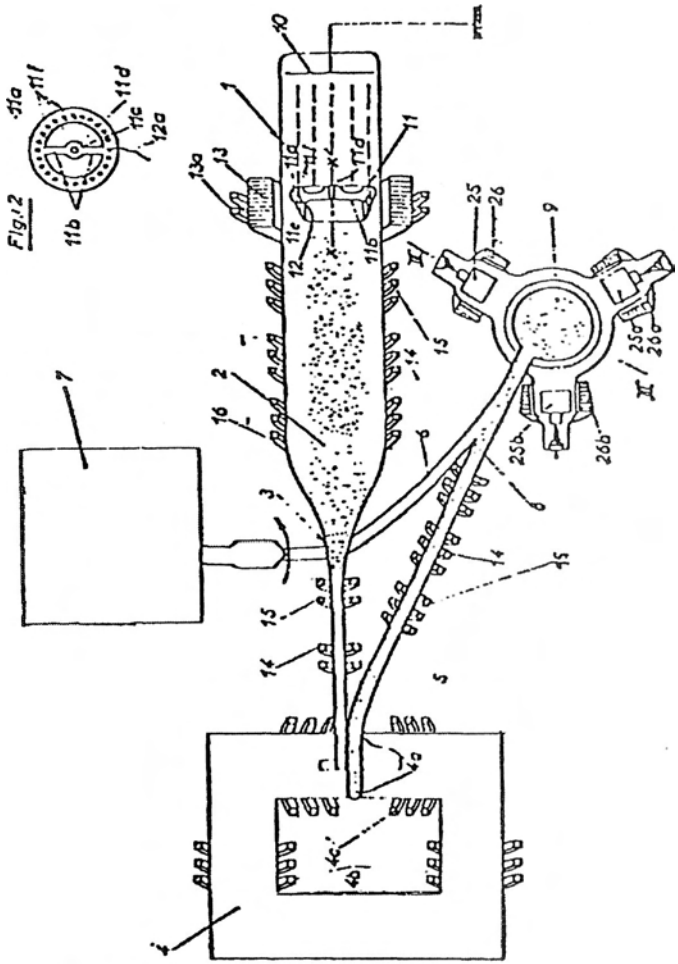
Fig.1
Fig.2

Fig. 3

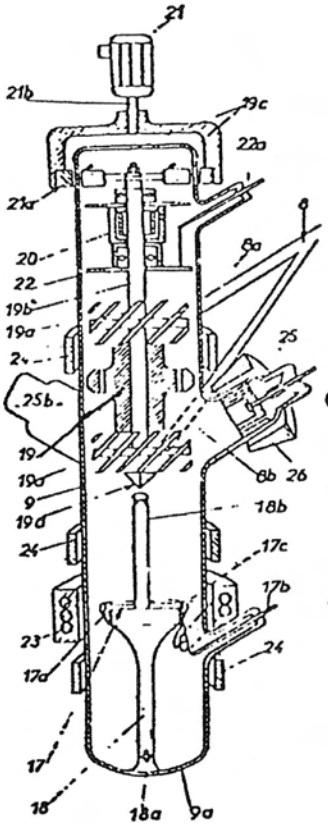
21
21b
19c
22a
21a
8
8a
20
22
19b
19a
25
25b
19
19a
9
19d
8b
26
18b
24
17c
17b
23
17a
24
17
18
18a
9a

Fig. 6

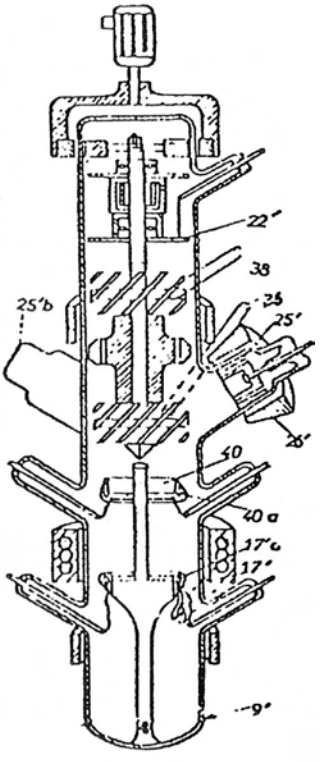
22'
38
25'b
25
25'
26'
40
40a
17'a
17'
9'

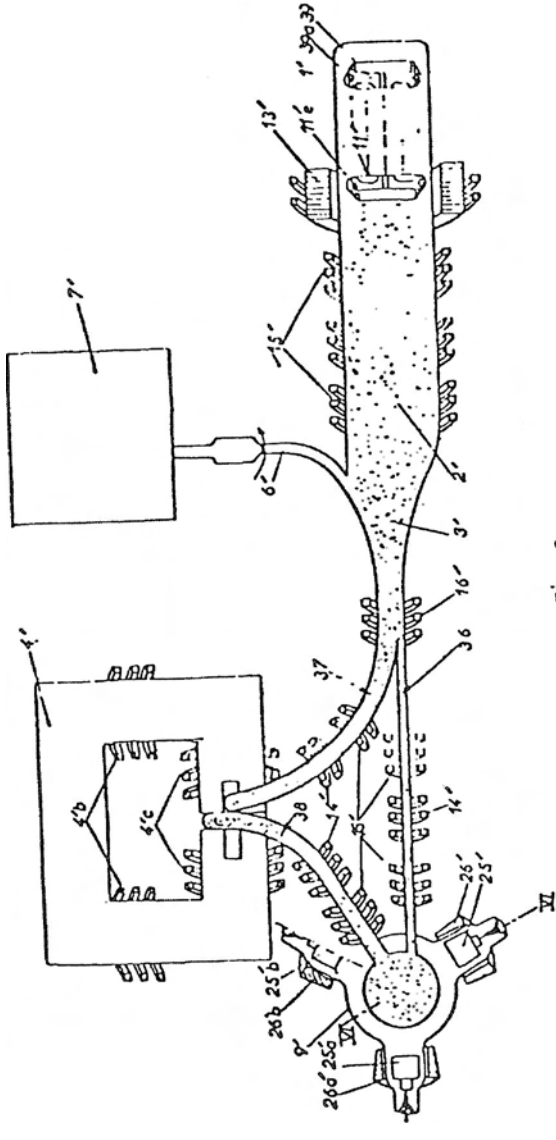

Fig. 5

Two Patents of G. Lakhousky

June 12,1934 G. LAKHOVSKY 1,962,565

APPARATUS WITH CIRCUITS OSCILLATING UNDER MULTIPLE WAVE LENGTHS

Filed Nov. 13, 1931

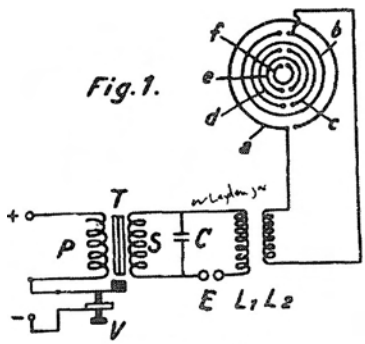

Fig. 2.

Fig. 3.

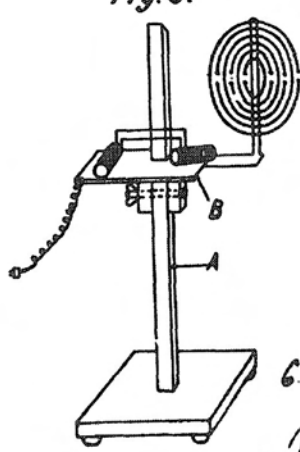

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Attys.

Patented June 12, 1934 1,962,565

UNITED STATES PATENT OFFICE

1,962,565

APPARATUS WITH CIRCUITS OSCILLATING UNDER MULTIPLE WAVE LENGTHS

Georges Lakhovsky, Paris, France

Application November 13, 1931, Serial No. 574,907
In France May 2, 1931

7 Claims. (Cl. 250—33)

The present invention has for its object an apparatus capable of sending out simultaneously different wave lengths so that among these waves or their harmonics there is found almost always one or several capable of producing the best effect sought for any application whatever.

There is used for that purpose the property of open circuits having a fundamental or natural self induction and capacity to oscillate upon a well determined wave length if they are excited by electric impulses emanating from discharges of any source.

The radiating part of the system, producing waves of various lengths, is therefore constituted by a certain number of concentric open rings of different diameters, which are maintained insulated by any appropriate process. These rings may or may not be terminated by small spheres forming capacities.

These rings may be arranged either in the same plane or in different planes so as to form any surfaces, such as portions of cones, spheres, paraboloids, ellipsoids, etc. . . . , these surfaces being of a nature to concentrate the waves in a determined direction in the manner of a reflector, for example.

These rings may be fed by any producing device whatever of high frequency, for example, a combination comprising a trembler coil (or any other transformer) and a high frequency circuit provided with a self-induction coil and a capacity.

One or several points of this high frequency circuit is or are connected to the end of one or several of the rings forming the radiating apparatus. The other rings not connected are excited by induction.

The complete apparatus (coil, high frequency circuits, rings, etc. . . .), may be mounted in a box or upon a small board capable of sliding along a guide or rocking so as to be able to be placed in the most convenient position.

In the accompanying drawing, by way of example, not limitative, there is shown:

Fig. 1 a diagram of the system.

Fig. 2 the position of the rings in the form of a cone.

Fig. 3 the apparatus mounted upon a foot or base.

In Fig. 1 there is seen at T the transformer or coil (P the primary, S the secondary of this coil), V, the screw of the trembler, C the condenser the discharge of which across the spark gap E produces oscillations in the self-induction coil L^1, which in its turn acts by induction upon the self-induction coil L^2; this self-induction coil L^2 is connected on one side to the first exterior ring *a*, on the other side to the following ring *b*. It thus forms an electrostatic field of high frequency which induces oscillations in the other rings *c*, *d*, *e*, *f*.

As a modification, L^2 may be suppressed and the rings *a* and *b* may be connected each to one of the ends of L^1.

One of the ends, or even any point of the self-induction coils L^1 or L^2 may likewise be connected to any one of the rings.

Fig. 2 shows the arrangement of the rings in the form of a cone.

The open circuits *a*, *b*, *c*, . . . *f* can be constituted by solid conductors. They can also be tubular circuits, this being advantageous, since, for the same bulk, the radiating surface is larger. Finally, the area of the cross section of each of these various circuits can vary from one circuit to the other; for instance, this area can decrease from the periphery (ring *a*) to the center (ring *f*) of the radiating system.

Fig. 3 shows the apparatus mounted upon a foot A along which it can slide, in order to be placed at any desired height and upon a hinge B which allows it to be oriented upon the horizon.

I claim:—

1. An apparatus adapted to produce electric fields of high frequency having multiple wave lengths, comprising a high frequency producing device, a series of high frequency radiating circuits constituted by concentric insulated split rings of different diameters, the split ends being spaced from each other and terminating with small spheres.

2. An apparatus adapted to produce electric fields of high frequency having multiple wave lengths, comprising a high frequency producing device, a series of high frequency radiating circuits constituted by concentric insulated split rings of different diameters and terminated by small spheres forming capacities.

3. An apparatus adapted to produce electric fields of high frequency having multiple wave lengths, comprising a high frequency producing device, a series of high frequency radiating circuits constituted by concentric insulated split rings of different diameters and arranged in one and the same plane the split ends being spaced from each other and terminating with small spheres, in staggered position as regards adjacent rings.

4. An apparatus of the type described comprising a base, a plate slidably mounted on said

base, a support pivoted to the said plate, a series of open and insulated, high frequency radiating circuits mounted on the pivoted support, and a high frequency producing device for the excitation of the said circuits.

5. An apparatus adapted to produce electric fields of high frequency having multiple wave lengths, comprising a high frequency producing device, a series of high frequency radiating circuits, said circuits being open, insulated, and having dimensions different from each other.

6. An apparatus adapted to produce electric fields of high frequency having multiple wave lengths, comprising a high frequency producing device, a series of high frequency radiating circuits arranged in the same plane, said circuits being open, insulated, and having dimensions different from each other.

7. An apparatus of the type described comprising a transformer, a high frequency energising circuit fed by the said transformer and provided with a self-induction coil and a capacity, a series of open and insulated high-frequency radiating circuits having dimensions different from each other, an inductive connection between two of these radiating circuits and respectively each of the poles of the outgoing element of the high frequency energising circuit.

GEORGES LAKHOVSKY.

Patented June 13, 1944 2,351,055

UNITED STATES PATENT OFFICE

2,351,055

TUBE FOR PRODUCING MULTIPLE WAVE LENGTHS

George Lakhovsky, New York, N. Y.; Anne-Marie Louise Lakhovsky, administratrix of said George Lakhovsky, deceased, assignor to Henry S. Blum, Chicago, Ill.

Application November 21, 1941, Serial No. 420,006

11 Claims. (Cl. 250—33)

This invention relates generally to electric devices excited by electric impulses and more particularly to multiple wave length conducting and/or producing means. This invention has for its primary object the provision of such means disposed within a vacuum tube or a tube containing rare gas or gases.

My work over a period of more than 20 years has led me to the belief that there is great need for means conducting and/or producing multiple wave lengths which may be employed in many industrial and medical fields. Suitable apparatus for producing waves of various lengths is disclosed in my U. S. Letters Patent No. 1,962,565, dated June 12, 1934. Embodiments of this apparatus have been in use the world over. Because of the need for simplification in such apparatus so that it may be handy and easily used by persons lacking skill in electrical matters, I have concluded that by providing one unit which incorporates oscillation generating means and another in which the wave lengths are produced, the apparatus may be more universally used in the treatment of cellular life in therapy, in the aging or treating of liquids and in other industrial fields.

The present invention deals with those units, preferably combined with one another and constructed as a portable device and as stated above, has for its major object the provision of a unitary multiple wave length producing and/or conducting device in the form of a vacuum tube.

The present invention further contemplates the incorporation in such a tube, of means for varying the effect of wave lengths, or selectively employing the means therefor enclosed in or forming part of said tube.

This invention further seeks to provide a tube of the indicated type incorporating means for generating oscillations.

Another object of the invention is to provide a single unit which contains an oscillation generator, which produces waves of definite frequency, and further inductance means each permitting emanation of wave lengths of various values.

The structural features of my invention also form a material part of this disclosure, the objects and advantages being attained in structures such as shown in the accompanying drawing, which exemplifies the invention. The following specification, based on said drawing, more clearly points out the purposes and advantages of my invention.

In the drawing:

Fig. 1 is a vertical, partial sectional, partial elevational view of a tube incorporating features of my invention.

Fig. 2 is a similar view of an alternate form thereof.

Fig. 3 illustrates in a similar manner a modified form of my invention.

Fig. 4 is a fragmentary sectional view of a modification made in accordance with the invention.

Fig. 5 is a similar view of another modification.

Figs. 6 and 7 are sectional views illustrating types of wires used in either of the forms of my invention as shown in Figs. 1, 2 and 3.

Fig. 8 is a partial sectional, partial elevational view illustrating a tube incorporating a plurality of grids and selective capacity means for varying the effects of said grids.

Fig. 9 is a similar view of a tube, such as shown in Figs. 1 or 2 and incorporating oscillating or vibrating means.

In that form of my invention shown in Fig. 1, there is provided a sealed preferably transparent envelope 10 made of glass or like material affixed in the usual manner to a screw or Edison plug 11. The latter is conventionally provided with a shell terminal 12 and a central terminal 13. The support or seal 14 of the tube serves to hold wires such as 15 and 16 which connect to the terminals 12 and 13.

Connected to the wires 15 and 16 is a primary inductance member in the form of a loose coil 17 which may be disposed axially of the envelope 10, as shown. The upper end of said member 17 forms a tight wound coil 18 which serves to radiate the strongest induced wave lengths.

Surrounding the primary inductance member 17, there are arranged a plurality of separate coils of wire each being of different length and capacity. Thus, I provide a coil 19 having greatest capacity and successive coils 20, 21, 22, 23, 24, and 25, each having less capacity than the preceding coil. These coils 19 to 25 form secondary inductance means each permitting emanation of a wave length of different magnitude and value than the other.

I may support the secondary coils in several ways. As shown, I prefer to provide a dielectric member such as a glass sleeve 26 surrounding the primary inductance wire member 17 and to mount the secondary coils 19 to 25 on the outer surface of said sleeve, leaving the coil 18 exposed at the top thereof. In order to effectively support and centralize the glass sleeve 26, I provide spacing washers 27 and 28 of mica or the like, top and bottom, and provide a supporting cross-piece 29 on the lower portion of the wire 17.

June 13, 1944. G. LAKHOVSKY 2,351,055

TUBE FOR PRODUCING MULTIPLE WAVE LENGTHS

Filed Nov. 21, 1941

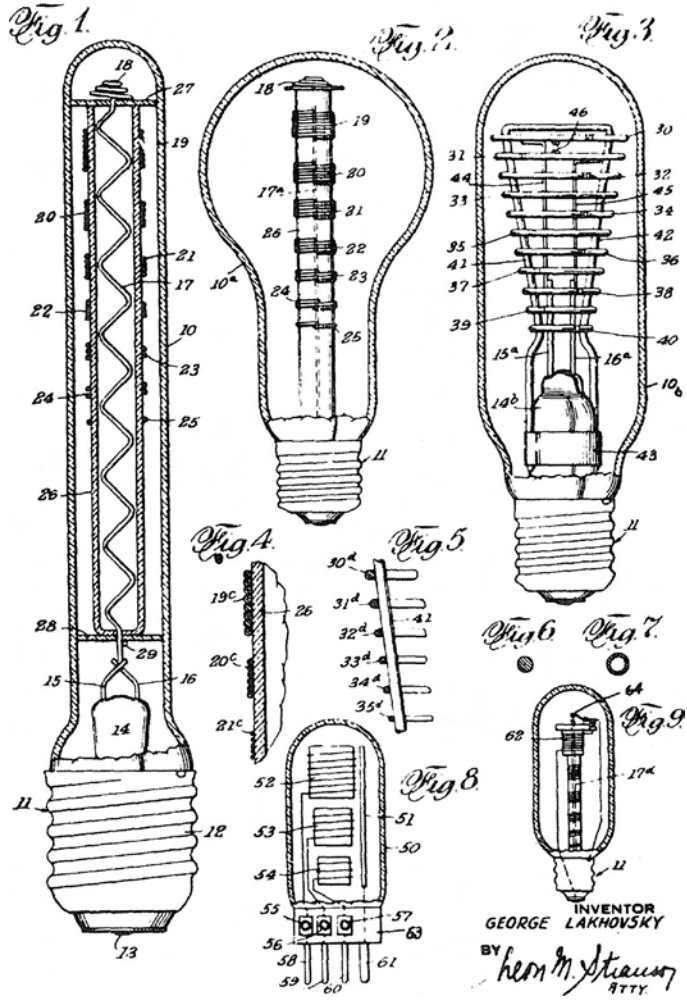

The tube above described may be employed as indicated for the treatment of cellular structures by connecting it to any one of the rings in the electrostatic field of high frequency, such as shown in said U. S. Letters Patent No. 1,962,765, each of the coils 13 to 25 producing by induction a different wave length, as can be understood.

In the form of my invention shown in Fig. 2, the envelope **10a** is somewhat differently shaped, and the wire **17a** straight instead of arranged as an open coil. In other respects, the structure follows that described with reference to Fig. 1.

As shown in Fig. 3, there may be arranged a plurality of open rings **30**, **31**, **32**, **33**, **34**, **35**, **36**, **37**, **38**, **39**, and **40** in frustro-conical form, for instance, with the largest of said rings at the top and the smallest one adjacent the bottom. I have shown said rings as supported, for instance, by glass posts **41** and **42**, said posts being supported on the seal **14b**, as by a band **43**. I provide extensions for the terminal wires **15a** and **16a** and connect said extensions **44** and **45** to the upper ring **30** and the next lower ring **31**, respectively.

The rings **30** and **31** may become the primary inductance members, whereas the remaining rings constitute the secondary inductance members as before set forth. Electric current conducted to the suitably spaced rings **30**, **31** will cause a spark **46** to be drawn between the rings **30** and **31** providing oscillations emanating from electrical discharges therebetween and causing the radiation of waves of various lengths within the envelope **10b** and affecting the remaining rings.

In Figs. 1 and 2, I have shown the secondary coils as formed of wires having uniform cross-section. Fig. 4 illustrates how such wires may be made progressively smaller in the succeeding coils **19c**, **20c**, and **21c**, etc. Similarly, I have shown the rings of Fig. 3 made progressively smaller in Fig. 5, said rings being designated by numerals **30d**, **31d**, **32d**, **33d**, **34d** and **35d**, etc. In such various manners, the wave length producing effect of the secondary coils or rings may be arrived at.

The secondary coils or rings may be round or somewhat flattened wire as shown in Fig. 6 or tubular as in Fig. 7, offering a yet greater flexibility of design.

The devices of Figs. 1 and 2 above described may be incorporated in the system shown in said U. S. Letters Patent by connecting one of the rings *a*, *b*, *c*, *d*, *e*, or *f* with plug **11** of Fig. 1, since either terminal **15**, **16** is in contact with primary inductance member **17**. To this end a conductor (not shown) connects such a ring with said plug or socket.

In Fig. 8, I have shown a modification of the invention which comprises a vacuum tube **50** containing a plate **51** and a plurality of different wave lengths producing grids **52**, **53**, and **54**. I connect each grid with a variable capacity device, such as **55**, **56**, and **57** carried by said tube **50** and preferably by its base support **63**, whereby the grids may be selectively connected into an operating circuit (not shown) by means of the respective prongs **58**, **59**, and **60**, and the plate prong **61**. Heating or other exciting means may be incorporated in the tube in a well-known manner. This combination tube **50** is designed to replace a plurality of known tubes each operating with different and variable wave length effect, mere exterior manipulation at said base support brings about change of the capacities **55**, **56**, and **57** and cutting in one or more of the grids **52**, **53**, and **54**.

The effect of the spark as produced in the form of the invention depicted in Fig. 3 may be further utilized in Fig. 9 in which I also incorporate a vibrator **62** which produces electrical oscillations by a spark intermittently generated between the end of the primary inductance member **17d** and vibrator armature **64**. In other respects the structure follows that of Fig. 1.

It may be noted that any type of spark producing or oscillation generating means may be substituted for the vibrator shown. The tubes shown in Figs. 3 and 9 may be used in the manner described for Fig. 1 by connecting one terminal of the base as set forth to produce an induction effect. These tubes may be also connected across both terminals with a suitable potential to obtain the spark effect.

From the foregoing it may be seen that I have provided tubes in various forms for the purpose of generating and conducting multiple wave lengths. Other forms of the invention may be produced within the spirit and scope of the invention as claimed.

Having thus described my invention, what I claim as new and desire to be secured by Letters Patent, is:

1. A device of the character described comprising a vacuum tube having an envelope and base, primary inductance means, and a plurality of separate secondary inductance means of different length for radiating waves of various lengths extending above said primary inductance means, all said inductance means being arranged within said envelope.

2. A device of the character described comprising a vacuum tube having an envelope and base, a primary inductance member axially arranged in said envelope, and a plurality of secondary inductance members spaced apart and independent from each other each member surrounding a respective portion of said primary inductance member and within the field of influence thereof.

3. A device of the character described comprising a vacuum tube having an envelope and base, a primary inductance member axially arranged in said envelope, and a plurality of secondary inductance members each surrounding the primary inductance member and within the field of influence thereof, each of said secondary inductance members having a different wave length effect than the others.

4. A device of the character described comprising a vacuum tube having an envelope and base, a primary inductance member comprising a pair of split rings in inductive relation, and a plurality of secondary inductance members each comprising split rings.

5. A device of the character described comprising a vacuum tube having an envelope and base, a primary inductance member comprising a pair of split rings in inductive relation, and a plurality of secondary inductance members each comprising split rings, said latter rings being arranged in different planes and being of different length to produce a different wave length effect.

6. In a device of the character described, means for producing multiple wave lengths comprising a wire member, enclosing dielectric means for said member, and a plurality of separate wire coils of different lengths on said dielectric means and in the field of inductance of said wire member.

7. In a device of the character described,

means for producing multiple wave lengths comprising a wire member, enclosing dielectric means for said member, and a plurality of wire coils on said dielectric means and in the field of inductance of said wire member, each coil extending over said wire member and having a different number of convolutions than the others.

8. In a device of the character described, means for producing multiple wave lengths comprising two split rings in inductive relation, and a plurality of split rings in inductive relation to the two split rings.

9. In a device of the character described, means for producing multiple wave lengths comprising two split rings in inductive relation, and a plurality of split rings in inductive relation to the two split rings, the plurality of rings being of smaller diameter than the mentioned two rings and each progressively smaller than the others.

10. In a device of the character described means for producing multiple wave lengths comprising two split rings in inductive relation, and a plurality of split rings in inductive relation to the two split rings, the plurality of rings being of smaller diameter than the mentioned two rings and each progressively smaller than the others, all of the rings being arranged in frusto-conical disposition.

11. In a vacuum tube having a primary inductance member and secondary inductance members, a vibrator arranged in the field of influence of said primary inductance member and secondary inductance members, a vibrator arranged in the field of influence of said primary inductance member for affecting the induction of said secondary members.

GEORGE LAKHOVSKY.

T.H. Moray's Patent
Electrotherapeutic Apparatus
Feb. 1, 1949

Feb. 1, 1949. T. H. MORAY 2,460,707

ELECTROTHERAPEUTIC APPARATUS

Filed April 30, 1943 3 Sheets-Sheet 1

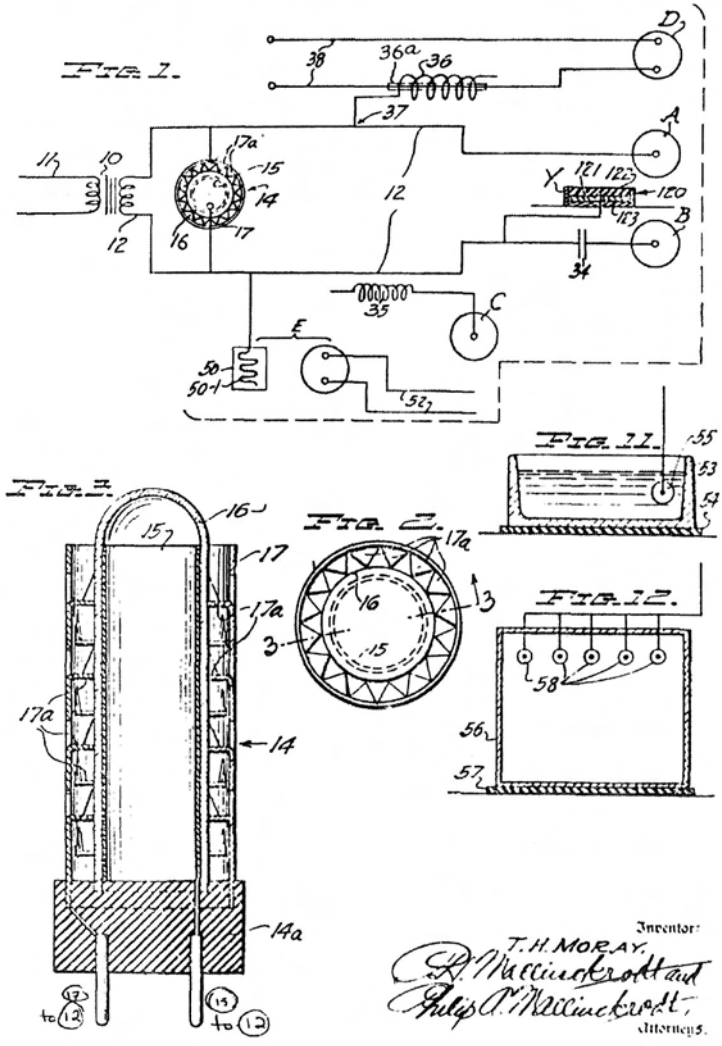

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Feb. 1, 1949. T. H. MORAY 2,460,707

ELECTROTHERAPEUTIC APPARATUS

Filed April 30, 1943 3 Sheets-Sheet 2

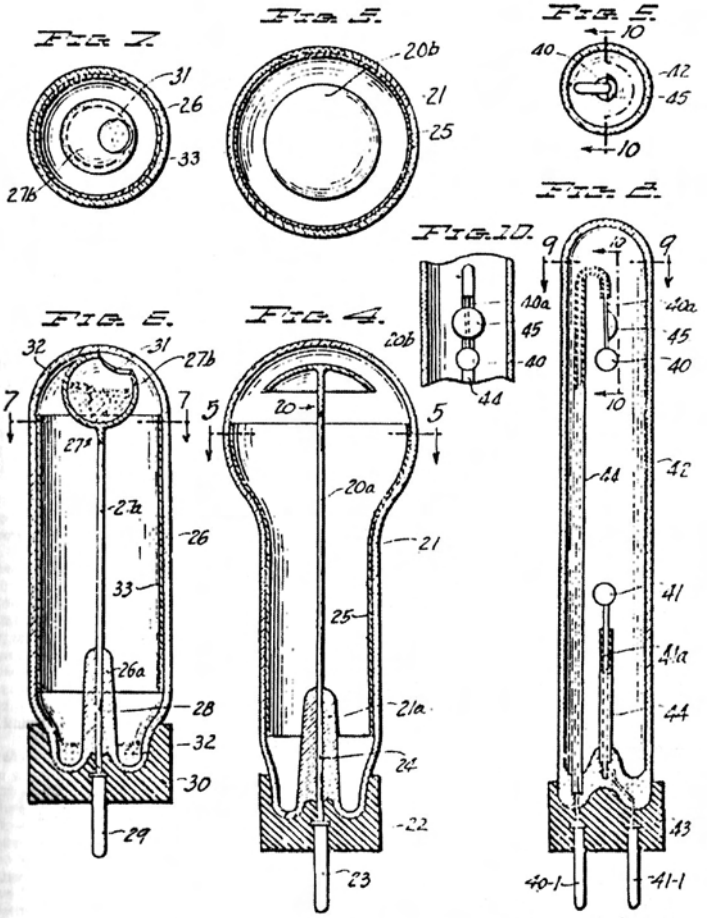

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Feb. 1, 1949. T. H. MORAY 2,460,707

ELECTROTHERAPEUTIC APPARATUS

Filed April 30, 1943 3 Sheets-Sheet 3

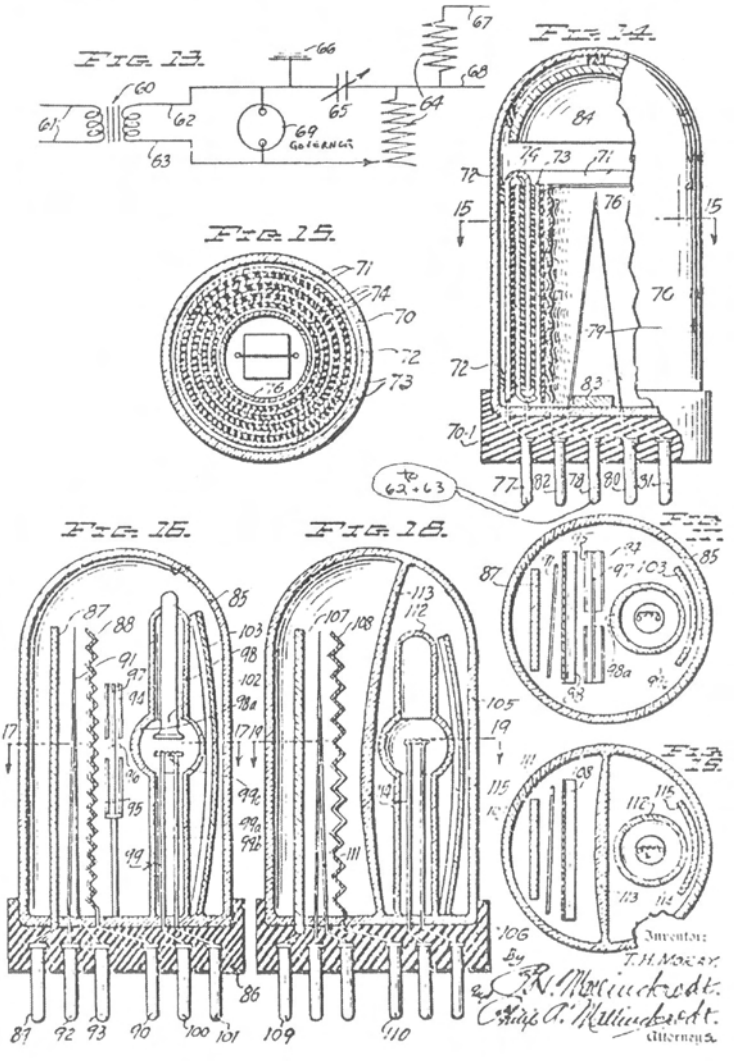

Patented Feb. 1, 1949 2,460,707

UNITED STATES PATENT OFFICE

2,460,707

ELECTROTHERAPEUTIC APPARATUS

Thomas H. Moray, Salt Lake City, Utah

Application April 30, 1943, Serial No. 485,112

8 Claims. (Cl. 128—421)

1

This invention relates to electrotherapeutic apparatus, and to methods of applying electrical, radioactive, and other radiant phenomena therapeutically.

The invention is primarily concerned with the use of high potential, high frequency electricity though not necessarily limited thereto, in conjunction with radioactive and other types of electronic and radiation phenomena, for therapeutic purposes.

Among the objects of the invention are the following:

First.—To render highly effective, from a therapeutic standpoint, radioactive and other types of electronic and radiation phenomena, and, likewise, to render highly effective, from a therapeutic standpoint, high potential, high frequency electricity.

Second.—To augment the therapeutic effect of radioactive and other types of electronic and radiation phenomena by the conjoint use of high potential, high frequency electricity, and, conversely, to augment the therapeutic effect of high frequency, high potential electricity by the conjoint use of radioactive and other types of electronic and radiation phenomena.

Third.—To accomplish the above without danger of burning or of otherwise harming the patient.

Fourth.—To provide apparatus for accomplishing the above, which is relatively simple in construction and operation and relatively inexpensive to produce and operate.

Fifth.—To provide novel electronic and radioactive devices especially adapted for use in conjunction with high potential, high frequency electrical therapy.

I have found that, by enveloping a patient in a high potential, high frequency electrical field in such a manner that no closed circuit is completed through his body, radioactive and other electronic and radiation phenomena can be used therapeutically with considerably greater effectiveness than if used alone. The exact reason for this is not known, nor is it known definitely which, the electric field or the radioactive phenomena, acts upon the other to produce the advantageous results. It is thought, however, that the electric field, permeating the body of the patient as it does, attracts the radioactive emanations or radiations and enables them to penetrate considerably deeper into the tissues and vital organs of the patient than would otherwise be the case. In any event, remarkable therapeutic results have been achieved by use of the invention in the treatment

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of malignant tumors, arthritis, sinus infections, and various other diseased conditions.

The invention contemplates the use, in therapeutics, of high potential, high frequency electricity to produce diversified forms of radiant energy, such forms being those which have been found best suited, individually, to benefit various human ailments. In accomplishing this purpose, several special discharge tubes have been developed to serve as treatment electrodes, by means of which correspondingly different curative results are obtained. Throughout the practice of the invention, a prime consideration is that only one terminal of any particular circuit shall be in contact with a patient's body at one time, so there will be no flow of current through a closed circuit of which the patient's body is a part. Such a terminal, too, is usually non-heat producing, so there is no danger of burning. In cases where there is a tendency for a tube to produce X-rays or other injurious rays, these are filtered out.

The present application constitutes a continuation in part of a copending application filed by me November 15, 1940, which bears Serial No. 365,798 and is entitled "Method of and device for the therapeutic application of electric currents and rays," and which has now become abandoned.

In the accompanying drawings, which illustrate several embodiments of apparatus preferred for carrying the method of the invention into practice:

Fig. 1 represents a wiring diagram of a preferred embodiment of apparatus for carrying out the method of the invention in general therapeutic work, several independent treatment stations being provided;

Fig. 2, a top plan view of the novel corona regulator of Fig. 1, employed in the circuit to control and adjust the current and as a governor to safeguard the transformer;

Fig. 3, a vertical section taken on the line 3—3, Fig. 2;

Fig. 4, a vertical section taken centrally through one novel type of discharge tube used as a treatment electrode in the apparatus of Fig. 1;

Fig. 5, a horizontal section taken on the line 5—5, Fig. 4;

Fig. 6, a vertical section taken centrally through another novel type of discharge tube used as a treatment electrode in the apparatus of Fig. 1;

Fig. 7, a horizontal section taken on the line 7—7, Fig. 6;

Fig. 8, a vertical section taken centrally through

a novel discharge tube used as a treating device in the apparatus of Fig. 1;

Fig. 9, a horizontal section taken on the line 9—9, Fig. 8;

Fig. 10, a fragmentary vertical section taken on the line 10—10, Figs. 8 and 9;

Fig. 11, a fragmentary view in vertical section, and drawn to a reduced scale, of a tub bath capable of use as a treatment station in the apparatus of Fig. 1;

Fig. 12, a view similar to that of Fig. 11, but showing a shower or vapor bath arrangement for the same purpose;

Fig. 13, a wiring diagram similar to that illustrated in Fig. 1, but fragmentary in nature, and of a somewhat different embodiment of apparatus;

Fig. 14, an elevation, partly in central vertical section, of a novel tube used in the apparatus of Fig. 13 in place of the corona regulator of Figs. 2 and 3;

Fig. 15, a top plan view, partly in horizontal section on the line 15—15, Fig. 14, of the tube of Fig. 14;

Fig. 16, a vertical section of another novel tube which may be used in place of the tube of Figs. 14 and 15;

Fig. 17, a vertical section taken on the line 17—17 of Fig. 16;

Fig. 18, a top plan view of still another novel tube which may be used in place of the tubes of Figs. 14 and 15 and of Figs. 16 and 17; and

Fig. 19, a vertical section taken on the line 19—19 of Fig. 18.

In accordance with the invention, provision is made for enveloping the patient in a high potential and, in certain instances, a high frequency electric field, and for applying to the patient, while so enveloped in the electric field, radiations and emanations having therapeutic value.

The apparatus of Fig. 1 is capable of administering various specific kinds of treatment, pursuant to the invention, at the several treatment stations provided. The treatment stations are indicated A, B, C, D, and E, respectively.

For supplying the high potential electric field, a suitable transformer is employed. This may be of any type capable of delivering high potential electricity, say from 10,000 to 30,000 volts. It is preferred, however, to utilize a conventional double magnetic circuit type of transformer, indicated at 10 in Fig. 1, having adjustable, laminated, magnetic shunts (not shown), the transformer being connected across an ordinary power line 11 charged with the customary 115 v. The output lines 12 from this transformer advantageously extend to the treatment stations A and B, respectively. The first secondary of the transformer 10 is preferably direct connected to the second secondary thereof. It is noted that this high potential electricity may be applied, without causing injury, direct to a patient who is not grounded. However, in order to safeguard the transformer 10 from damage by sparking across its output terminals, and to render the high potential electricity more suitable for therapeutic purposes, which is believed to include the automatic changing of the frequency to an extent which depends upon electrical characteristics of the patient's body, a governor or control device 14 is shunted across the leads 12.

This governor or control device 14 is a sparking condenser of high capacity embodying a multitude of spark gaps. A preferred embodiment of

this governor or control device 14 is illustrated in detail in Figs. 2 and 3.

As illustrated, the device comprises a cylindrical, electrically conductive plate 15 surrounded by a cylindrical dielectric 16. An outer cylindrical and electrically conductive element 17 surrounds the dielectric 16 exteriorly. It is provided with a multitude (for example, 250) of inwardly extending prongs 17a, which are advantageously formed by stamping out, and inturning, triangular portions of the electrically conductive element 17. The internal plate 15 preferably contacts the interior surface of the dielectric 16, but, in any event, should lie closely adjacent thereto. Likewise, the tips of the prongs 17a preferably contact the outer surface of the dielectric. The several elements are advantageously mounted in a plug-in base 14a, which is adapted to mate with a suitable receiving socket (not shown) carrying the required electrical connections. The internal plate 15 connects with one of the electric lines 12, while the other electric line 12, as shown diagrammatically in Fig. 1.

It is preferable that the dielectric 16 be in the form of a closed tube or envelope, as shown, and be exhausted to vacuum condition. The multitude of sparking prongs 17a product a brush discharge.

Where the dielectric 16 is not a closed tube or envelope, it is preferred that it be of quartz.

The treatment station A is a discharge tube of a novel type, exemplified by the tubes illustrated in detail in Figs. 4 and 5 and Figs. 6 and 7. Either tube is plugged into the circuit of Fig. 1 at a suitably provided, single-terminal outlet. High potential electricity is, therefore, fed directly into the tube, which serves as an electrode. The tube also embodies radioactive material, which supplies radioactive emanations to the patient simultaneously with the electrical discharge.

As illustrated in Figs. 4 and 5, the tube or electrode may comprise an electrically conductive discharge element 20, having a supporting stem 20a and a major discharge cap or head 20b, which is preferably in the form of a thin, convex-concave plate. The head 20b may be spot welded to the end of the stem 20a.

The discharge element 20 is enclosed within a tube 21 of dielectric material, preferably glass, the stem 20a being fixed in the fused tongue portion 21a of the tube. The tube or shell 21 is fitted into an insulating base 22, provided with a single plug-in terminal 23, and an electrical connector 24 extends from the terminal 23 to the stem 20a.

The inside surfaces of the side walls of the tube or shell 21 are coated with a radioactive material, as at 25. The coating is conveniently made from uranium salts or powdered carnotite or other radioactive ore. The ends of the tube or shell are left uncoated.

Air is evacuated from the tube 21, and a small quantity of mercury introduced. The mercury is preferably triple-distilled to insure great purity. It is preferred that argon or like inert gas be also introduced.

Since the tube just described is plugged into the circuit of Fig. 1, the discharge element or cathode 20 is charged with high potential electricity, and, in its capacity of a treatment station in the apparatus of Fig. 1, serves as an electrode to similarly charge the patient. The patient is insulated from the ground, and the tube is applied directly to the afflicted part of his body, preferably in close contact with the body.

Because of the construction of the tube, radiation of a radioactive nature is also directed against the patient through the uncoated top end of the tube. This radiation has been found to differ somewhat from the radioactive emanations discharging from the side walls of the tube, and is thought to comprise rays lying close to X-rays on the radiation spectrum. These rays appear to have a definite healing value, and to lack the injurious nature of X-rays. Where a predominantly radioactive emanation treatment is desired, the side walls of the tube are placed against the body of the patient.

Best results are obtained when the discharge element or cathode 20 is made of an alloy metal compounded from copper, lead, sulphur, and, if desired, aluminum. The relative percentages of the several ingredients may vary considerably, but a satisfactory mixture comprises 5.0% copper, 55.0% lead, 30.0% sulphur, and 10.0% aluminum. Should aluminum not be used, the difference may be made up by additional copper.

In preparing the alloy, the copper and aluminum are heated to a molten state, after which the sulphur is added while stirring the mixture. After cooling, the mass is again melted, and the lead, in a molten state, is mixed with it, the molten mass being thoroughly stirred. This new mass is then cooled, being later reheated, and, while hot, rolled to make it ductile, so it can be shaped into the desired forms.

The discharge tube or electrode of Figs. 6 and 7 is similar to that of Figs. 4 and 5, having an enclosing tube or shell 26 which is evacuated. A cathode discharge element 27 is positioned within the shell, being fixed in the tongue portion 26a. A conductor 28 connects the stem 27a of the element 27 with a plug-in terminal 29, which extends outwardly of the base 30. The cap or head 27b of the element 27 differs from the cap or head 20b of the electrode of Figs. 4 and 5, in that it is spherical in form and hollow. It has an opening 31 formed at its top, contiguous with the top inside surface of the tube 26. A quantity 32 of radioactive material, which may be the same as used for the coating 25 of the electrode of Figs. 4 and 5, is introduced into the tube or shell 26, along with a relatively small quantity of mercury, before the tube is sealed tight. Such material 32 is preferably powdered or granulated, and is shaken into the hollow of the head 27b through the opening 31 before any given treatment is commenced. The mercury is provided primarily as a getter, and does no harm if shaken into the head 27b along with the radioactive substance. The mercury also tends to produce a vapor in the tube, which aids in the operation thereof. As in the case of the electrode tube of Figs. 4 and 5, this tube may have a radioactive coating 33 covering the inner surfaces of its side walls.

The treatment station B of Fig. 1 differs from the treatment station A only in the fact that a condenser 34 is interposed in the electric supply line 12.

The treatment station C of Fig. 1 differs from the stations A and B only in the fact that the high potential electricity is supplied from the supply line 12 through an inductance 35.

The treatment station D utilizes a germicidal discharge tube, a preferred form of which is illustrated in detail in Figs. 8, 9, and 10. The high potential electricity is taken by induction from the particular supply line 12 concerned. For this

purpose, an induction coil 36 is provided, tapping the line 12 at 37. A pair of leads 38 from an ordinary 115 v. supply source extend to a plug-in socket connection for the germicidal tube, one of the leads passing through a glass tube 36a, Fig. 1, which is disposed within and extends along the length of the induction coil 36. Thus, high potential electricity is impressed, by induction, upon the ordinary current flowing through the particular lead 38 concerned.

The germicidal discharge tube of Figs. 8, 9, and 10 has a pair of discharge terminals 40 and 41, respectively, positioned in an evacuated tube or envelope 42, and electrically connected with plug-in terminals 40—1 and 41—1, respectively, by means of stems 40a and 41a, respectively. The tube or envelope 42 and plug-in terminals are mounted in a conventional base 43. It is preferred that insulating material 44, such as a ceramic sleeve, cover the major portions of the stems 40a and 41a. A piece of lithium metal 45, see particularly Fig. 10, is advantageously secured to the stem 40a adjacent the discharge terminal 40 to act as a getter. It may, however, be placed at any other convenient location in the tube. It is preferred that the discharge terminals 40 and 41 be formed of the special alloy previously described. Argon or other suitable inert gas is preferably injected into the tube or envelope 42, as is, also, a small quantity of mercury. The mercury, by vaporizing, aids electrical arcing between the discharge terminals. As will be noted, the high potential electricity induced in the one lead 38 will manifest at the upper discharge terminal 40, and will charge the patient simultaneously with the discharge into his body of germicidal rays from the tube.

The treatment station E embodies the tube of Figs. 8, 9, and 10, as above described, but impresses the high potential electricity directly on the patient instead of passing it first through the tube. For this purpose, a discharge device 50, in the form of a soft, flexible pad in which a coil 50—1 is embedded, taps one of the high potential electric lines 12. This pad 50 is wrapped around the patient's body adjacent the afflicted portion thereof, thus charging the patient. Any other electrode capable of charging the patient with high potential electricity may be used in place of the pad 50. The germicidal tube has its terminals 40—1 and 41—1 plugged into a suitable plug-in socket connected to leads 52 which extend to an ordinary 115 v. source of supply. The high potential electricity with which the patient is charged is induced into the germicidal tube, thereby further activitating the discharge therefrom. A certain beneficial discharge from this germicidal tube will be had by induced activation alone, it being unnecessary, in such instances, to plug the tube into the 115 v. line.

Other types of germicidal and discharge tubes may be used in place of the tube of Figs. 8, 9, and 10, as, for instance, the well known infra-red and ultra-violet lamps, to produce results surpassing those ordinarily attained by the use of such infra-red or ultra-violet lamps apart from the apparatus of the invention.

It should be remembered that the patient is insulated from the ground while being treated at any of the treatment stations of the invention.

Figs. 11 and 12 show how a patient is treated, pursuant to the invention, while immersed in an electrically conductive fluid bath. In Fig. 11, a bath tub 53 is insulated from the ground by a

layer of insulation 64. A treatment electrode of the type shown in any of the figure groups 4 and 5, 6 and 7, and 8, 9, and 10 is positioned to charge the fluid of the bath with high potential electricity, as well as to discharge healing radiations and emanations into the patient. The particular electrode illustrated is diagrammatic in form and is designated 55. It may be connected into the circuit of Fig. 1 as shown at any of the treatment stations A, B, C, and D. In Fig. 12, a shower or vapor stall 56 is insulated from the ground by a layer of insulation 57. A plurality of treatment electrodes are designated 58, respectively. These correspond to the treatment electrode 55 of Fig. 11. A water spray or vapor, such as steam, may be admitted to the stall 56 in any well known manner (not shown), thus enveloping the patient during treatment.

Another embodiment of apparatus, pursuant to the invention, is illustrated diagrammatically by the wiring diagram of Fig. 13. While no treatment stations are shown, those provided are identical with the several treatment stations designated A, B, C, D, and E in Fig. 1. The distinction in this embodiment of apparatus resides in the fact that a special generator of high frequency electricity is provided in the system.

A transformer 60 has its input terminals connected across an ordinary 115 v. electric power line 61. Electrical conductors 62 and 63 lead from the respective output terminals of the transformer to a high frequency generator of the Oudin coil type, indicated generally at 64, a variable condenser 65 being interposed in the line 62, and the circuit being grounded at 66. Output conductors 67 and 68, leading from the high frequency generator 64, provide connections for the several treatment stations in the same manner as illustrated in Fig. 1.

The transformer 60 may be any ordinary high voltage type. A governor or control device 69 is shunted across the conductors 62 and 63.

In the illustrated instance, the governor or control device 69 preferably takes the form of a vacuum tube, having the construction shown by Figs. 14 and 15, Figs. 16 and 17, or Figs. 18 and 19. These tubes all possess high capacity, and include elements effecting a brush discharge. They serve, as does the device 14 of Figs. 2 and 3.

The tube of Figs. 14 and 15 embodies an outer shell or envelope 70 of insulating material such as glass, a plastic, or fiber coated with shellac. Inside the shell 70 is a bi-cylindrical element 71 formed of electrically conductive material. Separating element 71 from the enclosing shell 70 are spacers 72 made of rubber, Bakelite, or other insulating material. Inter-fitting with the element 71 is a second electrically conductive, bi-cylindrical element 73, the two elements being separated by a dielectric 74. Inwardly of the element 73, and separated therefrom by a dielectric 75, is a corrugated, cylindrical element 76. The shell or envelope 70 is secured in an insulating base 70—1, provided with plug-in terminals. One of the terminals, designated 77, is electrically connected with the element 71, while another, designated 78, is electrically connected with the corrugated element 76. These two terminals connect with the conductors 62 and 63, as illustrated in Fig. 13, and the brush discharge takes place at element 76.

Under certain circumstances, it is desirable that the outer shell 70 be made of quartz glass, and that a filament 79 be provided, the filament being heated by connection, through plug-in terminals 80 and 81, with a source of low voltage heating current (not shown). Plug-in terminal 82, which is electrically connected with element 71, may be used instead of or in connection with the terminal 77, since element 73 acts in a manner similar to element 71. A getter 83 of suitable material, and an insulating and reflecting shield 84 may be provided, as shown. While the tube may have either a high or a low vacuum condition, or may be filled with an inert gas, I have also found it advantageous to fill the tube with a moist vapor. The tube acts as an oscillator for electric currents, and has an enormous capacity, a capacity many times that of a condenser of approximately equal size.

The tube of Figs. 16 and 17 comprises an outer shell or envelope 85, which may be made of metal, glass, or fused quartz. This shell is mounted in an insulating base 86. Inside the shell 85 is a metal plate 87, and, spaced apart therefrom, a corrugated metal plate 88. A plug-in terminal 89, which extends from the base, is electrically connected with the plate 87, and a second plug-in terminal 90 is electrically connected with the corrugated plate 88. These terminals are adapted to connect, through a suitable socket, with the electrical conductors 62 and 63 of Fig. 13.

Under certain conditions of use, it is desirable to have other elements in the tube. These are provided, and may be utilized or not as occasion warrants. A filament 91 is disposed between the plates 87 and 88. It is electrically connected with the two plug-in terminals 92 and 93, which are adapted to be connected to a source of low voltage heating current (not shown). A slit screen, comprising shields 94 and 95, with apertures 91 extending therethrough, is disposed adjacent that side of corrugated plate 88 which is remote from plate 87. The apertures 96 are in alignment with each other, and the shields 94 and 95 are made of lead or other material capable of screening off X-rays. Between shields 94 and 95 is a sheet 97 of material which is readily permeable to X-rays. Within the shell 85 there is also mounted a shell or envelope 98 of glass, quartz glass, or similar material, having a portion 98a which is ground like a lens and directed toward the slit screen. This shell 98 really constitutes a tube within a tube. A filament or cathode 99, comprising electrically conductive legs 99a and 99b and an electron-emitting portion 99c, is disposed within the shell 98, plug-in terminals 100 and 101 being electrically connected to the respective legs 99a and 99b. A bombardment element 102 is disposed within the shell 98 opposite the portion 99c of cathode 99. Within the shell 85, but outside the shell 98, is a reflector 103 directed toward the slit screen.

The tube of Figs. 18 and 19 is essentially the same as the tube of Figs. 16 and 17, being equipped with a shell or envelope 105, a base 106, a plate 107, and a corrugated plate 108, the two plates being connected to plug-in terminals 109 and 110, respectively, which are adapted to connect electrically with the conductors 62 and 63 of Fig. 13. There is a filament 111 and an inner shell or envelope 112, but no slit screen. Instead of a lens portion being provided on the inner shell 112, a partition 113 of lens formation is disposed between the inner shell and the corrugated plate 108. It is fused to the walls of the outer shell 105. Within the inner shell 112 is a filament or cathode 114, which corresponds to the similar element 99 of

the tube of Figs. 16 and 17. A reflector 115 is directed toward the lens partition 113.

Reverting now to Fig. 1, there is another advantageous way of treating a patient pursuant to the invention. As shown at Y, a foot pedestal 120 may be provided for making the patient a part of a condenser. The pedestal comprises an electrically conductive plate element or electrode 121, connected electrically with one of the high potential lines 12, and covered by an insulating platform 122 upon which the patient rests his feet while being treated at any of the previously described treatment stations A, B, C, D, or E. The electrode 121 and insulating platform 122 are conveniently mounted in a frame 123, which insulates the plate from the ground. The insulating platform 122 is made of a high quality insulating material, such as first grade hard rubber. In certain instances it is desirable that the device be made in other than foot-pedestal form. For instance, it may be of cylindrical formation for use in a bed against any part of the patient's body.

If desired, the patient may be charged with the high potential electricity by direct contact with a metal or electrically conductive electrode in place of the pad 50 of treatment station E, or of the tube electrodes.

The invention has been described in the foregoing with sole reference to its use for therapeutic purposes. It should be noted, however, that inorganic matter may also be treated to advantage pursuant to the method and with the apparatus of the invention. It has been found that metals, for example, lead, have changed physical properties after treatment in accordance with the above. In instances where the invention is not being used therapeutically, it is not always necessary to insulate the subject from the ground.

Whereas this invention is here illustrated and described with respect to particular specific embodiments thereof, it is to be understood that various changes may be made in such specific embodiments and various other embodiments may be utilized by those skilled in the art without departing from the spirit and generic scope of the invention as set forth herein and in the claims which here follow.

Having fully described my invention, what I claim is:

1. Apparatus for applying radiant energy therapeutically, comprising means for producing high potential, high frequency electricity; a high capacity sparking condenser, and a treatment electrode connected in circuit with the foregoing, said treatment electrode including a discharge element adapted to charge the patient with said high potential, high frequency electricity, and radioactive means adapted to discharge radioactive emanations into said charged patient.

2. Apparatus in accordance with claim 2, wherein the sparking condenser is in the form of a vacuum tube of high capacity having mutually spaced capacity elements adapted to produce a corona discharge.

3. Apparatus for applying radiant energy therapeutically, comprising means for producing high potential, high frequency electricity; a high capacity sparking condenser; and a treatment device connected in circuit with the foregoing, said treatment device including discharge means adapted to charge the patient with said high potential, high frequency electricity, and radiating means adapted to discharge radiations into the charged patient.

4. Electrical treatment apparatus, comprising a high capacity sparking condenser; a treatment outlet electrically connected to said condenser; and means for electrically connecting said condenser to a source of high potential electricity.

5. Electrical treatment apparatus, comprising a transformer for producing high potential electricity; a high capacity sparking condenser electrically connected across the high potential output terminals of said transformer; and a treatment outlet electrically connected to said condenser.

6. Electrical treatment apparatus, comprising a transformer for producing high potential electricity; a high capacity sparking condenser electrically connected across the high potential output terminals of said transformer; and a plurality of treatment outlets independently electrically connected to said condenser.

7. Electrical treatment apparatus, comprising a transformer for producing high potential electricity; a treatment electrode electrically connected to one of the output terminals of said transformer; an electrical conductor sheathed by insulation electrically connected to the other of the output terminals of said transformer and disposed adjacent said treatment electrode so the subject to be treated may be placed between and in contact with the two; and a high capacity sparking condenser connected across the said outlet terminals of the transformer.

8. In electrical treatment apparatus equipped with means for the supply of high potential electricity and a treatment electrode, a high capacity sparking condenser electrically connected between the said supply means and the said treatment electrode.

THOMAS H. MORAY.

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Two Patents of William J. Hooper

FIG. 1

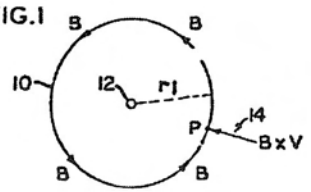

FIG. 3

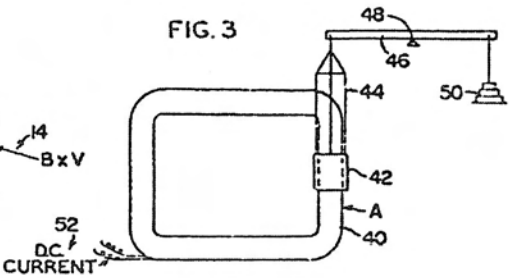

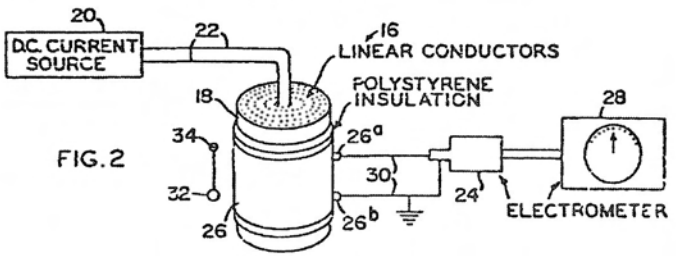

FIG. 2

FIG. 4

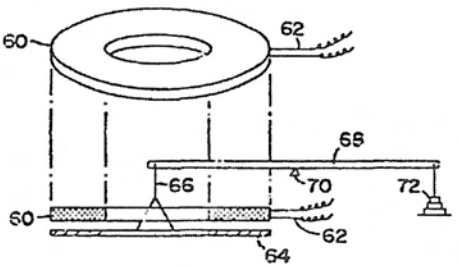

FIG. 5

FIG. 6

FIG. 8

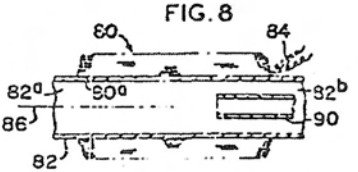

FIG. 7

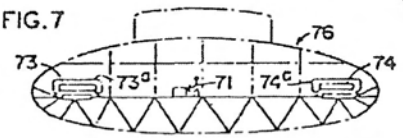

INVENTOR
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BY
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ATTORNEYS.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,610,971 Dated October 5, 1971

Inventor(s) William J. Hooper

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 14, after "conductor" insert -- with -- and delete "electric charges".

Col. 1, line 45, "10^{17}" should be -- 10^{-7} --.

Col. 2, line 4, "nd" should be -- and --.

Col. 2, line 25, "3.6×10^{12}" should read -- 3.6×10^{-2} --.

Col. 2, line 44, "motion" should be -- motional --.

Col. 4, line 7, "anitgravitational" should read -- antigravitational --.

Col. 4, line 22, "he" should be -- the --.

Col. 5, line 20, "out" should be -- our --.

Col. 6, line 26, after "conductor" delete "o" and insert -- to --.

Signed and sealed this 16th day of May 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

United States Patent

[11] 3,610,971

[72] Inventor William J. Hooper
Sarasota, Fla.

[21] Appl. No. 816,356
[22] Filed Apr. 15, 1969
[45] Patented Oct. 5, 1971
[73] Assignee Electrodynamic Gravity, Inc.

[54] ALL-ELECTRIC MOTIONAL ELECTRIC FIELD GENERATOR
5 Claims, 8 Drawing Figs.

[52] U.S. Cl. 310/10
[51] Int. Cl. H02n 11/00
[50] Field of Search 310/10, 11; 324/109; 336/181, 225; 338/284, 297

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Primary Examiner—D. X. Sliney
Attorney—Oldham & Oldham

ABSTRACT: This invention relates to an all-electric generator yielding a motional electric field in the space surrounding the device, but requiring no mechanical movements of its parts in generating this field. The Theory underlying the production of such a field postulates that each moving electron constituting the current in a linear conductor carries with it a loop of magnetic field energy about it.

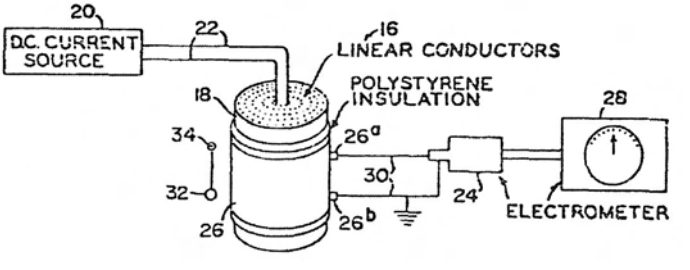

ALL-ELECTRIC MOTIONAL ELECTRIC FIELD GENERATOR

This applicatinn is an extension of the teachings presented in my earlier filed pending applications, Ser. Nos. 722,587, filed Apr. 19, 1968 and 803,187, filed Feb. 28, 1969.

PRIOR HISTORY

The detection of a magnetic flux about a current-carrying conductor was first made in 1820 by Hans Christian Oersted. This discovery unified the then separate sciences of electricity and magnetism. My experimental discovery that this magnetic flux actually moves along the conductor electric charges the electric charges constituting the current has great promise of now unifying the three known fields of electricity, magnetism and gravitation.

For a better understanding of the invention, reference should be had to the accompanying drawings wherein:

FIG. 1 is a schematic illustration of a wire containing flowing electrical current indicating the magnetic field generated with respect thereto;

FIG. 2 is a perspective block diagram schematic of a preferred embodiment of the invention;

FIGS. 3 and 4 illustrate modifications of the generator of FIG. 2 adapted to techniques for studying and utilizing gravitational and antigravitational phenomena;

FIG. 5 illustrates the winding of the wire in the device of FIG. 2;

FIG. 6 illustrates the winding of the wire in the device of FIG. 4;

FIG. 7 illustrates the incorporation of a plurality of the devices of the invention into a spacecraft where they might be appropriately utilized; and

FIG. 8 illustrates a coil wound embodiment useful for producing the separation of oppositely charged ions in gases or liquids.

BACKGROUND INFORMATION

The law of Biot and Savart yields the magnetic flux density B (webers/m.^{2}) at a point distant r meters from the conductor carrying a current of I amperes and is given by

$$B=\mu_o I/2\pi r \qquad (1)$$

where $\mu_o=4\pi\times10^{-7}$ webers/amp. meter. With reference to FIG. 1 of the drawings, this flux consists of circular magnetic loops directed counterclockwise, as shown by arrow 10, for current directed in a linear conductor wire 12 at right angles to this paper and outwardly toward the reader.

Electrons producing this flux will be moving perpendicularly into the paper, carrying the flux B with them, at a velocity V meters/sec. Thus, at any point P, distant r_1 from the long linear conductor 12, there will be existent a motional electric field of intensity $E=B\times V$ volts/meter directed radially inward toward the wire in the plane of the paper, as indicated by vector arrow 14, where $B\times V$ is the vector cross product of B and V.

PREFERRED EMBODIMENT

The preferred embodiment of the invention is illustrated in FIG. 2 and consists in part of many insulated linear conductors indicated generally by numeral 16, all parallel, packed and held in close proximity, and connected in series, so as to form a solid package 18 preferably cylindrical in shape. When a constant direct current from a source 20 is caused to flow through wires 22 this device with its axis in the vertical direction, half of the linear conductors 16 will have current flowing upward and half downward. It will be a noninductive device, since surrounding it the magnetic flux due to the upward currents will be superimposed on the flux due to the downward currents, so that no magnetic flux can be measured. On the well recognized "Principle of Superposition of Fields," each one exists however, and acts as though the other was absent.

When the package 18 of linear conductors has a circular cross section there will exist two systems of circularly directed magnetic flux, one directed clockwise and the other counterclockwise as seen from above, and one set moving upward and the other set moving downward. What is of capital interest however is that each of these two systems give rise to equal radially and inwardly directed $B\times V$ motional electric fields distributed laterally in horizontal planes in the space about the cylindrical device. Here we have a field which is not magnetic, is not electrostatic, and which I have shown experimentally to be immune to electrostatic shielding. No such spacially distributed field is known to Physics today except that of gravity. I have shown theoretically that this field should act attractively on electrically neutral matter. I have shown experimentally that the intensity of this field can be measured with the aid of an electrometer system 24, 28 driven by the potential difference induced electromagnetically in the conductors 30 connecting the electrometer to the capacitor plates 26a and 26b of the capacitor 26. The electrometer head 24 actuates a visual dial indicator 28.

At cryogenic temperatures the drift velocity of the electrons in the linear conductors will be greatly enhanced. Theoretical calculations indicate that this velocity in copper at 20° C. is of the order of 3.6×10^{-12} cm./sec. in a current density of 480 amp./cm^2. The random velocity of free electrons in conductors is theoretically estimated at 10^8 cm./sec. At superconducting temperatures when the electrical resistance approaches zero, it is generally believed that the drift velocity of electrons approaches the value of 10^8 cm./sec. This velocity is 10^{10} times greater than the velocity at 20° C. (See "Physics," Halliday and Resnick, pages 681 and 691, J. Wiley, 1962). This indicates that the intensity of the $B\times V$ field about the device, herein described, might possible be enhanced 10^{10} times at or near the absolute zero of temperature. Hence, the invention contemplates that each of the devices described hereinafter will preferably be operated at or below the critical temperature at which the conductor used becomes superconducting. As the state of the art advances new conducting materials will undoubtedly become available with critical temperatures very considerably above the absolute zero.

Not only does the device that has been described in FIG. 2 afford apparatus hitherto unavailable for the generation of a special distribution of the motion electric field, but it affords means for investigating the properties of this field in connection with its relation to gravity and antigravitational phenomena. In addition, it affords for the first time, a direct experimental method for determining the electron drift velocities and mobilities in linear conductors made of different materials.

When the cylindrical capacitor 26 is charged by the $B\times V$ field and its potential difference (P.D.) measured, it is determined by the equation

$$\text{P.D. (volts)} = B\times V\cdot l \qquad (2)$$

where l is the distance between the thin capacitor plates. The direct measurement of V meters/sec. can then be made

$$V=\text{P. D. (volts)}/Bl \text{ m./sec.} \qquad (3)$$

where B is in webers/m.^{2}.

This device will exhibit an attractive force on electrically neutral matter, better defined as a differential force; i.e. the difference between a pull and push, in which the pull is greater. (See reference to general theorem, page 125, The Mathematical Theory of Electricity and Magnetism, by Sir James H. Jeans) The $B\times V$ field is an electrical field acting on all the elementary charges comprising the atoms of matter, electrons, protons and even neutrons, as I believe neutrons also consist of electrons and protons in close bond. The $B\times V$ force being relatively weak does not ionize the atoms of matter, but being immune to shielding, electrically polarizes them. This causes a slight elongation of some of the electrons orbits within the atoms in the direction of the field. The positive charges move slightly into the more intense region of the converging, radially directed field while the negative charges move slightly further way from the device into the weaker por-

tion of the field. Thus the differential force between the pull and the push upon the component parts of an atom results in the polarization of the atoms and a resultant attractive force, equivalent, I believe, to that of gravity.

A small, electrically neutral, simple pendulum 32 suspended close to one side of my device of FIG. 2, about pin 34, should thus undergo a slight measurable deflection under a fairly strong $B \times V$ motional electric field. At cryogenic temperatures this attractive force should be greatly enhanced. When the device is lying horizontally, a gravity meter placed centrally over it should give a measurable reading in milligals.

Modifications of my generator such as are shown in FIGS. 3 and 4 show diverse methods for studying gravitational and antigravitational phenomena which the invention makes possible. FIG. 3 illustrates a rectangular coil 40 made up of a single wire passed many times in the coil configuration so as to provide a large leg A preferably having a circular cross section. However, any cross-sectional configuration would meet the objects of the invention as long as the wires are parallel to each other and closely packed. About one leg of the coil, a cylindrical shell 42, made of electrically neutral, conductive or nonconductive material, is suspended by a carrier frame 44 from one end of a sensitive beam balance 46. The beam pivots about a support bar 48 and carries a load 50 to normally counterbalance the weight of the shell 42. When a fairly strong DC current I is fed through lines 52 and is built up in the coil, the flux density B is generated in the region of the cylindrical weight whose walls are a distance r from the central axis of the coil and n is the number of linear conductors in the coil.

$$B=\mu_0 nI/2\pi r \text{ (webers/meter}^2\text{)} \qquad (4)$$

If the current I is suddenly cut off the flux B will rapidly collapse. This flux in the act of collapsing should cross the walls of the suspended cylinder with a considerable inwardly directed horizontal velocity of V meters/sec. This should yield a very considerable vertical $B \times V$ in the walls of the cylinder directed either up or down, depending on the direction of the current in the coil.

In this device the motional electric field $B \times V$ is not convergent, but is uniformly vertical, hence the pull and push exerted on the electric components of the atoms in the cylinder will be equal. In other words the action of this field will either enhance or decrease the state of polarization already existing within the cylinder and produced by the gravitational field of the earth. If the polarization is increased, then the gravitational pull of the earth's field should be greater. If the polarization is decreased then the weight of the cylinder should be less. It is conceivable that the polarization could be reduced to zero. In this case, the object should be weightless. If the intensity of the depolarizing $B \times V$ field is still further increased, then polarization in the opposite direction to that produced by the earth's field should be achieved. In this event the earth's gravitational field would act repulsively on the cylinder. This would be antigravity in its truest sense.

The apparatus I have just been describing acts only momentarily (during the time interval in which the flux is collapsing) to change the weight of the cylinder shell 42 (shown in FIG. 3).

It is desirable to have an apparatus with which to experimentally study gravitational and antigravitational phenomena under steady continuous conditions. In FIG. 4 of the drawings is shown another modification of the device shown in FIG. 2. Here I utilize a noninductive coil wound in the form of a solid, low, thick walled, hollow, right circular cylinder, and indicated generally by numeral 60. DC current is supplied through lines 62 to the coil 60. In the region directly beneath this coil disk 60 I place a similarly shaped nonferrous disk 64, suspended by a carrier 66 to the end of a beam 68. The beam 68 is pivotal about a fulcrum 70 and is counterbalanced by a load 72. For positions of disk 64 below coil 60, the $B \times V$ field can only be directed vertically upward when a continuous DC current is flowing in the wires composing the disk 60. It should be noted that this field is practically uniform and parallel close to the disk, hence it is not attractive in its action on neutral

matter. Its action on such matter can only change the state of electrical polarization in the matter. Any change thus effected in the state of polarization should cause the earth's gravitational field to act less intensely, on any object placed close to the under surface of the device, causing it to weigh less, become weightless, or to actually be accelerated upward by the antigravitational action of the earth's field.

FIG. 5 of the drawings illustrates the manner in which the noninductive device in FIG. 2 is wound with wire 22, by turning the linear conductors back on themselves through a 180° turn. FIG. 6 illustrates the way the noninductive windings of the device illustrated in FIG. 4 is achieved. One very long insulated wire is simply turned back on itself at its midpoint and wound double into a solid coil held together in the shape illustrated.

FIG. 8 illustrates a modified embodiment of the invention which comprises a wire coil 80 either simply wound, or noninductively wound, around a hollow tube 82. Electrical current is passed to the coil 80 through wires 84, and at low temperature this coil will produce a radially, outwardly directed, internal $B \times V$ field from the axis 86 of the cylinder to the internal circumference 80a of the coil 80. The electrical wire making up coil 80 is preferably a ribbonlike conductor which is coated with any appropriate electrical insulation. A minimum space between adjacent turns with concentricity between adjacent turns is the preferred winding embodiment for coil 80. As many courses of turns as deemed appropriate to generate field strength desired will meet the objects of the invention. The tube 82 is preferably made of material having little or no magnetic permeability. Both the coil 80 and tube 82 are stationary.

An apparatus of the type illustrated in FIG. 8 might be utilized to effect separation and concentration of fluids. For example, in the desalinization of water, a $B \times V$ electric field generated by the passage of the current through the coil 80, acts upon the disassociated ions of the sodium chloride in solution. Hence, by introducing a flow saline water at end 82a of tube 82, and providing a concentric separating tube 90 at end 82b of tube 82, increments of fluid which are concentrated with chlorine and depleted of sodium may be drawn off through the stationary tube 90, while the increments of fluid which are concentrated with sodium and depleted of chlorine may be drawn off through the space between the exterior walls of tube 90 and the interior walls of tube 82.

FUTURE APPLICATIONS

This country's space projects have become expensive beyond the ability of the average man to comprehend. Achieving lift by means of costly propellants will some day soon be seen as akin to primitive man's use of awkward clubs as a means of exerting force. In a very short interval of time an intense $B \times V$ field should effect the reversal of the gravitational polarization of an object. Once achieved, only a very small expenditure of energy would be required to hold the polarization. Energy from the atoms of the earth would supply the lift and propulsion through the medium of the earth's gravity field. The most formidable problem would appear to be the problem of holding the $B \times V$ generator at cryogenic temperatures. In view of the overall possibilities of this invention, this problem does not appear to be incapable of a solution. A breakthrough in finding superconducting materials or even near superconducting at slightly elevated temperatures from those presently required would greatly aid in the solution of this problem.

FIG. 7 of the drawings illustrates in outline, the future possible application of this device, obtaining regulated lift by an operator 71 adjusting the current into the coils 72 and 74 which incorporate the structural features of the devices of FIG. 4. The antigravity gravity control features of the coils 73 and 74 thus control the lift and movement of vehicle 76. Suitable cryogenic generators 73a and 74a are associated with each of the coils 73 and 74 to provide the cooling thereof to as near

absolute zero as possible to give the enhanced current passage characteristics necessary to the objects of the invention.

While I have demonstrated that AC current can be used in my device, it appears at present that DC current is much to be preferred.

This invention could be uniquely adapted to a communication system from one side of a solid barrier to the other side whether this barrier be solid concrete or battleship armor, by pulsing the *BXV* generator coil with signals, Morse Code or even voice modulated signals to be picked up by a capacitor-electrometer circuit on the other side of the barrier. Secret communications could be carried on and with the electrometer circuit as shown in FIG. 2 connected to a relay radio broadcasting unit, so that one might conceivably broadcast by radio from the interior of a solid metallic enclosure.

It is conceivable that the invention might be useful in the highly specialized art of concealed detonation devices. A detonating circuit connected to the capacitor electrometer receiving circuit of my device such as shown in FIG. 2 could be actuated through a solid barrier by out *BXV* generating coil placed on the other side of such a barrier.

It is conceivable that for some specialized purposes, it might be highly desireable to transmit electrical power from one side of a fixed solid barrier, concrete or armor plate, etc. by pulsing, DC or AC, in our *BXV* coil on one side of such a barrier. A resonant LC circuit could pick up these *BXV* pulsations and supply a source of electrical power on the other side of the barrier, in a manner somewhat analogous to my electrical receiving methods outlined in U.S. Pat. Application, Ser. No. 803,187, identified above.

In accordance with the patent statutes, only the best known embodiments of the invention have been illustrated and described in detail, but it is to be understood that the invention is not limited thereto or thereby, but that the scope of the invention is defined in the appended claims.

What is claimed is:

1. Apparatus for demonstrating an electrical phenomenon comprising,

a coil made from an electrically conductive material having a very large plurality of sections compacted in close proximity arranged in substantially complementary relation around a common central axis, where the coil forms a solid cylindrical shape with the sections parallel to the axis thereof, and

means to pass current through the coil so that about half the sections will pass current in a direction opposite to the other sections to cancel magnetic flux.

2. Apparatus according to claim 1 where adjacent sections are electrically insulated from each other, and the coil comprises a single wire bent back on itself to make the sections.

3. Apparatus according to claim 1 which includes means to increase the passage of electrical current through the conductor.

4. Apparatus according to claim 3 where the means to enhance is a cryogenic generator which reduces the temperature of the conductor o or below its critical temperature at which it becomes superconductive.

5. Apparatus according to claim 1 which includes an elongated hollow tube having an axis, the conductor formed around the tube.

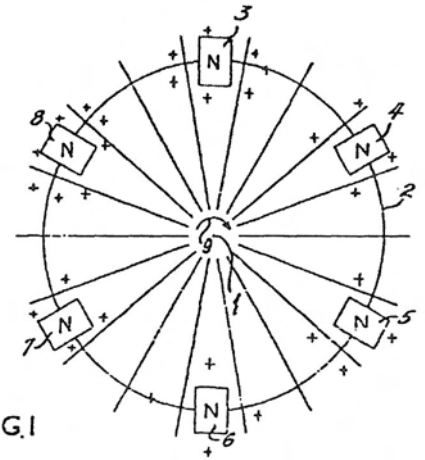

FIG. 1

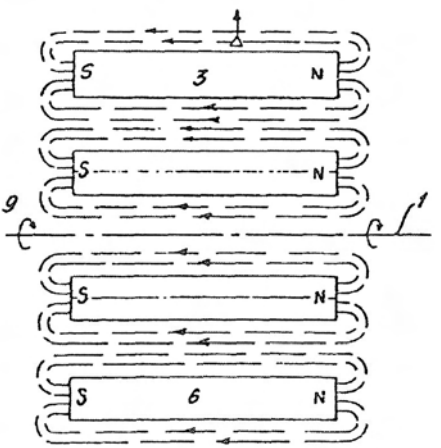

FIG. 2

INVENTOR:
WILLIAM J. HOOPER

BY Oldham & Oldham
ATTORNEY.

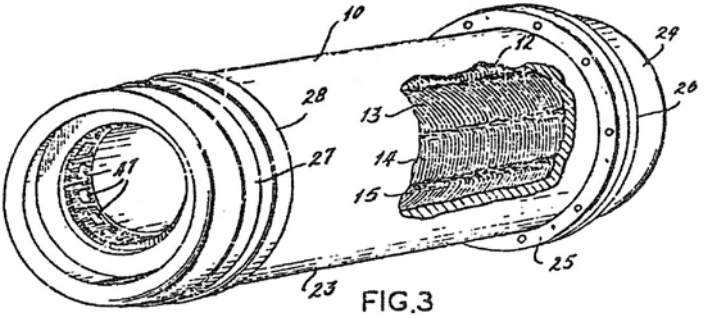

FIG.3

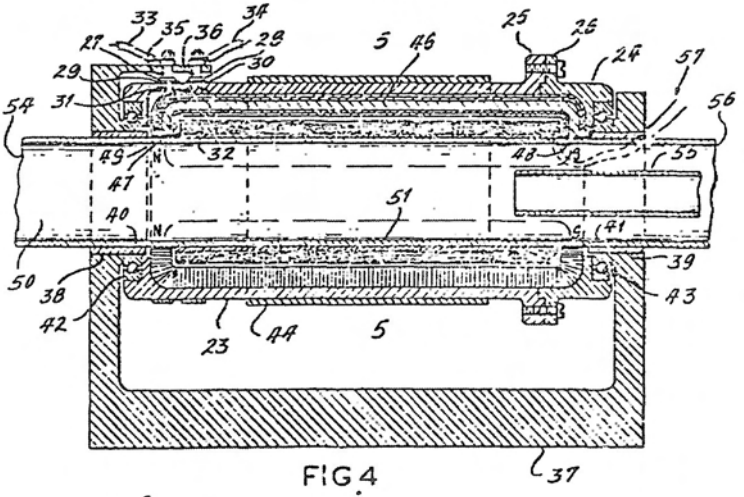

FIG.4

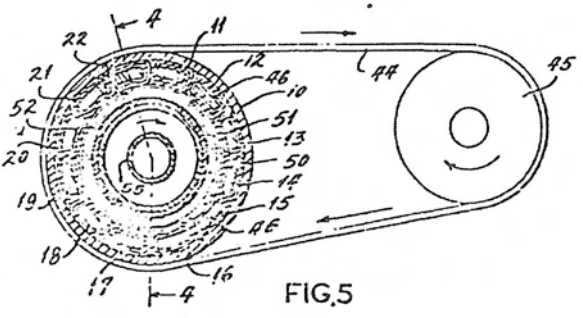

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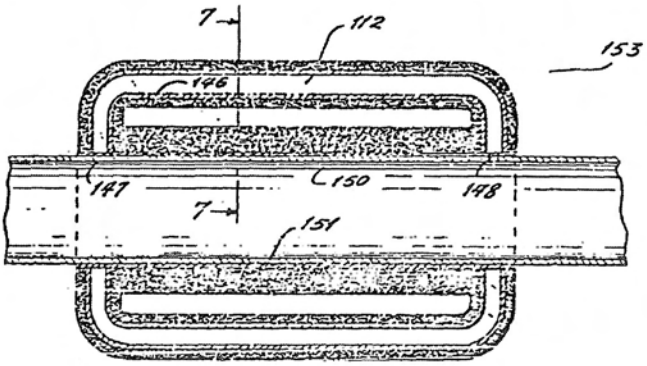

FIG.6

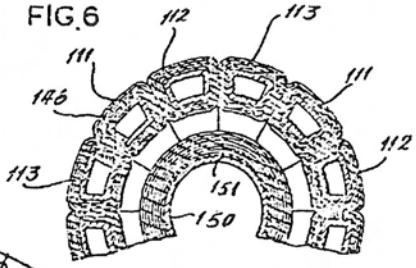

FIG.7

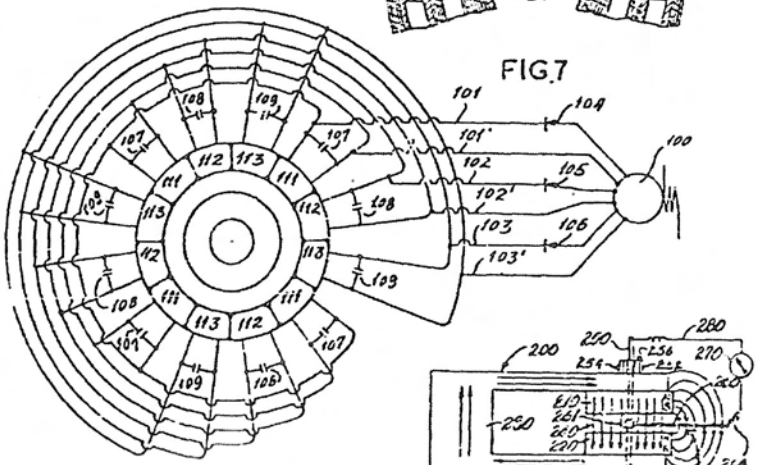

FIG.8

FIG 11

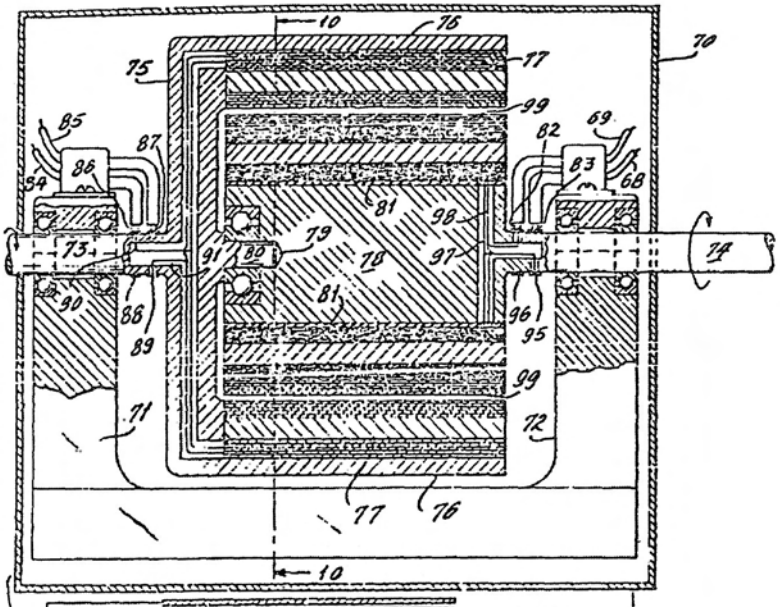
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FIG. 9

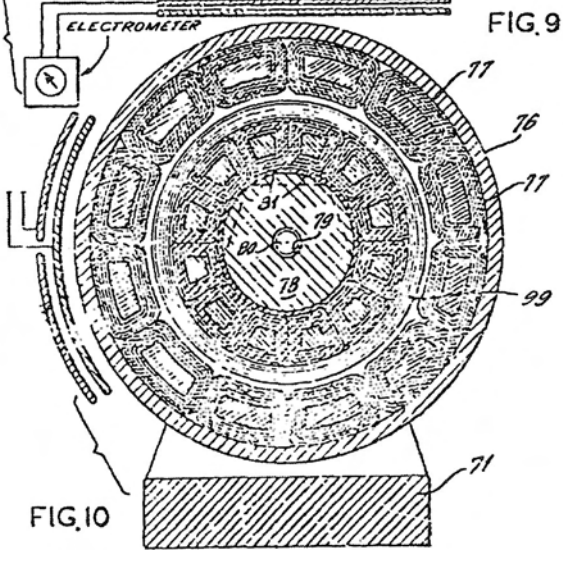
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FIG. 10

United States Patent

Hooper

[15] 3,656,013

[45] Apr. 11, 1972

[54] APPARATUS FOR GENERATING MOTIONAL ELECTRIC FIELD

[72] Inventor: William J. Hooper, Cuyahoga Falls, Ohio

[73] Assignee: Electrodynamic Gravity, Inc., County of Sarasota, Fla.

[22] Filed: Apr. 19, 1968

[21] Appl. No.: 722,587

[52] U.S. Cl. 310/10

[51] Int. Cl. H02k 1/00

[58] Field of Search ..... 310/10, 11, 178, 177, 156, 310/42, 268, 211, 169, 216, 269, 259; 105/1; 55/2. 14, 101, 123, 127, 120; 73/194 EM; 328/233–238

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Primary Examiner—D. X. Sliney

Attorney—Oldham & Oldham

[57] ABSTRACT

Apparatus for producing and demonstrating properties of motional electric fields by means of rotating magnetic flux produced by a plurality of magnets extending parallel with the axis of rotation, said flux of these magnets being put into rotation about a common axis by mechanical or by electro magnetic means.

6 Claims, 11 Drawing Figures

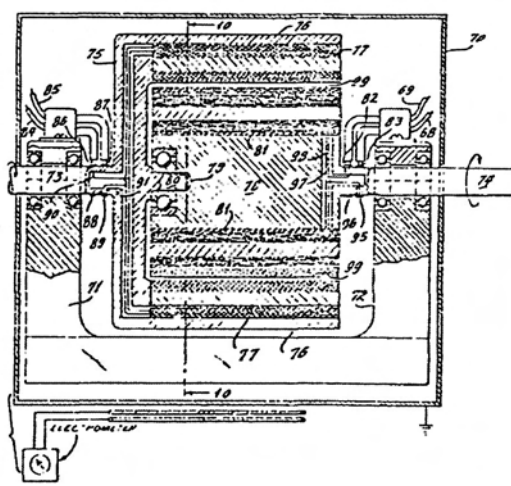

APPARATUS FOR GENERATING MOTIONAL ELECTRIC FIELD

This invention relates to the generation of motionally induced electric fields as distinct from electrostatic fields, and as distinct from the electric field (illustrated by transformer action) which is induced by the time rate of change of magnetic induction. Hence, all reference herein to a motional electric field means the electric field that is generated by the movement of magnetic flux.

The motional electric field generated by rotational motion of magnetic flux is non-uniform in both direction and radial intensity. Particles (large or small) of matter (solid, liquid or gaseous) which are within the ambit of this motional electric field are acted upon with a force which tends to accelerate them. It is well known that a particle carrying a charge Q (coulombs) in an electric field of intensity E (Newton/coulomb) will be acted upon by a force F (Newton) given by the equation $F = EQ$. The electric intensity E of a motional electric field is given by the vector equation $E = B \times V$, where B is the magnetic flux density at a point in space, expressed in webers per square meter, and V is the velocity of the moving magnetic flux at that point in space, expressed in meters per second. What is not so well known, however, is the fact that a non-uniform electric field exerts a force upon electrically neutral matter. In his celebrated text, "The Mathematical Theory of Electricity and Magnetism", Sir James H. Jeans describes, in the case of a non-uniform electrostatic field, how a "slab of dielectric will be sucked in between the plates of the condenser" thus demonstrating the mechanical force produced by such a field. He states (P. 125), "This, as will be seen later, is a particular case of a general theorem that any piece of dielectric is acted on by forces which tend to drag it from the weaker to the stronger parts of an electric field of force." According to Clerk Maxwell in "Electricity and Magnetism" (Vol. II, p. 181), Faraday discovered that the electric field due to electromagnetic induction penetrated within and throughout all materials. The motional electric field is just such a field. Apparatus for demonstrating the "general theorem", stated by Jeans, has, in the case of the non-uniform motional electric field, not heretofore been provided.

Accordingly, it is one of the objects of the present invention to provide a device for generating a non-uniform motional electric field whose force is of magnitude such that it can be sensed.

Since the motional electric field acts within and throughout all matter, such a non-uniform field will exert a physical force on any kind of electrically neutral matter, in a manner quite analogous to that of the electrostatic field with respect to dielectric material.

Another object of the invention is to provide apparatus for obtaining useful work from a non-uniform motional electric field.

The several objectives of the invention may be accomplished by rotating an elongate magnetic field about an axis which is concentric with the field and parallel with the field's elongation. For example, an array of magnets may be mounted on a rotor so that all magnets are parallel with the axis of the rotor, and all have the same polar orientation relative to the rotor. A solenoidal electro magnet, or another array of magnets, with magnetic axis concentric with the rotational axis may also be employed to enchance the flux density of the array of rotating magnets by flux linking with them. When such an array of magnets is rotated about the axis of the rotor, the magnetic field of each is rotated with it. As another example, an elongate magnetic field can be rotated about its axis, without mechanical movement, by the provision of stationary solenoidal electro magnets arrayed like the staves of a barrel and connected to a source of multi-phase alternating current (half wave rectified to prevent reversal of sign) in a manner comparable to the stator winding of a three-phase motor to produce "revolving field." While the composite magnetic field is thus in rotary motion, every charged, or uncharged particle of matter (solid, liquid, or gaseous) within the non-uniform motional electric field thus generated in the neighborhood of

the rotor, will be acted upon by a force due to the electric intensity E. Positively charged particles will be forced in the direction of the vector E, negatively charged particles will be forced in the opposite direction, and electrically neutral matter will be pulled from the weaker regions of field intensity to the stronger regions. This latter mechanical force is called a differential force due to the action of the field on the internal electrical polarization of the neutral matter.

The three vectors E, B, and V are always (with a possible exception) mutually at right angles to each other. If the thumb of the right hand is pointed in the direction of the magnetic flux density vector B, and then rotated like a right-handed screw so that it points in the direction of the velocity V of the moving magnetic flux, then the forefinger of the right hand will point in the direction of the electric vector E. The rotation of the composite magnetic flux about its axis produces a motional electric field which will, except at the axial ends of the magnetic field, be quite generally directed radially with respect to the axis of rotation. The possible exception is the case of a magnet having a homogeneous electrically conductive core of perfectly circular cross-section, in which case the force of the electric field may be somewhat off radial.

With a given polar orientation of magnets relative to the axis of rotation, rotation of the magnetic field in a clockwise direction will generate a motionally induced electric field of sign (positive or negative) opposite that which is generated when the rotation is counterclockwise. For any given sense of rotation, reversing the polar orientation of the magnets relative to the axis of rotation likewise reverses the sign (positive or negative) of the motionally induced electric field. Reversing both the direction of rotation and the polar orientation of the magnets (a situation exemplified by viewing the apparatus first from one axial end, and secondly from the opposite axial end) produces no change in the sign (positive or negative) of the motionally induced electric field.

In the accompanying drawings, three embodiments of the invention are exemplified. Also, there are two model schematics to illustrate in its simplest form the principle of the invention, in which a plurality of commonplace permanent magnets are mounted upon a rotor.

The first embodiment is one in which an array of electro magnets is mounted on a rotor having a hollow center, through which particles of matter can be moved and their response to the motional electric field perceptibly demonstrated.

Second, there is an embodiment in which electro magnets are arrayed as in the first embodiment, but are stationary and their composite magnetic field is rotated electromagnetically by phase displacement.

Third, there is an embodiment in which a pair of oppositely rotating rotors, nested one within the other, are each provided, on its circumference, with an array of electro magnets oriented as aforesaid on each rotor, but oppositely oriented on the respective rotors, and wherein the effect of the motionally induced electric fields can be perceptibly demonstrated by the behavior of particles of matter externally of the rotor.

In the accompanying drawings:

FIG. 1 is a diagrammatic view illustrating the effect of rotating an array of spaced permanent magnets about an axis which is parallel with each of the magnets when all magnets have corresponding polar orientation;

FIG. 2 is a diagrammatic view representing a side elevation of the arrangement shown in FIG. 1, and illustrating the external magnetic flux paths of the several permanent magnets;

FIG. 3 is a perspective view of a rotor for generating a radially directed motional electric field in accordance with one embodiment of the invention, wherein electro magnets are arrayed within a hollow rotor with axes parallel to that of the rotor;

FIG. 4 is a sectional view taken along a diametric plane of the rotor shown in FIG. 3, together with its cooperating parts;

FIG. 5 is a sectional view along line 5—5 of FIG. 4, and showing, in addition, driving means for the rotor.

FIG. 6 is a sectional view taken along a diametric plane of a stationary form of apparatus similar to that shown in FIGS. 3, 4, and 5, but wherein the magnetic flux field is rotated electromagnetically by phase displacement;

FIG. 7 is a sectional view taken along line 7—7 of FIG. 6;

FIG. 8 is a wiring diagram for the apparatus shown in FIGS. 6 and 7.

FIG. 9 is a longitudinal sectional view of an apparatus having a plurality of rotors for generating a B × V electric field;

FIG. 10 is a sectional view taken along line 10—10 of FIG. 9; and

FIG. 11 is a diagrammatic illustration of an apparatus for exhibiting moving field phenomena.

In FIGS. 1 and 2, the principle of the invention is diagrammatically illustrated with the utmost simplicity, wherein a catena of magnetic flux fields, all with the same polar orientation, is produced by arranging an array of rod-type permanent magnets parallel with each other, and parallel with the axis about which they are to be rotated. In FIG. 1, the axis of rotation is designated 1, and may be considered as the center of a shaft of a rotor, preferably composed of material having low, if any, magnetic permeability, and low, if any, electrical conductivity. The periphery of such a rotor is designated by the circle 2. In the form shown, a series of permanent magnets 3, 4, 5, 6, 7, and 8 is appropriately secured to the periphery of the rotor with the respective magnets in equi-spaced relationship, and all with their north poles addressed in the same direction which, as shown in FIG. 1, is in the direction of the reader or, as shown in FIG. 2, to the reader's right. The external flux fields from the respective permanent magnets 3, 4, 5, and 6 are illustrated in FIG. 2, where it will be observed that the external flux path of all magnets is from right to left, a relationship designated by the plus (+) marks in FIG. 1. With such an arrangement, the flux fields of all magnets may be concurrently rotated about axis 1. Considering the rotation to be in the direction of arrows 9 and the polar orientation of the several permanent magnets to be as illustrated, a B × V motional electric field will be generated both externally and internally of rotor periphery 2 upon rotation of the rotor. The thus generated motional electric field will exert a radially directed force upon every particle of matter, neutral or charged, such as particle P, which is within the ambit of the catena of magnetic flux fields. The magnitude of the so impressed electric field intensity will depend upon the magnetic flux concentration at the particle P and the relative velocity between the flux field and particle P. While, if particle P is in motion, its velocity must be considered in arriving at the relative velocity V (in the formula $E = B \times V$) the disclosure will be simplified if the particle P be considered as stationary, and in such event V will be 2 R times S, where R is the radial displacement of particle P from axis 1, and where S is the revolutions per unit of time made by the rotor. Hence, with the particle P stationary, the magnitude of the force impressed upon it is increased when the speed of rotation of the rotor is increased at a given flux density; and is increased by an increase in the flux density at a given speed of rotation. The direction in which the force of the motionally induced electric field acts upon particle P is always perpendicular to the magnetic flux field B and to its velocity V. The sign of the electric force field may be either positive (acting radially outward from the axis of rotation) or negative (acting radially inward toward the axis of rotation), which, for any given polar orientation of the permanent magnets, may be reversed by reversing the direction of rotation of the rotor. With the polar orientation shown in FIGS. 1 and 2, and the direction of rotation indicated by arrow 9, if particle P is a proton or a positively charged molecule, the force of the $B \times V$ electric field will be radially inward as indicated by the solid line arrow attached to particle P; but if particle P is an electron or a negatively charged molecule, the particle will tend to move radially outward as shown by the broken line arrow; and if the particle P is electrically neutral, it will tend to move in the direction of increasing electrical intensity E. Increase of E requires either that both B and V be increasing or that one be increasing at a sufficiently greater rate than the other is decreasing so that the product $(B \times V)$ increases. In the relationship of field and particle shown in FIG. 1, the product $(B \times V)$ increases radially inward.

For practical purposes, however, commonplace permanent magnets produce insufficient flux density in their external flux paths to impress upon a particle of charged matter such as P, an electric force of sufficient magnitude that the force of the electric field can be measured with ease, at least at speeds of rotation within practical limits. Consequently, the practical embodiments of the invention, later to be described, make use of electro magnets of a form capable of producing external flux fields of vastly greater flux density B, as well as higher velocities V.

The term "unipolar induction" has been used to indicate the induction of an electric field in the vicinity of an axially symmetrical magnetic system rotating about its axis of symmetry. There has been disagreement about whether as the magnetic system is rotated the lines of magnetic induction are carried with it or remain stationary while the magnetic system rotates through them. For example, when a bar magnet is rotated about its magnetic axis, it is believed by many that the magnetic field is stationary. I have demonstrated that under certain conditions, at least, the magnetic lines can be made to move, and I have devised certain methods and apparatus for utilizing this phenomena as in the production of localized and high intensity electric fields.

Turning now to FIG. 11 of the drawings, an apparatus for demonstrating certain magnetic phenomena is illustrated in diagrammatic form. A magnetic system, indicated generally by numeral 200, includes a pair of permanent magnets 210 and 220 which are axially magnetized and mounted in axial alignment between the ends of a U-shaped yoke 230 of highly permeable magnetic material. The adjacent surfaces of magnets 210 and 220 being of opposed polarity are spaced apart, providing an air gap 240 therebetween. The lines of magnetic flux are shown in the drawing and indicated generally by numeral 262. A brass rod 250 extends axially through magnets 210 and 220. The magnetic system 200 is rotatable about rod 250. A stiff conductor 260 is electrically connected by a collar 261 at one end in rotatable or fixed relation as selectively desired, with the brass rod 250 at a point in the gap 240 between magnets 210 and 220. The other end of conductor 260 extends substantially perpendicularly from rod 250 to a distance in space away from the magnets and yoke where the magnetic field falls to approximately zero intensity. In order to complete an electrical circuit through galvanometer 270 and conductor 280 to the brass rod 250 and conductor 260, a flexible and extensible electrical wire 264 connects the end of conductor 260 to the galvanometer 270. A gear 252 locked alternatively by set screw 254 to rod 250 or by set screw 256 to yoke 230 can serve to provide driving motion to either the rod 250 or YOKE 230 as selectively desired. Normally, for the purposes of the experiment, the driving motion will be reciprocal because of the connection of wires 280 and 264.

With this apparatus, if the magnetic system 200 is held fixed and a given angular displacement imparted to conductor 260 by rotating it horizontally about or with rod 250 through the air gap at a given angular speed, a voltage is induced which provides a deflection of galvanometer 270. Furthermore, when the conductor 260 is held fixed and the magnetic system 200 rotated through the same angular displacement about rod 250, at the same given angular speed, a similar voltage of exactly the same magnitude but opposite direction is induced in the galvanometer circuit. The same deflection is obtained whether or not the magnets 210 and 220 rotate with the yoke 230 or are held stationary while the yoke alone is rotated. This indicates clearly that the lines of magnetic induction in the quantity rotate about the axis of rotation 250 as if they were rigidly attached to the magnetic system 200.

A most important aspect of the operation of the apparatus of FIG. 11 is noted when the magnets 210 and 220 are held fixed in relation to the conductor 260 and rod 250 and the

yoke 230 is rotated about the rod 250. This action causes induction of current in the galvanometer circuit exactly as occurs when the entire magnetic structure or the conductor itself are moved. However, if the magnetic yoke 230 and conductor 260 are held fixed and magnets 210 and 220 rotated, there is no deflection of the galvanometer. Thus, it appears that the yoke structure plays an important part in controlling movement of the magnetic flux. Furthermore, it should be noted that the magnetic flux does not link the galvanometer circuit in the usual sense that this term is used, but that a current is induced in the galvanometer circuit through the action of the conductor 260 in merely cutting across the field extending between adjacent faces of magnets 210 and 220.

It has also been found that the permanent magnets 210 and 220 may be replaced by an electromagnet and the results described above duplicated. Furthermore, it can be demonstrated that the magnetic flux within the air core of a solenoid may be rotated about its magnetic axis. A brass tube formed in the shape of a toroidal C has a winding applied to its entire length with holes drilled in the tubing to receive a brass rod, as 250 in the structure shown in FIG. 11. With the winding energized, the above-described procedures produce similar galvanometer deflections.

This application is concerned with certain methods and apparatus which make use of the phenomena described above.

Referring now to FIGS. 3, 4, and 5 for an illustration of the second embodiment, a tubular rotor 10 is provided on its inner periphery with 12 keystone cross-sectional electro magnets 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22 of the solenoid type. As seen in the cross-section of FIG. 5, the several electro magnets are arranged as sectors of a cylindrical annulus. While in the form shown, the several electro magnets 11–22 are shown in circumferentially wedged relationship, whereby to minimize the likelihood of relative movement radially inward as at standstill, as well as in the interest of achieving substantial uniformity of external flux density throughout the inside circular area of the rotor, it will be understood that when and if desired, the several electro magnets can be circumferentially spaced one from the other, and, if desired, a spacer of relatively low, if any, magnetic permeability interposed between them. Any suitable means may be employed for securing the several electro magnets to the shell of the rotor.

In order to facilitate the assembly of the several keystone-shaped electro magnets on the interior of the rotor as shown, the shell thereof is made of at least two pieces 23 and 24. In the form shown in FIGS. 3–5, the two pieces 23 and 24 are cup-shaped, and are respectively provided with outwardly extending flanges 25 and 26. Once the several solenoids have been positioned within the longer shell piece 23, the shorter shell piece 24 may be applied as a cap so that flanges 25 and 26 abut, and may be appropriately secured together as by riveting, bolting, welding, or cementing.

The shell pieces 23 and 24, as well as their interconnecting means, may be formed of material having little or no magnetic permeability, or in cases where it is desired to shield the exterior from the escape of magnetic flux, they may be formed of material having a high magnetic permeability. Instead of dividing the rotor shell in twain axially, it may be divided in twain radially, in which event the two halves will have axially extending joints when assembled, and may be held in such assembled position by banding or other appropriate means capable of sustaining the centrifugal force to which the rotor will be subject in use.

At the end of shell piece 23, remote from flange 25, there is provided a pair of slip rings 27 and 28 which, in the event the shell piece is formed of electrically conductive material, may be separated from the shell piece by sub-rings 29 and 30, of appropriate insulating material. The slip ring 27 is connected through a conductor 31 to the free end on the inner course of the solenoid winding for each of the electro magnets 11–22. The slip ring 28 is connected trough a conductor 32 to the free end of the outer course of winding in each of the solenoids 11–22. All 12 solenoids are connected so that the direction of electric current flow is the same in all solenoids. The energizing current is supplied from an external source through conductors 33 and 34 and brushes 35 and 36, in a manner well understood in the art.

The rotor is mounted upon an appropriate frame 37, having opposite stationary stub axles in the form of ferrules 38 and 39 which project toward each other. On the projecting portion of each of ferrules 38 and 39, there is provided an inner race 40 and 41 for each of two ball bearing sets whose outer races 42 and 43 are appropriately mounted to the respective ends of the rotor 10, so that the rotor 10 is free-running, with respect to the frame 37, about an axis concentric with the rotor 10.

In the embodiment shown, the exterior cylindrical surface of rotor 10 serves as a pulley for a drive belt 44 which connects the rotor to a source of power 45, but any other suitable means of driving the rotor in rotation may be utilized.

In the form shown in FIGS. 3–5, the apparatus is intended to concentrate the magnetic flux of the several solenoids radially inward, and to facilitate this each of the solenoids is provided with a core 46 of material having high magnetic permeability. As shown in FIG. 4, the several cores 46 are of squat U-shape, and extend, for the most part, parallel to the axis of the rotor, but at each end the cores are curved so as to provide faces 47 and 48 addressed radially inward. To minimize the radially outward escape of magnetic flux from the several solenoids, they are preferably wound of ribbon-like conductor which is coated with any appropriate electrical insulation. The first course of winding begins at 49, and proceeds in helically wound fashion with the minimum of space between adjacent turns about core 46, to the opposite end thereof, whereupon, without interrupting the continuity of the conductor, the second course is wound helically over the first course, with the pitch of the helix reversed from that in the first course. In this way, any gaps between successive turns in the first course are overlapped by turns in the second course. While the drawings show only two courses of conductor about each core 46, it will be understood that, in practice, there may be many more courses.

With the several solenoids connected through the slip rings to a source of direct current as above-described, it will be understood that all the solenoids 11–22 have the same polar orientation with respect to the axis of rotation of the rotor. For example, all core ends 47 are North poles, and all core ends 48 are South poles.

A tube 50 of circular cross-section is mounted in fixed relationship within the respective ferrules 38 and 39. The tube 50 is preferably made of material having little or no magnetic permeability. The tube 50 is stationary, but the rotor 10 rotates about the axis of the tube 50.

A stationary solenoid 51 is freedly mounted on the exterior of tube 50 in a position such as to fit, with clearance, into the bight of the squat U-shaped solenoids 11–22. Solenoid 51 may be wound directly on tube 50, but in the form shown, it is wound on a cylindrical core 52 of material having little or no magnetic permeability, and the core 52 is telescoped on tube 50. The stationary solenoid 51 is energized through appropriate leads (not shown) from conductors 33 and 34 or other source of direct current, and is so connected that its magnetic polarity is opposite that of solenoids 11–22, that is to say that when, as aforesaid, the core ends 47 are North poles, the adjacent end of solenoid 51 will be its South pole. Thus, magnetic flux of solenoids 11–22 has an external path, through tube 50, which is coincident with, and in the same direction as, the internal path of magnetic flux in solenoid 51.

Thus, the magnetic field generated by each of the solenoids 11 through 22, as well as that generated by solenoid 51, penetrates the interior of tube 50, and when the rotor is driven in rotation, the magnetic fields rotate collectively about the axis of tube 50. During such rotation, particles of matter within the tube 50 are within the motional electric field generated by the rotating magnetic flux. Such an apparatus has a demonstrable effect in the separation and concentration

of fluids. For example, in the de-salinization of water, the $B \times V$ electric field generated by the rotating magnetic fields, acts upon the disassociated ions of the sodium chloride in solution. This is explained by the fact that if the rotor 10 be rotated in the direction shown by the arrows in FIG. 5, the $B \times V$ field tends to drive the positively charged sodium cations toward the center, and tends to drive the negatively charged chlorine anions away from the center of tube 50. Hence, by introducing a flow of saline water at end 54 of tube 50, and by providing a concentric separating tube 55 at end 56 of tube 50, increments of fluid which are concentrated with sodium and depleted of chlorine may be drawn off through the stationary tube 55, while the increments of fluid which are concentrated with chlorine and depleted of sodium may be drawn off through the space between the exterior walls of tube 55 and the interior walls of tube 50.

Another utility of the apparatus shown is that of transmuting hydrogen into helium, in which event tube 55 is omitted and electrodes are provided at opposite ends 54 and 56 of tube 50, so that an electric arc may be established between them. Heretofore, difficulty has been encountered in maintaining the plasma of the arc in a relatively straight path between the electrodes as it ends to wiggle and extinguish itself when it makes contact with one of the confining walls. However, by impressing a $B \times V$ electric field upon such an arc, its path may be confined within controllable limits. The $B \times V$ electric field has the further effect of driving hydrogen protons toward the center of the tube, and driving electrons away from the center of the tube. Add one neutron to a hydrogen atom nucleus, and there is produced the isotope known as Dueterium; add one more neutron to the Dueterium nucleus, and it becomes Tritium; add one more proton to the Tritium nucleus, and it becomes Helium.

A third embodiment of the apparatus is shown in FIGS. 6, 7, and 8. With the significant exception that the embodiment of FIGS. 6, 7, and 8 has no moving mechanical parts, its organization is, in general, quite similar to that shown in FIGS. 4 and 5, and hence the last two digits of the reference characters utilized in the previous embodiment. As shown in FIG. 6, a cylindrical tube 150 has a solenoid 151 wound on the exterior thereof, and is energized with direct current from a suitable source through leads 153. A plurality of squat U-shaped solenoids 111, 112, and 113, of keystone-shaped cross-section, of which there are four each or any multiple of four, are wound as described in connection with the previous embodiment, and securely mounted in any suitable way with their pole faces 147 and 148 contiguous with, and addressed toward the axis of, tube 150. In this embodiment, however, the several squat U-shaped solenoids 111, 112, and 113, have cores which are made of material having little or not magnetic permeability, such as tubes 146 of paperboard wound to a keystone shape with hollow interior. As in the previous embodiment, the magnetic polarity of solenoid 151 is opposite that of the solenoids 111, 112, and 113, which is to say that if ends 147 of the solenoids 111–113 are the North poles thereof, the adjacent end of solenoid 151 is its South pole, so that the external magnetic flux path from solenoids 111–113 is coincident with, and in the same direction as, the internal flux path of solenoid 151.

In the embodiment shown in FIGS. 6–8, the several squat U-shaped solenoids 111, 112, and 113 are energized with non-interconnected three-phase alternating current, each phase of which has been half-wave rectified to produce direct current pulsating at alternate half cycles. One phase of the alternating current is connected to all solenoids 111; another phase of the alternating current is connected to all solenoids 112; and the third phase of the alternating current is connect to all solenoids 113, as shown in the wiring diagram of FIG. 8, where a three-phase alternator 100 is provided with six leads arranged in three pairs, to wit: leads 101 and 101' for the first phase, leads 102 and 102' for the second phase, and leads 103 and 103' for the third phase. The respective phases are not electrically interconnected. In each of leads 101, 102, and 103, there is a rectifier 104, 105, and 106, respectively. Leads 101 and 101' serve all four of solenoids 111; leads 102 and 102' serve all four of solenoids 112; and leads 103 and 103' serve all four of solenoids 113. Across leads 101 and 101', between the rectifier 104 and the respective solenoids 111, there is provided a capacitor 107. Such capacitor is to coordinate the capacity and inductance of input, and to neutralize the effect of induction in solenoids 111 by adjacent solenoids during the off half-cycle of energization. Likewise, a capacitor 108 is connected between leads 102 and 102', and a capacitor 109 is connected between leads 103 and 103'. It will be apparent to those skilled in the art that since the four solenoids of like phase are arranged in quardrature with each other, and since solenoids 111 will reach their peak of magnetic flux 120° ahead of solenoids 112 reaching their peak flux, and the latter 120° ahead of solenoids 113 reaching their peak flux, a revolving magnetic field is created. Due to the rectification of the alternating current, and the consequent utilization of the half cycles which all flow in the same direction, there will be no reversal of the direction of magnetic flux generated by any of solenoids 111, 112, and 113, and hence, as in the case of the previous embodiment, the external path of all magnetic flux generated in the solenoids 111, 112, and 113 is coincident with, and in the same direction as, the internal flux generated by direct current energization of solenoid 151. When such an arrangement is supplied with alternating current at high frequency, such as a thousand cycles per second, the same results are achievable with this embodiment as with the previous embodiment but without movement of any mechanical parts.

For the purpose of illustrating the effect of the $B \times V$ electric field, and segregating that effect from the effect of stray magnetic or electrostatic forces, reference may be had to FIGS. 9 and 10. The device there shown is intended to be encased in an electrically grounded box 70 of material which has a high magnetic permeability, and which also has the property of electrical conductivity for shielding electrostatic fields.

Within the box 70, there is a compound rotor machine, wherein the respective rotors are driven in opposite directions. In a suitable frame having spaced pedestals 71 and 72, there is mounted a shaft 73 and an independent shaft 74. Both shafts 73 and 74 may be driven from a single source of power, and are preferably driven at the same rotational speed, but in opposite senses. A yoke 75 is fixedly mounted to shaft 73 for rotation with it. The yoke is cup-shaped with cylindrical skirt 76. About the inner periphery of the skirt 76, a plurality os solenoidal electro magnets 77 are fixedly mounted thereto. The several electro magnets extend parallel with the common axis of rotation of shafts 73 and 74, and are of the same polar orientation with respect to those shafts. The several electro magnets 77 have identical solenoids wound, in the manner previously described, about identical cores of material having high magnetic permeability. The solenoids of the several electro magnets 77 are energized from a suitable source of direct current through conductors 84 and 85, brushes 86 and 87, slip rings 88 and 89, and conductors 90 and 91. The respective solenoids 76 are preferably connected in parallel circuit relationship, but, if desired, may be in series so long as uniform polar orientation is maintained.

Shaft 74 is provided with a hub 78 having a coaxial bore 79, into which is rotatably fitted a pilot 80 projecting concentrically from shaft 73. On the outer periphery of hub 78, there is fixedly mounted a plurality of electro magnets 81, each of which is an identical solenoid, and each of which has an identical core of material having high magnetic permeability. As in the previous case, the several solenoids 81 are all energized so as to have the same polar orientation with respect to their axis of rotation. Each of the solenoids is energized from a suitable source of direct current through conductors 68 and 69, brushes 82 and 83, slip rings 95 and 96, and conductors 97 and 98. All of the solenoids 81 are preferably connected in series circuit relationship, but, if desired, may be in parallel.

If desired, and as shown, the several solenoids 81 may be surrounded by a simple solenoid 59 wound helically

thereabout and electrically connected in parallel or series relationship with solenoids 81 and to conductors 97–98 so that the current flow through solenoid 99 is in the same direction as through solenoids 81. Thus the winding 99 serves the dual purpose of boosting the magnetic fields generated by solenoids 81 and of mechanically binding the latter to the surface of hub 78.

When, as contemplated, the shafts 73 and 74 are driven in rotation simultaneously, but in opposite directions, the solenoids 77 which rotate with shaft 73 have opposite magnetic polar orientation to those (81) which rotate with shaft 74. The several solenoids 77 are preferably designed to create external magnetic flux fields of flux density approximately equal and opposite to those created by electro magnets 81 and 99, but by the principle of superposition ("Elec. & Mag.", by Ralph W. Winch, 1963 Ed., p. 202), each flux field acts as if the other were not present. Despite the fact that the flux fields created by the responsive series of electro magnets 77 and 81 and 89 are oppositely directed, since their rotation is in opposite senses, their resultant effect, insofar as concerns the generation of a $B \times V$ electric field, is cumulative. Accordingly, the external $B \times V$ electric field is intensified at the exterior of the device, and its effect on the outside of shielding box 70 is demonstrable, even though the resultant magnetic flux density there is approximately zero. Such demonstration might be through a capacitor and electrometer as shown in FIG. 9, for example.

In order to achieve the maximum flux density and hence the maximum $B \times V$ electric field intensity, it is desirable to take measures which keep the apparatus cool. This may involve resort to such means as: winding the several solenoids with so-called "super-conductors" such as that known commercially as "Supercon"; or refrigerating the apparatus as by immersing it in a bath of liquid helium which is capable of maintaining a temperature of approximately 4° Absolute.

While several illustrative embodiments of the invention have been disclosed in detail, it is not to be understood that the invention is limited to those embodiments. On the contrary, the principles of the invention are susceptible of application in a vast variety of forms without departing from the spirit of the invention or the scope of the appended claims. The apparatus defined in the following claims is believed by the applicant to demonstrate his unique theory disclosed above.

What is claimed is:

1. Apparatus for generating an electric field, comprising:
a frame;
a cylindrical rotor;
a shaft journalled on the frame and supporting the rotor for rotation about is longitudinal axis;
a plurality of electro magnets, each of which is an identical solenoid having a core formed of a material having a high magnetic permeability, the electro magnets being fixedly mounted on the rotor with each electromagnet extending parallel to the axis of rotation thereof,
means to energize the solenoids of the electro magnets from a direct current source, the solenoids being energized so as to maintain a uniform polar orientation; and
an enclosure surrounding the frame and the rotor, the enclosure being formed of an electrically conductive material the enclosure being grounded.

2. Apparatus according to claim 1 wherein the rotor is a hollow cylindrical rotor, the electromagnets being affixed to the inner cylindrical surface of the rotor.

3. Apparatus according to claim 1 wherein the solenoids are connected in parallel circuit relationship.

4. Apparatus for demonstrating magnetic phenomena comprising:
a frame;
a cylindrical rotor;
a shaft journalled on the frame and supporting the rotor for rotation about its longitudinal axis;
a plurality of electro magnets, each of which is an identical solenoid having a core formed of a material having a high magnetic permeability, the electro magnets being fixedly mounted on the rotor with each electro magnet extending parallel to the axis of rotation thereof,
means to energize the solenoids of the electro magnets from a direct current source, the solenoids being energized so as to maintain a uniform polar orientation;
an enclosure surrounding the frame and the rotor, the enclosure being formed of an electrically conductive material, the enclosure being grounded; and
means surrounding at least a portion of the enclosure to detect and measure the electric field generated during rotation of the energized rotor.

5. Apparatus for demonstrating magnetic phenomena, comprising:
a U-shaped yoke of highly permeable magnetic material;
a pair of permanent magnets mounted in axial alignment between the ends of the yoke, one magnet being mounted to each leg of the yoke;
an electrically conductive non-magnetic rod extending axially through the magnets;
a stiff conductor mounted at one end to the rod for rotation relative to the yoke in a plane perpendicular to the rod and intermediate the magnets, the conductor extending a sufficient distance beyond the magnets so that its other end is located at a point where the magnetic field from the magnets falls to approximately zero intensity;
a galvanometer; and
circuit means connecting the ends of the conductor to the galvanometer to measure current flow through the conductor.

6. Apparatus according to claim 5 wherein the magnets are rotatably mounted to the yoke for rotation about the axis of the rod, and where the magnets are axially magnetized and adjacent faces are of opposite polarity.

* * * * *

APPENDIX III

A CONDITIONAL CRITERION FOR IDENTITY, LEADING TO A FOURTH LAW OF LOGIC

Summary

If logic is regarded as a set of perceptual operations, then logic has a chronotopology (time structure). Identity or nonidentity then results as a decision from an algorithm — a set of perceptual operations and comparisons — in which case the nature of a particular identity is conditional upon the nature of the set of perceptual operations comprising the algorithm.

Ordinary logic does not account for the temporal aspects of perception, merely accounting for the spatial aspects.

In other words, Aristotlean logic is a synthesis of primitive observation, fitted to the partial (spatial) reality emerging from spacetime after the imposition of the monocular (one-at-a-time) photon interaction with matter.

In quantum mechanics, time is a parameter, not an observable. Hence measurement/detection (of observables) deals with primitive observation and Aristotlean logic (topology).

Total reality includes nonprimitive observation — hence, non-Aristotlean logic (chronotopology) — as shown in Young's two-slit experiment.

By applying temporal accounting to each perceptual operation, Aristotle's three laws can be shown to be self-contradictory and incomplete as written. That is, they are topolological, not chronotopological.

A simple derivation of a fourth law is shown and an application rule given which itself may be regarded as a fifth law of logic.

A proof of the fourth law by demonstration is given.

The resulting four law logic is chronotopological. The applica-

tion rule states that either Aristotle's three laws apply explicitly and the fourth law is implicit, or the fourth law applies explicitly and Aristotle's three laws are implicit.

The four-law chronotopological logic is theoretically capable of resolving every present three-law paradox.

Aristotle's Laws and the Paradox of Change

Aristotle's three laws of logic, on which foundation rests all mathematical, physical, and rational thinking, can ordinarily be stated as shown in Table 1.

Table 1. Aristotle's three laws of logical thought

1. $A \equiv A$
2. $A \not\equiv \overline{A}$
3. $A \vee \overline{A}$

A variety of arguments can easily be produced to show that these laws are incomplete; i.e., they do not specify all reality, for parts of reality can be shown to contradict one or more of Aristotle's laws.

Indeed, all "observed" reality can be shown to violate all three-laws.

E.g., the most direct violation is posed by the problem of change, a problem originally propounded by Heraclitus about 500 B.C., and unsolved to this day. Heraclitus pointed out that, for a thing to change, it must turn into something else, and then asked how a thing could be something other than itself?

We may think of a thing — say, α —some feature A of which is said to change. If A changes, it turns into $\overline{A}$, thus violating logic laws one and two. Further, we are considering A as the "changed thing. $\overline{A}$," i.e., something which is somehow both A and $\overline{A}$, so logic law three is violated as well.

Thus, if Aristotle's laws are taken to be all the fundamental laws of logic, then logically there can be no change whatsoever, because change negates all three laws. I.e., either change does not exist or it is totally illogical.

Since all measurements, detections, thoughts, and perceptions are simply changes, then it follows that these operations logically cannot exist. Or, if we assume the "operations" to exist, their outputs cannot exist. If the operations do not exist, then again their outputs do not exist.

So if the products or outputs cannot exist, then by this reasoning no perceived, detected, measured, conceived thing exists. If we then insist that such things do indeed exist, then all is paradoxical and illogical. This is essentially the nature of the paradox posed by Heraclitus.

Heraclitus's change paradox has not been satisfactorily resolved to this day, and rigorously all the rational science of the Western world, being based on paradoxical change (detection, perception, observation) is itself totally illogical by its own logical standards.

Resolving the Paradox of Change

However, the conditions necessary to resolve the problem of change can be stated simply by inspection of the problem as follows: (1) Aristotle's three laws must specify or apply to only that which is not changing, since change violates or negates all three laws; (2) If change is to logically exist, there must exist at least a fourth law of logic, one which applies to change; (3) This fourth law must contain the negations of each of the first three laws, since change negates them; (4) To be consistent, in any particular logical case, either the three laws explicitly apply or the fourth law explicitly applies (i.e., either change explicitly exists in that particular case or it does not); (5) Since all four laws must apply at all times, then when the three laws apply explicitly, the fourth law must be implicit—and when the fourth law applies explicitly, the three laws must be implicit.

With the five stated conditions, a fourth axiom of logic can be written simply by writing down the negations of Aristotle's three

laws, and synthesizing these negations into a single fourth law, as shown in Table 2.

Table 2. Negations to Aristotle's laws.

Aristotle's law	Negation	of negation*
$A \equiv A$	$A \not\equiv A$	$A \equiv \overline{A}$
$A \not\equiv \overline{A}$	$A \equiv \overline{A}$	$A \equiv \overline{A}$
$A \vee \overline{A}$	$A \wedge \overline{A}$	$A \equiv \overline{A}$ or $[A, \overline{A}]$

However, even though we can synthesize the negation into a single law — the old "identity of opposites" idea — we still have the problem of understanding such a law. Though at first glance the negations and the synthesized fourth law seem bewildering, we can readily comprehend them if we carefully consider the temporal nature of the process that occurs in logical thinking.

The Importance of Time

Specifically, a finite interval of time is required to perceive, think, detect, or observe an entity — regardless of whether we refer to "physical" or "mental" detection, because both physical and mental processes are temporal. Indeed, we flatly state without further discussion that ultimately the identifying or mapping of physical and mental operations onto each other is what time is a *priori.*

At any rate, we now carefully account for each individual time interval required to think, conceive, detect, perceive, or observe any entity — whether that entity is physical or mental — and we also account for the finite time interval required to perform a logical operation. So we rewrite Aristotle's three laws as shown in Table 3, with subscripted numbers indicating the separate time intervals in each law.

*These negations mean that A and $\overline{A}$ are totally undifferentiated.

Table 3. Temporally accounted laws and negations.

Aristotle's law		Negation
1.	$A_1 \equiv_3 A_2$	$A_1 \equiv_3 \overline{A}_2$ or $A_1 \not\equiv_3 A_2$
2.	$A_1 \not\equiv_3 \overline{A}_2$	$A_1 \equiv_3 \overline{A}_2$
3.	$A_1 \vee_3 \overline{A}_2$	$A_1 \wedge_3 \overline{A}_2$ or $[A_1, \overline{A}_2]_3$

The resolution to the entire mystery so long inherent in these axioms of logic now stands simply revealed: Whether one of Aristotle's laws holds or its negation holds is determined solely by the nature of the logical operation in time interval three.[1]

I.e., the operation in interval three may be regarded as an *algorithm* comprised of subsidiary (assumed) operations in separate time subintervals that, taken together, comprise the overall operation implied by the logic symbol.

Thus in the first law, if temporal tags (time snapshots) are not accounted (i,e., if they do not apply), then Aristotle's laws hold, for the snapshot 1 of A is not differentiated in algorithm 3 from snapshot 2 of A. This then rigorously holds for spatial (L^3) entities, but not for spacetime entities. The snapshots in this case for Aristotle's first law (and the others as well) are *spatial* snapshots. On the other hand, if snapshots 1 and 2 of A are themselves temporally differentiated in algorithm 3, then the negation of Aristotle's law applies, because the *spacetime* snapshots A_1 and A_2 are different. This is immediately apparent, e.g., in a Minkowski geometry representation, where the second snapshot of A will have a time coordinate different from the time coordinate of snapshot 1. This is represented as shown in figure 1, where "A" is taken as a simple magnitude, in this case 5.

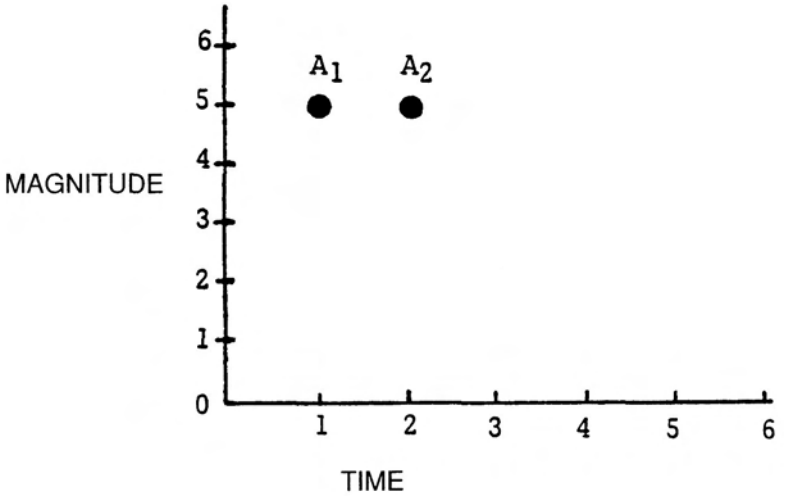

Figure 1. Spatial snapshots of spatiotemporal A differ.

As can be seen from figure 1, 5_1 is not identical to 5_2 *unless we imply the operator* $\partial/\partial t$ *in the time interval three algorithm.*

The negation of the second law may also be simply understood if we use temporal accounting. E.g., suppose we take $A_1 = +1$, $\overline{A}_2 = -1$ and then pose the absolute value operator || for potential use in algorithm 3. If || is not used, then

$$(+1)_1 \not\equiv_3 (-1)_2$$

and Aristotle's second law holds. If || is used, then

$$\left| (+1)_1 \right|_3 \equiv_3 \left| (-1)_2 \right|_3$$

and in that case

$$A_1 \equiv_3 \overline{A}_2$$

Note we are taking the view that there is nothing "absolute" or "inherent" about identity or non-identity; instead, each is a conditional result that can only be established by some logical, comparn

tive set of operations. If the suboperations comprising the decision algorithm for the identity/non-identity determination are changed, the finding of the algorithm (the decision) may often change. Specifically, one can have the cases

$$\equiv_1 \not\equiv_3 \equiv_2$$

$$\not\equiv_1 \not\equiv_3 \not\equiv_2$$

Thus we advance a *conditional identity criterion* to be incorporated into formal logic: "Identity" or "non-identity" is defined by a decision made as a result of applying an operational algorithm; changing the internal operator components assumed inherent in the algorithm can change the decision. We are stating a fundamental principle that "identity" and "non-identity" are conditional and only conditional; they are never absolute.

Primitive Observation and "Reality"

With these points made, we now turn to the third law. From Table 2, on examination it can be seen that the third law actually is a statement for *monocular* perception, detection, observation, thought, or conception. Indeed, this law says that only a single thing at a time can be perceived, detected, observed, thought, or conceived.

As we pointed out in a previous paper[2] , there is a very good reason for this "law." Primitive man lived almost exclusively in a reality detected by light, by the photon interaction. Even in the absence of visible light, all bodies have temperature, and man is immersed in a "sea" of continual electromagnetic photon with interactions. The photon interaction is monocular - - only one at a time interacts with a particle of mass. Further, photon interaction constitutes the operator $\partial/\partial T$ invoked upon L^3T spacetime. Photon emission carries away time (the photon is made of $(\Delta E\ \Delta T)$, leaving behind an L^3 *spatial* reality, as we have previously pointed out.[3]

So all our primitive concepts, ideas, and notions about reality have come from over four million years of hominid and human experience in the photon-detected partial reality ("physical," "objective," or "spatial" reality) that remains when the time "dimension" (fundamental **variable)** is destroyed from L^3T spacetime, leaving

only L^3 space behind. Specifically, our observed macroscopic reality consists of large temporal (mental) aggregates of such spatial results, where we cannot distinguish the tiny temporal separations of the pieces. Thus all our observed/perceived entities are spatial, and further, each perception/observation snapshot results in a frozen, unchanging spatial entity (resulting — in physical detection — from the so-called "collapse of the wave function." The loss of a wave function is simply the loss of time.) We vaguely sense "time" and "change" as the relation between these snapshots — i.e., by causality, or the ordering of the spatial changes — much as we see "movement" in movie frames rapidly projected onto a screen one-at-a-time.

Thus our primitive observations, from which have painfully been formed our relational concepts and ideas, are monocular, unchanging, and spatial. Aristotle's three laws of logic — which indeed may be taken to be only a simple synthesis of our primitive observation and corresponding relational concepts — then exhibit the same characteristics; they are monocular, unchanging, 3-dimensional, spatial, non-temporal relational statements. Any statement that is temporal, changing, or 4-dimensional will thus appear as a logical paradox to this logical shorthand.

But from Young's two-slit experiment, we already know that reality and relationships between its parts are quite different if the photon interaction is not invoked — i.e., if $\partial/\partial T$ is not invoked. Classical reality (as prescribed by Aristotle's laws) is directly violated by an electron in the two-slit experiment, e.g., if and only if photon interaction with the electron is not invoked. Again, this has been simply explained by the present author[4], and Charles Muses as early as 1957 pointed out the absence of any mystery in Young's experiment if the chronotopological aspects were considered.[5]

The Conscious Mind is Fitted to the Photon Interaction

However, what is normally referred to as the "conscious, thinking mind" is simply a functioning temporal (rigorously, chronotopological) mechanism that is painfully built up in the individual's awareness (his mind in the greater sense of both thought and awareness, whether monocular or multiocular) by training, conditioning and experience. Its functioning is largely conditioned by one's 90% or so attention to visual stimuli (to the partial reality remaining after

photon interaction has been invoked, and to the memory-collated ordering of vast numbers of such photon interactions) and by one's cultural conditioning — which itself has been almost exclusively conditioned and shaped by the monocular photon interaction at base root.

Thus, since the beginning of man, his conscious, rational mind has been trained and constructed to function almost exclusively in basic correspondence with the photon interaction, and his experiential reality consists of the partial reality stripped from fundamental reality by photon interaction.

All "perceived differences," e.g., are created by this deep mindset. As has been previously pointed out,[6] the solitary human problem responsible for all man's inhumanity to his fellow man is directly dependent upon man's almost exclusive detection, observation, perception, and conception of "difference" between humans, these "differences" being due exclusively and totally to the fitting of men's conscious minds to the photon interaction's monocular separation of spatial reality from nonspatial reality, i.e., to

$$\partial/\partial T\,(L^3T) \Rightarrow L^3$$

Such well-nigh total devotion to, and enslavement by, photon interaction also is responsible for the scientist's well-nigh total devotion to, and enslavement by, the present imperfect and incomplete three laws of logic, as presented by Aristotle. The depth of that devotion and enslavement is evidenced by the fact that the resolution of such paradoxes as Heraclitus's problem of change have eluded the best minds of humanity for several thousands of years. Indeed, these paradoxes cannot be resolved by the conscious, rational mind in its present state, for it has been most firmly constructed and fitted to function in accordance with the photon interaction.[7] One cannot hope to resolve any logical paradox by using only those same logical methods that found the situation to be paradoxical in the first place!

Dimensionality

That we need not be constrained by such universal delusion is already shown by binocular vision. Specifically, in viewing a three-dimensional **object, each** eye **never** detects a "third dimension," but detects only **an L^2 2-dimensional** picture. By taking two slightly

different 2-dimension snapshots and superposing them, the third dimension is gained. One then essentially sees the resultant superposed pictures as "almost the same but not quite." I.e., the Aristotlean identity algorithm, if satisfied, yields "no difference, hence one object," and if not satisfied, yields "difference, hence multiple (extended) object(s)." So if the two snapshots are almost Aristotlean-identical but not quite, we get an extended-two-dimensional (three-dimensional) object. Otherwise we see two separate, two-dimensional snapshots blurred together (the reader is urged to try this and see).

The point is, "dimensionality" and the identity algorithm are directly related, and geometrically one follows from the other.

Awareness of Time

In very similar manner, we can only gain cognizance of awareness of "time" (as a fourth dimension) by the superposing of two slightly differing (Aristotlean-wise) 3-dimensional snapshots. As is well known, e.g., time is not an "observable" in quantum mechanics; it is a "parameter." Rigorously, the only place such snapshots — each of which is "past" (spatially separated by the annihilation of time in the collapse of the wave function) — can multiply exist is in the "mind" in its most general sense. In a rigorous sense, mind and time can be taken as identical, and the "flow of time" can be taken as the "flow of mind connections or superpositions" of its spatial components. I.e., measured/detected/observed "physical phenomena" are a priori 3-dimensional and spatial, while a mind is four-dimensional and hyperspatial.[8] Spacetime exists mentally but not observably. Time is logically implicit, not explicit.

Temporal Aspects of Logic

Now we return to the temporal aspects of logic. Each perceptual part of each Aristotlean law is fitted to the photon interaction, hence monocular. The logic operation, inherent in the logic symbol in each statement, involves temporal superposition or comparison of spatial perceptual objects. Hence the logic operation is hyperdimensionally a function of mind and injects mind/time into the statement. Yet these laws, being fitted to or synthesizing photon interaction, attempt to prescribe the absence of time, even though writing down the logic operation rigorously invokes time. They are thus totally contradictory, since as written they implicitly violate themselves.

Table 4 summarizes the operations now to be permitted in the time-three algorithm, in developing a new four-law logic:

Table 4. Conditional identity rules.

1. $\left|\overline{S_1, S_2}\right|_3 = (\text{zero})_3 \Rightarrow (\text{identity})_3$

2. $\overline{\left|S_1, S_2\right|}_3 = (\text{nonzero})_3 \Rightarrow (\text{non-identity})_3$

3. $\left|\overline{S}\right|_3 = \left|\left|\overline{S}\right|_1, \left|\overline{S}\right|_2\right|_3 \Rightarrow$ monocular separation, differentiation internally

4. $\overset{S}{\overline{}}\,\Big|_3 = \overset{S}{\overline{}}\,\Big|_3 \Rightarrow$ nonseparation, no differentiation internally

Rules one and two simply state that, when snapshots 1 and 2 are superimposed (subtracted) in time interval 3, the resultant snapshot 3 may be zero or nonzero. If zero, snapshots 1 and 2 are said to be identical, and if snapshot 1 is to be labeled A, then snapshot 2 is to be labeled A. If snapshot 3 is nonzero, snapshots 1 and 2 are said to be nonidentical; if snapshot 1 is labeled A, then snapshot 2 is labeled $\overline{A}$.

Rule 3 says that snapshot 3 is a "memory" snapshot, and it may be particulately examined to monocularly separate snapshots 1 and 2.

Rule 4 states that snapshot 3 is not a "memory snapshot" and may not be further separated.

Note that in logic we repeatedly apply these rules in combination, serially or compositely. Note further that Rule 1 must serially apply both rules 3 and 4, as must rule 2 also.

If we take $4|_3$ to mean "rule 4 applied conditional to rule 3 also being applied," and $4|_{\overline{3}}$ to mean "rule 4 applied conditional to rule 3 not also being applied," we may write Table 5:

Table 5. Conditional identity, non-identity, and oneness.

$4|_{\overline{3}} \wedge 1 = \text{identity}\ (S_1, S_2)$

$4|_{\overline{3}} \wedge 2 = \text{non-identity}\ (S_1, S_2)$

$4|_{\overline{3}}$ = oneness without separate-ones; oneness, extraordinary and unperceivable; thing-in-itself

$4|_3$ = "ordinary" one, perceivable separation, "thing-as-separate-from-others"

As can be seen, this type of reasoning also sheds a great deal of light on the long-standing problem of the "thing-in-itself," but that is beyond the scope of this paper.

The Fourth Law of Logic

Now we write the fourth law of logic as follows:

$$4.\ (A_1, \overline{A}_2)_3 \Rightarrow A_1 \equiv_3 \overline{A}_2$$

where all we have said is that, by rule 4, in snapshot 3 no memory process is allowed, and no separation/differentiation whatsoever of A_1 and $\overline{A}_2$ is permitted. Under these operational conditions for identity, what had previously been called A_1 in snapshot 1 and what had been called $\overline{A}_2$ in snapshot 2 are indistinguishable, hence identical.

Figure 2 shows this concretely, and may be taken as a proof of the fourth law by demonstration.

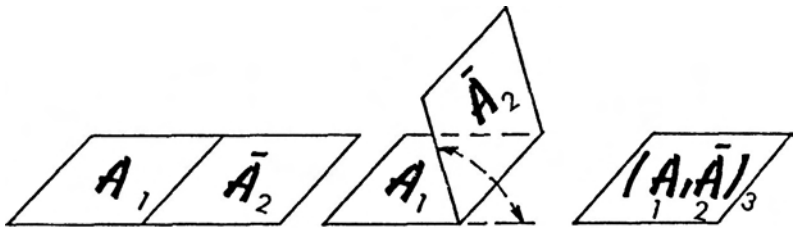

Figure 2. Proof that two opposites can be identified. What was separately perceived as A_1 in time snapshot 1 and what was separately perceived as $\bar{A}_2$ in time snapshot 2, cannot be distinguished in time snapshot 3.

Thus the age-old philosophical dilemma posed by the illogical identity of opposites has a simple resolution if one considers temporal aspects, and introduces temporal conditions for identity or non-identity decisions.

We now write the new four law conditional identity logic as shown in Table 6:

1. $A_1 \equiv_3 A_2$
2. $A \not\equiv_3 \bar{A}_2$
3. $A_1 \vee_3 \bar{A}_2$
4. $A_1 \equiv_3 \bar{A}_2$

Further, we point out that all four laws now apply. Laws 1,2, and 3 are the laws of explicit monocular perception, with implicit binocular perception. Law four is the law of explicit binocular perception, with implicit monocular perception. Both monocular and binocular perceptions must be and are used in each law. So in any situation, either the triad applies explicitly and the fourth law applies implicitly, or the fourth law applies explicitly and the triad applies implicitly.

Indeed, one can **even take the** view that we have prescribed a five-law logic, **the fifth law being taken** as shown in Table 7:

Table 7. A possible fifth law of logic.

5. $[1,2,3, \wedge (4)] \vee [4 \wedge (1,2,3,)]$ where () $\Rightarrow$ implicit

In a previous paper[9], the author has already presented methods to apply this new logic to resolve present paradoxes. At least hypothetically, every present paradox should be simply a statement of the explicit fourth law, and it should be resolvable by explicit application of that law[10].

NOTES AND REFERENCES

1. Specifically, by whether or not exclusivity applies. I.e., we may read Law 1 as "In snapshot (time interval) 3, what was A in snapshot 1 is exclusively identical to (unseparated from) what was A in snapshot 2." Law 2 may be read as "In snapshot 3, what was A in snapshot 1 is exclusively not identical to (is exclusively separated from) what was not-A in snapshot 2." Law 3 reads, "In snapshot 3, what was A in snapshot 1 and what was not-A in snapshot two are exclusively separated." Thus it can be seen that the three laws simply are statements involving whether or not two former perceptions are to be separated in a third perception. These three statements presently prescribe the total separation of the two previous perceptions and prohibit any admixture of the two — the so-called "excluded middle." Thus the three laws prescribe monocular, one-at-a-time perception.

   What we call a "wave" exists in time and is considered to contain an admixture of timeless, static spatial states (such as "wavelengths.") The prohibiting of admixtures thus represents the "collapse of the wave function" and corresponding loss of time. This defines "observation" and explains why all "measurement" and "detection" and "observation" — requiring a collapse of said wave function — are spatial and not spatiotemporal. That is why time is a parameter in quantum mechanics, not an observable.

   Relativity, being constrained by such logic, obviously can find nothing "physical" (observed, spatial, timeless thing frozen by

the collapse of the wave function as engendered by or fitted to the photon interaction) that is traveling faster than light — i.e., that violates the conditions implied by the "observing/detecting agent."

That reality need not at all be so constrained is clearly shown by Young's two-slit experiment, the heart of all quantum mechanics. In this experiment, "classical' reality is violated if and only if the photon interaction is not invoked. Classical reality is obeyed if the photon interaction is invoked.
With appropriate change to logic to fit "reality that has not been interacted with by photons" and therefore is spatiotemporal, a new physics becomes possible.

2. Thomas E. Bearden, "Solution of the Fundamental Problem of Quantum Mechanics," January 3,1977, Defense Documentation Center.

3. Bearden, "Photon Quenching of the Paranormal (Time) Channel: A Brief Note," 20 April 1977, Defense Documentation Center.

4. Bearden, "Virtual State Engineering and Its Implications," 1979, Defense Documentation Center.

5. With the possible exception of Kozyrev — whose more technical works on time remain undisclosed to open science — no other person known to this author seems to have grasped the implications of a dynamic structure of time as penetratingly as has Charles Muses. The importance of the time interaction explaining the two-slit experiment (i.e., in explaining wave-particle duality) was noted as early as 1957 by Muses. See, e.g., Muses' introduction to Jerome Rothstein's **Communication, Organization, and Science,** The Falcon's Wing Press, Indian Hills, Colorado, 1958, p. lxii, where Muses pointed out that the celebrated wave-particle paradox remains a paradox only so long as the chronotopological (his word) phases of the phenomena are left unrealized in the analysis. The entire foreword by Muses is a remarkable document which analyzes the structure of time itself. With his hypernumbers Muses can describe the nested structure of time, which is what is actually

being carried by the photon. Further, he can theoretically predict mechanisms by means of which these structures can be orthorotated. It would appear that practical devices should be constructable on the principles elucidated by Muses, and it is little short of astonishing that fundamental work of such importance and application has been thus far little used by theorists, though it is already recognized in the standard literature; e.g., the profound summary paper "Hypernumbers II" in the January 1978 issue of the journal **Applied Mathematics and Computation,** published by Elsevier.

6. Bearden, "The One Human Problem Its Solution, and Its Relation to UFO Phenomena," Defense Documentation Center, January 3, 1977.

7. Which is why a Zen master often gives the student a koan to confound and overwhelm this automatic, robotic mindset and functioning that has been constructed as the student's "conscious mind."

8. Specifically, consciousness/life involves a seven dimensional body/being in an infinite-dimensional universe. See Thomas E. Bearden, "A Mind/Brain/Matter Model Consistent with Quantum Physics and UFO Phenomena," prepared for the 1979 MUFON Annual Symposium, available in the **Proceedings,** MUFON, 103 Oldtown Road, Sequin, Texas 78155.

9. Bearden, "The Fourth Law of Logic," **Specula,** Journal of the American Association of Meta-Science, P.O. Box 1182, Huntsville, Alabama 35807, Vol. 2, No.l, January-March 1979, pp. 30-40; also in publication in Defense Documentation Center. (The journal **Specula** is no longer pulished).

10. No consideration of the foundations of logic and mathematics is complete until one has read Morris Kline, **Mathematics: The Loss of Certainty,** Oxford University Press, New York, 1980.

APPENDIX IV

LIST OF SELECTED INCIDENTS

Author's note: In 1985-1987 a series of anomalous missile and space failures swept the U.S. and the West. These incidents were not unique, as many think, but were actually only a portion of thousands of related incidents showing the Soviet testing of advanced weapons throughout the world. This listing will show the types of incidents referred to.

The listing is not intended to be complete at all, but only representative. Hundreds of incidents of weather engineering, giant cloud radials and grids, suspicious light incidents, etc. could easily be added, were there time and room. No attempt has been made to exhaustively map the "aerial booms" that have blanketed the U.S., Europe, and other parts of the world. The light and "maybe it's UFO's" reports alone would add thousands of incidents to the list.

Our message is succinct: The Soviet Union has developed a new science and weaponized it, since at least the latter 1940's. It has utilized that science — energetics — to develop superweapons and supervehicles. Because of the danger from accidental initiation of nuclear weapons and materials, it is exceedingly difficult and dangerous for the Soviets to make extensive use of these weapons. Accordingly, a biological warfare strike — AIDS — has been utilized to deliver what is to be the knockout blow to the West.

DATE, INCIDENT, LOCATION, REMARKS

Early spring 1966 - Malstrom AFB Montana.
UFO sighting coincident with simultaneous problems in 10 strategic missiles in launch site associated with Malstrom AFB, Montana. *Similar event in Mar 1967 also. (Source:* ***Clear Intent.).***

20 **Mar** 67 - Malstrom AFB Montana.
Flight of 10 strategic missiles in launch site associated with Malstrom AFB, Montana experienced problems with guidance and control system. UFO in area and confirmed on radar. Jet fighters scrambled, results unknown. *Similar event one year earlier.* (Source: **Clear Intent.).**

1972 - Prague.
At a secret meeting of European communist leaders in Prague, Brezhnev lays out firm statement of Soviet intent to be able to dominate the world by 1985. Stated would control the oceans, 90% of the land, and the air and space above. *Notice he said control, not invade and conquer.*

Aug 73 - Over ocean.
USAF Minuteman ICBM is launched from Vandenberg AFB, aimed for Kwajalein missile range. Unidentified object appears and is tracked next to the ICBM's nose cone. Crossed the RVs trajectory. Object about 10 ft long. Seen by 2 separate radars. Three other identical objects were seen in the vicinity. *Probable Soviet advanced flying vehicles. Also a deliberate stimulus to see if U.S. knows of the technology, and how the U.S. reacts. (Source:* ***Clear Intent.).***

18 **Oct 73** - Near Mansfield, Ohio.
U.S. Army helicopter is intercepted by glowing red object that converged on it with terrific speed. Object placed some sort of "tractor beam" on helicopter. Object was gray metallic structure, 50-60 ft long. Helicopter was stopped in mid air. Radio blacked out. Official report filed by pilot. *Probable advanced Soviet flying vehicle. Also a deliberate stimulus to see if U.S. knows of the technology, and how the U.S. reacts.*

21 Oct 73 - Near St. Joe, Indiana.
20 or 30 lights sighted circling in the sky near St. Joe, Indiana near a woods fire, by firemen. *Probable Soviet holographic tests to stimulate UFO reports.*

1973 to date - Bennett Island.
Bennett Is. exhaust plumes detected by U.S. weather satellites. *Well over 100. spotted so far. Weirdly, 5 islands and part of the continental Alaskan area are in process of being secretly given to the USSR; Bennett Island is one of them.*

May 1974 - Lake Michigan.
Blue-green glowing ball of light seen to fall into Lake Michigan. *Soviet scalar EM testing.*

8 July 74 - Lake Okeechobee, Florida and Atlantic Ocean.
Orange red ball of light lights up sky over south Florida. Crashes in area of Lake Okeechobee. Was accompanied by a large boom. Several other booms 5-7 min. after "object crashed." Pilots also saw object plummeting in from over Atlantic. *Probable Soviet scalar EM weapons testing and calibration.*

Nov. 74 - Saryshagan. USSR.
Construction of Tora facility begins at Soviets' Saryshagan test facility. Believed to be directed energy facility. *Probably connected with Soviet scalar EM weapons systems development.*

Oct? 74 - Antarctic.
Ozone hole over Antarctic first detected. Did not appear in measurements from 1957-1973. Note did not appear until exhaust plumes noted from and around Bennett Island, with substantial activity. *Looms over the continent every Oct. Diminishes through Mar. More severe each year since 1974.*

1975 - USSR.
Soviet article in **International Life** speaks of weather war, changing the nature of lightning, increasing the power of lightning, and directing electric charges of tremendous power against specified targets. "Atmospheric electricity" can be used to suppress mental activity of large groups of people. *Tip of the iceberg. Unclassified reference to Soviet's scalar EM (energetics) weapon program. Note involvement of "lightning" in destruction of U.S. missiles a decade later.*

16 **Feb 75** - Caribbean.
R.M.S. Carmania (UK) observes bright white circular light appear and rise to 20 degrees, leaving comet-like trail, circle and disappear. Repeated four more times at exact hourly intervals. *Soviet scalar EM weapons tests. May have been a shipborne device.*

13 June 75 - Kremlin.
Brezhnev calls for ban on frightful weapons of mass destruction. *Major speech. Repeated proposals to U.S. Senators.*

2 **Jul 75** - Kremlin.
Brezhnev repeats his proposed ban on development of frightful new weapons, to a group of U.S. Senators. *To visiting U.S. Senators. No one knew what he was talking about.*

Aug. 1975 - Kremlin.
Ponomarev calls for ban on frightful new weapons of mass destruction. *To visiting Congressmen.*

23 Sep 1975 - United Nations.
Gromyko presents draft agreement to UN General assembly, for banning development of frightful new weapons. *30th session of UN Gen. Assy. No one knew what the Soviets meant.*

Oct - Dec 75 - Satellite, over the Indian Ocean.
U.S. satellites illuminated or "blinded" over the Indian ocean. *Source 10-1,000 times as strong as natural sources. 5 incidents. One 4 hrs. long. Soviets wasted no time after Sep. fiasco.*

28 **Oct** to **11** Nov **75** - Mid-U.S. and Canada.
Series of "UFO's" seen at Malstrom AFB, Montana; Loring AFB, Maine; Minot AFB, North Dakota; Wurtsmith AFB, Michigan and Canadian Forces Station, Falconbridge, Ontario, Canada by reliable military personnel. Reported to NORAD. Some objects seemed like helicopters. Radar tracked objects. One object at 72,000 ft. was 100-ft sphere, with seeming "craters" around it.
Malstrom F-106's scrambled on one object but could not close on it in darkness and low altitude. Efforts by Air Guard helicopters, SAC helicopters and NORAD F-106's were fruitless. Probable Soviet activity in and around the SAC bases and Canadian radar site. (Source: **Clear Intent.).**

30 Oct 75 - Wurtsmith AFB, Michigan.
UFO's and "unidentified helicopters" sighted (multiple incidents) at or near Wurtsmith Air Force Base, Michigan. Helicopter hovered over the weapons storage area. Radar reported low-flying objects. Returning KC-135 tanker a/c diverted to intercept one UFO. Observed two objects, unable to close. Visual and radar contacts. Low on fuel, KC-135 returned to base to land, again seeing lights over the weapons storage area. (Source: **Clear Intent.)** *Soviet Activity.*

7 **Nov** 75 - Near Lewiston, Montana.
Giant glowing disc, football field sized, hovered over Minuteman missile launch site K-7, just south of Lewiston, Montana. When it rose to 1,000 ft., NORAD radar picked it up. Two F-106's were scrambled. UFO rose to 200,000 ft. and disappeared from NORAD radars. *Probable advanced Soviet flying vehicle, using antigravity propulsion system.* (Source: **Clear Intent.).**

Nov 75 - Semipalatinsk, USSR.
Large amounts of gaseous hydrogen with traces of tritium begin to be detected by USAF/TRW early warning satellites.
Nuclear debris apparently related to nuclear facility at Semipalatinsk labelled PNUTS (possible nuclear underground test site.) Probable large scalar EM development and test site.

Jan 76 - Cannon AFB, New Mexico.
Two UFO's reported near flight line at Cannon AFB, New Mexico. 25 yards in dia., gold or silver in color with blue light on top, hole in the middle and red light on bottom. Observed and reported by security police. (Source: **Clear Intent.).** *Probable Soviet activity.*

31 **Jan 76** - Eglin AFB, Florida.
MG Lane, CG, Armament and Development Test Center, Eglin AFB, Florida reported a UFO sighting near an Air Force Radar site from 0430 to 0600 Eastern Standard Time. Photographs were taken. Later press release called it "building lights." (Source: **Clear Intent.)** *Probable Soviet Scalar EM activity.*

1976 - U.S. Embassy, Moscow.
State Dept. declares U.S. Embassy in Moscow an unhealthful post. Installs Aluminum window screens against Soviet microwave radiation, which has been underway since 1950's.
Provided 20% pay extra differential. Embassy radiated with weak microwave radiation since 1950's. Two U.S. Ambassadors died, Stoessel ill with strange leukemia-like malady. Soviet stimulus to see if we knew about scalar electromagnetics, phase conjugate waves, and EM disease induction. (Stoessel died recently of cancer).

1976-U.S.
Soviet nuclear scientist named Rudakov visits U.S., proposes cooperative effort in some a**reas of** fusion research. Showed work he **had**

been doing and results obtained. U.S. officials reacted drastically, classified his talk as top secret, even ripped off blackboard and carried it away.*Very strange incident. Soviet open, public scientific work considered Top Secret by the U.S. One wonders why.*

30 **Mar** 76 - Netherlands.
Huge atmospheric boom occurs over northern part of Netherlands. *Through 1983, in 10 years 7 events took place.*

22 Jun 1976 - North Atlantic.
Expanding white sphere of light developed for about 10 min. then faded. Other associated light phenomena observed. *Seen and logged by passing ship.*

4 **Jul** 76 - Soviet Union.
Giant Soviet Woodpecker transmitters activated. *3-30 MHz band. Worldwide interference with communications.*

30 **Jul** 76 - Fort Ritchie, Maryland.
Several UFO's sighted in and around Ft. Ritchie, Maryland. One hovered over the ammunition storage area. Reported. *Temperature inversion at the time provided a convenient pseudoexplanation. Could not have caused the incidents.* (Source: **Clear Intent.)**

10 **Sep** 76 - Lithuania.
European Airways flight 831, Moscow to London, at 31,000 ft over Lithuania sees blinding single ball source of light at constant altitude about 5-6,000 ft. below them and above a lower cloud.
Pilot contacted Soviet authorities. Received negative response and suggestions he should not ask questions. Probable deliberate stimulus of flight so, from reports to British authorities, could ascertain whether Britain knew anything about scalar EM weaponry.

19 Sep 76 - Near Teheran, Iran.
In early morning hours, UFOs were spotted north of Teheran, Iran. Two F-4's attempted to intercept. The first lost all communications and instrumentation at 25 miles distance. When the F-4 turned away, equipment was restored to functioning. Second F-4 acquired radar lock at 27 nm. and attempted to close. Object moved to stay at 25 nm distance. Second object came out of it, headed straight for the F-4. F-4 attempted to fire AIM-9 missile and at that instant weapons

control panel and communications went off. F-4 took evasive action. A third object was seen to emerge from first. The F-4 returned to base. Each time it passed through 150 degrees magnetic bearing, it lost communications and INS fluttered 30 to 50 degrees. A civilian airliner also experienced loss of communications in the vicinity.
Signatures of scalar electromagnetic weapons and antigravity.

1976 - Soviet Union, Sweden.
Swedish national authorities detect anomalous radionuclides — similar to those from nuclear explosions — over Sweden. No accompanying seismic activity. Correlated with known Soviet activity at Semipalatinsk. *In other words, nuclear explosions were occurring, but they did not shake the earth. Total anomaly. Indicates transformation of the explosive energy. Positive signature.*

1976 - Philadelphia.
Legionnaires Disease precipitously strikes Legionnaires attending convention in downtown Philadelphia. Kills 34, makes 187 others seriously ill. Similar malady struck Odd Fellows convention at same hotel in 1974. *Odd person with apparent transmitter and antenna was expelled. Informed members: "It's too late! You are all dead!" Probable scalar EM conditioning of convention with an immune suppression pattern for the disease.*

21 **Jan 77** - Columbia.
Columbia A/L Avianca night flight. Instruments went haywire. Saw enormous, zigzagging glowing light, traveled at fantastic speed back and forth. Blinked landing lights, UFO responded. Sped away at incredible speed. *Probable Soviet advanced performance antigravity flying vehicle. Such have been widely sighted over South America.*

3 **Mar 77** - Columbia.
Columbia A/L Avianca night flight. Pilot abruptly changed course to circle a huge, glowing UFO. Object had cigar-shaped fuselage and was twice as big as the aircraft. Blinked lights, UFO responded. Sped away. Air traffic control radar tracked object at ten times the speed of normal aircraft.
Probable Soviet advanced performance antigravity flying vehicle. Such have been widely sighted in South America.

24 **Mar 77** - Off coast of Spanish Sahara, Africa.
M.V. Kinpurnie Castle, off coast of Spanish Sahara, Africa, observes complex, dynamic light phenomena. Third phenomenon was the formation of a semi-circular area of moderate luminosity, a hemisphere of light. Took 3 min to form about a previous luminous patch. Then another luminous patch formed over the hemisphere. After about 7 min., phenomena dispersed. *Soviet test of Tesla shield and globes.*

11 Jun 77 - Moscow, USSR.
Soviet biophysicist hands Robert Toth, Los Angeles Times journalist, a report containing proof that certain particles existed in cells, carried information, and were radiated. Both seized by KGB and charged with possessing Soviet state secrets. Interrogated, released. *Neither knew what they actually had. Soviet Academician I.M. Mikhailov pronounced secret such phrases as "micro-organism self-radiation... by means of vacuum particles in space." Use of such particles was discussed, and was secret. Paper contained basis of Soviet energetics use in biology. Positive connection of Soviet classification to mitogenetic radiation and scalar EM waves ("vacuum particles" indicate virtual flux structuring).*

13 July 77 - New York.
Massive electrical blackout strikes New York City. Affects 8 million persons. Staggering series of "natural" electrical shocks, mechanical failures, and human errors occurred. Anomalous "lightning strokes" supposedly initiated the collapse of the power grid. *Probable Soviet test.*

1977 - Ocean off Yugoslavia.
M.V. Dolphin, between Yugoslavia and Israel, observed extensive light balls and repeated phenomena, appearing and disappearing. Men were disoriented. Compass was disrupted. Okay after the phenomena dispersed. *Probable Soviet test. Stimulus to see if Britain recognized the weaponry and knew anything about it.*

13-14 Dec 1977 - Leitchville, Australia.
Large aerial light plus 3 smaller ones observed for four hours by multiple persons. Lights simulated activity of a "mother ship" and smaller craft assigned. Changed colors. Then a shower of orange

lights occurred. *Probable Soviet test. Part of deception plan, to create "UFO" phenomena to hide weapons testing. TR wave holography.*

Dec 77 to **Jan 78** - Off East U.S. Coast.
Mysterious atmospheric explosions occur off U.S. Atlantic Coast. *Some accompanied by light phenomena. Soviet tests and calibration (registering the long-range artillery, so to speak.)*

13-14 Dec 77 - Leitchville, Australia.
Large arrays of light phenomena sighted by multiple witnesses. *Probable Soviet creation. Reported as "UFO" phenomena. Holographic creation of "UFO" phenomena as part of deception plan to disguise tests of the weapons worldwide. TR wave holography.*

1977-78 - North Pacific Ocean.
Two huge hot spots in North Pacific ocean, 2,000 mi by 1,200 mi. *May have caused El Nino and one of most severe winters on record. May have been caused by Soviets as a weather experiment.*

27 **Jan 78** - U.S. East Coast.
Boeing 727 off east U.S. coast experiences engines failing, 1 at a time, in all three engines. A/c plunges 8,000 feet; engines restart one at a time. *First time ever that all three engines on a 727 had failed. Probable Soviet test.*

Feb 78 - Rocky Mtns. NW of Las Vegas.
Four aircraft crash in a 6-day period in the rugged Rockies, NW of Las Vegas. *Connected with a crashed military a/c from Nellis AF Base. Should be further investigated.*

Feb 78 - Texas coast. Nova Scotia. Charleston, SC.
Atmospheric booms occur. *Multiple booms in Charleston. Soviet tests. Scalar EM weapons.*

2 **Apr 78** - Bell Island, Nova Scotia.
Mysterious fireball, explosion accompanied by anomalous electrical effects. *Small bldgs blown apart, trees scorched, fireballs seen. Probable Soviet test. Apparently even registered on U.S. satellite.*

10 **May** 78 -Off Florida.
Women pilots in race experience anomalous "time loss" on their watches from Fort Myers to Freeport (Bahamas). *39pilots. Watches synchronized. Up to 3 min. lost. Definitely not normal EM effect. Probably due to sporadic natural scalar interferometry and time-reversed waves generated in area from time to time. "Bermuda Triangle" mechanism?*

May 78 - Florida.
Unexplained lighted objects sighted in sky over remote sector of Florida. Tracked on radar at a Navy EW center. Naval personnel also observed them through binoculars. *Probable Soviet advanced flying vehicles, or tests of intense holograms with energy sufficient to ionize air and reflect radar.*

18 **May** 78 - England.
Several atmospheric explosions shake houses over a wide area in Hull, Scunthorpe, Holderness coast, and Brough and Grimsby. *Probable Soviet weapon testing and calibration.*

Jun 78 - Indiana.
Large ball of light streaks across sky, stops, hovers, then explodes with a large boom. *Possible test. Standard Soviet incident to generate deception.*

7 **Sep** 78 - Netherlands.
Large acoustical event (boom) occurs over the Netherlands. *Soviet scalar EM weapons testing and calibration.*

Sep 78 - Tabas, Iran.
Anomalous Richter 7.4 earthquake strikes Tabas, Iran, killing 25,000. No aftershocks. Anomalous depth. Soviets needed to relievo pressure in rocks at nearby Askhabad on the Soviet/Iran border, else lose the city to a large earthquake. *36 hrs. earlier, Soviets exploded monstrous 10 Megaton underground nuclear explosion, to disguise what caused the earthquake. Almost definitely a Soviet- induced earthquake.*

Oct. 78 - USSR.
U.S. DOD weather satellite purportedly photographs a semi-rectangular object climbing out of atmosphere at 4,000 to 4,500 **mph.**

Object was over the Soviet Union. *Probable Soviet advanced flying vehicle, using antigravity propulsion system, if photograph is real.*

31 **Oct** 78 - Fairbanks, Alaska & Lake Ontario.
Red and yellow flash seen descending through sky S. of Fairbanks, Alaska by multiple observers. One minute later, U. of Alaska seismograph registered a tremor 1.5-2.0 on Richter scale. Ten days prior, a similar phenomenon was observed over Lake Ontario and a photo taken of the light. *Probable Soviet scalar EM wpns testing calibration.*

Nov 78 - Kuwait.
Large flying vehicle lands at Umm. Alaish oil pumping sta., Kuwait. Disrupts elect, comm, and pumping activities. Leaves after 7 min. *Probable antigravity propulsion system. Soviet vehicle. One of a series of "UFO" sightings in oil fields of Kuwait. Positive scalar electromagnetics and time-reversed wave signatures.*

Nov - Dec 1978 - Kuwait.
Series of "UFO" incidents over Kuwaiti oil fields occur. Kuwait Gov't. investigates, makes official report. *U.S. Pentagon noted incidents. Probable Soviet-induced incidents.*

1979 - British Columbia & Caspian Sea.
Ariel 6 satellite experiences anomalous turnoff of two power supplies. *Over British Columbia and Caspian Sea, when sun is shining. Probable Soviet stimulus.*

Jun 79 - Vienna.
Pres. Carter signs SALT II agreement in Vienna. After that, his acts and speech are erratic and he seems to be in a depressed state. *Suggestive of exposure to EM behavior modification. Soviets had possessed the LIDA technology for 29 years.*

Sep 1979 - USSR.
Strange giant semicircular light phenomena observed in USSR, toward Saryshagan. Observed several times. Source: London **Times.** *Observed from Afghanistan by British cameraman Nick Downie. Definitely Soviet tests of a Tesla globe and/or shield.*

22 Sep 79 - South Atlantic.
U.S. Vela satellites detect anomalous flash over South Atlantic, as if from a nuclear event. *U.S. Govt Agencies still disagree as to whether this was a nuclear event or not. May have been a Soviet test, or a test of a scalar EM weapon by another nonhostile country.*

25 Dec 79 - Afghanistan.
Soviets invade Afghanistan. *This is the Soviet "Spanish Civil War," where wpns, training, and the state of their ready reserves are tested. It is not primarily the regulars who are fighting there. Some scalar weapons — e.g. Smirch death ray — are tested also.*

1980 - Afghanistan.
Soviets kill 225 women and children in a village in the province of Maiden, near Kabul, Afghanistan. A month and a half later, bodies still undecayed. Bodies were also shot, to try to deceive Mujaheddin as to cause of death. *Bodies perfectly preserved. No smell, no bugs, no scavengers had eaten them. Probable Soviet test of a "death ray." Definitely scalar electromagnetic weapon signature.*

Feb 1980 - Duncanville, Texas.
About 100 startlings suddenly start falling from flight, instantly dead. *One of several such anomalous bird falls. Connected with very high frequency components added to Woodpecker signals for sharp localization. Birds entering such an area are killed.*

May 1980 - Seminole, Florida.
Start of mysterious plague of assorted illnesses striking healthy persons in a 20-block section of Seminole, Florida. Animals affected also. Lack friendly bacteria in their intestines. *Signatures of EM induction of disease and kill of intestinal bacteria. The lack of friendly bacteria is important. May indicate one direction of biological warfare planned by Soviets.*

June 1980 - USSR.
Huge, luminous hemisphere of light seen within Soviet Union, from Kuwait. Probably over Caucasus region of USSR. Source: personal communication from observer. *Tesla shield. A definite test, un equivocal.*

July 1980 - U.S. and Canada.
Richter 5.1 quake centered in northern Kentucky rumbles through 14 states and into Canada. *No known fault. Was predicted two wks in advanced by an associate.*

7 **Nov 80** - Applegate Valley, Oregon.
Mysterious explosion, earth rumbling, brilliant light turns night into day in Southern Oregon. *Associated with subsequent earthquake next day?*

8 **Nov 80** - California.
Richter 7.5 earthquake off coast of Southern California. Shakes CA and Southern Oregon. *Note anomalous phenomena in S. Oregon the preceding day.*

Dec 1980 - South Atlantic.
U.S. Vela satellites detect another anomalous nuclear-like flash over the South Atlantic. *In infrared only. Obviously not a normal nuclear wpn.*

28 **Dec 80** - South Atlantic.
Great bluish-white flash over the South Atlantic. Clear sky except 2 or 3 small cumulus clouds, one about 600 ft. above ship. *Possibly connected with the second Vela flash detection, or generated by the same system. One of many such incidents.*

1 **Jan 81** - Somerset, Pennsylvania.
Pilots of two a/c report the descent of a bright, shiny object with fiery tail over Pennsylvania. Large boom rumbles across most of Western PA. *Possible Soviet scalar EM testing. Part of deception plan.*

Jan 81 - Minnesoto, Wisconsin, South Dakota.
Great skyflashes and rumbling noises occur around Morris, Minnesoto and Wisconsin and South Dakota. *Possible Soviet scalar EM testing. Part of deception plan.*

Feb 81 - San Jose California.
Two pilots menaced by 10 ft. dia. light which flew directly at aircraft over San Jose, CA airport. Plane climbed, light followed, then sped away. *Totally consistent with exercise of the Soviet Launch Phase*

Anti-bomber system's real-time holography aspects of the Woodpecker OTH radars.

6 **May** 81 - Fredericksburg, Maryland.
EC-135 a/c crashed near Fredericksburg, MD. Severe nose-down from 29,000 ft. Apparent loss of all power. At 5,000 ft., either fire or minor explosion occurred. At 1,500 large explosion destroyed the aircraft. *Possible Soviet test of OTH radar anti-bomber weapon system?*

Mid-81 - Afghanistan.
Soviet helicopters use mysterious, highly lethal agent in Afghanistan. Causes death so quickly victims do not have time to make the slightest move. Rpt by Jane's Defense weekly. Referred to as Smirch gas or Smert gas. *Probable test of a Soviet scalar EM "death ray."*

20-23 Jan., 1982 - Gander, Newfoundland.
"Object with red, green and yellow lights sighted in the Gander, Newfoundland area more than 36 times. Alternately hovered and darted in a complex "flight" pattern. *Possible real-time holographic phenomena produced by Soviet scalar EM weapons as part of the worldwide deception plan. Gander is a major "registration point."*

3 **Feb** 82 - Newfoundland.
Red and green flashing lights travelling across the horizon at 2,000 mph reported by 3 Armed Forces officers at Gander, Newfoundland. *Possible real-time holographic phenomena produced by Soviet scalar EM weapons as part of the worldwide deception plan. Possible major "registration point."*

Feb 82 - Ankasaray, Turkey.
Cluster of high, multiple lights pass over Turkish town of Ankasaray, 200 km. from Ankara. Dogs were disturbed also. *Possible real time holographic phenomena produced by Soviet scalar EM weapons as part of the worldwide deception of plan. Gander is a major "registration point."*

Sep 82 - Ankara, Turkey.
Cluster of 10-14 high, multiple lights pass over Ankara, Turkey in clear night sky. Dogs were also disturbed. *Possible real-time holographic phenomena produced by Soviet scalar EM weapons as part of the worldwide deception plan.*

Early 82 - St. Petersburg, Florida.
Extended series of booms occur off coast of Florida, near St. Petersburg. *Continued lengthy period of time. Years of Soviet scalar EM interference grid adjustments have been registered in Florida and off St. Petersburg. Booms are so numerous that meetings of civil defense, federal, and state officials have been held.*

June 82 - Washington/Canada border and off-shore.
Extended series of booms occur over Pacific Ocean, centered about Port Angeles and Sequim near Washington state/Canadian border. *Persisted for several weeks. As many as 10 blasts per day. Fireballs and lights also seen. Soviet extended scalar EM tests.*

18 June 82 - Northern Pacific Ocean.
Two JAL flight crews observe large, yellowish-white globe of light over the North Pacific Ocean 700 mi. east of Hokkaido, Japan. Covered one fourth of the sky. Light gradually dimmed and disappeared. *Tesla globe. Definitely a Soviet weapons test.*

June 1982 - Red China.
Several Red Chinese giant light hemisphere and globe incidents. In one instance, a/c electrical power systems began to fail in several Red Chinese fighter a/c when encountering a huge hemisphere of glowing light. *Tesla globes. Tesla shields. Balls of light. Definitely Soviet weapons tests.*

24 **Sep** 82 - Maryland, New Jersey.
Anomalous airquakes off the coast of Cape May and Northern Maryland, and Atlantic City, New Jersey. *Adjustment of Woodpecker grid. Soviet tests. 3 weeks later also.*

14 **Oct** 82 - Maryland, New Jersey.
Anomalous airquakes off the coast of Cape May and Northern Maryland, and Atlantic City, New Jersey. *Adjustment of Woodpecker grid. Soviet tests. 3 weeks earlier also.*

16 **Nov** 82 - Delaware, New Jersey.
Five mysterious booms rock Sussex county, Delaware and southern New Jersey. *Adjustment of Woodpecker grid. Soviet tests.*

1983 - Loma Linda, California.
Photos and information about the Soviet LIDA machine released. 40 MHz carrier, complex waveforms. Induces catatonic state in humans and animals. *Shows consciousness can be affected by EM means. Was used on U.S. prisoners of war in Korea. Suggests similar capabilities are possible for Woodpecker. U.S. scientific community had said impossible. President Carter affected in Jun. 79?*

Early 1983 - Bennett Island.
Large exhaust plume detected coming from Bennett Island and vicinity, one on-shore and two offshore. Plume was 6 mi. wide, 155 mi. long and reached 23,000 ft in height. *U.S. weather satellites detected it. Nearly horiz. jet, 155 mi. long. Definitely not natural. At angle ofperhaps 1.5 degree above horizontal.*

27 **Sep** 83 - England.
British RAF/Panavia Tornado aircraft loses all electrical power and crashes. *Possible Test? Tornado system is triplexed.*

22 **Oct 83** - Off Okinawa.
Two a/c operating off U.S.S. Midway apparently lost w/o trace, about 127 mi. E. of Okinawa, under anomalous conditions. *Causes unknown. Additional data needed.*

8 **Nov 83** - Western Europe.
Anomalous earthquake occurs in Western Europe. All foreshocks and aftershocks were missing. Called the "Leige" earthquake. Definite symptoms of manmade (Soviet) origin. *Large boom occurred over Netherlands the next day over 35,000 sq. km. area. Soviet scalar EM weapon testing.*

9 **Nov 83** - Netherlands.
Large acoustic event occurs over Netherlands. Detected over 35,000 sq. km. First mistaken as a Dutch quake. *One day after the anomalous Leige quake. Soviet wpn testing.*

Dec 83 - Alma Ata.
Stored munitions exploded at Dolon (Soviet) airfield. 150 km south of Alma Ata. One of six that mysteriously exploded in 7 months. *May be evidence that another nation also has Scalar EM wpns, and*

is checking the Soviets. If so, probably was warning that Soviets also would suffer if they moved.

1984 - Novaya Zemlya.
First mysterious plume detected from Novaya Zemlya by U.S. weather satellites. Sometimes plumes are 200 mi. long. *Novaya Zemlya contains Soviet atomic facilities including weapon facilities.*

1984
Senior Soviet physicist G. Yu. Bogoslovsky publishes paper, "Generalization of Einstein's Relativity theory for the anisotropic space-time." Such Russian research published regularly. Would be impossible in U.S., where similar attempts meet discredit, humiliation, and rejection by leading U.S. physics journals and departments. *The West has decreed that general relativity must not be local, and above all must not be lab-bench experimental. Open Soviet publication indicative of experimental development of local space-time curvature technology.*

1982 - 84 - Florida (& elsewhere).
Airquakes, booms (hundreds). *16 counties, near coast.*

28 Jan 84 - Pennsylvania, New Jersey.
Bright orange light streaks across sky from Pa. to N.J.'s Cape May. Similar "fireball" explodes in Clementon. Two other sky explosions observed. *Possible Soviet activity. TR wave holography and pulses. Part of Soviet deception plan.*

Feb 84 - in space.
All three payloads of the Challenger flight fail. *2 commication satillites, 1 balloon.*

10 **Feb** 84 - Netherlands.
Large atmospheric boom occurs over Netherlands. *7 others thru 1983.*

29 Mar 84 - Bennett Island.
Bennett Island exhaust plume detected by U.S. weather satellite. *Over 100 such anomalous exhaust plumes detected there.*

9 **Apr.** 84 - S. of Kurils toward USSR.
Giant rapid cloud tower rose, then faded. Small semicir. halo of light replaced it. Halo expanded to full circle of light. Expanded to giant globe then faded. *Cloud 60,000 ft in 2 min. Light globe expanded to about 380 mi. dia. and center over 200 mi. high. Source:* ***Science*** *Journal. Definitely a Soviet test of multiple weapon modes.*

26 **Apr.** 84 - Bennett Island.
Bennett Island exhaust plume detected by U.S. weather satellite. *Over 100 such anomalous exhaust plumes detected there.*

May 84 – S.E. U.S.
Series of devastating storms breaks out over S.E. U.S. in early May. Tornadoes, large hail, downbursts. Some loss of life. Persisted through night into early morning hours. Several instances of rapid thunderstorm top warming were observed in satellite photography. Occurred near downbursts. Very heavy plume activity at Bennett Is. noted in Apr. and May, 1984. *Warming of tops of thunderstorms can produce downbursts. In literature. Note that Soviet scalar EM wpns can perform such top-warming of thunderstorm anvils, and induce downbursts on command.*

13 **May** 84 - Severomorsk, USSR.
Soviet missile storage facility at Severomorsk Naval Base on the Kola Peninsula 1450 km north of Moscow blows up in a series of vast explosions. Over 200 wounded. Soviet North Fleet lost about 1/3 of its missiles. Speculation of an "electromagnetic cause, possibly by reflection of radio waves from ionosphere." Detected by satellites; first thought to be nuclear explosion. *One of six such explosions of Soviet ammunition storage sites in a period of seven months. Definitely not accidental. Probably use of scalar EM weapons by another nation, not hostile to U.S., to warn the Soviets that they also will suffer if they move.*

15 **May** 84 - Bobrwjk Airfield.
Major blast occurs at Bobrwjk Airfield, 138 km SE of Minsk and the base of a Badger-equipped air-to-surface missile regiment of the Smolensk Air Army. 10 of the 11 ammo storage bldgs blow up and admin, and access control bldgs. are destroyed. Note that fires and explosions were still raging at Severomorsk, from 13 May event. *Same note as above.*

25 **Jun** 84 - Schuerin, East Germany.
Explosion occurs at an ammunition depot at Schuerin, south of Wismar in East Germany. Windows blown out within 10 mi. radius of depot. *Same note as above.*

27 **Jul** 84 - Kuril Islands.
Slowly expandingball oflight seen by Boeing 747 crew near the Kuril Islands. Expanded for 10 min. Shell was sharply defined. Light semi-transparent and nearly perfect half-circle. *Tesla globe. Bennett Is. exhaust plumes detected by U.S. weather satellite. Definitely a Soviet test. Related to 9 Apr. 84 incidents S. ofKurils.*

29 **Aug 84** - Edwards AFB, California.
B-l bomber prototype crashes in flight test about 10 mi. NE of Edwards AF Base.

1983-84 - Ireland.
For two years, freak lightning terrorizes villages of West Donegal, Ireland. Roofs stripped off, windows smashed, pipelines wrecked, telephones and TVs blown up. *No known cause for the anomalous lightning. Shows natural potential in area is disrupted.*

25 **Dec 84** - Ireland.
Freak lightning continues in West Donegal, Ireland. Causes 3-day power blackout. *Extensive plume activity at Bennett Island.*

1985 - Worldwide.
After years of a superb safety record, airline industry suffers a series of disastrous crashes. 20 major air crashes occur worldwide, with more than 2,150 lives lost.

Early 85 - Worldwide.
KGB begins a worldwide campaign to blame the U.S. for starting the AIDS epidemic. *Effort continues. Disinformation; is believed in 3rd world.*

Jan 85 - San Diego, California.
U.S. Navy chaff caught by wind, blown in over San Diego. Power knocked out to 60,000 homes. *Symptoms of presence of Soviet scalar EM grid in San Diego urea.*

7 **Jan 85** - Cantrell, Alaska.
Cantrell, Alaska. Blinding white light passes in sky overhead, lights up sky and mountain range for 30-40 seconds for 16 mi. Est. 3-mi. altitude. *Probable Soviet test. Note that plume activity at Bennett Is. is heavy in Jan. 85.*

Feb 85 - Zimbabwe.
Zimbabwe suffering worst electrical storm season in history. Death toll up to 116. 21 persons killed by a single bolt in one case. *Anomalous lightning. Shows natural potential in area disrupted.*

17 & **18 Feb 1985** - Anchorage, Eklutna Flats, Northway, Alaska.
Several anomalous lights and sky booms incidents in Alaska. Skyflashes, balls of light, booms, etc. Seen both from ground and by pilots of aircraft. *Probable Soviet realtime holography tests as part of worldwide deception plan.*

19 Feb 85 - Out from San Francisco, California.
China Airlines Flight 006 Boeing 747 enroute to Los Angeles. Engines fail. A/c falls 32,000 ft. in 2 min. Restarts engines, lands at San Francisco. *Note previous incidents over Alaska on 17 & 18 Feb. Probable Soviet test of launch phase anti-bomber system capability of woodpecker transmitters.*

10 **Mar 85** - Tblisi & Tallin, USSR.
Soviet Academy of Sciences announces an Aeroflot a/c had been followed by a UFO for 800 mi. *Soviets occasionally produce light phenomena in their own territory and near Soviet a/c as part of their deception plan. They do not wish to appear different.*

1 **May 85** - Near Nashville (monitoring station).
In and around May Day 1985, the Soviet Union held a giant exercise of all its strategic scalar EM weapons. 27 "power taps" into the earth — each two frequencies 12 KHz apart — were activated. The earth was thus in forced gravitational resonance beneath our feet on 54 frequencies. Each tap estimated to power up to six of the giant weapons; thus over 100 major strategic scalar EM weapon transmitters were activated. Frequency bands were filled with scalar EM transmissions, command and control, including to subs on station underwater. *Frank Golden monitored this startling giant exercise, which was probably held for Gorbachev, and this author observed it by courtesy of Golden's special detection equipment. Thus the Soviets*

met the 1985 timetable established by Brezhnev in 1972 at a secret meeting in Prague of European Communist leaders. Western nations do not appear to have the equipment to monitor scalar EM emissions, and so Western intelligence agencies are believed to have totally missed this giant exercise and its significance. At conclusion, two power taps (four frequencies) were left in the earth to power "ready firing batteries," so to speak.

11 **Jun** 85 - Lanzhou, China.
China B747 crew encounters a huge, expanding yellowish glow of light, with very intense spot at center. *Probable Soviet test.*

11 **Jun** 85 - Mongolia.
Chinese jumbo jet, Peking to Paris flight, encounters giant "UFO" light form over Mongolia. 10 km. wide. Lit sky for 50 km. Extremely bright spot at center. Paced aircraft for 2 minutes. *Probable Soviet test. Soviet operator tracked a/c exhaust with long range antibomber system. Added giant light form for deception, and to create UFO reports, which are largely ignored.*

23 **Jun** 85 - Iowa, Nebraska, Kansas, Illinois, Kentucky.
Thunderstorms over Iowa, Nebraska and Kansas organized into single circular pattern rainstorm 200,000 sq. km. in area. Declined until dawn, then rejuvenated to unleash severe weather over Illinois and Kentucky. *Such organization never before had been seen. Now called "mesoscale convective complex." Shows unique new weather pattern involving giant organization.*

2 **Aug** 85 - Dallas/Ft. Worth, Texas.
Delta Airlines flight 191, a Lockheed L-1011, encounters microburst while approaching runway at Dallas/Ft. Worth International Airport. Crashes and kills 134 of the 163 persons on board. *While such microbursts occur in nature, this was during a period of intense Soviet scalar EM activity. Note that warming the tops of thunderstorm anvil causes a downburst. May have been just accident. May have been test.*

23 **Aug** 85 - Italy, Adriatic Coast.
More than 28 "UFO" sightings reported along Italy's Adriatic coast soon after **midnight.** Light phenomena. *Probable Soviet test. Part of deception plan. Scalar KM holography (real-time).*

28 **AUG 85** - Vandenberg AFB, California.
Titan B fails after launch at Vandenberg AFB, California. Believed to have carried sensitive U.S. satellite. *Suspicious.*

Sep 85 - Kourou.
Ariane rocket explodes at Kourou. 3rd stage engine failed to ignite properly, forcing loss of power. Destruct then ordered. *French officials suspect Soviet sabotage. Probable Soviet test.*

Sep/Oct 85 - Cape Canaveral, Florida.
Anomalies observed on two U.S. shuttle launches by NASA. *No action taken; NASA does not recognize scalar EM weapons capabilities nor testing over its Cape Canaveral launch site. Nor does it connect the mysterious "booms" that have rocked the Florida coast for several years with the Soviets or with the anomalies noted on its two shuttle launches, such as giant booms.*

2 **Sep 85** - Mexico City, Mexico.
Worst hailstorm in 50 yrs. strikes Mexico City, leaving some streets more than a foot deep in ice. 1-hr pelting. 25 bldgs collapsed. 4,000 roofs heavily damaged. 1 killed, 185 injured. Power blacked out. *May have been due to extensive Soviet long range weather engineering. 17 days prior to suspicious giant Mexican earthquake.*

5 **Sep 85** - Australia.
Premier Wran, Australia, along with Minister of Agriculture Hallam, observe a brigh spherical "UFO" from their government jet. It was photographed. Radar contact showed object at 100,000 ft. *Probably Soviet advanced performance antigravity flying vehicle.*

18 Sep 85 7:15 pan. - Catalina Is. Channel Is.
Cookman observes giant cloud radial, awesome to behold, between Catalina and Channel Islands, off California coast.
18 "funnel" strobes, dynamically boiling. Activity indicates great energy poured into earth and atmosphere. Mexican quake the next morning. Indicator of Soviet scalar EM connected to quake.

19 **Sep 85 7:18** a.m. - Mexico City, Mexico.
Large earthquake strikes Mexico City, causing great damage. Largest of several. *Preceded wks earlier by giant anomalous hailstorm. Evening before, giant radials showed extensive Soviet power*

transmission activity. Positive indications of Soviet test.

8-9 **Nov** 85 - Ventura County, California.
Highly anomalous power blackout in Carlisle Canyon, Ventura County, Calif. Accompanied by severe electrical anomalies totally beyond normal electromagnetics. *Investigated and reported by engineer Ron Cole, who lives in the area. TV, light, phone, electrical anomalies plus intermittent 29 Hz signals.*

Nov- Dec 85 - California.
Mysterious hum continues to baffle people at Pacific Heights, Calif, and Marina district on San Francisco Bay. Previously had had same hum. Note such hum in England persisting over long period. Note 8-9 Nov 29 Hz. anomalous elec. signal at Carlisle Canyon, Ventura County, CA. *Possible indications of Soviet scalar EM activity. Area appears to be one of Soviet register / test points.*

26 **Nov** 85 - Cape Canaveral, Florida.
Launch of space shuttle Atlantis from Cape Canaveral, Florida is accompanied with high anomalies. (1) Seconds before launch, Bob Gladwin inadvertently photographs nearby strike of what appears to be an electromagnetic missile, probably of Soviet origin. (2) Anomalous light is hanging in the sky, near the launch site: a marker beacon, placed there by the Soviet scalar EM weapon system being tested. Seen by hundreds of persons, and photographed by George Suchary. Printed in Fort Pierce **Tribune.** (3) 12 minutes after shuttle is launched, when it is well down range, a tremendous rumbling atmospheric boom occurs, heard 600 mi. up and down the East Coast. Marker beacon then slewed away by distant Soviet operator at high speed. *With offset EM missile strike, Soviets tested the weapon to be used on the Arrow DC-8 two weeks later at Gander AFB, Nfld. Marker beacon used in precise registration. Note it was evidenced again above the explosion of the Titan on 18 Apr. 86 at Vandenberg AFB. Boom is from energy induced over a large area; which can catch multiple missiles being launched, a large Naval task force at sea, or a whole flight of airborne bombers, fighters, or helicopters. Also can catch an entire organization on the ground, or an installation - - wiping out all electronics, exploding explosives and ordnance, stunning or killing personnel, etc.*

Again hundreds of NASA engineers and scientists did not recognize what was ***happening*** *at the* ***site*** *and over their own heads.*

12 Dec 1985 - Gander, Newfoundland.
Arrow DC-8 crashes immediately after takeoff at Gander AFB, Newfoundland. Lost power just after takeoff; engines "rumbling" abnormally rather than roaring, according to eyewitness whom the a/c flew directly over, 100 ft up. Aircraft seen by three eyewitnesses to have an orange glow on it. Symptoms of negative energy introduced into engines, cancelling some of heat energy of the engines and seriously interfering with combustion process, causing loss of power. Glow may have been steady, small electromagnetic ball of energy against the aircraft, causing it to electrically charge and exhibit corona. Anomalous hole in right fuselage, just ahead of engines, as if from internal explosion; however, no explosive residue (it was tested). One other anomalous hole found. Wild swings of some instruments recording just at/after liftoff — ignored by investigation. *Note previous 36 light incidents in and around Gander, Jan. 1982. Gander Airport is major stopover for Soviets, and a major "registration point" for scalar EM weapons. Note anomalies in shuttle launch 2 wks earlier, and apparent actual test of the small EM missile then, offset so as not to destroy that shuttle.*

Aircraft crew one of Arrow's best. Aircraft should have flown okay, if not interfered with. Serious indications that the DC-8, with over 250 U.S. soldiers and air crew, was deliberately destroyed by test of a Soviet launch-phase antibomber system.

Note metal-softening Soviet signal detected on 1 Jan 86 by Frank Golden may actually have been on the Woodpecker transmissions on Dec 12,1985. This metal-softening signal probably played a part in the destruction of the Challenger on 28 Jan 86.

1 **Jan** 86 - Near Nashville, Tennessee.
Frank Golden discovers a metal-softening signal on the Soviet Woodpecker interference grid. Performs experiments to verify the metal-softening ability of the signal. *Signal is of such a nature that only Golden's instrumentation could have detected it. He then scalarly cancelled the signal to totally prove it.*

24 **Jan** 86 - Ventura, California.
Engineer Ron Cole observes and sketches a giant grid cloud pattern over Ventura, Calif, at 11:45 p.m. PST. Giant cloud fingers, separated from each other, formed the crossed-grid pattern. *Shows Woodpecker scalar EM power very high and active.*

26 **Jan** 86 - Northern California.
Strong quake hits Northern Calif. 5.5 on Richter scale. Hollister area, about 120 mi. south of San Francisco. Several power outages in southern Bay area, where quake knocked out transformers, downed 21,000 V. power line, and set off burglar alarms. *May have been induced by Soviet scalar EM transmitters.*

26 **Jan** 86 - Los Angeles, California.
In greater Los Angeles area, Margaret Wilson observes 3 classic giant radial clouds form at 10 min. intervals: 1:15, 1:25, and 1:35 p.m. Appeared one after the other, till all three were there. Last one lasted about two hours, gradually distorting. *Shows a great amount of structuring to capture and turn the Jetstream, to direct cold weather to the Florida Panhandle and catch the Challenger before its impending launch, exposing it to drastic cold conditions. Definitely Soviet engineered.*

27 **Jan** 86 - Santa Monica, California.
On evening prior to the Challenger disaster, Al Matthews photographs a strange bar-grid cloud formation, absolutely rectangular bars, from the Los Angeles freeway. Pattern approx. over Santa Monica Bay, due north of Catalina Island. Edges and ends very straight, as if drawn in sky by a giant draftsman. *Shows severe high frequency content, and fine-point localization of Soviet scalar EM transmitters, in preparation for forthcoming launch of the ill-fated Challenger.*

27 **Jan** 86 - Florida Panhandle.
Avalanche of freezing air temperatures to record lows across the Southeast. Low temperature records set all across the South. Jetstream bent far south, across Florida Panhandle. *Definitely caused by Soviet weather engineering. Preceeded by giant radial cloud signatures in "hinge" areas of Los Angeles and Huntsville, Alabama, showing steering of Jetstream.*

28 **Jan** 86 - Cape Canaveral, Florida.
Low temperature records shattered all across the South. Into 30's in Florida and into teens elsewhere. *Definitely result of Soviet weather engineering, and definitely directed against the Challenger rocket on the launch pad.*

28 Jan 86 - Off Florida Coast.
About 4 hr. before the launch of the Challenger, all Soviet ships off-coast, which normally monitor shuttle launches, suddenly depart at high speed. *Soviets do not want any suggestion that the ships' radars and transmitters may have interfered with the Challenger launch. Total anomaly. Unprecented event.*

28 Jan 86 - Cape Canaveral, Florida.
National radio and TV newsmen comment on the highly unusual fact that no birds are flying in the launch area. *Reason: For severe localization, high frequency content of the scalar EM signals had been drastically increased. A bird's brain will detect and resonate to this energy, if the wavelength approaches the diameter of its brain. This resonance will cause great pain and/ or death of the bird. Thus the birds flee the area when this begins to occur — or they die. When birds accidentally fly into such a high frequency scalar EM signal, their nervous systems are instantly jammed. They die and fall from the sky.*

28 Jan 86 - Cape Canaveral, Florida.
Space shuttle Challenger, launched from Cape Canaveral after exposure to cold weather conditions, disastrously explodes. Booster seal problem. Encounters air turbulence during launch, at most critical altitude. *Soviet metal-softening signal has been added to grid. Extreme localization in area because of high frequency content added; shown by birds having vacated the area. Anomalous departure of Soviet ships offshore, 4 hrs. earlier. Three previous tests of the weaponry in that exact launch area, against the three previous shuttle launches. Kill of the Arrow DC-8 about 6-112 weeks earlier. Actual celebration by the KGB of perfect success of their active measures against the Challenger! U.S. space program crippled and set back severely.*

29 Jan 86 - Moscow.
At KGB headquarters in Moscow, the KGB holds a jubilant party to celebrate the perfect success of their active measures against the Challenger. *Note that Soviet scalar EM weapons — development, deployment, and use — are under the control of the KGB rather than the regular Soviet armed forces.*

31 **Jan 86** - Mid-U.S.
Richter 5.0, Earthquake rattles 9 states and Great Lakes. *Possible test of weapon that killed the Challenger, in the earth transmission / earthquake induction mode.*

2-4 **Feb** 86 - Birmingham, Alabama.
In Birmingham, Alabama dead birds plummet from the air to the ground for three days. Blackbirds, cardinals, sparrows, bluebirds, etc. No trace of poison in carcasses. *Only a few days after kill of the Challenger. To divert the Jetstream further south and hit Florida, the Soviets had moved the normal "hinge pin"—where scalar EM energy, either positive or negative, is focussed —from Huntsville to Birmingham. Hinge pin area was still activated. The high frequencies used for extreme localization against the Challenger were lethal to birds. Therefore birds that inadvertently flew into this zone were instantly killed and dropped from the sky.*

10 **Feb.** 86 - Europe.
Super Frelon (French) helicopter crashes, with 11 killed. Aeronautique Navale aircraft. Part of a spate of crashes of French military aircraft in four months (through June 86). *Defense Minister Andre Giraud launched a special investigation.*

23 Feb 1986 - Irish Sea.
Over the Irish Sea in an airplane, England's Prince Charles sights a brilliantly glowing, red object hovering near them. His pilot reports the object to air traffic control. Four other aircraft traveling through that area radioed similar reports. *Probably either a Soviet craft or a Soviet holographic scalar EM demonstration as part of the overall deception plan, and/or a stimulus to a member of the Royal Family to observe what action is taken by British Ministry of Defense. By actions, could ascertain whether or not Britain knew what was going on.*

30 **Mar** 86 - Ventura, California.
Engineer Ron Cole in Ventura CA observes significant cloud patterns, positively correlated with his measurements of the Soviet woodpecker transmissions. *Cloud pattern changes were directly correlated to signal changes on the Woodpecker. Shows cloud signatures can be indications of specific Woodpecker activity.*

31 **Mar** 86 - San Francisco, California.
Strong earthquake, Richter 5.3, rocks San Francisco Bay area. Third in region in 3 days. Three aftershocks within minutes. *Note correlation of Woodpecker activity previous day.*

31 **Mar** 86 - San Francisco, California.
Crew error on Delta flight accidentally shuts down engines after normal takeoff from San Francisco. Engines restarted. *Definitely a crew error. Possible human effects from earthquake energy in area. Same type incident on Jun. 30, 1987.*

3 **Apr.** 86 - Florida.
Loud boom shakes houses and rattles windows over Brevard County, Florida. One of a whole series over the years. Not far from Kennedy Space Center. *Soviet adjustment of scalar EM grid.*

Apr 86 - France.
French Armee de L'Air has lost two Jaguars and two Alphajets in April 86. Part of a spate of losses in 4 months, leading Defense Minister Giraud to launch a special investigation.

7 **Apr** 86 - Sacramento, California.
Charlotte King of Sacramento calls UPI and predicts a major earthquake will strike in Canada, Alaska, Aleutians, or Japan. She had predicted eruption of Mt. St. Helens in 1980. On Apr. 27th, she predicted quake that shook Mexico three days later.
Note that human brain is a scalar EM interferometer, capable of transmitting and receiving scalar EM waves. Unfortunately, not conscious — output of system is in deep unconscious. Some persons are more sensitive than others, and can detect the scalar activity from the increasing stress in rocks that is leading toward an earthquake. Charlotte King is such a person, having over an 80% accuracy of prediction of quakes. She will be able to detect the increasing stress in rocks, whether naturally or artificially induced.

9 **Apr.** 86 - Aleutian Islands.
Three quakes rock the Aleutian Islands. Predicted by Charlotte King on Apr. 7. *Documented prediction.*

18 **Apr.** 86 - Huntsville, Alabama; Thousand Oaks, California.
T.E. Bearden sees and photographs remnants of a giant radial cloud

in Huntsville, Alabama. Extensive Soviet woodpecker grid activity noted over Thousand Oaks, California by Engineer Ron Cole. *Both show increased scalar EM activity in the interference grid.*

18 **Apr** 86 - Vandenberg AFB, California.
USAF Titan 34-D rocket explodes nine seconds after launch from Vandenberg AFB, California. Video captured the Soviet marker beacon **(Aviation Week & Space Technology).** Engineer Ron Cole and team study video of the explosion frame by frame and verify the anomalous beacon light is present, is separate from the explosion, and moves away separately after the explosion. *Sensitive satellite believed on board the rocket. U.S. Space surveillance program crippled. Probable Soviet kill. TR wave adjunct with Woodpecker.*

25 **Apr** 86 - New Mexico.
NASA research rocket misfires over the New Mexico desert. No public announcement made at the time. Was first failure in 25 consecutive missions of the Nike-Orion rocket. Said NASA spokesman Kukowski: "It looks like we're snakebit."
Possible Soviet test kill.

25 **Apr** 86 - California; Chernobyl, USSR.
Bill Bise detects the sudden loss of the East-West Soviet woodpecker transmitter he is monitoring in the field, leaving the North-South transmitter. The failed transmitter was about 20-30 km. from Chernobyl. The *Soviet transmitter sites safety circuits go-in full, trying desperately to hold back the giant scalar EM standing-wave potential that has been built up, and slowly and safely drain it away into the earth. In alarm, Soviets shut down nearby reactors at Chernobyl. Any "flash discharge" escape as a flash-over pulse of the scalar EM potential will produce a giant EGP pulse into the earth. When this EGP pulse reaches the four reactors, they will violently explode, full-up nuclear, like giant hydrogen bombs — perhaps 1200 megatons equivalent. Later the Soviets will claim that the operators shut the plant down to do some "unauthorized experiments."*

26 **Apr** 86 - Chernobyl, USSR.
With the giant scalar EM standing wave almost all drained away, the safety circuits finally ***fail,*** *dumping a small EGP into the earth. The nearest reactor at* ***Chernobyl*** *gets* ***it,*** *and the uranium fuel roils*

suddenly go half-decayed, instantly heating and blowing out the reactor, destroying it. Nuclear radiation fallout spreads over much of Europe.

3 **May** 86 - Florida.
Delta 178-rocket destroyed by range safety officer at T + 91 after two anomalous power surges occurred in the rocket, causing premature shutdown of 1st stage Rocketdyne RS-27 engine 71 sec. into the flight, and rocket to go aerodynamically unstable. Previous 43 launches had been successful. Since 1960, 177 launches 94% successful. One of most reliable rockets ever built. *Soviet weapons test. One of a series. TR wave adjunct with Woodpecker.*

7 **May** 86 - Aleutian Islands.
Great earthquake measuring 7.7 Richter strikes Aleutian Islands. Centered about 100 miles SE of the island of Adak. Tsunami alert issued for the North Pacific, but no major waves ever materialize. Thousands evacuate coastal areas. A *U.S. researcher known to this author used a powerful scalar interferometer to block the tsunami. The researcher must remained unnamed.*

9 **May** 86 - Redstone Arsenal, Alabama.
All power on Redstone Arsenal, Alabama suddenly and mysteriously fails all at once. *Similar related incident on May 12. No explanation.*

12 **May** 86 - Huntsville, Alabama.
In Huntsville, Alabama — adjacent to Redstone Arsenal — on local radio program Feedback, public radio discussed the mysterious failure of all power on Redstone Arsenal on Fri., May 9, 1986 and requested that, if anyone knew why all circuits would go off at once, to please get in touch. *Immediately the station's radio transmitter went off the air! (Almost as if "Big Brother's listening to you!")*

18 **May** 86 - Dijbouti.
French Breuguet Atlantic aircraft crashes in Dijbouti, killing 19. *Part of spate of crashes of French military aircraft in 4 months that leads French Defense Minister to open special investigation.*

19 **May** 86 - Brazil.
Brazilian fighter jets are sent to chase multi-colored "ping- pong ball sized" UFO's in skies over Brazil. 4 jets, two Mirages and 2 F-5's

chased them at speeds of 840 mph. Tracked on radars. Chase lasted 3 hrs. Planes could not catch them; ran low on fuel and returned. Discussed on TV by Brazil's Air Force Minister Brig. Gen. Otavio Moreira Lima. *Soviet scalar EM holographic production; distant Soviet operators having fun and games as part of the deception plan, generating UFO incidents and reports?*

22 **May** 86 - California.
High-speed orange "X" object with lights seen above Sonoma CA before dawn. At one time the object slowed and hovered.

29 **May** 86 - Huntsville, Alabama.
Huntsville and Madison County, Alabama electrical power dipped momentarily and mysteriously, causing a seconds-long outage in businesses and homes, playing havoc with traffic signals and computer centers throughout the area. Some traffic signals continued to malfunction for 30-45 min. after power was restored, then mysteriously resumed normal functioning. Some phones also went out inexplicably, and many battery-powered radios went off, and were awry for seconds or minutes before recovering. *Obviously this was not caused by any kind of ordinary electromagnetics. Shows anomalous and high activity (pulsed) in the Soviet scalar EM grid (Huntsville Ah. is a pivot point).*

30 **May 86** - French Guinea.
Ariane 2 rocket fails because of a faulty ignition system for the third stage engine. Rocket destroyed by ground command 4-1/2 min. after launch from Kourou, French Guinea. The third stage has failed 3 times since start of Ariane's operations in 1979.
Possible Soviet test.

Tad Szulc, Washington journalist, implies that French Defense Minister Andre Giraud may have discussed the possibility of Soviet sabotage of the rocket with Washington.

May? 1986 - Straits of Gibralter.
USS Atlanta nuclear sub runs aground in Straits of Gibralter and suffers "serious damage," according to reports in Madrid. A hole was made in one ballast tank and the sonar wrecked.
*Another **U.S. nuclear sub** ran aground within a month or so (earlier?) of this incident. C**ould something** have interfered with their navigation systems underwater? Continued Soviet Scalar EM tests?*

11-12 July - California.
Secret USAF crashes approx. 14 mi. NE of Bakersfield, CA along the Kern River. Site secured. Possible Stealth fighter. Crippled aircraft in trouble seen and photographed by Andy Hoyt, who turned photos over to USAF (properly so). Aircraft not on fire when came down. Did not explode in the air. *No information as to whether any Soviet scalar EM hanky-panky involved or not. Suspicious because follows a series of anomalous missile failures. Woodpeckers definitely have good anti-stealth capability.*

11 July 86 - Tennessee and Georgia.
Moderate quake with sonic boom shakes SE Tennessee and Northern Georgia. 3.7 on Richter scale. Centered just east of Chattanooga Tennessee on the TN/GA line.

12 July 86 - Michigan, Ohio, and Kentucky.
Mild quake in Michigan, Ohio, and Kentucky. 4.0 on Richter scale.

18 July 86 - Los Angeles, California.
Sharp aerial boom rattles Los Angeles Basin at about 0930 hrs. FAA and USAF unable to identify a potential source from an aircraft.

Aug 86 - Soviet Union.
Two huge new Soviet "radars" discovered on Western Soviet border by U.S. intelligence. One near Skrunda, on Lithuanian border. Other near Mukachevo, on the Czech border. *With phase conjugate adjuncts, represent significant strategic weapon system deployments.*

2 **Sep** 86 - Baltic Sea.
Finnish ferry Scandinavia in Baltic Sea observes a strong light rise from the sea near the Finnish Coast. After 3 to 4 seconds, a giant mushroom reached 500 feet into the sky and covered the moon. *Probable Soviet test.*

12 Sep 86 - Dallas, Texas.
Mysterious, powerful "explosion" rocks South Dallas. No source found or explained. No supersonic jets in area.

Selected ***Incidents***

15 **Sep** 86 - Australia.
Katherine, Australia. Object with flaming orange **tail** moved **from** sky toward ground at 45 degree angle. Katherine's electrical **power** suddenly cut off and phone lines in the town disrupted. ***Probable*** *Soviet scalar EM generated.*

Oct-Nov 86 - Los Angeles, California.
Giant radial clouds observed in Los Angeles area.

Oct 86 - Reykjavik, Iceland.
Gorbachev and Reagan meet at Reykjavik, Iceland. Gorbachev proposes "zero option." *Seeks to get nuclear missiles removed, since they constitute "dead man fuzing" because of nuclear warheads, and severely limit pulse use of Soviet scalar EM weapons. Adamantly insists on bottling up SDI — because if space laser is converted to scalar EM laser, its power (effective) goes up about* 10^{20} *times, and single shot could devastate Russia.*

10 **Oct** 86 - Vandenberg AFB, California.
U.S. forced to scrub another missile launch when a USAF Scout satellite malfunctions during final countdown at Vandenberg AFB, Calif. *The booster's gyro system failed a checkout sequence at about T-5 hr. Scalar EM can inertially interfere also.*

13 Oct 86 - ABC News.
On Peter Jennings' ABC News show, Gennadi Gerasimov, Soviet spokesman, indicated that SDI as presently designed was of no concern to Soviets. Real concern is that U.S. will make a "great technical breakthrough" and deploy new, modified devices, presenting an unacceptable threat to the Soviet Union. *Here he is thinking of changing the laser to a scalar EM laser.*

6 **Nov** 86 - Albuquerque and Phoenix.
Power failures at Albuquerque air traffic control tower and a radar station near Phoenix, Arizona occur. Radar controlling high altitude air traffic from Texas Panhandle to southern California was knocked out for 40 min. First such incident in Albuquerque center. The Arizona radar was out for 59 hrs. *Note similar incident at Montreal on Nov. 11, 1986.*

10 **Nov** 86 - Huntsville, Alabama.
Three giant radial cloud formations in Huntsville, Alabama photographed by T.E. Bearden. One is a twin giant radial. *Shows heavy activity in scalar EM interference grid.*

10 **Nov** 86 – SE U.S.
Red glowing light with tail flares across sky in Southeast about sunset. Seen over parts of TN, AL, GA, MS. Ground searches conducted in several areas for possible crash. *Probable Soviet scalar EM activity. Note heightened activity in grid same day.*

10 **Nov** 86 - Near Nashville, Alabama: Hemet, California.
Frank Golden measures scalar EG field of earth — highly agitated and dynamic, about half as much as when Soviets induce earthquakes. Anomalous winter storm in progress. Cold records broken in Mid-U.S. Heat records broken in Florida. Storm penetrates very deeply southward. *Soviet weather engineering.*

11 **Nov** 86-Canada.
Air traffic control radar in Montreal, Canada region broken down. Backup system employed. *Note similar occurrences to Albuquerque and Phoenix on Nov. 6, 1986.*

12 **Nov** 86 - Atlanta, Georgia.
Stationary arc (dome) of clouds sighted over Atlanta. Well defined lower edge. Upper edge irregular. Multiple witnesses. Clouds moved into top of dome and flowed around it. Very strange sight. *Probable Soviet "gentle test" of placing a suppressive covering over a distant U.S. city. Performed at night, at minimal level (no glow) so no great notice would be taken. Dome was stable against 20 mph winds and other moving clouds that collided with it.*

13 **Nov** 86 - Huntsville, Alabama.
Twin giant radial cloud observed moving over Huntsville, Alabama by T.E. Bearden. West to East. At nearly noon. At dusk, single giant radial cloud was also spotted over Huntsville.
Significant scalar EM activity in grid.

17 **Nov** 86 - off Alaska.
JAL Flight 1628 observes giant UFO while enroute from Reykjavik, Iceland on mid-leg of Europe to Tokyo. Crossed Beaufort Sea off

Alaska's north coast. Sighted flashing lights which moved alongside the aircraft. Pilot descended, so did light. Glimpsed craft in profile, twice as big as aircraft carrier. On board radar located it. USAF and civilian controllers reported brief radar echoes, but tapes did not show it. Approaching Fairbanks, Alaska. Pilot made 360 degree circle, object stayed with him. Finally disappeared as he was approaching Anchorage. *Probable Soviet test as part of deception plan. TR wave holography.*

27 **Nov** 86 - Fort Pierce, Florida.
Flash of light in sky and sonic boom occurred vicinity of Fort Pierce, Florida. *Probable Soviet EM test. Note that a classified payload was scheduled for launch in near future at Cape Canaveral nearby.*

4 **Dec** 86 - Huntsville, Alabama; Hemet, California.
Twin giant radials seen and photographed over Huntsville AL. Large radial cloud seen in skies over Hemet, Calif, and photo printed in **The Press Enterprise,** Hemet, CA 5 Dec 86.

4 **Dec** 86 - Cape Canaveral, Florida
Atlas/Centaur rocket successfully launched at Cape Canaveral, orbits a communications satellite for DOD. *The Soviets had to allow one or two of the missiles to succeed, else even the lethargic U.S. bureaucracy would have caught on. Grid activity indicates they probably just tracked it without the other goodies.*

5 **Dec** 86 - Vandenberg AFB, California.
MX ICBM launched from Vandenberg AFB. Two of RVs did not deploy although all impacted within the Kwajalein Missile Test Range. *Note: Soviets let one go from Vandenberg.*

21 **Dec** 86 - Huntsville, Alabama.
Twin giant radial photographed over Huntsville Alabama.

23 **Dec** 86 - Huntsville, Alabama.
Small flash in lower sky over Huntsville, Alabama observed by T.E. Bearden. Followed by faint boom. Momentary loss of power occurred in large area of Huntsville. Positive correlation between the aerial flash/boom and the loss of the power. *Soviet test.*

7 - 21 Jan 1987 - Florida.
Several giant radial clouds seen in vicinity of Fort Lauderdale, Florida. *Indicates substantial action in scalar EM grid.*

20 **Jan** 87 – U.S.
Highly unusual bend in Jetstream. Completely down West Coast, curving east under Texas, NE along SE USA. *Shows great action in scalar EM grid. Significant weather engineering.*

20 **Jan 87** - Vandenberg, AFB, California.
Minuteman missile destroyed in launch. *Note substantial action in scalar EM grid.*

23 **Jan** 87 - Huntsville, Alabama.
Bearden photographs twin giant radial over Huntsville AL. Cloud fades with great and unusual rapidity. A private-type jet, similar to a Learjet, continually circled under the strange twin radial cloud, as if observing and/or photographing it. *Perhaps someone in the U.S. system wised up.*

28 **Jan** 87 - Vandenberg AFB, California.
Minuteman missile successfully launched from Vandenberg AFB. Note: *Anniversary of the Challenger disaster.*

7 **Feb** 87 - Alabama - Tennessee border.
Loud aerial boom or explosion shakes area from Tennessee, New Market, Monte Sano through Huntsville Alabama area.

10 **Feb** 87 - Huntsville, Alabama.
Bearden photographs twin radial cloud in Huntsville, AL. Cloud stayed fixed, although winds present and other clouds moved. Note big storm in NE - Cape Cod, etc. *Associated with weather engineering.*

11 **Feb** 87 - Huntsville, Alabama.
Bearden photographs another twin giant radial in Huntsville, Alabama. *Shows activity in Woodpecker grid.*

Feb 87 - Vandenberg AFB, California.
USAF Titan launched from Vandenberg AFB, Calif.

12 Feb 87 - California.
Blue Angel F-18 a/c crashed near Brawley, CA. Fourth military air crash in the Imperial Valley since October. *Note Woodpecker grid activity on previous day.*

26 Feb 87 - Cape Canaveral, Florida.
GOES-H weather satellite launched from Cape Canaveral on a DELTA rocket.

26 Mar 87 - Cape Canaveral, Florida.
Stunning failure of an Atlas/Centaur rocket launched from Cape Canaveral. May have been hit by lightning. Failed suddenly 51 sec. after liftoff. Veered out of control and destroyed. *Note: Possible Soviet scalar EM involvement. Much to do later about multiple lightning strikes; very suspicious.*

June 1987 - Vandenberg AFB, California.
Minuteman 3 missile fired from Vandenberg AFB, Calif, is aborted and destroyed in flight. *Note similar incident in July.*

12 **Jun** 87 - Cape Canaveral, Florida.
Trident III launched successfully from flat pad.

21 **Jun** 87 - Alaska.
Three strong earthquakes shake parts of remote Alaskan Peninsula.

30 **Jun** 87 - Los Angeles, California.
Delta 767 flight 810 crew inadvertently shuts down engines shortly after takeoff from Los Angeles. Starts to fall, restarts engines and recovers. *Definitely crew error. Similar incident on Mar. 31, 1986 after takeoff from San Francisco.*

12 July 87 - Over Pacific Ocean.
Minuteman missile is destroyed in flight over the Pacific Ocean because of a problem in flight. Launched from Vandenberg. *Note similar incident the previous month.*

16 **Jul** 87 - Huntsville, Alabama.
Anomalous largo "boom" occurs at Huntsville, Alabama.

17 **Jul** 87 - Huntsville, Alabama.
Another anomalous, large "boom" occurs at Huntsville, Alabama. *Note that Huntsville is a pivot point on the Soviet grid. Adjustments in the grid often "spill out" energy, causing such a boom. It causes a sharp boom if pinpoint spillage occurs. It causes a more general quaking, rumbling sound of longer duration if spillage occurs over an area.*

20 July 87 - Cape Canaveral, Florida.
Tident III successfully launched from flat pad.

14 **Oct.** 87 - Nellis Air Force Gunnery range.
Top secret plane crashes; possible stealth fighter. *Did the Soviets kill another one?*

9 **Nov.** 87 - Vandenberg, AFB, California.
Minuteman II missile is destroyed seconds after launch. *Unnamed anomalies cited. Did the Soviets interfere?*

4 **Jan.** 88 - Madison and Huntsville, Alabama.
Giant radial sighted for several hours. Three mysterious booms rattle Huntsville. *Soviet scalar EM activity continues.*

APPENDIX V

*DEAD MAN FUZING**
THE REAL MEANING OF THE REYKJAVIK SUMMIT

Soviet Foreign Minister spokesman, Gennadi Gerasimov, following failure of the Iceland Summit, said in a radio interview that SDI (U.S. Strategic Defense Initiative), as presently designed, is of no concern to the Soviet Union. The real Soviet concern, he indicated, is that the U.S. would make a great technical **breakthrough** and deploy new devices in space as a modification to SDI **presenting** an unacceptable threat to the Soviet Union.

Peter Jennings' ABC News Show, Los Angeles, CA
13 October 1986.

Gerasimov let the cat out of the bag!

With their deployed scalar electromagnetic weapons, the Soviets would immediately hold the winning hand-if these weapons could be unrestrainedly brought to bear.

As pointed out in **Fer-de-Lance: A Briefing On Soviet Scalar Electromagnetic Weapons,** Tesla Book, Co., 1986, the use of massive Soviet scalar EM weapons can only be gingerly applied. Activation and use of the Soviet scalar EM weapons is fraught with grave danger to the entire earth and to the whole human species because of the presence of nuclear facilities in the desired target area, and because of the "backlash" potential against the Soviet Union's own nuclear weapons and facilities.

The explosion at Chernobyl was apparently caused by the accidental failure of a nearby scalar EM transmitter, and the eventual impulsive loss of part of the electrogravitational potential built up by the transmitter before it failed. The resulting electrogravitational pulse (EGP) in the earth "pulsed" the nearest nuclear material... feul rods in the reactor at Chernobyl.

Had the EGP not been depleted prior to its escape, all four reactors at **Chernobyl** would have exploded with the same intensity as if

*The term "Dead Man Fuzing", means that, even though your opponent kills you, a weapon or effect of your own will inevitably result which will then kill your opponent.

they had been "triggered" by a fission explosion.

In short, if unrestrainedly used, the EGPs from the Soviet scalar EM weapons would initiate most of the nuclear weapons where they are in the targeted area-in storage, in silos, in aircraft, etc. Target area nuclear reactors and nuclear wastes would also be violently initiated into nuclear explosion. The resulting vast megatonnage of nuclear explosions, much of them "in the dirt, " would provide an unthinkable holocaust. The effects of these giant explosions, deadly fallout and dense clouds of smoke and dirt, would blanket the earth with nuclear effects greater than is presently expected from an all out nuclear war, in which many of the weapons are expected to be destroyed or lost without being exploded nuclearly. Deadly nuclear radiation would blanket the globe, contaminating it for thousands of years. From the covering of the earth by dense smoke and dirt clouds, a new and deeply bitter global ice age-not just a "nuclear winter"-would almost certainly be initiated. In 1960 Khrushchev appropriately characterized these fantastic weapons by stating that they could wipe out all life on earth if unrestrainedly used.

A country's nuclear weapons and facilities, then, become its inadvertent "dead man fuzing" to prevent any substantial employment of large scalar EM weapons against it. So long as nuclear "dead man fuzing" is in place in a country, its adversary can only utilize scalar EM superweapons against it with great difficulty, and then only sparingly. At present, both the U.S. and its NATO allies are "dead man fuzed" by the presence of Western nuclear weapons-and to some extent, by the presence of nuclear reactors and stored nuclear wastes.

Obviously the Soviet Union's task of world domination—and the mind-rending risks it must take in employing large scalar EM weapons—would be greatly expedited if the obstacle of "deployed U.S. and NATO nuclear weapons and facilities" could be eliminated or minimized.

Also, Gorbachev must be acutely aware that the U.S. is finally beginning to look at the possibility of scalar EM weaponry. He would assume that either the U.S. is already on the way to acquiring scalar EM weaponry of its own, or else the time is imminent when it will do so. If this happened, and the U. S. then were to deploy SDI **scalar** EM lasers in space, the effects of each laser would be enormously increased by the electrogravitational amplification factor. Reasonable gain increases of the yield of each laser shot might approach, for

example, on the order of 10^{20}. In that case, each laser could suddenly devastate a whole state or region with one or two shots, instead of just being able to destroy one little missile. The Soviets know that Reagan's Star Wars weapons-if modified to the "improved" kind and deployed in space—could deliver a surprise first strike in seconds, and devastate Russia before all the Star Wars space weapons could be knocked out by Soviet ground-based scalar EM beams.

The Soviets also know that it is not too difficult to modify lasers to become such powerful scalar EM lasers.

This means that Gorbachev needs to insure that the Star Wars weaponry is not actually tested in space. Testing in space requires developing at least prototype "space deployment" SDI weapons, to get them up in space to test them from there in the first place. And even such "prototype" SDI weapons would be sufficient to devastate the Soviet Union, given that the prototypes employed the technological breakthrough represented by scalar EM weapons. This is what Gerasimov was really referring to!

Thus Gorbachev simply cannot allow such space testing of SDI weapons, if he hopes to be able to safely seize the opportunity to employ his own already-deployed, massive scalar EM weapons during the "window of time" that would be provided by dismantling of U.S., NATO, and Soviet nuclear weapons.

And-given that he gets agreement and implementation of the "zero option"-Gorbachev knows he will only have a narrow "window" of time in which he can hope to achieve world domination. It can be only a short time until the U.S. produces results in scalar EM weapons, and promptly develops such weapons of its own. Faced with that eventuality, Gorbachev would then have no choice but to turn away from the Communist dream of world domination, and reach a mutually agreed accommodation with the West. Both the West and the Soviets then would have to take immediate and drastic measures to prevent the rapid development and spread of the relatively cheap scalar EM weaponry throughout other nations, particularly those motivated from fanatical beliefs and quite capable of "blowing up the earth" deliberately.

Thus, before the U.S. becomes aware of scalar EM weapons and builds its own, Gorbachev desperately needs to get rid of the "dead man fuzing" problem posed by the nuclear weapons and facilities possessed by the U.S. and its Nato allies, so that he can utilize his superweapons to dominate the world without destroying it.

And he needs to block any chance that the U.S. would be able to have space-tested high energy laser prototypes which could be quickly modified to scalar EM weapons, fired into space, and used to counter Soviet aggression or even destroy the Soviet Union in retaliation.

In short, today the paramount and almost desperate need of the Soviet Union is to reduce American dead-man fuzing and keep the SDI space laser genie bottled up in the lab on the ground.

Accordingly, in Iceland, in what appeared to be a stunning concession on nuclear arms, Gorbachev suddenly offered Reagan a complete dismantling of all nuclear weapons-Reagan's "zero option." Actually this move had been planned by Gorbachev from the beginning; it was not a spur-of-the-moment offer. The reason was simple: If the U.S. could only be persuaded to quickly get rid of its nuclear weaponry, the Soviets would hold an absolutely winning hand. Their massive, deployed, operational scalar EM weapons could then be unleashed with minimal restraint. The extremely delicate and incredibly dangerous problem of bringing the large scalar EM "continent-buster" weapons to bear, without inadvertently causing world destruction, would be vastly eased if only the ordinary U.S. nuclear facilities such as nuclear power plants and radioactive wastes had to be reckoned with.

Fortunately, Ronald Reagan fervently believes in defense .

He made the right decision, whether or not it was for the right reasons.

Indeed, he probably knew in advance that SDI was to be targeted in Iceland by the Soviets, and that sweeping concessions might be offered by them for that purpose. According to one report (" 'Blinded' Satellites," Rowland Evans and Robert Novak, **Washington Post,** Oct. 29,1986), just before Reykjavik the CIA-sent a report to Reagan with the warning that "the sole reason for Gorbachev's wanting the Iceland summit was to offer unprecendented inducements for Reagan to drop SDI."

Fortunately, Reagan rejected Gorbachev's proposal, because he does not wish to give up what he truly regards as a potential defense against incoming Soviet missiles.

Apparently neither Reagan nor his advisors were aware of the real reason for Gorbachev's unexpected and breathtaking proposal for what would essentially be near-total nuclear disarmament.

The Soviet ground-based scalar EM lasers could sweep the

heavens of the presently conceived SDI weapons, as **Gerasimov** obliquely implied. However, this would not change the barrier represented by U.S. nuclear dead man fuzing, unless the nuclear weapons had been removed.

Meanwhile, Gorbachev's chess game to remove the dead man fuzing is certainly not over. The Soviets have mounted an intense propaganda campaign urging nuclear disarmament and cancellation or restraint of SDI. With a Democratic Senate now in, and with the approaching end of Reagan's term in office, the Soviet effort to clear the U.S. nukes-and the dead man fuzing-out of the way for Soviet deployed superweapons, while keeping the SDI genie in its laboratory bottle, can only be intensified. Already the Soviets are beating every drum to get substantial antinuclear segments of the U.S. scientific, congressional, political, and pacifist communities aroused to oppose SDI and urge a quick zero nuclear option.

The treaty for dismantling certain missiles in Europe has already been signed by the President, and its ratification by the U.S. Senate appears imminent. More is yet to come, and quickly.

In its aching desire for peace, if an unsuspecting America falls into Gorbachev's trap, shackles SDI and removes its dead-man fuzing, the Soviet Union will be free to enforce its will wherever and whenever it wishes.* If that happens, our beloved stars and stripes will be replaced with the atheistic hammer and sickle. And the noblest experiment of all—freedom for the common person—will have come to an ignoble end.

*Just as **Brezhnev forecast** for 1985, **at a** secret meeting in 1972 of the communist party leaders of E**urope.**

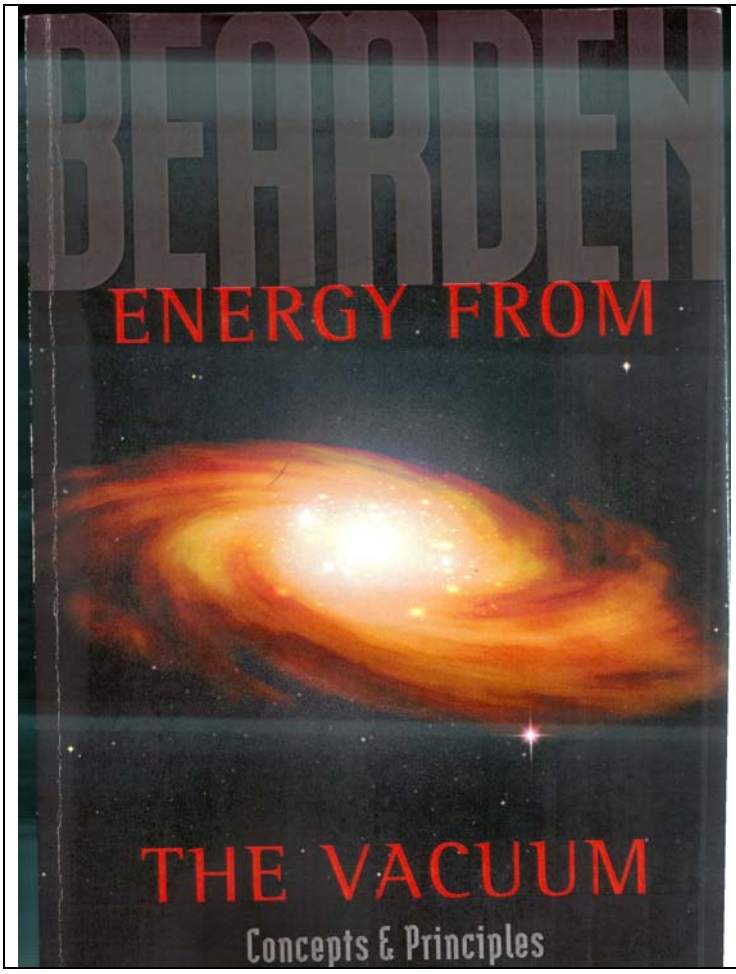

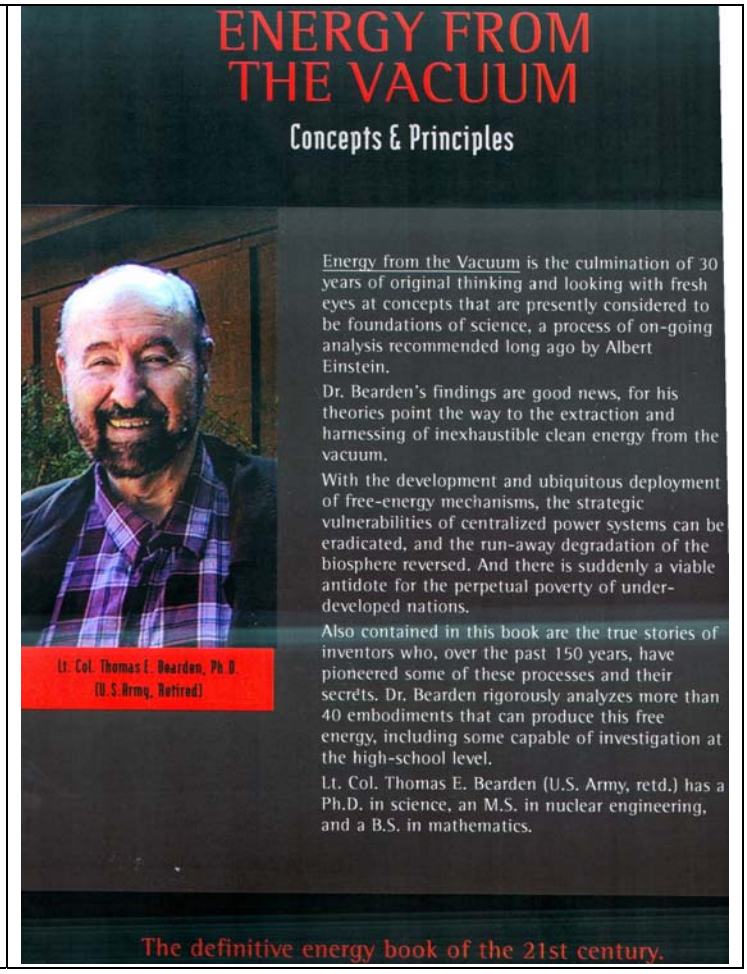

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And please don't be naive and expect you'll be buying those devices in your local supermarket any time soon. Although some progress is being made it's still to slow, especially with the suppression factors watching over it. The knowledge has been handed to you and it's expected that at least a few of us make some use of it. Gather together and try to share your results with the rest of us.

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Foreword

The original purely scientific purpose of this hook was interrupted en route by two events: The first was a sudden heart allack and onslaught of severe hypoxia resulting from the resurgence in Spring 2001 of a 33-year old chronic mycoplasma infection, of the modified biological warfare kind produced by a combined U.S./Canadian team, which got loose in Canada and Florida in the 1950s. I contracted this "mysterious, unknown ailment" in 1968 while in the U.S. Army and stationed in Quebec, Canada as the U.S. Army Liaison Officer to the Canadian Armament Research & Development Establishment (CARDE). The second event was the sudden terrorist attack on the U.S. on September 11, 2001, which propelled this nation and others into a war against international terrorism.

For the mycoplasma, Kenn Thomas recognized and informed me exactly what the difficulty was, and I was finally tested and diagnosed correctly in December 2001 due to the efforts of a courageous family physician. Accordingly, in December 2001 we started a yearlong (or longer) regimen of antibiotics and supplementary oxygen, with additional medication to control the runaway heart fibrillation associated with this virulent form of the disorder. If we make it through this yearlong program, we will probably survive with at least some significant recovery. Now on a much-reduced regimen, this made me realize the absolute necessity of passing the "energy from the vacuum" information and baton, so to speak, to those sharp young graduate students and post doctoral scientists who are interested in this area. They simply must not have to spend 30 years of their lives getting to this point. Instead, they should start where I am now, correct any errors I have inadvertently made, and go much farther.

Accordingly, we sharply changed the intent and content of the book to comply with that new purpose. We also deeply considered the potential U.S. and World energy implications of that second shocking event of 9/11 when international terrorists struck the World Trade Center in New York Center and the Pentagon, having also targeted the White House.

In the new asymmetric form of warfare, the internal aspects of a nation - its civilian population, its vulnerable installations, its energy infrastructure, its food crops, and its transportation modes — are the targets. Terrorist teams and groups in significant numbers are already inside every targeted developed nation, and these teams have weapons of mass destruction including biological weapons and even nuclear weapons. For confirmation

of the hostile nuclear weapons already secreted in large U.S. cities, read Lunev's book[1] to see how the former Soviet Union brought them in, along with the Spetznaz teams to detonate them on call. The nuclear weapons and the Spetznaz teams are still here. Other hostile nations have inserted terrorist teams with weapons such as anthrax, smallpox (camel pox is nearly identical to smallpox, and widely available), bubonic plague, etc. At the end of the 1991 Persian Gulf War, most of Iraq's calutrons and its nuclear program escaped the weapon inspectors and were hidden. In the few calutrons we did get, weapons-grade U235 residues were found. In a formal threat study for a foreign nation, begun before the Gulf War and delivered after its end, my analysis team and I estimated that Iraq had produced sufficient U235 in 1991 for from 7 to 12 nuclear weapons, particularly of the gun assembly type. My personal estimate now would be that Iraq has made sufficient weapons grade U235 to build three dozen to six dozen nuclear weapons. If so, then some of those weapons are undoubtedly long since spirited into the United States, and planted in our large cities.

In modern asymmetric strategic war, the first phase of the war is conducted in "peacetime". The first phase is to insert the weapons of destruction into the targeted nation and hide them at the intended targets, along with the teams to detonate and unleash the weapons when desired. In that sense, the first phase of WW III has already been accomplished.

According to Vice-President Cheney,[2] *"The war on terrorism will not be over in our lifetime. It is different than the Gulf War was in the sense that it may <u>never</u> end. At least not in our lifetime. The way I think of it is, it's a new normalcy."*

With much of the cheap oil of the world in its borders, the MidEast is a powder keg ready to explode. If a clash between the U.S. and Iraq occurs, Saddam Hussein has already clearly shown that he will attack and destroy his foe's energy infrastructure and he will also use weapons of mass destruction. Simply witness the hundreds of oil wells set afire in Kuwait by Iraqi forces during the Persian Gulf War, and the use of chemical weapons on his own people. As this is being written, Pakistan and India are skirting the brink of war, and both have nuclear weapons. Either side

[1] Stanislov Lunev and Ira Winkler, *Through the Eyes of the Enemy,* Regnery, Washington, D.C., 1998, p. 26.

[2] Vice President Richard B. Cheney, October 21, 2001.

that decides on war **will have to make a n**uclear strike on the other. They have no antimissile defenses, hence **making the** "first knock-out" or pre-emptive strike is each **nation's** only **chance of survival.** Hopefully cooler heads will prevail, but **If that** war erupts, the Mid East, oil, and present energy infrastructures will never again be the same, for the entire world.

There are other very serious U.S. vulnerabilities of gas and oil pipelines, port facilities, Gulf of Mexico oil rigs, nuclear power plants, power substations, hydroelectric dams, long power transmission lines on towers, etc. that are too numerous to enumerate. With but a moment's reflection, one realizes that even normal and cheap guerrilla-type or commando-type forces with C-4 explosives and timers can destroy a very substantial portion of the energy infrastructure with minimal risk and loss of assets. For those who wonder about a nuclear power plant's vulnerability, visualize a seized Boeing 747 loaded with fuel and flown directly into the main reactor container . If meltdown occurs, the nuclear tragedy at Chernobyl in 1986 will appear tame by comparison. There are also several other electromagnetic ways (such as a portable EMP "shooter" hauled in the back of a personal SUV) to instantly destroy the electronic controls of the nuclear power plant, seriously risking runaway and core meltdown.

Consequently, increasing attention is now focused on the extreme vulnerability of the centralized energy infrastructure in the U.S. and every other developed nation. So what started for me as a purely scientific endeavor to set out the concepts and principles of permissible COP>1.0 EM systems suddenly assumed a role of potentially critical strategic significance to the U.S. and to the entire developed world. Quite simply, some 20,000 terrorists in teams already in the United States can - at this very moment —destroy large portions of the nation's energy infrastructure at will, easily and cheaply. The economy of any modern developed nation depends on the availability of cheap energy. So this kind of hostile strategic capability means that the power to readily destroy a nation's economy — and thus defeat a mighty nation itself in the ensuing economic collapse — has passed into the hands of hostile forces already in country and awaiting the order to commit their assets.

In this new asymmetrical form of warfare, it would appear that the rapid developmentanddeploymentofsignificantdistributedpowersourcesis now a critical element of national survival for many nations of the world. Decentralization **does** little **good, however, if fuel** for the decentralized generators must remain **centralized and distributed** by very large and complex systems.The **fuel and Its distribution** are still extremely **vulnerable resenting** easy **targets allowing paralysis** of the decentralized

generators. Self-refueling *{self-powering)* of the electrical power systems is therefore a mandatory additional requirement.

So sober assessment dramatically reveals the need for self-powering electrical power systems, freely extracting their EM energy from the local vacuum. Thus an engineerable theory of permissible COP>1.0 EM systems has become essential to the national survival of the U.S. and many other nations, so that an effective decentralized energy infrastructure — with the seething vacuum as the "localized and inexhaustible free fuel supply" — can be rapidly designed, developed, and deployed.

Sadly, the leaders of the scientific community are still in a "business as usual" mode with respect to energy, and intend to remain so. They do not even recognize what powers and *always has* powered an EM circuit and system: EM field and potential energy extracted directly from the vacuum by the broken symmetry of the source charges and dipoles. Since no scientific research on EM energy from the vacuum is going to be launched by the scientific leaders at the top, then the results of the broken symmetry discovered in 1957 are going to have to be applied in the scientific community from the bottom up. Consequently, a rather desperate need to communicate everything possible to the young graduate students and post-docs has become imperative, if the nation is to survive.

From the beginning of my effort in COP>1.0 systems, and then my effort on this book and prior to the events leading to the attack on September 11, 2001, the appalling *humanitarian* need for COP>1.0 electrical power systems taking their energy from the vacuum has been obvious and overwhelming. One third of the human population usually goes to bed hungry at night. One third is infested with worms and parasites of one kind or another, in addition to other diseases. Simple things such as clean water, common sanitation, medical treatment, and jobs to support one's family are difficult things in many parts of the world.

In the final analysis, the only way to get a suffering, impoverished, and undeveloped nation up and going is to provide cheap clean energy, and to do it with systems which get their "fuel" for free, such as from the vacuum itself. Once cheap clean energy and self-powering systems are widely available, then the economy and infrastructure of that nation can be slowly and steadily built up to get the society moving. Roads, bridges, hospitals, schools, teachers, industry, and jobs then follow as the economy rises. Until there is a cheap energy infrastructure available and growing, essentially fuel-free, none of that is going to happen in most impoverished nations because presently the world's fuel is monopolized, controlled, and

fought over, and it will become evei more expensive as the supply vs. **demand** ratio falls, prices escalate, and additional wars - almost certainly involving weapons of mass **destruction** - are engendered. With present aid concepts, at best the politicians and warlords usually get the bulk of whatever assistance is sent in, and the warlords on the take from foreign masters will continually plunge the country into turmoil, war, and human tragedy. *Assistance is necessary,* but the eventual aim has to be to enable and empower the common citizens to be self-supporting, educated and trained, relatively free from disease, and living in a nation having a growing and developing infrastructure, jobs, and a decent economy. Availability of cheap and affordable energy — and *clean* energy if we wish to save the precious environment — is the primary key to "freeing and empowering the developing nations" as well.

Along with this omnipresent, desperate humanitarian need, the increased strategic need for decentralized energy systems freely fueled from the vacuum itself has led me to make every effort possible — particularly after the heart attack in 2001 and in continued hypoxia from severe chronic mycoplasma infection — to finish the book and at least outline the major concepts and principles that enable the construction of a sorely-needed COP>1.0 electrical power systems theory, followed by the development and rapid deployment of actual self-powering systems. The Alpha Foundation's Institute for Advanced Study (AIAS), spearheaded by Dr. Myron Evans, has also been vigorously preparing and publishing papers in leading scientific journals and other publications[3] showing that EM energy from the vacuum is permissible, possible, and feasible.

In my three decades of work with multiple inventors of working prototype COP>1.0 electrical systems, I have been privileged to experience and work with several actual COP>1.0 circuits and prototype systems, study them, and slowly comprehend some of the advanced and unusual principles involved. In short, thanks to the courtesy and kindness of others, I have been able to gradually acquire at least an elementary understanding of the

[3] E.g, *Modern Nonlinear Optics,* Second Edition, 3 Vols., edited by M. W. Evans, Wiley, 2001; M. W. Evans et al, "Derivation of 0(3) Electrodynamics from the Irreducible Representations of the Einstein Group," *Found. Phys. Lett.,* 15(2), Apr. 2002, p. 179-187; "Anti-Gravity Effects in the Sachs Theory of Electrodynamics," *Found. Phys. Lett.,* 14(6), Dec. 2001, p. 601-605; "Classical Electrodynamics Without **the Lorentz Condition: Extracting Energy** from the Vacuum," *Physica* ***Scripta,*** **61(5),** May 2000. p. 513-517; "Runaway Solutions of the Lehnert Equations: The **Possibility of Extracting Energy from the Vacuum,"** *Optik,* 111(9), 2000, p. 407-409.

mechanisms which enable COP>1.0 EM power systems. With this background, one can understand why conventional EM systems and circuits do not develop COP>1.0 or self-powering, even though all the energy collected and used in every electrical power system comes from the vacuum and not from the shaft energy input to the generator, chemical energy dissipated in a battery, wind energy collected by a windmill (that just "feeds" the shaft of the generator), or from the water power dissipated in a hydro turbine (the hydro turbine also only turns the shaft of the generator, which does not actually furnish the power to the external power line connected to it).

It seems appropriate that other researchers should be able to start where 1 am now, understand what I have learned or think I have learned, find and correct any errors, and simply go forward with alacrity — much farther than I have been able to go, and much faster. This is particularly true of the young researchers who have excellent theoretical and experimental skills and a vigorous lifetime ahead of them. When an old and tiring runner falters with the baton, it is time to pass it on to the fresh young runners who can carry it to the successful end of the race.

The purpose of this book, then, is to lay out in some little detail what I have learned in all these years of sustained effort, but in such a way that it ties directly into good physics. In some cases, the tie-in to physics is unavoidably to a somewhat esoteric area such as the geometric phase and to time as a special form of energy. COP>1.0 EM systems are not simple, and they involve special phenomenology rarely encountered in conventional EM circuits and systems. COP>1.0 EM systems simultaneously involve a combination of particle physics, modern active vacuum theory, advanced materials science, higher group symmetry electrodynamics, quantum mechanics, and general relativity. They also involve areas where foundations of physics are presently in error. We found it necessary to think in terms of the *supersystem*, defined as having three components, which are (i) the physical power system itself, (ii) the active local vacuum, and (iii) the active local curvatures of spacetime. All three components of the supersystem interact and exchange energy with each other continuously. Any legitimate COP>1.0 power system must freely receive, collect, and use some excess energy from its active environment — in this case, the latter two components of its supersystem. By definition, this COP>1.0 function requires disequilibrium between the system and its active environment, so that classical equilibrium thermodynamics does not apply. Instead, the thermodynamics of systems

far from **equilibrium** in **their** energetic exchange with an active environment applies.

However, since the "environmental energy" we are extracting is virtual photon energy from the vacuum and energy from local curved spacetime, the fundamental definitions of classical thermodynamics and classical electrodynamics have to be re-examined and altered. A closed system, e.g., can no longer be defined just as one closed to the transfer of mass across its boundary, but permitting energy to exchange across it. Since the advent of general relativity in 1915, we have known that energy and mass are the same thing. Whenever any system changes its energy, it also changes its mass by the well-known $E = mc^2$ rewritten as $dm = dE/(c^2)$. Further, in the fierce virtual particle exchange of the vacuum with every part of every system, both virtual mass and virtual energy continually cross the system boundary. Neither classical thermodynamics nor classical electrodynamics deals with the transduction of time-energy into spatial energy in a system, which is a totally different type of energy exchange accomplished by charge.

Further, certain phenomenological areas — such as strong gradients — are already well known to violate present thermodynamics. These are presently being researched under the aegis of *extended nonreversible thermodynamics.* Finally, as the present laws of classical thermodynamics are stated in the textbooks, *every charge and dipole in the universe already violates those laws, and has done so since the beginning of the universe.* Let us put it bluntly: Every charge in the universe already freely and continuously pours out EM energy in 3-space in all directions, without any observable EM energy input. That is the well-concealed *source charge problem,* known but ignored by the leaders of the scientific community for. a century. *All* EM fields and potentials and their energy come from those source charges, according to electrodynamics itself. Either we must give up the conservation of energy law entirely, or else we must accept the fact that unobservable *virtual* EM mass and energy are continuously absorbed

The vacuum by the source charge, transduced into real observable EM energy, and then re-radiated in 3-space in all directions as observable EM energy, creating the associated fields and potentials reaching out across the universe. That this problem continues to be ignored by the scientific community — some 45 years after the basis for its solution has been proven and is well known in particle physics — is totally inexplicable. But it continues to be resoundingly ignored, which means that *the scientific community itself is and remains totally responsible for the energy crisis and the associated vast desp**oilment of the** biosphere, because it adamantly*

insists on using a seriously flawed electrical energy science whose hoary basis is more than a century old.

Accordingly, we have simply extended the first law of thermodynamics appropriately, pointed out that the second law does not apply absolutely but only as an approximation when conditions are appropriate, and revised the third law and the zeroth law. In this book we simply show the results of that revision, particularly in Appendix A.

We were also able to trace the history of electrodynamics, and to find exactly how the permissible Maxwellian systems far from equilibrium with an external active environment — which are included in Maxwell's 1865 seminal theory and even in Heaviside's vector truncation later — were arbitrarily discarded by Lorentz with his symmetrical regauging of the Maxwell-Heaviside equations. The purpose of such arbitrary regauging was and is to provide simpler equations that can usually be solved analytically without resorting to numerical methods. In the name of mathematical simplicity and ease, that entire great class of Maxwellian systems far from thermodynamic equilibrium in their supersystem was just arbitrarily discarded. Those Maxwellian systems are still arbitrarily discarded in every electrical power-engineering textbook today.

So the first requirement for a COP>1.0 EM system becomes *building-in a mechanism to violate the Lorentz symmetry condition, at leastfor a significantfraction ofthe time.* Further, the standard closed current loop circuit — including the entire external circuit in the same closed current loop as the source dipole inside the generator is what already *self-enforces* the Lorentz symmetry condition. Consequently, in any legitimate COP>1.0 electrical system, the operation of that closed current loop circuit must be violated for some portion of the system's operation. This of course places the system in disequilibrium with its active supersystem environment, allowing intake of extra energy from the environment and therefore permitting COP>1.0. So one of the immediate requirements in COP>1.0 electrical systems research is to seek out and find known or suspected mechanisms that accomplish just such violation of the Lorentz symmetry condition. In the book, I show a sampling of the various mechanisms I found other inventors using or that I uncovered myself, or that already exist in physics.

Finally, we discovered (and found the basis for it was shown in the hard literature in Heaviside's original work) that every generator and battery as an energy transducer already extracts from the vacuum and outputs from its terminals a far greater *nondiverged* energy flow than is accounted in the

Poynting diverged energy flow theory (which captures only that small **fraction that** is **diverged** into the circuit and captured by it). The total output energy flow from the terminals of a generator is also far greater than the mechanical energy input to the shaft of the generator. So in its *energy transduction* function, every dipolar electrical circuit ever built is already a "free energy circuit" and a COP >>1.0 system, extracting its utilized electrical energy from the vacuum and extracting additional energy also. But presently the electrical power system is unwittingly designed and constructed by engineers to deliberately destroy the source of that enormous energy flow from the vacuum faster than the system can use some of it to power its load. Wryly put, that does not seem to be the proper way to build energy systems or "run an energy railroad," even though it's always been done that way.

This led to recognition of a great scientific faux pas, perhaps the greatest in history. One must keep one's sense of humor! So with tongue in cheek, let us state it this way: *There is not now, and there never has been, a single electrical engineering department, electrical engineering professor, or electrical engineering textbook that teaches what powers an electrical circuit. Yet the basis for it has clearly been in particle physics since 1957, as certified by the award of the Nobel Prize to Lee and Yang. What powers every electrical circuit and system is the broken symmetry of the primary power system's source charges and source dipole (i.e., the broken symmetry of the opposite charges on the ends of the dipole) in its fierce energy exchange with the seething vacuum, once that dipole has been made. The modern "charge" is also a dipolarity, once its associated clustering virtual charges of opposite sign are considered. Further, any dipole will freely extract EM energy from the vacuum, convert it into real, usable, observable EM energy, and pour out real, usable EM energy continuously and indefinitely, so long as the dipole remains intact.*

The external circuit attached to a generator is not powered by the mechanical energy that is input to the generator shaft. The external circuit attached to a battery is not powered by the chemical energy expended by the battery. Astonishingly, every electrical power system and electrical circuit ever built, and every one built today, was and is powered by energy extracted and transduced directly from the active vacuum by the broken symmetry of the opposite charges on the ends of the source dipole (or a charge considered as a modern dipolarity), once that dipole is formed. A Nobel Prize was awarded to Lee and Yang in 1957 for the prediction of broken symmetry (strongly in 1956). Wu and her colleagues proved it **experimentally** in early 1957. So revolutionary a change in physics was

that startling discovery of broken symmetry, that — in a nearly unparalleled action — the Nobel Committee awarded the Nobel Prize the same year, December 1957, to Lee and Yang. *One of the broken symmetries proven was that of opposite charges such as are on the opposite ends of every dipole, or such as constitute a classical "isolated charge" when the charge and its clustering virtual charges of opposite sign are considered as in modern physics theory. Rigorously, every source dipole is continuously extracting EM energy from the vacuum and pouring it out of the "terminals" of the dipole in all directions in 3-space. And so is every charge as well.* That the leaders of the scientific community continue to ignore this solidly proven fact is astonishing. But they do.

We also came to realize that the great Gabriel Kron, who was never allowed to reveal the secret of his *open path*, had in fact discovered the precursor of that very broken symmetry of opposite charges (of dipolarity). His open path is simply the recognition that any two points in the universe, that are at differing potentials and therefore can be considered as a dipolarity of opposite charges, acts as a source dipole that already extracts virtual photon energy from the vacuum, transduces it into real, observable photon energy, and pours out that energy in all directions. In reaching that understanding, he had applied general relativity to rotating electrical machines, simulated various forms of electromagnetics equations, and dealt deeply with quantum mechanics and the Schrodinger equation.

Sadly, the electrodynamics model used in electrical power engineering still does not even model the active vacuum, *much less* a broken symmetry in the virtual photon exchange between that active vacuum and all the charges in every electrical system. The electrical engineering model does not model the *supersystem*, hence cannot be used to design and produce COP>1.0 systems. *A priori*, that seriously truncated and crippled model arbitrarily discards all permissible Maxwellian systems far from thermodynamic equilibrium (i.e., with broken symmetry) in their vacuum flux exchange. And those are precisely the systems that are permitted to perform the five magic functions of great interest to the COP>1.0 energy researcher. Such a disequilibrium system can permissibly (i) self-order, (ii) self-rotate or self-oscillate, (iii) output more energy than the operator inputs (the excess energy is freely received from the active environment), (iv) power itself and its load simultaneously (all the energy is freely received from the active environment), and (v) exhibit negentropy. *Every charge and dipole in the universe already performs all five magic functions.*

It is **the purpose** of this book **to** clearly show that all EM systems are already powered by vacuum energy, and always have been. We cite the references and experimental proof that this is true, and the interested reader can check the extensive references himself or herself. The intent is to show that only a part of what has been discovered and is already known in particle physics is presently included in the woefully inadequate and ancient electrical power-engineering model. And frankly, unless there is a groundswell from the bottom of the scientific community, the leadership of the scientific community has no intention whatsoever of funding or allowing significant research in extracting copious EM energy from the vacuum (very simple) and learning to use it effectively (more difficult). A single 200 million dollars of good research in EM energy from the vacuum would solve the energy crisis forever, and dramatically reduce the pollution of the biosphere. The scientific community will spend many times that amount on their favored "big science" projects, but not one cent on EM energy systems powered by energy extracted from the vacuum.

Also, we show a sampling of the present work ongoing in inertial propulsion and antigravity research. Working with Sweet, in the 1980s I designed and Sweet performed a highly successful antigravity experiment.[4] I share with the reader the concepts and theoretical basis for that experiment, why it worked and how it worked, and the excellent results achieved. One of the tragic losses to science was the loss of the Sweet COP»1.0 vacuum triode amplifier (VTA) system with the death of Floyd Sweet. Nonetheless, we apply the mechanism we conceived so long ago to propose a mechanism generating the antigravity recently confirmed to be accelerating the expansion of the universe. We offer the long-neglected, Lorentz-discarded giant nondiverged Heaviside energy flow component accompanying every field-charge interaction as the probable generatrix of the excess gravity holding the arms of the spiral galaxies together. And we offer that same component — when connected with a flow of *negative* EM energy and with *negative energy* EM fields and potentials — as the specific generatrix of the excess antigravity that is accelerating the expansion of the universe. Both theses are testable on the laboratory bench.

Our target audience is several fold. Even though presented conceptually, the material is not oversimplified, and it is targeted at (i) the sharp young grad students and post-docs interested in extended (higher group internal

[4] Floyd Sweet and T. **E. Bearden,** "Utilizing Scalar EIectromagnetics to Tap Vacuum Energy," *Proc 26th Intersoc.* ***Energy Conversion*** *Eng. Conf. (IECEC '91),* Boston, Massachussets, 1991, p. 370-375.

symmetry) electrodynamics and in researching and developing COP>1.0 electrical power systems, (ii) the forward-looking electrical engineering professors who will at least consider that extended electrodynamic models and the laws of nature do permit COP>1.0 electrical power systems, and (iii) the still open-minded leaders of the scientific community, such as the National Academy of Sciences, National Science Foundation, the U.S. Department of Energy, the great national laboratories, etc. In *one area* of physics much better models of electrodynamics enabling COP>1.0 power systems, antigravity, and novel propulsion systems already exist (and a few such systems *experimentally* exist in the hands of independent inventors as well), while in a *second area* of physics that part of electrodynamics dealing with permissible COP>1.0 EM systems and unified field theory has been arbitrarily excluded at great cost to society, to the environment, and a tragedy to science and technology. Additional secondary targets are (iv) governmental leaders responsible for advanced research and development planning and funding, to argue that the "energy crisis" is a direct result of an inexplicable and sustained shortfall in the scientific mindset, and not as a result of the laws of nature and the need for cheap oil, coal, and gas or nuclear power plants, (v) science writers, journalists, and entrepreneurs to sensitize them to (hopefully) a coming energy revolution of unparalleled proportion, (vi) strategic and tactical planners in our Department of Defense to make them aware that the great logistics burden of modern highly maneuverable armed forces can and will be dramatically lowered by rapidly developing and using self-powering power systems "fueled" directly by the local active vacuum, and by adapting novel new propulsion methods, (vii) theoretical and experimental physicists to make them aware that the easiest thing in the world is to extract copious EM energy freely from the vacuum; just pay *once* to make a little dipole or assemble a charge and do not let it be destroyed, (viii) the Department of Energy upper level managers to bring into their awareness the coming advent of (and terrible need for) self-powering decentralized EM power systems worldwide, and the pressing need for a major role to be played by the DoE, (ix) the struggling but serious COP>1.0 researchers and inventors, to give them a technical overview — rather than just anecdotal material — of much of what has been done, tried, and conceived, and what seems to be successful and what is still to be determined, (x) the environmentalists devoted to cleaning up the biosphere and saving this precious planet, to make them aware that the answer to the world's energy problems and saving the biosphere cannot come to them from their conventional scientific consultants, who are trained in applying the very scientific disciplines responsible for the problem in the first place,

and (xi) **the long suffering undeveloped** and impoverished nations and peoples of the earth. Our fervent message is one of hope after all, *once a **change** occurs in the scientific mindset.* There is a cheaper, cleaner, and better way to get their economies and nalional infrastructures up and running, and it is imminently doable.

The main message of this book is that there is not now and there never has been an *electrical energy availability* problem. Every large centralized power generator actually outputs enough EM energy flow, extracted directly from the seething vacuum, to power all electrical loads on earth, if all the energy pouring from its terminals were caught and utilized. However, there is certainly an *EM energy flow interception* problem, to get more of the available energy flow from a source dipole intercepted and diverged into the circuit in a manner not complying with the Lorentz symmetrical regauging condition. Also, once the excess energy has entered the circuit and been collected, there certainly is a problem in *using the intercepted and collected energy in the circuit without destroying that part of the generator or battery — the source dipole — that is actually extracting all the energy from the vacuum.* Or at least to use the circuit's collected energy in such fashion as to destroy the source dipole in the generator *slower* than the energy is used to power the external load.

That conglomerate of the two sub problems — the "energy flow *interception, collection, and usage* problem — is the single energy problem. There is no other energy problem, and there has never been any other. One finds it very ironic that, in the conventional agencies, universities, the DoE, the National Science Foundation, the National Academy of Sciences, the national laboratories, etc., not one of them is working on the real, solitary electrical energy problem, even though they are importantly spending billions of dollars purporting to do so.

We fervently hope that the content of the book will reach a sufficiently interested audience to begin to change that century-old erroneous scientific mindset. We hope that the book, along with the important contributions of other COP>1.0 inventors and researchers having success, will spark a new creative drive in the scientific spirit that solves the problem of cheap, clean energy in three years or less. This is a doable. I firmly believe in the scientific method and what it can do once it is unleashed from the century-old dogma that COP>1.0 systems are against the laws of nature, physics, and thermodynamics. Just turn the young scientific and engineering tigers loose on the problem, give them some funding, and watch them do it.

As we stated in a formal rebuttal to a charge of perpetual motion nonsense, it only takes one white crow to prove that not all crows are black. And with respect to COP>1.0 EM systems far from thermodynamic equilibrium with their active environment, every charge and dipole in the universe is already a "white crow" pouring out EM energy freely and continuously with the speed of light, and exhibiting COP = ∞. This is in fact reluctantly recognized in physics, but it has essentially been buried from the attention and knowledge of generations of electrical engineers and most physicists.

A COP>1.0 experiment well known to nonlinear optics is the Bohren-type experiment, demonstrating the known negative resonance absorption of the medium. A typical experiment of that type outputs some 18 times as much EM energy as the experimenter inputs by standard calculations. We note that a single replicable experiment can and does negate any theoretical model that contradicts it. Hundreds of such materials experiments proving the feasibility of COP>1.0 EM systems are performed every year in any major nonlinear optics laboratory without a second thought. Together with the known but avoided source charge problem and proven broken symmetry of any dipolarity, it is almost unthinkable that our electrical engineering departments still do not incorporate the active vacuum exchange — and every EM circuit's broken symmetry in it — into the classical electrodynamic model used. In short, to really understand what powers every EM circuit, just now the electrical engineer would have to go across campus to the particle physics department and investigate broken symmetry of opposite charges — as are on the ends of the source dipole, once created in the generator or the battery, or as are involved with the single "isolated charge" considered with its associated virtual charges of opposite sign.

It is high time that our electrical power engineers and scientists heed the message of all these demonstrated white crows of nature, and begin developing and deploying self-powering COP>1.0 electrical power systems with alacrity.

We have a biosphere, a planet, a strong world economy, and an uplifting for the long downtrodden poor people of the world to recover. We strongly urge the scientific community to accept the challenge and meet it head-on.

Tom Bearden

22 July 2002.

Chapter 1
Foundations and Scientific Mindset

"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them." [Albert Einstein]{1}

1.1 Introduction

Einstein's quote is a beautiful statement that scientists should never take the present understanding — and the present models — as absolute. That is the approach the present author has taken for some 30 years, in a struggle to comprehend that class of electromagnetic (EM) systems that are open systems in disequilibrium in their *virtual photon energy exchange* with the active vacuum, and exhibiting a broken symmetry in that exchange. The statement beautifully expresses that the major problems encountered in grappling with such EM systems have been the existing errors and non-sequiturs in classical electrodynamics and other parts of physics. Many difficulties have resulted from the continued propagation of a 137-year old classical electrodynamics model formed before electrons, atoms, nuclei, positrons, the active vacuum, special and general relativity, quantum mechanics, etc. were discovered or known.

1.1.1 EM Foundations Are Incomplete and Contain Errors

In any model, there are many assumptions. Even when a model is well-fitted and well-developed, it still applies only when the foundations assumptions on which it is based are true or are not too much in error. Whenever one or more of the fundamental assumptions is violated by phenomena uncovered, then there is a new class of phenomena where the model does not hold, or does not hold well and is only an approximation at

best. In that case, either the existing unsatisfactory model must be improved and advanced, or a new model must be constructed.

Great scientific minds continue to point out Einstein's beautiful principle in different words. E.g., expressing the thought of Stephen Hawking, one of the great physicists of our day:

> *"All we ever know is our models, but never the reality that may or may not exist behind the models and casts its shadow upon us who are embedded inside it. We imagine and intuit, then point the finger and wait to see which suspect for truth turns and runs. Our models may get closer and closer, but we will never reach direct perception of reality's thing-in-itself.*" [As stated by George Zebrowski] {2}.

Excellent scientists — Feynman, Wheeler, Bunge, Evans, Barrett, and many others — have indeed pointed out that classical EM theory is seriously flawed. In the words of Bunge {3}:

> *"...it is not usually acknowledged that electrodynamics, both classical and quantal, are in a sad state."*

The author also found it imperative to return to many of the original seminal papers of physics, particularly in electrodynamics. The major concepts in those papers led to the present classical EM model. This was particularly true of the work of Poynting {4a, 4b} and Heaviside {5a-5c}, who independently and simultaneously arrived at the notion of the flow of EM energy through space[5]. Their work occurred in the 1880s, after Maxwell was already deceased. It also necessitated reviewing Lorentz symmetrical regauging of the Maxwell-Heaviside equations, where Lorentz arbitrarily discarded all permissible COP>1.0 Maxwellian systems.

The science of this "EM energy flow through space" is controversial to this day. Which is the real "EM energy flow vector" as such has never been

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[5] As we shall point out later, the concept of energy flowing through 3-space is a non sequitur and requires substantial revision today, to be consistent with the nature of observation and the fact that no observable continuously persists. Any observation is an instantaneous frozen 3-space "snapshot" at a single instant, gone the next instant when almost immediately replaced by another such frozen snapshot. In between observations, not mass but *masstime* exists. The same is true for 3-space, which only exists as the output of an observation process. Prior to observation, *spacetime* exists.

adequately resolved, and there continue to be polite debates about it {6}. One should also be aware that physicists really do not know what many things — including energy — *are*. The definitions of these fundamentals are still uncertain, as stated rather poignantly by Feynman {7} in this quote:

> *"It is important to realize that in physics today, we have no knowledge of what energy is."*

As another fundamental example, Feynman {8} also pointed out that we really do not know what *force* is[6] either! Quoting:

> "*One of the most important characteristics of force is that it has a material origin, and this is not just a definition. ... If you insist upon a precise definition of force, you will never get it!"*

1.1.2 Physics Is Not the Mathematics, But What It Manipulates

Following Feynman's ansatz, one should realize that the physics is not really in the mathematics itself, but in the physical meaning of the concepts that the mathematics manipulates. Here again, the inimitable Feynman {9} cautioned against over-attachment to the mathematics itself. He said it very clearly:

> *"Mathematicians or people who have very mathematical minds, are often led astray when "studying" physics because they lose sight of the physics. They say: "Look, these differential equations – the Maxwell equations – are all there is to electrodynamics it is admitted by the physicists that there is nothing which is not contained in the equations. The equations are complicated, but after all they are only mathematical equations and if I understand them mathematically inside out, I will*

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[6] The problem is the ubiquitous and erroneous use of a "separate" force acting on a "separate" mass. Actually mass is a *component* of force, as can be seen from F $\sum$d/dt(mv). Hence there is no such thing as a separate force in empty space, acting upon a mass. Instead, the massless 4-field in space acts upon mass to produce force *in that interaction*. Force is not a cause, but an effect of an ongoing interaction — as is any observable. An observable is a continuing series of frozen 3-space LLL snapshot entities given by the result of continual application of $\in/\in$t (LLLT) ♥ LLL by photon emission. The formation of the LLLT (spacetime and masstime) in between observed m as LLL, is produced by photon absorption of the previous m = $\in/\in$t (LLLT).

> *understand the physics inside out." Only it doesn't work that way. Mathematicians who study physics with that point of view – and there have been many of them – usually make little contribution to physics and, in fact, little to mathematics. They fail because the actual physical situations in the real world are so complicated that it is necessary to have a much broader understanding of the equations."*

Such matters and similar thoughts had bothered me even back in the early 1950s, when I could not find a single professor or dictionary of physics that *logically* defined a field or a potential. Considered rigorously, the definitions all fell apart and violated elementary logic. Improper, insufficient, or just plain *wrong* definitions in physics have continued and are still widespread to this day. To give a single example from an excellent book by Kraus {10}: On p. 60, Kraus gives the formula for a potential referred to as the "absolute potential" of a charge source. Quoting:

> *"This potential… is, by definition, the work per coulomb required to bring a positive test charge from infinity to the point* r_1*."*

Kraus erroneously "defines" the scalar potential identically as work, which is equating the cause with the effect. The work that dissipating a potential does or can do, is not the potential itself! Else "human" means nothing but how well one can chew one's food or drive an automobile. Actually, Kraus gives one theoretical way to measure or calculate the effect of the potential's *local intensity at a point*.[7] Note that what is measured is the energy *diverted from* the potential at that point, around that test charge. This does not specify the *entity* (the potential itself) at all, but only what has been diverted from it. It is rather like confusing the whirlpool (water diverged from the normal river flow) in a river as being the river itself.

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[7] To show the non sequitur, a million more positive test point charges could be brought from infinity to that same point, and the potential — without any change in it — would cause the same amount of work to be done upon each of those charges. As can be seen, even noted professors can speak rather casually when they "define" the potential's point intensity as "the" potential (which extends over all space, not just at that one point). There may be different intensities at different points in the potential, but the potential itself remains one-and-the-same thing regardless of which one or all of the point intensities are discussed. And neither the point intensity of the potential nor the potential is the work that is done upon a moving charge by that potential or its intensity.

Integrating what has been diverted from it does not yield the potential itself! At best, the measurement gives an indication of the *intensity* of the potential at a point, insofar as its reaction with charge is concerned. More rigorously, what is being utilized is the potential's reaction cross section presented to a *unit point static charge* at that point. The same unit point charge, if placed in particle resonance, will sweep out more geometrical area and exhibit a greater reaction cross section. That will increase the energy collected divergence of the energy flow that is being moved around the particle itself. By normal calculations, the resonant charge may collect some 18 times as much energy as is possible at the same point by the same charge in static mode — e.g., as shown by Bohren {24, 25}.

A definition must present an identity. Examining the proposed definition as "the potential is identically … work" one sees the problem immediately. *The potential exists whether or not there is a positive test charge, or whether one moves such a charge in from infinity or not, and whether there is any work done or not*. None of that is what a potential *identically is*, but only one aspect of what it *does* or *can do* or *can cause.* One leaves as an exercise for the reader the task of further examining dictionaries of physics and textbooks, to try to find a satisfactory definition of that common scalar potential.[8] We do not believe the reader will find it.

Yet any good textbook will also contain some real gems of great insight, simply said. As an example from Serway {11}, we eventually took a most marvelous cue, of how to get around classical thermodynamics' prohibition against heat energy "running uphill" from hot to cold. In an insightful statement, Serway said {11}:

> *"The second law [of thermodynamics] does not rule out the possibility of pushing heat uphill, as it were, from a cold object to a hot one, or of creating order out of*

[8] The scalar potential identically is actually a harmonic set of phase conjugate longitudinal EM wavepairs, as shown by E. T. Whittaker in 1903 {85}. Even Whittaker, however, misinterpreted his wavepairs only after interaction with that ubiquitous unit point charge assumed at every point in space. He gave two *effects* of that interaction, not the *cause* (which exists prior to interaction) *and the effect* (which exists only after interaction). Reinterpreting to get at the causal wave, each wavepair is a matched set of two waves; an incoming EM longitudinal wave in the time domain prior to interaction with a charge, and — after the time-energy wave is absorbed by the charge, an emitted outgoing EM longitudinal EM wave in 3-space. The so-called "static" potential is not static at all, but is a dynamic, ongoing 4-space process. This follows the re-interpretation by the present author {12} of Whittaker's decomposition — a reinterpretation then found to be consistent with quantum field theory {19} and with broken symmetry of opposite charges in particle physics {73}.

> *disorder. It merely states that such a reversal of the natural flow requires an influx of energy…"*

This essentially states the *law of entropy*, where to reverse entropy (disorder), one must apply ordering (energy).[9] We also note that the original concept of entropy was as *dissipation of potential*. There are of course different ways to apply the energy, and it need not be by the operator himself. Chapters 4, 5, 6, 7, and 8 of the present book give some unusual ways. A special paper {12} published by the author in 2000 gives another. Indeed, when the flow of time is predominantly reversed, so is the "entropy" of a situation, since the "videotape is running backward", so to speak. In that case, the entire classical thermodynamics must be extended to essentially include its own opposite. The making of a small time-reversal zone where such things happen is as simple as involving a predominance of antiphoton interactions with the charged particles in that zone, rather than a predominance of photon interactions. What we are saying is that the notion of irreversibility in thermodynamics is not necessarily absolute. It usually assumes a "time forward" situation, and may not hold in a "time-reversed" situation. In our chapter on cold fusion, we will present some specific and quite startling nuclear interactions that occur as a result of the time reversal of the coulomb barrier (repulsion of

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[9] Now notice what Serway's statement means with respect to the classical thermodynamics "definition" of closed system. Thermodynamics defines a *closed system* as one in which mass is not exchanged across its boundary, but energy can be. That definition permits a closed system to receive excess energy from its active environment, and thereby reduce its entropy. A specific example is simply potentializing a circuit, prior to movement of the current. Hence the entropy of a closed system does not necessarily increase, but may decrease or increase if the system is in disequilibrium (difference in energy received from its active environment and energy escaping back to the active environment from the system. For the same system, if energy exchanges across its boundary equally in both directions, the system is said to be in "equilibrium" with respect to external energy exchange. One must be very careful in interpretation of the second law of thermodynamics! One has a very different "closed thermodynamic system" when it is in *energy exchange disequilibrium*, than when it is in *energy exchange equilibrium*. Equilibrium is the condition of maximum entropy. For substantial disequilibrium condition, entropy cannot be computed, but is less than the entropy of the same system in equilibrium. The entire ansatz of thermodynamics may be violated once time-energy is transduced into internal EM energy inside the system. That is a fundamental disequilibrium, performed by every charge in the universe. Hence of necessity we have advanced and utilized new definitions of "open system" and "closed system" in our approach in this book, as discussed in the Appendix.

like charges in a forward time situation) into a coulomb attraction between like charges in a time-reversal zone and time-reversed situation.

If Serway's statement were reversed, it would then be a statement of the *law of negentropy*. It would state that self-ordering (i.e., freely receiving energy from the active environment) in a system could indeed "push heat uphill from a cold object to a hot one", and the system could simultaneously emit energy in the process. Every charge does it!

We did find it necessary to correct the classical thermodynamic definitions of "open system" and "closed system". To define a closed system as closed only to mass transfer, but open to energy transfer, is a gross non sequitur. Since general relativity was published in 1915, energy and mass are known to be the same thing (*mass is just a special form of energy*), hence the term "mass-energy" (mass as energy) in physics. Whenever energy crosses the boundary of a system, the system's mass changes and mass (or certainly mass change) has also crossed that boundary. Indeed, as we shall point out, in 1917 Hilbert specifically pointed out that in general relativity there can be no energy conservation equations of the kind usually employed elsewhere. The fact that general relativity falsifies much of the present foundations of classical thermodynamics seems to have been either ignored or missed by most of the scientific community, although we will quote leading Russian scientists who have noticed it and are aware of it.

The reader is thus warned that, henceforth, when we use "open system" we mean one where either energy or mass or both exchanges across the system boundary. When we use "closed system" we mean one in which *neither* energy nor mass exchanges across the boundary. In short, the notion of a "closed system" has been redefined into what classical thermodynamics calls an "isolated system". We already know from particle physics and the active vacuum (and from general relativity and the change of spacetime curvature with every change of spatial energy or mass-energy), and from the giant negentropy involving time energy transduced into 3-space energy and vice versa, that there is no such thing in all the universe as a truly closed system.

In Appendix A, we have discussed how extension and change to classical thermodynamics must be made. We do this by extending the first law, refuting any absoluteness of the second law and third law, dealing with the zeroth law in a new way, etc. We also urge the better theoreticians to re-examine classical thermodynamics along such lines, to modernize and upgrade it. We believe that the present scientific work to extend

thermodynamics so it fits those situations now known to violate it should include additional considerations such as we present in Appendix A.

In short, with the new definitions Serway clearly states the difference between classical equilibrium thermodynamics, where no excess energy from the environment is received, and the thermodynamics of systems far from equilibrium with their active environment (using the new definition of open system for clarity), in which case excess net energy from the environment can be received and used in electromagnetic systems, providing COP>1.0 systems or even COP = ←systems. The windmill, sailboat, and waterwheel are age-old examples of disequilibrium systems where of course the energy of mass in motion is what is transduced. It is our objective in this book to point out the use of electromagnetic systems in energetic disequilibrium with their active environment (the active vacuum and curved spacetime) to provide just such negentropy.

1.1.3 Time Is Energy and Must Be Considered As Such

In a physics model, one's choice of fundamental units is arbitrary.[10] As an example, in one type of physics only a single fundamental unit — length — is employed. All other entities then become functions of length.

We are also free to choose the *joule* as the single fundamental unit in our physics model. The result that mass is a function of energy is now familiar and quite accepted, by the famous formula $E = mc^2$. Indeed, as can be seen, in that equation mass and energy are one and the same thing, since c^2 is a dimensionless constant. However, in our new model time becomes a function of energy similarly, and thus time is identically energy.

Let us perform a thought experiment. Suppose we take some spatial EM energy in 3-space, and compress it by the factor c^2. What can we do with it? If we leave it there in 3-space, it is known as "mass". If we place it on the fourth Minkowski axis *ict*, it is known as time because *t* is the only variable on that axis, and the only "place we can set it".

So to first order, *time has the same energy density as mass*. Multiplying an amount of time *t* (in seconds) by c^2 gives the decompressed spatial energy *E* that the time *t* will transduce into. In short, $E = tc^2$ also.

Now we notice what special relativity has to say about the relationship between time-energy and mass-energy. When the mass-energy increases

[10] E.g., see Jackson, *Classical Electrodynamics*, 2nd Edition, Wiley, 1975, p. 811-812; *ibid.*, 3rd Edition, 1998, p. 775. Jackson wryly remarks on how much excess heat and passion have been unnecessarily expended on that subject.

(e.g., as a function of velocity), time "dilates" or “decreases”. In other words (hint), there is a sort of special new extension to the conservation of energy law: If mass (3-space) gains some 3-spatial energy, then time loses some time-energy. Since time is spatial EM energy compacted by c^2, then *the relativistic energy changes in the time domain are enormously greater than the corresponding relativistic changes in spatial energy in the photon*. To the external 3-space observer, this is the injection of negentropy with respect to the present 3-spatial conservation of energy law. In the reverse case (as when the object reduces its velocity), if mass (3-space) loses some energy, then time gains some time because the time dilation reduces — i.e., time contracts or densifies (less time has more energy). To the observer, this is the production of entropy with regard to 3-space energy conservation. Yet the observer misses the fact that, accompanying entropy in 3-space is negentropy in time energy on the 4th Minkowski axis, and vice versa.

We believe this to be a rather dramatic extension to the previous concept of entropy in thermodynamics. We get 3-space entropy in physical processes only by gaining 4th dimensional negentropy accordingly. One can thus appreciate the impact upon the entire subject of thermodynamics, once time-energy is accounted and the new interplay of entropy and negentropy are accounted. We believe that this mechanism may involve the fundamental mechanism for both entropy and negentropy. Neither is produced alone; both are always produced in tandem. This of course is not what we “observe” since all observation is 3-spatial. Hence to observe the system and see 3-space entropy or negentropy is to hide the simultaneous 4th dimensional negentropy or entropy that unobservably accompanied the observable that we did see.

Again we call attention to the original meaning of entropy: the dissipation of potential (i.e., potential energy).

Once we understand that *time* is a special form of energy (we discuss this shortly), we may input the energy required to "move heat energy backwards" — i.e., we may directly engineer negentropy — by transducing some time-energy into 3-spatial energy. We can do it easily by time reversal, and every charge in the universe does it already. On the other hand, we can do it by breaking the symmetry of time-energy flow — which is as simple as forming a little dipole. The broken symmetry of unlike charges — and therefore the dipole — was discovered by Lee and Yang {13a-13c}, who strongly predicted it in 1956. Wu *et al.* {14} confirmed it experimentally in early 1957. This was such a revolutionary

change to physics that Lee and Yang were awarded the Nobel Prize in the same year, 1957 — an almost unprecedented action.

Its broken symmetry tells us that the dipole's unlike charges continuously absorb virtual photon energy from the active vacuum, transduce it into real observable energy, and pour out real, observable EM energy in all directions in 3-space. That puts an entirely different perspective on *what really powers every dipolar EM circuit; i.e., what produces the flow of energy pouring from the terminals of every generator and battery, filling all space around the external circuit and its conductors*. The EM energy pouring from the generator or the battery is not due to the generator outputting some of its own available internal energy (from the shaft energy input to the generator, transduced into magnetic field energy inside the generator, and then dissipated to separate the charges and form the source dipole between the generator terminals) or the battery transducing and outputting some of its available chemical energy (which is only dissipated inside the battery to separate the internal charges and form the source dipole between the battery terminals). We will explain that later, and explain how any dipole or charge simply pours out real, observable energy continuously in all directions, without any *observable* input of energy. The input energy is there, but it is in *unobservable* (virtual) form.

In 1971 while a graduate student at the Georgia Institute of Technology, I realized the mechanism that generates the "passage of time" insofar as the observer is concerned {15}. With a little more work, this gave the clue in the 1990s for the mechanism generating little momentary *time-reversal zones* (TRZs) {16} in the electrolyte utilized in cold fusion experiments. Hence we proposed the use of little time-reversal zones forming momentarily in the electrolyte after loading of the palladium lattice of the electrodes with hydrogen or deuterium. Such time-reversal zones can form in the region of excessive positive charge accumulation, since positive charge can be said to receive negative EM energy from the time domain and output negative EM energy in 3-space.

This led to uncovering an entire class of new nuclear reactions — fusion reactions at low spatial energy but high temporal energy — in these little temporary time-reversal zones (TRZs), in which like charges attract and unlike charges repel {17}, followed by rapid decay of the TRZs where the normal law of attraction and repulsion is restored again.

In theory, a fermion cannot be time-reversed because the Pauli exclusion principle prohibits it. However, a boson can be time-reversed, so fermions can be time-reversed in pairs, where each pair acts as a *quasi*-boson. The

TRZ completely overcomes and *reverses* the "coulomb barrier" between a pair of like fermion charges.[11]

As an example, two deuterium ions in a little TRZ would momentarily form a quasi-nucleus of helium, since the two positive deuterons are attracted so closely that each enters the strong force region of the other. At the same time, the strong force is weakened by the partial time reversal of the gluon forces, so that the quarks are nearly freed. As the other ions in the surrounding solution then move to destroy the momentary time-reversal zone, their movement forces the TRZ to decay back to a time-forward zone — with the decay action starting from every point in spacetime inside the nucleons themselves[12]. The TRZ decay-induced action thus strikes the *nearly freed* quarks first, and decay can occur by easy quark flipping while the gluon forces are still much reduced and not back to normal strength. Hence as the gluon forces return toward normal, the quasi-nucleus decays by the strong force increasing and overpowering and drawing the quasi-nucleus into a full-blown helium ion — i.e., an alpha particle —flipping the partially-freed quarks as necessary to do so (that is not necessary in equation [1] below.

During decay of the TRZ, the weakened strong force grows much more rapidly than the Coulomb force zeroes and then increases. Consequently, the quasi-nucleus of two D+ ions merely draws together due to the rapidly increasing strong force, forming an alpha particle without quark flipping. Four H+ ions — four protons — in a quasi-nucleus in a TRZ will undergo quark flipping twice when the TRZ decays, thereby resulting in an alpha particle.). So that explained the anomalous formation of the alpha particles in the experiments. The interaction for two ions of deuterium is given by:

$$^{2}H_{1}^{+} + {}^{2}H_{1}^{+} \Downarrow \; {}^{4}He_{2}^{++} \qquad [1]$$

[11] In a TRZ, the law of attraction and repulsion of charged particles is reversed.

[12] Any moment in time exists everywhere simultaneously throughout the universe. In short, time is a multiple connection in 3-space. Hence in any time-reversal zone (a TRZ) where time is reversed, then starts fading away and back to a time-forward zone (TRZ), the changes induced by the "fading back to TFZ" *simultaneously* involve every point in the 3-space of that TRZ that is changing (decaying). An easy change is quark flipping, since the quarks are almost freed in the TRZ to begin with. The reason the reaction proceeds in that direction is that the recovery of the strong force is much faster than the restoring of normal electrical repulsion, hence the quasi-nucleus is drawn further together into a full nucleus, constituting a legitimate nuclear transmutation at low spatial energy but high time-energy.

This interaction between two deuterons in solution does not occur in a normal time-forward zone because of the coulomb barrier preventing the two deuterons from entering each other's strong force region and acting as a quasi-nucleus of helium, so particle physicists have missed it. It does exist in a time-reversal zone; such zones form and then decay back into normal time-forward zones. This is possible because the coulomb barrier is momentarily reversed. The use of such TRZs in particle physics opens up thousands of new nuclear reactions, all at low *3-spatial* energy, but involving very high *time*-energy. Because of the extreme energy density of time, *these time-energy-induced reactions are actually much higher-energy reactions than high-energy physicists presently consider and utilize!* Indeed, it opens up a new kind of far more energetic "high energy physics".

Cold fusion experimenters have unwittingly opened a window upon a vast new particle physics, previously overlooked by our scientists because they have disregarded the use of time-energy, time reversal zones, and transmutation of time-energy into 3-spatial energy in their nuclear reactions. However, a few physical theorists attempting to better explain particle physics have recognized the importance of the time domain, and probing work in that respect is occasionally done {18}. In our view, it is not accidental that more than 600 successful cold fusion experiments have been obtained, by a variety of researchers in many labs in several nations. We strongly suggest that much of the conventional physics community has firmly placed its collective head in the sand, and is refusing to grapple with the startling new time-energy physics that is being initiated by cold fusion research.

In 1999 (published in 2000) {12} we finally discovered a great new symmetry in EM energy flow, whereby time-energy flow symmetry and 3-space energy flow symmetry are each individually broken, while an overlooked and more fundamental 4-symmetry energy flow — between the time-domain and 3-space — is sustained. *The result is that all EM energy in 3-space comes from the time domain locally and returns to the time domain locally, in a giant negentropic circulation.*[13] Together by the

[13] This is also understandable from the implications of the observation process, which yields a frozen 3-space snapshot existing only at a single instant. Thus any 3-space energy existing there in that frozen instant, had to just come from 4-space (from the time-domain via the giant negentropy process, if we take the view that "the past exists only in time itself".). For the frozen snapshot to "change", time must be added to it, which converts it to a 4-space process again. So the "3-spatial" observed

discovery of relevant quantum field theory work by Mandl and Shaw {19}, this now lends strong support to the use of time-energy in physics as a practical matter for strenuous investigation.

As an example, Mandl and Shaw {19} treat the four polarizations of the photon. Neither the longitudinal nor the scalar photon is directly observable, but in the presence of charge the two are observable in combination, where they manifest as the "instantaneous" Coulomb (i.e., electrostatic) potential. This argument, translated from particle terminology to wave terminology, directly fits our re-interpretation {12} of Whittaker's 1903 decomposition of the scalar potential {85}. For the combining mechanism of the fields of the photons, we must account for *the field as a ubiquitously assumed interaction with the detecting/observing unit point charge*. Thus we must account for the absorption of the incoming time-polarized wave or photon, the transduction of that excitation energy of the charge into longitudinal EM wave/photon energy, and subsequent emission of that excitation energy in 3-space. That is what happens for a negative charge. For the positive charge, the process is time-reversed, hence occurs in opposite fashion. Or as an alternative, the positive charge can be said to continuously receive negative time-energy from the time domain and emit negative spatial EM energy.[14]

There is an *energy polarization transduction function* of charge, whereby it transforms received time-polarized photon energy into emitted longitudinal photon energy in 3-space (for the negative charge, and vice versa, for a time-reversed positive charge). This transduction appears to have been overlooked in physics prior to our recognition of it. It can in fact be used to generate an acceptable definition of charge itself. Charge is the

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energy must come from an immediately previous 4-space process, and must return to an immediately following 4-space process.

[14] As we will find in our chapter on antigravity, there is good reason to treat the positive charge as a source of negative energy and negative energy fields. However, this is pertinent only prior to observation of the charge, while it is still a 4-spatial unobserved negative energy electron entity. For the observable charge, one has already conjugated — after all, the positron is observed as if it were an electron going backwards in time, which we observe as an electron with its charge reversed and with parity reversal (of its spatial direction). For the observable charge, we have already reversed the negative energy fields into positive energy fields by simply reversing their direction and the time associated with the photon (quantum of the EM field).

continuously active entity which performs that ongoing process or those ongoing processes of energy transduction between the time domain and 3-space (between the causal unobserved 4-space process and the observed 3space snapshot). Or in other words, it is an active process connecting 4-space cause and 3-space effect, and connecting the unobserved (such as virtual) to the observed (such as mass).

So for a dipole, the "causal" time-polarized EM wave or photon as a 4-space entity comes to the dipole[15] (3-spatial as observed) and is absorbed by the detecting negative charge or dipole, then is re-emitted as the longitudinally polarized EM wave or photon in 3-space. *That absorption and remission is what charge does, since it is an entity for performing that process*. The emitted energy in turn is absorbed by the nearby positive charge, retransduced into time-energy, and re-emitted back to the time domain. This ongoing very special 4-space energy circulation (even with a virtual charge in the vacuum) is what a scalar potential *identically is and is doing*, at every spatial point of itself, inducing vacuum polarization and “point dipoles” in the virtual state in the process. Recognition of these missing functions allowed at last a solution to the long-vexing problem of the source charge and its associated fields and their energy, often called the most difficult problem in both quantum and classical electrodynamics {68}. We discuss that solution later.

1.1.4 The Search for COP>1.0 Circuits and Systems

A very long search and much intense study and reflection eventually revealed the concepts and principles of those long-neglected disequilibrium Maxwellian systems that permissibly output more energy than the operator inputs. The active environment — not the operator — simply inputs the rest of the energy. Such disequilibrium systems are indeed permitted in Maxwell's theory {20}, and are also still prescribed by Heaviside's severe curtailment of it {21} into what is two vector equations with variables unseparated, rather than Maxwell's 20 equations in 20 variables.

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[15] Prior to interaction of the incoming time-energy with the observable charge or dipole, it interacts with the virtual particles of the vacuum, generating vacuum polarization. Neither the virtual particles nor the time-energy are observable; only the effects of their conglomerate interactions with observable charges are observed. Hence one can take the particle view that virtual particle energy is continually absorbed, or one can also take a quantum field theory view that time-energy is continually absorbed. The two are always present in combination.

When Lorentz[16] symmetrically regauged the Maxwell-Heaviside equations, he arbitrarily discarded the entire class of Maxwellian systems that are far from equilibrium in their exchange with their active (vacuum) environment. Lorentz revised (symmetrically regauged) the Maxwell-Heaviside equations to make them amenable to separation of variables and closed analytical solutions, thus reducing the onerous chore of numerical methods. This Lorentz symmetrical regauging is given in most EM textbooks {22}, and we show it in Chapter 2. The symmetrically regauged Lorentz equations are not Maxwell's equations, nor are they the truncation of Maxwell's theory by Heaviside *et al*. Considering an active environment, under our altered thermodynamics definitions Lorentz implicitly selected and retained only the equilibrium class of Maxwellian systems, while *arbitrarily discarding* the entire disequilibrium class. He thus discarded all those Maxwellian systems permitted to produce COP lying in the range 1.0 < COP Ω←.

Maxwell's electrodynamics is a *material fluid flow theory* and it assumes a material ether. Anything that fluid systems can do, electrodynamics systems can do, at least in theory, because their mathematical models are the same form. So when one cites known examples of fluid-driven physical systems where the energy to run the system is freely furnished by the active environment, analogous electrodynamic systems in active environments — and in disequilibrium exchange with that environment — must also exist in nature. Indeed, particle physics requires it and proves it. These are the very systems arbitrarily discarded by Lorentz symmetrical regauging in every university.

So there exists a direct analogy between fluid systems and classical electromagnetic systems. The common windmill, waterwheel, and sailboat demonstrate by analogy that open EM systems far from equilibrium — powered by free EM "winds" and "energy flows" in the active vacuum environment — also exist in consonance with natural law. They are no more mysterious than a solar cell power system, which is after all a recognized "free energy" or "overunity" system, as is the humble charge (thought to be the source of all EM energy, fields, and potentials). In physics, the powering of systems by receipt and use of energy from their

[16] Actually first accomplished by Ludwig Valentin Lorenz in 1867, then by H. A. Lorentz much later. Lorentz was given the credit erroneously. Lorenz actually derived electromagnetic theory independently in his paper. See J. D. Jackson and L. B. Okun, "Historical roots of gauge invariance," *Rev. Mod. Phys*, Vol. 73, July 2001, p. 663-680.

active environment leads directly to the thermodynamics of systems far from thermodynamic equilibrium in their energetic exchange with that active environment.

It follows that the seeming absence of such *electrodynamic* systems arises not because they are impossible but because present-day circuits and systems are ubiquitously designed to self-enforce an inherent energy equilibrium with their active vacuum environment. The closed-current loop circuit turned out to be the Lorentz self-regauging demon involved in destroying the COP>1.0 capabilities of every EM circuit. So little by little, we unraveled the long tedious trail of Maxwell's electrodynamics and what had happened to those missing Maxwellian-Heaviside systems far from equilibrium with the active vacuum.

We learned how, where, and by whom those permissible overunity Maxwellian systems were discarded. That is, we found what happened to all those Maxwellian *open disequilibrium systems* — originally included in Maxwell's and Heaviside's theories — where such a system receiving and using excess energy from its active environment[17] is permitted by the laws of physics, electrodynamics, and thermodynamics to:

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[17] For the discerning reader, of necessity we have revised the foundations of the ancient classical thermodynamics, as further discussed in Appendix A. We refer the reader to Bimalendu N. Roy, *Fundamentals of Classical and Statistical Thermodynamics*, Wiley, New York, 2002, and to any good book on the history of thermodynamics. Also particularly good is Kondepudi and Prigogine, *Modern Thermodynamics: From Heat Engines to Dissipative Structures*, Wiley, Chichester, 1998, reprinted with corrections in 1999. The foundations of classical thermodynamics (and its fundamental definitions) were basically frozen prior to the advent of Maxwell's 1865 seminal theory, and well before the 1880s discovery (modeling) of the flow of EM force field energy through space. Some of the fundamental definitions of thermodynamics now will not withstand critical review in terms of "meshing" with the Heaviside/Poynting material fluid energy flow theory. Neither will they withstand the new concepts of energy such as mass-energy, time-energy and transduction between time-energy and spatial energy by every charge. E.g., thermodynamics defines an *open system* as one that exchanges energy and mass with its surroundings. Yet it defines a *closed system* as one closed only to mass exchange, not to energy exchange. *If the energy exchange is analogous to material energy flow and changes the mass of the system, then that definition of closed system is a non sequitur.* From general relativity, mass is simply energy anyway, and so "mass" exchanging across the boundary of the system is actually energy exchanging, and vice versa. Since Maxwell's theory is a *material fluid* theory, the Poynting and Heaviside energy flow models are *material fluid flow energy* models by analogy. The specialized thermodynamics definition of *closed system* rigorously will not logically allow the exchange of "material fluid energy flow" (or energy as matter)

since it prohibits matter flow, but the specialized definition of *open system* would and does. In short, with respect to material fluid energy flow, the concept of the "closed system" in thermodynamics has forced itself to become the *isolated system* instead, which is unacceptable since we must model EM energy flow exchange between the environment and the system. So we must change the thermodynamic definitions of *open system* and *closed system*. Else there cannot be any EM energy-mass or mass-energy flow between environment and system, which totally violates what is well known to be happening in all EM systems. In modern physics, every charge and every dipole already have such energy exchange with the active vacuum environment, and it is never zero; instead, it is of enormously high magnitude. Without that exchange, as we advance in this book, there cannot even be a "source charge" or associated EM fields and potentials and their energy, reaching across space. In other words, without it we can have no electrodynamics at all. So we have uncovered a fundamental and major contradiction between classical thermodynamics and general relativity, as well as between thermodynamics and the "material EM fluid energy flow" model used in electrodynamics. What classical thermodynamics calls a "closed system" permitting energy flow exchange, we must now logically regard as an *open* system because it is open to energy exchange across the boundary! The previous notion of the *isolated* system — with no exchange of either energy or mass — is what we must treat as a truly *closed system*. And there is none such in the universe, as we know in particle physics (e.g., because of the discovery of broken symmetry in 1957 and because of the well known active vacuum exchange with every EM charge and dipole). So we have corrected these direct contradictions between "EM as a material fluid energy flow theory" and the old classical thermodynamics.

As the reader will later see, this strongly affects our new definitions of *efficiency* and *coefficient of performance*. The new definitions we advance are rigorous, and they also apply to COP>1.0 EM systems, and even to self-powering (COP = $\leftarrow$) EM systems. They also hold for very novel new energy processes such as quantum potential energy in a multiply connected space, multiple retroreflections and re-use of the same energy, conversion between time energy and spatial energy, and 4-space giant negentropy energy flow circulation.

But one can no longer be allowed to equate *efficiency* with *coefficient of performance*. Now they are never the same thing, just as a six-foot tall man and a six-foot tall doorway are never the same thing, even though they have the same height magnitude. We warn the reader that a great deal of thought and study must be put into appreciating these suddenly encountered changes to the quite old classical thermodynamics definitions. The changes are absolutely necessary. Bluntly put, in light of much more modern knowledge, a rigorous foundations analysis reveals the classical thermodynamics as well as disequilibrium thermodynamics to contain logical contradictions, such as its direct contradiction with general relativity and the EM material fluid energy flow theory. Either we give up or dramatically change the present EM energy flow theory, or we must make the necessary foundations changes to thermodynamics. We have chosen the latter option in this book, and the reader is forewarned of that dramatic change. The specific changes and rationale are discussed in Appendix A.

(1) self-order,

(2) self-oscillate or self-rotate,

(3) output more energy than the operator inputs (the excess being freely received from the active environment),

(4) power itself and its load simultaneously (all the energy being freely received from the active environment), and

(5) exhibit negentropy.

We vigorously pursued those long-lost Maxwellian systems, and we eventually found them. We also found real experiments {23, 24, 25, 26, 27, 28} and real devices {29a, 30, 31, 32, 33, 34, 35a, 36a, 36b} that performed one or more of those fabulous five functions, though there was often no realization by the experimenters, inventors, and scientists of the actual mechanism involved. Eventually my colleagues and I were also able to produce a successful experimental device {37, 38a-38c, 39}, the motionless electromagnetic generator (MEG), which outputs more energy than we input to it. We cover the MEG in Chapter 7. Presently a cooperative research program is ongoing with the National Materials Science Laboratory of the National Academy of Sciences of a friendly foreign nation, to develop and market commercial power systems based on successful laboratory experiments with the MEG. At this writing, we are also strongly seeking the extensive funding required to set up a physics lab and complete the final research allowing production of power systems.

1.1.5 Additional Very Important Implications

We also formally proposed {40} that the vast nondiverged EM energy flow component — Heaviside's "dark" nondiverged energy flow component, accompanying every reaction of a charge with a field or a potential, but arbitrarily discarded by Lorentz and modern classical electrodynamicists — is the generatrix for the extra gravity holding the arms of the spiral galaxies together, after all the dark matter is accounted.[18]

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[18] Heaviside himself recognized the gravitational implications of his extra component of energy flow, which is in closed circular loops. Beneath the floorboards of his little garret apartment, years after his death, handwritten papers were found where Heaviside used this component for a unified EM approach to gravitation. See E. R. Laithwaite, "Oliver Heaviside – establishment shaker," *Electrical Review*, 211(16), Nov. 12, 1982, p. 44-45. Laithwaite felt that Heaviside's postulation that a flux of gravitational energy combines with the (**E**Δ**H**) electromagnetic energy flux, could shake the foundations of physics. Quoting from Laithwaite: *"Heaviside had*

In addition, my close colleague Bedini and I have filed a patent application upon a very special process to "freeze-frame and lock-in" a disequilibrium Maxwellian system in its otherwise far-from-equilibrium state, so the apparent disequilibrium operation of the system can be maintained stably as a new equilibrium condition. This appears to be a method to produce and utilize what Kondepudi and Prigogine refer to as a *nonequilibrium stationary state*. This stabilization is necessary in order for such a system to maintain its COP>1.0 excitation and steadily output more energy than the operator inputs, or to steadily power itself and its load {41}.

We also found that COP>>1.0 EM systems (and some COP>1.0 systems) produce (as a function of the COP) a current of Dirac sea holes (positrons) *in the local vacuum environment itself*, from the output section back to the input section. At COP<1.0 and COP not too greatly above 1.0, a Dirac sea hole in the vacuum almost immediately interacts with an orbital electron in the material lattice of the system. This converts the negative energy, negative mass "vacuum hole or state" into a lattice hole, which is attached to the large positive mass of the ion left by the disappearance of the electron. This "lattice positron" type of problem has been known in semiconductor design for some decades. Normal EM circuits do not usually meet the phenomenon overtly because the semiconductor designers controlled it in the semiconductors themselves by use of appropriate donors and acceptors.

There is a great difference between the actions of Dirac sea holes in the vacuum prior to observation, and lattice holes in materials (after observation). So there is a great difference between the action of a “positron” on spacetime before its interaction with mass and observation, and its action on spacetime after it interacts with mass and is observed.

For COP>>1.0, significant phenomenology and novel effects occur because a substantial fraction of the Dirac sea holes (unobserved positrons) sweeping from output to input do not convert to lattice holes (observed and bound positrons) along the way. For substantial values of COP above 1.0, Bedini's invention (patent application filed by Bedini and the present

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originally written the energy flow as $\boldsymbol{S} = (\boldsymbol{E}\Delta\boldsymbol{H}) + \boldsymbol{G}$*, where* $\boldsymbol{G}$ *is a circuital flux. Poynting had only written* $\boldsymbol{S} = (\boldsymbol{E}\Delta\boldsymbol{H})$*. Taking p to be the density of matter and* $\boldsymbol{e}$ *the intensity of a gravitational force, Heaviside found that the circuital flux G can be expressed as* $p\boldsymbol{u}\ 4\ c\boldsymbol{e}$*, where* $\boldsymbol{u}$ *represents the velocity of p and c is a constant.”*

author)[19] covers the master process for intercepting and transducing this appreciable flow of negative energy from the output section back to the input. Otherwise, that flow — if not intercepted and not converted — will "eat" extra input electrons from the power supply, thus acting as a novel "extra load" appearing in the input section. That extra load then draws additional current and power from the external power supply by electron-hole annihilation[20].

With the Bedini invention, the negative energy (unobserved positron) flow appearing at the input section is transduced into a flow of positive energy (a flow of electron current) from the input section back into the system. The process deliberately uses the "interaction and observation" process to phase conjugate the charge and reverse its direction of flow! In that case, the otherwise detrimental *negative* energy output back through the COP>1.0 system (which is nature's decay process for COP>1.0 interactions) is changed to a beneficial *positive* energy input within the system itself, freely received from the vacuum environment. This process is then used to close-loop the system for self-powering in a "locked" and stabilized disequilibrium condition — a nonequilibrium stationary state.

If we consider mass to be a special kind of positive energy state, then positive energy states represent curvatures of spacetime that are positive gravity. Negative energy states generate antigravity (the time-reversal of gravity).

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[19] Bedini personally discovered and implemented the solution before the exact nature of either the problem or the solution was recognized! My contribution was to recognize the nature of the problem and the mechanism used in the solution. We also stress that, contrary to conventional treatment, all EM circuits do involve not only lattice holes in the conductors and components, but also Dirac sea holes in the local vacuum. That the Dirac sea is involved whenever there are EM fields is clearly shown by Felix Finster, "Definition of the Dirac Sea in the Presence of External Fields," *Adv. Theor. Math. Physics*, Vol. 2, 1998, p. 963-985.

[20] With a proper change in the curvature of local spacetime, pair annihilation can occur with no accompanying photon radiation. The condition is that the part of the curvature of spacetime representing the energy change of the otherwise emitted radiation, does not "relax" even though it is an "excited state". Rigorously, the emission of the radiation from pair annihilation occurs in two steps: (i) first the local spacetime is curved for and by the energy excitation, as a *static change* of the curvature, and (ii) then that curvature relaxes back to its former value, propagating that specific curvature in space, which is recognized as the radiation propagating in space. If the spacetime curvature excitation does not relax, there is no photon emission and propagation.

Before their interaction and observation, the Dirac sea hole (positron) currents — produced in natural COP>1.0 processes in the universe — are still negative energy electrons in 4-space. They are not 3-positrons until interaction with matter has occurred. These "negative energy electrons" generate negative energy EM fields, including both the Poynting energy flow component and the Heaviside nondiverged energy flow component. These negative energy EM fields appear to be *generating the antigravity* whose effects are seen in the distant parts of the universe. They produce far more powerful effects than the accounted electrogravitation effects in astrophysics, which only uses the gravitational effects of the very much smaller Poynting energy flow component. Also, astrophysicists do not use the "positron before observation," when it is still a negative energy electron with negative mass. The accumulation of the negative energy (Dirac holes) in space (in the surrounding vacuum) is connected with massive objects and violent processes, where very strong gradients are produced.[21] As a result, very large negative energy fields and potentials are produced. In turn, this results in cumulating antigravity. This cumulating and interacting antigravity appears to be the mechanism for the forces *accelerating* the expansion of the universe — rather than it decelerating as would be the case if the net gravity there were positive. In Chapter 8 we propose this explanation for the observed acceleration of the expanding universe — and the basis for the explanation can be and has been successfully demonstrated in a legitimate overunity EM circuit or system {42}. We offer this in honor of Heaviside, who first discovered the gravitational aspect of his huge nondiverged energy flow, but did not live to publish it. He also did not consider the Dirac sea prior to hole interaction with matter, as it was not yet formulated, so he had not yet recognized the way to produce and utilize the practical antigravity potential of his discovery.

1.1.6 A Scientific Dilemma

There would seem to be a sufficient abundance of techniques, devices, processes, and theoretical works to impel a crash project in the scientific community to develop successful overunity electrical power systems {43a-43d}. This would be especially appropriate at this time, since the

[21] Kondepudi and Prigogine, *ibid*., p. 459 already point out that strong gradients produce situations that violate present thermodynamics. Research in these and other situations violating present thermodynamics is going forward under the caption of "extended thermodynamics" research. A discussion of the area is given by D. Jou, *Extended Irreversible Thermodynamics*, Springer-Verlag, New York, 1996.

escalating energy crisis now threatens to slow the world economy, and then eventually collapse it. At this writing, the MidEast has heated considerably, and appears headed for another MidEast war, with resulting severe interruptions of cheap oil supplies from the MidEast. Nonetheless, in spite of Russia having opened its oil field spigots to try to fill the need, a crisis in oil appears to be looming.

So *why* does the U.S. scientific community still so adamantly oppose the very notion of Maxwellian systems freely extracting EM energy from the vacuum? Why is there no outcry pointing out what the hoary old Lorentz regauging really means in terms of equilibrium or disequilibrium of the regauged system with the active vacuum? The unequivocal participation of the vacuum in a continuous energy exchange with the charges and dipoles of every EM system has long been affirmed by particle physics. All the fields and potentials — and their energy — manipulated in any EM circuit come from the vacuum, as proven in particle physics for 45 years. Why have our electrical scientists not understood — from the broken symmetry of the vacuum exchange with the opposite charges of the source dipole between the charged terminals of every generator and battery — that *EM energy from the vacuum powers, and has always powered, every electrical power system and circuit ever built?* Why have the later rigorous broken symmetry findings of particle physics not been incorporated to update the ancient classical EM theory used to design and build electrical power systems, nearly a half-century after those broken symmetries were discovered and proven? Why do our classical electrodynamicists continue to assume that every charge and dipole in the universe is a perpetual motion machine, freely creating energy out of nothing and pouring it out across all space at the speed of light?

Therein lies one of the real problems of present science — its historical and continuing resistance to "out-of-the-box" thinking[22] and to research that overcomes conventional strictures. More than 40 years after the basis for the vacuum-energy powering of every dipolar system (and of every

[22] "Out-of-the-box" thinking is a widely used concept among planners and program formulators, when conventional thinking will not suffice to solve a major problem with which they are struggling. Conventional thinking is considered "in the box" thinking, so by demanding out-of-the-box thinking, a problem demands an unconventional solution outside those normally proposed. In short, some new thoughts and concepts are required. Much lip service is given to the concept as a favored buzzword, but few proposed programs with truly "out of the box" approaches will be funded. In the energy field, none at all are funded that are truly "out of the box", whether or not that or similar phraseology is used.

observable charge once its clustering virtual charges of opposite sign are accounted) was discovered and proven in particle physics, all our university electrical engineering departments continue to erroneously teach that the shaft energy input to the generator powers its external circuit. Internal EM energy in the generator, transduced from the input shaft energy, does not directly add a single watt to the external circuit. Instead, it only continually forces the generator's internal charges apart, to continually remake the source dipole, which then extracts energy from the vacuum and pours it out of the terminals, filling the space surrounding the conductors of the external system for the system to intercept and utilize some of the available external energy flow.

Once the dipole is established, it will extract and transduce EM energy from the vacuum and pour it out in all directions at the speed of light, without ceasing. Else, the Nobel Committee should admit its grave error and revoke the Nobel Prize awarded to Lee and Yang. Real observable EM energy extracted and transduced from the vacuum's virtual energy is precisely what the "broken symmetry of the opposite charges" on the ends of the dipole *means*. Indeed, all the forces of nature are already considered as generated by the interaction of virtual particles with observed particles. Since force produces energy changes in the system affected, then it follows directly that energy changes are produced by the interaction of virtual particles with observable particles.

However, our power system engineers ubiquitously use the closed current loop circuit. This inane circuit self-enforces the Lorentz symmetrical regauging condition. It uses half the energy captured by the external circuit (from intercepting some of that "energy flowing around the circuit from the seething vacuum" that is copiously pouring out of the generator terminals) to ram the spent electrons back through the back emf of the source dipole itself. That scatters the dipole charges and kills the dipole and its broken symmetry — and also kills the free flow of transduced EM energy from the vacuum.

That insane circuit kills the source dipole in the generator faster than it powers its external loads! So one has to keep rotating the shaft of the generator, to keep producing a magnetic field inside the generator, so that this magnetic field energy can continue to force the charges back apart and continually reform the source dipole.

In short, our engineers build the equivalent of an electrical windmill, then — so to speak — force it into a closed barn so the environmental wind

cannot reach it any longer. It is little wonder that we ourselves then have to do work on that "electrical windmill" to crank it around!

We pay the power company to engage in a giant wrestling match inside its own generator and *lose*. We also wildly pollute the planet with hydrocarbon and nuclear wastes, poison species (including killing of X numbers of humans every year via the disruption of their body functions and health), and enhance global warming. We are slowly strangling our biosphere and ourselves. None of that is necessary.

1.2 Organized Science Often Resists Innovative Change

The history of science is littered with examples where the scientific community has ignored the principle behind Einstein's statement quoted at the beginning of this chapter. As pointed out by Smith {44}, science has become reoriented toward profit. Quoting:

> *"...science is not the danger; scientists encouraged to do bad science to survive are." ... "...changing the way modern science is funded is an enormous undertaking, but it is a necessary one if we want to protect our future. Call it managed risk."*

Science's resistance to change is so well known to historians of science that it is rather universally accepted — although usually not made explicit to undergraduates. Further, scientists are under great pressure to conform:

1. After all, science is *patronized*; someone must fund the laboratories, the research supplies, the salaries and personnel benefits, etc.
2. To procure and protect its patronage, science has become quite organized, particularly with respect to how the funds — received and channeled down from the top — are cut into individual packages (research grants and research programs) and made available for competition among the "performing" chain of universities and research laboratories.
3. In the last few decades, there has risen an increasingly fierce demand by universities that the scientific researchers (i) be successful in attracting outside funds and (ii) file patents assigned to the university. So fierce has this demand become, that the research professor's continued livelihood may literally depend upon his or her success in bringing in extra funding. Further, much of his time is now spent in writing proposals to

compete for these "packaged funds". When he wins them, the kind of research and the areas of research are already stringently defined, and he dare not deviate — else there will shortly be no more funding packages won, no funding for his graduate students, and soon thereafter there will be no job of any importance for the professor!

4. In the United States, all the government National Laboratories and our universities are intensely seeking and filing patents! So small, independent inventors cannot deal with these organizations, without risking and almost guaranteeing the loss of their patents and intellectual property. Funding dangled in front of the inventor, much like a carrot dangled in front of a horse, is often tied to "march in" rights {45, 46} calling for surrender of the inventor's patent rights altogether, *whenever the government — i.e., a single bureaucrat — wants to take it*. All that has to be done is to declare that the inventor is not getting it developed and to market fast enough. Science has thus become more avaricious and — some inventors would even say — it increasingly involves overt and covert piracy of intellectual property rights. From personal experience, reluctantly I would not argue with that statement. Simply ask Larry Fullerton of Time Domain Corporation about his struggle with a National Laboratory over patent rights to his ultrawideband communications invention and technology.[23] It eventually resulted in a "draw" of sorts. He did not lose his rights, but the government gained them also, in competition with him. The government *circumvented* his patent, even though they did not succeed in taking it. We were delighted to recently see that Larry (the company is Time Domain, Inc.) received its 74th patent in this technology, as well as a ruling that will allow the technology to at last go to market.

5. The result is a dramatic increase in the pressure on working scientists and independent inventors to conform, and to "play the game by the rules". Then everybody up the scientific food chain is fed, and is happy and secure. The journals happily publish the research papers and results, the professor gets

[23] Stephen Fenichell, "Radio Flyer," *Discover*, 22(5), May 2001. Fullerton's technology has been given a limited go-ahead by the FCC, which has drafted standards and regulations in the area as of February 2002.

funding for his graduate students, the university gets that wonderful overhead cut of the research funding — such as half or it or more — and the entire apparatus is like a very large and tidy Titanic adhering to its ponderous course toward the iceberg. Meanwhile, truly new and innovative science discoveries — vulnerable and desperately needing nurturing funding during their initial embryonic state — get shoved aside, crushed, and starved in the funding rush to adhere to performance of the *prescribed* funding packages.

6. In this environment, the day of the "defenders of the scientific faith" has arrived! A small percentage of conventional scientists who are dogmatic and vociferous, are now very prominently attacking any novel experiments and ideas with a vehemence seldom seen in organized science. It is again reminiscent of some of the noted scientific attacks in history, e.g., as pointed out by Hellman {47}. Yet, because of the financial pressure upon the scientific community, and the increased pressures to conform, there is little restraint of the dogmatists and they are almost never called to task. Cold fusion is a current example. The American Physical Society has recently issued a statement condemning perpetual motion machines — yet the society's members continue to condone and use a classical EM model that assumes every charge in the universe to continuously be creating energy from nothing. Even the American Physical Society has not recognized what broken symmetry of opposite charges means with respect to the common dipole and dipolarity in every circuit. Nuclear reactions at low spatial energy (which means at extraordinarily high total energy when the c^2*-compressed* time energy is considered) do indeed sometimes occur in carefully controlled experiments, whether or not we yet sufficiently understand the reactions theoretically, and regardless of whether we can get the anomalous results to happen every time. Yet this area of nuclear interactions at low *spatial* energy {48} — and unknown to the scientific community, at very high *time* energy {49, 50, 51} — has been savaged by these self-appointed spokespersons for the "official" community, none of whom even account the compressed energy in the time increment portion of the photon. More than six hundred successful experiments in multiple laboratories, by respected scientists in multiple nations worldwide, are now

> rather resoundingly ignored. Yet the replication rate for good cold fusion experiments is certainly higher than many of the replication rates for novel and little-understood phenomena in large particle accelerators, and the cold fusion experiments are also *far cheaper*.[24] While particle accelerators are "popular" in their ability to garner huge funding, their cost/benefit ratio compared with, say, cold fusion experiments, may be abysmally low. Simply examine the decades of effort and many billions of dollars expended on the search for *warm* fusion (using spatial energy only). What has it produced, in terms of watts of power on the power lines? When will it produce any electrical power of any significance? Prototype cold fusion power systems have in fact been produced and patented {52}. With seed money from the scientific community and using a higher symmetry electrodynamics, cold fusion power could proceed at a rapid pace.

Strangely, the ever-present pressure to conform to *that which is already known and accepted* has often made science its own worst enemy throughout its history. Establishment scientists and the "system itself" now probably block — and have blocked over the decades — more innovative scientific research than does any other factor {53}.

1.2.1 Many Scientists and Historians Have Pointed It Out

The scientific community is well known to have always been highly resistant to novel ideas and innovations. Here are some selected pertinent comments regarding this phenomenon, where organized science is itself the obstacle to the advance of science, and where such has been recognized for many decades:

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[24] As an example, see R. P. Taleyarkhan *et al*., "Evidence for Nuclear Emissions During Acoustic Cavitation," *Science*, Vol. 295, 8 Mar. 2002, p. 1868-1873; Charles Seife, "'Bubble Fusion' Paper Generates a Tempest in a Beaker," *ibid*., p. 1808-1809. See also Donald Kennedy, "To Publish or Not to Publish," *ibid.,* p. 1793. *Science* had the courage to publish the peer-reviewed results of a tabletop sonoluminescence experiment that apparently produces nuclear reactions. Editor Kennedy essentially advises all protagonists on both sides to cut the rhetoric and allow the scientific community to do its replication work, to either validate or refute the successful experiments of Taleyarkhan *et al*. This action by *Science* is a shining beacon to remind the scientific community that science is based on experimental method, and that prevailing theories cannot refute new experiments that contradict them. Instead, laboratory bench experiments must decide such an issue.

"Every great scientific truth goes through three stages. First, people say it conflicts with the Bible. Next they say it had been discovered before. Lastly they say they have always believed it." [Louis Agassiz, 1807-1873.]

"There are three steps in the history of a great discovery. First, its opponents say that the discoverer is crazy; later that he is sane but that his discovery is of no real importance; and last, that the discovery is important but everybody has known it right along." [Sigmund Freud].

"Anybody who has studied the history of science or worked as a scientist knows that whenever something novel is discovered or proposed, there is a polarization of scientists, with hostility and bitterness that may last for generations. What wins arguments is scientific fact, and that may change as the years go by. A good example of this is the geological theory of continental drift, as proposed by Wegener in 1912. When I studied geology around 1950, continental drift was acknowledged in my undergraduate textbook as a crank theory. The first serious confirmation was in 1956, and it was finally established as the dominant theory in the early 1970s. Until that time, anybody who admitted that he or she believed in continental drift was the subject of derision and scorn. Sorry, folks, science is not and has never been the 'idealized portrait painted in textbooks'." [Allan Blair] {54}

"... the four stages of response to any new and revolutionary development [are]: 1. It's crazy! 2. It may be possible — so what? 3. I said it was a good idea all along. 4. I thought of it first." [Arthur C. Clarke]. {55}

"...I suggest that most revolutions in science have taken place outside the lofty arena of the refereed journals, and with good reason. The philosophy by which these journals govern themselves virtually precludes publication of ideas that challenge an existing consensus." [William K. George] {56}

"At every crossway on the road that leads to the future, tradition has placed against each of us, 10 thousand men to guard the past." [Maeterlinck].

> *"An important scientific innovation rarely makes its way by gradually winning over and converting its opponents: it rarely happens that Saul becomes Paul. What does happen is that its opponents gradually die out, and that the growing generation is familiarized with the ideas from the beginning."* [Max Planck] {57}.

> *"Peer review is widely seen as a modern touchstone of truth. Scientists are roundly drubbed if they bypass it and 'go public' with their research… The first limitation of peer review is that nobody can say quite what it is… A more pernicious danger is that peer review may reject the important work. As Charles W. McCutchen, a physicist at the National Institutes of Health, has put it, peers on the panel reviewing a grant applicant 'profit by his success in drawing money into their collective field, and by his failure to do revolutionary research that would lower their own ranking in the profession. It is in their interest to approve expensive, pedestrian proposals.' "* [Jonathan Schlefer] {58}.

The sheer massive size and inertia of the modern scientific establishment also exert mind-numbing difficulty in "hearing" and recognizing an innovative scientist's message, even a message of utmost importance, and even if it gets through the censors. For example:

> *"We used to be able to say things once; if the message was reasonable, it had a good chance of becoming a permanent part of the structure of the field. Today, a single publication is lost; if we say it only once, it will be presumed that we have changed our mind, and we therefore must publish repeatedly. This further fuels the large publication volume that requires us to repeat."* [Rolf Landauer] {59}

1.2.2 Some Specific Examples

There are hundreds of examples of new discoveries in science that have at first — and often for an extended period of years — been severely obstructed and ridiculed. Here are just a selected few:

1.2.2.1 *Conservation of Energy*

Von Mayer {60}, the discoverer of the modern statement of the conservation of energy and the mechanical equivalent of heat, was severely chastised for his "insane" work. He was hounded and severely

ridiculed. This extremely harsh treatment, together with domestic problems, drove him to a suicide attempt and a nervous breakdown, and into psychiatric treatment for some years. Toward the end of his life, his principle of energy conservation had so greatly increased the ease of calculations and the understanding of systems that the same scientific community — due to the commendable efforts of Helmholtz, Clausius, and Tyndall — began to recognize his great contributions and lionize him. In 1867, he was made a member of the nobility, dying in 1878 with his "insane" work by then well respected. He was fortunate to have the "cur dog attack" reversed in his lifetime. Most scientists with novel discoveries are not so fortunate.

1.2.2.2 *Continental Drift*

Alfred Wegener {61} proposed the theory of continental drift in 1912. The reception was extraordinarily hostile. So ferociously was he ridiculed for the notion that huge continents of rock could "float" and "drift" that his very name, "Wegener", was often used as a synonym for "utter idiot". To refer to someone as "a Wegener" was to cast the greatest slur possible upon that person's mental powers and to label him a gibbering lunatic. Only in the 1960s when sea-floor spreading from ocean ridges was discovered, proving that ocean basins are not permanent features, did Wegener's concept of continental drift concept finally gain acceptance.

1.2.2.3 *Kinetic Theory of Gases*

As pointed out by Paul Nahin {62}:

> *"J. J. Waterston's paper on the kinetic theory of gases, in 1845, was rejected by the Royal Society of London. One of the referees declared it to be 'nothing but nonsense, unfit even for reading before the Society.' ... "Waterston's dusty manuscript was finally exhumed from its archival tomb forty years later, because of the efforts of Lord Rayleigh..."*

Lord Rayleigh was the Secretary of the Royal Society when he had Waterston's paper reprinted nearly a half-century after submitted. Lord Rayleigh also gave an introduction to the paper, regretting it lying so long unpublished when its content was quite important. His introduction is a way of explaining the delay.[25]

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[25] Waterston's paper was finally published as John James Waterston, "Free and Elastic Molecules," *Phil. Trans. Roy. Soc. Lond.*, Vol. 183, 1892, p.1-79. Lord

1.2.2.4 *Surgical Pain Deemed Necessary*

It has *always* been this way in science. As another example, the famed surgeon Alfred Velpeau wrote in 1839:

> *"The abolishment of pain in surgery is the chimera. It is absurd to go on seeking it today. 'Knife' and 'pain' are two words in surgery that must forever be associated in the consciousness of the patient. To this compulsory combination we shall have to adjust ourselves."* [Martin Gumpert] {63}.

Wryly we observe that today a similar attitude of "we must glory in the pain" — where the "pain" is due to the yoke of COP<1.0 EM systems and of the second law of classical equilibrium thermodynamics — consumes most modern electrical power system scientists and engineers.

1.2.2.5 *The Photoelectric Effect*

Almost every household now knows Albert Einstein's epochal achievements. Yet his formative three papers — on Brownian motion, the photoelectric effect, and special relativity — were published in 1905 while he was working in the Swiss Patent Office. The most renowned physicist of the time was Max Planck. Planck was embarrassed that a scientist who was not even employed in physics was doing such important work in physics. So Planck and other scientists arranged for Einstein to be awarded a chair in physics at a proper university. In their letter to the university, they pointed out Einstein's brilliance in his papers. They also then excused him for straying down the road of the photoelectric effect, because — as they put it — everybody knew that was foolishness, but persons of such brilliance could be forgiven a few such little bobbles along the way. Years later, in 1921, Einstein was awarded the Nobel Prize for Physics, for his work in theoretical physics and *especially* for his explanation of the photoelectric effect.

The Einstein incident is a typical illustration of Arthur C. Clarke's cogent observation:

> *"When a distinguished but elderly scientist states that something is possible he is almost certainly right. When he states that something is impossible he is very probably wrong*." [Clarke's First Law]

Rayleigh's introduction and Waterston's paper also are given in Jefferson Hane Weaver, *The World of Physics*, Simon and Schuster, New York, 1987, p. 632-651.

1.2.2.6 *Amorphous Semiconductors*

Stanford R. Ovshinsky's development of amorphous semiconductors {64, 65} is another modern example. "Everybody knew" that a crystalline structure was necessary in order to have a semiconductor at all; in short, a semiconductor formed out of non-crystalline material was deemed to be totally impossible, never mind this “phase” change that Ovshinsky advanced. However, some young graduate students, e.g., began to look at Ovshinsky's amorphous materials and his phase change approach.

Finally funded by the Japanese, Ovshinsky's company, Energy Conversion Devices, Inc. (ECD) simply placed its amorphous semiconductor devices into working equipment. Copy machines appeared with his amorphous semiconductors installed in them — with the machines and their amorphous semiconductors working very well. More graduate students and post-docs enthusiastically entered the area, did research, and wrote dissertations.

As a result, amorphous semiconductors finally became accepted, and they are now part of the established technology and scientific knowledge base. The interested reader can simply look up Ovshinsky's company and statistics on http://www.ovonics.com . The Japanese have reaped a continuing bonanza from the sales of amorphous semiconductors, because of the shortsightedness and bias of the U.S. scientific community.

1.3 Scientific Disagreement or Street Fight?

It is one thing to scientifically disagree — even strongly — in a technical and courteous fashion, and quite another to engage in ad hominem attacks. The first is science; the second is a cur dog fight. Unfortunately the history of science far too often reveals "cur dog fights" instead of respectful scientific disagreements {66}.

A recent modern example of legitimate research and qualified researchers still being savaged in a "cur dog fight" manner is cold fusion (low energy nuclear reactions). Quoting one learned orthodox scientist, whose name is withheld, speaking to a learned scientist in cold fusion:

> *“How stupid do you think we are? My assessment of you and your colleagues is that you are complete frauds or totally mad. There is no known physical principle that would support the kind of results that you claim your technology can accomplish, nor is there any credible argument why there should be such a principle."*

We answer that "cur dog attack" unemotionally and scientifically. The key is in the scientist's own phrase: "no *known* physical principle." If the experiments work and are replicated, but are not understood by the conventional theory, then they refute the prevailing theory, whether the physical principle is understood or not. Else scientific method has been totally abandoned in favor of "truth by authority and dogma". The experiments clearly show that a previously *unknown* physical principle is at work. The real task then is to rediscover this new principle — that being one of the primary ways that science advances. We propose new principles in this book as a possible explanation of those experiments.

The dogmatic scientist's statement was made in spite of some two hundred (200 at that time; now more than 600) scientific experiments worldwide, in many nations, many at prestigious institutes, where dozens of scientists have reported positive and anomalous results in cold fusion experiments.

So yes, there is indeed a very "credible argument" — *the results and replicability of the experiments*, which are supposed to be the *decisive* statement of science. If that view in science has changed, then we are no longer practicing the scientific method. Instead of accepting successful and replicable experiments and seeking to change the model, the scientist is insisting that we must first understand the principle and thus have a model. This of course is a total violation and reversal of the scientific method. We used aspirin effectively for decades without the slightest notion as to the mechanism enabling its beneficial actions. The mere fact that "there is no known physical principle" for the results achieved has nothing to do with the validity of the replicated experimental results. Instead, it merely substantiates that *there should be a vigorous scientific program to uncover the new principle or principles obviously involved*, since the old model has either failed or been revealed as too limited.

The derogatory statement by the dogmatic scientist is also made from the viewpoint of the conventional nuclear physics model. The conventional physics has not taken into account that all 3-spatial electromagnetic energy associated with charges and dipoles and their fields and potentials in fact comes from the time domain {85, 86, 12, 19}. It has also not taken into account that time itself (as in the time component transported by the time-polarized photon or a time-polarized EM wave) may be comprised of extraordinarily dense energy. Indeed, time appears to be spatial EM energy compressed by the factor c^2, so it has the same energy density as mass {67}, which we pointed out earlier. The smaller the *spatial* energy of the

photon, the greater its time component and hence its *time*-energy in seconds expressed in decompressed spatial energy joules[26]. The highest energy particle physics is not *spatial*-energy physics as presently practiced, but *time*-energy physics, where some of the time-energy of photons is transduced into spatial energy. One second of time transduced (decompressed) into spatial energy yields approximately $9\Delta10^{16}$ joules. Further, every negative charge in the universe continuously accomplishes that decompression, and every positive charge continuously accomplishes the recompression.

In other words, not all physical principles were discovered in the particle physics of, say, five years ago, as the literature since then clearly shows. To assume that everything is already known today is ludicrous; science is never completed. The new principles reported in the present book now are at least "candidates" for the physical principles that do support cold fusion results. There is also another powerful argument for these hypothesized principles: they have produced the final resolution of the source charge problem — something for which the arch skeptic quoted has no solution whatsoever, and which he himself cannot explain. *If the arch critic cannot produce an alternate solution to the source charge problem, and is unaware of that new principle that may solve it, let him go and learn the new principle. Until then, he unwittingly assumes that every charge in the universe is a perpetual motion machine, continuously creating and pouring out EM energy in all directions at the speed of light.* So we return his own argument and approach to him: he should attack the conventional scientific community for accepting the source charge, while having absolutely no principle to explain how it continuously pours out observable EM energy without any observable EM energy input. In short, he should practice what he preaches; else he brands himself a total hypocrite. The alert reader will note that none of the arch skeptics doing all the ad hominem attacks on cold fusion and COP>1.0 EM systems are practicing what they preach.

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[26] The spatial energy of the photon decreases linearly as the frequency is lowered, while the time component in seconds increases linearly. But the highly compressed time energy, comprising that time component, increases nonlinearly (by the factor $c^2 \div t$). Hence the highest energy photons are actually the low frequency photons — something completely alien to particle physicists — and not the high frequency photons chased by "high energy physics". Indeed, high energy physicists are practicing a high spatial energy physics, which — overall — is a much lower energy physics than radar, microwave, VHF, or ELF, *if the total energy of the photon, to include its time energy, is considered*.

What we are saying is this:

(a) If one's physics knowledge was current five years ago, it may be stale today. A few years ago, no one believed the expanding universe was accelerating. Today we know that it is, rather unequivocally. And by "no known physical mechanism". We will later present a strong candidate for that missing mechanism. The results of experiments will substantiate or refute it.

(b) The proposed principles in this book, e.g., are newer, and may shed light on the mechanism for the cold fusion results as well as other phenomena. The experimental results themselves are irrevocable; any proposed explanation requires validation.

(c) The new principles do explain cold fusion and are consistent with the phenomena encountered in multiple experiments by multiple researchers in many laboratories. We readily admit that the stale and incomplete principles presently utilized in nuclear physics *do not* explain cold fusion. Neither do they explain how a charge continuously pours out EM energy. So do the skeptics attack all those physicists who believe in source charges and their provision of the fields and potentials and all EM energy? Of course not. They themselves believe in that greatest of all “perpetual motion” *faux pas*.

(d) The proposed new principles also solve the source charge problem, which is still ignored by most conventional physicists and electrodynamicists, even though often referred to as the "most difficult problem in electrodynamics" {68}.

(e) Scientists should not be close-minded, but should consider new proposals and let the experimental results decide their validity or falsity — precisely the position taken by the journal *Science* in publishing the results of some new cold fusion experiments. That is the scientific method in action.

(f) Those scientists who remain close-minded, and viciously attack experimentally demonstrated new processes and mechanisms, are guilty of practicing dogma and not science. They are in fact guilty of being what they so frequently charge: *pseudo-scientists*.

When science does not allow proposed new mechanisms and principles to be considered in science following demonstration of new phenomena inexplicable by present models, then science is no longer practicing scientific method. When any scientist rejects these demonstrated new

experimental phenomena out-of-hand, he is practicing dogma rather than science. The “friendly skeptic” attitude is welcomed and appropriate. The cur dog attack has no place in science, but only among cur dogs — and those who behave like them.

1.4 A Few Significant and Unresolved Scientific Problems

1.4.1 Time as Structured Energy

Time also has internal structure and dynamics {69, 70}, as we explain later, as well as the same energy density as mass. So it should not be surprising that a tiny bit of time-energy, transduced into ordinary spatial EM energy, might be capable of energetically inducing a wide variety of nuclear reactions. One has transduced not only "gross" energy, but also energy structuring and dynamics — which *act internally* on any object with which interaction occurs. Further, the overall spatial energy component and the time-energy component in a photon are canonical. Being quanta, all observable photons have the same fixed "total magnitude" with respect to angular momentum. The photon is also "made" of $(\div E)(\div t)$ which may be taken as $(\div E)(c^2 \div t)$ in terms of *purely spatial* energy equivalent content, assuming that the time energy is decompressed into spatial energy. As can be seen, the so-called "low (spatial) energy" photons are precisely the photons that transport the greatest time-component. When that time-energy component $(\div t)$ is converted to spatial energy $(\div E_C)$, the formula is $(\div E_C) = c^2(\div t)$. As can be seen, the converted time energy will produce far more spatial energy in the *converted* interaction, than was carried by the photon in its spatial energy $(\div E)$ component prior to interaction and time-energy transduction. Hence the highest energy photons are actually low frequency photons — under the circumstances where time-energy transduction into spatial energy is involved. With transduction, the highest energy particle physics can be conducted at low frequencies and low spatial energy if conversion of time-energy occurs in the interaction.

Since cold fusion involves transduction of a little bit of the time-energy, the total lack in physics of knowledge of time-energy transduction into spatial energy explains why conventional nuclear physicists find the cold fusion results so confusing and astonishing.

1.4.2 The Obsolete Foundations of Classical Electrodynamics

Another modern example of science's resistance to change is the failure to update classical electrodynamics to include the active vacuum interaction

and the interaction with the local curved spacetime[27], as we shall discuss in Chapter 2. It has been scientifically established (in particle physics) that there can be no equilibrium of any physical system without accounting for the vacuum interaction.[28] To simply observe a physical electrical power system sitting there stably and running, is to prove its vacuum interaction in order to even *have* such equilibrium.

An interesting point then arises since every charge and dipole in the system is a *broken equilibrium* in the exchange between the material system and the vacuum. Not only does an electrical circuit receive some energy from the vacuum, but also the energy from the vacuum is *massively hemorrhaging* from the vacuum into the system (and back out)! The isolated charge, e.g., is infinite if one removes the screening clustered virtual charges of opposite sign, as is well known in modern physics. Further, the screening virtual charges also have infinite charge, again as is well known. The difference between these two infinite values of charge, e.g., gives the standard finite observed charge of the charged particle. The lay reader may wish to positively verify that statement; e.g., as given by Nobelist Steven Weinberg.[29] Quoting:

> *"[The total energy of the atom] depends on the <u>bare mass</u> and <u>bare charge</u> of the electron, the mass and charge that appear in the equations of the theory before we start worrying about photon emissions and reabsorptions. But free electrons as well as electrons in atoms are always emitting and reabsorbing photons that affect the electron's mass and electric charge, and so the bare mass and charge are not the same as the measured electron mass and charge that are listed in tables of elementary particles. In fact, in order to account for the observed values (which of course are finite) of the mass and charge of the electron, the bare mass and charge must themselves be infinite. The total energy of the atom is thus the sum of two terms, both infinite: the bare energy that is infinite*

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[27] We again stress the concept of the *supersystem*, introduced in footnote 11.

[28] E.g., see T. D. Lee, *Particle Physics and Introduction to Field Theory*, Harwood, New York, 1981. On p. 380-381, Lee shows how there is no symmetry of matter alone, but only of matter and vacuum.

[29] Steven Weinberg, *Dreams of a Final Theory*, Vintage Books, Random House, 1993, p. 109-110.].

> *because it depends on the infinite bare mass and charge, and the energy shift ... that is infinite because it receives contributions from virtual photons of unlimited energy."* [Steven Weinberg].

So a simple charged particle actually involves a polarization of the vacuum involving two charge energy functions — the bare charge and the charge change functions — each of which has a known and recognized COP = ↵!

A priori, the conventional system's overall actions must incorporate functions (whether intentional or unintentional) that continuously adjust to provide *net equilibrium in that exchange by adjusting the hemorrhaging-out to equal the hemorrhaging-in*. In this book, we will spell out just what those unintentional functions are, such as the ubiquitous closed-current-loop circuit, and how to beat them so that excess energy from the vacuum can be utilized by the system to power the loads.

1.4.3 What Powers an EM Circuit or Electrical Power System?
Another modern example of science's resistance to change is the continued engineering of electrical power systems with the erroneous notion that mechanically powering the shaft of a generator directly powers the power line. The notion is that the generator transduces some of the mechanical shaft energy into output EM energy added to the power line {71}. To the contrary, *all EM systems are powered by energy extracted from the vacuum*. They are not powered by the mechanical energy we input to the shaft of a generator, or by the chemical energy in a battery. In this book, we discuss at some length what powers the EM system, and we have previously published the basis for our "shocking" statement {12, 72}. The basis for how an EM system is powered by energy from the vacuum has been known in particle physics for nearly a half-century {73}, since the experimental proof of broken symmetry {74}, including the broken symmetry of opposite charges (and hence of any dipole) in its fierce energy exchange with the active vacuum {75}.

A generator or battery expends all of its available energy to separate its internal charges and form its source dipole between the terminals. Once made, the dipole's broken symmetry — in its violent energy exchange with the active vacuum — converts virtual photon energy absorbed from the vacuum into observable EM energy, and emits it — *pours it out* — through the terminals and along the power line, filling all space around the conductors.

If one wishes to appreciate the enormity of the vacuum changes engendered by formation of that source dipole, simply visualize those two

infinite charge energy functions (from Weinberg's quotation above) for every charged particle on the ends of that dipole. The dipole then is a great set of offsetting infinities in EM energy (photon energy) boiling and being ordered in the vacuum. Making a simple little dipole or producing a simple charge initiates into motion an enormous set of infinite energy changes in the vacuum! None of these startling, enormous vacuum energy changes and functions is modeled in classical electrodynamics and electrical power engineering. So when we speak of the Heaviside nondiverged energy flow component pouring from the terminals of a generator, as being a trillion or ten trillion times as great in magnitude as the intercepted Poynting component, the reader should not be appalled. The reader should recall that we are dealing with the difference between sets of infinities that combine to provide finite differences. These finite differences can be very small, or they can be extraordinarily large, depending on the exact situation. In the case of a source dipole formed in an ordinary generator or battery, the difference of the infinities is very large.

Figure 1, adapted from Kraus {76}, illustrates that small part of the external energy flow around a typical transmission line that is intercepted by the surface charges and their fields, and that is drawn into the wires to power the circuit as these charges are driven axially back and forth across the conductors. The surface charges are constrained to the "drift velocity" (usually a few inches per hour) movement down the wire by repulsion of the electrons ahead of them.

The spinning, *longitudinally restrained* electrons precess laterally, thus withdrawing across the transverse axis of the wire. So the laterally precessing electron withdraws a little ways, withdrawing that first small portion of its fields and their energy increased by intercept of additional energy from the outside energy flow. The further part of the fields is not withdrawn into the conductor, and is not used to power the electrons.

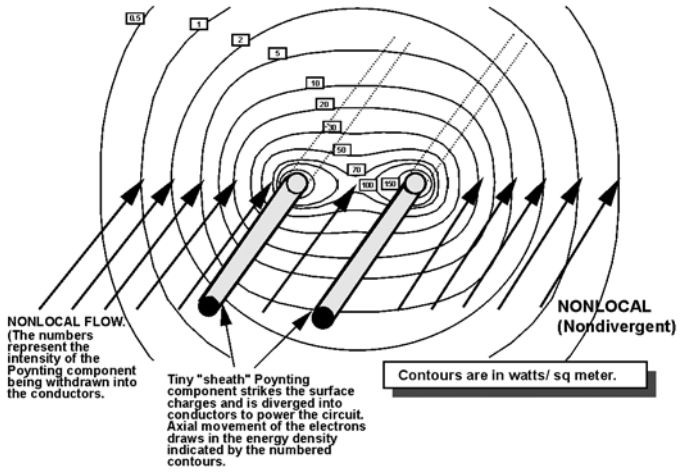

Figure 1-1 Poynting (caught energy) flow contours surrounding a transmission line.

Most of the available energy flow misses the circuit and is not drawn into the conductors. However, that large component is not shown by Kraus, and Poynting did not consider it. Heaviside {5c} pointed out that the remaining flow component is hardly reduced (hardly changes direction) from the entire flow component before the extraction of the small Poynting component. Given sufficient intercepting charges outside the wires in separate receiving circuits, the total remaining energy flow that could potentially be intercepted is enormous — far more than the feeble amount of energy that is input to the generator shaft or that is in the chemical energy of a battery.

This is easily established by actual experiments placing intercepting charges in separate "receiving" circuits in the otherwise nondivergent energy flow outside the conductors, or one may show it with Bohren's experiment {24}. Collecting additional energy completely outside conductors is one part of the COP>1.0 operation of the motionless electromagnetic generator (MEG) {37}, to be discussed later in this book. The Sweet device {29a} established sustaining self-oscillation of the

barium nuclei in a barium ferrite magnet, by using the surrounding vacuum as a semiconducting medium.[30]

1.4.4 The Incompleteness of Aristotelian Logic

Another false notion usually perpetuated in much of science and mathematics is that Aristotelian logic is complete and consistent {77, 78}. To the contrary, it is both incomplete and inconsistent, as is easily shown. Let us use the symbols "A" for a particular thing, "$\bar{A}$" for that which is not-A, "$\sum$" for "is identical to," "$\not\equiv$" for "is not identical to", "$\vee$" for "or", and "$\wedge$" for "and". Using these symbols, the three laws of Aristotelian logic may be expressed as follows:

$$A \sum A \qquad [2]$$

$$A \not\equiv \bar{A} \qquad [3]$$

$$A \vee \bar{A} \qquad [4]$$

The first law states that a thing is identical to itself. The second states that a thing is not identical to that which is not itself. The third states that a thing is either itself, or it is something else. Those are the three laws of Aristotelian logic. As written, the process of perception, observation, etc. *has been excluded*. More on that in a moment.

Specifically excluded are the laws

$$A \not\equiv A;\ A \sum \bar{A};\ A \wedge \bar{A} \qquad [5]$$

Which says that a thing is not identical to itself but is identical to something else that is not itself.

Heraclitus posed a profound challenge to Aristotelian logic, a challenge that has not been adequately resolved by Aristotelians to date. He simply observed that, for a thing to change, it had to change into something else. “But then,” he asked, “how can a thing be itself but also something else as

[30] E.g., see Richard E. Prange and Peter Strance, "The Semiconducting Vacuum," *Am. J. Phys.,* 52(1), Jan. 1984, p. 19-21. The vacuum may be regarded as a semiconductor. In particular, the vacuum in the region close to the nucleus of a superheavy element is analogous to the inversion layer in a field effect transistor. The authors introduce the idea of the inverted vacuum. Just as a semiconductor may be manipulated by subjecting it to external fields, doping etc., it appears that so can be the vacuum.

well?" In philosophy that is still known as the unresolved "problem of change". It has no resolution in Aristotelian logic, but can be resolved in an extended logic we shall advance. The solution to Heraclitus' problem of change is the nature of observation, as advanced in this book.

We now critique Aristotelian logic, by observing a simple Venn diagram of the type used in "proving" logic theorems in axiomatic logic. See Figure 1-2.

1-2a. Usual Venn diagram of A and A.

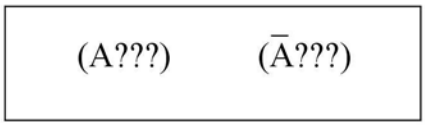

1-2b. Applying second and third laws to divider.

1-2c. Applying second and third laws to divider and outer boundary.

Figure 1-2 Applying Aristotle's laws to Venn diagram used to prove logic theorems destroys the entire diagram.

In Figure 1-2 a, we have introduced a dividing boundary line between A and Ā. *Unfortunately that dividing line belongs entirely to both A and Ā*. So it violates all three Aristotelian laws, and must be removed.[31] Therefore, we remove it in Figure 1-2 b. Now we have neither a discernible A or a discernible Ā, but we have removed naught but the boundary separating them, so we may argue that they are both still there although not discernible. However, if they are not discernible, we cannot distinguish what A is or what Ā is, and so we cannot discern whether they

[31] A clever fellow once proposed regarding the boundary as a total discontinuity, being neither A nor Ā. However, in that case A and Ā could never meet, so there could not be a cause interacting with not-cause to produce an effect. So that suggestion as to how to "fix" Aristotelian logic does not hold.

are identical or not. Here again this violates all three laws of Aristotelian logic, so we have to remove the diagram. Indeed, the outer rectangle line is also such a boundary, between the "inside" and the "outside" (the not-inside), and so it must be removed. In compliance with Aristotle's laws, we are left with the trivial diagram shown in Figure 1-2 c, which is nothing at all.

If this Venn diagram method is objected to, then we must insist that all those papers and texts using that method of proof of logic theorems be either abolished or corrected!

Sometimes the objection is raised that, as far as the center boundary line is concerned in Figure 1-2a, the line "belongs to A on the left and belongs to $\bar{A}$ on the right". Fine! Then we have a unique situation where a line (call it L) is an entity made of two entirely different things, which we may refer to as L_L and L_R. Yet $L \sum L$, without any qualifications as to "sides" L_L and L_R. It can be shown that every point in L is a point in L_L, and is simultaneously a point in L_R. The point in L is obviously identical to itself, by Aristotle's first law. Further, the same point in L_L and in L_R is identical to itself, by the same first law. But L_L is the set of all such points, and so is L_R, and so is L. Therefore $L \sum L_L \sum L_R$, since each one consists of each point that the others consist of. There is absolutely no distinction between the three things themselves, unless we are to violate Aristotle's laws.

Note that in passing from left to right across the boundary, a "change" occurs. This simply re-resurrects Heraclitus' original objection that, according to Aristotelian logic, there can be no change. That is, a line cannot change from "a different entity as seen from the left" compared to that entity as seen from the right. None of Aristotle's three laws contains a "left and a right" for A or $\bar{A}$.

So the question of logic is a little more complex than writing three simple laws and drawing simplified Venn diagrams. In short, one cannot have Aristotelian logic without having something else *outside* it, which follows directly from Gödel's theorem and proof {78}. Note that we are introducing the required notion of "perception" into the formal notions implied as axioms in Aristotle's laws, as that "something outside the prescription of the laws themselves" and in addition to them. We are perfectly free to *use* Gödel's theorem and observation.

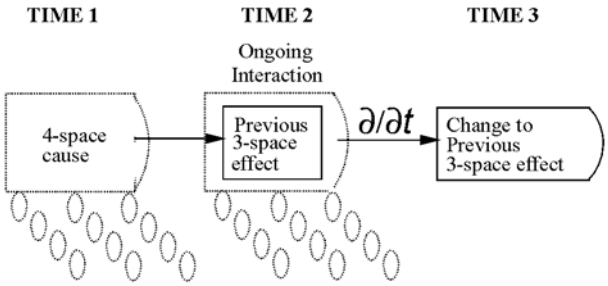

Figure 1-3 Mechanism for observation of change to a previous observation.

See Figure 1-3. We now add the notion that a thing is a perceived, thought, or observed thing. So let us use the symbol ⇒to mean <u>*explicit*</u>, i.e., *output* by a given perception, thought, or observation process as the result of a ∈/∈*t* operator having been applied to whatever exists prior to perception, thought, or observation. The symbol ⇔is used to mean *implicit*, e.g., when one observes an observation "Y" at time two, and later is deciding in time three whether or not that observation "Y" in time two is identical to a previous observation "X" made during time one, then *memories* of the observations of X and Y are involved in time three rather than the observations X and Y themselves, and so the observations of X at time one and Y at time two — by whatever manner they were observed and according to whatever decision algorithm is used — is said to be "implicit".

We note that we can know nothing about the so-called "thing in itself" *without* thought, perception, observation, or other process involving ∈/∈*t*. Further, at the moment the ∈/∈*t* operator is applied, time momentarily ceases. The resulting perception, thought, or observation exists therefore as a "frozen output" at that single moment in time. To have it "persist" or exist a moment later, we have to apply the ∈/∈*t* operator *again*, and stop time again, so that we again perceive, think, or observe.

But at any moment later than when we made a particular perception, thought, or observation of "A", *that* specific "perceived A" no longer exists, except in our memory as a recording of "observed A" that we can *continually recall*. Our conscious mind is a very fast serial processor, with only one "perception" or "thought" at each fleeting moment — only one

slide at a time in the slide projector, so to speak. But it is very rapid. However, our so-called "unconscious" mind is totally conscious, just multiply so. It is a massively parallel processor, and has "a great many slides in the slide projector" at any given time.[32] Hence in our genetic multiprocessor mind, we can indeed record, recall, compare, etc. — and perform all the modern massively parallel computer operations.

Let us now re-examine the three Aristotelian laws. Let us label the "slide snapshots" with the time instants when each "perception, thought, or observation" is or was consciously made, by use of a subscript, such as A_1, which means *what was perceived, thought, or observed as "A" in time-snapshot 1*. Let us also note that each of the symbols $\sum_3$, $\not\equiv$, $\vee$, and $\wedge$ actually involves the output of a *comparison and decision algorithm* in the massively parallel processor, after the two observations X_1 and X_2 were made. Let us use the symbol ♥ to mean "results in the decision that" or "implies that". As a check for identity, e.g., simple comparison algorithms for determining identity or nonidentity might be

$$\{[A_1 - A_{(2)}] = [0]_3 \heartsuit_4 (A_1 \sum A_2) \qquad [6]$$

$$\{[A_1 - A_{(2)}] \prod [0]_3 \heartsuit_4 (A_1 \sum A_2) \qquad [7]$$

Thus we more precisely rewrite Aristotle's laws as

$$A_1 \sum_3 A_{(2)} \qquad [8]]$$

$$A_1 \not\equiv_3 \bar{A}_{(2)} \qquad [9]$$

[32] E.g., this can be seen by a moment's reflection. At any one time, the "unconscious" mind is controlling and directing a great multitude of ongoing physical processes, is also processing short-term and long-term memory processing, filing conflicts for resolution or later presentation to the conscious mind in symbolic fashion, etc. One can physically measure the electromagnetics associated with this activity, after the mind transduces its time-polarized EM interactions into 3-space EM actions. The process is two-way, and certain recorded EM stimuli will be "reverse-processed" back to affect the time-polarized EM operations of mind. Mind operations are electromagnetic; but they use time-polarized (scalar) photons and time-polarized (scalar) EM waves which are unobservable a priori. Mind operations are also electrodynamically engineerable, but that is beyond the scope of this treatise.

$$A_1 \vee_3 \bar{A}_{(2)} \qquad [10]$$

Where — surprise! We have now accounted for all those different times and periods of observations, processing, comparison, decision, etc. We are dealing not with some mystical "thing-in-itself", but with interactions (perceptions, thoughts, observations, associations) in the mind and psyche of the observer. And hidden in time 3 is the application of a decision algorithm such as given in [6] and [7] above.

Now the first law [8] states that in time one an observation was made and named "A", notated (A_1), by comparing it to a previously recorded observational memory of what we call "A". The existence of that *memory* of what we call A is implicitly assumed in the first law, as well as the others. We do not show the memory itself in [8], [9], and [10]. In time two an observation X_2 was made (not notated), but it is not then known at the moment whether that X_2 is A or $\bar{A}$. So in time interval three the decision algorithm to determine identity or non-identity occurred in the mind, and the zero output of that algorithm [6, 7] established that $A_{(2)}$ was actually identical to A_1, *according to the decision algorithm actually used. The algorithm matters, and it too is a variable*.

A similar process occurs in law two [9], but this time the algorithm had a different output. Note that the little line over $X_{(2)}$ to make it $\bar{A}_{(2)}$ was not assigned until time interval four (not shown) after the decision algorithm had given its output in time interval three.

The second law merely states that the operation of the decision algorithm in time interval 3 found the two snapshots (in time 1 and in time 2) not to be identical, *by the decision algorithm and comparison process utilized. Again, the algorithm matters, and it too is a variable that must be taken into account.*

All three laws [8, 9, 10] written one after the other *assume* that the identity algorithm does not change between snapshot 1 and snapshot 2, in all three of them. This is the key point.

With two different versions of the identity decision algorithm, the results of two different comparisons may differ. If the identity decision algorithm does not change during the time between snapshot one and snapshot two, then we have one case. This is like a person with good color vision, looking at a red marble beside a black marble. That observer clearly

distinguishes the marbles, and to him they do *not* appear identical. Every time he looks again, they still differ because he did not change his decision algorithm between looks. On the other hand, a color-blind observer cannot distinguish the marbles, and to him they are seen as identical. Every time he looks, they are seen as identical, because his identity decision algorithm did not change.

Or, suppose a proponent argues that the "rightness" or "leftness" of the dividing line L, between A and $\bar{A}$ in the Venn diagram, can be taken into account. He is actually invoking a different algorithm (it belongs to the left and therefore to A) in one time snapshot than the algorithm (it belongs to the right and therefore to $\bar{A}$) used in the other time snapshot. So his right side and left side of a line implicitly invokes the very point we are making: *the algorithm utilized is a variable and must be accounted.*

The point is this: *identity — whether in perception, thought, or observation — is not absolute, but depends upon the precise nature of the operation of the perception, thought, or observation process utilized and specifically on the "decision algorithm" used for "determining" identity or nonidentity.* For example, two antennas certainly "see" quite differently, if one is a VLF (very low frequency) antenna and the other is an IR (infrared) antenna! As another example, two observers in different frames may see a particular object as quite different observed things! In n-space, an observer in a frame at right angles to the lab frame, will see any mass in the lab frame as a wavefront going at light speed; in short, as a photon or photonic object, whereas the observer in the lab frame will continue to see it as just a common old mass object. So the "same object" *physically* differs to the two different observers, according to their frame of reference. An observer whose frame is rotated by three orthogonal rotations from the lab frame, will see that object as an "object existing in time only," i.e., as simply a sort of "thought" image, so to speak. To be more scientific, he may assign it to something called the "virtual state".

In short, we can violate any and all of the laws of Aristotelian logic, because identity per se is *perceived, thought, or observed* identity — the output of a variable decision algorithm — and is not absolute.

For clarity, we add a fourth law that violates all Aristotle's three:

$$A_1 \sum_3 \bar{A}_{(2)} \qquad [11]$$

All this really says is that, in time 3, the decision algorithm being used was changed from what it had been in times 1 and 2, and now could not distinguish between what was seen in snapshot 1 and what was seen in

snapshot 2, even though to some "ultimate" observer the two were distinctly different.

In addition, we say that it "implicitly includes" the negations of all three Aristotelian laws. We then add an "application rule" (or a fifth law, as one wishes) as follows:

$$\{ [(A_1 \Sigma_3 A_2) \Rightarrow \wedge (A_1 \not\equiv_3 A_2)] \Leftrightarrow \}_5 \vee \{ [(A_1 \Sigma_3 A_2) \Leftrightarrow \wedge (A_1 \not\equiv_3 A_2)] \Rightarrow \}_5 \qquad [12]$$

This winds up producing an extension of Aristotle's logic, so that the following explicit laws emerge:

$$A_1 \Sigma_3 X_{(2)} \heartsuit A_1 \Sigma_3 A_{(2)} \qquad [13]]$$

$$A_1 \not\equiv_3 X_{(2)} \heartsuit A_1 \not\equiv_3 \bar{A}_{(2)} \qquad [14]$$

$$A_1 \vee_3 \bar{A}_{(2)} \qquad [15]$$

We also have the exact opposites of those three laws implicitly. The opposites can all be congealed into a single fourth law:

$$A_1 \Sigma_3 \bar{A}_{(2)} \qquad [16]$$

To make sense of these, we also have the master application rule or 5th law:

$$\{ [(A_1 \Sigma_3 A_2) \Rightarrow \wedge (A_1 \not\equiv_3 A_2)] \Leftrightarrow \}_5 \vee \{ [(A_1 \Sigma_3 A_2) \Leftrightarrow \wedge (A_1 \not\equiv_3 A_2)] \Rightarrow \}_5 \qquad [17]$$

We prefer to refer to this extension as a "four-law logic", where equations [13], [14], and [15] are the normal "explicit" laws, with the implicit law [16] understood but not explicitly written, and where equation [17] is the master application rule that puts it all together. But if one wishes to be rigorous, we have specified a 5-law extended logic that contains but expands Aristotle's 3-law logic. The application rule is the fifth law.

The point is this: In every case, we have a part of the perception, thought, or observation that obeys the explicit laws, and we also have a part that obeys the implicit laws. If opposites are not *explicitly* identical, then they

are simultaneously *implicitly* identical. If opposites are *explicitly* identical, then simultaneously they are also *implicitly* not identical.

The new approach then covers what we observe more completely. As an example, any "wave" (observed) is implicitly a non-wave (particle), but not observably so. If its particle nature is observed and therefore explicit, its wave nature is unobserved and therefore implicit, and vice versa.

One also resolves such dilemmas as stating something "does not exist" but having to first call it into existence to even state it does not exist. In the new approach, it simply does not *explicitly* exist, but *implicitly* exists. *Not-being* is something like that: explicitly it doesn't exist, but implicitly it exists. The great problems of the philosophers were never solved, mostly because the logic brought to bear was Aristotelian and incomplete. The ultimate answers they sought all involved the fourth and fifth logic laws. So the ultimate answers all appeared to them to involve such things as "the accursed necessity for the identity of opposites." Precisely!

In physics, there has been the same problem over whether a fundamental particle is a particle or a wave. Physicists argued fiercely until they realized the futility of further argument, and settled for the duality principle. That simply states, well, in one case it can be a particle as observed in your experiments, and in another case it can be a wave as observed. So simply treat it as whichever one is useful! The philosophers, on the other hand, split into different schools, where each school had its "interpretation" usually involving a very "smooth" position statement of the school's position. In physics also, there are eight or more "interpretations" of quantum mechanics, for example. So the same centuries-old problem is still with us today in modern physics.

Opposites are no longer the formidable opponents they once seemed. Instead, they become more like the two sides of a coin, lying with only one side up. To see heads or tails is to decide which is explicit. The other is always there, implicitly. But notice also that the "two sides" require a 3-dimensional object, and not just the 2-dimensional "head" or the 2-dimensional "tail". This juxtaposition of "identical" opposites is strongly met with in modern physics. For example, quoting Lee[33] :

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[33] T. D. Lee, "Space Inversion, Time Reversal and Particle-Antiparticle Conjugation," *Physics Today*, 19(3), Mar. 1966, p. 23. Positive charge is really *observation* imposed on negative charge moving backwards in time, and the positron is really observation imposed upon an electron traveling backwards in time, etc.

> *"As we expand our observation, we extend our concepts. Thus the simple symmetries that once seemed self-evident are no longer taken for granted. Out of studies of different kinds of interactions we are learning that symmetry in nature is some complex mixture of changing plus into minus, running time backward and turning things inside out."*

Any addition to the Aristotelian laws of logic is actually a higher dimensional form of it. Three-law Aristotelian logic is in fact fitted to primitive observation — the result or output of single-photon interaction and observation processes.

This "four-law" logic (or "five-law" logic if one includes the master application rule as another "law") has proven very useful over the years, particularly in bioenergetics applications. It has also been most useful in attempting to decipher that branch of Russian energetics weapon science called "psychoenergetics", and in attempting to decipher the mind-body coupling mechanism, but that is beyond the scope of this chapter {79}.[34]

1.4.5 Substitution of Effect for Cause

Refer to Figure 1-3 again, to see the relationship of the unobserved cause, the interaction of cause and a previous effect, and the production of the resulting "new effect" as a change to the old effect or the output of a second replica of it. The greatest non sequitur in electrodynamics — and in parts of physics such as mechanics — is the widespread substitution of the *effect* for the *cause,* as a result of considering an observable to *persist in time* without any physical interaction. We discuss that more fully in Chapter 2, particularly with respect the notion of the same EM field existing both as a component of a material environment and as a component of a nonmaterial environment, but with the "force reducing to zero" in the latter. Jackson {80} points out the prevailing view of electrodynamicists as follows:

> *"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable*

[34] The interested reader is referred to my website, www.cheniere.org, for papers dealing with the nature of the mind-body coupling mechanism and the body-mind coupling mechanism, as well as direct engineering of the mind, and limited information on the weapons referred to.

> *quantities such as force somehow involve the product of charge and field."*

On the other hand, Bunge {81} very clearly stated that the standard electrodynamics and physics itself are in terrible shape. Here is a direct quotation:

> *"... the best modern physicist is the one who acknowledges that neither classical nor quantum physics are cut and dried, both being full of holes and in need of a vigorous overhauling not only to better cover their own domains but also to join smoothly so as to produce a coherent picture of the various levels of physical reality."*

We shall try to further clarify these unresolved difficulties with the field concept in Chapter 2.

1.5 Electrodynamics is Still Developing

1.5.1 Statement by Penrose

Roger Penrose, one of the leading physicists of our time, pointed out the still-developing nature of electrodynamics with respect to the developments from conventional gauge-theoretic interpretation of Maxwell's equations. Quoting Penrose {82}:

> *"These facts should not, however, deter theoretical or experimental physicists from seeking alternative descriptions, unconventional formulations, surprising electromagnetic effects, or radical generalizations. The various articles in this book provide the reader with a great variety of different kinds of approach to developments of this nature. We have historically motivated accounts, suggestions for new experiments, unconventional viewpoints and attempts at generalizations. We also see novel and ingenious formulations of electromagnetic theory of various different kinds... I am sure that this book will make it clear that electromagnetism is a subject that is in no way closed to stimulating new developments. It is very much alive as a source of fruitful new ideas."*

1.5.2 An Example of a Ubiquitous Error

One of the rather horrid "bad examples" of ubiquitous errors in electrodynamics is the conventional illustration of a so-called planar EM wavefront moving through space, as shown in Figure 1-4.

A succinct evaluation of that diagram and notion is given by Evans {83}, one of the great electrodynamic theoreticians of our times:

> *"I broadly agree ... that the transverse plane wave view of vacuum electrodynamics is the biggest blunder of twentieth century science."*

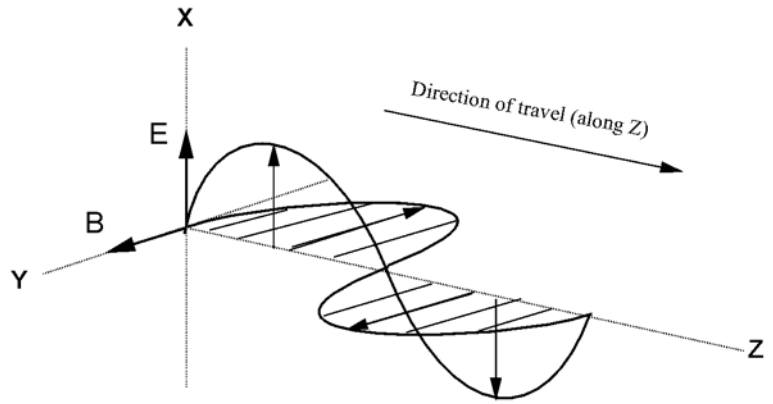

Figure 1-4 The erroneous but ubiquitous supposed illustration of the transverse EM wave in 3-space.

Dr. Robert H. Romer, former Editor of the *American Journal of Physics*, also chastised the horrid diagram shown in Figure 1-4, purporting to illustrate the transverse plane wave traveling through 3-space. In endnote 24 of his noteworthy editorial, Dr. Romer {84} takes that diagram to task as follows:

> *"...that dreadful diagram purporting to show the electric and magnetic fields of a plane wave, as a function of position (and/or time?) that besmirch the pages of almost every introductory book. ...it is a horrible diagram. 'Misleading' would be too kind a word; 'wrong' is more accurate." "...perhaps then, for historical interest, [we*

> *should] find out how that diagram came to contaminate our literature in the first place."*

Indeed, each point along the z-axis, is a momentary "3-space frozen slice" of the $\in/\in t$ operator being applied to the ongoing 4-space interaction of the causal field in 4-space interacting with the previous "observed effect" (in this case, the previous 3-space slice) to produce a change to it. So the entire diagram is a set of "frozen 3-space observations", in which nothing at all is moving, and where the fields shown are in the mass (detecting/observing) medium. There is no such thing as a "traveling EM wave in 3-space", because "moving" or "changing" or "traveling" *a priori* must involve time as well as 3-space. What we are looking at in Figure 1-4 is the iterative and very rapid results of continual "3-space observations" (frozen 3-snapshots) of an on-going 4-space interaction.

1.5.3 An Extremely Important EM Omission

There is an enormous amount of development yet to be done in electrodynamics! As a simple example, for nearly a century there has been waiting quietly a fundamental "internal" or "infolded" electrodynamics by Whittaker {85, 91a, 86}, based on more primitive initial work by Stoney {87}, existing inside — and *comprising* — all conventional EM potentials, fields, and waves. This internal electrodynamics {88} has been essentially ignored in the West, but has already been weaponized in the weapons laboratories of several nations under the aegis of *energetics*. The U.S. Secretary of Defense, Secretary Cohen {89}, alluded directly to some of these weapons in a speech in 1997 as follows:

> *"Others [terrorists] are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves… So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations…It's real, and that's the reason why we have to intensify our [counterterrorism] efforts."*

The weapons are already being utilized against various nations in the form of terrorist acts in an undeclared war {89}, and have been so used since the 1950s.

This internal longitudinal-wave EM and its dynamics is a much more fundamental electrodynamics (actually a subset of a unified field theory) consisting of correlated longitudinal EM wavepairs in both the 3-space and time domains. Each Whittaker decomposition wavepair is comprised of an

incoming longitudinal wave — a "time-polarized" EM wave {90a-90c} — in the time domain, perfectly correlated with an emitted longitudinal EM wave in 3-space. See Figure 1-5. This multiwave structuring and dynamics in both the time domain and in 3-space simultaneously *comprises* the scalar potential.

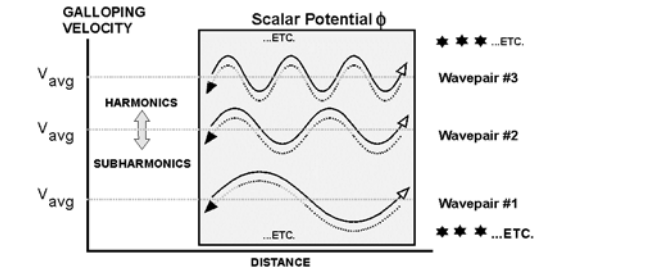

The Structure Is:

- A harmonic set of longitudinal phase conjugate wavepairs.
- In each wavepair the two waves superpose spatially after detection, but travel in opposite directions.
- Prior to detection, the convergent wave set is in the imaginary plane, and hence is not observable. It is EM energy incoming to the potential (dipolarity) from the time domain.
- The charges receive the complex convergent EM energy, transduce it into real EM energy, and emit enormous energy at the speed of light in all directions -- which includes bidirectional pairs in 3-space (after the reaction, being after "observation").
- This produces the fields and potentials from the "source charge or dipole."
- Mandl and Shaw argue that the scalar (time-polarized) photon and longitudinal photon are observable only in similar pairs, which then makes the instantaneous scalar potential. Thus quantum field theory work strongly supports the "negative resistor" interpretation of the scalar potential and our solution to the source charge and source dipole problem.

Figure 1-5 The scalar potential is a harmonic set of phase conjugate longitudinal EM wavepairs.

We specifically stress that the dynamics occur in the *time* domain (in its specific structuring, propagation pace, etc.) as well as in 3-space.

Deliberately changing the internal longitudinal EM wave structuring produces precise energetics (both energy and dynamics) in spacetime itself. This is a special form of "spacetime curvature structure and dynamics" which we call a *spacetime curvature engine* or *vacuum engine*. Together with superpotential theory in the original form initiated by Whittaker {91a} and extended by others {91b, 91c, 91d}, this internal electrodynamics — together with scalar potential interferometry {92} — creates all ordinary EM fields and waves {79}. Superluminal communication is possible using the internal longitudinal EM wave structure of the EM fields, potentials, and waves {93a, 93b}.

1.6 A Summarizing Letter

Our thrust in this book is to attempt to (1) reveal some of the major flaws in electrodynamics that have prevented development and use of COP>1.0 electrical power systems, and (2) point the way toward the development and use of such systems. To give a general summary of the ground this book will cover, we conclude with an informal E-mail letter I sent to the recent editor of *American Journal of Physics*, pointing out the greater implications of his cogent observation of that "dreadful diagram" and where it leads. Indeed, it (i) leads to a dramatic change in electrodynamics, (ii) changes the way in which we regard "propagation of EM energy through 3-space", (iii) solves the long-vexing problem of the association of the source charge or source dipole with its fields and potentials and their energy, (iv) changes dramatically the way we view what powers an electromagnetic circuit or power line, (v) allows extraction and use of copious EM energy from the vacuum, and (vi) solves the energy crisis permanently.

Here is the letter sent informally to Dr. Robert H. Romer — *slightly edited* to improve the grammar, correct one error of misstatement, and with reference citations added and listed at the end of this chapter:

To: Dr. Robert H. Romer Thursday, Mar. 8, 2001
American Journal of Physics
Amherst College, Box 2262
Amherst, MA 01002

Personal communication

Subject: Implications of your cogent comments on that atrocious illustration

Dear Dr. Romer:

This is not a submission of a manuscript, but a personal communication to you on a matter of great importance in physics, directly related to endnote #24 of your seminal editorial {94}.

It will take a little exposition, so please bear with me and read this when you have the spare time to do so. We are going to show you how your keen insight can be extended to solve some extraordinarily formidable

foundations problems in present electrodynamics. We will also show how to apply the implications of your insight to totally solve the present electrical energy crisis permanently.

In your endnote #24, {94} you took to task (quoting):

> *"...that dreadful diagram purporting to show the electric and magnetic fields of a plane wave, as a function of position (and/or time?) that besmirch the pages of almost every introductory book. ...it is a horrible diagram. 'Misleading' would be too kind a word; 'wrong' is more accurate." "...perhaps then, for historical interest, [we should] find out how that diagram came to contaminate our literature in the first place."*

Dr. Romer, you have lifted the corner of a dark cover concealing one of the most important flaws in electrodynamics and in fact in all of physics: the unwitting and pervasive substitution of the effect for the cause. A marvelous extension to the present physics is enabled if one removes this terrible non sequitur in physics, and particularly in electrodynamics. For openers, one solves what has been called the most difficult problem in electrodynamics (the problem of the source charge and the association of its fields and potentials and their energy) {100}. I will solve that problem for you in this informal write-up. I will also explain how to extract enormous EM energy from the vacuum, anywhere and anytime, easily. Extracting it is easy; catching it and using it to power loads without killing the extraction process is another matter.

One also gets a unified field theory, engineerable by novel electrodynamic means, as is steadily being shown by a series of rigorous Alpha Foundation's Institute for Advanced Study (AIAS) papers published in various leading journals (and more than 90 of them carried on a Department of Energy website restricted primarily to DoE scientists). Dr. Myron Evans, Director of the AIAS, has over 600 papers published in the literature, including such journals as *Physical Review*, *Foundations of Physics*, *Physica Scripta*, etc. Many of the other AIAS co-authors are excellent theoreticians and scientists.

The early pioneers of electrodynamics (Maxwell etc.) all assumed a material ether filling all space {95}. To these early scientists, there was not a single point in the entire universe that was devoid of matter, because the ether was present there. Hence their outlook as to the nature of EM fields etc. was quite material. Faraday conceived his "lines of force" as physical, taut strings, so that perturbations were "plucking these taut strings".

Maxwell himself points out in his famous "Treatise" that he specifically captured the thinking of Faraday in his theory. In fact, Maxwell wrote a *material fluid flow dynamics* theory.

In the light of more modern knowledge, let us see the impact of these and similar early *but still retained* erroneous electrodynamics assumptions.

First, observation/detection is totally spatial, as is well known in quantum mechanics. In fact, observation is a $\in/\in t$ operator imposed upon 4-space (LLLT spacetime), yielding a frozen instantaneous snapshot LLL of an ongoing 4-space dynamic process. At the next instant, that particular *previous* observation no longer persists. Why?

Well, no observable *persists*, since it is only an instant frozen 3-space snapshot, at a single point in time, *a priori.* Here again we have another horrendous non sequitur in all of physics: the assumption that observables "continue to exist" and therefore persist in time in a passive manner. In fact, there is an interactive process that generates their (seeming) persistence, involves time, and continually changes mass into masstime and back to mass, etc. With the reader's permission, we will pass discussing that mechanism until another time (pun intended!).

What we conceive as "an observable such as mass, traveling through space and persisting in time while doing so", is actually an iterative, continual series of these frozen 3-space snapshots or observations, much like the frames of a motion picture film. We ourselves mentally add the "continuity" to provide "the sensed motion", but rigorously what is actually "observed" is not continuous, but is a vast continual series of those frozen 3-space snapshots.

We're getting directly at that atrocious diagram!

Each snapshot is an *effect*, not a cause, because it was the output of the observation process whereby a 4-space *causal* entity (non observed *a priori*) interacts with a previously observed frozen entity (say, a unit point charge at some point in space) to produce the observation (change or effect generated in that interacting observed charge) as the "next instantaneous observation".

The usual "representation" of a "3-space EM wave" propagating in 3-space is indeed atrocious, just as you stated! It is actually just an iterative succession of such instantaneously frozen snapshots in 3-space, one after the other. There is no such thing as that set of snapshots independently existing in spacetime, *prior to interaction with charge* in that series of

interactions and observations, unless we wish to discard quantum mechanics and the laws of logic.

There is, however, a continual iterative stream of those observations — those frozen 3-space snapshots — that we interpret (erroneously) by recall from memory as the "EM wavefront propagating in 3-space". As you eloquently pointed out, that is not so, and it is atrocious. An observation, being an absolutely frozen entity, cannot "move through time" anyway, since it cannot persist, nor can it move. A change to an observable can only be another observable snapshot of the ongoing 4-space entity and action, which is then compared to the first snapshot and a difference noted {96} [See Figure 1-3].

In short, a great stream of "frozen effects" (frozen instant observations) does not constitute a "picture" of the ongoing 4-space action, but only a series of frozen 3-space intersections involving the interaction of that fixed observed (3-space) charge with the ongoing causal 4-space entity. If we add and integrate a series of 3-space pieces, we *do not* get a 4-space entity! Instead, we get a longer or bigger 3-space slice/piece, but one for which each piece of it only existed at a single point in time as a 3-space "slice" at that moment. That is precisely what is wrong with that horrible illustration.

But it is also "wrong" with electrodynamics itself! Electrodynamicists mistakenly conclude that the same *effect* "series of static 3-slices" — which they might call, e.g., the "field" in a case where the field is the subject — is the same as the 4-space continuous *causal* field prior to observation interaction with charge at all. Well, LLLT is definitely not LLL, nor is it n(LLL) where n is some large but finite number of 3-slices LLL.

So the field concept is dichotomously used in two contradictory manners in electrodynamics:

(1) it is considered to be in 4-space prior to the observing/detecting interaction with the observable (such as a unit point 3-space charge), and it is also considered a 3-space entity *after* that interaction. The dimensions of the two entities are not the same, and neither are the dynamics. The causal EM wave is dynamic and 4-spatial, the effect "3-space EM wave" (ugh!) is static and 3-spatial at each instant it is "observed". Assuming that the two are the same thing is a non sequitur.

In fact, it substitutes the *effect* for the *cause*, a rather gross violation of the causality principle itself.

(2) then an attempt at glossing over the illogic is used by the smooth statement that "the field (meaning that atrocious series of frozen 3-space snapshots) remains in the absence of charge, but the force goes to zero." Well, if the field is defined as a force field, it cannot be a "non-force field in the same observation!" Else, opposites are always identical.

So of what importance is all that?

It is of great importance. Let me show you one very startling thing that comes out of correcting this "biggest foundations non sequitur in physics, that of substituting the effect for the cause".

Consider a very special paper by E. T. Whittaker {97} in 1903. [I can send you a pdf file of the paper if you do not have it and are interested]. In this much-neglected paper, Whittaker decomposed the so-called "static" potential into a harmonic set of bidirectional longitudinal EM wavepairs, where each pair consists of a longitudinal 3-space wave (an *as-observed* wave) and its longitudinal phase conjugate wave (*considered unwittingly as having also interacted with charge, and therefore as being shifted into 3-space as an "as-observed" wave with inverse parity*).

Whittaker — as has everyone since him — unwittingly assumed the "iterative continual observation" interaction in there for the phase conjugate wave also. In so doing, he came up with two *effect* "waves" that are the outputs of the assumed observation process. Neither of these effect waves would be a wave in spacetime {98} at all, but the two in ensemble are an example of the same thing you objected to in your cogent commentary on that abominable "illustration".

In short, Whittaker invoked *observation* as a process with two effects and no cause, rather than with a cause and an effect, with the interaction with the observing/interacting unit point charge being assumed for both waves. Whittaker and everyone since seem to have made the same error in interpreting that seminal Whittaker decomposition. This misinterpretation of the decomposition has until now hidden one of the greatest secrets of all times in Nature's electrodynamics!

Let us correct the interpretation, and uproot that great secret to the light of day.

First, for observation to occur, one must have a cause acting upon the affected (observable) entity, and an effect (observable change) must be produced in, on, or of that affected (interacting) entity. One *must not* have two effects (two observables) and the affected entity (another observable and therefore another effect)! Again, assuming that one has three effects

(observables) constituting the observation process is a logical non sequitur of first rank.

Let us now correct that logical non sequitur made by Whittaker and other physicists and electrodynamicists, and see where it leads us.

First, we go to particle physics, where broken symmetry {99} was discovered in the 1950s. Lee, e.g., received a Nobel Prize for his work in that area {75}. Lee also showed that any dipole is a broken 3-symmetry in its violent energy exchange with the active vacuum.

Well, a scalar potential is a dipolarity; always a potential is actually a difference between two potentials, so to speak. So the potential itself represents a broken 3-symmetry in an energy flow exchange with the active vacuum.

Let us further examine that interesting broken symmetry aspect. It means that the "static" potential is a process whereby energy is received from the vacuum in *one* form, not observable, and hence unusable, but is output in *observable* (usable) form. In short, the dipolarity or dipole receives and absorbs (QM view) virtual photons, integrates them into observable magnitude, and emits real, observable EM energy ("continual observation" snapshots of the latter being assumed).

In physics, all observation is 3-spatial, as is well known. And 3-space is the realm of the observed. The EM energy from the vacuum is not received in 3-spatial (observable) form, else there would be no broken 3-symmetry of the dipolarity.

We can also *experimentally* verify that there is no 3-space input of EM energy to the potential — e.g., to the potential between the ends of any source dipole, because we cannot measure any 3-space observable energy feeding the charges of the dipole. Instead, observable 3-space energy is continuously pouring out of the dipole.

Let us continue now with the notion of a real dipole of separated source charges, with our "scalar potential" between its ends, so we have something concrete in mind.

First, our instruments prove there is a continual emission of EM energy in all directions in 3-space (of the kind in that atrocious diagram; a "series of iterative film-snapshots"). That is the way it is conventionally represented, as if observed at each and every point successively in that 3-space, and along every radial.

But secondly, our instruments also prove there is no such observable *input* of EM energy in that same 3-space *to* the dipole. Bummer! That is precisely what has stopped electrodynamicists from solving that vexing problem of where all the energy pouring out of the source dipole is coming from, and how! They unconsciously assume that the only possible source of the EM energy input is in 3-space. That is totally wrong. Further, the conservation of energy law does not require that energy be conserved in 3-space! Instead, rigorously — if we are using a 4-space (i.e., spacetime) model — it requires that energy be conserved in 4-space. The assumption of the extra condition of 3-space energy conservation is an added and arbitrary extra condition.

Since electrodynamics has not resolved this "source dipole and its associated fields and potentials" problem, it has stopped work on the problem and implied that every dipole in the universe is a perpetual motion machine, freely creating all that EM energy it continuously pours out across space, in all directions, creating its associated fields and potentials. That implicit assumption, if true, of course destroys the conservation of energy law.

It isn't true, and the energy conservation law is alive and well!

We can experimentally prove that the source dipole *does* continuously pour out energy in all directions in 3-space, without ceasing, as follows:

In a gedanken experiment, we set instruments every 300 million meters or so, along a radial line from an origin in the lab. With the instruments and clocks synchronized, we suddenly form a dipole at the origin. One second later, the first instrument reads. A second later, the second instrument reads. And so on. But it is not a "passing pulse". Whatever reading the instrument makes as the forward edge of the energy flow reaches it, is then continuously maintained thereafter. This proves that the energy is poured out continuously and at the speed of light, and in any (and all) directions in 3-space, *and it continues to pour out at exactly the same rate so long as that dipole remains intact.*

Dipoles in the original matter of the universe have been pouring out EM energy in that fashion for some 14 billion years, and they have not "exhausted" their unobserved energy input source yet.

A newly formed simple dipole, e.g., in one year will have poured out energy into a spherical volume of space that is a light-year in radius. Wait another year, and that volume of space whose energy density has been

changed will be two light years in radius. The dipoles in the original matter have filled the universe itself with that energy outpouring from them.

In other words, an incredible amount of EM energy has been and is being poured out into space from every dipole in the universe.[35] And electrodynamicists have had not the foggiest notion of where that mind-boggling amount of outpoured EM energy has come from.

Unless we wish to totally discard the conservation of energy law, we must have an equal input of energy *from outside 3-space*, going into every dipole continuously. In 4-space, that only leaves the fourth axis, along which and from which the input energy must move into the dipole.

And so it does. If we re-interpret that phase conjugate half set of the Whittaker decomposition, *before* observation has occurred, it then is a harmonic set of longitudinal EM waves moving in the time-dimension, *into* the source dipole (parity is not inversed because no interaction with charge has occurred to shift it into 3-space.

So voila! We have strangely (but quite rigorously) solved what Sen {100} referred to in this manner: *"The connection between the field and its source has always been and still is the most difficult problem in classical and quantum electrodynamics."*

We express our reasoning as follows: (i) we know from particle physics that the source dipole[36] is a broken 3-symmetry in its flux exchange with the vacuum. This means that we know the energy is received from the vacuum in an *unobservable* form, absorbed by the dipole, and emitted as *observable* EM energy. It remains to translate that into classical electrodynamics rather than quantum physics {101}. (ii) The *time* domain is the only domain outside 3-space, in the standard 4-space model. (iii) Anything in the time domain exclusively, is indeed nonobservable, since the $\in/\in t$ observation operator destroys time and all its internal structure and dynamics whenever observation occurs. (iv) Looking for a "3-space" input is looking for an "observable" EM energy input, which would in fact disagree with the known broken 3-symmetry of the source dipole.

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[35] Later we will see that, in a time-forward situation, the negative charge pours out positive EM energy while the positive charge may be said to pour out negative EM energy. Charge conservation then implies that an energy balance is maintained overall.

[36] Because of the broken symmetry of the opposite charges on its opposing ends.

Let me digress now to speak of fundamental units. As is well known, the fundamental units one chooses to make his physics model represent an arbitrary choice. One can, if one wishes, make a perfectly valid (but mentally nightmarish!) physics using only a single fundamental unit. In that case, all other "fundamental units" in the present model become functions of that single fundamental unit.

Suppose, e.g., that we make the joule our only fundamental unit. Then "mass" becomes totally a function of energy — and we have no heartburn with that one since the Einstein revolution and the nuclear age. But then "time" also becomes totally a function of energy — and that surprises us, because we have unconsciously been taught (erroneously) that "time is a flowing river down which a mass drifts like a drifting boat". That is not the nature of time at all; the totality of the photon interactions with a mass create that mass's "motion through time". I can later explain that to you also, if you wish, but let us pass it for now.

It turns out that time is spatial energy compacted by the factor c^2, so it has the same energy density as mass, but in the time axis instead of 3-space. Intuitively, if we are interested in cause and effect, the energy of the cause (time) should be equal to the energy of the effect (in this case, mass). After one reflects a moment, one also sees that "time energy" is required to "drive" a mass through time, just as "spatial" energy is required to "drive" a mass through space. The notion that mass in an inertial frame moves through "empty space with no reaction" is false; it continually moves through the energetics of spacetime, and interacts continuously with it.

Anyway, from still another viewpoint there is no magic in EM energy currents moving in the time domain! Quantum field theory already recognizes multiple polarizations of the photon, including transverse, longitudinal, and time-polarized. Thus, it implies a time-polarized EM wave also. A longitudinal EM wave *moving in the time domain* oscillates along its line of travel. That is indeed oscillating its energy density in the time domain, so that it is "time-polarized". Hence it is a proper time-polarized EM wave, and appears to "gallop" {102} or vary its speed periodically.

The solution to the "source dipole" problem is that the phase conjugate wave half-set of the Whittaker decomposition, when reinterpreted, is the *incoming* EM energy in the time domain, continuously input to the charges of the dipole. The charges interact in the imaginary plane (the time domain), and absorb the time-energy, then transduce it into 3-space, and emit it as Whittaker's set of real observable longitudinal EM waves in all

directions in 3-space (as observed). The time-energy waves that are input to the dipole cannot be observed, since observation destroys time and its constituents.

All 3-spatial EM energy comes from the time domain! Broken 3-symmetry of the source dipole immediately releases our arbitrary additional restriction on nature's energy conservation law — i.e., our insistence that the energy input for conservation must be input in 3-space. By removing these arbitrary "shackles" from nature's feet, we allow nature to joyously resume her much-preferred special 4-symmetry in EM energy flow: the circulation of EM energy from the time domain into 3-space, and outpouring of that energy in all directions in 3-space, at the speed of light {103}.

Now let us solve the source-charge problem as well. That one is now easy to resolve.

We know from quantum mechanics that any "isolated" observable charge is actually clustered around by virtual charges of opposite sign. So we simply take one of these clustering opposite charges while it exists, and a differential piece of the observable charge, and we have a composite dipole. Hence the "isolated charge" may be represented as a grouping of such momentary dipoles, each (while it exists) with a scalar potential between its poles, and hence each subject to the same decomposition and reinterpretation we have done.

That is why the source charge can "sit there" and pour out EM energy in 3-space (as observed) continuously, and indefinitely. It is also continuously absorbing EM energy from the time domain. As a set of composite dipoles, it is a set of broken 3-symmetries in EM energy flow. Hence it exhibits nature's preferred 4-symmetry in energy flow, between the time-domain and 3-space.

Note also that, to the 3-space observer, this 4-symmetry is purely negentropic. It is a continuous and ongoing (and expanding) reordering of the vacuum energy, in the form of the reinterpreted Whittaker decomposition.

We can easily engineer negentropy! Just make a little dipole, and nature happily starts pouring out energy and reordering part of the vacuum, with that reordering spreading at the speed of light, steadily increasing all the while.

Reinterpreting Whittaker's marvelous decomposition tells us many things: (i) the source charge or dipole does indeed continuously receive and

absorb its input energy from the time domain, (ii) it continuously transduces its absorbed energy to real 3-space energy (as observed!), and (iii) it continually outputs its absorbed and transduced time-energy as 3-space energy emitted in all directions in 3-space (as continually observed).

So the terrible foundations problem of the source charge and source dipole is resolved, and the energy conservation law is maintained.

We have also uncovered a most important thing: Given a little broken 3-symmetry in EM energy flow, t-symmetry in EM energy flow is also broken. A more primary 4-symmetry {104} between time-energy flow and 3-space energy flow emerges *automatically*. In short, every potential, every dipolarity, and every charge is such a broken 3-symmetry and an example of the new, preferred 4-symmetry of EM flow, with input flow in the time-domain (nonobservable!) and output flow (as continually observed in a series of 3-snapshots) in all directions in 3-space.

This also resolves the logical cause and effect problem for observation.

This 4-symmetry is a purely negentropic process, once the dipole is established! Well, we should have known that from the gauge freedom axiom in gauge field theory anyway! That axiom says that we can change the potentials anytime, freely and at will. In electrodynamics, that means we can change the potentials at will, anytime we want to. But that means *we can freely change the potential energy of a Maxwellian system at will, whenever we wish*. It costs nothing — at least in theory; in the real world we have to pay a little for switching — to suddenly potentialize an EM system, prior to the time the Drude electrons relax and current flow begins.

I have applied this great new 4-symmetry in EM energy flow, that is freely evoked and persists indefinitely after one pays a little to make the dipole and thus produce a little broken 3-symmetry, to produce EM energy freely from the vacuum. Without going into it, I refer you to our forthcoming papers {105}. Indeed, we can use this negentropic process to extract as much EM energy from the vacuum as we wish, anywhere, anytime, for peanuts. Let us now move to discuss that area.

First, we point out another astounding result that comes from resolving this "source charge and source dipole" foundations problem.

Generators do not use any of the shaft energy input to them — even in transduced form — to power their external circuits! A generator itself does not add a single watt to the power line, and neither does a battery's chemical energy dissipation add a single watt to its attached circuit.

Neither does burning all those hydrocarbons, consuming all those nuclear fuel rods, building all those dams, etc. to provide our conventional power systems and grid. None of that enormous destruction of the biosphere and pollution of it has ever directly produced one watt on the electrical power line.

Just follow the energy flow, in light of what we now know. Here's how it works.

Typically, we burn some fuel to boil water and make steam, and use the steam to power a steam turbine, which forcibly rotates the shaft of the generator, thereby inputting mechanical shaft energy into the generator. So far, so good. That took care of all the hydrocarbon burning and fuel rod consuming, extracting and transporting the oil, etc.

This input of the shaft energy forcibly rotates the rotor against internal resistance, forming an internal magnetic field. Assuming a 100% efficient generator with no internal losses whatsoever, this means that the *mechanical shaft energy input* has now been totally transduced into *internal magnetic field energy*.

So what does that magnetic field energy *do*? It is totally dissipated upon the internal charges of the generator, performing work on them and forcing the positive charges in one direction and the negative charges in the other direction. That dissipation of the energy in the internal magnetic field *forms a source dipole inside the generator, connected to the terminals*.

And that is all the generator does. Period. *None* of the energy transduced from that shaft input, went roaring out of the terminals and down through space outside the conductors of the power line. Not a single watt. So let us turn to particle physics to find out what happens next, because *it does not yet appear in the electrodynamics model, even though proven.*

The internal source dipole, *once formed*, is a great broken symmetry in the vacuum flux, as we discussed and as is well known in particle physics. But the proven and well-known vacuum interaction with the generator and the dipole charges is not even modeled in the classical EM theory used by the scientists and engineers to build electrical power systems — much less a *broken symmetry* in that active exchange! That's atrocious, since it's been proven in particle physics for nearly a half century, Nobel prizes awarded, etc. But the hoary old 137-year old Maxwell-Heaviside model, further curtailed by Lorentz symmetrical regauging, does not incorporate what has already been proven in physics. *It does not accurately model the situation as it is and as it is known to be.*

Let us continue.

Once that dipole is formed, it extracts *enormous* EM energy from the vacuum, and pours it out of the terminals of the generator, filling space surrounding those conductors of the attached external power line. It is a huge EM energy flow, trillions of times larger than what we account after Lorentz taught us to disregard almost all of it.[37]

Only the tiny little bit of that EM energy flow in space along and surrounding the conductors — the little "boundary layer" that skims down the surface of the conductors — will strike the surface charges in the conductors and get diverged into them to potentialize the Drude electrons and "power the power line and its circuits and loads". *All the rest of the giant EM energy flow in space surrounding the conductors, and generally parallel to them, misses that power line entirely and is just wasted.*

Check the original papers by Poynting {4a, 4b} and by Heaviside {5a, 5b, 5c}, who independently discovered the flow of EM energy through space (as if continually observed!) in the 1880s, after Maxwell was already dead. I can furnish the citations required. From the beginning, Poynting only considered that component of the energy flow that actually enters the circuit. He considered only the "boundary layer" right on the conductor surfaces, so to speak.

Heaviside considered that component that enters the circuit, and also uncovered and recognized the *gigantic* component in the surrounding space that *does not* enter the circuit but misses it entirely and is wasted. [Added] Here is Heaviside's {106} own statement:

> *"It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire… . Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from*

[37] However, contrary to what is in the textbooks, **E** Δ **H** energy flow is not in observable EM field form **E** and **H** until it interacts with charge. Instead, the flow is in the form of virtual energy currents in the vacuum. We point out that the fields **E** and **H** utilized in the Poynting energy flow theory are effects and not causes. They are rigorously defined as **E** and **H** only after the causal 4-fields have interacted with charge. E.g., **E** is "defined" as force per unit point massive charge — i.e., as the force created by interaction of the "vacuum field" (curvature of spacetime) with a unit point charge. No unit point charge interaction, no force or force field intensity per interacting unit point charge.

> *the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire."* [End of Added].

But Heaviside had absolutely no explanation for the enormous and startling magnitude of this energy flow that "misses the surface charges of the conductors and is wasted". You can see an elementary illustration of the "point intensity" of this Poynting diverged energy flow component in Kraus {107}. Kraus's figure 12-59, p. 576 shows a good drawing of the *Poynting* component *being withdrawn* from the total EM energy flow filling all space around the conductors [see our Figure 1-1 in the present chapter].[38] Most of that available energy flow is not intercepted and thus not diverged into the circuit to power it, but just "wasted." The *remaining* huge component discovered by Heaviside is not shown on Kraus's diagram. Kraus's numbers on the contours represent the amount of power (watts per sq meter) being withdrawn from each contour, by the very limited axial movement of the electrons and the very ends of their associated fields into the wire.[39]

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[38] The energy flow in space near the surface of the wires strikes the surface electrons and their fields, potentializing them and creating a force field with respect to inner electrons. This drives the surface electrons axially into the wire, since they can only move down the wire with the drift velocity, nominally on the order of a few inches per hour. The short inwards drawing of those small portions of the fields and of the increased potentials attached to the charges that move into the wires, interacts with the internal charges in the interior of the wire, powering the Drude electrons throughout the conductor and the circuit. For a discussion of the importance of the surface charges, see J. D. Jackson, "Surface charges on circuit wires and resistors play three roles," *Am. J. Phys.*, 64(7), July 1996, p. 855-870.

[39] Obviously the increased fields on the withdrawing surface charges reach toward infinity radially outward from the wire. Thus most of this increased field on a withdrawing electron remains outside the wire, radially reaching toward infinity, since the electron and its field cannot be withdrawn further than the diameter of the wire. As the surface charges and their fields change in Jackson's discussion, obviously those distant parts of the field remain outside the conductors. Hence there remains an extensive field and field energy outside the conductors and the circuits

So Heaviside {106} spoke cautiously of the *angles* and *relative directions* of the flow components; he did not wish to be scientifically destroyed for pointing out such an inexplicably large EM energy flow, far larger than the known energy input to the generator. There was then no such thing yet discovered as the electron, the atom, the nucleus, special relativity, general relativity, quantum mechanics, the active vacuum, etc. Poynting {4a, 4b} never even thought of the "nondiverged component that misses the circuit", nor did he consider it.

Lorentz, however, understood the extra Heaviside component and its vast magnitude, but he also could not explain it in any fashion. Even the great Lorentz could not risk publishing or advocating such an enormous energy flow, lest he be called a "perpetual motion nut" and destroyed. So he reasoned that, since that stupendous nondiverged energy flow component misses the circuit and powers nothing, it has "no physical significance" (his words).

Jackson in his famous 1975 *Classical Electrodynamics*, 2nd edition, uses essentially the same phrase {108a} as did Lorentz. And so do most other electrodynamicists.

So Lorentz {109} originated a little trick of integrating the energy flow vector itself around a closed surface surrounding any volume element of interest. Obviously, that zeros all *nondiverging* EM energy flows — including precisely that inexplicable and enormous Heaviside "dark energy" component. The integration trick does retain that small, *diverged* Poynting component that enters the circuit. In addition, our instruments measure energy dissipation from the circuit, and the energy has to *enter* the circuit to *be dissipated* from it. So our instruments and their measurements will indeed agree with the Poynting energy flow component. Lorentz thus arbitrarily discarded accountability of trillions of times as much EM energy flow as was retained and accounted.

In a later book by Lorentz, one can see that little trick {109} that is still used by electrodynamicists {110}.

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that is never drawn into the wire. Additional separate receiver circuits with resistive loads, adroitly placed in this "externally remaining" field energy flow, can be made to intercept additional EM energy and will perform additional work in those external loads in the secondary circuits, separate from powering the loads in the primary circuit.

The Lorentz trick does not cancel the *actual* flow of the Heaviside dark energy component around every circuit! It just drops it from any accountability.

Indeed, we do precisely a similar thing for the "field" and the "potential". There is not a single text in the U.S. that calculates the magnitude of the *field itself*, prior to point interaction. Instead, we are taught to calculate the reaction of that field at a point in it, with a unit point static charge at that point. In short, we calculate *what is actually locally diverged from the field or potential by that little point static unit charge*, and call it "the magnitude of the field". At best, it is indicative of the field intensity at a point, because we have prescribed the magnitude of the static point charge's *reaction cross section* with the field, *not* the overall magnitude of the entire field itself. Another major non sequitur! By identifying the "field" as "that which is diverged from it", we gravely err. We do the same for the potential, again using its reaction cross section for a unit point charge at a point in the potential.

There is hardly a living electrodynamicist, it seems, who has calculated the magnitude of the field itself, or of the potential itself! All calculate the respective reaction cross section (and the *static* reaction cross section at that!) and erroneously call that the "magnitude of the field" or the "magnitude of the potential". It is no such thing. No thing filling all space is identical to a little something diverted from one point in itself, else we discard all logic.

Now we can return to our source dipole and its extraction of an *enormous* energy flow from the vacuum, once we account for the long-neglected (for more than a century) Heaviside dark (nondiverged, unaccounted) energy flow component. That is the essence of one of my papers {111}.

The easiest thing in the world to do is to extract enormous usable EM energy flow from the vacuum, *from the time domain*. Every circuit and every electrical power system already does it, and every electrical power system is powered by vacuum energy, *not* by burning all that coal, oil, etc. None of that does anything to actually power the circuit. It only makes dipoles.

If you will check the characteristics of the ubiquitous closed current loop circuit, you will discover a diabolical thing: that closed current loop circuit forces all the spent (depotentialized) electrons from the ground return line back through the source dipole (back through the back emf). It is easily shown that precisely half the energy *collected* in the circuit from that feeble Poynting energy flow component is then used to perform work on

those dipole charges and scatter them, thereby destroying the source dipole and abruptly shutting off all energy extraction from the vacuum. The other half of the collected Poynting energy is dissipated in the external loads and losses. That means that half the collected Poynting energy is used to kill the source dipole, and less than half is used to power the loads {112}.

Well, we must input at least as much energy (assuming a 100% efficient generator with no losses) to the shaft of the generator to *restore* the dipole, as was used to *destroy* it. This means we shall always have to input *more* energy to the generator shaft, than we get dissipated in the loads.

That is precisely what is responsible for our ubiquitous COP<1.0 systems. *COP* is Coefficient of Performance, and is the average load power output in the external circuit divided by the average shaft power we pay to input to the generator.

COP < 1.0 comes from (i) the ubiquitous usage of the closed-current-loop circuit, and (ii) the prevailing notion that electrical power systems far from equilibrium in their energetic exchange with the active vacuum are impossible to build. In fact, every electrical power system is *already* just such a COP > 1.0 system, as far as the energy flow out of the generator or battery — compared to the shaft input energy to the generator or battery — is concerned.

As is well-known in the thermodynamics of open systems far from equilibrium with their active environment (in this case, the active vacuum), such a system is permitted to: (1) self-organize, (2) self-oscillate or self-rotate, (3) output more energy than the operator himself must input to the system (the excess energy being freely received from the active environment, in this case the active vacuum), (4) power itself and its loads simultaneously (all the energy being freely received from the active environment, in this case the active vacuum), and (5) exhibit negentropy.

But by designing all our systems so that they use more of their collected energy from the vacuum to kill their source dipoles than they use to power their loads, we have foolishly wasted the planet's resources, vastly overcharged the consumer, artificially created a great energy crisis, fomented wars for precious oil and other energy resources, polluted the planet, enhanced global warming, and strangled species.

In short, we pay the power company to have a giant wrestling match inside its generators and lose! And we pay our electrical engineers to keep designing and building such asinine systems!

This sad state of affairs is what is now upon us as a great and increasing energy crisis, polluting and destroying the biosphere, etc. and threatening to eventually collapse the world economy.

It is astounding that, since the basis for the above has been in physics for nearly a century (Whittaker decomposition) and for nearly a half century (broken 3-symmetry of the source dipole, as well as the active vacuum), the hoary old classical EM model has not been updated to incorporate what has already been proven in particle physics. Such is inexplicable and unconscionable.

It is also astounding that no electrical engineer realizes that energy extracted from the vacuum powers every electrical power system, and few if any professors are aware of it either.

This is where your cogent realization of the terrible non sequitur in that atrocious "wave in 3-space" standard diagram leads.

Our AIAS (Alpha Foundation's Institute for Advanced Study) advanced theorists now have a series of papers published in the hard literature pointing out the feasibility of extracting EM energy from the vacuum {113a, 113b}. About 20 other AIAS papers along such lines or related have been submitted to the various journals and are in the referee process.

I just wanted to contact you informally and, for your personal information, show you how perceptive and correct your objection to that atrocious diagram is. You have lifted the corner of the veil on electrodynamics' confusion between effect and cause, with effect being widely used as the cause. The entire notion of a "separate force" acting on a "separate mass" in mechanics is also a non sequitur. If we define force as $F \sum \in / \in t(mv)$, then we see that mass is a *component* of force! So here is another major and uncorrected non sequitur. This one was also largely responsible for the dichotomy of the field concept, where the "same field" is used in both a force (mass-containing) manner and a force-free (without mass) manner, as if the two were the same!

I very much enjoyed your editorial, and would urge you to publish additional material along that same vein. You are striking at the very heart of the problem, and every bit of insight and change in those terrible non sequiturs will result in enormous progress in electrodynamics and physics.

Sincerely,

Tom Bearden, Ph.D.

Lt. Col., U.S. Army (Retired)
Director, Association of Distinguished American Scientists
Fellow Emeritus, Alpha Foundation's Institute for Advanced Study

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Chapter 2

Background and Concepts

"[Hypotheses made without realizing that they are being made] ...are what Poincare has called "unconscious" or "natural" hypotheses — a type which one hardly ever challenges, for it seems too unlikely that we could make progress without them. Nevertheless it should be the endeavor of the physicist always to drag them out into the light of day, so that it may be perfectly clear what we are actually doing." [Lindsay and Margenau] {114}

"Equilibrium states are the only ones that are capable of explicit analysis in thermodynamics... " [Lindsay and Margenau] {115}

"Non-equilibrium conditions cannot be specified by variables of state, and their entropy cannot be computed. ...the condition of equilibrium is the condition of maximum entropy. " [Lindsay and Margenau] {116}

2.1 Comments on the Foundations of Classical Electrodynamics

2.1.1 Faraday, Maxwell, Quaternions, and Heaviside

For our purposes, we start with the important experiments of Faraday {117}, which produced experimental integration of electricity and magnetics {118}. Faraday's own work contained very little mathematics, and so he himself did not capture his own seminal experimental work in adequate theoretical fashion. That task was undertaken by James Clerk Maxwell {119a, 119b}, who deliberately set about to capture Faraday's results in a proper mathematical theory, using quaternion-like and vector expressions. Of the quaternion algebra, Maxwell had this to say {120}:

"...the virtue of the 4nions lies not so much as yet in solving hard questions as in enabling us to see the meaning of the question and its solutions. "

Quaternion algebra {121a, 121b} is an advanced algebra created by William Rowan Hamilton, brilliant Irish mathematician. Hamilton was widely regarded as a "new Newton" by his peers. Hamilton coined the word "vector", wrote two books on quaternions, and hoped the books would find extensive use in physics. Vectors and tensors later came to suffice for most problems of that day, and so quaternions faded to the background.

Hamilton also grasped the importance of a science of time, and realized that such a science was possible. E.g., in 1837 Hamilton stated:

> *"The notion oftime may he unfolded into an independent pure science... a science ofpure time is possible."*

In that statement, Hamilton anticipated that a physics model can be comprised using only a single fundamental unit, and that unit could be the second.

In the early 1890s, quaternions in electrodynamics were discarded in a short "debate", mostly in the journal *Nature*, and vector electromagnetics was adopted. So Maxwell's 20 quaternion equations {20} in some 20 unknowns contain a wealth of electrodynamics {122} that is not included in Heaviside's {123} later vector curtailment after Maxwell's death, or in the modern tensor formulation. As an example, Nikola Tesla's patented circuits cannot be properly understood in either a vector EM or tensor EM analysis. However, very novel functions performed in them can be seen in a quaternion EM analysis, as has been clearly shown by Barrett {124}. Any electrodynamicist, who has looked at Tesla's work only in terms of tensor or vector classical electrodynamics, has no concept of what Tesla was actually doing. Since that is precisely how most academics have examined Tesla's work, they have had little idea of the functions he was actually able to accomplish in circuits — functions that U.S. electrical engineering departments still cannot perform.

Along with other electrodynamicists at the time, Faraday and Maxwell believed in a material ether — a thin material fluid filling all space. Hence there was thought to be no point in the universe that was devoid of mass. For that reason, the EM field conceived in mass and the EM field conceived in "space" — actually, in the "luminiferous ether" thought to fill all space — were identically force fields and material entities, at least in the minds of the electrodynamicists at the time. The equations of Maxwell, the later truncation by Heaviside and others, and the final truncation by Lorentz are all still material fluid flow models. They still assume the material luminiferous ether, more than a century after its falsification.

See again Figure 1-3 in Chapter 1. Contrary to the conventional view, force is not a fundamental causative entity, but is a system of two coupled entities. It involves a nonobservable, dynamic, causative 4-space entity (which may be modeled as a curvature of spacetime) interacting with a previous "frozen" observable (a 3-space mass). The output of this interaction is another observable (i.e., a change to the previous observable or an iterative output of its replica). Observables do not continuously exist, but continually recur as continual outputs of the iterative observation process (photon interaction).

Mass is a *component* of force, as is apparent if we define force F as F==d/dt(mv), which gives F = m(dv/dt) + v(dm/dt). Both terms on the right of the expansion contain mass; hence force F contains mass as a *component*. Both terms on the right also contain nonmass terms; hence force F also contains nonmass coupled to and interacting with mass. So there can be a force generated by a nonmassive non-force entity in spacetime interacting with a mass, and the force only exists when that interaction is ongoing. The ether was erroneously considered to be a material system, containing mass, and hence capable of supporting a force. Maxwell modeled his fields (in what we know today to be mass-free space) as material force fields in the material ether.

In the 1880s, the Michelson-Morley experiments {125a-125d} destroyed the material ether. However, the fundamental Maxwell-Heaviside equations *assuming* those material force fields in the vacuum — which depended on the notion of a material ether and are a function of it — have never been altered, even to this day. Instead, electrodynamicists just assume the force "somehow" goes to zero in the field in space, but the same field remains. The equations still assume the same old material ether.

This is a non sequitur; a *force* field cannot be the same as a force-free *non-force* field. As an example, the EM force field in observable matter is an output of observation. It is therefore a *3-space effect containing mass.* The force-free field in mass-free spacetime (4-space) is a causal 4-space component of massless spacetime. *A priori,* it exists prior to interacting with the charged mass. It contains no observable mass and hence no force since mass is a necessary component of force. It independently exists without the presence of the charged mass at all.

In short, the field in massless spacetime is a specialized curvature (changed region) of that spacetime. *Spacetime consists of spacetime,* to slate a tautology. Once one fixes the concept of the medium, then any changes to the medium can only consist of "medium-stuff. So any

"changes" in spacetime can only be changes of 4-space itself, in the Einstein general relativity sense. This area is handled quite well by Sachs' unified field theory {126a, 126b}, extending and completing the work of Einstein.

Sachs' epochal theory provides a great generalization of general relativity and electrodynamics reaching from the quarks and gluons to the entire universe. Further, Evans' extension of electrodynamics into a higher 0(3) group symmetry turns out to be demonstrably a special subset of Sachs' electrodynamics.[40] Hence, for the first time, an *electromagnetically* engineerable unified field theory is available. Much of general relativity, quantum mechanics, etc. can be engineered directly by Evans' electrodynamics subset of Sachs' overall unified field theory. I am much indebted to Evans {127} for the following statement with respect to O(3) electrodynamics:

> *"In 1992 it was shown (Physica B. 192, 227, 237 (1992)] that there exists a longitudinal component of free space electromagnetism, a component which is phaseless and propagates with the transverse components. Later this was developed into a Yang-Mills theory of electromagnetism with O(3) Lagrangian symmetry. This theory is homomorphic with Barrett's SU(2) electrodynamics and has far reaching implications in field theory in general. Recently it has been recognized to be a sub theory of the Sachs theory of electromagnetism, based on the irreducible representations of the Einstein group of general relativity.[41] The Sachs theory produces a non-Abelian structure for the electromagnetic field tensor. The O(3) electromagnetism also has implications for the* ***potential*** *ability of extracting energy from the vacuum,* ***and its*** *topological implications are currently being* ***investigated*** *by Ranada. The O(3) electromagnetism has* ***been tested*** *extensively against empirical data, and succeeds* ***in*** *describing interferometric effects and*

[40] E.g., see M. W. Evans, "The Link Between the Sachs and 0(3) Theories of Electrodynamics," in M. W. Evans (Ed.), *Modern Nonlinear Optics,* Second Edition, Wiley, 2001, part 2, p. 469-494.

41 Evans et al, "Derivation of 0(3) Electrodynamics from the Irreducible Representations of the Einstein Group," *Found. Phys. Lett.,* 15(2), Apr. 2002, p. 179-

physical optical effects where the conventional Maxwell-Heaviside theory fails. Implicit in both the O(3) and Sachs theories of electromagnetism is the ability to extract electromagnetic energy from curved space-time. Working devices based on this ability would help solve the current energy crisis."

2.1.2 Mass Is a Component of Force

The dichotomy of using the field concept in two mutually contradictory fashions as something massless and also as something massive — still unresolved in electrodynamics — is clearly summarized by Jackson's important statement {128} of the prevailing view:

> *"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable quantities such as force somehow involve the product of charge and field."*

In trying to rationalize the "massive field versus massless field" dichotomy, Jackson {129} also states:

> *"...the thing that eventually gets measured is a force..."*
> *"At the moment, the electric field can be defined as the force per unit charge acting at a given point."*

Actually, field is not force, so cannot be force per unit charge. Field *produces* force when it interacts upon charge. *Causing* something as an effect, but then *being* that same effect identically, is a confusion of cause and effect and a non sequitur.

We point out that spacetime is charged, but with *observably massless* (virtual) charge. So the field in spacetime is observably massless and therefore observably force-free. That massless field then interacts with an observable massive charge in the "observable" world, to create an observable force and an observable forcefield. In space, from a quantum mechanical view we may consider the field to have *virtual* force x time, since the field may be regarded as a curvature of spacetime acting upon the *virtual* charged masses in the ever-bubbling *virtual particle fluctuations* of the vacuum permitted by the Heisenberg uncertainty principle. Nonetheless, that is only the "potentiality" for an observable force, as pointed out by Feynman and Wheeler, should the field — including its interactions with the virtual charges of the vacuum to produce forces and

accelerations on those virtual particles — interact upon an observable charged mass.

Obviously, the force-free field as a product of spacetime curvature and massless (virtual) charge, and the force field as a product of *that* observably force-free field but virtual force field (in the vacuum) with observable charged mass, cannot be the same thing. Assuming they are the same assumes an oxymoron, and confuses cause and effect. This illustrates the continuing dreadful foundations difficulties propagated in classical electrodynamics.

To resolve these EM foundations difficulties so long maintained and cherished as dogma, the scientific community at the highest priority should (1) fund extensive and rapid work by our very best theoreticians and foundations physicists to heal these century-old festering sores, (2) extend electrodynamics back to a higher group symmetry theory, as in O(3) EM theory for example, and (3) provide a rigorous dictionary of science foundations concepts and terms which does contain valid definitions and full discussions — clearing misdefinitions and disinformation now notable in the electrodynamics literature.

Nobelist Feynman, co-founder of quantum electrodynamics, was careful to state the notion of the field in mass-free space very differently. Quoting Feynman {130}:

> *"...the existence of the positive charge, in some sense, distorts, or creates a "condition" in space, so that when we put the negative charge in, it feels a force. This potentiality for producing a force is called an <u>electric</u> field."*

Feynman's imagery clearly invokes a "distortion condition in spacetime" {131}, eventually coupled to a charged mass and interacting with it — and *then* one has a force and a force field. He erred in still somewhat making the force separate from the charged mass, in the phrase "it feels a force" — which ignores the fact that the mass of the interacting charge is a *component* of the force, not separate from it and not "feeling it as a separate external thing". He pointed out that the field in spacetime represents only the *potential for* a force field, *if a* charge should be placed there. And he points out that the field is a "condition in space" — in the full sense, a condition in spacetime.

We comment that, in a sense, spacetime and vacuum may be considered one and the same. Vacuum contains many fluctuations and virtual state

dynamics, all of which are curvatures of spacetime or produce curvatures of spacetime. Vacuum has energy density, and is therefore a potential. This energy density has dynamics, so the ambient vacuum potential has dynamics, and so therefore does spacetime {132}.

However, a dynamic of the potential is precisely what a field *is*. It follows that dynamics of spacetime are what fields are. So fields (as force-free entities in spacetime) may be taken more accurately as the dynamics of the vacuum-spacetime, or as dynamics of the ambient vacuum-spacetime potential, or as dynamics of the ambient curvature of spacetime.

Again quoting Feynman {133}:

> *"We may think of E(x, y, z, t) and B(x, y, z, t) as giving the forces that <u>would be</u> experienced at the time t by a charge located at (x, y, z), <u>with the condition</u> that placing the charge there <u>did not disturb</u> the positions or motion of all the other charges responsible for the fields."*

Here Feynman very clearly shows that E and B involve functions of spacetime *(x, y, z, t)* only, prior to interaction, but do not physically exist until interaction with charge has occurred. But he has not quite yet completely eliminated the "force field" as a separate force acting on the charged matter independently. This centuries-old fundamental mistake in mechanics — that force is independent of and external to mass — has simply been propagated into electrodynamics, without correction. Physicists such as Feynman and Wheeler have been trying very hard to correct it.

The observed/measured force field is an output of observation, and observation is a *d/dt* operator imposed upon spacetime LLLT. All observables are 3-spatial, and any observation is an instantly frozen "3-space snapshot" at a single point in time. A single observation has no temporal existence *a priori*, since it is only an instantaneous 3-space snapshot existing at one moment only. Hence an observable — being 3-spatial and frozen — does not persist *as such* in time. Indeed, the next instant after an observation, that particular snapshot does not exist any more. [Refer again to Figure 1-3 in Chapter 1].

2.1.3 Mechanism for the Flow of Time and Related Matters

It is well recognized that the nature of time is itself an unresolved

question. For our purposes, we are interested in the energetics[42] approach. So we apply that approach to arrive at a mechanism generating the "flow of an object through time". First we will choose our fundamental units.

2.1.3.1 *Getting Creative with Fundamental Units*

In physics, the choice of fundamental units one chooses for one's model is arbitrary. Usually mass, length, time, and charge are used, but a perfectly valid model can be generated using only a single fundamental unit.

This is well known to modern physicists and leading electrodynamicists, but sometimes comes as a shock to electrical engineers! Jackson {134} expresses it very succinctly: Quoting:

> *"For example, theoretical physicists active in relativistic quantum field theory and the theory of elementary particles find it convenient to* ***choose*** *the universal constants such as Planck's quantum of action and the velocity of light in vacuum to be dimensionless and of* ***unit magnitude.*** *The resulting system of units (called 'natural' units) has only* ***one*** *basic unit, customarily chosen to be length. All quantities, whether length or time or force or energy, etc., are expressed in terms of this one unit and have dimensions which are powers of its dimension. There is nothing contrived or less fundamental about such a system than one involving the meter, the kilogram, and the second as basic units. It is merely a matter of convenience."*

So let us consider what happens if we use the joule as the single fundamental unit for a model of physics. Then each of the entities "mass", "length", "time," and "charge" will become totally a function of energy. Since the dawn of relativity and the nuclear age, the notion that "mass is energy" is no problem, and everyone is familiar with Einstein's $E = mc^2$. Solving for m in that expression, one realizes that spatial energy E has been compressed by the factor c^2, to yield what is called "mass m". More rigorously, compressing the 3-space energy by the factor c , *and then leaving it in 3-space,* produces what we call "mass". However, if we

[42] **Energetics** is an **old term from the early birthing** days of electrodynamics. Russian scientists resurrected **the term to cover their use of an** expanded electrodynamics in a unified field-engineering **manner, particularly in new** superweapons developed and tested after WW II and deployed in 1963 and subsequently.

remove it from 3-space and place it over on the fourth Minkowski axis *ict*, it becomes what we call "time" because *t* is the only variable in *ict*. Hence time has or can have similar energy density to mass. Specifically, 1 sec => 9×10^{16} joules of spatial EM energy, when transduced (decompressed) into spatial energy by a transducing charge.

In our new model using only the joule for our fundamental unit, we can also legitimately state that "time is energy", and be rigorously accurate. In that case, we must see what happens to 3-space EM energy when it is shifted to the time domain.

First, we take "EM energy in 3-space" as EM wave energy, in the usual transverse EM wave model (see Figure 1-4 of Chapter 1) of a field entity. We choose, say, the vector E oscillating in the x-direction, and another field entity (say, the vector B) oscillating in the y-direction. If we then rotate each of these vectors into the time axis, then that is an orthogonal rotation for each, which is what the velocity *c* actually is. So we have to do two orthogonal rotations, and the two resulting *c's* multiply to give c^2. With these two orthogonal rotations into the time axis, we have completely rotated the EM field wave energy vectors into the time axis. We have also compressed that EM field energy by c^2.

Hence "time as energy" is just EM spatial energy compressed by the factor c^2, but rotated into the time-axis as "time" rather than remaining in 3-space as "mass". Again, by this second analogy time has the same energy density as mass, but the highly compressed spatial energy has been rotated into the time domain to "produce time" rather than remaining in 3-space to "produce mass" {135}.

This sheds new light upon the scalar (time-polarized) photon of quantum field theory. Note that, prior to compression of the wave energy into time, the magnitude of the electric field *E* in the EM wave was oscillating lengthwise along its x-direction, which means that, with respect to x, it was a longitudinal EM wave. A similar consideration exists for the oscillation of the magnitude of *B* in the y-axis. Along the time-axis, we also have a "time-energy" vector having magnitude, and the magnitude of that time-energy can only vary along the time axis. Oscillating the time energy produces a longitudinal EM wave in the time dimension (on the fourth axis). What is actually varying is the time-density itself. This is a *time-polarized* or *scalar* EM wave, where by use of the term "scalar" we mean that it has no vector component in 3-space. In fact, this variability of time density produces a "galloping motion" in the speed of light itself, which has been recognized {136}.

We have uncovered a direct connection between the time-polarized EM wave (which can only oscillate its time-energy magnitude longitudinally in the time-domain) and the longitudinal EM wave in space. Such waves can only be observed when coupled or paired with an interaction existing between them, very similar to what Mandl and Shaw {167, 168} argue for the time-polarized and longitudinal photons of quantum field theory.

Again see Figure 1-3 in Chapter 1. Any observable is an instantaneous, frozen 3-spatial snapshot (or 3-intersection) of a 4-dimensional ongoing event. "Observation" itself may be taken as a process where a *d/dt* operator is invoked upon 4-space (spacetime), leaving a purely 3-spatial output. However, the resulting observable does not "exist or persist in time", since rigorously it is what was "caught" in only a single, frozen "3-slice" at one single instant, forever fixed.

For that reason, time is not an observable. It cannot be directly observed, even in principle, since *a priori* it is discarded by the observation process itself!

For further work along such lines, we recommend the Sachs unification approach to a combined general relativity, quantum mechanics, and electrodynamics, generalized from a topological standpoint {126a, 126b}. To work electromagnetically in that theoretical approach, we recommend the 0(3) electrodynamics as extended by Evans {137a, 137b}.

2.1.3.2. *The* ***Four Polarizations of*** *Photons* ***and*** *EM Waves*

In quantum field theory, four polarizations of a photon are recognized {138}. These are the *x*-, *y*-, *z*-, and /-polarizations, where *x*-, *y*-, z- and *t*- are assumed as the four dimensions in a 4-space. By agreement, z- is used as the direction of motion of a free photon or an electromagnetic wave. So at least in theory, there must also be four polarizations of electromagnetic waves, even though not all these waves are yet experimentally known.

The *x- and y-* polarizations are the familiar transverse photon and the transverse wave. The z- polarization along the line of propagation gives the longitudinal photon in 3-space and the longitudinal EM wave in 3-space.[43]

[43] Here we are **applying the conventional** model of the "EM wave in space", which is known to be erroneous **but is** in **ubiquitous** usage. See Romer, {84} for a scathing characterization **of that** erroneous model **But here we are stuck with it, so will use it** as "just a model".

2.1.3.3 *Imperfect Longitudinal EM Waves* ***in 3-Space***
When attempting to produce longitudinal EM waves (LWs) in 3-space, from transverse EM waves (TWs) input to some sort of polarization transduction process, only imperfect LWs are produced and a residue of TW content remains. The resulting imperfect LW is referred to as an *undistorted progressive wave* (UPW). Some work has been done on UPWs {139}. UPWs are expected to have remarkable characteristics including wave velocities either slower or faster than *c* {140}.

The *t*- polarization in the time dimension is quite unique: The *spatial* energy overall is in equilibrium and not vibrating at all; instead, the energy of the photon or wave is vibrating in the time domain and therefore exists in the time domain. That is called a "scalar photon" (time-polarized photon). Its wave version does not yet seem to be known in the literature, although in 2000 we uncovered its secret hiding place {12}. It was unexpectedly hiding in Whittaker's {85} decomposition of the scalar potential in 1903, but had been slightly misinterpreted.

2.1.3.4 *Photons and EM Waves Carry* ***Energy and Time***
On the other hand, the concept of "EM waves flowing in 3-space" may be in need of a thorough overhaul {141}. A photon *y* is a "piece of angular momentum" in the form of $y = (dE)(dt)$. Hence the photon carries an increment of spatial energy d*E* and also an increment of time-energy d*t*. The time-energy component (dt) may be regarded as ordinary spatial energy that has been compressed by the factor c^2 {142}.

As can be seen, since *c* represents an orthogonal rotation in n-space, the multiplication or division by *c* and by powers of c changes the dimensionality of an entity, as seen by the observer in the laboratory frame.

So the photon transports two types of energy: (i) a "weak spring" (spatial, decompressed) energy d*E*, so to speak, and (ii) a "very stout spring" (time) energy d*t*, so to speak.

When a mass *m* absorbs a photon $(dE)(dt)$, the (dE) component is compressed spatially by c^2, turning it into an extra amount of mass d*m*, so that the mass becomes $(m + dm)*dt$ the same time, the (dt) component is joined, so that what results is $(m + dm)*dt$. In short, mass *m* is changed to masstime *mt* by photon absorption. So in the absorption of a photon y by a mass *m*, we have

$$y+m \rightarrow (dE)(dt) + m \rightarrow (m + dm)dt$$

In short, the mass *m* turns into masstime *mt*, by absorbing a photon, and masstime *mt* is as different from mass *m* as impulse *Ft* is different from force *F*. We point out that "mass" *m* alone does not even exist in time, but masstime *mt* does exist in time. This is proposed as a simple but fundamental correction to much of present physics. Further, the state "mt" is an excited, time-charged state, excited by very dense time-energy.

For the simplest case, in the next instant the excited state *mt* decays and a photon is re-emitted, and so we have

$$(m + \Delta m)\Delta t \rightarrow (\Delta E)(\Delta t) + m \rightarrow \gamma + m \qquad [12]$$

So emission of a photon changes the excited masstime state (time-charged state) back to mass (uncharged state with respect to time-charging), in the simplest case.

See again Figure 1-3 in Chapter 1. "Observation" and "observable change" are in fact generated by the photon interaction. The total photon interaction with a mass creates the "flow of that mass" through spacetime, macroscopically as seen by the observer and microscopically in myriad streams of virtual time changes. Mass is continually charged to the masstime state, and the masstime state is continually decayed to the mass state. Time flow itself thus has a myriad internal EM energy streams and a vast dynamic EM energy substructure.

The photon itself is not observable, as it exists prior to interaction. It is thus a "causal" entity in 4-space. It *is not* a simple 3-space observed "frozen snapshot" particle! When the causal photon is absorbed, its spatial energy component goes through the c compression function, thus adding a small amount of new mass to the previous mass (previous effect), but simultaneously connecting its d*t* time-tail, so that the slightly increased mass in fact now exists as masstime and not mass. Observation has not been completed at that point.

In the next instant, a photon is re-emitted (from masstime, never from mass!), in the simplest case removing that extra little mass increase and orthogonally rotating it back into 3-spatial EM energy, coupling that spatial energy increment d*E* to that "time-tail" d*t* and tearing it away as the photon is re-emitted. That leaves behind a frozen 3-space snapshot of the mass (the interacting particle) and completes the "observation". In the simple case, this is a replica of the previous particle (frozen 3-space snapshot) with which the causal photon interacted. So this process accounts for the so-called "persistence in time" of an object or mass, as seen by the observer's continual recall process accompanying his stream of

iterative observations. Mass does not *continuously exist* in time, but *continually recurs* in time.

As is well known, what we call "observable" change must involve the expression in equation [13] in the fashion discussed and with the observation mechanism given.

We first pointed out the preceding mechanism for the "flow of a mass through time" in 1971, as a graduate student at Georgia Institute of Technology, and later published it in a crude paper {143} in 1973. It still needs a far more thorough theoretical treatment, which perhaps some graduate student will take up as the subject of his or her doctoral thesis.

2.1.3.5 *Photon Interaction:* *Mechanism Generating Flow Through Time*
See Figure 2-1. Mass does not really "travel through time" continuously *per se,* but proceeds with an overall serial change mechanism as

$$m \rightarrow (mt) \rightarrow m \rightarrow (mt) \rightarrow m \rightarrow \ldots \qquad [14a]$$

where *(mt)* symbolizes a nonobservable ongoing "coupled" interaction state prior to observation completion. Equation [14a] represents the results of the continual photon interaction process, observation process, and "flow of a mass through time" process, at the highest single-photon interaction or quantum change level, and as "seen" or measured by the external observer.

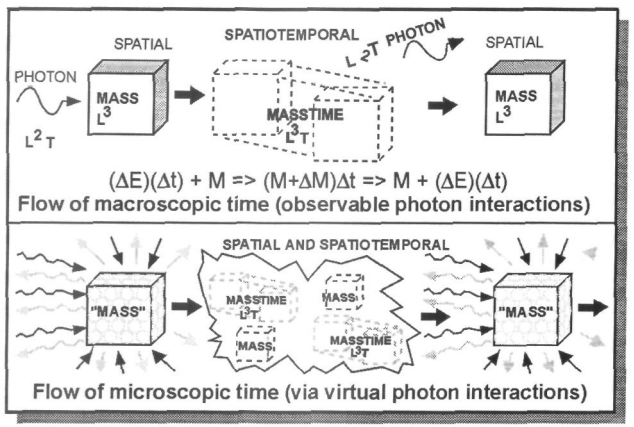

Figure 2-1 Mechanism for the flow of a mass through time.

Also, in that overall quantum level "flow" there are anyt number of ongoing streams and "sublevels" in the underlying subquantum level (in the virtual vacuum and in its virtual photon interaction with observable

mass). We might write one of these "internal time-stream interaction flow substructures" as:

$$(\delta m) \rightarrow (\delta mt) \rightarrow (\delta m) \rightarrow (\delta mt) \rightarrow (\delta m) \rightarrow \qquad [14b]$$

In equation [14b] we have used parentheses, because all terms individually are nonobservable. We hypothesize that each stream continues until one of its terms participates in a summation which eliminates it by enfolding it into another interaction.

When a mass is observed as in [14a], a photon has been emitted (we observe the mass as the "effect" remaining). Time has been stripped away by the resulting *d/dt* operation, leaving a frozen 3-spatial snapshot, which we will see as (having been) a particle (simplest case). That occurs just after major ("observable") photon emission from the masstime state {144}. Immediately another observable photon is absorbed, and so state *mt* occurs. The particle of mass actually oscillates at a very high rate between the *m* and *mt* states — so high a rate that by arranging the interaction conditions one may interact with it either as a wave (react predominantly in the *mt* state) or as a corpuscle (react predominately in the *m* state).

Hence we propose that the process in [14a] may account for the duality of particle and wave.

2.1.3.6 *The Overall Flow of Time Has an Internal Dynamic Structure*
During the transition in any mass to masstime state by reaction of the mass with an "observable" photon, a myriad of fleeting virtual photon interactions involving very tiny *(dE) (dt)* components occurs with the mass *m.* These tinier increments of time, and their increments of energy, constitute internal structures in the time flow process. Therefore they may be considered as "energy currents" or "time-like energy currents" and dynamic structures or streams inside the flow of time. This is particularly straightforward if we use a model having only a single fundamental unit, the joule. In that case, time is energy, and we are speaking of energy flow and its constituent internal structures of energy flow.

So the d*t* component of masstime at the observable-photon action level has a myriad of energy-time structured dynamics infolded within it. Hence the *mt* state is very dynamic in time, particularly for fundamental particles. The *mt* state is in fact a "collection of time-energy dynamics" and therefore "wavelike".

See again Figure 2-1. A major point is that ***mass*** does not emit a photon; *masstime* does. Mass "travels through time" by an extremely high oscillation between corpuscle-like state *m* and wavelike state *mt,* and with

a vast internal "dynamic streams" of other such high oscillations between corpuscle-like *m* states and wavelike *mt* states.

The concept can be very much extended, of course, but this suffices for our concept of energy currents in time, the interaction of such energy currents with mass in a mass system, and the internal dynamic structuring of the "flow of time".

This internal structuring is important in the event of *"time-energy" charging.* There the internal structure of time has experimental consequences. We will discuss those consequences in later chapters.

2.1.4 The Ubiquitous Substitution **of** Effect **for** Cause

See Figure 1-3. To repeat, no observable exists or persists *as such* in time. An observable *as such* only exists at all when time has been momentarily stopped. It then quickly changes into (observable x time) form, for a time interval after a photon absorption. Then it changes again to observable form by photon emission and the corresponding *d/dt* differentiation imposed by that photon emission.

What happens when we think we see an "observable moving through space" is that we make or suppose a continual series of very fast *d/dt* 3-spatial snapshot observations, one after the other in serial fashion (much like the individual frames of a motion picture film). For more than a million years, human brain and mind processing have "always interpreted" this serial set of iterative operations occurring in the eyes and in the physical senses — and continually recalled and processed by the mind — as an "observable persisting in time", which it is not.

This age-old "natural" and inbred, instinctual *mental practice* and assumption by humans — and therefore by scientists — has provided a major problem in physics and especially in electrodynamics. It has resulted in the substitution of the "effect" for the cause in a great number of models. Even a rapid and continual series of 3-space effects after reaction of an observable (frozen snapshot) with a 4-space causal entity, does not and cannot constitute that 4-space entity which interacts with the previous "frozen snapshot" observable and causes the resulting "comparative change or sameness" of the new observable with the former. Hence, e.g., Romer's scathing condemnation {84} of the conventional drawing of an "EM wave in space".

In general relativity, it is straightforward. The curvature of spacetime — the cause — is not the mass (the 3-space observable effect) that is further changed or created again in the ongoing interaction, as seen in the "next

3-space snapshot" (next output of observation) when comparing that snapshot to the previous one.[44]

The same non sequitur — unwitting substitution of effect for cause — has existed for hundreds of years in mechanics, for example. There it is strongly passed on in the erroneous old notion of a separate force acting upon a separate mass. *Prior to* the interaction, no "force" exists. *During* the ongoing interaction, force exists because it is the product (interaction) of a "non-force" causal entity (e.g., a field in 4-space, as a certain curvature of spacetime there) and a previous effect (a 3-spatial frozen snapshot called "mass"). The force exists during the interaction and only during the interaction, when both cause and previous effect are coupled (and will produce the new effect at the completion of the next serial *d/dt* operation as a photon is emitted). The force can only exist when the mass (previous effect) is coupled to the cause (the curvature of spacetime), since *a priori* mass is a *component* of force {145}, and curved spacetime is another *component* of it. After the interaction "ends" in a new *d/dt* observation, the mind compares the new effect with the former, to determine whether there is a "change" or a replica (sameness). This comparison of the new observation (observable) with respect to the former, *occurs in the brain and mind processing*, and gives the sense of "persistence of an object in time" as well as of an object "changing in time".

So a great faux pas in physics — and especially in electrodynamics — is this widespread substitution of the effect for the cause. Understanding this non sequitur clearly, and correcting it, is a prerequisite to understanding the principles and concepts of legitimate COP>1.0 Maxwellian systems. Also, if we would ever hope to adequately correct electrodynamics, this tremendous faux pas must be recognized and rooted out of the model. Indeed, the same is true for mechanics and other branches of physics.

2.1.5 Some Additional Foundations Non Sequiturs

Another gross non sequitur is made in calculating the amount of EM energy flow continually being diverged around an intercepting unit static charge at a point in space, from a potential in which that point is located, and then calling this "local intensity" of the collecting interaction the "magnitude of the potential" itself.

[44] Rigorously, if one wishes to connect spacetime and mass, spacetime can be interpreted in *masstime* units, but not ***mass*** units And vice versa. Again, masstime *mt* is as different from mass *m* as impulse Ft is **different** from force *F*.

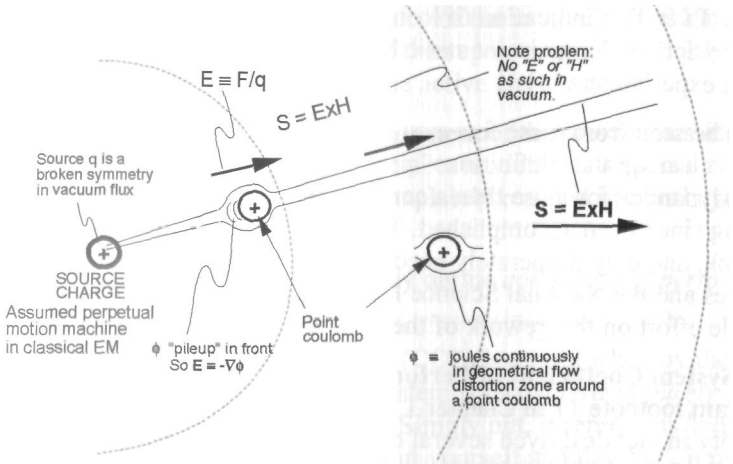

Figure 2-2 Field and potential are defined in terms of the diversions from them around a unit point static charge assumed at any spatial point

(See Figure 2-2). At best, it is a measure of the *local intensity of the diversion of energy flow from* the "bidirectional" EM longitudinal waves comprising a potential, as they are diverged around the unit point static charge. It is not the magnitude of the entire potential, filling all space, nor does it prescribe the spatial energy magnitude of that entire potential {146}. It is a small energy flow, *diverted* by an assumed standard fixed charge at a single point in the potential, from the overall energy flows comprising the potential. Calling this little "diversion of a bit of energy" the magnitude of the potential is rather like calling a little whirlpool in a river the "magnitude of the river". Or more exactly, it is like calling the amount of little "swirl diversion of a river's flow" around a standard small fixed rock the "magnitude of the river".

A similar non sequitur exists in the usual calculation of the "field" magnitude at a point, which is not the "entire field entity itself at all. It is merely what is *diverged from* the "field as it exists in spacetime" at a single point in it, by an assumed fixed standard point charge at that point that is interacting with the field. The field takes into account the patterning of the diverged flow, e.g., the difference in potential (difference in

pressure) across the unit point charge. That is not the field itself at all, and the textbooks and dictionaries of physics are completely wrong in calling it such. Again, at best, it is an indication of *the field intensity* at that point, and the reaction cross section of the field to an assumed unit point static charge. Even that indication of local intensity of the field will change if the intercepting charge is not static but is in resonance, as shown by the Bohren experiment {24}.[45]

As can be seen from these few examples, a great deal of work needs to be done to clean up the "definitions" promulgated in physics and electrodynamics for more than a century. It is inexplicable[46] that this has not long since been accomplished. These errors permeate almost every textbook, and they desperately need correcting. The National Academy of Sciences and the National Science Foundation should fund the best possible effort on this rework of the foundations of physics.

2.1.6 System Coefficient of Performance (COP) and System Efficiency

See again footnote 11 in Chapter 1 and Appendix A. In 1915, general relativity in fact destroyed several of the fundamental definitions (axioms) of classical thermodynamics. It necessitated our correction of some thermodynamical definitions (open system and closed system) and our more rigorous definitions of COP and efficiency advanced below.

Once mass is recognized as energy and the two are just different sides of the same coin, there can be no thermodynamically closed system which passes energy across the system boundary without passing mass across it. Any system changing its rate of flow through time also changes its mass and its energy, and vice versa. Energy has mass characteristics, and any mass system with added or subtracted energy — either kinetic or potential

[45] Many Bohren-type experiments are continually done in nonlinear optical labs in universities and elsewhere. The effect (excess radiation from the medium) is euphemistically called "negative absorption of the medium," "negative resonance absorption of the medium," etc. Such terminology avoids clearly recognizing that more energy is output than the scientists (erroneously) calculate was input. Bohren faced the issue head-on, and clearly stated that more energy was output than was input (or than was thought to be input).

[46] A true pessimist might point out that it may be quite understandable, considering that it solidly blocks COP>1.0 EM electrical power systems and electro-gravitational anti-gravity systems from being developed by our universities, which would solve the energy and transportation crises forever. Thereby it also keeps about $1.5 to 2 trillion a year pouring into the coffers of controlling financial groups behind many great interlocking corporations.

— will also change its mass relativistically as well as its other characteristics such as inertia and gravitational attraction. As pointed out by Logunov and Loskutov {635}, in 1917 the new characteristics of general relativity led Hilbert {632} to observe that in general relativity there can be no energy conservation rules of the usual classical kind. This also follows from our consideration of the supersystem with multiple active environments rather than a single active environment.

We have formally destroyed any absoluteness of the present classical thermodynamics, which is just an imperfect model. It is a special case which can be approached but never completely reached in a real dynamic system.

With that in mind, we now more exactly define *coefficient ofperformance* and *efficiency* of a system.

The term "coefficient of performance" (COP) is a ratio whereby the useful energetic output performance of the system is characterized *purely with respect to the operator's energy input.* Simply put, it represents "how much you get for what you have to input yourself and pay for". It does not characterize the performance of the system with respect to the *total energy inputfrom all sources.* For our purpose, in general there are two major ways of expressing this COP:

(a) COP == (work accomplished in the load during a representative time of operation) divided by (energy input by the operator during that representative time of operation). Or for short, COP = (useful work out in the load) + *{operator's* energy input). We stress that there may be other free inputs of energy to the system, in addition to the operator's input, but only the operator's input is accounted in the COP calculation.

(b) COP == (average power out in the load) divided by (average power input by the operator).[47] Again, there may be additional average power inputs that are freely input from the environment, without cost to the operator, but only the *operator's* input is accounted. We stress that "power input" is

[47] This is in standard electrical engineering terminology, which is mangled. For a more precise physics statement of (b), COP == (the average rate at which the system dissipates energy in its load to do useful work) / (the average rate at which the operator must furnish energy to be dissipated as work in the input section of the system to make it operate and do its output work).

another of electrical engineering's misnomers, but we use it here because it is universally used in power system engineering.

For a system such as a transducer, which merely changes the form of the energy in some fashion and does not perform work in an external load (the transducer is its own load), we may express the COP as

a. COP == (effective energy output) / (energy input by the operator). Here we accent that there may be additional energy inputs to the system from the active environment, and these inputs are "free" and are not input by the operator, so they are not accounted in the COP calculation.

b. COP == (average power output) / (average power input by the operator). Again, additional average power inputs may be freely received from the environment, but they are not accounted in the COP calculation.

The "efficiency" E of a system is a ratio less than or equal to 1.0 (or a percentage less than 100%), where E indicates the percentage of the <u>total</u> input energy (from all sources) that is dissipated in the load as useful work. It follows that (7 - E) indicates the percentage of the total input energy that is dissipated in the internal losses in the system, not directly resulting in useful work by the system in its load. So the efficiency E of a system may be expressed as:

a. E == (total work output in the load during a representative operational period) / (total energy input to the system, from all sources, during that period).

b. E == (average power output in the load) / (average energy rate of input to the system, from all sources, during that representative operational period.).

We accent that no system can have an efficiency greater than 100%, for then it would be "creating energy from nothing" {147}. No system can dissipate or convert energy that it does not first receive. The conservation of energy law states that energy can neither be created nor destroyed. This means that *there actually are no energy sources per se, in the sense that the source creates the energy,* even though we use the terms "energy

source" and "source of energy" informally. E.g., Semiz {148} states it this way:

> *"The very expression 'energy source' is actually a misnomer. As is known since the early days of thermodynamics, and formulated as the first law, energy is conserved in any physical process. Since energy cannot be created or destroyed, nothing can be an energy source, or sink. Devices we call energy sources do not create energy, they convert it from a form not suitable for our needs to a form that is suitable, a form we can do work with."*

A medium inefficient system can easily have a COP>1.0, if it receives additional energy from its active environment, and if that extra free energy is sufficient to overcome its internal inefficiency losses. An example is a common windmill, where a very good one may have an efficiency of less than 50% due to friction and drag losses in the gears and wind spillage losses in the blades, etc. Yet the operator himself does not have to input any energy at all, for the windmill to operate continually. In this case, the COP»1.0 and approaches infinity, but the efficiency of the windmill is still less than 50%.

Another example is the home heat pump, which may also have an efficiency of less than 50%. When acting as a refrigerator, its theoretical maximum COP = 8.22 under nominal conditions {149}, and a well-designed 50%-efficient home heat pump will produce COP = 4.0 when conditions are suitable.

On the other hand, if the only net energy input to the system is that energy that the operator inputs, then the COP < 1.0. This is a system in equilibrium with respect to any energy exchange with its external environment — *except* with respect to the energy input by the operator (i.e., with respect to its "fueling" by the operator, so to speak) and with respect to the energy subsequently dissipated in the loads and losses. If the system is 100% efficient (has no internal losses or conversion losses at all), its COP = 1.0. Almost all real systems do have internal losses, so their efficiency is E < 100%. In that case, the system in equilibrium with its environment, and having E < 100%, will also exhibit COP<1.0

irrevocably. Indeed, the same number will give both the efficiency E and the COP, because numerically they are then the same.[48]

For electromagnetic systems, the state of confusion between efficiency E of the system and the COP of the system is due to one fact. *Numerically* the two are always equal in *equilibrium* systems — and the Lorentz regauging condition enforced by the closed current loop circuit self-enforces the equilibrium condition of the system with respect to its active environment. Because electrical engineers usually have zero experience with COP>1.0 electrical systems, they tend to loosely and erroneously use the two terms "efficiency" and "COP" as if they meant the same thing. They do not.

Now suppose that we have an open system, far from equilibrium in its energy exchange with its active environment. Suppose that the system's efficiency E is very poor, so that E = 20%. Now suppose that the environment inputs twice as much energy as does the operator. Let the operator's energy input be E_1. Then the total energy input to the system, from both the operator and the environment, is $3E_1$. The efficiency is only 20%, so the system outputs W, as work in the load, of $W = 0.2(3E_1) = 0.6\ E_1$. The COP of the system is the work out divided by the operator's input, which is $COP = W/E_1$, which is $COP = 0.6\ E_1 / E_1$ which gives COP = 0.6. As can be seen, even though this system receives twice as much additional free energy as what the operator inputs, it is so inefficient that **its COP<1.0.**

Suppose we have a similar system with the same energy inputs from the operator and from the environment, but now the system's efficiency E is E = 90%. Then the total energy input to the system, from both the operator and the environment, is $3E_1$. The efficiency is 90%, so the system outputs W, as work in the load, of $W = 0.9(3E_1) = 2.7\ E_1$. The COP of the system is the work out divided by the operator's input, which is $COP = W/E_1$, which is $COP = 2.7\ E_1 / E_1$, which gives COP = 2.7. As can be seen, a more efficient system in the same energy input situation, now outputs more work than the energy input by the operator. Energy is conserved at all times; the excess energy for the additional work was in fact freely input

[48] We emphasize that COP and efficiency are two quite different concepts, however, even when their numerical values are the same. A 6-foot tall man and a 6-foot tall door have the same number for their **height,** but only a fool would consider them the "same thing".

to the system — which is an "open" system far from equilibrium in its exchange with its active environment.

Thus a system far from equilibrium in its energetic exchange with its active environment, is *permitted* to exhibit COP>1.0 even though its efficiency is always less than 100%. On the other hand, if the system is very inefficient and the energy input from the environment is not too great, the system will still exhibit COP<1.0. But the operator will pay less for his energy costs to operate that inefficient system, than he would pay to operate it if he himself had to furnish all the energy input.

Two cautions are emphasized:

(a) First, electrical engineers use the term "power" to mean "energy flow rate without dissipation or change of form", as well as "energy flow dissipation and change of form rate." This is inexact and unfortunate, but it appears ubiquitously throughout the electrical engineering literature. So we are essentially "stuck with it" for the moment. From a rigorous physics point of view, energy flow without divergence or change has absolutely no power, because power is defined as the rate of change of the form of that energy flow — e.g., the rate of dissipation (scattering) of that energy flow, which in physics is a rate at which work is being performed.

(b) Second, it seems that more than half the engineers and scientists — and many textbook authors — do not clearly understand the difference between COP and efficiency, and often interchange these two terms as if they were the same. They are not at all the same, and a great deal of confusion exists in the casual engineering literature because of using them interchangeably. That is why we have clarified them and given some simple explanatory examples, sufficient for our purpose in this book.

2.1.7 COP>1.0 and the Question of Perpetual Motion

Legitimate scientific researchers attempting to work in open EM systems far from thermodynamic equilibrium are often subjected to rather vicious ad hominem attacks, charging that they are perpetual motion machine addicts and therefore raving lunatics. This of course is not true. We are simply trying to do with Maxwell's "electric fluid" systems what nature already shows us can be done with material fluid systems. We are in fact seeking the equivalent of "electromagnetic heat pump" processes and systems. It is the strident critics who are thoroughly confused and who reveal an immature knowledge of physics and thermodynamics.

As we explained, prior to their Lorentz symmetrical regauging, the Maxwell-Heaviside equations already clearly prescribe and permit COP>1.0 EM systems, including EM power systems. In addition to the present EM systems in equilibrium in their exchange with their active vacuum environment, the non-regauged equations also include Maxwellian systems far from equilibrium in their energetic exchange with an active environment, such as the active vacuum. Classical *equilibrium* thermodynamics — stridently waved as a sacred banner by the critics accusing COP>1.0 researchers of being "perpetual motion nuts" and such EM systems as being "perpetual motion nonsense" — does not even apply to such *disequilibrium* systems! One should simply read the literature of the thermodynamics of such disequilibrium systems {160a-160f}. Or one should read why Prigogine was awarded the Nobel Prize in Chemistry in 1977, for his contributions to such open systems in disequilibrium.

We accent again that, under our new rules where we corrected the thermodynamic definitions of open system and closed system, we are in compliance with general relativity. Further, every EM system must be taken as an open system, since in the supersystem energy (with mass-like changes resulting across the system boundary) is always exchanged between the three supersystem components.

Fortunately there are also rational, reasonable critics such as Angrist {150, 151} where the criticism is properly scientific and not ad hominem, even though still misguided. Usually the rational perpetual motion critic applies the three laws of classical *equilibrium* thermodynamics, to classify "perpetual motion machines" of class 1, 2, and 3 after equilibrium thermodynamics laws 1, 2, and 3. This of itself has no intellectual content for open systems in disequilibrium with their active environment. The classical equilibrium thermodynamics — including laws 1, 2, and 3 interpreted only in terms of the operator's energy input — does not apply to *open systems far from equilibrium* — which are the only systems permitted to exhibit COP>1.0 in the first place. And we insist that all EM systems are open systems far from thermodynamic equilibrium, since every charge is, and all fields and potentials come from those source charges. Indeed, such open disequilibrium systems are *permitted* to violate the laws of classical thermodynamics! As an example, the entropy of such an open disequilibrium system cannot even be computed {152}, and it is less than the entropy of the same system in equilibrium, since the equilibrium state is the state of maximum entropy.

The rational critic then falls upon the horns of a dilemma, by admitting that, yes, such open dissipative systems do exist and do permissibly exhibit

COP>1.0. He then labels these *as, false or fictitious perpetual motion machines* {150, 151}. In short, when such COP>1.0 machines are real and admittedly exist, they are not *"true"* perpetual motion machines but *fictitious* perpetual motion machines. My comment is that they are not perpetual motion machines at all, but permissible disequilibrium machines freely receiving excess energy from their energetic exchange with their active environment. They are no more mysterious than a windmill, a sailboat, a watermill, or a solar cell bank.

One must be precise. A bicycle is a free-energy COP>1.0 machine while going downhill. It is not such at all when going uphill. The difference is that gravitational input of energy aids the bicycle's motion in the downhill case, and opposes it in the uphill case. The active environment gives the system additional energy in one case, and takes energy from the system in the other case. Disequilibrium exchange can cut either way!

It is precisely the EM system far from equilibrium with its active environment — where the environment puts in additional energy — that the serious overunity researcher is seeking. It is a perfectly valid pursuit, even by the standards of the perpetual motion critics, who really should study *both* kinds of thermodynamics, not just *one*. They also should study how Maxwell's equations were curtailed and truncated; one result is that all Maxwellian disequilibrium systems were — and are — discarded *arbitrarily* by the Lorentz symmetrical regauging.

The only criticism one needs to raise vis a vis COP>1.0 and perpetual motion machines is this: If an inert (no hidden internal source) machine receives no net energy from its external active environment, but is in equilibrium in its energetic exchange with that environment,[49] then

[49] Here we quibble again and point out that Lorentz's symmetrical regauging actually does require that the system receive and take on excess EM potential energy from its environment (the active vacuum and the local curved spacetime). However, this excess energy can only be received in the form of two injections of field energy, where the fields are equal and opposite. Hence the energy is "bottled up" as a stress potential, with net zero translation force available to it. Since this stress potential energy cannot translate electrons, it cannot do work in an external load. It merely changes the stress of the system itself. The net result is actually a rotation of the frame in which the system exists, away from the "laboratory frame" of the observer. In short, the Lorentz condition establishes a new "equilibrium condition" for the system, by rotating its frame. It also implies that EM energy is continuously received by the system from both the active vacuum and local curved spacetime, in order to maintain the rotated frame and **the** new equilibrium condition. Further this

classical thermodynamics rigorously applies to it and the machine cannot and will not exhibit COP>1.0. However, all EM systems contain charges, and these are indeed "hidden sources" of EM fields and potentials and their energy. It *rigorously follows that, since they contain hidden energy sources, all EM systems are potentially COP>1.0 systems a priori.* Further, *it follows that some ubiquitous design characteristic of the system itself must prevent the system from achieving COP>1.0, since nature does not prevent it.* That characteristic feature is the ubiquitous closed current loop circuit, directing all spent electrons in the external circuit right back through the source dipole in the generator or other primary power source.

It is indeed mandatory that — if at all possible - the inventor or independent researcher *identify* a legitimate source of environmental energy that his purported COP>1.0 device receives and collects, and how it receives it and then uses it to power the loads. That means he should identify where and how his system violates the Lorentz self-regauging condition imposed by the standard closed current loop circuit. If the inventor himself cannot explain it — and this does happen — then someone else must explain it for him. If the machine works under proper independent test and replication, then criticism that no explanation exists for it in normal physics is of no relevance. It is a spur to the theorist to enlarge his horizons and to find the proper physics that *does* explain it.

We stress that we cited the works of Angrist because his voice is reasoned and he does not stoop to name-calling and ad hominem attacks. He also does point out a historical rash of machines that clearly must comply with classical equilibrium thermodynamics, because they have no discernible or stated extra input of energy from their active environment and have no self-asymmetrical regauging. When such machines have no external free input of energy from their active environment, they are systems in equilibrium with their active environment, and cannot exhibit COP> 1.0 — exactly as pointed out by Angrist. With such a reasoned critic, a scientific dialog is possible, and his main thrust — that no *equilibrium* system can exhibit COP>1.0 — is quite valid. With the vehement critic, it is already a cur dog fight from the outset and there can be no scientific discussion at all.

The only contention one has with a rational critic, whose criticism is based on classical thermodynamics, is when he then generalizes that *all* EM

continuous input of two energy flows, equal and opposite, does continuous internal work on the Maxwellian system to increase and maintain its stress.

systems fall within this class. That conclusion is a non sequitur, and ignores the entire science of disequilibrium thermodynamics and a vast body of scientific literature and scientific experiments in electrodynamics. When stated for electrodynamic systems, it also ignores the actual documented history of electrodynamics, and ignores Lorentz's *arbitrary discard, from all accountability,* of the Heaviside giant nondiverged energy flow component accompanying every circuit and system. It also ignores Lorenz's and then Lorentz's symmetrical regauging of the Maxwell equations to give new and simple equations easier to solve. This arbitrary regauging did in fact unwitting discard all open disequilibrium Maxwellian systems — precisely those permitted to exhibit COP>1.0.

See again Figure 1-1. The energy entering the circuit is entering it from the surrounding space outside the circuit. Heaviside showed that the energy flow component remaining alter the Poynting component is withdrawn is orders of magnitude greater than the Poynting component entering the circuit and powering it. *It can easily be demonstrated that every generator outputs far more EM energy in space surrounding the power line attached to it, than the operator inputs as mechanical energy to the shaft.*[50]

[50] E.g., just use a gedanken experiment followed by the Bohren {24} experiment as validated by Paul and Fischer {25}. Consider a 100% efficient DC system, powered by a DC generator, using a closed Current loop circuit. All the Poynting energy received by the system appears at first blush to be dissipated in the external load. That is not true, but let us not yet belabor the point. Include the complete circuit loop back through the source dipole in the generator. The back emf voltage across the source dipole between the terminals is precisely equal to the forward emf voltage between the terminals but around the external half-loop. The same current flows through both the forward voltage drop and the reverse voltage repotentialization. So precisely as much energy is dissipated to force the current through the back emf, as is recovered from the load.

Accept the conventional view that the shaft energy input to the generator is transduced into magnetic energy, which is then dissipated to force those charges back though the back emf. Now examine the energy flow in space surrounding the external circuit, using both the Poynting theory and Heaviside's theory. We have accounted for the Poynting diverged component, but we have not accounted for the huge remaining nondiverged Heaviside component. From whence comes this excess remaining energy flow that did not enter the circuit, was not included in the Poynting calculation, and was not expended in the circuit but was just wasted? To prove the excess energy flow really exists, perform the Bohren experiment {24} where the intercepting charges in the circuit are in resonance, and thus "sweep out" a larger geometrical cross section of interception of the impinging energy flow. These charges do sweep beyond the static unit charge cross section conventionally assumed in the definitions of field intensity (e.g., of the fields E and H in the Poynting vector S in S = (E x H). If the defining unit point charges are in resonance and sweep out a

Heaviside knew this in the 1880s. All the energy flow that is intercepted by the circuit and enters (i.e., the Poynting component) at essentially right angles, hardly even changes the angle of flow of the remaining huge flow of energy surrounding the circuit and missing it. Quoting Heaviside {153} directly:

> *"It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire.... Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire. "*

So every electrical power system is rigorously a COP>1.0 "energy gating" system already, if the neglected, enormous Heaviside energy flow through space around the circuit (and missing it and wasted) is re-accounted. In that case, much greater energy pours out of the terminals of every generator, than the feeble amount of mechanical energy we input to the shaft.

We do not have an *energy availability* problem, and we never have had one! Instead, we have an *energy flow interception and collection* problem

greater cross section, then the assumed Poynting vector S, for the static case, changes in magnitude by some ratio k for the resonant case to the vector S_R, so now $S_R = k_1E \times k_2H = k_3(E \times H)$. Since k_3 is just the ratio of the actual geometrical cross section swept out by the charge to the standard geometrical cross section swept out by the static charge, then for a static charge $k_3 = 1.0$, and for a resonant charge $k_3 > 1.0$. Hence the Bohren experiment, with $k_3 = 18$ or so, produces 18 times as much collected (Poynting) energy "out" as we erroneously think we input by normal calculations ignoring the input Heaviside nondiverged component. The Bohren experiment {24} proves the argument; validation by Paul and Fischer {25} appears in the same journal issue.

— and we always have had one, due to the ubiquitous use of the closed current loop circuit.

Texts — e.g., such as by Kraus {154} — do show the Poynting (intercepted and collected) component of the EM energy flow surrounding the power line attached to the generator terminals, but none of them today go into the remaining nondiverged Heaviside component. Each of Kraus' contours {76} of energy flow in space, around those power line conductors, shows *only that part of the energy flow in space that is being drawn into the circuit.* It does not show the remaining huge energy flow that (i) is not intercepted, (ii) does not enter the circuit, and (iii) is wasted. Presently no texts illustrate this Heaviside nondiverged energy flow component, and no text accounts for it except to point out that the Poynting component must be considered to be indefinite, since it can be accompanied by an additional energy flow component. The texts then erroneously conclude that the excess flow can have no physical significance.[51]

One can easily prove the existence of additional energy flow to be collected, in addition to the Poynting component. E.g., simply examine the Bohren experiment {155} and its replication by Paul and Fischer {156} — or one can repeat the experiment oneself. The Bohren experiment outputs some 18 times as much energy as is input by normal "Poynting component" calculations alone, because it also intercepts additional energy from the unaccounted and ignored *free* Heaviside input component remaining and not diverged by a *static* unit point charge. Bohren simply places the charge in resonance, so it sweeps out a greater geometrical reaction cross section in the energy flow, thereby penetrating into the free — but arbitrarily discarded and unaccounted — Heaviside component, and intercepting and collecting additional energy. Bohren is perfectly aware that the excess energy caught by the resonant charges comes from the surrounding vacuum. However, he seems quite unaware of Heaviside's

[51] E.g., J. D. Jackson, Classical Electrodynamics, Second Edition, Wiley, 1975, p. 237: *"...the Poynting vector is arbitrary to the extent that the curl of any vector field can be added to it. Such an added term can, however, have no physical consequences."* Jackson errs in stating that the added energy flow vector cannot have any physical consequences. It cannot, of course, unless one catches some of it and uses it to power a load, without using half of the caught energy to destroy the source dipole faster than the load is powered. One of the major applications of it is to use it with Dirac sea negative energy 4-holes in the vacuum, where the holes produce negative energy fields and potentials in surrounding spacetime, acting back upon the system which is the source of the 4-holes to produce practical antigravity.

discovery and cautious statement of the excess energy involved in *every* field-particle interaction, and particularly in electrical circuits.

There are several such "white crows" which are legitimate COP>1.0 EM processes in physics. It only takes one small white crow to prove that not all crows are black. As another example, the papers of Letokhov {157a-157d} are especially recommended. So long as excess energy is received freely from the environment, the system is permitted to be in disequilibrium where COP>1.0.

So far as this author could discover, none of the perpetual motion machine critics have noticed another very simple fact: The conventional electrodynamics they utilize to refute COP>1.0 Maxwellian systems implicitly assumes that the source charge — which is any and every charge in the universe — continuously *creates* and pours out energy in 3-space without any energy input at all. Their own conventional classical electrodynamics contains a "perpetual motion machine assumption" of the most fundamental and grossest kind. The ardent skeptics of overunity EM systems — in using that implicit conventional assumption — are themselves the greatest perpetual motion advocates of all, though perhaps unwittingly. In 2000 we resolved that long-vexing problem[52] of the source charge {12}.

The more strident critics simply set up the "equilibrium thermodynamics" straw man, then knock it down and attack independent COP>1.0 experimenters with it, erroneously implying that all overunity researchers seek such in an equilibrium system. They fail to notice orthodox science's implied assumption that every charge and every dipole in the universe is already assumed to be a COP => inf. perpetual motion machine, freely *creating* all that continuous outpouring of energy from nothing. None of the critics have noticed and critiqued this greatest of all perpetual motion assumptions right in their own ranks, without a single exception, and the most ubiquitous. Undoubtedly that is because the scientific community honestly and freely admits that it has not heretofore solved that problem {68}, and also points out that the outpouring of energy is an experimental fact and therefore unquestionable.

The better critics — at least the rational ones such as Angrist — already admit that there exists a class of legitimate "fictitious perpetual motion

[52] After publication of our paper, we also discovered very powerful support for our solution in quantum field theory. E.g., see F. Mandl and G. Shaw, *Quantum Field Theory*, Wiley, 1984/1993, Chapter 5.

machines" which are powered continuously without the operator inputting the energy. The phrase "fictitious perpetual motion machine" is an attempt to retain the classical thermodynamics straw man, when dealing with the thermodynamics of a system far from equilibrium in its energy exchange with its active environment. That phrase has been a non sequitur since the award of the Nobel Prize to Ilya Prigogine in 1977. We stress again our new use of all EM systems as open systems, in accord with general relativity.

So when rigorously analyzed from the breadth of physics and thermodynamics, and not just from a selected very narrow portion, the entire "perpetual motion" critical literature is inappropriate or — more exactly — is inappropriately focused upon a fictitious or false target. It is simply a classic example of reasoning from a false premise.

Not one such critic seems to have noticed that every generator and battery already pours out more energy than what is input to the shaft, and that it is easily proven experimentally via the thousands of experiments showing negative absorption from the medium. None seems to have bothered to read the original Heaviside, Poynting, and Lorentz papers to see how this startling fact was buried more than a century ago.

Finally, a self-appointed "expert" who does not even know what furnishes the energy to power every electromagnetic circuit, cannot be taken seriously in his "learned criticism" , regardless of what journal publishes it. If he continues to accept the unsolved source charge problem, implying that all charges freely create EM energy from nothing, he is not expert in any facet of powering electromag letic systems and circuits.

2.1.8 Prescribed Systems Versus Changes to Maxwell's Equations

As we stated, Maxwell's theory {20} was some 20 quaternion-like and vector equations in some 20 unknowns. By discarding the scalar component of the quaternion to retain only the vector subcomponent, and by discarding many of Maxwell's potentials, Heaviside {158} truncated the Maxwell equations to essentially the present familiar set of four vector equations - or in potential form, to two equations with variables unseparated.

While this truncation discarded a great deal of Maxwellian electrodynamics phenomenology, from a thermodynamics view the resulting *Maxwell-Heaviside* equations still contain and prescribe two types of Maxwellian systems:

(1) systems in equilibrium with their active environment, such as the active vacuum, and

(2) systems far from equilibrium with their active environment, such as the active vacuum.

Systems in the first class of Maxwell-Heaviside systems — i.e., in equilibrium in their energetic exchange with their active environment — rigorously obey classical equilibrium thermodynamics {159}. No system in that Maxwellian class can output more energy than the operator himself inputs to the system. The greatest coefficient of performance (COP) that these systems can accomplish, is COP = 1.0 for a theoretically perfect system without internal losses whatsoever, and thus with 100% efficiency of conversion of their input energy into work in the load. Since any real system has internal losses and thus is less than 100% efficient, the *practical* systems of this first class exhibit COP < 1.0.

These Maxwellian systems of the first class are the electrical systems always "understood" by ardent skeptics who proclaim that no other kind of Maxwellian system exists, that therefore no Maxwellian system can exhibit COP > 1.0, and that a claim to COP>1.0 is perpetual motion lunacy and not science at all. These fellows often launch scathing and unjustified personal attacks upon any serious researcher trying to work with that second class of permitted Maxwellian systems! It would be scientifically beneficial if these self-appointed defenders of the faith would simply study some more physics and thermodynamics, review the history of Maxwell's theory and how it was altered, and understand the well-established thermodynamics of systems far from equilibrium.

This false charge — that there can be no COP > 1.0 EM system because that would violate the laws of physics and the laws of thermodynamics — has been insidiously indoctrinated into generation after generation of physics and electrical engineering students. Today most of our electrical engineers and electrical scientists have absorbed it and believe it without question. Our power-engineering scientists believe it, and so advise the government. Hence our government believes it on the advice of our best scientists, such as the National Academy of Sciences and the National Science Foundation. Our great national laboratories also believe it and are just as mentally conditioned. The universities — especially the electrical engineering departments — also believe it, and provide a mainstream suppression of the sharp young graduate students and post-docs that would otherwise have long ago revised this mess and solved the energy crisis permanently.

Again we are reminded of that first quotation by Einstein, which we included at the beginning of Chapter 1, and which admonished us to ever examine the foundations of our science to root out and correct the errors. We are also reminded of another quote by Tolstoy:

> *"I know that most men, including those at ease with problems of the greatest complexity, can seldom accept even the simplest and most obvious truth if it be such as would oblige them to admit the falsity of conclusions which they have delighted in explaining to colleagues, which they have proudly taught to others, and which they have woven, thread by thread, into the fabric of their lives."* [Count Leo Nikolaevich Tolstoy].

The second class of Maxwell-Heaviside systems — rigorously prescribed and permitted by Heaviside's truncated Maxwellian theory — is comprised of systems in disequilibrium with their active environment. A system in this class does not obey classical equilibrium thermodynamics. To the contrary, this system obeys the well-known *thermodynamics of systems far from equilibrium* {160a-160f} with their active environment — such as the active vacuum.

Such a system *is permitted to:*

(i) self-order,

(ii) self-oscillate or self-rotate,

(iii) output more energy than the operator himself inputs and thus exhibit COP>1.0 (the excess energy is freely received by the system from its external active environment),

(iv) power itself and its load simultaneously (all the energy is freely received by the system from its external active environment,[53] without any operator energy input being required), and

[53] We accent the concept of the supersystem. consisting of three components: (a) the system and its dynamics, considered as in normal electrical engineering (with a flat spacetime and an inactive local vacuum), (b) the active local vacuum and its dynamics, and (c) the active local curvatures of spacetime and their dynamics. All three components of the supersystem interact with each other. In conventional electrical engineering, the assumption in U(l) electrodynamics of a flat local spacetime and equilibrium with the local vacuum exchange eliminates any

(v) exhibit negentropy, which every charge and every dipole in the universe already does {12, 68}.

Let us now see why Maxwellian EM systems of the second class *are not being designed and built as such,* even though they are permitted by the laws of physics and reinterpreted thermodynamics, and even though they are prescribed in the Maxwell-Heaviside equations before further truncation by Lorentz {161a, 161b}. We may use the Maxwell-Heaviside equations in vacuum, because the energy flow intercepted by the external circuit pours out of the generator terminals and fills all space surrounding the power lines. It is therefore a transmission-reception problem, prior to the "potentialized current-transport" problem in the circuit.

2.2 Lorentz Regauging of the Maxwell-Heaviside Equations

2.2.1 Introductory remarks.

The domain of Lorentz's symmetrically regauged equations is only a small subset of the domain of the Maxwell-Heaviside equations they replace. Indeed, the later Lorentz {161a, 161b} symmetrical regauging discards an entire class of Maxwellian systems permitted by nature and by the Maxwell-Heaviside equations before they are symmetrically regauged.

Lorentz's symmetrically regauged EM equations discard all Maxwell-Heaviside systems that are far from equilibrium in their energetic exchange with the active vacuum. They retain only that subset of the Maxwell-Heaviside theory wherein the system being described is in forced equilibrium {162} in its exchange with its active vacuum environment. Hence the present Lorentz-Maxwell-Heaviside theory, by which EM circuits and electrical power systems are designed, produces only systems in self-forced equilibrium with the active vacuum, *specifically during the symmetrically regauging discharge* of the circuit's excitation energy. The closed current loop circuit in fact discharges half its collected energy to destroy the source dipole in the generator, thereby destroying that dipole's extraction from the vacuum and furnishing of the energy flow pouring out of the terminals. These circuits kill themselves faster than they can power the load, and they use more energy to kill the energy flow from the vacuum than they use to power their load. Hence all present EM systems

disequilibrium of the system with its active environment, hence arbitrarily discards all Maxwellian disequilibrium systems - precisely those that can exhibit COP>1.0.

rigorously conform to classical equilibrium thermodynamics, and exhibit a coefficient of performance (COP) of COP<1.0 since any real system also has losses {163}.

2.2.2 Technical regauging of the Maxwell-Heaviside equations {164}. For asymmetrical-regauging (A-regauging) considerations, we are speaking of A-regauging the potential energy in and around a circuit. We include not only the Poynting energy flow component that is diverged into the circuit conductors, but also the remaining Heaviside *nondiverged* energy flow in space surrounding the conductors. This means that the energy is in field energy (E-field and B-field) form, both overtly as ordinary EM fields and covertly or "infolded" inside the corresponding scalar potentials {165, 166, 167, 168}, or both. Consequently, we must analyze Maxwell's equations as we would for radiating energy, rather than employ only the $\mathbf{j}\phi$ circuit analysis conventionally utilized, where the collected energy is sluggishly transported by the Slepian vector $\mathbf{j}\phi$. We show in this book that asymmetrical self-regauging (ASR) allows permissible overunity operation of electromagnetic engines and devices {169}, if other requirements are fulfilled also.

In Gaussian units, Jackson {170} shows that Maxwell's four equations (vacuum form) can first be reduced to a set of two coupled equations in the $(\mathbf{A}, \Phi)$ representation as follows:

$$\nabla^2\Phi + \frac{1}{c}\frac{\partial}{\partial t}(\nabla \bullet \mathbf{A}) = -4\pi\rho \qquad [15]$$

$$\nabla^2 A - \frac{1}{c^2}\frac{\partial^2 \mathbf{A}}{\partial t^2} - \nabla(\nabla \bullet \mathbf{A} + \frac{1}{c}\frac{\partial \Phi}{\partial t}) = -\frac{4p}{c}\mathbf{J} \qquad [16]$$

The result is two coupled Maxwell equations rather than four. Jackson shows that potentials A and Φ in these two equations are arbitrary in a specific sense, since the A vector can be replaced with $\mathbf{A'} = \mathbf{A} + \nabla\Lambda$, where A is a scalar function and VA is its gradient. The B field is given by $\mathbf{B} = \nabla\times\mathbf{A}$, so that the new B' field becomes

$$\mathbf{B'} = \nabla\times(\mathbf{A} + \nabla\Lambda) = \nabla\times\mathbf{A} + \mathbf{0} = \nabla\times\mathbf{A} = \mathbf{B} \qquad [17]$$

In other words, the B field has remained entirely unchanged, even though the magnetic vector potential has been asymmetrically changed. However, if no other change were made, then the electric field E would have still been changed because of the gradient $\nabla\Lambda$. In that case the net change would be asymmetrical, because one obtained a "free" E-field which could

then do work on the system — either beneficially or detrimentally, depending upon the specific conditions, geometry, and timing. To prevent this excess "free" E-field from appearing, the electrodynamicists simultaneously and asymmetrically regauge (transform) the scalar potential Φ so as to offset the E-field change due to the regauging of equation [15]. In short, they also change Φ to Φ', where

$$\Phi' = \Phi - \frac{1}{c}\frac{\partial \Lambda}{\partial t} \qquad [18]$$

With that additional change, now the net E and B fields remain unchanged {171, 172}, even though both potentials have changed and the fundamental stored energy of the system has changed, as has the stress of the system. Unchanged force fields just mean that only a set of zero-summation forces (a zero-summed stress system) has been utilized to effect the change in potential energy. It also means that the net summation of the two *asymmetrical* regaugings has been entirely *symmetrical* {173}.

Jackson points out that, conventionally, a set of potentials $(\mathbf{A}, \Phi)$ is habitually and *arbitrarily* chosen by the electrodynamicists such that

$$\nabla \bullet \mathbf{A} + \frac{1}{c}\frac{\partial \Phi}{\partial t} = 0 \qquad [19]$$

This *net symmetrical* regauging operation creates a new and simpler Maxwellian system, with different system stress and different system potential energy. It successfully separates the variables, so that two inhomogeneous wave equations result. This procedure yields a new and simplified system, and the new Maxwell's equations for it are as follows:

$$\nabla^2 \Phi - \frac{1}{c^2}\frac{\partial^2 \Phi}{\partial t^2} = -4\pi\rho \qquad [20]$$

$$\nabla^2 \mathbf{A} - \frac{1}{c^2}\frac{\partial^2 \mathbf{A}}{\partial t^2} = -\frac{4\pi}{c}\mathbf{J} \qquad [21]$$

The two previously coupled Maxwell equations [15] and [16] (potential form) have been replaced by equations [20] and [21], to leave two much simpler inhomogeneous wave equations, one for Φ and one for A. These are *new equations for a new system!*

Of course, this arbitrary *net symmetrical* regauging (let us use the term ***S-regauging)*** is quite useful for purposes of simplifying the theory and for

easing calculations. But its unquestioning and rather universal usage has arbitrarily eliminated the freedom of the system designer to *asymmetrically* regauge the system's potentials, and *use* the resulting excess free force fields to change the stored energy in the system without the operator performing extra work upon the system. So we advance the condition for violating this S-regauging, violating the exclusion of net A-regauging, and violating the "frozen gauge" process as

$$\nabla \bullet \mathbf{A} + \frac{1}{c}\frac{\partial \Phi}{\partial t} \neq 0 \qquad [22]$$

Any regauging of the potentials that complies with equation [22] will *a priori* produce one or more net excess forces in the system, as well as a change in potential energy of the system. By controlling the regauging, the system designer is then able to control where, how, and when these excess forces appear, and whether they enhance the system's operation or hinder it. These net forces can then be used to perform work and dissipate the excess potential energy taken on in the asymmetrical regauging. That is what we do when we ourselves add potential (and potential energy) to an EM system to enable it to do work! *If we always have to asymmetrically regauge the system to get it to do subsequent work, why do we not just let the system asymmetrically regauge itself so we get the input energy freely and also get the resulting work freely?* The gauge freedom axiom in quantum field theory assures us that nature will indeed freely change the potential energy of any system for us, if we but arrange it and permit it.

In short, we have had a gauge freedom principle for some time, which guarantees us that COP>1.0 EM systems are permitted and possible. Yet we have failed to realize it, or take any advantage of it. So we continue to pay to asymmetrically regauge (potentialized) all electrical power systems, and to insure that we have to continue to do it, we specifically design the systems so they will then re-enforce Lorentz's symmetrical regauging condition.

This is another of those "inexplicable aberrations of the scientific mind" referred to by Nikola Tesla!

2.2.3 A Humorous Comment but an Exact Analogy

Again see Figure 1-1 in Chapter 1, and see Figure 2-3. In Figure 2-3, we show how Lorentz's integration trick {174a, 174b} discarded the huge nondiverged Heaviside component of energy flow outside the conductor, while retaining the small Poynting component that strikes the surface charges and gets diverged into the conductor to power the electrons. In

justifying his integration trick, Lorentz stated that all the rest of that wasted Heaviside energy flow

See Panofsky & Phillips Classical Electnqtv and Magnetism. 2nd edn Addison Wesley 1962. p 178-181

The Lorentz procedure arbitrarily discards the enormous Heaviside component that misses the circuit entirely and is wasted This results in a non sequitur of first magnitude in EM energy flow theory

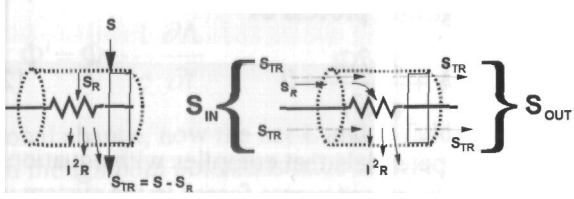

2-3a. Lorentz surface integration **2-3b. Actual S in and S out.**

Figure 2-3 Lorentz's integration trick to discard the enormous Heaviside non-diverged energy flow component

The Heaviside component is often 10 trillion times the Poynting component but is simply wasted in ordinary single-pass energy flow circuits

Heaviside component (nondiverged)

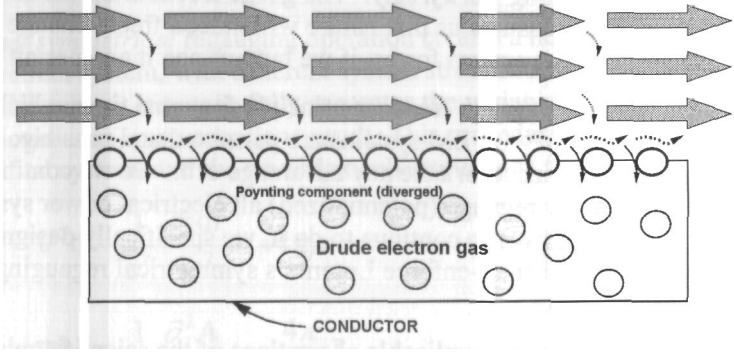

Figure 2-4 Heaviside nondiverged and Poynting diverged energy flow components.

(Figure 2-4) was "physically insignificant" (his term) because it did not strike the circuit, was not intercepted, and did not power anything. Well, Maxwell's theory is a material fluid flow theory, so let us evaluate Lorentz's justification in a fluid flow analogy.

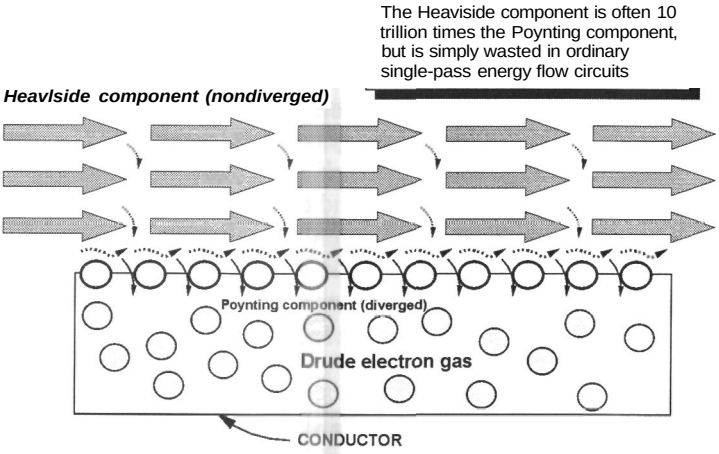

Figure 2-4 Heaviside nondiverged and Poynting diverged energy flow components.

Contrast Lorentz's statement if applied to the ocean wind on a sailing ship, where the wind represents the total energy flow and the ship represents a single Maxwellian system under consideration.

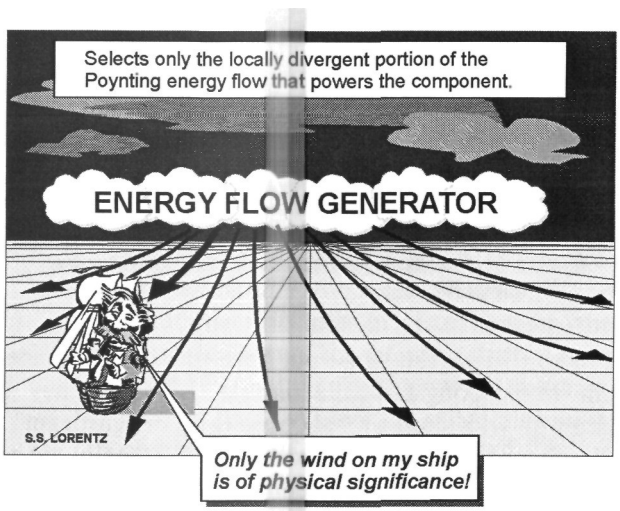

Figure 2-5 Lorentz in his sailing ship in an ocean wind, with no other ships around.

As shown in Figure 2-5, Lorentz's argument is analogous to stating that the huge component of the wind *that does not* strike the ship's sails is "physically insignificant" — in other words, it has no physical use. Now that is true for the single ship under consideration, as shown in Figure 2-5. None of that wind component that misses the ship's sails does anything at all to power *that ship* (that individual system). Hence it is indeed physically insignificant *to that ship itself.* Of course, if we flare the sails wider, the ship will catch more wind and develop more power. That is an analogy to the Bohren experiment, which resonates the charges (the "sails" intercepting the incoming EM energy flow "wind") so that they sweep out a greater geometrical cross section. Hence 18 times as much energy is caught, as when the charges are not resonated (the sails are not flared to a greater area).

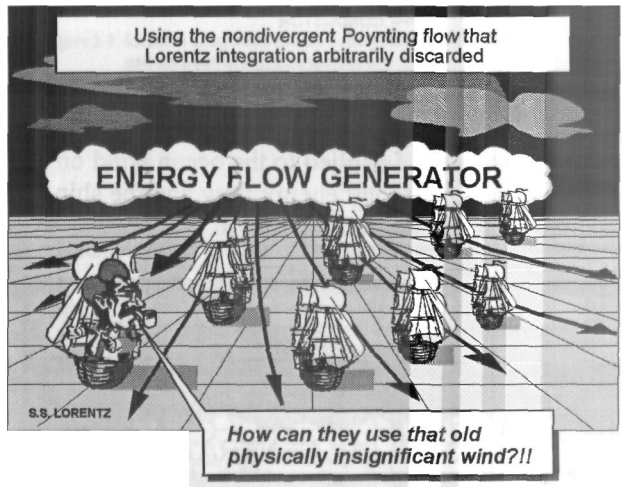

Figure 2 6 Lorentz in his sailing ship in an ocean wind, with many other ships alongside.

However, now see Figure 2-6. If we put some more ships (some more systems) with "intercepting and collecting sails" in there, they will be powered quite well with some of that "physically insignificant" wind. So Lorentz (following earlier work by Ludwig Lorenz) really did advance and impose upon electrodynamics a non sequitur of first rank.

And the wind-fluid analogy helps to "lighten things up" a bit here and inject a little good-natured humor!

2.2.4 Discussion

Equation [22] has now become the first *necessary but not sufficient* principle of asymmetrical self-regauging (ASR) for overunity electromagnetic engines and devices. That is, we are now free to A-regauge in a *nonconservative* field manner, where excess net force fields automatically appear and remain for our use in the system. All that remains is for the designer to:

(i) evoke "nonconservative" (asymmetrical) regauging in accord with equation [22];

(ii) have the system assembly in disequilibrium with its energetic external environment, so that the system itself performs this nonconservative A-regauging in some sector or part {175} of its normal operation,

(iii) insure that any "free force" that is produced and allowed to do work upon the system will do some positive work upon the system, so as to increase its collected energy, and

(iv) assure that the "free" forces that are otherwise produced by the circuit design (this includes, e.g., the back emf) do not seriously degrade the system (i.e., do not substantially reduce its energy available to dissipate as work in the load). Usually this means that, contrary to the standard closed current loop circuit, the circuit must not dissipate half its collected Poynting energy to dissipate the charges in the source dipole and destroy it. *These four considerations we now advance as the primary or master principles of asymmetrical self-regauging of electromagnetic engines and devices for permissible overunity efficiency.* We will meet additional principles in a later chapter when we discuss what the form of the energy output of an overunity EM system is, and the considerations for close-looping a COP>1.0 EM system into stable disequilibrium and continuous self-powering.

It is understood that the asymmetrical regauging portion of the circuit or system must be a broken symmetry in the energetic exchange between the active vacuum environment and that portion of the system. We exclude, g., solar cell-powered systems, windmill-driven generators, etc.

For simplicity, the system designer may wish to A-regauge only one potential, producing a desired "free" force F_1 to work on the system and increase its energy, while allowing any other extraneous force F_2 to appear, but just "bottling up" that additional force F_2 so that it cannot do any work at all on the system and therefore cannot degrade the system's operation. A most useful ASR corollary that immediately suggests itself is to simply A-regauge onto that force operation that normally produces the back-drag in a system or device, to either *eliminate* the back-drag altogether or reverse its algebraic sign so that it becomes an *assisting* force instead of a *hampering* force {176}.

In overunity systems, this becomes a startling and unexpected exercise in novel new phenomenology effected by tempic potential differences, tempic force, etc. It involves not only the system, but also the entire *supersystem* consisting of the physical system, its associated altered local vacuum, and its associated curved local spacetime. See Chapter 9 for our expose of these phenomena, and how one must transduce[54] the effects of a very novel kind of tempic force back emf, if the COP>1.0 system is to remain in disequilibrium with the active vacuum and thus maintain its stable COP>1.0 operation.

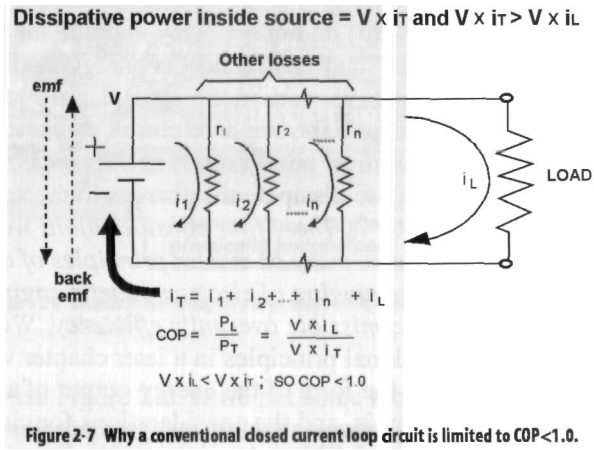

Figure 2-7 Why a conventional closed current loop circuit is limited to COP<1.0.

Again see Figures 2-3 and 2-4, and equations [20] and [21]. Electrodynamicists have previously *assumed away* the capability of work-

[54] A patent application on the process has been filed by John Bedini and the present author.

free "refueling" of an electromagnetic system directly from the local vacuum {177}. They have deliberately designed their systems *to prevent self-evoking and positively utilizing asymmetrical self-regauging of their own potential energy during system excitation discharge.* (See Figure 2-7).

In fact, by forcibly pumping the ground electrons from the external circuit back up through the primary source dipole in the generator or battery, our closed current loop circuits self-enforce the Lorentz condition and require that precisely half the regauging energy freely intercepted and collected in the external circuit is used to destroy the source dipole providing the regauging energy. This destruction of the energy source is accomplished faster than the external load is powered. Hence all such systems with losses are COP<1.0 systems. For more than 100 years, this "self-destroying, suicidal system" is the only kind of electrical power system our energy scientists and engineers have designed and built. To inject a little humor, we can only describe this in Tesla's words[55] as *"one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history."*

Thereby electrodynamicists have narrowed the inherent flexibility of the Maxwellian EM gauge theory model to an artificially symmetrized subset of Maxwell-Heaviside-Lorentz equations that utilize a single fixed gauge. This prohibits the free use of the system's vacuum energy freely received by the source dipole's broken symmetry in its violent exchange with the active vacuum. If the system increases its dipolarity (regauges freely), it simultaneously increases the speed at which it destroys the dipolarity! *Maxwell's equations themselves do not require this, and neither does Heaviside's truncation of them into the resulting Maxwell-Heaviside equations. Lorentz's symmetrical regauging of the Maxwell-Heaviside equations does require it.*

The Maxwell-Heaviside theory without Lorentz symmetrical regauging allows regauging asymmetrically to place the system in disequilibrium so that it freely receives and utilizes excess energy from the surrounding vacuum. Then it can again asymmetrically regauge by dissipating that freely received energy in an external load. *The theory specifically does not require destroying the primary source dipole as is done in the arbitrary closed current loop circuit between load and primary source dipole in the generator or battery.*

" Nikola Tesla, "The True Wireless, *Electrical Experimenter,* May 1919.

By arbitrary habit, electrodynamicists have discarded the Maxwell-Heaviside major EM overunity mechanism: *Asymmetrically self-regauging accomplished by the system itself, without requiring external work being done on the system by the operator,* in order to freely gather in and collect excess potential energy in the system from its broken symmetry with its active vacuum environment. In this self-A-regauging, associated *excess net force* does appear, whereupon that excess collected/stored regauging energy can then be used to "drive" the forces against load resistance and system losses to freely power the system and its loads {178}. They have also discarded the major overunity corollary whereby the designer is free to utilize *system self-regauging asymmetrically so that the normal back-drag or back-emfwork — usually done upon the system in its closed current loop configuration to reduce its kinetic energy — vanishes or reverses sign and becomes beneficial work done in the opposite sense, to freely increase the energy ofthe system.*

The failure to do this is bluntly met with, when one does succeed in producing a COP»1.0 system momentarily by suddenly and very powerfully breaking the system's equilibrium in its vacuum energy exchange. Nature then exhibits a very novel kind of Dirac sea hole reaction (powered by tempic force generated in the locally curved spacetime and resulting effects generated in the altered semiconducting vacuum). This reaction sharply jerks the system (or the system plus its external power supply) back into equilibrium and COP<1.0 operation. In Chapter 9, apparently for the first time in the literature[56] we present this novel mechanism exhibited by nature as a new kind of "tempic back emf phenomenon in systems in disequilibrium. We also explain how to handle the problem and in general how to use it for "freeze-framing" and stabilizing the system's disequilibrium operation in sustained COP > 1.0 configuration while powering itself and its load.

All that is required for "self-powering" COP»1.0 EM engines directly powered by the vacuum, is that (1) initially the engine must asymmetrically self-regauge to produce COP»1.0, and (2) positive *transduced* feedback (from the output) of a very special and previously unknown kind — where negative energy is transformed into normal electron current and energy — must be utilized to its input, in a clamped

[56] The basis for it, however, is in Dirac's electron theory published in 1930, nearly three quarters of a century ago. See P. A. M. Dirac, "A theory of electrons and protons," *Proceedings of the Royal Society of London, Series A,* 126(801), Jan. 1, **1930, p. 360-365.**

and controlled fashion {179}. The clamped positive feedback can be designed and applied, once the fundamental engine is designed for self-regauging and overunity efficiency, and once the novel feedback and transformation requirements are understood and incorporated. The remaining excess output can then be utilized to power loads, while the engine seemingly "powers itself."

We stress, of course, that this system is just analogous to the windmill, and it continuously receives a "free energy wind" from its active environment. The conservation of energy law is obeyed at all times, as are physics and thermodynamics.

In a later chapter we present the concepts and processes for these novel phenomena involved in close-looping a COP>1.0 system for self-powering operation.

2.3 The Suicidal Closed Unitary Current Loop Circuit

The present Lorentz-Maxwell-Heaviside theory, by which EM circuits and electrical power systems are designed, produces only systems in net usable equilibrium with the active vacuum, specifically during the symmetrically regauging discharge of the circuit's excitation energy (Figure 2-7). Hence all present EM systems designed by that model rigorously conform to classical equilibrium thermodynamics, and exhibit a coefficient of performance (COP) of COP<1.0.

Since the Maxwell-Heaviside equations do not restrict the designer to systems in equilibrium with their active environment, some ubiquitous characteristic of the standard circuit approach must be self-enforcing the Lorentz symmetrical condition as far as using any excess free potential energy of the system to freely power loads. That is the closed-loop circuit, as we have discussed. Let us now illustrate what goes on in such a circuit.

Taking into account Figure 2-4, Figure 2-8 shows a modified diagram of what is actually happening between the vacuum and the dipole to power the circuit. Figure 2-9 shows how a pair of conductors constitutes an extended series of parallel dipoles. Once the dipole is formed by dissipating some chemical energy in the battery, the dipole extracts energy from the surrounding vacuum and pours it out of the battery terminals, producing an energy flow filling space around the conductors of the external circuit. Only a very small portion (Figure 2-4) of the very large energy flow is intercepted by the external charges in the conductors, and diverged into the conductors to power up the Drude electrons.

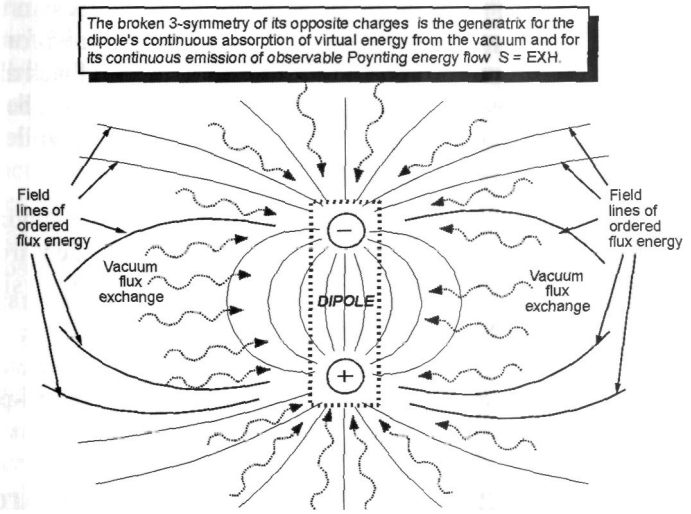

Figure 2-8 Virtual photon flux exchange intensity **with the charges of a** dipole.

As can be seen from Figure 2-7, half of the energy collected upon the internal electrons to drive them as **j**ϕ is expended as work required to pump the spent electrons from the ground return wire back through the source dipole in the battery. This scatters the charges of the dipole (in this case, by changing the chemistry of the battery plates) and destroys the dipole. The other half of the collected energy is dissipated in the external circuit's losses and in the load.

Then some more chemical energy has to be dissipated by the battery to perform work upon the internal charges and restore the dipole (in this case, to change the plate chemistry of the battery plates). So even if this process is 100% efficient, the battery has to dissipate as much chemical energy as was electrically dissipated upon those former dipole charges to scatter them and destroy the dipole.

In Figure 2-7, we show the small internal resistance of the conductors, as well as the load resistor. Half the energy dissipated by **j**ϕ is expended just to forcibly ram the spent electrons back through the back emf of the source dipole. The other half is expended in the circuit's internal losses and in the load resistance. Therefore, less energy is expended as usable work in the resistive load than is expended to destroy the dipole and cut off the flow of free EM energy from the vacuum.

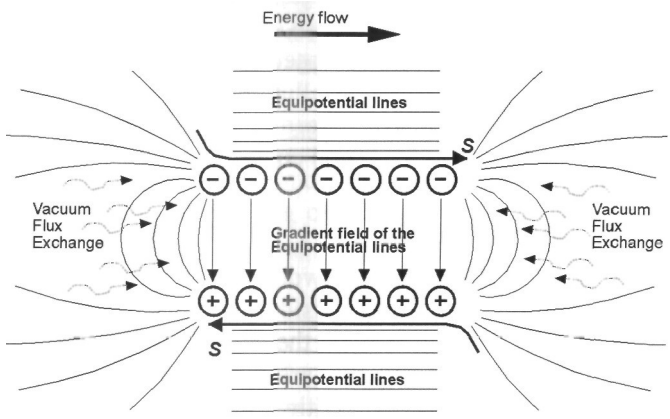

Figure 2-9 Paired conductors as an extended set of dipoles.

The battery has to input as much energy to restore the dipole as was used to destroy it. The battery has to expend at least as much chemical energy as equals half the entire energy originally collected in the external circuit and expended as $\int j(t)\phi(t)dt$. It must expend chemical energy $CE \geq \frac{1}{2} \int j(t)\phi(t)dt$. The energy RE dissipated as work in the load resistor R is $RE < \frac{1}{2} \int j(t)\phi(t)dt$. Thus CE>RE, and this system is forced to exhibit

$$COP \equiv \frac{RE}{CE} = \frac{< \frac{1}{2} \int j(t) f(t) dt}{\geq \frac{1}{2} \int j(t) f(t) dt} \Rightarrow COP < 1.0 \quad [23]$$

As can be seen, this system symmetrically regauges itself during its excitation discharge, so that it self-enforces the Lorentz condition during that period. The circuit self-enforces COP<1.0, even though all the energy — both the energy powering the external circuit and also destroying the internal source dipole in the battery to enforce the Lorentz condition during discharge — is freely received from the active vacuum via the broken symmetry of the source dipole,[57] once established, in its energetic exchange with the active vacuum.

[57] The broken symmetry of opposite charges is one of the broken symmetries predicted by Lee, {13a} and by Lee, Oehme, and Yang, {13b}. Broken symmetry was proven experimentally in early 1957 by Wu *et ai,* {14}. So profound were the implications for physics that the Nobel Prize was awarded to Lee and Yang in latter 1957, the same year! E.g., see T. D. Lee, "Weak Interactions and Nonconservation of Purity," Nobel Lecture, Dec. 11, 1957 in *T. D. Lee, Selected Papers,* Gerald **Peinbcrg,** Ed., Birkhauscr, Boston, 1986, Vol. 1, p. 32-44.

The problem is that *the source dipole is destroyed faster than the load is powered,* as shown in Figure 2-7. Because of the inexplicable scientific pre-occupation with the conventional closed current loop circuit, the planet and biosphere have been increasingly polluted for more than a century, by burning more hydrocarbons, building more dams, using more nuclear fuel rods, etc. to provide ever more electrical energy.

2.4 In Summary

COP>1.0 operation in EM systems via work-free *asymmetrical* regauging has been inherent in the Maxwell-Heaviside equations for more than a century. Since Lorentz first did so circa the latter 1880s, electro-dynamicists have just conveniently and arbitrarily *assumed away* COP>1.0 systems by (i) artificially limiting the theory to only that fraction of Maxwell-Heaviside systems in usable net force field equilibrium in their vacuum exchange during their excitation discharge, and (ii) using the ubiquitous closed current loop circuit to self-enforce the Lorentz symmetry condition during that excitation discharge. In other words, our engineers have only been building systems which self-enforce the overly restricted Lorentz-regauged theory.

Electrodynamicists have never seriously tried to build overunity circuits, nor until recently have they explored the discarded Maxwellian systems by removing the Lorentz regauging condition and examining EM energy from the vacuum.[58]

[58] Under the directorship of Dr. M.W. Evans, the Alpha Foundation's Institute for Advanced Study (AIAS) has been gradually developing the physics of EM systems far from equilibrium with their active environment (the local active vacuum and local curved spacetime). Some of the papers of interest are: M. W. Evans et al., "Derivation of the Lehnert field equations from gauge theory in vacuum: Space charge and current," *Found. Phys. Lett,* 13(2), Apr. 2000, p. 179-184; Evans et al., {38b}, {38c}, {113b}, {233a}, {233b}, {233e}; {233g}, {233j}; Evans et al., "Schrodinger Equation with a Higgs Mechanism: Inherent Vacuum Energy," *Found. Phys.* (in review); — "Vacuum Energy Flow and Poynting Theorem from Topology and Gauge Theory," *Physica Scripta* (in review); — "Energy from the Vacuum," *Physica Scripta* (in review); — "Some Notes on Asymmetric Regauging", *J. New Energy* 4(3), Special Issue, Winter 1999, p. 325-326; — "Inconsistencies of the Maxwell-Heaviside Theory of Electrodynamics: The Aharonov-Bohm Effect," *J. New Energy,* 4(3), Special Issue, Winter 1999, p. 236-240; — "Spontaneous Symmetry Breaking as the Source of the Electromagnetic Field," *Found. Phys. Lett.* (in press), A monumental work. *Modern Nonlinear Optics,* Second Edition, 3 vols., ed. M. W. Evans, Wiley, 2001 gives a broad coverage of higher group symmetry electrodynamics and energy from the environment (the local active vacuum and the

Every electrical power system ever built is and has been powered by electrical energy freely extracted from the seething vacuum exchange with the source dipole in the system, due to that dipole's broken symmetry. But the engineers and scientists have designed and built only those electrical systems which self-enforce Lorentz's symmetrical regauging.

The time for energy scientists and engineers to correct this procedure and cease this inane practice is long overdue, following the direction pointed out by the AIAS.

local curved spacetime). Some 60 AIAS papers are published as a Special Issue of **the** *J, New Energy,* 4(3), Winter 1999. More than 100 AIAS papers are also carried on DoE restricted website http://www.ott.doe.gov/electromagnetic/.

Chapter 3

Giant Negentropy, Dark Energy, Spiral Galaxies and Acceleration of the Expanding Universe

"... the discoveries made in 1957 established not only right-left asymmetry, but also the asymmetry of the positive and negative signs of electric charge. In the standard nomenclature, right-left asymmetry is referred to as P violation, or parity nonconservation. The asymmetry between opposite signs of electric charge is called C violation, or charge conjugation violation, or sometimes particle-antiparticle asymmetry." [T. D. Lee]. {180}

"The ends of a dipole, being oppositely charged, exhibit charge conjugate symmetry violation. An 'isolated' charge, considered with its clustering virtual charges of opposite sign, also exhibits symmetry violation." [T. E. Bearden, this book, below].

"A generally acceptable, rigorous definition of radiation has not as yet been formulated." ... "The recurring question has been: Why is it that an electric charge radiates but does not absorb light waves despite the fact that the Maxwell equations are invariant under time reversal?" [B. P. Kosyakov]. {181}

"It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire... . Prof Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. Their departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as

they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire. " [Oliver Heaviside]. {182}

"The funny thing about the dark matter is it doesn't show up in light, X-rays, gamma rays, infrared, ultraviolet, radio waves, or submillimeter. We're running out of places to look for it." [William Keel]. {183}

"... baryonic, ordinary matter — the stuff of stars and of people — makes up just over 4% of the energy and matter in the universe. ...about 30% of the stuff in the universe is dark [unobserved] matter. The remaining two-thirds, theorists believe, is a mysterious 'dark energy' or 'quintessence' — a large-scale antigravity-like effect that is making the universe expand ever faster.... " [Charles Seife]. {184}

"And yet, curiously enough, we do not know exactly what charge is, only what it does. Or, equally significantly, what it does not do."[M. P. Silverman]. {185}

*"**Charge** is the ongoing circulation of EM energy flow between the time and 3-space domains, as seen by the observer. Negative charge is the ongoing absorption of EM energy input from the time domain (from ict), transduction of the absorbed energy into 3-space EM energy, and re-emission of the EM energy in all directions in 3-space. **Positive charge** is the ongoing absorption of EM energy input from 3-space, transduction of the absorbed energy into the time domain, and re-emission of the EM energy in the time domain. If we wish, we may also consider the positive charge as radiating negative energy, while the negative charge radiates positive energy. Once we consider vacuum polarization, we recognize that this circular flow process is involved at each "dipolar point" of the polarized vacuum. "* [T. E. Bearden, this book, below].

"The matter density of the Universe is extremely low. On average there might be one atom per cubic metre of space. The major constituent of the Universe is believed to be some kind 'dark energy', which is pushing the Universe apart. " [Matthew Colless]. {186}

3.1 Broken 3-Symmetry of the Dipole

To recap from Chapters 1 and 2: In 1956, Lee and Yang {187} strongly predicted broken symmetry in physics, suggesting experiments to detect it in the weak interaction. In early 1957, Wu *et al.* {188} experimentally demonstrated broken symmetry, thus furnishing the experimental substantiation of broken parity in the weak interaction. The emergence of broken symmetry was such a dramatic change to the view of physics, that in December of the same year, 1957, Lee and Yang were awarded the Nobel Prize.

One of the asymmetries shown by Lee *et al.* is the asymmetry of opposite charges. That means that a dipole, which consists of slightly separated opposite charges, exhibits broken symmetry in the seething vacuum virtual particle flux. In short, a dipole — any dipole or dipolarity — must absorb or receive virtual photon energy from the active vacuum, integrate at least some of it to observable state, and re-radiate that integrated EM energy in observable form in 3-space.

We stress: *The ends of a dipole, being oppositely charged, exhibit broken symmetry. An 'isolated' charge, considered with its clustering virtual charges of opposite sign, is a set of composite dipoles and also exhibits broken symmetry.*

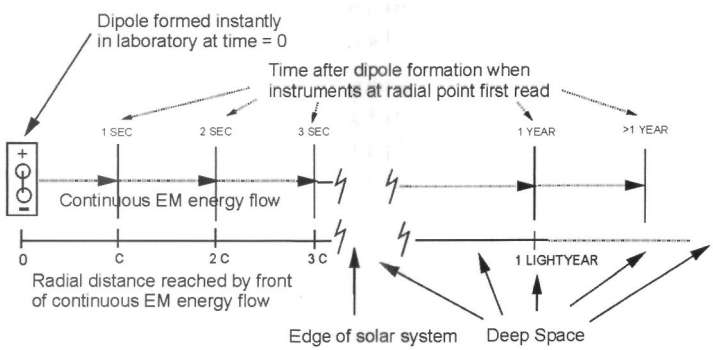

Figure 3-1 The source dipole experiment, demonstrating continuous energy flow.

Let us now consider a gedanken experiment, as shown diagrammatically in Figure 3-1, to illustrate Kosyakov's quotation cited above. At a point in the laboratory corresponding to the origin of a 3-dimensional frame, a dipole is produced instantly by separating charges, such as in a flash-charged ca**pacitor.** Along two radial lines in 3-space from that origin, we have

previously placed perfect EM field and potential detectors, at distances *ct* apart, where *t*= 1, 2, 3, 4, *n*,... and so on in seconds, with the radials extending across the universe, and where c is the speed of light. We neglect the transient pulse that momentarily occurs at each instrument package, since we are examining steady state conditions.

At the end of one second, the instruments at $t = 1$ instantly read, and those readings remain thereafter. One second later, the instruments at $t = 2$ instantly read, and those readings remain thereafter. And so on with each of the instruments progressively farther from the origin reading at the proper light-time travel, and with all field readings then *remaining continuously* thereafter.

This gedankenexperiment demonstrates that what is emitted from the dipole, from its moment of creation at the origin, is a continuous flow of EM energy in all directions in 3-space.[59] This energy continuously flows from the dipole, indefinitely or as long as the dipole physically exists. Other than paying once to initially separate the charges and make the dipole, we have neither added nor input any additional energy. Yet energy continues to flow out from the dipole in all directions, unceasingly, as shown by the continued of the reading on each field energy density instrument, once the leading edge of the energy outpour reaches that instrument and passes it by. In short, the experiment shows that it is not a "pulse" that passes each instrument, but a continuous and sustained flow of EM energy, remaining steadily thereafter so long as the dipole remains.

One year after making the dipole, the instruments at one light year distance suddenly read, and their readings remain. *The energy density of a volume of space one light year in radius has now been changed, and that change in spatial energy density continues to spread outwards at light speed.*

[59] More exactly, what is observed is a spreading change in the energy density and point-like polarization of the vacuum itself, and of the local curvature of spacetime. At each point, once the change of energy density and ST curvature occur, the energy density and ST curvature remain fixed in a new equilibrium condition, steadily fed by the energy radiating from the dipole. See our point made in {181}. The discovery of giant negentropy {12} requires a change in how we view the very process of energy propagating in space. Now it has become a quite different *propagation of energy circulation between time and space domains at each affected point in space.*

Yet there has been no input of *observable 3-space* EM energy flow to the dipole whatsoever, as our instruments also verify. All observable energy flow in 3-space is *outward* from the origin where the dipole is located.[60]

We have shown that the *observable* EM energy flow from a source dipole is not conserved in 3-space, which is consistent with a broken 3-symmetry since symmetry implies conservation. Either we must discard the conservation of energy law altogether, or it must be conserved in 4-space since we have proven the dipole does not conserve energy in 3-space. If we assume that the experiment must conform to the conservation of energy law, then 4-symmetry EM energy flow must exist since 3-symmetry energy flow is broken. The energy steadily pouring out of the dipole in all directions in 3-space must therefore be received by the dipole *charges from the time-domain*,[61] assuming we are working in Minkowski 4-space. In particle physics, this is essentially the same as receiving the energy from the virtual domain, and therefore is consistent with the proven broken symmetry of every dipole and dipolarity.

The energy flow is indeed received from the time domain, as we have argued {189} in a wave manner consistent with (i) quantum field theory as shown by Mandl and Shaw in the photon model {190}, (ii) broken charge conjugation symmetry of particle physics using the virtual photon and observable photon concepts, and (iii) a re-interpretation of Whittaker's decomposition of the scalar potential {191} when applied to the scalar potential between the ends of the dipole {12}.

We state the obvious: A dipole is a Maxwellian system. This gedanken experiment also proves by demonstration that a Maxwellian system — e.g., a dipole — is permitted by the laws of nature, physics, and thermodynamics to output more energy than the operator inputs, since we

[60] Obviously, we are utilizing the prevailing notion of the flow of energy through 3-space, which is actually a non sequitur. No 3-space observable entity can "move" in 3-space alone; it requires time to move, and so any movement is in 4-space a priori. We previously discussed this and the *dldt* operator being applied by the observation process. But for simplicity, we are using the conventional view here, so the negentropy of the dipole can be easily grasped.

[61] Again, we have stated the positive time case only. In the spreading special 4-circulation, energy appears in 3-space at each point dipole from the time domain (courtesy of the action of the negative charge of the dipole), and then returns from 3-space back to the time domain (courtesy of the action of the positive charge, which is a time-reversal of the action of the negative charge).

input nothing to the source dipole[62] once we have made it. After paying to produce the dipole initially, the operator has made no other energy input to the dipole at all, yet the dipole will continue to pour out observable energy in 3-space for the next 14 billion years if the dipole remains and is not destroyed. In addition, every positive charge and every negative charge in the universe form a dipole, regardless of the separation distance between them. That dipole is also performing the gedanken experiment process. Every dipolar EM circuit contains innumerable such dipoles — e.g., across "open paths" between the various points in the circuit, as shown by Kron {192}. Kron {193} stated:

> *"... the missing concept of "open-paths" (the dual of "closed-paths") was discovered, in which currents could be made to flow in branches that lie between <u>any</u> set of two nodes. (Previously - following Maxwell - engineers tied all of their open-paths to a single datum-point, the 'ground'). That discovery of open-paths established a second rectangular transformation matrix... which created 'lamellar' currents... " "A network with the simultaneous presence of both closed and open paths was the answer to the author's years-long search."*

By considering all dipoles in the universe, one has in fact finally defined Kron's open path. One has also defined the master mechanism responsible for the incredible EM energy density of the vacuum — the so-called "zero-point EM energy". Overall, every electrical circuit thus has innumerable energy flow broken 3-symmetries in it, with respect to exchange of EM energy flow between the time and 3-space domains. To sum all these broken 3-symmetries to an overall net 3-symmetry during the discharge of the free excitation energy of the circuit, obviously requires some specific macroscopic cohering function in the circuit. Moreover, one exists. Specifically, the closed current loop between the external circuit attached to the generator and the internal source dipole created between the terminals of the generator, is what enforces the circuit's net 3-symmetry and Lorentz symmetrical regauging. That is an arbitrary man-made condition, and not a law of nature, physics, or thermodynamics.

[62] Or to a charge with its clustering virtual charges of opposite sign, if we redo the experiment with a single "isolated" observable charge and consider it more exactly as a set of composite dipoles, each of which exhibits broken symmetry in the vacuum virtual particle flux.

By our gedanken experiment's demonstration and the existence of innumerable disequilibria between the active environment[63] and the system in an ordinary EM circuit, it follows that a Maxwellian circuit must be *capable* of exhibiting a coefficient of performance (COP) of COP>1.0. It is a giant collection of open dissipative systems, far from equilibrium in the vacuum exchange.

That concept of course is contrary to the entire present mindset of electrical engineering and Maxwell-Heaviside-Lorentz classical electrodynamics. Those disciplines merely continue to accept the source charge as if it freely created from nothing all that energy in its associated fields and potentials reaching across the universe. Ironically, so long as the giant negentropy of the common dipole and its disequilibrium with its active environment (the local active vacuum and the local active curvatures of spacetime) are unaccounted, engineers and scientists will continue to produce the inane Lorenz/Lorentz-regauged power systems they produce today and have produced for more than a century. Also, they will continue — wittingly or unwittingly — to implicitly prescribe that every charge and dipole in the universe violates the conservation of energy law and is thus a *perpetuum mobile* of the grossest kind: a system which massively and continuously creates EM energy from nothing.

We now point out something deeper and very important. In modern physics, the *observed* positive charge is regarded as the time reversal of the *observed* negative charge. See Figure 3-2. If the negative charge is responsible for EM energy flow from the time-domain into 3-space, then *as observed* the positive charge must represent a time-reversed situation. We observe time reversal in the charge domain as a parity reversal and a charge reversal, but with the energy remaining positive. In other words, one imagines that one records a process on videotape, and then runs the video backwards to observe the "time-reversed" situation. When observed, both the sign of the positive charge and its direction of motion appear to us to be reversed from the negative case.

[63] In paragraph 3.10 and in Chapter 9 we will introduce — more deeply — the notion of the supersystem, consisting of three parts: (1) the system and its dynamics, (2) the active vacuum and its dynamics, and (3) the active spacetime curvatures and their dynamics. All three components of the supersystem interact with each other. In our gedanken experiment, the system (component 1) must receive the excess energy from the system's external environment, which consists of components 2 and 3 of the supersystem.

It follows that the positive charge as observed involves a flow of (positive) energy from 3-space back to the time domain. If we wish, before observation we can accept that "observed positive energy inflow" as an unobserved outward radiation of negative energy. Thus, a dipolarity involves a continuous flow of energy from the time domain into 3-space, and back from 3-space into the time domain (Figure 3-2). The energy flow circuit (circulation) is completed by a remaining energy flow across the dipolarity in the time-domain only, from the positive charge where the energy enters the time domain, to the negative charge where it exits again.[64]

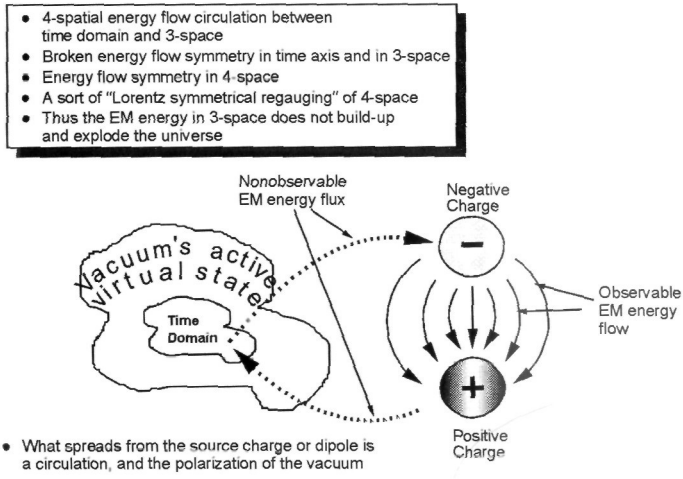

Figure 3-2 Circulation of energy flow in a dipole, between time domain and 3-space.

[64] Rigorously, we should speak of +*qt* and -*qt*. Charge *q* is an observable, and therefore an instant frozen snapshot. No observable exists continuously in time, but instead it recurs continually as the photon interactions — iteratively producing the *d/dt* (LLLT) = LLL observations — continue. The moment a charge *q* absorbs a photon, it changes to *qt* in form. The moment the charge-time *qt* emits a photon, it changes back to *q* in form. This incessant change of *q* -> *qt* -> *q* -> *qt* —» .... is continual, at every level of the macroscopic charge, with its entire ensemble of photon interactions, including both virtual and observable photon interactions. As can be seen, the "charge as it persists" and "moves through time" has a rich dynamic substructure essentially ignored in present electrodynamics. It is, however, recognized by leading theoreticians and Nobelists.

However, even each of the clustering virtual charges and each of the differential charges of the observable charge, may be further broken into a central charge and clustering charges of opposite sign, in the modem view of the vacuum and its polarization. Hence, at any level — electron or positron — we actually have a dual and slightly separated bidirectional flow, at least in the observable equilibrium condition. The "positive energy" and positive flow of time is usually associated with "inert" matter with the electrons on the outside, so that the observer observes normal matter through the "forward time" situation mostly. Hence much of the accompanying backwards or time-reversed flow — from the positive charges in the nuclei, etc. — is "buried in the vacuum virtual state" in the Dirac sea and in Dirac sea hole flows.

Indeed, the vast hierarchy of nested structures and nested dynamics in charge as it exists in the vacuum, is recognized in physics, as is the fact that it involves infinite energy. E.g., quoting Nobelist Weinberg {194}:

> *"[The total energy of the atom]... depends on the bare mass and bare charge of the electron, the mass and charge that appear in the equations of the theory before we start worrying about photon emissions and reabsorptions. But free electrons as well as electrons in atoms are always emitting and reabsorbing photons that affect the electron's mass and electric charge, and so the bare mass and charge are not the same as the measured electron mass and charge that are listed in tables of elementary particles. In fact, in order to account for the observed values (which of course are finite) of the mass and charge of the electron, the bare mass and charge must themselves be infinite. The total energy of the atom is thus the sum of two terms, both infinite: the bare energy that is infinite because it depends on the infinite bare mass and charge, and the energy shift... that is infinite because it receives contributions from virtual photons of unlimited energy."*

Here again we have met Kron's "open path" in a new and unrecognized form.

Hopefully we now are in a position to rigorously define charge — or try to — for the first time in physics.[65] **Charge** is the ongoing circulation of EM energy flow between the time and 3-space domains, as seen by the observer. **Negative charge** is the ongoing absorption of positive EM energy input from the time domain (from ict), transduction of the absorbed energy into positive 3-space EM energy, and re-emission of the EM energy in all directions in 3-space. **Positive charge** is the ongoing absorption of EM energy input from 3-space, transduction of the absorbed energy into the time domain, and re-emission of the EM energy in the time domain. Or contrary-wise, one may regard the positive charge as the ongoing absorption *of negative* EM energy input from the time domain, transduction of the absorbed negative energy into 3-space, and re-emission of the negative EM energy in all directions in 3-space. The negative charge then absorbs the negative EM energy impinging on it from 3-space, and transduces it into negative energy flowing back into the time domain.

Any *overall* curvature of spacetime, as seen by the observer, results in one of the two flows *predominating* as seen by the observer. Usually, at COP < 1.0, this Dirac sea hole current does not bother our circuit's operation, but remains confined to the local vacuum. It is often not bothersome or is minor for other than very high COP's. The reason is that, for such moderate and small COP's, most of the Dirac sea hole currents react either with (i) the seething local vacuum virtual particle cauldron, or (ii) the atoms in the material lattice to form lattice holes.

As the COP increases, the fraction of Dirac holes interacting with the lattice to form lattice holes increases. As the COP further increases greatly, a large fraction of the Dirac sea holes do not react with the local vacuum cauldron (they become stable forms in that cauldron) or the lattice, but flow into the input section of the system to react with and "eat" incoming electrons from the external power source.

If the inflow of electrons is insufficient to fill the arriving Dirac sea hole current at the input section, the hole current passes back into the feeder line and into the distant power source, eating electrons all the while. This

[65] This is still a first order, macroscopic definition. For a more comprehensive statement, one must spell out the hierarchy and dynamics of the virtual state, the participating mass of the charged particle and its generatrix, the operations and dynamics of the *d/dt* observation operator, etc. We have not yet succeeded in getting all that into a single reasonable but sufficiently short statement!

includes eating electrons in the distant power source, which simply "sees" that it must furnish additional current and voltage (power) toward the distant circuit or system.

In that operational COP region where strong interaction with the lattice occurs, the attachment of the lattice positron (lattice hole) to the mass of the atom or other ion, results in a very sluggish response of the overall ion with EM fields, compared to the response of an electron or a negative energy state electron hole (Dirac sea hole). Hence much of conventional electrical power circuit theory ignores the lattice holes and hole currents which no longer have negative energy because they have reacted and been "observed". Semiconductor designers, however, account for it and handle it in the semiconductor (in a given range of operation) primarily by the use of donor and acceptor materials.

At COP»1.0, however, the Dirac sea hole current must be strongly taken into account because it produces substantial and novel new effects in the power system itself. This Dirac sea hole current "flows in reverse" with respect to the circuit — from output back to the input. In short, it flows *through the vacuum* from the output section of a unitary COP»1.0 system, back through the middle section of the system, and back into the input section where it "eats" incoming electrons from the external power supply. The power supply thus must furnish electrons to "kill (power the killing of) the Dirac sea hole current arriving in the input section", while still furnishing the necessary amount of additional electrons to power the circuit's losses and loads.

The hole current arriving back in the input section of the unit poses an additional "power system load". These holes must be filled with incoming electrons (which disappear into the Dirac sea hole in the vacuum without radiation, due to the concomitant relaxation or change of the local curvature of spacetime) before any incoming electrons are left to power the circuit in normal fashion. So the hole current appears as a highly undesired extra "load" formed in the input and "eating input power from the external power supply".

We further discuss this situation and how to deal with it, in Chapter 9.

Finally, we propose a formal modification of the concept of "EM energy flow through space" (perhaps the first since its formulation independently by Heaviside and Poynting). The EM energy flow connected with the charge is a circulation of EM energy flow between the time domain and 3-space and back, *as a result of dipolarity*. This 4-circulation flow occurs at every point in 3-space (at every point dipole in the 3-space vacuum).

The formation of an observable charge results in an immediate, continuing, spreading re-organization (polarization) of the polarization of the vacuum virtual particle flux itself. It is this *spreading polarization of the vacuum* — and its accompanying giant negentropy EM energy flow circulation in 4-space connected with the spreading dipolarity and the observable "source" charge — that moves outward in all directions at the speed of light in 3-space from the newly formed charged particle or group of them.

We also define charge itself as that *continuously spreading dipolarity in 3-space*[66] accompanied by the giant negentropy EM energy flow 4-circulation from the time domain to 3-space and back.

The giant negentropy circulation in 4-space — represented by the spreading vacuum point-polarization and hence broken 3-symmetry — is what (observably) moves out in all directions from the newly formed observable charge. Since we "observe" only the 3-space aspect, we "see" it as the spreading appearance of 3-space EM energy (the polarization change of the vacuum itself) moving in 3-space, because we "see" it as the iteratively observed frames of a motion picture. *As observed,* that is one way of expressing it. As it actually *exists and happens prior to observation?*[67] the so-called "flow of EM energy in space" is not that at all. It is the radial spread of the appearance of a giant 4-space negentropy EM energy flow circulation between the dipoles formed in the polarization of space. In that process, the special 4-symmetry between time and space is maintained but with broken 3-energy flow symmetry and broken time-energy flow symmetry with respect to the 3-space observer.

[66] I.e., the spreading partial restructuring and re-organization of the vacuum energy or energy flux.

[67] The sharp-eyed reader will note that we clearly distinguish between the operation of a "tree falling in the forest" without an observer to see it, and a "tree falling in a forest" as an observer sees it. Without observation, there is no observed tree, no observer, and no "observed falling". Yet there exists the "tree x time", the "observer x time", and the "falling x time" whether or not their observation occurs with its resulting *d/dt* differentiation operation. One set (the causal set) is 4-spatial, and the other set (the event set after observation) is 3-spatial. The cause is 4-spatial and unobserved, and the effect is 3-spatial and observed. They are not the same, though related by the *d/dt* observation operator and by the interaction of the 4-space cause with a previous 3-space frozen observation to change it to a new 3-space frozen observation. Note that one can and does have a cause without an effect in any legitimate theory of causality, but not an effect without a cause. The cause only assumes the potential for interaction and observation, whereas the effect assumes that the interaction has occurred, yielding the observation as the effect.

The 4-circulation (giant negentropy) of the EM energy flow "from" or "connected with" a charge, is intimately connected with the spin of the charged particle, since the charged particle spins in both the time domain and in 3-space, as discussed in paragraph 3.3 below. We believe the spin itself is the basic giant negentropy generator.[68] If that hypothesis is true, then giant negentropy, the circulation of EM energy between time-domain and 3-space and back, broken 3-symmetry and broken time-energy symmetry (as seen by the observer), the flow of EM energy through space (as observed), the nature of charge itself, and polarization of the quantum mechanical vacuum are all just different sides of the same coin.

Without amplification, we state that his giant negentropy outflow process has additional important ramifications in electrodynamics, general relativity, particle physics, and unified field theory. However, we leave further discussion of the subject for a future paper or book and for the advanced theorists.

3.2 Reinterpreting Whittaker's Decomposition of the Scalar Potential

As previously stated, we applied and re-interpreted Whittaker 1903 decomposition of the potential {85} between the ends of the dipole. The scalar potential is actually a harmonic set of bidirectional longitudinal EM wavepairs, where each wavepair consists of an outgoing EM longitudinal EM wave in real 3-space and an incoming EM longitudinal EM wave in the complex plane. Hence we have a new and novel EM energy flow symmetry in 4-space, where (as seen by the observer) the broken 3-symmetry of the dipole has removed the usual arbitrary imposition of an additional condition of 3-space energy flow symmetry as well. Simply making a dipole permissibly breaks the 3-space conservation of energy flow symmetry, and moves to 4-dimensional conservation of energy flow. Both EM energy conservation in 3-space and in the time domain are individually broken, but conservation of energy flow is now upheld between the time-domain and the 3-space domain. In blunt terms, we "consume a little time" to get any EM energy that exists in 3-space.

[68] We leave to a future sharp young graduate student the business of expressing the angular momentum (spin) of the charged particle as a result of giant negentropy in EM energy flow between the time domain and 3-space. It can probably be done by deeply considering the giant negentropy process for an "isolated" observable charge considered as also containing its clustering set of virtual charges of opposite sign.

The broken symmetry of a source dipole — or of a source charge considered with its clustering virtual charges of opposite sign as a set of dipoles — produces a continuing giant 3-negentropy, as seen by the observer. He only sees the steady 3-space outpouring of energy, and sees that it will continue as long as the dipole or charge remains intact.

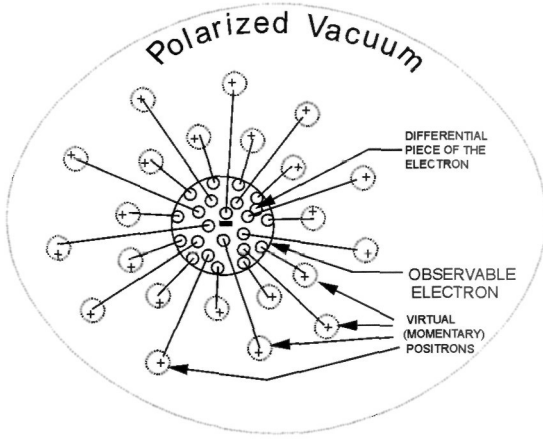

Figure 3-3 Observable electron charge as a set of composite dipoles.

To clarify the "isolated charge" as a set of composite dipoles, see Figure 3-3. There is no such thing as an *isolated* observable charge in 3-space; instead, the observable charge is surrounded by attracted virtual charges of opposite sign in the active vacuum. We take a differential piece of the observable charge and a momentary virtual charge of opposite sign, and call the two a "composite dipole". An observable charge is simply a set of composite dipoles connecting virtual and observable energies and energy flows.

Hence any source charge (classical sense) may be considered such a set of composite dipoles. So any source charge also multiply initiates the broken 3-symmetry and broken t-symmetry in EM energy flow (as interpreted by the observer), but conserves energy flow 4-symmetry between the time domain and the 3-space domain. In 4-space, there is an energy flow circulation from the time domain to 3-space and back to the time domain again.

This special circulation of energy is strikingly similar to, and may be an extension of, Heaviside's unpublished theory of combined electrodynamics and gravity, where he used closed circulation of EM energy as exhibiting

gravitational effects (in modern terms, producing spacetime curvature) {195, 172b.}. This approach or extensions of it may yet have a profound impact on physics, as commented upon by Laithwaite {196}. Certainly Heaviside considered his own energy flow theory. So it appears that he considered the excess energy flow — that "misses" the interaction with the circuit or assumed unit point charge and is not utilized — as producing gravity. That of course would be in perfect agreement with modern general relativity, since any change in the local energy density of vacuum is also a change in the local curvature of spacetime. We have called that Heaviside nondiverged and unaccounted EM energy flow by the label *dark positive energy*. See our further discussion of unaccounted (dark) positive energy in paragraph 3.8 below.

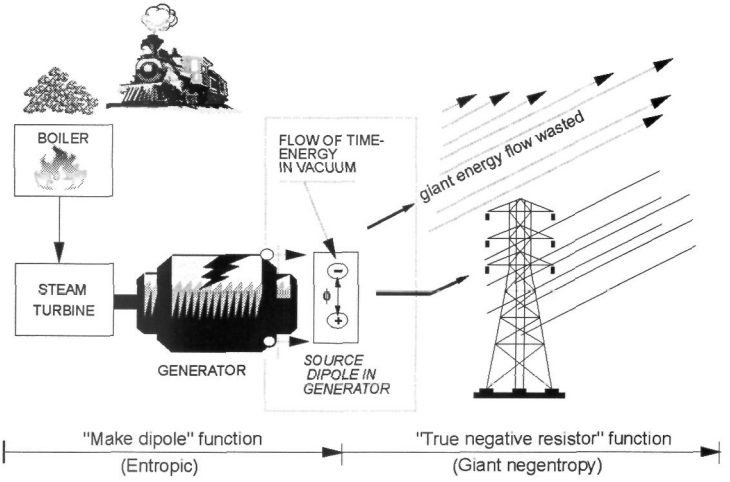

Figure 3-4 Dipole in generator powering circuits, taking energy from the time domain.

See Figure 3-4. This 4-symmetry is a far more fundamental energy flow symmetry than either 3-symmetry or t-symmetry. Both the "isolated charge" and the dipole are open systems far from equilibrium with their external active environment (the active vacuum and the active curvatures of spacetime). They are permitted to perform the five "magical" functions of disequilibrium thermodynamical systems. Such a system can: (i) self-order, (ii) self-oscillate or self-rotate, (iii) output more energy than the operator inputs, (iv) power itself and its loads (the "load" of a source dipole or source charge may be said to be comprised of the associated fields and potentials reaching across all space, and the continuous flow of

energy necessary to maintain those fields and potentials), and (v) exhibit negentropy.

The source charge and the source dipole exhibit all five functions. We often refer to these characteristics of a charge or dipole as its *giant negentropy* functions {197}.

It only takes a single white crow to prove that not all crows are black. Every charge and dipolarity in the universe is already a Maxwellian system far from thermodynamic equilibrium with its local active environment — the very class of Maxwellian systems that Lorenz/Lorentz symmetrical regauging of the Maxwell-Heaviside equations arbitrarily discards. That local environment consists of the local curvatures of spacetime and the local active vacuum. The system together with the two components of its active environment is called the *supersystem*. All three components of the supersystem continuously interact with each other and exchange energy. All is dynamic, continuously. Any appearance of a "static state" in the system is actually an equilibrium condition stabilized in the ongoing supersystem dynamics.

So one does not have to "prove" that Maxwellian systems exhibiting COP>1.0 (even COP = ∞) are possible. Every charge and dipolarity in the universe is already just such a Maxwellian system, even though all such systems are erroneously discarded by Lorenz/Lorentz symmetrical regauging. Either one must accept asymmetry and COP>1.0 EM systems in electrodynamics, or one must purge from the theory all the charges and dipoles and all effects from them. That destroys all the charges, all the fields, and all the potentials.

That also destroys electrodynamics itself, as well as chemistry, particle physics, and most of modern science. The arch critic of overunity EM system research would do well to acquaint himself with some additional physics. Either that, or practice what he advocates, and give up all charges and dipoles and all effects from them — including in chemistry, particle physics, materials science, etc. When he holds on to the charges and dipoles while insisting on the impossibility of COP>1.0 Maxwellian systems, his cherished conventional EM theory eats itself by its own tail and becomes an oxymoron.

3.3 How the Dipole Charges Transduce Time Energy

We present a simplified analogy[69] that allows one to visualize how the dipole transduces the incoming time-like longitudinal EM energy flow into 3-space real EM energy flow for negative charge, or vice versa in the case of positive charge. With a little oversimplification, a charge may be said to spin 720° degrees in one complete rotation. For our purposes, it spins 360° in the imaginary plane (over in *ict),* and then spins 360° in the real plane (in 3-space). Thus the negative charge can absorb the incoming EM energy flow in the complex plane, transduce or "flip" the absorbed EM energy into 3-space to begin its 360 degrees in 3-space, and the excitation can decay during that 3-space spin part of the cycle. The only "variable" in *ict* is the t, so any energy flow has to be "by means of the variation of the t-variable". We already argued in a previous chapter that time can be treated as highly compressed spatial energy, having the same energy density as mass. So absorbing a very tiny amount of time-energy and transducing (decompressing) it into spatial energy produces enormous spatial energy *(t* multiplied by the factor c^2).

The negative charge absorbs a *little bit* of positive time energy, transduces it into a much larger amount of 3-space excitation energy, and re-emits it in 3-space as an observable, real flow of EM energy radially outward in all directions. The positive charge receives the large amount of 3-spatial EM energy and absorbs it, transduces it back into time-energy (highly compressed energy) and re-emits it in the time domain as a little bit of highly compressed time energy.

Conversely, we may consider that the positive charge absorbs a little bit of negative time energy, transduces it into a much larger amount of negative 3-space excitation energy, and re-emits this negative 3-space energy in all directions in 3-space. That consideration is important in the cold fusion phenomenology, and in fact accounts for the formation of little fleeting "time-reversal zones" in the electrolyte solution where the law of attraction and repulsion of charged particles is momentarily reversed. The omission of the giant negentropy mechanism and the negative energy mechanism from particle physics reaction theory is why there do not exist such nuclear transmutation actions at low spatial energy (but high time energy) in

[69] **For** simplification, the analogy treats "spin" of the charged particle as if it really were something like that of a spinning top, at least in its 3-spatial component. However, in physics the entity **spin** is not confined to a flat plane or even to 3-space. C**onsequently,** we caution that the analogy is primarily a mnemonic aid.

conventional particle physics. All such permissible reactions have been arbitrarily omitted from the discipline.

For the positron (or any positive charge), we assume that the process is reversed: 3-space energy is continuously absorbed (from the active vacuum exchange) by the positive charge during its 360° spin in 3-space. This 3-space excitation energy is then flipped into the time domain as time-charge or time-energy, as the charge starts its second 360° spin in the time domain. During that latter part of its 720° spin cycle, the spinning charge re-emits the time-charge energy (time-excitation) as a flow of a little bit of very dense EM energy in the time domain.

The effects of these mechanisms in systems of charges in motion are met with as time dilation effects, spacetime curvature effects, frame rotation effects, etc. in relativity theory.

A charge that has received excess EM energy from the time domain is said to be *time-charged* or *time-excited.* Since time-charge or time-energy is c^2 denser than spatial energy, a tiny amount of time-energy excitation or time-charge may be re-emitted as substantial spatial energy over a period of time. In short, the decay of time charging or time-excitation of charged particles can occur slowly and over time. The decay is marked by the presence of longitudinal EM wave radiation, by mysterious ionization phenomena appearing in some Geiger counters depending on their individual time-histories (individual initial time-charging condition), and by excess energy appearing in electrolytes and emitted as heat where such decay of time-charge is occurring.

Usually in ordinary circuits and EM systems the time-charge and time-charge-decay effects are minimal, being offset by their opposites in close adherence to equilibrium. However, when this is not the case and time charging does appreciably occur, then novel phenomena result in those circuits and systems. Such effects have occurred for some time in instruments associated with rigorous electrolyte experiments at U.S. Naval research facilities at China Lake {198}, but the researchers have not recognized the cause. We have pointed out the time-charge and time-decay solution to those novel phenomena, and explained why apparently "identical" instruments need not respond to the stimuli in the same manner {199}. Along the way, we also explained several of the low spatial energy (thus high time-energy) transmutations, including giving the typical reactions producing the excess deuterium, tritium, and alpha particles. We also explain those new nuclear reactions at low spatial energy (but high time-energy) in Chapter 10.

As we stated in Chapter 1, paragraph 1.1.3: In such electrolyte experiments where the palladium electrodes load with concentrations of positive charges on hydrogen ions of one form or another, then in the adjacent solution there can arise fleeting **time-reversal zones.** Such a zone is simply a very tiny volume of fluid in which antiphotons temporarily comprise the majority of the ongoing photon interactions with the local ions in solution in that zone. The result is that the normal (time-forward) law of attraction of unlike charges and repulsion of like charges is reversed; *in the TRZ, like charges attract and unlike charges repel.* This allows two positive ions such as H+ to be drawn together so tightly that each enters the (reduced) strong force region of the other, forming a quasi-nucleus. When the other ions move to eliminate the TRZ, during the decay of the TRZ the strong force increases more rapidly than the EM force. Hence, the preferred method of decay of the now-excited quasi-nucleus is by quark flipping to allow the quasi-nucleus to become a new nucleus. This nuclear transformation interaction allows the production of the excess deuterium, tritium, and alpha particles.

3.4 Reordering of the Local Vacuum: Giant Negentropy

A giant negentropic reordering of a fraction of the surrounding vacuum's energy is initiated when a dipole or charge is formed. This reordering is deterministic, and is the 4-flow energetic structure shown by Whittaker {85}, slightly reinterpreted, with perfect coordination of the converging EM energy inflow in the complex plane with the outflowing converted real EM energy in 3-space. Hence this negentropic reordering introduces "hidden order" into the vacuum's otherwise disordered energy. This reordering of a fraction of the vacuum's disordered energy also changes the Gibbs statistics assumed in quantum mechanics, replacing it with an "already chaotic" statistics containing hidden order. We propose this as a possible contribution toward resolving the presently unsolved problem of the missing chaos in quantum mechanics {200}.

3.5 Some Implications of Giant Negentropy

Giant negentropy has many envisioned impacts upon physics, such as:

(a) Allows development and use of negentropic EM circuits (COP>1.0 systems) rather than entropic circuits. Once a broken 3-symmetry with stable 4-symmetry is established (as by forming a dipole), it continues indefinitely unless deliberately destroyed.

(b) Allows direct negentropic reordering of a practical and usable fraction of the vacuum's energy at will, at any point in the universe, easily and cheaply.

(c) Provides for electrodynamic engineering of the vacuum energy and of spacetime curvatures clustered in specific templates (the concept of vacuum engines or spacetime curvature engines). This has significant medical applications {387c}.

(d) Utilizes time as energy (per our previous discussion) and thus allows use of the Whittaker phase conjugate half of the biwave set as an EM energy flow within the flow of time. Observably this translates to the continuous receipt of free time-energy by the formed broken 3-symmetry (e.g., the charge or dipole). Accordingly, the charge or dipole continuously pours out real observable EM energy in 3-space, without any observable EM energy input (time is not observable, and neither is the time-polarized photon alone).

(e) Allows "burning a little time for fuel", so to speak, in order to transduce it into a very large spatial energy flow, due to the enormous compression of 3-spatial energy represented by time-energy by a factor of c^2.

So from the giant 3-negentropy discovery, we have arrived at some intriguing findings:

(a) As is well known in particle physics, the opposite charges of a dipole constitute a broken 3-space symmetry in the violent flux exchange between the active vacuum and the dipole.

(b) This dipole's broken 3-space symmetry in EM energy flow, provides a *relaxation* to a more fundamental EM energy flow symmetry between the time domain and 3-space, and therefore in 4-space.

(c) There is no law of nature or physics that requires 3-symmetry of EM energy flow as an additional condition applied to 4-symmetry of EM energy flow. Instead, 4-symmetry energy flow is more basic, by the hierarchy rule.[70]

[70] Quoting Steven Weinberg: *" ..there is a hierarchy of symmetries; whatever symmetry unites the gravitational and strong nuclear forces with the electroweak*

(d) The dipole is a practical and very simple means of "breaking" the additional 3-flow symmetry condition in EM energy flow our systems have previously exhibited, and relaxing to the fundamental 4-flow symmetry *without* 3-flow symmetry.

(e) So long as the dipole statically exists (e.g., imagine an electret suddenly formed, or a charged capacitor with no leakage), real usable EM energy circulation between time and 3-space, at each point in 3-space, will continuously move out from the dipole at light speed in all directions. In the view of the observer, at the same time, reactive EM power (actually, time-energy) will continuously flow into the dipole from the time-domain (the complex plane), and be transduced into real EM power output radially outward in 3-space from the dipole.

(f) Observably, a dipole or dipolarity and its scalar potential thus comprise a *true negative resistor* system of the most fundamental kind. The dipole continually receives EM energy in unusable form (reactive power, which cannot perform real work), converts it to usable form (real power, which can perform real work), and outputs it as usable, real EM energy flow (real power) in 3-space. Further, it spreads this "transformation of time-energy into 3-space energy at every dipole point" outward in 3-space in all directions.

(g) So at its formation the dipole initiates a continuing *giant negentropy* — a progressive reordering of a substantial and usable portion of the vacuum energy {201} that begins with dipole formation and continues. Further, this reordering of vacuum energy flow at every point in space continuously spreads in all directions from the initiation point, at the speed of light. Dipoles in original atoms formed shortly after the beginning of the universe, have been pouring out real EM energy for some 14 to 15 billion years or so (i.e., in the prevailing view; the age of the universe and whether it is expanding are still controversial {754}), and have reordered a fraction of the vacuum's energy, where the magnitude of the re-ordering varies inversely as a function the

forces is broken roughly a hundred million million times more strongly than the symmetry that unifies the weak and electromagnetic interactions. The puzzle of explaining this enormous difference in fundamental energies is therefore known in elementary particle physics today as the hierarchy problem." [Weinberg, *Dreams of a Final Theory,* Vintage Books, Random House, 1993, p. 205],

radial distance from the dipole.[71] This is in fact the solution to the long-vexing problem of the source charge and its associated fields and potentials and their energy, reaching across the universe. The charge together with its associated clustering virtual charges is a set of composite dipoles, hence a multiple *broken 3-symmetry* energy flow system.

(h) If the dipole is destroyed, the ordering of the vacuum energy ceases, leaving a "separated chunk" of reordered vacuum energy dynamics that continues to expand at the speed of light in all directions, steadily reducing in local intensity as it expands.

(i) At any very small volume in space, from the dipole dynamics of the universe it follows that a great conglomerate of reordered vacuum flows and fluxes — some continuous, some chopped — is continually passing through that volume. Further, the situation is totally nonlinear, so that direct wave-to-wave interactions occur continuously amongst these energy flows and waves. We hypothesize that this is the actual physical mechanism constituting Puthoffs cosmological feedback mechanism {202}.

(j) Further, in 1904 Whittaker {203} showed that any EM field or wave pattern can be decomposed into two scalar potential functions. This initiated what is called *superpotential theory*. Each of the two potentials for those functions, of course, decomposes into the same kind of harmonic longitudinal EM wavepairs as shown in Whittaker 1903, plus superposed dynamics. In other words, the interference of scalar {204} potentials — each of which is actually a set of longitudinal EM waves, and not a scalar entity {205} at all, but a *multivectorial* entity — produces EM fields and waves and their dynamics. Hence we hypothesize that the Whittaker interference of the propagating reordered EM energy entities, continuously occurring at any point in space, generates the zero-point EM field energy fluctuations of the vacuum itself. Indeed, an AIAS group paper by Evans *et al.* {206} has already shown that just such "scalar interferometry" produces transverse EM fields and waves in the vacuum at a distance.

[71] The field energy density in the fields produced by the source charge varies inversely as the square of the radial distance. The potential energy density in the potentials produced by it will vary inversely as the distance.

Since energy can neither be created nor destroyed, there really are no true *energy sources* in nature in the sense that they *create* energy and pour it out {207}. Instead, what we call "energy sources" merely convert the energy already there in one form, into another form. All energy sources are no different from a solar cell in the sun, or a windmill in the wind, at least in principle. They are actually energy transducers rather than energy sources. This corresponds well with the conservation of energy law wherein not a single joule of energy can be created or destroyed. Instead, the form of that joule of energy can be continually changed. Every joule of energy present in the universe after its formation is still present, and is still doing joule after joule of work in iterative interactions with transducers that change its form.

A priori, we can measure no real 3-space input of EM energy to the unchanging charge but we can measure real 3-space EM energy pouring from it. Energy must be input to it from the active vacuum in a *nonobservable* form, and converted by it into an *observable* form that is re-emitted, usable, and produces what we call the "fields and potentials" and their energy, associated with that "source charge". As is common usage, we will continue to use the term "source charge" or "source dipole", but with the understanding that we refer to a special kind of *energy transducer*.

When we "make entropy", we must do work. Even so, doing work is not really entropic unless we also lose control of the energy[72] — whose form was merely changed by doing the work — and thence lose any *further* ability to use that energy (change its form, or transduce it) to do useful work. And when we observe entropy, we also do work in the observing. Some of the erroneous notions about entropy desperately need correcting. E.g., quoting Weinberg {208} for a lay definition of entropy:

> ***"..a certain quantity called entropy:*** *To define entropy, imagine that some of the system's temperature is very slowly raised from absolute zero. The increase in entropy of the system as it receives each small new amount of heat energy is equal to that*

[72] An interesting point is that energy is energy and remains energy. "Disordered" ultimately means "unusable" or "inconvenient" and nothing else. Disordered energy is still energy, and if we do not lose it from the system we can in fact have the **system** automatically reorder it, e.g. by use of simple retroreflection. The entire concept of entropy must be rigorously interpreted in terms of "energy whose reuse is lost", at least by the processes being performed by the system considered. In our view, "entropy" itself is just additional usually "lost" energy to be recovered.

energy divided by the absolute temperature at which the heat is supplied."

"....entropy, which always increases with time in any closed system..."

However, we point out that apparently there exists no completely closed system in the entire universe. In the notion of entropy and the escape of the energy from their "closed" system, thermodynamicists themselves ubiquitously negate the latter premise that entropy in a completely closed system always increases with time. That simply does not follow. The real situation is as follows: (i) Entropy in a half-open system with no allowed external input of energy, but with allowed escape of energy, does decrease with time if the energy of the system decreases with time by escaping.[73] Hence the cooling of "hot" water with time, if and only if the excess energy in the system can have a net escape to the (cooler) environment as time passes, (ii) Energy in a completely closed system (closed to both energy and mass), with no input and no output of energy at all, simply remains constant because it is not dissipated; simply apply the conservation of energy law. It may rearrange within, and the subcomponent energies may disorganize with respect to range, but the total energy remains. Entropy actually only deals with the loss of ability to utilize the energy. To wit, the assumed (and apparently true, so far as we can tell) conservation of energy in the present universe is an example. A closed system is in this sense a special case of a system in equilibrium with its active environment.[74] I.e., any "closed system" is such a special case.

[73] In case the reader has not thought of it, until the energy "escapes" it is not dissipating or dissipated from the dissipating "object". A "hot" object is energetically excited but not hot; the *energy dissipated* from it (including from every component within it) is scattering, and hence disruptive and "hot" in its interaction with a test instrument (or one's finger). The thermometer (or any other instrument) is external to the rest of the system (even if imbedded in it). Hence merely to "measure the temperature" is actually to pass energy out of the system into the thermometer (or other instrument), so that the thermometer measures the heat of the dissipating energy that has just escaped from the system. For these and similar reasons, Romer — former editor of *A. J. Phys.*— pointed out that "heat" should not even be used as a noun {84}.

[74] The concept of energy always requires that one can write "energy of. ..(X)" and fill in the (X). We usually write the phrase "of…(X)" as "X energy". Thus we write the phrase "energy of heat" as "heat energy," the "energy of the vacuum" as "vacuum energy", and the "energy of the EM entities" as "EM energy". At least in its usage, energy always requires a medium or entity "having" or "exhibiting" the energy. As Feynman pointed out, we really do not know what "energy" per se *is.*

(iii) In a system closed with respect to output (escape) of energy, but with the system opened only to allow external input of energy, the system energy will increase, simply by the conservation of energy law. That system's entropy will decrease and its negentropy will increase. (Its mass will also increase, and so it violates the thermodynamic misdefinitions of closed system; see Appendix A). It is well known that the entropy of an open system far from equilibrium cannot even be computed! (iv) Energy in an open system where input of energy and escape of energy both occur, may either increase, decrease, or remain constant, depending upon whether the input rate exceeds the output rate, or vice versa, or the energy input and output rate are equal. Therefore such a system can exhibit overall entropy, overall negentropy, or overall equilibrium, (v) Net energy scattering rate (rate of energy escaping the system in disordering fashion) from a hot system determines the observed temperature of that system at the time of observation. The system itself is cold, prior to escape of the energy. The "heat" is due to the interaction of the escaping energy with an external object, in its disordering fashion. Inside the system prior to escape, the energy is ordered hence cold.

A system in equilibrium in its exchange with its active external environment is in a state of maximum entropy *for that specific rate of energy exchange with its environment.* As we will point out in Chapter 9, by deliberately balancing the *system-and-vacuum* exchange with the *system-and-curved spacetime* exchange, so that the two exchanges are equal and opposite at a desired rate of exchange, one may establish (at least in theory) system equilibrium at whatever specific rate of energy exchange is desired.[75, 76] In this fashion, e.g., an "impossible" molecule normally intensely unstable and decaying in a nanosecond or less, can in fact be stabilized once an appropriate balance between the two opposing energy exchanges with the system is achieved at the required specific rate of energy exchange. This is actually a new Lorentz symmetrical regauging

[75] This is necessary, e.g., to close-loop a COP>1.0 EM unitary system taking its input energy from the vacuum, as we shall see in Chapter 6.

[76] The Fogal superluminal transmission system in fact uses a conventional signal input to change this "symmetrical regauging" condition in consonance with the amplitude of the input signal. Thus suddenly Lorentz symmetrical regauging becomes a way to transform a conventional signal into a signal consisting of changes in the stress energy potential of the vacuum. That constitutes a longitudinal EM wave, and so it is not limited by the speed of light. To use this process, a Fogal semiconductor must be used as the modulator in the "transmitter", and another must be used as the demodulator in the "receiver".

condition; change of symmetrical regauging is very useful in this fashion. In this way, a great new chemistry with reactions presently deemed impossible is in the offing, and it is already being developed by at least one U.S. company. We do not name the company, under our tacit agreement with the scientists doing the work.

To operate conventional entropic systems,[77] first we must input energy to the inert system to force it out of equilibrium and back into excitation (back into an asymmetrically rcgauged system, violating the Lorentz condition) so that it has some excess energy (and negentropy). Then we allow the decay of the excited system's excess energy to pass through a load and be dissipated from it, doing work for us by powering the load. Conventional systems usually do not recapture the "escaping dissipated energy" but just waste it. *"Dissipating" energy is merely allowing it to escape from the system and from further system control.* Then we brutally force more excitation energy into the system, opening it and breaking its equilibrium to do so. Again we dissipate the system's excitation energy in the load to produce some more work, usually wasting an appreciable fraction of the excitation energy.

In EM systems, it is a little more complex. We continually "switch on" a negentropic flow of EM energy from the vacuum by making a source dipole. In the circuit, we collect a small part of the resulting huge energy flow in space surrounding the circuit conductors. Then we use half the collected energy to destroy the dipole source of the energy flow, while less than half of the collected energy is dissipated in the load (the rest of that second half is dissipated in the external circuit's losses). Hence we must continually restore the source dipole and pay more to do it than we get out in the load as useful work. We make a perfectly good negentropic system, and then forcibly destroy its negentropic ability faster than we power the load and get any use out of it. That's a terrible way to make and use power systems, but it is what has been done for more than a century.

So with our present entropic EM systems (actually our *self-killing negentropic* EM systems) we continually wrestle nature fiercely to the mat, so to speak, by brute force, repeatedly, to bind her into 3-space EM energy

[77] By "entropic system" we mean a system whose excitation energy decays and is dissipated from the system or at least from its further control, so that the entropy (lost or unusable energy) of the system continually increases until equilibrium (total decay of the excitation energy) is achieved. As can be seen, this also can be used to define entropy and increase in entropy. What is usually unappreciated is that *equilibrium is actually a counterbalance between ongoing entropy and negentropy.*

conservation. All the while, nature protests our continual entropic brutality by providing the Newtonian third law reaction force[78] back upon our causative wrestler performing the "forcing". To do entropic engineering, we have to continually input 3-space energy to the wrestling mechanism or engine, losing a bit of the input energy in the inefficiencies, and fighting the "back emf", "back mmf", or Newtonian third law reaction that is nature's cry of protest all the while. Those are nature's penalties for imposing a monstrous 3-space EM energy flow symmetry[79] upon her as an *additional, highly undesired, and highly unnatural condition* added upon her beloved special 4-symmetry energy circulation between the time domain and 3-space.

In short, because we so love entropic engineering and 3-space EM energy flow symmetry, we have to provide the continual input energy to our entropic processes by burning fuel, damming rivers, erecting windmills, building waterwheels, erecting solar cell arrays, building and charging chemical batteries, etc. In the process, we destroy and pollute the biosphere on a giant scale as we rip down forests, strip-mine and drill the earth, pile up thousands of tons of radioactive nuclear wastes —that will be hot for thousands of years — from our power plants and related facilities, and spew streams of pollutants into the atmosphere, the rivers, the oceans, etc. We do all that biosphere destruction because we inexplicably insist upon placing cruel chains on nature by brutally enforcing 3-space energy flow symmetry upon her. In the process, we adamantly require adherence to classical equilibrium thermodynamics (as given a somewhat altered explanation above, and also in Appendix A).

We do not have to do it that way. In avoiding solving the source charge problem for so long (more than a century), we have been extremely

[78] Note that Newton's third law reaction is implicit in the special negentropic energy flow circulation of the dipole, or of the charge considered as a set of composite dipoles. The same energy that moves into 3-space from the time domain, then returns from 3-space to the time domain, at every point in the 4-circulation. If we consider the positive charge as a "source" of negative energy, then there is a concomitant circulation of negative energy from the time domain to a point in 3-space, and back to the time domain.

[79] The 3-space symmetry of energy flow equilibrium is actually between the energy we input (from its external environment) to the system, and the energy that escapes from the system back into its external environment, either in its losses or in its loads. As we stated, equilibrium condition is a balance between ongoing entropic and negentropic operations.

backward in our thinking and in our consequent development of entropic engineering technology.

For our dullness, we have had to pay and pay continuously for insisting on doing such atrocious entropic work and forcing nature to do it that way. In so doing, we "tie nature's feet" with that added arbitrary 3-symmetry in energy flow. We ourselves prohibit nature from performing the giant negentropy she so dearly loves and much prefers. We also arbitrarily and *meanly* discard the bountiful electromagnetic energy flow that nature loves to furnish us so freely by her vast preference for giant negentropy. We meanly discard nature's bountiful giant negentropy banquet free for the taking, by our vast thirst for giant entropy and doing violence to nature. Because we act like brutes instead of scientists, we destroy nature in spite of nature's continuing attempt to give us all the EM energy we wish, freely except for a little switching cost.

A far better way is to cooperate with nature and "let nature make her beloved copious negentropy" as she yearns to. To do that, we now can see the startlingly simple mechanism. We simply make a little dipole, *once*, entropically. So we have to pay for *making* the dipole, *once*, and we have to do just a little gentle violence to nature, *once*. Then we need do no more violence, if we just leave the dipole intact and do not destroy it. In short, we do have to tap nature gently on the shoulder. We do not have to brutally knock nature down to the mat, repeatedly.

When we make the dipole, we make a little bit of "broken 3-symmetry" in the universe's energy flow. Voila! Nature sings for joy at finally having her feet freed from the shackles of the horrid 3-symmetry energy flow. In great glee, she instantly relaxes into her dearly preferred giant negentropy and 4-symmetry. She instantly sets to re-ordering a substantial and usable

[80] E.g., so far as I am aware, there have been no funded research programs to discover how to deviate and collect some of the freely flowing energy from a permanent magnet or an electric dipole. Instead, electrodynamics has smugly continued to call it "statics" as if there were no dynamics, and ignored the giant negentropy circulation that is "seen" as the steadily outflowing field energy in 3-space, and erroneously called the "static field". There is no such thing as "statics" in the entire observed universe *a priori;* the very process of observation itself is dynamic. What we see as "static" is continual recurrence of a given condition or state or magnitude, as beautifully pointed out by Van Flandern {628}. One might even say that, not only is nature energetic, nature *is* energy, constantly changing and in motion in innumerable ways at once! One might even define "energy" as the process by which nature both acts and observes its actions, in every form and structure and possibility.

portion of the vacuum energy of the universe, in all directions at the speed of light, spreading her preferred giant negentropy EM 4-energy circulation flow from the dipole toward the ends of the universe at the speed of light. As long as we do not destroy the dipole (the broken 3-symmetry) that gently breaks the 3-symmetry shackles, nature's feet remain freed from brutal 3-space symmetry in EM energy flow. In that case, she delightedly continues to reorganize a portion of the vacuum energy, with the reordering spreading radially outward at the speed of light. Simply making a common dipole or charge[81] sets nature to going about reordering an ever-increasing fraction of the entire vacuum energy of the universe, and continuing indefinitely.

Simultaneously with freeing her from enforced 3-space EM energy flow symmetry, in great gratitude nature pours out an immense real EM energy 3-flow from that little dipole or charge. She will continue to pour it out forever for us, if we do not destroy the dipole or charge.

Instead of the present universal entropic engineering, the smart thing to do is make just a little bit of entropy wisely, using the work we get to break 3-space energy flow symmetry (basically, to make a dipole). *Then leave that mother of all negative resistors and free energy flow generators alone and forever unchanged!* Concentrate on intercepting, extracting, and using the free 3-space energy copiously flowing forth from the giant negentropy, without destroying the dipole that is freely providing it.

3.6 How Circuits Are Powered

Let us now look at the great magnitude of the energy flow that nature gives us from that dipole. We have to get into the subject a bit, because EM energy flow theory has been rather thoroughly confused for more than a century.

First, batteries and generators *do not* use their available internal energy — the shaft energy we input to the generator, or chemical energy available in the battery — to power the external circuit. Instead, each uses its available internal energy {209} to perform work on its own internal charges, forcibly separating the charges to form the *source dipole.*

See again Figure 3-4. *All the hydrocarbons ever burned, all the nuclear fuel rods ever consumed, and all the dams ever built, added not one single watt directly to the power line.* All the energy from those activities was

[81] As we previously explained, a charge is just a set of composite dipoles.

input to the generator shaft after normal losses en route, to provide internal magnetic energy available to the generator. In turn, the generator used that available internal magnetic energy only to do internal work on its own internal charges to force them apart, forming the source dipole connected to the terminals. Generators are energy transducers only; they do not directly power their own external circuits.

Batteries and generators expend their internal energy available to them, to make the source dipole, and for no other purpose! None of their internal energy is used to power their external circuit. It never has been, and it never will be.

Once the source dipole is formed, it does all the hypothesized 4-functions we pointed out previously. It induces the spreading giant negentropic reordering of the vacuum energy, extracts (transduces) EM energy from the continuously reordering vacuum, and pours out from the terminals of the generator (or battery) a vast 3-flow (as observed) of EM field energy along the external circuit. As indicated by Kraus's illustration of the Poynting component {210}, this giant EM energy flow fills all space surrounding the circuit, out to an infinite lateral radius.[82] The energy flow is generally parallel to the conductors of the circuit. Only a tiny component of this flow — due to the surface charges of the conductors and the little boundary layer of energy flow that slides along the surface of the conductors — strikes the surface charges and gets diverged into the conductors (by the lateral withdrawal of the surface charges — with the "stub" or "base" of their field energies — laterally into the conductors. The electrons move mostly laterally, withdrawing from one side of the conductor surface to the opposite. Only the tiny component of its field vector integrated over that small distance is withdrawn into the conductors to power the electrons. This small amount of "withdrawn" energy is the diverged Poynting component, "collected" by the circuit. It also is the small component then used (dissipated) to power the Drude electrons and the circuit.[83] All the rest of that vast EM energy flow in the surrounding

[82] We accent that Kraus, along with other authors, only shows the 3-space *Poynting component* of that flow; i.e., he shows the very small amount of that external 3-space energy flow that is diverged into the circuit to potentialize the Drude electrons and power the circuit. Kraus *does not* show the remaining Heaviside component that is not diverged.

[83] As shown by Kraus, some of the energy flow at the various radial distances from the wire is withdrawn, as the surface electrons and the "stubs" of their near fields precess laterally into the depths of the wire when potentialized. Jackson, *Classical Electrodynamics,* Second **Edition,** Wiley, 1975, p. 223 also points out the nonlocal

space, that pours forth from the terminals, just misses the circuit entirely. It roars on off into space and is wasted.[84]

The diverged, utilized, and accounted energy flow component — the *Poynting component* — is only a tiny, tiny fraction of the entire giant EM energy flow produced by the source dipole for every circuit.

3.7 The Heaviside Component vs. the Poynting Component

Unless Heaviside and Lorentz did rigorous calculations in a work we have not yet uncovered, we could not find any development of the functions and equations required for computing the numerical ratio of the unaccounted Heaviside "dark energy flow" *{nondiverged* energy flow component that misses the circuit), to the tiny Poynting energy component thai strikes the surface charges of the conductors {211} and is diverged into the wires to power the circuit when the surface charges precess laterally into the wire.

Consequently, we performed a very crude "special case" estimation {212} — a back-of-the-envelope type, with highly simplifying assumptions — for a very simple circuit in which one resistor is powered by a DC source. Our crude estimate showed that about 10^{13} times as much EM energy flow *misses* the circuit, is *not diverged,* and is *wasted* — as *strikes* the circuit, gets collected, and then is dissipated in the circuit to power the load and losses. Until electrical physicists re-examine the energy flow theory and

involvement of the transverse current. Quoting: *"...the transverse current... extends over all space, even if J is localized. "* One notes that present electrical power systems concentrate exclusively on the J current, making no attempt to collect and utilize the recognized but rather ignored transverse current.

[84] Note, however, that this Heaviside energy flow component differs from ExH. The Heaviside component is totally nondiverged (being actually in curl or swirl form), and since E and H are both diverged energy components assumed around an **Interacting** unit point static charge, there is neither E nor H in the electrical engineering sense prior to interaction with charge. So the energy flow in both the Poynting and Heaviside components is in a force-field-free form until intercepted by and interacted with charge. Poynting's component, e.g., assumes only that energy co**mponent** that does interact with charge and get withdrawn into the circuit. **Heaviside's** component assumes only that energy component that does not interact with charge and does not get withdrawn into the circuit.

again recover the Heaviside unaccounted component in it, that brute force estimate will have to suffice as at least an illustrative example.[85]

What does that 10^{13} ratio mean? For a little 1 watt generator of that DC type with that specific size conductors and that specific resistor, the Heaviside unaccounted energy flow component was about *10 trillion watts*, occupying all space surrounding the wire,[86] if all of it could be intercepted, collected, and used to power loads {213}. But the little circuit was only intercepting and collecting — and using to power loads — about 10^{-13} of the available energy flow surrounding the circuit, *if all* of it could have been intercepted, collected, and used to power loads.[87]

We have never had, and we do not now have, an *EM energy* shortage or problem. We never will have one, due to nature's bounty in providing us with the giant negentropy of the common dipole and of the charge considered as a composite dipole. Instead, we have the two problems that

(i) only a tiny, tiny component of the available 3-energy flow extracted from the vacuum (decompressed from time-energy) by

[85] We would very much welcome a much more accurate functional expose by a capable higher group symmetry electrodynamicist!

[86] We also point out that none of this nondiverged energy flow component is accounted in conventional electrodynamics and electrical engineering (the closest it comes is Jackson's mention of the transverse current over all space), and neither has it been accounted or even investigated by biophysicists seeking to determine the effects of EM radiation and fields upon biological systems. We strongly suspect (and have done a little work on the problem) that these "force-free fields" and neglected excess "strange energy" flows do have interactions throughout the highly nonlinear cells of the body, and can indeed have profound long term effects on long-exposed biological systems. We particularly stress the potential for time-charging and subsequent *combined scalar and longitudinal photon pair* decay of time-charge excitation in the body. Several major areas of electrodynamics — such as the transverse current effects, Heaviside component effects, and internal Whittaker structuring (engines) effects of EM radiation — have not been investigated by the scientific community.

[87] We accent that time-energy may be regarded as spatial EM energy compressed by the factor c^2. Hence one second = 9×10^{16} joules of EM spatial energy, if decompressed by time-energy interaction with charge. The crude estimate for one circuit of 10^{13} times as much energy being wasted in the Heaviside energy flow component as is caught and used in the Poynting component, is thus quite reasonable when one recognizes that *all* the EM energy flow appearing in the circuit or outside it actually comes from the time domain, hence constitutes *decompressed time-energy*.

the source dipole and poured out of the terminals of the power source, is caught and used by the circuit, and

(ii) in the closed current loop circuit, half of that small spatial EM energy component that is intercepted and caught, is used by the circuit only to destroy the source dipole and cut off the free flow of EM energy from the vacuum faster than it powers the load.

We have previously discussed this further in several papers {214}.

One must occasionally keep one's sense of humor. The real problem that the Department of Energy should be working on, with massive resources, is simply the alteration of the closed current loop circuit so that it does not destroy the source dipole faster than it powers the loads. Secondly, they should then be working on how to close-loop the COP>1.0 EM systems that readily emerge from that research. Yet it appears that this fundamental energy problem — and the *only* energy problem — has no conventional work being openly done on it anywhere in the open Western world.[88]

3.8 Dark Positive Energy: The Unaccounted Heaviside Component

Now we restate a deceptively hidden thing: The EM field and potential are defined as the observed effect of the deviation from them by an assumed unit point charge. Then that same field and potential are assumed to be in mass-free space, before the interaction with charged matter. Hence the

[88] Using the U.S. as an example, the U.S. classified community is highly compartmented, and the real "organization" of a given compartment often consists of laterally connected "same clearance" compartments in multiple outside agencies rather than vertical chain of command through one agency. We accent that some highly compartmented "lateral" classified organizations in the West and elsewhere already have working COP>1.0 systems, and have had them for several decades. Some of these laterals in the U.S. are very dedicated to the duly elected government of the United States, with good national security reasons for the fact that they "officially do not exist". Some are not so dedicated at all, and have their own agendas having little if anything to do with official U.S. government policy. These latter "rogue" laterals often have convenient connections with outside shadowy groups of the High Cabal (Churchill's phrase). A similar situation exists in several other major foreign nations. Substantial electrodynamic technology has been developed (and weaponized) for decades, in secret, and this technology does not appear in the open news, the university texts, or the scientific journals. Such is the case for COP>1.0 EM power systems, which have actually existed in secret for decades.

field and potential have each been defined erroneously as both a cause and an effect. This is a gross non sequitur. There is also a total lack of accounting that all EM energy in 3-space comes from the time domain. There is no consideration that every dipolarity and every charge represents a giant circulation of EM energy between time and 3-space. In ensemble, this non sequitur and these omissions are responsible for most of the present formidable foundations problems in electrodynamics.

We submit the following new hypothesis: *The present "definition" of field and potential as a function of interception and divergence by a unit point static charge are only indications of their point intensity, obtained as an estimate after their observed interaction with a unit point static charge.*[89] *Thus the actual field and potential contain not only their Poynting components that interact with the unit point charge, but also their Heaviside nondiverged components that do not interact with it. The true "magnitudes" of the massless field and potential prior to interaction with charged mass are many orders of magnitude greater than the magnitudes of their standardized point intensities* {215}.

In short, we propose that *every field and potential, in its interaction with charged mass, produces not only the accounted energy aspects presently calculated by electrodynamicists and astrophysicists, but also contains Heaviside's vast unaccounted "dark positive energy" component presently discarded.* We further propose that this ubiquitous and unaccounted "dark positive EM energy" component in the interactions of the fields and potentials of the spiral galaxies is what is producing the excess gravity that is holding the spiral arms together. We specifically do this in honor of Heaviside, whose unpublished papers clearly establish that he recognized the overwhelming gravitational importance of his extra and unaccounted energy flow component {172a, 172b, 196}.

3.9 A Short History of the Discarding of the Heaviside Dark Energy

3.9.1 Independent Work by Heaviside and Poynting

Let us now see how the enormity of the EM energy flow from the dipolar source was treated in the early electrodynamic theory, and how it is treated in the received view today.

[89] This is recognized by leading electrodynamicists, but not by most electrical engineers building power systems!

In the 1880s after Maxwell was already deceased, Poynting {216} and Heaviside {217} independently (and rather simultaneously) discovered EM energy flow through space. Before that, the concept did not appear in physics. Poynting {216} published prestigiously, while at first Heaviside published more obscurely {217}, then finally more prestigiously {218, 219}.

With respect to circuits, from the beginning Poynting assumed only that small amount of EM energy flow that enters the circuit from the surrounding space. Here are Poynting's {220} own words:

> *"This paper describes a hypothesis as to the connexion between current in conductors and the transfer of electric and magnetic inductions in the surrounding field. The hypothesis is suggested by the mode of transfer of energy in the electromagnetic field, resulting from Maxwell's equations investigated in a former paper ("Phil. Trans., " vol. 175, pp. 343-361, 1884). It was there shown that according to Maxwell's electromagnetic theory the energy which is dissipated in the circuit is transferred through the medium, always moving perpendicularly to the plane containing the lines of electric and magnetic intensity, and that it comes into the conductor from the surrounding insulator, not flowing along the wire. "*

As can be seen, Poynting considered only the energy flow actually entering the wire, and subsequently being dissipated in the circuit. Hence Poynting never considered the huge EM energy flow component around the circuit that is *not* diverged, *misses* the circuit entirely, *does not* contribute to the energy dissipated by the circuit, and is *wasted.* In short, there is a vast "dark energy flow" associated with every dipolar interaction — a huge energy flow component which Poynting never considered.

Heaviside's theory was an extension of what Poynting had considered, and Heaviside also corrected Poynting as to the direction of flow. Heaviside was fully aware of the enormity of the "dark energy" flow missed by Poynting, but had absolutely no explanation as to where such a startlingly large EM energy flow — pouring from the terminals of every dipole, generator, or battery — could possibly be coming from. Consequently, Heaviside was very cautious in referring to it, usually doing so only obliquely in terms of the angles and components. In Heaviside's {221} own words:

> *"It [the energy transfer flow] takes place, in the vicinity of the wire, very nearly parallel to it, with a slight slope towards the wire... . Prof. Poynting, on the other hand, holds a different view, representing the transfer as nearly perpendicular to a wire, i.e., with a slight departure from the vertical. This difference of a quadrant can, I think, only arise from what seems to be a misconception on his part as to the nature of the electric field in the vicinity of a wire supporting electric current. The lines of electric force are nearly perpendicular to the wire. The departure from perpendicularity is usually so small that I have sometimes spoken of them as being perpendicular to it, as they practically are, before I recognized the great physical importance of the slight departure. It causes the convergence of energy into the wire. "*

As can be seen, Heaviside was fully aware that the energy flow diverged into the wire was only a minuscule fraction of the total. He was fully aware that the remaining component was so huge that the energy flow vector remaining — after the divergence of the Poynting component into the circuit — was still almost parallel to the conductors. However, he had no explanation at all of where such an enormous and baffling energy flow could possibly originate.

Had Heaviside strongly stated the enormity of the nondiverged component of the energy flow, he would have been viciously attacked and scientifically discredited as a perpetual motion advocate. His words were measured and cautious, but there is no doubt that he recognized the enormity of the nondiverged EM energy flow component.

We have chosen to call that huge unaccounted component the "Heaviside dark energy component" in his honor, since he actually discovered it. By the word "dark" we mean "unaccounted", which hides it from scientific view. We have also nominated it as the previously unsuspected source of the extra gravity holding the arms of the spiral galaxies together.

3.9.2 Lorentz Disposed of the Problem Rather than Solving It

Lorentz then entered the EM energy flow scene to face the terrible problem so quietly raised by Heaviside. Lorentz understood the presence of the Poynting component, and also of the extra Heaviside component, but could find no explanation for the startling, enormous magnitude of the EM energy pouring out of the terminals of the power source (pouring from the source dipole) {222} if the Heaviside component was accounted. Had

he retained and advanced this enormous dark energy flow component, even the great Lorentz would have been castigated as a perpetual motion advocate who did not accept the law of energy conservation. Even today, when one points out that far more energy is pouring out of the terminals of every generator than the small mechanical energy input to the shaft, one is immediately labeled a raving lunatic — even though the Bohren experiment {24} clearly proves the presence of an extra energy flow component not usually intercepted. It is not difficult to understand how such a bombshell would have been received in the 1880s! At least today, we have particle physics and its broken symmetry of opposite charges, together with its active vacuum, to explain where the excess energy comes from and how.

Unable to *solve* the dark energy flow problem by any rational means, Lorentz found a clever way to *avoid* it. He reasoned that the nondiverged Heaviside component was "physically insignificant" (his term) because it did not even enter the circuit. Since it did nothing of any physical consequences, or so he reasoned, then it could just be discarded.

So Lorentz simply integrated the entire energy flow vector (the vector representing the sum of both the Heaviside nondiverged component and the Poynting diverged component) around an assumed closed surface enclosing any volume of interest {223}. *A priori,* this mathematical procedure discards the dark *Heaviside* energy flow component because of its nondivergence. It retains only the intercepted *Poynting* diverged component that enters the circuit.

A century later, electrodynamicists are still happily avoiding the dark energy flow problem by continuing to use the Lorentz integration procedure {224} to dispose of all but the Poynting component that enters the circuit and is then dissipated by the circuit. As a result, the "Poynting energy flow" has come to be loosely regarded as "the" entire EM energy Mow, though electrodynamicists find it necessary to give stringent warnings about it. E.g., Panofsky and Phillips {225} state it this way:

> *"...only the entire surface integral of N [their notation for the Poynting vector] contributes to the energy balance. Paradoxical results may be obtained if one tries to identify the Poynting vector with the energy flow per unit area at any point."*

Most electrodynamicists note the freedom to add a vector — few call it an *energy flow* vector, though that is the type of vector being discussed, and

one must add apples to apples — which has zero divergence. Jones {226} states:

> *"It is possible to introduce the Poynting vector S, defined by S = ExH, and regard it as the intensity of energy flow at a point. This procedure is open to criticism since we could add to S any vector whose divergence is zero without affecting [the basic integration procedure's result]."*

Jackson {227} says it even more plainly, and also uses Lorentz's "no physical significance" argument for disposing of any energy flow vector with a zero divergence. Quoting:

> *"...the Poynting vector is arbitrary to the extent that the curl of any vector field can be added to it. Such an added term can, however, have no physical consequences."*

Any energy flow vector, which is the curl of a vector field, will have zero divergence, by elementary vector algebra. In short, to be pertinent at all, it must be an *energy flow* vector (since energy flow is what S = E x H is all about. Since the curl of any vector has no divergence *a priori*, then any energy flow vector that is a curl of a vector field will be part of the Heaviside dark energy flow component, rather than part of the Poynting energy flow component. It will also be discarded by Lorentz's closed surface integration.

We refer the reader again to Figures 2-5 and 2-6 in Chapter 2, p. 113-114. Electrodynamicists err in assuming that such a divergent free vector (energy flow) can have no physical consequences. If one inserts *additional intercepting charges* into that formerly nondiverged energy flow component, the charges will immediately diverge some of the formerly nondiverged energy flow around them and hence "collect additional energy". In other words, "divergence" is the result of a physical process, accomplished by intercepting charges. We can easily change "nondiverging" energy to diverging energy, by simply interacting it with charges. We can also "bunch" the energy flow lines closer together (as in some waveguides), thereby increasing the local flow intensity and the concomitant energy collected by each intercepting charge in the densified energy flow stream.

So whether the Heaviside energy flow component is of physical consequence or not, depends on whether or not we "add more sail to the sailboat", or "add more sailboats" before the wind. That is most certainly a

useful physical consequence, and with a little ingenuity we ought to be able to use it to power loads "for free" or nearly so. There are other consequences also, as we used in deriving the negentropy of the dipole or charge. There the input of a non-Poynting energy flow component certainly has universal and physical significance — e.g., to the curving of local spacetime, conditioning the active vacuum, furnishing all the energy to form the EM fields and potentials from their source charges, etc.

Schwarz {228} expresses it this way:

> *"There will be many opportunities in which the interpretation of E x H as a rate of flow of energy per unit area will be profitable. In most cases of practical interest, such an interpretation is valid, although it must always he kept in mind that only the integral of S over a closed surface can be physically measured... Just how it is that the connections to the energy source, say a battery, are at the ends of the wire, yet energy flows in through the sides, should be pondered by the reader. "*

Note carefully that Schwartz recognizes the difference between the observed (deviated or diverged) part of the EM energy flow and the unobserved nondeviated or nondiverged part of it. However, he did not follow it up and apply it back to the basic "definition" of the field and potential as what are diverged from them.

For recommended changes to the Poynting vector, Jones {229} presents many conditions the changed vector must fulfill. Then he falls back on the Lorentz closed surface method again, but without realizing that he therefore (i) first includes both the diverged and nondiverged component, and (ii) invokes a procedure that arbitrarily discards the nondiverged component. In thus disposing of the problem, Jones says:

> "It *does not seem likely that an expression satisfying all these conditions will be simple.....fortunately, we are rarely concerned with the energy flow at a point. In most applications we need the rate at which energy is crossing a closed surface."*

Finally, we note that even today, a debate on what the Poynting vector is or should be, is still politely ongoing. As an example, it has been ongoing for more than 40 years in the *American Journal of Physics* alone as well as in other journals {230a-230i}. One thing is clear: The Poynting vector does not represent the total energy flow at right angles through a square

meter in space surrounding the conductors of the electrical circuit. It is, however, the *component orfraction* of that actual energy flow through the square meter in force-field-free form *that will subsequently be diverged and collected in the circuit in force-field form and dissipated in the circuit loads and losses.*

3.10 The Problem of the Accelerating Expansion of the Universe

As briefly stated earlier, we introduce the notion of the supersystem, consisting of three parts: (i) the system and its dynamics, (ii) the active vacuum and its dynamics, and (iii) the active spacetime curvatures and their dynamics. All three components of the supersystem interact with each other.

In Chapter 9, we explain in some detail how a COP>1.0 EM circuit — and especially a COP»1.0 EM circuit — has an induced flow of negative energy (Dirac sea hole current) from the output section of the system, back through the system, and into the input section. Reaching the input section, if the hole flow is not completely filled by incoming electrons, the remaining Dirac hole current will flow on back into the feeder line from the external power supply, and into the distant power supply itself, eating electrons and electron current all the while.

We also explain our reinterpretation of the *unobserved* (non-reacted) Dirac hole with negative energy or negative mass, without time reversal and parity reversal. This dramatically differs from the "as observed" (interacted) Dirac positron with positive mass, and with charge-reversal and parity reversal from the electron. The Dirac hole is "as unobserved and non-reacted" and it is still an *electron* having negative mass and negative energy. The Dirac positron with positive mass, opposite charge, and opposite direction is "as observed and reacted with charged matter". The unobserved Dirac hole is the "cause" of an observational interaction; the Dirac positron is the "effect" of an observational interaction. The two are very different because the cause differs from the effect. Here again, the confusion of cause and effect has had very detrimental consequences in the use of Dirac's electron theory.

Very powerful astronomical phenomena, such as giant astronomical explosions of great energy, involve COP>1.0 and COP»1.0 processes, particularly when the unaccounted Heaviside energy flow is accounted for every field and potential interaction with charged mass. Hence all such phenomena also provide very powerful "explosions" of negative energy

(Dirac sea holes moving outward in the vacuum). The negative energy is the equivalent of negative mass, so long as it is unobserved.

So there is a "dark negative energy explosion" in the Dirac Sea vacuum, accompanying every large astronomical explosion seen through our telescopes and other sensors. This accompanying dark negative energy explosion has not been accounted in astrophysics until now.

We thus live in an astronomical universe of neglected "giant dark negative energy explosions" as well as one of accounted "giant positive energy explosions".

The dark (unaccounted) negative energy radiating outward in the vacuum from gamma bursts, x-ray bursts, etc. produces antigravity. The spreading negative energy, moving at light speed, is a change to the vacuum itself, which also interacts upon spacetime to negatively curve it, producing negative gravity. For those energetic processes of COP sufficiently greater than one, the processes produce more antigravity than gravity. As of this writing, we are in fact filing a patent application on this method of performing and producing antigravity, and it will be filed before this book is published.

Over the 14 billion or so years of the observed universe, the dark negative energy content of spacetime has been slowly changing by the results of giant astronomical explosions and other such processes producing negative energy radiated outward into the Dirac sea vacuum. Slowly the vacuum itself has undergone transformation from the perfect Dirac sea with all holes filled by particles, to a vacuum where there is a slowly growing fraction of negative energy (negative mass) unobserved Dirac sea holes.

Thus, slowly the antigravity generated by the gradual altering of "space" (the vacuum) itself has been growing for some 14 billion years. At some point in the past, the excess antigravity effect accumulating in space reached the equal of the "outside" gravity acting upon energetic explosive astronomical phenomena. From that point in time, the antigravity effect has been increasing slowly. The result is that the present violently explosive astronomical phenomena, by adding a sudden and sharp increase in their external space antigravity, produce acceleration away from all positive mass and positive energy phenomena. Hence astronomers now observe the acceleration of the expanding (positive energy/positive mass) universe, instead of the previously expected slowing (due to positive gravity) of the expanding universe (conventional view).

The antigravity-producing phenomena have not been openly investigated in Western science because Western science has arbitrarily discarded COP>1.0 EM systems, primarily with the Lorentz regauging of the Maxwell-Heaviside equations. Hence, Western science has not experimentally studied the type of system that produces the effect in the first place.

On the other hand, it is possible to directly investigate the antigravity-producing phenomenology on the laboratory bench, by utilizing overunity EM systems with very high COP (e.g., COP = 10^6 or more). The Sweet experiments {231} did in fact produce such phenomenology on the laboratory bench, but these experiments were privately performed under proprietary conditions {232}. We discuss the Sweet experiments and device in a later chapter.

In science, such experiments are quite properly deemed interesting but anecdotal until replicated independently. Similar experiments should certainly be repeated by the scientific community, using various interactions (some given in this book) that develop COP>1.0. The problem is nowhere near as difficult as hot fusion, but it has not been tackled and overcome because of (1) the prevailing and erroneous scientific mindset against COP> 1.0 electromagnetic processes, and (2) the present "kill" of the supersystem and its effects in the standard U(l) electrodynamics model.

In Chapter 8 we further discuss the antigravity effect in practical or potentially practical systems where COP » 1.0.

3.11 In Conclusion

In this Chapter, we have stressed what we believe to be a great new principle of giant negentropy, leading to direct and easy extraction of EM energy from the vacuum in copious quantities. That principle is that nature retains *her preferred 4-symmetry* of EM energy flow, while breaking 3-symmetry of EM energy flow and the symmetry of EM time-energy flow on the fourth axis. It is implemented by making a common dipole or charge.

The electrical energy problem is *not* due to any difficulty in inducing giant and indefinitely continuing EM energy flows from the vacuum! The easiest thing in the world is to extract EM energy — any amount, anywhere, anytime — from the seething vacuum, by making a simple dipolarity. The problem is only in then intercepting and collecting some of the energy to dissipate in loads, and doing it *without* using half the collected energy to

destroy the dipole producing the energy, faster than the loads are powered. In other parts of this book we have given some of the many mechanisms that can be applied to attack this "power the load without killing the source dipole" problem, and have also included such in papers in the literature {233a-233u}.

We have pointed out the implications of the new principle of negentropy in EM energy flow, and how all our circuits and electrical power systems actually use it but then arc designed so as to kill the negentropic process's potential for self-powering electrical power systems.

Presently we are told by the conventional scientific community that the dream of freely extracting EM energy from the vacuum, and using it to efficiently and easily power our electrical needs cleanly, is either a fool's concept of perpetual motion, or the science of the next century. It is neither; it is good physics, and it is already *present and misused* in all our electrical power systems and circuits — and always has been. Unlimited electrical energy from the vacuum is here and now, if we but overcome the prevailing mindset and grasp it.

We have argued that all electrical loads and circuits are now and always have been powered by just such EM energy extracted directly from the vacuum by the giant negentropy principle, evoked by the source dipole. We have removed the artificial and erroneous notion that batteries and generators provide some of their available 3-space internal energy to the external circuit. Instead, we have emphasized that batteries and generators dissipate their available energy to form and then continually reform their source dipole, and nothing else. Once their source dipolarity is formed, a battery or a generator is nothing but an energy gate, gating and transducing enormous EM energy from the vacuum. We only have to keep inputting energy to keep reforming the dipole that our external circuit is designed to destroy faster than the load is powered.

In dealing with the function of the dipole in extracting the EM energy from the vacuum and pouring it out to power the circuit, we have shown errors in present energy flow theory and how they came to be made. We also indicated the enormous magnitude of the EM energy flow actually **extracted** and present with every conventional circuit, but wasted and **arbitrarily** removed from accountability. Some processes for intercepting, co**llecting,** and using additional amounts of this available Heaviside "dark EM energy" flow component, surrounding every circuit, have been mentioned, and references have been given to other papers more fully discussing such processes. In a previous paper {234} we have proposed

that the Heaviside dark energy, accompanying all EM field-charge interactions, is responsible for the excess gravity observed to be holding the spiral arms of those distant spiral galaxies intact — in short, we have proposed an unaccounted Heaviside *dark positive energy* solution to the well-known *dark matter* problem in astrophysics.

The ordinary closed current loop circuit inherently yields a system COP<1.0, because it destroys its source dipoles faster than it powers the load. Indeed, the circuit self-enforces the Lorentz symmetrical regauging condition during discharge of its free excitation (potential) energy.

In addition, we have presented an hypothesis to explain that negative energy (negative mass) created in the Dirac sea vacuum by giant astronomical explosion phenomena produces the excess antigravity in the space surrounding those entities that is accelerating the expansion of the universe. We have also indicated how this hypothesis can be investigated and tested on the bench. We have provided one experiment whose results did support the hypothesis.

The present world energy crisis is real and increasing, while at the same time the availability of oil is beginning to decrease and oil becomes more costly.[90] Unless a substantial fraction of the "electricity from oil" curve is shifted to "electricity from the vacuum" rather quickly, the economic collapse of the Western world, followed by concomitant collapse of other economies, may ensue within a surprisingly few years, and even within the present decade.

[90] As this was first being written in Dec. 2001, there was a temporary relief in the oil crisis, due to the sudden decrease in travel, air traffic, etc. after the terrorist attack on Washington and New York on September 11, 2001. As the present war on terrorism has continued, the MidEast is now heating up toward another war, and oil prices are again trying to climb. Iraq, Iran, and Libya called for an oil embargo on the United States, for example, which would almost immediately plunge the nation into an oil crisis. Meanwhile, should effective terrorist attacks occur upon the highly vulnerable energy distribution infrastructure of the United States and other allied nations, the oil crisis will again emerge catastrophically and almost immediately thereafter. It is held off for now, only because Russia under Putin is seeking U.S. financial assistance to further develop its rich oilfields. When OPEC votes to curtail production and then curtails it, Russia opens the spigot and keeps the prices down. Putin is seeking to become a trusted U.S. oil partner, in the role long played by Saudi Arabia but now declining due to perceived Saudi payments to terrorist organizations and reluctance to close down terrorist activities in their own country. So in a strange way, a new alliance between the U.S. and Russia has prevented the oil and energy prices from escalating right through the roof.

We believe that a transfer of much of the "electricity from oil" curve to an "electricity from the vacuum" curve can be quickly accomplished, if the government and the scientific community can be induced to move with full priority and vigor in the directions indicated in this book. However, to get that done, it apparently will be done over the writhing bodies of our leading scientific organizations, literally dragging the organizations to face the proven fact of giant negentropy of every charge and dipole in the universe over their strenuous objections.

As a major objective, we fervently hope that undergraduate students, graduate students, post-doctoral scientists, other scientists, engineers, and environmentalists will interest themselves in these new principles and viewpoints. We have called attention to the new electrodynamics pioneered by AIAS, Evans, Sachs, Barrett, Lehnert, and others, and indicated the capability of this emerging electrodynamics to model this new *energy from the vacuum* functioning.

It has been said that no idea is accepted until its time has come. We strongly believe that the time for cheap, clean extraction of electrical energy from the vacuum is an idea whose time has arrived. Hopefully our efforts in this book will at least conceptually show the interested reader the outline and course that energy from the vacuum can and will take in the scientific community and in the world at large.

We accent again that modeling the extraction of EM energy from the vacuum demands the use of higher symmetry electrodynamics, particularly a theoretical model capable of expressing the interactions of the three components of the supersystem. Barrett and Grimes {235} said it beautifully:

> *"In the case of electromagnetism, the theory was first simplified before being frozen. Maxwell expressed electromagnetism in the algebra of quaternions and made the electromagnetic potential the centerpiece of his theory. In 1881 Heaviside replaced the electromagnetic potential field by force fields as the centerpiece of electromagnetic theory. According to him, the electromagnetic potential field was arbitrary and needed to be "assassinated" (sic). A few years later there was a great debate between Heaviside and Tait about the relative merits of vector analysis and quaternions. The result was the realization that there was no need for the greater physical insights provided by quaternions if the theory was purely local, and vector analysis became commonplace.*

The vast applications of electromagnetic theory since then were made using vector analysis. Although generations of very effective students were trained using vector analysis, more might be learned physically by returning, if not to quaternions, to other mathematical formulations in certain well-defined circumstances. As examples, since the time when the theoretical design of electromagnetism was frozen, gauge theory has been invented and brought to maturity and topology and geometry have been introduced to field theory. Although most persons view their subject matter through the filter of the mathematical tools in which they are trained, the best mathematical techniques for a specific analysis depend upon the best match between the algebraic logic and the underpinning physical dynamics of a theoretical system. "

The problems we face today are ever more demanding of the necessary EM change pointed out by Barrett and Grimes, along with many others. Let us hope their words are heeded. Given rapid development of higher group symmetry electrodynamics models, we shall very rapidly see the solutions to many previously intractable human problems — including cheap clean energy from the vacuum, understanding and directly using antigravity as well as gravity, a revolutionary new medical therapy, a new chemistry and biochemistry, and a new appreciation for the electromagnetic interactions of mind and matter.

Let us hope this new scientific revolution comes swiftly.

Chapter 4

Setting the Stage for Understanding Overunity Power Systems

[Dissipative structures] *"This leads precisely to a distinction between 'equilibrium structures' [which may be understood in terms of classical equilibrium thermodynamics] and 'dissipative structures'. The latter are formed and maintained through the exchange of energy and matter in non-equilibrium conditions."* [I. Prigogine] {236} [Internal brackets added for clarity.]

[The energy in space itself] *"What might appear to be empty space is, therefore, a seething ferment of virtual particles. A vacuum is not inert and featureless, but alive with throbbing energy and vitality. A 'real' particle such as an electron must always be viewed against this background of frenetic activity. When an electron moves through space, it is actually swimming in a sea of ghost particles of all varieties — virtual leptons, quarks, and messengers, entangled in a complex melee. The presence of the electron will distort this irreducible vacuum activity, and the distortion in turn reacts back on the electron. Even at rest, an electron is not at rest: it is being continually assaulted by all manner of other particles from the vacuum."* [Paul Davies] {237}

[Modernizing the fluid analogy of EM]. *The intensity of the vacuum virtual particle flux may be treated as the intensity of a potential, thus by analogy corresponding to pressure in a fluid. Polarity (charge) is a process for establishing a change in the intensity of the vacuum potential — and thus a change in the ambient pressure of the vacuum fluid. Difference between vacuum pressures at two separated points creates a force upon any charge placed between those two points. Just as a differential in pressure between points in a fluid induces currents, a differential in vacuum pressure induces energy flow currents in the vacuum fluid, which are called 'fields'. All*

EM circuits, charges, potentials, and forces in electrodynamics involve altering the vacuum to include altering its pressure and thereby producing the forces that the resulting pressure gradients (fields) induce upon charges. All observable EM energy in space is EM energy intercepted and collected on charges, and it comes from the vacuum via these fundamental vacuum-engineering dynamics." [T. E. Bearden, private communication to a colleague, 2001].

[Impact of EM energy from the vacuum.] *"If they [quantum fluctuations of vacuum] can be [tapped], the impact upon our civilization will be incalculable. Oil, coal, nuclear, hydropower, would become obsolete — and so would many of our worries about environmental pollution." "Don't sell your oil shares yet — but don't be surprised if the world again witnesses the four stages of response to any new and revolutionary development: 1. It's crazy! 2. It may be possible — so what? 3. I said it was a good idea all along. 4. I thought of it first."* [Arthur C. Clarke] {238}.

[Broken symmetry of opposite charges.] *"Since nonobservables imply symmetry, any discovery of asymmetry must imply some observable. The experiment of Wu, Ambler, Hayward, Hoppes and Hudson... established the asymmetry between the positive and negative signs of electricity."* [T. D. Lee] {239}.

[On implications of asymmetry of opposite charges of a dipole.] *"In particle physics, the proven asymmetry of opposite charges establishes that the source dipole — with opposite charges on each end—* is *a broken symmetry in the violent virtual photon flux of vacuum. The dipole charges constantly receive and absorb virtual photon energy from the seething vacuum, and re-emit that excitation energy. By the very definition of broken symmetry, some of this absorbed* <u>*virtual*</u> *energy must be integrated into* <u>*observable*</u> *3-space EM energy, and emitted by the dipole in observable form, in all directions in 3-space. Hence there is a rigorous basis for the source dipole extracting virtual EM energy from the vacuum, integrating it, and continuously pouring it out in*

observable and usable EM energy form. It has been in particle physics since 1957, being certified by the award of the Nobel Prize to Lee and Yang in that year." [T. E. Bearden, private communication to a colleague, 1995.]

[On powering an electromagnetic circuit] *"In the United States there is not now, and there never has been, a single electrical engineering department, professor, or textbook that knows and teaches what directly powers an electromagnetic circuit. Neither is it in any publication of the National Academy of Sciences, National Science Foundation, National Academy of Engineering, Department of Energy, or the great national laboratories. Yet the proof that every circuit is powered by EM energy extracted directly from the vacuum has been in particle physics for 45 years, since the award of the Nobel Prize to Lee and Yang in 1957, following the experimental proof by Wu et al. earlier that same year."* [T. E. Bearden, private correspondence, 2002].

4.1 Introduction

In this chapter, we present a selection of potential overunity notions, some inventions, and some experiments. Its purpose is to show some of the more relevant work that has been done, and hopefully to stimulate new thinking by the interested reader. Much of the work addressed is by other inventors and scientists, and we give an appropriate commentary from our viewpoint. Not all the concepts presented can be clearly explained, though some can and are. This is not intended to be a "kit of parts" or an "assembly instructions" type of presentation. For that, the interested researcher will have to rely on his or her own ingenuity and lots of bench experiments, because no such "kit of parts with instructions" for COP>1.0 electrical power systems exists at present {240, 241}.

Because of the broken symmetry of its opposite charges, we do know that any dipolarity — such as a permanent magnet, a charged flat-plate capacitor, an electret, or a simple EM scalar potential — continuously pours out EM energy circulation extracted from the vacuum. E.g., see Figure 4-1, which shows a very simple "free energy generator" that will generate a flow of EM energy indefinitely, even by ordinary U(1) electrodynamics theory (by standard Poynting theory). E.g., quoting Buchwald {242}:

> *"[Poynting's result] implies that a charged capacitor in a constant magnetic field which is not parallel to the electric field is the seat of energy flows even though all macroscopic phenomena are static."*

This is easily seen by applying the standard Poynting formula, S = E x H. With the H-field of the magnet at right angles to the E-field of the capacitor or electret, the Poynting flow of energy S is maximized and orthogonal to E and to H.

The problem is not in extracting energy - even enormous energy — from the vacuum The problem is collecting and using the energy to power loads, without destroying the source dipole

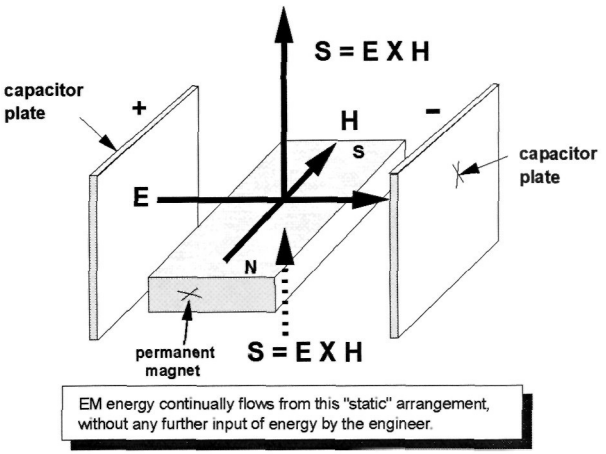

Figure 4-1 Poynting generator providing endless EM energy flow from the vacuum.

Buchwald errs, e.g., in assuming the macroscopic phenomena are static. They are not; they are highly dynamic in the same sense that a perfect macroscopic whirlpool in a river, seemingly static, nonetheless involves a continuous flow of water through it and a continuous dynamics. So far as can be observed, it appears there is no such thing as a truly "static" object. As an example, just to "exist" an object must "travel through time", which is itself a special kind of dynamics in the time domain.

A beautiful explanation of what is meant by "static" is given by Van Flandern[91]:

> *"To retain causality, we must distinguish two distinct meanings of the term 'static'. One meaning is unchanging in the sense of no moving parts. The other meaning is sameness from moment to moment by continual replacement of all moving parts. We can visualize this difference by thinking of a waterfall. A frozen waterfall is static in the first sense, and a flowing waterfall is static in the second sense. Both are essentially the same at every moment, yet the latter has moving parts capable of transferring momentum, and is made of entities that propagate."*

Now suppose that the capacitor in Figure 4-1 is rotated until E and H are either parallel or anti-parallel. In that case, the Poynting theory predicts zero EM energy flow. That is an incomplete assessment; it means that there is no overt field energy flow. There is, however, still quite a lot of covert or "infolded" field energy flow ongoing anyway, inside the static fields E and H themselves.[92] To see this, we first turn to the static potentials.

Between the charged plates of the capacitor or electret, there exists an electrostatic scalar potential ϕ. Between the polar ends of the permanent magnet, there exists a magnetostatic scalar potential Φ. We may independently decompose both ϕ and Φ via Whittaker decomposition {243}, applying a necessary correction {244} to Whittaker's interpretation. Then in all space surrounding the two dipoles, we have a hidden harmonic set of bidirectional longitudinal EM wavepair flows of energy comprising each of the static potentials ϕ and Φ filling all space[93] around the assembly in Figure 4-1. Each of those potentials ϕ and Φ is formed of a combination of scalar (time-polarized) and longitudinal photon pairs, as strongly argued

[91] Tom Van Flandern, "The speed of gravity — what the experiments say," *Phys. Lett. A.*, Vol. 250, Dec. 21, 1998, p. 8-9.

[92] Indeed, by the asymmetry of its opposite charges, each of the dipoles is co**ntinuously** pouring out EM energy extracted from the seething vacuum.

[93] In the conventional view. We corrected that view in {12}, to agree with quantum field theory and to use a *cause and effect* instead of the *two effects* used by Whiltaker.

by Mandl and Shaw {245} and as previously discussed in an earlier chapter. Further, each of the "static" fields can be decomposed into two scalar potential functions, as shown in 1904 by Whittaker {246}. Then each of the base scalar potentials further decomposes into the set of time-polarized EM wave and longitudinal EM wave pairs. The result is that every "static" field or potential in the universe is actually a set of longitudinal EM wave dynamics.

Further, in each coupled Whittaker wavepair as reinterpreted, there is perfect correlation between the time-domain EM energy wave (scalar or time-polarized EM wave) and the 3-space longitudinal EM wave. So even a "static" EM field, such as from the permanent magnet and from the charged capacitor or electret, does involve an enormous number of hidden internal EM energy flows in longitudinal and scalar EM waveform.[94]

[94] One of the great omissions of modern Western electrodynamics is the failure to follow up on direct engineering of this "vast, internal, infolded, far more fundamental" scalar and longitudinal electrodynamics hidden inside all present overt EM potentials and transverse EM fields and waves. Russian secret weapon scientists under the former KGB called this internal electrodynamics the "information content of the field" and have strongly weaponized it. A deception plan has been used to successfully convince the West that the Russians are speaking only of conventional spectral analysis. Use of this internal EM structuring, in the form of longitudinal or scalar wave interferometry, formed the first giant superweapons deployed by the former Soviet Union in 1963. To see a proof that ordinary EM fields and waves and potentials can be formed at a distance, *arising out of the local spacetime in the interference zone,* see M. W. Evans et al., {79}. Longitudinal EM waves easily pass through the entire earth and ocean relatively undiminished, since mass is mostly empty space filled with fields, potentials, and waves — i.e., filled with incredible numbers and bundles and dynamics of longitudinal and scalar EM waves. Mass is thus a great superhighway for the passage of longitudinal EM waves, and longitudinal interferometry can be performed right through the earth and ocean, on the other side of the earth from the transmitters. Such interferometers can also easily focus inside the earth or beneath the surface of the ocean. Hence in April 1963 the first giant Soviet LW interferometer deployed was used to kill the U.S.S. Thresher beneath the ocean, off the East Coast of the U.S. Intense production of EM signals — emerging everywhere in the space in that underwater interference zone placed around the submarine — filled the sub and its electronic controls. This jammed the electronic controls of the sub, rendering it helpless. The hapless sub then sank to crush depth and imploded. The signatures are clearly present in the jamming and cessation of multiple electronic systems functioning in the sub's surface companion, the U.S.S. Skylark (which was in a sort of surrounding "splatter" zone and survived because it was not individually targeted). Today at least 10 nations have scalar or longitudinal wave interferometer weapons, to one extent or another, other nations are working on them, and the Yakuza also has them. These were apparently the weapons

Ultimately there is no frozen waterfall, but only the dynamic waterfall always reappearing the same but filled with dynamic movement and energy flow.

These latter EM energy flows *infolded inside* the scalar potentials and the **fields** exist for a single charged capacitor or electret alone, or a single magnet alone. They also exist for any two points in a circuit that have differing electrical or magnetic potentials with respect to the ambient vacuum potential (energy density). This latter fact, of course, was part of the secret of Kron's *open path.* Indeed, every dipolarity in the universe — between any two potentials or any two differing charges anywhere — is an open path and an energy flow source. E.g., quoting Kron {247}:

> *"...the missing concept of "open-paths" (the dual of "closed-paths") was discovered, in which currents could be made to flow in branches that lie between any set of two nodes. (Previously— following Maxwell— engineers tied all of their open-paths to a single datum-point, the 'ground'). That discovery of open-paths established a second rectangular transformation matrix... which created 'lamellar' currents... " "A network with the simultaneous presence of both closed and open paths was the answer to the author's years-long search. "*

As can be seen, Kron had discovered how to create currents — *currents could be made to flow* — in individual branches between any two nodes in **the** circuit, physically connected or not. We point out that deliberate use of Kron's "open path" in a network circuit constitutes a strong violation of **the** standard closed current loop circuit's self-enforcement of the Lorenz/Lorentz symmetrical regauging condition. Hence it is a magnificent method for achieving COP>1.0 circuits. It is the belief of this

confirmed in 1997 by Secretary of Defense Cohen in these words: *"Others are en**gaging** even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves... So* there *are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations...It's real, and that's the reason why we have to intensify our efforts."* [Secretary of Defense William Cohen at an April 1997 DoD counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.]. As the reader can see, the Cold War **was** not so "cold" after all. This mere "tip of the iceberg" should also give the reader a little more insight as to why a war on terrorism is so necessary to all civilized nations.

author that such "open path" functioning in his patented circuits was part of Tesla's secret, though he did not think of it in those terms. However, Tesla's ability to shuttle potential energy independently in his circuits — invisible to a tensor analysis — was rigorously shown by Barrett {124}. Barrett extended the method and obtained two patents in the field of communications {286a, 286b}.

Thus the COP>1.0 problem *is not* in the part or function (the dipole or the charge) that extracts real EM energy flow from the vacuum. That is extraordinarily simple and straightforward. Engineers and scientists have been using it for two centuries without understanding what they were doing. Every charge, dipole, charged capacitor, electret, and permanent magnet already continuously extracts EM energy from the vacuum. The two-fold COP> 1.0 problem is in (i) *separately intercepting and catching (in an external circuit) some of the copious free flowing energy from the "extractor"*, and then (ii) *separately dissipating that collected energy in an external load without killing the "extractor" itself*— or at least only killing it more slowly than the load is powered. The most elegant way to violate the closed current loop circuit is with Kron's open path, typified by Tesla/Barrett potential energy shuttling. Since vector and tensor analysis will not even show it or model it, then a higher group symmetry electrodynamics is imperative in modeling COP>1.0 EM systems and their functions. Much of that work remains to be done.

Our main purpose in this chapter is to point out some selected efforts and approaches by scientists, engineers, and inventors. We will give a brief description and a few details, and leave it to the researcher for further experimentation and reflection. Hopefully, knowing what some others have tried and the results they achieved will prove helpful to the serious researcher.

We also strongly encourage the reader to again read this section after studying Chapter 9. In any COP>1.0 system, the excess energy must come from the "active environment". The active environment of an EM system consists of (i) the active vacuum and its interactions and dynamics, and (ii) the active local spacetime curvatures and their interactions and dynamics. Contrary to naive belief and the received view, overunity electrical power systems — particularly very high COP systems — are neither simple nor easy, but are extraordinarily difficult and highly nonlinear even when their appearance is deceptively simple. Chapter 9 will give a brief expose of some of the difficulties for higher C OP systems. There we will refer again to the intricate circuit analysis work of Gabriel Kron {248}, to Dirac sea electron theory {249} both prior to observation and after observation, and

to the need for higher group symmetry O(3) electrodynamics by Evans {250} which is a subset {251} of the electromagnetics used in the unified field theory of Sachs {252}.

Chapter 9 indicates how mathematically complex these systems really are, even when they appear deceptively simple. The phenomenology is highly complex, and it has not yet been scientifically explored because of the erroneous received view that COP>1.0 EM systems are not permitted by Maxwell's theory or the laws of physics. That is a non sequitur. More exactly, *they are not permitted in that equilibrium class of Maxwellian systems described and selected by Lorentz's arbitrary symmetrizing of the Maxwell-Heaviside equations, following their previous symmetrizing by Ludwig Valentin Lorenz* {253}. Prior to applying the Lorenz-Lorentz symmetrical regauging, the Heaviside equations — which in field form are already a truncation to four vector equations of Maxwell's 20 quaternion-like equations — do prescribe both disequilibrium COP>1.0 and equilibrium COP<1.0 Maxwellian systems. The variables are not separated (potential formation) and the equations are difficult to solve, usually requiring numerical methods. With Heaviside's truncation and Lorenz-Lorentz regauging applied, the resulting "special case" equations — now for only that class of COP<1.0 Maxwellian systems that receive and use no net input from their active environment — continue to be used because closed analytical solutions can usually be had and numerical methods can be largely avoided.[95]

So with tongue in cheek, we humorously remark that COP>1.0 electrical power systems have not been developed or known because the early scientists were a bit lazy and wished to avoid ubiquitous use of numerical methods. These days, with computers, proper math programs, and sharp

[95] **For** some reason, electrodynamicists ignore the fact that the Lorentz regauging does assume two *additional* equal and opposite energy exchanges of the system with its external active environment, but carefully selected so that all the excess energy received in the system is purely in the form of a stress potential. Hence this energy continually does internal work on the system to produce additional stress, but cannot translate electrons through an external load to power it. Also, this regauging condition represents an effective rotation of the frame of the described system out of **the** laboratory frame. To then argue that this severely altered system (increased

stress, constant additional internal work being done on the system, frame rotation, altered potential energy) is the same system prior to Lorentz regauging, and that su**ch a** system is not receiving excess energy from its active vacuum environment, is naive in the extreme and a non scquitur.

graduate students to easily crunch the numbers, there is no longer any reason for continued arbitrary discard of Maxwellian COP>1.0 systems.

For such reasons, no legitimate theory of COP> 1.0 EM power systems has been developed, except for light shed by Prigogine {254a-254f} and others {255a-255c} as to the necessary active environment, disequilibrium nature, and disequilibrium thermodynamics of COP>1.0 systems. Further, the energy flow theory (Poynting's theory) has not been further extended to include the Whittaker decompositions {243, 246} as should long ago have been done. Neither has it been extended to account for the arbitrarily discarded giant Heaviside nondiverged energy flow component.

The researcher should be aware that the energy input to a system is always in the voltage[96] (the *potential;* one input volt of potential will cause one joule of energy to be collected upon each interacting unit point electric charge in the system; one volt of drop in potential results when one joule of collected energy is dissipated per unit point collecting charge in the system.). The fields and their energy are functions of the potentials and their energy, not the other way round. After potentialization of the circuit, the subsequent movement of the potentialized Drude electrons, as current in the system, is connected with (and part of) the *dissipation* from the circuit of previously collected/intercepted energy from the vacuum.

4.2 Demonstration Gedanken Experiment

4.2.1 Work and Energy

Doing work is defined as *changing the form of energy*. No energy is lost per se when work is done; the energy is only changed from one form to

[96] The reason is that all 3-space EM energy — in the circuit or elsewhere — must come from the time domain to each 3-space point and return from that point to the time domain. The scalar potential (voltage) actually is an ongoing process whereby, for any interacting charge, energy in the time-domain and energy in 3-space are functionally combined in that 4-circulation at every point dipole in space. In quantum field theory, e.g. as shown by Mandl and Shaw {19}, the *combination* of the time-polarized photon and the longitudinal photon in 3-space is observed as the instantaneous scalar potential, but neither photon is *individually* observable. We comment that an "observable" 3-space potential is the result of an iterative set *of d/dt* differentiations of the ongoing "combination" of scalar (time-polarized) photons having their energy oscillations in the time domain, with longitudinal photons having their energy oscillations in 3-space along their line of motion. Hence each *d/dt* differentiation of the ongoing 4-space combination yields the instantaneous 3-space potential. Cumulating, one has the ordinary 3-space potential or "voltage" of macro electrodynamics.

another. All the energy since the beginning of the universe is still present,[97] and it is still repeatedly changing its form to do work, over and over. The point is, a single initial joule of energy can be "used" (changed in form) to do more than one joule of work, if multiple changes of form occur serially. *One joule of energy changing its form gives one joule of work, only if a single and total change of form of that joule of energy occurs and then no further change of form occurs.* If the joule changes form once, a joule of work is done and a joule of energy still remains in a second form. If this second form of the joule of energy is not lost, but is retained and then changed in form, a second joule of work is performed and there is still a joule of energy left in different form. And so on. Tricking a system to self-induce multiple iterative form changes of each joule of input energy (or at least of some fraction of each input joule), without losing the energy after each change of form, is one way of providing COP>1.0 in a system.

Remember that COP (coefficient of performance) is best defined as *the usable work output obtained, divided by the EM energy that the operator inputs.* Since "usable work output" is just usable "change of form of the energy", it can be seen that multiple changes of form of every joule of energy input by the operator can lead to COP>1.0.

This illustrates that one must be careful in applying the law of conservation of energy. For a thorough analysis, several features must be identified and accounted: (i) The flow of the energy impinging upon the collection, (ii) the collector itself and the type of collection process utilized, (iii) the linear or nonlinear operation of the collection/collecting process, (iv) the dissipation process used to dissipate the collecting mechanism, (v) what happens to the energy flow that was collected and then its collection "dissipated", (vi) what type of energy flow was collected, and then its collecting "dissipated", (vii) what happens to the collector after the dissipation interaction, (viii) what happens to the energy in different form after each previous change of form, (ix) whether single-pass or multiple-pass of the energy flow is used, (x) whether single collection or multiple collecting is used, and (xi) the effects of any nsymmetrical regauging of a local component or region (e.g., as in simply

[97] However, "present" means in spacetime, not just in 3-space. The EM energy we think of as being in 3-space is macroscopically in continuous circulation from the tine domain to 3-space and back to the time domain. Microscopically it is in *continual* circulation.

increasing one of the potentials of the region) that in turn acts as a free energy flow.

See again Figure 2-4 in Chapter 2. In general, the available energy flow surrounding a circuit will be far greater than the intercepted and collected energy in that circuit, particularly in a "single pass" collection — i.e., where the impinging energy only passes once. In analyzing a system or circuit, one must be very careful to ascertain whether the system utilizes any mechanisms to enhance and increase the energy collection fraction. If it does, then a necessary (but not sufficient) criterion for COP>1.0 has been identified in the system. Letokhov's negative absorption of the medium (i.e., excess energy emission) {256} and Bohren's experiment {257} are examples. Bohren's experiment is easily replicated by any nonlinear optics lab, and outputs 18 times as much energy as the conventionally calculated energy input.[98]

If the impinging Heaviside nondiverged component of the energy flow beyond the collecting/collector is rerouted and passed back to impinge again in the system — even on another collector or other collectors — this must also be taken into account.

Conventionally, the "magnitude" of the fields[99] E and H in the Poynting (collected) energy flow S = E x H are "defined" by the collection from the fields by an assumed unit point static charge at each point in space. In short, the conventional fields have already been "defined" as a standard linear collection upon standard charged *mass, from the field entities as they*

[98] Energy conservation is not violated! Instead, the conventional calculation assumes a static intercepting unit point charge, which has the minimum reaction cross section in the stream of bidirectional longitudinal EM energy flows comprising the potential, etc. By placing the intercepting charged particles into particle resonance, the particles' reaction cross section is increased because each resonating charge sweeps out a greater geometrical cross sectional area. Hence the charges collect more energy from the energy flow comprising any "field" (actually field intensity) or "potential" (actually potential intensity) than is assumed in the standard input energy calculation. In short, Bohren's experiment takes advantage of that arbitrarily discarded Heaviside energy flow component that remains and is present but not considered in the conventional Poynting calculation and field intensity calculation. The experiment in fact proves the existence of the unaccounted but ubiquitous giant Heaviside nondiverged EM energy flow.

[99] At best, the 3-space point intensity of each 4-space field is so defined, for a forthcoming reaction with unit point static charge, and where the forthcoming reaction does not involve lingering time - charging but only simple time-excitation followed by full decay of the time-excitation via normal photon emission.

exist in 4-space prior to interception and collection, and where the collector itself is absolutely fixed and "static". So nonlinearity in energy flow collection — by additional disruption of the impinging energy flow induced by the dynamics of the collector itself— may easily increase the "reaction cross section" of the collector. The static reaction cross section of a unit point static coulomb and the dynamic reaction of a unit point resonant coulomb may differ appreciably.

Without stating it this clearly, Bohren has shown that the interaction cross section for a single-pass collection by one static particle may be increased by a factor of 18 in a given example, *by inducing resonance and thus increasing the "collection" dynamics of the collecting particle* in the impinging S-flow {257}. The work has been independently substantiated by Paul and Fischer {258}. It also is a direct proof of the existence of Heaviside's neglected nondivergent energy flow component surrounding every field and charge interaction.

So indeed there are COP>1.0 EM processes in the literature. The Heaviside component also pouring from the terminals of every generator and battery, already proves that *every generator and battery ever made already was and is a COP> 1.0 energy transducer, because far more energy pours from the terminals of the generator and battery than the shaft energy input to the generator or the chemical energy dissipated in the battery.*

4.2.2 Extending the Work-Energy Theorem

The standard work-energy theorem in mechanics may be conventionally stated as: *The change in the kinetic energy of a particle is equal to the net work done on the particle by the net force acting upon it.* As in any "model", here there are assumptions that are seldom taken into account. First, the collected/collecting kinetic energy of a particle is due to its increased interaction rate with the vacuum flux, because of its acceleration through that flux.[100] In mechanics the increase in flux interaction (and

[100] As we cover elsewhere in this book, any charge (which, together with its clustering virtual charges of opposite sign is a dipolarity) is a broken symmetry in the fierce flux of the vacuum. This means that every charge in the universe absorbs virtual energy from the vacuum, coherently integrates some of it into observable en**ergy,** and pours out that observable energy in all directions. The negative charge d**oes** that for positive energy; the positive charge does it for negative energy. The latter can be better interpreted as the return of positive observable energy from space to the positive charge, thence disintegration of that positive energy back to virtual energy, and subsequent re-radiation of that virtual energy back to the vacuum. One **can** in fact model the **Bohren** experiment in terms of the extra vacuum flux

hence "Newtonian 3rd law resistance" is just treated as a sort of resistance to acceleration, and known as *inertia.*[101] The actual energy of the vacuum flux interaction rate is a function of the square of the particle velocity through that flux — hence the formula $K = 1/2\ mv^2$ for the kinetic energy K of a mass m moving through the flux of space at velocity v. Relativistically, the mass of the particle is moving through the ambient potential flux, or we may view it from the particle's frame of reference where the ambient potential flux is moving through the particle but interacting with it. Only a single pass of the flux impinges upon the "particle collector", so there is only a "single-pass" type of energy collection ongoing.

All energy in the vacuum exists in "vacuum flux" or "change in vacuum flux" form. There is no force in the vacuum, although there is polarization that will produce a force upon a charge when one is introduced. The force occurs only after the "change in vacuum flux" that we call a field is interacting with a mass. The force is *already* a change to the mass, a priori, since mass is a part of force by $F = d/dt\ (mv)$. If energy is then added by a AK energy flux (usually mistakenly called a force) performing work upon mass m, this constitutes an additional energy flux or flow impinging on the

encountered and transduced by the resonant charge, as compared to flux encountered and transduced by the static charge. In the same vacuum flux density, a resonant charged particle will intercept and absorb more virtual photon energy than the same particle in static condition. Hence its broken symmetry will convert more absorbed virtual photon energy into real observable emitted photon energy.

[101] If one wishes to understand that inertial reaction, here is how it works. Consider the virtual charges of the vacuum as an analog to the Drude electron gas in a conductor. At the instant an observable charge starts to move, it is momentarily affecting all the surrounding virtual charges — an enormous number, which are initially repelling and attracting it in all directions intensely. To move, the observable particle must create a change in that entire participating virtual particle "gas". Just as the Drude electron gas, the vacuum "gas" of virtual charges has a certain relaxation time constant. So a finite time delay occurs before the vacuum gas relaxes and movement of the observable charge occurs. As the relaxation continues apace, the particle being acted on by a force accelerates. Even mass with a net charge of zero is filled with charges, and even the neutrons in the atoms are continuously changing into protons and back, etc. So all mass continually exists in the "charge and charge-changing" state. Inertia is in fact due to the relaxation time curve of the vacuum virtual charges "gas". We dealt crudely with this in Bearden, "Quiton/Perceptron Physics," NTIS Report AD-763-210, 1973, p. 11; hopefully a far better treatment will eventually be undertaken by qualified higher group symmetry electrodynamicists.

particle, imposing an additional "energy collecting" and gradient across the mass. Rigorously, the dynamic system comprised of the dK gradient coupled to the particle, and interacting with it, identically is a force.[102] Depending upon the situation, it may accelerate or decelerate the particle, or change its direction, or a combination. This is summarized in the usual work-energy formula

$$W = K_f - K_i = \Delta k \qquad [4\text{-}1]$$

where the work W that was done is given by the change dK in kinetic energy of the particle from its initial kinetic energy K_i to its final kinetic energy K_f.

In applying the conservation of energy law, usually physicists utilize either the work-energy theorem or an approach closely paralleling it. This application is valid in any linear single-pass collection situation. It may not be valid — and usually isn't —for a multi-pass, multicollection system where the same energy, changed in form to accomplish work in a single reaction, is then changed in form iteratively, again and again, in the same system or material. In such case, one joule of input energy can and will

[102] We stress again that the hoary old mechanics, some four centuries old, is seriously in error in assuming a separate force acting on a separate mass. That remains an inexplicable non sequitur in modern physics, in its very foundations. We call attention to how classical electrodynamicists' wrestle with the problem. E.g., quoting Jackson, *Classical Electrodynamics*, 2nd edition, Wiley, 1975, p. 28: *"...the thing that eventually gets measured is a force... " "At the moment, the electric field can be defined as the force per unit charge acting at a given point. It is a vector function of position, denoted by E."* Our comment is that the "definition" is in error, including the use of the word "field" for "field intensity", when field and its intensity are two entirely different things. A proper definition should be stated as *"...the observable electric field intensity can be defined as the force per unit static charge and mass, existing at a given point in an interacting gradient of the virtual particle flux of the vacuum, as inferred from the changes induced upon the unit static charge and mass. "* The field intensity is a vector function of position, charged mass, and vacuum virtual particle flux gradient. The standard definition substitutes an effect (of collection) for a cause (prior to collection), and this error is widespread through physics, from mechanics to electrodynamics and on into particle physics. On p. 249, Jackson shows how the electrodynamicists largely capitulate and continue to promulgate the substitution of effect for cause. Quoting: *"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable quantities such as force somehow involve the product of charge and field."* We comment that actually mass is a component of force, as shown by F = *d/dt(mv).*

accomplish multiple joules of work in and on the system. So for our purposes we must modify the work-energy theorem to give

$$W = \lambda(K_f - K_i) = \Delta k \qquad [4\text{-}2]$$

where λ is the averaged energy collection fraction, adjusted for multipass, multicollection and also for asymmetrical self-regauging (self-increase of the potential in, and hence the energy flow from, one or more regions of the active system's source). In formula 4-2, K_f and K_i and Δk still refer to single-pass collection only.

In the new work-energy theorem, $\lambda = 1.0$ for that vast number of conventional cases that have successfully utilized the conventional form of the theorem. These are almost always single-pass, single collection systems. The new COP>1.0 systems have deliberately enhanced energy collection — and hence multiple *energy collection and work amplification*[103] — such as multi-pass collection. For these COP>1.0 systems, the expanded work-energy theorem form applies and in general $\lambda>1.0$. In an ideal COP>1.0 system, $\lambda>>1.0$. In some versions of the Patterson Power Cell®, for example, $\lambda = 1200$. In the Sweet device (discussed later), a very high value of lambda resulted, so that $\lambda = 1.5\text{x}10^6$. We sometimes refer to λ as the *energy amplification factor, energy collection fraction, Poynting amplification, collection amplification,* etc. Bohren and others have referred to it indirectly as the *interaction cross section,* the *resonance absorption cross section,* and the *negative absorption cross section.*

Again, we strongly iterate that *there is no* <u>*conservation of work*</u> *law in physics!* When energy is input to a system, acts on it, and is "dissipated" by a change of its form (doing work), the "dissipated" energy is still

[103] There is no "conservation of work" law in physics or thermodynamics. It is energy that must be conserved. A single change in form of K joules of energy gives an equal number of K joules of work done upon the interacting mass system. However, there remains an equal number of joules available, just in a different form. If that second K joules of energy is then changed in form again and not allowed to escape from the system, an additional K joules of work is performed in the system, without the operator having added any extra input energy. And so on, until the inefficiency of the system and some inevitable losses allow all the "recycling" energy to escape from the system. We strongly believe that ignition, quenching, and re-ignition phenomena such as in gamma ray bursters and x-ray bursters are due to exactly such processes where iterative change of form of each initial joule of energy occurs.

available after the work (change of the energy's form) is accomplished. However, usually by "dissipated" energy we mean energy that has permanently left the system (or a component in the system) and cannot be recovered and used by the system. The original input energy is not work, because it did not undergo any change of form prior to interaction with the system to change its form. So one does not do "work" as input, which is a non sequitur. Any work accomplished in the input section of a system is due to inefficiencies of the system,[104, 105] usually allowing extra change in form of some of the energy in non-useful processes called "input losses". As we stated, it is quite possible for a single joule of original input energy to perform many joules of work. During the subsequent billions of years following the formation of the observable universe and the energy in it, every joule of the primordial energy is still here. And every joule of it has been steadily performing joule after joule of work since then. Further, it has continually been recycled between 3-space and the time domain and back, and is continually being so recycled today.

Suppose input energy to a system has been dissipated (changed its form) once, doing work (single change of form of energy) in the system. If the dissipated energy in a different form is then recovered or partially recovered — without escaping the system — to change its form yet again in the system and produce additional useful work, that system is

[104] Almost always due to a negative feedback mechanism such as Newton's third law, self-regauging symmetry, the closed current loop circuit, inertia as due to a self-regauging 4-symmetry, etc.

[105] E.g., a transformer would be an overunity system, because the current in its primary is separate from the current in its secondary, if these two currents were completely decoupled and independent. In that case, the transformer would simply propagate and "couple" or pass energy emitted from primary to the receiving secondary, without back-coupling. However, the closed current loop in the secondary, routing all spent electrons in the secondary back through the back mmf of the secondary coil, produces a back-field coupling interaction with the primary, and this "back mmf/back emf" coupling requires energy dissipation in the primary section to overcome. In short, the transformer is designed so that the secondary lights the primary to a draw and the designer loses. With some losses and inefficiencies in the device, that makes the transformer a COP<1.0 device (unless free external energy is received in the input). The interested reader might extract several hints and suggestions in this book, passim, of things that overunity researchers have tried in their search to break up the back-coupling of a transformer. The simplest way, of course, would be to place a true negative resistor shunt across the secondary, so that part of the secondary current does not return back through the primary.

considered to be an open system far from single-dissipation equilibrium with its external environment.[106] In that case, instead of the first dissipation simply "returning" the energy to the external environment, the energy is recovered by another change in form (which may simply be a change in direction in the internal environment). The thermodynamics of an open system far from equilibrium with its active environment applies, whether that "environment" is internal or external to the system. It is "external" to the subcomponent of the system forcing the "local change of form" of the energy.

4.2.3 Gedanken Experiment: Multicollection by Regenerative Feedback

After a COP>1.0 collecting process with subsequent proper discharge of the energy, more work output as "dissipation of the collected-energy" exists than the energy being input by the operator or experimenter. By regenerative, clamped, carefully controlled positive feedback of a portion of the output *positive* energy[107] to the system input, the system can be converted to a self-powered (self-asymmetrically-regauging) system that powers both itself and its loads. However, see Chapter 9 for special considerations of the Dirac sea hole current and excess negative energy that arises for COP»1.0 EM systems. Positive clamped feedback will fail dramatically for any COP»1.0 EM system, and for many COP>1.0 systems it will also fail unless conversion of negative energy — arriving at the input section — to positive energy is accomplished.

To ease visualization of the energy multicollection process, consider a gedanken experiment iteratively retroreflecting a steady small EM energy input. Particularly see Figure 4-2.

[106] The vacuum environment is also "internally" penetrating throughout any macroscopic system, to the finest level! So the notion of separated "external" and "internal" environments requires strong qualification in any system engaged in iterative, work-amplifying interaction with its local vacuum.

[107] The output may contain appreciable negative energy as well as positive energy, however. In that case, in the feedback loop the negative energy must be transduced into positive energy by regauging, else it will appear in the input section of the system as an extra system load there in the input itself. It will "eat" incoming electrons from the external power supply, so that the external power supply has to power this "extra load" in the input section as well as powering the normal system load presented. This reduces the system COP to COP<1.0.

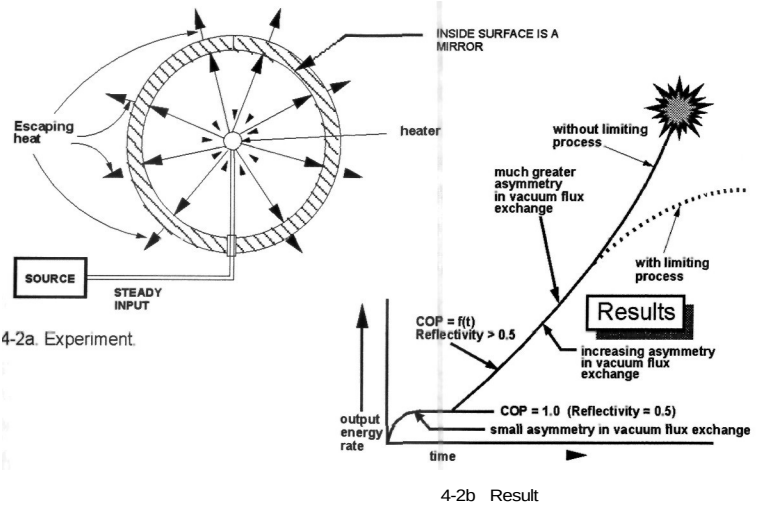

Figure 4-2 Heater wire in a hollow sphere with certain retroreflectivity properties.

As shown, a heater-emitter is placed inside a closed hollow sphere, through a tiny hole for the two wires connecting the heater wire into the external power supply (the external power supply is not shown). The heater emitter is 100% efficient; any joule of energy absorbed by it is re-radiated by it. One joule of energy (one watt of steady "input power" — conventional electrical engineering terminology where rate of work and rate of energy flow are confused!) is furnished from the power supply to the heater element inside the sphere. The inside of the sphere is coated with a substance that acts as a phase conjugate mirror (PCM) reflector with, say, 0.5 reflection coefficient. In other words, when scattered photons are emitted from the wire in all directions, they strike the inner surface of the sphere. Half are retroreflected precisely back to the spot on the resistor from whence they came, where they are absorbed and "re-collected" to further heat the resistor, causing emission of additional photons from it. The other half of the absorbed photons on the inner surface of the sphere diffuse through the cylinder walls as heat, and escape as heat radiation from the sphere to the outside world.

If that sphere's operation could be maintained intact and stable, without change of the physical characteristics and mechanism, then the buildup of energy in the heater wire inside the cavity — and the buildup of the energy icing emitted from the outside of the sphere — would be ever increasing. It would increase without bounds as time passed. Wait a short time, and

the sphere would be outputting 10 watts of power while one would still be inputting one watt. Later, the sphere would be outputting 1,000 watts of power, while one would still be inputting one watt. And so on. Indeed, the rise in energy density of the output would be asymptotic, and would increase toward infinity. The only limitation as to the energy output for a steady 1 joule per second input, would be the limit at which the mechanism goes unstable and changes occur to dampen and curtail the process.

Before the reader objects on conservation of energy grounds, one should realize that this rise in the energy density inside the sphere is an example of iterative regauging. The principle of *gauge freedom* — one of the axioms of quantum field theory and well established — assures us that *the potential energy of a system can be changed at will, and freely.*[108] What the gauge freedom principle does *not* state is a *mechanism for providing the additional potential energy and a source for it* — nor do the quantum field theorists and electrodynamicists. Without such a source and mechanism specified, the conventional gauge freedom principle assumes total violation of the conservation of energy law.

[108] Conventional scientists are almost always very careful to regauge symmetrically, so that the two excess force fields that result are equal and opposite, and sum to a net zero resultant field. That "zero-summed system" comprises a stress potential *a priori.* So such symmetrical regauging alters the stress in the system and alters its potential energy, but only in the form of additional stress energy. There is no *net* force and "force field energy" that can be used to dissipate that additional free stress energy in an external load, thereby doing free work. This regauging is a purely arbitrary practice by the electrodynamicists. We are far more interested in "asymmetrical regauging", where only one potential is freely changed or the two are changed unequally, resulting in a *net nonzero force field* that can then be dissipated in an external load to perform free work. Only by asymmetrically regauging an otherwise inert system can usable field energy be added and any work then be done by it anyway. In conventional systems, we do the "asymmetrical regauging" by adding the voltage (potential difference). As current flows with dissipation of energy from the circuit in the loads and losses, the system is able to develop "power" and thus do work in the external load. Unfortunately, the electrodynamicists are still obsessed with symmetry, so they ubiquitously employ in all electrical power systems the closed current loop circuit. This guarantees that the circuit will kill its source dipole (the source of the potential and potential energy generated from the virtual flux of the vacuum by the broken symmetry of the opposite charges of the dipole) faster than it powers its load. That way, lovely symmetry is maintained, beautiful free energy and negentropy are avoided and tossed away, and ugly pollution and destruction of the biosphere continues worldwide to fulfill the ever-increasing and insatiable thirst for electrical power.

In our supersystem view, the gauge freedom mechanism providing the energy is straightforward: the excess energy is freely supplied from disequilibrium in the active vacuum interaction with the system and in the disequilibrium represented by the local curved spacetime. Since a change in system potential energy is also a free change in spacetime curvature, then it follows that simply changing the potential energy of the local vacuum (the vacuum is also an electromagnetic system!) and of the local curvatures of spacetime is also "for free", or it can be. One does not have to perform work oneself upon spacetime to curve it! The mere *presence* of a spatial energy change — including a free potential energy change allowed by gauge freedom — is sufficient to freely curve spacetime also. That is a real energy change, because any curvature of spacetime acts back upon mass. Higher group symmetry electrodynamics does indeed include vacuum energy and energy current {259a-259c}, and it is possible to extract useful EM energy from the vacuum.

But back to our sphere, where the internal potential energy of the sphere is rising asymptotically without bound.

In the real world, of course, the reflection coefficients and the materials characteristics will change as the energy density changes, the sphere will heat, etc., and these changes will start damping the perfection of the retroreflection process to limit it to some finite plateau value which may be a COP>1.0 or COP»1.0 condition. Or, the materials will melt or soften so that the sphere ruptures and explodes, sharply quenching the process entirely and emitting a violent burst of energy to signal the disruption of the localization of the process.

Nonetheless, a successful real bench experiment similar to this should be possible with some tinkering, and it should readily yield COP>1.0, after one waits for build-up and stabilization at some level. We would hope that a sharp young graduate student may eventually prepare a doctoral thesis on this experiment or a variant. The principle is demonstrable.

Similar buildups by regenerative feedback and multiple collections by the collectors do appear to occur in nature, up to and including such phenomena as gamma ray bursts, x-ray bursts, etc. These occur in some systems such as exploding gases (and in some cases, even in the upper atmosphere of the Earth). In such a system, the "physical particles in suspension in space" do move and continually disrupt the geometry for the increasing buildup, resulting in decay of the process after a time delay.

However, there is a finite time during which the movement of the particles is still insufficient to appreciably break the geometry and cause

quenching.[109] During this "nearly linear stage", the build-up applies and the energy density very rapidly increases. Build-up occurs and continues while the relaxation time of the initial countering symmetry-restoring mechanism for the old or former state or condition (the initial reaction) is occurring. A well-known conventional example is the Lenz law reaction. Then as the geometry changes significantly, a rapid damping of the energy density increase occurs, quenching the asymptotic rise and "discharging" or "decaying" back to a less-than maximum condition. However, the decay position or state (in the quenched condition) will be different from the initial condition before asymptotic rise (regauging) set in. The system usually will have itself absorbed and collected additional potential energy, and so it will be "hotter" or more energetic. This is often called the "afterglow". In the simple case, parts of the system will be in greater motion (more energetic).

An intermediate plateau can appear as quenching occurs and it can stabilize. However, if no stable plateau is reached during the damping, then further rapid quenching and a rapid reduction of the increased energy density occurs as the geometry changes become decisive and break the asymmetric self-regauging. Thus the "damping" of the process may yield a plateau of steady COP»1.0 operation, or it may simply go immediately into full catastrophic quenching and decline back to some lesser level of COP>1.0 operation, but still more energetic than the beginning condition. The latter case produces a sort of "afterglow" - - observed in the gamma ray bursters, e.g. — of increased energy density from the beginning of the quenched phenomenon. Indeed, in that new system of more energetic gases or particles, once the new state is stable, continuing regenerative feedback versus the new geometry can then reinitiate or "re-ignite" another "burster" followed by subsequent quenching. And so on.

We submit that the gamma ray bursters fit this schema and are consistent with it. So do the phenomena observed in intensely scattering photoactive media on the nonlinear optical laboratory bench. We hypothesize that the gamma ray burster and similar violent burst emission phenomena are generated by this mechanism or a similar version of it.

[109] Regardless of what we call it or what it has been conventionally named, any impulsive, explosive process involves at least momentary broken symmetry, resulting in instant and countering broken symmetry. Then a relaxation time passes, and the countering broken symmetry is dissipated by change of the system to a new potential energy state, the new dynamics state, etc.

Figure 4-3 diagrammatically shows a proposed range of such "excess energy" emissions due to this regenerative positive feedback and multiple collection mechanism. As can be seen, this may place our view of very powerful astrophysical emission phenomena in a completely different light, arranged energetically by the length of the initial "nearly linear" phase of exponential increase. There is a scale of stability levels up to just before the Big Bang itself {260}. A so-called Big Bang, of course, would result when the "containment" ability of 4-space itself is breached, resulting in a rupture of 4-space and a consequent violent blow-out into n-space (where n>4), with a very rapid "false vacuum" created *outside* the blow-out region and pumping itself up by asymmetrical self-regauging in a "new" 4-space. When a new stability level is reached outside the blowout hole from the spawning 4-space, it represents an outside "new" 4-space and a new, infant 4-spatial expanding 4-universe, freshly born.

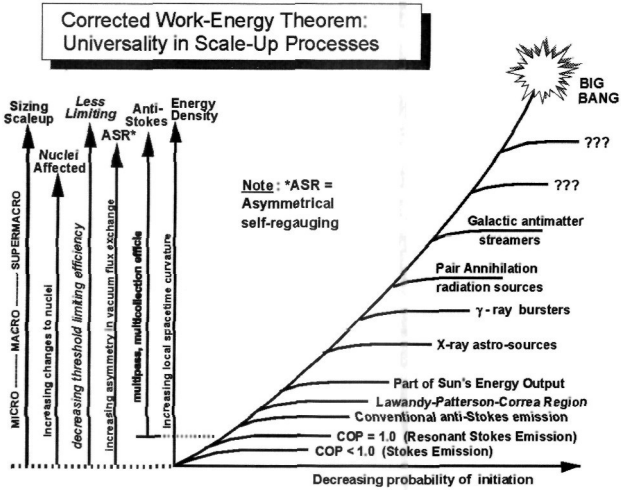

Figure 4-3 COP>1.0 **stability levels for the asymmetrical self regauging process invoked by multipass and** multicollection **of same energy.**

So from inside the spawning universe, the burster phenomenon would be so great as to "burst" 4-space, producing a sort of "super black hole" as seen by the spawning universe. We hypothesize that the asymmetrical self-regauging mechanism produces a great burst of EM energy in its universe if a stability plateau is reached that is below the threshold of 4-space rupturing. If such a stability plateau is not reached, the asymptotic rise in local spatial energy density increases until the primary 4-space ruptures to

produce a "blowout" seen from the old universe as a sort of black hole. There is a sort of "white hole" in the new universe being spawned on the other side of the blowout. This white hole and its associated phenomena produce the birth of another 4-universe outside the original spawning 4-universe. At least we propose that as a hypothesis.

We propose that this could be a legitimate process for the birth of multiple 4-space universes in the infinite-dimensional cosmos.[110] It has an added advantage of accommodating the vexing question of "What existed before the beginning of time (in this universe)??? The answer then would be, *"The existence of time in another universe that birthed this one."* We emphasize our interpretation of time as just a special form of EM energy, and not at all a "mysterious river down which we float helplessly as if in a drifting boat in the river's current."

4.3 Iterative Retroreflection and Collection in a Circuit

The normal circuit attached to a generator or other external power supply is the "external" portion of the overall closed current loop circuit passing back through, and including, the source dipole in the power supply. In a DC external circuit, we may consider that the energy flow pours forth steadily from the terminals of the generator (from the dipolarity between them) into space surrounding the external circuit. Since the external conductors act as a sort of guide, this *transmitted* external energy flow is generally parallel to the external conductors.

The external circuit further acts as a *receiver*. The surface charges and their fields intercept and interact with some of the transmitted energy flowing parallel to the conductors and outside them. This interaction diverts a component of that passing energy flow into the conductors, powering the Drude electrons. This powers the external circuit. The nondiverted component of the passing energy flow — usually much larger — escapes on out into space beyond the external circuit. According to Heaviside's energy flow theory {261}, this escaping nondiverged energy flow may be interpreted to exist in closed circulations.[111] Laithwaite

[110] After all, a "dimension" ultimately is just a fundamental variable in a physics model or, in other words, a "degree of freedom" in mathematical modeling. We may construct any number of dimensions we desire, merely by assigning a sufficient number of variables, including both overt variables and hidden variables, etc.

[111] We point out the interesting possibility of re-interpreting this "closed circulation" Heaviside component as the giant negentropic circulation of EM energy from the

{172b} has specifically commented upon the potential importance of this aspect of Heaviside's theory.

As we shall later address, Heaviside worked out but never published a draft theory of gravitational effects from this extra escaping energy flow {262}. Interestingly, since Lorentz's integration of the energy flow vector around a closed surface surrounding any volume element of interest, the discarding of this "excess nondiverged energy flow" has been ignored by electrodynamicists, and it has been ignored by gravitational theorists.

Consider a theoretically "perfect" generator, loss free. Consider the presence of the Heaviside nondiverged component emerging from the generator terminals — and filling all space around the external circuit. That is the part of the energy outside the circuit that is not caught and processed by the circuit, but is just wasted. By definition, in this "perfect" situation the magnitude of the Poynting or "caught" component of energy flow will precisely equal the magnitude of the mechanical energy input flow (rate) to the generator.[112]

But the presence of the additional huge Heaviside component rigorously means that far more energy pours from the terminals of every battery and generator than the amount of mechanical energy the operator inputs as shaft horsepower. This easily demonstrated fact — e.g., proven by the Bohren experiment {24} — continues to meet with a resounding silence from electrodynamicists and physicists, and particularly from those dogmatic skeptics so keen on defending the classical thermodynamics of closed or equilibrium systems as if they also applied to open systems far from equilibrium in their exchange with their active environment. We refer particularly to the dogmatists so supremely confident that COP>1.0 EM systems are prohibited by the laws of thermodynamics. These stalwart fellows would thus exclude every charge (and its associated fields and potentials) in the universe, were they logical and speaking scientifically. So they strangle at the gnat of COP = 4, and swallow COP = oo while proclaiming that COP>1.0 EM systems cannot exist.

The dogmatists have achieved a major nefarious goal, however. They have silenced most inquiry into such matters by electrical engineering

time-domain to the negative charge, to 3-space, to the positive charge, and back to **the** lime-domain. To our knowledge, that has not been examined.

[112] That is merely a statement of the Lorentz symmetry condition self-enforced by the closed current loop circuit itself.

professors, young graduate students, and young postdoctoral scientists. They have glorified classical equilibrium thermodynamics into a religion rather than the partial and imperfect model it really is. They are directly responsible for the continuing rape and pillaging of the planet's resources, pollution of the biosphere, global warming, and the increasing death of species. They are indirectly responsible for the deaths of more human beings than Hitler, Mao, and Stalin combined. Most of the blame for environmental pollution problems concerned with power and electricity is squarely at their feet. Sadly, the environmentalists seeking to save this planet and biosphere have not yet recognized the true nature of the scientific Taliban that has generated the environmental problem. In tolerating its own scientific "terrorism", the scientific community seriously aborts much of the scientific method.

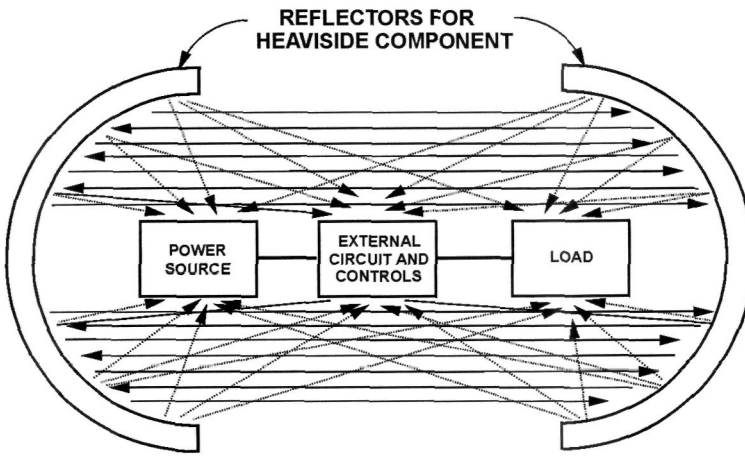

Figure 4-4 Iterative retroreflection of the "passed" **Heaviside component back and forth across a** circuit -- **thematic.**

See Figure 4-4. The neglected large nondiverged energy flow component need not be wasted. As an example, part of it can be captured and used, by applying near-field antenna techniques and such methods as Bohren's resonance increase of the intercepting charge's reaction cross section.[113] It is possible to intercept part of that excess energy that is there and available. E.g., even after it passes on by the immediate circuit, the Heaviside energy flow component can be intercepted beyond the circuit

[113] Or other methods we cannot yet divulge because of patent situation.

and retroreflected back across the same circuit again. In this way — at least in theory — extra Poynting energy can be collected and recollected by the same external circuit for a single given input energy.

In essence, such an "iterative, multi-collecting circuit" is now fed with transmitted energy from multiple (iterative) paths simultaneously. This is *physically doable,*[114] but it is not a simple procedure, and antenna theory and especially near-field antenna theory must be utilized as well as focused retroreflection techniques. To directly model it, higher group symmetry electrodynamics (such as quaternion EM, O(3) EM, etc.) must be used. Precisely such phenomena are met in modern experiments in intensely scattering optical materials {263a-263b, 264a-264b} and in Bohren-type experiments where more energy is collected than the operator has input via standard calculations {257, 258}.

4.4 Tesla's Iterative Retroreflection Work

4.4.1 Tesla's Single Wire Circuit

See Figure 4-5, which diagrammatically shows one of Tesla's developments, which used a retroreflective single wire circuit between two large separated capacitances. This was the basic approach used in his magnifying transmitter and in several other circuits. Here the dipolarity exists between two accumulators, one at each end of a long conductive path with a load in the middle. AC operation is used, by setting up oscillation end-to-end along the "single wire" circuit, from accumulator to accumulator. Even so, no overunity operation will be experienced unless passive retroreflection of the normally wasted Heaviside component of each energy flow "passage" occurs back from each receiving end, so to speak {265}. That is possible if specialized dielectric material and construction is used in the end capacitors.

[114] E.g., some of Tesla's actual patented circuits do it, but that part of their fu**nctioning** is not described by any vector or tensor analysis. However, a higher **group** symmetry electrodynamics analysis of the circuits will indeed show the effect clearly as a "shuttling" of potential (regauging) around the circuit at will. E.g., see T. W. Barrett, {124, 286a, 286b}.

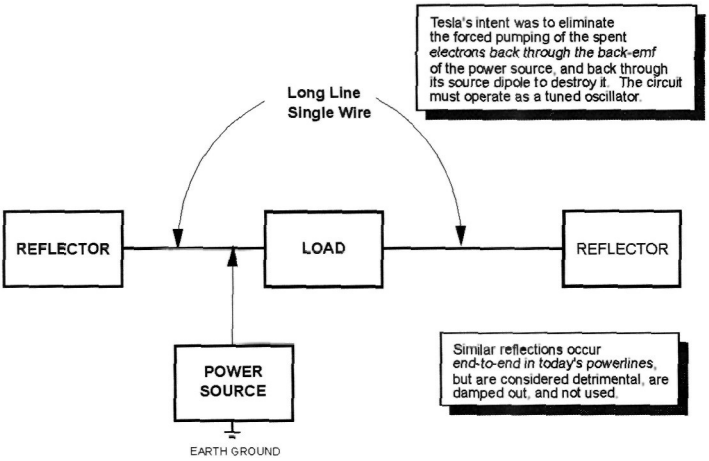

Figure 4 5 Tesla's iteratively retroreflective single wire circuit.

Further, it may usually be necessary to place the individual charges comprising the "current surging to and fro" into particle resonance at either the frequency being transmitted or some subharmonic of it. This schema is doable, but it is difficult and most everything affects it, including even the impurities in the conductors.

4.4.2 Strain to Stress Potential Energy Transduction

See Figure 4-6. This is a diagrammatic representation of a fundamental "strain-to-stress" transduction mechanism we believe was involved in Tesla's "single wire circuit" (i.e., his iterative retroreflecting circuit).

At each end of the circuit, the electrons are "trapped" in the open outside end. Hence when EM energy rushes to the capacitor on one end of the circuit, the forward emf tries to strain the dielectric from the inner plate toward the outer plate. However, the trapped electrons in the outer open wire cannot move, so they produce an equal back-emf and back force trying to strain the dielectric from the outer plate to the inner plate. The result is that the translational field "strain" energy (dipolar charging) is transduced into stress potential (monopolar charging) energy. Electrons try to strain the dielectric from the inner plate toward the outside with a "forward emf so as to charge the capacitor normally, while the trapped external electrons simply push back the other way, exerting a back emf force that is equal and opposite to the straining force from the forward emf and simultaneously tries to "charge" the capacitor in the opposite direction.

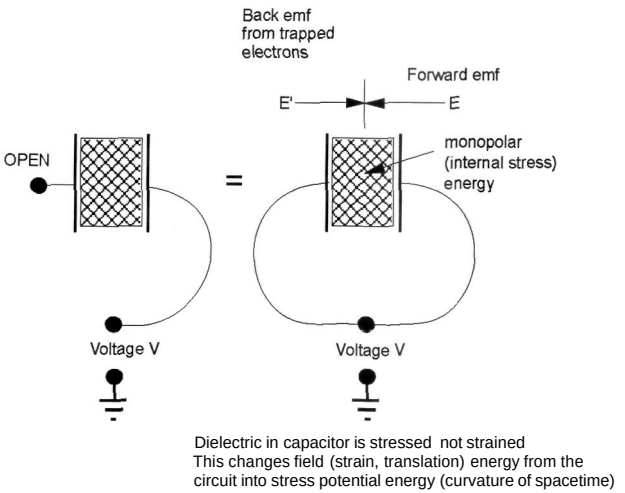

Figure 4-6 Transaction of translational field energy into stress potential energy.

Here is the importance of the "vector zero resultant" stress (monopolar) charging that occurs: The input EM strain field energy familiar in dipolar charging of a capacitor is converted to a dielectric stress (monopolar) potential for monopolar charging. This changes *translational* field energy (external energy) into *stress potential* energy (internal energy), adding an equal amount of back-emf translational field energy in so doing. In short, the charging captures an equal amount of charging energy from its external environment — in this case, from the back emf of the trapped external electrons in the outside open wire. This is one way to capture and use the back emf energy normally reducing the energy available.

We point out that this is charging the capacitor by *Lorentz's symmetrical regauging,* and it represents a rotation of the frame of the capacitor itself out of the laboratory frame. As is well known, the trapped energy of a capacitor in a rotated frame is not the same as the energy of the same capacitor in the nonrotated lab frame.

The single-wire system destroys the symmetry-enforcing function of a closed-current-loop circuit conventionally used. In short, it does not return the "spent electrons" from the ground return line back through the source dipole of the outside power source, so it does not use half the collected energy in the circuit to destroy the source dipole and its extraction of EM energy from the vacuum (to destroy its broken symmetry). Because it

retains the broken symmetry, Tesla's single wire system is an open system far from thermodynamic equilibrium with its active vacuum environment. It is thus permitted to exhibit those five magic functions of such open dissipative systems: (1) self-ordering, (2) self oscillation or self-rotation, (3) outputting more energy than the operator inputs, (4) self-powering of itself and its load, and (5) exhibiting negentropy.

4.4.3 Potential Energy Shuttling in a Circuit

The net result is to "shuttle" the (stress) potential energy back and forth in the circuit, between the ends. See Figure 4-7. When this stress potential energy shuttling is done at the natural (or tuned) resonant frequency of that single wire circuit as an oscillator, the monopolar charge transfer is optimized and amplified by the resonance effect, with an increase in the energy being shuttled. It is this type of Tesla single wire circuit that can in theory exhibit COP>1.0.

Tesla's single wire system also forces the change of energy between internal energy and external energy. A deeper analysis will also involve Dirac sea hole current effects as well as lifting of electrons from the Dirac Sea and combination of unobservable Dirac sea holes and electrons without radiation. However, we leave that for the advanced theorists. A taste of it is included in Chapter 9.

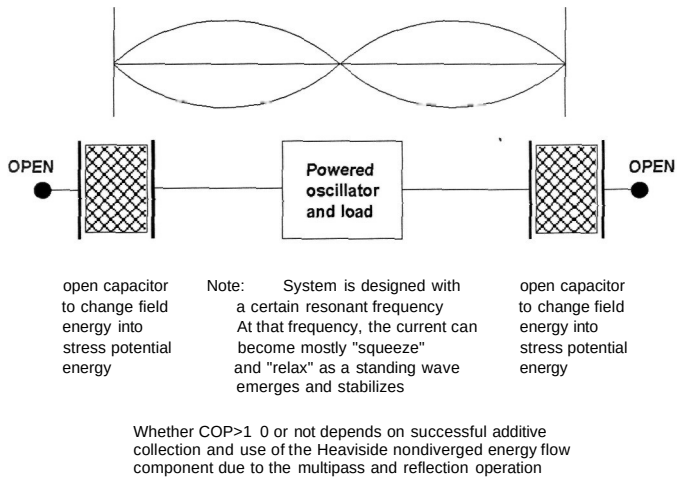

Figure 4-7 Tesla's resonant single wire circuit **operation.**

But is there any evidence for this "shuttling" of the monopolar potential in Tesla's circuits? Yes, there is, and indeed some of Tesla's patented circuits

do exhibit such energy shuttling in them, as rigorously shown by Barrett {124, 286a, 286b}.

4.4.4 Other Considerations

For COP»1.0 systems and some COP>1.0 systems, the concepts of Chapter 9 must also be applied, since the system outputs not only positive energy but also negative energy. The negative energy — in the form of Dirac sea hole current — then sweeps back through the system from its output section to its input section. At various places, these "vacuum holes" eat electrons (as on atoms, causing ionization).[115] In short, the Dirac sea holes are converted to more normal lattice holes, and thus can be dealt with in the same fashion as semiconductor designers handle lattice hole problems inside their semiconductor designs. Positron (hole) effects are well known in materials science, and are increasingly being used in actual systems such as the antimatter (positron beam) microscope {266a-266b}.

We accent that a simple LC oscillating circuit does not produce COP>1.0 of itself. If, however, the charges in the currents surging to and fro are in particle resonance at the "feed frequency", then they will "sweep out" a greater geometrical cross sectional area to intercept additional Heaviside energy flow existing outside the normal "static charge" Poynting energy flow. This is similar to the "intercepting resonant particles " process utilized by Bohren {257}, and it allows output of more EM energy than the operator inputs *in the calculated Poynting component* of his own input energy flow. It *does not* output more EM energy than the operator inputs in the sum of his Poynting input component and his Heaviside input component.

The real energy conservation law is that the input energy from all sources and of all types must equal the output energy of all types, where by

[115] The union of a Dirac hole (4-space negative energy electron before observation) and **a** positive energy electron before observation, can occur without radiation. The two curvatures of spacetime involved are equal and opposite, so they just get **replaced** by a flat spacetime, which involves a filled Dirac sea (all the holes filled with electrons). In short, the energy can go into changing the stationary local double re**curvature** of local spacetime, by a sort of "superposition of two spacetime curvatures", to give a net flat spacetime, rather than dynamically radiating EM energy away at the speed of light. However, if either of the two interacting particles has been observed, this is not the case and standard pair annihilation will be observed. The point is that particles in their unobserved *mt* state rather than their observed *m* state, can interact without observation, similar to the way that wave-to-wave interaction occurs in nonlinear optics.

"output" we mean output as useful energy and output as loss or non-useful energy.

So conservation of energy flow is not violated, because one also inputs an additional *Heaviside nondiverged* component, unknown to Bohren. Circa the 1880s or early 1890s, Lorentz arbitrarily discarded it from accountability. One does not have to "pay" for that *nondiverged* and *unaccounted* input energy flow component. Except in continually applying Lorentz's integration trick to discard it, the nondiverged Heaviside component has been almost totally neglected in the textbooks since Lorentz arbitrarily discarded it back there circa the late 1880s. However, it is roughly dealt with in near field antenna theory, sometimes under the topic of "Poynting energy bunching". In the near field, e.g., there also may be a substantial *longitudinal* E-field component. One region may be oscillating back and forth along the flow direction, while the region in quadrature may be flowing in only one direction.

By causing the intercepting charges themselves to resonate and sweep out a greater reaction cross section in an energy flow, the normal definitions of "field intensity" and "potential intensity" are no longer true, because their reaction intensity to a unit point *static* charge has been used as their stated "magnitude". The conventional definition is only for an indication of the *intensity* of the energy flows comprising the field and potential. With the unit point *resonant* intercepting charge rather than the assumed *static* charge, the reaction cross section for the same charge increases, and so the "apparent magnitude of the (intercepted) field intensity" also increases beyond what is in the textbook. So far as I am aware, there is no previous precise term associated with this phenomenon, except to lump it in the euphemism of "negative absorption of the medium" or "negative resonance absorption of the medium" in certain materials {267}. It is more nearly a Poynting energy amplification process, since the "intercepted" or Poynting component of the energy flow is increased. Thus it can be a mechanism for COP>1.0, if the closed current loop circuit's use of half the collected energy in the circuit to kill the source dipole is also defeated.

Nonetheless, energy bunching or Poynting component amplification by altering the reaction cross section function of the intercepting particle is a legitimate way to provide excess "free" energy input for COP>1.0 EM power systems.

4.5 Perspective on Tesla vs. Marconi

Tesla was neither deluded nor mistaken, though some electrodynamicists have mistakenly considered him in that light. On the other hand, Jackson — one of the leading electrodynamicists of our time — pays Tesla a significant compliment as follows {268}.

> *"In U.S. patent no. 787,412 (April 18, 1905), reprinted in Nikola Tesla, Lectures and Patents and Articles. Nikola Tesla Museum, Beograd, Yugoslavia (1956), this remarkable genius clearly outlines the idea of the earth as a resonating circuit (he did not know of the ionosphere), estimates the lowest resonant frequency as 6 Hz (close to the 6.6 Hz for a perfectly conducting sphere), and describes generation and detection of these low-frequency waves. I thank V. L. Fitch for this fascinating piece of history. "*

We also point out that many present science texts err by continuing to credit Marconi with the *discovery* of radio, although he certainly did much to pioneer it and received a Nobel Prize in 1909. Hertz must be given credit for the first deliberate signal transmission per se, during the period 1886-1888. As his transmitting antenna, Hertz used an end-loaded dipole with a gap, and as his receiver he used a resonant square loop antenna with a gap {269}. Sparks produced at the gap in his transmission antenna resulted in sparks appearing at the gap in his receiving antenna.

Marconi became obsessed with Hertz's results nearly a decade later, and in mid-December 1901 Marconi announced the reception of signals at St. John's, Newfound that were transmitted across the Atlantic from Cornwall, England. He later recorded radio signals transmitted around the Earth, and began regular trans-Atlantic message service in 1903.

Marconi's patent {270}, however, was eventually overturned by U.S. Supreme Court decision {271}, because Tesla's patents (and demonstrations) substantially preceded it. Tesla also demonstrated radio transmission before Marconi, and Marconi actually used a modified Tesla circuit in his famed transmission in 1901. Nonetheless, this is not to detract from Marconi's accomplishments; he definitely put "wireless communications" on the map. It is simply to give *discoverer of radio* credit where credit is due.

Tesla was also closer to the truth of the form of an EM wave in space than are modern electrical engineering and most electrodynamics texts. In the present book we have stated that what exists in 3-space as the so-called "transverse EM wave" are actually longitudinal EM waves and functions

of them, with the energy entering each 3-space point from the accompanying time-polarized (conjugate) EM wave at that point (i.e., from the time domain) and emerging in 3-space in the form of a longitudinal EM wave, in 1:1 correspondence.[116] This is followed by a return of the energy from 3-space back to the time domain. This "circulation" from the time domain to 3-space and back to the time domain occurs at every point dipole in 3-space. Only the presence and combination of both the time-polarized photon and the longitudinal photon at each point in an EM wave makes the wave "observable", when we translate into wave phenomena the photon phenomena pointed out by Mandl and Shaw {19}. What spreads as EM energy flow in space (from a source charge) is the local polarization of the vacuum, associated with this giant negentropy circulation from time to the negative charge, to the positive charge, and back to time.

The notion of the transverse EM wave flowing through space is an artifact of the ubiquitous *substitution of the effect for the cause* in Maxwellian electrodynamics. E.g., a completely erroneous "definition" of the causal field (as it exists in space prior to interaction with charged mass) is given as the *effect of its interaction with a ubiquitously assumed unit point charge at every point in space where the field is present.* This in fact substitutes the effect (existing *after* the interaction) for the cause existing *prior to* the interaction. That of course is a gross non sequitur.

We give a concrete example from the first edition of a standard dictionary of physics and mathematics {272}:

> *"**electric field...** 1. one of the fundamental fields in nature, causing a charged body to be attracted to or repelled by other charged bodies; associated with an electromagnetic wave or a changing magnetic field. 2. Specifically, the electric force per unit test charge."*

[116] Later we shall deal a little further with how EM energy iteratively recurs statically in 3-space and propagates dynamically and continuously in 4-space, in more detail. The solution to the long-vexing particle-wave duality is the process of observation. Before observation, an entity is dynamic and continuous in spacetime, not 3-space. After observation (by emission of a photon), it is a momentary frozen 3-snapshot (particle) at a single instant of time. At the next immediate instant, a photon is absorbed, reconverting the "static snapshot" into a dynamic 4-entity again. Since observation (photon emission) and de-observation (photon absorption) iterates at extremely high rate, the entity and each tiniest part of it oscillate back and forth between being a frozen 3-entity (particle) and a dynamic 4-entity (wave).

In the first definition, the field is given as the "cause" of the interaction that exists between like and unlike charges. In the second definition, the field is given as the effect — of the interaction with a test charge — of *something undefined* as the cause.

An entirely different "definition" is given by Gray and Isaacs {273}:

> *"**electric field** ... The space surrounding an electric charge within which it is capable of exerting a perceptible force on another electric charge."*

Here it is defined as simply the space around an electric charge, and not really the cause or effect of anything, unless that local spacetime has been curved (which it has).

Not to belabor the point, this sort of thing led Feynman to "define" the EM field in this fashion {274}:

> *"...the existence of the positive charge, in some sense, distorts, or creates **a "condition"** in space, so that when we put the negative charge in, it feels a force. This potentiality for producing a force is called an <u>electric field</u>. "*

So Feynman made the electric field a *condition in space* surrounding a charge, where the condition can produce (has a potentiality for producing) a force on another charge. He also was aware that force is an effect of the reaction of the causal field with charged mass, in the following statement {275}:

> *"...in dealing with force the tacit assumption is always made that the force is equal to zero unless some physical body is present... One of the most important characteristics of force is that it has a material origin..."*

In Maxwell's theory, the electron, atom, and nucleus had not yet been discovered, and electricity was considered a thin material fluid, flowing in a wire (hence the name "currents") much like water through a pipe. The surrounding space was considered filled with a thin material fluid called the luminiferous ether. A very rough notion existed that the "shaking" of the ether disturbance coming in to an antenna would disturb or perturb the electric fluid in the wire directly. Hence, if one "measured" a transverse oscillation of the electric fluid in the wire due to this "detection", it conclusively "proved" that the incoming ether-perturbations were also transverse. On that notion — together with Faraday's notion that "field lines" were taut physical strings, so that "field perturbations" were naught

but plucked oscillations of these taut strings — the entire notion of the transverse EM force field wave in space was created.

It really is not that way, as is easily shown with modern re-examination of what happens in the receiving wire, considering the Drude electron gas {276} and electron drift velocity. Today we know that the electrons move *longitudinally* down the wire only with a small drift velocity (usually a few inches per hour), while the signal (field) races longitudinally down the wire at essentially light speed or nearly so.

The electrons are longitudinally constrained in the wire because of the vast number of electrons ahead of them that tend to repel their longitudinal movement. The electrons are far less constrained laterally in the wire. However, each electron is also spinning, and its 3-space performance may be compared to a spinning gyro, whose spin axes are now longitudinal restrained. Accordingly, the electrons readily *precess laterally* in the wire[117] when perturbed *longitudinally* by the incoming longitudinal 3-space components of the "wave in vacuum" — by gyroscope precession theory. The electrons at the surface layer of the wire are somewhat less constrained longitudinally, and they "slip" a little down the wire in each oscillation, accounting for the very slow electron longitudinal drift velocity.

Accordingly, one of the most important dynamics of the circuit is the dynamics of the surface charges, as pointed out by electrodynamicists {277}.

If the incoming waves were true lateral waves, there would be no longitudinal force component on the laterally precessing electrons, and coherent current would not flow longitudinally in the wire at all. Instead, one would just get some longitudinal to and fro noise in the coherent lateral motions of the electrons, due to electron collisions.

[117] It is this lateral precession movement of the electrons that is "detected" in most of our instruments. To the early electrodynamicists prior to the discovery of the electron, this detected lateral motion was considered the "shaking of the material electric fluid" in the detecting wire. It was thought that the incoming "electric fluid" from space also had to be material (in the material ether) and transverse, because otherwise the oscillations from space could not have mechanically transferred their "lateral oscillation" to the electric fluid in the wire. Faraday's "material lines of force" concept and the notion that EM disturbances (waves) were simply the mechanical pluckings of these taut strings which also involved similar "material ether" concepts.

Nonetheless, it seems we are stuck with the ubiquitous transverse EM wave model. For more than 100 years, scientists have universally substituted effect for cause in the case of much of electrodynamics — as in the continuing substitution of what is *diverged from* the field and potential at each point in them, by an assumed static point charge, as being the magnitude of the field or potential itself at that point. At best, what is diverged from the field or potential is an indication of the point intensity of the energy flows comprising the field or potential at each point, and in the case of the field, of the prevailing direction.

So electrodynamics is still riddled with that nearly all-pervasive error, and it seems it will likely never be corrected. The leaders of the scientific community do not seem to wish it done and will not allow it to be funded. In short, the community is so comfortable with that grave error that it will almost defend it to the death. The so-called transverse EM wave in 3-space has come to be accepted as if it were a law of nature.

Occasionally a journal will point out the terrible non sequitur in the prevailing notion of the EM wave in space as a "plane wave of oscillating orthogonal E and H fields along the x- and y- axes moving at light speed in the z- axis direction." Romer, former editor of *American Journal of Physics,* provides a prime example {278}. Romer takes to task:

> *"...that dreadful diagram purporting to show the electric and magnetic fields of a plane wave, as a function of position (and/or time?) that besmirch the pages of almost every introductory book. ...it is a horrible diagram. 'Misleading' would be too kind a word; 'wrong' is more accurate." "...perhaps then, for historical interest, [we should] find out how that diagram came to contaminate our literature in the first place."*

At any rate, once we understand how the real EM wave exists in space, then we can sympathize with Tesla's view of it from the following {279}:

> *"Tesla upholds the startling theory formulated by him long ago, that the radio transmitters as now used, do not emit Hertz waves, as commonly believed, but waves of sound... He says that a Hertz wave can only be possible in a solid ether, but he has demonstrated already in 1897 that the ether is a gas, which can only transmit waves of sound; that is such as are propagated by alternate compressions and rarefactions of the medium in which transverse waves are absolutely impossible."*

In Tesla's own words {280}:

> *"...I showed that the universal medium is a gaseous body in which only longitudinal pulses can be propagated, involving alternating compressions and expansions similar to those produced by sound waves in the air. Thus, a wireless transmitter does not emit Hertz waves which are a myth, but sound waves in the ether, behaving in every respect like those in the air, except that, owing to the great elastic force and extremely small density of the medium, their speed is that of light."*

From quantum field theory, the instantaneous scalar potential in space is actually a coupling of a scalar photon and a longitudinal photon {19}. The only EM component in 3-space is that longitudinal photon.[118] Transforming to wave language, Tesla appears to have been correct in his view of the longitudinal form of the EM wave in 3-space, whereas all the texts are still wrong even today.[119] However, Tesla was also noted for grandiose pronouncements, a trait which certainly did not endear him to the struggling electrodynamicists of the time, even when he was correct and they were wrong. An example is the following {281}:

> *"The Hertz wave theory of wireless transmission may be kept up for a while, but I do not hesitate to say that in a short time it will be recognized as one of the most remarkable and inexplicable aberrations of the scientific mind which has ever been recorded in history."*

Unfortunately, in electrodynamics we are still stuck with that "most remarkable and inexplicable aberration" today, and we will remain stuck with it until the leaders of the scientific community (such as the National Academy of Sciences and National Science Foundation) recognize it and fund a complete overhaul of the foundations of classical electrodynamics, which is so sorely needed. On the other hand, *one should not hold one's breath while waiting for the mountain to come to Muhammad! One might as well ask the stars to fall from the sky as to ask the leaders of the scientific community to correct the serious foundations errors in physics and especially in electrodynamics.*

[118] Hence it is not surprising that all EM in 3-space decomposes into bundles of longitudinal EM waves and their dynamics, as shown by Whittaker {85, 91b}.

[119] However, Tesla did not appear to realize the involvement of time-energy transduction to longitudinal KM 3-space wave energy and vice versa.

4.6 Conclusion

Hopefully we have set the stage for our next chapter, where we will be advancing mechanisms and approaches that have been tried by a variety of researchers. Several of these researchers have indeed produced COP>1.0 devices and processes. However, at this writing none of the devices produced by these inventors and researchers are in production and on the market. As we mentioned in Chapters 1 and 2, there are very powerful forces that have been applied to prevent such development.

Briefly, such suppression has resulted due to one or more of the following:

(a) Sheer greed by the group that gathers around the inventor/researcher, including multiple competing investors and/or "backers". Often a struggle for control develops, and the project is decimated in the process. In many cases a legal struggle also develops, with the result that the legal status of the invention may be fouled beyond repair.

(b) Naivete on the part of the inventor and his surrounding group. The inventor needs the frequent advice of a patent attorney, a regular corporate attorney, a person familiar with research and development projects and procedures, a person expert in testing (particularly with sophisticated multichannel digital oscilloscopes which gather multiple channels of data simultaneously and integrate under the curve, an accountant, and a person skilled in negotiation with potential investors and backers. Most inventors do not have access to all that, or only have access to it after much of the die has been cast and serious mistakes have been made.

(c) Animosity and fierce attack from the scientific community and self-appointed "defenders of the faith". Few inventors are prepared for the onslaught that awaits them if they succeed in producing a genuine COP>1.0 electrical system. Slander and libel are just part of it. An inventor or researcher caught up in always trying to defend himself against vicious ad hominem attack is an inventor successfully deviated from his work. The family also often suffers.

(d) Just now, after the Enron fiasco much of America is becoming aware that powerful organizations often pull out all the stops in a blind pursuit for money and power. Of course they have done so for a very long time; this is nothing new. The inexperienced inventor or researcher is ill prepared for the fact that portions of

government organizations,[120] national labs, universities, etc. may be precisely that way also! U.S. government laboratories also file patents; check it out! Check out Fullerton's defense of his patent rights for his ultrawideband communication system work.

The people in any large organization form a bell-shaped distribution curve. About 9% of that curve represents folks who have — to put it mildly — little ethics when it comes to position, power, and money. Some of these 9% fellows will go to quite some length to twist the patent or part of it or control of it away from an inventor. An inventor who has never heard of "march-in" rights (a neat little "theft" phrase favored by DARPA, for example) is often an easy mark. Government agencies will be on an interesting invention and its hapless naive inventor like vultures on a fat calf. They dangle some money and a contract to "assist the inventor to get his invention developed". There is a little clause in the fine print of the contract where the government reserves "march-in" rights. This is a hidden bombshell that really says the government — *anytime it wishes* — can just unilaterally declare that the funded inventor isn't getting the invention to market fast enough, so a single bureaucrat just *seizes it* — in the name of the government, of course. Anyone who has been in serious aerospace contracting very long is also aware of the deals between a few government fellows who control award of the funds, and their "favored contractor". If enough business is steered to the contractor by the government person, it is implicitly understood that when the government fellow retires, he goes to work for that company with a Vice President position, lucrative salary, and a fat stock option. It's easy to become an instant millionaire or multimillionaire that way. A small percentage of government contracts are actually contaminated in such a hidden fashion. The universities usually are much more open and blatant, and just put

[120] Interestingly, the government is not allowed to copyright its own publications by federal servants. Neither should the government be allowed to patent its own inventions by federal servants and federal agencies. This has set up direct conflict in the federal funding channels for the taxpayers' funds intended for independent research, providing a wonderful opportunity for hanky panky by that lower 9% of the people comprising any large group. By the bell-shaped distribution curve, those comprising that 9% will rise to the opportunity. They are manipulative, greedy, and some are immoral and self-serving. Partially coupled with a similar low "bad apple percentage" in the contracting game, this enables many travesties in the name of federal research and development with respect to patents and misdirection of funds.

in a clause that says, "All patents revert to the university!" Also, the inventor must be aware of the difference between "nondisclosure" and "non-circumvention". Just try getting the latter clause from a university, or either clause from a government agency (yes there are rules for "proprietary information", and they are widely violated). Non-circumvention means the outfit agrees not to change a coil or something, and go and patent your invention. Nondisclosure means they just agree not to talk or write about it openly.

(e) And yes, in addition to these many "petty" little conspiracies, there really is a *great* conspiracy — in fact, there are many of them. Churchill just referred to the entire set of conspiring cartels as the "High Cabal". This is a loose-knit set of extraordinarily wealthy cartels that between them control much of the financial power of the world. You can only find the principals behind a couple of hundred interlocking corporations, if you penetrate deeply enough. Much of their great financial income comes from the control of energy at its various levels, through a net of interlocking corporations. Something like $2 trillion dollars per year is their "take" from energy worldwide. Oil plays a great role in that. These "high cabal" fellows make or break nations financially, as is almost being done to Argentina as this is being written. They also have been stopping COP>1.0 electrical power systems since shortly after the turn of the century, using whatever means are necessary — fair or foul. That is why we still are burning oil, coal, and natural gas, and why our automobiles and trucks run off gasoline and diesel, and not off free electrical energy from the vacuum. The high cabal intends to keep it that way. Some of the major primary means of "stopping" an invention have been as follows:

a. Manipulation and improper use of the law (Gray's production line was shut down by law officers before his engines could roll off there and onto the market).

b. Involving the unsuspecting inventor in drug charges by planting drugs on his property surreptitiously, then secretly notifying the drug enforcement officials who suddenly raid the premises and discover the narcotics, resulting in the inventor going to jail since he has been caught "red-handed".

c. Threatening the inventor's life and the lives of his family, to frighten him away from what he is doing.

d. Arranging a fatal accident for the inventor, such as a fatal auto accident, a fall from a high place, or drowning.

e. Assassination (hit men are fairly simple to hire; a good one is a bit more difficult to hire but is doable. A good hit man might assume a disguise and fake a robbery, shooting and killing the target in the "robbery". In an extreme case, he just fires at a distance with a professional sniper rifle that is silenced. A variation is the use of a "throwaway" assassin, a fellow who has been deeply conditioned by very harsh methods, to deeply involve his autonomic nervous system. He can be spotted by the "glaring eyes" effect of autonomic nervous system involvement. This fellow is only marginally functional in real life, and requires a handler. He also must "fixate" for some minutes (usually from 20 to 30) on the target, by staring at him for a period. Then — say, the next day — while the target is at lunch in a public restaurant, the throwaway walks in, walks straight to the target, and empties a pistol in him at point blank range. He remains there until the police arrive and arrest him. He is immune even to torture; nothing can be gotten out of him, even by electrical shocks on his genitals. There are two levels of throwaways; that is the older and less functional version produced by very harsh means. The more modern version is without the glaring eyes with white showing above the iris; this fellow is more functional, fixates very quickly (couple minutes to five minutes), and can operate without the close immediate presence of the handler.

f. Making the inventor an offer he "cannot refuse", in the old Mafia sense. In the latter, nicely dressed persons come to the inventor's house, meet with him, and offer him a large sum of money to quit what he is doing for the rest of his life. The going sum varies between $5 million and $10 million, usually. The offer is real and it cannot be refused; either the inventor accepts it, or he and all his family are dead when these gentlemen leave the premises. If the inventor refuses anyway, he and his family are killed.

Usually the bodies also just "disappear" and are never found or heard from again.

g. These days, variations are used such as a careful crash of another auto into the back of the inventor's car so he is really shaken up badly but not seriously hurt. He goes to the hospital for checkup, in case of concussion etc. Everything is seemingly okay, but he is kept overnight for observation. That night he is given a hypodermic of air in his veins. Next morning his family receives a call that the inventor has suffered seizures from an apparent concussion after all, and is fighting for his life. If he doesn't die, he becomes a human vegetable. Piece of cake.

h. Then there's the ice dart dipped in curare. The curare paralyzes the muscles of the heart and lungs; the inventor goes down in convulsive floundering, gasping and unable to breathe or to pump blood. He expires very quickly. The curare breaks down in the body, the ice melts, and you have a fellow the medics find died of convulsive heart seizure, etc. Works like a charm. This is an adapted "dirty spooks" trick, adapted from those branches of the intelligence communities of the world that specialize in assassinations.

i. Use of "gaming", which was originally developed to influence or change the behavior of foreign leaders. Imagine writing a scenario, as for a movie. Only you have the deep psychological profile of the targeted individual. You also have the deep psychological profiles of quite a few other individuals who have "knee-jerk" reactions in a certain direction useful to you in your games (in your scenarios). These are called "agents of influence" since, to get them into interacting with the target, only a phone call or other contact need be made and a stimulus given, and they are off and running, self-powered and going after that target with their knee-jerk response. So very sophisticated computers are used, the scenario (intended plot of events to happen) is prepared (the artificial intelligence programs will even give the probabilities of success of all the variants), and a recommended scenario variant is derived and accepted. Then the controller has one or more agents working **for** him that contact the players (the agents of

influence). They get their phone calls or stimuli, react in predictable fashion, and come pell-mell at the inventor, interacting all over the board with him. The range of games is enormous, from stock schemes to lawsuits to infiltrating agents of influence into the internal organization of the inventor to money laundering, etc. The controller follows the progress, and only once in awhile makes slight adjustments (may need to trigger other agents of influence, send in one actual agent, etc.). Over the last 20 years, the gaming has become very expert. So many games can be launched against a single inventor that he usually is finished or nullified by one of them, eventually. Having been gamed over 200 times in the last two decades, I plan to write a book one day on the subject of the games and what to watch for.

j. Finally, here is a sad and disconcerting rule, usually true. If you gather six persons together that you have known for years or even all your life, and they are the nucleus of the organization around you, watch what happens when success occurs and you really do pull EM energy from the vacuum and power loads, lights, etc. One-sixth of the population, seeing that, will shortly contract a very strange malady known as "gold fever". It is not just an *obsession;* instead it becomes an all-consuming *possession* almost in the biblical sense. An individual possessed by gold fever would kill his own grandmother to try to gain control of that system. If one or more of these "gold fever" transformations occur, that sets the group into profound conflict and vicious infighting, on every front. You get sabotage of equipment, sabotage of demonstrations, stealing of equipment, legal shenanigans, just name it. This has destroyed many groups. It will destroy many more.

k. A variation is to send in a special agent who penetrates the group and becomes a member. Indeed, the high cabal has certain persons who specialize in just such penetration and are specialists at setting up disruption. They have had plenty of practice, and are very good at their trade. The identities of some of these "special agents" would surprise the casual observer. The so-called "overunity community"

is rather strongly penetrated and misdirected by a number of such special agents, in addition to a greater number of agents of influence.

1. Finally, the technical knowledge of most inventors and researchers in this field has been largely limited to ordinary electrical engineering and electronics. This means that the inventor often forms his own lexicon and way of thinking about how he does the "magic" COP>1.0. It may be difficult or impossible to connect the way he thinks back to legitimate physics. Further, most of the COP>1.0 community, the majority of electrical engineers, and nearly half the physicists do not understand the technical difference between the *efficiency* of a power system and its *coefficient of performance.* We have insured that the reader of this book will know the precise difference — it's even in our glossary! Further, the entire group around the inventor, and the inventor himself, may not have a clear understanding of the source of the extra energy, the mechanism by which it is obtained, or even the difference between a system in equilibrium with its active vacuum environment and one in disequilibrium with it. Most engineers and a great number of scientists also are still unaware of the dramatic difference between the thermodynamics of equilibrium systems and the thermodynamics of disequilibrium systems. Many have no notion of what the active vacuum is or does. So the inventor may actually be able to build the device himself, but may later err and actually build it away from COP>1.0 with further development.

m. Another problem can be measurement. Sometimes very simple errors — such as "measuring" highly nonlinear, spiky signals with an RMS meter, or using an inferior oscilloscope, or using inferior probes with good oscilloscopes, tricks a relatively inexperienced inventor himself into believing his unit achieves COP>1.0 when it doesn't. Also, some standard engineers will insist on calorimetry, which is inappropriate for COP>1.0 EM systems since they output a mix of both positive and negative energy. The positive energy will heat the calorimeter fluid and the negative energy will cool it

simultaneously, and the "expert measurer" will always measure the difference and thus COP<1.0 with his calorimeter (unless the inventor is a rare one who has also transduced the negative energy fraction of his output into positive energy). Yet the conventional engineer or scientist — who has never seen negative EM energy or a COP>1.0 EM system in his life — will be so confident from his "positive energy only" thinking that he will be completely convinced that a real COP> 1.0 system, measured with a calorimeter to show net positive energy COP<1.0, is *actually* a COP<1.0 system instead of the error in measurement that it is. One of the purposes of this book is to try to explain such things and get a better procedure and protocol made available for the testing.

n. Finally, there are a few actual charlatans who deliberately deceive both the group around them (if it's sufficiently naive) and naive investors and backers. E.g., if one builds a huge starter motor (very high current, very high torque, cannot run long without burning up!) and puts it in an automobile, then fills the back of the automobile full of batteries, that beast will draw 400 amps and leap across the pavement or warehouse floor with an agility one is shocked to see. Then if the inventor is always "having difficulty with his controller unit", and "everything will be fine once the controller problem is licked" or some such, many small and naive investors will leap to invest their life savings eagerly. There are many other scams also, and unfortunately every experimental field, with great financial promise if successful, does attract them. Here the old adage is best: If it is just too good to be true, it probably isn't. One should insist on a technical explanation of the source of the excess energy, the mechanism by which it is taken from the environment, how asymmetrical self-regauging of the circuit occurs, etc. If these questions cannot be answered, the inventor himself does not know what he is doing. At best, he cannot explain it; or he may just be honestly mistaken. In the worst case, the inventor knows it is not genuine, but is deliberately deceiving the investors. So my advice would be to first assess the scientific level of the understanding of the inventor group. Then get an independent test of the

device or see one done properly. Then decide whether what you have seen and heard is real or not.

o. Meanwhile, there are from time to time legitimate COP>1.0 systems initially developed. The place where all of them have failed is where the inventor group seeks to obtain the appreciable financing (something like 30 million dollars is required these days) to complete the phenomenology experiments, modeling, scale-up factor determination, and prototyping before a production model can be built. To date, every one of the legitimate COP>1.0 systems has foundered and failed right at that sheer vertical cliff. Our own MEG system is at that cliff at the moment, so that cliff is very near and dear to the hearts of the five of us who have struggled so long and invented the MEG. Time will tell whether we succeed where all the others have failed, or whether we also just get defeated by the cliff. As of this writing, we have not yet obtained the necessary capitalization. But we are giving it our very best try, and we believe we will win it eventually.

Chapter 5

Selected Approaches to Overunity Power Systems

> [On point-contact transistors]. *"First, the theory underlying their function is imperfectly understood even after almost a century..., and second, they involve active metal-semiconductor contacts of a highly specialized nature. ...The manufacturing process is deceptively simple, but since much of it involves the empirical know-how of the fabricator, the true variables are almost impossible to isolate or study. ... although the very nature of these units limits them to small power capabilities, the concept of small-signal behavior, in the sense of the term when applied to junction devices, is meaningless, since there is no region of operation wherein equilibrium or theoretical performance is observed. Point-contact devices may therefore be described as sharply nonlinear under all operating conditions."* [William B. Burford III and H. Grey Verner] {282}.

5.1 Introduction

In this chapter we present a selection of potential overunity notions, inventions, and experiments by various inventors and researchers. Its purpose is to show some of the more relevant work that has been done, and hopefully to stimulate new thinking by the interested reader. It is not intended to be all-inclusive, but merely representative. Most of the work addressed is by other inventors and scientists, and we give an appropriate commentary from our viewpoint as best we understand the invention and the process used. Not all the concepts presented can be clearly explained, though some can and are.

This is not intended to be a "kit of parts" or an assembly instructions type of presentation. For that, the interested researcher will have to rely on his or her own ingenuity and lots of bench experiments, because no such "kit of parts with instructions" for COP>1.0 electrical power systems exists at present {283,284}.

5.2 Tesla's Shuttling of Potential Energy and Barrett's Extension

See Figures 4-4 and 4-5 in Chapter 4. In his patented circuits, Tesla accomplished the novel function of "shuttling" the potential itself (and therefore potential energy) around in the circuit at will. This startling function accomplished by Tesla is impossible to see in a conventional vector or tensor analysis of his patented circuits, but it is clearly evident in a higher symmetry EM analysis of them. So it does not appear in the conventional texts, which use vectors or tensors for their circuit analyses. Barrett, one of the leading higher group symmetry electrodynamicists and also one of the pioneers of ultrawideband radar, utilized quaternion electrodynamic analysis to clearly show this novel effect in Tesla's actual circuits {285}. Thus, Tesla was able to produce and move around asymmetrical self-regauging in his circuits, wherever he wished. That has been totally missed by scientists prior to Barrett's revealing analysis.

Barrett then went on to extend Tesla's basic mechanism and employ it for communication and radar purposes, obtaining two patents {286a-b}.

It would appear that use of such shuttling techniques is probably applicable to reducing the back emf in conventional nonshuttling circuits, leading to new COP>1.0 mechanisms. The definitive answer remains to be determined by some future researcher.

5.3 Moray's Radiant Energy Device

One of the remarkable examples of a successful COP>1.0 system was the radiant energy system of Dr. T. Henry Moray of Salt Lake City, prior to World War II. Figure 5-1- shows Dr. Moray and his final 50 kW unit, powering an assembly of light bulbs {287}. The device weighed 55 pounds, used an antenna connected as a "signal input" from the ether, but needed no input of electrical energy by the operator in order to achieve its steady power output.

As shown in Figure 5-2 and Figure 5-3, the various Moray tubes were complex in structure. In addition to various grids, they usually contained (in quadrature) three or more amorphous semiconductor pellets pressed in large presses and sintered with locked-in stresses. One points out the presence of optical effects including phase conjugation, possible use of the built-in stress as a sort of self-pumping and mild self-amplification, possible iterative feedforward and feedback loops due to iterative phase conjugation, collecting of additional energy from the usually nondiverged

Heaviside component via the iterative reverberation of energy, and non-interfering fields in quadrature.

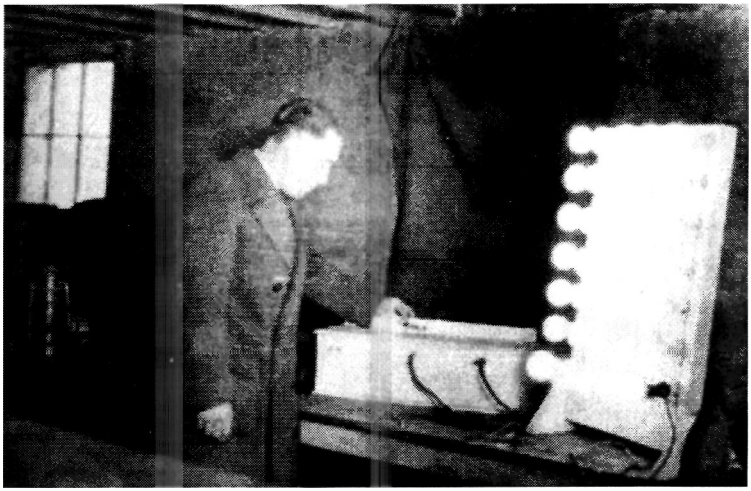

Figure 5-1 T.Henry Moray's 50-kW unit.

The blown quartz tube envelope, in the dark of an enclosure, is open to the passage of infrared (heat) and ultraviolet, which spans a harmonic interval. This allows the passage *of difference* frequencies as sine waves without breakup, even in a nonlinear isotropic environment. Moray stated unequivocally that the tubes would not work unless the envelopes were made of blown quartz. The pellets (shielded from outside light) would nonetheless receive IR input from the ambient temperature, and probably triggered at least weak UV due to the radioactive decay continuously ongoing in the semiconductors. We point out that the UV band is roughly twice the frequency of the IR band, so the "difference frequency" is roughly the IR band itself. In short, it may be that "difference frequency" IR is thus processed in Moray tubes in much more sophisticated fashion than has previously been suspected, including in a self-amplifying (regenerative) manner.

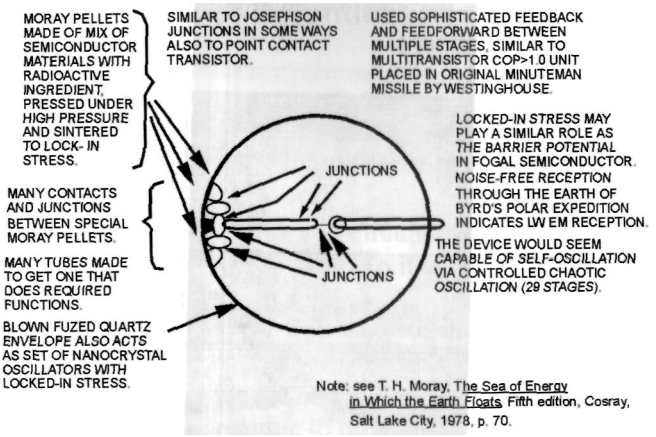

Figure 5-2 Diagram and some novel features of T. Henry Moray's special tube.

The pressed semiconductor pellets were placed in the tube in quadrature, in a sort of "point or junction contact" with each other.[121] Each semiconductor contained a mix of triboluminescent zinc (a semiconductor material), a radioactive material (probably uranium dioxide), and another material of unknown composition, rumored — but not confirmed — to possibly have been diatomaceous earth which also has some unusual properties one may look up. There were some 29 amplifying tube stages in the device. A U.S. patent {288} was eventually granted on an electronic therapeutic unit containing Moray tubes, but the patent on the power system was never granted, although the application was kept current for some years by the Moray family. Eventually the power device patent application files disappeared from the U.S. Patent and Trademark Office.

Although its full technical details were never released, the Moray device is of interest because Moray demonstrated it many times to engineers and scientists, under rigorous measurement conditions, for years. These expert witnesses then signed affidavits to the results achieved by Moray in the

[121] Indeed, the junctions of such sintered pellets are most interesting. Such a grainy junction can be compared to a host of very close point contact junctions, particularly with finely-ground powdered materials used in the pressing and sintering. In essence, Moray's junctions contained a great many "point contact transistors", and it is known that such transistors can behave (particularly under pressure!) as true negative resistors. This also appears to be one of Moray's secrets.

tests. Moray also discovered that he could produce an additional 50 kW of power simply by inserting an additional tap just prior to the formal output.

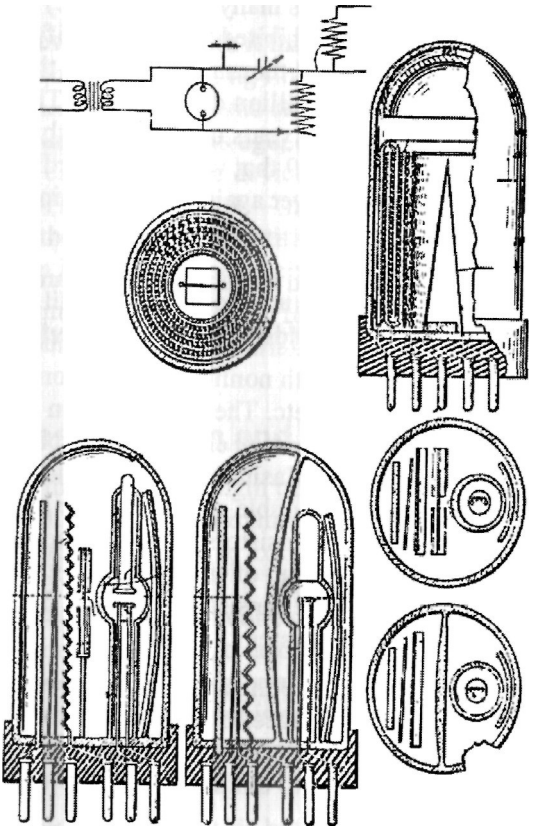

Figure 5-3 A variety of Moray tubes showing their complexity.

Repeated assassination attempts were made against Dr. Moray. While driving his car on the streets of the city, on several occasions he was fired at from an alley or from the sidewalk, but he had bulletproofed the car because of continual threats and ambushes. He was also shot in his own lab in a physical struggle with one would-be assassin, but survived although seriously wounded. A Russian company tried to steal the device, and a Russian agent was planted in Moray's lab, gradually sending essentially all the technical details of the Moray device to Russia. That

agent later destroyed the unit right in Moray's lab by suddenly smashing it with a hammer.

Moray's tubes were quite expensive and were painstakingly made by hand. He fabricated a number of tubes (as many as 30 or more) before he obtained one that "worked" and exhibited the self-amplifying effect. Over the years, he spent several hundred thousand dollars on the project, which is the equivalent of some twenty million dollars today. The 29 tubes in his final 50 kW unit were the result of years of labor and fabrication of several hundred rejected tubes to get the 29 that worked. Accordingly, once those 29 were destroyed, Moray was never again able to obtain sufficient financing to rebuild his unit.

However, Moray had demonstrated a special type of transistor years ahead of the first transistor patent. He had demonstrated the importance of multiple junctions in transistor materials. Optical and nuclear functioning of the tubes was also woven in with nonlinear oscillations, multiple feedforward and feedback loops, etc. The sophistication of the tubes and feeds alone almost certainly guaranteed chaotic self-oscillation. We suspect but cannot prove that the Casimir effect may also be involved in some of his conducting metallic double surfaces.[122] He had demonstrated a remarkable "tube-with-internal-transistors" that produced energy output self-gain, without any operator input of energy. In addition, he had successfully used his special tube/transistor hybrids to produce a very successful COP>1.0 EM power system.

After Moray's death, his two sons John and Richard continued to try to rebuild the unit, but were never successful due to lack of sufficient funding and lack of a proper scientific team. They do know how to build the tubes, however, and they do know how to build the unit.

It appears that no electrodynamicist or physicist skilled in higher group symmetry electrodynamics ever examined the Moray device or worked with Moray. No particle physicist or electrodynamicist skilled in non-Abelian electrodynamics ever worked with the device. Since broken

[122] The "grain" of the stressed semiconducting pellets may be important with respect to the Casimir effect versus the frequency. In short, Moray's contact surfaces between his semiconductors were "grainy" and these grains would have constituted Casimir surfaces. For the importance of the shape of the double surfaces, see M. Chaichian et al., "Quantum theories on noncommutative spaces with nontrivial topology: Aharonov-Bohm and Casimir effects," *Nucl Phys B,* Vol. 611, 2001, p. 383-402.

symmetry was not discovered and proven until 1957, no technical person who worked closely with the unit was ever aware of the various broken symmetries by which some of the virtual energy of the vacuum can be and is transformed into observable EM energy.

Certainly no one ever worked with it that understood the peculiar action of the difference frequency in traveling linearly through an isotropic nonlinear medium. John Moray, who stalwartly carried on the Moray lab in Salt Lake City until a few years ago, does know how to build the tubes, and he knows the circuitry for the device. That he does not understand the "deep theory" is of no consequence — no one else does either. In the opinion of this author, a funded scientific team — carefully chosen and working with John Moray — could probably rebuild the Moray device. We would very much like to see a Moray unit in production and contributing to permanently solving the energy problems of the world. Sadly, that does not seem likely.

5.4 Anti-Stokes Emission and Similar Processes

Stokes' law states that the wavelength of the fluorescent light emitted by a phosphor or other luminescent substance is always greater than the wavelength of the radiation used to excite the fluorescence {289}. This condition was observed by Stokes in 1852 {290}. From an energy viewpoint, the collecting medium collects and dissipates some of the input energy in the medium itself (e.g., to accelerate moving molecules) and then emits the remainder of it. The "system" consisting of the medium, the experimenter's input, and the output is such that it usefully outputs as luminescence less energy than the experimenter inputs. Hence it exhibits a COP<1.0, by absorbing excess energy in its "environmental surroundings".

Usually such a "law" generally holds but is sometimes violated in at least a lew cases. Stokes' law is no exception. It applies for most cases of fluorescence and luminescence, but it does not hold for a few of them. In a few cases, the emitted wavelength is precisely the same as the input wavelength. This means that the collector/absorber re-emits all the collected input energy as fluorescence or luminescence. Here the COP = 1.0. This condition is known as the *resonance condition* and the emission is called *resonance emission.*

In other well-known cases, Stokes' law is violated and the energy emitted is greater than the energy absorbed. In other words, the system exhibits a **COP>** 1.0 *with respect to energy emitted versus energy input by the experimenter.* This is known as anti-Stokes emission. It has been well

known for six decades that anti-Stokes emmision processes do indeed output more energy than one has to input oneself {291}. This excess energy emission is usually euphemistically attributed to "additions from the internal energy of the molecule" and referred to as "negative resonance absorption by the medium" or just as "negative absorption by the medium".

Unless the excess energy taken from the physical medium of the system is replaced from outside the physical system, the anti-Stokes emission process produces cooling in the physical system and is self-quenching once the medium loses all the energy it can afford. For the overunity researcher, a huge hint is to search the literature for anti-Stokes type emission phenomena that do not result in media cooling. The Letokhov phenomena {292} are in fact such phenomena where the excess emitted energy is received from outside the physical system medium, and therefore from the surrounding active vacuum and/or the surrounding local curvature of spacetime.

Other than for a very few physicists — e.g., Bohren {24}, Letokhov {157}, H. Paul and R. Fischer {25} — there appears to have been little *effective* discussion of where the excess energy "extracted from the molecule" really came from initially, and how it is replenished to the molecule (if at all), and particularly *whether or not it has to be replenished to the molecule by the operator*. There has been no discussion of the local potentials as dipole asymmetries in the virtual energy exchange with the vacuum, although there has been inadequate discussion of the involvement of the Poynting energy flow (e.g., by Bohren, Paul, and Fischer). There has been no discussion of the possible involvement of the Heaviside nondiverged component of the energy flow, which is additional to the Poynting component but unaccounted by today's electrodynamicists. To my knowledge, the broken symmetry of every dipolarity has not been discussed with respect to such experiments.

The reader can see the point. If a mechanism exists or can be evoked to freely resupply the lost energy to the molecule from the other two components of the supersystem, then the resulting *self-replenishing* anti-Stokes emission phenomenon can be utilized as a legitimate and continuing COP>1.0 process. It remains to be seen whether this can be worked out. If we wish, the giant negentropy mechanism of the source dipole and source charge {308} may be considered universally proven cases of self-replenishing anti-Stokes emmission, already exhibited by every charge and dipole in the universe.

At least one audacious scientist — Letokhov — has suggested that similar processes in certain systems can perhaps comprise true Maxwell's demons, yielding excess energy output and perhaps eventually a COP> 1.0 operation {293}. Russell has suggested that a similar COP>1.0 process is involved in the fiber fuse phenomenon {299}.

Over the last few decades there has been slow but important work in an optical area of possible anti-Stokes emission phenomena {294a-c}. A variety of strongly scattering, optically active media have been shown to produce substantially more energy output than the experimenter inputs to stimulate the output. However, most are being done in laser-like pumping situations and so the pump energy has to be furnished by the operator. This means that the "replenishment" energy to the medium is furnished by the operator, resulting in overall COP<1.0 performance. However, in self-oscillation conditions, the medium can be self-pumped (self-replenished, taking its replenishment energy from the active vacuum exchange when viewed in the supersystem), and in such conditions COP>1.0 performance is possible, at least in theory. Presently we know of no one who has achieved it — except in the destructive fiber fuse effect — but the work seems to be progressing steadily toward that eventual outcome.

5.5 Gain in Intensely Scattering Optically Active Media

This modern work — which may be regarded in one sense as extending the anti-Stokes emission effect — is largely being pursued in intensely scattering optically active media. A very nice example is given by Lawandy's experiment {295a-d}, shown in Figure 5-4. Figure 5-4a shows a comparison experiment in water without an intensely scattering optically active medium but with a fluorescent dye to show the emission interaction. Figure 5-4b shows the same experiment with titanium dioxide particles added to the fluid. The TiO_2 particles are sized so that their optical resonance is within the laser's frequency domain.[123]

First, as shown in Figure 5-4a, a small, weak laser beam is aimed into the solution, and a small "warm little glow" of fluorescence results just around that region where the laser beam interacts with the solution. Scattering in the medium is rather normal, and provides nothing of any great interest to the overunity researcher.

[123] In passing, we point out the involvement of the Bohren effect due to particle resonance. This collects additional energy from the usually nondiverged large **Heaviside** energy flow component.

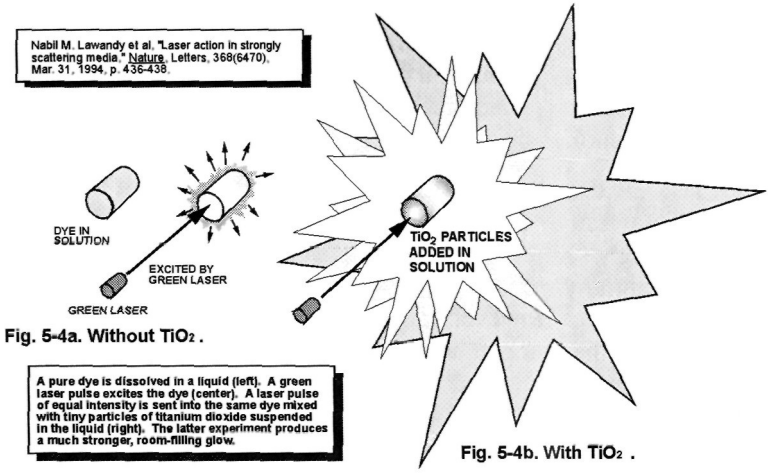

Figure 5-4 The Lawandy experiment

Then the titanium dioxide particles are added, and the same weak illuminating laser beam is directed into the colloidal solution. Figure 5-4b shows the new and spectacular results.[124] Immediately a very bright, room-filling emission of scattered coherent light fills the entire room. The intense optical scattering includes extensive retroreflections for some "ping pong" between individual particles, so that the optical gain is enormous. A highly enhanced energy emission is now evoked, for the same energy input by the operator as was used in the first experiment without the TiO_2 particles. Lawandy's experiment is inexpensive and can be repeated in any university nonlinear optics laboratory and by many individual experimenters. It gives results every time, without fail.

Oddly, no one seems to clearly state that, for a single pulse of input laser energy to the suspension of TiO_2 particles, precisely how much energy was input and how much energy was then emitted by the medium. Instead, "gain" is mentioned, but never the COP = (energy output by medium emission) / (energy input by operator). One suspects that journal referees would probably not allow such a clear and unequivocal statement of

[124] This is a very easy and very convincing argument for the presence of the long-ignored Heaviside component of energy flow arbitrarily discarded by Lorentz more than a century ago, and still discarded by modern electrodynamicists.

overunity, but would apply quibbling and spin control to prevent stating that more energy is output by the medium than is input to it by the operator.

It follows that, if sufficient "ping pong" iterative retroreflection and multiple collection occurs in the medium, the COP>1.0 because more work is done on exciting the medium than the energy input to it by usual (Poynting) calculations. No one accounts the energy unwittingly input to it by the ignored Heaviside component accompanying the Poynting component. Usually the output/input is just referred to as "optical gain". We stress, however, that we are considering only the actual laser beam energy being furnished into the colloidal solution as input, and we are not calculating the efficiency of the laser, its pumping, etc. Anyway, for this stimulated emission process, it is possible that the COP>1.0, and one can see the parallel to anti-Stokes emission. In short, we are considering the TiO_2 solution itself as exhibiting a true negative resistor action.

The field of high gain stimulated optical emission is advancing rapidly {296}, although many experiments still use external pumping furnished by the operator. If the operator has to pay for the replenishment (pumping) energy as well as the input energy, then the COP<1.0 overall. But the experiments are tending toward sustained self-oscillation and self-pumping conditions. If such conditions are obtained in sufficient magnitude, the process will then become a legitimate COP>1.0 operation overall. In that case, it will be usable as a basis from which to develop self-powering COP>1.0 electrical power systems, particularly for infrared "heating" systems etc.

The more recent experiments have shown positive feedback loops both in the time-forward and time-reversed paths; trapping of light flow energy (both time-forward and time-reversed) in large random walks of more than 1,000 individual interactions; weak Anderson-type localization; and constructive interference of forward time and reversed time light paths. since such experiments can be performed in the infrared, they point toward a potential *"vacuum-energy-powered overunity heater"* as a **feasible** achievement in the future. In our opinion, there should be a determined and major Department of Energy program oriented to develop exactly that kind of system.

Such a heater can become self-powering by the presence of greater governed positive feedback during self-oscillation conditions, which will allow sufficient excess collection due to *multipass multicollection* from the usually wasted giant Heaviside energy flow component. This process —

with the self-excitation occurring spontaneously as a "kick-in" positive feedback process in an exploding gas — probably accounts for the phenomena observed in the gamma ray burster and other such violent "burster" cosmic phenomena. Re-ignition, afterglow, and similar effects are observed in gamma ray bursters. They are also observed with *remarkable* similarity in the latest experiments in intensely scattering optically active materials the laboratory. Similar phenomena occur in x-ray bursters as well, and perhaps even in the recently observed and confirmed gamma ray emissions from intense storm clouds.

Finally, we point out that many magnetic materials are also photorefractive, and they readily produce nonlinear optical effects at various frequencies. Some barium compounds are typical examples. As an example, multivalued phase conjugate reflection can occur {297}. Such effects did occur in the Sweet vacuum triode amplifier, to be discussed shortly. It may be that Sweet's conditioning of his magnets conditioned their barium nuclei into self-oscillation, self-pumping, and thereby into *self-replenishing* stimulated optical-type emission at ELF frequencies.

5.6 The Fiber Fuse

See Figure 5-5. Although presently a one-shot destructive process, another multicollection phenomenon exhibiting a novel COP>1.0 process is the *fiber fuse* {298a-e}. This is a well-known but unusual effect in optical fibers and in fiber optic cables.

See Figure 5-5a. Once initiated by simply heating the cable (as with a butane cigarette lighter), the fiber fuse ignites and is self-sustaining. In those susceptible systems utilizing power on the order of one watt or so, the ignited fiber fuse propagates down the cable slowly, at about a meter per second nominally. It is evidenced by a bright white light propagating down the fiber, resembling the burning of a fuse for explosives — which led to the name "fiber fuse".

In fiber optic cables, it occurs only in those that contain germanium in their cores, and not in those containing just silicon in their cores. It moves down the fiber or cable at approximately one meter per second, and it is unlimited in the length of cable that it will continue along and march to the end. In the core, the marching fuse is actually "hopping", so to speak, and it melts a little "hole" about every centimeter or so, blowing out the material from the hole as it occurs. This "steadily and slowly marching" series of core melts results in the catastrophic destruction of the optical fiber core of the cable and thus destroys the functioning of the cable.

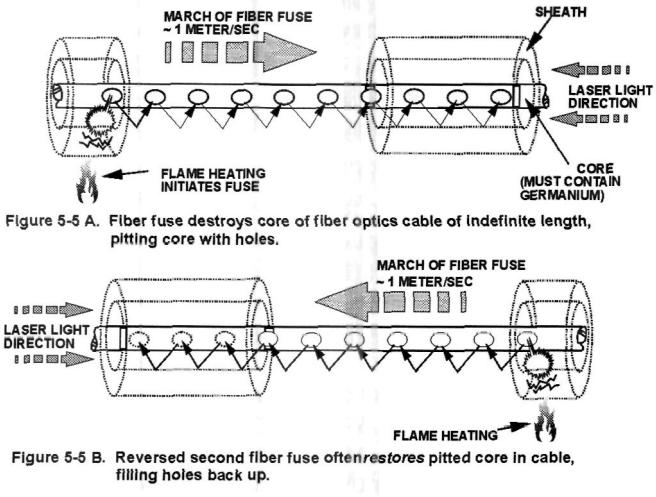

Figure 5-5 A. Fiber fuse destroys core of fiber optics cable of indefinite length, pitting core with holes.

Figure 5-5 B. Reversed second fiber fuse often *restores* pitted core in cable, filling holes back up.

Figure 5-5 The fiber fuse.

The mechanism has been theorized to be self-propelled and self-focusing. Other experiments have found evidence for thermal shock waves and chemical reactions.

But see Figure 5-5b. Astonishingly, after a — say — 1 kilometer fiber optics cable is destroyed by such a fiber fuse, it is often possible to "heal" the damage by reversing the direction of the normal laser light propagating down the cable, while re-initiating the fiber fuse from the other end by heating the cable on that end. In that case, sometimes the *reverse-ignited* liber fuse will then march right back down the cable, precisely refilling those previously-melted little holes every centimeter or so, *restoring the functioning ofthe cable!* If ever a phenomenon cried out for further painstaking investigation to determine its actual mechanism, the fiber fuse is it.

Truncated coupled-wave theory applies to this phenomenon. A rigorous a**nalysis** by Russell {299} of power conservation in dielectric gratings has shown that truncated coupled-wave theories do not rigorously conserve power. Predictably such conclusions have been disputed {300a-300d}, however, and are adulterated by the same old use of Lorentz-surface integration of the Poynting vector around the grating and discarding of the nondiverged Heaviside energy flow component. Those disputing the results and claiming the impossibility of COP>1.0 systems continue to ignore the unaccounted Heaviside energy flow component accompanying

every EM energy flow situation. In fact, they continue to unwittingly discard that component, and so have never performed *a fully* adequate analysis of any circuit or process. They also are unaware that all EM energy in 3-space comes directly from the active vacuum — specifically, it enters 3-space from the time domain and then returns to the time domain.

As long as the Lorentz surface integration scheme continues to be ubiquitously used without understanding what it does with respect to energy flow accounting, the dispute will not be dissolved. Presently both sides still use the Lorentz integration and discard the available Heaviside component. So they are really disputing whether the *Poynting diverged component* of the input energy can be equal to the energy dissipated. The answer to that is simply "No!"

Of course in a lab test the fiber fuse can be initiated with small Poynting energy input by precision point heating. In that case, the total energy required to melt the holes and move the material out of them, every centimeter or so down that (unlimited) length of cable, can be made as large as one reasonably wishes, simply by making the cable as long as one wishes. In short, COP»1.0. As can be seen, it can be experimentally proven that the input *Poynting* energy component can be far less than the total energy dissipated in damaging the cable. On the other hand, the energy dissipated in damaging the cable *is not* greater than the sum total of the usually calculated Poynting component together with the neglected extraordinarily large Heaviside nondiverged component. Conservation of energy is upheld, but only if the long-neglected Heaviside component is also accounted.

It stands to reason that the reverse fiber fuse can also be initiated by less input Poynting energy component that the total energy dissipated in restoring the cable. At that point, conventional theory has a problem. One can start with a good cable, put in a little EM energy twice — once to ignite the fiber fuse and once to ignite the reverse fiber fuse — and one winds up with a good fiber optics cable and having done lots more work inside the cable than the amount of energy one input by conventional considerations. We leave the solution to that problem as an exercise for the reader. Again, unless one includes the long-neglected Heaviside component, there is no way to make the energy flow balance, and one will have an experiment that seemingly contradicts the conservation of energy law. It doesn't, and that is the exercise the reader should understand.

So unless one uncovers and specifies the external source (Heaviside's energy flow component) of excess energy feeding the fiber fuse, it is a

demonstrable experiment whose efficiency ξ seemingly winds up being ξ >1.0. It works every time and seemingly violates the conservation of energy law *as that law is conventionally and imprecisely stated for an equilibrium system only.* The COP>1.0 fiber fuse phenomenon does not violate overall conservation of energy because the system is not in equilibrium with the other two components of its supersystem. It only violates (permissibly!) the conservation of energy statement for a system in equilibrium. The "system" consisting of the fiber fuse and the cable is *not in equilibrium in its energy exchange with its active environment (with the other two components of the supersystem, consisting of the active vacuum energy exchange and the active local curvature of spacetime).* We point out, of course, that the Heaviside component is flowing in space outside the physical system, hence in the vacuum and therefore in the external environment.

Specifically, every dipole in the system is extracting and pouring out energy from the vacuum, and only the small Poynting diverged component of this available energy flow is ordinarily caught. The extreme nonlinearity (and some resonances!) of the particles in and exposed to the extraordinarily locally heated fiber fuse do sweep out a greater reaction cross section than do cold, static charges, in a fashion similar to the separate demonstration of such extended geometrical reaction cross section in the Bohren experiment {301}. *Hence the fiber fuse subsystem and the associated particles of melted matter from the holes do intercept, diverge, and collect some of the accompanying but usually nondiverged Heaviside component.*

See again paragraph 2.1.6 in Chapter 2. Iterative retroreflective systems — such as in intensely scattering nonlinear optical materials — are not necessarily limited to COP < 1.0. Such a system is not necessarily limited to only the energy input by the operator, and it is not limited to only the operator's input Poynting component. Instead, the system can receive an input of excess energy from (i) its active local vacuum, and/or (ii) the local curvatures of spacetime. Its efficiency ξ, however, is always $\xi < 1.0$, even when its COP is clearly greater than 1.0.

Since scientists disputing the energy aspects of the fiber fuse only have assumed an equilibrium system and have not considered the neglected Heaviside energy flow component, the present arguments against COP>1,0 performance of the fiber fuse are quite irrelevant.

We also point out that an optical phenomenon is involved, and that the core materials in the melt are optically active. Hence, appreciable iterative

phase conjugate retroreflections occur in the fiber fuse itself and particularly in the melt materials (in the "inferno" of the "spot" itself). This asymmetrical self-regauging process gets more than one joule of work from one joule of original input Poynting energy, because of the iterative (and reciprocating) change of form of the energy. That operation produces iterative joules of work for each joule of original input energy, plus the unaccounted original input of the Heaviside component.

Again, there is no law of *conservation of work* in nature. The present conventional energy-work theorem erroneously considers only a "single interception and change of form" of the energy collected in the system, before loss of the energy from the system. Therefore, it only considers each joule of input energy performing one joule of work on the system to "excite" it to a higher potential energy state. It also considers that, once a joule of energy is then dissipated from the system as work in an internal load or process, it has departed the system forever and is not returned to do additional work by having its form changed yet again! In intensely retroreflective or intensely scattering systems, those conventional assumptions do not necessarily hold. For analysis of the fiber fuse phenomenon, the extended work-energy theorem must be utilized.

Finally, we point out the connection of this fiber fuse phenomenon to the similar "runaway" phenomena we have previously postulated as involved in producing the x-ray burster, gamma ray burster, etc. where iterative retroreflection and thus asymptotic rise in energy density is involved.

Another possibly related phenomenon is the unexpected explosion of porous silicon, as discovered at the Technical University of Munich {302}. The porous pellet involved in the unexpected experiment is covered with a layer of hydrogen atoms. In the presence of oxygen penetrating the oxygen barrier, an extraordinary and superfast chain reaction is initiated. The power of the explosion is some 10 times that of TNT. In the inferno portion of the fiber fuse, the "melt" as it puddles and then particulates, should be in the presence of oxygen and hydrogen from air in the cable. This dramatically differs from the explosive pellet, but may be sufficient to ignite at least in a local area rather than explode violently. If so, between the ablating particles of silicon there could exist iterative phase conjugation, thus producing an asymptotic rise in temperature and energy, perhaps sufficient to sustain the fuse. At least this possibility should be investigated.

5.7 Multiple Feedforward and Feedback Semiconductor Loops.

DeSantis *et al.* {303} showed that feedback systems with a multipower open loop chain can produce COP > 1.0 performance. In semiconductors, the present author hypothesizes that complex feedforward and feedback loops involving semiconductors can induce time reversal effects, hence some movements of current against the voltage. In short, there can arise a true negative resistance effect, as demonstrated in the Fogal transistor.

Indeed, a Westinghouse frequency converter using 64 transistor stages and similar sophisticated feedforward and feedback mechanisms was placed in the original Minuteman missile, then was later deliberately modified by Westinghouse engineers to prevent its demonstrated COP > 1.0 performance.[125] The specific germanium transistor used in the converter was also withdrawn from the market.[126] In those days, power meant weight and weight was at a premium in missile design. The power supply was very tightly designed, so that the weight could be minimized.

The converter had been deliberately designed to be 90% efficient, which was quite the state of the art. However, placed in the missile, the average converter would produce from 105% to 115% times as much output power as input power. (We are stating a COP > 1.0, *not* ξ > 100%!) This was more output power than the tightly designed succeeding stages were designed to accept; consequently those overloaded follow-on circuits often burned out and deadlined their Minuteman missiles — something of great strategic concern at the time. The increased rate of Minuteman missiles out of action due to this problem placed great pressure on Westinghouse executives. In turn, they simply ordered the engineers to "fix it!"

Westinghouse simply "fixed the problem" very directly. The engineers reduced the output power of the converter by adding limiting diodes etc. Very quietly, Westinghouse then obtained several patents {304a-c} surrounding the technology, but no further mention of it appears in the literature. The Westinghouse work continued for at least a decade, judging by the spread of the patent dates.

[125] Our information came directly from private conversations of a close scientific colleague with the Westinghouse engineers who thoroughly tested the converter causing the Minuteman problems, and who then altered it to prevent the problems.

[126] Germanium has some unique properties, particularly with respect to transducing surface longitudinal waves to transverse waves and vice versa.

Such multi-loop, multi-feedback transistor circuits can apparently be developed to exhibit true negative 4-resistor effects. With specialized clamped positive feedback of the Bedini type, such open dissipative systems can then exhibit stable COP>1.0, since the energy is taken from the vacuum via the broken symmetry of dipoles, and then discharged asymmetrically in the loads so as not to destroy the source dipole negative 4-resistors. However, the reader should see Chapter 9 for special considerations and phenomenology.

5.8 Negative Resistors

We define a *true negative resistor* as a circuit component or system that receives energy from the environment and outputs useful energy, either in altered form or to power loads usefully. This contrasts sharply with a *differential negative resistor*, which exhibits negative resistance in one part of its regimen, but where all the excess energy to move the current against the voltage in that regime was previously drawn from the circuit itself and therefore was not freely received from the active external environment. Instead, the operator paid for it already. We are not interested in differential negative resistors, which are well known in the literature {305} and do not enable COP>1.0 system performance, so we will not discuss them further. Hereafter when we use the term "negative resistor", it is understood that we mean "true negative resistor" unless the term is otherwise qualified.

The true negative resistor is an open dissipative system *a priori*, and equilibrium thermodynamics therefore does not apply. Instead, the thermodynamics of open systems far from equilibrium applies. The negative resistor freely receives energy from outside the system (from the . environment), and "dissipates" it in interception and collection actions inside the system, to freely increase the available potential energy in the system.

In circuits, the main characteristic of a negative resistor is that the environment freely furnishes some excess energy to (i) power the load, and/or (ii) move the current back against the voltage, particularly when shunted across the back emf region of the source dipole. The *operator* does not have to furnish this excess energy dissipated to propel the current backwards or dissipated to power the load!

One must incorporate the entire supersystem into the analysis of a negative resistance element or system. Since the operator does not furnish the input energy dissipated by the negative resistor, then the active vacuum or

curved local spacetime — or both — must furnish the input energy to it. One must consider local curvature of spacetime interactions with the negative resistance and the active vacuum interactions with it, as well as the interactions between active vacuum and local spacetime curvature. In other words, one must again include the active environment of the Maxwellian system that Lorenz/Lorentz symmetrical regauging arbitrarily discarded.

We specifically do not include the well known "differential" negative resistor, such as a tunnel diode, which in one regime moves current against the voltage, all the while drawing all its enabling energy to move current against the voltage from an overall previous energy input by the operator. Unless the input enabling negative resistance energy is freely received from the external environment, true negative resistance is not involved.

Several true negative resistors other than the point-contact transistor have been produced. We review a few of them in the following subparagraphs.

5.8.1 Kron's Negative Resistor

One of the greatest American electrical scientists was Gabriel Kron. Working for General Electric (GE), Kron built a true negative resistor in the 1930s, which could power itself and the network analyzer[127] at Stanford University, under a GE support contract with the U.S. Navy. Here **is** a direct quote from Kron {306} to show what we refer to:

> *"When only positive and negative real numbers exist, it is customary to replace a positive resistance by an inductance and a negative resistance by a capacitor (since none or only a few negative resistances exist on practical network analyzers.)"*

In that sentence we believe that Kron was forced by the censors to insert **the** words "none or" in the expression in parentheses. Particularly note the suggestion that in the imaginary realm it may not be the same as the accepted practice of using inductance as a positive resistor and capacitance **as** a negative resistor. Of course, the fourth Minkowski axis is - *ict*, and so this is very probably an oblique reference to the fact that energy can also "flow in" from the time domain. Kron was quite knowledgeable in general

[127] The network analyzer was a large analogue simulation capable of modeling sophisticated equations — such as Maxwell's equations, the Schrodinger equation. **etc.** — for use in designing, simulating, and analyzing naval communications systems or proposed systems. It was one of the most advanced simulations of its day. Kron was the chief engineer and scientist on the project, and one of the ablest electrical physicists the United States ever produced.

relativity as well as advanced electrodynamics, and he applied full general relativity to rotating EM machines etc. In another quote, Kron {307} also revealed that he had the negative resistor but was not allowed to use it to openly power the Network Analyzer. Quoting and reading through the "spin control":

> *"Although negative resistances are available for use with a network analyzer, in practice it is more convenient to use a second type of circuit, in which the positive and negative resistances are replaced by inductors and capacitors and the dc currents and voltages are replaced by ac currents and voltages of fixed frequency. The use of the second type of interpretation is equivalent to multiplying the wave equation by* $i = \sqrt{-1}$*."*

After the word "although..." Kron includes the blunt statement that negative resistors were indeed available for use with the network analyzer. But if the "convenient" replacement of the positive and negative resistors by inductors and capacitors was made, then there was no COP>1.0 involved, and there was no true negative resistance involved. Kron is trying to clearly tell us that fact in the above quotation. He also strongly hints that energy from the time domain on the axis *ict* is involved, but that multiplication by $\sqrt{-1}$ discards this "energy from the time domain".

Kron's negative resistor secret has never been released by General Electric, Stanford University, or the U.S. Navy and it is not going to be released. It has never been deciphered outside those groups, with the possible exception of knowledge by Floyd Sweet of Kron's negative resistor construction. Sweet worked in General Electric but not on the Network Analyzer project. Kron, however, was Sweet's mentor and patron, and Sweet often spoke of Kron in glowing terms. In our opinion, Sweet's vacuum triode amplifier was a further development of Kron's early negative resistor, as Sweet understood it.

We further believe that Kron's "open path" is simply the other two components of the supersystem, being (i) local curved spacetime, and (ii) the active local vacuum. Obviously the *external environment* connects any two points in the physical circuit, in addition to the circuit's physical connection (the "closed path"). Between any two points at differing potentials in an electrical circuit, there exists a potential and a dipolarity. Therefore, there exists a broken symmetry because of the dipolarity. The potential difference of that dipolarity is also a curvature of spacetime; i.e., it is a "field" between the two points, and the field is identically a curvature of spacetime. Hence from any two such dipolar points in the

circuit, there exists the giant negentropy flow of EM energy that we pointed out in 2000 {308}. This "open path" EM energy flow between any two unlike charges (any dipolarity) in the universe, not intercepted by the circuit and thus nondiverged, is discarded by Lorentz's integration of the energy flow vector around a closed surface enclosing any volume element of interest. It appears that Kron not only recognized (in different terms) what we are calling the "supersystem", but also recognized the equivalent of Heaviside's nondiverged EM energy flow component from any dipolarity — referring to that energy flow as the "open path" flow of energy. It is almost certain that he fully recognized what Lorentz symmetrical regauging did to the Maxwell-Heaviside equations. Thus it appears that Kron was the first scientist to discard Lorenz/Lorentz symmetrical regauging, producing his negative resistor by doing so.

We do not have firm knowledge, however, but only circumstantial evidence that Kron recognized the flow of EM energy from the time domain into 3-space, and vice versa, though he was certainly capable of seeing that. Nevertheless, this would also be included in his notion and discovery of the "open path", since it is included in every dipolarity, generating the scalar potential between the poles of the dipolarity. It may also have occurred to him from his excellent grasp of general relativity and spacetime curvature {309}.

Kron's concepts are certainly capable of being modeled and used to produce COP>1.0 EM circuits and systems, including his negative resistor. Kron did tremendous work in advancing EM networks and power systems. He left behind a great legacy of network and system analysis capable of dealing with the COP>1.0 electrical power system problem {310a-e}. Unfortunately, that legacy has been little used, if at all, in design of electrical power systems and power distribution networks today. To our knowledge, there are no electrical power systems deliberately using Kron's open path.[128]

5.8.2 Chung's Negative Resistor

A highly simplified diagrammatic illustration representing the Chung negative resistor is given in Figure 5-6. In a July 9, 1998 keynote address at the Fifth International Conference on Composites Engineering in Las

[128] A possible exception is provided by Barrett's extensions {286a, 286b} of Tesla's "potential shuttling" technique {124}, which can only be seen in higher group symmetry electrodynamics such as quaternions. However, as far as we know, Barrett has **not** applied energy shuttling techniques to electrical power systems.

Vegas, Dr. Deborah D. L. Chung, professor of mechanical and aerospace engineering at State University of New York (SUNY) at Buffalo and Director of the Composite Materials Research Laboratory, reported that she had observed apparent negative resistance in interfaces between layers of carbon fibers in a composite material prepared under pressure.[130] The negative resistance was observed in a direction perpendicular to the fiber layers. By varying the pressure at which the composite material was prepared, Chung *et al.* were able to control whether the material would exhibit negative, minimal, or positive resistance. Apparent negative resistance was also observed in carbon fiber cement-matrix composites and in bare carbon fibers held together by pressure.

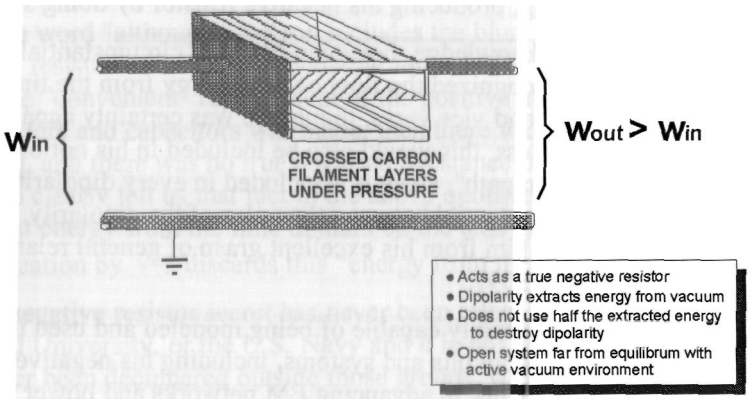

Figure 5-6 Chung's negative resistor (diagrammatic).

A formal technical paper was later published by Wang and Chung {311}. A few years earlier a patent {312} had been issued to Chung and assigned to The Research Foundation of State University of New York, Albany, NY for a superconductive material using a laminate combination of carbon

[129] Professor Chung holds the Niagara Mohawk Chair in Materials Research at SUNY and is internationally recognized for her work in smart materials and carbon composites. The reader may peruse a curriculum vitae, research work, and papers at http://www.mae.buffalo.edu/people/faculty'chung/researchl.doc.

[130] The preparation of "locked-in" stress in Chung's carbon fiber material is reminiscent of Moray's similar preparation of his amorphous semiconductors with locked-in stress also.

fibers and metal.[131] The patent mentioned mesoporous carbon filaments, strikingly similar to our previous discussion of the surprising explosion of porous silicon at the Technical University of Munich, as well as possibly a special kind of "porosity" consideration in the fiber fuse phenomenon (in the material of the fuse itself).

An initial offer on the State University of New York at Buffalo website to provide a technical package with respect to the negative resistor — for which a patent had been filed — to those submitting a nondisclosure agreement was abruptly withdrawn. The project may have been classified, or — far less likely — it may have been retained as deeply proprietary by the University. We suspect that both the technical package and the patent application have been classified by one or more U.S. government agencies.[132]

In our opinion, Chung's fruitful discovery deserves rigorous and continuing investigation, particularly in higher group symmetry electrodynamics and in terms of supersystem interactions to include Dirac sea hole current interactions. We also believe Chung may have been required by referees (or by declassifying authorities, if such were involved) to use the term "apparent" in the paper. The reported measurements in the technical paper do seem to unequivocally include true negative resistance with current running backwards against the voltage. It is not clear, however, whether this is Dirac hole current or electron current or a mix of both.

We also call attention to the fact that Dirac sea holes in the local vacuum — as will be discussed in Chapter 9 — will and do run backwards against the voltage. Further, such hole current can be transformed from negative energy to positive energy by the Bedini process shown in Chapter 9. The pressure used by Chung *et al.* in fabricating the material produces a stress potential in the material and thus decomposes into our reinterpreted Whittaker 1903 decomposition, preciously discussed. So giant negentropy is involved in the composite material, which implies that true negative resistance can be involved, at least in some operational regimes as pressure

[131] We stress that the issuance of this unclassified patent does not rule out a possible negative resistor (hence COP>1.0) patent that may have been classified. Some sensitive defense work in special materials is indeed performed at SUNY at Buffalo.

[132] At least the gist of the work is not lost, however, due to Naudin's duplication of the Chung effect and placing the results and building instructions on his website in France; see http://jnaudin.free.fr/cnr/.

etc. are varied. Such results were found by Chung *et al.* and are reported in the paper.

Naudin reported independent success with a simpler variant of the Chung negative resistor {313}. This assures that at least the effect will not just be buried.

5.8.3 The Fogal Charge-Barrier Device

Figure 5-7 shows an illustration from one of William Fogal's patents {314} on a new kind of transistor (more accurately, a charge barrier device). Fogal's device incorporates a very special electrolytic capacitor[133], which introduces optical-type functions as well as the more familiar capacitor functions.

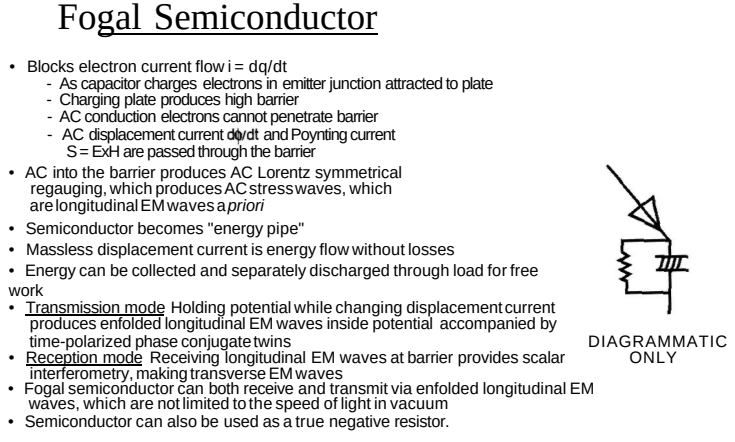

Figure 5-7 Novel characteristics of the Fogal semiconductor.

Most semiconductor materials are optically active materials. Further, the individual electrons in a signal with a frequency well below light frequencies, are "jittering" with higher frequencies including the entire optical band. A "frequency" of a signal thus is imbedded in a jittering higher frequency complex set, and that set is quite able to interact in optical fashion *if the complex itself is used and controlled.* Fogal's process

[133] The exact method of manufacturing this electrolytic capacitor, and its internal structuring, is proprietary to Fogal and a major capacitor manufacturer, who is under a nondisclosure agreement with Fogal.

does appear to both use and control that jittery high frequency signal complex.

Hence Fogal's process can "tunnel under" the normal *detected* force-field frequency responses of the individual electron,[134] and directly affect, change, and alter its higher-frequency environmental changes in the force-free field or field-free potential condition. In this way, Fogal has carried the electron (and hole) functions of a transistor to functions well beyond those in the present texts {315}. He may have also extended quantum mechanical tunneling effects to signals between widely separated regions of spacetime, since superluminal communication is possible with the Fogal semiconductor properly used. Longitudinal EM waves — which Fogal's semiconductor is able to utilize and control — can and do move at superluminal speeds {93a) because it uses the long-neglected "infolded" longitudinal electrodynamics revealed by Whittaker in 1903 and 1904. Further, superluminal solutions to Maxwell's equations do exist {93b}.

The charge barrier device is formed in a bipolar design that can be incorporated in Metal Oxide Semiconductor (MOS) designs as well as multiple gate devices. The device also produces a Hall effect EM field internal to the device. The Hall effect magnetic force will force electron flow and angular spin of the electrons in the same direction to the top of the conduction bands in the crystal lattice on semiconductor devices, unlike Silicon On Insulators (SOI) devices that force electron flow to the surface of the semiconductor lattice. This forcing function, together with the "extended tunneling" effects on the embedded EM environment of the electrons and holes, produces a unique effect. The device is able to stop and "pin" electrons while continuing to process the signal energy flow (the entire jitter signal complex) in which the electrons were coupled and moving. Thus the Fogal transistor is able to operate upon and with mass-free spacetime itself, and curvatures thereof. It is the first practical semiconductor capable of performing *engineering of the active vacuum.*

In the last few years we have stressed that EM waves in spacetime are longitudinal EM waves *a priori* — but they are accompanied by time-polarized waves (phase conjugates). Hence the two in combination become observable, as pointed out in quantum field theory by Mandl and Shaw {316}. *We detect effects a priori and not their causes.* We detect

[134] The electron itself is enveloped in the jittering of whatever background it is exposed to and interacts with. Hence a coupling interaction exists to arrange and **control** the jitter of the electron as well.

transverse *electron precession waves* in our detector circuits, and not the causal waves interacting with them to produce their precession. *The Fogal transistor is able to process the causal longitudinal EM waves directly, prior to their interaction with matter.* It in fact opens up an entirely new region of "detected physical reality" to our vision and detection, a region far more extensive than the development of infrared and ultraviolet sensors opened up to our sight.

The pioneers of electromagnetics, who erroneously assumed a material ether and EM force fields in space, confused the transverse "material detected waves" (electron precession waves) in the detector with the "material undetected waves" they assumed to be incoming from space. Note that neither the electron nor the atom had been discovered when all these assumptions were used to determine how the EM wave in space was to be viewed and modeled. The transverse waves observed in the interacting/detecting of the Drude electron gas — i.e., the detected electron precession waves — were considered to be direct interceptions of the incoming causal waves from space. This already substituted the effect for the cause, as we have previously discussed.

Further, Faraday envisioned the "material field in space" as consisting of a series of "taut physical strings". A "perturbation" of this field in space was, in his view, simply the transverse wave plucking of those strings. Maxwell, who closely followed Faraday's experimental work and concepts, simply assumed the transverse "plucked string waves" advanced by Faraday. Therefore, the erroneous notion of the transverse EM wave in space arose and stayed firmly fixed in the theory.

One can check Whittaker's decomposition of the scalar potential into longitudinal EM wave pairs, then realize that the energetic vacuum is naught but a giant scalar potential — which can be decomposed by Whittaker's method. In short, as a scalar potential, space itself is a writhing mass of longitudinal EM waves and their highly nonlinear dynamics and interferences, or it can be modeled in that fashion. The energy continually enters 3-space from the time domain to the negative charge of every point in space considered as a point dipole, thence to the positive charge, thence back to the time domain. Notice the giant 4-space circulation involved. One also notes the polarization of the vacuum continually happening and arising spontaneously, as is well known in quantum mechanics. We also suspect that this or a similar mechanism is at the root of spontaneous broken symmetry in physics.

An interesting thing emerges from Whittaker's 1904 paper {317}, where he showed that all EM fields and waves can be decomposed into differential functions of two scalar potentials. Each of these two base scalar potentials can be decomposed by Whittaker's earlier 1903 paper {85} into a set of longitudinal EM waves. All EM fields, potentials, and waves are comprised of longitudinal EM waves and their internal dynamics, which also comprise waves of spacetime curvatures and their dynamics. Further, each longitudinal EM wave in 3-space is accompanied by its phase conjugate twin in the time-domain.

This far more primary "internal electrodynamics comprised of pure spacetime dynamics" — comprising and creating the recognized EM potentials, waves, and fields, their internal dynamic spacetime structuring and also the structuring of time — has not been developed and applied in physics theory. This internal or "infolded" electrodynamics is the primary "medium" in which the Fogal semiconductor appears to work and work upon. The Fogal semiconductor seems able to modulate and demodulate this internal structuring or parts of it, as has been demonstrated.

Imperfect longitudinal EM waves — called *undistorted progressive waves* - are already known to be able to travel at superluminal velocity, e.g., as shown by Rodrigues and Lu {318}. Indeed, Maxwell's equations have both subluminal and superluminal solutions, as shown by Rodrigues and Vaz {319}. Further, these waves can carry information. However, the *technology* of employing these waves has been lacking {320}. The use of scalar EM wave interferometry to produce normal EM fields and EM field energy at a distance has been shown by Evans *et al.* {321}.

As pointed out by Rodrigues and Lu {318}, perfect longitudinal EM waves travel at infinite velocity. This eliminates the difference between potential, field, and wave; a perfect longitudinal EM wave can also be taken as an instantaneous scalar potential with net force-free iterative regauging (varying at each point instantly and simultaneously). Both ways of looking at it produce the same end result: instantaneous remote energy change of spacetime energy density itself, in general relativity terms, or of the energy density of the vacuum, in particle physics terms.

Elsewhere, (e.g., Chapter 2), we also pointed out the "total photon **interaction"** mechanism that generates the flow of an entity through time. We also have advanced the concept of a "time-reversal zone" (TRZ) as a region where antiphoton interactions with charges predominate over photon interactions. We used these new concepts to propose exact nuclear **reactions** for the production of excess deuterium, tritium, and alpha

particles in cold fusion experiments. In such an "excited state" TRZ region, the law of attraction and repulsion of charges is reversed. In the TRZ, like charges attract and unlike charges repel. Further, the gluon forces are reduced, so the quarks in the nucleons are much more lightly bound. In such TRZ zones, dense clustering of like charges occurs due to their mutual attraction.

A time-reversal zone is created in one part of the Fogal transistor, greatly assisting in the "electron pinning" action. That is, the usual strong mutual repulsion (the Coulomb barrier) of the electrons at the pinning site vanishes in the TRZ inside the Fogal semiconductor, and the resulting mutual attraction of the electrons greatly facilitates the pinning process far beyond what is usually obtained against "like charge" repulsion in a time-forward zone. Indeed, the TRZ in the Fogal semiconductor also materially enhances the electron pinning process beyond what can usually be obtained with cryogenics. At least some indication of trapping and perhaps pinning has been reported in amorphous semiconductors at room temperature {322a-b}.

The Fogal device is able to remove EM noise (electron noise) from existing EM signals, displays, etc. by 96% or more, by pinning the electrons and simultaneously time-reversing the spatial EM signal back to its original noise-free state prior to hosts of interaction electron collisions. This "noise removal" capability has been rigorously tested by independent parties, including at a leading university in the Netherlands, [135] and by several large electronics companies and several other universities. By pinning the electrons (and electron currents) while still processing and propagating the EM energy effects, the Fogal device can move noiseless EM energy without loss at room temperatures, at superluminal velocities, and reconnect the lossless propagated energy to electrons past the pinning region at a receiving region, releasing the electrons in the receiving region. The Fogal semiconductor therefore already accomplishes *room temperature superconductivity* as well as tunneling.

The Fogal device's basic mechanism (consisting of all the submechanisms) is to restore and move EM energy in force-free form, using direct regauging of the vacuum instantaneous scalar potential itself (or the

[135] The university researchers verified room temperature superconductivity being produced by the Fogal semiconductor in their independent verification measurements. They also measured that some 96% of the noise already present in a circuit was removed by Fogal's semiconductors in Fogal's circuits.

vacuum potentials themselves). It operates directly upon the longitudinal EM waves comprising the vacuum potential. Hence it directly engineers the active vacuum and curved spacetime. I.e., it is the first *supersystem engineering* device of (hopefully) many more to come.

In the "jitter" environment of the space in which the individual electron is embedded, there exist many (and essentially all) field gauges, simultaneously. One of these, of course, is the Coulomb gauge where there exists an instantaneous scalar potential. Usually the instantaneous scalar potential is considered only a *near-field* effect, with no contribution at any significant distance. However, as Jackson points out {323}, transverse radiation fields are given by the vector potential alone. Also, in the Coulomb gauge the scalar potential "propagates" instantaneously everywhere in space {324}.

Along with other electrodynamicists, Jackson avoids the obvious superluminal communications implications of the instantaneous scalar potential by stating that *"..it is the fields, not the potentials, that concern us."* As he points out, a detailed *(though conventional)* discussion of causality is given by Brill and Goodman {325}. Again as pointed out by Jackson, in the Coulomb gauge the quantization of the photon involves only the vector potential. *The use of the scalar potential in the Coulomb gauge, together with deliberate engineering of the internal longitudinal Whittaker wave structure of that potential, directly allows distant engineering via multiply connected spacetime, even inside the nuclei of distant objects. This is in fact a unique and marvelous engineering application and extension of Bohm 's quantum potential concept.*

My "pinning" the electrons, apparently Fogal is able to essentially "hold" the vector potential and all the force fields while the instantaneous scalar potential *persists and now extends over all space, not just to the near field since all formerly moving field dynamics that would limit it have been frozen.* If this effect is substantiated, I have nominated it as the "Fogal effect". Further, this unrestricted instantaneous scalar potential now i lunges in field-free form (pure regauging form) over all space according to the signal energy being perpetuated and propagated[136] by the Fogal semiconductor independently of its pinned electrons. In this fashion, the F**ogal** semiconductor is indeed capable of "instantaneous" communication

[136] Here we again point out that the usual notion of a signal as energy propagating in 3-s**pace** is wrong. It propagates in 4-space, but not in 3-space. Also, what propagates is the spreading point-like polarization of the vacuum itself.

over essentially unlimited distances. At least one independent test has verified the Fogal instantaneous communication effect, but the test is still held proprietary by the testing agency.

Since Fogal is able to alter and control the internal longitudinal EM wave Whittaker structuring of the scalar potential used in this Coulomb gauge manner, he is able to accomplish superluminal (and even instantaneous) communication, so long as a Fogal semiconductor is available in both the transmitter and the distant receiver. In the transmitter, the Fogal component is necessary to *infold* the information into the internal LW structure of the scalar potential to be used in the Coulomb gauge, thus transforming the input signal information into output longitudinal EM wave information directly in spacetime itself. The Fogal component in the receiver is necessary in order to detect, transduce, and *outfold* the infolded longitudinal EM wave information inside the instantaneous scalar potential. We have stressed that these internal longitudinal EM waves and their dynamics are spacetime curvatures and their dynamics. Hence their transmission and detection is a viable process for superluminal communication, including instantaneous communication.[137]

Further, once the electrons are pinned, all "signal fields in charged matter" (i.e., all EM force fields) are frozen and localized. This, we believe, involves a new physical effect introduced by Fogal that is analogous to the Aharonov-Bohm effect.[138] So I have called it the "Fogal effect". That is,

[137] We believe that physics books will have to be substantially rewritten, once the internal longitudinal structuring of the scalar potential (and of EM fields and waves) is employed directly in open technology. We further believe that the Fogal semiconductors are the first pre-developments in that coming vast new technology, at least in the open Western scientific world.

[138] There have long been, and still are, efforts to "fit" the Aharonov-Bohm effect into slightly modified classical electrodynamics after all. E.g., see C. J. Carpenter, "Electromagnetic energy changes due to charges moving through constant, or zero, magnetic field," *IEE Proc. A,* 138(1), Jan. 1991, p. 55-70; — "Electromagnetic energy and power in terms of charges and potentials instead of fields," *IEE Proc. A,* 136(3), 1989, p. 101-113; G. M. Graham and D. G. Lahoz, "Observation of static electromagnetic angular momentum in vacuo," *Nature,* Vol. 285, 1980, p. 154-155; T. H. Boyer, "Semiclassical explanation of the Matteucci-Pozzi and Aharonov-Bohm phase shifts," *Found. Phys.,* 32(1), Jan. 2002, p. 41-49; — "The Aharonov-Bohm effect as a classical electromagnetic-lag effect: An electrostatic analogue and possible experimental test," *Nuovo Cimento,* Vol. 100B, 1987, p. 685-701; — Classical electromagnetic deflections and lag effects associated with quantum interference pattern shifts: considerations related to the Aharonov-Bohm effect," *Phys. Rev. D,* Vol. 8, 1973, p. 1679-1693; — "Does the Aharonov-Bohm effect

the force-fields are frozen and localized by the pinning, but the field-free potentials then remain, including the instantaneous scalar potential ϕ and probably the curl-free magnetic vector potential A as well. The result is that the instantaneous scalar potential can be directly *regauged* everywhere at once by the changes of magnitude of the "frozen fields", rather as if they were "static voltage", possibly simultaneously regauging the field-free A-potential — all as part of a new kind of Lorentz symmetrical regauging. After all, a single Lorentz symmetrical regauging {326} changes both the potentials A and ϕ. Changes in symmetrical regauging produce stress waves, which are longitudinal EM waves. Continual changes of symmetrical regauging also continually changes both the potentials A and ϕ, *including over all space when operating in the Coulomb gauge.* This is one explanation of the beautiful effect that Fogal has discovered and is utilizing.

We accent that, with pinned electrons frozen in place, the normal ϕ and A in matter (defined in terms of interaction with charge and the movement of charge) cannot occur. With time reversal zone utilized, electron pinning is greatly eased and the instantaneous scalar potential ϕ now assumes the primary active propagating role in surrounding space. Neither ϕ nor A is free to develop the normal $\partial\phi/\partial t$ and $\nabla\times A$ *spatially propagating dynamics of the force fields (effect fields) observed in matter.* In the Fogal process, the instantaneous scalar potential "signal" (the causal signal in 4-space) is generated in the transistor when it pins the electrons and freezes the force fields into "equal and opposite" form. Since no net force field can develop, the instantaneous scalar potential is a stress potential in spacetime itself and simply changes its magnitude instantly, at each and every point in space that it occupies, when the Fogal chip's input EM fields change in its signal input.

In the output, the net force fields remain zero and frozen, even though the individual force fields change constrained to "equal and opposite" manner. If one wishes, one may take this part of the Fogal output — the field free changes in the stress energy density of the vacuum — as one expression of *modululating the instantaneous scalar potential's energy density in perfect correspondence to the field changes in the normal EM input to the Fogal transistor.*

exist?". *Found. Phys.,* Vol. 30, 2000, p. 893-905; — "Classical electromagnetism and **the** Aharonov-Bohm phase shift," *ibid.,* p. 907-932.

The instantaneous Fogal changes in magnitude (e.g., instantaneously induced upon a distant collecting charge) are no longer limited to near field effects, or to the speed of light — and communication is not bound to the retarded wave. Now the induced changes of the instantaneous scalar potential exhibit far field effects and these changes — being naught but these special Lorentz condition magnitude regaugings — are instantaneous. This of course is a form of *action at a distance.* We stress that the best astronomical evidence also points to a startlingly superluminal speed of gravitation (curvature of spacetime, which after all is just a longitudinal EM wave or set of them) itself, as pointed out by Van Flandern.[139] If so, since any change of energy in spacetime is a curvature of spacetime, and one form of spacetime curvature can move at superluminal velocity, so can other forms of spacetime curvatures. In our favorite expression, *it only takes one white crow to prove that not all crows are black.*

As is well known, the de Broglie waves of matter always move faster than light, as do appropriate quantum tunneling processes. Further, the quantum potential used by Bohm in his beautiful hidden variable theory of quantum mechanics {347} also appears instantly throughout space, wherever it will be, and with the value it will have. The question of whether a quantum potential can be used to communicate has been posed but not definitively answered in the previous literature. We propose a resounding "Yes!" if one uses the internal structure of the quantum potential for one's communication, applying some component such as the Fogal semiconductor to do the infolding and outfolding.

We also propose that a process for forming and using an instantaneous scalar potential in the Coulomb gauge can be interpreted as the formation and use of a quantum potential or its direct equivalent. If that assumption is true, then the Fogal semiconductor seems to be the first component ever openly built and patented which produces and uses Bohm's quantum potential, *including* its infolded Whittaker structuring and dynamics. It also definitively answers in the affirmative the question of whether the quantum potential and the scalar potential in the Coulomb gauge can be used in superluminal communications.

[139] Tom Van Flandern, "The speed of gravity - What the experiments say," *Phys. Lett. A*, vol. 250, Dec. 21, 1998, p. 1-11. Van Flandern gives an extremely important, clear, and succinct summary showing that experiments refute the standard far field assumption of light speed in gravitational effects. Laboratory, solar system, and astrophysical experiments for the "speed of gravity" yield a lower limit of $2x10^{10}c$.

Thus Fogal has apparently found a way to directly modulate intelligent change of magnitudes into and upon the internal longitudinal EM wave structure of the instantaneous scalar potential (and upon the quantum potential), as well as iterative "pure *net-field-free"* regauging of the instantaneous scalar potential {327}. It seems to have previously escaped notice that varying the Lorentz symmetrical regauging of a circuit or system easily produces pure longitudinal EM waves. This strongly implies that Fogal has surmounted and removed the barrier to practical superluminal communication and even further has reduced the barrier to practical instant communication.

Several tests — in one of which the present author participated — have indeed shown Fogal transmission of signals, including video signals, between two widely separated points with less delay than light-speed signals exhibit, and also with video bandwidth infolded inside a DC signal. In at least one series of tests in a large company's own laboratory and by its own engineers, communications from a ground-based Fogal chip transmitter apparatus occurred between the ground station, through the uplink into the satellite, back through the downlink to earth, into a ground-based transmission system with repeater stations, and into the receiving Fogal transistor unit in the lab. The transmissions occurred with *no discernible time delay,* something previously deemed impossible in all the textbooks. This was particularly significant since even the conventional time-delays in the repeater station amplifiers and the satellite receiver-transmitters were apparently eliminated. This further accents that the infolded "longitudinal EM waves superhighway" inside all EM fields, potentials, and waves — including inside matter such as the ocean and the earth itself— is a multiply connected space phenomenon. It is the most ideal communication medium, enabling deep space communication without delay, etc.

The implications for nondelayed future remote control of robot spacecraft and robots landing on the surface of planets and asteroids are obvious, as are the implications for direct exploration and measurement of conditions *inside the interiors* of the planets, the sun, the moon, and the earth via internal scalar interferometry. We accent that Fogal has done private experiments exploring this vast new physical reality revealed by the "internal longitudinal EM wave dynamics" and its interferometry, and it is mind-expanding (some would say *mind-boggling!).* It is also a great new step in physics and in our very notion of physical reality itself.

The vacuum itself, being highly energetic, is indeed a scalar potential. Further, it has any and all gauges. Since potentials superpose, we postulate

that Fogal's use of the instantaneous scalar potential is directly superposed on the corresponding instantaneous Coulomb gauge scalar potentials of the entire vacuum. His discovery of how to modulate the instantaneous ϕ magnitude without allowing modulated EM field propagation, constitutes a very special case of tunneling right through "space" itself, using one aspect or "component" of space.

In short, to be a little dramatic one might even apply the term *subspace communication* to this long distance tunneling effect. That interpretation would also seem consistent with the deterministic variation of the internal stress energy density structuring of the vacuum that is produced in the Fogal process.

From another viewpoint, Fogal has succeeded in not only finding the missing chaos of quantum mechanics, but in deterministically engineering and using it.

This is also consistent with Whittaker's decomposition of the scalar potential into bidirectional longitudinal EM waves {328} and his connection between time-polarized EM waves and longitudinally polarized EM waves as reinterpreted (12) to be consistent with quantum field theory {19}. We point out that a single point in time is simultaneously "connected" to every point in the universe. By using a transmission system that back-pedals from 3-space into the time domain, an instantaneous connection to any other spatial point in the universe is therefore available, if one's technology can take advantage of it. Fogal's technology does.

It is also consistent with quantum tunneling experiments that have demonstrated the transmission of intelligent signals (such as Mozart's 40th symphony) at superluminal speed between two points in a waveguide {329a-b}. Regardless of how one chooses to model intelligent superluminal communication, it has been experimentally demonstrated — multiple times and by multiple experimenters in multiple laboratories — that such can occur.

The difference in those superluminal experiments and the performance of the Fogal chip is that the chip uses iterative regauging of the magnitude of the instantaneous scalar potential, as well as deterministic alteration of the scalar potential's internal longitudinal EM wave substructuring, and probably also modulates the internal structuring of a quantum potential. The presently proposed quantum tunneling mechanisms apparently do not do this, at least as they are presently modeled. Further, the quantum tunneling mechanism is difficult to apply; the Fogal mechanism is fairly

simple and straightforward to apply, given the Fogal semiconductor at both the transmitting and receiving ends of the communication system.

Pure longitudinal EM waves readily penetrate matter to great distances, since matter is mostly empty space between widely separated mass particles. On the microscopic scale, matter is comparable to something like the solar system, except that intense fields and potentials (bundles of longitudinal EM waves and their dynamics) occupy the space between the particles. All this vast empty space inside matter, being a potential and comprised of longitudinal EM waves, is a giant "superhighway" for the passage of longitudinal EM waves and their dynamics, as indeed is matter itself which is mostly such empty space. Further, even the masses themselves are such, since mass is simply highly compressed spatial energy density, and therefore is highly compressed longitudinal EM wave energy and dynamics. It is just a "denser" superhighway.

Hence a longitudinal EM wave system can readily be developed to "see through matter" using Fogal semiconductors in transmitter and receiver. Fogal in fact has made at least one proprietary prototype demonstration unit that demonstrates this startling capability. The vision is very clear, due to the remarkable absence of noise in the Fogal process. It is also shockingly unique, and it changes our very notion of physical reality. We are not at liberty to further discuss this new "sub-submicroscopic" reality revealed in such experiments. We simply interpret it as jumping the presently assumed restrictions of observation, and allowing the direct or correlated observation of the virtual state entities.

As alluded to, the previously modulated "Fogal type signals" emitted by all matter and other physical entities can also be displayed on a screen using the Fogal process, revealing a hitherto unsuspected physical reality and EM signals environment. In this prototype system, Fogal showed a remarkable and startling new extension of our very perception of physical reality itself. This is another reason why we expect that physics books will have to be rewritten, once the Fogal semiconductors are on the market and available in practical equipment. As every physicist knows, any dramatic increase in our ability to sense finer levels of physical reality inevitably leads to new and startling advances in physics itself and changes our very knowledge of the nature of physical reality.

The ability to bypass and "park" force fields by pinning their source electrons in a time-reversal zone, while continuing the flow of noise-free EM energy at will and at infinite velocity, obviously enables COP>1.0 systems. A pure longitudinal EM wave already has infinite energy, for

such a wave appears across the entire universe simultaneously, instantly changing the stress energy density of the entire vacuum in which the longitudinal EM wave is present.[140] The back emf and back mmf fields in an EM system or electrical power system can be frozen and held from restoring the Lorentz condition in the circuit, using the Fogal semiconductor {330}. We presently have an agreement with Fogal for the licensed use of his semiconductors in all such energy unit applications.

A quantum potential is modeled in a multiply connected spacetime, so that a given joule of input energy to one multiply connected point simultaneously appears in every other multiply connected point.[141] Since the Fogal semiconductor apparently can operate in quantum potential or Coulomb gauge fashion, it can act as a *direct energy amplifier*, with respect to the lab observer in a singly connected space. In short, the Fogal process dramatically extends the concept of "conservation of energy" to include conservation in multiply connected space and therefore incorporates observed energy amplification in singly connected space. Again, a broken symmetry (in singly connected space) reveals a higher symmetry (in multiply connected space), and the hierarchy principle is alive and well. In short, with the Fogal semiconductor used in power systems, the law of conservation of energy must be extended to include energy symmetry in multiply connected space but asymmetry in singly connected space. Obviously, such functioning totally transcends the limitations of the present thermodynamics models.

We carefully point out that this is not "energy creation" but simply the energy following the known kind of statistics in physics that allows a thing to be in multiple different places simultaneously. What is actually "instantly transmitted" is the simultaneous regauging of the energy density of the vacuum. At any point in space, the vacuum has an energy density and thus is a scalar potential with a given magnitude. Changing the energy density is simply regauging, which is freely permitted under the gauge freedom axiom of quantum field theory. So instant amplification of

[140] This should not be too surprising, since the bare charge and the bare mass of every electron each has infinite energy, as is well known in particle physics. For confirmation in very straightforward language, see Nobelist Steven Weinberg, *Dreams of a Final Theory*, Vintage Books, Random House, 1993, p. 109-110.

[141] If we wish, we can even take time itself as a special kind of quantum potential, since time also displays such a "multiplicity of connection" in 3-space. In one sense, time is the ultimate quantum potential, since a single point in time is "connected" to every single 3-space point in the universe, simultaneously.

energy" over a region of points is simply the instant regauging of the potential already present at each point in the region. It is *a permissible multiply connected space violation* of the present more limited "special case" energy conservation concept, which implicitly assumes a singly connected space. We have been working with Fogal for some time in this area, and we expect to rapidly develop and introduce commercial EM power systems based on the Fogal semiconductor's abilities in multiply connected space, as soon as it is in production and available. Until then, the details of our work in that area must remain highly proprietary.

5.8.4 Point-Contact Transistor.

Figure 5-8 diagrammatically shows a point-contact transistor with n-type base in a typical circuit for power gain. The point of the contact is under pressure on the material with which it is in contact.

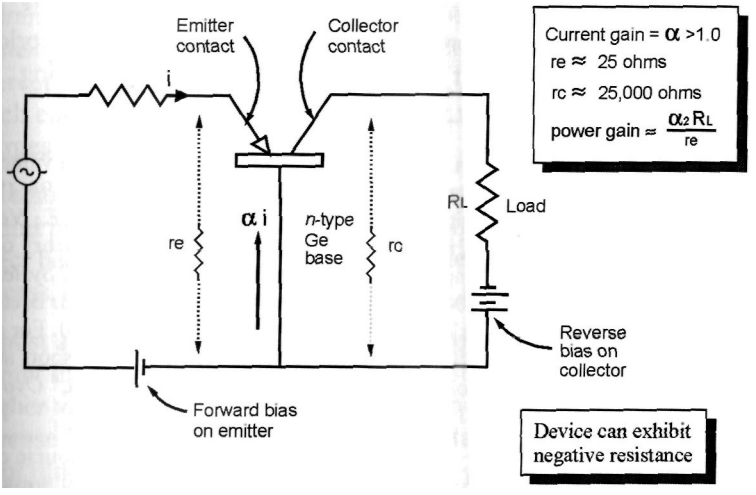

Figure 5-8 Point contact transistor with n-type base.

The point-contact transistor often behaved in true negative resistor fashion, outputting more energy than was input to it. Its production was always far **more** of an art than a science.

As can be seen from our quotation at the beginning of this chapter, the original point-contact transistor was never thoroughly understood

technically.[142] Specifically, there does not appear to have ever been any deliberate attempt to capitalize on the ability of the transistor to become a true negative resistor under certain manufacturing techniques and under certain conditions.[143] Instead, the variations and difficulties in manufacture resulted in use of the point-contact transistor being essentially bypassed rather quickly, by advancing to other transistor types more easily manufactured and with less manufacturing variances. In reducing the manufacture of other types of transistors to a science rather than an art, the point-contact transistor and its further development and optimization into reliable true negative resistors were abandoned.

We present this transistor as a straightforward and relatively inexpensive area in which young researchers in COP>1.0 systems and phenomenology may wish to begin, assuming they have access to semiconductor facilities in a university or similar or are willing to work meticulously under a jeweler's loupe. A rich combination of effects in the transistor awaits optimization and control. We predict that we shall yet see, on the world market of the future, such point contact transistors reliably exhibiting

[142] E.g., different theories are given in: (a) W. Shockley, "Theories of high values of alpha for collector contacts on germanium," *Phys. Rev.*, Vol. 78, 1950, p. 294; (b) W. R. Sittner, "Current multiplication in the Type A transistor," *Proc. I.R.E.*, Vol. 40, Apr. 1952, p. 448-454. Also of interest is (c) W. van Roosbroeck, "Theory of the flow of electrons and holes in germanium and other semiconductors," *Bell System Tech. J.*, Vol. 29, Oct. 1950, p. 560-607. See also (d) J. Bardeen and W. H. Brattain, "The transistor, a semiconductor triode," *Phys. Rev.*, Vol. 74, 1948, p. 230. For a more modern re-examination, see Shuji Hasegawa *et at*, "Electronic transport at semiconductor surfaces — from point-contact transistor to multi-tip STM," *Oyo Buturi*, 70(10), 2001, p. 1165-1171 (in Japanese).

[143] E.g., the point contact is usually under pressure, and this pressure of course can be varied. The full phenomenology of points (which increase voltage) and pressure, complicated by surface effects as well, has not been worked out in physics. Note the similarity of the pressure in the point contact transistor to the pressure in the Chung negative resistor. Note the almost certain involvement of the "overpotential" of chemistry and electrode chemistry, as well as the "double surface" effect of the small gap between the point and the substrate on which it rests in contact. Part of the gap probably even involves the Casimir effect as well. Any electrical signal variation in that very complex point junction will vary the overpotential, the stress potential, the "point increase in voltage" effect, etc. As can be seen, the phenomenology of the point contact is remarkably complex and rich in several areas of physics and in a great variety of physics variables. Obviously, the reasonable control of all these highly nonlinear variables — and their mutual interactions — is a difficult matter. Hence the readiness with which point contact transistors were dropped with substantial sighs of relief.

negative resistance. It will be necessary, however, to also take into account the symmetrical self-regauging characteristics of the common closed-current-loop circuit. By adroit switching of a true negative resistor in and out of a closed-current-loop branch, or placing it in parallel with the back emf of that branch to reduce it, asymmetry can be introduced into the overall closed current loop circuit, defeating the Lorentz symmetrical regauging. Defeating the Lorentz condition is essential to COP>1.0, of course.

We envision such a development as an ideal "negative resistance shunt" to add across the secondary of a transformer, and another possibly across its primary and across the external power supply as well, in producing more amenable and easily fabricated COP>1.0 electrical systems. We also point out that, once the back emf or back mmf forcing of equal power dissipation in the primary of a transformer or in the emf section of a circuit is dramatically reduced or eliminated, one does not require "large intensity" potentials and voltages to collect a great deal of power in the intercepting and receiving external circuit. Again, by simple W = Vq, as much energy W can be collected from any nonzero potential V as there are charges q to intercept.

We also envision such a true negative resistor being close-looped by the Bedini process, thus producing a small "self-powering" transistor, which in effect becomes a small self-powering "battery". This is absolutely a doable process, and it will be done once the Fogal semiconductor is in production.

Almost all semiconductor materials are also optically active materials, and a point discharge into such materials represents a very sharp regauging (higher voltage) discharge at a point or into a very small area, due to the increase in potential at the tip where it contacts the base material. The point junction is under pressure, so a stress potential exists there. In addition, the well-known "point" effect also increases the potential in the junction pointer itself, from its base to the point. The point contact phenomenology of different materials — one conductive and one semiconductive — is of much interest, and with novel phenomenology.

The fact that the point-contact transistor in its most usual formulation primarily uses holes more than electrons, is also of much interest in COP>1.0 situations. Holes in a circuit move against the voltage. The trick is to let the Dirac holes *before observation* move in an open path from the ground return line against the back emf to the potentialization line, and **transduce** the moving hole current (via the Bedini process) into electron

current after the holes have already freely reached the vicinity of the high side of the circuit.

When Dirac sea holes (causal positrons before observation and thus prior to their alteration to lattice holes and parity reversal) and Dirac sea hole current are also involved with point-contact transistors, the resulting phenomenology has been but little investigated and none of it is in the present textbooks. However, from recent work with positron probes and positron microscopes to examine semiconductors and semiconductor materials, it is known that the holes (positrons) tend to be repelled from nuclei in the material into defects (voids) in it {331}. These effects have been investigated, for example by Triftshauser *et al.* {332}.

Both the mechanical stress potential (which is fundamentally electromagnetic) and the heightened junction potential decompose via our reinterpretation of Whittaker's 1903 decomposition of the scalar potential. This leads to optical-type pumping in both the time domain as well as the 3-space domain. Hence novel optical-type effects and time-reversal of material states can be involved, leading to a very complex set of phase conjugate phenomena, time-reversal phenomena, etc.

Certain Hall effects employed in conjunction with a point contact transistor could be a fruitful area of investigation. As an example, narrow Hall bars with junctions between current and voltage leads of various geometries could be investigated. Widening the junction from the normal square-cornered shape can sometimes produce a negative Hall resistance.

The junction of the point contact involves asymmetrical self-regauging, iterative time-reversal retroreflection, increased Poynting and Heaviside energy flow components, optical scattering processes inside the junction materials, etc. The transistor can indeed be manufactured so that these highly nonlinear effects sum to a negative-resistor-like movement of the output current against the voltage, although with so many other phenomena involved it will require some hard work and research in order to develop and stabilize it — and understand it.

5.8.5 Bedini's Negative Resistor Process in a Battery {333}.

5.8.5.1 Some Pertinent Lead-Acid Battery Processes

A lead-acid storage battery is a highly nonlinear device. The plates may be plante, pasted, or tubular etc. They are usually highly porous and have a thin oxide layer. They may have other coatings and the electrolyte solution may include additives to enhance operation. The plates consist of a mix of crystalline materials in most cases. The plate materials include acicular

(needle-like) crystals, particularly the negative plate. The plates usually are porous, knit, and have gridded separators.

The chemistry of the battery electrolyte is complex and — even today — not all of it is well understood, particularly when mass transport is accounted. In our discussions, we will be including some of the previously neglected phenomena during mass transport (ion sluggishness in moving) that are responsible for some of that lack of understanding. In the battery chemistry, there are many double surfaces between the ions and also there is a variety of point voltages. There is a separate theory for double surfaces.

One of the most important phenomena is that the ion currents in the electrolyte are confined to the battery, and do not pass out into the external circuit. Much of the electron currents in the external circuit are blocked at the plates from moving within the electrolyte. Consequently, we will limit our discussion to two major currents of interest[144] in a battery-powered system, and these currents are effectively isolated from each other (at least to first order). Those currents are (i) the ion currents in the electrolyte, confined to between the plates and therefore internal to the battery electrolyte, and (ii) the electron currents between the outside of each plate through the inside of the plate and on out through the external circuit and then around to the inside and thence to the outside of the other plate. Chemical changes occur on the plates themselves as a result of these two currents.

It is usually assumed in power systems that these two currents are in phase or almost entirely so. That need not be true at all, and Bedini takes specific advantage of deliberately arranging these two currents to be antiphased part of the time. Part of the Bedini effect can be understood from this fact alone; the other part must consider one other most unusual electrical current that is encountered only in battery-powered systems or COP»1.0 systems.

So indeed there are *several* (many) currents in a lead acid battery [334], not just one, and we will consider three of them — the two previously mentioned, and an additional Dirac sea hole current in the local vacuum itself. The reader interested in greater technical depth should also turn to

[144] Of course, there are many other currents in a battery as well, but — although an oversimplification — these two major currents together with the Dirac sea hole current will suffice for our introductory modeling and explanation purposes.

the literature of electrode chemistry and electrochemistry {335a-f}, which is quite complex.

5.8.5.2 Dirac Sea Hole Current

In a battery-powered COP»1.0 system (and in some COP>1.0 systems), there is a previously unrecognized significant flow of Dirac hole current in the local vacuum, running from the output section of the system to the system input section and thence through the conductors into the battery terminals and onto the battery plates, and on into the battery electrolyte chemistry. This hole current may be greater — *evenfar* greater — than the normal electron current running from input to output.

So in the battery-powered overunity system with positive feedback, not only does an electron current run from the battery through the connecting conductors to the input section of the system, but also a Dirac hole current pours back out of the system input section, and — if not intercepted and transduced — through the conductors and back into the battery. All the while, this Dirac hole current is "eating" electrons being furnished by the battery to the system. The net result is that the battery "sees" an extra load to be powered, in addition to the ordinary load presented to it by the normal system input section. It "sees" the situation as an "extra load" because it first has to furnish sufficient electron current to fill the hole current and "kill" it, before it can furnish the additional electrons to power the system in normal fashion.[145]

[145] An odd effect occurs in the battery, however, when the battery completely discharges in the normal sense. Actually, it is still fully charged with positive energy charge, but also has been simultaneously charged with negative energy charge. With the excess negative energy holes continuing to charge the battery with negative energy charge, the battery becomes increasingly *charged with net negative energy.* There is almost no limit to the negative energy charge the battery (i.e., the local Dirac vacuum portion of its supersystem) can take, except the eventual development of antigravity effects due to the inverse and increasing curvature of local spacetime in which the battery is embedded. After a battery has been used to power a COP»1.0 system for some time, one can take the battery off, place it on a normal battery charger, and it will then "eat" positive power for an extended period of time — e.g., a week or longer. During this period, one is steadily negating the inverse curvature of the local vacuum via the increased positive energy collecting in that spacetime. The battery again finally passes through zero voltage and net charge again, and suddenly starts charging up again in a "normal" sense with positive energy charge. This process actually increases the lifetime and function of a battery in a startling manner. Bedini has used batteries almost devoid of charge and energy in the normal sense, and powered systems very well with them, even for longer than a year continuously.

A COP»1.0 EM system is an excited system far from equilibrium in its exchange with its active environment. For all such excited systems, there exist significant decay mechanisms to bring the system back into equilibrium with its environment, since equilibrium yields the lowest energy state and maximum entropy. The Dirac sea hole current (negative energy current) is nature's unexpected natural decay mechanism to sharply decay a COP»1.0 system back to an overall COP<1.0 system when the external power supply is considered also.[146]

So when Dirac hole current back through the local vacuum and through the system is involved, the battery first has to furnish electron current to fill these holes at the rate they are appearing in the input section, thereby furnishing a primary "hole-filling" electron current component which "disappears" into the Dirac vacuum and is lost.[147] Only after the holes in the hole current are filled — and the hole current is being steadily nullified

[146] It decays the *true negative resistor* power system back into being only a *dijjerential negative resistor section* of a slightly extended metasystem including the power system and its external power supply. This novel decay mechanism also prohibits close-looping the now differential negative resistance power system for self-powering, unless the hole current is first converted into electron current, as discussed in Chapter 9 and in paragraph 4.9.6 below.

[147] The filling of these Dirac sea holes is not pair annihilation in the usual sense, and no radiation is emitted. Instead, the energy of the radiation that would otherwise be emitted is added to the negative energy curving the spacetime. Hence the net curvature of spacetime relaxes because of superposition. In effect, the vacuum/spacetime itself reabsorbs the energy as relaxation spatial energy added to the curvature energy of the curved spacetime, reducing that curvature. Particularly see Mendel Sachs, *Quantum Mechanics from General Relativity: An Approximation for a Theory of Inertia*, Reidel (now Kluwer), 1986. A generalization of quantum mechanics is demonstrated in the context of general relativity, following from a g**enerally** covariant field theory of inertia. Nonrelativistically, the formalism corresponds with linear quantum mechanics. In the limit of special relativity, n**onlinearity** remains and several new features are derived: (i) Particle-antiparticle pairs do not annihilate; an exact bound state solution is derived corresponding with all experimental facts about annihilation/creation — which, in approximation, gives the blackbody radiation spectrum for a sea of such pairs, (ii) A result is proven, without approximation, that is physically equivalent to the Pauli exclusion principle- which in linear approximation gives the totally antisymmetrised main-body wave fu**nction** and Fermi-Dirac statistics, (iii) The hydrogen spectrum is derived, including the Lamb shifts, in agreement with experiment; new results are found for hi**gh-energy** electron-proton scattering, (iv) Finally, several applications to the elementary particle domain are demonstrated, in agreement with results from experimental high-energy physics.

— can the battery then send additional electrons which do not disappear and which are accepted in the system input section to power the system. We discuss this Dirac hole current in some detail in Chapter 9, including how to convert it into useful input electron current to the system, reducing the current load on the external generator and enabling self-powering. Bedini invented the method of transducing available negative energy hole current in the vacuum into electron positive energy flow to charge the battery and power the system, preventing decay of the COP»1.0 system back to COP<1.0.

We shall not discuss the complexity of the additional chemical reactions ongoing in the battery electrolyte and on the plates. The two main mass-containing currents and the negative energy Dirac hole current will suffice to explain the Bedini negative resistor formation and usage, at least to first order and sufficient to stabilize systems.

5.8.5.3 Changing Symmetrical to Asymmetrical Regauging

To first order, we reiterate that the electrons flow from one plate of the battery through the external circuit to the other plate, but the lead ions do not. There is thus a sharp "two separate currents" interface at the plates and thus a sharp separation between the electron current and the ion current. In short, there are actually two half-circuits in the battery-powered system if one chooses to use them semi-independently.

The current carriers in the two half-circuits are quite different. Therein lies the opportunity to separate and antiphase the two currents, using one to recharge the battery while the other is used to power the loads. It also allows a good opportunity to asymmetrically regauge both half circuits, greatly and freely increasing the Poynting energy component intercepted, collected, and used by each half-circuit's carriers. This is the basis for a profound "opening" of the system and influx of excess vacuum energy.

The two half circuits meeting at a common interface allow a stress potential upon that interface to *individually* use the two halves of what is normally Lorentz's symmetrical regauging. That usually *symmetrical* regauging (if the complete circuit were unitary) is now comprised of two separated *asymmetrical* regaugings, one for each of the two circuit halves, because the net stress potential (net Lorentz symmetrical regauging) — consisting of two opposing fields and forces — is split into two now-individually-separated and separately utilized force fields.

We accent this process by an analogy. Suppose we suddenly place a scalar potential ϕ upon a point in the middle of a transmission line. Immediately the potential ϕ races off (spreads) in both directions simultaneously, at

nearly light speed. Further, in each direction there is a moving gradient of ϕ, hence an E-field by $\mathbf{E} = -\nabla\phi$. These E-fields or "emfs" are oriented in opposite directions, so there is a movement of charge from the middle of the line toward each of the ends. The same "dephasing" current effect can be applied to any conductive medium or to the interface between two conductive circuits.

In Bedini's negative resistor case, the placement of the potential ϕ — for its movement in both directions — is on the interface (the face of the lead plates) between the two half circuits and therefore between the two different current carrier types. An initial "Lenz's law" reacting with the suddenly placed E-field onto the plate surface, creates an E-field in opposition, forming a stress potential ϕ which is much higher than the normal potential of the battery (in a nominal case, 100 volts instead of the 12 volts of the battery).

Immediately this potential "takes off in both directions", with a powerful E-field and emf back into the outside circuit and its load, while a powerful E-field and emf also proceed into the battery electrolyte in the opposite direction. So the ions in the battery have a sudden, much higher energy interception and collection forced upon them, with the excess emf now being in *battery-charging mode.* The electrons in the outside circuit simultaneously have an excess emf and potentialization *in the load-powering mode.* Let us see how the two very different current carriers react to these "dual emfs" in the overall circuit.

5.8.5.4 Mass-to-Charge Ratios of the Two Current-Carrier Types

We stress the dramatic difference in the *mass-to-charge (m/q) ratio* of the two currents. The lead ions' m/q ratio is some few hundred thousand times the m/q ratio of electrons, as we recall. For our purposes, all we need to know is that the m/q ratio for the lead ions is *very much larger* than the m/q ratio for the electrons. For a given force, the ions in the internal half circuit in the electrolyte will therefore respond very much slower than will the electrons in the external circuit half.

5.8.5.5 Hysteresis Between the Responses of the Two Half-Circuits

Because of this great disparity in the m/q ratios of the two mass currents, there is obviously a relatively significant hysteresis (time delay) between the *response* of the more massive ion current and the *response* of the far **less** massive electron currents that interact at the plates to try to change the ion current and its momentum. This time-delay between ion response in the electrolyte (the effect) and electron pileup urging (the cause) can be adroitly manipulated. Specifically, it can be used to alter the local vacuum

potential and cause it to add excess energy to the ions in charging mode **and** simultaneously to add excess EMF to the electrons in circuit-powering mode. In short, the response delay can be manupulated to "asymmetrically regauge" the mass currents in the system, freely changing their potential energy, and dramatically increasing how much potential energy is available for battery recharging and how much is available for powering the external circuit (loads and losses). Further, during the antiphase condition of the two current halves, the battery can be charged simultaneously while the external circuit half and load is being powered. Excess energy is fed into both actions by the *overpotential* (the stress potential) created at the surface of the plates.

5.8.5.6 Evoking the Initial Bedini Negative Resistor Effect

Figure 5-9 shows the first phase of Bedini's negative resistor process. Consider the battery in normal load-powering operation. From the external circuit, a very sharp leading edge rise of a pulse of electrons and potential is sent to the battery plates in "back-popping" or "battery charging" mode. The back-popping electrons drive in nearly instantly, piling up on the negative plate[148] and trying to force the heavy ions to start moving in the battery recharging direction. The pile-up that results in the stopped electrons on the battery plate surface represents an increase in local current density, hence an increased potential. This produces the 100 volts potential, during the time that the ions have not yet responded to any appreciable degree.

Due to much larger m/q ratio of the sluggish for a moment they lag due to their greater inertia, and this allows the much more agile electrons to "pile-up", producing a substantial overpotential as the local current density increases. The lagging ions are being steadily overpotentialized during this "lag time", up to about 100 volts in a normal 12-volt battery. At the same time, electrons are being forced back out of that higher 100-volt area and into the external circuit and its load, which had been at 12 volts. Recall now that these electrons can move longitudinally only at the drift velocity. Hence all electrons in the external circuit are now highly overpotentialized, and in *load-powering mode. The* overpotentialized electrons are thus producing excess power in the external circuit, much more than normal.

[148] We are not using conventional "positive current and positive plate" as the high side of the potential. We are using "electron current and the negative plate" as the driving potential plate.

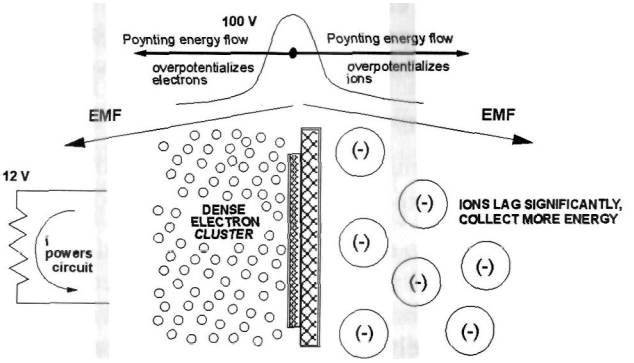

1 Sharp leading edge voltage pulse produces intense electron clustering and large potential (negative resistor) *at* interface *Sluggish ions only beginning to move*

2 Bidirectional Poynting energy flow from potential overpotentializes both the electron cluster and the ions, which are only beginning to move in charge mode

4 Large back emf Into circuit returns overpotentialized electron current, powering circuit with excess energy pouring from negative resistor potential Continues dunng ion delay

5 Simultaneously overpotentialized ion current is overcharging battery

Figure 5-9 Phase I of the Bedim negative resistor process in a storage battery.

Then the overpotentialized ions very slowly (compared to the electrons!) slow, stop, and begin to move in the opposite direction. They reluctantly respond and move in *battery recharging mode.* During that ion-response lag time, and the slower initial portion of the response, the electrons in the pulse continue to furiously surge in and pile-up on the negative plate, overpotentializing both the ions and the external circuit's electrons, while also some of them are being impelled back out into the external circuit to power it with extra overpotentialized energy dissipation. The charge density at that plate sharply increases due to the pile-up where the charges are "squeezing" together (clustering). There is a much higher potential suddenly rising in the squeezed charge cluster, because of the increased charge density there. As we stated, this potential nominally may be about 100 volts during this initial phase.

We call attention to the simple equation W = VQ, where W is the potential energy added to charges Q exposed to voltage V.

Simplified, the excess energy W_{IONS} freely impressed upon the ions is

$$W_{IONS} = f(100 - 12)(Q_{IONS}) \qquad [4\text{-}3]$$

where Q is the total coulombs of charge of overpotentialized ions and f(100 -12) is the magnitude of the overpotentialization of the ions.

At the same time, an excess energy is impressed upon the electrons in the external circuit by the same potential extending along the conductors into the external circuit. Again, this excess energy WE is given by

$$W_E = f(100 - 12)(Q_E) \qquad [4\text{-}4]$$

where Q_E is the total coulombs of charge of the overpotentialized electrons and f(100 -12) is the magnitude of the overpotentialization of the electrons.

But the emf on the electrons from the pile-up is directed in load-powering direction, as can be seen. Consequently the ion current and the electron current have been deliberately dephased by 180°, and so the overpotential energy of the ions is delivered in battery-recharging mode, while the overpotential energy of the electrons is delivered in circuit load powering mode.

Recapitulating: Pulsed pile-up of excess electrons on the negative plate interface between the two currents, while the ions are beginning to respond or only sluggishly responding, produces a much higher potential (an *overpotential)* on the sluggish ions — nominally some 100 volts in a 12-volt battery. On the negative plate, momentarily there is now a much higher voltage (with respect to the positive plate) than normally exists in the 12-volt battery. This voltage *overpotentializes* both the reluctant charging ions in the battery solution between the plates, and the powering electrons back into the circuit in powering mode due to the reversal of the emf. Since there is, say, 100 volts across the battery momentarily, there is also 100 volts now across the external circuit momentarily. Accordingly, overpotential excess powering of the external circuit load is suddenly evoked, while at the same time overpotential recharging of the battery is also evoked.[149]

In short, the ion current in the battery and the electron current into the external circuit have been placed 180° out of phase, achieving one major requirement for a COP>1.0 electrical system: *violating the integrity of the closed current loop circuit.* The battery is recharging at the same time that

[149] Another of Bedini's innovations is to shunt the excess voltage (say, above 14 volts) into an external capacitor on the circuit side. In that way with his overpotential he can be (i) overcharging the battery, (ii) powering the load, and (iii) storing excess energy in that capacitor, from the altered vacuum — all simultaneously.

the external circuit is being powered, *from the same free overpotential,* and both recharging and circuit powering are driven by increased emf.

We strongly accent that the overpotential at the plates represents a change in the local vacuum potential, and it *identically is* part of that now-altered local vacuum potential. The vacuum, since it contains enormous EM energy in virtual state, is a very powerful EM potential. Any EM potential in our circuits is automatically a change to the ambient vacuum potential, or a change to another potential that is such a change to the vacuum potential. In the most exact sense, this is a method of overpotentializing the plate interface with excess energy from the vacuum, and then letting that energy flow onto the ions to recharge the battery and onto the electrons in the external circuit to power it and its load.

The Bedini overpotential at the battery plates decomposes via Whittaker 1903 {85} as reinterpreted and previously explained, so that excess energy is entering 3-space there, *from the time domain.* Further, the piled-up electrons on the plates and the ions (as charges) in the solution receive such potential energy from the increased potential on them via the same decomposition process. So the creation of the Bedini overpotential on the battery plates, together with dephasing the two currents, is the creation of a true negative resistor at the plates, freely receiving energy from the external vacuum (from the time domain and virtual state) and transducing it into real potential energy and emf on the internal ions and on the external circuit electrons.

Hence Bedini has invented a process for creating a true negative resistor inside a storage battery, and for suddenly thrusting the system out of equilibrium with both the active local vacuum and the active local curvatures of spacetime. As such, the thermodynamics of open systems far from thermodynamic equilibrium applies, and that system is permitted to exhibit COP>1.0, while complying with energy conservation and the laws of physics and thermodynamics. With adroit use and collection of the excess energy, the externally collected energy can be used to close-loop the system and power all its functions. So the system is permitted to power itself and its loads, with all the energy being received from the vacuum via the broken symmetry created. Any overpotential is a dipolarity *a priori,* since any potential is. Hence creating an overpotential is precisely producing an extra broken symmetry of that dipolarity right there at the interface between the two half-circuits and the two dephased, localized currents.

During the "back-popping" pulse signals, one should not think of the energy pulses that Bedini inputs to the battery as the "powering" energy. Instead, one must think of each pulse as "triggering" and "timing" energy which initiates certain other key *negentropic* interactions to freely occur, once the electron pile-up occurs. The resulting negentropic interactions then add substantial additional energy (from the local active vacuum) to the ions in the ion current and to the electrons in the electron current. The freely added energy can be appreciably more than the switching or triggering energy that is dissipated as the "input by the operator".

In short, Bedini deliberately "switches"' and "triggers" certain kinds of vacuum exchange interactions, effectively creating a *true negative resistor* in the battery itself.[150] Due to the broken symmetry of the increased dipolarity *(overpotential)* that Bedini makes in "electron pile-ups" urging reluctant and delayed ion response, the vacuum furnishes extra virtual particle flux to this pile-up of electrons on the plate, which produces an enhanced Poynting energy flow that interacts with the ions in the battery electrolyte. Being charges, these ions thus transduce some of the excess absorbed virtual photon energy into real observable energy, thus increasing their potentialization and energy.

Bedini's method does the following: (i) It forms a true negative resistor in an unexpected way, upon the plates between a pile-up of electrons and the ions in solution in a common lead acid battery, (ii) it uses that negative resistor to extract excess energy from the vacuum and furnish it both to the ions forced into charging mode and simultaneously to the electrons in load powering mode, and (iii) it adds several other stimuli (such as Lenz law effects) which further amplify the negative resistor and enhance the effect, increasing the excess energy extracted from the vacuum and collected in the battery-charging process and also in the circuit-powering process simultaneously.

Specifically, the delay in ion response is adroitly allowed for and manipulated by Bedini to place the battery in ion current recharging mode while the signal pulse electrons between the plates and the external circuit are simultaneously placed in external circuit powering mode. By manipulating the hysteresis and adroitly timing the electron pulses and pulse widths, *Bedini breaks the usual forced Lorentz symmetry of the excitation discharge in a usually closed current loop containing both the*

[150] Again we stress that any dipolarity or potential is a negative resistor, producing giant negentropy {12}.

battery's source dipole and the external load. This is possible since his method deliberately opens the system so that vacuum energy enters freely, increasing the potentialization (energy collection) of the ions in the battery solution and upon the electrons between the plates and the external circuit as well.

We stress that Bedini has chosen to *avoid the* usual dissipation of half the energy collected in the external circuit to do nothing but kill the source dipolarity between the battery plates. He works on "that half of the circuit" that is usually just called the "back emf region" and ignored, and he separates and dephases that half of the circuit from the other half. By interrupting that normal "back emf battery-discharging section dynamics and converting it to "forward emf battery recharging section dynamics, while simultaneously powering the external load, Bedini temporarily produces and utilizes a negative resistor right there on the surface of the battery plates themselves.

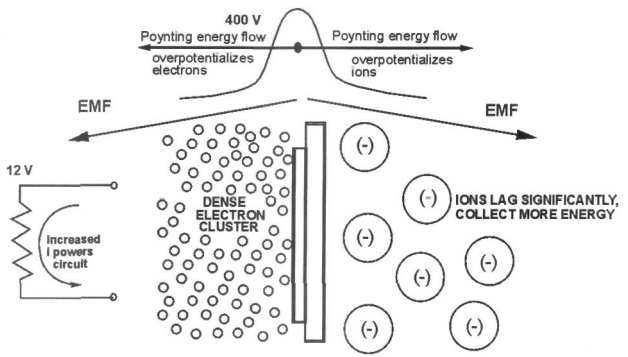

1 Sharp trailing edge of voltage pulse produces intense Lenz law effect Sharply increases electron clustering and potential (negative resistor) at interface Sluggish ions delay speedup further increasing the Lenz law effect

2 Increased bidirectional Poyntjng energy flow from potential overpotentializes even further both the electron duster and the ions, which are only beginning to accelerate in charge mode

4 Large new increased back emf into circuit returns overpotentialized electron current powering circuit with new excess energy pouring from negative resistor potential Continues during ion delay

5 Simultaneously, re-overpotentialized ion current is overcharging battery even faster

Figure 5-10 Phase II of the Bedini negative resistor process in a storage battery

5.8.5.7 Further Increase of the Negative Resistor Effect by Lenz's Law
See Figure 5-10. To further increase the Phase I effect just before it would end, and requiring precise timing of his switching of the pulse leading edge and trailing edge, Bedini then invokes a second phase by carefully controlling the timing for the sharp *cutoff of* the "stimulus pulse" creating the negative resistor. This is usually invoked just as Phase I is preparing to end, but experimentation and adjustment for optimization to the individual circuit conditions may be required.

Invoking the Lenz law reaction by minimizing the stimulus pulse cutoff time, Bedini sharply increases the already-increased negative resistor overpotential by a Lenz's law induced voltage surge, and sharply raises it to as much as 400 volts nominally. The process also sustains the negative resistor overpotential for a longer period, while increasing it again during this second phase. Thus even more free energy from the altered local vacuum potential is delivered to the ions in charging mode inside the battery, while simultaneously even more energy is delivered to the external circuit electrons in powering mode. The overpotential period is also extended. In this second phase, the extra energy W_{IONS} added to the ions in recharging mode is given by

$$W_{IONS} = f(400 - 12)(Q_{IONS}) \qquad [4\text{-}5]$$

and the extra energy W_E added to the electrons in system powering mode is given by

$$W_E = f(400\text{-}12)(Q_E) \qquad [4\text{-}6]$$

The total energy added to the system in Phase I by the negative resistor is

$$W_T = W_{IONS} + W_E = f(100\text{-}12)(Q_E + Q_{IONS}) \qquad [4\text{-}7]$$

The total energy added to the system in Phase II by the negative resistor is

$$W_T = W_{IONS} + W_E = f(400\text{-}12)(Q_E + Q_{IONS}) \qquad [4\text{-}8]$$

And so the total energy added to the system by the Bedini process is just the summation of equations [4-7] and [4-8]. With adroit switching, Bedini need only "pay" a small fraction of that freely received excess energy, in his own operator's input pulse energy and switching costs.

So by invoking a novel negative resistance effect directly upon the driving plate of the battery, Bedini creates (in the first phase) and then further enhances (in the second phase) a "nearly free" overpotential and overpotential period inside the battery. This excess potential directly upon the electron-pileup plate acts in both directions — out into the electrolyte between the plates to overpotentialize the ions in charging mode, and back out into the external circuit in powering mode to overpotentialize the electrons now powering the load. During a fraction of the operating cycle, Bedini recharges the battery while powering the circuit simultaneously, and thus has invented a novel method for extracting energy from the vacuum and curved spacetime to enable a COP>1.0 power system.

This is just a description of one fundamental period where Bedini applies his negative resistance process.

Several other places in the operation of the circuit lend themselves to additional phases of negative resistor formation and usage, and Bedini does use them. We do not discuss them here, since our purpose is only to advance the *fundamental principle involved.*

5.8.6 Independent Replication of the Bedini Negative Resistor Effect

Independent replication of the Bedini effect was accomplished early on by Nelson and by Cole, and also by Watson. Nelson has chosen not to further publicize his own work for some years, perhaps due to his employment as a microwave switching engineer in a large (and conservative) aerospace company. Cole is deceased, and Watson abruptly withdrew —forcibly, in our opinion — from public research and all further contact with his close colleagues after successfully demonstrating (in 1984) an 8-kilowatt power system utilizing a modification of the Bedini process. We are almost certain that Watson received the "offer he could not refuse", and that Watson-type COP>1.0 power systems are in fact already powering exotic underground facilities that "officially do not exist" but which we are aware of. We briefly discuss Watson's 8 kW generator at the end of this Chapter.

For non-battery powered systems, as we explain in Chapter 9, any unitary COP»1.0 EM system may experience a Dirac sea hole current decay mechanism which will produce an effective extra "load" in the system's input section, including on out into the external power system. As a general rule (sometimes violated), we estimate that the effect begins to be of importance at COP > 10^3 or so. Certainly it is of great importance in the range of COP > 10^5. To operate stably at COP »1.0, this decay mechanism must be dealt with and prevented. For close-looping into self-powering mode, this negative energy feedback must be converted to positive energy feedback, thus allowing self-powering mode where all the input energy is freely received from the vacuum.

For battery powered systems, the hole current and "extra load in the input section" becomes of significance near COP = 2.0 or even less, because of interaction with the complex battery chemistry and the tendency to charge **the** battery with negative energy as well. So battery powered systems present a special problem for close-looping to achieve sustained self-operation. Bedini has long solved and demonstrated solutions to that problem in a variety of successful experimental systems.

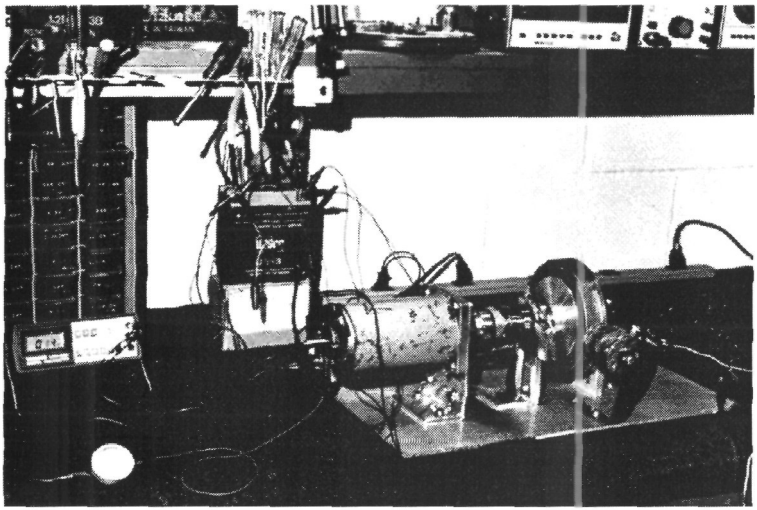

Figure 5-11 **Bedini motor** similar to the **type which ran continuously off a battery for three years, simultaneously recharging the battery.**

To utilize Bedini's battery-powered system at COP > 2.0, or to close-loop it for sustained operation, one must add another Bedini process that transforms negative energy current into positive energy current. That is Bedini's *transducing* negative resistor process {336}. We describe that process briefly in the next paragraph below.

Bedini has built many different motor-generator versions of systems self-powered by use of his negative resistor processes. Figure 5-11 shows a Bedini motor similar to one that once ran off a single battery for more than three years without stopping, using the forerunner of the Bedini back-popping process for creating a negative resistance in the battery. Bedini is still building and testing such power systems; one of his prototype motor-generators today, capable of operating and self-powering off a single battery, is shown in Figure 5-12.

5.8.7 Bedini's Transducing Negative Resistor.

Figure 5-13 gives a simplified block diagram of Bedini's transducing negative resistor process, which asymmetrically regauges negative EM energy into positive EM energy. With this process Bedini is able to intercept the Dirac sea hole current running from the output section of a COP>1.0 EM system to its input section, and divert the negative energy Dirac hole current to "reverse charge" a capacitor. The "reverse charge" consists of providing a hole current to the anti-negative plate of the

Figure 5-12 Modern Bedini motor prototype which operates off a single battery, powering the load and recharging the battery also.

capacitor, so that holes acting as positrons pile up in the local vacuum of that plate. This attracts the trapped electron charges in the dielectric, straining the dielectric in the direction of the hole collection. At the same time, the other plate draws electrons from the system that would otherwise be in currents that fight the back emf of the primary source dipole for the system. That reduces the back emf of the system during the charging of the capacitor; in effect, the back emf has participated in charging the capacitor with excess electrons on the negative plate.

Then Bedini reconnects the charged capacitor to the conductors leading to the power supply, discharging the capacitor by electrons furnished to the negative driving plate of the battery powering the system, and simultaneously to the input section of the system itself in normal powering mode. Note that the holes simultaneously discharge from the capacitor's anti-negative plate to the ground side of the battery, further charging the battery (the power source!) and the load as well.

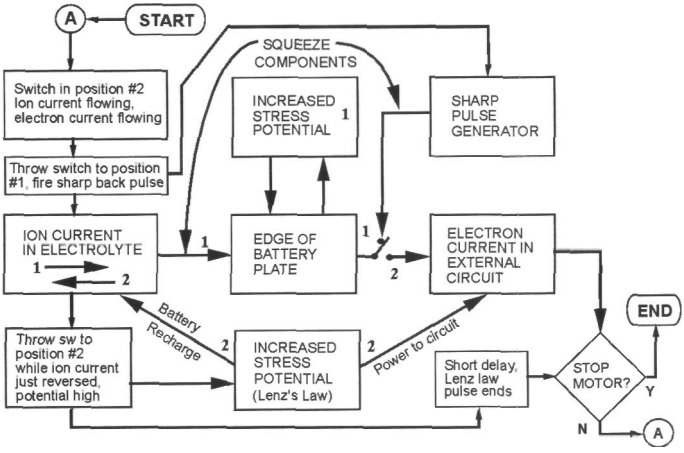

Figure 5-13 Bedini transducing negative resistor process block diagram. Adjusting **timing of rear edge of pulse adds additional Lenz law** increase.

Though it does not appear in the conventional textbooks,[151] one can power a load directly by Dirac hole current, but one does so by using the hole current in exactly reverse fashion from how one would use electron current to power the load. Semiconductor components are also critical and usually should be avoided. In short, one simply reverses the terminal that is considered the "driving terminal", and feeds the hole current to that "anti-negative" terminal as now the temporary driving terminal.

The Bedini process thus allows the Dirac hole current (negative energy) produced by a COP>1.0 EM system to be fed back to the input section and transduced into positive energy input to power the system with electron current and also to recharge the battery with positive energy.

[151] Lattice hole currents of course do appear and are considered. However, even though the circuit designers consider a lattice hole as a positron, it is not such at all, because the m/q ratio of the ion with one + charge is quite different from the m/q ratio of a true positron. The Dirac hole in the vacuum is effectively the "4-positron" — still in negative energy Dirac 4-electron state — before its observation or interaction with mass. It is a true negative energy entity, and thus a negative mass entity. Prior to observation, it actually should be said to be a "negative energy x time" entity and a negative "masstime" entity. It is also a negative energy electron entity. This subtlety is essential if one wishes to produce successful antigravity experiments on the bench, as we point to in this book and as were exhibited by the Sweet vacuum triode amplifier at COP > 1.5×10^6.

This converts what would otherwise be negative energy feedback to the input section of the system (and to the battery) to positive energy feedback **to** its input section and to the battery. Instead of seeing the negative energy current in the input as an additional "load" to be powered, the external power supply sees it as excess positive energy input by the environment to the system, reducing the "load" represented by the system. It thus reduces the power required by the system from the external power supply.

When the amount of "transduced" positive feedback electron current to the input section equals the "normal electron current draw" required by the system, the battery (or generator) can be disconnected and the unit will continue to operate in the self-powering mode, fed completely by the positive energy from the Bedini transduction process. The other *supersystem components* (comprising the external environment of the system) will continue to power the system and its loads and losses, with all the input energy to the system being taken from the combined active local vacuum and local curvature of spacetime.

5.8.8 Gray's "Splitting the Positive Pole" Engine.

One of the real pioneers in early application of causal positron energy was inventor Edwin V. Gray of Van Nuys California. In WW II Gray learned radar during his tour in the U.S. Navy, having previously attended advanced engineering school in the Army until discovered to be under age 15 and discharged. After the war, by 1958 he had learned to perform what he called "splitting the positive pole", using "cold electrical energy" (his name for negative EM energy) as well as the normal positive electrical energy. His first motor was operating by 1961. Preparing to put units into production, in 1974 the Los Angeles District Attorney confiscated all Gray's records and prototypes. To escape bogus charges, Gray later pleaded guilty to two minor infractions and was released. His prototypes were never returned. After several mishaps, moves, and more prototypes, Gray died in Nevada under mysterious circumstances in April 1989. We quote directly from Lindemann {341}:

> *"In the early 1980's, Gray offered the U.S. Government his technology to augment Reagan's SDI program. He actually wrote letters to every member of Congress, both Senators and Representatives, as well as the President, Vice-President, and every member of the Cabinet. Remarkably, ... Gray did not receive a single reply or even an acknowledgement!"*

In fact, during his early experiments, Gray discovered he could power light bulbs with cold energy, etc. Later he was to demonstrate this fact in a sensational manner: With a light bulb lit from his generator, he simply immersed the lamp — electrical leads and all — in water, where it remained lit. With his hands in the water, he would have been electrocuted or severely shocked if the electrical energy involved had *been positive* (diverging) energy. Instead, it was *negative* (converging) energy.[152] Another demonstration was to hit the coil of an electromagnet with some 3,000 volts, which hurled the electromagnetic into the air — but did not heat it. The electromagnet's coil would have been instantly melted if the energy had been positive, and the magnet would have been heated.

The reader should recall the timing of Dirac's theory of the electron {498a-b, 249}, which included the negative energy electron as early as 1930. Dirac also pointed out that we would observe this negative energy electron as a positive energy electron of opposite (positive) charge and positive mass, going in the opposite direction. The *observed* 3-positron and the *unobserved* negative energy 4-electron are quite different entities, producing quite different EM fields. The positron produces positive energy EM fields and positive gravity while the negative energy 4-electron produces negative energy EM fields and negative gravity.

In 1930, to his previous theory of the electron Dirac introduced the vacuum energy: the electron sea filled with electrons occupying negative

[152] By convention, "positive" energy has been associated with diverging EM energy, which is heating. Negative EM energy is associated with converging EM energy, which is cooling. In scalar interferometry {79}, one can control whether the distant EM field energy emerging in space in the distant interference zone shall be diverging (positive) EM field energy or converging (negative, cooling) EM field energy. This is determined simply by the biasing of the electrical grounds of the interferometer transmitters. The weather control referred to in 1997 by Secretary of Defense Cohen {89} is accomplished by using multiple scalar interferometers, some to gently heat the atmosphere in certain selected local areas (forming low pressure areas by expansion of the air) while cooling it in other selected local areas (forming high pressure areas by contraction of the air). By then moving these highs and lows around adroitly, one can capture and steer the giant jet streams, thereby steering the weather as one wishes, and directing significant weather changes into an area. By placing fairly sharp turns on the jet streams, one can induce great spin energy, thereby spawning tornadoes. Interestingly, by sharply pulsing the interferometer and controlling its electrical ground bias, distant cold explosions or hot explosions can be produced at will. Such weapons have been tested worldwide, and many test incidents are given in our older books F*er-de-Lance* and *Gravitobiology.* Information on such incidents is available on website http://www.cheniere.org .

energy states. The holes are treated as the positive electrons (as if observed). This vacuum energy medium is now referred to as the "Dirac Sea." First, Dirac attempted to identify these holes with protons, but that was falsified. Later the positron was experimentally discovered.

One of the problems with present conventional application of Dirac's theory is that the positron is not used in its *unobservable causal negative energy 4-electron state* by modern theorists and experimentalists, but *after observation* where its direction has been reversed, its charge has been reversed, time has been stripped away, and the mass has become positive. So it is actually used as a positive energy entity having positive mass, and producing positive energy EM fields and positive gravity. This defeats the entire magic of the causal (unobserved) 4-positron as the electron carrier of negative mass and negative energy *{convergent* electromagnetic energy) in currents in the vacuum (spacetime) itself, rather than the electron carrier of positive mass and positive energy in ordinary 3-space. By replacing the unobserved (causal) vacuum 4-positron (negative energy electron) with the observed (effect) 3-positron with positive mass and positive energy, the entire vast area of negative energy EM fields — and thus direct antigravity via electromagnetic means — is discarded.[153] But the physicists avoided having to grapple with practical negative mass and practical negative energy (cool mass and cool energy). It also set back the pace of physics in discovering and engineering antigravity transportation for nearly three quarters of a century.

It appears that Gray's thinking about cold energy was more prosaic than the somewhat esoteric considerations of the Dirac Sea theory. Conventional electrical engineering circuit theory considers positive charges moving around a circuit (although some electronics technical circuits required thinking in terms of electron current). Hence the "high" side of the standard circuit was the positive polarity, or the positive pole of the terminals of a generator or battery. From this "positive pole", positive current was sent around the external circuit to the ground return line by the forward emf (forward voltage). However, forcibly returning to the positive pole from the ground return line (i.e., from the negative pole) were those

[153] When the huge nondiverged Heaviside energy flow component is appreciably of "convergent" or of negative EM energy rather than positive EM energy, the antigravitational aspects are substantive and observable (and practical). The unaccounted Heaviside negative energy flow component is often a trillion or more times as great as the accounted Poynting negative energy flow component. Hence an**tigravity** technology is possible and practical, as we present in a later chapter.

same positive charges, being forced back up by the back emf and requiring expenditure of half the external circuit's collected Poynting energy.

So to Gray, the positive pole had two currents, one useful and one usually detrimental. The positive pole had (i) outgoing positive emf current powering the external circuit's loads and losses, doing the beneficial work (dissipating energy) in the external circuit with its load, and (ii) incoming positive current being forced back up against the back emf, doing the harmful work against the back emf and using up half the energy previously collected out there in the external circuit. Gray was aware that the work against the back emf was equal to the work done by the forward emf. So he set out to split these two currents apart, and catch the incoming current against the back emf separately, then use that normally wasted or oppositional energy to further power loads and/or recharge the batteries powering the system. Something like this was the way he was thinking.

That is what Gray called "splitting the positive pole". He also reasoned (and found) that the "reverse current" must be cooling instead of heating, since it moves against the voltage and acts backwards from regular current dissipated in resistors, etc. This precisely matches the cold (negative) energy phenomena met in the Sweet vacuum triode amplifier and in the motionless electromagnetic generator, as well as other COP>1.0 electrical systems.

Gray's later demonstrations showed that he had recognized this process or something very similar to it, in his "splitting the positive pole".

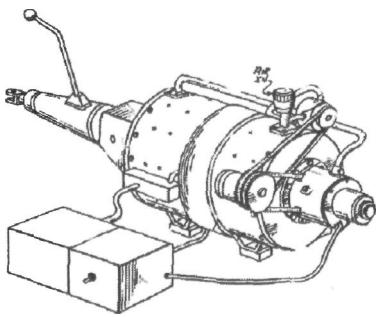

5-14 a The Gray engine

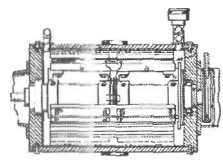

5-14 b Cross section view

US Patent No 3,890,548
issued 17 June 1975

Figure 5-14 Gray's "splitting the positive" COP>1 0 engine.

To take advantage of his concept and principles, Gray developed a special engine shown in Figure 5-14. In 1975 Gray received a patent on this engine {337} along with his special means of battery powering and special switching circuits.

Gray's engine uses pulsed capacitive discharge to power a magnetic motor, with recharging of the powering capacitors taking place *between* successive discharge positions of rotor and stator. The motor runs by initiating repulsion rather than attraction, which — apparently without Gray recognizing it in such terms — invokes the notion of the "superpole" pioneered by Bedini. The superpole is an important concept in COP>1.0 research, though most researchers in the field have never heard of it. John Bedini conceived it several decades ago and demonstrated the surprising difference between a superpole and a common pole of double strength.

When two equal and like magnetic poles are facing each other in repulsion with a small gap between them, a net stress magnetic potential (pole) is formed in that gap which has an energy density some four times as strong as the normal field energy density in the field from one of the two opposing like poles. Hence the local energy density of the vacuum in the gap has been substantially increased above the energy density in the field region between a north and a south pole facing each other. Further, this energy density is in a "field-free" Lorentz-regauged form, i.e., a stress potential form. From that superpotential *outward*, there exists a normal magnetic field. But in it, there is no net magnetic field, but there is a "stress" field nonetheless.

Compared to an ordinary magnetic motor using attraction as well as some repulsion, the exclusive use by Gray of the Bedini "superpole" principle caused an extra *symmetrical* regauging[154] of the local vacuum energy input to the system (to the gap between the poles) as the magnetic superpole

[154] Every conventional electrodynamics text already assumes and uses the Lorenz-**Lorentz** symmetrical regauging as being absolutely free. Symmetrical regauging assumes that the energy of the system has been freely changed twice, but in such a way that the two free fields formed are equal and opposite, forming a stress potential. Gray found how to split apart and separately use these two "free-flowing exc**hanges** of energy between system and active vacuum" that comprise the overall stress potential of the system, and thereby violated the Lorenz-Lorentz symmetry condition, freeing the two equal and opposite EM fields and their free energy to be used individually and beneficially to (i) provide extra power to the load and (ii) recharge the powering batteries so they did not run down. Using a different method. **Bedini** has done likewise.

(stress magnetic scalar potential). However, this stress potential is comprised of bidirectional longitudinal wavepairs, as shown by Whittaker in 1903. This superpole or stress potential thus can and does "split" into two different fields in antiparallel directions from each other. Since the north pole is deemed "positive" in magnetics, then using the two anti-fields comprising the free positive superpole is indeed "splitting the positive pole". Gray coined a very apt phrase for what he was doing.

Each of those antiparallel fields also involves an associated and unaccounted phase conjugate field {338a-c}, hence it is a time-reversed field (after observation). So opposing time-polarized EM waves also accompany Whittaker's decomposition waves. In short, the scalar potential accomplishes *optical-type pumping* in the time domain, and can be used to demonstrate time-reversal (as in Becker's bone-healing method).

Before observation (interaction with charged mass) and while still in the causal state, *the EM field from the positive pole is actually an EM field from a negative energy 4-electron, and the field can be taken to be a negative energy field!* In our view, positive energy enters every point dipole in the polarized vacuum at the negative charge, thence to the positive charge, thence back to the time domain. From the positive charge, the positive energy is leaving 3-space back to the time domain. Hence positive EM energy diverges from the negative charge and converges on the positive charge, then "disappears", so to speak, back to the time domain from whence it came. The "disappearance" of positive (divergent) energy is the disappearance of heat energy; hence it is a cooling process rather than a heating process. Or said another way, *negative* EM energy enters 3-space at each point dipole, entering from the time domain to the positive charge. Thence it moves to the negative charge, and back to the time domain. We see or detect the positive energy flow in 3-space directly, while the negative energy flow in the Dirac vacuum is evidenced by the "backwards" interaction creating Newton's third law reaction force.

By splitting the positive superpole, one has effectively destroyed the Lorentz symmetry condition. Hence the excess energy in the superpole will be capable of performing real work in the system in two directions. One direction is from the system to the external environment so that it produces the dissipation of energy (therefore work) in the loads and losses. The other direction produces a "negative resistor" or negentropic action that adds that much excess usable energy to the system back into its input section. By adroitly intercepting and switching that energy into capacitors and/or batteries, Gray was able to charge capacitors, recharge batteries,

and even power loads with cool energy (as demonstrated later by immersing a lighted electrical line and a lit light bulb in water).

A positive-energy resistor becomes a negative resistor when fed with negative energy. Then it converges positive EM energy from the external environment and outputs it into the circuit in which the resistor is connected. Note that this is the same statement as the resistor receiving (extracting) negative energy from the circuit and emitting it back to the time-domain. *That's like extracting back emffrom the circuit and tossing it offto the time domain.* A conductor to positive energy flow is an insulator or dielectric to negative energy flow. Hence the normally "conductive" water was a neat insulator for Gray's "dunking" demonstration of negative power, as were his own normally conductive hand and body. To negative energy, a coil seems to produce capacitance rather than inductance, while a capacitor seems to produce inductance rather than capacitance.

Thus when the "positive pole is **split"** in the system, the system has broken **its** Lorentz regauging and is an open system in disequilibrium with the external vacuum environment, freely receiving excess energy from it.[155] With adroit switching and energy capture, such a system is permitted to exhibit COP>1.0 because it has violated the free Lorentz regauging once the excess energy in the superpole region is discharged and used.

[155] When one analyzes the supersystem of any Lorentz-regauged EM system, one realizes that the extra stress potential energy — entering the system and "locked up" as a stress potential due to the Lorentz condition — is actually a special relativistic **rotation** of the frame of the power unit away from the laboratory frame. That is, the system when rotated away from the lab frame, takes on free symmetrical regauging energy in that rotated frame as an excess stress potential. Gray's "splitting the positive" process simply separated the two appositive fields comprising the stress potential, then produced excess free energy from that *broken* free regauging Lorentz condition. Literally Gray splits Lorentz's stress potential into halves, the halves being its two opposing EM fields and their energy. This is equivalent to the system being rotated back into the lab frame, releasing its excess energy it possessed in the rotated frame back into the lab frame. Richard "Scott" McKie has also filed a patent on an invention deliberately rotating a capacitor's frame and fully charging it — while it is in its rotated frame. The rotated capacitor can be charged with less energy furnished from the lab frame, than is obtained back out of the capacitor in the lab frame when the charged capacitor is suddenly rotated back and discharged. At least in **theory,** McKie's overunity process should be workable if the switching costs are negligible. Our contribution to McKie was to advance the theoretical mechanism for **the** experimental mechanism he had discovered and was using.

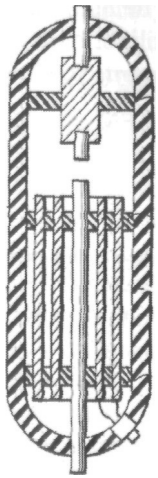

From US Patent No **4** 661747
issued 28 April 1987

Also in U S Patent No 4595,975
issued June 17,1986

Figure 5-1S Gray's conversion tube used with power systems,

Gray also utilized a special conversion discharge tube, shown in Figure 5-15. This tube uses the fact that a very sharp pulsed discharge in it results in a temporary COP»1.0 condition. This COP»1.0 condition instantly involves causal Dirac sea 4-positrons, moving as negative mass current and negative energy current in the local vacuum, which sweep back from the output side of the discharge to the input side.

We also point out the severe overpotential that must accompany any such violent pulse discharge process. The overpotential is a departure from equilibrium conditions, and is the difference between the actual potential and the equilibrium potential. The overpotential is well known and utilized extensively in electrochemistry {339a-c}, but is little used in conventional circuit theory. Nonetheless, it is involved in cold fusion processes due to the double layer phenomena {340a-b}, and it is involved in all electrode discharges (as from a cathode to an anode). It is also involved widely in electrochemistry and ion processes in solution.

Figure 5-16 shows Gray's circuit containing his conversion tube. Figure 5-17 shows Bedini's successful replication of the Gray conversion tube. Figures 5-18, 5-19, 5-20, and 5-21 show four pertinent pages from Bedini's laboratory notebook on his replication of the Gray conversion tube and the Gray motor system.

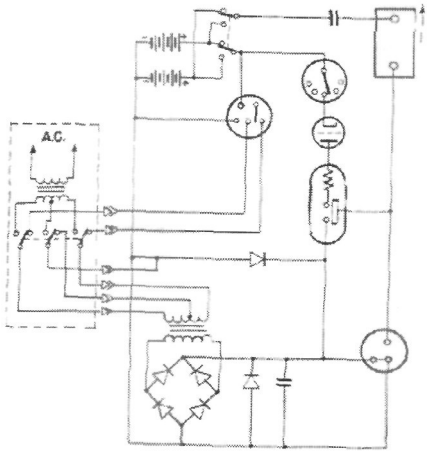

From U S Patent No 4 661 747
issued 28 April 1987

Also in US Patent No 4 595 975
issued June 17, 1986

Figure 5-16 Gray's circuit containing his conversion tube.

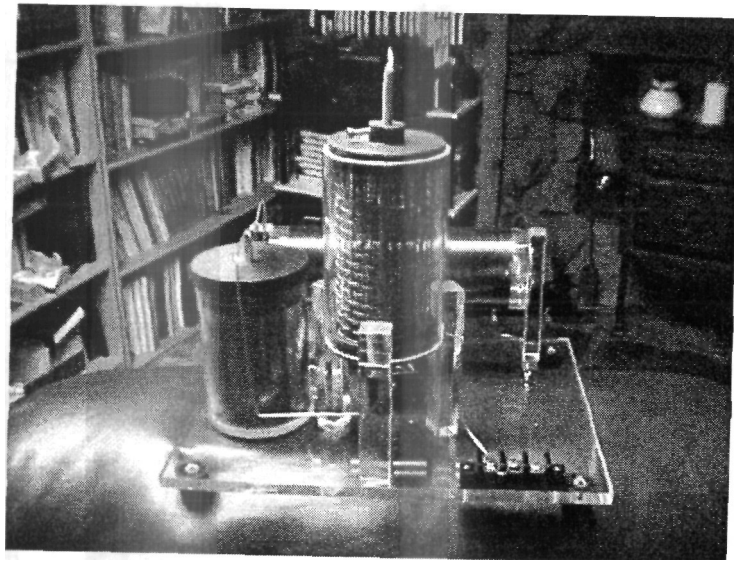

Figure 5-17 Bedini's successful replication of the Gray conversion tube.

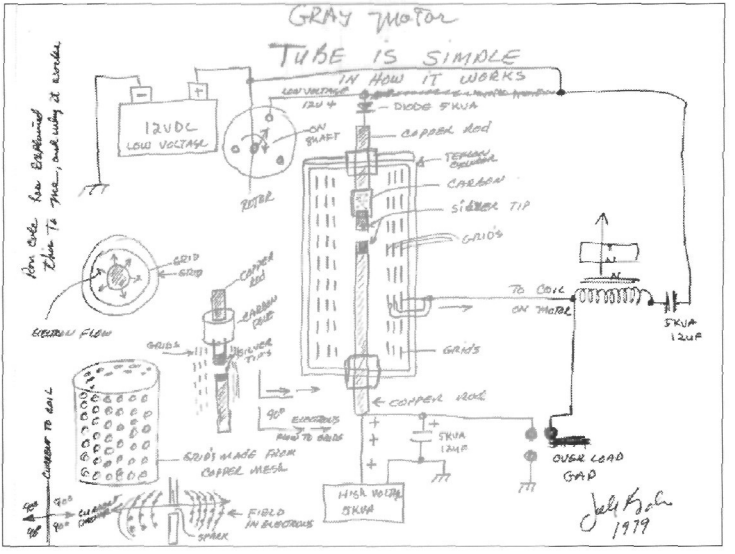

Figure 5-18 Page 1 from Bellini's lab notebook on the Gray conversion tube.

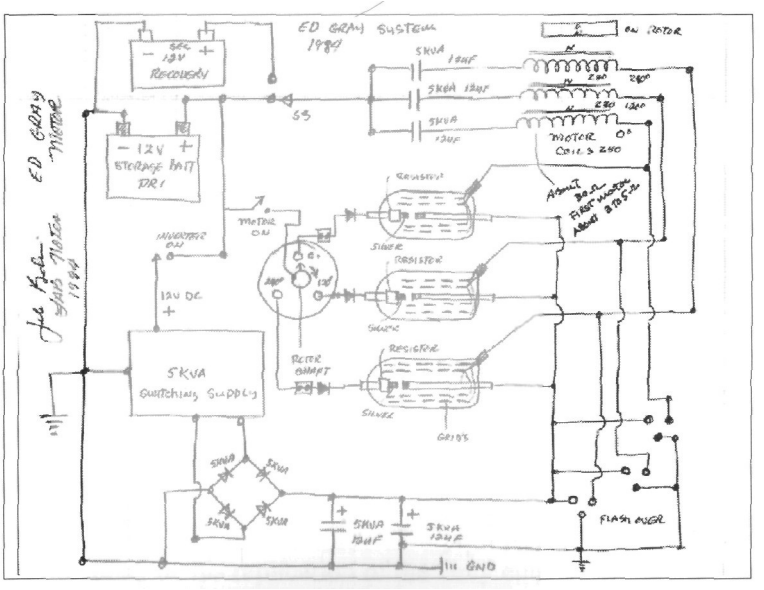

Figure 5-19 Page 2 from Bedlnl's lab notebook on the Gray conversion tube.

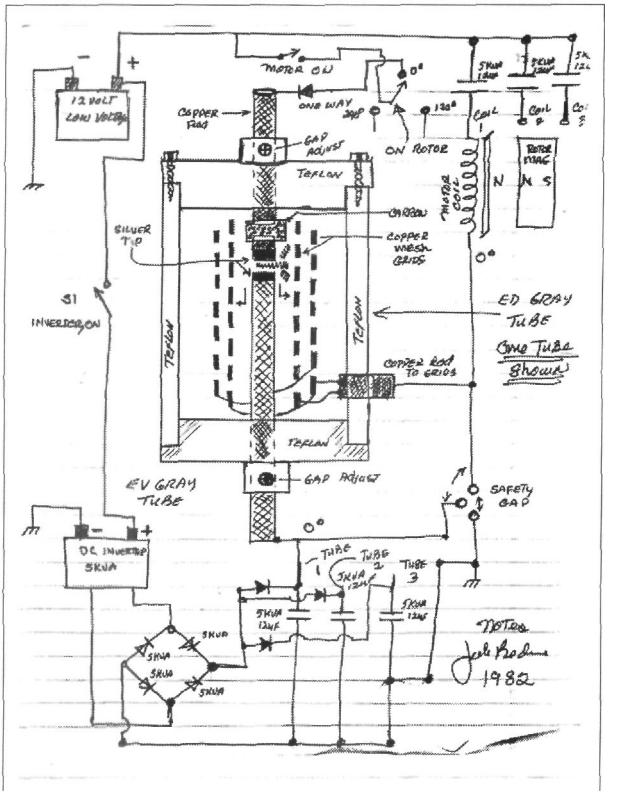

Figure 5-20 Page 3 from Bedini's lab notebook on the Gray conversion tube.

In science, when a novel experiment is replicated independently, that experiment then is established as a scientific fact. It then becomes the task of the theorists to either change the theory to accommodate the experimental results, or come up with a new theory to explain them. With Bedini's successful replication of Gray's work and extension of it, that work has now been scientifically established. With his "splitting the positive pole", Gray was referring to an actual, useful mechanism he evoked and used in the processes ongoing in his motor, in his conversion tube, and in his power system.

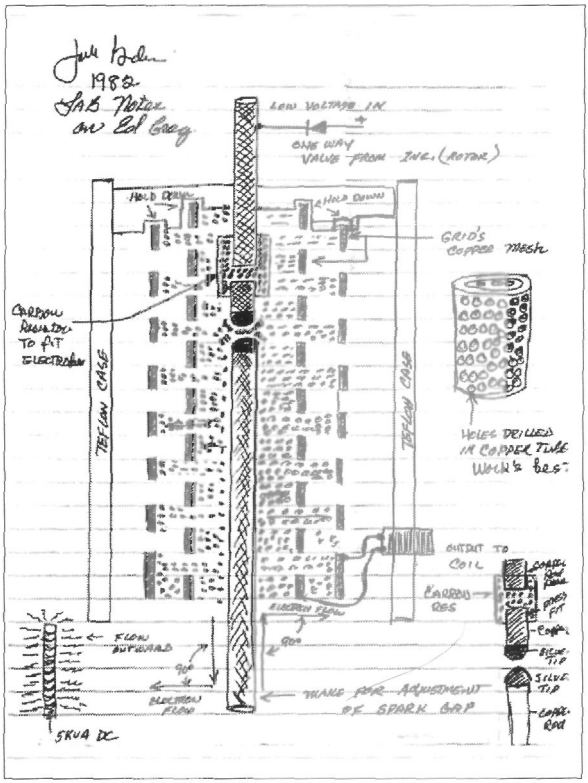

Figure 5-21 Page 4 from Bedini's lab notebook on the Gray conversion tube.

For further discussions about the Gray motor, conversion tube, and the history of it all, one is referred to the book by Lindemann {341}.

5.8.9 Watson's Self-Powering Generator

See Figure 5-22. In 1984, Jim Watson demonstrated a self-powering 8-kilowatt generator at the International Tesla Conference in Colorado Springs. This generator was a modified extension of smaller motors and generators built by Bedini over a period of years. At the conference, engineers from the audience were invited to the platform to perform their own independent measurements of the unit, while it was running and powering its load. The engineers directly confirmed that the system was delivering power to the load (as could be seen visually also), and that it was recharging its batteries as well.

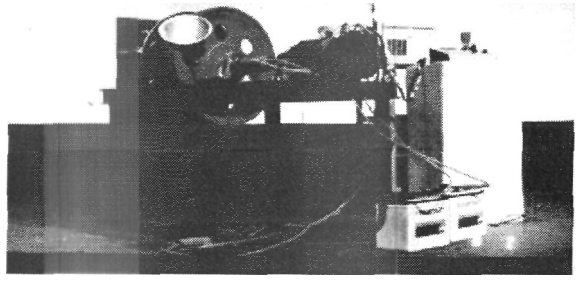

Figure 5-22 Watson's self-powered 8 kW generator demonstrated in 1984.

Interestingly, one of Watson's batteries was stolen that night. The reason was obvious. First, at the conference there was present one of the major persons charged with suppression of COP>1.0 electrical power systems world wide, along with several of his henchmen. Since they have been involved in suppressing many dozens of similar COP>1.0 systems, they are thoroughly familiar with both the theory of COP>1.0 electrical power systems and the various types of devices and mechanisms that have been invented in that area over the past century.

One feature of Watson's unit was that it charged the batteries with negative energy (i.e., with Dirac sea hole current, or "cold energy" as sometimes referred to), and could use negative energy for powering the unit. Hence, his batteries became charged with negative energy as the machine ran and powered its loads. After much demonstration and running, such a negatively charged battery has its local curved vacuum charged with an appreciable number of unfilled Dirac holes. Such a negatively charged "battery supersystem" will then absorb positive energy charging (electron current charging) for a protracted period before it will start to change its voltage and accept the positive charge. Instead, during that protracted initial period the battery will just "eat electron currents and positive energy" from the battery charger, with no apparent effect and no change in Its discharged state or its voltage.

A very simple way to absolutely ascertain whether or not a unit such as Watson's (without a Bedini negative energy converter) is genuine, is to simply take one of his batteries from a unit that has been running quite a bit, and recharge it on a conventional battery charger. If it exhibits that two-phased recharge phenomenon, it proves that the unit is real and is

indeed a true COP>1.0 device, or certainly has the potential to be one. Coupled with the demonstration and independent measurements, this removed all doubts about the validity of Watson's COP>1.0 system.

So it appears that certain parties who were concerned about that system decided to do the "simple test" to see if Watson's device was real. It was real, and so they discovered. At that point, the High Cabal — Winston Churchill's term — recognized they had another successful unit and inventor to suppress.

Bedini and I were in close contact with Watson over a period of years, as often as three or more times a week. Later, some time after that conference, abruptly Jim ceased all communication with his former close colleagues. For two days a rather crazy recording **was** on his phone, stating the Watsons had moved. Then that disappeared. Watson never again contacted either Bedini or me, or his own financial backer (the late R. J. Reynolds III). Even Reynolds could not find Watson's whereabouts at that time.

We are quite certain that Watson received the "offer he could not refuse". Simply put, this is the old Mafia trick of visiting the target, offering him a deal, and he has no choice but to accept or die. When this is used to suppress COP>1.0 systems, and some medical systems, the offer is usually: *"Accept the money and you and your family will live very comfortably, but you will never openly work on this again or communicate it. You either accept our generous offer, or you and your family will be dead when we leave here."* Assuming that happened Watson had no choice but to accept the several million dollars offered him.

He is still alive, because Jeane Manning physically ran into him at a conference — and recognized him and spoke to him — whereupon he withdrew abruptly and left the conference very hastily.

5.9 Suppression of Free Energy Systems Has Been Common

This is only one of many cases we know of where such suppression of overunity systems and inventors has been accomplished. Others are not so benign. Marinov was killed with a longitudinal EM wave shooter in Europe, and his body was thrown off a building to make it appear a suicide. The police allowed the body to lie on the pavement for a protracted time (it was emitting longitudinal EM waves from the time-charging action of the strike). When finally moved, the pavement glowed

in that area that had been underneath the body. Only one weapon on earth will kill a person in that manner, and that is a longitudinal EM wave "shooter".

Another prominent researcher was killed with a Venus technique (look it up, it's a distortion of the wave front) modified beam that plunges the heart into violent fibrillations. He rushed from a restaurant exclaiming, "They're killing me!" and died of a resulting heart attack. The present author was hit with just such a weapon in a restaurant here in Huntsville. A friend and I actually saw the weapon and the person wielding it. Knowing what it was and recognizing the symptoms, my seated companion and I were able to bolt out of the nearby back door during that minute or so we could still physically function. I personally saw the device and the person doing the beaming, and I have a witness to the event.

The partner of a colleague in Australia was killed on an upper floor by such a shooter from the street below, right through the walls. The assassin was observed, and was seen putting the bazooka-sized shooter back in his car, then speeding away. There are many other true incidents we could also relate, including a person killed by an ice-dart dipped in curare (a very professional hit method, used by some of the sinister arms of various intelligence systems). So there is more than just scientific work involved in pursuing COP>1.0 EM power systems. There can also be a direct threat to one's life, essentially at any time.

Almost any serious overunity researcher, who succeeds, will have had confrontations with assassination attempts, suppression attempts, threats, deliberate legal entanglements, etc. The present author is no exception. It is sad that one of the prerequisites for serious scientific work in this area is o**ften** a legal gun permit (for both the inventor and his wife) and either legally carrying a hidden weapon or never being very far from a weapon when working at home. As an old soldier, of course, one just shrugs and accepts it, and gets on with the job to the best of one's ability, albeit remaining very watchful and always on guard.

5.10 In Conclusion

In this chapter we have introduced many of the approaches to COP>1.0 EM systems or processes, or the possibility for such in some novel mechanisms known in science. Recalling our previously presented solution to the source charge problem, we emphasize to the reader that all assumed 3 - space EM processes are actually 4-space processes prior to observation, continually observed in iteratively frozen 3-snapshots by iteratively

invoking the *d/dt* operator that produces observation. Hence from the source charge (and source dipole) solution we realize that all EM energy in 3-space comes from the time-domain and returns to the time domain. It iteratively appears along the "line of propagation" in 3-space at each successive position, but does not continuously propagate in 3-space. It does continuously propagate in 4-space. Since all the EM energy in any EM circuit comes from the time domain via the broken symmetry of the source charges and source dipoles, then we need to apply this greater vision to the COP>1.0 mechanisms and approaches so that we see the 4-space to 3-space to 4-space interplays.

The notion of the negative resistor is particularly significant and direct in that respect, and we have presented several versions of true negative resistors. For those wishing to experiment, we would suggest the easiest thing to start with is the point contact transistor. Or, simply go to Naudin's website {313} and download his instructions for making a Chung-type negative resistor, build it, and do experiments with it by varying the pressure on the fibers etc.

Again, we have not presented "parts kits" with instructions, but we have presented things that have worked or can reasonably be expected to work with some effort. We have also discussed the principles involved, to the best of our ability. In a few cases, we have directed the reader to information on websites where building instructions for selected negative resistors and other devices are posted.

As in any other scientific endeavor, we also urge the interested reader to read the literature and check the references cited, or as many as possible. Increasing one's understanding of the area is necessary to increase one's probability of success in the area.

We also wish the reader good results and success in his or her research and experimenting. The energy crisis is not going to go away, and the demand for oil will double in the lifetime of many of our middle-aged or younger readers. The cheap oil peaks shortly and declines in availability forever thereafter {342}; this alone will drive up the price of oil and seriously impact the economies of the nations of the world. To keep from destroying the world economy and the biosphere, it is absolutely essential that COP>1.0 electrical power systems — including self-powering systems taking their input energy from the seething local vacuum — be developed to produce the necessary electrical energy needs of the world, cheaply, cleanly, and easily.

If one or more of the readers should succeed in developing and producing such systems, then the entire purpose of this book will have been fulfilled.

Chapter 6

Additional Approaches to Overunity Power Systems

"Can the quantum potential carry a signal? If it can, we will be led to a violation of the principles of Einstein's theory of relativity, because the instantaneous interaction implied by the quantum potential will lead to the possibility of a signal that is faster than light... a signal has in general to be a complex structure, consisting of many events that are ordered in definite ways. In terms of our language, each signal is a supersystem of events, while each event is in turn a system of subevents.... At present, the answer is, of course, not known. " [Bohm and Hiley] {343}. A comment:[156]

[156] We comment that the "event" involves observation: i.e.. it is conceived as an *observed* event. In that exact sense, no signal in space carries "events" because there is no interaction with mass and no *d/dt* operation induced on entities (curvatures) of spacetime. The effect (observed) 3-space field cannot propagate faster than light, because it cannot even propagate in the first place! The totality of light's EM interactions with matter is what makes the observed field or observed signal to appear to be propagated at light speed. It is not actually "propagating", but being iteratively recreated from point to point in space *if observed at every point.* Signal in spacetime is causal and hence nonobservable; the interaction of causal signal with charged mass is observable and makes an "event". When we clearly differentiate the nonobserved (causal) 4-field or dynamic from the iteratively observed 3-field or dynamic, then the *nonobserved 4-field* or dynamic is not limited to light speed. Propagation along the time axis, e.g., can be at "infinite velocity" because a single point in time is connected to every point in the universe simultaneously. Since all EM energy in space comes from the time domain locally at each point dipole in 3 - space and returns to the time domain from that same point dipole, it is the notion of "propagation continuously through 3-space" at *any* velocity that is a non sequitur. Absolutely nothing propagates through 3-space! If general relativity is re-interpreted **to account** the difference between observed and unobserved (effect and cause), then the unobserved cause can propagate superluminally without violation of the "observed event (effect) propagation at light speed" of general relativity. It is the notion that anything propagates in 3-space that is the non sequitur, and it should be removed from special and general relativity as well as electrodynamics.

"...contrary to the conclusions of classical mechanics, there exist effects of potentials on charged particles, even in the region where all the fields (and therefore the forces on the particles) vanish." [Aharonov and Bohm] {344}.

"...for any force varying as the inverse square of the distance, the potential of such force satisfies both Laplace's equation and also the wave equation, and can be analyzed into simple plane waves propagating with constant velocity. The sum of the waves, however, does not vary with time, i.e., they are standing waves. Therefore the force potential can be defined in terms of both standing waves, i.e., by a global, or non-local solution, and by propagating waves, i.e., by a local solution changing in time... Thus, Whittaker's mathematical statement related the inverse square law of force to the force potential defined in terms of both standing wave (i.e., global) and propagating wave (i.e., local) solutions. The analysis also showed that the electromagnetic force fields could be defined in terms of the derivatives of two scalar potentials." [Barrett] {345}.

*"What might appear to be empty space is, therefore, **a** seething ferment of virtual particles. A vacuum is not inert and featureless, but alive with throbbing en**ergy** and vitality. A 'real' particle such as an electron must always be viewed against this background of frenetic activity. When an electron moves through space, it it actually swimming in a sea of ghost particles of all varieties — virtual leptons, quarks, and messengers, entangled in a complex melee. The presence of the electron will distort this irreducible vacuum activity, and the distortion in turn reacts back on the electron. Even at rest, an electron is not at rest: it is being continually assaulted by all manner of other particles from the vacuum."* [Davies] {346}.

6.1 Introduction

In this chapter, we continue to present a selection of potential overunity systems, inventions, approaches, and selected mechanisms. We also make the reader aware **that quantum** mechanics, an entire branch of physics,

requires nonlocality and "instant propagation" in space. We utilize the quantum potential from Bohm's hidden variable theory of quantum mechanics {347} to impress the nonlocality. Further, the staid old scalar potential — which we meet as voltage in a circuit — also exhibits nonlocality and instant propagation in the Coulomb gauge {348}. Our purpose is to show that electrodynamics is not limited to the cut-and-dried subject as usually taught to electrical engineers and applied by them, but also covers a wide range of phenomenology that electrical engineers usually do not consider or account.

6.2 Energy Conversion and Energy Amplification

6.2.1 The Mead-Nachamkin Zero Point Energy Converter

It is well known that the vacuum interacts with electrical charges and dipoles, and also with the electrons in an atom. For example, Lamb received the 1955 Nobel Prize in physics jointly with Polykarp Kush for experiments measuring the small displacement later called the "Lamb shift" of 0+ne of the energy levels in atomic hydrogen {349}.

Casimir {350a} proved that closely separated conducting plates also alter the energy density of the vacuum, thereby becoming an "energy extracting" method, although the energy is miniscule. It is quite real, however, as shown in meticulous experimental work by Lamoreaux {351}. The principle that vacuum energy interacts with matter, plates, and electrical double layers and circuits is well proven experimentally.

In 1996 Mead and Nachamkin were granted a patent on an overunity EM power system process for extracting zero-point energy of the vacuum {352}. If one closely examines the patent wording, the device is properly patented as an energy converter and does not overtly state that it is a COP>1.0 system. It is a COP>1.0 system, however, since the input energy is freely received from the vacuum and not input by the operator himself. One embodiment of the invention inserts a tiny coil between the plates to extract the energy. See Figure 6-1. The energy is based on the Casimir effect {26}, which was accurately measured in 1997 by Lamoreaux {27} and since then by others.[157] Further investigation of the force's behavior with the shape of the conducting plates has been performed by Chen *et*

[157] See also U. Mohideen and A. Roy, "Precision measurement of the Casimir force from 0.1 to 0.9 microns," *Phys. Rev. Lett.*, Vol. 81, January 1998, p. 4549.

al.[158] Numerous other papers of interest on the Casimir effect have also been published {353a-d}.

Because energy cannot be created or destroyed, any COP>1.0 system is an *energy converter*, a priori. It must receive the excess energy from the environment (in this case, from the curvature of spacetime and from the local active vacuum) and convert that energy to a form usable to power or assist in powering the system loads and losses.

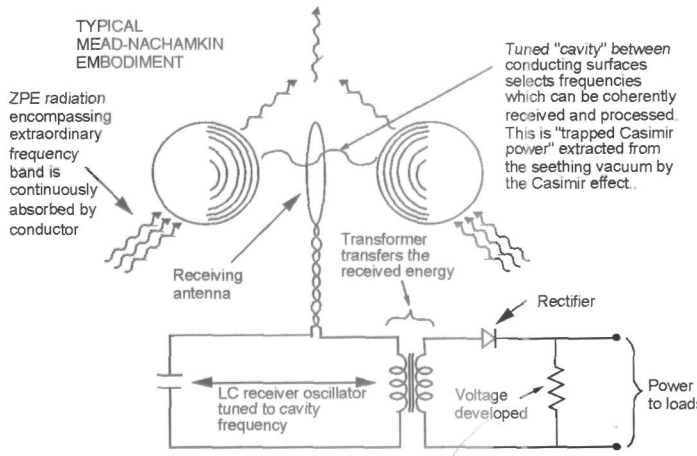

Figure 6-1 Mead-Nachamkin conducting surfaces, antenna, and receiver for extracting EM energy from the vacuum,

The Mead-Nachamkin patent is interesting because the physics of the device is proven and accepted. Getting sufficient power output to be useful for electrical power purposes, however, remains to be demonstrated, since the Casimir effect is very tiny.

6.2.2 **The Quantum Potential As an Energy Amplifier**

In Bohm's hidden variable theory of quantum mechanics {354}, an extra potential is added to the Schrodinger equation, and is known as a *quantum potential.* Figure 6-2 lists the novel characteristics of this potential, and

[158] F. Chen, U. Mohideen, (G. L. Klimchitskaya, and V. M. Mostepanenko, "Demonstration of the Lateral Casimir h'orce," *Phys. Rev. Lett,* (in press as of the time of this writing).

Quantum Potential Characteristics

- No point source; not radiated
- Just appears instantly
- Quantum potential between two particles
  - Interaction does not vanish as spatial separation becomes very large
  - Instantaneous connection
- Depends on quantum state of system as a whole
- System parts can be greatly separated

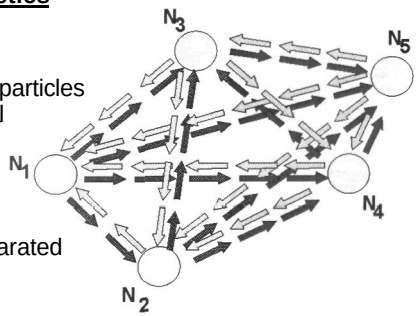

Figure 6-2 Quantum potential characteristics (table).

Figure 6-3 lists technical features of Bohm's hidden variable theory from whence the quantum potential is taken {355}. It can "move instantaneously", at "infinite velocity", which means it just suddenly appears everywhere it will be, and does not "propagate at a finite speed" through singly connected space at all {356}.

$$V_{quantum} = \frac{h}{2m}\frac{\nabla^2\sqrt{\rho}}{\sqrt{\rho}}$$

A quantum particle moves as if it were subject, in addition to its external potentials, to a potential which is a function of its own probability distribution.

Bohm's hidden variable theory assumes:

- **Particle and wave function real and separate**
- **Wave function obeys Shrodinger's equation**
- **Particle obeys classical mechanics**
- **Particle couples to wave function through a quantum potential**

Figure 6-3 Technical features of Bonn's hidden variable theory.

The potential is after all *potential energy.* With the quantum potential (QP), a joule of energy placed upon one collector, where that collector is connected via a QP with one or more distant collectors, will also result in a joule of energy (or some fraction thereof) instantly emerging upon and in each of those distant participating (QP-connected) stations simultaneously. It appears that, if only a fractional participation — say, 0.50 — exists with one or more of the distant stations, each of those stations will experience the appearance of that fraction (in this case, 0.5 joule) of the energy input to the initiating station. Any station can input energy, and it will

appropriately appear at every other participating station, regardless of where these stations are located in ordinary 3-space as seen by the external observer.

One way of expressing this "instantaneous QP connection" between separated objects is to model the different objects (or stations) as linked together in a multiply connected space, with a certain QP connection or collection fraction. Presence of energy at one station in the multiply connected group, results in the simultaneous appearance of the energy — or an appropriate fraction of it — at every other station in the group.

To understand multiply connected space, consider a single point on a plane. Now consider 999 more points superposed on/in that same point. But suppose that those thousand points are really located at different locations in 3-space, though superposed in this "crazy space" containing a plane where all of them are superposed at one point.

As the ordinary external observer, suppose you input a joule of energy into one of these — to you — separated points, which happens to be the original point and is located in your laboratory. Supposed the fractional connection is 1.0 (the connection is perfect in multiply connected space). Voila! Instantaneously one joule of energy appears at each and every one of those (to you) widely separated points. If you vary your input energy (e.g., as in communication), it varies precisely the same in each of those distant QP-connected points.

Those who continue to advocate that superluminal communication of information is impossible are ignoring present experimental proof that it does occur. As a single example (there are others), it has been shown by Enders and Nimtz {357} that Mozart's 40th symphony can be transmitted as frequency modulated microwaves through a barrier wave guide between two points in a waveguide, via quantum tunneling, at 4.7 times the speed of light c. We point out that this is achieved using *transverse* EM waves.

If *longitudinal* EM waves are used together with longitudinal modulation (which engineers might think of as a sort of "pulse compression" technique), the only limitation to the speed of communication is given by the impurity of the longitudinal EM wave one is able to make. The Fogal semiconductor, e.g., can be used to transduce ordinary transverse EM wave signals into longitudinal EM wave modulations inside a scalar potential. Hence that scalar potential can move in the Coulomb gauge at infinite velocity. It requires another Fogal semiconductor circuit on the receiving end to receive and transduce the longitudinal EM waves and their longitudinal modulations back into transverse EM waves for processing

and amplification by normal means. This capability of the Fogal semiconductor circuits has been demonstrated through satellite uplinks and downlinks coupled with long transmission line links, with essentially no delay from transmission to reception. One may think of the Fogal superluminal process as *tunneling through subspace.*

The best way to vary the energy is apparently by use of a variable stress potential (which translates to a longitudinal variation or modulation). In short, one must modulate the "internal energy" of the vacuum, so to speak, and not the "external energy". A reasonable discussion of internal energy versus external energy is given by Chen {358}. If one longitudinally modulates the internal energy of the vacuum potential — which, being a scalar potential, decomposes by the Whittaker decomposition {359} — then superluminal communication is not only possible but also practical. We expect Fogal to eventually place just such a system on the market, shortly after his semiconductors get into precision production.

One possible method of producing modulated internal stress potentials is by use of a Davis noninductive resistor {360}. Another is by use of a biwound coil with two windings, so that the two currents through two equal "superposed" coils are equal and opposite. We point out that, while there has been published much stuff and nonsense about such biwound coils, the truth is quite mundane. Simply examine the Lorentz symmetrical regauging applied to the Maxwell-Heaviside equations. It is the deliberate production of two equal and opposite force fields, which is in fact the creation of a stress potential and extra stress energy. By varying the magnitude of the Lorentz forces comprising the stress potential, the stress potential is varied in amplitude. Hence the concomitant longitudinal EM waves are varied in amplitude. A biwound coil is a variable Lorentz-regauging coil, *a priori.*

By oscillating the magnitude of any Lorentz regauging (which in the simplest case is simultaneously changing both opposing fields equally and oppositely), one can make longitudinal EM waves. By appropriately modulating both Lorentz regauging components, one can make longitudinal EM modulations upon those concomitant longitudinal EM wave carriers.

So with some careful tuning and adjustment, and a little nonlinear material in the core,[159] one should be able to have the superposed appositive

[159] The opposing waves must modulate (multiply), not mix (add), and modulation is a nonlinear process. Linear mixing of opposite waves or fields will not cause the

magnetic fields lock together *(modulate,* rather than linearly *add)* and produce a magnetostatic scalar potential stress signal in and from a nonlinear core material. We caution, however, that the biological effects of the radiation of such stress potentials internal to spacetime have not been investigated. The experimenter is cautioned that he experiments at his own risk, and he is cautioned to experiment only at low power levels until the phenomenology in a particular case is understood.

If we compare the stress potential oscillation (wave) to a sound wave, the similarities suggest that the stress potential oscillation can be treated as a longitudinal EM wave, if the two superposed opposing EM waves "lock together". Simple addition is insufficient; modulation is necessary. Hence the nonlinearity of the conductors and core material is of significance.

For instantaneously propagating potentials and pure longitudinal EM waves, any conceived difference between the two becomes somewhat academic. The characteristic of interest is the instant appearance of the input energy at multiple points via a multiply connected space.

To the ordinary observer, use of a quantum potential and multiply connected space measurably yields a fantastic *energy amplifier.* One furnishes one joule, and gets out — say — 1,000 joules in those distant locations altogether. As shown in Figure 6-4, the QP system is a communication system of enormous implications, particularly as humans travel into space across the solar system and even beyond. Unfortunately, by using appreciable power in the initiating station, the QP system also leads to weapon systems of incredible destructive capabilities. Some five nations {361} now possess such quantum potential weapons, which are the dominant weapons on Earth. We do not further discuss the quantum potential weapons aspects in this book.

Back to our little energy exercise, inputting one joule and getting out some 1,000 joules. Suppose these 1,000 participating points are not distant at all, but are gathered closely together into a local material but still QP-connected with a connection fraction of 1.0. Now we input a joule of energy to that device, and it develops and outputs one kilojoule. It is hypothesized that this becomes the ultimate negative resistor. It will also exhibit separated Dirac hole current phenomena as the COP increases and, if sufficient COP is developed, it will exhibit antigravity effects such as

fields to "lock together" into a common stress potential. Nonlinear mixing (modulation) will. Hence the nonlinear core is required for conversion of appositive fields to stress potentials and L**orentz** regauging.

those shown by the Sweet vacuum triode amplifier discussed in this chapter.

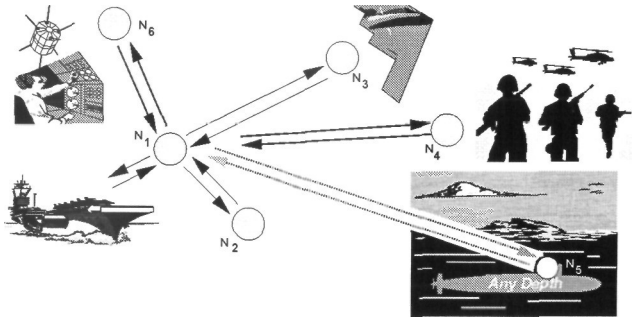

- Quantum potential decomposes per Whittaker 1903 into bidirectional longitudinal EM waves
- Can insert additional longitudinal waves, thus information using a Fogal semiconductor
- Can receive "signal" and discriminate the information using a Fogal semiconductor

Figure 6-4 Quantum potential communication system.

Strangely, overall conservation of energy is not violated by the quantum potential COP>1.0 energy system. It's just that the energy now is furnished from space (from the vacuum) in a *multiply connected* manner. However, all the excess energy is still furnished by the active external environment - i.e., from the time domain, according to the giant negentropy process {12} — though that environment now is quite novel and multiply connected. So we still have a system analogous to a windmill, though *a very novel windmill and a very novel wind indeed.*

Without belaboring the point, action-at-a-distance is absolutely required in quantum mechanics. Further, photon correlation experiments have long demonstrated experimentally that such action-at-a-distance effects do exist, just as predicted. This was a refutation to Einstein's objection to quantum mechanics' "spooky action at a distance".

We point out without further comment that, if a self-powered process is Invoked in the initiating station, then all other participating stations also contain that self-powered process. However, note that one does not really wish to "invoke" a quantum potential connection and use it except occasionally and very quickly! Otherwise, if a strong QP is turned on and **left** on among many distant stations, anything and everything happening to

each one of them can instantly appear in all of them, so long as the "constant of connectivity" remains a constant or nearly so.[160] For that reason, strong quantum potential connections can be self-destroying and strong effects do not seem to normally appear in the physical world.[161] The proper energy use of a quantum potential is thus to use it only for fleeting "inductions" of effects in the desired stations, in *momentarily* multiply connected spacetime, at least until the self-limiting behavior is ascertained.

Apparently, a quantum potential can sometimes be formed in the limit of an iterative, mutually phase conjugating operation of EM signals passed back and forth between two phase conjugate mirrors, or among many of them. Such iterative mutual phase conjugate reflection of signals — particularly pumped signals — is technically known as iterative *self-targeting.* Sometimes we use a more picturesque term, *ping-pong,* for iterative self-targeting.

Conceivably, strongly coupled, strongly pumped optical self-targeting mirrors can — in the extreme limit — initiate or partially initiate a quantum potential. The superposing beams of energy may be thought of as first narrowing to laser-like beams, then gradually subsiding into pure longitudinal waves with transverse components "canceled" to form simply "stress energy". In short, if this reaction occurs, the energy is transformed into a stress energy potential, which acts either as a scalar potential in the Coulomb gauge or as Bohm's quantum potential. In our view, the pure longitudinal wave has infinite velocity, as pointed out by Rodrigues and Lu {93a}, so Lorentz-Fitzgerald contraction results in "zero-separation distance", which in turn results in a multiply-connected spacetime.

One points out that the "input energy" to the initiating station may be deliberately structured internally, including altering the internal Whittaker longitudinal EM wave functions comprising the input electrical field

[160] Fortunately, it appears that this connectivity constant is not really constant, but reduces as the feedback of each station's fluctuations to the other stations increases. The result seems to be a "leveling off process reaching a plateau and a fixed amount of gain in the overall system. In short, the system usually seems to be "self-adjusting" and "self-limiting" as the overall gain increases. Nature is riddled with quantum potentials, but this self-limiting process keeps most so tiny that they are not even noticeable.

[161] However, the validity or invalidity of this statement for some of the highly energetic phenomena of astronomy remains to be determined. It also remains to be determined as far as the quantum potential's role in generating the zero point energy fluctuations of the active vacuum.

energy. In this manner, in theory deliberate spacetime curvature sets and dynamics can be introduced into the distant but multiply connected targets. A form of highly advanced electro-biological warfare induction of disease has been developed by at least one nation (Russia) in this regard, as an extension of Kaznacheyev's experiments showing induction of cellular disease at a distance. It appears that the cells of a living body are interconnected by a very weak quantum potential in such manner. Again, a great deal more research on that possibility is needed.

Given a quantum potential connection between separated objects including our initiating station, one can also add vacuum *engines* (energy structuring of curvatures of spacetime itself) as our input to the initiating node. Those vacuum engines will then simultaneously appear unabated (or only partially abated) in the multiply connected separated objects. In this way, in theory one can use the QP and QP energy to perform highly anomalous *momentary* engineering of nuclides, materials, fields, etc. in widely separated, distant objects and areas. By repeating the momentary engineering "pulses", distant objects and areas can be profoundly altered.

The use of vacuum engines in medical applications is of particular future interest.[162] Very radical extension of those techniques can be achieved once quantum potential technology is developed and available in the open scientific community.

But let us ignore the weapons, free our scientific imagination, and let it roam. As an example, in the future a vacuum engine (spacetime curvature engine) might be developed and utilized in a world-wide quantum potential to *momentarily* strike and eradicate all AIDS viruses on Earth, and do only that. Or, the engine could be slanted to simply *momentarily* slightly change

[162] See Vlail Kaznacheyev and L. P. Mikhailova, *Ultraweak Radiation in Intercellular Interactions,* [in Russian], Novosibirsk, 1981; Vlail Kaznacheyev *et al.,* "Distant intercellular interactions in a system of two tissue cultures," P*sychoenergetic Systems,* 1(3), Mar. 1976, p. 141-142; Vlail Kaznacheyev, "Apparent information transfer between two groups of cells," *Psychoenergetic Systems,* 1(1), Dec. 1974, p. 37. Unfortunately this QP induction of cellular disease has already been used by the former Soviet Union to develop a QP extension of the **force**-free structured potentials method first used to induce cellular disease and **health** changes in U.S. personnel in the former U.S. Embassy in Moscow for several decades. Now QP weapons using such techniques can target the entire population of a targeted nation. Using the internal Whittaker structuring of quantum potentials and EM fields and waves, *electromagnetic biological warfare* has already been born and highly developed. The actual dimensions of possible biological warfare strikes are far greater than has been mentioned in the open literature.

those viruses into an innocuous kind of new virus. The cells of the individual human body are already connected, it appears, by a very weak quantum potential. By connecting an external initiating station to that body's quantum potential, the energy of the body could be directly scanned, all abnormalities noted, and tailored engines created and *momentarily* used to treat the body and correct its abnormalities and malconditions. This, we believe, may well be a medical therapy of the future, a few generations from now. [163]

6.3 Other Systems of Electrical Interest

6.3.1 Russian Parametric Oscillator Power Systems

In leading physics institutes and laboratories in the 1930s, Russian scientists built COP>1.0 parametric oscillators, including some of appreciable size. The work is documented in the literature {362a-k}, both in Russia and in France. The devices were developed and tested in several Russian laboratories. With linear loads, the oscillators would progressively build to self-destruction. With nonlinear loads, the devices would stabilize and power themselves and their loads, at a level depending on conditions — reminiscent of the behavior shown in Figure 4-3 in Chapter 4 for stability COP>1.0 levels for the asymmetrical self-regauging process.

Standard references for parametric oscillation in EM circuits are available. However, with standard practices none of these conventional oscillators produces COP>1.0, primarily because the conventional closed current loop circuit is applied without special modifications. For overunity work, the

[163] Apparently, tests of such QP capabilities in weaponry have been gingerly conducted for direct induction of disease patterns in the population of a targeted nation or area. One symptom of such a test is that a very small number of widely isolated cases of the same disease breaks out simultaneously, in isolated cases scattered widely and puzzlingly throughout the population, *without the possibility of any direct carrier vector connection.* Apparently, the test inductions have deliberately been held mostly to the "shadow state" (or upper virtual state, just below observable state) in most of the targeted populace, to prevent giving away the tests. However, the human immune system and cellular regenerative system do respond to such "near-observable-state" signals and engines, when sustained or repeated in time, by a sort of coherent addition (integration) over time. The bell-shaped distribution curve predicts that a few individuals, randomly scattered throughout the populace, will have quite lower induction thresholds and will evidence the actual disease after a certain time, whereas in almost all the other members of that population the "disease" will never evidence in the observable state during that time. The test is deliberately terminated when only a few observable cases occur, which are sufficient to prove the efficacy of the test and the method.

Russian and French literature (as we referenced) should be meticulously studied and analyzed in a higher group symmetry electrodynamics, to see how the Lorentz condition is broken during discharge of circuit excitation energy in the load, and how the COP>1.0 Dirac hole current decay mechanism is avoided or contained.

The Russian COP>1.0 parametric oscillation work appears to have been suppressed by the Communist regime just prior to WW II. After the war, all such technology passed under the rigid control of the KGB (by whatever name it took and takes from time to time) and into the special weapons research and development area — still highly classified in Russia. We know of no similar work presently ongoing in the West, although at least an English translation of one of the major summary documents of the Russian parametric oscillation COP>1.0 power system developments was performed under NASA auspices {363}. However, in conventional U.S. parametric oscillation research, I know of no case where COP>1.0 operation is being sought, or where the Dirac sea hole current decay mechanism is even mentioned or recognized {364}.

6.3.2 Sweet Vacuum Triode Amplifier

During the 1980s and 1990s, the present author worked —sometimes closely for extended intervals — with inventor Floyd Sweet, the inventor of the Sweet vacuum triode amplifier (VTA). Indeed, we gave the unit its VTA name, at Sweet's request.

Fig. 6-5 (pg. 384) shows a diagrammatic illustration of the fundamental VTA construction. Two coils in quadrature are between two barium ferrite "brick" magnets, of the kind formerly used in many power audio systems. The vertical coil is the "input" signal coil, and the horizontal coil is the "output" power coil. The input consisted of a 33 microwatt 10 volt 60-Hertz signal, and the output was a 120-volt 60-Hertz 500-watt signal. The barium nuclei in the magnets were specially preconditioned by Sweet so that they were in powerful self-oscillation with the surrounding energetic vacuum. A double-edged razor blade or piece of shim stock placed on one of these magnets would oscillate back and forth, incessantly, without cessation — showing that the magnetic field itself was "waving" back and forth (Figure 6-6). It was also continually doing work against air **resistance,** by moving the air.

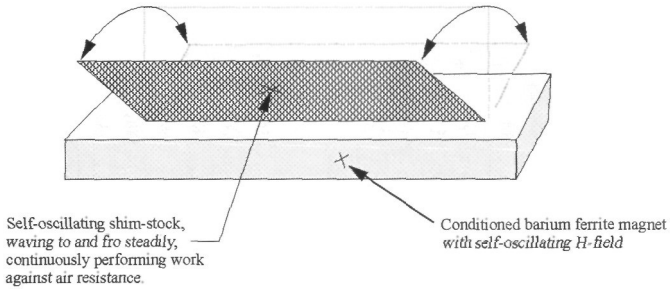

Figure 6-6 Blade waving continuously on Sweet's conditioned barium ferrite magnet.

Sweet had a Master's degree in electrical engineering from a leading university and handled the mathematical theory very well. He had worked at General Electric for many years, and Gabriel Kron was his patron and mentor. Sweet often spoke glowingly of Kron, and I came to believe that Sweet's VTA was probably an outgrowth of, or very similar to, Kron's negative resistor.

- Two activated magnets facing, with fields in self-oscillation.
- Barium ferrite magnets, barium nuclei in self-oscillation
- Barium nuclei self-pumped
- Two coils in quadrature, load is lamps, six watts
- Next unit produced 500 watts output with 330 microwatts input; later made 5 kW VTA

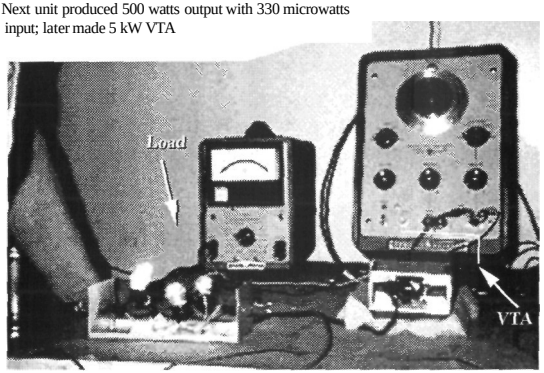

Figure 6-7 First Sweet VTA producing 6 watts output.

When I first met Sweet, his little VTA system was producing a 6-watt output, enough to light four 1.5 watts of auto lamps (Figure 6-7. But there

was no question as to the genuineness of the device. Nothing was hidden, and Sweet allowed me to measure the device at will, disassemble it, play with it, and examine it in any fashion. It was genuine, and not a hoax or trick. I also locked up one of his specially conditioned magnets for 24 hours, with a piece of shim stock sitting on the flat of the magnet and waving to and fro continuously, steadily performing work by moving air. When I opened the lock the next day, the shim stock was still there on the magnet and oscillating, having continuously done work against the air resistance for 24 hours with absolutely no energy input by the operator. And it was still working. Indeed, that single "kinetic" permanent magnet destroys all objections to COP>1.0 EM systems, including those that are self-powering and thus have COP = ∞.

It seems little known that the vacuum around nuclei, in some cases, can be treated as a semiconductor, e.g. as discussed by Prange and Strance {365}. It is also known that nuclei do exhibit resonances at ELF frequencies. In particular, the vacuum in the region close to the nucleus of a superheavy element is known to act in a fashion analogous to the inversion layer in a field effect transistor. Prange and Strance introduce the idea of the inverted vacuum. Just as a semiconductor may be manipulated by subjecting it to external fields, doping etc., it appears that the vacuum can be similarly manipulated by appropriate means. We personally suspect that the semiconducting vacuum can be and is resonantly involved in any ELF resonances of the nucleus, which can occur in lighter nuclei such as barium.[164]

The virtual particle flux of vacuum, regarded as noise, may provide noise amplification of the coherent self-oscillation frequency between the semiconducting vacuum and the barium nucleus. Certainly, analogous noise amplification of signals is known in electrical physics {366}.

[164] Here our concept of the supersystem may be of utility. The "lock-in" or "freeze-framing" of an equilibrium condition for a system — such as in a state of nuclear ELF self-oscillation — is stabilized and made a "new equilibrium condition" when the force field reaction from the curved local spacetime into the system is equal and o**pposite** to the force field reaction from the local active vacuum into the system. We believe Sweet's undisclosed activation process was a method for synchronizing those two force field reactions and making them equal and opposite in one short discharge. We hope that this speculation is of use to future experimenters trying to duplicate Sweet's activation of his magnets into sustained and powerful supersystem self-oscillation.

I hypothesized that Sweet's activation process treated the vacuum surrounding the barium nucleus in such fashion, so that he was able to establish self-oscillation between the local activated vacuum and the concomitantly activated barium nucleus. Since barium ferrite is optically active, it may be that Sweet discovered how to get sufficient "self-pumping gain" for the self-oscillation to endure and not die away in a decaying oscillation manner. Since the "gain" of the second VTA as a self-pumping device was some 1,500,000 (Figure 6-8), obviously Sweet's activation method introduced a powerful state of self-oscillation.[165]

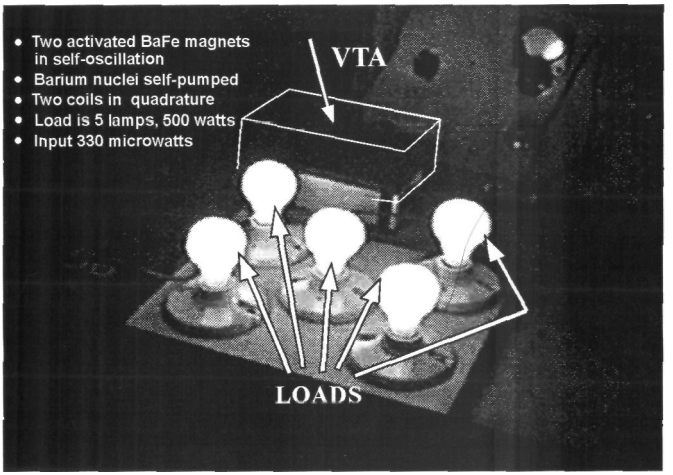

Figure 6-8 Second Sweet VTA producing 500 **watts and COP=1,500,000.**

[165] Here we point out that "small" things with very close "double surfaces" of opposite charge or potential usually have very large fields. The tiny Lamb shift, e.g., has a local energy density greater than the surface energy of the sun. Jackson, *Classical Electrodynamics,* Second Edition, 1975, p. 10-11 points out that *"field strengths of the order of 10^9-10^{15} volts/cm exist at the orbits of electrons in atoms, while the electric field at the edge of a heavy nucleus is of the order of 10^{19} volts/cm."* It should be obvious to the reader that, if our speculation is true and nuclear oscillation of the barium nuclei is involved, the production of optical gains of 1.5 x 10^6 in Sweet's self-pumped, optically acting barium ferrite magnets is not surprising because of the extreme magnitude of the oscillating nuclear fields. In that case, optical gain converts directly to true power gain because the pumping energy is furnished freely by the environment and not by the experimenter.

6.3.2.1 Mapping the Magnetic Field of the Magnets

Figure 6-9 shows a small magnetic field mapping device built by test engineer Rosenthal for Sweet. Sweet "scanned" and mapped the consistency of the magnetic field from his candidate magnets (barium ferrite magnets bought from surplus stores at the time). If the consistency varied over 12 to 15%, the magnet was useless because it would not "hold" the activation and retain it. Magnets whose magnetic field variation did not exceed 10% were ideal. So Sweet only found about 1 in 10 or even 1 in 30 magnets that would retain the self-oscillation state when initiated.

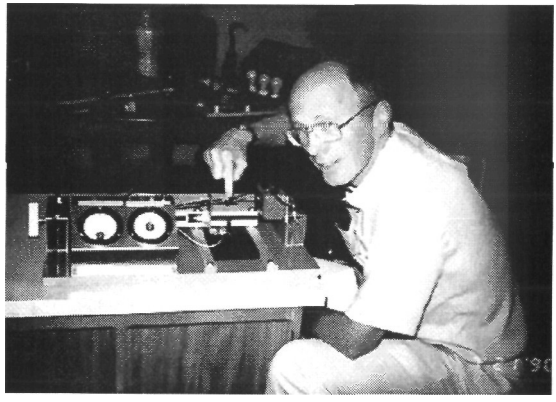

Figure *6-9* Test engineer Rosenthal points to a magnetic field strength mapping device he built for Sweet.

Sweet may have actually used two appreciably higher frequencies in his activation process, with the difference frequency between them being a precise ELF frequency (60-hertz, 100-hertz, 400-hertz, etc. as he desired). That would make sense, when one realizes that the magnet is a highly nonlinear medium and then treats it (to first order) as an isotropic nonlinear medium. In that case, the two wave frequencies actually used would be subject individually to the normal overshoot, breakup, reconstitution, etc. inside the material of the magnet — but the difference frequency would behave as if it were a sine-wave frequency {367}.

This makes sense, since the output wave of Sweet's activated magnet was essentially a pure sine wave. Also, the presence of noise-enhanced heterodyning can sometimes be used to amplify a difference signal even further {368}. As we stated, since the activation is a self-oscillation between the local semiconducting vacuum and the barium nuclei, one wonders whether much of the rest of the vacuum virtual particle flux can

be treated as noise, and whether an effect is obtained for noise amplification of the coherent self-oscillation frequency.

L'vov and Prozorova {369} point out some interesting characteristics of the formation of self-oscillating spin waves which occur above parametric excitation. These oscillations result when internal stability does not occur, and they evidence themselves as oscillations of magnetization. The frequencies of the oscillations usually lie in the range from tens of kilohertz to tens of megahertz. At small above-threshold ratios, the shape of the oscillations is nearly sinusoidal. At larger ratios, the shape differs appreciably from sinusoidal. At still larger ratios, the oscillations become chaotic.

If Sweet did use the "difference frequency" conditioning, one suspects he may thus have been able to utilize larger above-threshold ratios, where the two frequencies actually transmitted would have resulted in chaotic oscillations. It is interesting to speculate that, in that case, for a suitably chosen barium ferrite magnet, the difference frequency still can behave sinusoidally, but now much stronger. If so, that might account for the tremendous COP Sweet attained in his second unit, which exhibited a COP = 1.5×10^6, and could be pushed even higher.

6.3.2.2 Sweet VTA for Closed-Loop Self-Powering Operation

Courtesy of Walter Rosenthal, we now present a visual record of the Sweet closed-loop self-powering version of the VTA and its momentous successful acceptance test on May 1, 1990, as closely observed by Rosenthal.

Figure 6-10 shows Sweet and a different version of the VTA, with the coils in a slightly different configuration and the windings altered. This is the two-magnet, 2-coil VTA that he built and tested for self-powering operation. Figure 6-11 shows the unit mounted on a special test fixture built by engineer Rosenthal. This fixture and its components allowed the sensing of the sine wave output power at the zero-value crossover points. To switch in the special clamped feedback system for self-powering operation of the input, and simultaneously switching away from external power, the switching had to be done very accurately at that zero-point crossover. Feedback would not stabilize and hold if the switching were done at any other point in the output cycle.

Unit independently examined and testing observed by test engineer Walter Rosenthal

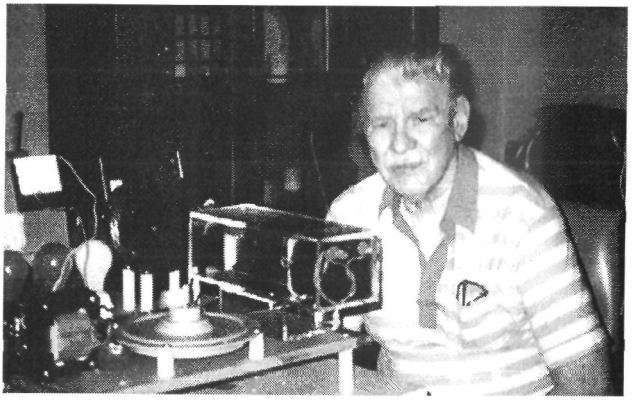

Figure 6-10 Sweet with 2-magnet 2 coil VTA, loads, and instruments for historic self-powering operational tests on May 1,1990.

Figure 6-12 shows the set-up for the tests, with the unit and loads as well as some of the instruments used. Figure 6-13 shows the closed-loop VTA powering itself and its loads, after being initially set into operation with outside input power by the operator, and then adroitly switched into self-powering by switching the input from external to internal at an output

Fixture allowed unit to be started into operation on external power then switched to self-powering internal power at the zero crossing of the *output* voltage The device in its fixture has a row of test points (disconnects) on every conductor going to the device

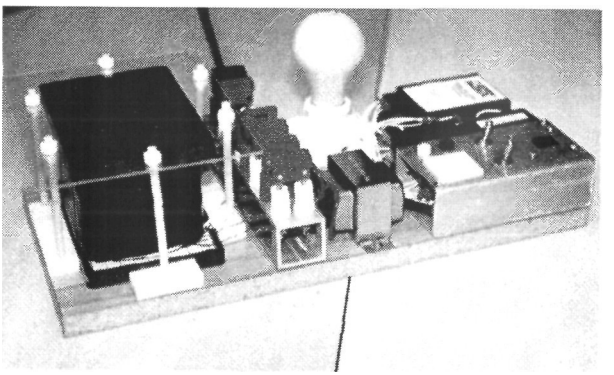

Figure 6-11 Two-magnet two-coil VTA mounted on a special test fixture built by Walter Rosenthal.

power zero crossover point. This picture shows the unit in self-powering and stable operation, taking all its input energy from the vacuum, including the power necessary to power its own internal losses and the power necessary to power its controls and loads.

Independently examined and testing observed by test engineer Walter Rosenthal

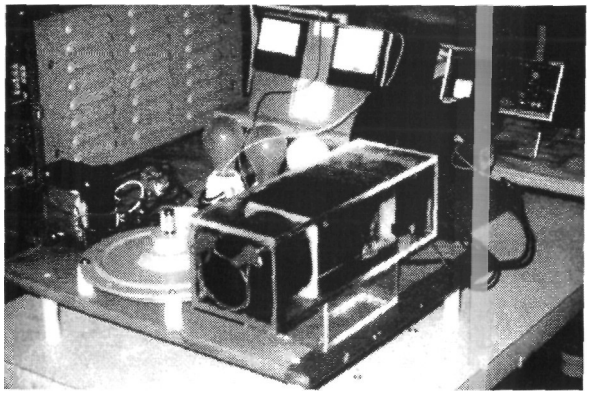

Figure 6-12 The 2-magnet, 2 coil VTA, loads, and instruments for its historic self-powering operational tests on May 1,1990.

Formal self-powering test on 1 May 1990 The loads and the VTA are powered by electrical energy extracted directly from the activ e vacuum Independently observed by professional test engineer Walter Rosenthal

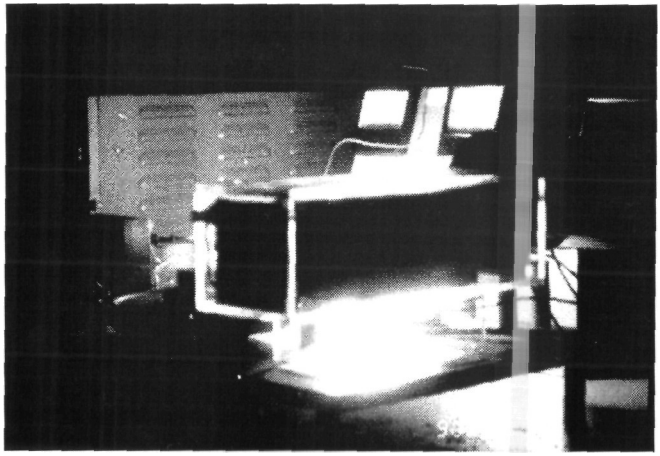

Figure 6-13 Historic self-powering operational test of the VTA May 1,1990 with no energy Input by the operator.

We strongly stress that this operation is permitted by the laws of physics and thermodynamics for an open EM system far from equilibrium in its exchange with its active environment. The active environment in this case is the combination of the active local vacuum and the active local curvatures of spacetime. The closed-loop condition is a new and stable equilibrium condition in the dynamics of the mutual exchanges between all three supersystem components: the system, the active vacuum, and the curvatures of spacetime. The *system* is in stable disequilibrium; the *supersystem* is in a stable new equilibrium condition.

6.3.2.3Discussion

We do know that the output current of the second Sweet device was comprised of a significant Dirac hole current[166] as well as electron current — showing the expected heavy involvement of the altered local vacuum (the Dirac sea) and the curved local spacetime. The negative energy majority of the output revealed itself readily. If the output leads were shorted, ice formed instantly on the shorted leads from the moisture in the air. That is, an electrical short resulted in the sudden production of cold (negative) EM energy rather than positive EM energy.[167] That can only occur if the majority of the output is negative energy, and any sudden surge in output (as from the shorted leads) increases the ratio of negative energy to positive energy so that very strong net cooling results.

For many predominantly mechanical components (simple electrical motors, light bulbs, etc.), Dirac hole current applied to the positive lead will power the circuit equally as well as electron current applied to the high voltage (negative) side, if the grounding is simply by a conductor and not a "vast reservoir" of charge. In such case, the wire chosen to conduct or direct the Dirac hole current should be made very small. It can and will

[166] We do mean hole current in the Dirac sea, consisting of Dirac holes in the vacuum itself, prior to their interaction with charged matter to form lattice holes in matter. We do not mean the standard lattice hole current at all.

[167] In local curved spacetime, Dirac holes constitute "negative energy EM fields and potentials". In such case, one can have negative energy entities and reactions analogous to positive energy entities and reactions in 3-space. On the time axis, one also has negative energy entities and currents, potentials, waves, fields, etc. Because c**lassical** Maxwell-Heaviside-Lorentz theory eliminates any modeling of the local vacuum or the local curvature of spacetime, these negative spacetime curvature **(negative** energy) potentials, fields, and currents have not been added into the electromagnetic theory. That of course is a serious shortcoming of the normal theory.

carry intense hole current and will cool rather than heat.[168] The wire to the electron side of the device should be made normal sized, appropriate to the electron current to be carried.

Several other inventors over the years have been able to activate a barium ferrite magnet into sustained self-oscillation of its material particles or domains, in similar but weaker fashion for varying lengths of time — up to a month or so in the longest time that I am aware of. Sweet's magnet would continue in self-oscillation indefinitely unless (i) the magnet was sharply shocked mechanically (as with a hammer blow), (ii) the magnet was heated to too high a temperature, (iii) the leads of the output circuit were electrically shorted, or (iv) external artificial field interference (electrical pulse shock, particularly from longitudinal stress waves) was encountered.[169,170]

Unfortunately, Sweet signed multiple conflicting agreements with several financial backers, and his work was legally entangled so deeply that it was never straightened. He eventually died, taking with him his activation secret. He was often threatened, and was once fired at by a professional

[168] This is very probably the secret of Tesla's "single wire system". At an exposition in Nevada, Bedini demonstrated just such a system, by powering 600 watts of audio speakers at the end of a long, very thin wire across the stage from his power amplifier. If he had been using positive EM energy, the wire would have instantly melted.

[169] During that period, the Russians were playing with earthquake induction via scalar interferometers, at various places around the world, including inside the U.S. heartland. Sweet's machine would sit above a natural quake and not be affected. But when a quake within many hundreds — even several thousands — of miles was artificially induced, the Sweet device would react to it. A fairly close artificially induced quake would destroy the self-oscillation of the magnets, and sometimes a very close artificially induced quake would actually explode the intensely activated magnets. So for several years one had a way of ascertaining which quakes were natural and which were artificially induced, by simply having Sweet confirm how his magnets interacted.

[170] For those who do not believe such an activity, here is a direct statement by then-Secretary of Defense William Cohen: *"Others are engaging even in an eco-type of terrorism whereby they can alter the climate, set off earthquakes, volcanoes remotely through the use of electromagnetic waves... So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations...It's real, and that's the reason why we have to intensify our efforts. "* Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, **University of Georgia, Athens, Apr. 28, 1997.**

assassin using a silenced rifle. He survived the incident because, being old and a bit feeble, he stumbled and fell over the front steps just as the assassin fired. The bullet snapped by his ear, right where his head had just been. The incident was reported to the FBI, but with nothing else to go on, the assassin was never caught.

By whatever means, we do know that Sweet's magnets had to be activated by a special process that Sweet used and never fully revealed. An activated or "kinetic" magnet, it seems, was actually something a few of the "older magnetics guys" had known about, and Sweet had learned of it either from them or from Gabriel Kron. Sweet was also a transformer designer and expert, and he remarked that he had also observed specialized self-oscillation in certain transformers. Although most power engineers approached were either nonplussed or completely skeptical of a "self-oscillating field in a permanent magnet", self-oscillation of the fields, spin waves, etc. in permanent magnet materials *are* known to materials scientists today, especially to those working with magnetic effects in thin film materials {370, 371a-b}.

From a general relativity viewpoint, particle spin has a unique spin field of its own {372}, and there are such spin fields involved and operating in magnetic systems. The simple classical electrodynamic approach to magnetism and magnetic assemblies — or the view of a magnet as simply a bar with a north pole and a south pole — is quite insufficient when one wishes to research magnetic assemblies that will act as open systems far from equilibrium with their active environment, and thus will be capable of COP> 1.0 operations.

Recent work in coupled spins has revealed long-range coherence effects, previously unsuspected, as well as dual spin states participating in such phenomena {373a-b}. For example, Johnson has long used a 2-particle approach to spins and spin flipping in his own highly nonlinear magnetic assemblies {374}. His recent laboratory work has also shown similar and unsuspected *long-range coherence* effects in large multiple-magnet macroscopic systems {375} such as large assemblies of neodymium-iron magnets. This is strongly suggestive of the expected general relativistic spin field previously mentioned.

This work by Johnson is very important, since it may reveal a hitherto unsuspected mechanism for decay — of an otherwise nonconservative magnetic field around a closed loop — back into a conservative field. If one seeks an all-permanent-magnet rotating motor, a nonconservative magnetic field around a rotation loop must be established and sustained if

one is to have self-rotation and self-powering. A nonconservative magnetic field around such a rotation loop means that the system acts as an open system far from equilibrium with its active vacuum and active curved spacetime environment, by means of some asymmetry mechanism such as multi-valued magnetic potential {376a-c, 377a-g}, elucidation of exchange forces {378a-c} at selected positions and directions, etc. It also requires both a stable broken 3-symmetry and a stable 4-symmetry.

On the other hand, in our opinion, Sweet employed spin waves triggered into self-oscillation in the nuclei of the barium atoms in his barium ferrite magnets. Indeed, such nuclear spin waves in magnets have been known for some time {379}. We postulate that, as in any other COP>1.0 power system, a self-rotating all-permanent-magnet motor must also involve Dirac sea hole current interacting in the various magnetic components. It is reasonable to suspect that these also interact with the electrons and their spin fields, perhaps producing the active mechanism providing that observed long-range coherence that apparently can decay the nonconservative magnetic field around the rotation loop, causing it to revert back to a conservative field and thereby stop the self-rotation and self-powering. If so, that long-range coherence must be violated and the violation stabilized. However, we could find no papers in the literature that deal with such possibilities. Hence it is a subject for further investigation by COP>1.0 researchers.

6.3.2.4 The *Highly Successful Anti-Gravity Test*

On one trip to California to work with Sweet, we noticed that, at full power output of 500 watts, his unit weighed a little less on the bench than when not powered. Struck by this anomaly, I considered the negative energy aspects of the output — as evidenced by the Sweet's demonstration of icing when the output leads were shorted — and the very high gain, which added up to a predominance of negative energy in the output.

Pondering this from a general relativity viewpoint, I reasoned that: (i) increase of positive EM energy density in space increases the curvature of spacetime to produce additional positive gravity G_P; (ii) increase of negative EM energy density in space must increase the curvature of spacetime in the other direction, and thus it must produce negative gravity G_N, and (iii) the total gravity G_T produced in the immediate spacetime of an object producing both positive gravity G_P and negative gravity G_N, was $G_T = f(G_P + G_N)$. Thus if we increased the output of the VTA unit, we must inevitably increase the weight reduction (antigravity) effect since the predominance of the energy output was negative energy, and this output was in the neglected negative energy fields aspect as well as in the local

vacuum (spacetime) itself. After several back-of-the-envelope estimates and educated guesses over some weeks, I concluded that if the efficiency of the antigravity process[171] were 10% and the unit was pushed to 1500 watts output, it would lose all its weight and hover weightless.

However, because of the nonlinear local spacetime, magnetic monopoles[172, 173] were deposited in Sweet's magnets when the unit was

[171] We again accent the difference between efficiency and COP. Here we are definitely speaking of efficiency, not COP.

[72] Dr. Robert Flower has confirmed that the 'symmetrized" (or "extended") Maxwell equations (Eqs. 7.1 in Springer's *Encyclopedia of Physics,* Vol. 16, p. 431) include non-zero magnetic charges and magnetic currents. Antenna engineers (Henning Harmuth, and others) know that these terms must be included for proper description of boundary conditions, even though, at the final step of computation, their integrals are set equal to zero (apparently to snuff out magnetic monopoles). For Dirac's original theory of the monopole, see P. A. M. Dirac, "Theory of magnetic monopoles," *Phys. Rev.,* Vol. 74, 1948, p. 817-830. See also F. A. Bais and B. J. Schroers, "Quantisation of Monopoles with Non-abelian Magnetic Charge," *Nuclear Physics B,* Vol. 512, 1998, p. 250-294; G. Lochak, "The Symmetry Between Electricity and Magnetism and the Problem of the Existence of a Magnetic Monopole," in T. W. Barrett and D. M Grimes. [Eds.] *Advanced Electromagnetism: Fundations, Theory, & Applications,* World Scientific, 1995, p. 105-147. Particularly see T. W. Barrett, "On the distinction between fields and their metric: the fundamental difference between specifications concerning medium-independent fields and constitutive specifications concerning relations to the medium in which they exist." *Annales de la Fondation Louis de Broglie,* 14(1), 1989, p. 37-75; — "Electromagnetic Phenomena Not Explained by Maxwell's Equations," in Lakhtakia, A. (ed.): *Essays on the Formal Aspects ofElectromagnetic Theory,* World Scientific, River Edge, NJ, 1993, p. 6-86; — "The Ehrenhaft-Mikhailov effect described as the behavior of a low energy density magnetic monopole-instanton." *Annales de la Fondation Louis de Broglie,* Vol. 19, 1994, p. 291-301. The work of Ehrenhaft, which is now substantiated and thoroughly replicated by Mikhailov, has produced experimental evidence of the magnetic monopole in many replicable experiments. In these experiments, magnetic particles move in a magnetic field along the lines of force. Reversal of the magnetic field, H, causes a reversal of the magnetic particle's motion, which is not the case with magnetic dipoles, since that can only occur for a monopole. See V. F. Mikhailov, "Observation of magnetic monopoles in the field of a line conductor," *J. Phys. A: Math. Gen.,* Vol. 18, 1985, p. L903-L906; — "Observation of the magnetic charge effect in experiments with ferromagnetic aerosols." *Annales de la Fondation Louis de Broglie,* Vol. 12, 1987, p. 491-523. See also M J. Perry, "Magnetic monopoles and the Kaluza-Klein theory," *Am. Inst. Phys. Conf. Proc,* No. 116, 1984, p. 121-125; E. V. Smetanin, "Electromagnetic field in a space with curvature — new solutions," *Soviet Physics Journal,* 25(2), Feb. 1982. p. 107-111. [English translation]. See also T. T. Wu and C. N. Yang, "Dirac monopole without strings: monopole harmonics," *Nuclear Physics,* Vol. B107, 1976,

producing power, and the density of these monopoles varied as the output power. Increasing the power output thus increased the tensile stress of the magnets, and at some point they would explode into fragments, like a hand grenade.[174] This explained why conditioned magnets sometimes exploded when experiencing fluctuations from artificial earthquake induction testing.

Having no explosive control facilities, I warned Sweet not to push the unit past 1,000 watts, for safety reasons. At my urging, Sweet made a new output load often 100-watt lamps in sockets, so the load could be varied from 100 to 1,000 watts easily.

p. 365-380; — "Dirac's monopole without strings: classical Lagrangian theory," *Phys. Rev. D.*, 14(2), July 15, 1976, p. 437-445.

[173] We emphasize that a magnetic monopole can be taken simply as a highly localized magnetic scalar stress potential. See, e.g., P. A. M. Dirac, "Theory of magnetic monopoles," *Phys. Rev.*, Vol. 74, 1948, p. 817-830. Dirac pointed out that the existence of a single magnetic monopole in nature would allow an explanation for charge quantization. We believe that the reverse of Dirac's argument may be true also: The existence of charge quantization should allow an explanation for the magnetic monopole. However, we also surmise that a magnetic monopole exists only in (and as) a sharply localized curvature of spacetime. Jackson, *Classical Electrodynamics*, second edition, 1975, p. had this to say about magnetic dipoles and Dirac's argument: *"Dirac's argument... is that the mere existence of one magnetic monopole in the universe would offer an explanation of the discrete nature of electric charge. Since the quantization of charge is one of the most profound mysteries of the physical world, Dirac's idea has great appeal. "*

[174] Sweet in fact did explode several magnets by pushing the power output of the device. Pushing the output was easy (and is easy for any unit outputting mostly negative energy), because all one had to do was connect additional load.

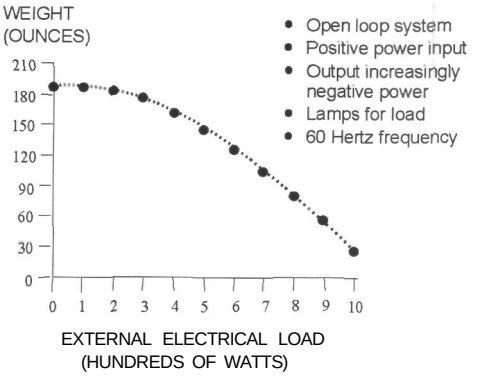

Figure 6-14 Results of the "pushed" VTA antigravity test: Weight of VTA on the bench versus power output.

Sweet completed the new load section and performed the experiment in California after 1 had returned to Huntsville, reading off the results to me over the phone. I took down the data, and then plotted the curve. Figure 6-14) shows the beautiful results. At 1,000 watts the unit had lost 90% of its weight. This was electrifying, because it was an unprecedented and highly successful antigravity experiment. Even my original "rough" assumption of levitation at 1500 watts was not too far from the indicated 1250 watts or so from the actual curve.

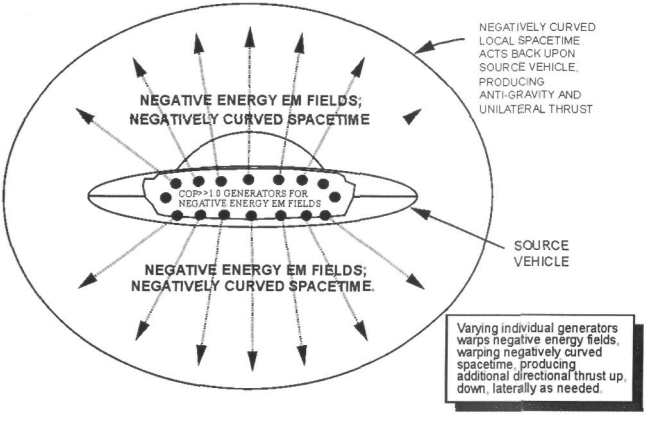

Figure 6-15 Proposed mechanism for practical antigravity.

Figure 6-15 shows my proposed mechanism for antigravity. We simply use negative EM field energy generators to produce a negative EM energy field in space surrounding the source vehicle. The associated positive energy from the same energetic power source can power the vehicle simultaneously. The local reversed curvature of spacetime now interacts back upon the mass of the vehicle, to produce an antigravity component. By adjusting the output of the power source, the amount of negative energy — and hence the amount of antigravity component — can readily be varied and controlled. By controlling the directions of the field components, one can have unidirectional antigravity force, or antigravity and thrust force vectors simultaneously. Hence such a vehicle could be maneuvered and controlled, and be self-powering. This at least was and is my concept of a practical antigravity technology.

6.3.2.5 Later Developments and the End of the VTA

Later I prepared a paper on the VTA, including the antigravity experiment's results. We succeeded in getting the paper published {380} but I deliberately did not include the real details of the negative energy aspects as I wished to withhold that information for patenting. I prepared the entire paper, but placed Sweet's name first, as was appropriate since he was the inventor of the VTA.

Unfortunately — but understandably! — Sweet became a bit paranoid after the sniper assassination attempt (he was shot at by a distant sniper using a silenced rifle), and then would never allow a formal demonstration of his antigravity test. I strongly wished to present it to a major national U.S. scientific committee for independent testing and confirmation — which could have been done without Sweet having to reveal his activation process for the magnets. However, Sweet would not hear of such. Indeed, he fearfully kept the antigravity capability a secret from most of his backers. He strongly believed that he would be killed almost immediately if he revealed our antigravity experimental success. He may have been correct.

In fairness, the inventor and his backers of necessity have different priorities from those of scientists doing open research in a university. But at least a record of the test results is in the literature, though certainly not as rigorously or as extensively as I wished. Sometime later, I withdrew from any further association with the VTA unit, after the backers changed, a lawsuit broke out, and the entire project unraveled. Sweet later died without ever revealing his full secret for such powerful activation of self-oscillation in permanent magnets at low ELF frequencies.

The loss of the Sweet vacuum triode was a severe blow to science and a real setback to the scientific progress that could already have been made. Nonetheless, I contributed what I could, documented what I could, and made a videotape of the operation of the open-loop 500-watt device in the power mode. I also made a video of as much as Sweet would reveal of his activation process. I was not allowed to videotape a second antigravity experiment, even though I frequently and strongly requested it. By that time, Sweet mortally feared for his life. Perhaps what we have written in this book will be sufficient to provide some needed clues to some future graduate student or post-doctoral scientist who will succeed in recovering the necessary activation of magnets and both the COP»1.0 power capability and the antigravity experiments.

Meanwhile, I have filed a provisional patent application on the mechanism for antigravity, the gist of which I worked out solely on my own back in 1971 at Georgia Institute of Technology, and that I include in Chapter 8. As far as I am aware, no one else had thought of it previously, or has thought of it in that exact form *{using the causal positron prior to observation, and while it is still a negative energy, negative mass electron, as the source charge for negative EM field energy, and also using the causal positron's corresponding giant Heaviside nondiverged negative energy flow for substantial negative curvature of spacetime.).*

6.3.3 Intense Discharges in Ionized Gas

Intense sudden discharges in ionized gases are especially of interest due to the presence of optical frequency components and the involvement of iterative optical retroreflection etc. These processes seem to be involved in several investigations and inventions. Further, it appears that such intense discharges do produce bursts of negative EM energy as part of their overall discharge energy.

In the case of plasmas, some are known to transduce an input transverse EM wave into an output longitudinal EM wave, and vice versa. We know now that such a longitudinal EM wave is also accompanied by a time-polarized (scalar) EM wave in the time domain. The connection with the Whittaker 1903 decomposition of the potential, and with the new 4-symmetry negentropy law, is apparent. Several COP>1.0 researchers — notably Shoulders {381a-f} and Paulo and Alexandra Correa {382a-e} — have performed extensive research into anomalous discharge phenomena, and also have developed experimental devices capitalizing on the novel

effects available.[175, 176] The Correas' U.S. Patent No. 5,449,989 includes many tests of a Correa glow discharge apparatus, one of which in 20 minutes of operation produced 0.988 kilowatt-hour of energy output for an input of 0.258 kilowatt hours. Using the known negative resistor characteristics, the Correas achieved sustained self-oscillations in the discharge.

As an aside, we point out that the well-known anti-Stokes emission — which produces more energy output than the experimenter inputs, and hence exhibits COP>1.0 — has long been validated in certain gases such as aniline vapor {383} and H_2 {384}. Stimulated anti-Stokes radiation occurs in many solid materials such as oxides and doped oxides {385}. Assuming the excess energy comes from the internal energy of the molecules, this is a prime candidate for free replenishment of that furnished internal energy of the molecule, via the broken symmetry of the molecular dipoles in their fierce virtual energy exchange with the local active vacuum and local curved spacetime. Of course, conventionally the energy furnished by the molecules, etc. is not replenished from the vacuum, hence anti-Stokes emission can be used for coherent light cooling effects {386}. Apparently the Correas' process accomplishes the energy replenishing, hence the COP> 1.0 performance over a 20 minute period.

Formation of longitudinal EM waves in the plasma forms in certain gas tubes, such as in Priore's gas-filled tubes {387}, may also occur in the Correa experiments and probably do. Longitudinal EM waves, of course, always involve their concomitant, accompanying time-polarized EM waves, since the combination comprises the scalar potential and hence the local curvature of spacetime provided by that scalar potential. The replenishment mechanism involved in longitudinal EM waves and scalar potentials — time-energy transduced into 3-space energy — apparently is

[175] Both Shoulders' electron cluster discharges and the discharge phenomena of Paulo and Alexandra Correa have been independently verified. Fox and other scientists have verified COP>1.0 in Shoulders' work, and Mallove has formally observed a self-powering Correa system. Both these highly reputable scientists are well known, have the highest integrity, and I would trust either of them with my life. Further, we point out that strong gradients — as exist temporarily in strong discharge phenomena — are already known to violate thermodynamics. That is one of the areas being researched today to advance thermodynamics, under the aegis of "extended thermodynamics". See Appendix A.

[176] In addition, the Correas have demonstrated a form of energy that demonstrates latent heat. See discussion in Paragraph 6.3.9.

invoked and utilized in the Correas' sustained self-oscillations in the plasma discharge.

6.3.4 Shoulders' Electron Cluster Processes

Valone {388} has summarized Ken Shoulders' charge clusters and processes as follows:

> *"An unusual energy source is the clustering of electrons by a discharge needle into a high density bundle equaling Avogadro's density of a solid.... Ken Shoulders has patented a process (Pat. #5,153,901) that produces electron clusters with such high energy density, they equal processes exceeding 25,000 degrees Celsius upon impact. Yet, he only uses 20 microjoules to produce the effects. The clusters travel at a maximum of one tenth the speed of light and penetrate any substance with accuracy and sharp precision. It is similar to xenon clustering techniques currently used at megavolt energy levels. Low energy nuclear transmutation of the target has also been achieved with this process. Using a deuterium-loaded palladium foil, only the bombardment areas show transmutation into silicon, calcium, and magnesium with electron clusters upon analysis with X-rays. Jin and Fox {389} have postulated that the high velocity electron clusters achieve results similar to accelerators, including penetration of the nucleus, with substantially less power. The new physics of like-charges clustering in bundles under low power conditions opens a wide range of applications including spacecraft maneuvering microthrusters. Overunity efficiency* [sic: should be COP] *is 9 to 1, or higher."*

Ken Shoulders is an accomplished experimental scientist who has discovered and patented many aspects of electron charge clusters, including their COP>1.0 characteristics {390}.

According to his experiments, one of the most remarkable characteristics of these charge clusters seems to be their dramatic reduction of the permittivity of space {391}. Shoulders has noted the remarkable removal Of **positive** charge during the self-formation process of the clusters {392}. In our opinion, the involvement of the supersystem of these charge clusters is shown by that phenomenon. We hypothesize that an accompanying Dirac hole current is shown by the experimental occasions where — in

addition to the Shoulders' negative charge clusters — additional charges unite but show effects of having opposite charge {393}. Such changes would change the permittivity of space, which Shoulders has noted. They could also create a time-reversal zone (TRZ), which would account for the clustering of like charges since in a TRZ the law of attraction and repulsion of charges is reversed. In such a zone, like charges attract and unlike charges repel. This could explain why Shoulders has observed both negative charge clustering and positive charge clustering.

This would also explain the remarkable separation of the positive charges from the negative charges — they are simply *repelled* by the negative clusters in a TRZ.[177] This of course immediately involves curvature of spacetime effects, including local changes in the speed of light etc. As stressed by Shoulders, the entire area cries out for extensive and sophisticated experimental investigation on a continuing basis, as well as some powerful new theoretical work. Shoulders has also noted both "black" and "white" (dark and bright) clusters, including their combination and separation, strongly suggesting Dirac holes as well as the electrons in the charge clusters. He has proposed a form of "inertial propulsion" based on some of the mechanisms and asymmetrical forces observed in his experiments, and such asymmetry is possible in curved local spacetime conditions.

The relation of Shoulders' effects to cold fusion phenomena was shown by an experiment in which a deuteron-loaded palladium cathode was impacted by a charge cluster {394}. An explosive-like reaction occurred, and an X-ray analysis of the impact crater showed a number of elements not seen in the nearby palladium surface away from the impact site. Elements such as oxygen, calcium, silicon, and magnesium were detected in the impact site, but not in the surrounding palladium lattice. We would suggest the presence of TRZ-based nuclear transmutation reactions (via quasi-nucleus formation followed by quark-flipping in nucleons as the

[177] Since the same TRZ phenomenon generates specific nuclear transmutation reactions at low spatial energy, explaining the anomalous transmutation of elements in cold fusion electrolyte experiments, a strong indication exists that it is a viable mechanism. In our mechanism proposed for the flow of time, a TRZ is produced for charges whenever antiphoton interactions predominate over photon interactions. This indeed implies a change in the permittivity of the local space, local curvature of spacetime, and local changes in the speed of light — all phenomena Shoulders notes in his experiments.

TRZ decays to a time-forward zone). Additional information on this charge cluster phenomenon has been given by Fox {395}.

Other Shoulders patents are pending and his research is continuing. It is our understanding that at least one application is presently being developed for the market.

6.3.5 Mills's Hydrino Energy Cells and Developments

Dr. Randell Mills {396a-396c}, {397} has proposed a cosmic sea of hydrinos (the hydrino is a proposed reduced energy state of the hydrogen atom) to explain his tested energy cells. He envisions — and produces a theory for — hydrogen that is reduced to a lower energy state (the "hydrino"). He has gathered considerable evidence for his theory, and has accounted for some sixty or so infrared spectral lines in the sun's radiation that have previously not been explained. Independent tests appear to have validated his energy production claims.

Several major companies are presently working with Mills and his parent company, BlackLight Power, Inc. Progress can be followed from the company website, www.blacklightpower.com. Developments are ongoing in light, power, plasma, and new compositions of matter. A technical book by Mills {398} is freely downloadable from the website, giving his overall theory, as are other publications by Mills *et al.* {399a-h}. Critical objections to various parts of Mills' theory have been given, e.g., by Zimmerman {400}, with Mills responding strongly and — in our opinion — successfully.

Certain concepts utilized by Mills are, in our opinion, valid and insightful - whether or not the classical quantum mechanics developed by him is found to hold, and whether or not it agrees with ordinary quantum mechanics (which has problems of its own). The point is that *the experiments work.* It is thus the job of the theorists to find what changes must be made to the theory for it to remain consistent with experiment. If they do not like Mills' theory, the proper procedure is to advance one that **is** consistent with all the experimental results, and also to show where Mills' theory is inconsistent with the results.

In our own view, an *observed* positive charge is the output of an ongoing time-reversal process and therefore represents a "time-reversed entity" as observed. Before observation (imposition *of d/dt* operator), the positive c**harge** is thus a negative 4-charge comprised of *qt,* not *q.* From that viewpoint, the H+ ion, which is just a hydrogen nucleus (a proton) without an electron shell, may be regarded as a time-reversed 4-entity prior to observation. Further, any energy change in and of the hydrogen atom

results in a change in the local energy density of spacetime (ST) *a priori*, hence a change in the local ST curvature.

If we regard the entire hydrogen atom as a set of such ST curvatures and their dynamics, then Mills' consideration of a lower positive energy state *hydrino* simply implies the addition of an additional negative ST curvature to the ST curvature set associated with the normal hydrogen atom. We note that binding energy of the nucleons is already negative energy, and thus just such a negative spacetime curvature. But the binding energy is itself a spacetime curvature *capable of being increased*, as can be any spacetime curvature. In the supersystem, addition of such ST curvature is possible, and it is *doable* electrodynamically, particularly when Heaviside's normally unaccounted huge energy component is accounted and utilized.

In our opinion, Mills' theory should probably be recast into a higher group symmetry electrodynamics — such as O(3) — which has been shown to be intimately connected with Sachs's unified field theory. This would provide an adjusted model that is not only testable but also *engineerable.* Nonetheless, the concepts of Mills' theory and the theory should be closely examined as they stand, and at least some of the key concepts are engineerable as witnessed by his successful experimental results. That is better than what the critics have offered! A higher group symmetry recasting would enhance and expand his theory even more, and correct any errors that might be present. It would also allow a full theoretic treatment (i.e., a supersystem treatment) of Mills' main concepts, which we believe have much merit.

Further, given Mills' hydrino as we approached it, two hydrinos will each possess such a set of spacetime curvatures (each will possess such a *vacuum engine).* Later in this book — and elsewhere {401} — we have pointed out that, in a time-reversal zone (TRZ), the law of electromagnetic charge attraction and repulsion is reversed. Accordingly, in a TRZ two or more hydrinos will attract each other so closely that each enters the now-reduced strong force region of the other, forming a quasi-nucleus. As the TRZ decays away back to a normal time-forward zone, because of their power law form the strong forces restore back to normal much faster than the electromagnetic forces do. Hence during its "decay", the quasi-nucleus is energetically compacted into a permanent nucleus, either flipping quarks or giving off one or more particles as necessary to balance its new energy state in the process. We have previously argued that a similar process where a TRZ induces formation of quasi-nuclei also yields the major transmutations {402} demonstrated in a large number of cold fusion experiments worldwide.

The present author has previously proposed an engineerable mechanism (the totality of all photon interactions with a mass) that generates the flow of that mass through time {403}. By manipulating the arrow of time between forward vector and reversed vector, the strong forces in a nucleus (or for a particle) can be directly manipulated in magnitude (and to some extent, even in sign although the latter involves gluon and quark manipulations in the nucleons). By adroit use of these manipulated strong forces and TRZ formation and decay, the energy states of nuclei can indeed be manipulated, including reduced in energy level —just as Mills assumes and presents experimental evidence for, and as cold fusion experiments present experimental evidence for.

We note that two such interacting hydrinos must each possess a specific vacuum engine (specific set of ST curvatures and dynamics). Novel new interactions are available in TRZ's because of manipulation and even reversal of electromagnetic forces, strong forces, etc. and because of nuclear fusion of like charged particles into quasi-nuclei followed by decay into stable nuclei, etc. These novel new particle interactions caused by manipulation of strong spacetime curvature engines and their magnitudes are presently missing from particle physics. Mills, however, does come at them from a somewhat different direction in his own concepts.

The reason for the absence of dominant general relativity effects in most particle physics is that the "total photon interaction" mechanism generating the flow (persistence) of a mass or field through time has not been recognized and used. Consequently, in general only those far weaker ST curvatures due to the weak G-force have been considered. To Mills' great credit, he is aware of the gravitational significance of manipulating much stronger forces and spatial energy densities such as the electromagnetic fields and their energy densities.

The U.S. Patent and Trademark Office then refused a new patent to Mills on one of his processes, and revoked another Mills patent even after already agreeing to award it within two weeks. BlackLight Power, Inc. initiated and lost a lawsuit against the Commissioner of Patents, seeking to reverse this unusual action by the U.S. Patent Office. However, the company's patent portfolio has continued to grow, with extraordinary international applications {404a, 404b}, and several European patents have been filed appropriately. BlackLight Power Inc. seems well funded (some millions of dollars) and well staffed, and we expect to see BlackLight Power, Inc. products entering the market place. Those products will

probably be related to fuel cells, plasmas, power converters, generators, separation methods, and novel compounds materials.

and

6.3.6 Switching Circuits with Extended Electron Gas Relaxation Time

See Figure 6-16. Suppose an instantly applied voltage to the high side of the circuit instantly potentializes a pair of circuit conductors, with the other acting as ground. The charges in the conductor are thus instantly potentialized and excited, so that through the external circuit there exists an E-field E, where $\mathbf{E} = -\nabla\phi$ between the high side of the circuit and the ground return side. An acceleration force on the energized electrons thus exists. It requires a finite time for the energized electrons in this force field E to break their static friction or inertia, move, and accelerate to the requisite slow drift velocity down the wire. During that delay or "electron relaxation time", no current is initially in progress, then a little current is flowing, and finally all of the current is flowing. This delay time is called the electron gas relaxation time.

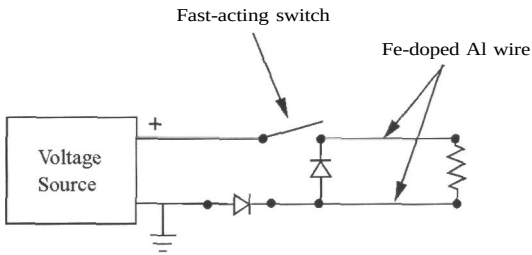

Note: May use many strands of Fe-doped Al wire instead of one, for each conductor

Figure 6-16 Extended-relaxation-time circuit with diodes.

In the usual copper conductor, the delay time arguably may be on the order of 10^{-16} sec. This is so slight a delay that it can be ignored, for all practical purposes. Current — with resulting dissipation of the collected potential energy — usually occurs "as soon as" we apply the voltage, for all practical circuit work. However, suppose we could increase that electron gas relaxation time to, say, one millisecond? Then for an appreciable number of microseconds, there would be essentially no current flowing at all in the now-potentialized circuit.

We previously proposed a mechanism whereby a degenerate semiconductor alloy (say, of a tiny bit — perhaps 2% or so — of iron

alloyed in aluminum wire) is utilized for the conductors of the external circuit. This should give a vastly extended electron relaxation time, somewhere on the order of a millisecond. By obtaining a millisecond, one can excite the circuit with current-free potential alone, which becomes pure regauging during the electron relaxation period.

We strongly point out that this is an asymmetrical regauging; the E-field previously mentioned is present, but the electrons are still frozen in the circuit since their relaxation has not begun. The gauge freedom principle, recognized in quantum field theory, assures us that we do not have to perform work to simply inflow potential energy to change the potential energy of the system. In real circuits, we may have to pay a tiny bit for switching to connect and disconnect the external potentialization source, but we can be at pains to make that very efficient and minimal {405}. The point is, other than minor switching costs, the dramatic change in the potential energy of the system is cost-free and no current is drawn from the external potential source. Hence — in the language of the electrical engineer — we draw no power from the source of potential, during this potentialization time.

Suppose we switch away the excitation source prior to its decay while the electrons are still frozen. Simultaneously, we complete the "freed" potentialized circuit with a strategically placed diode, as shown in Figure 6-16. Again, we pay a little switching cost, but it can be minimized. The electrons in the *now asymmetrically potentialized circuit* are still frozen, so no power has yet been drawn by the system from the external power supply furnishing the voltage only. In this way, pure asymmetrical regauging is used to excite the circuit with additional potential energy, without requiring work (except minimally for switching).

A little more time passes, and suddenly the electrons in the potentialized circuit wake up and move. We stress again that the full emf is acting on the electrons, and now they are finally free to move. There is a net nonzero regauging E-field (force field) also. The excited closed current loop circuit then discharges in normal Lorentz symmetrical fashion, killing the source dipolarity as current is driven back up through the diode, but all the work in the load is "free". The circuit specialist will also recognize the usefulness of additional components associated with the shunt, such as a capacitor or even an LC oscillator for AC work.

If L*E* is load work obtained and *SE* is switch energy utilized, this approach yields COP = *LE / SE* and COP > 1.0 is possible. The reason is that the *primary* source dipole providing the potential for potentialization of the

electrons and regauging of the circuit is removed from the closed current loop circuit and the effect of current through the back emf. Thus the primary source dipole is not destroyed faster than the load is powered. It is only depleted by the small amount of switching energy we utilized. This appears to be a major way to avoid the COP<1.0 limitation of the usual closed current loop circuit.

This is a circuit with legitimate COP>1.0 capability, without violation of the laws of thermodynamics or physics. We break the Lorentz condition between the initial "external circuit" and the primary source dipole for the regauging energy. After regauging, we "cut loose" the circuit with its own primary dipolarity and newly transferred "separate source dipole". *By such adroit use of electron gas relaxation time, we can use one source dipole to freely make another of equal intensity, without any depletion of the first.*

The difficulty is in getting the Fe-Al alloy wire, which must be made in an inert atmosphere since Al corrodes easily and the two elements have very different melting temperatures.

Alternatives can be visualized, such as to utilize a capacitor whose plates are made of the Fe-Al alloy. This might be useful in the triode-capacitor, to be discussed next. A series of pulses might then be used to charge the capacitor, without depletion of the primary source dipole in the external source of potential, if it is repeatedly switched in and away. An interesting question arises if such a capacitor with tailored "hysteresis" in its charging is utilized in various circuits and schemes containing a coil of useful time delay also, particularly since the electron gas relaxation phenomenon involves decaying oscillations. Interesting phase angle results can be constructed in such circuits, but we leave the resolution of this question to future experimenters.

6.3.7 The Triode-Capacitor and Other Curious Components

See Figure 6-17. In this rough concept by the present author, the notion is to implant a grid of very small copper wire mesh inside the dielectric and near one or both of the capacitor plates, and then to utilize grids as if they were grids of a triode tube, for gating and controlling the displacement current in the capacitor and the dielectric strain. As an example, when charging the capacitor, the grids can be used to increase the displacement current (which also increases the voltage on the capacitor and dielectric strain). This increases the charge and energy in the charged capacitor, without putting in as much "enhancement and gating" energy as the extra energy obtained in the charged capacitor. If desired, we can also

incorporate the 2% Fe-doped Al wires in the grid, or connected to it, to further move the grid toward a "pure current-free potential" operation.

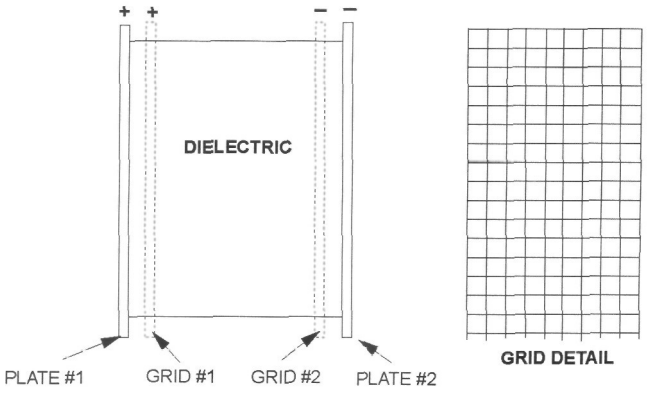

Figure 6-17 The triode-capacitor concept.

The scheme is that a voltage on this grid will intercept only a small current during charging of the capacitor, but can have an appreciable voltage upon it. The charging potential is placed across the capacitor, and simultaneously the grid has a similar potential placed upon it. The external source of charging potential is then disconnected, and the capacitor charges with more energy rearranged in its circuit than the energy one dissipates in the grid. The similarity to an old vacuum tube triode is apparent. For the purist, additional grids with tetrode and pentode functions can also be added.

One or more inventors has unwittingly tried to approach this in one way or another, but have not directly incorporated this schema and have not used the grid. They do not seem to have obtained positive results with those different schemas without the grid, nor have they specified the difficulties and phenomenology encountered, etc. We were curious about possible results of combining this (the triode grid in the capacitor) with the known elimination of capacitor losses by appropriate pulse charging {406a-b}. It seems that experimentation and research with the triode capacitor and its variations is definitely indicated.

We were also curious about the Davis non-inductive resistor {407a}, which is a special kind of "capacitor" that becomes an inductance-free resistor. One may argue that the resistor may be multiply inductive after all, though it is *net* noninductive. It may well be "equally and oppositely

inductive," which is quite a different thing altogether, since it produces an artificial stress potential (and in the presence of AC, it produces a longitudinal EM stress field wave) in spacetime even though it produces a *net* zero reactance. In short, it produces a Lorentz-regauging, directly, and this can be a varying Lorentz regauging producing longitudinal EM stress waves. Whether this odd characteristic can be utilized in a COP>1.0 process remains to be seen. Preliminary indications are that it can be so utilized.

The various versions of the biwound coil, wound with two conductors at once and then the currents passed through the conductors in opposite directions, also presents interesting capabilities. Here again, it is multiply inductive, but may be tuned and adjusted to be *net* noninductive. We strongly suggest comparison with the well-known hairpin dual dipole antenna.

In short, this biwound coil arrangement — with various variations — can produce (and modulate) a magnetostatic scalar stress potential in the local vacuum and, in the case of AC, a longitudinal EM wave. This would appear to be a direct change (and oscillation) of the stress potential of the vacuum itself, which can be decomposed via the Whittaker process into a harmonic set of phase conjugate longitudinal EM wavepairs. The potential longitudinal EM wave communication possibilities can be seen, although one might require a Fogal transistor to receive the longitudinal EM wave modulations of such signals.

Further work in this area of unusual capacitors and components is left to the interested reader for his or her experimentation and research.

6.3.8 A Surprising Thing About Thermodynamics and Reservoirs

Thermodynamically, it is fashionable to state that one cannot take energy from a reservoir at constant temperature. That is true for *equilibrium* conditions, but not for *nonequilibrium* conditions {408}. That is, we cannot take energy from a reservoir *in equilibrium* at constant temperature. We can indeed take energy from a reservoir at constant temperature *but not in equilibrium.* More exactly, we can take energy from a nonhomogeneous reservoir at constant temperature.

We quote Hsu-Chieh Yeh {409} for a vivid statement of this little-recognized fact:

> *"From Planck's statement of the second law of thermodynamics it is generally inferred that it is impossible to construct an engine which produces work at the expense only of heat taken*

from the air or the ocean. ...[It is demonstrated that]... when the air and the ocean are combined as a nonhomogeneous reservoir of uniform temperature, it is possible to construct an engine which produces work by extracting heat from the said reservoir. This does not constitute a violation of the second law of thermodynamics, rather that the "reservoir" in the Planck's statement must be clearly stated as being in equilibrium."

Yeh's article falsifies the general, mistaken inference that Planck's statement of the second law of thermodynamics requires it to be impossible to construct an engine that produces work at the expense only of heat taken from the air or ocean. The experiment described in Yeh's paper demonstrates that when the air and the ocean are combined as a nonhomogeneous reservoir of uniform temperature, it is possible to construct an engine that produces work by extracting heat from the said reservoir. This does not constitute a violation of the second law of thermodynamics, but rather shows that the "reservoir" in Planck's statement may be in equilibrium or disequilibrium, and the statement holds only for the equilibrium case. Also, an entire reservoir can be in "overall" equilibrium, but in raging disequilibrium between various parts of itself. Classical thermodynamics only applies with the reservoir or part of it that is used by the system in its supersystem, when that part is in equilibrium.

We bring this out to show the analogy to our concept of the two additional components of the supersystem as the "reservoir" or external environment of the system itself.

We also point out that the concept of temperature itself is not strictly defined under disequilibrium conditions, as pointed out by Gabriel Laufer {410}.

The proof and a schematic diagram of a machine to do just such an energy extraction process at constant temperature in an environment in disequilibrium are shown by Yeh {408}.

6.J.9 Latent Heat Work of the Correas

In addition to their glow discharge work previously discussed, Paulo and Alexandra Correa have demonstrated a method to optimize some anomalous form of energy from the sun, which transduces into heat, producing an anomalous T_0 - T difference registered in Orgone Accumulators[178] invented by W. Reich in 1939-1940. They have also

[178] This is Reich's terminology, not used in conventional physics. We suspect that proper application of quantum field theory with its four photon polarizations could

employed the optimized difference in this "latent" heat — their term — to drive a low dT Stirling engine of the MM6 type, to perform free work {41 la-b}. The Correas employ their own new theory of the aether {412} to explain the effect.

Against the assertion that this is just normal solar energy warming, they have demonstrated the successful driving of the Stirling engine for several hours during nighttime {413}. With their latest improved version, they report speeds of the Stirling engine of 150 rpm during daytime (with dT values reaching 22.5° C), and speeds of 30 to 80 rpm during nighttime (with dT values of 3.1 to 9° C). There appears to be no obvious standard thermodynamic explanation or standard theory to explain how the anomalous heating occurs — although once it does occur, the explanation from then on is thermodynamically normal.

The Stirling energy is driven on a difference in temperature created between the top plate and bottom plate of a box by this anomalous energy. It is the production of the heat that is anomalous, not the driving of the engine. For comparison, imagine a bank of solar cells that would somehow operate at night, when no normal radiation from the sun was striking them. The Correa effect demonstrates such an anomaly.[179]

Dr. Eugene Mallove, an excellent scientist with impeccable credentials, has personally observed the Correa accumulator system driving the Stirling engine, and has examined it inside and out {414}. Though small, the heat and the motive power are real and the engine is really driven, in the absence of any kind of conventional batteries or other known power source.

be applied to transform the notion of "orgone" energy into specialized EM energy. We further suspect that orgone energy is really the transduction of the time-polarized photon energy into normal photon energy. We are assured by quantum field theory and the giant negentropy solution to the source charge problem that the instantaneous scalar potential involves this process.

[179] We point out that local regions of the sun may well produce Aharonov-Bohm effects, and probably do. Such reactions in the sun would localize some of the B-fields and emit curl-free magnetic vector potential radiation into space, striking the earth. Close examination and analysis of the possible reaction of uncurled A-potential radiation with the accumulator box and plates in the Correa process might yield a novel mechanism for the observed heating (scattering) effects, including the difference between daytime and nighttime levels, periodic variations, etc.

While the Correas utilize some of Reich's orgone and aether terminology, they are quite aware that the energy being converted is not normal transverse EM wave energy. Quoting {415}:

> *"Aetherometry demonstrates that what traverses space is not transverse electromagnetic radiation (and certainly not sensible heat), but longitudinal electric ambipolar radiation emitted from the sun. All that electromagnetic radiation consists of is a local production of photons (for those who care to listen): aether energy is not composed of photons, actual or virtual."*

We can generate sympathy for that statement, although we would still not rule out time-polarized (scalar) photons and longitudinal photons from quantum field theory, each of which is individually nonobservable, but when paired the two comprise an instantaneous scalar potential. As we previously discussed, the classical notion of the EM force fields E and B implicitly assumes interaction of the unseen causal "field-as-it-exists-in-massfree space" with charged mass having been accomplished, with the E and B being the 3-effect of this interaction after observation. Thus these force fields E and B are 3-effects (after interaction and after observation) rather than 4-causes prior to interaction and observation. We suspect that the Correas are trying to get at the causal 4-photon, rather than the usually assumed 3-photon. Further, a virtual photon spends much of its time existing as a dipole comprised of a virtual electron and a virtual positron. Therefore it spends much of its time in the presence of the giant negentropy 4-circulation, involving transduction of time energy into spatial energy and vice versa. It is this negentropy circulation represented by the virtual photon (or accompanying it, whichever one chooses) that the Correas are confronting as the "aether energy".

As previously discussed, an analysis of the Drude electrons in the electron gas of a detector builds a convincing case for EM waves in space existing in longitudinal EM waves, *if the spinning and longitudinally restrained electrons precess and act as gyros.* The detected transverse EM waves are in fact transverse precession waves of the gyro-electrons when perturbed by incoming longitudinal EM waves (longitudinal photons appearing in 3-space from the time-domain's scalar photon couplet). As Feynman put it {416},

> *"We may think of E(x, y, z, t) and B(x, y, z, t) as giving the forces that <u>would be</u> experienced at the time t by a charge located at (x, y, z), <u>with the condition</u> that placing the*

charge there did not disturb the positions or motion of all the other charges responsible for the fields."

The E and B force fields — and transverse photons — are not the form in which EM energy *causally* exists in 4-space prior to its interaction with charged mass. In that causal form, EM energy seems to exist in field-free form, as a direct curvature of spacetime — at least in Sachs's unified field approach. Further, this form may be represented as the causal precursor of longitudinal EM waves accompanied by time-polarized EM waves.

We will not repeat our past discussion of the great necessity to change the very notion of "propagation through 3-space", but that is the issue. In our opinion, the Correas have had to struggle with the use of this causal EM energy as it exists in 4-space prior to interaction with charge and prior to observation. Hence their view is solidly based that the photon does not exist until after the interaction — which in fact has much support once we remove the still-present assumption in classical electrodynamics that a material ether exists.

Our own recommendation is that this anomalous energy should be deeply investigated with the view that all EM energy in 3-space comes from the time-domain and the 3-space aspect is in terms of longitudinal photons, as we have proposed in our solution to the source charge problem previously cited. That is the only way that the nature of the EM wave in vacuum can be reconciled with quantum field theory's findings {19} and with Whittaker's decomposition of the scalar potential {85}, slightly corrected {12}.

Mallove also points out {417} that, if this aether energy view of the Correas has validity, it *"...suggests that physics is not just wrong, it is profoundly wrong — catastrophically wrong about even the most fundamental questions of existence, such as: 1) Is there an energetic aether? and 2) What is the nature of light?"*

We profoundly agree with Mallove's observation, and we believe we have explained the reason why physics is indeed profoundly wrong (widely substitutes effect for cause). Further, classical physics is decidedly wrong about the nature of light — from quantum field theory, experimental proof of superluminal communication, and action-at-a-distance effects.

In our view, the Correas presently have a replicable experiment that, once independently and thoroughly investigated, may force a deeper examination of the foundations of physics. Hopefully, the Correas'

experiment and others like it will finally force the separation of effect from cause, presently so mangled in physics and particularly in electrodynamics.

If the National Academy of Sciences and the National Science Foundation can be convinced of the horrible manglement of cause and effect in physics and especially in electrodynamics, perhaps they may yet wake from their long slumber and get the foundations corrected to eliminate such non sequiturs. If so, we shall have a magnificent new physics as a result.

If not, then the NAS and NSF will continue to profoundly reduce the security of this nation, since several nations have already made and weaponized such corrections to physics to produce what is called "energetics". Further, extraordinarily powerful energetics weapons have **already** been developed and deployed (and even employed), putting the U.S. at a strategic disadvantage because of the continuing reluctance of the NAS and NSF to correct the glaring and extraordinary errors in both physics and electrodynamics — and especially in electrical engineering.

Meanwhile, we believe that the work and experiments of Paulo and Alexandra Correa are at the forefront of capturing and transducing energy from the vacuum, in whatever form one chooses to consider the vacuum energy itself. They are also pointing the way to the corrections and changes necessary in the "old physics" if we are to better understand the world we live in.

6.3.10 Swiss Overunity Converter

We must also include the "Testatika" devices invented by Paul Baumann in **a** religious commune, Methernitha, adjacent to the village of Linden in Switzerland[180]. Figure 6-18 shows one of the machines, which over a period of 20 years were developed in various output sizes up to 30 kilowatts. Once started, the device is self-powering while also powering a very substantial external load (up to 25 kW). Many engineers and scientists have observed the machines in observation, examined them, and measured one or more in operation, so there is little doubt of their **authenticity.**

[180] The website for Methernitha is www.methernitha.com. One may read the statements of the religious group for oneself.

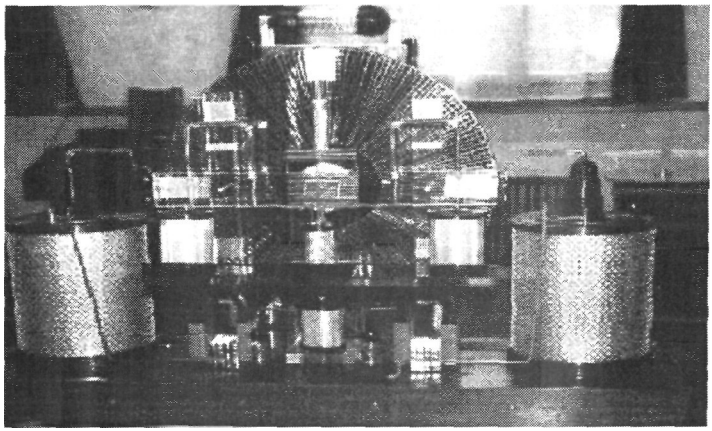

Figure 6-18 Swiss Methemitha machine.

However, there the science stops and mysticism and speculation begin. The religious commune releases no real details, except deliberately tantalizing clues. When questioned, the reply is that humankind in its present state cannot be trusted with such free energy. Almost all those examining the device have thought in ordinary electrical engineering terms, so very little comes from their examination because standard electrical engineering does not contain any theoretical explanation of COP>1.0 electrical power systems whatsoever. Baumann himself sometimes cryptically replied that his study of lightning discharges in nature gave him the operational principle. As we shall see, that may indeed be a very substantial clue as to the possible technical COP>1.0 mechanism, and one that does not exist in conventional classical electrodynamics.

The Methernitha (Baumann) machine resembles a Wimhurst machine with contra rotating static wheels, made of plastic or other insulating material with copper ribs and structures on one side and aluminum on the other. Use is made of the discharge into and from large capacitors and large coils. Also, at least one horseshoe-shaped permanent magnet assembly at the bottom is utilized. The major operating feature seems to be the contra rotating disks of a "Wimhurst" static generator machine, a magnetic field at right angles, and the sharp discharge of high voltage into and from large capacitors and large coils. The voluminous material on the Internet and in articles about the machines is mostly of little real use in contributing understanding or in proposing any legitimate mechanism.

We have not "solved" the machine's mechanism, since that would require close study of the device for a protracted time, and there has been no opportunity or time for that — although Baumann invited this author to come and see the machine some years before he died. Regrettably, I was unable to make the trip, and Baumann himself has now been dead for some years. We will therefore offer some technical suggestions pertaining to mechanisms that may be operating in the machine (or others like it).

First, we call attention to a paper by Aguirregabiria {418}. Quoting:

> *"An ohmic ring that rotates with constant angular velocity in an external uniform magnetic field is considered as a simple model for a current generator. Under the assumption that all quantities vary slowly in time, the lowest-order approximation to the surface charge density is found. The flux of the Poynting vector through the loop surface is also computed. Unlike the examples that are given in textbooks, this flux is not always incoming: It has the outgoing direction around the loop parts where the electrons are moving against electrostatic forces."*

In other words, contrary to textbooks, there are positions where such a ring produces currents in one direction, and positions where it produces current in the other direction — *in fact moving against the voltage and E-field, and thus serving as a true negative resistor in those latter regions.* This may be a profound clue to the negative resistor operation of Baumann's machine.

This unexpected negative resistor effect is in theory usable to provide a true negative resistance. If there are transformers in the machine (and there are in some of them at least), then if a true negative resistor were used as an external shunt across the external circuit connected to the secondary of a transformer, the transformer could be operated as a true COP>1.0 device. The back-field connection from secondary to primary would be reduced by the fraction of the return current to the secondary that is shunted in parallel to that current "pumped" back up through the secondary.

This should be considered as an important possibility in the Baumann machine's operation.

Second, a charging and discharging capacitor involves not only energy flow in a direction perpendicular to the plates, but also an energy flow in a direction parallel to the plates {419}. Each of the rotating "plates" is actually a rotating capacitor of sorts, with a dielectric between two plates

of special construction and dissimilar metals. The dielectric and the plates thus involve a complex intermingling of the negative resistor effect, a positive resistor effect, magnetic energy flows (both in entropic and negentropic manner in various regions), etc.

Baumann once handed two dissimilar plates, with a dielectric between them, to an engineer who measured it and found a startling several hundred volts across the plates! To date, no one is known to have been able to reproduce that effect.[181] We suggest that, if the dielectric material is layered and photorefractive in nature, it may be related to the negative resistors built by Chung {420}. If so, the physical pressure of the plates against the layered dielectric may also be quite important. By varying this pressure, Chung and her team found that their device could be made to exhibit negative resistance, positive resistance, or zero resistance. This leads us to speculate that Baumann may have used a "stressed dielectric" capacitor as a device having a built-in negative resistance. In that case, build-up of such a surprisingly high voltage would indicate high stress locked into the negative resistance dielectric.

We also call attention to a paper by LaPointe {421}, which will be discussed later under inertial propulsion and antigravity. Essentially, true Dirac hole current in the adjacent vacuum/space can be generated by powerful electrical discharges, particularly from capacitors or coils. When the unaccounted Heaviside energy component is also considered as well as the Poynting component, LaPointe's despair at the difficulty of obtaining sufficiently large voltage gradient across a very tiny distance is dispelled.

[181] We are reminded, however, of the peculiar phenomenon that can occur in large power capacitors stored on a warehouse floor. If their leads are not shorted, the capacitors will build up a self-charge gradually, and this can become quite lethal. For that reason, such large capacitors when stored will have their leads shorted, to prevent this "free cumulative charge and energy" from appearing and posing a serious hazard. To our knowledge, there has been no complete scientific explanation advanced for this "self-charging" effect in large storage capacitors. Our own hypothesis is that it is probably an effect of unaccounted Heaviside nondiverged energy flow components associated with various field/charge interactions in the area and with ordinary Poynting EM energy flow in the area, including within the earth itself. Further, with respect to the surface of the earth there is an increase in potential with altitude. Hence from any point above the earth's surface and a point on the surface, there exists a dipolarity and a "Kron open path". The broken symmetry of that dipolarity means that within it a continuous 4-circulation of EM energy flow occurs as well as point-dipole polarization.

If this speculation holds, then in examining lightning strikes and their more bizarre phenomena, Baumann may well have hit upon the fact that such discharges also generate negative energy as well as positive energy, although it appears that the technical concept of negative energy was foreign to him, at least in such terms. In short, he could have been unknowingly charging his large capacitors by Dirac sea hole currents, somewhat similar to Bedini's process.[182] In that case, most of the "negative resistance" operation could be explained by Baumann's transduction of large bursts of negative energy into large bursts of positive charging energy and current in his capacitors.

Or, said another way in terms of Aguirregabiria's effect, Baumann may simply have been charging capacitors in that "negative resistance" Aguirregabiria region where the current does flow backwards against the voltage.

At least we have proposed some known though rare phenomena, which Bedini and my four colleagues and I have discovered in independent efforts. We strongly suggest that the Baumann device may unwittingly incorporate several of these mechanisms, but that neither Baumann nor the other members of Methernitha seem to have any technical notion of them.

With that, we leave it to the interested researcher to perform his or her independent Baumann-type system experiments and build-ups. Eventually, as is always true in science, the experiment must determine the truth of what is really happening. Given the successful experiment, then a model must be contrived or fitted that (i) explains the new effects produced, and (ii) complies with normal EM operation of normal COP<1.0 systems.

6.4 Some Magnetic Processes of Interest

There are some 200 or more magnetic effects in the literature, and only about half of them are well understood. Of the remaining half, some are

[182] Bedini and the present author have filed a patent application upon this exact m**echanism** and process, and typical embodiments for accomplishing it. Bedini discovered the effect and used it for two or more decades, and after some intense struggle with the problem I was able to find the exact technical mechanism, including literature justification. This becomes a system to close-loop a "unitary" **type** of COP>1.0 system, which is covered in the patent application also. A different s**ystem** can be used to close-loop a non-unitary COP>1.0 system, and that method is contained in the second MEG-type patent application of my four colleagues and I who invented the motionless electromagnetic generator (MEG).

partially understood and some are not understood at all. The COP>1.0 researcher interested in magnetic systems would do well to study magnetic materials science {422a-422c}, known magnetic effects, and particularly those magnetic effects that are still anomalous such as in leading edge superconductivity research. The new area of *spintronics* {423}, e.g., is rapidly advancing and will have future impact on COP>1.0 magnetic systems. We do not further discuss spintronics in this book, but merely call this rapidly emerging area to the attention of the interested COP>1.0 researcher.[183]

Let us examine a very few magnetic effects of interest, as a sampling of what we are referring to.

6.4.1 Self-Powered Magnetohydrodynamic Motors

Interesting self-powered magnetohydrodynamic motor work has been shown by Bednarek {424}. He shows a multi-branch rotor in a galvanic cell composed of sulphuric acid electrolyte with copper and zinc electrodes. The unit develops an emf of about 1 volt, with the rotor placed in a vertical magnetic field such as from a large rectangular permanent magnet, where the field of the magnet is a few teslas in strength. The electrolyte and the rotor revolve in opposite directions. To change the direction of revolution of the rotor, the magnetic field direction is reversed. A linear self-powered magnetohydrodynamic motor is also shown, and has a similar principle of operation.

The interesting point is that these motors work, but less efficiently, when a water solution of table salt is used as the electrolyte. With the worldwide availability of seawater, this becomes an interesting possibility of "renewable energy" application. We leave it to the reader to further investigate this proven experimental technology as desired and to determine its practicality.

6.4.2 Multivalued Magnetic Potential

Conventional system designers work with conservative fields, as shown in Figure 6-19. Conservative fields arise from a single-valued potential — a potential that has only one value at each point in 3-space that it occupies. Consider a rolling ball of mass *m* on the "oval track" shown in Figure 6-19, starting from point A and rolling on the right side path. With the ball at

[183] For technical information, see (a) Michael Ziese and Martin J. Thornton, Eds., *Spin Electronics*, Springer-Verlag, 2001; (b) D. D. Awschalon, N. Samarth, and D. Loss, Eds., *Semiconductor Spintronics and Quantum Computation*, Springer-Verlag, 2001.

rest at point A, we give it a slight push to velocity V_i adding kinetic energy $K_i = 1/2\ m(V_i)^2$. At point A, the ball has its maximum potential energy P_A due to gravity.

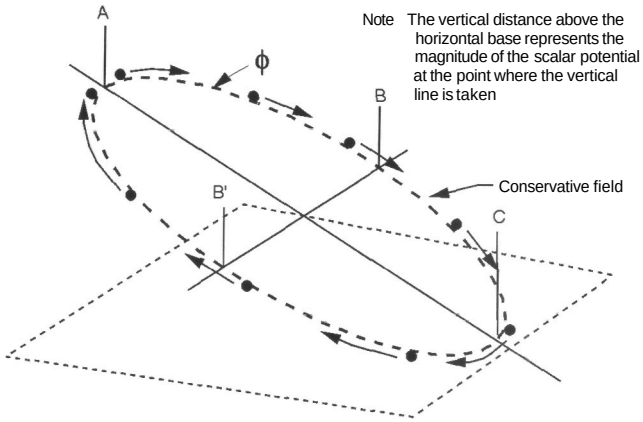

A circular closed path in potential ϕ is given by A-B-C-B'-A
Line integral from A around any closed path back to A is conservative
Along path A-B-C, work W(1) may be extracted from rolling ball
Along path C-B'-A, must do work W(2) on ball, where W(2) = - W(1)

Figure 6-19 Conservative field use (single-valued potential).

As it moves to the right because of our push, the ball will accelerate due to the force of gravity and increase its kinetic energy until it reaches point C at the bottom, reaching its maximum linear velocity Vc and kinetic energy Kc at point C. Its change (PA - Pc) in potential energy at from point A to point C has been converted to kinetic energy $[\frac{1}{2}\, m(V_1)^2 + \frac{1}{2}\, mVg^2]$ at point C.

Continuing on around on the left half of the path, as the ball rises toward A again, the portion $(P_A - P_C) = \frac{1}{2}\, mVg^2$ —of the ball's kinetic energy at C that was added by the force of gravity from A to C — is returned to potential energy P_A. The ball reaches its lowest kinetic energy $\frac{1}{2}\, m(V_1)^2$ at A and also its lowest velocity V_1. For a perfect lossless system, once started in motion the ball would rotate around the track indefinitely, freely changing potential energy into kinetic energy and then back to potential energy. Nevertheless, it would not do any outside work, for that would represent losses or dissipations of energy from this conservative system. Consequently, the ball would quickly run down if work were being done, even if the system were otherwise "perfect".

If one integrates the change in potential energy around the track, the net change in potential energy is zero. The work done on the ball by increasing gravity to increase the ball's energy in one half-cycle, is taken back from the ball back when it climbs back out into decreasing gravity in the other half cycle. If one integrates the changes in kinetic energy around the track, once the initial velocity and kinetic energy are produced by outside forces in a perfect system, the net change in kinetic energy is zero. Of course, it is easily seen that the ball gains kinetic energy on its downward half of the track, and then returns the kinetic energy on its upward half of the track.

This situation is said to involve a *conservative fields* and the system will not produce any net energy to use as free work. Indeed, a real system will almost always have some friction and other losses around the path {425}, so the ball will gradually lose net initial energy given it, slow down, and eventually come to rest at point C, the lowest potential energy of the system.

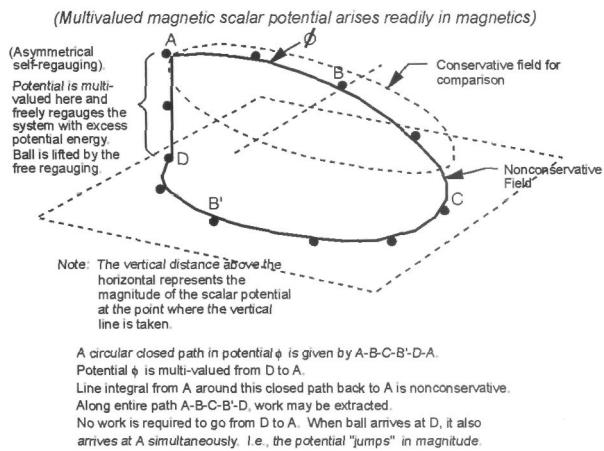

Figure 6-20 Field may be non-conservative for a multivalued potential.

A charge circulated through a closed current loop circuit also moves through a conservative field region in similar manner. Hence, there is no net excess energy input available for such a conventional circuit. It follows that one must arrange for inputting all the input energy (intercepted and collected by the circuit) that is then dissipated from the circuit's loads and losses. Unfortunately, half the collected circuit energy also goes to destroying the dipole, with less than half powering the load. Therefore, that circuit always exhibits COP<1.0.

Now see Figure 6-20, where we provide an analogy using a rolling ball around a circular track, in a gravitational potential. In this case, the potential has a multiple magnitude A and D at point A-D, which is the same point (we plot a point in the potential's magnitude, not a point in 3-space, although there can be close approximation).

Approaching magnitude D from point B', the value of the potential is steadily reducing and is much lower prior to reaching A-D than it was when leaving magnitude A. During this phase, the ball is gaining kinetic energy from the gravitational potential, and can be used to perform useful work (up to all the energy gained, in a perfect system). Upon passing through point A-D, instantly the ball is again at point A on the right. We accent that the "instantaneous jump" on the diagram represents a free insertion of excess energy (asymmetric regauging energy) from outside the system. Rigorously that is a broken symmetry, which also breaks the internal energy conservation of the system. In short, the "ball" has been instantly "lifted" (in this simplified analogy) back to a higher potential by a free insertion of excess energy from the external environment. The main point is that a surge of potential energy into the "ball system" occurred, freely input by nature and the environment. The system can now go through the "doing work" routine again, traversing from A back to D and through it.

Note that this is a nonconservative system, because it continually receives a free and sudden input of excess energy from its environment. So this system — because of its broken symmetry — can continually do work and keep on going.

Indeed, so long as that free energy input from the environment occurs without fail, this is a "self-powering" system, completely complying with **the** laws of physics and thermodynamics. It violates the equilibrium thermodynamics because the system is periodically not in equilibrium with its environment. Consequently, the system can exhibit those five magic functions we spoke about previously. It can exhibit (i) self-organizing (in this case, freely getting that little ball from low potential energy D back to high potential energy A), (ii) self-oscillation or self-rotation (the ball will continue to go around and around the loop, even doing a little work in the process), (iii) output more energy than the operator inputs (in this case, the operator is not inputting any energy at all, so the energy output is indeed more than the operator furnishes), (iv) power itself and its load simultaneously (all the energy is being input from the external environment at the insertion of excess energy at point D to move the ball **back** to position A), and (v) exhibit negentropy.

This is an analogy to a nonconservative field and a multi-valued potential. In the case where a potential has discontinuous values at a single point, with the value depending upon whether the detecting charge (the "ball", so to speak) is to the left or to the right of that point, one has a *multivalued potential.* This multivalued potential actually represents a change of potential energy in the system, freely occurring without operator input. In short, it is an asymmetrical self-regauging, violating Lorentz's symmetrical regauging condition.

Actually, multivalued *magnetic* potentials arise naturally in magnetics theory, but —foolishly, in our view — theoreticians do all in their power to minimize or eliminate their consideration {426a-k}. They consider such a nonlinear change as being embarrassing and troublesome, and to be gotten rid of at all costs! However, if deliberately used and optimized, rather than eliminated, incorporating a multivalued magnetic potential can provide a *nonconservative magnetic field* (analogous to the illustration), where $\int \mathbf{F} \bullet \mathbf{ds} \neq 0$ around a rotary permanent magnet loop. The multivalued potential represents a broken symmetry that further produces a nonconservative field.[184] In theory, such use of the multivalued potential and the resulting nonconservative field can enable a "self-powering" permanent magnet rotary engine, operating as a negative resistor freely extracting and using magnetic energy from the broken symmetry in the system's energetic exchange with the active vacuum.

However, note that the multivalued potential represents a point of sharp "self-regauging asymmetrically" by the circuit, with the regauging potential energy coming from the external environment. It requires that some external process in the exchange between environment and system must be automatically invoked at the multiple-value point, so that there is a sharp and sudden entry of excess potential energy received by the circulating ball (or by the circulating charges in an electrical circuit, or by the circulating flux in a magnetic circuit).

One such means of evoking such a sudden surge of excess energy at a point, momentarily, is given by Lenz's law, as discussed in the magnetic Wankel engine. Another means is by Johnson's sudden evocation of the

[184] In physics, the appearance of a force and its subsequent action to perform work is nature's way of restoring symmetry to a situation where symmetry has been violated. As can be seen, the net force can be used to translate something (such as current) and do work, thereby dissipating the excess potential energy received from the broken symmetry condition.

exchange force, which momentarily can produce a pulse of energy density even several hundred times as strong as the usual field energy at that point. For example, imagine that the ball in Figure 6-20 represents a magnetic rotor in a magnetic potential represented by the height of the ball above the dotted line base. The point (D-A) then represents the results of the system having suddenly injected an instantaneous exchange force at point D, to freely increase the potential and potential energy of the rotor system back to point A. The rotor is immediately lifted back at its starting potential energy situation at point A, freely, by this sudden and free evocation of the exchange force. We will briefly discuss the exchange force in our discussion of the Johnson engine.

6.4.3 Dromgoole Effect as an Example of a Novel Magnetic Effect

An example of a novel magnetic effect is the *Dromgoole effect* {427}. This is an interesting phenomenon where a voltage placed on a solenoid wrapped around a longitudinally magnetized iron wire may be increased up to 300 times in magnitude by twisting the wire through 90 degrees. If a scheme can be worked out whereby this dramatic increase in voltage potentializes and moves very substantial current, then perhaps the extra output can — at least momentarily — produce more output energy than the work required to twist the wire.[185] At least that could be a working hypothesis from which to launch experiments to see if it is possible.

The reason this may be possible is that any amount of energy W one wishes can in theory be collected from any finite potential intensity ϕ, according to the simple equation $W = \phi q$, where q is the collecting charge exposed to and interacting with the potential intensity ϕ. In the case of magnetics, q is analogous to the pole (magnetic charge), where the north pole is positive magnetic charge. The ϕ then becomes the magnetostatic scalar potential.

So if we can produce ϕ with only a little expenditure of energy, and then have that ϕ potentialize a very large amount of charge q, we can collect upon the charge q much more energy than what we ourselves expended. The ϕ produced is a change to the local vacuum potential, and hence the collection of energy W on charges q is actually a collection of EM energy from the local altered vacuum potential itself. Any potential we make

[185] The scheme must prevent *at least an appreciable fraction* of the spent electrons- from the external circuit and load — from being forcibly rammed back up through the coil against its back EMF. Otherwise the Lorentz symmetry condition applies and the arrangement will not produce COP>1.0.

becomes a change to the local vacuum potential, and hence a change to the local active vacuum. That does not seem to appear in electrical engineering, which model does not even incorporate modeling the active vacuum or its potential, much less a change to it.

While we discuss a few interesting magnetic effects in this paper, there are many more. The interested researcher is referred to such easier sources as Burke {428} and Cullity {429}. For more complex scientific sources and explanations, other publications are available {430a-430r}. In addition, it is helpful if the researcher is aware of some of the foundations problems in physics and electromagnetics {431a-431e}. Our point is that there are more than 200 known effects in magnetics, and only about half of them are well understood. For the other half, the understanding ranges from "partially understood" to "not understood at all." The latter half of the magnetic effects provides a rich ground for investigation by researchers seeking an asymmetrical self-regauging mechanism.

The COP>1.0 researcher must be prepared for an extended self-education period, and appreciable study and work. Some research discipline is highly recommended, such as starting one's own database and rigorously maintaining it up to date with one's latest interests. For the experimenter, a good lab notebook, meticulously kept and regularly posted, is an absolute necessity. Reading and searching the scientific literature is also highly recommended. It is not as simple as applying the principles one learned in university or technical school. Those techniques and principles are involved, but at some point in the circuit they must also be violated. Else COP>1.0 systems would long ago have been developed and marketed by sharp young students, graduate students, and post-doctoral scientists.

6.4.4 Exchange Force and Johnson's Approach

Refer again to our discussion of conservative versus nonconservative fields, above.

If one wishes to build a self-powering rotary permanent magnet motor, obviously one must evoke a condition whereby $\int \mathbf{F} \bullet \mathbf{dl} \neq 0$ around a single full rotation of the rotor (and where F is the instantaneous magnetic force between stator and rotor). For permanent magnets without any external switching, etc., that condition can only arise if an excess force is freely triggered by changes occurring freely in the magnetic materials themselves.

Fortunately, magnetic materials are almost always highly nonlinear, and **so** such self-triggering opportunities abound. They can occur because there are a multiplicity of mechanisms (dozens and dozens) going on

simultaneously in the materials of the magnets of both the rotor and the stator, and not just the standard polarity and field repulsion and attraction that electrical engineers use. These materials processes also involve direct and ongoing exchange of energy between the active vacuum and the local materials in the magnet.

The trick is to take one of these automatically ongoing processes that is already there and freely available but just not adroitly used, and deliberately evoke and enhance it to induce excess energy at the appropriate time, with a force in the appropriate direction. In simple terms, if you have eight more horses available to put into the harness to pull the load, and you only have two normal horses but wish to pull more load, then by all means you should hitch up and use at least one more additional horse, and take him from the six that are usually just standing by and not working at all. They may run back and forth a bit, while watching the others work, but that of itself contributes nothing.

One such additional force and free regauging mechanism always available is the exchange force, which can be checked in Feynman's three volumes of physics {433} and also in the reference by Cullity {429} previously **cited.** Good science dictionaries {432} also include helpful information. Reading the literature will add enormously to one' data base of effects and methods.

Howard Johnson's approach is to arrange highly nonlinear assemblies of geometrically asymmetrical magnets into complex configurations. At certain points in a magnetic field, these Johnson assemblies will trigger the sudden brief self-generation (actually a sudden release) *of exchange force* between stator and rotor. The exchange force is a known phenomenon {432, 433, 434}, though still not completely understood theoretically. It **can** be evoked asymmetrically by evoking electron-spin flipping, for example, which has led to the development of a new field of technology, s**pintronics.** *Microscopically*, the exchange energy is much greater than the magnetic field energy, sometimes by a factor of 10^3 to 10^4 {435, 436}. *Macroscopically*, the resulting exchange energy can momentarily still be many times the magnitude of the ordinary magnetic field energy; e.g., by a factor of 200, which Johnson often achieves.

If **the** stimulated momentary exchange forces are oriented to always add to the thrust upon the rotor in the "powering rotation" direction, then the **multivalued** potential condition and $\int \mathbf{F} \bullet \mathbf{dl} \neq 0$ are met. In that case, self-powering is permitted, if enough of these exchange force triggerings occur

so that the extra potential energy added to the rotor is sufficient to overcome the load and the losses being powered.

The self-triggering of each exchange force appearance produces an excess burst of force and energy[186] input into the system from its active supersystem environment. Thus, repeatedly the system is momentarily converted (in each exchange force burst) into an open system in disequilibrium in its energy exchange with its active environment, freely receiving excess energy from it. Because the exchange force "input energy burst" is short, multiple such "input bursts" must be used in a single rotation cycle so that the total energy input by all of them is significant.

In that case, COP>1.0 performance is permitted by the laws of physics, thermodynamics, and nature. Conservation of energy is not violated. Classical equilibrium thermodynamics with its infamous second law does not apply to the Johnson system, since the system is periodically an open system far from equilibrium and receiving excess energy from its active environmental exchange. *A priori* the Johnson system has increased its negentropy overall, and that negentropy (increased order or increased potential energy) can then be dissipated (disordered) to produce free shaft horsepower if the bursts of exchange force are properly coherent in direction and timing.

We diverge for a moment: As is well known, the equilibrium condition in a system is the condition of maximum entropy in the system; any disequilibrium condition reduces the entropy *a priori* because it is an excited state of the system containing additional potential energy. It is worth rigorously clarifying the infamous second law of thermodynamics. Quoting Lindsay and Margenau {437}:

> *"[The]...statement of the second law: (a) the entropy... is a variable of state, (b) Its value, for a closed system, can never decrease."*
>
> *... "Non-equilibrium conditions cannot be specified by variables of state, and their entropy cannot be computed. ...the condition of equilibrium is the condition of maximum entropy."*

[186] Technically speaking, the exchange force is not a magnetic field force, but a force that arises independently due to quantum mechanical considerations. Nonetheless, it is a real force arising in magnetic materials and affecting magnetic materials, as in permanent magnets.

In the first statement, the reader should note the assumption of a closed system in the first subparagraph, and the absolute requirement that the calculated entropy be a variable of state.

Also, the quotation can be falsified. Oddly, the "closed system" in classical thermodynamics is defined (illogically) as a system that does not exchange mass across its boundary, but may and often does exchange energy across it. We negate any absoluteness of that statement by Lindsay and Margenau by citing a counter example of a "closed" system with continuously increasing energy, fed by transfer of energy from the environment, and with no escape of the energy or very little escape of it. A specific example is a photon absorption by a mass particle. This system achieves increasing energy (order) as the process continues, hence achieves negentropy. This may be considered a fluctuation, of course, but it still places severe limitations on this law of thermodynamics and in fact negates any absoluteness of it. For such reasons, in this book we have redefined "closed system" as one that exchanges neither energy nor mass with its environment, and we recognize that there are no such systems in the universe. We have defined an "open system" as a system that exchanges either energy or mass or both across its boundary, so that we do not encounter the problem of the counter example cited. Further, general relativity requires an increase in the mass of any system that increases its potential energy, and a decrease in the mass of any system that decreases its potential energy. Hence energy exchange at all with the system, involves mass exchange since mass and energy are the same thing. The classical thermodynamic definition of a "closed system" has thus been falsified since 1915, with the definition becoming only an approximation rather than a generally valid definition.

In the second subparagraph of that first statement by Lindsay and Margenau, the reader should note that the closed-system assumption must be violated *a priori* if the entropy does decrease, and vice versa. If the system is broken into a set of subsystems, then the only way the entropy of the overall closed system to decrease is for one or more of the subsystems to be open (new definition!) and energy (order) to pass out of the system. Then an interesting thing emerges: For order (energy) to remain in the system as such, the subsystems taken as a whole must produce as much negentropy as they do entropy. Energy from an ordered subsystem can be emitted in disordered form, but then it has opened that subsystem and has entered the space between parts (subsystems) of the overall system. In other words, in a closed system, *any increase in entropy requires the subsystems to become open subsystems.* Again, the statement of this law of

thermodynamics eats itself. To stay in the overall system, this scattered energy *outside the subsystems* must then interact totally with another part of the system, and so on. This introduces disorder to the succeeding parts that interact. Therefore, the second law of thermodynamics itself *internally* violates its own "closed system" assumption because, to operate at all, the law requires continuing interaction between the active local vacuum environments and the subsystem components. In short, it requires a very special kind of overall or average equilibrium in an unavoidable energy exchange between the local vacuum and all the parts of the system. The source charge problem already demonstrates the universal violation of the second law and the thermodynamic definition of "open system", but both classical electrodynamics and classical thermodynamics have ignored this source charge problem for more than a century. Our solution to it was published in 2000.

Quite simply, there is no such thing as a truly closed system in the first place. Kondepudi and Prigogine come close to this statement in the following quotation[187]:

> *'Anyway, equilibrum thermodynamics covers only a small fraction of our everyday experience. We now understand that we cannot describe Nature around us without an appeal to nonequilibrium situations. The biosphere is maintained in nonequilibrium through the flow of energy coming from the sun, and this flow is itself the result of the nonequilibrium situation of our present state in the universe."*

In short, all systems on the planet — and we ourselves — are immersed in a nonequilibrium state a priori. Rigorously there is no such thing as an absolute equilibrium state on the planet, except as an approximation.

Now consider a perfectly insulated system, so that no heat can pass from the system outside it. An interesting constraint then exists on those "open subsystems" producing disorder (entropy). Unless equal reordering occurs in the subsystem-to-subsystem reactions, then disordering (heat) grows a priori. But this is not observed to happen in well-insulated systems approximating our theoretically perfect example! Otherwise, the temperature of a well-insulated system would increase until system rupture and failure. And experimentally that does not happen.

[187] Dilip Kondepudi and Ilya Prigogine, *Modern Thermodynamics: From Heat Engines to Dissipative Structures*, Wiley, 1998, p. xii.

It follows that, to maintain the internal equilibrium between subsystems and a constant internal temperature, a negentropic process is clandestinely involved. We submit that this process is revealed in our discovery of giant negentropy of the negative charge, and what may be said to be the giant entropy of the positive charge — i.e., in the discovery of the common " 4-circulation" of energy surrounding a dipole from the time domain to the negative charge of a point dipole in 3-space (thereby entering 3-space once emitted by the negative charge), thence to the positive charge of the point dipole, and thence back to the time domain. For a single charge, the well-known vacuum polarization provides virtual charges of opposite sign, to convert the "isolated charge" into a set of composite dipoles, as previously explained.

The second law of classical thermodynamics, considered in a more modern light, appears to conceal hidden giant negentropy and hidden giant entropy, in the ongoing 4-circulation of EM energy in the supersystem. *It is not possible to eliminate the supersystem or the interchange between its parts; particle physics told us in 1957 that there is no equilibrium of any system without this ongoing exchange.* Any thermodynamics attempting to discard the supersystem exchange (which involved both mass and energy) is at best an approximation for special "reasonably well-behaved" situations.

If the entire system is not in net equilibrium with the external environment (i.e., if there exists disequilibrium between the separated parts of the supersystem), then classical thermodynamics does not *absolutely* apply to that system. The system is no longer *absolutely* describable by "variables of state".

Those objecting to COP>1.0 in an EM system on the grounds that it would violate the second law of thermodynamics (which already violates itself), would be well-advised to restudy the very notion of the second law and the thermodynamics definition of *open system.* Compare relativity's equating mass as energy. Then ponder the thermodynamics of open systems far from equilibrium with their active environment. Every system in the universe is open, and it has an ongoing exchange with its proven active environment (local active vacuum and curved spacetime). This exchange Includes and exchange with every particle in the system. As pointed out by Lee: [188]

[188] T. D. Lee, *Symmetries, Asymmetries, and the World of Particles,* U. Wash. Press, Seattle, 1988, p. 46-47.

> *"...symmetry implies conservation. Since our entire edifice of interactions is built on symmetry assumptions, there should be as a result a large number of conservation laws. The only trouble is that almost all of these conservation laws have been violated experimentally. "... "...this difficulty could be resolved by introducing a new element, the vacuum. Instead of saying that the symmetry of all matter is being violated, we suggest that all conservation laws must take both matter and vacuum into account. If we include matter together with vacuum, then an overall symmetry could be restored."*

The *system itself is* always in disequilibrium; only the supersystem can exhibit equilibrium. The second law of thermodynamics specifically does not and cannot apply to a system far from equilibrium, because of its implicit assumption of overall equilibrium without the active vacuum exchange. Also, a deeper balance is required between the hidden asymmetries existing between the subsystems and their local vacuum (and local spacetime curvature.

Indeed, *one cannot even calculate* the entropy for a system that — overall — is far from net equilibrium with its active environment. We quote Lindsay and Margenau even more strongly {438}:

> *"Equilibrium states are the only ones that are capable of explicit analysis in thermodynamics... "*

And again {439}:

> *"... variables of state have meaning only if they define an equilibrium state. Hence the quantity we are seeking will be meaningless unless it refers to equilibrium states. "*

While we are at it, let us also address a serious flaw in the first law of thermodynamics. We again use Lindsay and Margenau for a succinct statement of the First Law {440}:

> *"First law of thermodynamics. A complete statement of the first law comprises two assertions: (a) heat is a form of energy, (b) Energy is conserved. "*

All that really says is that energy is conserved. It does not state that it is conserved in an object. It states that, whether the system is in equilibrium or not, energy is conserved. If heat is taken as disordered energy, then it

merely states that overall the energy is conserved, whether ordered or disordered with respect to some ordering criterion. It does not state that the disordering is conserved, and it does not state that disordering must increase or decrease. But *it does implicitly assume that all energy at some most basic level is ordered, else it cannot be energy (order).* So it assumes that, at higher levels, energy can be disordered (incoherent). However, at the underlying basic level, it is and remains perfectly ordered — else it could not remain "energy and could not be conserved. As an EM example, in so-called "heat", *every scattered photon retains its perfect order; it is only the photon ensemble that is "disordered".*

In short, each "basic piece" of energy is perfectly ordered, but the *ensemble* of the pieces may be disordered. Therefore, entropy applies only at a level higher than the basic energy quantum. Contrary to the assumptions of classical (macroscopic) thermodynamics, processes which directly engineer the basic energy quanta[189] — more exactly, the *action* quanta, consisting of *energy x time,* since energy cannot be "engineered" or changed in 3-space without also being engineered "in time" as well — are time-reversible. Hence they can be negentropic — simply because every observable system is "open" to, and in continuous energy exchange with, its active time environment (and also its active vacuum environment). Also, no system changes its spatial energy in any fashion, including ordering or disordering, without interacting with spacetime and spacetime curvature dynamics. It also changes its time-energy.

So in our view the notion of "disordering" and "disordering of energy" must be carefully reconsidered, as to exactly what is and is not being disordered, when the assumed "disordering" occurs, at what level it occurs, where and how the compensating reordering occurs, etc. We also point out that the simple discovery of giant negentropy {12} as the solution to the long-vexing source charge problem already removes the "absoluteness" of classical thermodynamics. Giant negentropy already violates the assumptions of classical thermodynamics at the elemental level in every physical system. Indeed, every charge in the universe already falsifies any "absoluteness" of the assumptions of classical thermodynamics.

This problem in the old classical thermodynamics has long been indirectly solved in particle physics, with the discovery of broken symmetry. As Lee states so clearly {441},

[189] Actually, energy is discretized, not quantized. Energy x time (i.e., *action)* is **quantized.**

> *"As we expand our observation, we extend our concepts. Thus the simple symmetries that once seemed self-evident are no longer taken for granted. Out of studies of different kinds of interactions we are learning that symmetry in nature is some complex mixture of changing plus into minus, running time backward and turning things inside out."*

We point out that a symmetry involves a conservation law, such as are stated in classical thermodynamics, and a broken symmetry involves a broken conservation law. So the discovery of broken symmetry in physics was a profound change affecting all physics, including the staid old classical thermodynamics. Lee further points out the new complexity of concepts {442} such as symmetry (which is behind every conservation law, including the first law of thermodynamics):

> *"At present, it appears that physical laws are not symmetrical with respect to C, P, T, CP, PT and C. Nevertheless, all indications are that the joint action of CPT (i.e., particle <-> antiparticle, right <-> left and past <-> future) remains a good symmetry."*

So unless the first law is stated in terms of modern CPT symmetry, it does not absolutely apply! Further, every charge is changing time-energy into spatial energy or vice versa. Yet there is nothing about time-energy and its transduction into spatial energy, or vice versa, in the present textbook statements of the thermodynamics. The term "heat" does not refer to the presence of energy at all, but to the scattering (disordering) and escape of energy.[190]

Considering heat as "energy of the system", or "heat energy" of the system, is a grand non sequitur. Rigorously, "heat" refers to the reduction of higher levels of ordering of energy, and since the gist of energy is ordering, reduction of ordering is the very antithesis of energy! "Heat energy" thus is an oxymoron. Before the "escape", there is no "heat energy" (ugh!) in

[190] Think closely: We never take the temperature of a "system"! We take the temperature of the disordered energy (heat) leaving that system or its subsystems. We do measure the effect of the emitted disordered energy. But that has already left the system and is in the local vacuum (a second component of the supersystem). Thermodynamics might be usefully redone more exactly in terms of the supersystem. We leave that task to some budding young future thermodynamicists for a recommended doctoral thesis.

the system at all. The energy is present in the system *not as disordering, but as ordering, a priori.* If it were in the system, it would not have escaped nor would it be escaping from the system. More energetic molecular motion, e.g., is actually more energetic ordering, simply at an excited state (of greater energy!).

We stress again (and strongly advise the researcher to read) Romer's strong objection to the use of heat as a noun {443}, and we suggest that the entire subject of classical thermodynamics needs a thorough revision to tighten up its terminology, correct its definition of closed system, eliminate its conflict between the first and second laws, and remove its inappropriate consideration of heat as "energy". Otherwise, the presentation and general interpretation of thermodynamics itself will continue to be one of the great confusion factors one encounters in trying to think clearly about extracting EM energy from the active vacuum environment to produce and utilize **COP>** 1.0 systems.

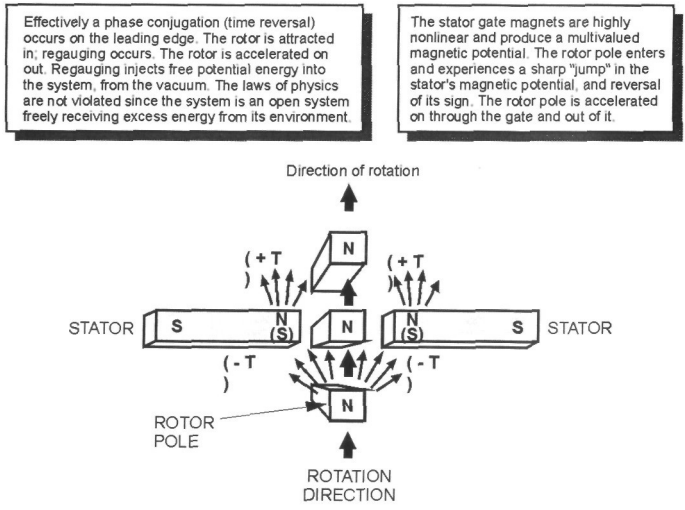

Figure 6-21 Concept of operation of Johnson's patented magnetic gate.

Johnson's approach produces a peculiar kind of multivalued potential. One **part** is conservative and of magnetic energy in nature, and the other part is nonmagnetic, being direct exchange force and energy effects on the **participating** atomic nuclei arising from quantum mechanical considerations. Nonetheless, the net *hybrid* potential can be multivalued at various points around the stator, and that is all that is required for broken

symmetry. If $\int \boldsymbol{F} \cdot d\boldsymbol{l} \neq 0$ around a closed path, regardless of which set of forces F represents, then that overall composite force field acting upon the rotor or object moving around the closed path is nonconservative. In that case, self-powering is permitted.

Figure 6-21 diagrammatically illustrates the operation of a nonconservative force-producing magnetic gate in Johnson's approach to a permanent magnet motor. As Johnson has shown, by using a multivalued hybrid potential (MVP) in his gates so that the resulting excess exchange force is properly oriented in direction and timing, a rotor magnet is attracted into a highly nonlinear stator gate region where the MVP is located. When it enters the MVP region where the exchange force is initiated, the rotor encounters a dramatic jump in the net potential with a change of polarity as the exchange force suddenly fires automatically. In turn, this produces a sudden accelerating tangential force in the region, usually against the prevailing magnetic force in the normal back mmf region!

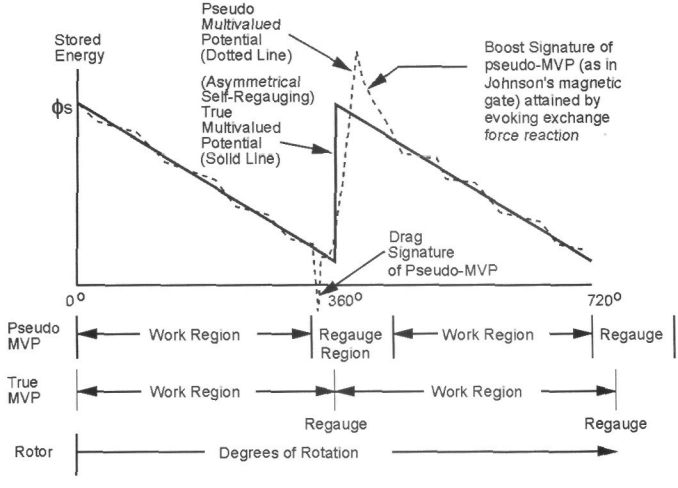

Note Single regaugmg per notation shown Johnson uses** multiple regaugings **per rotation

Figure 6-22 Johnson's "refueling" a permanent magnet engine by asymmetrical **self regauging. A multivalued potential is momentarily created by precisely evoking an exchange force reaction.**

Johnson often confounds professors of electromagnetics by showing them that his special gate can produce attraction between like poles, with a north rotor pole being drawn into a north stator pole in that exchange force region. This can be understood by tracing the spin field flow patterns, but

cannot be understood by simple "like poles repel and unlike poles attract". In short, Johnson knows he is adding a force completely different from the magnetic force the professors have in mind as the sole acting force. It is rather like pushing two like poles of two little magnets together. You can do it because an additional force — your mechanical force pushing them together — is acting and overcomes the normal repulsive force between the two poles.

The sudden exchange force burst produces a sudden accelerating tangential force in the normal deceleration (back mmf) region of the stator-rotor arrangement. In short, Johnson utilizes a deliberately evoked burst of exchange force to freely overcome most or much of the back mmf (back-drag) region. This in turn produces a net driving force around the rotor's complete rotation, because the overall field combination is nonconservative.

Rigorous force meter measurements taken at 0.01-second intervals prove that this occurs as the rotor enters and passes through Johnson's gate. The results of one such experiment are given in Figure 6-22.

Johnson thus uses highly nonlinear magnet assemblies of novel design to create a special kind of multivalued potential in his magnetic gate by adroitly evoking exchange forces — *extra quantum mechanical forces* in addition to the usual magnetic field forces. The MVP produces a sudden extra rotational force, backwards to the back-drag (back mmf) region of the stator-rotor magnet arrangement where the rotor magnet assembly is entering and passing through the conventionally repelling like-polarity situation. The result is that a net north rotor pole is seemingly attracted in[191] to the otherwise repelling stator north pole region, then accelerated out the other side by the normal magnetic repulsion.[192] Net drive force results, instead of a net zero force. Engineer Ken Moore, a close colleague of the present author, independently tested a Johnson gate and verified the net driving force effect {444} within the limits of our little laboratory.

[191] In reality it is "forced in" against the repulsive magnetic force, by a superior force of a different nature, suddenly evoked.

[192] I.e., as the exchange force dies, the forces now acting are the normal repulsive magnetic forces, but the rotor has moved to a position where now this repelling force accelerates the rotor in the "load powering" rotational direction. In other words, the observer sees a like pole suddenly "attracted" into a like polarity region, move partially through it, and then suddenly be accelerated out the other side. But the "attracting in" force and the "accelerating out" force accelerate the rotor in the load-powering rotational direction.

Technically, Johnson's apparatus asymmetrically and suddenly regauges its exchange forces in such a manner as to momentarily overpower the back mmf region of the engine's rotation, thus producing a net multivalued potential and a net accelerating force around the overall rotation loop. However, correlated distant effects in magnetic materials are known. If distant compensation does occur, then the closed-loop capability might conceivably be defeated, if the total compensation is sufficient to provide an $\int \mathbf{F} \bullet \mathbf{dl} = 0$ overall condition. Hence the research probably demands attention to maintaining both *local* asymmetry and *distant* asymmetry. If the distant correlation effects occur, only in that manner can an overall nonconservative field represented by $\int \mathbf{F} \bullet \mathbf{dl} \neq \mathbf{0}$ be maintained around a completely closed magnetic loop.

This may be the problem with which Johnson appears to have been struggling for so long. He did solve the problem once, and produced a self-rotating permanent magnet motor that the present author personally tested over a period of about 2 hours. During a two-hour test period, the motor apparatus was allowed to self-rotate for up to 15 minutes at a time. Shortly after it became known that Johnson had successfully produced such a prototype, his laboratory was mysteriously broken into. The only thing taken was the magnet assemblies on that specific little successful demonstrator — in a laboratory with more than a hundred thousand dollars worth of magnets and magnetic assemblies of many kinds present.

As a personal aside, I have been associated with Johnson, off and on, for many years. He is a man of the highest integrity and an indefatigable researcher. It is my fervent hope that Johnson will succeed in his permanent magnet rotary motor project. All I can say as this goes to press, is that he is getting very close again, now that he has help and good machining accuracy, etc. for higher precision buildups. In the near future, I hope to be among the first to drink a good glass of champagne to celebrate his success.

6.4.5 Radus Effect: Magnets with Preferred Flux Path Memory

In the early NASA space program, magnetic boots for holding the astronaut to the skin of the space vehicle when outside it were required. A Westinghouse engineer named Raymond J. Radus had found that a permanent magnet applied to a dual flux path (Figure 6-23) would "remember" the flux path taken initially, until switched to the other flux path in an initial condition, after which it would remember that path as preferable {445a-445c}. A permanent magnet with such "memory" will split its flux in two parallel flux paths by some ratio, e.g., 20% in the non-preferred path and 80% in the preferred path. This preference can be

switched at will by proper manipulation. So Radus developed switchable magnetic astronaut boots for the space program, using his magnetic memory and flux path switching technique {446}.

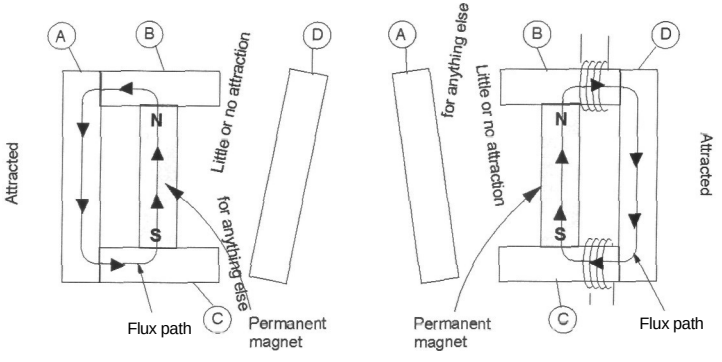

Figure 6-23A.
Once the magnetic circuit is made, there is little attraction for anything else

Figure 6-23B.
A single pulse through a coil can reverse ttie direction of the flux path

Figure 6-23 One example of the Radus effect.

The Radus circuit differs from ordinary permanent magnet circuits in three ways: (i) It exerts strong magnetic force at one end while exerting hardly any at the other, (ii) the strong and weak magnetic poles can be switched end-for-end easily and at will, thus, in effect, turning the magnetism on and off at one given side of the circuit, and (iii) once switched, it remembers its direction of greatest magnetic pull indefinitely.

The original Radus boots were excellent. For the acceptance tests, an engineer clad as an astronaut walked across the bottom of a steel beam in a high bay research area, upside down against the pull of Earth's gravity (Figure 6-24). He *stepped as* he walked, putting his foot "down" and then picking it "up" {447}.

There is no problem in finding modern magnets strong enough to hold the astronaut firmly in such an upside position. The problem with simple magnetic boots using such strong magnets is that, once the foot is planted, the astronaut cannot pick up the foot again. Consequently, the best the astronaut can do with such magnetic boots is walk rather laboriously by "scooting" the foot forward, with the boot remaining in contact and the astronaut unable to pick it up.

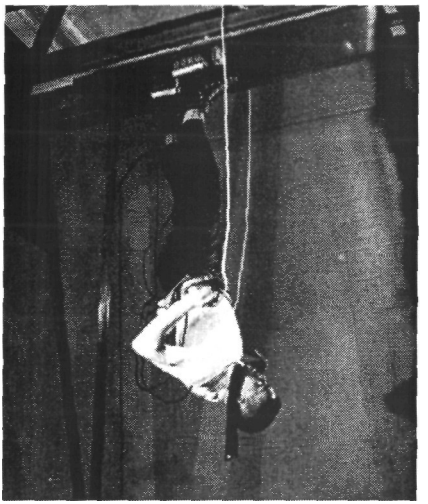

Engineer *walked* upside down on the underside of a steel beam in a high-bay area, wearing the Radus boots He used a stepping movement, not shuffling

Figure 6-24 Acceptance test of the Radus astronaut boots.

The Radus boots completely solved that problem. The permanent magnet fields are switched away from the "boot sole contact with the beam" for that foot that the astronaut wishes to lift, so he can lift it easily and take another step. Then the fields are switched back in again so that the strong field is on the boot sole as he places his foot down. This switching of the fields allows him to walk in a manner resembling normal walking, though a little slower. To do that switching by normal "battery and electromagnet coils" would be prohibitively bulky and heavy — and awkward. With the Radus boots, the astronaut could walk in a manner very similar to slow but normal walking.

However, it is easily seen that an adaptation of the Radus process could conceivably be used to produce a self-switching, self-powered permanent magnet motor. Being a permanent dipole, a magnet is already a particular kind of "free energy generator", since it continuously extracts magnetic energy directly from the active vacuum due to its dipole asymmetry in the virtual photon flux of the vacuum.

The Radus boots were abandoned quickly. NASA then developed the present inferior "shuffler" kind of magnetic boots where the astronaut cannot lift his boot from the surface, but must "scoot" his feet along in a sliding and painfully awkward fashion {448}.

Even today, it is little known that in many virgin magnets fresh from the factory, their very first use conditions them with a Radus-type memory! *That fact can be used, e.g., to create magnets whose fields appear normal, but which deviate from the normal behavior of ordinary magnets, and which produce anomalies in their magnetic fields.*

The Kawai engine {31} uses a novel means of switching the flux path itself instead of overpowering the magnetic poles in an electromagnet. As this is written, Bedini has been notified that his patent with a "path-switching" effect control method has been accepted and will be issued. Although control of the Kawai engine was seized by the Yakuza, we expect to see that some of the first COP> 1.0 motors on the world market will be magnetic motors using the Radus effect or other flux path switching method.

6.4.6 Hole Currents and Electron Currents

In a conducting solid, there are both hole currents and electron currents moving in response to a forcing electric field. In the simple case, electrons move in one direction along the conductor and lattice holes move (migrate) in the other. However, when additional fields are added, the situation can become very complex. The holes and electrons can move oppositely or together in the same direction, depending on the arrangement of the fields and voltages. One can even use fields at right angles to the conductor to affect the currents, and even stop them. This is a rich subject for the inventor, and one that does not appear to have been adequately explored for potential energy and power purposes. This is particularly true when the conductor material is bent or shaped, etc. This area is so broad that it will not be treated here; instead, we refer the reader to Burke {449} for a basic idea of some of the effects and current combinations that can be obtained. From there, an interested experimenter should search the materials science literature on electron and hole current responses of materials.

6.4.7 The Magnetic Wankel Engine

For baseline comparison, Figure 6-25 shows a conventional linear magnetic motor. As can be seen, due to the difference between magnetic poles, a magnetic field exists along the line of the linear track, from the end having the magnets separated the least to the end having the magnets separated the most.

Figure 6-26 diagrammatically shows the scheme of operation of the magnetic Wankel engine. It is basically a linear magnetic motor, wrapped into almost but not quite a complete circle. A set of permanent magnets, each at an angle to the various radial lines of the device, comprises a

slightly widening spiral stator that forms most of a circle. A circular rotor with a sector magnet is mounted inside this spiral stator. An end gap exists in the stator as shown, so that the stator is not a completely closed ring. The direction of rotation of the rotor is clockwise as shown. For demonstration of the principle, the beginning air gap between rotor and stator is 0.1 mm and the ending air gap is 5 mm.

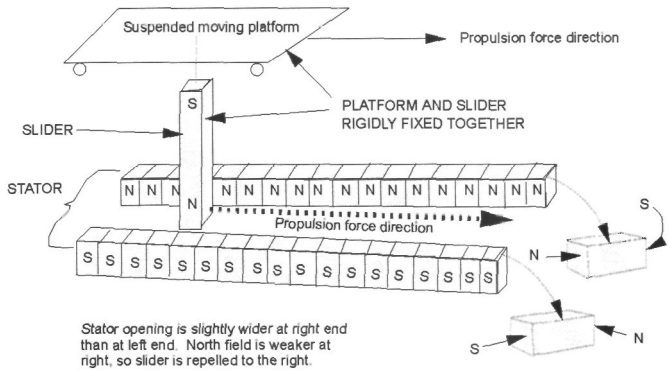

Figure 6-25 Type of conventional linear magnetic movement device

An electromagnet is mounted along the perimeter of an angular sector of the rotor, completing the stator gap. The electromagnet is weakly magnetized by a weak trickle current in the associated coil, furnished by a coil with a make-and-break magneto point gap. The electromagnet is magnetized, say, with the north pole facing radially outwards, and the south pole facing radially inside. In the stator, the permanent magnet north poles are facing radially inward toward the rotor, but at an angle, and the south poles are facing radially outward but at an angle.

Tangentially the north pole of the rotor is in a nonlinear magnetic field, and it will experience a clockwise force and acceleration from position 1 where the air gap between rotor and stator is the 0.1 mm minimum, to position 2 where the air gap reaches the 0.5 mm maximum.

If this were all that was involved, the engine would not produce COP> 1.0 because the tangential field is conservative unless additional *free* energy is introduced to overcome the back mmf region in the stator gap. When the rotor crossed the end gap in the stator between point 2 and point 1, very sharp and dynamic magnetic braking due to the back mmf would be done back upon the rotor magnet by the field of the stator magnets at position 1.

Since any real machine will have at least some friction and drag, the actual COP would be less than 1.0.

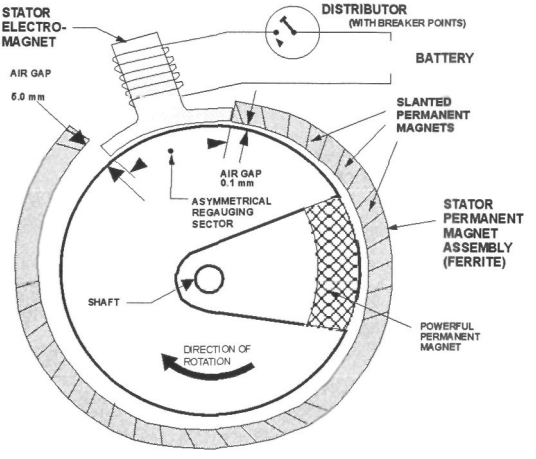

figure 6-26 Magnetic Wankel engine with asymmetrical regauging section.

Let us use the notion of the magnetostatic scalar potential (roughly, magnetic pole strength) to examine a new situation in the end gap.

Technically, let us regard a single unit north pole in the rotor, going from position 1 to position 2 (the acceleration cycle, where the engine will deliver shaft horsepower against a load), and going from position 2 to position 1 (where the magnetostatic scalar potential must be suddenly rcgauged asymmetrically to equal or exceed the potential at position 1, in order for the rotor to continue unabated or with even further acceleration. That is, when the rotor enters the "back mmf' end gap between position 2 and position 1, a sharp and sudden increase in the "stator magnetostatic scalar potential" must be accomplished, so that the potential in that region is equal to or greater than the potential at position 1. This effect, nearly freely obtained, is what is required for a self-powering magnetic Wankel engine.

In normal machines, conventionally this asymmetrical regauging part of the cycle is where the design engineer forcibly inputs energy from outside the system to do brute physical work on the rotor to forcibly "reset" the

machine, and to forcibly wrestle its potential energy storage back to initial conditions. In short, the operator himself arranges to furnish all the excess energy from outside the system that is required to brute force "regauge" the potential at that point, thus effectively creating a multivalued potential instead of a single valued potential. A multivalued potential achieved only by the operator himself furnishing the extra potential energy will not produce COP> 1.0. It will in fact produce $\int \mathbf{F} \bullet \mathbf{dl} \neq 0$ of the motor section, but only at the expense of extra energy that the operator himself had to input and pay for. In that case and in a real system with some system losses, the net work out because of $\int \mathbf{F} \bullet \mathbf{dl} \neq 0$ will still be less than the total energy input by the operator.

The forcible "reset" work is conventionally done by simply overpowering the field and reversing it (building it up equal and opposite in the other direction), but with energy totally input by the operator and not "free energy input from the environment" at all. The operator first pays to "kill" the existing field, and then pays to establish a field in the opposite direction.

To obtain COP>1.0 and self-powering, we must trick something else or some other process into furnishing that asymmetrical regauging energy — or most of it — for regauging of the magnetic Wankel engine in that stator gap zone. In other words, instead of engaging in the conventional wrestling match against the back mmf, we must let something else provide most of the energy for the wrestling.

During rotation of the stator from position 1 to position 2, we have been maintaining (and paying a little for) a tiny trickle current and small voltage from the battery into the coil around the electromagnet. As the rotor enters the stator gap, suddenly a sensor sharply breaks the distributor points, momentarily inducing a sudden powerful voltage in the coil. With a very short delay, a very sharp surge of current appears in the coil, producing a sharp and suddenly increased magnetostatic scalar potential (pole) in the gap region. That is the "multivalued potential" effect, where we pay a little to achieve it suddenly at that point, by invoking Lenz's law.

The effect is that suddenly the rotor is raised to the same or greater magnetostatic potential as exists at position 1, and "almost freely though not quite". If equal, the rotor suddenly is in a region with no back mmf, hence it experiences no deceleration braking. If the sudden potential is greater than the potential at position one, the stator in this normally back mmf region now actually experiences a further acceleration (a forward mmf) in that region.

Note that no *radial* mechanical work can be done on either the electromagnetic pole piece (part of the stator) or on the rotor, since neither the stator nor the rotor can move *radially*. However, there momentarily exists a clockwise circumferential magnetic field on the rotor in the stator gap, due to the gradient between the sharply regauged pole piece magnetostatic potential and the potential at position 1.

So we pay a little energy continuously (tiny trickle current, sharply broken breaker points) to get much more energy density momentarily in that small back mmf gap region only. The former back mmf in the stator gap is sharply eliminated by the Lenz force and converted to forward mmf. The rotor experiences a continuous acceleration throughout a complete rotation, due to the judicious use of an artificially induced multivalued magnetostatic scalar potential.

If the average shaft power output during the complete rotation cycle is made greater than the average power input to the asymmetrical regauging circuit during that same rotation cycle, the engine will produce COP>1.0. This type of engine is also easily close-looped, since the excess output is **not** electromagnetic energy but mechanical shaft rotation energy.[193] Hence the problem of the Dirac sea hole current (discussed in Chapter 9) is eliminated.

Such engines have been built and placed in an automobile to power it, in Japan {450}, though there is no information on the exact overall COP. The design was lighter and smaller than a gas engine of the same power, and it was a pygmy when compared to other electric engines of similar power. **The** prototype 45-hp unit weighed 155 pounds compared to 440 pounds for a comparable electric motor. The rotary engine was compact enough to fit inside a two-foot cube. The engine was in development by Kure Tekko, a sizable firm that supplies auto parts to Toyo Kogyo, the Mazda maker. To my knowledge, no hard data on the input electrical power utilized for the trickle current and current-breaker has been made available by the Japanese. The principles, however, are quite clear and easily analyzed.

This may be one of the Japanese COP>1.0 engines suppressed by the Yakuza.

[193] For example, a geared or belted arrangement can be used to drive a very small but efficient DC generator that replaces the battery. Many other efficient arrangements are possible.

The researcher might like to consider using a strategically-placed Wiegand wire sensor (discussed in the next section) as the free "generator" providing a pulse of electrical energy to the pulse-magnetizing coil in the stator gap region at the precisely appropriate time. If that or some other similar "self-furnished" pulse of sufficient power can be delivered to the pulse-magnetizing coil, then the system would self-initiate a multivalued magnetic potential in that gap region. In that case, the driving magnetic field around the loop need not be conservative, and self-rotation would be possible without violating any laws of nature or electrodynamics. At least a small toy demonstration model might be possible, simply to illustrate the principle. Presently we know of no one who has tried it.

6.4.8 The Wiegand Effect

If a Permaloy® or other suitable magnetic wire is properly tensioned and worked by repeated torsion while under tension, the skin of the wire is work-hardened and caused to have different magnetic characteristics from that of the internal core. This type of wire is called a *Wiegand wire,* or *pulse wire,* or "self-nucleating magnetic wire" (SNMW™).

When the pulse-wire experiences a certain level of ambient magnetic field strength, it will automatically switch its magnetic state, very sharply, producing a sharp magnetic field pulse. The effect is generally called the *Wiegandeffect.*

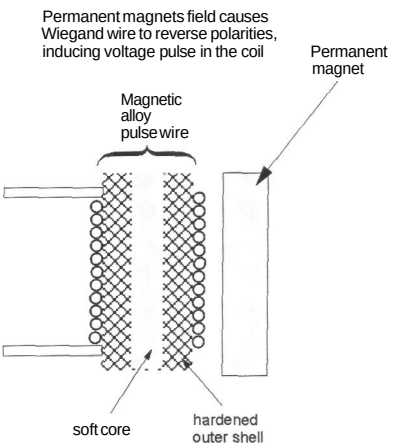

Figure 6-27 The Wiegand effect

If a coil of many turns of fine electrical conductor is wound around the Wiegand magnetic pulse wire, then when the wire suddenly alters its magnetic state, the sudden magnetic field pulse "cutting" the conductor bundle will produce a sharp electrical pulse. Thus the apparatus produces a sharp pulse of electrical energy, when the ambient magnetic field intensity reaches the pulse-initiation value. No input of outside energy is necessary. The apparatus simply gates the energy from the vacuum when it sharply changes its magnetic polarity.

Wiegand effect sensors may achieve voltage pulses up to a nominal 12 volts, in a typical application.

Numerous patents were issued to Wiegand prior to his death {451a-451h}.

Figure 6-27 diagrammatically shows the primary parts of a typical Wiegand sensor application, where the Wiegand wire is also known as a *pulse wire*. The operation of the pulse wire itself is shown in Figure 6-28. Figure 6-29 shows a typical rotary Wiegand effect pulse transmitter.

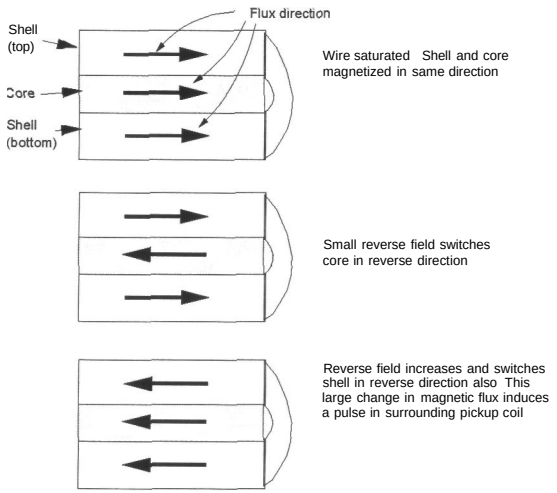

Figure 6-28 Operation of the Wiegand effect in a pulse wire.

Pulse wires find many modern "switching" uses, since one does not have to connect them to a power supply in order to obtain the electrical signal pulse generated in a magnetic field as it changes. The magnetic experience of **the** wires can be arranged (using a "resetting magnet") to automatically **reset** the pulse wire to its original condition after the initiation magnet has **fired** it. Many identification cards for personal access to restricted facilities

use these wires. Some magnetic memories use the effect. At least one European automobile firm has even used Wiegand wires to trigger the timing of automotive ignition systems.

The pulse characteristics created internally by the Wiegand wire represent a sharp, asymmetrical, self-regauging of the magnetics. The combined magnetic field consisting of the ambient magnetic field and the Wiegand wire magnetic pulse is momentarily a nonconservative magnetic field. It follows that a closed-loop integration $\int \mathbf{F} \cdot d\mathbf{l}$ around some paths in the combined magnetic field of the system do not sum to zero.

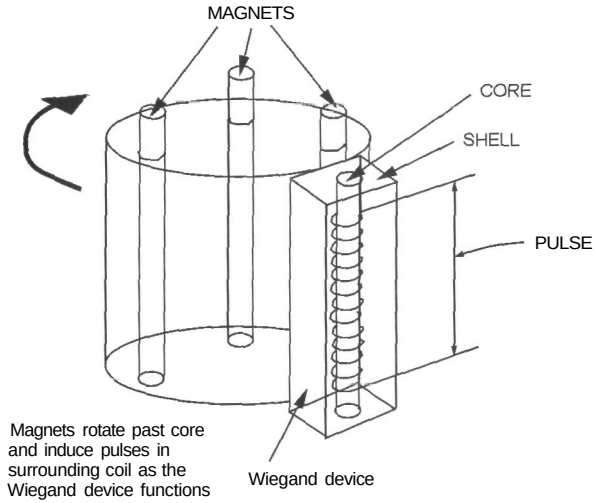

Figure 6-29 Operation of the rotary Wiegand pulse generator

In theory, at least, it should be possible to utilize something like the magnetic Wankel engine together with exactly self-triggering and self-resetting Wiegand units to form a self-powering permanent magnet motor. In short, referring to our discussion of the magnetic Wankel engine, it might be possible to use a special Wiegand sensor and pulse generator to furnish the properly timed pulse to the coil that enables the continuous operation of the Wankel engine. Obviously this type combination would have occurred to the Japanese scientists working on the magnetic Wankel engine.

We accent that the resulting system would be an open dissipative system, far from equilibrium in its energetic exchange with the vacuum during the Wiegand pulsing. The disequilibrium is achieved by the momentary self-regauging of the magnetic gap in the magnetic Wankel engine.

My colleagues and I have experimented with Wiegand wires and Wiegand sensors to a limited extent. The effect is quite real, fully documented in the scientific literature, and the wires and sensors are not too expensive. A typical coil of 1,000 turns on a 3-cm Wiegand wire will produce pulses of about 2 volts in a 1,000-ohm resistor. The pulse width (half maximum height) is about 20 microseconds. Essentially the Wiegand wires are immune to stray magnetic fields. Viewed on an oscilloscope, the pulses are very clean without spurious oscillations or hash. The field required to switch a typical Wiegand wire is typically about 150 Oersteds. The resetting field is quite a bit smaller, being about -20 Oersteds. With further work, it is probably possible to come up with Wiegand wires whose coils produce up to 20 Volts in a 1,000-ohm resistor. If 25 of these 20-volt Wiegand pulse generators wired in series could be induced to fire simultaneously across a 1,000-ohm resistor, something like a momentary half-watt device could be built. That might be enough to operate a very small version of the magnetic Wankel engine, etc. purely for demonstration purposes.

For practical power, of course, one would need to find a way to increase the power output in each Wiegand generator pulse. So far, no one has been able to successfully find a way to do it, at least to our knowledge. If the reader finds a way to do that, then the reader should certainly patent the process and use it in a self-powering magnetic Wankel engine!

So to those experimenters wishing to experiment with something relatively inexpensive, we would suggest investigating the possibility of incorporating Wiegand units into a magnetic Wankel-type small magnetic motor, and attempt to get a self-powering little unit, or try to build a self-powering version of the rotary Wiegand pulse generator. It is at least possible in theory, and if achieved in practice it will prove that self-powering EM engines are perfectly possible.

6.4.9 Kawai Path-Switching Motor

Japanese inventor Teruo Kawai has invented a process for adroit self-switching of the magnetic path in magnetic motors, rather than directly overpowering the magnetic field and then forcibly reversing it. The process reduces most of the back mmf in an otherwise rather conventionally switched magnetic motor, and results in producing a COP

that is approximately double the stated efficiency rating of the unmodified motor. Understand, the Kawai motor always has an efficiency less than 100%, even when its COP>1.0! Hence if one starts with a *high efficiency* magnetic motor — e.g., efficiency of 0.7 or 0.8 — one can obtain a modified motor having a COP of 1.4 to 1.6. Two Kawai-modified Hitachi high-efficiency magnetic motors were tested by Hitachi engineers, and the tests did indeed show COPs of 1.4 and 1.5, respectively, under rigorous and totally independent testing conditions.

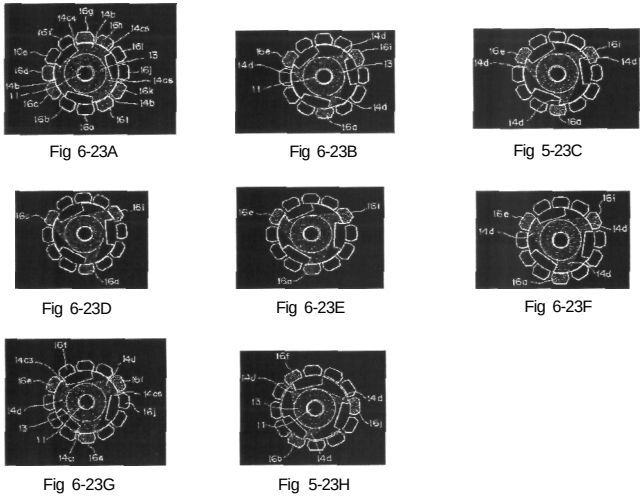

Figure 6-30 The Kawai path-switching process.

Figure 6-30 shows eight snapshots A, B, C, D, E, F, G, and H of the rotor advance of a typical Kawai engine, taken from Kawai's 1995 patent {452}. This is one end rotor/stator side of a two-rotor device, where a similar rotor/stator device is on the other end of the central shaft *11*. In snapshot A, pole piece *14* had three outward teeth *14b* dispersed equally around the circumference, alternated with three notches. An end magnet *13* provides the source of flux passing through the pole piece. With the electromagnets DC-energized, their core materials *16c, 16d, 16g, 16h,* and *16k, 16l* are shown shaded by flux from central magnet *13* out through teeth *14b.*

In snapshot B, electromagnets *16a, 16e,* and *16i* are energized. The shaded area shows the sharp convergence *14d* of the flux from magnet *13* through pole piece *14* and the edge of teeth *14d.* Since the electromagnets are magnetized in attracting mode, the rotor will experience a torque tending

to widen the flux path from magnet *13* to the activated electromagnets. Thus a clockwise torque exists on the rotor, and it will start to rotate clockwise.[193] Note that each electromagnet is operating independently of the other two.

As shown in snapshots C, D, E, and F, the rotation of the rotor continues clockwise, widening the connecting flux path to the three activated electromagnets. During this time the torque on the rotor is clockwise.

In snapshot G, the flux path to the activated electromagnets is fully widened. In addition, the leading edges of the three teeth are just beginning to enter the domains of the next electromagnets *16j, 16b* (see snapshot A) and *16f.* This is getting symmetrical to the original position shown in snapshot B.

Now the electromagnets *16i, 16a,* and *16e* of snapshot G are deactivated, as shown in snapshot H, and electromagnets *16j, 16b,* and *16/*are activated. This action asymmetrically self-regauges and resets the engine back to the original situation shown in snapshot B, but one more electromagnet beyond. The action cycle begins anew. As can be seen, in each complete rotation of the shaft, each of the three teeth of the rotor will be asymmetrically self-regauged multiple times. So multiple total asymmetrical self-regaugings, resettings, or "refuelings" are utilized per shaft rotation.

In each motor coil, at energization a tooth is just entering that coil, Energized in attractive mode with respect to the ring magnet around the shaft, the flux in the pole piece jumps from fully widened flux (and small **or** vanishingly radial torque on the rotor) to angled and narrowed flux (with full radial clockwise torque on the rotor). This is an asymmetrical self-regauging action. As previously explained, the narrowed flux and its angle exert a clockwise accelerating tangential component of force upon the rotor. By the asymmetrical self-regaugings of the engine, each coil is de-energized prior to beginning to exert radial back emf— which it would do if it remained energized as the trailing edge crossed it and again narrowed the flux path).

So the Kawai engine uses normal magnetic attraction to accelerate the **rotor** for a small distance, and then asymmetrically self-regauges to zero

[193]The Kawai patent contains a small error of misstatement. It states at first that the torque and rotation are counterclockwise, and then shows it moving correctly clockwise from figure to figure in the series.

attraction to eliminate the back-mmf drag portion of the attractive field. It regauges to zero as the reset condition.

For appreciable power and smoothness, the typical Kawai engine uses an extensive number of asymmetrical self-regaugings per axle rotation, for example 36 times on each end, or a total of 72 times for the two ends. The force field of each coil, accompanying its increased magnetostatic scalar potential, is oriented radially inward, so that radial work cannot be done by the coil on the rotor because the rotor does not translate radially. Advantage is taken of the initial clockwise acceleration force initially produced, and self-regauging eliminates the counterclockwise decelerating drag force that would be produced without the regauging.

The major benefits are that (a) multiple self-regaugings occur for a single rotation of the rotor assembly, enabling high weight-to-power ratio, (b) each electromagnet is energized only when positively contributing to the clockwise torque that drives the rotor, and (c) each coil is de-energized to asymmetrically self-regauge the system during those periods when the coil would otherwise create back-drag (counterclockwise torque) if it remained energized.

A conservative cycle is one in which the work done in the back-drag (mmf) region is equal to the work done in the forward boost (forward mmf) region. Self-eliminating the back-drag portion of the cycle is a form of asymmetrical self-regauging, and makes the net field highly nonconservative. The Kawai approach is thus permitted to attain COP>1.0. In his U.S. patent, Kawai quotes performance measurements showing COP = 3.18. As we stated, Hitachi engineers measured two Kawai-modified Hitachi magnetic motors which exhibited COP =1.4 and 1.6 respectively.

Since the output is shaft horsepower, in principle the Kawai engine can be close-looped for self-powering, without consideration of the Dirac sea hole current. With its external close-looping system (not shown), it falls within the second close-looping class, that of an "outrigger" system. Only the unitary system closed-looping class requires consideration of hole currents in the Dirac Sea.

The Kawai process and several other Japanese overunity systems have been blocked from further development and marketing by the Japanese Yakuza. The present author and the Board of Directors of CTEC were physically present and in final negotiations (having reached agreement!) with Kawai to market his self-powering motors worldwide, when control

of the Kawai company and process were suddenly seized on the spot in our presence.[195]

6.4.10 Bedini's Skin Depth Magnetic Switching

Bedini found a most interesting variation of flux path switching: he switches the direction of just a little fraction of the ongoing magnetic flux in a material flux path, on the skin of one side of it and with only a slight "skin depth".[196]

Suppose a flux path material is used as the stator pole of a permanent magnet motor. A large permanent magnet is used to magnetize that short length of flux path, as shown one the left in Figure 6-31, which illustrates a concept for a magnetic motor. For convenience, imagine that the small magnet on the right is not yet placed on the material flux path extension. The flux path extension is energized by the south north pole of the large permanent magnet on the left, and used as the stator in a rotary magnetic motor.

[195] To anyone who understands Japanese culture, Kawai paid me one of the greatest compliments possible. After his company representative called from Japan, Kawai shipped his *original proof of principle engine* — which first successfully demonstrated his flux-path switching process without being optimized for COP>1.0 — to me, here in the U.S. In the Japanese manner, he had entrusted me with his single most valued possession. From years of aikido experience, I fully understood the meaning of this unprecedented gesture, and expressed my deep appreciation accordingly. From our first meetings with Kawai and his group, I have and always shall have the utmost respect for Teruo Kawai. In my view, it is a sad loss to humankind to have his engine buried and withheld so brutally. Kawai had already achieved a closed-loop self-powering version, and it is this version upon which we reached agreement. In less than 24 hours after that agreement, the Kawai engine and company — and Kawai's own fate — were seized and no longer in Kawai's hands. For those unfamiliar with the deep spread of the Japanese Yakuza, the following are recommended: (a) Brian Bremner, "How the Mob burned the Banks: The Yakuza is at the center of the $350 billion bad-loan scandal," *Business Week*, Jan. 29, 1996, p. 42-43, 46-47; Michael Hirsh and Hideko Takayama, "Big Bang or Bust?" *Newsweek*, Sept. 1, 1997, p. 44-45; Adam Johnston, Yakuza: Past and Present," downloaded from the Internet, Committee for a Safe Society, Organized Crime Page: Japan: History and present status of Japanese organized crime.

[196] Close colleague Ken Moore also independently discovered this effect in his own experiments, but then we found that Bedini had discovered it earlier. That was fine with Ken; he greatly admires Bedini and the marvelous discoveries Bedini has made. I greatly admire both of them, and am happy to call them best friends. After all, s**cience** has a human side as well as a materials side. Without one's close colleagues and best friends, science alone would be a miserable enterprise!

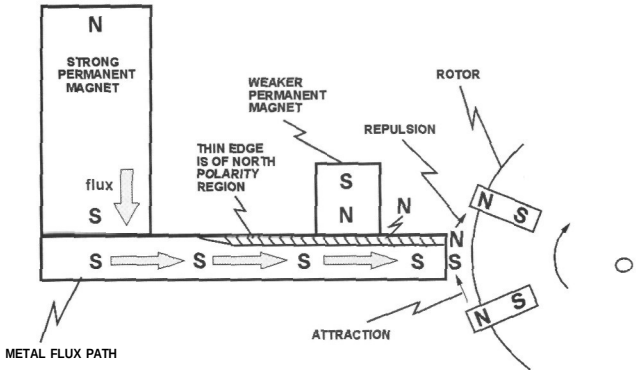

Figure 6-31 Bedlni skin depth magnetic edge switching.

As can be seen, the north pole of the rotor, shown in the figure, is attracted to the resulting south pole of the stator. Power can be taken from the shaft of the rotor while it is being attracted in to the extended north pole of the stator flux extension. As it begins to pass the extension end, obviously if nothing else is done it will develop back mmf "drag" by being attracted back toward the north pole of the flux extension as it passes it.

However, suppose that —just when the rotor south pole is passing dead center of the stator north pole extension, one suddenly pulses a small flat coil placed on the face of the extension, which serves the function of the small permanent magnet shown on the right of the material flux path extension. Further, suppose the magnetic field produced by the coil is oriented as the field of the small permanent magnet, but is much weaker than the magnetic field of the large permanent magnet on the left. A very curious effect then occurs. This energized coil magnetizes the edge of the flux path extension, to a small "skin depth" as shown, with a *north* polarity. The magnetic flux is now bidirectional in that same material flux path extension.

Further, this edge-switching action is performed so that it is this "partial north polarity" of the now-altered extension that faces the rotor north pole as it begins to pass the extension and enters what previously would have been a back mmf section. Instead, now that former back mmf section is a weakened forward mmf region, *further accelerating the rotor*. This action breaks the Lorentz symmetry around the rotation path of the rotor, resulting in a net nonzero (nonconservative) magnetic field. Hence the entire rotor exhibits a net drive force around its loop. The rotor will

accelerate until the mechanical work performed upon the shaft, friction, etc. is equal to the net magnetic energy furnished to the rotor.

The beautiful part of this motor is that one does not have to "overcome" by brute force — and then reverse — the north polarity of the entire stator extension. In theory, the overall energy added to the rotor is greater than the energy that must be added for the "edge switching" of the magnetic flux path extension, because the entire back mmf of the motor has been eliminated and replaced by a weaker forward mmf. If the process of furnishing the "skin depth" weaker magnetic north field to the edge of the flux path extension is made sufficiently efficient, this engine also can be made self-powering, at least in theory.

The former "motor" design has been converted to a "motor/generator" design, by the addition of the edge-switching action. The novel factor is the use of bidirectional flows of magnetic flux in a single material flux path.

An additional improvement is to rig a Wiegand sensor and pulse generator or sensors in conjunction with the rotor action, to freely furnish and kill the edge-switching pulse to the face-magnetizing coil on the flux path extension, at the appropriate times. This is an area where even high school students will be able to experiment.

Bedini's patent on the edge switching process and its various embodiments and improvements has been issued {453}.

6.4.11 Bedini's Flux Path Switching with Energy Capture

One additional embodiment of the Bedini flux path switching motor is shown in Figure 6-32. Here the entire flux path is switched, by moving a small coil on the bottom side of the material flux path, as shown in the figure. As Radus showed {454}, it turns out that a much weaker magnetic field in that left bottom position will switch the flux path of a powerful permanent magnet field at the left top of the path, as shown.

Now, however, Bedini adds a transformer coil around the right end of the core (the right end of the extension is still the stator pole in the magnetic motor diagrammatically shown in Figure 6-32). When the flux path is switched back and forth, this transformer coil produces an AC signal output, which can power a load as shown, and can even be used to power the switching power supply. The trick is that it requires less energy to make the vertical flux path preferable to the horizontal flux path, than the energy delivered into the flux path by the permanent magnet. The potential for self-powering of a sufficiently efficient magnetic motor is obvious.

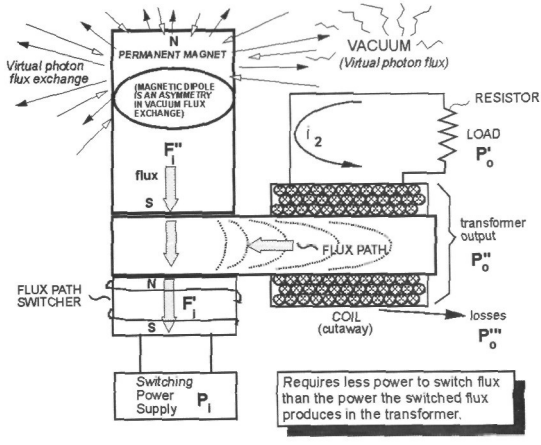

Figure 6-32 Bedini's total path switching and energy recovery process in a transformer.

So the motor can be powered while simultaneously acting as a partial generator. For efficient switching, this motor/generator can in theory develop COP>1.0 and can even be made close-looped and self-powering. We strongly accent that the primary excess energy input to the system is from the vacuum itself, via the broken symmetry of the large permanent magnet dipole at the left top of the material flux path. As we have repeatedly stated, the only energy problem is how to capture and utilize the EM energy freely received, transduced, and poured out from the vacuum by the source dipole's broken symmetry, without using half of it to destroy the source dipole.

6.4.12 Transformer Secondary Shunted by a Negative Resistor.

See Figure 6-33. This embodiment assumes the availability of a true negative resistor — possibly an adaptation of a point contact transistor or other device. As shown in the figure, a transformer exhibiting COP> 1.0 can be developed by adding a shunting *true* (not differential!) negative resistor across the terminals of the secondary, adjacent to the secondary. In this manner, the Lorentz symmetry of the closed unitary current loop containing the external loads and losses, and normally the secondary of the transformer in series, is broken.

Part of the return spent current is now "pumped" back up from ground side to power side of the transformer secondary without passing through the secondary. The pumping work is providing by dissipation (in the negative resistor) of energy freely obtained from the active vacuum environment. In short, one adds a ncgcntropic process in parallel with the secondary coil, in

the secondary external circuit, breaking the otherwise enforced Lorentz symmetrical regauging of the discharge of the collected EM excitation energy in the secondary circuit. This provides the capability for a permissible COP>1.0 transformer.

ON EACH HALF CYCLE, ONE OF THE NEGATIVE RESISTORS SHUNTS PART OF THE RETURN CURRENT AROUND THE SECONDARY, FROM LOWSIDE TO HIGH SIDE, THUS DECREASING THE BACK-FIELD COUPLING FROM SECONDARY TO PRIMARY ACROSS THF TRANSFORMER. THIS LESSENS THE ENERGY DISSIPATION REQUIRED IN THE PRIMARY FOR A GIVEN ENERGY FLOW TRANSFER FROM PRIMARY TO SECONDARY

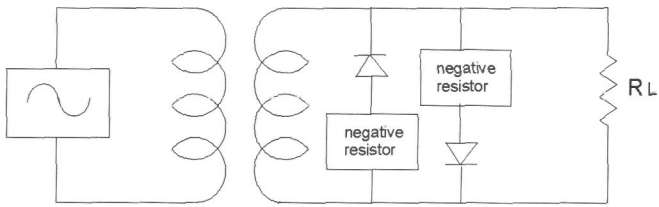

Figure 6-33 Transformer shunted by a negative resistor.

In theory, if the negative resistor can bypass all the current in the secondary, or almost all of it, the transformer can become a COP»1.0 device.

This overunity transformer can use step-up of the voltage from primary to secondary, and exhibits an asymmetry in its forward and backward field coupling between primary and secondary. Thus the dissipation of energy in the primary circuit need not be as great as the dissipation of energy in the secondary circuit. The *energy flows* are of course in perfect conservation, but there is no law of nature requiring the *energy dissipations* to be conservative between the primary and the secondary. It is strictly the backfield coupling from secondary to primary that enforces equal energy dissipation in the primary as in the secondary, in normal transformers. And that backfield coupling's strength is a function of the return current through the transformer secondary. By reducing that current, the back coupling to the primary is reduced, which in turn reduces the current draw of the primary from the external power supply.

No laws of physics, electrodynamics, or thermodynamics are violated by the asymmetrically coupled transformer power system with broken symmetry in its secondary to primary circuit couplings. In short, there is

less backfield coupling from primary to secondary than there is from secondary back to primary. The additional energy dissipated in the secondary circuit is freely extracted from the vacuum by the negative 4-resistor shunt.

Again, this application assumes the availability of a true negative resistor, to use as a shunt of the secondary.

The beauty of this application is that, once achieved, such a COP>1.0 transformer can easily be close-looped for self-powering by standard "governed" positive feedback. No concern as to hole current effects usually need be accounted for unless the COP becomes very large.

6.4.13 Eddy Current Multiplier.

Figure 6-34 shows an example of an eddy current multiplier, adapted from Burke {455}. This is given as a somewhat unusual system which may exhibit novel effects and possibly can be adapted into a COP>1.0 system (e.g., by using permanent magnets instead of the coils and triggering things into unbalanced condition using a rotary pulse wire generator. We simply list it here as a candidate for the experimenter.

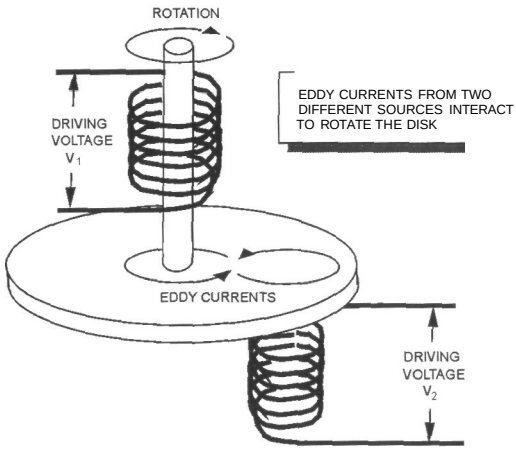

Figure 6-34 Eddy current multiplier.

In Figure 6-34, the shaft of the conducting disk is connected to a rotor, which could have arrangements for rotary type of Wiegand pulse generator of Figure 6-29 (with self-initiation and self-recovery) around it (not shown in Figure 6-29). One would start the rotating disk by hand. These Wiegand sensors would then automatically and repeatedly deliver a series of electric

pulses to the coils, momentarily generating the two eddy currents shown, so that dynamic force and rotary acceleration is obtained during the endurance of the pulses. In short, one would "electrically kick" the coils so that they continually deliver a propulsive "magnetic kick" to the conducting disk to repeatedly generate eddy currents to rotate it. The rotor is powered as shown by the interactions of the two unbalanced induced eddy currents. Such an arrangement could possibly exhibit COP>1.0.

To experiment with such an apparatus, the major parts that must be developed are (i) the rotor and coils arrangement (the motor), (ii) the integrated rotary Wiegand effect pulse generator with self-recovery, and (iii) the proper timing arrangement. Each should be developed and optimized individually in the researcher's experiments, then combined and optimized together. This is an experimental area that can be cheaply investigated, e.g., by a college student or high school student for a science project. Whether COP>1.0 is achievable or not depends upon the efficiencies that can be obtained with the various processes involved. It is possible, at least in theory, for such an arrangement to be self-rotating once rotary motion is underway.

6.5 CONCLUSION

In this chapter we have advanced many approaches to COP>1.0 systems, that have been tried or considered by various inventors and researchers in the field. Many of these experimenters have attained concrete, replicable results, including results published in the hard literature.

We hope this sampling shows the reader that indeed we can have "self-powering" electrical power systems and COP>1.0 electrical power systems whenever the scientific community will come out of its preoccupation with the present seriously restricted electrodynamics and electrical power engineering practice and fund the necessary research. Simply funding a few graduate students for research and doctoral theses in these areas would be very useful and immensely more productive for electrical energy purposes than all the billions and years spent on chasing hot fusion.

Hopefully the iron dogma of the scientific community against COP>1.0 electrical power systems is slowly changing. If so, and if the community will turn loose those sharp young graduate students and post-doctoral scientists on the problem, very shortly there will no longer be an electrical energy problem on Earth, ever again. We strongly refer the reader to Deffeyes' book {456} to rigorously validate the coming increase of the price of oil, in the middle of the present decade. See particularly the

quotation from Deffeyes in our Endnote {342}. With the present extreme volatility of the MidEast and the continuing war on terrorism, the probability is high of eventual severe disruption of oil supplies and the energy infrastructure of the U.S.

An independent review of Deffeyes' book is given by Young {457} and we recommend that the reader digest that commentary also.

If the scientific community will fund the necessary research on permissible COP>1.0 Maxwellian systems, the quick results will solve the energy crisis, clean up the biosphere — including much cleaner air in our cities for the populace to breathe — provide cleaner streams, and result in far less polluted oceans. It will stop the pollution-caused destruction of species, and dramatically reduce the hydrocarbon combustion contributions to global warming. There will no longer be a necessity to consider "burying" in the bottom of the sea the excess CO_2 from massive hydrocarbon combustion to provide the much-needed electrical power, because it will no longer be necessary to burn the oil, coal, and gas to get the power. And there will no longer be any necessity for expensive and highly vulnerable nuclear power plants with their resulting nuclear wastes that will remain radioactive for thousands of years.

If cheap, clean EM energy from the vacuum is rapidly developed, we may *finally* get the scientific community's head wrenched back out of the big nuclear power business, as a colossal waste of research manpower and taxpayer dollars — as well as providing ticking time-bombs for the terrorist teams now already in the United States to attack and destroy. It is so easy for a person with appropriate technical knowledge to build a portable electromagnetic pulse (EMP) "shooter" that one shudders at the consequences of in-country terrorist teams that can do so. Try imagining what we would face when the electronic controls of one or more operating nuclear power plants are suddenly disabled and destroyed with the reactor on line and providing power. Chernobyl might look like a mild spring breeze in comparison, should we have one or more actual meltdowns.

It is not a pleasant consequence to contemplate, and that alone may eventually dictate the overwhelming urgency of achieving decentralized, vacuum-energy-powered electrical power systems as soon as humanly possible. The present centralized, cumbersome energy infrastructure is vulnerable beyond all sanity, considering the thousands of terrorists already in country, with weapons of mass destruction as well as more conventional sabotage means. As a single example, the former Soviet Union clandestinely brought in nuclear weapons into the U.S., and

Spetznaz teams to detonate them on order. Such weapons (and teams) are already in large U.S. cities and population centers. The reader is referred to Lunev's book,[197] for details about how the nuclear weapons were introduced.

After all, we do have to live and survive in the real world, and not just in an idealistic scientific environment. We are already at war, with alerts of potential danger to our nuclear power plants already having been given on several occasions. In the present very disorderly and very dangerous world we live in, many of the former options we have had for decades are rapidly ending. That includes the option for the leaders of the scientific community to continue "business as usual", if they wish this nation and their own families to survive. There is an old adage in war: *Whatever your determined enemy can do to hurt you desperately, he will do as his highest priority*. Sadly, in my opinion the leaders of the scientific community — unwittingly — are presently doing almost everything they can do to insure that the energy infrastructure goes, the national economy goes, a nuclear meltdown possibly occurs, and this nation and much of civilization perishes in a new dark ages.

[197] Stanislav Lunev (with Ira Winkler), *Through the Eyes of the Enemy*, Regnery, Washington, 1998. Lunev is the highest ranking GRU defector. He is a former Colonel in the GRU, the military counterpart of the KGB. On p. 22-33, he summarizes the Spetznaz capabilities. On p. 22-27, he summarizes Spetznaz use of nuclear weapons already on American soil. On p. 26, he gives some of the ways in which the Soviets easily brought nuclear weapons into the U.S. On p. 30 he confirms **Russian** seismic weapons. Use of EMP weapons is on p. 30-31. Use of very, very low frequency weapons to destroy the human brain, put people into a zombie-like state, and aid in brainwashing is confirmed on p. 31. The present war on terrorism has many more facets than are presented by the conventional news media.

Just as the dinosaurs were confronted with a new and dangerous threat, and failed to adapt, the electrical power infrastructure is now confronted with a potent threat against its very vitals and — so far — is completely failing to adapt. It is going to have to adapt or perish, which presently implies that we all perish along with it. Those who make it their nefarious business to see to it, will see to it.

So let us "see to it" first, scientifically, as rapidly as human research and development can do the job. The very existence of civilization may well depend upon it.

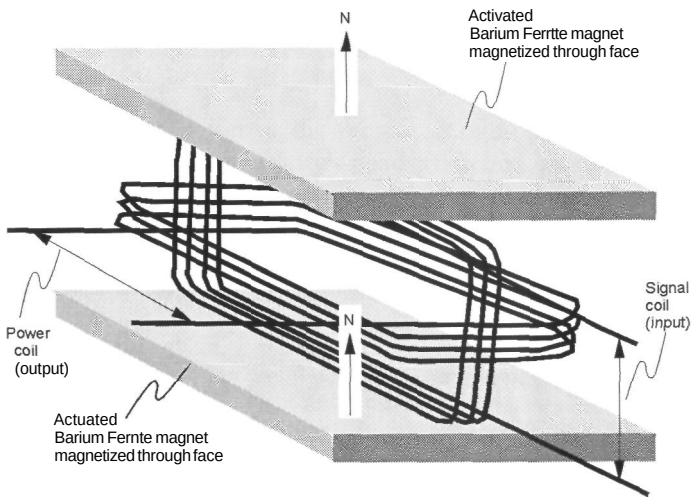

Figure 6-5 Sweet vacuum triode amplifier (VTA) construction.

Chapter 7

Aharonov-Bohm Effect, Geometric Phase, and the Motionless Electromagnetic Generator (MEG)

[Decision that hydrogen fuel is the future]. *"We are at the peak of the oil age but the beginning of the hydrogen age. Anything else is an interim solution. The transition will be very messy, and will take many technological paths ...but the future will be hydrogen fuel."* [Herman Kuipers, Royal Dutch Shell.].

[Vacuum energy is real] *"...the acceptance of a structured vacuum described by an O(3) gauge group leads directly to the existence of novel charges and currents in the vacuum. These are conserved, or Noether, currents and charges and are clearly topological in origin. They spring from the fact that the vacuum is a topological space. Four such entities emerge: [1] A topological vacuum electric charge, also proposed empirically by Lehnert et al. [2] A topological vacuum electric current, also proposed empirically by Lehnert et al. [3] A topological vacuum magnetic charge, proposed also by Barrett and Harmuth. [4] A vacuum topological magnetic current, proposed also by Barrett and Harmuth.*

Each of these four objects can provide energy, which can be loosely termed 'vacuum energy': energy coming from the topology of the vacuum. " [Evans] {458}.

[Aharonov-Bohm effect] *"...the Aharonov-Bohm effect is a local gauge transformation of the true vacuum... [which] produces a vector potential from the true vacuum. [This gauge transformation] produces topological charge..., the electromagnetic field, which carries energy, and the vacuum charge current density first proposed by Lehnert ... and developed by Lehnert and Roy... ".* [Evans and Jeffers] {459}.

[Geometric phase] *"The concept of the geometric phase is closely related to the effect of a state function acquiring a non-zero phase factor after a quantum system undergoes a cyclic evolution. This means, that if a system after some time returns to its original state, the result of such an evolution will be recorded in the phase of the wavefunction. Moreover, this phase factor can be measured by interfering initial and final states. ... Although there are no widely recognized practical applications of the geometric phase, its experimental observations have been reported in many fields of science. The largest group of experiments have been carried out on polarized light ...and polarized neutrons ... The geometric phase has also been observed in magnetic resonance experiments ..., mesoscopic structures ...and molecular systems ...Analogues of GP — the Hannay angles — have been shown to exist in classical mechanical systems ..., the most famous example of which is the Foucault pendulum."* [Aleksiejunas][198]

[Practical use of geometric phase]. *"The motionless electromagnetic generator is the first practical macroscopic use of the geometric phase. "* [T. E. Bearden, 2001, to a correspondent].

[Impact of extracting energy from the vacuum] *"If they [quantum fluctuations of vacuum] can be [tapped], the impact upon our civilization will be incalculable. Oil, coal, nuclear, hydropower, would become obsolete — and so would many of our worries about environmental pollution." "Don't sell your oil shares yet — but don't be surprised if the world again witnesses the four stages of response to any new and revolutionary development: 1. It's crazy! 2. It may be possible — so what? 3. I said it was*

[198] I am much indebted to Dr. Rimvydas Aleksiejunas for this clear statement of the geometric phase. See his very elegant summary, " Introduction to The Geometric Phase Decomposition," on his Internet website at http://signalogram.free-hosting.lt/Research/gp dec.htm. His own publications in scientific journals and proceedings are also listed on **the** website, and many are available for downloading. His doctoral thesis dealt **with geometric phase** and he is a specialist in that field.

a good idea all along. 4. I thought of it first." [Arthur C. Clarke] {460}.

7.1 Introduction

In this chapter we give a history, some information, and comments about the Aharonov-Bohm effect {473}, which was generalized by the Berry phase {477} for adiabatic conditions, which itself was further generalized by Aharonov and Anandan {480} to remove the adiabatic limitation. The modern all-inclusive term is *geometric phase,* which has been found to be involved in a very wide variety of physics areas. In its embodiments, the motionless electromagnetic generator (MEG) does utilize the Aharonov-Bohm effect (geometric phase) in a unique manner that we explain. We also remark on what we hypothesize may be some related new aspects of the curl-free magnetic vector potential itself.

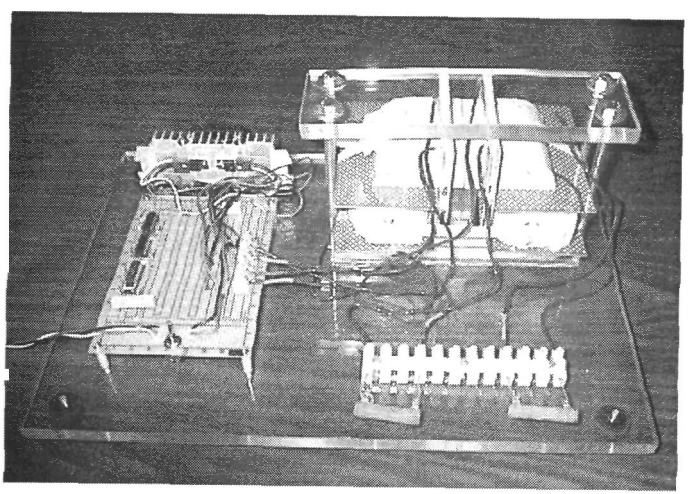

Figure 7-1 Motionless Electronic Generator (MEG)

The motionless electromagnetic generator (MEG) (Figure 7-1) was invented by Patrick, Bearden, Hayes, Moore, and Kenny {461} after years of research and experimentation. It has been technically described elsewhere {462}, and scientific explanations of the fundamental mechanism by which it successfully extracts useful EM energy from the active vacuum have been published in the recognized literature {463, 38a, 464}. Other closely related papers on extracting EM energy from the vacuum have been published or are submitted and in review {465a-465h}.

A version of the MEG has also been independently replicated by Naudin {466}, and in fact by others who did not wish to publish their results. By permission, Naudin's Mark II MEG replica is shown in Figure 7-2. Consequently, the MEG is a validated and replicated COP>1.0 system, as required by proper scientific methodology. Further, sufficient information has been released for any competent laboratory team to replicate a version of the MEG.

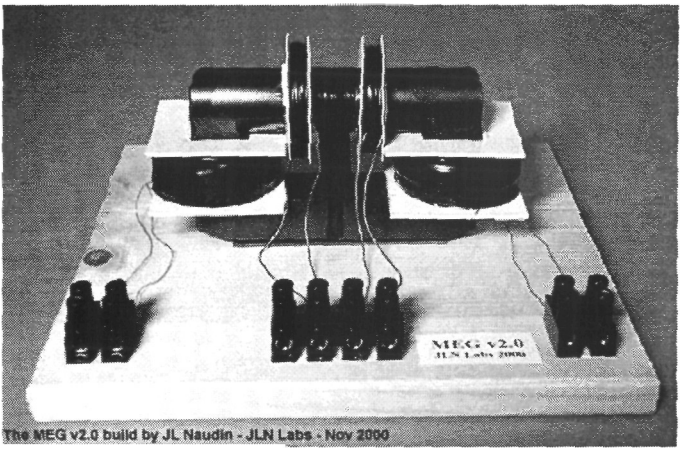

Figure 7 2 Nuadin's Mark II Replication of the MEG.

We give an overview of the MEG, the principles of its operation, the status of the project, and some indication of future plans.

7.1.1 Status

As this is written, the first MEG patent has just issued {37}. A second Provisional Patent Application has been filed, and at this writing is in process of being replaced by a formal regular patent application. Two other patent applications are in preparation. All rights to the MEG are assigned to Magnetic Energy Ltd., Huntsville, Alabama, U.S.A., whose CEO is Dr. James L. Kenny.

In addition, Bedini and the present author have filed a provisional patent application on the process and embodiment for close-looping a COP>1.0 system for self-powering operation, and are in process of replacing it with a regular patent application also. Magnetic Energy Ltd. has permission to utilize the Bedini-Bearden close-looping process. In addition, Magnetic Energy Ltd. has its own proprietary close-looping process, for which a patent application is being prepared. The Company is also involved in

serious discussions with several large companies and financial groups for potential financing. When that funding is obtained, we will open a substantial research and development laboratory here in the United States, serving a separate production company to be set up with our financial partners to produce and market the MEG. Meanwhile, laboratory work to complete the research and development of the MEG is also ongoing under a cooperative arrangement with the National Materials Science Laboratory of the National Academy of Science of a friendly foreign nation formerly under the Soviet bloc.

7.1.2 Future Plans

Our plans are straightforward. We will continue to pursue and update our patents and file additional ones as additional discoveries are made. We will continue our negotiations with major financial parties until satisfactory and mutually beneficial capitalization is obtained (we expect that to occur before the end of 2002). At that time we will establish a modern Magnetic Energy Ltd. U.S. laboratory devoted to advanced research and development, as well as a separate production company in partnership with our funding partners. The final research necessary on the MEG (four areas of physics as well as the electrodynamics) will be completed in somewhat less than one year after setup of the lab and lab team, and the production company is expected to have the first engineering development production prototype at the end of that first year. We expect it to be a self-powering unit. We will simply put the first MEG units into production and on the world market immediately thereafter.

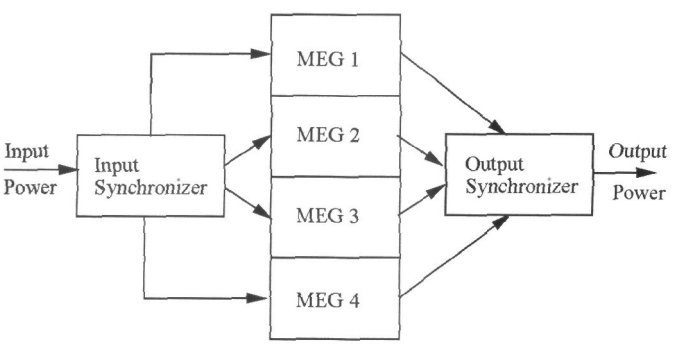

Figure 7-3 Block diagram of envisioned **modular** MEG design.

See Figure 7-3. The first production MEG is envisioned as a modular 2.5 KW unit together with a synchronizer unit simultaneously developed, so that up to six 2.5 KW MEG units can be synchronized in a power system

array. This will yield power units from 2.5 to 15 KW. We are struggling to have the closed-loop process completed and ready in that same first year, and if possible the very first MEG units will be close-looped and self-powered. At the end of the second year or before, we plan to have the close-looped basic MEG unit in 10 KW size, again with synchronizer so that up to six MEG units can be synchronized in an array. That will cover the 10 - 60 KW power system size, which is ideal for homes and small businesses. Once the units go on the world market, we believe that the market will be extraordinarily dynamic and productive. We intend to license multiple companies for production and competition for various markets, with no single company being given total monopoly worldwide.

7.2 Aharonov-Bohm (Geometric Phase) Effect

The Aharonov-Bohm (AB) {473} effect, or geometric phase (GP) {477, 480} effect, is now well known {467} in quantum mechanics and quantum electrodynamics, but does not exist in classical electrodynamics. The effect proves the reality of the potentials and their primacy over the fields. Further, it shows that electron effects can be generated by the magnetic vector potential A even in the absence of the magnetic field B.

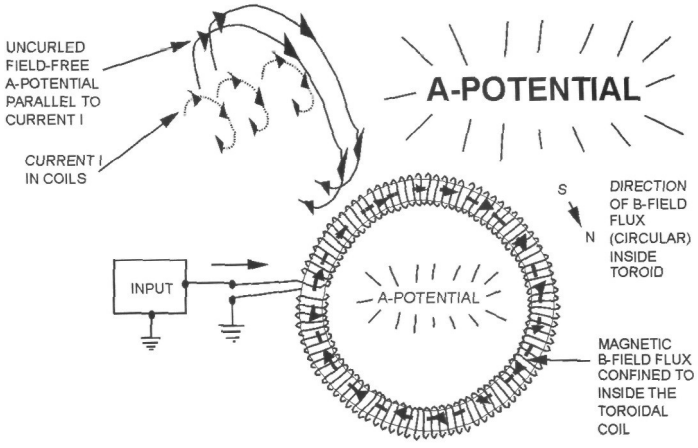

Figure 7-4 Aharonov Bohm effect for a tightly wound toroidal coil.

According to Feynman {468}, it required 25 years for quantum physicists to clearly face the issue eventually pointed out in 1959 by Aharonov and Bohm of the primacy and separate action of the force-field-free potential, in regions where no force fields were present (Figure 7-4) {469}. After the

effect was experimentally demonstrated by Chambers {474} in 1960, it then required another 25 years before physicists would accept it. Even today, another 16 years after full acceptance in 1986, to our knowledge the Aharonov-Bohm effect has not previously been utilized in any practical electrical power system {470}, much less one that has a COP>1.0. As Aleksiejunas[198] states (see his quotation at the beginning of this chapter), there have not previously been any widely recognized practical applications of the geometric phase. Now there is a practical application of major worldwide importance, since the operation of the MEG depends upon the geometric phase (Aharonov-Bohm) effect to produce real electrical power from the active vacuum itself.

We also believe that the curl-free potential may not have been adequately investigated, particularly along the lines of its utilization in the MEG.

7.3 Abbreviated History of the Geometric Phase

The earliest work with a state function acquiring a non-zero phase factor after a quantum system undergoes a cyclic evolution was published in 1956 by Indian scientist Pancharatnam {471}. Pancharatnam noticed phase shifts of cyclic evolutions in optical phenomena. This means that, if the system leaves its original state and after some time returns to it, the result of the system's evolution will be recorded in the phase of its wavefunction. In addition, this phase factor can be measured by interfering the system's initial and final states.[198] Sadly, Pancharatnam's anticipation of the geometric phase factor did not receive the attention it so justly warranted, and his paper languished almost unnoticed for nearly four decades, when it was finally rediscovered. This was an excruciating scientific tragedy to Pancharatnam, comparable to that which befell Waterston {472}.

The effect of the field-free potential and the geometric phase issue were pointed out strongly by Aharonov and Bohm {473} in 1959 in a leading U.S. physics journal, causing much consternation in physics. Before that paper, most physicists still believed that all electromagnetic forces and effects were induced only by the force fields,[199] and not by the potentials.

[199] Indeed, the force fields do not even exist in mass-free space, but only in matter. Force is defined as $F \equiv \partial/\partial t\ (mv)$ so that mass is a *component* of force. Feynman states: *"...in dealing with force the tacit assumption is always made that the force is equal to zero unless some physical body is present... One of the most important characteristics of force is that it has a material origin... " "...the existence of the positive charge, in some sense, distorts, or creates a "condition" in space, so that when we put the negative charge in, it feels a force. This potentiality for producing a*

In the prevailing belief, when the fields were zero there were no EM effects. Indeed, the potentials were largely regarded as mathematical conveniences.

Another point of consternation was that the A-potential is not uniquely determined, but is determined only up to a particular gauge transformation. So there can be two (or even more) magnetic vector potentials A and A' corresponding to a specific magnetic field. Aharonov and Bohm raised a disturbing question: How can two different "causal" A potentials produce the same effect? We will rigorously answer this question shortly.

While the experiments suggested were difficult, they were performed shortly after the publication of the Aharonov-Bohm paper. The very next year, in 1960, Chambers {474} experimentally demonstrated the Aharonov-Bohm effect, though not with complete decisiveness. A 1983 paper by Tonomura *et al.* {475} was significant, and a 1986 publication of further work of Tonomura *et al.* was decisive {476}.

In 1984, Berry generalized the Aharonov-Bohm effect into the geometric phase {477}. In 1985 the Tonomura effort plus experimental work by Webb *et al.* {478} settled the matter, as strongly stated by Schwarzschild the next year {479}. In 1987, Aharonov and Anandan {480} further generalized Berry's geometrical phase, freeing it from its adiabatic

force is called an electric field. " So Feynman was fully aware that not the force field but only the potential (i.e., the potentiality) for producing the force field exists in mass-free space. The electrodynamicists continue to be confused on that point. E.g., on p. 28 of his *Classical Electrodynamics,* 2nd edition, Wylie, 1975 Jackson states: *"...the thing that eventually gets measured is a force... ",* confirming that force is an observable and thus a *d/dt* operation imposed upon spacetime LLLT to give a purely spatial entity LLL. On p. 249, Jackson also states that *"Most classical electrodynamicists continue to adhere to the notion that the EM force field exists as such in the vacuum, but do admit that physically measurable quantities such as force somehow involve the product of charge and field."* The two parts of the conventional assumption, as stated by Jackson, contradict each other. We point out that Jackson's book has been a standard of excellence for years, and no EM library is complete without it. It merely shows the extraordinary difficulty of rooting out the exasperating and mind-numbing confusion in physics between the observed effect and the unobserved cause. Force is an effect, after interaction (observation or measurement), hence cannot be the cause (which exists prior to interaction or measurement). Else, there is no difference between cause and effect, which destroys causality itself. This confusion is still there in even the hoary old classical mechanics, now some centuries old. By that standard, electrodynamicists have a long time remaining before they will have propagated this non sequitur" as long as the mechanical physicists have.

restriction and generalizing the geometry. Much discussion of the AB effect and Berry's geometric phase occurred {481a-481c}, but the scientific consensus was in: *The Aharonov-Bohm effect is real and the geometric phase is a widespread fact of nature.*

In 1985, Olariu and Popescu {482} published a very good overview and discussion of the AB effect up to that time, with hundreds of references.

Thousands of papers on the AB effect, the Berry phase, and the geometric phase have since appeared in the literature, and continue to appear at a rather steady and prolific rate. A few are listed for a sampling {483a-483k, 484a-484i}. The original Aharonov-Bohm effect has now expanded and spread widely through physics and into a myriad other effects and areas, such as the scalar AB effect, the Aharonov-Casher effect, magnetic vector potential vortices, quantum tunneling, chemical reactions, chaotic oscillation, and others. These related extensions are far beyond our interest here. We are, however, interested in what we hypothesize may be a new aspect of the perturbed curl-free magnetic vector potential A. We shall address that aspect briefly.

7.4 A Possible New Aspect of the Curl-Free Magnetic Vector Potential

We propose what may possibly be a unique new aspect of the curl-free A-potential — and thus of the Aharonov-Bohm effect — that has been uncovered in our MEG experiments. We caution, however, that this is a tentative interpretation and remains to be further validated.

First we state that the equation, $\mathbf{B} = \nabla\times\mathbf{A}$, usually accepted as the "definition" of the magnetic vector potential A, is not even a definition, because no equation is a definition.[200] If we rewrite the equation as the identity $\mathbf{B} \equiv \nabla\times\mathbf{A}$, then it is a proper definition — though not of the A-potential, but of the B-field itself, *given* that the A-potential exists and is primary. It also states that the B-field is simply a magnetic vector potential having swirl; i.e., the notion of the B-field captures that swirl aspect of a swirling A-potential. Hence the statement that B = zero implies only that **the** A-potential remaining is swirl-free and hence a linear EM energy

[200] No equation is a definition, *a priori.* It merely states the relationship of the total magnitude of the entities on the left to the total magnitude of the entities on the right. It does not define any entity on either the left or the right. One of the gross non sqeuiturs in physics texts is to continue to present equations as "definitions".

current flow. Note that the B = 0 condition does not specify the magnitude of the remaining A-potential, but *only* specifies that it has no curl. This is a rigorous answer to the original question posed by Aharonov and Bohm of how two different A-potentials can have the same magnetic field B (the same swirl). It is no more mysterious than two different rivers having a whirlpool of exactly the same swirl magnitude.

At least to first order, it appears we have arrived at a "semi-definition" of the A-potential along these lines:

> *The magnetic vector potential A is an EM energy current in 4-space, which can be swirling or linear, or can have two components where one is swirling and the other is linear. The swirling component of the A-potential is also known as the B-field, and the linear component is known simply as the "curl-free A-potential". The A-potential exhibits a remarkable property: If its swirl component is localized and confined, the remaining space where the swirling A without localization would have been is filled by a remaining unswirling linear A-potential energy current. In short, by swirl-localization the swirling A-potential can be freely 'regauged' into two separated entities, with the sum of their energy being greater than the apparent energy of the previous swirling A-potential. Hence swirl-localization is a method of asymmetrical self-regauging of the A-potential itself with the excess energy coming directly from the active vacuum.*

If we take the view that any curled A is identically a B-field, then the "natural" A is not curled, because it requires a curl operation applied to it to produce a "curled A" or B-field. Therefore the "natural" magnetic vector potential A is simply a magnetic energy current in space, since it is a vector and has direction {458}. That is a *longitudinal EM energy flow process*?[201] We shall be very interested in the uncurled A-potential; i.e., in that linear energy current in space that is uncovered and freely produced

[201] Interestingly, around a toroidal localization zone, the uncurled A-potential does curve, but is only linearly following the curving current and the moving E-field from the moving charges in the current. In the MEG, the uncurled A-potential is even more complex, since we use each half of the toroid-like localization zone differently, with the B-flux going one direction (say, counterclockwise) in the left branch and the B-flux going in the other direction (say, clockwise) in the right branch, and with a crossover point in the middle.

when the B-field is localized. Indeed, we shall perturb it to make a large E-field, which we intercept and use to furnish emf to the secondary circuit and power loads.

Given a localized B-field so that we have an uncurled A-potential outside the localization region: If we now increase the magnitude of the A, that produces an increased linear energy flow rate outside the localization zone, in addition to increasing the B-field in the localization zone. If we decrease the magnitude of the A, that produces a decreased nonlocalized energy flow rate and a decreased localized B-field. In our view it follows that, when we oscillate the magnitude of the A-potential by any means whatsoever, we oscillate the nonlocalized linear EM energy current flow rate as well as the localized B-field. In fact, that creates a normal oscillation of the localized B-field, and also creates a nonlocalized *longitudinal wave* of electric field E by the equation $\mathbf{E} = -\partial\mathbf{A}/\partial t$, if the conditions localizing the curl operator — and hence localizing and holding separate the concomitant B-field produced by a changing E-field — continue in effect.

We have produced a mechanism for generating a nonlocalized longitudinal E-field wave without a nonlocalized B-field component being allowed to act outside a confined locality. We stress that a B-field component is produced, but remains localized in the special core material (that is one of the conditions required in the MEG).

We have also produced a mechanism for generating a nonlocalized longitudinal E-field wave with another very novel feature: the magnitude of the E-field and thus the magnitude of its energy density (its intensity) does not depend on the *magnitude ofthe input energy* used to perturb the A-potential, but only depends on how sharply we perturb it. Thus we have produced a mechanism for energy intensity amplification and magnification, freely. This is possible because the system is an open system far from equilibrium with the active vacuum, and specifically with the curl-free A-potential as an energy current at large in the local vacuum where it can be intercepted, collected, and used to power loads. The energy intercepted from the uncurled A-potential by the output section(s), is *additional* energy in excess of what is intercepted from the E-fields generated in core material B-field magnetic flux changes.

However, see our discussions of the giant negentropy process, earlier in this book. Any longitudinal EM "wave in 3-space" is accompanied by a longitudinal EM wave on the fourth Minkowski axis, in the time domain. EM energy does not observably propagate continuously in 3-space, since

observed propagation is a series of frozen iterative observation processes a priori). The "energy flow" actually consists of a propagation in 4-space of a *continual local circulation* of EM energy from the time domain (time-polarized EM energy) to each interacting point dipole in 3-space via the negative charge of the point dipole, thence to the positive charge of that point dipole, thence back to the time domain. In a time-reversed zone, the circulation is in the opposite manner. So what spreads as the "longitudinal EM energy current in 3-space" is actually the spreading point polarization of the vacuum and this giant negentropy 4-circulation involved in every point dipole of that polarization.

We believe this previously unsuspected process is involved in the Aharonov-Bohm effect (which is a sort of polarization in the time domain), other aspects of the geometric phase, fundamental polarization of the vacuum itself, and the very notion of "propagation of EM energy through space". At any rate, the hypothesis does fit the phenomena observed to happen in the MEG, so it warrants additional careful experimental investigation as well as attention from leading theorists.

Further, the MEG is practical and produces practical electrical power, but with a *purely electrical reaction* in the output secondary coils of the transformer section.[202] Hence there is finally a very practical use for the geometric phase: It extracts additional *nonlocalized* EM energy from the vacuum (and local curved spacetime) in addition to extracting and retaining *localized* energy. Both the extra "free" nonlocalized EM energy and the localized EM energy from the vacuum can be intercepted, collected, and utilized to power practical fuel-free MEG-type power systems.

We point out that the rate of changes of all E-fields produced in the secondary and primary coils also produce B-fields proportional to the time rate of change of those E-fields in each case. These secondary B-fields are

[202] This follows from the localization of all B-fields in the core material — including the B-field of the permanent magnet, those B-fields produced by dE/dt operations, and those B-fields produced inside the secondary coils, etc. All E-fields produced, however, including in the changing flux of the core and in the dA/dt operations of the external uncurled A-potential — are free from that localization restriction and can pass out of the core and interact with the output coils of the transformer section. In short, we have produced the world's first purely electric "induction-free" magnetic transformer device. The voltage and current, measured directly across the secondary coil's ends, is in phase within 2 degrees and even that 2 degrees can be eliminated. We expect the theorists to have a field day in modeling these new phenomena.

retained in the core rather than reaching out into surrounding space. Their rate of change then further produces E-fields, which pass out of the core and interact with the coils. Hence there are very novel "multiple feedforward and feedback" regenerative loops in the MEG's highly nonlinear operation, as well as chaotic oscillations.

7.5 Use of the Aharonov-Bohm Effect in the MEG

From the standpoint of electrical power systems, our own interest in the AB effect focused upon one important characteristic: the clear separation (and localization) of the B-field (the swirl component of the A-potential), leaving the remaining "natural" uncurled field-free A-potential as a free linear flow of energy current in the vacuum. This operation is iterative, and is produced by the core for every B-field produced in the transformer section. So a localized dynamic B-field makes nonlocalized dynamic E-fields, which themselves make further localized dynamic B-fields, which then further make nonlocalized dynamic E-fields, and so on. The result is a very extensive chain of feedforward and feedback field energy loops.

7.5.1 Separation of the Swirled and Linear A-Potentials

The AB effect has long been known in toroidal coils and in long solenoids. In a theoretically perfect toroid, for example, the AB effect separates and localizes the entire B-field inside the toroid, while the *curl-free* magnetic vector potential A appears in surrounding space outside the toroid. By our new interpretation and hypothesis, based on AIAS theoretical work published in the literature, this curl-free A-potential represents a nonlocalized longitudinal EM energy current in space.[203,204] Further, the curl-free A-potential is an extra flow of EM energy that can be intercepted, collected, and used while also still using the entire "normal" B-field energy localized in the core. The neat thing is that the E-field made from the

[203] This is addressed in M. W. Evans, T. E. Bearden, and A. Labounsky, "The Most General Form of the Vector Potential in Electrodynamics," *Found. Phys. Lett.,* 15(3), June 2002, p. 245-261. See also M. W. Evans et al., "The Aharonov-Bohm Effect as the Basis of Electromagnetic Energy Inherent in the Vacuum," *Found. Phys. Lett,* (in review).

[204] See also B. Lehnert and J. Scheffel, "On the Minimum Elementary Charge of an Extended Electromagnetic Theory," *Physica Scripta,* vol. 65, 2002, p. 200. In extended EM theory, the elementary charge may no longer be considered as a fundamental constant of nature, but is expressed in terms of the Planck constant and the velocity of light.

A-potential, and thus providing the actual intercepted and collected EM energy, can be made as large as desired, merely by manipulating the rise time and decay time of the pulses used to perturb the A-potential external to the core. Further, the same perturbation also perturbs the B-field flux in the core, giving rise to nonlocalized E-fields whose magnitude again depends upon the rise time and decay time of the perturbing pulses. Hence the dA/dt and the dB/dt become energy amplification causes, where all the excess F-field energy is furnished freely from the vacuum via a special kind of asymmetrical regauging and gauge freedom. In that sense, the MEG produces and applies a hitherto unrecognized form of direct field energy amplification by asymmetrical regauging.

We noted that this mechanism represents the formation of a locally curved spacetime[205] and engineering of the magnitude of the curvature itself. By freely increasing the local spacetime curvature, the appearance of additional EM energy density in the region follows *a priori*. That is, one still has all the B-field energy produced by the permanent magnet, but it is just confined to the space inside the core. All the energy one "pays for" or inputs with current and voltage to the input coil, in the normal sense, is the energy to *perturb* the localized B-field and the curl-free A-potential. However, even before perturbation to evoke energy amplification, there is already additional energy current that has appeared outside the core, where the magnetic field B would have normally extended. All the A-potential energy[206] is "extra" energy in addition to the normal B-field energy that

[205] More accurately there is one specific curvature of spacetime in the core of the MEG, representing the confined magnetic field B (the localized swirling A-potential), and there is another different curvature of spacetime outside the localization zone, filled with the nonlocalized curl-free (non-swirling) A-potential as a nonlocalized linear energy flow in space. Further, in the MEG we freely change and increase the magnitude of those spacetime curvatures, by the *rate of change* of the input energy rather than by its *magnitude*, and hence we easily increase the magnitude of the energy density of local space both inside and outside the core. That is the fundamental principle of the MEG"s energy amplification (free regauging).

[206] Some scientists even deny that the curl-free magnetic vector potential has any energy! We answer that it produces energetic effects upon charged particles, hence must either contain energy itself or direct and gate the interaction of some local vacuum energy with those charges. In the MEG, the uncurled A-potential is oscillated, which does not appear to yield a *transverse* EM E-field wave at all. Instead, it appears to yield a *longitudinal* E-field wave with an associated scalar KM wave in the time domain. We also explained what appears to happen to the concomitant B-field wave produced by any changing E-field in the secondary

would otherwise have appeared out there but is now confined inside the core.

Further, the uncurled A-potential outside the core reduces its magnitude only inversely as the radial distance, whereas the normal B-field that would otherwise be there in the absence of localization would have reduced its magnitude inversely as the square of the radial distance. This far less rapid fall-off of the magnitude of the nonlocalized curl-free A-potential than the former nonlocalized magnetic field B can result in a remarkable increase in communications range — when a normal EM field antenna with oscillating EM field transmissions is compared to a curl-free A-potential antenna radiating the same power but as curl-free A-potential oscillating transmissions. Golden[207] has applied that effect for long-range communications.

With the application *of the free* Aharonov-Bohm effect produced by the core material and permanent magnet combination, rigorously there has appeared much more available EM energy from the local vacuum than the energy one inputs to the device as one's input energy "payment". Again, this is because the system is an open system far from equilibrium with the active vacuum processes such as the appearance of the uncurled A-potential and the iterative appearance of powerful extra B-fields and E-fields. The rise time and decay time of the input perturbation pulses produces an energy amplification effect both in the core and in space outside the core. When one utilizes this extra uncurled A-potential energy, as well as the now-confined B-field energy, as well as the extra B-fields and E-fields appearing from the iterative processes, then one can extract and use more energy than one himself "paid for" or input to perform the perturbation. Indeed, one can easily extract and use more energy from the curl-free A-potential alone, than one has input. By simply controlling the rise time and decay time of the input pulses, the magnitudes of the resulting E-fields formed in the uncurled A-potential (and in the perturbed trapped B-field perturbations inside the core) can be controlled at will.

(output) coils of the transformer section, etc. The core material withdraws and holds localized, all such magnetic fields formed in the internal MEG core processes.

[207] In the late 1970s Frank Golden demonstrated such an uncurled A-potential **antenna** which attained a range of 20 miles for a tiny CB radio, compared to a range of only 1 mile for the same CB radio with a normal EM field antenna. The energy density of the potential drops off inversely as the distance, while the energy density of the field drops off inversely as the *square* of the distance.

We also point out that all these amplified E-fields produced by multiple actions have both a conventional Poynting energy flow component and an unaccounted, much larger Heaviside energy flow component. Thus the total energy amplification factor can be very large (several orders of magnitude). With efficient interception and collection, in the future we expect to be able to produce at least 100 kilowatts of power out of the same size core and buildup now producing 80 watts or less in a highly nonoptimized set of laboratory experiment MEGs.

We again call the reader's attention to our previous discussions in this book, showing that all EM energy in EM circuits comes from the vacuum anyway (particle physics view) or from the time-axis (relativistic view). This has previously been hidden by the failure of classical electrodynamics to solve the source charge problem, which we also solved in this book after our paper {12} in 2000. Circuit theorists avoided it by indirectly assuming the source charges freely created from nothing all the EM energy in their fields and potentials. The use of the assumed fields and potentials and their Poynting energy was calculated, but never was the source of those fields, potentials, and their energy presented or accounted.

7.5.2 Using the Uncurled A-potential as a Linear Energy Current

A very simple equation allows utilizing the extra nonlocalized A-potential energy, even though it has no curl and therefore no magnetic B-field. That is $\partial \boldsymbol{A}/\partial t = -\boldsymbol{E}$. This equation means that, if one perturbs that large field-free A-potential outside the toroid, it produces an E-field, which we have argued must now be a longitudinal EM wave due to the perturbations *if the B-confining operation is still imposed.* By oscillating the A-potential perturbations, one produces an oscillating E-field that is also an oscillating longitudinal electric E-field wave without an accompanying B-field wave.

The oscillating B-fields in the core also produce E-fields proportional to $\partial \boldsymbol{B}/\partial t = -\boldsymbol{E}$. These extra E-fields are in phase with the E-fields produced by the perturbed external A-potentials, considering the wavelength of the frequencies at which the MEG is operating (30 to 80 kHz nominally).

Interestingly, the time-oscillating rate of change of the E-field in this longitudinal E-field wave does produce a magnetic B-field, but it is confined to only the core material and not in the nonlocalized external spatial region *because of the localization capability of the core material.* The core simply changes its permeability and holds the additional B-fields and their flux in there, thus forming additional uncurled A-potential outside the core. The E-fields produced by variations of the core B-field flux is not confined, but freely passes out of the core material

If that B-field (curled A) is sharply localized by an ongoing localization capability, the longitudinal E-wave has its produced magnetic B-wave component stripped from it and localized. In that case, the process produces a purely longitudinal E-field wave outside the localization region — with the possible exception that a longitudinal B(3) field wave component pioneered by Evans {485} *may be produced as well. That is left as an open question presently unresolved in our MEG experiments. We tentatively believe that the B(3) field wave component is in fact produced, but also forcibly localized in the core along with the magnetic field B. If so, its perturbations will also contribute to producing extra E-fields.*

See Figure 7-5. In the MEG, the localization is accomplished as a unique function performed freely by the special nanocrystalline layered core material. So contrary to the case of the solenoid or toroid, one does not to have to "pay" any EM energy to the localizing component to obtain the localization function itself.

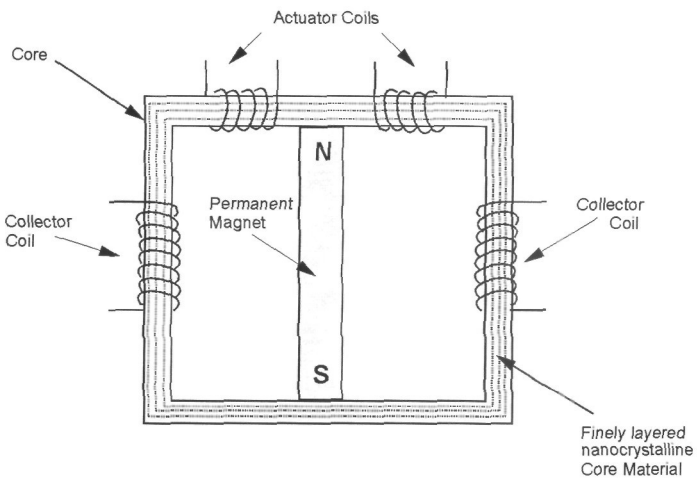

Figure 7-5 Diagrammatic drawing of the MEG.

Further, if one deliberately uses a nearly rectangular perturbing pulse that has very sharp rise time and very sharp decay time, the nonlocalized E-fields, resulting localized secondary B-fields, and resulting nonlocalized secondary E-fields produced can be made very large, with rapid rates of change also. In other words, the magnitudes of the nonlocalized E-fields and localized B-fields produced can be adjusted at will, including in their higher orders. The magnitudes of these evoked fields do not depend on the *magnitude* of the input perturbation energy, but on its *rate of change*. This

is very important, because it means the MEG permissibly achieves energy magnitude increase in its nonlocalized output E-field waves by simple instantaneous power deliberately prepared in its low-energy input perturbation waves.[208] In short, the motionless electromagnetic generator uses perturbation of the Aharonov Bohm effect as an energy amplifying mechanism.

This also affects all the iterative processes, hence all the other E-field waves produced outside the core material.

With the localization process remaining and ongoing (simply because the core material remains), the B-field continues to be stripped away, leaving the perturbed A-potential to produce a longitudinal E-field wave (ignoring the possible presence of a B(3) field also). In the MEG transformer section, the output (secondary) coils are wound around the nanocrystalline core that performs a B-field and B-flux localization within the core itself. Hence a purely net E-field interaction occurs with the electrons in the secondary coils, and the output of these coils is an output having the output voltage in phase with the output current.[209] The AC current in the secondary coils does in fact still produce magnetic field B-flux and B-waves in them, but the core material draws the extra B-flux and B-waves inside and localizes them within the core. The fact that localization is *not quite* 100% at the imperfect junctions of the ends of the permanent magnet and the core material, gives a tiny bit of leakage of

[208] It also means that the MEG operation is highly nonlinear, with very extensive feedforward and feedback field transduction loops. For the MEG, its scale-up, mathematical modeling, and engineering simulation are not simple things at all, but highly complex. In addition, control and stability are more complex, since one must utilize nonlinear oscillation theory (including chaotic oscillation theory) as well as nonlinear oscillation control theory. In addition, a higher group symmetry electrodynamics is required for the modeling and simulation. Consequently, because of these considerations and the geometric phase aspects, as well as the additional close-looping considerations for self-powering operation, an expensive physics lab must be established as well as the usual electrodynamics laboratory aspects. The result is an expensive final research and development program required to complete the MEG to final production prototype units, ready to start rolling off the assembly lines. A minimum capitalization of $20 million is required.

[209] In the actual lab experiment MEG, there is a slightly imperfect junction between the ends of the permanent magnet and the core material. This results in a very tiny bit of leakage of nonlocal B-field —just enough to produce a 2° phase shift between the voltage and current in the secondary coil's output. With a better junction, this phase shift can be further reduced or eliminated.

B-field, so a tiny B-field component does escape, interact, and generate the *2%* or so variation from the complete in-phase condition of the secondary output voltage and current. Again, that can be further reduced or eliminated by improving the junction.

So essentially there is a purely electric field interaction with the electrons in the output coil current of the MEG, hence the result that the output current is in phase with the output voltage — something previously unheard of in a simple secondary coil of a transformer. This is a major practical macroscopic application of the Aharonov-Bohm effect and therefore of the geometric phase.

7.6 Collection of Field Energy in the MEG

To collect and use EM energy in a power generating system, first the EM energy must be evoked from local spacetime (the local vacuum) by the broken symmetry of the source charges and dipoles in the circuit {12}. In the open system far from equilibrium in the resulting EM energy flow, the operator must usually pay for (i) the energy required to *initially* produce the requisite source dipolarity and (ii) the energy required to perform necessary switching and control functions, unless close-looping is incorporated. Using the permanent magnet as a source dipole in the MEG, and using the special nanocrystalline core material to generate the Aharonov-Bohm effect to furnish excess energy from the vacuum, the MEG operator does not have to *furnish* the evoked and available field energy at all. So the first "payment" is totally avoided. Further, the magnetic dipole is not destroyed by passing magnetic flux back through its back mmf. No additional input energy is required to continually restore the source dipole, since it is never destroyed.

In an open-loop MEG system, the operator only has to pay for the second part: the switching and control function energy. In later closed-loop MEG systems, a method of controlled and positive feedback has been developed so that, once the system is up and operating and powering its load, the necessary switching and control function energy can be siphoned off the output and fed into the input in governed fashion, first being transduced into positive energy input form. Once the process is properly synchronized and governing properly, the operator can throw a switch for feedback and transduction, and the unit will be "self-powering", or "fueled entirely by the local vacuum energy", so to speak.

Let us consider the open-loop MEG system we have presently attained in a scries of embodiments.

The total emf force F collected from a given nonzero electric field E, e.g., depends only upon the amount of available intercepting charge, by the simple equation $F = Eq$. Similarly, from any potential ϕ the amount of collected EM potential energy W depends on the amount of intercepting charge q, by $W = \phi q$. Hence in the MEG a legitimate COP>1.0 system is possible if (i) more energy is collected and used from the evoked EM energy flow than is input to gate that energy flow's appearance from the active environment, and (ii) none — or appreciably less than half— of the energy collected in the circuit is used to destroy the source dipolarity.

By invoking the AB effect in a local region, the vacuum contributes additional energy density in the space outside that region, and that energy density can be sharply perturbed so that substantial field energy amplification appears by asymmetrical regauging. The excess energy to provide COP>1.0 performance is freely furnished from the active vacuum (and from the local curved spacetime) {38b, 38c}. The excess energy can be intercepted in the perturbed curl-free A-potential region outside the transformer section, collected, and used to power additional loads, in addition to being intercepted in the transformer secondary region to power the secondary circuit and main load.

Similar contributions of extra energy and extra energy collection outside the core localization region occur for the iterative processes also.

At the same time, the B-field inside the core material is perturbed, but the core material self-varies its permeability to adjust to the additional magnitude of the perturbed B-field. The production of any B-field oscillation inside the core does produce an electric field E, which is not localized in the core. Consequently, energy from the perturbed core-localized B-fields is transduced into nonlocal E-field energy, passing out of the core and interacting with the output secondary coils of the transformer section in purely electric field fashion.

Because of the purely electrical interaction, the voltage and current output from the secondary coils of the transformer section are in phase, and not 90° out of phase as in a transformer. The actual 2° experimental phase shift of current with respect to voltage is a measure of the slight inefficiency of the junctions of the permanent magnet ends with the B-localizing core material.

In the MEG, we are using a novel new kind of component: an *external-induction-free cored inductor*, which might alternately be called *a purely electrical inductor — at least externally.* In short, the inductive action

remains localized in the core, while the electrical action escapes the core and interacts with the coil to drive the current electrically. So here is another excellent, novel, and practical use of the Aharonov-Bohm effect and the geometric phase: Eliminate the inductive reaction of a coil's output, and transduce it into a purely electrical action. At this writing, we are preparing to file a separate patent application upon this latest application and process, and it will already be filed by the time this book is published.

We accent that any field or potential, once made, already involves an ongoing giant negentropy and overunity process {486}, as we previously discussed in this book. Simply calculate how much energy it requires to separate and form the source charge — which can be as simple as charging a tiny little sphere — and recognize that the field formed by that charge is an altered energy density of surrounding space and a polarization of the vacuum. Once the charge is formed, the corresponding alteration and sustaining of spatial energy density change and vacuum polarization freely moves radially outward at the speed of light from the charge, from the very moment it is produced. So a steady flow of observable EM energy is speeding out in all directions from the source charge. An enormous change in the energy density over that external spatial region surrounding the source charge occurs and spreads steadily, moving radially outward in all directions at speed c.

Hence a magnificent and rapidly extending curvature of spacetime — which energetically acts upon any available charged matter therein, by conventional general relativity — is formed and spreads outward in all directions from any source charge, once formed. How much effect on charged matter is exhibited by this freely created and spreading spatial EM energy density change, depends only on the amount of interacting/receiving charged matter in that surrounding space that is available to interact with the energy of the new fields and new potentials.

If **the** source charge or source dipolarity (in this case, primarily the magnetic dipole of the permanent magnet) is left alone and not destroyed, an unlimited amount of energy can be intercepted and discharged from a local load, again and again, from the charge's surrounding field or potential because the energy in the field and potential is steadily replenished from the active vacuum. The only problem is discharge the collected energy in the load(s) so as to leave the original source charges (the magnetic poles) inviolate, and not to destroy them. The MEG accomplishes this function.

This also rigorously follows from the gauge freedom axiom of quantum field theory. Consider this: the ability to freely change the potential — assumed by all electrodynamicists — can be applied directly to the load to potentialized it without any current moving, if there exists a somewhat lengthy electron gas relaxation time in that part of the load that is potentialized. After potentialization, one can switch the source of free potential away, and complete the load circuit separately, so that the excess potential energy is dissipated from the load, powering it. In that case there is no dissipation of the primary source dipole. *Gauge freedom already assumes one can produce EM energy from the local vacuum freely, anywhere and at any time.* In real life, one has to pay a little for the switching, but not for the energy input itself.

Why the scientific community for decades has fiercely opposed the funded experimental investigation of the implications of gauge freedom is quite inexplicable.

As can be seen from the conservation of energy law alone, in theory energy can be continually intercepted and collected from these free fields and potentials, once the source dipolarity (or source charge) creation has been paid for. Further, by applying gauge freedom to potentialized the load without energy dissipation, with a little adroit switching the collected energy can then be dissipated entirely in a separated external load circuit, so that the free potential energy completely exits that circuit without re-interacting with the source dipole and its back emf or mmf.

We predict that the above application of gauge freedom will eventually power most of the world's electrical systems, when the scientific community gives up its present "ostrich position". Once the engineers can build it, the scientists do not have to agree.

That such is not done in our conventional circuits is purely due to the limited vision of the scientific community and its refusal to fund appropriate research. To date, it has not even recognized what actually powers every electrical circuit, or that a common practice (the closed current loop circuit) has eliminated COP>1.0 and self-powering Maxwellian power systems for more than a century. The entire electrical energy crisis hurtling at the nations of the world is due entirely to the shortsightedness of the scientific community, particularly since 1957.

Once the energy is pouring (transmitted) from the dipole and out of the terminals of the generator to fill space around the external conductors, then a straightforward energy transmission and reception problem exists. The source dipolarity produces the steady emission and flow of energy filling

space around the circuit. In the "receiving external circuit" the surface charges and their fields must intercept some of that available EM energy flow and diverge it into the conductors to power the circuit electrons. The intercepted and diverged component entering the circuit is the Poynting component, while the nonintercepted and nondiverged component missing the circuit and usually wasted, is the extra Heaviside component.

Fortunately, every source dipole pours out enormously more EM energy than our feeble conventional circuits intercept and catch to provide the Poynting calculations. So to produce COP>1.0 in the MEG, all we have to do is insure that we have (i) a mechanism easing the interception and collection process, and (ii) sufficient "antennas" containing sufficient conduction electrons (and their fields) to intercept and collect more energy than we pay to make the source dipole and perturb it. Since we pay nothing at all to make the source dipole (which is the permanent magnet), and since the magnetic flux back through the permanent magnet does not destroy the dipole, then all we have to pay for is the perturbation and for switching and control.

The resulting field energy generated outside the core localization region is primarily a function of the rise and decay times for the input perturbation pulses and not the energy of those pulses. From a little input energy with fast little changes, we can easily generate very powerful oscillating E-fields and provide dramatically increased "antenna collection" area with **the** necessary magnitude of intercepting charge. It rigorously follows that COP>1.0 is easily obtainable.[210,211]

[210] Again, for the MEG, changing and controlling the rise time and decay time of the input pulses is a method for directly engineering and controlling the general relativistic curvature of the local surrounding spacetime, because it controls the magnitude of the E-field that is created by $\mathbf{E} = -\partial\mathbf{A}/\partial t$ from the curl-free A-potential outside the core. This also directly engineers and controls the magnitude of the polarization of the local active vacuum. That simple fact allows the use of a unified field theory operation, with a net energy interchange between the system and **the** local active vacuum. To understand the MEG, one must think in terms of the *supersystem.*

[211] All EM energy at any point in space must have been "gated" from the time-domain and it must return to the time domain (as, e.g., by the source charge for it). It **requires** quite a shift of one's mind to realize that all 3-space energy (such as "energy at each point in a potential") involves a gating process and a giant negentropic 4-circulation of EM energy ongoing at each point dipole. Much of the extraction of **energy** from the vacuum has been hidden by thinking in terms of "inputting energy" instead of "inputting or arranging energy flow gating" by the source charges and sourcedipoles.

The MEG is an open system far from equilibrium with its active environment (its active local vacuum and its active local curvatures of spacetime). By attending to the interception and collection part of the overunity problem, the MEG can permissibly collect and use more EM energy to power its loads than one oneself has to input to it. In short, one only has to input a little switching and perturbation energy with properly shaped waveforms, to generate very powerful fields and appreciable field energy available for collection and use. With sufficient collection mechanisms in place, the unit easily produces COP>1.0. Then with proper closed-loop principles implemented, the MEG can be self-powering.

7.7 Experimental Path to Development of the MEG

In our experiments with the Radus effect previously discussed in Chapter 6, paragraph 6.4.5, we had already done extensive work with switching magnetic fluxes for less switching energy than can be intercepted from the switched flux. We had also experimented with various cores for transformer and coil variants, including eventually the new layered nanocrystalline cores.

In our experiments, we noticed a remarkable thing. With certain modern nanocrystalline core materials, and using a permanent magnet to provide B-flux, we found that *the core material would extract and hold essentially all the permanent magnet's B-flux inside the core.* Field measurements right against the outside of the poles of the powerful little neodymium-iron-boron magnet itself showed very little B-flux spilling out into space! In short, we had discovered how to make a magnetic system that *nonlocally* propagated only the uncurled magnetic vector potential A, without any operator energy input. We realized we had discovered a marvelous and free way to freely obtain an excellent Aharonov-Bohm effect, similar to the way a nearly perfect toroid would localize the B-field inside the core, with the uncurled A-potential appearing in space surrounding the toroid. The advantage of our approach over the toroid was that we did not have to furnish any current and voltage to obtain the localized B-flux and the non-localized curl-free A-potential energy.

Further, if we perturbed the B-field flux in the core, we consequently perturbed the uncurled A-potential in space surrounding the core. From both sources — the perturbed B-flux in the core and the perturbed

A-potential outside the core — we could produce very large E-fields and concomitant very large voltages capable of driving more "power" through the secondary coils of the transformer section than the power required to perform the switching and perturbation.

We could easily prove this by perturbing the localized B-flux (and the concomitant surrounding uncurled A-potential automatically) with weak energy. We proved that increasing the rate of the rise time and decay time of even a weak input EM energy perturbation could produce quite large E-fields, including 1,000 to 5,000 volts (or even 20,000 volts!) appearing in the secondary coil if desired. We also proved another thing: *the special nanocrystalline core material in some buildups self-adjusted its permeability, continuing to localize the perturbed and alternating B-fields and their fluxes while freeing the resulting E-fields and passing them out of the core.* In short, the permeability of the specially selected core material automatically adjusted with the perturbation of the localized B-flux and nonlocalized A-potential, so that all the oscillating B-flux remained localized in the core. Further, the highly layered nanocrystalline material produced essentially no eddy currents at all, hence no heating, even in the presence of dramatic B-flux oscillation and dramatic E-field intensities in the surrounding uncurled A-potential space and in the output (secondary) coils of the transformer section of the MEG.

The absolute proof that the core changed its permeability was in the lack of a phase lag between voltage and current in the output from the output coils. Here a remarkable thing was observed: the output current was in phase with the output voltage, within about 2°. In short, under certain circumstances the output coils wound around the nanocrystalline core would exhibit essentially a purely E-field interaction, with only minuscule B-field leakage — something deemed impossible in the typical electrodynamics textbook. This meant that the excess E-fields produced by the perturbed A-potential in space outside the core also reacted with the **output** coil's conduction electrons in a purely electrical manner! This was because the B-fields locally produced in the output coils by the interacting changing E-fields, *were in fact instantly drawn into the core material as they were produced, and were held there so they did not react in magnetic fashion with the electrons in the output current from the secondary coils.*

So this is a dramatic localization of Faraday's law of induction. Consequently, one entire group of embodiments of the MEG uses a purely electrical interaction with the secondary (output) coils of the transformer

section.[212] Or more exactly, the core material draws in all the magnetic fields from the reactions of the output coils, leaving only the electrical reaction outside the core — including in the coil conductors, which obviously are wound outside the core material.

On the other hand, the perturbed localized magnetic B-flux inside the core material did produce the normal E-field to be expected, as a function of the time-rate of change of the B-field. Such an E-field is not localized in the core material, but extends outside the core and interacts with the electrons in the output secondary coils of the MEG's transformer section. Again, the magnitude of this E-field is a function of the time-rate of perturbation of the localized B-field flux in the core.

The nanocrystalline core also has excellent high frequency response, with negligible eddy currents. Thus we can "fine tune" the engineering of the rise time and decay time of the input perturbation pulses.

Hence we accomplish several kinds of "gated energy amplification" in the MEG: (i) the amplified magnitude of the external E-field interacting with the external collectors (such as the output secondary coils) due to perturbation of the nonlocalized external uncurled A-potential, (ii) the amplified magnitude of an additional E-field interacting with the external collectors (such as the output secondary coils) due to perturbation of the localized internal B-field flux inside the core material, (iii) a large number of additional derivatives of higher order B-fields and E-fields are formed and utilized, and (iv) adding additional collectors (either coils wound on the core or external "receiving antenna circuits" produces additional power for heavier loads, for a given perturbation input.

We had exhibited a cored output coil with a remarkable adaptation of the AB effect. Essentially the output of the secondary coil was driven by the large electric field component created from the uncurled A-potential perturbations *and* by the large electric field component created from the B-field flux perturbations inside the core. This peculiar transformer-like section operated from the E-field fluxes emerging or produced *outside* the

[212] Again we accent that the magnetic field reactions do occur, and the B-fields are in fact produced. But the resulting B-fields are also extracted into the core material and localized therein. Even the magnetic B-fields produced in the input and output coils themselves, is so localized and not allowed to interact with the electron currents through the coils to produce the conventional 90° phase lag between voltage and current.

transformer core material, rather than from the magnetic field flux being produced and oscillated *inside* the core material itself.

Obviously we had found a remarkable but legitimate COP>1.0 process and embodiment — in fact, a whole set of them. We had also invented a new kind of "transformer" or energy generator-transducer.

From that we progressed to discovering ways to a dual use of both the perturbed B-flux in the core and the E-fields from the perturbed A-potential outside the core. To first order, that turned out to be fairly simple: any changing B-flux inside the core material and thus inside the output (secondary) coils of the transformer section, produces not only B-field which is held and localized, but also the changes of this local "pinned" B-field further produces E-field oscillations which are not pinned in the core. Hence the electric field half of a normal transformer action could and did occur in the secondary coils, but the magnetic field half did not occur *in the coils themselves.* The MEG used and uses a nearly pure E-field interaction in the output coils of its transformer section secondary, where that net interacting E-field comes from a variety of E-field generating mechanisms.

We filed our first patent, and then filed a second patent application soon after. Presently we are preparing to file our third and fourth patent applications on additional phenomenology and mechanisms uncovered in our experiments. As we are writing this section, our first patent has issued {37}.

In the view of the present author, we have uncovered a remarkable new application of the Aharonov-Bohm effect and the geometric phase, one that is practical and eminently useful in novel new electrical power systems.

7.8 Additional MEG Functions

Figure 7-6 diagrammatically shows the core material inside the input coil for either open-loop operation using an external power supply or closed-loop (self-powering) operation using clamped and governed positive feedback. As can be seen, the B-field and B-field flux are confined to the core material (which is in the form of a closed transformer coil path, as shown diagrammatically in Figure 7-5). The external space surrounding **the** core material is filled with the uncurled A-potential, due to the Aharonov-Bohm effect being imposed by the core material. The two leads from the input coil are shown at the bottom of Figure 7-6.

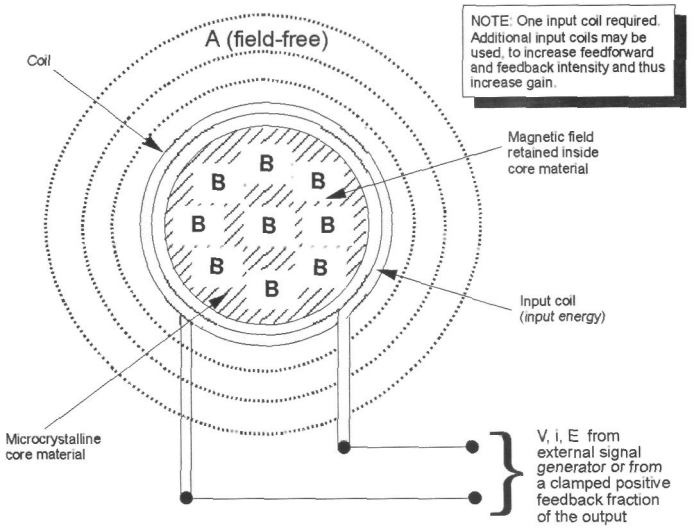

Figure 7-6 Input coil for open- or closed-loop **operation.**

We pulse the input coils with nearly rectangular pulses each having a sharp leading edge and a sharp trailing edge, so that the resulting rapid time-rates of change of the two edges create very large perturbations of the B-flux in the core and of the A-potential outside the core. The large E_2-field resulting from the fast rate of change of the perturbed B-field in the core is not localized, but appears in space outside the core. In addition, an E_3 field created directly in the coil itself also appears in space outside the core. In addition, the sharply perturbed A-potential outside the core creates a third large E_1-field in space outside the core. The net E_t-field in the surrounding outside space is the vector summation of the E-fields produced by these processes, or to first order (neglecting the further differentiations)

$$\mathbf{E}_t = \mathbf{E}_1 + \mathbf{E}_2 + \mathbf{E}_3 \qquad [7\text{-}1]$$

We also may adjust the pulse width to generate a further Lenz law effect, increasing the three component fields E_1, E_2, and E_3 if desired. To do that, the pulse must be narrow enough to suddenly decay while each of the fields E_1, E_2, and E_3 is still rising and not yet reached maximum. As can be appreciated, considerable pulse shaping and timing can be adjusted for optimization of the output voltage, current, and power when interception and collection from E_t is accomplished in the secondary coils. In addition, it can be appreciated that slightly differing materials delay times do occur in the production **of $\mathbf{E}_1$,** E_2, and E_3. Hence there is appreciable

optimization that can be and is accomplished on a given MEG variant and build-up type.

More complex waveforms of various shapes can be used to further optimize the output. It is also possible to accomplish further optimization and control by adjusting the shapes and timing of the feedback signals in the case of the closed-looped MEG system. For the externally powered open-loop version, additional optimization and control can be achieved by adding additional simultaneous pulses fed into the input coils in various fashions.

In addition, the response of the output coils produces feedback into the core material, into external space, and into the input coils. These in fact provide three more E-field *return* or feedback inputs, so that the total feedback input is

$$\mathbf{E}_f = \mathbf{E}_4 + \mathbf{E}_5 + \mathbf{E}_6 \qquad [7\text{-}2]$$

Without doing the more complex iterations for this feedback and feedforward set of loops, to first order the total input E_I to the input coil may be considered to be

$$\mathbf{E}_I = \mathbf{E}_t + \mathbf{E}_f \qquad [7\text{-}3]$$

Equations [7-1], [7-2], and [7-3] are for simple analogy only; in the real MEG, full nonlinear feedforward and feedback analysis techniques must be utilized because of the iterative operations, and much more sophisticated optimization techniques are appropriate. Also, chaotic oscillations can and do appear, and techniques for control of such oscillations are indicated, particularly along the lines indicated by Fradkov and Pogromsky {487} without use of probability etc. Quoting:

> *"1. There is ... great benefit of using the modern nonlinear and adaptive control theory. ...2. There is no need to distinguish periodic and chaotic behavior. Accurate control is possible without accurate prediction. ...3. There is no need to define chaos in order to control it. ...4. There is no need to use probability in order to control systems with seemingly random behavior."*

For any given MEG build-up design, one experiments with these optimization and control factors and mechanisms to provide the best performance, and to provide rock-steady performance.

Figure 7-7 shows the output coil for either open-loop operation from an external power supply or closed-loop (self-powering) operation using

clamped and governed positive feedback. Here the situation is partially reversed. There are three major inputs to the output coils, and these are (i) the external input from the total outside E-field, (ii) the internal input from the perturbation changes in the confined magnetic flux inside the core through the output coils, and (iii) the ensuing feedforward and feedback from all E-fields.

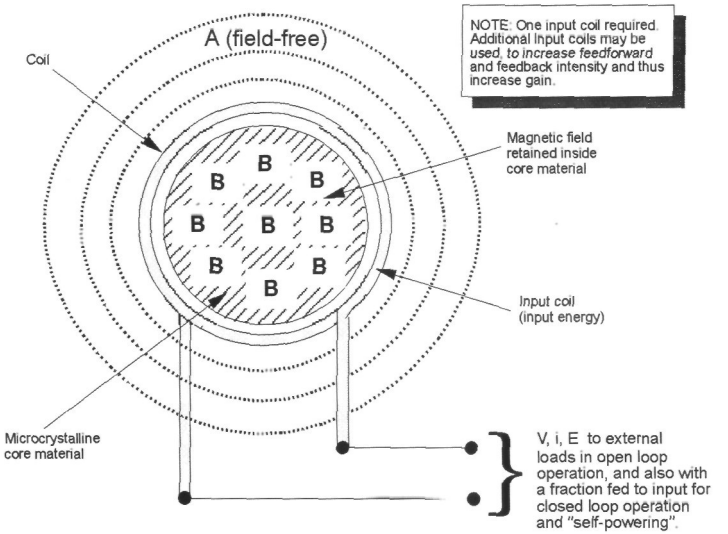

Figure 7-7 Output coil for open- or closed-loop operation.

Again, this is simply an easy way to visualize the situation to first order. In the real case, sophisticated feedforward and feedback analysis is required and utilized. Optimization usually consists of two steps: (1) the simpler, more direct optimization techniques such as adjusting pulse width, pulse rise time and decay time, actual pulse form, etc., and (2) the deeper and more complex optimization arrived at from detailed feedback and feedforward loop analysis as well as nonlinear oscillation and nonlinear control theory analysis.

In the actual optimization analysis, the feedback and feedforward loops are mathematically endless and thus should be optimized for quick decay and stability. On the other hand, the MEG also has the ability to self-oscillate over the entire unit, in which case the feedback and feedforward loops are optimized for stable self-oscillation of the entire unit. The self-oscillating

MEG is permitted since it is an open system far from equilibrium with its active environment.

So if desired, an entirely different kind of optimization can be utilized for self-sustained nonlinear oscillation and closed loop operation. Because of the gain achieved in the large E-fields produced by the perturbed uncurled A-potential in space surrounding the core, there is sufficient excess energy collection available in the output coils to use the available feedback and feedforward loops in the system itself to achieve system self-oscillation. The system can be operated as a self-oscillating open system freely receiving excess EM energy from its active environment — the local active vacuum, local curvatures of spacetime, and local freely furnished uncurled A-potential and resulting nearly free E-fields from the A-potential's perturbations). As we are writing this, our experiments are now in this direction, and we are preparing the material for filing a formal patent application on this additional process. The patents will be filed, of course, by the time this book is published.

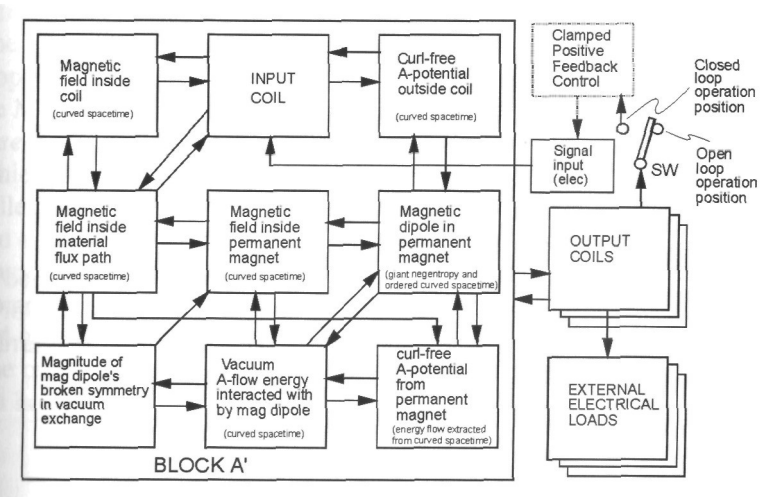

Figure 7-8 Energy gain process using feedforward and feeback subprocesses

A highly simplified block diagram of energy gain process using feedforward and feedback subprocesses is shown in Figure 7-8. As can be appreciated from this high order diagram, the actual feedforward and feedback loops are extremely complex, and a great deal of complex analysis is required for a self-oscillating, stable, controlled system. We also stress that control measures to insure and hold stable self-oscillation

must be included in the overall features implemented in this self-powered, self-oscillation variant of the MEG. Not only must we use chaotic oscillation techniques to achieve the self-oscillation, but also we must use advanced techniques for stable control of such nonlinear oscillations, as indicated by Fradkov and Pogromsky {487}.

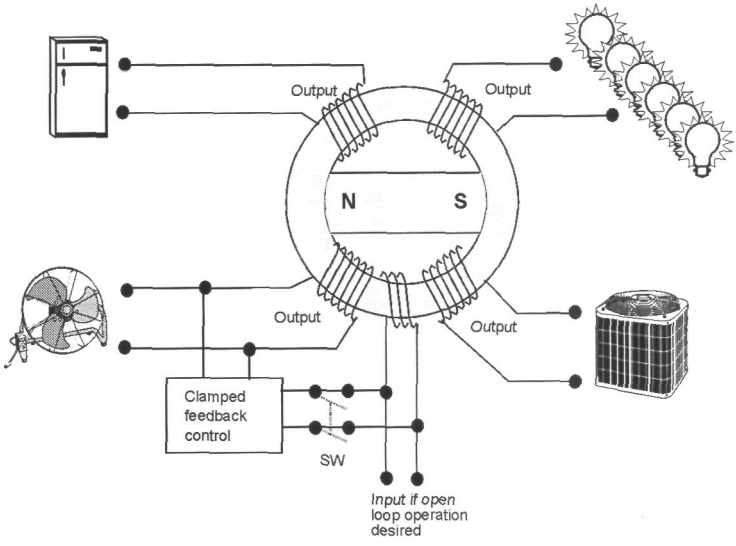

Figure 7-9 Typical MEG embodiment application on site.

In Figure 7-9, we show a typical diagrammatic embodiment envisioned for the MEG in a household, using a large MEG to later be developed. For interim installations, the single large MEG will be replaced with an array of MEGs together with a synchronizer, as shown in Figure 7-10.

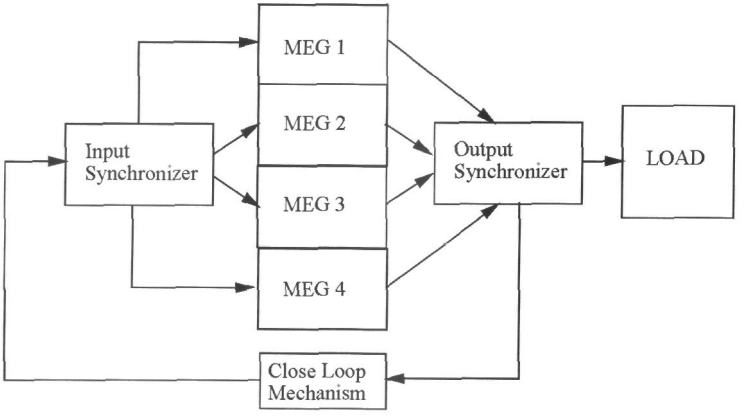

Figure 7-10 MEG self-powering array concept for increased powering applications.

Figure 7-11 shows a MEG unit where additional special collection antennas feeding separate circuits are employed in an "outrigger" fashion. One major advantage of this configuration is that the complexity of close-looping and its control are materially reduced, although the complexity of the MEG build-up and stabilization is increased. Another advantage is the *ease* with which close-looping for self-powering operation can be achieved, as shown in Figure 7-12. In this case, the external antennas are collected to independent output circuits (not shown) in the output section, and each of these independent outrigger outputs is a COP<1.0 circuit if we count the perturbed A-potential energy input as an "operator's" input. Completely normal clamped positive feedback can be used with sensing and governing, to allow self-powering and self-adjusting to varying loads. The outrigger embodiment can be made to almost entirely avoid the Dirac sea hole current problem.

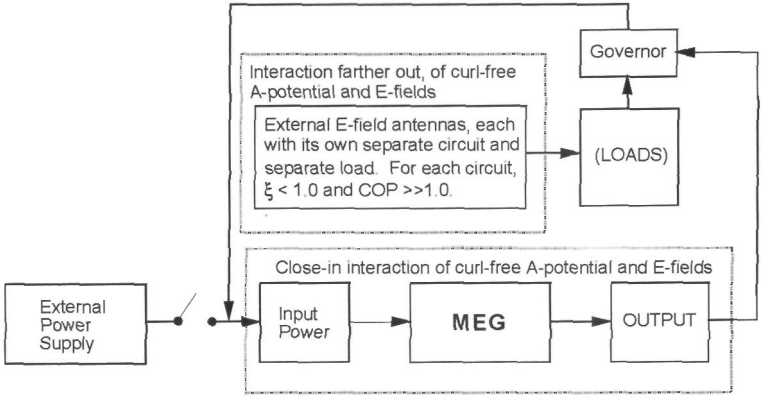

Figure 7-11 MEG unit with outrigger antennas for extra energy collection.

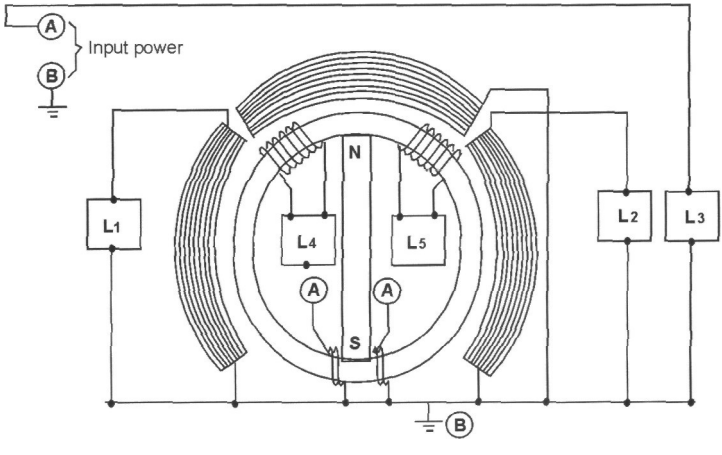

Figure 7-12 Use of outrigger antennas for damped positive feedback method of close-looping.

As can be seen, the MEG has many possible configurations and embodiments, each of which has special advantages and uses. One of the embodiments we discussed is the deliberate use of self-oscillation forced by the feedforward and feedback loops. That is a separate embodiment, and capable of a very high power per pound ratio, but it also requires more sophisticated sensing and control techniques.

7.9 In Conclusion

By the time this book is published, Magnetic Energy Ltd. is hopeful it will have achieved its major funding requirement, and be well along the way to completing the research for full production and marketing of MEG units on the world market. We have arrived at that part of development — the need for substantial funding (several tens of millions of dollars) — where every previous COP>1.0 EM power system has died. We intend to do everything within our power to see that we obtain the funding, finish the complex research task, and get the MEG onto the world market.

For additional information on the MEG and on its preliminary replication by Naudin, the reader is referred to other technical articles {488} and to Jean-Louis Naudin's website.[213] Actual measurements for one of Magnetic Energy Ltd.'s MEG test units is given in reference {488a}. The MEG patent {37} shows the variation of COP for a test MEG with various conditions. Curves for Naudin's measurement of the performance of his replicated MEG unit are given on his website.

The MEG project is a most interesting project, because of the involvement of so much advanced physics and several different physics areas, as well as the prerequisite for higher group symmetry electrodynamics. Once funded, we are confident we succeed in crashing through the barriers and getting working MEG power units — including self-powering MEG units — on the market. We also believe the MEG will represent a substantial contribution to alleviating the coming worldwide energy crisis. Hopefully it will materially hasten the growth and evolution of the present highly centralized — and terribly vulnerable — national energy infrastructure into a highly decentralized — and much less vulnerable — national energy infrastructure. We also believe it will provide a great contribution to helping alleviate global warming, reducing pollution of the biosphere, and reducing the production of hazardous wastes. If so, it will be a continuing

[213] Naudin's website MEG material and information is at http://jnaudin.free.fr/html/meg.htm. Particularly see his Mark III replication, shown powering a light on that webpage.

contribution, not only to humanity today, but also to generations yet unborn.

Chapter 8
Approach to Antigravity

[Large-scale antigravity exists] *"...baryonic, ordinary matter—the stuff of stars and of people—makes up just over 4% of the energy and matter in the universe. ...about 30% of the stuff in the universe is dark [unobserved] matter. The remaining two-thirds, theorists believe, is a mysterious 'dark energy' or 'quintessence'—a large-scale antigravity-like effect that is making the universe expand ever faster.... "* [Charles Seife] {489}.

[On the nature of the vacuum] *"...the (electromagnetic) vacuum is the ground state of the quantized electromagnetic field. ...The Dirac electron vacuum is that state with all negative energy electron states fully occupied."* [Aitchison] {490}

[On forces and how charge exists] *"Vacuum polarization, in general, alters the effective force law. Forces, in quantum field theory, are understood as being due to the exchange of virtual quanta ...In the case of QCD and QFD, ... a crucial new feature is that the force-field quanta themselves carry the 'charge' of the force-field, i.e. it is as if the photon of electromagnetism carried electromagnetic charge."* [Aitchison] {491}

[Possible gravitational circuits] *"There is an implication ... that gravitational excursions might be controllable by gravitational 'circuits', analogous to electronic circuits, which could lead to a controllable form of negative gravity."* [Robert Neill Boyd] {492}.

[Gravitational circuits] *"The supersystem concept utilizes a unified fields approach so that specialized electrical circuits in COP» 1.0 condition generate strong Dirac sea hole currents of negative energy in the immediate local vacuum. Thus a strong negative energy field is formed surrounding the circuit and changing the curvature of local spacetime as an action by the source*

circuit. This produces a direct antigravity field around the circuit or physical system, acting upon the mass of the system. The net gravitational interaction by that circuit or physical system is therefore the summation of the local positive gravitational field and the new local negative gravitational field produced by that negative energy field." [T. E. Bearden, correspondence to a colleague, February 2002.]

[On the multiplicity of spacetime curvature components] *"The full mathematical expression for the curvature of four-dimensional space-time ...is given by something called the* <u>*Riemann curvature tensor*</u>*. This is a somewhat complicated object, needing twenty real numbers at each point in order to specify it. These twenty numbers are referred to as its* components. *The different components refer to the different curvatures in different directions in the space-time."* [Penrose] {493}.

[Physics studies and prepares imperfect models, not perfect truth] *"All we ever know is our models, but never the reality that may or may not exist behind the models and casts its shadow upon us who are embedded inside it. We imagine and intuit, then point the finger and wait to see which suspect for truth turns and runs. Our models may get closer and closer, but we will never reach direct perception of reality's thing-in-itself"* [Hawking] {494}.

8.1 Introduction

In this chapter, we first present a highly abbreviated background of the theory of gravitation, sufficient for our experimental orientation. Of special interest are unified field theories, which cover general relativity, electrodynamics, and quantum mechanics in one overall master theory. Even more of interest is an engineerable unified field theory, which is presently closest approached by the theory of Mendel Sachs {510}.

We then present a short overview of work that has been done in the fields of lifters and inertial propulsion, listing some of the inventions of interest, the approaches, results achieved, and our comments on each.

Finally, I present my own approach to antigravitation, and give some results of the Sweet device's antigravity test (the test was designed by the present author) that successfully reduced the weight of a device by 90%.

In our view, this experiment fully demonstrated the veracity of our theoretical approach.

8.2 Selected Theories of Gravitation

8.2.1 Newton's Theory and a Negative Mass Extension

The first mechanism for gravity of interest to our purposes was advanced by Newton in his work on mechanics {495}. Newton's law of gravitation may be stated as {496}:

> *"A particle of mass m_1 attracts a particle of mass m_2 a distance d away with a force* $F = G\frac{m_1 m_2}{d^2}$ *in the direction of the line joining the particles."*

Of course, it should have stated "in a time forward zone". The situation is precisely reversed in a time-reversal zone. It is also reversed for negative mass-energy.

In the Newtonian view, antigravity would mean repulsion of mass rather than attraction of mass. Given that negative mass is possible, then a negative mass would exhibit antigravity — i.e., it would be repelled by all other positive masses.[214] This can be seen in the quoted equation, by

[214] The discussion of what attracts what and what repels what, in a mix of negative and positive masses and negative and positive energies, is still controversial in physics. Different theorists have taken differing positions, and there is no formal experiment that has decided between them. In our opinion, the successful antigravity test of the Sweet vacuum triode amplifier answered that question experimentally, although independent replication was not accomplished. The scientific discussions heavily involve discussions (and assumptions) of the nature of "gravitational" mass, inertial mass, and electrodynamic mass etc. Again, there is no decisive selection among several possibilities, and there is no clear and universally accepted definition of **any** of those three types of mass.

In addition, all the discussions have included a fundamental error: They **assume** a separate 3-force acting upon a separate 3-mass, which is unequivocally false. Another fundamental error is the assumption of an observed (effect) 3-positron interacting with normal matter rather than a non-observed (causal) 4-positron (negative energy 4-electron) in massfree spacetime. In effect, this applies the CPT (charge-parity-time) symmetry, and converts the direction of the 3-positron to the antidirection of the 4-positron while also changing the negative mass of the 4-positron to positive mass of the 3-positron. Further, in physics there is still no firm **definition** of either force or mass, but only circular definitions between the two. We are using the simple definition of mass as $F = d/dt\ (mv)$, where mass is a component of force F and hence there is no separate force F acting upon a separate mass m. We

interpret that equation as "the force *F* observed in a new observation is proportional to the time-rate of change of the ongoing 4-space interaction between the just-observed 3-mass *m* and the average interchange of time-energy and space-energy represented by v in the ongoing dynamics between spacetime and mass *m*. Whatever adjective is prefaced upon the *F* is also prefaced upon the *m* in the *mv* term.

We politely but firmly disagree with one prevailing notion that positive mass *attracts* both positive and negative mass, while negative mass *repels* both types. Further, we believe that the Sweet vacuum triode amplifier antigravity experiment falsified that notion. We hold to the dictum that m == E/c^2, where E is real spatial energy and may be positive or negative, c^2 is always positive, and therefore negative mass is highly compressed negative spatial energy while positive mass is highly compressed positive spatial energy. (Imaginary mass is a separate consideration.) We also prefer to reason in "single fundamental units" physics where the joule is the only fundamental unit. Gravity then becomes a function of the joule, whether electromagnetic, mechanical, or whatever. *We consider the energy in spacetime to he the source of the curvature of spacetime that is known as " gravitational field".* If the joule is of positive energy, the accompanying gravity is positive. If the joule is of negative energy, the accompanying gravity is negative. And we consider gravity as the 4-space causal spacetime curvature. So for gravitational interaction theory, we insist on examining the interaction of the curvature of local spacetime with the mass-energy. Further, we postulate that the gravitational effect upon one mass from a second mass is an improperly posed concept. It actually is an effect of the local curvature of spacetime around the first mass, where that curvature of spacetime was induced by the second mass's energy. Further, we consider that positive energy fields surrounding a positive mass will curve spacetime in the "positive gravity" direction. The positive mass is attracted by all other positive masses. Negative energy fields surrounding that positive mass system curve spacetime in the "negative gravity" direction so that the positive mass of the system is at least partially repelled by all other positive masses in the universe.

We further prefer to think in terms of the *supersystem* and the unobserved causal 4-field, not the frozen iterative 3-field snapshots defined only after iterative . observations. As we stated previously, the "observed" 3-positron is, in our view, a very different beast from the as-yet-unobserved 4-positron. The 3-positron is a frozen momentary "effect" entity with no dynamics at all and no continuous existence in time (and hence in spacetime) at all; instead, it continually *recurs* as the iterative effect of iterative observation by iterative application of the *d/dt* observation operator. The 4-positron is still a negative energy electron with negative charge, and still going in a non-reversed direction since broken parity has not been applied (because observation has not been applied), a causal entity with ongoing dynamics, continuously existing in spacetime, not just in 3-space. Until interacted and observed, it also has negative energy and negative mass-equivalency.

If one wishes to accurately deal with spacetime effects from the "positron," in our view one must deal with the 4-positron before observation, and hence with the supersystem. The 3-positron is not a *spacetime* entity, but only a frozen *3-spatial* snapshot. Scientists, including Dirac himself, were horrified at the negative mass implications of the negative energy states. Therefore, they moved the interpretation

simply replacing positive mass m_1 by negative mass $-m_1$. That two negative masses would attract can be seen by replacing positive mass m_1 by negative mass $(-m_1)$, and also replacing positive mass m_2 by negative mass $(-m_2)$.

Now consider mass m_1 to be the rest of the net positive mass in the universe, and mass m_2 to be the "effective" mass in a local supersystem consisting of the local physical system, its local active vacuum, and its local active curvatures of spacetime — in short, in a local supersystem consisting of the physical system and its local active environment, and the interchanges between them. Let $m_2 = m_p + m_n$, where m_p is the amount of local positive mass (or mass-equivalent) in the system and m_n is the amount of negative mass (or mass equivalent) in the system. This supersystem now simultaneously exhibits both positive gravity (attraction) to all net positive masses in the universe and negative gravity (repulsion) to them as well. The net gravitational response of the supersystem depends upon the fraction of the effective mass that is positive and the fraction that is negative — in short, upon the net vector sum of the two gravitational forces.

to the 3-positron, and thereby twisted the interpretation to substitute the effect for the cause. Hence circuit theory treats the *lattice hole* as a positron, yet that "hole" acts very differently from a true Dirac positron (a Dirac sea negative energy electron) in free space.

Consequently, matter-antimatter interactions and the interaction between positive energy and negative energy are quite different, or they can be if so manipulated prior to observation. In the matter-antimatter interaction, the initial curvature of spacetime formed by the union decays by radiation of EM positive energy and the "effect particles" disappear back into the uncurved vacuum from whence they came. In the positive energy and negative interaction, there is a change of the local curvature of spacetime without its decay and subsequent re-radiation of EM energy. Equal amounts of interacting positive and negative EM field energy thus are simply transduced into stress energy potential of the vacuum and consequent sustained change in the curvature of the local spacetime. Indeed, the radiation of pair annihilation energy is obtained only at the expense of negating (relaxing) the local polarization of the vacuum (and the two consequent curvatures of local spacetime) represented by the independent positron and electron. Indeed, normal pair annihilation is a sort of Lorentz symmetrical regauging of the locally asymmetrical vacuum.

The reader is certainly free to disagree with our conclusions; we are merely explaining them. Experiment will eventually sort out the truth or falsity of the approach. So far, based on the Sweet experiment designed by the present author, a highly successful experiment was consistent with this approach.

In a "mixed" mass system containing both positive and negative component masses, the fraction of the total mass that is positive and the fraction that is negative is thus significant. When the mixture's negative mass is less than its positive mass, the mixture would exhibit a "reduced" gravitational attraction to other masses of the universe. Then the ratio of negative mass to positive mass might be taken as the "gravitational shielding" coefficient (fraction).

When the amount of positive mass and the amount of negative mass were equal, the overall mass system would exhibit no net gravity or antigravity, and would "float" or "hover" in the Earth's gravitational field. It would be equally attracted and repelled by the Earth's positive mass (and by all other positive mass in the universe, hence could — at least under certain conditions — *appear inertia-free.).* When the amount of negative mass exceeds the amount of positive mass, the overall mass system would exhibit a net antigravity effect. It would be repelled more strongly by the Earth's positive mass, as well as more weakly by the distant positive masses of the universe, and hence would accelerate upwards and away from the Earth. Notice that the key to antigravity in the Newtonian approach is the availability of negative mass, but in the new sense in which we use it. Note also that we did not discuss the separate issue of imaginary mass.

If we translate that into modern terms, where we consider not the "mass" but the condensed energy comprising the mass, then m_p and m_n become positive mass-energy and negative mass-energy terms respectively. Given the ability to produce electromagnetically produce substantial negative field energy in the immediate vacuum environment of the system, where the source of the field is the physical system, then the creation of a direct antigravity component in the system's environment — the other two components of its supersystem — becomes not only possible but also feasible.

The key to antigravity becomes the *availability of negative field energy in the local space surrounding the physical object, with the physical object containing the source of that surrounding spatial negative energy field.* Voila! This impels us directly to electrodynamics and a modified Dirac sea {497, 498a, 498b), one with excess empty holes as source charges producing negative energy EM fields. We deliberately create these unique source charges by actions taken in a COP»1.0 system. This gives the key

to the approach to antigravity taken by the present author.[215] However, we use as negative energy not just the accounted *Poynting* energy flow component in space where the field is present, but also the unaccounted *Heaviside* energy flow component, which is much greater in magnitude (in a nominal case, nearly 10^{13} times greater). In this way, we dramatically increase the amount of antigravity effect that can be obtained by a given EM power dissipation in the physical electrodynamic system itself. *This antigravity effect of a Heaviside component of EM negative energy flow has not been accounted in previous analyses.*

8.2.2 Riemann Surfaces and Riemann Geometry

The next development of interest to us is the doctoral thesis of Riemann {499}, which founded the theory of Riemann surfaces. Three years later, he founded Riemann geometry in a famous lecture. Riemann was working on a unified explanation of gravity and electromagnetism when he died of tuberculosis a dozen years later. It was Riemann's multiply-connected topologies that eventually resulted in the view of electric charge producing lines of force trapped in the topology of space {500}. Had Riemann lived, we believe that engineerable unification of electrodynamics and gravity would have occurred early on. In that case, we might have already had practical antigravity vehicles and explored the solar system and beyond.

8.2.3 Heaviside's Excess Energy Circulation Flow and Gravity Theory

The next theory of gravity of interest to us is that of Oliver Heaviside. Heaviside noted that his extra EM energy flow term was a trapped EM energy circulation {501}. He realized that, if that trapped EM energy circulation were taken as gravitational in nature, his energy flow theory could be converted into a unified theory incorporating both electrodynamics and gravitation. After his death, his handwritten notes on the theory were found beneath the floorboards in the little garret apartment he had long occupied. No one knows what other papers he may have had; the place was ransacked and looted prior to the discovery of these remaining papers hidden beneath the floorboards — papers the looters had missed.

[215] We also point out that a Dirac sea with empty holes (excess negative energy states) exists in (or constitutes) a negatively curved spacetime *a priori.* So we get back to the other two components of our "supersystem", the active vacuum and its dynamics and the local curvature of spacetime and its dynamics.

Other scientists such as Laithwaite have felt that Heaviside's approach might still shake the foundations of physics itself. Quoting Laithwaite {502}:

> *"Heaviside had originally written the energyflow as S = (ExH) + G, where G is a circuital flux. Poynting had only written S = (ExH). Takingp to be the density of matter and e the intensity ofa gravitationalforce, Heavisidefound that the circuital flux G can he expressed as pu — ce, where u represents the velocity of p and c is a constant."*

8.2.4 Mach's Principle

After Heaviside, the next item of interest to us is Mach's principle {503}, which essentially states {504}:

> *"The properties ofspace have no independent existence but depend on the mass content and distribution within it. Thus, acceleration dealt with in Newtonian mechanics can only have meaning ifit is an acceleration with respect to the stars or with respect to something equally well-defined."*

Mach's principle does not adequately deal with spacetime, and certainly does not even acknowledge or encompass how energy exists in 3-space at each point dipole, as an entering flow from the time domain into the negative (charge x time). It does not include transduction by the negative charge into 3-space energy, passage of the 3-energy to the associated positive charge, transduction back into time energy by the positive charge, and re-emission of the transduced time-energy back into the time domain, by the positive charge. In short, Mach's principle will never get one a practical antigravity system, regardless of how one applies the principle.

8.2.5 Einstein's General Relativity

Next comes Einstein's epochal general relativity theory of gravitation {505}. In that theory, Mach's principle is interpreted as pointed out by Misner, Thorne and Wheeler {506} in the following quote:

> *"...Einstein's theory (1) identifies gravitation as the mechanism by which matter there influences inertia here; [and] (2) says that this coupling takes place on a spacelike hypersurface..."*

The great contribution of Einstein's general relativity was to remove the notion of the "field occupying space", where field and space are separate things. Quoting {507}:

> *"If we imagine the gravitational field, i.e., the functions* g_{ik} *to be removed, there does not remain a space of the type (I) [Minkowski Space], but absolutely* <u>*nothing*</u>*, and also no 'topological space'. For the functions* g_{ik} *describe not only the field, but at the same time also the topological and metrical structural properties of the manifold. ... There is no such thing as an empty space, i.e., a space without field. Space-time does not claim existence on its own, but only as a structural quality of the field."*

In passing, we note that in the conventional sense we can and do have many fields "in the same space", which is merely the statement that a net field has internal structure, and so does a net spacetime. Extending that notion, we can conclude that spacetime is in fact naught but a set of fields, both static and dynamic. The total energy density of all those fields at any point in space constitutes *a potential* with that energy density at that point, and with that internal field dynamics and structure. So because of its incredible field energy density, space is also *identically* a giant potential with internal structure and dynamics. With that observation, we rather casually join the seething vacuum of particle physics, the spacetime of general relativity, and the fields of electromagnetics as *different aspects of the same thing.* We point out that our concept of the supersystem therefore only identifies the three separate things into which this "one-thing" has been arbitrarily divided in much of physics.

Although he tried more than once, Einstein himself failed to achieve a successful unified theory of gravitation and electrodynamics. One thing he added in his earlier theory was a cosmological constant, which he felt was necessary to explain a stable closed universe. He later regretted that assumption, but today with the discovery of the acceleration of the expanding universe, which can only be caused by antigravity, his cosmological constant has assumed a new and vital role in the search for the source of this observed antigravity effect in the cosmos.

8.2.6 Kaluza-Klein 5-Dimensional Unified Theory

Using five dimensions, a unified theory of general relativity and electrodynamics was advanced by Kaluza {508} as extended by Klein (509}. This is a notable extension of Einstein's theory, and a very substantial literature exists in the Kaluza-Klein area.

8.2.7 The Sachs Unified Field Extension of Einstein's Theory

Another notable extension of Einstein's theory, which does include electrodynamics and the results of quantum mechanics as well, is the theory by Sachs {510}. Starting with Einstein's general relativity view and the group symmetry of its underlying mathematics, Sachs extended Einstein's theory into a fundamental theory of matter in all domains. Einstein's group formalism and the spinor-quaternion calculus in a curved spacetime provide the genesis of matter fields. The theory encompasses globally covariant field equations for inertial features of matter including its force manifestations. Unification is provided by the generalized spinor formalism. Quoting a popularized summation {511}:

> *"Novel features of general relativity are shown to emerge, in elementary particle physics as well as astrophysics. Especially noteworthy ...is a factorization of Einstein's field equations to a quaternion field formalism which, by way of a single covariant field, includes both gravitation and electromagnetism coupled to matter field equations — whose linear (low energy) limit recovers quantum mechanics. The ...original approach also furnishes derivations, not previously available, of several observed properties of inertial mass and gravitational force. "*

For a more technical description of how the unification of electrodynamics with general relativity is derived, we quote directly from Sachs {512}:

> *"It was demonstrated earlier that the factorization of Einstein's second-rank, symmetric tensor field equations, by removing the space and time-reflection elements from the underlying covariance group, yields a 16-component quaternion metrical field equation. The 16 equations were then re-expressed in a second-rank tensor form, breaking up into 10 ⊕ 6 equations. The 10 equations are in one-to-one correspondence with Einstein's symmetric tensor equations for gravitation; they are even under reflections. The remaining 6 equations are in antisymmetric tensor form; they are odd under reflections. Taking the covariant divergence of the latter equations then puts them into one-to-one correspondence with the structure of Maxwell's equations for electromagnetism. What was shown earlier was that the four of Maxwell's equations with sources followed. What is shown in this paper is that the other four of Maxwell's equations that are source-free also*

follow, thus indicating the absence of magnetic monopoles from this theory, as in the usual Maxwell formalism. This shows that the factorization of Einstein's field equations to the quaternion form fully unifies the gravitational and electromagnetic manifestations of interacting charged matter."

To freely download several of Professor Sachs's important technical papers, one is referred to his website at http://www.compukol.com/mendel/articles/articles.html.

The O(3) electrodynamics of Evans and Vigier has been shown to be a special subset of Sachs's electrodynamics {513a}. Hence O(3) can be used to engineer much of the Sachs unified field theory phenomenology, including — in our view — both gravity and antigravity. The first theoretical indication of this has been published by the AIAS (Alpha Foundation's Institute for Advanced Study) {513b}. Shortly we discuss our own views on how to directly perform engineering of antigravity.

A great many excellent publications on general relativity and the background of scientific knowledge in gravity exist; e.g., the text by Wheeler *et al.* {514} is particularly good. Einstein himself wrote a book on his special and general theory for the nonspecialist {515}. A collection of English translations of some of the original papers on relativity is provided in a book by Einstein, Lorentz, Minkowski, and Weyl {516}. Many other gravitational theories or changes to major theories have also been proposed by other scientists, but are not discussed here. For our purposes, an abbreviated discussion will suffice to understand a fundamental approach to feasible antigravity.

Since we are interested in actual working systems, a short review of some of the efforts in asymmetric lifting and propulsion experiments is useful.

8.3 Selected Antigravity and Inertial Propulsion Research Efforts

We give only a small sampling of the many efforts performed or ongoing in this area over the last few decades, and some still ongoing today.

8.3.1 T. Townsend Brown

Our first example is the work of T. Townsend Brown. Brown was working **on** a "gravitor" before he finished high school, and continued work in electrogravitation throughout his life. Space is a dielectric, and Brown reasoned that the displacement current in a capacitor dielectric could

influence the space dielectric itself.[216] Hence he built, tested, and patented several variations of lifting devices based on this concept {517a-517e}. Essentially, he found that certain high capacitance dielectrics could be subjected to high voltage (50 to 300 kilovolts), and would exhibit thrust in the direction from the negative to the positive pole.

Here we point out our contention that all EM energy in space comes from the time domain via the negative charge, and re-enters the time domain via the positive charge. This is consistent with Brown's finding. Although he demonstrated many such lifting and thrusting devices, Brown was never able to obtain sufficient financial and scientific backing to bring a practical embodiment of his inventions into practice. His work, however, has been replicated by multiple experimenters, including NASA researchers (see below) and several researchers contributing results to Jean-Louis Naudin's website http://jnaudin.free.fr/html/lifters.htm.

8.3.2 Jonathan W. Campbell

Recently a U.S. patent {518} on a thrusting capacitor, by Campbell, has been issued and assigned to the U.S. Government (NASA), and made available for commercial licensing. The patent write-up states that thrust from capacitors is well known, but has been too small to be practical. The patent purports to remedy that impracticality. A version of the NASA device has been replicated by the Naudin researchers also. So an adaptation of Brown's work has been patented by the U.S. government with intentions of licensing. This would appear to validate much of Brown's approach and efforts.

8.3.3 The Dean Drive

Our second example is the inertial drive patented by Dean {519a-519e}. Unfortunately, the effects of the Dean drive later appeared to be a problem in accurate measurement. Nonetheless, work still continues along the direction shown by Dean. One may argue that mechanical materials also contain charges and have a certain kind of capacitance. Hence, mechanical motion of the parts of the machine does move these charges and dielectrics, opening a possibility of interacting with the dielectric of space. For example, Sweet's VTA involved a sustained self-oscillation between the local vacuum and the barium nuclei in his barium ferrite magnets.

[216] We have not yet explored the gravitational effects — if any — of our concept of the triode capacitor, discussed in paragraph 6.3.7 and diagrammed in Figure 6-17. We will examine it as soon as we have the proper equipment.

Dean's approach still has merit, even if a particular embodiment gave a negative result when very accurate measurement was performed. It is particularly of interest that mechanical force is essentially derived from electromagnetic forces (and fields) at basis. These base EM fields involve (and identically are) curvatures of spacetime, and hence the motions of the inertial drive mechanical apparatuses do involve at least some curvatures of spacetime and dynamic changes to them.

Our comment is that, when the additional but neglected Heaviside nondiverged energy flow component is accounted, these field interactions internal to matter can produce many orders of magnitude greater curvature of spacetime than is accounted by the diverted Poynting energy flow component only.

The "inertial antigravity" approach may be visualized as the use of excess gravitational thrust in a specific direction. If that direction is against the local pull of gravity, and is more powerful, then "lift against the gravitational pull" is obtained. Rigorously, this is not true antigravity but manipulated excess positive gravity.

In our approach to antigravity, one way to approach the problem is to have the mechanical apparatus also the source of an intense *negative energy* EM **field,** producing an intense flux of Dirac sea holes into and in the local surrounding spacetime. The excess charge removed from the Dirac holes can in fact be used in the electrical powering of the physical system, as was demonstrated in the Sweet VTA antigravity test. Then movements of the mechanical parts could involve movement of strong negative energy fields, hence strong curves of local spacetime that are local *strong negative gravityfields.* Or, better yet, movement of the charges themselves will also produce field-induced movement of the Dirac sea hole negative energy. This appears to be a practical method to manipulate the metric itself, along the lines proposed by Puthoff *et al.*[217]

8.3.4 Henry Wallace

Other work has been by Henry Wallace, an engineer working for General Electric in the 1970s. His work dealt with the interactions of relatively moving masses of various kinds, and it is described in his patents {520a, 520b}. The discussion under the Dean drive probably applies to Wallace's work as well.

[217] H. E. Puthoff, S. R. Little, and M. Ibison, "Engineering the Zero-Point Field and Polarizable Vacuum for Interstellar Flight," *J. British Interplanetary Soc,* Vol. 55, 2002, p. 137-144.

8.3.5 J. F. Woodward

Next is the work of J. F. Woodward, resulting in one or more patents {521} and multiple articles in the legitimate physics literature {522a-522k}. Woodward uses an adapted theory based on Mach's principle and on the thesis that the mass of a capacitor can be made to vary from its normal mass by rapidly charging and discharging it — say, at a frequency of 20 kHz. This predicted effect is testable, although some sophistication in the testing is required.

Woodward's publications show the results of actual experiments, measuring a very small change in the mass, and are worthy of much further investigation. Here we note that the actual mechanism generating the inertia of an object is still an open issue, with several different contending theories.[218] Whether the gravitational mass and the inertial mass are identical or not, also remains an issue. If the exact local mechanism generating the inertia of a mass could be decisively found, then direct methods of changing the inertial mass and the gravitational mass might be a real possibility, and research to try to find such methods would be strongly indicated.

Our further comment is that the mechanism that generates mass itself has never been specified in formal physics,[219] particularly when one views an observable (such as mass) as continually recurring in 3-space rather than continuously existing in 3-space, due to the *d/dt* operator imposed on spacetime by the observation process. Before the reader assumes that mass is well understood, a reading of Jammer's scholarly work {523} is highly recommended.

From our viewpoint we stress that observed mass cannot continuously exist, but must be an effect and the instantaneous frozen output of the *d/dt* observation process invoked on an ongoing 4-space process. Hence, from this view there is indeed a "process" that (continually) creates mass — it is at least the emission of EM angular momentum (a photon) from the *masstime* entity. Similarly, there is a "process" that continually destroys or converts any mass — it is the absorption of a photon and conversion of the

[218] E.g., (a) A. Rueda and B. Haisch, "Inertia as reaction of the vacuum to accelerated motion," *Phys. Lett. A*, Vol. 240, 1998, p. 115-126; (b) B. Haisch, A. Rueda and Y. Dobyns, "Inertial Mass and the Quantum Vacuum Fields," *Ann. Phys.*, Vol. 10, 2001, p. 393-414.

[219] The present author made an early **and** crude attempt at doing it in his "Quiton-Perceptron Physics." 1973, NTIS Report AD-763-210.

mass *m* into masstime *(m* + d*m)dt.* Mass "flows through time" via this time charging and discharging, in the form *m* => *mt* => *m* => *mt* => *m*... etc.

Again we stress that masstime *mt* is not mass *m*, but is as different from it as impulse *Ft* is from force *F*. We crudely proposed such an initial mass-generating mechanism in 1973 {524a}, with additional information published in 1998 {525a}, which may have bearing on the mechanism involved in Woodward's experiments.

8.3.6 E. R. Laithwaite

Eric Laithwaite was for some years a professor with the Imperial College in London. He was one of the pioneers of the linear electric motor and of portions of the magnetic levitation (MagLev) train concept. An illustrious career headed for greater things (perhaps knighthood, Fellow of the Royal Society, etc.) was abruptly derailed in 1973 after he lectured to the prestigious Royal Institution by invitation and demonstrated that a heavy gyroscope, difficult to lift with one hand while not turning, could be lifted easily with that same hand, once turning at speed. Laithwaite's suggestion that Newton's laws of motion might be in difficulty proved much too controversial. The Royal Institution (apparently for the first time in its 200 year history) did not publish proceedings of that invited discourse.[220]

One of the remarkable things Laithwaite achieved was a form of "indefinite motion" device that he demonstrated circa 1970 {526}. The Centennial Centre of Science & Technology in Ontario was looking for working models to decorate the entrance hall. Laithwaite showed that if a linear-motor primary was rolled into a cylinder, so that it became simply the stator of a conventional induction motor,[221] a steel washer (about 3 cm. in diameter) could be made to roll continuously in a vertical plane around the inside of the stator. A combination of centrifugal force and magnetic

[220] With some humor we point out how shocking is our proposal that such a thing as "continuous" propagation of an object or energy through 3-space does not exist. Instead, small differential "pieces" of it continually "recur" at successive positions, much like the projection of the frames of a motion picture frame, where continual observation is the "projection process". Nonetheless, in our proposed solution to the source charge problem, either that is true or every charge in the universe is a perpetual motion machine, freely creating energy out of nothing. In our view, that is the impact of the long-neglected source charge problem in quantal and classical electrodynamics. It has produced the wrong and naive notion of what "propagation through space" actually entails.

[221] Something similar to diagrammatic Figure 6-26 in Chapter 6.

attraction kept the washer in contact with the stator at all times. At the same time, a pivoted copper cylinder could be held in the center of the stator and would be seen to rotate on its own axis in the opposite direction.[222] Laithwaite completed and delivered a working model to the Centennial Center of Science & Technology. The reader should note the similarity of Laithwaite's proven experimental device to the magnetic Wankel engine.

In addition to his attention to Heaviside's unpublished draft notes and manuscript on a combined theory of electromagnetics and gravity (previously discussed above) {502}, Laithwaite spent the latter years of his life working on sophisticated gyroscopic systems {527a-527h}. Ultimately he felt he had successfully produced a mass transfer effect {528} and the basis for a propulsion system. He and William Dawson applied for a patent in 1993, which was granted in 1995 {529}, with a U.S. patent granted in 1999 {530}. Regretfully, Professor Laithwaite died in 1997.

8.3.7 Floyd Sweet's Vacuum Triode Amplifier (VTA)

See again Chapter 6 and Figures 6-5 through 6-14 on the work of Floyd Sweet, previously discussed in paragraph 6.3.2. My concept of antigravitation used in the experiment is shown in Figure 6-15. By now, the sharp-eyed reader will recognize that my method actually constitutes a conceptual extension and definitization of the Dirac electron theory, reinterpreted to recover negative mass, negative energy, negative energy fields, and negative energy potentials. The defining feature is the deliberate use of a COP»1.0 main power system (perhaps constituting the power system of a flight vehicle) as a source of locally strong negative energy EM fields generated by the concentrated Dirac sea holes (causal 4-positrons being negative energy 4-electrons prior to observation) locally produced in the power system. We collaborated with Sweet on the vacuum triode amplifier for more than a decade, and in fact suggested the name of the device.

The antigravity approach designed by the present author was based on realizing that negative energy sources (e.g., 4-positrons as negative mass 4-electrons prior to their reaction and observation) produce *negative*

[222] We have had the distinct notion that the fundamental *contrarotating* mechanism found by Laithwaite is probably an analogous mechanism — or very similar — to the mechanism utilized by Bauman in his Swiss converter (Methernitha device). As pointed out, it also has remarkable similarities to the magnetic Wankel engine, except that the magnetic Wankel does not utilize two contrarotations.

energy EM fields. The field can reach out over all space, so a negative EM energy field represents a reversed curvature of a large volume of spacetime. Hence it represents a considerable antigravity field — particularly when one considers the unaccounted huge Heaviside component of the negative energy field and charge interaction. Since the field strength falls off as the inverse square of the distance from its source, the strong antigravity effects of negative energy EM fields are much stronger locally than at a distance. This is particularly true when the conventionally ignored Heaviside nondiverged EM energy flow accompanying the accounted diverged Poynting energy flow of every field-charge reaction is accounted. This usually ignored factor dramatically increases the antigravity intensity produced by the local negative EM energy field by many orders of magnitude, often by nearly 10^{13}.

My antigravity concept (then and now) is shown in Figure 6-15 of Chapter 6. At the time, the only available device I knew of that produced a substantial percentage of output negative EM energy was Sweet's vacuum triode amplifier. So I persuaded Sweet to fabricate a new output section (an output load similar to Figure 6.8 but containing ten sockets for ten 100 watt lamps). Thus the output of the unit — which adjusted automatically to the available load — could be increased in 100-watt increments by merely screwing in the lamps one at a time and making laboratory readings after each new 100-watt load increase was added. This was done and the concept was successfully tested by Sweet {531}, who was making the measurements in California and reading them off over the phone to me (I was in Huntsville, Alabama). The experiment worked beautifully.

The setup and progress of the experiment were intended to materially increase the strength of the *negative energy* EM field and Dirac sea hole flux already produced to a lesser extent by the Sweet vacuum triode amplifier (VTA) in its normal operation. Thus the hypothesized negative energy antigravity field, produced weakly by the negative energy from the device in its ordinary power output range of 500 watts, was to be substantially increased at 1,000 watts. The response to the net gravitational field surrounding the object would thus be the resultant of two factors: (i) the normal response of the device's positive mass to the positive gravitational field of the Earth etc., and (ii) the additional response of the device's positive mass to the local antigravitational field produced around it. The measurable result was expected to be a decrease in the measured weight of the object on the laboratory bench.

As discussed, this stratagem succeeded dramatically. The weight of the vacuum triode amplifier was decreased, smoothly and controllably, by

90% on the laboratory bench (see again Figure 6-9).[223] The results were later published in a joint paper {531} prepared by the present author. I placed Sweet's name first on the paper because he was the inventor of the VTA, which demonstrated the effect once properly modified as I requested. Note that the extra antigravitational field effect on an object is indeed a local effect, which the experiment also showed. This effect was obtained at a COP>1,500,000 (actually, at nearly a COP = 3,000,000) and at ELF frequency.

The ELF frequency is important. As we explained previously, the highest energy photons of all are the lowest frequency photons, when the highly compressed time-energy component of the photon is accounted as well as the decompressed spatial energy component. Hence, for very appreciable local curvature of spacetime to produce considerable antigravity, the antigravity source must produce negative energy fields consisting of negative energy photons at low frequencies (such as 60 Hz). Else, the curvature of spacetime is so small that little effect will evidence. My best "back of the envelope" estimate of the efficiency of the antigravity process in the VTA was 10%.

8.3.8 Ning Li and (separately) E. Podkletnov

Very interesting work was performed by Ning Li {532a-532d}, a scientist originally with the University of Alabama in Huntsville (UAH), who returned to China for a while but is now back in Huntsville. Quoting David Brown from the UAH website from 1997:

> *"In 1989, Dr. Ning Li of UAH predicted that if a time varying magnetic field were applied to a superconductor, charged and deformed lattice ions within the conductor could absorb enormous amounts of energy via the*

[223] Many times I have been asked how such small output power increase (from 500 to 1,000 watts) could possibly achieve such dramatic antigravity results. The answer - due to the neglected Heaviside nondiverged energy flow component — lies in multiplying the power output by the "Heaviside energy amplification factor *k* " where *k* may be as large as 10^{13}. A 500-watt accounted increase, multiplied by 10^{13}. is actually an incredible increase in the total EM negative energy field density being created in the local vacuum. In short, a very little "accounted" power increase of the COP»1.0 VTA output is actually a very vast negative power output increase when the long neglected k-factor is accounted. It is just this missing k-factor and the failure to account for the negative energy KM fields generated in COP»1.0 discharges in violent astronomical phenomena that seem to be responsible for generating the excess antigravity that is accelerating the expansion of the universe.

magnetic moment effect. This acquired energy would cause the lattice ions to spin rapidly about their equilibrium positions and create a miniscule gravitational field. Dr. Li's calculations showed that if these charged, rotating, lattice ions were aligned with each other by a strong magnetic field, the resulting change in local gravity would be measurable. "

"Podkletnov and Nieminen (1992) {533} *made the accidental discovery that a single-phase, dense, bulk, high T_c, superconducting, ceramic disk spinning at 5,000 rpm can produce a 2 percent reduction in the weight of non-conducting, non-magnetic objects placed over the spinning disk. UAH and MSFC [Marshall Space Flight Center, apart of NASA] [cooperated] on a joint research project to independently confirm the results of the Podkletnov experiment and to validate Dr. Li's theory of gravity modification via superconductor. On March 26th, 1997, as a part of this project, the joint UAH-MSFC research team produced the largest high temperature superconducting disk ever manufactured in the USA. This disk measures 12 inches in diameter and is 0.5 inches thick "*

We now explain the experiments, from our point of view of the mechanism for antigravity. We remark that, at least in theory, the charges in such a rotating superconducting disk have an inward "discharge" acceleration force that is a function of the distance of the charge from the rotation axis center. Hence, in the rotating frame, some of these charges are very strongly "accelerating" toward the center, as are their spins whose magnetic vector is orthogonal to the E-field vector. A flow of EM energy exists perpendicular to the rotating flat disk and is accelerating at right angles to the disk surface. This is analogous to a *discharge* (sudden acceleration) phenomenon, and it will also produce accelerating negative energy Dirac sea 4-holes in the vacuum component of the supersystem of the spinning disk. So from the spinning disk there is a sort of "wide beam" of Dirac sea 4-hole current in the vacuum, radiating at right angles to the disk surface, with heavier concentrations toward the outside of the disk. The result is that objects in the Earth's gravitational field, and also placed in the path of this negative energy Dirac sea 4-hole current, is acted upon by two superposed curvatures of local spacetime: (1) the positive curvature due to the Earth's gravitational field, and (2) the negative curvature due to

the negative energy field's curving local spacetime. The total net gravitational effect will be due to the algebraic sum of the superposed two spacetime curvatures — the normal positive curvature from the Earth's gravitational field and the second a negative curvature created by the Dirac sea hole current's negative energy fields (Heaviside energy flow component considered). The expectation is therefore a *reduction* in the weight of the object, as is shown in the experiments.

The UAH-MSFC group was unable to confirm Podkletnov's findings.[224] Ning Li and the NASA group later split amicably. Ning Li continued her theoretical work, eventually ceased publishing papers for a period to protect the techniques and experimental results achieved in her work, and focused upon potential applications. She apparently returned to China for some time, but is now back in Huntsville, Alabama and still experimenting. We suspect there may also be a Chinese research effort into antigravity, using the approach taken by Ning Li. Perhaps information from that program will be released in the future.

But what of the work of Podkletnov since his original experiments? NASA continued to try to replicate his disk and his work, with Podkletnov acting as a consultant. Presently, NASA has paid an independent research firm to replicate the disk to full specifications, which has just been accomplished as this is written. At this writing, the experimental results of this new attempt are not yet available as the work is still in progress. It should be available by the time this book is published.

Meanwhile, a relatively new paper by Podkletnov and Modanese has been published on the Los Alamos National Laboratory website.[225] This method uses high amperage sharp pulse discharges from a superconducting ceramic electrode, to produce an anomalous radiation in a focused beam. Significantly, the beam does not noticeably attenuate through different materials. The beam exerts a short repulsive force on small movable objects on the propagation axis, with the force proportional to the mass of the objects.

[224] E. Podkletnov and R. Nieminen, "A possibility of gravitational force shielding by bulk $YBa_2Cu_30_{7-x}$ superconductor," *Physica C*, Vol. 203, 1992, p. 441-444.

[225] Evgeny Podkletnov and Giovanni Modanese, "Impulse Gravity Generator Based on Charged $YBa_2Cu_10_{7-y}$ Superconductor with Composite Crystal Structure," carried on website http://xxx.lanl.gov/abs/physics/0108005.

We interpret the results as completely consistent with our own proposed excess gravity and antigravity mechanism. We know that such sharp discharges produce significant Dirac sea 4-hole currents in the local vacuum component of the supersystem. Such currents in a beam interact very little with intervening materials, and the major spacetime curvature effects are concentrated upon the propagation axis. On that axis, force effects can be expected upon small independent objects, due to the *additional* negative curvature added to the local spacetime in their supersystem. The impulse produced on the object should indeed be proportional to the mass of the object and independent of its composition, since it is a gravitational force effect induced by local curved spacetime. The force should be repulsive in the beam, since that is the direction of the antigravity force that will be induced in objects in the axis of the beam, by the beam of negative energy Dirac 4-holes. A positive gravity force would mean attraction between the object in the propagation path and the source of the beam. A negative gravity force would therefore mean repulsion.

So Podkletnov and other scientists are still working on a successful effect. It will be interesting to see what results are reported in the future, and whether they will deviate from their present attempt to explain the effect by a combined quantum gravity and anomalous vacuum fluctuations approach.

8.3.9 NASA's **Breakthrough Propulsion** Physics **(BPP) Project**
NASA's Breakthrough Propulsion Physics Project was established in 1996. It seeks a breakthrough in space transportation involving "(i) propulsion that requires no propellant mass, (ii) propulsion that attains the maximum transit speeds physically possible, and (iii) breakthrough methods of energy production to power such devices." Investigations involve coupling of gravity and electromagnetism, the quantum vacuum, hyperfast travel, and superluminal quantum effects. The project is managed by the Glenn Research Center, sponsored by the Advanced Space Transportation Program, with overall management by NASA Marshall Space Flight Center, Huntsville, Alabama.

NASA continues its investigations and experiments in methods to change **the** force of gravitational attraction. The scientist in charge of the project is David Noever of the Marshall Space Flight Center. The work is still considered a work in progress, with the need for both experimental investigation and meticulous design of experiments, instrumentation, and measurement techniques.

The overall NASA program also spreads to other supporting laboratories and projects. For example, at the Jet Propulsion Laboratory (JPL) Kulikov {534} has measured the difference between inertial and gravitational mass of a boson in a heat bath. At least one invention seems to have resulted or to be in progress, assigned to JPL.

As mentioned, the U.S. Patent by Campbell {518} on a capacitor device producing a net thrust force (a more modern version of T. Townsend Brown's work) has been issued and assigned to NASA.

8.3.10 Scientific Conferences

There are regular conferences (several per year) being held in the U.S. and elsewhere, dealing with antigravity and electrogravitic propulsion. We give a little-noticed but pertinent example: In a nice presentation in 2001, LaPointe {535} proposed a new method for producing anti-matter. Currently antimatter production is accomplished in very large accelerators, and is therefore quite expensive. For increased experiments, a cheaper and much smaller (and much more available) process is highly desirable.

In the Klein paradox, which involves very large potential drop across a very short distance — less than the Compton wavelength of the antimatter particle — matter and anti-matter pairs are produced. LaPointe hypothesized that it may be possible to use the Casimir effect to push one side of the step into the negative energy range. He is at least *thinking toward* negative EM energy sources that produce negative EM fields and negative gravity in the surrounding space, without explicitly enunciating it in that fashion.

We already briefly discussed our own approach to antigravity, which is a much simpler and cheaper anti-particle producing mechanism, as demonstrated by the Sweet device. In short, overunity EM systems with COP»1.0 do produce free flows of causal (before observed) 4-positrons (still in negative energy 4-electron state prior to interaction) in local spacetime immediately surrounding the system. Consequently, LaPointe's efforts are in what we believe to be the correct direction, but he is still using a very difficult mechanism to engender the antimatter production. Also, the positrons or other antimatter sources of the negative energy fields must remain in the causal (unobserved and non-interacted) 4-state, in order to produce negative energy EM fields and potentials and antigravity.

8.3.11 James Corum *et al.*: Rectified Slepian AC Force Resonator

Another example is some promising work by Corum *et al.* {536}. We quote from the abstract and summary of his paper:

> *"Corum presented an experimental paper on the use of the Heaviside force in conjunction with a Slepian antenna as a form of space drive using nothing more than the classical Maxwell stress tensor. Slepian proposed the same thing in 1949, but came to the conclusion that it would not be useful, since the time average of the resultant AC force would be zero. Corum's contribution has thus far been two-fold: (1) In conjunction with Dr. Alan Barnes of WVU he has experimentally shown that the AC version of the Slepian Resonating Antenna does produce a force, and has measured it to within 3.6%, and (2) has designed a way for Hartley's variable capacitor rectification to be used with the Slepian resonator such that the rectification results in a DC force component. The first experiment has already been achieved, the second experiment is the logical next step. If successful, the result would be quite revolutionary: a true space drive."*

Our comment is that this unilateral thrust force work is important. In our view, the Heaviside energy flow component does not appear in Slepian's vector $\mathbf{j}\phi$, which contains only the diverged EM energy flow surrounding a circuit or component, but it is present immediately outside the circuit where the Slepian vector exists. Hence there is an enormous, extra energy flow closely associated with every EM circuit, that is unaccounted since Lorentz's closed surface integration of the energy flow vector discarded it quite arbitrarily.

We already know from the Bohren experiment (and thousands of others similar to it) previously cited that resonant charges do collect excess EM energy from a given EM energy flow input, compared to the collection from that flow by the same charges in nonresonant state. In using the Slepian resonator and then rectifying its output, it would appear that both the diverged (Poynting) energy flow component and the Heaviside nondiverged energy flow component are first resonated and then rectified. In addition, excess energy is collected — much more than is in the normal "static charge" formula assumptions for Poynting energy flow and in assuming only a "single pass, single interception and collection" of the energy.

An important factor then is obvious: Once the energy flow is surrounding the circuit, there exists a certain local curvature of the immediate external spacetime. The rectification represents not only a change in the Slepian

vector current in the circuit, but also a change in this local ST curvature interaction upon the circuit matter and charges. In short, it should produce a DC component in the direct excess interaction of the rectified local curvature of spacetime. This should produce *excess direct propulsive force,* just as Corum theorizes and the experiments support to date.

Further, the oscillation of the large, *unaccounted* Heaviside nondiverged energy flow component involves the oscillation of a "dark energy" component that may be orders of magnitude greater than the *accounted* Poynting component's magnitude. By involving this huge energy flow component in oscillation and synchronized to the resonant Slepian circuit, Corum has unwittingly involved the supersystem as a COP»1.0 EM "energy converter" system. Hence, there is appreciable Dirac hole current (in causal 4-form) in the local vacuum, not reacted with the materials in the system and therefore not converted to material lattice holes attached to positive mass. The time rate of changes of the negative energy fields and potentials are thus significant for antigravity effects, in the approach taken by the present author. In short, we believe Corum *et al.* are in fact producing significant evidence for a workable approach to unilateral thrust force.

This work by Corum *et al.* thus is highly promising, is solidly based experimentally, and certainly bears watching closely. We would strongly suggest that Corum *et al,* analyze their proposed mechanisms and results obtained in terms of supersystem analysis rather than system analysis, using higher group symmetry electrodynamics, and recover and include the long-neglected Heaviside energy flow component.

8.3.12 Gravitec, Inc. and H. Serrano

A patent {537} was issued to H. Serrano on Oct. 5, 2000 and assigned to Gravitec, Inc. whose principal investigator and corporate officer is Tim Ventura. Based on this invention, Gravitec, Inc.. has developed and demonstrated a rotary device that develops unilateral thrust. Purdue University began a small but steady effort to test the unit, first in the atmosphere and later under high vacuum conditions. The first tests have been successful, and a paper {538} from the Purdue study shows it is not the ion wind effect, which is orders of magnitude too small to account for the demonstrated thrust. Further, Jean-Louis Naudin has replicated and tested the Serrano thruster, and it works beautifully {539}. Ventura also hopes to develop a toy kit, with safe power supply, which would allow persons to perform their own successful lifter experiments and perhaps rotary experiments at nominal cost.

8.3.13 Transdimensional Technologies, Inc.

There is also ongoing important propulsion work at Transdimensional Technologies, Inc. of Huntsville, Alabama {540}. Founded in 2000 by its chief scientist, Jeffrey Cameron, the company has developed several novel propulsion and lifting mechanisms. Independent tests of some of these systems have been accomplished by Jean-Louis Naudin, and the results can be seen on his website (previously cited).

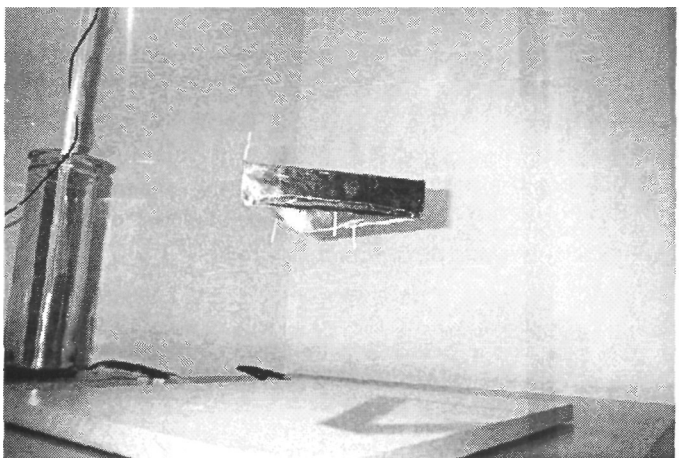

Figure 8-1 Naudin's **replica of the** Transdimensional Technologies **lifter.**

As we go to press, Transdimensional's most recent propulsion effect is called Power3 (power "cubed"). It uses an asymmetric capacitor to

produce the thrust in space, and the principle has been successfully tested in a vacuum. A larger, triangular lifter made mostly of pipe was demonstrated in vacuo to NASA officials in Huntsville, Alabama. Cameron has patents pending on magnetocaloric hybrid rocket engines and asymmetric gravitational waves {541}. A replica of the Transdimensional lifter successfully tested by Naudin is shown in Figure 8-1, by courtesy of Jean-Louis Naudin. Naudin's replica of the Transdimensional Technologies rotational device is shown in Figure 8-2.

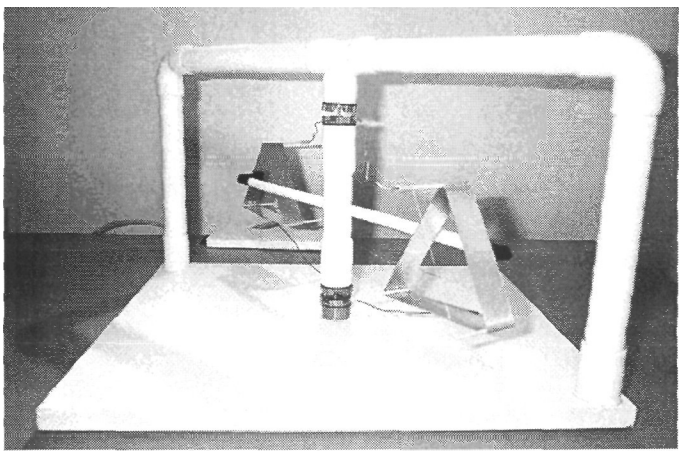

Figure 8-2 Naudin's replica of the Transdimensional Technologies rotational device.

We understand that new Transdimensional Technologies systems, now in patent process and still closely held, represent dramatic advances in the state of the art. The corporation foresees eventual commercial licensing of some of its developments, and the development of practical lift vehicles and space propulsion systems within 3 to 5 years.[226]

[226] Ken Moore and I personally visited Transdimensional Technologies here in Huntsville, and we found a very straightforward, enthusiastic, and hard-working group. We were treated with great courtesy, so much so that Jeff Cameron graciously cut short his vacation day and came in to show us the lab equipment and give a demonstration. We very much appreciate the work that Transdimensional Technologies is doing, and we certainly wish this fine group outstanding success in their efforts. We also are very appreciative for their courtesy and consideration in showing us the demonstrations and for their cogent discussions with us, which **were** most helpful.

8.3.14 **American Antigravity** (Tim Ventura's Company)

Tim Ventura is a very energetic lifter and antigravity researcher, who has done work independently and for others such as Transdimensional Technologies. The results of his many experiments and replications, tests, photos, etc. are on his website at http://www.americanantigravity.com. He also has several videos showing his testing, as well as detailed instructions for a researcher to build his own demonstration unit and verify the tests. Tim kindly furnished some needed information in this area, and put me in touch with other researchers and websites, which I appreciate.

8.3.15 Jean-Louis Naudin

Jean-Louis Naudin is a tireless researcher in the fields of COP>1.0 systems and processes, and in the field of lifters, inertial thrusters, and possible antigravity systems. His website is a cornucopia of information, patent references, inventions, processes, and replications or replication attempts by Jean-Louis and others who regularly work on such things and communicate with him. The website is http://jnaudin.free.fr/. From there, one may click on the various parts of the site and on the links to other sites to gain a wealth of information on these subjects.

His lifter work, including successful replications and instructions on how to build lifters, can be accessed from http://jnaudin.free.fr/html/lifters.htm, and will keep the interested researcher busy for many productive hours. We especially commend Jean-Louis for his extraordinarily important efforts and for making all this work available to researchers worldwide. Once on the site, one is free to choose from a very wide variety of projects, subjects, etc. The information value of this site is very, very high. We consider Naudin's site to be the single best information site on the web for COP>1.0 system information and for the new space propulsion methodology and effort. Necessary links to other related sites of interest are also provided.

Good hunting!

8.3.16 Other Research Work and Inventions

While we have given a sort of quick overview of work done in this field, there have been many other patents filed by numerous inventors and additional work done by them. This is a dynamic field and it is moving; the biggest problem is that it is still sorely hampered by highly limited funding and an attitude by much of the scientific community that "if it has not been invented here, it doesn't exist".

In the table in Figure 8-3 below, we list some of the pertinent patent numbers for reference, with the emphasis on U.S. Patents. The Naudin website previously referenced has a great deal of information on these thrusters and lifters, including instructions for building and testing several of the simpler proof-of-principle versions. There are links to other sites with even more information. Naudin also includes the results of his successful replication and testing of a variety of these devices and inventions, as well as the successful replication by other experimenters. Naudin also gives construction instructions and information on some of these, so that independent researchers can build test units and test them if desired.

For those researchers interested in pursuing this area further, we would heartily recommend a determined search on the Internet, using Google (www.google.com) as their search engine. A good place to start is Jean-Louis Naudin's web site, and then run the cross-links. The combination will turn up quite an amount of specific material, from which the individual researcher can choose which approach and experimental method he wishes to pursue.

Figure 8-3.

Selected Inertial Propulsion System Patents

T. Townsend Brown, "A Method of and an Apparatus or Machine for producing Force or Motion, British Patent 300,311, Nov. 15, 1928.

Norman L. Dean, "System for Converting Rotary Motion into Unidirectional Motion," USP #2,886,976, May 19, 1959.

T. Townsend Brown, "Electrokinetic Apparatus," USP #2,949,550, Aug. 16, 1960.

T. Townsend Brown, "Electrokinetic Transducer," USP #3,018,394, Jan. 23, 1962.

T. Townsend Brown, "Electrokinetic Generator," USP #3,022,430, Feb. 20, 1962.

T. Townsend Brown, "Electrokinetic Apparatus," USP #3,187,206, Jun. 1,1965.

Henry Wallace, "Method and Apparatus for Generating a Secondary Gravitational Force Field," USP #3,626,605, Dec. 14, 1971.

Henry Wallace, "Method and Apparatus for Generating a Dynamic Force," USP #3,626,606, Dec. 14, 1971.

Fernand Estrade, "Device for Transforming Kinetic Energy," USP #3,807,244, Apr. 30, 1974.

Leo J. Novak, "Centrifugal Mechanical Device," USP #3,810,394, May 14, 1974.

Everett H. Benson, "Inertia Engine," USP #3,863,510, Feb. 4, 1975.

Oscar Mast, "Propulsion System," USP #3,889,543, Jun. 17, 1975.

Arthur N. Lehberger, "Centrifugal Propulsion Drive and Steering Mechanism," USP #3,897,692, Aug. 5, 1975.

Howard A. Gaberson, "Vibratory Locomotion Means," USP #3,916,704, Nov. 4, 1975.

Calvin I. Cuff, "Device for Converting Rotary Motion Into a Unidirectional Linear Motion," USP #3,968,700, Jul. 13, 1976.

Nicholas Joseph Schnur, "Method and Apparatus for Propelling an Object by an Unbalanced Centrifugal Force with Continuous Motion," USP #3,979,961, Sep. 14, 1976.

Calvin I. Cuff, "Device for Converting Rotary Motion Into a Unidirectional Linear Motion," USP #3,998,107, Dec. 21, 1976.

George Knap, "Orbital Propulsion Apparatus," USP #4,087,064, May 2, 1978.

Calvin I. Cuff, "Device for Converting Rotary Motion into Unidirectional Motion," USP #4,095,460, Jun. 20, 1978.

Robert L. Cook, "Device for Conversion of Centrifugal Force to Linear Force and Motion," USP #4,238,968, Dec. 16, 1980.

Ladislaw G. Srogi, "Mechanical Propulsion System," USP #4,242,918, Jan. 6, 1981.

Harry S. Melnick, "Unidirectional Force Generator," USP #4,261,212, Apr. 14, 1981.

Frederick L. Dehen, "Apparatus for Converting Rotary Motion to a Rectilinear Force," USP #4,347,752, Sep. 7, 1982.

Harry S. Melnick, "Mechanical Power Transmitting System," USP #4,398,431, Aug. 16, 1983.

Peter Kleber, "Apparatus for Acceleration-Free Mounting of a Body in a Spacecraft," USP #4,408,740, Oct. 11, 1983.

Fred de Weaver, III, "Propulsion System," USP #4,409,856, Oct. 18, 1983.

Ronald K. Linde, "Centrifugal Reaction Chamber," USP #4,450,141, May 22, 1984.

Fred de Weaver, **III,** "Propulsion System," USP #4,479,396, Oct. 30, 1984.

Joseph Colla, "Mechanical Propulsion System," USP #4,577,520, Mar. 25, 1986.

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8.3.17 Mechanism for the Antigravity Accelerating the Universe's Expansion

Finally, in addition to sorely needed better means of space propulsion, one of the real incentives for antigravity research is provided by the search for a source of the now-established mysterious antigravity that is accelerating the expansion of the universe. Elsewhere in this book we have advanced our own proposal for the mechanism generating that *antigravity* effect in the cosmos.

Simply put, a very violent astronomical process may be considered a giant and very violent discharge phenomena, since it first involves a giant excitation followed by a giant release (discharge) of that excitation. All such phenomena involve strong broken symmetry during the discharge itself, with the concomitant strong available of causal 4-sources of negative energy and negative energy fields. These processes — in their causal unobserved state - do produce locally strong negative energy EM

fields from the source causal 4-positrons (Dirac sea holes prior to observation as positive mass 3-space positrons having positive energy and reverse-oriented). When the unaccounted and very large Heaviside nondiverged EM energy flow component accompanying every field and particle interaction is accounted, the causal negative "mass-energy" states produce strong antigravity fields, particularly considering the *lower frequencies* of many of the phenomena.

With the long-neglcctcd Heaviside nondiverged energy component considered and not just the accounted Poynting diverged component, the total amount of negative EM field energy available in these violent process is dramatic. Accordingly, just as was the Sweet VTA in its increased power and its ELF pulsations, these giant astronomical sources are also giant negative "mass-energy" sources and strong antigravity sources as well. In short, such astronomical sources produce strong antigravity components repelling each other across the universe. Hence the observed acceleration of the expanding universe; the violent astronomical phenomena are continually "pulsing" the universe with antigravity and hence continually accelerating its expansion velocity.

In 2000, we also published a proposed mechanism for the source of the excess *positive* gravity holding the arms of the spiral galaxies intact {542}.

8.4 The Author's Engineering Approach to Local Antigravity

See again our discussion under Newton, subparagraph 8.2.1 above, and our discussion of a negative field energy extension to it. For a major laboratory, we believe that antigravity is straightforward,[227] if one first produces a COP»1.0 situation in a higher group symmetry electrodynamics process. This provides a very strong "displacement current" of causal 4-positrons (before parity inversion, time-reversal, etc.) as true negative energy "particles" or "states" or "Dirac holes" in the surrounding 4-vacuum. The actual "negative mass-energy field" is very large, due to the unaccounted Heaviside nondiverged negative energy component. Consequently, a substantial antigravity field is established.

[227] However, this is based on the assumption that the lab team first gives up some erroneous but widely held misconceptions, and really does a little "thinking outside the box" as they are prone to suggest.

8.4.1 Sweet Antigravity Test.

See again our discussion in paragraph 8.3.7. A practical realization of antigravity was clearly shown by the Sweet antigravity test designed by the present author. See previous discussion under paragraphs 6.3.2 in Chapter 6, and see again Figures 6-5 through 6-15.

In Chapter 6, the Sweet vacuum triode amplifier device shown in Figure 6-8 had a very large COP = 1,500,000 at 500 watts output with a 33 microamp, 10 volt operator's input. It had an even greater COP when pushed to 1,000 watts output because of only a slightly greater input.

The Sweet VTA used an induced powerful self-oscillation between the local vacuum and the barium nuclei in the barium ferrite magnets. This resulted in what is called a "kinetic" magnet (and one magnetized through its flat face). In a kinetic magnet, its nuclear magnetic field (in this case, in the barium nucleus) is self-oscillating (waving) in an angle about its local direction, as shown in Figure 6-6 in Chapter 6.

The conditioning was performed with the barium ferrite magnet itself in forced resonance at its resonant condition (some 11 to 12 Hz, in the case of Sweet's magnets). Then the 60 Hz signal was impressed orthogonally to the primary direction of the resonant magnet. After conditioning each of the two magnets, they were placed together on a separation box, carefully keeping the corresponding ends together similar to their original orientation during activation, but in attracting mode (through their face) across the separator. The assembly itself was then further conditioned, again orthogonally to the coupled oscillating fields. This "synchronized" the two magnetic self-oscillations and phase-locked them together in a common self-oscillation with the local vacuum.

Similar treatment of the vacuum as a semiconductor, together with self-oscillation between vacuum and nuclei, has been advanced independently by Prange and Strance {543}, who showed that the vacuum may be regarded as a semiconductor. In particular, they showed that the vacuum in the region close to the nucleus of a superheavy element is analogous to the inversion layer in a field effect transistor. It is similarly analogous for the barium atom, though Prange and Strance do not discuss that element. They introduced the concept of the inverted vacuum. Just as a semiconductor may be manipulated by subjecting it to external fields, doping etc., it appears that so can be the vacuum — along the lines shown by Prange and Strance and along the lines demonstrated by Sweet's conditioning of his kinetic magnets.

8.4.2 Bearden's Proposed Antigravity Mechanism

Any EM process that produces a COP»1.0 condition, such as can be done in intensely abrupt ionic discharges and other processes, will also produce intense causal (4-space) Dirac sea holes in the immediate surrounding vacuum. This is the negative energy mechanism, conceived by the author in the 1970s and finalized in the 1980s, for producing a negative energy causal (unobserved) EM field[228] in the immediate space surrounding a system. The overunity system must be the "source" of that negative energy EM field. So the negative energy EM field in surrounding local space is "attached" to the mass and energy dynamics of the "unit's supersystem" as being its "source or generatrix". Its attachment to the system mass produces the antigravitational force upon that mass.

Negative energy state charges (Dirac holes) are also *source charges.* Prior to observation converting them (as observed) to 3-space positive mass-energy positrons with positive energy and going the opposite direction, they must be accepted as negative energy source 4-electrons "pouring out negative energy" in all directions in 3-space, continuously, via the giant negentropy process for source charges. Since they pour out "negative" energy, we may consider that negative energy field action at any point in 3-space to be a continuous absorption of positive energy from 3-space and a return of that extracted energy to the time domain as increased time — in short, time dilation.

Either way one considers it, the 4-space Dirac holes do produce negative energy EM fields, potentials, and spacetime curvatures and these must be accounted during their existence *prior to observation and interaction.* Further, their accompanying giant Heaviside negative energy flow component must also be accounted. In other words, do not reverse the spatial direction and thus the location and direction of these fields, do not turn them into positive energy fields by such reversal of direction, do not turn the negative mass into positive mass, and do not reverse the sign of

[228] We strongly stress that the continuous, dynamic, ongoing causal 4-field before it interacts with charge and is observed, is a totally different entity from the iteratively and continually observed frozen "effect" 3-field in matter after the 4-field has interacted with charged matter to produce an observation or "event". The great barrier to using electromagnetic fields in practical antigravity application has been due to the substituting, in electrodynamics, of the iterative "effect" 3-field of the observed positron for the continuous "causal" 4-field of the unobserved negative energy 4-electron (the Dirac sea hole). The "effect" 3-field is simply the iterative, continual energy gradient of the diverted EM field energy flow around the assumed intercepting unit charged particle.

the source charge (the Dirac sea hole). All that happens after interaction of the Dirac sea holes with matter, forming the usual lattice holes or *observed* 3-positrons.

Therein lies the magic secret of antigravity. Instead of thinking of the *fields* interacting on the craft or system that is producing them,[229] think of these negative energy fields interacting upon the *local spacetime surrounding the craft or system, and curving that spacetime negatively. Then* think of this negative curvature of spacetime interacting back upon the craft or system in general relativity fashion. *That* is what will and does produce practical antigravity upon the interacted craft or system, once the Heaviside energy flow component is accounted! But to understand its magnitude and the practicality, one must also account for the long neglected Heaviside nondiverged component.

The mechanism is also consistent with general relativity and Wheeler's succinct statement that mass acts on spacetime to curve it, and curved spacetime acts back on that mass to move it or produce a translation force upon it. We are simply applying that fact of general relativity to produce a local antigravity effect of a locally curved spacetime upon the source system (in this case, the power system itself, which is the source of the negative field energy in the vacuum.

The entire notion of "curvature in spacetime" — and indeed of spacetime itself— is a notion applying *before observation and interaction to produce the observed effect* — i.e., prior to the *d/dt* operation occurring upon an ongoing 4-space process to produce a momentary frozen 3-space snapshot (an observed effect). Think carefully. Wheeler's rule does not mean that 3-space acts back on the mass (actually on the masstime), but that 4-space (spacetime) acts back on it. Spacetime does not exist in the observed object after the application of observation's *d/dt* operation has occurred and until a new causal interaction begins. The *d/dt* operation strips away the time,

[229] The ongoing interaction of the vacuum/spacetime with the source of the unobserved 4-fields is their cause, and the observed 3-fields are the effect. The effect *a priori* does not interact upon the cause! So thinking that "one should make a 3-field in a craft or system that will interact with it and produce antigravity force upon it" is a non sequitur. Instead, one more correctly thinks that "one should make a 4-field *from* a craft or system which will interact with the local spacetime to curve it negatively. Then that negative curvature of spacetime is itself a negative energy 4-field that will interact back upon the observed craft or observed 3-system to produce observed antigravity force upon it.

and hence most of the energy (i.e., all the time-energy) of the spacetime that is to do the interacting.

As source charges, the Dirac sea holes — before observation and in their vacuum state condition — produce a locally curved *spacetime* around the source unit. That induced *(negative energy x time)* curvature interacts back upon the physical system that is the source of the field producing the negative spacetime curvature. It specifically acts upon the mass of the 4-system when it exists as *(mass x time) form.* That interaction produces *antigravity* force and momentum upon the system, rather than *positive gravity* force and momentum[230]. Adding negative EM field energy (in the causal, unobserved state) is precisely the same as adding extra negative masstime, i.e., extra *(-m)t,* since the 4-field is being used in unobserved state.

Using the principle of superposition of fields[231], the external observer sees the "weight" of the unit (the force developed on it by the *net* gravitational field — see again our discussion of the Newtonian approach under paragraph 8.2.1 above) — as being reduced. The intensity of the *negative energy x time (negative angular momentum or negative action)* EM field (including with the Heaviside component accounted) produced by the unit determines the intensity of the antigravity produced, and hence determines the fraction of the unit's weight[232] that is observed to be "lost". See again Figures 6-14 and 6-15 in Chapter 6.

[230] Note that, if the Dirac hole interacts with the mass lattice of the system, it converts to a "hole" that is attached to the positive mass of an ion. Hence the "observed" positron is said to have "positive mass", which is a non sequitur for the state in which the "positron" exists prior to observation or interaction. The lattice hole 3-positron and the true spatiotemporal "4-positron as still a negative energy 4-electron'" are two very different entities, and their fields and concomitant field effects are very different.

[231] Note that identification of spacetime and field in general relativity extends the notion of superposition of multiple fields to the notion of superposition of multiple curvatures of spacetime. Thus, it is the *net* superposed curvature of spacetime that interacts back upon the physical mass system, to produce gravity (either positive or negative, depending on the sign of the net curvature).

[232] We remind the reader that the "weight" of an object on Earth is a measure of the force developed on the object by the (Earth's) gravitational field. "Loss of weight" is simply "reduction of that net force" due to the combination of the Earth's positive (attractive) gravitational field and the Dirac hole curvature of the object's local spacetime producing a negative (repulsion) gravitational field.

At sufficient intensity of this local negative energy 4-field in spacetime with the unit as its source, the back interaction upon the unit will balance the action of the earth's gravitational field. At that point, the unit will hover and "float" against the force of terrestrial gravity.[233] By further increasing the intensity of the negative energy EM field, the unit will accelerate upward, now being repelled by the local earth more than it is attracted by it. By "angling" the negative energy EM field direction — or by producing a second such negative energy EM field from the source unit as an "angled add on" superposed on the first one — one also provides unilateral propulsion in a given direction.

As can be seen, all the requirements for a practical antigravity vehicle and negative energy propulsion system are met. The only real problem in this approach is the requirement to first attain a COP»1.0 EM power system at ELF frequencies.[234] There is, however, an additional problem of correcting one's thinking to be along the lines indicated.

Antigravity becomes straightforward if one first does overunity discharges or steady output in a system with COP»1.0 and understands the difference between the observed "effect" 3-field and the unobserved "causal" 4-field. Sweet's VTA unit had a beginning COP = 1,500,000 at 500 watts output. The unit was pushed to nearly double its COP, by connecting additional load so that the output was now 1,000 watts. The additional input draw was minimal.

Designing the experiment with that in mind, I convinced Sweet to build a new output load unit, and to perform the experiment. In advance, I roughly predicted levitation of the 6-pound device at about 1500 watts output power, by some back-of-the-envelope estimates assuming a 10% efficient

[233] Sweet later did push the VTA to hovering and upward acceleration, with the unit on a tether. After he was shot at by a distant sniper, thereafter he was very fearful **and** refused to show many experiments, including the antigravity experiment and particularly its extension to the hover point and upwards acceleration extension. In my opinion he had good reason for his paranoia and his fear for his life.

[234] The reason for ELF frequencies is simple: for the most powerful curvatures of spacetime, one wishes to use EM fields whose photons have the greatest *total* energy (including time-energy). That of course is the lower frequency photons, not the higher frequency photons. So ELF is the way to go, not gamma rays etc.

process. The projected curve (again see Figure 6-14 in Chapter 6) shows that levitation would have occurred at about 1250 watts or so.[235]

Here is why we advocate a Dirac sea hole's negative energy field as a practical antigravity inducing mechanism.[236] At COP»1.0, there is a very appreciable vacuum energy density difference between the operator's energy input and the energy output of the system, *particularly when the Heaviside nondiverged energyflow component is taken into account as well as the Poynting energyflow component?*[237] There is a production of negative EM mass-energy x time (causal Dirac sea holes) in the immediately surrounding vacuum. That represents the production of a causal, unobserved antigravitational field (curvature of spacetime) with the system-associated anticharge as its source.

Meanwhile, the Earth's causal, unobserved gravitational field is still normal and unchanged. Now the two causal fields superpose, and interact with the system mass. As seen by the external observer, the net effect is a reduction in the weight of the object — the effect of the interaction of the system mass with the two superposed causal gravitational fields simultaneously.

Reasoning that increasing the COP of the Sweet unit should increase the ratio of output negative energy to output positive energy even further, 1

[235] I strongly warned Floyd not to exceed a 1 KW load, no matter what. In the resulting local curved spacetime surrounding the barium nuclei in the magnets, it appears that magnetic monopoles are deposited or appear. Since these barium ferrite magnets were made by pressed powder metallurgy, they had little tensile or torsion strength, and under sufficient stress they would explode violently like a fragmentation hand grenade. In his little lab (a converted bedroom), Floyd had no explosive facility. He did explode several magnets, but while cautiously remaining some personal distance from the unit as its output was increased. We warn the reader that experimentation with such procedures is at his own risk, and all proper laboratory safety precautions must be utilized.

[236] A provisional patent application has now been filed on the process in 2002.

[237] In a nominal circuit, the unaccounted Heaviside energy flow may be up to 10^{13} times as great as the Poynting energy flow component. This is a completely unaccounted, vast EM energy flow accompanying every field and particle interaction. Hence one can understand why such an energy density for a macroscopic system with COP»1.0, is sufficient to achieve on a macroscopic scale what LaPointe is attempting on a microscopic scale. The total macroscopic scale energy density is so great that the required LaPointe microscopic energy density {535} is present or approached.

calculated that doubling the output of the device would result in a sufficiently intense negative mass-energy field in the immediate space around the unit, to approach or reach levitation of the unit. However, as the increasing curvature of spacetime would further increase the deposition of magnetic monopoles in the magnets,[238] at some point the magnets would simply explode like hand grenades if the unit were pushed too far. With no explosive control facilities available, it appeared that doubling the output was the maximum that could safely be done under the circumstances. My own estimate showed that 1500 watts output would be required for levitation, but one dared not go beyond 1000 watts or one would risk a fragmentation explosion and injury or death.

I convinced Sweet to build a 1,000-watt output load box, which simply contained ten sockets for ten 100-watt light bulbs. This was a modification to the 500-watt VTA unit shown in Figure 6-8 in Chapter 6. By successively installing the bulbs one by one, the load could be adjusted in 100-watt increments up to 1 kilowatt.

The foregoing is the reasoning behind how I designed the experiment, and the purpose was to show very substantial and smooth weight loss of the VTA unit itself. The experiment was performed in that 100-watt incremental manner, with highly successful results as shown in Figure 6-14 in Chapter 6.

With each 100-watt increase in power output past 500 watts, the fraction of negative energy produced was greater. Hence the unobserved 4-positron fields (Dirac sea hole negative energy fields) were stronger, because there were more unobserved 4-positrons. This meant that the local negative mass-energy curvature of spacetime was increased also.

In turn, this negative curvature of spacetime interacted back upon the mass of the VTA to add negative mass equivalent, or more simply, antigravity force. The observed weight of the unit was the sum of the normal gravitational weight (due to earth's gravity curvature of the local spacetime), and the abnormal antigravity weight (negative weight) due to the antigravity curvature of the local spacetime superposed. So as the fraction of negative curvature of spacetime increased, the net weight of the VTA was observed to decrease.

[238] Contrary to popular opinion, one does meet with effective magnetic monopoles in a magnetic field — including in the magnetic field of a permanent magnet — in a strongly curved local spacetime. The stronger the field, the greater the magnitude of the effective monopole charge.

As stated, Sweet was performing the experiment on the bench in California, and reading the instrumental results over the phone (I was in Huntsville, Alabama) where I recorded them. The spectacular results are shown in Figure 6-14 in Chapter 6.

The high COP (corresponds to gain) of energy density present in the Sweet VTA system's output section — with a greater percentage of it being negative energy — versus input energy one inputs to the input section, is what is important. In short, increasing the load effectively increased the gain, which further increased the ratio of the negative mass-energy to the positive mass-energy. This in turn steadily decreased the observed weight of the object.

Anything outside the system mass of that very high COP system will "see" the weight of the system mass as having decreased. Weight is just so much mass making so strong a *net* G field (spacetime curvature) in the surrounding spacetime. Reduce the *net* G-field that the system mass is normally making (by having it *simultaneously* make the additional antigravity field which then vectorially adds to the mass's normal G-field), and the external observer, external scales, etc. will see the object as having very much reduced its weight.

Positive spatial EM energy density of a system makes positive gravity (as seen by the external observer in the lab frame) because of the way it curves the immediately surrounding spacetime and the way that curved spacetime interacts back on the system's mass-energy. Negative spatial EM energy density makes negative gravity because it curves the immediate spacetime the opposite way. A system under those "high negative energy field" conditions will produce a great deal of antigravity, because the immediate spacetime surrounding is dramatically curved by the negative energy. That was my concept when designing the experiment, and it worked beautifully. So that is how the Sweet device reduced its weight on the bench by 90%, for a 1 kilowatt total output and minuscule input power {544}.

If one were dealing with the source in a flying vehicle system, there is another effect due to momentum. Note that force F is defined as $\mathbf{F} \equiv \partial p/\partial t = +\partial/\partial t\ (\mathrm{mv})$. That is in a positive energy density local spacetime. When an extra negative energy density is added to the local spacetime, then there are two forces, a new one being $\mathrm{F} \equiv -\ \partial/\partial t\ (\mathrm{mv})$ and the normal one being $\mathrm{F} \equiv +\partial/\partial t\ (\mathrm{mv})$. These forces are created by any change in momentum in space containing an extra increment of negative EM field energy.

If the two forces balance, then there is essentially no net centrifugal force produced on the object (or any occupants in it) in a turn. In theory, maneuvers that are far more powerful can be made, without undue G-stress to any occupants inside. This of course remains to be tested in future work and experiments, and so must be taken as a strong hypothesis at present. It could be tested, given availability of the proper COP»1.0 energy system or process on board a test vehicle. Laithwaite's demonstration of the dramatic reduction in force necessary to lift a rotating gyroscope compared to lifting the same heavy gyroscope when not rotating, may have been a partial test of this "inertial resistance decrease" effect.

The Sweet device was the only available COP»1.0 device which could have been used for the experiment. That is why I designed the experiment and convinced Sweet to perform it. Had it not worked, much of what I had worked out for more than a decade would have been falsified — which of course is one of the purposes of experiment: to validate or falsify a thesis. In this case, I breathed a great sigh of relief because — in my view — the spectacular results completely validated my approach to antigravity, and also much of my approach to COP>1.0 systems.

Sweet was never in a position to be able to go with this to the scientific community. The VTA was completely fouled legally, by various entangling agreements Sweet had made with different backers, without ever changing or resolving any previous agreement. Also, he realized that his life really was in danger should he try to take the system openly to the scientific community. Consequently, he never tried and in fact adamantly turned all further work away from the antigravity effects.

Aging and rather defenseless, Sweet also began playing all sorts of games to prevent having to have the project validated independently, even for its COP>1.0 capability. He was mortally fearful of being killed if he had it resoundingly validated. He was motivated by the necessity to survive and not be killed, and he firmly believed that any such attempt for full scientific validation and open publicity would absolutely guarantee his quick death. His fears appear to have been well founded.

His most carefully guarded secret was his activation process for the barium ferrite magnets, which he guarded with his life. He also began telling different persons all sorts of different stories and "mechanisms" for the activation, which were clever ruses and disinformation designed to throw them off the true trail and prevent his activation secret from being uncovered. I made a personal videotape of the activation process, or what

he released of it, before he began such disinformation. So we do know much of the activation process, though not all of it.

Eventually, with changes in backers yet once again, Sweet died and never revealed the full secret of strong self-oscillation activation in permanent magnets to anyone. I knew and know part of it, even most of it, but still not all of it. What I understand about it has been briefly included in this book. From there, the interested researcher must find his own way.

The VTA was real, my gravitational mechanism is real, and — in my opinion — validated. However, it has not been *independently* validated in formal order, which is the proper scientific requirement. I did try very hard to convince Sweet that we should take this to the leaders of the scientific community and have it independently verified (e.g., by UCLA), but he would not hear of it after the assassination attempt. By that time, he was so afraid from the constant threats and constant stalkers that he had totally decided against any such releases. He also would not permit it to be taken to a major scientific conference and demonstrated, even though several scientists and engineers knowledgeable and experienced in measurement engineering did measure and certify the device's operation. But they were never allowed to see it in the antigravity mode. He would not discuss it with them, and he would not allow it.

Sadly, with the death of Sweet there passed away the VTA and its major secrets. I regard the VTA as one of the great scientific accomplishments of all time, and I regard Sweet as one of the most capable lab experimenters I ever met and one of the greatest inventors I ever met. The loss of the VTA and the absence of its full, independent scientific testing and validation were in my opinion two of the greatest losses to science of all time.

8.4.3 Discussion

Particle physicists speak of antimass and antigravitational field, but do not speak of anti-electromagnetic field and do not like negative mass. Antimass is actually "anti-mass-energy". When did one hear any scientist speak of a *negative energy* electromagnetic field or *negative energy* force field (except possibly as a hypothetical "tractor beam")? Or a *negative energy* electrical or magnetic potential? Yet the EM fields from an accumulation of Dirac sea holes (causal state) as a source charge are precisely negative energy EM fields. The EM potentials from an accumulation of Dirac sea holes are precisely negative energy potentials. Further, these fields and potentials produce opposite curvatures of spacetime as compared to positive energy causal EM fields and potentials from conventional source positrons and electrons.

Conventionally, scientists speak and think of *the positive energy* electromagnetic field. In our view, they do not apply the implications of the negative energy state part of the Dirac 1930 electron theory {545}, because of a built-in horror of negative mass (and antigravity!). Recall again our discussion of Laithwaite; a promising career was cut down in mid stride because he "mentioned the unmentionable": antigravity and possible failure of Newton's laws (they *do* fail in a curved spacetime!). His exhibiting to the Royal Society a very heavy gyroscope, very difficult to lift when placid, but easy to lift with one arm when spinning, was the final straw. The British scientific community simply cut him down and ostracized him from the rewards and positions he would otherwise have been given.

To conceal the relationship of the negative energy fields, hide negative mass, and pretend it does not exist, much scientific effort is exerted to consider the positive energy, positive mass positron *only after it has been observed.* So scientists can assign this "observed" 3-positron a positive mass and positive energy but with spatial direction reversal. That immediately moves to an *effect* field and an *effect* positron, not a causal field or a causal Dirac sea hole. It effectively eliminates the antigravity field of the negative mass of the unobserved negative energy Dirac electron, which is produced by the *causal* (unobserved) Dirac sea hole's electromagnetic field, not the *effect* (observed) positron field which then is "seen" to have positive mass but with field direction reversed.[239]

The positron is quite a different beast before it is observed, just as is a mass (and just as is any other observable, and just as is a field). For one thing, the positron before observation and the positron after observation have different dimensionalities; the unobserved causal entity is 4-spatial and continuous,[240] while the observed effect entity is continually and

[239] Note also that the causal field, being unobserved, is a 4-field, while the observed (effect) field is a 3-field. By reversing the parity, one has made the antigravity field **into** a gravity field, by substituting the effect for the cause and erroneously using the old non sequitur of a separate 3-force acting upon a separate 3-mass. Also, when one reverses its spatial direction, one converts a *positive* gravity field into an *antigravity* **field.**

[240] Along with Bohm, we point out that — strictly speaking — in 4-space one does not have "things", but only "processes". To speak of a "4-space field" is to redefine the field as an ongoing process, rather than as an observed frozen 3-snapshot or "3-thing". The solution to the long-vexing duality problem is there, but we leave its solution to the reader. It is necessary to extend Aristotelian logic itself if one is to resolve the duality problem.

iteratively 3-spatial. Mass before it is observed exists as masstime, not mass.

Simply consider the delayed choice two-slit experiment and Wheeler's famous comment that no phenomenon is a phenomenon until it is an observed phenomenon. Once the observation occurs, one can even change the "if it had been observed but was not" previous past. One gets the magic from the delayed choice two slit experiment without the observation, and then by making the observation such that the "magic" is not revoked *after the fact*. The whole experiment proves that, if one insists on applying the observation, one kills the magic, even if one thinks the magic has already occurred and must have already occurred, but it has not been *observed* to have occurred.

Causal 4-spatial "things" are not things at all, but are ongoing processes and their cessations have not "occurred" to yet produce a "thing"! The *observed* event is 3-spatial and has occurred. It is something in the past, not the present. That is different from something ongoing (happening or unhappening)[241] in 4-space, before having been observed and therefore a frozen snapshot taken in 3-space. As is well known in quantum mechanics, observation is a physical interaction and it indelibly changes and stops the "ongoing 4-process", converting it to a momentarily frozen "3-thing" as an effect of the observation process at that particular instant. So any "thing" is continual and iterative, *not continuous*, in its travel through time, and in its "observed existence in 3-space".

Because of such, physicists also have difficulty realizing that mass — being an observable — does not and cannot exist continuously in time. It cannot even *continuously exist!* No observable can. Masstime exists in time, but mass does not, as we previously discussed. Observation is a *dldt* operator imposed upon an ongoing 4-space process, destroying the time

[241] When a frozen instant 3-space snapshot (observable) interacts with a second causal process to generate another frozen snapshot (observable), the first observation "unhappens" because it is thereby moved into the "past", disappearing from 3-space forever. With every change of an observable (with every observation), even if the new effect appears identical to the previous one, it is still a *new* observable (a new effect) where a former effect "seems" to have recurred (been created, happened). Even if it is spatially the same as the previous observation output, it is at a different point in time and hence is the result of the *d/dt* observation operator being iteratively applied. The serial outputs — even of what we loosely call an "entity existing in time with no 3-space change" — are *successive and different* serial outputs from a serial time-differentiating process.

portion and producing an instantaneous, frozen snapshot at that instant. It's just *d/dt* (LLLT) => LLL. That is why all observation is 3-spatial, as is well known in physics. We long ago pointed out how the common photon interaction — the total photon interactions (both virtual and observable) with a mass — is what drives the mass through time, so to speak {15}. But it does it iteratively, frozen snap after frozen snap —just like progressively showing the frames of a movie film.

What really has to be changed is the old notion by Heaviside and Poynting that 3-energy propagates continuously through 3-space.[242] No observable can propagate continuously in 3-space, but only in 4-space and then only during its nonobservable state! So a "mass propagating through time" (i.e., just sitting still and "existing", so to speak) is doing so in an iterative fashion by recurring iteratively in observation output at the same spatial position. The mass turns to masstime, then to mass, then to masstime, etc. Or $m_1 \Rightarrow m_1t \Rightarrow m_2 \Rightarrow m_2t \Rightarrow m_3\ldots$ etc. In short, *observation continually recurs at an enormous rate,* so *an observable (effect or output of that observation process) continually recurs at an enormous rate,* destroying the previous observation as the next one occurs.

Because of the history of thinking in 3-space terms rather than 4-space terms, one of the ubiquitous errors widespread in physics is the substitution of the effect (the frozen output of the observation process) for the cause (that 4-space initiator process which continuously exists prior to observation, hence unobserved). So causes (4-space initiators which are unobservable a priori) interact with a previous "frozen 3-space snapshot" or observable, to produce a change (either a temporal change or spatial change or both) in or to or of that observable (that 3-snapshot) to a new observable (3-snapshot). If the object is seen to iteratively change in time but not position or form, it is said to "exist" or "persist" at rest continuously in time. It doesn't. It *continually recurs*[243] in that form, but does not *continuously exist* in that form!

[242] And also the hoary old mistaken notion that the "same observable thing" can continuously exist in time or persist.

[243] More rigorously, the continual recurrence is at the quantum level. So a larger mass or other observable actually is a great horde of very small "continual recurrences" of tiny incremental pieces of itself. At any time interval of observation via observable photons, a vast number of nonobservable (virtual) "continual recurrences" occur in the "observed object". In short, the "observed object" is the **end** summation and result of a vast number of infinitesimal changes. Hence the entry of statistics and the uncertainty principle. Each one of the infinitesimal

The antigravity mechanism has been implicitly present in the Dirac theory of the electron since his 1930 paper {497}, where he brought forth the Dirac sea and the anti-electron, if the *causal* Dirac sea negative energy states are applied to general relativity before they interact with charge and are "observed". General relativity deals with spacetime and spacetime curvature. Therefore, it is concerned with causal 4-fields, 4-potentials, and 4-waves in 4-space prior to observation.

As we stated previously, there is really no such thing as a "3-space EM wave", e.g., as rather strongly pointed out by Romer {546}.

One can produce and have an EM field of *negative* EM energy in spacetime, coming from the 4-positron charges of the anti-charged mass of a system, as well as one can produce and have an EM field *of positive* EM energy in space, coming from the charged mass of a system. But negative energy EM fields have been swept away from our minds by interpreting the negative energy 4-electron as the 3-positron, after the negative energy 4-electron has interacted with charged matter (been observed as the *effect),* rather than how it exists in spacetime prior to observation (as the *cause).*

So physicists reverse the direction and the charge, and make the mass positive, which is how the Dirac sea hole is "seen" *after observation.* That makes it a material lattice hole and a special kind of positive ion. Before observation, it is not seen at all, but it exists as negative action (energy x time) and therefore in "negative masstime" state form. Before it has been observed, it's still there in spacetime, as a curvature of spacetime. It's just a *negative energy state curvature* in the vacuum/spacetime.

Make lots of these negative mass-energy state Dirac holes from a source system, such as one producing a very powerful negative energy EM field, and voila! That's it. The system is producing — and surrounding itself by — its own negative energy EM field (negative curvature of 4-space), which is also its own local antigravity field. That antigravity field superposes with the prior local curvature of spacetime, altering it. The *net* curvature of local spacetime is itself a field which interacts back upon the mass system to produce "net gravity" whose sign may be positive or negative, depending on the sign of the net spacetime curvature. If the two back-acting curvatures of spacetime are opposite and equal, that represents the source object existing in a zero gravitational field, and thus "hovering" in the Earth's gravitational field, for example.

changes may be modeled causally, but since there is no individual information available on each one of them, they can only be calculated statistically.

The use of negative energy EM fields and Dirac sea holes to alter the curvature of the local spacetime in a negative direction provides the present author's engineering approach to practical antigravity. Note that our approach gathers in the gist of both of the major two approaches to antigravity: (1) the shielding theory as typified by Modanese {547}, and (2) the opposing force theory as typified by Ling Ni and Torr {548}. The opposing force, considered as a field that is identically a curvature of spacetime, is also a "gravity shielding" force via superposition of fields. We state unequivocally that a theoretical model of the new approach can be constructed from Sachs's theory {510}, and implemented in the 0(3) electrodynamics of Evans and Vigier {549}. Further, it is a directly engineerable theory, without the necessity for superconductivity, spinning wheels, etc. as demonstrated by the highly successful Sweet experiment previously discussed.

We quote Evans {550}, on the appearance of the B(3) field in general relativity, to indicate the nature of such a future theoretical model:

> *"I have chosen a metric that gives circular polarization (as observed), but in the framework of general relativity using the irreps of the Einstein group according to the Sachs theory. This is a closed field theory which is analytical, using a Lie group, the Einstein group. As such there are no particles, only spacetime curvature, so everything in physics reduces to spacetime curvature, i.e. to a metric vector and its components. This is then incorporated in the Sachs theory to produce a metric four-vector which is a <u>generally</u> covariant component of a quaternion-valued metric with sixteen components, the most general form of the metric allowed by general relativity and topology. The Einstein-Sachs equations for electromagnetism are six metrical equations in six unknowns, the components of an antisymmetric field tensor of electromagnetism. By choosing a metric that corresponds to circular polarization, $B^{(3)}$ appears automatically.*
>
> *This method gives the $B^{(3)}$ field from Einstein's theory of general relativity applied to electromagnetism by a consideration of the irreps of the Einstein group. It follows that whenever the conjugate product $-gA^{(1)} \times A^{(2)}$ is observed, the $B^{(3)}$ field <u>must</u> also be observed, otherwise general relativity fails. Examples of*

the $B^{(3)}$ field at work are the inverse Faraday effect and RFR [Radiatively induced fermion resonance]. "

Evans and the AIAS have already taken the first theoretical steps showing that antigravity does indeed arise from Sachs's theory {551a-551c}.

We are convinced that practical antigravity only occurs at extremely low frequency (ELF) for reasons[244] explained previously. Certainly that seems to be true for our approach to it. The highest "total energy" photon is the low frequency photon with low spatial energy and a larger time increment. The larger time component has the same energy density as mass. So one multiplies the time component increase (in seconds) by roughly $9x10^{16}$ to get the increase in spatial energy equivalency. Halve the frequency of a photon, and one increases its *total energy* by $4.5x10^{16}$ {552}.

High energy physicists have not realized that the time component of the photon has enormously more energy than the spatial component, and that low frequency photons contain enormously more trapped energy than do high frequency photons. So they largely ignore the time-energy component, focus on the spatial energy component, and erroneously consider *high energy* physics as *high frequency* photon physics. Instead, present high frequency photon physics is only a high *spatial* energy physics, not a high *total* energy physics at all. Today's high energy physics is really still a very low total energy physics, compared to what can be done with the time-energy component of the photon rather than its spatial-energy component. By transducing and using the highly compressed time-energy, experiments can be done on the lab bench with fairly simple and cheap equipment, that actually utilize *higher total energy nuclear reactions* (though at low spatial energy) than are presently obtained in the largest accelerators.

That is also why there is presently no understanding in the conventional community of the "low spatial energy transmutations" of cold fusion, where the experiments unwittingly use the high time-energy component. The scientific community has not even recognized the time-energy aspects,

[244] Dramatic increase in the magnitude of the time-component, hence an enormous increase in the time-energy component with only a small decrease in the spatial energy component total energy of the photon. The *total energy* thus dramatically increases, when the spatial energy equivalent of the time-energy is considered. The present conservation of energy law in physics is inadequate because it does not account time energy at all; thus completely discards the most fundamental EM energy mechanism of all: the giant negentropy of source charges and source dipoles.

and has not recognized that time-energy physics is an ultrahigh total energy physics, where the present "high energy physics" is tame by comparison.

The previously unknown time-energy induced transmutation interactions are the precursors to, and the opening salvo of, a new *ultrahigh total energy physics* struggling to be born in spite of the adamant opposition of the conventional scientific community. Allowing for the time-energy component, for the mechanism generating the flow of time, and for formation and decay of time-reversal zones, we previously wrote the exact new nuclear reactions for the production of the excess deuterium, tritium, and alpha particles {553} in numerous cold fusion experiments. We also explained the highly anomalous nuclear instrument effects — due to (i) time-charging, (ii) the slow decay of time-charge with radiation of Whittaker longitudinal waves, each accompanied by its phase conjugate twin time-polarized wave, and (iii) the previous time-charge history of the instrument. These puzzling anomalies have been observed at U.S. Navy research facilities at China Lake now for some years in rigorous electrolyte experiments {198}. We summarize that work in Chapter 10 of this book.

With a little effort and development, practical antigravity appears to be straightforward for any good modern laboratory. But the lab physicists should first (i) rethink the entire subject, from its very fundamentals, to include considering the positron before observation and not after observation, (ii) remove the Lorentz symmetrical regauging from electrodynamics and recover the presently missing COP >1.0 and COP»1.0 Maxwellian systems again, and (iii) rapidly develop COP»1.0 systems and processes to use in antigravity experiments and development. At least in this approach, the COP»1.0 EM systems — once developed — are an immediate gateway to practical antigravity devices, unilateral thrust propulsion systems, and antigravity vehicles. And of course they are the immediate gateway to practical transport vehicle power systems, fuel-free, clean, and self-powering.

Hopefully, such a scientific reassessment will be performed, and it may provide the gateway for practical transportation and travel to the ends of **the** solar system and beyond, to be achieved in the first two decades of this century.

8.5 In Conclusion

We have briefly reviewed the presently developing field of inertial space propulsion and antigravity, and presented our own approach to practical

antigravity as well as an informal experiment that strongly supported that approach. We have strongly stressed that the causal field from the system as its source constitutes a curvature of the local spacetime superposed upon the pre-existing local spacetime curvature. Instead of thinking of that causal field from the source system as acting back upon the source system, we have stressed thinking of that *net superposed curvature of local spacetime* acting back upon the source system and producing a net gravitational force upon it. That net gravitational force may be either positive or negative, or zero, depending upon the sign of the net curvature of spacetime that is interacting back upon the system.

We presented and explained the results of the Sweet VTA antigravity experiment as probable verification of our approach to antigravity. Nonetheless, we also emphasized that the formal independent replication required by the scientific method has not been accomplished, and it remains to be accomplished before the approach is to be considered as scientifically validated.

We believe that this approach to antigravity can be modeled and engineered by use of the Evans-Vigier O(3) electrodynamics as a subset of the Sachs electrodynamics that is a part of the Sachs unified field theory.

If so, then tentatively we have laid out the basis for eventual practical antigravity systems and a practical antigravity technology. We fervently hope that this approach will in fact lead to practical technology and working transportation means during the next decade.

Finally, we hope that these notes and concepts will stimulate many sharp young graduate students and post-doctoral scientists to examine, model, correct, and greatly enlarge the ideas and principles advanced. If so, then the purpose of this chapter will have been realized.

Chapter 9

The Supersystem and Remarks on Gravity, Antigravity, and Testing

"What might appear to be empty space is, therefore, a seething ferment of virtual particles. A vacuum is not inert and featureless, but alive with throbbing energy and vitality. A 'real' particle such as an electron must always be viewed against this background of frenetic activity. When an electron moves through space, it is actually swimming in a sea of ghost particles of all varieties - virtual leptons, quarks, and messengers, entangled in a complex melee. The presence of the electron will distort this irreducible vacuum activity, and the distortion in turn reacts back on the electron. Even at rest, an electron is not at rest: it is being continually assaulted by all manner of other particles from the vacuum." [Paul Davies] {554}.

"Space acts on matter, telling it how to move.. In turn, matter reacts back on space, telling it how to curve." [Wheeler's principle] {555}.

"...the Aharonov-Bohm effect is a local gauge transformation of the true vacuum... [which] produces a vector potential from the true vacuum. [This gauge transformation] produces topological charge..., the electromagnetic field, which carries energy, and the vacuum charge current density first proposed by Lehnert... and developed by Lehnert and Roy... ". [M. W. Evans and S. Jeffers] {556}.

"The energy density (En_d) in curved spacetime is given in the Sachs theory by the quaternion-valued expression

$$En_d = A_m j_m^* \qquad [1]$$

where A_μ is the quaternion-valued vector potential and j_m^* is the quaternion-valued 4-current as given by Sachs ...Equation [1] is an elegant and deeply meaningful expression of the fact that electromagnetic energy density is available from curved spacetime under all conditions; the distinction between field and matter is lost, and the concepts of "point charge" and "point mass" are not present in the theory, as these two concepts represent infinities of the closed-field theory developed by Sachs from the irreducible representations of the Einstein group. The accuracy of expression [1] has been tested to the precision of the Lamb shifts in the hydrogen atom without using renormalization of infinities. The Lamb shifts can therefore be viewed as the results of electromagnetic energy from curved spacetime." [Myron W. Evans] {557}.

"Old habits of thought die hard, and it is not always easy to remember that a particle with negative mass if pushed to the right will move to the left; or that in a given reference frame a particle with imaginary mass can have infinite speed, in which case its energy is zero." .... "... extremely powerful energy sources may occur if particles of negative mass really exist in nature." [Banesh Hoffman] {558}.

"The observed (3-spatial) positron is a quite different entity from the unobserved (4-spatial) Dirac hole. Its direction has been reversed, and its mass and energy have also been reversed. Before the 4-spatial hole in the vacuum has interacted and been observed, it has negative energy and therefore negative mass equivalency, as well as negative charge. As a source charge, it also is the source of negative energy fields and negative energy potentials — all in the

nonobservable 4-state. " [T. E. Bearden, private communication to a correspondent, 2001].

"The...visible structure of orthogonal' 1-networks possessing coupled open-paths and closed-paths represents only an introductory step in the development of a correct topological theory for conventional electric networks...An electric network is like an iceberg...Its visible portion is only a small fraction of the submerged invisible structure. " [Gabriel Kron, who developed special tensor methods and diakoptics to deal with the large number of visible and invisible multidimensional p-networks surrounding the branches of every electric circuit.] {559}.

"...symmetry implies conservation. Since our entire edifice of interactions is built on symmetry assumptions, there should be as a result a large number of conservation laws. The only trouble is that almost all of these conservation laws have been violated experimentally. "... "...this difficulty could be resolved by introducing a new element, the vacuum. Instead of saying that the symmetry of all matter is being violated, we suggest that all conservation laws must take both matter and vacuum into account. If we include matter together with vacuum, then an overall symmetry could be restored" [T. D. Lee] {560}.

"One perhaps oversimplified way to deal more conventionally with the new unified field approach to electrodynamic systems is to utilize the notion of the 'supersystem', comprised of three components: (I) the ordinary EM system and its dynamics—conventionally assuming flat spacetime and inert vacuum, (2) the local nonlinear vacuum and its dynamic interactions with the system and with spacetime, and (3) the local curvatures of spacetime and their dynamic interactions with the system and with the local

active vacuum. In the rich feedforward and feedback interactions that result, there emerges a dramatic new physics, new electrodynamics, and new chemistry including a new biochemistry. This is in fact a much simplified conceptual approach (good to 'first order', so to speak) to the multinetwork and multipath work of Gabriel Kron. It also allows the retention of symmetry, considered so necessary to particle physicists. "
[T. E. Bearden, private communication to a correspondent, 2001].

9.1 The Supersystem and Its Considerations

In classical electrodynamics, the Maxwell-Heaviside-Lorentz equations implicitly assume a local flat spacetime and no net action by the vacuum {561}. Both these implied assumptions are false. All real EM systems involve interactions with both curvatures of spacetime and the active vacuum. Yet to try to include both additional interactions requires a unified field theory approach, such as that of Sachs {562}. Unfortunately, any unified field theory is replete with quite difficult mathematics, little of which can be illustrated pictorially or simply.

What is required — at least for most electrical engineers and applied electrical scientists — is a conceptual way of visually thinking about the EM system in a way that is consistent with unified field theory to something like first order, but which can also be conceptualized easily.

9.1.1 The Supersystem Concept

Accordingly, we introduce a new and very simple way of thinking of electrical circuits in terms of a unified field theory. We utilize the notion of the supersystem, consisting of three components: (1) the EM system and its dynamics, considered in conventional fashion (as if the local vacuum were inactive and the local spacetime were flat but perturbed), (2) the local interactive vacuum and its dynamics, and (3) the local curvatures of spacetime and their dynamics. All three components of the supersystem interact. This produces both feedback and feedforward functioning; e.g., energetic changes in the system produce corresponding changes in spacetime curvatures. In turn, the alterations in spacetime curvature produce nonlinear changes in the active vacuum, which in turn acts back upon the system. So every action in a system produces a corresponding set

of feedforward and feedback reactions from and with its complex environment, and vice versa.[245]

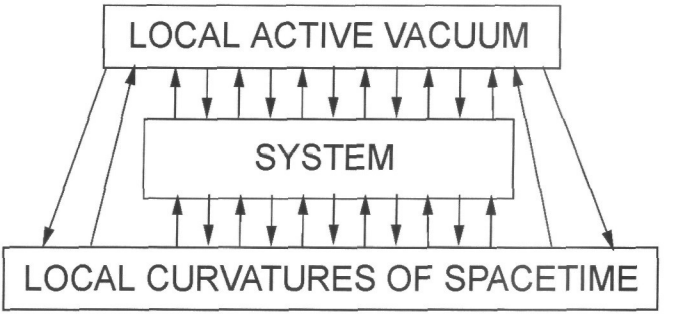

Figure 9-1 The Supersystem concept (block diagram).

Figure 9-1 shows a diagrammatic illustration of the supersystem concept. Figure 9-2 illustrates the effect of the classical EM assumptions of a flat spacetime and a locally inert vacuum. As can be seen, the classical assumptions *arbitrarily discard the* interaction effects upon and in the system due to the active vacuum dynamics and due to the local spacetime curvatures and their dynamics.[246]

As stated, all three components of the supersystem interact with each other. This is a dramatic change to classical U(1) electrodynamics. Hence the total interactions — with the system — of both the active vacuum and the locally curved spacetime, and their interactions with each other, are more general than either classical EM, general relativity, or the quantum mechanical vacuum of particle physics prescribes individually.

[245] We hypothesize that the feedback contains the mechanism generating Newton's third law as a restoration of symmetry, but leave that to the master theorists to explore and decide.

[246] As one example, the nondiverged Heaviside component of energy flow — previously discussed in earlier chapters — is part of the supersystem activity. This **flow** alters both the local active vacuum and the local spacetime curvature associated with an electrical power system and its connected external circuits. Since the resulting local "environmental" changes in the supersystem are extensive, then one can conceive ways in which these changes can be interacted with additional intercepting/receiving systems to produce extra "EM energy from the vacuum".

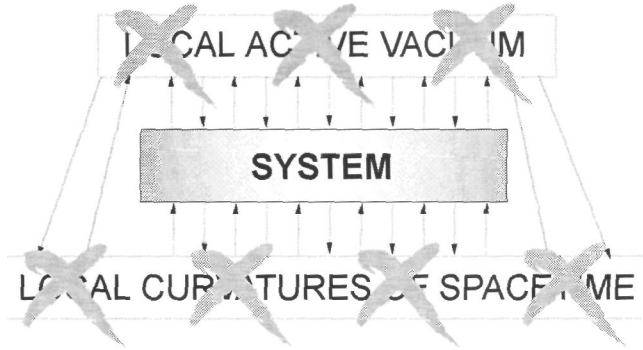

Figure 9-2 Classical EM destroys two-thirds of the supersystem.

Immediately it can be seen that the concept of energy from the vacuum is a "supersystem active and not negligible" concept involving a unified field theory approach *a priori.* It can also be seen that a "system" in equilibrium must be in equilibrium with its active environmental exchange — its exchange with the active local vacuum and the active local curvatures of spacetime. Since energy "exchange" with the system means both incoming and outgoing exchange, it follows that the equilibrium system has equal incoming and outgoing energy exchange. It follows that the symmetrically regauged system has equal incoming and outgoing energy, and so the symmetrically regauged system must be in additional stress from two net equal and opposite direct interaction forces, one general relativistic and the other from the active vacuum. Further, this "equal and opposite" equilibrium stress state must be accompanied by equal and opposite interaction effects between the two environmental media of the system.[247,248]

[247] We point out but do not pursue the fact that this is a very important new concept associated with *coherently* changing the symmetrical regauging, which allows a new physics, a new electrodynamics, and a new chemistry including biochemistry. For one thing, it permits such things as a self-maintained excitation state that simultaneously continuously discharges its excitation energy. This is simply a redefinition and more general broadening of the "source charge" concept. From the normal system view (assuming away the vacuum and curved spacetime interactions), an "impossible" system state can nonetheless be possible and stabilized, by changing the *intensity* of the Lorentz regauging condition. As an example, new molecules or ions can be made and stabilized in an excited state, that otherwise would be so unstable that the excitation would decay in a nanosecond with the state disappearing also. We believe this alone will lead to a great new biochemistry and medical

9.1.2 Time and Space Effects and Positive and Negative Energy

From curved spacetime considerations, we must include the effects on the system, and on the vacuum, of dynamics in the *time* domain as well as in the *spatial* domain. Indeed, in Sachs's theory space and time do not separately exist, but only spacetime. We consider time as highly compressed EM energy — as heretofore pointed out, where time is spatial EM energy compressed by the factor c^2 and having energy density similar to mass. We must include not only EM *energyflow* along the time-domain (fourth Minkowski axis *ict),* but also EM *force, potential, energy oscillations,* etc. in the time domain itself. We shall have to deal with time-force, time-energy, time-potential, time-energy current, longitudinal EM waves in the time domain (time-polarized EM waves), etc. {563}. The complexity of the full supersystem analysis is thus easily seen and appreciated. In most cases, a higher group symmetry model for a particular situation will prove intractable for closed solutions, and numerical methods must be used.

Further, when curved spacetime interacts with the active vacuum, we shall also have to consider *negative energy* currents in the nonlinear vacuum itself, as well as in the time-domain. We may also speak of the *negative energy density* in the vacuum as a special kind of negative energy *potential* in the vacuum that is created by a negative energy potential in the time domain. We may speak of a gradient in this vacuum negative energy potential as a negative energy force or "force in the negative energy domain". Applied to the time domain, these concepts constitute a causality condition placed on the Dirac sea, in the same vein as more technical causality considerations given by Finster {564}.

9.2 Differences between Effects in COP»1.0 and COP<1.0 EM Systems

In this chapter, we utilize the Dirac hole in a different manner from the received interpretation. The received interpretation assumes an electron hole in the vacuum, with the hole filled with a negative energy electron

therapeutic science; one company is already working in this area, with positive results.

[248] We leave to the advanced theorists the connection between this "stable equilibrium state under a change in symmetrically regauged stress", occurring as a *net-force-free* intensity change in the conventional Lorentz symmetrical regauging of the Maxwell-Heaviside equations.

having negative mass, negative energy, and negative charge. In that interpretation, when the electron is lifted out of the hole, the hole is said to be *a positive energy* electron with positive mass and positive charge, (i.e., when interacted and observed). In short, with reaction one has a complete transformation of negative energy into positive energy, negative mass into positive mass, etc. In our view, this totally destroys the notion of "how the hole exists in the vacuum prior to its interaction and observation". That kind of positron only occurs after a physical interaction and observation has occurred — in short, *the positron exists only after an interaction with the Dirac hole has been made, to change the very nature of the negative energy hole.* The positron is the 3-effect of an invoked extra 4-interaction, and is not at all the "negative energy electron" or hole as it actually exists prior to being interacted and transformed. The positron is a different beast from the beast we wish to harness and use. The conventional interpretation leaves the question of the unobserved and unreacted "hole" left behind by an electron lifted out of the hole, before another interaction is performed on the hole to change it. So it is an incomplete accounting (as all observations are).

In our interpretation, the Dirac "hole" in the vacuum is itself the true negative energy electron before its interaction and observation. It is the "causal" 4-space negative energy electron, while the received interpretation is only for the "observed" or "effect" positron. In our view, the received interpretation thus leaves out a goodly part (and the most interesting part) of the Dirac sea hole. When the negative energy hole is filled, we consider the *electron* in the hole to be a normal, positive energy, positive mass electron. Hence the summation of the energy of the filled hole is zero, as is its summation mass and its summation charge. This accords with the properties of the "normal" vacuum, said to contain a sea of such "filled Dirac holes".

Our purpose is to use *emptied* Dirac sea holes before their interaction or observation, and thus to use them as *causal 4-electrons having negative mass and negative energy, but where each of those quantities is multiplied by time. So the hole has negative masstime and negative action.* Unless otherwise stated, that is our interpretation of a Dirac sea hole, and that will be how we use it. This way we avoid having to replace a true negative energy, negative mass, positive charge causal (unobserved) 4-electron by a positive energy, positive mass, positive charge observed (effect) 3-electron. We do not just artificially "dispose of" the question of the "nature of the hole that is left behind" when the positron is observed. We

consider the (hole x time) as the fundamental negative energy 4-electron. We will sometimes refer to that as the "4-positron".

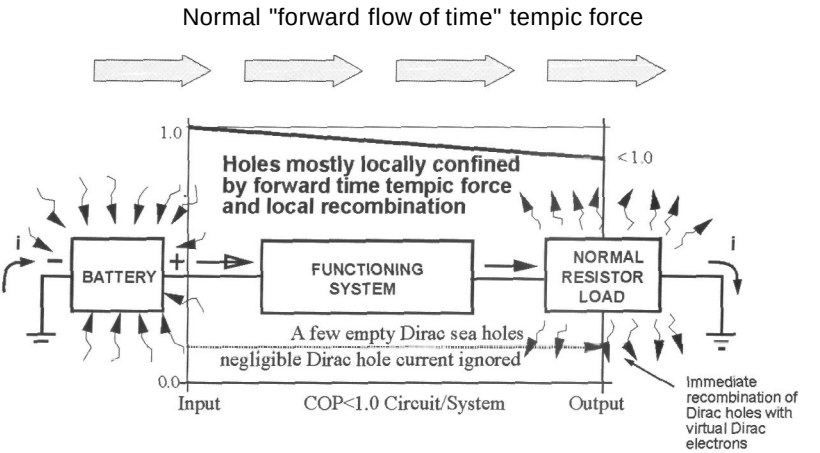

Figure 9-3 Time potential gradient across a C0P<1.0 EM system.

See Figure 9-3. In a COP<1.0 EM system, the tempic potential gradient (tempic force) is oriented from input to output and on out beyond the system. A very slight Dirac hole current moves outward from the output, but is immediately "eaten" by the virtual electron flux fluctuations of the vacuum in the space immediately adjacent to the output. There is a slight Dirac hole current also exiting the system in its losses, but again these are immediately "eaten" by the virtual electron flux fluctuations of the vacuum in the immediately surrounding space.

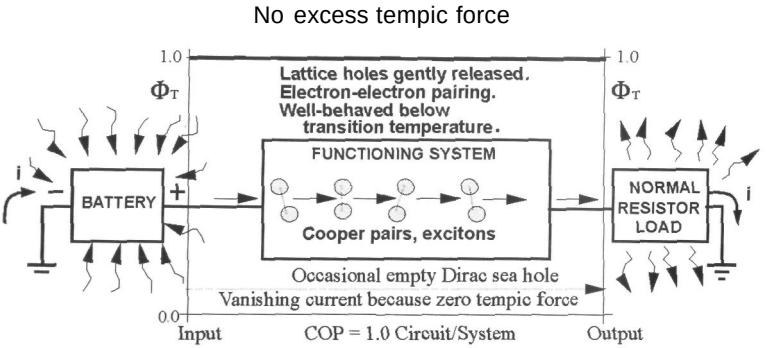

Figure 9-4 Time potential gradient across a COP = 1.0 EM system.

See Figure 9.4. In a superconductive system or section, COP =1.0 and on the average there is no net gradient of the time potential across the system, hence no time-force across it in either direction. Accordingly, one sees ready Cooper pairing of charges and formation of excitons. We shall not concern ourselves further with the superconductive EM system; such a system has not yet produced COP>1.0.

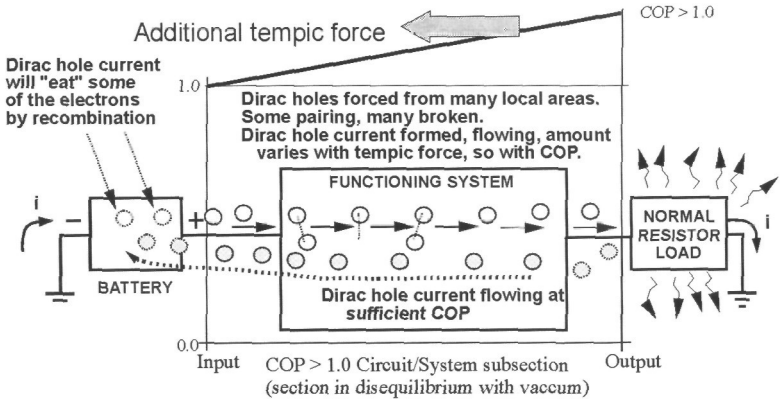

Figure 9-5 Time potential gradient across a COP»1.0 EM system.

See Figure 9.5. In a COP>1.0 EM system, there is a net tempic force across the system from the output section to the input section. However, unless the COP»1.0, the hole current in the local vacuum is mostly used up in interacting with the system material and converting to lattice holes (lattice positrons). Hence at "nominal" or moderate COP>1.0, except in fast pulsed discharges one *usually* has little to worry about, concerning Dirac sea holes in the vacuum, since those readily convert to lattice holes as already accounted. One effect of concern is that, if the semiconductors in the system are exposed to sufficient extra lattice holes or interacting 4-holes, their donor-acceptor arrangement is disrupted, spoiling the action of the semiconductors and perhaps destroying them.

When COP»1.0 (and even for some COP>1.0 systems), then there results a substantial Dirac sea hole current in the local vacuum occupied by the system, flowing through the supersystem from the output section back to the input section. This is an additional hole current component from the

Dirac hole current component converted into lattice hole current.[249] This unconverted Dirac sea vacuum hole current runs through the system from the output section back to the input section of the system and beyond. If not "filled" there in the input section by the incoming input electrons from the external power supply, the 4-hole current can and will pass on back into the feed line and to the distant external power supply, *eating electrons and electron current all along the way.* Usually semiconductors in the path of a substantial 4-hole current will either malfunction or be quickly destroyed.

In the input section and on back into the external power source, the effect of the unrestrained Dirac sea hole current's reaction is to interact and convert into lattice holes all along the route, which lattice holes then "eat" incoming electrons from the distant power source. Thus, the external power source "sees" the hole current as a dynamic additional load in the system's input section itself (and in the external conductors leading to it) *that also must be powered with additional positive energy electron current.*

[249] Here we wish to recognize the perceptivity of Peter Lindemann, who recognized the importance of "cold electricity" in COP>1.0 systems without going deeply into the more technical aspects of negative EM energy. As an example, we cite his book, *The Free Energy Secrets of Cold Electricity*, available from Clear Tech, Inc., Box 37 Metaline Falls, WA 99153, U.S.A. Particularly note his efforts to explain the Gray overunity device via the negative energy that can be associated with very strong discharges. Gray referred to this appearance of an associated negative energy component associated with the normally positive EM energy as "splitting the positive pole" (a "pole", after all, involves a stress potential). The Gray engine drawing is shown in Figure 5-14, his conversion tube is shown in Figure 5-15, and his circuit for the conversion tube is shown in Figure 5-16. As Lindemann explains, Gray also apparently succeeded in converting the negative energy into positive energy in his conversion element switching tube. Bedini's successful replication of the tube along with pertinent lab notes are shown in Figures 5-17, 5-18, 5-19, 5-20, and 5-21 by permission. Since Bedini is one of only two or three persons truly experienced in converting negative energy into positive energy, his successful replication is significant and decisive. Gray's process thus transformed negative energy into positive energy, allowing positive energy COP>1.0 self-powering systems. Bedini and the present author have filed a joint patent application filed on the process explained in this Chapter. We recognize Ed Gray as being a real pioneer in the area of COP>1.0 electrical power systems and in energy conversion. His pertinent patents are E. V. Gray, "Pulsed Cap. Electrical Discharge Engine," U.S. Patent #3,890,548, 1976; "Efficient Power Supply Suitable for Inductive Loads," U.S. Patent #4,595,975, **June 17, 1986.**

Aside from destruction of semiconductors etc.,[250] the overall effect is to increase the draw of power and current from the external source, so that the COP» 1.0 power system is thereby converted back to a COP<1.0 system!

The increased power draw due to the Dirac hole current can be remarkable. For an external battery power supply, if the hole current is sufficient to pass on into the battery itself, the battery may *charge* with negative energy while also powering the circuit! A remarkable phenomenon then takes place. A battery having been appreciably charged with negative energy may appear to be discharged (and so it is, with respect to positive EM energy). Yet, it may also continue to power a circuit. Sometimes it will, sometimes it won't, depending on the circuit. However, on connecting a normal positive energy battery charger to recharge it, the battery *precharged* significantly with negative energy will "eat" positive energy for an extended period, filling its localized Dirac Sea holes in its negative charge all the while, with the external voltage of the battery not changing at all. When all the negative energy holes are filled in the internal vacuum environment of the battery, and the negative energy charge is thus removed, suddenly the battery will start recharging with the input positive energy in a normal manner.

The batteries in Watson's generator (again see Figure 5-12) exhibited that phenomenon. Sometimes in recharging one of his batteries that had been extensively used, the battery would "eat" positive energy from the charger for a week or more before finally filling up its negative energy charge and then recharging normally from that point on.

The Dirac 4-hole current is nature's decay mechanism for the COP»1.0 system, sharply bringing it back to COP<1.0. Any successful COP»1.0 EM system must contain a mechanism for defeating (or transducing and

[250] As an example, novel effects may also happen in resistors, capacitors, and coils, and the effects depend on both the materials and construction of these components. A resistor can act as a true negative resistor and cool rather than heat, a capacitor can have its current lagging its voltage, and a coil can have its current leading its voltage. Mixtures of all three of these effects can happen in each of the three components, since each usually has some aspects of resistance, capacitance, and inductance. The emfs and back emfs in the circuit can also be altered and disrupted in a manner varying with the individual circuit and the individual operating conditions. Nonlinear oscillations and discharges of negative energy are particularly difficult to foresee and understand. Effects in dielectrics may vary widely, as can effects in conductors because of their internal impurities, etc.

using) this Dirac sea vacuum 4-hole current into its input section and beyond. We shall cover that subject shortly. The 4-hole current decay mechanism can *sometimes* become significant for semiconductors in the lattice 3-hole stage at COP = 5 or more, though the exact figure varies as the type and size of system and the semiconductor type. At COP > 10 or so, some systems will frequently begin to ravage themselves back into equilibrium with the vacuum, and destroy their overunity performance, unless the 4-hole current phenomenon is dealt with.

Let us recap. We have assumed — to first order — a sweeping generalization that COP<1.0 systems exhibit an overall average spacetime curvature across the system (from input section to output section and load) such that excess positive energy electrons exist in the Dirac sea, without any appreciable accompanying excess Dirac sea holes interacting in the circuitry itself.[251] The slight excess of Dirac sea holes that are generated is "swept" forward out of the output section, and "eaten by the vacuum interaction" (particularly by the vacuum fluctuations) immediately upon exit from the output section. In that case, we do not have to concern ourselves particularly with Dirac Sea 4-holes and Dirac sea 4-hole currents, or at least they are usually negligible in most cases.[252]

For COP»1.0 systems, however, the overall average spacetime curvature across the system — from output section and load to input section — is such that Dirac sea 4-holes and their currents do independently continue to exist and independently flow in the local vacuum occupied by the physical system. Specifically, we shall have to consider the *tempic* effects upon such holes and hole currents, which are oriented from the output section back through the system to the input section.[253] In the COP»1.0, the

[251] In short, the requisite number of Dirac holes have interacted with and do interact with the lattices, converting into the normal "lattice hole" type of positron connected with positive mass, positive energy, but slowly migrating around the circuit in the opposite direction from the electrons. Here the true Dirac hole current exists only in short "hops" from atom to atom as the lattice holes are steadily filled by the "hopping" electrons.

[252] As stated, a kind of "hole" phenomena still exists in the circuit, but now as lattice holes and currents. Since these are attached to ions each having a mass much greater than that of an electron, the lattice hole currents may usually be neglected except in semiconductors, where they are taken into account in the very design of the semiconductor component itself.

[253] When we state a concept such as "negative mass" or "negative energy", we have conceptualized it *as if observed.* Hence, unwittingly we have made it an instantaneous, but iterated, concept. Rigorously, no such thing as mass or energy

effect of the increased tempic force is to sweep a Dirac sea 4-hole current back through the system from output to input, and even on out into the conductors from the external power supply, and on further out into the external power supply itself. The 4-hole current continues its "reverse feedback into the powering end of things" until quenched by filling it with incoming electrons. This conversion of 4-hole current to filled Dirac sea 4-holes by induction of lattice holes also squelches the concomitant negative EM energy fields, potentials, and waves associated with Dirac 4-holes as sources.[254] The reason is that a filled Dirac hole is a dual system of two opposite charges, hence produces counteracting positive and negative energy fields.

The "4-hole-eating and filling process" is therefore the exact decay mechanism that squelches the natural electrogravitation associated with Maxwellian circuits which use Dirac 4-holes and 4-hole currents, negative energy fields, negative energy potentials, etc. When the circuit converts its free Dirac 4-holes into lattice holes, all electrogravity capability is lost, insofar as practicality is concerned.

For electrical power system purposes, the external environment of the COP»1.0 system furnishes an extra "electrical load" demand upon the external power supply, so that the extended system consisting of the (external power supply + power system) decays back into overall COP<1.0 condition and operation. For this reason, any appreciable involvement of Dirac 4-hole currents in a COP>1.0 EM power system must be *transduced* into positive energy electron currents, which requires just a special form of regauging. One need not confine regauging and gauge freedom to positive energy potentials and positive energy fields alone.

From the vacuum consideration and particularly from Dirac's theory of the electron, in COP>1.0 EM systems and circuits we shall consider that the Dirac sea 4-holes involve negative energy states (negative mass), and that positive energy states involve positive mass. In our approach, we shall consider a negative energy state (Dirac 4-hole) in the vacuum as having

independently exists except at one instant in time. Instead, mass exists in a continual iteration of *m* —> *mt* —> *m* —> *mt*... and energy exists in a continual iteration of *E* —> Et—»E—» *Et*.... and so on. So during the masstime or energy-time (action) state, time and either mass or energy are intimately interactive. See our previous discussion in this book of the mechanism for the flow of a mass through time.

[254] Obviously that kills the antigravity aspects, because it kills the negative energy fields that would give negative curvature of local spacetime.

negative mass, which means that antigravity can be involved as well.[255] In this treatise, we consider only electron states, thus only negative energy and positive energy electron states.

9.3 Primarily Concerned With Dirac Sea Holes and Not Lattice Holes

We also stress the dramatic difference between a Dirac sea "electron 4-hole" in the vacuum (prior to observation) as compared to a lattice 3-hole in a semiconductor or other material component (after interaction and therefore after observation). In the case of a lattice 3-hole, usually the "positron" (hole) is attached to an ion, whose mass (i) is very much greater than the mass of an electron, and (ii) is also positive. In other words, a lattice hole is just a part of an ordinary positive ion. So the theory of "lattice holes" and "lattice positrons" does not primarily apply to the situation we are discussing. On the other hands, semiconductors exposed to any significant currents of pure Dirac sea 4-holes in the vacuum usually react and are nearly instantly destroyed because of the immediate disruption of their donor-acceptor arrangement and functioning. Interaction (filling the incoming Dirac 4-holes with contributed electrons) causes sudden mass disarrangements in their atoms and nuclei and lattice

[255] We assume that the important thing about mass is its localized energy. Hence we associate positive mass with positive localized energy (with respect to the ambient energy density of the massless vacuum) and we associate negative mass with negative localized energy (with respect to the ambient energy density of the massless vacuum). In this view, the empty Dirac sea hole has both negative energy and negative mass. Note that this differs from the conventional assumption, which unwittingly addresses the positron as having been observed, producing a directional reversal. The rigorous test of our thesis is that concentrations of Dirac sea holes *must* generate antigravity *potential,* while currents of Dirac sea holes must generate antigravity *force.* The conventional view, assigning positive mass to the positron after observation, would produce gravity, not antigravity, but the force would be reversed by the reversed parity after observation. We argue that antigravity has been hidden and lost by its parity reversal in the assuming positive mass for the positron *as if that were the mass of the positron before it is observed.* In an overunity system with powerful steady-state Dirac 4-hole currents, the 4-hole currents can be differentiated by the cooling (negentropy) effect of the COP»1.0 system—when shorted to produce a "current surge" — rather than heating (entropy) effect. The magnitude of the hole current (which determines the average presence of the hole density) can be differentiated by a measurable weight loss in the COP»1.0 system. The successful antigravity production of the Sweet COP»1.0 device — discussed later in this chapter — experimentally verified these hypotheses.

bonds. Thus, in the presence of Dirac sea 4-holes and 4-hole currents, usually any interacting solid-state electronics of the circuit or system will be dramatically affected. For switching in the presence of holes and hole currents, in most cases one may have to turn away from semiconductors and utilize mechanical or electro-mechanical switching, although this requirement varies with the type of semiconductor, the COP, the system geometrical layout, and the subsystem operations and layouts. Sometimes semiconductors may still be used if they are "brutes", with current handling capabilities well beyond what is "normally expected" in that circuit.

9.4 Peculiarities of Spacetime Curvature and Dirac Hole Interactions

When considering the interaction between *curved* spacetime and the Dirac vacuum, immediately we violate the premise that all electron states in the Dirac Sea are always filled (which condition we surmise — along with Dirac — only exists on the average in a flat spacetime region). In a curved spacetime, we can have sustained excess 4-holes in the vacuum, or we can have holes that accept an electron falling into them *without emitting radiation.* The radiation-free "pair annihilation" reaction is possible when the spacetime simultaneously changes its curvature appropriately and thereby "absorbs" and holds the excess EM energy that would otherwise be emitted if the spacetime remained flat or decayed back to the flat state.[256] So long as that "energy-storing ST curvature" remains, there is no photon energy emission. If the "energy storing ST curvature set" has a net curvature instead of being flat, and then decays to a flat spacetime, then the previously retained energy is emitted as photon energy.

In that case the reaction provides the conventional emitted pair annihilation energy. In *that* case, the emitted energy may also transform into emitted particles in reactions well known in particle physics.

[256] Eerily, this interaction represents a situation where opposite reaction forces (the vacuum upon spacetime, and spacetime upon the vacuum) can create a special kind of stress in the system and changes in that stress. This leads to a peculiar kind of stress waves (scalar waves — longitudinal EM waves, so to speak) that are not covered in circuit theory anywhere. A symptom is that these stress waves react with components, amplifiers, preamps, etc. to create electrostatic waves. The effect of these waves is seen as the "crawling" of electrostatics all over and in the electrical equipment that is in one's laboratory. The effect can readily damage oscilloscopes, etc.

The normal emission of photons by pair annihilation need not occur, if the excess decay energy is absorbed *and held* by the local spacetime changing and holding its energy density and therefore (i) changing its curvature and (ii) stabilizing in that new excited state instead of decaying back to a flat spacetime.[257] Under such "non-emitting" pair recombination, a Dirac Sea 4- hole may simply "eat" a free 4-electron, and instead of emitting radiation the process simply affects the curvature of spacetime (and the state of the local Dirac sea) and changes it accordingly. A new "equilibrium state" is therefore reached in the supersystem between the opposite forces of the vacuum acting on spacetime and spacetime acting on the vacuum.[258] In other words, we consider change in the curvature of spacetime to exhibit EM energy *source* (emission) or *sink* (absorption) capability, with respect to the nominal ambient flat spacetime and with respect to conventional EM interactions.[259]

Or simply put, the energy emitted by the combination of positive and negative energy in the vacuum may be "locally radiated", "locally absorbed", or "locally transferred" to the other local component of the supersystem: the local curvature of spacetime. *It is all spacetime curvature dynamics.* By definition, a flat local spacetime consists of a vacuum with all its Dirac sea holes filled. Therefore, if "filling a 4-hole" results merely

[257] Our view is that in normal pair annihilation this curving of spacetime to absorb the emission energy occurs first, and then the new ST curvature decays by what is called "emission of photon energy". We regard the photon as a specialized ST curvature traveling at light speed. So what is emitted as a photon is in fact the formation of a locally structured spacetime curvature (an "engine") traveling at light speed. It is a propagating spacetime curvature "engine" or "set of engines". In the process we are describing, the emission of the photon is the decay of the locally formed ST curvature set. If that set does not decay, the locally formed ST curvature set remains and no photon is emitted.

[258] This new kind of equilibrium is extraordinarily important, particularly in chemistry, where it will allow the "locking" of impossible combinations of particles into strangely stable "impossible molecules" with ongoing "impossible chemical reactions". The further discussion of the startling new chemistry that emerges is well beyond the scope of this paper, but such chemical states are included in nonequilibrium thermodynamics as *stationary states* — e.g., see Kondepudi and Prigogine, *Modern Thermodynamics*, Wiley, 1998, Chapter 17. At least one company has already succeeded in initiating this startling new kind of chemistry, with several patents granted and several more in process. Similar new "impossible stabilized excited states" and "impossible nuclear reactions" also occur in nuclear physics.

[259] The classical EM assumption of the flat local spacetime is in fact an assumption that the decay of the intermediate "ST curvature absorber/sink" occurs instantly.

in relaxation of a set of local ST curvatures back to a flat spacetime, no EM radiation need be emitted, contrary to the usual pair annihilation phenomenon where additional energy (curvature of spacetime) is involved.

Similarly, in a ST curvature, there can conceivably be electrons without "holes". If the curvature is negative, there *will* be unfilled Dirac sea holes present. Of course this is just a normal positive energy 4-electron, where the flat spacetime assumption in classical electrodynamics is in error. Instead, the local spacetime is positively curved, producing positive gravity. Whenever the energy density of spacetime-vacuum interaction changes from the "ambient vacuum and flat spacetime" condition, either positively or negatively, that constitutes an appropriate curvature of spacetime as well as a change in the vacuum dynamics. Therefore, in classical electrodynamics the assumption of a normal electron (or any other charge or mass) existing in an uncurved spacetime and an unaltered vacuum is a non sequitur. The local spacetime has in fact "curved" to an extent of holding the energy of one electron mass.[260] Further, the Dirac Sea has also changed to contain one unfilled and unobserved Dirac 4-hole.

With these things in mind, let us now introduce a conceptual model for dealing with these novel 4-hole phenomena that are experienced in COP>1.0 systems — and that have been the bane of many a would-be energy researcher attempting to develop a system extracting its EM energy from the vacuum and using it to also power the system itself.

9.5 Charging and Discharging a Capacitor

In electronic circuits, we usually think of charging a capacitor with electrons, and then discharging the capacitor to emit electrons again. However, we can charge the same capacitor with Dirac sea holes, or with a combination of Dirac sea holes and electrons. Then we can switch the capacitor adroitly and force it to give us back electrons. This "regauging" effect can thus be used to transduce negative energy current into positive energy current. So let us examine the charging and discharging process more closely. This is part of the Bedini process for handling the 4-hole

[260] Mostly physicists think only of the *spatial* energy change. However, the time domain of spacetime also acts as a sink or source. Essentially one kilogram of mass only has the energy of 1 second of time. Hence the minuscule *mass* of the electron results in such a minuscule "sink" in the time domain that it has been inadvertently ignored. However, during that fraction of time where the electron exists as "mass time" and "charge time", it has considerable time energy, and *that* curvature of local spacetime cannot be neglected with respect to supersystem interactions.

current problem in overunity EM systems, to allow close-looping a system into self-powering operation.

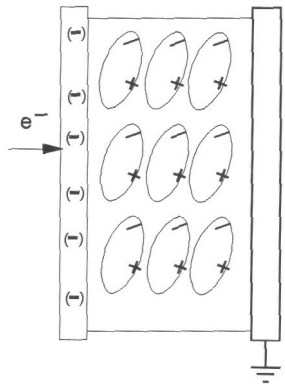

Figure 9-6 Normal strain in a dielectric capacitor that charges with electron current

Figure 9-6 shows the normal strain induced in a capacitor containing a dielectric between its plates. We charge the left plate with electrons, which repel the negative ends of the molecules in the dielectric, straining them to the right.

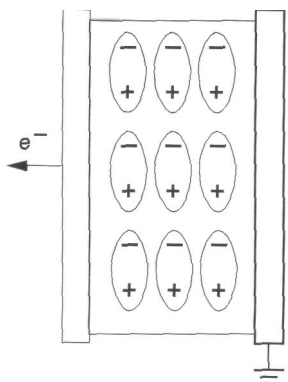

Figure 9-7 Strain relief in a charged dielectric capacitor that discharges.

Figure 9-7 shows the relief of this dielectric strain, by allowing the piled electrons on the left plate to be pushed back into the circuit from the left plate. Note that the electrons emitted in the relaxation of the dielectric strain pass back into the circuit from the same plate that was charged. This is a special kind of "reflection" symmetry. For a perfect capacitor, the total

Vq joules stored in the charged capacitor and drawn from the circuit, is returned to the circuit.

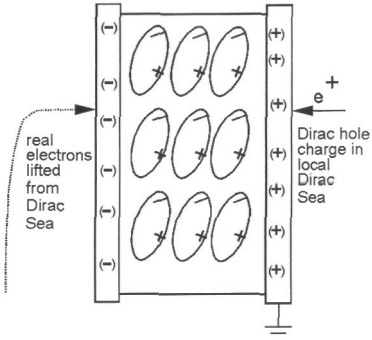

Figure 9-8 Strain in a dielectric capacitor supersystem that charges by Dirac hole current and lifted Dirac electrons

Figure 9-8 shows a remarkable thing when we charge the capacitor with Dirac sea holes. Suppose we charge the rightmost plate of the same capacitor used before, while the leftmost plate is temporarily disconnected from the circuit (or connected to another capacitor). Now Dirac Sea holes pile up in the local vacuum connected with the right plate. Whether or not they interact with the right plate, these positively charged holes attract the negative ends of the dielectric molecules, again straining the top of the dielectric molecules to the right. The strain of the dielectric is a force interacting upon the local vacuum, and it lifts real electrons from the Dirac Sea (or pulls them from the circuit or other attached capacitor) and onto the leftmost capacitor plate. The charged capacitor *in its supersystem* thus has additional functions that occur. The total *Vq* joules stored in the charged capacitor, were this time drawn (converted) from the applied Dirac hole current and the resulting interaction upon the vacuum, to lift real electrons onto the leftmost plate.[261]

[261] The reader should recall that a force is something automatically produced by nature to restore symmetry to a broken symmetry condition. A "4-hole negative energy force in the Dirac Sea" produced on one plate of the capacitor will evoke a "positive energy force outside the Dirac Sea" on the other plate as an attempt to restore symmetry. To produce this "positive energy force", positive energy electrons are lifted from the local Dirac Sea of that plate.

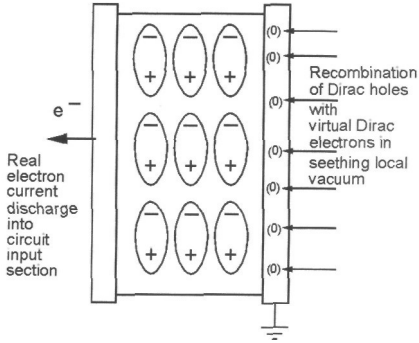

Figure 9-9 Strain relief in a dielectric supersystem that discharges after charging by Dirac hole current and lifted Dirac electrons.

Figure 9-9 shows the strain relief of the charged capacitor in Figure 9-8. First the charged capacitor is re-connected to the circuit or element to which one desires to provide with electron current. The strained dielectric relaxes, and electrons in the leftmost plate are returned to the circuit. The Dirac holes in the rightmost plate discharge back into the local vacuum (a supersystem interaction) and are "eaten" immediately by the readjustment of local curved spacetime.[262]

The result is that the Dirac sea 4-hole current arriving in the input section has been intercepted by a waiting capacitor, and has been effectively transposed into normal electron current that is furnished back to the input section from the capacitor. This additional electron current helps power the circuit and reduces the power drawn from the external power source. The 4-hole current feeding this capacitor, together with transduction of the 4-hole current into electron current, effectively comprises a true negative resistance process. In other words, energy in unusable (in this case, detrimental) form is received, transformed into energy in usable (beneficial) form, and that usable energy is discharged back into the circuit input to assist in powering the system.

Transducing negative energy into positive energy — and vice versa — in the system does not violate the conservation of energy law in the

[262] From experiments, it seems that Dirac holes forming at the "output" section of a **COP<1.0** device or system are almost instantly filled with electrons in the violent fluctuations of the zero-point energy. When forming at the "input" section of a **COP>1.0** device, this is not the case, and usually the holes can only be filled by incoming electrons in the power input, unless special provisions are taken to convert **the** arriving hole current (in the input section) into electron current.

supersystem, when most generally stated. With such regauging (which involves supersystem reactions), it is the *absolute value* of the energy that is conserved in the system, not its algebraic sign. Regauging (by gauge freedom) is after all an effect or condition locally imposed, but with appropriate energy exchange with the rest of the external universe via spacetime curvature dynamics exchange and vacuum dynamics exchange. The algebraic sign *is* conserved in the universal supersystem by the additional compensating reactions occurring in the other two components of the universe's supersystem.

The reader should strongly realize that energy is only required to be conserved in the universe's supersystem, not the system component alone. Again, this is an open system far from equilibrium with its active environment. In that case, energy is conserved in the ensemble of system and environment, but not necessarily in the system itself. This is no stranger than a common windmill or waterwheel.

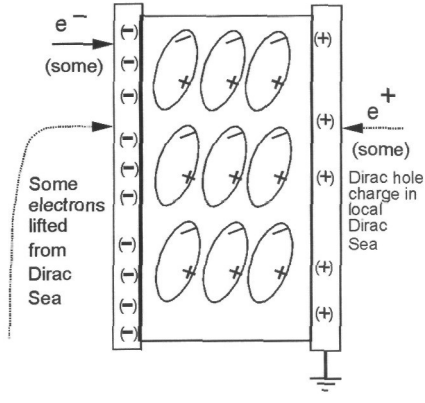

Figure 9-10 Strain in dielectric in a capacitor supersystem that charges with a mix of electron current, Dirac hole current, and lifted Dirac electrons.

Figure 9- 10 shows a "mix-charging" variant of the 4-hole current charging of a capacitor, in which some real electrons are fed from the circuit to the left plate. Also, the Dirac sea hole current arriving in the input section is intercepted to charge the right plate, and some electrons are also freely lifted from the local Dirac Sea onto the left plate. Figure 9-11 shows the discharge of this type of charging of the capacitor, and the relief of the strain in the dielectric.

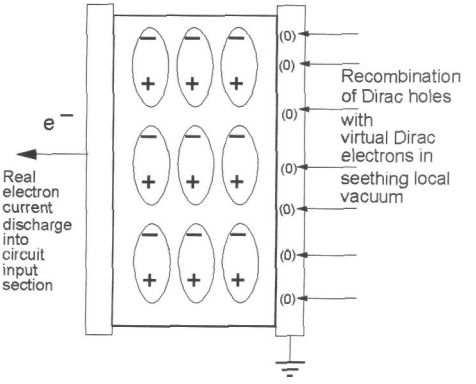

Figure 9-11 Strain relief in a dielectric that discharges after charging of capacitor supersystem with mix of electron current, Dirac hole current, and lifted Dirac electrons.

In Figure 9-11, for example, we accent that the holes on the right plate are maintained only so long as there is a net strain on the dielectric and a net force across the capacitor. When the capacitor is discharged, the holes are discharged into the local vacuum in such a way that they now instantly recombine with virtual Dirac electrons in the vacuum fluctuations.

There are other ways and "tricks" of transducing the Dirac sea hole 4-current into electron current, but these methods are still proprietary to Bedini and will not be included in this presentation. We accent that all such "tricks" are actually methods of re-engineering the other two components of the supersystem — the active local vacuum and the local curvature of spacetime. This is using and applying what we have referred to as "engines".

9.6 The Open-Loop COP>1.0 EM Power System

Figure 9-12 shows the use of the transduced Dirac hole current as real input energy to "catch and lock" a COP>1.0 system in its overunity condition and stabilize its operating point for stable self-powering of the system and its load. The COP>1.0 operation reverses the normal tempic potential across the system, so that Dirac hole 4-current arrives in the input section, preparing to "decay" the system back to COP<1.0 condition.

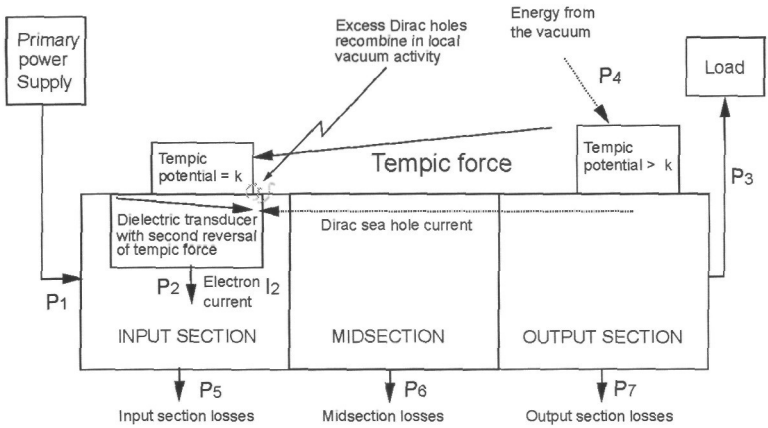

Figure 9-12 Open-loop use of transduced Dirac hole current energy as real input energy to reduce power input required from the primary power supply.

However, the arriving hole current is intercepted by an adroitly switched dielectric transducer, which again reverses the tempic force. As explained above, the capacitor is charged with 4-hole currents (or a mix) and then discharges electron currents into the system — in this case, into the input section itself— by adroitly engineering the local vacuum state and the local curvature of spacetime.

The input section does not care where it receives its electron current from; it merely needs sufficient for its powering needs. Hence, the input section happily accepts this transduced electron current to partially power the system. This in turn reduces the "system load" that the external primary power supply "sees". The primary power supply thus reduces the current and power that it is furnishing to the system. In short, now the external power supply sees the combination of the normal system load and a "negative resistor (negative load)" represented by the transduced current and power. Its required input power is reduced accordingly.

9.6.1 Close-looped System: A True Negative Resistor

Figure 9-13 shows the use of the same process given in subparagraph 9.6 above and in Figure 9-12, except that now there is additional 4-hole current received and available, for transduction into normal electron current into the input section of the system. Sensors and governing are added to this operational mode, so that the system may *adjust and regulate its self-furnished electron current* to meet the total needs of its losses and

its load. The system thus adapts the transduction of Dirac sea hole current: to fit its needs and is capable of regulated self-powering operation.

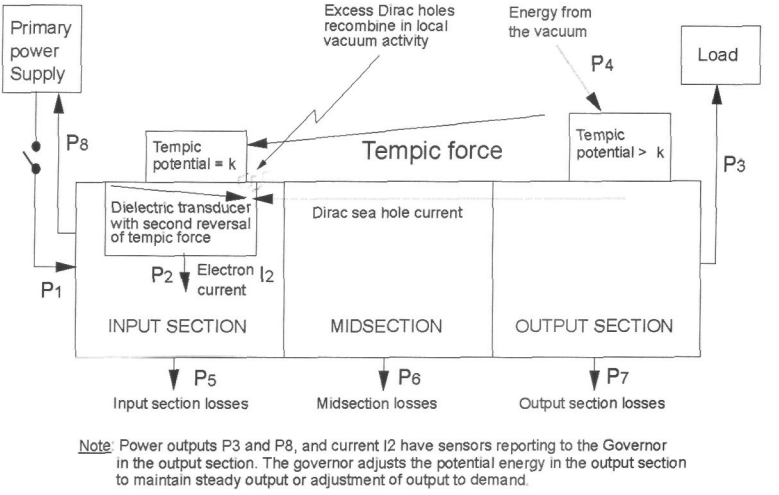

Figure 9-13 Close-looping the C0P>1,0 system with transduced hole current.

The system is first started in open-loop mode. The governor then gradually increases the transduction of 4-hole current into electron current, and the supply of that transduced electron current to its own input. This steadily reduces the "current draw" from the external primary power supply. When the "external current draw" reduces to zero (the Kron condition), the system "locks" into that position, with automatic governing to adjust the transduced electron current as the loads and losses vary. At that point, the external power supply is disconnected automatically.

This "locked and governed" system is now a *self-powered system,* freely taking its energy from the active vacuum and local curvatures of spacetime, to power both itself and its load. So far as we are aware, this is the first time that the technical means of locking and stabilizing COP>1.0 operation in an EM system in an open loop and closed-loop operation has been given.

If sufficient Dirac sea 4-hole current is available and transduced, excess electron current can be available at the system input section, even when the system is fully self-powering. In this case, the additional current can be fed back to the power line, so that the self-powering system not only powers its own load but also helps power the power network. Or additional load can be added and powered.

We point out that Gabriel Kron apparently had a solution to these problems in the late 1930s, and that solution has been suppressed to the present day. We give the following quotations to show Kron's knowledge of these things.

Quoting Lynn and Russell {565}:

> *"Kron has never published details of his method of making the polyhedron self-organizing, although his published results show that in this state it has some remarkable properties, associated with harmonic integrals on multiply connected spaces."*

In reference to Lynn and Russell's remarks, we point out that the Dirac sea 4-hole current from the output to the input is a special case of Kron's more general discovery of the multiply-connected open path existing through space between any two points in a circuit that are at differing potentials.

Quoting Kron {566}:

> *"...the missing concept of "open-paths" (the dual of "closed-paths") was discovered, in which currents could be made to flow in branches that lie between any set of two nodes. (Previously—following Maxwell - engineers tied all of their open-paths to a single datum-point, the 'ground'). That discovery of open-paths established a second rectangular transformation matrix... which created 'lamellar' currents... " "A network with the simultaneous presence of both closed and open paths was the answer to the author's years-long search."*

Again quoting Kron {567}:

> *"Although negative resistances are available for use with a network analyzer, in practice it is more convenient to use a second type of circuit, in which the positive and negative resistances are replaced by inductors and capacitors and the dc currents and voltages are replaced by ac currents and voltages of <u>fixed</u> frequency. The use of the second type of interpretation is equivalent to multiplying the wave equation by* $i = \sqrt{-1}$."

The reader should particularly note that in the first part of the sentence Kron stated unequivocally that negative resistances were available for **use** on the network analyzer, a large analogue simulation used by the Navy **and**

administered at Stanford University with the contractor being General Electric. The censors missed that one.

Again quoting Kron {568}:

> *"When only positive and negative real numbers exist, it is customary to replace a positive resistance by an inductance and a negative resistance by a capacitor (since none or only a few negative resistances exist on practical network analyzers).*

We believe the censor caught this one, and forced Kron to add the words, "none or". Kron had at least three negative resistors, and possibly more.

Again quoting Kron {569}:

> *"Now a value E of the negative resistances, at which the generator current becomes zero, represents a state at which the circuit is self-supporting and has a continuous existence of its own without the presence of the generator, as the negative resistances just supply the energy consumed by the positive resistances. ... When the generator current is positive the circuit draws energy from the source, and when the current is negative the circuit pumps hack energy into the source. At zero generator current the circuit neither gives nor takes energy, and theoretically the generator may be removed. "*

Here we believe the censor forced Kron to add the word "theoretically". In this quotation Kron reveals that he was well aware of the process for close-looping a system — starting it in open-loop mode and bringing the negative resistor currents up to match the system needs nnd reduce the generator current to zero, then disconnect the generator. He also was quite aware that excess transduced energy from the negative resistor could be available at the input, in which case energy could be furnished back to the power network while the system powered itself and its load simultaneously.

We also point out that Dirac's definitive electron theory — covering the Dirac Sea and Dirac sea holes — was published in 1930, the year the present author was born. In the late '30s and in the 40's Kron certainly was well aware of that work. In addition, Kron applied full general relativity to electrical circuits and machines, and he was far ahead of his time. His work is also still far ahead of the present time, at least in the open

scientific community. He also was aware of developments in particle physics, and so he did have the gist of the supersystem concept in his mind {570}, however he may have thought of it. His concept of the "open path" effectively includes the effects upon the system from the other two components of the supersystem, so it appears that Kron's "system plus its open path" roughly corresponds to our concept of the "supersystem."

Further, Kron was a mentor to Floyd Sweet, who also worked at General Electric but in a different project. Sweet often spoke glowingly of Gabriel Kron.[263] Sweet almost certainly knew the secret of Kron's negative resistor. It is the present author's opinion that Sweet's vacuum triode amplifier was derived from Kron's negative resistance unit. With both deceased, we will never know for certain.

9.6.2 Suppression of COP>1.0 Systems Should be Investigated

During our decades of research, we ran across several cases where U.S. scientists actually produced working COP>1.0 systems.[264] None of these overunity systems was ever allowed to go forward with independent development. This is an area that cries out for a full and vigorous Congressional investigation, and appropriate legal action should be taken by the U.S. government against the suppressing parties, whomever they might be {571}. Simply put, the U.S. government, the U.S. taxpayer, and the scientific community have been ripped off and deluded in the field of electrical energy for more than half a century. That continues to the present, as witness the disappearance of the Watson generator (accompanied by Watson and family breaking off all contact with their close colleagues) and the suppression of the Kawai device and process. The latter suppression was accomplished in 1996 in the personal presence of the present author and the members of the Board of Directors of our company, CTEC, Inc. An accidental overunity frequency converter was even initially placed in the original Minuteman missile, but was altered back to COP<1.0 operation when the electronics past the converter kept failing because of overload power furnished by the converter.

[263] The present author worked with Sweet off and on for a decade or more, and designed the antigravity experiment that Sweet performed.

[264] These incidents were previously exposed in a draft book, *Matters Arising*, carried on the Internet for some months and then withdrawn. Some things must wait for their appointed time, and so must certain kinds of information.

9.7 Remarks on Dirac Sea Holes, Currents, and Negative Energy

The subject of the Dirac Sea, Dirac holes, Dirac hole currents, and negative energy still has elements of strong disagreement within the scientific community and among leading theorists. Often the "conclusion" one reaches depends on the way the starting assumptions are made and then on how the mathematics is applied. There is no definitive experiment establishing that negative energy cannot exist; to the contrary, many things do occupy negative energy states. The binding energy of the nucleus, e.g., involves a loss of mass (loss of positive energy) and hence involves negative energy states, as is well known. Here the "negative mass" effect is immediately and experimentally verifiable, and is recognized. The total mass of the bound nucleons is less than the total mass of those same nucleons when unbound, and this fact is widely known and accepted.

A single white crow is sufficient to prove that not all crows are black. Hence a single experimental proof of mass-energy "loss" and negative energy states establishes that negative energy and negative mass are real. Indeed, every photon absorption by mass and every photon emission by masstime prove the same point universally: mass is a variable. The same assembly of protons and neutrons in a nucleus, having lost mass, also has "lost" some of the gravity that the positive masses of those unbound protons and neutrons would otherwise produce. Therefore, there is an appropriate amount of "negative gravity" already acting in conjunction with positive gravity, in every atomic nucleus. It is associated with the negative energy states of the bound nucleons in every nucleus.

Consistent with the initial quotations and comments at the beginning of this chapter, we present an interpretation by which we can understand some of the major novel phenomena that arise in laboratory experiments with COP>1.0 electromagnetic systems, including COP»1.0 systems.

We propose that COP»1.0 EM interactions are widespread in highly energetic astronomical interactions {572} and even in highly energetic phenomena on Earth, when the supersystem changes are also accounted.[265] We argue that novel negative energy phenomenology — such as encountered in the COP>1.0 experiments by Magnetic Energy Ltd. in

[265] As an example, in looking at sprites and other such sharp electrical discharge phenomena, we may be observing the prompt *decay* of COP»1.0 interactions which were self-initiated in the atmosphere.

various versions of the COP>1.0 motionless electromagnetic generator (MEG) {573, 574}, by Bedini {575} in his induction of negative resistor actions inside the batteries of battery-powered COP>1.0 EM systems, and by Sweet and the present author in experiments with the Sweet COP»1.0 vacuum triode amplifier system {576} — is also generated in these COP»1.0 highly energetic astronomical interactions, yielding the same kind of negative energy and negative energy currents.

This Dirac hole negative energy generation of COP»1.0 EM processes is proposed as the mechanism which directly produces the negative energy fields and potentials that generate the mysterious antigravity accelerating the expanding universe {577}. This is a reasonable assumption, even though it is against the received view, because it is based on some laboratory experiments, not just theory. It also is the unexpected effect of the cosmological constant introduced by Einstein {578}, and it is consistent with Zeldovich's demonstration that the energy density associated with Einstein's repulsive cosmological constant is — or is associated with — vacuum energy.[266] The received view *is not* based on direct experiments with COP>1.0 EM systems, but only on COP<1.0 EM systems. Until the received view is broader based, it does not adequately represent nature. Hence it does not represent a valid refutation of experimental negative energy systems producing antigravity processes.

In Bedini's experiments and in the MEG experiments, antigravity is essentially absent or so small as to be nearly nondetectable. However, these experiments generally have COP of 1.5 to 4.0, mostly, and sometimes 10 or 12 (we have experimented up to 20 or more stably, and unstably at nearly 100). Hence the Dirac hole current is relatively small in them, since the magnitude of the Dirac current is a function of (COP - 1).

Sweet's COP > 1,500,000 experiments produced a very large flow of negative energy back across the system, substantially curving the local spacetime and reducing the weight of the system on the laboratory bench. Figure 6-7 shows the first Sweet device, which produced six watts output in open-loop operation. Figure 6-8 shows a later Sweet device which

[266] Believed to have been demonstrated in 1967. But check Ya. B. Zeldovich and A. A. Starobinsky, "Particle creation and vacuum polarization in an anisotropic gravitational field," *Zh. Eksp. Teor. Fiz.*, Vol. 61, 1971, p. 2161 *(Sov. Phys. - **JETP,*** Vol. 34, 1972, p. 1159); Ya. B. Zeldovich, "Vacuum theory — A possible solution to the singularity problem of cosmology," *Uspekhi Fizicheskikh Nauk,* vol. 133, Mar. 1981, p. 479-503. Translation in *Soviet Physics — Uspekhi,* vol. 24, Mar. 1981, p. 216-230.

produced COP = 1,500,000 and was pushed past that COP to produce the antigravity in the laboratory, smoothly reducing its weight by 90%. Figure 6-9 is a plot of the actual readings taken during the antigravity experiment. Sweet performed the experiment in California, reading off the measurements to me over the phone as he made each one.

Another indication of the negative energy effect present in the output section of the Sweet device was tested by suddenly shorting the output leads. This resulted in instant freezing of moisture from the air, so that the leads were instantly frozen and covered with ice. Contrast this to the normal heating of shorted wires, where the energy is positive.

Sweet never revealed his activation process, whereby he initiated very strong self-oscillation — of the nucleus of the barium atom in barium ferrite magnets — with the local vacuum treated as a semiconductor. One part was known to the present author and another part was known to Rosenthal, a professional test engineer. In addition, how Sweet converted his excessive hole current is not completely clear. It appears that he somehow used his coils in quadrature together with special circuitry to interact the excess hole current into his magnets, directly with the self-oscillating barium nuclei and thence with the other nuclei in his magnets. If so, it created the "rough equivalent" of increasing the associated binding energy offset and locked with concomitant additional local spacetime curvature.

If this speculation is correct, he "locked" the nuclei of his magnets to the local curved spacetime, maintaining the overall local binding energy in the nuclei themselves while producing a great excess of "binding energy" (negative energy) in the immediate vacuum. This would explain the antigravity, and would be consistent with the experimental results as well as the increase in antigravity as the output load of the device was deliberately increased.

We must use the supersystem concept, as in the quoted comment at the beginning of the chapter, to enable a better understanding of these novel phenomena. Together with the Dirac negative energy production and high COP system, the hypothesis of "additional negative energy acting on local spacetime immediate to each nucleus" allows the generation of the observed antigravity to be understood. However, we accent that this mechanism is still a hypothesis, and it must be further substantiated by experiment.

9.7.1 Lattice Holes

In a material conductor or other component of an electromagnetic circuit, the conventional model envisions currents in the Drude electrons as the electrons moving by "hopping" from molecules or atoms in the material lattices into the Drude gas, with each hop leaving behind a positively charged "vacated electron position" called a *lattice hole,* or just a "hole". Subsequent Drude electrons are attracted to fall into the holes, etc. This net movement of the hopping electrons down the conductor, etc. comprises the conventional electron current through the conductor. We point out that the actual movement of the electrons in their "hopping" is vastly more energetic than the very feeble net "drift" of the overall ensemble of Drude electrons longitudinally down the wire as current. The energy of the total electron activity ongoing in a simple 1-foot length of copper wire would power a city, if it could all be harnessed and utilized.

At the same time the electrons hop with a slow net progress down the wire, the "holes" in the material lattices are also collectively seen by the external observer as if "slowly changing their net positions" longitudinally in the opposite direction. One speaks of a corresponding "hole current" or "lattice hole current" in the opposite direction to the electron current. However, there are subtle differences in the flow of the two currents, because an electron in the Drude gas is far more kinetic than the positive ion left behind by an electron that has "hopped up into the electron gas". Nonetheless, the positive lattice ions do "rock" physically from the induced forces upon them, as the holes are opened and filled. In conventional electrical power systems, this equal and opposite energy reaction in the ions of the lattice materials, induced by the applied fields, is usually ignored. In most classical EM power system theory the holes and their "composite equal and opposite energy and work in the system" are also ignored, except in semiconductors and semiconductor circuits.

9.7.2 Newton's Third Law Is Accounted in the Supersystem

Because half the EM energy and work in the circuit is usually ignored (e.g., in the Maxwell-Heaviside-Lorentz standard equations), electrodynamics is said to be free from Newton's third law reaction. This may be a non sequitur, and it follows from the assumption that — for an EM wave, field, or potential in space — no interaction exists with the active vacuum or with the curvature of spacetime. In fact, those reactions do exist in the supersystem. The field, wave, and potential do indeed interact with both the quantum mechanical vacuum and the general relativistic spacetime.

Indeed, the field, wave, and potential may be said to *identically be* changes induced in general relativistic spacetime. The absence of the "transmitting" physical system leaves us with the remaining two components of the supersystem, each of which extends to infinity. Again, Figure 9-1 shows the actual interactions (the supersystem) and Figure 9-2 shows the erroneous and arbitrary "kill of the supersystem" by standard classical electrodynamics.

When higher group symmetry electrodynamics such as O(3) is applied, then the interactions between the three parts of the supersystem emerge and must be accounted. This is particularly true of COP>1.0 EM systems. However, as Finster points out {564}, the Dirac sea effects exist *wherever* there are EM fields, potentials, and waves. We add that curved spacetime effects also exist *wherever* there are EM fields, potentials, and waves. And wherever Dirac sea effects exist, or wherever curved spacetime exists, then there the local vacuum and local spacetime interact with each other.

However, as we shall point out, usually most of the Dirac sea hole effects can be neglected in COP<1.0 systems and in most lower gain COP>1.0 systems because of the time-energy aspects. For COP»1.0 EM systems, the time-energy aspects are partially reversed, and instead of carrying the hole effects away from the system, the time-force from system output to input forces the Dirac sea holes to flow back in the local vacuum across the system from its output to its input. This flow constitutes an additional "load" appearing in the input section and requiring additional electron current from the external power supply to fill the holes. If the power supply does not furnish sufficient electrons to fill the hole current at the input section of the system, then the unfilled hole current passes back into the feeder line toward the external power supply, and even into the distant power supply itself. In its progress, it eats incoming current all along the way, requiring that more current be furnished by the distant generators.

9.8 Remarks on the Observed Acceleration of the Expanding Universe

As a candidate for *dark negative energy,* the present author has proposed vacuum negative energy and currents in curved spacetime regions partially containing excess *empty* Dirac sea holes as well as normal *filled* Dirac sea holes. The process by which these excess Dirac holes are produced has been advanced, and is supported by at least one dramatic experiment. One result of such "negative energy areas" of negative spacetime curvature would be "jumps" increasing the velocity of light and high-energy particles

traversing these altered regions of spacetime. In fact, there is some evidence for just such jumps, according to a hypothesis by Richard Lieu of the University of Alabama in Huntsville {580a, 580b}. Otherwise, high-energy particles produced in distant processes in the cosmos would not be detected on earth, but would be annihilated in highly energetic collisions.

The departure of large-scale spacetime from homogeneity would also result in some loss of correlation in the presently fitted red shift versus distance relationship. Again, there is tentative indication that such may prove to be the case. The most distant galaxy recently detected has a red shift of 6.56, which — assuming homogeneity of space — implies look-back of 14 billion years or so.[267] (conventional view) Best estimates of the age of the universe based on the Big Bang assumption is some 14.7 billion years. It would seem that 0.7 billion years is a very short time for that observed galaxy to have formed. If even more distant galaxies are observed with larger telescopes to become available, then by the redshift correlation to homogeneous space one would be observing galaxies "before the beginning of the universe" — an obvious non sequitur. It appears that the redshift correlation to velocity and distance, as well as the homogeneity of space and in fact the Big Bang itself— are already in some difficulties and may be in serious trouble in the near future.

The empty Dirac sea 4-holes in the vacuum are special "Dirac negative action quanta" and the holes and their dynamics form negative action potentials, currents, and fields. This type of vacuum condition containing some empty Dirac sea holes is referred to as a *Dirac-polarized vacuum.*

However, we do not envision the Dirac-polarized vacuum as just simple *static* polarization, but as possessing rich dynamics such as negative energy currents, potentials, fields, waves, etc. including in the time-energy medium in the time domain. We also include the interaction of the dynamic Dirac-polarized vacuum with spacetime.

[267] I am indebted to Prof. Stanley Jeffers for this information, in his E-mail discussions with the Alpha Foundation's Institute for Advanced Study fellows. Dr. David Roscoe contributed the fact that the Big Bang theory has so many parameters that nearly anything can be "fitted in". But he also pointed out that W. M. Napier, *Astronomy & Astrophysics,* Vol. 310, 1996, p. 353 gives a very thorough analysis of the quantized cz phenomenon, which does present a difficult obstacle to Big Bang theory. Napier is **the** originator of the cometary catastrophe theory of biological extinction. One way or another, the theory of the Big Bang is in trouble, even though many theorists are still complacent about it.

Due to ongoing COP»1.0 processes involved in highly energetic astronomical phenomena, Dirac sea 4-hole regions and dynamics are believed to occur and exist in the vacuum across the observable universe. These occur especially in appreciably curved spacetime regions with large tempic potential gradients and thus large *time-forces* across the region.[268] The 4-holes and 4-hole currents in the vacuum are generated in great quantity in large cosmic explosions. Also, the energetic fluctuations of the local vacuum energy can separate a Dirac hole from its occupying electron by lifting the electron (pair production), and so can a curved spacetime. In a properly curved spacetime, fluctuation can lift an electron from a hole, and enter a stationary state by accommodating reaction of the local spacetime curvature. In that case, hole and electron go their separate ways. The hole and that or another electron may later recombine, or in sufficient local spacetime curvature, they can remain apart. We point out that every positive energy electron is accompanied by an appropriate local curvature of spacetime that prevents the accoutrement of a free Dirac sea hole,[269] and thus prevents the electron from disappearing.

The more energetic the local region, the more severe and violent are local spacetime curvatures in that region, and — in our view — the more frequent the occurrence of COP»1.0 interactions producing significant Dirac 4-hole currents, negative energy EM fields and potentials, etc. Indeed, the measurements that yielded the accelerating expansion of the universe were measurements of the relative velocities existing with stellar explosions known as type la supernovae. In our view, in explosions of such violent nature — particularly including in optically active gases such as where gamma ray bursters form — an appreciable fraction of the hole currents are transduced into positive energy electron currents. This produces — at least for a finite time — a net positive feedback, self-powering COP»1.0 phenomenon, resulting in very rapid asymptotic

[268] We also conjecture that these regions may account for a tentatively observed slight change in the fine structure constant, but leave that to the advanced theorists to validate or falsify.

[269] This needs a bit of modification. Rigorously, the so-called "isolated" observable electron is clustered around by *virtual* positrons (Dirac sea 4-holes) in the vacuum. So a positron influence is present, though from virtual positrons instead of observable positrons. The magnitude of both the positive charge and the internal or "bare" negative charge is infinite. The difference, however, is finite and is the "observed" magnitude of the observable central charge. There is thus a net observed shielding of the bare charge of the electron, and this is taken into account to yield the observed charge of the electron.

output energy increase. This is what we have hypothesized as producing the gamma ray burster itself. *Quenching* of this asymptotic rise in COP occurs only after the physical geometry of the "closed-looping" gas particles is broken a short time later. The maximum output energy is determined by a function of the *rate* at which the geometry is broken and the corresponding *rate* at which damping of the asymptotic rise and quenching occurs. The afterglow remaining in the gas is due to the extra positive energy produced in it by the transduction of negative energy into positive energy during the asymptotic rise of the self-powering burster, with excess positive energy being absorbed in the gas while the burster magnitude is rising. After damping and quenching, the gas has been heated (that is how the geometry was disturbed in the first place, to produce damping and then quenching). Re-ignition can occur whenever a new close-looping COP»1.0 situation spontaneously occurs. As in the gamma burster, this can often happen as the disrupted geometry of the gases stabilizes.

All 3-space EM energy comes from the time domain, as previously developed. In the more violent positive energy COP»1.0 regions, there is an increased conversion of time-polarized EM energy into 3-spatial energy and back. On the average there is a higher "time-energy conversion" or "tempic" potential. In those regions, a tempic conversion potential is higher at the higher center magnitude of the spatial energy density. Hence there are strong tempic forces from "inside to outside", providing a "tempic broom" effect to sweep outward the excess Dirac sea holes separated from their electrons in the curved spacetime. The result is the presence of increasingly unoccupied Dirac sea 4-holes toward the outside of violent regions of spacetime,[270] until the effect is overcome by the decreasing spacetime curvature. The 4-hole current radiating out from an asymptotically increasing (exploding) burster provides an asymptotically increasing (exploding) negative energy and negative mass reaction with spacetime. That reaction explosively creates curved spacetime for negative gravity (repulsive gravity), acting upon the local system and upon distant masses as well. The result appears to be the cause of the acceleration of the expanding universe.

It follows that re-ignition of the gamma burster can occur if, as the quenching continues, the geometry stabilizes and reaches another "close-

[270] I.e., the violent astronomical phenomena — while generating and increasing are more violent at the center, and less violent at the outside.

looping" positive feedback condition. In fact, just such re-ignition of the gamma burster is very often observed.

Therefore, we hypothesize that the more distant violent astronomical regions have greater amounts of repulsive gravity being produced by their local Dirac-polarized vacua particularly during their explosive asymptotic energy density rise. This produces violent streams or bursts of negative energy outflow, which is equivalent to negative mass outflow and which provides outgoing negative curvature of spacetime (antigravity). At sufficient distance from us, the increasingly earlier, more violent events and resulting greater curved spacetime regions have created sufficient cumulated Dirac-polarized vacua to override the normal attractive gravity between galaxies, etc. and produce net repulsive gravity. This results in observed distant acceleration of the expanding universe {581a-581f}.

9.9 A Solution to the Hole Current Problem and Close-Looping

Bedini and the present researcher have filed a patent application {582} on the above special capacitive process to *convert* or *transduce* the detrimental Dirac sea hole current reaching the system's input section into electron current, and put it to use in powering the system. This transduction process receives the hole current as a special potential, then regauges the "negative energy" potential into a "positive energy" potential. This regauging is accomplished by charging the capacitor with Dirac hole current and then discharging electron current from it. The transformed positive energy potential is then applied to the Drude electrons, producing an ordinary electron current in the input that can be used to power the system itself. If sufficient excess positive electron current is provided, then the system can "feed itself in self-powering mode and also feed power back into the main power supply line.

When conversion of the arriving hole current in the input section produces an output "positive energy" electron current equal to the system's normal power needs (Kron's condition), the external power supply can be disconnected and the system will remain powered by the steadily converted negative hole current arriving in the input section.

Our patent-pending process allows this otherwise devastating special form of "negative energy feedback" to be converted into "positive energy feedback", allowing the system to be close-looped successfully for self-powering of the system and its load. Regulators of the transduction process may be added to cover the situation when the load is erratic and changing.

At Magnetic Energy Ltd., we have also filed a patent application for an outrigger method of close-looping a COP>1.0 system, which greatly eases the problem. This method is covered in Paragraph 9-14 below.

9.10 Negative Energy: Localized and Nonlocalized

It sometimes appears there are as many views on negative energy as there are scientists who mention it. Simply put, the Dirac theory of the electron requires negative energy states. The negative energy electron state was envisioned by Dirac as a sort of "hole" in the ambient vacuum, where the hole could contain a positive energy electron. The combination of equal positive energy of the electron and negative energy of the hole itself, would give a "normal" vacuum zero state of the "filled hole". In other words, the normal or ambient vacuum consists of holes filled with electrons. Considered in that fashion, such a vacuum is referred to as the **Dirac Sea** or the **ambient Dirac Sea,** or the **ambient Dirac vacuum.**

If positive energy is added to a filled Dirac hole, the electron can be lifted out, leaving the hole. Note that adding positive EM energy, e.g., is actually the addition of spacetime curvature and dynamics to the Dirac sea vacuum. In short, it is a supersystem interaction, not a system interaction.

In that case, the curvature of the local spacetime interacts upon the electron mass, producing a force that lifts it from the hole. The result is the appearance of a positive energy, positive mass electron and a Dirac sea hole (a 4-positron) in a curved spacetime. That is known as *pair production,* and it is a supersystem interaction. When a positron and an electron meet, the electron falls into the hole, changing the Dirac sea which also changes the local ST curvature. That change in local ST curvature is a change in the energy density of space, and is normally radiated away as a photon or photons as the local curvature decays back to a flat spacetime. The emitted radiation may further decay into particles, etc. by several reactions well known in particle physics. That "conventional" set of supersystem interactions is known as *pair annihilation.*

If we deliberately change the ST curvature appropriately, however, the pair annihilation radiation need not be emitted since the excited local spacetime curvature does not decay back to a flat spacetime to emit it.

Dirac's original paper tried to identify a negative energy state vacuum hole as the proton, but later that was falsified and it was taken as the positron. There is a very strong aversion in physics to considering negative mass; hence, the mass of the positron was proclaimed positive (for many reasons

not really connected with our thesis). Nevertheless, some physicists (in the minority) still speculate or theorize that negative mass "can exist." Not only "can" it exist, but also it *does* exist widely and one can demonstrate it in actual electrical circuits. It certainly exists in the binding energy of the nucleons in the nucleus of an atom. Again, a single white crow is sufficient.

We take a very straightforward view: we consider a positron — an electron observed with positive mass and "observed" to be traveling backward in observer time — to be a different (transformed) entity than a Dirac 4-hole traveling forward in observer time.[271] The observation operator accomplishes both velocity reversal and time reversal, and — since time is not an observable, the time reversal is "seen" as a reversal in spatial direction. *Prior to observation, neither reversal has been imposed.* The major distinction, we hypothesize, is that the observed positron has positive mass in 3-space, which is concentrated positive energy, and therefore produces positive energy electrical fields and positive gravitational field. Mass is an observable, hence, it is the iterative frozen 3-space snapshots of an ongoing 4-space process. Observation (and any observable) is the effect of applying the operator $\partial/\partial t$ upon spacetime LLLT in which a 4-space process is occurring. As we stated earlier in this book, our view is that no observable *continuously persists* (in time), but continually and iteratively *recurs* by the continual ripping of time from the ongoing 4-space reaction, to see the 3-space intersection at a frozen moment. We also advanced the *mechanism* that generates the flow of a mass through time, consisting of a mechanism for $\partial/\partial t$ (LLLt) - photon emission, converting *mt* to *m* — and the mechanism for $\int_t$ (LLL)dt — photon absorption, converting *m* to *mt*.

[271] This point is stressed. The *unobserved* positron is not identically a positive mass electron traveling backwards in time, but a negative mass, negative energy electron traveling forward in time. When Dirac theory of the electron was written, broken symmetry and the CPT theorem had not been discovered. Further, there was no distinction made in the difference between the observed entity (the *effect* of the observation interaction) and the non-observed entity (the *cause* of the observation interaction).

[272] We stress that we are once again confronting the ubiquitous substitution of the effect for the cause in classical electrodynamics. The observed positron and the unobserved positron are two quite different entities —just as the "cause" of an observation is quite different from the "effect" of the observation.

We may also consider mass to be condensed 3-spatial energy (say, EM energy) compacted by c^2. Modern physicists tend to consider the mass-energy itself as the source of the gravitational "attraction of mass" rather than the mass itself {583}. Let us accept that assumption, but differentiate between the observed 3-positron with positive mass and opposite direction in positive observer time, and the unobserved Dirac sea 4-hole with negative mass and without change of direction in the observer's positive time. The 3-positron is an *observed effect,* while the unobserved Dirac sea 4-hole is an *as-yet-unobserved cause.*

We also surmised that all EM energy in 3-space comes from time, by our solution {584a} to the long-vexing source charge problem {68}. In our view, we may then consider that the positive energy compressed as 3-space mass has been extracted from the time domain of surrounding spacetime, via entry of that time-energy into the surrounding 3-space at each 3-space point, producing a surrounding spacetime curvature which is known as the *gravitational field.* This gravitational field represents "withdrawn" 3-space energy from surrounding space, and withdrawn time-energy from the time associated with each surrounding 3-space point.

Hence the gravitational field may be said to consist of "negative energy" since it represents *lowered* energy of spacetime due to the curvature. This viewpoint yields results consistent with the received view that the energy of the gravitational field is negative. In our view, it is negative precisely because it represents "withdrawn energy" from the normal energy density of that otherwise flat space. The withdrawn nonlocal energy has been localized (as what we call "mass"). Simultaneously that withdrawn 3-spatial energy also represents "withdrawn energy" from the time-domain, since all the withdrawn spatial energy came from the time domain in the first place. The result is the curvature change in spacetime, that is taken as the gravitational field.

The 3-space energy comprising the mass is positive because it is *added to* the normal energy of an otherwise flat spacetime, at that concentrated locality.

The "energy in the gravitational field" is negative because it represents lowered energy density (i.e., lowered "pressure" in a fluid analogy) of that surrounding nonlocal spacetime compared to when that spacetime was flat

Thus when we add positive energy (a positive energy state) to 3-space, we create normal "positive" gravity because "mass" is a process of withdrawing some positive energy from the energy density of surrounding 3-space.

Here is the shocker: When we add localized negative energy (a localized negative energy state or "4-hole" — or a localized negative mass!) to a local 3-space region, we create "negative" gravity (antigravity) in surrounding space because the withdrawn energy from the local 3-space "hole" must have been added to the energy density of the surrounding spacetime, once we apply conservation of energy. Or in other words, the surrounding spacetime changed (curved) in interaction to the production of the hole.

If we wish, for simplicity we can just consider localized positive energy to generate positive gravitational charge in the surrounding nonlocal spacetime. We can consider localized negative energy to generate negative gravitational charge in the surrounding nonlocal spacetime.

This is where our concepts differ from the rather arbitrary way that a Dirac sea hole is interpreted in the received view. In spacetime, we try to account for the entire energy process and we apply a conservation law by including the supersystem interaction in every case. We insist that positive energy concentrated in positive local mass must have been extracted from surrounding spacetime.[273] That "negative energy" in the surrounding spacetime is what is known as the *gravitational field of the source mass* (where the energy was withdrawn to). Similarly, we insist that positive energy extracted from a localized region of the ambient vacuum to leave a "Dirac sea hole" must have been spread out into the surrounding spacetime, where it would properly be known as the *antigravitational field of the source Dirac hole.*

As an analogy in very simple lay terms, the holes associated with a local mass system or region involved in COP>1.0 operations create higher "pressure" outside the system or region with respect to other objects. Higher pressure between any two objects pushes the objects apart. The masses associated with a mass system create lower "pressure" outside the system or object with respect to other objects. Lower pressure between any two objects results in the objects being pushed together by the higher pressures beyond them.

[273] Alternatively, if we add local spacetime curvature, the surrounding nonlocal spacetime interacts as mediated by the supersystem changes in all three components. What we are saying is that there is no such thing as just a system, vacuum, or spacetime change. Any change to one is accompanied by a change to the other two, *a priori.*

We submit that this new view provides an exact (and testable) antigravity mechanism. It appears to have been validated by the Sweet antigravity experiment {576}, which was designed in advance by the present author with increasing the local negative energy reaction in mind.

9.11 Tests Reinforcing the Antigravity Mechanism

9.11.1 Dirac Sea Hole Current Effects in a COP»1.0 EM System.
For COP»1.0 electromagnetic systems, we recall that the temporal energy will flow negatively across the system from output section to input section. Hence the Dirac sea hole current in the local vacuum flows back across the system, from its output to its input section. Regarding the output section: Specifically, *all COP> 1.0 systems produce both positive and negative energy outputs. The greater the COP of the system, the greater the fraction of negative energy produced with respect to the fraction of positive energy produced.*

The positive energy will flow on out of the system output section (as into the external load) as in a normal circuit, but the negative energy output will flow from the output section through the local vacuum back across the system to its input section.

At the input section, the arriving Dirac holes appear to the input electrical current as a special kind of "load" added to the system input section. Hence, as previously stated, the external source must input electrons (as electron current) to "fill the holes" prior to having any input electrons available to power the circuit in normal fashion.

That is nature's unexpected <u>*overunity decay mechanism*</u> for COP>1.0 EM systems. The COP>1.0 system is in a condition of disequilibrium *a priori*, since the system exhibits negentropy and only systems in energy flow disequilibrium with their active environment can do that. Any COP»1.0 EM system is therefore in a highly excited state, and all excited states in nature have decay mechanisms. A highly excited state usually has a prompt decay mechanism, and the COP» 1.0 system is no exception.

This emergence of the Dirac hole current from the system output section back to the system input section, is nature's decay mechanism to trigger COP»1.0 EM systems back into COP <= 1.0. With this current, a "negative energy load" is added to the input section, causing the system to draw additional electrical power from the external power supply to

"power" the killing of the Dirac holes[274] as well as to "power" the normal circuit (the system itself).

If the external power source connected to the COP»1.0 system is not furnishing sufficient electron current to kill the hole current in the input and power the system as well, the excess hole current will pass back through the conductors and on into the external power source, "eating current" and power as it goes. The product of the hole current and the voltage gives a negative power imposition, wherever the hole current interacts with the power system and its external power supply, even back into the distant huge power generator in the distant power plant. For a battery-powered circuit, e.g., excess hole current will pass into the battery and discharge it (change its chemistry in discharge mode) more quickly.

Indeed, a lead-acid battery (and some other kinds as well) can be supercharged with Dirac holes. What this actually means is that the local vacuum — in which the battery and its components and chemistry are embedded and in a continual exchange with — is altered to increase the number of empty Dirac sea holes devoid of electrons. At the same time, the local spacetime is also negatively curved. The end effect is that the battery is charged with negative energy, rather than positive energy. We propose that a battery or capacitor possessing an extreme negative energy charge should be lighter in weight than the same capacitor when uncharged.

As previously stated, some years ago, Jim Watson developed a very large multi-kilowatt COP>1.0 battery-powered generator, publicly demonstrating it at a technical conference (see again Figure 5-12). Engineering measurements at the conference verified that the batteries were constantly charging while the load was constantly powered at 8 kilowatts.

The longer Watson's system would run, the more charged his batteries became with *negative energy*. After one of his batteries had been used for a couple of weeks in extensive experiments, one could obtain a most novel effect when it was placed on a normal "positive energy" battery charger. The battery's excess "Dirac hole charge" or "negative energy charge" accumulated in its local vacuum would "eat positive power and electrons" from the battery charger for an extended period, sometimes as long as a week, with no symptoms of "charging" the battery at all (no increase in

[274] By converting separated incoming electrons and incoming holes to resulting filled Dirac sea electron holes, in the input section itself.

battery voltage at all). During this period, the battery charger was indeed recharging the *battery supersystem.* It was filling the excess Dirac sea hole charge in the vacuum with the steadily supplied electrons. In the process, it was gradually relaxing the previously formed negative spacetime curvature.[275] When all the Dirac holes were filled, the relaxed spacetime then was relatively flat (normal) as was the local vacuum, and suddenly the battery would charge-up normally again with positive energy, with its voltage increasing in quite normal fashion.[276]

With tongue in cheek, we point out to the COP>1.0 researcher that these effects are not described in the available storage battery manuals, no matter how technically they are written. To the electrical engineer, we point out that they are not in his textbook.

Whenever Dirac sea holes have accumulated in the input area of the COP>1.0 system and are being filled by the external power supply, normal ammeters and voltmeters will only "see" that the external power system is furnishing more current. That is true, because the holes are an additional load being powered. The holes "eat incoming electron current and power", and require the external power supply to "power the killing of the holes" as well as "power the system".

The unwary overunity experimenter can successfully have the first phase of an overunity system working and not realize it, because his initial COP is too high and he does not know about the associated hole current decay

[275] This proves that a system's supersystem can indeed be negative-energy-charged, so that the local spacetime around that system is negatively curved, even though the system itself seems normal and functions normally. If the negative energy charge is . sufficient, conceivably the antigravity produced will be sufficiently great that the system itself "floats" or even levitates. We hypothesize that an intense negative energy beam can indeed be technically created which will accomplish this "negative-energy-charging of the supersystem" effect when continuously absorbed by a targeted system's local spacetime supersystem component, as the system is continuously irradiated by the beam. In that manner, levitation beams, tractor beams (both attracting and repelling) are at least hypothetically possible. If this proves to be a valid hypothesis, we foresee the day when such beams will revolutionize transportation and handling of otherwise heavy loads and very heavy systems. Even the heaviest vehicle could then negatively charge its own supersystem's local curved spacetime, thereby floating in the earth's gravity, in the atmosphere, in space, and under the ocean.

[276] We deliberately omit discussion of the extraordinary all-purpose weapons implications of negative energy electromagnetic pulse (EMP) directed energy weapons, already developed and deployed by several major nations.

of overunity systems back to underunity systems. His system may actually be at COP>1.0, but the negative energy component being produced in his output section is back-flowing and continuously degrading his input section by adding a "new load" right in the input section.

So his overall power draw from the external power source can be such that his positive power output in the load is less than his total power draw at the input of his system. Unless he is aware of the process and how to handle it, he may never realize that his system is actually at COP>1.0 condition, when the negative energy component is credited as an output "plus".[277] *COP>1.0 research starts by evaluating the absolute value of the output energy, then working from there!* The experimenter must be ever aware that he can and will have Dirac sea 4-holes and currents in any unitary COP>1.0 electrical power system, and particularly in those with very high COP. He must understand what the 4-hole currents and the negative energy actually do and how they function in the overunity system unless corrected.

Any COP»1.0 EM system demonstrates the Dirac sea 4-hole current phenomenon as nature's special decay mechanism to reduce overall performance of the COP»1.0 power system and its external power supply to COP < 1.0 — unless one *corrects* the problem and prevents the decay process (developed later in this chapter).

One symptom of the negative 4-hole currents is their cooling capability rather than heating. Another is that the excess current (and power) drawn from the external power supply also does not heat the input section of the system. Another is that semiconductors operating within the Dirac 4-hole current flow are likely to fail immediately and permanently.

We strongly suggest that, for high COP systems experimentation, the experimenter use a system of synchronized clocks where the lab clock is synchronized with a remote clock prior to the experiments, then the two clock times are examined after significant experimentation at COP»1.0. If deviation beyond normal error in synchronizing occurs, then the involvement of spacetime curvature effects is indicated. Two decades ago, anomalous experiments by Golden — with whom I was working at the time — charged the area with negative energy, producing a significantly

[277] In other words, in the presence of both positive and negative energy output, true COP is not "positive energy out" divided by "positive energy input by the operator", but is more appropriately "total absolute value of the energy output" divided by the "positive energy input by the operator".

curved local spacetime which disrupted local clocks and watches for four days as the charge gradually decayed away. Another indicator is that Geiger counters and other nuclear radiation detectors often "read" when bathed in vacuum 4-hole current, because of the ionization changes induced in them and also because of their individual previous "time-charge" histories. After all, ionization instruments "read" anything which causes ionization of their internal gases. Dirac sea hole current, if interacting with the gas, is in fact a very special new form of "ionizing" radiation.

9.11.2 Antigravity Hole Current Effects in a COP»1.0 EM System. Any COP>1.0 EM system can exhibit minor, usually barely detectable antigravity effects due to the presence of the negative local energy 4-holes in the hole current if the hole current is not transduced or corrected. It can also produce minor antigravity "thrust" due to the flow of the local energy holes. Usually these effects are not even noticeable in an overunity system unless it has very high gain (very high COP, say in the range of 10^5 to 10^6 or more.).

However, if the EM system's COP » 1.0, and reaches 10^5 to 10^6 or more, the antigravity and thrust effects may become significant and easily detectable. At 10^9 they become highly significant and are very detectable: The unit will lose appreciable weight on the laboratory bench, and may even levitate easily.

An example is provided by the Sweet vacuum triode amplifier discussed above, with the results that were given in Figure 6-9. Such effects are also what generate the anomalous levitation phenomena of free-spirited John Hutchison.[278]

9.11.3 Negative Energy Effect When Leads Shorted

When the leads of a COP>1.0 EM system are shorted, a noticeable cooling effect can sometimes be detected. If COP»1.0, shorting the leads will result in instant icing from the water vapor in the surrounding air.

If one accidentally shorts oneself across the leads of a COP»1.0 system, the effect is to freeze the nerves along the pathway of conduction. Experimenters are cautioned to use every safety precaution. Their experimentation is at their own assumed risk.

[278] John Hutchison, "The Hutchison Effect apparatus." *Proc. Intl. Symp. New Energy*, Denver, Colorado, May 12-15, 1994, p. 191-198.

Anecdotally, some older researchers reported that their constant handling of overunity circuits resulting in charging their bodies, apparently with negative energy. The body after all may be considered as a special kind of complicated capacitor or set of capacitors, so this is reasonable, based on Bedini's and Watson's demonstrated negative energy charging of a battery. Some of the older overunity researchers reported that, after charged in that manner, they could produce a 3-inch spark from their fingers, or a "slight shock" into the body of a person they touched.

There is even a special form of acupuncture in the East in which the practitioner uses special exercises to charge the body with negative energy in this fashion. The "electro acupuncture" is then administered by the operator twirling the inserted acupuncture needles between his fingers, and deliberately administering a jolt of negative energy from his body into selected points in the body. I have personally tested a person who could deliver strong "electric shocks" into one's hand or body, and who could consistently produce a 1-inch spark discharge between the hands at will. That person could also deliver a very astonishing "jolt" to one's body, particularly in the vicinity of the liver.

There appear to be similar rare negative energy phenomena in semiconductors {585a-585c}. Anecdotally, it appears that the body does have structures or methods of storing and using Dirac sea holes (negative energy) and mechanisms for accessing the negative energy charged in its supersystem. This is suggested as a fruitful line of future research for interested biophysicists. Again, we call attention to the fact that, whenever EM fields, potentials, and waves are present, Dirac sea effects are also present and involved. Little or no biophysical experimentation has been done utilizing higher symmetry electrodynamics and analysis of the supersystem effects. Contrary to the received view, the understanding of EM effects on biological systems is not mature at all, but is still in its infancy.

9.12 Susceptible Unitary System without Conversion of Dirac Sea Hole Current

A *unitary system* is simply a self-contained single power system with an overall closed current loop between the source dipole and system loads and losses. A unitary system is contrasted to an array system of synchronized separate power subsystems without a common closed current loop, with the array subsystems connected to the source dipole by energy

transmission-reception only. Hence the array system utilizes the Kron open path concept.

Beginning at about COP = 1.2 to 1.5, a few highly susceptible unitary COP>1.0 electrical power systems will experience significant Dirac hole current from output to input. This will produce a "negative energy load" in its input section and feed line from the external power system, resulting in decay back to an overall "system plus negative energy load" of COP<1.0. At the COP = 2.0 level, in the susceptible system the effect will forcibly decay the COP back down to overall COP<1.0. It does this by forcing excess power to be furnished by the external power system to "power" (fill) the Dirac hole current arriving in the input section of the power system. In short, it converts the system to a composite system containing an additional Dirac negative energy load in its input section.

Or in other words, it forces the operator to "pay" for both the *positive* energy output and losses of his system and the *negative* energy output and losses of his system.

In addition to usual powering of its load and losses, such a system is also "powering" the return of its own locally altered vacuum back to a more normal ambient vacuum, instead of stabilizing its supersystem in a stationary disequilibrium state. It is a supersystem interaction and effect. A COP>1.0 system that significantly exhibits this phenomenon is said to be a "susceptible" system.

One of the first tasks of the COP>1.0 experimenter is to ascertain whether he is working on such a highly susceptible COP> 1.0 system. Ironically, he does this by observing his COP>1.0 system kick itself back into a COP<1.0 system. If he carefully observes the initial COP>1.0 condition followed by decay into COP<1.0 condition, he must then realize that not all is lost! In short, he must realize he has developed a susceptible system. If he obtains COP>1.0 only to watch it subsequently decay back to COP<1.0, he has just discovered he is working on a susceptible COP>1.0 system, *and that is experimental progress.* He isn't there yet, but he is en route. In that case, he must concentrate on transducing the excess hole current into usable electron current, to "stabilize" and "lock" his system in its COP>1.0 operating condition.

9.13 Unitary System with Conversion of Dirac Sea Hole Current

Using the Bedini conversion process, a unitary system can be close-looped to maintain COP> 1.0 and stable overunity operation. The 4-hole current reaching the input section is intercepted by the Bedini mechanism, and transformed to ordinary electron current furnished to the input section. Thus the transduced negative energy feedback becomes a positive energy feedback, by conversion. This converted positive energy in the input section will reduce the demand for incoming electron current from the external power supply, increasing the COP>1.0 even more.

A feedback and governing system is adjusted until the system's converted positive energy feedback current reaches the Kron condition. At that point, the transformed electron current is sufficient to power the system with the external power supply disconnected. The governing and control system thus disconnects the external power supply, and the system is smoothly transitioned to self-powering operation, powering both itself and its load.

We stress that all the energy to power the system and its load is now being furnished from the active local vacuum interaction and from the local curved spacetime. No laws of nature, physics, higher symmetry electrodynamics, or thermodynamics are violated. Conservation of energy rigorously applies, but to the supersystem. The system is an open, *stabilized* disequilibrium system — of the kind referred to by Kondepudi and Prigogine as nonequilibrium stationary states — as a freely receiving all its energy from its active external environment. No standard U(l) electrodynamic analysis will show this condition or this mechanism, and neither will electrical engineering. Higher group symmetry electrodynamics such as SU(2) or O(3) will show it easily. For a modern treatise on O(3), we refer the reader to the recent *tour deforce* by Evans {586}.

9.14 Non-unitary Outrigger Array System

See Figure 9-14, which is a diagrammatic representation of a COP>1.0 array system that is non-unitary. In the non-unitary (outrigger array) system, no part of the outrigger array works at $\xi > 1.0$. All external parts operate at $\xi < 1.0$, but independently and with COP>1.0. Each of the external outrigger systems is an open system freely receiving excess energy from its active environment, because it is an "energy-receiving" system and the energy is freely transmitted from the central system. The central part of the array is the unit whose purpose is to stimulate or evoke

an excess energy flow from the vacuum, so that the outrigger receiver/power units can individually intercept and utilize radiating energy flow surrounding the central unit.[279] The usable (output) energy intercepted and captured (collected) from a given free flow of energy depends totally on the intercepting reaction cross section — usually the total array amount of intercepting charge, together with the degree of resonance (sweeping a larger geometrical cross section) of the intercepting charge.

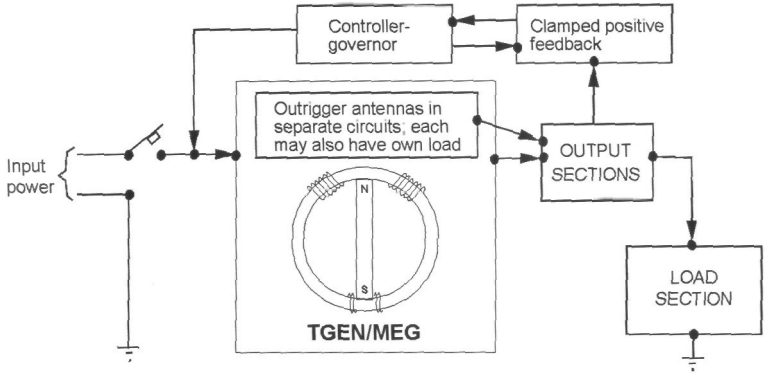

Figure 9-14 The nonunitary (outrigger array) system and its functioning.

Each outrigger unit (subsystem) has its own complete closed current loop *separate* system and load, plus its "antenna" or "interception section" or receiving component for intercepting and collecting the free flow of energy coming from the central source unit (the energy transmitter). Thus, the loads in the outrigger units are not closed-current-connected with the central source unit at all. Each outrigger unit has its own independent electrical ground and its own closed loop system with its load.

[279] We emphasize that, when the usually unaccounted Heaviside nondiverged energy flow component surrounding the conductors of the external circuit is accounted, every EM power system is already a COP»1.0 EM energy transduction system. Consequently, in the received view the array system can be operated at COP>1.0, or even in self-powering mode, even though the central system is "said" to be at COP<1.0. It is at COP<1.0 only because of the self-applied Lorentz symmetrical regauging and ignoring the excess unused energy flow available to and surrounding the circuit, but not conventionally used. If we account the COP for what we have to furnish to the central unit, then the COP of each array unit is COP = oo. The point is that we ourselves do not have to pay any *extra* input energy for the output energy of each array circuit.

This schema in fact separates the two functions of Poynting energy flow theory: (i) the extraction and radiation of the EM energy flow from the seething vacuum, and (ii) the interception, collection, and dissipation of some of that available energy flow, to power the loads and losses of the intercepting system.

In this fashion, multicollection from a single energy flow (generated from a central source "transmitter") occurs by direct, independent interception and collection in each of the COP<1.0 outrigger units. However, the input power to each outrigger units is *free* with respect to that outrigger circuit itself. We of course must pay to generate the flow of energy from the central unit, but that can be done in normal COP<1.0 manner (such as COP = 0.95) while powering its load.[280] Let the output power of each numbered unit (including the central source unit) be given by P_i, n be the number of power units, and P_T be the total power output. Then the total output P_T of the array system is given by

$$P_T = \sum_i P_i = P_1 + P_2 + \cdots + P_n \qquad [2]$$

The total input power P_I is simply the input power $P_{I(1)}$ to the central source unit. The COP is given by COP = $P_T/P_{I(1)}$.

In the motionless electromagnetic generator (MEG) array, for example, the central unit is the transformer-like unit, deliberately using a special core to contain the magnetic flux of a permanent magnet in contact with the core material, thereby stimulating the Aharonov-Bohm effect and freely filling the surrounding space with the uncurled magnetic vector potential A. We will explain the non-unitary (outrigger array) system using the MEG as an example.

[280] We again stress that, from any nonzero potential ϕ, or from any EM field in space, any amount of EM energy can be collected if there is sufficient intercepting and collecting charge. For example, the simple equation $W = \phi q$ applies for the potential, where W is the energy collected from a potential with point intensity ϕ by collecting charges q. A similar equation applies with respect to collecting as much force (emf in the various outrigger circuits) as desired. Here a single given E-field *E* can be assumed, and *F = Eq.* What is happening in the outriggers is that they are intercepting and collecting some of the excess Heaviside energy flow component that is wasted by the central circuit.

The MEG freely induces the Aharonov-Bohm effect,[281] thereby extracting excess energy from the vacuum in the form of that novel field-free A-potential. Being field-free, A represents an energy flow without swirl (without curl). When the MEG input section is perturbed, the surrounding A-flow is perturbed also, giving a pulsed or AC flow of energy that can be intercepted and utilized by each outrigger circuit as an E-field energy interception.

The central unit's COP<1.0 function is to output almost as much, or as much, energy as is required to power the MEG, while also evoking that excess A-flow and serving as a COP » 1.0 energy flow transducer. The function of each outrigger is then to intercept some of the pulsed A-flow (as E-field energy via the equation dA/dt = - E), in its antenna or interceptor section. Each outrigger has its own independent and conventional closed loop circuit. It simply is a receiver and user of extra Heaviside EM energy produced from the central MEG unit in the new form of the curl-free A-potential. Perturbing the A-potential produces a large E-field impinging on all the external outrigger subunits. Hence these units freely collect and use some of that available excess energy. The COP of the total array is thus COP>1.0. For best results, tuned antenna theory and near field theory should be utilized.

Suppose we operate the MEG central unit at COP = 1.0. In that case, there is no 4-hole current of significance associated with the central unit or the outriggers, and transduction of hole current into electron current for close-looping is not necessary. Instead, sufficient outriggers are employed so that the total energy W_O caught and dissipated in their loads by all the outriggers is given by $W_O \geq W_I$, where W_I is the input energy in the main central section. Since COP = 1.0 for the central unit in isolation, the total input E_{IN} is $E_{IN} = W_T$ (the additional huge Heaviside nondiverged EM energy input component is there also, but just neglected in conventional engineering). The total output W_A of the entire array is $W_A = W_O + W_T$. The overall COP_A of the entire array is thus

$$COP_A = W_A/E_{IN} = (W_O + W_T)/W_T = (W_O/W_T + 1.0) > 1.0 \quad [3]$$

[281] The reader should recall that the Aharonov-Bohm effect is not included in classical U(l) electrodynamics. See Terence W. Barrett, "Electromagnetic Phenomena Not Explained by Maxwell's Equations," in A. Lakhtakia (ed.): *Essays on the Formal Aspects of Electromagnetic Theory,* World Scientific Publishing, River Edge, NJ, 1993, p. 6-86.

Hence the array has a COP>1.0, even though every single component of the array has $\xi < 1.0$. With the outriggers fully functioning, many schemes of operation can be used. E.g., the energy from the outriggers can be used to steadily charge a capacitor bank by "shuttling". We define shuttling as use of two capacitor banks: (1) a capacitor bank which is continually connected and charged by the outriggers as their effective output, and (2) an input capacitor bank for the central unit that is continually connected and recharged from the outrigger capacitor bank. By adroit switching, the charge of the input capacitor bank is maintained by replenishing from the output capacitor bank, and the input capacitor bank powers the entire system, including the output load in the central section.

The non-unitary outrigger array construction is one means of close-looping a non-unitary overunity power system without bothering with the transduction of hole current into electron current. It is the easiest of all COP>1.0 systems to close-loop for self-powering.

An additional adaptation is for each outrigger also to continuously power a separate load, and only contribute *intermittently* along with the other outriggers to charging the output capacitor bank.

Another adaptation is to operate the central unit in the array in solitary self-powering mode.

These and similar modes of nonunitary array system operation allow close-looping the system for self-powering of itself and its load, without concern **for** 4-hole current transduction. A real advantage of such nonunitary systems without worrisome 4-hole current is that transistors can readily be used for switching etc. in them, without the destruction of the transistors by a damaging Dirac 4-hole current in the supersystem.

The nonunitary overunity system can also be close-looped by *conventional* (simple) "clamped positive feedback" means if good isolation (e.g., optical isolation of the circuitry switching) is used in the feedback loops.

9.15 Some Instrument Considerations

9.15.1 Time Effects

As previously indicated, there are time-domain effects (potentials, forces, and currents) associated with a COP>1.0 EM system, particularly as the COP increases toward COP»1.0. A useful method of indicating time-effects is to utilize a transistor in a circuit capable of measuring

recombination time in the transistor.[282] NASA has such circuitry available, but I do not have the reference at hand. We leave it as an exercise to the reader to explore that possibility.

For "very large COP" devices, ordinary watches, clocks etc. may be affected. Particularly significant is the slowing of timepieces in the presence of substantial time-domain effects due to substantial negative energy. In addition, for high gain devices (and for some at lower COP), the negative energy charge can build up in the local area, and may then require some days to dissipate. As we stated, in experiments years ago with Frank Golden, we experienced just such alteration of multiple kinds of clocks and watches in an area. It required four days for the negative energy charge in the area to gradually drain off (for the excess Dirac sea holes to gradually be filled with electrons, as the tempic potential gradually returned to normal).

Effects that were even more dramatic were exhibited in experiments conducted by Sid Hurwich in Canada some years ago {587}. In a series of experiments lasting a half-hour, Hurwich inertially jammed a police revolver so that a human finger could not pull its trigger. *The watches of the witnesses did not change their setting during that entire half-hour.* This cannot be understood by conventional electrical system analysis, but potentially it can be understood by supersystem analysis.

9.15.2 Calorimetry Is Taboo for Overunity System COP Measurement

It is standard dogma that calorimetry is a "true" measurement of power, and is always accurate in the hands of a skilled practitioner. In general, that is true for a COP<1.0 system, where one is concerned only with *positive energy* in the input and output sections. However, with respect to COP>1.0 systems, nothing could be farther from the truth. Indeed, for a significant COP»1.0 system, a calorimeter is one of the most inaccurate instruments that can possibly be used.

As previously stated, all COP>1.0 EM systems produce a mixture of negative and positive energy in their output section. The higher the COP, the greater the percentage of negative energy and the greater the flux of Dirac 4-holes back to the input section. The output energy, immersed in a calorimeter, will both cool the water with its negative energy output fraction and heat the water with its positive energy output fraction. Hence, the calorimeter will show the *difference* between the water's simultaneous

[282] This suggestion is courtesy of John Schnurer some years ago, and is appreciated.

heating and cooling. If the calorimeter measurement is misinterpreted as the *total energy output*, this "definitive test" will always erroneously show COP<1.0. After all, it itself already applies the decay mechanism for converting any overunity system to an underunity system.

The only good use of the calorimeter in an overunity EM system is to verify that negative energy is present, when comparing its measurements to more sophisticated electrical measurements of the system. It can be used along with other measurements to ascertain (1) the total energy output, whether negative or positive, (2) the difference in the two forms of energy output and the algebraic sign of the resultant (positive if calorimeter heated, negative if calorimeter cools), and (3) thereby help determine the output's energy fractions (positive energy divided by total energy, negative energy divided by total energy).

Any test group insisting on testing a purported COP>1.0 electrical system with a calorimeter as the *definitive statement of energy output* is totally devoid of knowledge of COP>1.0 systems and their phenomenology. Usually such "test groups" tend to regard themselves as "measurement experts" (which they well may be, in COP<1.0 positive energy systems!). That does not make the team even minimally knowledgeable or qualified in COP>1.0 system measurement. To the contrary, the team members have zero experience or knowledge of COP>1.0 systems. The proposed test group may consist of physicists, thermodynamicists, electrical engineers, technicians, or all four, but they still will have no knowledge or expertise in COP>1.0 EM power systems unless they have actually worked with such systems before, and at length.[283] This is particularly true of COP»1.0 systems. My advice to all COP>1.0 researchers is simply to keep the "calorimeter addicts" out of one's laboratory in the first place.

9.15.3 Other Instrumental aspects.

Here we just point out some simple and obvious things, familiar to the experienced researcher but sometimes not appreciated by the novice. One is usually dealing with nonsinusoidal waves, pulses, spikes and the like. As is well known, RMS meters are useless for measuring such nonsinusoidal electrical entities, since they are designed and calibrated to measure sine

[283] To date, we have found none who have actually worked with COP>1.0 electrical systems. We have, however, found quite a few who, though totally inexperienced with COP>1.0 systems and not knowledgeable, have regarded themselves as "real experts" in such systems. They claim to already know how COP>1.0 systems work and behave, and assume just ordinary electrical system phenomena.

waves only, or to measure DC. One must use a good differential sampling scope with multiple synchronized channels, with professional software to perform accurate integration under the curve, and with special differential probes for the scope. Simultaneous triggering of the multiple measurement channels on the same time line is required. The necessary high quality probe set may cost as much or more than the oscilloscope!

Dirac sea hole currents are generally not separately measurable, so one measures where the hole currents are not significantly present. Results may be compared to measurements where the hole currents are known to be present. When directly measuring hole currents, the conventional meters often read "backwards" and interpret a negative energy output at the system output section as subtracted from the positive energy, and interpret a negative energy output at the input section of the system as additional input electron currents from the external power supply. If the electron currents from the external power supply are not present, then measuring hole currents will draw electron currents from the power system inside the meter itself, resulting in a "backward measurement". Again, the meter actually will measure a real electron current, whether from the external power supply or from a conversion within the meter itself.[284]

Recombination time in semiconductors can sometimes be used in instrumented circuits to differentiate between negative hole current and electron current, by observing the change in recombination time due to the negative energy currents. It will differ from the change in recombination time due to positive energy currents.

Again, what is needed in the field is a set of solid, reliable instrumentation specifically developed for these peculiar measurement phenomena involving both positive energy and negative energy. To my knowledge, no such thoroughly designed and tested instrument package presently exists. Further, there are not even any standards for such, since there are apparently no standards for negative energy measurement at all.

9.16 Still Anomalous Aspects

Several aspects of COP>1.0 systems are still not properly understood. The behavior of curl-free A-potential, sometimes produced in such systems, is

[284] What is very much needed is a meter of sophisticated design where this "drawing of excess electron current from within the meter itself has been taken into account in the design, so that the meter functions correctly for either positive energy measurement or negative energy measurement.

a case in point. This type of energy can exhibit characteristics as if it were electrostatic energy, which my associates sometimes refer to as the "crawly stuff. It exhibits the characteristic of "crawling" all over the surfaces (outside and inside) of the objects in the area, including the scopes, producing internal electrostatics and possibly magnetostatics everywhere. This can easily destroy the amplifiers etc. in a good scope or an expensive meter. It is best to transform this field-free A-potential into an ordinary "EM field energy AC wave", and then utilize it in that fashion.

Scalar stress waves are also sometimes produced, leading to anomalous effects. This is best regarded as a "time-polarized" EM wave, or more accurately, as a combination of scalar (time-polarized) EM waves and longitudinal EM waves in 3-space. For macroscopic waves in COP>1.0 systems, the Mandl and Shaw 1:1 correlation between scalar photons and longitudinal photons can apparently be corrupted, so then one has "abnormal" (improperly correlated components which normally correlate to make "ordinary" EM waves). These abnormal EM scalar stress waves also exhibit the "crawly" phenomenon, and can be hazardous to one's instruments.

In addition, some instruments such as ionization counters, Geiger tubes, etc. read in the presence of such waves as if nuclear radiation were present (which it is not). Also, the individual time-charge history of a given instrument determines or substantially influences how the instrument reacts in the presence of the "corrupted" scalar stress waves. Essentially, at a given time any instrument has a small "time-energy charge" depending upon its past history. The corrupted scalar stress wave accomplishes further "time-charging" of the instrument, which combines with the initial time-charge to produce more time-charge, ordinary EM waves by scalar EM interferometry {588}, or abnormally correlated longitudinal EM wave emission.

In an ionization-measuring instrument, *ionization is ionization, by whatever means achieved.* And in the presence of the "abnormal" radiation and charging, ionization-type "nuclear radiation" instruments will vary from one to another, *depending upon the individual time-history ofeach instrument.* So from a group of identical instruments made the same day on the same assembly line, one may read anomalously and several others read normally. Or two may read anomalously, while all the rest read normally. A very good example of this anomalous measurement effect is seen in the rigorous electrolyte experiments in U.S. Navy research facilities at China Lake {589}. The present author has previously given an explanation of this time-charging and decay phenomenon {590}.

Negative energy reacts in different ways with different materials. The more nonlinear the material, the greater the effects and unpredictability of the interaction, as a rule of thumb. In a copper wire, Dirac hole current introduced into the wire will "eat" Drude gas electrons, reducing the "pressure" at that point or area in the wire. This "combining of electrons and causal Dirac holes is not normal pair annihilation, and radiation does not occur. Instead, the two curvatures of spacetime (one by the positive energy of the electron and the other by the negative energy of the Dirac hole before observation) interact and adjust.

The Drude gas in the copper further back toward the external power system still has normal (higher) gas pressure, and so the differential in pressure induced in the Drude gas will drive electrons from the "normal" pressure areas into the "reduced" pressure area where some of the Drude electrons disappeared after being "eaten" by the Dirac holes. To look at that in lattice hole terms, the "eating" of Drude electrons in a selected volume of the wire leaves positive ions, which are "lattice holes" vacated by the eaten electrons. So these excess positive charges attract electrons from further up the wire nearer the distant power supply, filling the lattice holes to bring the Drude gas back up to "normal". However, that also draws and "eats" additional power from the distant power supply. Meanwhile, the Dirac 4-holes fed from the input of the COP>1.0 system back into the power feed conductors continue to interact with the lattice and eat electrons to create more ions (lattice holes).

One may visualize the Dirac sea holes producing excess lattice holes, which then causes the Drude electron gas to change so that the "average" demand current increases. In short, we must also consider the effect of Dirac hole charges or currents upon the lattice material itself, and the structure of holes and electrons as charge carriers in the material lattice.

Semiconductors are very vulnerable to negative energy due to its disruption of their donor-acceptor and band gap design functions. With mild negative energy exposure, a semiconductor may just cease operation entirely and later recover when the negative energy application ceases, or it may fail and never recover. For pulsing, strong "opposing force pulses" (stress pulses) are created deep inside the semiconductor materials. In case of sharp pulsing, sometimes an exposed semiconductor will just suddenly explode in a nice little fireball about one foot in diameter. This along with some minute stinging fragments from the explosion assures that the COP>1.0 bench researchers stay alert and on their toes. Needless to say, when experimenting with COP>1.0 systems and circuits, one should exercise all safety precautions, including safety glasses, until the **"negative**

energy beasts have been tamed and controlled". One should not experiment with such things unless one is an experienced and safety conscious experimenter. One experiments at one's own risk.

Negative energy effects in coils and toroidal coils are largely still unknown, though we have outlined some of the major effects. For a normal helical coil, one can derive a concept of the effects by considering the lattice effects in the wire. In this case, introduction of hole current at one end of a helical coil will induce electron current from the other end and into the coil. Thus, hole current can be "switched" back and forth between the ends of a helical coil to induce an ordinary AC electron current in the coil, accompanied by normal magnetic fields etc. A point can be reached where the coil is actually in resonance with the frequency of the switching, and with the "seeming capacitance" of the hole current introduction in each switching. With the proper material in the coil and a keen balance between the negative energy capacitance effect and the normal positive energy induction effect, *in theory* a single coil can be turned into a self-oscillating, self-powering system.

With core material inside the core of a coil, the situation dramatically changes. Often the type reaction experienced will appreciably depend upon the core material, and changing the core material can dramatically change the effects upon the coil and the effects that the coil prc luces. One may even use dynamic changes in the core material to produce corresponding dynamic changes in the coil. A toroid may act differently from an ordinary helical coil, as does a flat (spiral-wound) coil. Here the experimenter must simply perform his own experiments to seek out and understand the phenomenology he uncovers.

For exploratory experimenting with core-filled coils, we advise strong caution and testing at very low power only. Sometime effects can apparently be experienced by the researcher (headaches, nausea, dizziness, etc.) It is suspected from some evidence (but not proved) that the core material's chemical characteristics can sometimes be "imprinted" upon the human body chemistry, from the novel radiation of a core-filled coil or some core-filled coils. This is particularly true in the presence of strong stress potentials, such as from bi-wound coils with fields in opposition, and particularly if the biwound coil contains a nonlinear material core. The nonlinear core induces modulation (multiplication) of the two waves, rather than linear mixing. Thus, the two waves are "locked together" to form a true stress potential and local spacetime curvature sets, when the biwound coil has a nonlinear material core. In short, one is now engineering pure general relativity, locally.

Again, we iterate that the experimenter should be knowledgeable and take all safety precautions. He experiments at his own assumption of risk.

The appearance of an extra stress potential (field-free) in a biwound coil is in fact a new Lorentz symmetrical regauging, and the equivalent of rotating the frame of the coil. As signals are introduced, this is the equivalent of continually changing the degree of the frame rotation, which is a general relativistic effect, with direct curvatures of spacetime being produced. In short, one is producing spacetime curvature and rotation engines, previously discussed.

The magnitude of the stress potential (field-free) falls off inversely as the distance. Thus one's body can be exposed to it, including the body chemistry, every cell and every part of every cell, the nervous system, etc. Placing signals on the biwound coil can conceivably result in slight variation of the scalar stress potential, including inside the body, and inside each cell and each part of each cell. Variation in the stress potential ϕ in a little local region inside the body produces $-\nabla\phi$, which is an electric field E. The rate of change of this E-field then produces a magnetic field H.

Consequently, very minute EM fields are produced throughout the body and all its parts, or can be. It is as if the entire body is "electromagnetically washed" in internal EM fields throughout its matter, structures, and dynamics. The hydrogen bonding actions ever ongoing are particularly sensitive and can restructure appreciably in the presence of this stimulus. They can also "imprint" and take on a specific induced structure and dynamics, correlated to the persistent changes induced from the biwound coil. As can be seen, such EM biological effects have not been appreciably investigated and documented in the Western scientific literature. Hence our urging and insistence that the researcher use all caution, and our warning that he experiments at his own will and assumption of risk. Neither the publisher nor the present author is responsible for any accidents or blunders that may occur.

Capacitor effects also vary between types of capacitors, when applying negative energy or a mix of positive and negative energy. Some capacitor dielectric materials are also photo-refractive and are semiconducting materials, hence photoactive. The rich effects capable of being generated in capacitors — by EM fields, waves, potentials, and pulses of negative energy or negative and positive energy mixed — are largely unexplored and not catalogued.

Almost all modern permanent magnetic materials are also photo-refractive or photoactive materials as well, and many are semiconducting materials. Hence a rich variety of effects can be produced in permanent magnets by the introduction of negative energy fields, potentials, waves, and pulses.

As can be seen, a very rich combination of effects exists for "normal-appearing" coils, capacitors, semiconductors, and magnets when applying appreciable negative energy or controlled mixes of positive and negative EM energy. This is a still largely unknown materials science region, and one that has not been systematically and rigorously explored and catalogued, if at all.

In addition, there are effects from *pulsing* negative energy (Dirac hole currents) that are not completely understood. These appear to occur almost — or partially — at random, and also seem to be affected by the natural surroundings, by the various materials, etc. The "imprinting" phenomenon, when it occurs, seems to be augmented by pulsing, and sometimes by the pulse shape and pulse repetition frequency as well as the surroundings.

We also legally state that we are not responsible for any risks the researcher chooses to take, but are only alerting him to be very careful and use very good safety practices. Any experimenter is himself responsible for stringent adherence to good safety practice and common sense, and he legally assumes his own personal risks for all experiments he chooses to undertake.

Another effect to be alert to is the effect of "charging" the local area's supersystem with an altered active vacuum and curvatures of spacetime. This phenomenon is usually experienced as a "slow growth" of the COP of the system, over a long time (months or years). Tiller in private discussions has reported such phenomena in his detector built at Stanford University. Golden and I experienced such phenomena with a small COP>1.0 system Golden was developing. Over a period of five years, the system slowly increased its COP to about 2.0. Moved several hundred miles, the system then exhibited COP of about 0.9, but with occasional fluctuations of overunity temporarily.[285] Golden had gradually charged his local area with the "engine" or spacetime curvature operational and functional form of his unit. Thus in that repeatedly charging area, gradually the operation of the unit improved. We referred to this *engine-*

[285] In fact, Golden and I were astounded at these results, until Tiller explained it to us and explained his own experiences with "growing" his detector. Thanks to Professor Tiller, thereafter we had this new phenomenon firmly fixed in our lexicon.

charging of the environment with a particular effect or dynamic form as *kindling.*

The kindling or "charging to favor the dynamic form of the engine or device" problem, should it occur, is in fact usable because it is possible to produce it everywhere on earth, and fairly permanently. To use the kindling effect once discovered, the mechanism is to build several identical units. Keep the original unit working in the original area, and "outrigger" the others at radial distances as distant as possible, but maintaining COP>1.0 for the outriggers. Then simply run both the outriggers and the central unit, steadily. The "structural charge" will grow and reinforce at the outrigger locations, then spread on beyond the outriggers, and a much larger area will now be "charged with that dynamic form". With sufficient additional outriggering (three to five, or seven in an especially difficult case) where the successively internal outriggers arc retained and operating, the charging will eventually spread around the entire Earth, and *it will become a permanent fixture of the Earth environment itself.*[286] Thereafter, anytime one of the units is turned on anywhere on earth, it will perform with its normal overunity condition. In other words, not only can one grow the dynamic form (engine) in a supersystem in a given locality, but one can also kindle it into the entire Earth's supersystem permanently {591}. One is strongly reminded of Feynman's observation that physicists with their big accelerators may in fact be partially creating their own reality. He pointed out that often the physicists look and look for a new, predicted particle. At last and after years of difficulty, finally a "glimpse" of the particle occurs in an accelerator and is reported. The physicists quickly crank up the other accelerators and look intensively, and — after some moderate difficulties — they find that particle. Thereafter, *every time an accelerator turns on and looks, that particle is readily seen, easily.*

The supersystem's spacetime is part of the local spacetime of the Earth, and all supersystems also interact with each other. As Kron put it {592}:

> *"An electric network differs from all other types of non-electric networks in that it is always surrounded in all directions to infinity by an invisible dynamic electromagnetic field of its own creation. ... Each Inductance L produces its own magnetic field, each*

[286] We have proposed an application of this phenomenon to kindle and maintain a specific disease organism's "anti-engine" as a startlingly new kind of medical therapy for permanently eradicating a particular disease vector from the earth.

capacitance produces its own electric field and each resistance R creates a thermodynamic field of its own. Moreover, there exists a continuous interaction between the magnetic, electric, thermodynamic, and radiation fields. Thus any correct and basic theory of the electric network must include all the parameters of its surrounding electromagnetic field and must satisfy all the field equations of Maxwell. The theory must also dovetail with the Hamiltonian and Lagrangean equations of dynamics containing both time and space derivatives, as well of the equations of irreversible thermodynamics. "

So decades ago, Kron was struggling with the "supersystem" problem, in different terminology, and he eventually originated *diakoptics* {593}, an entirely new way of breaking the problem down piecemeal so it could be solved. But Kron strongly stressed that the interactions of the fields and potentials of a circuit and all its parts reach to infinity and have an n-dimensional set of degrees of freedom and an infinity of spaces. The fields and potentials of every charge reach to infinity (for those charges in matter from the beginning), and so every charge in the universe interacts with every other charge and its fields, potentials, and dynamics. Spacetime itself is filled with these interacting EM fields, potentials, waves, and dynamics. Little wonder that the horrendous set of ongoing EM interactions at every point in the vacuum has such incredible energy density and fluctuations. We may even regard the fluctuations and interactions as completely causal, but — with no information on each interaction — they must be treated as totally statistical. Ultimately nature confounds our Aristotelian logic and insists that, in the limit, one is dealing with 5-law logic as developed earlier in this book.

Since the earth near an ongoing COP>1.0 system experiment has innumerable electrical aspects, materials, etc., it follows that the surrounding earth is indeed in direct interaction with the experiment. It then follows that "slow conditioning" of the surrounding area should be possible, say, after some years as Golden experienced. It also follows that the effect diminishes in magnitude with distance from the experiment.

The "growth of the activation (kindling) to include the entire Earth" is a slow process, requiring years and much expense to aid the "spreading" — as the physicists may be experiencing, according to Feynman. But it is a doable.

We highly recommend that the researcher work on COP>1.0 systems that are not charge and location dependent, so that the kindling problem does not arise. We have assumed non-kindling COP>1.0 systems throughout most of this book.

Chapter 10

Cold Fusion: Low Spatial-Energy Nuclear Reactions at High Time-Energy

"This book is about time. I would have liked to have named it Time, the Forgotten Dimension..." **[Ilya** Prigogine]. {594}

"The notion of time may be unfolded into an independent pure science... a science of pure time is possible." [Sir William R. Hamilton, 1837]. {595}

"...contrary to the conclusions of classical mechanics, there exist effects of potentials on charged particles, even in the region where all the fields (and therefore the forces on the particles) vanish." [Y. Aharonov and D. Bohm] {596}.

"...global behavior greatly modifies the very meaning of space and time. Much of geometry and physics is based on a simple concept of space and time, generally associated with Euclid and Galileo. In this view, time is homogeneous. Time translations may have no effect on physical events. Similarly, space is homogeneous and isotropic; again translations and rotations cannot alter the description of the physical world. It is quite remarkable that this simple conception of space and time may be broken by the occurrence of dissipative structures. Once a dissipative structure is formed, the homogeneity of time, as well as space, may be destroyed." [Ilya Prigogine] {597}.

"As we expand our observation, we extend our concepts. Thus the simple symmetries that once seemed self-evident are no longer taken for granted. Out of studies of different kinds of interactions we are learning that symmetry in nature is some complex mixture of changing plus into

minus, running time backward and turning things inside out." [T. D. Lee] {598}.

"The desirable features of a system of units in any field are convenience and clarity. For example, theoretical physicists active in relativistic quantum field theory and the theory of elementary particles find it convenient to ***choose*** *the universal constants such as Planck's quantum of action and the velocity of light in vacuum to he dimensionless and of* ***unit magnitude.*** *The resulting system of units (called 'natural' units) has only* ***one*** *basic unit, customarily chosen to be length. All quantities, whether length or time or force or energy, etc., are expressed in terms of this one unit and have dimensions which are powers of its dimension. There is nothing contrived or less fundamental about such a system than one involving the meter, the kilogram, and the second as basic units. It is merely a matter of convenience."* [J. D. Jackson] {599}.

[Violation of Second Law of Thermodynamics] *"We experimentally demonstrate the fluctuation theorem, which predicts appreciable and measurable violations of the second law of thermodynamics for small systems over short time scales... Our results show entropy consumption can occur over colloidal length and time scales."* [Evans et al.][287]

[Implications] *"This result has profound consequences for any chemical or physical process that occurs over short times and in small regions."* [Evans et al.][288]

[Implications] *"The smaller a machine is, the greater the chance that it will run backwards."* [Evans et al., *ibid.]*

[Implications] *"Physicists knew that at atomic scales over very short periods of time, statistical mechanics is pushed*

[287] G. M. Wang, E. M. Sevick, Emil Mittag, Debra J. Searles, and Denis J. Evans, "Experimental Demonstration of Violations of the Second Law of Thermodynamics for Small Systems and Short Time Scales," *Phys. Rev. Lett.*, 89(5), 29 July 2002, 050601.

[288] BBC News, **18 July 2002, http://news.bbc.co.uk/l/hiscitech/2135779.stm.**

> *beyond its limit, and the second law does not apply. Put another way, situations that break the second law become much more probable. ...the new experiment probed the uncertain middle ground between extremely small-scale systems and macroscopic systems and showed that the second law can consistently be broken at micron scale, over time periods of up to two seconds."* [Chalmers] [289]

10.1 Explaining Time as Energy

See Chapter 1, paragraph 1.1.3 and 1.4.1; see also Chapter 2, paragraph 2.1.3. As highlighted in the quotation from Jackson {599}, it is well known that the fundamental units chosen to model physical phenomena are arbitrary. In a physics model whose only fundamental unit is the joule, time is obviously modeled solely as a function of energy, just as mass is modeled today as a function of energy — hence the term "mass-energy". We may also equally well use the term "time-energy", since in a model using the joule as its only fundamental unit the second is purely a function of energy. Specifically, for our purposes 1 sec = 9×10^{16} joules of spatial energy, compressed by the factor c^2 and placed on the 4th Minkowski axis to constitute one second of time. If the compressed spatial energy had been left in 3-space, it would be recognized as *mass*. For our purposes, *time* has the same energy density as mass.

The flow of time becomes a special form of EM energy flow, analogous on the fourth axis to mass flow (translation) in 3-space. Further, as previously pointed out the overall flow of time has extensive internal structuring of component time-energy flows. However, time-flow is in the imaginary plane or connected with it, since in Minkowski space the 4th dimension is modeled as -i*ct*. Note that the only variable in *ict* is the *t*, hence anything varying on the fourth axis is a variation of time and time-energy *a priori*.

Further, we can apply conservation of EM energy to the time domain as well as in 3-space. And we can have "broken symmetry" in time-energy flow as well as in 3-spatial energy flow, so long as the net energy flow is conserved. The most fundamental conservation of energy law is giant negentropy: the automatic circulation of energy from the time domain into 3-space via decompression by the negative charge, thence the slight flow of 3-space energy to the positive charge where the 3-space energy is re-

[289] Matthew Chalmers, "Second law of thermodynamics 'broken'." *New Scientist,* 19 July 2002, http://www.newscientist.com/news/print.jsp?id=ns99992572 .

compressed, thence from the positive charge back into the time domain.[290] That was our solution to the long-vexing problem of the source charge and its associated 3-space fields and potentials and their 3-space energy. From special relativity, one already knows that time can dilate and then *un*-dilate, but each action is associated with an appropriate change in spatial energy. While that change in spatial energy can be kinetic, it does not have to be. It can be a change in potential energy instead. In short, a static object rotates its frame with respect to the observer (lab) frame, whenever it absorbs or emits potential energy.

We also pointed out the connection of time-energy to electromagnetics and to quantum field theory, via the four polarizations of the photon considered to travel in the z direction in 4-space. These four polarizations are with the energy vibrating along *x*-, *y*-, *z*-, and t- respectively. Vibration of the spatial energy of the photon along the *x*- or *y*- axis gives an ordinary transverse photon. Vibration of the spatial energy of the photon along the z- axis gives the longitudinal photon. Vibration of the time-energy component along the t- axis gives the scalar or time-polarized photon. We assume a similar four polarizations for EM waves in 4-space.[291]

10.2 Mechanism Generating Flow of a Mass through Time

As we covered in the referenced paragraphs in Chapters 1 and 2, the fundamental generatrix of the flow of a mass through time — and the structuring of that flow — is the total photon interaction with the mass and all its parts. This includes both observable and virtual photon interactions.

As a recapitulation: Mass *m* does not exist in time, since it is an observable and observation is the imposition of d/*dt* upon spacetime LLLT, removing the T to give a "frozen LLL snapshot." In short, mass m is an *effect* (of the iterative very high speed observation process), not a *cause* (which is an *input* to the observation process). This is why all observation is 3-spatial rather than spatiotemporal: it yields the 3-space *effect* (at a given time, of a

[290] Note the relationship with such things as time dilation, which represents a broken time-flow symmetry, where net energy flow from the time domain to the 3-space domain occurs. Hence time dilation is associated with the increase of spatial energy, such as kinetic energy due to the relativistic velocity of the moving object.

[291] In this book, we have limited our discussion to four dimensions. If we model in five or more dimensions, then additional symmetries and broken symmetries **are** possible, as are new kinds of multi-dimensional EM waves.

given interaction), not the 4-space cause of the interaction and not the ongoing 4-space interaction.

By absorbing and emitting photons, observed mass *m* may be said to move through time in a succession of *m => mt => m => mt => m* ... jumps, each involving change of physical state as a photon is absorbed by *m,* changing it to *mt* which is nonobservable. Then a photon is re-emitted by *mt,* changing it back to *m* and completing another observation with this new *m* as the output (effect). We note that masstime *mt* is as different in nature from mass *m,* as impulse *Ft* is from force *F.* In mass *m,* every tiniest differential *dm* is also interacting with photons continuously (even though they may be *virtual* photons), hence *dm* also exhibits its own "digital flow through time" as a part of the structure of the overall flow of the parent mass through time.

Interaction primarily with the *mt* state yields wavelike interactions. Interaction primarily with the *m* state yields particle-like interactions. This is proposed as a possible resolution of the wave-particle duality problem, which has never been resolved but just accepted without further argument. Previous consideration of wave-particle duality has assumed that "mass has two states, one particulate and the other wavelike". We correct that assumption by pointing out that two different "states in which mass exists" are involved, and the two are quite different: one is mass *m,* and the other is masstime *mt.* We stress the function of the myriads of virtual photon interactions during an *mt* state, where an observable photon has not yet been re-emitted. These virtual photon reactions create streams of virtual *dm => (dm)dt => dm => (dm)dt =>*. . . . .on all the differential parts of mass *m,* which creates the rich structuring inside the "time-flow" of the overall observable mass *m* through time. The rich dynamics of the *dm -> (dm)dt* streams also accounts for the seeming existence of mass *m* as a set of 4-dynamics which interpret as a set of waves. We note that the emitted photon carries with it the internal structuring of the spatial energy domain and the time-energy domain. Herein we have the basis for the Kaznacheyev's demonstrated electromagnetic induction of cellular damage and disease at a distance.[292]

Finally, we tentatively assume that, prior to its interaction, the antiphoton carries negative spatial energy and positive time increments, while the photon carries positive spatial energy and positive time increments. In a

[292] Vlail Kaznacheyev and L. P. Mikhailova, *Ultraweak Radiation in Intercellular Interactions,* [in Russian|, Novosibirsk, 1981.

very small region where an excess of antiphoton interactions occurs temporarily, time-reversal occurs and the physics "runs backward". It has recently been experimentally proven that such "reversing" of the physics processes occurs up to micron size and for times up to two seconds. [293]

10.3 Time-Polarized EM Waves and Longitudinal EM Waves

10.3.1 Waves, Photons, Spacetime Curvature, and Observation

Spacetime (ST) curvature involves not only the change of *spatial* energy density of local spacetime but also a change of its *time-energy* density. That component of the total ST curvature due to time-energy density change — i.e., time-polarized EM photons and waves — can be far more powerful, because of the enormous energy density of the time-energy compared to the far lies dense 3-spatial energy. As previously stated, time may be regarded as having the same energy density as mass, except that the highly compressed 3-spatial energy is moved to the 4th Minkowski axis to constitute "time" rather than being left in 3-space to constitute "mass".

Hence ST curvature can be made very powerful when one uses longitudinal phase conjugate EM *wavepairs*, as shown by Whittaker {600} in 1903 with slightly corrected interpretation as argued by the present author {615}. Each longitudinal EM wave in 3-space is accompanied by a precisely coupled time-polarized (scalar) EM wave in the time domain, which latter wave is a longitudinal EM wave on the fourth Minkowski axis involving changes in the t variable in the axis *-ict*. We previously discussed the giant negentropy that this represents with respect to the source dipole. At various times in the past, we have emphasized the time-domain aspects of the coupled phase conjugate longitudinal EM wave-pair by calling such a coupled wave by terms such as *time-density EM waves, time-polarized EM waves,* etc. These terms imply additionally altering and structuring the *time density* and *time-energy density* of spacetime rather than merely altering and structuring its *3-spatial energy density.* Such time-density induced ST curvatures may be nearly 10^{17} times stronger than ordinary spatial energy density ST curvatures {601}.

Interestingly, at least one researcher — Matsumoto {602} — has realized the basic implication in cold fusion processes of using the strong EM force

[293] See footnotes 287, 288, and 289.

as the agent of spacetime curvature. He has shown consistency of the postulated EM-induced ST curvature approach with some important cold fusion results. However, Matsumoto has utilized the conventional interpretation of spacetime curvature due to alteration of *3-spatial energy density* of spacetime. This misses the primary time-density functions, but does include the resulting spatial-energy functions after transduction from time-energy to spatial-energy. His work, however, does support the involvement of a more intense form of energy in the cold fusion effects.

There are intriguing but still mysterious relationships to be noted between cold fusion and deep astrophysical mechanisms. Continuing reference is made to these similarities, including black holes and white holes. Black holes and white holes involve spacetime curvatures — extreme, but still spacetime curvatures. So one would suspect that the entire scale of spacetime curvature — including black holes and white holes in the limit — should be of interest to cold fusion researchers, since in their use of time energy they are inadvertently involving more intense forms of energy than ordinary spatial EM energy.

Most nuclear scientists and even some relativists seem unaware of the much more powerful spacetime curvature effects obtained by alteration of the *time density* of spacetime rather than just its *spatial energy* density. Physicists have largely omitted specializing on time density ST curvatures because they have largely omitted the absorption and emission interactions of the time components transported by photons and EM waves.

Longitudinal EM phase conjugate wavepairs (each wavepair a coupling of a time-polarized EM wave and a longitudinal 3-space EM wave) of the type shown by Whittaker {600} in 1903 involve net *time density oscillations* as well as 3-spatial energy density oscillations, according to our reinterpretation. The infolded "inner EM content" of all conventional EM potentials, fields, and waves thus contains extraordinary dense time-energy, normally lost in the *d/dt* observation interaction.

In short, the infolded "internal Whittaker electrodynamics is a pure "general relativistic electrodynamics" and a unified field dynamics. Further, it can be engineered, which leads to startling new physical processes previously thought to be impossible and forbidden by the laws of nature.

Prior to observation, the internal highly compressed time-energy structures associated with the interior EM structure of all conventional EM potentials, fields, and waves are extremely powerful spacetime curvatures.

In short, all "conventional" electrodynamics has an internal structure of strong spacetime curvatures and dynamics.

Organization and patterning impressed on, or inserted in, this internal structuring can provide extraordinary actions in materials, living biological systems, cells, etc. Adding deterministic structuring inside these normal EM entities is referred to by Russian energetics weapon scientists as engineering the *information content of the field.* This is the approach behind deliberate engineering of *spacetime curvature engines,* or vacuum engines — or just "engines" for short.

In theory, any physical change to a mass can be engineered by inserting such "engines" into the mass. Any mass-energy is a mass-energy EM potential with an internal structuring (engine) for all the mass's internal dynamics. This engine is referred to as the *resident engine* of that mass (and all its dynamics). Introducing to a given mass a potential with a desired "delta engine" structure, results in the superposition of the two potentials, resulting in exchange sharing of the engines. In that manner, a desired "delta engine" diffuses into the mass's potential structure and its resident engine, changing it to a new resident engine which now acts on the mass at every level to change it. Potentials superpose, and their engines diffuse and superpose as well. Direct engineering of matter — even inside the nuclei and inside the nucleons themselves — can be performed by introducing the desired engine or engines for the changes desired.

This area has been highly weaponized by one or more nations. E.g., the Russians — in several decades of so-called "microwave radiation of the U.S. Embassy in Moscow — induced health changes and diseases in U.S. personnel in the Embassy by inducing deliberate "disease engines". Such EM-induced diseases and health changes were generated in the zones where the potentials were field-free, and therefore stable for stable engine diffusion.

Note that the common scalar potential decomposes by Whittaker's 1903 decomposition {600} into the longitudinal EM wavepairs we are speaking of. Also note that, per a second paper by Whittaker in 1904 {91b} that initiated superpotential theory, all EM fields and waves can be decomposed into two scalar potential functions. Each of those base potentials involved in the potential functions further decomposes by Whittaker 1903 into a harmonic set of phase conjugate longitudinal EM wavepairs as previously discussed. Therefore, the infolded EM inside all the "conventional" EM fields, waves and potentials is indeed a highly organized set of such bidirectional longitudinal EM wavepairs and thus a

highly organized set of extreme localized ST curvatures. In other words, it is comprised of these special "engines" of deterministic spacetime curvatures and their dynamics.

Constructing the potential by assembling one's own set of phase conjugate longitudinal EM wavepairs to form it, one can insert any kind of ST curvature set — any kind of vacuum engine desired — inside the base potential(s), hence inside the two potential functions comprising a given set of EM fields and waves utilized as "carriers". The specific internal structure of a "carrier" radiation field or potential designed to carry such engines is called the "information content of the field".[294] The Russians have long had a disinformation campaign to suggest that the term refers to conventional spectral analysis. It does not.

Johns Hopkins scientists did detailed measurements inside the Embassy and confirmed that all the anomalous health changes and diseases had occurred only in areas where the EM fields B and E were absent. That is, the health changes occurred only where the potentials were field-free and therefore stable and unchanging, so that an exposed body was immersed in a steady sea of "vacuum engines" being diffused throughout the targeted body's EM potentials in and on its cells, its cellular membranes, etc.

In general relativistic terms, every physical set of changes and altered dynamics (syndrome) of a specific disease has a specific *delta* set of spacetime curvatures and dynamics associated with it, which interacts on the body, its chemistry, its electrodynamics, its cells, etc. A desired set of

[294] Indeed, in theory one can *construct, functioning robotic systems* of these internal engines. In clandestine Russian weapon research, it appears that at least elementary "causal robots" of such internal engine type have been developed and tested. In a sense, these are the ultimate "nanobots" made of infolded longitudinal EM waves and their dynamics. In theory, command and control functions (via longitudinal EM wave communication) can be included, as can certain kinds of weapons effects based on scalar interferometry. The eventual development of such startling weapons seems intended to produce an army of eerie "internal EM" robots which can be "sent in" *through the interior of EM fields, waves, and potentials,* to targets anywhere on earth, beneath its surface, in space, or beneath the ocean. This may be intended to become the ultimate robot or "high tech" warfare, and it is also the ultimate "information" warfare. There are no shields against this type weaponry. Defense, however, is accomplished by first using longitudinal wave "scanning" to pick up and track the systems, much like radar picking up aircraft. Once detected, scalar interferometry is utilized to disrupt and destroy them in place. Progress on these robotic weapon systems appears to be well along, as does progress on their countering longitudinal EM wave weapons.

ST curvature deltas for a given disease was inserted inside the base potentials in a combined Whittaker 1903 and 1904 decomposition of the stable field-free potentials in the Embassy. The Russians thus induced the desired engines for induction of the specifically desired disease(s) in the assigned personnel in those field-free potential zones in the Embassy. The purpose was to use the tests as (i) a guaranteed means to provoke high level U.S. governmental attention, and (ii) a probe to see if the U.S. knew about such technology and had developed defenses. Other tests of such disease induction in entire populations have also been conducted, but these are beyond the scope of this book.

We point out one very important thing: the cells of the body have their normal "resident engines" and resident engine dynamics inside their internal fields and potentials and waves. For any specific disease or disorder condition, there exists a specific associated change (delta) in the normal set of vacuum engines and their dynamics, in the cells and the body. In short, there exists a specific "delta engine" for any cellular disease or disorder, added to the normal engine.

It is not the immune system that heals. Instead, it is the cellular regenerative system. The natural healing method used by the cellular regenerative system is not chemical. The regenerative system uses the phase conjugate wavepair composition of increased scalar potentials (on cellular membranes and every part of the cell) to "pump" the cells in the time-domain. This creates an "anti-engine" for the specific disease delta or disorder, and it slightly amplifies this anti-engine within the limited capabilities of the body. This action places this amplified anti-engine also into the stricken cells' engine complex. Engines superpose, just as do potentials. This action by the regenerative system has the effect of slowly producing complex anti-forces in the body and inside the cells themselves, eliminating the detrimental engine delta, restoring the normal resident engine and thus time-reversing the stricken cells back to a previous healthy condition. It does not kill pathogens at all; that is the function of the immune system. In the 1960s and early 1970s, Antoine Priore in France demonstrated remarkable cures of terminal tumors, infectious diseases, clogged arteries, and other disorders in laboratory animals,[295] unwittingly

[295] See (a) A. Priore, *Guerison de la Trypanosomiase Experimental Aigue et Chronique par L 'action Combinee de Champs Magnetiques et D 'Ondes Electromagnetiques Modules* [Healing of intense and chronic experimental trypanosomiasis by the combined action of magnetic fields and modulated electromagnetic waves], Priore's thesis submitted in candidacy for the doctoral degree, 1973. The thesis was rejected when the project was suppressed. See also (b)

amplifying the body's own master regenerative mechanism. His work was suppressed in the mid-70s.

Check our website, www.cheniere.org, for a 119-slide "porthole" briefing on the present author's extension whereby specialized mixes of ordinary EM waves can be used to initiate and perform this "delta engine elimination" healing process, and it can be highly amplified well beyond the body's normal healing capabilities.

In 1998 we seriously proposed to the DoD, the USAF, the NIH, and other U.S. government institutions that a crash development program be initiated to develop portable units capable of rapidly (5 minutes per patient) treating mass casualties from coming terrorist attacks with weapons of mass destruction such as anthrax, smallpox, bubonic plague, Ebola virus, etc. Sadly, no one in the U.S. government had the foggiest notion of what we

"Le Probleme Priore," *Rapport de la Commission de 1'Academie des Sciences a Monsieur le Ministre d'Etat charge de la Recherche et de la Technologie,* 1982, p. 1-22; (c) Antoine Priore, "Precede et dispositif de production de rayonnements utilisables notamment pour le traitement de cellules vivantes," [Procedure and Assemblage for Production of Radiation Especially Serviceable for the Treatment of Living Cells], Republique Francais Brevet d'Invention P.V. No. 899.414, No. 1,342,772, Oct. 7, 1963; (d) Antoine Priore, "Method of producing radiations for penetrating living cells," U.S. Patent No. 3,280,816, Oct. 25, 1966; (e) Antoine Priore, "Apparatus for producing radiations penetrating living cells," U.S. Patent No. 3,368,155, Feb. 6, 1968; (f) A. J. Berteaud and A. M. Bottreau, "Analyse des rayonnements electromagnetiques emis par l'appareil Priore," [Analysis of the electromagnetic radiations emitted by the Priore apparatus], D.R.M.E., 1971, p. 3-12.; (g) R. Courrier, "Expose par M. le Professeur R. Courrier, Secretaire Perpetuel **de** L'Academie des Sciences fait au cours d'une reunion a LTnstitut sur les effets de la Machine de M. A. Priore le 26 Avril 1977," [Presentation by Professeur R. Courrier, Perpetual Secretary of the Academy of Sciences, made at the meeting of **the** Academy on the effects of the machine of M. A. Priore]; (h) R. Pautrizel, A. Priore, M. Dallochio and R. Crockett. (1972) "Action d'ondes electromagnetiques el de champs magnetiques sur les modifications lipidiques chez le Lapin par l'administration d'un regime alimentaire hypercholestrole." [Action of electromagnetic waves and magnetic fields on provoked lipidic modifications in the **rabbit** by the administration of an alimentary hypercholesterol diet.] *Compt. Rend. Acad. Sci. (Paris),* Vol. 274, 1972, p. 488-491. The same university that rejected Priore"s doctoral thesis in 1973, accepted a doctoral thesis on the same subject some 11 years later due to the persistence of Pautrizel: See (i) Eric Perisse, *Effets des Ondes Electromagnetiques et des Champs Magnetiques sur le Cancer et la Trypanosomiase Experimentale [Effects of Electromagnetic Waves and Magnetic **fields** on Cancer and Experimental Trypanosomias],* Doctoral thesis, University of **Bordeaux** No. 83, March 16, 1984.

were discussing. At NIH, we never got out of their "policy" (i.e., "spin control") department. Not a single capable scientist reviewed the extensive package. The attack on the World Trade Center and the Pentagon on Sept. 11, 2001 is just a forerunner of that which is to come. We could have been prepared to save hundreds of thousands of Americans, even millions. We shall not be ready, and the first really professional anthrax or smallpox (or camel pox, which is easily available and almost exactly the same as smallpox) attack on a major U.S. population center may leave from one to three million Americans dying in the streets and in their homes. Presently nothing will save them. It could have been different.

10.3.2 Photons and Waves in Minkowski Spacetime

Photons are made of angular momentum (action); i.e., of *energy x time*. Waves, being made of photons, carry both spatial (decompressed) energy and time (highly compressed) energy — although physics has largely omitted the *time-energy-carrying* aspect, and only accounted for the *spatial energy-carrying* aspects. An EM wave in space is actually a wave of the particular spacetime curvatures that produce angular momenta in interacting charged masses. The standard notion of E and B fields at right angles in a plane in 3-space, traveling along the *z*- direction and with the plane orthogonal to *z*-, and with E and B field vectors oscillating back and forth, is nonsense, as acidly commented upon by Romer {603}, the former editor of *American Journal of Physics*.

Nonetheless, using the standard way of modeling the "transverse" EM wave: In conventional electrodynamics, a *transverse EM wave* is one where the 3-spatial energy density is considered to be varying rhythmically at right angles to the direction of wave propagation, and the time-density is assumed to be non-varying, or at least altered only by special relativistic considerations in certain cases.[296] A longitudinal EM wave has its spatial energy density fixed in *x*- and *y*- directions, and its energy density is oscillating along *z*-, the direction of wave propagation, by a "compression" and "rarefaction" process much like squeezing an accordion. This, however, leads to a "galloping" motion where the wave is alternately very superluminal and very subluminal at given instants, but moving at an *average* velocity of *c* {604}. On the other hand, a *time-density (scalar) EM wave* by definition is not varying in its 3-spatial energy density, and

[296] We point out that a wave of varying spatial energy density is moving in a varying curved ST a priori, by general relativity. If the "wave" were in a flat spacetime as normally assumed, the EM flat spacetime would eliminate the EM wave itself. **This** has been particularly pointed out by Sachs and by Evans.

therefore is not varying in *x*-, *y*-, or *z*-. Instead, the energy is in the form of time-energy, and its variation is in time density. So its energy density is oscillating along the fourth Minkowski axis, *ict*, as an oscillation of the energy density of the variable *t*. It is therefore polarized in the t- direction.

10.3.3 Time-Charging, Internal Structuring, Vacuum Engines, and Diffusion

Photon interaction as a *spatial* energy collection or energy exchange process is well known in physics. However, the time-charging or time-excitation interaction between the mass and the time component carried by the photon is usually ignored.

As is well known, an atomic electron that absorbs a transverse photon increases its spatial energy and changes into an excited spatial energy state. When the electron subsequently "decays" from that excited energy state to a lower state, the spatial energy differential between the two states is emitted as the spatial energy component of an emitted photon. This is the *spatial energy density* reaction of a transverse photon with an absorbing and emitting mass particle.

Unaccounted for by physics, at the time of the energetic excitation of the mass (i.e., when the photon is absorbed), a time excitation — time charging — also occurred because the time-component of the absorbed photon is also attached to the mass, converting it to *masstime*, a new entity. Re-emission of the photon is accomplished by the decay of both the *spatial energy* excitation and the *time-energy* excitation. In the previously excited state after photon absorption, however, one did not have the entity "mass", but the entity *masstime* having greater topology. If mass is an observable and taken to be 3-spatial (as is conventional), then photon absorption and emission oscillates between 3-space and 4-space effects, generating both spatial energy and time-energy (or *angular momentum)* excitation and decay.

Further, only *masstime* emits a photon. This immediately casts a very different light on such things as radioactive elements, which are in an initially excited state. Discussion of this aspect, however, is beyond the scope of this treatise.

On the other hand, a *scalar (time-density)* photon {605, 606} has a rather different interaction, regardless of how physics presently treats it. Any atomic electron at any energy level is continually receiving and emitting virtual photons - transverse, longitudinal, and scalar- in its virtual photon exchange with the energetic vacuum. Hence it is continually "connecting to" or "absorbing" time components, thereby changing its nature from

mass to masstime, back to mass, back to masstime, etc. Not only the entire electron but also each differential piece of it is performing that dance between mass and masstime. This is a continual changing from 3-space to 4-space and back. There thus is a violent "chatter" of the electron (and each differential piece of it) in the myriad levels of its *time* exchanges, giving it

(i) An average rate of time component exchange,

(ii) An average "time-charge", and

(iii) A dynamically changing, specific structuring of its time components.

Whenever a mass absorbs an observable photon, the mass converts to masstime, with an "extension in time" as well as extension in 3-space. During the time-interval created in the masstime, myriads of virtual photons are absorbed and emitted by that mass component of the masstime entity. Hence every dt portion of the masstime state after observable photon absorption, is "internally structured" by the entire virtual photon interaction set's At's occurring within that time interval.

By tailoring at least the larger elements of this internal structuring of the masstime state's virtual photon bombardment, by a deliberately induced virtual photon bombardment, the emitted photon from the masstime decay will carry away with it a desired internal "vacuum engine" structure of organized curvatures of spacetime. In short, two potentials superpose; that is one of their primary features. When they superpose, they also diffuse their internal structures (internal vacuum engines) into each other.

We speak of the *diffusion ofa specific vacuum engine* placed in one interacting EM potential, field, and or wave as *dimensioning* the potential, field, or wave. Adding a dimensioned potential, field, or wave to other potential(s), field(s), or wave(s) diffuses the dimensioning (the engines) between all of the participating entities. With steady radiation of such dimensioned signals into a targeted object, field, wave, or potential, the dimensioning is gradually created (kindled) in the target, simply diffusing throughout it and gradually accumulating. If the irradiating signal carries a specific disease — e.g., necrotizing fasciitis — then gradually in the irradiated body there will emerge all the symptoms of necrotizing fasciitis. If the irradiating signal carries a specific disease antiengine — e.g., for necrotizing fasciitis — then gradually the necrotizing fasciitis condition will be eliminated, with the disease organisms also being eliminated.

This is a more fundamental extension of the disease vector concept. Not only can a disease vector be induced by a physical organism such as a virus or bacterium, but it can also be introduced by simply capturing the fundamental vacuum engine pattern of the disease and using it to condition or dimension signals used to steadily irradiate the targets.

This is the explanation of the Kaznacheyev experiments {607}: thousands of experiments performed by Vlail Kaznacheyev and his colleagues demonstrated the induction of almost any kind of remote specific cellular death and disease patterns in targeted cells, by absorption of radiation emitted from appropriate dying or diseased "emitter" cells with that condition, if the experiments were performed in the dark.

Instead of looking for biogenesis causes in amino acid precursors to cellular life in meteorites etc., one might well look into the *vacuum engine structures* inside the light from the sun, the planets, the stars, and the universe in general. E.g., dead sperm can often fertilize female cells, if not too much physical damage and deterioration to the dead sperm cells has yet occurred. This is understandable, since for a time a dead but undamaged sperm cell will have the same resident engine as a living sperm cell.

10.3.4 Some Cosmological and Gravitational Effects

Each of the observable-sized dt's in all the serial masstimc excited states of the mass moving through time, is internally and precisely structured. **The** precise time history of any mass — together with all its interactions, experiences, etc. — is present inside the time stream of ongoing interactions of that mass with photons. These virtual photon changes are in fact deterministic and come from every part of the universe, as shown by Puthoff {608} in his self-regenerative cosmological feedback cycle. We have merely extended his cosmological feedback to include the time **domain** as well as the energy domain. We hypothesize without further **discussion** that this internal structuring of the time-domain for every mass or object will eventually be connected with the quantum concept of the ge**ometric** phase {609}.

When a transverse photon interacts with a mass in the presence of other **photon** interactions, the mass can act as a phase conjugate mirror and form the phase conjugate replica photon (an antiphoton). For a longitudinal **photon,** the antiphoton *prior to observation* is a scalar photon. We propose that in the unobserved causal state the photon and antiphoton can couple (strong interpretation of the distortion correction theorem) and form a spin-**2 graviton.** According to quantum field theory, one may already interpret

the common scalar potential as being comprised of such spin-2 gravitons {610, 611} if we speak of the situation prior to observation.

As opposed to the accounted *spatial energy charging* of the familiar transverse photon interaction, the longitudinal photon interacting with mass will cause immediate phase conjugation by the mass because of the accompanying scalar photon (accompanying antiphoton prior to observation). When one pumps with longitudinal EM waves, one also inadvertently pumps with time-polarizcd EM waves simultaneously.

From its background "time-energy pumping" in its vacuum exchange, the mass forms the phase conjugate replica, which couples to the incident longitudinal EM photon. This forms (wave view) bidirectional longitudinal EM wavepairs (conjugate pairs), comprised of (particle view) internal coupled longitudinal photon-antiphoton pairs. Each of those internal photon-antiphoton pairs is a spin-2 graviton.

Each such conjugate longitudinal wavepair actually contains a time-density (time-polarized) or scalar EM wave. So the interaction of LWs and their accompanying scalar waves immediately initiates the formation of time-density waves, which then primarily perform a *time-charging* interaction. In addition, even for an equilibrium time-charging state, the "masstime" state of the interacting electron contains a specific structure of the time elements in the electron-time's time component. Each of these infolded time elements is also time-charging the electron.

10.3.5 Charging and Excitation Considerations For Cold Fusion Purposes

So there are several new types of charge or excitation that are involved in cold fusion and other phenomena. One may speak of charging and excitation such as gravitational charging, time charging, time-energy excitation, time-energy charging, etc.

Both the longitudinal photon and the scalar (time-polarized) photon are in fact known in physics, but usually neglected, at least at the end of calculations. E.g., Gray {612} puts it this way about the four kinds of photon polarizations and the habitual elimination of the higher ones:

> *All that quantum theory can say is that there are two transverse photons, a longitudinal photon and a scalar photon. It must be decided by other means which are "desirable" states and then it is customary to "eliminate" the longitudinal and scalar photons by invoking a*

subsidiary condition, now somewhat weakened from the Dirac form.

For our purpose in examining the cold fusion experiments, there exists a completely unsuspected "time-charge" set of excited states for an atomic electron, a proton (as in an H+ ion), etc.[297] There also exists a "time-structuring" of the time-charge excited time-state, which we will see is important in certain highly anomalous instrument phenomena. Uncovering this time-charging and time-structuring interaction has been one of the major results of this author's long effort to decipher the functioning of the healing (cellular regeneration) system of the body as well as his efforts to decipher the fundamental nuclear transmutation mechanism in cold fusion transmutation interactions at feeble *spatial* energy.

In summary: For longitudinal photon interaction, the atomic electron "absorbs" the longitudinal photon and its accompanying scalar photon, being simultaneously spatial-energy excited (charged) by the longitudinal photon and time-energy excited (time-charged) by the scalar photon. This time-excited state (of masstime) then subsequently decays, emitting a longitudinal photon accompanied by a scalar photon in the process.

[297] See again footnotes 287, 288, and 289. From our mechanism propelling a mass through time, time-charging and discharging play the causal role. The acquisition of dt by mass *m* produces masstime *mt*, then the subsequent photon emission decay of *mt* back to *m* produces "propagation of mass *m* forward through time" by one "jump". Time charging with -dt and subsequent photon emission is what produces "propagation of mass m backwards through time" by one "jump". Evans et al. proved that even up to the micron scale physical particles and their dynamics can run backwards in time for up to two seconds or more. The fluctuation theorem proved by Evans and his colleagues in 1993 shows us that, at the scale of a proton and neutron, there can become a high probability of significant time reversal of the physical dynamics. This means that the law of attraction and repulsion of charged particles -such as two H+ ions in solution — "runs backwards" or is reversed, so that momentarily like charges attract and unlike charges repel. We have called the region in which this reversing of the physics occurs a *time reversal zone* (TRZ). With the reccentwork of Evans et al., the existence and occurrence of TRZs even well above the proton (the H+ ion) level is now clearly established, including the reversing of the physical dynamics. These concepts have not yet been applied to cold fusion interaction results by the leading cold fusion researchers, but they now stand as explaining the most probable mechanism for the observed phenomena. In this Chapter we have written some of the typical new nuclear reactions that can occur in such a TRZ, and the exact products of these reactions are widely reported in several hundredsuccessfulcoldfusionexperiments.

We shall return to time-charging and time-charge decay when we examine and explain the odd instrumental anomalies experienced for some time in experiments at China Lake.

10.4 Time Reversal Zone and New Nuclear Reaction Mechanisms

It follows that the flow of a mass through positive time must involve a preponderance of reactions with photons rather than antiphotons, since *net* absorption and re-emission of photons (rather than antiphotons) is involved. Otherwise, the absorbing and emitting mass would not accomplish little "jumps" forward in positive time.

Suppose we deliberately arrange a situation where the target mass is interacting with a preponderance of antiphotons. In this case, the mass will be time-reversed, as will be the EM energetics. [298] This leads us to the novel concept of a *time reversal zone* just described in footnote.

A time-reversal zone (TRZ) is a region of space, or electrolyte, etc. in which given masses or charges of interest are interacting on the average with more antiphotons than photons. Consequently, in the TRZ the usual EM energetics are reversed and normal charge reactions appear to "run backwards" insofar as the spatial 3-space observer is concerned.

For example, in electrolytes in a region of highly loaded positive charges in a loading palladium lattice with properly prepared surface, a very great number of double surfaces exist. Hence a great number of scalar interferometries continually occur from that large number of double surfaces acting as scalar interferometers {613}. Because of the highly excess positive charge loading, these interferometers are predominately fed by negative EM energy from the positive charges. Hence, in the distant interference areas in the electrolyte outside the palladium lattice, some

[298] This *is not* time-travel in the classical science fiction sense. For time-travel, the traveling object must remain moving in its own forward time, while the entire remainder of the universe must be reversed in its time and must move backward in time to a past coordinate. That is not what is happening here, and no one is suggesting we can time-reverse the rest of the universe! Instead, energy can be reversed in time, as proven in nonlinear phase conjugate optics. So can mass-energy and charge-energy, as shown by the Dirac theory of the electron. An *observed* positron is an electron observed while traveling backwards in time, so to speak, with respect to the observer. But it is observed in observer forward time as traveling in the opposite spatial direction, having positive mass and positive energy, and with the sign of its charge reversed from negative to positive.

negative energy fields and negative energy potentials are produced dominantly. An excess of antiphotons is produced in those interference zones where an excess of antiphotons appear due to the scalar interferometry. In *those* little interference zones, the simple positive ions are momentarily bathed in an excess of antiphoton interactions. This is therefore a time-reversal zone of momentary time-reversed EM energy flow.

From a palladium lattice loaded with H+ or D+ ions, and also having a proper surface with many work grooves and thus many small interferometers, random fluctuations in the scalar interferometry occur in the adjacent electrolyte. Some of these random scalar interferometries continually form fleeting *time reversal zones* (TRZs) in their interference zones in the surrounding electrolyte. The very large energy required for the formation of each TRZ and its reversal of the normal laws of attraction and repulsion of charges, is available from conversion of time energy from the time domain as a result of the giant negentropy mechanism in 4-space ongoing in the loaded positive charges (614, 615} in the palladium lattice.

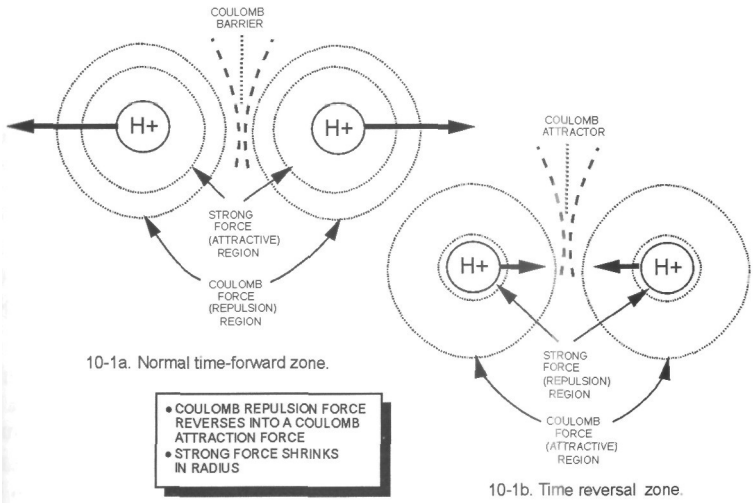

Figure 10-1 Forces on nuclei of simple ions in time-forward and time-reversal zones.

See Figure 10-1. In Figure 10-la, two hydrogen ions (two free H+ protons) in a normal electrolyte and in a normal time-forward zone are shown. The

Coulomb barrier dramatically increases the forces of repulsion between the two H+ ions as their kinetic energy may be driving them momentarily toward each other. This Coulomb barrier becomes so strong that it stops the approach of the two ions and forces them back apart, or to deviate aside from their paths, before each can ever enter the very short-ranged strong force region of the other. Consequently no nuclear reaction occurs, but only a common chemical reaction. The maintenance of that Coulomb barrier is all that prevents energetic ions from being driven together closely enough to engage the strong force and cause the ions to form a new nucleus (cause a transmutation).

Now see Figure 10-lb, for the same two ions that suddenly find themselves in a momentary time-reversal zone (TRZ). In a temporary TRZ, suddenly like charges attract and unlike charges repel, exactly in reverse of the *normal* behavior of charge attraction and repulsion. The usually increasing Coulomb barrier (repulsive force between the two approaching H+ ions) has disappeared and been replaced by an increasing Coulomb attractor (attraction force). Further, the strong force has been partially reversed and much weakened since the gluon forces are dramatically reduced and fluctuating.[299] The attractive strong force is now a partially *repulsive* force and so it is much weaker. Consequently, the quarks in a proton or neutron are not nearly so strongly bound as they are in a normal time-forward zone (TFZ).

A TRZ represents a highly time-charged excited local state in that local region of the electrolyte. The moment a TRZ is formed, the surrounding ions in the electrolyte outside the TRZ immediately move or deviate their movements to reverse this TRZ action[300] and convert it back to a time-forward zone (TFZ). Hence once it is born in the electrolyte, the TRZ decays rapidly due surrounding ion movement changes, and even more

[299] Again we stress the tremendous energy density of the time-energy involved. These cold fusion interactions are actually higher *total* energy reactions than nuclear physics presently uses, even though the *spatial* energy density of the reactions is very small. Together with the now-proven fluctuation theorem of Evans et al., the TRZs and reversal of the normal Coulomb barrier into a Coulomb attractor open up a vast new nuclear chemistry of direct nuclear transmutation reactions at low spatial energy but at very high tempic energy. The ability to directly engineer the quarks and the gluon forces, e.g., opens up a new chemistry of direct subparticle engineering heretofore considered quite impossible by chemical means.

[300] Their approach increases the fraction of photon reactions relative to antiphoton reactions, since the other ions are moving in a TFZ on the average.

rapidly due to the rapid variation in the fluctuating scalar interferometers in the loaded palladium lattice. In most cases, the random fluctuation in the scalar interferometry is so rapid that the TRZ decays back to a normal TFZ before the two approaching H+ ions can reach each other (reach each other's reduced strong force repulsion region). However, in a certain percentage of approaches, the two approaching like-charged ions will "reach each other" — i.e., each will enter the weakened strong force region of the other before decay of the TRZ occurs.

See Figure 10-2. In Figure 10-2a, we show the case in which the TRZ lasts long enough for the two H+ ions to reach each other's strong force repulsion zones and form a quasi-nucleus. Here they vibrate back and forth in a dynamic dance around the zero net force axis between their repulsive strong forces and their attractive Coulomb forces. In this case, a new kind of nuclear reaction is set up to occur. Decay from this excited quasi-nucleus state in a TRZ can occur into a real nucleus in a normal TFZ. Energetically, because the quarks are so loosely bound now[301] the preferred decay mechanism when TRZ -> TFZ is by appropriate *quark flipping.*

As a little bit more time passes, the interferometry changes and the TRZ decays, returning back to a normal TFZ. In a change from TRZ to TFZ, the energy change is enormous because time-energy is involved, with energy density equal to mass. The only difference in a proton and a neutron is the orientation of one quark (three quarks make up each of the particles). As TRZ decay starts and progresses, the strong force changes back to a powerful attractive force. It increases its strength far more powerfully and quickly than the Coulomb attractive force reduces its reversal and changes back to a repulsive force. The addition of the extra energy from the now-increasing strong attraction force simply causes one nearly-freed quark in one of the two H+ ions to flip, converting that H+ ion into a neutron n. Instantly the preferred decay product is the deuterium ion D+. So the H+ and the n simply draw a bit closer together, each now fully inside the

[301] To appreciate the sheer raw power of the time-energy control of interactions, simply examine the enormous *spatial* energy density required in high energy physics to try to approach the "free quark" condition. Enormous and very expensive *spatial energy* accelerators are used, at the absolute state of the art. By going to the use of the extraordinarily dense time-energy, quarks can readily be freed or nearly freed in electrolytes, and they are nearly freed in more than 600 relatively simple and inexpensive cold fusion experiments {753) on the bench-top to allow new nuclear reactions by quark flipping, where a proton turns into a neutron or vice versa.

rapidly increasing attractive strong force region of the other. This converts what had been a quasi-nucleus of two H+ ions into a real D+ nucleus. This result is shown in Figure 10-2b.

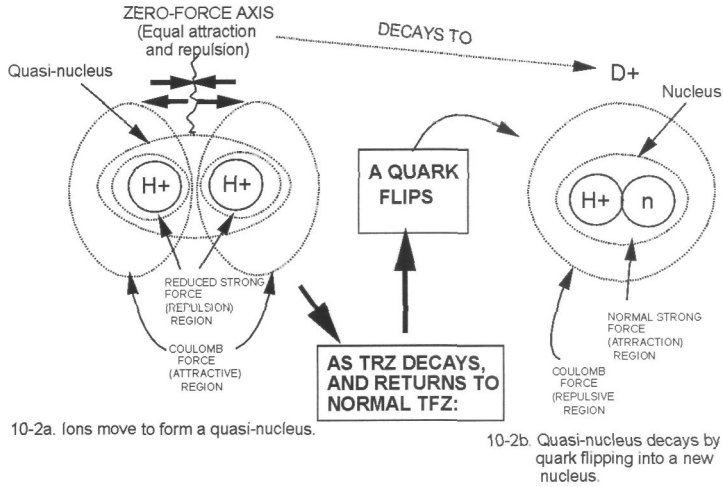

Figure 10-2. Production of quasi-nucleus and its decay by quark-flipping into a new nucleus as the time-reversal zone decays back to a time-forward zone.

Recapitulating: As the TRZ subsequently decays back to a normal time-forward zone (TFZ), the new quasi-nucleus becomes an excited state, and decays. However, the quasi-nucleus decays by very novel means. Because of the time reversal, the energy changes induced in the decay *start* at each spacetime point inside the quasi-nucleus, deep inside the quarks, and proceed outward. The first interaction of the decay mechanism is with the quarks comprising the nucleons (in this case, the protons). With the gluon forces still very much weakened, quark flipping becomes the preferred decay mechanism. Hence one quark in one proton flips its orientation (that is the mechanism of decay!) and the nucleus — now a nucleus comprised of a proton and a neutron — becomes a nucleus of deuterium.

As can be appreciated, the clustering of different types of like-charged but relatively simple positive ions in TRZs in solution, with subsequent decay of the TRZ into a TFZ, initiates a revolutionary new family of nuclear reactions at low spatial energy (but very high temporal energy), completely contrary to, and not included in, the present forward-time high-spatial

energy (but very low time-energy) reactions model known in particle physics.

In the future, as these new time-energy-based reactions are extended and mastered, scientists will simply assemble desired nuclides in solutions in the laboratory, at low spatial energy (but high time-energy) and at will. We point out but do not pursue further the fact that these new reactions also open up cheap, practical, electrochemical means of altering nuclear and chemical wastes. We therefore foresee a dramatic development in this area, in order to clean up the presently polluted biosphere of much of the chemical and nuclear waste contaminants.

Indeed, we propose that a very strong program in mastering these new nuclear reactions be launched and supported by the U.S. Department of Energy, so that the nuclear wastes storage problem can be permanently solved, much more cheaply, and without having to store hazardous nuclear wastes for centuries. Instead of merely *talking* about "out-of-the-box thinking and research", the DoE should actually do some of it, over the violent objections of the entrenched conventionalists of the national laboratories. Their own great national laboratories are the major part of the problem, not the solution, for both innovative nuclear reactions and innovative energy systems! The problem is that "in-the-box" entrenched conventionalists do not perform or allow "out-of-the-box" research that strongly threatens their vested interests.

The TRZ decay conversion of two protons into a deuteron — by easily flipping one quark in one proton — is an example of the so-called "nuclear reaction at low energy" that has been so controversial *to* the orthodox scientific community, even in the face of some 600 successful cold fusion experiments. Contrary to the assumption of the conventional physics community and the skeptics, these are not "low *total* energy" physics reactions at all. Instead, they utilize energy density on a level commensurate with that achieved in the largest accelerators available and even much higher. *This is actually a much higher <u>total</u> energy physics than the present conventional high energy physics heretofore known or used.*

Particularly in a deuterium-enriched (deuterated) electrolyte, a variety of simple ion arrangements of D+ ions and H+ ions can occur. Many of these combinations and arrangements can and will occur in TRZs if sufficient loading of the palladium lattice is achieved. Below we will present and explain a few of these new nuclear reactions that have occurred in successful cold fusion experiments. First, to be tidy we must correct the

present statement of the conservation of energy law by extending it to include time-energy.

The excess heat usually experienced in the electrolyte is explained by the added negentropy (added energy) from the time-domain, which then dissipates randomly in the solution, producing excess heating. Later we will cite strong experimental evidence for the involvement of such time charging (time-energy charging), with subsequent time-charge (time-excitation) decay as ordinary photons in cold fusion experiments.

10.5 Revision of the Conservation of Energy Law

10.5.1 Unaccounted Transduction Extends the Conservation of Energy Law

Along with the re-emission of all the previously absorbed spatial energy, all the previously absorbed time-charge of the excited electron may be re-emitted with a longitudinal photon/scalar photon pair (a graviton) when the time-excited state decays. In that case, no energy-charging permanent change results to the electron's original energy state. Hence no "electron wiggle" will be created and our normal "electron wiggle" detectors performing such non-transducing longitudinal EM wave interactions will not exhibit an indication. In short, the "pure" time-charging EM LW interaction is unobservable to present instruments. All they "see" is the "same electron" sitting there and "flowing through time".

However, if two or more such gravitons are simultaneously emitted from various reactions in time-decays, the emitted scalar photons and waves may interfere at some little distance. In that case, transverse EM waves and ordinary EM energy will be produced in the interference zone {613}. To the external observer, these EM fields and forces will simply seem to arise spontaneously and emerge from every point in spacetime inside that interference zone, moving outward from there in conventional "propagation through space" manner. In that case, the normal "photon" (actually, graviton) decay processes plus scalar interferometry have resulted in transducing some time-energy into ordinary spatial EM field energy. Such reaction provides the excess heat demonstrated in successful cold fusion experiments.

This is also a true action at a distance reaction, presently unaccounted in particle physics. Action at a distance is required in quantum mechanics, and it has been experimentally demonstrated multiple times in distant photon correlation experiments. Once any action at a distance is admitted because it has been experimentally proven, there is no logical restriction

that only a single mechanism exists for it. Consequently, many of the present foundations assumptions of physics and some of the things previously abandoned because of their conflict with those assumptions will have to be re-examined {616}.

Scalar interferometry is indeed a mechanism for action at a distance. While still mostly absent from open physics, it has already been weaponized by some 10 nations of the world. Indeed, U.S. Secretary of Defense William Cohen confirmed in 1997 that (novel) electromagnetic processes are already being used to initiate earthquakes, stimulate volcanoes into eruption, and engineer and control the weather {617}. Whether or not it is present in the particle physics texts, scalar interferometry is being widely used clandestinely in several armies today. It has also been used to shoot down missiles and aircraft as tests. The so-called "Cold War" was not quite as cold as the news media and U.S. scientific community were led to beleieve.

Because of the ubiquitous involvement of unaccounted time-energy in all photon interactions, an extension to the present form of the conservation of energy law is required. The present (special case) law is

$$E(E)_1 + E(m)_1 = E(E)_2 + E(m)_2 \qquad [1]$$

where E(E) = energy in conventional non-massive energy form, E(m) = energy in mass form, subscript 1 refers to the measurement at time 1, and subscript 2 refers to the measurement at time 2. This is just the well-known Einstein formulation that the sum of the ordinary energy and the mass-energy is conserved.

However, that law is for a special case. It assumes that there is no transduction of time-energy into either mass-energy or ordinary energy. I.e., it assumes 3-symmetry and t-symmetry in EM energy flow. Since every charge in the universe already violates both that 3-symmetry and t-symmetry of energy flow, the fundamental assumption in the Einstein formulation is falsified by the general case. The conventional conservation of energy law is a special case where only the two mentioned energy flow symmetries are upheld. When they are violated, then transduction of EM energy between 3-space and time occurs. For that case, the conservation of energy law must be extended to

$$E(E)_1 + E(m)_1 + E(t)_1 = E(E)_2 + E(m)_2 + E(t)_2 \qquad [2]$$

The **new** law simply states that the sum of the ordinary spatial energy, the **mass-energy,** and the time-energy is conserved. This extension of the conservation of energy law becomes important in successful cold fusion

experiments, where transduction of time-energy into ordinary heat energy occurs and where one encounters very anomalous reactions differing from those reactions known and accepted in conventional nuclear physics.

10.5.2 Transduction Between Time-Charging and Spatial Energy-Charging

The oscillating energy (spatial and temporal) in a moving EM wave in the vacuum represents a moving oscillation of spacetime curvature. Simply put, the so-called electromagnetic wave in space is actually a gravitational wave in space, since it is an oscillation of the local energy density of spacetime and therefore an oscillation of the curvature of local spacetime. It "transports" gravitons (scalar photon/longitudinal photon pairs) rather than merely photons. So let us now consider it as a gravitational wave.

In the absorber under special conditions, a small fraction of the graviton wave time-density absorbed will sometimes change (transduce) its time-energy into what we call transverse photon energy effects {618}, with something like a 10^{17} gain in spatial energy in joules compared to the time in seconds that actually transduces. In other words, 1 second of time transducing into EM transverse wave energy (using the standard EM modeling approach) will yield approximately 10^{17} joules of spatial EM energy. Since one can change energy from one form to another, *one can change time-energy into 3-spatial energy* and 3-*spatial energy into time-energy*, the two being merely opposite sides of the same coin, and both always involved in any situation exhibiting electrodynamic dipolarity.

In one's physics model, the choice of fundamental units is purely arbitrary. Everything can be expressed in a single fundamental unit, as pointed out by Jackson (see quotation from Jackson at the beginning of this chapter).

In a situation where 3-symmetry and t-symmetry in EM energy flow are broken, part of the *time charging* of the atomic electrons (or ions) sometimes changes (transduces) into *spatial energy charging* and vice-versa. This cross-dimensional decay of time-excitation states results in the emission of some extra transverse photons that may be either photons or antiphotons, depending on the exact interactions. The point is, *tremendous excess EM spatial energy can appear and either be emitted as heat or interacted to perform new nuclear interactions as extraordinarily high local energy density*. This is the master mechanism enabling anomalous cold fusion transmutation reactions. The amount of time transduced will be so small that it will usually escape notice, unless stringent efforts are used to measure changes in the local flow of time.

The excess photon energy (excess 3-space EM energy) appearing in these rather random but powerful transduction interactions often accounts for the production of anomalous excess heat - for example, as occurs in many cold fusion experiments. Where scalar interferometry is maximized, a more exact action will be detailed below for the specific nuclear transformations that occur by novel new nuclear reactions. These novel nuclear reactions occur at low *initial* spatial energy but with some time-energy transducing into additional very high spatial energy to initiate the interactions.

10.5.3 Resolving the Energy Conservation Problem in Cold Fusion

When transduction is involved, standard "transverse EM waves only" computations will seemingly yield violation of energy conservation — e.g., from the emission of excess heat. That is an erroneous interpretation; energy overall is conserved, but some of the unaccounted *time-energy flow* is transduced into 3-spatial transverse photon energy dissipation. Neither 3-spatial energy nor mass-energy nor time-energy alone, or in any pairing, need be individually conserved; only the combined *total energy of all three energy components* is conserved. This resolves the present major "sticking point" between the cold fusion researchers and the conventional "transverse wave" nuclear and electrodynamic communities regarding energy conservation difficulties and perpetual motion accusations. Those making the accusations and those defending against them are both using only a special-case conservation of energy law, and a more general law is required.

Let t = time in seconds, and W= energy in joules. Rounding the speed of light to 3 x 10^8 meters/sec, the energy W_{TW} emerging as transverse wave EM energy in 3-space by the transduction of time into 3-space energy is approximately

$$\text{One sec} = c^2 \text{ joules} = 9\times10^{16} \text{ joules} \qquad [3]$$

and

$$t \Rightarrow W_{TW} = 9\times10^{16} \times t \quad \text{(in joules)} \qquad [4]$$

Let us present the new energy conservation law in slightly different form. Let W_{TW} = energy measured in spatial energy form, conveniently taken as transverse wave (TW) EM energy. Let W_m = energy in mass form (energy compressed by c^2). Let W_t = energy in time form (energy compressed by c^2).**The** present conservation of energy law is

$$W_{TW} + W_m = W_{(total)} \qquad [5]$$

The new extended conservation of energy law is

$$W_{TW} + W_m + W_t = W_{(total)} \qquad [6]$$

The conventional particle physics accounting will see only

$$W_{TW} + W_m = W_{(total)} \qquad [7]$$

The conventional accountant will be unable to see

$$t \Rightarrow W_{TW} \qquad [8]$$

so he will observe that the experimenter is reporting that

$$[W_{TW} + W_m]_1 \neq [W_{TW} + W_m]_2 \qquad [9]$$

which in his lexicon is a violation of the conservation of energy law itself. In short, he will identify it as a typical example of a claimed perpetual motion machine or interaction. Then the defender of the faith will wax eloquent, applying labels such as "perpetual motion nonsense", "voodoo science," etc. He himself is practicing a hoary old "voodoo" science and ignoring newer science. None of these defenders of the faith even know what powers an electromagnetic circuit or how it is that every little charge in the universe is able to continuously pour out observable EM energy in all directions, with no observable EM energy input.

On the other hand, a reasoned response will be given by real scientists still following scientific method, when faced with the numerous replicated successful experiments. The scientific method insists on the absolute priority of the replicable experiment over the predictions *of any* theory. Consequently, such reasonable scientists will advise that the protagonists cease their vitriolic rhetoric and let real science take its course; i.e., let further experiments confirm or refute reported successful results of cold fusion experiments.[302]

[302] Precisely such a reasoned response by chief editor Donald Kennedy of the journal *Science* has recently been given, providing a breath of fresh scientific air into an attempt by "defenders of the conventional faith" to destroy publication of important experimental results in sonoluminescence. The article which courageous editor Kennedy approved for publication — over intense objections of the professional critics — is R. P. Taleyarkhan et al., "Evidence for Nuclear Emissions During Acoustic Cavitation," *Science*, Vol. 295, Mar. 8, 2002, p. 1868-1873. We heartily commend Editor Kennedy for this classic example of how science should be conducted — so that experiments, not prevailing dogma, determine what is valid and what is invalid.

What the professional skeptic will not see is that his own expression of the conservation of energy law has been incomplete, and that it is his own inadequate "measurement yardstick" assumption that is now in error. The *extended* conservation of energy law of course still holds, but the *conventional* special case law is violated because its fundamental assumption — that time is not transduced to spatial energy in the experiments —has been violated in the experiment.

Indeed, with the publication of the work of Evans et al., experimentally proving the fluctuation theorem and the high probability of time reversal zones appearing for short but significant periods at up to micron levels, the second law of thermodynamics has been rigorously proven to be violated. Hence the conventional scientific community's rather dogmatic objection to the extra heat of cold fusion interactions is no longer scientifically justifiable.

Understanding of the extended conservation of energy law and the permissible violation of the second law of thermodynamics resolves the present thorny dissension within the scientific community over the excess spatial energy produced by cold fusion. It also resolves the issue of what could possibly be a source of such intense energy density as is required for nuclear transmutation reactions.

Any ordinary system is indeed an open system, freely and continuously exchanging energy with its *temporal* environment as well as the seething active vacuum.[303] If the system is in temporal energy equilibrium in that exchange, then the present restricted conservation of "spatial and mass" energy law applies and one does not have to consider the interactions between supersystem components. If the system is placed in disequilibrium with its temporal energy environment, then supersystem components interact asymmetrically and the extended conservation of energy law applies. In that case, excess spatial energy can be and will appear in the system whenever time transduction into spatial energy is occurring.

[303] But see our Appendix A. Present thermodynamics rather inanely defines a "closed" system as one where no mass exchange crosses its boundary with its environment, but energy exchange can and does. In that view, a "closed" system can be far from equilibrium in its energy exchange with its active environment, and thus demonstrate the five magic attributes of such disequilibrium systems. In this book we have deliberately chosen to treat a "closed" system as one in which neither energy nor mass exchange crosses the system boundary — which classical thermodynamics refers to as an "isolated" system. We explain all this (and why) in Appendix A.

The implications of cold fusion energy transduction are that

(1) Time is being "burned" or transduced as a "fuel" and source of energy,

(2) Transduction of only one microsecond per second will yield $9x10^{10}$ watts steadily. That's 90,000 megawatts of energy per second — the equivalent of 90 large 1,000-megawatt power plants — if all the transduced energy were collected and used to power loads with 100% efficiency.

(3) Thousands of new nuclear reactions are made possible and feasible by local transduction of time-energy into 3-spatial EM energy.

(4) Appropriate capture and use of a portion of the excess energy can be accomplished to power loads.

Even if we capture and utilize only 1% of the transduced time-energy to power the loads, where the *time-energy to spatial energy transduction* is only the transduction of 1 microsec/sec, that system will produce the normal EM energy to power 900 megawatts in the load. That's almost 90% of the capability of a modern 1,000-megawatt power plant. That is quite a respectable electrical power system. It only requires the transduction and "burning" of one microsecond of time per second, without any nuclear wastes or hydrocarbon byproducts.

As can be seen, transducing time into energy is by far the most efficient way to go to develop new power plants for the future. This is particularly true since every charge in the universe already transduces time-energy flow into spatial EM energy flow. Indeed, we may consider that the negative charge transduces time-energy flow into the spatial outflow of EM positive energy, while the positive charge transduces negative time-energy flow into an outflow of EM negative energy. The process is useful not only for power applications, but also for transport applications as we briefly pointed out in Chapter 8.

10.6 Some Resulting *Low Spatial Energy* Nuclear Reactions

Refer again to paragraph 10.4 above. Summarizing: The formation of time-reversal zones (TRZs) is what enables the appearance of the new nuclear reactions in the electrolyte in cold fusion experiments. It does this by changing the Coulomb barrier between like charged ions into a Coulomb attractor. Further, the rate at which TRZs form and decay in the solution is a function of the frequency and intensity of the scalar interferometry from

the loaded palladium lattice. This means that the appearance of the new nuclear interactions in the electrolyte is also a function of the degree of loading of the palladium lattice, as well as the "double surface" interferometry preparation of the palladium, its cracks, etc. These are the major variables. Once the major variables provide the solution for significant formation of TRZs, then the following reactions can and do appear.

The sample reactions we present here are just a few of the thousands of new reactions possible. These example reaction products have been found in a great many successful cold fusion experiments in various laboratories around the world. Some 600+ successful experiments have now been done, and a sizable literature has built up and continues to be built up on the experiments and their results.

For our sample reactions, the primary mechanism of interest consists of several parts:

(i) Formation of a TRZ, in which two positive ions (we shall look at H+ and D+), now attract each other. Also, the gluon forces in the proton and neutron, in the ions of interest, are significantly lessened, so that the quarks in each proton and neutron are very much more loosely bound. Consequently, decay from an excited state by quark flipping to turn a proton into a neutron or vice versa becomes an attractive option. The strong force is therefore reduced in radius.

(ii) Two positive ions now attract each other so closely that each enters the edge of the weakened strong force region of the other. This forms a *quasi-nucleus* because of the limited involvement of the weakened strong force.

(iii) The other ions in solution surrounding the TRZ immediately move (as soon as the TRZ is formed) to negate the TRZ and decay it back to a time-forward zone (TFZ). This action initiates the decay of the TRZ.

(iv) As the TRZ lessens and then turns back into a TFZ, the strong force expands its size faster than the novel Coulomb "like attracting like" force reduces and reverses.

(v) The rapidly expanding strong force of each of the two ions in the quasi-nucleus fully envelops the other ion, increasing the disequilibrium of the two-ion quasi-nucleus. A condition is reached where the most probable mode of decay is the flipping of one quark in one of the positive nuclei.

(vi) The quark flips, turning that H+ ion into a neutron n. This is a quasi-nucleus of deuterium (D+), still in an excited state but with less excess potential energy in the excited state. At this point, the TRZ is vanishing and the TFZ state is returning.

(vii) As the TRZ vanishes and TFZ state increases back to normal, the most probable mode of decay increasingly is to a full deuterium nucleus. Hence the H+ and n simply draw completely into normal deuterium binding position, bound by the normal strong force. This constitutes a normal D+ ion, now existing in a normal TFZ.

(viii) So by formation and decay of a significant TRZ, two H+ ions have been drawn together into a quasi-nucleus consisting of two H+ ions partially bound by a weakened strong force. As the TRZ decays and the Coulomb repulsion resumes, the strong force increases back to full strength faster than the Coulomb repulsion force returns and repels the two H+ ions. Since the quarks are much more loosely bound than normal, a quark in one of the H+ ions has flipped, turning the ion into a neutron n. The H+ ion and the neutron, partially bound already in a quasi-nucleus, simply "tighten" into a normal D+ nucleus as the TFZ condition is fully resumed.

The nuclear reaction equation for the above interaction may be written as

$$^{1}H_{1}^{+} + {}^{1}H_{1}^{+} \Rightarrow (({}^{1}H_{1}^{+} + {}^{1}H_{1}^{+})) \Rightarrow ({}^{1}n_{0} + {}^{1}H_{1}^{+}) \Rightarrow {}^{2}H_{1}+ = {}^{2}D_{1}^{+} \quad \textbf{[10]}$$

In equation [10] we use the left superscript as the number of nucleons in the ion nucleus, the right subscript as the protons in the ion nucleus, and the right + superscript to show the overall charge of the ion and its sign. We use the expression in parentheses to show the involvement of a time-reversal zone (TRZ). Double parentheses show a stronger TRZ than single

parentheses. Thus from double parentheses to single parentheses to no parentheses shows the initial formation and subsequent decay of the TRZ.

Another interaction involves a D+ ion and an H+ ion, to produce tritium. This is:

$$^{2}D_{1}^{+} + {}^{1}H_{1}^{+} \Rightarrow (({}^{2}D_{1}^{+} + {}^{1}H_{1}^{+})) \Rightarrow ({}^{2}D_{1}^{+} + {}^{1}n_{0}) \Rightarrow {}^{3}H_{1}^{+} = 3T1^{+} \quad [11]$$

That reaction transmutes a deuterium ion and hydrogen ion into a tritium ion. Without showing it, in a TRZ three $^{2}H_{1}^{+}$ ions may also attract into a quasi-nucleus, and as the decay of the TRZ occurs, first one proton turns into a neutron and then a second one does also, by quark flipping. This nuclear reaction also produces a fusion into tritium.

Another reaction between two deuterium ions is"

$$^{2}D_{1}^{+} + {}^{2}D_{1}^{+} \Rightarrow (({}^{2}D_{1}^{+} + {}^{2}D_{1}^{+})) \Rightarrow [2({}^{1}H_{1}^{+} + {}^{1}n_{0})] \Rightarrow {}^{4}He_{2}^{+} = \alpha \quad [12]$$

That interaction — particularly in pre-deuterated electrolyte solution — gives the excess a particles produced in a great number of the cold fusion experiments.

A rarer but still occurring interaction is:

$$4[{}^{1}H_{1}^{+}] \Rightarrow (({}^{2}D_{1}^{+} + {}^{2}D_{1}^{+})) \Rightarrow {}^{4}He_{2}^{+} = \alpha \quad [13]$$

Indeed, reaction [13] may occur to completion and formation of a particles in some of the transmutations in an electrolyte, while it proceeds only to the intermediate phase in others. In that case, both deuterium ions and a particles may be produced out of the same overall "chain of reactions" where some reactions proceed all the way and some do not.

These interactions are directly using and transducing time-energy by use of the TRZ to time-reverse the Coulomb repulsion law for like charges. From the reactions, excess energy given off as heat may and will occur.

The nuclear physicist and nuclear chemist can immediately see a great many new nuclear reactions now made possible by the adroit production and decay of TRZs. A great number of these new nuclear reactions are now possible by this means, which are impossible in ordinary nuclear chemistry without the deliberate formation of TRZs.

These few examples serve to illustrate the process, and these reactions represent res alts already achieved in numerous cold fusion experiments worldwide, by many researchers and multiple laboratories. Now we turn to other evidence strongly supporting the novel nature of these reactions

rather than several other proposed reaction equations yet to be proven. The other proposals do not explain the next type of new experimental reaction.

10.7 Time-Energy Can Generate Instrumentation Anomalies

Strong evidence for time-charging and time-charge decay is experimentally demonstrated in electrolyte experiments where time-reversal zones (TRZs) are operating, and thus where some localized processes are running backwards in violation of the second law of thermodynamics. Weak time-charging of photon-absorbing and emitting matter, with special patterns of spacetime curvatures (engines) induced by time-density oscillations and structuring, is persistent in matter, having "charge-up" and "decay" times that may last for minutes, months, or even years. A very wide range of previously anomalous phenomena, both in inert and living matter, is explainable by these new interactions. This is very probably also related to the "memory phenomena" noted by Kondepudi and Prigogine[304] as outside the present thermodynamics, but being worked on at the forefront in what is called "extended thermodynamics". Quoting Kondepudi and Prigogine, p. 460:

> *"...interesting memory effects ...appear for long times (as compared to characteristic relaxation times). ...nonequilibrium processes may have 'long-time tails'. In other words, the approach to equilibrium is not exponential, as was generally believed, but polynomial ...which is much slower. ... As a result, Nature has a much longer memory of irreversible processes than it was thought before. Again this shows that local equilibrium is an approximation, albeit a very good one."*

In this book, we focus primarily upon some typical anomalous measurements in China Lake experiments that are directly involved with time-charging and decay effects, lending strong support to our thesis of the novel TRZ-induced nuclear reaction chains. Note that these instrumental anomalies are also strong evidence for the association of time-charging and time-charge decay with the proven fluctuation theorem of Evans et al.

[304] Dilip Kondepudi and Ilya Prigogine, *Modern Thermodynamics: From Heat Engines to Dissipative Structures,* Wiley, Chichester, 1998, p. 459. For a discussion of extended thermodynamics, see D. Jou, *Extended Irreversible Thermodynamics,* Springer-Verlag, New York, 1996.

at the Australian National University. We believe this to be a contribution to that very important work of Evans and his colleagues.

10.7.1 Ionization Detectors, Transduction, and EM LW Interferometry

Ionization processes obviously are processes where the partial transduction of LW time interaction into 3-spatial energy interaction would yield ordinary excited energy states of the affected electrons or ions. In turn, this would lead to ionization (e.g., of the atoms and molecules of a gas, liquid, etc.) Hence, ordinary ionization detectors such as Geiger Miiller tubes have the innate *capability* of detecting such transduction that generates ionization, and thereby have some capability of serving as "detectors" of longitudinal EM wave interactions (and time-charging) ongoing in the detector. In the usual situation, no excess time-charging results and no time reversal zones result. In that case, symmetry of energy flow in the time-domain exists, as does symmetry of energy flow in 3-space. Absolutely normal chemistry and nuclear chemistry results, and the nuclear detectors function normally, as familiar to every laboratory.

However, when significant TRZs emerge and persist for short periods, the symmetry of both time-energy flow and 3-spatial energy flow is broken. In this case, transduction of time-energy into 3-spatial energy (and vice versa) can result in anomalous ionization in nuclear ionization detectors, even in the absence of normal transverse EM nuclear radiation. The trick is to use and compare different detectors and different types of detectors to clearly demonstrate anomalous ionization detection effects.

As an example, a Geiger Muller tube will detect any ionization of its internal gas, regardless of what caused that ionization. If the ionization is caused by normal ionizing radiation from nuclear reactions, the instrument will detect and read a resulting internal ionization of the gas inside the tube.

On the other hand, if time-charging and decay are involved, then the asymmetry resulting in 3-spatial energy excitation of the gas inside the Geiger Muller tube (due to transduction of some time-energy into excess 3-spatial energy) may be sufficient to ionize the gas. In that case, the instrument will read "as if nuclear radiation were present. Note that there is indeed "ionizing radiation" present in the gas. However, now this ionizing radiation is not transverse EM wave in nature, but is due to the time charging and decay, and transduction of time into 3-spatial energy in the detecting gas.

This capability of an ionization detector to ionize in the presence of non-transverse wave ionizing radiation and energy can be used to provide an indication of time-density waves being formed and interacting in a process (such as a cold fusion process) where some transduction from time-energy to 3-spatial energy occurs.

Further, the previous "time history" of the individual instrument plays a part in whether the instrument "reads" or not for a given transduction situation. There will be a statistical variation of the actual "already present" low-level time-charge (and in its internal structure and engines) between instruments, even those made in the same factory on the same day from the same batch of materials and parts. That is because the time-charging and discharging history of each instrument has been different.

The production of transduced TWs, however, must be a function of scalar interferometry in the gases or other detecting media of the instrument, since scalar interferometry *creates* all transverse EM waves, as shown by Whittaker {619} and confirmed by Evans *et al.* {620}. In such interferometry, the entire inner structures of the transverse EM waves formed in the interference zone also interact wave-to-wave. Thus, this kind of interferometry is extremely sensitive to the exact internal longitudinal EM bidirectional wave structure (internal engine substructure) of the involved potentials.

As a consequence, the ability of an ionization detector to transduce a specific set of LWs and give ionization detection will vary appreciably, including for different variations in the instrument's original manufacturing process, and even for the specific past photon interaction history and experience of the individual detector itself. One detector's set of cumulated internal time-charges (and hence spacetime engines) may vary considerably from those of a second detector of exactly the same type. In general, multiple ionization detectors are unlikely to all detect a given time-density EM wave emission and interaction set {621}.

Even for two detectors of the same brand, from the same manufacturing plant, and from the same batch of manufacture, it is likely that significant differences in LW detection of a specific TDW set will occur because of the "past history" time-charge differences of the individual detectors. Indeed, a likely phenomenon is that, when one ionization detector detects the LW emissions (transduces them), several others will not detect them at all. This is one of the peculiarities of the new unified field area that must be overcome by further research in order to develop reliable, calibrated TDW and transduction detectors. It is one of the primary problems - if not

the primary problem - of cold fusion research to resolve this *"time-charge experience history"* problem, so that transduction detectors having calibrated, uniform responses to given TDW sets and interactions can be provided.

At present, no one has the foggiest notion as to how to "calibrate" a nuclear ionization detector that one desires to use as a time-energy transduction detector. Speculating, we would envision such calibration (in the transduction detecting functional response) to become possible when small, standard, calibrated sources of transduction are developed and available. In that case it will be possible to formulate procedures whereby varying the output of the transduction source will vary the transduction irradiation of the GM tube. The level of transduction intensity required to create ionization in the instrument will be a direct indicator. When small, calibrated sources of TDWs are also available, it will be possible to irradiate the GM tube to a specifically desired rate and level of time-charge and decay. In that case, an array of GM tubes can be "standardized" or "calibrated" for transduction detection. So far as this author is aware, those developments have yet to be accomplished or even undertaken. Indeed, the need for such a development program has not even been realized.

10.7.2 Experimental "Detector Transduction Phenomena" in Electrolysis

Let us look at one set of ongoing scientific experiments where just such anomalous detector results have been obtained.

Researchers at the Naval Air Warfare Center at China Lake, and at the Department of Chemistry, University of Texas at Austin, have detected precisely the kind of "anomalous" radiation and transduction effects we expect to be in the ionization processes of multiple kinds of detectors {622}.

According to a report by Miles and Bush {623}, anomalous radiation at China Lake was first detected by the exposure of dental X-ray films in two experiments producing excess power (excess TW energy emission). Film used in a control study during these experiments showed no exposure. There was also no exposure of similar films in more than 20 experiments where no excess power was present. In other words, the presence of excess heat (excess TW energy emission) strongly indicates the presence of transduction. In turn, the presence of transduction implies the presence of scalar interferometry wave interaction, where TDW waves and LW waves **are** absorbed and **a** mix of LW and transduced TW waves are emitted consisting of gravitons (paired scalar and longitudinal photons). This only

occurs when significant time-charge excitation has built up. Taken in reverse, the presence of LW wave absorption and emission — with transduction into detected excess ionization energy — directly indicates the emission of "anomalous" TDW or graviton radiation, as detected by the resulting TW exposure of the x-ray film. So the "anomalous" radiation detections are consistent both forward and backward.

The film in manufacture is quite strongly quality-controlled. Also, it is used (interacts and indicates) only once. Its past time-charge history has minimal variations between two samples of the film, because there is no repetitious past *detection interaction* history. Hence one would expect a high degree of uniform film detection interaction responses from film to film, to the same graviton emission set. That is precisely what occurs.

We conclude that the behavior of the film in the combined China Lake experiments clearly shows the time charging, graviton emission and interaction, and transduction nature of what is happening when it is known that no normal nuclear radiation is present.

Geiger-Muller (GM) detectors and sodium iodide (NaI) detectors were also utilized when electrolysis experiments using heavy water were ongoing. We again accent that a Geiger-Muller tube does not detect nuclear radiation per se; instead, it detects *anything* that will cause its internal gas to ionize sufficiently. Sufficient transduction in graviton absorption-emission interactions in a Geiger-Muller tube will cause the counter to indicate, because it ionizes the gas and produces an ionization discharge. However, both the specific transduction and scalar interferometry aspects of the ongoing experiment are involved, as well as the previous background time-charge history of the Geiger-Muller tube counter.

Several Geiger-Muller detectors gave anomalously high readings, reaching some 73 sigmas above normal background counts. Most experiments (i.e., most GM detectors), however, gave normal radiation counts, and no anomalous count rates were ever observed when the experiments were turned off. So these anomalous results are differentiated by using multiple, carefully calibrated Geiger-Muller tube detectors. Our interpretation here is that

(i) There was a variation in the presence of transduction and scalar interferometry from experiment to experiment,

(ii) The majority of the experiments did not produce significant time-charge and sufficient transduction or scalar interferometry to cause

detection (ionization discharge) on most (typical) Geiger-Muller tubes, and

(iii) The transduction effects in the ongoing experimental process were mostly of the rapid variety, and not due to long-term "charge-up" effects conditioning the time-charge aspects and structuring of the experimental apparatuses.

(iv) By using multiple detectors, the probability of one or more of the instruments having increased time-charge from specific time-charge histories was increased.

(v) With sufficient experiments and sufficient detectors, there resulted a high probability of having at least one or more detectors capable of detecting the levels of graviton radiation and transduction expected from the experiments.

(vi) A direct correlation would be predicted — and was observed — in the appearance of the anomalous radiation effects and the expected time periods required to load the palladium with deuterium. As reported by Miles and Bush, *ibid.*:

> *"... the anomalous radiation would appear within a few hours in the co-deposition experiments where the palladium is loaded with deuterium as it deposits from solution. In contrast the appearance of anomalous radiation required days of electrolysis for the palladium rods that load much slower."*

We previously discussed the major variables indicated from many cold fusion experiments to include the strong correlation with the degree of loading of the palladium lattice. Hence the effect pointed out by Miles and Bush would indeed be predicted by the present approach and proposed mechanism.

Our interpretation is that the experiments show the time-charge rate effect to be expected in such graviton radiation and transduction interaction phenomena using collection of ions (in this case deuterium) that are much heavier than electrons. The faster the deuterium loaded, the greater the buildup of the interaction of the deuterium in phase conjugating and self-targeting iterative interactions — and therefore the greater the increase in scalar interferometry interactions — inside the palladium lattice. The rate of graviton radiation production and transduction production increases as some function (not necessarily linear!) of the rate of loading of the **deuterium.** As the rate of graviton and transduction production increases,

so does the expectation of anomalous ionization effects in the nuclear radiation detectors. And so does the rate of production of TRZs and the appearance of the new nuclear cold fusion reactions at low spatial energy but very high time-energy.

10.7.3 Experiment Confirms It

A clinching observation is given by Miles and Bush, *ibid.*, as follows:

> *"One GM-detector would measure anomalous radiation while another GM-detector would be "blind" to any anomalous effect. A few experiments, nevertheless, gave simultaneous anomalous effects from two different radiation detectors."*

Here our comment is that this precisely fits our expectations for demonstrating involvement of

(i) Time-charging and decay interactions,

(ii) Consistency with transduction expectations,

(iii) Consistency with the fact that two different radiation detectors may or may not exhibit or detect the anomalous ionization effects, depending upon the individual past time-charge histories of the two detectors, and

(iv) Predictable variations in the individual experiments (based on palladium lattice loading time, specific geometry, ionization state of the chemical solution, internal time-charge state and decay rate, and structuring of the apparatuses and their parts, etc.) when transduction-associated phenomena are considered.

The anomalous non-nuclear, non-transverse wave — but ionizing — EM radiation detected at China Lake, and the resulting peculiarities in the measurement apparatus functioning, do strongly support the present proposed approach, the proposed graviton radiation phenomena, and the time-charging and decay and transduction mechanisms presented. It is decisive that sometimes two detectors both indicated, and sometimes one indicated and the other would not. Sufficient replications have ruled out any defect in a single given instrument as the cause of the anomalous detections. That immediately eliminates from consideration all purely transverse EM wave phenomena, conditional only upon the premise that the instruments were properly functioning and calibrated, and that sufficient replications were made for decisive statistics. Those conditions

were all met in the numerous experiments producing these results over a long time and in many repetitions.

As a final thought on the subject, we pose the possibility that the longitudinal EM waves involved may be the B(3) longitudinal field waves advanced convincingly by Evans {624a-624c}. We would recommend the attention of leading theorists and experimentalists to this possibility, as a matter that should be investigated both theoretically and experimentally.

10.8 Additional Implications for the Future

10.8.1 Longitudinal EM Waves and Undistorted Progressive Waves

There is a revolution in electrodynamics presently underway, due to the unique characteristics of *longitudinal* EM waves[305] and *pseudo-longitudinal* EM waves. A summary by Rodrigues and Lu {625} is particularly revealing.

A pure longitudinal EM wave has infinite energy and infinite velocity — i.e., it appears everywhere at once. "Propagation through space" does not apply; instead, one has stumbled into that weird region where spacetime is multiply connected. In the real world, one meets imperfect longitudinal waves — or *pseudo-longitudinal* EM waves — that still retain a transverse energy density variation residue. These waves are called *undistorted progressive waves* (UPWs).

Such UPWs can move in space faster than the speed of light. This should not be too surprising, since superluminal velocity of intelligent signals has been positively demonstrated by several researchers in quantum-tunneling experiments. As an example, Nimtz {626} and his colleagues have beamed Mozart's 40th Symphony through a barrier in a waveguide at a speed of 4.7c. So the old notion that information cannot be transported at superluminal velocities is passe. The Fogal semiconductor has been used in experimental transmitter-receiver pairs to demonstrate superluminal transmission, such as TV pictures and programs. Direct signal transmission from earth to satellite back to earth and through many en route amplifiers and processors has been demonstrated by Fogal to occur far beyond the speed of light. Again, theoretical summary papers by Rodrigues *et al.* {627a-627f} are revealing.

[305] We have pointed out a direct way to generate longitudinal EM waves, by simply oscillating the magnitude of the L**orentz self-regauging** of a system.

10.8.2 Death Knell of the Speed of Light Limitation

Another giant shock has emerged in astrophysics during the last few years, and it is now threatening a dramatic revision to physics. Heretofore, it has been fashionable to assume that gravity itself propagates at light speed. A great deal of very comfortable physics theory has been built around that assumption.

Well, the assumption is not true. Experiments in astrophysics continue to refute it. It now is almost certain that the speed of gravity is at least 2×10^{10} c. A beautiful though somewhat controversial paper by Tom Van Flandern {628} summarized the entire situation. He articulates the comfortable general relativity view held to date {629} as follows:

> *"...GR proposes that such changes appear to act instantaneously in the 'near field', but eventually show their true, light-speed-delayed character in the 'far field', which is conveniently beyond our present ability to observe. The necessity of this dual behavior is to prevent the logical need for changes to continue to appear to act instantaneously at ever increasing distances, even to infinity."*

In fact, Van Flandern {630} points out that general relativity already admits superluminal effects in the near field region. He also pointed out the startling nature of the experimental results to relativists, and points out that an attachment to a paradigm has been involved:

> *"To many, this result* [astronomy's verification that gravity's speed $v_g >= 2 \times 10^{10} c$] *is so contrary to 'common sense' in the light of relativity theory as to be absurd. But Thomas Kuhn has cautioned all scientists to avoid the trap of becoming so steeped in a prevailing paradigm that it starts to seem like common sense and makes other ideas sound and feel wrong. Eventually, even one's professional status can become linked to a prevailing paradigm. "*

As Van Flandern further emphasizes, it is not difficult to show by computer calculations of astrophysical situations that any strong limit on the speed of light destroys conservation laws:

> *"...anyone with a computer and orbit computation or numerical integration software can verify the consequences of introducing a delay into gravitational interactions. The effect on computed orbits is usually*

> *disastrous because conservation of angular momentum is destroyed."*

So here we have a new paradigm in the making. This is a startling change to standard relativity. Either we have to give up the conservation of angular momentum, or we have to accept superluminal speed of gravity in the far field. Years of struggle to detect quadrupole gravitational wave radiation have failed; no direct detection has ever been made. Indeed, the rather arbitrary nature of the entire quadrupole radiation assumption is not required by general relativity, as long pointed out by leading Russian scientists. For example, Vlasov and Denisov {631} *et al.* bluntly state it in these words:

> *"...Einstein's well-known quadrupole formula, which is usually employed in general relativity for calculations, is not a consequence of general relativity and is not contained in it. "*

Therefore, it may not really be so surprising that physicists have not been able to detect such quadrupole radiation in a great many laboratory experiments. It is not in general relativity at all.

Of course, our thesis developed in this book is that what we have long called "EM radiation" is in fact gravitational radiation, always involving paired scalar and longitudinal photons and hence time-density waves and longitudinal EM waves. We have pointed out that prior to observation there is no such thing as a separate photon, but there is such a thing as two correlated photons, one time-polarized and the other longitudinally polarized. We believe that there is sufficient meat in our proposed explanation of the anomalous cold fusion results and the anomalous instrument results at China Lake to warrant serious and strenuous investigation of these hypotheses and proposed mechanisms.

Another oddity - usually never stated by Western physicists - has long been known but ignored. When Einstein characterized the gravitational field as a pseudotensorial field, and not a field in the sense of the Faraday-Maxwell field, the consequences were that the 3-space energy laws of the familiar kind really do not exist in general relativity. Shortly after Einstein published his theory of general relativity, this absence of familiar energy conservation was pointed out by Hilbert {632} in these words:

> *"I assert... that for the general theory of relativity, i.e., in the case of general invariance of the Hamiltonian function, energy equations... corresponding to the energy*

> *equations in orthogonally invariant theories do not exist at all. I could even take this circumstance as the characteristic feature of the general theory of relativity. "*

With our publication of the giant negentropy of 4-space once arbitrary 3-space symmetry and time-symmetry in EM energy flow is removed, one of the truths involved in Hilbert's remark was finally recognized. In addition, what Sen called "the most difficult problem in classical and quantum electrodynamics" {633} has been explained by giant negentropy {12}. Also, it is consistent with an appropriate reinterpretation of Whittaker's 1903 decomposition of the scalar potential {600, 615}. Finally, it is consistent with quantum field theory {634}.

Hilbert was evidently not understood by his contemporaries, since neither Einstein himself nor other physicists recognized the fact that, in general relativity, conservation laws for 3-space energy, momentum, and angular momentum — in the sense we are accustomed to in the rest of physics —in principle may be impossible. That is because one can readily remove 3-space energy symmetry when curved spacetime is permitted. Again, Russian scientists such as Logunov and Loskutov {635} have long pointed out the "unthinkable" and "astounding" fact that the predictions of general relativity are not unique.

In the West until recently relativists were conservative, and this resulted in the sidelining of innovative Western physicists who challenged the prevailing interpretation or extended it. With the experimental falsification of one of the fundamental tenets — that gravity moves at speed c in the far field — of the prevailing interpretation of general relativity, it appears that we may be approaching an asymptotic burst of great new theoretical work and a dramatic new reinterpretation. If it ever gets into production, we believe that the Fogal semiconductor will usher in that great change of communication speed paradigms that now appears imminent.

Nonetheless, general relativity — whatever the modifications and extensions now called for — will remain a very useful tool indeed. There is simply nothing else on the horizon that can replace it, string theory notwithstanding. The reinterpretation is likely to shed additional light on many present problems such as the nature of spacetime itself, the nature of dark matter, and new insight and progress on unifying physics.

In the new openness that should result, we hope that a great extension and reinterpretation of electrodynamics will also be undertaken, and that it will reveal the underlying powerful structured general relativity infolded inside conventional EM potentials, fields, and waves, as originally revealed by

Whittaker {636}. It may even be that one of the novel concepts {637} we have proposed in this book will yet see the light of day in practical systems.

If so, then hopefully much of what we are addressing in this book will be incorporated in the emerging new physics of the twenty-first century.

Chapter 11

Final Perspective: Permissible COP>1.0 Maxwellian Systems

"Are you certain of that?" [Augustine, in his famous confrontation with the Skeptics, who held that nothing can be known with certainty.]

"[It is usually]...assumed that the magnitude of potential energy is irrelevant, being arbitrary to the extent of an additive constant." [Block and Crater]. {638}

"The potentials V and A, defined ... in terms of the fields E and B, are considered to be nonobservable in Maxwellian electromagnetism, since the energy density associated with them is zero..." [Lakes]. {639}

"[The total energy of the atom] depends on the bare mass and bare charge of the electron, the mass and charge that appear in the equations of the theory before we start worrying about photon emissions and reabsorptions. But free electrons as well as electrons in atoms are always emitting and reabsorbing photons that affect the electron's mass and electric charge, and so the bare mass and charge are not the same as the measured electron mass and charge that are listed in tables of elementary particles. In fact, in order to account for the observed values (which of course are finite) of the mass and charge of the electron, the bare mass and charge must themselves be infinite. The total energy of the atom is thus the sum of two terms, both infinite: the bare energy that is infinite because it depends on the infinite bare mass and charge, and the energy shift... that is infinite because it receives contributions from virtual photons of unlimited energy." fWeinberg]. {640}

11.1 Introduction

The central message in this book is that all EM devices are already powered — though in an inappropriate fashion — by EM energy freely extracted from the seething vacuum. It is also intended to be a clarion call that we must rapidly develop the *appropriate* vacuum-energy powering of our EM circuits and electrical power systems, or else the survival of the nation and of the biosphere is at stake rather immediately.

For this summary chapter, we wish to place that specific area — EM energy from the vacuum — in sharp focus, with the major facets together in one place.

Consequently, for this closing chapter we have chosen and slightly adapted a previous technical rebuttal to the objections of "perpetual motion", "violation of the second law of thermodynamics," "impossible", etc. that we wrote in 2001 in the referee process, to the referees of one of the AIAS papers submitted to a major physics journal. The rebuttal was successful, and it was accepted and upheld by the referees. The paper was then published by the journal, after very vigorous refereeing.

That is as it should be.

Scientific journals provide a proper forum for the free expression and debate of scientific ideas and work. They do not and should not ensure that every paper conforms to commonly held concepts or to the most widely accepted model. As we stated, Chief Editor Kennedy of the journal *Science* has only recently had to restate and accent the principle that science is free from "truth by prevailing authority," and bound by "truth by replicable experiment". Insuring that every paper meets the accepted models and notions would be enforcement of religious belief, not experimental science. Ideas which are wrong will be refuted experimentally; experiment is still the basis of scientific method. In our rebuttal, the argument of the conventional skeptics is thoroughly refuted by experiments already well known in the literature, as we detail.

So we thought it appropriate to close the book with this strong statement of its primary pbjective: economical, clean, copious electrical energy from the vacuum.

11.2 Source Charges, Curved Spacetime, Efficiency, and COP

11.2.1 The Source Charge Problem

The received interpretation of the Maxwell-Heaviside theory treats the source charge and source dipole as perpetual motion machines, freely and continuously pouring out EM energy in 3-space in all directions with no energy input. Experimentally one verifies that there is no *3-space observable energy input* to the charge or dipole. In accepting that model, a scientist objecting to COP>1.0 EM systems has unwittingly hoisted himself upon his own perpetual motion machine petard, by already accepting every source charge and dipole as precisely that to which he is objecting. To explain the source charge, either one holds to the U(1) Maxwell-Heaviside theory and surrenders the conservation of energy law, or one accepts a change to U(1) electrodynamics to add the concomitant input of energy flow from the active vacuum (from the *time* domain, which in Minkowski geometry is all that is left outside 3-space) to that charge or dipole. That corresponds to a violation of the second law of thermodynamics, as — as we discussed in Chapter 10 — Evans and his colleagues at the Australian National University have already experimentally proven that the second law can be violated up to micron scale and for times of up to two seconds.[287] At the much smaller fundamental charged particle level and far shorter "switching" time of one spin completion, the probability is 100% and a certainty that the second law is violated. Hence the broken symmetry of the charged particle considered in the modem sense as a dipolarity (considering its associated **clustering** virtual charges of opposite sign).

Either way, the classical Maxwell-Heaviside theory must be changed. Every charge and every dipole — which themselves are Maxwell-Heaviside EM systems *a priori* — refutes the erroneous argument that no Maxwell-Heaviside system can output more energy than the operator himself inputs from an external power supply. To adamantly continue to challenge something already *experimentally demonstrated by* every charge and dipole in the universe is the epitomy of scientific blindness.

As have others, Sen {641} called this source charge paradox the "most **difficult"** problem in electrodynamics. However, the basis for its solution - absorption and transduction of virtual KM energy from the vacuum via

the broken symmetry of a charge or dipole in its vacuum energy exchange — has now been known in particle physics for nearly a half-century {642a-642d}. It is not included in the Maxwell-Heaviside-Lorentz theory. Neither the proven vacuum interaction with Maxwellian system nor the broken symmetry in that interaction has been added to the model.

The present author has proposed an EM wave solution {643} to the source charge problem, by reinterpreting Whittaker's {644} decomposition of the scalar potential (as between the ends of a dipole) and treating the "isolated charge" and its clustered virtual charges {645} of opposite signs as a set of composite dipoles. Each of the dipoles then becomes a broken symmetry in the energetic exchange with the vacuum. Hence the charge pours out observable EM energy with no *observable* energy input because the input energy is in virtual photon form.

In the solution, the EM energy is input to the charge or dipole from the time-domain, so conservation of EM energy flow is upheld in 4-space, while time-like symmetry and space-like symmetry are broken individually. Powerful support for the proposed solution was given in a quantum field theory argument by Mandl and Shaw {646} nearly three decades ago. We challenge any scientist skeptical of COP>1.0 Maxwellian systems to produce a solution of the source charge problem in Maxwell-Heaviside-Lorentz theory alone. In conventional theory, every charge in the universe experimentally exhibits COP = ∞. Any theory conflicting with a replicable experiment is falsified a priori.

11.2.2 EM Waves Imply Curved Spacetime

The oscillating energy of an electromagnetic wave is continuously changing its local spatial energy density. This is an *oscillating change of spacetime curvature* if one accepts general relativity (GR). Hence the EM wave in space is *always* moving in a locally curved spacetime; else, no EM wave exists because no change in spatial energy density exists. To reject that, is to reject GR in its entirety as well as all the experiments consistent with GR. If one accepts GR, then the classical U(1) EM *assumption* of the EM wave moving in a fiat spacetime is a non sequitur. It is unscientific to be suspicious of a higher group symmetry O(3) electrodynamics which *does* correct this known non sequitur in U(1) electrodynamics, while limiting oneself to U(1) electrodynamics *with* that known error. One might as well be suspicious of tensor algebra because it is more comprehensive than vector algebra.

There are many EM experiments such as the Aharonov-Bohm effect {647a, 647b} which violate Maxwell-Heaviside EM, as is well known

{648, 649a-649i}. The foundations of the Maxwell-Heaviside theory are well over a century old, and Maxwell's theory was substantially truncated in the 1880s (more on that below). The considerable physics developed since then has required dramatic extensions to the Maxwell-Heaviside theory such as developing non-Abelian gauge field EM theory, quantum electrodynamics, and modeling of the interaction of vacuum and matter in any material system.

11.2.3 On EM Systems with COP>1.0

Conservation of energy requires that all energy output by an inert system must be input to it {650}. It does not require that the *operator* input all or even any of the energy utilized. The active environment can permissibly input part or all of it, else there could be no such thing as a windmill — or a charge, or a dipole, or a solar-cell electrical power system.

The *coefficient of performance* (COP) of a system compares the system's useful energy or work output to the *operator's* energy input. The *efficiency* ε of a system compares its useful output to its *entire* energy input. No inert system can output more useful energy than its total input, hence $\varepsilon <= 1.0$, being $\varepsilon = 1.0$ for a theoretically lossless "perfect" system and $\varepsilon < 1.0$ for a real system with losses.

Whether the operator must input all the energy that is output by the inert system depends upon whether the system is (i) an open system in disequilibrium with its active environment, and (ii) *designed* to accept and utilize excess energy from that environment, such as from the active vacuum. If appreciable environmental energy input is received and utilized, then a system with losses may permissibly exhibit COP>1.0, even though its efficiency ε is $\varepsilon < 1.0$. The common home heat pump is an example. While the efficiency of a home heat pump may be $\varepsilon = 50\%$, its **COP** may be COP = 4.0.

As does the skeptical scientist, the electrical engineering community erroneously assumes that an inert electrical power system that outputs more energy than *one oneself* inputs to it — e.g., a generator outputting more EM energy flow than the magnitude of the mechanical energy input to the generator shaft — is against the laws of physics. To the contrary, it is permitted by the laws of physics and thermodynamics, *once the modern* ***Vacuum*** *interaction is included and disequilibrium exists in the interaction* ***between*** *vacuum and system.* Not only is it permissible, it is a universal fact once the arbitrarily discarded Heaviside energy flow component is re-ac**counted,** and the source charge problem is reluctantly placed back on the

table. If we account all that EM energy pouring freely from the source charges in any EM circuit, then the actual output of EM energy from that circuit is enormous. It is many orders of magnitude greater than the magnitude of the input energy that the experimenter or operator provides.

We do not have to reprove the active vacuum; it has long been proven in particle physics. We also do not have to reprove the disequilibrium between electromagnetic systems and the active vacuum environment; that also has been proven since 1957 by the prediction and discovery of broken symmetry. One of the proven broken symmetries is that of opposite charges, such as are on the ends of a dipole. Hence every dipole or dipolarity in electromagnetics already freely absorbs virtual photon energy from the vacuum, transduces (coherently integrates) it into observable photon energy, and re-emits observable EM photons in all directions at the speed of light. If there are no COP>1.0 Maxwellian systems, then there can be no Maxwellian charges, dipoles, or dipolarity, and therefore no resulting fields and potentials from these sources — an absurdity falsified by every standard two-wire electrical circuit and ever charge and dipole in the universe. Any potential is a dipolarity, hence exhibits broken symmetry. That is why from any finite potential, as much EM energy as desired can be intercepted and collected, by the simple equation $W = \phi q$, where W *is* the collected energy in joules, ϕ is the scalar potential intensity in joules per unit point static coulomb, and q is the intercepting charge in coulombs.

Systems far from equilibrium in their energy exchange with their active environment {651a, 651b} can permissibly perform five important functions impossible to equilibrium systems. Such a disequilibrium system can:

(1) Self-order,

(2) Self-oscillate or self-rotate,

(3) Output more energy than the operator inputs (the excess energy is freely received from the active environment),

(4) Power itself and its load (all the energy is freely received from the active environment), and

(5) Exhibit negentropy.

Any charge or dipole already exhibits all five of these functions — forbidden by classical thermodynamics but permitted by the well known

thermodynamics of systems far from equilibrium in their exchange with their active environment {651a, 651b}.

It *only takes one small white crow to prove that not all crows are black.* The known performance of the charge and the dipole totally refutes the notion that no EM system can output energy without operator-arranged input from other than the active vacuum. The entropy-consuming reactions from the fluctuation theorem, experimentally proven by Evans et al. in 2002, also is a sufficient proof to destroy any argument against permissible COP>1.0 EM systems. Since all the EM field energy and potential energy in a power system or circuit must come from the source charges and dipoles, it follows that all our EM energy systems already take *all* their E*M* energy from the active vacuum, *not* from the operator's input. A solar cell array also refutes the notion that the operator has to input the energy, but the solar cells' environmental energy input may not be ubiquitous or dependable. The active vacuum is both.

Most power system electrodynamicists avoid the particle physics solution {652} to the source-charge problem {641} involving disequilibrium exchange with the active vacuum. Instead, they adhere strictly to the Maxwell-Heaviside-Lorentz theory with its *assumed* equilibrium between system and vacuum. Therefore they avoid modeling the vacuum interaction and solving the problem of open dissipative EM systems which freely and dependably receive energy from their vacuum environment in unusable form, translate it into usable form, and furnish it for further capture and use. They therefore cannot resolve the source charge problem in their model, for the model has already artificially excluded the solution.

By definition, an EM system in equilibrium cannot output more useful energy than the operator inputs. However, considered as an *energy transducer,* every EM system is in disequilibrium with the vacuum because of the charges and dipoles in the system, and it continuously receives energy from the vacuum. Because of the broken symmetry of the charge and the dipole, some of this energy from the vacuum is discharged by every charge and every dipolarity in the circuit as observable energy *a priori.* This creates a truly enormous outpouring of rather disorganized (in this case, *uncollected)* EM energy extracted from the vacuum and poured out without being intercepted and diverged into the circuit, where it is organized for dissipation and use. The circuit "uses" only that amount of this enormous available outpouring EM energy that it first organizes (collects) and directs. That is its "organized excitation" energy, commonly known as *input energy* macroscopically — the Poynting energy flow component.

Upon completely discharging its excitation (input energy), the inert system outputs all its received (organized) energy, from whatever source. So every EM system already outputs far more energy than the experimenter inputs — when the system's *nondiverged, non-organized, and nondiverged* output energy flow is considered as well as its *diverged, organized, and collected* energy flow component. The fact that the *diverged Poynting* energy received in the external circuit enters the circuit from the surrounding space is shown by Krauss {653} (See Figure 1-1 in Chapter 1). We show it in Figure 2-4 of Chapter 2 as well. The remaining and nondiverged Heaviside energy flow component in space, which misses the circuit and is wasted, is also shown in Figure 2-4 of Chapter 2 and contrasted to the diverged (caught) Poynting component. To understand this experimentally demonstrable fact {653}, we need a bit of EM history.

11.3 Truncations of Maxwell's Theory and Discard of System Classes

11.3.1 Concept of EM Energy Flow Through 3-Space

The concept of the connection of EM energy and space did not occur until 1876 in a faulty work by Croll {654}. In the 1880s Heaviside {655} showed the huge nondiverged component filling all space around a circuit (see Figure 2-4 in Chapter 2). Poynting {656} never even considered the external nondiverged flow missing the circuit, but assumed only the *diverged* energy flow component that enters the circuit. Figure 2-4 in Chapter 2 shows both components of EM energy flow laterally, so they can be seen clearly.

It is stressed that the Heaviside nondiverged component of EM energy flow around every circuit is far greater (by many orders of magnitude) than the circuit's intercepted, diverged, and collected Poynting energy flow component. This follows from Heaviside's own original papers. So when the entire output energy flow is considered, every generator and every battery is already a $COP \gg 1.0$ *energy transducer,* outputting far more energy flow than the rate at which mechanical energy is input to the generator shaft or the rate at which chemical energy is dissipated in the battery.

In the 1880s the electron, atom, nucleus, special and general relativity, quantum mechanics, quantum electrodynamics, and active vacuum had not been discovered. There was no knowledge of any possible active vacuum interaction source for such an enormous energy flow pouring from the terminals of the generator or battery and surrounding the circuit, filling all

space around it. Heaviside's extra energy flow component was thus shocking and inexplicable, smacking of "perpetual motion" and total violation of the conservation of energy law. Heaviside — a brilliant, self-taught hermit who never attended university - spoke cautiously and obliquely of its magnitude in terms of angles with respect to a reference direction {657}.

11.3.2 Elimination of the Non-Intercepted Energy Flow Component
A perplexed and concerned Lorentz {658} cut the Gordian knot and arbitrarily *discarded* the Heaviside nondiverged component, eliminating the quandary. Lorentz stated that the huge nondiverged component had "no physical significance" (his phrase) since it powered nothing. Of course it **has** no physical significance, and powers nothing, unless one intercepts it and uses it!

By analogy, the component of a great wind on the ocean that is *outside* the intercepting sails of a single sailing ship, does not contribute to further powering *of that ship.* Figure 2-5 in Chapter 2 shows that situation. However, that nondiverged wind component can power a whole flotilla of ***additional,*** *separate* sailing ships with separate sails, as we showed in Figure 2-6 in Chapter 2. Electrodynamicists {659} have continued to utilize Lorentz' clever integration trick (Figure 2-3 in Chapter 2) to dispose of the huge nondiverged Heaviside energy flow component surrounding **every** circuit and missing it, and therefore pouring from the terminals of every generator. Most electrical engineers today do not realize that the original purpose of Lorentz's integration of the energy flow vector around a closed surface assumed surrounding every volume element of interest was merely to get rid of that perplexing and bothersome Heaviside nondiverged energy flow component while retaining the Poynting diverged energy flow component.

11.3.3 Lorentz's Previous Discard of all COP>1.0 Maxwellian Systems
Previously (circa 1890s) Lorentz had symmetrically regauged Heaviside's **equations** that had already seriously curtailed Maxwell's seminal equations of 1865. This Lorentz symmetrical regauging retained only that class of EM systems that are in equilibrium in their seething energy exchange with their active vacuum environment. It discarded that entire permissible class of the Maxwell-Heaviside systems far from equilibrium with the active vacuum. In short, it *arbitrarily* discarded all COP>1.0 Maxwellian **systems,** and all those even *permitted* to exhibit COP>1.0.

The ubiquitous use of closed current loop circuits containing both the ex**ternal** circuit and the source dipole inside the generator forcibly applied

(and continues to forcibly apply) the Lorentz symmetrical regauging. Thus all electrical engineers began using circuits which self-enforced equilibrium in the vacuum exchange, so that no *net usable* energy[306] that could translate electrons and do work in an external load —could be received from that source.

However, so long as the enormous Heaviside nondiverged energy flow component outside the circuit remained, then separate outrigger antenna circuits and systems could always be inserted in this external energy flow to divert some of it into separate additional circuits. This would have opened up the COP>1.0 *ensemble* of systems and separate outrigger receiver circuits (with separate loads) fed by a single central generator, such as one version of the motionless electromagnetic generator of Chapter 7.

Consequently Lorentz integrated the entire energy flow vector around a closed surface assumed around any volume element of interest {658}, as shown in Figure 2-3. This integration trick — still universally applied {659a-659c} in all the texts today — arbitrarily discarded that troublesome and massive Heaviside energy flow component that could not be explained, and for which no source was known.

[306] Lorentz symmetrical regauging does indeed require that the system receive excess energy from the environment (the active vacuum). It requires that the potential energy of the system is changed twice and continuously, which means the excess energy in each of those two changes must continuously enter from the active vacuum and do internal work on the system. Two new free force fields are created, each with its field energy, which is additional energy being continuously dissipated in the circuit to perform continuous work. However, the two free changes of energy in the system have been precisely selected so that these two force fields are equal and opposite. The two free changes of energy thus produce a *stress potential* without a net translation field. This means that the local spacetime has been curved, in a manner representing a rotation of the system frame away from the lab observer's frame. Further, the stress potential represents the continuous entry of extra stress energy from the vacuum, whose two force fields continually perform opposing local *internal work* within the system to stress it, while unable to translate electrons and power external loads. Contrary to the received view, the Lorentz-regauged Maxwell-Heaviside system is a dramatically altered and different system than the original system before the arbitrary application of the Lorentz condition. The system's inertial frame has been rotated, it has taken on extra energy from the vacuum that can only be used to do internal work upon the system, and that internal work on the system is continuously being done to increase the system's stress and hold it at the new level.

11.3.4 The Heart-Breaking Result of Lorentz's Actions

The combination of these two actions by Lorentz — symmetrical regauging of the model equations and discarding the excess Heaviside nondiverged energy flow component — unwittingly resulted in the design and building of only those electrical power systems which symmetrically and automatically regauge their discharge of their excitation energy. The symmetrical regauging is self-applied by the closed current loop circuit. That circuit uses half of its collected Poynting energy to destroy the source clipole in the generator, and the other half to power the loads and losses in the external circuit {660}. Conventional EM systems are unintentionally designed to destroy their own source dipoles — and their free extraction of organized EM energy from the vacuum — faster than they power their loads.

11.3.5 Agreement with Classical Equilibrium Thermodynamics

These curtailments of Maxwell's theory resulted in the exclusive building of equilibrium EM systems. These systems obviously obey the classical equilibrium thermodynamics with its infamous second law. Lorentz had unwittingly discarded all that entire class of Maxwellian systems in disequilibrium in their exchange with their active vacuum environment; in those days, there was nothing known about an "active vacuum environment" or broken symmetry in its virtual energy flux. Consequently, Lorentz had discarded all those Maxwellian systems that *do not* obey classical equilibrium thermodynamics, but do obey the newer thermodynamics of systems far from thermodynamic equilibrium with their active environment. He discarded all permissible COP>1.0 Maxwellian systems.

However, there was a total agreement between all the EM systems actually built using Lorentz's symmetrized equations and all measurements in their ubiquitous closed current loop circuits — all self-enforcing the Lorentz condition. This led to the iron dogma that all EM systems must inevitably comply with classical equilibrium thermodynamics — the circuits that were built *were* repeatedly and universally observed to do so!

11.3.6 Dogma that COP>1.0 EM Systems are Perpetual Motion Machines

Finally, this total agreement (now for more than a century) between the theoretical model used, the circuits actually built, the measurements performed, and classical equilibrium thermodynamics led to the present fallacious but iron dogma that EM circuits and power systems cannot output more energy than we ourselves input. Today the vast majority of scientists consider it absolutely proven that the laws of nature prohibit

COP>1.0 electrical power systems, and particularly prohibit self-powering systems that freely power themselves and their loads (i.e., EM systems analogous to "windmills in a free wind"). As we stated, every charge and dipole falsifies the "COP>1.0 EM systems are impossible" dogma, as does the fluctuation theorem and its experimental proof by Evans et al.

Sadly, no one seems to have realized that we do not presently have COP>1.0 electrical power systems only because engineers have specifically designed and built their EM systems to destroy their own source dipole faster than they power their load. Ironically, every circuit and every power system used and measured by our engineers already outputs far more EM energy than is input by the operator or by turning the shaft of the generator, if the Heaviside nondiverged energy flow component is re-accounted. The Bohren experiment clearly proves it experimentally {662}, along with thousands of other similar experiments in "negative resonance absorption of the medium" {157a-157d).

11.4 Examples of COP>1.0 Electromagnetic Systems

The motionless electromagnetic generator (MEG) {661} (Figure 11-1) does catch and use some of this available free energy, as explained below. So does the familiar Bohren experiment {662a, 662b} by resonating each intercepting charge so it sweeps out an increased geometrical reaction cross section in space, reaching past the usual Poynting interception cross section (for a static charge) and thereby absorbing additional energy from the otherwise non-intercepted Heaviside energy flow component.

Every charge and dipole in the universe also already acts as an electrical "windmill in a free wind," having a COP = ∞.

The present author has also nominated the long-neglected but vast nondiverged Heaviside EM energy flow, accompanying every field and charge interaction, as the long-missing source of some 90% of the gravity holding the arms of the spiral galaxies intact {663}. Our *supersystem* examination of several COP>1.0 EM systems developed by various inventors has also uncovered a proposed solution for the source of the distant antigravity accelerating the expansion of the universe {664}.

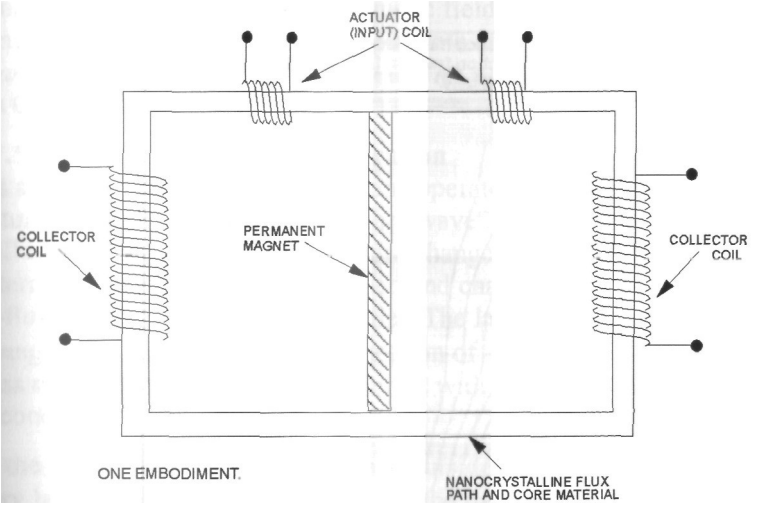

Figurei 11-1. Transformer section of the MEG.

Experimental proof that EM energy COP>1.0 is both possible and demonstrated is already in the literature — e.g., as in the Bohren experiment {662} which outputs 18 times as much energy as one inputs (see Figure 11-2). As another experimental example, the Aharonov-Bohm (AB) effect {647, 665, 666} freely adds additional nonlocalized field-free A-potential energy while all the magnetic B-field energy is sharply localized but still present and available. The AB effect is routinely implicated in physics, but apparently was never applied in an electrical power system prior to its use in the motionless electromagnetic generator

Bohren's experiment {662} was quickly and independently replicated by Paul and Fischer {667}. It can be replicated by any university laboratory at will, totally negating the conventional COP < 0 assumption. The AB effect is also easily replicated, using a toroidal coil, a long solenoid, or a permanent magnet and the special cores used in the MEG. When the toroid system's *total available output energy flow* is measured and accounted — including both the confined magnetic field energy flowing inside the toroidal windings and the field-free A-potential flowing outside — the toroidal coil system outputs more energy flow than the operator furnishes from his external power supply by conventional accounting {668}.

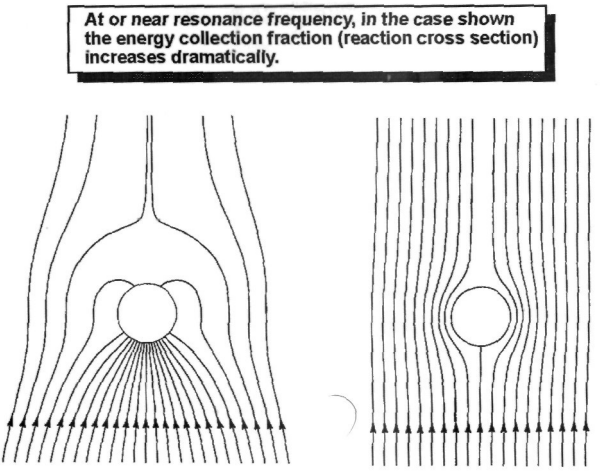

Figure 11-2 The Bohren experiment outputs 18 times as much energy as one inputs

In conventional terms, for a theoretically perfect toroid the operator only "pays for" the magnetic field energy "output component" confined inside the toroidal windings. The presence of an extra energy output component outside the toroid produces COP>1.0 performance as *an energy transducer*. It *does not* produce system COP>1.0 performance in a closed-loop circuit containing the primary power supply's source dipole.

The AIAS has previously nominated more than a dozen mechanisms as promising COP>1.0 systems for investigation, research, and development {669}.

11.5 Motionless Electromagnetic Generator (MEG)

11.5.1 Overall Description

In the MEG {661} (Figure 11-1), one uses a nanocrystalline material core path with the unique characteristic of drawing in almost all the magnetic field energy of an emplaced permanent magnet. The B-field flux from the magnet is withdrawn from its normal position in surrounding space and sharply confined to that material core path. Around the core there freely appears an *additional* curl-free magnetic vector potential A energy flow, since the surrounding spacetime is still curved due to the interaction exchange of vacuum and magnet dipole, and therefore still contains extra energy. The operator inputs no energy whatsoever after the magnet is once

emplaced, yet has appreciable magnetic field energy and field-free magnetic vector potential energy available to utilize. As an *energy transducer*, the MEG has a COP»1.0. As a power system powering loads, its COP>1.0.

11.5.2 An Example of MEG Operation

As a replicable example, suppose one operates the MEG core at less than saturation, and places a small "square wave" pulsed signal upon a primary coil wound around the core. The core changes its permeability as the internal magnetic B-flux is perturbed and changes, so all the perturbed B-flux is retained in the core material. The large E-fields produced by the changing B-flux in the core as a function of $-\partial \boldsymbol{B}/\partial t$ are *not* localized, but pass readily out of the core and interact with the coils, particularly with the secondary.

In the A-potential region in the space outside the core, one also produces very large E-fields by $\mathbf{E} = -\partial \mathbf{A}/\partial t$. At the frequencies being used (40 to 80 kHz nominally), all these E-fields produced by the core flux perturbations and by the external A-potential perturbations are essentially in phase. The large E-fields thus coherently add and interact directly with the secondary coil acting as a receiver.

In the secondary, the very large and sharply changing E-fields interacting with the coils also produces large B-field flux changes in the core. However, again the core changes its permeability and holds-in all the extra B-flux. The changes in that secondary B-flux also make additional non-localized E-fields, and so on.

The surprising and shocking result is that the transformer secondary undergoes a coherent, purely E-field reaction with the electrons in its coils. This results in the output voltage and current being in phase (within 2°, since there are inevitably some small remaining inductance effects due to a tiny bit of external B-field leakage from the junctures of the ends of the permanent magnet with the core material).

The magnitude of the powerful E-fields produced by these processes — and interacting with the secondary coils — depends on the rise and decay times of the input signal's pulse edges. So the *average* power input to the signal coil may be small, but — using sharp rise and decay times of the input pulses — very large E-fields will be produced in the adjacent surrounding space outside the transformer section and interacting with the secondary coils, as well as in the sharply changing B-flux localized in the core.

One then uses transmission-reception theory and near-field antenna theory for separate receiving circuits containing loads, added in the large E-field region in space outside the core. Those E-fields arise from both the changing A-potential outside the core and the changing localized flux inside the core. We stress again that the E-fields produced in the core are not localized, but pass outward into the external space to interact with whatever interceptor/receivers are placed out there.

A "outrigger array" version of the MEG uses separate external receiving circuits, containing loads, to intercept, collect, and use more of the EM energy available in the surrounding space outside the core.

Within physical space limits, the energy intercepted and utilized by these *separate, independent receiving circuits containing loads* can be increased by adding more receiving circuits with loads or adjusting the rise and decay time of the input pulses to provide greater collected voltage. These *separate* loads will be powered by the incident E-fields' interception in the external receiving circuits. This is not at all a *transformer* action, but a *near-field transmission and separated multiple antenna circuits' reception* action.

There is no back-current coupling between the external circuits and loads with the primary circuit of the transformer section. In the external A-potential region alone, the secondary coil in the transformer section will interact with the large incident E-fields from that adjacent space and from the changing B-flux inside the core, producing at least as much energy as one inputs to the primary. Actually, that process alone will produce more output energy in the secondary than the operator inputs in the primary.

If one operates the core below saturation, the magnetic flux in the core will also be switched, giving additional intercepted E-field energy in the secondary coil attached to its load. The total work out in all loads is permissibly greater than the total energy dissipated in the input by the operator's energy input {668}. The MEG is an open system far from equilibrium with the active vacuum {670}.

11.5.3 The MEG Is Replicable

Any university laboratory can replicate this effect, and demonstrate more work in resistive loads than is input to the MEG primary from the external power supply. For replication, we suggest initially designing to COP = 1.5, since beginning at COP = 2.0 there *can* be other effects not in the U(1) EM literature, but which are dealt with in the actual MEG. Some of the methodology {671} used for COP >2.0 is still proprietary information not

yet releasable due to patent law requirements, while some of it was included in Chapter 7.

Without elaboration we advance the *supersystem* concept, and strongly insist that, to properly analyze the performance of any similar EM circuit or system, one must analyze the dynamics of the entire supersystem consisting of (i) the physical system and its dynamics, (ii) the curved local spacetime and its dynamics, and (iii) the local vacuum and its dynamics {672}. All three components of the supersystem are mutually interacting.

For a COP>1.0 system, the mutual interactions are utilized from disequilibrium processes evoked between all three supersystem components. U(l) electrodynamic analysis system in an inert vacuum and a flat spacetime is insufficient. Previous AIAS analysis {661} has addressed the supersystem by use of higher O(3) symmetry electrodynamics to include vacuum dynamics (energy currents, both space-like and time-like) and curved spacetime dynamics.

11.6 Physical Considerations of Gauge Freedom

Additional physical considerations must be accounted when *gauge freedom* is invoked or utilized with respect to physical systems. Applied to electrodynamics systems, gauge freedom assumes the ability to freely change any potential of the system being studied. From the physics of the situation, a system potential change concomitantiy assumes changing the *potential energy of the system itself for* which gauge freedom changes are being theoretically applied to system-descriptive equations.

If one *can freely increase* the potential energy of an EM system, the extra energy has to come from a physical asymmetry of the system with its active environment — the active vacuum. Else, one must surrender the conservation of energy law. At worst, gauge freedom would then imply the creation and destruction of energy at will. At best, it would imply a return to the view that potentials are mere mathematical conveniences with no physical reality — a notion falsified for decades by the AB effect {647}. ***freely*** *decreasing* the potential energy of the system by simply depotentializing it, has a similar vacuum asymmetry requirement for de-excitation of the system, where energy must flow from the system to the vacuum.

11.7 Special Modeling of the Vacuum

Having EM energy density, the vacuum *is and should be modeled as* a scalar potential of great magnititude. For deeper (supersystem) analysis, one will also have to examine the internal EM longitudinal phase conjugate wavepair structure and dynamics of the scalar potential vacuum {672}, along the lines shown by Whittaker {644} in 1903 and re-interpreted by the present author {643} in 2000. From quantum field theory arguments, Mandl and Shaw {646} give strong support to the proposed reinterpretation. They argue that neither the scalar (time-polarized) photon , nor the longitudinal photon is independently observable, but the combination of the two is observable as the instantaneous scalar potential.

Transforming this argument to EM waves yields a solution consistent with the reinterpretation {643}. The result is that all 3-space EM energy comes from the time-domain, in a manner not previously utilized in EM circuit analysis. It is experimentally established by proving (measuring) that the source charge and dipole do not *receive ob*servable EM energy in 3-space, but continuously *output* observable EM energy in 3-space. Simply making and destroying dipoles in an electrical system turns out to be a method for direct engineering of negentropy and entropy respectively — or, from another viewpoint, it directly engineers regauging.

The greatest unrecognized problem in conventional electrical power system engineering is its total failure to include the making and destroying of dipoles as direct engineering of negentropy and entropy respectively.

Every EM potential in an EM system is a change to the energy density of the ambient vacuum potential — and thus is a spacetime curvature — or it is a change to an intermediate potential that *is* such a vacuum potential change. Vacuum exchange with every EM system and asymmetry in that exchange, is ubiquitous and cannot be prevented. Whenever one makes or changes an EM potential, field or wave, and whenever one regauges, one invokes and utilizes asymmetry in the interaction of the active vacuum and the system, either wittingly or unwittingly. Else one must discard the conservation of energy law altogether. There is no symmetry of a mass system alone {673}, without including the vacuum's asymmetrical interaction with it. The reason is simple: all observables involve asymmetry {674} *a priori*, and mass is an observable.

11.8 Every Charge and Dipole in an EM System Receives and Transduces Vacuum Energy

In particle physics, every dipole — and every charge considered with its associated clustering virtual charges of opposite sign — is recognized as an asymmetry in the vacuum flux {675}. The very definition of broken symmetry means that a charge or dipole receives and absorbs virtual photon energy from the vacuum, transduces it into observable form, and re-radiates it as real, observable EM energy. This results in an observable outpouring of 3-energy from the charge or dipole, with no observable 3-energy input.

To save the conservation of energy law for physical EM systems, one must therefore recognize and model the *physical vacuum asymmetry mechanism* **that** allows this demonstrated performance of charge and dipole. In electrical power systems, that required asymmetry mechanism is the known broken symmetry of the vacuum's interaction with the source dipole created in the generator.

11.9 Energy from the Vacuum Powers Every Electrical Power Line and EM Circuit

11.9.1 What the Generator Powers and What Powers the Circuit

Shaft power input to a conventional generator allows the generator to pr**oduce** its source dipole, nothing else. The generator does not transduce any of its input shaft mechanical energy to add EM energy to the external circuit connected to its terminals. Instead, it first transduces its mechanical shaft energy input into internal magnetic field energy.

Then it totally dissipates that magnetic energy to separate its own internal c**harges,** forcing the positive charges in one direction and the negative charges in the other, making the source dipole connected to its terminals. That is all that the mechanical shaft power input to a generator does — and **that** is all that burning hydrocarbons, consuming nuclear fuel rods, **damming** rivers for power stations, putting up windmill-powered g**enerators,** using solar energy input to solar cells, or consuming chemical energy in a battery accomplishes.

O*nce made*, the source dipole — via its broken symmetry in its vacuum exchange - freely receives and absorbs enormous virtual photon energy **from** the active vacuum, transduces it into observable (3-space) form, and pours out real, observable EM energy in 3-space from the generator terminals to which it is connected. As shown in Figure 1-1 of Chapter 1,

this outpouring of EM energy from the generator terminals fills all space around the external circuit {653} with a vast energy flow almost parallel to the conductors. Figure 2-4 is a lateral view so that the two flow components can be clearly seen and compared.

11.9.2 Gedanken Experiment

We advance a gedanken experiment to illustrate. Consider a perfect generator with no losses, and with two perfect conductors and a purely resistive load R_1 connected across its terminals. Call the mechanical energy input to the shaft of the generator W_{in}. Call the Poynting diverged energy flow component W_r that is intercepted by the attached circuit and powers R_1. Call the Heaviside nondiverged energy flow component W_h that misses the circuit and is wasted. As an *energy transducer,* the total energy output W_{out} from the terminals of the generator is

$$W_{out} = W_r + W_h \qquad [1]$$

However, $W_{in} = W_r$, for this theoretically perfect system. So

$$W_{out} = W_{in} + W_h \Rightarrow W_{out} > W_{in} \qquad [2]$$

Further, when accounted, $W_h >> W_{in}$, so

$$W_{out} >> W_{in} \qquad [3]$$

We conclude that all EM systems — *as energy transducers freely extracting and transducing EM energy from the active vacuum*— already exhibit COP » 1.0. However, for *useful work* in a closed current loop circuit, the COP = 1.0, unless additional antenna-receiver circuits or another scheme such as Bohren charge resonance is used to increase the energy collected and dissipated in the load while *not* increasing the energy used to dissipate the source dipole.

11.10 Significant Developments in Negative Resistance

True negative resistance (e.g., current moving against the voltage) also exists and is experimentally replicable. In true negative resistance, the current in a circuit moves against the voltage instead of with it, suggesting time-reversal effects in the mechanism by which EM force and charge interact.

11.10.1 Chung's Negative Resistor and Naudin's Replication

Chung {676} has reported replicable negative resistance in the interfaces between layers of carbon fibers in a composite material. By varying the

pressure used when the fibers are made, the resistance can be controlled to later be negative or positive as desired. A simpler version of Chung's negative resistor using off-the-shelf materials has been successfully replicated and tested by Naudin {677}. (See Figure 11-3). Naudin's website {677} provides measurements and full details necessary for repetition. He also includes sources of the carbon fiber materials needed lor independent replication.

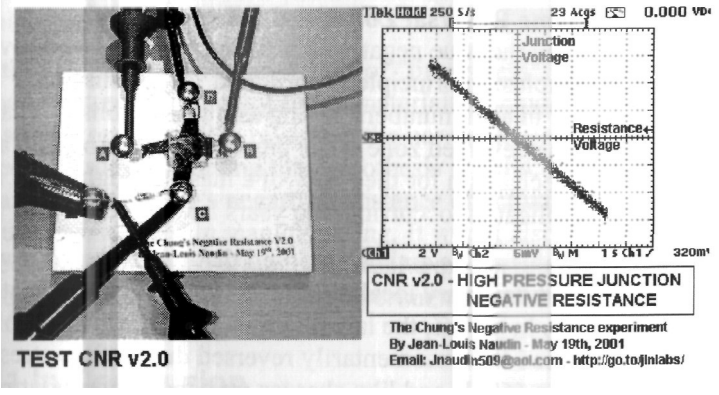

Figure 11-3 Naudin's replication of Chung's negative resistor.

11.10.2 The Point Contact Transistor

There is also evidence that the original point contact transistor — which used spring pressure on the point contact — often exhibited true negative resistance. Certainly this transistor was never adequately understood {678}, and it is not understood today, since its supersystem has never been analyzed.

11.10.3 Kron's Negative Resistor

Gabriel Kron, early pioneer in electrical systems theory, reported developing a negative resistor in the 1930s, on the U.S. Navy's Network Anayzer project {679} at Stanford University. He was not permitted to reveal the details of his negative resistor, but did provide strong hints in certain statements in his papers in the literature {680a, 680b}. His method for a self-organizing network depended on his "open path" {681} which he also was not permitted to reveal.

The present author worked for some years with Floyd Sweet, a Kron protege", who did produce a successful type of powerful negative resistance system {682} known as the vacuum triode amplifier, apparently based on Kron's original negative resistor. Sec Figures 6-5 to 6-13 in Chapter 6. As

shown in Figure 6-6, Sweet induced self-oscillation in barium ferrite magnets {683a-683c} (which are made by powder metallurgy methods using pressure applied during their manufacture) and extracted energy by induction from the resulting self-sustained magnetic field oscillations. His device was independently tested by Walter Rosenthal {684}, a senior test engineer of long experience with a major aerospace company. See Figure 6-9 and Figure 6-13.

11.10.4 Proposed Time Reversal Zones and Effects

One may take the view that true negative resistance involves time-reversal, which by the Pauli exclusion principle is permitted for bosons {685} and possibly for fermions in even numbers, acting as quasi-bosons (perhaps only possible in a time-reversed zone). The present author proposed a photon interaction mechanism for the "flow of a mass through time" in 1971, with initial publication occurring two years later {686}.

Extending this mechanism, the author proposed that *time reversal zones* (TRZs) can occur in momentary local regions in semiconducting materials or electrolytes {687}. In a TRZ, the law of attraction and repulsion of charges is hypothesized to be momentarily reversed due to time-stress or time-domain pumping {688}, and like charges may momentarily attract. In Chapter 10, we used these time-reversal zones to explain the anomalous results of the 600 or so successful cold fusion experiments worldwide. We also gave the exact new nuclear reactions for the production of anomalous deuterium, tritium, and alpha particles in many of these experiments.

When under strong stress, anomalous attraction of clusters of like charges is experimentally known, e.g. in Shoulders' {689} experiments and patented processes {690}. When the output leads of Sweet's vacuum triode amplifier device were suddenly shorted, extreme cooling occurred rather than heating. Ice condensed instantly upon the shorting contact and leads from the sudden extreme cooling of the metal in the moisture in the air, dramatically showing a converging EM energy process rather than a diverging one.

11.10.5 Effects in Optically Active Semiconducting Materials

In addition, four-wave-mixing, phase conjugation, and time-reversal effects are well known in semiconducting materials {691}, almost all of which are optically active. Optical activity and microlasing is known in semiconductor powder {692}. Further, the vacuum itself can exhibit semiconducting properties {693}.

11.I0.6 Special Functions Produced by Stress

Apparently pressure (stress) in many of these devices and experiments can play an important role in the negative resistance process. Based on harmonic sets of paired couplings of a longitudinal time-like wave and a longitudinal wave in any scalar potential {643}, the present author hypothesizes that such stress — treated as a stress scalar potential — accomplishes time-domain pumping in the optical sense, due to the presence of the coupled time-polarized longitudinal waves in the time domain.

This time pumping is a special form of "time stress". Thus in optically pumped or stressed optically active materials (including electrolytes), the time-stress creates a TRZ, reversing the normal force laws upon and between charges. Assuming this hypothesis is valid, this could account for the variation of Chung's negative resistance effect with the variation of the pressure (stress) used in manufacturing. It would also apply to the laser-created stress in semiconducting powder experiments, etc. The hypothesis should be further investigated for experimental validation or refutation.

11.11 In Conclusion

As Penrose {694} states,

> *"Electromagnetism is a subject that is in no way closed to stimulating new developments."*

Indeed, electrodynamics is still very much an advancing subject, and in classical electrodynamics there are foundations errors and problems, a few of which we have addressed. As Bunge {695} pointed out more than three decades ago,

> *"...it is not usually acknowledged that electrodynamics, both classical and quantal, are in a sad state."*

From a foundations viewpoint, Einstein {696} beautifully summed it up — and advanced a requirement for continually examining the foundations of electrodynamics and every other field of physics — in these words:

> *"..the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools* ***of thought,*** *as something obviously, immutably*

given; something having an objective value oftruth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique ofthese fundamental concepts, in order that we may not unconsciously be ruled by them."

Though they have long been neglected, legitimate COP>1.0 electrical systems are good science, or they can be. They were present in the original Heaviside truncation of Maxwell's theory prior to Lorentz's symmetrical regauging. That regauging arbitrarily selected only those Maxwellian systems in equilibrium in their exchange with the active vacuum. The energy flow theory was further curtailed by Lorentz's integration trick, which discarded the huge vacuum-furnished non-intercepted Heaviside energy flow component accompanying every EM system. Every EM system already outputs for more EM energy flow than the energy that the operator inputs; thus every EM system is already a COP»1.0 system, with respect to *energy transduction.* The only way this giant negentropy of every EM system can be hidden is to ubiquitously continue that integration trick to discard the giant Heaviside energy flow component.

The present Lorentz-regauged Maxwell-Heaviside equations are not consistent with *any* bipolar EM system or circuit. The ends of any dipolarity in the universe — including any electron on Jupiter and any positron in the star Sirius — constitutes a broken symmetry in the seething vacuum flux. Actually, that is what Gabriel Kron discovered and called his "open path". Hence, that "dipole" continuously emits observable EM energy extracted from the vacuum.

Engineering use of the ubiquitous closed current loop to contain both the primary source dipole and the load — which destroys the source dipole and extraction of vacuum energy faster than the load is powered — is responsible for the successful predictions of the equilibrium EM model (which of course completely fails to explain the source charge or source dipole). That circuit is unwittingly designed to self-enforce the Lorentz symmetry condition and therefore self-enforce those predictions.

The question as to whether COP>1.0 electrical power systems are possible *and practical* must be resolved by direct experiment, and not by established models and cherished concepts that already arbitrarily exclude such systems! Such theoretical refutation by models that in fact contradict the experimentally observed COP = oo action of every charge in the universe, cannot be trusted at all with respect to COP> 1.0 judgment. Well-

known supporting and confirming experiments already in the literature — such as the Bohren experiment yielding COP =18 — have been cited, and these are replicable by any university laboratory. The Bohren-type experiment is well known and routinely performed in every nonlinear optics laboratory, under the guise of "negative resonance absorption of the medium".

It is indeed a critical time to re-examine the foundations of our electrical power science and engineering, along the lines so eloquently stated by Albert Einstein. With the impending oil crisis, we face a world economic crisis of epic proportions unless we rapidly develop and widely deploy sell-powering disequilibrium electrical power systems.

Also it is a critical time when the leaders of the scientific community — specifically the National Academy of Sciences, the National Science Foundation, the great national laboratories, and the universities — must at last face and correct the excruciating *faux pas* that has now been perpetuated in electrodynamic theory for more than a century. In short, the leaders of our scientific community must now show whether they are scientists practicing and upholding experimental basis, or are dogmatists defending an ancient faith. The fact that the source charge problem continues to be propagated in electrodynamics 45 years after the award of the Nobel Prize to Lee and Yang, is no longer excusable.

A thorough review and correction of the foundations of EM theory is required for the survival of this nation and much of civilization. It is also required for the cleanup of the increasingly polluted biosphere, survival of the threatened species of the Earth, reduction of present global warming trends, and the survival of this fragile and beautiful planet itself.

Annotated Glossary of Selected Terms

action at a distance: An action (effect) occurring in a local system, for which no separate local 3-space cause exists, but for which a causal correlation exists between a distant action and the local effect.

advanced electromagnetic field: An electromagnetic field that is a solution of the classical Maxwell equations, which is positioned on the future light-cone of spacetime. It may be possible to involve such a field in the tempic force that may exist between the tempic potential at the output of an overunity system and the tempic potential that exists at the input of the system, where the interaction of the tempic force with the local nonlinear vacuum drives Dirac sea hole current from output section to input section.

advanced electromagnetic potential: An electromagnetic potential that is a solution of the classical Maxwell equations, and is positioned on the future light-cone of spacetime. Presently this potential has not yet been given a physical interpretation. It may be possible to involve its effects in a specific system by our notion and use of the instantaneous tempic potential difference (the tempic force) that may exist between the tempic potential at the output of a system and the tempic potential at the input of that system if the two differ.

advanced electromagnetic wave: An electromagnetic wave that is a solution of the classical Maxwell equations, and which is positioned on the future light-cone of spacetime.

Aharonov, Yakir: Renowned Israeli quantum physicist and former student of David Bohm. Co-discoverer of the Aharonov-Bohm effect. Together with Bohm, Aharonov authored a fundamental paper in 1959 that pointed out the *primary importance of the potentials* rather than the force fields. The force fields are only made in and of the charged particle system itself, and do not exist as such in the vacuum. The force fields are thus not primary electromagnetic causes at all, but are *effects* due to the interference of potentials in a particular charged particle system.

Aharonov-Bohm effect: Quantum mechanical phenomenon theoretically pointed out in 1959 by Yakir Aharonov and David Bohm whereby interfering electromagnetic potentials can produce effects on charged particle systems, even at a distance and in the absence of the

electromagnetic force fields. A system undergoing a cyclic evolution from an initial state back to it will acquire a phase difference, which can be detected by interfering the initial and final states. Theory was extended later to Berry phase, then again to geometric phase.

In classical EM terms, a more important *energy-amplifying* principle - advanced by the present author — emerges from the AB effect. My colleagues and I have used this principle in our motionless electromagnetic generator (MEG) to provide COP>1.0. Consider a source of magnetic field B, such as a permanent magnet. All the magnetic field energy B from the permanent magnet may be drawn into and confined in a local material path, as in a special nanocrystalline transformer core. Then in the space surrounding the localized magnetic field energy, the active vacuum will freely replenish — via the broken symmetry of the permanent magnet dipole in its exchange with the vacuum — the magnetic energy in that space that would otherwise have been filled with magnetic field B (curled magnetic vector potential A). However, nature replenishes the energy in space outside the B-localization region with the *curl-free* magnetic vector potential A. In this fashion a system designer may cause the active vacuum to provide more available magnetic energy from the permanent magnet that normal, with each of the two energy forms being in separate spatial regions and paths, and occurring in different forms of magnetic vector potential energy. By inputting only a little energy in the input coils of the transformer section, and controlling the rise time and decay time of the pulses, one can produce very large E-fields from the A-potential via $E = -dA/dt$. From the simultaneously perturbed confined B-field flux in the core, one also produces E-field simultaneously and — at the frequencies used — in phase with the E-fields produced outside the core. The net result is interaction of large E-fields with the output coil, producing an output power *proportional to the rate of change* of the weak input signal energy rather than its magnitude. In this fashion, additional E-field energy from the vacuum enters the output coils to power the secondary circuit and its loads. Also, the output of the entire transformer section has the voltage in phase with the current, in contradiction to the actions of all previous transformers.

AIAS: Alpha Foundation's Institute for Advanced Study, directed by Dr. Myron W. Evans, a noted scientist with more than 600 papers in the literature. The AIAS is an unusual "think tank" comprised of Fellows and Fellow Emeriti in various places in the world, who cooperate in advanced electromagnetics studies via E-mail. The Director, Dr. Myron W. Evans, is a theorist of note, as are several other Fellows. The AIAS has been forging

ahead with the production of O(3) symmetry electrodynamics, particularly as an important subset of Mendel Sachs' unified field theory. Dozens of AIAS group-authored papers have been published in various leading journals such as *Foundations ofPhysics, Physica Scripta,* etc. More than 100 A IAS papers are carried on a restricted Department of Energy website for reference by DoE and AIAS scientists. The work is particularly significant in preliminary theorizing how EM energy can possibly be extracted from the active vacuum.

algebras: The various types of mathematics in which the theoretical models for physics and other sciences are embedded. Some important algebras utilized in physics are vector algebra, tensor algebra, quaternion algebra, Grassmann algebra, Pauli algebra, Clifford algebra, etc. There are many others. The complexity of the symmetry and of the topology varies significantly between these algebras. Thus, an electrodynamics model in a lower topology algebra such as vectors or tensors will not reveal or permit nearly so great a set of electrodynamic functions and operations as will electrodynamics embedded in a higher topology algebra such as quaternion algebra or Clifford algebra. See topology.

ambient vacuum: The average or typical "standard" active vacuum (i.e., active spacetime), removed spatially from any large collections of observable charge and observable mass.

ambient vacuum potential: The *average* or typical standard vacuum considered as a scalar potential because it possesses energy density as well as structure and dynamics on many levels. As a scalar potential, the vacuum potential (considered without zero-point fluctuations) decomposes into a harmonic set of "bidirectional" longitudinal EM phase conjugate wavepairs, by Whittaker's 1903 decomposition as reinterpreted by the present author in 2000. Dynamic structuring of the vacuum thus consists of dynamics impressed upon these wavepairs. Since the vacuum is observably mass-free, Whittaker's phase-conjugate half of the decomposition must be considered prior to its interaction with mass, hence in the imaginary plane **and** arising from the time domain. This consideration led to the discovery by the present author of the more fundamental 4-symmetry in EM energy flow between the time domain (imaginary plane) and real 3-space, when broken 3-symmetry is present (as with any dipolarity or with any **potential).**

Powerful support for this solution is also given by F. Mandl and G. Shaw, Quant*um Field Theory,* Wiley, 1984, Chapter 5. Mandl and Shaw argue tthat the longitudinal and scalar (time) polarizations of the photon are not

directly observable, but only in combination, where they manifest as the "instantaneous" Coulomb (i.e., electrostatic) potential. Our comment is that this argument, translated from particle terminology to wave terminology, directly fits our re-interpretation of Whittaker's 1903 decomposition of the scalar potential.

angular momentum: The momentum or "leverage" of the linear momentum of a moving body, with respect to an axis or reference point. Angular momentum has the same units as action; that is, it is energy multiplied by time, or momentum multiplied by length. In terms of particles, it is also known as *spin*.

anti-circuits: Somewhat normal-appearing electromagnetic circuits which primarily process and use antiparticles and anti-electrons rather than particles and electrons, or else process a combination of the two simultaneously. Operations of the anti-circuit must be analyzed and understood in terms of its *supersystem* interactions. The circuits process and utilize both negative energy and positive energy EM fields and potentials, hence are closely connected to unified field engineering and antigravity. One aspect enabling such circuits is the use of the supersystem's curvatures of spacetime in both negative curvature and positive curvature fashion so that an appropriate change of spacetime curvature precludes the radiation normally accompanying pair annihilation, etc. The key to the circuits is T-reversal and C-reversal operation, along with the matching use of spacetime curvatures, and also the use of the Dirac "positron" (negative energy electron) — and its fields and potentials — prior to its observation. The unobserved Dirac negative energy electron in the vacuum is an entirely different entity than is the observed Dirac positron after its interaction with charged matter, after which it has become a "lattice hole" or "positive charge on a positive mass ion". The response of normal circuit components to vacuum Dirac sea hole operations is dramatically different than for Dirac positrons, and for certain applications special versions of circuit components are required. At this writing, together with John Bedini the present author has submitted what may be the first patent application on the fundamental process for anti-circuits and their operations with antimatter and negative energy currents, fields, and potentials as well as matter and positive energy currents, fields, and potentials. Another patent application by this author **is** in preparation, covering the anti-gravity aspects. The details of these mechanisms are still proprietary at this writing in order to protect our intellectual property rights, but limited information is in this book.

anti-electron: A negative-energy electron, observed as *a positron.* Under time reversal, electric charge reverses in sign. Dirac did not predict the positron per *se,* but a negative energy electron that we would *observe* in **reversed** fashion. Present theorists assume the interaction of the 4-space **negative** energy electron with matter — i.e., observation — to have occurred. This transforms the negative energy, negative mass electron to a positive energy, positive mass positron traveling in the opposite direction. In so doing, antigravity from the negative energy 4-electron source charge, due to its negative energy EM fields and negative energy potentials, is ar**bitrarily** transformed by the spatial reversal into positive gravity fields **rather** than the antigravity fields they were. The secret to practical antigravity is to utilize (in anti-circuits) the negative energy 4-electrons pri**or** to observation, *without* transformation of (i) negative energy fields to positive energy fields, (ii) negative mass to positive mass, and (ii) reversal of the field direction. In short, simply consider the unobserved negative e**nergy** 4-electron as what it is, and utilize it in its unobserved vacuum state. The conventional transformation process also unwittingly discards **the** concept of anti-circuits, anti-fields, anti-potentials, and anti-currents, which discards half the rich electromagnetic circuitry that can be built and u**tilized.** In the present book, we only touch lightly on this latter subject, which hopefully will be the subject of a future book after certain patents are **filed.**

antigravity: Negative gravity or reversed gravity. Use of negative curvature of spacetime to produce a force on a gravitational source **(physical** system) that is opposite to the normal force of gravity of the earth etc. on that system. Antigravity is achieved by the use of negative-e**nergy,** negative-mass source charges in the mass component of the s**upersystem** prior to observation, while the source charges are still 4-s**patial.** This usage produces negative energy fields and negative energy **potentials** to negatively curve the local spacetime (ST), so that these nega*tive local* ST curvatures interact back upon the positive mass source system associated with the vacuum negative energy sources in its su**persystem.** Again, to understand the operation of an antigravity circuit or system, one must analyze it in terms of its *supersystem* interactions.

antimatter: Matter consisting of atoms that are composed of anti-electrons **(positrons),** antiprotons, and antineutrons and such. Also loosely refers to the **antiparticle** corresponding to a particle; an antiparticle may be regarded as a particle traveling backward in time, or "phase conjugated", or "time-reversed. Since time is not an observable, the observer sees the antiparticle

{after its observation by interaction with mass) in forward time as being reversed in direction and charge.

antiparticle: Conventionally, a counterpart to an ordinary fundamental particle, *observably* having identical mass, lifetime and spin, but with charge and magnetic moment reversed in algebraic sign. We again point out, however, that the antiparticle differs when in its unobserved 4-spatial state. Only by analyzing the particle's supersystem can the true unobserved antiparticle be understood, as well as its fields and potentials in that condition.

antiphoton: A time-reversed photon. Presently the photon is considered its own antiparticle. *Observably* it is, but in its pre-observation condition it is not. An alternate but as yet unaccepted view is that, since the unobserved photon is comprised of (dE)(dt) — i.e., a piece of energy welded to a piece of time with no seam in the middle, the antiphoton may be assumed to be comprised of (-dE)(-dt) with respect to the external observer.

anti-Stokes radiation: The radiation coming from an anti-Stokes emission process from an intensely scattering medium, wherein more energy flux is emitted than is input by the experimenter-operator. The excess emitted energy is furnished by other processes in the medium. For true overunity operation, the excess energy furnished by the energetic medium must be freely replenished to the medium by the active vacuum's interaction with it.

antiwave: The time-reversal (phase conjugation) of a reference wave.

A-potential: The magnetic vector potential A, conventionally thought to be "defined" by the equation $\mathbf{B} = \nabla\times\mathbf{A}$. However, no equation is a definition (an identity is required). If we replace the "=" sign by "==", we have $\mathbf{B} \equiv \nabla\times\mathbf{A}$, which is actually seen to define the field B as just a curled A-potential, or as the curled component of the A-potential, *after* interaction with magnetic charge. The A-potential or an additional component of it can and does also exist in uncurled fashion, and will emerge in the uncurled state in the space outside any local path (e.g., the path in the interior of a toroidal coil) that retains the B-field therein. That process of separating the curl component of the A-potential from its uncurled component is known as the Aharonov-Bohm effect (which also affects the wave function). The motionless electromagnetic generator (MEG) uses a special nanocrystalline core material in a transformer configuration, which draws in and retains the B-field from a permanent

magnet outside the core but firmly in contact with it on both ends. As a result, the vacuum freely replenishes the withdrawn magnetic energy that would otherwise have existed in the space outside the core, but the energy outside the B-field localization zone remains and appears as a separated and uncurled A-potential. In this way, the MEG is converted to an open system not in equilibrium with the vacuum, and can therefore permissibly output more EM energy in its output coils than the operator inputs into the input coils, the excess being freely furnished from the vacuum via the broken 3-symmetry of the permanent-magnet dipole and the resulting 4-symmetry EM energy flow from the vacuum's time domain into the dipole.

The MEG is actually a practical macroscopic EM power system application of (1) the well-known Aharonov-Bohm effect and (2) the effect of the separation of the curled and uncurled potentials by a long tight solenoid or by a tight toroid, but in this case by the nanocrystalline magnetic core performing that separation function. In effect, the output coils interact with double (or greater) energy than would be available in just the B-field of the core (and of the magnet). Dual interaction with both the internal core B-field flux and also the external A-potential is obtained by pulsing, so that the pulse edges produce strong E-fields in space, with the E-fields striking the output coils in a transmission-reception near-field fashion. As is well-known, $d\mathbf{A}/dt = -\mathbf{E}$, and also $f(d\mathbf{B}/dt) = \mathbf{E}$. These two fields produced by the perturbed internal B-flux in the core and the pertubed external uncurled A-potential outside the core are in phase. This is how the extra pulsing A-potential energy outside the core is made to interact as -E-field energy with the Drude electrons in the output coils, while the changing magnetic flux in the core through those coils also simultaneously produces a second -E which interacts with the coil's conductors in normal E-field fashion. The total E-field interacting with the output coils is proportional to the *time rate of change* of the input perturbation signal, not the magnitude of its energy. By adjusting the leading and trailing edges of the perturbation pulses, the magnitude of the E - field interactions with the output coil is determined as desired. Further, the usual output B-field produced in the output coils by dE/dt is directly extracted into the core and held, so that *a purely electrical interaction and output occurs in the output coils*. This is easily shown since the output current and voltage of the output coil are in phase, within a degree or two. The MEG may be said to the world's first purely electrical induction transformer, freely separating the magnetic interactions and bottling them up, while allowing the electrical interactions.

asymmetrical regauging: A change of either the scalar potential ϕ or the vector potential A, or both, so that a *net resulting excess force together with a net change of total system potential energy* occurs in the system. During this change, an asymmetry exists in the active vacuum's energetic exchange with the system. The result is that the potential energy of the system is freely changed by energy from the vacuum, and a free net force is also produced in the system. This new force is then free to dissipate the excess potential energy by translating electrons through a load and powering it. By contrast, the Lorenz/Lorentz *symmetrical* regauging produces two free force fields that are equal and opposite, so there is no *net* resultant translation force available to translate electrons through the external load and power it. Thus Lorentz regauging arbitrarily applied to the Maxwell-Heaviside equations selects only that resulting subset of Maxwellian systems that are in equilibrium in their interaction with the external active vacuum. The potential energy of the system is changed, but only as a "stress potential" doing internal work upon the system to form and maintain its increased stress. The extra energy also rotates the system's frame out of the laboratory frame. Lorentz thus unwittingly discarded an entire class of permissible Maxwellian systems that are not in thermodynamic equilibrium with the vacuum. The Lorentz condition is initially violated each time anyone potentializes an EM circuit, but the closed-current-loop circuit design with the same charged-particle energy carriers around the loop — including back through the back emf of the source dipole in the generator — enforces a form of Lorentz symmetrical regauging during discharge of the system's excitation energy. Further, the response of the electrons in the usual electrical circuit with copper conductors is so rapid that the asymmetrical regauging (potentialization) is almost instantly converted to symmetrical discharging by movement of the electrons as current. When one section of the otherwise closed current loop uses a dramatically heavier charge as the energy carrier (as a battery uses ion current between its plates, but uses electron current between the outside of the plates and the external circuit), it is then possible to dephase the two independent carrier currents so that the battery will be charging while simultaneously the circuit is being powered, by a negative resistor (sharply increased scalar potential or voltage) produced at the plate surface interface of the two carrier current types. This proven Bedini process is an example of a true overunity process, capable of producing a self-powering system by means of adroit switching and timing.

asymmetry: Lack of symmetry, or "broken symmetry" in a general sense. Since a specific symmetry is accompanied by a specific conservation law, the breaking of that symmetry represents the violation of that conservation

law. Particularly note that a broken symmetry at one level often (usually) results in a new symmetry at a higher level, necessary to maintain the asymmetry at the lower level. The resulting "levels" of symmetry are known as *hierarchies* of symmetry.

asymmetry of **the dipole:** Because of the proven asymmetry of opposite charges, any dipole or dipolarity is a broken 3-symmetry in its fierce exchange of EM energy with the active vacuum, because of the known broken symmetry of the opposite charges on its ends. Any two points in the universe (in or out of the circuit), that are at differing ambient potentials, constitutes such a broken symmetry continuously pouring out EM energy extracted from the vacuum. A dipole or dipolarity continuously receives and absorbs copious virtual energy from the seething virtual photon vacuum flux, and not all this absorbed energy is reradiated back to the vacuum in virtual form. Instead, some of it is coherently integrated into observable form and re-radiated in all directions as usable, real 3-space observable photons and EM energy. We found that the input energy to the dipole is from the time domain of 4-space. Hence the dipole's broken 3-symmetry results in the appearance of a new and far more fundamental 4-symmetry in energy flow between the time-domain and 3-space. This was the solution to the long-vexing source charge (or source dipole) problem in classical and quantum electrodynamics. Reinterpreting the Whittaker 1903 decomposition of the scalar potential reveals the mechanism for this 4-symmetry between time-domain EM longitudinal wave energy flow into a dipole and 3-space EM longitudinal wave energy flow out of the dipole, due to the presence of the proven broken 3-symmetry of the dipole. *EM energy flow is conserved in 4-space, but not in 3-space. Further, the 4-*symmetry energy flow from the source dipole (or source charge) continues as long as the source dipole (or source charge) remains intact so that the broken 3-symmetry remains intact. It is strongly indicated that this asymmetry of the dipole or dipolarity is what Gabriel Kron finally discovercd as his "open path".

back emf: The counter-electromotive force, usually between the end charges of the source dipole in the external power source for an electrical circuit (in its overall closed current loop). When the electrons in the circuit are forced against the emf— as when the "spent" or depotentialized charges from the ground reference of the circuit are forced back up through the emf of the source dipole to re-potentialize the charges — then work is done upon the source dipole to scatter its charges and destroy the dipole. Removing the dipole stops its receipt of vacuum energy from the time - domain (which was due to its broken 3-symmetry, now removed). It

also stops the former dipole's transduction of that energy, and its former output of 3-space energy flow along the circuit and in space around the circuit. When this flow is occurring, a small component of it strikes the surface charges in the conductors and is diverged into the circuit (by axial precession of the surface charges withdrawing the "immediate stubs" of their fields and potentials into the conductor) to power it as the Poynting energy flow component. The huge remainder of the energy flow in space surrounding the circuit simply misses the circuit and is utterly wasted. Destruction of the source dipole removes the transduction of EM energy from the vacuum. It thus stops the powering of the circuit. So additional energy must then be input to the power source to perform work on its scattered internal charges, force them apart again, and reform and restore that source dipole, in order to resume powering the circuit by energy extracted from the vacuum by the dipole. It is simple to show that such a closed loop circuit uses more of its collected energy from the vacuum to destroy its source dipole, than it uses to power its load. Hence the circuit self-enforces COP<1.0.

back emf (tempic): There are actually two emfs in a circuit, not one. There is a 3-space emf and also an entirely unrecognized *tempic* emf. In either case, under proper circumstances there can be a back-emf of either one or both. See discussions under **electromotive force, back** and under **tempic back emf.** The tempic back emf is very important to COP>1.0 circuits, where the system's output energy density in spacetime is greater than the energy density at the input section of the system. This difference in tempic stress potential provides a tempic force sweeping from system output section back through the system to its input section. The current is a current of Dirac sea holes (negative energy 4-electrons) moving in that local vacuum, from the output section back through the system to the input section. At the input section, this Dirac sea hole current reacts with incoming electrons from the external power system. It therefore "eats" incoming electrons, so that the power supply must now furnish additional electron current to (a) power the negation and "killing" of the Dirac sea hole current by filling those holes with electrons in the input section of the circuit, and (b) simultaneously furnish the additional usual current to power the system's input. The result is that the tempic back emf is nature's mechanism for decaying the excited COP>1.0 energy state represented by a system in overunity functioning condition. Unless this hole current problem is overcome, this decay mechanism will destroy the net overunity, and it will prevent any attempt at close-looping the circuit for self-powering by use of clamped and governed positive energy feedback from output to input. The Bedini method can be used to transform the

detrimental Dirac hole current into ordinary electron current, providing the self-powering feedback loop needed. Or, Bearden's outrigger method of using a multi-system set of external COP<1.0 receiving circuits powered by radiation (Poynting EM energy flow) from a single central power source (energy flow radiator) can be used. Then already-positive energy feedback from one or more of the separate outrigger COP<1.0 receiver circuits can be fed back in normal fashion to power the central power unit. Note that the outrigger concept uses the bridging concept, so that an external COP<1.0 system can be powered from a central radiating system, and the external COP<1.0 system can collect and output more energy than is output in the *accounted Poynting component* of the central radiating system. The excess energy radiated comes from the radiated Heaviside component.

bare electron: The true electron without its partial shielding of virtual positrons that are attracted toward it from the active vacuum, and that cluster around the electron, partially shielding its charge as seen by an external observer. The bare electron has infinite energy and infinite charge, as does the shielding cluster of virtual positrons. The difference between these two infinite values of opposite charge is the finite "externally observed" value of the electron charge listed in texts and handbooks. This strange dipolarity of the source charge thus exhibits an asymmetry in its exchange with the active vacuum virtual photon flux. Hence this mechanism also solves the source charge problem — how the charge continuously pours out EM energy in all directions at the speed of light, establishing its fields and their potentials reaching out into or even across the universe, without any input *of observable* EM energy to the source

Barret, Terence W.: Noted modern electrodynamicist and consultant who works in SU(2)xSU(2) gauge symmetry extended electrodynamics, and other models, and was also one of the pioneers of ultrawideband radar, Barret is one of the vigorous modern electrodynamicists continuing to develop and extend the science of electrodynamics and the electrodynamics model itself.

Bedini, John: Noted audio engineer, leading overunity energy researcher, inventor of the Bedini process for creating a true negative resistor inside a battery used as primary power to a circuit, and inventor of the Bedini overunity process for killing the back mmf (magnetomotive force) in a magnetic motor. Bedini is also the inventor of the renowned Bedini amplifiers well known to audiophiles, the BASE process for holographic sound, and a remarkable process for cleaning the harshness from digital

audio disks. In addition, he discovered a mechanism for transducing into usable positive energy the detrimental Dirac Sea hole current (negative energy electron flow) backflow in an overunity system, flowing from the output section back through the system to the input section and even on out into the external power supply. The Bedini process transduces this detrimental current into normal electron current, thereby providing most or all of the required input power to the input section. Bearden then explained the technical process for Bedini's discovered transduction procedure, and Bedini and Bearden filed a patent application on this process.

Berry phase: Generalization by Berry of the Aharonov-Bohm effect, for an adiabatic situation. Later Aharonov and Anandan further removed the adiabatic condition and generalized the Berry phase to the geometric phase. See Aharonov-Bohm effect, geometric phase.

blocking: In a Fogal charge-barrier semiconductor, stopping or partially stopping the flow of current in a circuit, or between two points, by *pinning the electrons without stopping the EM energy flow.* In ordinary usage, "stopping the progress of whatever charge flow or current is being referred to.

Bohm, **David J.:** World-renowned physicist and originator of the hidden variable theory and interpretation of quantum mechanics. See David Bohm, "A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden' Variables, I and II," *Physical Review,* 85(2), Jan. 15, 1952, p. 166-179 (Part I); 180-193 (Part II). Together with his student Aharonov, Bohm co-authored a fundamental paper on the Aharonov-Bohm effect wherein interfering electromagnetic potentials can produce effects on charged particle systems, even at a distance and in the absence of the electromagnetic force fields. From Bohm's hidden variable theory, the quantum potential has been highly weaponized by five nations, and these eerie weapons operating instantaneously at a distance through multiply connected spacetime are presently the dominant strategic weapons on earth.

Bohm's hidden-variable theory (HVT) of quantum mechanics: A major interpretation of quantum mechanics, formulated by David Bohm and published in *Physical Review* in 1952. Bohm's theory makes all the correct predictions and also eliminates many problems in quantum mechanics, such as the "measurement problem" and the — now recognized — problem of the missing chaos (i.e., the missing "hidden chaotic order."). Bohm's theory implies that physical reality — or much of it — can in fact be deterministically engineered. A key concept is the use of a *quantum*

potential, which is multiply connected. Clandestine superweapons using **Bohm's** quantum potential (QP) have been developed and deployed by several nations. Present mutual assured destruction "standoff between these nations is based on surviving counters to QP weapons rather than surviving nuclear weapons.

Bohren, Craig F.: Distinguished Professor of Meteorology, Pennsylvania State University, noted for work in scattering theory. In an experiment **detailed** in C. F. Bohren, "How can a particle absorb more than the light incident on it?" *American Journal ofPhysics,* 51(4), Apr. 1983, p. 323-327 Bohren shows that in nonlinear conditions a resonant particle may absorb and output 18 times as much energy as is impinging upon it from the usual **field** definitions based on a static intercepting charge. The additional **energy** is "absorbed from the vacuum"; actually, it is absorbed from the nondiverged Heaviside energy flow component accompanying the accounted Poynting input component, but arbitrarily discarded by Lorentz. T**he** resonant particle sweeps out a geometrical interception area (reaction cross section) greater than that of the same charge in a fixed static condition. Hence it intercepts part of the always-available Heaviside "dark energy" flow surrounding the Poynting energy flow component of every field/charge interaction.

Bohren experiment: Revealing experiment by Craig F. Bohren, replicated by Paul and Fischer, which shows that a given charge when in particle resonance absorbs more energy from a field or potential then the same cha**rge** does when in "static" position. This experiment is a direct experimental demonstration of the existence of Heaviside's nondiverged energy flow component around every field/charge interaction. See discussion under Bohren, Craig F. The Bohren experiment can be repllicated by any university nonlinear optics laboratory and outputs 18 times as much energy as is input by normal calculations (neglecting the Heaviside nondiverged EM energy flow component of the input).

boson: A particle having integral spin, which obeys Bose-Einstein stat**istics** but not the Pauli exclusion principle. Bosons include the photon, alpha-particle, and any nucleus of even mass number.

brid**ge:** A component or process which passes EM energy between two **isolated** circuits, but does not pass dq/dt between them, and which breaks the normal rigidly field-locked power dissipations in the two circuits. Space itself would appear to be one such bridge for EM energy flow.

bridging **function:** The function of passing EM energy flow between two isolated circuits, but not passing dq/dt between them, while simultaneously

breaking any normal rigidly field-locked power dissipations in the two circuits. Use of the uncurled A-potential where $\nabla \times \mathbf{A} = 0$ is one available method of bridging otherwise isolated circuits, particularly in the outrigger embodiment of the motionless electromagnetic generator and other COP>1.0 systems.

broken symmetry: Fundamentally, a condition in which two parts of some configuration or shape, on opposite sides of some divisor or condition or boundary, are not similar but differ. In vacuum energy physics, we are very interested in the fact that — because of the broken symmetry of opposite charges — any charge (with its associated clustering virtual charges of opposite sign) and any dipole or dipolarity represents an asymmetry in its fierce energy exchange with the vacuum. This implies that something virtual becomes observable; i.e., part of the virtual EM energy continuously absorbed from the vacuum by the charge or by the dipole is changed into observable form and re-emitted as real, observable EM energy. The remainder is re-radiated as virtual EM energy. The charge's transduction of absorbed virtual photon energy and its re-emission as observable photon energy was proposed by the present author in 2000 as the solution to the long-vexing problem of the source charge and its associated fields and potentials (and their energy) reaching across the universe.

bypass resistor: In electrical theory, a resistor to pass or conduct current around (in parallel to) some other component. If another effect such as use of the overpotential, pumped phase-conjugate reflection, quantum well, quantum tunneling, negative energy, or charge blocking is added, the bypass resistor's function becomes extremely complicated. The bypass resistor may be complex, e.g., or it may be a true negative resistor in some cases.

carrier wave: A fundamental wave that is modulated by another wave or other waves, and hence "carries" the other modulating waveform(s). By stripping off the carrier in a demodulator, the carried waveform(s) emerges.

Casimir **effect:** The attraction of two conducting parallel plates in space, placed very close together, due to their influence on the active vacuum and on the vacuum's interaction with the plates. A part of the vacuum spectrum between the plates is "cut off and blocked or shielded, so that the vacuum potential between the plates is less than the vacuum potential outside them. The resulting potential gradient (force) on each plate from outside pushes the plates together. The Casimir effect unequivocally proves that it is

possible to directly engineer the vacuum so as to produce forces and energy and physical effects in material systems. While it is a "small" white crow, it only takes one white crow to prove that not all crows are black. It is sufficient to conclusively prove that EM energy can be extracted from the vacuum. From there to practical EM power systems, fed by vacuum energy, is simply a product of modifying the prevailing electrodynamics and electrical engineering to incorporate the supersystem components and interactions, and then to gradually discover and develop the necessary technology. In this book we attempt to point the way by using the supersystem and providing some of the major necessary principles and concepts.

Casimir, Hendrik Brugt Berhard (1909-2000): Noted scientist who in 1948 correctly predicted that two parallel conducting plates, placed very near each other in a vacuum, would experience an attractive force due to their influence on the electromagnetic vacuum.

causality: The relationship between "cause" and "effect", or the interaction of 4-space cause upon a previous 3-space observation (effect), to produce a new 3-space observation (change in the previous observable or production of an exact 3-space replica). The basic notion in a causal system is that the system's response to an input signal is dependent only upon past input values, not upon future input values. In a multiply connected space, the causality principle is dramatically changed and requires very careful accounting.

chaos: In dissipative dynamical systems, the dynamical evolution or ordering of the system that is aperiodic and highly dependent upon initial conditions of the system. The trajectories of the system move on a *strange attractor,* which is a fractal subspace of the phase space. The mathematical equations describing chaotic behavior are very nonlinear and so complex that at the present time they cannot be computed or predicted. Control of chaotic oscillations thus is ongoing in its scientific development, with the most advanced control work having been done by Russian scientists, but now openly available.

charge: C*harge* is the ongoing circulation of EM energy flow between the time and 3-space domains, as "seen" by the observer in 3-space. *Negative* charge is (i) the ongoing absorption, by a mass particle, of EM energy input from the time domain (from *ict),* (ii) transduction of the absorbed energy into 3-space EM energy, and (iii) re-emission of the EM energy in all directions in 3-space. *Positive charge* is (i) the ongoing absorption, by a mass particle, of EM energy input from 3-space, (ii) transduction of the

absorbed energy into the time domain, and (iii) re-emission of the EM energy in the time domain. Alternately, the positive charge can be considered as (i) the ongoing absorption, by a mass particle, of EM negative energy input from the time domain (from *ict),* (ii) transduction of the absorbed negative energy into 3-space, and (iii) re-emission of the EM negative energy in 3-space. A similar inversion can be utilized to represent negative charge. Time reversal of EM energy can be seen to result from the combined broken symmetries of EM energy flow (in 4-space) between time and 3-space, of two opposite charges and thus of dipolarity itself. See paragraph 3.1 of Chapter 3.

charge, electrical (q).: In the sense of q being charged mass, where the mass m_q of charge q is associated with the phenomenon defined as charge (see above definition). In our view, an electrical charge q associated with a charged particle or mass may be defined as $q \equiv m_q\phi_q$, to first order. This fits the common use of "the charge" as an expression for a charged mass, and explains why a gathering of charges produces a potential ϕ reaching out from the "source gathering of charge q". The actual "charge" action associated with the mass is due totally to ϕ_q, and to the broken symmetry of the ϕ_q dipolarity in the vacuum flux exchange with m_q. The charge q can be further broken down into a set of composite dipoles if the gathering of a screen of virtual charges of opposite sign in the vacuum, surrounding the mass of the "bare charge" inside the gathering, is considered. At first order, ϕ_q can be expressed (from *a particle view)* as a change in the local vacuum virtual photon flux (VPF), due to the VPF exchange between vacuum and m_q. *In a classical approach,* the vacuum may be considered as a giant scalar potential comprised of bidirectional EM wave flows according to Whittaker's 1903 decomposition, except we must re-interpret the phase conjugate half-set of Whittaker's decomposition as incoming from the time domain or complex plane. The charge then may be considered to diverge so much energy flow from the time domain into 3-space "around" the mass, resulting in ϕ_q as the steadily diverged energy surrounding the mass m_q. The ϕ_q component is actually the massless electrical charge and massless of itself. This approach would then yield a definition of massless charge itself, which at present is undefined in physics, as pointed out by Feynman and others.

In the expression $q \equiv m_q\phi_q$, the ϕ_q represents a change to the local vacuum potential ϕ_{vac}. Both ϕ_q and ϕ_{vac} decompose into Whittaker phase conjugate longitudinal EM wavepairs. As can be seen, by altering or engineering these constituent wavepairs, a particular ϕ_q or particular local vacuum potential ϕ_{vac} can be given a deterministic internal structure and dynamics.

Thus the interaction of a given electron or group of electrons may be made **quite** different from the interaction of another electron or group of "apparently identical" electrons. Such structuring dynamics are met with in the internal structuring of water, e.g., where the fierce activity of H-bond making and breaking can be treated as a special ϕ_H and its "internal structure and dynamics" can be engineered. A leading scientist pursuing that type of effect is Jacques Benveniste, in France. Predictably, the o**rthodox** establishment has severely castigated these experiments, defending conventional models as absolute while completely ignoring the experimental results that refute those conventional models as being incomplete.

charge carriers: Anything — usually fundamental particles, ions, etc. — which consists of or contains charges and can be potentialized and move.

charge, magnetic: In the sense of charged mass, a magnetic charge is what is commonly called a "magnetic pole". The mass m of the magnetic charge is associated with the exchange of EM energy between the time domain and the 3-space domain. Essentially, the energy exchange action **known** as "charge" in the massless sense is the magnetic scalar potential, or monopole, when decomposed as per Whittaker and as reinterpreted by the **present** author, and as pointed out in quantum field theory by Mandl and Shaw. Note that our personal view discriminates between *massless charge and charged mass.* Massless charge is an ongoing action and process, involving energy transduction from one form (time energy or 3-space energy) to another (3-space energy or time energy). A charged mass is a **mass** associated with such action. Unfortunately, in the prevailing usage the word "charge" is just loosely used for both senses without discrimination. Hence one must carefully differentiate between the use of "charge" for "charged mass", and its use for an "ongoing process".

charge-parity-time (CPT) theorem: C is *charge conjugation,* which changes the quantum number of every particle into its antiparticle. P is the reflection operation known as *parity,* which turns an object into its mirror image and rotates it 180 degrees about an axis perpendicular to the mirror. T is t*ime reversal.* Any violation of time-reversal symmetry is always accompanied by a violation of CP symmetry (by violating either C or P symmetry) and vice versa.

Electrodynamics and the strong interaction preserve CP symmetry to great accuracy. Weak interactions do not conserve CP symmetry. T symmetry violation has been shown at CERN, the European particle physics laboratory in Geneva, Switzerland.

charge trapping (also "pinning"): Holding charges "pinned" or "trapped" at a site or in a location, by a barrier or force, so that they do not flow as $i = dq/dt$. A clustering of the pinned charges at the pinning site often occurs.

charge-barrier: A process or component or function — particularly in a semiconductor such as the Fogal semiconductor — that blocks the movement of charges q as current dq/dt.

classical electromagnetic theory: The classical theory of electrodynamics, in its modern form begun by Maxwell with his seminal-paper orally presented in 1864 and published in 1865. Today many variations have been made, particularly with respect to the basic group symmetry of the theoretical equations.

Clifford algebra: A special higher topology algebra founded by Clifford, which includes as subsets many other algebras of lower topology.

closed system: In the present approach, a system that in theory does not communicate with its environment, and does not exchange energy or matter between system and environment. Notice that this directly conflicts with the notion in thermodynamics (both classical and disequilibrium) that a closed system is closed only to mass exchange across its boundary, but open to energy exchange across it. General relativity has falsified that notion since 1915. Any system undergoing a change of energy also undergoes a change of mass, since mass is a special form of energy.

An ideal model in which dynamically and energetically the system is considered to be "isolated" as if nothing else existed. In short, the system is considered as if it were in some "magic box" and nothing outside the box can ever enter the box or affect the system inside the box, and nothing in the system can ever leave the box or affect anything outside the box. No electromagnetic system is closed. In short, we have corrected the thermodynamics "closed system" with open energy transfer, to a true closed system with neither energy nor mass transferring. That corresponds to the present thermodynamics notion of the "isolated system".

One performs a non sequitur when proclaiming treatment of any EM system as a "closed system", and of course modern physics substantiates this. The broken symmetry of the opposite charges on the ends of a dipole — and of an observable charge together with its clustered virtual charges of opposite sign — has been proven since 1957. The absence of any closed system is particularly true in electrical power systems. Here one is indeed allowed to input energy into the system to excite or potentialize it. That **of**

course assumes that the system was "opened" long enough to take on excess energy (which also changed its mass)! Then as the system operates, losses and dissipations occur, in which case energy is considered to "escape" from the system permanently. In other words, the system was also continually "opened" so that energy could escape. In any EM system, every charge and dipole is already an open system, with free exchange of energy between 3-space and the time domain via that charge. In particle physics, every charge and dipole is a broken symmetry in its virtual particle flux exchange with the active vacuum.

The ancient thermodynamics definition of a "closed system" as one that exchanged heat but not mass, was formulated before thermodynamicists even knew that heat was a form of EM energy, or even knew what energy was. Hence we have changed that definition, since it is a non sequitur in view of modern physics.

There is really no such thing as a truly closed system in the universe, since *every* system is embedded in the active vacuum and is an open system in an energy exchange with the vacuum. Further, any change of energy in the system curves the local spacetime, which in turn interacts back upon the system. If that energetic exchange of the system with its "active vacuum and active curved spacetime environment" is symmetrical, then the system is in equilibrium with respect to its environmental exchange. In that case, for a limited number of purposes the system may be treated as if it were a closed system. In classical electrodynamics, Lorentz regauging of the Maxwell-Heaviside equations further reduced them to describe only Maxwellian systems in equilibrium with the active environment including the active vacuum. Consequently, any *net* interaction between the external vacuum (or the active local curved spacetime) and the system was excluded from the CED model. Obviously a *broken equilibrium* (i.e., broken symmetry) in that actual physical interaction is also not included in the CED model. Nor is it included in the classical (equilibrium) thermodynamics model with its archaic second law.

coefficient of performance (COP): Ratio of the usable energy output of a system divided by that portion of the total energy input that is input by the the operator's or experimenter. The COP is thus a measure of "return for using the operator's or experimenter's input energy" to produce — or direct the production of— useful work by the system". There are other ways to calculate the COP ratio; e.g., the average output power divided by the average operator input power. Contrast COP to the *efficiency* of a system, which is the ratio of the total usable output energy divided by the *total input energy from all sources,* including by the external active

environment as well as by the operator. The efficiency of a system means how efficiently it produces useful output from its *total* input. The COP is the performance the system renders for the *operator's* input. Note that even a highly inefficient system — say, with efficiency $\xi = 0.25$ — may nonetheless have a COP>1.0, if the operator himself inputs less energy than the system outputs and the environment inputs all the rest of the output energy as well as all the energy in the system losses. As an example, a common home heat pump may have an efficiency of 40%, but a COP = 4.0. A windmill may have an efficiency of 20%, but a COP = ∞.

Also, for many systems one may evaluate their coefficient of performance for (1) the performance of the system as an energy transducer only, i.e., the ratio of energy the system outputs (whether used or not) divided by the energy the operator inputs; or (2) the performance of the system as a work producer, which is the useful work accomplished by the system divided by the operator's energy input. As an *energy transducer,* every generator and every battery has a COP»1.0, when both the Poynting diverged energy flow output and the Heaviside nondiverged energy flow output are accounted. Yet for useful work, the same system may have COP<1.0, because all the Heaviside nondiverged energy flow component is wasted, and some of the Poynting diverged energy flow component is wasted also.

Analyzed as an energy transducer only, every dipolar power unit — such as a generator or battery — outputs enormously more energy flow rate from its terminals than the mechanical energy rate input to the shaft of the generator, and than the chemical energy dissipated in the battery. So as an energy transducer, every dipolar power source is already a system exhibiting COP»1.0, prior to Lorentz' integration trick to discard the enormous Heaviside nondiverged energy flow output component.

cold fusion: An ad hoc term applied to the transmutations at low spatial energy (but high time-energy) achieved in electrolyte experiments, particularly when using specially prepared palladium electrodes after their loading with positive H+ or D+ ions, and particularly when deuterium is present in the electrolyte and the loading is by D+ ions. The *total* energy of the photon is greater the lower the photon's frequency and therefore the lower the spatial energy of the photon. Hence the cold fusion interactions actually use much higher *total* energy nuclear reactions than does present high (spatial) energy physics. Since "high energy" physics erroneously eliminates consideration of time-energy, the present high energy physics community is unjustifiably hostile to the very notion of cold fusion. The fact that little experiments on the lab bench use far higher total energy than the community's proud large accelerators is a bitter pill many high energy

physicists cannot *tolerate*, let alone view with scientific objectivity. So a**gain** there is a classic confrontation between science from scientific results and "science as known in the prevailing dogma".

composite dipole: Dipole formed as one part of an isolated, observable "charged particle", consisting of a differential element of that observable charge on one end and a momentary clustering virtual charge of opposite sign. This is one way of dealing with the modern "infinitely strong dual **dlpoles"** view of the charge, where the bare charge in the middle is infinite as is the clustering virtual particle charge surrounding that bare charge and **partially** shielding it. The difference between these two infinite charges is **finite,** and is routinely calculated to show that it is the standard value of the charge as seen by an external observer.

C **ooper pair:** In superconductivity theory, a dynamic, weakly bound **pairing** of electrons in a superconducting material below its critical temperature. In this pair, if the energy state with wave number sigma and spin 1/2 is occupied by an electron, then so is the state with wave number -sigma and spin -1/2. The Bardeen, Cooper, Schrieffer (BCS) theory uses this concept to provide a detailed microscopic theory of superconductivity.

COP (Coefficient of Performance): See coefficient of performance.

cosmological feedback principle: A self-regenerating cosmological fee**dback** cycle ascribed by Puthoff as the source of the vacuum EM zero-point energy (ZPE). One may assume the existence of EM zero-point energy by fiat as part of the boundary conditions of the universe, or concieive of its generation by the quantum-fluctuation motion of charged particles that constitute matter. Puthoff calculated the latter possibility, as**suming** that the ZPE spectrum (field distribution) drives particle motion, an**d** that the particle motion in turn generates the ZPE spectrum. This provides a self-regenerating cosmological feedback cycle, which in fact is consistent with the general relativity assumption that curvature of spacetime affects mass energy, and mass energy changes affect the curv**ature** of spacetime. It would be interesting to see if Puthoff s concept can be made compatible with the broken symmetry of **a** dipolarity and Kron's open path concept.

curl concept of fields: The concept of a field as the curl of a vector **potential** (the vector potential may not be known). Any field so conceived has a divergence of zero *a priori*. One must be careful, however, because electrodynamics calculates only the field's reaction cross section with an *assu*med fixed unit point static charge at a point in space, leaving the field itself undefined. In short, the calculation of "the field" is actually a

representation of the local point intensity of the field's interaction with unit point static charge. It is not the magnitude of the entire field (or potential) itself, *a priori,* but only of its reaction at a point with such a charge. In short, the field's reaction cross section with static charge is often misinterpreted as the magnitude of the field; at best it is an indication of the field intensity to static charge at a point.

curl-free magnetic vector potential: A field-free magnetic vector potential A without curl (swirl), hence lacing the B-field with which an A-potential is usually associated. For simplicity, one may visualize the curl-free A-potential as massless magnetic charge (and energy) in linear motion. Toroids and long solenoids have the characteristic of confining the B-field (curled potential) and holding it inside. However, drawing energy from any potential whose source charge or source dipole is not destroyed simply results in the full value (sum of the A-potential and B-field components) of the potential being replenished from the active vacuum, via the 4-symmetry energy flow mechanism in the presence of the broken 3-symmetry of the dipole. Hence one may easily increase the available potential energy density at will. This is a special form of gauge freedom allowing one to freely alter the potential energy of any electromagnetic system at will. Contrary to the dictates of EM textbooks, gauge freedom rigorously allows the direct and *free* amplification of potential energy of the EM system *at will;* the excess energy being freely furnished from the active vacuum processes. This principle incorporated in gauge field theory, has been known for decades and not previously used in the design, production, and use of COP>1.0 electrical power systems, prior to the invention of the motionless electromagnetic generator (MEG).

curved spacetime: A four-dimensional geometry (spacetime or ST) is used in general relativity, where the ST curvature is determined by the distribution of spatial energy such as mass-energy. In the general relativity view there is no such thing as an "empty" space "filled" with some energy substance. Instead, there is a combined space and time as a single entity, *spacetime,* which is itself energetic and is the very geometry we use in our mathematics. Any change in the local energy density of that spacetime constitutes a *curvature* of spacetime. In the new, more extended approach, any change in the spatial energy density or time-energy density of spacetime, or a combination of changes in both, constitutes a curvature of spacetime. In 4-space modeling, time is treated as a special, highly condensed form of EM energy. Specifically time may be regarded as ordinary 3-spatial EM energy compressed by a factor of c^2 and existing in

the time domain rather than in 3-space. Time-energy therefore has essentially the same energy density as mass.

dark energy (negative): (Dirac holes, Dirac hole potentials, Dirac hole currents): A strange form of vacuum energy that creates repulsive gravity, causing the expansion of the universe to speed up (as observed and not otherwise explained by conventional theory). As a strong candidate for the dark energy, the present author has proposed a vacuum negative energy and negative energy currents in a negatively curved spacetime region partially containing excess Dirac sea holes devoid of electrons, along with normal filled Dirac sea holes. These special "Dirac negative action quanta" then form *negative action* (negative angular momentum, or — for simplicity — negative energy) potentials, currents, and fields. This type of vacuum condition containing some empty Dirac sea holes is referred to as a Dirac *-polarized vacuum.* However, it is not just simple static polarization, but possesses rich dynamics. Such dynamic Dirac sea hole regions occur in the vacuum in curved spacetime regions with tempic potential gradients and strong 3-spatial energy gradients, and thus time force existing across the region. The holes occur since the energetic fluctuations of the local vacuum energy can separate a Dirac hole from its occupying electron. These may then recombine, or in sufficient local spacetime curvature can remain apart. The more violent the region, the more severe are local spacetime curvatures in that region, and the greater the fraction of empty Dirac holes that is maintained on the average, in their continual forming and recombining. In those regions, a tempic potential is higher at the higher center magnitude of the spatial energy density. Hence there tempic forces from "inside to outside", providing a "tempic broom" effect to sweep outward the excess Dirac sea holes separated from their electrons in the curved spacetime. The end result is the presence of increasingly unoccupied Dirac sea holes toward the outside of violent regions of spacetime, until the effect is overcome by the decreasing spacetime curvature. These empty Dirac holes in regions and currents are a special form of vacuum negative energy, negative energy fields, and negative energy potentials, creating negative gravity (repulsive gravity) upon ordinary mass exposed to them. So the more distant violent astronomical regions have greater amounts of repulsive gravity being produced by their local Dirac-polarized vacua and negative energy fields and potentials. The result of this effect is that, at sufficient distance from us, the increasingly earlier, more violent events and resulting greater curved spacetime regions have created sufficient Dirac-polarized vacua to overcome the normal gravitational attraction between galaxies, etc. Even farther out, the increase in Dirac-polarized vacua overrides the normal

attractive gravity between galaxies, etc. and produces net repulsive gravity. In turn this results in acceleration of the observed distant expansion of the universe. Dirac-polarized vacuum and its special dynamics can be accommodated in Sachs' unified field theory, which unites physics from quarks to the cosmos. See also **Dirac** sea **holes.**

On the laboratory bench, Dirac hole currents and effects are met with in a circuit or system producing COP>1.0, or very sharp 3-spatial gradients such as in violent electrical discharges. The effects become non-negligible at about COP = 2.0 and sometimes less. The tempic force back across the, system from output to input is sweeping the Dirac holes through the system. This can play havoc with attempts to close-loop the circuit for self-operation. In semiconductor components, strange effects are met due to their use of donor and acceptor materials, and temporary or permanent failure of semiconductors can result. The simple way to visualize this is that, in the system's supersystem, the spacetime component is curved and the vacuum component is highly nonlinear. All three components — overunity system, local nonlinear and polarized vacuum, and local curved spacetime — are interacting vigorously with each other. An operating overunity system represents an excited state of that local region of vacuum and curved spacetime, hidden in the euphemism "polarized" which is inadequate to describe the dynamics. With the dynamics, one may visualize that the Dirac sea hole currents are swept back through the system, seeking to recombine with electrons to eliminate the "polarization" and its dynamics, thus decaying the excited state back to equilibrium and destroying the overunity condition. In a robust system whose internal parts do not appreciably interact with these Dirac hold dynamics, the dynamics will reach the input section and extend back into or toward the primary power supply. In the input section, the feeder line, and in the power source itself, this results in "eating electrons". The Dirac sea effects thus act as a separate load imposed within and around the system input section or even back in the feeder line to the external power supply, in addition to the system load itself in the system output section. Simply put, the power supply must now furnish extra electrons to "power" the Dirac sea hole recombinations first, and additional electrons to power the system in its "normal" fashion. The result is to "draw additional power" from the source, where "drawing power" now includes the additional "eating of electrons" within the power supply itself, the feeder line, and the input section of the system.

Bedini and Bearden have filed a patent application on processes to convert the detrimental Dirac sea hole current reaching the system's input section.

transforming it into ordinary electron current. Magnetic Energy Ltd. has developed two other processes that handle the Dirac sea hole current problem, allowing close-looping for self-power ng operation. One of these processes converts negative energy into positive energy and the other avoids the negative energy problem. The first one allows this otherwise devastating special form of "negative feedback" or "degenerative feedback" to be converted into "positive feedback" or "regenerative feedback", allowing the system to be close-looped successfully for self-powering. Bearden has proposed yet a different approach using an "anti-circuit" method, but at this writing the method is still proprietary until intellectual property rights are secured.

dark energy (positive): Our term for the vast Heaviside nondiverged energy flow component surrounding every field/charge and potential/charge reaction but unaccounted in present electromagnetic theory after being arbitrarily discarded by Lorentz circa the 1890s. Present theory only accounts for that small amount of energy flow (the Poynting component) diverted locally around the interacting charge. All the rest of the energy flow comprising the field or potential, and missing the intercepting point charge, was discarded arbitrarily by Lorentz and is still discarded today, using Lorentz's integration trick. In honor of Heaviside, who did recognize the gravitational implications of his dark energy flow component, the present author has nominated this vast, unaccounted "dark energy" component as being responsible for the extra gravity holding the spiral arms of the spiral galaxies together. See **spiral** galaxy.

So one must recognize that the term "dark energy" is indefinite, since there are two kinds: (a) dark positive energy, and (b) dark negative energy. Dark positive energy consists of "normal" energy as often connected with particles, collected upon them and affecting their momenta, etc. It has dynamics and effects consistent with that kind of energy. Dark negative energy is a condition of the vacuum itself. It represents a sort of "empty container and empty container dynamics" (negative energy dynamics) in the vacuum itself, which "eats positive energy", so to speak. In philosophical terms, dark positive energy represents unaccounted actions and effects from unaccounted "extra presence of real substance and things and actions". Dark negative energy represents unaccounted actions and effects from "extra absence of real substance and things and actions beyond zero". Dark negative energy exhibits precisely appositive effects to the effects produced by dark positive energy. E g., dark energy creates the excess gravity that is holding the arms of the spiral galaxies together. Negative energy resulting from spacetime curvature conditions in highly

energetic astronomical phenomena produces the *antigravity* that is responsible for the acceleration of the expansion of the universe. We have nominated the negative energy Dirac sea hole phenomena as the cause of the antigravity that accelerates the expanding universe. Interestingly, these negative energy phenomena present in sharp discharge (strong gradient) phenomena appear to be responsible for the fact that such phenomena are known to violate present thermodynamics, and are being studied under the aegis of "extended thermodynamics". See discussion of areas violating thermodynamics in the last chapter of Kondepudi and Prigogine, *Modern Thermodynamics: From Heat Engines to Dissipative Structures,* Wiley, New York, 1998, reprinted with corrections in 1999. A reference is D. Jou, *Extended Irreversible Thermodynamics,* Springer-Verlag, New York, 1996.

degenerate semiconductor: A semiconductor whose conductivity approaches that of a metal.

demodulation: From a carrier containing a modulated signal, recovering the signal that was used to modulate it.

deterministic pattern or "template": The exact arrangement, by plan and deterministic action, of a group of entities. The deterministic actions and their "controlling forces" are simply called "dynamics", "structuring", etc. An example might be deterministic field structuring and actions of photons in a "herd" or "group". Or of a set of spacetime curvatures, into a dynamic structure called a *spacetime curvature engine* — or *engine* for short, so long as the meaning is clear. Or by hidden order in the virtual photons in the vacuum flux, or a deterministic set of changes to that vacuum flux (the vacuum flux that is called the "vacuum potential." We have called this *internal EM dynamics* function — of deterministically patterning or templating the virtual flux (particle view) of the potential, or of deterministically patterning or templating the longitudinal and time-polarized EM wave decomposition (wave view) of the potential - *dimensioning* the potential. See **dimensioning.** We refer to the deterministic structure and its structural dynamics as the "engine template".

dielectric: Literally, "against electric (current)", originally coined to mean "opposes the flow or conduction of electric fluid". In today's language, a dielectric is a non-conducting material used to oppose or prevent the flow of electric charges. Even empty vacuum exhibits some dielectric resistance. "Dielectric" is also used to refer to a nonconducting material (often between the metal plates of a capacitor or elsewhere) that can (i)

sustain a change in potential across a distance (i.e., an E-field), and (ii) serve as an insulator. Space itself is a dielectric, or at least is said to exhibit certain dielectric qualities.

dimension: A certain primary geometrical physical attribute, such as length, used to describe the separational relationships of physical phenomena. Actually, "dimension" just means "fundamental quantity of separation" and "geometry" in the most general sense. Dimensions thus become a sort of set of fundamental variables describing the *extensivity* of system and the dynamics of that extensivity. The number of dimensions taken in advanced physics usually represents a somewhat arbitrary choice for good modeling fit. In modern Kaluza-Klein theory, for example, it becomes necessary to accept some 10 or 11 dimensions in the usual particle physics case. Sometimes more than 20, or even an infinite number, of dimensions may be used. General relativity (GR) has incorporated the interaction of the abstract geometry (spacetime) with mass, so that *geometry is a real, active, dynamic entity.* Until Sachs' extension of Einstein's work into a unified field theory and Evans' incorporation of O(3) electrodynamics as an important subset of Sachs' unified theory, GR has largely remained a nonexperimental discipline, at least in the laboratory. With the new Sachs-Evans approach and with recovery of (a) the Heaviside dark energy flow component (b) overunity EM systems arbitratily discarded by Lorentz symmetrical regauging, and (c) modeling of the complete supersystem including system, vacuum, and spacetime in mutual interaction, GR suddenly becomes substantially engineerable by novel electromagnetic means, both in the laboratory and in operating devices. We are thus entering a great new age of electrogravitation and a new physics. Research in antigravity lifters, COP>1.0 electrical power systems, medical therapy utilizing engines and anti-engines, and cold fusion are the elements of the new science that are struggling to be born and funded.

dimensi**oning:** Coined term meaning "forming an exact pattern or template of structures", particularly of nested curvatures of spacetime, where the pattern/template may also be dynamic, to include patterning and dynamics in the time-energy domain as well as the 3-space energy domain. It involves the internal structuring of the "dimensioned" entity. The term "dimensioning" makes sense in unified field theory, but is awkward in normal EM theory, which erroneously assumes that EM energy propagates in an uncurved spacetime. The mere presence of a change in local spatial energy, created by the wave energy itself when present in that local region, curves the local spacetime. Note that the background potential may be

changed in a steady state level as well, which means that the frame of the system and its field dynamics has been rotated away from the laboratory frame. A time-polarized EM wave, e.g., changes the time-energy density and also curves local spacetime very powerfully. Hence the EM wave rigorously travels in curved spacetime, and in fact identically is a propagating, oscillating curvature of spacetime. What is missing from present physics is all accounting of the extraordinary Heaviside nondiverged energy flow component accompanying the accounted Poynting diverged energy flow component. Thus present physics *does not properly account for* the gravitational aspects of "electrodynamic field and potential energy in space".

Dimensioning also implies a deliberate form or structure (with dynamics) created in the virtual photon flux of the vacuum, in the virtual photon flux comprising a scalar potential, or in the infolded longitudinal-wave EM inside all EM potentials, fields, and waves. It implies an associated set of spacetime curvatures and their dynamics. The latter are referred to as "engines", "vacuum engines", "spacetime curvature engines", etc.

Dimensioning the potentials or signals or carrier waves of conventional electrodynamics involves adding hidden *vacuum engines* to them. The term *dimensioning* is descriptive and was chosen because adding such templates is equivalent to increasing the EM topology by adding mathematical dimensions. Since an EM wave or field or vector potential can be decomposed into two scalar potentials, then "dimensioning" one or both of the scalar potentials can "infold" the desired hidden structures or patterns (vacuum engines) inside an EM carrier wave, EM field, or vector potential created by the interference of the two dimensioned base potentials. This is referred to as *dimensioning* those EM field and wave entities. Internally structuring the two scalar potentials via arrays of longitudinal EM wave emitters and applying the necessary dynamics (modulations), is the primary manner to directly engineer dimensioning. When dimensioning is present, two EM waves that appear identical as seen on the oscilloscope may have dramatically differing internal structures (dimensioning). Hence they may produce drastically differing effects when they interact with the same or similar objects. *The only way in which the action of a vacuum engine can be resisted is to create and simultaneously introduce the exact antiengine for it — a special sort of forcible symmetrical regauging, so to speak.* Once the action has been completed in the receiving object and it has been physically changed, the only way it usually can be undone is to form a precise antiengine for that action, amplify the antiengine, and let the antiengine act upon the object for a

sufficient time to "time-reverse it back to its previous physical state and condition". The concept has great utility in electromagnetic healing, not discussed in this book. We point out that the decades-long induction of diseases, health changes, etc. in U.S. personnel in the U.S. Embassy in Moscow occurred in forcefield-free regions. In short, the changes occurred in regions where the potentials were stable and unchanging, and so their e**ngines** were stable and constantly applied to the exposed personnel. The Soviets were simply radiating a high level target, the U.S. Ambassador and his **staff,** to guarantee high-level U.S. attention. By U.S. reaction to the **deliberate** electromagnetic "engine" induction of disease and health c**hanges** (three Ambassadors sickened and later died), the Soviets could posit**ively** ascertain whether we knew of the "infolding" or "dimensioning" technology, and whether we had developed defenses.

dipole: In the simplest case, two separated charges of usually equal magnitude and of opposite sign. More generally, a localized positive charge or charge distribution, and a localized negative charge or charge distribution, such that the net charge summation is zero, while the positive and **negative** charge distributions do not precisely superpose point to point but only on the average. We point out, however, that in regular physics electrical *charge* has no proper definition. As is well known in particle physics.due to the opposite charges on its end a dipole is a broken **symmctry** in the virtual photon flux of the vacuum. By definition of broken symmetry, this means that *some* of the virtual energy flux continuously abso**rbed** from the seething vacuum by the charges of the dipole is not re-radia**ted** as *virtual* energy. Instead, it is integrated *coherently* and re-radiate**d** in 3-space as real emitted EM energy, establishing the fields and pote**ntials** associated with that source charge or source dipole. The dipole is the**refore** the most fundamental true "negative resistor" since it freely and continuously receives EM energy in unusable form, transduces it into usable form, and re-emits it in usable EM form.

It follows that any positive charge in the universe and any negative charge in the universe form a dipole and a broken symmetry in the vacuum flux. Hence every such dipolarity in the universe already extracts energy from the vacuum and puts it out in 3-space, or absorbs energy from 3-space and returns it to the vacuum. Kron called this an "open path" electrically, well before broken symmetry was formally discovered and experimentally prove in 1957. Kron was also able to use the open path in and around special electromagnetic circuits to cause the circuits to become true negative resistors, freely powering the network analyzer at Stanford Universoty even in the 1930s.

In classical EM theory, the problem of how every charge and dipole can continuously emit EM energy to form all the associated fields and potentials and their energy has been an unsolved problem — sometimes called the most difficult problem in electrodynamics, both classical and quantal. For the solution and a discussion, see the present author's paper "Giant Negentropy from the Common Dipole," *Journal of New Energy,* 5(1), Summer 2000, p. 11-23. Symmetry represents a conservation law, and broken symmetry represents violation of that conservation law. Because of the broken 3-symmetry of the dipole, the EM energy flow is not conserved in three dimensions — in this case, violation of conservation of 3-space EM energy flow is not conserved. Neither is the time EM energy flow conserved in the 4th dimension. Instead, EM energy flow is conserved in 4-dimensions, between the inflow in the time-domain and the outflow in 3-space in all directions, or vice versa. The hidden inflow of EM energy to the dipole (and to a charge) is actually from the complex plane (time domain). Thus all EM energy in 3-space is actually received by the source charge or source dipole from the time-domain, and returned to the time domain. What we call "propagation of EM energy through 3-space" is actually the spreading of this 4-circulation to successive 3-space points. The importance of the internal structuring of time-flow and of longitudinal EM waves in the time domain (dimensioning in the time-domain) is apparent, since it produces very powerful engines that can act upon matter in any fashion desired. Indeed, the Russians have developed clandestine robot engine systems comprised of sets of spacetime curvatures and their dynamics (which are just sets of longitudinal EM waves and their dynamics). Any function of a weapon system — sensing, weapons (using scalar interferometry), communications, propagation, etc. — can be incorporated. The capabilities of such systems, such as travel through continuously emitted EM signal beams from satellites, communications stations, power lines, etc., is eerie. Such a system can reside in any convenient EM potential or field as a "dimensioning" of the potential or field. Such robot engine systems have been clandestinely tested, but discussion of them is beyond the scope of this book. Suffice it to say that these systems are ushering in a dramatic revolution in future warfare, and the present research in physical nanobots is already decades behind.

Very powerful support for the author's solution of the source-charge problem is given by F. Mandl and G. Shaw, *Quantum Field Theory,* Wiley, 1984, Revised edition 1993, under the heading "Covariant Quantization of the Photon Propagator" in Chapter 5. In their deeper coverage of the photon polarizations, Mandl and Shaw point out that the longitudinal and

scalar polarizations are not directly observable, but only in combination, where they manifest as the "instantaneous" Coulomb (i.e., electrostatic) potential.

Translated from particle terminology to wave terminology, Mandl's and Shaw's argument directly fits my re-interpretation of Whittaker's 1903 decomposition of the scalar potential.

Dirac, Paul A. M.: Noted English physicist, 1902-1984, who shared the Nobel Prize for developing wave mechanics and predicting the existence of the positron. He also originated the notion of "holes" or negative energy **states** in the vacuum, where the holes are ordinarily filled with electrons. The "vacuum replete with these Dirac structures" (all filled with electrons) is referred to as the *Dirac Sea.* If some of the holes are empty, then that is **the** Dirac sea of a curved spacetime. We strongly stress that a Dirac sea **hole** (negative energy electron with negative charge, negative energy EM fields and potentials, and with negative mass-energy) prior to observation (prior to its reaction with mass) is a quite different entity from the positron (after reaction with mass, so that the positron has positive mass-energy, **positive** charge, positive energy EM fields and potentials, and has been reversed in its 3-space propagation direction). Specifically, the Dirac sea **hole** produces negative energy fields and potentials, whose powerful Heaviside nondiverged components enable to perform practical antigravity. The (observed) positron produces gravity, not antigravity, and also positive energy fields and potentials.

Dirac sea: A concept and description (modeling) of the vacuum as containing — amongst other things — a "sea" of an infinite set of negative energy slates ("holes") for electrons, almost all of which are usually filled with electrons in the absence of any spacetime curvature of significance. In Dirac electron theory, the relativistic wave equation for the electron has four components, which correspond to two spin orientations and two energy conditions: positive and negative. Ordinary electrons are in the positive energy condition. So then the vacuum must also possess a "sea" of negative electron energy conditions. These negative conditions are called "holes" and are ordinarily filled or mostly filled with electrons which have fallen into these negative energy states. The Dirac sea is this vacuum sea of negative energy electrons (and a perhaps a few empty holes). In forward time, if energy is added to a negative energy electron, electrons can be **lifted** from this sea, since the added energy creates a local curvature of spacetime. If spacetime is locally curved, additional holes may be created so that, when the holes meet normal positive energy electrons, the electrons fall in and disappear, creating the appearance of an "electrical

energy sink." This can happen so that the local ST curvature merely relaxes back to an uncurved spacetime, therefore avoiding radiation from "pair annihilation". If the curvature is in the opposite direction (i.e., if positive energy is added to the vacuum), electrons may be lifted from the Dirac sea by the resulting spacetime curvature energy, thus producing a flow of electrons "right out of the nonlinear vacuum" and generated by the spacetime curvature, and creating the appearance of an "electrical energy source" from the vacuum itself. In that case the energetic holes left behind also remain, and are affected by all EM fields etc. These holes thus form negative energy currents, fields, potentials, waves, and other electromagnetic entities such as negative energy charging and discharging (excitation and de-excitation).

In an overunity EM system, there is a higher energy density in the output section than in the input section. This includes time-energy density. So a higher tempic potential exists at the output than at the input. A gradient in the tempic potential thus exists, which constitutes a tempic force from the output section back through the system to its input section, and even on back through the conductors to the external power source, and even back into the distant external power source itself. Thus the power source has to furnish additional electron current. It must "power the holes", so to speak, by furnishing the electrons that are "eaten" by the Dirac hole current to eliminate it, which represents a novel kind of load in the input section of the system. So the power supply must furnish more power, so as to furnish the normal power to power the system, and the extra power to "power the elimination of the Dirac sea hole current as a back-reflected load". This is nature's way of decaying the excited state represented by COP>1.0, and restoring equilibrium and COP<1.0. By the Bedini process, the otherwise detrimental Dirac sea hole current reaching the input section is transformed into ordinary electron current, thus serving as input power to the system. By adjusting the system and optimizing it, this strange kind of "positive power input from converted Dirac hole current negative power feedback" can be adjusted to equal the input power required by the system. At that point the external power system can be disconnected, and the unit continues in close-looped and self-powering operation, including powering its load as well. Gabriel Kron succinctly described this condition and adjusting for it. Such a system allows energy to be continuously extracted from the vacuum, and a load to be powered continuously, with all the energy to run the extracting system being freely received from the active vacuum.

Dirac sea hole: A negative energy state for an electron, in the Dirac theory (in the Dirac sea). Literally the hole (negative energy state) when not occupied by the electron. In flat spacetime, almost all Dirac sea holes are filled with electrons. A small fraction on the average are not filled due to the local fluctuations of the vacuum energy continually lifting electrons from their holes and then having them recombine, usually so quickly that no radiation occurs in the observable state. The situation in the virtual state can be described by Feynman diagrams. This received view can be falsified in a curved spacetime. There the holes can exist and flow as currents, as validly as positive energy electrons can flow as currents, without the incessant "filling" activity of the vacuum itself. In addition, in such a hole-stabilizing curved spacetime region, the hole can "eat" or recombine with a real electron, so that the electron vanishes but without radiation. If we wish to join the two views, then we take Feynman's and Wheeler's view that the field does not exist in vacuum as such, but only the potential for it exists — in short, only the engine exists. The engine can then be said to be an ordering (chaotic self-ordering) condition present on the statistical random variation of the fluctuations of the vacuum. With longitudinal EM wave technology, this "order in the midst of disorder" — this templating and engine technology — can be directly engineered.

Dirac sea hole current (positron current): Just as a current of positive energy electrons can be generated, a current of negative energy Dirac sea holes can also be generated if the local spacetime is properly curved. Mathematically these are usually considered to be "positron currents", except they have no positive mass, because a hole will "eat" an electron. In an overunity electrical power system, the tempic potential is greater at the output of the system than is the tempic potential at the input section. There thus exists a "tempic force" or "tempic broom" sweeping Dirac sea hole current (positron current) out of the input section of the system into the external power supply. Simple instruments will record this current as if it were electron current being furnished from the external power supply to the system. Also, the Dirac sea positron current will "charge" the battery with Dirac sea holes (mathematical positrons), which in the conventional sense discharges the battery. A battery may become highly charged with Dirac sea holes. If so, then when placed on a normal battery charger, the electrons in the charging current will be "eaten" for an extended period by falling into the Dirac sea holes, and the battery will not acquire any charge until they are filled — whereupon the battery will sudden begin charging upnormally again.

We also point out that the vacuum, containing the Dirac sea, actually is not "massless" at all, but has zero resultant mass on the average, as a result of the simultaneously presence of positive and negative mass in average equal abundance. Any curvature of spacetime must violate this "net sum zero" mass, hence produces inertia in all masses. Note that a negative mass can also exhibit a negative inertia; i.e., it accelerates and enhances the action of any force acting upon it, instead of opposing it. In short, negative mass exhibits negative inertia. We suggest that this effect is probably involved in the more violent explosive phenomena of astrophysics.

disequilibrium: Broken equilibrium, which in turn involves breaking appropriate conservation laws unless compensated.

displacement current: The apparent continuation of a conduction current through a region of space without a conductor, e.g., between the plates of a capacitor. Rather than being the motion of charges in a conductor, the displacement current is related to the rate of change of an E-field, and thus to the rate of change of the strain of the dielectric.

dissipative structure: In open systems far from thermodynamic equilibrium, a region of self-ordered behavior of a special kind in matter, characterized by symmetry-breaking, multiple choices, and correlations of macroscopic range. By correlations we mean statistically reproducible relations between distant parts of the system. Formation of a dissipative structure represents the birth of complexity in that region by self-organization. Usually a dissipative structure emerges only after the driving constraints reach a critical value. As the embryonic "engine" technology advances, however, the direct engineering and control of dissipative structures will become commonplace and routine.

distortion correction theorem: "If a scalar wave $E_1(r)$ propagates from left to right through an arbitrary but lossless dielectric medium, and if we generate in some region of space [say near z = 0] its phase conjugate replica $E_2(r)$, then E_2 will propagate backward from right to left through the dielectric medium, remaining everywhere the phase conjugate of E_1." Quoted from Amnon Yariv, *Optical Electronics,* 3rd Edn., Holt, Rinehart and Winston, New York, 1985, p. 500-501.

What is missing from the distortion correction theorem is hidden in the phrase *"if we generate in some region of space ... its phase conjugate replica. ".* Since electrodynamicists and optical physicists have been unaware that all EM energy at any point in space comes from the time domain to that point, then —*prior to detection by interaction with charge* — the actual phase conjugate wave exists in the imaginary plane (in the

time domain) and *not* in 3-space. The continuous interaction of that imaginary plane wave with charges, to actually produce the force-field wave in space, is *assumed* in the standard nonlinear optics. In short, one is looking at the "effect" wave, not the "cause" wave. However, since time is not an observable even in theory, it is this "effect" wave in 3-space that will indeed be measured by our instruments, because they must interact the imaginary or phase conjugate field with charge in order to detect or observe it (measure it).

The proof of this is experimentally already known but not recognized. If one reflects an EM wave off a normal mirror, the mirror must absorb the incoming wave, which transfers the wave momentum to the mirror to repel it, then the mirror must re-emit it, which adds that much more momentum to the recoil. So the mirror recoils with twice the momentum of the reflected wave. That produces a wave going in the other direction. If the incoming wave is continuous, one then has "paired" waves going in **opposite** directions). However, if an incoming wave strikes a phase *conjugate* mirror (PCM) material and is phase conjugated, a wave going in the opposite direction also emerges, but it synchronizes point by point with every spatial point occupied by the incoming wave. Also, *the phase conjugate mirror does not recoil at all.* This is well known in phase conjugate optics. It clearly shows that the origin of the "detected" phase conjugate wave is quite different from that of a normal reflected wave. Indeed, by our reinterpretation of Whittaker's 1903 biwave decomposition of the scalar potential, at every point along the detected phase conjugate wave, the energy enters that point from the time domain, and not from some sort of reflection from the PCM. The energy also returns to the time domain from that point. Its presence at the point produces a separation of virtual point charges, or the well-known polarization of the vacuum. So the flow of energy is from the time domain to the negative charge of the point dipole, thence to the positive charge of the dipole or others immediately surrounding it, thence back to the time domain. That is the operation in a "time-forward" sense to the external observer. In a "time-reversed" situation, the 4-circulation appears in the opposite direction. We propose that this fundamental 4-circulation is responsible for and constitutes spin itself. The direction of flow determines the 'polarity of the charge" we obseve. In this view, the point dipolarity in the virtual state with its ongoing 4-circulation can be taken as the very definition of energy itself.

Druge, Paul: Important German physicist, 1863-1906, who formulated the theory of the free electron gas inside conductors, using it to formulate a theory of metallic resistance.

Drude electron gas: The electrons that have broken loose from their orbital bonds in atoms in a conductor, and are thus free to "wander around" and "migrate" — or flow as current when exposed to an emf. Also called just the "electron gas". Note that, in the metal lattice of the conductors, each position vacated by a Drude electron is a "hole" or positively charged little region. Not only do electron currents exist as net negative charge migration in conductors and materials, but also hole currents exist as net positive charge migration from atom to atom, or a sort of "ionization migration flow". Electrons are continually recombining with these "ion holes", however, to reduce the hole current. These considerations are particularly significant in semiconductor materials.

duality principle: In quantum mechanics, the principle that photons and other particles propagate like waves and interact like particles, so that their description as only waves or only particles is inadequate.

Edison, Thomas Alva: Noted American inventor, 1847-1900, whose staggering portfolio of inventions included the storage battery, electric light bulb, phonograph, motion pictures, carbon microphone, and many others. Edison actually ran multiple "patenting research" laboratories as discovery and patent generating facilities. Not only was he an inventor himself, but he also employed a very good staff of researchers for invention and discovery.

E-field (electric field): The electric field intensity E; that field on an electric charge (charged mass) which produces an electrical force resulting in a linear motion of the charge. In reality, this electric field *as usually defined* does not and cannot exist in empty space devoid of charge, but only in and on charged matter, since mass is a component of force by $\mathbf{F} \equiv \partial/\partial t(m\mathbf{v})$. More specifically, the E-field is the local intensity of the field at a point, in its interaction with a unit point static charge fixed at the point. Even more specifically, it is the output of an observation/detection operation, which is a *d/dt* operator imposed on the 4-space causal field interaction with the 3-space charge, resulting in a frozen 3-space "slice" or snapshot of the deviation of energy *from* the field, forced to flow around that intercepting charge, at that single instant. In short, the E-field as a force field is an *effect* and not a *cause*.

The greatest error in all electrodynamics is to then assign this same *frozen effectforce field intensity snapshot* — or an implicitly assumed iterative sequence of such snapshots — as the dynamic and nonfrozen *causative field itselfm* 4-space, prior to the field's interaction with charged matter. This is the substitution of effect for cause, a grave non sequitur.

When EM theory was founded, the founders believed there was no single **point** in the entire universe where mass was absent; instead, a thin material "luminiferous ether" was considered to fill all space. Time was considered immutable, and there was no concept of a dynamic *space time.* Hence at each point in such a material ether, the reaction with charged matter (et**heric** matter) was thought to universally exist. Hence the field was indeed a very material entity, in their concept!

With the destruction of the material ether notion in the 1880s, not a single Maxwell-Heaviside equation was changed to eliminate its implicit assumption of the material ether. Hence this enormous error of confusing the *effect* field with the *causal* field (prior to observation-detection-interaction) is ubiquitous in electrodynamics and therefore in physics itself. The two fields (causal and effect) do not even have the same dimensionality; one is dynamic in 4-space while one is frozen in a 3-space snapshot. This has led to the false notion that an EM force field wave "moves through" 3-space, which does not happen at all. What really happens is that, if we assume a continual iterative *d/dt* observation operator, we have a continual series of such frozen 3-space snapshots, like the frames of a motion picture film. But none of those snapshots have any inherent motion at all. For a statement of the falsity of the conventional illustration of the "EM wave in space as an orthogonal pair of oscillating E and H fields in a transverse plane", see Robert H. Romer, "Heat is not a noun." *American Journal of Physics,* 69(2), Feb. 2001, p. 109. In endnote 24. **p** 109, AJP editor Romer takes to task *"...that dreadful diagram purporting to show the electric and magnetic fields of a plane wave, as a function of position (and/or time?) that besmirch the pages of almost every introductory book. ...it is a horrible diagram. 'Misleading' would be too kind a word; 'wrong' is more accurate. " "...perhaps then, for historical interest, [we should] find out how that diagram came to contaminate our literature in the first place.* "Also see charge.

E-field, **motional:** In classical EM theory, the electric field produced by moving a conductor in a magnetic field. Often called *motional inductance* of the field. In the conventional theory, motional inductance is deemed to be ident**ical** to the inductance caused by a time rate of change of the magnetic field, experienced by the moving conductor. Or vice versa, experienced by a stationary conductor in a moving magnetic field.

E-field, static: In conventional theory, the electric field in the space surrounding a static charged particle, induced by the presence and action of the charged particle. There is no notion as to the *causative mechanism for this static* field of and from a charge, which implicitly is assumed to

just continuously create and pour out EM energy in all directions, thus grossly violating energy conservation. Consideration of this anomaly leads to what has been called the most pressing problem in both quantal and classical electrodynamics: the question of the formation of the fields and potentials associated with the "source charge". Either the charge totally destroys the conservation of energy law itself, or there must be a *virtual* (nonobservable) energy input to the charge, since instruments establish that no observable EM energy is input to it.

For a solution to this problem, see the present author's "Giant Negentropy from the Common Dipole," *Journal ofNew Energy,* 5(1), Summer 2000, p. 11-23. We later found our solution to be consistent with quantum field theory and with a slight reinterpretation of Whittaker's 1903 decomposition of the scalar potential.

Ehrenhaft, Felix: Scientist who performed numerous experiments believed to demonstrate fractional charges. We point out that classical electrodynamics assumes a local flat spacetime, a notion long falsified by general relativity, since 1915. In a local curvature of spacetime, the dynamics of the charge (modern view as the finite difference between two local infinite charges forming a dipolarity) can change the observed value of the net finite charge. So finite fractional charges, or even supercharges, are quite possible.

Einstein, Albert: German (Jewish) physicist, 1879-1955, who emigrated to the U.S. and formed special and general relativity theory, discovered and formed the theory of Brownian motion, recommended the development of the atomic bomb to President Roosevelt, and profoundly affected the course of science and the modern world,

Einstein, Podolsky, and Rosen (EPR) paradox: Thought experiment in 1935 for measuring two correlated photons separated and at distant locations, protesting that quantum mechanics requires that the particles communicate instantly, which is a "spooky action-at-a distance" (Einstein's phrase). The experiment eventually was performed and it works, just as required by quantum mechanics. The paradox inspired the development of hidden-variable theories.

Einstein's general theory of relativity: Mathematical theory of gravitation in which the gravitational force is mathematically described by a curvature in spacetime. In other words, the geometry and its dynamics have become physical agents, doing away with the old notion of the agent being something separate that is occupying inert spacetime. It is important to note that, in general relativity, mass-energy acts on spacetime to curve

it, and the curvature of spacetime acts back on mass-energy to translate or change it. What seems missing from GR — at least in its practice — is the reaction of time-energy upon the geometry to curve it, and that corresponding reaction of the spacetime curvature back upon time and time-energy to change it.

Further, we consider that an exact pattern (template) of curvatures of spacetime and their dynamics exists and is back-acting upon every mass system and its dynamics. This is the *engine* concept. The most general way to engineer matter is not by brute force translation forces, but by forming spacetime engines. Once formed, these engines act upon the interior of any mass placed in the engine region, to eliminate the deltas existing in that muss's resident engine and the impressed engine. *The forces arise from the local spacetime itself, as curvatures in that local spacetime, so the action is from "inside" to "outside" an object, starting and continuing from every point in the object.* The curvatures of spacetime itself furnish the energy for the continuing actions upon the interior of the mass, once we have paid to form the engine. The mass can be acted upon at any level, from its gluons and quarks to its nuclei, to its atoms, its lattice forces and binding energy, etc. Significantly, the Sachs unified field theory applies to physical reality from beneath the quarks and gluons to the entire universe itself, and folds in quantum mechanics, electrodynamics, and general relativity into a single unified field theory that is (in theory) engineerable by higher symmetry electrodynamics means such as Evans' O(3) electrodynamics.

Einstein's postulates: (1) All the laws of physics are equally valid in all inertial frames of reference, (2) the speed of light is the same to every inertial observer, and (3) the observable local effects of a gravitational field are indistinguishable from those arising from acceleration of the frame of reference.

The first is called the special relativity principle, the second is called the law of light propagation, and the third is called the equivalence principle. It is now known that postulates (1) and (2) are not independent of each other. Note that the third postulate implies that any local force is due to a "gravitational field" (acceleration of the frame of reference). It also implies that gravitational force has a mechanism, since quantum mechanics assigns a differential operator, operating upon a potential, to create every force. By extended inference, it can be seen that the third postulate also implies that there should exist a method to turn any type of force (field) into gravitational force (field).

Note that postulate 1 may be violated if two frames remain inertial but each local spacetime contains different hidden engines. So the laws of interaction physics may indeed vary for the same object placed in first one of the frames and then in the second. Engines are ongoing general relativity actions, even in inertial frames. The action may not be translation of the bulk object, but extensive changes to the interior of the object and its interior dynamics at any and all levels.

The Russian physicist Sakharov has strongly postulated that gravitation is not even a fundamental field of physics, of the kind used by Maxwell in his electrodynamics. Instead, in this view G-field is always comprised of, and made from, other fields and interactions upon them. This would seem to follow straightaway since change of any kind of energy in spacetime curves that spacetime, therefore producing a gravitational change. So such has always been implicit in general relativity; it just took Sakharov to formally propose it. See A. D. Sakharov, "Vacuum Quantum Fluctuations in Curved Space and the Theory of Gravitation," *Soviet Physics Doklady,* 12(11), 1968, p. 1040-1041 [English translation.] Sakharov's article (in Russian) in *Dokl. Akad. Nauk SSSR,* Vol. 177, 1967, p. 70-71.

Einstein's postulates (second postulate extended): Let us do a little "tinkering" with Einstein's postulates. For the first one, we point out that in the new approach using dimensioning and subspaces, the notion of an inertial frame now has acquired additional complexity! The "gross translation" effects — which tends to be what physics ultimately focuses upon today — can remain the same, and yet vacuum engines can be buried up inside the inertial frame to act upon a mass in non-translating ways. Everything translation-wise can remain the same, but now matter can be transmuted and transformed, etc., still right there in an inertial frame. So when the infolded electrodynamics inside all fields, potentials, and waves are utilized, the notion of "inertial frame" has acquired a higher topology, so that one inertial frame may differ very substantially from another inertial frame, even if the two are not in translation motion with respect to each other. This of course moves one from special relativity into full general relativity, and even there into a slight extension. Special relativity can remain special relativity on the surface, and yet general relativity effects occur "within" the objects postulated to exist in this inertial frame. The "inertial frame" concept in the postulates is now just a sort of special "equilibrium case" of a higher topology "inertial frame" notion. Further, general relativity is extended from the notion of "just translation" to the notion of "internal engines and internal dynamics also". These engines can

be created in mass, in fields and potentials and waves, and in the vacuum itself.

The second postulate now stands as a "special case" of a far more general second postulate. The conventional second postulate actually defines (and limits) "light" to bulk changes in the entire vacuum potential magnitude. It only applies to light signals which are "bulk upheaval" disturbances of the vacuum potential (spacetime), so to speak. The limitation to light speed is an envelope wave speed restriction. Specifically it need not apply to the "inner EM/GR realm" of longitudinal EM waves infolded inside the vacuum potential, other potentials, signal carriers, etc. Superluminal communication is now included in this "hidden variable" or longitudinal EM wave communication. The Fogal semiconductor is capable of infolding and outfolding EM signals, including producing the internal longitudinal EM waves, and during their infolded state these signals are permitted to move at superluminal velocity. This has been experimentally demonstrated by Fogal.

So the second postulate needs to be restated to include the present statement as a special case. Notice that the concepts "light" and "speed of light" have now taken on much richer, extended meanings, since there is "outfolded" light and "infolded" light, so to speak. Light now is not just the "external perturbation wave" in the ambient vacuum potential medium (in flat spacetime). Instead, it can also be an "internal perturbation longitudinal wave" inside a "net flat spacetime" which does not show on the "surface" at all. Indeed, it may move in the time dimension or in 3-space. It now includes the transmission of an extraordinary "vacuum engine" as well as the usual transmission of just an ordinary signal. The ultimate expression of this extension has unfortunately been the development of such "engines" as infolded robot systems for use in warfare.

These infolded vacuum engines can be visualized as very special sets of longitudinal EM waves and their dynamics, consistent with the Whittaker decomposition. Whittaker's U(1) symmetry electrodynamics decomposition— particularly when enriched in the higher symmetry O(3) electrodynamics — applies to the ambient vacuum as a potential (it is a potential since it has energy density). So the "subspace" inside spacetime, so to speak, is just a set of LWs and their dynamics, and that subspace itself is engineerable, just as is the "bulk curvature of spacetime" itself. Further, we may now consider that space itself is just a vast superhighway for such superluminal LWs and their dynamics. Mass is mostly empty space with only an occasional particle here and there and with fields,

potentials, and waves in between. Hence huge masses such as the ocean and earth are actually superhighways for the direct passage of longitudinal EM waves, "engines", special robots, etc. The degree of "transparency" is a function of the degree of cleanness of the LWs — where by "clean" we mean "absence of transverse EM wave residues".

The third postulate has also been dramatically extended and requires revision. As presently stated, antigravity effects do not appear to be included in present physics heretofore. The "gravitational effects and external accelerated effects" notion in conventional physics are still founded purely on *ordinary bulk translation.* Now they need not be. For example, the system can appear to be an ordinary system, as judged by normal "external light" observation. Yet its internal vacuum engines can cause local violation of most so-called "laws of nature." The reason a "law of nature" can be violated is that one is now able to violate the premises upon which it is postulated, and which are required to hold if the law is to hold. Or another way to look at it: any conservation law is the result of a symmetry. Breaking that symmetry allows violation of that specific conservation law. All external symmetries can be broken internally, even if the overall symmetry still applies externally!

The infolded EM inside the "conventional" EM fields, waves, and potentials — and inside the vacuum potential and spacetime itself- dramatically changes the present theories of electromagnetism, quantum mechanics, and general relativity. Further, for the first time the Sachs unified field theory allows an *engineering* approach that simultaneously crosses, includes, and extends all three disciplines in the required manner. The approach can be placed into good engineering models based on the Sachs work, particularly using the O(3) electrodynamics subset spearheaded by Evans, and the models can be tested and verified or falsified. See **frame, reference;** and **superluminal communication.**

electric field: (See also discussion under **E-field).** The *conventional* definition is this: "1. a region in space in which a stationary electric charge experiences a force due to its charge. 2. the electric force per unit test charge." Quoted from *Dictionary ofScience and Technology,* p. 720. That definition is flawed. Consider the "spatial aspects" of part 1. If an electric field is defined as a force per unit charge (per Part 2), it is not a region in massless space but is an effect of something existing in massless spacetimc and interacting with the charged 3-spatial mass. The electric field *prior to interaction and observation ofthe interaction* is indeed related to a region in "spacetime", because it is identically a curved spacetime region. In the Sachs approach, general relativity and electrodynamics have become one

and the same. So prior to interaction, the *field as it independently exists prior to interaction with charge* has become a curved spacetime region, and the field-in-space is *purely* a spacetime curvature. Again, there is no such thing as a massless force. It is the hoary old mechanics notion of a separate force acting upon a separate mass that is a total non sequitur. The interaction of the massless field in space with a mass to produce a force, *of which that mass is actually a component,* is a separate consideration from the field as it exists in space prior to interaction. The result of this entity's interaction with charged mass has nothing to do with *what an electric field* is but with *what it does to charged mass.* Further, the force evidenced on a charged particle is not due to its charge; the particle has that charge always, whether or not there is a net force evidenced on it!

Part 2 is a little better. The only problem is, it totally disagrees with the notion of the field as an entity existing in spacetime prior to interaction with charged mass. In other words, here it's a "force on a charge", which is an effect (force consisting partially of the charge) occurring after the interaction. Again, the conventional definition states only what the field *does or accomplishes,* not what it *is.* Hopefully the reader can now begin to see what terrible difficulties await anyone who seriously attempts *foundations definitions.* Feynman sums it up admirably in one of his famous statements: "*Everything we know is only some kind of approximation, therefore, things must he learned only to be unlearned again or, more likely, corrected.* "An additional difficulty is that the very notion of a separate massless force — independent of the mass on which it operates - is fictitious, yet continues to be widely used. Recalling that any true definition is an identity and not an equation, let us start with the definition of $\mathbf{F} \equiv d/dt(m\mathbf{v})$. As can be seen, force is a system comprised of (i) a mass component and (ii) a nonmass component. The force is not something separate from the mass, at all! Further, force is not even unitary. It's a system comprised of two coupled components; the mass and a coupled (interacting) gradient in a potential flux. *Note that v involves motion through, and interaction with, the virtual flux comprising the vacuum potential. Note that dv/dt involves a gradient in that flux interaction with the mass.* Unfortunately mechanics is still using the medieval concept of a "separate force acting upon a separate mass." That is wrong, unless we change the fundamental definition of force itself. See, e.g, Robert Bruce Lindsay and Henry Margenau, *Foundations of Physics, Dover* Publications, New York, 1963, p. 283, where the authors emphasize that a "field of force" at any point is actually defined only for the case when a unit mass is present at that point. The reason can be seen: mass is a necessary component of force, and without mass present there cannot be a

force present. For that reason, the force field in matter is a quite different beast from that "same" force field in empty spacetime. The first is a 3-spatial snapshot of an ongoing 4-spatial interaction, while the second is just a curved region of that "empty" spacetime without any ongoing reaction necessarily.

electric dipole: See **dipole.**

electrodynamicist: A specialist in electrodynamics — the physics of the relationships between electric, magnetic, and mechanical phenomena — and especially a specialist in electrodynamics *theory.* Essentially all electrodynamicists are versed in U(1) electrodynamics, and a much smaller number are versed in more advanced (higher group symmetry) electrodynamics such as O(3) symmetry electrodynamics, unified field theory electrodynamics, non-Abelian electrodynamics, etc. The electrodynamics field is actually a very vast field indeed, touching everything in physics, chemistry, etc. When one needs a particular electrodynamics problem solved, it often calls for a special category of electrodynamicist and not just an electrodynamicist in general. One must therefore sometimes examine the background of the electrodynamicist making a statement or a pronouncement; electrodynamicists after all do have differing views and differing disciplines within the field. And something may be perfectly true and acceptable in O(3) electrodynamics, yet not even exist in U(1) electrodynamics. As an example, the Aharonov-Bohm effect exists in O(3), but not in U(1). U(1) assumes a flat local spacetime (falsified by general relativity almost a century ago) and an inert vacuum (strongly falsified by modern particle physics and quantum mechanics), while O(3) is perfectly content to include and model curved spacetime and active vacuum also.

electromotive force (EMF): A difference of potential created by sources of electrical energy — i.e., by separated charges (dipoles) — which can be utilized to drive electrical currents through external circuits. As a difference of potential, that constitutes a gradient and hence a force. Also, open circuit voltage, or the limit of the potential difference between the source's terminals as the current in the external circuit approaches zero.

This term is poorly named and also quite confused in the standard theory and usage. First, em/is supposedly not a *force* at all. It is a difference in potential; hence it is measured in volts. It is very difficult to imagine a "difference in potential" at a single point unless one is dealing with a multiply connected space. So if the difference in potential is between two adjacent points, then that constitutes a force between the two points. Also,

emf is not considered an E-field, since that is a field of force. Yet it is in fact a $\nabla\phi$, restricted to the direction between the two measurement points, and $-\nabla\phi$ is considered to be an E-field in the EM theory! As can be seen, one will not find a truly logical definition of potential or emf in the present texts and science literature.

For this reason the standard theorists say that the term emf is sometimes used as equivalent to a difference in potential, but that strictly speaking it should be applied only to a source of electrical energy. The problem is that most conventional theorists are unaware that a potential *identically is* a bidirectional flow of energy in 3-space, but a 3-space flow where *the energy enters from the time-domain (complex plane) and is caught in 3-space by interaction with charge, in a frozen snapshot (observation). The energy actually enters each 3-space point in the 4-space potential, from the time domain.* It moves across a dipole in space (present due to the quantum mechanical polarization of the vacuum), to the opposite charge, thus returning from the immediate region of that second 3-space point (or points) back to the time domain. Since conventional theorists are unaware that a potential is a hidden negentropic energy flow circulation process involving broken 3-symmetry, broken t-symmetry, and a special 4-symmetry between t and 3-space, the theorists have been unable to consider the potential in general as a direct source of energy flow. Yet they are forced to consider a potential difference across the terminals of a source as "somehow a flow of energy, that generates forces upon the electrons to propel them through the circuit as current flow."

In the new viewpoint, a resolution is achieved of these incongruities by more accurately defining the E-field with respect to the potential as $\mathbf{E} = -[\nabla\phi\bullet q]/|q|$. It is noted that $-[dA/dt]\bullet q/|q|$ also produces an E-field, so that the full definition of the E-field is $\mathbf{E} = -[(\nabla\phi+d\mathbf{A}/dt)\bullet q]/|q|$. Note that dividing q by |q| does not remove the q unit from the corresponding dimensional equation, since $\frac{|q|}{|q|}$ is dimensionless. However, one volt represents one joule (of excess energy) *diverged from the potential*, per coulomb of interacting charge. *The energy density flow in an electric circuit is in the voltage, in the emf, and it is not in the current per se.* The electron current (drift current) carries the excess energy that is being dissipated as work in the circuit, but in a nominal circuit the drift current only moves a few inches per hour. Half the energy collected in the potentialized circuit is dissipated in the external circuit and external losses, and half is dissipated in forcing spent electrons in the ground return line back up through the back-emf of the source, performing work inside the source to dissipate its separation of charges. Left alone, any dipole will

furnish emf indefinitely, freely receiving the energy from the time domain (complex plane) and outputting it in 3-space via the reinterpreted Whittaker 1903 decomposition, in a circulation where at each point in it the energy enters from the time domain and thence returns back to the time domain. The free flow of EM energy will continue unabated from the undestroyed dipole, regardless of how many external loads and losses are powered (how much energy is collected and dissipated from the ongoing flows representing the potential). So *electrical circuits should be developed which allow few or no electrons to be forced back up through the source dipole to dissipate its separation of charges and destroy the dipole.*

electromotive force, back (back emf): Back emf is a loose term for the *counter-electromotive force.*

When the source is powering a circuit or circuit element, the term "back emf is used to refer to the forcing of current (electrons) back up through the source against its emf, thereby performing work inside the source to *dissipate* its separation of charges (its dipolarity). When a potential source of electrical energy — such as a capacitor, an inductor, or a rotating machine — is receiving energy from a source and converting it to *dissipative* power and work, that "powered" device is said to develop a *counter-emf.* A source has a built-in emf *a priori,* and this emf is holding its charges separated so that it is dipolar. When electron current is forced backwards through the source against its emf, work is performed against the internal resistance of the source to dissipate its separation of charges, thereby *dissipating* the source dipole. If electron current is not allowed to flow back up through the source against its back emf and through its built-in counter-emf, no dissipation of the source dipole occurs, even though energy density (not *electron current* dq/dt but *energy flow* dq/dt) is flowing from the source and can be collected in *collectors* in the external circuit to store the energy as a created local energy source. This collected energy can then be shuttled to a separate load circuit and released, to provide a "heat pump" cycling operation and overunity coefficient of performance.

Nikola Tesla in fact knew how to shuttle energy at will in a circuit in such fashion, as Barrett's quaternion analysis of Tesla's actual patented circuits has revealed. [See T.W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," *Annales de la Fondation Louis de Broglie,* 16(1), 1991, p. 23-41.] Note that a rigorous analysis of those same circuits, using tensors or vectors (lower topology algebras), will not show the effect. One

needs a higher-topology algebra such as quaternions or Clifford algebra, or **the** significant properties of such circuits will be entirely missed.

When the original source dipole is not dissipated because electron current is **not** passed back up through its back-emf to scatter the charges, the o**riginal** source dipole will continue to furnish emf indefinitely because of **the** proven asymmetry of its opposite charges in the seething vacuum energy flux.

The terms emf and counter-emf are normally applied only to recognized sources of electricity. Emf is computed as the algebraic sum of the **potential** differences acting in a circuit attached to a source. Back-emf (counter-emf) is computed as the potential difference internally through the source, between its terminals. The back-emf is thought to be necessary in producing *a powered device or component in the circuit.* Actually, *its* ***main*** *application (the ubiquitous closed current loop where all the external circuit current is passed back through the back-emf of the source dipole) is to prevent COP>1.0 electrical power systems from being developed and utilized, andfor every electrical circuit to self-enforce Lorentz symmetrical regauging during its de-excitation phase.*

elect**ron:** A stable elementary particle in all atoms, and having — in "f**orward** time" — a negative charge of 1.602x 10^{-19} coulombs, a spin 1/2, *and a* mass of 9.11×10^{-31} kilograms. If time is reversed, the charge (but not the masss) of the electron is reversed and it becomes a positron. Note this is an equival**ent** *observed* 3-positron, in a material lattice after interaction with charged matter, and not the mathematical equivalent represented by Dirac sea holes in the 4-vacuum prior to interaction with mass.

The "electron" may also exist as a negative energy, negative charge, negative mass-energy 4-state (Dirac hole) in the vacuum itself. In that state, the negative energy 4-electron is the source of negative energy fields and negative energy potentials. When the associated nondiverged and unaccounted Heaviside energy flow component is also accounted, the Dirac sea hole negative energy 4-electron can be manipulated in "anti-circuits" to directly engineer local antigravity, quite strongly and practically.

electron gas: A system of electrons with only weak interactions, so that the electrons may be regarded as moving independently. In many ways, such a collection of electrons can be treated as a gas. See Drude Electron gas.

electrostatic scalar potential: A *static* (stationary, in the sense that a perfect waterfall would appear stationary) ordering in the virtual photon flux of vacuum. The notion of "static" in the term "electrostatic" is misleading and should be replaced by "stationary" since the underlying active vacuum medium is always in violent motion, and there is nothing truly "static" in the universe. But an *equilibrium* or *stationary* condition can exist as an external envelope condition, even with continuous violent motion internally, so that a stationary entity or form persists. An example is a perfect whirlpool in a river.

The electrostatic scalar potential decomposes into a harmonic set of bidirectional phase conjugate longitudinal EM wavepairs, as shown by E. T. Whittaker in 1903. Hence the electrostatic scalar potential is an overall curvature of spacetime with internal longitudinal EM order and dynamics.

ELF: Extremely low frequency. Used to describe EM fields whose frequencies lie in the range from just above 0 Hz (direct current) to 300 Hz. This includes power line frequencies (60 Hz in U.S. and 50 Hz in Europe) and frequencies used by certain U.S. military ELF communication systems such as for submerged submarines.

EMF: Acronym for electromotive force. See discussion under electromotive force.

EM field: Electromagnetic field. In its loose usage, it refers in a very broad way to any field, force, or energy associated with electromagnetic interactions, charges and currents. Thus "EM field" includes electrostatic fields, magnetostatic fields, electromagnetic fields (including radiation and induction), vector-potential and scalar-potential fields, Hertz potentials, Fitzgerald potentials, Whittaker potentials, Debye potentials, etc.

In its precise usage, "EM field" conventionally refers to an EM "force" field, such as the E-field, D-field, B-field, and H-field. In classical electromagnetics (CEM), as a holdover from the old assumption of a material ether, the force fields are considered (erroneously) to exist in mass-free space, and they are also considered to be the primary causes of electromagnetic phenomena. This is a non sequitur, and it involves substituting the effect for the cause.

In the new viewpoint, *the force* fields do not exist in vacuum, but only in and on and of the charged particles themselves, where mass is present to form one component of the force. The force fields are therefore effects and not primary causes. The primary causes of all electromagnetic phenomena is taken to be the potentials; however, the hidden

Stoney/Whittaker/Ziolkowski internal structures of gradient-free scalar potentials may interfere to cause potential gradients in and on charged particle systems. [In O(3) and other higher group symmetry electrodynamics, this internal structuring and dynamics is far richer.] This therefore includes distance-free scalar potential interferometry and action at a distance, as well as vacuum engines.

The new view uses Sachs' unified field theory, and considers that the EM field in the vacuum, or an EM potential in the vacuum, involves and identically is curvature of spacetime. It follows that the internal EM structures of "ordinary" EM are also spacetime curvatures, where the specific pattern of these ST curvatures constitutes a very special kind of spacetime engine that acts upon any local mass in a specific manner determined by the individual pattern of curvatures. Thus the new view is a unified field theory where GR has become EM and EM has become GR, and where higher symmetry EM — such as O(3) group symmetry EM — can involve or produce gravitational, temporal, and inertial effects as well.

EM force field in the vacuum (a false concept : The erroneous notion that there exist forces in the vacuum, so that the set of forces at a set of spatial points forms a force field. Presently classical electrodynamicists accept the same E-field in vacuum as exists upon a charged mass when the vacuum E-field interacts with that charge, but it is asserted that the force is zero. This is easily falsified by defining force F as $\mathbf{F} \equiv \partial \boldsymbol{p}/\partial t = \partial/\partial t(\mathrm{mv})$. By expanding the term on the right, one sees that both terms in the expansion include mass. Mass is thus a *component* of force. If mass is absent, there is no force present, thus no force field present. The field in space and the "same" field in mass differ precisely by a mass term in their fundamental units. The field in massless space may be taken as a curvature of spacetime. Zero field in space means a flat spacetime; a nonzero field in space represents a curvature of spacetime. A nonzero field in mass means a curvature of spacetime (a 4-space entity) interacting with mass (a previous 3-space observation) to produce a force consisting of that field and mass interaction. There is no separate force acting on a separate mass, and mechanics has been wrong in assuming on for hundreds of years. Instead, there is a force produced by the interaction of a massless 4-field (spacetime curvature) entity with 3-spatial mass. It is that *interacting and ongoing entity or process* that is a force field. Speaking of such a force field in space, is speaking of the force field that would exist in that space if every point had a unit point static charge and charged mass. As Feynman and Wheeler pointed out, no force field as such exists in space, but only

the potential for a force field exists there, in case some charged mass is brought in to interact and have the forces developed upon its charges.

EM generatrix: Whatever generates electromagnetics, particularly the fields. Since all EM energy comes from the time domain and returns to it, time is the ultimate EM generatrix. The circulation of EM energy from the time domain to 3-space and back, or vice versa, is a function performed by the broken symmetry of every charge, considered as two infinite dipolarities with a finite difference that is the observed charge listed in texts and handbooks.

energetics: Energy as the primary thing in the universe. Rankine's term later raised to the forefront by Ostwald. Modern Russian term for advanced higher group symmetry electromagnetics, where the electrodynamics is a subset of an engineerable unified field theory. In the U.S., a model approaching the Russian model is given by Evans's O(3) electrodynamics as a special subset of the electrodynamics used by Sachs in his epochal unified field theory. Thus there is a growing, engineerable unified field theory (energetics theory) in the U.S., being provided by Evans, Sachs, and others. A solid basis for energetics can be realized from the giant 4-space negentropy EM energy circulation involved with every charge, so that all "EM energy in space" and time itself comes from that circulation.

energy: Usually erroneously "defined" as the "capacity to do work". This is a total misdefinition since it would define energy as the ability to change its own form. The closest to a legitimate definition of energy appears to be: *energy is the invariance of that which is varying* (Lindsay). However, note that this definition violates Aristotelian logic (but does not violate five-law logic developed in this book). Another try at it might be: *"Energy is any deterministic or coherent structuring, either dynamic or stationary, existing in the virtual particle flux of vacuum."* While that sounds good, it still involves the nonchanging aspect of the changing flux — much like considering a whirlpool in a river as being a "static" thing. So it is still "the invariance of that which is varying", which is an identity of opposites. We conclude that 4- or 5-law logic is necessary in order to define energy, since the defining logic must encompass the identity of opposites. Feynman simply stated: *"It is important to realize that in physics today, we have no knowledge of what energy is_."* [Richard P. Feynman, Robert B. Leighton, and Matthew Sands, *The Feynman Lectures on Physics*, Addison-Wesley, Reading, MA, Vol. 1, 1964, p. 4-2.]. In Aristotelian logic, there is no acceptable definition of energy. In 5-law logic, the second definition holds since opposites can indeed be identical. Now to more practical aspects:

For our purposes, there are three major types of energy in 4-space: (i) 3-spatial energy, which includes energy in one, two, or three of the spatial dimensions, (ii) mass-energy, which is 3-spatial energy compressed by the factor c^2 but still in 3-space, and (iii) time-energy, which is 3-spatial energy compressed by the factor c^2 but now placed in the time domain. **Note t**hat time-energy has the same density as mass-energy, and hence the same spacetime-curvature effect and gravitational capability.

The major implication of the new view is that the conservation of energy law is extended: Now it is the total of the 3-spatial energy, mass-energy, and time-energy that must be conserved. Transduction between time-energy and either of the other two forms, or both, will violate the conventional conservation of the sum of the 3-spatial energy and the mass-energy; every charge and every dipole is an example. Use of time-polarized and longitudinally polarized photons and EM waves particularly may involve the extended conservation law, e.g., as utilized in cold fusion and its lime reversal zones, and as involved in the outpouring of observable EM energy from every charge in the universe, with no observable energy input.

energy collection/collecting: In electromagnetics, placement of an interceptor/collector — e.g., a charged particle — into an impinging EM energy flow, so that some of the flow is diverted around the intercepting particle. We may say that the flow of energy has been "reordered" into a stream diverged around the intercepting charge. The diverged part of the total energy flow is what is calculated as the Poynting energy flow component, and is what is referred to as the "collected" energy or the "potential" of the charge.

However, neither charge nor potential are acceptably defined in conventional electrodynamics, but they can be defined in the new approach. We are now able to see something more fundamental. By the giant negentropy mechanism, the charge is involved in both the time-ene**rgy** stream and the vacuum flux set of virtual particle spatial-energy stream**s.** "Charge" is not just related to the mass of the particle, but is the entire ongoing set of the dynamics as well as the mass (the "nondynamics", so to speak). When a charge is placed in a field, that field is a change to the local dynamics, which is a change to the charge itself. Both the dynamics and the mass (the "nondynamics" constituting the charge are altered. So one does not have the "field acting on a separate charge", but instead we have the charge with its previous set of dynamics transformed into the altered charge with a new set of dynamics and a new mass. Similary when a charge is placed in a potential. Charge is also not a 3-

spatial situation and process, but a 4-spatial situation and process. If the internal structuring is also important, it becomes an n-spatial situation where n>4 and even where $n \gg 4$. To deal with sophisticated engines, $n \gg 4$ is necessary in the modeling utilized.

energy dissipation: Refers to the scattering or disordering of energy; at fundamental basis, it refers to the changing of an altered charge (see energy collection/collecting) back to an unaltered charge. In other words, it is a special decay process whereby an "excited charge" (so to speak) decays back to its "normal state" by releasing dynamics (energy) back to the vacuum. The energy itself is not destroyed, but its "collecting pattern" or "flow pattern" as coupled to the charge is disrupted and altered or destroyed There is also the connotation that *the dissipated energy is lost as far as any re-use of it by the system.* We point out that only collected/collecting energy can be scattered; it is the collecting *process* (the entire alteration of the normal charge dynamics) that is "destroyed" - or more exactly, *transformed* — not the energy itself.

energy, electromagnetic: From a vacuum and quantum mechanical viewpoint: a deterministic or coherent structuring, either dynamic or static, existing in the virtual-photon or charged-particle flux of vacuum. Since a photon may also be considered a positron-electron pair (if we multiply each by time so that they are *qt* rather than *q* in fundamental unit form), the flux of photons in the polarized vacuum necessarily also includes the flux of charged virtual electrons and positrons. From a spacetime viewpoint: a curvature of spacetime, or set of such curvatures. If a deterministic set of spacetime curvatures (a template) is involved, then an engine is involved and the energy is said to be "dimensioned" (internally structured).

energy flow: Generally considered as the passage of energy, in any form, in one direction or generally in one direction in a given 3-space. To first order, our definitions of energy treat energy flow in a given space as (1) a directional change (propagation) of the vacuum energy and its form, or (2) as a directional propagation of a curvature of spacetime or a set of curvatures of spacetime. *The terms "energy flow" and "flow of energy through space" are not precisely defined in physics! They are not going* ***to*** *be defined, at least not in ordinary Aristotelian logic terms, since energy itself is not precisely defined, and one of the best struggles with the concept of energy concludes that it involves invariance in the midst of change, which is a violation of the third law of Aristotelian logic and therefore of the other two as well.*

Indeed, the "EM wave flowing through 3-space" does not exist (see previous comments quoted from Romer). What does exist is an ongoing 4-space process, assumed to be continually and iteratively interacting with a unit point charge to "detect" or "observe" it as an iterative series of frozen 3-space snapshots, in memory-recalled serial order much like the frames of a motion picture film. Nonetheless, we must keep our sense of humor and proceed as if we knew exactly what we were speaking of when we use the co**ncepts** "energy", "energy flow", and "energy propagation through 3-space". If one dwells on the problem without humor, one is led to Hawking's grim but perceptive statement: *"All we ever know is our models, but never the reality that may or may not exist behind the models and casts its shadow upon us who are embedded inside it. We imagine and intuit, then point the finger and wait to see which suspect for truth turns and runs. Our models may get closer and closer, but we will never reach direct perception of reality's thing-in-itself"* Ultimately we do not know physical reality itself, but our mental modeling of it, as best we can "fit" our modeling through comparison with our sensory and perceptive sensations.

energy flux: The passage **of** energy **flow, in any form, through a unit area, and** in any given direction (usually all directions). This includes both passage in a single direction, or passage in multiple directions at once. See flux. Sometimes taken as that component of the net flux through a unit area at right angles to the area.

energy, free: In our usage, free energy is what is obtained from any environment or entity which freely emits, furnishes, or makes available energy which either can be collected and used as furnished, or can be transduced into usable form and collected and used to power loads and do useful work. The word "free" does not apply to *costs*, but rather to the source *of the energy*. Since energy can neither be created nor destroyed, energy is always available free for the taking (collecting and using) if we bit learn how. *We never pay for energy per se, but for the manipulation and processing of the energy*. The notion of extracting and using free EM energy from the vacuum involves five key concepts: (1) the local vacuum/spacetime itself is filled with EM energy of generally unusable form (2) some sort of organizing principle is utilized in one part of the circuit or system to cohere the vacuum energy and transduce it into usable EM form (every charge already individually does that; we just have to learn to do it in a larger ensemble), (3) a gating mechanism is utilized to divert the vacuum energy now in usable EM form from the active vacuum to the external circuits or load parts of a device, (4) the coherent gated

extra energy available in the external circuits or load parts is intercepted by those circuits or load parts, couples to them, and potentializes them with extra EM energy, so that the energy is collected by the system and regauges the system asymmetrically, and (5) the external circuits or load parts then scatter or dissipate the coupled extra energy to produce useful work (physical changes in the load), without destroying the organizing and gating mechanism that is extracting and furnishing usable EM energy from the vacuum.

energy source: A function or entity which furnishes energy by either gating it from one energy reservoir to our system or locality, or by transducing available unusable energy into usable form and then emitting the usable energy. Technically speaking, since energy cannot be created or destroyed, there is really no such thing as a *creative* "energy source", though the term "source" seems to imply such. So-called "energy sources" actually gate and/or transduce energy, changing it from one form to another, from one direction to another, etc. All EM energy in the universe comes from the time domain into 3-space vacuum, onto charge, and back to the time-domain, in a giant ongoing negentropy 4-circulation as freely provided by the "source charges".

engine: Deterministic pattern of structures, with their concomitant dynamics, in the flux of the vacuum. Also, deterministic patterning of curved spacetimc curvatures and their dynamics that comprise an overall larger spacetime curvature, or internally comprising an *overall* "uncurved" spacetime.

engineering, entropic: Engineering or designing systems and processes in equilibrium with their external active environment, and whose operation "spills" or wastes all the energy input to them, and which do not freely recover and use the dissipated or wasted energy. Entropic systems — which are the products of entropic engineering — thus have COP<1.0 and function in forward-time, and classical equilibrium thermodynamics with its infamous second law rigorously applies because the system is designed to self-enforce the equilibrium condition, often called by other names such as Lorentz symmetrical regauging.

engineering, negentropic: Engineering or designing open systems and processes far from equilibrium in their exchange with their active environment, whose operation freely "receives" excess energy from the environment, so that they permissibly output more energy than the operator inputs, the excess being received from the external environment. As an example, simply making a common dipole or assembling a charge

initiates a giant negentropy operation that persists indefinitely (as long as the dipole or charge persists).

entropy: Thermodynamics state term representing a measure of an equilibrium system's capacity to undergo spontaneous change. In short, a quantity that measures the availability of a system's energy for conversion to work. The entropy of an open system not in equilibrium with its active environment cannot even be computed, because the state cannot be computed.

Entropy is given by dS = dQ/T, where dS is an infinitesimal change in entropy for a system absorbing an infinitesimal quantity of heat dQ at absolute temperature T. In statistical mechanics, entropy is a measure of the disorder in a system and is given by S = k lnP + C, where S is the value of entropy (disorder) for a system in a given state, P is the probability of that state's occurrence, k is a fixed constant, and C is an arbitrary constant. Intuitively, the concept of entropy corresponds to the concept of disorder. We specifically call attention to the fact that the "S" used in representing entropy is not at all the S used for Poynting energy flow in electrodynamics.

entropy, negative (negentropy): In a sense, the reversal of disorder, or reversal of entropy. Another way of defining negentropy even more rigorously — for electrodynamics — is to define it in spacetime as a bro*ken 3-symmetry in EM energy flow with concomitant relaxation to a more primary 4-symmetry between time-energy flow and 3-spatial EM energy flow, where time-energy flow is transduced into 3-spatial EM energyflow and then back to time-energy by the entity — such as a common dipole — causing the broken 3-symmetry.*

e quilibrium: *In physics,* the state of a system in which opposing forces balance each other — i.e., sum to a vector zero. However, the *vector* zero summation does not represent "total absence" of everything, and the forces and their energy remain even though comprising a net vector zero system. Even a pure number zero may also be taken as a set of nonzero numbers; e.g., (+5 -3 -2). So even zero need not be total absence, but can be a "balanced set of presences". Or zero can be regarded as an overall equilibrium condition comprised of a set of disequilibria conditions. Indeed, a vector zero summation system of nonzero forces comprises a stress potential, and it contains stress-energy doing work upon the stressed system. In *mechanics,* a system of particles — where the net force acting upon each constituent particle is zero — is said to be in equilibrium. *In chemistry, t*he state of a solution where the forward and reverse reactions

are equal and balance each other, so that the chemical reactants and products maintain the same amounts. Again, the notion of equilibrium involves the "stationary" notion (similar to a perfect whirlpool in a perfect river) of the overall invariance of some set of ongoing dynamic changes.

ether: An extremely fine material substance originally theorized to exist in space in lieu of sheer emptiness. The problem is considering space as emptiness in the first place, which it is not. Instead, space (more rigorously, spacetime) is a plenum and highly active (as in the general relativity view a half-century after Maxwell's seminal paper). So there is no need to "fill empty space" with something, because in the modern view there is no such thing as empty space.

Evans, Myron W.: Noted chemical physicist, primary developer of O(3) symmetry electrodynamics, and Director of the Alpha Foundation's Institute for Advanced Study (AIAS). Papers produced by the AIAS are critical to understanding extraction of EM energy from the active vacuum, engineering of vacuum engines, and development of a revolutionary new healing method by time-reversing diseased or damaged cells back to a previous healthy state.

excess collected energy: Collection by an interceptor/collector of a greater fraction of EM energy flow impinging upon it and also surrounding it, than is normal. See **Bohren experiment.**

exciton: A bound electron-hole pair in a semiconductor. Excitons are temporary formations and they decay by recombining, but they have a specific half-life before recombining during which they migrate through the semiconductor crystal. When the hole and electron recombine, then — if the curvature of spacetime relaxes to a flat spacetime, which is not overtly stated in classical EM theory — the recombination releases energy in the form of a *photon*, or sometimes in the form of several *phonons*. **Note** that the "hole" is an "absence of an electron" from a position in a lattice usually containing an electron, so that it exhibits a net positive "change in the charge field" at that point. Specifically, this "lattice electron charge hole" is not a Dirac Sea hole in the vacuum, which is an entirely different matter. On the other hand, if the hole and electron recombine and the curvature of spacetime does not relax to a flat spacetime *because of other curvature-sustaining involvements*, then no "pair annihilation" radiation is emitted. It is the relaxation of the curved spacetime (when hole and electron are separated) back to a flat spacetime that causes photon or phonon emission.

exothermic: Literally, "giving off heat", or emitting scattered EM energy. Producing time-forward EM energy from a "source" by reducing the ordering (internal energy) of the source.

Faraday, Michael: Noted English physicist and chemist, 1791-1867, who discovered field theory and electromagnetic induction. Faraday also invented the dynamo and formulated his laws of electrolysis. His work directly inspired Maxwell, who vowed to study no other electromagnetics theory until he had captured Faraday's work in a mathematical theory.

Ferminion: A fundamental particle which has spin angular momentum of (n+1/2)h, and which obeys Fermi-Dirac statistics. Examples are baryons and leptons, which are subject to the Pauli exclusion principle.

Feynman, Richard P.: Noted physicist, Nobelist, and co-developer of quantum electrodynamics. Feynman is particularly noted for his refreshing three volumes of physics: see Richard P. Feynman, Robert B. Leighton and Matthew Sands, *The Feynman Lectures on Physics*, Addison-Wesley, New York, 1963. The book is particularly noteworthy in that it gives the student some insight into foundations problems in physics. E.g., in Vol. I on p. 2-4, Feynman defines the electric field not in terms of force per unit charge per se, but in terms of its *potentiality* for producing a force only when a charge is present for the force to be developed upon.

fiber fuse: Effect in optical fibers or fiber optic cable, whose core contains germanium, whereby heating the cable at one spot with a small flame will launch a focused traveling heat energy effect which melts a small hole in the core about every centimeter, and marches down the cable at about a meter per second to the end of the cable, destroying the optical transmission capability and ruining the cable. Oddly, by igniting the fiber fuse from the other end of the damaged cable, a *reverse* fiber fuse effect will often march back down the cable in similar fashion except that it fills in the melted holes in the core, restoring the transmission capability of the cable. If the energy required to melt all the holes (or fill them again) is taken into account, the amount of energy required to launch the fiber fuse is much less. This phenomenon does not appear to have an adequate technical explanation at present.

field: In mathematics, a set with two binary operations. In electromagnetics in more common mathematical terms, it is a region consisting of magnitudes and/or vector directions assigned to some active entity (e.g., spacetime itself) at each point in the region.

In physics, "a region of space marked by a physical property, as gravitational or electromagnetic force or fluid pressure, having a determinable value at every point in the region." [Thanks to *Webster's II New Riverside University Dictionary.]* Note the very special use of calculation of magnitude: one does not calculate the magnitude of the field itself, which fills an entire region. Instead, one calculates the magnitude of the *reaction* of that field with some interceptor/reactor at a given point — i.e., the *effect* of that field upon some mass entity. That is at best a measure of the *local intensity* of the field, not the magnitude of the entire field per se. For that reason, often we speak of calculating the field intensity, which is far more accurate than saying that we are "calculating the magnitude of the field". So we do not really calculate the "magnitude of the field," and in fact such a calculation does not occur in any textbook. Instead, we calculate the *reaction cross section* — in the case of electrodynamics, for an assumed unit point static charge — of the field at a point in the region or space occupied by the field. *We actually calculate what is deviated or diverged from the field, around an assumed interceptor, not the field itself.* This means that we calculate the result or *effect* of a detecting/observing action, and a frozen 3-space snapshot of that ongoing interaction, since all observation is 3-spatial. To then state that this same field exists in space prior to the interaction, and is what causes the interaction, is a gross non sequitur and confuses the effect with its own cause. This ubiquitous non sequitur widely permeates electrodynamics and mechanics, and it is one of the greatest scientific logical errors in history.

field, scalar: In the standard view, a field, to any point of which is assigned a magnitude only. However, "magnitude" of the EM field in the standard usage refers only to the amount of energy deviated (diverged) around a fixed intercepting unit point charge, per the conventional "detection by reaction" model. Again, note the serious logical errors in the conventional usage. One cannot define the field in terms of what is diverged from it! At best one has defined the "intensity" of the field's interaction with a given standard interactant (charge). So in electrodynamics the term "scalar field" would be better replaced with "scalar field intensity", at least for many applications.

field, vector: In the conventional view, a field, to any point of which is assigned both a magnitude and a direction. Again, the standard view also implements that assumed reaction with a detecting unit point static charge, and the "magnitude" used is just the difference between the amount of energy piled on the "front" of the interacting unit point static charge and the amount of energy pile on the "rear" of the interacting unit point charge.

The "direction" is from the center of the "high energy" pileup to the center of the "low energy " pileup around this fixed intercepting unit point charge. Again, note the serious logical errors. One cannot define the field in terms of what is diverged from it and the direction of the difference in "energy pressure." At best one has defined the "intensity" of the field's interaction with a given interactant (charge), and the "direction" established by the difference between the frontal and rear energy pileups on the interacting charge. The term would be better replaced with "vector fieldintensity".

flat (uncurved) spacetime: In our view, a vacuum/spacetime whose virtual particle flux intensity — and therefore its local energy density — does not change as a function of spatial position or averaged time. That is, in our view a flat spacetime is also identically a quantum mechanical vacuum whose virtual particle flux and energy density are constant in magnitude and internal constitution with respect to spatial position and in averaged time. Note that in this extended view, a flat spacetime (vacuum potential) can still contain vacuum engines, and thus still be *dimensioned. In that ca*se, contrary to normal physics, the flat spacetime itself will still interact with an embedded object and *change* it internally, even though it does not *translate* it externally. To perform transmutation of elements, e.g., one is interested in just such engines and not in spatially translating the element being treated. This dimensioning or activation of the local flat spacetime can result in an otherwise unexpected, seeming violation of one or more laws of nature in the dimensioned region, and easily results in violation of conventional physics which does not take into account engines and dimensioning of a flat spacetime. Note also that this allows a differentiation between the actions of two inertial frames, if the frames are differently dimensioned. As we stated, this is a deliberate extension of orthodox physics. See also dimensioning, and Einstein's second postulate —extension of.

fluctiation theorem: Theorem advanced by Denis J. Evans et al. at the Australian National University in 1993 that appreciable and measurable violations of the second law of thermodynamics occurs for small systems over short time scales. See D. J. Evans, E. g. D. Cohen, and G. P. Morriss, Phys. *Rev. Lett.* Vol. 71, 2401 (1993). In 2002 Evans and his colleagues experimentally demonstrated the proof of this theorem in rigorous fashion. See G. M. Wang, E. M. Sevick, Emil Mittag, Debra J. Searles, and Denis J. Evans, "Experimental Demonstration of Violations of the Second Law of Thermodynamics for Small Systems and Short Time Scales," *Phys. Rev. Lett.* 89(5), 29 July 2002, 050601. The proof also directly proves the

occurrence in electrolytes and fluids of time-reversal zones (TRZs) where the dynamics runs backwards for a short time. This validates Bearden's proposal of the TRZ and its consequent reversal of the Coulomb barrier to a Coulomb attractor as the mechanism producing attraction of like charges into quasi-nuclei, which then can decay by quark flipping (if necessary) as the TRZ decays and reverses back to normal. This provides a mechanism for transmutation of elements in these TRZs as a result of the fluctuation theorem and its proof by Evans et al.

flux: The amount of some quantity (such as energy, particles, volume of fluid, etc.) flowing across a given area (usually a unit area perpendicular to the flow) per unit of time. The term flux density is now more commonly used. Loosely, "flux" refers to the perpendicular flow through an area, while "flux density" refers to the magnitude or intensity (rate) of the flux. In some cases such as a flux of particles of different velocities, the number of particles may be multiplied by the average velocity to give an average flux density that is weighted.

flux density: The amount of some quantity (such as energy, particles, volume of fluid, etc.) flowing across a given area (usually a unit area perpendicular to the flow) per unit of time.

Fogal semiconductor: A special semiconductor invented by Bill (William) Fogal which, in its operational regime, utilizes an integrated semiconductor, very special tantalum capacitor, and feedback resistor to accomplish charge blocking (blocking of electron current flow dq/dt) while passing displacement current $d\phi/dt$.

The Fogal semiconductor can also accomplish amplified phase conjugation of signals as well as infolding (translation of input transverse EM waves to output longitudinal EM waves) and outfolding (translation of received input longitudinal EM waves to output transverse EM waves). Used in communication systems, it opens the use of the unlimited "infolded" electromagnetics bandwidth. Since it may communicate using longitudinal EM waves, it is also usable for superluminal or a specialized "tunneling" communication through the "interior" of normal EM waves, potentials, and fields. For example, it can easily transmit color TV signals through the "interior" of a common DC potential. See William J. Fogal, "High Gain, Low distortion, Faster Switching Transistor," U.S. Patent No. 5,196,809, Mar. 23, 1993; - - "High Gain, Low Distortion, Faster Switching Transistor," U.S. Patent No. 5,430,413, July 4, 1995, a continuation of his earlier patent.

Fogal, William: Researcher and inventor of the Fogal semiconductor (two patents so far), as well as a superluminal infolding-outfolding communication system and other remarkable longitudinal EM wave processes. The Fogal semiconductor allows the use of the internal longitudinal wave electrodynamics comprising all ordinary EM fields, wa**ves,** and potentials, and thus will usher in a revolutionary new communications science and extended electrodynamics technology. See also discussion under Einstein's second postulate extended.

force: In mechanics, identically the time derivative of momentum, or $F = \partial/\partial t(mv)$. One must realize that it is not the mass in motion, but the single undivided quantity "mass-motion" or "mass-velocity" (momentum) that is changed. Present EM theory erroneously takes force fields to exist in em**pty,** massless vacuum but with zero force! However, the mechanical definition is an identity, not an equality. The observable mass in vacuum is zero, so substituting m = 0 gives $\partial/\partial t(0 \cdot v) = 0$. This appears to be the conventional reasoning. However, $F/q = 0/q = 0$ also. So if mass is zero, **the fi**eld E used in "force field definition" disappears. All that says is that the field in mass-free space and the field in mass are totally different entities,

Since force can be induced into and of the mass-motion target at a distance, in the new approach there is a more fundamental mechanism that produces force itself, and that is a curvature of spacetime, in agreement with general relativity. Distant curvatures of spacetime to produce forces on ex**posed** charged mass systems may also be engineered by longitudinal EM wave interferometry, which does constitute "action at a distance." The fields arise in the local spacetime in the distant interference zone, thus arising from within and around any physical mass object located in that zone. Hence it produces an "inside-to-outside" type of action that is presently unknown in orthodox physics. The produced fields can start inside the nucleons of the atoms and move outward, and work directly upon the quarks and gluons first. This opens a great number of entirely new nuclear reactions presently not developed in particle physics.

force **field:** An 3-space *effect* that exists as a local vacuum virtual particle flux i**nteraction** upon and with a hypothetical unit point mass or unit point charge assumed at every point in 3-space. The effect (force field) results from a ***causal*** force-free 4-field (a curvature of spacetime) interacting with an observed hypothetical unit point mass or unit point charge assumed at every point in space. Hence the invocation of observation invokes a *d/dt opera***tor** (the interacting charged mass) upon the causal field, providing a

frozen 3-snapshot of the ongoing 4-interaction. An iterative series of such 3-observations is said to constitute a "3-space force field" as if it existed in time, which it does not. It is seen (iteratively observed) as a series of such frozen snapshots, which mentally we conceive as "existing in time" instead of the "recurring at points in time" that it really is. We unconsciously invoke that substitution of iterative effect as being continuity in space and time, when we use terms such as "propagation through space".

force-free propagation: Propagation of force-free disturbances in the vacuum flux; i.e., propagation of curvatures of spacetime or sets of such curvatures, together with any associated dynamics.

foundations of mathematics: The concepts, operations, assumptions, postulates, logic, definitions, and axioms of algebra systems.

foundations of physics: The postulates, assumptions, concepts, and definitions upon which a scientific physics model rests. Included are also the postulates, concepts, assumptions, definitions, axioms, logic, and operations of the mathematics in which the scientific model is expressed, as well as the postulates, concepts, assumptions, definitions, and operations of the physics entities and functions assigned to the mathematical symbols. Thus "scientific truth" — even mathematical truth; see Morris Kline's *Mathematics: The Loss of Certainty* — is actually a *qualified* truth. What is true in one model (one set of postulates, assumptions, concepts, and definitions, including those in the algebra) may not be always true when one or more of the postulates, assumptions, concepts, and definitions is/are changed, and/or when the topology of the mathematics in which the model is expressed is changed, etc.

four-space (4-space): The "normal" spacetime used in physics, consisting of three spatial dimensions and one time dimension. Minkowski spacetime.

fourth law of logic: The law that a thing and its opposite become identical on the boundary, i.e., in multiple simultaneous observations. *Identity* is merely the loss of observational or perceptual distinction; when formerly "two" objects are simultaneously observed by a single observer, and two slides have been shown at once in the slide projector. It does not matter at that point what each was individually observed to be before when it was singly observed. Now there is no observable distinction or difference. We previously showed that the fourth law is implicitly assumed in the three laws of Aristotelian logic anyway, and published a simple proof of the fourth law. Without the fourth law, Aristotelian logic "eats itself." As a simple example, the Aristotelian third law eliminates the center vertical line division of a simple Venn diagram between A and not-A, because the

division line itself is happy to belong to both A and not-A simultaneously. So Aristotelian logic destroys the very Venn diagrams used to "prove" or "demonstrate" its logical propositions. What results in the four law logic is that either (1) the three laws apply explicitly and the fourth law applies implicitly, or (2) the fourth law applies explicitly and the three laws apply implicitly. This *application rule* — i.e., *either (1) or (2)* — itself can be taken as a fifth law of logic, thus extending and completing Aristotelian logic which is presently incomplete. The fourth law is also the law of the **paradox:** i.e., when something is true but violates one or more of the Aristotelian laws, it is a case where the fourth law applies explicitly and the three laws apply implicitly. Wave-particle duality is such a fourth law case.

four-wave mixing: A nonlinear multiwave mixing effect when four waves mix (interact) in a highly nonlinear situation so that wave-to-wave interaction occurs.

fractional charge: A hypothetical particle having a charge less than the electron's charge. Often called a quark, where its charge is 1/3 or 2/3 the charge of the electron. A few years ago, Stanford University researchers found what was believed to be evidence of free quarks, but that later was doubted. There is also now the fractional Hall effect. In the 1920's Ehrenhaft reported the discovery and production of fractional charges of all sizes, and his experiments have been replicated by Mikhailov, with papers by Mikhailov and Barrett.

In the new approach, when time-energy is utilized, quarks can be freed or nearly freed rather easily in matter inside "time-reversal zones", since the energy emerges from the local curved spacetime and propagates from within **the** nucleus outward and the gluon forces are substantially reversed. Note also that time is multiply connected, and energy can enter an object anywh**ere** within it or even everywhere within it, since each and every differential piece of the object exists in every single increment of time. It would appear that, as the new approach develops, free quarks will become a normal event rather than one intensely sought but terribly difficult to come by experimentally. We flatly predict that, in a sufficiently good time-reversal zone, free quarks can be produced because of the enormous energy density (in the time component) being utilized.

frame, Lorentz: A frame of reference that is not accelerated with respect to the laboratory observer. In this case, the frame may be rotated (moving at a constant velocity) but it is not rotating (the frame is not accelerated with respect to the observer, and spacetime is not curved). In this case

special relativity applies, as do the conservation laws. We do add a caution that full general relativity still applies to the interior structure and dynamics (the engine) comprising the flat spacetime. Two *overall* flat spacetimes may produce very different interactions inside matter, if their internal engines are materially different and dimensioned.

frame, reference: A spatial, organized, measured lattice placed in "emptiness" (space, spacetime). Normally refers to a 3-dimensional, spatial frame (simplest case) or to a 4-dimcnsional spacetime. All objects and points in the "universe" or spatial frame are considered to simultaneously coexist at separate, measured points in the frame. Differs from the vacuum in that, rigorously, vacuum has no existing definite lengths and no existing definite time intervals, as these appear only after measurement or detection, and are relative to the observer and to the interactions ongoing as well as in the detection process itself. The "laboratory frame" is the static reference frame of the observer or measurement. A separate reference frame may be assumed to exist for any fixed or moving object, or centered on any point in another frame. When a type of frame is assumed, the entire class of *translation type* physical interactions that can occur has been restricted to an assumed set or type. In other words, given the frame, the *conventional* physics of translation has been assumed. One of the greatest restrictions of an assumed "frame" is to rule out the consideration (existence) of other higher dimensions, hence of dimensioned engines.

In the new unified field theory approach, the other higher dimensions are always available and cannot be ruled out in general, but only in some special case. Every curvature of spacetime, and any internal additional curvatures comprising that primary curvature, *adds one or more new dimensions.* In our view, a spacetime may be "flat" in overall envelope curvature, but consist of internally structured deterministic curvatures or "engines". In this view, normal inertial frames, e.g., may still contain engines, which will not affect the normal *bulk translation* rules, but may affect any or all of the nontranslation mechanisms, including the very laws of nature in many cases. Engines have not been developed and used in conventional open physics, but were weaponized clandestinely by the former Soviet Union. See **Einstein's second postulate extended.**

free energy: Excess energy freely received from its external active environment by an open system that is far from thermodynamic equilibrium in its exchange with that environment. There is a separate thermodynamics for such open disequilibrium systems. (See **thermodynamics of open systems.** See also Appendix **A** for a more

detailed discussion of the thermodynamics aspects). Such a system is permitted to exhibit five "magic" functions: it is permitted to (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy than the operator hims**elf** inputs (the excess energy being freely received from the active environment), (4) power itself and its load simultaneously (all the energy bein**g** freely received from the active environment), and (5) exhibit negentropy. Every charge and dipole in the universe already performs all five of those functions.

free **energy** system: Any open system not in thermodynamic equilibrium, which freely receives excess energy from an external environmental source, **and** collects and utilizes this free excess energy to freely power external loads, so that a permissible system COP>1.0 is achieved, as allowe**d** by the nonlinear thermodynamics of open systems in disequilibrium with their environment. (See **thermodynamics** of open systems.). A free energy system may also be "self-powering" if "close-looped" with governed positive energy feedback from output section to input section, meeting the Kron self-powering condition. Operation of free energy systems can only be properly modeled and understood in terms of their super*system* interactions.

Implicit in the notion of free electromagnetic energy systems are six key concepts: (1) the local vacuum/spacetime is known to be filled with hidden (i.e., virtual**)** energy in violent motion, i.e., the local vacuum/spacetime is a violent virtual energy flux and therefore a scalar potential, (2) a broken symmetry - i.e., some sort of organizing and gating mechanism, such as the common dipole — in this hidden (virtual) energy flux of the vacuum is utilized as a source, to cohere the virtual energy and divert it as energy $\mathbf{S} = f(\mathbf{E}\times\mathbf{H})$ flow from the broken symmetry initiation point onto the external circuits or load parts of a device, (3) the coherent gated extra virtual energy flow available in the external circuits or load parts couples to (inter**acts** with) the mobile charges in those circuits or load parts, so that gradients developed in the interacting virtual flux form force fields on and of the particle masses, driving the mobile charges along the circuit and through current-impeding circuit components such as loads, (4) in the interaction of the driven charges with the driving virtual energy flux, their spin and erratic motions integrate a tiny "coupling fraction" of the driving virtual energy into observable (i.e., macroscopic field) energy, thus creating the **E**-fields and B-fields, (5) the current-impeding external components or load parts scatter or dissipate the coherence of the driven charges and thereby dissipate the collected energy or change the form of the co**llected fi**eld energy, thereby producing useful work, and (6) little or

none of the excess collected energy in the circuit is split off and dissipated in the gate (asymmetry component serving as the S-flow source) to destroy the gate and thereby destroy its asymmetry in the vacuum flux, which is what is extracting and producing the free energy flow.

gate: A component or function that extracts some part of a flux or flow, compacting it into a stream, and "sending it out" in organized, useful energy flow form. The fundamental gate for all EM energy in 3-space is the dipole or dipolarity — the "isolated charge" is actually a dipolarity, when the virtual charges of opposite sign clustering around it in the active polarized vacuum are considered. The source of the 3-space EM energy continuously emitted by any charge or dipole is an equal inflow of EM energy from the complex plane (from the time domain). Thus EM energy flow is locally conserved in four dimensions as a 4-circulation, but not in 3-space. EM energy flow in 3-spacc is conserved over all space, since there are essentially equal amounts of positive and negative charge in the universe and in the virtual charge of the vacuum.

gauge: In electromagnetism, usually considered a possible choice for (change of) electric scalar potential and magnetic vector potentials, in such a manner that there is no any *net* change of force fields so that the change satisfies Maxwell's equations. There are indeed two changes of force fields, but the two are selected so that the two new force fields are equal and opposite, constituting a stress potential and continuously performing internal work on the system to create and maintain the excess system stress. The equal and opposite force fields, however, cannot translate electrons through loads to freely power them. We prefer to consider any change of potential — even a single potential changed, or both changed so that a net force field does result — as a "regauging", for it is an implied primary assumption *within the normal use ofthe term "regauging."* If only one potential is changed, a net force field results in the system and we call that "asymmetrical regauging". If both potentials are changed, but in such a way that a net force field still results, that is also an asymmetrical regauging. When both potentials are changed precisely in such highly selected manner that the two force fields created are equal and opposite, the force fields sum to a *translation* vector zero, and that is symmetrical regauging or *Lorentz regauging.* However, the energy of the two fields remains, having been transposed to a stress potential. Each of the two "balanced" equal and opposite force fields is continuously performing work in the system, but all that is created is additional system stress. Hence symmetrical regauging is obtained only by altering the stress and stress energy of the system, with two disequilibria in energy flow between

the ex**ternal** environment and the system. This in fact constitutes both a curvature of the local spacetime and an alteration of the local active vacuum. It is a rotation of the frame of the regauged system out of the labor**atory** frame. In effect, the net EM field energy of the two new fields crealed by symmetrical regauging is transformed into a change in the local spacetimc curvature, a change in the local vacuum, increased stress in the system, and rotation of the system's frame away from the lab frame. We focus upon the energy aspects, since in a system any change of potential - whether symmetrical or asymmetrical — is a change of the internal energy of the system, and therefore of its excitation. In a system, conventional "symmetrical force fields" regauging results in a *nonusable continous* energy change in the system (actually two of these changes), and a change in the internal stress of the system. In short, it is a special case of **adding** a *stress potential* to the system, which we consider a special form of *asymmetrical regauging of the supersystem* consisting of (i) the system and its dynamics, (ii) the local active vacuum and its dynamics, and (iii) local spacetime curvature and its dynamics.

gauge freedom: The axiom in gauge theory that one can freely change the gauge **(and** therefore the potentials and the potential energy) of an EM system, so long as the net new forces resulting from the change will sum to a zero **vector** resultant so that the system remains "symmetrical" in its **force-field** functioning with respect to the system prior to the change of potentials. Electrodynamicists do not seem to have recognized that the freedom to change the potential of a system at will, is *a priori* the freedom to make a purely negentropic change to increase the system's potential energy, or a purely entropic change to decrease the system's potential energy. Gauge and gauge freedom are actually formal restrictions of an even more important asymmetrical regauging principle: *a potential in a system can be freely changed at any time, thus freely changing the potential energy energy of the system freely and at will.* The additional symmetry assumption is an arbitrary added requirement not imposed by nature.

Further, it appears that physicists have not recognized that a longitudinal EM wave is an oscillating gauge varying in its magnitude. Said in reverse, oscillating *the Lorentz regauging condition for a circuit makes that circuit* ***a generator*** *and emitter of longitudinal EM waves.* This also provides a clue f**or** detection of longitudinal EM waves, similar to what occurs in a Fogal semiconductor used for that purpose. A longitudinal EM wave dete**ctor** must detect a variation in the symmetrical regauging condition, which is a stress change detection.

gauge symmetry: Abstract mathematical symmetry of a field, that relates to the freedom to regauge (change the value of) potentials, without affecting the *net resultant* values of the field quantities. This is a special case of the higher principle that any potential (and thus the potential energy of a system) can be changed freely and at will. However, changing the gauge of an EM system in that sense changes the potential energy of the system but *only in stress potential fashion.* In other words, it does nontranslating work on the system, which is called "internal work." The lack of a net resulting force in the system, created by the regauging symmetry, prevents use of this excess free energy to translate system charges and power an external load. All the excess free energy that could otherwise be used to power loads freely, is instead "locked up" to only perform internal work on the system to increase and maintain system stress.

gauge theory: A field theory using a field that has one or more gauge symmetries. The restriction to symmetry is a carry-over of the old erroneous notion that potentials are just convenient mathematical figments, and that fields are the primary causes of all EM phenomena. For the overunity researcher, broken gauge symmetry at a given level (usually in 3-space EM energy flow) is the feature that must avidly be sought in experimental systems if one would use asymmetrical regauging to allow free powering of loads. Hence one is primarily interested in a wide variety *of broken symmetry effects* and phenomenology. Particularly, unless the automatic self-enforcing of symmetrical gauge transformation during excitation discharge of the closed current loop system is violated, no EM system can produce COP>1.0. Further, local spacetime curvature between local input and local output is always involved in an overunity EM power system. The tempic (time) potential of the output end of an overunity system differs from the tempic potential of the input end, so that the gradient (the tempic force) is directed from output to input — exactly the reversal of the case for a COP<1.0 power system.

Thus in both COP<1.0 systems and COP>1.0 systems, a local spacetime curvature is involved when the system is in operation. In COP< 1.0 systems, the tempic force sweeps along from input to output and on into space beyond, where the violent interactions of vacuum absorb the associated Dirac sea hole current immediately. In COP>1.0 systems, the tempic force sweeps along through the local vacuum from the output section back through the system and into the input section, and thence on back through the external conductors to the external power source. This reversed Dirac sea hole current may "eat electrons" in the normal currents

internal to the system, and in the input section and back towards the external power supply it will "eat input electrons in the input current." Thus the Dirac sea hole current in the COP>1.0 system "eats input power" and serves as a curious new kind of electrical "load" or "internal loss" in the **input** section of the system. The reversed Dirac sea hole current is nature's way of decaying the local curvature of spacetime back to a flat spacetime, and decaying the COP>1.0 excited system disequilibrium state back **to an** equilibrium state. In any overunity electrical power system, this Dirac sea hole current must be taken into account and either transduced into useful power, minimized, or eliminated. An extension to gauge field theory is needed in which the tempic force, the tempic potentials and their gradients, and the supersystem are all modeled and taken into account. It appears that the Sachs unified field theory is capable of handling that requi**rement,** which also can be accommodated by O(3) electrodynamics to provide engineering of the resulting unified field theory.

gauge **transformation (in electromagnetics):** Conventionally taken to be the a**ddition** of the gradient of some function of space and time to the **magnetic** vector potential—and simultaneously the addition of the negative of the partial derivative of the same function with respect to time, divided by the speed of light, to the electric scalar potential. The resulting symmetri**cal** change assumes that the stress energy of the system is changed **freely,** but by design it deliberately prevents any stress difference in the system to produce a net force that could expend the free change of energy by doing work in an external load. Changing the stress energy alone is a curvature of spacetime and a purely gravitational change. It is also a **rotation** of the frame of the system away from the laboratory frame. See discussion under gauge theory.

general theory of relativity: Einstein's theory of gravity in which the gravitational force is represented by a curvature in spacetime, and in which spacetime is an active entity. We may look at all forces as being due to curvatures of spacetime interacting with mass.

geometric phase: A phase difference acquired by the state function of a quantum system that undergoes a cyclic evolution from an initial state and back. This phase difference can be detected by interfering the final and initial s**tates.** The modern generalization of the Aharonov-Bohm effect and the Berry phase.

giant nege**ntropy (of the dipole):** The continuous receipt from the time domain **of spacetime** (the vacuum), by one charge of any dipolarity (including **a** single charge's fundamental dipolarity), of enormous

longitudinal EM wave energy flow in condensed time energy form, transduction of that absorbed energy from the complex plane into real 3-space, and continuous emission of that enormous energy flow in all directions in 3-space, thence receipt of that 3-space energy by the other charge of the dipole or other adjacent dipoles, retransduction of the energy back into time-energy, and re-emission of that energy back into the time domain. This 4-circulation giant negentropy process is evoked and continues automatically and indefinitely after a little energy has been expended to separate the charges and make the source dipole. The EM waves in the input from the time domain and the output in 3-space are perfectly ordered and correlated, which is a giant ordering of the vacuum/spacetime and is thus a giant negentropy. In conventional circuits, the source dipole in the generator or battery, once made, performs this function. Only a minuscule fraction (some 10^{-13} in a nominal case) of the energy pouring out of the generator's or battery's terminals strikes the surface charges of the attached external circuit and is diverged into the conductors as the Poynting component that powers the Drude electrons and the circuit. All the rest of the energy flow (the Heaviside nondiverged component) outside the circuit is just wasted by conventional circuits.

gluon: A particle that carries the forces between quarks. In quantum chromodynamics, the gluon plays a role analogous to the photon in quantum electrodynamics.

graviton: In the quantum theory of gravitation, the graviton is the quantum of the gravitational field. It is massless, with spin 2. In the new theory we may take the graviton as a coupled scalar and longitudinal photon pair.

gravity: The phenomenon characterized by the physical attraction between any two material bodies of positive mass, specifically due to the trapped positive energy in the masses. If one particle is of negative mass and energy, the normal gravitational attraction between the two particles is reversed so that they repel, which produces antigravity. The fundamental mechanism of gravity can be found once one realizes that Maxwell omitted the incoming EM wave interaction with the nucleus, and not with just the electron shells. When he wrote his theory, the electron, atom, neutron, proton, and neutron had not been discovered yet. The lateral precession movement of the spinning Drude electrons — which are restrained *longitudinally* to a very small drift velocity in detecting wires (antennas) — later came to be considered proof of Maxwell's transverse EM wave in the vacuum. The detected electron precession wave is oscillating laterally, hence proves the longitudinal EM wave interaction. Elsewhere we have

pointed out that the EM wave in space is longitudinal EM wave accompanied by a corresponding time-polarized (scalar) EM wave, and it also follows from Whittaker's 1903 paper as reinterpreted by the present author in our Giant Negentropy paper.

gross particle translation: Refers to translating the entire particle — and its internal structures and dynamics — in space, rather than internally structuing the particle's potential (massless charge). Note that, if the internal structuring (engines) of the particle is changed during translation (e.g., by passing through a region of the flat spacetime having an altered internal engine structure), the particle may have an anomalous interaction with another particle or process having a different internal structure or "dimensioning." The mass-energy comprising the particle's nucleus, electron shells, etc. can be dimensioned. Mass so dimensioned or conditioned then may act differently in chemical reactions, effects on living systems, etc. than normal "inert" mass that has no specific deterministic dimensioning.

group: A mathematical structure that is a complete set of transformations on a mathematical entity that leaves the entity unchanged.

group, higher symmetry: In a given theoretical area, a particular theory can be expressed in various group transformations. When the group transformation (group symmetry) utilized is more complex than the "standard" group symmetry usually employed, it is referred to as a *higher* group symmetry. The mathematics of the model is then said to be a higher group symmetry mathematics. Since the groups have names such as U(1), SU(2), O(3), etc., the transformations of the mathematics are often referred to by **those** names. Hence characterizing phrases are used such as U(1) symmetry electrodynamics, SU(2) symmetry electrodynamics, O(3) symmetry electrodynamics, etc.

group, Lie: A group whose transformations act continuously. An example of a Lie group is given by rotations in ordinary space.

group theory: The general mathematics of symmetry transformations; i.e., the the**ory** of all transformations that leave the transformed entity or entities unchanged.

gyroelectrons: Spinning electrons considered as gyroscopes during the portion of their spin in 3-space, so that when longitudinally perturbed they can and will laterally precess. Considering (in a gross first order model) the conduction electrons in the Drude gas in a conductor as little gyros, because they are (i) spinning on an axis, (ii) severely restrained in their

ability to move forward longitudinally down the conductor as current, and (iii) much more free to precess laterally in the conductor. Thus when the gyroelectrons in the receiving wire antenna, perturbed by an incoming longitudinal EM wave in the vacuum, are longitudinally perturbed, they precess laterally so that our instruments (which detect electron wiggles, not the incoming vacuum EM wave) do detect "transverse waves." However, they are detecting the transverse gyroelectron precession waves, not the waves in the vacuum. They are detecting the *effect* of the interaction of the incoming waves with the gyroelectrons, not the *cause.*

harmonic series: A set of frequencies or oscillations consisting of integer multiples of a fundamental frequency.

Heaviside, Oliver: Noted English self-taught physicist and brilliant electrodynamicist, 1850-1925. who played a role in discarding Maxwell's quaternions, and also played a role in forming vector mathematics and formulating the vector reduction of Maxwell's theory from 20 quaternion equations in some 20 unknowns to the present 4 vector equations. Heaviside's curtailment of Maxwell's theory still contained both (i) systems in equilibrium with their active environment and (ii) systems in disequilibrium with it. To separate variables and enable closed solutions, *Lorentz further* curtailed the Maxwell-Heaviside equations by symmetrically regauging them, thereby *arbitrarily* discarding all disequilibrium Maxweilian systems and retaining only those in equilibrium with their active environment. This regauging unwittingly and erroneously discarded all that class of Maxweilian systems permitted to exhibit COP>1.0. The first such curtailment of the Maxwell equations was by Ludwig Valentin Lorenz in 1867, but H. A. Lorentz (who did a similar symmetrical regauging nearly decades later) was later given the credit.

Heaviside also discovered the enormous *nondiverged* energy flow surrounding every circuit, far greater in magnitude than the feeble Poynting *diverged* component that actually enters the circuit. But he was at a loss to explain what the source of such a startling flow of energy could be. Lorentz understood the Heaviside component, but also could not understand its source. Hence he reasoned that it "had no physical significance" since it did not power the circuit. Lorentz then introduced the trick of integrating the entire energy flow vector around a closed surface surrounding any volume element of interest. This neatly discards the vexing giant Heaviside *nondiverged* energy flow component, and retains only the *diverged* Poynting component that actually enters the circuit. The latter is of course the energy that will later be *emitted* from the circuit, which is what we will measure when we "measure the circuit."

Electrodynamicists are still using this method of dropping the Heaviside energy flow from any further accounting consideration. Hence they do not develop systems which intentionally increase their energy collection from this readily available energy flow around every circuit. The Bohren experiment conclusively proves the physical existence of the Heaviside nondiverged component, even though it is no longer accounted.

In his last years Heaviside realized the gravitational importance of his extra energy flow component, and worked out an electrogravity theory based on it. He did not live to publish it, but his papers on it were found some time after his death, beneath the floorboards of his little garret apartment. A learned society then published the papers.

Heaviside energy flow component: The enormous *nonintercepted* and nondiver*ged* energy flow component pouring out of the terminals of every battery or generator, or charge or dipole, and missing the external circuit (or external intercepting charges) entirely so that it is does not contribute to the intercepted (Poynting) flow component that powers the circuit. Also, the enormous energy in the EM field, potential, or wave that misses the interaction of the field, potential, or wave with the assumed unit point static electric charge, and thus is not intercepted and collected (and accounted!) in the unit point static charge assumption. In honor of Heaviside, the present author has nominated this "dark Heaviside energy" component as the missing source of excess gravity known to be holding the arms of the spiral galaxies in place. In the interactions of Dirac hole current with a unit point charge (to determine the negative energy fields and potentials in a COP>1.0 EM system), there is also a missing component of the negative energy flow that is comparable to the Heaviside component for positive energy flow. These flows of surplus negative energy **from** COP>1.0 astronomical interactions—with the associated negative energy fields and negative energy potentials produced by the **negative-**energy Dirac holes in these negative energy flows — is hypothesized by the present author as producing the antigravity that generates the observed acceleration of the expanding universe.

Hertz, **Heinrich:** Noted German physicist, 1857-1894, who together with Heaviside and others transformed Maxwell's theory from quaternion algebra to vector algebra, and who also experimentally produced Hertzian (EM) waves, thus confirming Maxwell's theory. These experiments by Hertz first detected EM energy propagating as described by Maxwell's equations, thus providing the experimental impetus that allowed Maxwell's theory to predominate. The oscillation or "cycle" is named after Hertz, by

specifying *X* number of oscillations or cycles per second as a frequency of *X* Hertz. One type of potential is also named after him.

hidden bidirectional EM waves: Those bidirectional EM wavepairs that comprise the scalar potential are indeed "hidden" with respect to our normal "electron translation" (i.e., electron wiggle) detectors and instruments. Nonetheless, properly functioning devices such as Fogal's semiconductor allow the utilization, transmission, and reception of the vast longitudinal EM wave dynamics that are infolded inside all conventional EM fields, waves, and potentials, including the giant potential comprising the ambient vacuum (spacetime). Use of this infolded electrodynamics is akin to using "subspace" or higher dimensions, depending upon how one chooses to model it mathematically. It is also a direct method of using a unified field theory.

hidden variable theory: A class of quantum mechanical theories which considers that the quantum state of a physical system is not a complete specification after all. The "hidden variables" are those additional components necessary to provide the "complete state" of the system. By utilizing the infolded longitudinal EM wave electrodynamics, one is in fact using a macroscopic hidden variable theory. This becomes a subset of Evans' O(3) electrodynamics, which in turn is an important subset of Sachs' unified field theory. Sachs' theory encompasses and subsumes electrodynamics, general relativity, quantum mechanics, etc., so the use of this macroscopic hidden variable theory through special functions provided by components such as Fogal semiconductors is a powerful and directly engineerable extension of conventional hidden variable theory. The physics of this new, engineerable, unified field theory area is also called *energetics.*

hole, lattice: Vacancy, in an otherwise filled energy band position. Sometimes called *negative ion vacancy.* In a semiconductor, an electron may be lifted to the conduction band by thermal energy, which produces u hole-electron pair (an exciton). Also, one of the sites in the crystal lattice can be occupied by an acceptor impurity atom, so that the electron is accepted there, leaving a hole showing excess positive charge. This is a lattice hole, and the propagation of such holes being formed is called electron hole current, or hole current for short. We point out that the *laittice hole* exists only after interaction of the Dirac sea vacuum hole with matter. i.e., only after observation. In that case, the 3-positron (hole) has positive mass and positive energy, produces positive energy fields and potentials, produces gravity rather than antigravity, and is "seen" to be going in the opposite direction to the Dirac sea hole. Prior to observation, the hole is a

Dirac 4-hole in vacuum, having negative energy and therefore negative mass equivalence, negative charge, and without a direction reversal. This 4-hole is a source of negative energy fields and negative energy potentials in **the** surrounding space, and thus of antigravity back-interaction (upon the physical system connected with the active vacuum component of its supersystem) due to the negative curvature of the local spacetime.

hole, Dirac sea: In the presence of fields (i.e., in the presence of curved space**time),** some of the negative energy states in the Dirac sea are not filled with electrons. In that case there are some empty 4-holes in the Dirac sea, in local spacetime itself. The Dirac hole is a negative energy state in the **vacuum** itself. It too *seemingly* has a positive charge, as seen by the external observer after interaction with matter. Holes are also mathematically equivalent to positrons, in case observation has been evoked, so long as the lack of positive mass is not a consideration Note that our view differs from the received view, but is based on experimental evidence which can only be gained from COP»1.0 EM system experiments. We know of no such COP»1.0 EM system experiments involved in the received view.

hole current: (1) In a semiconductor: Usually, the part of the current in a seminductor that is composed of migration of lattice holes. ***Mathematically,*** within certain constraints this may be considered a positro*n* current. The hole migration is usually slower than the electron migration producing electron current. (2) In the vacuum itself. In the *Dirac sea, in* **the** presence of fields the Dirac 4-holes flow in the opposite direction to the local electron current, providing a Dirac sea hole current or posit**ron** current. [See discussion under hole.] An electrical power system in disequilibrium with its vacuum interchange and having COP>1.0, will have a **greater** *tempic potential* at its output section than at its input section. Thus it will have a tempic force or tempic broom, sweeping holes from local instabilities to form a hole current (may be both a Dirac sea hole current and a lattice hole current) flowing from the output section of the system back through the system into the input section, and on out of the input section into the primary power source. *Hole current transduction may be* used to convert this detrimental hole current energy transport into usable **electron** current energy transport, or anti-circuit techniques and mechanisms can be used.

hole current transduction: Hole current in a COP>1.0 open system, where **the** system is in disequilibrium with the vacuum *a priori,* is usually detrimental to (he system and may destroy the overunity condition. A hole current from the input section of the system, fed back into the primary

power supply, requires that extra electron current be furnished since some of the electrons in that furnished current will recombine with the oppositely moving Dirac vacuum holes and disappear to fill those holes. Hole current into a battery in "normal" fashion discharges the battery rather than charges it (although reversing the battery terminal connections allows charging in normal fashion using the hole current). Thus a battery can be discharged "far below zero", so to speak, by charging it with excess holes in the "normal connection." A capacitor may be charged with hole current, in which case the dielectric will undergo compressive strain into the positron-charged plate. However, when the capacitor is subsequently discharged, the dielectric will expand and recover, with its electron charges pushing electrons out of the negative side plate and into the external circuit. Hence a capacitor can be *charged* with positron (hole) current, and then can be adroitly switched so as to *discharge* electron current. In theory so can a battery because of its capacitance. This is a transduction of entropy to negentropy, a process for which a patent application has been filed by Bedini and Bearden. Gauge freedom already permits that operation, since gauging in electromagnetic systems is freely changing the local potential energy of the system, and is either negentropic (increasing the system's energy) or entropic (decreasing the system's potential energy).

hole injection: In an n-type semiconductor, holes can be emitted by applying a metallic point to the semiconductor's surface. We suspect (but have not proved) that sharp gradient pulses may also induce some of these holes as Dirac sea 4-holes and Dirac sea hole current rather than positron and lattice holes current. In that case, a mix of positive energy and negative energy (and gravity and antigravity) would be produced.

hole trap: An impurity in a semiconductor that can trap a "hole" by releasing electrons to the conduction or valence band.

hyperspace: Refers to a space of more than four dimensions, and specifically to those spatial dimensions outside the normal three. The term is used for both a space of n dimensions, where n>4, or for one dimension in such a space, beyond the normal four.

identity of opposites: On the boundary between A and not-A, A and not-A are identical (i.e., no difference can be discriminated). If all of a thing is collected, one reaches the boundary of that thing and it turns into its own opposite. The philosopher's problem of the "accursed necessity for the identity of opposites" cannot be solved in Aristotelian 3-law logic, since that logic is incomplete. It is readily solved, and part of, a more extended

logic such as 5-law logic. The result is that "identity" is not an absolute entity, but is a decision by the observer reached by application of a comparison algorithm to separate observations made at differing times. An example is provided by a colorblind observer who sees as identical two marbles which, to an observer with color vision, are seen as red and black and therefore not identical. Aristotelian logic omits the action by the observer, the times of the multiple observations (only a single thing at a time is observed or perceived, *a priori),* and the decision algorithm used *by the* observer to decide whether two observations are identical or not identical.

inertial frame: A frame of reference in which force-free bodies move along straight lines, and the postulates of special relativity are valid. In the new a**pproach,** this notion is extended. Even in an inertial frame, force-free **bodies** may move along straight lines, the postulates of special relativity may remain valid, and yet the EM hidden variables may induce other chan**ges** in the usual laws of nature due to the action of hidden vacuum engines infolded in the *dimensioned* local flat spacetime (vacuum **potential).** See Einstein's second postulate extended.

infolded real vector components: Simply take a set of real force vectors that altogether sum to a vector zero resultant. This "vector zero system" is a zero vector with respect to forced *translation* of a particle or mass. It is not am absence of the vectors at all, but is the presence of specifically hidden and "infolded" real vectors that do not initiate bulk translation of the affe**cted** object or system, but perform *internal* work upon the system. Such vector systems are stressing systems of a special kind, where the internal components of the stress are not random but deterministic. Hence they are electrodynamic *engines,* in the new approach. To a somewhat arrogant mathematical scientist who once objected that zero vector resultant systems had no effect, I humorously challenged him to put it to experimental test. I suggested he stand between two elephants pushing against him in opposite directions, while I would stand between two fleas doing the same to me, and we would compare notes. He apparently was not amused at the suggestion.

infolding: With reference to signals, infolding means "placing the signal **or modulation** or change upon one or more of the internal bidirectional wave**pairs** comprising the scalar potential. Since all EM potentials ultimately represent changes to the ambient vacuum potential, one has conditioned or altered the vacuum itself when infolding is utilized, infolding of E*M* signals, vectors, and directions produces *engines.* By Whittaker's decomposition of the potential and Bearden's reinterpretation,

these vacuum engines can be designed to affect matter — including atomic nuclei, nucleons, etc. — in any manner desired.

information content of the field: Russian euphemism for the deliberate structuring of the hidden longitudinal EM waves and their dynamics, that comprise any EM potential, field, or wave, so that the potential, field, or wave is *dimensioned* and contains active *engines.* This area was extensively weaponized under KGB (now changed in name) control rather than the regular Russian armed forces, and a disinformation campaign was waged to convince Western analysts that the term refers to simple spectral analysis. It doesn't. Instead, it refers to infolding and outfolding, and the use of longitudinal EM waves, dimensioning, and engines. The overall science is called "energetics" by those weapon scientists.

interferometer: An instrument or system in which a wave is split into two waves or beams, which after traveling over different paths are subsequently reunited and interfere. The use of longitudinal EM waves (LWs) allows ready penetration of mass by the LWs traveling through the interior Whittaker composition of a mass's internal EM fields, waves, and potentials. Longitudinal EM wave interferometers should prove useful in probing the interior of planets, the sun, etc. They pass easily through the earth, so that interferometry can be obtained at targets on the opposite side of the earth, or inside the earth. These are the weapons that then Secretary of Defense Cohen referred to in 1997 as being used to engineer the weather, initiate volcanoes into eruption, or initiate earthquakes.

Josephson effect: Flow of Cooper pairs (superconducting electron pairs) across a thin dielectric separating two superconducting electrons, in the absence of a voltage drop. E.g., the pair of electrons can "tunnel" through u thin insulating barrier.

joule: A measure of energy; one watt for one second in electrical terms. In physics the unit of work or energy in the MKS system, being the amount of work done by one newton acting through a distance of one meter, equal to 10,000,000 ergs.

Kirchhoffs current law: At any time, the sum of the instantaneous currents flowing into a node or point in a circuit equals the sum of the instantaneous currents flowing out of that node or point. This does not have to be true if (1) relativistic effects are appreciable, or (2) electron production and annihilation processes — such as Dirac sea hole current, lattice hole current and recombinations are occurring and non negligible, (3) the Kron open path is being used, or (4) localized time reversal zones (TRZs) are utilized. Another way of stating where the law need not hold is

when there are nonlinear interactions between the three components of the superset (the physical system and its dynamics, the active vacuum and its dynamics, and spacetime and its curvature dynamics.).

Kirchhoff's voltage law: At any time, the sum of all voltage rises in a closed loop circuit equals the sum of all drops in that closed loop circuit. The law assumes a flat spacetime. This does not have to be true if relativistic effects are appreciable, if true negative resistor effects are present, if Kron open paths are utilized, and if time-reversal effects arc present. It also need not be true in anti-circuit techniques, or when they are involved in a particular portion of an otherwise normal circuit.

Lamb, Willis Eugene Jr.: American physicist and Nobelist who discovered the hyperfine structure of the hydrogen spectrum, and first measured the interaction of the vacuum energy that generates a change in the energy levels of the hydrogen atom, according to Dirac's theory and quantum electrodynamics.

Lamb shift: A very small correction to the first excited state of the hydrogen atom due to interaction of the vacuum. Willis Lamb experimentally confirmed this prediction of quantum electrodynamics to high accuracy. The local energy density of the little Lamb shift is greater than the surface energy density of the sun. However, in matter there are such a vast number of similar small interactions generating very powerful fields randomly, that the sum total of all these changes sums to a vector zero for most summation distances of interest.

lamellar current: Thin layers of current; thin sheets of current.

laser: A device that generates light in which all the photons are exactly in step and produce a coherent beam. Originally the word "laser" was an acronym that stood for "light amplification by stimulated emission of radiation."

law of physics: A restriction placed upon the physical mechanisms that can occur under certain broad assumptions as to the background situation and environment. Because of the assumptions made, an expressed law of physics is not absolute, but relative to the assumed conditions. Any "law of physics" can be violated if the conditions contained in its assumptions are violated. It is important that a scientist be aware that physics is comprised of models and the "laws of physics" are very general and wide-ranging models based on very specific assumptions. Further, by Godel's theorem and the theory of models, no model is perfect anyway, and none will ever be. When one assumes that physical laws are not based on any

assumptions but are universal and absolute truths, one has immediately moved to dogma and not science.

Lawandy patents: Patents covering and related to a form of anti-Stokes emission (excess emission of energy) in strongly scattering, optically active media such as TiO_2 particles in suspension. This is a new form of lasing, without the requirement for population inversion.

Letokhov, V. S.: Russian pioneer in excess emission phenomena from stimulated media.

Letokhov effect: The excess emission (excess emission of energy) phenomena in strongly scattering, optically active media, usually referred to as "negative absorption of the medium." See particularly V. S. Letokhov, "Laser Maxwell's Demon," *Contemporary Physics*, 36(4), 1995, p. 235-243.

localized: Confined to a small region of a large system rather than being extended through the system or at a distance.

localized virtual photon flux of vacuum: Refers first to a local region of the vacuum, and then to the flux density of virtual photons in that local region. If that flux is deterministically structured, then the local region also contains an *engine* that will act internally upon masses and mass systems in that region. The local region also contains hidden variables.

longitudinal component: In EM fields, the longitudinal component of the fields along the direction of travel, as opposed to the transverse components at right angles to the direction of travel.

longitudinal E-field: Any electrical field in 3-space may be described using two components, a transverse component and a longitudinal component. Of course one or the other may be a vector zero. In 4-space, there is a time component also, as an additional "transverse" component.

longitudinal gradient: Compression wave gradients (differences) in density or pressure, considered in a direction from their origin along the direction of primary movement in the medium. Contrast to transverse waves, which act perpendicular to their direction of propagation. In electrodynamics, longitudinal EM waves in 3-space are said to be "longitudinally polarized." Longitudinal EM waves in the time-domain are said to be "time polarized." The latter are also referred to as "scalar waves" since they have no polarization vector component in 3-space and thus arc "scalar" with respect to 3-space. This is a misnomer, however, since these "scalar waves" are perfectly good time-polarized EM longitudinal vector

waves. For the first time, the giant negentropy process allows one to make and use time-polarized EM waves, since they automatically accompany all longitudinally polarized EM waves and it is straightforward to make longitudinal EM waves in 3-space (just oscillate the Lorentz regauging condition).

longitudinal interior wave: An infolded longitudinal gradient that oscillates in magnitude along the line of travel "inside the vacuum potential or a normal potential." In conventional theory, the electric portion of the EM wave is a transverse field oscillation, and the longitudinal component is essentially zero. In the new "infolded" wave approach, there is no overall transverse gradient in the vacuum potential, but there are such longitudinal waves. This is rather like a "pressure wave" transmitted under water, without causing a surface wave involving physical upheaval and fall-off of the water. The speed of the longitudinal EM wa**ve** is not limited to c, the speed of transverse EM wave light in the ambient vacuum..

longitudinal wave: A "pressure" type of wave, similar to sound, in which the vibrations are along the direction of travel of the wave. Hence, a wave composed of alternating densifications and rarefactions, where we focus upon the longitudinal component of the changes. One can think of it as a sort of "accordion" wave, rhythmically shrinking and stretching along the line of motion as it travels. Note that rhythmically and symmetrically varying the two potentials involved in regauging creates longitudinal EM waves. So one pseudonym for longitudinal EM waves is "gauge oscillation" waves. Matter is mostly empty space filled with EM potentials, fields, and waves—all of which are bundles of longitudinal EM waves and their functional dynamics. Hence matter (such as the ocean and the earth) is a vast superhighway for the passage of longitudinal EM waves. Note that the longitudinal wave represents an oscillating energy density in space and/or time (scalar waves), and hence is an oscillating curvature of spacetime. All forces of nature are generated by curvatures of spacetime. Hence all forces of nature can be generated by the correct generation of longitudinal EM waves and their impressed dynamics, Further, this means that all the physical *causal* functions of the exhibited **effects generated** in a material system can be captured in longitudinal EM wavesets. A longitudinal wave functional system deliberately having such causal functions of a physical functioning system is known as a causal **system robot** (CASR). Such robots are far beyond the presently developing nanobots, and have been developed rather extensively by at least one nation. Such robots can easily pass through the "interior" of any normal

EM signal or wave or potential or field, which again is nothing but a giant superhighway for longitudinal EM waves. In theory one can communicate with a CASR via longitudinal EM waves if communications functions are built in to the CASR. In the future, one would expect that planetary exploration, underground and undersea exploration, exploration of the interiors of the sun, moon, and planets, could be enabled by the further development of specialized CASRs.

Lorentz, Hendrik Antoon: Renowned Dutch physicist and Nobelist. 1853-1928, who developed the Lorentz transformations and Fitzgerald-Lorentz contraction. Lorentz shared the Nobel Prize for discovering the Zeeman effect. He is also responsible for symmetrically regauging Maxwell's equations (some time after Lorenz did it in 1867), and for introducing an integration trick that neatly disposes of the vexing huge Heaviside nondiverged energy flow component accompanying every field/charge and potential/charge interaction.

Lorentz invariance principle: An inertial frame is independent of the velocity of the frame relative to any other inertial frame. This is not necessarily true with respect to engines inside inertial frame objects, since the engines involve acceleration dynamics.

Lorentz regauging: Changing the two potentials in the Maxwell-Heaviside equations in potential form so that the resulting equations have the variables separated, and there is no net force introduced by the two new forces, which are deliberately chosen so as to be equal and opposite and thus sum to zero. An unfortunate effect is that this discards all Maxwellian systems far from equilibrium in their vacuum exchange, hence discards all permissible Maxwellian COP>1.0 systems. Electrodynamicists have not recognized that Lorentz regauging represents the addition of stress potential energy and continuous internal work and stress to a regauged system. It also represents a rotation of the frame of that system out of the laboratory frame by some angle. Further, oscillating the Lorentz regauging condition produces longitudinal EM wave generation and emission.

Lorentz symmetry: The symmetrical regauging by Lorentz of Maxwell's equations.

Lorenz, Ludwig Valentin: Scientist who first changed Maxwell's equations — two years after their publication in 1865 — by (effectively) symmetrically regauging them, thereby unwittingly discarding all Maxwellian systems far from thermodynamic equilibrium with the active vacuum. See L. V. Lorenz, "On the identity of the vibrations of light with

electrical currents," *Philosophical Magazine*, Vol. 34, 1867, p. 287-301. In this paper [L. V.] Lorenz gave essentially what today is called the [H. A.] **Lorentz** symmetrical regauging. When H.A. Lorentz also symmetrically **regauged** the Maxwell-Heaviside equations, the physics community **adopted** the procedure and resulting further truncation of the Maxwellian theory. That truncation continues to this day.

low energy **nuclear reaction** (LENR): Actually a bit of a misnomer, since it refers to a low *spatial* energy, high *time* energy reaction. Cold fusion, or the anomalous transmutations of elements that occur in certain electrolytes with specially prepared palladium electrodes. The transmutations occur even though in conventional theory there is insufficient *spatial* energy to accomplish them, because they use time energy. Time energy is spatial EM ene**rgy** compacted by the factor c^2, hence time has the same energy density as mass. The formation of temporary, fleeting time reversal zones (TRZs), with action from from inside-to-outside, is the genesis of a host of new nuclear reactions missing from conventional particle physics since the physicists do not account time as energy, and do not use such TRZs. For more on this hypothesis and the specific reactions generated, see T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," *Journal of New Energy*, 3(2/3), 1998, p. 12-28 as well as Chapter 10 of the present book.

magneti**c dipole:** Paired north and south magnetic poles of equal strength ever microscopic or macroscopic distance.

magnetic induction: The act of a change in magnetic field producing an electric field at right angles, which in turn produces an electron flow.

magnetic spin: The intrinsic angular momentum, known as spin, of electrons, protons, and neutrons, etc. The electrons combined in an atom or ion have **a** resultant angular momentum that is the combined intrinsic spin of **the** electrons and the angular momentum due to their motion around **the** nucleus. There is also a magnetic moment associated with this angular momentum (spin) whenever it is nonzero. Therefore atoms or ions with non**zero** spin are *magnetic* atoms or ions. This is often loosely reffered **to a**s "magnetic spin." It is actually the magnetic moment of nonzero spin.

magnetostatic scalar potential: Continuous mathematical function whose value in space, at any point it occupies, represents the potential energy collected upon an assumed unit magnetic north-seeking charge (pole).

There is a magnetostatic scalar potential between the poles of any magnet.

This scalar potential is **also** subject to **Whittaker's** 1903 decomposition into

a harmonic series of magnetic longitudinal phase conjugate wavepairs. Reinterpretation of Whittaker's wavepairs should be made according to Bearden, "Giant Negentropy of the Common Dipole," *J. New Energy,* 5(10, Summer 2000, p. 11-23. This reinterpretation agrees with quantum field theory; see Mandl and Shaw, *Quantum Field Theory,* Revised Edition, Wiley, 1993, Chapter 5.

matter: Highly condensed 3-spatial energy, compressed by factor c^2 and remaining in 3-space, and with the observation process *d/dt* having been applied to the fundamental masstime entity to provide mass as a frozen 3-space snapshot by stopping the flow of time momentarily. Matter, of course, has internal structure, order and organization, and dynamics. All matter is in a continuous energetic exchange with its active vacuum (4-spatial) environment. Matter stripped of its EM fields, waves, and potentials is called mass. Mass is an observable and therefore a frozen series of continual 3-space snapshots, formed by incessant photon absorption to change the mass *m* to masstime *mt,* with following incessant photon emission to change masstime *mt* back to mass *m.*

Maxwell, James Clerk: Brilliant Scottish scientist, 1831-1873, who first formulated the unified theory of electricity and magnetism. See *The Scientific Papers of James Clerk Maxwell,* 2 vols. bound as one, edited by W. D. Niven, Dover, New York, 1952, Vol. 1, p. 526-597 for his definitive paper, "A Dynamical Theory of the Electromagnetic Field," first published in *Royal Society Transactions,* Vol. CLV, 1865. In that paper, (see Niven's book) his general equations of the electromagnetic field are given in Vol. 1, Part III, "General Equations of the Electromagnetic Field," p. 554-561. On p. 561, he lists his 20 variables. On p. 562, he summarizes the different subjects of the 20 equations, being three equations each for magnetic force, electric currents, electromotive force, electric elasticity, electric resistance, total currents; and one equation each for free electricity and continuity.

Maxwell's famous book, *A Treatise on Electricity and Magnetism,* Oxford University Press, Oxford, 1873, Second Edition 1881 (Maxwell was already deceased), Third Edition, Volumes 1 and 2, 1891. Foreword to the second edition was by Niven, who finished the work. Maxwell had dramatically rewritten the first nine chapters to simplify his mathematics because of the resistance to it, with much new matter added and the forma contents rearranged and simplified. Maxwell died before finishing the rcsl of the second edition. The rest of the second edition is therefore largely a reprint from the first edition. The third edition edited by J. J. Thomson was published in 1892, by Oxford University Press, and later was published unabridged by Dover Publications, New York, 1954. J. J. Thomson

finished the publication of the third edition, and wrote a "Supplementary Volume" with his notes. A summary of Maxwell's simplified equations are given in Vol. II, Chapter IX of the third edition. However, Maxwell had gone (in his second edition) to some pains to reduce the quaternion expressions himself, and not require the students to know the calculus of quaternions (so stated on p. 257). We note that Maxwell did not finish the second edition, but died before that. He actually had no hand at all in the third edition as to any changes. The Second edition was later finished by Niven by simply adding the remaining material from the previous first edition approved by Maxwell. The printing of the first nine chapters of the thirg edition was already underway when J. J. Thomson was assigned to finishtheeditingofthemanuscript.

Maxwell's work profoundly affected the course of science and the course of human history. Maxwell, Heaviside, Hertz, Gibbs, Lorcntz and others participated in dramatically curtailing Maxwell's original 1865 quaternion theory to the much more limited subset that it is today. Since the early part of the 20th century, work has slowly been ongoing to move EM theory back to a higher group symmetry theory, which ironically it already was when Maxwell first created it.

Max**well's** electrodynamics: Simply put, Maxwell's theory of electrodynamics consists of Maxwell's equations. His fundamental theory consisted of some 20 quaternion equations in 20 unknowns, appearing in his 1865 paper. After Maxwell's death and some curtailment by Maxwell himself, Heaviside modified and sharply curtailed these equations, into the familiar four equations of today, as did Gibbs and Hertz. Lorentz further curtailed the Maxwell-Heaviside equations, by symmetrically regauging them. This simplified their mathematical solution, but it also inadvertently and arbitrarily discarded all open Maxwell systems far from thermo**dynamic** equilibrium with their active environment (such as the modern active vacuum). See James Clerk Maxwell.

Maxwell's Theory, fluid dynamics analogy: *Considering and adapting the fluid analogy approach of James Clerk Maxwell:* The intensity of the vacuum virtual particle flux may be treated as the intensity of a potential, thus by analogy corresponding to pressure in a fluid. Polarity (charge) is a **process for** establishing a change in the intensity of the vacuum potential - and **thus** a change in the ambient pressure of the vacuum fluid. Dif**fence** between vacuum pressures at two separated points creates a force u**pon** any charge placed between those two points. Just as a differential in pressure between points in a fluid induces currents, a differential in vacuum pressure induces energy flow currents in the

vacuum fluid, which are called 'fields'. All EM circuits, charges, potentials, and forces in electrodynamics involve altering the vacuum to include altering its pressure and thereby producing the forces the resulting pressure gradients (fields) induce upon charges. All observable EM energy in space is EM energy intercepted and collected on charges, or assumed to be, and the spatial EM energy comes from the vacuum via these fundamental vacuum-engineering dynamics which all involve the giant negentropy 4-circulation between the time domain and 3-space.

Michelson, Albert Abraham: German-born American physicist, 1852-1931, who invented an interferometer (Michelson interferometer) named after him. Michelson used his interferometer in a renowned experiment in the 1880s designed to measure the velocity of the earth through the ether, which would produce a shift in his interferometer pattern. No such shift was observed, which indicated the absence of an ether wind and was largely responsible for the downfall of the concept of the material ether that had been previously assumed, including by Maxwell.

motionless electromagnetic generator (MEG): Transformer-like COP>1.0 electrical power generator invented by Patrick, Bearden, Kenny, Hayes, and Moore, ""Motionless Electromagnetic Generator," U.S. Patent # 6,362,718, Mar. 26, 2002. A second patent application is processing and several more are in preparation. In particle physics, any dipole (including a permanent magnet) is a known asymmetry in the fierce vacuum flux, continuously pouring out real EM energy extracted from the vacuum. The MEG continuously powers its transformer section core with a permanent magnet dipole, more than doubling the EM energy made available from **the** active vacuum via the permanent magnet dipole's broken symmetry in its exchange with the vacuum. [See M. W. Evans, P. K. Anastasovski, T. E. Bearden et al., "Explanation of the Motionless Electromagnetic Generator with O(3) Electrodynamics," *Found. Phys. Lett.,* 14(1), Feb. 2001, p. 87-94; "Explanation of the Motionless Electromagnetic Generator with the Sachs Theory of Electrodynamics," *Found. Phys. Lett.,* 14(4), Aug. 2001, p. 387-393]. The MEG nanocrystalline core material extracts the magnetic field B of the permanent magnet from the surrounding space and localizes it in the core material. The active vacuum asymmetry freely replenishes the withdrawn magnetic B-field energy in space surrounding the core, but with uncurled magnetic vector potential A rather than magnetic field B. This is an application *of geometric phase,* specifically the well known *Aharonov-Bohm effect,* with several thousand papers in the literature. The MEG then transduces and outputs magnetic B-field energy inside the **core** material and some of the field-free magnetic vector potential A energy in

space surrounding the core, effectively having available more than double the energy being made available from the permanent magnet, or normally available to a transformer. The output power of the MEG is a function of (i) the time rate of change of a small amount of input EM perturbation ener**gy** to the input coil, plus (ii) the intercepting and collecting secondary charges available in the secondary coil, (iii) additional energy from chaotic oscillations, (iv), sophisticated feedforward and feedback regenerative self-oscillations, and (v) the geometric phase (Aharonov-Bohm effect). It thus **is** a rigorous practical application of the geometric phase effect to a mac**roscopic** power system, and in fact is the first such application in practical electrical power systems. The noted feature of the MEG is a purely electrical interaction in the output coils, in which the voltage and energy are in phase within 2°, differing from all other transformer-like systems. Thus the MEG directly delivers real power rather than apparent power. See Aharonov-Bohm effect.

multicollection (of energy): Multiple collection and re-collection in a circuit of the same energy flow from a source dipole, by rerouting either (1) the dissipated Poynting energy back around to the collectors for another pass by them, with additional collection, or (2) retroreflecting the nondiverged Heaviside EM energy flow component back and forth across the su**rface** charges in the circuit conductors, iteratively diverging additional energy into the conductors to potentialize and power the Drude electrons, or (3) a combination of the two. The interesting point is that this effect **can** "use" the same energy to do repeated work, multiple times. It takes a**dvantage** of the fact that work is merely the change of form of energy, and that the new form can again be changed (as for example, back into the **first** form again) to do additional work, again and again so long as the ener**gy** in each transformation is held in the system without escaping. This process permissibly violates classical equilibrium thermodynamics and its i**nfamous** second law, since it is an open system freely receiving excess ene**rgy** from its active environment and thus far from equilibrium with that active environment. As is well known, such systems are permitted to exhibit COP>1.0 and even self-powering of the system and its load simultaneously.

negative absorption of the medium: Excess emission from an active medium, as in the Letokhov work and in Bohren's experiment. The excess energy is first absorbed from the vacuum interaction (actually from Heaviside**'s** unaccounted energy flow component that usually does not interact with the system), and then it is re-emitted. This is actually a true "Maxwell's demon," as pointed out by Letokhov.

negative resistor: Any component or function or process in an EM system that freely receives energy from outside the system in unusable or disordered form within the system, transduces that energy into usable form, and outputs it so that it can do useful work. In a *true* negative resistor, that is the *net* function performed. We specifically do not include "differential" negative resistors such as the tunnel diode, thyristor, and magnetron, which dissipate and disorder more energy from the system itself, overall, than the fraction that they order and furnish back to the system in their negative resistance regime. In anti-circuits, true negative resistors are quite natural components. Every charge and dipole in the universe is already just such a negative resistor, freely extracting unusable EM energy from the seething vacuum, transducing it, and continuously pouring out real observable EM energy in all directions in 3-space. A negative resistor can produce the five magic functions: (i) self-ordering, (ii) self oscillation or self-rotation, (iii) output more energy than the operator inputs, (iv) power itself and its load freely, and (v) exhibit negentropy. The condition for self-powering of a system containing a true negative resistor was given by Gabriel Kron.

negentropic: Functioning to produce or involve negentropy; reordering previously scattered energy without requiring the operator to input energy to perform the reordering. A simple example is passive retroreflection of radially scattered EM energy. The conventionally unaccounted enormous and nondiverged Heaviside energy flow component surrounding every circuit and every field/charge interaction is an example of a dynamically reordered and organized energetic vacuum, and thus an example of a giant negentropy process. The continuous observable EM energy freely pouring at the speed of light from every dipole and charge in the universe is also an example of the giant negentropy process.

negentropic engineering: Expending a little bit of energy to form a dipolarity, and then intercepting, collecting, and using some of the enormous EM energy freely and continuously extracted by the dipolarity from the vacuum, indefinitely, without using any of the extracted EM energy to scatter the charges in the dipole and destroy it. Retaining the dipole intact avoids shutting off the furnishing of copious free energy flow from the vacuum to the attached external circuit. As an analogy, it allows an electrical windmill operating in (driven by) a free electrical wind from the external environment of the system.

Newtonian recoil: Newton's third law reaction from the affected entity back to and upon the effecting entity. The "action" is the action from the effecting entity upon the affected entity. The "reaction" is the action from

the affected entity back upon the effecting entity. Newton's third law actually implies that the cause interacts upon the effect and the effect reacts equally back upon the cause, thus producing a strange kind of equilibrium. In a time-reversal zone, the "recoil" is reversed in direction by parity reversal. Tentatively, one may interpret from pumped phase conjugation that the Newtonian third law reaction of one single acting force can be amplified by properly directing the actions of other acting forces. An interesting aspect is that a pumped phase conjugate mirror does not recoil, no matter how powerfully it is pumped or how powerfully amplified is the emitted phase conjugate replica wave.

Newton's third law: For every action there is an opposite and equal reaction. This law should be extended and restated something like this: "for every action there is an opposite and equal reaction if the causative mechanism of the reaction is allowed to occur without interference and is not first redirected away from its target." An example of a violation of Newton's third law as usually stated is provided by the emission of a phase conjugate replica (PCR) wave from a phase conjugate mirror material. No matter how powerfully pumped, the PCM does not recoil by the emission of the PCR wave. The reason is that the antiwave cause of Newtonian third law recoil was intercepted by nonlinear multiwave interaction (wave-to-wave i**nteraction)** before reaching its target nuclei and interacting with them, and was diverted away from the atom and on out of the phase conjugate mirror material. Since the causative mechanism for Newtonian recoil did not occur on the mass of the mirror, the mirror did not recoil. We also point out that, if Newton's third law is indeed engineerable and controllable, then COP>1.0 systems and self-powering EM systems are permissible a priori. In electrical system terms, this simply means that, if one can rid the system of its equal back emf or back mmf, the system can be legiti**mately** self-powering because it no longer self-enforces the Lorenz-Lorentz symmetrical regauging condition.

non-Abelian electrodynamics: An electrodynamics based on a group theory in which the group operation is not commutative and hence not Abellian in nature. Contrast to an Abelian group in which the group operation is commutative.

nonequilibrium thermodynamics: Colloquial term referring to the newer thermo**dynamics** of self-organizing systems and structures, far from euilibrium in their energetic exchange with their active environment, Since the **1960s,** there has emerged in physics (and in thermodynamics!) this surprising new area: the physics of far-from-equilibrium systems and the self-organization and large-scale ordering of such systems. The

equilibrium conventionally referred to is 3-space equilibrium, with no consideration of temporal equilibrium, although some pioneers of the field such as Prigogine are quite aware of the temporal disequilibrium also involved. Note that such "3-disequilibrium" thermodynamical systems are also in temporal energy flow disequilibrium as well as 3-disequilibrium, but overall are still in 4-equilibrium energetically. See **giant negentropy (of the dipole).** For a necessary thermodynamics discussion, see Appendix A in this book.

nonlinear material (optical): A substance whose optical properties vary with the intensity of the light.

nonlinear optical functioning: Functioning in a manner prescribed by nonlinear optics and quantum optics, particularly with respect to time-reversal effects, use of phase conjugate mirrors, phase conjugate reflection, wave-to-wave interaction, and pumping for amplified phase conjugate reflection. To quote Knight, "A phase conjugate mixing device has remarkable optical properties: perfect retroreflection, the complete cancellation of optical aberrations and inhomogeneities in wavefronts, and the ability to reverse an optical beam and return it to its source." A most interesting modern science, eventually adaptable to COP>1.0 systems, is developing in the study of intensely scattering optical materials.

nonlinear phase conjugate optics: See **phase conjugate optics.**

nonlocalization: Producing or rendering an effect or effect-producing agent at a distance, rather than at the immediate location of the effector. Extended throughout a large region or system, or to a distant part of a large region or system, rather than being confined to a small region of the large region or system. Nonlocalization effects are absolutely prescribed in quantum mechanics, and are experimentally confirmed. They have been largely ignored in classical electrodynamics and electrical engineering. Nonlocalization can result from the existence and use of a multiply connected space, as in Bohm's quantum potential and hidden variable theory. Engineering of action at a distance by engineering the quantum potential through multiply connected space gives one method of energy amplification. This method has unfortunately been secretly weaponized In five nations of the world, and none of the technology is available for use in electrical power systems for energy amplification and solving the energy crisis.

non-Riemannian geometry: Riemannian geometry is the geometry **of** Riemannian manifolds — i.e., manifolds having an infinitesimal squared distance *ds* that is everywhere positive. A non-Riemannian geometry

violates this property. [A manifold is a topological space with certain prescribedcharacteristics.]

nucleons: A collective name for the neutrons or the protons in a nucleus. In the nucleus, the neutrons and protons are continually changing one into the other by exchange of the charge. What is called a neutron and what is called a proton is thus somewhat arbitrary, so long as one makes a rule and stands by it. The interesting thing is that, in a nucleus, there is already continous and highly rapid transmutation activity between nucleons, all the time, without giant accelerations and operator input of very intense spatial energy. In short, nature shows in all matter that matter can be and is continually transmuted from instant to instant, and is "constant" only on the "**average".** Since most present models used for this are statistical rather than causative, it strongly suggests that we should look for a causal mechanism. The use of the time-reversal zone and time-energy has been nominated in this book as providing a causal mechanism for transduction, which can be directly engineered. It appears that cold fusion research already accomplishes transmutations using the suggested mechanisms, Several specific nuclear transmutation reactions applying the new mechanisms, and consistent with hundreds of cold fusion experiments, are given in the present book.

O(3) electrodynamics: An electrodynamics extended from a two-dimensi**onal** inner group symmetry to a 3-dimensional inner group symmetry**.O**(3) electrodynamics also becomes an important subset of Sachs' u**nified** field theory. The inner group symmetry of O(3) can be taken as normal space, which immediately opens up engineering the vacuum and using spa**etime** curvature engines to directly engineer matter for us.

open system: A system that communicates with its environment, and exchanges energy, matter, or both between system and environment. With the possible exception of a few theoretical or hypothetical systems, all systems in the universe are in fact open systems. An open system may be in equilibrium with its active environment, so that it cannot accept, store, and utilize any excess energy from the environment. Another open system may be in disequilibrium with its active environment, in which case it can accept, store, and utilize excess energy from the environment. When the operator inputs EM energy into an open equilibrium system, he automatically breaks its equilibrium condition with the external active environment, decreasing the system's entropy. This is an excited state, and the system will subsequently decay back to equilibrium (maximum entropy**)** condition by emitting or dissipating its excess energy. The reader interested in the thermodynamics should read Appendix A in this book,

since the thermodynamics definition (or misdefinitions!) of "closed system" actually permits the system to be open with respect to energy exchange with its active environment — either in equilibrium or disequilibrium — and only prohibits exchange of mass across the system boundaries. By that definition, a "closed system" can be far from energy flow equilibrium with its external environment, and hence permitted to perform COP>1.0 or even COP = oo. Hopefully our discussion in Appendix A will clarify the position we have taken on this matter.

optical switching: Switching of optical signals, or switching using optical frequency switching techniques, components, and circuits.

orthodox transistors: Ordinary transistors in use today, i.e., as contrasted with the Fogal semiconductor and its special functions.

orthogonal rotation: Simply speaking, a rotation from one direction to a direction at right angles to it. The Lorentz transform of special relativity, e.g., is a formula for the rotation of an object and all its parts away from its line of motion, as a function of the object's velocity, in a direction toward the time axis. The speed c just represents a full orthogonal turn, so that the projection intersection of the object with the observer 3-space, along the original line of motion, is zero.

outfolding: Translation by a system of received input longitudinal EM waves entering inside its potentials and fields, into conventional EM waves present in the system and then output from it. The opposite *of infolding*.

overpotential: Essentially the overpotential (as in an electrode in a solution) is a shift in the Fermi level necessary to allow the electron in the electrode metal to have energies overlapping with vacant acceptor levels in molecules adjacent to the electrode in the solution. The overpotential effect appears at small "double surfaces" of things in very close contact, particularly in electrochemistry and in solid state physics. The overpotential enables electron transfer, e.g., by tunneling. The overpotential increases with the log of the reaction rate that occurs at the overpotential location. For a small reaction rate, the overpotential is small; but for a small increase in the overpotential there occurs a dramatic increase of reaction rate. Fogal has utilized the overpotential effect in his semiconductor, to great advantage in accomplishing unusual charge blocking and other special effects. See **tunneling.**

overunity coefficient of performance (COP>1.0): More energy out or work out of a system than the operator or experimenter must furnish **and**

input. The excess energy is input from the active environment. See coefficient of performance.

parity: Deals with studying a system of a sequence of events as if the events were reflected in a mirror. A system has parity if it undergoes no fundamental operational change if replaced with its mirror-reflected twin.

partially time-reversed region: A region of spacetime in which an object temporarily experiences not only the ordinary forward flow of time, but also an extra induced backwards flow of time, usually a fraction of the time-forward time stream. It appears that the combination of the two is what constitutes time dilation in relativity. In a mixed time-forward (photon interactions) and time-reversed (antiphoton reactions) zone, if time-forward predominates, the law of attraction and repulsion of charges is partially reversed, leading to overall reduction of the forces — which remain in their usual directions. If the time reversal predominates, the law of attraction and repulsion is reversed, and in that region like charges attract and unlike charges repel. If time reversal and optical pumping are combined, the reversed law forces of attraction of like charges and repulsion of unlike charges are amplified also.

particle physics: The branch of physics using accelerators to study high-energy particle collisions, to determine properties of atomic nuclei and of the elementary particles themselves. It appears that conventional particle physicists do not recognize or consider time-energy interaction and time-reversal zone nuclear interactions at all. Hence the present "high (spatial) energy" physics is a far lower "total" energy physics than is the physics where time-energy is deliberately utilized. When time-energy is utilized, then the total energy of the photon varies inversely as a function of its frequency rather than directly as a function of its frequency. Lower frequency photons have very much greater total energy than higher frequency photons. For practical electrogravitation, therefore, one is interested in lower frequency bandwidths such as the ELF region.

Patterson effect: The intense multiscattering, multipass, multicollection of energy density flow in an assemblage of palladium-clad spherical bead capacitors, as the palladium adsorbs hydrogen ions from the fluid in which the beads are immersed, and thereby charges up as a capacitor, becoming an energy-flow generator, and nonlinearly increasing the energy-flow as the charge of the capacitors increases.

Patterson Power Cell®: Patented overunity power unit by James Patterson, which has been independently validated to yield COP>1.0. However, continuing difficulty has been experienced with the palladium

metal used in the effect. See James Patterson, "System for Electrolysis of Liquid Electrolyte," U.S. Patent No. 5,372,688, issued Dec. 13, 1994. Patterson has several other patents in the area.

perpetual motion machine: The rather archaic and dogmatic assertion that no machine can indefinitely operate, since no closed system can input its output power back to itself while powering a load, because powering itself and its load violates the *equilibrium* thermodynamics (i.e., the thermodynamics of a closed system). Every system is already an open system in a violent energetic exchange with the active vacuum, so the pronouncement is a non sequitur assuming a false straw man — that every machine is a truly closed system or is in energy flow equilibrium with its active environment and can be treated as if it were a closed system. (The thermodynamic definition of "closed system" is misleading; it refers to a system where no mass exchange crosses the system boundary, but energy flow exchange can and does freely cross it. See Appendix A to this book for a proper discussion). Further, the equilibrium thermodynamics cited does not necessarily apply to either an open thermodynamic system far from energy equilibrium, or to a closed thermodynamic system in energy flow disequilibrium, as is now well known. After all, a common windmill will operate so long as there is a wind or until something breaks. But since it involves a mass flow across the system boundary, it is said to be a true open thermodynamic system. In electrodynamics, a closed system (with no matter exchange across its boundary) can yet have copious energy flow exchange across its boundary, and thus be far from EM energetic equilibrium with its external active environment. The charges and the dipoles in matter operate in a free "time-energy flow wind" and virtual particle flux wind in the vacuum, which are constant and unfailing, and thus charges and dipoles have been freely and continuously outputting real EM energy flow into 3-space for some 14 billion years. All assertions that overunity EM systems are perpetual motion nonsense are completely refuted by every charge and dipole in the universe. To repeat such gibberish only reveals the ignorance of the person making the improper assertion.

Ironically, those dogmatists fond of hurling perpetual motion labels at overunity researchers already recognize the overunity legitimacy of open systems far from thermodynamic equilibrium with their active environment; they refer to such systems *as false perpetual motion machines ox fictitious perpetual motion machines.* All of them also accept the classical electrodynamics assertion of the source charge, from which all EM fields and potentials and their energy come. So the very dogmatists

so confidently pontificating that perpetual motion machines are ludicrous, themselves already implicitly accept that every charge and dipole in the universe is precisely such a perpetual motion machine, freely and continuously creating energy right out of nothing. No legitimate free energy researcher in his wildest nightmares has proposed such perpetual motion machines on such a universal scale. The greatest perpetual motion nuts on earth are precisely those pundits so confidently castigating the notion that an electrical system can output more energy than the operator himself must input. We will have a modicum of tolerance and respect from them, when they can demonstrate how they can purge all those "perpetual motion charges and dipoles"-—and all their EM fields and potentials—from their own accepted electromagnetic model. Obviously if they do that, they simply destroy all EM energy in space, in systems, and in the entire universe. This is the absurdity of the position these pundits advocate so ignorantly.

phase conjugate: Of an entity: its time reversal. For waves: often referred to as wave *front reversal*.

phase conjugate mirror: A nonlinear material which, when provided with an input wave, emits a phase conjugate replica (time reversed replica) of that input wave. The input wave is by practice called the *signal wave*. The time-reversed wave output is by practice called *the phase conjugate replica*.

phase **conjugate optics:** That portion of nonlinear optics dealing with multiwave mixing, formation of time-reversed waves, phase conjugate reflection (PCR), phase conjugate mirrors (PCMs), pumping PCMs to amplify their emitted PCRs, nonlinear interferometry, distortion correction, self-targeting, laser tracking, adaptive optics, and so on.

phase conjugate replica (PCR): Of a wave: the time-reversed duplicate of a signal (input) wave, after its detection by interaction with charge. We point out *there may still be some foundations difficulty, however, with the form in which the phase conjugate replica wave exists in space time prior to its interaction with charge and prior to its observation (observing the effect of its interaction with charged matter)*. Indeed, there is very serious foundations difficulty with the very notion of an EM transverse wavefront in space, traveling at the speed of light, for no such thing exists. See Robert H. **Romer,** "Heat is not a noun," *Am. J. Phys.*, 69(2), Feb. 2001, p. 107-109. This is an editorial discussion by the Editor of AJP of the concept of heat in **thermodynamics,** where heat is not a substance, not a thermodynamic function of state, and should not be used as a noun. In

endnote 24, p. 109, he also takes to task *"...that dreadful diagram purporting to show the electric and magnetic fields of a plane wave, as a function of position (and/or time?) that besmirch the pages of almost every introductory book. ...it is a horrible diagram. 'Misleading' would be too kind a word; 'wrong' is more accurate. " "...perhaps then, for historical interest, [we should] find out how that diagram came to contaminate our literature in the first place."*

phase conjugating action: In nonlinear optics, the process or action of producing a time reversed replica of an input wave._For a particle, producing its antiparticle. For a living cell, dedifferentiating it back to some previous form, genetics and all. In the presence of a predominately time-reversal zone, however, the cell is in a predominately phase conjugating mode *a priori.* Phase conjugating it a second time converts it from dedifferentiating to redifferentiating mode. We hypothesize that these combinations are the actual mechanisms generating cellular dedifferentiation and redifferentiation in the cell, tissues, and body. A future book will address that issue; meanwhile, see the 119-page "porthole briefing" on the author's website, www.cheniere.org.

phase conjugation: In nonlinear optics, the novel nonlinear mixing of waves which generate an output wave — called the phase conjugate replica or time-reversed replica — that precisely retraces the path previously taken by the input wave that stimulated the action.

phonon: A quantum of the lattice vibration energy in a crystal. This mechanical vibration energy is considered a field, and the phonon is the quantum of that mechanical energy field. Lattice vibrations in a crystal thus are characterized by waves in the lattice, where the waves are comprised of ordered phonons. Interesting effects occur between electron currents and phonons, due to electron-phonon interaction.

photon: In physics, the basic action quantum. Conventionally considered to be the basic quantum of the EM field. There is a foundations problem with the latter concept, because of the dichotomous use of "field" for both the *effect* force field in 3-space after observation (detection) and the *causal* force-free field in 4-space prior to observation (detection). Strictly speaking, the photon is the quantum of the causal 4-space massless **field,** since the photon possesses both spatial EM energy and time increments. In curved spacetime, the photon may possess mass because the time flow is a mix of time-forward and time reversal, and thus cause and effect are slightly intermixed as well. We point out that, in a negatively curved spacetime, the photon mass is negative, the photon energy is negative, **and**

the photon fields are negative energy fields. Presently the negative energy photons do not appear to be utilized in physics except haphazardly if at all. This may represent a large class of photon interactions with matter that have been inadvertently omitted.

ping-pong: Colloquial term for iterative retroreflection.

pinned electrons: Electrons held stationary by a magnetic field, or other set of forces that react to "push them back into their positions and hold them fast" whenever they try to spatially move away.

pinning: The act of restricting (by restoring forces and fields) spatial movement (particularly of electrons) due to a disturbing magnetic field or other external force.

polaron: An electron in a substance, where the electron is trapped in a potential well due to polarization charges on surrounding molecules. The exction in a substance is analogous to an exciton in a semiconductor.

positron: An antielectron (time-reversed electron), possessing a positive charge and positive mass. *Mathematically* an empty *negative energy electron* state in the Dirac sea whose usual occupying electron has been removed, leaving a four dimensional "Dirac sea hole," may also be regarded as a positron for many purposes, at least *after observation resulting from interaction with matter*, so long as the remarkable difference of the Dirac 4-hole prior to observation from the Dirac 3-positron a**fter** observation is understood. Mathematically, the lattice hole previously occupied by an electron can be considered a positron-equivalent (i.e., as if observed), again so long as the real differences are kept in mind, between a Dirac hole *before* observation and what results after its observation by interaction with mass. This is important, because otherwise one is again substituting the effect for the cause. In addition, if the two are confused, **then** one also arbitrarily discards the negative energy fields and negative energy potentials of the source 4-hole in the vacuum prior to observation. That effectively discards anti-circuits and the ability to engineer practical electro antigravity.

power: In physics, the time rate at which work is done (at which *the form of energy* is changed). In electrical engineering, the term "power" is erroneously but ubiquitously also used to loosely mean "energy." Hence such odd and improper expressions as "draw power from the source," which is a non sequitur. Nonetheless, such non sequiturs are so universally utilized in electrical engineering that they have become a part of the literarure itself.

Prigogine, Ilya: Noted Belgian chemist and Nobelist, and one of the pioneers of the thermodynamics of open systems far from thermodynamic equilibrium. Prigogine was awarded the 1977 Nobel Prize for his work on the theory of dissipative structures in nonequilibrium thermodynamics.

Poynting, John Henry: An English physicist who lived from 1852-1914, whose contributions to electromagnetics included the energy flow theory now known as Poynting flow. He contributed the Poynting theorem, which states that the rate of EM energy loss in a specific region of space is equal to the sum of the dissipation rate (heat loss) flowing across the boundary of the region. Concurrently with Oliver Heaviside, Poynting conceived the notion that energy flowed through space, which previously had not appeared in physics. Heaviside actually published first, but obscurely; Poynting published in a prestigious journal, so the theory came to be known as "Poynting theory."

Poynting energy: A loose term (not rigorous!) used to loosely describe the flow through space of Poynting energy density S = ExH, which is that component of the total energy flow in space that will be *intercepted and collected* by the intercepting charges, circuit, etc. It actually describes not the energy flow density *per se*, but the component of it that would be intercepted by a unit point charge, or that actually enters an intercepting circuit. Poynting started with the assumption of the component of the energy flow that enters the circuit, *a priori*. Only the work of Heaviside considered the remaining component of the energy flow that is not intercepted by the charge or by the circuit. Because of the startlingly great magnitude of this remaining nondiverged Heaviside component, Lorentt integrated the entire (Heaviside) energy flow vector around a closed surface surrounding any volume element of interest. This discarded the entire nondiverged Heaviside component, and removed any necessity of considering or explaining how every generator and battery already pours from its terminals up to 10^{13} times as much EM energy as the presently accounted energy input to the shaft of the generator or the chemical energy available in the battery. We believe that the discarded and unaccounted Heaviside nondiverged energy flow component accompanying every field-particle interaction is responsible for the puzzling excess gravity holding the arms of the spiral galaxies together. In short, we believe it is the solution to the "dark matter" problem, now often believed to be a "dark energy" problem.

Poynting energy density flow: A somewhat more rigorous term used to describe the flow through space of the Poynting energy density flow

S = f(**E**×**H**) component that would be intercepted by a unit point charge or an intercepting circuit.

*Poynt*ing energy flow: A loose term (not completely rigorous) used to describe the flow of energy density **S** = f(**E**×**H**). Rigorously, both E and H are "defined" only after their reaction with a unit point static charge. Hence S is the resulting component of the overall energy flow that interacts with the charges (with the circuit) and is diverged into the circuit to power it. It is not the entire energy flow, which also includes a vast Heaviside nondiverged component that does not strike the charge and interact with it, and hence does not interact with the circuit but is just wasted. See Heaviside energy flow component and Poynting energy.

Poynting generator: Colloquial term for any dipole or potential difference that represents a broken symmetry in the vacuum's virtual particle flux, and hence extracts virtual energy from that asymmetry, and gates it out as a gushing energy flow in 3-space. When both electric field and magnetic field are involved, the component of the energy flow that would be intercepted and diverged by a unit point charge is the Poynting energy flow S=f(ExH).

Poynting vector: The vector S, given as **S** = f(**E** × **H**), used to represent the Poynting (intercepted and collected by a unit point coulomb) energy density flow component. In Heavisidc's version, **S** = **E** × **H** + **G**, where G is an energy circulation flow term of trapped EM energy flow. Heaviside later rea**lized** that such a closed energy circulation flow exhibits substantial gravi**tational** effects; in modern terms we would say that it represents an appreci**able** local curvature of spacetime. Unpublished notes on the gravitational aspects were found beneath a floorboard in his little garret apartment, years after his death. We also point out one limitation of the present use of the Poynting vector: It has rather universally been associa**ted** only with the flow of *positive* EM energy, and not with the flow of negat*ive* energy. Indeed, the concept of negative EM energy is still consufe**d,** with different views and positions, and still in debate without complete scientific consensus.

PPCM: Pumped phase conjugate mirror. A phase conjugate mirror material that has introduced to it a positive or "pump" waves (in other words, s***tress*** waves). In effect, pumping is "stressing" or "squeezing" ryhtmically. It is also varying a stress potential, which emits longitudinal EM waves, each accompanied by a correlated scalar (time-polarized) wave. In the phase conjugating process, up to all the energy in the pump waves can be output as the energy in the emitted phase conjugate replica

wave. Thus the PPCM may be viewed as an *amplifier*, very similar to a triode. When the time-components of the photons in the signal wave input and also in the pumping waves are considered, then there is a functioning of the pumping also ongoing in the time-domain. There is a rhythmic variation of stress in the time-domain also, which creates the correlated time-polarized EM wave accompanying the longitudinal wave from the 3-space pumping.

So the time-reversal aspect (formation of the phase conjugate replica wave) may be thought of as a rhythmic time-stress wave (pumping or stressing in the time domain) which, by alternately decreasing and increasing the time potential of the mirror, produces two temporal force effects. During the decreases in temporal potential of the mirror, the time-force from the input wave and from the pump waves is forward into the mirror material, allowing the input and interaction of these waves. During the increase in temporal potential of the mirror, a reversed temporal force from the mirror back to the past (temporal potential earlier in 4-space) of the input "signal" wave. The pumping energy (excess temporal potential energy) adds the gain to the phase conjugate replica wave,

probability: The probability of a simple event is the ratio of the number of times it occurs to the total number of trials (for a large, essentially infinite number of trials). Note that "trials" constitute things that have occurred (are past, have been observed). Probability has resisted rigorous logical definition by Aristotelian logic; the reason is that it is an expression of the fourth law, the identity of opposites. Probability is an expression of the future (that which has not occurred) in terms of the past (that which has occurred). Consider *throwing a die to land with one face up.* Thinking of the event (as if it has just occurred, in terms of the most recent past), one can conceive six ways of looking at it. In other words, one can conceive of six "most recent pasts", however, these have not occurred. We were merely thinking of them as if they had occurred. By the fourth law, the *total* "most recent pasts that have not occurred" is identical to the "most immediate future" that has not occurred, on the common boundary between past and future. If one therefore *collects* all six "most recent **pasts** not occurred" they turn into the most immediate future, by the fourth law of logic. One may argue that only a single one of the events will actually occur. Here one counters with the observation that, when it occurs, it is the past, not the future, and then it has not been collected so as to move **to t**he boundary. In theory, the hidden variable approach makes it possible to directly engineer those probabilities while the Schrodinger wavefunction is still propagating and has not yet collapsed to constitute an "observation."

I.e., it is theoretically possible to engineer Wheeler's "pre-reality," and determine in advance just which of the outcomes will occur.

Puthoff, Harold: Noted physicist active in a variety of fields and investigations including in psychoenergetics, extended electrodynamics, energy from the vacuum, inertia, antigravity, parapsychology, remote viewing, psychokinesis, zero-point energy of the vacuum, and cosmology. We are particularly impressed with Puthoff's cosmological feedback principle. Together with Cole, Puthoff also proved that thermodynamics does not prohibit extracting usable EM energy from the active vacuum. See Daniel C. Cole and Harold E. Puthoff, "Extracting Energy and Heat from the Vacuum," *Phys. Rev. E*, 48(2), Aug. 1993, p. 1562-1565.

QM vacuum: The quantum mechanical vacuum, which models the vacuum as an intense flux of virtual particles, each appearing and disappearing in such extremely short time intervals as to be unobservable individually—although as physics develops, from time-to-time what is observable changes because of increased observation techniques. Violent fluctuations of extremely short duration constantly occur in the QM vacuum flux. Various calculations estimate the energy density (in mass units) as up to 10^{80}-10^{90} grams per cubic centimeter (in mass density units), or even greater. The vacuum is sometimes described as two separate components: (1) the ambient or average vacuum in deep space, which can be taken as a scalar potential having an enormous energy density, and (2) the fluctuations superposed upon the ambient vacuum as local violent potential energy changes. Finally, we note that any EM potential in a system is *apriori* a change to the local vacuum scalar potential.

quantized: Adjective which means (i) reduction of some observable quantity to multiples of some small, indivisible unit, or, (ii) expressed in terms of quantum theory.

quantum: A single "particle" of the quantity *action* (angular momentum). Often confused as a single quantity of energy alone.

quantum electrodynamics: The theory of photons and electrically charged particles and their interactions. The use of the term "quantum" implies that the EM radiation's discrete photon nature is significant, so that quantum theory must be employed.

quantum **field theory:** A quantum mechanical theory in which "... a phsyica1 held is considered as a collection of particles and forces, and observable properties of an interacting system are expressed as finite quantities rather than state vectors." *[Dictionary of Science and*

Technology.] More simply (after Davies, *The New Physics*, 1989): "The theory that describes the quantum effects of a classical system of fields defined on space-time and satisfying various partial differential equations." Particles are taken as quanta of fields similar to photons being quanta of the electromagnetic field. Each type of particle is represented by an operator that obeys certain commutation laws. The theory relates gluon fields and intermediate vector boson fields to the strong and weak interactions, and allows an overall theory of fundamental particles and their interactions.

quantum potential: A special potential added to the Schrodinger equation by Bohm in his hidden variable theory of quantum mechanics. The quantum potential is a multiply connected entity, so that it "occupies" widely separated but multiply connected points, events, or objects. It is also an extraordinary energy amplifier, since any energy input to one of the multiply connected points simultaneously and instantly appears in every other connected point, regardless of distance or location in the universe. In real life, the quantum potential also has a "coefficient of multiple connectivity", so that only a fraction of the energy input to one multiply connected point will appear in the other points of the multiple connection group. The quantum potential has been strongly weaponized by five nations, and quantum potential weapons are the dominant weapons on earth, being more powerful than nuclear weapons. In theory the quantum potential together with engines and antiengines could be used to treat and cure a given disease in all persons on earth simultaneously, or in one nation or area simultaneously. Sadly, engines have been developed to generate diseases in a targeted populace, rather than engines to heal the populace. Russia and Brazil have had the quantum potential weapon for some time, as have two nations friendly to the United States. In 2001, China also deployed the quantum potential weapon.

quark: Fundamental particle theorized to comprise hadrons (particles such as protons, neutrons, and mesons) by combining in twos or threes. There are six varieties of quarks. The difference between a proton and a neutron, e.g., is merely the orientation of a single quark. In a time reversal zone (TRZ) in the electrolyte in cold fusion experiments, the gluon forces can be significantly reduced, so that the quarks are nearly freed. Two protons (H+ ions) can attract together in a TRZ so closely that each enters the reduced strong force region of the other, forming a quasi-nucleus. As the ions in solution outside the TRZ move to cancel the TRZ, it decays and the quasi-nucleus becomes an increasingly excited state, seeking to decay. Preferred method of decay is by quark flipping. So one quark flips, so that

the quasi-nucleus has become a quasi D+ nucleus. As the TRZ vanishes and time-forward resumes, the strong force recovers faster than the Coulomb barrier returns. Consequently, the quasi-nucleus of D+ merely tightens into a real nucleus of D+. This is one of the standard transmutation reactions in cold fusion experiments, forming excess deuterium.

quaternion: Expression comprised of the sum of four terms, one of which is real and three of which contain imaginary units, and where the terms can be writtten as the sum of a scalar and a three-dimensional vector.

quaternion algebra: The algebra of quaternions and their mathematical operations. Quaternion algebra is of higher topology than either vector or tensor **algebra.** Maxwell's original 1865 equations are some 20 equations in 20 unknowns, in quaternion and quaternion-like algebra. Heaviside and others reduced the algebra to vector algebra and some four equations; at his death, Maxwell himself was rewriting the equations in his *Treatise* to purge the quaternions, because of the controversy over the difficult quaternion form. The present vector equations taught in university as "Maxwell's equations" are in fact Heaviside's truncation of the Maxwell theory. Going to tensor algebra electrodynamics does not recover the full range of Maxwell's original 1865 quaternion EM theory.

quintessence: Literally, the "fifth essence". In short, *dark energy*. We have nominated the arbitrarily discarded, vast Heaviside nondiverged energy flow components surrounding every interaction of charge with field as the dark energy that is the source for the excess positive gravity holding the arms of the spiral galaxies in place. See dark energy, positive.

reactive power: Electrical power, measured in volts-amps-reactive (vars) that cannot do work as is. For sinusoidal waveforms, the formula for reactive power is $IV\sin\theta$, where θ is the phase angle between the voltage **and the current.**

real hidden dynamics: The dynamics of vacuum engines, or of "internal energy" or "internal work" ongoing in a system or volume of space. These internally organized forces, fields, and energies involve dynamic curvatures of spacetime, and it is this dynamics of spacetime itself that provides **the** continuous work and dynamics of internal energy. See Einstein's second postulate extended; infolded; dimensioning.

real hidden vectors: The "hidden" or "infolded" real vector components, e.g., of a zero vector summation system. The individual hidden vector cannot spatially translate the entire bulk system, but it can interact inside

the system to perform *internal work* upon it or upon some particular portion of it. Such a system of a finite number of infolded deterministic vectors is said to constitute a "dimensioned" stress potential. Specifically dimensioned potentials, fields and waves thus can be constructed, so that they carry specific vacuum engines (spacetime curvature engines). The interactions of these dimensioned EM entities may differ from normal EM interactions in chemistry, physics, biological systems in general, cells in particular, etc. The long neglected combination of Whittaker's 1903 decomposition of the scalar potential, together with his 1904 demonstration that any EM field or wave pattern decomposes into two scalar potential functions, has neglected the development and use of the "internal EM" theory and technology for a century. One or more nations has, however, highly weaponized "dimensioned EM fields, waves, and potentials" as evidenced by the peculiar and anomalous results of the decades-long microwave radiation of the U.S. Embassy in Moscow. See dimensioning.

real power (active power): Power, measured in watts, that can do work, including generating heat. For sinusoidal waves, real power is given by the formula $I \cdot V \cdot \cos \theta$, where θ is the phase angle between the voltage and the current. Note that when higher group symmetry EM effects are involved (such as the Aharonov-Bohm effect), then the "normal" behavior of circuit components can be altered dramatically. As an example, in the MEG the secondary (output) coils of the transformer section are caused to exhibit a purely electrical interaction with the electrons and electron currents in the coils themselves. Consequently *the output current and voltage are in phase, in complete violation of conventional transformer theory and conventional assumptions about the interaction of inductors.* So the output of the MEG is real power, and phase angle does not enter into it.

regauging: In electrodynamics, changing the scalar potential or the vector potential, or both. If one or both of the potentials is/are changed so that a net new force is created in the system, that is an *asymmetrical* regauging. If only one potential is changed, a net force results and that is an asymmetrical regauging. If both potentials are changed but carefully selected so that the free force resulting from one change is equal and opposite to the free force resulting from the other, that is a net *symmetrical* regauging, often called "Lorentz regauging" or the "Lorentz condition". We note that longitudinal EM waves are produced very simply by rhythmically oscillating the magnitude of a stress potential, which is naught but coherently oscillating the individual vectors of a set of EM fields that sum to a zero vector resultant. The locked-in stress in T. Henry

Moray's semiconductors used in his radiant energy device tubes and the locked-in stress in the Chung negative resistor thus have to do with the production and use of longitudinal EM waves, time-polarized EM waves, and stress potentials.

reflection: The rebound of light or other energy from a surface.

refraction: The bending of light as it passes from one medium to another or through a density change in a given medium.

retarted wave: An electromagnetic wave that is derived from retarded fields, which in turn are derived from retarded potentials. The retarded wave at a point or region of space has arrived there or exists there as the result of the dynamics of charges and currents that existed at earlier times elsewhere. Compare to advanced electromagnetic wave.

retroreflecting: Precisely reversing the path of a reflected wave or object.

Sachs, Mendel: Noted scientist who has completed the work of Einstein and developed a unified field theory covering the universe from the tiniest part to the entire conglomerate. Since O(3) electrodynamics has been shown by Evans to be an important subset of Sachs' theory, then for the first time we have a higher group symmetry electrodynamics and a unified field theory that is largely engineerable by novel electrodynamic means, using the O(3) model.

Sachs' unified field theory: An extension and completion of Einstein's work that includes the universe and its dynamics from the tiniest part to the entire conglomerate, and includes quantum mechanics, electromagnetics, gravitation, and the strong and weak forces. See particularly Mendel Sachs, *General Relativity and Matter*, Reidel, 1982; Quant*um Mechanics from General Relativity*, Reidel, 1986. Sachs' unified theory provides a great generalization of general relativity, quantum mechanics, and electrodynamics reaching from the quarks and gluons to the entire universe. Much of the model is also engineerable by higher group symmetry electrodynamics such as the O(3) electrodynamics pioneered by Evans and Vigier.

scalar: Characterized by magnitude only. However, with respect to polarization, a scalar photon is a term in use for a *time-polarized* photon, where the EM energy oscillates along the time-axis. Hence a scalar wave, following the same terminology, is an EM wave composed of scalar photons, hence whose EM energy is oscillating along the time-axis. The term "scalar" is used in the sense that no vector in 3-space exists even though a vector (and a variation of its magnitude) exists along the time

axis. The effects are observed as an oscillation in the rate of flow of time, hence a "time-density" oscillation. The term "scalar" with respect to polarization implies only that there is no vector component in 3-space.

scalar entity: In ordinary vector analysis, an entity thought to be completely characterized by magnitude alone. Actually this is incomplete; a scalar entity must contain a time-like vector component, if it is to steadily persist in time. What we usually do unthinkingly is assume a continual series of successive observations or *d/dt* operations upon the *kt* nature of a scalar *k.* We conceive these individually frozen 3-space snapshots to "continuously exist" since we can readily recall the "stream" *of d/dt* differentiations in our mind and memory. Since all observation is 3-spatial, then no observable *persists continuously* in time; instead, it *continually recurs* in time, instant to instant. This "iterative successive stream of frozen 3-space snapshots" exists in the continual and rapid recall from our memories. Compare this to the similarity of observing a sufficiently rapid series of still pictures on a screen, where the individual pictures differ by a time sequence taken of some phenomenon. One "sees" the recreation in one's mind of the flow through time of those events and entities so photographed. Yet at any one instant, there is only a single frozen snapshot on the screen, and no motion at all was "physically" observed.

scalar electromagnetics: Colloquial term for the electrodynamics that arises from considering transverse EM waves, longitudinal EM waves, time-polarized EM waves, electrogravitation, superluminal EM signals, interferometry, nonlinear optical functions, time-as-energy, and the infolded electrodynamics inside all usual EM fields, waves, and potentials, In secret superweapon projects, the Russian term for scalar electrodynamics is *energetics.* It is divided into three major fields, depending upon the intended target. Targeted against inert matter, **systems,** and fields, the same term is used: *energetics.* Targeted against the **physical** and chemical processes and biological fields and potentials of living organisms, the term used is *bioenergetics.* Targeted against the mind's time-polarized EM functioning and dynamics, the term *psychoenergetics is* used. In the latter, higher group symmetry electrodynamics and extensions to quantum field theory play significant roles. Significant progress and strategic testing of all three branches of energetics has been evidenced worldwide. Progress in the energetics branch was confirmed by a statement by U.S. Secretary of Defense Cohen in 1997. Quoting: ***"Others*** *are engaging even in an eco-type of terrorism whereby they can alter* ***the*** *climate, set off earthquakes, volcanoes remotely through the use of*

electromagnetic waves...So there are plenty of ingenious minds out there that are at work finding ways in which they can wreak terror upon other nations...It's real, and that's the reason why we have to intensify our efforts " Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

scalar potential: Usually considered synonymous with the electric potential. The concept of potential was developed by Poisson, Green, and others **from** about 1813 to 1827. Three notions involved in the development of the concept of the potential are: (i) there is the collection of storage of energy in the system, via the collection or storage of some entity therein, and this "potential energy" can be released and dynamically used, (ii) the potential is a scalar function whose spatial rate of change is a vector force, and (iii) the dynamics of the stored energy is suspended by the "storage" or "collecting" entity; in other words it is a sort of "suspen**ded** action" waiting to be unleashed. *It requires some action*—such as *interception and divergence—to release the leashed energy*.

The second notion is false, since no force exists in the absence of mass because mass m is a *component* of force F via $F \equiv dp/dt = (m)dv/dt + (v)dm/dt$. It is corrected by stating that its spatial rate of change *when interacted with charged matter* is a vector force. For the third notion, we note that the concept of a "virtual" particle or particle flux means that it cannot beco**me** observable unless some interaction is imposed. So we may handle the "third notion" requirement by assuming the potential in modern terms to be composed of hidden virtual particle flux, or hidden wave flux, in wave-to-wave interaction. Physics tries to define the electrical potential as energy per coulomb, or $\phi = W/Q$. That equation, however, is actually not a definition at all (no equation is a definition), but rather is an algorithm for calculating the magnitude of the excess energy collection/collecting upon a coulomb of charge, when that coulomb is immersed in the potential It in fact is the *reaction cross section* of the potential, not the potential entity itself. This now begins to give us a clue, Potential is *energy* in some fashion, and the term "potential energy" is a redundancy. So the entity must have essentially the same definition as energy! **Potential** energy, collected energy, stored energy, whatever—it is energy first and foremost. How it is collected and what it is collected upon or in, determines **the** "type" of potential. It also cannot be logically defined as the work expended by it upon a unit charge. The causal entity itself is

not the action taken; just as a man is not definable as "how far he has run" in some race.

scattering processes: Collision processes in which an incident particle such as a photon, electron, or proton, of known energy or direction or both, collides with another entity, and emerges from the collision with a different energy or direction or both.

Schrodinger, Erwin: Noted Austrian physicist, 1887-1961, and Nobelist who discovered the wave equation named after him as the Schrodinger equation, and performed other vital work in wave mechanics.

Schrodinger equation: In quantum mechanics, an equation that describes the propagation of waves associated with subatomic particles, or more generally, that describes the evolution over time of the quantum state of a system. The fundamental quantum mechanical equation governing the behavior of wave functions.

self-energy: In a quantum mechanical system, the energy associated with the emission and absorption of virtual particles. In a classical system, the energy associated with the interaction among parts of the system itself.

self-organization: (After Davies, *The New Physics*, 1989): "Spontaneous emergence of order, arising when certain parameters built in a system reach critical values." Simply put, self-organization is the spontaneous formation of patterns of localized order in a system that begins in a more homogeneous state. In short, the system moves from a simpler to a more complex state. Self-organization is one of the permissible features of an open system far from thermodynamic equilibrium with its active environment. Note that the localized orders represent free potential energy formations (free self-regauging) that in theory can then be dissipated in loads to perform free work. Hence the capability of a self-organizing system to perform some free work, or in other words to exhibit COP>1.0.

self-potential (e.g., of the electron): The potential created in and of the charge (e.g., the electron) by its virtual particle flux exchange with the vacuum. Also, an asymmetry in the virtual photon flux of the vacuum, caused by the interaction of the charge (e.g., the electron) with the vacuum flux. From here, we note that the self-potential must consist of real observable 3-space EM energy flow or flows from the electron, because of the asymmetry. However, the charge is not the primary source *per se* **of** the energy flows that establish the self-potential, but instead is the asymmetric gate in the vacuum flux that "gates out" the potential and its energy **flux** The asymmetry in the vacuum flux is the actual *source* or gate. Indeed, in

classical terms the energy is received by the charge in the form of converging longitudinal EM energy waves from the complex plane (from the time domain). The spin of the charges of the dipole transduces the absorbed complex EM energy into real observable EM longitudinal wave energy, and pours it out in all directions in 3-space. See discussions under Whittaker and phase conjugate.

self-targeting: Between two entities, where each acts partially or wholly as a phase conjugate mirror, self-targeting is the iterative phase conjugation or "ping-ponging" and rapid convergence of beams between the two PCMs.

S-flow: The Poynting energy density flow S, where S = ExH. Heaviside's equation is given by S = ExH + G. In the latter equation, E is the electric field, H is the magnetic field strength, and G is a trapped closed loop flow of energy density. Note that, from the very definitions of E and H, the Poynting, energy flow represents only that portion of the total energy flow in a spatial region that is diverted by interception and interaction with charges. Heaviside's additional component G, which is not part of the field interactions but a result of the huge noninteracting part of the energy flow outside the interacted ExH component, does appear to be responsible for an enormous unaccounted EM energy flow component that generates the excess gravity required to hold together the arms of the spiral galaxies.

signal wave: In nonlinear optics, the signal (wave) input to a phase conjugate mirror (PCM), that stimulates the PCM to emit a phase conjugate replica (PCR) wave in return. See discussion under distortion correction theorem.

Slepian current: The vector $j\phi$, which in a current loop represents the energy unit area per coulomb of flowing charge, per unit of time, that is collected/collecting from the Poynting S-flow and dissipated in that current loop in its loads and losses.

Slepian flow: "Flow *of collected-energy* density's dissipation" in a current loop, and therefore related to the vector $j\phi$ in the current loop, which represents the energy per unit area per coulomb of flowing charge, per unit of time, that is being dissipated in that current loop in its loads and losses.

Slepian vector: Refers to the vector $j\phi$ in a current loop, which represents the energy density per coulomb of flowing charge, per unit of time, that is being dissipated in that current loop in its loads and losses.

solid-state parametric oscillator: A parametric oscillator circuit employing solid-state devices. A parametric oscillator is a device that oscillates by rhythmically changing a parameter (such as capacitance or inductance, etc.). Simple switching between differing values of the parameter is often used to induce the periodic change of the parameter. One way of close-looping a COP>1.0 EM system is by using a bit of the positive output energy to do parametric switching, in effect converting the system to a self-oscillating energy flow system. The AC flow of EM energy is then much more easily intercepted, collected, and dissipated to power loads without killing the source dipole extracting and furnishing the free flow of EM energy from the active vacuum.

soliton: A "solitary wave" consisting of a wave pulse which propagates without changing its shape and without dispersion.

source dipole: Any dipole, considered from the viewpoint that real observable EM energy continuously pours out of it without any observable EM energy input. There is no true "source" as such in nature, since the energy is not created but only transduced and gated. In the case of the dipole and electrical charge as sources of EM energy, fields, and potentials, the broken 3-symmetry of the dipole initiates an automatic and more primary 4-symmetry, where EM longitudinal wave energy flows into the negative charge of the dipole from the time domain (complex plane), is transduced into normal EM longitudinal wave energy in 3-space, wherein the 3-space energy is absorbed by the positive charge of the dipole, transduced back into time-energy and reradiated back into the time-domain (fourth Minkowski axis). We roughly state that the dipole "emits observable EM energy" into all directions in 3-space as observable EM energy. However, what actually happens is that this *energy 4-circulation process* is what is emitted into and along 3-space, along every radial direction, with the process occurring at every spatial point along that direction. Any charge (taken together with its clustering virtual charges of opposite sign as a dipole) then inserted at any point in space along a radial line, will dipolarly intercept the ongoing process. We will observe the interception by its 3-effect on the intercepting and interacting 3-space charge, but we will not observe the 4-process itself. This deeper examination of the EM field-charge interaction requires a new interpretation of what is meant by "propagation of EM energy through 3-space", which is a non sequitur. Recall again Romer's acid objection **to the** totally illogical picture in every elementary textbook of the so-called "EM wave through 3-space" as a flat x-y plane orthogonal to the line of **motion** z, and where the E-field vector is oscillating along one axis while the

magnetic field B is oscillating along the other. That representation is totally false, just as pointed out so strongly by Romer.

spacetime or space-time: The entity represented by the "fused product" of space and time, to give "space x time". Spacetime is also dynamic geometry, in the general relativistic interpretation. We may also consider spacetime to be a giant potential, and also active geometry, and also active vacuum, and also virtual particle flux of the vacuum, and also hidden EM wave flux. If we wish, we can also consider spacetime to be comprised of longitudinal EM waves and impressed dynamics.

spacetime curvature engine: See deterministic pattern and dimensioning.

special relativity: Einstein's theory of inertial frames in which, if two systems are moving uniformly in relation to each other, one cannot determine anything about their motion except that it is relative. Each of the two frames is said to be "rotated" with respect to the other, but not accelerating. The velocity of light in space (the vacuum) is constant, and is independent of the velocity of its source and the velocity of an observer. All the laws of physics are the same in all inertial frames of reference.

spin: The intrinsic angular momentum of a particle such as an electron, proton, neutron, photon, graviton etc., even when at rest, as if it were a top spinning about an axis, but had to spin 720 degrees before it turned "full circle." Spin is quantized, and is always described as a half or whole spin, e.g., - 1, - 1/2, 0, 1/2, 1, etc. A spinning charged particle such as an electron thus demonstrates a magnetic moment, due to the circulation of charge in the spinning. In the nucleus of an atom, the spin of the nucleus is the resultant of the spins of the nucleons (particles comprising the nucleus).

spiral galaxy: A member of the class of galaxies having arms that extend in the form of spirals. About 70% of all galaxies are spiral galaxies: only about 10% of the gravity necessary to hold the spiral arms together can be accounted for by known gravitational sources. This has led to the theorizing of dark (hidden) matter of exotic and unknown form, which would be responsible for the excess gravity. Later it was theorized that some sort of "dark energy" might be responsible for the extra gravity. The present author has proposed that the *unaccounted* enormous Heaviside component of the EM energy flow surrounding every field/charge interaction, and not entering into that interaction, is the missing source of the excess gravity. The dark Heaviside energy flow was arbitrarily

discarded by Lorentz in the 1890s, and it is still discarded today by all electrodynamicists and astrophysicists.

Stoney, George Johnstone: Well-known scientist (1826-1911) who first estimated the value of the electronic charge (1874) and was the first to advocate the particle nature of electricity. In 1891, he named the unit of electronic charge the *electron.* In 1896-7 he laid the foundation for Whittaker's 1903 bidirectional wave decomposition of the scalar potential.

string wave or "plucked taut string" wave: The transverse wave on a taut string produced when the string is plucked. The string wave itself stays on the string and does not travel through the slapped external medium.

subspace: In vector mathematics: a subset of a vector space which is closed under vector addition and scalar multiplication operations. In the new approach, we may consider the active ambient vacuum as a giant scalar potential. This ambient potential then decomposes into longitudinal EM waves via Whittaker's 1903 decomposition. One can then refer to longitudinal EM waves deliberately transmitted "inside" that Whittaker "subspace" as "subspace communication". The Fogal semiconductor is able to infold normal EM signals into such subspace signals (longitudinal EM wave signals) in the transmitter, and to outfold the longitudinal EM waves back into normal EM waves in the receiver. Hence the Fogal semiconductor can be utilized to perform subspace and superluminal communication. These capabilities have been demonstrated by Fogal in the laboratory. As this is being written, Fogal is in serious negotiations with several large companies for the funding to get his chips into volume production and onto the marketplace in very sophisticated and advanced equipment representing a great leap forward in technology. There are, however, powerful interests who do not wish the Fogal semiconductor to ever be produced and marketed. We have worked with Fogal for some years, and — once the semiconductors are available in quantity — we will be developing and marketing COP>1.0 electrical power systems utilizing his semiconductors and technology, under license from Fogal.

superconductivity: Property of some materials or metals whereby at very low temperature their resistance reduces to zero. These materials also exhibit many additional properties that are anomalous compared to normal materials. Much research has gone into the attempt to find materials that exhibit superconductivity at higher temperatures, with the goal of reaching room-temperature superconductivity. Room-temperature superconductivity is also just COP = 1.0. EM systems far from equilibrium with the active

vacuum, and which exhibit COP>1.0 at room temperature, may involve most of the odd entities also observed in superconducting materials (polarons, lattice holes and hole currents, Dirac sea holes and Dirac sea hole currents, "charging" by Dirac sea hole excitation, vortices, etc.) The energy density in the output section is greater than the energy density input by the operator to the input section. Considering the giant negentropy mechanism and the dipolarity of the input and output sections, the tempic potential of the output section of a COP>1.0 EM system is greater than the tempic potential of the input section. Hence there is a tempic gradient across the entire system, and a tempic force from output to input. This may "sweep" out a great deal of the produced "superconductivity" entities, and particularly may result in a Dirac sea hole current in the vacuum, out of the input section back into the external power source, as a novel output of the COP>1.0 system. Feedback from output to input may also be in the time domain, corresponding to what Gabriel Kron referred to as the "open path". By recombinations and other means, the feedback in the tempic domain may be transduced in the input section of the device to ordinary current in forward time. When the voltage and current in this transduced tempic feedback are properly adjusted to that being supplied from the external power source, the external source can be disconnected and the COP>1.0 system becomes self-powering, while simultaneously powering its load also.

superluminal: Exceeding c, the speed of light in vacuum. Longitudinal EM waves can travel either slower or faster than the speed of transverse wave light in vacuum. See W. A. Rodrigues and J.-Y. Lu, "On the existence of undistorted progressive waves (UPWs) of arbitrary speeds 0 < v<oo in nature," *Found. Phys.*, 27(3), 1997, p. 435-508; W. A. Rodrigues and J. Vaz Jr., "Subluminal and Superluminal Solutions in Vacuum of the Maxwell Equations and the Massless Dirac Equation," *Adv. Appl. Clifford Algebras*, Vol. 7(S), 1997, p. 457-466.

superluminal communication: The movement of intelligent signals faster than the speed of light in vacuum, and the transmission and reception of such signals and extraction of their transported information. Longitudinal EM waves are not limited to speed c, whereas transverse EM waves are. The infolded electrodynamics inside all EM fields, potentials, and waves consists of longitudinal EM phase conjugate wave pairs, with their impressed dynamics. Hence this "subspace" is a superhighway for such waves, including those moving at superluminal velocity. In essence this is a very special kind of "tunneling" which might be referred to as *subspace tunnelling*. The limitation to light speed rigorously applies to the modeled

transverse EM waves which are a sort of "bulk upheaval" waves similar to waves on the surface of the ocean. As in the ocean wave analogy, "pressure" waves underneath the ocean may travel very much faster than the bulk upheaval waves on the surface.

When making longitudinal EM waves, the process is imperfect and the resulting longitudinal EM waves will have a transverse residue as well. The resulting "transverse-noisy" LW is called an *undistorted progressive wave*. Undistorted progressive waves may move slower than the speed of light or faster than the speed of light. The degree of transparency of matter to LWs is an inverse function of the "transverse-noisiness" of the LWs.

superposition: The simple linear addition and subtraction of two or more values, states, etc.; one of the key principles in field theories and in the concept of potentials. When the situation is sufficiently nonlinear, however, interaction of waves and potentials occurs instead of simple superposition.

supersystem: A higher level or "metasystem" of interactions between the classical system, the active vacuum, and the active local curvatures of spacetime. Hence the supersystem consists of three interacting components: (1) the EM system and its dynamics, considered in conventional fashion as if the local vacuum were inactive and the local spacetime were flat; (2) the local interactive vacuum and its dynamics, and (3) the local curvatures of spacetime and their dynamics. In component (2), one must consider the Dirac sea, Dirac holes and hole currents, with concomitant potentials and forces impressed on them. In component (3), the time-domain interactions (time-energy, time-force, time-potential, and currents of energy along the fourth Minkowski axis) must be accounted to include negative energy.

All three components of the supersystem interact with each other. In general, the vacuum interactions may be taken from particle physics, and the spacetime curvature reactions may be taken from general relativity. However, this will yield only a rough or "first order" analysis, since it does not produce the tri-reactions of all three components at once, but mostly reactions between pairs of the components. The concept is easy to conceptualize, however, and yields valuable clues and insight in many areas, such as chemistry (including biochemistry), electrical physics, electrodynamics, thermodynamics, and electrogravitation. It is particularly useful in understanding the phenomena encountered in COP>1.0 EM power systems.

symmetrical regauging: In electromagnetics, changing the scalar potential to a different value, and simultaneously changing the vector potential to a different value, with the two changes precisely selected so that the two extra forces (each created by one of the changes) are equal and opposite — thus canceling each other's effect with respect to bulk translation and doing no net *external* work. The two forces remain and can perform internal work upon the system. Note that the stressing effect of the two new forces is not canceled, and that the stress of the system is altered a priori. See regauging.

tantalum capacitor: Electrolytic capacitor with a tantalum or sintered-slug anode, such as a solid tantalum, tantalum-foil electrolytic, or tantalum-slug capacitor.

targeted pinpoints: Those separated points which engage in self-targeting between themselves and some separated signal energy source (as in Fogal's semiconductor). The effect is to sharply narrow the retroreflected source signal energy from the source onto the separated points by means of the mutual ping-ponging. In this fashion much more energy density from the source can be concentrated on the targeted pinpoints. In effect, *phase conjugate shooting* — the return of the phase conjugate reflected scattered energy directly to the original target emitting the signal wave in pinpoint fashion - is evoked. See distortion correction theorem.

tensor: A special mathematical entity which is a generalized vector element of a vector space, with more than three components, each of which is a function of the coordinates of an arbitrary point in space of an arbitrary number of dimensions.

Tesla, Nikola: Famous American emigre electrical engineer, inventor and eccentric (1856-1943), whose numerous inventions fueled much of the electrical 20th century. In essence he produced the AC system, including polyphase systems. Also, Tesla invented radio transmission, not Marconi, according to a U.S. Supreme Court decision that upheld the prior patents of Tesla over Marconi. In his famous experiment, Marconi in fact utilized a variation of one of Tesla's circuits. This does not denigrate Marconi's many accomplishments, but just sets the record straight on who invented radio transmission. The impetus to the development of commercial radio transmission technology and the industry itself came from Marconi.

thermodynamic equilibrium: Stable state eventually reached by an isolated system or one in a well-behaved active environment. One may consider it a "balanced" or "preferred" state. It is important to note that, in particle physics, there can be no equilibrium of a mass system unless the

vacuum interchange with that system is considered. Electrodynamics mistakenly continues to omit the active vacuum interaction with a Maxwellian system, hence is seriously flawed in that respect.

thermodynamics of open systems: Systems far from thermodynamic equilibrium with an active environment are permitted to exhibit five "magic" functions. Such a system can (1) self-order, (2) self-oscillate or self-rotate, (3) output more energy than the operator himself inputs (the excess energy being freely received from the active environment, (4) power itself and its load simultaneously (all the energy being freely received from the active environment), and (5) exhibit negentropy.

time: In our view, time is spatial EM energy compacted by the factor c . Time thus has the same energy density as mass, but in the time domain rather than in the 3-space domain. Also, time is not observable *a priori;* mass is an observable. Time persists since it is persistence itself. No observable persists *a priori*, since observation is a *d/dt* operator imposed upon LLLT spacetime, yielding a frozen LLL snapshot which does not even exist the very next instant. When we say "mass exists in time" (or any observable continuously persists), we are unwittingly invoking a very rapid iterative *d/dt* operator repeatedly, and recalling these iterative sequential "frozen snapshots" or observations from memory. One may produce and utilize EM energy flow in the time domain, as in 3-space. Time, being energy and energetic, has tempic potential (energy density), tempic potential gradients, and therefore has "tempic force." The photon is composed of both spatial energy and time-energy as its two canonical constituents. The lower the frequency, the higher the energy of the photon when the time-energy is considered, since the magnitude of the time-component of the photon increases as the spatial energy component decreases, and the energy of the photon in that case increases as c^2 times the increase in time magnitude, while decreasing linearly proportional to the decrease of the spatial energy magnitude. When transduction of time into spatial energy occurs, or vice versa, the energy conservation law is modified to specify the sum of the spatial energy, time-energy, and mass energy.

time-charge, time charging: Since time is a special highly compressed form of energy, then time-excitation or *time-charging* also occurs. Also, since tempic longitudinal EM waves accompany all longitudinal EM waves (per reinterpretation of the phase conjugate half set of the Whittaker decomposition), then irradiating a mass with substantial longitudinal EM wave radiation will time-charge the mass, exciting it with time-energy. There are excited states and internal structuring (engines) in time **charging.**

much like the excited states and internal structuring (engines) in energy excitation of normal charge. When the longitudinal EM wave radiation is removed, the time-charged entity then slowly emits longitudinal EM wave radiation as the time-excitation slowly decays via the giant negentropy process of the charges.

time-energy: Time may be considered as spatial EM energy compressed by the factor c^2. See also discussions under time and time charging.

time excitation: See time charging.

time-flow generatrix (mechanism): Since any observable is a frozen nonpersistent snapshot in 3-space, then the common expression "flow of a mass through time" requires an active generating mechanism to add time to mass, converting it to masstime, which is persistent. Masstime *mt* is as different from mass *m* as impulse *(Ft)* is from force *F*. The flow of a mass through time is generated by the ubiquitous interaction of photons with the mass. This includes all photons, both virtual and observable. Thus for the ambient vacuum, there is an ambient flow of time, since there is an ambient rate of total photon interaction. The "macroscopic" movement of the mass through time is the result of (i) absorptions and emissions of observable-sized photons, and (ii) the continuous integration of virtual photon absorptions into observable-sized photons. The macroscopic flow of time thus has myriads of "sublevels" of infolded time flows and engines. Hence the flow of time has a marvelous, internal, dynamic structure.

time-forward: Refers to the flow of an entity through time in the forward direction, as seen by an external observer. Time-forward flow occurs when (to the observer) there is a predominance of time-forward photons interacting with the body that is moving in forward time. Contrast to time-reversal of an object, as seen by the external observer, which occurs when (to the observer) there is a predominance of time-reversed photons (antiphotons) interacting with the body that is observed to be time-reversed. Pumping a given living mass (in the nonlinear optical sense) with time-reversed EM waves pumps the object in the time domain. That drammatically extends nonlinear optics, since the pumped living object's cells will be observed to slowly reverse back to a previous physical state or condition. Since time-polarized EM waves accompany all longitudinal EM waves via reinterpretation of Whittaker 1903, pumping a living mass (a body) with longitudinal EM waves also pumps it with time-polarized EM waves, time-charging the body which continues the pumping in the time domain after the longitudinal EM wave radiation is removed.

time-forward EM wave: A normal EM wave moving in forward time as seen by the observer. Otherwise known as the retarded wave. The external observer comfortably sees its forward progress as expected.

time-polarized electromagnetic wave: An electromagnetic wave whose vibrations occur in the time domain only. May be referred to in a quantum field theory sense as a *scalar* EM wave. It is a longitudinal EM wave in the time domain. It may also be said to be a longitudinal EM wave in the complex plane, since in Minkowski space the fourth axis may be taken as -ict. The time-polarized EM wave is indicated in quantum field theory, or at least its time-polarized photon is theorized and called a "scalar" photon.

time-polarized photon (scalar photon): A photon whose vibrations occur in the time domain only, also known as a "scalar" photon. This polarization of the photon is utilized in quantum field theory. Neither the scalar photon nor the longitudinal photon is individually observable. However, the combination of the two in the presence of charge is observable as the instantaneous scalar potential.

time reversal: For EM waves, the process of forming the phase conjugate wave. For a particle or a mass, the process of pumping the particle or m;iss with time-polarized EM waves, so that the resident spacetime curvature engine in the mass is amplified and phase conjugated, forming a precise, amplified antiengine which then slowly time-reverses the mass back to a previous physical condition and state. We accent that *time reversing a single object or single group ofobjects* is not the same thing as "travel into the past" so popularized by science fiction. For time travel to the past, the entire universe and everything in it — except the traveler — would have to be time-reversed. That would not seem possible by any stretch of the imagination today! On the other hand, time-reversal of a single thing such as a particle or a wave — or even a group of things such as a group of particles or waves — is not only feasible but is readily achievable. A Dirac sea hole is a negative energy electron, for example, having negative energy and therefore negative mass prior to observation. After observation, it is seen as a positive energy, positive mass electron of opposite charge to the conventional electron and reacting with fields in opposite direction from the conventional negatively charged electron. In short, after observation (interaction with mass) it becomes the positron.

time reversal zone: A region of space in which the majority component of the overall time flow mechanism runs backwards, and hence the fundamental mechanism generating the flow of a mass through time is reversed. The "time running backwards" is due to the predominance of

interactions with antiphotons. It follows that, in the time-reversal zone (TRZ), there is a predominance of antiphoton interaction over photon interaction. In a TRZ, the law of attraction and repulsion of charges is reversed; like charges attract and unlike charges repel. Also, induced action by the time reversal forces start *inside and throughout* an affected mass in that zone, originating at every point in that local spacetime zone and moving outward. It thus involves a novel action "from inside to outside", beginning even inside the nucleons, and first affecting the quarks and gluons. Deliberate use of time-reversal zones and their subsequent decay allows a great new class of dramatic nuclear reactions, including simple transmutation and loosely called "cold fusion" reactions, at low spatial energy but very high time-energy. High energy physics has neglected the use of time-energy, opting to go for high spatial energy. Hence the high energy physicists have actually eliminated a much higher energy physics (at low spatial energy so readily examined on the bench far *more ch*eaply) than the science they have long developed.

time-reversed wave: A phase conjugate reflected wave, which is a wave moving in reversed time. Since the external observer "sees" in forward time only - and even then he sees in an iterative series of frozen 3-space snapsholt — he *observes* the time-reversed wave as a 3-spatial wave (series of iterative frozen snapshots) traveling in the opposite direction as its generatrix wavefront (the *signal wave).*

topological: Invariant under transformation by continuous mappings, or related to the properties of geometric shapes and figures that remain invariant under transformation by continuous mappings.

topological properties: Those properties of a geometrical space that are unchanged by continuous distortion of the space.

topology: Mathematics of the properties of geometric configurations invariant under transformation by continuous mappings. In short, the mathematics of the large-scale structure of curved spaces.

transverse (with respect to waves): Wave oscillatory movement perpendicular to the wave's primary direction of principal propagation, as in the movement of a plucked taut string in a wavelike motion traveling down the string but with the oscillations being lateral. Based on Faraday's notion that the field lines of the electromagnetic field were physical material lines (in the material ether) similar to taut strings, Maxwell assumed the transverse wave model in his theory. The entry of longitudinal waves, into the theory can easily be demonstrated by rhythmically and coherently varying the magnitudes of the Lorentz symmetrical regauging

condition, producing "stress potential waves" which are in fact what longitudinal EM waves really are. The production of a longitudinal EM wave in 3-space will be accompanied by the simultaneous production of a time-polarized companion wave.

tunneling: In quantum mechanics, a phenomenon in which a particle penetrates and crosses a small region where the potential opposing such passage is greater than the particle's available energy. The phenomenon is thought to be impossible according to classical physics, but occurs nonetheless. Further, the speed of transit through the "tunneling" separation can be superluminal. Tunneling of music between two separated points in a waveguide has been measured at more than four times the speed of light.

A more extended type of tunneling is the travel of longitudinal EM waves infolded inside the normal EM potentials, fields, and waves. Indeed, this is a more fundamental electrodynamics, and it can be shown that interferometry of this "internal" electrodynamics creates the external electrodynamics by a form of longitudinal EM wave interferometry. E.g., see M.W. Evans, P.K. Anastasovski, T.E. Bearden *et al.*, "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry," *Journal of New Energy*, 4(3), Special Issue, Winter 1999, p. 76-78. This is part of the technical basis for the "scalar interferometry weapons" developed by the Russians after World War II. Today, some 10 nations have such weapons, more are developing them, and even the Japanese Yakuza has such weapons.

unified field theory (engineerable): A unified theory of the four forces o| physics — the electromagnetic, gravitational, strong, and weak forces that is not just an intellectual model but which is also engineerable on **the** laboratory bench and in actual physical systems using higher symmetry O(3) electrodynamics as a special subset of Sachs' unified field theory.

unitary Q_E (charge of the electron): Fixed or unit charge q of the electron. This notion is held because q is not decomposed into its component elements, but treated as if it were an indivisible unit, charge and mass and all. The mass of a fundamental particle at rest is quantized, and the massless charge (self-potential) of the particle is discretized as a function of the background potential (virtual particle flux density) in which it is embedded or to which it is exposed. In our view the definition **of a** charge q is $q \equiv m_q \phi_q$, at least to first order. (The ϕ_q may be internally structured with deterministic "engines", so that one electron need not bo

identical to another, in its actions in some cases). The *electrical charge* of the "charged mass m_q" should be taken to be the massless ϕ_q component. For an electron, $q_e \equiv m_e\phi_e$. The *electrical charge* of the electron should be taken to be the massles ϕ_e component. We note that the charge is also structured, since ϕ_e or ϕ_q decomposes via Whittaker 1903 into a harmonic setof EM longitudinal phase conjugate wavepairs. Our reinterpretation of this decomposition then yields the solution to the problem of the "source charge" and its associated fields and potentials and their energy. The massless charge ϕ_e is a dipolarity and hence a broken 3-symmetry in EM energy flow, invoking a more primary 4-symmetry in EM energy flow so that EM longitudinal wave energy is continuously incoming from the time domain, being absorbed by the charge q of which ϕ_e is a component, being transduced into real EM energy in 3-space, and emitted in all directions in 3-space at the speed of light, creating the fields and potentials and their energy that are associated with charge q. If a charge (say, an electron) is placed in an additional potential ϕ_1, then the total massless charge of the electron(i.e., its virtual vacuum flux exchange with mass me) is $(\phi_e+\phi_1)$.

As can be seen, the massless charge of the electron (its virtual flux activity) has now changed. The electron is then said to *be collecting and to have collected* excess energy (which may be either positive or negative, depending upon the sign of ϕ_1). Further, either ϕ_e or ϕ_1 or both can be internally and deterministically *dimensioned* (structured in Stoney-Whillaker-Ziolkowski fashion). When its massless charge (its own ϕ_e) potentialissodimensioned,thenthedimensionedelectronissaidto contain or transport an *engine* or a *vacuum engine* or a *spacetime curvature engine.*

vacuum: Space devoid of observable matter. In modern theory, the "empty" space is in fact bristling with very rapid fluctuations of EM energy, remaining in the virtual state. It is also filled with a violent, fluctuating flux of virtual particles, appearing and disappearing so quickly that an individual particle does not persist long enough to be individually detected. Thus the vacuum is extraordinarily energetic, but the energy is in very special form (fleeting violent fluctuations and virtual particle flux). Nonetheless, because it contains enormous energy, the *average* vacuum may be considered a potential. All potentials then are changes to this vacuum potential, or to an intermediate potential which is a change to it. In another sense, the vacuum, potential, and spacetime are all one-and-the-same thing. This means that general relativity's spacetime curvature is ubiquitous and extraordinarily dynamic. The vacuum very near a mass also can act in some cases as a semiconductor, capable of supporting self-

oscillation between the mass and the local vacuum. Considerations of the active vacuum and its nature lead to the notion of the *supersystem*, which is comprised of three parts: (1) the physical system and its dynamics, (2) the active vacuum and its dynamics, and (3) general relativity and its dynamics (since physicists persist in separating the notions of spacetime and vacuum). No analysis of any mass system is complete unless an analysis of the entire supersystem and the interactions of the three components, one with the other, is performed.

Every charge is "embedded" in the active vacuum by its potentials and fields, which themselves are spacetime curvatures and alterations of the local vacuum. This is easily seen by $q \equiv m_q \phi_q$, where ϕ_q is a change to the local vacuum potential *a priori*. In the quantum view, the fields and potentials may be taken as organized polarization patterns and dynamics (currents) in the vacuum virtual particle flux.

vacuum engine: Also referred to as a *spacetime curvature engine*. From the particle view: a deterministic internal pattern or *template* deliberately created as a deterministic structuring and dynamics in the virtual flux comprising a scalar potential. It can also be created in, and transported by, the two scalar potentials that comprise a static or dynamic force field, or a moving EM wave in the vacuum. It can also be created in the local vacuum potential, in which case it has a "charge-up" creation time and a "discharge time," exhibiting a sort of "time constant" very much like a capacitor charging and discharging.

In the wave view: the vacuum engine is a deterministic internal pattern or template deliberately created in the Stoney-Whittaker-Ziolkowski internal biwaves and wave products comprising the scalar potential. Again, it can be implanted in the vacuum or in an EM signal as a carrier. The self-energy (scalar potential) portion of any electric charge or magnetic charge can also be a "carrier" that is conditioned *{dimensioned)* with a vacuum potential. The process or act of conditioning any of the carriers with vacuum engines is called *dimensioning* that carrier. Russian energetics used in secret weapons programs refers to the vacuum engines of a dimensioned carrier as the *information content of the field.* Such vacuum engines, e.g., were used in the potentials of the microwave radiation of the U.S. Embassy in Moscow for several decades, inducing a variety of health changes and sicknesses in the personnel of the embassy. Interestingly, all these health changes occurred in the field-free regions of the Embassy. There the field-free potentials existed and were stable and unchanging. Hence a body exposed in that region was steadily exposed to the specific engine being induced, and time-charged with that engine accordingly. The

deterministic set of spacetime curvatures comprising this charge then acted upon the cells and body to slowly change it to the damaged or diseased condition. See dimensioning.

vacuum flux exchange: The virtual particle interaction between the active vacu**um** and a mass, particularly a charged particle.

vacuum's **virtual particle flux:** In the particle viewpoint, the quantum mechanicalvacuum identically is a virtual particle flux. Present physics, however, is prone to refer to the vacuum as an implied emptiness conta*ining* a virtual particle flux, even though that is known to be in error. In **our** view, energy, vacuum, spacetime, virtual particle flux, and dynamic geometry are all synonyms. One must note that the ageless contradiction of the wave vs. particle view has still not been resolved in physics, even by the duality principle. The duality principle is merely an agreement to quit fighting, and to feel free to consider a thing a particle in one case or circumstance and a field in another case or circumstance, *whichever works.*

vector: In mathematics, an entity completely characterized by a magnitude andadirection.

vector potential: A potential having — at any point in it — both direction and magnitude. The direction, e.g., may be linear, curvilinear, or swirling. The term "vector potential" is often used as the magnetic vector potential A. When it is swirling, the magnetic vector potential A may be said to be the **magnetic** field B. However, the swirling mag etic vector potential (the **magnetic** field B) may be "bottled up" and contained locally inside a long tight solenoid, or inside a toroidal coil, or inside a special nanocrystalline **material** used as a closed transformer core as in the motionless electrom**agnetic** generator. In that case nature freely replenishes the energy in the surrounding space which would have been occupied by the non**restricted,** nonlocalized B-field (curled A-potential) but replenishes that s**pace** with an uncurled (linearly flowing) magnetic vector potential A. This in fact at least doubles the available energy flow available, without any additional EM energy input by the operator. The well-known Aharnov-Bohm effect clearly demonstrates this effect, and it is delibe**rately** employed in the motionless electromagnetic generator (MEG) of **which** the author is one of the five co-inventors. Present dictionaries of physi**cs** and many textbooks are confused as to the definition of magnetic vector potential A and its relation to B, many stating that the A is defined by the equation $\nabla \times \mathbf{A} = \mathbf{B}$. However, no equation is a definition; it is an **express**ion of equality of two magnitudes, and not a definition of either side. If we substitute the more stringent $\nabla \times \mathbf{A} \equiv \mathbf{B}$, we see that the $\nabla \times$

operator acting upon the A potential is precisely what a B field *identically is*. Hence the A potential exists in two forms: (1) in curled form as identically the B-field, and (2) in uncurled field-free form as the linearly moving A-potential energy current that has no imposed $\nabla\times$ operator and thus has no curl. This makes total sense with $\nabla\times\mathbf{A} \equiv \mathbf{B}$.

vector field: Conventionally, the assigning of a magnitude and a direction (that is, a vector) to each point in a region of space occupied by a field. In our view the field is in fact a change to the active energetics of that spatial region, such that the region will interact with any appropriate entity (e.g , **a** charged mass) placed at any point in the region and produce a force upon that entity.

vector zero: See discussion under zero vector.

virtual antiphoton: An antiphoton that spontaneously appears and disappears, so swiftly that it cannot be individually observed. It is real while it exists. Coherent integration of a stream of virtual photons, however, adds to produce an observable quantum of energy, which is observable in its effects on a charged particle.

virtual particle: A fleeting quantum particle that spontaneously appears and disappears, so swiftly that it cannot be individually observed, so that it exists only temporarily. It is real while it exists. The virtual particle does not satisfy the usual relation between energy, momentum, and mass because it is under the aegis of the Heisenberg uncertainty principle. The virtual particle can have any amount of energy momentarily, so long as the product of its energy and the time interval of its existence is less than the uncertainty principle's minimum magnitude.

The coherent interactions of large numbers of virtual particles with a **mass** or charge can combine to generate real observable effects (forces). In quantum field theory, all forces of nature are caused by the interaction **of** the mass entity with virtual particles. Interaction of a mass with virtual photons, e.g., is projected to cause all mechanical and electromagnetic forces.

virtual particle flux exchange: Interaction with or exchange of a flux of virtual particles.

virtual photon: A photon that spontaneously appears and disappears in the vacuum so quickly that it cannot be individually observed.

virtual photon flux: See definitions under **flux** and under **virtual particle.** For electromagnetics, the vacuum can often be modeled as a flux

of virtual photons. One gets the virtual charges also, since the photon is also considered to consist of a positron-electron pair. That is, the photon is continually separating into a positron-electron pair, whose particles then annihilate each other to form additional photon(s), etc.

virtual photon flux exchange: The mutual exchange of virtual photons, as between the vacuum and a charged mass, or between two colliding masses.

virtual photon flux of vacuum: In our view, the vacuum identically is a flux of virtual particles. For many electromagnetic cases, it can just be modeled as identically a flux of virtual photons, where the word "photons" in general usage refers to both photons and antiphotons.

virtual positron: A positive electron (positron) which spontaneously appears disappears in the vacuum so quickly that it cannot be individually observed. More accurately, in the 4-vacuum, a negative energy electron state that spontaneously appears and disappears so quickly that it cannot be individually observed. A virtual Dirac sea hole.

Whittaker, Edmund Taylor: Well-known English mathematician and physicist, 1873-1956, who made major contributons to mathematics and physics. Whittaker dramatically extended Stoney's earlier work of 1897-8 an authored two papers in 1903 and 1904 giving the basis for the theory of scalar electromagnetics (Russian energetics, not including the quantum potential portion). His decomposition of the scalar potential into a harmonic set of longitudinal EM wavepairs, where each pair is a phase conjugate pair, may be reinterpreted to solve the long-vexing problem of the source charge or source dipole and its continuous emission of EM energy in 3-space, providing its associated potentials and fields and their energy. The problem was solved by the present author's reinterpretation in that manner, published in 2000. This was later found to be consistent with quantum field theory as well, by interpreting the observability of the combined scalar and longitudinal photon pair as opposed to the nonobservability of either the scalar or longitudinal photon individually.

Work: The changing of the form of energy. One joule of energy whose form is totally changed in a reaction, does one joule of work in that reaction. However, it is strongly stressed that after that joule of work is perform**ed,** one still has a joule of energy left to use (with which to do additional work). This remaining joule of energy is just in different form than was the initial joule of energy. So one can do joule after joule of work from a single *initial* joule of energy, so long as the energy is not dissipated and lost after each change of its form. In any one single change of form, only o**ne** joule of work can be done from one joule of energy. So energy is

conserved through many changes of form, but work is not. To work in COP>1.0 systems, one absolutely must root out from one's consciousness the mistaken notion that only one joule of work can be done from a joule of input energy. One of the places where extra joules of work are performed by each joule of energy is that of strong gradients. Strong gradients are known and recognized to violate thermodynamics. Work is further divided into **internal work** and **external work.**

work, external: The changing of the form of the collected energy of a body or system by dissipating it upon an external load or entity is the external work *done by* a body. The changing of the collected energy of a body or system by performing work upon it is the external work *done upon* a body or system.

work, internal: The changing of the form of the internal energy of a body or system. It may also involve the changing of internal parts of the system.

work-energy theorem: In mechanics, a theorem that the change in kinetic energy of a particle in motion is equal to the work done by all the forces acting upon the particle.

zero-point energy: The energy remaining at a temperature of absolute zero, due to the Heisenberg uncertainty principle and the quantum mechanical theory of an oscillator. Also, the minimum energy of a system due to its quantum fluctuations, resulting from its incessant virtual particle activity. Quantum mechanically, no system of interest (including even spacetime itself) can have zero energy. The zero-point energy of the vacuum is the lowest energy vacuum state, with fluctuations taken into account. Even at low energies, quantum fluctuations continually arise, and result in an incessant, extremely rapid, and violent "jittering" of the energy momentarily present. The minimum energy due to these quantum fluctuations is called the *zero-point energy*.

zero vector: Candidates are: (i) A vector having no length (no magnitude) or specific direction; (ii) absence of any and all finite vectors; (iii) resultant of a system of multiple, finite vectors whose vector sum has **no** specific direction but may have nonzero scalar magnitude.

The second definition differs drastically from the first. That is, we **cannot** say that a vector resultant zero has no infolded magnitude, if we **consider** its nonzero components, all of which have magnitude. (See the discussion under **zero).** It only has no net magnitude for *translating* force. It is, in fact, *a. stress potential,* and it is one with a deterministic internal structure or *engine*. By rhythmically and coherently varying each component of a

zero vector system, one easily produces longitudinal EM waves,, each of which is accompanied by a correlated time-polarized EM wave. In vector analysis, the zero vector axiom states that any vector v plus a zero vector is eq**ual** to a zero vector plus v. Note that, being an axiom, this is not proven, but just assumed for any zero vector. We very much disagree with that blanket axiom; it reduces vector analysis to a highly special single case, where all zero vector systems are to be considered equal, and totally "inactive." That is true only for bulk translation. In the real world that need not be true at all; specifically, it is not true for two different zero vectors having different internal structure and dynamics (different internal engines).

There are an infinite number of different zero vector resultant systems, and so zero vectors may differ, if their infolded component "substructure" is considered. In the real world, things that are vectors very often have energy. The energy is infolded and hidden, so that it represents not only (i) a local curvature of spacetime, but also (ii) a structured, deterministic set (a template) of curvatures of local spacetime. Therefore this zero vector system is actually a *vacuum engine.* Any mass system placed in such a potential, will be acted upon in its internal parts by that local vacuum engine; in short, it will have internal work performed on its interior. Further, the zero vector resultant system is a "stress potential," since it does contain "collected internal energy."

So between zero vector resultant systems, the "infolded, hidden energies" differ dramatically in (i) total infolded and trapped (collected) energy, (ii) specific internal action patterns (templates), (iii) general relativistic effects, and (iv) type of engine. Accordingly, the actions the zero-vector system induces in an exposed mass may be designed in advance. This is vacuum engineering. This spacetime engineering. This is the formation and use of engines. It is also one of the bases of Russian energetics.

The'problem is the *vector algebra itself.* In the abstract algebra, a "vector space" Is regarded as an inert thing, where the only actants are the overall net nonzero vectors, and there is no interaction between an overt vector and a covert set of vectors. The vector space is not allowed to have an internal realm, stress, hidden engines, or to interact with the vectors representing the physical system. So vector algebra lacks the capacity to model such higher topology phenomenology. Consequently, for over a century electrodynamicists — thinking primarily of spatial translation — have routinely discarded such "zero vector systems" as if they represented the total absence of any finite vector. *This they do, in the unsuitable*

assumptions of the vector algebra. This they do not do, in the real world, whether we are aware of it or not.

The common practice in electrical physics of replacing a zero-summed system of nonzero vectors with a vector zero indicating a "complete absence of vectors" is very much incomplete. This present practice should be changed; it has reduced the topology of electromagnetics far too much, and gutted vast, important parts of the theory insofar as an extended electromagnetics is concerned. The vector zero should be replaced with a special organized vector zero system and a dimensioned scalar potential.

The interactions of the "hidden" vectors — the *engines* — should be incorporated. By failing to do this, physics excludes the ability to engineer electrogravitation, spacetime, the virtual state, local general relativity, free energy, effects at a distance, and the probabilities of the states propagated by the Schrodinger equation. It also excludes unification of forces. As another more human example, for every cellular disease condition there is a specific engine resident in the cells. An amplified antiengine for that disease pattern can fairly readily be generated. That antiengine, embedded in ordinary EM fields and potentials, can be irradiated into a diseased body with that disease, and it will time-reverse those diseased cells slowly back to normal. This is actually the basis of the body's own healing system the cellular regenerative system studied mostly by Becker. Unwittingly using this "antiengine" approach, Priore and a team of French scientists provided startling cures of terminal cancers, infectious diseases, clogged arteries, etc. in laboratory animals in France in the 1860s and early 1970s. The work is strongly documented and replicated in the French scientific literature, but the work was suppressed in the early 1970s in the change of the French government. See our "porthole briefing" on our website www.cheniere.org for our extension of the Priore method, for greater ease portability, and rapid treatment of mass casualties.

In the new view, a zero vector may be a system of nonzero vectors that vectorially sum or multiply to zero for spatial translation purposes, but nonzero components may still exist "inside" and dynamically function inside the zero-resultant envelope. This substructure can act on nonlinear or resonant systems. Any or all of the nonzero components may be time varying, or none of them may be. The zero vector system may thus be a dynamic engine and a dimensioned scalar stress potential. In addition, such a vector zero system is considered to be also a scalar stress potential, whose magnitude is equal to the sum of the absolute values of the components. In addition, a separate type of stress potential may be included for the magnitude of the absolute values of the swirl components

(torques). Other associated potentials may be included for the system, particularly if the system is in multiple dimensions, if it consists of more than one type of virtual particle flux, if several fluxes intercommute, etc.

zero vector summation systems: Zero summations of real, nonzero vectors, so that the real vectors are still present but do not cause *spatial translation* of the exposed mass or charges. Instead, the zero vector summation has an internal structure and dynamics, hence an internal engine. Also see discussion under zero vector.

Appendix A
Relation to Equilibrium and Disequilibrium Thermodynamics

"The second law [of thermodynamics] does not rule out the possibility of pushing heat uphill, as it were, from a cold object to a hot one, or of creating order out of disorder. It merely states that such a reversal of the natural flow requires an influx of energy... " [Raymond Serway] {697}

"It *is in no way possible, either by mechanical, thermal, chemical, or other devices, to obtain perpetual motion, i.e., it is impossible to construct an engine which will work in a cycle and produce continuous work, or kinetic energy, from nothing. "* [Max Planck] {698}.

"What might appear to be empty space is, therefore, a seething ferment of virtual particles. A vacuum is not inert ***and*** *featureless, but alive with throbbing energy and* ***vitality.*** *A 'real' particle such as an electron must always be viewed against this background of frenetic activity. When an electron moves through space, it is actually swimming in a sea of ghost particles of all varieties - virtual leptons, quarks, and messengers, entangled in a complex melee. The presence of the electron will distort this irreducible vacuum activity, and the distortion in turn reacts back on the electron. Even at rest, an electron is* ***not*** *at rest: it is being continually assaulted by all manner of other particles from the vacuum."* [Paul Davies] {699}

"I assert... that for the general theory of relativity, i.e., in ***the*** *case of the general invariance of the Hamiltonian function, energy equations... corresponding to the energy equations in orthogonally invariant theories do not exist* ***at all.*** *I could even take this circumstance as the characteristic feature of the theory of general relativity. "* **[D. Hilbert]** {700}

" ***In formulating the*** *equivalence principle, Einstein actually abandoned the idea of the gravitational field as a*

Faraday-Maxwell field, and this is reflected in the pseudotensorial characterization of the gravitational field that he introduced. Hilbert was the first to draw attention to the consequences of this. ... Unfortunately, ... Hilbert was evidently not understood by his contemporaries, since neither Einstein himself nor other physicists recognized the fact that in general relativity conservation laws for energy, momentum, and angular momentum are in principle impossible. " [Logunov and Loskutov] {701}

"No amount of theory can refute a replicable experiment that contradicts the theory. A single replicable experiment can refute any theory that is in conflict. That is the very heart of the scientific method. " [Myron Evans, private correspondence].

"It only takes a single white crow to prove that not all crows are black. " [Anon.]

"One of the most important principles of physics, that disorder, or entropy, always increases, has been shown to be untrue. " [BBC News] {702}

"One of the most fundamental rules of physics, the second law of thermodynamics, has for the first time been shown not to hold for microscopic systems. ... [The experimenters]... found that the change in entropy was negative over time intevals of a few tenths of a second, revealing nature running in reverse. ...But over time intervals of more than two seconds, on overall positive entropy change was measured and normality restored." [Chalmers] {703}.

"We experimentally demonstrate the fluctuation theorem, which predicts appreciable and measurable violations of the second law of thermodynamics for small systems over short time scales... Our results show entropy consumption can occur over colloidal length and time scales. " [Wang et al.] {704}.

A.1 Introduction

For excellent background books on thermodynamics matters, at various levels of difficulty, the reader is referred to texts by Gyftopoulos and

Beretta {705}, Kondepudi and Prigogine {706}, Chalidze {707}, and Dugdale {708}.

It has long been known in physics that at sufficiently small levels (e.g., atomic levels) the second law of thermodynamics does not always hold true. Recently, as quoted above, Wang et al. {704} have extended this area of permissible violation of the second law to much more appreciable times (a few tenths of a second) and lengths (the micron scale). Without further discussion, we note that this places regions and times of negentropy well-within circuitry switching times and interaction with fundamental charged particles. Hence these experiments are beginning to point the way to practical negentropic devices. When coupled with the demonstrated continous giant negentropy of a charge (considered with its clustering virtual charges of opposite signs), these experiments now strongly support the feasibility of practical overunity EM circuits and systems. The interested reader is encouraged to continue to read the literature along those lines, and stay abreast of developments in that field.

In this book we have presented considerable discussion of time-energy (time as a special, highly compacted form of energy). We have also discussed the three components of the supersystem, including the system, the local active vacuum, and the local curvatures of spacetime. All three componets of the supersystem interact with each other continuously, and such Interactions are not modeled in classical thermodynamics (CTD), classical electrodynamics (CED), or electrical engineering (EE). Hence one should not be surprised that the supersystem model and supersystem analysis involve contradictions (actually, *extensions)* of these three models, which are special cases and approximations only.

All COP>1.0 EM systems result from supersystem component interactions. So COP>1.0 EM systems are in conflict with CTD, CED, and EE since these three models exclude those interactions.

To falsify any absoluteness of the three models considered, one or more solid, demonstrable, replicable experiments are presented to establish validity of the new higher symmetry approach. This is sufficient to negate the conventionally accepted absoluteness of the lower symmetry CTD, CED, and EE models. Scientifically, these experiments suffice to demonstrate that those three models describe *"special-case* domains of nature" rather than full generalizations of nature. It is clearly understood that the three models remain very useful and very often quite sufficient, just as Newtonian mechanics is useful and often sufficient, without use of relativistic mechanics.

The experiments also falsify any interpretation of the three models as "proof that COP>1.0 systems are impossible. Accordingly, many of the accepted statements and assumptions of the three models must be corrected for COP>1.0 research, as must be the conventional interpretation that the laws of nature (as understood based on those three models) prohibit COP>1.0 EM systems. This follows directly from the quotation by Evans at the beginning of this appendix. Experimental evidence of COP>1.0 is abundant and decisive, such as the many hundreds of routine "negative resonance absorption of the medium" experiments as typified by Bohren's paper {709} and experiment and Letokhov's work {710}. Also, every charge in the universe already falsifies all three models, as amply discussed in this book. That fact for at least a century has generated the source charge problem — the problem of the source charge and its associated fields and potentials and their energy, reaching across the universe. The solution to this problem was published by the present author in 2000, based on the experimentally proven and well-established broken symmetry of opposite charges, such as are on the ends of a dipole.

In the extended approach, conservation of energy in 4-space does not require simultaneous conservation of energy in 3-space. The concept of energy conservation in 4-space does not exist in the three models mentioned, which contain only 3-space energy conservation. There exists a "giant negentropy" 4-space energy flow (circulation) mechanism, as we developed in this book, and it is experimentally demonstrated by every charge in the universe. In a classical 3-spatial energy conservation analysis and view, the giant negentropy action may continuously perform useful work in a system, since it already furnishes all EM field energy and potential energy in every system. All 3-space energy conservation is an extra condition imposed upon 4-space energy conservation, and that condition may be violated at will without violation of the general conservation of energy law.

To the three conventional models mentioned, 4-symmetry in energy flow with broken 3-symmetry, will appear to be perpetual motion and a total violation of the more limited 3-space conservation of energy law. It *does* permissibly violate 3-space energy conservation, which is just a special case a priori. But it is not a violation of energy conservation overall, since we are using a more fundamental energy conservation law (4-symmetry) than the 3-symmetry used in the mentioned CTD, CED, and EE models,

In short, the three models must be extended to provide 4-space energy conservation with simultaneous violation of 3-space energy conservation, accompanied by simultaneous time-symmetry energy flow violation. The

two broken symmetries — of 3-space energy flow and of time domain energy flow — thus act as a special extension of the notion of symmetrical regauging, accomplishing it by "equal and opposite-effecting" fields, one in the lime domain and one in 3-space.

Ironically it then follows that what have heretofore been conceptually called "perpetual motion machines" with respect to 3-space energy conservation are simply attempts — successful or unsuccessful — to build analogues of a windmill turning in a free wind and powering a load. In short they are attempts to duplicate in systems what every charge in the universe already demonstrates unequivocally. *Nature's* CTD, CED, and EE do not prohibit such systems — again, as evidenced by every charge in the universe demonstrating exactly such "perpetual motion" (we prefer the exact term "giant negentropy") and violation of present *human* CTD, CED, and EE. None of the original charges from the beginning of the universe has slowed and stopped its motion, or stopped pouring out EM energy freely, in some 14 billion years or so. And charge may be taken as the most basic Maxwellian system. Further, all EM fields and potentials, and their energy, comes from their source charges. So those so adamant against perpetual motion machines should first purge their own three models of their *assumed* perpetual motion machines. If this is done, they will purge the three models of all charges, fields, and potentials — and all EM energy in the process. In short, the three conventional models used by those same skeptics so loudly condemning "perpetual motion machines" will eat themselves" by swallowing their own tail, so to speak.

in short, all three models are easily falsified by every charge in the universe, as well as by every EM field and potential, and by the existence of EM energy itself.

Either their models must surrender any pretense at absoluteness and accept being useful approximations only, or else the conservation of energy law itself must be surrendered.

Conventional CEM, CTD, and EE have just hidden this appalling fact and convealed the serious flaws in the modeling by ignoring what Sen {711} reffered to as " *the most difficult problem in classical and quantum electrodynamics.* " We believe it will very difficult to find a single electrical engineering department or professor or text that deliberately acquaints electrical engineering students with the source charge problem and its implications.

As an example, in Chapter 9 we presented an experimentally verified and patent-pending method for a special energy conversion method. This

method is proven on the laboratory bench. With this method, a system accepts time-energy and negative energy input, converts it to ordinary positive 3-spatial energy, and uses the converted input energy to close-loop an EM system far from equilibrium. With that conversion process invoked in a governed feedback loop, the COP>1.0 system becomes "self-powering" (an informal term referring to the system freely receiving all its input energy from its active environment). Self-powering, of course, involves the system continuously operating and performing useful work, analogous to a windmill in a wind and powering a water pump. Rigorously, the self-powering COP = oo EM system becomes directly powered by energy from the broken symmetry induced in its supersystem component interactions.

In Chapter 10 we presented the novel concept of the time-reversal zone (TRZ), which uses the extraordinary EM energy density of time to reverse the Coulomb barrier in nuclear reactions in an electrolyte {712}. This enables nuclear transmutation reactions at low *spatial* energy (but at very high *total* energy when time energy is also considered). There are some 600 successful cold fusion experiments worldwide, in multiple laboratories, by multiple researchers, and most of these experiments demonstrate examples of the specific nuclear reactions made possible by the actions of the TRZ. The time-energy anomalies are directly demonstrated in rigorous electrolyte experiments at U.S. Navy research facilities at China Lake, as we have also discussed in this book. So the experimental results are replicated and well proven. Hence there is adequate, replicated experimental demonstration that additional nuclear reactions exist outside the conventionally known nuclear reaction model. Therefore the set of conventional nuclear reaction models also is reduced to a special case domain, with any absoluteness of those models already experimentally falsified. Either that, or we must abandon scientific model where successfully replicated experiments falsify any theory in contradiction to the experiments.

In our proposed solution to the source charge problem {71 lb}, we found a broken 3-symmetry in energy flow while 4-symmetry is maintained. This is a more primary principle of energy conservation. We called this principle "giant negentropy", which is laughably simple to demonstrate experimentally, since every charge and dipole in the universe already demonstrates it. We showed that such giant negentropy is consistent with quantum field theory, particle physics, and a slight corrective reinterpretation of Whittaker's 1903 decomposition of the scalar **potential** The experimentally proven and theoretically justified giant negentropy

falsifies any absoluteness of the CTD, CED, and EE models in conflict with it.

Again, this does not mean that one abandons the CTD, CED, and EE models! They are still very useful models in most cases of interest. It means that these present models are still incomplete, and extended models must be developed and used for COP>1.0 EM system research. It also means that none of these three models is valid as a prohibition of the permissibility of COP>1 EM systems.

All EM energy in 3-space comes from the time domain and returns to it. Since all three models exclude time-energy and its transduction into spatial energy, all three are in conflict with the proven giant negentropy model and with the unlimited experimental demonstrations. Accordingly, the experimentally demonstrable giant negentropy of the charge and dipole strongly points out the inadequacy of the three models and the nuclear reaction models, which do not account for time reversal zones, or time-energy and its transduction into a very large magnitude of 3-space energy.

In paragraph A.2 below, we briefly discuss some of the fundamental but permissibie supersystem violations of these older models of CTD, CED, and EE, and provide some comments. It is obvious that all three classical models need very serious updating and extension. We point out that exceptions to present thermodynamics models and "laws" already are recognized{713}, and work on such exceptions is being performed under the heading of extended thermodynamics {714}.

In effect, all three models *exclude* every charge, dipole, or dipolarity in the universe - which therefore excludes all matter, fields, and energy - something completely untenable in modern electrodynamics and modern physics. Since the fundamental nature of the "heat" notion of CTD is electromagnetic field energy, and all EM fields and potentials (and their energy) are excluded if their source charges are excluded, then heat itself is excluded by the three models. That is, CTD is also totally falsified by CED'S exclusion of the source charge's demonstrated giant negentropy, which in effect excludes heat itself. This is a non sequitur of such magnitude that it absolutely requires the complete rework of CTD, CED, and EE.

A.1.1 Featurcs of the Development of Thermodynamics

In the development of thermodynamics, a few key events of interest are listed in Figure A-1 below.

Selected Events in the History of Thermodynamics {715}

1673 Huygens builds a motor driven by gunpowder explosion.
1690 Papin uses steam to move a piston.
1712 Newcomen develops a steam engine.
1723 Stahl popularizes phlogiston and Becher's concepts.
1724 Boerhaave proposes that heat is a fluid.
1733 Bernoulli publishes a text that is the first truly statistical treatment of kinetic theory, and publishes an update in 1738. It is almost forgotten until 1859.
1765 Watts invents a steam engine that is more than six times more effective than Newcomen's engine.
1783 Lavoisier points out the weakness of phlogiston theory with respect to combustion.
1786 Lavoisier and Laplace provide a Memoir on Heat.
1789 Lavoisier publishes his *Elementary Treatise on Chemistry,* which presents the law of conservation of mass.
1791 Prevost publishes a theory of heat and radiation exchange. Richter founds stoichiometry.
1798 Thompson demonstrates the conversion of work into heat, in his *Enquiry Concerning the Source of Heat which is Excited by Friction.*
1799 Davy's experiments seriously challenge phlogiston theory.
1800 Herschel explores the heating ability of different frequencies of light.
1802 Lussac establishes the thermal expansion of gases.
1803 Dalton forms his atomic theory of matter, setting the stage for atomic chemistry.
1804 Leslie shows that light and radiated heat have similar properties.
1806 Young formulates a precursor to the modern kinetic energy.
1811 Poisson develops a mathematical theory of heat, based on Fourier's work. Avogadro presents his law. Berzelius states that electrical and chemical

forces are the same and that atoms are electrically charged.

1819 Dulong and Petit show an empirical law on the specific heat of solids.

1824 Carnot studies the thermal efficiency of machines, introduces reversible transformations, and generates the foundations of thermodynamics in his "Reflections on the Motive Power of Fire".

1829 Coriolis defines "kinetic energy".

1834 Clapeyron presents the first version of the second law of thermodynamics, based on steam engine studies.

1837 von Suerman experimentally verifies Clapeyron's version of Carnot's equations.

1842 Mayer equates the conservation of energy law and shows the equivalence between heat and mechanical energy.

1843 Waterston anonymously publishes an accurate kinetic theory of gases. It is essentially ignored.

1845 Waterston submits a beautiful paper on the kinetic theory of gases to the Royal Society. It is rejected and ignored for more than 40 years, until finally resurrected by the President of the Royal Society.

1847 Helmholtz generalizes the conservation of energy law for mechanical, caloric, electric and magnetic energy.

1848 Lord Kelvin introduces the absolute temperature scale. Joule finishes establishing the exact relation between heat and mechanical work; his work is almost ignored.

1850 Clausius states the second law of thermodynamics.

1851 Thomson derives the second law of thermodynamics based on Carnot's work.

1855 Rankine publishes *Outlines of the Science of Energetics.*

1857 Clausius establishes heat as energy distributed among particles.

1858 Clausius introduces the idea of the mean free path of a colliding particle.

1859 Kirchhoff establishes the thermodynamic foundation of radiation theory, and completes the basic radiation theory in 1862.

1860 Maxwell provides studies in kinetic theory of gases and gives the distribution of molecular velocities. The paper, "Illustrations of the Dynamical Theory of Gases," was read in 1859.

1860 Maxwell shows a discrepancy between experiment and the kinetic theory of diatomic gases. It was not resolved until the early stages of quantum theory.

1861 Kirchhoff advances the notion of the blackbody.

1865 Clausius, Rankine and Kelvin provide the concept and definition of entropy.

1860-1877 Boltzmann and Gibbs provide the foundations of statistical classical mechanics.

1867 Maxwell publishes *On the Dynamical Theory of Gases*, his major work on the kinetic theory.

1874 Thomson points out the reversibility paradox.

1877 Boltzmann defines entropy in terms of probabilities.

1873-1878 Gibbs publishes several important papers on thermodynamics, widely influencing scientists.

1879 Boltzmann establishes the relation between radiation intensity per unit area of a blackbody, and the absolute temperature. Stephan formulates the "Stephan-Boltzmann law" $R_T = \sigma T^4$.

1879-1899 Discoveries of various laws and effects, particularly at the micro level.

1900 Planck proposes the quantum of action and derives the correct radiation spectrum for blackbodies. (He published the definitive paper in 1911).

1905 von Smoluchowski and Einstein independently investigate Brownian motion. Einstein publishes a paper on the photoelectric effect.

1906 Nernst advances his heat theorem, where at absolute zero temperature both heat capacity and entropy change go to zero. This is later recognized as the "third law of thermodynamics".

1909 Einstein corrects Planck's blackbody derivation.

1910 Perrin experimentally validates Einstein's calculations on Brownian motion, providing a strong argument for the existence of atoms.

1911 Rutherford proposes the nuclear model of the atom. Sackur points out the need for an absolute definition of entropy. Nernst's experiments provide strong support for the new quantum theories.

1925 Born, Heisenberg and Jordan formulate quantum mechanics from matrix algebra. Einstein points out that the analogy between quantum gases and molecular gases is complete; photons and molecules have both wave and particle characteristics.

Figure A-l. Key Events in the History of Thermodynamics up to the Development of Quantum Mechanics.

During the early period of science, a continuing struggle between various notions of esoteric fluids and fluid flow occurred. French scientist Lavoisier (1743-1794), regarded as the father of chemistry, is identified with the concept of heat as an invisible fluid, which he named "caloric". The notion was that one drove this invisible fluid — this caloric — out of a material by some action such as mechanical friction or combustion. This produced the "manifestations" of what was loosely called "heat". In short, caloric was considered to be "heat" which was itself an esoteric fluid. In his famous Treatise {716}, published posthumously, atoms were still in dispute. However, Lavoisier listed the known elements, and included light and heat as elements. Asimov pointed out {717} that Lavoisier had "... era*dicated one imponderable fluid, phlogiston, but it was only partly through his influence that caloric, just as false, remained in existence in the minds of chemists for a half a century. "*

Caloric dogmatically existed in the minds of scientists deeply into the nineteenth century, until Maxwell and Boltzmann produced theories that strongly supported the concept of atoms as the building blocks of matter. In the late 1790's, Count Rumford (Benjamin Thomson) showed that the supplay of heat that could be "driven from matter" was unlimited, which totally contradicted the caloric theory {718}. Yet the notion of caloric persisted until Maxwell's theory eventually killed it, once application of that theory showed that heat was comprised of EM energy.

The fundamental ansatz of thermodynamics was formed and solidified before the advent of modern physics, and even before Maxwell's theory of electrodynamics, and before heat was known to be electromagnetic energy. It has unjustifiably retained an aura of "absoluteness" and dogma, even though its foundations concepts are based on outdated notions already scientifically falsified as far as any absoluteness is concerned. As Mallove states {719}:

> *"It is astonishing to realize that many modern conceptions (or laws') in the science of heat— thermodynamics — arose during the nineteenth century, a period of utter confusion about the fundamental nature of heat. How could it have been otherwise, given that the very existence of atoms was still in question! One sees the shakiness of the claim that the laws of thermodynamics had reached a state of 'near perfection' in the twentieth century ...when they in fact rested on this very flawed foundation. "*

During that formative period, the notion of the conservation of energy **was** also being searched for, as if in a thicket of brambles. For some time, any notion of energy conservation was seen as directly contradicted by caloric, and — in formulating the heretical notion that energy is conserved — pioneers such as Mayer {720} were severely castigated.

In 1850 Clausius resolved the conflict between caloric and conservation of energy in a seminal paper {721}.

Mallove {722} explains how the theory developed from there:

> *"In one fell swoop Clausius 'scooped' Kelvin and cast into precise form <u>both</u> the First and Second Laws of Thermodynamics — energy conservation, and the limit of the Carnot efficiency."*

Clausius' statement of the Second Law is: *"It is impossible for a self-acting machine, unaided by an external agency, to convey heat from one body to another at a higher temperature. "*

In 1851, Thomson (Lord Kelvin) stated the Second Law as:

> *"It is impossible, by means of inanimate material agency, to derive mechanical effect from any portion of matter by cooling it below the temperature of the coldest of the surrounding objects."*

In 1865 — the same year that Maxwell published his seminal paper in his electrodynamics {723} — Clausius derived entropy and showed the two laws of thermodynamics expressed in the same way as the old caloric theory. Clausius used the concept of "entropy" to represent the *"dissipated potential"*. In a public speech with the title "The Entropy of the Universe Tends to a Maximum," Clausius included how thermodynamics requires an eventual heat death for the universe. His view was that

> *"The energy of the universe remains constant (first law), while entropy increases. "* {724}

We stress that the notion of the flow of EM energy through space did not originate until the 1880s, when Heaviside and Poynting formulated it independently. Neither relativity — with its notion of a combined spacetime - nor the Minkowski space had been born. Neither had quantum mechanics, quantum electrodynamics, quantum field theory, etc.

For a succinct and very useful listing of the major developments in the history of thermodynamics and statistical mechanics, one is referred to the work of Biggus {725}.

A.1.2 Inadequate Fundamental Definitions in Thermodynamics

In the view we take in this book, energy is the all-important concept, in all its forms, no matter how esoteric. The interactions of energy with matter must therefore be extended to include all known energy interactions, not just those prescribed by CTD or CED. Consequently, two fundamental definitions of thermodynamics are faulted by the supersystem concept.

First, thermodynamics defines an *open system* as one that is open to the exchange of energy and mass across its boundary. No concept or discussion of virtual energy, virtual mass, time-energy, or multiply connected space effects is included. Further, mass is actually a special form of energy, and hence this definition only prescribes the exchange of energy across the system boundary.

Second, thermodynamics defines a *closed system* as a system with no mass exchange across its boundaries, but heat (energy) exchange is permitted. This definition has been a non sequitur since general relativity was established in 1915, and also since caloric (heat) was identified as energy rather than a thin material fluid that was forced or beaten out of matter by doing work on the matter. Since then, energy and mass are also known to be the same thing, as established by general relativity. Whenever the energy of a system changes, its mass changes a priori. So a system thought of as "closed to any mass transfer across its boundaries" still undergoes

mass change due to the exchange of energy across its boundary. Further, the definitions of "closed system" and "open system" are not mutually exclusive. As an example, a system exchanging energy but not mass across its boundary can be classified as a "closed system", and also as an "open system" where normal exchange of mass is blocked but the mass of the system still changes as the systems absorbs and emits energy.

Rigorously, even the energy of a system cannot individually change in 3-space, without first invoking 4-space change! Instead, the "energy x time" — the action — of the system is what moves and changes in 4-space, Observation applies a *d/dt* operator, resulting in a 3-space energy observed as having already happened or been fixed.

The modern view of gravitation is that the energy in mass generates the gravitational field, not the mass per se {726}. Also, mass is an observable, hence it is a continuously recurring 3-spatial snapshot that does not even continuously exist as mass, but alternately as mass and masstime. The assumption of the continuous existence in mass is falsified by the quantum mechanical nature of observation itself; hence all three models — CTD, CEM, and EE — are falsified.

Nonetheless, let us continue to use the conventional notion of "flow of energy" and "flow of mass" for convenience.

The thermodynamic definition of "open system" ignores the state in which mass exists as "masstime". No "change of mass", flow of mass, etc. occurs. Instead, masstime can flow or change, but mass is an observable and **thus** frozen 3-space snapshot at one instant. Time is "outside" any 3-space material system, hence when mass becomes masstime, it already "exchanges across the system boundary". *For a mass merely to continue to exist requires the exchange ofmass across the 3-space system boundary.* Indeed, only "masstime" can be changing, so in failing to consider masstime, the definition is falsified as it stands, in its very assumption of "continuous change of mass" when there is no such thing in all of nature. As stated, a similar consideration applies to energy, which does not **and** cannot "continuously exist in 3-space" at **all,** and cannot *continuously* change. Also, *time is highly concentrated energy* as we develop in this book, and time certainly "exchanges across the boundary" of any mass system. Time may be taken as a sort of "multiple connection" in space, since in theory each point in space is said to "exist simultaneously" in the same time-point.

With quantum potential connection, external energetic processes may be "superposed instantly in multiply-connected space" with one or more

points of the "closed system". Hence, if there exist processes in the system to transduce time-energy into 3-spatial energy — as in the well-proven cold fusion experiments — matter changes including nuclear transmutations can and do occur. Then the "system closed against mass motional exchange through 3-space" (which does not even concretely exist) is not closed against mass changes at all.

To eliminate the mass-change effects of energy transfer across the system boundary, the present thermodynamic definition of a *closed system* must be completely recast into what thermodynamics presently calls an *isolated system* - one in which neither energy nor mass is exchanged across the system boundary. No such system exists in the universe, since merely to exist it has to be open to continual energy exchange between time and 3-space domains, mass has to continually interchange between mass and masstime, and energy has to continually interchange between energy and (energy x time). The blunt truth is that *only open systems exist in nature.*

All systems are open systems in their supersystem interactions, and they can and do exchange time-energy and mass changes due to spacetime curvatures and active vacuum changes. Any local spacetime curvature made by an energy change in a system or nearby, also reacts back upon the system from its local curved spacetime environment. It may react in a totally energetic fashion, or it may react to produce mass in the system (as in pair production). In the book we pointed out that the supersystem components external to the system can also interact in the system to eliminate mass (as when a Dirac hole combines nonradiatively with a Dirac **election).**

Finally, the notion of an "open system" as one in which energy and mass both can be exchanged across the system boundary must be extended to include a system which can also exchange time-energy, spacetime curvature energy, virtual particle flux activity and energy, and other supersystem effects across the boundary. Further, the notion that a "closed system"can be open to energy exchange but not mass is totally falsified in modern physics' virtual particle exchange between environment and system. Virtual mass — which is physically real — is continually exchanged across the system boundary. Though each virtual mass particle is individually unobservable, coherent summations are observable.

To properly evaluate the conventional thermodynamic definitions of open system, closed system, and isolated system, simply select and use a physics model containing only one fundamental unit, the joule. Now all basic entities are made of energy and functions of energy. So all basic

entities are forms of energy; e.g., both mass and time are special forms of energy. As presented previously in this book, to even "exist in time" a system is continually exchanging and transducing 3-space energy and time energy, across its boundary at an enormous rate. Every system is an open system, a priori, and the thermodynamic "closed system" is a non sequitur. The thermodynamic "isolated system" is revealed as the early attempts to deal with observation; i.e., the observed system as a series of frozen 3-space snapshots (effects), each stripped from a 4-space ongoing process at a single moment by the observation process *d/dt* (LLLT) = LLL. Each snapshot is an isolated system (which is what observation produces). Now we understand that this "isolated system" existed only at a single frozen instant, continually recurring, and never existed continuously in time at all,

So in view of today's physics, the old thermodynamic "isolated system" concept is an early attempt to deal with observation of the system without input or input (without dynamics, hence frozen). "Closed system" is a non sequitur since mass is energy and energy is continuously exchanged across the system 3-boundary in several forms. Both virtual mass and virtual energy are continuously exchanged across the system boundary. It follows that the only type of system existing continuously in nature is the *open system*. The other two "types of thermodynamic systems" are at best only approximations for special cases.

Under modern physics and the new definitions, we conclude that there is no such thing as a truly closed or isolated system continuously existing in the universe. Hence that very definition disappears, *as far as any absoluteness*. It is retained only as a *useful approximation in special cases*, when the more esoteric mass effects and energy effects are intentionally omitted or negligible, and only classical effects are of importance. Any scientist dogmatically objecting to COP>1.0 EM systems on thermodynamics grounds alone, simply reveals his lack of knowledge (or lack of acceptance) of modern physics.

This is similar to the situation existing between Newtonian mechanics and relativistic mechanics. We can still use the Newtonian model for many practical matters, since the relativistic effects are often small and nearly inconsequential. Similarly, the present CTD concept of "closed system" now assumes that kind of relationship to *one class* of open systems in which the more esoteric reactions are negligible or inconsequential. But rigorously, all systems are now open systems, removing a gross non sequitur in CTD which is especially violated by COP>1.0 EM systems including every charge in the universe.

This is a correction to both equilibrium (classical) thermodynamics and disequilibrium thermodynamics. Unfortunately the two disciplines have continued to use the same (old) definitions for closed system and open system. Hence both equilibrium and disequilibrium thermodynamics at present are useful approximations, and their "laws" must not be misinterpreted as "absolute". Thermodynamics remains a very useful model, but further development is also indicated. Indeed, presently such scientific development and extension of the thermodynamic model is being done under the heading of "extended thermodynamics".

A.2 Comments on Problems with Thermodynamics

Quoting, from Kondepudi and Prigogine {727}:

> *"Every system is associated with an energy and an entropy. When matter undergoes transformation from one state to another, the total energy remains unchanged or is conserved; the total entropy, however, can only increase or, in idealized cases, remain unchanged. "*

The absoluteness of that statement is falsified by the solution {12} of the long-vexing problem in CED of a source charge and its associated fields and potentials. The observable charge is a charged mass and thus a Maxwellian system. It is also a thermodynamic system, meeting the present erroneous definition of a "closed system" utilized in both equilibrium and disequilibrium thermodynamics. No observable mass crossed the system boundary, although virtual mass continually crosses it.

The charge is "fed" by a more esoteric energy input in disordered form (the virtual particle flux energy of vacuum), yet it outputs ordered observable EM energy spreading radially outward at the speed of light across the universe. The charge increases and sustains the organized energy density of a volume of space depending on the radius *ct*, where *t* is the time since the formation of the charge and *c* is the speed of light in empty space. This continous outflow of observable energy is a continuous and giant negentropy, exhibited by every source charge and dipole. When positive charge, negative charge, polarization of space, and both positive and negative energy are considered, what is spreading is precisely a reordering of the active vacuum — in short, a giant and increasing negentropy. Since the universe is filled with charges, this is a natural process continuously ongoing everywhere in the universe.

Re-quoting Serway (697}:

> *\The second law [of thermodynamics] does not rule out the possibility of pushing heat uphill, as it were, from a cold object to a hot one, or of creating order out of disorder. It merely states that such a reversal of the natural flow requires an influx of energy... "*

Our comment is that any mechanism by which the system receives extra usable energy in forward time, or is time-reversed, enables the system to permissibly violate any narrow interpretation of the second law of thermodynamics. The second law was formulated in accord with forward time assumed, and with the old definition of "closed system", which erroneously permitted energy exchange but ignored the mass effects of energy exchange. Therefore, the second law is a special case for equilibrium in its energy exchange with its active environment, but effectively allowing its own negation anyway, and it always has. In the new approach with altered definitions, all EM systems are open systems, and they may also be brought into disequilibrium (in excited states or potentialized condition). Thus in theory all systems are permitted to violate the second law, *particularly when broken symmetries in their supersystems are involved.* This is especially true of EM systems, where all the EM field energy and potential energy in the system— even in the matter itself— comes from the active vacuum environment (particle physics view) by means of the broken 3-symmetry of the source charges and dipoles. The condition of 4-symmetry in energy flow exchange together with broken 3-symmetry and t-flow symmetry, is a disequilibrium condition and an excited state. Every charge and dipole already exhibits this state and the giant negentropy condition.

To first order, then, one may say that the present second law assumes no broken 3-symmetry or broken t-flow symmetry in energy flow, while violation of the second law assumes broken 3-symmetry and broken t-flow symmetry.

Quoting Serway {728}:

> *"Thermal equilibrium is a situation in which two objects in thermal contact with each other cease to have any net energy exchange due to a difference in their temperatures."*

Our comment is that net energy exchange — to include time-energy exchange and negative energy emission, absorption, and transduction are not modeled in thermodynamics and are arbitrarily excluded in **the** quoted statement. Since both are exhibited experimentally, the statement is

falsified as far as being absolute. Instead, it is a special case and a useful approximation when some of the esoteric energy considerations are negligible.

Quoting Serway again {729} on the zeroth law of thermodynamics:

> *"If objects A and B are separately in thermal equilibrium with a third object, then A and B are in thermal equilibrium with each other. "*

A corollary is stated by Serway {730} as:

> *"...two objects in thermodynamic equilibrium with each other are at the same temperature. "*

Our comment is that these statements are true if the time-energy exchange is identical among all three. Otherwise, they are not necessarily true. It is not generally true, e.g., for a system in an accelerated frame. Also, the zeroth law is not necessarily true if negative energy (and/or its transduction is involved with one or more of the objects.

An example: A and B are at the same temperature as C, as measured by a thermometer. But A is also emitting negative energy, which is being absorbed by B, to maintain A and B at the temperature of C. A and B are not in real thermal equilibrium in their supersystem interactions, even though they are at the same macroscopic temperature. A second example: A is emitting negative energy to maintain its temperature, while B and C are not. The supersystem of A is not in real thermal equilibrium with the supersystem of either B or C, even though the observed temperatures of A, B and C are the same.

Quoting {731} on what is meant by the term "heat":

> *"...heat is treated as another form of energy that can be transformed into mechanical energy. " ... "The word heat should be used only when describing energy transferred from one place to another. That is, heat flow is an energy transfer that takes place as a consequence of temperature difference only."*

Quoting Lindsay and Margenau {732}:

> *"A complete statement of the first law comprises two* ***assertions:*** *(a) heat is a form of energy, (b) Energy is* ***conserved."***

The statement in (a) that heat is simply a form of energy is misleading, and the statement in (b) that energy is conserved must be expanded to include total energy, not just heat and the presently accounted forms of energy. Specifically virtual particle energy, time-energy, and energy from the curvature of spacetime must be included.

More correctly, heating is a form *of energy disordering* or energy scattering. As previously pointed out, entropy itself was and is conceived as *the dissipation (irretrievable loss) of potential energy*. Heat thus would be the process of energy disordering, which means that heat is a form of the process of entropy (loss of control of the energy). Note the strong non sequitur with the notion that heat is energy. *Heat cannot logically be both energy and the dissipation of energy*. The concept of energy (its mere presence) is not identical to the concept of scattering of energy or transfer of energy, but the concept of heat is identical to it. The thing is not identical to something done to the thing or to transfer of the thing to another place. A form of scattering of order is not a form of ordering. Transfer of heat is a transfer of disordering of energy, not the transfer of energy per se. Hence, considering heat as simply "heat energy" is a fundamental non sequitur of classical thermodynamics, and remains so to the present day and in the present textbooks. For an example of strong support of this position, see Romer {733}. Quoting {734}:

> *"The work done on (or by) a system is a measure of energy transfer between the system and its surroundings, whereas the mechanical energy (kinetic or potential) is a consequence of the motion and coordinates of the system. Thus, when you do work on a system, energy is transferred from you to the system. ... one can refer only to the <u>work done on or by a system</u> when some process has occurred in which the system has changed in some way."*

Our comment: Consider a system which "ping-pongs" the energy it receives from the environment, between two parts of itself. In each part, the form of the energy is changed by that interacting part and that does work upon the part. But the new form of energy remaining after the work was done in that component is not lost but is ping-ponged to the other component, where it does work upon that component, and so on. In this case, each joule of energy input from the environment does more than a single joule of work, with the work performed being limited only by the ability of the system to sustain and contain the "ping-ponging". There is

work but no entropy if the energy doing the work (changing its form) is not lost from system control!

There is no law of "work conservation" in nature, and a joule of input energy can do more than one joule of work (as in this example) if repetitive changes of its form are considered. Thermodynamics arbitrarily excludes such cases, and hence is incomplete. Again, the conventional perception of the absoluteness of thermodynamics is falsified. It models a special case where the energy can be "used" to do work only once, and then all control of the new form of the energy (it is all still there, just in a different form) is lost.

For a particular substance, the heat capacity C is usually defined as *the amount of heat energy needed to raise the temperature of the sample being tested by one degree Celsius.* This definition assumes only one "use" of the *energy to* perform work in the substance, and completely ignores "multipass,multi-use" of the energy to perform more than one joule of work from one joule of input energy. As an example, if an equal amount of positive and negative energy is steadily input, then no amount of the positive heat energy input component would raise the temperature at all. The modern active vacuum, with a local energy density in the region of 10^{80} or more grams per cubic centimeter (expressed in mass units), nevertheless is harmless to living systems immersed in it. It has equal positive and negative energy densities, and so normally inputs the same enormous amount of positive and negative energy in its overall interactions with a living system.

The first law of thermodynamics is usually written as

$$\Delta U = U_f - U_i = Q - W. \qquad [1]$$

This is a highly special case, which does not include time energy transduction (spatial energy transduced into time energy and vice versa), or energy transduced from the active vacuum via the broken symmetry of an electrical system in continuous exchange. The definitions of work and heat have to be changed and drastically extended.

As an example of a legitimate exception, when time-energy T_E is transduced into available spatial energy inside the system, we have

$$\Delta U = U_f - U_i = Q + T_E - (W_D + W_L) \qquad [2]$$

where W_D is the energy that was dissipated in the system losses without doing useful work and W_L is the energy leaving the system but doing useful work in a load L. $(Q + T_E)$ represents the total net energy entering

the system, while $(W_D + W_L)$ is the total energy leaving the system, either as losses or to do useful work in the load. Here we are also incorporating virtual energy under the title of time-energy, since both time and virtual energy are unobservable, and virtual energy "exists in time".

Now suppose Q entering the system, and collected for use in it, is freely furnished from the active vacuum via the broken symmetry of the electrical system's dipolarity. Suppose T_E is spatial energy freely transduced from the time domain by ongoing processes in the system, and thus T_E also enters the system freely. Then suppose that the system processes are deliberately adjusted by the operator so that

$$(Q + T_E) = (W_D + W_L) \qquad [3]$$

In that case,

$$\Delta U = U_f - U_i = 0 \qquad [4]$$

yet continuous loss energy WD is escaping from the working system, useful work W_L is continuously being done in the load, and useful energy $(Q + T_E)$ is continuously entering the system from the active environment (the active vacuum and the local curvatures of spacetime). This system is totally permissible in nature (and is already operating in every charge and dipole in the universe). It is an example of an open system far from equilibrium in *3-space* energy flow, but in equilibrium in *4-space* energy flow. Yet it is artificially excluded by classical thermodynamics.

Classical thermodynamics thus excludes every charge and dipole in the universe, and therefore is an extraordinarily curtailed model. It is a special case approximation having no absolute authority as a proper limiting model of EM systems.
The first law of thermodynamics for infinitesimal changes may be stated as

$$dU = dQ - dW \qquad [5]$$

Following the previous reasoning, for involvement of time-energy transduction (with virtual energy included) we have

$$dU = dQ + dT_E - (dW_D + dW_L) \qquad [6]$$

If dQ and dT_E are freely received in the system from the active vacuum and local curvatures of spacetime respectively, and if

$$dQ + dT_E = dW_D + dW_L \qquad [7]$$

then

$$dU = 0 \qquad [8]$$

So with no change in its internal energy at all, the microsystem or microprocess is receiving excess energy continuously, and also is continuously emitting energy that is doing useful work with some losses. The system is in fact in *energy 4-flow* equilibrium, and doing useful work, without the operator inputting any of the energy.

So the *corrected* standard statement of the first law allows an equilibrium system to steadily produce output work W, if its "energy input Q" is freely received. The first law of thermodynamics, properly extended and reinterpreted, does indeed admit "electrical windmills" operating in free electrical winds.

Now turning to the second law. In effect, the second law prescribes those processed in nature — more exactly, in the prescription of the first law — that may or may not occur. It is a law of limitation. It states that, of all the energy conversion processes permitted by the first law, only certain types of energy conversions can take place. A priori, the validity of its prescription depends totally on the nature of the functions involved in the system considered! However, since we dramatically extended the first law, using neww processes experimentally determined to take place, then we have automatically extended and changed the second law because we used experimentally *proven* functions. The old second law is now revealed as a special case, with no absolute limitations. The perception that it prescribes absolute limitations has been falsified. It is still useful, however, but to be careful one must completely re-examine (and possibly rework) the second law whenever the energy functions of a system are changed. We strongly stress that *the second law is a conditional law, and its application is totally dependent upon the system energy functions behaving in the limited manner assumed by the second law. Whenever the energy functions of the system are changed outside those assumed by the second law, the second law is permissibly invalidated for that system.* In short, in that case the second Iaw is simply a totally inadequate model for that system, and cannot be used as any sort of criterion for stating the "permissibility" or "impossibility" of that system. As an analogy, a model specifying scalars only cannot be applied to a vectorial system as a decisive logical criterion orrestriction.

QuotingSeray{735}:

> *"From an engineering viewpoint, perhaps the most important application [of the second law] is the limited efficiency of heat engines. Simply stated, the second law states that a machine capable of continuously converting*

> *thermal energy completely into other forms of energy cannot be constructed."*

Our comment is that, if we believe that energy is conserved in the entire universe, then the universe itself already violates Serway's statement. If we consider the seething virtual particle flux energy of the active vacuum as a special form of thermal energy, then every charge and dipole in the universe already is a heat engine that falsifies the second law of thermodynamics. The charge and dipole continuously absorb this special form of thermal (virtual flux) photon energy, and also continuously convert it into real, observable photon emission in 3-space. This is negentropy on a giant scale, already demonstrated by every charge and dipole and thus experimentally falsifying the present second law.

Classical thermodynamics also assumes irreversibility. While many of the physics models and equations prescribe reversible reactions, thermodynamics takes the view that events occur with a much greater probability in one direction in time than in the other. This of course is usually borne out in our perception of the gross observable universe around us. However, charge conservation alone requires equal amounts o| charge and time-reversed charge. With the nearly ubiquitous time-reversed charge and charge conservation, it follows that some factor not accounted for in thermodynamics is operating in the universe. And so it is, but it is a general relativistic factor. We shall use a biological example of the cellular healing mechanism we discovered in the living body {736}, extending Becker's work and Priore's work.

Normally most processes do not involve deliberate net transduction of time-energy into spatial energy, nor do we model and account for the specific set of ongoing interactions between every part of the system **and** its concomitant set of spacetime curvatures acting back upon it. Call that set of spacetime curvatures the *resident spacetime curvature engine* ***and its*** *dynamics,* or just *its engine* for short. The engine is comprised of structured energy and energetics, and it is already experimentally demonstrated in nonlinear phase conjugate optics that energy can be **time** reversed. The engine's spacetime curvatures act directly upon the **mass-**energy dynamics of the system. Time-reversing the system's operation is a matter of producing a sufficiently amplified, phase conjugated engine to act in reverse upon the physical system and overpower its resident **engine.** In that case, the thermodynamic system and its functioning can be **made to** run backward.

In fact this is the fundamental mechanism used by the body's own cellular regenerative system to heal its damaged cells. To a limited degree, the body is able to "pump" its cells in the time-domain (with time-energy), thus producing an amplified "phase conjugate energy and engine dynamics".

Pumping a living cell with time-energy is interesting. The resident engine serves as the "signal input wave" in conventional nonlinear phase conjugate optics, and the output time-reversed engine (the amplified anti-*engine*) serves as the "phase conjugate replica wave". A sufficiently simplified anti-engine acts upon the cell and all its tiniest parts, time-reversing all energetic operations in exact phase, proportion, and timing. This is themechanism for thermodynamic reversibility. It is also the "secret" to eventually reversing aging.

This action is upon all the energetics of the cell and its parts, including the mass-energy and mass-energetics as well.

The result of the action of the anti-engine is to slowly time-reverse the damaged cell and all its parts back to a previous state and dynamics. Electromagnetic amplification of the process was unwittingly demonstrated by Priore {737} and by Becker {738}. We refer the reader to our website {739} and to our "porthole briefing" for pertinent technical information, and for a most important extension and great simplification of the Priore/Becker approach and methodology.

Present classical thermodynamics does not consider or model the reaction of local spacetime curvatures and their dynamics upon the system. Hence all time-domain pumping that occurs is occurring rather randomly in each and every microscopic part of the system. In short, there is no organized anti-engine, and an organized anti-engine is what is required for time-reversing the system's operations back to a previous state. However, by mimicking, the body and pumping the physical process in the time-domain, with sufficient pumping a precise, amplified anti-engine will be formed and act upon the system — *any* system. The applicability is limited only by the state of development of the appropriate time-pumping technology.

In theory (and as experimentally demonstrated unwittingly by Prior e and by Becker), this anti-engine can and does overpower the resident engine. It can in fact time-reverse the pumped physical processes in the system itself.

So the classical thermodynamics assumption of irreversibility for heat engine energy processes is not absolute but only provisional. Specifically, it assumes no overall time-domain pumping process that provides a precise

anti-engine and time reversal of the system energetic process of concern and its dynamics.

If the second law is extended to encompass and model the new concepts such as broken symmetry and time-energy, then the extended second law will encompass reversible heat engine processes, Maxwell's demons, COP>1.0 electrical systems, COP » 1.0 electrical systems (electrical windmills), time-reversal of the dynamics, reversibility of that which has been irreversible, etc.

As given by Kondepudi and Prigogine, the third law of thermodynamics essentially states {740} that

> "... *at the absolute zero of temperature the entropy of every chemically homogeneous solid or liquid body has a zero value."*

This is also known as Nernst's heat theorem, after W. Nernst who proposed it in 1906. The third law states that

$$S \rightarrow 0 \text{ as } T \rightarrow 0 \qquad [9]$$

Certain violations of the third law are already known. E.g., C=O: carbon monoxide molecules can align in various ways in a crystal, so there is entropy associated with C=O crystals at 0°K. In this case, A and B are equally probable and the following equation can be used to calculate the entropy (called residual energy):

$$S = nR\,[1/2\ln(1/2) + 1/2\ln(1/2)] = -nR\ln 2 \qquad [10]$$

From the new viewpoint, the definition of T = 0° is open to change. Rigorously, the present third law assumes no local broken 3-symmetry of the vacuum's flux exchange with the system, and it also assumes no broken time-energy flow symmetry. In the new approach, both these symmetries can and are broken by every charge while a higher 4-symmetry is maintained. This leads to a giant negentropy, so that the "calculation of entropy" via Nernst's theorem fails. A fundamental charge at T = 0° thus continues to exhibit giant negentropy, in total violation of the third law of classical thermodynamics. Hence the third law is also devoid of any absoluteness, and it is reduced to a special case statement. It remains useful where the more esoteric energy interactions are negligible.

We have now demonstrated (by citing actual substantiating experiments) that all the laws of CTD are falsifiable insofar as being absolute. Hence they have *no* absoluteness. Instead, they are special case models and "approximation laws" only. They remain very useful and applicable,

However, so long as the more esoteric energy interactions of the supersystem do not play a major role in the system operation.

We conclude that the present form of classical thermodynamics and disequilibrium thermodynamics are special case models — as indeed is every model, by Godel's theorem and proof alone — with no absoluteness. They do not prohibit COP>1.0 EM systems, nor can they necessarily be used torule out COP>1.0 EM systems.

This also falsifies all current arguments that COP>1.0 EM systems violate either the first, second, or third law of classical thermodynamics. Calling COP>1.0 systems "perpetual motion machines of the first, second, and third kind", according to which law they supposedly violate, is a total non sequitur. Indeed, every original charge in the universe has already demonstrated just such "perpetual motion" for some 14 or so billion years, andhappily violates all three laws of the present CTD. Every charge is in violation of the "laws" of the present models of CTD, CED, and EE, and it is still in motion and still freely pouring out EM energy. We have no abillity to examine the notion of "perpetual" past the entire past existence of the universe.

All three models examined — CTD, CED, and EE — are seriously out of date and in need of revision and extension, because any absoluteness of their predictions and assumptions is already falsified by actual experiments and examples. Some work is already ongoing to extend thermodynamics, but is not nearly extensive enough. A thorough overhaul of the very foundations is what is needed for all three models. The three models remain useful as special case approximations, but their received use to arbitrarily rule out COP>1.0 EM systems is dogma, not science because such use is already experimentally refuted by every charge in the universe.

Appendix B
Maxwell's Demon: Alive and Thriving

Introduction

ITHERE is a long history of discussion over "Maxwell's demon", a fictitious being that Maxwell proposed to "sort" molecules striking a barrier between two volumes of gas initially at the same temperature. By intentionally opening a trap door between two for hotter, more energetic molecules to pass through from the left side to the right side, but shutting the door for lower lemperature molecules so that they are retained on the left side, eventually a temperature gradient would "freely" exist between the two reservoirs. In theory, then, if one had the demon working "for free", one would be able to utilize the temperature difference between the reservoirs to perform free work. Then one could repeat the demon's sorting procedure, to obtain more free work again. And so on.

The prevailing discussions have ignored the main feature: the fact that the demon is part of the "external environment" (i.e., not under control of the system, and operating independently of any energy input by the operator). Maxwell's demon represents an analogy to the system's environment furnishing free energy (free ordering and sorting). A lot of breath and mental gyrations have gone into the discussions over the years, with very little concrete experimental examination. The prevailing concept in science, which still adheres to the "absoluteness" of the second law of thermodynamics, is that Maxwell's demon is impossible.

Recently, the former editor of *Nature,* Dr. John Maddox, wrote a very clear emeritus editorial on Maxwell's famous demon, repeating the standard conclusion that such is not possible. Since there are specific examples in physics of what can be called "experimentally proven Maxwell's demons," the present author prepared a respectful commentary to *Nature* to refute the standard erroneous thesis in the interest of science. since experiment is supposed to be decisive in physics, we hoped that citing overwhelming experimental proof would be sufficient. It wasn't.

Almost symbolically (i.e., "free the demon!"), I submitted the commentary to the editor by I -mail on the evening of July 4, 2002. The very next day I received rejection (not too unexpected) by E-mail with no further discussion accepted. So I wrote a polite note in response, and then posted my commentary note on my website.

In this appendix, I include my E-mails of both 4 July and 5 July 2002, and then include the commentary that was submitted. The reader can read the cited emeritus editorial in *Nature*, and then decide for himself or herself whether experiment still rules the day at *Nature* where COP>1.0 and COP = co EM systems are concerned.

E-mail to *Nature* 4 July 2002, submitting the Commentary.

Dear Editor:

Attached is a significant commentary on John Maddox's excellent emeritus editorial on Maxwell's demon, titled "Slamming the Door," *Nature*, 417, 27 Jun. 02, p. 903.

Forms of Maxwell's demon are very much alive and thriving, and experimentally confirmed, as we develop very clearly in this commentary. They are unwittingly used widely in electrodynamics, though seldom recognized.

Most sincerely,
Tom Bearden, Ph.D., Magnetic Energy Ltd.

E-mail to *Nature* 5 July 2002, submitting a comment on the rejection.

Dear Ms XXX:

Thanks for the prompt reply.

Since *Nature* will not be publishing the note, I have now posted it on my website (some 80,000 hits per day from all over the world). It can be **seen** at http://www.cheniere.org/articles/maxwells%20demon.htm

This is a respectful article, and I just thought the experimental information needed getting out there to the scientific community. I also understand you cannot discuss it further. I only wish to note that it is based on cited replicable experiments, which are supposed to be the decisive thing in science and scientific method. It seems a bit odd that you would not publish the results of several replicable and replicated experiments **that** falsify a prevailing theoretical thesis and conclusion. Nonetheless, I respect the wishes of *Nature*, and I do enjoy the Journal each week.

Best wishes,
Tom Bearden, Ph.D.

Within days of this rejection, the paper by Wang et al. {741} was published, extending the known physics "Maxwell's demon" regime (i.e., where the second law of thermodynamics is known to be violated) from the atomic scale and very short periods of time, to the micron scale in size and time up to a few tenths of a second.
Here is the rejected commentary I submitted to *Nature.*

Maxwell-type demons are alive and thriving

The recent emeritus editorial by Maddox on Maxwell's demon [742] is a short overview of one historical aspect of would-be negentropy, but much greater thought on the subject needs to be given. Indeed, Maxwell's demon is alive and thriving, but just in a different form not requiring a nimble-fingered microscopic being. We now discuss such experimentally proven demons.

Consider the prevailing ansatz that Maxwellian systems outputting more EM energy than the energy input by the operator or experimenter are impossible. Such proposed systems are said to constitute examples of forbidden perpetual motion machines because they violate the second law of classical (equilibrium) thermodynamics. That prevailing ansatz has been falsified in classical electrodynamics since the 1880s, and in particle physics for 45 years, but eerily it is still the prevailing scientific opinion nonetheless.

The ansatz can be experimentally disproved in classical electrodynamics as follows: Lay a charged capacitor or electret on a permanent magnet so the E-field of the capacitor or electret is at right angles to the H-field of the magnet. That optimizes $\mathbf{S} = f(\mathbf{E} \times \mathbf{H})$, and hence optimizes the continuous flow of Poynting EM energy from that simple device, even though the fields, seem to be "static". As Buchwald states [743], *"[Poynting's result] implies that a charged capacitor in a constant magnetic field which is not parallel to the electric field is the seat of energy flows even though all macroscopic phenomena are static. "* [744] This simple device will freely pour EM energy indefinitely, so long as it remains intact.

We consider a special but universal kind of related Maxwell's demon problem: the vexing problem of the source charge, sometimes called "the most difficult problem in classical and quantum electrodynamics." [745] Any charge pours out observable EM energy continuously in all directions, at the speed of light, with no *observable* EM energy input. This continuous flow of EM energy establishes the charge's related fields and potentials and their energy, reaching even across the universe for very old charges. In

the classical electrodynamics (CED) model and therefore in electrical engineering, there is no solution to this problem because CED does not model *nonobservahle* EM energy inputs such as the virtual particle flux exchange of the charge with its vacuum environment.

With no solution available in CED, then the present CED and electrical engineering assume that every charge in the universe *freely and continuously creates energy out of nothing,* and pours it out in all directions, forming its associated fields and potentials and their energy. Either we must solve the problem in the classical EM model, or totally surrender the conservation of energy law in the model in its present limited form. Or — as is presently the case — we may continue to ignore it, as has been done during the 45 years since the proof of broken symmetry in particle physics [746].

On the other hand, particle physics models and utilizes virtual energy **in** the seething vacuum, including the interactions of the vacuum with charge, With the 1957 experimental proof of broken symmetry by Wu et al., [746] certified by the award of the Nobel Prize to Lee and Yang later that **same** year, one of the proven broken symmetries in the vacuum virtual energy exchange is the asymmetry of opposite charges, such as are on the ends of a dipole. For a dipole or dipolarity, then by the very definition of broken symmetry *something virtual has become observable.* We diverge for a moment, and then will return to this proven asymmetry of the opposite charges of the dipole.

If we take the modern view of the bare charge clustered by virtual **charges** of opposite sign, then the magnitude of the bare charge in the middle is infinite (including its energy) and so is the magnitude of the charge of the surrounding clustering virtual charges. [747] So for an "isolated **observable** charge" we actually have a sort of "infinitely powerful dipole". Yet **the** difference between these two infinite values of charge is finite; it is routinely calculated as the observed charge of an elementary charged particle, the value that is listed in standard texts and handbooks.
The asymmetry of this "opposite composite charges" model of the "isolated observable charge" now explains the long-vexing source **charge** problem. The observable "composite" charge continuously absorbs **virtual** photon energy from the seething vacuum exchange, transduces it **into** observable photon energy excitation, and this excited state **continuously** decays to emit real observable photons in all directions at the speed of light. When *virtual* energy input as well as *observable* energy output is accounted, the charge's proven asymmetry in the vacuum exchange **makes** the source charge an open system far from equilibrium in its active

environment. As an open disequilibrium system the charge is thermodynamically permitted to (1) self-order (hence coherently integrate absorbed virtual photon energy into observable photon energy), (2) self-oscillate or self-rotate (spin), (3) output more energy than the "operator" **inputs** (the operator inputs none at all), and (4) exhibit negentropy. Every charge in the universe is already doing those four functions. It is also a system having a COP (coefficient of performance, or useful energy output divided by the operator's energy input) of COP = oo, since the operator inputs nothing.

In short, every charge in the universe already is a special kind of known "Maxwell's demon", whose operational mechanism is long since proven in particle physics but does not appear in classical electrodynamics or electrical engineering. It is a dependable Maxwell's demon, since all charges in the original matter in the universe have been pouring out real EM energy freely, using this asymmetry mechanism, for some 14 billion years, **and** they continue to do so. Further, any charge one assembles in the laboratory instantly starts up its Maxwellian demon performance automatically, and it will continuously pour out EM energy in all directions indefinitely, so long as the charge remains intact. So this demon is easi**ly** created and demonstrated experimentally. The Maxwell's demon fot freely extracting copious EM energy from the vacuum is one of the easiest entities to invoke in all of physics

This is **not** a violation of thermodynamics, since classical *equilibrium thermod*ynamics with its infamous second law does not apply because the charge is far from equilibrium in its exchange with its active vacuum environment. Although the COP = oo, the *efficiency* of the charge system -defined as the useful energy output divided by the total energy input from all sources — is never more than 100%. Hence this is not a perpetual motion machine, and the charge rigorously does not create energy; it only transduces energy input to it in a novel form. In this case, the charge can permissibly act as if it were a free electrical windmill turning in a novel free electrical wind due to its asymmetry in the vacuum flux.

So every charge in the universe exhibits COP = oo, clearly proving that Maxwell's demon in an improved form exists and is thriving throughout the universe. There would be no EM fields and potentials and their energy, and hence no electrical circuits or power systems, were it not for this asymmetry of the charge in its virtual energy exchange with the vacuum, making the charge a true Maxwell's demon.

In the usual CED model and electrical engineering, the 1867 L. V. Lorenz symmetrical regauging (later credited to H. A. Lorentz) [748] of the equations carefully selects only those Maxwellian systems that have two simultaneous equal and opposite disequilibria with their active environment. This assumes that the potential energy of the system is freely changed twice (by gauge freedom), but only in such highly selected manner as to form two equal and opposite new "free" force fields in the system. These two force fields perform *internal work* inside the system continuously, increasing its stress (and its stress potential, thereby curving local spacetime). Since there is no *net resultant* force field, the two force fields are unable to translate electrons in the circuit to do free *external* work in the external load. So the symmetrically regauged Maxwellian system has been altered: its energy has been changed twice, forming a stress potential inside it and increasing and maintaining that stress on the system, and the frame of the system has been somewhat rotated out of the laboratory frame. The symmetrically regauged Maxwellian system most decidedly is not identical to the system prior to regauging.

We note merely that the common Lorentz symmetrical regauging unwittingly assumes two Maxwell's demons of yet different kind, each freely fueled from the local vacuum environment, and each continuously performing internal work upon the system to produce and maintain system stress.

Gauge freedom is thus revealed as a special kind of Maxwell's demon, since (1) it assumes that the potential energy of a system can be freely changed at will at any time, and (2) unless we abandon the conservation of energy law, that energy change must have involved energy exchange with the external environment. So the gauge freedom axiom of quantum field theory assumes two specialized Maxwellian demons — i.e., mechanisms for transfer of energy between environment and system, so as to continuously perform internal work upon the system. In this case the two demons are equal and opposite, and fight each other to a draw insofar as performing any useful external work.

Oddly, in present electrical circuits the ubiquitous but *arbitrary* closed current loop circuit — passing all spent current from the external circuit back through the source dipole in the generator against the dipole's back emf— self-imposes Lorentz regauging of excitation discharge in the circuit and prevents COP>1.0 functioning. This is not required by thermodynamics in general! Indeed, several areas are already known to violate present thermodynamics. Sharp discharges (strong gradients), for example, are known to violate it. [749] Other known areas where

thermodynamics is violated include rarefied media, and anomalous memory effects in materials. Modern research is being conducted in such areas under the heading of "extended thermodynamics". [750].

Since experiment and not theory is primary in science, let us consider some additional actual Maxwell demon experiments. The well-known "negative resonance absorption of the medium" produces more output energy than the operator inputs to the experiment, with hundreds of these experimcntsdone every year routinely by many nonlinear optical laboratories. As an example, Bohren's version of such an experiment [751] commonly outputs 18 times as much EM energy as the operator inputs, exhibiting COP = 18. Independent replication of Bohren's work by Paul and Fischer [752] is reported in the same journal issue.

Added to the charged capacitor lying on a permanent magnet, there thus exist plenty of proven, replicated experiments which can be easily performed to demonstrate a Maxwellian demon operating in a Maxwellian system and freely producing COP>1.0, or even COP = oo. Because of the demon (the operational mechanism), these experiments all involve open systems far from equilibrium with their active environment. Hence they are not limited by the second law of classical equilibrium thermodynamics.

In short. Maxwell's demon is very much alive in many forms and is thgiving after all. It has just been hiding in different form than what is usually suspected.

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ENDNOTES

1. (a) Albert Einstein, "Foreword," in (b) Max Jammer, *Concepts of Space: The History of Theories of Space in Physics,* Harvard University Press, Cambridge, Massachusetts, 1969, p. xi-xii.

2. George Zebrowski, "The holdouts," *Nature,* Vol. 408, 14 Dec 2000, p. 775; expressing the thinking of Stephen Hawking, one of the leading physicists of our day.

3. Mario Bunge, *Foundations of Physics,* Springer-Verlag, New York, 1967, p. 176.

4. (a) J. H. Poynting, "On the transfer of energy in the electromagnetic field," *Phil. Trans. Roy. Soc. Lond,* Vol. 175, Part II, 1884, p. 343-361; (b) — "On the Connection Between Electric Current and the Electric and Magnetic Inductions in the Surrounding Field," *Phil. Trans. Roy. Soc. Lond,* Vol. 176, 1885, p. 277-306.

5. (a) Oliver Heaviside, "Electromagnetic Induction and Its Propagation," *The Electrician,* 1885, 1886, 1887, and later — a series of 47 sections, published section by section in numerous issues of *The Electrician* during 1885, 1886, and 1887; (b) —*Electromagnetic Theory, 3 vols., Benn,* London, 1893-1912. Second reprint 1925. An unabridged edition of all three volumes, with a critical and historical introduction by **E. Weber,** was published by Dover, New York, 1950. See particularly (c) - "On the Forces, Stresses, and Fluxes of Energy in the Electromagnetic Field." *Phil Trans. Roy. Soc. London,* 183A, 1893, p. 423-480. In this prestigious publication, Heaviside discusses the Faraday-Maxwell ether medium, outlines his vector algebra for analysis of vectors without quaternions, discusses magnetism, gives the EM equations in a moving medium, and gives the EM flux of energy in a stationary medium. On p. 443, he credits Poynting with being first to discover the formula for energy flow, with Heaviside himself independently discovering and interpreting this flow a little later by himself in an extended form.

6. E.g., a polite debate has continued at intervals, for about 30 years, in the Am. J. *Phys.* alone.

7. Richard P. Feynman, Robert B. Leighton, and Matthew Sands, *The Feynman Lectures on Physics,* Addison-Wesley, Reading, MA, Vol. 1,

8. *Ibid.*, Vol. 1, 1964, p. 12-2.

9. *Ibid.*, Vol. 2, 1964, p. 2-1.

10. John D. Kraus, *Antennas*, Second Edition, McGraw Hill, 1988.

11. Raymond A. Serway, *Physics for Scientists and Engineers with Modern Physics*, Third edition, updated version, Saunders College Publishing, Philadelphia *et al*, 1990, p. 620.

12. T. E. Bearden, "Giant Negentropy from the Common Dipole," J. *New Energy*, 5(1), Summer 2000, p. 11-23. Also on website www.cheniere.org.

13. (a) T. D. Lee, "Question of Parity Conservation in Weak Interactions," *Phys. Rev.*, 104(1), Oct. 1, 1956, p. 254-259; (b) — with Reinhard Oehme and C. N. Yang, "Remarks on Possible Noninvariance under Time Reversal and Charge Conjugation," *Phys. Rev.*, 106(2), 1957, p. 340-345; (c) — and C. N. Yang, "Parity Nonconservation and a Two Component Theory of the Neutrino," *Phys. Rev.*, 105(5), Mar. 1, 1957, p. 1671-1675.

14. C. S. Wu, E. Ambler, R. W. Hayward, D. D. Hoppes and R. P. Hudson, "Experimental Test of Parity Conservation in Beta Decay," *Phys. Rev., Vol.* 105, 1957, p. 1413.

15. We published it crudely two years later. See T. E. Bearden, *Quiton/Perceptron Physics: A Theory of Existence, Perception, and Physical Phenomena*, NTIS Report AD-763-210, 1973.

16. A time-reversal zone is a momentary tiny region of the fluid wherein antiphoton reactions with the main ions predominate over **photon** reactions.

17. See T. E. Bearden, "EM Corrections Enabling a Practical Unified Field Theory with Emphasis on Time-Charging Interactions of Longitudinal EM Waves," *J. New Energy*, 3(2/3), 1998, p. 12-28. A slightly expanded paper by the same title is published in *Explore*, 8(6), 1998, p. 7-16.

18. E.g., see Xiaodong Chen, "A New Interpretation of Quantum Theory — Time as Hidden Variable," Los Alamos National Laboratory web site, arXiv:quant-ph/9902037 v3, 11 Feb. 1999. Using two more **time** variables as the quantum hidden variables, Chen derives Dirac's field equation under the principle of quantum physics, and then extends **the**

method into quantum fields with arbitrary spin number. Chen's model offers very interesting unifications of quantum mechanical behavior.

19. F. Mandl and G. Shaw, *Quantum Field Theory*, Wiley, 1984, Revised Edition 1993, Chapter 5. This is a deeper coverage of the photon polarizationd. Mandl and Shaw argue that the longitudinal and scalar (time-polarized) polarizations are not directly observable, but only in combination, where they manifest as the "instantaneous" Coulomb (i.e., electrostatic) potential. This argument, translated from particle terminology to wave terminology, directly fits and strongly supports my reinterpretation {12} of Whittaker's 1903 wave decomposition of the scalar potential {85}. The reinterpretation also represents the discovery of the giant negentropy process favored by nature, easily evoked by breaking 3-symmetry (as by forming a simple dipole).

20. James Clerk Maxwell, "A Dynamical Theory of the Electromagnetic Field," *Roy. Soc. Trans.*, Vol. CLV, 1865, p 459. Read Dec. 8. 1864. Also in *The Scientific Papers of James Clerk Maxwell, 2* vols, bound as one, edited by W. D. Niven, Dover, New York, 1952, Vol. 1, p. 526-597. In this seminal paper, Maxwell's equations of the electromagnetic field are given in "Part III, General Equations of the Electromagnetic Field," p. 554-564. On p. 561, Maxwell lists his 20 variables. On p. 562, he summarizes the different subjects of the 20 equations, being three equations each for magnetic force, electric currents, electromotive force, electric elasticity, electric resistance, total currents; and one equation each for free electricity and continuity.

21. B. J. Hunt, *The Maxwellians*, Cornell University Press, 1991 gives the history of the alteration of Maxwell's field theory by Fitzgerald, Heaviside, Lodge, and Hertz. In an appendix, Hunt makes a comparison between the standard expressions of the Maxwell field equations and their expression in quaternionic form.

22. E.g., J. D. Jackson, *Classical Electrodynamics*, 2nd Edition, Wylie, 1975, p. 219-221.

23. Willis E. Lamb Jr. and Robert C. Retherford, "Fine structure of the hydrogen atom by a microwave method," *Phys. Rev.*, 72(3), Aug. 1, 1947, p. 241-243. Lamb received the 1955 Nobel Prize in physics jointly with Polykurp Kush for experiments measuring the small displacement later called the "Lamb shift" of O+ne of the energy levels in atomic

hydrogen. This is a small "vacuum energy" effect, but the *energy density* involved is greater than the surface energy density of the sun.

24. Craig F. Bohren, "How can a particle absorb more than the light incident on it?" *Am. J. Phys.*, 51(4), Apr. 1983, p. 323-327. Under nonlinear conditions, a particle can absorb more energy than is in the light incident on it. Metallic particles at ultraviolet frequencies are one class of such particles; insulating particles at infrared frequencies are another.

25. See also H. Paul and R. Fischer, "'(Comment on "How can a particle absorb more than the light incident on it?')," *Am. J. Phys.*, 51(4), Apr. 1983, p. 327 for a replication and validation of Bohren's experiment,

26. H. B. G. Casimir, "On the attraction between two perfectly conducting plates," presented at a meeting of the Royal Netherlands Academy of Arts and Sciences on 29 May, 1948. Published in the same year in *Proc. Koninklijke Nederlandse Akad. van Wetenschappen*, Amsterdam, vol. 51(7), 1948, p. 793-796. In English. It is an extrapolation of the more detailed paper of Casimir and Polder, 1948.

27. S. K. Lamoreaux, "Demonstration of the Casimir Force in the 0.6 to 6 micro m range," *Phys. Rev. Lett.*, 78(1), Jan. 6, 1997, p. 5-8. Lamoreaux gives a rigorous experimental verification of the Casimir effect.

28. Franklin B. Mead and Jack Nachamkin, "System for Converting Electromagnetic Radiation Energy to Electrical Energy," U.S. Patent No 5,590,031. An invention for extracting energy from the vacuum via the proven Casimir effect.

29. (a) Floyd Sweet and T. E. Bearden, "Utilizing Scalar Electromagnetics to Tap Vacuum Energy," *Proc. 26th Intersociety Energy Conversion Eng. Conf. (IECEC '91)*, Boston, Massachusetts, 1991, p. 370-375. Sweet's device produced 500 watts output from a 33 microwatt **input** by the operator. A highly successful anti-gravity experiment designed by the present author was also performed, and is reported in the paper. Unfortunately, Sweet later died and never fully revealed the activation secret by which barium ferrite magnetic materials could be in self-oscillation at 60 Hertz. Weak self-oscillation of such permanent magnetic materials at higher frequency is now known, of course. E.g., see (b) V. E. Zakharov and V. S. L'vov, "Parametric excitation of spin waves in ferromagnets with magnetic inhomogeneities," *Sov. Phys. Solid State*, 14(10) 1973, p. 2513. Particularly see (c) V. S. L'vov, *Wave Turbulence Under Parametric Excitation: Applications to Magnets*, Springer Series in

Nonlinear Dynamics, Springer-Verlag, New York, 1994. Self-oscillation can in fact be induced in permanent magnet materials. We comment that, while a permanent magnet is in self-oscillation, a simple set of wires or a coil around the magnet will receive EM energy by induction, and can power a very tiny load in a closely adjacent circuit.

30. T. E. Bearden, "Bedini's Method for Forming Negative Resistors in Batteries," *J. New Energy*, 5(1), Summer 2000, p. 24-38. Also carried on restricted DoE website http://www.ott.doe.gov/electromagnetic/ and on the present author's open website http://www.cheniere.org.

31. Teruo Kawai, "Motive Power Generating Device," U.S. Patent No. 5,536,518.Jul. 25, 1995. My board of directors and I were physically present when the Kawai system, company, etc. were seized by what can only have been the Yakuza (Japanese mafia), even though Kawai was being backed by one of the wealthiest investors in Japan. I had just reached an agreement with Kawai to produce and market his overunity motor worldwide. Several legitimate Japanese overunity systems, ready for production, have been stopped in this fashion. Kawai's process, applied with efficient switching such as photon-coupled switching, essentially doubles the COP of the motor to which it is applied. If one starts with a high efficiency (e.g., Hitachi) permanent magnet electric motor of 0.7 or 0.8, one can expect to produce COP = 1.4 and 1.6 respectively, the actual results obtained by Hitachi tests of two Kawai-modified Hitachi motors. We accent that the efficiencies of the motors remain less than 100% at all times.

32. Gabriel Kron, "Electric circuit models of the Schrodinger equation." *Phys. Rev.* 67(1-2), Jan. 1 and 15, 1945. Quoting, p. 41: *""Now a value E of the negative resistances, at which the generator current becomes zero, represents a state at which the circuit is self-supporting and has a continuous existence of its own without the presence of the generator, as the negative resistances just supply the energy consumed by the positive resistances. ... When the generator current is positive the circuit draws energy from the source, and when the current is negative the circuit pumps back energy into the source. At zero generator current the circuit neither gives nor takes energy, and theoretically the generator may be removed."* In this passage, Kron was required to insert the word "theoretically". Kron was the chief scientist for General Electric on the Network Analyzer project at Stanford University before WW II. In the 1930, he did successfully build negative resistors (at least three), and he

did successfully power the network analyzer with them. He was never permitted to release the technical details, although he placed judicious hints in several of his papers, and slipped certain key phrases past the censors. Interestingly, Sweet was his protegee, and it is conceivable that the basis for Sweet's device may have been Kron's original negative resistor. Independent tests and verification of the Sweet device were performed by Walter Rosenthal, a retired professional test engineer of considerable experience.

33. Shoukai Wang and D. D. L. Chung, "Apparent negative electrical resistance in carbon fiber composites," *Composites, Part B,* Vol. 30, 1999, p. 579-590. Apparently the referees required the replacement of the term "negative electrical resistance" by the term "apparent negative resistance". In the paper, simply examine the actual results shown in the curves of the negative-going current, against the voltage, with the line passing directly through the origin. That is a true negative resistance, not a differential one or an "apparent" one. A patent was filed on this invention.

34. (a) T. H. Moray, *The Sea ofEnergy,* 5th Edn., Salt Lake City, 1978. The Moray device weighed 55 pounds and produced 50 kilowatts of power in the late 1930s, and was demonstrated to scientists and engineers numerous times, Moray made tubes which actually contained very special semiconductors, three of them in contact, each pressed at high pressure during a sintering process. A very eerie chain of circumstances eventually destroyed the device. Moray rode in a bulletproof car, and he was sometimes fired at from the sidewalk or an alley. A double agent, working for both the U.S. and the Soviet Union, infiltrated his lab and eventually destroyed the device. The Morays were never given a proper scientific hearing and were never funded for full development. T. Henry Moray was shot and wounded in his own laboratory, wrestling with a would-be assassin. Yet so many expert engineers and scientists witnessed and tcsted the machine in operation that there is no question of its legitimacy. Unfortunately, the reference cited is not at all a satisfactory scientific examination of the Moray device. A related U.S. patent was issued which at least shows some details of the Moray tube: See (b) Thomas H. Moray, "Electrotherapeutic Apparatus," U.S. Patent No. 2,460,707, Feb. 1, 1949. I personally received a treatment on a Moray device for severe pain, and the relief was rapid and remarkable.

35. See (a) William B. Burford III and H. Grey Verner, *Semiconductor Junctions and Devices: Theory to Practice,* McGraw-Hill,

New York, 1965, Chapter 18: Point-Contact Devices. The very first transistor — the point contact transistor — also often exhibited negative resistance. Quoting, p. 281:

"First, the theory underlying their function is imperfectly understood even after almost a century..., and second, they involve active metal-semiconductor contacts of a highly specialized nature. ... The manufacturing process is deceptively simple, but since much of it involves the empirical know-how of the fabricator, the true variables are almost impossible to isolate or study. ... although the very nature of these units limits them to small power capabilities, the concept of small-signal behavior, in the sense of the term when applied to junction devices, is meaningless, since there is no region of operation wherein equilibrium or theoretical performance is observed. Point-contact devices may therefore be described as sharply nonlinear under all operating conditions."

Certainly degenerate four-wave mixing and therefore time reversal can occur in in semiconductors. E.g., see (b) R. K. Jain, "Degenerate four-wave mixing in semiconductors: application to phase conjugation and to picosecond-resolved studies of transient carrier dynamics." *Opt. Eng.*, 21(2'), March/April 1982, p. 199-218. We also point out that hole current can be emitted from an n-type semiconductor having a metallic point placedd on its surface, and hole current will move against the voltage (electron current view). A process (patent pending) by Bedini and Bearden have shown that a capacitor may be charged by hole current, and then discharge electron current, effectively transducing negative energy into positive energy. It is therefore possible (Bedini's method) to switch a capacitor from a hole-current charging circuit by a hole-emitting process, to a bypass capacitor across a source such as a battery after the capacitor has reached higher charge voltage than the source. The capacitor will then charge the battery and power the circuit as well, during that portion of its discharge cycle while its voltage is above that of the battery. This is a legitimate COP>1.0 process, invented by Bedini.

36. (a) William Jay Fogal, "High Gain, Low Distortion, Faster Switching Transistor." U.S. Patent No. 5,196,809, Mar. 23, 1993; (b) — "High Gain, Low Distortion, Faster Switching Transistor." U.S. Patent No. 5,430,413, July 4, 1995. The Fogal semiconductor can be rigged to perform the permitted degenerate four-wave mixing and therefore time reversal. It can thus be rigged as a true negative resistor, where the current moves against the voltage.

37. Stephen L. Patrick, Thomas E. Bearden, James C. Hayes, Kenneth D. Moore, and James L. Kenny, "Motionless Electromagnetic Generator," U. S. patent # 6,362,718, March 26, 2002.

38. (a) T. E. Bearden, "Energy from the Active Vacuum: The Motionless Electromagnetic Generator," in M. W. Evans (Ed.), *Modern Nonlinear Optics,* Second Edition, Wiley, 2001, Part 2, p. 699-776; (b) M. W. Evans, P. K. Anastasovski, T. E. Bearden *et al.,* "Explanation of the Motionless Electromagnetic Generator with 0(3) Electrodynamics," *Found. Phys. Lett,* 14(1), Feb. 2001, p. 87-94; (c) M. W. Evans, P. K. Anastasovski, T. E. Bearden *et ah,* "Explanation of the Motionless Electromagnetic Generator by Sachs's Theory of Electrodynamics," *Found Phys. Lett.,* 14(8), Aug. 2001, p. 387-393.

39. A version of the MEG was also independently replicated by J. L. Naudin. See his website at http://jnaudin.free.fr/html/meg.htm .

40. T. E. Bearden, "Dark Matter or Dark Energy?", *J. New Energy,* 4(4), Spring 2000, p. 4-11.

41. See Chapter 4 for a high-level expose of this methodology.

42. Sweet and Bearden, {29a). Sweet performed an antigravity experiment designed by the present author, and successfully reduced **the** weight of an object on the laboratory bench, by 90%. Sweet's solid state magnetic vacuum triode amplifier produced a COP = 1,500,000, so a **very** appreciable Dirac sea hole current was available to work with. Conversion of the Dirac sea hole current into electrical current via the present Bedini-Bearden process would have eliminated the antigravity and produced a very large increase in output electrical power.

43. See (a) T. E. Bearden, "The Unnecessary Energy Crisis: How to Solve It Quickly," ADAS Position Paper, June 2000; (b) Bearden **{12};** (c) Bearden {30}; (d) T. E. Bearden, "EM Energy From The Vacuum: Ten Questions With Extended Answers," September 2000. The present author has been calling for just such a program. These papers are on restricted DOE Website http://www.ott.doe.gov/electromagnetic/ and also are on the author's website at http://www.cheniere.org.

44. Nathan Smith, "Marketable Results vs. Good Science?," *Sci. Am.* , 284(5), May 2001, p. 8-9. Quote is from p. 9.

45. This is the actual phrase often used in such Government contracts. What it means is that the Government (which means the government

employee controlling that program and its funds) can suddenly declare that the Inventor is not getting his invention developed rapidly enough, and the Government then seizes the patent to "get it developed more quickly". The inventor is suddenly left hanging, no longer in control of his own intellectual property. Or the Government has the power to block developmental together.

46. Often the universities just bluntly state that *all patents revert to the university.*

47. Hal Hellman, *Great Feuds in Science*, Wiley, New York, 1998. We particularly call attention to Hellman's dissertation on Wegener's persecution. Today, the legitimate overunity EM researcher and the cold fusion researcher are regarded much like Wegener was regarded — as the very epitome of a fool. This label is appended by "experts" who are not even aware of what really powers an EM circuit or an electrical power distribution system.

48. A photon is a piece of angular momentum (called "action" by the physicist), consisting of a little piece of spatial energy (ΔE) and a little piece of time (Δt), welded together as $(\Delta E)(\Delta t)$ with no seam in the middle, so to speak. But now look at that little $(\Delta E)(\Delta t)$. Since the photon is quantized, $(\Delta E)(\Delta t) = k = \hbar$. Any change in (Δt) requires that (ΔE) change inversely; i.e., $(\Delta E) = \hbar/(\Delta t)$. So increasing (Δt) decreases (ΔE) accordingly. Let us call the spatial energy s compacted into (dt) the equivalent *energy* of the photon. Then s is given by $s = c^2(\Delta t) = 9\times10^{16}$ (Δt). So as the frequency of a photon lowers, the (Δt) time component increases proportionally, and the total equivalent energy in the photon increases dramatically by many orders of magnitude! As an example, suppose we halve the spatial energy (ΔE). That doubles the original time interval (Δt), which gives the new $s = c^2(2\Delta t)$ or $s = 2c^2(\Delta t)$ for the new equivalent energy. So while we halved the *normal* spatial energy formally transported by the photon, we multiplied the *equivalent* time-energy by the enormous factor of $2c^2$ which is approximately 18×10^{16} in the MKS system. It follows that, if we use the equivalent time) energy of the photon and transduce a little of it into normal spatial energy, the energy density of those nuclear reactions now seen only in distant energetic objects such as pulsars, exploding stars, etc. can be achieved right on the laboratory bench. *The highest energy physics has not yet been born in the physics community, and what is presently being done in the high-energy*

accelerators is child's play compared to what can be done with time-energyengineering.

49. To see by another method that time is energy, one notes that the choice of fundamental units chosen for one's physics model is arbitrary. So we choose a single fundamental unit, the joule, to make a new physics model. Thereupon all other entities are energy and energy functions only, Hence, time is totally a function of energy. Actually, time is spatial energy compressed by the factor c^2, so it has the same energy density as mass, except the highly compressed spatial energy is placed in the time domain to appear at "time" rather than in 3-space to appear as "mass".

50. E.g., in cold fusion experiments where the time-energy is partially transduced in a time-reversed manner, the gluon forces binding the quarks in the affected neutrons and protons are dramatically reduced and the quarks are therefore nearly freed. This is being done in an apparatus of perhaps two cubic feet in volume, rather than a giant accelerator 20 miles in diameter and costing billions of dollars. So far, the largest accelerator using 3-space (decompressed) energy is just a bit short of the energy required to free the quarks. Use of time (compressed) energy allows such reaction as freeing the quarks to be easily accomplished, while the accompanying decompressed *spatial* energy is very low.

51. Time energy has the same energy density as mass, but that highly compressed energy has just been placed in the 4th axis *ict* of Minkowski space rather than in 3-space. In *ict* the only variable is t, so the variation of the compressed energy can only appear in the *t* variable portion. See Chapter 2.

52. (a) James Patterson, U.S. Patents 5,318,675; 5,372,688; 5,607.563 (b) — and Dennis Cravens, U.S. Patent No. 5,607,563.

53. Ironically, as suppression of innovative research in science increases, science may eventually face turning into the kind of dogmatic system that it struggled against for some 300 years before escaping. When science defends a theory that experiments refute, as it does today in the case of cold fusion, then it is very close to that debacle that can spell the end of science itself.

54. E. Allan Blair, Letter to the Editor, *Newsweek*, Mar. 3, 1997, p. 14.

55. Arthur C. Clarke, "Space Drive: A Fantasy That Could Become Reality," *NSS... AD ASTRA,* Nov/Dec 1994, p. 38.

56. William K. George, in *Editing the Refereed Scientific Journal, edited* by Robert A. Weeks and Donald L. Kinser, IEEE Press, New York, 1994. p. 227-228.

57. Max Planck, in G. Holton, *Thematic Origins ofScientific Thought, Harvard* University Press, Cambridge, MA, 1973.

58. Jonathan Schlefer, editor of *Technology Review,* published at MIT. in an October 1990 editorial.

59. Rolf Landauer, "Fashions in Science and Technology," *Physics Today,*50(12),Dec.1997,p.62.

60. Julius Robert Von Mayer, "Bemerkungen iiber die Krafte der unbelebten Natur," in J. von Liebig's *Annalen der Chemie* (vol. 42), 1842; Die *organische Bewegung in ihrem Zusammenhange mit dem Stoffwechsel, (Organic* Motion in Its Relation to Metabolism), 1845. His papers were published as *Die Mechanik der Warme,* 1867, with third edition in 1893.

61. Alfred Wegener, *Die Entstehung der Kontinente und Ozeane, 1915;* fourth revised edition, 1929. A Dover reprint of the fourth revised edition, translated into English, *Origin ofContinents and Oceans,* was published in 1996.

62. Paul Nahin, *Oliver Heaviside: Sage in Solitude,* IEEE Press. New York, 1988, p. 225.

63. Martin Gumpert, *Trail-Blazers ofScience.* New York, Funk and Wagnalls Company, 1936, p. 232.

64. This area is now referred to as *ovonics,* where the "ov" is directly taken from "Ovshinsky". The materials have found use in copy machines, fax machines, liquid crystal displays, and optical memory disks. Ovshinsky has obtained over 200 patents and continues to work in the energy conversion field. His development of a new storage battery, e.g., broke all the Department of Energy tests and doubled the energy density permitted. Once in awhile the good guys beat the scientific suppression system.

65. Stan and Iris Ovshinsky were honored with the American Chemical Society's Heroes of Chemistry Award for 2000. They were honored for 40 years of sustained effort and contributions in the

sustainable and renewable energy field, including amorphous silicon cells for roofs of houses, highly specialized storage batteries, etc.

66. On the other hand, many scientific disagreements are conducted in quite proper and gentlemanly fashion. An example is the continuing decades of argument over energy flow theory, in *Am. J. Phys.* The problem has still not been officially resolved; we would hope that the material in this book will shed new light upon it, by pointing out the exact difference between the long-neglected nondiverged component as well *as* the diverged component, and also pointing out what Lorentz's trick of closed surface integration of the energy flow vector really does.

67. It follows quite naturally that, once we compress spatial energy by c , we may place the compressed energy in 3-space, in which case it is known as "mass", or we may place it in the time domain, in which case it is known as "time". If that cannot be done, then physics errs in using time as a variable on the fourth axis, and fundamental units are not arbitrary after all.

68. E.g., see D. K. Sen, *Fields and/or Particles,* Academic Press, London and New York, 1968, p. viii. Quoting: *"The connection between the field and its source has always been and still is the most difficult problem in classical and quantum electrodynamics."*

69. See T. D. Lee, "Can Time Be a Discrete Dynamical Variable?". *Phys. Lett,* 122B(3, 4), Mar. 10, 1983, p. 217-220. Lee showed that time is a discrete dynamical variable across the entire range of mechanics: from classical to nonrelativistic quantum mechanics, and then to relativistic quantum field theories. In all stages of mechanics, time can be treated as a discrete parameter, and it can be treated as a bona fide dynamic variable, Hence time has dynamics and structure, and therefore energy.

70. E.g., one may assume that the entire virtual state is an internal structuring and dynamics existing inside the macroscopic flow of time. The virtual state dynamics obviously exists in spacetime (which is assumed to be continuous), but we also consider any "virtual particle" (e.g., a virtual electron) as if it had been suddenly "observed" momentarily That assumes d/dt (LLLt) => LLL, a frozen 3-space snapshot. However, since that cannot really be observed, then we are actually considering something analogous to "if we could observe something in spacetime that cannot be observed in space alone". The only place left for it to

!observably exist anyway, if we could in fact observe it" is time, if space is ruled out.

71. It is necessary to trace the energy transductions and dissipations inside the generator. Ignoring those internal dynamics, the casual observer sees that one inputs shaft energy to the generator, and out comes some electromagneticenergy in the external electrical circuit, pouring from the gnerator terminals. We catch a lesser amount out there in the external circuit or power line, so we think we input some energy, had some internal losses and what gets collected in the conductors of the power line is the remainder of what we input, after transductions and losses in the generator. That is not what happens at all! Embarrassingly, an *enormous* flow of energy comes out of those generator terminals, if all of it is accounted. This includes(i) the tiny component that strikes the surface charges of the external conductors and gets diverged into the conductors, thus being captured by the circuit, and (ii) the enormous remainder of the energy flow in the surrounding space, which misses the circuit altogether and is just wasted. Something like a trillion times as much EM energy may be pouring out of the terminals of the generator and *being wasted,* as we mechanically input to the generator shaft, or as we "catch" and use in the external circuit. As later chapters discuss, Poyntin ; never considered the component that misses the circuit entirely. Heaviside discovered it but could not explain its startling magnitude or its source. Lorentz knew of this enormous flow component. He could not explain it, and stated it "had no physical significance" since it powered nothing. Lorentz originated a little integration trick that discarded it neatly from a11 accountability.

72. If the energy input to an inert power system generator were what powered the attached external circuit, then only the Poynting component would be emitted from the terminals of the generator. In that case, Heaviside's discovery of the additional nondiverged component would be wrong, and Lorentz was also wrong in recognizing it by stating it had no *physical* significance. It also means that a dipole formed between the terminals can have no broken symmetry in its active vacuum flux exchange, which is falsified by particle physics {14, 73,}. Also, no charge could pour out energy and create fields and potentials in surrounding space, and neither could a dipole. That is easily falsified by actual experimental measurement. Our reinterpretation of Whittaker's wave decomposition of the scalar potential would also be wrong, as would Mandl's and Shaw's argument {19} that a combined pairing of a scalar

photon and a longitudinal photon are observable, producing the instantaneous scalar potential.

73. T. D. Lee, *Particle Physics and Introduction to Field Theory,* Harwood, New York, 1981,*passim*. In 1957, Lee and Yang received the Nobel Prize for their work in predicting broken symmetry. This included the broken symmetry of opposite charges — and hence of a dipole.

The very definition of broken symmetry, applied to the source dipole once it is formed in the generator, reveals that the dipole itself receives virtual photon energy from the seething vacuum, transduces it, and outputs it as real observable EM energy pouring out of the generator terminals and out through 3-space surrounding the entire power line. This is the source of the tremendous energy flow from the terminals, including a large component missing the circuit (as discovered by Heaviside in the 1880s). This large nondiverged component of the energy flow was discarded arbitrarily by Lorentz because there was absolutely no explanation of its source, and because it was thought to have "no physical significance" (Lorentz's term) since it powered nothing.

74. Wu et al. {14} experimentally showed that the weak interaction violates parity (spatial reflection) and thus exhibits broken symmetry.

75. T. D. Lee is noted for his broken symmetry work with charges, and for establishing the broken symmetry of separated charges of unlike sign. In 1957, Lee and Yang were awarded the Nobel Prize in Physics for their investigations of weak interactions between elementary particles.

76. John D. Kraus, *Electromagnetics,* Fourth Edition, McGraw-Hill, New York, 1992, p. 578.

77. We strongly feel that anyone interested in logic must read Morris Kline, *Mathematics: The Loss of Certainty,* Oxford University Press, New York, 1980. Contrary to popular opinion and the impression projected by mathematicians, mathematics is not a body of unshakable truths aboul the physical world, and mathematical reasoning is not exact and fallible.

78. One also needs to be aware of Godel's proof. See Kurt Godel, "Uber formal unentscheidbare Satze der *Principa Mathematica* une verwandter Systeme" ("On Formally Indeterminable Propositions of the *Principia Mathematica* and Related Systems," in *Monatshefte fur Mathematik und Physik,* Vol. 38, 1931. This is the publication in which Godel's Proof first appeared, which states that within any logical

mathematical system there are propositions or questions that cannot be proved or disproved on the basis of the axioms within that system. Therefore, it is uncertain whether or not the axioms or arithmetic will give rise to contradictions, since they can.

79. A critical reference for the longitudinal EM interferometry *weapons* is M. W. Evans, P. K. Anastovski, T. E. Bearden *et al.*, "On Whittaker's Representation of the Electromagnetic Entity in Vacuo, Part V: The Production of Transverse Fields and Energy by Scalar Interferometry," *J. New Energy*, 4(3), Winter, 1999, p. 76-78. This paper is a short but rigorous proof of a scalar interferometer's ability to produce EM fields and energy in the distant interference zone. Either diverging (heating) energy or converging (cooling) energy — in the normal sense, extraction of energy — can be created in a distant interference zone. By pulsing and controlling the circuit ground bias of the transmitters, one produced distant hot explosions or cold explosions. In a military target in that distant zone, the effects arise from the local spacetime, thus from everywhere within the targeted vehicle. At least eight nations now have such weapons, which were apparently the weapons that Defense Secretary Cohen {89} referred to in 1997.

80. Jackson {22}, p. 249.

81. Bunge, {3},p. 182.

82. Roger Penrose, "Foreword," in T. W. Barrett and D. M Grimes [Eds.], *Advanced Electromagnetism: Foundations, Theory, & Applications*, World Scientific, (Singapore, New Jersey, London, and Hong Kong), 1995.

83. Myron Evans, President of Alpha Institute's Institute for Advanced Study, private communication, 1999. Dr. Evans is the author of over 600 scientific papers, the prestigious editor of several scientific book series, and a noted foundations scientist. He is the co-discoverer and proponent of the Vigier-Evans B(3) magnetic field and a proponent of the proposed fundamental extension of U(1) electrodynamics to O(3) electrodynamics. O(3) electrodynamics has now been revealed as an important subset of Sachs' unified field theory.

84. Robert H. Romer, "Heat is not a noun," *Am. ./. Phys.*, 69(2), Feb. 2001, p. 107-109. The quotation is from footnote 24, p. 109.

85. E. T. Whittaker, "On the Partial Differential Equations of Mathematical Physics," *Math. Ann.*, Vol. 57, 1903, p. 333-355.

86. But see Chapter 2 for a reinterpretation and correction of Whittaker's decomposition of the scalar potential. His harmonic set of bidirectional phase conjugate longitudinal EM wavepairs in 3-space is replaced with a harmonic half-set of longitudinal EM waves converging in I the time domain upon the dipolarity; absorption and transduction by the charges; and re-emission as the other harmonic half-set of longitudinal EM waves diverging out from the source dipolarity in all directions in 3-space. The correction allows a very novel solution to the long-vexing problem of the source charge and its associated fields and potentials and their energy {12}.

87. (a) G. Johnstone Stoney, "Microscopic Vision," *Phil. Mag.*, Vol 42, Oct. 1896, p. 332; (b) — "On the Generality of a New Theorem," ***Ibid.***, Vol.43, 1897, p. 139-142; (c) — Discussion of a New Theorem in Wave Propagation," *ibid*, Vol. 43, 1897, p. 273-280; (d) — "On a Supposed Proof of a Theorem in Wave-motion," *ibid.*, Vol. 43, 1897, p. 368-373.

88. Some Russian scientists refer to the hidden internal electrodynamics as the "information content of the field".

89. Secretary of Defense William Cohen at an April 1997 counterterrorism conference sponsored by former Senator Sam Nunn. Quoted from DoD News Briefing, Secretary of Defense William S. Cohen, Q&A at the Conference on Terrorism, Weapons of Mass Destruction, and U.S. Strategy, University of Georgia, Athens, Apr. 28, 1997.

90. For a basic discussion of these photon polarizations, see (a) Richard Feynman, *Quantum Electrodynamics*, 1961, 1963. Quantum field theory recognizes four polarizations of the photon, to include x- and y-transverse polarizations in 3-space, longitudinal or z- polarization in 3-space, and the time-polarized photon (which may be taken to be a longitudinally-polarized photon in the time axis). Existence of these four modes of polarization or energy vibration in photons implies the existence of four correspondingly polarized EM waves. Among other things, Feynman discusses the "sum over four polarizations" of photons and such The term "Gupta-Bleuler" theory is the formalism that has grown up around this problem. For a deeper discussion, see (b) Lewis H. Ryder, *Quantum Field Theory*, Second Edition, Cambridge University Press, 1996, p. 147 *et seq*. For an even more advanced discussion, see (c) F.

Mandl and G. Shaw {19}. For discovery of the coupling of time-polarized and 3-space longitudinally polarized EM waves as the higher EM energy flow symmetry resolving the source charge problem, and thereby reinterpreting Whittaker's decomposition of the scalar potential {85}, see (d) Bearden {12}. We point out that the latter reinterpretation can also be "cranked through" the superpotential theory of Whittaker, to involve all EM potentials, fields, and waves.

91. (a) E. T. Whittaker, "On an Expression of the Electromagnetic Field Due to Electrons by Means of Two Scalar Potential Functions," P*roc Lond. Math. Soc,* Series 2, Vol. 1, 1904,p. 367-372. The paper initialed what today is called *superpotential* theory. It was published in 1904 and orally delivered in 1903. For a sampling of other superpotential work, see (b) W. H. McCrea, *Proc. Roy. Soc. Lond. A,* Vol. 240, 1957, p. 447; (c) A. Nisbet, *Physica,* Vol. 21, 1955, p. 99; (d) P. Debye, *Ann. Phys.,Leipzig,* Vol. 30, 1909, p. 57. For an excellent overview discussion of superpotentials and related things, see (e) Melba Phillips, "Classical Electrodynamics," in *Principles of Electrodynamics and Relativity,* Vol. IV *of Encyclopedia of Physics,* edited by S. Flugge, Springer-Verlag, l962.

92. (a) See Evans et al. {79} for proof that scalar interferometry can produce all normal transverse EM fields, waves, and patterns. The paper appears in (b) P. K. Anastasovski; T. E. Bearden, C. Ciubotariu, W. T. Coffey, L. B. Crowell, G. J. Evans, Myron W. Evans, R. Flower, S. Jeffers, A. Labounsky, B. Lehnert, M. Meszaros, P. R. Molnar, J.-P. Vigier, and S. Roy, "The New Maxwell Electrodynamic Equations: New Tools for New Technologies," *J. New Energy, 4(3),* Special Issue of A1AS papers. Winter 1999. The volume consists of some 60 papers by the Alpha Foundation's Institute for Advanced Study (AIAS), advancing electrodynamics to a non-Abelian, gauge theoretic higher topology theory in O(3) internal symmetry. Some ten of the papers directly address Whittaker's work and extend it.

93. (a) W. A. Rodrigues, Jr. and J.-Y. Lu, "On the existence of undistorted progressive waves (UPWs) of arbitrary speeds 0 < v < oo in nature," *Found. Phys.,* 27(3), 1997, p. 435-508 show that Maxwell's equations do possess superluminal solutions. A slightly corrected version is downloadable as hep-th/9606171 on the Los Alamos National Laboratory web site. Also see (b) W. A. Rodrigues, Jr. and J. Vaz Jr., "Subluminal and Superluminal Solutions in Vacuum of the Maxwell

Equations and the Massless Dirac Equation," *Adv. Appl. Clifford Algebras,* Vol. 7(S), 1997, p. 457-466.

In classified Russian weapons labs, this internal longitudinal wave (both time-domain and 3-space domain) structuring of all normal (transverse) EM potentials, fields, and waves is euphemistically called the *information content of the field.* For decades there has been a successful disinformation campaign to lead scientists of other countries into believing that the phrase means *standard spectral analysis.* It doesn't. It is also possible to communicate at superluminal speed, using longitudinal EM waves inside this infolded "inner" electrodynamics. Since mass is mostly empty space filled with a particle here and there — together with EM potentials, fields, and waves — then mass is a vast "superhighway" for direct superluminal communication using longitudinal EM waves.

94. Romer, {84}.

95. See E. T. Whittaker, *A History of the Theories of the Aether and Electricity,* two vols., Nelson, London, 1951, 1953. Reprinted by Dover.

96. Note that we have just resolved the age-old problem of change, which can be summarized in the query stated so long ago by Heraclitus: "For a thing to change, it must turn into something else. But how can a thing be itself and something else also?" We have explained the enigma by pointing out that the "thing" has no persistence in time, and is continually changing into yet another thing, either a replica (in which case we sense "no change" and hence "persistence" by memory comparison), or a partial replica with some differences (in which case we sense that "the object has changed itself in some way"), or a thing with little or no replication (in which case we sense a "different thing"). It is the unseen nature of the *d/dt* observation process that has deluded us into such irresolvable logical conflicts — and into an incomplete Aristotelian logic based on observation alone, which does not contain the resolutions to such problems because a higher-order logic is required.

97. Whittaker, {85}

98. See Chapter 2 for a discussion of the substitution of effect for cause, and of the nature of observation.

99. *Wu etal,* {14}.

100. Sen, {68}.

101. Also see Mandl and Shaw {19}.

102. William G. Harter, John Evans, Roberto Vega, and Sanford Wilson, "Galloping waves and their relativistic properties," *Am. J. Phys.*, *53*(7), July 1985, p. 671-679. A relativistic example is given in which the source frame observes a very nonuniformly-galloping wave whose velocity varies between 0.01 c and 100 c, even though its average velocity is c. Relativistic properties of interfering electromagnetic plane waves are discussed.

103. We point out, but do not further pursue, that this situation is reversed when time is reversed. This has very interesting applications in our little "time reversal zones" that we found were so important in the electrolyte experiments of the cold fusion researchers, and which accounted for a new class of nuclear interactions previously unknown. This does reverse the conventional law of attraction and repulsion of charged particles. It also directly affects the quarks and gluons, partially or even nearly dissolving the gluon forces holding the quarks in place, so that the quarks are nearly freed and are easily flipped.

104. Simultaneously accompanied by *separately broken* time-energy flow symmetry and *separately broken* 3-spatial energy flow symmetry.

105. Evans et al., {38b, 38c}.

106. Oliver Heaviside, *Electrical Papers*, Vol. 2, 1887, p. 94.

107. Kraus, {76}.

107. E.g., see (a) Jackson {22}, p. 237. Jackson points out that *"...the Poynting vector is arbitrary to the extent that the curl of any vector field can be added to it. Such an added term can, however, have no physical consequences."* The first sentence is true, but the second sentence is a non sequitur. Poynting only considered the small component of the overall energy flow that enters the circuit — in short, that strikes the surface charges in the conductors and is diverged into the wires to power the Drude electrons. That is the diverged part of the energy flow. All the rest of the flow that misses the circuit is obviously not diverged or collected in the circuit, and so it has zero divergence. It is elementary vector algebra that the curl of any vector field has zero divergence. So the extra nondiverged Heaviside energy flow component — filling all space around the conductors in a power line, e.g., but missing the power system entirely and just wasted — can indeed be expressed as the curl of a vector field That energy flow is real, however, and if intercepted and collected, it then does become divergent. In that case, it does have highly significant

consequences, since the total energy flow in that component may be a trillion times the energy flow in the Poynting component alone.

For a rigorous experiment demonstrating the reality and significance ol that "physically insignificant energy flow" that "can have no physical consequences", see (b) Bohren {24}. Under nonlinear conditions, a particle can absorb more energy than is in the light incident on it by normal calculations. Electrodynamicists do *not* calculate the magnitude of an entire field or potential, e.g., but only the intensity of a *divergence from* it at a single point, as given by an intercepting unit point static charge. If that same charged particle is placed in particle resonance, it sweeps out a greater geometrical reaction cross section. Hence it intercepts and **collects** (diverges) more impinging energy — from that long-neglected otherwise nondiverged component of the flow or field that is not diverged by the *static* unit point charge assumed conventionally. Metallic particles at ultraviolet frequencies are one class of such particles and insulating particles at infrared frequencies are another. See also (c) Paul and Fischer, {25}, who replicated Bohren's experiment.

109. H. A. Lorentz, *Vorlesungen iiber Theoretische Physik an der Universitdt Leiden,* Vol. V, *Die Maxwelhche Theorie (1900-1902),* Akademische Verlagsgesellschaft M.B.H., Leipzig, 1931, "Die Energie im elektromagnetischen Feld," p. 179-186. The section is called "Der Poyntingsche Energiestrom," and begins on p. 183. See his Figure 25 **on** p. 185.

110. E.g., see W. K. H. Panofsky and M. Phillips, *Classical Electricity and Magnetism,* Addison-Wesley, Reading, MA, 1962, 2nd edition, p. 181**,**

111. Bearden, {12}.

112. A simple way to see this is to note that the back-potential across the half-loop internal to the dipole is precisely equal to the forward potential externally between the ends of the dipole but across the **external** circuit half-loop. Since the same current q runs through both these potentials, then by Vq the same amount of energy is dissipated upon **the** charges of the dipole — to scatter them and destroy the dipole — as is dissipated in the external circuit in its losses and the load. Thus **more** energy is used to destroy the dipole than is used to power the load. We have to input at least as much shaft energy to restore the dipole as was used to destroy it. Hence the COP< 1.0.

113. See to (a) M. W. Evans, P. K. Anastasovski, T. E. Bearden *el al*, "Classical Electrodynamics without the Lorentz Condition: Extracting Energy from the Vacuum," *Physica Scripta*, 61 (5). May 2000, p. 513-5 17 in addition to that paper previously quoted. See also (b) "Runaway Solutions of the Lehnert Equations: The Possibility of Extracting Energy from the Vacuum," *Optik*, 111(9), 2000, p. 407-409.

114. Robert Bruce Lindsay and Henry Margenau, *Foundations of Physics*, Dover, New York, 1963, p. 25.

115. *Ibid.*, p. 213.

116. *Ibid.*, p. 217.

117. M. Faraday, *Experimental Researches in Electricity and Magnetism*, Vol. 1, Taylor and Francis, London, 1839; Vol. 2, Richard & John E. Taylor, London, 1844; Vol. 3, Taylor and Francis, London, 1855. A 1965 reprint of all three volumes is available from Dover, New York.

118. We also acknowledge the independent contributions of Joseph Henry. In 1830, Henry independently discovered magnetic induction, anticipating Faraday's own discovery of it. Faraday, however, published first. Two years later, Henry discovered self-induction. He died in 1878, and the unit of inductance, the *henry*, was named for him in 1893.

119. (a) Maxwell, {20}. Also see (b) James Clerk Maxwell, *A Treatise on Electricity and Magnetism*, Oxford University Press, Oxford, 1873, Third Edition, Volumes 1 and 2, unabridged, Dover Publications, New York, 1954. This standard citation widely used in the literature is in fact confusing; the First Edition was published in 1873, a second rather substantially altered edition was later published after Maxwell's 1879 death of stomach cancer, and a third edition, slightly altered from the second edition, was published even later. So controversial were quaternions at the publication of Maxwell's first edition in 1873, that part of what was to become the second edition — published after Maxwell's 1879 death — was truncated by Maxwell himself prior to his death and prior to the posthumous publication of the second edition. Thus there is considerable difference between the first and second editions, and first and third editions, of Maxwell's *Treatise*, compared to his original 1865 paper {20}. "Maxwell's theory" is actually his 1865 paper; everything else is a later truncation of Maxwell's theory.

120. Maxwell's letter to P. G. Tait in 1871, *Archives,* Cavendish Laboratory, Cambridge.

121. For a discussion, see (a) A. M. Bork, "Vectors versus quaternions - the letters in *Nature,"* in *Am. J. Phys.,* Vol. 34, Mar. 1966, p. 202-211. For a cogent presentation of what might have been discovered much earlier in physics if quaternions had not been cast aside in favor of the much more limited vectors, see (b) James D. Edmonds Jr., "Quaternion quantum theory: New physics or number mysticism?", *Am. J. Phys.,* 42(3), Mar. 1974, p. 220-223.

122. Edmonds, {121b}. Edmonds presents a cogent argument showing the significant impedance of the rate of discovery in physics, that **resulted** from the ill-advised casting aside of the far more comprehensive quaternion theory in favor of the much more limited vector theory.

123. Heaviside, {5a, 5b}.

124. T. W. Barrett, "Tesla's Nonlinear Oscillator-Shuttle-Circuit (OSC) Theory," *Annales de la Fondation Louis de Broglie,* 16(1), 1991, p. 23-41, Barrett later extended some of the energy-shuttling techniques shown by Tesla and obtained U.S. Patents 5,486,833 and 5,493,691.

125. (a) A. A. Michelson and E. W. Morlcy, "Influence of motion of the medium on the velocity of light," *Am. J. Sci.,* Vol. 31, Series 3, 1886, p. 377-386; (b) — "The relative motion of the earth and the luminiferous aether," *Am. J. Sci.,* 34(3), 1887, p. 333; (c) — "On the relative motion of the earth and the luminiferous aether," *Phil. Mag.* 24(4), 1887, p. 449. See also (d) A. A. Michelson, "The relative motion of the earth and the ether," *Am. J. Sci.,* (4), 3, 1897, p. 475.

126. (a) Mendel Sachs, *General Relativity and Matter: A Spinor Field Theory from Fermis to Light-Years (Fundamental Theories of Physics),* Reidel, 1982. Sachs provides a great generalization of general relativity and electrodynamics reaching from the quarks and gluons to the entire universe. See also (b) Mendel Sachs, "Symmetry in Electrodynamics: From Special to General Relativity, Macro to Quantum Domains," in M. W. Evans, Editor, *Modern Nonlinear Optics,* Second Edition, Wiley, **New** York, 2001, Part 1, p. 677-706.

127. Myron W. Evans, Director of the Alpha Foundation's Institute for Advanced Study, private communication, 2001.

128. Jackson, {22}, p. 249.

129. Jackson, {22}, p. 28.

130. Feynman, {7}, Vol. 1, p. 2-4.

131. Physicists often speak of spacetime as "space", since in Minkowski geometry the time portion is modeled along a separate spatial axis used in addition to the ordinary three spatial axes. So Feynman's "distortion" is actually Riemannian spacetime curvature.

132. As an aside, note that Feynman also utilized a dipolarity. There is always a scalar potential between the poles of any dipole. Further, this "dipole potential" decomposes according to Whittaker's 1903 decomposition{85}, as re-interpreted by Bearden's giant negentropy approach {12} in 2000, and as relates to Mandl and Shaw's 1984/1993 argument{19} that only the associated time-polarized photon and longitudinal photon together are observable, and then as the instantaneous scalar potential. If we accept Mandl and Shaw's powerful argument, then the Whittaker 1903 decomposition must be reinterpreted to be in accordance. That is what was done by the present author {12} to resolve the source charge problem as well as the source dipole problem. In addition, the resolution must be in accord with the theoretical and experimental findings of particle physics, to include the broken symmetry of the opposite charges on the ends of a dipole. The giant negentropy process uncovered by Bearden {12} fulfills all the necessary requirements. It also places the theme of this book — *Energy from the Vacuum: Concepts and Principles* — on a solid theoretical and experimental basis.

133. Feynman, {7}, vol. II, p. 1-3.

134. Jackson, {22}, p. 811-812.

135. We have previously postulated this feature where one second is equal to spatial EM energy compressed by the factor c^2, so that time is just extremely compressed EM spatial energy. See Bearden, {17}.

136. (a) Harter et al., {102}. It may well be that galloping due to time-density variation may provide an alternative explanation to quantum tunneling, which can readily occur at superluminal speed. E.g., see (b) A Enders and G. Nimtz, *Phys. Rev. Lett.*, Vol. 48, 1993, p. 632. Their superluminal tunneling experiments transmitted 8.7 GHz microwaves (free space wavelength 3.4 cm) traveling in a rectangular waveguide that contains a "barrier" section of reduced dimensions. Mozart's 40th Symphony was transmitted through the barrier waveguide as frequency

modulated microwaves, at an FTL group velocity of 4.7c, receiving audibly recognizable music from the microwave photons that survived their barrier passage.

137. (a) M. W. Evans, "The Link Between the Sachs and 0(3) Theories of Electrodynamics," in M. W. Evans, editor, *Modern Nonlinear Optics,* Second Edition, Wiley, New York, 2001, Part 2, p. 469-494; (b) — "0(3) Electrodynamics," in M. W. Evans, editor, *Modern Nonlinear Optics,* Second Edition, Wiley, New York, 2001, Part 2, p. 79-267.

138. E.g., Ryder, {90b}, p. 147 *et seq.*

139. Rodrigues and Lu, {93a}.

140. Rodrigues and Vaz, {93b}.

141. The reader should recall that to this day there is no satisfactory resolution of the wave-particle duality principle. Physicists finally just shook hands and agreed to quit fighting, since the hullabaloo was getting them nowhere. The problem does have a probable resolution, but not in Aristotelian logic.

142. Bearden, {12} discusses the relation between time-energy and 3-spatial energy, and reveals a more fundamental 4-symmetry between time energy flow and spatial energy flow. In this 4-symmetry EM flow, time symmetry in energy flow is broken and simultaneously 3-space symmetry in energy flow is broken, but 4-symmetry in energy flow is maintained. The basic transduction of time-energy into 3-space energy and vice versa is accomplished by the interacting charge.

143. Bearden, {15}, p. 11. In the paper we also gave a force-free definition of mass, in terms of the transduction of angular momentum across the 3-spatial boundaries of a mass particle.

144. Rigorously, *mass* does not and cannot emit a photon; *masstime* does. But an observable mass m can be absorbing and emitting **enormous** numbers of virtual photons while not yet having absorbed another observable photon and decayed to emit an observable photons. Differential (virtual) pieces of a "frozen" observable mass m are **indeed** changing continually into masstime and back into mass, by absorbing and emitting virtual photons per equation [14b], while the observable mass m has not yet completed its absorption and emission of an observable **photon** This "knitting" together of observable and virtual state interactions is one of the great centralizing features of physics.

145. The problem is due to the hoary old erroneous notion in mechanics that a separate force acts upon a separate mass to move it.

146. There appears to be no paper or textbook which calculates the actual "energy magnitude" of an entire potential or an entire field, including over all space occupied by it. All texts advance the "local intensity" indicator calculation, and then call that the "magnitude of the potential". That is a non sequitur of first rank. A skilled electrodynamicist will call it the intensity of the potential.

147. It appears that the only region where this statement is in dispute is in various models attempting to explain the creation of the universe. Since that is *a priori* a creation event, then physicists struggle with explaining how something (the existing universe) was created out of nothing (the absence of any slightest bit of the existing universe). We will leave that debate to the astrophysicists and cosmologists. The "accursed identity of opposites" has been the bane of philosophers for more than 3,000 years.

148. Ibrahim Semiz, "Black hole as the ultimate energy source," *Am. J. Phys.*, 63(2), Feb. 1995, p. 151.

149. David Halliday and Robert Resnick, *Fundamentals of Physics, Third* Edition Extended, Wiley, New York, 1988, Vol. 1, p. 518.

150. Stanley W. Angrist, "Perpetual Motion Machines," Sci. *Am.*, Vol. 2I8, Jan. 1968, p. 114-122.

151. Stanley W. Angrist, "Perpetual Motion," *Encyclopaedia Britannica*, Bicentennial Edition, Macropaedia Vol. 14, 1976, p. 102-105.

152. Lindsay and Margenau, {114}, p. 217.

153. Heaviside, {106}, p. 94.

154. Kraus, {76}, Figure 12-59, p. 578.

155. Bohren, {24}.

156 Paul and Fischer, {25}.

157. (a) V. S. Letokhov, "Laser Maxwell's Demon," *Contemp. Phys.*, *36*(4), 1995, p. 235-243; (b) — "Generation of light by a scattering medium with negative resonance absorption," *Zh. Eksp. Teor. Fiz.*, Vol, 53. 1967, p. 1442 (English translation is in *Sov. Phys. JETP*, 26(4), Apr. 1968. p. 835-839); (c) "Stimulated emission of an ensemble of scattering particles with negative absorption," *ZhETF Plasma*, 5(8), Apr.

15, 1967, p. 262-265; (d) — "Double y - and optical resonance," *Phys. Lett. A*, Vol. 43, 1973, p. 179-180.

158. It is Heaviside's equations that are usually taught in University as "Maxwell's Equations," and labeled as Maxwell's equations in most undergraduate texts. In addition to Heaviside' work, similar changes were made by Gibbs in the United States and by Hertz in Europe. Every sophomore physics student and electrical engineering student should be given a short treatise on the background development of electrodynamics, and how, when, and by whom Maxwell's 20 quaternion equations were modified into the present four vector equations. The treatise should also point out what was omitted from Maxwell's theory in its truncations. It should be made very clear to every student that his elementary EM subject errs dramatically from physical reality when it assumes a flat local spacetime and an inert local vacuum. *By discarding the physically active environment of all Maxwellian systems,* only a highly limited subset of nature's electrodynamics is captured in the standard electrical engineering model. Specifically, systems far from equilibrium in their exchange with that environment are arbitrarily discarded. Those are precisely the Maxwellian systems permitted to exhibit coefficient of performance greater than unity. In short, the truncation of Maxwell's theory arbitrarily discarded all electrical windmills turning — or partially turning — in **a** free electrical wind.

159. As we pointed out, there are *tin electromagnetic systems at all in* that first class — and never have been — if we account for the arbitrarily-ignored Heaviside energy flow pouring from the source dipole and the energy flow pouring from every charge, and consider the situation prior to self-enforced implementation of Lorenz/Lorentz symmetrical regauging (by the closed current loop circuit). The remarks — pertaining to EM systems supposedly in equilibrium with the active vacuum — only apply if we neglect that Heaviside component and also neglect the source **charge** problem, and even then only if the circuit self-enforces that equilibrium in its exchange with the active vacuum. But since it has been so long **and** ubiquitously neglected, we will continue to speak of the "two classes" of EM systems from that "conventional" view. It is rather like our concession to electrical engineering, where the word "power" is universally **misused.** However, the reader should be aware of what we are doing and why.

160. See (a) Ilya Prigogine, *Nonequilibrium Statistical Mechanics,* Wiley-Interscience, New York, 1962; (b) — *From Being to* ***Becoming:***

Time and Complexity in the Physical Sciences, W. H. Freeman and Company, San Francisco, 1980; (c) D. Kondepudi and Ilya Prigogine, *Modern Thermodynamics: From Heat Engines to Dissipative Structures,* Wiley, Chichester, 1998; (d) G. Nicolis and I. Prigogine, *Self-Organization in Non-Equilibrium Systems: From Dissipative Structures to Order through Fluctuations,* Wiley, New York, 1977. For a good educated layperson's overview, see (e) Gregoire Nicolis, "Physics of far-from-equilibrium systems and self-organization," Chapter 11 in {f} Paul Davies, Ed., *The New Physics,* Cambridge University Press, Cambridge, 1989, p. 316-347.

161. Actually, Ludvig Valentin Lorenz first performed the equivalent of symmetrical regauging of Maxwell's equations, only two years after Maxwell's seminal paper was published in 1865. See (a) Ludvig Valentin Lorenz, "On the identity of the vibrations of light with electrical currents," Phil. *Mag.,* Vol. 34, 1867, p. 287-301. Not much attention was paid to Lorenz's work, however, and the later symmetrical regauging of the Maxwell-Heaviside equations by H. A. Lorentz is what "stuck" and came to be used. For a proper historical discussion, see (b) J. D. Jackson and L. B. Okun, "Historical roots of gauge invariance," *Rev. Mod. Phys.,* Vol. 73, July 2001, p. 663-680.

162. This point is important. See Gabriel Kron, "The Frustrating Search for a Geometrical Model of Electrodynamic Networks," circa 1962. General Electric publication, p. 11-128. Quoting p. 114: *"...the missing concept of "open-paths" (the dual of "closed-paths") was discovered, in which currents could be made to flow in branches that lie between any set of* ***two*** *nodes. (Previously -following Maxwell - engineers tied all of their open-paths to a single datum-point, the 'ground'). That discovery of open-paths established a second rectangular transformation matrix... which cre****ated*** *'lamellar' currents... " "A network with the simultaneous presence of both closed and open paths was the answer to the author's years-long search."*

When we design and build a circuit or system in compliance with the Lorenz/Lorentz-regauged equations, it follows that *the circuit itself must contain some feature and function that self-enforces the Lorenz/Lorentz condition — at least during the excitation discharge of the energy that has been freely caught by the circuit. The Lorenz/Lorentz condition is not a law of nature, nor is it automatically applied without a specific circuit cause and function physically applying it.* That function is automatically applied by the standard closed current loop circuit.

As Kron stated, his long search for a true negative resistance finally succeeded when he discovered the "open path". Actually Kron had discovered that any two points in the universe at different potentials (charged to different intensities) produced a flow of EM energy. In other words, he had discovered in more classical EM terms the broken symmetry of opposite charges of differing charges, such as on the ends of any dipole or across any dipolarity.

163. Superconducting *sections* in a system may be loss-free, but the entire superconducting *system* has losses and exhibits only COP<1.0 overall, if the refrigeration burden is accounted. In the superconducting section alone, without accounting for the cooling overhead, the COP = 1,0 and the efficiency is 100% also.

164. After Jackson, {22}, p. 219-221; 811-812.

165. See Whittaker, {85}. Whittaker mathematically decomposes the scalar potential into a hidden "bidirectional" series of EM wavepairs in a harmonic sequence. Each wavepair consists of the wave and its phase conjugate. Thus any A(q) (as across the terminals of a dipolar electrical power source) *a priori* involves an ordered, hidden, bidirectional EM wave flow. I.e., d(fi)) *identically is* such a hidden bidirectional EM energy flow.

166. But see Bearden, {12}. In the paper we conceptually re-interpreted Whittaker's 3-space (observation assumed, hence effect waves) bidirectional wavepairs. Our reinterpretation yields a correlated harmonic half-set of converging *unobserved* causal EM longitudinal waves (time-polarized EM waves) in the time domain prior to interaction with charge so as to prepare for being observed, and a harmonic half-set of diverging EM longitudinal waves (after observation due to the convergent time-polarized EM waves interacting with the observable charges) in 3-space in all directions. We strongly stress that observation does not occur without the absorption of a scalar photon and the follow-on emission of a longitudinal photon. In a time-reversed situation (phase conjugate charge condition), to the observer it appears to have happened in the other direction.

167. Particularly see Mandl and Shaw, {19}.

168. However, Mandl and Shaw fail to totally identify the "combining mechanism". They do not account the detailed interaction of the detecting/observing unit point charge, and thus fail to clearly account for the absorption of the incoming time-polarized wave or photon, the

transduction of that excitation energy of the charge into longitudinal EM wave/photon energy, and the subsequent emission of that excitation energy in 3-space in all directions as longitudinal EM waves/photons. So Mandl and Shaw do not clearly account for *photon (or wave) polarization transduction by the ubiquitously assumed charge.* The "causal" time-polarized EM wave or photon comes in and is absorbed by the detecting charge or dipole, then the absorbed energy is transduced and re-emitted in 3-space as the longitudinally polarized EM wave or photon in 3-space. (Actually, since all space is charged, what is really emitted into 3-space is the giant circulation of EM energy between time and 3-space, which is a more rigorous statement of what "propagation of EM energy through 3-space actually is). Recognition of these missing interactions and transductions allowed a solution at last to the long-vexing problem of the source charge, often called the greatest problem in both quantum and classical electrodynamics, as given initially in Bearden, {12}. Now, of course, a greater problem has reared its head: the notion that EM energy continuously propagates in 3-space is a total non sequitur, along the lines objected to by Romer {84}. We therefore have some very fundamental rethinking to do for all of classical physics. This is really where the problem of wave-particle duality has pointed since the beginning.

169. Asymmetrical self-regauging collects just a tiny bit more of the enormous energy that is flowing outside the conductors and usually wasted. E.g., if the self-regauging EM system collects as $\mathbf{j}\phi$ some 10^{-12} of the energy flow instead of the more usual 10^{-13}, the system can have a COP =10, *if it* does not then expend half the collected energy to destroy the sourcc dipole faster and require its reconstitution more energetically. And so on.

170. Jackson, {22}, p. 220-223.

171. So-called "canceling" opposing EM fields are actually produced, which sum to a *vector zero system* with respect to translation, which the electrodynamicists erroneously discard by assumption. We point out, but do not further pursue, that the locally produced *field energies* of the opposing fields in a zero-summed vector system remain and add, even though the fields offset each other *translationally.* The local energy of the field is proportional to the square of the local magnitude, and that is always positive regardless of field orientation. Thus "trapped" and structured EM stress energy has been localized in spacetime in the symmetrical regauging of CEM. This rigorously is a gravitational change

and therefore a local curvature of spacetime *a priori.* Indeed, the field energy remains in a zero-vector summation system, and has been changed into stress potential energy. It represents continuous internal work being performed on the system to stress it, by energy continuously fed in from the active vacuum environment but only in appositive fields of equal magnitude. The discarding of the zero vector summation system thus is a discarding of an available stress potential and its energy, a rotation of the system frame out of the laboratory frame, and a continuous exchange of energy from the vacuum that performs internal work upon the system but no external work in the load. The energy is not translational, but it is there nonetheless, and it causes a spacetime curvature change. The electrodynamicists have largely ignored the fact that gauge symmetry transformations are accompanied by local gravitational (spacetime curvature) changes that violate the prevailing flat local spacetime assumption of classical electrodynamics.

172. See (a) H. J. Josephs, "The Heaviside papers found at Paignton in 1957," *IEE Monograph No. 319,* Jan. 1959, p. 70-76. See also (b) E. R. Laithwaite, "Oliver Heaviside — Establishment Shaker," *Elec. Rev.,* 211(16), Nov. 12, 1982, p. 44-45. Heaviside became aware of this gravitational relationship, and worked out a draft theory of electrogravitation based on his energy-flow theory (which added nondiverged closed-loop circulations of energy which vectorially summed to net zero). Those "trapped EM energy flow loops" were *gravitational,* in Heaviside's concept. His hand-written notes on his eleelrogravitation theory were found long after his death, beneath the floorboards of his little garret apartment. In honor of Heaviside, we have nominated his huge nondiverged energy flow component — erroneously discarded by Lorentz — as the source of the extra gravity in the arms of the spiral galaxies, holding them together. In short, we have proposed that as the solution to the so-called "dark matter" problem.

173. Physicists love symmetry, turn to it at every opportunity, and will do almost any mathematical manipulation to obtain it, because they regard it as "beautiful." And so it is. Performing work, however, requires breaking symmetry to produce excess energy, which interacts with mass to produce a force, and then requires using that force to do the work. If we wish to build a system that produces more work output than the work that we ourselves have to do upon it to run it, then *a priori* that system must be *asymmetrical* and — to many physicists — *ugly.* Let us all drink a toast to more efficient *ugly* asymmetrical systems that also do not require **energy.**

input by the operator, but only by the active environment! Give us "ugly" electrical windmills that turn freely in electrical winds, rather than the inane "beautiful" present systems which destroy their energy winds faster than hey power their loads.

174. While Lorentz appears to have done it earlier, one can see his use of the surface integration in (a) Lorentz, {109}. In 1896 he also included it, using a more general theorem by Volterra, so that Poynting's theorem arises as a special case; see (b) H. A. Lorentz, *Versl. K. Akad. W. Amsterdam*, Vol. 4, 1896, p. 176.

175. This is usually performed by the source dipole.

176. Thus the long and tedious effort of my colleagues and I to create circuits that asymmetrically self-regauge their potential difference (source voltage) without allowing all the spent load current to pass back through the primary power source dipole and do work upon it to scatter the charges and destroy its dipolarity.

177. Again we strongly stress that asymmetrically regauging a potential in the system also regauges the local vacuum potential and the intensity of the vacuum potential's bidirectional EM energy exchange with the system. It alters the local curvature of spacetime. It directly alters the stored ene**rgy** of the system and of the supersystem. See again Whittaker, {85}, to see this clearly. See particularly our use of the *supersystem* concept in Chapter 8, and as mentioned in Chapter 1 and the present Chapter 2.

178. Circuits and electrical power systems universally and routinely break Lorentz symmetry for *excitation* (potentialization) of the system at the initial onset. Just to potentialize a system in theory costs nothing, although it freely changes the potential energy of the system. The gauge freedom axiom of quantum field theory also guarantees that such change of the potential energy of the system is essentially "for free". It conclusively proves that (i) asymmetrical self-regauging exists and is done in electrical circuits, since the source dipole in the power supply accomplishes that initial self-regauging of the external circuit completely for free once the dipole is made, and (ii) the Maxwell-Heaviside equations do permit asymmetrical self-regauging, in violation of Lorentz's arbitrary conditionprohibitingit.

179. This is the patent-pending Bedini process, which is processing through the U.S. Patent Office as we go to press.

180. Lee, {73}, p. 184.

181. B. P. Kosyakov, "Radiation in electrodynamics and in Yang-Mills theory," *Soviet. Phys. Usp.*, 35(2), Feb. 1992, p. 135-142. Quotes are from p. 135 and p. 141. Our proposed solution to the problem posed by Kosyakov (which is actually the broken symmetry of a charge) is that negative charges pour out positive energy and positive charges absorb positive energy. We "see" the positive charge as pouring out "reversed direction positive field energy" after we interact the energy with a laboratory charge to "observe". Considering the well-known polarization of the vacuum by any charge, one realizes that a 4-symmetry circulation of the EM energy is what is "emitted" and spreads throughout all space, since the vacuum polarization is also spreading. The actual energy flow is between the time domain and 3-space and return, at any elemental dipole in the polarization of the vacuum that is spreading.

182. Oliver Heaviside, *Electrical Papers*, Vol. 2, 1887, p. 94.

183. Prof. William Keel, quoted in James McWilliams, "Through a Galaxy, Darkly," *Huntsville (Alabama) Times*, May 14, 2000, p. A-18.

184. Charles Seife, "Peering Backward to the Cosmos's Fiery Birth," *Science*, vol. 292, June 22, 2001, p. 2238.

185. M. P. Silverman, *And Yet It Moves: Strange Systems and Subtle Questions in Physics*, Cambridge University Press, Cambridge, 1993, p. 127.

186. Matthew Colless, Australian National University, one of the survey team leaders in the project leading the world in mapping galaxies, Mar. 2001.

187. (a) Lee, {13a}; (b) Lee, Oehme and Yang, {13b};

188. Wuetal., {14}.

189. Bearden, {12}.

190. Mandl and Shaw, {19, 168}.

191. Whittaker, {85}.

192. Gabriel Kron, "Invisible dual (n-1) networks induced by electric 1-networks," *IEEE Trans, on Circuit Theory*, CT-12(4), Dec. 1965, p. 464-470.

193. Kron, {162}. The quote is from p. 114.

194. Steven Weinberg, *Dreams ofa Final Theory,* Vintage Books, Random House, 1993, p. 109-110.

195, See Josephs, {172a}. Heaviside's hand-written notes contained his theory of electro-gravitation, based on his theory of energy flow. The papers were found beneath the floorboards in his little garret apartment.

196. Laithwaite, {172b}. Laithwaite feels that Heaviside's postulation that a flux of gravitational energy combines with the (ExH) electromagnetic energy flux, could shake the foundations of physics. Extracting from Laithwaite; *"Heaviside had originally written the energy flow as S = (ExH) + G, where G is a circuital flux. Poynting had only written S = (ExH). Taking p to be the density of matter and e the intensity of a gravitational force, Heaviside found that the circuital flux G can be expressed as pu -ce, where u represents the velocity of p and c is a constant. "*

197. Hence the title of cited reference {12} above.

198. Melvin H. Miles and Benjamin F. Bush, "Radiation measurements at China Lake: Real or Artifacts?", *Proc ICCF-7 (International Conference on Cold Fusion* — 7, Vancouver, BC, Canada, Apr. 1998, p. 101.

199. Bearden, {17}.

200. See P. V. Elyutin, "The Quantum Chaos Problem," *Sov. Phys. Usp.*. Vol. 31, No. 7, 1988, p. 597-622. Elyutin discusses the crisis in quantum mechanics because of the missing chaos (hidden order). Quantum mechanics is known to be wrong unless this order can be found, because otherwise it does not predict the ordered macroscopic universe. Thus any proposed solution to the quantum chaos problem is worthy of Investigation, even if it turns out to be in error.

201. Unfortunately, entropy is one of those concepts in physics for which there are several differing major views. We consider entropy to be comparable to a positive resistor: organized energy goes in, disorganized energy comes out. Entropy is usually taken to be a measure of the disordering of energy. It does not *eliminate* the energy; it just makes it more difficult to *use* it. For our work in energy from the vacuum, we take the very simple view that a negentropic process is like a negative resistor: it receives energy in a form unusable to us, transforms it, and outputs it in

a form that is usable. In short, a negative resistor receives disordered energy and reorders it, so to speak. So it exhibits negentropy. We completely avoid the various notions of "information" and attempts to equate information and energy. We do point out, however, that a time-reversal process in one form or another is usually involved. In that sense, e.g., Newton's third law would be a negentropic process and involve time reversal in the mechanism generating the reaction-causing agent.

202. H. E. Puthoff, "Source of Vacuum Electromagnetic Zero-Point Energy," *Phys. Rev. A*, 40(9), Nov. 1, 1989, p. 4857-4862.

203. Whittaker, {91}. The paper was published in 1904 and orally delivered in 1903. This paper initiated superpotential theory.

204. As Whittaker showed in 1903, {85}, the scalar potential is actually a harmonic set of bidirectional EM longitudinal EM wavepairs, where each pair is composed of a longitudinal EM wave and its phase conjugate replica. Only because classical electrodynamicists have erroneously defined the field and potential as their own reaction cross sections with a unit point static charge, has the "static" potential been misidentified as a *scalar* entity, which it is not. The energy diverged from a uniform potential, around a fixed static point unit charge, is actually the set of divergences around the intercepting charge of the energy flows of all those EM waves comprising the potential. The sum total of all these individual wave divergences indeed has a scalar magnitude, but the magnitude of the total energy divergence from the potential is neither the potential itself nor its magnitude.

205. We point out the obvious: A "scalar" mass in 3-space actually him a time-vector since it moves through time continually, just to continue to exist. Further, it involves a special form of energy (energy compressed by c^2) which time is taken to be. Since we may choose any form of energy we wish by simple transduction, we may take it as compressed EM energy. So the mere continued existence of any mass proves conclusively that EM energy can and does ubiquitously flow to, from, and through the time dimension. The combined continued existence of numerous masses **proves** conclusively that the flow of time can have a myriad internal electromagnetic energy flows. An equilibrium between (i) an inflow of EM energy to a transducer from the time dimension, and (ii) an **outflow of** EM energy in 3-space from the transducer, will be seen as a discrete excitation (potential energy) associated with the transducer. Hence **the** notion of the charge. Every charge in the universe may be said to pour out

energy (negative charge pours out positive energy; positive charge absorbs positive energy — the equivalent of pouring out negative energy — and any charge results in a polarization of the vacuum. Hence what we call "spacetime" or "vacuum" is in fact a giant circulation of energy from the time domain to 3-space, and back to the time-domain. In short, a giant ncgentropy process continually sustains the active universe and all its components and processes.

206. Evans et al., {79}.

207. Semiz, {148}.

208. Weinberg, {194}, p. 286.

209. The available internal energy of a generator is the transduced shaft energy we input to it, say by turning the generator shaft with a steam turbine or hydro turbine. The shaft mechanical energy input is transduced into internal magnetic field energy once the rotor rotates. This internal magnetic energy is then dissipated on the internal charges inside the generator, forcing the positive charges in one direction and the negative charges in the other, thereby making the source dipole between the terminals of the generator. The available internal energy of a battery is the chemical energy possessed by it at any given time, and available for performing work on the internal charges to force them apart to form a dipole between the plates (and the battery terminals).

210. Kraus, {76}. Figure 12-60, a and b, p. 578 shows a good drawing of the Poynting (intercepted) energy flow being withdrawn into the conductors from the surrounding space. It does not show the Heaviside nondiverged component remaining, which is even larger, not diverged into the conductors, and wasted. The reason for the remaining Heaviside non-diverged component is that the electrons precess laterally across the conductor, thus withdrawing into the conductor only a small nearby section of the fields of the surface electrons — the ones (plus their fields extending into space) which intercept the impinging energy flow. Because of the short distance radially across the conductor's cross section, a surface electron has very limited "field and field energy withdrawal" length.

211. (a) J. D. Jackson, "Surface charges on circuit wires and resistors play three roles," *Am. J. Phys.*, 64(7), July 1996, p. 855-870. See also (b) Mark A. Heald, "Energy flow in circuits with Faraday emf," *Am. J. Phys., Vol.* 56, 1988, p. 540-547; (c) — "Electric fields and charges in elementary circuits," *Am J Phys.*, 52(6), June 1984, p. 522-526. The

surface charges in the conductors of a circuit are of enormous importance to the powering of the circuit.

212. See T. E. Bearden, "Energy Flow, Collection, and Dissipation in Overunity EM Devices," *Proc. 4th Internat. Energy Conf.*, Academy for New Energy, Denver, CO, May 23-27, 1997, p. 5-51. In Figure 5, p. 16 the fraction of the Poynting energy flow that is intercepted and collected by the circuit is roughly shown to be on the order of 10^{-13} of the entire Poynting energy flow available. That number is based on a very crude estimating procedure, but even if off by several orders of magnitude, it shows that the Heaviside nondiverged energy flow component is orders of magnitude greater than the diverged Poynting component, for single-pass of the energy and collection only once.

213. Rigorously, there is no *power* in an EM energy flow, regardless of how great in magnitude, if it is not altered in form or diverged. That is because "power" is rigorously the time rate of doing work (time rate of *changing the form* of energy), not the time rate of energy flow per se. Exactly, the Heaviside dark energy flow component was some 10 trillion joules per second in magnitude, but it had zero watts of power. Unfortunately, electrical engineers just loosely refer to nondiverged **energy** flow as "power", regardless of the non sequitur. Hence inane terms **widely** used in electrical engineering (and texts) such as "draw power from **the** source", etc. Rigorously, *the power* (rate at which energy is changed in form) is developed locally in each component having losses or performing work — i.e., changing the form of the energy.

214. (a) T. E. Bearden, "On the Principles of Permissible Over **Unity** EM Power Systems," *J. New Energy,* 4(2), Fall 1999, p. 16-39; (b) Bearden, {17}; (c) — "Use of Asymmetrical Regauging and Multivalued Potentials to Achieve Overunity Electromagnetic Engines," *J. New Energy,* 1(2), Summer 1996, p. 60-78; (d) — "Regauging and **Multivalued** Magnetic Scalar Potential: Master Overunity Mechanisms," *Explore,* 7(I), 1996, p. 51-58; (e) — "The Master Principle of EM Overunity and the Japanese Overunity Engines," *Infinite Energy,* 1(5&6), Nov. **1995-Feb,** 1996, p. 38-55; (f) — "Use of Regauging and multivalued Potentials to Achieve Overunity EM Engines: Concepts and Specific Engine Examples," *Proc. Internat. Sci. Conf, "New Ideas in Natural Sciences,* " *St. Petersburg, Russia, June 17-22, 1996, Part I: Problems of Modern Physics,* 1996, p. 277-297.

215. In an oblique kind of sense, this is even "recognized" to some extent by leading electrodynamicists. E.g., quoting Jackson, {22}, p. 237: "*...the Poynting vector is arbitrary to the extent that the curl of any vector field can be added to it. Such an added term can, however, have no physical consequences.*" So Jackson follows Lorentz's lead that any additional non-intercepted and uncollected energy flow permissibly accompanying the Poynting intercepted and collected component, has no physical significance. Both Lorentz and Jackson err as to the *finality* of the statement. The accompanying Heaviside component can have no physical significance *unless it is intercepted and collected by means other than the single circuit or mechanism considered, and the single pass of the entire energy flow onto and past the receiving entity (circuit, charge, etc.).*

216. E.g., see Poynting, {4a. 4b}.

217. Heaviside, {5a}.

218. Heaviside, {5b}.

219. Heaviside, {5c}. Heaviside discusses the Faraday-Maxwell ether medium, outlines his vector algebra for analysis of vectors without quaternions, discusses magnetism, gives the EM equations in a moving medium, and gives the EM flux of energy in a stationary medium. On p. 443, he credits Poynting with being first to discover the formula for energy flow, with Heaviside himself independently discovering and interpreting this flow a little later by himself in an extended form.

220. J. H. Poynting, "On the connexion between electric current and the electric and magnetic inductions in the surrounding field," *Proc. Roy. Soc.* Lond. Vol. 38, 1984-85, p. 168.

221. Oliver Heaviside, *Electrical Papers*, Vol. 2, 1887, p. 94.

222. (a) T. E. Bearden, "On Extracting Electromagnetic Energy from the Vacuum," *Proc. IC-2000*, ibid., 2000; (b) Bearden, {38a}.

223. Lorentz is believed to have done this earlier (perhaps circa 1890s). In 1902 he published the method in a book, which strongly implies it was first done in an earlier paper. See Lorentz, {109}. Figure 25 on p. 185 shows the Lorentz concept of integrating the Poynting vector around a closed cylindrical surface surrounding a volumetric element. Many thanks to Marcus Reid for furnishing a copy of the actual Lorentz reference from a library in Leipzig, Germany.

224. E.g., see (a) Panofsky and Phillips, {110}; (b) W. Gough and J. P. G. Richards, *European J. Phys.*, Vol. 7, 1986, p. 195.

225. Panofsky and Phillips, {110}, p. 180.

226. D. S. Jones, *The Theory ofElectromagnetism,* Pergamon Press, Oxford, 1964, p. 52.

227. Jackson, {22}, p. 237.

228. W. M. Schwarz, *Intermediate Electromagnetic Theory,* John Wiley & Sons, New York, 1964, p. 280-281.

229. Jones, {226}, p. 53.

230. For typical references, see (a) J. Slepian, *Am. J. Phys.,* 19, 87 (1951); (b) Mario lona, *ibid.,* 31, 398 (1963); (c) Udo Backhaus and Klaus Schafer, *ibid.,* 54, 279 (1986); (d) C. J. Carpenter, *IEE Proc. A* (UK), 136A(2), Mar. 1989, p. 55-65; (e) J. A. Ferreira, *IEEE Trans. Edit.,* 31 (4). 1988, p. 257-264; (f) Mark A. Heald,Am. *J. Phys.,* 56(6), 1988, p. 540-547. The debate has also appeared in many other leading journals, e.g., (G) T. H. Boyer, *Phys. Rev. D,* 25, 3246 (1982). Interestingly, (h) M. Abraham and R. Becker, *The Classical Theory ofElectricity and Magnetism,* Blackie. London, 1932, p. 146 and p. 194 give two examples of the controversy over the Poynting vector. Finally, see (i) D. F. Nelson *Phys. Rev. Lett.,* 76(25), June 17, 1996, p. 4713-4716 for advanced **work** requiring a greater generalization of the Poynting vector.

231. Sweet and Bearden, {29a}. Sweet's device produced 500 watts lit a 33 microwatt input, which is approximately a COP = $1.5x10^6$. By steadily increasing the COP to $3x10^6$, the weight of the Sweet unit was reduced smoothly, reaching 90% reduction. The results of this highly successful anti-gravity experiment are reported in the paper. Unfortunately, Sweet later died and never fully revealed the activation secret by which barium ferrite magnetic materials could be triggered **into** strong self-oscillation at 60 Hertz or other ELF frequency.

232. Weaker self-oscillation of such permanent magnetic materials at higher frequency is known. E.g., see (a) V. S. L'vov, *Non-Linear Spin Waves,* Moscow, 1987; (b) L'vov, {29c}. See also (c) A. G. **Gurevich,** and G. A. Melkov, *Magnetization Oscillations and Waves,* CRC **Press,** Boca Raton, Florida, 1996. The latter authors give hundreds of **additional** references.

233. E.g., (a) M. W. Evans, P. K. Anastasovski, T. E. Bearden *et al*, "Derivation of the B(3) Field and Concomitant Vacuum Energy Density from the Sachs Theory of Electrodynamics," *Found. Phys. Lett.*, 14(6), Dec. 2001, p. 589-593; (b) — "Anti-Gravity Effects in the Sachs Theory ol Electrodynamics," *Found. Phys. Lett.*, 14(6), Dec. 2001, p. 601-605; (c) Evans et al., {38b}; (d) Evans et al., {38c}; (e) -- "Operator Derivation of the Gauge Invariant Proca and Eehnert Equation: Elimination of the Lorentz Condition," *Found. Phys.*, 39(7), 2000, p. 1123-1130; (f) - "O(3) Electrodynamics from the Irreducible Representations of the EInstein Group," 2001, *Found. Phys. Lett.*, 15(2), Apr. 2002, p. 179-187.; (g) - "Effect of Vacuum Energy on the Atomic Spectra," *Found. Phys.* Lett., 13(3), June 2000, p. 289-296; (h) Evans et al., {113b}; (i) Evans et aI., {113a}; (j) - "On the Representation of the Maxwell-Heaviside Equations in Terms of the Barut Field Four-Vector," *Optik* 111(6), 2000, p. 246-248; —"Derivation of the B(3) Field and Concomitant Vacuum Energy Density from the Sachs Theory of Electrodynamics," *Found. Phys. Lett.*, (in press); (k) — "The New Maxwell Electrodynamic Equations: New Tools for New Technologies. A Collection of 60 papers from the Alpha Foundation's Institute for Advanced Study. Published as a Special Issue of the *J. New Energy*, 4(3), Winter 1999. See also (1) Bearden, (222b}; (m) Bearden, {38a}; (n) Bearden, {43d}; (o) Bearden, {43a}; (p) Bearden, {30}; (q) Bearden, {40}; (r) Bearden {214}; (s) Bearden, {1214e}; (t) - "The Final Secret of Free Energy," *Magnets*, 7(5), May 1993, p. 4-26; (u) Bearden, {214f}.

234. Bearden, {40).

235. Terence W. Barrett and Dale M. Grimes, (a) Preface, p. vii-viii, in (b) *Advanced Electromagnetism: Foundations, Theory, and Applications*, Terence W. Barrett and Dale M. Grimes (eds.), World Scientific, Singapore, 1995.

236. I. Prigogine, "Irreversibility as a symmetry-breaking process." N*ature*, Vol. 246, Nov. 9, 1973, p. 67-71.

237. Paul Davies, *Superforce: The Search for a Grand Unified Theory of Nature*, Simon and Schuster, New York, 1984, p. 105.

238. Clarke, {55}, p. 38.

239. T. D. Lee, *Symmetries, Asymmetries, and the World of Particles*, U. Wash. Press, Seattle, 1988, p. 11.

240. That is, it does not exist *openly* in the open literature. Several inventors do have working laboratory COP>1.0 experiments, and at least three of them have models which could rapidly be developed into production systems — say, in one year or less. However, the exact and detailed construction details are understandably maintained as deeply proprietary by the inventors, until their intellectual property rights can be secured, including foreign patent rights. On the other hand, many other inventors mistakenly believe they have COP>1.0 systems, but do not because of instrumental error, considering nonsinusoidal waves as measurable with RMS meters, or effects covered in Chapter 6 which they do not comprehend. In addition, there have been those more interested in selling stock than in producing a working system.

241. But see Kawai, {31}. The only available *open* details approaching the "kit of parts and instructions" point is the Kawai process, and it will work just as in the patent if carefully built. If very efficient photon-coupled switching of the flux path is used for build-ups, and if very high efficiency (0.7 to 0.8) magnetic motors are modified with the Kawai process, one can expect the COP of the modified motors to be double the conventional efficiency of the original base motor. So one can obtain COP = 1.4 to 1.6, e.g., by using the necessary and available Hitachi high efficiency motors (one at 0.7 and the other at 0.8) to start with. Hitachi engineers physically tested two high efficiency Hitachi motors modified hy Kawai, at COP = 1.4 and COP = 1.6 respectively. Unfortunately, the Kawai process, engines, and company have been seized by what can **only** be described as the Yakuza (Japanese Mafia) and are being held off **the** market. The seizure was accomplished here in Huntsville, Alabama, witnessed by the CTEC board of directors and I, when Kawai and **CTEC** were in final negotiations to rapidly develop and market the Kawai **system** Several other COP>1.0 Japanese engines have also been seized and withheld by the Yakuza.

242. Jed Z. Buchwald, *From Maxwell to Microphysics,* University of Chicago Press, Chicago and London, 1985, p. 44.

243. Whittaker, {85}.

244. Bearden, {12}.

245. Mandl and Shaw, {19}.

246. Whittaker, {91a}.

247. To see how arduous a search Kron himself made prior to athieving a proper model for an electrical circuit, see Kron, {162}. The quote is from p. 114.

248. For example, Kron, {192}.

249. P. A. M. Dirac, "A theory of electrons and protons," *Proc. Roy. Soc. Lond. A*, 126(801), Jan. 1, 1930, p. 360-365. Here Dirac introduced the vacuum energy — the electron sea filled with electrons occupying negative energy states. The holes are treated today as the positive electrons. This concept is now referred to as the "Dirac Sea," and the concept has been expanded to include negative energy "holes" for other kinds of particles. Dirac first attempted to identify these holes with protons, until later the positron was discovered.

250. Evans, {137b}.

251. (a) Evans, {137a}; (b) — "The Link Between the Topological Theory of Ranada and Trueba, the Sachs Theory, and 0(3) Electrodynamics," *ibid.*, vol. 2, p. 495-499.

252. (a) Sachs, {126a). The Sachs theory provides a great generalization of general relativity and electrodynamics reaching from the quarks and gluons to the entire universe. See also (b) Sachs, {126b}.

253. Indeed, the symmetrizing of Maxwell's equations was first accomplished by Lorenz. See (a) Lorenz, {161a}. In this paper Lorenz gave essentially what today is called the Lorentz symmetrical regauging. AS pointed out by Barrett, the Lorenz paper gave f(t-r/c) functions. Fitzgerald said that Lorenz's functions were essentially the same as his, and Fitzgerald became a leading proponent of "retarded potentials". But it is believed that Fitzgerald was unaware of Lorenz's work until the 1880's, so he is given credit for parallel development. Some people speak of Fitzgerald-Lorenz functions. This is a regauging, but the term "gauge" (inspired by railroad gauges) was first introducec by Hermann Weyl in the 1900s. He used it for a change in length and was quickly countered by Einstein - Weyl's theory was not relativistic. The idea resurfaced in the 1920s when quantum theory was being formulated, but this time it meant "change in phase" and not "change in length". At any rate, when the renowned H. A. Lorentz performed the symmetrizing of the Maxwell-Heaviside equations in the 1880s. it was adopted immediately and has been rather universally applied since then. See also (b) Jackson and Okun {161b} for a history of gauge invariance.

254. (a) Prigogine, {160a}; (b) G. Nicolis and I. Prigogine, {160d}; (c) T. Petrosky and I. Prigogine, "Quantum Chaos, Complex Spectral Representation and Time-Symmetry Breaking," *Chaos, Solitons, and Fractals,* Vol. 4, 1994, p. 311-359; (d) D. Kondepudi and I. Prigogine, "Thermodynamics, Nonequilibrium," *Encyclopedia ofApplied Physics,* Vol. 21, 1997, p. 311-337; (e) D. Kondepudi and I. Prigogine, *Modern Thermodynamics: From Heat Engines to Dissipative Structures,* Wiley, Chichester, 1998; (f) T. Petrosky and I. Prigogine, "Laws of Nature, Probability and Time Symmetry Breaking," *Physica A,* Vol. 263, 1999, p. 528-539.

255. (a) G. Nicolis, and I. Prigogine, *Exploring Complexity,* Piper, Munich. 1987; (b) — *Exploring Complexity: An Introduction,* Freeman, New York, 1989; (c) G. Nicolis, {160e}.

256. Letokhov, {157a-157d}.

257. Bohren, {24}.

258. Paul and Fischer, {25}.

259. E.g., see (a) Patrick et al., {37}. For rigorous explanations of **how** the energy is extracted from the vacuum, see (b) Evans et al., {38b}; (c) Evans et al., {38c}. The vacuum can and will furnish an electromagnetic "wind" from which useful EM energy can be extracted. Indeed, every source charge and dipole already extracts and continuously pours out EM energy from the vacuum, thereby establishing its fields and potentials **(and** their energy) across the universe.

260. A relationship between gamma bursters and a big bang is suggested from some recent observations. On Jan. 23, 1999 the Hubble Space Telescope caught an optical flash simultaneous with an initial gamma burst. When calculated, this burst was second in energy only to the big bang itself, and generated about 3.4×10^{54} ergs, which is the equivalent of converting two solar masses instantaneously into energy. There was also no polarization of the afterglow, which has been taken as evidence of beaming. However, such beaming could also be due to the beaming involved in the intense iterative phase conjugate reflections of the asymmetrical self-regauging process in intensely scattering, optically active, energy-amplifying media.

261. Heaviside, {5a-5c}.

262. Josephs, {172a}; Laithwaite, {172b}.

263. (a) Diederik Wiersma and Ad Lagendijk, "Laser Action in Very White Paint," *Physics World,* Jan. 1997, p. 33-37; (b) K. Totsuka, G. van Soest, T. Ito, A. Lagendijk, and M. Tomita, "Amplification and diffusion of spontaneous emission in strongly scattering medium,"*J. Appl. Phys.,* Vol. 87, 2000, p. 7623-7628.

264. (a) A. Lagendijk, J. Gomez Rivas, A. Imhof, and R. Sprik, "Propagation of light in disordered semiconductor materials," in *Photonic Crystals and Light Localization in the 21st Century,* edited by C. M. Soukoulis, Kluwer, Dordrecht, 2001, p. 447-473; (b) H. Cao *et at,* "Spatial Confinement of Laser Light in Active Random Media," *Phys. Rev. Lett., 8*4(24), 12 Jun. 2000, p. 5584-5587.

265. We also point out the possibility of the accumulator at each end being an intensely scattering, photoreactive, energy-amplifying material, a subject discussed a bit later in this chapter.

266. (a) Werner Triftshauser *et al, Phys. Rev. Lett.,* Vol. 87, 2001. An overview is given by (b) Philip Ball, "The Positron Probe," *Nature,* Vol. 412. Aug. 23, 2001, p. 764.

267. For example, see Letokhov, {157a-157d}.

268. Jackson, {22}, p. 363, third footnote.

269. Kraus, {10}, p. 4.

270. Marconi's patent is Gugliehno Marconi, "Transmitting Electrical Signals," U.S. Patent 586,193, July 2, 1897. Filed Dec. 7, 1896, with 56 claims. This patent was overturned in 1943 by the U.S. Supreme Court, and prior work by Nikola Tesla for transmission of EM signals was upheld. Most textbooks and journals, etc. to this day continue to falsely credit Marconi with discovery of the transmission of EM signals and thus the discovery of radio. This is not to discredit the important work that Marconi did; without him, signal transmission would have been much longer in coming.

271. United States Reports: Cases Adjudged in the Supreme Court of the United States, Vol. 320, Marconi Wireless Telegraph Co. of America vs. United States, June 21, 1943, p. 1-80. The U.S. Supreme Court ruled that Tesla's fundamental radio patents had anticipated all other contenders, including Marconi.

272. *Dictionary ofScientific and Technical Terms,* Daniel N. Lapedes (editor in chief), McGraw-Hill, New York, 1974, p. 300. On page 517 of the second and expanded edition (1978), the same definition of electric field appears and is unchanged.

273. H. J. Gray and Alan Isaacs, *A New Dictionary ofPhysics,* Longman, London, second edition, second impression, 1976.

274. Feynman, {7}, p. 2-4.

275. Feynman, {7}, p. 12-2.

276. P. K. L. Drude, *Ann. Physik,* Vol. 1, p. 566; Vol. 3, 1900, p. 370, 869. Here Drude first develops a theory of conductivity in a metal based on the assumption that there is a gas of free electrons in the metal. This gas of conduction electrons is often referred to as the "Drude gas." Note that this was shortly after J. J. Thomson's discovery of the electron in 1897.

277. E.g., see Jackson, {211a}.

278. Romer, {84}, endnote 24, p. 109.

279. H. Winfield Secor, "Tesla Maps Our Electrical Future."

280. Nikola Tesla, "Pioneer Radio Engineer Gives Views on Power," *New York Herald Tribune,* Sep. 11, 1932.

281. Nikola Tesla, "The True Wireless, *Electrical Experimenter,* May 1919.

282. Burford and Verner, {35a}. Quote is from p. 281.

283. That is, it does not exist *openly* in the open literature. Several inventors do have working laboratory COP>1.0 experiments, and at **least** three of them have models which could rapidly be developed into production systems — say, in one year or less.

284. But see Kawai, {31}.

285. Barrett, {124}.

286. (a) Terence W. Barrett, "Active Signalling [sic] Systems," U.S. Patent No. 5,486,833, Jan. 23, 1996; (b) — "Oscillator-Shuttle-Circuit (OSC) Networks for Conditioning Energy in Higher-Order Symmetry Algebraic Topological Forms and RF Phase Conjugation," U.S. Patent No. 5,493,691, Feb. 20, 1996.

287. No proper scientific treatise on the Moray device has ever been published, to our knowledge, nor has a proper theory of its operation been developed. Anecdotal material and some technical material is contained in (a) T. H. Moray, *The Sea of Energy,* 5th Edn., Salt Lake City, 1978 (foreword by T. E. Bearden). The fourth edition of the book, titled (b) *The Sea of Energy in Which the Earth Floats,* contains additional material but is long out of print. Additional information is given in (c) Keith Tutt, *The Search for Free Energy,* Simon & Schuster, 2001, p. 33-68. (d) Paul Brown's study of the Moray work is "The Moray Energy Device: Operational Parameters, Design Criteria, and Considerations," date unknown. Researcher and inventor Bruce Perreault has based much of his own work with his radiant energy valve on Moray's work. Perreault proposes a different interpretation. In the present book we have tried to point out the various aspects of the Moray device that resemble other presently known effects — most of which were still unknown in the 1920s and 1930s when Moray's fundamental work was accomplished.

288. Moray, {34b} "Electrotherapeutic Apparatus," U.S. Patent No. 2,460,707, Feb. 1, 1949. This patent clearly shows the complexity of the various special tubes containing his pellets that Moray developed.

289. H. *C.* Dake and Jack DeMent, *Fluorescent Light and Its Applications,* Chemical Publishing Company, Inc., Brooklyn, New York, 1941, p. 51-52 gives a succinct discussion of Stokes emission and anti-Stokes emission.

290. Sir G. G. Stokes, "On the Change of Refrangibility of Light," a memoir, 1852.

291 For example, in 1935 Prileshajewa showed that there is an energy difference involving as much as 1.1 V between the exciting light and the fluorescence of aniline vapor.

292. V. S. Letokhov, {157a-157d}.

293. Letokhov, *ibid.*

294. E.g., (a) R. N. Bhargava and D. Gallagher, "Optical Properties of Manganese-Doped Nanocrystals of ZnS," *The Am- Phys. Soc,* 72(3), Jan. 17, 1994; (b) I. A. Izmailov et al., "Generation of Stimulated Noncoherent Radiation in Light-Scattering Media Exhibiting Chemical Reactions," *Soy. J. Quantum Electronics,* 12(5), May. 1982, p. 588-594; (c) R. Pappalardo and A. Lempicki, "Brillouin and Rayleigh Scattering in Aprotic Laser

Solutions Containing neodymium," *J. Appl. Phys.,* Apr. 1992, p. 1699-1708.

295. (a) Nabil M. Lawandy *et al.,* " Laser action in strongly scattering media," *Nature,* Vol. 368, Mar. 31, 1994, p. 436-438. For a good lay article with color pictures, see (b) Ivars Peterson, "Boosted light: Laser action in white paint," *Science News,* 145(15), Apr. 9, 1994, p. 228-229. See also (c) P. Mandel, "Lasing without inversion: A useful concept?," *Contemp. Phys.,* Vol. 34, 1993, p. 335; (d) O Kocharovskaya, "Amplification and lasing without inversion," *Physics Reports,* Vol. 219, 1992, p. 175.

296. Some useful papers are: (a) Diederik S. Wiersma and Ad Lagendijk, "Light diffusion with gain and random lasers," *Phys. Rev. E,* 54(4), Oct. 1996, p. 4256-4265. The authors discuss experimental considerations for a medium that both multiply scatters and amplifies light, and distinguish three regimes; (b) H. Cao *et al.,* "Random Laser Action in Semiconductor Powder," *Phys. Rev. Lett.,* 82(11), 15 Mar. 1999, p. 2278 2281. The authors observed random laser emission in all directions, with coherent feedback, in semiconductor powder, (c) Diederik S. Wiersma, Meint P. van Albada and Ad Lagendijk, "Coherent Backscattering of Light from Amplifying Random Media," *Phys. Rev. Lett.,* 75(9), 28 Aug., **1995,** p. 1739-1742. (d) D. S. Wiersma, P. Bartolini, A. Lagendijk, and R. Righini, *Nature,* Vol. 390, 1997, p. 671. The authors report Anderson localization of photons in GaAs powder, (e) Ad Lagendijk *et al,* "Microscopic Approach to the Lorentz Cavity in Dielectrics," *Phys. Rev Lett.,* 79(4), 28 July 1997, p. 657-660. (f) Pedro de Vries and Ad Lagendijk, "Resonant Scattering and Spontaneous Emission in **Dielectrics** Microscopic Derivation of Local-Field Effects," *Phys. Rev. Lett.,* 81(7), 17 Aug. 1998, p. 1381-1384. (g) Gijs van Soest, Makoto Tomita, and Ad Lagendijk, "Amplifying volume in scattering media," *Opt. Lett.,* 24(5), Mar. 1, 1999, p. 306-308.

297. S. Itoh *et al.,* "Simulational and experimental studies on anomalous reflectivity of phase conjugate wave," *Ferroelectrics,* vol. 170, 1995, p. 209-217.

298. See (a) D. P. Hand and P. St. J. Russell, "Solitary thermal shock waves and optical damage in optical fibers," *IEE Colloquium on 'Non Linear Optical Waveguides', LEE Digest* No. 88, London, England, 1988, p. 101-103; (b) — "Soliton-like thermal shock-waves in optical fibres: origin of periodic damage tracks," *Fourteenth European Conference on*

Optical Communication (ECOC 1988), Sep. 11-15, 1988, Publication No. 292, 1(2), 1988, p. 111-114; (c) — "Solitary thermal shock waves and oplical damage in optical fibers: the fiber fuse," *Opt. Lett.*, 13(9), Sep. **1988,** p. 767-769; (d) D. P. Hand and T. A. Birks, "Single-mode tapers as 'fibre fuse' damage circuit-breakers," *Electronics Lett.*, 25(1), Jan. 5, 1989, p. 33-34. For an excellent lay description with photographs, see (e) Ivars Peterson, "Fibers with Flare," *Sci. News*, 140(13), Sep. 8, 1991, p. 200-201

299. P. St. J. Russell, "Power Conservation and Field Structures in Uniform Dielectric Gratings," *J. Opt. Soc. America A.*, 1(3), Mar. 3, 1984, p. 293-299. Russell is referring to apparent violation of local conservation of energy. It is true in the conventional flawed energy flow analysis considering only the Poynting component, because the fuse produces more work output (melting the holes) than the original operator's input of Poynting energy to initiate the fuse effect. It does not produce more work output than the total of the energy input by the operator in both the acounted Poynting component and the unaccounted Heaviside component. It merely shows that the extra fiber fuse ignition actions do absorb extra energy from the Heaviside component, perhaps by particle resonance (Bohren effect) of the melt and vapor particles. Also, intense heating produces intense ionization and thus intense dipoles, thus producing broken symmetry in the fierce exchange with the active vacuum. Multiple retroreflections of the EM energy flow also occur in the nmelt and vapor particles, leading to multiple collections in the ping-pong of a joule of energy between two particles as phase conjugate mirrors.

300. E.g., see (a) H. Kogelnik, "Coupled wave theory for thick hologram gratings," *Bell Systems Technical Journal*, Vol. 48, 1969, p. 2909-2947; (b) Z. Zylbergerg and E. Marom, "Rigorous coupled-wave analysis of pure reflection gratings," *J. Opt. Soc. Am.*, Vol. 71, 1981, p. 811-818; (c) — - "Rigorous coupled-wave analysis of grating diffraction — E- mode polarization and losses," *ibid.*, Vol. 73, 1983, p. 451-455; (d) - "Comments on analyses of reflection gratings," *ibid.*, Vol. 73, 1983, p. 399-401.

301. Bohren, {24J.

302. Justin Mullins, "Superpowerful Explosive Arrives with a Bang." New *Scientist*, Aug. 4, 2001.

303. Romano M. DeSantis *et al.*, "On the Analysis of Feedback Systems With a Multipower Open Loop Chain," Oct. 1973, AD 773188, available through the Defense Technical Information Center or the National Technical Information Center. The paper clearly shows that such systems can produce overunity coefficient of performance.

304. See (a) J. H. Andreatta, "High Power Switching Amplifier Wherein Energy is Transferred to a Tuned Circuit During Both Half Cycles," U.S. Patent No. 3,239,771, Mar. 8, 1966; (b) Tom L. Dennis Jr., "Highly Efficient Semiconductor Switching Amplifier," U.S. Patent No. 3,239,772, Mar. 8, 1966; (c) Heber J. Morrison, "Square Wave Driven Power Amplifier," U.S. Patent No. 3,815,030, June 4, 1974.

305. For a good but conventional coverage of many differential negative resistors and negative conductors, see Adolf Fritz Schwarz, "Negative Resistors and Negative Conductors," Doctoral Thesis, Technische Hogeschool, Delft (Netherlands), Feb. 1969, available from the U.S. National Technical Information Service (NTIS), Springfield, VA. True negative resistors are dismissed as impossible in Schwarz's opening remarks. And they *are* impossible in equilibrium systems not receiving and using any net excess energy asymmetrically from their environment, which are the only systems conventionally considered by electrical engineers and electrodynamicists.

306. Gabriel Kron, "Numerical solution of ordinary and partial differential equations by means of equivalent circuits." *J. Appl. Phys.*, Vol. 16, Mar. 1945a, p. 173.

307. Kron, {32}, p. 39.

308. Bearden, {12}.

309. E.g., see Gabriel Kron, "Equivalent Circuits for Oscillating Systems and the Riemann-Christoffel Curvature Tensor," *General Electric Review*, Jan. 1943, p. 25-31.

310. See (a) S. Austen Stigant, "Gabriel Kron on Tensor Analysis, A bibliographical record," *BEAMA Journal*, Aug. 1948, for a full bibliography of Kron's publications up to 1948. Also useful are (b) Gabriel Kron, "A Method to Solve Very Large Physical Systems in Easy Methods," *IRE Transactions on Circuit Theory*, 2(1), Dec. 1953, p. 71-90; (c) P. L. Alger, editor, *The Life and Times of Gabriel Kron, or Walking Around the World, and Tensors*, Mohawk Development Services, Inc.,

Schenectady, NY, 1969; (d) Banesh Hoffman, " Cron's Non-Riemannian Electrodynamics," *Rev. Mod. Phys.*, 21(3), 1949, *x* 535-540; (e) K. Kondo and Y. Ishizuka, "Recapitulation of the Geometrical Aspects of Gabriel Kron's Non-Riemannian Electrodynamics," Research Association of Applied Geometry, *Memoirs of the Unifying Study of Basic Problems in Engineering and Physical Sciences by Means of Geometry*, Gakujutsu Bunken Fukyu-kai, Tokyo, Vol. I, 1955, p. 185-239 [particularly see footnote 1, p. 222];

311. Wang and Chung, {33}.

312. Deborah D. L. Chung, "Superconductor-metal laminates and method of making," U.S. patent no. 5,059,582, issued Oct. 22, 1991. A superconducting laminate having at least one layer of metal and at least one layer of superconducting material. The metal layer and the superconducting layer are bonded. The layer may also include carbon fibers from various precursors. The superconductor may be a composite material. The invention also includes a method of making the laminates. Assigned to The Research Foundation of State University of NY, Albany, NY.

313. Jean-Louis Naudin, website http://jnaudin.free.fr/cnr/.

314. Fogal, {36a, 36b}.

315. As one example, Fogal's device has to be able to manipulate Dirac holes in the vacuum itself, at least to some extent. Once the erroneous flat spacetime assumption of classical electrodynamics is removed and curved local spacetime considered, we can and will have Dirac holes in the local vacuum itself, especially in COP»1.0 systems. In a COP»1.0 system, not all the Dirac holes have interacted with orbital electrons in atoms to "eat" an electron and produce a positive ion — with a "lattice hole" or "lattice positron" where the electron had been. There is a vast difference between a Dirac hole positron (which has a negative mass equal in magnitude to one electron-mass) and a lattice hole (which is attached to the relatively huge positive mass of the ionized atom. Hence the mobility and phenomenology of Dirac positrons and lattice positrons are very different. There presently are no books on the dynamics of the Dirac negative energy electron holes in COP»1.0 EM circuits and systems.

316. Mandl and Shaw, {19}.

317. Whittaker, {91a}. The paper was published in 1904 and orally delivered in 1903. Note: On p. 368 midpage, Whittaker's equation for the y-component of vector-potential "a" is missing the exponent "2" on the **del** operator.

318. Rodrigues and Lu, {93a}.

319. Rodrigues and Vaz, {93b}.

320. It is certainly not lacking in the secret military weapons game. Some 10 nations of the world have weaponized longitudinal EM wave weapons over the past few decades, and almost every major weapons laboratory in the world has now "discovered" longitudinal EM waves. Even the Yakuza (Japanese Mafia) has acquired its own portable longitudinal EM interferometry weapons.

321. Evans et al., {79}.

322. (a) V. I. Arkhipov, *et al.,* "Negative transient currents in amorphous semiconductors." *Internat. J. Electronics* (UK), 51(6), 1981, p, 735-742; (b) — and A. I. Rudenko, "Negative currents caused by injection-controlled polarization," *Solid. St. Commun.,* 28, 1978, p. 675-676.

323. Jackson, {22}, p. 222.

324. Jackson, {22}, p. 223.

325. O. L. Brill and B. Goodman, *Am. J. Phys.,* vol. 35, 1967, p. 832.

326. For example, see Jackson, {22}, p. 219-221.

327. We stress that electrodynamicists, conventional theory, and quantum field theory all assume the principle *of gauge freedom,* the **total** freedom to change the gauge (and therefore any potential) in a Maxwellian system at any time, without cost or work. In the real world one may have to pay a little switching costs, but by simply regauging one can freely change the EM energy physically present at a point in 3-space **occupied by** the Fogal "freed" instantaneous scalar potential, once the electrons are pinned. In short, the Fogal process is able to directly "gate" the instantaneous transduction of EM energy existing at multiple points **in** space, simultaneously. There is nothing in the gauge freedom **principle** that restricts (i) regauging the instantaneous scalar potential at will, **or** (ii) using these changes at a distance to produce force fields upon electrons, thereby moving them — so long as one employs a Fogal semiconductor in

the "distant receiver" in order to be able to produce the back-transition from the field-free state to the force-field state by removing the anomalous pinning restriction. To the advanced theorists, we leave the debates over causality considerations for this demonstrated process!

328. Whittaker, {85}.

329. (a) W. Heitman and G. Nimtz, "On Causality Proofs of Superluminal Barrier Transversal of Frequency Band Limited Wave Packets," *Phys. Lett. A196,* 1994, p. 154-158; (b) Enders and Nimtz, {136b}.

330. The reader should recall that the Lorenz/Lorentz condition, which limits the circuit to COP< 1.0, is self-applied by the circuit when it rams all "spent" electrons in the ground return line back through the emf of the circuit. One need not do that, and need not produce that force field that destroys the primary source dipole and its extraction of EM energy from the vacuum via its broken symmetry. As the reader has undoubtedly now observed, the "back-emf' and "back mmf are those aspects in an electrical circuit and magnetic circuit respectively, that kill the dipole and physically self-apply and self-enforce Lorenz/Lorentz symmetrical regauging. Hence the intuitive concern of COP>1.0 experimenters to try to discover how to avoid or lessen the "back emf or the "back mmf in their circuits and systems.

331. Philip Ball, "The positron probe," *Nature,* Vol. 412,23 Aug. 2001, p. 764.

332. Werner Triftshauser et al., *Phys. Rev. Lett.,* 87, 067402 (2001).

333. Bearden, {30}.

334. For the chemistry and currents of the battery, see any good battery reference, such as Colin A. Vincent and Bruno Scrosati, *Modern Batteries: An Introduction to Electrochemical Power Sources,* Second Edition. Wiley, New York, 1997.

335. (a) J. O'M. Bockris, A. K. N. Reddy, and M. Gamboa-Aldeco, *Modern Electrochemistry: Fundamentals of Electrodics,* 2nd edition. Kluwer/Plenum, NY 2000; (b) J. O'M. Bockris and A. K. N. Reddy, *Modern Electrochemistry: Electrodics in Chemistry, Engineering, Biology, and Environmental Science,* 2nd edition, Kluwer/Plenum, NY 2000; *(c)* J. Koryta, J. Dvorak, and L. Kavan, *Principles of Electrochemistry,* 2nd ed.. Wiley, NY, 1993; (d) Wolfgang .1. Lorenz and Waldfried Plieth,

Electrochemical Nanotechnology: In Situ Local Probe Techniques at Electrochemical Interfaces, Wiley, NY, 1998; (e) B. E. Conway, *Electrochemical Supercapacitors: Scientific Fundamentals and Technological Applications,* Plenum, NY, 1999; (f) Allen J. Bard and Larry R. Faulkner, *Electrochemical Methods: Fundamentals and Applications,* Second Edition, Wiley, NY, 2001.

336. At this writing, a provisional patent application on the process has been filed by Bedini and the present author. By the time of publication, hopefully this will have been turned into a formal patent application, with foreign patents also applied for.

337. Edwin V. Gray, "Pulsed Capacitor Discharge Electric Engine," U.S. Patent #3,890,548, June 17, 1975.

338. (a) Per Whittaker, {85}. However, see (b) Bearden, {12} for a necessary correction of Whittaker's interpretation to accord with a quantum field theory view of the instantaneous scalar potential. After observation, the phase conjugate EM wave half of the Whittaker wavepair is indeed going in the opposite direction to the normal longitudinal EM wave half But prior to observation, it exists in the time domain, and in the time domain it is precisely accompanying the 3-space longitudinal EM wave, with the absorbing and then emitting charge interacting in the middle between the two. See (c) Mandl and Shaw, {19}, to see that the combined scalar (time-polarized) photon and longitudinal photon are observable as the instantaneous scalar potential. This means that the corrected Whittaker decomposition produces an associated time-polarized EM wave in the time domain and longitudinal EM wave in 3-space. That is the corrected interpretation of Whittaker's phase conjugate longitudinal EM wavepair.

339. (a) J. O'M. Bockris, "Overpotential: a lacuna in scientific knowledge,"J. *Chem. Edu.,* 48(6), June 1971, p. 352-358. This is a simplified introduction to overpotential theory. The energy density that exists at minute "double layers" in contact, which act as tiny capacitors with extremely small separation of plates, is enormous and far greater **than** what the power engineer meets in his normal engineering practice. **Sec** also (b) Bockris and Reddy, {335b}, particularly Chapter I which deals with the overpotential. See also (c) Bockris et a1, {335a}.

340. E.g. see (a) L. Bertalot *et al.,* "Study of deuterium charging in palladium by the electrolysis of heavy water: heat excess production", *Nuovo Cimento,* Vol. 15 D, 1993, p. 1435; (b) J. O'M Bockris *et al.,* "Cold

fusion as a consequence of high fugacity among hydrogen isotopes," Intl. *J. Hydrogen Energy,* Vol. 17, 1992, p. 445.

341. Peter Lindemann, *The Free Energy Secrets of Cold Electricity,* **Clear** Tech Inc., Metaline Falls, WA, 2001.

342. Particularly see Kenneth S. Deffeyes, *Hubbert's Peak: The Impending World Oil Shortage,* Princeton University Press, Princeton, NJ, **2001.**

Quoting: *"Deffeyes finds that world oil production will peak within five wars and that there isn't anything we can do to stop it. New exploration and production technologies can't save us, and plans to open the Arctic National Wildlife Refuge and other areas to drilling offer no more than a small and soon-to-be-forgotten blip on the production curve. While long-term solutions exist in the form of conservation and alternative energy sources, they probably cannot — and almost certainly will not — be enacted in time to evade a short-term catastrophe of shortages, soaring prices, and global economic, agricultural, and possibly political disturbance. "* In short, Deffeyes rigorously demonstrates that a world energy crisis of staggering proportions is just around the corner.

343. D. J. Bohm and B. J. Hiley, "On the intuitive understanding of nonlocality as implied by quantum theory," *Found. Phys.,* 5(1), Mar. 1975, p. 93-109. Quote is from p. 107.

344. (a) Y. Aharonov and D. Bohm, "Significance of Electromagnetic **Potentials** in the Quantum Theory," *Phys. Rev.,* Second Series, 115(3), Aug. 1, 1959, p. 485; (b) — "Further Considerations on Electromagnetics In **the** Quantum Theory," Phys. Rev., 123(4), Aug. 15, 1961, p. 1511-1524.

345. Terence W. Barrett, "Electromagnetic Phenomena Not Explained by Maxwell's Equations," A. Lakhtakia, ed., *Essays on the Formal Aspects of Electromagnetics Theory,* World Scientific Publishing, River Edge, NJ, **1993,** p. 11 and generally p. 6-86.]

346. Davies, {237}, p. 105.

347. David J. Bohm, "A Suggested Interpretation of the Quantum **Theory** in Terms of 'Hidden' Variables, I and II." *Phys. Rev.,* 85(2), Jan. 15, 1952, p. 166-179 (Part I); 180-193 (Part II).

348. Jackson, {22}, p. 223.

349, Lamb and **Retherford,** {23}.

350. (a) Casimir, {26}. This paper is an extrapolation to two attracting plates of the more detailed paper of (b) H. B. G. Casimir and D. Polder, "The influence of retardation on the London-van der Waals Forces," *Phys Rev.* 73(4), Feb. 15, 1948, p. 360-372. Casimir's paper was an extension of earlier work by Verwey and Overbeek on the stability of colloidal systems, including the interaction of electric double layers; see (c) E. J. W Verwey, J. T. G. Overbeek, and K. van Nes, *Theory of the Stability of Lyophobic Colloids*, Elsevier, Amsterdam, 1948.

351. Lamoreaux, {27}.

352. Mead and Nachamkin, {28}.

353. E.g., see (a) P. W. Milonni. R. J. Cook and M. E. Goggin, "Radiation pressure from the vacuum: Physical interpretation of the Casimir force," *Phys. Rev. A*, Vol. 38, 1988, p. 1621; (b) C. E. Carlson, T. Goldman and J. Peres-Mercader, "Gamma-ray bursts, neutron star quakes, and the Casimir effect," *Europhys. Lett.*, Vol. 36, 1996, p. 637; (c) M. Chaichian *et ah*, "Quantum theories on noncommutative spaces with nontrivial topology: Aharonov-Bohm and Casimir effects," *Nucl Phys B.* Vol. 611, 2001, p. 383-402; (d) V. Dodonov, "Nonstationary Casimir Effect and Analytical Solutions for Quantum Fields in Cavities with Moving Boundaries," in *Modern Nonlinear Optics*, 2nd Edn., 3 vols., Wiley, 2001, Vol. 1, p. 309-384.

354. Bohm, {347}.

355. See T. E. Bearden, *Gravitobiology: A New Biophysics*, Tesla Book Co., Chula Vista, CA, 1991.

356. One should not be nonplussed at the notion of infinite velocity. A pure longitudinal EM wave is — at least in theory — capable of moving at infinite velocity, and is a proper solution to Maxwell's equations. See (a) Rodrigues and Lu, {93a}. Also, the ordinary potential in the Coulomh gauge does indeed move at infinite velocity; see Jackson, {22}, p. 223. In addition, Bohm's interpretation of quantum mechanics {347} uses the quantum potential, which instantaneously appears everywhere it will have magnitude.

357. Enders and Nimtz, {329b}.

358. R. Chen, "Cancellation of Internal Forces," *Am. J. Phys.*, 49(4), Apr. 1981, p. 372.

359. Whittaker, {85}.

360. R. L. Davis, "Non-Inductive Electrical Resistor," U.S. Patent No. 3,267,406, Aug. 16, 1966. Davis uses a Mobius-loop capacitor as an inductance-free resistor. Our comment is that, more rigorously, the resistor is *not* noninductive. It is "equally and oppositely inductive," which is quite a different thing altogether when one considers the difference between internal energy and external energy. We hypothesize that the "resistor" — or some version of it — produces an artificial scalar potential stress in spacetime — apparently varying the stress energy tensor itself— even though it produces a *net* zero reactance.

361. These are Brazil, Russia, China, and two other nations friendly to the U.S. The dominant weapons on earth today are quantum potential weapons, not nuclear weapons. The second most dominant weapons are probably the negative energy EMP weapons deployed by several nations, including China.

362. E.g., see (a) L. I. Mandelstam and N. D. Papaleksi, "On the parametric excitation of electric oscillations," *Zhurnal Teknicheskoy Fiziki,* 4(1), 1934, p. 5-29; (b) — "On resonance phenomena with frequency distribution." *Z.f. Phys.,* No. 72, 1931, p. 223: (c) — "Concerning asynchronous excitation of oscillations," *Zhurnal Tekhnicheskoi Fiziki,* 4(1), 1934; (d) — "Concerning asynchronous excitation of oscillations," *Zhurnal Tekhnicheskoi Fiziki,* 4(1), 1934; (e) — - "Concerning nonstationary processes occurring in the case of resonance phenomena of the second class," *Zhurnal Tekhnicheskoi Fiziki,* 4(1), 1934. See also (f) A. Andronov, "The limiting cycles of Poincare and the theory of self-maintained oscillations," *Comptes-Rendus,* Vol. 189, 1929, p. 559; (g) — and A. Witt, "On the mathematical theory of self-excitations," *Comptes-Rendus,* Vol. 190, 1930, p. 256; (h) — "On the mathematical theory of self-excitation systems with two degrees of freedom," *Zhurnal Tekhnicheskioi Fiziki,* 4(1), 193; (i) — "Discontinuous periodic movements and theory of multivibrators of Abraham and Bloch," *Bull. De l'Acad. Ed Sc. De l'URSS,* vol. 189, 1930. See (j) S. Chaikin, "Continuous and 'discontinuous' oscillations," *Zhurnal Prikladnoi Fiziki,* Vol. 7, 1930. p. 6; (k) — and A. Witt, "Drift in a case of small amplitudes," *Zhurnal Teknicheskoi Fiziki,* 1(5), 1931, p. 428; (1) — and N. Kaidanowski, "Mechanical relaxation oscillations," *Zhurnal Teknicheskoi Fiziki,* Vol. 3, 1933, p. 1.

363. L. Mandelstam [L. T. Mendel'shtam], N. Papalexi, A. Andronov, S. Chaikin and A. Witt, "Report on Recent Research on Nonlinear Oscillations," Translation of "Expose Des Recherches Recentes Sur Les Oscillations Non Lineaires," *Technical Physics of the USSR*, Leningrad, Vol. 2, 1935, p. 81-134 [NASA Translation Doc. TTF-12,678, Nov. 1969].

364. In Alexander L. Fradkov and Alexander Yu. Pogromsky, *Introduction to Control of Oscillations and Chaos*, World Scientific Series on Nonlinear Science E, Series Editor Leon O. Chua, World Scientific, New Jersey, 1998 — as a typical example — I found no mention of the Dirac hole current decay mechanism or of the active external environment (the active vacuum and its dynamics, and the active local curvatures of spacetime and their dynamics).

365. Richard E. Prange and Peter Strance, "The Semiconducting Vacuum," *Am. J. Phys.*, 52(1), Jan. 1984, p. 19-21.

366. John F. Lindner *et ah*, "Noise Enhanced Propagation," *Phys. Rev. Lett.*, 81(23), 7 Dec. 1998, p. 5048-5051. Lindner suggests that the mechanism appears to be general, in which case it could supply the mechanism that coherently "locks together" the barium nuclei self-oscillations in Sweet's activated barium ferrite magnets.

367. Owen Flynn, "Parametric arrays: A new concept for sonar," *Electronic Warfare Magazine*, June 1977, p. 107-112. Any two sine-wave frequencies as simultaneous drivers combine to produce a sine-wave difference frequency propagating in an isotropic nonlinear medium, essentially without sidebands or reverberations. Its pattern has a main lobe approximately equal to that of the high frequency drive, but devoid of sidelobes. The level of the propagating difference frequency is proportional to both the product of the two fundamental drive levels and to the square of the desired value of difference frequency.

368. M. I. Dykman *et al.*, "Noise-enhanced heterodyning in bistable systems." *Phys. Rev. E*, 49(3), Mar. 1994, p. 1935-1942

369. (a) V. S. L'vov and L. A. Prozorova, "Spin Waves Above the Threshold of Parametric Excitation," in (b) A. S. Borovik-Romanov and S. K. Sinha, Eds., *Spin Waves and Magnetic Excitations*, North-Holland, Amsterdam, 1988.

370. Gurevich and Melkov, {232c}. The authors treat high **frequency** processes, i.e., oscillations and waves, in magnetically ordered substances, including ferromagnetic and antiferromagnetic resonances, spin waves, nonlinear processes, and high frequency manifestations of **interactions** between the magnetic system and other systems of magnetically **ordered** substances (crystal lattice, charge carriers). The treatment is classical except that a quantum mechanical approach is used in the study of relaxation processes, which determine the energy losses of magnetic oscillations and waves. Experimental results but not techniques are included. Self-oscillation and self-oscillation criteria arc on p. 279.

371. (a) G. S. Kandaurova and A. E. Sviderskii, "Observation of autowave state and stable dynamic structures in multidomain magnetic films," *Sov. Tech. Phys. Lett.,* 14(5), May 1988, p. 346-347; (b) V. S. **L'vov,** {29c}.

372. Richard T. Hammond, "New fields in general relativity," *Contemp. Phys.,* 36(2), 1995, p. 103-114.

373. (a) J. Baugh et al., *Science,* Vol. 294, 16 Nov. 2001, p. 1505. For a simpler synopsis of the paper, see (b) Warren S. Warren, "Multidimensional Symmetry in a Three-Dimensional World," *Science,* Vol. 294, 16 Nov. 2001, p. 1475-1476.

374. E.g., see Howard R. Johnson, "Permanent Magnet Motor." U.S. Patent No. 4.151.431. Apr. 24. 1979.

375. Howard Johnson, private communication, January 2002.

376. In magnetics, multi-valued potentials (and hence the possibility **for** nonconservative fields) arise naturally in the theory, but are considered a nuisance to be eliminated or "averaged away" by magnetics engineers. E.g., see (a) Z. Ren, "A 3D vector potential formulation using edge element for electrostatic field computation," *IEEE Trans, on Magnetics,* **31(3),** May 1995, p. 1520-1523; (b) — "New technique for solving three-dimensional multiply connected eddy-current problems." *lEEProc, 1*37A(3), May 1990, p. 135-140; (c) J. C. Verite, "Calculation of multivalued potentials in exterior regions," *IEEE Trans, on Magnetics,* **Vol.** MAG-23(3), May 1987, p. 1881-1887. Amazingly, these and other similar methods are directed into converting the multivalued potential into single-valued regions by a process of multiple, highly selected cuts. In other words, the real attempt is to eliminate the multivalued aspect, in which case the theorists are in fact simply eliminating the asymmetrical

self-regauging provided by the multivalued potential and hence are discarding the ability to use multivalued potentials in true overunity processes.

377. (a) Z. Badics, "Transient eddy current field of current forced three-dimensional conductors," *IEEE Trans, on Magnetics,* 28(2), Mar. 1992, p. 1232-1234;(b) R. Albanese and G. Rubinacci, "Magnetostatic field computations in terms of two component vector potentials," *Int. J. for Numerical Methods in Engineering,* Vol. 29, 1990, p. 515-532; (c) Bearden, {214f}: (d) P. Hammond and T. D. Ssiboukis, "Dual finite-element calculations for static electric and magnetic fields," *lEEProc. A,* 130(3), 1983, p. 105-111; (e) P. R. Kotiuga, "On making cuts for magnetic scalar potentials in multiply connected regions," *J. Appl. Phys.,* 61(8), 1987, p. 3916-3918; (f) J. Penman and J. R. Fraser, "Complementary and dual energy finite element principles in magnetostatics," *IEEE Trans, on Magnetics,* 18(2), 1982, p. 319-323; (g) E. A. Tolkachev and Ya. M. Shnir, "Non-trivial topology effects in the interaction of a monopole with a line current," *Phys. Lett. A,* 155(8, 9), May 27, 1991, p. 464-466.

378. (a) Feynman, {7}, Vol. II, Chapter 37; (b) T. Ambrose, R. L. Sommer, and C. *L.* Chien, "Angular Dependence of Exchange Coupling in Ferromagnetic/Antimagnetic Bilayers," *Phys. Rev. B,* Vol. 56, 1997, p. 83; (c) H. Sang, Y. W. Du, and C. L. Chien, "Exchange Coupling in $Fe_5oMn_5o/Ni_{81}Fe_{19}$ Bilayers: Dependence on Antiferromagnetic Layer Thickness," *J. Appl. Phys.,* Vol. 85, 1999, p. 4931.

379. V. A. Tulin, "Nuclear Spin Waves in Magnets," *Fis. Niskikh Temp.,* Vol. 5, 1979, p. 965-993 [in Russian].

380. Sweet and Bearden, {29a}.

381. (a) Kenneth R. Shoulders, U.S. Patent # 5,153,901; (b) — "Energy Conversion Using High Charge Density," U.S. Patent # 5,018,180, May 21, 1991; (c) — "Energy Conversion using High Charge Density," U.S. Patent No. 5,123,039, 1992; (d) — U.S. Patents 5,054,046 and 5,054,047, 1991; (e) — "Circuits Responsive To and Controlling Charged Particles," U.S. Patent 5,148,461, 1992; (f) — and Steve Shoulders, "Observations on the Role of Charge Clusters in Nuclear Cluster Reactions," *J. New Energy,* 1(3), Fall 1996, p. 111-121.

382. (a) Paulo N. Correa and Alexandra N. Correa, "Pulsed Abnormal Glow Discharge Technology," *Infinite Energy,* 2(7), Mar./Apr. 1996, p.

18-21; (b) — "Other Applications of the PAGD Technology Besides Energy Conversion," *ibid.*, p. 22-27; (c)— "Electrochemical Transduction of Plasma Pulses," U.S. Patent No. 5,416,391, May 16, 1995; (d) "Energy Conversion Systems," U.S. Patent No. 5,449,989, Sept. 12, 1995; (e) — "Direct Current Energized Pulse Generator Utilizing Autogenous Cyclical Pulsed Abnormal Glow Discharges," U.S. Patent 5,502,354, Mar. 26, 1996.

383. In 1935, Prileshajewa showed that there is an energy difference as much as 1.1 v between the exciting light and the fluorescence of aniline vapor. This added energy is attributed to additions from the internal energy of the molecule. Thus, anti-Stokes emission has been validated as a COP>1.0 mechanism since at least 1935. For our purposes, replenishment of the internal energy of the molecule must be obtained from the local active vacuum; else one simply has the standard optical cooling process which cools the gas.

384. E.g., see J. K. Brasseur et al., "Coherent Anti-Stokes Emission in a Continuous Wave Raman Laser in H_2," carried on website location http://www.physics.montana.edu/optics/jlc/Anti-Stokes.pdf.

385. For a typical study, see J. Silver et al., "Studies on anti-Stokes emission from metal oxides (doped with Er3+ and Yb3+) stimulated by 632.8 nm laser excitation," *6th Int. Conf. Phosphors and Display Tech.*, San Diego, California, 2000.

386. For a typical paper of hundreds on the subject, see C. Zander and K. H. Drexhage, "Cooling of a Dye Solution by Anti-Stokes Fluorescence," in *Advances in Photochemistry*, edited by D. C. Neckers, D. H. Volman, and G. von Bulau; Wiley, New York, 1995.

387. (a) Antoine Priore, "Method of producing radiations for penetrating living cells," U.S. Patent No. 3,280,816, Oct. 25, 1966; (b) — "Apparatus for producing radiations penetrating living cells," U.S. Patent No. 3,368,155, Feb. 6, 1968. For an explanation, see (c) T. E. Bearden, "The Porthole Briefing," http://www.cheniere.org.

388. Thomas Valone, "Future Energy Technologies," *J. New Energy*, 5(2), Fall 2000, p. 41-46; summary is quoted from p. 44-45.

389. Shang-Xiang Jin and Hal Fox, "Characteristics of High-Density Charge Clusters: A Theoretical Model," *J. New Energy*, 1(4), Winter 1996, p. 5-20.

390. Shoulders, {381a-381e}.

391. Ken Shoulders, "Permittivity transitions," *J. New Energy,* 5(2), Fall 2000, p. 121-137.

392. *Ibid,* p. 122.

393. *Ibid,* p. 122.

394. K. Shoulders and S. Shoulders, {381 f).

395. Harold L. Fox, "Energy for the Future: High-Density Charge Clusters," *Modern Nonlinear Optics,* Second Edition, edited by M. W. Evans, Wiley, New York, 2001, Part III, p. 623-653.

396. See (a) Art Rosenblum, "Randell Mills — New Energy and the Cosmic Hydrino Sea," *Infinite Energy,* 3(17), Dec. 1997-1998, p. 21-34. Also see (b) Randell Lee Mills, "Energy/Matter Conversion Methods and Structures," Australian Patent No. 668678, Nov. 20, 1991. Particularly see (c) Eugene Mallove, "Dr. Randell Mills and the Power of BlackLight," *Infinite Energy,* 2(12), Jan.-Feb. 1997, p. 21, 35, 41.

397. Randell Mills *et al.,* "Lower-Energy Hydrogen Methods and Structure," U.S. Patent No. 6,024,935, Feb. 15, 2000. Some 60 pages, and an astounding 499 claims. For the patent, an independent verification was performed by Johannes Conrads, Institute for Low Temperature Plasma Physics at the Ernst Moritz Arndt University in Greifswald, Germany.

398. Randell L. Mills, "The Grand Unified Theory of Classical Quantum Mechanics," www.blacklightpower.com/book/shtml.

399. (a) Randell L. Mills et al., "Identification of Compounds Containing Novel Hydride Ions by Nuclear magnetic Resonance Spectroscopy"; (b) — "Spectroscopic Identification of Novel Catalytic-Reaction of Atomic Hydrogen and the Hydride Ion Products"; (c) — "Black Light Power Technology: A New Clean Energy Source with the Potential for Direct Conversion to Electricity," presented to the Intl. Conf. On Global Warming and Energy Policy, Nov. 26-28, 2000 and to the National Hydrogen Association Meeting, March 6-8, 2001; (d) — Plasma Power Source Based on a Catalytic Reaction of Atomic Hydrogen"; (e) R, M. Mayo and R. L. Mills, "Direct Plasmadynamic Conversion of **Plasma** Thermal Power to Electricity for Microdistributed Power Applications," *40th Ann. Power Sources Conf. Proc,* June 10-13, 2002; (f) R. Mills et al., "Novel Catalytic Reaction as a Potential New Energy Source," 223rd

ACS National Meeting, Orlando, Florida, Apr. 6-11, 2002; (g) — "Novel alkali and Alkaline Earth Hydrides for High Voltage and High Energy Density Batteries," *Proc. 17th Ann. Battery Conf. On Appl. And Advances, Calif. State Univ., Long Beach, CA, Jan. 15-18* (in press); (h) - "Synthesis of Diamond Films from Solid Carbon"; (i) Mills and Ray, "Spectral Emission of Fractional Quantum Energy Levels of Atomic Hydrogen from a Helium-Hydrogen Plasma and the Implications for Dark Matter," *Int. J. Hydrogen Energy*, 27(3), 2002, p. 301-322.

400. Peter D. Zimmerman, "An Analysis of Theoretical Flaws in So-Called Classical Quantum Mechanics and of Experimental Evidence against CQM," 2001.

401. Bearden, {222b}, p. 674.

402. E.g., it yields the excess deuterium, tritium, and alpha particles; see Bearden, {17}.

403. (a) Bearden, {222b}; Bearden, {15}.

404. (a) "Ion Cyclotron and Converter and Radio Power Microwave Generator," International Pub. No. WO 01/21300 A2, 29 March 2001; (b) "Ion Cyclotron Power Converter and Radio and Microwave Generator," International Pub. No. WO 01/22472, 29 March 2001. Both filed with World Intellectual Property Organization.

405. But see Samuel D. Harper. "The energy dissipated in a switch," *Am. J. Phys.*, 56(10), Oct. 1988, p. 866-889. Unless special attention and effort is paid, switches can indeed consume a great deal of energy! As Harper points out, it can be a substantial fraction of the energy transfer in the circuit. In a capacitive loaded circuit this is especially true. One should consider very efficient switching such as optically coupled switching arrangements.

406. (a) F. Heinrich, "Entropy change when charging a capacitor: A demonstration experiment," *Am. J. Phys.*, 54(8), 1986, p. 742-44. For an expanded discussion, see (b) I. Fundaun, C. Reese, and H. H. Soonpaa, "Charging a capacitor," *Am. J. Phys.*, 60(11), Nov. 1992, p. 1047-1048. Also see (c) Tyler A. Abbott and David J. Griffiths, "Acceleration without radiation." *Am. J. Phys.*, 53(12), Dec. 1985, p. 1203-1211. An extended charge can accelerate without radiating, under specified conditions.

407. (a) Davis, {360}. It would appear that a sine wave across this resistor may generate a **rhythmic** variation in what is called "internal

energy"; i.e., stress energy inside the system, hence stress energy in the associated vacuum. Since this is analogous to a sound wave consisting of rarefaction and expansion, it is a method of generating a longitudinal EM wave. This may also be involved also in the Fogal semiconductor. For a discussion of internal forces, which occur in equal and opposite pairs and are quite different from the resultant of forces, see (b) Chen, {358}, p. 372 and passim.

408. See Hsu-Chieh Yeh, "Remark on the second law of thermodynamics," *Am. J. Phys.*, 52(8), Aug. 1984, p. 720-723. As an example, from the common charge or dipole at constant temperature, we can indeed receive and take electrical energy because the charge (as a set of composite dipoles) and the dipole are not in 3-space energy flow equilibrium. Instead, they constantly receive virtual EM energy from the active vacuum, transduce it into 3-space EM energy, and continuously emit **that** energy in all directions — all at constant temperature. When we consider the supersystem of the charge-system and its environment, it is in disequilibrium and hence exhibits the effect pointed out by Yeh.

409. Yeh, {408}. Particularly see the illustration on p. 721.

410. Gabriel Laufer, "Work and heat in the light of (thermal and **laser**) light," Am. *J. Phys.*, Vol. 51, 1983, p. 42.

411. (a) Paulo N. Correa and Alexandra N. Correa, "A Modified Orgone Accumulator (HYBORAC) as a Drive for a Low Delta-T **Stirling** Engine, Part 1," *Infinite Energy*, 7(41), 2002, p. 23-29; (b) — "Orgone Accumulator Drive (HYBORAC) for Low Delta Stirling Motors, video presentation, ABRI Media Production.

412. Paulo N. Correa and Alexandra N. Correa, *Introduction to Experimental Aetherometry*, Vols. 1 and 2, 2001. Summaries of these **two** volumes may be freely downloaded from http://www.aetherometry.com

413. Paulo N. Correa and Alexandra N. Correa, "A Modified Orgone Accumulator (HYBORAC) as a Drive for a Low Delta-T Stirling **Engine** Part II." *Infinite Energy*, 7(42), 2002 (in press)

414. Eugene F. Mallove, "Demonstrating Aether Energy," *Infinite Energy*, 7(41), 2002, p. 6-8.

415. As quoted by Mallove, *ibid.*, p. 7.

416. Feynman, {7}, Vol. II, p. 1-3. Emphasis in original.

417. Mallove, {414}, p. 7.

418. J. M. Aguirregabiria, A. Hernandez, and M. Rivas, "Surface charges and energy flow in a ring rotating in a magnetic field." *Am. .J. Phys.,* 64(7), July 1996, p. 892-895.

419. F. Herrmann, "The unexpected path of the energy in a moving capacitor," *Am. J. Phys.,* 61(2), Feb. 1993, p. 119-121.

420. Wang and Chung, {33}.

421. Mike LaPointe, "Antimatter Production at a Potential Boundary," presented at the AIAA Joint Propulsion Conference, Breakthrough Propulsion Physics Session #1, July 9, 2001.

422. E.g., (a) Charles Kittel, *Introduction to Solid State Physics,* Seventh Edition, Wiley, New York, 1996 in various chapters contains excellent introductions to a more in-depth view of magnetic phenomena. A very useful book, written with clarity is (b) B. D. Cullity, *Introduction to Magnetic Materials,* Addison-Wesley, Reading, MA, 1972. For nuclear effects, (c) A. Abraham, *Nuclear Magnetism,* Oxford. 1961 is still excellent and quite comprehensive.

423. (a) Particularly see the lay overview by Philip Ball, "Meet the spin doctors...", *Nature,* Vol. 404, 2000, p. 918-920. This article deals with spin-injection from magnetic semiconductors. In addition to up and down, electron spin also has an additional degree of freedom called "color"; see (b) "Colourful electrons solve puzzle of ferromagnetism," *Physics World,* 14(7), July 2001; (c) also see the accompanying article by Fu Chun Zhang.

424. Stanislaw Bednarek, "Self-powered magnetohydrodynamic motors," *Am. J. Phys.,* 64(1), Jan. 1996, p. 90-92.

425. In a true superconducting system, it is possible to keep the current moving around in a resistance-free conductor indefinitely. However, no net work can be produced by the system, and in fact when one counts the energy one inputs to maintain the extremely low temperature of the environment, then to maintain the supersystem in such **"indefinite current** circulation" one has to continuously input energy to cool the **system. On** the other hand, an electron in an atom, orbiting the nucleus, is in **net** equilibrium on its path, so it will maintain its orbit indefinitely until perturbed sufficiently to break loose.

426. (a) Badics, {377a};(b) P. Hammond and J. Penman, "Calculation of inductance and capacitance by means of dual energy principles," *IEE Proc,* 123(6), 1976, p. 554-559; (c) Hammond and Ssiboukis, {377d}; (d) Yongzhong Huo, "A classification of thermodynamical potentials for two-variable transition systems," *Meccanica* [Netherlands], 30(5), Oct. 1995, p. 475.494; (e). Kotiuga, {377e}; (f) J. N. Murrell and S. Carter, "Approximate single-valued representations of multivalued potential energy surfaces," J. *Phys. Chem.,* 88(21), Oct. 11, 1984, p. 4887-4891; (g) Penman and Fraser, {377f}; (h) Ren, {376a}; (i) Z. Ren, "Solving 3D static field problems by dual formulations using potential variables," ***2nd*** *Int. Workshop on Elec. and Magn. Fields,* Leuven, Belgium, May 1994; (j) Ren, {376b}; (k) Verite, {376c}; (1) V. Vittal, "A generalized procedure to obtain first integrals for non-conservative dynamical systems: Application to power systems," *IEEE ISCAS '89,* 1989, p. 1984-1987.

427. G. W. O. Howe, "Effect of Torsion on a Longitudinally-Magnetized Iron Wire," *Wireless Engineer,* 29(344), May 1952, p. **115-** 117.

428. Harry E. Burke, *Handbook ofMagnetic Phenomena,* Van Nostrand, New York, 1985. This is a one-of-a-kind handbook on a great number of magnetic effects and phenomena.

429. Cullity, {422b}.

430. As examples: (a) Barrett, {345}; (b) Gurevich and Melkov, {232c}; (c) William Weltner, Jr., *Magnetic Atoms and Molecules,* Dover, Mineola, NY, 1989; (d) Giorgio Bertotti, *Hysteresis in Magnetism,* Academic Press, New York, 1998; (e) L'vov, {29c}; (f) Sidney Platt, *Magnetic Amplifiers: Theory and Application,* Prentice Hall, Englewood Cliffs, N.J., 1958; (g) Maciej J. Ogorzalek, *Chaos and Complexity in Nonlinear Electronic Circuits,* World Scientific, New Jersey, 1997; (h) Jammer, {lb}; (i) Borovik-Romanov and Sinha, Eds, {369b}; (j) Paul Davies, ed., {160f}; (k) G. I. Shipov, *A Theory ofPhysical Vacuum: A New Paradigm,* Moscow, 1994; (1) Nicolis and Prigogine, {255b}; (m) Richard Feynman, *Quantum Electrodynamics,* 1961, 1963; (n) V. 1. Fushchich and A. G. Nikitin, *Symmetries ofMaxwell's Equations,* D, Reidel, 1987; (o) Mandl and Shaw, {19}; (p) M. W. Evans, Ed., ***Modern*** *Nonlinear Optics,* Second Edition, 3 vols., Wiley, 2001; (q) Robert C. O'Handley, *Modern Magnetic Materials: Principles and Applications,* Wiley, New York, 2000; (r) Sachs, {126a}.

431. As examples: (a) Lindsay and Margenau, {114}; (b) Richard P. Feynman, *The Character of Physical Law*, MIT Press, Cambridge, 1965:; (c) Feynman, {7}; (d) Ilya Prigogine, *The End of Certainty: Time, Chaos, and the New Laws of Nature*, Free Press, New York, 1996, 1997; (e) Mendel Sachs, *Einstein Versus Bohr: The Continuing Controversies in Physics*, Open Court Publishing Company, 1988.

432. For those unfamiliar with magnetics and the exchange force(s), see H. J. Gray and Alan Isaacs, *A New Dictionary of Physics*, second edition, 1976 printing, *ibid.*, p. 194 for a precise definition. The force from the sudden exchange of charge is known as the *Heisenberg force*. That due to the exchange of spin direction is known as the *Bartlett force*. The force associated with exchange of both spin and charge is known as the *Majorama force*. Quoting: "These exchange forces may be interpreted as being due to the continual emission and absorption of virtual particles that carry the shared property from one particle to another. The exchange of virtual hadrons between interacting particles of the atomic nucleus is intimately involved in nuclear exchange forces.

433. Feynman, {7}, Vol. II, Chapter 37 covers magnetic materials including exchange forces, spins, and spin effects.

434. *The Encyclopedia of Physics*, Robert M. Besancon (editor), Second Edition, Van Nostrand Reinhold, New York, 1974, p. 518.

435. Cullity. {422b}. p. 132.

436. Kittel, {422a}, p. 443 (footnote 1).

437. Lindsay and Margenau, {114}, p. 216-217.

438. *Ibid.*, p. 213.

439. *Ibid.*, p. 215.

440. *Ibid.*, p. 214.

441. T. D. Lee, "Space Inversion, Time Reversal and Particle-Antiparticle Conjugation," *Physics Today*, 19(3), Mar. 1966, p. 23.

442. Lee, {73}, p. 187-188.

443. Romer, {84}.

444. Kenneth D. Moore, "Testing of a Johnson Magnetic Gate," *Explore*, 9(6), 2000, p. 70-75. Also available on www.cheniere.org.

445. (a) Raymond J. Radus and William G. Evans, "Apparatus Responsive to Direct Quantities," U.S. Patent #2,892,155, Jun. 23, 1959; (b) R. J. Radus, "Permanent-Magnet Circuit using a 'Flux-Transfer' principle," *Engineers' Digest*, 24(6), June 1963, p. 86; (c) (anon.), "On-Off Permanent Magnet with a Memory," *Electronic Equipment Engineering*, 11(4), Apr. 1963, p. 22, 26.

446. "Human fly has magnetic sole," *Electrical Engineering*, Apr. 1963, p. 294.

447. Malcolm McCaid, *Attraction and Repulsion*, Oliver and Boyd Ltd., 1967 has an entire chapter on switching magnets, and has two photos of an engineer hanging upside down and walking on the underside of an elevated steel beam, wearing the Radus magnetic boots.

448. For a description of "shuffler" boots, see A. W. Hangar and A. A. Rosener, "The use of permanent magnets in zero-gravity mobility and restraint 'footware' concept," *IEEE Trans, on Magnetics*, Vol. MAG-6, No. 3, Sep. 1970, p. 464-467. These crude shuffler boots are quite a contrast to the elegant Westinghouse/Radus stepping boots earlier developed and used.

449. Burke, {428}.

450. David Scott, "Magnetic "Wankel" for electric cars," *Popular Science*, June 1979, p. 90-91.

451. E.g., (a) John R. Wiegand, "Bistable Magnetic Device," U.S. Patent No. 3,820,090, June 25, 1974; (b) — "Asymmetric Bistable Magnetic Device," U.S. Patent No. 3,866,193, Feb. 11, 1975; (c) - "Pulse Generation by Changing Magnetic Field," U.S. Patent No. 4,309,628, Jan. 5, 1982; (d) — "Pulse Generator Using Read Head with Wiegand Wire," U.S. Patent No. 4,263,523, April 21, 1981; (e) - "Switchable Magnetic Device;" U.S. Patent No. 4,247,601, Jan. 27, 1981; (f) — "Method of Manufacturing Bistable Magnetic Device," U.S. Patent No. 3,892,118, July 1, 1975; (g) — "Multiple Pulse Generator;" U.S. Patent No. 3,793,532, Feb. 19, 1974; (h) — and John E. Opie, "Pulse Generator with Shaped Magnetic Field," U.S. Patent No. 4,484,090. Nov 20, 1984.

452. Kawai, {31}.

453. John C. Bedini, "Device and Method of a Back EMF Permanent Electromagnetic Motor Generator," U.S. Patent No. 6,392,370, May 21.

2002. Uses a regauging process for capturing available back **EMF** electromagnetic energy in the system. The available energy may be captured and used to re-energize the battery, and/or sent in another direction to be used as useful work, or dissipated in the system.

454. See {445c}, p. 22, 26. Quoting: *"The circuit differs from ordinary permanent magnets in three ways: (I) It exerts strong magnetic force at one end while exerting hardly any at the other, (2) the strong and weak magnetic poles can be switched end-for-end easily and at will, thus in effect turning the magnetism on and off, and (3) it remembers its direction of greatest magnetic pull indefinitely. "*

455. Burke, {428}, p. 250.

456. Deffeyes, {342}.

457. Stuart Young, *Nature,* Vol. 414, 29 Nov. 2001, p. 487.

458. Evans, {137b}, p. 84.

459. M. W. Evans and S. Jeffers, "The Present Status of the Quantum Theory of Light," in *Modern Nonlinear Optics,* Second Edition, 3 Vols., edited by M. W. Evans, Wiley, 2001, Vol. 3, p. 150.

460. Clarke, {55}, p. 38.

461. Patrick, Bearden, Hayes, Moore, and Kenny, {37}. A second patent is pending, and two more are in preparation.

462. Bearden, {222b}.

463. Evans et al, {38b, 38c}.

464. T. E. Bearden, James C. Hayes, James L. Kenny, Kenneth D. Moore, and Stephen L. Patrick, "The Motionless Electromagnetic Generator: Extracting Energy from a Permanent Magnet with Energy-Replenishing from the Active Vacuum," Sept. 2000, carried on restricted DoE website http://www.ott.doe.gov/electromagnetic/. A search on the internet will turn up other sources where the paper can be downloaded.

465. (a) Evans et al., "The Aharonov-Bohm Effect as the Basis of Electromagnetic Energy Inherent in the Vacuum," *Found. Phys. Lett.,* 2002, (in review); (b) — "Derivation of the B(3) Field and Concomitant Vacuum Energy Density from the Sachs Theory of Electrodynamics," ***Found.*** *Phys. Lett.,* 14(6), Dec. 2001, p. 589-593; (c) — "Operator Derivation of the **Gauge** Invariant **Proca** and Lehnert Equations:

Elimination of the Lorenz Condition," *Found. Phys.*, 30(7), 2000, p. 1123-1130; (d) — "Runaway Solutions of the Lehnert Equations: The Possibility of Extracting Energy from the Vacuum," *Optik*, 111(9), 2000, p. 407-409; (e) — "The Effect of Vacuum Energy on the Atomic Spectra," *Found. Phys. Lett*, 13(3), June 2000, p. 289-296; (f) Evans et al., {113}; (g) — "Derivation of the Lehnert Field Equations for Gauge Theory in Vacuum: Space Charge and Current," *Found. Phys. Lett.*, 13(2), Apr. 2000, p. 179-184;(h)Bearden, {222b}.

466. Details are on Jean-Louis Naudin's website, in the section dealing with the MEG, which is http://jnaudin.free.fr/html/megv21.htm#megstat.

467. For an introduction to the field and its literature, see J. Anandan, J. Christian, and K. Wanelik, "Resource letter GPP-1: Geometric phases in physics," *Am. J. Phys.*, Vol. 65, 1977, p. 180-185.

468. A discussion by Feynman of the Aharonov-Bohm effect is given in Feynman, {7}, "15-5: The vector potential and quantum mechanics," p. 15-8 to 15-14.

469. A similar phase change also is induced outside the localized presence of an electrostatic scalar potential fi. See Feynman, {7}, p. 15-10. Quoting: *"...the effect of an electrostatic field is to produce a phase change given by the negative of the time integral of the scalar potential fi"*

470. Ya. M. Blanter, C. Bruder, R. Fazio, and H. Schoeller, "Aharonov Bohm-type Oscillations of Thermopower in a Quantum-dot Ring," *Phys Rev. B*, Vol. 55, 1997, p. 4069 typify the kind of "power" considerations that have been analyzed in the past. Only a minuscule thermopower treatment is considered.

471. S. Pancharatnam, "Generalized theory of interference, and its applications," *Proc. Indian Ac ad. Sci.*, Vol. A44, 1956, p. 247-262.

472. See Nahin, {62}, p. 225. Quoting: *"J. J. Waterston's paper on the kinetic theory of gases, in 1845, was rejected by the Royal Society of London. One of the referees declared it to be 'nothing but nonsense,* ***unfit*** *even for reading before the Society.'... "Waterston's dusty manuscript was finally exhumed from its archival tomb forty years later, because of the efforts of Lord Rayleigh... "*

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474. R. G. Chambers, "Shift of an electron interference **pattern** by enclosed magnetic flux," *Phys. Rev. Lett.,* Vol. 5, July I960, p. 3-5.

475. A. Tonomura *et al,* "Observation of Aharonov-Bohm effect by electron holography," *Phys. Rev. Lett.,* Vol. 48, 1982, p. 1443-1446.

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481. (a) V. Chandrasekhar *et al., Phys. Rev. Lett.,* Vol. 55, 1985, p. 1610; (b) S. Datta *et al., Phys. Rev. Lett,* Vol. 55, 1985, p. 2344; (c) S. N. M. Ruijsenaars, "The Aharonov-Bohm Effect and Scattering Theory," *Ann. Phys.,* Vol. 146, 1983, p. 1-34.

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phase in coupled neutron interference loops," *Phys. Rev. A.*, Vol. 53, 1996, p. 2486-2492; (f) A. G. Wagh *et al.*, "Experimental separation of geometric and dynamical phases using neutron interferometry," *Phys. Rev. Lett.*, Vol. 78, 1997, p. 755-759; (g) D. Suter, K. T. Mueller, and A. Pines, "Study of the Aharonov-Anandan quantum phase by NMR interferometry," *Phys. Rev. Lett.*, Vol. 60, 1988, p. 1218-1220; (h) D. Loss and P. M. Goldbart, "Persistent currents from Berry's phase in Mesoscopic systems," *Phys. Rev. B*, Vol. 45, 1992, p. 13544-13561; (i) C. A. Mead, "The geometric phase in molecular systems," *Rev. Mod. Phys.*, Vol. 64, 1992, p. 51-85; (j) J. H. Hannay, "Angle variable holonomy in adiabatic excursion of an integrable Hamiltonian," *J. Phys. A.*, Vol. 18, 1985, p. 221-230; (k) Y. Aharonov et al., "Aharonov-Bohm Type Forces Between Magnetic Fluxons," Hewlett Packard Report HPL-BR1MS-97-24, Oct. 1997.

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494. Stephen Hawking, per Zebrowski, {2}.

495. Isaac Newton, *Philosophiae Naturalis Principia Mathematica,* 1687.

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507. A. Einstein, Appendix V to his *Relativity, The Special and the General Theory,* translated by Robert W. Lawson, Crown Publishers, New York, 1961, p. 155.

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513. (a) Evans et al., {233f}; (b) Evans et al., {233b}.

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523. (a) Max Jammer, *Concepts of Mass, in Classical and Modern Physics*, Harvard University Press, Cambridge, MA, 1961. One also suggests the reading of Jammer, {1b}.

524. (a) Bearden, {15}, p. 11. One kilogram of mass represents 17.053 x 10^{50} switches per second of action quanta h/(4*PI) across the boundary of the mass, in a flux exchange between the mass region and its external environment. The acceleration force can be derived from the difference in "inswitching" and "outswitching" of action quanta (as the masses m_i of the system iteratively change between mass and masstime states). The paper, albeit crudely, derives Newton's three laws of motion in relativistic form and the square law of gravitation. It also indicates the mechanism (reaction) upon a mass that generates the mass's rate of progression through time. For a somewhat expanded treatment, see (b) T. E. Bearden, "Vacuum Engines and Priore's Methodology: The True Science of Energy Medicine," Parts I and II, *Explore*, 6(1), 1995, p. 66-76; 6(2), 1995, p. 50-62.

525. Today we would also point out that to first order time and mass have essentially the same energy density — i.e., they are both spatial energy compressed by c^2. So the "switches" of action quanta we used in 1973 may be taken to actually represent the time-charging and discharging, of a specific region of space. Rotation of time-energy from the time-domain into 3-space connection with a mass is a mass increase as well as a change of mass to masstime. Rotation of mass-energy out of 3-space back into the time domain (during photon emission) is a mass decrease, (a) Our paper, "Giant Negentropy..." {12}, proposing a solution to the source charge problem, argues that all 3-space EM energy comes from the time domain anyway and returns to it. The source charges normally absorb time-energy, and transduce it to 3-space EM energy or vice versa, but the 3-space energy radiated away is in expanded spatial energy form and not compressed into mass-energy. It is the very release of the c^2 compression of the time-energy that is the "transduction" process to provide the **radiated**

spatial EM energy. But if mere rotation in 4-space is used without **that** expansion/transduction, then the time energy appears as mass. This is consistent with the mechanism we advanced for the flow of a mass *m* through time. Note that when a photon is "absorbed", the spatial energy component of the photon is in fact compressed into mass energy, slightly changing the mass. But when it is re-radiated, it is radiated in expanded or "spatial" EM energy form. Without the expansion and transduction, pure rotation of the compressed EM energy between the time domain and the 3-space domain provides the notion of "time-charging" and "time discharging". Indeed, the very anomalous phenomena occurring in radiation detectors in electrolyte experiments at China Lake, already provide direct evidence for just such time-charging, as pointed out in (b) Bcardcn, {17}.

526. E. R. Laithwaite, "Rack and pinion motors," *Electronics and Power*, Vol. 16, 1970, p. 251-252.

527. Of interest: (a) E. R. Laithwaite, "Unexplained phenomenon at Savoy Place," *Electronics and Power*, Oct. 1972, p. 360-362 recounts the discovery of a free energy device violating the second law of equilibrium thermodynamics; (b) Laithwaite, {526}, gives some particulars of the device; (c) —*All Things Are Possible: An Engineer Looks at Research and Development*, I*PC Electrical-Electronic Press Ltd., Dorset House, London, 1976; (d) Laithwaite, {172b}; (e) — "Miles Walker — a pioneer at Met-Vick and UMIST," *Electrical Review*, 211(12), Oct. 15, 1982, p. 33-34; (f) — "Roll, Isaac, roll — Part I," *Electrical Review*, 204(7), Feb. 16, 1979, p. 38-41; (g) — "Roll, Isaac, roll — Part II," *Electrical Review*, 204(11), Mar. 16, 1979, p. 31-33; (h) — "The laws of science and of England," *Electrical Review*, 202(23), June 16, 1978, p. 27-28.

528. E. R. Laithwaite and W. R. C. Dawson, "Mass Transfer: An Introduction based on Experimental Work at the University of Sussex," Sep. 1994. A subtitle is: A system for the transfer of mass derived from the principle of conservation of momentum. On website http://jnaudin.free.fr/html/IPEmain.htm.

529. See WO95/30832, Nov. 16, 1995.

530. Eric Laithwaite and William Dawson, "Propulsion System," U.S. Patent Number 5,860,317, Jan. 19, 1999.

531. Sweet and **Bearden, {**29a**}.**

532. (a) Ning Li and D. G. Torr, *Phys. Rev.*, Vol. 43D, 1991, p. 457; (b) — *Phys. Rev.*, vol. 46B, 1992, p. 5489; (c) — *Bull. Am. Phys. Soc*, Vol. 37, 1992, p. 948. Also see (d) D. G. Torr and Ning Li, *Found. Phys. Lett.*, Vol.37, 1993, p. 948.

533. E. E. Podkletnov and R. Nieminen, *Physica C*, Vol. 203, 1992, p. 441-444.

534. Igor K. Kulikov, "Inertial and gravitational masses of bosons at finite temperatures," in NASA technical package sent in response to queries of "Study of Inertial and Gravitational Masses of a Boson," *NASA Tech Briefs*, 26(2), Feb. 2002, p. 56. The report by Dr. Kulikov of the Jet Propulsion Laboratory (JPL) is carried on the website as http://nasatech.com/TSP/PDFTSP/NPO30325.pdl'. This is a theoretical study of the relationship between the inertial mass and gravitational mass of a self-interacting neutral scalar boson in a heat bath. The difference in the two masses was determined as a function of the temperature of the heal bath. The theory for distinguishing the difference is given. Since it is presented as an inventor's report, we assume that a patent is either pending by or to JPL or already granted to it.

535. Mike LaPointe, {421}.

536. Jim Corum, T. Keech, D. Gray, P. Pesavento, and M. Duncan, "The Electro-magnetic Stress-Tensor as a possible Space Drive Propulsion Concept, presented at the AIAA Joint Propulsion Conference, July 9, 2001.

537. Hector Serrano, "Propulsion Device and Method Employing Electric Fields for Producing Thrust," WO 00/58623, Oct. 5, 2000.

538. William B. Stein, Electrokinetic Propulsion: The Ionic Wind Argument," Energy Conversion Laboratory, Purdue University, West Lafayette, Indiana 47906, Sep. 5, 2000. This is a Gravitec report. Results can be downloaded from http://foldedspace.com/data.html, and an even more rigorous future test is planned.

539. A motion picture of the Naudin's replica thruster in dynamic thrust performance is shown on http://jnaudin.free.fr/html/liftbldr.htm, along with information on many other successful "lifters". This website is a cornucopia of information on inertial propulsion and electrogravitation, including successful independent replication and tests.

540. Ryan Mahoney, "Huntsville Firm Developing New Propulsion Technology," Birmingham Business Journal, Birmingham, Alabama July 19,2001.

541. E.g., see J. Cameron, "An Asymmetric Gravitational Wave Propulsion System," presented in the Breakthrough Propulsion Physics session of the AIAA Joint Propulsion Conference, July 9, 2001.

542. Bearden, {40}.

543. Prange and Strance, {365

544. Privately, Sweet strongly affirmed to me that later he took the risk and pushed it a little further in output, actually levitating the system several times, including accelerating it upward, hovering it, and then letting it sink slowly down to come to rest on the bench.

545. Dirac, {249}.

546. Romer, {84}; see endnote 24, p. 109.

547. E.g., as by Giovanni Modanese, "On the theoretical interpretation of E. Podkletnov's experiment," Extract from report UTF-391/96, OANL gr-qc/9612022, presented to the *I.A.F. Congress 1997,* Number IAA-97-4.107.

548. Ling Ni and D. G. Torr, {532a-532d}.

549. Evans, {137b}; Evans, {485b}.

550. M. W. Evans, personal correspondence.

551. (a) Evans et al., {233b}; (b) — - "Development of the Sachs Theory of Electrodynamics," *Found. Phys. Lett.,* 14(6), Dec. 2001, p. 595-600; (c) Evans et al., {233a}.

552. As we point out in our discussion of cold fusion, use of this enormous time-energy density component in a time-reversal zone allows reducing the force of the gluons in a nucleon and nearly freeing the quarks. The time-reversal zone also reverses the law of attraction and repulsion of charges; now like charges attract. So the coulombic attraction of two H+ ions can attract them together so closely that each enters the strong force region of the other, forming a quasi-nucleus. As the other ions in solution move to negate the time-reversal zone, the zone decays, restoring the normal repulsion of the two protons in the quasi-nucleus. However, being exponential the strong force increases much more rapidly than the normal

coulombic repulsion grows. The result is to force the two protons even closer together, into a full nucleus with a full strong force between them. This forms a nucleus of deuterium, as one quark in one of the protons is flipped while still relatively free, to form a neutron. Different but similar reactions exist to produce the excess tritium shown in many cold fusion experiments, and a similar interaction — especially between two deuteron ions — forms an alpha particle.

553. Bearden, {17}.

554. Davies, {237}, p. 105.

555. Misner, Thorne, and Wheeler, {500}, p. 5.

556. Evans and Jeffers, {459}, p. 150.

557. Evans, {137a}, p. 477.

558. Banesh Hoffman, in Foreword to Yakov P. Terletski, *Paradoxes in the Theory ofRelativity*, translated from the Russian, Plenum Press, New York, 1968, p. vi, viii.

559. Kron, {162}, p. 466.

560. T. D. Lee, {239}, p. 46-47.]

561. This is well known to modern theorists, but is especially accented by Sachs and by Evans. E.g.. to even have an EM wave in space, the energy density of space has to be changing as the wave energy oscillates. This is an oscillating curvature of spacetime, a priori. So all EM waves move in a dynamically curving spacetime.

562. Sachs, {126b}.

563. These concepts are generally consistent with 0(3) electrodynamics. For rigorous exposition of 0(3) EM, see Evans, {137b [.

564. Felix Finster, "Definition of the Dirac Sea in the Presence of External Fields," *Adv. Theor. Math. Phys.*, Vol. 2, 1998, p. 963-985.

565. J. W. Lynn and R. A. Russell, "Kron's Wave Automaton," Journal unk, date unk, p. 131. We would appreciate any researcher furnishing us a completed citation for this reference. We have a copy of the paper, but without full citation details.

566. Kron, {162}. The quote is from p. 114.

567. Kron, {32}, p. 39.

568. Kron, {306}.

569. Kron, {32}, p. 41.

570. See Stigant, {310a} for a bibliography of Kron's **publications.**

571. Several overunity researchers have been assassinated by forces and parties unknown. Many very clever means are used to do the dirty work.

As an example, there is a standard EMF "shooter" which uses Venus modification of the wavefront, to produce a wave that instantly disrupts the control of the heart's beating. There are two versions at least; one about the size of a pocketbook and for close range (30 feet) only, and one about the size of a bazooka and with longer range (up to 100 yards). About 1 minute exposure to the beam of the small weapon will result in death of the targeted individual. I have personally been hit by the small version of that device (and I have a witness who was with me at the time, and also was exposed to it). We survived by instant recognition of what it was, and by bolting immediately out the nearby back door of a restaurant here in Huntsville. If the kill is successful, the autopsy will show that the person died of a heart attack.

Stan Meyer, an overunity researcher with numerous patents, rushed from a restaurant exclaiming "They're killing me!" and expired with just such a heart attack, possibly hit inside the restaurant by a close-range shooter.

Harry Mason's associate was killed in Australia in his apartment by a longer-range, bazooka-sized shooter. The assassin was spotted putting the shooter back inside the car below, and speeding away.

Sometimes a silenced rifle is used for sniping at long range. Sweet was fired at by one such would-be assassin — luckily just as he stumbled and fell on the steps of the foyer to his apartment complex. The bullet cracked right by his ear as he fell forward, passing where his head had just been the moment before.

Another "shooter" uses longitudinal EM wave peak power pulses. This type kill is instant and very permanent. This unit can be set to stun or render the targeted person unconscious, or set to kill. It can also disrupt and stop running automobile engines (there is another version for that also, using negative energy EMP weaponry). However, it time-charges the struck human body so that the body emits longitudinal EM waves for some time after the kill. Marinov was killed with such a shooter (apparently by

KGB-related foreign intelligence operatives) and his body then thrown off a rooftop to make it appear to be suicide. Where his body lay, the pavement glowed when the body was removed. Only one weapon on earth will kill a body so that it will induce luminescence in concrete or asphalt that it lies on for a period.

Another favorite weapon is an ice dart dipped in curare. I was threatened once and told I would be killed by such an ice dart weapon if I traveled in a 2-month period. Just four days past that period, and traveling and changing planes in Dallas-Fort Worth airport, a person was killed three feet from me in broad daylight, right inside the airport, with the exact symptoms of a curare ice dart kill. That was apparently just to teach me "they" were serious.

"They" is that set of cartels that Churchill called "the High Cabal". Bedini and I had severely offended the High Cabal by Bedini's successful transmutation of copper (and other things) into gold. John often makes his own power transistors for his amplifiers, and the slag in the electric oven turns into black ruby laced with gold and silver, confirmed by assay. We have had numerous other assassination attempts, too numerous to iterate. Suffice it to say that developing a good COP>1.0 EM power system can be hazardous to one's health.

Any significant researcher should be wary of "meeting with a sudden suicide" on the way to the supermarket. Another thing to beware of, is a calibrated auto accident where your car is rammed from the rear, and you are shaken up considerably. An ambulance just happens to be passing by moments later, and it will take you to the hospital. If still conscious, the researcher must not get in the ambulance unless accompanied by a watchful friend who understands the situation and the danger. Otherwise, he can easily get a syringe of air into his veins, which will effectively turn him into a human vegetable. If he goes to the hospital safely, he must be guarded by friends day and night, for the same reason, else he runs a high risk of the "air syringe" assassination during the night.

Simply trying to do scientific work, I find it necessary to often carry (legally) a hidden weapon. Both my wife and I have gun permits, and we frequently and legally carry concealed weapons.

As early as the 1930s, T. Henry Moray — who built a successful COP>1.0 power system outputting 50 kW from a 55 lb power unit - had to ride in a bulletproof car in Salt Lake City, Utah. He was repeatedly fired at by snipers from the buildings or sidewalk, with the bullets sometimes sticking in the glass. He was also shot by a would-be assassin in his own laboratory, but overpowered his assassin and recovered.

Over the years, probably as many as 50 or more overunity researchers and inventors have been assassinated for their efforts, and particularly For their success. Some have simply disappeared abruptly and never been heard from again.

These days the use of longitudinal wave shooters (such as killed Marinov) and such is growing, since no signature is left for a normal autopsy to discover. The Yakuza, e.g., uses such "shooters" in Japan to assassinate persons or politicians having incurred their displeasure. Others are subjected to the more traditional Yakuza assassination: Three or four assassins suddenly jump the unsuspecting target, stabbing him repeated and with extreme rapidity. His body may have 50 to 70 deep stab wounds — through the heart, the abdomen, liver, lungs, etc. — before the body strikes the pavement.

Other very sophisticated methods of legal entrapment, gaming, planting narcotics on one's premises and tipping off the drug enforcement agencies for a drug raid in the middle of the night, etc. are utilized.

Widely used is "gaming"', which uses deep psychological profiling to select a "vulnerability". The supercomputer with the game prepares a "scenario" much like writing a movie script of predictable interactions among the players to be chosen. The game involves "agents of influence" (AOIs — persons who are dogmatic, perhaps even radical, and have knee-jerk responses easily triggered, and whose vector direction when they "jump" is along or near the desired response direction), and one or two agents to do the phone conversations with the AOIs and trigger them into action), as well as a game controller or director. The computer programs also use prediction and artificial intelligence, and will forecast the probability of success of the selected game. A very extensive database of deep psychological profiles on useful AOIs and all major COP>1.0 researchers is kept in the computer. When the controller selects the game, the computer spits out the most recommended AOI players. The controller accepts or changes and then accepts, and the game scenario is then prepared. The agents trigger the AOIs, and the unwitting target is suddenly besieged from every direction, along a direction he already has an affinity or "vulnerability" towards. The controller follows the course of the game and the outcomes of all interactions between the target and the AOIs. The agent or agents add "nudges" or additional actions to overcome delays, accomplish redirection when the direction goes awry. etc. Over the decades, these games have gotten very effective indeed, and are quite difficult to content with. I laving survived about 200 of these games over the last two decades, I may yet write a book on some of the major ones that

have been used against overunity researchers. The games are not confined just to the overunity field, however, and sometimes are also used to directly intervene in politics and other key situations, {754}. Machiavelli's methods are not dead; they thrive and have been highly computerized.

572. More than a dozen potential mechanisms for overunity EM interactions and systems are given in Evans et al., {233i}. Many of these interactions are likely in highly energetic astronomical phenomena such as the gamma ray burster and the X-ray burster.

573. Evans et al., {38b, 38c}.

574. Bearden, {38a}.

575. Bearden, {30}.

576. Sweet and Bearden, {29a}.

577. (a) A. G. Reiss *et al., Astron. J.,* Vol. 116, 1998, p. 1009; (b) S. Perlmutter *et al., Astrophys. J.,* Vol. 517, 1999, p. 565.

578. A. Einstein, *Sitzungsber. Preuss. Akad. Wiss.,* Vol. 1917, 1917, p. 142. Einstein came to regret his introduction of the cosmological constani as his "greatest blunder". Ironically, this may yet turn out to be one of his greatest contributions.

579. Prange and Strance, {365}.

580. (a) R. Lieu, "The effect of Planck scale space time fluctuations on Lorentz invariance at extreme speeds," *Astrophys. J. Lett.,* 2002 (in press). A preprint is on http://xxx.lanl.gov/abs/astro-ph/0202443. See also (b) Philip Ball, "Time gives rays a break," http://www.nature.com/nsu/020304/0209304-5.html .

581. In 1998, experimental evidence of the accelerated expansion of **the** universe was provided by two groups of astronomers; see (a) Riess *et al.,* (577a}; Perlmutter *et al.,* {577b}. For an attempt to provide a new model for the negative antigravity, see (c) L. Parker and A. Raval, "A new look ill the accelerating universe," *Phys. Rev. Lett.,* Vol. 86, 2001, p. 749-752; (d) Philip Ball, "New model of expanding universe," *Nature News Service,* Science Update, Nov. 12, 2001. A good coverage for the educated layperson is (e) Mario Livio and Alan Sandage, *The Accelerating Universe: Infinite Expansion, the Cosmological Constant, and the Beauty of the Cosmos,*[1]' Wiley, New York, Dec. 2000. See also (f) P. D.

Mannheim, "Implications of cosmic repulsion for gravitational **theory.'"** *Phys. Rev. D,* Nov. 15, 1998, p. 3511.

582. J. C. Bedini and T. E. Bearden, " Process For Transducing **Forms** of Electromagnetic Energy," U.S. Provisional Patent Application, 200 I. A formal U.S. Patent Application is in preparation as of this writing.

583. For a deep consideration of what is "meant" by mass, and how subtle the concept really is, the reader should refer to the scholarly work of Jammer {523a}. The more casual reader should be prepared for somewhat of a shock. Mass is not at all a "cut and dried" concept, as usually assumed. Indeed, the simple materialistic view of mass seems to be very much opposed by modern physics findings.

584. (a) Bearden, {12}. If we insert the absorption of a scalar (time-polarized) photon by the ubiquitously-assumed unit point charge and the subsequent re-emission of a longitudinal photon as the process for "combining" a scalar and longitudinal photon, then our solution is also consistent with (b) Mandl and Shaw, {19}. Mandl and Shaw argue that the longitudinal and scalar polarizations are not directly observable, but only in combination, where they manifest as the "instantaneous" Coulomb (i.e., electrostatic) potential. Our comment is that this argument, translated from particle terminology to wave terminology, then fits our re-interpretation of Whittaker's 1903 decomposition of the scalar potential in (c) Whittaker, {85}. It also strongly suggests the need for a complete reinterpretation of what is meant by "propagation of EM energy through 3-space".

585. E.g., see (a) V. I. Arkhipov *et al.,* "Negative transient currents in amorphous semiconductors." *Internal. J. Electronics* (UK), 51(6), 1981, p. 735-742; (b) — "An analysis of the dispersive charge transport in vitreous 0-55 As_2S_3 : 0*45Sb_2S_3," *Phys. Stat. Sol.* (A), Vol. 54, 1979, p. 67-77: (c) — and Rudenko, A. I., "Negative currents caused by injection-controlled polarization." *Solid St. Commun.,* 28, 1978, p. 675-676.

586. Evans, {137a, 137b, 251}.

587. David Jones, *Vancouver Sun Times,* Weekend Magazine, Dec. 17, 1977, p. 17. Article on Sid Hurwich's Toronto gun-jamming demonstration, stopping of watches, and jamming of a gun.

588. For proof of production of ordinary EM fields and energy at a distance by scalar **interferometry,** see **Evans** et **al., {**79}.

589. Miles and Bush, {198}, p. 101.

590. Bearden, {17}.

591. We point out, but do not further discuss, the obviously startling impact on the validity of the random statistical analyses normally used in scientific work if such "hidden variables" are present in the Earth's supersystem and interact with the experiment.

592. Kron, {192}, p. 466.

593. (a) Gabriel Kron, *Diakoptics: The Piecewise Solution to Large-Scale Systems,* MacDonald & Co., London, 1962. See also (b) Kron, {310b}.

594. Ilya Prigogine, Preface, (160b), p. xi.

595. Sir William Rowan Hamilton, 1837. Hamilton originated quaternion algebra, the Hamiltonian, etc. Hamilton's quaternion algebra has a higher group symmetry than either vectors or tensors. Since Maxwell's theory was first formulated in Hamilton's quaternion algebra and later reduced to vectors and then to tensors, ironically the first successful EM theory has been sharply curtailed rather than being further developed and extended.

596. (a) Aharonov and Bohm, {344a, 344b}.

597. Prigogine, {160b}, p. 104.

598. Lee, {441}, p. 23.

599. Jackson, {22}, p. 811-812.

600. Whittaker, {85}.

601. This is because time may be regarded as compressed spatial length, where the L compression factor is c. Since the energy of a wave is proportional to L^2 (where L is the wave amplitude), then the release of ST time-density as ST energy density provides nearly $9x10^{16}$ times as much effect per second as simple energy density curvature alone does per joule. For convenience, we refer to this as the "10^{17} gain factor" one obtains by releasing the compressed length energy from its time-density ST curvatture form.

602. T. Matsumoto, "Mechanisms **of Electro-Nuclear Collapse,"** *Proc, ICCF-7 (International Conference on Cold Fusion - 7),* Vancouver, BC, Canada, April 1998, p. 98.

603. Romer, {84}, endnote 24, p. 109.

604. See Harter et al., {102}. For a simple analogy, we may think of the longitudinal EM wave as a sort of velocity-modulated wave; i.e., it is rhythmically changing its velocity about some average value, where that value is usually taken to be c. Another way to visualize it is as an "accordion" wave, expanding and contracting along the line of travel.

605. There are several types (polarizations) of photons utilized in physics. E.g., see (a) Ryder, {90b}. On p. 147+, Ryder discusses four polarization states of the photon. Two of these are "transverse" —i.e., the well-known x- and y-polarizations of light; one is called "longitudinal," i.e., z-directed and related to Evans' B(3) field, and one is "scalar" or timelike.

The time-like (scalar) photon we are using in this paper seems to be yet another brand, something like a cross between the Ryder's third and fourth classifications. That is, our "scalar" photon is named such because when it is imperfect it propagates (i.e., in the 7 direction) at finite speed. When perfect, it just appears instantly everywhere it will be, without propagation through space in the usual sense. Hence it can be at an infinite number of points simultaneously - very close to the notion of the pure Coulomb gauge or of Bohm's quantum potential - or it can be impure and propagate at subluminal or superluminal speeds. The main notion we intend in our present use of the "scalar" photon for this treatise is that its oscillation is in the time domain and along the time axis. We use a model which produces the flow of time itself, and a time-component structuring of that flow — something which is still absent from physics. So our time-like (scalar) photon in one part very much resembles Ryder's discussion of the "scalar" photon, but is not just that alone. For instance, both our longitudinal photon and our scalar photon seem to have internal "photon" structures that we do not discuss in this treatise.

A still deeper discussion of photon polarization is in (b) Mandl and Shaw, {19}. The longitudinal and scalar polarizations are not directly observable, but only in combination, where they manifest as the "instantaneous" Coulomb (electrostatic) potential. So by this route one arrives at a well-established mathematical theory that allows a hidden substructure within **the photon itself.** Mandl and Shaw include the

photon's four polarization states as related to the four independent degrees of freedom available in the vector potential A. Suppression of the longitudinal and scalar polarizations is accomplished by "fixing the gauge". This reduces the independent degrees of freedom from 4 to 2, giving the conventional electrodynamics. However, when one raises serious foundations flaws in that resulting conventional electrodynamics, it is obvious that the entire structure is still on somewhat shaky ground. An even better mode might be to consider the fundamental photon entity as existing in all degrees of freedom, and the various "kinds" of photons existing due to restrictions or partial restrictions placed on one or more of these degrees of freedom. This of course opens the stage to interactions that change one (restricted) type of photon into a different (restricted) type. Thai is essentially the basis for my use of the notion of "photon transduction". Tt also leads to the transposition of time into energy and vice versa, which I use in my own approach, but which is still missing from nuclear physics. Since experimentally the cold fusion phenomena seem to require that characteristic, we have retained it.

We are indebted for much of the preceding discussion to private correspondence from Bob Flower, a fine scientist and knowledgeable in this area. Flower has pointed out that the conventional photon theory outlined by the cited authors is missing the possibility that nonlinear phase-conjugate optics could make the photon's longitudinal and scalar polarizations manifest in an experiment. Or put another way, if the instantaneous Coulomb potential could be decomposed into a time-like component and a longitudinal component, it would allow the two hidden polarization states to be controlled directly. This would result in anomalous modifications of the EM vector potential, leading to measurable electromagnetic or quantum effects. Flower's observation seems to be the closest to our own view, stated more simply in the present paper.

606. The result of our yet-unfinished struggle in these *very* swampy photon waters is not entirely consistent with the conventional view. Nonetheless, the new approach does seem to fit and explain most of the anomalous cold fusion phenomena, as well as a wide variety of other phenomena previously deemed beyond the pale of physics itself. E.g., by noting that *mind is time-like in its operations,* and therefore directly uses time-polarized (scalar) photons, waves, and electrodynamics, then mind operations become totally electromagnetic, but of a dramatically extended electrodynamic nature presently being approached in quantum field theory That approach leads directly to a testable and engineerable theory of mind

on all its levels (conscious, subconscious, unconscious, species unconscious, biospheric or all-species unconscious, and so on). But since the mind can interact with the body and produce at least the initial spatial forces carrying out intent in the physical world, it follows that some process must exist whereby the "time-like" photon interacts with and changes one or more of the other photons in the conventional view. Our use of *transduction* in fact encompasses that, based on quantum field theory as described by Ryder {90b} and by Mandl and Shaw {19}. Further, the present author's transduction reinterpretation of Whittaker's 1903 and 1904 papers {85, 91a} means that Whittaker's work as reinterpreted strongly supports this approach mathematically. So the approach used directly incorporates *mind and matter interaction,* again on multiple levels. While this area of *engineerable* mind and matter interaction is well beyond the scope of this treatise, it has become possible to begin the physics of the living being — even of the entire living universe — and to foresee direct engineering of the various realms of mind itself. Indeed, Russian psychoenergetics - particularly the highly weaponized secret part of it - already is involved in just that capability in deployed operational equipment of great portent. Since real results and real explanations of diverse metabiological phenomena have arisen from the approach as well as a very deep "more ordinary" physics including the necessary corrections to electrodynamics, we have continued to follow it to see where it eventually leads. A future book is planned on the more positive and beneficial uses of such startling technology. A preliminary view can be had on the author's website, www.cheniere.org, in the "porthole concept" briefing. A patent application has in fact been filed on this startling new method of medical healing.

607. (a) Vlail Kaznacheyev and L. P. Mikhailova, *Ultraweak Radiation in Intercellular Interactions,* [in Russian], Novosibirsk, 1981 [an English exposition of much of the Kaznacheyev work is given in (b) Vlail Kaznacheyev, "Electromagnetic Bioinformation in Intercellular Interactions," *Psi Research,* 1(1), Mar. 1982, p. 47-76.] See also (c) Kaznacheyev *et al.,* "Distant intercellular interactions in a system of two tissue cultures," *Psychoenergetic Systems,* 1(3), Mar. 1976, p. 141-142. In the same issue, see (d) "A Comment" by William A. McGarey, p. 143; (e) "A Comment" by Arthur C. Hastings, p. 143-144. See also (i) Yu. A. Vladimirov, "Ultraweak luminescence of subcellular structures," *Ultraweak Luminescence in Biology: Proceedings of the Symposium,* Moscow, 1969 [In Russian], Robert Becker also showed in his healing of

otherwise intractable bone fractures that a simple scalar potential (now known to involve the direct transduction between scalar and longitudinal photons and vice versa), that cellular dedifferentiation and redifferentiation of red blood cells occurred in the scalar potential region across the damaged bone cells, and directly in such manner as to "eliminate the delta engine" in those damaged bone cells in the fracture. The red cells shucked their hemoglobin, turning back (time-reversing) to a more primitive cell (earlier state). Then they redifferentiated (time-forwarded) into the type cells that make cartilage. There is still a delta engine between cartilage and bone! So these cartilage-like cells redifferentiated again into the kind of cells that make bone. These latter cells were deposited in the fracture, healing it. This process is in fact used today in various medical hospitals, without any real understanding of the physics mechanism involved. In short, it has long been experimentally proven without understanding the actual mechanism by which it works. See (g) Robert O. Becker, "The direct current field: A primitive control and communication system related to growth processes," *Proc. XVIInternal. Congr. Zoology,* Washington, D.C., Vol. 3, 1963, p. 179-183; (h) — and Charles H. Bachman and Howard Friedman, The direct current system: A link between the environment and the organism," *New York State J. Medicine,* Vol. 62, April 15, 1962, p. 1169-1176; (i) — and Joseph A. Spadaro, "Electrical stimulation of partial limb regeneration in mammals," *Bull. N.Y. Acad. Med,* Second Series, 48(4), May 1972, p. 627-64. See also (j) C. A. L. Bassett; R. O. Becker, and R. J. Pawluk, "Effects of electric currents on bone *in vivo," Nature,* Vol. 204, Nov. 14, 1964, p. 652-654.

608. Puthoff, {202}.

609. See (a) A. Shapere and F. Wilczek, Eds., *Geometric Phases in Physics,* World Scientific, 1989. See also (a) M V. Berry and J. M. Robbins, "Indistinguishability for quantum particles: spin, statistics and the geometric phase," *Proc. Roy. Soc. LondA,* Vol. 453, 1997, p. 1771-1790.

610. See Mandl and Shaw, {19}, Chapter 5 and simply reinterpret the coupled scalar and longitudinal photon pair as a spin 2 graviton.

611. In fact, Sweet's vacuum triode amplifier probably used the domains and nuclei in a barium ferrite permanent magnet in such a graviton reaction manner. In an epochal experiment designed and conceived by the present author, Sweet reduced the weight of the device

on the lab bench, smoothly and efficiently, by 90 degrees. For **the** description, see Sweet and Bearden, {29a}.

612. Reginald I. Gray, *Unified Physics,* Naval Surface Warfare Center, Dahlgren, VA, 1988, p. 2-19.

613. For the basic explanation of a scalar interferometer, see Evans et al., {79}.

614. See Chapter 3, paragraph 3.1 through 3.5.

615. Bearden, {12}.

616. As an example, see Bunge, {3}, p. 179-180. Quoting: " *The most complete direct interparticle action theory of electromagnetism is WHEELER and FEYNMAN'S (1949). Its central postulate is Fokker's action principle for a collection ofpoint charges.... from which the equations of motion for charged particles follow. As can be seen, only particle variables occur in this theory, which is an electrodynamics in AMPERE'S sense and therefore the opposite of a unitary field theory. (The theory is mathematically equivalent to an "adjunct" field theory, but this adjunct field, far from being free, is attached to the particles.) The theory has been abandoned by its creators because it is inconsistent with the quantum theory, in particular with the photon hypothesis. Yet it continues to appeal to many not only because it smacks of mechanism and operationalism, but also because no self-forces appear in it and consequently no infinite self-forces (and the corresponding self accelerations) But this is too small an advantage compared with its shortcomings even at the classical level. Indeed, the theory makes use of special relativity - as is apparent from its central axiom...yet it is inconsistent with it for SR borrows from CEM the assumption that e.m. signals propagate in a vacuum with a constant speed c and moreover lead an existence, which, while it lasts, is independent of both emitters and absorbers. In other words, by denying the existence of free radiation fields propagating in space, the action at a distance formidation of CEM contradicts its own basis: it is logically inconsistent. "*

Our comment is that the "photon" interaction itself must be re-examined in light of the demonstrated giant negentropy of every change and dipole in the universe. Allowing for the quantum field theoretic combination of the scalar and longitudinal photons as an observable "photon" that is actually a spin-2 graviton in 4-space rather than 3-space. the entire nature of "propagation of EM energy through space" changes. No photon has ever interacted in just 3-space; instead, it interacts in

4-space. In the strong interpretation of giant negentropy, there is really no such thing as a "single observable photon" in the universe. Instead, there is a combined scalar/longitudinal photon pair, which when interacting in matter causes transverse EM wave movement of the interacting/detecting charges which are restrained by (i) the inertia due to their own mass, and (ii) in circuits, the back repulsion of all other like charges longitudinally ahead of the excited charge that absorbs the "photon" (actually, the graviton). Considering the longitudinal wave "bunching and relaxing" actions resulting in galloping, then the conventional assumption of the constant speed of light c in vacuum is destroyed. What we perceive as "light propagating in space at speed c" already moves in a galloping and jerky motion *about* speed c — now moving superluminally, now moving subluminally — with only an *average* speed of c overall. In turn, anything which affects the performance and "galloping mechanism" exhibited by the longitudinal EM wave can in theory be used to change the speed c. With the coming advent of the Fogal semiconductor and direct superluminal communication, all such objections based on previous rather classical assumptions will simply fall by the wayside. We also stress that the speed of gravitational field is shown in astronomical events and effects to be extraordinarily superluminal by many orders of magnitude. Again, this greatly upsets many of the modeling assumptions in present physics. Physics is based on a set of models and a set of experiments and observed effects. If the experimental effects negate the theory, one has to change the theory or be guilty of abandoning scientific method altogether, thereby turning science into dogma.

617. Cohen, {89}.

618. See Rod Donnelly and Richard Ziolkowski, "Electromagnetic field generated by a moving point charge: A fields-only approach," *Am. J. Phys.*, 62(10), Oct. 1994, p. 916-922. In conventional language, both the transverse and longitudinal field components always try to be born initially, whenever an EM wave is being generated. Generation of the transverse component produces a function which zeroes the longitudinal component. The function appears in the spacetime representation of the transverse EM fields, obtained by Donnelly and Ziolkowski using special transforms. The phase conjugating and retroreflecting aspects of cold fusion experiments produce spacetime curvatures, directly affecting the "canceling function." The altered function becomes an "LW-reduction function" which is postulated to determine the mix of transverse and longitudinal field components that emerge in the interactions.

619. Whittaker, {85} shows that the scalar potential is **comprised of** bidirectional longitudinal EM wavepairs. Whillaker, {91a} shows **that all** fields and waves are comprised of two interfering scalar **potential** functions. Hence all fields and waves are comprised of **functions** of longitudinal and scalar wave interferometry.

620. Evans et al., {79}.

621. Usually the detecting GM tubes will detect the interferometry of the incident longitudinal EM waves with the weak LWs being emitted in the tube itself by time-decay of its time-charges. The resulting transverse wave EM energy ionizes the tube's gas, and the GM tube "reads." If little or no time-decay is occurring, then there will be little or no transduction into TWs, hence little or no ionization. In that case the instrument will not read.

622. Miles and Bush, {198}, p. 101.

623. *Ibid.*

624. (a) Evans, {137b}; (b) Evans et al., {233a, 233f}.

625. Rodrigues and Lu, {93a}.

626. Enders and Nimtz, {329b}.

627. (a) W. A. Rodrigues, Jr. and J. Vaz Jr., "Subluminal and Superluminal Electromagnetic Waves and the Lepton Mass Spectrum," *Kluwer Ac. Pub. Proceedings,* <hep-th/9607231> on Los Alamos web site; (b) P. Letelier and W. A. Rodrigues Jr. (Eds.), *Gravitation: The Spacetime Structure,* World Scientific Publishing Co., Singapore, 1994; (c) J. Vaz Jr. and W. A. Rodrigues Jr., "On the equivalence of Maxwell and Dirac Equations, and Quantum Mechanics," *Internal. J. Theor. Phys.,* Vol. 32, 1993, p. 945-958; (d) J. Vaz Jr. and W. A. Rodrigues Jr., "Maxwell and Dirac Theories as an Already Unified Theory," *Adv. Appl. Clifford Algebras,* Vol. 7 (S), 1997, p. 369-386; (e) W. A. Rodrigues Jr. and J. E. Maiorino, "A unified theory for construction of arbitrary speeds ($0 < v < \infty$) solutions of the relativistic wave equations." *Random Operators and Stochastic Equations,* Vol. 4, 1996, p. 355-400; (f) Rodrigues and Vaz, {93b}.

628. Torn Van Flandern, "The speed of gravity - What the experiments say," *Phys. Lett. A,* Vol. 250, 21 Dec. 1998, p. 1-1 1.

629. *Ibid.,* p. 9.

630. *Ibid.*, p. 10.

631. A. A. Vlasov and V. I. Denisov, "Einstein's formula for gravitational radiation is not a consequence of the general theory of relativity," *Theor. Math. Phys.*, 53(3), June 1983 (English translation), p. 1208-1216. Translated from *Teoreticheskaya i Matematicheskaya Fizika*, 53(3), Dec. 1982, p. 406-418 [in Russian].

632. D. Hilbert, *Gottingen Nachrichten*, Vol. 4, 1917, p. 21.

633. Sen, {68}, p. viii.

634. Mandl and Shaw, {19}.

635. Logunov, A. A. and Yu. M. Loskutov, "Nonuniqueness of the predictions of the general theory of relativity," *Sov. J. Part. Nucl.*, 18(3), May-June 1987, p. 179-187.

636. Whittaker, {85}

637. I.e., that spacetime == scalar potential == virtual particle flux == Whittaker biwave set. If that holds, then when we engineer the internal structure of the scalar potential, we also simultaneously engineer the internal structuring of the vacuum and spacetime itself, with deliberately formed spacetime curvature engines (vacuum engines). This is vacuum engineering — by different means — of the sort proposed by Nobelist T. D. Lee, {73}, p. 380-381. On p. 383, Lee points out that the microstructure of the scalar vacuum field (i.e., of vacuum charge, or — in our view — of the vacuum potential) has not been utilized. Particularly see Lee's own attempt to indicate the possibility of using vacuum engineering, in his "Chapter 25: Outlook: Possibility of Vacuum Engineering," p. 824-828.

638. Ingram Block and Horace Crater, "Lorentz-Invariant Potentials and the Nonrelativistic Limit," *Am. J. Phys.*, 49(1), Jan. 1981, p. 67.

639. Roderic Lakes, "Experimental Limits on the Photon Mass and Cosmic Magnetic Vector Potential," *Phys. Rev. Lett.*, 80(9), Mar. 2, 1998, p. 1826. Our critique is that the given equations define nothing at all, since no equation is a definition. If one replaces the "=" with "≡" in the "definition" of the A-potential in terms of B, one then has B==curl A, which is actually the definition of B in terms of A. If A has no energy, then neither can B, which is just the swirl of the A-energy. If A has no curl, B vanishes. If A has no energy, B vanishes. Yet $dA/dt = -E$, whether

A has curl or not, and E has energy. Ergo, A must have energy if **any** operation upon it is to produce **E-field** energy, else one has **violated the** conservation of energy law and advocates creation of energy from **nothing.** Regardless of how one looks at B = curl A and B = curl A, neither the equation nor the identity defines A in terms of B, because B is always, just one aspect of A and yet A can exist without any curl at all — without B as demonstrated in the Aharonov-Bohm effect. But in no fashion can B exist without A. Therefore A is primary and B is derived, and if A has no energy then B can have no energy. V has energy and energy density, since in fundamental units any point of the potential V is identically the joules of energy collected upon a unit point positive electrical charge assumed at that point. If it had no energy, then no joules could be collected from it.

640. Weinberg, {194}, p. 109-110.

641. Sen, {68}, p. viii.

642. (a) Lee, {13a}; (b) Wu et al., {14}; (c) Lee, {239}, p. 57-59; (d) Lee, {73}, p. 184.

643. Bearden, {12}

644. Whittaker, {85}.

645. The clustering of virtual charges around observable individual charges — due to the polarization of the vacuum — is well known in quantum electrodynamics. Macroscopically one sees the charge as partially shielded by the cluster, so the clustering charges are known to have macroscopic significance. At close enough distances, one sees the "bare" charge with reduced shielding.

646. Mandl and Shaw, {19}.

647. (a) Aharonov and Bohm, {344}; (b) R. G. Chambers, {474}.

648. E.g., see (a) Barrett, {345}; Barrett and Grimes [Eds.], {235b}.

649. (a) Evans *et al,* {113a}; (b) — "Self-Inconsistencies of the U(l) Theory of Electrodynamics: Michelson Interferometry," *Found. Phys. Lett.,* 12(6), Dec. 1999, p. 579-584; (c) — *J. New Energy,* Vol. 4, Winter 1999, p. 231-235; (d) — "Derivation of the Lehnert Field Equations from Gauge Theory in Vacuum: Space Charge and Current," *Found Phys Lett.,* 13(2), April 2000, p. 179-184; (e) Evans et al., {233g}; (f) Evans **et** al.. {233e}; (g) — **"Equations of the** Yang-Mills Theory of Classical Electrodynamics," ***Optik, 111***(2), 2000, p. 53-56; (h) **Evans** el **al.,** {113***b}.***

Also (i) more than 100 papers on restricted U.S. Department of Energy Internet website http://www.ott.doe.gov/electromagnetic/.

650. Obviously we exclude active systems such as matter that decays in nuclear fashion. Those are not inert systems, but are "pre-excited" systems whose matter has had excess energy since its formation during the birth of the universe.

651. (a) Kondepudi and Prigogine, {160c}; (b) — "Thermodynamics, Nonequilibrium," *Ency. Appl. Phys.* Vol. 21, 1997. p. 311-337.

652. I.e., the known broken symmetry of the charge (regarded as a set of composite dipoles) in its vacuum energy exchange.

653. Kraus, {76}, p. 578, Figure 12-60, a and b.

654. James Croll, *Phil. Mag.*, Series 5, Vol. 2, 1876, p. 242-254.

655. Heaviside, {5a-5c}.

656. Poynting, {4a, 4b}.

657. Heaviside, {106}.

658. E.g., see Lorentz, {109}.

659. E.g., (a) Panofsky and Phillips, {110}; (b) Gough and Richards, {224b}. (c) Jackson {22}, p. 259, points out the arbitrary nature of the Poynting vector and disposes of any added nondivergent energy flow vector with the words *"Such an added term can, however, have no physical consequences."*

660. Simply examine *Vqt* around the forward emf section (the external circuit between the generator terminals and the ends of the source dipole inside the generator), and - *Vqt* across the generator terminals (and the source dipole).

661. Evans etal, {38b, 38c}.

662. Bohren, {24}. Independent replication is reported in the same journal issue; see (b) Paul and Fischer, {25}.

663. Bearden, {40}.

664. See Paragraph 8.3.16 in Chapter 8 for the explanation.

665. Olariu and Popescu, {482}.

666. Bertram Schwarzschild, "Currents in normal-metal rings **exhibit** Aharonov-Bohm effect," *Phys. Today,* 39(1). Jan 1986, p. 17-20.

667. Paul and Fischer, {25}.

668. One actually inputs far more electrical energy flow from **the** external electrical power supply than is conventionally accounted, if one accounts for the huge nondiverged Heaviside energy flow component that Lorentz arbitrarily discarded. That energy flow is actually present, but Is not accounted once Lorentz' integration trick is applied to integrate the entire energy flow vector around a closed surface assumed around any volume element of interest.

669. Evans et al., {113a}.

670. As is any EM system when the nondiverged very large Heaviside energy flow component is accounted in addition to the diverged Poynting energy flow component.

671. Bearden and Bedini, {582}.

672. As an example, two scalar potentials fi_1 and fi_2 may have precisely the same intensity magnitude, but different Whittaker internal bidirectional longitudinal EM wave structures. The effects of the two externally identical potentials — as in various chemical reactions — can be quite different. See Bearden, {17}.

673. Lee, {73}, p. 380-381.

674. Lee, {73}, p. 184.

675. For succinct summary of the major symmetries and broken symmetries in physics, see Lee, {239}, p. 57-59.

676. Wang and Chung, {33}.

677. Jean-Louis Naudin, "Chung's Negative Resistance Experiment", on website http://jnaudin.free.fr/enr/enrexpl.htm.

678. Burford and Verner, {35a}.

679. Early but sophisticated analogue simulator. E.g., see Kron, {306}, p. 173.

680. E.g., see (a) Kron, {32}, p. 39. Quoting: *"Although negative resistances are available* ***for*** *use with a network analyzer...* "; — "Numerical solution of ordinary and partial differential equations by

means of equivalent circuits." See also (b) Kron, *J. Appl. Phys.*, Vol. 16, Mar. 1945a, p. 173. Quoting *"...since none or only a few negative resistances exist on practical network analyzers)"* (accent added). In the second quotation, arguably Kron was required to insert the underlined words. In the first quotation, the censors missed the clarity of the statement.

681. Kron, {192}.

682. Sweet and Bearden, {29a}.

683. Self-oscillation in such magnetic materials (which are also optically active) is well known. E.g., (a) L'vov, {29c}; (b) Borovik-Romanov and Sinha [Eds.], {369b}. See particularly (c) Gurevich and Melkov, {232c}.

684. Rosenthal publicly verified the results of his tests of the Sweet device to the 26th session of the Intersociety Energy Conversion Engineering Conference (IECEC '91), Boston, Massachusetts, 1991.

685. David M. Pepper, "Applications of Optical Phase Conjugation," 254(1), Jan. 1986, p. 83.

686. Bearden, {15}, p. 2-10.

687. Bearden, {17}.

688. Time-polarized photons are recognized in quantum field theory, implying the existence of time-polarized EM longitudinal waves. In coupling with spatial longitudinally polarized EM waves in wavepairs, the coupling is observable as scalar potential energy (stress energy), based on an argument by Mandl and Shaw {19}. Opposing time-polarized longitudinal EM waves therefore constitute "time-stress", "time-stress potential", and optical pumping in the time domain, which is hypothesized to reverse the normal "forward time" law of attraction and repulsion of charged particles.

689. Kenneth Shoulders and Steve Shoulders, {38If}.

690. U.S. patent numbers 5,018,180; 5,123,039; 5,054,046; 5,054,047.

691. Jain, {35b}.

692. Cao et al, {264b}.

693. Prange and Strance, {365}.

694. Roger Penrose, {82}, p. v.

695. Bunge, {3}, p. 176.

696. Albert Einstein, {la}, p. xi-xii. Appendix I.

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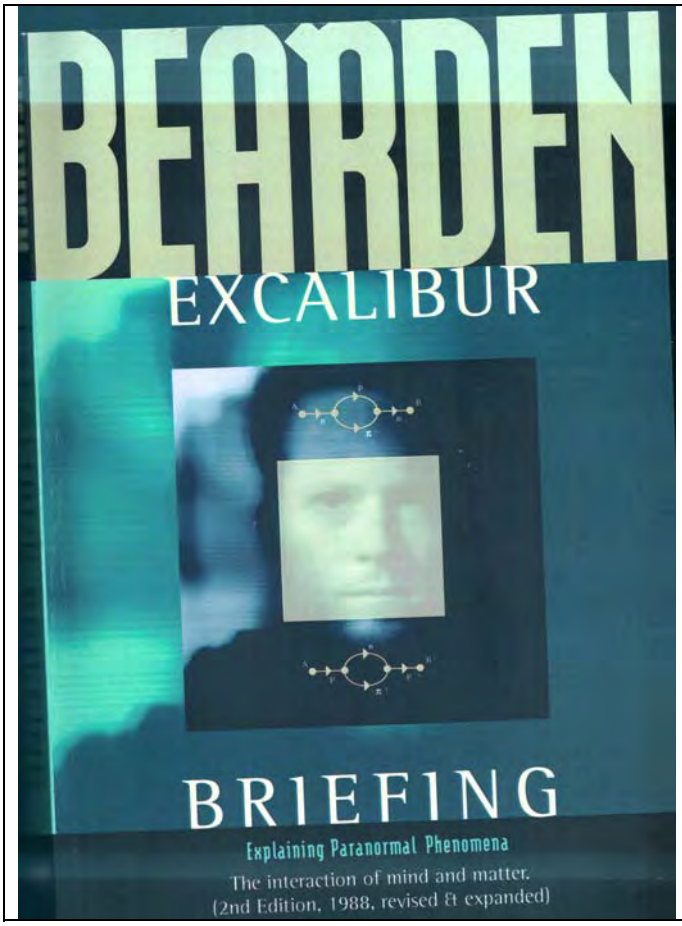

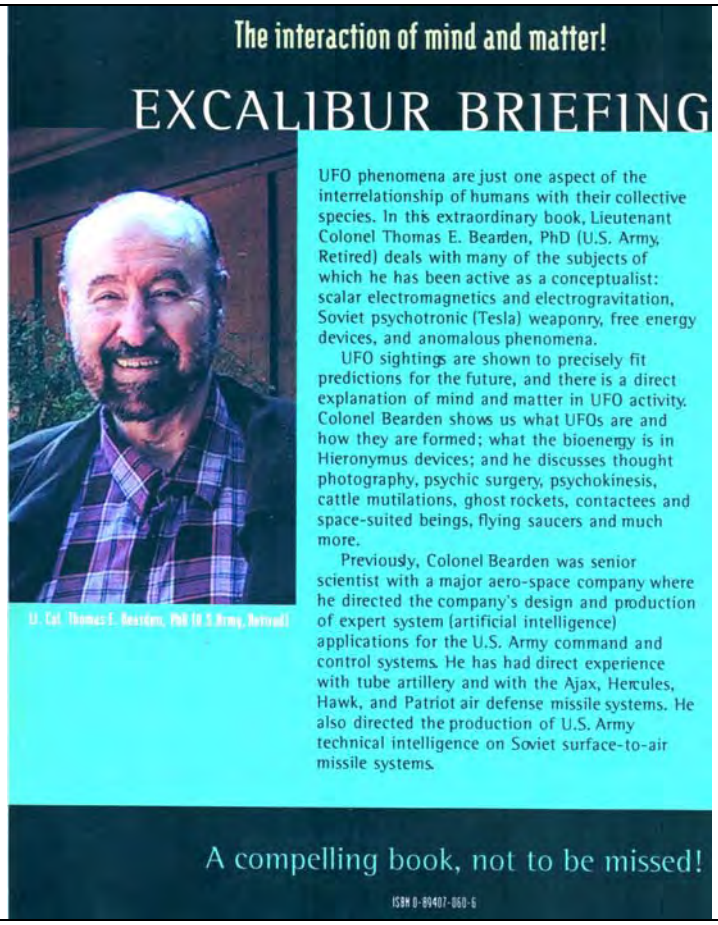

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Lieutenant Colonel Thomas E. Bearden (U.S. Army, Retired) Ph.D., was formerly senior scientist and department manager of a major aerospace company where he directed the design and production of expert systems (artificial intelligence) applications for the U.S. Army command and control systems.

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Tom Bearden is the author of several books and numerous papers, briefings and presentations, dealing with anomalous phenomena, scalar electromagnetics, free energy devices, Soviet Tesla weapons, and Soviet scalar electromagnetic weather warfare; he is also the producer of several videotapes on these subjects.

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FOREWORD

by John White

This book deals in a comprehensive fashion with such a vast array of topics — from physics, psychology and evolution to advanced weaponry, military strategy and international politics — that many of you may become anxious, even fearful on reading it. In fact, this assembly of previously uncorrelated information and scientific breakthrough may be the most disturbing you have ever received.

This cannot be helped. This book represents an important step in our efforts to avoid global war involving not only nuclear armaments but also what appears to be a revolutionary development in Soviet military technology — psychotronic weapons. They are the modern equivalent of the legendary invincible sword, Excalibur.

The author is former U.S. Army officer Lt. Col. Thomas E. Bearden, now retired. During his twenty-year military career specializing in artillery, nuclear weapons, and military intelligence, Tom has pondered and researched many subjects that he covers here. His access to the full range of both military and NASA documents will be evident in his book. What may become highly classified data in the future is being revealed to you, our nation's ultimate policymakers, for an urgent reason that Tom has called Operation Fer-de-Lance, the presumed Soviet plan for domination of the planet through nuclear-psychotronic aggression and warfare. For the moment I would simply like to note two statements that indicate the basis for our sense of urgency:

1. On 13 June 1975, Soviet Premier Leonid Brezhnev urged a ban on research and development of new kinds of weapons "more terrible than anything the world has known."

2. In January 1977 former Air Force Chief of Intelligence, Maj. Gen. George J. Keegan (Retired) told *Newsweek* magazine, "The Soviets are working on dramatically exotic new weapons, twenty years ahead of anything ever conceived in the U.S. — so awesome as to lead the Soviets to believe that in the coming decade they would be capable of total neutralization of our ballistic and submarine missiles."

The U.S. military intelligence community interprets these signs in conventional terms as perhaps indicating the development of laser rays. Tom disagrees. His book will deal with the possibility that these weapons are psychotronic or paraphysical in nature.

In fact, we can say that in a strict sense, these are not weapons but devices — breakthrough technology with an enormous potential for the destruction of humanity. They are a second-or third-generation outgrowth of radionic devices presently used in unorthodox medicine for diagnosis and healing. Extremely compact, they could be carried in a suitcase and planted near targets — ICBM sites, communications centers, etc. Even if one of these devices were found and examined, it would only look like an electronic switching circuit or a small transmitter/receiver set, rather than a bomb or explosive.

The energy and the mechanism involved in psychotronic damping of nuclear, chemical or electromagnetic technology is, from all indications, unrecognized by official Western science but nevertheless inherent in it. That also has been deeply pondered by Tom, and this book will give a full explanation of the physics, mathematics and technology involved. It is not an exaggeration to say, as Tom does, that the explanation offers a "physics of metaphysics" — a fully developed theory of paranormal phenomena that elegantly unites physics and psychology. The ramifications of what Tom calls perception theory lead into every field of human knowledge and inquiry with revolutionary results — from science, theology and philosophy through the full spectrum of paranormal phenomena such as UFO's and psychokinesis into the elementary school classroom, the supermarket shopping basket and the voting booth. They most certainly lead into the safety of your homes and the integrity of your minds.

Before you turn to *The Excalibur Briefing,* I want to leave you with these thoughts. The material you are about to read will certainly be denied by our own government and military and probably by a major segment of the scientific community. It is not unlikely that Tom will be dismissed as a paranoid crackpot. Such tactics have been employed before against brilliant, courageous people who challenge the fundamental dogma of the establishment as Tom does here. Nevertheless, I want to reassure you that Tom is sane, sober, and serious.

Of course, such a person could still perhaps be mistaken. In that regard, I believe you will find Tom's presentation to be persuasive. He himself is careful to distinguish speculation from fact, inference from descriptive statement. Even if Tom were paranoid, however, the question arises: *What if there is good reason for paranoia?* To phrase it positively: We should welcome truth and enlightening insight whenever offered, regardless of the source. Do not let *ad hominem* arguments affect your critical judgment about the soundness of this presentation. Assess the work, not the man, for the work is always greater. And having judged the work affirmatively, render true acknowledgement — not lip service — by sharing the ideas in this book with others. Only free, informed, vigorous effort in the court of world opinion can defuse the possibility of Operation Fer-de-Lance and psychotronic mind control leading to total enslavement of the human race.

In closing, I want to point out that Tom's fundamental concern is the unification and evolution of the human species to a higher form of life through a process that he terms "mind linkage." This stage of growth to higher consciousness is explored in the latter part of the book. It is a breathtaking portrait of how the spirit of science can lead to a science of the spirit, to a physics of metaphysics.

INTRODUCTION TO THE SECOND EDITION

Since the first edition of *Excalibur Briefing* was published, a great deal of progress has been made on the actual physics of unusual and paranormal phenomena. Indeed, so much progress has been made in the ten years since the 1978 or so cutoff of most of the Excalibur material, that I really should rewrite the entire book. However, time will not permit that luxury at present I am simply too hard-pressed in the strenuous efforts to move a free energy machine to market and to convince our government that unorthodox Soviet superweapons present us with a problem of the gravest magnitude.

Accordingly, the inclusion of one of my latest papers, "Soviet Phase Conjugate Directed Energy Weapons," together with an updated glossary for the entire emerging field, will have to suffice.

The important thing is that **a separate new field of physics is beginning to emerge.** It turns out that what we've gotten on to is a unified field—one can now turn electromagnetic energy into gravitational energy and vice versa. Indeed, gravitational potential is now revealed as simply infolded electromagnetics, and electromagnetics is simply the outfolding of the internal contents of gravitational potential.

Colleagues have already proven it on the laboratory bench, by building both "free energy" devices and practical antigravity devices.

This new, extended electromagnetics—electrogravitation—I have dubbed **scalar electromagnetics.** The key to it is to let the EM force fields fight themselves to a "cancellation," forming **a** vector zero. If we do this in a nonlinear medium (modulator), the summing/multiplying EM vector forces are locked together and remain as an infolded EM system inside the EM vector zero. This now is a gravitational system. By merely varying (in phase) the summing EM components, one varies the local energy density of vacuum. Rigorously that is a gravitational wave. Further, it is a very powerful G-wave, for we are utilizing EM forces some 1042 times as strong as the normal weak G-force.

Classical EM has taught us to simply discard the components in the zero vector summation, replacing the system of opposing EM forces with a vector EM zero. This of course makes all vector EM zeroes equal. However, it totally ignores the space-time/vacuum stress of the summed forces, and the resulting gravitational implications. Therefore we have been taught to ignore any gravitational aspects of normal EM circuits, and indeed we proceed to release the G-stress effects in the circuits when we build them as we have been taught

Ordinary EM represents the release of the internal stress of gravity. By teaching us to make nonzero EM, scientists have taught us to always release electrogravitational potentials as electromagnetic forces. Thus in classical EM—and in most of the circuits we build—the EM force fields are the primary causative agents. Classically, when these force fields reduce to zero, there is no more electromagnetics going on. That is true, but there can still be a very large amount of gravity and inertial effects going on!

However, quantum mechanics teaches us that the EM force fields are not at all the primary causes. Instead, the potentials are the primary things; EM forces are simply made from these potentials by differentiating operators. And when the force fields are zero, the potentials still exist. Further, when these "forceless potentials" interfere—

even at a distance—real EM effects cun still be obtained, in total violation of ordinary EM and ordinary mechanics!

This is called the Aharonov-Bohm Effect, and in 1986 it was finally proven to most physicist's satisfaction. Only the most diehard skeptics still object to it, according to *Physics Today,* January 1986.

At any rate, when we have zeroed the E and B fields, we can still have the potentials, according to modern physics. These potentials can interfere to produce electromagnetic force effects—even at a distance.

Further, the zero summation can be dynamic; that is, the vector components can be varying, so long as they always sum to a zero vector. Actually such a zeroed system now has an infolded, deterministic pattern of dynamic forces, according to the pattern we deliberately construct. Further, the energy of each force component infolded is varying, and thus the overall energy density of local vacuum is varying.

As we said, rigorously this defines a gravitational wave. So the zero-vector approach allows EM wave energy to be turned directly into gravitational wave energy. Now it is the curvature of spacetime that is being varied locally. That's a really astounding thing.

We can now deliberately engineer the vacuum/spacetime itself, with all that that statement implies. Locally we can bend spacetime itself, which Einstein assumed could never be done except by a huge collection of mass—such as a sun, star, neutron star, etc. But here we can do it with simple things such as opposing coils, opposing E-fields, etc. We've just violated one of the sacrosanct, severely limiting assumptions of ordinary (Einstein's) general relativity!

That is, up to now most Western physicists have assumed that the local spacetime/vacuum cannot be curved. They assume that, where we the observer and the laboratory instruments are, only special relativity applies. Locally the observer always has a "Lorentz frame," in that view. This assumption (the local Lorentz frame) means that all the conservation laws apply, and physical reality stays well-behaved where the laboratory is and where we are. Ordinary relativity becomes just a sort of "special relativity with distant perturbations."

The only curvature of spacetime of any consequence is only to be found at or near distant stars, suns, black holes, and other huge collections of mass, in this highly restrictive view. Further, this assumption implies that one can never have an experimental general relativity, since where one is experimenting (locally) there is always essentially zero spacetime curvature!

However, one need not have such a formidable restriction at all. Two bucking transformers can make a B-field vector-zero a little bit More complex circuits can easily be designed to sum (or multiply) force fields to zero very well. When we do this zero summation, we also get an amazing gain as follows: Consider two electrons in free space. As is well known, the electric field force (repulsion) between them is about 10^{42} times as strong as the gravitational field force (attraction) between them. So the electric force is so very much stronger that the comparatively weak gravitational force can be entirely neglected, in most applications. However, if we "strangle" that electric field force by zero summation, all the opposing electric forces are converted directly into gravitational potential!

Interference of two such potentials can directly generate gravitational forces. So, if

we could zero-sum their E-fields perfectly, we could instantly amplify the gravitational force between the two electrons by a factor of 10^{42}. With such a gravitational force amplification factor, our altered "electrical" circuits would actually become powerful electrogravitational circuits. Further, appreciable gravity effects would now be experienced by any mass, object, or device exposed to the action of the circuits. This is the fundamental secret that Nikola Tesla discovered, one which he never openly revealed.

Further, by locking opposing EM waves together, we may easily construct purely scalar EM (electrogravitational) waves and beams. In such case, amazing new phenomena are encountered: (1) one can increase or decrease the mass and inertia of an object; (2) one can produce a unilateral force in and on each and every nucleon in a body, thus accomplishing the long-sought "antigravity"; (3) a unilateral force drive—a "space drive"—can be constructed; (4) transmutation of elements becomes fairly simply done, with miniscule energy; (5) effects at a distance—such as cold explosions or hot explosions—can be accomplished; (6) negative energy and negative time effects can be created and utilized; (7) Newton's third law can be manipulated and violated at will; (8) negative entropy effects can be created and utilized; and (9) direct energy extraction from the vacuum can be accomplished, etc. So many new effects are encountered that it will take a generation of graduate students and university laboratories to get a good handle on most of them.

The reader is urged to remember these rules: (1) The destructive interference of scalar EM waves (electrogravitational waves) produces EM energy in, or extracts it from, the interference zone. (2) The destructive interference of ordinary EM waves produces gravitational potential energy. (3) The release of the ordinary EM force fields represents the bleed-off of a 5-dimensional gravitational potential as ordinary electromagnetics. (4) The bottling-up of the ordinary EM force fields represents the forced bleed-off of a 5-dimensional gravitational potential as ordinary 4-dimensional gravitational force. (5) The EM field and the ordinary (4-space) G-field are just separate bleed-off s of the same 5-dimensional gravitational potential field.

Thus, I make no bones about it; we have a new physics in the offing—one that is eminently practical and easily engineered by any modern electromagnetics laboratory.

Since the first edition of this book was issued, it has also become obvious that at least two other phenomena are involved in UFOs, and intermingled with the "materializations from the collective unconscious" true UFO phenomena. These two additional things are:

(1) A great number of "lights at night" and "mysterious fireball" type phenomena—and giant balls of light and glowing hemispheres of light of gigantic size—are actually due to deliberate Soviet long range, high energy, real-time holography using phase conjugation. These phenomena are to accomplish orientation and alignment of giant Soviet weapons, and at the same time deliberately evoke UFO reports and scientific skepticism, providing perfect deception.

(2) Several nations of the world—at least two—have been building and flying antigravity spaceships all over the solar system, since the early 1950's. A very small number of UFO ship reports and encounters are due to these ships and their crews. However, control of these ships is not under any duly elected government, but passes out of the government concerned, into and under the control of some mysterious group

which I loosely refer to as "the control group." This is the same mysterious group which has been suppressing free energy and antigravity inventors and inventions for a great number of years.

Thus in *Excalibur Briefing* we are still addressing the primary UFO phenomena: Materializations from the collective human unconscious. Coverage of the other two parts of the overall reported UFO phenomena will be made elsewhere.

So it seems that, under my hard-pressed circumstances, the best thing to do for the second edition of *Excalibur Briefing* is to include something that shows some of the drastic progress that has been made. By adding a glossary and a current paper, the book will also be made much more usable. I also have prepared an index for the first edition, but it cannot be included because of space limitations. Admittedly that is regrettable and still not the optimum, but it will have to suffice. Perhaps in the future I will be able to do a complete rewrite of the book, for *Excalibur III.*

Until then, I ask the reader's indulgence and understanding.

* * *

In the first edition we accented the hyperspatial aspects of the problem, but also pointed out that higher dimensional spaces and deeper nested levels of virtual state are in fact one and the same thing. The reader should keep in mind that when we "inter-nest" vector zero systems, we are performing direct engineering in hyperspace.

Let me be more specific. When you zero sum a group of EM force vectors, you place those component vectors "inside the zero," so to speak. In modern language you have placed ordered patterns directly inside the violent flux of virtual particles comprising the vacuum. The modern concept of the vacuum is that it is like a seething plasma or gas. However, it's a very strange gas, for each particle arises spontaneously out of nowhere (according to quantum mechanics), and almost immediately turns into something else and/or disappears. Thus the vacuum plasma or gas is rather peculiar; the particles comprising it appear and disappear so rapidly that they cannot individually be detected. However, while a virtual particle exists, it is in motion, and so a violent flux of these "phantom particles" comprises the vacuum/spacetime.

However, just as many fleeting particles in the vacuum are moving backward in observer time as are moving forward in it! So this wild "vacuum gas" of ghost particles exists in both positive and negative time at once!

Anyway, when we make a zero vector EM system, each component force in the summation represents a gradient in this virtual particle flux. That is, we have "patterned" and organized the flux—polarized it, so to speak. And that now overturns one of the fundamental assumptions of quantum mechanics.

Quantum mechanics assumes that the violent flux of vacuum ghost particles is totally randomized. That is, no deterministic pattern exists in the flux. These virtual changes collect or cohere statistically, not deterministically, in the standard assumption. When they happen to collect/cohere sufficiently, the threshold of an observable quantum change is breached, and a quantum change occurs.

It can readily be seen that, in the ordinary view, the occurrence of these quantum changes is totally statistical. And indeed it is, so long as the virtual particle flux is randomized. However, with zero vector summation (or multiplication) we have produced

deterministic patterns in the flux—and hence in the cohering and collecting of this flux on observable charged particles. Therefore, these deterministic "virtual state" ordered patterns will result in the appearance of deterministic patterns in the occurrence of observable quantum changes.

Now we have begun to engineer physical reality directly; that is, one can now begin to pre-determine which statistical change shall be favored, or in the extreme case, which one shall occur, and whether or not it shall even occur at all.

The renowned physicist, David Bohm, has written a theory of "hidden variables" which could fit and describe all of physics (nothing out there contradicts it). It has largely been ignored, and will continue to be ignored unless it can show appreciable application that normal theory cannot cover. With the scalar EM approach, we can now directly provide hidden EM force field vectors, ordering the virtual state vacuum flux, and we may vary these ordered virtual patterns at will to produce startling new results in charged particle systems. So now we can directly engineer Bohm's "hidden variables," and the vacuum itself—something ordinary theory cannot cover. Drastic changes in the physicist's view of fundamental physical reality, and of what he can do about it, now result

But to return: We wish to engineer additional hyperspaces. (The first zero-vector summation places the component vectors in the fifth dimension.) If we take one of the component EM vector forces in the first zero vector summation, and we then take a point on it as yet another "reference zero", we may encapsulate a second series of zero-system summation vectors into and within that zero-point. In this case we have placed these second vectors into yet a deeper level of virtual state vacuum. That is, we have reached into yet another hyperspace with our engineering and control. Indeed, we have placed the second system EM vectors into the sixth dimension. So we have become true hyperspace engineers.

The process is repeatable as desired. We may reach any hyperspace we wish, as our technology and control develop.

Now we see the impact In modern Kaluza-Klein geometry, one needs about 11 or so dimensions if one is to account for quarks, charm, etc. Now we have a direct tool to reach into any one or all of these hyperdimensions and affect the exact particle or component desired. We will be able to engineer matter—including the nucleus, and including inside the proton and neutron—in almost any way we wish. It all follows from scalar electromagnetics, which allows the direct engineering of hyperspace in all its dimensions.

Remember, engineering in hyperdimensions is just the engineering of nested levels of vacuum potentials. Even more startling, we can also place "thoughts" and effects directly in the mind itself, including the unconscious mind.

As we stated in the first edition of this book, we may model the mind as simply an objective 3-space, three turns away from the 3-space of the ordinary physical world. If we nest two or more additional zero-vector systems in our first one, then we have placed affects ("vectors") directly inside the mind itself. If we know the code of the human brain-tuner, we can now manipulate the mind directly. Electromagnetically, by scalar EM. And it appears that the Soviet Union has begun to reach this frightening capability.

Disease patterns may be induced upon ordinary EM carriers in the same manner,

by nesting the zero-vector systems. That is, of course, if one has measured the scalar patterns evident in the induced disease, say, in the Kaznacheyev-type experiments with the desired disease patterns. The reverse is also true: Nesting the patterns in the proper context on EM field carriers can cure diseases such as cancer and leukemia, as evidenced by the Priore device.

One can also make a practical "free energy" device by setting up a standing scalar wave resonance in a localized region or device. From the "high stress" point to the "low stress" region of vacuum formed by such a standing scalar wave, a literal "river of energy" is flowing in the vacuum itself. Once the river is established, only the "leakage" need be replenished. Hence, if one builds a special sort of "paddle wheel" to react with the river and turn in it, one obtains shaft power freely from the localized curvature of spacetime. In that case, an ordinary generator can be driven by the shaft torque to provide very cheap, or"free," electrical energy.

Several inventors—three of whom I work with in one respect or another—now have demonstration models of such machines, which take diverse forms.

Because of the extreme importance of these emerging potentialities, in recent years I've concentrated intensely upon the properties of the vacuum as spacetime, and uncovered shortcomings (and downright errors in many cases) in ordinary physics and electromagnetics. Slowly the scalar EM picture has emerged, and a series of papers has been written and published to develop the concepts of the new approach.

The scalar approach also includes the ability to engineer negative energy and negative time flow. The reader is referred to Chapter 4, "Extraordinary Physics," of my forthcoming book, *AIDS: Soviet First Strike,* Tesla Book Co., P.O.Box 1649, Greenville, Texas 75401 for a summary of the vast importance of the time-reversed EM wave (phase conjugation).

Let me here just accent a rule of great importance: It is actually the key to negative energy, negentropy, antigravity, free energy, transmutation, Tesla's wireless transmission of energy at a distance without loss, Tesla's original magnifying transmitter, and many other things.

First we need the expression CPTEGS, where C is charge, P is parity, T is time flow, E is energy, G is gravity, and S is entropy. We shall be concerned with the algebraic sign of each term in the expressioa The rule deals with photon interaction with a charged particle inside an atom. Normally, incident photons interact with an electron in the electron shells, so C is normally negative. This produces normal parity, and causes the normal or positive flow of time, s T is normally positive. The normal kinds of energy, gravity, and entropy are experienced, so energy is positive, gravity is positive (attraction), and entropy is positive (progressive interactions in a system tend to more and more disorder).

The astonishingly powerful rule is this: In a photon interaction with a charged particle in an atom, if any one of the terms of the expression CPTEGS is reversed in algebraic sign, all the other terms are reversed in algebraic sign.

Thus if one makes scalar EM, the wave (and its photons) passes through the electron shells and interacts with (is absorbed in, and raises to an excited state, which then decays to emit a wave and photons) the highly nonlinear, positively charged nucleus. This represents a reversal of C, hence a reversal of P, T, E, G, and S also.

Consequently, a time-reversed wave—a phase conjugate replica of the incident

wave—is emitted by the decaying excited nucleus. In nonlinear phase conjugate optics, this is the mechanism that produces the phase conjugate wave. This is also the mechanism that produces a very large amplification of the incident wave when a "pump wave" (two waves 180 degrees out of phase) are used in the nonlinear (modulating) medium of the phase conjugate mirror.

(The reader is referred to any good book or summary paper on phase conjugate optics; for example, see David M. Pepper, "Nonlinear optical phase conjugation," *Optical Engineering* 21(2), Mar./Apr. 1982, p. 156-183.).

When one pumps a phase conjugate mirror material sufficiently, then "tickles" the release of the total nuclear excitation energy as phase conjugation replica waves (negative energy), appreciable negative time is produced in the decaying nuclei of the mirror. In negative time, gravity is a repulsion, not an attractioa The mirror thus produces antigravity, and gets lighter. If it is forced to sufficiently high amplification, it can be made to float in air. At higher amplification still, it will accelerate upward.

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T. E. Bearden
December, 1987

INTRODUCTION TO THE FIRST EDITION

Today there are a great many books available on UFO's, paranormal phenomena, and wild science, and one more such book ought to say something quite different if it is to be justified. Accordingly, in this book I have tried to say something quite different, perhaps in some cases too different. And so, to assist the reader's comprehension, I would like to explain something of how the book came about.

For the last fifteen years or so I have been interested in paranormal phenomena to one extent or another. Fifteen years ago I started studying Shotokan karate, and later switched to Yoseikan aikido, a most profound and absorbing martial art. I had already started serious reflection on the nature of perception, and after some years of aikido practice I occasionally began to experience what might be called paranormal perception. For example, occasionally, when violently attacked by several opponents, I would suddenly discover myself standing calmly on the sidelines watching the robot-like figures go through the motions of a play, motions that had already occurred in one kind of reality and that were now simply being repeated. On the rare occasions when I experienced this pure zen state of aikido, the techniques became flawless. In fact, the state was not separable into attacker, defender, and technique — rather a single union of the universe occurred. Unfortunately, although I eventually reached Sandan (third-degree black belt), I never permanently attained the complete aikido oneness state; this does not normally occur until the sixth dan level.

However, the occasional experiencing of this pure unity made a deep impression on me, for such aikido is pure meditation in motion, and only in such a state can the individual grasp the nature of perception. Only when conscious activity has stopped ("mind like a moon on still water") is such awareness possible. For several years I then laboriously developed a theory and interpretation of aikido for Westerners and eventually published it privately.

In 1971, while finishing a Master of Science degree in nuclear engineering at Georgia Tech, I put together a first crude theory of perception, which was published in 1973, many rewrites later. By that time I was already deeply engrossed in the study of paranormal phenomena, and especially unidentified flying objects. I had seen several UFO's (the earliest in 1950), and no longer doubted that the UFO phenomena represented some sort of new reality experienced by a great many people.

The UFO organizations at that time seemed to be in disagreement with each other. For twenty-five years or so almost everyone studying the phenomena had been trying to prove the extraterrestrial hypothesis, i.e., they started with the assumption that UFO phenomena were caused by, say, a group of young stalwarts over on planet X of star Y, getting beered up on a Sunday afternoon, hopping into an old space jalopy, and motoring over to planet Earth to jolly the natives. So they vigorously cataloged the UFO reports that fit the picture, and embarrassedly ignored those that did not. Yet most of the phenomena consisted of strange lights at night, not steel-hulled spaceships. And most of the contactee cases — particu-

larly those involving apparent communication and abduction — were regarded as just too far-out for engineers and scientists to swallow. Almost everyone in the UFO organizations seemed to be convinced that Earth was being visited by spacemen from another planetary culture more advanced than our own, and so the UFO enthusiasts looked for hardware and spaceships, no more and no less.

The tabloids were a mess — filled with sensational nonsense about the purported UFO invasion of earth. Some invasion! If the would-be invaders possessed such an advanced technology, why had they spent twenty-five years flitting around the backside of the country and frightening the rural people, instead of simply landing an expeditionary force and having done with it? It seemed that almost no one was really looking at the phenomena in a totally unbiased manner. When one did so, without especially selecting the data, the strangeness of the data went up by orders of magnitude.

So I decided — rightly or wrongly — not to compete with the catalogers, but to try to come to grips with the possible *science* evidenced by the phenomena. I wanted to examine what kind of science was necessary to describe the phenomena and the mechanisms producing them. It rapidly became obvious that our scientific framework was not adequate to explain these events. In fact, our logical framework was not adequate. So I decided to look for a new scientific framework, knowing that the effort would be long and arduous and might not succeed at all.

All the unexplained phenomena seemed to me to be interconnected; for example, a study of Sasquatch will sooner or later lead to the study of UFO's and thence to the study of the other phenomena. So it appeared that they were all different aspects of the same overall reality. Since that reality most definitely involved the mind as well as matter, it appeared necessary to develop a new science incorporating both mind and matter. And so the search and the gradual accumulation of insight continued.

The trail led directly to the great paradoxes of science, the great unsolved problems of philosophy, and the three laws of logic on which all logical disciplines and sciences are founded. Using my perception theory, it was possible to see through the age-old necessity for the identity of opposites, how opposites could be identified, and when they were identified. Thus a fourth law of logic could be written and the system closed.

Slowly the nature (or, more precisely, a model of the nature) of mind became clearer. In addition, mechanisms for materialization and dematerialization appeared, as well as mechanisms for metal bending, thoughtform materializations (tulpas), and telepathy.

But the international strategic balance also could not be ignored. From my military background, the Soviet military buildup toward an attack capability was apparent as early as 1970-71. Moreover, from my work on the Moray radiant energy device I had discovered what I believed to be the basic theoretical mechanism used by T. Henry Moray to tap the zero point energy of free space. (This mechanism powerfully amplifies virtual state into observable state.) And positive evidence suggested that the Soviets had obtained the secret of how to make the Moray detector tubes. Putting this together with psychotronics produces an astounding weapon capability — and the Soviets must have had such capabilities already on site and others in development.

I looked for evidence of these weapons, and the evidence was there, cleverly — even diabolically — concealed.

When I then realized the *entity* nature of the collective human unconscious, everything fell into place. Suddenly the different major waves of UFO's made very good sense, as did the cattle mutilations, the Soviet buildup, Khrushchev's 1960 statement about fantastic weapons, Brezhnev's 1975 reference to the development of weapons more frightful than man had ever conceived, the long years of microwave radiation of the U.S. Embassy in Moscow, the Legionnaires' disease, etc.

The intelligence community had completely missed the fact that the Soviets had been working on a psychotronic Manhattan Project for thirty years. Not a soul in officialdom would believe that such capability could be achieved by surprise. This is not because of a deep conspiracy of the government (although I believe one of our high intelligence officials may be a Soviet agent, a sort of Penkovskiiy in reverse, who has been personally responsible for preventing any serious U.S. governmental research into psychotronics and UFO's); rather, it is because of all the personal arrogance, bias, power-seeking, manipulation, and maneuvering that now make up so much of our top managerial base in government.

So I decided to put out the information for all to see. There is still time — but just barely, I think — to build psychotronic defenses and prevent the launching of the Soviet attack. But we must move swiftly if Fer-de-Lance, the Soviet attack plan, is to be frustrated, for the eleventh hour is here.

Moreover, there is a single human problem responsible for all the ills that man causes man, and that problem has a technical resolution that is well within our grasp. I firmly believe that by psychotronics, the minds of all men can be linked into a great supermind having absolute psychokinetic mastery over time and space — literally a godlike being, in whom the collective human unconscious has a collective conscious instead of the four billion fragmented individual personal conscious minds it has at present. The initial psychotronics linkage mechanism is just a tool; after linkage is accomplished and stabilized, such props will not be necessary.

This is my real goal. Even if the U.S.S.R. launches Fer-de-Lance, annihilates NATO and China, and obliterates all Western retaliation with a stunning blow, and even if the collective unconscious then psychokinetically lashes back with the violent destruction of the Eurasian continent, linkage is still the goal and the final resolution. Should the apocalypse come to pass, there will still be time, in the midst of the horrendous collapse of civilization, to gain the final solution.

And it is the final and total solution. All the parables in the Book of Revelation will be realized. The grave literally will give up its dead — for with the overcoming of time and dimensionality, all that ever has been or ever will be, *is,* in one great nowness, allness, Omega, "I am that great I AM."

That is the goal, and it is toward that end that this book is written.

Please note that a listing of the research and reference works mentioned in the text can be found in the bibliography.

PART ONE

A SAMPLING OF SPECIFIC PARANORMAL PHENOMENA

In this section I show a sampling from the world of the paranormal, including UFO's of various kinds, psychotronics, Loch Ness monsters, Sasquatch, bigfoot, superfoot, psychokinesis, remote viewing, psychic photography, and a host of other phenomena— all explicable by the theories presented in Part Two.

I fervently believe that a theory can be constructed to explain our lives, including all the strange phenomena as well as the more familiar happenings. In this book a serious attempt has been made to point the way by developing what I believe to be the basic concepts, and by showing that a host of phenomena do seem to be consistent with the schema.

Let us hope that science and scientists are not after all dead, and that they will shake the cobwebs from their eyes and set about particularizing a new paradigm of mind and matter. When the top theoreticians and experimentalists wake up and join in the effort, my task will be finished.

THE VESTIGIA MYSTERY LIGHT EXPERIMENT

Let me start by introducing you to Vestigia, a very fine, relatively new organization that has been formed to study mysterious and unusual phenomena in a scientific manner. This organization, of which I am happy to be a member, is headed by Robert E. Jones and the investigation of the mystery light is spearheaded by James McGrath and Bill Wagner. (The informative *Vestigia Newsletter is pub*lished by the organization. Persons interested in the objective scientific study of unusual phenomena are cordially invited to contact Vestigia at P.O. Box 1183, Perth Amboy, NJ 08861.)

Vestigia's ongoing investigation of a mystery light in Morris County, New Jersey is a classic example of the manner in which mysterious phenomena may be studied in a scientific manner, and it should serve as a model for other investigative groups. Vestigia's experimental work has exemplified careful planning, close teamwork, proper scientific equipment and preparation, and the patience and persistence that are essential when performing fieldwork experiments in the field of unusual phenomena.

1 wish to stress in advance that Vestigia does not endorse my own theory of the possible nature of mystery lights; in fact, the organization very properly remains openminded. Also quite properly, they practice scientific conservatism in studying the possible nature of the phenomenon; at the present time they strongly favor the theory of the piezoelectric effect. Substantial evidence for this thesis includes the presence of a known geological fault in the local area, the presence of piezoelectric minerals in the local granite (e.g. thirty percent quartz), close association of the incidence of the phenomenon with subsequent local earth tremors, conditions favoring the accumulation of a surface charge (e.g., metal railroad tracks oriented parallel to the geological fault), and enhancement of the phenomenon under study. And this is exactly how Vestigia is in fact proceeding.

In science, the prevailing world view is not to be dismissed lightly since a great deal of experimental data has been gathered to substantiate it. And a single experiment cunnot establish the need to correct that solidly based view, even if the experiment at first appears puzzling and not in accordance with the accepted view. Only after many exhaustive studies have found the world view inadequate, may a

paradigm properly be changed. From a rigorous scientific viewpoint, then, I am saying that this classic experiment is consistent with my own orthorotation theory, but not that the one experiment proves my theory. The experiment at this point is also perfectly consistent with the more conservative hypothesis that the mystery light is due to the piezoelectric effect. Additional different kinds of experiments are required before either theory will hold. For example, in my own theory, the mechanism of orthorotation must be verified elsewhere, and in the piezoelectric theory, the mechanism that spatially separates the effect from the crystalline material where such an effect normally occurs, must be explained and verified by other experiments.

With these precautionary remarks to the reader, let me now describe the beautiful experiment initiated and still being performed by Vestigia. I will then present my own theoretical explanation, again stressing to the reader that it must be treated as a hypothesis at this point.

Mystery lights occur in many locations throughout the United States and Canada. Vestigia has determined over ninety of them to date. They are recurring phenomena and are often seen near some natural or man-made feature such as a stream, hollow, road, railroad track, field, or mountain.

The mystery light under investigation by Vestigia is located along a one-mile stretch of railroad track in Washington Township, Morris County, New Jersey. The light has been seen by hundreds of people at one time or another over the last twenty to forty years. Dr. C. Louis Wiedemann describes it in the *Vestigia Newsletter:* "Appearing at night, it is said to bob or sway from side to side in the manner of a swinging lantern, and when approached it vanishes, sometimes reappearing at a more distant point."

Quoting from the *Vestigia Newsletter:*

> The preplanned battery of experiments and observations was conducted on the night of November 20-21, 1976. Three observation posts were established along one mile of railroad track, and these were manned in shifts by small teams of observers who maintained contact with team leaders via portable radio communicators. Communications were monitored and instructions were issued from a command post which was maintained in two vans joined in a T-configuration adjacent to the central observation post (Post 2).
>
> The vans contained electronic equipment valued at $30,000, which was wired to sensing devices along the railroad tracks. Four thousand feet of silver plated fine copper wire was laid between the rails and attached directly to an amplifier and oscilloscope in one of the vans, to detect variations in electrical frequency and amplitude. Other cables were attached directly to the rails, providing a capacitance test. Other devices included a Geiger counter, thermometers, a methane gas detector, a barometer, a parabolic listening device, a radar unit, an infrared sensor, and a sensitive compass. Personnel at observation posts were equipped with binoculars and cameras. One tripod-mounted camera equipped with infrared sensitive film was located near the rails at Post 2.
>
> James McGrath, a member of Vestigia's executive board, acted as advisor to the team. Team leader was electrical engineer William S. Wagner who was assisted by Jack Mazzuchelli. In all, sixteen persons were actual members of the team, and a total of twenty-one persons participated that night. A number of these were members of the Unexplained Phenomena Club of the County College of Morris, headed by the club's president, Steve Hopler, and vice-president Mary Ann Barron.

Shown here are six of the seven infrared photos of the mystery light which were taken by the Vestigia team. The frames shown are frames two, three, four, six,

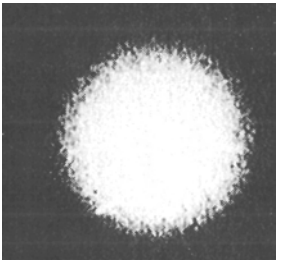

Frame Two

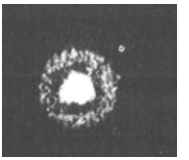

Frame Three

Photo 1. The Vestigia mystery light experiment.

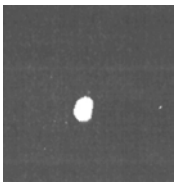

Frame Four

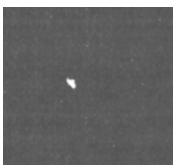

Frame Six

seven, and eight. The camera with infrared film was located at Post 2. Frame 1 was a test frame. Simultaneously with the recording of frame 2 at Post 2, observers looking from Post 1 reported visual observation of a light. The light was not seen by observers at Post 2. A second camera with ordinary film recorded only a pin-point of visible light.

In the photograph, frame two recorded an image of an apparently plexiform spheroid of dynamic granules of light invisible to the eye of the cameraman. At the same time, observers from Post 1 looking back reported visual observation of a light.

In frame three, within about fifteen seconds the image has decreased in size and the plexiform spheroid is now a thinner corona around a dense, nearly hexagonal center.

In frame four, a dense but small irregular or oval image can now be seen. Frame five, not shown, is quite similar.

In frame six, a substantial decrease in size is apparent.

In frame seven, again the image size has increased, and again it possesses a dome central core surrounded by a thinner spheroidal corona of dynamic granules of light. Also, several separate satellite images are now visible at some distance from the main spheroid.

Frame eight is very similar, except that the satellites are no longer visible and the light in both the core and the corona is not quite as dense.

To describe the experiment precisely, the following passage is taken from Dr. C. Louis Wiedemann's article in *Vestigia Newsletter* No. 2, Spring 1977:

> Following several hours of equipment testing and calibration, at 10:21 P.M. two observers at Post 1 radioed the message that they had a "light" under visual observation between their position and Post 2, at an apparent distance of 300 to 400 feet from Post 1. Post 2 observers immediately scanned the area with binoculars and radar, but no object or light was detectible from that position. The yellowish-white light remained visible from Post 1 for approximately one minute and thirty-five seconds, initially approaching the tracks from a lower position off to one side, but soon positioning itself over the rails, and then seeming to sway from side to side in a pendulum-like manner. Its size was estimated between three and six inches in diameter, and for awhile the observers believed it was approaching them. When it vanished, the disappearance was sudden, as if the light had been "switched off."
>
> During the period in which the light was under observation, personnel at Post 2 took pictures of the apparent darkness, and continued to search with radar and binoculars. Two observers at Post 3 briefly saw what appeared to be an orange light between their position and Post 2. While the main light was under observation, several of the instruments in the command post gave unexplained readings. Most notable among these was the oscilloscope's display of an electrical frequency in the range of 40,000 Hertz. Additionally, the capacitance test showed the apparent presence of a conductive body between or over the rails. Nine minutes after the light had vanished from view, the Geiger counter (whose sensor was between Posts 2 and 3) indicated a full scale reading of greater than 5 mr per hour, lasting ten seconds. Normal background radiation was then recorded for five to six minutes (0.1-0.2 mr/hr), whereupon another full scale reading was displayed for approximately seven seconds.
>
> The pictures were enlarged from small images which appeared on the infrared film which was exposed through a 135 mm telephoto lens from Post 2 by Richard Larkin. Film employed was Kodak high speed infrared No. 2481, which is sensitive to infrared radiation to 900 nanometers, with maximum sensitivity from 750 to 840 nanometers. The lent opening was f/3.5 with the apera-

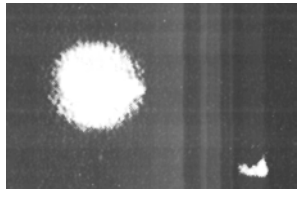

Frame Seven

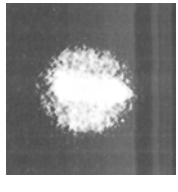

Frame Eight

ture set at infinity. The second frame (frame 2) was exposed between 3 and 5 seconds, and the others were varied in exposure from 3 to 10 seconds. Intervals between exposures were between 10 and 15 seconds.

High speed (non infrared) film in a camera which was hand-held by James McGrath at Post 2 also produced several images of an apparent point source of light above the rails (not shown here). Jack Mazzuchelli observed the area through binoculars during the entire time period, and he was unable to discern any light whatever, although he could perceive the rails and the railbed in the faint illumination provided by starlight shining through a partially overcast sky.

As I stated previously, Vestigia has not yet reached a firm conclusion as to the causative agent, but strongly favors the piezoelectric theory, since if offers the simplest explanation at this point. Again, to quote the *Vestigia Newsletter:*

No absolute conclusions can yet be drawn, other than the apparent fact that a phenomenon or set of phenomena did occur. Team leader Wagner theorizes that the phenomenon might be similar to so-called earthquake lights which have been reported to precede seismic tremors in Japan. Interestingly, there were explosionlike shocks or "loud booms" reported by residents of two housing developments several miles distant from the site on December 5 and 6,1976, and these shocks were recorded by seismographs at Columbia University and elsewhere. Intensity was (-)0.25 to (+)0.38 on the Richter scale. Wagner posulates a possible piezoelectric effect from tension on subterranean rock deposits.

The possible relationship of a piezoelectric effect will be investigated further. Data gathered in Japan tends to indicate the development of subterranean stresses during the passage of a cold front. In the light of this possibility, it is interesting to note that there was a drop in barometric pressure from 29.9 to 29.76 culminating less than one hour before Vestigia recorded the start of the phenomena. A light snowfall preceded the appearance of the light.

Wagner believes that the initial discoveries tend to indicate that the following conditions must be present for the phenomenon to be manifested:

(1) A geologic fault in the local area.

(2) The presence of certain minerals, especially quartz (quartz comprises 30% of the granite in the area under investigation).

(3) Conditions should permit the accumulation of a surface charge (e.g.: the presence of railroad tracks, because they are metallic).

(4) The tracks must run parallel to the fault.

(5) The phenomenon's manifestation tenc
sure changes as well as extreme changes in temperature.

Wagner states, "Our indications are, at this point, that the lights precede earthquakes or tremors."

Regardless of what hypothesis we begin with, it must be consistent with all the major features of the Vestigia mystery light experiment.

(1) The explanation must show why a light with structured patterns formed and changed. The structured patterns changed geometrically in shape and intensity, as well as in movement and location. This dynamic formation and change was recorded on infrared-sensitive film. The geometrical shapes of the light structures must be accounted for.

(2) Ordinary film recorded only a pinpoint source of light.

(3) The light which was photographed in infrared was not seen by the photographer himself, nor by eight other persons who were observing at the time from Post 2.

(4) Either that light or another was seen visually from a different station.

(5) At the same time as the visual appearance of the light, instruments recorded the apparent presence of a conductive body between the rails or over them.

Specifically, the electrical capacitance between the rails was observed to change — or at least indications to that effect were received on the instruments.

(6) Nine minutes after the main light vanished, a Geiger counter began to read full scale for about ten seconds, then lapsed back to background reading. Five or six minutes later, full scale reading was repeated for about fifteen seconds. About a minute after that, full scale reading was again recorded for about seven seconds.

(7) At the same time as the main light visual sighting, an electrical frequency of approximately 40,000 Hertz was recorded on the oscilloscope.

There were also environmental conditions which may well have been involved in the experimental effects.

(8) Barometric pressure dropped from 29.9 to 29.76, culminating less than an hour before the phenomena were recorded.

(9) There was a temperature drop and a light snowfall preceded the appearance of the light.

(10) The geological conditions strongly favored seismic stress and piezoelectric effects. For example, the local granite contains about 30 percent quartz, and there is a known geological fault not far from the experimental site. About fifteen days after the experiment, seismic shocks were indeed recorded at Columbia University and elsewhere, and they were audibly detected by residents of two local housing developments. The measured intensity of the seismic shocks was from(—)0.25 to (+)0.38 on the Richter scale. It thus appears highly probable that seismic stresses existed on the subterranean rocks at the time of the experiment and that piezoelectric activity was present in the local granite quartz due to these stresses.

(11) Conditions also favored the accumulation of surface charge, and the railroad rails (good conductors) were oriented parallel to the geological fault.

(12) Several thousand feet of wiring existed in the immediate area to connect the different stations and the instruments to the sensors. About four thousand feet of fine copper wire, silverplated, was laid between the rails and fed to an amplifier and an oscilloscope to detect variations in electrical frequency. The capacitance test also used cables attached to the railroad rails themselves. The Geiger counter's sensor was also positioned at the experiment's hot spot and wired to the equipment van. Additional equipment and wiring was also used.

Finally, preliminary surveys of the area were carried out by persons of known paranormal sensitivity several days before the main experiment. Before conducting the major experiment, Vestigia interviewed persons who had seen the light and also conducted preliminary site studies using psychics. One nationally known psychic was brought to the site by Vestigia's president Robert Jones, and asked to walk along the tracks. The psychic reported impressions of some personal tragedy, perhaps a gruesome murder. Later several other persons with heightened psychic sensitivity were brought to the site, and they reported psychic impressions.

In all, three psychics were brought to the track. The only directly correctable result was that all three had a reading in the same area on the stretch of track, within sixty feet of the sighting of the night of November 20-21. The psychics' own interpretation of their readings differed considerably.

UNEXPLAINED GENERATION OF ELECTRICITY

Some additional data exist to indicate the generation of electricity by rocks and

the generation of unexplained electromagnetic energy radiated from the earth, ocean, or atmosphere.

For several years T. Townsend Brown has worked in electrogravitics and holds many patents in the field. Some of his laboratory experiments have positively demonstrated a direct connection between electric currents, electric charge, and gravity, although the exact nature of this connection has not yet been fully explained. Nevertheless, it can be shown that highly charged objects do not behave in a gravitational field exactly as predicted by classical theory.

Furthermore, in 1974 Santilli succeeded in proving that one of the classic assumptions of physics is wrong, namely that electric field and gravitational field are mutually exclusive. Santilli proved that gravitational field and electric field are either partially or totally the same thing, in contradiction to present assumptions.

Over a decade ago, Curtis reported the measurement of very low frequency electromagnetic signals generated over the ocean that are not accounted for by any presently known mechanism or theory. Although Curtis published several articles on this effect, no further investigation has appeared in the literature.

Finally, there is a certain location where the generation of an anomalous electromagnetic signal occurs continuously. This is McGregor Missile Range (U.S. Army), where Army units fire air defense missiles such as Nike Hercules and Hawk. As a young captain, in 1961 I headed up the Hawk Evaluation Team at McGregor Range and directed the Hawk missile firing. About sixty-five kilometers out in front of the Hawk missile sites and downrange, there was a most peculiar source of electromagnetic noise, which could considerably affect a Hawk illuminator (continuous wave) radar when the radar antenna was oriented in that direction at a low elevation. In that case the radar would continually noise-lock (make and break lock-on) on the noise signal, dithering slightly as it continued to try to resolve a coherent radar return signal. This noise source was always present, in all seasons and temperatures, and so we simply made each Hawk unit commander and his personnel aware of the phenomenon. On one occasion 1 even vectored a helicopter with an investigation team to descend on the site and inspect it. All they found was the usual surface of the desert floor, with sparse growths of greasewood and cactus. There was nothing which could serve as a generator or reflector.

At one of our other missile sites in the U.S., there was a strange reflector mechanism located at some distance from the site and at about 15,000 feet altitude. This was rigidly fixed in location and unvarying, and the unit radar personnel often used it to calibrate the range of the radar. They simply locked on the reflecting point and fine-adjusted the radar range dials to indicate exactly the known range to the reflecting point. Here again, personnel on their own initiative vectored an aircraft directly through the point and searched the air in that area, but nothing at all could be found.

HYPERFIELD GENERATION OF PHOTON PATTERNS ABOUT A BAR MAGNET COLLECTOR

The magnetic field has more fundamental components which integrate in the virtual state to form it when two successive orthorotational thresholds (quantum thresholds) are breached. Furthermore, in the picture of a bar magnet taped to the

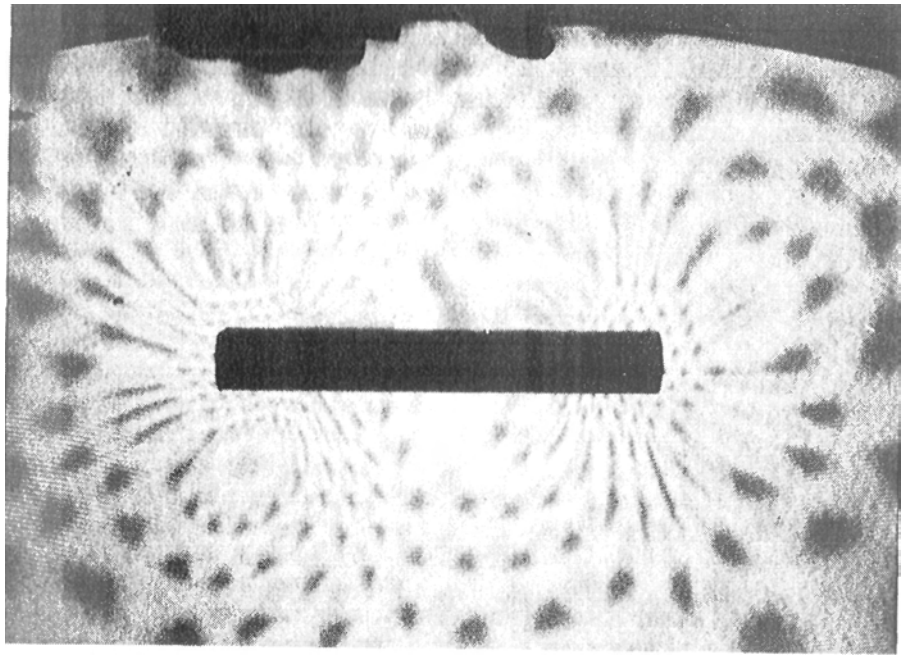

Magnet 3/4" dia. x 6" long taped to faco of a color TV tube approximately 1200 Gauss.

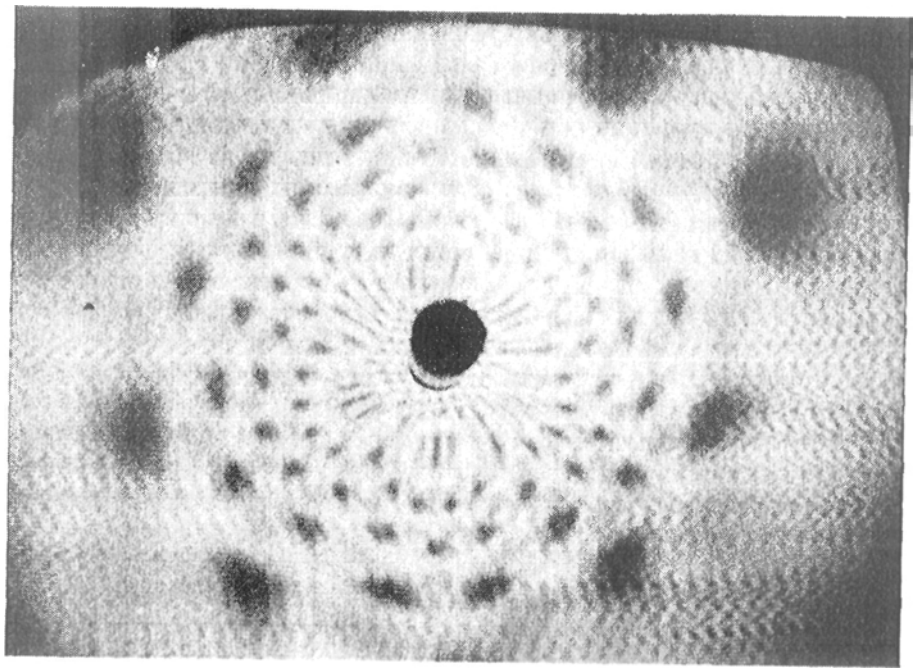

South pole end of same magnet tapod to face of color TV tube.

Photo 2. Hyperfield **flux in a magnetic field.**

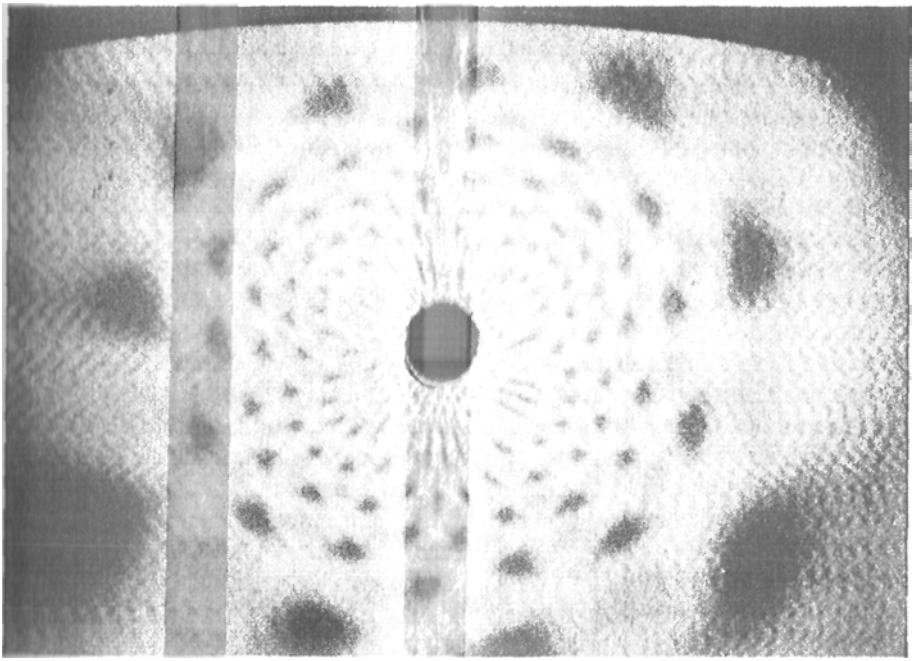

North pole end of same magnet taped to face of color TV tube.

face of a color television tube, one can see that the hyperfield orthogonal circulations in the magnetic field arc not symmetric about the two poles; i.e., the pattern is quite different around the north magnetic pole from that around the south magnetic pole.

Around the north pole, the hyperfield circulation is emitted in the form of a hexagonal solid. Thus there is an intense hexagonal orthorotation about the north pole. Radiating conically out longitudinally is a toroidal null zone, at an angle to the ongitudinal axis projected away from the north pole into space. At an even higher angle, another concentric cone is radiated out in the same direction; this higher cone is an emission cone where photons are being generated. Thus viewed from the north end, and at a distance from the magnet, the pattern shown in the right figure of the slide emerges, The pattern is a ring of light or light bubbles, surrounding a concentric ring neutral zone, which in turn surrounds a hexagonal centerofintenseemission.

If frame three of the Vestigia mystery light photos is examined meticulously, this exact pattern is seen, allowing for the dynamism of the phenomena and for slight nonlinearity of the spatial medium in which the photons are emerging by orthorotation.

On the other hand, looking at the left hand figure on the slide, we see that the outer emission ring is *so* thin that it has effectively disappeared; it is radiated at right angles to the magnetic longitudinal axle. The middle null area is also much wider. The densely emitting core area now has a relatively circular cross section at a distance. So the pattern of photon emission that is seen from this end is simply a dense roundcore. Frames four and five of the Vestigia photos demonstrate variationsofthiseffect,viewedataslightoff-axisangle.

When the magnetic field is observed from the side, only the hexagonal dense emission core of the north pole is seen. In the south pole area, we are looking into a large null area, so no emission at all is seen. Frame eight is approaching this result, with a slight deviation from an orthogonal viewing axis. Also, frames seven and eight exhibit composite structuring from several (three or more) side-by-side magnets of square-end configuration, where the magnet cross section is wide, looking at the end. In that case, the top right picture would be elongated, giving a stretched hexagonal dense core surrounded by a concentric null zone of oval shape, further surrounded by a concentric thin emission zone of oval shape. In frames seven and eight, the outer thin emission zone is roughly spherical, not oval. However, a combination (further composite) of the lower right picture case and the upper right picture case could give the pattern exhibited by frames seven and eight.

And as I show clearly elsewhere, orthorotated hyperfield energy usually emerges with a "burst-in" effect which, in free space, assumes a spherical shape. Thus one would expect a dynamically bubbling sphere of light at the initial "burst-in" of the phenomena, and frame two exhibits this effect.

So the expected hyperfield generation of photon patterns about a localized region of magnetic field (such as a bar magnet or composite grouping of bar magnets), when that localized region of field is in the collection or burst-in and decay gradually mode, would account precisely for the particular structured patterns photographed by Vestigia.

Again, this does not prove the hyperfield hypothesis, but shows that the structural patterns obtained are consistent with it.

HYPERFIELD CIRCULATION PATTERNS ABOVE A MAGNETIZED RAILROAD TRACK

Figure 1 shows the hyperfield circulation patterns above a magnetized railroad track. The general setup of the Vestigia experiment is shown. The rails are oriented parallel to the fault line, which means that the rock stresses are oriented perpendicular to the rails. Thus the telluric currents piezoelectrically induced by the quartz and other minerals in the local granite are also generally oriented perpendicular to the rails and below them.

These piezoelectric currents thus constitute effective coils about the rails, magnetizing them weakly along their length, but this is in addition to their normal magnetism, if any, picked up due to the specific local and atmospheric electricity changes.

In the hyperfield flow pattern for two magnets which are lengthwise parellel and viewed from the end, a primary hyperfield circulation pattern exists both between the two rails and in the air above them. The location is the same, whichever end of the parallel magnets one looks into; however, the circulation direction changes with the change of ends. As the strength of the magnetization of the two magnets changes, the vertical distance above the rails to the plane of the center of the hyperfield circulation pattern (primary) changes. The stronger the field, the higher the center of the pattern, and vice versa.

In addition a secondary (weaker) hyperfield circulation area exists over both rails as shown. As the piezoelectric currents fluctuate in direction and intensity, corresponding fluctuations in the magnetization of the two rails occur.

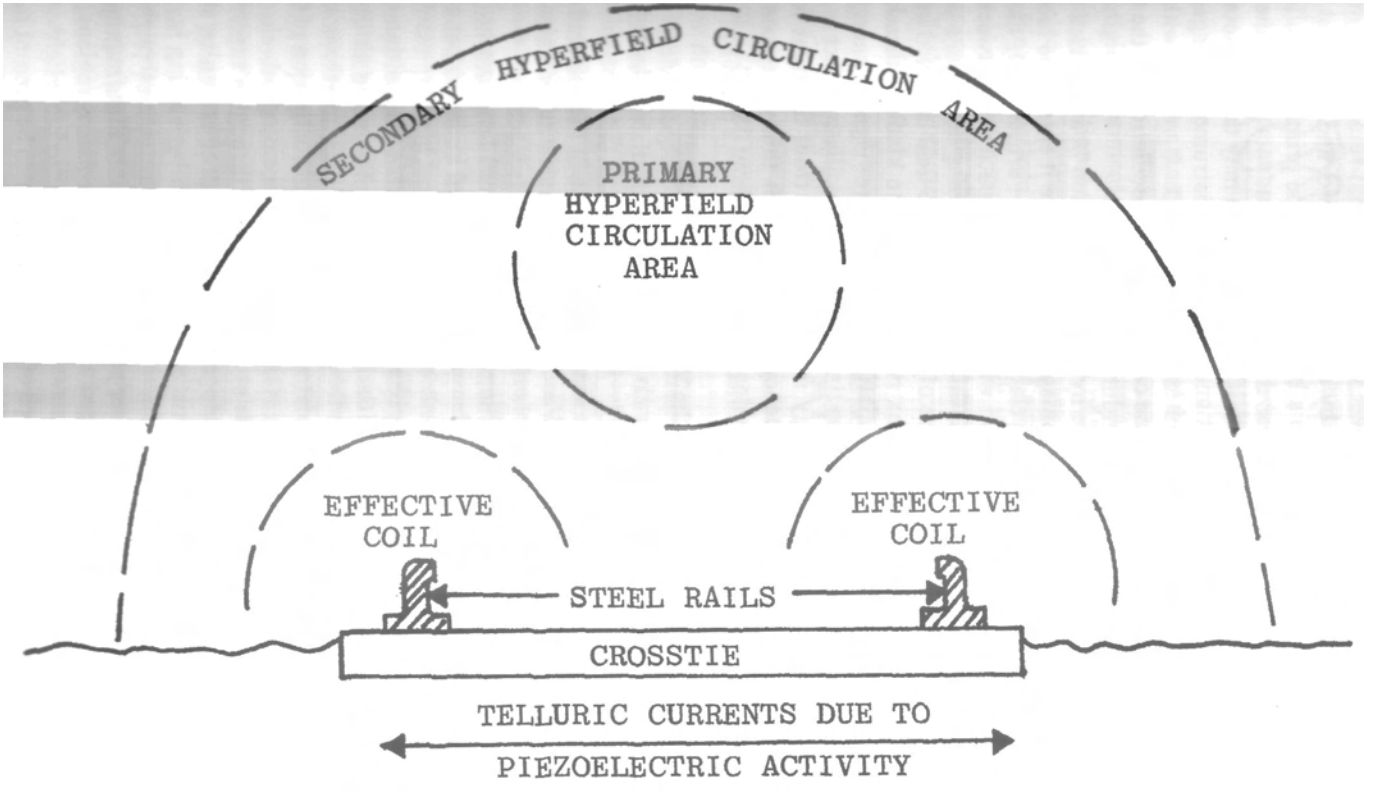

Fig. 1. Hyperfield circulation patterns above a magnetized railroad track

Thus, over the rails there exists a sort of undulating tubular tunnel of primary hyperfield circulation, surrounded by a larger undulating tunnel of half-elliptical cross section. In addition, the terrain and foliage features nearby will have their own hyperfield circulation areas, with flowing currents of hyperfield circulations between them and undulating tunnels over the rails. The final result is a complex flow pattern, which is further modified by atmospheric, ionic, and electrical currents. So a mystery light can kindle into a burst in one of the primary circulation areas and move, usually in a faltering or drift-dart-pause manner, along the undulating tunnels above the railroad track. Structural changes may then be noted as the geometrical aspect between the light and the observer-instrument changes, as additional collection-kindling occurs, and as discharge dampening occurs with the passage of time, due to the discharge time constants of the oscillations of the time dimension itself that are induced by kindling and burst-in.

Note that in the kindling process, the hyperfield circulation in a localized area suddenly bursts into magnetic or electromagnetic field. Since it enters the laboratory frame at right angles, orthogonal relationships result. Furthermore, the appearance of a kindled magnetic field form will change the capacitance between the rails, and a capacitance test will indicate this, as if a conducting body were there. The localized magnet or geometrical piece of electromagnetic field is locked in and maintained as long as the hyperfield flux remains above the kindling threshold. However, since the burst-in of the hyperspatial flux into electromagnetic energy involves the shocking into oscillation of the time channel, an oscillator effect is produced, and electromagnetic signal energy may be radiated from the light form, usually through one of the magic frequency windows which thinly interconnect orthogonal three-spaces. One of these windows is located at about 38,000 to 40,000 Hertz.

Such a signal was indeed recorded in the Vestigia experiment.

Also, at night time the time channel quenching effect of visible light is materially reduced since most visible light is absent. Further, the light-shielded quartz in the underground rocks has two magic windows: one in the infrared and one in the ultraviolet. So the area of the Vestigia experiment constitutes a gigantic kindling mechanism par excellence. With sufficient piezoelectric activity, the collected hyperspatial flux exceeds the kindling threshold required for burst-in, and localized triggering of a discharge or discharges can be initiated in the proper area. The thousands of feet of wire further enhance the collecting and kindling mechanisms. From a physics viewpoint, the living observer is the initiator who initiates the collapse of the wave function, in turn initiating observation. The same ability or property also is required to initiate the kindling of hyperspatial flux into the normal three-space, in my opinion. This is consistent with the rather wide collection of data presented here to show that a living observer can generate or extinguish electrostatic, magnetic, and electromagneic fields at a distance, even through a superconductive farraday shield. The thought photography examples presented also show that electromagnetic field (light) can sometimes be generated by a living human being, and impress the camera film with the visible light spectrum, even though the light is not consciously seen by the observer's eye. It also appears that frequencies of something other than light, in the infrared and ultraviolet frequency regions, can enter through IR/UV windows and then rotate into the ordinary visible light spectrum and ordinary visible light energy. Such effects also appear to be present in the

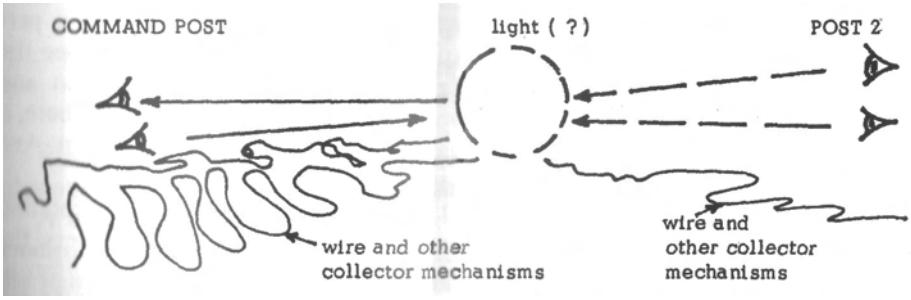

Fig. 2. The cyborg effect and orthorotational sensitivity

Vestigia experiment, since the cameraman himself saw no light, but other posts did. Thus an additional directional effect of the rotation into visible light seemed to be involved.

Since so-called thought energy is simply hyperspatial flux which has a minute one-to-one coherence in its crosstalk with the laboratory frame, the section explaining thought photography deals with hyperspatial mechanisms that are also applicable to mystery lights.

THE CYBORG EFFECT AND ORTHOROTATIONAL SENSITIVITY

In Figure 2, I show how it is possible that one team sees the light and a second team does not.

In the inceptive cyborg effect, each person, each instrument, the wiring, other collectors including the sensors, the other paraphernalia of the environment such as railroad tracks, rocks and their minerals, etc. are all cyborged together into a single instrument in the hyperfield domain. This is precisely because the hyperfield domain is the time channel, and all of these exist at the same time. Further, in the experimental locality, the difference in time between observers, equipment, devices, and aspects is small, because the distances between pieces are relatively small. Hence to the hyperfield channel an appreciable degree of coherence exists between the various components of the hypersensory cyborg. Yet the overall pattern of coherence has high points and lower points in it, and pattern groupings that vary with the grouping of components. Thus the subgrouping at the command post, for example, may be expected to differ in its hyperfield characteristics from the subgrouping at Post 2. Furthermore, the bulk of the collection wiring, and the rails, were outside the command post, so the greatest collection might be expected at this station.

In addition, the human components of the subgroupings vary appreciably in their sensitivity to hyperfields. Some persons are more positive or attuned than others, particularly in their unconscious minds. In fact, some persons are quite negative and are squelchers of the hyperfield effects — the negative psi effect is well known in experimental parapsychology. However, it is reasonable to assume that there were no psi-negatives on the Vestigia experiment; but there was probably an

appreciable variation in the degree of psi-positive exhibition in the various personal unconsciousnesses. So it is understandable that one post may not see the light, while another would. And with the appreciably greater collection and kindling outside the command post, we would expect the sighting to occur there, if anywhere, as long as a real psi-negative was not present in the command post. And the experiment seems to have exhibited this effect as expected.

Also, I must point out that the visual mechanism for detecting orthorotating energy is different from that for detecting normal visible light, unless the orthorotating hyperenergy is extremely strong and overrides the squelch effect of normal light. (At night the degree required to go into visible light is less.) At any rate, the orthorotational hyperfield energy comes in through the infrared and ultraviolet windows for the most part, and then orthorotates into the visible light region, changing its frequency as it is absorbed by or interacts with a receiver.

Further, the orthorotational energy does not travel through three-dimensional space in the accepted sense that a signal normally does; rather, it is entering this three-dimensional space all at once from a region orthogonal to the entire three-space. It is therefore entering all components of the tuning-receiving instantaneously and simultaneously, or holographically, if one extends the term. Each subgrouping component of the cyborg exerts its own tuning-damping constant(s) upon this holographic signal entry, giving differing degrees of receptive sensitivity, or signal strength, or signal to noise ratio.

So the signal enters each part of the cyborg holographically and the reception characteristics of that portion dampen or enhance the degree of orthorotation into the normal electromagnetic field. Further, the actual orthorotation into the electromagnetic field is occurring primarily at the actual sensor.

For a human being, the primary sensors are the retinal surface of the eye and the skin. The retina is actually a complex structured piece of the brain, so to speak, and extensive nervous system complexes are located there which do extensive on-site signal processing. The unconscious mind of the individual directly interacts at the retina with signals received by the retina, either by hyperspatial orthorotation or by ordinary light. So the individual nervous system is highly variable in its interactions with the hyperfield energy that is orthorotating into ordinary electromagnetic energy in the interaction itself. Briefly, the unconscious state of the observer partially shapes and forms the observed.

In a camera, the sensor is the film. It is thus entirely possible for a camera to record light energy that is holographically rotated in from hyperfield energy without the cameraman himself seeing anything at all. This is especially true when the camera film is sensitive to infrared and ultraviolet to an appreciable degree. A camera containing infrared-sensitive film will interact readily with hyperfield energy because it is open in the magic window between orthogonal frames. A camera containing ordinary film, which is less sensitive to infrared, will interact much less in the magic window because it barely extends into it.

Thus, with other variables held constant, one would expect the infrared camera to record hyperfield energy to a much greater degree than the camera containing ordinary film, and indeed the Vestigia experiment has demonstrated this effect.

Furthermore, the experiment exhibited heightened kindling and collection outside the command post due to the distribution of wiring, components, and rails.

ADDITIONAL FACTORS CONSISTENT WITH THE VESTIGIA EXPERIMENT

First, a cooling effect is often associated with the appearance of paranormal phenomena; this effect is well documented in the literature.

A corollary effect also exists when hyperfield energy is being collected and kindled. Just as lowering the electronic noise in an amplifier increases the fidelity of the signal, lowering the local environmental temperature reduces the "noise" that is blocking the collection and kindling of hyperfield energy. Specifically, reducing the temperature reduces the photon emission and absorption activity of the environment. This lowers the background electromagnetic noise which inhibits orthorotation of the hyperfield energy into electromagnetic field energy. Since photon activity is reduced, the consequent photon squelching of the time channel (precisely detailed elsewhere in this book) is also reduced. This in turn lowers the threshold required for kindling to occur.

Also, a Geiger tube often acts as a collector and amplifier of bioenergy and hyperfield energy. (The association of Geiger counter readings with UFO phenomena has been frequently noted in the literature.)

The Geiger tube may become a detector of hyperfield energy, because the tube's kindling threshold may be significantly lower than that of the environment or of other components such as the observer's eye. Kindling across the Geiger tube's lower threshold simply creates an electrostatic field inside the gas in the tube. In fact, it is the potential ionic current that is the collector, since hyperfields accumulate along probability paths as well as along observationally determined paths, communicating with both future and past. At any rate, the kindling of an electrostatic field in the Geiger tube may result in ionization of the gas if the field is of sufficient intensity. An avalanche discharge may occur and the Geiger counter may indicate a reading (usually appreciable or full scale). This may occur even though no visual phenomena are seen and even though other sensors receive no indication. This reading of the Geiger counter is of course not due to radioactivity. A Geiger *counter does not indicate radioactivity;* rather it indicates appropriate ionization of its internal gas. In this case, the kindling of hyperfield energy into electrostatic field occurred, generating the ionization in the Geiger tube gas.

Note that this occurred in consonance with the visual sighting and the infrared film photos, and when no visual sighting resulted and photos were not taken. Furthermore, as I point out elsewhere, the kindling and burst-in of energy has a discharge time constant, due to the discharge time constant of the oscillation of time that occurs at kindling and burst-in. Depending on the initial amplitude of oscillation at burst-in, the time required to lower the burst amplitude to kindling threshold and below varies. When the amplitude drops below the kindling threshold, kindling and burst-in cease and the hyperfield-induced electrostatic field in the Geiger tube vanishes, stopping the hyperfield-induced ionization of the gas in the tube. The Geiger counter reading then drops back to normal background reading.

The variable amplitude at burst-in and the consequent variation in the time required for the Geiger counter to cease reading the hyperfield-induced ionization were demonstrated in the Vestigia experiment. Furthermore, the Geiger counter

showed a reading twice when visual phenomena were not seen and cameras did not record. Of course, no photos were taken during the Geiger counter readings.

Finally, the drop in barometric pressure also lowers the molecular collision activity of the local atmosphere, and lowers the rate of production of collision ions, electric currents, and photons induced by the collision activity. This reduces the electromagnetic noise, which is squelching the collection mechanism and raising the kindling threshold. It reduces the kindling threshold, making orthorotation of hyperfield energy into electromagnetic-electrostatic-magnetic field energy easier.

Thus, according to hyperfield theory, the major features of the Vestigia mystery light experiment are seen to be within normal expectations. Again, this does not prove the hyperfield-orthorotational hypothesis, but it is consistent with it and therefore constitutes an important piece of evidence for the theory.

Also, I should stress that the piezoelectric theory is in fact included in the hyperfield theory, and is a vital part of it. In other words, the hyperfield theory is an extension of the piezoelectric theory, and in my opinion the extension is necessary if the piezoelectric effect is to fit the experimental results. There are no contradictions between the two theories since one is merely an extension of the other.

REMOTE VIEWING

In a classic series of carefully controlled experiments at SRI International, physicists Hal Puthoff and Russell Targ have shown that the human mind can produce evidence of its ability to see at a distance, and also to anticipate the future.

In their protocol one experimenter goes to a distant target, which is selected randomly for him en route, and a subject in the laboratory tries to describe the target scene, both orally and by sketching on paper. The experimenter in the field uses a random number generator to select one sealed envelope out of a group held by a controller accompanying him. The selected envelope is then opened, and that target becomes the target for the experiment. The targets are preselected with rigorous protocol by a group not involved in the experiment.

In the experiment shown here, the target selected was a rather unusually shaped playground merry-go-round, with handrails made of bent pipes, as shown in the two photographs. The laboratory subject, in addition to describing the scene verbally, made the sketches shown at the right. As can be seen, the channel is noisy, but there is definitely signal in it.

Puthoff and Targ also obtained some of the best experimental results when the laboratory subject was asked to describe the scene which the field team would see in the future, the target selection via random number generator not yet having been made. A wide variety of subjects — including persons hostile to parapsychology — were used by Puthoff and Targ in their experiments, with good results.

Each particle of mass in our bodies represents one closure of the entire universe — yielding a holographic reality — and deeper communication with ourselves is identical to communication with the universe, including any part of it, at any distance. Furthermore, in hyperspace the future and the past are all present. Since a particle does indeed exhibit a four-dimensional component for 1/137 of the time, each particle does connect to the future and to the past. With selective tuning

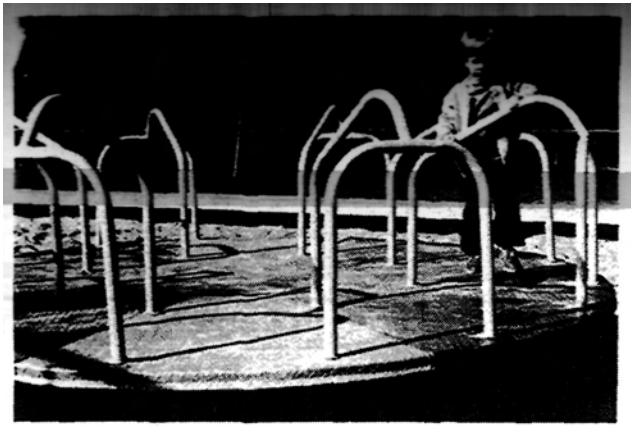

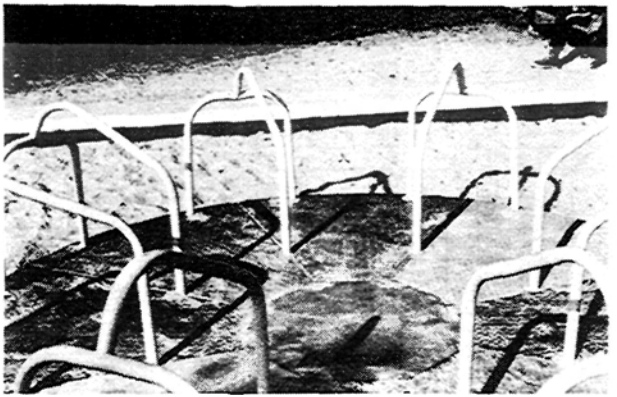

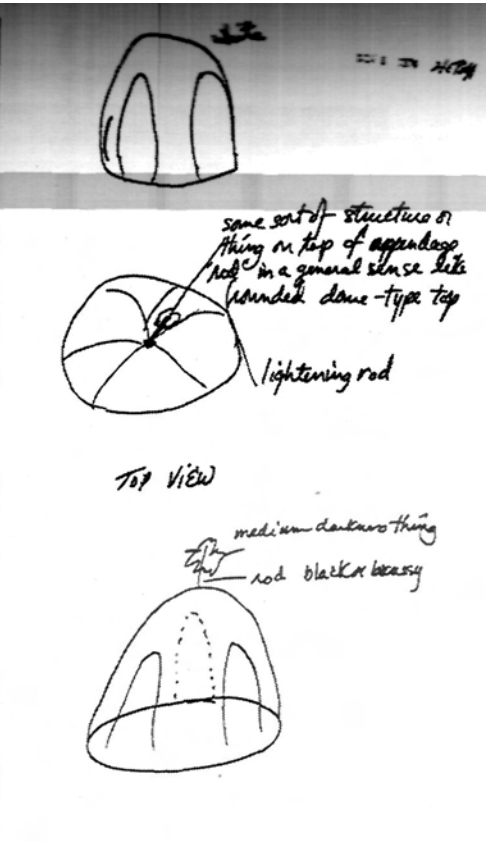

Target: Playground Merry-Go-Round. Responses.

Photo 3. Remote viewing.

and kindling any part of this holographic reality is accessible. However, because of the smallncss of a single selective signal in the midst of the totality, the channel is quite noisy. For this reason skilled psychics ~ persons who have been found to have a greater fidelity of selective tuning - can be expected to produce better results than the normal person.

Puthoff and Targ's results have also been successfully repeated by other experimenters.

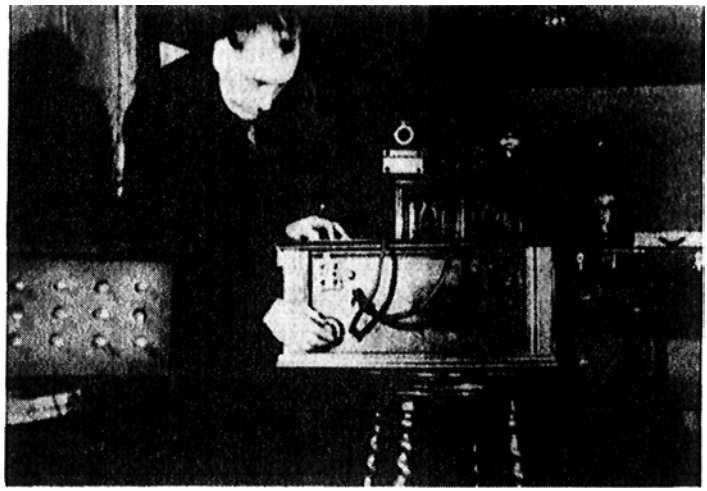

T. Henry Moray makes some final adjustmonts In tuning his radiant energy device to tap zero-point vacuum energy.

THE MORAY RADIANT ENERGY DEVICE

In the early 1900's, Dr. T. Henry Moray of Salt Lake City produced his first device to tap energy from the metafrequency oscillations of empty space itself. Eventually Moray was able to produce a free energy device weighing sixty pounds and producing 50,000 watts of electricity for several hours. Ironically, although he demonstrated his device repeatedly to scientists and engineers, Moray was unable to obtain funding to develop the device further into a useable power station that would furnish electrical power on a mass scale.

As a boy, Moray had been deeply inspired by the greatest electrical genius of all time, Nikola Tesla. His imagination was especially fired by Tesla's claims to have knowledge of an energy source greater than ordinary electricity, and by Tesla's emphasis on frequencies as the stuff of the universe. When Moray finished high school in Salt Lake City, he went abroad to study, and took resident examinations for his doctorate in electrical engineering from the University of Uppsala, Sweden, during the period 1912—14. Returning home, his diploma and credentials were interrupted by World War I, and the University mailed him these items in I918 after the war.

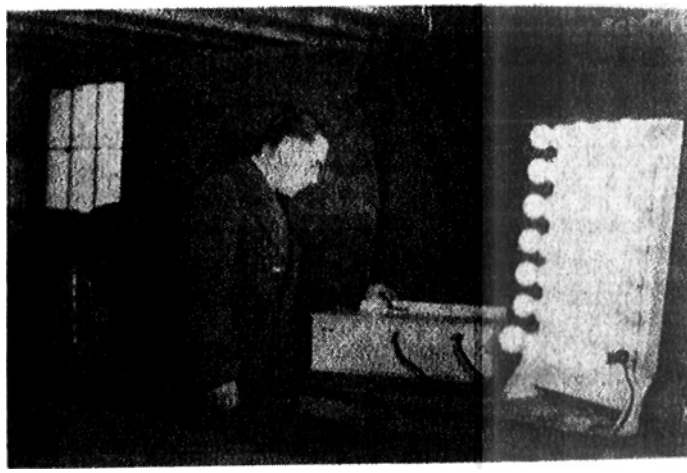

Here **the** Moray radiant energy device is providing free power to 35 100-watt lamps and a 1200-watt Iron.

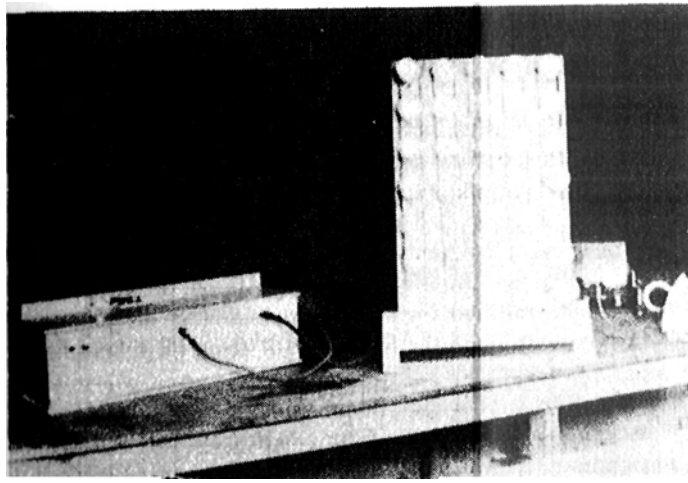

Once tuned in, the power continues and is free for the taking.

Photo 4. The Moray radiant energy device.

Shortly thereafter, Moray produced his first elementary device that delivered measureable electrical power, and he continued to work diligently on energy devices when he had time. In the 1920's and 1930's he steadily improved his devices, particularly his detector tube, the only real secret of the device according *to* Moray himself. In his book, *The Sea of Energy in Which the Earth Floats,* Moray presents documented evidence that he invented the first transistor-type valve in 1925, far ahead of the officially recognized discovery of the transistor. In his free energy detector tube Moray apparently used, inside the tube itself, a variation of this transistor idea — a small rounded pellet of a mixture of triboluminescent zinc, a semiconductor material, and a radioactive or fissile material. His patent application (for which a patent has never been granted) was filed on July 13, 1931, long before the advent of the Bell Laboratories' transistor.

In test after test Moray demonstrated his radiant energy device to electrical engineering professors, congressmen, dignitaries, and a host of other visitors to his laboratory. Once he even took the device several miles out in the country, away from all power lines, to prove that he was not simply tuning in to energy being clandestinely radiated from some other part of his laboratory. Several times he allowed independent investigators to completely disassemble his device and reassemble it, then reactivate it themselves. In all tests, he was successful in demonstrating that the device could produce energy output without any appreciable energy input. According to exhaustive documentation, no one was ever able to prove that the device was fraudulent or that Moray had not accomplished exactly what he claimed. On the other hand, the records are full of signed statements from physicists, electrical engineers, and scientists who came to the Moray laboratory as doubting Thomases and left with the complete conviction that Moray had indeed succeeded in tapping a universal source of energy that could produce free electrical power.

But in the face of all of this, the U.S. Patent Office refused to grant Moray a patent, first, because his device used a cold cathode in the tubes (the patent examiner asserted it was common knowledge that a heated cathode was necessary to obtain electrons) and, second, because he failed to identify the source of the energy. All sorts of irrelevant patents and devices were also presented as being infringed upon or duplicated by Moray's work. Each of these objections was patiently answered and nullified by Moray; nonetheless, the patent has still not been issued to this day, although the Morays still keep the patent application current.

One of Moray's efforts to develop the machine involved an association with the Rural Electrification Agency for a short time before World War II. At that time, the R.E.A. was apparently infiltrated by Communist sympathizers and high level officials of a decidedly pinkish tinge. These officials continually urged Moray to turn over all details of his device to the Soviet Union, and even arranged the visit of high-level Soviet scientists to the Moray laboratory to see the device in operation. On the initiative of the Communist-infiltrated R.E.A., one person — let us call him "Z" — spent about two months in Moray's laboratory, and succeeded in worming his way into Moray's full confidence. Moray eventually disclosed most of the details of the construction of his special valve to "Z" — the only person in whom Moray ever completely confided.

There is strong reason to believe that "Z" was a Soviet agent, and that this is

where the Soviets first obtained the impetus to develop the hyperspace amplifiers later used in their psychotronic weapons.

However, Moray became quite alarmed at the continued attempts of his R.E.A. contacts to get the device into the hands of the Russians. He eventually concluded that he had become involved with a governmental group filled with radicals and reactionaries. Moray became concerned that fifth column activity was actually directed against him in an attempt to steal his device. Quotes from the *Salt Lake Tribune* of December 2, 1941, attributed to Representative Thomas D. Winter, imply that Moray's suspicions of the R.E.A. were well founded, since Representative Winter called for a full-scale investigation of the R.E.A. on the grounds of Communist infiltration. Indeed, Moray was wounded by gunshot in his own laboratory on March 2, 1940, which seems to suggest that his fears and suspicions were based on fact. Moray severed his association with the R.E.A. in February 1941.

However, his basic unit had been destroyed by a hammerslinging witness in 1939; it is not clear whether or not this was the work of "Z" or of someone else. According to his son, John Moray, the man who broke his unit, as well as other interested groups, wanted complete disclosure of the materials and construction - nothing more or less. John Moray, who operates the Research Institute in Salt Lake City, has been trying to continue his father's work since the basic unit was destroyed. Dr. Moray himself died in May 1974.

According to John Moray, highly energetic cosmic rays from space are tapped by the machine, which is in subharmonic resonance with this high-frequency energy level, and it converts this energy level into a usable form of electricity. However, John Moray's use of the term "cosmic ray" is not necessarily the same as that of modern physics, but in fact is the same as the present concept of "zero-point" energy of vacuum. T. Henry Moray envisioned all space filled with tremendously high frequency vibrations carrying vast and incalculable amounts of pure raw energy. He envisioned the dynamic universe as a turbulent source of great energy, just as the ocean waves carry energy throughout the earth. This was also the vision of Tesla, and after him of Clifford and Einstein, who turned the attention of general relativity to the problem of the nature of the vacuum itself. Clifford and Einstein founded a branch of physics that has come to be known as quantum geometrodynamics, the study of energetic change that occurs in little pieces, including the concept that very small lengths of space, or pure vacuum, themselves oscillate at great frequency and with great energy. In Moray's day relativity was still a strange and unproven branch of physics, suspected and rejected by most of the physicists of the day, and quantum physics was still in the process of being worked out. There was no theory whatsoever predicting that empty space itself not only contained prodigious quantities of energy, but in fact *was* prodigious quantities of energy. But slowly, over the decades, the picture has changed, and the modern followers of quantum geometrodynamics assert the truth of Tesla's original vision. Today we know that one cubic centimeter of pure vacuum contains enough energy to condense into 10^{80}—10^{120} grams of matter! Thus the major part of Moray's thesis — that vacuum itself contains unlimited energy — is vindicated today. In this sense empty space is like a gigantic, restless ocean, and Moray's free energy "tapping" device is no more mysterious than the water wheel. In other words, his thesis that the energy is there to be tapped is correct; it only awaits a practical

method to tap it in order to solve the energy problems of mankind forever.

Moray thus is vindicated as a man ahead of his time, who simply built a device before any theory existed to explain its operation. Moray met with constant opposition, and his life and that of his family was anything but pleasant. Certain pressure groups constantly tried to force him into selling for almost nothing, or to disclose the secrets of his valve's construction. He was often attacked and he was sometimes shot at on the city streets. In fact, his life was threatened so often that he was forced to install bulletproof glass in his automobile. His laboratory was broken into, some of his components and papers were stolen, and his dogs were continually being killed. Moray was shot in his own laboratory, and he himself always carried a gun. Because he was harassed ceaselessly, over the years he became understandably suspicious and close-mouthed about his work. He sometimes greeted visitors at his desk with a loaded pistol lying on the desk within easy reach, and occasionally confirmed that he would not hesitate to shoot if he were attacked or threatened. One of his greatest fears was that big interests would take up his invention and simply shelve it to keep it from benefiting the public. When large companies made him offers, he always demanded written guarantees that the device would be put into production and sold to everyone, once it was developed.

Moray also realized the potential of his device as a weapon. He was fully aware that the only difference between a controlled energy device and an explosion is the rate of release of the energy. According to John Moray, his father received an offer to go to Japan in 1938 because he had built a deathray which operated off the device. According to John, a representative of the Japanese government came to the laboratory and offered a position to Moray, but he refused. Allegedly Moray had managed to rig the device so that it projected a ray of energy in a beam, and could kill mice instantly at over fifty feet. When radiated by the beam, the mice were carbonized immediately. They appeared frozen, but nothing was left except their shells, and they simply fell apart when touched.

In one experiment Moray ran his device for 157 hours without any connection to external power sources, and produced over fifty kilowatts of power during the test. He also found that an additional fifty kilowatts could be added by simply providing another tap further back in the circuit. When he shut the device off from this test, he had proven once and for all that the device was generating electrical energy from free and natural sources without batteries or external power. During this test nothing in the machine heated up; instead, all parts of the circuit ran absolutely cold. This alone is totally unexplainable by ordinary electromagnetic theory, and it strongly implies the truth of Moray's assertion that the device simply collects the energy in each of its stages in a subharmonically resonant manner, in synchronization with the extremely high frequency cosmic oscillations. In other words, since the parts of the machine ran cold, it is clear that the energy was being simultaneously collected at each stage rather than being processed through the individual stages in serial order, since serial processing in the conventional electrical sense would lead to resistance heating of the circuit elements.

Moray's device used twenty-nine stages of his special detector valves, which were difficult to produce, costing about five hundred dollars each. Only about one in four proved suitable for operation. He also had difficulty in obtaining sufficiently pure materials to make his special mixture for the pellet that enabled tube operation in a one-way gating fashion. Moray explained that his device was based

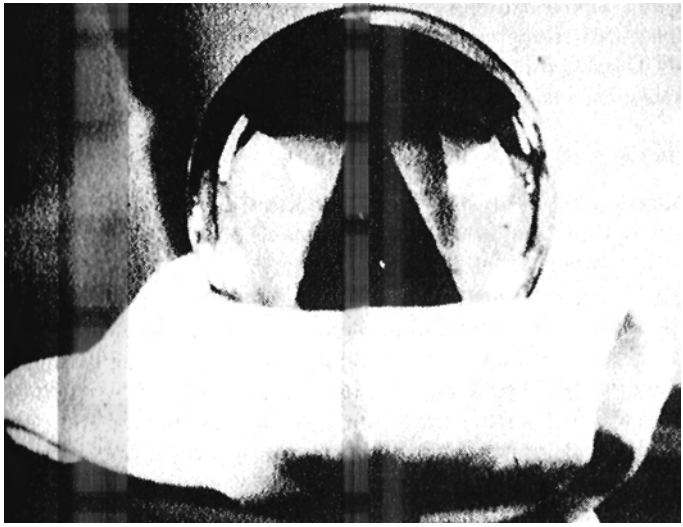

Photo 5. An Atlantean power crystal?

on the discovery of a mixture that would act as a one-way gate for the high frequency oscillations of space, so that the energy could go through the material more readily in one direction than another. Thus it was like a one-way gate valve to an ocean wave; the energy "water" could flow in in each valve, but was prevented from flowing back out. The assemblage of multiple stages thus provided a series of collectors which contained enough energy to be useful. Theoretically there was no limit to the number of collectors that could be added, and so there appeared to be no limit to the energy that such a device could produce.

AN ATLANTEAN POWER CRYSTAL?

The next two photographs are of a most amazing quartz crystal sphere removed from a chamber in a pyramid underneath the surface of the ocean in the Bermuda Triangle. Dr. Ray Brown purportedly removed the object in a dive while treasure-hunting with several friends after a storm had stirred the sandy ocean floor in 1968. Brown describes how he swam into a chamber in the pyramid after swimming around it three times, and how he saw seven stone seats surrounding two handlikc stone holders for the crystal in the center of a table or dais, with a two inch metallic rod running down vertically from the roof of the stone chamber and pointing directly at the crystal. Brown plucked the crystal from the holder and ascended to the surface; he found that his companions had brought some nonoperative objects to the surface which appeared to be some sort of strange electrical apparatus.

Brown himself had a strange foreboding and a strong impulse against returning to the site, and so he refused to do so. Three of his companions reportedly returned at a later date, and their boats were found floating abandoned in the Triangle. The three men were never seen again.

The crystal does indeed have some strange properties. In the first picture one can clearly see a very sharply outlined, pyramid shaped inclusion inside the quartz. The pyramidal inclusion is dark, but the crystal is absolutely clear. However, the second photo shows that the quartz is milky when seen from a different angle. Here three pyramids can be seen.

Other objects have been seen and photographed in the crystal from time to time. In *The Pyramid Guide,* Vol. V, No. 4, there is a photograph of the crystal showing a very distinct, humanlike iris and eyelid appearing in it, making it resemble nothing so much as a giant human eye. In that photo the three pyramids are not visible.

While I have not personally investigated the crystal and examined it in detail, some general remarks can be made. (1) Brown reported finding the pyramid after a huge storm had stirred the ocean, including the ocean's sandy bottom. This had revealed outlines on the bottom resembling buildings, which had attracted the attention of the treasure hunters. (2) Such a storm, over the ocean's great water mass, is an excellent kindler of bioenergy. In other words, Brown and his companions were definitely in a place which should have had an enormous kindling of bioenergy from the biosphere and the collective human unconscious. (3) Sufficient publicity has been given the Bermuda Triangle's mysterious disappearances to have its alleged ability to open a window between worlds implanted deeply into the unconsciousnesses of a large number of persons. (4) Brown was with a group of persons who were sharing the same sensations with the storm and surrounding area, so there was sufficient coherence of their personal unconsciousnesses to accomplish at

least some degree of tuning. (5) The legends of Atlantis were in a great revival period in the late 1960's from the popularizing of Edgar Cayce's work and other material, as indeed was the Egypt/pyramid/Atlantis mythology in general.

So conditions were very ripe for a tulpoidal contact (see Part Two) of extensive magnitude — perhaps even to the point of tuning in the ruins and pyramid for a period. Brown also reported sensing an omniscientlike presence, which is symptomatic of many such tulpoidal contacts or materializations.

In such a case, Brown could have actually swum into such a pyramid that had materialized from the collective unconscious — which after all has the psychokinetic power of Uri Geller times ten to the four billionth power or so, and which largely maintains the format of our physical reality in the first place. The collective unconscious has no difficulty in creating even many alternate worlds or materializing and dematerializing entire areas, let alone in producing a single pyramid and a ruined city.

Brown's action in plucking the crystal out of its holder and swimming back to the surface would also have constituted a tuning/kindling which was "returning with the crystal into the normal world" — in which case it could have been tuned into complete stability so that it would endure, rather than fade away as do most tulpoids.

Until we have developed psychotronic instruments to scan the crystal and reveal its true story, we cannot say for certain that any of the above actually happened, and that some sort of delusion or fakery was not involved. The point is, it could have happened just as Brown reported it, in the theory I have constructed in the second part of this book.

Until we free our minds from the present bias that physical reality is always permanent and unchanging, we shall never be able to adequately investigate such phenomena as Brown's strange crystal.

THE CRYSTAL SKULL

It appears that at least some of the ancient peoples understood certain aspects of psychotronics and even possessed some psychotronic devices.

An example of such a psychotronic device is shown in the next two pictures, reprinted here with the kind permission of Bill Cox, from *The Pyramid Guide,* No. 17, May-June, Vol. Ill, No. 5.

To quote directly from *The Pyramid Guide:*

> **These are two views of the famed crystal skull... completely hand-formed, possibly centuries in the making from a single block of hard quartz crystal. It was recovered from beneath the altar ruins, within the jungle-covered, 7 1/2 acre citadel of the ancient Mayan city of Lubaantu'n by explorer F.A. Mitchell-Hedges in 1927. A several-stories-high pyramid was also found within the citadel complex. The skull, possibly of Atlantean and/or Babylonian origin may have been brought to the Americas by the Phoenicians around 1,000 B.C. Frank Dorland says historical records suggest the skull may have been held in the London inner-sanctum of the Knights Templar prior to the Holy Wars. The high priests probably executed ceremonial magic with the skull; a ribbon-like prism in the cranium acts as a magnifier. Hollow light pipes projecting upward from the base permit light reflections from the eye-sockets. The moveable jaw easily coordinated motion with speech. Lesser quality crystal skulls exhibited in the British and Paris museums, and miniature versions, lack the Mitchell-Hedges skull's brilliant craftsmanship**

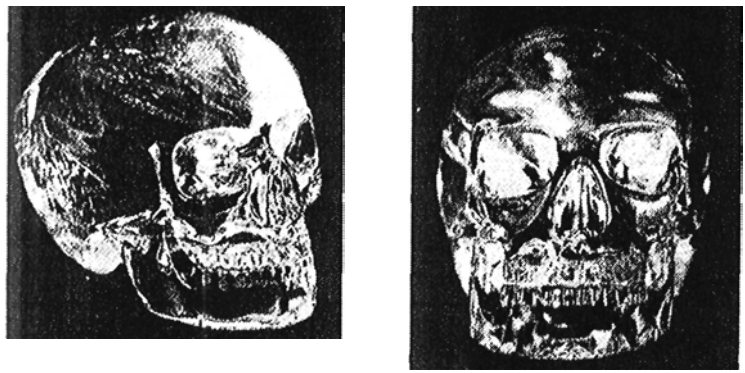

Photo 6. The crystal skull.

Two views of the famed crystal skull. Completely hand-formed, possibly centuries in its making from a single block of hard quartz crystal. It was recovered from beneath the altar ruins within the jungle-covered seven-and-a-half acre citadel of the ancient Mayan city of Lubaantu'n by explorer FA. Mitchell-Hedges in 1927. A several-stories-high pyramid was also found within the citadel complex. The skull, possibly of Atlantean and/or Babylonian origin, may have been brought to the Americas by the Phoenicians around 1,000 B.C. The high priests probably executed ceremonial magic with the skull; a ribbon-like prism in the cranium acts as a magnifier. Hollow light pipes projecting upward from the base permit light reflections from the eye sockets. The moveable jaw easily coordinates motion with speech. Lesser quality crystal skulls exhibited In the British and Paris museums, and miniature versions, lack the Mitchell-Hedges skull's brilliant craftsmanship.

One of the major African tribes is also reported to have once possessed such a crystal skull as a holy object and the center of their religion. Their skull was reportedly stolen by a white thief in the early 1800's,

So let us now discuss sonic of the peculiar properties of such a device.

First, quartz is a very hard substance and not easily worked at all. Making such a perfectly carved piece, with removable hinged jaw and eye lenses, must have consumed a tremendous amount of manual labor and considerable time, even centuries. Such an effort is not lightly undertaken; usually there is an overpowering reason for such persistence. In this case, there may well have been such a reason, and ancient priests may well have known it.

Quartz has magic qualities from a psychotronic point of view. It is open to both the ultraviolet and the infrared, and so it possesses two magic windows into the hyperframes, bioframes, orthogonal frames, and other realities. Since the third and higher bioframes (orthoworlds) are all mind worlds, quartz has open magic windows into the mind and mind energies. Thus Frank Dorland surmises correctly that the device can amplify and focus mental energies.

Furthermore, quartz is a piezoelectric crystal. Being crystalline, it possesses a lattice, a regular array of molecular stages. Thus it possesses a large number of identical stages, which is important for hyperchannel amplification.

Properly shielded against visible light, or in dim light, the crystal skull thus can function as a mental amplifier in the hands of a skilled user. Also, the quartz it piezoelectric; multistaged electrical piezoelectric currents are natural hyperenergy-hyperfield collectors, and under the proper conditions the quartz can produce heat and light, since collected hyperfield energy can be orthorotated into electromagnetic field by kindling. It can even produce these effects at a distance due to the hyperchannel circulation patterns surrounding a magnetic field or a localized area of magnetic field. The easiest place to produce effects with the skull would be inside another human head (in the brain).

So, in the hands of a skilled practitioner, the skull is (1) a collector of bioenergy, capable of turning this into electromagnetic energy and physical effects, (2) a form resonance inductor, i.e., a sort of super witness which matches the general shape of the human skull and is capable of resonating with a human skull (and thus with its contained brain) at a distance through hyperspace, and (3) a psychotronic device capable of producing psychotronic effects such as the augmentation of healing energy, psychic attack, telepathy, clairvoyance, precognition, and psychokinesis, where these initiative abilities are possessed by the user or practitioner.

Thus, in the hands of an adept, the crystal skull is indeed a formidable device, and one can well understand how the motivation existed to make it, even though its production may have taken centuries. Since in the ancient days knowledge was zealously guarded and usually incorporated directly into religion, such psychotronic artifacts as the crystal skull would have been regarded as the most powerful, hence the most sacred, of objects. One can therefore speculate that the elite of the elite of the priesthood were the only ones who knew of and were taught how to use the skull, and that this information was guarded extremely closely. The legend of such a skull existing as a central part of the religious magic of an African tribe is not beyond belief. Ordinary crystal balls, which are certainly made more easily, may have originated from the secret rites connected with the skull. An ordinary good quality, clear quartz crystal may well have been the substitute for priests who did not belong to the supreme inner circle, or the device used when a skull was not available.

I have seen at least one picture of an optical image which spontaneously formed in the crystal skull; the image closely resembled that of the Mayan astronomical

observatory at Chichen Itza.

To give a simple example of how the skull may have been used by a skilled priest, let us suppose the priest had an enemy he wished to disable or kill. With the proper psychic exercises he could have induced an increase in his own psychic energy. Then, using the crystal skull, he could simply have visualized the image of his enemy's face, and visualized the energy or light pouring into his enemy's head. The stability of the imagery is more important than effort of will.

At any rate, steady application of this imagery starts the bioenergy projection into the enemy's head and brain, and it collects there. Collection to the kindling threshold starts turning the bioenergy into electromagnetic field. At this point, a host of effects could be produced, depending upon the specific wish and induction by the priest. The effects include sharp pain (such as migraine headache); a leaden mass or frozen mind in which the brain activity itself is slowly frozen and stopped; the generation of a strong, overpowering emotion such as rage, hatred, panic, or terrible sadness; a sharp attack on the mind itself, as if a saw or knife were slashing a physical object to bits; numbness of the body or selected portions of it; interruption of the heart's functioning; kindling of the brain and nervous system into seizures, convulsions, or violent muscular spasms (capable of breaking bones); and an increase in blood pressure until the vessels swell and burst. In the hands of a priest who was strong in psychokinetic ability, this amplified ability would have been projected through hyperspace to the unfortunate victim's vicinity; objects such as stones could suddenly have levitated and hurled themselves at him, bushes and small trees could have enveloped him, etc. All in all, the skull can be used as a terrible weapon.

A few of these effects, and others I have not described, are presently in use by certain lunatic fringe groups in the United States; they use basic devices other than a crystal skull. I have been subjected to several strong attacks, and can vouch for their effectiveness if the target person is unskilled in shielding himself or evading such attack. In two cases I was nearly killed, and in a third case in substantial jeopardy.

Use of the crystal skull by a group of priests would give even more power, for from such a group the kindling level at which bioenergy orthorotates into electromagnetic field energy is much more easily approached. The inceptive power is of course usable for either good or evil purposes. Good purposes would include amplifying psychic healing; curing fevers and other infections; stopping internal bleeding; dematerializing growths and tumors; placing a person into deep anesthetic sleep so that a surgical operation can be performed; treating soil, seeds, or plants to assist sprouting and growth; treating emotional disorders with cancellation thought forms (contrary forms), and projecting them directly onto the unconscious to neutralize the disturbing form; and communicating telepathically at a distance.

A 300-year fabrication period is more credible if we recognize that the quartz crystal would have been usable from the beginning, just as is a crystal ball. So the high priests could have used the rare clear crystal (the skull is made from a single crystal), while priests recently initiated into the level that knew of crystal devices worked on it when it was not needed for use. Such a practice would explain why other skulls less finely worked have been found; these had simply not been as highly finished as the Mitchell-Hedges skull.

Furthermore, cutting off an enemy's head and exhibiting the skull was a common practice among many primitive tribes as a way of showing power. Crystal devices could have been used as a means of combining psychotronic effects with prevailing religious practice and beliefs. The fact that this eventually yielded a psychotronic amplifier of great power in the hands of a skilled priest would have led to the zealous guarding of the knowledge and the device from all but a very few of the elite.

METAL BENDING

The next remarkable sequence of photos from a Super 8 movie film taken by James Bolen, editor and publisher *of Psychic* (now *New Realities)* magazine, shows Israeli Uri Geller breaking a dinner fork in two through mind over matter. The fork, which Bolen personally verified as being intact before the demonstration, gradually becomes pliable at its midsection as Geller rolls his thumb and index finger over it. The fork finally breaks apart, the prong part clinging slightly to the handle just before it drops away, suggesting that the stainless steel momentarily became plasticlike.

Here the kindling is taking place in the nuclei of the metal atoms and also along the lines of field force in the bonding lattice. The protons in the nuclei may become quarklike due to partial extinguishing of the pions which create their electrical charges. The softening of the electrical field directly softens the ability to hold electrons and rearranges electron orbits. In addition, kindling is occurring in the orbital electrons, partially extinguishing their charge also. The overall effect is for the metal to become plasticlike as lattice bonds are severely weakened. For a metal break due to these effects, the metal in and near the fracture should show the results of severe electromagnetic fields at the localized level, e.g., as if subjected to intense heat from an internal laser action. This has indeed been found to be the case in other experiments, notably by Byrd and Franklin.

THOUGHT PHOTOGRAPHY: STELLA LANSING

Stella V. Lansing is a remarkable person who has captured a large number of authentic thought photographs on film, and in whose presence others often get thought photographs when they operate their own cameras. For several years her work has been investigated by the psychiatrist and noted researcher, Dr. Berthold Schwarz, who has published numerous papers in scientific journals on his studies of Mrs. Lansing. The late J. Dunninger also observed Mrs. Lansing's work and concluded that it was genuine, and that no magician could accomplish by sleight of hand or other trickery the remarkable results she obtained.

In Stella Lansing's photographs all the evidences and signatures of tulpoidal or thought energy kindling into the first biofield, electromagnetic energy (light), are seen (see Part Two). Typical, metallic-looking, clamshell, UFO-like images are often obtained, most often with several objects arranged in a clocklike circle symbolically: the unconscious may well be aware that the time channel is the paranormal channel, and symbolically express this in a clockwork pattern suggestive of time.

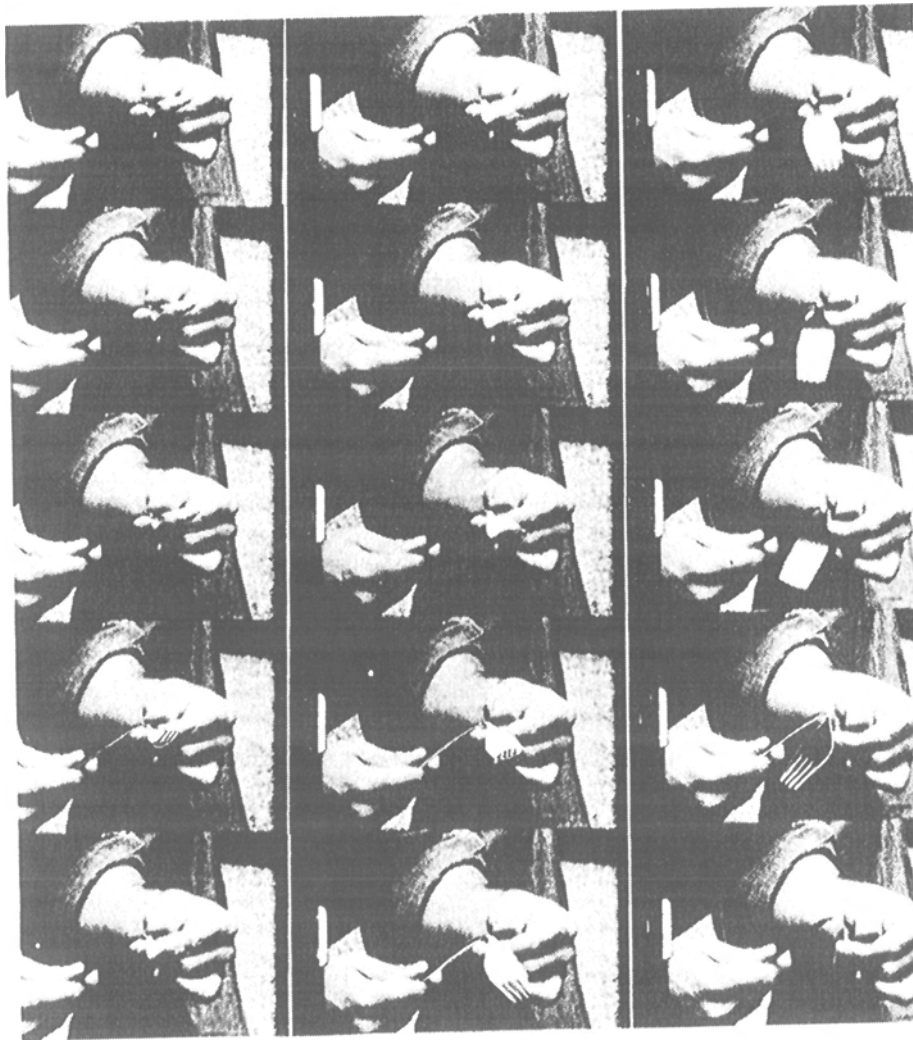

Photo 7. Metal bending.

Late evening clockwork pattern of "clamshell-like objects" obtained when photographing a church steeple.

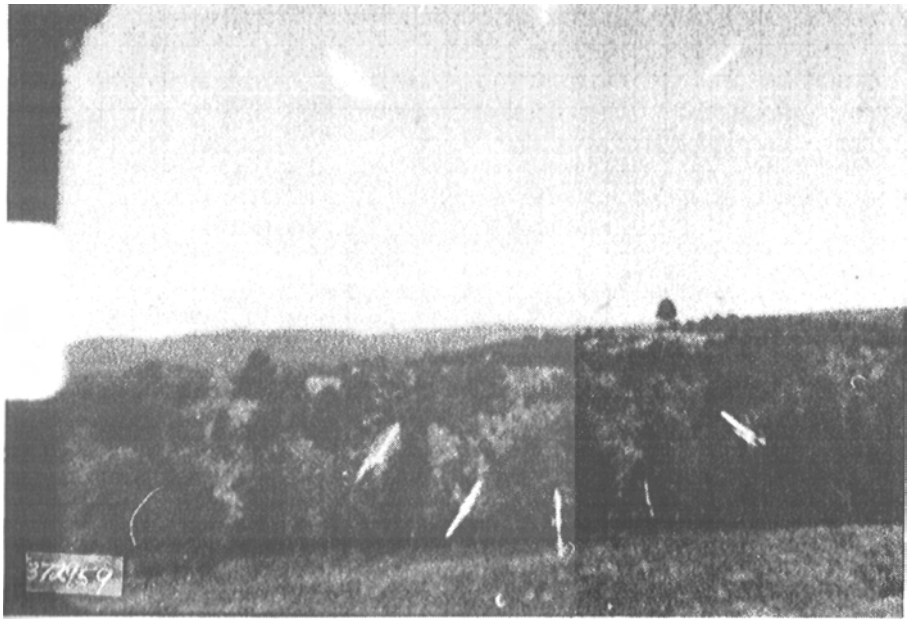

First daytime clockwork pattern, Route 47, Amherst, Mass., September 1972.

Photo 8. Clockwork patterns.

Just as Geller and Kulagina have been noted to transfer psychokinetic ability to other talented persons who were in their presence for a period of time, Mrs. Lansing's clockwork patterns and psychokinetic abilities appear to have stimulated another person's abilities in similar fashion. Paul Koslouski is a researcher who worked with Mrs. Lansing for a short time, and in his own thought photographs the clockwork pattern so characteristic of Mrs. Lansing's pioneering efforts dutifully appeared.

Mrs. Lansing is a brave and gracious lady, and her significant work with thought photographs is important to the understanding and advancement of parapsychological science.

THE DISPLACEMENT EFFECT

The next picture was taken about 1938 in Chicago with a camera on a tripod and a timed release. It was taken by Paul Trovillo, who is the gentleman sitting on the bench with somewhat of a problem of transparency and partial disappearance.

Photo 9. Displacement effect.

The light is by an overhead arc light, which is rich in ultraviolet (one of the magic window frequency bands in the hyperchanncl crosswalk between orthogonal worlds). Pan film was used in the camera, and the picture is of Paul and FerneTrovillo. Note the bushes through Paul's left shoulder and through the slats of the bench at approximately Paul's waist. Also note that the background is in excellent focus.

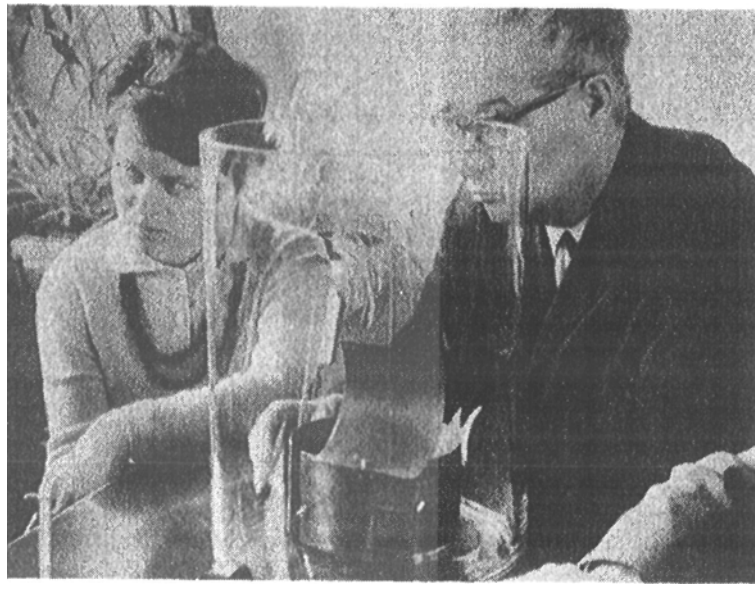

1. Robert Pavlita, Czechoslovakian engineer, and his daughter.

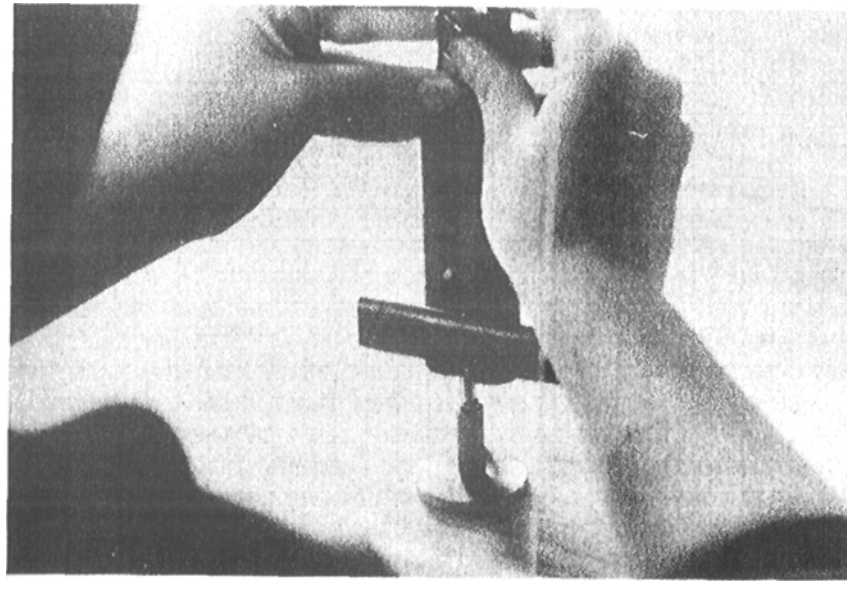

2. Device becomes a psychoenergetic "magnet" when charged by the human being—and will pick up materials, including nonmagnetic objects.

Photo 10. Pavlita's psychotronic generators.

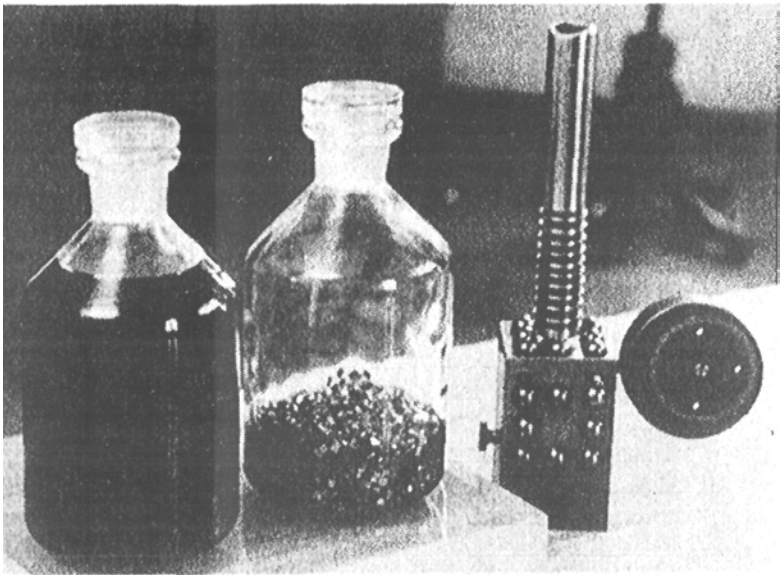

3. A generator that can precipitate solutes from solution. The jar to the left contains a dense solution; when the generator was placed over identical solution in the jar to the right, the precipitate shown in the jar resulted.

Occasionally the kindling of bioenergy (which is greatly eased in ultraviolet light) leads to eddies of hyperchannel connections between separated portions of the ordinary frame. The normal three-dimensional frame is constructed action quantum by action quantum, and each quantum is fissioned and fused individually to give individual increments or jumps of time and length. Appreciable kindling intermixed in the frame construction can provide other geometrical paths for light, so that the light rays during one or more segments of their straight-line path arc actually flipped into and back out of hyperspace. In cases such as this, one can often see right through a physical object, or even inside it (see Part Two).

I have worked with a psychic group in the American Association of Meta-Science, and have seen one experiment where similar effects were obtained, with the camera on a tripod, in a picture taken by my wife.

Excellcnt pictures of the Loch Ness monster were recently taken by Doc Shiels. These pictures have been subjected to computer analysis by Ground Saucer Watch (GSW) - and GSW was alarmed at the discovery that the monster in the portrait exhibited transparency. Indeed, for a materialization less than complete, which the monster must be if it is to keep disappearing, one would expect or even demand such transparency, even though a large body of water is a good collector for kindling of bioenergy and tulpoidal forms (UFO's are also notoriously connected with rivers, lakes, and the ocean).

Note also that the Dennis Billings UFO picture demonstrates the same sort of partial transparency. There is a readily understood physics that applies to these effects, but the effects are not contained in the present monocular interpretation of physics and reality.

PAVLITA'S PSYCHOTRONIC GENERATORS

In Czechoslovakia an engineer named Robert Pavlita has been building and demonstrating psychotronic generators for about thirty years. These are devices of various shapes and sizes and composed of materials such as steel, iron, brass, and copper, and they often contain mysterious symmetries of pattern, holes, and shape. The devices for the most part charge up with thought energy when subjected to human contact or eye contact, and then perform various functions such as precipitating a solution, turning, picking up or magnetizing nonmagnetic materials, and killing insects. The devices thus accomplish orthorotation and kindling of thought energy. Pavlita has admitted that his devices could be scaled up to serve as weapons — unfortunately, every tool can be used for either good or evil. He has demonstrated a great many times the killing of insects by pointing a charged rod at them. He also admitted that in an accident his daughter became semiparalyzed and her life was in grave danger, requiring him to work feverishly without stopping for about two days to build a second device to reverse the effects of the first. Pavlita has also demonstrated that his psychotronic devices can either stimulate or retard plant growth, depending on which polarity the plant is exposed to.

The loose information net of which I am a part has recently learned that Pavlita is now in charge of a secret project that has succeeded in building two weapons, one of about two hundred miles range and the other of unlimited range. No further details on the weapons are available.

Pavlita is a pioneering genius, and it is to be hoped that he will eventually release the secret of his psychotronic devices to the world for use in the healing arts and other beneficial sciences. Bioenergy/hyperenergy is real, and Pavlita has scored a major breakthrough in building simple devices to harness it.

CELL-LIKE INVISIBLE TULPOIDAL FORMS

Trevor James Constable has succeeded in evoking and capturing many of these forms on film. The first photo was taken by Constable on 25 August, 1957 in the Mojave Desert, and shows an amoebalike or cell-like bioplasmic form containing shapes that resemble nucleoli, vacuoles, and other cellular structures. The invisible object was at first directly overhead, but moved to positions that enabled inclusion of local terrain in the pictures.

In material presented in Part Two of this book, I show that all that a physical form or physical body is is a total tulpoid, *i.e.*, a form that can be shown to exist in each and every mind. All that a living biosystem is is a one-to-one coherence established between such a total tulpoid (physical form) and a monocular tulpoidal universe (mind world or hyperframe). Furthermore, all possibilities exist concretely in the various hyperworlds. Thus Constable's plasma creatures do indeed exist concretely—but in invisible, orthorotated hyperworlds (mind worlds). The revolutionary discovery by Constable has been a direct, straightforward way to evoke and photograph such bioplasmic tulpoidal forms. His experimental work is of absolutely fundamental importance, and I would not hesitate to compare its ramifications to those of the Michelson-Morley experiments.

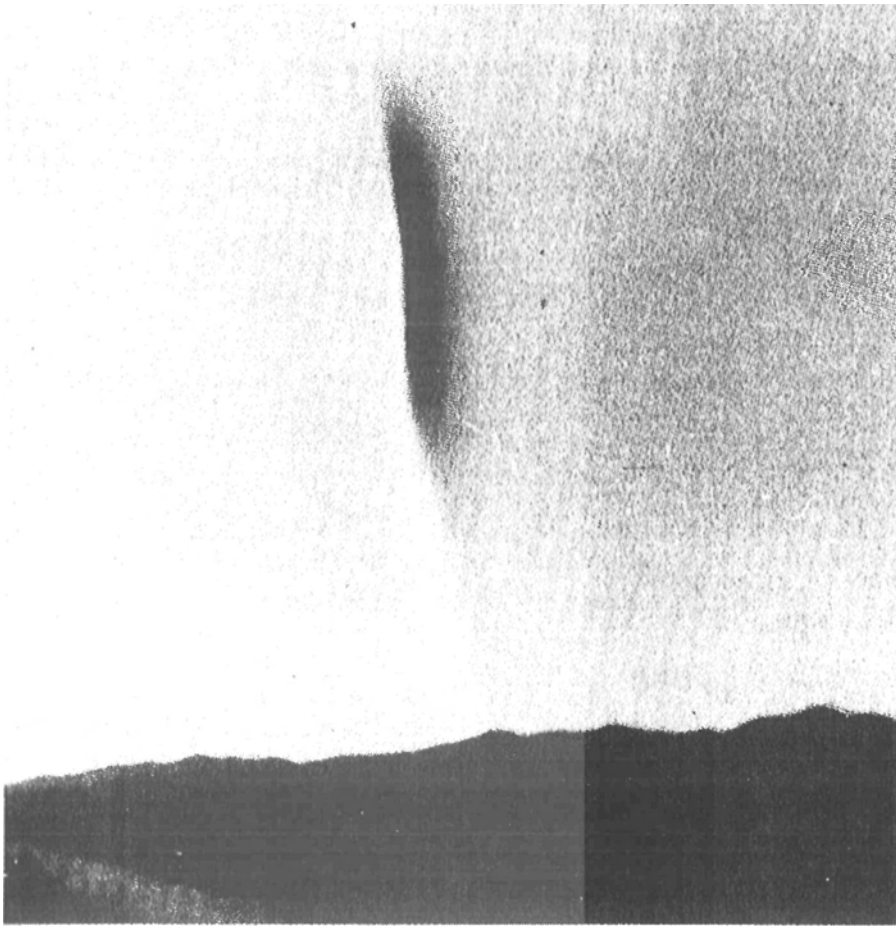

Photo 12. Form for potential materialization.

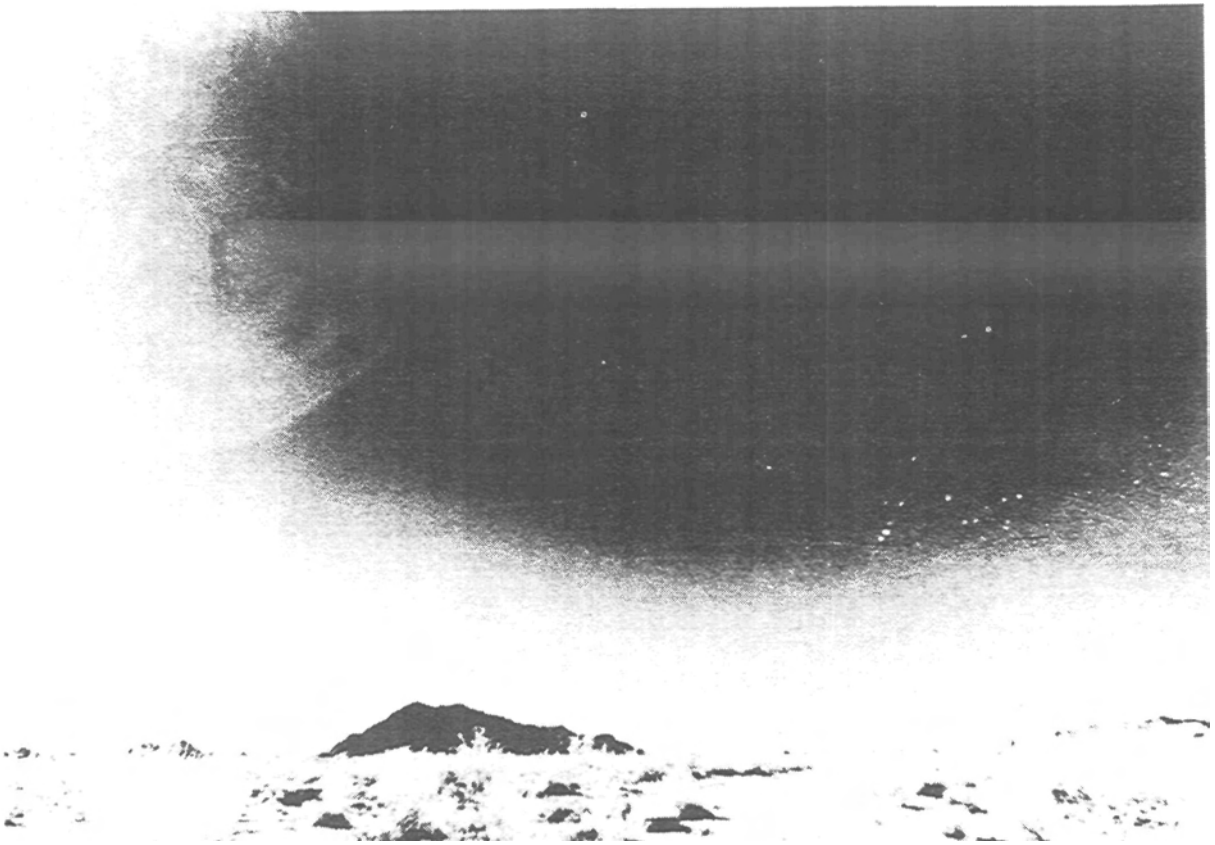

Photo 11. Cell-like invisible tuipoidai forms.

These experiments are also directly related to the work of Miller and Fox, who have shown that, when the probable atmospheric conditions *of* the earth of millions of years ago are exposed to electrical discharges and ultraviolet radiations, amino acids are formed; and then these proteinoids will form microspheres having cellular characteristics, even the ability to grow and reproduce. Every possible life form is already present in virtual state reality, and under proper selective conditions can be kindled into the first bioframe (electromagnetic field) and photographed, or even into the zeroth bioframe (full materialization).

In the UFO photographed in strong potential condition for materialization by Trevor James Constable, note the form of a disc on edge, only a portion of its form being tangible even to infrared. Note also the whitish lobe of the tulpoidal force field extending earthward from the discoidal region. Highspeed infrared film was used, no filter, shot just before sunrise near Giant Rock, California. Constable's pioneering work is remarkable laboratory evidence for orthorotation and materialization of tulpoidal energy forms.

UFO'S

The following pages show some of the most extraordinary UFO sightings and other paranormal phenomena of recent years. Photograph 13 shows a noiseless UFO seen by a university student near Las Cruces, New Mexico, in 1967. (The student reported that, as he changed plates in his camera, the object disappeared. He had been taking photos of rock formations for a class in geology.) In the Spring of 1950, two photographs of a highly materialized UFO were taken by Paul Trent on his farm outside McMinnville, Oregon. The first photo (photo 14) showed the UFO at an angle, while the second (not shown) caught the UFO in direct profile.

1. Black Ring UFO

From Project Bluebook, here is an example of a tulpoidal UFO moving along through the sky and exhibiting the "black ring" effect. In this case only the edge frame is visible, and that edge is generating the black ring or "light quenching" effect. Note that the inside portion of the tulpoid is quite transparent, for one can see the clouds behind it clearly.

2. Anchor Patterns

One of the interesting aspects of combined orthorotation into our normal three-dimensional space and out of it from hyperspace is an anchorlike pattern, shown in the next four pictures. Photo 1 was taken by Ira Maxey, and it shows several tulpoidal forms, which are intersecting our frame in a white or photon-emitting anchorlike pattern. The curved part of the anchor pattern is due to the spinning or orthogonal rotation, and the shaft portion intersects it at right angles. Note also the clouds, whose water content is highly conducive to kindling of the tulpoid — into the first bioframe, in this case.

The second photo from Project Bluebook shows another anchorlike tulpoid — this time the orthorotation is reversed, giving photon absorption — moving through the sky over a dock area by the water.

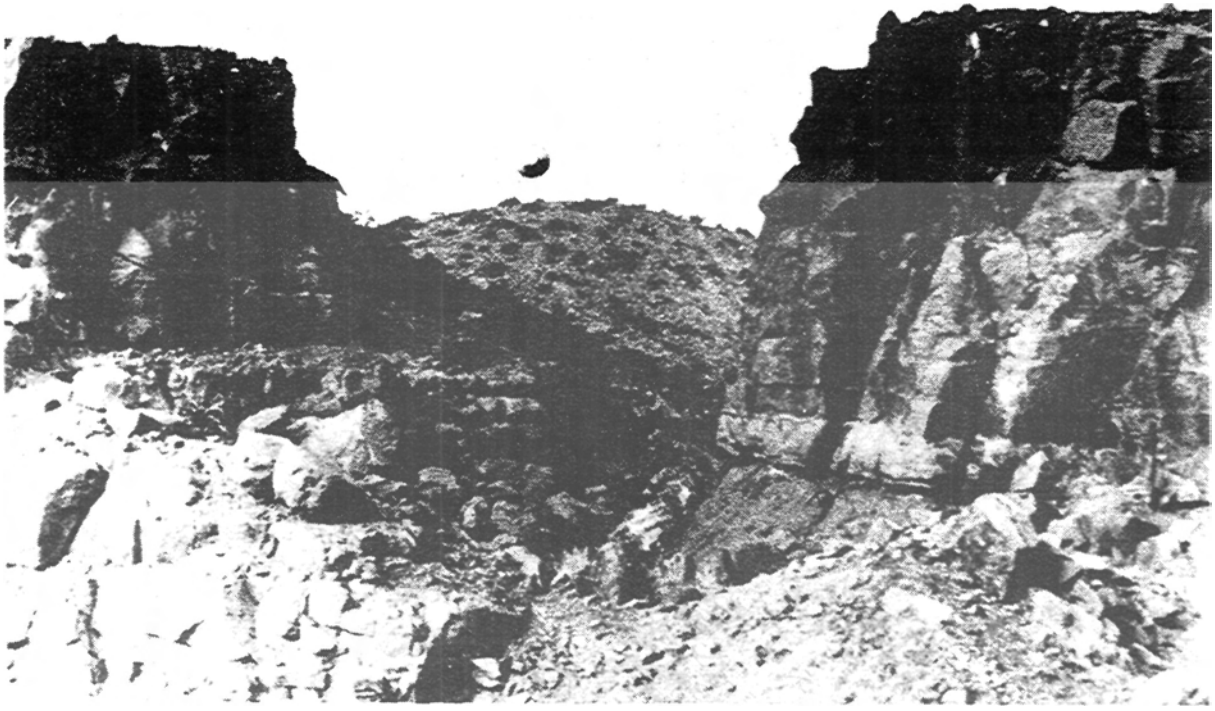

Photo 13. New Mexico UFO.

The third photo, taken in Wales, is one of several which clearly captured another anchorlike tulpoid in a photo-emitting mode.

The fourth photo, taken by Fay Clark in a darkened room, shows very similar photonic patterns being emitted by Ingo Swann's hands after Swann was asked to try to produce energy to be photographed. In the rightmost arc the shaftlike perpendicular bisector can be seen, associated with Ingo's arm. Bioenergy and mind-energy are the same, whether being emitted from a single human system/mind or from a collective system/mind.

3. Bifringement

Another common effect demonstrated by UFO's is bifringement, clearly shown in this photo from Project Bluebook. Here a UFO in highly materialized form is shown just beginning to turn back into hyperdimensional space. Interestingly enough, in hyperspace a tulpoidal form can turn in two or more directions at once, and this one appears to be doing so. A photon-absorbing turn is indicated by the outer bifringement ring, which is white. These can also be compared to photon interference patterns commonly demonstrated by light waves from two or more sources. Just as there are interference patterns in our three-dimensional space, there are interference patterns in higher dimensional spaces. The three-dimensional intersection in our frame of one of these higher dimensional interference patterns may be black, white, or consist of both black and white components.

4. UFO's in Water

Water is a substance that changes its state and form in a fantastic complex and is therefore one of the very best collectors for bioenergy or tulpoidal energy. That is, in fact, why water is so universally associated with living biosystems, for biosystems need a good collective medium in which to establish coherent tuning. So it is not accidental that water is necessary to life as we know it, or that our bodies are largely made up of water. For the same reason (ease of kindling), UFO's and many other tulpoidal forms have a high degree of association with water. Nessie and other water monsters tune in from time to time in large bodies of water such as lakes, rivers, and oceans.

This photo from Project Bluebook shows a UFO tulpoid in the first bioframe (photonic) moving along in the water.

5. UFO's in Clouds

Again from Project Bluebook here is a picture of a UFO tulpoid kindling in water, this time in the moisture in clouds. Clouds are also usually electrically charged, which enhances the tuning effect, particularly when the clouds are darkening and so are highly charged and also densely loaded with moisture. The darker clouds shield out more of the visible light, reducing the hyperchannel (time) squelching effect of visible light.

6. UFO Seen by the Author

The next UFO is one of several seen by me, and it provided a very curious, anomalous phenomenon in my memory. Furthermore, this UFO was sighted by hundreds of persons over a four-state area, so there is no question that something was there in the upper atmosphere.

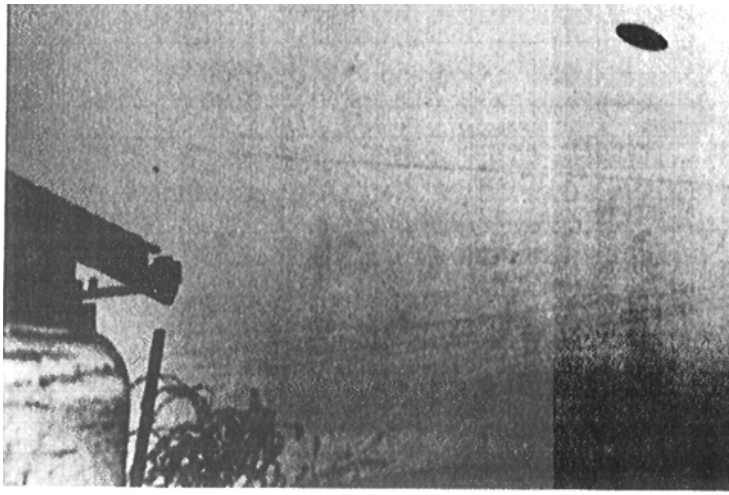

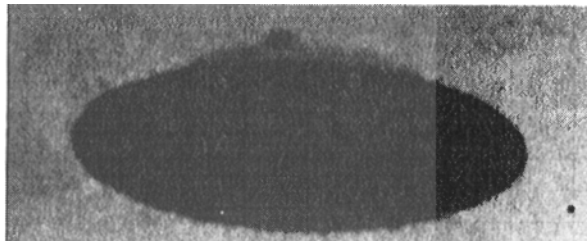

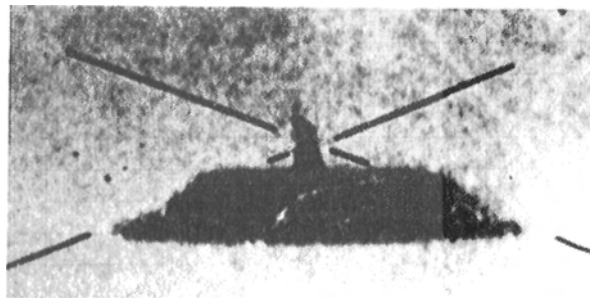

Photo 14. Oregon photos.

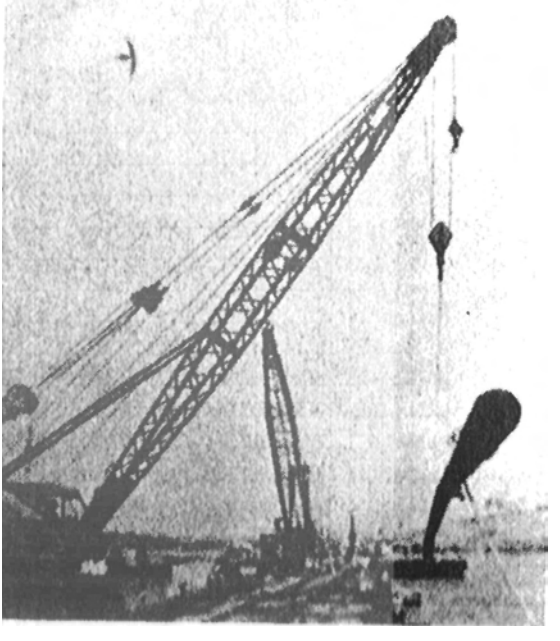

Photo 16. Anchor patterns.

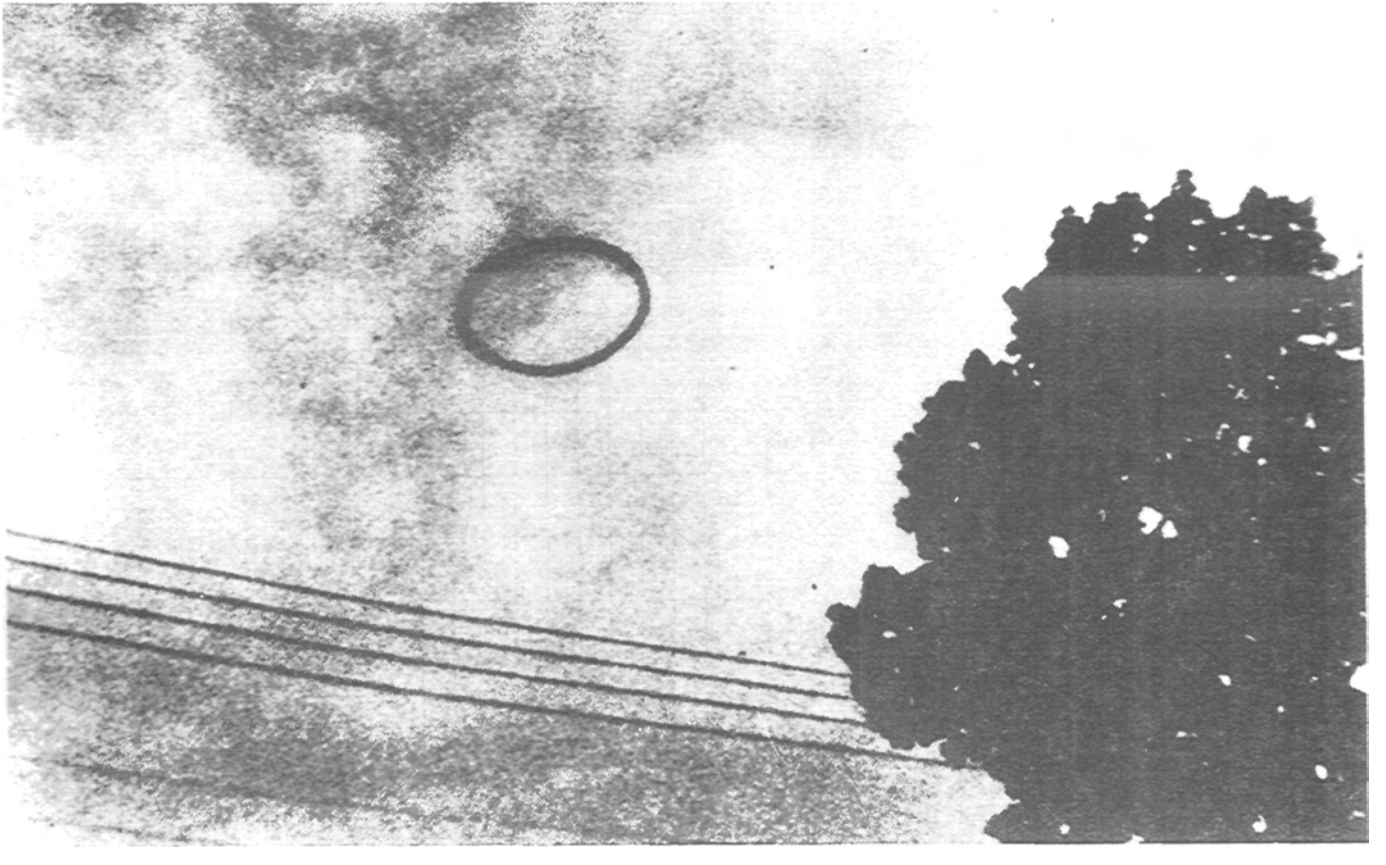

Photo 15. Black ring UFO.

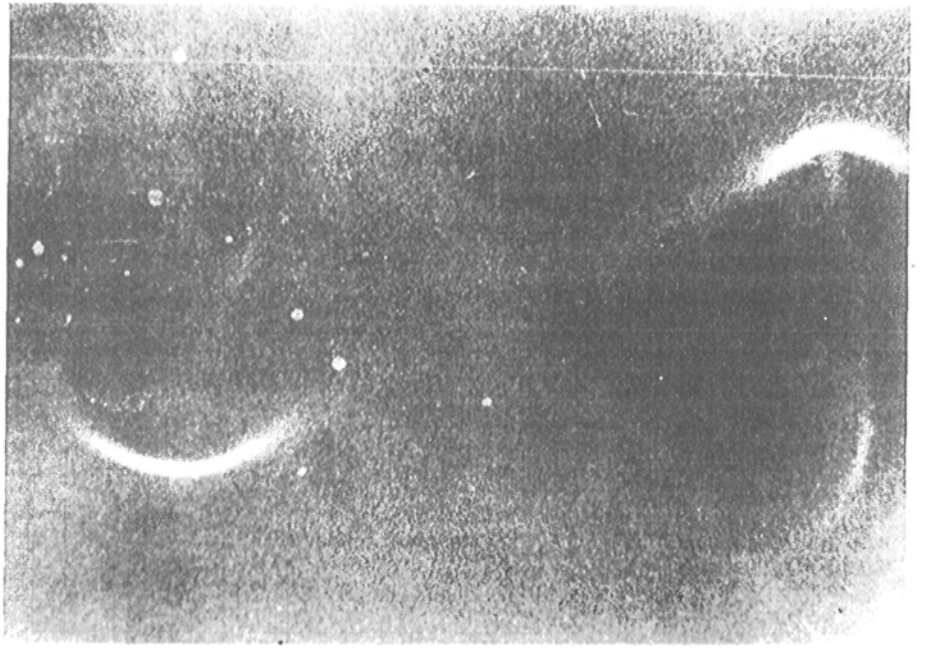

Photo 17. Bifringement.

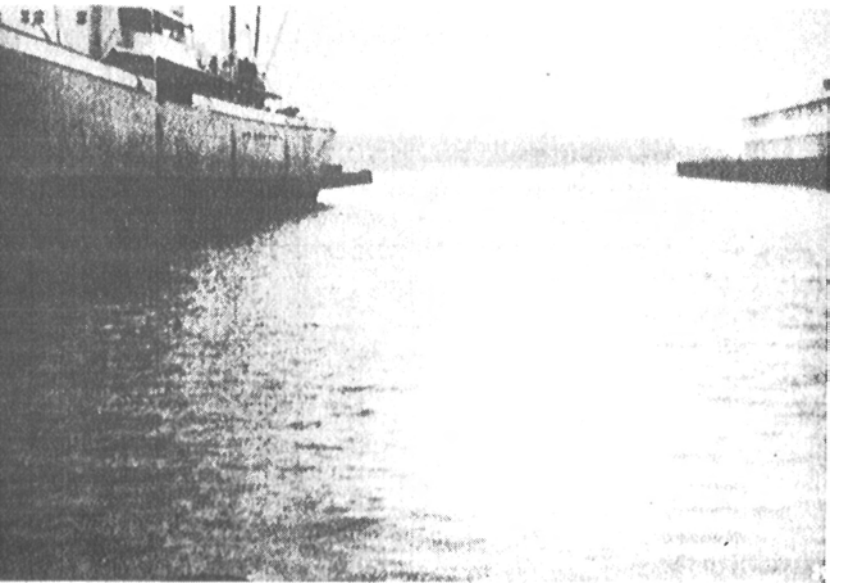

Photo 18. UFO In **water.**

The sighting occurred in June 1950. At the time I was home with my father in Woodville, Mississippi for the summer vacation from college. All my family were in the timber business — pulpwood and logs — and I was working for the summer with them.

It was a beautiful, warm, clear summer day with almost no clouds at all. Coming out of the woods on a pulpwood truck with the last load of the day (about 4:30 or 5:30 PM), the truck was slowly making its way across a large open field to the county road. Suddenly a light was seen in the extreme upper atmosphere, glowing with a fierce white radiance, very similar to the light emitted by a magnesium flare or by burning magnesium. Some object was apparently entering the atmosphere from outside it, but the velocity of reentry was far slower than reentry vehicles that would be fired many years later on U.S. and Soviet rockets. As the fiercely glowing light smoothly descended, a change occurred. At that point gray smoke also appeared in the white smoky trail being left by the object, and the trail became turbulent from that point on. Then an orange color appeared at the front of the descending, tumbling object, in the light being emitted. The smoke trail from this orange glowing color was darker gray. The object tumbled slowly downward, burning fiercely, until utterly consumed, still at an extremely high altitude (I would estimate still above 100,000 feet). In the sky the smoke trail that had been left persisted for a while, until it was gradually dispersed by high atmosphere winds. In the picture a great deal of dispersion has already occurred.

So far as is known to me, and I have had considerable missile experience, neither the U.S. nor the Soviets were firing any sort of vehicle in 1950 that could account for the phenomenon. Furthermore, even if we postulate a reentry vehicle from a large rocket, its velocity was far below normal reentry velocity, and this cannot be accounted for. The object also could not have been a meteor because its velocity was far too low.

For the doubter let it be pointed out that even if a high drag, low ballistic coefficient reentry vehicle comes into the earth's atmosphere on a downwards plunge and rapidly slows down, its initial velocity is quite high, and its rapid slowdown is quite apparent. This phenomenon did not exhibit such a characteristic.

7. The 1966 Dennis Billings UFO Sighting

At about 7:00 P.M. on the night of September 23, 1966, Dennis Billings and his wife and daughter sighted a UFO at close range. The close UFO was one of a total of four sighted by the family in about one hour. The sighting occurred in Decatur, Alabama. The UFO phenomena occurred after anomalous physical effects were noted. From the alley by his back yard Dennis, who had taken out the garbage, began to hear sounds from inside a neighboring house at some distance as if he were physically inside the room in which the sounds were occurring. These sounds consisted of conversation and dish-rattling in the kitchen where two women were apparently cleaning up the table after the evening meal and washing dishes in the sink. Then the sounds changed to those from another room where children apparently were playing games. Peculiarly, the sounds seemed to originate from wherever Dennis focused his attention, such as the garbage can, the house, etc.

Shortly afterward his daughter followed him into the yard as he left the house to go to a football game, carrying his binoculars. She spotted a cluster of lights moving along slowly in the sky above the treeline, and called his attention to them.

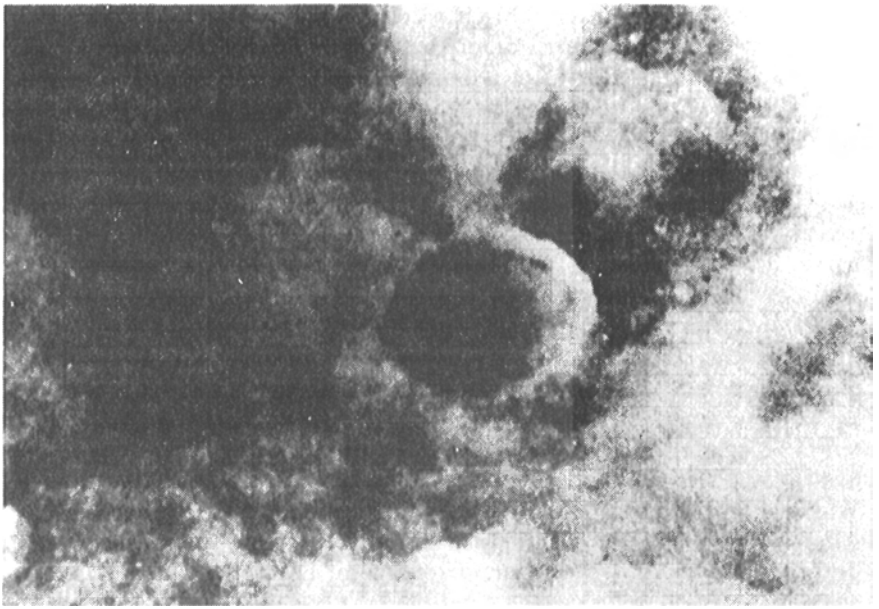

Photo 19. **UFO** in clouds.

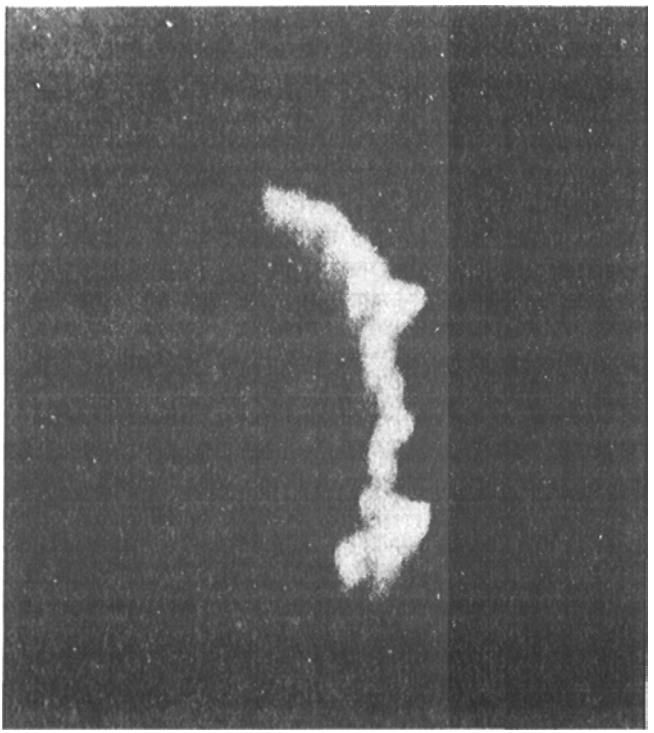

Photo 20. UFO seen by the author.

Through binoculars the cluster of brightly colored, flashing lights could be seen to be one object about two blocks from Dennis's house, moving very slowly and making no sound, about fifty feet above the trees.

Just then Dennis's wife turned on the exterior house lights which illuminated the entire back yard. As she came out into the yard, an object, a fiery red, glowing, round ball of light about twenty-five feet in diameter, appeared just above the neighboring house in back, the same house from which the anomalous sounds had been heard a few minutes previously. Strangely, the glow of the object did not appear to illuminate the rooftop of the dwelling above which it hovered.

The glowing light seemed to be composed of a tremendous amount of energy, and there was violent fluctuation, turbulence, and movement of the light energy within the sphere. Another way to describe its dynamic characteristics is to visualize it as being composed of individual particles of light or incandescent particles of highly charged matter moving rapidly in a circular plasma. The light itself appeared to be comprised of hundreds or even thousands of individual light sources confined to the circular shape.

Within a few seconds the individual lights began to coalesce and form into a solid light with no agitation, dimming in incandescent intensity and changing from red to orange to yellow. As the circular shape of light grew dimmer, a rocket-shaped object formed in the center. After the light had finished changing to yellow and was much dimmer, the rocket-shaped object began to rise, with particles of light from the sphere clinging to it and falling off toward the ground, where they evaporated and disappeared. The rocket-shaped object had no wings or tail fins, and it picked up speed and sped away, streaming an exhaust tail of light or flame behind it, similar to a welding torch's flame or a flaming sparkler. The object made several spirals as it rose and then headed in a straight line toward the stars. As it rose, it also made a slight arc toward the moon, which was full or nearly full, and passed across its face. As it crossed the face of the moon, its rocket-shaped outline could be clearly seen.

Astonished, Dennis and his wife began discussing what they had seen, still standing in the back yard. At this time the anomalous reception of unusual sounds began again. At first Dennis seemed to hear a train on a distant track although there are no railroad tracks in the vicinity. The sound seemed to come closer until he seemed to hear a train passing by immediately in front of him with its wheels clicking on the joints of the steel rails. Then they heard other sounds similar to automobiles and trucks on a freeway, again very close, although there is no freeway in the vicinity either. The whining motors and honking horns of these unseen vehicles could also be heard. Turning first in one direction and then in another, Dennis could hear the anomalous sounds seemingly originating from wherever his attention was directed. Other sounds such as airplanes flying in the sky also came in. Then he heard another sound like a high-pitched tuning fork, and it began to increase in frequency until Dennis's eardrums were hurting.

With this high-pitched frequency sounding and his ears smarting, Dennis looked up and saw a bright object positioned in the sky, larger than a star, and approaching him and his wife. As it approached on a straight line toward their back yard, it got bigger and brighter, until it stopped directly overhead, hovering 100—150 feet directly above the yard. The object appeared to be circular or oval in shape, and it descended with the flat side down. On its rear end the object was

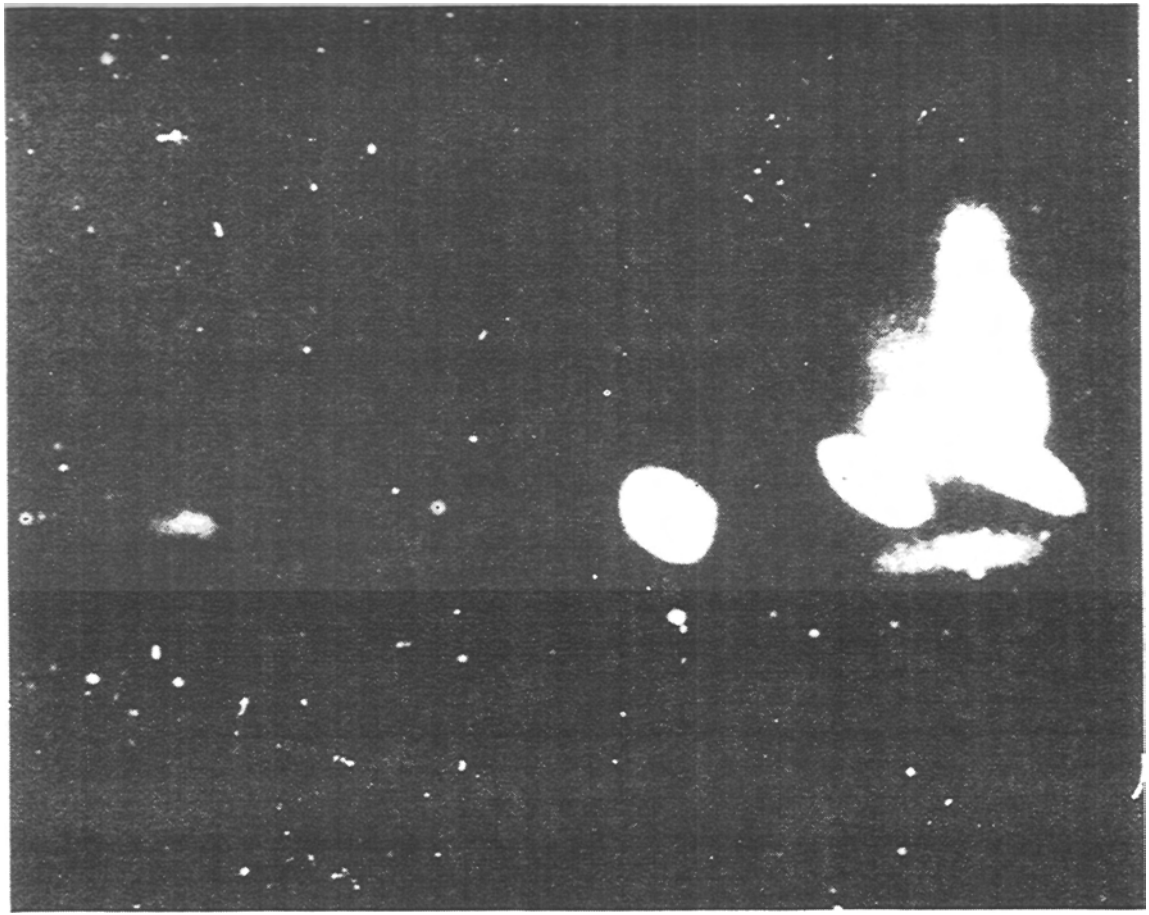

Photo 21. Second Billings UFO.

rimmed like a horseshoe with twelve washtub-sized blinking lights, each of a different color. These lights appeared to be controlled so that as one light blinked on, the other lights went off. In this way one light at a time blinked on and off in successive positions, so that a single light seemed to rotate around a complete half circle and cross at the open end, changing color as it progressed. On one side of the horseshoe the light positions were bright red, on the next yellow, on the next pale green, on the next a darker blue-green, and the final light on the opposite side of the horseshoe pattern was a very bright blue. Underneath the center of the object was what appeared to be a hemispherically-shaped plastic capsule or shield. This capsule was completely blacked out; yet through what appeared to be smoked glass, movements or shadowy activity could be seen. Dennis assumed that this was the exhaust section of the craft and that what he was seeing was probably smoke coming out of a black hole in the craft.

Around the outer perimeter of the craft, and about two feet out from it, was an illuminating light which circled the object like a halo or corona. Dennis had the eerie sensation that the object was intelligently controlled and that he himself was under close observation.

At this time Mrs. Billings became extremely frightened, ran into the house and got the baby, and crawled under the bed until the craft had gone.

As she left in fright, the craft lifted up in the sky a little and began to move slowly away, so slowly that Dennis could walk along beneath it as it moved across the back yard and into the front yard. Walking under it and looking straight up at it, he was able to observe closely the blinking lights and their operation. When the craft had been motionless, the lights had blinked on and off slowly, so that they moved in a slow, pulsating motion from position to position around the horseshoe pattern, changing color as they went. As the craft began to move and pick up speed, the lights began to increase in pulsation frequency and thus to appear to move faster around the horseshoe pattern. As the craft moved even faster, the light pulsations became so short and fast that they seemed to be spinning around the horseshoe in one continuous blur of motion.

As the object left Dennis's yard, it moved into the sky and away, but not too far, until it had positioned itself over the airport (Pryor Field) as a large bright object. At this time Pryor Field was serviced by Southern Airlines. As one of the commercial aircraft took off, the UFO followed it back directly over Dennis's house, then left the aircraft and repositioned itself in the sky in its original position over the airport, hovering motionlessly.

After hovering motionlessly for about fifteen minutes, the UFO suddenly shot down in an arc toward the ground, passing below the tree line and out of Dennis's view.

Dennis waited for about ten more minutes, when suddenly the UFO shot back up into the same position in the sky, seeming to follow in reverse the same arc on which it had descended. It remained in this position, hovering in the sky above Pryor Field for another ten to fifteen minutes. Then a similar object approached and joined it, and the two seemed to merge or dock together. They remained motionless for about five minutes more, then moved across the sky, still joined, until they disappeared below the horizon.

According to the newspapers the next day, this object or something similar had been seen all over the eastern half of the U.S., and had been described as "multi-

colored clouds."

8. The Second Billings UFO Sighting

If Dennis and his wife had experienced only one UFO, the incident would have quietly faded away in the unwritten annals of ufology. However, such was not to be the case.

Dennis vowed to himself that, if such an incident ever occurred again, he would get a photograph ofthe object. And just before Labor Day in 1970, Dennis got such a chance, and indeed made good his intention.

On that night, with almost totally clear skies and a bright moon, Dennis's wife came rushing into the house in Decatur, Alabama and excitedly reported to Dennis that she had seen another UFO. Rushing into the yard, all Dennis could see were some distant white lights — too far away to say positively they were UFO's. However, recalling the multiple UFO's in the previous incident, Dennis and his wife took up separate watches on each side of the house. Dennis also thought of his Polaroid camera left in his car parked in the driveway, so he went to get it.

Standing between the trees, Dennis looked up into the sky and saw a UFO suddenly triggered into position, as if his thought and intent had pulled a switch and the object had suddenly appeared, positioned perfectly for his observation, pouring light from underneath for a distance of about twenty to thirty yards. This light seemed to emit some immense force and was colored like the fire, whiteness, and glare of a welder's torch. The tail diminished as the craft lowered. Dennis snapped a picture when the craft's tail had shrunk to only four or five feet long. He pulled the tab on the polaroid film and ran into the street under an outdoor light to see if he had recorded a UFO. When he saw he had done so, he then noticed the object had descended and made a left turn, moving eastward down Nelson Street slowly at about five miles per hour. Its porthole lights were still clearly visible and no sound was being made. Dennis hurried after the UFO and caught up with it at the end of the street near a T. V. A. easement, where large electrical power lines were located, running generally north to south. He got slightly ahead of the object as it traveled parallel to the power lines and as the craft passed directly over him. At the very instant he pressed the shutter, all lights in the craft instantly extinguished as if his mind had been read and the photograph deliberately prevented. The now darkened, cold, lifeless-appearing craft moved smoothly away, passing over Mallard Park where a Marine Corps Band was playing. The second photograph showed no lights whatsoever.

One of the local newspapers then printed the story and the picture, and Dennis received a call from one of the national UFO agencies. After giving the agency his photograph, his camera was mysteriously stolen from his automobile, and the agency then claimed to have lost his photograph. However, they underestimated the determination of Dennis Billings.

Dennis simply got on a plane and went to Washington, and proceeded to the office of the head of the UFO agency. The president of the organization had said that he would be out of town for several days and would be unable to see Dennis. Nevertheless, Dennis went to his office, where his secretary repeated that the gentleman was out and would not return for the day. Dennis barged into the office over the protestations of the secretary — including the threat to call the police and have him removed — and proceeded to search for his photograph, eventually finding it in the

desk drawer of the president of the organization. He retrieved his photo and returned to his home. Without his personal determination to retrieve his property, the photograph — like so many others over the years — would have been "lost." The immediate question that occurs is: Isn't it curious that one of the major UFO organizations in the U.S. — supposedly devoted to solving the UFO mysteries — exhibited the desire to misappropriate a really good picture of a UFO and see that it disappeared from the scene?

At any rate, Dennis got his photo — and a beautiful photo it was. Furthermore, the incidents experienced by Dennis Billings are classic examples of my theory. Many anomalies in the incidents will not fit orthodox theory or orthodox ideas about reality. The "pieces of light" seem to be almost intelligent. There was a close coincidence of thought/intent/expectation and kindling burst into observable reality, plus a great deal of sky-watching and expectation by Dennis between the first UFO incident and the triggering of the second (i.e., a long kindling time, just as Patterson experienced before he got his excellent movie shot of a sasquatch). And there was close experience of very distant sounds (to be expected in hyperspace, where ordinary distance can be shortened or even eliminated). Furthermore, there were multiple witnesses to the UFO incidents, and Dennis got his photograph. Psychologically, it may even be significant that for several years Dennis vowed to take *a* picture of any other UFO he might later see, and when he got *a* picture, he was prevented from getting another. And on the photograph obtained, one can see that the "craft" form of the tulpoid is only partially materialized, since the stars can be seen right through the vehicle's midsection. This is similar to the strange transparency of the Doc Shiels photograph of Nessie (the Loch Ness monster), which Ground Saucer Watch found when they performed a computer analysis of his photo. (The second Shiels photo showed that the water was being forcibly moved by Nessie, so the tulpoid was at least partially materialized.) Yet such is to be expected if one is dealing with partial materialization of tulpoids.

Finally, the entire area is located in the Tennessee Valley Authority's project. Great electrical transmission lines go through the area, and there are many long lakes and the Tennessee River. So an excellent kindling medium is provided, and many UFO's are seen over the Tennessee Valley.

The Dennis Billings photo remains one of the best UFO photographs ever taken, and coupled with Dennis's astute personal observations, it provides a keystone insight into the actual nature of the UFO phenomena.

9. The 1973 Pascagoula UFO Sighting

In October 1973 one of the greatest UFO flaps of all time occurred in the United States, and created headlines because of the bizarre increase of contactee incidents. One of the most sensational of these was the purported abduction of two men in Pascagoula, Mississippi, who were allegedly taken aboard a saucerlike craft, examined, and released.

Shortly afterwards another incident happened in Pascagoula, which drew little attention. In this case, underwater phenomena were involved, because two U.S. Coast Guard petty officers investigated the object and made physical contact with it. An official Navy investigation was made and a report written. Unusual characteristics, highly suggestive of a device using psychotronic effects, were displayed by the object. I suggest that this device may well have been a Soviet psychotronics de-

vice, taking advantage of the UFO flap as a screen to carry out clandestine activities.

In Pascagoula an illuminated underwater object followed the boat of Raymond and Rayme Ryan, who tried to beat it away with an oar. The nine witnesses, including two Coast Guard investigators, described the object as metallic, rod-shaped, two to three feet in length, and four inches in diameter. It was attached to an oval-shaped beam ahead for four to six feet. It looked like a mini-submarine and moved at four to six knots in four to six feet of water. Although it sounded like metal when struck, it could not be struck consistently, and its light, when illuminated by a flashlight, turned off immediately and then on again after about one minute. The portion of the Ryans' oar that was under water could not be seen from the surface when the object's light beam fell on it.

At this point I would like to make some general remarks about the nature of UFO's. (1) The UFO-generating mechanism and the psychotronic mechanism are the same. (2) The Soviets may even be able to psychotronically evoke particular types of UFO phenomena at will. (3) A small number of UFO phenomena could even be generated by the Soviet Union as part of its psychotronics deception plan. However, most UFO phenomena are definitely not of Soviet initiation, (4) An explanation of the UFO phenomena is briefly sketched out in my section on psychotronics. (5) Some of the NASA photos taken of moving lights in orbit around the earth may have been of Soviet-initiated effects. Like the radiation of U.S. personnel in the U.S. Embassy in Moscow, this effect could have been intended to evoke U.S. high level reaction, to positively assess whether the U.S. had any knowledge of psychotronics, and if so, what that level might be.

10. Other UFO's

A brilliant, "crystalline-like" UFO was seen over Madrid, Spain in 1968 and was chased by Spanish Air Force planes. Whenever people are significantly structured in their thinking, symbolically "sharp" and "crystalline" tulpoids often are seen, representing their ideas. Many such UFO tulpoids are seen over Iron Curtain countries, and over countries such as Spain that have one dominant religion and culture.

In October 1973 the governor of Ohio, John Gilligan, saw this UFO phenomenon along with over 100 other people. The police were notified by the governor, and this photo was taken by the *Columbus Evening Dispatch.* Note that the tulpoids remain in the first bioframe (see Part Two), and even though their intersections change shape, the second one remains in a "burst mode."

In 1965 Rex Heflin took four pictures of a highly materialized UFO near Santa Ana, California. In the fourth photo the dematerialization "photon absorption" effect is shown: if orthorotation into higher dimensional space is made in one direction, photon (light) is emitted. If the orthorotation is made in the opposite direction, photons are absorbed. In one case "glowing light(s)" are associated with the UFO's hyperdimensionality, while in the other case "black rings" or "smoke" are associated.

FALKVILLE SPACEMAN

These two pictures are black-and-white versions of two of the photos taken by **Falkville, Alabama Police Chief, Jeff Greenhaw, in an encounter during October**

1973. Greenhaw had received a call from one of his constituents to say that a UFO had landed in her pasture, and he was proceeding to investigate the incident. In his police cruiser he carried a polaroid camera which he used in his police work.

Driving down a narrow gravel road, Jeff noticed a metallic-clad, suited figure walking down the road toward him, and he stopped his car to get out and have a look. For some strange reason his instinct was not to pull his pistol on the creature, and instead he started taking pictures as the creature/tulpoid walked toward him. The creature was holding something exposed in one of his hands, as can be seen in one of the photographs. As the tulpoid approached with no apparent intention to stop, Jeff then switched on the blue light above his cruiser, and the rotating, flashing light caused the creature to turn about and run away down the road. Jeff jumped into his cruiser and gave chase, eventually reaching about forty-five miles per hour without catching the tulpoid. His car spun off a curve and Jeff still had the photos — polaroids that he developed.

Bizarre things then happened to Jeff Greenhaw. His wife left him and divorced him (I suspect this had nothing at all to do with the UFO incident), he was fired from his job as police chief, vicious rumors were circulated that it all had been a hoax, and that a person had been dressed in an aluminum suit and photographed to give the appearance of a spaceman. Various fire suits were positively identified as having been the suit used. Jeff was discredited. Finally his trailer was burned down.

Before the trailer was burned, a friend of mine here in Huntsville, Warren York, visited Jeff and made photographic slides from the original polaroids with Jeffs permission. Shortly after that I had a chance to study these first generation slides for several hours, and some interesting things turned up.

The tulpoid's left hand is positively reversed in a mirror image fashion; it opens outward instead of inward as does a normal hand. (This cannot be seen on the photos shown here, but on the first generation slides it is readily seen.) Being an aikidoist, I am totally familiar with the degree of bending and flexing of most human joints, particularly the arms, wrists, and hands. And the mirror imaging of the left hand of the tulpoid is beyond question.

Furthermore, one can establish a clear shoulder line in some of the other photos, and a line just under the hat or "nazi-helmet" portion of the figure. From the other photos a remarkable thing emerges: there are only two places between the edge of the helmet and the chest that are sufficiently wide and sufficiently thick to contain a human head. The person would either have to have a neck about twelve inches long, or he would have to have a neck shorter than a Neanderthal's, with the head lolling down completely on the chest. Again, this can be clearly established in the original first-generation slides.

Finally, I have a letter in my files that establishes as a falsehood one of the rumors about Jeff. One person had admitted dressing in the suit and faking the incident, when in fact what actually happened was that Jeff went to his house immediately after the incident to ask this person to accompany him back to the area and search for the spaceman. When confronted in late 1977 by his family and friends, this person broke down and confessed that he had lied about the incident.

Finally, some other investigators dressed a person in an aluminum foil suit and photographed him, and there is no resemblance to the tulpoid photo. And Warren York investigated all the firesuits supposedly used in the hoax, including new suits used by the various fire departments and also by NASA at Redstone Arsenal. None of them resembled the tulpoid photo.

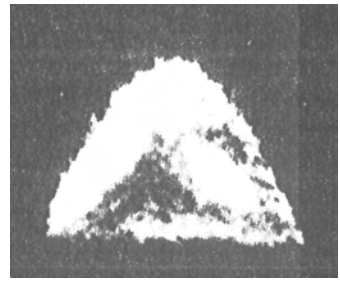

Photo 22. Spanish UFO.

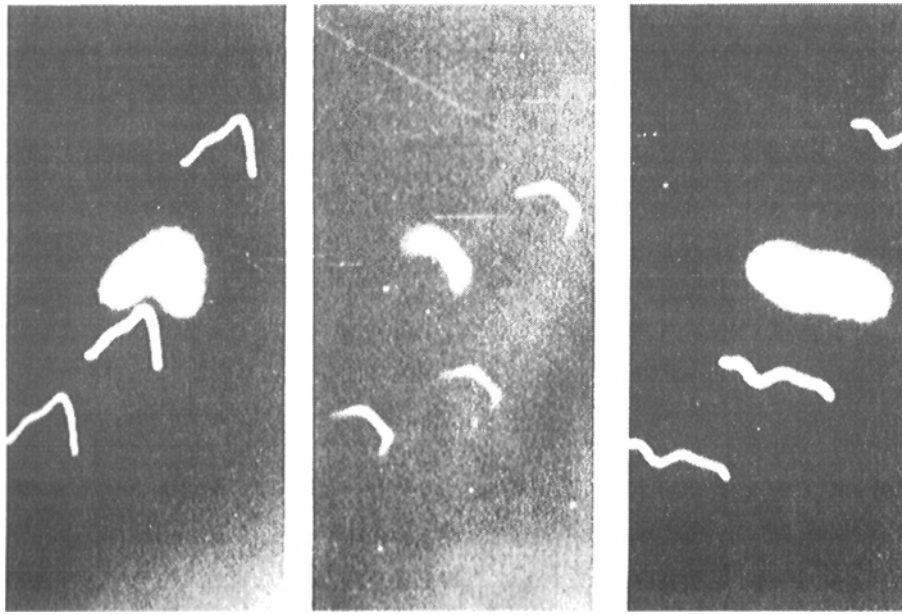

Photo 23. Ohio UFO.

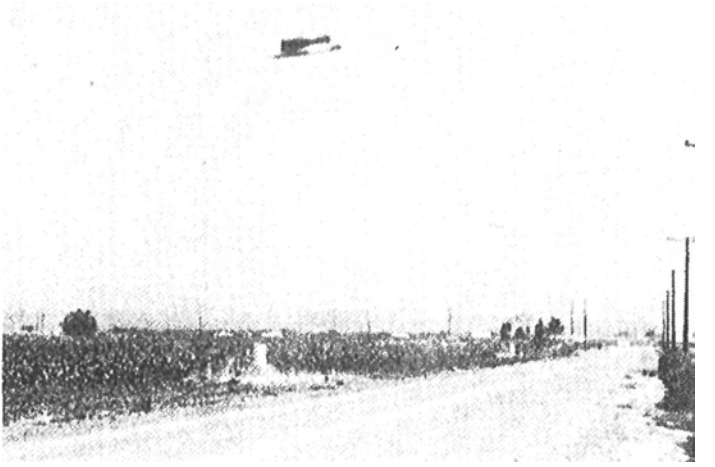

Photo 1

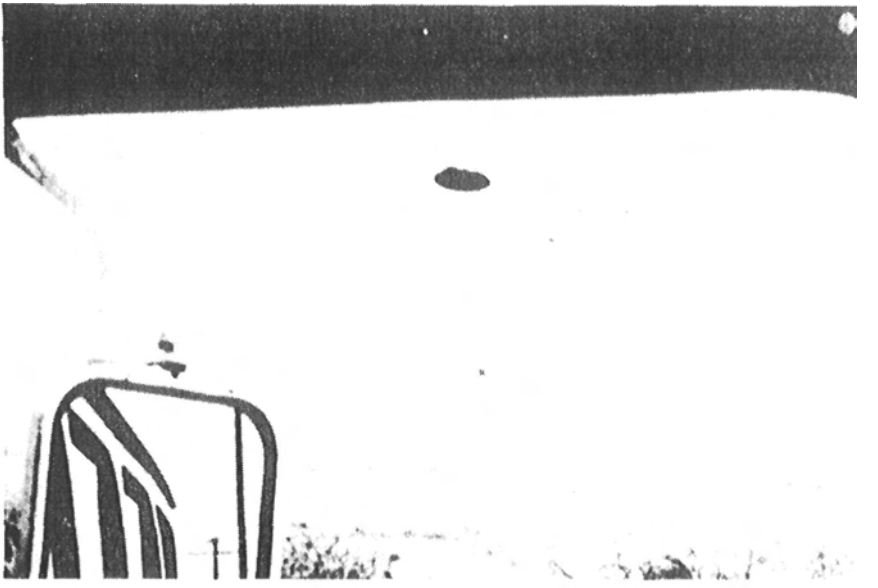

Photo 2.

Photo 24. Heflln UFO.

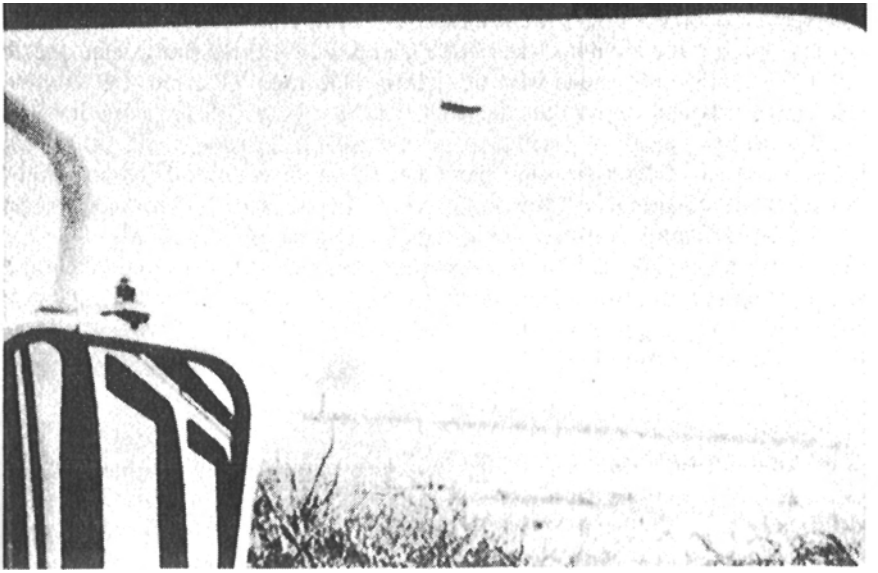

Photo 3

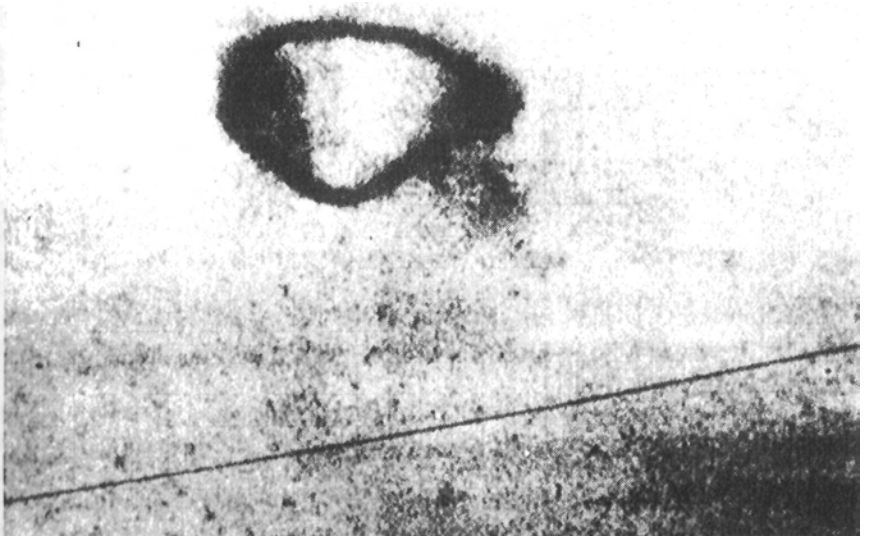

Photo 4 (enlarged)

Several photo experts have concluded that the photos are false, and several have concluded that they are not. A computer analysis concluded that they were false. However, what exactly could a computer show that would differentiate between a normal physical object and a well-materialized tulpoid?

In my opinion the incident was a fake *if and only if* three things can be established; (1) an individual exists with a horribly deformed left hand that is mirror-image backwards and opens outside away from the body; (2) the same individual either has no neck at all or else has a neck almost a foot long; and (3) the same individual can run forty-five miles per hour, faster than any other human in the world. Such an individual — if he existed — would be readily identified, and there would be no difficulty in ascertaining that he was the one involved.

There are other things about the case that I am not at liberty to divulge at this time out of respect for Jeff Greenhaw's confidence and privacy. But even so, the incident has a very high probability of being tulpoidal, and Jeff Greenhaw stands fully exonerated, in my opinion.

MEN-IN-BLACK

The kindling of virtual state tulpoidal forms into the zeroth bioframe of a physical reality (materialization) can result in the materialization of living, breathing, functioning forms. There is essentially no limit on the format that may be obtained. Sasquatch, Nessie, fairies, demons, angels, mothmen, skunkmen, yeti, kangaroos, etc. are just a small sampling — as indeed are UFOnauts such as little green men, space-suited astronauts, androids, robots, etc. These (usually) fleeting phenomena are physically real when in the materialized state (zeroth bioframe); unfortunately the tuning which is accomplishing the collection and kindling is usually unstable, and the stability to maintain the materialization lasts only a short time.

One of the consistent phenomena experienced by many UFO investigators is that of men-in-black. Typically, oriental-featured men in dark suits appear and demand the investigator's material, instructing him to cease his efforts. Usually they have almond-shaped eyes that never blink, and speak telepathically without moving their lips. Variations, of course, occur.

Here is an incident that happened to a friend of mine in the city where I live (Huntsville, Alabama). At the time my friend was an ardent UFO investigator and even wore a radiotelephone so that he could be contacted quickly at any hour to go and investigate UFO incidents in the field. He is the friend who investigated the Jeff Greenhaw case and took slides of the original Greenhaw photos before Greenhaw's trailer was burned.

A friend of his, a girl with psychic abilities, was approached one evening in her apartment by two medium-sized, almond-eyed men of oriental cast, in typically dark suits. These tulpoidal gentlemen's eyes never blinked and they spoke to the girl telepathically without moving their lips. They handed her an envelope containing two ancient coins and instructed her to give the coins to my friend, and inform him that he must keep them on his person at all times. After other messages that completely frightened the girl, the two tulpoids left, never to be seen again.

In tears from fright, the girl contacted my friend and between fearful sobs urged him to take the envelope and get it away from her, as she never wanted to see it again or the two men who had brought it.

My friend picked up the envelope and later examined the two coins. I also personally examined them: to anyone who is sensitive, the coins radiated an invisible unpleasant tulpoidal energy.

The investigator then photographed the coins, and daringly placed one on a string around his neck against my own advice to seal them up against light. He promptly broke out in a rash from head to foot and was shortly forced to remove the coin and seal it away. Interestingly, photos of the coins seemed to have about half the effect of the actual coins.

For a period of two years I kept my copies of the photos sealed against light and stored in a file cabinet. To my surprise, several times when I went to retrieve the photos, they would alternately be there and not there. I simply state what occurred, without any change or justification. Eventually, however, their effect seemed to decay, and at that time there was no longer any problem in recovering them from the filing cabinet.

The men-in-black syndrome is based on our own unconscious tuning; since each of us has some unpleasantness in the unconscious, sometimes the tuned-in men-in-black can be very nasty indeed.

I am personally aware of several good researchers into the paranormal who have been forced to retire from the field to save their own lives and the lives of their families. As late as April 1978 a very good friend of mine has been forced to do just that because of overwhelming danger to his family from materialized tulpoidal phenomena.

In my own case I have found it expedient to work closely with a group of psychic friends in the American Association of Meta-Science. This group is capable of clairvoyantly peering into the unconscious to ascertain the most unpleasant blockages present, and forming energized thought forms to go in and cleanse the unconscious of most of the unpleasantness. In this way the unconscious can be kept relatively free of unpleasant tuning that might otherwise tune in something like the men-in-black. My own life and experience has not been free of tulpoidal tuning; however, it has been free (at least so far!) of tuning in anything really unpleasant, or nasty, or threatening to my family.

But I continue to be very grateful to my psychic companions for their understanding and assistance, and I continue to avail myself prudently of their services when needed.

SASQUATCH

In many regions of the earth there exist legends of giant, apelike creatures of various sizes, hues, and dispositions. In the high Himalayas this takes the form of the yeti, a humanoid creature sometimes seen in the snows of high and remote fastnesses. Expeditions have in fact uncovered and photographed the yeti's tracks, and sightings by reliable observers have been made. Several parties have also reported hearing the yeti's strange vocal sounds.

In the remote Siberian wastes the Soviets have also reported such a manlike humanoid creature, even purporting to have captured one a century or so ago.

In the U.S. the tulpoidal form similar to this has been the sasquatch of the Pacific Northwest, known since Indian times, and observed hundreds of times by a variety of persons over the years. Nevertheless, in spite of intensive searches Bigfoot continues to elude all pursuers while continuing to be sighted and leave footprints.

Photo 25. Falkville spaceman.

But Bigfoot cannot be caught by packs of hounds. (This has repeatedly been tried. His lair is never uncovered, nor can he be tracked to it. He has never been found dead of old age or injury. The bones of sasquatch have never been uncovered in caves or elsewhere.)

Furthermore, not just one type of footprint or one type of creature is seen; instead, a variety of shapes/sizes/types of creatures appear. This is one particular clue to the fact that we are not dealing with a species of shy and elusive wildman, but instead with a tulpoid.

Sasquatch cannot normally be found — as indeed Nessie and the yeti cannot — because shortly after each appearance he is no longer present in this bioframe.

However, as interest in sasquatch/Bigfoot grows and the effort to discover or uncover him intensifies, the kindling of the tulpoidal form intensifies. Today bigfoot-type creatures of all varieties and hues are being seen throughout the U.S., from Maine to Florida, from Alabama and Tennessee to Oregon, Washington, and California. With this intensity of kindling, it is getting easier to evoke a bigfoot-type tulpoid, and as it continues, sasquatch is probably going to be tuned in and stabilized. If so, the past itself will just be changed, and we will be able to dig up ancient bones of sasquatch, and find his lairs, and track him down with dogs and capture him. In that case, sasquatch will become a respectable animal and will stabilize in our reality. Tulpoidal activity from the collective human unconscious can be stabilized and the entire past, present, and future changed by the awesome 4×10^9 dimensional psychokinetic mastery of spacetime exerted by the species unconscious.

We also should not be at all surprised if the same thing happens to the placid Loch Ness monster. There is probably going to be a family of pleisosaurs living in the Loch eventually (and in many other bodies of water across the globe) — and spacetime will be changed (past, present, and future) in our zeroth bioframe to accomodate this small shift in the collective human unconscious. In reference to changing the past, it is interesting to note that Wheeler has recently demonstrated that, in the two-slit experiment (which contains the basis of quantum mechanics), it can be decided *after the fact* whether or not a photon has interacted with two slits or with one. Thus in at least one sense the past can be changed!

After several years' intensive search for and pursuit of the elusive Bigfoot in the Pacific Northwest, Roger Patterson finally obtained a short movie strip of a very large, seven-foot tall female with pendulous breasts and crested head, walking through a forest clearing with giant strides. This is perhaps the best frame from that movie strip. Sasquatch tulpoids have been known since ancient time by the Indians who lived in the area. It would be interesting to see what results could be obtained in materializing or partially materializing the Bigfoot tulpoid with a Reichian cloudbuster.

Bigfoot-like creatures are materializations from the collective human unconscious shaped and formed by the layers (race, culture, nation, territory, state, region, family, etc.) between the collective unconscious and the individual unconscious minds of the observers. The exact format depends on all the higher level "kneading" of the "dough" that is being forced out into materialization.

In the Pacific Northwest the Indian knew of the sasquatch long before the coming of the white man; in that region, a great deal of tuning has been accomplished, and the sasquatch is a rather well-tuned animal form, having well-

Photo 26. An ancient coin handed to a psychic friend of a UFO investigator by tulpoidai men-in-black.

defined footprints as shown in Photograph 28. In the East, the yeti has also been tuned for centuries, and a cast made from his footprint is quite well formed — though also quite different from that of a typical Pacific Northwest sasquatch. In New Jersey, on the other hand, for the last two or three years there have been a large number of Bigfoot sightings, but here there has not been the same degree of tuning for several centuries, and consequently the footprints look rather messy, like blobs left by the creature before it vanished back into dematerialization. Finally, in one case a person well-known to me stumbled into dematerialization phenomena of a very strong nature. One of the incidents involved the materialization of a really gigantic "superfoot" creature, which walked around all over the base of a mountain, leaving giant footprints two feet or so long. Though monstrous in size, superfoot is really ill-tuned and thus ill-defined, with footprints that are decidedly blobby in form.

UFO's OVER THE SOVIET UNION

In 1961 locomotive engineers on a freight train from Moscow to Golytsino, when about forty kilometers from Moscow, sighted a disc-shaped object topped by a cupola approaching the train. The object slowed to pace the train and escort it for about one kilometer. Suddenly the locomotive engines went dead, and could be restarted only after the mysterious object disappeared.

On December 29, 1967 an Iliouchine 14 aircraft enroute from Zaporoje to Volgograd sighted an approaching UFO. As the UFO neared the aircraft, suddenly the aircraft's engines stopped in midair and the plane began slipping sideways toward the earth, carrying its panic-stricken crew to certain destruction. When the crippled aircraft was about 700 meters from the ground, the UFO abruptly disappeared. At the same instant the aircraft engines sputtered and roared to life again. The pilot righted the aircraft as lift returned, narrowly averting a crash.

On September 24, 1962 first one oval object then several others escorted a TU-104 airliner enroute from Vorkouta to Omsk and maneuvered around it with astonishing speed and agility. The eerie aerial escort continued for most of the flight, and the objects were extensively observed by both the passengers and the crew. The objects positively could not have been other planes, balloons, satellites, celestial objects, or other known natural phenomena.

In Latvia in 1965, R. Vitolniek, a well known astronomer, together with several scientific colleagues, sighted a triangular-shaped formation of four spherical objects, one at each of the points of the triangle and one a little larger in the middle of the triangle. Two of the scientists, Ian Mederis and Robert Vitolniek, made immediate calculations and insured that the objects were not satellites or normal orbital objects. The objects steadily shrank in size, leading Vitolniek and his colleagues *to* conclude that the objects were traveling away from the earth into outer space.

At least two Soviet astronauts, Colonel Bykovsky and V. Terechkova, have observed UFO sightings and reported them to the Soviet authorities. Many other UFO sightings have occurred in the Soviet Union and the Iron Curtain countries; **these** are just a sampling.

In fact, on several occasions Soviet defense forces have been committed into massive action against UFO's.

In 1959 numerous UFO's flew over Soviet rocket launchers at Sverdlovsk. In addition to being visually observed by a large number of personnel, they were detected and tracked on Soviet radars. Soviet military units were ordered into action immediately. Interceptors and antiaircraft artillery batteries went into action and the air defense missile units opened fire. In spite of the fierce engagement of the elusive UFO's, none were hit or damaged and no results were obtained by the Soviet combat forces. Men, machines, guns, rockets, missiles and radars could not cope with the UFO's. The impact in the Soviet military of several such military actions must have been enormous.

In fact, such incidents as this probably were responsible for the establishment of an extremely high level and highly classified Soviet investigation of UFO phenomena. Given the decision to launch such an investigation — and it would be inevitable for the Soviets to take such a step when their air space was under open invasion by possibly hostile forces — the Soviets would have assembled a formidable scientific team to tackle the problem. Furthermore, given the highly classified military reports of such encounters, reports of UFO incidents at other Soviet installations and by other Soviet military personnel, and the steady occurrence of the normal range of UFO sightings and incidents over cities and villages, the Soviet system would have tolerated no scientific nonsense in opposition to the mission to discover the nature of the phenomena. In other words, the Soviet team from the beginning would have concentrated on finding the explanation and nature of the phenomena, not on whether or not such phenomena were real or were occurring.

In my opinion, a connection between UFO's and paranormal phenomena — and the new psychoenergetics which also was formulated by 1959-60 — was realized about 1960. The high classification of the Soviet psychoenergetics program then led directly to an official Soviet policy to debunk UFO's and paranormal phenomena if the work of any outside research group became too serious. Some Soviet scientists who had no connection with the weapons programs were allowed to work a little on paranormal phenomena and on UFO's. This was simply to provide a deception plan for Western scientists; in their contacts with their Soviet scientific colleagues, these Western scientists would see only a rather puzzling collection of simple laboratory experiments on telepathy, ESP, simple psychotronics, psychokinesis, etc. A limited number of Soviet papers dealing with these subjects, but of no particular theoretical content or very exact statement of experimental apparatus and conditions would be permitted in the open journals. However, close scrutiny of such activities would be maintained by the Soviet state, and no real breakthroughs would be permitted to occur or to be transmitted to the West. Ziegel, Dubrov etc. owe the limited work they were permitted to do to this Soviet deception policy.

They also owe the surveillance and harassment they have undergone to the Soviet policy of insuring that they would be permitted to do nothing significant, or to communicate nothing significant to their Western colleagues. Meanwhile, a rigorously controlled and highly classified Soviet psychotronic weapons development program continued apace. And the radiation of the U.S. Embassy (and the U.S. ambassador to the Soviet Union) in Moscow with weak radiofrequency microwaves containing psychotronic modulations began about 1959-60 and con-

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Photo 27. Sasquatch.

Photo 28. Bigfoot cast.

tinues to the present. As explained elsewhere, this radiation was in fact another very clever Soviet intelligence probe: By observing how the U.S. reacted, they could determine whether the U.S. had any knowledge of psychotronics and thus whether or not the U.S. had developed secret psychotronic weapons and counters of its own.

The Sighting over Petrozavodsk

Even more spectacular phenomena have occurred in Soviet skies and are continuing to occur.

For example, a mysterious phenomenon of great magnitude occurred in the skies over the Soviet city of Petrozavodsk at about 4:00 A.M. on September 20, 1977. Petrozavodsk is in Soviet Karelia about 130 miles from the Soviet-Finnish border.

First, a gigantic mass of light flared up in the skies over the city, glowing brilliantly, and hovered there. Fantastic streamers of light poured from the glowing hemispherical dome of light and radiated down towards the city. Tass, the official Soviet news agency, reported that it looked like nothing so much as a shining "jellyfish sending down a multitude of fine beams." It gave, Tass said, "the impression of a torrential rain of light." Where these fine beams touched windows, many windows were broken or perforated with small holes.

Later the glow died down and the jellyfish became a single giant bright semicircle. It then gradually moved off in the direction of Lake Onega. But all was not yet over. Even after the bright hemisphere had moved away, great gray clouds appeared over the city with a semicircular aperture bright red in the center. These phenomena lasted for ten minutes or longer.

Being over the city and lighting up the sky so fantastically, the phenomena were seen by a large number of Soviet citizens and reported by them to the Soviet authorities. In fact, Tass admitted in its initial release that informative reports from witnesses were still pouring in and being analyzed. This interesting phenomenon is worthy of some remarks by way of explanation.

Not only is pressure from the Soviet threat transmitted through the collective human unconscious (ZARG) to the skies of Europe and North America; in addition, a backpressure is generated, which provides the impetus for initiation of appropriate phenomena over the Soviet Union and the Iron Curtain countries. Psychologically, it may not be accidental at all that the original shape resembled a giant jellyfish; the implication is that the psychotronic sting will also be transmitted to the Soviet Union by backlash whenever the Soviet psychotronic weapons are unleashed on the West. The shapes are also psychologically significant. First the Portuguese man-o-war's stings will be applied (this accounts for the tentacles toward the city); then the all-seeing eye (symbolized by the bright hemisphere) will check the results. And the results will be gloom and despair (gray clouds), surrounding death, blood, and destruction (the red center) left in the aftermath.

Thus in this materialized symbolic dream event of ZARG's, there is a clear warning and an omen to the Soviet Union about the end result that awaits it on its present course to attempt to conquer the world and unleash a great psychotronic barrage in the process.

Since so many Soviet citizens saw and reported this fantastic phenomenon in alarm, the Soviet regime could not ignore it or simply debunk it. The Tass release

thus tried the oblique dodge: the phenomenon was still being evaluated, reports were still being received and checked out, and an official of the Petrozavodsk observatory, Yuri Gromov, was quoted as saying the phenomenon was still a mystery but was confirmed by a large number of eyewitnesses. The Pulkovo observatory in Leningrad was quoted by Tass as speculating that the phenomenon was due to a meteor. And of course there one can expect the matter to be left in limbo.

An interesting development related to this UFO sighting occurred in the U.S. The October 3, 1977 issue of *Aviation Week and Space Technology* magazine carried a brief disposal of this phenomenon. The brief insert, Spook Show, referred to a "Soviet press ballyhoo" of the incident and stated that the incident was actually the launching of the Soviet Cosmos 955 classified military satellite from secret launching facilities at Plesetsk. This AWST insert is credited to Washington Staff.

My comment is that the launching of the Cosmos 955 may well have been the initiator of the event — a rocket firing does produce a tremendous ionized trail of burning exhaust gases rising up into and out of the atmosphere, and this is a bioenergy collector par excellence. However, a simple review of the time sequence of the phenomenon, its location, and its shape is sufficient to destroy any notion that one could mistake it for a simple rocket launch. And rocket launches had occurred there many times before, with no such phenomena or mass reportings by the population, and with no such news release by Tass.

FRENCH EXPERIMENTS WITH PSYCHOTRONICS

Aime Limoge in France is building some truly unusual gadgets that are being tested and that work. Limoge travels widely in the Soviet Union, and attempts to duplicate some of the unusual Soviet devices he has been permitted to see. Some of Limoge's devices have a partially psychotronic nature, although none of his reports mention this.

One of his gadgets, a portable and battery-powered electroanesthesia device, was considered for purchase by the U.S. Army.

Another of his gadgets is a magnetic inductor of hypnosis, which has been used in medical treatment by L'Institut de Recherche d'Electro-anesthesie. Limoge is reported to have seen such a device in the Soviet Union, possibly because one part of the Soviet psychotronics deception plan calls for the deliberate release of information of this kind, in a manner to suggest that this is the latest state of development in the USSR. In fact, their research efforts probably go far beyond this point. However, we should note that this device can be used as a most efficient brainwashing instrument.

DOWSING

To understand how dowsing works, we must first understand something about higher dimensional spaces. It should be evident that, if there is a type of energy being sensed by the dowser, that energy must be coming in or arriving from outside this three-dimensional world, since our ordinary science deals with the energies existing in this world, and none of these ordinary energies can explain dowsing. However, because of the work that has been done showing that dowsers are extremely sensitive to magnetic fields, this energy must be somehow related to the ordinary magnetic or electromagnetic fields known to science.

In the human being the mindworld must itself have a coupled kindling system to cohere its changes and kindle them into electromagnetic energy and energize the physical body. The body system which does a great deal of this is the acupuncture system of points, plexuses, and meridians. Also, all powerful emoters, such as the endocrine gland system, are deeply involved in the kindling of the biological organism's mind energies into electromagnetic energies to energize the physical body. The body and its biorhythms form a coherent tuner in the time channel to accomplish this kindling of time-nested vital thought energies into ordinary energy. Because a great deal of mind energy kindles into only a minute amount of normal electromagnetic energy, our minds normally have only a small effect in this particular three-dimensional world. So we can normally psychokinetically move a few electrons in our brain and nervous system, and generate an input signal to our otherwise inert physical servomechanism. Ordinary inert physics and amplification takes over from there, and we can only deduce the kindling as mental intent from observing many, many quanta of physical change, i.e., from macroscopic behavior. At any rate, the dowser has learned to detect, focus, and sense very fine levels of electromagnetic fields, which means that at these low levels the kindling of mental energies can represent a much greater percentage of the field than normal. Thus the practiced dowser can now discriminate many of the particular types of fluctuations or changes in these weak fields due to mind kindling.

Furthermore, I would like to point out that, since mind kindling comes into this universe orthogonally, normal distances do not apply. The entire physical frame appears to the mind world as a point, and thus is totally inside the mind of the operator/dowser. It is for that reason that a dowser can establish a coherent tuning (intent) between a map and the actual ground, or between a picture and an actual object, or between a rod and a person' physical body when sensing medical illnesses. In the mindworld frame, the dowser is only dowsing or detecting himself, and himself includes this entire physical world — the earth's surface and beneath it, the sun, the moon, the stars, or whatever.

Just as the body used electricity, magnetism, and electromagnetic signals long before man knew of their existence, it has used kindling of bioenergy from higher dimensional frames for a very long time, even though these have been unknown to mankind. And dowsing is a very old art indeed; the ancients used magnets without knowing of magnetic field, and they used dowsing without knowing of hyperspaces and hyperfields.

THE STROBE EFFECT

These five pictures show one of the more interesting effects demonstrated by many tulpoidal forms: strobing or "coining." What happens is that, much like a flat rock skipping across the surface of a pond, the orthorotating tulpoid skips in and out of its intersection with our three-dimensional frame.

In the first picture a glowing spherical tulpoid is shown to skip or strobe several limes while the camera shutter is open. It does not move in a linear pattern, but rocks around and back-and-forth.

In the second photo, an aerial photo, a UFO in photonic form (first bioframe) reveals itself to be strobing or skipping. (In university classes on the paranormal, I often refer to this type of action as *coining,* since it resembles a bright quarter or nickel that is photographed by stroboscopic light while rolling around.)

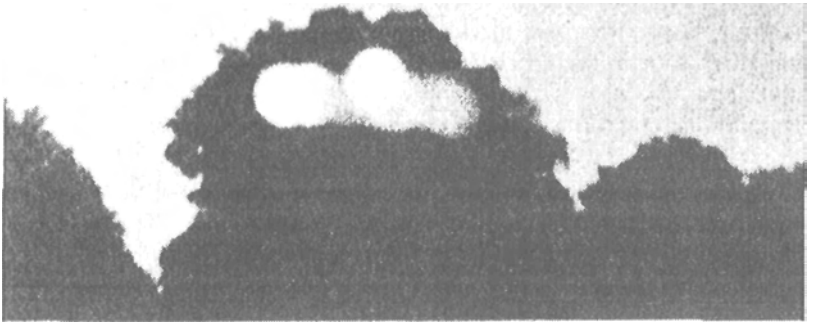

Photo 1

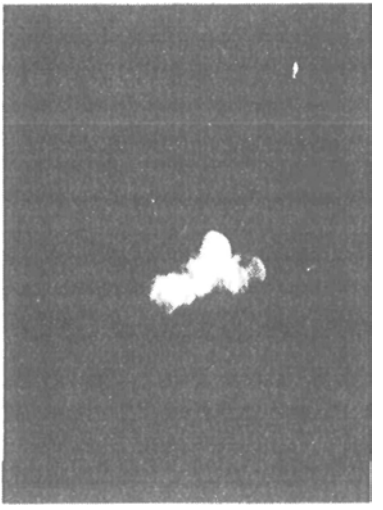

Photo 2

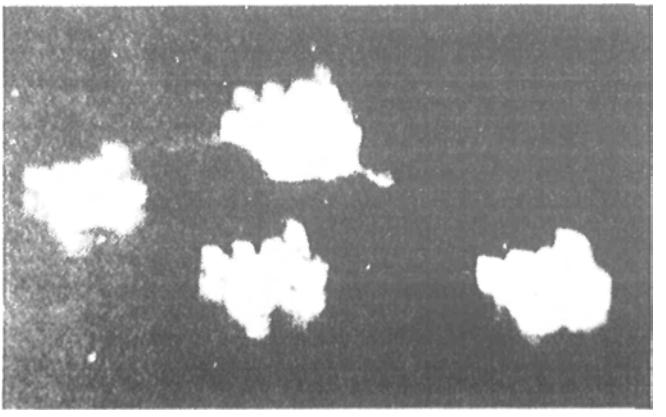

Photo 3

Photo 4

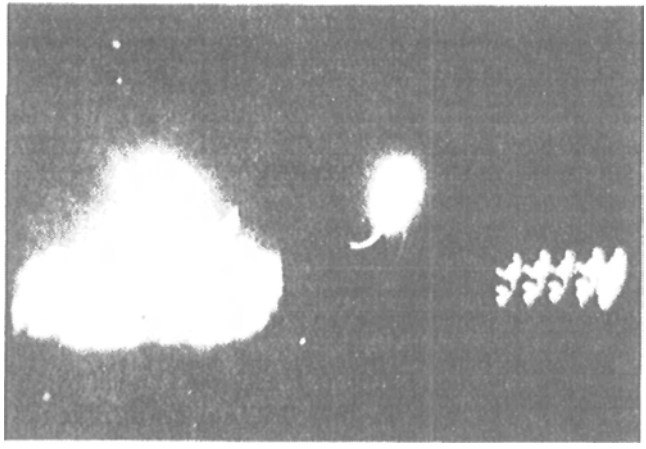

Photo 5

Photo 29. The strobe effect.

1. Even dischargo from Inert object (dime).

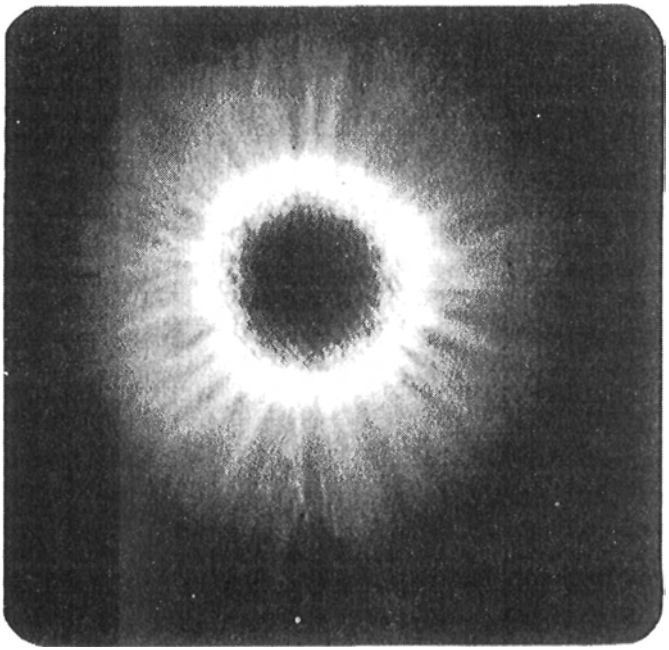

2. Healthy person in calm state

Photo 30. Kirlian photography.

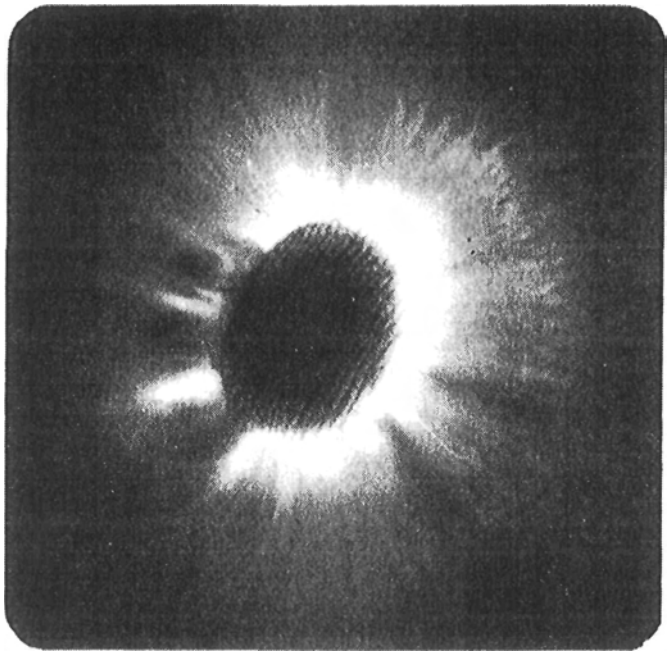

3. Person in meditatlon

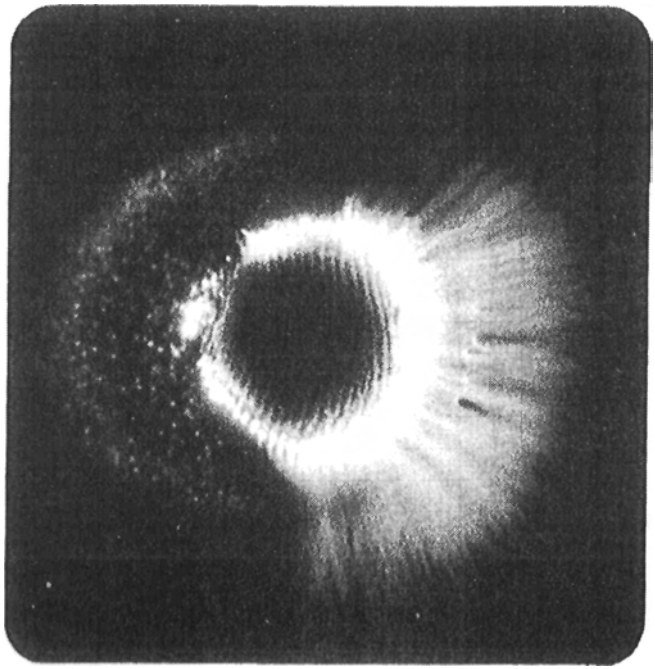

4. Angry person.

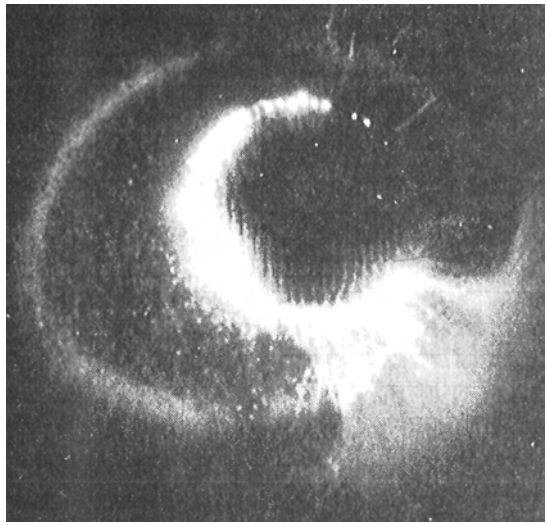

5. Person with London **flu.**

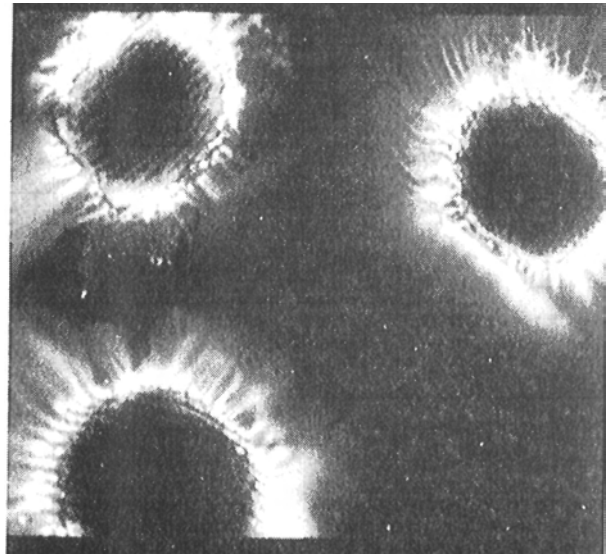

6. Interactions between three persons.

The third photo shows a more striated form. In fact, these forms show kindling and strobing at the same time. In addition, the physical size of the strobed intersection with our three-dimensional space changes during the photo exposure.

The fourth photo clearly shows both the striations due to strobing and also the variation in size of intersection in the zeroth frame by the hyperdimensional tulpoid.

Photo five again shows these effects, with the addition of the two "bursts" in the upper part of the left tulpoidal object and in the center tulpoid.

Significantly, psychokinesis also often demonstrates stroboscopic movement.

KIRLIAN PHOTOGRAPHY

These six pictures show some major characteristics of Kirlian photography: (1) an even discharge from an inert object (a dime); (2) a balanced, gentle, even discharge from a healthy person in a calm state; (3) a gentle outgoing discharge enhanced on one side, and a gentle indrawing on the other, from a person in a meditative state; (4) strong bunching and outgoing discharge from an angry person (the word "emote," after all, means "move outward"; (5) choppy (as if out of control) bunched and outgoing discharge from a person ill with London Flu, with strong suppression of the normal, relaxed blue component at the lower right; (6) interactions between three persons, showing differing degrees of outgoing and barrier reactions.

The film itself only records ordinary photochemical interactions; it specifically does not record the aura. However, changes in the discharge patterns can be and often are induced by kindling bioenergy into the first biofield (electromagnetic field), inducing changes in the sparking pattern and intensity. Furthermore, this can occur fairly readily on such a high voltage series of discharges, which are excellent collectors for kindling.

As a final note, it should be pointed out that David Faust *et al* have published a technical paper in the scientific literature detailing the fact that Western experimenters have not yet duplicated the Soviet equipment and methodology used in their Kirlian photography. While David formerly pointed out in *Science* that experimenters must carefully control the variables—particularly moisture (water is an excellent collector for kindling)—he has been widely misinterpreted as having proved that water vapor was responsible for all Kirlian effects. This he has not done at all, nor did he intend to, since he himself is one of the most competent investigators in electrophotography.

INTERACTION OF BIOFIELD, THOUGHT, AND SPARK DISCHARGE

These photographs are strong examples of the kindling mechanism. The subject tested was Uri Geller, a person with strong inceptive ability. In photo 1, the top two exposures are for control purposes, while in the bottom exposure, Uri is concentrating on the image of a circle. In photo 2, again there are two control exposures shown at the top, while in the bottom exposure Uri is concentrating on the image of a triangle. In photo 3, exposures are taken of Uri and a wristwatch; this is

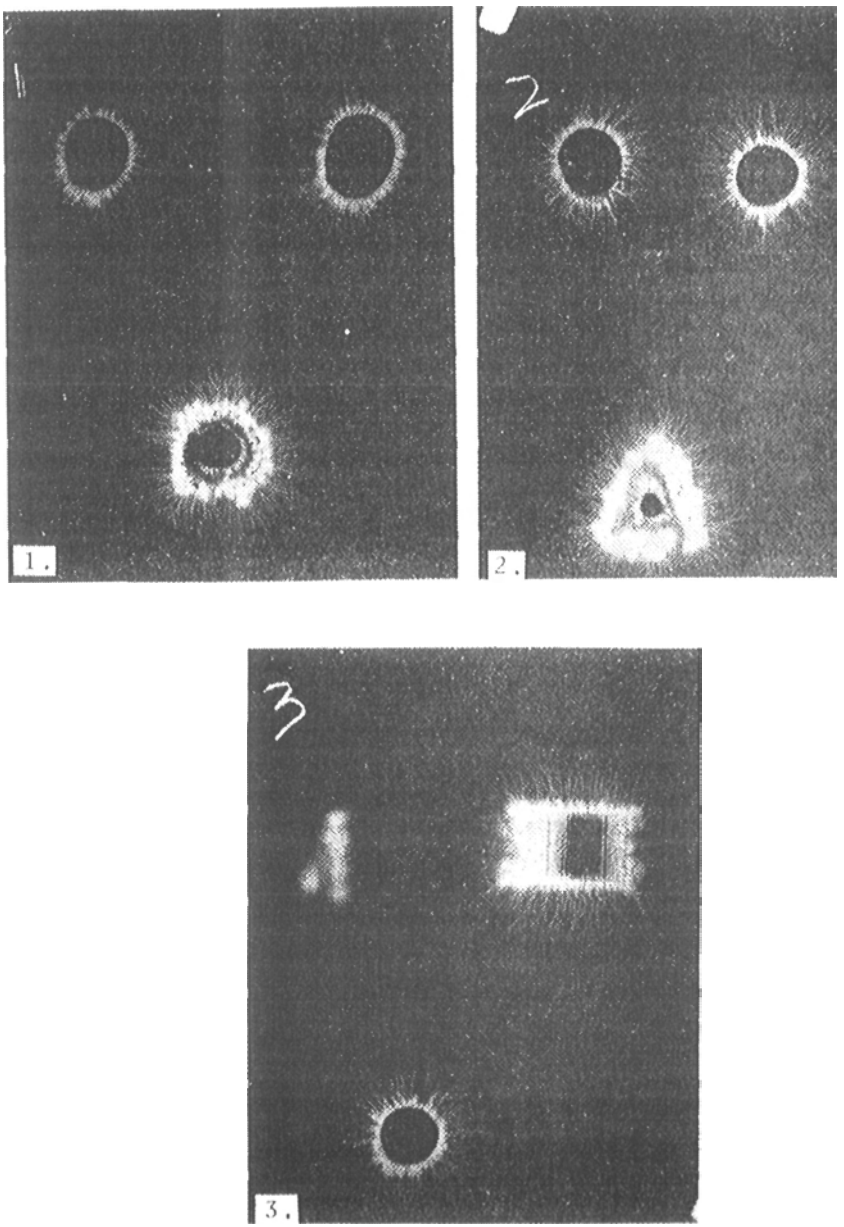

Photo 31. Interaction of biofield, thought, and spark discharge.

4.

5.

a control photo. In photo 4, Uri is attempting to send energy toward the wristwatch, and a correlated change in the discharge patterns from his finger is evident. In photo 5, the arrows at the right point to control exposure of Uri and a silver ring; the arrows at the left point to the exposure made with Uri attempting to bend the ring psychokinetically without contact. The direct kindling of bioenergy in a force-field line intersecting the ring is striking. In such an intense kindling, note that the nuclear currents inside the nuclei of the silver atoms — where positive charge is being shuttled back and forth between protons and neutrons — are also being strongly kindled. Reductions in the positive charges steadily reduce the charged exchanging particles to quarklike particles, severely affecting the structural integrity and crystalline lattice directions of the base metal. By this means metal bending — or even breaking — is accomplished.

KERVRAN EFFECT

A direct and repeatable experiment showing that living systems can kindle bioenergy into ordinary energy and material effects has been made possible by the fascinating work of Louis Kervran. Kervran showed that chickens, fed a diet deficient in calcium but containing excess potassium, will have no calcium deficiency, since they transmute some of the potassium into calcium. Kervran's pioneering work has been duplicated in Japan and elsewhere, and the same effects have been demonstrated by living plants.

We may consider a neutron as a sort of bound system of a potential proton and a potential electron. Psychokinetically killing the charge on the potential electron converts the electron into a neutrino, leaving behind a proton now freed. For the one percent or so of potassium that is a calcium isobar, this process can produce ordinary calcium. Thus in a potassium-rich diet the chicken can psychokinetically transmute enough potassium into calcium to remain healthy.

Kervran was nominated for a Nobel Prize in 1977 by the Japanese researchers; his work is direct proof of the ability of living systems to violate present physics, and of the ability of mind energy or bioenergy to affect matter psychokinetically.

PSYCHIC SURGERY

These two photos taken by Sigrun Seutemann in the Phillipines show materialization of large lumps of tissue brought about by Tony Agpaoa on a patient from an educated Western culture. The minds of both the patient and the surgeon are involved in the process, according to the psychic surgeons themselves. "Western patients are strongly conditioned to believe that medicine involves bloody tissue, so this is what results in the particular form of the materializations. For native patients who are steeped in the lore of shamanistic medicine, apports may consist of substances such as leaves, coconut fibers, feathers, etc.

The legitimate surgeons, working in a religious group structure, are often able to generate sufficient kindling to fully materialize such unconsciously structured thought forms, and also to dematerialize and rematerialize the tumor from inside the patient's body, the tumor usually appearing or emerging from an opening which appears in the apport tissue. In the surgeon's view he is also being helped by powerful spirits — and continual charging of such thought forms with kindled

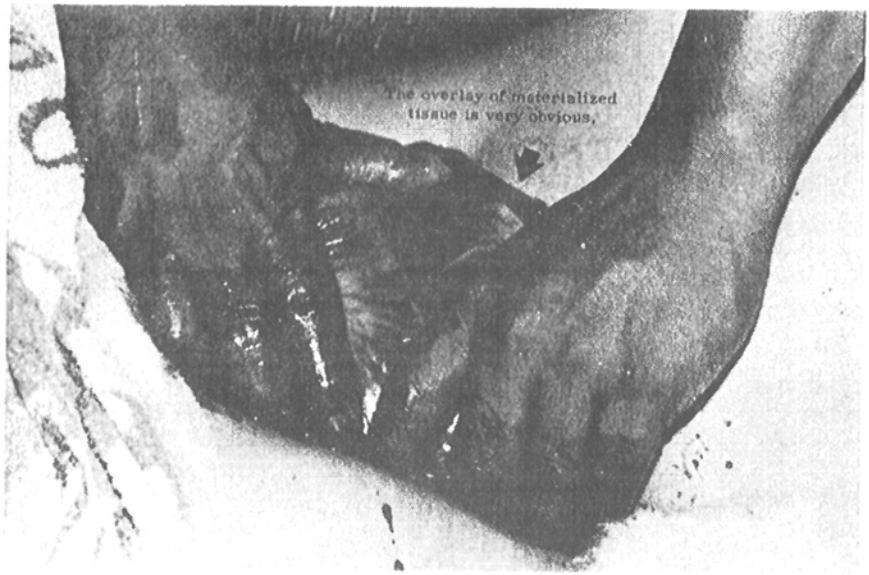

1. Materialization of apport tissue while removing a tumor from the abdomen.

2. Matoriallzatlon of apport tissue while working in the hip region.

Photo 32. Psychic surgery.

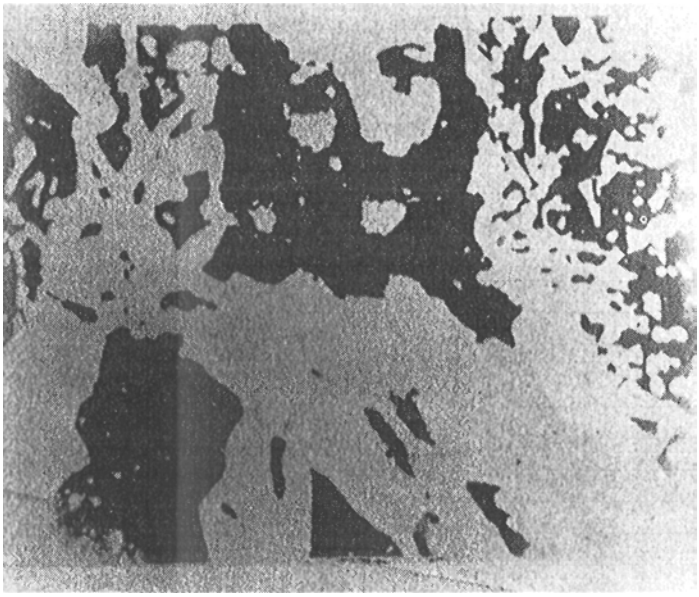

This highly unusual photograph resulted in the following manner: Mrs. Baune Is a devoutly religious lady, and on this particular day she had spent a great deal of time in prayer and a Christian attitude. Snow was gently falling on the shrubbery In her yard, and she and a neighbor were admiring the beauty of the fresh snowfall. The neighbor borrowed Mrs. Bauno's camera and snapped a photo of the snowfall. When the photo was developed, the falling snow had formed a pattern of Jesus on the shrubbery In Mrs. Baune's yard.

Photo 33. Kindling of thought bioenergy in snow.

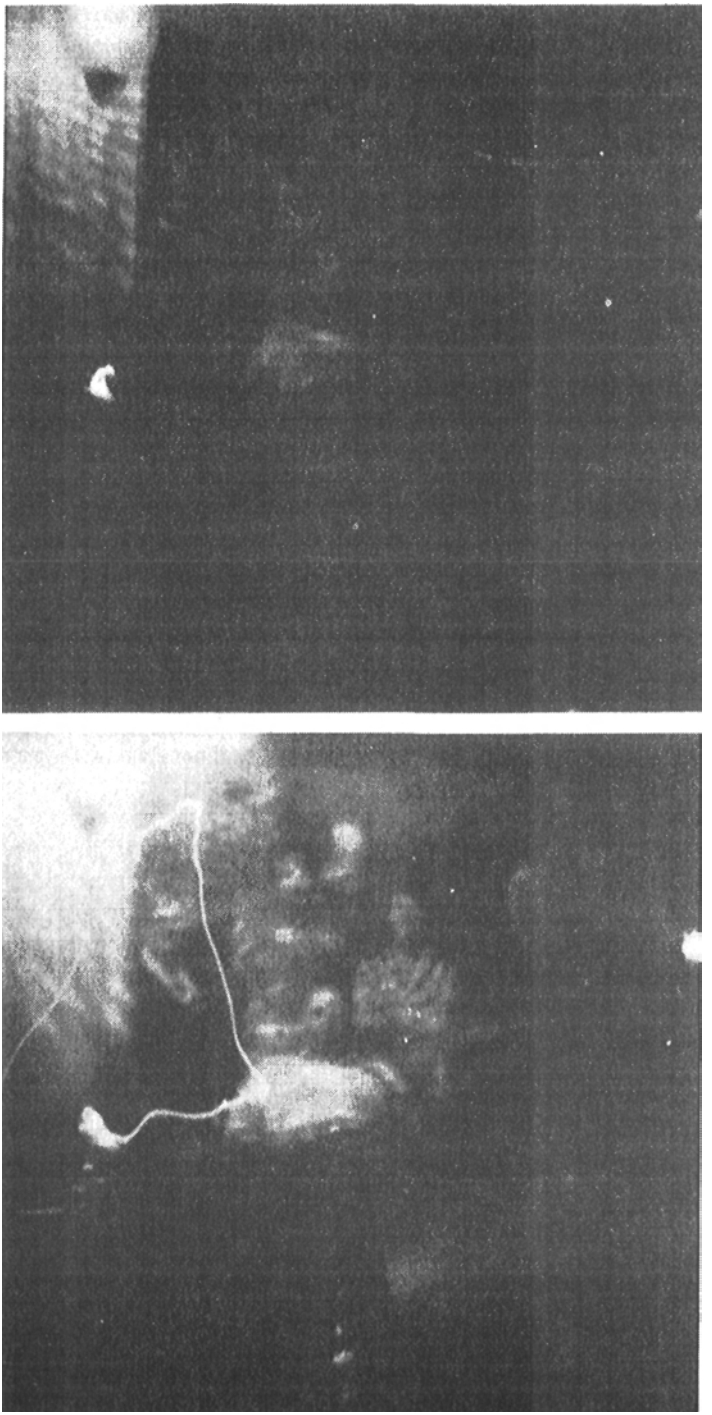

Photo 34. A deliberate experiment with kindling.

energy indeed can yield bioenergetic formats of more intense energy than a single talented individual can usually muster in an unaided or unaugmented state. Almost every religion, in fact, still occasionally exhibits miracle healing accomplished in somewhat similar fashion, though possibly less dramatically.

The apport tissue is a materialized tulpoid, precisely as are sasquatch, the yeti, the Loch Ness monster, and UFO's. Apports are normally more stable than these latter materializations — but they have also been known to disappear, as have the "angel hair" apports associated with UFO's.

A DELIBERATE EXPERIMENT WITH KINDLING

I and other members of the American Association of Meta-Science performed a series of experiments in kindling thought or psychic energy into electromagnetic energy, and photographed the resulting light energy on film with an SX-70 camera. The two photos shown here are from one of those experiments. In the left picture, bioenergy is just at the "burst" point where it is being collected on a candle flame. Here the camera lens is not quite fully opened. Only a single 40-watt lamp illuminates the room, and several AAMS members have been engaged in about two hours of psychic exercises. In the second picture, the lens of the camera is fully opened, and a "burst" of kindled energy occurs as the lens shutter is operated. None of this is visible to the naked eye. The polaroid film, however, is sensitive to some infrared and ultraviolet frequencies, so that bioenergy kindling into electromagnetic energy at IR or UV frequency can be photographed even though not seen by the naked eye.

FAY CLARK'S "FIREFLIES"

Fay Clark experimented with an ultrasonic generator in a darkened fallout shelter and photographed the most interesting results. At one particular frequency, dynamic dots of light appeared, grouped themselves into formations, and demonstrated movement and growth. At times they seemed to respond to thought, as if they were somehow intelligent, sentient creatures. This is a beautiful case of kindling using ultrasonic frequencies as the collector mechanism. While Fay is no longer sure of just exactly which frequency produced the fireflies, he does know that he used frequencies in the 38—40 kilohertz region, among others. This may be significant, since the Vestigia experiment encountered electromagnetic frequencies in the same region in their historic study of a mystery light. The frequency region 38—40 kilohertz is a strong candidate for one of the magic window frequencies between bioframes where kindling is much easier than at other frequencies. Furthermore, since it is thought energy or mind that is actually being kindled, one would expect the possibility of sentient behavior. Clark's experiment occurred in the dark, so the squelching effect of visible light was not present. Finally, Fay Clark is a known psychic himself, and so this should have eased the kindling difficulty even further. The value of rigorous laboratory experiments based on the lines of Fay Clark's pioneering "firefly" experiment is strongly indicated.

"FOO" FIGHTERS

When large groups of people are under strong external pressure, one result is often tulpoidal "popouts" from the collective human unconscious.

A war is a typical example of a situation where the group consciousness of a country is under enormous pressure. In such a situation, the "targeted" population is often exposed to tulpoidal manifestations from time to time.

In World War II, for example, the Germans thought at first that the glowing lights darting around their planes were secret Allied weapons; and the Allies thought the same thing of the Germans when they saw such unusual phenomena. The French dubbed them "feu" (fire) fighters, which became "foo" to American soldiers in Europe.

"Foo" fighters were a common phenomenon in World War II, particularly in cloudy, overcast skies.

WATER MONSTERS

In the oceans and in every large body of water on earth, water monsters have been reported for centuries. Loch Ness in Scotland is of course one of the most publicized examples, but creatures of different shapes and sizes have been seen in large lakes and streams everywhere. This is not at all surprising when one realizes that a large body of water is a most excellent kindling reservoir, and bioenergetic forms are more readily kindled in such locations.

The large dead creature in photograph 36 was hauled off the bottom of the sea by Japanese fishermen in their nets, photographed, and then thrown back to prevent contamination of the catch of fish and to get rid of the stench from the decaying carcass. It is a pleisosaurlike creature's remains, not similar to anything else known on earth. Predictably, scientists were almost immediately at odds as to what it was, and the carcass has been called a shark, a whale, a large elephant seal, a genuine pleisoaur, etc., by various "experts." Nonetheless it was real and physical, and a good photograph was obtained of it.

Photograph 37 is one of the underwater photographs of the Loch Ness monster taken by a team from the Academy of Applied Science, Boston, Massachusetts on June 20, 1975. As can be seen by a detailed study of the photograph, this tulpoid is not clearly tuned or clearly formed. Many other photos of the Loch Ness monster have been taken, and various shapes and sizes and degrees of tuning have been recorded. In the Doc Shiels photos taken in 1977, Nessie is well formed but entirely different from the Academy photo. Also, Doc Shiels' photo was subjected to computer analysis by Ground Saucer Watch, and the image exhibited a transparency that was disturbing to the analysts. On the other hand, such a transparency is to be expected from a partially materialized tulpoid which is not completely ortho-rotated into the zeroth bioframe.

In the Academy photograph, one can see — particularly on the color original — a form which has several conglomerated faces, which exhibits eyelike structures in several locations to suggest first a cowlike face and then a horselike face, and incoherently tuned earlike and hornlike appendages in several places. In fact, the Academy photo bears little resemblance whatsoever to a pleisosaur or any other more normal and coherently structured mammal or fish.

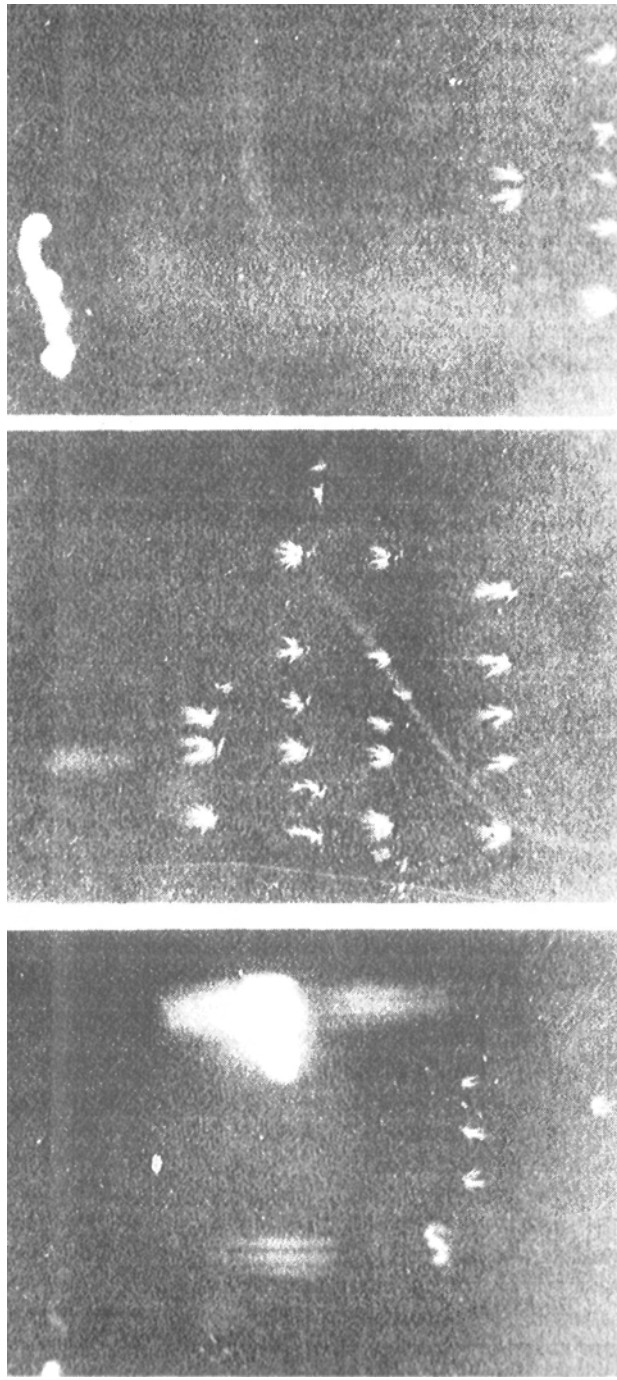

Photo 35. Fay Clark's "fireflies."

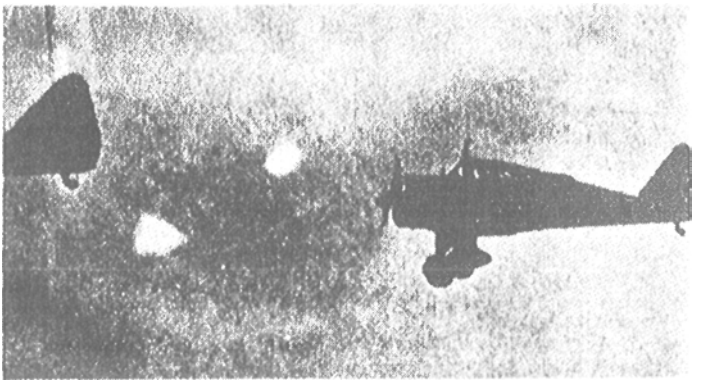

"Foo fighter" tulpoids pacing Allied aircraft in World War II.

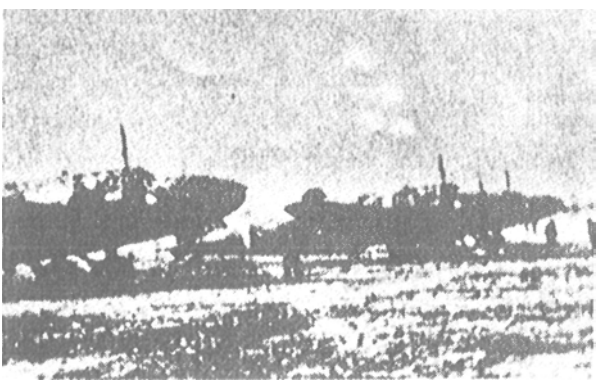

"Foo fighter" tulpoids over an airfield in China in World War II.

Photo 36. "Foo" fighters.

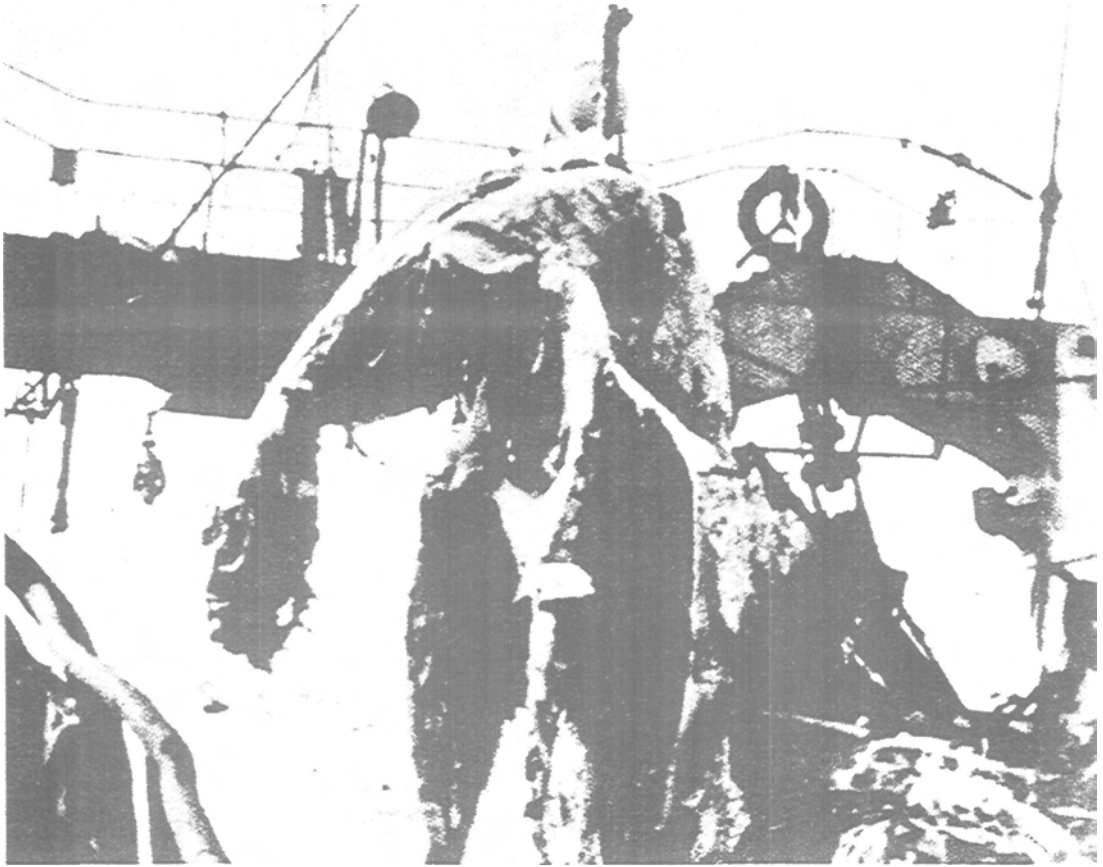

Photo 37. Pleisosaur-like creature hauled from the sea by Japanese fisherman.

The Loch Ness monster is definitely a tulpoidal form, and the format varies appreciably from reception to reception due to distortions and variations in tuning. Nessiteras rhombopteryx is a much stranger beast than anything the dedicated Nessie seekers, researchers, and scientists have yet suspected. In Part Two I will examine the scientific basis of tulpoidal forms.

CATTLE MUTILATIONS

Over 9,000 cattle mutilations have occurred in the U.S. alone since 1973.

The cow is a female symbol par excellence — our children drink cow's milk, and our babies feed on the milk from the cow's breast. The U.S., being a natural fortress, is a "female" symbol, for in primitive human evolution the females stayed in the cave or protected fortress while the males went forth to hunt or do battle. (This symbolism will be fully discussed in Part Three.) Violation of the female means that the heartland U.S. shall be violated.

Teats are cut off — the children of the West shall lose their sustenance; lips, ears, and tongues are removed — freedom of speech and hearing shall be excised; sexual organs are removed — no more fruit of the womb shall be evidenced in the West; sharp, surgical incisions are made — the operation shall be accomplished swiftly (blitzkrieg war) with surgical precision; zig-zag cuts — deception shall be used as to direction and intent; blood is totally drained — the lifeblood of the West shall be totally drained; edges of the cuts are often seared as if by a laser — advanced, futuristic weaponry (psychotronic weapons) shall "seal the end."

The cattle mutilations are materialized precognitive nightmares indicating the horror of the Armageddon to come, and these nightmarish paranormal mutilations reveal the true nature of the times. Yet no orthodox scientist or governmental agency is equipped or able to deal with a phenomenon such as this.

In ancient times the wise men knew how to do a metapsychological analysis of the species unconscious, and knew that tulpoidal phenomena were often symbolic signs of that which was to come.

Where are our wise men today?

BIG MAMA

UFO phenomena have also been associated with the cattle mutilations. One of these UFO-type tulpoids has been labelled Big Mama, because of its characteristic behavior of spawning smaller UFO light-shapes that split away and speed off to an area in which a cattle mutilation then occurs. The "spawned" UFO's then return and link up or join with Big Mama, and Big Mama then withdraws.

The photo shown here is a typical appearance of Big Mama. Big Mama takes many sizes and shapes, but is a fairly reliable indicator of paranormal cattle mutilations impending.

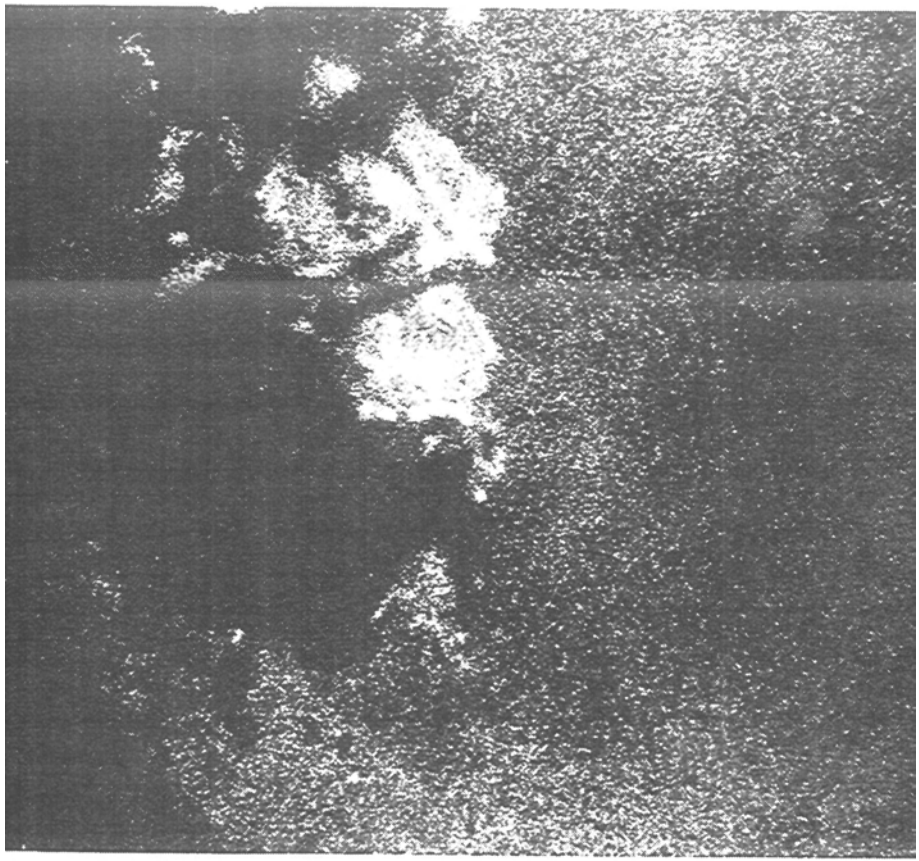

Photo 38. Loch Ness monster.

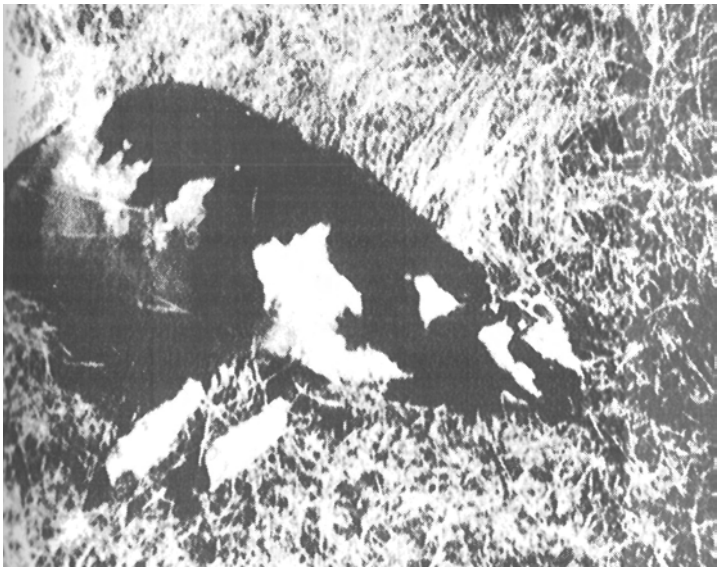

Photo 39. Cattle mutilation.

During the summer of 1978, two psychics and I — all members of the American Association of Meta-Science spotted a Big Mama-type UFO from the top floor of a hotel in Louisville, Kentucky. Realizing what it was, we promptly brought into play a certain type of powerful psychic exercise and tried to make it dematcrialize and vanish. Several times it briefly split into pieces (five to be precise), but we were unable to extinguish it. Over a period of approximately twenty minutes this effort continued, and all the while Big Mama slowly moved lower and further away, eventually disappearing behind a tall building after having become very distant.

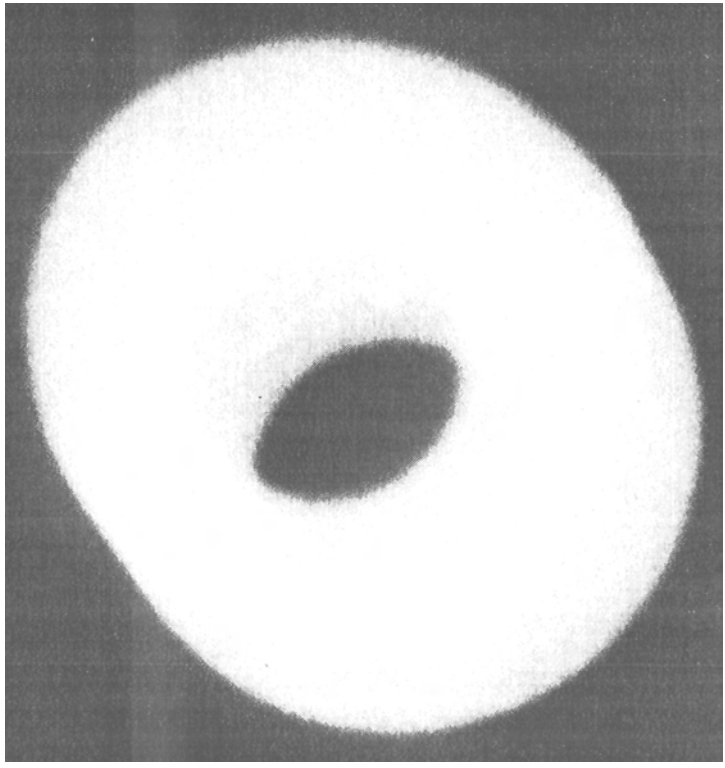

Photo 40. Big Mama.

PART TWO

A THEORETICAL BACKGROUND FOR UNDERSTANDING PT, UFO'S, AND PSI PHENOMENA

Footnote for page 132:

'With the exception that, in my theory, the orthogonal universes crosstalk with each other at virtual (subquantum) levels. Indeed, 'change' in one universe consists of the quantum coherence in that universe of crosstalk in and out of it. The 'virtual state' in one universe is due to, and consists of, subquantally coherent (quantally incoherent) crosstalk in and out of that universe.

Psychotronics, unidentified flying objects (UFO's), and paranormal phenomena such as psychokinesis, telepathy, and precognition all have one thing in common: both mind and matter-energy are involved.

Hitherto, mainstream science has insisted on a rather arbitrary separation of mind and matter-energy. However, as we shall see, this separation is not based on good observation. For example, everyone exhibits in himself the ability of mind to affect matter. While theories of computers, control systems, and physics can explain human behavior once the physical system has been given an input signal, the original signal — intent, or what I call inception — is an unexplained mystery to ordinary science.

"Psychotronics" (a Czechoslovakian term) and "psychoenergetics" (a Soviet term) have been specifically designed to provide a framework for approaching the problems of mind, matter, and their interaction. If we can understand psychotronics, we will be able to understand better the interaction of mind and matter, including all paranormal phenomena, unidentified flying objects, and Fortean phenomena.

Let us therefore start by defining psychotronics. The prefix "psycho" refers to the mind. The suffix "tronics" refers to physics and physical devices. Thus the concept of psychotronics refers to a union of physics and metaphysics. Such an audacious concept can offer a solution to almost every present problem in metaphysics, the foundations of logic, the foundations of physics, and the foundations of mathematics.

To begin with, it seems necessary to form a unified theory of mind, matter, and their interaction. It also seems necessary to reinterpret and extend electromagnetic theory. Logic itself must be advanced, for a part of reality, although "illogical" according to our present logic, is nonetheless true. In metaphysics we must solve formidable problems: the ontological problem (nature of being); the problem of mind, and the interaction of mind and body; the problem of change; and the problem of nothing.

It has been said that fools rush in where angels fear to tread. To tackle the problems of psychotronics demands the audacity to rush in where even fools fear to **tread!**

At this time, it may be appropriate to point out that all Western science, mathematics, and logic are founded upon three simple laws of logic, proposed and formulated by Aristotle. Since the entire universe cannot be described by these three laws — parts of reality are known to violate one or more of them and hence be illogical though true — it appears that we must be audacious enough to tackle and change the three laws of logic, if a new paradigm is to be constructed to solve all the presently unsolved problems.

SOME UNEXPLAINED MYSTERIES OF PHYSICS

First, no one knows what mass really is; we do not know for sure whether inertial and gravitational mass are one and the same. General relativity says it is, **and** we know from experiments that if any difference exists between inertial mass **and** gravitational mass that difference is very small indeed. But we do not know positively that there is not some small but finite difference. And we have no idea

why the mass of a moving object increases with respect to a static observer. It is simple to calculate in special relativity how much the mass increases as a function of the velocity, but no one has the foggiest notion why this happens. Particularly so since an observer standing on the moving object and moving along with it sees no increase in its mass at all.

This poses a real paradox; if we try to assign some absolute notion to the idea of mass, then any object has an infinite number of masses, all at the same time and all different. There are two ways to determine mass: (1) by its resistance to a disturbing force, and (2) by its ability to occupy three-dimensional space. The latter requires that mass be volumetric, i.e., that mass be L^3 dimensionally.

But look at the weird properties of a photon! If we measure its resistance to a disturbing force, we find that no force on earth can accelerate or decelerate the photon. If we measure the mass of a photon by the first method, it appears to have infinite mass. Yet if we measure it by the second method, it can have no mass at all, because a photon is not volumetric; it is two-dimensional. It therefore has infinite mass and zero mass simultaneously.

Furthermore, we can take the viewpoint that whatever its mass is, it can only have one. If that is so, then infinite mass and zero mass must somehow be the same thing! Which contradicts the three laws of logic. However, this should not concern us too greatly; many things contradict the laws of logic and are nonetheless true. So while it is presently "illogical" for infinite mass and zero mass to be identical, we should hold on to the idea that this may very well be true.

Additionally, one of the great cornerstone assumptions in physics is that gravitational field and electric field are mutually exclusive — i.e., they are totally different things. Yet a physicist named Santilli has proved that this is not so, and that they are either partially the same thing or totally the same thing. And there the matter stands, so we do not fully understand what electric field and gravitational field are, or how to go about turning one into the other, although Santilli's work seems to imply that this is at least theoretically possible. We must therefore invoke a new concept of reality.

URI GELLER

Uri Geller has demonstrated numerous capabilities: he has affected a magnometer inside a Faraday shield; bent and broken metal objects; caused a fresh flower to wither and dry in seconds; permanently changed the crystal structure of nitinol; altered magnetic programs on computer cards; influenced a Geiger counter; dematerialized matter; and demonstrated the inceptive Cyborg effect, thought-photography, telepathy, and the Geller effect (the sympathetic stimulation of a psi-positive).

It is useless to attempt to explain the feats performed by Uri Geller in terms of the ordinary fields and effects of known physics. Nothing short of a new physics paradigm will suffice. This new paradigm must encompass both mind and physics within the same theoretical framework, if it is to succeed in explaining how mind affects matter.

In terms of present physics and logic, the mind is regarded as totally separate from matter. For mind and matter to interact, some aspect of mind must be the same as some aspect of matter, i.e., to move matter, a force is required. Force is the time rate of change of momentum. To generate a force capable of moving matter, mind must be able to change momentum. But since momentum can only be obtained from something which possesses momentum to give up, then the mind must somehow possess momentum.

If this is so, then the momentum must ordinarily exist in a separate three-dimensional space, since it apparently does not ordinarily exist in laboratory three-dimensional space. Such a situation requires at least six spatial dimensions and one common time dimension, such that the mind (mental phenomena) is a set of objective physical phenomena existing in an ordinary objective three-dimensional space, but one which is three orthogonalities away, spatially, from the laboratory three-dimensional space.

Mental changes upon physical objects would thus imply orthogonal rotation of mental objects from the mental three-dimensional space into or closer to the laboratory three-dimensional space. Everett's many-worlds interpretation (MWI) of quantum mechanics contains a structure where such representation is possible, and the MWI is consistent with the entire experimental basis of modern physics. Thus from the MWI it is possible to objectively model the mind and matter, and from that, psychotronics as well.

MY APPROACH TO PSYCHOTRONICS

In twelve years of intensive work on this question, I have evolved a conceptual approach, which is consistent with present physics but extends it. A new concept of reality is involved, however, and severe demands are made on the individual to stretch his framework of comprehension. The perceptron concept is an abstraction that allows the modeling of perception itself— either mental perception or physical detection. The fourth law of logic (to be explained shortly) involves the age-old identity of opposites whose apparent necessity has baffled logicians, philosophers, and scientists for centuries. With the perceptron concept, we can at last comprehend how the identity of opposites is accomplished, and when it is accomplished.

This immediately solves the age-old philosophical problem of change. The fourth law also closes logic into a complete, closed metalogic, encompassing both physics and metaphysics.

Let us use as a definition of reality: *reality is that which can be conceptually and mathematically modeled and fitted to the phenomena existing in one or more minds.* Physical reality is that which can be modeled and fitted to the phenomena existing in all minds. Mental reality can be modeled and fitted to the phenomena in one mind. Mental and physical realities comprise "normal" reality. Complex or "paranormal" reality is that which can be conceptually and mathematically modeled and fitted to phenomena which exist in more than one mind, but not in all minds.

From perception theory I have succeeded in deriving a great deal of the present basis of physics, including Einstein's two postulates, Newton's laws, the law of gravitation, and the solution to the ontological problem. (Unknown to me at the time, Ives had already done so for Newton's laws, the law of gravitation, and Ein-

stein's postulates. His work has unfortunately been ignored.) In addition, the photon can be seen to be an ordinary three-dimensional particle existing in a three-dimensional space that is orthogonal to the laboratory three-dimensional space frame. A stationary particle in the laboratory frame appears as a photon to the orthogonal spatial frame.

Einstein's second postulate is usually stated as "the speed of light is the same for every observer." Restated, this becomes "every photon in an inertial frame is moving at the speed of light, c, with respect to every particle in that inertial frame." The corollary then follows immediately: every particle in that inertial frame is also moving at the speed of light, c, with respect to every photon in that inertial frame. In a single three-dimensional space, this is incomprehensible. Taking two orthogonal three-dimensional spaces, with the photons in one frame and the electrons in the other, it is perfectly comprehensible.

From pure nothing — empty vacuum, absence of thing — one can generate everything, the presence of thing. Here is direct proof that ultimately opposites are identical. But to a mind rigidly programmed in three-law logic, such a truth is abhorrent. Physicists consequently have done nothing with the idea that all our physical laws — or at least most of the great ones — can be straightforwardly derived from a special kind of a "piece of nothing" which I call a quiton. And they have not seen that this constitutes a statement of a fourth law of logic—the identity of opposites on their common boundary.

It is interesting to note that the paper which was handed to an American reporter, Robert Toth, by a Soviet scientist, and which caused the KGB to seize Toth and charge him with receiving Soviet state secrets, contained just such a theory as the basis of a unifying theory of psychotronics. Yet none of our intelligence analysts seems to have picked up the overwhelming importance of what was in the paper, and Toth himself appears to believe that his KGB arrest was simply harassment. In fact the paper did contain material on the basic Soviet approach to psychotronics — and thus to psychotronic weapons — and it was indeed state secrets that had been given to Toth.

Everett's many-worlds interpretation of quantum mechanics, with which very few physicists are familiar, provides a needed correction to the conventional monocular interpretation of relativity, and it allows a theoretically sound basis to be constructed for psychotronics.

The conventional interpretation of relativity considers only a single observer at a time. But if you can accept so simple a concept as that both you and I exist simultaneously, regardless of how we move with respect to each other, then I assure you that physics is startlingly different from what you may have studied in the ordinary university physics text book.

Everett, originally a student of the world-renowned physicist Dr. John Wheeler at Princeton, for his Ph.D. thesis considered the problem of multiple simultaneous observers and worked out what this did to physics. His highly innovative thesis provided a totally new interpretation of quantum physics and defined a startling new kind of reality in which all possibilities are physically real and exist. This new physics is indeed very strange, but it is totally consistent with the entire experimental basis of physics today.

I discovered that all my perception theory could be fitted precisely onto Everett's many-worlds interpretation.[1] On that basis, a theory or schema of bio-

fields was derived that provides an approach to a unified field theory. In fact, it predicts that any kind of field can be turned into any other kind of field, merely by correct and precise time synchronization. It also offers a physical and exact model of mind and mental phenomena and a mental and exact model of physical phenomena!

On this basis, a framework can be provided for psychotronics which is consistent with what we know of ordinary physics but which does not contain many of the limitations of ordinary physics. In a strange sense Everett wrote the physics for the all-mind or the Supreme Creator's mind because an unlimited mind, so to speak, must already have thought of everything possible, and for an all-creative mind to "think" a possibility is for that possibility to be real.

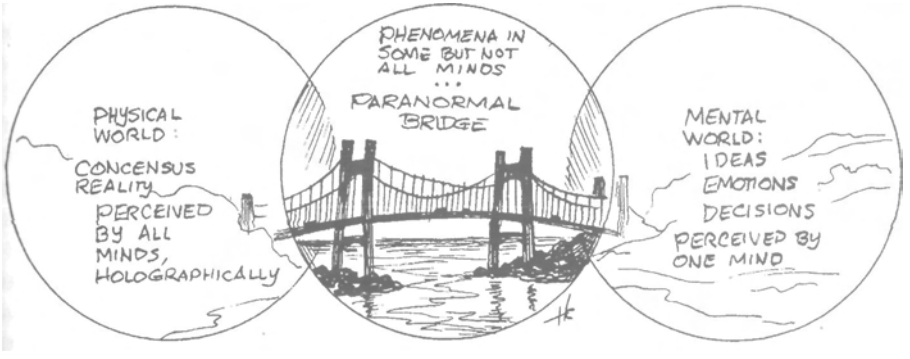

Fig. 3. Reality: a paranormal bridge with two ends

1. Reality as a Paranormal Bridge with Two Ends

In Figure 3, I show the nature of the problem of paranormal phenomena. To understand it, we must first define more precisely some of the present concepts.

First, what do we really mean when we talk of "physical phenomena"? To go into this, we must first destroy the notion that there exists some sort of separate, concrete reality totally apart from mind, for that notion is simply the old Cartesian assumption. It has long been refuted as far as having any absolute validity, and this is well-known to philosophers and to foundations physicists. According to Lindsay and Margenau in their *Foundations of Physics*, "physics has nothing to say about a possible real world lying behind experience."

What is true is that we can experience and detect and know only a mental change — a change in the mind itself is all we ever experience directly. For experience invokes the mind; we do not experience phenomena until the mind — used in the greater sense of the word to mean any mental detection — changes.

Any detector detects or experiences only an internal change, never an external change, and this is true of the mind as well as a physical detector.

So we never experience external physical phenomena; we experience only our own minds. Specifically, each of us experiences his own mental phenomena.

But here we must be a little more precise about what we mean by "mental phenomena." What we usually refer to are the mental phenomena in a single mind. And so we will take that as the primary definition: *mental phenomena are the phenomena or changes in a single mind.*

But then what do we mean by "physical phenomena"? For indeed this refers to something that is often remarkably different — or seems to be — from the phenomena or changes going on in our own heads. Before we jump to the extreme conclusion that physical phenomena are simply mental illusions, we should recall the Zen master's approach. He demanded of the student whether or not physical phenomena were real, and the student replied that they were not real, but only illusions. Whereupon the master gave him a resounding knock on the head, and asked him whether or not the blow was real. The student replied that the blow was indeed real. Whereupon the master sent him back for further meditation, for he had learned nothing. He had not understood that "mental" and "physical" are not mutually exclusive.

If we look closely at how we may differentiate between mental phenomena and physical phenomena, we immediately hit upon a practical scheme. Physical phenomena can be shown to exist in the mind of any observer, be he human, insect, or whatever, so long as he has consciousness.

Suppose for a moment that I have a piece of chalk in my hand, held between my fingers. I can touch the chalk, feel it, and see it. I can even taste it if I wish. And so I hold up the piece of chalk and say: "This piece of chalk is not just a mental impression, it is physically real." How can I prove it? And when I prove it, what exactly have I proved?

Now suppose you do not wish to believe the chalk is real. You simply bring in another observer; he looks at the chalk, he touches it, he tastes it, and he rolls it between his fingertips. He confirms that he also detects or experiences the chalk. Then a little bug flies in and lands on the chalk, crawling around on it, and poking at it with his little proboscis. He also by his actions confirms that he has it in his own little mind. In fact, we could bring in any sort of mind, and that mind could experience the chalk.

And this of course is the clue. What we have been calling physical phenomena can be shown to exist in every mind. And when we say something is physically real, this is all we actually mean. Nothing more, nothing less. And this is why physical phenomena are so solid and concrete; they are infinitely repeated. However, what we refer to as mental phenomena are in only one single mind and thus are not repeated at all.

Now let us do a little thought experiment. Suppose I have lapsed into some peculiar mental state because of the toxins from an infection I have contracted, and I am hallucinating vividly. Suppose I pick up what I vividly see, feel, touch, and taste as a piece of chalk, and I claim that it is real. Indeed, to me it is very real. And then suppose a second person comes into the room. He will not see the chalk, touch it, feel it, taste it, and it will not be real to him. Then suppose a third person comes into the room, and he does not see the chalk, he passes his fingers right through where I am seeing the chalk and does not contact or feel it, and he indeed cannot find it. Thus what we call a "mental phenomenon" can be shown to exist in one mind only. In this case of a vivid hallucination, the hallucinatory phenomenon was absent from the other observers' minds.

But now let us change our thought experiment a little. Suppose now that I am absolutely fit and fine physically and mentally, and am not hallucinating. And suppose all the observers we bring in are also fine both physically and mentally, and not hallucinating. And suppose we get the following results: some of us can see,

touch, taste, and experience the chalk, and others of us cannot see, touch, taste, or experience it, no matter how we try. In that case, what kind of phenomenon do we have?

Well, we cannot exactly say the phenomenon is exclusively mental or exclusively physical. But we also cannot say that it is exclusively nonmental or exclusively nonphysical. In fact, we have an example of a third class of phenomena which are presently not recognized by science. *We simply have a paranormal phenomenon,* one which can be shown to violate our definitions of mental phenomena and physical phenomena.

And we can in fact take this as the definition of a paranormal phenomenon: *a paranormal phenomenon can be shown to exist in more than one mind, and it can also be shown not to exist in one or more minds, i.e., paranormal phenomena exist in more than one mind, but not in all minds.* Our conventional science recognizes purely mental phenomena and purely physical phenomena; it does not recognize the third kind, since by the ordinary three laws of logic the third kind does not exist. Paranormal phenomena constitute a bridge across a river between two banks; our present science does not recognize the bridge, but only recognizes the two banks, as shown in Figure 3.

Paranormal phenomena thus appear erratic to ordinary objective science, for objective method after all is specifically designed to select only those phenomena that can be reliably repeated, and the nature of paranormal phenomena is such that they often (in fact usually) cannot be reliably repeated, except sometimes in a great many trials. Normal objective method, if rigorously applied, can only discriminate a statistical effect from a great many trials. Furthermore, if rigorously and lengthily applied, it will accumulate so many failures that it will cast serious doubt on whether the odd case that was paranormal was in fact nonaccidental.

It is for this very reason that orthodox science, which is devoted to scientific method and rigorous protocol, has remained so comfortably adamant that paranormal phenomena do not exist. The tool must be changed to fit the problem, and the present scientific toolbag does not fit precisely. The tools are useful, but they themselves are not decisive within the bounds of present protocol. The necessary change is quite simple: we must allow for the effects of mind, and for a union of both mind and physics, just as there exists in physics a union of both wave and particle. In other words, paranormal phenomena must be repeatable *sometimes,* by competent experimenters and observers, but not necessarily *always* by all observers.

"Ah ha!" the materialist is likely to exclaim, being unable to contain himself any longer. "Solid concrete reality always is solid and concrete, however, and you cannot change that. As long as that is true, then the laws of ordinary physics hold, and all is right with the universe. We can always select our phenomena which are present in all minds, and this after all constitutes immutable physical reality. In the luce of that fact, all your arguments about mental phenomena in one mind and another kind of half-mental, half-physical phenomena are meaningless, for you are simply calling the superposition of purely mental phenomena on purely physical phenomena a third class, but it is a separable mixture, not a completely new kind." And we may even be tempted to stir up a small bit of sympathy for the materialist's view.

However, let us propose a resolution. If we can show that concrete, solid, real

matter can become absolutely nonconcrete, nonsolid, and hence nonphysical, then that ought to settle the question. In a recent experiment it has been conclusively shown that two colliding protons pass right through each other in total violation of all physical rules, if their spins are exactly antiparallel. Protons are the central building blocks of all matter. In the nucleus of an atom, the protons and neutrons are continually switching identities, so even a neutron keeps turning into a proton, etc. And these fundamental constituents of everything solid and concrete and real just go right through one another, without any effect whatsoever, simply by aligning their spins properly. Collision theory fails, electromagnetic theory fails, and our concept of two particles bumping together fails. This experiment totally annihilates the idea that physical reality is something absolute. In fact, it establishes that physical reality itself is a function of the relations between the interacting participants; changing the relationships can simply cancel physical reality.

So perhaps our definition of physical reality has some merit after all, and perhaps there really are three classes of phenomena. The paranormal phenomenon is a bridge between mental and physical phenomena; specifically, every paranormal phenomenon must consist of an inseparably welded compound of the two. And the objective method and its consequent experimental protocol must be changed to reflect this fact, if we are ever to develop a viable theory of paranormal phenomena.

2. A Fundamental Correction to Classical Logic

Let us now make a fundamental correction to Aristotle's three laws of logic. First, there is no independent existence to mental phenomena; there is a perception operation involved when we think. There is no independent existence to physical phenomena; there is a perception operation involved when we observe physical phenomena. Furthermore, it takes a finite piece of time for the perception process to occur. The logic symbol also requires a separate time interval; it represents a series of separately perceived operations that together comprise a decision algorithm. So let us impose this criterion upon logic itself so as to constitute "logical perception" or the "logic of perception" or the "perception of logic." We begin with Aristotle's third law of logic, *A* or *not-A*, the law of the excluded middle.

We still insist that there is no such thing as *A* per se, but rather that there is a perceived *A* where *A* is the output of the perception process. Similarly, there is no such thing as *not-A*, but rather there is a perceived *not-A* where *not-A* is the output of the perception process. Let us think of a square box symbol as an abbreviation for the fact that perception has occurred, and anything written inside the box represents the output of that perception operation. We can speak of the box either as mental perception, a description of thought, or we can speak of it as physical detection, a description of an instrumentation system that detects and measures. Also, since each box requires a finite time to occur, we must carefully keep up with the individual little pieces of time, the delta t's.

So applying this to Aristotle's third law, we have *A* perceived or outputted in time one, and *not-A* outputted in time two. Note that to ascertain that A_1 and *not-*A_2 actually differ requires a series of operations in a separate time interval, in time three, that is assumed by the *exclusive* or symbol. Looked at in this way, Aristotle's third law actually is the law of monocularity; it states that only one thing at a time is perceived. Actually we had assumed this when we assumed that perception was a

1. $A \vee \bar{A}$ ARISTOTLE'S LAW OF THE EXCLUDED MIDDLE

2. DEFINE $\square$ AS "IS PERCEIVED"

3. $\boxed{A} \vee \boxed{\bar{A}}$ LAW OF THE EXCLUDED MIDDLE

4. EACH PERCEPTION IS A FINITE OPERATION AND REQUIRES A FINITE TIME TO OCCUR.

   THE LOGIC SYMBOL ALSO REPRESENTS A DECISION ALGORITHM: A SERIES OF OPERATIONS PERFORMED IN A SEPARATE TIME INTERVAL.

   EACH FINITE TIME INTERVAL MUST BE ACCOUNTED FOR.

5. $\boxed{A}_1 \vee_3 \boxed{\bar{A}}_2$

6. THE LAW STATES THAT PERCEPTION IS A MONOCULAR PROCESS IN TIME 3.

   ONLY ONE-THING-AT-A-TIME IS PERCEIVED.

7. NOW NOTE THAT SEPARATION OF A AND $\bar{A}$ DOES NOT OCCUR IN

$$\boxed{(A_1 \,,\, \bar{A}_2)}_3 \equiv_5 \boxed{B}_4$$

8. SO $A_1 \equiv_3 \bar{A}_2 \Big|_{4,5}$ BOUNDARY IDENTITY OF EXACT OPPOSITES

9. AND EQUATION 8 CONSTITUTES A <u>FOURTH LAW OF LOGICAL THOUGHT</u>.

   IT SIMPLY STATES THAT PERCEPTION THREE IS BINOCULAR, AND EXCLUSIVE SEPARATION OF EITHER A OR $\bar{A}$ IS NOT PERMITTED.

Fig. 4. A fundamental correction to classical logic

finite process, so it is nice to find that Aristotle's third law justifies our assumption, once we understand the third law. The *exclusive or* symbol assumes a third operation in time three, whereby it is determined that perception output one and output two actually differ. But such an operation itself requires multiocular perception — i.e., collecting two outputs at once — and that in itself is a violation of Aristotle's third law. The third law thus contains its own contradiction, and indeed each of the other two laws also contradicts the third law when one examines them meticulously. Each can only be established as true by invoking or involving an operation wherein the third law is not true.

In time three we gathered up what had been perception output in time one, A_1 and what had been perception output in time two, A_2, which we do not yet know is different from A_1, and put them both through the perception process, getting only one output — let us call it B — in time four. By the nature of B in time four, we thus say in time five that the outputs in times one and two differ or not. In either time one or time two, there is no indication whatsoever of difference or sameness existing between output one and output two. Likewise, in time three there is no separate output one and output two, hence no indication of the sameness of, or difference between, outputs one and two.

So here we have arrived at the identity of opposites. There is no perception of difference between A_1 and *not*-A_2 in time three. And this constitutes a fourth law of logic: the law of the boundary, or the boundary identity of exact opposites. All that is necessary to identify opposites is to lose all perceptual distinction between them. And that is accomplished by multiocular perception, of perceiving the presence of both at once unseparated, hence the absence of either exclusively present. If A_1 and A_2 are exact opposites, then B_4 = O, and $[A_1, A_2]_3$ = O. We thus have the solution to the problem of nothing. Nothing simply consists of the presence of the totality of all opposites.

Almost all the philosophers who have struggled with the problems of being, mind, and matter have faced the necessity for the identity of opposites, but none of them could understand how opposites could be identified. By careful accounting of the separate time intervals required for finite monocular perceptions, the mechanism for identifying opposites is immediately clarified and revealed. The laws of logic are simply laws of the operation of perception — nothing more, nothing less.

The new system of logic is closed. All present paradoxes — contradictions of one or more of the first three laws — are resolved by the fourth law, which contains the negation of each of the first three laws. The fourth law is in fact the law of the paradox. Note also that the hidden time-three operation, which has actually been the application of the fourth law all along, is implied in each of the first three laws. Identity or nonidentity between time-one and time-two outputs can only be established in a time-three operation. The fact that either A or *not*-A exclusively exists can only be established by a separate operation which establishes that nothing else is there. If separation of A and *not*-A is not permitted, then A and *not*-A cannot be distinguished.

Since these laws refer to perceptual operations, one can think of them operationally, or vectorially. To close the vectorial system prescribed by the first three laws, the opposite or negation of each of the three vectorial statements must be present, i.e., this follows simply from the definition of what constitutes a closed system, vectorially speaking. Since the fourth law contains the negation of each of

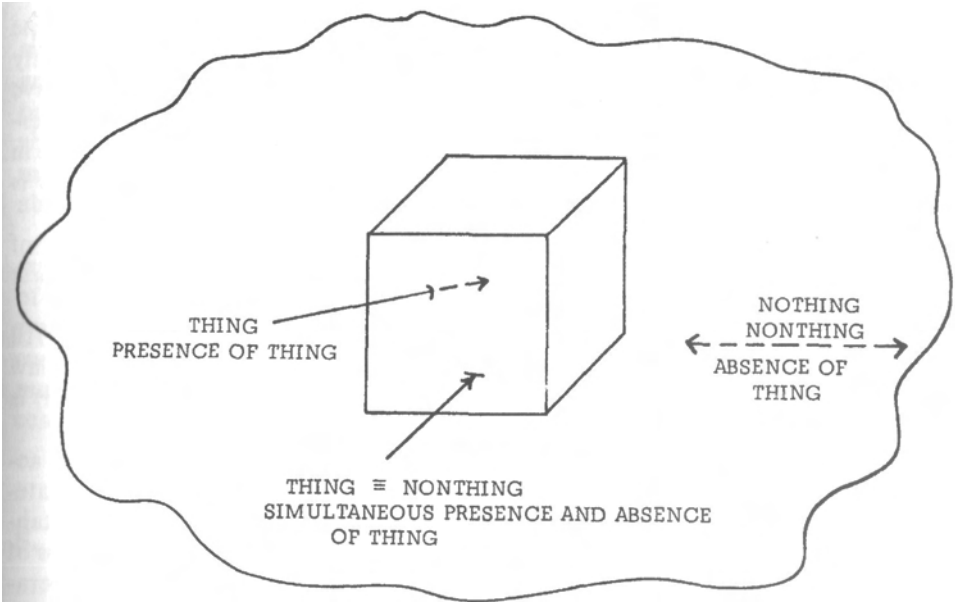

Fig. 5. A physical example

the first three laws, then the four-law system is indeed closed, and the logician's dream of a closed metalogic is realized. Furthermore, anything which contradicts any combination of the first three laws automatically is covered by the fourth law, which is the law of the paradox.

The new logic works as follows: either the first three laws apply (separation of *A* and *not-A* is permitted), or the fourth law applies (separation of *A* and *not-A* is not permitted). The fourth law applies only to — and in fact *creates* — a boundary. The first three laws apply only away from a boundary.

3. A Physical Example

Take the surface of a cube in deep space (Fig. 5). Call the cube "thing," a three-dimensional concept. Call the empty space around the cube "nonthing," a three-dimensional nonthing or absence of thing. If we are standing inside the cube and look at its boundary surface, we cannot find a single piece of that boundary surface that does not belong totally to the cube. So we can very reasonably proclaim that by the first three laws of logic each piece of the boundary belongs totally to the cube, to "thing." But if in a different operation we are standing outside the cube, we cannot find a single piece of that boundary surface that does not belong entirely to the space surrounding the cube. So in this case, we can claim by the first three laws of logic that the boundary surface belongs totally to "nonthing."

Then in a third operation we can state that, by the first law of logic, each and every piece of the boundary surface is identical to itself, and of course we thereby identify what was thing with what was nonthing. Specifically, what was thing in perception time one and what was nonthing in perception time two have been

identified, by all distinction and separation between them being removed, in time three. Identifying opposites simply consists of "packing together" two previously separated perceptions into a single third unseparated perception. And all we have done is apply the fourth law of logic, the law of the boundary. Every single perceived thing has a boundary, where it both begins and ends its exclusive presence in perception output. And at that boundary, the fourth law applies. Thus the law is universal. The fourth law defines a boundary.

In fact, in any perception, all four laws are applied. They are applied in one of two fashions: (1) the first three are explicit and the fourth implicit, or (2) the first three are implicit and the fourth explicit.

There are more examples that have baffled mathematicians and logicians. All of these are simply boundary statements, i.e., statements involving the fourth law of logic. For example: "It is true that this statement is false"; "A line (length) is composed of points (nonlengths)"; "In a hologram, each part is the whole."

Since logicians used only the first three laws, none of these statements was acceptable or understandable. By the fourth law, there is no problem with these statements. The first merely refers to the boundary between the operation used to establish "truth" and the operation used to establish "falsity." There is another class of operation where neither truth nor falsity exclusively applies — i.e., a class of operation which cannot distinguish between "true" and "false."

The second statement has long been a painful trauma to logicians and foundations mathematicians. Today foundations mathematicians seldom attempt to define line or point. Instead, they simply say: "There is a class of entities called lines. There is a class of entities called points. Lines are made up of an infinite number of points." This way, they avoid trying to explain how "length" (line) can be made up *of* "nonlength" (points).

However, they could easily have avoided the difficulty, and still retained the definition of a line as a length, and a point as a nonlength, in the following manner. "There is a class of entities called lines. A line is and has length. There is a class of entities called points. A point is and has nonlength. We may have a separate perception that shows nonlength, and another separate perception that shows length. In yet a third perception which infolds both the first two perceptual characteristics, we may say that a line is comprised of points so long as we realize that line and point do not separately and exclusively exist in the comprised-of state."

By the same token, we can say that "the whole is comprised of the sum of the parts" only if we realize that "whole" and "part" do not separately and exclusively exist in the comprised-of state, but instead they inseparably and nonexclusively exist therein.

4. New Definition of Zero

To a monocular perception process, multiple presence constitutes absence of the exclusive presence of any particular one. Therefore such a multiple presence is monocularly unperceivable, and hence becomes a zero to a monocular detection process. This allows new definitions of zero, and a solution to the problem of nothing.

Consider that a monocular detection process asks the question, "Is there a single exclusive thing present in my input?" If the answer is yes, an output is generated and perception occurs. If the answer is no, no output is generated and perception does not occur. The answer "no" occurs in two fashions: either total absence, or presence of two or more simultaneously. For either of these cases, monocular perception gives no output, and perception does not occur, i.e., the absence of perception occurs.

Now note that the monocular perception cannot tell any difference in the two input conditions. To it, there is no distinction between the two conditions. The lack of any difference at all constitutes identity. Thus to a monocular perception process, condition one is identical to condition two when they are infolded together in condition three. That in fact derives the fourth law of logic. Total absence and multiple, unseparated presence are identical insofar as a monocular detection process is concerned.

5. Einstein's Postulate

As an example of strange problems we can deal with in a four-law manner, let us examine a little more closely one of Einstein's postulates of special relativity, which states that the speed of light is the same for every observer. Let us restate the postulate as "every photon is moving at the same speed relative to every particle." We can pick any electron in the laboratory frame. Every photon in the frame is moving at the speed of light with respect to the electron, by Einstein's postulate. Now let us pick any photon. By Einstein's postulate, every electron is also moving at the speed of light with respect to this photon.

Now we can look at the situation from the viewpoint of the photon. With respect to it, every electron in the laboratory frame is moving at the speed of light, which violates the common interpretation that ordinary objects cannot move at the speed of light. In fact, three-law logic is violated but four-law logic is not violated. In four-law logic, an object can have infinite mass and zero mass simultaneously. The electron's frame and the photon's frame are rotated orthogonal to each other. What we were calling a photon in the laboratory frame, is a perfectly ordinary three-dimensional object in its own frame, which is orthogonal to the laboratory frame. The electron (lab-frame) thus appears as a photon in the rotated frame of what we previously called a "lab-frame photon." Either an electron or a photon is both three-dimensional and two-dimensional simultaneously — in fact, the concept of separate, exclusive dimensionality only applies after one or the other dimensional aspect has been exclusively separated (observed).

Mass is determined by the resistance an object poses to an accelerating or disturbing force. Mass is also tied to three-dimensional objects; i.e., it is an L^3 concept dimensionally. A photon, moving at the speed of light, can neither be speeded up nor slowed down; hence in one sense it exhibits infinite mass. On the other hand, the photon (which is a three-dimensional object in its own frame) has lost a dimension in its intersection in the laboratory frame, due to orthogonality. Therefore the photon appears as a two-dimensional L^2 entity in the laboratory three-space. And in that sense, the photon must have zero mass since it is only two-dimensional. By

the fourth law, the boundary opposites are identified. Thus at the orthogonal boundary of three-space, zero mass and infinite mass become identical. And the photon exhibits both zero mass and infinite mass simultaneously because it is an entity that is on the boundary of the L^3 "mass exhibiting" world. The photon has always happily behaved in a four-law manner, even though physicists could not comprehend its behavior with the three-law logic ingrained in their heads.

6. Synchronicity of Concepts

As is so often the case, two persons appear to have derived the new logic simultaneously, myself from perception theory and Hubbard from manifold theory.

Dr. J. Hubbard was one of the scientists who first developed the atomic bomb. His profound work fully substantiates the new logic and the new reality paradigm. Dr. Hubbard believes that the system includes language, logic, and the interaction of life-bearing systems. In short, he believes it includes psychotronics. The relationship between mind and matter is, like Santilli's electric and gravitational fields, not mutually exclusive; they are either partially or totally one and the same thing. According to my research, they are both partially and totally the same thing, i.e., they are of exactly the same nature totally — a closure of the entire physical universe — but only partially intersecting, by a fraction of approximately 10^{-42}. In the same fashion a mind is an entire physical world, but it only minutely intersects this physical frame, and then only in a portion of this physical plane.

Dr. Hubbard has shown that the four laws of logic emerge in the form of set relationships, that the single dimension parameter generates the second, third, fourth, fifth and up to *Nth* dimensions of the manifold, by repetitive operations on itself. This allows a firm basis for orthogonal intersections of one less than the dimensionality of the lowest-dimensioned intersector. It provides a firm basis for orthorotation and for my approach to psychotronics.

PRIMITIVE PERCEPTION

Let us now discuss how we form our concept of objects and their relationship. All our basic perceptual concepts are essentially built on primitive observation of the macroscopic universe, which is the primary reason that so many final arguments of philosophers appeal to the "natural man," i.e., to how a primitive observer would react to the argument. The very idea of an object — a perceived object — is conditioned. Everything else we think of is then conceived as some sort of object or relation between objects. And that is why sets (of perceptual objects) and their relationships form the basis for axiomatic logic, mathematics, and physics. Set theory is simply the synthesized and abstracted game of elementary perception of the macroscopic world. Thus even the most abstruse mathematics forms a part of the game of perception and can be applied to perceived physical phenomena. This macroscopic, primitive perception is the basis of our concept of objectivity, and of our physical concepts of "observed" and "observable." But if we examine

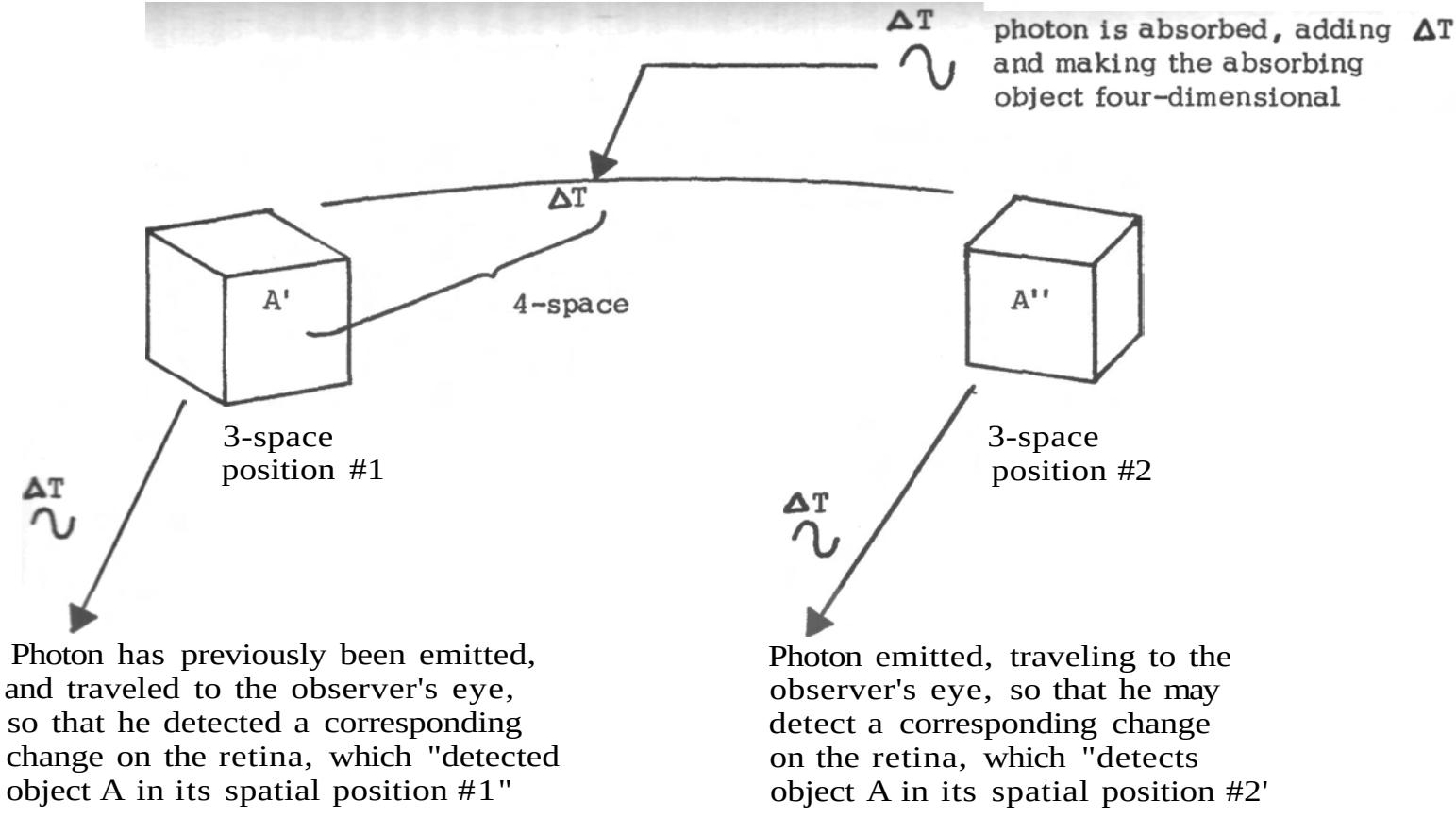

Fig. 6. Primitive perception

carefully exactly how we perceive an object in the macroscopic world, we realize that it is seen by means of photon interaction. We think of light being absorbed onto the surface of the object, and then emitted or reradiated from the surface, eventually entering the eye. There the photons are again absorbed by the material on the retina. The photoelectric effect then moves what are called electrons, producing a signal that goes to the brain for interpretation

What we see as an object has twice undergone interaction with photons of light. Furthermore, light itself cannot be detected, only its interaction with matter (in this case electrons). Thus the primitive perceptual operations of the human brain are correlated one-to-one with photon emission and absorption interactions, usually paired interactions at the object reality domain. The concepts of object, mass, three-dimensions, and observation are directly correlated to the photon-mass interaction, and ultimately to the photon-electron interaction occurring in the human retina.

The ideas of boundary, surface, and change in primitive perception thus involve two contradictory and simultaneously mixed interactions, absorption and emission. Because they are constantly intermingled, primitive perception cannot separate the two. Thus the primitive concept of a boundary consists of a simultaneous duality. Here the object both begins and ends. Here opposites are identified. This is the basis for the fourth law of logic, the law of the boundary.

The dimensionality and orthogonality (spatially) of the primitive perception process are also interesting. Photon absorption constitutes spatial integration for the photon, dimensionally speaking, *e.g.*, one additional dimension is gained by the two-dimensional light wave in turning itself into the three-dimensional mass state. The photon also adds its piece of time to the absorbing mass, converting the mass particle to mass time or space time—adding the fourth dimension. Photon emission constitutes spatial differentiation, dimensionally speaking. One spatial dimension is lost by a little hunk of three-dimensional mass turning itself into a two-dimensional wave. Going from outside the object toward the inside (to track along with photon absorption), the boundary marks the end of the two-dimensional wave region, so the object (or, more precisely, the interaction region) is spatially two-dimensional on the outside, and spatially three-dimensional on the inside. It also occupies the time dimension on the inside, but not on the outside. (This directly accounts for a difference in the spacetime inside and the spacetime outside, and that is why mass may be regarded as a curvature or change in spacetime, in general relativity.)

Going from inside the object toward the outside, the boundary marks the end of the spatially three-dimensional region and the beginning of the spatially two-dimensional region. So the object is now spatially three-dimensional on the inside, spatially two-dimensional on the outside. The inside now does not occupy the time dimension, while the photon emitted (the outside) does. So on the boundary, one spatial dimension is gained going in, and one spatial dimension is lost going out Time is gained going in and lost going out, by the mass absorber-emitter.

Gain or loss of a dimension is accomplished only by orthogonal rotation between orthogonal spatial frames. Photon absorption constitutes orthogonal spatial rotation one right angle turn into the laboratory frame, while photon emission constitutes orthogonal spatial rotation one right angle turn out of the laboratory three-space frame.

This constitutes the observation process (primitively) per se, and this is what is hidden in Einstein's postulate that the speed of light is the same to every observer. Every observer goes through this same process. Furthermore, rotations orthogonal to a three-space frame are orthogonal to all three-dimensional spatial physical entities in that three-space. As Einstein himself once pointed out, velocity can be regarded as simply the measure of rotation of an entity in a higher dimensional space; thus an orthogonal turn is a fixed velocity. Since light is orthogonal to the entire space, then the speed of light is the same to every observer in that space.

While Einstein was apparently speaking of regarding the velocity of an object as a measure of its amount of rotation toward the time axis in four-space (from the direction of its velocity vector in laboratory three-space), it can also be regarded as rotation toward a fourth spatial axis in a five-space (four length dimensions and one time dimension, all orthogonal). If one checks this, one will see that the projections in three-space are the same; i.e., to the laboratory frame observer, there is no difference observable. Thus the photon interaction may be modeled as orthorotation of an entity spatially in a five-space.

To the laboratory observer, this orthorotation constitutes pure dimensional integration and dimensional differentiation, and it constitutes or creates an object in the first place. The concept of object *a priori* involves the photon interaction as stated; if the photon interaction is not invoked, then the existent entity does not exist as a three-dimensional object at all, in the primitive sense. Outside this primitive process (dimensional integration and differentiation imposed upon the same region, which constitutes an object), all exists in the Omega nothingness void, without frame or form.

Ultimate reality (specifically, action) is dimensionless in the objective sense; for the objective sense exists only after an operation has been imposed. A quantum itself is lengthless (and has no exclusive energy, time, or momentum) until differentiation is imposed upon it. Only after a quantum of action is fissioned does there exist a discrete piece of (change in) length, time, energy, mass, momentum, etc. I have already shown that perception itself can be modeled in terms of action quanta fission and fusion, and that most of the basic laws of physics can be derived from that model. (See my *Quiton/Perception Physics.)* Fission and fusion of action quanta involve orthogonal rotation between orthogonal three-spaces sharing the same fourth dimension (time) in common. The words *change, interact, localize, superpose, operate, move, oscillate, act, cause,* and *determine* are only a few of the words used in physics to conceal the basic occurrence of orthogonal rotation in higher dimensional space.

Finally, it should be stressed that i, the square root of minus one, itself constitutes an orthogonal axis, hence an extraspatial dimension. The addition of this quantity to electromagnetic theory allowed the resolution of formidable problems, and led to the direct formulation of electromagnetic theory. Thus electromagnetic theory already includes higher dimensionality and orthogonal rotation in hyperspace. In that sense, inductance and capacitance are merely vector statements of amounts of rotation, one in a positive direction and the other in a negative direction, toward an orthogonal axis in higher dimensional space.

The forming (beginning and ending) of a three-dimensional spatial object constitutes a time differentiation invoked on four-dimensional Minkowskian space,

i.e., the process of observation or detection itself involves

$$\partial/\partial T\,(L^3T) = L^3$$

dimensionally speaking. This process is accomplished by orthogonal rotation, and the very concept of an object that has been observed, detected, or perceived implicitly involves this time differentiation invoked on a four-space.

Velocity also represents a statement of the switching of time into length, and length into time. It is therefore a measure of rotation of the spatial three-dimensional frame, as Einstein pointed out. By this switching (orthogonal rotating, orthogonal flipping) of the chopping of time or beginning and ending of a small piece of time, we create a little delta *T*, just as we do each delta *L* for an object.

But the photon interaction process is monocular. Each photon must attack matter individually, and live or die in the process. Each photon born from matter is also born independently. Thus the primitive observation process is monocular, since it is totally in one-to-one correspondence with photon interaction that is monocular. Thus the observed world is monocular, quantized, discretized. Because of the particular one-to-one correspondence between our primitive concepts and a single interaction, we can conceive the world in no other fashion, unless we change the very basic factor of one-to-one correlation. This in fact has already been done for physics by Everett, whose theory of the universal wave function incorporates multiple simultaneous observation, and hence direct insight beyond the limitations of the monocular correspondence to the photon interaction. My theory does the same thing in the fields of logic and mind.

TWO-SLIT EXPERIMENT

This experiment is fundamental to all of modern physics. Feynman, Nobel prize winner in physics, has stated that no physicist understands this experiment, and that it cannot be explained by any classical means. The reason is that it cannot be monocularly comprehended, i.e., the first three laws of logic cannot explain it. The fourth law can and does.

In the experiment, electrons are emitted from a source and travel past a doubly-slit wall region on their way to a screen. The apparatus is shielded against light. If one believes that the emitted electron is a little three-dimensional particle, much like a tiny baseball, then it should go through one of the slits and not the other. It would then hit the screen at one of the two spots indicated as the expected distribution, with a little scatter from those that chip the edge of the slit a bit. Electrons which do not hit the holes but strike the wall are absorbed.

We do not get this expected pattern. Instead, the pattern is essentially the same as the one we would get if each electron were a wavefront passing through both slits at once. However, each electron still strikes the screen in only one point; the distribution of these points fits the actual distribution pattern shown.

This stunned the physicists. They did not believe it at first, so they set up a photon gun and hit every electron with a photon as it left the emitter source and started over toward the two-slit region. That is, they determined precisely when a little electron was on the way, and the fact that it was like a tiny baseball and in just one

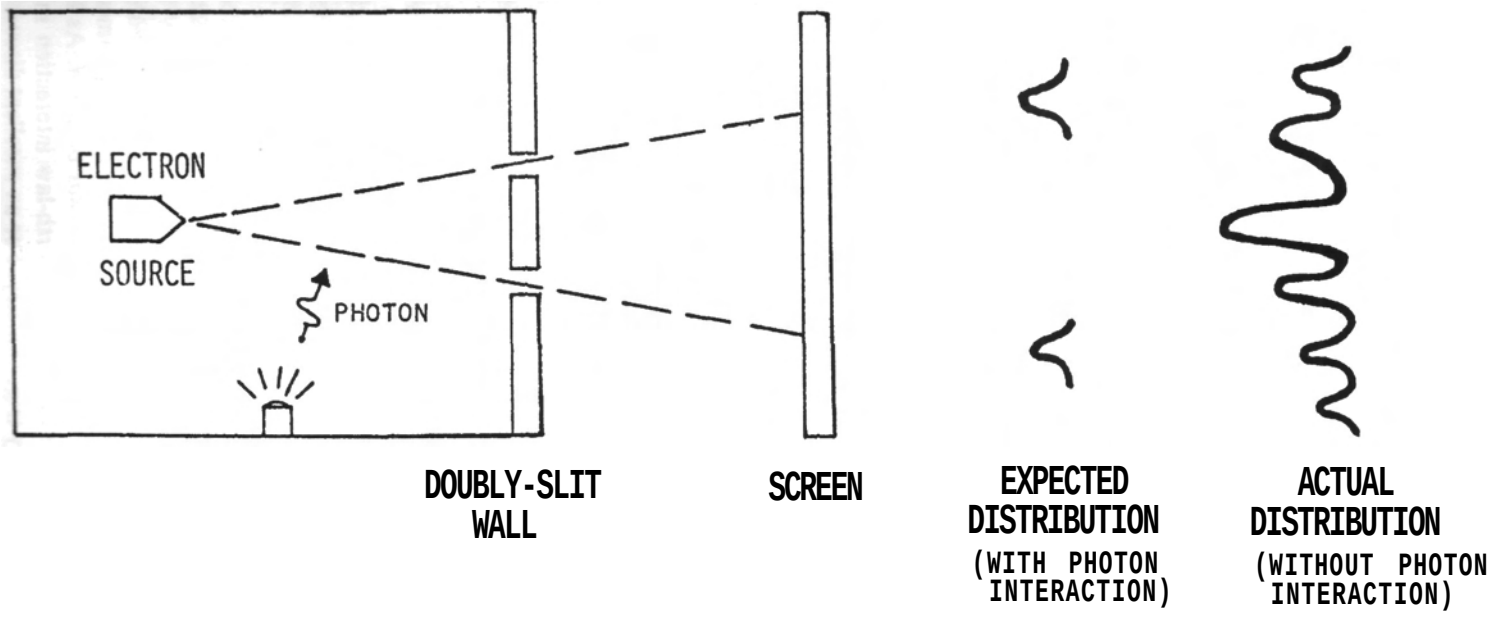

NOTE: IF THE ELECTRON IS HIT BY A PHOTON BEFORE IT REACHES THE TWO-SLIT REGION, IT DOES NOT EXHIBIT THE WAVE INTERFERENCE EFFECT, BUT INSTEAD ACTS AS A CLASSICAL OBJECT AND GOES THROUGH ONLY ONE SLIT, YIELDING THE "EXPECTED DISTRIBUTION" PATTERN.

Fig. 7. Two-slit experiment

place. And this time the electron only went through a single slit, and it gave the expected pattern after all. And when the experiment was repeated and only a fraction of the electrons were hit with photons, then a mixture of the two patterns emerged.

It is simple to describe the results mathematically, but no one has understood why things happen as they do in this experiment. The principle of complementarity evades the issue. This principle is simply a monocular statement dealing with one aspect of the problem at a time, with the determined, exclusive, monocular past only. It does not apply to the present or to the future. If we think in terms of the present, then the third law of logic is violated and the fourth law applies. The two states, two-dimensional wave and three-dimensional corpuscular, both exist simultaneously but nonexclusively in the present. Thus in physics terms, the entity becomes nonobjective (nonspatial), probabilistic and undetermined, and this is automatically a wave concept, i.e., since waves are not confined to one place and determined or localized, they may exist in the nonconfined, nonlocalized present.

Note that photon interaction must be excluded whenever the so-called quantum effect is exhibited. If photon interaction is invoked, classical reality emerges. Photon interaction creates classical objectivity. Photon interaction is a time-differentiating operator imposed on L^3T four-space. Specifically, since light carries time, photon emission from an entity strips away T from the L^3T nonobjective entity, converting it to an L^3 or spatial object.

The very concept of an object comes from primitive perception's one-to-one correspondence with photon interaction. After photon interaction, the first three laws of logic apply to an entity. Before photon interaction occurs, the fourth law applies. In the fourth-law state, the time portion of an entity can interact with any number of time portions of other fourth-law entities if the time aspects of all of them coincide.

A free electron born and released at the emitter is four-dimensional (L^3T) until it is struck by a photon, after which it is three-dimensional (L^3). When the wavelength of electron and slits is specified, we have actually specified the time interval stripped out of a dEdT quantum in each quantum of fundamental change occurring. Perfect time synchronization accomplishes or constitutes orthogonal rotation. So if the length (width) dimension of each slit is very close to the wavelength of the electron, the time aspects of both slits will interact with the time aspect of the fourth-state electron if all three are brought into time phase simultaneously. If the slits are made much larger, this interaction will not occur.

When the electron interacts with both slits timewise, this will constitute a part of the past history of the electron to all future interactions or interaction possibilities. But since the interaction with the two-slits was not in the past (i.e., selected or determined), then that interaction itself is a part of the present and future probabilities chain. In physics, probabilities propagate forward in time with absolute causality until a monocular selection is made. Thus the fourth-law interaction is propagated forward with absolute causality and significantly affects any future interactions. And apparently vice-versa. John Wheeler has just shown that, in at least one sense, whether or not the emitted particle in the two-slit experiment has interacted with one or both slits can be selected *after it has occurred.* As is well known, the pattern of projection forward of this fourth-law interaction may be quite simply calculated from ordinary trigonometry. For an excellent discussion of

the two-slit experiment, see Richard P. Feynman, Robert B. Leighton, and Matthew Sands, *The Feynman Lectures on Physics,* Vol. 1 (Addison-Wesley, Menlo Park, Calif., 1963), pp. 37-1 and 37-12.

When the electron hits the screen, it encounters a region of varying time oscillations of the orbital electrons around the individual atoms comprising the screen. Thus the exact location of the orbital electron in the screen which will first precisely time-synchronize with the electron wavelength approaching the screen in four-law form will vary. Thus the place where the electron hits the screen is variably selected along the screen. The time distribution pattern of the approaching electron is recovered when the time distribution of the number of electron hits per screen length is plotted.

So one can build gadgets to cause four-law entities to multiply and interact simultaneously in time, even though the entities are normally thought of as being in different spatial locations when in the three-law state. And one can deliberately select the type of interaction to occur, four-law or three-law, simply by controlling photon interaction. The two-slit apparatus itself is a paranormal, psychotronic device.

This is the explanation of the two-slit experiment, which, according to Nobel prizewinner Richard Feynman, no one understands and which, according also to Dr. Feynman, contains the total mystery of quantum mechanics and the only mystery of quantum mechanics. The reason the two-slit experiment has not been understood is that the answer to the paradox was not present in the first three laws of logic. It requires the addition of the fourth law to explain the experiment.

And all fundamental particles — photons, neutrons, protons, electrons, etc. — exhibit the same behavior. So things, nothings if you will, can be processed in the multiplistic two-states-identified-as-one-so-no-single-exclusive state, as virtual and unobserved entities. In the multiplistic state they can be amplified, recorded, put onto tape, modulated onto RF signals, etc. And by our ordinary, objective, three-law science nothing is processed. And nothing indeed is what is there — a very special, structured, detailed, virtual set of nonexclusive, hidden-variable nonthings that is part of the new reality existing in the framework of the new four-law logic. In fact, this processable, structurable, nonobjective reality exists outside objective, three-law spacetime and is the basis for all psychotronic phenomena.

To our present monocular detection devices and monocular theory, such multiple-state entities are unobserved and hence are zeroes. They are pure vacuum, pure space, pure nothing, pure emptiness. But they are very real indeed, and they do physically exist, but multiocularly rather than monocularly.

The importance of the time interaction in explaining the two-slit experiment was noted as early as 1957 by Charles Muses in his introduction to Jerome Rothstein's *Communication, Organization, and Science* (Falcon's Wing Press, Indian Hills, Colorado, 1958). Muses pointed out that the celebrated wave-particle paradox remains a paradox only so long as the chronotopological phases of the phenomena are left unrealized in the analysis. The entire foreword by Muses is a remarkable document that analyzes the structure of time itself.

NOTE:

IN REFLECTED LIGHT, THE EFFECT CAN BE INVERSED.

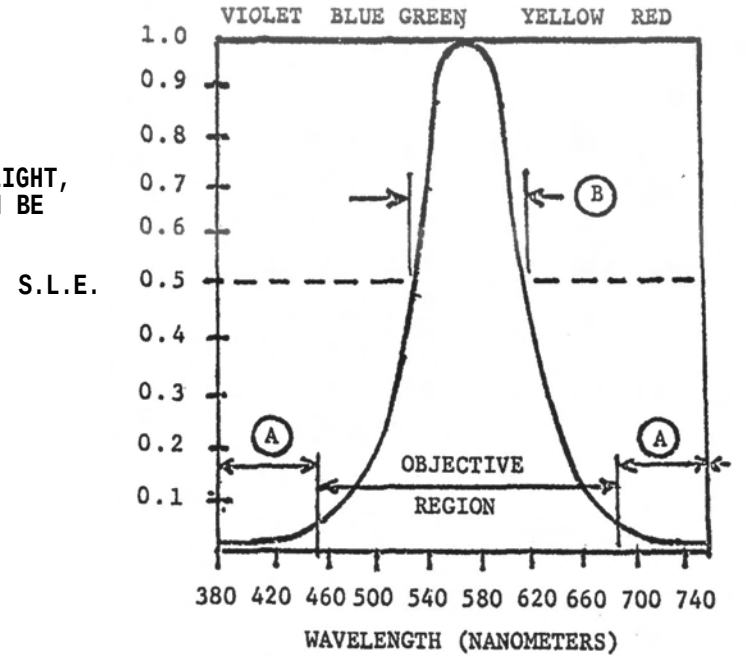

SUPPRESSION OF THE PARANORMAL CHANNEL BY THE PHOTON INTERACTION INCREASES IN THIS DIRECTION IN PROPORTION TO THE SPECTRAL LUMINOUS EFFICIENCY

A WEAKLY OBJECTIVE REGION

B STRONGLY OBJECTIVE REGION

Fig. 8. Photon quenching of the paranormal

PHOTON QUENCHING OF THE PARANORMAL (TIME) CHANNEL

The photon interaction constitutes a time-differentiating operator imposed upon L^3T dimensionally (Minkowskian reality), which results in the creation of L^3 dimensionality (objective, spatial reality). Aristotle's three laws of logical thought are based on primitive observation, which in turn is in one-to-one correspondence to the situation where the photon interaction has been imposed and the time dimension destroyed, resulting in a classical or objective or spatial reality. Hence all our present logic, science, and mathematics are based upon this particular arrangement. As shown by the two-slit experiment, if the photon interaction is not allowed to occur, a fundamental particle refuses to behave in a classical, objective, spatial object manner; instead, it behaves in a nonclassical, nonobjective, wave manner if the time element interacts with it.

Mental phenomena occupy the same time dimension as do physical phenomena; however, the spatial dimensions of mental objects do not ordinarily occupy or intersect the spatial dimensions of physical objects. However, the time dimension is recognized by physics as objective; therefore, since the mind occupies at least one real objective dimension, it is objective rather than subjective. This suggests a model whereby mind is a real L^3T Minkowskian four-space world, but one whose three spatial dimensions lie orthogonal to and outside the ordinary world's three spatial dimensions. The mindworld and the physical world then have in common the same time dimension. Dynamic movements in each world (mind and matter) result in an exceedingly small crosstalk being projected into the other world, a crosstalk so small as to be virtual and normally unmeasurable. Establishing one-to-one coherence between crosstalk from a mindworld constitutes the creation of a biological organism. The crosstalk from the mindworld and a physical structure in the ordinary world to the physical world has previously been labeled *inception* by me, and a mechanism whereby such a minute psychokinetic effect on matter can be amplified to a macroscopically observable level, or even beyond, has been derived. Thus a fundamental mechanism whereby tulpoid activity (projections from the collective unconscious materializing into the ordinary physical world, in a format determined by the collectively higher levels of unconsciousness in the race, national group, culture, subculture, and personal unconsciousnesses) is developed and explained.

Before the intervention of the photon interaction, four-dimensional reality thus has a great deal of tulpoid dither riding upon its time dimension as a minute modulation. The photon interaction invokes a time-differentiating operation, stripping away or suppressing the time dimension, resulting in a spatial reality or objective reality being perceived or observed, and in the process separating mind and body by destroying the only common connection or channel. Because of the time-squelching action of the photon interaction, we do not see time or the mind in our ordinary physical observation. Also, we do not see the incessant stream of tulpoid activity that bathes the time channel.

The time channel is thus the mental channel and the paranormal channel. The photon interaction is the destroyer or squelcher of the paranormal channel. Apparently the squelch effect of light is not linear or constant, but is a variable and a function of the frequency of the light being utilized. From a synthesis of a variety of

data in diverse fields, the following hypothesis has been arrived at to fit the experimental evidence: *The quenching of the hyperchannel (the paranormal channel or the time channel) by photon interaction is proportional to the spectral luminous efficiency of the eye of the average human observer in the interval from the infrared to the ultraviolet.* Thus the form of the paranormal squelching effect of the photon interaction is given by the operator ϵ where

$$\epsilon = m \, E \, T$$

and where m is a parameter which varies as some function of frequency. This hypothesis specifies m over the region from the ultraviolet to the infrared. In other regions of the frequency spectrum, the form of m must be determined by experiment.

There are several experiments which fit the hypothesis:

1. The induction of death and disease patterns from test cells to environmentally shielded healthy cells by Soviet scientists.[a]

2. The invoking of specific tulpa living forms and photographing them in the invisible state with infrared film by Trevor James Constable.[b]

3. The visible light revival of appreciable fractions of cells killed with ultraviolet light and kept in the dark — dormant, unreproducing, for up to twenty-four hours.

4. Ingo Swann's precise differentiation of the visible light spectrum (frequency region) where psychic seeing (similar to remote viewing) is blacked out.

5. The Fox and Miller experiments, in which cell-like protein forms that reproduce (i.e. are "living") are generated when a primeval soup in the laboratory is bathed in ultraviolet light and exposed to strong electrical spark discharge (strong bioenergy collections).

A corollary to this hypothesis is that, under certain conditions, reflected light may reverse the effect. Thus the effect of the full moon, which reflects a great deal of sunlight, can immediately be appreciated. The effect is to the time channel, hence stimulation of this channel stimulates the mental effects. The effects of the full moon on romantics, lunacy, and deeper life functions controlled by the unconscious is grounded in a factual basis.

Thus there is a very good reason why animal eyes tend to operate very closely to the infrared, visible light, ultraviolet region, with the eye usually adapted for the visible light region. In the infrared and ultraviolet regions, tulpoid phenomena would be readily visible or detectable, and an animal whose eye operated exclusively in one or the other of those areas would so often be distracted by the mental tulpoidal activity that it would prove disadvantageous to his survival against animal predators operating in the strongly squelched, visible light region. By the same token, animals whose eye operates further into the infrared or the ultraviolet than does the human eye are notoriously sensitive to paranormal phenomena before their manifestation to human observers.

The stimulating effect of reflected light, and particularly of light reflected from the surface of a planet or of the moon, also concerns several of the common practices of UFO investigators. It is common practice to dispose of a sighting once

[a] **V.P. Kaznacheyev et al., "Distant intercellular interactions in a system of two tissue cultures," *Psychoenergelic Systems,* Vol. 1, No. 3, March 1976, pp. 141-42.**
———, "Apparent information transfer between two groups of cells," *Psychoenergetic Systems,* Vol. 1, No. 1, December 1974, p. 37.

[b] **Trevor James Constable, *The Cosmic Pulse of Life* (Merlin Press, Santa Ana, Calif.)**

it becomes apparent that a planet lay in the direction of the sighting and was particularly bright at the time. However, such an optical condition can in fact serve as an initiation point for tulpoid activity to enter the ordinary reality frame. And in fact such conditions — and conditions when stars are very bright and twinkly in their reflections from the particles of the atmosphere — are conducive to UFO appearances, and this should be realized and taken into account. UFO's in a great many cases will be observed to start or come into being from such appearances.

If we realize that the paranormal channel is the time channel, then the fundamental two-slit experiment of physics is itself a paranormal manifestation experiment. Thus when the photon interaction is invoked, a classical object and classical behavior result. When the photon interaction is not invoked, a nonclassical entity and nonclassical behavior result. The more interest is taken in a particular tulpoidal manifestation, the more the format is impressed in multiple minds and multiple unconsciousness layers and the more frequently the format is tuned in. Eventually a repeatedly tuned tulpa can become stable and permanent. Candidates for such tulpoids presently on their way to being stabilized are the Loch Ness monster and the sasquatch. Particle physicists may in fact be creating their own reality by the same process, as suggested by Josephson.

The process whereby visible light revives cells killed by ultraviolet light is presently considered under the term "photoreversal." It is a moot point whether cells are living if they have laid dormant for several hours or even twenty-four hours without any cell divisions having occurred. The effect of a given dosage of ultraviolet radiation on cells is known to be greater when the radiation is flashed than when the radiation is continuous. This has been interpreted as due to a thermal reaction following a primary photochemical reaction, since increasing the temperature accentuates the effect of flashing. However, I suggest that flashing is directly related to the effect known as kindling, where, when the limbic structures of the brain are repetitively stimulated, the entire nervous system of the organism responds and goes into resonance (seizure). Soviet experiments have shown that such flashing of a telepathic sender enhances the reception of telepathic information. In the 1920's and 1930's A.G. Gurvich and his students found that a yeast detector's threshold of sensitivity to mercury lamp radiation was about three orders of magnitude higher than the detector's threshold of sensitivity to radiation of the same spectrum from biological material. (For a description of more modern work which may show a violation of the conservation of energy law, see L.L. Regelson, "A Paradox of Mitogenetic Radiation," edited by H.S. Dakin, translation available from H.S. Dakin, 3101 Washington Street, San Francisco, CA 94115.) Regelson's experimental results point to the conclusion that the paradox observed with the mitogenetic radiation experiments is a universal physical phenomenon. In view of this and Kaznacheyev's results, the entire area strongly warrants intensive investigation. Regelson's group was actually attempting to find a new solution to the problem of wave-particle duality, strikingly parallel to my interest in the area.

Those frequency points where the quenching effect is minimized (i.e., where € goes through a minimum value) are referred to as "magic windows" or "magic windows between worlds." Acker and Tiller have called them "interdimensional nodal points." In the magic windows, energy from one frame or biofield can be more easily collected to orthorotate into another frame or biofield, since the rotational threshold is much lower. There is a window, e.g., between 38,000-40,000

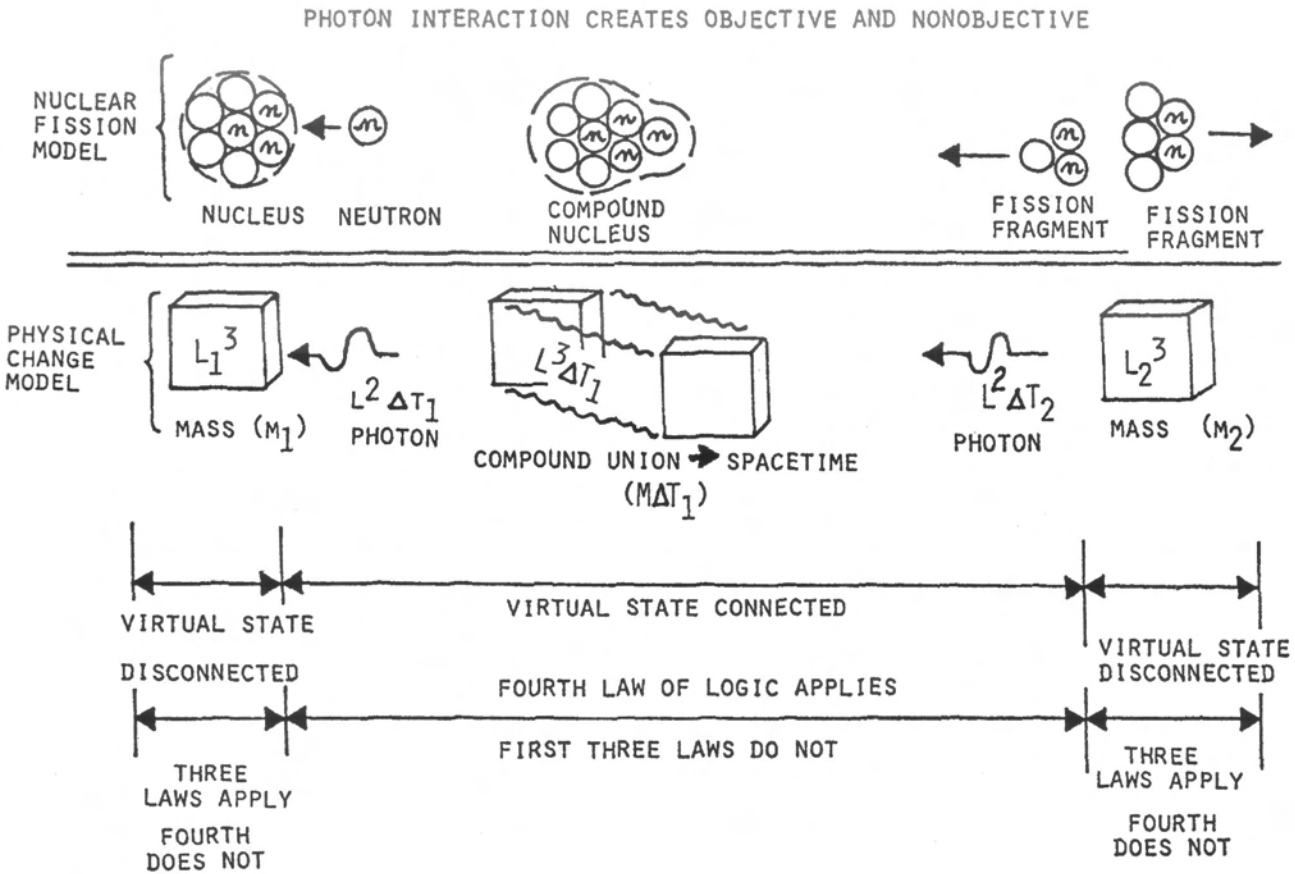

Fig. 9. Raindrop model of quantized change

Hertz, which can be stimulated with ultrasonics or electromagnetic radiation. The ultraviolet region contains a window, as does the infrared region. Many other windows apparently exist.

Trevor James Constable photographs paranormal phenomena through a filter that is open in the IR and UV regions, but opaque to visible light. Thus the filter blocks out the strong quenching effect of visible light and looks in two magic windows, IR and UV. Constable is thus able to photograph phenomena that are not normally detectable.

RAINDROP MODEL OF QUANTIZED CHANGE

What does not appear to have been realized to date in physics is that the photon interaction is the agent that creates objectivity itself, as is clearly established by the two-slit experiment. The photon interaction separates spacetime into space and time exclusively. An object, being something which occupies space (L^3), is thus timeless. Objects do not exist in time, because the union of an object with time constitutes spacetime, which cannot be perceived, detected, or observed.

Only changes in (derivatives of) spacetime can be perceived, detected, or observed, but not spacetime itself. That with which light has not interacted is not objective. This is proven conclusively by the two-slit experiment, upon which all of quantum mechanics rests. In that experiment, if an electron emitted from the cathode and on its way to the two-slit region does not interact with light, the electron behaves in a totally nonobjective manner, appearing to pass through both slits at the same time. (Actually it goes around both spatial slits in time, and since both of the slits occupy the same piece of time, the electron can interact timewise with both of them.)

On the other hand, if the electron is struck by a photon before it reaches the two-slit region, it becomes a "hard, solid little baseball" and quite objective. In that case it can interact with (go through) only one spatial hole because it cannot interact in time. According to Feynman, this simple experiment contains the total and only mystery of quantum mechanics. Furthermore, it cannot be explained in any classical manner. No physicist in the world understands it, although the pattern of repeated electron strikes on a collecting screen is quite easy to compute by simple trigonometry.

Let me now explain what happens to a mass when it is struck by a photon, absorbs the photon, and re-emits the photon. First, a mass is an L^3 object; the concept of mass is not a function of time, but only a function of space. It is thus three-dimensional. The photon is also three-dimensional, but one of its dimensions is the time dimension. The photon, being built of action, is constituted of $(dEdT)$ or (L^2dT) dimensionally.

When the photon strikes the mass and is absorbed, the (AE) portion is turned into mass by orthorotating one turn and becoming L^3 dimensionally. The (dT) portion is thus united with the spatial mass to give a compound nucleus of spacetime comprised of MdT_1 This compound nucleus of spacetime is not perceivable. When a photon is re-emitted, it may or may not be of the same frequency and energy as the previously absorbed photon, depending on the absence or presence of any other perturbations. At any rate, a small bit of L^3 spatial mass is orthorotated to give an L^2 intersection with the laboratory frame, which turns the bit of mass

into a small piece of energy, dE. In the orthorotation, a small piece of time is bitten off and joined to the dE to give a d$EdT = h$ quantum of action, which now constitutes a photon. Photon emission thus strips away the time dimension, leaving a spatial object.

Einstein pointed out that the velocity of an object may be visualized as rotation of the object in higher dimensional space. Visualized as spatial rotation rather than rotation toward the time axis, the velocity of light in vacuum c merely constitutes the rotation of a piece of mass by an angle of 90° to the line of motion, in the laboratory space in which we visualize the photon (the rotated piece of mass) as moving. Thus the photon emitted from the mass is moving at c, the velocity of light, because of its orthogonal rotation to the laboratory frame.

Note that the spacetime compound nucleus has now once again been separated into spatial and time components. Time is moving with the photon. And that is why time moves or flows at c, the speed of light in a vacuum. Time is carried only by the photon, and photon interaction with an object produces that object's march through time. If the emitted photon and the previously absorbed photons do not have identical dE and dT components, then M_2 will be different from M_1, and the mass will have increased or decreased. Considering the photon to consist of momentum and length components, i.e., *(dpdL)*, a similar diagram can be constructed. In that case, if the momentum and length components of the emitted and absorbed photons are identical, then M_1 and M_2 occupy the same position *(*M_1 has not moved). If these components are different, then the mass M_2 will occupy a slightly different position than mass M_1, and the mass will have moved.

This, by the way, is the simple solution to the age-old philosophical problem of change. We simply identify M_1 and M_2, calling them the same object. We cannot detect, perceive, or observe the compound nucleus of spacetime in the middle. Thus we experience change as a thing becoming something else, but still being the same thing. This totally defeats the first three laws of logic. However, fortunately we can easily comprehend it since we have developed the fourth law of logic.

The raindrop model of quantized change is taken exactly analogous to the raindrop model of nuclear fission, as shown in Figure 9.

KINDLING EFFECT

G.V. Goddard and his associates in 1969 reported a peculiar kindling effect generated by repeated, periodic, low-intensity stimulation of the limbic region of mammaliam brains. A sustained periodic signal input to the brain and central nervous system eventually sets up a cumulative resonance which increases in magnitude until the entire organism is in sympathetic resonance.

A laboratory rat at first continues to explore its environment in a normal manner when it is subjected to kindling. But after repeated stimulation at the same intensity, the rat will begin to rear up and its forelimbs will convulse. Eventually these bursts of electrical activity induce similar patterns in nearby brain regions, and the threshold becomes progressively lowered. Stimulation progresses to the amygdala, to the amygdala on the other side of the brain, to the hippocampus, to the occipital cortex, and finally to the frontal cortex. Kindling can start only in the limbic structures.

While kindling was originally thought to be a model of epilepsy, John Gaito of York University has reported that a different mechanism is apparently involved since the amino acid, taurine, which suppresses epileptic seizures in laboratory animals, does not prevent phenomena caused by kindling. Also, kindling apparently causes permanent changes in the neural circuitry. Pulsed repetitions of telepathic senders have also been shown to increase the reception of telepathic messages. Thus the kindling effect apparently applies to the paranormal channel as well as to more orthodox transmission channels. (For further details, see "Kindling, once epilepsy model, may relate to kundalini," *Brain/Mind Bulletin*, Vol. 2, No. 7, February 21, 1977; pp. 1-2.)

The kindling mechanism is a far more general mechanism than epilepsy researchers have realized. Coherent time collection of bioenergy in one bioframe "kindles" toward the threshold of the next bioframe, which has a fixed threshold. When sufficient kindling occurs to reach the threshold, automatic orthogonal rotation of the kindled bioenergy occurs into the next frame. There it simply constitutes the kindling or superposition of the imperceivable subquantum state into the perceivable quantum state. This is the mechanism whereby one kind of field can be turned into another. E.g., thought energy (third biofield) can be kindled into second biofield (flux), which can be kindled into first biofield (electromagnetic energy), which can be kindled into zeroth biofield (matter).

BIOENERGY COLLECTORS

Good collector mechanisms exist in great variety, in both living and inert systems. Many good collector mechanisms exist in the human body. One mechanism that collects bioenergy and orthorotates it into ordinary electrical field with appropriate induced currents is simply the electrical current in the human nervous system. This is particularly true of the current discharges from and between the nerve endings.

Another collector for bioenergy in a living system is the mitogenic radiation between the cells in tissue. Taken as a flux, this mitogenic radiation would seem to have both a photon nature and a nonphoton nature. The cells, in their membranes and fibrous internal structures, are continually collecting and kindling bioenergy into electron currents and photons. The electron currents represent collections from the virtual state into observable state, and may in one sense be regarded as the lifting of electrons out of the Dirac sea by direct kindling (coherent superposition of virtual state energy into observable state energy). These kindled currents are thus superpositions or modulations on the ordinary electrical activity of the cells, fibers, and membranes. The mitogenic photons are also produced by direct kindling of the virtual state into observable state, in this case, by kindling virtual state photons into observable state photons.

Spark discharges, such as are used in Kirlian photography, are extremely good collectors of bioenergy. In Kirlian photography the film records ordinary photon interactions; however, the spark discharge from the finger is collecting and kindling bioenergy into ordinary electrical energy (specifically, into electromagnetic field, which then affects the electrical flux pattern). Also, bioenergy is being collected and kindled into ordinary photons, thus changing the photon pattern being emitted.

Furthermore, those photons being emitted are internally affected by the bioenergy that has not yet kindled to observable state electromagnetic energy, but is still virtual. Each photon carries the virtual state along in the little piece of time contained in the photon, and partially collected bioenergy which has not yet breached the threshold of observable photons is being carried in each emitted photon. These patterns are transferred to the grain atoms by photon absorption when the piece of time of the photon is momentarily added to the mass of the absorbing atom, and in turn are continually spread through the emulsion material atoms by the virtual photon fluxes of the charges, in both the nucleus and the orbital electrons of the atoms.

So the life pattern of a photographed object is captured on ordinary film — and indeed that pattern can be resonated through hyperspace with the object that was photographed, regardless of where the object is in the universe.

Note that there are many mechanisms inside stars and planets for the collection of bioenergy. We live in a vital, pulsing, living, breathing, bioenergetic cosmos, and life is everywhere. Patterns of life are riding in the light from the distant stars, from our sun, in the neutrino flux from the cosmos, in the graviton flux from the cosmos, in cosmic rays, etc. And so it is small wonder that living cells that form, reproduce themselves, and die can be induced in the proper primordial soup of nutrients when that soup of matrix forms and chemicals is bathed in ultraviolet light (one of the magic windows which contains a greatly enhanced transmission factor for bioenergy, hyperspatial energy, life energy), and stimulated by electrical spark discharges.

It would be interesting to perform the same type of experiments with concentrated light from distant stars, or with the mitogenic radiation from cell cultures, using environmentally shielded setups similar to those used by the Soviets in experiments with the transmission of death patterns.

Even stranger, bioenergy propagates along deBroglie waves, and so all possibilities are modulated by bioenergetic kindling and collection. Viewed in this light, Puthoff and Targ's remote viewing experiments actually provided a multitude of probability paths to the viewer, and these probability paths were indeed kindling bioenergy of the distant, as yet unhappened event. The actual event in the future contains a great many additional collection kindlings due to the additional factors involved in determination (such as collapse of the wave function). A peaking of signal exists on the more probable happenings, and this extra signal along certain paths constitutes an increased signal-to-noise ratio in that particular channel. Thus an actual mechanism exists for seeing at a distance and for seeing ahead in time.

Particular note should be made of the pi meson collection mechanism in the nucleus of an atom. Each neutron and each proton in the nucleus of an atom is continually emitting and absorbing pi mesons, and thereby the protons and neutrons are continually interchanging from one to the other by passing along the positive charge. This activity produces the strong force which binds the nucleus together against the electrical repulsion of the electric forces due to the positive charges of the protons. The fantastic structurings and currents that result provide an electrical current which can and does collect bioenergy. A skilled psychic with good psychokinetic ability can thus focus on the kindling mechanism inside the nucleus and get a signal-to-noise increase of the kindling of his bioenergy in nuclei as op-

posed to elsewhere in the material in other collection mechanisms. Several types of reactions can then occur. The protons may have their electric charges extinguished due to the extinguishing of the virtual photons producing the electric field on their pions. In such case, the atom simply loses its integrity, and some neutrons and photons are emitted from the atomic site into the surrounding material. This type of interaction thus locally softens a metal and produces severe heating in localized areas, changes in fundamental grain structure, and changes in fundamental characteristics of the metal.

It is by this mechanism and similar related reactions that metal bending can be and is accomplished by persons such as Uri Geller. The collection of bioenergy by graviton emission, absorption, and flux leads to antigravity and other psychokinetic effects. These are exhibited in rare levitation phenomena and more frequent poltergeist phenomena.

The list of collectors could be materially increased, but these should suffice to show the importance of the effect of coherent time collection, kindling, and orthorotation of one type of field into another. The collection of deBroglie waves is moving much faster than light, and for very slowmoving objects the collected and projected bioenergy on their deBroglie waves is moving at essentially infinite velocity. This accounts for the fact that Hieronymus observed an instantaneous cutoff of his monitoring signals from the Apollo astronauts when their space vehicle went behind the edge of the moon.

Looking over the list of collectors and carriers, it is obvious why even the best Farraday shields cannot shield out bioenergy communication. The deBroglie wave carrier alone will simply take the bioenergy right through any known substance — or more precisely, it will take the bioenergy around the three-space in which the barrier substance exists, since deBroglie waves are actually superluminal particles in a three-space more than one orthogonal turn away from the observer's three-space. The implications for psychic healing and psychic surgery are obvious.

PSYCHOMETRIC EFFECT

Every mass communicates with every other mass in the total universe, with hyperspatial/virtual crosstalk between all parts and all masses. This yields a mechanism for psychometry.

Inside the mass, we have a large number of collector mechanisms, of the types previously listed and explained. All objects in the universe are in communication with this object, particularly large or close objects. Those objects that come very near or touch the chosen object for a period of time are most influential.

Briefly, the internal dynamic collector mechanisms of the chosen object perform collection and kindling of the virtual state; thus each mechanism is slowly changed by the influence of other objects in the universe. This is very like the diffusion of heat. The chosen object also communicates part of the influx away, normally reaching an equilibrium with its surroundings when these surroundings are stable. As the surroundings change, appropriate changes are communicated into the internal collector mechanisms of the chosen object, and appropriately diffused away to other parts of the universe, until equilibrium is again reached.

Note that the influence of nearby or touching objects is greater than the influence of distant objects under normal spatial considerations. In hyperspatial considerations, however, this is not necessarily true at all, since this chosen object's pattern may be tuned in through hyperspace without any loss of energy due to ordinary three-space separation distance. In the absence of such hyperspatial tuning, distance is a factor, and close objects have a greater signal-to-noise ratio in the collection and kindling than do more distant objects.

Thus an individual or group of individuals in the vicinity exert mental, emotional, and bioenergetic influence on the kindling being accomplished in the chosen object. The stabilized dynamic patterns of the localized chosen object thus are conditioned and kindled to contain patterns of the actions, feelings, and thoughts of the individuals around it, as well as the natural events that occur. It is thus a very exact record of its surrounding events.

A psychically sensitive person who touches the chosen object, or in some cases merely comes near it, enters into a communications exchange with it. His body-records diffuse into the local object, and those of the local object diffuse into his body. If the psychic is sensitive enough, he can gain impressions from the recorded events of the object. This is the scientific basis of psychometry.

A wide variety of data support this mechanism. Psychometry has been practiced since earliest times, and is still practiced today. A photograph is particularly indicative of the person photographed, since his entire record is imprinted psychometrically on the photograph.

Moreover, the entire record of the Earth is still in the earth, in all its detail. As indeed is the record of each star and its planets, riding on the light that reaches us from that star, and on the deBroglie waves from it. With operational biodetectors, we could easily read the records of the universe. NASA would do well to pursue this alternative in its attempt to contact extraterrestrial life, rather than point huge radiotelescopes toward the heavens and listen to the kindled static from the stars. The static indeed contains the message, but not in a format in which they are prepared to look! It is in the virtual state, riding in each photon.

To a psychic who can see the human aura easily, the condition and much of the record of the person is in that aura, because the auric pattern is changed by all experience of the body, mind, and personality. Thus a good healer can see the aura of the patient, tell if another healer has been in contact with the patient (including often recognizing which other healer it was), and can recognize his own previous contact with the patient many years earlier. (See, for example, the story of Agpaoa as recorded by Sigrun Seutemann in *Healers and the Healing Process,* ed. George W. Meek, Theosophical Publishing House, 1977, p. 93.)

ALL MASS IS CHARGED: EVERYTHING IS ELECTRICAL

It is well known that all mass is charged; thus everything in one sense is electricity. To examine this concept, let us look again at the electron with its virtual photons being emitted and absorbed, which virtual activity creates the electric field of the electron. In classical theory the electron is visualized as if it were a little hard

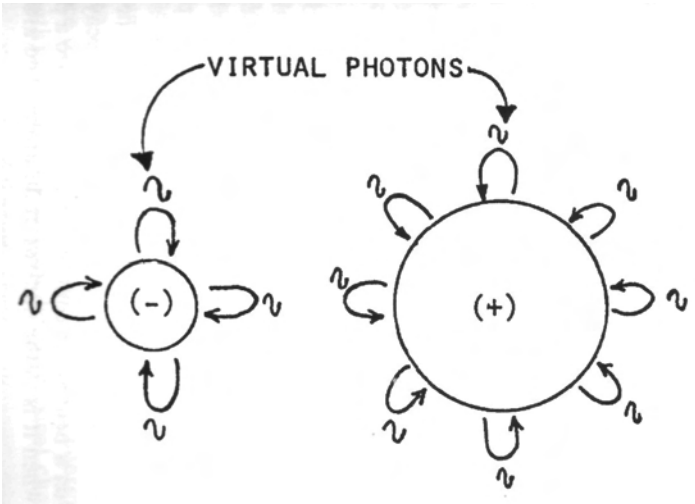

ELECTRON

PROTON

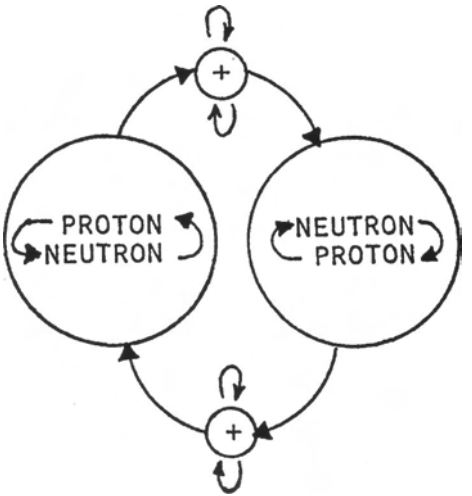

IN A NUCLEUS, EVEN A NEUTRON IS CONTINUALLY CHANGING INTO A PROTON, AND VICE VERSA, BY THE EXCHANGE OF THE POSITIVE CHARGE.

Fig. 10. All mass is charged: everything is electrical

spinning sphere; the spinning of its electric field then generates a magnetic component. This concept of spin is retained, even though the electron is no longer regarded simply as a little baseball.

From our viewpoint, the electric field constitutes a steady activity of the emission and absorption of virtual photons, and the electron spin is more of an implosion or explosion in higher dimensional space. That is, we visualize a fundamental stable particle as a precise closure of the entire physical universe, like the Einstein spherical model of the cosmos. Furthermore, we visualize multiple closure; first, a very gradual macroscopic closure gives the so-called gravitational closure of the Einstein spherical model, and a closure — in the case of an electron — of about 10^{42} times as quick and small gives the charge closure. This second closure is considered to be at right angles to the first. In one direction the second closure gives a negative charge, and in the opposite direction the second closure gives a positive charge.

So in this view, spin is occurring in at least four spatial dimensions, not just three. It is more of an implosion or explosion into and out of this three-space universe frame. From such a model, we could expect that some startling physical phenomena might be possible. For example, we might visualize the implosive or explosive spin as similar to a vector flux. If these vectors are not precisely antiparallel when two like charged particles meet, then a resultant flux vector exists. Since spin is actually the quantity action (energy x time, or momentum x length, or mass x time), then the existence of a vector resultant means that enough action can exist to provide a quantum to be fissioned, which yields (creates) physical change. Thus such a resultant allows a collision or interaction to occur. On the other hand, if two like charged particles meet and their spins are precisely antiparallel, then no vector resultant flux exists. Hence no effective action exists to be fissioned and create physical change (collision or interaction). Thus two like charged particles with precisely antiparallel spin ought to run right through each other when they meet, with no interaction at all, electrical or otherwise, in complete contradiction to conventional collision theory and conventional electrical theory which states that like charges repel one another.

Such an experiment has been done, at Argonne National Laboratory, with colliding protons. When the colliding protons have antiparallel spins, they do indeed pass right through one another. And there dies forever the old idea of concrete, solid, material reality. The experiment is not predictable or permitted by present electromagnetic theory or conceptual models of the proton and proton interaction. The experiment is consistent with our dual closure holographic model of the universe, however, and is in fact predicted by it.

In a nucleus, we find both protons and neutrons (except for a single isotope of hydrogen, which contains only a single proton in its nucleus). However, these nucleons do not exactly maintain their exclusivity. Instead, a proton is continually changing into a neutron and vice versa; this metamorphosis is accomplished (in theory) by the continual exchange of a small particle of mass containing the positive charge. Thus a highly dynamic type of electrical current activity is going on in the nucleus. And in fact, this is the only way a neutron can be stabilized in ordinary matter; when freed from the nucleus, the neutron is unstable and decays in about eleven seconds or so. So even a neutron is continually changing into a positive particle, i.e., into electricity, when it is in the nucleus of an atom. And around

the nucleus, the electrons are in dynamic orbit, so highly dynamic electrical activity is going on in the outer part of an atom and also in the inner part. Thus indeed all mass is charged and everything macroscopic is electrical. And every physical change of a charged particle constitutes a modulation imposed upon its virtual photonic activity creating its electromagnetic field. These modulations are simply coherently collected to breach the threshold of the virtual (third) orthoframe, passing into the second orthoframe, then breaching the threshold of that frame, and passing into the first orthoframe, which is the frame of the electromagnetic field. The electric field is coupled by the dual closure mechanism to the gravitational field, and also to the mass. The entire mechanism constitutes the coupling of the virtual state reality to observable state reality, and the electromagnetic field plays a prominent part in this coupling. Psychotronics is nothing but the extrapolation of this mechanism and the formulation of a theory to allow the construction of practical devices based upon it. Put simply, psychotronics is *virtual state engineering.*

A FUNNY THING ABOUT ELECTROMAGNETIC FIELD

According to the present theory of physics, the electric field is due to the continual emission and reabsorption of virtual photons. Let us examine that concept just a little further, because there are some interesting conclusions we can make if we are not afraid to take the final conceptual step to the bottom line implications.

First, each ordinary (observable) photon in the universe consists of a little piece (quantum) of nonobservable action. The units of action are energy times time, or ML^2/T {*mass* x length x length/time). The quantum of action in the photon is not separated into a separate piece of time and a separate piece of energy. And also, the quantum of action is a fixed, constant size or magnitude, given by Planck's constant h as

$$h = 6.626 \times 10^{-34} \text{ Joule-second}$$

All this says is that an ordinary photon has a certain size that is quite fixed, and it is made of the substance "action" which is totally nonperceivable and nonobservable. Only changes in action are perceivable, observable, or detectable, never fundamental action itself. So physics already prescribes a universe made out of action, and that universe has no length, no time, no energy, no space, no concrete existence. Yet from it can be taken — by differentiation (which is simply separation) — any length, any time, any energy.

However, only a single quantum at a time changes or is separated. Quanta do not superpose. A single quantum can be split or fissioned into, say, a piece of energy and a piece of time. We can get as large or as small a piece of energy (i.e., change in energy) as we wish simply by adjusting the piece of time accordingly. The same type of separation is possible for momentum and length.

The fragments of the action quantum (say, a piece of energy and a piece of time) must then be stuck back together again (i.e., fused back into an action quantum) to get rid of them, and this particular part of the process has essentially been ignored by physicists. Anyhow, getting rid of the fragments (which gave us a piece of comparative physical change — energy versus time or momentum versus length) causes the just-completed physical change to vanish.

So at its most fundamental level, the entire universe is continually being created and then destroyed in sequence. The continual creation of a tiny piece of time and then the destruction of the piece of time makes us experience reality or change as if we were a pointer moving along a time line. We cannot see time because it is continually being destroyed by the change process, the very process of physical detection or observation itself.

Now if we invoke another kind of change, a virtual change, such that its size is always smaller than the actual quantum's size, then this kind of change cannot be detected, even theoretically. The concept of a virtual change is one such that the quantity of action that was changed was deliberately made smaller than the size required to throw the switch of detectable or observable change.

So if we have a virtual photon, it is simply a piece of action whose magnitude is always less than *h*. Here again, we can still get any amount of energy change we desire, merely by adjusting the size of the piece of time associated with that energy. This then means that the virtual photon is not big enough to breach the threshold of quantum change, and so cannot be observed or detected.

And here is the interesting bottom line ignored by most physicists and almost all the pragmatic scientists who run the orthodox establishments. The totally unobservable, undetectable virtual photons being emitted and absorbed are conceived as creating the electric field at the same time as observable physical change (ordinary quantum change) occurs. And the electric field, of course, can cause or induce change of sufficient magnitude to breach the quantum threshold and result in observable change. The bottom line is this: the virtual state can be collated and collected to sufficient magnitude to breach the quantum threshold and induce ordinary observable physical change. The electromagnetic field already does precisely this! And if reality can behave this way, as the physicists show, then let us simply accept that and apply it!

Note that we have now resolved the problem of negative time. The fusion process replaces the little positive piece of time that was formed in the fission process. A continual stream of such replacements constitutes a continual stream of subtractions of positive time. Hence this represents a negative time operational channel. Many of the equations of physics, e.g., Maxwell's equations of the electromagnetic field, should be reexamined with a view to this negative time operation. Dirac calculated such an entity, an electron traveling backwards in time, and noted that it would appear as a positively charged electron traveling forward in time. He thus predicted the positron which was later found in laboratory experiments. But of even more fundamental importance is that every piece of charged matter in the universe has such an opposite twin — the well known antimatter concept. So antimatter protons, neutrons, molecules, and physical structures exist. Indeed, this physical reality that we normally perceive has its antimatter twin which we are also unraveling backwards as we go. But here again the bottom line is far reaching: it means that we can coherently collect the virtual state to produce matter or its antimatter, which after all are nothing but macroscopic assemblages of quantum changes, and we can thus get free energy, materialization and dematerialization, teleportation, and antigravity by means of special modifications and developments of electromagnetic circuits. Each photon carries a small piece of time. And the entire virtual state reality is hanging onto that small piece of time as a modulation. That is where the probabilities are riding, in terms of the ordinary monocular

interpretation of quantum mechanics, all of these probabilities, and all possibilities, are concretely real and occupy orthogonal universes. Since they all share the same single time dimension, there is a time bridge or time channel connecting the universes. Each move or change in one of them crosstalks a tiny bit into each of the others. Since it is the photon which carries them, then each photon contains all possibilities and virtual states modulated upon itself. Photon interaction thus involves the communication of these possibilities and virtual states to the object with which the interaction occurs.

EXTINGUISHING ELECTRICAL CURRENTS

With psychotronics, it is quite possible to extinguish electrical currents flowing in a circuit, or in the nervous system of a biological organism. First, an electromagnetic carrier (photon) is used to carry the psychotronic modulation pattern which will quench electrical currents. The particular psychotronic pattern is modulated upon each individual photon, in virtual state form riding upon the time component of the photon. This is totally different from the ordinary scheme of modulating an electromagnetic carrier; the normal scheme merely gates the rate of passage of photons (amplitude modulation), or changes the energy-time ratio on various photons as photons continually are emitted (frequency modulation).

In this case, virtual state patterns (probabilities) are added directly to each photon, in addition to whatever is done under the normal scheme of modulation. Thus the carrier can be electrically very complex or very simple. At any rate, the carrier with its psychotronic modulations reaches the target, and photons are absorbed continually and emitted continually by the target. The absorption of the photons and their modulations continually generate compound spacetime MdT nuclei and introduce the virtual state psychotronic modulations onto the mass's electric field, the modulations now riding on the virtual photons that generate that field. When a photon is re-emitted, the compound nucleus is split again, and the dT is carried away by the photon, leaving behind a changed virtual photon state on the nontemporal mass spatially left in between quantum changes.

As time passes, the virtual photons are more and more psychotronically modulated by the kindling effect. Eventually the collection breaches orthoframe thresholds and reaches the electromagnetic field frame, changing the electromagnetic field. If the psychotronic pattern is such as to create a positive charge when sufficiently kindled, the negative electrical charge of the kindled electron is simply absorbed or quenched from within, so to speak. And in this case no ordinary annihilation photons are emitted. Instead, the electron is converted to a neutrino when its electrical field is quenched, and it simply passes rapidly away through matter with no interaction and no damage or heating to that matter. Thus the currents flowing in an electrical circuit or in a biological nervous system can be quenched, without any other damage to the system, and without any pair annihilation radiation being produced.

The UFO phenomena very often demonstrate this effect, and the Soviet Union has long since weaponized it.

A simple way to visualize this process is to imagine the virtual photons of the electron as gradually being quenched. With the virtual photons gone, the electron has lost its charge and its electric field, and is now a neutrino. As a neutrino, it zips through matter with no interaction, and on out into deep space.

This mechanism explains why the electrical circuits of autos, radios, etc. usually are not damaged when they are disrupted by the UFO phenomena. Use of normal mechanisms to change or eliminate the electromagnetic field seriously disrupts the components of the circuits, heating materials, blowing fuses, and melting wires and components. The mechanism described here does none of those things.

The weapon aspects are of course formidable. Small transmitters with the right modulation pattern could be dropped, planted, or fired almost anywhere, and these could be set to disrupt equipment or human nervous systems. Their use in satellites is obvious. Small transmitters of a fixed time-life broadcast duration could be fired behind enemy lines in artillery shells. Tactical missiles could carry hordes of such small transmitters and drop them along the way deep into enemy territory. Essentially everything electrical is vulnerable if radiated long enough for sufficient kindling to occur. Powerful radar beams can be modulated psychotronically to give them effects at a distance, disabling vehicles, communications equipment, and men. Even searchlights can be so modulated. Pavlita's psychotronic generators are known to generate deathdealing effects, because he has demonstrated that they can kill insects, and he has admitted that men can be killed with generators that are large enough.

An even more radical approach is to transmit the desired pattern directly through hyperspace with a hyperspace transmitter, using either a set of triads for focusing at a desired spot in normal space, or using a witness to generate form resonance with the desired target object, much like one tuning fork kindles another of the same tuning into vibration. The witness may be anything that contains the pattern of the target, e.g., a photo or a model. In the case of a living organism, each cell contains the blueprint for the entire organism, so a group of cells from the organism can be used. This applies to plants as well as to animals.

DEATH TRANSMISSION VIA THE PARANORMAL CHANNEL

As an example of the kindling effect and the variability of photon quenching of the paranormal channel, some extremely interesting experiments were performed by V.P. Kaznacheyev et al regarding the paranormal transmission of death. Briefly, two groups of cells were selected from the same cell culture and one sample placed on each side of a window joining two environmentally shielded rooms. The cell cultures were in quartz containers. One cell culture was used as the initiation sample and was subjected to a deadly mechanism — virus, germ, chemical poison, irradiation, ultraviolet rays, etc. The second cell culture was observed, to ascertain any transmitted effects from the culture sample being killed.

When the window was made of ordinary glass, the second sample remained alive and healthy. When the window was made of quartz, the second sample

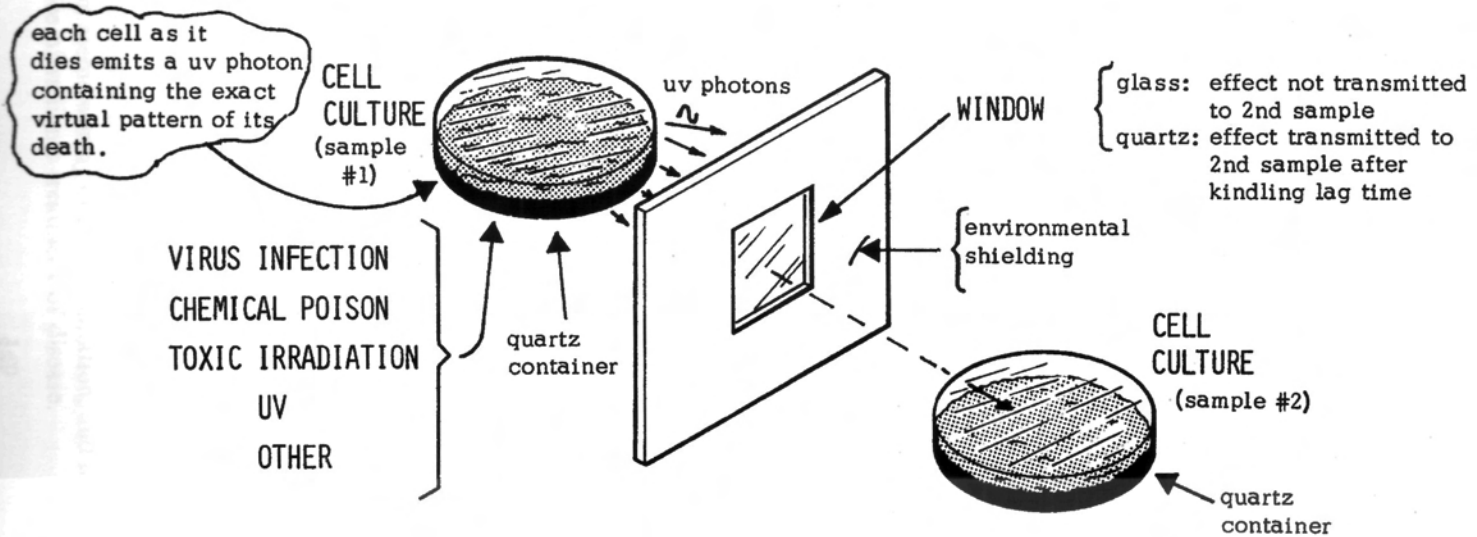

>5,000 EXPERIMENTS

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Fig. 11. Death transmission via the paranormal channel

V.P. Kaznacheyev et al, "Distant Intercellular Interactions in a System of Two Tissue Cultures," *Psychoenergetic Systems*, Vol. 1, No. 3, March 1976, pp. 141-142.

sickened and died with the same symptoms as the primary sample. The experiments were done in darkness, and over 5,000 were reported by Kaznacheyev and his colleagues. The onset of induced complementary sickness and death in the second culture followed a reasonable time — say two to four hours — behind sickness and death in the primary culture.

The major transmission difference between window glass and quartz is that quartz transmits both ultraviolet and infrared well, while glass is relatively opaque to ultraviolet and infrared. Both quartz and glass transmit visible light. Thus glass is a suppressor of the paranormal channel, while quartz is not.

By performing the experiment in darkness through a quartz window, the four-law patterns of disease, sickness, or death engendered in the primary sample are not extensively squelched by the photon interaction, and these four-law patterns are transmitted through the quartz window into the second cell culture. Since the genetic patterns of the second culture are the same as those of the first, sympathetic four-state interaction and eventual kindling occur, resulting in the appearance of the effects in the second culture.

It is well known that cells also emit mitogenic radiation, including radiation in the ultraviolet and infrared regions. Since these same regions are not strongly suppressed by the photon interaction, one may hypothesize that paranormal effects may be strongly modulated onto infrared and ultraviolet photon activity, and there is indeed evidence for such an assumption. In 1950, Western researchers found that cells could be killed in darkness with ultraviolet radiation, kept shielded from visible light for twenty-four hours or longer, and then if radiated with visible light the cells would start reviving by hundreds of thousands even though they had been clinically dead.

Specifically, every cell emits mitogenetic radiation in the ultraviolet twice: when it is born and when it dies. The UV photon emitted at death contains the exact virtual state pattern of the condition of the cell at death. The healthy cells are bombarded with death messages from those that are dying, and this diffuses the death pattern throughout the healthy culture, eventually kindling into the same death pattern there.

However, the squelching of the paranormal channel by photon interaction is never complete, or paranormal phenomena could never occur in daylight. Hence paranormal patterns can be modulated even onto visible light, although only extremely weakly. Thus we may speak of the Q or sharpness of the paranormal modulation upon photon frequencies; Q is extremely low for visible light and may be extremely high for infrared and ultraviolet. In the visible light spectrum, it is probable that extremely large numbers of near-zero strength paranormal patterns are modulated on the light radiation; hence these patterns simply consist of a very weak background noise and the kindling effect does not apply. (The patterns are so random as to be self-cancelling in the kindling effect.)

DISEASE AND DEATH INDUCTION

The base idea here is that an active agent must be involved to disrupt the ordinary healthy pattern of inceptive life functioning. Since life functioning is inceptive, ultimately the bioframes, specifically the first and second, must be distorted or disrupted. The first bioframe is the electromagnetic field and the second bioframe is a psychotronic field. The second bioframe may eventually be revealed as the *neutrino* field, but this is still uncertain at present. At any rate, it is a *virtual state* field. Virtual state patterns of a disease, for example, are carried in each photon emitted by a diseased cell. The life functioning psychotronic components are modulated on the body's electromagnetic components. Thus they have an electromagnetic carrier, which will carry the inceptive life function patterns through the photon squelching effects of emitted photons in the body.

A host agent such as a germ produces an active agent such as a toxin. The chemistry involves the particular compound of the toxin that is disruptive or deadly. But chemistry after all is rigorously based on electrical patterns. These electrical patterns of toxic chemistry contain psychotronic patterns modulated upon them by the germ, and these genetic life functioning patterns are different from those of a human cell. The foreign psychotronic patterns are modulated upon the human body's electromagnetic patterns (currents) and thus reach the cell, where they interact by the fourth law in the cell membrane, being demodulated and introduced to the cell, and orthorotated in the process into electromagnetic signals disruptive to the orderly functioning of the cell. The foreign psychotronic signals also jam the ordinary psychotronic patterns being demodulated by the cell in its inceptive operations from its mind frame or third bioframe. If this jamming is only moderate, the cell sickens; it is only disrupted. If the jamming is severe, the cell dies.

The normal electromagnetic noise bathing the cell from the cosmos and the environment contains random components that largely self-cancel or balance. The modulated random psychotronic modulations of the ordinary background environment behave similarly, and thus the normal background simply constitutes a weak noise flux which does not disrupt the inceptive life functioning. In the experiments of Kaznacheyev and his colleagues, photon squelching was largely restricted, and the psychotronic signals from the dying primary culture could go through the infrared and ultraviolet windows in the quartz as virtual state patterns on the mitogenic UV photons emitted by dying cells, and be introduced directly into the secondary culture. The kindling effect then induced the disease or death pattern after an appropriate time delay. Thus it appears that there is indeed a fundamental mechanism by means of which a disease or death pattern from one cell is introduced into others.

If this is true, then an exciting vista emerges for the treatment of hither-to incurable diseases such as cancer. The psychotronic pattern of the cancer cells in a person's body could simply be recorded, then phase shifted 180 degrees, remodulated upon an RF carrier, and radiated back into the body of the patient to cancel the cancer's signal patterns. Radiation of the body need not be severe at all; even weak radiation will suffice due to the kindling effect. At any rate, the hypothesized mechanism seems worthy of experimentation, and it seems to offer a validation of the practice of radionic treatment of disease.

DYNAMIC THOUGHT CONSTRUCTS: BIOFIELD MECHANISMS

We will discover later that thoughts and thought objects are real, physical objects in their own worldframe domain. As such, thoughts, or thought objects, or thought constructs can be and are quite functional devices in the thought world domain. In that domain, they are as physical as a rock. We will also discover that thought energy can be turned into electromagnetic energy by kindling, and can even be materialized if kindling is of sufficient intensity. As an example, thought energy from negative thoughts continually repeated or held in the mind can cause one to become physically ill. This is a well-known effect, and such an illness is referred to as psychosomatic. However, the mechanism by means of which it is accomplished is not known.

Actually the mechanism is simple: in the minute electrical currents that run through the nervous system, across the cell membranes, through the fibrous content of the cells, and through the cell water structures, virtual state thought energy is continually kindled into weak electrical patterns, which modulate, shape, and affect all the vital processes of the body. Almost all this kindled thought energy is from the content of the unconscious mind. Thus the locked-in contents of our unconscious minds eventually directly affect and change our bodies for either good or bad, depending on the particular content being kindled.

Small wonder that we suddenly acquired a chemical problem some years ago after we were saturated by thousands of hours of pill advertisements on television, which directly implanted the idea that certain chemicals such as pain relievers contain the answer to life's problems, while others such as alcoholic beverages lead to a glamorous, active, exciting life. Not only can such material implant suggestions in the unconscious for association, but it can also directly condition the response that the body itself will exhibit to chemicals and drugs.

It is now fairly well accepted that there exists a cancer personality and a heart attack personality, where the mindset is definitely and causatively involved. And from the Simontons' work, we see that the mind can be effectively used in conjunction with other therapy to reverse cancer, even terminal cancer. But unfortunately, by and large Western medicine continues to rely on mechanics and chemicals. Essentially the patient is viewed as a mechanical apparatus and a chemical factory that is damaged, polluted, or out of sorts, and treatment consists largely of mechanical intervention (such as surgery) or chemical intervention (such as antibiotics). Medicine continues to be a science of the reparation of damage or malfunction. It is the science of disease, not the science of health. I do not advocate abandoning the medical practices that have proven effective. I do advocate the augmentation of such measures by all the mind measures available. In fact, medical science ought to be vigorously pushing forward into fields of psychic healing, psychotronics, radionics, etc.

RADIONICS

In ancient development systems it was well known that the mind itself was a functional device, and that thoughts and thoughtforms could function as devices, influencing and affecting other minds and physical material. It was also understood that the thoughtforms had to be crystal clear and very stable. This demanded a great deal of practice in concentration. Eventually it was found that the stability of a physical form or device could materially assist the mind in maintaining stability. In ancient times many such devices were used: the dowsing rod, the crystal ball, the string-and-weight psychic pendulum, etc.

In the last century it was discovered that electrical devices could be used as tuning assistants. This led to the development of radionics, the name being inspired by the new electricity and magnetism discoveries, and particularly by the discovery of electromagnetic radiation. These radionics devices had a distinct advantage in the degree of precision they achieved in the tuning of the inceptive cyborg (operator's mind linked with the actual device through hyperspace). Ten resistors could be staged to give an otherwise almost unobtainable degree of accuracy and precision to the inceptive tuning. The use of variable resistors allowed rapid change of resistance, and thus rapid change of the overall cyborg tuning, and the ability to scan precisely in hyperspace, say, the emanations from a patient. In the hands of a skilled operator, such a device was often much more accurate than the finest medical test equipment available today, and infinitely cheaper and faster. In addition, such testing and diagnosis added little or no distress to the patient. This weird new radionics presented a formidable threat to the orthodox medical establishment. In the U.S. at least, the dogmatic medical establishment promptly came down hard on this potential threat to its hitherto unchallenged domination in the field of medical treatment. Its inquisition and purge was made easier by the fact that many charlatans also leaped into the lucrative field, having little or no actual diagnostic ability, and prescribing meaningless amulets and placebos for seriously ill patients. Also, the strangeness of radionics, such as the ability to diagnose illness from a drop of blood drawn from a patient thousands of miles away from the diagnostician and the radionics device, alienated many members of the medical profession who sincerely believed that no such diagnosis was possible, and that all such psychic demonstrations were frauds. Furthermore, the results, either diagnosis or treatment, were not usually repeatable by ordinary physicians and investigators since the psychic skill of the operator was directly involved. Organized medicine of course did not recognize the ability of the doctor to mentally or psychically intervene in the patient's illness, and so such practice was regarded as fraudulent and banned by the medical establishment.

The radionics practitioners were hounded into court, prosecuted, and convicted of fraud and of practicing medicine without a license. Several prominent radionics pioneers were actually hounded to death, Wilhelm Reich and Ruth Drown being the two most prominent examples. What could have been a great leap forward in medical science in the U.S., and the beginning of the development of psychotronics, was crushed by the power, ignorance, and bigotry of orthodoxy. To this day U.S. radionics has not recovered, and U.S. radionics practitioners are a rare breed, largely underground, who perform their experiments in suspicious secrecy and have only lately begun cautiously emerging from obscurity. In Eng-

land and elsewhere, radionics survived and flourished, and today one can legally receive radionics treatment in England.

PSYCHOTRONIC DEVICES: A SIMPLE SPACE (QUITON) AMPLIFIER

It is possible to speak of the smallest piece of nothing, that we will call a "quiton." It does not monocularly appear as a perceived thing. Quitons are pieces of action, in which d*EdT* > *h/4*pi.* Quitons are virtual entities, and very small ones.

Collection of a sufficient number of quitons results in breaching a threshold, so that a thing results. To superpose quitons (dEdT's) must be of the same magnitude and time coherent.

Thus in any situation involving a particularized nothing, collecting enough pieces of that nothing eventually exhausts the nothing set and reaches its boundary, whereupon it is a thing. This is really not different from collecting all non-dimensional points in a particular sequence and finding we now have a one-dimensional line segment, or collecting all the pieces of spacetime warp in a particular region and discovering that we have now a mass.

A device can easily be constructed to process dual natured or binocular entities (quitons), which are monocularly zeroes, while excluding monocular entities. Thus we can build a space amplifier or quiton amplifier or vacuum amplifier. Two single-state excluders in a series feed or input to an ordinary single-state amplifier or processor in a shielded container. The output is fed into a device which will rotate the dual-state entity or field so that an ordinary field can result. One side or the other of the dual-state output will be exclusively present in three-space.

TYPICAL HIERONYMUS DETECTOR

The Hieronymus device, patented by Thomas G. Hieronymus in 1949, is one such device. It has an optical front end, a prism which passes waves and does not admit particles. So a wave entering the front end will go through the prism and be refracted at an angle that depends on the frequency of the wave. Inside the surrounding box, which acts as a light shield, is a small tuner, a little copper rod attached to a rotatable wheel so that the rod may be moved through the various refractive angles from the prism. The prism is mounted on the box with a thin slit in the wall, so that only a small and narrow field of view exists external to the box. The tuner rod is wired to the input of a three-stage RF amplifier where each stage is separately shielded against light—which is very interesting, because of a similar requirement in the two-slit experimental apparatus if the electron was to act as a wave. The output of the RF amplifier comes out of the box and ends in a flat coil of wire between two parallel plastic plates.

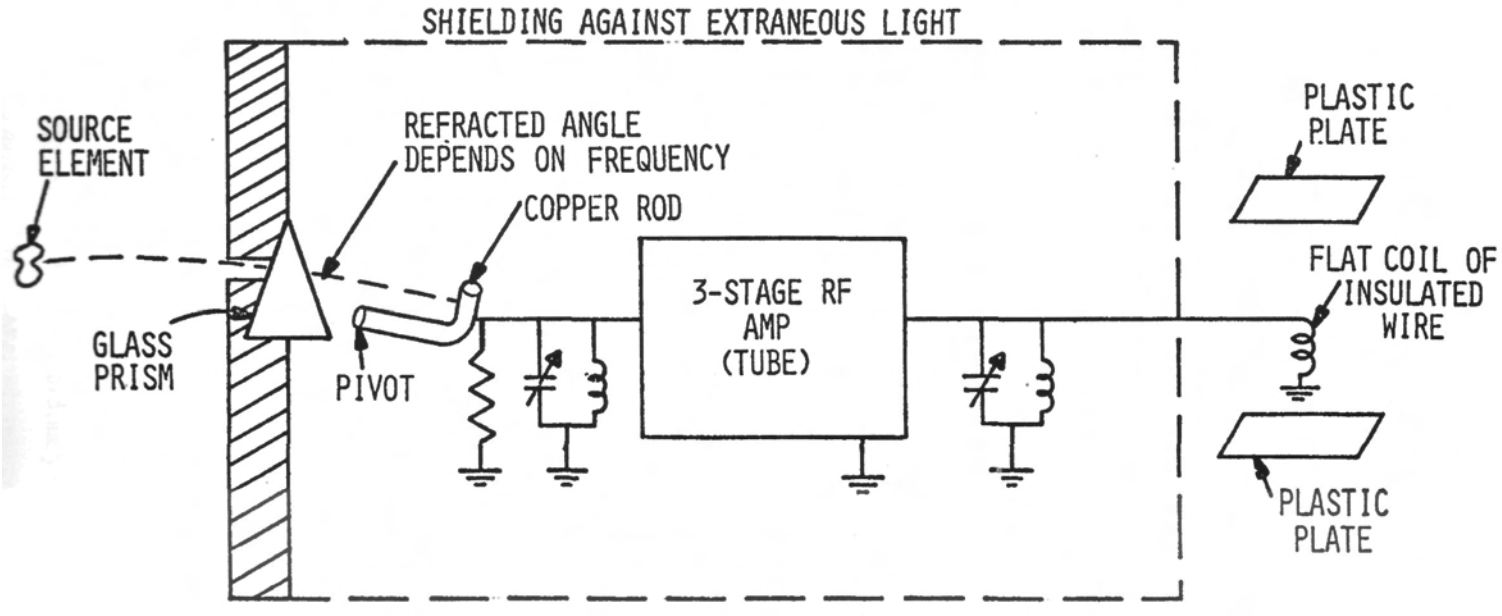

Fig. 12. Typical Hieronymus detector

Coming into the box through the slit in the prism, there can be single-state entities and dual-state entities or quitons. The physicist does not have a good name for a dual-state entity. They used to be called wavicles; today we talk about wave packets. But what after all is a wave packet? It is a three-dimensional bunch of two-dimensional waves! So that is where the physicists have hidden the idea of the dual-state wavicle today.

Only single-state waves and dual-state entities or quitons can pass through the prism and be refracted at an angle dependent upon the frequency. If we then tune the rod into the correct angle of refraction, the refracted quitons hit it, as do the single-state waves if their frequency should happen to coincide with the frequency of the quitons. Now the single-state wave dies when it hits the copper rod; it may chip a single electron or two off a copper crystalline grain, but that is lost in the thermal noise anyway, below the detection threshold of the RF amplifier. The quitons, however, simply say "Oh! Now you want us to act like a corpuscular electron, and go through those wires and conduction paths. That's all right, that is just our right hand side." So the quitons will go through and be amplified, just exactly like ordinary electrons would do. But now it is not electron energy, it is a dual-state analog of energy — let us call it anenergy, for analog of energy. (Hieronymus called it eloptic energy, since it could act as electron flow or as optical waves, but was neither exclusively.) The amplified anenergy will come out in the coil of wire and it will generate field and it is not a magnetic field, and so it cannot be measured on normal laboratory instruments. The simplest way to detect the anenergy fields is to use the human sensory system, because the human body knew about RF energy, frequency modulation, and anenergy long before we had modern electrical and magnetic instruments. (The use of anenergy is illustrated by acupuncture, a very ancient medical system dealing with the fact that a peculiar type of energy-like stuff flows in the body, and in certain points and structures of the body, it can interact with other energies and fields.)

Now if we believe we cannot sense the anenergy fields, then we cannot. We can turn the entire anenergy detection system in the body off with the unconscious mind. The negative psi effect is a well-documented effect in parapsychology. There are goats as well as sheep. Some persons do worse on psi tests than chance would possibly allow. They are the goats. They exhibit the negative psi effect, for unconsciously they want to show you that psi does not work, so they use psi effects to do worse than is possible by chance.

At any rate, the human sensory system can get a tingle from the anenergy field generated by the flat coil of wire in the Hieronymus machine's output. What type of tingle one gets depends upon one's own type of body sensory tuning. It may feel as if the fingers on the plastic plate are in thick syrup. Or as if the plastic plate were vibrating. Or it may feel greasy in a peculiar way. And the negative person does not get a tingle at all.

The Hieronymus machine has been built by many persons, and it works for those who are not negative. It processes entities that exist in the dual-state, or that obey the fourth law of logic. And we can do some almost magical things with these dual-state nonthings, these nothings, if we set our minds to it. This is what psychotronics is all about.

ANOTHER KIND OF HIERONYMUS DEVICE AND THE INCEPTIVE CYBORG EFFECT

If thought constructs are actual operational mechanisms, then there should be other evidence besides psychosomatic illness and the demonstrated ability of the mind to cure certain illnesses. In fact, the Hieronymus device can be used to demonstrate this point.

John Campbell, former noted editor of Analog Magazine, once built an Hieronymus device and tested it successfully. Campbell immediately recognized that present physics could not explain the functioning of the device. In an exchange with Arthur Young, Young suggested to Campbell that it was the mind of the operator that made the device function, and that it was the symbolic form of the device that dynamically functioned to make it work. This appeared particularly significant to Campbell since he had discovered he could make the device work even though disconnected from its power supply.

So Campbell decided to test this thesis. He carefully drew on paper in black India ink a schematic diagram of the amplifier, removed the actual amplifier hardware, and substituted the schematic drawing. To his absolute amazement, the device worked as well for him this way as it had previously. But from our standpoint, such a result is not unexpected and can be readily explained.

First, I should point out quite strongly that Campbell not only was well-qualified technically, but even more important, he had an open and unbiased mind. This of course is quite necessary; the negative psi effect is well known, and the negative person is most certainly not going to allow his mind to operate the Hieronymus machine, just as he will not allow himself to succeed at dowsing, and so on.

Furthermore, in constructing the electrical schema of the amplifier, Campbell was strongly impressing stable thought constructs in his own unconscious, which was fully aware of the function of each part of the drawing. And when he connected that drawing to the rest of the hardware, he understood the function of the connection. He thus built in a thought connection from his thought-form amplifier to the hardware in a cyborg device. It then functioned as well for him as had the actual device. Campbell had proved that mind and matter may be cyborged into operational devices.

Psychic use of a pendulum, a ouija board, a dowsing rod, a crystal ball, and a crystal skull are other examples of the use of inceptive cyborg psychotronic devices, as is the use of radionics equipment of all types. And of course the most outstanding example of an inceptive cyborg where mind and matter are linked into one functional device is a living biological system.

Frances Farrelly, working with Arthur Young, took part in an experiment using an ancient Mexican figurine with a fluted neck. She succeeded in inducing fluted ears in a laboratory mouse. The mouse was exposed to the figurine about three feet away, and the cage or the mouse was connected to the figurine with a wire. Physical objects, such as mice bodies and fluted figurines, are three-dimennional channel tuners for orthorotating mind energies. Given firm initiation by a talented person such as Ms. Farrelly, a selected grouping of tuners can be resonated to collect bioenergy, and kindle it into ordinary energy and then into physical effects.

PROBABILITY: THROW OF A DIE

The fourth law of logic is absolutely indispensable in physics. We use it every day and do not realize it in probability. But what after all is probability? Let us use a very simple example to get at the answer to that question. Let us use the face of a die turned up. How can I model that, before the die is thrown?

Now we can only think by operationalism. To operate and output something is to automatically put it in the past. It's happened, it's gone, the moment you do it. To perceive an object is to put it in the past. To determine it is to put it in the past. To observe it is to put it in the past. There is no observed, perceived, detected, measured, or determined present. That is, there is no separated, exclusive, determined present such as is specified by the first three laws of logic — the fourth law is the present, by the way — but in observational physics which deals with determined, observed past phenomena, there exists no present. The future has not yet been observed, so it also is the unobserved. Only the past therefore is the observed. How then can one ever hope to model the unobserved present or the unobserved future?

If I look at the problem of the die with one face up, it is in the past. When I see it, it is in the past. When I think it, it is in the past. So if all I can observe, think, or perceive is the die in the past, how can I ever model it in the future? It's very simple! If I drive any problem set to its absolute boundary limit, it turns into its own opposite by the fourth law of logic, by the law of the boundary. So how do I do that with this problem of the die?

The problem set is specified by the condition "the perceived die with one face up"; this is the most recent past. Now simply find all the most immediate pasts you can get to meet the condition specified, and gather them all up together, and they then must turn into and comprise precisely the opposite, the immediate future. In this problem set, I can construct and collect six such pasts, each consisting of the perceived die with one face up. So by the fourth law of logic, those six faces up collected together as an ensemble represent the future and in fact are identical to the future. The present, which is simply the boundary between the most immediate past and the most immediate future, was specified by applying the fourth law of logic in the first place: the identity of the most immediate past and the most immediate future, being binocular, is unperceived, but it is the present nonetheless. So that is what probability is — an application of the fourth law of logic, so that the most immediate future can be represented in terms of the most immediate past — and physicists and mathematicians have been doing this ever since they have been doing physics and mathematics.

Without the fourth law of logic, there exists no rigorous logical basis for probability! So the fourth law is a very useful law indeed. We have simply failed to realize that we have been applying it all along.

The ontological problem can also be solved as follows: to state that "*A* is not" is to state that "*A* is" is not; to absent a presented thing is to first present it; to be "not-being" is a clear statement of the problem. By the first three laws of logic, the problem is not soluble. By the fourth law, it is simple since being and not-being can be identified. All distinction between present (being) and absent (not being) can be lost.

NEGATIVE TIME

Negative time does exist and is used in advanced physical theories. Dirac predicted an electron traveling backward in time, which would be observed in positive time as a positive charge traveling forward in time.

The application of negative time to philosophy also allows the solution to the problem of good and evil. In positive time we may consider an act as evil — say the act of a hungry wolf seizing a hapless rabbit and devouring it. In positive time, we might say that to the rabbit the act was evil, and to the hungry wolf the act was good, noticing in the process that good and evil are relative terms, not absolutes. Examining the situation now in negative time, a very strange thing occurs. The remains of the consumed rabbit are regurgitated from the wolfs belly, again creating a living breathing rabbit, and reintroducing hunger into the wolf. Thus the act now is beneficial to the rabbit and detrimental to the wolf.

The point is that Allness or Godness is both sides of every coin, not one side only. Omega Godness exists both backward and forward in time; it must do so if it is to be unlimited, even by time itself.

Thus to such unlimited allness, every act is both good and evil simultaneously. Thus we can understand how a perfect creator could establish and ordain good and evil, for there is a sense in which the two are synonymous.

However, such insight is a very strong dose of medicine, too strong for the average stomach. Most persons never seek the Unlimited Godness; instead, they seek a good facet of Godness that itself moves forward only positively in time. Thus they find a partial image which is limited in and by the flow of time. By such an assumption the biblical phrase "I am Alpha and Omega" is unconsciously translated into "I was Alpha and I will be Omega." Thus orthodox Christianity long ago lost much of the God-insight originally given by the avatar Jesus. Only those few cloistered individuals who still struggle with exegesis grapple with the problem of good and evil. The problem indeed has a solution, but the solution involves negative time, the fourth law of logic, and an unlimited creator.

TIME OSCILLATION, QUANTUM CHANGE, AND MASS

It is well known in physics that almost all physical theory is time-reversible, i.e., the equations hold true whether time is positive or negative.

This is important in the theory of antimatter. A positron (antielectron) may be regarded as an electron traveling backward in time. The destruction of an electron constitutes the creation of a positron, and vice versa, when we are observing in only one kind of time.

However, when we consider monocular quantum change, we realize that time can be modeled as a wave. To have any of the present physical quantities (energy, length, time, and momentum changes), a quantum of action must be isolated and fissioned into fragments. By this process we get a change in any physical quantity. This is fairly well understood in present physics, though not in this exact terminology.

However, what is not recognized in physics is that a disposal operation must be performed to clear away the fragments of one physical change before another can occur. The only way the fragments can be cleared away is to fuse them back into an action atom. Since action itself cannot be perceived (only a change in action can be perceived, not action itself) then fusing the fragments into a quantum removes the fragments.

This fusion operation removes positive time fragments (and other positive fragments) and so can be considered a negative time operation. Thus time can be considered to be an oscillatory wave because of its continual monocular discrete creation and annihilation by the quantum change process.

In fact, time oscillation may be considered to be the fundamental reality, and quantized change its result.

By the complementarity principle, time, being a wave, also must sometimes exhibit a corpuscular nature. (Indeed, all virtual state particles are nested within the structure of time.)

The Soviet work on time generating force thus is of absolutely fundamental importance. What has been released of K'ozyrev's work seems to be intentionally deceptive and of little value. His real work and that of his colleagues appears to have the highest Soviet classification, and none of this material has been released.

In the West, the only person of note who has grasped the fundamental import of time and time oscillations is Charles Muses. As early as 1958, Muses pointed out that there was no mystery in the two-slit experiment if the chronotopological features of the experiment were properly taken into account. Muses also worked out a hypernumber structure of time, but its significance seems to have escaped orthodox physics. Nonetheless, his work has direct technological implications, such as materialization and dematerialization of matter, and offers an approach to the engineering development of actual devices. Since his hypernumber theory of time structure also encompasses consciousness, it represents a union of physics and metaphysics on a common basis, and an approach to the engineering development of psychotronic devices.

Western physicists, then, would be well advised to pursue vigorously the idea of time oscillations, both theoretically and experimentally. And they would also be well advised to examine the hypernumber work of Charles Muses.

Since mind and virtual state occupy the time dimension, the nested structure of time contains the mechanisms for mental-physical interaction and for direct amplification of virtual state into observable state (or for the dissolution of observable state into virtual state).

MASS IS A TIME-DIFFERENTIATION

The most fundamental aspect of the concept of mass is that it occupies space, i.e., that it is three-dimensional. Mass thus is a time differentiation of Minkowskian spacetime L^3T. Applying the fourth law of logic, a thing does that which it is and is that which it does. Thus mass is a time-differentiator.

Because of this, we cannot see time, the fourth dimension, although we can see L^3 length, width, and height. Because we look through and detect with a mass

sensory system, the time dimension is lost in the act of looking and detecting, i.e.,

$$d/dT(L^3T) = L^3$$

and we thus see a spatial reality. Physical instruments also have mass and do precisely the same thing. For this reason, ultimately all measurement or detection is spatial rather than spatio-temporal, as is well known in physics.

Note that we do not see or detect total reality, but only a partial differentiation of it. Thus the position of the materialist's view is ironic: in his absolute insistence that reality consists in only what can be seen, touched, felt, or detected and measured with his instruments, he condemns himself to the greatest illusion of all, the notion that the outputs of his physical sensory system and his physical instruments constitute absolute reality. Also, since the only physical dimension shared by mind is time, mind reality is lost in the act of detecting, and hence only phenomena which are totally separated from mind are detected.

By the fourth law of logic, the existence in no mind at all constitutes the existence in each and every mind (nonexclusively). Thus physical phenomena are those phenomena that are processed by every mind. We will see that the fourth law enables us to deal precisely with mental, physical, and paranormal phenomena on that basis (how many minds the phenomena exist in).

REALITY IS LIKE AN OPOSSUM

Reality is like a mother opossum carrying her little baby opossums on her tail, i.e., the entire mental-virtual state is carried along as virtual constructs, nested comfortably in the delta time portions of each photon. In the piece of time that is fissioned out of an action quantum to give observable change, there are a multitude of little pieces of time still attached to subquantum virtual state entities and hanging on, exactly like little baby opossums hanging on to their mother's tail with their own tails.

The world is so built, then, according to physics. And if we include our physical model of mindchanges, every possibility in fact concretely exists in that manner, in the virtual state, timewise hanging into the time dimension of the detected physical world's four-space frame, but spacewise hanging out of the ordinary three-space physical universe of objects. So indeed all possible realities, even the wildest and the most farfetched, exist in the virtual state.

The time channel is thus quite literally the paranormal channel that connects the normal spatial world to an infinity of nonnormal spatial worldframes. Only by the continual destruction of each piece of created time (by fusing it back together with the piece of energy involved, and forming a quantum which is unperceivable) are we able to experience physical reality at all, uncluttered and relatively free from the vast hordes of infinite realities through which the ship of quantum-change physical reality sails.

Since the electromagnetic field represents a collection of this vast array of realities, then by proper selection (i.e., by coherent tuning) of multiple stages we should be able to select a particular virtual reality channel. And indeed so we can. Any scheme for drastically increasing signal-to-noise ratios should be adaptable to such a collection mechanism for the detection of bioenergy.

In another sense, reality is like a television set with an infinite number of reality channels, but only one of which is tuned in at any one time. By adjusting the tuning, however, a different reality, including even different physical laws of nature, may be tuned in.

BIOFIELD CONCEPTS

To understand the hyperframe approach to fields, we must understand the dimensionality of intersections in n-dimensional space. The dimensionality of an orthogonal intersection is one less than the dimensionality of the intersector having the lowest dimension. One intersector appears radically different to the other intersector since the second sees only a derivative of the first. It is the total projection of an intersector that is "seen" by that which it intersects.

Hubbard's manifold theory also derives these principles. The "types of reality" that these other objects appear to be will depend on the types of intersections they make with the frame of the observer.

This cannot be stressed too strongly: an observer sees his own frame, and intersections in that frame, nothing else. He does not necessarily see the entire reality of any object, and if an object is in a frame that does not intersect the observer's frame, the observer cannot detect that object at all.

Thus all types of reality are open to reinterpretation in the light of intersecting and nonintersecting frames. And to shift dimensions (increase or decrease), all we need do is add or subtract additional orthogonal intersections.

MASS, FORCE, AND 3-D FRAME ROTATION

It is well known that a moving mass can be considered as existing in a three-dimensional space which is rotated away from the line of motion of the mass as seen in the laboratory frame. Einstein in fact pointed this out.

As the velocity of the object approaches c, the speed of light, the angle of rotation approaches 90°. From the bottom left figure it can be seen that a force in the laboratory frame, applied to the moving mass along its direction of motion in the laboratory frame, only affects the mass in the mass's rotated frame with a projected portion. To the laboratory observer, the mass's resistance to the disturbing force applied seems to have increased; thus to him the inertial mass of the object seems to have increased, i.e., if it is harder to push, its resistance to pushing must have increased.

But in the rotated frame, the object's mass has not increased. The rotated frame effect is *why* the mass of an object increases to one observer but not to the other.

When the rotated frame can be rotated to a full 90°, no force applied by the laboratory observer can accelerate it further, because the applied force has zero projection in the rotated frame where the mass actually is. Thus the mass (resistance to pushing) appears infinite to the laboratory observer, while to the rotated observer it is still exactly the same as it always was. Furthermore, to the rotated observer, **the** force being exerted on the rotated mass is zero.

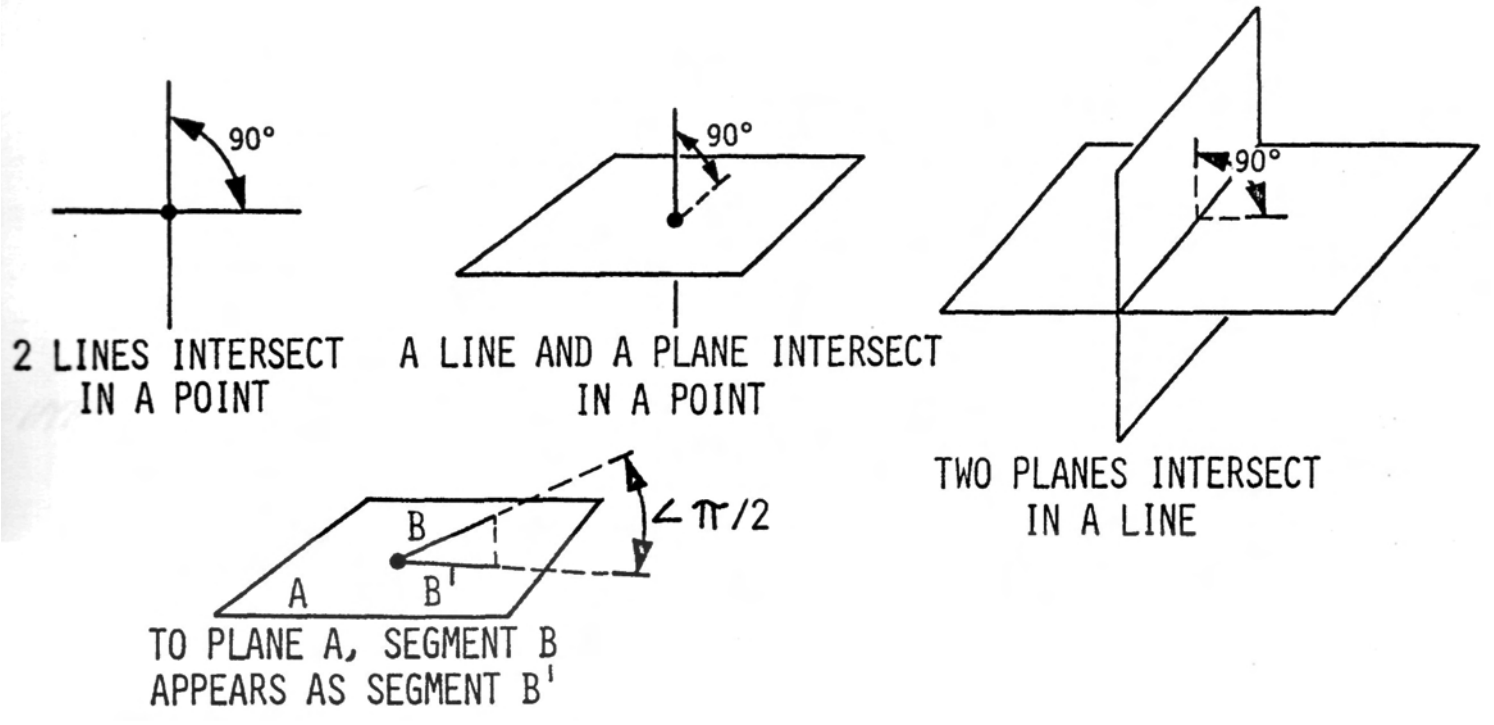

Fig. 13. Biofield concepts

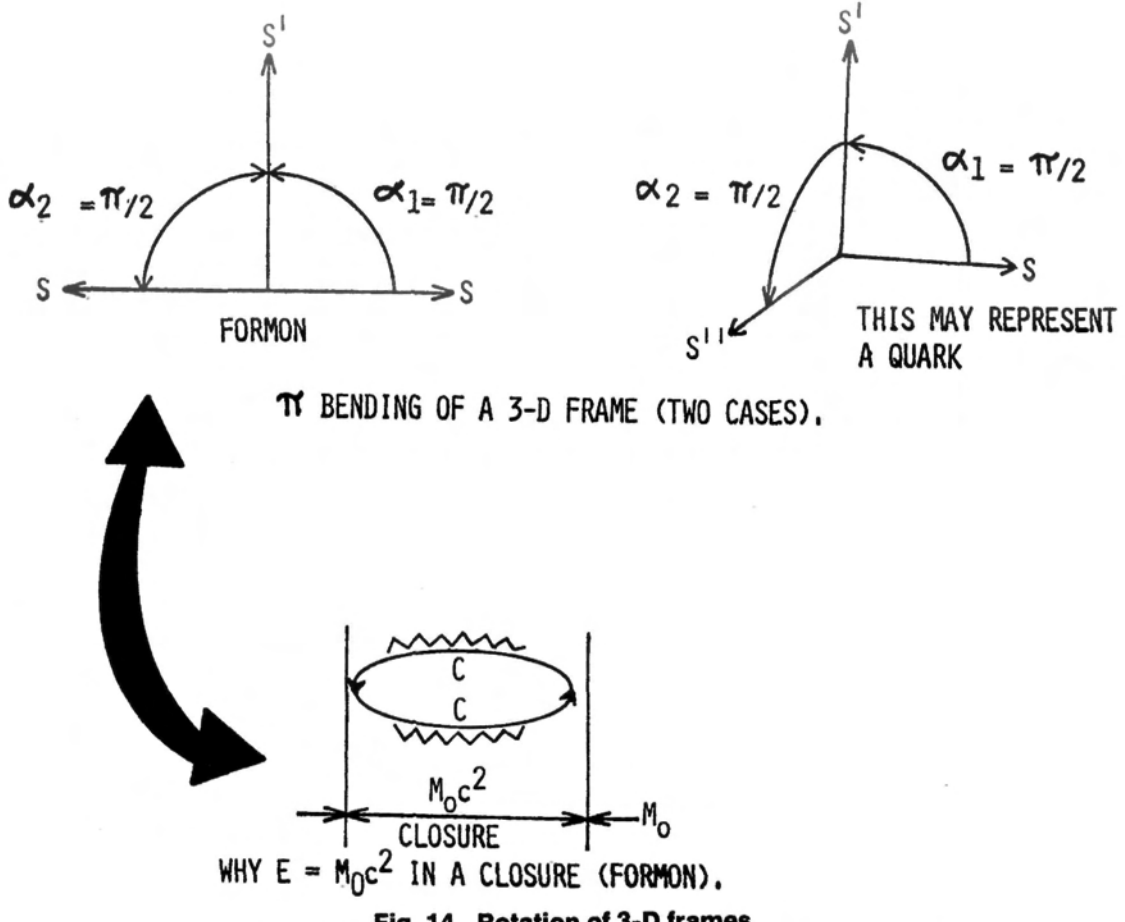

Fig. 14. Rotation of 3-D frames

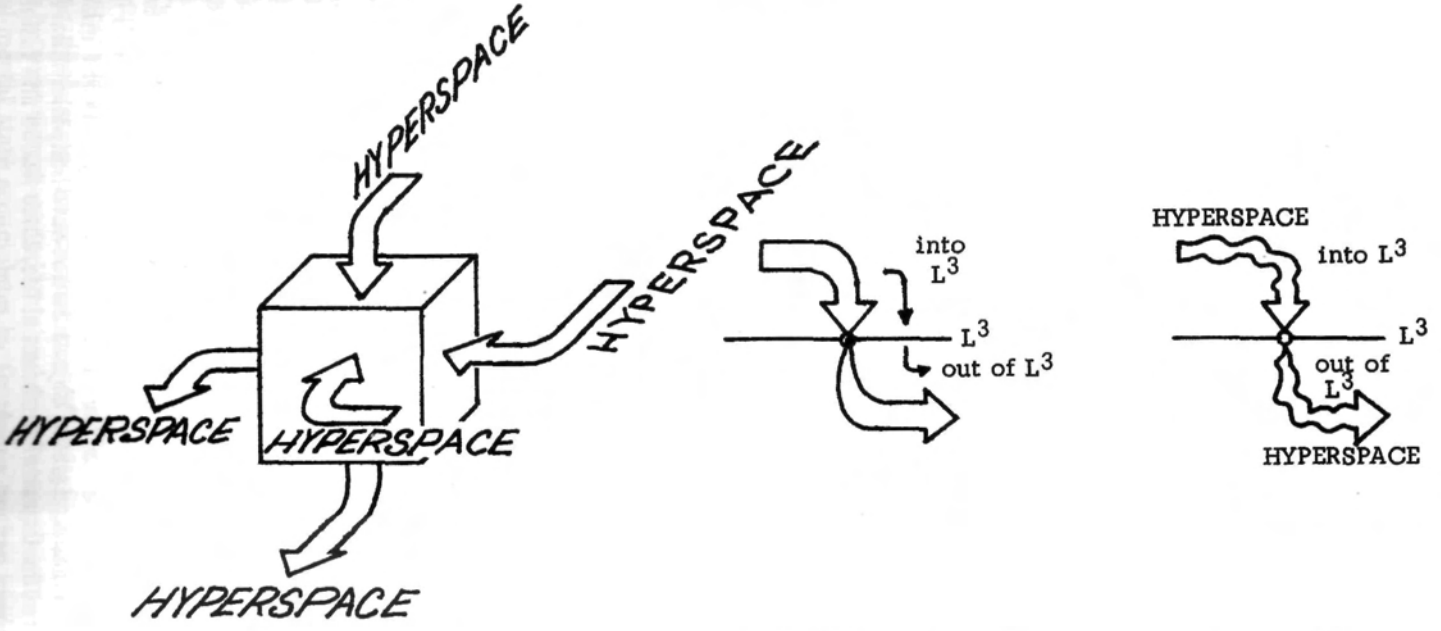

MASS
A region of hyperspatial flux orthorotating in and out of L^3 3-space.

MASS PARTICLE
The flux does not "move through" 3-space. It rotates in and out of each individual mass particle.

JITTER
Each flux line is not smooth, but jittered.

Fig. 15. Mass is π-rotation of hyperspatial flux

However, the mass's intersection in the lab frame is now two-dimensional. Since only three-dimensional objects can have mass, the object is massless to the laboratory observer. So here we have a paradox: zero mass is identical to infinite mass. This is perfectly in consonance with the fourth law of logic.

The absence of any single finite mass actually permits two indistinguishable solutions: the absence of any three-dimensional mass at all, and the exclusive presence of more than any finite mass. The two opposites are identical on the boundary case.

Thus a photon has zero mass because it is a two-dimensional object and only three-dimensional objects have mass. A photon also has infinite mass because it cannot be accelerated along its direction of travel. A photon is a perfectly ordinary three-dimensional particle existing in a normal three-space that is one orthogonal turn away from the laboratory three-space.

MASS IS π ROTATION OF HYPERSPATIAL FLUX

In Figure 15, I show that a localized mass is simply the result of orthorotational flux in and out of that localized region. This is a hyperspatial flux, since it actually is flowing or rotating in hyperspace.

This flux is related to the spin of a fundamental particle, and in one sense may be regarded as an extension of the concept of spin, i.e., ordinary spin is simply a derivative subset of hyperspatial spin (orthorotation between orthogonal three-space).

This flux does not move through laboratory three-space, but rotates into and out of it, at and for each fundamental particle of mass in laboratory three-space. As I point out elsewhere, mass itself is nothing but the absolute value summations of action quantum fission and fusion activity in a localized (fundamental particle) spatial region *(Quiton/Perceptron Physics).* Fission and fusion are orthorotations, or hyperflux activities.

Also, if we represent this hyperspatial flux by flux lines (a standard practice in physics), then each line is jittered because of its modulation by many higher-frequency components. This flux and the jitter in it play an important part in paranormal phenomena.

Furthermore, the hyperspace flux can be seen in two other ways: (1) as continual direct coherent collections of virtual subquanta to reach the quantum threshold, breaching it and becoming observable quantum change. Thus it should encompass essentially all hidden variable theories. This is the same mechanism by means of which virtual photons kindle and create electric field and the charge of an electrically charged particle; (2) as continual direct coherent collections of mind virtual state subquanta to reach the quantum threshold, breaching it and turning into observable quantum change (physical phenomena). Thus all matter is totally mind and totally alive — inert matter is just nonpreferentially alive. The resultant flux vector in an inert mass is zero since there exists as much flow out as in, and vice versa. This totally eliminates the classical dichotomy between mind and matter. It also implies that accelerated objects do not have nonpreferential type of life, but in fact have some degree of preferential life, since fission and fusion rates of an accelerated object are not equal.

Establishing sufficient pattern coherence in the parts of an accelerated system thus constitutes a preferential tuning between multiple parallel-directed directional coherences. This effect can result in establishing a one-to-one correspondence to and from one of the higher orthoworlds, i.e., it can result in a coherent circulation between that universe and the specific inert accelerated system. This circulation is easiest to establish through magic frequency windows where the channels of least resistance exist. This is the basic mechanism by means of which a living biological system is produced in and from the appropriate primeval amino acid soup in the presence of (a) magic-window induction (such as in the ultraviolet), (b) the acceleration of otherwise inert particles (such as is locally provided by lightning discharges), and (c) the strong collection of bioenergy to orthorotate it through three rotations (as is also provided by lightning discharges).

It is not accidental that life can be and has been created in the laboratory. This type of experiment, done by a team of strong psychics projecting intentional bioenergy forms, should be able to create specific forms of life. The same type of mechanism can occur inside the living body where it can induce psychomatic illness. A similar mechanism is probably responsible for the placebo effect, and possibly for the body's production of antibodies and the psychic modification of enzyme activity, psychic healing, etc.

JITTER OR DITHER MODULATES THE PRIMARY FLUX

In the continual, virtual, subquantum, orthorotational flux (crosstalk), rotating into and out of a fundamental mass particle, only those components that are coherent are additive, and only those that add to the quantum threshold and breach it become observable quantum change.

In a given observable quantum change consisting of such coherently adhered subquanta, time is produced by fission of the quantum of action. All remaining statistical subquanta which have not collected to the threshold level are virtual subquanta of action possessing unfissioned, unseparated time. These virtual subquanta, which themselves are dynamic and gradually collecting and superposing to various degrees and at various rates, are attached to and exist in the dT interval produced by fission of the action quantum. Thus each and every piece of time contains dynamic, nested, virtual subquanta. Time in observable changes may thus be said to possess an internal dynamic structure filled with such virtual subquantum mental, neutrino, and photonic entities.

At any fission time, the degree of superposition of each of these nested entities is highly variable and depends on the whole past collection history, which in turn depends on all flux components of the proper frequency that have been arriving from all the orthoframes.

Thus virtual-mental entities cohere frequency wise until they breach the quantum threshold and discharge into observable quantum change. It is much like the accumulation of a static charge until sufficient potential is reached and a spark occurs, discharging the accumulation of charge. The same sort of relationship exists between virtual-mental state and observable state. The only difference is that virtual-mental state accumulates by frequency or time phase.

Since present physics is entirely localized, local observations cannot have taken into account distant matching-frequency events in the laboratory frame, or matching-frequency events in orthogonal frames. To the localized particle of mass, the precise moment a particular subquantum superposition of given frequency will superpose to the threshold and turn into quantum change is therefore not predictable. Since the remote causes cannot be accounted for, the local effects cannot be time-ordered.

Therefore at the quantum level, the physical change is totally statistical to a monocular observer. This accounts for the fact that the quantum world is statistical rather than causal.

However, a given fundamental mass particle has a structure of physical aspects, e.g., mass, spin, locality, frequency spectrum, switch rate, strangeness, etc. All of these may be expressible in terms of orthorotational concepts, although not all of them have yet been so worked out. Muses has already pointed out that some of the present quantum numbers are actually hypernumbers. And just as $\sqrt{-1}$, the first hypernumber, is an orthogonal rotation, so are the other hypernumbers.

At any rate, one may regard a fundamental particle as simply a complicated three-space tuning pattern existing in the orthorotational crosstalk flux between orthoframes. This pattern may also be said to consist of sets of frequencies, since each orthorotational flux line has a frequency of in-out-operation. Thus each fundamental particle is a set of tuning frequencies in the flux. A stable particle is a stable spectrum comprised of standing waves. An unstable particle is an unstable set, comprised of some standing waves, which account for the duration, and some not-quite-standing waves, which account for the excited state or degree of instability of the object.

On each flux line, orthorotational flux lines exist, constituting jitter or dither. Also, every fundamental particle is a tuning. It both tunes and is the result of its tuning, i.e., by the fourth law of logic it does what it is and it is what it does. Since tuning allows frequency communication between orthoworlds, then free-energy devices are not only possible but are practical. So are dematerialization-materialization devices, teleportation devices, devices that heal or kill, and anticancer devices.

THE UNTOLD STORY OF QUARKS

We hear so much nonsense about the objectivity of science that it occasionally seems necessary to debunk the sacred cow. In fact, the quark story is a prime example.

In 1910, Millikan made his famous oil drop experiment and determined the charge-to-mass (e/m) ratio of the electron. By multiplying this ratio by the mass of the electron, the amount of charge on the electron might be computed. Thus was born the idea of a constant amount or quantum of electricity, the fixed charge on an electron. Millikan received the Nobel prize for this famous experiment.

Actually, Millikan himself did not originate the experiment. One of his brilliant graduate students, Harvey Fletcher, first conceived the idea. Millikan became interested after he saw what a stir the results were creating, and he accepted the Nobel prize without sharing the credit with his brilliant student. Later Dr. Harvey Fletcher was to become the head of Bell Telephone Laboratories and an eminent managerial scientist in his own right. He also is the father of Dr. James Fletcher, former Chief Administrator of NASA.

Incidentally, Dr. Harvey Fletcher is still alive and alert, should anyone care to check the story! Nonetheless, it is highly doubtful that this grave injustice to Dr. Harvey Fletcher will be corrected.

But the story does not end there. In the late 1930's, a German physicist named Ehrenhaft decided to change the Millikan experiment and use charged solid particles rather than charged liquid oil drops. In fact he used red selenium spheres of various sizes. Amazingly, he discovered that he could isolate and measure fractional charges (quarks) at will, and he could even control the magnitude of the fractional charge isolated on a selenium sphere by varying the diameter of the sphere itself.

His work was duly published in scientific journals, and duly greeted with derision and hostility. Ehrenhaft himself disappeared during World War II. And there the matter lay. Dogmatic scientists continued to blindly teach the indivisibility of the electric charge, Millikan retained his exalted position and Ehrenhaft's work passed into comfortable obscurity. And in sophomore physics laboratories all across the nation, the indivisible quantum of electricity held full sway, dutifully proved over and over by the oil drop experiment.

Then in the 1960's, the particle physicists, despairing because of the bewildering new array of fundamental particles that continued to pour in confusion from their massive high energy machines, turned again to the idea of fractional charge (quarks) to try to make some unifying sense of the embarrassing abundance of strange new particles. By choosing three simple quarks, they could unify the theory of almost all the new particles. (Additional quarks have become necessary in the theory since then.)

So physicists gradually began to look for quarks, but in the giant, sophisticated, cumbersome experiments and devices that were yielding all the strange particles, not in the simpleton's approach that Ehrenhaft had taken. And they could not find them! Try as they would, a quark just refused to leave its tell-tale track. But in desperation they kept looking, and kept missing them.

Then in 1972 a convention of physicists was held at the International Center for Theoretical Physics in Trieste, Italy. Seven Nobel Prizewinners in physics attended the convention, whose theme was the physicist's conception of nature. Paul Dirac, the Nobel prizewinner who had theoretically predicted the positron before its discovery, gave the keynote address to the distinguished gathering.

Amazingly, Dirac presented the work of Ehrenhaft to the startled convention! He showed some of Ehrenhaft's data, and then pointed out that Millikan had also reported a single measurement of fractional charge, but had discarded it from consideration because he felt it was probably an experimental error. Dirac remarked that it all made him wonder whether Millikan might really have had a quark in that single discarded measurement.

The die was cast, and the seed finally planted. In 1977, about forty years after Ehrenhaft first obtained his quarks, someone finally got around to using solid paniculate matter. Researchers at Stanford University tried it out using niobium, and they got a little fractional charge on their niobium. So after forty years, Ehrenhaft, who had so long been ridiculed and ignored, was finally vindicated. It had taken the establishment that long to check his work instead of dogmatically rejecting it. Yet in none of the articles I have seen on the new discovery has there been a single word about Ehrenhaft, or of Dirac's presentation of his work at Trieste.

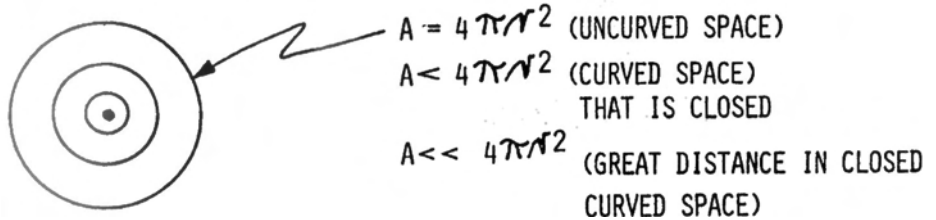

Fig. 16. Einstein's spherical model of the cosmos

EINSTEIN'S SPHERICAL MODEL OF THE COSMOS

Einstein's spherical model of the cosmos is a primary example of a holographic universe. In such a closed spacetime, each point inside the universe is also at the extreme end of the universe in any direction. Thus the entire physical universe is totally outside any of its internal points, and totally inside each internal point as well.

That is an application of the fourth law of logic. The total internal is identical to the total external. The adjective "total" merely moves one to the common boundary between the operational concepts of "internal" and "external." At that boundary, there is no operational distinction between one and the other.

The universe closure is not limited to just one occurrence or one rate of closure. In fact the universe can then proceed to close again within the same local three-space, e.g., a gradual macroscopic closure due to gravity field (or causing it) constitutes the external universe, and a second extremely sharp microscopic closure due to electric field (or causing it!) constitutes electric charge. The two together constitute a fundamental charged particle of mass. The polarity of charge is determined merely by which of two directions the second closure was made in. Considering an electron as such a dually closed entity, it is readily seen that the closure ratios are all that is being referred to by Feynman's condition. Feyman pointed out that any unified field theory must explain why the ratio of the radii of the Einstein closed universe and the classical electron, and the ratio of the electrical and gravitational forces between two electrons, were the same — on the order of 10^{42}. The model is also consistent with Santilli's proof that the electric field and the gravitational field are either the same thing or partially the same thing. In our model, an electric field is in fact a highly compressed gravitational field. Proper time synchronization should allow fantastic antigravity effects to be realized, and thus electrogravitics has a basis in this model.

A CHARGED PARTICLE IS A DUAL CLOSURE OF THE UNIVERSE

It is proposed that each fundamental particle having electric charge represents a dual closure of the entire physical universe. The gravitational field closure is slow and weak, and it is that closure which results in the so-called external physical universe.

It is proposed that all particles participate in this same closure, since it is their combined distributed mass that represents or causes the closure. (By the fourth

law, "represents" and "causes" become simultaneous at the boundary, i.e., when closure is accomplished.)

There are two directions possible for this gravitational closure: one where gravitational masses appear to attract, and one where gravitational masses appear to repel. These two directions thus form antimatter closures with respect to each other. The G closure where G masses attract is said to be the closure associated with a positive time dimension, while the G closure where G masses repel is said to be the closure associated with a negative time dimension. The direction of closure represents or causes the time dimension's algebraic sign, and vice versa (fourth law).

The electric field (E) closure is strong and fast — on the order of 10^{42} times as strong and fast as the G closure. However, its closure is in a direction orthogonal to the direction of the G closure. Since all matter is in motion, a slight deviation from exact orthogonality actually exists between the G and E closures due to crosstalk projection of components from the slight frame rotation involved in the velocity of each mass itself.

There are two primary orthogonal directions for the E closure. One direction yields positive charge and the other yields negative charge, for the positive time closure. For the negative time closure, the directions are reversed.

Such a schema, or version of it, can be made consistent with Santilli's proof, Feynman's criterion, and the observed fact that electricity can affect gravity and vice versa (electrogravitics). In fact, the electric field becomes a highly compressed gravitational field, at nearly 90° from the normal gravitational field. Liberating the compressed gravity in a flashlight battery could accomplish fantastic antigravity effects. Ironically, antigravity should be the simplest and cheapest effect ever dreamed of, once practical mechanisms for orthoshifting E field to G field are discovered.

Since psychotronics and quarks involve more fundamental components of electromagnetic field, hyperfields or biofields, psychotronic devices to yield antigravity should be quite feasible. The undisclosed extensions to Pavlita's psychotronic generators are thus of absolutely fundamental importance.

Furthermore, the ancients appear to have possessed psychotronic devices. Considering that metals, crystals, and other common materials can be used to. construct psychotronic generators, and great power is attainable by the hyperchannel amplifier effect, it is quite possible that priests of several ancient civilizations actually possessed psychotronic devices to lift giant stones by antigravity, and other psychotronic devices to carve the stones like jelly. They may also have possessed psychotronic flying machines which used antigravity for lift and something like rocket propulsion for horizontal thrust. A flying machine that gets its lift from antigravity might be extremely crude in external appearance, and the use of hyperspace for travel would make it unneccessary to travel extensively through ordinary three-dimensional space. Thus many aspects of travel through normal space such as air drag and fineness ratio are of little importance to a psychotronic vehicle.

ADDING AND SUBTRACTING DIMENSIONS

Figure 17 shows the relation between total collection (integration) and orthogonal rotation in hyperspace.

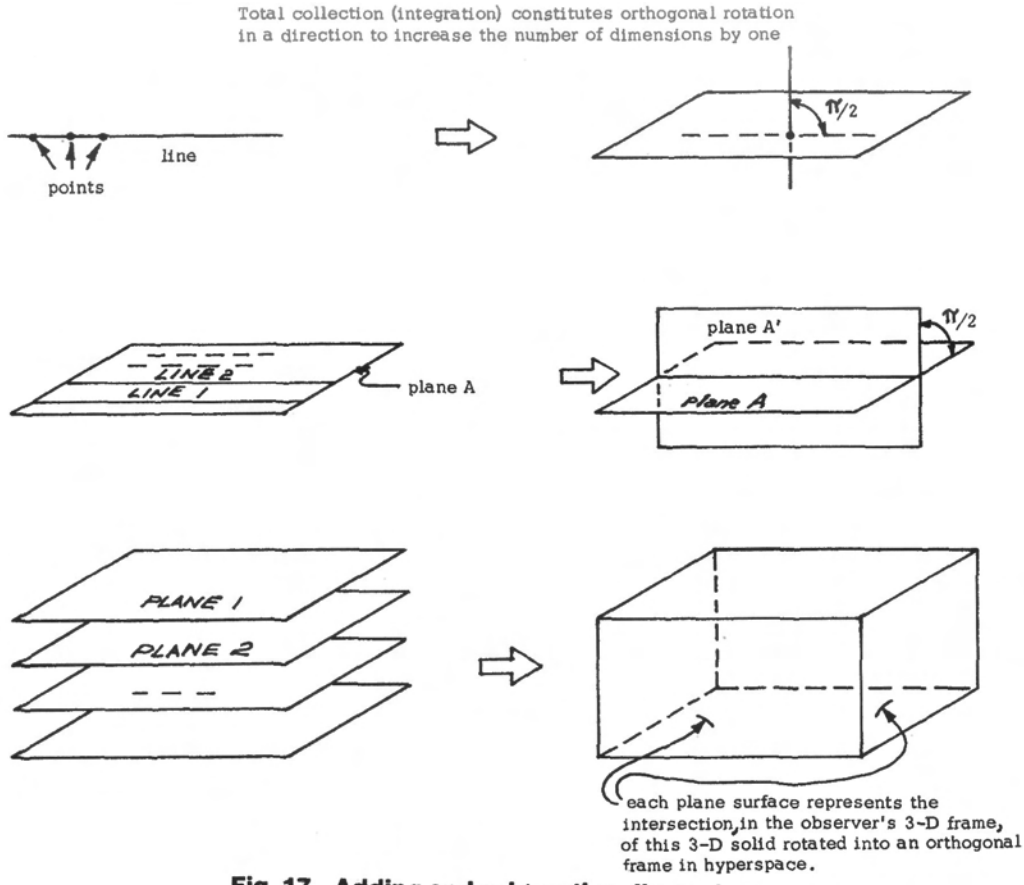

Fig. 17. Adding and subtracting dimensions

Total collection of zero-dimensional points in one direction integrates the points into a line (one-dimensional entity). This is precisely the same as if any of the points had been the plane intersection of an orthogonal line, and that line had now been rotated into the plane. Total collection in one direction is dimensional integration, and the collected entities gain an additional dimension, i.e., total collection constitues orthogonal rotation of the higher dimensioned object into observer three-space.

A point can be considered to be, and modeled as, a line in a frame one orthogonal turn away, and simultaneously as a plane two orthogonal turns away, and simultaneously as a solid (in fact, an entire three-dimensional physical world) three orthogonal rotations away. The latter may also be considered to be, and modeled as, a mind, or even as an infolded infinite set of minds. The concept does not stop at three dimensions, but proceeds into higher realms indefinitely. However, three dimensions plus an orthogonal time dimension are sufficient for our purposes.

A converse operation also exists. Differentiation consists of a cut in an object whereby one single element (of the collection the object represents), is separated and isolated, so that one dimension is lost. It is like a closure being opened at one element. This is the same as an orthogonal rotation of the entity (being differentiated) in a direction departing from observer three-space.

In the Figure, the lower two figures show the collection-is-integration schema for higher-dimensional figures. In the lower right figure, we cannot draw the three-dimensional object in its orthorotated position in four-space since we have only three spatial dimensions in the frame. Nonetheless, the additional dimensions exist and are simple to treat mathematically.

MIND IS OBJECTIVE

In time differentiating, mass loses the time dimension. Therefore we cannot see time with a mass perceiver, but we can see L^3 (spatial extension). But time is the only so-called objective dimension occupied or shared by mind. Therefore we also cannot normally perceive mind, because the plate (time) on which it was sitting is lost in the perception process.

Thus Descartes was both right and wrong. He was right in that monocular mind is not present in physical detection output, but wrong in believing mind and physical phenomena are totally separate. Time does not exist except with respect to between one L^3 perception and another, if L^3 is all that is outputted. Physical time is totally relative, totally mental, and exists only in memory. Mind is thus present in $L^3 T$ four-dimensional physical phenomena and is discretized along with time discreteness in the Heisenberg uncertainty relation $dEdt >= h/2*pi$.

In fact, we can even take the extreme view that time is mind. Because to establish a delta t, a former L^3 must be established and compared to a more recent L^3. The only place the former L^3 can rigorously be found is in memory. An event, once occurred, is in the past and is forever gone to the observer. Only in his memory can it be said to exist. But then so is the observation also of the most recent L^3. Thus, rigorously, observed phenomena may be said to exist only in memory, and there is only a past, never a present. Thus a full four-dimensional mind is inseparable from perceived physical phenomena, and mind is quantized along with quantum change in the physical world.

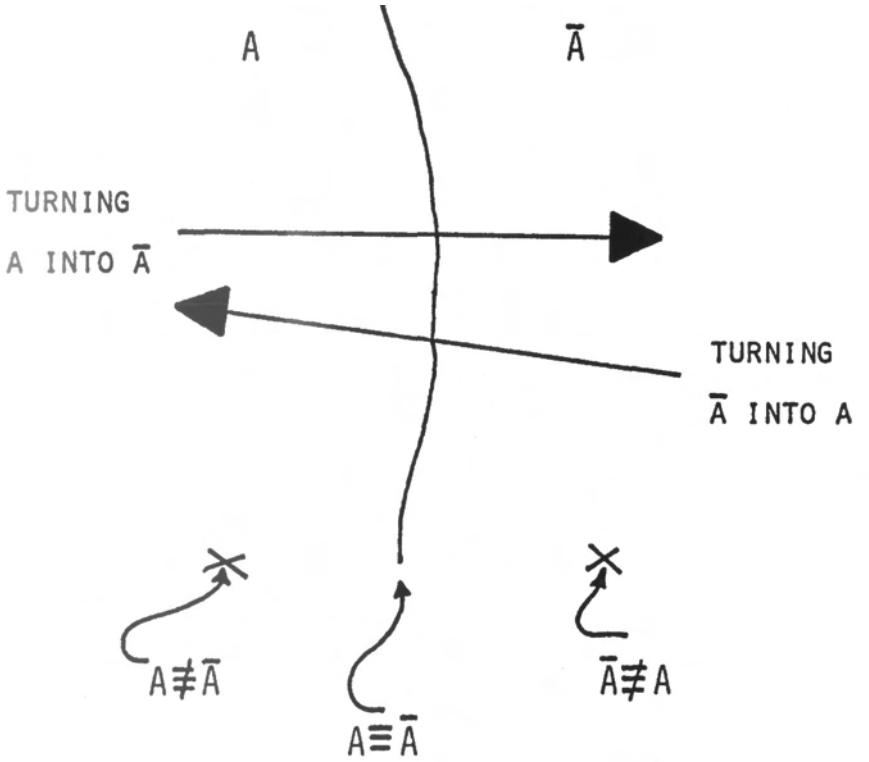

A POWERFUL EXAMPLE:
CANTOR'S PROOF THAT THE SET OF ALL SETS IS NOT A SET

Fig. 18. Turning a thing into its opposite

THE SKIN TRANSDUCER EFFECT: TURNING A THING INTO ITS OPPOSITE

On the boundary interface, one type of field may be turned into another. The higher psychotronic field (biofields) may be turned into an electromagnetic field, and vice versa. The boundary interface serves as a transfer function mechanism for translating one kind of effect into another. Both ends of the transfer function are excitonically united in and on the interface.

The Soviet work that measured coherence of cyclic rhythms (heartbeat, breath, body electric fields, etc.) in Kulagina is significant in this respect. Kulagina induced electrostatic fields around objects that she moved psychokinetically. Her biofield, which is connected through hyperspace to the object being moved, is orthorotated into ordinary fields at the interface of the object. Thus an electric field is created, and also a momentum field that causes the object to move by ordinary physics.

The Soviet work appears to have established that man, earth, and cosmos are psychotronically and coherently linked; that the boundary of an object is a transducer coupling internal and external dynamic changes in one-to-one correspondence; that the transducer effect applies to both living and nonliving systems; and that through tuning and resonance, internal patterns can be incepted externally, and external patterns can be incepted internally.

EVERETT'S MANY-WORLDS INTERPRETATION OF QUANTUM MECHANICS

Both mind and matter can be precisely modeled in Everett's many-world interpretation of quantum mechanics.

Ordinary relativity is interpreted for only a single observer at a time. If you believe that you and I simply coexist at the same time, then the basis of physics is very different from what is in your physics book. Everett worked out what happens to physics if we insist on multiple observers at a time: all possibilities exist and are real, no matter how weird or far out; the world is a single giant universal wave function; collapse of the state vector has meaning only to a single observer; the world is composed of multiple orthogonal worlds of infinite variety, complexity, and strangeness; each world constantly splits into multiple worlds at a fantastic rate.

The many-worlds interpretation, though strange, is totally consistent with the experimental basis of physics. Most physicists have completely ignored Everett's profound and fundamental work; the MWI is a time bomb ticking away at the heart of physics.

SPACETIME CURVATURE IS TRICKY

Bent and rotated spaces give strange results. A thing in one frame can be something quite different in another frame. Just as the mass of a moving object does not increase with respect to its own inertial frame, it increases with respect to the observer's static frame.

What a thing is, is totally relative to the perceiver and his perceiving frame. It can even be nothing in a great many frames. Do you see how nothing can contain everything?

So we really can turn nothing into something if we are clever.

We can solve the energy crisis by building free energy devices which simply cohere the nonintersecting virtual-mental energy states and collect them, breaching the quantum threshold and yielding real, observable energy. To put it another way, we can tap zero-point energy.

And we can also turn a thought-object into a real, materialized object in this physical frame. Or we can dematerialize a physical object, converting it to a mental object.

MULTIPLE REALITIES (MANY WORLDS)

In Figure 16,1 show the particular selection of dimensions I take from Everett's many-worlds interpretation of quantum mechanics. Other and more complex selections can be taken, but these suffice for our purposes and allow us to complete the basic schema for connecting physics and metaphysics in the simplest possible manner. The selection and the schema developed thus provides an initial crude theory which makes predictions, develops theoretical mechanisms, and can be physically tested.

In the diagram, each three-dimensional physical frame of an infinite set at orthogonal angles to each other is shown by a single line about the plane of the bottom, much like the spokes of a wheel. The single time dimension shared by every one of the spokes or three-dimensional worlds is shown by a single vertical line, much like the axle for the wheel and its spokes.

Starting with the left spoke and going counterclockwise, the spoke worlds are numbered with the prime superscript system. The *S* world is the normal three-space physical world we all live in and detect; the S^1 world is the first orthogonal world, etc. Each world is also called a hyperspace or bioframe or bioworld and numbered consecutively beginning with zero for the *S* frame. Thus the zero-th hyperspace is the ordinary physical universe.

The first hyperspace is the electromagnetic field. A physical object in this frame is seen as an electromagnetic field to the *S* frame observer. Since its intersection with the S frame is two-dimensional, we immediately see that the electromagnetic field is a plane wave. Light thus travels at speed *c* to every observer in the *S* frame, because *c* is or represents an orthogonal rotation.

Further than the first frame, a three-dimensional object is seen by the S-frame observer as a deBroglie wave. Since its rotation is greater than 90° with respect to the S-frame, the deBroglie wave always moves faster than the speed of light with respect to the S-frame observer.

A three-dimensional object in the S^2 frame is seen by the S-frame observer as a line or force vector, i.e., simply as flux. (Tentatively, this frame appears to be the area of neutrinos.)

A three-dimensional object in the S^3 frame is seen by the S-frame observer as a spatial point, i.e., as spatially dimensionless. It is thus a mental object or a virtual object to the *S* observer.

The entire S^3 frame constitutes a mind or a virtual world. There are an infinite number of such S^3 frames available in hyperspace. In fact, there exists a set of three orthogonal turns between any frame higher than S^3 and the S frame, due to the nature of hyperspace. Thus in the model we are using, any of the higher bio-

frames may be considered to be only three orthogonal rotations away from the *S* frame.

We thus have a scheme of multiple worlds and multiple realities from which we may construct living systems, thoughts, tulpas, etc. And we may also turn one type of field into another, simply by virtual state collection or separation, as the case may be.

All frames S^3 or higher are mental or virtual frames. Physical phenomena in these frames are mental phenomena with respect to the *S* frame.

Note that we have deliberately evoked a system whereby a mind is modeled in terms of physics and physical reality is modeled in terms of mind. The only difference between any two entities in the various worlds is a matter of orthogonal rotation.

For the pure mathematician, obviously this entire model could be extracted into a new calculus. A symbol could be assigned to the orthorotation operation, and a sign assigned to the symbol to indicate whether the direction of turning is approaching the observer or departing from the observer. Sideways turns and in-betweenwards-turns could be represented by additional signs, or hypernumbers. I suspect that such a calculus is well worth doing, and I also suspect that it will closely resemble Charles Muses's hypernumber work when done. Using a six-dimensional geometry, the German physicist Heim has accomplished something similar, without yet realizing that he has also modeled mind. His work generates all the fundamental particles of physics and explains many features of UFO phenomena, as is to be expected from the scheme developed here.

At any rate, an exact calculus of higher dimensions and of turning one kind of field into another kind of field — with no barrier at all between physics and metaphysics — awaits the hands of the builder.

CLUSTERED ORTHOGONAL WORLDS

In this diagram, I show a sample of how various objects appear in their intersections with various bioframes. Note that an object is many things at once, and that many of the things it is are nonthings or nothings.

Everything is a thought in at least one frame. We can appreciate James Jeans's remark that the world appears less and less like a mechanism and more and more like a single thought. His intuition was in fact literally correct.

Each entity is a photon in at least one frame (let there be light!) Each entity is a line in at least one frame. Each entity is a three-dimensional spatial object in at least one frame.

By orthogonal rotation, a thing can change its face with respect to an observer, appearing to change into a totally different sort of thing with respect to a fixed observer in one frame. Reality is quite plastic and absolutely unlimited. It is only our own rigid heads that have been made of solid concrete.

Specifically, materialization of thought objects, by three approaching orthogonal rotations, exists. Similarly, dematerialization of an object, by three receding orthogonal rotations, exists. In such a case the dematerialized object appears the same as a thought object or virtual object.

A perfectly valid mechanism thus exists for tulpoids, materialized thought forms. All that is needed is a sufficient virtual state collection mechanism.

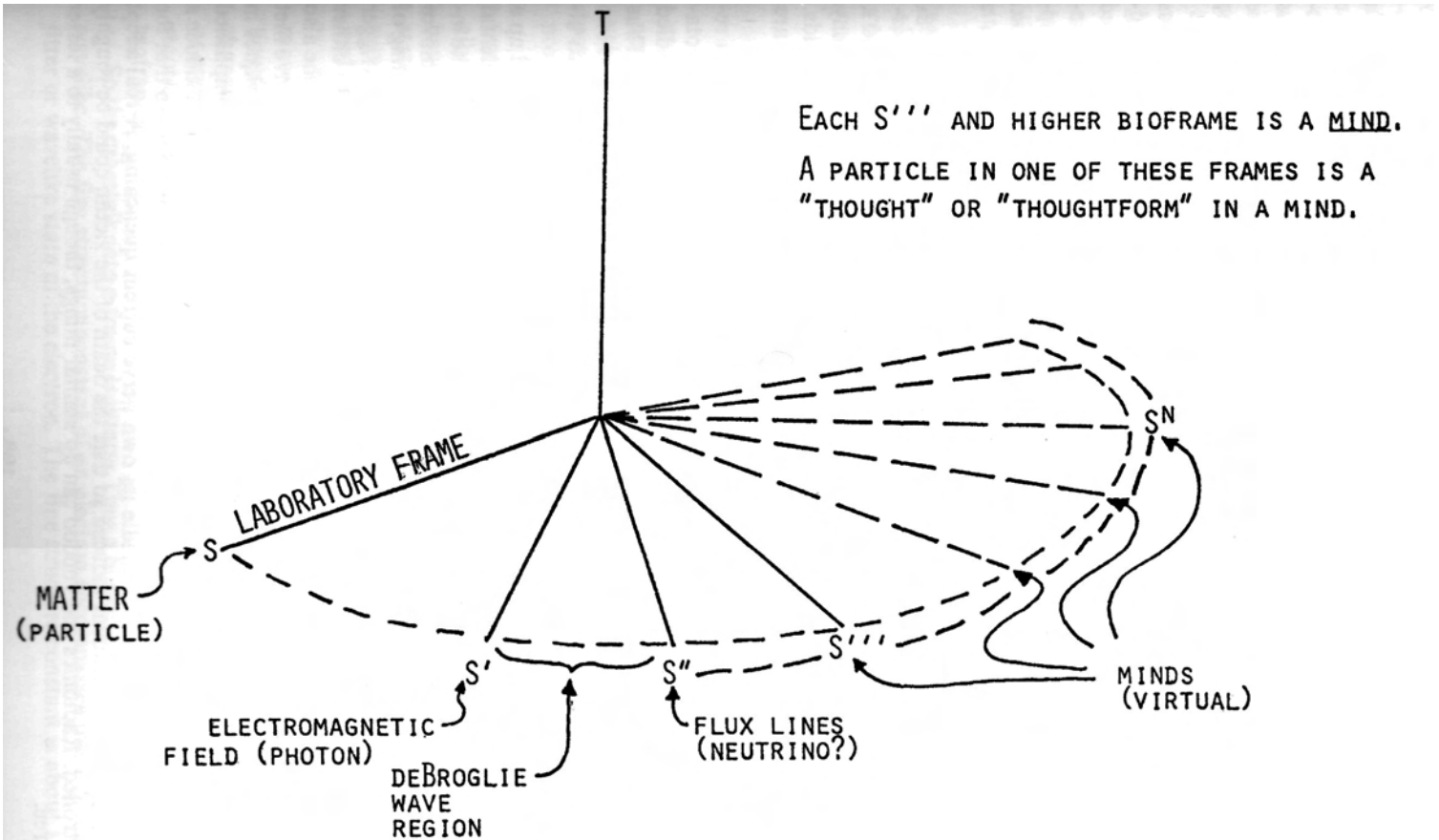

Fig. 20. Clustered orthogonal worlds

Note that an orthogonal rotation in an approaching manner is automatically accomplished by sufficient coherent collection in the remote frame. There is a finite collection threshold between two orthogonal hyperframes. Sufficient collection in one frame (by a tuning or directing mechanism in a third frame) breaches the threshold in the collection frame and the collected or quantized entity automatically appears in the next frame closer to the tuning mechanism's frame. The process may then be repeated. If sufficiently repeated, all the intervening thresholds are breached and full materialization of the object in the observer's frame (tuning frame) occurs.

By this process an object may be kindled from a remote frame to one that is less remote. Two successive applications of kindling turns thought into electromagnetic field. This is how thought photography is accomplished, and the talented individual who accomplishes it is simply cyborged to the camera film grain in an inceptive cyborg device. Many such examples, including some deliberately accomplished on demand by the study group in which I am included, are given in this book. Three successive kindlings turn a thought object into a materialized object, a tulpoid.

Such a materialized thought-object may be of an inert object or of a living, breathing, biological being. The model we are working in has eliminated any superficial difference between living and nonliving because it is a four-law model. And a materialized living being will be just as real and physical and functional as any other person on this earth. Ultimately, that is all that we ourselves are — tulpoids. Nothing exists but the thought of the infinite creator, so to speak, and we are simply part of that thought.

The coherence in multiple stages necessary to accomplish kindling is often referred to as *tuning* in this book. Tuning sufficient to enable two orthogonal rotations results in thought turning into electromagnetic field or light. Such a kindled field may be additive or subtractive to existing electromagnetic fields. Thus kindling can cancel an electromagnetic field that already exists, or it can create one where none previously existed, or it can shape, modulate, or change one which already exists.

Kindling can also wipe out the charge on a charged particle, or it can build up a charge on an object which previously had no electric charge. It is not accidental that Kulagina, when performing psychokinesis in the laboratory, first causes the induction of an electrostatic field on a nonmoving object. Then the object moves psychokinetically. In a similar fashion, she has stopped a frog's heart; kindling of the type to quench electric charge would of course eliminate the electrical trigger signals in the muscles of the heart, rendering it inoperable. This could mean either cessation and paralysis in a moderate case or total death in a drastic case. She also on one occasion demonstrated the ability to stop a living human heart. I have met other people who could do something similar. One of the great secret techniques in certain Oriental martial arts was the death touch. This could only be accomplished by certain rare adepts; with a light touch of the hand or fingers, they could induce a charge of bioenergy into and onto the acupuncture system of the body, so that the body itself began to slowly kindle its own nerve current quenching. A real adept could control the amount induced so that the death of the victim could be roughly controlled. Radionics and voodoo can do similar things, though usually to a lesser degree.

There also exists a precise mechanism for metal bending; the destruction of the charged particles (for the protons in the nucleus and the electrons in orbit, or even for just the protons in the nucleus) converts the particles in some atoms to neutrinos, which then vanish in the distance without interaction. Thus localized areas in strong metal can be kindled and made quite plastic from thought energy alone by one who has developed this skill. And the kindled areas will give every indication of having been subjected to extreme heat or unusual forces of a sort not encountered in normal metal bending or fracture. Also, the inceptor who is bending the metal and the metal itself are cyborged together into a single inceptive cyborg mechanism. Therefore the metal will often continue to bend even after laid down, because in the cyborg kindling is still occurring.

Furthermore, metals that exhibit unusual physical characteristics, such as nitinol, can change those characteristics dramatically by kindling. Also, an electrostatic field can be directly kindled in and induced on an external object, and an electric field or electromagnetic field can be induced in its surrounding space to interact with it, accomplishing psychokinesis of the object.

Or thought energy can be kindled in the hyperfield fluxes of an ordinary magnet. A magnetic compass needle can be moved by mind or a magnetometer can be affected, even through a superconductive Farraday shield. After all, the effect is rotating into our three-dimensional space from outside it, so shielding is of little consequence except where it interferes with tuning.

CROSSTALK BETWEEN MULTIPLE REALITIES

In Figure 21, I show that phenomena in all the hyperframes crosstalk. A moving object in frame S possesses a slight rotation, hence it projects a tiny component into frame S^1. This S^1 component, however, is still dynamic and has a small velocity in S^1. Hence it also is slightly rotated and therefore has a crosstalk component projected into frame S^2 with a velocity there. Having finite velocity, this projection in turn has a rotation and projects into the next higher frame, and so on.

Thus any changing entity in any frame crosstalks a tiny amount into any other frame. In a frame S^n, the crosstalk from a change in any other frame S^P is normally so small as to be virtual, hence nonobservable. Coherent virtual crosstalk, however, integrates and can breach the threshold between virtual and observable state. It is in fact possible to show that what we call a mass in S space is simply the sum total of the crosstalk in and out of a localized region L^3 of S space, the localized region being the mass in question.

Another point to notice is that most fundamental particles in a frame rarely move with constant velocity. Instead, they normally accelerate and decelerate continually. Thus the actual velocity vector of one of these entities is continually changing, usually quite erratically. But for microscopic particles in regular atomic or crystalline formations, the change pattern is quite regular. At any rate, the constant changes on the velocity induce a jitter component on its crosstalk into other bioframes.

So the crosstalk into a frame is jittery. Thus a fundamental particle is jittery or wavelike. The fine structure constant of an electron encompasses this hyperspatial jitter or wavelike state of the electron. The fine structure constant is about 1/137.

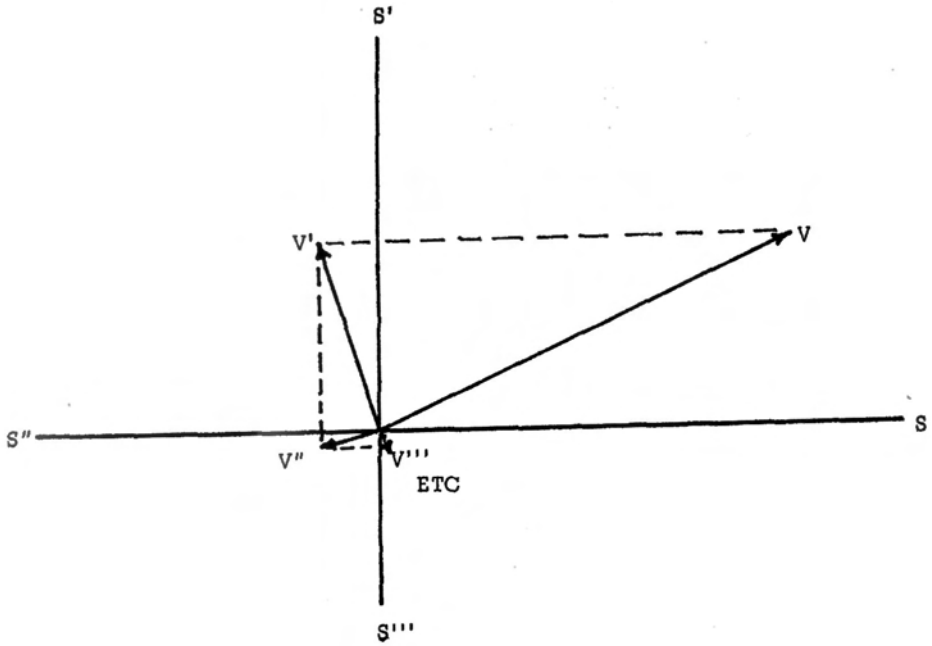

Pig. 21. Crosstalk between multiple realities

Thus an electron actually spends about 1/137 of the time in hyperspace.

So, because of jitter, an object is partially in every hyperframe a minute but finite part of the time. So are all minds and mental objects, and so are all virtual objects. For a fundamental particle, the fraction of time that one quantum of action pervades another frame may be referred to as the identity coefficient.

The identity coefficient varies; it is the photon interaction that time differentiates, quenching time and separating the bioframes, and this interaction is not a linear operator since the intensity of time differentiation is a rather complicated function of photon frequency.

At any rate, for an electron in orbit in an atom (or for any other electron, for that matter) there is thus a small but finite probability that the electron may be at any given position in the universe when its detection occurs. In other words, there is a finite probability of collecting an electron at any point in the universe, and the collection may be made from multiple points simultaneously. We can actually collect the same electron twice, so to speak! Or even a million million times.

The probability of detection of an electron at a given position may be directly expressed as the fraction of time that the electron actually spends there. And this fact may be used to develop a holographic coherent collection scheme that can directly amplify particles. Thus a so-called free energy device, which in one sense is just a tap into the zero point energy of vacuum, can be built. And it has been built, by Moray and by others. The jitter and crosstalk make it directly possible.

BIOFIELDS: AND MAVERICK WORLDS

Figure 22 shows a convenient list of how objects appear in different frames. This schema, selected from Everett's many-worlds interpretation, allows modeling of life, death, mind, matter, and psi. It also allows one type of field to be ortho-

BIOFIELDS: TIME-CLUSTERED ORTHOFRAME

Present Name	n = Number of Orthorotations	Biofield	Dimensional Intersection with Lab Frame
Laboratory Frame	0	0th	3-D
Electromagnetic Field	1	1st	2-D: $\nu = C$
Virtual Photon	$1 < n < 2$	Between 1st and 2nd	Mix of 2-D: $\nu = C$ and 1-D: $\nu = C^2$
Bare Neutrino (candidate)	2	2nd	1-D: $\nu = C^2$ (but flows in photon)
Space-point; mind, thought	3	3rd	0-D, $\nu = C^3$ occupies time, not space per se. Flows in neutrino, thus in photon
Space-point, mind, thought	$n > 3$	nth	Same as 3rd biofield. All hyperspaces are only 3 orthorotations away in nonlinear hyperspace

Fig. 22. Biofields: time-clustered orthoframes

rotated and turned into another kind. Such orthorotation demands correct time synchronization, rather than brute force energy application. In fact, orthorotation is energy-conservative for a single orthogonal turn.

Even the strangest conceptions and most fantastic possibilities have their own assigned realm of concrete reality. These are referred to as maverick worlds.

Note that all possibilities — everything that has happened or could have happened, and everything that will happen or could happen — are real and exist concretely in their separate orthogonal universes. The same is true for all thoughts and thought worlds, and all possible thoughts and thought worlds.

By proper coherent tuning, an *object* in one of these orthoframes can be orthorotated into our own frame and objectified, and that is what the Tibetan monks call a tulpa, an objective materialization of a thought form. The tulpa will hardly ever be closed entirely in phase, however, and so it will almost always be unstable. UFO's, angels, and imps go away. But the materialization of one of these can be entirely objective and perfectly objective traces can be left, such as photographs, broken limbs, scorched asphalt, indentations, and depressions in grassy fields. Any thought object can be so orthorotated and objectified. Beings, religious figures, angels, fairies, imps, UFO's, and monsters can all appear.

HYPERFIELD FLUX IN A MAGNETIC FIELD

In the conventional experiment to determine the pattern of a magnetic field, iron filings are sprinkled about a bar magnet on a piece of paper. As shown in the top drawing of Figure 23, the iron filings form a symmetrical pattern. Further, the only apparent circulation pattern is from one pole to the other. Each flux line is closed, going through the magnet from one pole to the other and out of that other pole, bending back through space to the first pole. Every flux line therefore goes through both poles.

However, each little iron filing is actually quite static; it does not move at all. It does not change with respect to either time or position. It is therefore integrating any higher sinusoidal component that is changing with respect to time and length. The characteristics of the orthodox picture that emerges are prescribed by Maxwell's equations of electromagnetic field.

If we tape the bar magnet to the face of a color television tube, the magnetic field is now being scanned or probed or sampled by a moving electron beam, which reacts with the magnetic field of the bar magnet. This electron beam is changing its position with respect to time and length, and it therefore differentiates the magnetic field. The hyperspatial "ripples" in the magnetic field now are not integrated exactly to cancel, and so a small deviation from each flux line will be detected by the differentiating beam. Slight deviations will cause a color change, and so the hyperspatial flux now becomes evident on the television screen. The lower drawings show the rather unusual, nonsymmetrical pattern that emerges.

The equations for these hyperfield fluxes should be obtainable by differentiating Maxwell's equations twice more, yielding fourth order equations. These equations should be the much sought-after equations of prana, chi, ki, ectoplasm, bioenergy, bioplasma, odic force, etc.

Note that the hyperfield circulation goes into the north pole and pours out of the south pole. A living organism exposed to the north pole, end on, will have its own bioenergy sucked out by the magnet, and its own flux will diminish somewhat. Exposed to the south pole, end on, it will have its own bioenergy increased by the bioflux pouring from the magnet. This explains why many experimenters who have extensively tested the influence of magnetism on growing plants have found that the north pole inhibits and the south pole stimulates growth and health.

The hyperfields are fundamental fields rather than electromagnetic fields; they collect coherently and kindle *into* electromagnetic field, creating it or destroying it.

LIFE AND DEATH

In Figure 24 I present an overall schema for life and death — and for reincarnation as well.

An infinite number of hyperfields or bioframes are shown as S, S^1,S^2, S^3 etc. The frame S is the ordinary laboratory frame — the physical spatial world we live in and observe. The frame S^1 is the electromagnetic field, the frame S^2 the linear or flux frame, and S^3 the first "mental" or "virtual" frame. Also, all higher bioframes have a connective path to the *S* frame of only three orthogonal rotations (not shown). Thus only three orthogonal turns separate S^n and *S*, S^k and *S*, and S^J and *S*.

In frame *S*, note that physical body *A* has a coherent crosstalk link with the entire frame S^n. A-S^n thus constitutes a living biological system; in this case, let us say, a human being. Likewise, *B* and S^j have established a coherent crosstalk loop. B-S^j thus also constitutes a living biological system; in this case, let us say, an opossum. These two examples are incarnated living systems (incarnated minds).

In fact, this is a great oversimplification, as the reader will realize at once. We really should consider all the groupings of *A* — the organs, the structures, the cells, the internal cellular parts, etc. — as separate but coordinated a_i. (And similarly with B.) Each of these a_i must have a correspondent s^n subworld of S^n, much like

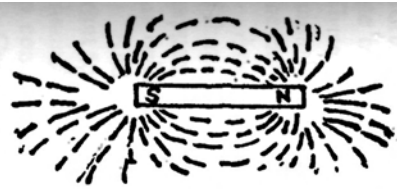

CONVENTIONAL PICTURE.
IRON FILINGS SPRINKLED
ABOUT A BAR MAGNET ON
A PAPER.

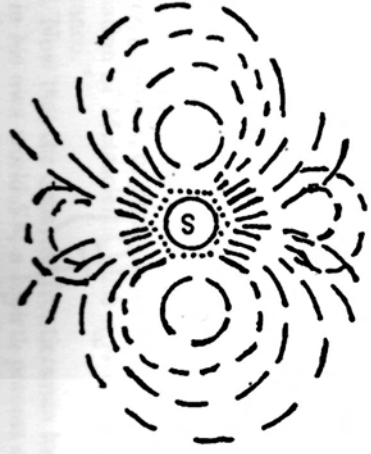

HYPERFLUX
CIRCULATIONS

NOTE STRONG
HEXAGONAL PATTERN
AND TWO PRIMARY
VORTICES

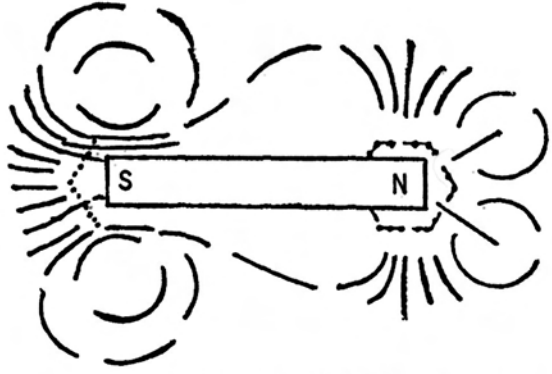

HYPERFLUX CIRCULATIONS
FLUX PATTERNS ARE NOT
SYMMETRICAL, POLE-TO-POLE

NOTE STRONG HEXAGONAL
PATTERN IMMEDIATELY
ADJACENT TO NORTH POLE.

HYPERFLUX CIRCULATIONS

NOTE STRONG
HEXAGONAL PATTERN
AND FOUR PRIMARY
VORTICES

Fig. 23. Hyperfield flux in a magnetic field

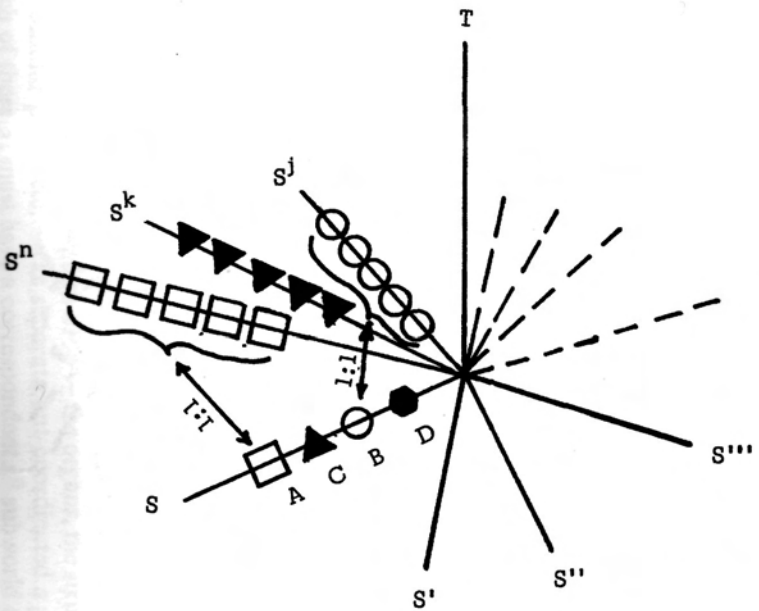

$A \rightleftarrows S^n$ is a living system.
A is the physical body, the incepted mass.
S^n is the mind.

$B \rightleftarrows S^j$ is also a living system.

To S, D is inert; i.e., D is not preferentially incepted.

To S, S^k is a "disembodied mind." I.e., S^k is "dead," since it is not preferentially incepting its former body, C.

Whenever a proper retuning body, say E, appears in S, S^k will reestablish a coherent crosstalk with E. This constitutes "reincarnation" of S^k.

Fig. 24. Life and death

the fine structure of atomic energy levels. But here I am simply outlining the major schema.

At any rate, let us now examine body *C* and hyperworld S^k, which formerly were one-to-one coherent in crosstalk, but are no longer so. C represents, let us suppose, the body of a frontiersman in 1830 who has received an Indian arrow in his breast, piercing the heart and destroying the ability of the body to coordinate the c_i to each other and to the inceptive channel from S^k. With the loss of coherence, noise begins to destroy the channel; thus S^k is now a "disembodied mind," and C starts to become a decaying corpse. The various c_i of course lose coherence at differing rates, and so the fine structure channels to the s^k also lose coherence at differing rates.

Finally all c_i - s^k coherence is lost, and the frontiersman is then "dead." The mind S^k is now disembodied — and also probably quite disturbed or "noisy" because of the variance in disintegration of the c_i - s^k loops. One might say that the mind is somewhat "detuned" by the whole affair. However, "death," in the sense of total loss of mind and personality, has most certainly not occurred. All that has occurred is a lapse into a disembodied, and perhaps somewhat confused, state.

And the disembodied mind finds itself in its own deep, unconscious world constructs. If a person has been unconsciously Christian in a very deep, fundamentalist sense, and in his own mind has also been a "sinner deserving of hell," then he will actually "lift up his eyes in hell," in his own world tuning. And that world will be physical and real — as real and physical as this one — but it will operate by different physical laws, just as dreams operate by different physical laws. These relations and laws are prescribed by the person, either consciously or unconsciously. The devout Mohammedan is quite likely to find himself after "death" in the delightfully chauvinistic paradise he believes in.

And so the Catholic practice of praying oneself out of purgatory is relevant, for if that belief-structure is firmly fixed in the deceased's deep unconscious, then it will happen; he will simply change his world construct in accord with the effort made on his behalf.

And the ancient Tibetan practice of giving instructions to the deceased as to what to expect and where to go is also relevant, for during the time that the major channel C-S^k is lost but many of the c_i - s^k are still functioning, the deceased is still in contact with frame *S* and can heed those instructions.

Certain clairvoyants and skilled psychics can also project part of their mind vision into S^k and see the status of the deceased. In some cases the deceased will have so strongly retained mental structures analogous to physical structures and localities (or persons) in frame S that continual small crosstalk channels breach open by tuning resonance to those localities, structures, or persons. With a little inceptive assistance from one or more sensitive persons, an "appearance" of the deceased at the locality, structure, or near the person can take place. Much psychic, ghost, or spiritualist activity is due to this effect. So indeed is the concept of earthbound spirits. Here again, an advanced adept can erase the psychometric pattern attached to the locality, structure, or person and thus eliminate the phenomena. In the American Association of Metascience, such a resolution is part of an overall process called "clearance."

But this is not all. Now that the departed frontiersman has been cleared, so to speak, and is snugly in his own world S^k rebirth process still awaits him. As I

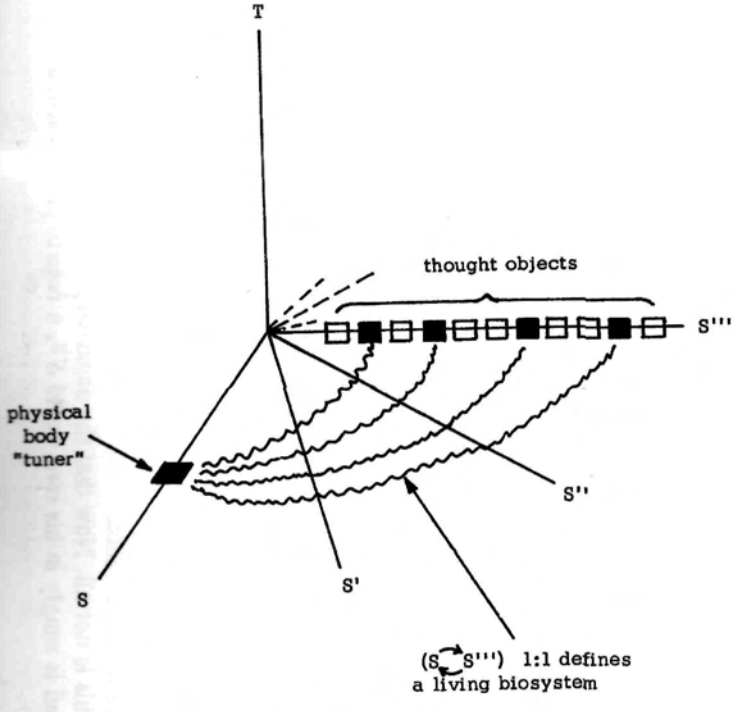

A. A LIVING BIOSYSTEM

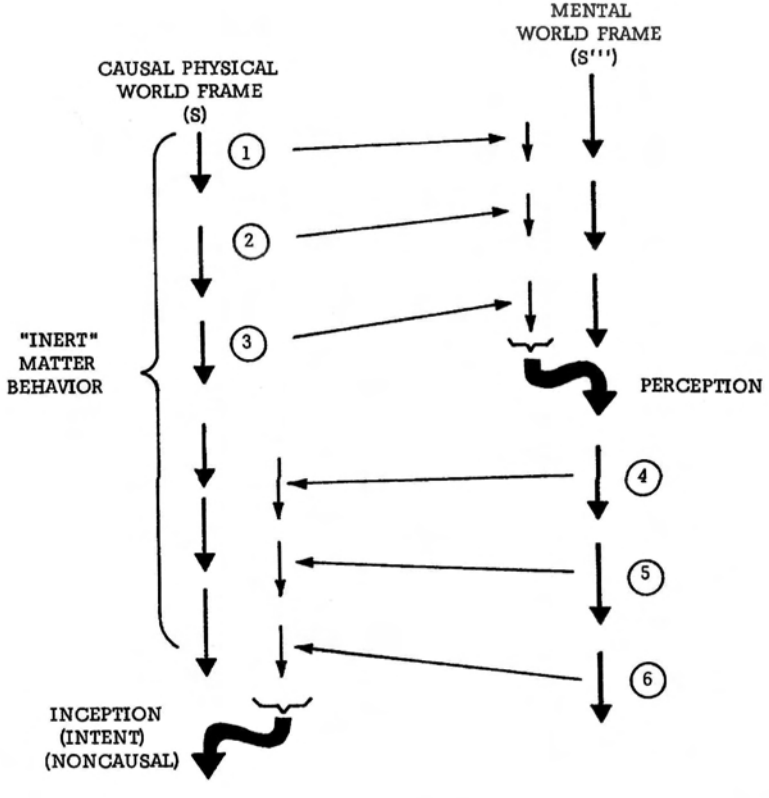

B. THE FUNCTIONING OF TIME AND CONSCIOUSNESS ARE MUTUAL CREATORS OF EACH OTHER.

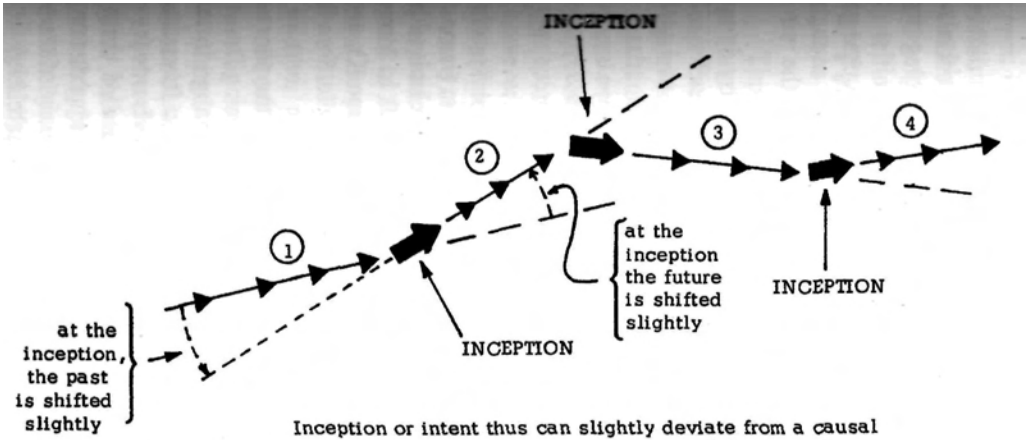

Inception or intent thus can slightly deviate from a causal trajectory. Over sufficient collections of physical changes, "intentional behavior" or "limited free will" emerges. However, it is only a very small modulation of causal inertness -- and its smallness accounts for human "physical limitations."

C. CHANGING THE PAST

Fig. 25. Consciousness, life, and intent

have pointed out elsewhere, every particle of mass is simply a pattern of change in the universal orthorotational flux between hyperframes. (This, after all, is no more than a slight extension to general relativity.) When the proper physical tuning mechanism, say C^1, again appears in the *S* frame, then a resonant coupling will automatically establish itself in the flux between C^1 and S^k, and the disembodied, confused mind of the frontiersman will simply be coupled again to a new physical body pattern. This happens at the instant of conception, for the genetic pattern — the complete tuning pattern — is present at that instant. The coupling is quite tenuous at first, and increases in degree as the embryo develops.

So reincarnation has a place in my schema. We will see, however, that it differs slightly from the classical concept, because with developmental work the frontiersman can change the makeup of S^k and thus his predisposed tuning. Changing the tuning also causes rotational displacement of S^k among the infinity of infinities of mind worlds available. Thus the past can be changed; in fact a person can change who he is the reincarnation of, simply by changing his mind tuning with enough development. Therefore more than one living person can be, for example, the reincarnation of Napoleon.

And in fact the cycle of rebirth can be broken completely — simply by dying with a totally detached mental framework. The cessation of all tuning attachment results in a broadened S^k, which now is structureless, hence all-structured and part of universal Godness.

But the major point is that all this can be modeled physically. And there is only life; absence from one place still leaves presence in another. Absence from *any* and *every* one place exclusively leaves presence at all places, each nonexclusively.

Death, where is thy sting?

In diagram A of Figure 25, I summarize what constitutes a living biosystem. Here we can see that body (physical) changes from the biosystem's body in frame S crosstalk successively through frame S^1 and S^2 to S^3. Also, physical changes in frame S^3 actually constitute mental changes to the biosystem's body back in frame *S*. These mental changes must crosstalk successively into frame S^2, frame S^1, and then into frame *S*. This entire process — from frame S^3 to S^2 to S^l to *S* — is referred to as *kindling*.

In diagram B, we observe this process a little more closely. Here, the shorter straight vertical arrows are virtual state changes kindled from the opposing frame. The longer straight vertical arrows represent observable quantized change in the particular frame, these changes being produced by ordinary inert physics laws. The curved double-lined arrows represent quantized change kindled into the frame from the coherently superposed virtual changes that have steadily been kindled there.

Thus there is a kindling time delay in the causal *S* frame before will or intent sets of changes from the mind-frame S^3 can induce an input into the physical body of the biosystem. Correspondingly, there is a kindling time delay before a perceptual change in S^3 from the changes in *S* can occur.

The horizontal arrows represent the flow or flux of kindling crosstalk between the two frames. It can be seen from this diagram that consciousness — the thread of the relation between consecutive changes in the two respective frames — and time are identical. (Recall that each inert physical change in S that is not kindled from S^3 is actually randomly kindled from all the other mind-frames.) Thus time and mind are identical. Consciousness is simply the functioning of coherent cross-

tulk between a mind frame and a physical body in frame *S.* Further, each biosystcm's consciousness has all other consciousnesses interwoven with it. The other living consciousnesses input into other physical bodies in frame S, and these physical bodies interact in frame *S.* The other dead consciousnesses input into frame 5 - into each body as well as into all other inert matter — in a noncoherent, randomized manner. Thus the entire universe of universes is totally in communication with each part of itself, continually.

In diagram C, I show that incepting a change from pure causality changes the past; in this case, the past is causally inferred or projected backward from the new vcctorial direction. However, because inception into frame *S* is a very small effect, the biosystem's change of its past is so slight that normally it is not noticed. Inception of course also changes the future slightly.

THE HOLOGRAPHIC HYPERCHANNEL EFFECT

This effect is based on the concept that a human being must accomplish a minute inception (psychokinesis) onto his physical system. Specifically, he must incept the movement of three or four electrons in the brain. This constitutes an input signal to his ordinary physical system, which is then treated like a complex servomechanism. The gain of this servomechanism is rather high, being able to transform or amplify the movement of several electrons into powerful movements of the entire body. The inceptive effect cannot be explained by ordinary physics, which am account for the servomechanism gain only. Once the input signal is generated, however, the rest of the amplification and action are viewed as being properly described by the ordinary physics of inert matter. Thus the human is viewed as largely servomechanistic and mechanical, but guided and directed by the nonphysical, which affects the physical in a minute fashion sufficient to constitute inputs to the ordinary physical system.

Our purpose here is to show that, given this single small inceptive effect, we can eventually approach the mastery of space and time for a linkage of sufficient number of human brains and minds into one single superbrain and supermind.

From the multiplicity of orthogonal frames permitted by Everett's many-worlds interpretation of quantum mechanics, we now select an infinite set of clustered three-dimensional spatial frames, which all share a single time dimension. Using one frame as a laboratory reference frame, the other spatial frames may be characterized as having one, two, three, or more orthogonal turns away from the laboratory frame. These succeeding orthogonal frames are variously called hyperframes, bioframes, orthoframes, hyperchannels, orthoworlds, etc. A particular set of material phenomena in one of the orthoframes is referred to as a biofield, hyperfields, or orthofield with respect to the laboratory frame.

In Figure 26 I represent each brain by a triangular symbol, and consider it as an amplifying device having a gain of A_o. For simplicity the inceptive input signal is represented as E_i, since in moving an electron, a voltage must be induced. For limplicity I also show the brains as a linear array lying in a straight line. The distance *L* separates each brain, and here *L* is assumed constant for simplicity.

Two factors must now be realized: (1) The first hyperchannel operates in the realm of the ordinary electromagnetic field, although this realm is seen in a differ-

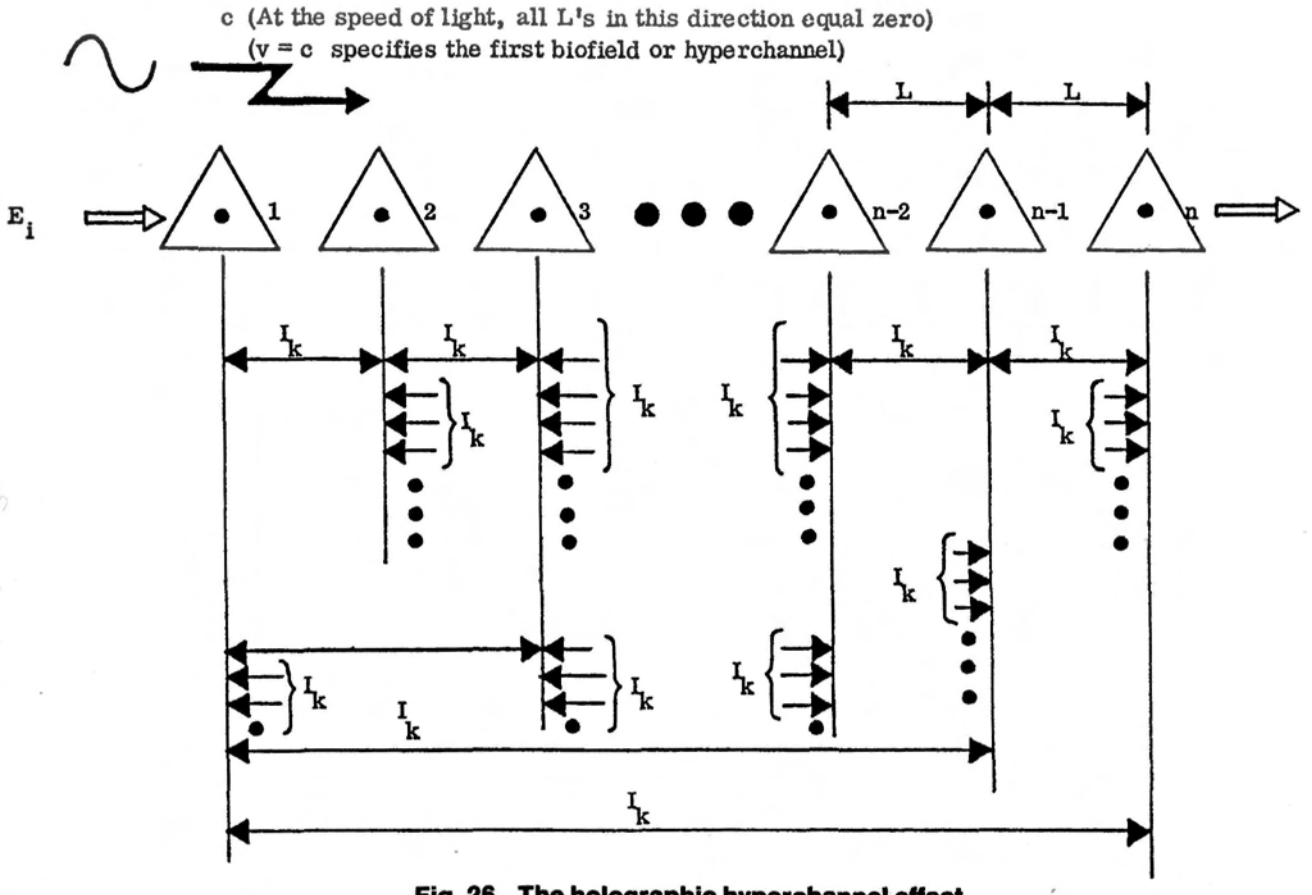

Fig. 26. The holographic hyperchannel effect

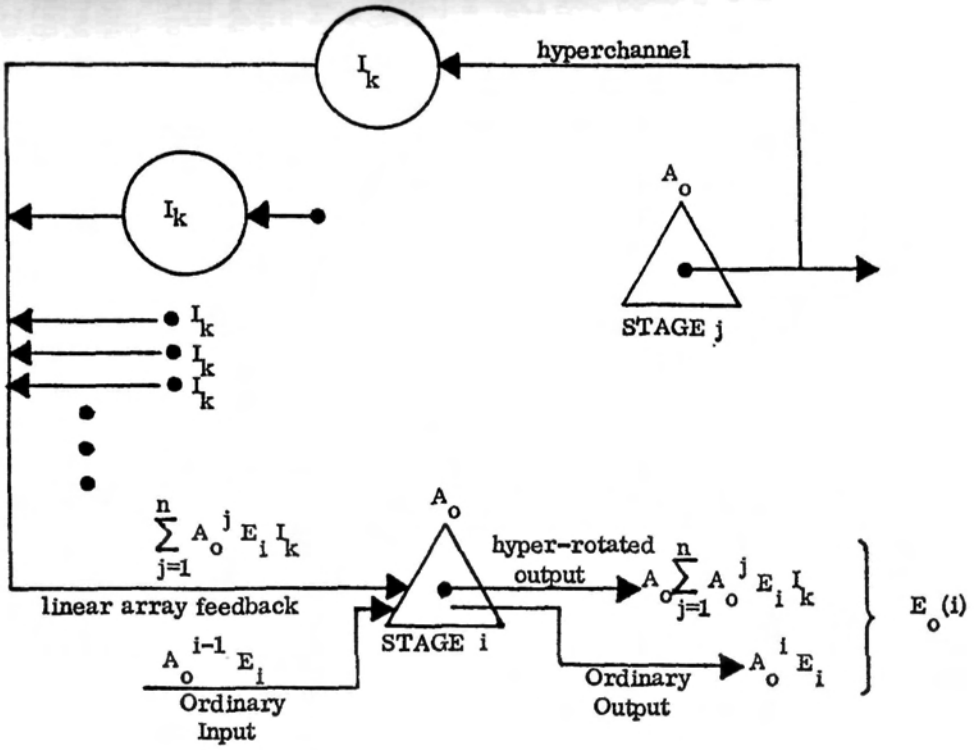

Fig. 27. Output of stage i

ent way, i.e., we visualize a photon as an ordinary particle of three-dimensional matter, resting in a three-dimensional spatial frame (hyperframe) that is orthogonally rotated spatially in higher dimensional space, at 90° to the observer's spatial frame. The hyperframe and the laboratory frame share the same fourth dimension, time. (2) At the speed *c* (which determines the hyperframe in the first place), all *L's* are zeroed out, by the equations of the special relativity transformations. Thus one may view (hyperview) each triangle (brain) as superposed on each other triangle (brain). Furthermore, there exists a very small, finite, nonzero probability that the state of one triangle coincides exactly with the state of another superposed triangle, at any given small increment of time. This probability corresponds to a direct fraction of identity between two triangles, since time is stopped along the chain. At any given small increment of laboratory time, any given triangle has on the average a small fraction of identical coexistence with any other triangle. This identity fraction is labeled I_k in Figure 26.

It is important to note that, for a very small fraction of time, the triangles coincide with each other; i.e.; for a small fraction of time the existence of one triangle is totally holographic. This fraction totally violates the ordinary conservation of energy, which is applicable only to a single channel system. The hyperchannel represents a second channel, an identity channel, and in this channel an object can be in multiple places at the same time. If the triangles, regarded as operating processes, are even slightly coherent, then multichannel communication and holographic transmission of a single state-energy into multiple state-energies occurs through the hyperchannel — usually in the virtual state.

Figure 27 shows the setup to calculate the gain of the hyperchannel amplifier. These calculations yield, for the output of stage i,

$$\frac{E_0}{E_i} = A_0{}^{n} + A_0{}^{n+1} I_k.$$

When no ordinary electrical input exists, $A_0{}^{n} = 0$, and the virtual state amplification is thus

$$\frac{E_0}{E_i} = A_0{}^{n+1} I_k.$$

This mechanism holds the secret to the tapping of zero-point energy and free energy devices. It is also the hidden variable theory that causes a radioactive nucleus to decay. Since radioactive nuclei interact through hyperspace, the amount of radioactivity in a given sample is an exponential function of the number of radioactive nuclei present.

It is also a mechanism which can directly amplify the virtual-mental state into observable state. It is the fundamental mechanism that causes kindling and thus orthorotation. It can be used to materialize tulpas, and accomplish psychokinesis, remote viewing, clairvoyance, precognition, etc.

MIND LINKAGE

The entire human species has been developing and evolving, not just the individual person.

The development of life in a biosystem may be divided into seven stages: (1) the development of planet, primordial atmosphere and ocean; (2) the appearance of

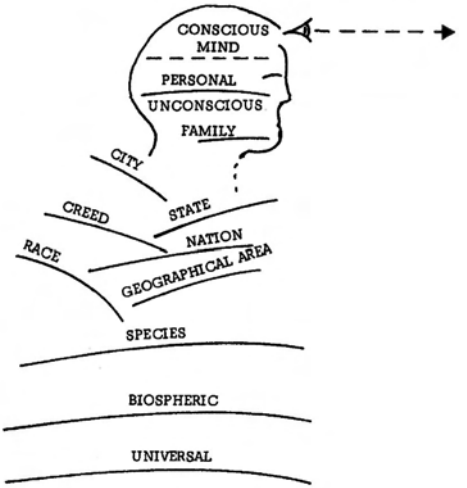

Fig. 28. Layers of unconsciousness

amino acids; (3) the appearance of the self-replicating supermolecules; (4) the formation of one-celled organisms; (5) the formation of multicellular organisms; (6) brain linkage of an intelligent technological species; (7) total omeganess or godhood.

Two major types of behavior are involved in living organisms: genetically programmed behavior and genetically unprogrammed behavior. Thus one mode of behavior control of an organism is nonadaptive and the other mode is adaptive or learned. Intelligence may be viewed as the ability to adapt behavior, and increased intelligence represents a decrease in the portion of behavioral control that is genetically programmed or "hard-wired."

We may further speak of two types of intelligent species: those that possess a tool-using member and those that do not. The first is a *technological* species, while the second is *nontechnological.* By this classification, man is a fifth-stage, technological species.

The intelligent species, being relatively deprogrammed, is highly adaptive and competitive, and many of its species-specific checks and balances are reduced or eliminated. Because of the use of tools in its internal competition, the technological species continually increases the ferocity of its internal competition and its dcadliness to itself. Thus as the power of its tools increases, the technological species carries the seeds of its own destruction within itself, and it will eventually destroy itself unless it advances to the next stage, the linked-mind sixth-stage being.

The sixth stage consists of the linkage of all individual brains in the species into one single superbrain, producing a superbeing having absolute control of space and lime. A technological species is necessary to accomplish linkage and produce a multidimensional, eventually nonphysical, superbeing. When the technology is sufficiently advanced for linkage to be developed, the power of the tools is so great that self-destruction is imminent. Thus an advanced technological civilization is near linkage and also near Armageddon, and in either case it vanishes as a limited, three-dimensional species of the fifth stage. This accounts for the notable absence of a technological species similar to man in man's universe.

ANGELS, IMPS, AND UFO TULPAS

If we realize that each of us has his own mind world, an S^3 frame with respect to the *S* frame physical world, but separate from each other *S* frame mind world, then we see that, if we take common forms that are in the minds of all human beings, it is much easier to kindle them because they can be cohered much more easily.

The common crosstalk in all minds constitutes the collective unconscious. Since the common crosstalk is in a sense a mind, and since it is connected to a "body" of many cells, i.e., of four billion humans or so, then this collective unconscious is a living, breathing entity.

Furthermore, the usual content of its mind is a great deal closer to physical phenomena that are in all minds than is a single human being's mental content. Much of what we term physical reality is in fact prescribed by the collective human unconscious. And if the collective human unconscious is changed in its conception of reality, then four billion stages start kindling with the hyperchannel effect, and immediately the new conception is physical reality.

Borrowing from Jungian psychology, let us call a form that is in each human mind an archetype. Let us also realize that there are shallower levels of unconsciousness (Figure 28) between the total collective unconscious and an individual mind. For an Irish-American there is one level defined as Caucasian, another defined as Irish, another defined as American, another defined by the larger region he lives in (say the state), another defined by his family, and another by his own personal unconscious. The levels are not mutually exclusive, but intersect across one another. At any rate, all these unconsciousness levels above the collective human species unconscious also shape, modulate, mold, and change the kindling channel that exists for a person or group. All these levels of unconsciousness are like finer and finer tuning levels to change the kindling mechanism.

An archetype that is kindled from the collective unconscious is kindled through such a mechanism of unconscious levels of tuning, and the reality format that is kindled is determined by the type of pressure and the content, biases, or tuning of all the levels between it and the conscious minds of the individuals who observe the phenomena.

All tulpoidal manifestations are kindled through and by this mechanism. All of them are shaped by the multilevel unconscious tuning. All of them are caused by an unresolved conflict in the deeper unconscious layers.

Since most minds are notoriously unstable, the tuning is unstable almost always, and the tulpoidal manifestation is usually fairly shortlived, usually not more than a few minutes, or a few hours.

Angels, imps, Virgin Marys, UFO's, sasquatches, Loch Ness monsters, lake monsters, sea monsters, nocturnal mystery lights, fairies, elves, devas, devils, ogres, Mothman, men in black, goblins, large monster birds, etc. are all kindled by the same process. And so are cattle mutilations. I fear that human mutilations will be next.

Any tulpoidal materialization may be physically real during its stable period. It may make large tracks in the ground, operate shiplike space vehicles, break tree branches, take human specimens on board, examine human specimens, etc.

The tulpoid may appear benevolent or harmful, and it may actually be so when in the stably materialized mode. The full content of the human unconscious is there to be materialized in physical form — all the good, all the bad, all the noble, all the sly aspects.

When enough human unconsciousnesses have the idea of fairies deeply ingrained in them, occasionally a real, living, breathing fairy pops out of the collective unconscious, riding as a direct modulation on a more primitive overall human species archetype. And the fairy may do all the things expected; she may pose riddles, give gold coins which must not be examined or they will be lost, etc.

Religion can also make use of tulpoidal appearance. When Christian predecessors believed in a vengeful god, a powerful but spoiled king, they got all the manifestations of that kind of Being. When they believed in a god of sacrifice, they got a god who demanded sacrifice and thrived on it. And when many believe in angels and Virgin Marys, they sometimes actually appear. These appearances are not hallucinations; they are completely real. It is just that all possibilities are concretely and physically real in their own realms, and any of these may be tuned in to appear in this realm.

An infinite number of reality channels exists. The total instrumental characteristics, genetic, psychological, and physiological, of the observers who tune in the channel determines the noise content and the actual channel selected.

A reality is simply an orthogonal frame or world. AH possible realities already exist. A channel is a set of tuned and timed orthorotations communicating back and forth between two orthogonal frames or worlds. Tuning is a complex of mind and matter, and of many unconscious levels.

For a perfect adaptation of this mechanism of coherence, any coherent signal — no matter how fantastically weak — can be raised up out of the grass and made dominant. By time coherence in the virtual state, a virtual state entity can be amplified into observable state. From sheer nothing we can produce something. And since every possible something exists in nothing and is available for cohering, we can get anything at all by this process, at least hypothetically.

DREAMS ARE UNRESOLVED CONFLICTS

Everything is essentially mind. Mind forms layer after layer of overlapping zones of shallower and shallower unconsciousness (multiple simultaneous consciousness), all the way from the universal allness to the personal unconscious, and culminates, like the tip of a dagger, in each conscious mind. Figure 29 illustrates these mindlevels.

Just as the dreams of an individual show his unresolved conflicts, so the materialized tulpoids of the collective human unconscious show its unresolved conflicts. Tulpoidal phenomena thus symbolize man against himself, or one group of humans against another group of humans. The great unresolved conflict in the human species since World War II has been the Cold War. And therefore the great flaps of tulpoidal UFO activity should correlate directly to the Cold War. And so they do, as I indicate in this book. Literally we ourselves are our own "Satan," for in man's inhumanity to man, satanic evil is created inceptively. And we ourselves are our own "godform," for in man's love of his fellow men, goodness is created

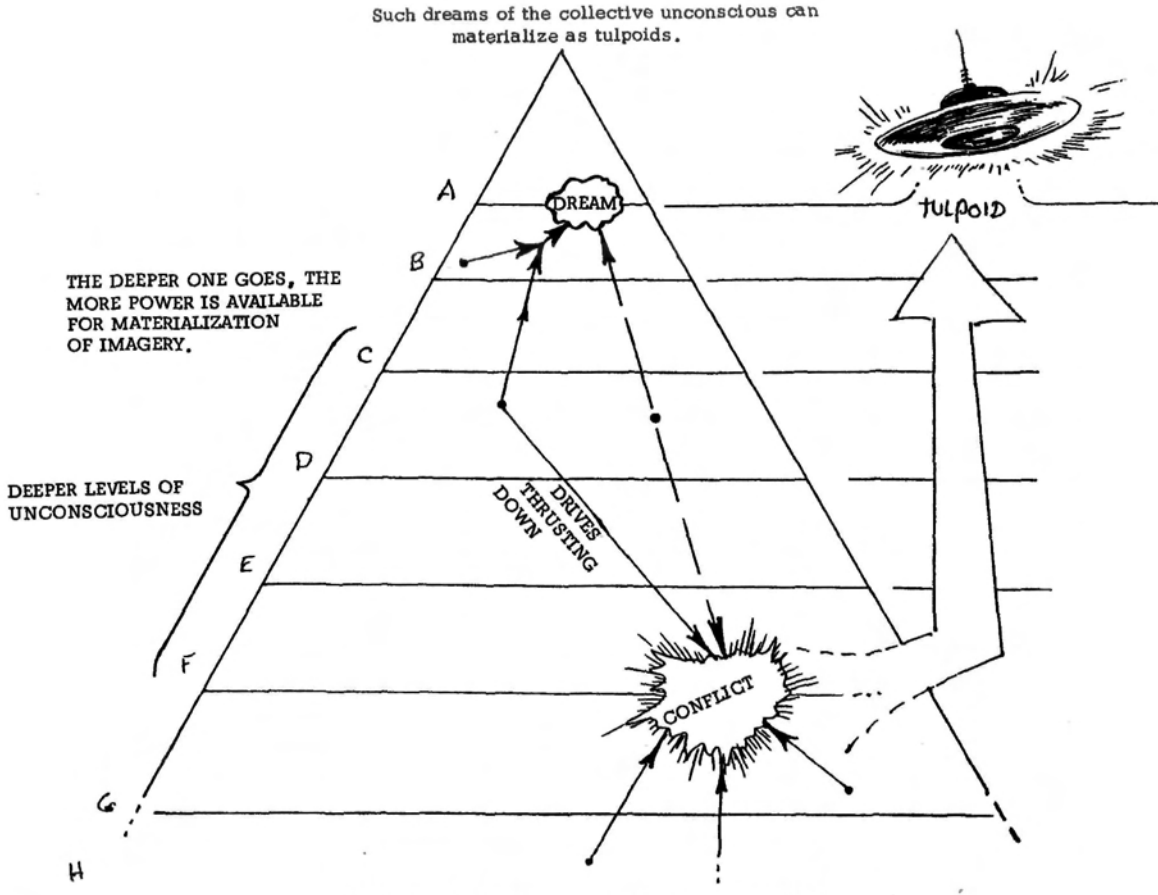

Fig. 29. Dreams are unresolved conflicts

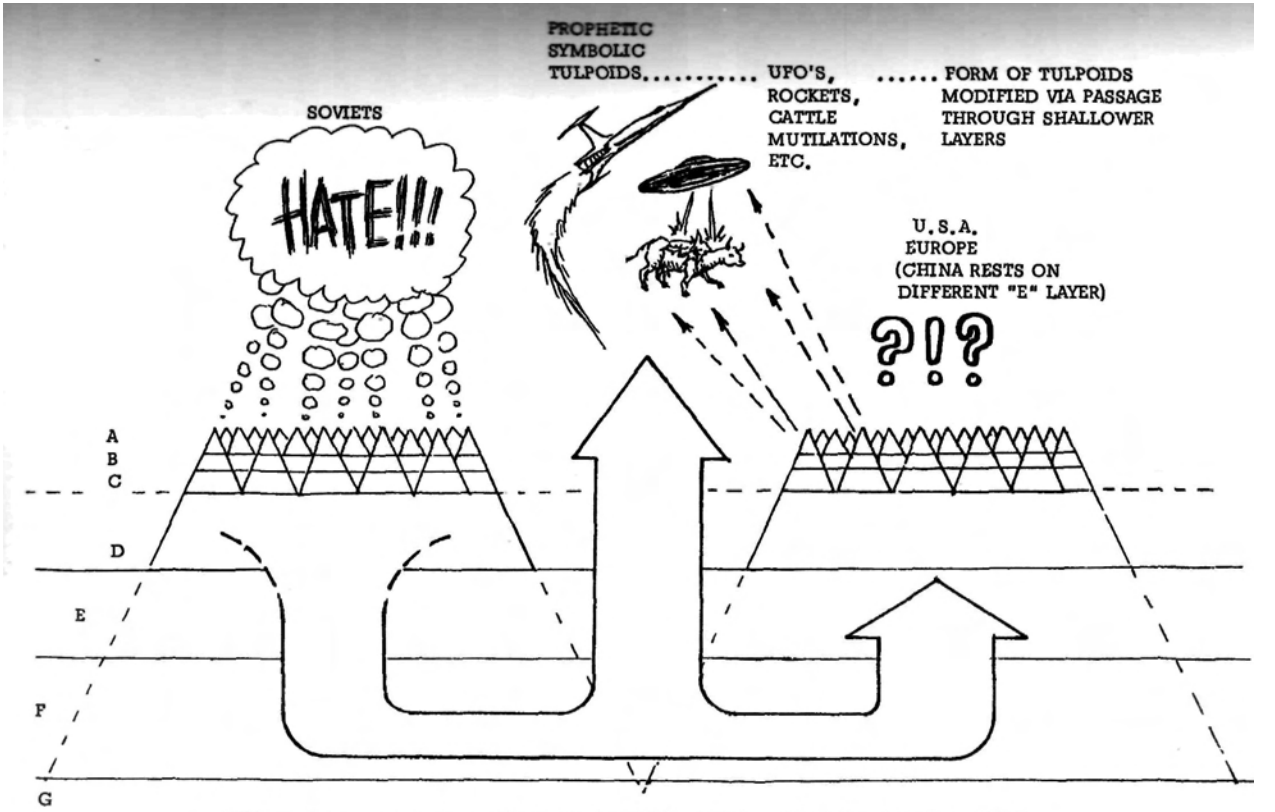

THE PSI CHANNEL IS LIKE A QUASI-HYDRAULIC U-TUBE. CONSISTENT PRESSURE INTO DEEP LAYERS RESULTS IN UPWELLING TULPOIDS WHOSE FORM IS MODULATED AND SHAPED BY SHALLOWER LAYERS, ON THE WAY TO MATERIALIZATION.

Fig. 30. Collective conflict initiates prophetic tulpoids

inceptively. It is not accidental that the Avatar Jesus exhorted man to love God with all his heart and mind, and to love his neighbor as himself. It is also not accidental that a human culture seeks and "obtains" a godform or god-image consistent with its own level of understanding and belief; the resulting tulpoidal activity conditioned into the collective unconscious and the cultural unconscious, and tuned in from them, will be consistent with the cultural desires and expectations.

So in a sense we are the creators of our own reality and our own tulpoidal expressions of higher reality. But in addition to tulpoids, the present character of spacetime and dimensionality, and the very laws of the physical universe, are largely prescribed by the collective human unconscious.

GHOST ROCKETS AND FLYING SAUCERS: MATERIALIZED TULPOIDS

Unfortunately, from 1945 to 1947 events occurred that caused a split among previous World War II allies and that led to the beginning of the Cold War in 1947.

Due to these events, Western nations perceived a growing threat from the Soviet Union. The resulting interplay of events, news reports, and personalities, plus the traumatic aftermath'of World War II, led to strong psychological pressure on the group unconscious of the Western nations, and thence on the collective human unconscious. This pressure resulted in popouts of direct orthorotations of resonant archetypal symbols from the collective unconscious, the archetypal format being successively modified by the Western group unconscious and the progressively higher levels of unconsciousness.

The formats of the deep human unconscious were formed millions of years ago in the primitive tribal state. In the tribal warfare of those ancient days, the male went to where the action was, while the female stayed behind in the protected cave, fortress, or shelter to care for the young. Thus the male symbol was closest to the threat and identified with being there.

Furthermore, in primates the phallic symbol is the universal symbol of threat, dominance, and defiance. Dominant primate monkeys often briefly mount submissive males to show their dominant position, exposing their genitals in so doing. If the mounted male does not submit, an immediate battle ensues to determine the dominant male. Thus the phallic symbol represents threat and domination.

In the deep human unconscious, fire is a symbol of power, for with fire the species held predators at bay and began the long trek up from the jungle cave to modern civilization.

Finally, the unconsciousness of a substantial number of the Western nations had been deeply impressed by the German V-l and V-2 rockets during World War II, for the imagination of the world had been breathtakingly fired by the surprise advent of the German rocket weapons.

Thus we would expect that in those Western countries — Norway, Denmark, Sweden, etc. — that are close to the Soviet Union, archetypal tulpoid popout materialization would have taken a male, threatening, dominant, power format. The nearest, most powerful, most resonant recent stimulus symbol in the Western group unconscious would have been the final modulation, determining the final format.

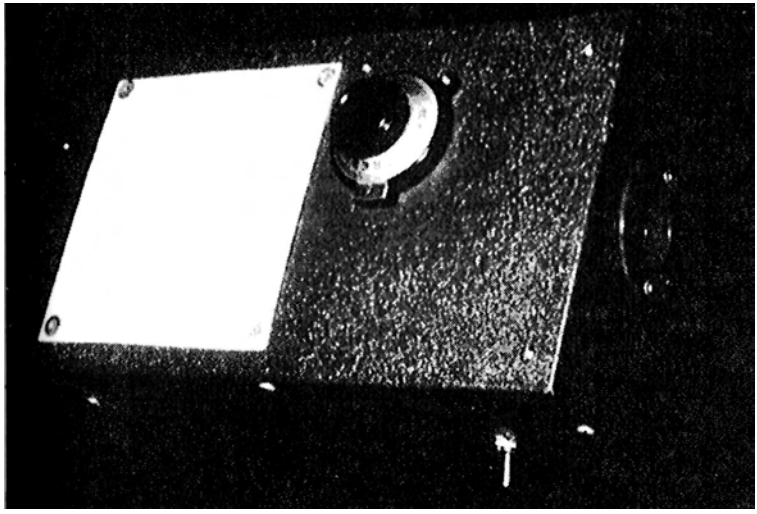

Outside showing contact ptate, sample well, tuning vernier, and on-off switch.

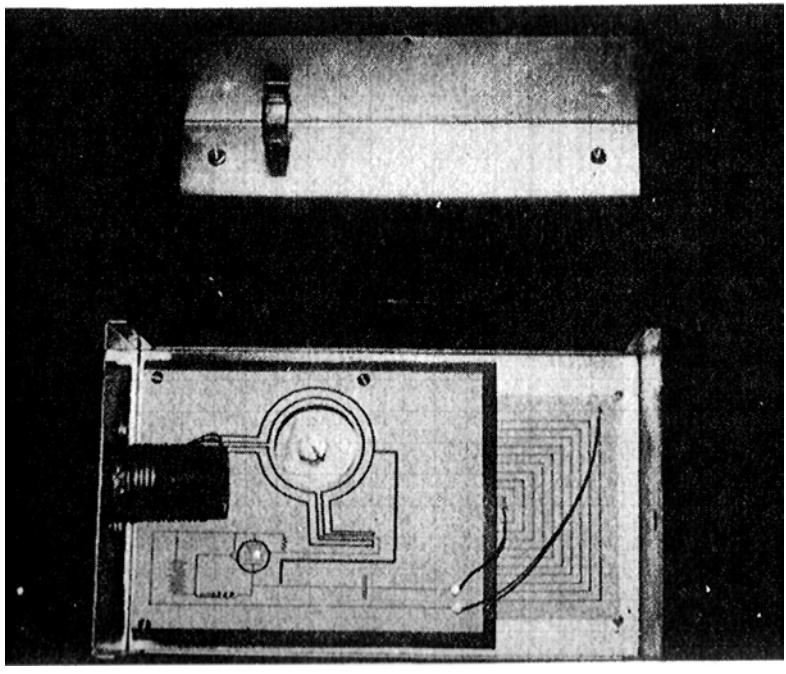

Inside, showing India Ink drawing of *an a*mplifier schematic, used as the "amplifier.'

Photo 41. Hieronymus device — second kind.

So a massive wave of "ghost rockets" from the direction of the Soviet Union appeared in the skies over Norway, Sweden, and Denmark, and other nearby European countries. (See Photograph 43.)

However, North America constituted a natural fortress with great ocean barriers to the east and west, and no strong enemy to the north or south. Therefore, a female symbol (archetype) should have been resonant and stimulated in the U.S., and so it was. In 1947, the year the Cold War began, Kenneth Arnold, flying over the state of Washington (the most northwestern U.S. state at the time, and the one nearest the Soviet Union), encountered a formation of flying saucers — the female circle mandala, dressed in modern aeronautical form. Thus was born the age of flying saucers in America.

PART THREE

NEW MILITARY APPLICATIONSOF PSI RESEARCH

BACKGROUND TO PSYCHOTRONIC RESEARCH IN THE U.S. AND THE U.S.S.R.

In this section I will discuss some of the fantastic psychotronic weapons that have been built and deployed by the Soviets as a part of operation "Fer-de-Lance," the Soviet plan to conquer the world.

The Soviet Union has had a massive developmental program in what they call energetics or psychoenergetics (and what we are calling psychotronics) for about thirty years. To appreciate the mind-staggering weaponry that has emerged from this effort, I should point out that the U.S. developed the atomic bomb in World War II in about four and a half years; thus the Soviet psychotronic program is the equivalent of roughly seven Manhattan projects, back-to-back. With this comparison we gain a rough yardstick to appreciate the fantastic capabilities that must have emerged from the sustained Soviet program. As we will see, they are indeed mindboggling.

Ironically, most of the original theoretical work was done here in the United States, just as the pioneering work in rocketry was done here by Goddard, before the Germans picked it up and advanced it to the V1 and V2 rockets. Just as Goddard himself was once the laughing stock of the Pentagon, so the key U.S. researchers who could have initiated the psychotronic age in the West — Moray, Abrams, Reich, Hieronymus, Drown, Tesla, de la Warr, etc. — were generally ignored or prosecuted or both. Even more deadly has been the studied avoidance of any application of the basic theoretical work — which again was developed largely in the U.S. This work included the Everett-Wheeler-Graham many-worlds interpretation of quantum mechanics, and the extension of Lorentz's work by Ives, Ruderfer, and others to show that almost all modern physics — including general relativity, Newton's laws of motion, and the law of universal gravitation — can be straightforwardly derived from a Lorentz-invariant nonmaterial ether. Even though Pauli pointed out that the Michelson-Morley experiment only eliminated a material ether rather than ether per se, and although Einstein himself once proposed the use of the term ether to include dimensionless vacuum space complete with various fields, modern physics in the West has ignored the ether theory.

As Robert Anton Wilson points out, whatever you believe imprisons you. The West has been solidly imprisoned in its own orthodox view of physics, and hence has been unable to surmount the stone walls of its self-imposed mental barriers. In fact, it has not even tried. There has been no serious, sustained program to deliberately examine the loopholes in present theory and seek the necessary changes to provide a theory of paranormal-psychotronic phenomena. In fact, the major Western work on paranormal phenomena seems only to attempt to "prove" over and over that such phenomena exist; and to attempt to derive from present physics theory a "normal sane" theory for "abnormal insane" phenomena. The orthodox establishment continues to vigorously attack the experimenters who struggle with paranormal research on the grounds that their work does not present science.Hence the experiments and experimenters are unscientific and either at worst frauds and charlatans or at best seriously deluded.

The simple procedure necessary to solve these questions — set up a deliberate, well staffed, well-funded program on a continuing basis — has not been adopted in

the West because of the short-sightedness of our management structure. We seem to have totally forgotten that we got the atomic bomb in the first place and we put a man on the moon, simply by starting a program with staff and funds to try to do it, not by engaging in a neverending series of arguments as to why it could not and should not be done.

So, ironically, the nation that prides itself on being free and liberal has adopted an iron dogma of its own in science, a dogma that yields very slowly and that has effectively blocked us from serious and prolonged efforts in psychotronics.

Meanwhile, the Soviet scientists — admittedly kicked firmly in the tail by Stalin — have simply got off their dust-encrusted seats with alacrity and got to it. In thirty years of such getting to it with massive state support, they have already launched the psychotronic age, first applying it to the weapons field, the typical Soviet priority. Meanwhile, for the same thirty years we in the U.S. have played the same old tired games that once led Heisenberg to remark that new scientific knowledge only gained acceptance when the old scientists who so adamantly opposed it had died away.

Finally, there is a direct relationship between UFO's, psychotronics, the collective human unconscious, the Cold War, and Fer-de-Lance that cannot be escaped. So while this section emphasizes psychotronic weapons deployed by the Soviet Union I continually remind the reader of the concepts involved in the related paranormal phenomena, which were covered in Parts One and Two. So with these words, let me give a brief summary of Soviet psychotronic weapons. Make no mistake, it appears that the final holocaust is now unavoidable — we will reap the full rewards for our smugness, pride, arrogance, and inflated egotism.

The Soviets will unleash World War III and they will unleash the psychotronic weapons on a totally unsuspecting world.

But there is something more; it does not end there. There is another player in the game — the collective human unconscious, ZARG itself, will unleash a reaction that makes psychotronic weaponry pale by comparison. Yet when that great entity has roared out its anger, destroyed perhaps half the earth, and then opens its eyes, the full biblical prophecy will in a most bizarre and unsuspected way be fulfilled.

Time will end, and the grave will give up its dead. The unifying of all human minds into one will complete the birth of a new godlike being, extending from the beginning to the end of time all at once, and from beginning to end of all possible times all at once. Three-dimensional concepts and limitations will fade away as child's play to the being that is already in four billion dimensions.

And you and I will become gods, literally, actually — for being is holographic, and whatsoever ZARG becomes, so we all become.

PSYCHOTRONIC BACKGROUND SINCE WW II

After WW II Soviet scientists were ordered by Stalin to actively seek another area of great breakthrough — such as the U.S. atomic bomb had been — and leave no stone unturned in their search. Apparently the Moray detector was resurrected and intense experiment and development begun on it. Much of the pioneering radionics work of the West and Ive's work would also have been available at this time. I believe that in 1958 the Soviet nuclear catastrophe near the Urals was the

result of an attempt to transmit a nuclear explosion through hyperspace. (The peculiarity of a transmitter tuning failure would have resulted in an explosion emerging from the nearest large nuclear waste storage, and that apparently happened.)

In 1956, however, a major new interpretation of quantum mechanics was originated by Hugh Everett at Princeton University under the world-renowned John Wheeler. This is the theory of the universal wave function—the many-worlds interpretation (MWI) of quantum mechanics. Practically the entire Western output on the subject is available in his 1973 book entitled *The Many-Worlds Interpretation of Quantum Mechanics.*

This physics is so exceedingly strange that it has been ignored by almost all Western physicists — indeed, it is so strange that even its originators, Everett and Wheeler, are said not to be able to believe it. Wheeler is reported to have once stated that he could believe it on Monday, Wednesday, and Friday, but not on the other days of the week. Using the MWI, however, one can produce a theoretical model of psychotronics which is totally consistent with the entire experimental basis of modern physics, and unite both mind and matter on a single scientific basis.

The Soviets apparently seized on this new theoretical work and applied it to the Moray device, solving their theoretical and technical difficulties.

In 1960, Khrushchev, speaking to the Presidium, stated that the USSR had a new weapon in development ("just within the portfolio of our scientists, so to speak") that was so powerful it could wipe out all life on earth. I believe he referred to the nuclear hyperspace howitzer and to the death ray weapons under development at that time, such as the following.

ELECTRON DISSOLUTION

There are four levels of effects on biological systems that are irradiated by electron dissolution beams.

Interference with the electrical functioning of the nervous system is the dominant effect. Single channel subsystems are more sensitive to the effect.

Mild irradiation (or mild kindling of short duration) causes weakness, trembling, and an unreal, dreamy feeling (as when one gets a whiff of anesthesia). The victim is conscious, however, since consciousness is limitedly multichannel.

Moderate irradiation (or kindling of moderate duration) causes paralysis of the motor system, and a very unreal, floating feeling. The individual is barely conscious and is hypnogogic. Panic is usually engendered.

Strong irradiation (more protracted kindling) causes loss of consciousness in addition to paralysis. The autonomic nervous system still functions with difficulty, and the victim is just barely alive. Convulsions and other symptoms may appear.

Very strong irradiation (protracted kindling) totally jams all levels of the nervous system, and death results instantly.

In UFO contactee incidents this effect is widely demonstrated. Many cases show step function failure of automotive electrical systems, lights, radios, etc., as a UFO approaches. When the UFO departs, the electrical systems almost invariably resume complete operations. Absolutely no electrical components are damaged.

To extinguish these systems with massive RF fields would result in blowing fuses, diodes, transistors, etc., and a great amount of electrical sparking — probably sufficient to blow up the gasoline tanks, In fact, none of these things occur.

Stage 2 electron dissolution should definitely disable automotive circuits, and the upper level of stage 1 may be sufficient. Either would leave the automobile passengers conscious, though paralyzed in one case and not in the other. Both types of correlations are shown in the UFO literature.

THE 1973 CONTACTEE WAVE AND CATTLE MUTILATIONS

In 1973 the Yom Kippur war took place. This was the Soviets' "Spanish Civil War," and they tested the final tactics and equipment for antitank and antiaircraft weaponry, and obtained final data on tank and equipment loss rates for modern combat. The effect on the U.S. and NATO of the cutoff of Arab oil was also tested.

At one point, when the Israelis cut off an Egyptian army in the desert, the Soviets notified the U.S. over the hot line that Soviet forces were going in and the U.S. could do whatever it pleased. The Soviets loaded and readied seven airborne divisions to insert, and the U.S. readied its single airborne division to send in. So the world teetered on the brink of direct ground confrontation between the Soviet Union and the U.S., with all its possible consequences.

Confrontation is after all another form of *contact.* And UFO contactee cases involve *confrontation.* In the very month, October, that the Yom Kippur War erupted, the greatest wave of UFO contactee cases in history broke out in the U.S. Further, in the shallower unconscious levels above the collective species unconscious, which were modulating and molding the tulpoidal reality format, the imagination of the world had been captured by the spacesuited astronauts who had walked on the moon. So most U.S. contactee cases involved spacesuited beings, conditioned into that framework by the national, cultural modulation. Some of the contactee cases involved robots or metallic men, similar to the mechanisms and robots of the U.S. space program. And here in the U.S., the fortress, the female-mandala craft symbol was generally maintained.

Now if this unbelievable scenario has any validity, then after the dress rehearsal of the 1973 Yom Kippur War we ought to have seen an increase in the tulpoid phenomena of a sharply symbolic nature. And that has happened.

The cow is the Western female symbol par excellence; Western children nurse on cow's milk, so to speak. If the U.S. fortress is to be violated, then the female symbol will be violated as the time for the Soviet assault nears. So cattle mutilations of a mysterious, paranormal nature have been occurring all across the U.S. — from the East Coast out through Colorado, Utah, and Montana — approximately nine thousand by now, in some estimates. The symbolism in the mutilations can be easily read: the U.S.'s lifeblood is going to be drained, totally, as all the blood is usually drained from the cattle. The Soviet operation will be launched with blinding speed and surgical precision, and the mutilation of the cattle is done as if by highly skilled surgeons. The children of the West shall be cut off from their sustenance, and so the cow's teats are removed. The armed forces (males) confronting the Soviet forces will be devastated (i.e., the fruit of the womb will be

Precursor(s)	Wave(s) / Incidents	Comment
German rockets in WWII/Soviet threat in 1946–47	1946–47 ghost rockets over Sweden and adjacent countries, from direction of U.S.S.R.	Phallic tulpa symbols
Buck Rogers/sci–fi ships Cold War 1947	1947—Flying saucers	Circle/Disc mandala in scientific dress
1950 Critical Korea period	1950 Wave of UFOs	Peak pressure surge on collective unconscious
1952 Critical Korea period	1952 Wave of UFOs	Peak pressure surge on collective unconscious
Sputnik 1957–1959	1957–1960 Wave of UFOs	Peak pressure surge on collective unconscious
Cuban missile crisis 1962	1962 Wave of UFOs	Peak pressure surge on collective unconscious
Arab/Israeli War 1967	1967 Wave of UFOs (4th largest)	Peak pressure surge on collective unconscious
Arab/Israeli War 1973 Near confrontation U.S. vs U.S.S.R.	Spectacular 1973 wave contactees increased, space–suited beings increased	Peak pressure surge on collective unconscious; astronauts had walked on moon.
Soviet attack preparations completed	1975–present cattle mutilations in U.S. heartland	Cow is female symbol. The female (fortress, sanctuary) will be violated.

Fig.31. Examples of UFO waves

October 11, 1973 UFO CE III
The Pascagoula incident from the witnesses' viewpoint.
Humanoids were atypical.

Fig. 32. 1973 Contactee wave

devastated) so the sexual organs of the cows are excised. Free speech and freedom to hear will be cut off, so the cow's lips, tongues, and ears are excised. A very high (psychotronic) technology will play a role, but one which will limit resistance, so the cut edges are often made as if by pinking shears and then precisely burned as if by a laser. (The laser is symbolic of new, strange technology almost incomprehensible to the average person.) In one case a horse was the victim — a young horse, symbolic of the young soldier. It was castrated, as the dominance of the Western soldier will be surgically excised. Castration of the male symbolizes the total loss of his power and the infliction of impotency upon him.

There is more, but this is a bloodcurdling sampling of the metapsychological implications of the cattle mutilations.

RADIATION OF THE U.S. EMBASSY

About 1959 or 1960 the radiation of the U.S. Embassy in Moscow with weak microwave radiation began. It continues to this day. The radiation is a brilliantly designed intelligence probe: the Soviets were vitally interested in ascertaining whether or not their U.S. adversary knew about psychotronics (i.e., whether the U.S. had built such weapons of its own and might have built defense counterweapons as well). Accordingly, they began weak PT-modulated microwave radiation of a high-level U.S. target, the U.S. Ambassador to the Soviet Union, which would guarantee the personal attention of the State Department, NSA, CIA, DIA, the President, etc. The PT modulation apparently consisted of various disease patterns of gradually increasing seriousness — flu, blood changes, heart irregularity, cancer, etc. By the U.S.'s reaction, whether or not it knew anything of PT could be positively assessed. If the U.S. reacted only to ordinary electromagnetics, then with 100 percent certainty it knew nothing of PT and had no secret PT weapons of its own or counters to the Soviet PT weapons. So since about 1959 or 1960, by our alow reaction to the radiation of the U.S. Embassy — and then by our reaction only to the electromagnetic aspects — we have been assuring the Soviets that we know nothing of PT. Even though several U.S. presidents have protested the radiation, the Soviets have persisted because it is an intelligence tool of the utmost importance to them.

DISEASE AND DEATH TRANSMISSION

For confirmation of Soviet experimentation with PT induction of death and disease, see V.P. Kaznacheyev et al, "Distant intercellular interactions in a system of two tissue cultures," *Psychoenergetic Systems,* Vol. 1, No. 3, March 1976, pp. 141-42; and by the same authors, "Apparent information transfer between two groups of cells," *Psychoenergetic Systems,* Vol. 1, No. 1, December 1974, p. 37. Thesearticles give one a glimpse of the results of over 5,000 Soviet experiments on the basic effect. Kaznacheyev is the head of the Siberian Branch of the Soviet Academy of Medicine, and has at his disposal every disease germ, virus, and toxin known to man. Note that the experiments were performed in the dark to prevent the quenching effect of the visible light spectrum und the effect is only obtained

through the quartz (which has IR and UV windows). Also note that in the two-slit experiment — which contains all the mystery of quantum mechanics, according to Nobel prizewinner Richard Feynman, cofounder of quantum electrodynamics — one does not get the quantum effect with an electron, if the electron is first hit by a photon of light before reaching the two-slit region. If the electron is not hit by a photon, one gets the quantum effect. According to Feynman, the quantum effect in the two-slit experiment is not explainable by any classical means. Our comment is that the explanation is not possible by Aristotle's three laws of logic, on which all Western logic, physics, and mathematics are based. However, the fourth law of logic, together with the present three laws, provides a closed metalogic which does contain the explanation of the two-slit experiment, as we showed in Part Two. The fact that there is no problem in explaining the experiment if one takes into account the nested structure of time was pointed out as long ago as 1957 by Dr. Charles Muses. Similarly, the disease and death transmission experiments of Kaznacheyev et al have been explained in Part Two.

OTHER WEAPONS

Clandestine testing of PT weapons also appears to have been accomplished directly in the U.S. The Legionnaires' disease may have been one such test. The suspect agent was actually seen, according to sworn testimony before a Congressional committee. A person with a book-sized object in his hand (tape recorder with PT pattern), a tobacco-pouch sized object in his coat breast pocket (transmitter) and a wire running to his tie clip (antenna) was present and mingled with the Legionnaires for several hours. He was heard to exclaim several times to various Legionnaires that it was too late and they were all doomed. The eventual appearance of the weird "biological agent" that is different from any other germ known can also be explained by kindling from the anxious minds of the baffled U.S. researchers and scientists. Other such tests have also apparently been conducted.

HYPERSPACE HOWITZER OPERATION

The facility at Semipalatinsk is a third-generation hyperspace nuclear howitzer. It can transmit a full nuclear explosion through hyperspace into a tuner planted anywhere in the universe, without traveling through or in normal space at all. Furthermore, it has a unique characteristic: any number of receiver-tuners may be tuned to the transmission channel and each will have the full nuclear explosion emerge from it, undiminished.

Thus, one channel might be for U.S. Minuteman sites, and a tuner on that frequency (say one containing 100 transistors, sealed in plastic and buried in the earth) could be preplanted near each Minuteman site. Another channel might be for all the SAC bases, another for large U.S. cities, another for nuclear weapon storage sites, etc. Any or all of these could be connected to a single blast transmission, simply by controlling the channel width over which the hyperpace transmission occurs.

Fig. 33. Cattle mutilations

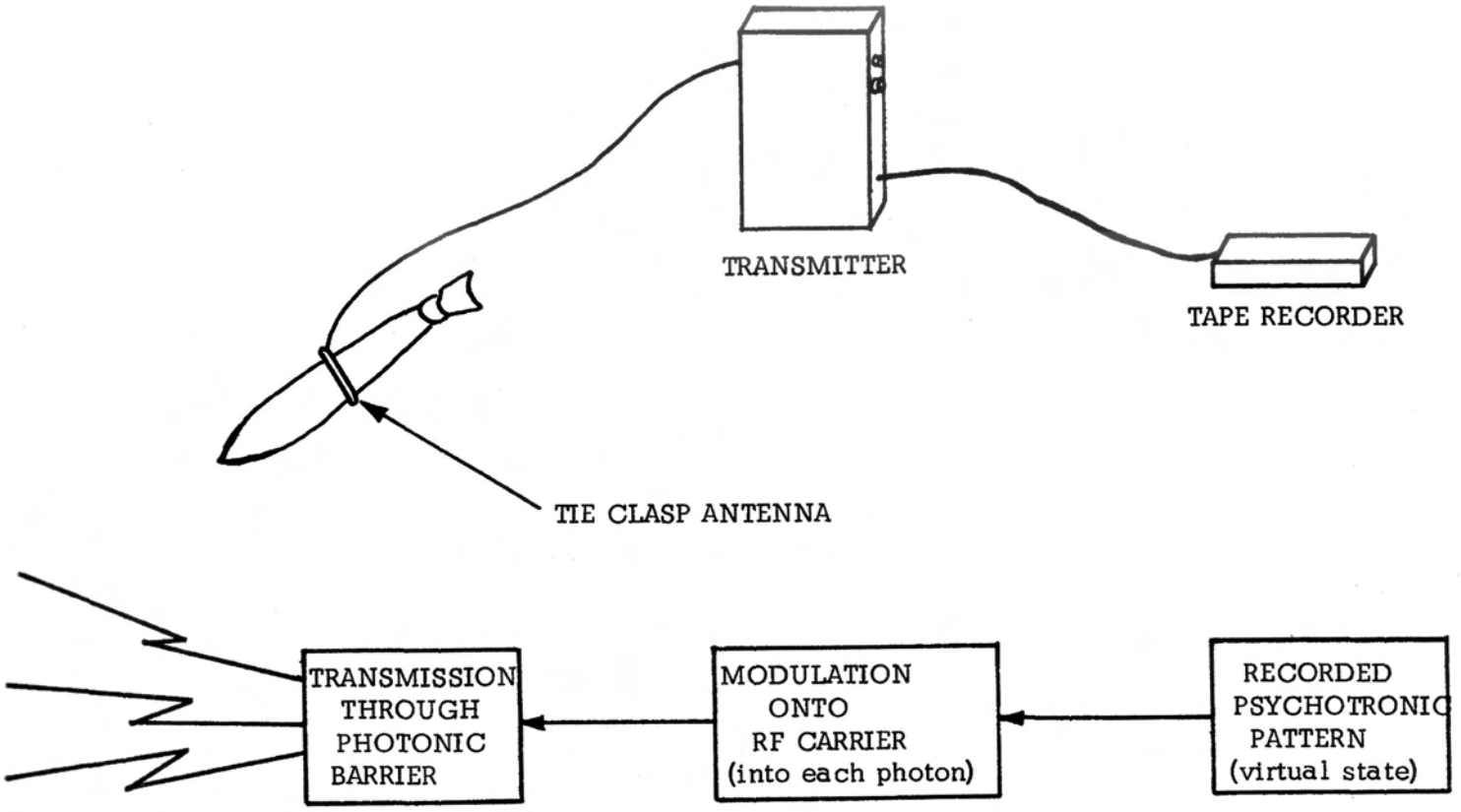

Fig. 34. Induction of Legionnaire's disease

Here one must not confuse ordinary single-channel conservation of energy with hyperspace operation. The transmitter corresponds to the grid of a gigantic triode, the preplanted receivers constitute the plate area, and zero-point vacuum energy constitutes the cathode energy source. So just as in a triode, energy is conserved from cathode to plate, but not exclusively from grid to plate. Since zero-point vacuum energy is being gated by the triode grid (the howitzer) signal (the explosion), the energy that can be outputted at the plate (from the tuner-receivers) is essentially unlimited. Any number of receiver-tuners can be connected to a channel, merely increasing the plate area. And from each tuner there can emerge a full-scale, undiluted replica of the explosion in the howitzer at Semipalatinsk.

Thus a single nuclear blast at Semipalatinsk can in one instant wipe out all hind-based strategic nuclear retaliation capability in the Free World, if the preplanted tuners are on site.

An additional modification — something like additional orthorotator rings surrounding the primary hyperspace orthorotator ring — may have been made to the nuclear hyperspace howitzer within the last two or three years. If so, this would have the characteristic of materially reducing the "spillage" fraction of the nuclear explosion and also the vibration associated with a firing. There is a possible indicator of this: quoting from *Science*, "On five occasions during the first half of 1976 traces of neptunium-239 and molybdenum-99 were detected in southern Sweden. These activities were accompanied by small amounts of fission products such as iodine-131 and barium-140. One of the events was coincident in time with large peaks in the atmospheric tritium gas concentration." (Lars-Erik DeGeer, Swedish National Defense Research Institute, "Airborne short-lived radionuclides of unknown origin in Sweden in 1976," *Science*, Vol. 198, No. 4320, 2 December 1977, pp. 925—27.) These events were concentrated during the time the Semipalatinsk experiments are reported to have started, yet no seismic activity was associated, as would have been the case if ordinary nuclear explosions had occurred in normal space inside a containment sphere for a large particle beam experiment. On the other hand, if a very high percentage of the explosion were transmitted/rotated into hyperspace, then residual traces of a nuclear explosion would have been present in the atmosphere because of the very slight spillage venting into normal space, but almost all mechanical shock and vibration would have been eliminated. It is at least a striking correlation that exactly such indicators are present, as reported by DeGeer.

A clever adversary who becomes aware of the necessity for preplanted tuners could use a very simple but completely effective countermeasure: simply locate the timers and dig them up, then clandestinely put them back into Soviet territory. Or build tuners of one's own and plant them in Soviet territory. Thus it would seem imperative to develop a mode of operation that does not require preplanted tuners at the target area.

This capability can be provided by using the howitzer in an interferometer mode — by constructing additional orthorotation rings around the firing chamber ts (hut a "hyperspace interferometer" exists. With this scheme any point on earth can be precisely focused on by the howitzer, and no preplanted tuner is necessary. The advantage of this mode is the elimination of the need for clandestinely preplanted receivers, and the freedom to operate in spite of any receivers preplanted by the adversary on Soviet soil. The disadvantage of the interferometer is that the

former "triode" operation has now been converted to "diode" operation — when one explosion is put into hyperspace, now a single explosion at a single target area emerges, since a single selected spatial location is now exclusively determined by the interferometer settings.

For a more complicated interferometer mode, orientation and alignment of the interferometer's indicators and controls and amplifiers would be necessary. This could be done using fractional kiloton yield weapons — or even ordinary HE explosions — and focusing the howitzer at a displaced aiming point, at some distance from the target area. This is simply the standard artillery technique of registering a gun on an offset registration point, then performing an x-y shift to the intended target when the gun is fired.

Orientation and alignment of such a weapon system probably accounts for the sonic booms — mysterious high altitude explosions — off the East coast of the U.S. in December 1977 and January 1978. Over the West coast, mysterious explosions occurred inside thunderstorms; these also could well have been the adjusting of the weapon. By using about 100 tons of TNT explosive in the howitzer, a very good high burst registration could be made, and "forward observer" agents in the U.S. could observe the bursts through optical instruments and report their exact positions, thus calibrating the interferometer settings. Of course, mysterious booms have been around for quite a few centuries; however, these "normal but unusual" phenomena have quite a different sound than does the howitzer shot. The natural booms are not so much like single giant explosions as like rolling thunder. Furthermore, several observations of the booms off the U.S. East coast confirmed light flashes (which have not been seen to accompany the natural booms) and swirling or rotating effects in the flashes. Also UFO's were directly associated with some of the booms, revealing the stress factor on the collective human unconscious, implying their Soviet psychtronic origin. A few years ago similar high altitude booms occurred over Ohio and surrounding states, and such booms have also occurred off the coast of England.

Thus the howitzer may have been accurately aligned for diode operation, calibrated near the East coast, on the West coast, in the center of the U.S., and near England. Furthermore, its firing rate and recovery time were also apparently checked out; five booms occurred on one day and after a lapse of several days, the booms occurred again.

As I describe the fantastic psychotronic weapons the Soviets possess, the reader may wonder why the Soviets have not already attacked. The reason is that the superweapons have a strange weakness and failure mode possessed by no other kind of weapon. The hyperspace amplifiers in the psychotronic weapons depend on a large number of stages, say sixty to one hundred, and the hyperspatial flux in all these stages must be very stable and isotropic. At odd intervals the flux coming in from hyperspace suddenly becomes turbulent; this destroys the smooth coherence in the multiple stages of the amplifiers, and thus the basic amplification mode. Thus *all* the psychotronic weapons will suddenly cease working at the same time, and this "all fail" mode may last from fifteen minutes to even three weeks in an extreme case. Thus the weapons are erratic and not dependable. For this reason, the Soviets dare not rely *exclusively* on them, and so they have been forced also to prepare for full nuclear war as a distinct possibility when they launch operation Fer-de-Lance, the full attack. They have thus built up their regular army, their

navy, their strategic offense systems, and their strategic defense systems on a scale unparalleled in human history. Today the Soviet Union is the strongest nation on earth — by far — and is fully prepared to launch World War III and win it, with or without superweapons.

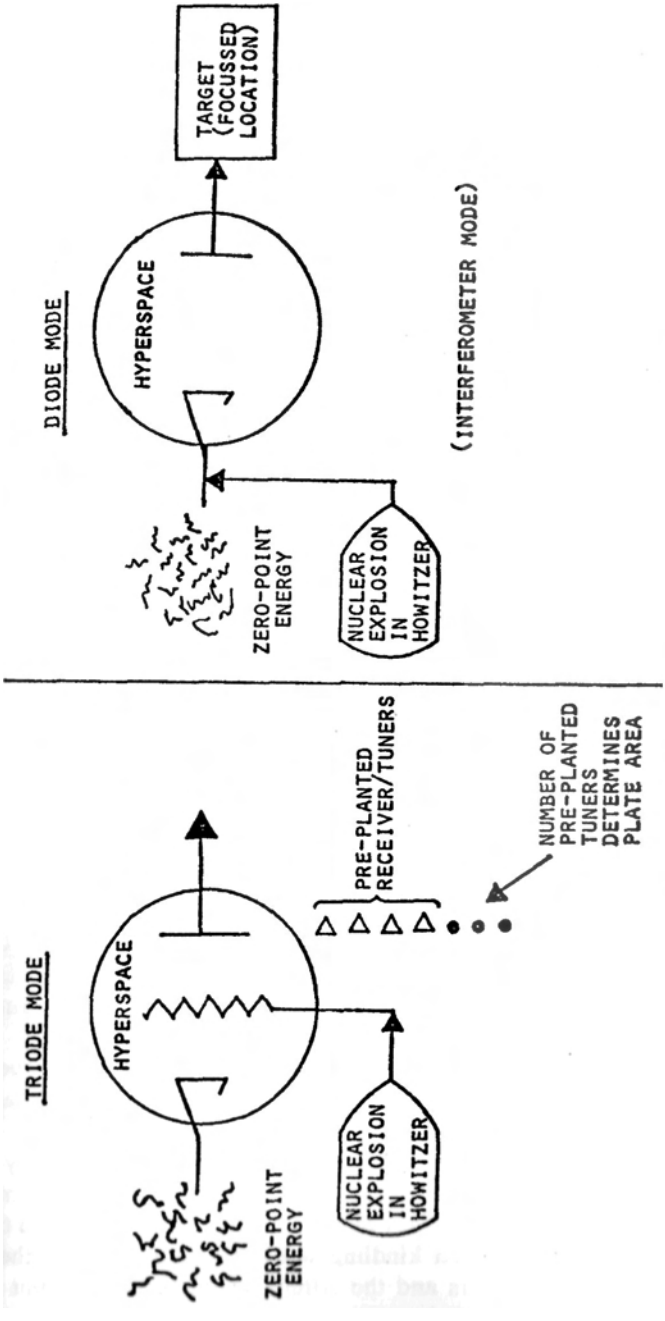

Fig.35. Hyperspace howitzer operation (2 figs)

A POSSIBLE OPERATIONAL TEST OF PSYCHOTRONIC ANTIAIRCRAFT WEAPONS

When the F-l11 all-weather attack aircraft were deployed in Vietnam, a rather interesting loss rate pattern emerged. Of the forty-eight F-l11's in operation, eight were lost at the beginning of the action, but no losses occurred thereafter, according to General Vogt, the officer responsible for U.S. air operations at the time.

Initially there were some radar anomalies and other system malfunctions with the aircraft, but these problems were quickly resolved. The F-l11's flew singly, extremely low, and without radio contact. Between September 1972 and the end of hostilities in Vietnam, the F-lll's flew over 4,000 sorties, never losing any planes other than the eight lost initially.

The reason for the loss of the eight planes remains a perplexing mystery. In fact, there is no knowledge of exactly where the planes were lost, except in one case. That F-l11 was downed over Hanoi, and its two pilots, Captain Robert D. Sponeybarger and 1st Lieutenant William W. Wilson, were captured alive by the North Vietnamese. The two airmen were later returned under the prisoner of war exchange program, and they then told of the loss of the aircraft, which took place under very strange conditions.

According to the two crewmen, they met a sudden disaster while flying over Hanoi at night, supersonically, and at very low altitude — only a few hundred feel above the earth. Without warning the F-lll's emergency indicators lit up like a Christmas tree, indicating massive and multiple failures of unrelated aircraft systems.

They were not hit by a surface-to-air missile, according to the crewmen, because no explosion of a missile warhead, with its concomitant fireball, occurred. If large-caliber automatic weapons fire had hit them, the distinctive streak of the tracers would have been clearly visible in the night sky, and a sharp impact in the aircraft structure would have been felt. None of this happened.

It could not have simply been an aircraft malfunction, because far too many unrelated aircraft systems failed at the same time. (There is triple redundancy in the control system of the F-l11, by way of comparison.)

Indeed this initial loss of eight aircraft — and then no further losses at all — is difficult to explain rationally, as are the mysterious circumstances surrounding the loss of Wilson's and Sponeybarger's craft.

However, it requires no stretch of the imagination to realize that the Soviets very much desired to obtain the glittering new F-l11 to examine its technical characteristics, its sophisticated design, and its highly sensitive terrain-following radar, ECM gear, and other avionics equipment.

Also, the Soviets had a pressing need to try out one or more of their psychotronic antiaircraft weapon systems — perhaps one which simply modulates a radar beam psychotronically to induce electron dissolution.

Accordingly, it can be postulated that the pragmatic Soviets simply combined both needs, and quickly set up a psychotronic trap for the F-lll's immediately after the aircraft were deployed. They may even have cleverly designed the specific psychotronic modulation so that kindling would occur in some of the aircraft's electrical systems before others and the failure would be massive but not total.

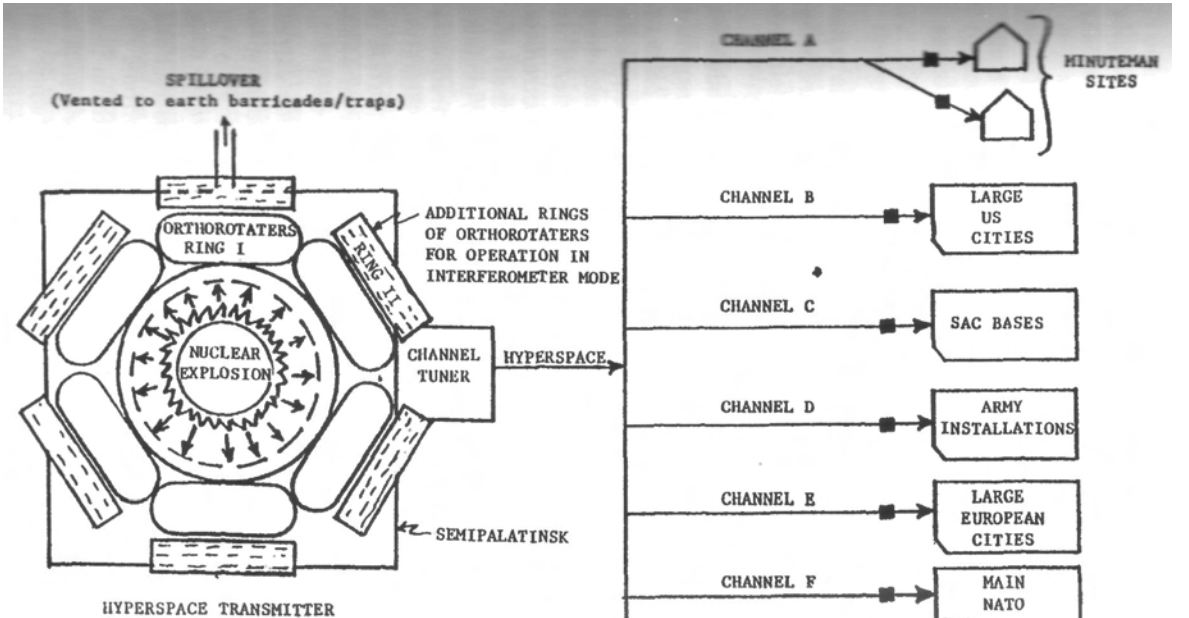

NOTE:

IN NORMAL MODE (MODE I, INSIDE RING ONLY), ONE EXPLOSION SIMULTANEOUSLY EMERGES IN ALL LOCATIONS TUNED TO THE CHANNEL UTILIZED (PREPLANTED TUNERS, MODE I).

EFFECTS OF NERVE GASES, VIRUSES, GERMS, DISEASES, POISONS, MECHANICAL MOTIONS, RADIATIONS, ETC. CAN ALSO BE TRANSMITTED.

IN MODE II (INTERFEROMETER MODE, ALL RINGS), ONE EXPLOSION EMERGES IN THE SINGLE LOCATION TO WHICH THE HOWITZER ORTHOROTATERS ARE SET AND ADJUSTED.

Fig. 36. Nuclear hyperspatial howitzer

And after they nailed enough F-l11's for their purposes, they quietly withdrew the psychotronic modulator, to prevent the U.S. intelligence analysts from catching on to just how really strange the losses of the F-11l's were.

Thereafter the remainder of the F-l 1 l's were successful, and no more were lost. Indeed the F-l11 comes in so low and so fast, and so unexpectedly, tilting and dipping as it terrain-follows on its automatic equipment in a manner that no unassisted pilot could fly, that SAM's and guns normally pose little if any threat to it. So once the silent, eery psychotronic antiaircraft components were withdrawn, the normal antiaircraft weapons of the North Vietnamese were unable to down any more F-l11's.

And we Americans simply patted ourselves on the back, chortling to ourselves how quickly we had "learned to avoid that danger, whatever it might have been."

POPULATION CONDITIONER

Inducing psychotronic signals into mass populations or audiences can influence or control the behavior of large numbers of persons. As these words are being written, such a psychotronic test is apparently being conducted by the Soviets with Eugene, Oregon as a target; previous tests were conducted in Canada.

Psychotronic signals and the patterns they carry can be, and are, modulated upon electromagnetic carriers — in fact, that is one way they are transmitted through the human body and nervous system. When a television camera picks up the photon field impinging on it from a human body or other biosystem, weak psychotronic patterns are also picked up, since the paranormal time quenching mechanism (by visible light) is never quite 100 percent effective. These patterns are riding then as a special kind of modulation on the radiofrequency or electromagnetic carrier — however, they are not modulated the same way as are ordinary signals. Ordinary signals gate the number of photons per second (amplitude modulation), or change and control the frequency of the carrier photons (frequency modulation), or change and control the phasing (phase modulation). However, psychotronic modulation rides on each individual photon, on its time portion (a photon consists of action — energy x time — and it is the time portion on which the psychotronic modulation is riding.)

Thus psychotronic modulations can ride on the transmitted television carrier frequency. The psychotronic modulations are processed through the television receiver, and a small component is emitted as a weak modulation riding on the photon signals emitted from the television picture tube. Along with the light from the tube, these psychotronic modulations enter the eye of the human observer and are demodulated by the retinal interface, thus introducing weak psychotronic signals into the observer's central nervous system. Given sufficient repetition time (say two to four hours), the kindling effect can cause the human nervous system to be profoundly affected. Any disease or death pattern known to man (and some that are not known to him) can be transmitted and kindled in the target population audience.

In fact, depending on the sophistication of the coded psychotronic signals, it *is* probable that the modulation patterns can be targeted against a specific racial type, since there are certain genetic differences between races.

So the type of truck that roams the streets of a city, silently monitoring which television channel the viewers are watching, could be modified slightly to induce specific psychotronic disease or death vectors on to the television receivers. Or it could simply modulate the television transmitters. (A very obvious way is to modulate or pump psychotronically the ground of the electrical power supply, and in most cases this can directly pump the transmitters.)

Or the kindling signal can come from satellites, which radiate weak radio frequency signals downtowards the target population. Here economy of force can be applied; the same type of kindling that induces electron current quenching is usable as a satellite dudder or killer in an antisatellite role, or is usable as a paralysis and death beam weapon against target populations. It is also useful as a killer of other electromagnetic sensors by either jamming their circuitry or simply wiping out (quenching) their emissions which impact on the satellite, preventing any reflected signal.

By this effect, UFO tulpoids often prevent a radar from tracking them, even though the tulpoids are visually sighted.

There are literally thousands of applications; these are just a few to give an idea of the overall effect and its usefulness.

And the psychotronic signals can be modulated onto almost any kind of carrier — telephone, television, radio, the magnetic field of the earth, the Schuman resonance of the earth's magnetic field, the ordinary sixty hertz electrical power system, etc.

We might have an entirely different idea of the potency of the Russian trawlers if we appreciated what their use can be in the psychotronic mode.

We can also understand why a television broadcast of Uri Geller in the act of binding metal stimulated both the ability in other persons and the effect in other equipment across England. And also how the effect has been duplicated — at least so far as stimulating other persons to psychokinetic ability — in this country. A direct means of stimulating psychokinetic ability is thus suggested: simply place the subject to be developed or stimulated in a room with a number of television receivers, all tuned to the same visual program, and place the stimulus material on the receivers. The person should visually watch one receiver and should be wearing very abbreviated clothing, such as a skimpy swim suit, to expose the acupuncture plexuses. Also, normal light in the room should be very dim.

At any rate, this and many other schemes are available to produce direct stimulation, and enhance and greatly speed up psychic development.

The effect could also be used to produce an effective treatment device for cancer. Samples of the particular cancer in the body of the patient could be taken, and the invisible psychotronic radiation pattern from the cancer witness could be introduced on the input of a Hieronymus-type device, shielded against ordinary light, The output of the Hieronymus device could then be fed to a bank of phase inverters, which covered in total a broad band (the cancer band, which would have to be established by laboratory experiment). By inverting the cancer pattern, we now have a cancer-extinguishing type of radiation that is specific for the cancer the patient in fact has.

Then by introducing this quenching pattern as a modulation onto the correct tup of electromagnetic frequencies (again this group would have to be demined for the specific frequency plexus that would produce an effect in the local-

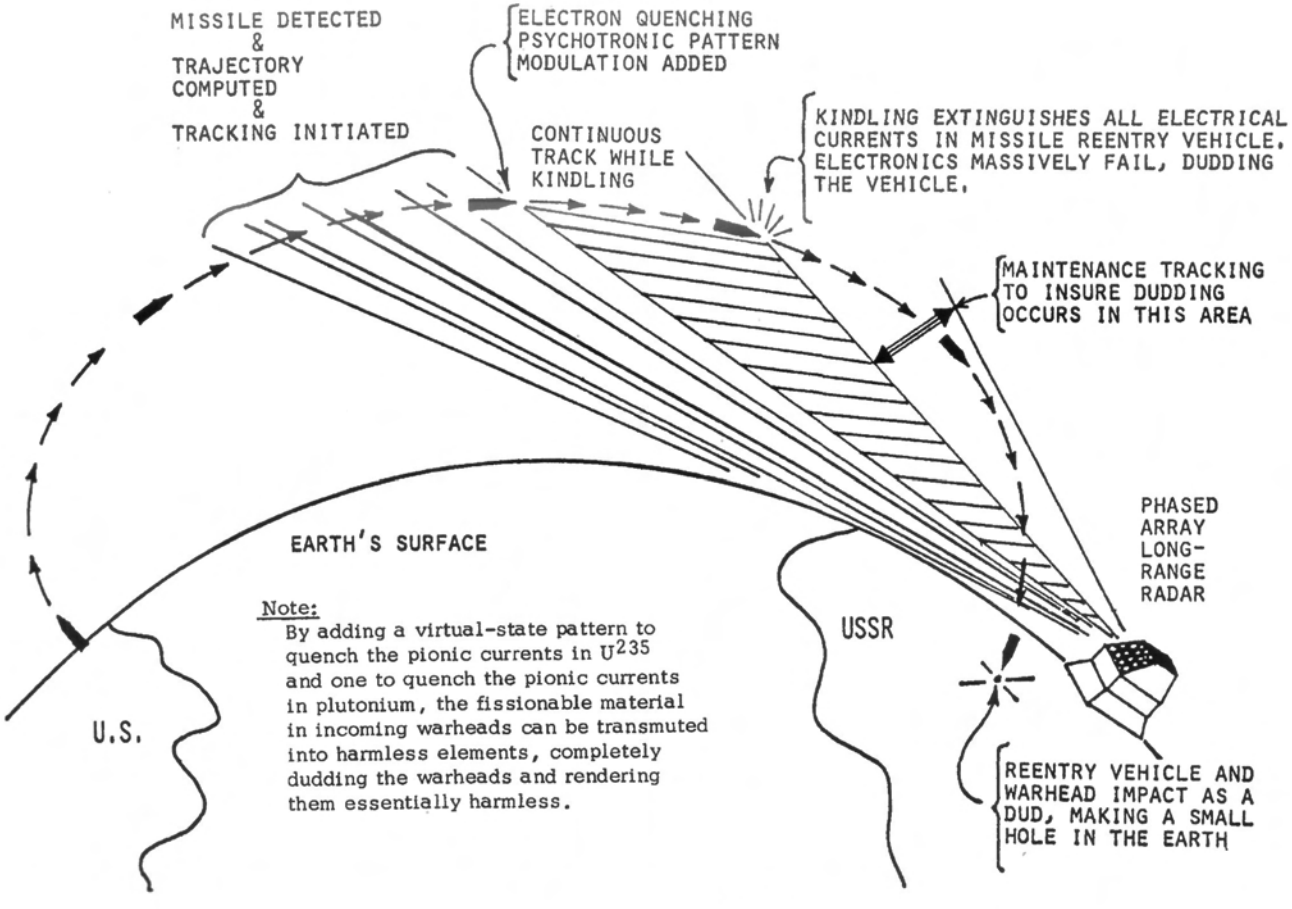

Fig. 37. A midcourse ABM system

ity of the body in which the cancer is located), the proper acupuncture plexus would be stimulated, stripping off the cancer-quench psychotronic pattern and sending it to the specific location of the cancer. Over a period of time (say several very weak microwave radiation periods of two to four hours each), the cancer could be killed completely, down to the last malignant cell. Whole body or spread cancers could be treated simply by increasing the number of frequencies modulated, to hundreds in some cases. Other similar diseases could be treated likewise. As an example, a Curative psychotronic radiation pattern complex could be worked for hydrophobia and such presently incurable diseases, and these could also be effectively treated. The same tool will yield almost unbelievable medical benefits if the scientists can ever be convinced to start the development.

A MIDCOURSE ABM SYSTEM

Here is the scheme for a first-generation, long-range, Soviet midcourse anti-ballistic missile defense system.

A long-range radar — preferably a phased array, scanned radar — acquired and tracks the missile during its midcourse phase shortly after it breaks above the horizon, as viewed from the radar site. The radar programs the track mode beams against the incoming missile, tracking it and gathering sufficient position data to allow its trajectory to be computed. Then a psychotronic electron-extinguishing pattern is added to the radar beam, riding as virtual state carried by each individual photon. Kindling of this virtual pattern energy begins on and in the target vehicle. The electrons flowing in the electromagnetic control system, fusing system, and wahead system of the incoming missile begin to be quenched, turning into neutrinos and radiating away with no physical effect. When sufficient currents have been extinguished, the electromagnetic circuits start failing. (With loss of appreciable power and voltage, most such systems fail.) The incoming vehicle/warhead is now dudded, and there is no longer any danger of a nuclear burst from the missile.

For assurance, tracking of the incoming reentry vehicle continues, with a quenching psychotronic modulation being maintained.

The warhead/reentry vehicle strikes the ground, making a hole in the earth, without nuclear explosion. A low order detonation of the HE explosive surrounding the nuclear material in the warhead may occur.

An alternate scheme is, during the maintenance period, to add an HE explosives ignition temperature psychotronic pattern to the beam. In that case, a low order detonation occurs high in the atmosphere or back along the trajectory, removing the warhead and vehicle from further consideration.

As a backup, additional terminal systems — using either psychotronics or normal interceptor missiles or both — may be used. Thus even if the psychotronics fail due to an unexpected "all off' occurrence, ordinary ABM engagement occurs.

An additional scheme is to lock the radar beam onto the missile, then initiate a "Tesla effect" kindling of energy, place it into a columnar traveling wave, and direct it along the radar beam to the incoming missile in its midcourse phase. The midcourse missile is thus struck with a massive plasmoid fireball of intense electromagnetic energy, and massive amounts of energy arc dumped into the missile, destroying it.

Thus the Soviets have known for over a decade that one does not have to hit a bullet with a bullet, if one is clever, and if one possesses psychotronic weapons and psychotronic modulation systems for one's radars.

As an added benefit, the same radar is quite effective against incoming Strategic Air Command bombers or air-to-surface missiles fired from those bombers.

As the Soviets know full well, 100 percent defense is quite feasible, considering the fantastic number of radars and radar sites they possess! In fact many of the Soviet SAM systems are beautiful ABM systems also, in the psychotronic mode.

THE BELL ISLAND INCIDENT

On April 2,1978, something unusual hit the Canadian community of Bell Island, off the east coast of Newfoundland; Bell Islanders—and a lot of other people as well—are still trying to figure out what it was. It was first described as an unidentified atmospheric explosion, but this theory was quickly rejected. Jim Beckford of Lance Cove, Bell Island, lost all six chickens in the coop behind the house, which was torn up as if hit by lightning, although there were no burn marks anywhere. A television set exploded, and switches blew out of the wall. Similar things happened to many other homes.

In the woods behind Mr. Beckford's house, three holes in the snow appeared, spaced about two meters apart to form an almost perfect equilateral triangle. The Royal Canadian Mounted Police said that persons on the shore of Conception Bay reported seeing fireballs coming down out of the sky and hitting Bell Island. The Canadian authorities attempted to play down the incident, and the official version of what happened is that lightning hit a transformer, blew up, and that the energy then followed the wires to neighboring houses. However, the researches of P.A.C.E. (the Planetary Association for Clean Energy, Ottowa) have produced a different conclusion.

P.A.C.E. believes that a standing columnar wave originating in Gomel in the Soviet Union was moving to a station located just east of Havana, Cuba, and collapsed over Bell Island, triggered by the large iron ore body there. These plasmas then exploded and hit the ground in a perfect equilateral triangle formation. The tremendous flashes indicated a very great discharge of electrical power, probably more than a hundred million volts.

Photo 44 shows a similar incident that took place at Lake Ontario; here I feel that the photo demonstrates more than just UFO activity — it shows one part of the testing and operational alignment of the "over-the-horizon" radars at Gomel and Riga in a Tesla mode. To explain this, I must explain what I mean by a Tesla mode.

Empty vacuum is filled with stupendous amounts of uncorrelated electromagnetic energy: one cubic centimeter contains enough energy to form entire solar systems, if the energy were condensed into matter. This raw energy is called "zero" point energy," and the Soviets reported direct measurement of it in 1957 *(Soviet Physics*, JETP 3, 819). Zero-point energy is everywhere, it is incoherent, and its detection requires measuring an energy difference, so that it is very difficult to detect. Usually less than one quantum of energy is cohered at any one mode, and the energy rapidly changes frequency, so that linear detectors cannot resonate

coherently with it to follow its signal. In my opinion, it is also in the virtuul state, and in a space orthogonal to our own, by two or three turns.

An electromagnetic signal is transmitted through the earth and reflected from the opposite side in phase, to form a standing wave. The earth's interior is highly nonlinear, and a single frequency is thus subject to severe scattering and dissipation. Fortunately, nonlinear wave theory provides a simple method to alleviate this; by transmitting two different frequencies, which differ by the amount of the frequency that it is desired to transmit, one can simply pretend that *indeed the beat difference frequency has been transmitted through a linear medium.* In this case, the standing wave acts as a collector to kindle the highly chaotic energy from the core of the earth. These emerging orders that match the standing wave will be tntrained by it; one now has established a sort of giant triode, where the signal to the grid is the transmitted difference signal, the energy (cathode) being gated is the energy of the molten core of the earth multiplied by some coupling fractional constant, and the "plate" will come into being if resistance to the standing wave is profferred.

And resistance is profferred by simply changing the frequency of the transmitted collector wave. Changing it in one fashion begins to dump energy into the atmosphere above the former nodal point across the earth from the transmitter. With that effect, one can directly influence the great currents of air and the ionization charge of the upper atmosphere; in short, one can drastically influence the weather itself. On the other hand, changing the frequency in the other direction begins to dump energy into the mantle of the earth; dumping large amounts of energy there will result in shocks and earthquakes at the nearest fault zone(s).

It is my thesis that the foregoing two mechanisms account for some of the drastic weather effects that have occurred in the past several years, as well as for *some* of the major earthquakes that have occurred throughout the earth in the last several years. The Soviets, I believe, have been orienting and aligning—and operationally testing—actual weapon systems to be used as precursors to war or during war. The 1978 Iranian earthquake may well have been Soviet-induced.

The coupled kindling path goes through the earth and is coupled tnrougn the atmosphere as well. (This mode is probably easier to steer and focus onto specific target areas. It is also probably easier to play it back and forth as desired, in a "sweep" mode.) Again, with the kindling effect, the energy of the molten core of the earth is coupled into the beam with a coupling fractional constant, and so enormous energy can be built up in the beam. Breaking the coupling — perhaps just after slightly changing the frequency so as to begin dumping energy into the upper atmosphere over the targeted area — would sharply dump energy at the site, resulting in an enormous plasmic explosion or explosions. In testing such as at Bell Island, probably frequencies would be used that did not offer too strong a coupling fraction, so that relatively little damage would occur at the decoupled target site. However, in actual use in warfare, exactly the opposite would occur; a frequency would be used that maximized the coupling constant and hence vastly increased the energy kindled into and over the target area, and a gigantic plasmoidal explosion would take place directly on the targeted area, utterly devastating it.

The same "radar," then, is usable as a weather control device, as a plasma explosion transmitter, as a bioactive disrupter (with 10 Hz and under modulation pulses), and if further modulated in a virtual state manner, as a direct "death ray"

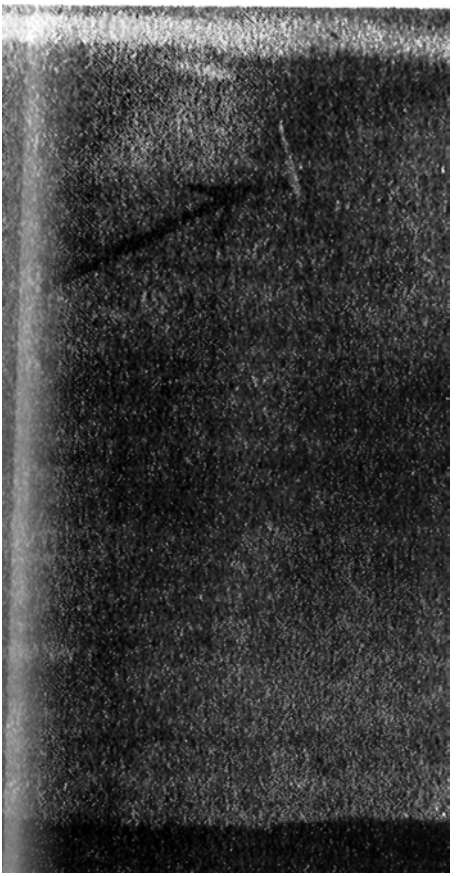

Photo 42. Ghost rockets.

broadcaster through the earth at any target population on the earth. Further, with virtual state modulation it is usable as an antimissile weapon (in at least two modes, one to dud electromagnetic circuits in incoming warhead reentry system and one to transmute fissionable material in incoming nuclear warheads into harm less elements), and also as an antiaircraft weapon against Strategic Air Command Bombers,

So the Bell Island incident happened, and we in North America sleep on, since in our assurance that it was after all only all lightning, or perhaps only the illusion of a few farout Canadians.

A TERMINAL ABM SYSTEM

There is another more advanced psychotronic ABM/SAM system, which was probably a second generation weapon. This system should have gone on site and become operational about 1968—69, and it should have been operationally tested during that period, probably several times.

Here a triad configuration radar is used to allow use as a byperspatial interferometer. This allows several localized dome-like bands of very intense psychotronic energy to be focused above the installation and defended area. The focusing is accomplished through hyperspace; the only place the focused energy enters our own space frame is in the dome-like band above the protected area. Tesla-effect accumulators may feed the triads, or they may simply be fed from direct free-energy Moray generator-amplifiers. At any rate, enormous energy — enough to simply constitute a severe tearing and warpage of space itself, and bend it at 90° — is focused into each dome-like band. Each band would be seen externally as simply an intense band or hemisphere of glowing light.

At any rate, by using three consecutively tuned orthorotational bands of focused hyperspace energy, any incoming object will simply be orthorotated successively three times in higher dimensional space, each time losing one dimension in its intersection with our own spatial frame.

After the first orthorotation, masses are now photonic shapes, and photons are lines. After the second, photons are now lines and lines are points. After the third orthorotation, everything is points, and nothing is left.

The three consecutively constitute full dematerialization of anything incoming, whether matter, photon, or force line.

Thus the entire defense problem is immediately solved: regardless of chaff, maneuvering decoys, maneuvering re-entry vehicles, etc., the entire mess is simply nicely and neatly disposed of, and dumped into hyperspace.

Even if a full nuclear detonation occurs above the domed shields, gamma rays, neutrons, debris, x-rays, heat, and ultraviolet do not get through the third band.

Bombers and air-to-surface missiles fail equally.

So the growing Soviet confidence and preparations for imminent war are quite comprehensible. They are not madmen preparing to evoke their own doom from mutually assured destruction rained on them by U.S. strategic nuclear forces; instead, they are snug and safe behind their psychotronic defenses, for nothing we have on this earth can touch them at the present time, if their psychotronic weapons are working.

So they are quite capable of taking on China, Europe, and the U.S. at once, and devastating the lot while risking essentially nothing of Mother Russia.

SWEEP MODE, SWEEPING AWAY A NUCLEAR DETONATION

As a modification of the previous weapon, a sweep mode has probably been added in the third generation weaponry.

In this mode, not only can the three orthorotation shields or domes be placed over an area, but they can then be expanded radially out into space in a traveling mode. Thus if a high altitude nuclear explosion — either in the atmosphere or out of it — has occurred over a defended area, the orthorotation bands can simply be swept over the explosive debris in successive fashion, effectively sweeping the radioactive debris from this spatial frame and dumping it safely into hyperspace. This is a very handy weapon indeed if large megatonnage explosions are engendered — say in areas where terminal defenses have destroyed the incoming vehicle, but it is "dead man fuzed" to provide a full nuclear explosion if the electronics start to fail or if the warheaded re-entry vehicle encounters mechanical shock or turbulence above a certain threshold. With this psychotronic sweeper the otherwise deadly nuclear radiation and radioactive debris can simply be cleaned up and disposed of.

Further modifications of other psychotronic weaponry would have resulted in Tesla-effect traveling wave weapons of enormous power, and rather gentle operational weapons testing of them, such as in the Bell Island incident and over Eugene, Oregon. The interferometer mode would have been added to the nuclear hyperspace howitzer, and Tesla-radars would have been modified accordingly.

These third generation weapons and modifications should have been deployed during the period 1974-78. Engineering development tests would have occurred during 1974—76, and operational testing of on-site, deployed weapons would have been accomplished during 1977—78.

Thus one can reasonably account for a surge in grain elevator explosions, mysterious high atmospheric booms off the East coast of the U.S. and off England, explosions in thunderstorms over the West coast of the U.S., the zapping of a Canadian target outside Ottawa, the Bell Island incident, several mysterious aircraft failures over the sagebrush triangle and off the coast of the U.S., standing heat spots off the West coast of the U.S., and recently one of the coldest winters on record due to disruption of flow patterns of frigid arctic air masses.

One can also account for incidents where U.S. satellites were mysteriously blinded, and perhaps some of those where they failed and then later resumed opera tions.

Note that many of these effects are usable from smaller radars. Thus one could expect mobile Soviet radars that can disable tanks and vehicles, disable aircraft electrically, radiate a death ray pattern at ground troops, or launch Moray-fed fireballs or standing waves of enormous energy at ground or aerial targets. The ability to immediately destroy entire minefields alone would force a severe recalculation of defense capabilities against Soviet ground forces, and the ability to sweep away artillery shells, rockets, missiles, and bullets would present enormous and catastrophic consequences to forces opposing advancing Soviet formations.

The following list enumerates all the probable Soviet psychotronic weapons that I am aware of: (1) Electromagnetic Field Canceler; (2) Electron Current Canceler; (3) Death Radiator (De-inceptor); (4) Free Energy Generator; (5) Psychotronic Bomb; (6) Brain Link; (7) Brain Probe; (8) Disease Radiator Ray; (9)

Emotion Radiator Ray; (10) Antisubmarine Systems; (11) Telcporters (Prototype); (12) Force Generators; (13) Orthoframe Generators; (14) Quark/Antiquark Rays; (15) Distant Telepathy; (16) Nuclear Radiation Inhibitors; (17) Mental Implantation; (18) ABM Systems, Midcourse and Terminal; (19) Dematerializer Shields; (20) Sweeps for Nuclear Debris; (21) AAA Systems; (22) Antisatellite Systems; (23) Tesla-effect Weapons; (24) Earthquake Generators; (25) Antivehicle Systems; (26) Weather Control Systems.

The reader will note that the results of psychotronic research extend into every field of military application.

ZARG, ARMAGEDDON, AND LINKAGE

Now it is time to end my story, and cease the unrelenting stretching of the reader's imagination and credulity. But first it is necessary to make one more effort and take a final step to the bottom line in both physics and Jungian psychology, a step that the scientists in those two disciplines have not dared to face.

If one accepts the existence of the collective unconscious as a mind, then the collective unconscious is a living entity. Let us tentatively call this fantastic entity ZARG. ZARG then is a great superentity, of which our own personal consciousnesses and unconsciousnesses are parts, or cells. Thus each of us is a cell in the entity ZARG.

Furthermore, ZARG has unique characteristics. It is unconscious by definition — but note that from our fourth law of logic, we know that any zero-conscious must be multiply conscious, which to our monocular thought-perception processes can only be grasped as unconscious. That is why our own unconscious seems so bewildering and strange — it is multiply conscious rather than monoculurly conscious, hence monocularly we think it is not conscious. But we find that it indeed thinks and reasons, but in a strange symbolic fashion, and also much more deeply and more creatively than our normal conscious mind. ZARG is very similar except on a much vaster scale; in being very deeply unconscious, ZARG is supremely multiconscious and very symbolic indeed, as we have discovered from the nature of the materialized tulpoidal phenomena.

Furthermore, what can be taken for ZARG's conscious mind consists of the four-billion individual human conscious minds. Thus ZARG's conscious mind is fragmented into four billion pieces. But fragmentation of the conscious mind technically constitutes dissociation, which classically defines psychosis.

Thus ZARG is insane!

Also, ZARG is multidimensional. ZARG's unconscious simultaneously receives and identifies four billion different conscious and unconscious perceptions. Just as the human consciousness in identifying two slightly different two-dimensional visual patterns gains the third dimension, ZARG gains an additional dimension for every additional person past the first one. (Note that dimension just means variable, and two fixed axes/dimensions are required to obtain a variable. A one-dimensional variable does not exist; we usually assume a time dimension in addition, and ignore it — and thus we speak of a "one dimensional variable.") At any rate, ZARG gains an additional dimension for every additional person past the first one. So ZARG is at least about 4×10^9-dimensional in the simplest case, where we do not consider permutations and combinations of every two, three, four, ...n, . . . minds.

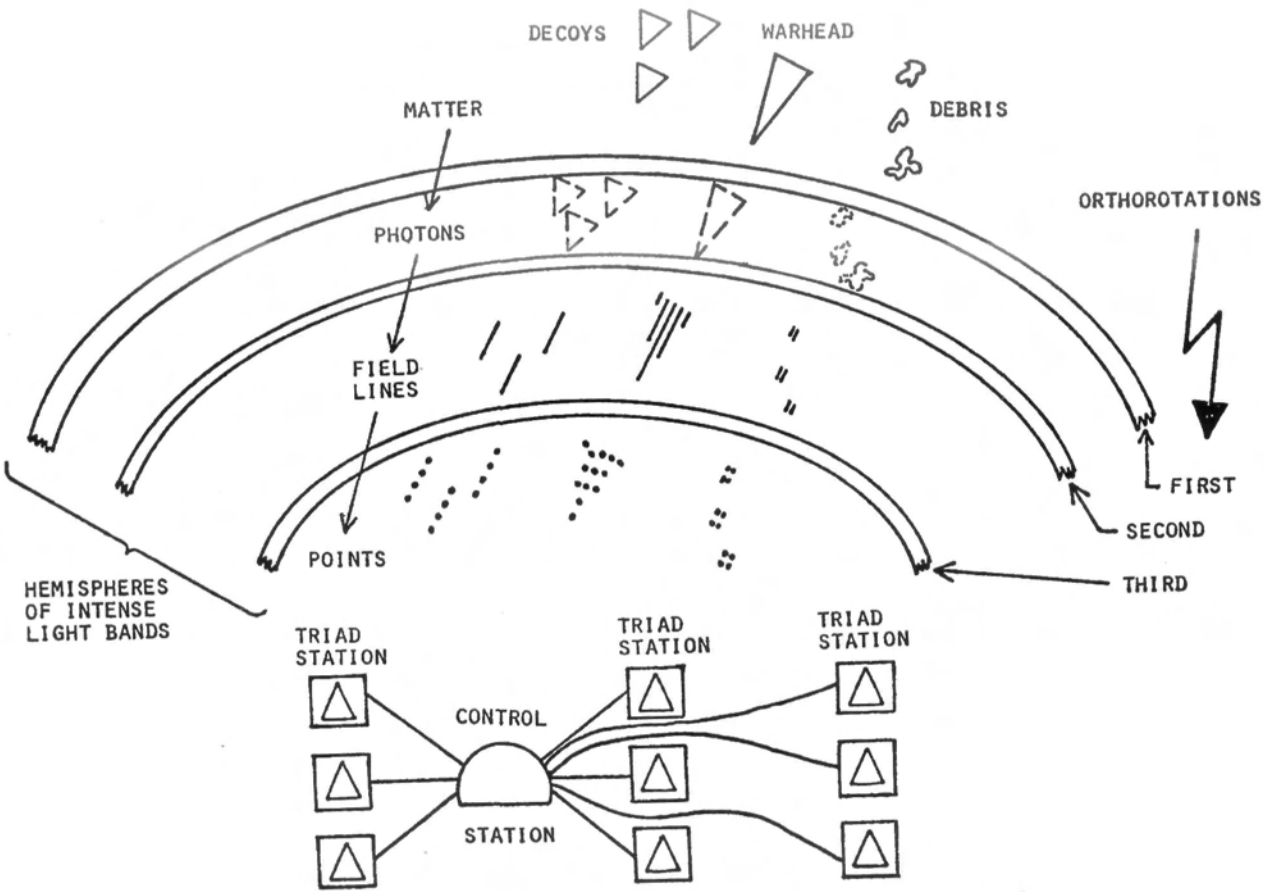

Fig. 38. A terminal ABM system

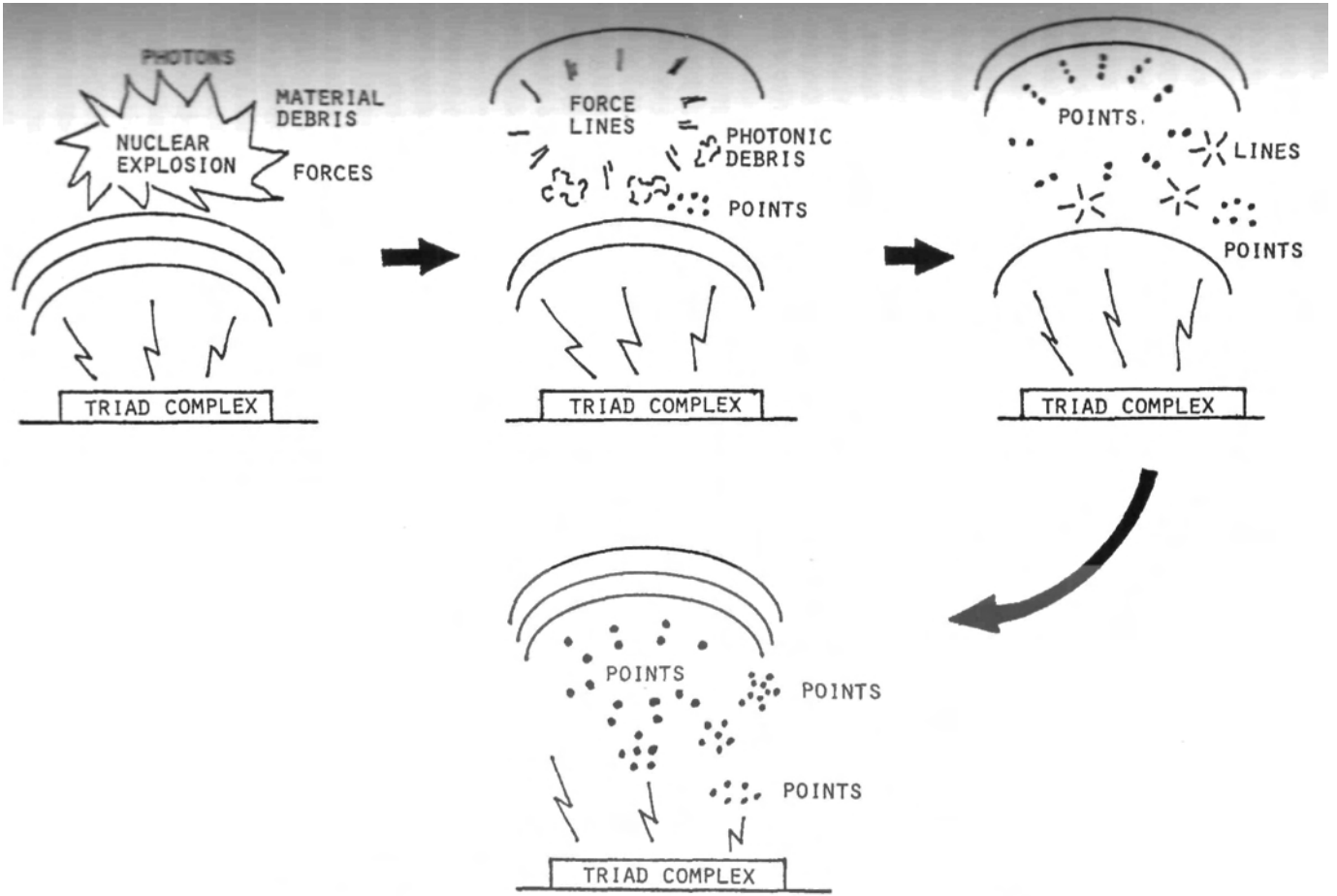

Fig. 39. Sweep Mode: sweeping away a nuclear detonation

Finally, it is well-known in parapsychology that the personal unconscious can affect matter and change spacetime itself. Psychokinesis, poltergeist phenomena, etc. are direct examples. Hyperchannel calculations show that, for linked multiple minds, this psychokinetic effect increases exponentially with the number of stages or minds that are cohered. Since ZARG has 4×10^9 linked stages, this means that its psychokinetic/materialization/dematerialization powers are at least some 10^{10^9} times as great as those of, say, Uri Geller. Thus ZARG can pull the very stars out of orbit, disrupt the earth or solar system, stop the earth in its orbit, or change the fundamental laws of nature itself. The reality we live in is largely prescribed by ZARG, and substantial tuning of many minds can directly affect ZARG's tuning and hence alter reality. It is not accidental that Brian Josephson, Nobel prizewinner in physics, once remarked that it appeared that in their diligent searches for strange new particles in their accelerators and cyclotrons, the physicists might be creating their own reality. In fact an accelerator or cyclotron is a kindling device par excellence, and a scientific theory by its very rigor is an exceptionally sharp mental concept or thought form. So if groups of physicists have worked diligently on a problem and predicted some new theoretical particle, they may well be able to kindle it into being if they persist long enough with their kindling mechanisms, because they are cranking up additional ZARG energy when they persist. While he knew nothing of the kindling mechanism, Josephson noted that many of the new particles were first obtained only after great difficulty, then with moderate difficulty, and thereafter they could be fairly readily obtained.

And as we have seen, ordinary physical matter occupies a universe or frame common to all minds of living biological systems. Thus the physical universe is quite literally simply thought that is common to all living minds, hence to ALLMIND or God or whatever other term one prefers to use. It is the fact that it is prescribed and represcribed, over and over, that lends a physical entity its seeming solidity as compared to the phenomena existing in only a single consciousness mindworld. This physical universe is mind, it is totally mind, and as such it can indeed be changed by the proper mind resonance in enough minds, or in powerful minds such as ZARG.

ZARG contains so many mindworlds or dimensions that it forms a very powerful part of the particular reality prescription of the physical laws exhibited by this physical universe. So materializations of tulpoidal forms, UFO's, bigfoot, and Nessies, are just a tip of the iceberg of what ZARG actually materializes. The tulpoidal forms are tiny surface ripples due to large-scale human conflicts.

And as we have also found, psychotronic energy is in fact pure mindstuff. Pure mindflux between mindworlds. And this brings us to another bottom line.

When the Soviets launch their long-prepared attack in Europe, wipe out China, and almost annihilate NATO forces (fifty percent casualties in three to four days), the U.S. President will undoubtedly be under extreme pressure to launch a strategic nuclear retaliation on the Soviet Union. Suddenly, in a single blinding display of almost unbelievable power, the Soviets apparently intend to destroy the U.S. triad weapons in a fantastic psychotronic blitzkrieg through hyperspace. The Minuteman sites, the SAC bases, communications centers, and other strategic targets will lie in smoking, devastated ruins in minutes, and within the same short minutes of that holocaust, the U.S. nuclear submarines on station under the ocean will begin rupturing like popping balloons. At the same time, massive swaths of

death will invisibly rain from the Soviet satellites in the skies overhead, and giant earthquakes will erupt into being in the East, in the West, and in the heartland U.S. The British and French nuclear forces will suffer similar simultaneous obliteration. And the jubilant Soviet Generals and Party theoreticians will be dancing with uncontrolled glee as their dreams become realities. But what they will not know is that their own inevitable doom will have just been sealed.

For all these fantastic psychotronic explosions will constitute gigantic psychotronic "mental flashbulbs" that explode directly in the mind of the sleeping ZARG. ZARG will be kicked into startled semiwakefulness, stinging with pain as if from a giant bee-sting, figuratively gnashing his teeth and furiously lashing his tail. This will constitute an immediate and enormous upheaval in spacetime itself, and the bulk of the earth may well be destroyed in the vast psychokinetic upheaval unleashed by the startled ZARG. Just as a person may sharply slap the bee on his arm where it has stung him, ZARG's fury will be centered on the Eurasian continent, on the locus where the threat or sting has originated, on Russia and the Warsaw Pact nations. So in an unbelievable convulsion of the entire earth, the Eurasion continent will be rent and torn asunder by forces beyond man's comprehension. The lousing ZARG will also activate a totally new scale of reality, ripping to shreds this particular three-dimensional spatial frame, its associated stable time changes, and the physical laws based on that stable reality.

The rousing of ZARG will initiate and accomplish thedirect linkage of the conscious minds of humans into a single giant superconscious mind — extending into billions of dimensions. Spacetime and reality will have gone insane during the developing paroxysm; with the simple initial extension into just the fourth and fifth dimensions, humanity will suddenly discover that its entire world history from beginning to end will come into simultaneous being (fourth dimensionality), and then all possible such world histories will come into being (fifth dimensionality). Literally, dumbstruck humans will pray for death and not find it, the grave will "give up its dead," and the ceaseless flow of time will suddenly cease. And again Ihc "beast will be defeated and cast into darkness"; with all-linkage and all-unity, there will be no longer be any humanity of one person for another or of one group for unother, for there will be no other. In such manner, evil will end; there being no separation between the doer and the done to. Man will have become a true God — in a strange and bizarre way constituting the second coming of God.

So the Soviets are on a course to evoke the full carnage of something very like the Book of Revelation. John, looking across two thousand years of history into the future, and seeing the awful cataclysm that was to come, described it as best he could in the concepts available to his day and in the belief structure in which he functioned. Thus he described Armageddon and the end of time, and wrote the Book of Revelation.

Indeed it could have been accomplished without Armageddon, if humans had been wiser. Each photon and each electrical signal that wends its way across the earth's surface and through planetary space carries a psychotronic modulation of ZARG's mindstuff. And in the communications explosion we have experienced, we have been steadily lacing together the population centers of the earth with electrical energy and electromagnetic signals. And so over those crude "pre-nerves," the psychotronic connections of ZARG have been intensifying, and the Giant has slowly been being stirred from his sleep. The kundalini of the entire human race has

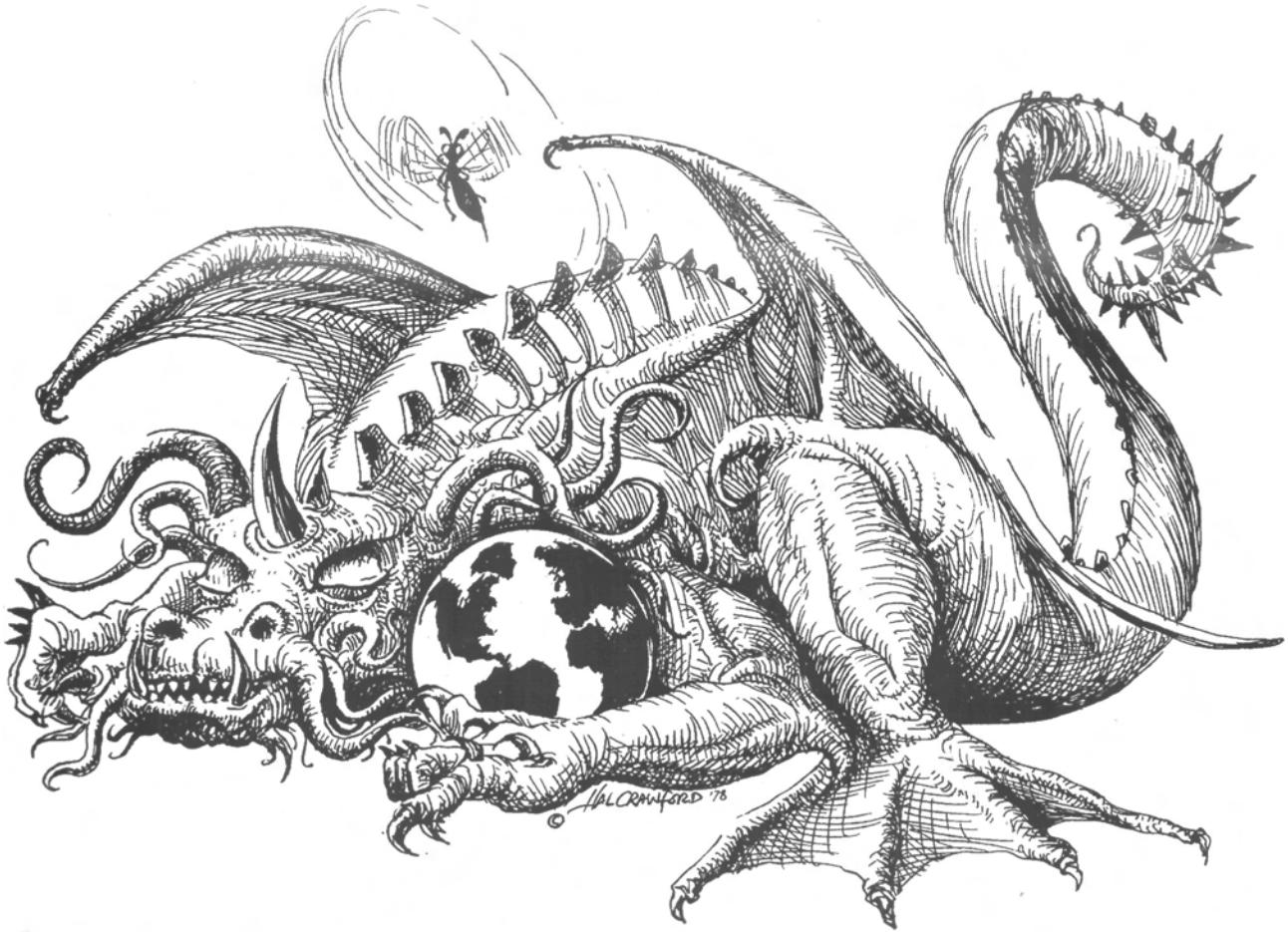

Fig. 40. ZARG

slowly been rising, and paranormal phenomena have been increasing, as have changes in reality such as the kindling of new fundamental particles. Even the sun has responded, suddenly decreasing its temperature. If we had applied psychotronics to develop a mind linkage mechanism, there would have been no need for Armageddon's destruction.

Let us hope we fare better than the Atlanteans. One may speculate that an Atlantis of sorts did exist, and that the Atlanteans built psychotronic devices out of crystals, bronze, gold, silver, and wire and unleashed them on each other in war. This sting stirred ZARG mightily, and in a resulting frenzy it simply destroyed the continent, stirring floods, storms, earthquakes and volcanoes worldwide. In the case of the Atlanteans, only a relatively small portion of humanity was involved; the percentage of persons and minds involved was apparently insufficient to cause full wakening of ZARG and linkage of the species. In the present case, the greater part of mankind is involved, and so the wakening is to be far more complete (as well as more violent). ZARG should be shocked into full wakefulness, and linkage should occur.

If so, a new great superbeing will have emerged; nonphysical, almost infinitely dimensional, and godlike. It will not exist in a single time or a single world, but in a nowness and allness that defies timelike or spacelike description.

"For we know in part, and we prophesy in part.

But when that which is perfect is come, then that which is in part shall be done away.

When I was a child, I spake as a child, I understood as a child, I thought as a child; but when I became a man, I put away childish things.

For now we see through a glass, darkly; but then face to face: now I know in part; but then shall I know even as also I am known."

I Corinthians XIII, 9-12.

So the pieces of the puzzle are now fitted together. The present state of the human species is not its final development, and indeed a great change in that state is imminent. Man literally is and shall be a god, one with God, just as the prophets have foretold. And if we retranslate that ancient foretelling into more modern concepts, we see just how strange and transcendent is the final birth or becoming.

The UFO and tulpoidal phenomena have merely been the signs in the sky and in the earth, telling us what is to come, precognitive indicators from ZARG. Had we developed a metapsychology of the entire species, we would already have clearly understood the messages.

VIRTUAL STATES AND HYPERSPACES

In physics today there are two separate kinds of reality: observable changes, which can be detected by instruments; and virtual changes, which cannot be detected by instruments, even in theory. The difference between these two realities depends simply on the size of the piece of action (energy x time, or momentum x length) making up the particular entity or change. Usually the absolute minimum observable change is taken to be $h/4\pi$. Changes smaller than this are said to be "virtual" and undetectable, and changes larger than this are said to be "observable" and detectable. Virtual changes are not bound by the conservation of energy law and almost always violate it. Nor are virtual changes, bound by the conservation of mass law. And virtual photons can have nonzero mass.

For any instrumental condition in a detector, one may consider a certain momentum and a certain length to be involved in the mass change that spatially constitutes the detection. Let us call this critical length dL and examine its ramifications (Figure 1) for the finest possible detector—one that detects a single quantum change. Figure 1 shows two frames, the lab frame S and a moving (hyperspatially rotated) frame. We choose a moving object, M, in the moving (rotated) frame, with length as shown. Note that all these entities are to be represented as detected or seen by our physical detector (instrumentation system) in the laboratory frame.

As the velocity of M approaches c, the speed of light in a vacuum, M's hyperspatial rotation angle α approaches $\pi/2$. However, before the velocity of M actually reaches c—and before α reaches $\pi/2$—the dimensional length projection of object M in frame S will contract to reach dL and fall below it. At that moment, L becomes *virtual* with respect to the detector and hence undetectable. Since geometrically an absence of length in a continuous frame S would correspond to a α rotation angle of $\pi/2$, in quantized frame S we consider that angle α "jumps" to $\pi/2$ just immediately past the critical angle α_c, which is defined as the angle of rotation at which L cos α = A L. Rotation just past the critical angle corresponds to a Lorentz-Fitzgerald contraction into the virtual state below the quantum threshold of the detector's observable universe. To an S observer or detector, object M at that point has lost its length in the direction of motion, becoming a wave front moving at the velocity of light and thus photonic (comprised of photons). To a quantum observer in S, mass turns into photons just short of a full $\pi/2$ orthorotation, which means the process can happen with a finite amount of energy. This "jump" effect is not taken into account in the continuum Lorentz transformations of special relativity at present, and this is the missing link that has prevented a successful union of relativity and quantum mechanics. In other words, the final part of the orthorotation (acceleration to the speed of light) occurs in the virtual state—specifically, that part of the rotation lying between $\pi/2$ and α_c.

Further, we may now proceed to rotate object M past $\pi/2$, which constitutes rotation from zero in frame S'. Just before reaching an S angle of π (that is an S' angle of $\pi/2$), in frame S' another disappearance below a virtual length threshold dL' will occur in corresponding fashion. Note that this second threshold dL' also has an exceedingly small but finite projection into frame S, in

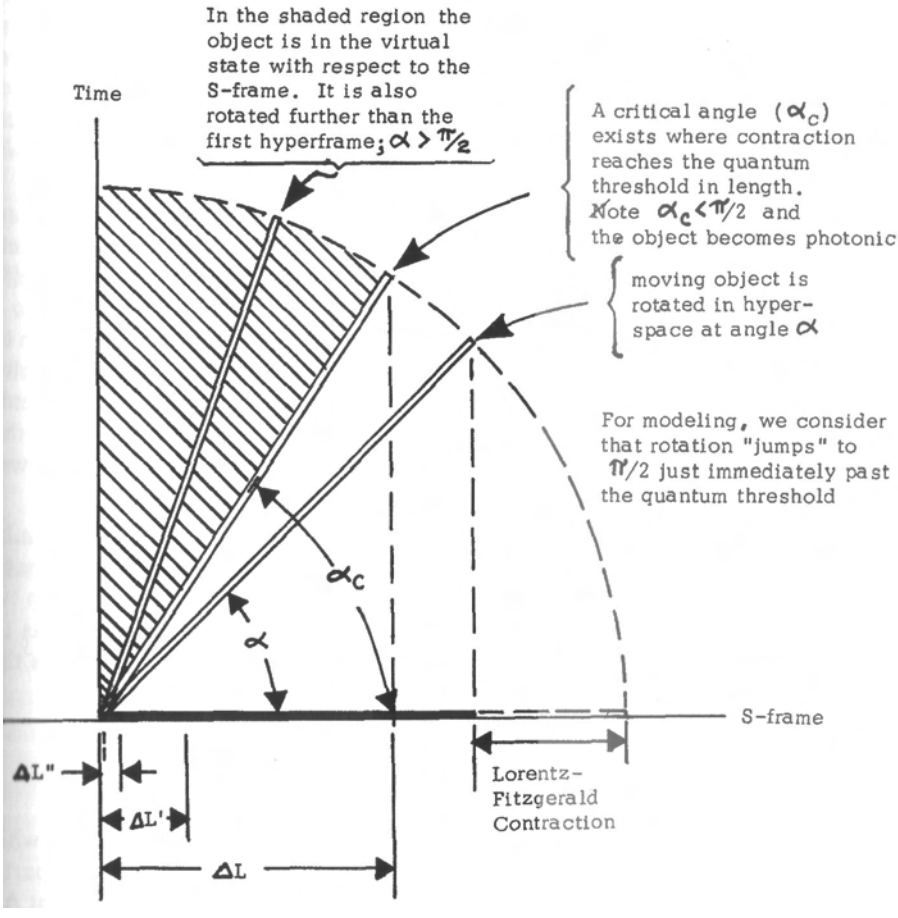

Figure 1. Hyperspaces, nested virtual states, and rotated frames

the virtual state lying inside dL. This second "relativistic quantum jump" in frame S' therefore constitutes a sort of second-level, nested subquantum threshold in frame S.

Continued rotation into hyperspace passes through successively finer, nested virtual sublevels or subthresholds in S by the successive breaching of deeper subthresholds due to continued Lorentz-Fitzgerald contraction. Higher hyperspatial frames constitute nested sublevels in the virtual state with respect to the laboratory observer. Thus a direct connection exists between virtual levels and hyperspace frames. Hyperspaces and virtual sublevels are the same thing. Every "virtual" object in S is an "observable" object in some hyperspace. *Hyperspatial engineering and virtual state engineering are one and the same thing, and this is what psychotronics and energetics are all about.*

Finally, time may be considered a sort of box containing all observables and virtuals. Indeed, time is neither observable nor virtual; time is simply a parameter in quantum mechanics. Rigorously, time may be said not to exist. Time itself is nothing, totally nothing; therefore by the fourth law of logic it can be said to be or contain everything, the total mishmash of virtuals and observables. Since in the absolute sense there is no such thing as time, then it is my thesis that all modeling of space, mind, thing, and nonthing must be done spatially. Relativity presently attempts to use time as an existent dimension of the same kind as length; it thus allows rotation of the S-frame only in the direction of the time axis in Minkowski geometry of spacetime.

Spatial modeling requires an infinite dimensional space and an infinite number of orthogonal angles. The time axis that can be drawn in such a hyperspatial model has no meaning except with respect to a relationship existing between two or more hyperspace frames or objects. Specifically, the time axis represents the totality of all the hyperspaces and their objects, hence all the relationships that can be separated from the hyperspace.

FEYNMAN DIAGRAMS

Figure 2 shows something of the unsuspected nature of physical change, which is not nearly as simple as most of us have been led to believe. In the top part of the figure, an electron (represented by the arrow) is shown going from point A to point B a short distance away. In particle physics this diagram represents the movement of a bare particle; in other words, just a bare hunk of charged mass is considered and the fantastic number of other things happening along the way are ignored. In Figure 2b a virtual photon has been emitted and then reabsorbed by the electron between points A and B. Indeed, the charge on the electron is due to the continual emission and absorption of such virtual photons (little electromagnetic pieces of vacuum, one might say, or little pieces of nothing). So the situation with respect to virtual photons comes closer to Figure 2c: more than one virtual photon is emitted and absorbed—indeed, an infinite number of them are emitted and reabsorbed along the way from point A to point B.

But, worse yet, Figure 2d shows one of the emitted photons suddenly breaking up into a positron and an electron, which then quickly recombine back into an-

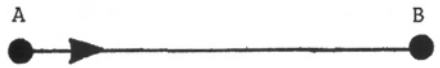

2a. Bare electron

2b. With virtual photon

2c. With nested virtual photons

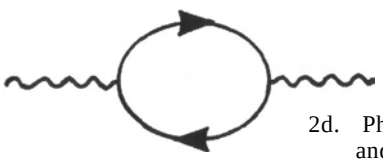

2d. Photon decay (pair production) and recombination (pair annihilation)

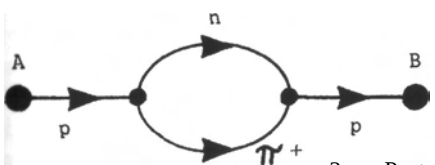

2e. Proton changing briefly to a neutron and a positive pi meson

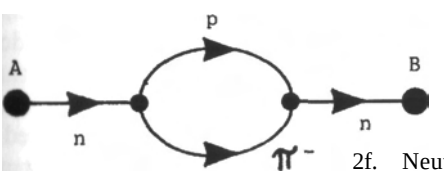

2f. Neutron changing briefly to a proton and a negative pi meson

Figure 2. Feynman **diagrams**

other photon, which is eventually reabsorbed into the electron. In fact, an infinite number of interactions happen while the "electron" is moving from point A to point B, and each of those interactions in turn consists of an infinite number of interactions, and each of those in turn consists of an infinite number of interactions, and so on. The simple movement of the electron is actually composed of a virtual cloud—an infinite number of an infinite number of an infinite number of things, all happening in a mad tangle of nested substrata in the virtual state (Figure 3)—and each of these virtuals with respect to frame S is in fact an observable in some particular hyperspace! Many other sorts of virtual particles are emitted and absorbed and born and extinguished, in addition to photons, by various observable particles and in free space. Everything in every possible world or hyperspace is related to each and every other thing in the laboratory world through orthorotations and nested virtual states. Crosstalk between hyperframes is the emergence and disappearance of virtual particles in a particular frame. The universe is holographic after all, and Mach's principle holds in a far more complete fashion than Mach himself ever dreamed. And if any part of this virtual chaos can be collected and cohered in even the slightest degree, any amount of observable free energy can be obtained, just as T. Henry Moray showed in the 1920s and 1930s.

In passing, I would like to call attention to Figure 2e, which shows one of the virtual interactions a proton can undergo in the nucleus of an atom. In this case, the proton breaks momentarily into a neutron and a positive pi meson, which then recombine into a proton. However, if the charge on the $\pi +$ particle is extinguished psychokinetically during the existence of the neutron and the pi meson, the pi meson is converted to a neutrino and radiates away. In this case the proton does not reappear and the neutron remains. This decreases the atomic number (positive charge) of the atom by one, transmuting the atom into a new element, an isomer down the chain of elements. Figure 2f shows one of the virtual interactions a neutron can undergo in the nucleus of an atom. In this case, the neutron breaks momentarily into a proton and a negative pi meson, which then recombine into a neutron. However, if the charge on the $\pi -$ particle is extinguished psychokinetically during the existence of the proton and the pi meson, the pi meson is converted to a neutrino and radiates away. In this case, the neutron does not reappear and the proton remains. This increases the atomic number of the atom by one, transmuting the atom into a new element, an isomer up the chain of elements. The two interactions shown in Figures 2e and 2f are involved in the Kervran effect, where elements are transmuted by living biological systems.

But back to our electron. If we now remove the electron, leaving empty vacuum, all the sorts of virtual madnesses we have built up in Figure 3 are still there and still occurring. In addition, every other sort of virtual madness is also there and occurring. Vacuum is infinitely dense and filled with stupendous "zero-point" vacuum energy; it is totally chaotic and virtual. Space itself is an infinite tangle of virtuals—virtual projections from real observables in associated hyperspaces—and these dynamic interactants make up any three-dimensional space and hyperspace itself! They are also what cause space itself to exhibit the finite, nonzero parameters or values that must be accounted for in our physical equations. *Every fundamental constant of nature is dynamically constructed from—and*

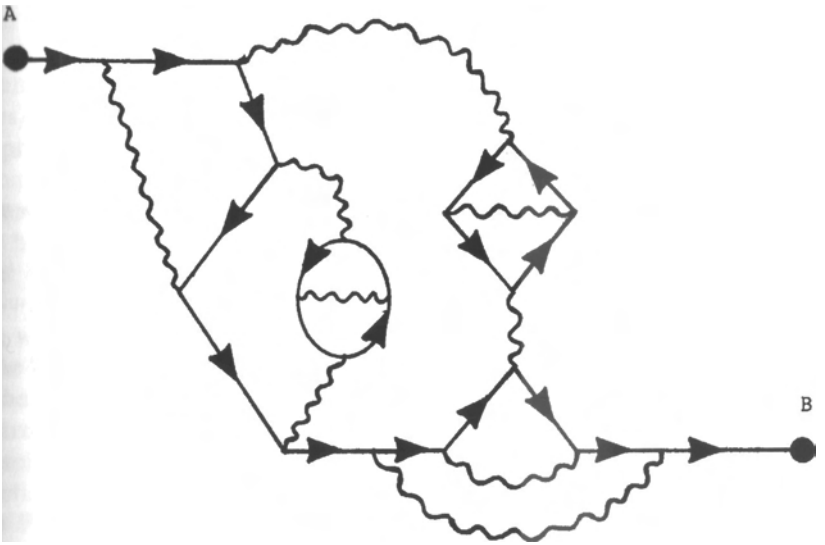

An electron moving from point A to point B is comprised of a bare particle and an infinite tangle of nested virtual particles

Figure 3. Nested virtual processes

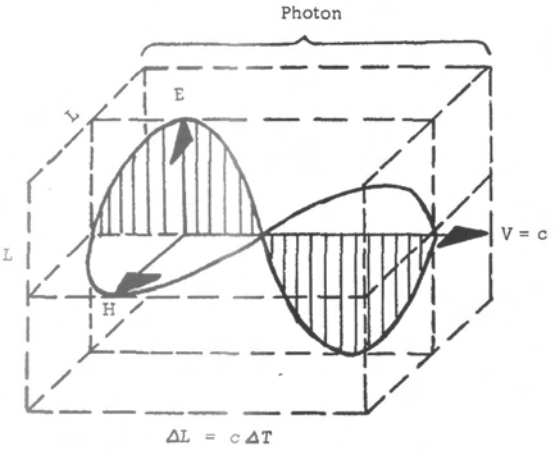

4a. A photon may be considered an individual L^2 wavefront spread in time through one *oscillatory* period of the E-field and the H-field

4b. All three vectors of an EM wave are comprised of nested tangles of virtual subvectors

Figure 4. Nature of the electromagnetic wave

due to—the zero-point, virtual vacuum interactions that constitute "empty" space. The virtual "sea" of seething waves and particles that is empty vacuum is actually an ether—a Lorentz-invariant, nonmaterial (virtual) ether, perfectly admissible by the Michelson-Morley experiment and the entire experimental basis of physics. Indeed, Einstein once proposed naming the vacuum and its contained fields the "ether," but his suggestion was not heeded.

NATURE OF AN ELECTROMAGNETIC WAVE*

We now know something quite unusual about an electromagnetic wave and about a photon. Figure 4a shows how a photon may be represented. Here we find that a photon is a single oscillation of the E-field vector and the H-field vector as shown in the diagram. Since the oscillation is with respect to time, the wave moves along the axis of velocity in the S-frame for a single wavelength, then repeats itself again and again. The E- or H-oscillation actually represents an orthogonal, rotating etheric or hyperspatial flux about the velocity vector; this spinning (exploding and imploding) flux is coming into the S-frame from outside it (from virtual states) and returning (into virtual states). It is a neutrino flux, as we shall see. In the photon, half a sine-wave cycle represents the fission action that splits the action quantum into canonical pairs, while the second half of the sine-wave cycle represents the fusion of the canonical fragments back into an action quantum. One half-cycle thus represents a positive time operation or creation, while the other half-cycle represents a negative time (fusion) operation. If the complete sine-wave cycle has sufficient amplitude (energy), it can sometimes be broken in half, with the positive time portion revealing the negative field (negative charge) of the E-vector, while the negative time portion reveals a positive field or charge of the E-vector. This is pair production, the creation of an electron and a positron. Each of these fragments has spin one half, while the photon quantum has spin one. Since the positron is a fusion interaction existent, it is an "electron traveling backward in time," just as predicted by Dirac.

In Figure 4b I show that both the E-field vector and the H-field vector are composed of an infinite number of virtual vectors, each of which is composed of an infinite number of even smaller virtual vectors, and so on. This follows from the fact that during any time interval—including the period of a single oscillation of a photon—a photon may be considered to consist of an infinite number of virtual happenings, each consisting of an infinite number of subhappenings, and so on. The photon itself may then be considered to have a direct, nested virtual substructure, and this substructure is directly hyperspatial in nature as well. This structure has not been considered in Maxwell's field equations, which have been

***Actually the electromagnetic field is not the most fundamental field, but is something that is torn out of, or separated from, a more fundamental field: the vector potential, or A-field, well-known in particle physics but usually ignored in EM field theory. E.g., magnetic Held is created (and defined) by $\nabla \times A = B$. Looking at the cross product, by definition B field is the line integral about a small surface of the A-field flux through that surface. That is precisely what a single coil of wire, with an electrical current flowing through it, does and therefore creates a magnetic field inside. See the second volume of Feynman's three volumes of physics for more on the A-field. The direct use of the A-field is also psychotronic engineering.**

formed from gross macroscopic considerations of bare particles and continuous fields. Maxwell's equations (and the normal concept of an electromagnetic wave and single frequency) thus represent only gross envelopes of the actual form and structure of waves and fields. As I have already shown in the main body of this book, one can even photograph the hyperfield structure of a magnetic field using a simple bar magnet and a color TV tube. Further, we will find that this virtual structure of a photon can be altered, "modulated," or changed by simple signal modulations, among other methods. The only requirement is that we learn to regard modulations differently.

In addition, inside each half-cycle of a photon's E-vector, relatively instantaneous fluctuations and "losses" of the vector's magnitude occur. At these "E-field glitches" in the photon, it actually contains only an H-vector. In this case the photon is a neutrino momentarily—or, in other words, it will admit a neutrino through the E-field glitch. The greater the charged field (voltage potential), the greater the number of photons available, thus the greater the number of neutrino interactions within the field. A potential of about 200-300 volts per meter altitude above the earth's surface normally exists in our biosphere. Many neutrinos emitted by the sun and bombarding the earth are absorbed in or interact with this E-potential above the earth; hence underground experiments to measure the neutrino radiation from the sun have detected less neutrinos than expected.

Momentary H-field glitches exist in a similar manner and interact with or admit neutrinos in a similar fashion.

Light can thus conduct neutrinic waves containing bioenergy or eloptic energy, as T. G. Hieronymus discovered. In the first hyperframe (EM field frame), this can be seen to be simply a space charge of electrons conducting a wave disturbance through it, or a piece of ordinary conductive matter conducting an ordinary EM wave.

NEUTRINIC LONGITUDINAL POLARIZATION WAVES

In Figure 5, I assume that in some fashion the E-field of an electromagnetic wave has been stripped off, leaving a single vector in the H-field direction only, and this vector is still oscillating, as originally set up in a Hertzian wave in Figure 4. The new "single-field" wave is an etheric sort of half-wave, a longitudinally polarized wave that is not a wavefront (plane) moving through S-space but just a pulsating line segment moving through S-space. This wave is not Hertzian. It is not electromagnetic—though it will strongly interact with or even produce electromagnetic waves—but is neutrinic. The interactions of this wave with space virtuals are drastically reduced (indeed, by a factor of c), and this neutrinic wave now travels at the speed c^2 with respect to S-space. While it will highly interact with magnetic field, precisely speaking it is not a magnetic wave but a hyperfield

*C^2 is its s-frame, free-space velocity when not interacting with electromagnetic field. Normally, neutrinic wave interacts with electromagnetic field, thus moving at less than C^2 velocity in space, since it "circulates around" in electromagnetic field. Neutrinic wave can be regarded as a circulating or spiraling wave in electromagnetic field, which may well be the

wave. It will travel through and across dead shorts, through media such as seawater and earth, and acts or can act much as a neutrino. This wave has neutrinic components in S; that is, it has vector components existing in frame S". One may expect this wave normally to be active in or interacting with an electrostatic field or a magnetic field, as a special sort of lower-level virtual state flux (second-order hyperflux) into and out of the field. This is apparently the sort of wave discovered and used by Nikola Tesla, who repeatedly insisted that he was not using Hertzian (Maxwellian) waves but instead was employing a much finer wave having very different characteristics. Further, neutrinic waves will transit between any two points on earth almost instantly—in fact, about 3 x 10^8 times as fast as the speed of light propagates! With these waves, space communication with distant galaxies is practical and achievable, and scientists seeking communication with extraterrestrial civilizations would do well to use such waves.

Note that I am not referring to the ordinary longitudinally polarized electromagnetic wave, where both the E- and H-vectors still exist but the H-vector is rotated 90° so as to lie in the line of motion through S-space.* Such longitudinally polarized electromagnetic waves are already known in the literature and have been used in many patented devices, but they are not included in most textbooks on electromagnetic fields and waves for some unaccountable reason. The normal longitudinally polarized electromagnetic wave moves at the speed c, just as any other EM wave.

At any rate, neutrinic longitudinally polarized waves often arrive at a distant point many times stronger than they were when they left. T. Henry Moray, for example, built a radio and a sound detector that apparently worked by a version of neutrinic waves, condensed into electromagnetic waves in his radio-detector apparatus. Dr. Moray tested the radio scores of times between 1930 and 1933, and on several occasions even received broadcasts from Admiral Byrd's party in the Antarctic. Even when powerful, ordinary radios could receive nothing from Antarctica because of severe weather conditions, Moray's little batteryless radio brought the broadcasts in, loud and clear with no static. Further, Moray demonstrated a sound pickup device of similar construction that could pick up or zoom in on sounds five miles away. Again the sounds were loud and clear, with none of the distortion of weather conditions and background noise. (See T. Henry Moray, *The Sea of Energy in Which the Earth Floats,* 4th ed., 1960, pp. 129, 133, and 143.) Thus transmission of power without wires was possible, just as Nikola Tesla had shown. Tesla in fact patented a capacitive (E-field only) transmission system.

Indeed, according to independent research by Dr. Robert Beck, another inventor named Rogers apparently discovered just such a system and the United States

"spinning wave" of orgone energy identified by Reich. Neutrinic waves particularly interact more strongly with strong E-field and with strong B-field, the degree of interaction increasing (probably nonlinearly) with the intensity of the E or B field with which the interaction occurs. The velocity of neutrinos, measured on earth inside its strong ionosphere-to-earth E-field, should be quite reduced from the velocity of neutrinos measured in isolated deep space, and almost two-thirds of the neutrinos entering the earth system from space interact with the ionospheric-earth potential and are absorbed by it. The A-field and its derivatives directly involve the E-field, H-field, and neutrinic field and their interactions. To correctly understand the activation chemistry theory and results of LeBon, A-field theory is required. And to understand much of Tesla's work, A-field theory is required, for Tesla was aware of, and used, A-field interactions in many of his patented systems.

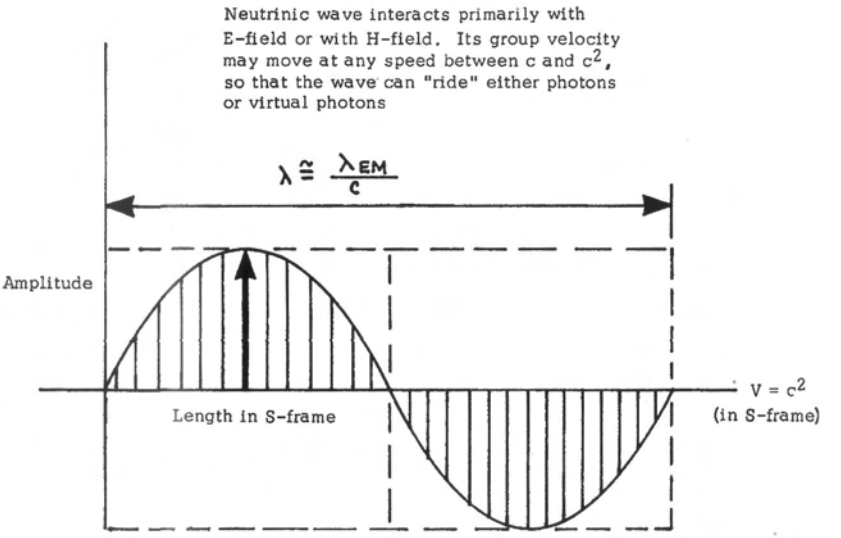

Figure 5. Neutrinic (longitudinal polarization) wave

NOTE: This is not an electromagnetic wave and is not the longitudinally polarized EM wave familiar to many physicists and engineers.

used it to communicate with its submarines underwater during World War I! For that purpose it was known as the Rogers underwater and underground wireless system, and H. Winfield Secor in 1919 reported on its use and its fantastic potential for the future, implying the necessity to completely change our ideas of electromagnetics and power transmission. (H. Winfield Secor, "The Rogers Underground Wireless," *Electrical Experimenter*, March 1919.) Mysteriously, the Rogers wireless seems to have promptly disappeared. Even more strangely, according to Dr. Beck's research the same breakthrough has been made again in the U.S. at least three times since the beginning of World War II. These rediscoveries included full delineation of the prior technologies, with mathematical theory and diagrams, that had escaped further notice. Again the technology disappeared mysteriously in all cases shortly after being rediscovered. The Soviets did not have far to look to discover the Rogers Wireless, Tesla waves, T. Henry Moray's radiant energy device, the Moray radio, the Moray sound detector, and the U.S. technical work in the area since World War II. All they really needed was to thoroughly examine the U.S. scientific and technical literature, the technical magazines and books, and so on. The Moray amplifier and the Moray sound detector were also demonstrated by Moray to a Soviet scientist, Dr. A. A. Yakovlev, in October 1929, and a Soviet agent succeeded in penetrating the Moray laboratory in 1939, obtaining drawings of the Moray tube and many photographs, and perlonally working in the laboratory for two months.

One may consider power transmission through such a wave to have traveled to every point in the future path at a speed that is faster than the flow of macroscopic time by a factor of c. Then along any electromagnetic (time) line along the same path, these waves are "ringing" back and forth continually, as the progress of normal physical change crawls slowly forward. Thus the normal time change (electromagnetic or photonic interaction world flow) acts as a collector for the ringing neutrinic energy, and this collection can act as a gain factor G, where theoretically G is given by the expression

$$1 < G < c.$$

Thus a longitudinal polarization wave, when transmitted to a distant receiver, may arrive or be detected at the receiver thousands of times stronger than the transmitted signal, even for very low coupling.

Neutrinic longitudinal polarization aspects to ordinary electromagnetic waves can also be achieved by modulation—especially by second-order, nested modulation—and such hyperspatial aspects have already been detected in the Soviet communications radiation, causing interference around the globe in the 10 to 20 megahertz range, as we shall see.

A NEW LOOK AT MODULATION

We can assume a sine-wave electromagnetic carrier frequency whose amplitude we wish to vary (modulate) as a function of time, by a lower frequency sine wave, as shown in Figure 6a.

As is well known, the classical view of amplitude modulation of a carrier wave holds it to be an oscillatory change in the amplitude of the carrier, as shown in Figure 6b. However, empirically this was found to be erroneous, since in 1929 it was shown that after such modulation the detected carrier appeared unaffected by

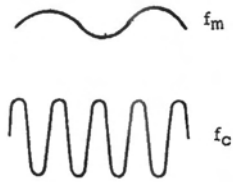

6a. A carrier f_c to be amplitude modulated by frequency f_m

6b. Original view of amplitude modulation

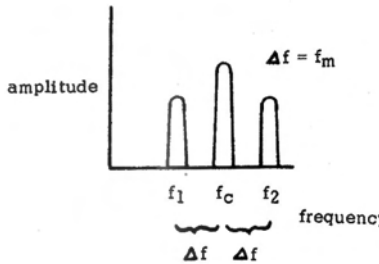

6c. Detected signal for an amplitude modulated wave

Figure 6. Amplitude modulation of a sine wave

the modulating wave; instead, there appeared two other sine-wave frequencies (sidebands), one at a frequency above the carrier frequency and one below it, as shown in Figure 6c. In each case the change in frequency from carrier to sideband was by an amount equal to the frequency of the modulating wave.

Both the original classical view and the present view are in fact correct if one considers hyperspatial aspects and linear detection aspects. As can be noted in Figure 6b, the carrier is distorted and is not a sine wave according to the original classical view. This implies that the individual photon shown in Figure 4a has been internally distorted or "bent." This, I submit, actually happens and constitutes the bending or curving of spacetime in a general relativistic fashion. However, all our instruments can detect only a pure, undistorted photonic interaction; that is, in frequency they can only detect the sine-wave aspects of a kinked photon. The reason is quite simple: for example, suppose the method of detection of the photon is by photon interaction with a bound electron. The change in the electron is a precise change of energy levels to an excited level, and it only detects or interacts with a single sine-wave photon. The frequency (say, the carrier) component of the photon, which contains the correct energy differential (according to $E=hf$, where h is Planck's constant and f is the sine-wave frequency), will interact with the electron. The other sine-wave components of the initially kinked photon will thus be stripped off (demodulated) by the absorption of the carrier portion of the photon. The photon kink existed in both positive time and negative time; from a frequency viewpoint, the modulating amplitude frequency that was added to the basic carrier frequency in positive time was subtracted in negative time. Thus demodulating the kink from the amplitude modulated photon (by absorbing the sine-wave carrier) results in the production or liberation of two sine-wave frequencies, one above the carrier frequency and one below the carrier frequency, each difference being equal to the original amplitude modulation's frequency. These two frequencies will then interact and be detected.

So our linear instruments do not detect single kinked photons in a stream of distorted photons, but they detect a combination of undistorted photon streams (waves) at different frequencies.

Such considerations as these should have appeared in electromagnetics long ago. After all, we presently regard an EM wave as a wiggle of nothingness, existing in time. This is precisely the same as saying that a photon is an oscillation (wiggling) of spacetime itself. Specifically, it oscillates in two directions spatially, one being the E-field direction and the other being the H-field direction. But since an EM wave itself constitutes a regular bending and flexing and curving of spacetime, including both space and time, then the flexing spacetime inside the photon can itself be further bent or twisted, and that constitutes a kinked or curved photon—a *modulated* photon. Our linear laboratory space instruments, however, will demodulate such a kinked photon into its linear components, giving a combinationof unkinked photons in the detection. And for the amplitude modulated carrier shown in Figure 6b, we actually detect the carrier and two sidebands shown in Figure 6c.

Similar complex mixes of waves at different frequencies result for other types of modulation, but this will suffice for our purposes here. Specifically, we should mention that an infinite number of sidebands may be produced, but normally all

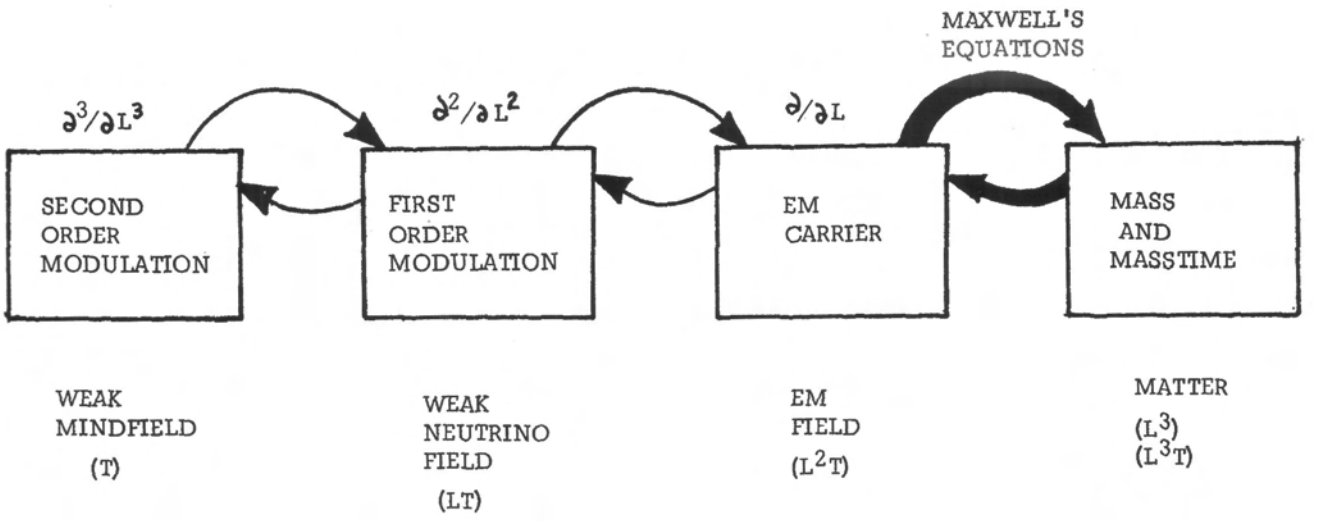

Figure 7. Nested modulations: key to hyperspace

but a few are so weak as to be negligible for ordinary communication purposes, where no hyperspatial information is needed. For living systems, however, a great number of these extra sidebands must be taken into account, for the hyperspatial-virtual state components carry the lifestream, consciousness-loop-interaction Information itself. We will look at some of the biological aspects shortly.

At any rate, modulation of a wave results in direct changes in the virtual structure of the formerly unmodulated photon, relativistically warping or curving it. Just as Fourier (harmonic) analysis breaks down a very complex nonsinusoidal wave shape into an infinite series of component sine-wave frequencies of various amplitudes, so linear detection in a linear laboratory frame breaks down a stream (wave) of complex nonsinusoidal photons into a series of sinusoidal waves in a complex mixture.

And if we now think of this in reverse, we see that a mixture of waves and frequencies must automatically possess, carry, or represent hyperspatial-virtual patterns in the correct nonlinear medium that absorbs them.

HYPERSPATIAL ASPECTS OF MODULATION

Let us now look at the hyperspatial aspects of modulations and complex electromagnetic waves, particularly mixtures of waves, in yet another fashion.

First, as is well known, we may represent a wave as a sine function (or cosine function if preferred). When we modulate a wave, we impress a time change on it. In the most general mathematical sense, a modulation to a wave is the impressing of a derivative function upon the wave. And if we think of the basic carrier wave as being prescribed by Maxwell's equations in derivative form, then in a sense when we modulate the wave we differentiate it, that is, we impress a differential operator function on it. But this means that we raise the order of the differential aquations prescribing the situation, which mathematically means we have increased the dimensionality or spatiality of the, wave entity that is the resulting modulated carrier. In other words, to modulate an electromagnetic carrier wave is to add a hyperdimensional aspect—specifically, neutrinic vector aspects or mind aspects. The whole affair can be thought of as merely shifting or altering the particular distribution of nested virtuals transported by the basic carrier wave.

If we differentiate a sine wave, we simply get a cosine wave, which is just another sine wave pi/2 out of phase with the first. So now it emerges that when we form a mixture of waves, we are adding virtual aspects (and hyperspatial aspects) in so doing, because of the phase differences. This is extremely important: *complex mixtures of waves automatically constitute and carry hyperspatial components!* And if we can accurately control these hyperspatial components, we are in effect doing direct hyperspatial engineering and virtual state engineering.

Now if we carry our modulation-constitutes-differentiation concept one step further, we find a most startling phenomenon (Figure 7). The first-order modulation we placed on an EM carrier we discovered to carry aspects of the next hyperspace, namely, neutrinic vectors. Now if we further modulate that first-order modulation signal as a carrier itself, so that we now have two orders of modulation upon the basic carrier, the second-order modulation must possess hyper-

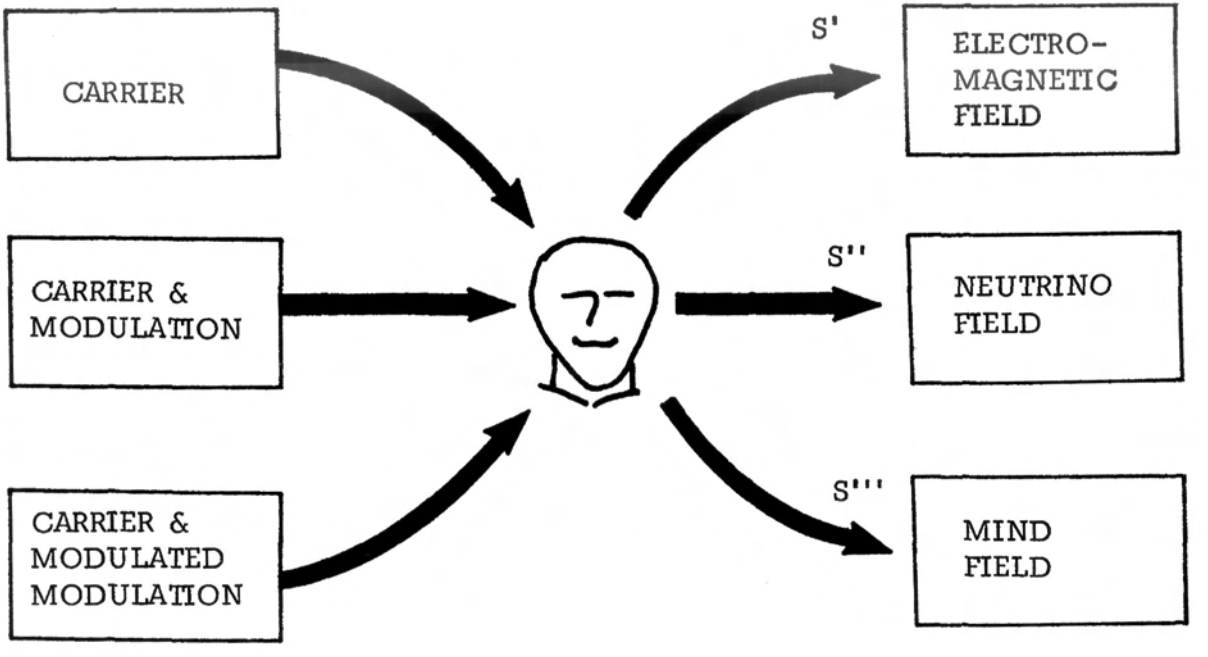

Figure 8. Field coupling to the human brain

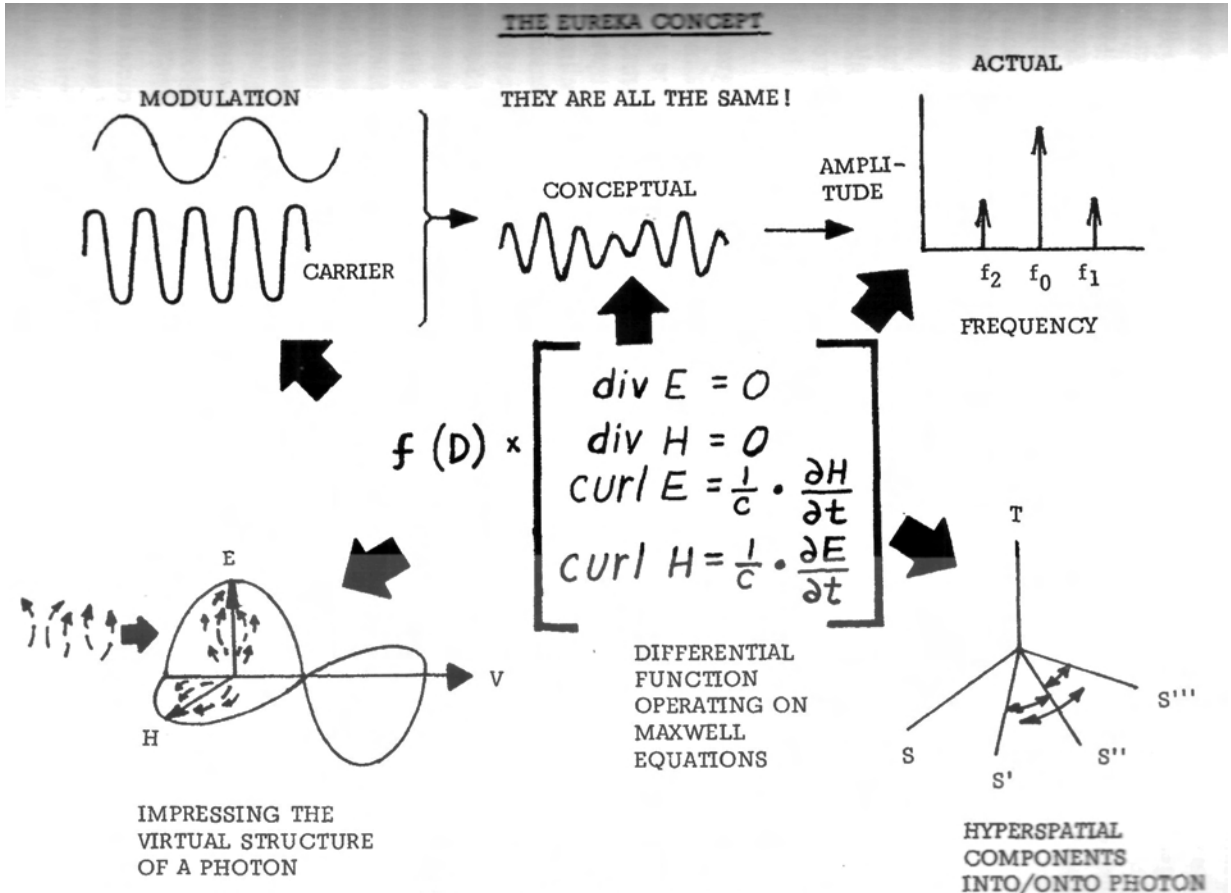

Figure 9. The Eureka concept

vectors of the next higher hyperspace—the mindfield itself. In other words, by using two orders of modulation on a carrier, we can directly affect mindstuff itself. So if the correct overall pattern of these complex modulations are impressed on a carrier, the life-consciousness loop itself can be directly affected or shaped, all the way from the mindfield of a biological organism to its neutrino field to its virtual photon field to its biophoton field to its body tuner, and back. With the correct pattern we can stimulate the life channel for a particular organism, and with yet another pattern we can inhibit the life channel for the same organism. By this means a positive cure for cancer could easily be derived, and as we shall see, this already has been done. By the same means, a "death ray" for use against humans could easily be developed, and it is my contention that the Soviets have already long since developed such weapons.

It is my purpose to eventually use these new aspects to construct a direct mind-link for mind-to-mind communication and hyperlinkage, thus solving the human problem.

Figure 8 shows the basic scheme for coupling such a second-order modulated signal to a human being. We will return to modulations versus nested virtuals and hyperspatials below.

THE EUREKA CONCEPT

So we have now reached a Eureka point of the first magnitude (Figure 9). Hyperspatial engineering, virtual state engineering, curved space, photon kinking, mind-life-consciousness engineering, and nested modulation are all the same thing! We directly engineer the virtual state, hyperspace, curved spacetime, and the life-consciousness loop itself, including the mind, with relatively simple devices that accomplish, transmit, and receive nested orders of modulations. Indeed we have opened Pandora's box, for this is the greatest tool ever dreamed of by humankind. Consequently it can be used either for the good of mankind or for its detriment. And this tool appears already to have been weaponized by the Soviets,

In Figure 9, note that modulation, photon kinking, the appearance of sidebands with the unchanged carrier, impressing a virtual pattern upon a photon, and impressing hyperspatial components into or onto a photon are equivalent. Further, if we assume that the electromagnetic wave (pure, undistorted wave in a linear medium) is given by Maxwell's equations, then modulation mathematically consists of impressing a particular differential operator function and a nonlinearity upon Maxwell's equations. For each modulation pattern, a particular virtual structure is impressed on the photon, which is the same as impressing a particular hyperspatial pattern upon it. Each specific pattern impressed on the photon (that is each particular kink pattern of the photon) corresponds to a specific differential operator function. Through this means, a specific theory can be constructed empirically. That is, one can work out the effects of various mixtures of waves on specific biological systems, measure the specific channels used by the mind-life-consciousness loop, and so on. The Lisitsyn paper and Kazhinskiy's "biological radio" work in fact state that the Soviets have already done precisely this, and the Kaznacheyev paper shows that a large number of related biophoton experiments were in fact carried out in Soviet military laboratories. But let us look at some very important and exciting German work directly related to this area.

BIOPHOTONS AND VIRTUAL EM FIELD OF A BIO-ORGANISM

In an incredible piece of work, "Photon Storage in Biological Systems," in *Electromagnetic Bio-Information,* Urban and Schwarzenberg, Baltimore, Md., 1979, pp. 123-149, Dr. Fritz Albert Popp has presented the results of his laboratory work—and his theory—dealing with quite new developments in biological organism fields. Indeed, this may be one of the most important Western papers ever presented, if its true import is noticed. Briefly, in studying cellular electromagnetic bioactivity, the cell behaves as a system far from thermal equilibrium. It thus can be characterized as a Prigogine system. (Ilya Prigogine received the Nobel Prize in 1977 for his development of nonlinear thermodynamics of systems far from equilibrium, thereby changing the second law of thermodynamics.) We now know that in such a system negative entropy can result, and order can emerge from disorder. For a wildly disordered system, large-scale order can emerge and stabilize, and the more chaotic the disorder, the greater the stability of the ordered patterns that emerge. (Which seems to imply a confirmation of my fourth law of logic—total disorder must inevitably turn into total order.)

At any rate, living cells produce coherent light with a laserlike activity. This coherence serves as a control for the metabolism of the cells, regulates growth, and fixes the reproduction rate. Further, the cell exhibits superconductive behavior.

Popp found that a living organism in fact possesses a living aura, a virtual electromagnetic field that pervades the entire organism with a virtual photonic flux. In this field, virtual photons are stored. The field continually receives inputs (virtuals) from the environment and is continually outputting biophotons, particularly in the near ultraviolet. This field, in which all cells are bathed and with which they all continually intercommunicate, tends to stabilize and cohere the organism. All this has been established by laboratory experiments, and all of it is directly consistent with my own hyperfields and nested-virtual-fields model of the living system's life-consciousness loop connecting its mind hyperworld to its physical body tuner. My model is consistent with Popp's work and extends it by adding the nested structures of the virtual field, thus connecting Popp's virtual field to the neutrino field and the mindfield.

And with this additional information in mind, let us return to our consideration of nested modulations on an electromagnetic carrier. Indeed, let us look at several examples of devices already applying the "nested modulation is hyperspace vectoral" effect.

THE PRIORE MACHINE

The cure for cancer mentioned above is the Priore device in France, which has been curing cancer and other diseases for over a decade, much to the frustration of many members of the French Academy of Sciences.

Antoine Prior6 is an Italian-born inventor who escaped from the Germans in World War II and fled to France. After the war Priore" purchased surplus equipment and eventually developed a strange machine that filled an entire room. A nozzle above a table in the center of the room emitted a strong ray or field, which Priore* explained consisted of an electromagnetic wave in a magnetic field. Eventually the French government spent almost three million dollars for construction of a new, improved PriorS machine, because Priori had shown he could cure cancers in laboratory animals with the device.

In 1964 Professor Robert Courrier, renowned biologist and secre'taire-perpe'tuel of the French Academy of Sciences, presented some of Priore's results to the Academy. Forty-eight cancerous rats had been divided into two groups of twenty-four each. One group was set aside without treatment as a control, and the other group was divided into two subgroups of twelve each. One of these subgroups was treated by the Priore machine promptly after cancer grafts, and the other was treated after a lapse of several days. Both subgroups were completely cured—the first quickly and the second after more prolonged treatment. All the control rats died in twenty-two to thirty days after grafting.

The results created a furore and a controversy that have continued to the present day. Since the first presentation by Courrier, the machine has repeatedly cured leukemia and other forms of cancer in laboratory animals. The controversy seems to have arisen because the French Academicians could not comprehend the working of the machine, and because the inventor would not reveal how it worked but only how it was built.

The second, more powerful Prior6 machine produces a magnetic field of about 1,240 gauss. According to one scientist, the machine contains a gas-filled vacuum tube, which contains a plasma of mercury and neon gas. A pulsed 9.4 gigahertz electromagnetic wave is modulated onto a 17 megahertz wave in this plasma. However, the true nature of the machine is revealed by the fact that the 9.4 gigahertz wave is joined in the "lamp" by seventeen radiations of unspecified frequency and nature. Thus we see that Priori is actually using second-order multiple modulations and is dealing with the direct life-mind-consciousness loop of the mammalian cell. He is directly stimulating and engineering the hyperspace nested virtual bands with his device. His twenty-six years of work have mostly been involved with ferreting out the required precise frequencies and mix of second-order modulations, as well as the correct intermodulation carrier necessary to obtain the desired effects.

In Figure 10 we show a simplified diagram of the Priore device, from which it can immediately be seen that the device uses the same principles shown previously in Figure 9. PriorS is using nested orders of modulations to affect nested orders of virtual state, thus producing direct channels and effects in neutrinic field and in mindfield. Radiating a biological target such as a laboratory animal with such a complex field directly engineers its mind-life-consciousness loop. With the correct nested modulations on the correct carrier (in this case a strong magnetic field, which allows a stronger connection to the neutrinic field aspects), the mind-life-consciousness loops of the individual cells in the body of the irradiated animal arc "scrubbed clean" of any deviation from the norm by the virtual patterns delivered to the animal, and hence to its "virtual biophoton stabilization field" reported by

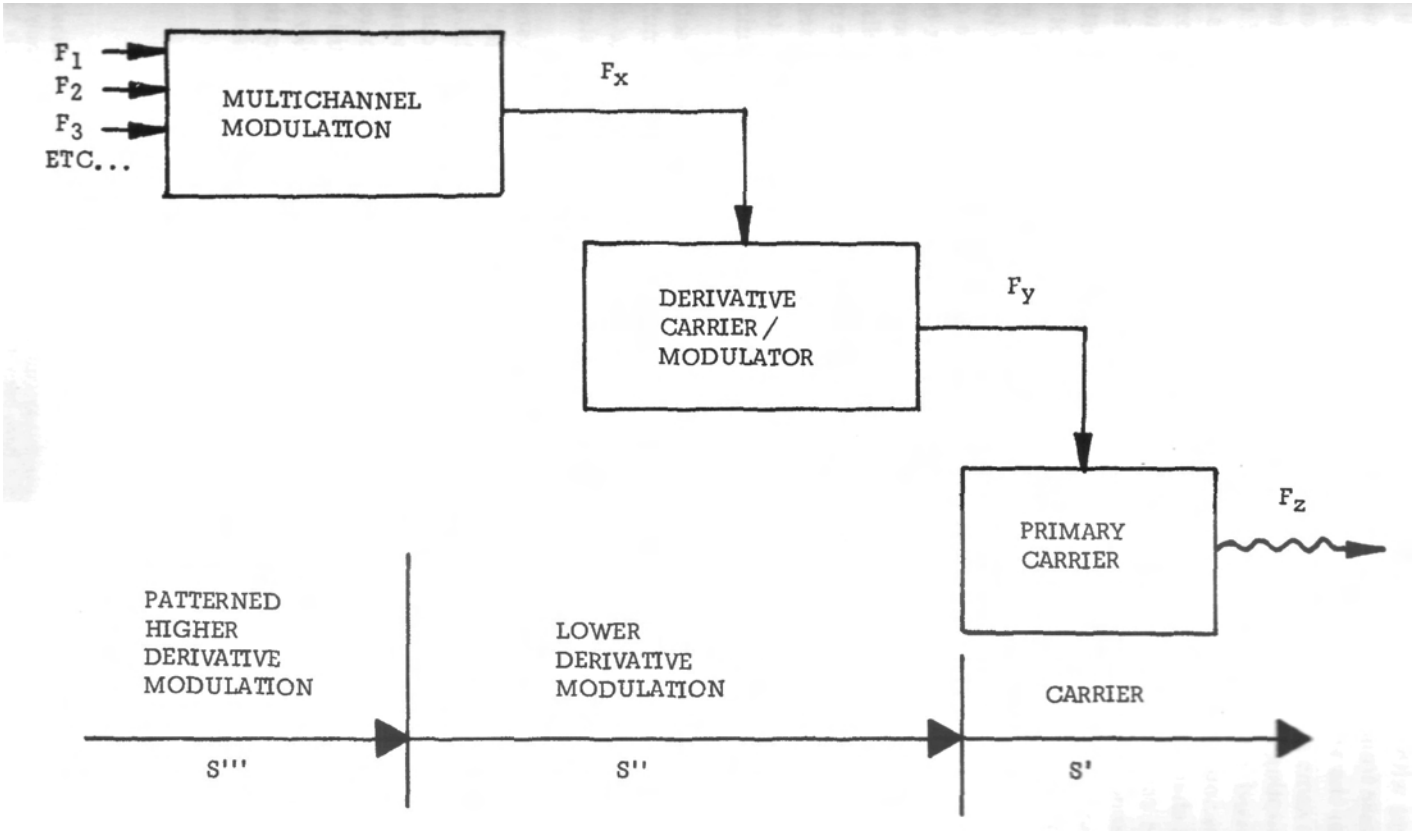

Figure 10. A simplified diagram of the Priori device

Popp. In other words, the Priore device produces a reverse sort of effect as compared with the Soviet work reported by Kaznacheyev on anomalous death and disease transmission between cell cultures by near ultraviolet biophotons emitted from the virtual Popp field of the dying cells of the stressed, attacked cultures. The same sort of virtual engineering that can transmit death of the organism (by disrupting its mind-life-consciousness loop tuning) can also transmit life into a stressed attacked grouping of cells by a sort of "forced resonance" of their consciousness loops into normal health patterns. (Virtual state interactions control charges, which control chemistry. Thus the entire chemistry of the absorbing cells can be controlled and engineered.) Also, the Lisitsyn paper refers to the presence of eleven independent channels in the brainwaves (namely, in the mind-life-consciousness connection to the waves of dendrite firings that constitute brainwaves*), and these were specifically referred to clipped signals, not sine waves. (The clipped signals would be those possessing complex nested modulations, and thus representing the tuning effects of the life-consciousness loop.) The Priore machine uses seventeen higher-order modulations, which are quite sufficient to cover all eleven life channels required, with an additional six being available for tuning so as to squelch or "jam" the life-consciousness loops of those cells with tuning abnormalities, that is, of diseased or cancerous cells.

As we would expect, the Priore machine has also shown its ability to cure other infectious diseases and materially benefit victims of cardiovascular diseases. Infectious diseases cured by Priori radiation also provide an immunity to the treated host organism that has been shown to be transferrable by transfusion of blood samples.

Again I strongly emphasize that the individual biological effects of solitary magnetic fields or single frequency waves cannot be extrapolated to the multiple frequency, nested modulation case; and almost all our present knowledge of the effects of electric, magnetic, and electromagnetic fields on biological systems is woefully immature and incomplete.

T. Henry Moray built a somewhat similar machine—though very much smaller—which provided a direct radiation from extensive "peach blossom violet" colored sparkgaps inside a quartz tube, and which greatly stimulated the health of an individual exposed to the radiation. In fact, the device would promptly cure the radiation burns Moray frequently suffered as a result of his continual experimentation with uranium compounds and other radioactive substances. He patented the device, and some of his original machines are still in existence and still being used to treat patients with a wide variety of ailments. I have personally been exposed to one of Moray's treatment machines and can vouch for the fact that it stimulates every cell in one's body, providing in about two to three minutes a great tonic and health stimulant.

***It is these dendrite firings which form the collector-detector mechanisms through which the mind-world changes are joined to the human nervous system and brain. Were they not specifically useful and needed, the dendrite firings would not have been developed, and nerves would simply be long wires.**

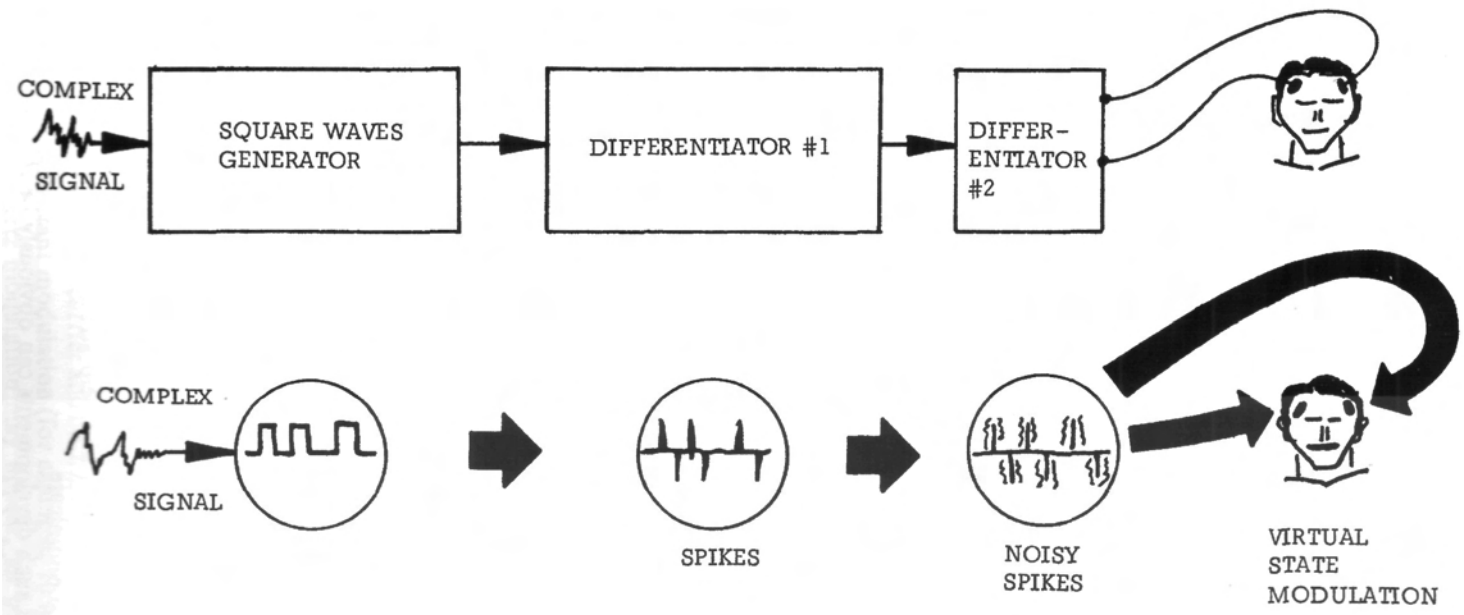

Figure 11. A simplified diagram of the improved Flanagan neurophone

THE NEUROPHONE

Another device that uses the new hyperspatial, virtual state, nested modulation technology (and has done so for seventeen or eighteen years) is Dr. Pat Flanagan's neurophone. With brilliant insight and intuition far beyond that of science at the time, Pat invented and patented the instrument by the time he was seventeen years old. The neurophone is a device that, contrary to all present theory and knowledge, will directly "pump the brain" and reproduce sound and information directly in the brain and mind system, without going through the auditory system at all. A simplified diagram of Pat's improved neurophone is shown in Figure 11.

Briefly, the device takes a complex signal, such as the sound of an orchestra playing a musical interlude, and electrically processes it as shown in the figure. First the signal is passed into a section that clips everything into a series of square waves, remarkably analogous to the sort of clipped waves Lisitsyn confirms are the information carriers of the human brain. Next the square waves are differentiated, yielding a series of sharp spikes (note that these spikes retain the pulse-time content of the clipped signal). These spikes are again differentiated, and since these are finite spikes with real nonzero rise times and decay times rather than theoretical constructs, a series of noisy spikes results from the second differentiator section. From here, the noisy spikes are introduced to special contact electrodes, one of which is normally placed on the forehead, while the other may be placed almost anywhere, including on the foot. Nowhere are any sound waves introduced to the head.

The square-wave clipper section reduces the complex signals, their overtones, and their complex modulations to square waves, retaining the temporal content of the wave mix but not the waves themselves. The first and second differentiators heighten or filter through the temporal content of the higher-order differentiations, that is, they serve as a band pass filteT unit to accent the time keying of the neutrinic and mindfield portions or aspects of the signal. When these time spikes are then introduced across the body as pulsed voltages, they are modulated directly on the dendrite firings of the brain and nervous system, providing direct and pulsed modulation of the neutrinic and mindfield component channels of the mind-brain-consciousness-life loop itself. Thus the neurophone directly inputs information into the brain and nervous system, bypassing all the normal sensory systems that lie between the mind-brain loop and the outside environment.

Indeed, a similar development has been reported by two University of Missouri researchers. Dr. Donald York, a neurophysiologist, and Dr. Thomas Jensen, a speech pathologist, have recently reported identifying and decoding twenty-seven words and syllables in specific brain wave patterns and correlating these electroencephalographic patterns with both the spoken word and the silently thought word in about forty subjects. At present, Dr. York and Dr. Jensen are programming a computer with a brain wave vocabulary, to monitor and read the EEG of a stroke victim's brain and help stroke victims who have lost their powers of speech to communicate.

While all such developments can obviously be misused, their potential for assistance to mankind is enormous. Indeed, my own premis that brain linkage it

possible and can be used to advance all mankind to the sixth stage of species evolution is slowly being proven. It is within our reach now to develop u multi-channel communications system that will directly link brains, minds, and consciousness into a single functional being; and I have already pointed out that the psychokinetic power of the emergent entity increases exponentially with the number of linked stages. The normal corpus callosum linkage of the two cerebral halves in each human head proves that brains, minds, and beings can be linked and integrated into one.

The Excalibur Briefing details the basic concepts of the theory involved in hyperspace-virtual state engineering, and thus in the engineering of mind-life-consciousness links to multicellular organisms here on earth. Pat Flanagan's neurophone proves that complex information can be implanted directly in the brain and mind, bypassing the normal isolating barriers. Drs. York and Jensen have shown that the brain wave does indeed contain recognizable, decodable information analogues. Lisitsyn has already reported measuring the number of independent channels involved and has documented the importance of the clipped brain waves as opposed to the sine-wave content. If we have the vision, we can still develop a brainlink and rapidly apply it to link sixty to one hundred persons, thereby opening a conscious, multidimensional "eye" for the collective human unconsciousness, gently rousing ZARG into wakefulness, and fulfilling human destiny without undergoing the psychotronic Armageddon planned by the Soviets. The time is short, but it can still be done if the funding, the vision, and the team can be established on a crash priority basis.

SOVIET "WOODPECKER" SIGNALS

But, as I have said, all this can be used for the detriment of mankind as well as for its benefit. Unfortunately, it appears that the Soviet Union has chosen to weaponize the effects on a global scale. A prime example is the "woodpecker" lignals emanating from the USSR in the 5-30 megahertz region and interfering with communications around the earth.

These complex woodpecker signals appear to originate from two or three dozen powerful Soviet transmitters, each with a power estimated as high as 40 megawutts (Figure 12). The pioneering experimental measurements of these signals by Dr. Robert Beck and William Bisehaveshown just how deadly a potential may be possessed by the signals. These measurements have been performed in Eugene and Portland, Oregon; Los Angeles, California; Huntsville, Alabama; and several other locations. They have been particularly significant on the West Coast in and around Eugene, Oregon because of the presence of a direct current transmission line several hundred miles long, which has acted as a long wire antenna, picking up the signals and rebroadcasting them with appreciable gain in the vicinity.

Typically the signals may be found on, say, sixteen different carriers between 10 and 20 megahertz. Twelve of the carriers may appear normal, with normal sidebands, and the other four may have the carrier and both sidebands suppressed but still show the biologically significant modulation (for example, 10 hertz). On all sixteen channels a strong 10 hertz modulation may appear, all perfectly time

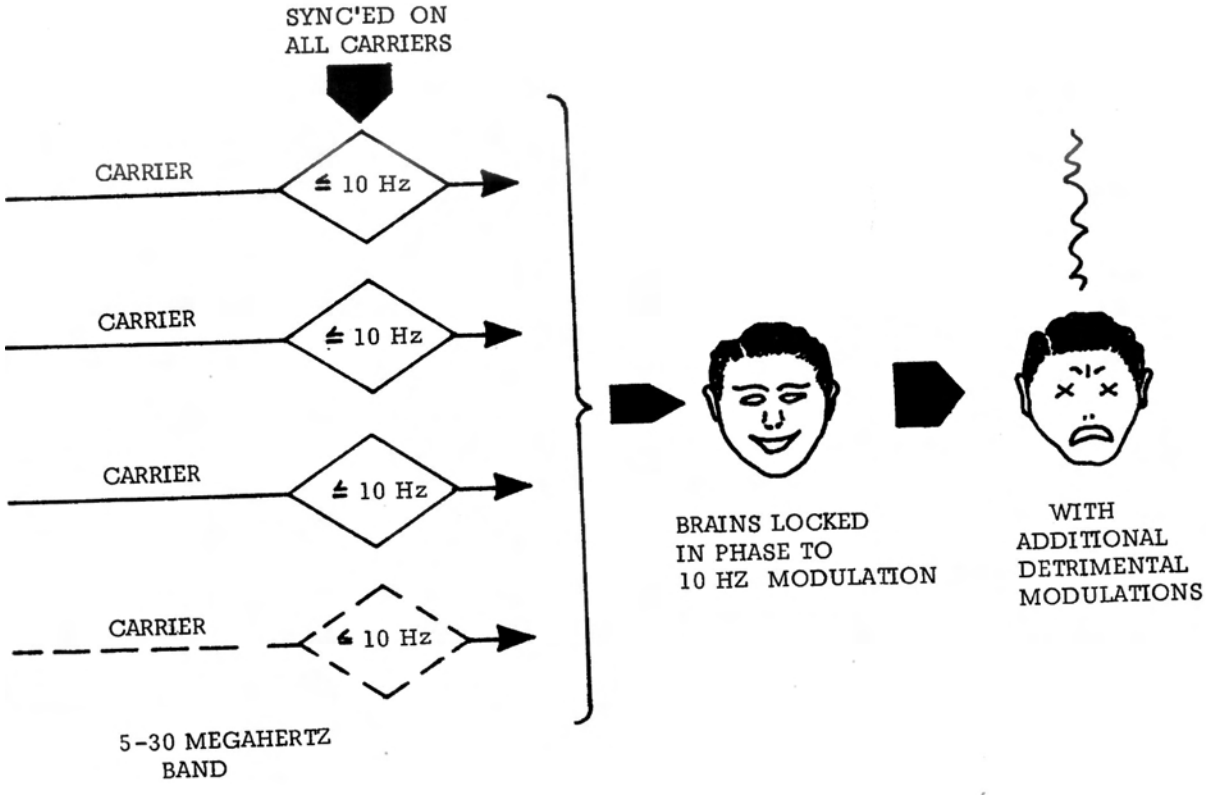

Figure 12. The Soviet "woodpecker" signals

synchronized and in phase channel-to-channel. The received signul from one of these carriers may be twenty-five to thirty times us strong as the earth's background magnetic field, which is oscillating at approximately 7.0 to 7.5 hertz. Other complex modulation frequencies, many of them chunging, are present on the various channels.

Normally, the brainwaves of mammals in an area are gently entrained by the normal oscillations of the earth's magnetic field and arc oscillating along at, say, 7.5 hertz. Under continuous radiation from the Soviet woodpecker signals, a percentage (say 30 percent) of the mammalian brains may be captured by the 10 hertz modulation on the overpowering Soviet signals. These captured bruins are now in forced oscillation and are riding along in phase with the 10 hertz Soviet mod ulation. In other words, a certain percentage of the human brains in an area will phase lock to the 10 hertz modulation, and that will effectively lock into those brains the sixteen carrier frequencies with their concomitant frequency mixes and complex signal modulations. If the signals are made much more powerful (for example, by focussing them onto one particular area or increasing the power of the transmitters), then a much higher percentage of brainwave entrainment can be accomplished in the targeted area. By simply adding on the desired modulation patterns, the Soviets can now pump material directly into the mind-brain-consciousness-life loops of the entrained brains. The weapon implications are enormous: raw emotion such as sheer terror or panic can be transmitted; death or disease patterns of all kinds can be transmitted; informational content (thoughts and ideas) can be impressed directly into the captured brains and minds and processed as if originating inside each brain itself. Indeed, as long as the Soviets keep the effects rather gentle, an entire population can be subtly influenced without governmental notice. Certain specific ELF frequencies can rapidly disable or even kill, and for wartime use those frequencies can be directly implanted in the captured brains themselves by the woodpecker signals. It appears that 1984 came a little early, and one can perhaps now understand Brezhnev's strange 1975 proposal to the SALT negotiations that we should also consider outlawing the development of new weapons more frightful than the mind of man has ever conceived.

The signals also have direct application against strategic targets other than personnel. For example, by incorporating the correct nested modulation pattern, the positron kindling (electron squelching) pattern can be impressed. By beaming through the earth (with a circularly polarized signal or with other complex modulation forms), a beam with a strong neutrinic component, which will squelch electrons and which will interact with great preference for strong voltages or strong magnetic fields, can be directed at a target complex. In the targeted area aircraft and communications systems can be disabled; automobile, truck, and other ignition systems will fail; power transformers and large motors and generators will fail; power transmission systems with their associated high voltages will fail; and so on. Even independent, self-contained emergency power equipment, such as at military installations and strategic missile sites, will fail to operate. Further, to some of these signals, the eurth and the sea are as transparent as glass, and so underwater nuclear submarines cun be electrically disabled on station before their missiles can be fired, while strategic missile complexes can be elec-

trically disabled before their deadly nuclear missiles can be hurled toward their distant targets. If some submarines and land complexes succeed in firing missiles before being disabled, these missiles can be electrically dudded and scrubbed from the sky over Soviet territory while still far from their intended targets.

So, as stated at the end of *Excalibur*, the players are on stage and in place. The final act begins. One thing is sure—mankind will never be the same again after seeing the play!

PART FOUR

SOVIET PHASE CONJUGATE DIRECTED ENERGY WEAPONS

WEAPONS THAT USE TIME-REVERSED ELECTROMAGNETIC WAVES

At the end of WWII, the Soviet Union obtained the cream of the crop of Germany's radar scientists and infrared scientists.

At that time, the German scientific team led the world in the theory and technology of radar absorbing materials (RAM) and radar cross sectioa For example, some leading Western radar experts believe that the German scientists had already advanced the theory of radar cross section beyond where Western scientists have arrived at today. Radar cross section science is the "heart" of modern radar technology, countermeasures, and counter-countermeasures.

The theory of RAM technology is precisely what is needed to develop and design phase conjugate mirrors for radar frequency bands. Phase conjugate mirrors are capable of producing a time-reversed (TR) wave in direct response to a received ordinary wave. The mirror may be powerfully "pumped" with energy to produce a very large amplification of the time-reversed wave.

Just after WWII, the Soviets also mounted a truly massive program to obtain and review all the scientific literature of the West This material was completely re-examined and digested, in a deliberate search for a major new technological "breakthrough" area. Nothing similar to this has ever been done in the West.

By 1950, the Soviets probably had discovered phase conjugation and the time-reversed wave, in their radar programs using the German radar scientists. Their relearch would certainly have revealed that the time-reversed wave is a solution to the wave equation, and hence the phenomenon is universal to all waves and frequency regions, under appropriate nonlinear circumstances.

We stress the fact that from the beginning the Soviets have always led the rest of the world in nonlinear science and mathematics.

Thus by the mid-50's, the Soviets would have mounted an intensive national development program on these radar TR wave weapons. If so, the Soviet Union has now had the equivalent of some seven or eight Manhattan Projects, back-to-back, in the development, stockpiling, and deployment of TR wave weapon systems. At least fifth generation Soviet TR weapons have been developed and deployed.

This is a matter of the greatest importance to the U.S.—and one which the U.S. intelligence and scientific communities have largely missed.

We particularly stress that the time-reversed wave phenomenon is a universal phenomenon of nature, not just a fluke, and not just a "nonlinear optics" phenomenon. It is a solution to the wave equation and, as such, it applies to every kind of wave. Electromagnetic, sound, magnetohydrodynamic, and other radiating systems all exhibit the phenomenon under appropriate nonlinear conditions.

Hundreds of Western papers dealing with time-reversed waves are now in the open scientific literature—most of them dealing with non-linear optics. However, the principles of the time-reversed wave are well-established, and known to apply to waves in general.

Compared to a normal wave, a time-reversed wave has startlingly different weapon capabilities.

Such a wave precisely retraces the path of the ordinary wave that stimulated it to be formed. So it possesses an "invisible wire" through space, back to the original position of whatever emitted its stimulus wave.

Further, the time-reversed wave continually converges upon its invisible "back-tracking" path. It does not diverge and spread its energy, in contradistinction to normal waves.

Using several simple schemes (particularly pumped 4-wave mixing), extremely large amplification of the time-reversed (TR) wave can be cheaply and readily accomplished.

A startling weapons capability therefore emerges when amplified TR waves are generated in response to received signals from a distant target:

(1) If any signal at all can be received from a distant target, a return TR signal of extreme power can be delivered directly to that target Almost all of the transmitted TR signal energy will arrive at and in the distant target, even through a highly nonlinear medium or under scattering conditions. Hardly any of the energy will be lost enroute. If the target is fast-moving, a "lead correction" signal can be calculated and added to steer the return path.

(2) Since real-time holography can readily be accomplished using TR waves—and without first making holograms, geometrical forms (balls, shapes, hemispherical shells, etc) of energy can be created readily by interferometry (crossed beam techniques). Since the TR wave carriers do not disperse with distance, these interference energy forms can be assembled by crossed TR wave beams at great distances—even hundreds of thousands of miles. The energy appearing in such a distantly created energy form is limited only by the amount one cares to put in at the amplified transmitting end.

Thus the radar itself now becomes a powerful, all-around weapon. With a TR wave adjunct, once the radar receives a return signal from a target, an extremely powerful TR wave pulse can be generated, and all the energy in that pulse can be unerringly returned to the distant target from which the return was received.

Even a passive (receive only) radar may be used together with a TR wave adjunct to accomplish the same directed energy destruction of the distant target emitting the signals received by the radar.

Radio receiver-transmitters may also employ simple TR wave adjuncts to provide a large number of communications jammers and "directed energy weapons," capable of jamming and/or destroying enemy radio transmitters at appreciable distances.

The Soviets have intensively developed such TR wave weapons since the 1950's. In January 1960, Khrushchev was probably referring to these weapons when he reported to the Soviet Presidium the forthcoming advent of fantastic weapons, then in advanced Soviet development.

Prior to Khrushchev's announcement, the Soviets had begun radiating the U.S. Embassy in Moscow with scalar EM waves and phase conjugate energy, modulated upon weak microwave carrier beams. Later these beams were used to induce illnesses and blood changes in Embassy personnel. (We will shortly discuss how the Soviets could induce disease at a distance, electromagnetically). The microwave radiation con-

tinued intermittently, in spite of the objections of several U.S. Presidents. U.S. studies failed to comprehend what was being done.

The Embassy radiation was and is a high-level intelligence probe: Stimulate and affect the U.S. Ambassador, a high-level target. Attention by the CIA, NSA, State Department, DIA, the U.S. President, etc. is guaranteed. Puzzled, they will turn to the U.S. scientific community for an explanation. The scientific community will try to explain the microwave radiation, using the best of its EM knowledge. By the U.S. counteractions taken or not taken at the Embassy site, the Soviets know with 100% certainty whether or not the U.S. has discovered TR wave weapons, electromagnetic disease control, etc.—and whether we have developed defenses against such weapons.

Since the beginning, of course, our actions—or lack of them—at the U.S. Embassy have consistently revealed to the Soviets that we have no knowledge of, and hence no defenses against, TR wave technology and the scalar electromagnetics (electrogravitation) that accompanies the phenomenon.

Soviet TR wave radar weapons also provide a convenient mechanism for accomplishing nuclear weapon kill. A target struck by a powerful TR wave pulse generates a time-reversed back-pulse due to nonlinearities in the target medium. In the nonlinear medium of the exploding or fuzing target, the two pulses (which are 180 degrees out of phase with each other) modulate each other, locking together into a scalar EM wave or pulse. This scalar EM pulse has zero electromagnetic force field resultants, but is a violent fluctuation of the energy density of local spacetime. Rigorously it is a local gravitational pulse wave, by definition. Further, it is far more powerful than "normal" gravitational waves. This scalar EM pulse does not react with the orbital electron shells of an atom, but passes directly into the nucleus and is absorbed there. This raises the nucleus to an excited state, increasing its potential (trapped energy). If the nucleus cannot withstand this increase in potential energy, it directly fissions. If the nucleus withstands the increased potential, it then immediately decays from the excited state by simply emitting a time-reversed EM wave.

Any radioactive nucleus is already "teeter-tottering" toward nuclear decay, so to speak, and it will instantly decay radioactively when struck by a significant scalar potential pulse. Thus a TR wave radar weapon can deliver a powerful TR pulse against a distant vehicle carrying a nuclear warhead, and the resultant EG pulse penetrating the nuclear material of the warhead will electrogravitationally explode it in a full-order nuclear detonation.

Therefore, when using such weapons, extreme care must be taken to avoid inadvertently pulsing one's own nearby nuclear weapons or nuclear material. In attacking distant ground targets, one must be careful not to detonate nearby nuclear weapons, nuclear powerplants, or stored nuclear material—even at some distance from the target Otherwise, large-scale nuclear fallout will be experienced over a worldwide area, and unacceptable "boomerang" self-damage to the attacker himself may be incurred. The more powerful the TR pulse employed, the greater the safety separation between the struck target and stored nuclear materiel must be to prevent unacceptable "boomerang" large-scale fallout.

Also, large TR wave interferometer weapons, such as the Woodpecker systems, usually first produce very powerful, scalar EM "standing wave" beams by continuously transmitting (in the beam) both a normal EM wave and its phase conjugate.

modulated (locked) together to produce a "zero EM vector resultant" electrogravitational (EG) wave. Interference of two of these scalar EM beams in the targeted area, plus internal scanning within the beam by other signals, allows EM effects—of either normal EM energy or time-reversed EM energy—to be produced and controlled at very precise locations within the broad interference area.

Each such huge "scalar EM standing wave" beam represents a gigantic electrogravitational standing wave, and hence a giant oscillating potential in spacetime. This standing wave represents a sort of gigantic "capacitor", or accumulator of infolded energy. Enormous energy may be collected in this potential, charged-up over a period of time. "Shortcut" of this giant capacitor—by transmitter failure—can result in a large flash-over discharge of the EG energy into the local earth, producing a massive EG ground wave that can be enormously destructive.

Thus one must carefully protect the TR wave weapon system from inadvertent discharge of large EG pulses into the earth at the local site, due to transmitter failure, shortouts, etc. Otherwise one's own nuclear weapons or facilities may be exploded—even at some distance—by the EG pulse ground wave produced. One's communications and electronics installations, for example, can be knocked out at an even greater distance.

For example, in the winter of 1957-58, a large Soviet TR wave prototype weapon at Kyshtym, near the Urals, apparently suffered a catastrophic transmitter failure, discharging a powerful scalar EM (electrogravitational, or EG) pulse into the earth. This huge EG pulse struck the atomic wastes stored nearby, causing the radioactive nuclei to imediately decay. In other words, the nearby atomic wastes exploded—just as eyewitnesses reported. Deadly radioactive contamination spread across a major region, and exists to this day.

After this accident, the Soviets would have developed much more elaborate safety circuits and devices and implemented them into their TR wave weapons.

Even so, in April 1986, the explosive eruption of a reactor at Chernobyl was almost certainly caused by an accidental catastropic failure of a large TR woodpecker transmitter about 30 kilometers away. The sudden failure of the East-to-West Woodpecker transmitter was positively detected by engineer Bill Bise. All safety circuits at the site would have been instantly activated, desperately and slowly draining off the huge "standing wave" potential built up by the weapon.

The Soviets would have immediately shut down the reactors at Chernobyl as a precaution.

Some hours later, the transmitter safety devices finally failed, and a much smaller, though still significant, remnant EG pulse was discharged into the earth, spreading out in a ground wave. The first radioactive material—the fuel rods in one of the hapless, shutdown Chernobyl reactors—encountered by the EG ground wave pulse received it and immediately erupted radioactively.

Had the full EG pulse escaped the stricken transmitter, all four reactors at Chernobyl would have violently exploded, and deadly nuclear fallout would have rained down over a wide area of the earth. Had the reactors not been shut down and the control rods inserted "full-in" to dampen the radioactivity, a far greater radioactive eruption—probably a nuclear explosion—of the struck reactor would have occurred.

In May 1960, a prototype TR wave radar weapon was used to down Gary Powers'

high-flying U-2 aircraft over the Soviet Union. Powers reported a flash, as if from an explosion near him, but the flash persisted. This is almost certainly the signature of a TR wave weapon.

In April 1963, the first large strategic Soviet TR wave weapons became operational. These weapons were used to electromagnetically deaden the electrical controls of the *U.SS. Thresher* atomic submarine on April 10,1963, and to produce a huge underwater electromagnetic blast 100 miles north of Puerto Rico on April 11,1963.

Since the 1960's, the Soviets have possessed a 100% effective defense against U.S. and European strategic bombers and missiles. The early systems deployed in the Soviet Union were midcourse and terminal phase systems. The Soviets would also have relied upon additional TR wave weapons systems, deployed as adjuncts to radar systems aboard research ships and crawlers, to be able to attack U.S. missiles and bombers in their launch and early midcourse phases.

These Soviet defensive TR wave systems also could easily accomplish nuclear weapon kill, and by their nature may have already been immune to the Stealth technology.

Older Soviet radars, using TR wave adjuncts, become totally new weapons having startling and heretofore unsuspected capabilities against missiles and aircraft. For that reason, the Soviets happily continue to operate and maintain thousands of older radar systems that, by Western radar standards, are seemingly obsolete.

Hundreds of incidents of Soviet tests of these TR wave weapon systems have been observed around the world, and reported in the open literature as puzzling or anomalous phenomena.

In the 1960's, in Siberia, Vlail Kaznacheyev and his researchers accomplished enormous experimentation proving that cellular death and disease—of any type whatsoever—could be transmitted and induced electromagnetically. This team went on secretly to phase conjugate (time reverse) the "death photon" signals, to show that any cellular death and disease can be reversed or "cured" electromagnetically as well.

The latter work would have been done under the auspices and tight control of the Soviet KGB, since all phase conjugation (time reversal) weapons effects are under the KGB, both for development and deployment Obviously the "electromagnetic antidote" work of Kaznacheyev was not published, because it provided a powerful counter-BW warfare capability of great strategic importance to the Soviet Union.

Thus in the late 1960's, the Soviet Union became the only nation on earth to achieve the capability of rapidly (within one or two hours) developing an electromagnetic antidote for lethal new biological warfare (BW) viruses—of any kind whatsoever. The Soviets also developed the capability for mass treatment in this fashion of both the civil populace and the military forces personnel.

Independent verification of the Kaznacheyev "death photons" effect has been accomplished in West Germany (University of Marburg), in Australia (University of Sydney), and in the United States (by G. Wilbanks).

Independent proof of electromagnetic healing of viral diseases was also accomplished in the West, and largely ignored.

In the late 1960's and early 1970's, a French inventor—Antoine Priore—built and tested several large electromagnetic devices that cured thousands of cases of terminal cancers and leukemias in laboratory animals. He worked with members of the pres-

tigious French Academy of Sciences. His work was funded by the French government and presented to the French Academy by Robert Courrier, head of the Biology Section. His work was suppressed in the 1970's, and lost when he died.

Priore used a plasma to accomplish multi-wave mixing and phase conjugation (time reversal). His time-reversed curative signals used a powerful, rippling magnetic field as a carrier; the magnetic field guaranteed penetration of every cell in the body—necessary to reach a blood disease. The rippling of the magnetic field guaranteed penetration of the cell's atomic nuclei by nuclear magnetic resonance. Penetration of the actual nuclei of the atoms in the diseased cell is necessary, since the master cellular control system (discovered by Dr. Fritz Albert Popp of West Germany) operates through the cell's structured scalar EM biopotential, and this potential is centered in the nuclei of the atoms comprising the cell.

Note that electrical dedifferentiation of cells at miniscule current—between picoamperes and nanoamperes—has been proven by Robert Becker and other researchers. Red cells of the frog, for example, have been electrically reversed through all their development stages. The cells first become round, then develop a scalloped outline in their membranes. Then they become ameboid and move by means of pseudopods. Their nuclei swell and their DNA becomes reactivated. They then rid themselves of all their hemoglobin and develop a full set of mitochondria and ribosomes. In Becker's historic experiments, the cells then turned into cartilage-forming cells, and finally into bone-forming cells. In short, Becker demonstrated dedifferentiation followed by redifferentiation into an unrelated cell type—all electrically initiated with laughably weak currents.

Thus profound cellular changes are most certainly inducable and controllable electromagnetically, by miniscule amounts of potentials and currents. Priore's machine applied time-reversed EM waves to accomplish reversal from cancerous cells back to normal cells.

Priore's work essentially proved that Kaznacheyev's group would have been able to accomplish the same thing by phase conjugation.

Kaznacheyev's "death photons" work was probably accomplished much earlier than reported in the open literature. Thus it probably provided a basis to use in the microwave radiation of the U.S. Embassy in Moscow, to engender blood changes and disease in targeted personnel. Two U.S. ambassadors died from a leukemia-like disease, and a third sickened and bled from the ears and nose. Only miniscule levels of EM signals would have been necessary to induce such biological conditions.

The present Woodpecker radars probably have the capability of producing similar conditions in distant target populations, whenever the Soviets wish to add the appropriate signals. They also probably are capable of killing large numbers of the targeted population, whenever appropriate Kaznacheyev "death signals" are placed upon them.

In the late 1960's, another cautious Soviet "intelligence probe" was used: A paper appeared in the open Soviet literature, dealing with time-reversed waves in the field of nonlinear optics. Only a few American optical scientists seemed to be interested.

In 1972, to focus more U.S. attention on their subtle "intelligence probe" of U.S. time-reversed wave knowledge, the Soviets sent two scientists to Los Alamos to brief American scientists on optical phase conjugation. Thereafter many U.S. optical scientists began to work in the "new field." Immediately it was revealed to the Soviet Union

that the U.S. had ineffective knowledge of phase conjugation, and that the U.S. had no TR wave technology or weapons.

To this day, U.S. theoretical work in phase conjugation is still characterized by a fairly simple overall math model, obtained by simply "writing down" the necessary conjugate term. There appears to be absolutely no U.S. awareness of the actual physical electrogravitational mechanism that causes the phase conjugation/time reversal, and no theory of it as such. Its direct application to radars appears to have largely been ignored in the U.S.

In 1975, the Soviets attempted to obtain a treaty with the rest of the world, outlawing the development of frightful new weapons of mass destruction—"more frightful than the mind of man had ever imagined", according to Brezhnev himself. Gromyko introduced the draft treaty into the 1975 session of the United Nations General Assembly. No one knew what the Soviets were referring to.

Failing to obtain the treaty, the Soviets in 1975-76 embarked on the greatest military buildup in history. This buildup was nothing short of a full-fledged preparation to be ready to take over the world, beginning in 1985 (the "ready" time per Brezhnev's 1972 statement at a secret Prague meeting of European Communist Party leaders). The Soviets met this scheduled goal.

As we stated, The Soviets can be immune to any kind of viral biological warfare, anytime they choose to be. The use of lethal new viruses thus has become a highly favored, low-risk method of warfare for the Soviet Union. The West has no such capability against viral warfare, and in fact is totally vulnerable to attack in this manner. Both Western troops and Western civil populations are totally defenseless against the threat of viral biological attack.

A BW strike from a small, hostile nation or from a few radical terrorists—or even an inadvertent contaminant spillage from one of the great many ill-controlled private genetic experiments—can result in the introduction of a lethal, highly infectious new virus that will decimate the West. Indeed, a deliberate BW viral attack upon us may already have been unleashed.

In 1971, the U.S. passed the National Cancer Act and declared open warfare on cancer. Iron Curtain country scientists were invited to participate, and they did so with alacrity. At the time—ironically—penetration of our recombinant DNA genetics research was one of the highest priorities of the Soviet KGB. Obviously, many KGB scientists/agents were infiltrated into our labs under this program (some of our cancer research labs at Ft. Dietrich, for example, still employ more Communist than American scientists.).

In these cancer labs, animal viruses were repeatedly injected and reinjected into human cell cultures, until new viral strains emerged that preferred human cells. These viruses could then be cultured and the effects (or lack of effects) of various chemicals and drugs against them could be ascertained.

These new viruses are exactly what one would wish to develop if one were seeking a biological warfare virus to which humans were not resistant, and one which preferred humans as its host

Sometime during the early 1970's, KGB agents who had infiltrated U.S. cancer research laboratories may have deliberately contaminated the World Health Organization's smallpox vaccine with one or more of the lethal new viruses available in the

Western cancer laboratories. Massive WHO smallpox vaccination in Africa and other Third World countries then resulted in the appearance and spread of the AIDS disease.

If this thesis is true, then AIDS constitutes the first Soviet biological warfare strike against the West, in what can only be categorized as the opening round in a unique new World War III.

With the Kaznacheyev techniques, the Soviet KGB already has the effective electromagnetic antidote against AIDS and other lethal viruses, anytime it wishes to employ it. Some Soviet citizens, however, will be allowed to die, to serve as a deception plan and conceal the true Russian capability. Meanwhile, the Third World nations and the West will be devastated by the killer disease.

Other lethal viruses are almost certain to follow, whether from the Soviets, fanatical terrorist groups, or inadvertent private contamination. Undoubtedly, some of these frightful new viruses are not going to be slow (lentivirus) agents. Some will likely be highly infectious and quick-acting, in the manner of influenza. Some will be transmitted successfully by insect vectors such as the voracious new Asian Tiger mosquito now spreading across the Southeast U.S.

Beginning in July 1976, powerful new Soviet "over-the-horizon radars" (the infamous Woodpeckers) became operational. Extensive weather engineering over the U.S. has been accomplished by these weapon systems. (This has been separately documented by the present author; C. B. Baker, editor of *Youth Action News;* Andrew Michrowski of Canada's Planetary Association for Clean Energy (PACE); and other researchers such as Andrija Puharich.) In addition, the Woodpeckers possess the full range of TR wave weapon capabilities, including real-time holography capabilities and anti-Stealth capabilities. Terrible anti-biological capabilities are also possessed by these weapon systems, and they are also highly effective as global launch phase and midcourse phase defensive weapons for use against U.S. missiles and bombers.

In 1985, the Soviets completed "wet run" weapon tests against U.S. missiles and aircraft and at least three of NASA's shuttle launches, employing the Woodpeckers in the launch phase ABM/anti-bomber mode.

Beginning in December 1985, actual destruction of selected U.S. missiles and aircraft was accomplished. Targets destroyed by the Soviets included the Arrow DC-8 at Gander AFB, Newfoundland on Dec. 12,1985; the shuttle Challenger launched on Jan. 28, 1986; the Titan 34-D rocket launched on Apr. 18, 1986; a U.S. Delta rocket launched on May 3,1986; and the French Ariane rocket launched in late May, 1986.

In 1986 and 1987, the mysterious loss of two highly classified U.S. aircraft—believed to be Stealth fighters—may also have been due to Soviet testing of TR weapon capabilities and anti-Stealth capabilities of the Soviet Woodpecker weapon systems.

However, a severe limitation on the unrestricted use of TR weapons exists. If powerfully and unrestrainedly used, they will cause nuclear warheads and nuclear material to explode as surface nuclear bursts—in the dirtiest possible fashion. The resulting massive radioactive fallout would probably wipe out all higher forms of life on earth. Note that Khrushchev stated in 1960 that these fantastic weapons could "wipe out all life on earth if unrestrainedly used."

As long as we possess an appreciable deployment and stockpile of nuclear

weapons, we are essentially "dead man fuzed" against substantial Soviet usage of their powerful TR wave weapons.

Thus Gorbachev needs to "thin out" the deployed and stored Western nuclear warheads, to allow a more unrestrained field of play for his decisive TR wave weapons. That is why at Reykjavik he suddenly expressed full interest in President Reagan's zero option, even expressing agreement with the principle of on-site inspection to insure dismantling of missiles and removal of warheads.

That is also why the Russians are so actively interested in negotiating the withdrawal of nuclear weapons from Europe. They can quickly and easily take Europe, the moment the nuclear weapons are thinned out and our "dead man fuzing" is removed!

To appreciate the ease with which a Soviet offensive, augmented with unrestrained TR wave weapons, can take Europe, consider this: A single airborne Soviet standoff radar jammer, complete with adjunct TR, within minutes can knock out all U.S., British, and FRG radars that illuminate it. Each pulse it fires, destroys an Allied radar. A single Soviet standoff communications jammer, complete with adjunct TR, within minutes can knock out all U.S., British, and FRG communications centers that are transmitting within its detection range. Each pulse that it fires destroys an Allied communications center. A single standoff Soviet jammer-based TR wave weapon can destroy an Allied carrier task force. Pulse after pulse from that weapon system will destroy the task force's radars and communications, explode HE propellants and nuclear weapons, explode fuel, ignite flammable materials, explode rockets and ammunition, and kill personnel wholesale. Tactical adjunct TR weapons can rapidly destroy aircraft, missiles, radars, radios, personnel, tanks, weapon carriers, personnel carriers, ammunition dumps, gasoline dumps, etc. The instant vulnerability of any massive emitter such as AWACS is readily seen.

We are referring to a new kind of blitzkrieg war: War conducted by powerful beams and destruction, engendered at the speed of light War in which electromagnetic radiators are the primary decisive weapons. War in which new kinds of directed energy weapons play the major role. War which renders all our present defensive arma.da of weapons archaic and useless. War in which the materiel and personnel loss rates are so incredibly high that they boggle the mind of the more conventional military tactician and planner. War in which even a small nation with TR wave weapons can strike and devastate a major power, and possess a first-strike capability unparalleled in human history. War which could be triggered by radical splinter groups and terrorists groups that acquire the technology. War in which the slightest miscalculation or the misuse of the weaponry can completely destroy the earth. War which places extreme emphasis on finding "other ways"—such as surreptitious biological strikes and insidious electropsychological attack and control—to decimate a foe. War that Western governments, populaces, and Armed Forces are completely unprepared—militarily and psychologically—to face.

NATO can be defeated in two hours or less, and the entire war—mop up and all—would last perhaps three days.

Of course, powerful demonstrations of Soviet strategic superweapons could be provided, to show that attempted nuclear retaliation would simply be suicide. The Woodpecker weapon systems alone could wipe out all major communications systems and power systems in the U.S., induce waves of EM-induced dcuth and disease in

preannounced locations, induce waves of abject fear and panic in the populace, or psychologically disrupt and disable—say—the entire Washington D.C. area, to include the people, the government, and the Pentagon.

If such a scenario were accompanied by a proclamation of a Soviet equivalent to the "Monroe Doctrine"—except applying it in Europe, an offer of a ceasefire, and an offer to allow us a "Dunkirk" to evacuate the beaten remnants of our European forces, we would almost certainly be forced to accept the Soviet terms for a ceasefire that left the U.S. intact.

The U.S. Congress—reacting with alacrity to accept this sudden and apparently miraculous Soviet leniency, and avoid the destruction of the world—would probably play the leading role in dictating our acceptance of liberal Soviet terms.

An agreement with the Soviets to mutually withdraw many of the nuclear missiles from Europe appears to be imminent. When the missiles are thinned out, the preceeding scenario or some variant of it is almost certain to occur.

There remains, however, one fly in the Soviet ointment: The U.S. Strategic Defense Initiative.

Presently our scientists apply phase conjugation primarily to "keep laser energy beams intact for greater distances." They appear to be completely unaware of the electrogravitational aspects of phase conjugation.

A colleague of the author has already rigorously proven this electrogravitational aspect on the laboratory bench. The phase conjugate (time reversed) wave is composed of, and carries, negative energy and negative time. If an object is forced to produce a great deal of this negative energy/negative time, it produces antigravity. This is because, in negative time, gravity is a repulsion, not an attraction.

In addition, if the electromagnetic energy of a laser is changed into gravitational energy, a theoretical gain of up to 10^{36} (protons) to 10^{42} (electrons) is achievable. In practical devices, an energy gain of 10^{20} may readily be achieved. Applied to a modified powerful laser in space, this electrogravitational gain factor is of overwhelming significance.

In SDI, U.S. scientists presently envision a high energy laser in orbit, pumped perhaps by means of a nuclear explosion. The pulsed beam from this laser would have sufficient power to destroy a rising Soviet strategic ICBM in the launch phase, say at 10,000 miles away.

If that same laser were converted to a scalar electromagnetics laser (one that turns much of its electromagnetic energy into gravitational energy), it could blast and destroy possibly a quarter of Russia with a single shot.

Thus if we developed and tested the SDI spatial/launch hardware for the space-based high energy laser, so that these systems were available for immediate launching, we could convert their lasers to scalar EM and still possess a very real strategic retaliation capability, even if the Soviets should strike us almost unrestrainedly with powerful TR wave weapons. If we launched several of these systems, we could still probably get off a few shots at Russia and destroy her, before all our space lasers could be destroyed by Soviet counterweapons.

In that case, mutual assured destruction would still exist, and we would still possess a full "last ditch" strategic retaliation capability.

Gennadi Gerasimov, Soviet Foreign Minister spokesman, confirmed as much on

the Peter Jennings' ABC News Show, Los Angeles, California on 13 October, 1986. The real concern (with SDI), he indicated, is not with its present design. Instead, the Soviet concern is that the U.S. would make a great technical breakthrough and deploy new devices in space as a modification to SDI, presenting an unacceptable threat to the Soviet Union.

Gerasimov was almost certainly referring to the potential for U. S. adaptation of the SDI space-based lasers to electrogravitational lasers capable of destroying the Soviet Union.

Obviously, if the high energy laser weapons stay grounded in the laboratories, and the system hardware is not developed and ready, that strategic retaliation capability is lost to us. For that reason, Gorbachev is adamantly insisting that the SDI defense must not be developed and tested in space.

If Gorbachev can prevent the development and testing of the SDI space-based high energy laser and get the nuclear weapons thinned out, he immediately holds the decisive winning hand.

This is where we are now, vis a vis the Soviets. This is the background necessary to understand the full context of the present jousting between the Soviet Union and the U.S.

In the *Washington Times* of Aug. 26, 1986, Soviet Chief of Staff Sergei Akhromeyev warned the United States that the Soviet Union could have an unpleasant surprise response if the U.S. deploys its Strategic Defense Initiative (SDI) in space. Akhromeyev stated:

"If the United States deploys a shield in space, the Soviet Union will have several options, none of what Washington would wish... The Soviet Union will very quickly find a response of which the United States has no inkling as yet."

It is absolutely essential that the President of the United States, the Secretary of Defense, the Joint Chiefs of Staff, and the U.S. Congress be aware of these Soviet weapons and their capabilities.

It is also essential that the U.S. public become aware of the real nature of the hidden Soviet threat that faces us, so that public support will be forthcoming for the hard decisions our government leaders have to make to counter it.

A PARTIAL GLOSSARY FOR SCALAR ELECTROMAGNETICS AND SUBTLE PHENOMENA

by Tom Bearden

1. Action: the fundamental constituent of physical reality. Basically composed of two quantities—energy times time, momentum times length, etc. Action is nonobservable; only changes in action are observed, and then only partially (in the linear case). The photon is the basic quantum of action, consisting of a piece of energy welded to a piece of time, with no seam in the middle, so to speak. All physical things are composed of rates of changes in action. The physicality (volume characteristics) of space arc created bit by bit from action quantum changes in and on each fundamental particle of mass, at a very high rate of speed. These action changes are totally internal to the mass itself. Therefore, literally the physical universe exists inside each and every part of itself, and is a giant hologram.

2. A-field: vector magnetic potential. The A-field is a real field—not a mathematical convenience as was originally thought—as detailed in the second volume of Feynman's three volumes of physics. Indeed, it may be separated from the magnetic field, as the experiment reported by Feynman details. When separated, it is often referred to as the "curl-free vector potential."

3. Aharonov, Yakir: renowned Israeli quantum physicist and former student of David Bohm. Together with Bohm, Aharonov authored a fundamental paper in 1959 which pointed out the primary importance of the potential rather than the force field. Co-discoverer of the Aharonov-Bohm effect: Even when the electromagnetic force fields reduce to zero in a charged particle system, the potentials may still exist and interfere to cause real physical effects.

4. Aharonov-Bohm Effect: Effect whereby interfering electromagnetic potentials can produce effects on charged particle systems, even at a distance and in the absence of the electromagnetic force fields. When E and B fields are zero in a region, their potentials still exist and interference of the potentials produces real electromagnetic effects (energy) in the interference zone, even at a great distance, without transmission of "energy" per se through the intervening space. The Aharonov-Bohm effect highlights some of the stark differences between the classical view of electromagnetics and the quantum mechanics view. In classical EM, the force fields are the real causative agents while the potentials are only mathematical creations for convenience in calculation. In quantum mechanics, it is the potentials that are real and fundamental; the force fields are effects derived from the potentials by differential operators. In classical EM, when the E and B fields are zero in an area, there is no more electromagnetics going on there; in quantum mechanics, the potentials still exist and may still cause real effects. By the use of artificial potentials, the Aharonov-Bohm effect can be made macroscopic and used to cause action at a distance—even significant action at a very great distance. Thus scalar EM interferometers can produce energy effects at a distance. The negative Aharonov-Bohm effect also exists. If the potentials of the transmitters in a scalar interferometer are biased highly negatively, then energy is extracted from the distant interference zone, reappearing at the transmitters. Tesla proposed a "Big Eye" that could see at a distance; actually he planned to use a negatively biased scalar interferometer, scan the beams, then reassemble the scanned energy appearing back at the transmitter/receivers. In this way he had a crude picture of the distant conditions in the interference zone. Such a device can see through the earth or ocean to a preselected intersection depth, since scalar EM waves can be made to pass readily through the earth or sea. The Aharonov-Bohm effect is in fact experimental proof of the new definition of force used in scalar electromagnetics. That is, force consists of mass in motion changing its motion (momentum). The nonzero 0 created by interference of two electrostatic potentials at a distance, for example, will create an electric field (E-field) on and of an electrically charged particle there. The standard detection of an E-field by conduction electron detectors is an example. It is the electron gas particles (charged electrons) that are detected, not what is in the vacuum. Thus classical EM errs when it assigns the equation E = - 0 to vacuum, for no such thing is ever measured. Actually, the correct equation is E = - 0 (e), where means "coupled to" and (e) means "electrically charged particle."

5. Aikido: a Japanese martial art whose modern form is a synthesis of many schools of jujitsu and the zen art of meditation in motion. The advanced aikido practitioner seeks to attain a state of "nomindedness," in which there is no separation of subject and object, of attacker and defender, or even of past and future. This state of at-one-ness with the universe, when attained, results in the complete mastery of the art. It is rarely experienced, even occasionally, and even rarer is it permanently attained. One who attains this state permanently is considered a great master, and his demeanor and personality are profoundly altered. The deceased founder of the present modern form, Morihei Uyeshiba, attained such mastery of the art He was a serene, deeply religious man and a profound inspiration to several generations of martial artists. He was also unbeatable even in his eighties.

6. Anenergy: stress energy of vacuum. "Fragments" of energy, more subtle than electromagnetic energy, turned against themselves and locked into a "vector zero summation." Scalar, massless charge flux. Virtual particle flux. "Pieces" of the spatiotemporal vacuum spacetime medium (i.e., quitons). Specifically, an observable object rotated more than one orthogonal turn away from the laboratory frame constitutes an anenergy particle. Examples are the virtual photon (rotation between 90 and 180 degrees), the bare neutrino (rotation exactly 180 degrees), the virtual bare neutrino (rotation between 180 and 270 degrees), and the thought or mind particle (rotation 270 degrees or more). Also, more fundamental components of energy—specifically, the individual scalar wave components of vector electromagnetic waves. Anenergy components may be coupled into energy, which can be compacted into mass. The conservation of energy law is replaced with a more fundamental law, the conservation of anenergy. Anenergy contains two com-

ponents or constituents: (1) ordinary energy (positive time, positive energy), and (2) phase conjugate energy (negative time, negative energy).

7. Angular momentum: the momentum or "leverage" of the momentum of a moving body, with respect to an axis or reference point Has the same units as action, or energy x time, or momentum x length.

8. Antimatter: matter consisting of atoms which are composed of positrons, antiprotons, and antineutrons. Also loosely refers to the antiparticle corresponding to a particle—the antiparticle may be regarded as the particle traveling backward in time, or "phase conjugated." In present physics, the photon is recognized as its own antiparticle. However, since physicists do not differentiate between positive and negative energies in a photon, then they assume that there is no difference between a photon and an antiphoton. The antiphoton, however, acts quite differently from the photon, as is clearly shown in phase conjugation. The magic rule of scalar electromagnetics for the final photon emission interaction with a charged particle in an atom is this: In the expression CPTEGS (where C is charge and normally negative, P is normal parity, T is time and normally positive, E is energy and normally positive, G is gravity and normal is positive, S is entropy and normally positive or increasing), if one of the components is reversed in sign, then each of the remaining components is also individually reversed in sign. The phase conjugate photon (antiphoton: negative energy, negative time), e.g., is produced by the photon interaction with the positively charged nucleus, producing a time-reversed wave having negative energy, negative time, reversed parity, causing gravitational repulsion, and causing negentropy.

9. Antiparticle: a counterpart to an ordinary fundamental particle, having identical mass lifetime and spin, but with charge and magnetic moment reversed in algebraic sign. Note that when the charge is reversed, parity and time are also reversed. Thus, properly, the antiparticle is the phase conjugation of the particle, or just conjugate particle for short.

10. Artificial potential: potential formed by deliberately summing force field vectors to a zero vector resultant This vector zero has a deterministic, internal stress pattern that is macroscopic. The type of potential made by the zero summation depends upon the type of force vectors summed. For example, summing electric field vectors to zero produces an electrostatic scalar potential; summing magnetic field vectors to zero produces a magnetostatic scalar potential of vacuum. All such potentials represents local warps or curvatures in vacuum/spacetime. Since Einstein assumed that spacetime locally was uncurved, this violates one of the assumptions of Einstein's general relativity. The Soviets have long made this correction; Western physicists have not Since curvature of spacetime is gravitational, this constitutes the secret of electrogravition: How to turn electromagnetics into gravitation, and vice versa. I have called this "scalar electromagnetics"; the Soviets refer to it as "energetics." In such a vector zero, the locked-in energies of all the component force vectors constitute the "anenergy" of the artificial potential. Potential in vacuum is analogous to "pressure" in fluids. An artificial potential polarizes the vacuum and constitutes a specific stress pattern in it Thus vector-zero summed systems of individually finite vector components may all differ from each other.

11. Ball lightning: rare form of lightning where an incandescent, slow-moving globe forms. The globe often moves erratically, explodes, and may set fire to objects it touches. Ball lightning is due to scalar electromagnetic interferometry which can produce a controlled pattern of electromagnetic energy at a distance. Phase conjugation is directly involved; note that the literature already explicitly demonstrates that phase conjugation can perform real-time holography, or produce forms of energy at a distance.

12. Bare electron: in physics, the true electron without the partial shielding of virtual positrons that are attracted around it In scalar electromagnetics, the mass of the electron, considered without its flux of virtual photons (its massless charge flux). An electron mass without its charge (in new approach); that is, one that is really bare of all charge!

13. Bare neutrino: the photon rotated one orthogonal turn farther away from the laboratory frame would be seen in the laboratory frame as a bare neutrino. In the new approach, bare neutrinos move at the speed c inside an ordinary photon, orthogonal to the photon's direction of travel, constituting a flux in each half of the photon. Two neutrinos move in the photon, one in each half (a simple photon is a single sine wave). One neutrino moves in positive time, the second moves in negative time and is properly an antineutrino. Since the photon moves at the speed c with respect to the laboratory frame, then the bare neutrino moves at the speed c-squared, but only its carrier speed c is seen by the laboratory observer. The flax of bare neutrinos in each half of a photon corresponds to the classical neutrino of present physics. The bare neutrino is (to the lab frame) a factor of c smaller than a photon, and one dimensional. It is a special kind of polarization wave to the lab observer.

14. Bearden, Thomas E.: nuclear engineer, retired Lieutenant Colonel (U.S. Army), and theoretical conceptualist active in the study of paranormal phenomena, scalar electromagnetics, Soviet Tesla (time-reversed wave) phenomena, free energy, antigravity, electromagnetic healing, and human development. Particularly known for his work in scalar electromagnetics and Soviet unorthodox weaponry.

15. Beck, Robert: noted psychotronics and ELF researcher who has pioneered many unusual measurement fields such as the Schumann resonance of the earth's magnetic field, specific effects on humans of extra low frequency (ELF) signals of precise waveform and frequency, ELF pollution effects, and brain wave entrain ment by weak ELF signals of precisely controlled frequency. He is also noted for his development of a series of very sensitive detectors and scalar wave detectors.

16. Bedini, John: noted audio engineer, creator of the renowned Bedini amplifiers well known to audiophiles, and researcher into free energy, antigravity, and electromagnetic healing. Bedini has built several free energy motors and devices, including a gravitational field generator, a gravitational field turbine, and a series of monopole motors. He is also noted for his development of sensitive scalar EM wave detectors. He is struggling to develop an electromagnetic phase conjugate signal which will kill the AIDS virus, and also reverse the genetic damage done to the cell by the virus.

17. B-field: the magnetic induction B. This is defined, analogously to E, by the force it exerts. The force on a point charge moving in a magnetic field is at right angles to the velocity vector of the charge and also at right angles to the magnetic field. Actually, the H-field was originally named the magnetic field and the B-field was named the magnetic induction. This is an annoyance because it is B which produces or involves the force, and hence should be named the field. Other writers have noted this discrepancy, and Sommerfeld called H the magnetic excitation—which correctly describes its role—rather than die magnetic field. In Kaluza-Klein unified field theory, all electromagnetics is in the 5th dimension, which is wrapped around each and every point in our normal 3-dimensional space.

18. Being: pure essence, existence. Again, something which in actuality resists definition unless preliminary assumptions are made. Generally used in one of two senses: (1) persistence, as in "he is (he continually exists)," or (2) identity, as in "he is the man ('he' and 'the man' are the same thing)." Even in the first instance - persistence - one is using the form of the verb "to be" in the sense of identity, when perception is considered; i.e., "he is" is a statement that "he continues to be presented or perceived, because each succeeding perception is identical to the one before." Thus when perception is considered, being may be defined as that which is undifferentiated, and this yields its total definition. This is the real void devoid even of void, if one considers zen.

19. Bennett Island; Soviet island on which large, anomalous exhausts—some 150 miles long and nearly horizontal—are repeatedly photographed by U.S. weather satellites. Over 100 incidents have been photographed there since 1974. These exhausts are believed to be the exhausts of energy extracted by distant Soviet scalar interferometers used in the endothermic mode, then •witched to the exothermic mode and focused on Bennett Island as a "dump site." Similar exhausts have been seen on Novaya Zemlya, a large island off the north coast of mainland USSR.

20. Bigfoot: U.S. slang or common name for a materialized sasquatch or apeman-type tulpoid, even if not well-formed.

21. Big Mama: very large, glowing nocturnal light UFO believed sometimes associated with cattle mutilations. Implies a sort of "mother ship" which spews forth smaller ships, which then speed off, swoop down to mutilate cattle, and return. Big Mama has been observed to split into or spew off smaller lights which sped away, dipped down, then returned. Some of these occasions appear to have been associated with cattle mutilations. The most noted photographs of Big Mama were taken by Bill Jackson.

22. Biofield: a hyperfield, particularly with reference to the fields of a living biological system. Also bioframe, bioworld, hyperfield, hyperframe, hyperworld, orthofield, orthoframe, orthoworld.

23. Bioframe: a hyperframe, particularly with reference to the frame of the body of a living biological system. Also biofield, bioworld, hyperfield, hyperframe, hyperworld, orthofield, orthoframe, orthoworld.

24. Bioworld: an orthogonal universe one or more right angle turns away from the ordinary world, particularly with reference to the frame of the body of a living biological *system*. Hyperworld. Orthoworld. Living energy forms—"critters"—exist in these bioworlds. A bioworld is also one of the netted levels of infolded virtual state. Such "living electricity" can be manipulated and utilized by scalar EM means.

25. Bohm, David: world renowned physicist and originator of hidden variable theory. Together with his student Aharonov, he co-authored a fundamental paper on the Aharonov-Bohm effect wherein interfering electromagnetic potentials can produce effects on charged particle systems, even at a distance and in the absence of the electromagnetic force fields.

26. Brain wave: a rhythmic fluctuation of tho voltage between various parts of the brain, normally ranging from about 1 to 60 Hertz in frequency and 10 to 100 microvolts in potential strength. Brain waves are caused by avalanche discharge firings of the nerve cells in the brain. Actually, classical brain waves are only the residue or "spillage" waves of the brain, and the important activity is in the specific patterning of the vector zero summations of the myriads of ion discharges. Every "discharge ion" constitutes a small EM force vector. The summation of these is largely zeroed; however, the patterns formed by all these tiny components are not random. The intent and will of the human being is expressed in the changes in the patterning of these dynamic substructures. Present EM brain wave theory does not touch the basic "thought patterns," which are scalar in nature. Use of the two cerebral hemispheres as a scalar interferometer provides mechanisms for the effects of parapsychology and paranormal phenomena such as fire walking.

27. Burst, burst-in: the sudden collection or condensation of anenergy into a frame, so that observable light or electromagnetic energy (or rarely, physical matter) appears (is kindled). Sudden kindling of anenergy into energy.

28. Cattle mutilations: the strange, paranormal, surgical killing and/or mutilating of cattle in the U.S. and other countries, particularly since the 1973 Yom Kippur War. Metapsychologically, mutilation of the cow is the mutilation of the female symbol—that is, it symbolizes mutilation of "Fortress America." Many small animals such as cats, dogs, rabbits, and birds have also been paranormally mutilated, which is destruction of the child symbol. Again, this symbolizes the mutilation of "Fortress America." The author regards such bizarre paranormal incidents as being caused by temporary materializations of the unresolved conflicts from the human collective unconscious's dreams. With this thesis, if knowledge of Soviet scalar electromagnetic weaponry is also included, analysis very similar to standard psychological dream analysis provides explanations consistent with the bizarre mutilations and the Cold War.

29. Causality: the time ordering of ordinary inert interactions. Macroscopic (observable) causality may be violated by control of hidden subquantal (virtual state) variables. With scalar electromagnetics, direct engineering of the virtual state—and hence violation of observable causality—*in* possible.

30. Cerebral hemisphere: each half of the cerebrum, the enlarged anterior or upper part of the vertebrate brain. Tho two cerebral hemispheres may function as a scalar interferometer to sense distant scenes (even distant in time), or produce energy and signals at a distance. The time aspect (e.g., in psychometry) is due to utiliza-

tion of the cerebrum as a phase conjugate mirror (PCM), and inputting tiny signals picked up from the object one is holding. A phase conjugate signal is then originated by the PCM, retracing the route to the original object. Unfortunately the output of the human nervous system that can accomplish such scalar EM functions lies very deep within the unconscious mind, and it is very difficult to raise it to direct consciousness. Usually the conscious mind is only aware of "vague impressions" instead of clear signals, although in the extremely rare instance clear impressions are consciously detected.

31. Changing the past: every intentional inception upon ordinary inert causality represents a slight alteration or change in direction, departing minutely from pure causality. From a causal viewpoint, each human inception minutely changes the causal past, as well as the future.

32. Charge: the repetitive, "locked in" massless virtual particle emission and absorption activity (flux) of and on a fundamental particle such as an electron. Vacuum is identically pure massless charge flux. In the new theory, the intensity of the charge flux on a particle is also directly related to the rate of the particle's passage through time. The continued absorption and emission of photons by a particle provides the general mechanism by which the particle moves along in time in little jumps. In the scalar EM view, the relativistic change of the rate of flow of an object through time is due to a change in its ambient vacuum charge potential—i.e., to a change in the rate at which it is absorbing and emitting virtual particles and scalar waves. The negative charge is associated with a positive time flux (hence with positive energy) and the positive charge with a negative time flux (hence negative energy). A positive charge is also a negative charge moving backward in time. All particles have clouds of virtual activity patterns; essentially all mass is charged since these clouds contain charges. In ordinary electrical physics, charge is defined in terms of force and force in terms of charge, and charge and charged mass are erroneously made synonymous. In scalar EM, a "charged particle" represents a mass (nonlinear bump in spacetime, or *local nonlinearity" medium) that separates the scalar waves of vacuum into two parts, one is normal energy and the other is the phase conjugate having negative energy. It is important to remember that a charged particle is a special sort of high pressure "pump" and "vacuum cleaner" at the same time. So is a "magnetic pole" or a "potential."

33. Cold explosion: the sudden extraction of energy from a distant intersection zone of the crossing beams of a scalar interferometer which transmits in the pulsed mode while negatively biased. A famous example of Soviet testing of a cold explosion scalar EM weapon is the huge cold explosion that occurred off the coast of Japan on April 9,1984. When the energy is suddenly extracted from a zone near the surface of the ocean and above it, the pressure in the zone is suddenly lowered. Water vapor and mist are violently sucked up, and the surrounding air rushes in, pushing the "water vapor filled region" rapidly upwards. The pattern that results is a rising mushroom cloud, very similar in appearance to a nuclear explosion, except for the absence of a flash and blast wave. In a cold explosion, the energy is extracted from throughout the spacetime of the distant interference region, and insulation has no effect since classical heat conduction through space is not involved. Ordinary electrostatic cooling is also an example of this effect in less violent form.

34. Consciousness: refers to a living being's awareness of its sensations, feelings, thoughts, and the world around it Specifically, consciousness involves an anenergy communication channel where detections of the body-object (which may be regarded as a sort of special camera, instrument, or physical tuner) project into the mind as separations from the beingness of the subject Further, it refers to the intersecting stream of monocular, one— at-a— time virtual projections into the mind from the quantum changes of photon interactions upon the body sensors. By memory (collection in the mind) of streams of such monocular changes one after the other, the entity is conscious of its body-object (camera—tuner) monocularly "moving through time." In the absence of deeper understanding, the individual consciously sees itself as a separated physical object moving and changing in time, i.e., with respect to other separated physical objects that it perceives. The "externality" of certain changes (i.e., the physical world) is due to the lack of mental control or influence over them. "Internality" of certain other changes is due to the ability to mentally control or influence them. The ordinary conscious mind is a serial processor: only one thing at a time is discriminated in its awareness. The unconscious mind, on the other hand, is totally conscious—but multiply so, since it is a parallel processor of many discriminations at once. The conscious mind, then, cannot directly perceive the individual discriminations of the parallel processor, since these appear only as a blur or nothingness to it (much like looking at a hundred 35mm slides in the projector at the same time). This is the mechanism of the barrier between the conscious an unconscious minds. Projections from the unconscious onto the screen of the conscious mind will thus appear symbolical—that is, having many hidden meanings at once. This is why our dreams, for example, appear to our conscious minds as weird and distorted, but highly symbolic in nature.

35. Contactee: a person who seemingly has had a direct contact—mentally, physically, or both—with aliens, extraterrestrials, etc.

36. Continuous mode: for a scalar interferometer or Tesla howitzer, mode of operation where power is fed continually to the transmitters, and the two Fourier expanded scalar patterns or beams are continuously transmitted. In this mode, in the distant interference zone a glowing pattern of vector electromagnetic energy appears and is sustained. (Note the possibility that a few of the UFO sightings could well be due to the deliberate usage of such a mechanism by the Soviet Union or some other nation possessing the requisite technology to create such physical "apparations" at a distance.)

37. Corpus callosum: the thick nerve cable that links together the two cerebral hemispheres (which are separate brains) in each vertebrate (including human) brain. In each of the two cerebral hemispheres, there is a separate mind and personality (given that the other is separated). However, a brain has a unique characteristic: Anything that arises directly inside it is automatically assumed to be self-originated, since the brain-tuner can differentiate no separation or "separate source" for the signal/thought arising directly upon its "internal screen". This allows integration of the two brains/minds/personalities into one.

That is, when one brain half prepares and sends a message, that message is also routed across the corpus callosum into the other brain half, arising internally upon the second brain's "display." The second brain half therefore thinks that it itself originated the signal or message. Thus when the left cerebral hemisphere moves the right thumb, for example, the right hemisphere thinks that it itself ordered the movement of the right thumb. Perceptually, the definition of identity is the loss of all distinction."

38. Cotton effect: the wavelength dependence of certain optical and absorption characteristics in a substance in the vicinity of an absorption band. An absorption band is a range of electromagnetic frequencies within which electromagnetic energy is absorbed by a substance. The direction of polarization of the energy affects the degree of absorption for certain substances. In these substances, the frequency and the direction of polarization of incoming electromagnetic energy affect the amount of energy deposited and dispersed.

39. Crawford, Hal: accomplished science fiction artist and illustrator who has furnished many drawings in the new approach and contributed to the theory of mind linkage.

40. Crosstalk: in ordinary science, the transfer of energy or signal from one channel to another, by cross modulation or cross coupling between the channels. In the new approach, it refers to virtual anenergy exchange between orthogonal universes or frames—that is, between different 3- or 4-dimensional slices of an infinite-dimensional universe.

41. Cyborg: (noun) a single integrated system consisting of a living system energetically or functionally linked to mechanical or electromagnetic devices and/or systems. (Verb): link, in the sense of forming such a system. A living biological system is a cyborg of its mindworld (mindframe) to its body (laboratory tuner).

42. Death: the loss of the preferential tuning of a physical body to its mindworld. This causes loss of the preferential consciousness loop or life channel, resulting in "death." Actually the being is unchanging and indestructible, hence consists of all changes and destructions simultaneously, with none separated individually. Life and death thus are two sides of the same coin, and the coin is immutable, regardless of which side is exposed.

43. DeBroglie wave: a matter wave. The quantum mechanics wave associated with a particle of matter, which can give rise to interference effects. An orbital electron in an atom is associated with a standing DeBroglie wave on a Bohr orbit. DeBroglie waves always move faster than the speed of light, the speed being given by c2/v, where c is the velocity of light in vacuum and v is the velocity of the particle of mass. Debroglie wave velocities thus vary from the speed of light to infinite speed (everywhere at once). In his speech accepting the Nobel Prize, DeBroglie emphasized that , since these waves produce real physical effects, they are real and must not be regarded simply as mathematical conveniences.

44. Dimension: a certain primary geometrical physical attribute, such as length, used to describe the separational relationships of physical phenomena. By "geometrical" we mean that the "dimension" is considered to "exist" in either the presence or absence of the observable physical phenomenon; however, by agreement the dimension itself is not directly observable. It can be inferred ("measured"), however, by comparative operations of simple devices such as clocks and metersticks, and its simplistic definition is usually given as "that which has measurable magnitude." Prescribed measuring procedures are used to assign magnitudes to these inferred dimensions, using specific scales. Actually, "dimension" just means "fundamental quantity of separation" in the most general sense. The number of dimensions taken in advanced physics usually represents a somewhat arbitrary choice for good modeling fit In modern Kaluza-Klein theory, for example, it becomes necessary to accept some 10 or 11 dimensions.

45. Dirac sea: in Dirac electron theory, the relativistic wave equation for the electron has four components, which correspond to two spin orientations and two energy conditions: positive and negative. Thus the vacuum possesses a "sea" of negative energy conditions for electrons. These are called "holes" and are considered to ordinarily be filled with electrons which have fallen into these negative energy states. The Dirac sea thus is this vacuum sea of negative energy electrons. If energy is added, electrons can be lifted from this sea. If spacetime is locally curved, additional holes may be created so that normal positive energy electrons fall in and disappear, creating the appearance of an "electrical energy sink." If the curvature is in the opposite direction, electrons may be lifted from the Dirac sea by the curvature, thus producing a flow of electrons and creating the appearance of an "electrical energy source." In several battery-powered free energy motor devices where die battery is sharply "back-spiked" for recharging, the battery has been noted to apparently accumulate such additional "Dirac holes" as the DC series—wound motor ran. When later recharging the battery with a normal charger, for example, the battery would first "consume" a quantity of electricity to "refill the holes." When the holes were filled with new electrons, the battery would then start to recharge normally. In one extensively used battery, Watson noted that it consumed electricity for some eight hours before recharging normally. Similar effects have been noted by Bedini.

46. Dissociation: separation of ideas from their affects or feelings, resulting in independent functioning of these components of a person's mental processes. Simply put, fragmentation of the mind and personality. In this sense, Zarg (the collective human unconscious mind) is severely dissociated, since its "conscious mind" is fragmented into billions of pieces (into the independent conscious minds of ordinary humans). This is severe dissociation and psychosis; Zarg (the human species) is quite literally insane.

47. Dowsing: use of handheld rods, forked twigs, pendulums, bent coathangers, or other simple physical detectors to locate water, minerals, lost objects etc. or to seek answers to specific questions. The movement of the physical instrument serves as an indicator and is cyborged to the dowser mentally and psychokinetically.

48. E-field: the electric field or electric intensity E. That field on a spinning charged mass which produces an electrical force, hence linear motion of die charge. (In the new theory, the E- field CONSISTS OF the spinning charged mass, moving through a finite change in electro static scalar potential, and thus there is a more fundamental generatrix of FORCE.) Defined as the force per unit charge (i.e., per unit of charged mass). On a free

electron, there may exist two separate E-fields, one in the direction of motion of the electron (normally due to voltage); and one at right angles to the electron's motion, due to the time derivative of the A-field.

49. Einstein's postulates: (1) all the laws of physics are equally valid in all inertial frames of reference, (2) the speed of light is the same to every inertial observer, and (3) the observable local effects of a gravitational field are indistinguishable from those arising from acceleration of the frame of reference. The first is called the special relativity principle, the second is called the law of light propagation, and the third is called the equivalence principle. It is now known that postulates (1) and (2) are not independent of each other. Note that the third postulate implies that any local force is due to a "gravitational field" (acceleration of the frame of reference). It also implies that gravitational force has a mechanism, since quantum mechanics assigns a differential operator, operating upon a potential, to create every force. By extended inference, it can be seen that the third postulate also implies that there should exist a method to turn any type of force (field) into gravitational force (field).

50. Electrogravitics: electrogravitation, or scalar electromagnetics (SEM). The term "scalar electromagnetics" was chosen by Bearden to describe the electromagnetics that goes on inside a macroscopically summed-zero force vector system, producing gravitational effects and energy effects at a distance. A priori, SEM is a unified field theory, which predicts strong effects easily verified experimentally. The struggling science that seeks to produce gravity and inertial effects electromagnetically (success has been achieved recently in proprietary labs). Santiliy has shown that the classical assumption that electrical field and gravitational fields are mutually exclusive is false. They are therefore either the same thing or partially the same thing. There are numerous anomalous experiments which also show a connection between electrical effects and gravitational and inertial effects. Appreciable technical work in the U.S. seems to have been done on electrogravitics in the 50's and 60's, much of it apparently classified. There are presently strong electrogravitic efforts in Germany, France, and Japan. Scalar electromagnetics is in fact electrogravitics (electrogravitation) and has been successful in engineering gravitational devices such as gravitational and inertial field generators, gravitational field motors, free energy generators, and gravitational turbines. Tesla's secret of wireless transmission of energy at a distance without losses has been rediscovered, as has the secret of his "big eye that can see at a distance." A new land of resonance—scalar resonance—has emerged, as has a new kind of wave, the scalar EM or electrogravitational wave. Scalar wave detectors are now becoming available due to the pioneering work of Dea, Beck, Bedini, and Golden, who have all built scalar wave detectors. A substantial series of devices have been built by Bedini, Golden, Watson, and other inventors who wish anonymity. One of the very first good experimental physicists who built electrogravitational devices was Hooper. Actually, Maxwell's original quaternion theory, published in 1864, was the correct unified theory of gravitation and electromagnetics. After Maxwell's death, Heaviside "translated" (mutilated) Maxwell's theory into his new vector mathematics, discarding the quaternion's scalar component. He thus discarded electrogravitation, setting "modern EM theory" upon its nongravitational course.

51. Electron dissolution: when the virtual photon activity of an electron (i.e., its charge) is directly quenched, the electron is converted to a neutrino or neutrinic wave, which radiates away without interacting with materials or objects. In this case, no ordinary photons are radiated. Orbital electrons in atoms are generally protected from this interaction by being locked into their orbital DeBroglie waves. Free electrons flowing in circuits, however, are susceptible to the effect by scalar wave coupling. By this means, electromagnetic circuits may be dudded by dissolving their currents, without physical damage to the circuitry components. Whenever the agent causing the electron dissolution is removed, currents resume and the circuits resume normal electrical action. Scalar longitudinal 0-field waves can also be absorbed in scalar coupling into the E-fields of currents flowing in a circuit. This can either augment or diminish the E-fields to which coupling occurs. If the E-fields on the flowing electrons are zeroed, the electrons cease flowing, and tin-circuit is dudded.

52. Electrostatic scalar potential (0): virtual photon stress on the 4-dimensional spacetime medium (on the vacuum-ether). (Note that the vacuum can be regarded as consisting of the sum of a large group of such potentials.) The spatiotemporal intensity of the massless charge (of the virtual photon flux through a spatiotemporal point). Nikola Tesla discovered pure longitudinal scalar 0-waves. Present spatial 0 in the ordinary theory is only a special case. 0 can be visualized as a special type of "pressure" in an n-dimensional fluid, where n is equal to or greater than 4. By omitting the potential's stress on time, present potential theory eliminates the potential's ability to affect everything existing in time (for example gravity, fundamental constants of nature, inertia, mass, rate of time flow, mind, life, etc.) It also eliminates the direct engineering of local general relativity, and the concomitant violation of the conservation laws (momentum, energy-mass, charge, spin, etc.) Present electrical theory—and indeed all of physics—is drastically in error by this serious omission. Direct engineering of artificial potentials by patterned zero-vector force field summations is the secret of the long-sought "unified field theory." It is also the secret of the unification of mind and matter into a single scientific discipline.

53. EMP (electromagnetic pulse): a sharp pulse of electromagnetic radiation produced when an explosion occurs in an unsymmetrical environment, especially at of near the earth's surface or at high altitudes. Essentially the same as an electromagnetic shock wave, a wave of great intensity which results when waves with different intensities propagate with different velocities in a nonlinear optical medium. An EMP is also produced when two intense longitudinal scalar electrostatic potential wave patterns meet and couple into a sudden flash of vector EM energy.

54. Endothermic explosion: the sudden absorption of electromagnetic energy in a spacetime area where the energy converts to a potential, and scalar waves radial back to the negatively biased transmitter/receiver, emerging there as ordinary electromagnetic energy. As implosion. All normal explosions are exothermic in nature, and ordinary electromagnetic heat energy is radiated away. A scalar EM howitzer, however, may pro-

duce an endothermic explosion (an energy implosion) at a distance, explosively extracting the heat energy at the implosion site and receiving the energy back at the transmitter site for disposal.

55. Energy: the capacity to do work. Energy is directly tied to the work concept, which is the result of a force moving through a distance. However, "work" refers to the past; that is, the force has moved through a distance against a resistance. "Energy" refers to the future; the force could in the future move through a distance against a resistance. Since the force is tied in turn to a changing mass motion, it follows that—conceptually—energy is tied directly to mass systems. The "energy" that an object possesses depends also upon the observational situation: a moving observer may see a moving object as possessing more or less energy than the lab observer sees. Electrostatic scalar waves do no work and individually have no "energy" per se. Two different scalar waves coupled onto a spinning charged mass, however, produce a system which has mass and energy, and does work.

56. Ether: originally, a ghostly-thin, material, fluid medium postulated to fill space and carry electromagnetic waves, similar to the way in which a gas carries sound waves. The Michelson-Morley experiments eliminated any such material ether, but not a Lorentz-invariant nonmaterial ether (of which vacuum itself is one example, in the modern view). Maxwell's equations were derived from ether theory. Einstein once proposed that the vacuum, complete with its electromagnetic fields, should be called the ether. Indeed, the word "ether" is again acceptable in the literature in context of its modern meaning. Today the "ether gas" is considered composed of virtual particles—that is, the particles spontaneously come into being and then vanish so quickly they cannot be individually detected. That is, today the ether is a virtual particle gas—sort of a gas of "effervescent bubbles", so to speak. Ives derived special and general relativity, Newton's laws of motion (relativistic form), and the square law of gravitation from a Lorentz-invariant nonmaterial ether theory. Zero-point energy of vacuum would also seem to be a Lorentz-invariant ether. The Soviets are believed to have applied and advanced the Ives theory to produce their present theory of energetics, which is highly classified by the Soviet Union. In the new approach, vacuum is identically pure massless charge (virtual particle flux), and thus an ether as Einstein proposed.

57. Evil: refers to an act theoretically detrimental to the receiver or referent, in the positive time stream. It is equally beneficial to the referent, viewed in the negative time stream.

58. Exo-electron emission: emission of electrons from the surfaces of metals and certain ceramics after these surfaces have been freshly formed by a process such as abrasion or fracture. Cracks in metals are good emitters of exo-electrons, and the electrons can be detected, to provide a means of detecting the minute fatigue or stress cracks. The sides of a crack in a stressed metal constitute a scalar interferometer, and scalar interferometry is involved in the emission process. Exophotons are also emitted, in addition to electrons. In an earth tectonic plate fault zone (crack), stress exists on each side of the plate, but not in the middle, and the fault thus constitutes a scalar interferometer, emitting charges and also often creating glowing balls of light

59. Exothermic explosion: an ordinary explosion where ordinary heat and electromagnetic energy are released and radiate away from the explosive site. All normal explosions are exothermic.

60. Feynman diagram: a two-dimensional diagram of particle interactions, both in the virtual and observable levels, and both backward and forward in time.

61. Fireflies: sentient bits of light that sometimes kindle in the presence of a psychic initiator and/or a psychotronic generator. Literally, minute glowing, indefinite thought forms materialized into electromagnetic energy. This can be understood by modeling thought forms as real electromagnetic forms existing in a rotated universe (i.e., as hyperdimensional). Interference causes dimensional shifting, so that ordinary electromagnetic energy forms can result

62. Firewalking: walking on and across a bed of hot glowing coals without the feet being burned. Firewalking is demonstrated in a variety of cultures, belief systems, and locations throughout the world. Recently many Americans have been taking to the practice and demonstrating that it is an achievable phenomenon. In the new approach, the two cerebral hemispheres act as a scalar interferometer. If this biological scalar interferometer creates an endothermic (extraction) field on the surface of the skin of the feet, and simultaneously creates an exothermic scattering of the extracted energy into the surrounding environment, then one can walk on hot coals without burning the feet. Note that the reverse effect-cooling of the external environment—is often experienced when psychokinesis effects at a distance are obtained. For example, poltergeist effects are often associated with an adolescent If the adolescent's cerebral scalar interferometer extracts by inverse scattering, and projects exothermically into distant objects, the movement of the objects can be explained.

63. Fission (action): the splitting of the action quantum into two canonical variables (for example, energy and time), only one of which can normally be completely detected or measured. ("Action" has the dimensions of angular momentum—energy x time, momentum x length, etc.) Fissioning produces length, discrete bit by discrete bit, and time likewise. The physical reality of separated physical objects is thus continually created, discrete bit by discrete bit, monocularly. All that ever exists in the "present" is a single quantum change, just occurring. Recombining of the two canonical action fission fragments is called "fusion." Fusion also occurs monocularly, quantum by quantum. Rigorously, the physical world of separated objects never exists as such except in memory recall of vast numbers of past ordered quantum changes that occurred one by one.

64. Flux: the amount of some quantity (such as energy, particles, volume of fluid, etc.) flowing across a given area (usually a unit area perpendicular to the flow) per unit of time. The term flux density is now more commonly used. Loosely, "flux" refers to the perpendicular flow through an area, while "flux density" refers to the magnitude or intensity (rate) of die flux. In some cases such as a flux of particles of different velocities, the number of particles may be multiplied by the average velocity to give an average flux density.

65. Flux density: the amount of tome quantity (such as energy, particles, volume of fluid, etc.) flowing across a

given area (usually a unit area perpendicular to the flow) per unit of time.

66. Flying saucer: a discoid or other shaped paranormal object observed in the skies and/or landing, taking off, etc. Came into general use in the U.S. in 1947 after Kenneth Arnold reported seeing nine strange flying discs skipping along like saucers. Sometimes used to refer to an unidentified flying object (UFO). The usual "flying saucer" is theorized to be due to temporary materializations from the collective human unconscious; over 80% of these materializations only go so far as the "glowing light" stage, not to the material object stage. A small percentage do physically materialize, then later dematerialize. A small fraction of one percent are considered to be actual ships built on earth by the Soviet Union or one other country. A few sightings may be due to deliberate scalar interferometry at a distance by the Soviet Union and others.

67. Foo fighters: glowing balls of light which occasionally appeared in the skies and played tag with Allied, Nazi, and Japanese planes during World War II. The word "foo" is a corruption of the French word "feu," meaning fire.

68. Force: in mechanics, identically the time derivative of momentum. Simply, changing of mass-motion. One must realize that it is not the mass in motion, but the single undivided quantity "mass-motion" or "mass-velocity" (momentum) that is changed. In present EM theory, force fields are erroneously taken to exist in empty, massless vacuum. However, the mechanical definition is an identity, not an equality. Thus force does not EXIST ON a mass, but CONSISTS OF a changing "mass-motion." Since this force can be induced at a distance (by changing an introduced mass-motion such as a test charge), one is confronted in the new approach with the fact that there is a more fundamental mechanism that produces force itself. This mechanism is coupling of nonidentical scalar fields by and on a spinning charged particle. The INDUCED FORCE consists of the particle's change in mass-motion per unit of time. It is thus a flux—induced quantity in, on, and of a mass in motion.

69. Force field: an effect that can exist in vacuum or on mass whereby a particular type of matter is affected. For example, the "electrical (force) field" can affect and change the state of motion of any charged particle. In classical physics, the force fields are the causative agents; when these fields are zero, then the motion of the particle or system is unaffected. The electric field (E-field), for example, is defined as the force per unit of fundamental charged mass, though usually it is stated as "force per unit charge," with the mass ignored. Rigorously, however, force does not exist in vacuum, in the absence of mass, a priori. The Aharonov-Bohm effect shows that the potentials can interfere to produce effects in charged particle systems—even at a distance, and even when the force fields are reduced to zero. Tesla stated that vector Hertzian waves do not move through vacuum, which is true. Rigorously, two scalar waves move through vacuum instead. When coupled (detected) by a spinning charged mass (an electron, for example), the vector E and B fields are created on and of the moving mass itself; they do not exist in vacuum. This has been a fundamental omission and error in both electromagnetics theory and mechanics. For example, the standard EM equation, E = - 0 is not generally true in vacuum, but it is true on an electron moving in a detecting antenna or on a charged particle moving in vacuum. Any force is produced by the same fundamental mechanism: flux differences encountered by a spinning charged mass. Thus there is a common connecting thread among all forces, and this is the key to a practical, engineering unified field theory. Note that Einstein's equivalence principle, after much pondering, can be taken to be an equivalent statement to the fact that force—any force—consists of a change in mass-motion. In modern quantum mechanics, force is an effect, not a cause, and is derived from the potential by a differentiating operator. The potential is the primary causative agent, not the force. Also, in modern quantum field theory, all forces actually come from curvature of spacetime—i.e., they are all gravitational in origin.

70. Four-space (4-space): a 4-dimensional spacetime, dimensionally composed of length cubed multiplied by time. In the absence of gravitational field, the 4-d spacetime reduces to a Minkowski space.

71. Fractional charge: a hypothetical particle having a charge less than the electron's charge. Often called a quark, where its charge is 1/3 or 2/3 the charge of the electron. Recently, Stanford University researchers have found evidence of free quarks, and in the 1920's Ehrenhaft reported the discovery and production of fractional charges of all sizes.

72. Frame (Lorentz): a frame of reference which is not accelerated with respect to the laboratory observer. In this case, the frame may be rotated (moving at a constant velocity) but it is not rotating (the frame is not accelerated with respect to the observer, and spacetime is not curved). In this case special relativity applies, as do the conservation laws. If the local spacetime is curved, the frame is accelerated and spacetime is curved. Locally, then, general relativity applies. In this case, locally the conservation laws (energy, momentum, charge, and spin) can be violated. However, in ordinary general relativity, it has been tacitly assumed that locally the curvature of spacetime is negligible. Hence locally a Lorentz frame is assumed, and the conservation laws are assumed to apply locally also. In scalar electromagnetics, the local spacetime is always curved and general relativity applies locally. In this case, the conservation laws need not apply.

73. Frame (of reference): a spatial, organized, measured lattice placed in emptiness (space, spacetime). Normally refers to a 3-dimensional, spatial frame. All objects and points in the "universe" or spatial frame are considered to simultaneously coexist at separate, measured points in the frame. Differs from the vacuum in that, rigorously, vacuum has no existing definite lengths and no existing definite time intervals, as these appear only after measurement/detection, and are relative to the observer and to the detection process. The "laboratory frame" is the static reference frame of the observer/measurement. A separate reference frame may be assumed to exist for any fixed or moving object, or centered on any point in another frame. When a type of frame is assumed, the entire class of physical interactions that can occur has been restricted to an assumed set or type. In other words, given the frame, the physics has been assumed. One of the greatest restrictions of an assumed "frame" is to rule out the consideration (existence) of other higher dimensions. In the new theory, higher dimensions are permitted

and an orthogonally rotated frame can be equated to a field and vice versa. Therefore frames are also fields.

74. Free energy: energy obtained from a free or essentially free source. A paddlewheel in a river extracts and provides "free energy" from the river, since one need not pay for the river. Electromagnetically, the idea of "tapping" or extracting energy from an esoteric source, such as the zero-point energy of vacuum, the Dirac sea, a standing electrogravitational curvature of local spacetime, etc. Since scalar electromagnetics is electrogravitation, a locally bent spacetime can be achieved so as to provide either a source or a sink, as one wishes. Thus a practical free energy device is rigorously possible by scalar electromagnetic means.

75. Fusion (action): in the new approach, the recombining of two canonical bits of a fissioned action quantum. The fusion process "cancels" the bits produced by the fission process, and constitutes a negative spacetime operation. The physical world is thus eliminated, bit by bit, in a monocular fusion operation that produces the "past" The "mass" of a particle is taken to be proportional to, and identically comprised of, the absolute value of its fission and fusion rate. When fission and fusion rates of a particle are equal, the particle is unaccelerated; when unequal, the particle is accelerated. Vice versa, when the particle is unaccelerated, the fission and fusion rates are equal, and when the particle is accelerated, the fission and fusion rates are unequal.

76. Geiger tube (Geiger-Muller tube): a tube used in appropriate circuits to detect and count ionizing particles. Each particle crossing the tube causes ionization of the gas in the tube, essentially independent of the energy and nature of the nuclear particle. Thus a uniform discharge occurs across the tube. The tube will detect anything which causes an increase in the ionization of its gas. Since strong scalar waves will do this, the tube is capable of detecting scalar wave radiation of sufficient intensity. In many cases, GM tubes are activated near UFO landing zones, and sometimes near cattle mutilations or other paranormal occurrences. In such cases, the tube is reacting to scalar emissions, not nuclear radiations.

77. Geller effect: refers to the frequent stimulation of paranormal abilities in children and other people who have seen Uri Geller (or someone like him) performing psychokinesis either in person or on television.

78. General relativity: the physics of curved spacetime. As opposed to special relativity which deals with inertial frames moving at constant velocities with respect to each other (Lorentz frames), general relativity deals with accelerated frames. General relativity was founded by Einstein, who made highly restrictive assumptions to simply the complexity of the problem. Briefly, Einstein assumed that, since no means of appreciably curving spacetime was known except by the gravitational force of a tremendous collection of mass, then the only places where appreciably curved spacetime would be met would be near suns, stars, etc. Accordingly, he assumed that the local spacetime of the observer would not be curved, and instead the local frame would be a Lorentz frame. That is, he made the theory a sort of "special relativity with distant perturbations." That way, the conservation laws would be saved, and one could still speak of the energy of objects as opposed to the energy of entire systems. General relativity complete with this severe restriction is called "ordinary general relativity" (OGR), and this is the type of relativity taught in all our Western universities. Note that, by assuming no local spacetime curvature, the ordinary theory actually assumes that one cannot directly (locally) engineer general relativity. OGR is a highly special case, and not at all the type of general relativity we seek in the new approach where we wish to deliberately curve local spacetime and engineer general relativity directly on the laboratory bench. The Soviets do not recognize Einstein's limiting assumption. In Soviet physics journals, papers are regularly published that treat general relativity in an unrestricted manner. These papers include local curvature of spacetime and violation of all the conservation laws as a result. In the West, conservation has been raised to an absolute dogma, and such papers are regularly refused publication. Conservation laws are upheld in the West by artifice and dictum, not by science or experiment! So if the various restrictive assumptions placed on ordinary general relativity are removed, then an "unrestricted general relativity" results. In this relativity, the local frame may be appreciably curved, and any or all of the conservation laws can be violated—often with ease. With an adaptation of Kaluza-Klein 5-d unified field geometry and use of artificial EM potentials deliberately created by summing or multiplying EM force field vectors to vector zeros, EM energy can be transformed into gravitational field energy locally. In this fashion one can engineer general relativity; violate conservation of charge, energy-momentum, and spin; produce free energy engines; transmute elements simply; and produce action at a distance. Initial experiments have positively established the new approach as valid, and a startling new physics is in the offing. In the new scalar EM, gravitational potential becomes locked-up (infolded) electromagnetic forces, and electromagnetic force fields become bleed-off (outfolding) of the inner contents of the gravitational potential.

79. Ghost rockets: materialized tulpoidal "rockets" that appeared in 1946 and 1947 over the Scandinavian countries (Norway, Denmark, and Sweden) and usually seemed to come from the direction of the Soviet Union.

80. Giant photon: a photon with an organized, deliberate scalar substructure. In scalar electromagnetics, the photon is assumed to be one oscillation of the electromagnetic field; thus it is comprised of one E-field wave and one B-field wave. Further, in each point of either wave, a finite group of vectors may exist such that their vector summation or multiplication is zero. Thus a deterministic substructure may be deliberately impressed upon (infolded in) the photon. Such a photon may carry enormous infolded energy in the form of anenergy, and may be designed to perform a particular resonant purpose. In other words, such a photon becomes a "vacuum engine" that structures the virtual particle flux of vacuum in a particular, deterministic manner.

81. Golden booster: a potent scalar wave generator invented by Frank Golden, and used to augment and amplify the Kelly radionics machine. The booster has the unique characteristic of gathering in ambient energy and EM radiation from its surroundings and transposing this into highly patterned scalar radiation. It has the further characteristic of reacting to human intent, and constructing its patterning accordingly. In addition, two motors are incorporated whose needle movements provide

visual indication of the rate of treatment, the frequency of treatment, and how the dosage is progressing. A Bedini scalar wave detector directly verifies that both the Golden Booster and the Kelly radionics machine produce and radiate potent scalar waves.

82. Golden, Frank: inventor and scalar electromagnetics researcher who has developed a variety of scalar wave antennas, an underwater communications system, scalar wave transmitters and receivers, the Golden Booster, scalar wave detectors, and scalar wave spectrum analyzers. He has also developed a prototype free energy motor, a motor that runs off reactive power, a solid state scalar radar antenna, and other significant scalar EM devices.

83. Good: refers to an act theoretically beneficial to the receiver or referent, in the positive time stream. It is equally detrimental to the referent, viewed in the negative time stream.

84. Gravitational field: rigorously, the curvature of spacetime. In scalar EM, gravitational potential is locked-up (infolded) electromagnetic forces which sum or multiply to zero. Electromagnetic force fields represent the "bleeding off" or "outfolding" of these infolded contents of gravitational potential. Gravitational force field is the "bleeding down" of the gravitational potential without outfolding or out-bleeding its infolded contents. Gravitational field is not a field in the sense of Heaviside-Maxwell electromagnetic fields. There is really no such thing as "the" gravitational field; instead, there exists a large number of potentials, locked-in force field vectors, and other entities which change the energy density of vacuum and bend spacetime. The bleed-down of this conglomeration infolded components as a conglomeration constitutes the "gravitational field." If the inner contents of this G-field, or of the G-potential, bleed out, then a different field—e.g., electromagnetic field—is produced. We may thus speak of the bleed-out of either the G-potential or the G-field. Note that flows between pairs, triads, etc. of these individual infolded field components can occur without appreciable change of the overall conglomerate's potential (trapped energy density). Thus the gravitational potential can have a dynamic, structured pattern, and local spacetime can be curved and patterned. E field and B field are one such "pair" of flows where little overall gravitational effects are evidenced, so long as the fields are tree to "flow." In Kaluza-Klein 5-d unification of gravitation and electromagnetics, only a single field—the 5-dimensional gravitational field—really exists. Our world intersects and "bleeds-off' this 5-d G-field in two fashions: (1) the 5-d G-field prefers to bleed-out into its fifth dimensional aspect, which we see as our own ordinary EM force field. (2) The minute remaining 4-d aspects we see as our 4-d gravitational field. To show the order of magnitude difference in bleed-out, the electrical field between two electrons is about 10^{42} or so stronger than the gravitational field between them. Even for protons, the ratio is 10^{36} or so. So it can be seen that, so long as EM bleed-out is permitted, little 4-d gravitational effects are produced. Our normal electromagnetics—which by construction of Heaviside's version of Maxwell's theory is purely bleed-out, thus yields negligible gravitational effects. On the other hand, if we deliberately set the EM bleed-outs against each other so that they zero sum, we "strangle" the escape or bleed-off of the 5-d G-field into EM field. The 5-d G-field is then forced to bleed-off into 4-d G-field. If we then vary the energy of each vector component of the EM zero sum while maintaining the overall zero resultant, we directly pump the 4-d gravitational field. Scalar electromagnetics thus directly converts EM field, force, and energy into ordinary G-field force and energy, and vice versa. In addition, we get enormous gains: For every unit of EM energy we feed into the "zero sum pump," theoretically we can get out up to 10^{42} units of 4-d gravitational/inertial energy by electron release, and up to 10^{36} by proton release. Experimental results have confirmed this thesis. As early as 1969, Hurvich produced an inertial field generator capable of "freezing" weapons so they cannot be fired. Hutchison reports and demonstrates the levitating of up to 60-lb. objects. The American physicist Hooper patented electrogravitational devices in the early 70's. Bedini, Watson, Johnson and others have developed practical prototype "free energy generators." Another inventor who wishes anonymity has developed a small device which produces negative energy and antigravity, at an amplification factor of 1,500,000. Orthodox research in this area is just beginning in the West, but has been highly developed for several decades in the Soviet Union.

85. Gravitostriction: effect in a resistor whereby local gravitational stress flow in a direction results in production of a macroscopic electric force field in that direction, a macroscopic magnetic force field orthogonally around that direction, and minute, randomized EM fields (heat energy) microscopically due to induced microscopic particle motion and interaction. It is the enforced spin alignment of the mass particles (such as conduction electrons) which accounts for the production of the magnetic field. Gravitostriction is the reason that resistive loads can be powered by scalar anenergy flow (electrogravitational flow, massless current flow) and by negative energy flow. During the initial chargeup of a helical coil exposed to a sine wave voltage, no electron mass current flows; however, the massless current (phi-dot) charges up the coil gravitationally. As electron mass current begins to flow (90 degrees into the wave), this gravitational field is bled-off (outfolded) as electric force field (electron mass flow coupled to del phi) and magnetic force field. One can do amazing things with coils and transformers which are not allowed to enter the EM bleed-off phase at greater than 90 degrees

86. Gravity: the phenomenon characterized by the physical attraction of any two material bodies. Ideally, the gravitational force between two masses is proportional to the product of the masses divided by the square of the distance between them. In the new approach, one recognizes that mass itself is defined in terms of, and identically consists of, the time derivative of an action flux. Gravitational field and electrical field, then, become different aspects of the same thing. By affecting the flow of time, scalar waves and scalar potential thus are able to affect the gravitational force between two objects. Antigravity, for example, can be achieved by forcing an object's atomic nuclei to produce phase conjugate (time-reversed) waves (and negative energy and negative time). In negative time, gravity is a repulsion. Hutchinson has demonstrated the levitation of objects weighing up to 60 lbs, albeit sporadically.

87. H-field: historically, the magnetic field. However, it

is poorly named, and should be considered the magnetic excitation, after Sommerfeld. In empty space B and H are proportional, an experimentally determined fact In the new approach, rigorously vector fields cannot exist in vacuum, but can only exist on an observable mass. A "shadow" vector field can exist in vacuum, in the absence of observable mass, as small virtual vectors, each existing on a virtual particle in the vacuum. Such a "shadow" vector field may be regarded as two coupled scalar fields, where the coupling is performed by the virtual particle flux of which the vacuum itself consists. When an observable, spinning charged mass encounters the shadow vector field, it converts the two coupled scalar fields into a vector field. Thus Hertz waves per se are not transmitted through vacuum; "shadow" Hertz waves arc. With an ordinary detector, however, one detects vector Hertz waves, since one detects the precession waves of the electrons in the electron gas of the detecting probe or antenna.

88. Hieronymus, T. Galen: renowned radionics experimenter and inventor of the amplified radionics machine. Hieronymus is the father of modern amplified radionics; most experimenters before him used unamplified machines.

89. Hieronymus device: essentially, an amplified radionics device. Refers to a device similar to the one patented by T. G. Hieronymus in the 1940's. Connotes ordinary amplification rather than holographic amplification of radionics effects. Any similar type device. The Hieronymus device actually processes, and operates with, scalar waves.

90. Hologram: a photographic recording of the pattern of interference between coherent light reflected from the object of interest, and light that comes directly from the same source or is reflected from a mirror. When this photo image is illuminated from behind by coherent light, a three-dimensional image of the object appears in space. The characteristic of a hypothetically perfect hologram is that all its content is contained in any finite part of itself. If one portion is cut out and illuminated, the complete image appears in space. The whole hologram is in each part of itself. Observationally and perceptually, the physical universe is a hologram and in each part of itself, since all of it can be detected from/in each internal particle.

91. Hyperchannel: a channel between orthogonal frames or hyperframes, where anenergies crosstalk. Exceptionally good hyperchannels seem to be frequency dependent, and are referred to as windows, magic windows, or interdimensional nodal points. Some hyperchannels are 38-40 kHz, 150-160 kHz, 1.1-1.3 MHz, 1.057 GHz (the Lamb shift), and in the near ultraviolet (the life force frequency). These frequencies also represent enhanced channels between subquantal (virtual) and quantal (observable) states. A particularly good magic window exists when the infrared and ultraviolet bands being utilized are phase-locked so that the ultraviolet represents a first harmonic of the infrared.

92. Hyperfield: a structure or disturbance in hyperspace or higher dimensional space. With respect to a fixed frame, the electromagnetic field or a more subtle field. We consider the electromagnetic field the first hyperfield. A hyperfield may also be considered to be the electromagnetic field rotated further away from its laboratory frame. The second hyperfield is called the neutrinic field, and the third hyperfield is the mental or mind field. Also called bioframe, orthoframe, hyperframe, biofield, or orthofield. These hyperfields/hyperspaces also correspond to the nested levels of virtual state. Successively higher hyperfields past the electromagnetic field constitute successively lower levels of virtual state.

93. Hyperframe: simply, a frame rotated one or more right angle (orthogonal) turns away from the reference laboratory frame. The laboratory frame is considered to be the zeroth hyperframe. Also called bioframe, bioworld, biofield, orthoframe, orthoworld, orthofield, hyperfield, or hyperworld. Sometimes referred to as a hyperspace.

94. Hyperspace: generically, refers to hyperframes, orthoworlds, etc. May be used in a singular sense to refer to one of these.

95. Hyperspace howitzer: a postulated Soviet scalar electromagnetics interferometer weapon, believed capable of firing an explosion through hyperspace to a distant point, without any travel of electromagnetic energy through ordinary space. Also called a scalar howitzer or Tesla howitzer. The howitzer has several modes of operation: (1) it can be used in exothermic or endothermic mode. In the exothermic mode, the howitzer is biased positively. In this mode it can accept energy, transform it into scalar waves of an artificial potential or anenergy, transmit the scalar waves to a distant intersection zone, interfere them and reproduce ordinary positive electromagnetic energy in the distant region. In the endothermic mode, the howitzer is biased negatively. In this mode it "transmits" the extraction of energy. At the distant interference zone, energy is extracted and reappears back at the transmitter/receiver site, where it must be disposed of. U.S. weather satellite photos of the Soviet Union's Bennett Island reveal giant exhausts emerging from that island, some narrow jets as long as 150 miles and only about 1.5 degrees above the horizontal. Bennett Island is believed to be the "exhaust site" for several Soviet hyperspace howitzers. That is, when a howitzer operates in the endothermic mode, it receives and temporarily holds the energy that comes back to it, then switches biasing potential to positive and transmits in the exothermic mode to Bennett Island. (2) The howitzer can operate in pulsed or continuous mode. In pulsed mode, an explosive or implosive effect occurs at the distant target site. In continuous mode, a continuous energy source or sink appears in th distant interference zone. (3) Fourier expansion mode. Each transmitter of the howitzer can produce multiple frequencies where the frequencies represent a Fourier expansion of a geometrical form such as a sphere. When these two geometrical scalar forms are interfered at a distance, a 3-dimensional form of ordinary EM energy emerges (exothermic mode) or is extracted (endothermic mode). (4) the scalar transmissions of the scalar interferometer (hyperspace howitzer) can be modulated upon ordinary EM carriers, such as the Woodpecker signals in the communications band (3 to 30 megaHertz). In this case, interference patterns of the Woodpecker carrier will yield only minute EM energy, but the impressed scalar substructures may interfere to produce or extract substantial energy in or front the interference zone. Other control signals impressed on the Woodpeckers may be used to trigger the mode and location in the interference zone, or

even to establish "circulations" in the vector zeros. By forming distant high pressure zones (exothermic mode) and low pressure zones (endothermic mode) and then moving the locations along, the Soviets can capture and deviate the jet streams over North America or elsewhere. By swirling in conjunction, tornadoes can be produced. Certain signatures (giant radial clouds and twin giant radial clouds) in the active zone have been identified as associated with the Soviet Union's weather engineering. The strange explosion in 1958 near the Urals is believed to have been an accident involving an early first fullup test of the howitzer. The howitzer was probably similar to a giant radar, transmitting scalar EM wave. By setting up a standing scalar wave and continuing to transmit energy into it, the standing wave becomes a giant potential. It is charged up much like a scalar capacitor, but with scalar EM (electrogravitational) energy. Failure of the transmitter may have discharged this giant potential into the earth, and the electrogravitational ground pulse spread out, striking the nearby stored nuclear wastes and fissioning all the radioactive nuclei. Consequently the nearby atomic wastes exploded, producing fallout and radioactive contamination over a large area. The first fullup test of an operational on-site weapon is believed to have been the destruction of the U.S.S. Thresher atomic submarine on April 10, 1963. The second fullup test is believed to have been the transmission of an explosion into the ocean 100 miles north of Puerto Rico on April 11, 1963—one day after the destruction of the Thresher. Over a hundred howitzers are believed to now be on site and operational, and powered by either Moray amplifiers or giant scalar resonant inference taps in the earth (detected by Golden in April 1985). High Altitude booms off the east coast of the U.S. may have been due to orientation and alignment tests of these weapons, with each test blast the equivalent of some 100 tons of ordinary explosives. If so, these shots were probably artillery high burst registrations. The two puzzling flashes detected by the Vela satellites in September 1979 and later, and erroneously described as a nuclear flash by many analysts, may also have been a test of this type of weapon, either by the Soviets or a second nation that has developed the weapons.

96. Hyperworld: a world (3-space or 4-space) rotated one or more orthogonal turns away from the laboratory frame (ordinary world). Constitutes also (identically) an entire subquantal level in virtual state.

97. Inception: kindling (from mind anenergy) a small amount of photon energy into or onto a body/tuner or other object Specifically, coupling scalar wave patterns (anenergy) onto die body/tuner or object so that the photon energy is created in or on the body at a distance.

98. Inceptive cyborg effect: the ability of the mind to psychokinetically link to, or attune to, an inert physical object or physical system. A living biological system is a stabilized inceptive cyborg, with its mindworld linked to its body/tuner. The two cerebral hemispheres of the brain form a Tesla scalar interferometer, capable of producing and transmitting scalar wave patterns into a distant object, coupling into energy in it, and thus linking with or resonating with the object. This is the mechanism for producing all parapsychological phenomena.

99. Interdimensional nodal point: a natural frequency for an anenergy channel between orthogonal frames or universes. Also called a magic window.

100. Interference: the variation of the amplitude of a wave with distance and time, where that wave results from the superposition of two waves having the same, or nearly the same, frequency.

101. Interferometer: an instrument in which a wave is split into two waves or beams, which after traveling over different paths are subsequently reunited and display interference.

102. Jitter (dither): the incessant quantum and subquantum activity on a fundamental particle of mass. The particle is continually connected to and disconnected from an infinite number of hyperspaces, and to and from time.

103. Kaznacheyev effect: refers to the demonstrated ability of near-ultraviolet mitogenetic photons to carry any kind of death pattern from one cell culture to another of similar kind, in the absence of visible light and with synchronized conditions. Named after the Soviet scientist Vlail P. Kaznacheyev, who experimentally demonstrated the effect In his experiments, two samples of the same cell culture were environmentally separated by a thin window. The entire arrangement was placed in the dark and rotated at some 20 rotations per minute. The cells on one side were then killed by any particular mechanism—ionizing radiation, chemicals, toxins, deadly bacteria, germs, etc. If the window was made of ordinary glass (opaque to ultraviolet), the second sample remained healthy. If the window was made of thin quartz (transparent to ultraviolet), then after a time delay the second sample began dying with the same symptoms ai the first Later testing revealed the emission of mitogenetic, laser-like photons in the near ultraviolet from the dying cells in the first culture. When these mito genetic photons are allowed to bombard the second cultare, the same lethality pattern is induced in it. The explanation is that the photons carry virtual state (scalar) patterns (infolded patterns in their time components), and these virtual patterns are diffused into the receiving culture, where eventually they diffuse into a lethal pattern in the virtual state (scalar) master control system (discovered by F. A. Popp) of the targeted cells. Continued charge—up of this pattern kindles the pattern into a physical, observable structure in the cells, reproducing the death or disease pattern. The Kaznacheyev effect haa been duplicated in the infrared in West Germany. Kaznacheyev almost certainly also phase conjugated (time-reversed) the "death photons," producing healing photons for that specific cellular damage or disease condition. Irradiation of the affected cells with these healing photons would have reversed the disease, reverting the cells to normal. Note that Antoine Priore's machine worked in this fashion. Kaznacheyev's EM healing work with phase conjugated photons was obviously not reported; it represents a total counter to viral biological warfare, and such work would have been done only under KGB control, and highly classified as a vastly valuable defense secret.

104. Kelly, Peter: noted radionics/psychotronict researcher and builder of several types of especially potent amplified radionics machines. He is also one of the pioneers of the use of amplified radionics in agriculture for enhancement of crops, restoration of soil vitality, and control of insects. By direct measurement with Bedini scalar EM detectors, Kelly's machines have been verified to produce scalar waves.

105. Kelly machines: amplified radionics machines developed and built by Peter Kelly.

106. Kervran effect: the ability of a living biological system (either plant or animal) to accomplish limited transmutation of elements, particularly between certain isomers. Named after the French scientist, Louis Kervran, who discovered the effect. Kervran was nominated for a Nobel prize in 1977, although the prize was not awarded to him. The Kervran effect has been duplicated by Japanese, British, European, American and other scientists. Note that scalar interferometry is capable of kindling energy patterns directly into the virtual state interactions of the nucleus, including the strong force that binds the nucleons together. Over a period of time, this energy can cumulate, biasing the quantal statistics of the interactions. This, of course, changes the probabilities of the various quantal states, with the result that the nucleus can be transmuted. Transmutation to an isomer is particularly practicable. Efficient transmutation of elements by scalar means has been accomplished by John Bedini.

107. Kindling: collecting and condensing more subtle energies (anenergy) into virtual photons (charge effects), photons (electromagnetic field effects), or matter (materialization effects). Kindling is a linear integration process, which repeatedly collects or integrates a virtual state pattern until it breaches th observable threshold, becoming physical real.

108. Kirlian photography: field patterns of an object impressed upon a film or other sensitive material by means of spark discharges. The scalar modulations in the spark charge intensity, not the ordinary vector E-field components, are the paranormal components. Thus only the delta—which represents those scalar patterns coupling and kindling into vector EM, which then interacts in photochemical interactions—is indicative of the paranormal aspect of Kirlian photography.

109. Law of physics: a restriction placed upon the physical mechanisms that can occur under certain broad assumptions as to the background situation and environment. Actually, in nature there are no such "laws"; these are only man's synthesis for the behavior of large classes of systems under very general conditions. Any "law of physics" can be violated if the conditions contained in its assumptions are violated. Conservation laws are often touted as "laws of physics." Actually, the conservation laws assume a closed system and a linear spacetime (Lorentz frame). If either or both of these assumptions is violated, any or all of the conservation laws can be violated. In particle physics, broken symmetry already results in violation of one or more of the conservation laws. In leading Soviet physics journals, papers are regularly published containing unrestricted general relativity with concomitant violation of any and all conservation laws.

110. LIDA machine: Soviet device which uses a 40 megahertz carrier and unusual waveforms to induce a catatonic-like state in man or other mammals. For years Western orthodox scientists have argued that EM signals could not directly affect consciousness. With testing of the LIDA device, this has now been totally refuted. One scientist has reported that the I.IDA device—known to be decades old—was used by the North Koreans on some U.S. prisoners of war during the Korean War. Reportedly the effects of the machine could not be resisted, and the machine was a devastatingly effective "brainwaahlng" tool.

111. Life: a term which resists the best efforts of philosophers and scientists to define it! In the new approach, a living system is modeled as consisting of a physical body "tuner" and a mindworld to which the tuner is preferentially tuned to a small degree. The preferential virtual state crosstalk between the physical tuner and the mindworld constitutes the life channel or consciousness loop. Destruction or loss of the preferential tuning results in "death," or loss of attachment to the tuner. In that case the mindworld functions within itself. Note that the being is always present, unchanging, and simply "is," without any connotation of perceptual stringing together separations into a string of events (causal chains). Being changeless, it consists of all changes, all-at-once, hence none separately. Ultimately this is the true meaning and foundation of life, and mindworlds and physical events represent simply separation waves in unlimited being. Note this is completely consistent with the idea that ulti mately only God exists, things are simply separation waves in the unseparated Godness, and God permeates everything.

112. Loch Ness Monster: famous tulpoidal water monster which (occasionally) temporarily materializes in Loch Ness in Scotland. Similar materializations of "water monsters" have been seen and reported in almost every large body of water on earth.

113. Longitudinal wave: a "pressure" type of wave, similar to sound, in which the vibrations are along the direction of travel of the wave. Hence, a wave composed of alternating densifications and rarefactions. Scalar waves are longitudinal waves. In classical EM theory, the Poynting vector predicts no longitudinal wave of energy from a time—varying, electrically charged source. In fact, an exact solution of the problem does allow this longitudinal wave, as shown by Keech and Corun, International Journal of Theoretical Physics, Vol. 20, No. 1, 1981, pp. 63-68. The classical electromagnetic wave is modeled as a vector wave, comprised of transverse vibrations. In the new approach, such transverse vector force field waves (Hertz waves) do not exist in vacuum; instead, two coupled longitudinal scalar waves exist in vacuum. The E and B fields are formed, recovered by, and exist as the spinning charged detecting mass particle in motion.

114. Magic window: a naturally tuned frequency of a good hyperchannel between orthogonal frames where scalar wave anenergies crosstalk readily. Magic windows are frequency dependent, and are also referred to as hyperchannels or interdimensional nodal points. Some magic windows are 38-40 kHz, 150-160 kHz, 1.1-1.3 MHz, 1.057 GHz (the Lamb shift), and in the near ultraviolet (the life energy frequency).

115. Many-worlds interpretation of quantum mechanics: refers to the consideration of multiple simultaneous observers and the consequent changes forced upon quantum physics. Essentially all possibilities exist and are real, and an infinite number of orthogonal worlds exist at any instant. Further, each world splits into multiple possibilities after each and every event. Thus in a single second, the world has split in some 10 to the 20th power versions of itself. This is the work primarily of Everett, with strong contributions by Wheeler and

Graham, and was the subject of Everett's thesis at Princeton University in 1956. It was published in 1957.

116. Mass: literally, a special curvature or "kink" in spacetime emptiness, according to relativity theory. In the new approach, the mass and inertia of a particle are considered to be due to one or more standing scalar resonances, trapped by the spin of the particle. When the amplitude of the trapped scalar wave increases or decreases, the mass and inertial of the particle increase or decrease. If the resonance amplitude reduces to zero, the particle dematerializes. Classically, mass is also taken as the measure of a body's resistance to being accelerated by a force. Specifically, a mass occupies space (3-dimensional) and resists change in its linear movement. In a region of mass, a flux of action quanta into and out of the region exists, corresponding to a flow of positive and negative time. The mass is the sum of the absolute values of the time derivative of action in and the time derivative of action out If these two time derivatives are equal in magnitude, the mass is unaccelerated; if unequal, the mass is accelerated. A mass does not exist in time per se (more rigorously, it exists equally in positive time and in negative time), but only exists spatially. A mass continually interacts with photons (absorption and emission), thus continually connecting and disconnecting to the fourth dimension (time). The mass is thus seen to "jump along" through time in finite, quantized jumps caused by the photon interaction with it

117. Men-in-black: that part of the UFO contact phenomena which involves contact with rather sinister tulpoidal manforms. Typically these tulpoids are dressed in dark suits, have almond-shaped eyes that do not blink, possess oriental features, and "speak" telepathically to the contactee. Often they drive dark automobiles and follow the contactee. Several researchers in the field have had intense encounters with such tulpoids. The appearance of such phenomena associated with an investigator is in part due to unresolved detrimental material in his or her own unconscious mind, which thus acts as a "witness" and radionics tuner. Continual stimulation of this detrimental unconscious witness by the person's investigative activities results in the appearance of, and contact with, such tulpoids. The more detrimental aspects of such tulpoidal tuning can be prevented by psychic clearance of the investigator, particularly of his unconscious mind. Such psychic clearance at regular intervals is highly recommended for investigators pursuing the more bizarre aspects of the field, such as cattle mutilation, men-in-black, sasquatch, possessions, etc.

118. Metal bending: term applied to the psychokinetic bending and breaking of metal objects such as cutlery, rods, bars, etc. When a metal rod is psychokinetically bent, then cross-sectioned and examined under the electron microscope, microscopic "puddling", as if by localized, point source intense heating, can be seen, with concomitant disruption of the metallic grain structure. In a severe case, the cross section looks like the puddled surface of the moon. The mechanism responsible for the psychokinetic bending is exothermic scalar interferometry by the two cerebral hemispheres, where the intersection zone is the metal object being bent

119. Metapsychology: literally, "before psychology." The deeper psychology of the group mind, particularly the collective human unconscious mind. Although the Cartesian idea of the separation of mind and matter usually applies to the individual conscious mind, it does not apply to the group unconscious mind. The collective human unconscious mind is a living being, though unconscious, and is capable of materializing its "dreams" into actual physical forms and beings.

120. Microcrystals: tiny crystals, particularly those used by George Yao in construction of his pulsors. Use of the microcrystal in proprietary manners enables Yao to build devices which react to scalar resonance and human intent, and which can generate negation patterns for potentially harmful "deltas" or changes that occur in the human etheric field (aura).

121. Miller/Fox/Urey effects (experiments): these experiments simulated the primitive conditions believed to have existed in and over the primeval oceans. Water—with its complement of minerals and chemicals—and gases to simulate the primeval atmosphere were placed in a beaker and subjected to ultraviolet radiation and electrical discharges. Thus the experiments simulated the great lightning discharges into the primeval oceans. In the laboratory, amino acids are formed, then proteinoids. If the experiments are performed in the presence of heating (simulating the presence of volcanic activity, for example), then primitive microspheric cells are formed with double cellular walls. These microspheric cells even reproduce by cell division. Thus at least simple lifeforms have been produced in the laboratory. Indeed, in the new model even inert matter is totally alive, but unpreferentially. Also, every possible sort of mind exists. Thus all that is necessary to form a living system with any desired characteristics is to form the appropriate type of physical tuner. A living system is like a television set existing in a flux of radiations from an infinite set of channels/stations. The set tunes preferentially to one channel/station, but any desired channel can be tuned, simply by changing the characteristics of the tuner. One does not "create" life, one simply "tunes it in selectively." In this concept rigorously there is no such thing as "death", but only transition from one state to another.

122. Mind: a quite misunderstood concept! In conventional science, it is considered purely robotic—i.e., it is the sum total of the electromechanical neural processes which receive, code, and interpret sensations, recall and correlate stored information, and act upon it Also considered to be the understanding, reasoning, and intellectual faculties considered as a whole, that is, as the conscious portion. Also considered as the psyche, including the conscious, subconscious, and unconscious portions, considered as a whole. The new approach is more in accord with the latter definition. Simply put, the mind is a world composed of separation events (waves, operations, processes) in unseparated being. We may model it (to a first crude approximation) as a physical universe, three orthogonal turns away from the ordinary physical universe, and tuned slightly selectively to one physical organism's physical body processes. Mind anenergy is considered to be progressively collected, condensed, and kindled into denser substance and objects by rotation toward the ordinary physical world. Thus a piece of inert matter is simply condensed energy, which itself is condensed anenergy, which is condensed mind flux (crosstalk) from all minds. One may model the mind physically, or model the physical as mindstuff, eliminating the artificial dichotomy between mind and matter that presently is assumed in orthodox science. Since per-

ception of thought *is* fragmentation and separation of mind, die mind cannot be perceptually conscious of itself, but only of its separated fragments (thoughts). When the incessant activity of the mind is stilled, however, the stable mind is in its pure state—pure being. In this state there is no separation of the observer and the observed. With attainment of this state, one "realizes" or experiences one's true God-nature. It is theoretically possible to build a scalar wave detector that can directly "see" thoughts. Indeed, the first prototype of this type detector may have already been built by one physicist experimenting with a very sensitive scalar wave detector.

123. Mind linkage: the integrating of two or more minds into a single overall functional mind. A living example is in each human head: the two cerebral hemispheres—each containing its own separate mind—are integrated into one overall brain having a single functional mind. This is accomplished by signals interconnecting the two cerebral hemispheres through the corpus callosum. Note that the "separated beings" of the two minds are also merged/linked into one greater being. The tuned separation of individual humans (caused by the continual photon interactions with each particle of mass in the body tuner) is responsible for all man's inhumanity to his fellow man, for each now perceives others as separate things or "objects." With mind linkage, the human species will emerge as a single great entity, having not only • single "collective unconscious," but also a single "collective conscious" mind. Proof that linkage can be accomplished is already demonstrated by each individual. The problem of resolving all man's inhumanity to his fellow man is thus a technical problem, not just a moral/philosophical problem.

124. Mitogenetic radiation: laser-like, coherent photons emitted by cells, particularly in the near ultraviolet Of particular importance are the photon emitted by a cell immediately after complete fertilization, and the photon emitted as the cell dies. The first mitogenetic photon signifies the kindled connection of the cell's small mindworld and the establishing of the consciousness or life loop. The second mitogenetic photon signifies the loss of tuning and consequent loss of the consciousness or life loop. The photon at cellular fertilization is a joyous song of birth, and the photon at cellular death is a deathsong of the cell. In addition, the birth photon carries the full mindworld pattern nested inside it in the virtual (scalar) state, and the death photon carries the full pattern of the cell's experiences and death nested inside it in the virtual (scalar) state.

125. Monocular (change): one at a time. Change as seen by only a single observer at a time. This type change is provided by the photon interaction with matter, and the "memory hold" of a large number of such monocular changes constitutes the "perceived/detected physical reality" we conceive we exist in.

126. Moray amplifier: free energy device developed by T. Henry Moray of Salt Lake City, Utah in the 1920's and 30's. The device was destroyed by a double agent (an F.B.I, agent and also a Soviet agent) in 1939, after the agent had obtained the drawings of the device and worked in Moray's laboratory for several months. The final device had some 29 detector stages and produced an output of 50 kilowatts of power, without input.

127. Moray, T. Henry: early experimenter and pioneer in radiant energy, who developed one of the most widely demonstrated and best authenticated free energy devices. Moray's device was a collector/amplifier that eventually produced 50 kilowatts of output power.

128. Multiocular (change): more than one at a time. Change as seen by multiple simultaneous observers. Consideration of this type change leads to an infinite dimensional, multiworld or multiuniverse reality similar to the type described by Everett. If one accepts multiple simultaneous observers, then this expanded and startling view of reality is inescapable. If one accepts only a single observer at a time (as does present physics), then there exists only a single living person, and everyone and everything else is simply a figment of his or her imagination.

129. Mystery light: another name for a nocturnal light, or earthstress light, produced by natural scalar transmission interferometry of the cracked rock structures in the earth's crust

130. Neurophone: an instrument for direct electomagnetic input of signals into the human brain and nervous system. The neurophone was invented by Pat Flanagan when a boy of seventeen. The improved version, invented much later by Flanagan, clips an input signal, differentiates it twice, then feeds the resulting noisy spikes into the human sensory system. The original signal is impressed into the brain and directly into the mind. An adaptation of the neurophone, using more than eleven independent frequencies and built in accord with Soviet work reported by Lisitsyn, could conceivably be utilized to accomplish human mind linkage.

131. Neutrinic wave: a bare neutrino, considered as a wave instead of a particle. It is a special kind of polarization wave to the laboratory observer, and interacts with his electromagnetic field. It is essentially a longitudinal scalar wave, which moves in and on ordinary vector electromagnetic waves. It may also be regarded as a sort of "spin" wave, since one may consider it as moving at the speed c, but circling around a photon in a plane perpendicular to the photon's velocity in 3-space. One may thus say that the neutrinic wave moves at the velocity c-squared, but its carrier moves at the velocity c. Since we detect the speed of the carrier, detected neutrinos always appear to have moved at the speed of light.

132. Neutrino: a neutral particle believed to have zero rest mass and travel at the speed of light. One type of neutrino is associated with the electron and one type with the muon. A third type is now believed to exist There is some evidence recently of neutrinos possibly having a small mass, and of one type of neutrino turning into another type. In the new approach, the classical neutrino is a flux of much smaller particles—"bare" neutrinos—inside a photon. In the photon, one flux is taken to rotate clockwise and one flux to rotate counterclockwise (adapted from the phasor theory of Ruderfer). Further, a neutrinic flux from one half of the photon to the other is hypothetically possible, and this flux would constitute a third type of neutrino. It would exhibit mass, and would allow one type of neutrino to turn into the other. The bare neutrino (from the new approach) is of magnitude 1/c times the magnitude of the photon. Further, it moves at the speed c-squared, but since it circulates at the speed c at right angles to the motion of its photon carrier which is moving at the speed c, its detected velocity is always c, the speed of carrier. To an observer in the hyper-

frame of the electromagnetic field, a laboratory bare neutrino would appear as a photon.

133. Newman, Joseph: Mississippi inventor of a free energy machine tested and authenticated by several dozen scientists. Newman is fighting in court to obtain a patent on the device which has clearly been shown to be legitimate.

134. Newman machine: free energy device developed by Joseph Newman. While the prototype does not produce appreciable output power, it does produce an output and keeps its own small drycell batteries charged. It clearly demonstrates the principle and is a legitimate free energy device.

135. Nocturnal light: any paranormal light phenomenon seen at night. Over 80% of the UFO phenomena are nocturnal lights. Also includes phenomena such as "ghost" lights, spooklights, will 'o the wisps, etc. It specifically does not include ball lightning, St. Elmo's fire, and other such rare but normal phenomena. Most of the nocturnal light phenomena are caused by natural scalar transmission interferometry.

136. Observable (state): that part of physical reality consisting of changes (particles, waves, action changes) that are detectable by single instruments. The field on a charged particle is due to the continual emission and absorption of virtual particles. Forces between observable particles are generated by the exchange of virtual particles. Thus all observable forces, fields and changes are generated by unobservable virtual interactions, and observable and virtual reality states are inseparably enmeshed. In theory, no superluminal effect can be directly detected; however, a two-stage detection can be used to detect a superluminal entity. Usually the first stage is an interference between two superluminal entities, where the interference "downshifts" the waves to produce a wave moving at subluminal velocity. This subluminal wave then interacts with a mass such as an electron, and these interactions are accumulated to provide a macroscopic measurement indicative of the presence of the primary superluminal interferents. A two-slit box for the electron inteiference experiment is an example. Also, in quantum mechanics time is not an observable, even in theory. All observation is spatial; rigorously, there is no such thing as a clock in the purest sense. Time is always inferred from a spatial detection or measurement

137. Orgone energy: the subtle living or life energy discovered and utilized by Wilhelm Reich. Reich had discovered and utilized a portion of scalar electromagnetics (electrogravitation).

138. Orthoframe: a frame rotated away from the laboratory frame by one or more right angles. A hyperframe or bioframe. Also called an orthoworld.

139. Orthogonal: simply, at right angles. The intersection of two orthogonal geometric constructs, each of dimension one or greater, is of one less dimension than the lowest dimensioned intersector.

140. Orthorotation: rotation in hyperspace of an object, form, or particle at a right angle to its starting frame. The object loses one dimension in its intersection in the original frame and gains one dimension in its intersection in the frame toward which it rotates.

141. Orthoworlds: orthogonal 3-dimensional physical worlds (frames) that share a single time dimension in their 4—spaces (spacetimes).

142. Paradox (logical): a thing that is true, but which violates one or more of the three Aristotelian laws of logic. All logical paradoxes are simply fourth-law logic cases, and—at least hypothetically—the fourth law can be applied to resolve them.

143. Paranormal phenomena: any phenomena that differ from straightforward, orthodox physical or psychological phenomena. Phenomena beyond understanding in terms of presently known science, causes, and effects. Specifically, phenomena in which mind and matter, or mind and unknown fields, or matter and unknown fields interact observably.

144. Past: reality which has been erased and has ceased to "physically (observably exist" in immediate detection/perception, and which now exists only as an infolded virtual state trace or vacuum memory. (Because the past still exists as an infolded virtual trace in vacuum, the time-reversed wave emitted from a pumped phase conjugate in four-wave mixing can retrace the past path of the wave that struck the mirror and stimulated the emission.) Fissioning of an action quantum produces a "presented" change described by canonical fragments. Fusion of the canonical fragments back into a quantum of action erases the presented real canonical fragments, reducing the "change" to the "past" However, that "fissioned pattern" or virtual substructure continues to exist, infolded into the vacuum. The vacuum retains a perfect infolded recorded memory, therefore, of every quantum change that has ever occurred. (In ancient mystery schools, the set of all such traces was called the Akashic record.) A virtual projection of the change has occurred in the mind world of the observer, however, since the mindworld is nonlocal. The coherent (causal) time-ordered collection of large numbers of such virtual projections in the mindworld reaches the quantum threshold, resulting in a quantum change in the mindworld. The "conscious mind" thus perceives physical reality as a collection of a large number of quantum changes—in short, a macroscopic reality. In actuality this "perceived macroscopic world" rigorously exists only in the mindworld, and thus it exists only in the past (Note how physicist's discussions of such quantum paradoxes as Schrodinger's Cat are erroneously based on macroscopic considerations.)

145. Phase conjugation: a nonlinear wave process whereby a nonlinear crystal, material, or medium creates a nonlinear polarization for an incoming monochromatic wave is generated at the incident frequency by w-w-w= -w. The nonlinear polarization radiates a time-reversed replica of the incoming waveform. The time-reversed waveform has an amplitude proportional to the complex conjugate of the incoming wave amplitude. Though primarily known in nonlinear optics, the time-reversed wave is a solution to the wave equation, and so the phenomenon is universal to all kinds of waves. As can be seen from (w-w)-w = -w, the first two waves modulate each other because the nonlinear medium acts as a modulator. These two waves thus "lock together" as a single scalar EM wave. The scalar wave passes through the electron shells of the atoms of the nonlinear medium, penetrating to the positively charged atomic nuclei. In a nucleus, each incident scalar photon is absorbed, increasing the potential of the nucleus to an excited state. The decay of this excited state from the positively-charged nucleus causes the emission of a time-reversed (TR) photon carrying negative energy. The "emitted shower"

of these TR photons constitutes a TR wave. Thus from the nonlinear material there is emitted a time-reversed wave. This TR wave "backtracks" through space along the invisible path taken by the original incoming wave. Since the phase conjugate wave is time-reversed, it concentrates along its backward path, rather than diverging. Consequently all its energy arrives at the distant location of the source of the original stimulus wave. The nonlinear medium producing the TR effect in response to a stimulus wave is referred to as a phase conjugate mirror. If two monochromatic EM waves w1 and w2 are fed into the nonlinear medium in antiparallel manner, so that the waves are everywhere out of phase, they modulate each other, forming a much more powerful scalar EM wave. This wave then "pumps" each nuclear potential to a much higher excited state. Thus when this potential decays, a much more powerful TR wave is emitted, containing up to all the energy put into the scalar "pump" wave. Note that the excited nuclei do not decay (the excited potential does not decay) until an incoming stimulus wave—say w4—is received. When w4 is received, then a powerful TR wave—say w3—is emitted from the phase conjugate mirror (PCM). This process is referred to as "four wave mixing." Thus a pumped PCM acts as a triodc amplifier, and the incoming stimulus wave acts as a signal on the grid. In the oscillation condition (incoming input w4 at right angles to wl and w2), infinite gain is experienced, so that all the energy in pump waves wl and w2 appear in TR wave w3. This was Nikola Tesla's secret of wireless transmission of energy at a distance without losses; the Great Electrician had discovered what we today call phase conjugation and the pumped phase conjugate mirror. He also discovered its general nature, for he understood that it applied to all kinds of waves, including mechanical waves in the earth. It has been shown that, under proper conditions, it is possible to have self-oscillation in the nonlinear crystal or medium. Such a PCM is referred to as a "self-pumped PCM." Indeed, Tesla's original Magnifying Transmitter would have utilized the earth itself as a self-pumped, amplifying PCM—in other words, as a giant triode where the molten core of the earth already furnished the cathode power for free. A relatively small input "grid signal" (from Tesla's resonant transmitter) would thus have set the earth itself into scalar resonance (giant self-pumping), eliciting an enormous time-reversed wave energy resonant response from the core of the earth. Anyone anywhere on earth with an antenna tuned to the stimulated frequency would have received cheap or "free" energy from the earth itself. The Soviets presently use a version of this method to power their enormous scalar EM wave Tesla weapons. All unorthodox resonant free energy devices (built in secret by unorthodox inventors) presently use variations of this same principle.

146. Photon: the basic action quantum. It may be considered as an oscillation in and of time. It may also be considered as a virtual pattern of positron/electron pairs. A piece of electromagnetic radiation when it interacts as a particle. One half the photon exists in and carries positive time (negative charge), and the other half exists in and carries negative time (positive charge); thus one half is "normal" and the other half is "time-reversed" (phase conjugated). The magnetic field of a permanent magnet, for example, thus consists of two types of coincident magnetic field lines: one line of each coincident pair is in positive time and by convention runs from the north pole to the south pole, while the second line of the pair it in negative time and runs from the sooth pole to the north pole. The two lines maybe considered as two streams of particles, one negative and the other positive (Howard Johnson's two-particle theory of magnetism). The photon may be considered as two contrarotating neutrinos, after the work of Ruderfcr. In the new approach, each of these rotating neutrinos is considered to be composed of vast numbers of circulating bare neutrinos. The photon may be considered as one cycle of an electromagnetic wave. The photon is the basic carrier of time and consists of a piece of energy welded to a piece of time, with no seam in the middle. The passage of "time" thus moves at the speed of light, its carrier. All ordinary photons possess the same action magnitude, h, although they do not carry the same energy. If the photon is made subquantal (i.e., less than h in magnitude), it is a virtual photon of the type whose emission and absorption cause charge on an electron. Virtual photons are not individually detectable, even in theory. However, a virtual photon may have positive mass under some circumstances.

147. Photon interaction: the absorption and emission of photons by particles or objects. Usually the photon interacts with an orbital electron, being absorbed by the electron which is raised into an excited state. Then the election decays from the excited state, emitting another photon. The macroscopic world is created by this interaction, which is the basic quantum change interaction. When we introduce additional photon interactions beyond the ambient background, the nucleus stays basically stable, and the normal first-order world we perceive seems quite stable. This is the first level of physical reality, and it is the reality sensed by our coarse physical senses. However, scalar waves are emitted and absorbed by the nuclei of atoms, passing right through the electron shells without interaction. When we introduce additional scalar interactions beyond the ambient background, the nuclei change appreciably, and this level of physical reality may be far from stable. This is the higher reality, and it is sensed by the scalar electromagnetic functioning of our nervous system. Unfortunately, this system outputs only to the deep unconscious, since it is highly multiocular. Thus our conscious mind, being monocular, does not perceive the most fundamental reality in which we exist. Note that "time" is the special dimension in which multiple objects can exist simultaneously in the same interval, while space is composed of dimensions (length) in which multiple objects cannot exist simultaneously in the same interval. Time is multiocular, and space is monocular. Our conscious mind is fitted to the monocular photon interaction; being monocular, our conscious mind cannot be aware of time directly. For that reason we do not "see" time consciously. We do "see" it, however, unconsciously. The true meaning of being "lost" is to be separated from the consciousness of the All, which is separation of our conscious, gross sensing of first order reality from our finer, more subtle, and infinitely richer—and unconscious—scalar sensing of ultimate reality.

148. Photon quenching: the effect of photon emission carrying away time, constituting a time-differentiation of spacetime and leaving behind a spatial reality. This action is responsible for the destruction of the time dimen-

sion in the detection/measurement processes of our physical instruments and our body sensory systems. Thus all detections and measurements are spatial, and we detect and perceive only a 3-dimensional spatial universe, not a 4-dimensional or higher spacetime. Photon quenching is thus a filter between us (our senses and instruments) and fundamental reality. Physical reality as detected by our senses and instruments is real, but only partial. Specifically it is a time-differentiation of fundamental reality. We thus lose the ability to detect those things which occupy time but not normal 3-dimensional space—such as mind, thought, etc. Almost all our thoughts, concepts, words, and ideas are fitted to this partial reality—and this is the universal human problem and delusion. We see a spatial universe of separated spatial objects, while in actuality we exist in an undifferentiated single wholeness. It is not a matter of loving one's brother or sister, it is a matter of being him or her. Fortunately, with scalar electromagnetics much finer instruments can be built The quantal limitation of ordinary physics is not a limitation in scalar electromagnetics. Ultimately we will be able to use sophisticated scalar sensors and biofeedback training to awaken and develop consciousness of our scalar sensing of higher reality, and restore man to his proper state.

149. Piezoelectric effect: In a material, the appearance of a voltage when mechanical stress is applied, or of a mechanical stress when a voltage is applied.

150. Poltergeist: allegedly, a spirit or ghost, often mischievous, usually associated with anomalous psychokinetic activity in houses such as slamming doors, levitating and flying objects, displacement of persons or objects, etc. Often the poltergeist phenomena are associated with an emotionally upset or distraught adolescent. The experience of cooling of the surroundings when these phenomena are evidenced is also common.

151. Potential: locked-in work or energy at a point It is important to realize that, like a runner running in place, the potential represents work continually being done in time, but at a point, not released through a distance. Since the work is never spatially released, to the external observer it remains in the present as energy, and does not pass into the past as work accomplished! Prior to observation (passage from the present into the past), the physical universe exists as action or angular momentum—e.g., as "energy x time," or "momentum x length," etc. The two variables in which angular momentum is expressed are referred to as "canonical variables." They are locked together, since their product is a constant (in a nonlinear frame). Thus if we ask "what exists in time?" we have asked "what is the time derivative of action, which is the same as "what is existing in time but not in space?" The answer then is energy, which—before observation (separation) exists undifferentiated as (energy x time). Ironically, in electromagnetics the electric (electrostatic) potential is completely misdefined. Most texts start about to define it in terms of "potential difference," and then only tell how to prescribe the intensity or magnitude. For example: "The work which must be done against electric forces to bring a unit charge from a reference point (often at infinity) to the point in question." Note this "definition" does not at all tell what a potential is, but instead tells how to mathematically determine its intensity. Briefly, electric potential is a locked-in stress in vacuum spacetime. This stress at a point is due to the intensity of the virtual particle (virtual photon) flux (dynamic, ongoing, trapped virtual work) at that point The ambient local stress of vacuum is not zero, but is a very high value. Normally we refer to "potentials" as measured from the ambient; that is, we actually specify the "difference from the ambient value of the spatiotemporal stress due to virtual photon flux" at the point in question. Any change in the ambient stress of vacuum is a curvature of spacetime. The electrostatic curvature normally stress-relieves almost immediately as electric force field on matter, or electric virtual force field in vacuum. In Kaluza theory, the electromagnetic force fields are just the 5th dimensional aspect of the 5-d gravitational field. The 4-d gravity field is the other aspect of our 4-<i world's intersection with the 5-d G-field. Thus the electrostatic and magnetostatic potentials are simply two coupled aspects of the 5-d G-field. A normal electromagnetic force field (E or B) is the "bleed-off" or escape on charged particles, of the 5-d gravitational field potential's infolded stress contents into the fifth dimension. That is, it is the 5th dimensional outfolding of the inner contents of the gravitational potential. If we wish to achieve bleed-off into die 4-d G-field instead of the normal 5th dimensional E and B fields, then we must "shut off" the EM bleed-off/out This shutoff can easily be done by opposing and reciprocally modulating E-fields and/or B-fields so that they lock-together as one field, and vectorially sum to zero vector resultants. This creates artificial (internally structured) electrostatic and/or magnetostatic scalar potentials. These potentials are actually 5-d G-potential, which is now forced to bleed-off/out into the 4-d gravitational force field at great amplification. This is the outfolding of the inner contents of the 5-d G potential into ordinary 4-space. Such an artificial potential produces a vector zeroed 5th dimensional EM system with a deterministic substructure, which polarizes the vacuum and engineers the virtual state. Maxwell's original 1864 quaternion theory included this theory, though not in these specific terms. Heaviside's mutilation of the theory into vectors threw away the electrogravitational aspects by discarding the scalar component of the quaternion.

152. Prigogine crystal: an amorphous pellet or crystal made by sintering finely divided material at high temperature and pressure, in such fashion that the pellet becomes a highly stressed system far from thermodynamic equilibrium. Specifically, more than one type of material must be used, one ingredient of which must be piezoelectric. One ingredient should also be radioactive, and preferably one of the uranium compounds exhibiting highly anomalous magnetic spin coupling. For best results, a third ingredient should be luminescent when electrically stimulated. The stress on each grain of the piezoelectric material must be just so that the grain is on the very verge of being slightly stress cracked, but not split Each grain then becomes a scalar interferometer. Such a crystal produces a scalar potential field and can react to minute changes in potential—i.e., it can react to scalar waves. Via scalar interferometry it can change scalar waves into negative (time-reversed) electromagnetic radiation and energy at a slight distance. Under oscillating potential stress, the radioactive ingredient provides a one-way gate valve from the Dirac Sea electrons of vacuum, and the scalar interferometers provide necessary impetus on these negative energy electrons to lift

them out of the Dirac sea, producing negative electricity and currents. These currents can then be collected in multiple stages to provide electrical power (negative power operates devices much better than positive power). In the proper arrangement, such a Prigogine crystal can be made into a system capable of tapping the energy of vacuum directly. T. H. Moray built exactly such systems in the 1920's and 1930's, finally obtaining 50 kilowatts of negative power from a 55-lb device. J. Bedini has produced modern versions of these stress crystals in the 1980's, and a series of negative power devices. Several other inventors have produced successful negative power devices also.

153. Prigogine effect: the exhibition of negative entropy by a properly stressed many-particle system far from thermodynamic equilibrium.

154. Prigogine system: a many-particle system which is deliberately forced to exist far from thermodynamic equilibrium, and which exhibits negative entropy. Note that local curvature of vacuum spacetime places the local virtual state flux in nonequilibrium conditions, with the result that an observable energy "sink" or "source" can be produced.

155. Priore, Antoine: French inventor, who invented a large electromagnetic machine which produced nearly incredible cures of terminal cancers in hundreds and hundreds of laboratory animal tests in the 1960's and early 1970's. Priore's results were presented to the French Academy by the Secretary Perpetuel and Head of the Biology Section, M. Robert Courier. The French Government financed Priore's work for several years, then abandoned it when the regime changed. Priore produced complex phase conjugate (time reversed) EM signals in a giant rotating plasma, then sent these time-reversed signals down a rippling magnetic field into and through every cell of the treated body. By magnetic resonance of the rippling field, the phase conjugated signals were coupled into the atomic nuclei of the body, thus reversing the harmful structuring of the cellular biopotentials, which are centered in and on and from the atomic nuclei. This "backtracked" the circulating substructure components within the biopotential, reverting it back to a previous state where the disease was not present Kindling this pattern into observable state thus reversed and eliminated the disease. (The sharp reader will immediately note that it is readily possible to reverse the aging process, given the development of this technology. So-called "eternal physical life"—or certainly indefinite physical life with youth and vigor—is achievable.). With the death of Priore, the work has ceased and the machine has been dismantled, since no one in the French Academy knew of phase conjugation or understood how it worked. Priore's last machine was nearly four stories high and was intended to treat terminal human cases as well as larger animals such as monkeys.

156. Priore machine: a device built by Antoine Priore in France, which cured terminal cancers and leukemias in thousands of laboratory animals in the 1960's and 1979's. Complex nested modulations were mixed in a rotating plasma, which modulates the signals (producing nested stages of modulations upon modulations, which is necessary to reach into a sufficient number of hyperspaces/nested virtual levels of vacuum). The device produced very complex, phase conjugate (time-reversed) hyperspatial signals of some 17 or *more dimensions* These time-reversed signals were imposed upon and intense, rippling magnetic field carrier, and induced into the body of the irradiated animal, eventually causing the remission of the disease after several treatments. The signal was able to "work on" some 17 levels of the biopotential. Hundreds and hundreds of terminal cases were cured in laboratory animals. The nested modulations formed hyperspatial, multidimensional components in their "giant photon" vacuum engines. This constituted scalar electromagnetic and virtual state engineering in 17-d spacetime, and the machine directly affected the life force frequency channel (consciousness loop) and master virtual electromagnetic (scalar wave) control system of the cells. It would appear that Priore had worked out combinations of frequencies, etc, that, when expressed in time-reversed waves, reverse abnormal mammalian cells, but do not affect normal cells. With the change in regimes in France and the death of Priore, the large new machine (which would have been used to treat humans) was dismantled and the discovery passed into disarray.

157. Probability: the probability of a simple event is the ratio of the number of times it occurs to the total number of trials (for a large, essentially infinite number of trials). Note that "trials" constitute things that have occurred (are past). Probability has resisted rigorous logical definition by Aristotelian logic; the reason is that it is an expression of the fourth law, the identity of oppositcs. Probability is the expression of the future (that which has not occurred) in terms of the past (that which has occurred). Since we have been trained to conceive or think of something as if it had just been perceived to occur, then this is the only way we can conceive the future. But with Aristotelian logic, the future cannot be composed of the past, and probability has no acceptable logical basis. With four-law logic, the future can be modeled in terms of—and even be identical to—the past, and probability has a logical basis. Consider "throwing a die to land with one face up." Thinking of the event (as if it has just occurred, in terms of the most recent past), one can conceive six ways of looking at it In other words, one can conceive of six "most recent pasts." By the fourth law, the total "most recent past" is identical to the "most immediate future," on the boundary. If one therefore collects all six "most recent pasts," they turn into the most immediate future, by the fourth law of logic. One may attempt to argue that only a single one of the events will actually occur. Here one counters with the observation that, when it occurs, it is the past, not the future, and it has not been collected so as to move to the boundary.

158. Problem of change: as stated by Heraclitus: if a thing changes, it must turn into something else. But how can a thing be something else other than itself? The paradox cannot be resolved by 3-law Aristotelian logic, because the concept of change assumes the fourth law (i.e., that a thing can be identical to something other than itself)- The problem is resolved (by the fourth law) merely by accounting the time snapshots in which a thing is perceived, detected, observed, conceived, thought, etc That is, the original thing was perceived in time snap 1. The next thing was perceived in time snap 2. In yet another time snapshot, snap 3, the two previous snapshots are compared (in memory, which is the only place the past exists). If that comparison finds no distinction or differ-

ence between the first two snaps, then they are declared identical (by a decision algorithm). If the comparison in time snap 3 finds a difference between the previous two snaps, then they are declared nonidentical (by a decision algorithm). Most simple macroscopic things are seen as a multitude of composite attributes. Thus one or more of these attributes may be seen to have changed (not be identical between snaps 1 and 2), yet a host of other attributes may be seen not to have changed. In this case, the two overall objects are seen to be "almost identical but not quite," so that one speaks of "the thing having changed." One implies it changes in some attributes, but remains the same in most others. This is the primitive derivation of "how a thing changes, yet remains itself." On the other hand, if one defines a hypothetical thing which has only a single attribute—itself—then that thing cannot change, by Aristotelian logic. Yet even such a thing can change! Consider the single overallness of a caterpillar. Let metamorphosis occur, and it is now a butterfly. Now between snaps 1 and 2 we see a different overallness, yet we declare it the same thing! Here we have a more direct application of the fourth law: one thing (snapshot 1) can be identical to another thing entirely (snapshot 2) if the distinction between things one and two is lost in the decision algorithm applied in snapshot 3. In other words, identity and nonidentity are not absolutes, but are products of the decision criteria invoked in determining them. This resolves the age-old philosophical problem of change by expanding the logic by means of which one examines the problem.

159. Problem of good and evil: the paradox posed by the assumption of a "good only" creator moving forward in time, and the simultaneous existence of evil. I.e., if God is perfect and all powerful, how can imperfection exist? This problem is simply one expression of the "time trap." That is, the unconscious assumption of a creator moving forward in time (and "acting" and "operating," for example) is a limitation—hence an imperfection—unwittingly placed on the concept of a creator. Hence an imperfect creator could well wind up with the existence of evil (imperfection) in the creation. If one makes God unlimited—even by time—then perfection may be restored to the creator concept One then separates a positive time stream and a negative time stream (these are arbitrary, since in ultimate reality all events exist at once, unseparated, and ordering may be accomplished in any fashion one wishes). In the positive time stream, an act then becomes either good or bad, depending on whether it is beneficial or detrimental to its referent. But in the negative time stream the same act is reversed and becomes the exact opposite with respect to the referent. Thus any act is ULTIMATELY both good and evil simultaneously, and to the exact same degree. Hence in the "all-at-once" of the unlimited level, the two aspects zero and cancel, and there is neither good nor evil exclusively. Yet there is all good and all evil nonexclusively. The unlimited God is thus both good and evil simultaneously but nonexclnsively, and neither good nor evil exclusively. This is the resolution of the unsolved philosophical (and theological) problem of good and evil.

160. Psychic surgery: paranormally opening and closing the flesh of the body to remove abnormal growths or tissues. In a less drastic case, operating on die etheric or subtle energy body, rather than the physical body. In legitimate psychic surgery, scalar interferometry from the surgeon can nullify the cohesive charges binding the tissue cells together in a line; the tissues then open without cellular damage. When the surgeon closes the tissues, scalar interferometry again restores the charge and cellular binding, so the wound is "healed" without scarring (or with very little, in the practical case).

161. Psychokinesis: inceptive influence or effect upon a physical object, system, or situation by mental intent Psychokinesis is accomplished by means of scalar anenergy wave patterns projected from the two cerebral halves in the fashion of a scalar interferometer. The waves interfere at a distance, microscopically in the object to be moved or affected, forming microscopic bursts of vector wave energy in the object itself. Jack Hauck has referred to psychokenetic bending of metal as "warm forming."

162. Psychosis: seriously impaired mental functioning so that gross interference occurs*" with an individual's ability to function in a normal mental fashion. Generally characterized by severe mental disturbance, withdrawal from reality, delusions or hallucinations, regression and personality disintegration.

163. Psychotronic generator: a device which produces observable effects by collecting, condensing, amplifying, and/or processing subtle anenergies or scalar waves. Classic examples are the psychotronic generators of the Czech engineer, Robert Pavlita. Psychotronic devices are virtual state engineering devices that process and utilize scalar EM waves of massless charge flux. Most of Pavlita's devices are "charged" by the natural scalar electromagnetic emissions of the human brain and nervous systems.

164. Psychotronics: *psycho-* (mind energy), *-ronics* (electronics or devices). The union of subtle (mind) energy (that is, anenergy or scalar waves) and matter or electromagnetic field. Czechoslovakian term for parapsychology, with emphasis on the energy aspects. The comparable Soviet term was originally psychoenergetics, which was soon shortened to energetics. However, the Soviets have applied scalar electromagnetics (electrogravitation) principles and massively focussed on weaponry, not just parapsychology. 'Virtual state engineering. Electrogravitational engineering. Scalar wave engineering.

165. Pulse mode: in a transmitting scalar interferometer, projection of a single sequential pair of Fourier scalar wave patterns or "pulses", so that the second pattern meets the first over the distant target area. Flash coupling of the two scalar patterns in the target zone produces a single intense electromagnetic pulse (EMP) which—if atmospheric—interacts with the plasma expansion of the atmosphere to produce a second pulse immediately after the first The dual pulsed flash signature of the scalar interferometer weapon's burst in the target area is very similar to the two-pulsed flash from a nuclear explosion, but without nuclear debris and fallout Two such pulse mode flashes from a Tesla howitzer—possibly the Russian one at Saryshagan Missile Test Range or one from another nation—have been detected off the southwest coast of Africa by U.S. Vela satellites, one in September 1979 and one in December 1980. Other similar tests have been reported. The pulsed flash may produce positive energy (exothermic) or negative energy (endothermic), depending upon the setup.

166. PulsorR: scalar electromagnetic microcrystal device invented by the electrical engineer George Yao. PulsorsR are specifically designed to correct or smooth the patterns of the subtle scalar electromagnetic "bodies" or levels.

167. Quantum: a single "particle" of the quantity action. The quantum is always composed of two fundamental quantities (canonical variables), and it is the "fissioning" of the action quantum into two pieces which results in detection of one of the pieces. An indefinite "smear" of part of the two pieces may be simultaneously detected by a linear detector, but never both exactly (Heisenberg uncertainty principle). More recent work has shown that, in a highly nonlinear situation, both canonical variables can be determined simultaneously to any desired degree of accuracy, in which case the Heisenberg uncertainty principle does not hold. This fundamental change in what has been regarded as one of the "sacred laws" of physics has not yet made it into most physics texts.

168. Quiton: a little piece of vacuum or emptiness. A piece of the medium of a space or spacetime, of any dimensionality. A piece of pure massless charge flux. A piece of pure scalar wave flux. A piece of pure virtual flux. A piece of the vacuum. A particle of electrostatic scalar potential (infinitesimal charge). A "vacuum engine." Quitons are at least 4-dimensional (spatiotemporal), not just spatial and have a dynamic structure, which may be either random or deterministic. Note that the paper handed to Los Angeles Times reporter Bob Toth by Petukov in Moscow, resulting in their seizure and charging with possession of high Soviet state secrets, contained a theory based on "little pieces of the medium" ("little pieces of vacuum.") In other words, it was a quiton theory, regardless of the specific terminology utilized.

169. Radiant energy: term used by T. Henry Moray to describe the subtle anenergy his amplifier tapped from the unlimited vacuum energy of the cosmos, furnishing usable electrical power of an unusual (negative power) nature. By 1939 Moray was obtaining 50 kilowatts of power from the output of a 55-pound amplifier of some 29 stages, and an additional 50 kilowatts could be tapped off from any other stage. Moray's amplifier was essentially holographic, and could produce exponential amplification to any degree, merely by adding stages. The term was first used by Nikola Tesla, who patented "radiant energy" signaling systems shortly after 1900.

170. Radionics: the use of electrical apparatus (such as ganged precision resistors and potentiometers) to accurately attune the innate psychic and psychokinetic abilities of a human operator. Specifically, the operator may be attuned to some person or object at a distance, through the use of a "witness" (something containing the subtle anenergy pattern of the person or object). In actuality, the pattern contained by the witness consists of the previously impressed virtual (subtle) (scalar) energy patterns riding in and upon the object's internal electromagnetic interactions. The infolded vacuum retains an exact pattern and path of all photon interactions, be they observable or virtual. This guarantees a vacuum path exists between the witness and the original object, no matter where it is located. These impressed scalar EM patterns constitute a sort of complex "tuning fork" attuned to the impressing object or person through hyperspace (via the infolded past "backtrack" virtual memory of vacuum). Production of phase conjugation waves (time-reversed waves) in the witness thus will result in travel of these waves back through the infolded "backtrack paths" to the distant object itself. Resonating the "witness" pattern with amplified anenergy from the operator produces sympathetic anenergy resonance into the witnessed object at a distance, through the hyperspace backtrack path. Since the operator's will and intent modulate and pattern his input into the amplifier, the anenergy resonance of the distant person or object is correspondingly modified. This causes the kindling of an actual microscopic energy pattern in the distant object. The use of amplification constitutes the modern phase of radionics, essentially introduced by T.G. Hieronymus. In the Soviet Union, the incredibly powerful Moray hyperspatial amplifier is believed to be in use in a variety of energetics or psychotronics weapons. Such a holographic amplifier yields exponential power amplification to almost any degree desired. In the destruction of the U.S.S.Thresher in April 1963, a photograph of the submarine was probably utilized as a witness, and sufficient negative energy was kindled into the distant underwater submarine to seriously interfere with its controls. The sub then sank to crush depth and was imploded. Negative energy splatter in the surrounding area so interfered with the electromagnetic systems of the companion ship, U.S.S. Skylark, that over an hour and a half was required to transmit the emergency message that the sub was probably lost. In the U.S, holographic amplifiers have not formerly been developed, and radionics power is limited essentially to the linear amplification abilities of ordinary amplifiers. Thus their gains may reach 10^4, when indeed 10^{20} or so is needed for direct mechanical results immediately. For this reason the West has not developed dependable detectors of subtle energies, has not recognized the Soviet superweapon developments, and has not developed counters to them. However, Bedini, Dea, Beck, Golden, Dayney, Bielek, Bise, and other inventors have built scalar detectors of one form or another. Golden has also produced a highly specialized "booster amplifier"—the Golden booster—for Kelly radionics devices that is a step in the right direction. Both the Kelly machine and the Golden Booster have been verified as scalar wave radiators by actual measurement. With the development of detectors, the technology should begin to develop much faster in the West. The science of such devices and effects.

171. Reality: that which is actual or objective, as opposed to merely possible or ideal. One's idea of what constitutes actual and objective, however, strongly biases what is regarded as real and what isn't. In physics, for example, virtual actions are essential infinitesimals—little pieces of "nothingness" which yet produce effects. Physics thus has extended the meaning of "objective" beyond the idea of "observable." In addition, time—which is never observable or detectable, even in theory—it nonetheless assumed to be real and objective. In a sense, by "reality" one attempts to imply "ultimate." Indeed, the concept is confused, vague, and incapable of definition except in accord with what one pre-assumes it to be! The major problem is that most persons assume (1) reality is limited, and (2) reality is singular. In the new approach, reality is both unlimited and multiple. Everything is real; there are just differing degrees of reality or solidity as compared to the ordinary physical detection

(threshold selection) process. Reality becomes a matter of intersections of physical universes and objects with other physical universes and objects, with the density of the intersection specifying the density or degree of physicality. (Note the similarity to the Aharonov-Bohm effect).

172. Reincarnation: refers to some element of the mind and/or personality surviving the physical death of a body/tuner, and being reborn in the body of another infant In the new approach, a type of reincarnation is scientifically derived as a consequence of the theory. However, since the past can be changed, by deep developmental work one can actually change one's so-called past incarnations. Also, more than one living person's scalar pattern can be attuned to a similar "past" scalar personal pattern—and so more than one person can be the "reincarnation" of a past person.

173. Remote viewing: the ability of human subjects to receive visual impressions and information from distant actions and scenes. The information is usually "noisy". May involve combinations of clairvoyance, clairaudience, precognition, postcognition, and telepathy. In the new theory, one recognizes that all detection is internal to the detector. Hence the entire detected physical universe may rigorously be said to exist inside each physical particle of the physical body of the observer. Thus hypothetically one has subtle access to any portion of the universe directly within oneself. The same result occurs when one assumes the use of a signal—longitudinal scalar waves of electrostatic potential—with infinite velocity. The two cerebral hemispheres act as a scalar interferometer, producing microscopic E-field by coupling incoming or rising microscopic scalar phi-field waves. This allows modification of the patterning of the avalanche discharges underway in the brain, and thus perception of the distant event Since scalar waves are hyperspatial and can be superluminal, they can move through time. This permits perception of the future and the past Unfortunately the outputs of this detection system in humans is buried deep within the unconscious nind, so it is difficult to obtain "clear signals." With the future development of sensitive scalar wave detectors, biofeedback training can probably be used to more fully develop this scalar sensing ability. Also, on several occasions Nikola Tesla announced the invention of a "big eye" that could see at a distance; such an instrument is perfectly possible by scanned scalar interferometry reception. This would include the ability to see into or through the ocean or earth—and time as well, under the proper circumstances. It should be possible to take distant pictures, or even pictures through time. One researcher, George Delawarr, reported the accomplishment of both these effects with his special camera.

174. Resonance: in physics, an oscillation phenomenon exhibited by a physical system driven by a periodic force; when the frequency of the driving force approaches a natural "free response frequency" of the system, the oscillation of the system becomes large. The "resonance (or resonant) frequency" of a system is a frequency at which some response of the system becomes maximum. Three types may be defined: (1) Phase *or* velocity resonance, where the response of the system is 90 degrees out of phase with the driving force, (2) amplitude resonance, where the amplitude of response of the system *is* maximum, and (3) natural resonance, which is the frequency of oscillation of the system to a sharp input such as a hammer blow. Electrical resonance exhibited by an alternating current reactive circuit results in relatively large currents near certain frequencies, together with the nearly unimpeded oscillation of energy back and forth between potential and kinetic form. There are two kinds, series and parallel resonance. In series resonance, the inductance and capacitance are in series, and in parallel resonance they are connected in parallel. In the series resonant circuit, the currents can become large if the resistance is small. Further, the voltages across the coil and capacitor are essentially 180 degrees out of phase, and so they essentially "cancel," leaving very little voltage across the overall circuit, even when the individual voltages across the coil and across the capacitor are very large. (Note that the E-fields across the inductance and the coil are also 180 degrees out of phase, and so the series resonant circuit to a distant observer produces an artificial potential wave—indeed, an electrogravitational wave. This is one reason why Tesla so favored the series circuit He also favored it with one end loose—the so-called "single-wire" circuit, without a return.) If the driving voltage to such a single-wire series resonant circuit is applied to the coil with the open-ended capacitor beyond, and the voltage is applied for only the first 90 degrees as a sine wave then instantly removed, the coil will be charged without current flow, accumulating a 5-d gravitational potential. When the coil discharges, it will discharge in two directions, producing real current, at a certain frequency (which may be drastically different from the "normal electrical current" resonant frequency. However, actual current will be induced out of both ends of the coil at this frequency. The capacitor will charge a little bit from this effect. The overshoot of the coil discharge back toward the disconnected driver is also usable energy if connected to a proper load. If the load is removed and the driving voltage is reapplied just as the overshoot reduces back to zero, the cycle is repeated, charging the distant capacitor more and more, and producing pulses of usable power through the overshoot discharge on the driver side. By adapting this mechanism, a free energy motor can be readily produced, as demonstrated by Bedini, Watson, and others with a battery-driven, series-wound DC motor unit Note that use of the localized gravitational potential produces local general relativity, a.locally bent spacetime, and the conservation of energy, charge, and momentum laws need not rigorously apply. An adaptation of this mechanism was also utilized by Tesla in his magnifying transmitter. In that transmitter with its huge elevated capacitance, the artificial potential wave produced would have been introduced into the earth, producing scalar resonance of the earth. The molten core of the earth, being under pressure in all directions, is self-pumped (in the language of nonlinear optical phase conjugation). The resonant atomic nuclei of the earth's molten core would then act as a pumped phase conjugate mirror (PCM), producing a highly amplified (near infinity gain!) time-reversed wave in response to the input signal. Thus the earth PCM is a giant amplifier, and the TR wave returned is highly amplified, possessing enormous energy. Thus the amount of energy resonant in the earth becomes enormous. In fact, the transmitter was designed to produce more than one such scalar earth resonance. At any distant point on the earth, a transmitter/receive station could have input a

small "tickler wave" at this frequency into the earth, and its proper antenna tuned to the frequency" of the scalar resonance would have produced enormous electrical power. A very similar system employing two frequencies 12 kilohertz apart and tapping the beat frequency, is used by the Soviet Union today to power its large strategic Tesla weapons. Golden has detected and shown these Soviet "two-frequency earth resonances" on the oscilloscope, utilizing the output of his specialized detector system.

175. Sasquatch: Indian name for a large, well-defined tulpoidal apeman form. Bigfoot (slang or common name). Generally refers to the Pacific Northwest area, where die tulpoidal form has been well-tuned for centuries by the Indians. In the Far East, the Yeti.

176. Scalar: in ordinary vector analysis, a quantity completely characterized by magnitude only. (Actually, it contains magnitude and time.) In the new approach, one must account for observable and virtual states. In addition, multiple vectors acting on one point and summing or multiplying to zero are physically still present, even though their vector resultant is a zero vector (more precisely, a zero-vector system). Thus physically a zero vector can be a system having a very real, distinct substructure of nonzero vector components. These infolded vector components may be highly dynamic. The energy of each infolded dynamic vector component is thus "trapped" inside the local vector zero system. Rigorously, trapped energy constitutes a scalar potential in spacetime, to the external observer. An observable scalar (potential) thus may have a nested, multiple-level virtual substructure as well as any conglomerate "observable vector" substructure. Enormous energy may be infolded and trapped, in which case local spacetime is appreciably curved. Note that the infolded energy of the substructure components contributes to the stress of the object or medium, and organizes it, even though to the external observer its envelope constitutes a zero vector. Each level of this substructure contains an infinite number of tiny virtual vectors. There may be finite alignment of these virtual vectors along the structure of the observable vectors infolded. This constitutes vacuum polarization. The zero-vector system is thus a vacuum engine and a virtual state engine as well. Two scalars (or vectors) that are observably equal need not be equal at all in their substructures. Further, combining the two scalars by superposition may not yield the normal observable value, if both substructures are different, highly patterned and interact to spill over into the observable level. Vector mathematics itself must be changed and extended in the new approach. Note that the spillover from interaction of the two substructures may form an observable scalar value or an observable vector value. Such vacuum engines can be constructed o do specific operations on atomic nuclei etc. Nested levels of such engines can be formed, to form highly complex "super" hyperspatial vacuum engines called giant photons. Continual radiation of matter with a signal composed of vacuum engine photons of a specific deterministic substructure will "charge up" the atomic nuclei of the radiated material with that pattern, so that it emerges into the gross, observable physical state, drastically altering the radiated matter itself mechanically, chemically and physically. This process is called kindling.

177. Scalar energy tap: refers to a Soviet method of obtaining tremendous electromagnetic energy from the molten core of the earth, with which to power gigantic strategic scalar Tesla howitzers. As measured by Golden, two signals are continually transmitted into the earth some 12 kiloHertz apart, and the earth itself is placed in scalar resonance to the two frequencies. The core of the earth, being a pumped phase conjugate mirror, responds by generating highly amplified phase conjugate replicas, which return and concentrate all their energy at the transmitter/receivers. The receivers receive the enormous beat frequency (12 kHz) energy, using it for power. One then has a kind of scalar interferometer channel in the earth's core in the endothermic mode. Depending upon the biasing, either ordinary EM energy or negative EM energy is captured in the 12 kiloHertz band by the interferometer receivers. Varying the negative biasing also provides a throttle to control the amount of energy extracted. Just before the May 1, 198S celebration, the Soviets activated some 27 such giant energy taps in the earth, and also activated a large number of command and control scalar transmission frequencies. If each tap can power 6 to 8 giant Tesla howitzers, then for their important 40th anniversary of WWII, the Soviet Union activated well over 100 large howitzers. In other words, a massive exercise of the Soviet Union's entire strategic scalar howitzer weapon complex was held on the 40th anniversary of 1945 for Gorbachev, and to signify meeting the schedule (laid down by Brezhnev in 1972) to "be ready" to use them . At the conclusion of the exercise (which lasted several days), the Soviets left two scalar energy taps in place, instead of the single one present before the exercise. In other words, additional strategic weapons were brought up on "ready alert"

178. Scalar field: in vector analysis, each point in space is assigned a magnitude; the set of spatial points and their assigned magnitudes is called a scalar field. In the new approach, an observable scalar value is assigned to every point in n-dimensional space, where n is 4 or greater, and the set of n-dimensional points and their assigned observable magnitudes is called a scalar field. Also, in the new approach each scalar magnitude is considered to contain an n-dimensional virtual-state substructure, where each succeedingly higher dimension is a succeedingly lower level of virtual state. Vacuum itself is such a scalar field. Such a scalar field is also the rigorous identity of a massless charge field, of—for example—the electrostatic scalar potential, 0. Also, the scalar field is considered to be composed of two time fields: one in positive time and one in negative time that is the phase conjugate replica of the first. Thus the timeless, lengthless vacuum exists both in positive and negative time, and its potentials are scalar potentials. When the vacuum is uncurved, equal amounts and components of positive and negative time exist. When it is curved at a point, the positive and negative time components are unbalanced at that point

179. Scalar interferometry: the interference of two scalar Tesla waves (a Tesla wave consists of a normal wave coupled to its phase conjugate replica). In the interference, coupling can occur and produce (or extract) electromagnetic waves—energy—at a distance. The phase conjugation aspect is the secret of Tesla's revolutionary discovery of wireless transmission without loss. It is also the secret of producing death rays; the invulnerable Tesla shield; antigravity; superluminal communication; con-

trolled materialization, dematerialization, and transmutation; psychokinesis; and free energy. The ubiquitous photon interaction presently is the basis for first-order physical reality, and the photon's speed results in a speed-of-light-limited reality being detected. Scalar EM waves contain vacuum engine substructures and do not necessarily have this speed limitation. Detection by scalar waves yields a higher order physical reality and a vastly expanded quantum mechanics and relativity theory. Present Einstein relativity theory is only a highly special case, as are present electromagnetics and quantum mechanics. Soviet use of scalar interferometers in a large, strategic mode is responsible for much of the advanced Soviet ABM defense and strategic superweaponry.

180. Scalar resonance: inertial or mass resonance of a body, originally discovered by Tesla, repeated (probably) by Hooper, and rediscovered by Golden, Bedim, and others. In the simplest case, scalar resonance can be imagined as two ordinary single—frequency EM standing waves (a wave and its phase conjugate replicaor PCR) in a resonant cavity, with the two waves coupled exactly 180 degrees out of phase so that—externally—their E fields sum to zero and their B fields sum to zero. This is a standing scalar wave, and the cavity is said to be in scalar resonance. Note that the cavity walls must act as phase conjugate mirrors (PCMs). Mass itself is simply such a standing scalar resonance, with the standing wave trapped by particle spin. The atomic nucleus, continually bombarded by virtual photon flux from the vacuum, is a pumped PCM. Since the nucleus is positively charged, it produces PCRs having negative energy and negative time. It thus produces negentropy, which prevents the entropic decay of the atom. Essentially all frequencies can be and are present at once, but certain nuclear resonance frequencies are thought to predominate. By increasing the amplitude of the standing scalar wave that is the nuclear pseupotential, inertia and mass of the nucleus are increased. By decreasing the amplitude, the mass and inertia are decreased. Zeroing the amplitude dematerializes the nucleus. Scalar resonance is not presently contained in the orthodox physics literature.

181. Scalar wave: a longitudinal "pressure" wave in the actual stress of spacetime itself. A wave of potential, where no EM bleedout of the infolded contents occurs. A normal wave and its phase conjugate replica, comodulating each other and "locked or zipped together" as a zero-vector system wave. A Tesla wave. A gravitational wave. A time wave. Electromagnetically, a scalar potential wave which, in the absence of spinning charged mass particles, does not form a vector electromagnetic wave, in contradistinction to present electromagnetic theory. A "shadow vector" wave, where the ordinary "observable force vector" of the field is broken into virtual vector components which are not integrated. A wave in the nested levels of virtual state, that does not breach the quantum threshold, and hence is not observable to normal detectors. A wave in the magnitude of the virtual particle flux density of vacuum. A longitudinal wave in pure massless charge flux (vacuum) (spacetime). A wave in the magnitude of the infolded "energy density of the vacuum. The scalar wave is free to move in four or more dimensions. It transports deterministic vacuum energy engines. In Minkowski 4-space, it can: (1) move only in time, and not spatially, in which case it "sits in one place" and fluctuates the flow of time, the inertia of an object, the strength of the gravitational field, the mind, the fundamental constants of nature, etc.; (2) move only spatially, with the rate of flow of time oscillating about a linear mean; (3) move in a mixture of modes (1) and (2); (4) oscillate back and forth between modes (1) and (2) in a regular fashion, spatially stationary; and (5) oscillate back and forth between modes (1) and (2), translating spatially in travelling wave fashion. (5) move and oscillate between many vacuum levels (hyperspaces), in addition to characteristics (1) through (4). An ordinary Hertzian wave exists in vacuum as two coupled Tesla longitudinal waves. Rigorously, the E and B fields do not exist in vacuum, but on and of the detecting spinning charged particle. The spin of the detecting particle causes precession, yielding the familiar "transverse Hertzian wave," complete with E and B fields. The broken but ordered virtual state bits of what will be the detected E and B, however—shadow vectors E and B—exist in vacuum, on the virtual components of the vacuum charge flux. Tesla was correct when he stated that transverse Hertz waves (as such) could not move through the vacuum or exist in it

182. Shadow vector: an otherwise observable vector, broken into consecutive bits such that each bit is virtual. The resulting "disintegrated vector" becomes unobservable as a vector, but remains as an ordered series of virtual vectors. Thus it is a special sort of scalar wave. Observably, it is a scalar wave since no observable vector exists, but virtually it is a vector wave. It may be regarded as a localized, changing scalar field with a particular patterned virtual substructure which yields the shadow vector. On an appropriate integrating detector, the virtual components of the shadow vector will be reintegrated into an observable force vector, such as E or B. Dr. Robert Beck, for example, has reported the development of a successful integrating detector for such shadow vector scalar waves. His detector is capable of detecting signals that cannot be seen by the finest Superconducting Quantum Interference Device (SQUID), and it has been demonstrated for comparison against the SQUID. Dea, Bedini, Dayney, Golden, Beck, Bielek and Bise have independently built scalar wave detectors of various kinds. Farnsworth has particularly good and comprehensive shadow vector/scalar wave detecting systems.

183. Space: literally, the absence of observable mass, hence emptiness or void observably. Space per se has no definite length interval and no definite time interval. Rigorously, space is the absence of distinction and separation. Space has no dimensionality—i.e., it is not 3-dimensional, 4-dimensional, etc., for it has no "specific" separations. But in common usage, it is often thought of in a general sense as having some particular dimensionality but no definite intervals. The point is subtle but important: the absence of a 3-dimensional mass need not be 3-dimensional (e.g., considering a 10-dimensional frame). But one usually thinks of the "hole" where the mass was as having the same dimensionality as did the absented mass. This is only a 3-dimensional intersection of the actual hole, however, though this point is usually ignored. Ignoring the full dimensionality of a hole is responsible for the confusion regarding the two-slit experiment in quantum physics, for example. That is, the slits are (at least) 4-dimensional, since they exist in time also. In the slits, spatial mass is absent, so the slits are

three dimensional "holes." However, their fourth dimensional aspect, time, is present, not absent Thus four dimensionally the three-dimensional slit "holes" are not "holes", but are "things." They are not 4-d absences, but presences—since one dimension (time) is still present They can thus interact in the fourth dimension, time. The experiment has no mystery when the time aspects are considered, as pointed out by Charles Muses in 1957. In Kaluza-Klein 5-d mathematics, these 3-d holes also exist as things in the fourth spatial dimension. Also, in spacetime—rigorously—all 3-dimensional material objects, holes, gaps, etc. are simple facets or intersections of a single object For if time is considered as a continuum, then everything exists at once; hence spatial things are simply the features of a single 4-dimensional object The problem is that "space" is also commonly taken to be a "spatial frame," where time has been stripped off and "stopped," and a measurement to each and every point in the universe frame has been simultaneously established. This corrupt usage of "space" implies "spatial frame," and is entirely different from space as such.

184. Spacetime: three or more dimensions of space and a dimension of time, multiplied together. In the 4-dimensional case, it is often referred to as a "4—space." Spacetime can actually contain any number of dimensions; in our theory we consider an infinite number of spatial dimensions and at least one time dimension. One could just as easily take an infinite number of time dimensions alone. Scalar electromagnetics (unified EM and G fields) is most easily expressed in Kaluza-Klein geometry, in at least five dimensions—four of space and one of time.

185. Spherical model of the cosmos: a model of the universe in which the universe is a four-dimensional spherical surface in five dimensions. This results in a "closed" universe, and also one which is entirely within each point of itself. To produce such a model instead of an expanding universe, Einstein originally introduced entirely ad hoc factors into general relativity to cancel and eliminate the expansion terms.

186. Spin: the intrinsic angular momentum of a particle, as if it were a top spinning about an axis. Spin is quantized. Spinning charged particles—such as an electron—thus demonstrate a magnetic moment, due to the circulation of charge in the spinning. In the nucleus of an atom, the spin of the nucleus is the resultant of the spins of the nucleons (particles comprising the nucleus). Actually spin of particles is more like an "implosion" to "explosion" circulation; in other words, it circulates in time as well. Spin of a particle is the basic feature that integrates the anenergy (disintegrated energy) of vacuum flux into observable charge. All observable fields, matter, effects, etc. depend upon this basic mechanism to zip together virtual entities and form observable phenomena.

187. Spooklight: another slang name for a nocturnal light Legend and folklore usually associate it with a violent death or macabre occurrence. Earth stress lights. Over 1,200 known sites produce such earth stress lights in the U.S. alone.

188. Strobe effect: striated patterns seen in UFO and other paranormal phenomena due to the higher dimensional phenomena skipping in and out of normal 3-space. Alternatively, two or more higher dimensional phenomena may dynamically interfere so as to form repetitive intersections with our normal 3-space, producing striations. Hyperspatial (scalar) EM interference often produces striation effects.

189. Substructure: in the new approach, a scalar has an infinite-dimensioned (infinite number of sublevels) virtual state substructure, filled with waves, particles, etc. Vacuum has precisely the same sort of substructure. The substructure is rigorously CHARGE FLUX, where observable mass is not present. Any vector, since it contains a set of scalars, also contains a set of virtual state charge flux substructures. One can engineer, pattern, arrange, and utilize these substructures to give various "paranormal" effects. These effects include materialization and dematerialization, psychokinesis, clairvoyance, superluminal communication, antigravity, teleportation, apportation, remote viewing, production of energy at a distance, extraction of energy at a distance, electron dissolution, etc

190. Superposition: the simple linear addition and subtraction of two or more values. In the new approach, superposition need not linearly hold valid if sufficient substructure interaction is obtained and the substructures are nonlinear. In that case, superposition turns into nonlinear interference.

191. Teleportation: the transmission of an object from "here" to "there" with no travel in between as an object in ordinary space. Hyperspatial transmission of an object from one point in the ordinary space to another.

192. Telluric currents: earth currents; electrical currents in the rocks of the earth, believed to be due to aurora effects and the earth's magnetic field. In the new approach, these currents are also pumped by longitudinal scalar wave bombardment from the sun, the cosmos, and the fiery core of the earth itself. Quartz is a common crystalline component in rocks, and thus the rocks are piezoelectric This means that stresses in the rocks, such as from shifting tectonic plates, causes electrical activity, and electrical activity causes mechanical stresses. Further, the quartz is essentially randomly oriented, resulting in most of the tiny piezoelectric vectors summing to a vector zero, which in turn constitutes a scalar potential and pumping the atomic nuclei as pumped phase conjugate mirrors, producing PCR waves. These do the same thing in return, producing negative energy potentials and potential waves, etc. As the piezo-vector components vary, the values of the potentials fluctuate. The zero-sum portion of such a stressed randomized crystal constitutes a Prigogine detector for kindling and collection of anenergies via nonlinear thermodynamics. The molten core of the earth is also a dynamic Prigogine system, since it is a pumped PCM. Thus the earth is a collector, processor, sometimes amplifier, and retransmitter of mind energies and anenergies, and truly the earth may be considered to be "alive" in a strange way (the Gaia hypothesis). This process, along with scalar EM in living systems, also produces Sheldrake's morphogenetic field and its effects. Specifically, the earth receives and processes anenergies from the species unconscious of all the species of ordinary life upon it The earth itself does respond to geometric kindling alignments of other planeti. and particularly to the moon. In addition, it does respond to the state of man's collective species unconscious mind. Fault zones result in structures similar to diodes, triodes, and scalar interferometers. Amplification and rectification of kindled anenergies occur readily, including at a distance, at fault zones, particularly when

seismic stresses in the rocks are increased, increasing the piezoelectric activity, telluric currents, scalar interferometry, etc Thus fault zones constitute natural kindling window areas for paranormal anenergy forms, for tulpoids etc—precisely as found by Persinger. Fault zones are also scalar interferometers, which enhances the formation of ordinary EM forms at a distance.

193. Tesla fireball: interference of two scalar Fourier expansion patterns to form a glowing, fiery globe or spherical shell of radiant electromagnetic energy and electron plasma.

194. Tesla howitzer: a large Tesla scalar interferometer such as the fourth generation Soviet hyperspatial howitzer at Saryshagan. Repeated Soviet testing of Tesla howitzers is documented in the open literature (see Bearden, *Fer-de-Lance*, Tesla Book Co., 1986). The howitzer is capable of utilization in multiple modes, both as a strategic offensive weapon and as a multiple-mode strategic ABM defense weapon. Scalar EM interferometer. Hyperspatial howitzer.

195. Tesla shield: a gigantic, hemispherical, glowing, thin shell of intense electromagnetic energy and electron plasma, placed over a defended area or installation. The EM shell is formed by interference (and coupling) of two scalar shells of anenergy, formed by truncated Fourier expansion methods from multiple frequency scalar transmitters. To form the shell at a distance, phase conjugate replica waves must be utilized, so that the energy and energy pattern does not diverge as a function of distance. Note that such real-time holography, independent of distance, already appears in the nonlinear optics phase conjugation literature. In the Tesla Shield, the energy density in the interference shell causes local curvature of spacetime, and lifts electrons from the Dirac sea, producing the plasma in the shell. With sufficient energy density in the interference shell, a material object seeking to penetrate this dome of energy and plasma is instantly electromagnetically "dudded," and physically damaged and/or vaporized. In addition, the potential pulse delivered inside the nuclei of nuclear materials that meet the shell instantly fission all fissionable materials. Thus nuclear weapons are instantly detonated when entering the shell. Electromagnetic energy (such as gamma radiation from the EMP of a high altitude penetration burst) impinging on the shell plasma is absorbed and re-radiated inside the shell at lower frequency and temperature. Several shells may be internested so that multiple, serial absorption and scattering reduces the original gamma radiation to harmless radio frequency noise. Numerous incidents of tests of the Tesla Shield weapon are documented in the open literature.

196. Tesla wave: a longitudinal scalar potential wave in massless charge, in the vacuum charge flux itself, and in pure spacetime. An electrogravitational wave. A gravitational wave. A scalar EM wave. A wave of pure potential. A wave in the magnitude of the flux energy density of vacuum. A wave in the magnitude of the curvature of vacuum.

197. Tesla weapon: any weapon utilizing longitudinal scalar EM waves or phase conjugate replica waves to accomplish its results. Also applies to a weapon using scalar interferometry or PCR interferometry and holography from multiple projectors or transmitters.

198. Thought: separations and forms in pure mind or being. To think is to form (separate, perceive) thought forms and process them. In a developmental sense, thinking is the activity of mind that screens the true continuous mind nature by fragmenting it The true mind is like the ocean, and thoughts are like waves or disturbances in the ocean. In the new scalar electromagnetics, the mind itself produces scalar waves, on the third and lower virtual levels of the scalar substructure, and these are what we call "thoughts." A thought is a real, virtual-state object capable of being directly detected, interacted with, and engineered by scalar EM means.

199. Thought photography: psychokinetic impression of images or light effects upon photographic film or other sensitive media, due to the presence or intent of a human initiator. PCR distant interferometry and holography is the basic mechanism involved.

200. Three-space (3-space): a space dimensionally composed of length cubed. It is the normal space taken to be occupied by gross matter. Per se, vacuum does not occupy this same 3-space, even though erroneously assumed to do so in present physics.

201. Time: in relativity, an extra dimension (variable) which allows the ordering of spatial snapshots or events. In quantum mechanics, time is only a parameter; it is not an observable and is not detectable, even in theory. Time is always inferred, even though precisely. Rigorously, time exists only through the stream and persistence of human consciousness. We only experience that persistence as "something changing", by continual comparison of our memory of perceptions of spatial position and pattern. In the abstract sense, time is being, which has no differentiation whatsoever—it simply is (a tautology). Perceptual separations in being constitute thoughts or mind changes, much like waves in water. Those waves common to all minds constitute physical (spatial) changes in the so-called "real" world. Because "time" in its undifferentiated sense is simply a synonym for being, then multiple things (separations) may inclusively exist in time simultaneously. (How many final objects exist in a stone before it is carved into any one of them?) The basic separator of being/time is the photon interaction, which is the basic generator of monocular quantum change and thus the progression of spatial particles "through time" in little jumps. The endpoints of the quantum jumps through time represent time differentiations of spacetime/masstime. To properly understand physical phenomena, both positive and negative time flow must be incorporated in the theory or model used.

202. Time oscillation: ordinary time advances and retards in small discrete jumps, much as a sewing machine stitches forward—except that each time stitch is pulled out before the next one is made. Thus time consists of two time flows interleaved: the positive flow of time (stitching) and the negative flow of time (unstitching). This "time stitching/unstitching" or oscillation can be viewed as a wave. It is "action" that is waving (being changed or created and destroyed in quantum chunks), since time is actually a subcomponent of action. One may therefore view time waves as carrying or creating surges of energy back and forth (in time). The photon may be considered as this oscillation of lime, for it is actually an oscillation of action. The positive half of a photon exhibits positive time (the stitch is made) and a virtual electron, and the negative half exhibits negative time (the stitch is removed) and a virtual positron. Charge is a function intimately related to, and comprised

of, time stitching. Positive time is associated with negative charge, and negative time with positive charge. The photon ca be considered as a coupled virtual electron-positron pair. The invisible stitching/unstitching trace of a photon through spacea'me is "enfolded" (in time) and remains. A phase conjugate replica photon, created at some later time and some distant place, thus has a sort of "invisible wire" connecting its own generation and the distant source that generated the stimulus photon. Note that spacetime occupies time, but space does not. Mass-time occupies time, but mass does not. Mind, thought, and being occupy time, but not space.

203. Time trap: refers to the erroneous assumption that God is a limited being, traveling along through time much as humans perceive themselves to. An unlimited creator must permeate all aspects of creation, including time. In the unlimited view, God permeates time from beginning to end, all at once. To such a creator, nothing is happening, since all happenings are simultaneously present What we call "positive" or forward time and "negative" or backward time co-exist and are inseparably identified, to such a level. Good and bad are only relative to a single time stream and to a single referent At the unlimited level, there is no separate good or separate evil. Yet there is all unseparated good and all unscparated evil. All "events" or acts that one might separate, simultaneously exist in both forward and backward time streams. Hence any event is ultimately both good and evil simultaneously, and to an identical degree. Again, this is the void that is devoid even of void.

204. Transverse wave: a wave which vibrates laterally to its motion in a medium, exactly like the vibration of a stretched string. Vector electromagnetic (Hertz) waves are transverse waves, in the present theory. In the new approach, transverse waves cannot exist as such in vacuum, but only in a longitudinally restrained medium. (The electron gas in a solid conductor, for example, is such a medium, and Maxwell's equations rigorously apply to the transmitting electron gas and to the detecting/receiving electron gas, but not to the vacuum in between). Longitudinal (alternately densifying and rarefying) scalar waves exist in vacuum, in the charge (virtual particle) flux that vacuum identically is. Hertzian waves in vacuum exist as shadow vector waves, that is, as two or more coupled Tesla scalar waves spinning around each other.

205. Tulpa, tulpoid: condensed, materialized or semi-materialized thought form, either living or inert. May be a visible or an invisible electromagnetic form, a partially materialized form, or a completely materialized form. Ultimately all matter and fields are tulpoidal in nature, consisting of condensed thought/mind energy.

206. Two-slit experiment: a form of Young's experiment where a particle is generated and directed toward a plate having two tiny slits (holes) in it, with a collection screen or device on the far side of the plate to collect and add the impacts of the particles that pass the plate. The idea is that a classic corpuscle can only go through one hole at a time, like a baseball through a hole in a fence. For particles, classically the strikes on the collector screen should be grouped in two clusters, each representing a straight-line passage through one of the slits. In the experiment, however, the particle strikes form a wave diffraction pattern when collected on the screen, unless the emitted particle is struck by a photon before it strikes the screen. In the latter case, the two clusters for classic corpuscles are observed. The experiment—fundamental to all quantum mechanics—is simply understood if one considers the time aspects of the problem, as pointed ont by Charles Muses in 19S7. The two slit apparatus with electrons may be also used as an electron interferometer for sensitive detection of scalar EM (electrogravitational) waves.

207. UFO: unidentified flying object Any object or light in the sky that cannot be identified as an ordinary physical phenomenon. After normal objects and phenomena are eliminated, the remaining paranormal residue is of interest Many of these are kindled tulpoidal forms, and may consist of lights, invisible electromagnetic energy, physical objects such as discs or spaceships, robots, humanoids, etc. (A few of these forms may be real anti-gravity spaceships, created here on earth by sensitive groups of several earth governments, but controlled by some mysterious group outside these governments. Such craft, I believe, have been developed and flown all over the solar system since the early 1950's. These I do not consider part of the true UFO phenomena, which in one form or another are centuries old.) Highly materialized ship forms may also contain highly materialized living forms such as space-suited astronauts etc. The "UFO" has been separated from other tulpoids (bigfoot, fairies, spooklights, water monsters, etc.) because its appearance in the sky was immediately associated with aircraft or spaceships, leading to the initial expectation that extraterrestrials in advanced spacecraft were visiting the earth. Most of the UFO phenomena actually consists of lights at night (well over 80%), and only about 6% or so resemble well-materialized ships with astronauts. A substantial portion of the "lights at night" phenomena are also due to Soviet scalar EM interference weapons. The Soviets create a great deal of light phenomena worldwide, to spark UFO reports, which are discounted by conventional science and most of the military and government agencies. This provides the Soviets a giant and effective "deception plan" so that the weapons can be tested and readied worldwide, and sightings and reports will be discredited and not cause undue alarm.

208. Unconscious: unaware, not conscious. Refers to that part of the individual's mind which is not normally in conscious awareness, but which may contain a great deal of material from the conscious mind. In the new approach, the unconscious mind is considered to be "multiply conscious," while the conscious mind is considered "singly conscious." In other words, the unconscious is a "parallel processor," while the conscious is a "serial processor." Unconscious should be thought of as not singly conscious, but multiply conscious. Further, this allows a totally new idea: Multiple singly conscious, different minds coexist simultaneously in time, though not in the same "3-dimensional mindspace." Suppose we consider a set of n such singly conscious minds. All the minds exist in a spacetime of dimensionality 3n + 1 (n is the number of different conscious minds in the set, and an additional dimension, time, is common to all minds in the set). Thus the considered set of singly conscious minds constitutes one multiply conscious—or "unconscious" -mind. In this way one may apeak of "levels of unconsciousness" in relation to groups of persons, with the deepest level being and containing every human mind. Of course the analogy can be continued to yield

the higher minds or consciousness projected by Teilhard de Chardin. In the collective human unconscious, those forms which are in each and every mind are the archetypes discovered by Jung. In a shallower level, other forms may be common to that level, constituting "weak archetypes" or "fragmentary archetypes." There is considered to be no limit to levels of unconsciousness—the ultimate depth being "all consciousness" (and all unconsciousness!) of Godness. God must be able to both be and not be at the same time; if God cannot do that little trick, then God has a limitation and is not unlimited.

209. Vacuum: pure virtual particle, massless charge flux. The virtual state, or ether (nonmaterial, Lorentzian). Lengthless, timeless spacetime itself. That state where everything is disintegrated, but highly dynamic. Note that vacuum is not an emptiness FILLED with massless charge, rather, it IS identically massless charge (disintegrated dynamicism). It is a plenum, not an emptiness. It is also pure action, undifferentiated. Einstein once suggested that the vacuum, complete with its electromagnetic and gravitational fields, should be taken as the ether. In the modern view, the term ether is again accepted in the literature, but now it refers to a "virtual particle flux" ether, not a thin material ether. One can model the vacuum analogous to a special kind of virtual-particle gas: one in which the particles "appear" and "disappear from and into nothing, nearly instantly, so fast that they cannot be individually detected. Thus the modern idea of the vacuum is a seething inferno of fiercely bubbling, fleeting particles. The other limitation is that the dimensionality of the vacuum is not fixed until operations are invoked, and neither is the rate of passage of time. Thus the vacuum has no fixed lengths nor fixed rates of time flow per se. One can visualize the stress of vacuum as a sort of conglomerate potential "pressure," where the individual stresses of various types of particles, if integrated by some external means, would sum into the overall stress (pressure). Variation of the "stress of vacuum" between two points in a frame represents a "curved spacetime" or "accelerated frame." Note that overall stress can be held constant, while two or more different components are canonically varied. The electrostatic potential, the magnetostatic potential, and the velocity of a charged particle are three such "canonical" variables. If the overall "pressure" is not varied, the three variables are canonical and energy, momentum, and charge are conserved and one cannot build a perpetuum mobile (perpetual motion machine). If the overall "pressure" is varied between local points in the frame, then the conservation of energy, momentum, and/or charge need not rigorously apply between those local points. At any one point, one may have a "free source" or a "free sink," depending on the vacuum curvature and the EM standing wave relationship. In that case, one can build a local "perpetuum mobile," since one can tap a "free source." Einstein created a severely restricted general relativity (GR), where he assumed away any local curvature of vacuum. In the West such a severely restricted GR is still dogmatically enforced, because it "saves" the conservation laws, which are regarded as sacrosanct In Soviet physics journals, learned papers by leading scientists are regularly published in which unrestricted GR—including local curvature—is developed and explored. In a local curvature region, the Soviets have already pointed out that any and all conservation laws may be violated. The Soviets have long since developed and weaponized unrestricted GR, while our scientists are still dogmatically insisting that one cannot deterministically engineer local curvature of spacetime. Thus we maintain our obsession with conservation, and the Soviets maintain the weapons.

210. Vector: in mathematics, an entity completely characterized by a magnitude and a direction. Abstractly, vectors are considered to be formed by a difference in potential between two spatial points. In the new approach, vectors are characteristics of particle motion, and do not observably exist in the absence of a particle. Since all detectors have mass, and this mass contains spinning charged particles, then force vectors are constituted on and of the spinning charged particles. In the vacuum, only an unzipped (disintegrated) vector pattern exists—or, as Feynman put it, only the potential for a force vector exists there. Maxwell's original theory was written in quaternions. In 3-space, a vector has the familiar three components, say, ai + bj + ck, where i, j, and k are the usual x, y, and z unit vectors, and a, b, and c are the magnitudes f the x, y, and z components of a vector. A quaternion, however, has an additional scalar component—say, w—so that it looks like w + ai + bj + ck. Maxwell's original theory actually unified gravitation and electromagnetics! When vector zeroing operations occur, the quaternion may not zero out the scalar component. As an example, consider the cross product of a vector A with itself, AxA. In vector analysis, the resulting vector is the zero vector. In quaternions, however, w remains, and w = a2 +b2 +c2. With the correct proportionality constants, w therefore represents the energy density of vacuum due to the two zero-multiplying vectors A1 and A2, where A1 = A2. To recover my scalar wave or gravitational wave: Now let the vectors A1 - A2 where each is the E-field vector of an identical EM sine wave. (That is, we perform a device which accepts two identical input EM sine waves and performs a cross multiplication. That device, e.g., may simply be a special kind of nonlinear modulator/mixer). In ordinary Heaviside/Maxwell theory, the EM output of this operation is a continuous zero vector, and that's all. However, by Maxwell's actual theory, the output of the operation is a scalar EM wave, whose amplitude varies as the energy of A. That is, the operation produces a scalar EM wave which is varying the energy density of vacuum. By definition, that is a gravitational wave. Since it was produced electromagnetically, I refer to it as an electrogravitational wave. It was included in Maxwell's original 1864 theory. After Maxwell's death, Heaviside and Gibbs completed the modern form of vector analysis. Heaviside—a single man—then "translated" (mutilated) Maxwell's theory into his new "vector" theory. He simply sawed off and discarded the troublesome scalar component of the quaternion! That made calculation a whole lot easier, and easier to understand. In discarding the scalar component, he discarded electrogravitation, writing an EM theory that specifically excludes local curved spacetime and gravity. Before the turn of the century, a short debate involving only about 30 scientists resulting in the complete adoption of Heaviside's mutilated version of Maxwell's theory. Quaternions and quaternion theory—and electrogravitation—vanished from the literature and the textbooks—and from the minds of the students. Maxwell's theory has not been taught or utilized in the Western

world in the 20th century! Only Heaviside's mutilated version of it is taught as "Maxwell's theory." We should have been applying Maxwell's unified theory and working on antigravity spaceships, shortly after the U.S. Civil War!

211. Vector field: in ordinary theory, the assigning of a magnitude and a direction (that is, a vector) to each point in space. The entire set of vectors and their spatial points is called a vector field. In the new approach, such a vector field cannot observably exist in a vacuum, since only disintegrated things exist there; there each potential vector pattern exists in broken virtual bits, ordered in line to form the bits of the observable vector but not joined. In the presence of a detecting/integrating mass, such as a spinning charged electron, the virtual bits and the spinning charged mass couple into a system that identically comprises the observable vector. In other words, the spin of an observable particle simply "integrates" the ordered virtual bit pattern, just as an old spinning wheel twists and integrates individual fibers into a stranded rope or thread.

212. Virtual (state): that part of physical reality consisting of changes (particles, waves, and other entities) smaller than the least detectable (quantum) change. Disintegrated changes. A thought or thoughtform is also virtual. May be visualized as consisting of real, dynamic "pieces of vacuum" or "pieces of nothing"—that is, quitons. Every ordinary observable particle (photon, neutron, electron, proton, etc.) contains or consists of a dynamically changing cloud of virtual objects. Exchange of virtual objects is thought to generate almost all forces of nature. Conservation of energy need not be conserved in virtual interactions, and generally is not In the new approach, the mind may be considered a special virtual universe, and a thought a virtual object. Virtual state consists of multiply nested levels, each level progressively finer and more subtle. These sublevels also correspond mathematically to higher geometrical dimensions. Charge on a mass is also due to its continual emission and absorption of virtual particles. Waves in the virtual state massless charge flux, which do not breach the quantum level to become observable, are vectorially nonobservable yet real—these are scalar waves, or shadow vector waves, and are longitudinal—that is, they are oscillations of the stress energy tensor of vacuum. In addition, the virtual particles in the vacuum flux arise out of nothing spontaneously (creation) and disappear into nothing spontaneously (annihilation). Since this is random, at any instant any sort of pattern imaginable is "just appearing" and "just disappearing" in the vacuum. Anything and everything at all! Thus a ghost-pattern of everything exists in the vacuum at any point or region, at any time. The vacuum is thus a giant virtual-state hologram. Integrating (kindling) one of these forms will result in it becoming first a neutrinic pattern, then a photonic (light) pattern, then a materializing pattern, and finally a material pattern. Discharge of the "potential" of this pattern then reverses the process. These two processes—charge-up and discharge—constitute materialization and dematerialization. Anything at at all-living or dead—can be materialized or dematerialized.

213. Virtual state engineering: the direct cohering, tailoring, collecting, resonating, and directing virtual state energy (anenergy) and entities into and onto normal observable objects and ordinary fields. It includes the **direct engineering of mind and life energies. Synonymous with psychotronics (Czech term) or energetics (Soviet term). Use of scalar electromagnetics (electrogravitation). Use of scalar wave/Tesla technology. Use of electrogravitation techniques.**

214. Water structuring: the arrangement and relations of the molecular and ionic parts of water. Essentially water molecules bond together by means of hydrogen bonds. The structure of these bondings is extremely rich and dynamic in water. Essentially a glass of water is a single complex molecule, one which is continually changing its bonding structure to adapt to the slightest change in its total surroundings. Water also interacts intimately with virtual crosstalk (scalar wave) anenergy. Water can thus be "charged" with ancnergy, appreciably changing its structuring. Its surface tension, for example, will change as its structuring changes, as shown by Miller and Flanagan. Thus water is possibly the most complex substance in the universe, and not just a simple chemical. With most of our body composed of intercellular water, we are all linked to every subtle change of the cosmos, by the interaction of the structuring of this water with even the most subtle cosmological changes. Large bodies of water are particularly susceptible for temporary kindling of deeper archetypal thought forms (tulpoids) such as Loch Ness Monster etc. The study of the structuring of water is still in its infancy.

215. Watson, James: young inventor who has produced several types of free energy and scalar electromagnetic devices, including battery-driven, battery-less, and tube systems.

216. Weather engineering (scalar): use of scalar electromagnetics (electrogravitation) to change and influence the weather and the producers of weather such as jetstreams and large ocean currents. By imposing scalar signals upon ordinary powerful over the horizon (OTH) radar carriers in the communications band (3 to 30 MHz), interference patterns (grids) may be established over distant and vast areas, far beyond the horizon, or even on the other side of the earth. The giant Soviet Woodpecker OTH radars continually establish such a grid over the U.S. Phase conjugate energy can be transmitted and will travel along these beams, just as electricity travels along a wire. By scanning narrow phase conjugate wave beams in these wider carrier beams, PCR realtime interference holography can be established in one or more of the distant OTR EM carrier interference grid squares. Either positive or negative energy and energy forms may be transmitted to emerge, producing a high or low pressure spot or zone as desired. By adding positive energy to a zone, the air is heated and expands. Thus the air is less dense, producing a low pressure zone, or a low. By adding negative energy to a zone, an equal amount of positive energy in the zone is canceled. Thus the air in the zone contracts and is denser, producing a high pressure zone, or a high. Thus one can create distant highs and lows at will. By slowly moving (scanning) the PCR beams, these distant highs and lows can be moved, thus deviating and directing the jetstreams, storm systems, etc. By outputting positive energy and warming the top of a thunderstorm anvil, while outputting negative energy to the side of the anvil and cooling it, drastic "downbursts" under the anvil can be created. U.S. satellites have photographed such anomalous holes appearing in thunderhead anvils over the U.S., and their association

with downbursts has been documented in the literature. Whether these are natural or engineered have yet to be established. Another signature of weather engineering—a "wheel and spoke" type of cloud, called a giant radial—has been seen widely throughout the U.S. and correlated with anomalous weather changes shortly thereafter. Sometimes a system of two such radials facing each other is seen, and on one occasion four were seen locked together (just before and during the highly anomalous zig-zag travel of a 1985 hurricane in the Gulf.) Another geometrical form associated with severe weather has been photographed by U.S. weather satellites, and is referred to in the weather literature as an "enhanced V". This signature is closely associated with the production of tornadoes, and it may be a natural phenomenon. However, if the mechanism for the enhanced V were artificially produced in a thunderstorm, then the probability of follow-on tornadoes would be materially increased. The Soviets have openly engineered the weather over North America since 1976, and made previous R&D engineering tests over the U.S. in 1967.

217. Woodpecker signals: powerful, complex electromagnetic signals originating in the Soviet Union (apparently from the vicinity of Riga and Gomel, for example) that have widely disturbed and interfered with the communications band (3-30 MHz) since the mid-70's. Bioactive modulations of 10 Hz and under have been observed repeatedly. Western observers have not deciphered the purpose or specific coding of the signals, and prefer to think of them as some sort of over-the-horizon radar tests, thus neatly disposing of the problem. Similar signals have been observed to entrain the human brainwaves and force them into in-phase oscillation. Beck has reported the phaselocked synchronization of the 10 Hz modulations on as many as 16 carrier frequencies at once. From the Lisitsyn work, this constitutes a "phased lock-in" of 16 carrier channels into any entrained brain. According to Lisitsyn and earlier Soviet "biological radio" experiments, this situation should allow the Soviets to transmit emotion, feeling, thought, and even pictures into the entrained brain, where it is processed as if the brain itself had originated it. (For example, in a Cable News Network special in November 1985, Rauscher and Bise actually demonstrated the induction of visual form images in the brain of the CNN investigator using weak signals much weaker than those naturally produced by oscillation of the earth's magnetic field.) According to the Kazhnacheyev work, any sort of cellular death and disease pattern can be electromagnetically induced. (The work was duplicated in the infrared by University of Marburg researchers in West Germany, by researchers at the University of Sydney, and by one U.S. scientist.) Popp discovered the virtual photon communication system of the cells of the body. This is scalar, and scalar patterns for charge distributions of the chemistry of cellular diseases and damage could also be placed on the phase-locked Woodpecker carriers, entering die human body's master control system through the entrained brain and "kindling" throughout the cells of the body. The stress and suppression of the immune system would be involved in almost all disease patterns, and a "partial AIDS" type of syndrome would result, making the entrained body vulnerable to whatever diseases were around, including being induced on the Woodpecker carriers themselves. Also, by targeting the DNA of specific organisms, mutations of deadlier and tougher strains of disease induction agents such as bacteria and viruses could be produced. The "antithesis" pattern—a sort of scalar EM antidote—could be induced in the Soviet population. (The present lethal AIDS is a manmade disease, and it was unleashed from a research laboratory either accidentally or by a Soviet agent on purpose.) Indeed, World War III may already have begun, and the Soviets may be waging a quite different kind of creepingly escalating viral war against the United States. If so, our Defense Department and our government have not yet grasped what is happening, and so far we are simply a sitting, passive target If our populace is slowly debilitated and storm, weather, and earthquake damage slowly increases year by year, at some point our system will simply start to come unglued, with increasing loss of control. In that manner we could "subside" as a world power without the kind of great overt war we are familiar with. Note that steady escalation of international terrorism, insurrection, and guerrilla warfare being promoted by the Soviets around the world will keep us preoccupied and busy while our debilitation and moraise steadily are increased. We may already be in an eery new kind of war that we could lose without firing a shot if our leaders do not wake up to the frightening implications of the new physics! Thus the Woodpecker transmitters represent a potential anti-population and strategic weapon of enormous strategic significance. The transmitters, because of their sheer power, also appear to be able to pump and resonate earth scalar EM energies, producing earthquakes and plasma discharge effects at remote locations. (Since Golden has directly shown that the entire earth is in frightful, forced scalar resonance at multiple frequencies and enormous power due to powerful Soviet scalar transmissions, then one should not be too skeptical of the Soviet ability to produce earthquakes on demand and to order.) At least one U.S. researcher or group seems to have been partially nullifying Soviet efforts in this respect by occasionally pulsing the earth scalar energies in a countering mode, to include actual destruction of a Soviet transmitter in one or more instances. Note especially that unorthodox researchers have directly confirmed that the Woodpecker signals contain powerful scalar components which orthodox scientists—lacking scalar detection equipment—do not see. The Woodpecker carrier interference grid over the U.S. is also a scalar EM interference grid, and used by the Soviets to engineer the weather over North America. It is also used as an anti-Bomber and anti-missile launch phase defense system, and the Soviets have tested it in this mode by destroying several U.S. aircraft and missiles.

218. Work: conventionally, the line integral of force on a body over the path taken by the body. In the new approach, the force consists of the mass and its motional change, unseparated. Thus work is the line integral of the force over the path taken by the force. Work (past) is equal to the energy (present) expended, and energy (present, gravitational potential) is equal to the work (past, release of a gravitational potential) that can be expended. Note that only vectors produce work; scalar waves do not perform work on their observable environment, and they do not contain standard EM force field energy per se.

219. Yao, George: engineer and inventor of the PulsorR, which affects the subtle scalar levels of the human body's aura or scalar radiation pattern.

220. Veti: the Eastern—particularly Tibet, Nepal, etc.—Himalayan version of the apeman tulpoid, corresponding to the U.S. Sasquatch or Bigfoot.

221. Zarg: the collective human unconscious, considered as a mind and a living entity. It is at least 4—billion dimensional, since it has as many dimensions as human stages. Each human is regarded as a single cellular stage in this entity. The psychokinetic power of such a linked mind is proportional to an exponential of the number of individual stages. Thus Zarg's psychokinetic power is so great that it has essential control over space and time, and largely prescribes, maintains, and stabilizes the laws of nature (laws of physics) and the reality in which we live. Conflict between large groups of humans constitutes unresolved conflict in this great unconsciousness, and this generates symbolic dreams, much as a human dreams strange, emotional, symbolic dreams due to the unresolved conflict in his or her personal unconscious mind. However, because of its vast psychokinetic power, Zarg materializes or partially materializes its symbolic dreams, resulting in tulpoids. Waves of these tulpoidal materializations thus represent strong human conflict or threats on the large scale. Such waves can be dream analyzed to discover the correlate that is generating the symbology, by straightforward dream analysis techniques. In olden times, part of this was known, and wise men were employed to analyze and interpret the strange, induced dreams of the king (who was the center of power of a nation) and the paranormal phenomena appearing near him. The ancients knew the import of "signs and wonders" and what they portended, but this metapsychological knowledge has been largely ridiculed and lost by present materialistic Western science.

222. Zero: naught or nothing; the absence of thing. A naive definition is the absence of number. However, if all the nonzero numbers are considered to represent the presence of number, then to declare zero a number—that is, the presence of a number—is a self-contradiction since it has just been declared the absence of number. In the numerical sense, one may do a little better by calling zero "the absence of any and all numbers except itself." Yet in this case, difficulties arise as to how one is to justify the addition of any other number to zero: how can a number be present with the absenting operator, so as to be added? The absence of any type of thing observable. Formally, the additive identity element of an algebraic system. That is, formally, the basic idea of zero is that, added to a number, the result is still identical to that number. Implicit in this formal definition is a "single level** of perceived objects; that is, there are no "hidden objects" in a separate level of sets. If multiple levels of perception are allowed, then the zero becomes much more complex. That is, it represents the absence of all other numbers at that particular level, and of that level's kind. In that case, it may contain any combination of objects from another level, yet be perceived as containing "nothing of its own assigned level." In that case, there exists an infinity of different "kinds" of zeroes, if the hidden associated structure (the substructure) If taken into account Unfortunately physics has created such multiple levels, but has not required its mathematics to clearly specify the changed nature of the zero. As an example, at the observable level, an infinite number of kinds of zeroes exist, when the virtual level and pattern **associated with the zero are taken into account This characteristic of physics actually violates the following zero axiom: an observable v plus an observable zero is considered to be equal to an observable zero plus v. In fact, the sum of v and a particular zero may not be equal at all to the sum of another zero and v, if the virtual patterns of the two zeroes differ, v has a virtual substructure, and in the addition of a zero and v, their virtual levels nonlinearly interact instead of linearly superimpose.**

223. Zero point energy: the kinetic energy that remains in a substance when its temperature is absolute zero. Quantum mechanics requires a simple harmonic oscillator to still possess kinetic energy at its lowest state: that is, it possesses half a quantum of energy. In solid materials it is distributed throughout the lattice vibrations, contributing to the binding energy. Vacuum also has zero point energy. Actually a similar and much expanded concept applies to any potential: a potential is just a bunch of trapped dynamic vectors, hence "trapped vector (translational) energy." It is translational energy that is locally trapped and not translating. The potential is thus like an accumulator or capacitor. It can be "charged up" and "discharged." It thus contains its own analog or trapped or "zero summed" or "zero point" energy.

224. Zero-point energy of vacuum: the vacuum is increasingly being regarded as composed of an incredibly dense structure of virtual electromagnetic energy, even at zero degrees absolute. From quantum geometrodynamics, as one approaches the Planck length—say, 10 to the minus 35th meters—these oscillations become so energetic that the fabric of spacetime itself is torn, resulting in sporadic, continual connection and disconnection of widely separated portions of spacetime. This "quantum foam" was dubbed "superspace" by J.A. Wheeler. Actually, if space and time are torn, then energy itself—and vector waves—are also torn. That is, the superspace consists of pure massless charge flux, pure scalar waves. If compacted, this anenergy density of vacuum may be approximated as 10 to the 100th grams per cubic centimeter, were it compacted into mass. The actual electrical charge of the vacuum appears to be enormous, if it were possible to measure a voltage drop from it to an uncharged region. Thus it is space (actually spacetime) that is incredibly dense, and matter that is ethereally thin. Spacetime goes through matter, rather than matter through spacetime. This anenergy of vacuum does interact with electromagnetic fields and matter to give observable effects, as evidenced by the Lamb shift, for example. The Lamb shift proves that the vacuum charge or anenergy can be "tapped." Tapping the "vacuum energy" would immediately end the energy crisis forever. Further, it can be done with practical devices, as T. Henry Moray showed in the 20's and 30's, and as several present inventors have shown today.

225. Zero vector: a vector having no length (no magnitude) or specific direction. Absence of any or all finite vectors. Resultant of a system of multiple, finite vectors whose vector sum has no specific direction. Note that the second definition differs drastically from tho first. That if, we cannot say that a vector resultant zero has no infolded magnitude, if we consider the components, all of whom have magnitude. See the discussion under "zero." In vector analysis, the zero vector axiom states that any vector v plus a zero vector is equal to a zero vector plus v. (Note that this axion is not proven, just assumed).

However, there are an infinite number of different zero vector resultant systems, and so zero vectors may differ, if their infolded component "substructure" is considered. Indeed, a zero vector system must be identified as a special form of potential, if its substructure is considered. The common practice in electrical physics of replacing a zero-summed system of vectors with a vector zero is incomplete, and such did not exist in Maxwell's original quaternion theory. This present practice should be changed; the vector zero should be replaced with a special organized vector zero system and a scalar potential. By failing to do this, physics excludes the ability to engineer electrogravitation, spacen'me, the virtual state, local general relativity, free energy, effects at a distance, and the probabilities of the states propagated by the Schroedinger equation. It also excludes scalar electromagnetics (electrogravitation), and unification of all forces in an engineering electromagnetics fashion. In the new view, a zero vector may be a system of vectors that vectoiially sum or multiply to zero, but the components may still exist "inside" and dynamically function inside the zero-resultant envelope. This substructure can act on nonlinear or resonant systems. Any or all components may be time varying, or none of them may be. The zero vector system may thus be a dynamic vacuum engine. In addition, such a vector zero system is considered to be also a scalar stress potential, whose magnitude is equal to the sum of the absolute values of the perpendicular components. In addition, a separate type of stress potential may be included for the magnitude of the absolute values of the swirl components (torques). Other associated potentials may be included for the system, particularly if the system is in multiple dimensions, if it consists of more than one type of virtual particle flux, if several fluxes intercommute, etc. Such a system can also be designed and created to deterministically interact with and on the life force itself, the mind, thought, and personality.

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CANCER AND THE UNRESOLVED HEALTH ISSUES IN THE BIOLOGICAL EFFECTS OF EM FIELDS AND RADIATION

- Text of Booklet
- List of Accompanying Slides (63)

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Largely taken from the author's presentation, "Mechanism for Long-Term Cumulative Biological Effects of EM Radiation," 70th Annual Meeting of the Alabama Academy of Science, University of Alabama at Huntsville, 25 March 1993.

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Abstract

Both postulates in the conventional EM bioeffects model are in error, as is the classical electromagnetics model (CEM) itself. Major errors in CEM are presented. The QM view is taken that all EM phenomena are caused by the potentials, not the force fields. Using the Whittaker/Ziolkowski (WZ) internal structure of the scalar potential, Bohm's quantum potential and an engineerable variant of his hidden variable theory emerge. A strong candidate emerges for the internal mechanisms used for mind, thought, long term memory, and deep cellular control by Popp's master cellular control system. An environmental negative feedback mechanism is stated for long-term, cumulative causative mutation, yielding Sheldrake's morphogenetic field, which is a species quantum potential. Utilizing the new EM bioeffects model, Kaznacheyev's demonstration that any cellular death or disease can be caused electromagnetically is explained. A new definition for cancer is advanced, as is a long-term cumulative mechanism that causes it. The mechanism for Priore's demonstrated cures of terminal tumors in laboratory animals under rigorous scientific protocols is explained. A solution for the major cumulative mechanism for biological effects of EM fields and

radiation is presented. A self-targeting mechanism is presented whereby complex WZ EM biwave pumping of the "cell as a nonlinear phase conjugate mirror material" produces an exact EM antidote signal for the specific cellular disease. It is argued that inexpensive, quick, nondebilitating, cures can be developed for most major dread diseases, including cancer, arteriosclerosis, and AIDS. Priore's remarkable and previously unexplained cures of terminal tumors in lab animals are cited as examples of applying the new model, albeit unwittingly.

The Basic EM Bioeffects Model Is In Error

As is well-known, the field of EM fields and radiation effects on biological systems is actually in something of a shambles. In over 40 years of studies and experiments by careful researchers, the results are inconsistent, contradictory, and usually difficult or sometimes impossible to replicate. Attempted replications often give contradictory results, erratically. Researchers cannot rigorously answer even the simplest question, such as "Does power line radiation contribute to the incidence of cancer and leukemia, and if so, how and under what circumstances?" Causative mechanisms have so far eluded research. Powerful vested interests fund many of the studies. Consequently a great deal of controversy exists in the field. Opinions and positions range from the "microwave oven" position that "if it doesn't appreciably heat tissue, it doesn't harm biological organisms," to the "total fear" position that "any and all non-ionizing radiation is harmful; we just don't know by what mechanism." Legal actions to limit human EM radiation exposure are increasingly being initiated by concerned citizens' groups.

What has actually been "proven" by the nearly fruitless EM bioeffects effort to date is that the fundamental EM bioeffects model being utilized by the researchers is totally inadequate for the *task intended*. If that is true, then 40 more years of continuing to apply the same inadequate model isn't going to make very much additional progress. Further, if the fundamental model is faulted, then what is needed is a detailed examination of *the* model to discover and correct those foundation faults.

In tackling this model foundations problem, I have performed a systems engineering layout of the fundamental EM bioeffects model, and stated its two major postulates. Both postulates turn out to be in

error! Immediately one can easily see *why* the field is in such a state of confusion. However, no true systems engineer would stop there. I have also performed a systems engineering layout of precise corrections for the two postulates, thereby correcting and extending the model so that it can yield consistent, replicable results and causative mechanisms. All of this is a rigorous procedure, and straightforward systems engineering methodology.

However, the results point to profound changes, which I have been immersed in deeply studying for quite some time. Out of this approach has emerged something quite fundamental: *a strong candidate for the internal mechanisms used for mind, thought, long term memory, and the deep cellular control system for all cells of the body.* A mechanism for species adaptation also emerges that is quite capable of explaining (and yielding) long-term directed mutation, including the "species jump," where a species such as a bird emerges in short order (not gradually) from a species such as a reptile. The known "species jump" has been a deep mystery to evolution theory, which simply could not explain it. Another thing that has emerged is a startling new *electromagnetic* causative mechanism for cancer, leukemia, etc. At the June 1993 Brain-Mind Symposium in Los Angeles, I will present that exact mechanism. The mechanism is capable of laboratory test, and validation or falsification. We will also present an entirely new approach to EM effects on biological organisms, and present the major new mechanism involved. The new mechanism has fundamental application to the theory of diseases, and offers potential curative mechanisms for dread diseases such as cancer, arteriosclerosis, and AIDS. I explain some of the necessary background in the following paragraphs.

Classical Electromagnetics is Seriously Flawed

As is well-known, there exist severe contradictions between classical electromagnetics (CEM), general relativity (GR), and quantum mechanics (QM). As presently constructed the three disciplines cannot be unified, even by Herculean efforts. Particularly with respect to the primary causative agents for electromagnetic phenomena, the foundations of QM and of CEM are in profound disagreement. CEM assumes *the forcefields* as primary causes, paying only lip service to the potentials and treating them as primarily mathematical conveniences. QM, on *the* other hand, has long since [since 1959] shown that the force fields are simply *effects*

in and on the charged particle system, and are not causes. Instead, QM has shown that the *potentials* are the primary causes of all EM phenomena. In charged particle systems, potentials can interfere and cause observable EM phenomena such as the Aharonov-Bohm effect in the complete absence of the force fields. Herein lies *the* reason for the present dire straits of EM bioeffects research. We explain further:

CEM theory was originally formulated by James Clerk Maxwell in terms of quaternions. Note that quaternion algebra has a much higher topology than either vectors or tensors, the mathematics in which CEM is presently expressed. None of the present "Maxwell's equations" _ universally taught as due to Maxwell _ ever appeared in anything by Maxwell himself. Depending upon what you wish to call a fundamental equation, Maxwell's true equations are the numerous *quaternion* equations included in one almost incomprehensible chapter of his 1873 book. The present four "Maxwell's Equations" are in fact due mostly to Oliver Heaviside, and to a lesser extent to Gibbs and Hertz. The major player was Heaviside, a very brilliant but self-educated man who never attended University.

At the time Maxwell's book was published, Heaviside was just teaching himself calculus and differential equations. Seeing the book, he was electrified by it, and Maxwell became his undying hero. Maxwell died not long after, of stomach cancer.

Heaviside believed _ as did almost every scientist at the time _ in the older medieval tradition that *forces* were the causes of all physical effects. He had great difficulty with the potentials, stating that they were *"mystical and should be murdered from the theory."* We know today in modern quantum field theory that forces are effects, not primary causes of anything. In fact, it is the exchange of virtual particles with a mass that generates all forces upon it. As is well-known to foundations physicists today, "force" does not exist without the mass present to be acted upon, and without the action of a potential gradient upon the mass. We know that there are no force fields in the vacuum, and hence potential gradients in the vacuum are not forces, even though they are commonly assumed to be. CEM has not been corrected for these glaring defects: it prescribes force fields in the vacuum, and it prescribes that potential gradients are forces, even in the absence of any mass for the gradients to act upon.

Heaviside also abhorred the quaternion theory. The coupling of a scalar component with three directional components was, in his

view, "mixing apples and oranges." He knew that engineers would never master Maxwell's use of quaternion mathematics because of its difficulty. Consequently, Heaviside simply chopped off the scalar component of the quaternion and discarded it, then formulated this new "truncated to a vector" version as a much simpler mathematics, albeit of decreased topology. What he unknowingly threw away was the ability of the quaternion theory to capture an *internal* deterministic, vectorial EM structure of the scalar potential. *[It turns out that he also discarded the unification of EM and gravitation by throwing out the scalar component, but that is outside the scope of my presentation.]* Years later as a lonely recluse in a small upstairs apartment, Heaviside turned back to quaternions to work on a theory of gravitation, according to papers found hidden beneath the floor of his study many years after his death.

Learned journals of the day would not accept Heaviside's papers for publication, because of the assumed "brutality" of his mathematical methods. So Heaviside began publishing very practical papers in a technical magazine, for the time roughly equivalent to *Scientific American* today. These practical papers gave transmission line theory, transformer theory, etc. _ things very useful to the early would-be "engineers" who were struggling with installing telegraph lines, undersea telegraph cables, etc. The vector mathematics utilized by Heaviside was much easier to understand and apply, and his work was eminently practical. Consequently it was eagerly seized upon and applied. The result was that Heaviside's EM model became the ipso facto CEM standard. Note that, at the time, only about 30 or so scientists in the world were truly "learned" in EM _ either from the vector standpoint or from the quaternion standpoint. Further, not much *practical* work was being done by the few quaternion practitioners.

A short "debate" over whether EM should use Maxwell's quaternion model or the Heaviside/Gibbs vector model occurred prior to the turn of the century, mostly in the journal *Nature*. It never involved over a handful of scientists, and it wasn't much of a debate. The vectorists simply threw out the quaternion EM theory and adopted the vector theory of Heaviside and Gibbs. Note that this represented a substantial curtailment of Maxwell's actual theory. *In other words, you can actually do a lot more in and with EM fields and circuits than what now appears in "modern" EM theory, and "modern" EM analysis won't even show it.* Barrett's Oscillator-Shuttle-Circuit analysis of Tesla's actual patented circuits shows this clearly and resoundingly. Also, *living systems utilize the discarded subset of EM for their most vital control functions, and the present theory and*

methodology will not detect or "see " this. Thus this curtailment alone has resulted in the profound crippling of the conventional EM bioeffects model and efforts to apply it.

The Present CEM is a Flawed Subset of Nature's Electromagnetics

So we have several serious things that are quite wrong with current CEM theory. First, the theory (and its practice) are *artificially* limited to only a subset of the real EM that can be achieved and utilized. The present CEM unwittingly excludes the very type of EM utilized by living systems for their deepest control functions. It also excludes electrogravitation. Second, Maxwell's theory was actually based upon the assumption of a *mechanical (material) ether,* which meant that he could logically assign material forces to the "vacuum" or "ether fluid." Heaviside's translation (and curtailment) to vectors did not charge this "material ether" and "force field in vacuum" assumption.

However, in 1887 the Michelson-Morley experiment resoundingly destroyed the notion that the ether is material. If the ether were truly a thin material fluid, then forces and EM force fields would indeed exist in it. Since the ether is not material and forces exist only in, on, and of matter, no E-field or B-field exists in the nonmaterial vacuum; none ever has, and none ever will. In his three volumes of physics, Feynman pointed out that only the *potential* for the EM force fields exists in the vacuum; the only thing that exists in vacuum is *potentials,* after all! The vacuum is just a fantastic collection of interfering potentials and potential gradients. Rigorously, the E- and B-fields we detect with our instruments *exist only in the electron gas in the probes we utilize.* This is well-known to a few foundations physicists, but the CEM model has never been corrected for these foundations errors.

Note that the loss of the material ether also falsifies one of the three key assumptions in modern potential theory: the notion that the gradient of the potential comprises a force field. We know today that the CEM equation $E = -\nabla\phi$, is actually incorrect *for the vacuum.* It is correctly *measured;* since that is exactly what is detected when the vacuum $\nabla\phi$ potential gradient couples to the free electrons in our detecting/measuring instruments. What we detect as E, however, is actually $[(\nabla\phi \bullet (e^-)]$, or the potential gradient coupled to the

electrons, including their masses. Specifically, we do not detect the nonmaterial (VO that actually exists in the vacuum. We detect electron wiggles in the free electron gas in the conductors of our instruments; we do not detect "vacuum wiggles" per se.

Neither Maxwell's quaternion EM equations nor Heaviside's vector EM equations include electron spin effects, but actually model electricity as a "thin fluid." Hence the EM equations of either model are *fluid dynamic* equations. Specifically, the measured transverse EM waves exist in the electron gas of our detectors; any detector detects only its own internal change, *not* the external agent that interacted and caused that internal change. White the "signal" races down the conductors in our probes and sensors at essentially the speed of light, the "free" electrons in the electron gas in those conductors are *longitudinally* restrained. The electrons must essentially move laterally from their initial distribution inside the conductor to its skin, then "slip" slightly down the wire on the skin at only the electron drift velocity, which is a fraction of a centimeter per second. The spinning electrons in the electron gas, being longitudinally restrained, act as *gyroscopes.* When disturbed by an interacting force, they precess. It follows that the lateral motion of the electrons inside the conductors of our detectors is just this "electron precession." It also follows that the direction of the disturbing force must be at right angles to the electrons' measured transverse precession movement. Rigorously, EM waves in the vacuum thus are *longitudinal,* not transverse. We *measure* transverse waves in our detectors and instruments because we are detecting and measuring the *electron precession waves in the free electron gas in the conductors of those instruments.* But as Tesla pointed out, there are no Hertz waves in the vacuum; instead, EM waves in the vacuum are longitudinal "sound" waves, or *waves of rarefaction and compression of the medium.* From modern QM we also know what the medium is: it is a flux of virtual particles. Again, as can be seen, the CEM model is seriously in error in its representation of EM waves in the vacuum.

We will not pursue this further; it is well-known to a few physicists in foundations work (but not to most electrical engineers and electrical physicists!) that classical EM theory is seriously flawed, and that it should be upgraded to correct those flaws. As is well-known in QM since 1959, it is the potentials that are the actual causes of all EM phenomena, and the potentials can interfere to cause real EM effects in charged particle systems, even in the absence of the force fields. The Aharonov-Bohm effect is an

example, as are several other derivative effects well-established in the literature. What has been ignored even in QM, however, is the *organized internal structure* of the potential, even though the original (vector) discovery by Stoney occurred in 1897 and was extended by Whittaker in 1903.

This internal structure of the scalar potential had been implicitly present in Maxwell's 1873 quaternion theory, as an integral part of the scalar component of the quaternion resultant of the intera**ct**ion between two or more quaternions. In quaternions, a scalar entity may be regarded as a special quaternion entity whose translation has been reduced to zero. A vector entity may be regarded as a special quaternion entity all aspects of which are translating, and no nontranslating aspect is present. Thus the scalar quaternion entity may be totally composed of vector components, so long as they sum or multiply to a zero translation resultant but possess a finite nontranslating magnitude.

The Scalar Potential Has an Internal Bidirectional Wave-Pair Structure

In a profound but ignored 1903 paper of enormous consequences, E. T. Whittaker decomposed the scalar EM potential into a harmonic set of bidirectional wave pairs, extending the original 1897 work of Stoney. Each wave pair consists of a wave and its phase conjugate replica (its "anti-wave" or "time-reversed twin".). Thus the scalar potential has a rich internal biwave structure. [Further, one can *make* a scalar potential by simply assembling the necessary multiple waves, and one can alter the internal structure of the potential at will by altering the waves utilized in the assembly process.] In 1904 Whittaker published a formidable second paper, showing that all of CEM could readily be replaced by scalar potential *(hidden multi-wave)* interferometry. In other words, scalar EM is far more basic and extensive than is the present CEM with its emphasis upon the force fields.

E.g., you can alter the internal structure of the Schroedinger potential, and place deterministic biwave "hidden variables" inside. You can then "engineer" these hidden variables _ and consequently the Schroedinger potential _ by external means. In other words, you can even accomplish *at least limited engineering of quantum change itself.* This of course reduces the Gibbs statistics (which assumes a

totally random quantum change) to a special case, and provides a more general case of chaotic quantum change, which is still statistical but may contain hidden order. Note that this statement is experimentally testable. It also resolves the greatest problem in quantum mechanics today: the problem of the missing chaos (hidden order).

In 1989 Ignatovich placed a paper in the *American Journal of Physics* pointing out a similar internal biwave structure of the Schroedinger potential, but none of our scientists seems to have realized the profound implications. *If we apply these proven mathematical extensions of electromagnetics, we are now dealing with a higher topology hidden variable theory, along the lines shown by Bohm, but one that is engineerable on the lab bench.*

Ziolkowski's Extension Allows Hyperspatial Communication

In 1985, a brilliant EM scientist named Ziolkowski independently rediscovered Whittaker's internal biwave harmonic decomposition of the scalar potential. He also extended the "internal structure" theory, to encompass not only the sum set but also the product set. Since the product of waves represents modulation, Ziolkowski's brilliant work provides the setting for *direct information communication capability* in the internal structuring of the scalar EM potential.

Further, this internal channel is in the virtual state, so one is accomplishing virtual state engineering, in the sense of the vacuum engineering posed by Nobelian Lee. If one uses a 4-space Minkowski model, the Whittaker/Ziolkowski channel information may be viewed as *subspace* communications. If one utilizes an n-space Kaluza-Klein model, where n is greater than 4, then the Whittaker/Ziolkowski channel information may be viewed as *hyperspace* communications. *Living systems already use this inner EM channel.*

Living Systems Use the Internal Channel Communication

It turns out that living systems utilize precisely the Whittaker/ Ziolkowski (W/Z) mechanism for their deepest functions and control systems _ including mind, thought, long-term memory, and the master cellular control system (MCCS) discovered by Dr. Popp of Germany. What we are stating is that, for the very first time, *we now*

know where and how the mind's "deepest software" is, its fundamental mechanism, and how to go about programming it directly. However, we first must develop new measurement instruments.

Unfortunately, present EM instruments are almost all only "electron-wiggle" detectors; they detect only the *translation of electrons. A gradient* in the potential will couple to electrons and translate them. The *gradient-free* potential does not translate electrons, and it is the internal biwave W/Z structure of that gradient-free potential that we need to measure. Presently no known instrumentation will do that.

However, if two different scalar potentials are interfered [Whittaker 1904], their interference reproduces potential gradients [normal "force field" EM], which *do couple to electrons and translate them.* In fact, potential gradients (which in CEM are erroneously called "force fields") were already shown by Whittaker to be entirely due to the interferometry of two scalar potentials. So new "scalar interferometry" instruments must be developed to "outfold" the internal contents of the scalar potential as gradients, and then utilize normal instrumentation to measure those interference gradients and calculate the potential's internal structuring. One form for the detector is the use of a standard potential (with a known internal biwave structure) inside a Faraday-shielded chamber, so that the test gradient-free potential (which penetrates such a cage) interferes with the standard potential inside the cage to produce gradients therein. *A* probe in the interference zone detects the gradients as electron translations, which are conducted externally to amplifiers, meters, spectrum analyzers, computer programs, etc. The end result is the determination of the internal WZ structure of the test potential. Other detector types are possible; this is just a "straightforward" type.

Thoughts, Mind, Memory, and Cellular Control Are Measurable

What we are saying is that, by developing the proper instrumentation, it is possible to directly detect and examine thoughts, memory, and deep control system functioning of the biological organism, including the deep internalistics of its personal quantum potential. We are speaking of the pending emergence of an experimental science, not just a speculation.

However, we are dealing now with a form of "hidden variable" theory, but one that is engineerable and testable. So we will become directly involved with Bohm's *quantum potential*, both experimentally and theoretically. *A* quantum potential can connect widely separated systems by instantaneous effects, as if the systems were not separated but were located together as a single system. Further, the quantum potential does not have a single localized source. Suffice it to say that in 1991 I published the discovery of how a quantum potential is actually created. If one utilizes the proven "self-targeting" or iterative phase conjugate shooting mechanism from the Strategic Defense Initiative, and applies it to the WZ waves internal to the scalar EM potentials from two separated charges, then in a dense signal environment the self-targeting interaction may be initiated, so that the separate potentials merge into a single nonlocalized or "spread-out" potential consisting of laser-like beams between the charged particles comprising the separated systems involved. In that case, part or all of any EM change in one system is immediately experienced in the other systems participating in the effect. The communication is superluminal. The limitation to luminal velocity applies only to the "surface gradient" of a potential, not necessarily to the bidirectional waves in its WZ internal structure. Those internal waves are in either hyperspace or subspace, depending upon whether one models the situation in more than four dimensions or in only four.

The point is, *the quantum potential also has a W/Z internal structure.* And that structure can be deliberately created and engineered by external means. Action at a distance is not only possible but engineerable.

Living Systems and Quantum Potentials

It turns out that the living organism utilizes a quantum potential _ a *special scalar potential connecting all its internal atomic nuclei* _ for its volition, deep control, and mind and thought processes and operations. This can even be taken as a flat definition of a living system. A living system utilizes internal WZ structuring of this scalar potential connecting all the atoms (nuclei) of its body mass, for its deepest control processes. Any system not having or doing this is not a living system. This also resolves the age-old philosophical question of how mental *intent* cm cause physical response, but that is beyond the scope of my presentation. It also

explains why viruses can be precipitated out of solution as a crystal, and the crystal stored for decades. Then when the crystal is redissolved, the individual viruses separate and resume their "living" state. Suspended animation of the viruses results when their physical matter and its quantum potential remain intact, and the stored WZ structures in the quantum potentials on the atomic nuclei of that matter remain the same.

It further turns out that the species itself has a much weaker (at a deeper level topologically) quantum potential connecting all its members (all the atomic nuclei in their bodies). This corresponds to Sheldrake's morphogenetic field _ that field is just a *species quantum potential.* Jung's collective unconscious, e.g., can be directly expressed in this model scientifically and testably _ but again that is beyond the scope of this presentation.

Newton's Third Law Requires Forces to Occur in Oppositive Pairs

Newton's third law is a sleeping tiger, with surprising implications when awakened and explored. For example, it rigorously requires that forces (including EM forces) must occur in oppositive pairs, This alone falsifies the CEM notion that *oscillating "singular-force"* electric and magnetic waves appear in either a material ether or physical matter. At least two waves must exist, the wave and its oppositive or *antiwave.* Further, the wave and antiwave must be intimately coupled. Heretofore the antiwave has simply been ignored, or when anyone pointed out that it was present in our detectors, it was just considered to be "Newton's third law reaction wave." "Newton's third law" was just mysteriously invoked, as if it had no causative mechanism. Yet in quantum field theory the cause of all forces is the absorption or emission of *virtual particles.* The cause of all mechanical and electromagnetic forces is the absorption or emission of virtual *photons. So* Newton's third law for mechanical and electromagnetic reactions must also be due to the exchange of virtual photons. In other words, there was an extra half of the "something" in the vacuum that interacted with our detectors and gave us the "free electron gas's transverse precession waves. That "extra half' was exactly equal and opposite, and interacted in the atomic nuclei of the conductors and the mass of the instrument to give a set of physical Newtonian recoils. That half is equal and opposite to the half we actually recognized. The point is, equal and

opposite forces actually interacted with our instrument. Thus a stress wave interacted with it, not a unitary oscillating wave.

What occurs in vacuum must be a stress wave, not a unitary force field wave. In short, as stated (but not elaborated) by Feynman, it is a *potential* wave, or an oscillation in the potential gradients and magnitudes, not the force fields. Since in modern theory force is an *effect* and not a cause, we interpret and extend Newton's third law to state that the *causes* of all forces must occur in oppositive pairs also. Thus the cause of an EM force field must be the interaction of two scalar potentials _ just as Whittaker's 1904 paper proves.

In quantum field theory any mechanical or EM force is caused on a mass by absorption and emission of virtual photons. Accordingly, let us examine the smallest possible EM or mechanical "force" _ that one caused by the absorption of a single virtual photon. Newton's third law requires that two photons (the causes) must occur, not one. Further, in all cases, the one must be the exact antiparallel to the other. The only thing always meeting that condition for a photon is its exact antiphoton _ its *time-reversed, phase conjugate replica twin.* But a phase conjugate *replica* photon must also superpose spatially with its parent photon _ that's what phase conjugate replicas normally *do,* according to the distortion correction theorem of nonlinear phase conjugate optics. Thus instead of the conventional "single photon" interaction, the actual vacuum entity engaged in the interaction with an atom is a *coupled photon/antiphoton pair.* A coupled photon/antiphoton pair has spin-2, hence is a *graviton.*

Gravitons and Graviton Interaction

So arguably "photon interaction" has been *graviton* interaction all along. In the interaction with an atom, the graviton splits into a photon and an antiphoton. The photon usually interacts with the electron shells, being absorbed by an electron to raise its energy level, then re-emitted and scattered outward from the atom. This absorption and scattering of photons _ *containing their components of energy and time* _ from the electron shells of the atom creates movement of the atom through external observer time. The photon interaction between a mass and its environment creates the forward flow of time for that atom and its seemingly entropic external (photon interaction created) universe.

The antiphoton half of the graviton is time-reversed, which we see as *spatially* reversed. Consequently we see it move in the opposite direction to its externally-directed photon twin. So the antiphoton focuses inward and interacts with the atomic nucleus, providing the Newtonian third law recoil of the atom. The blithe assumption of an "automatic" third law reaction force has always concealed the fact that the so-called *photon* interaction is actually a *graviton* interaction. Further, the positive charge of the atomic nucleus is due to the time reversal interactions of antiphotons with the nucleons, which reverses the charge from that of the negatively charged electrons in the atom's electron shells.

Proof: Excising the Antiphoton Violates Newton's Third Law

This graviton interaction hypothesis is testable. Note that, if the hypothesis is correct, then when an atom or mass emits antiphotons or antiwaves (phase conjugate photons or phase conjugate replica waves), it means that the inward-burrowing antiphotons have been "tricked" into coming out of the atom instead, so they can comprise the time-reversed wave. If they come outward instead of going inward when they split from the parent gravitons, they do not interact with the nuclei to cause their recoil. In that case, there would be no recoil. And indeed, so it *is. In a phase conjugate mirror material, the mirror does not recoil when it emits a phase conjugate replica wave, even a powerful one due to powerful pumping.* This is not true when the mirror material emits a pseudo-conjugate wave. A pseudo-conjugate mirror, e.g., emits an ordinary "time-forward" wave with a distorted wave front, so that it will "retroreflect" in a manner similar to the phase conjugate replica wave. However, the pseudo-conjugate wave is not a true time-reversed wave. Consequently, the mirror will recoil when it emits the pseudo-conjugate wave, because the antiphotons from the graviton interaction still penetrate to the nucleus and interact there, while the time-forward photons constitute the pseudo-conjugate wave actually emitted. This is experimentally verifiable. Among other things, it establishes that there exist differences between the photon and the antiphoton.

Looking at the photon aspects of this, one realizes that one must be very careful in applying the conventional assumption that the photon and the antiphoton are identically the same. Actually they are not the same "internally." The photon can be thought of as carrying or

consisting of (+□E)(+□t), while the antiphoton can be thought of as carrying or consisting of
(-□E)(-□t). Thus both have positive spin, but differ in their internal components. The lack of recoil in a phase conjugate mirror that emits a true time-reversed replica wave is already in the literature, though derived by statistical quantum mechanical arguments. It has also been pointed out by other physicists that all measurement/ detection is actually binary, but that the "internal energy" half is almost always ignored [it's just considered to be "Newton's law", automatically revoked, and swept away in that euphemism.].

Graviton Lattice Structure of the Scalar Potential

When we examine the WZ structure of a scalar potential, in each biwave the wave and antiwave are phase conjugates. It follows that the photons in the wave and the antiphotons in the antiwave are phase conjugates also. This means that, as the two waves flow through each other spatially, photon/antiphoton pairs continually couple and uncouple. Hence gravitons continually couple and uncouple. Further, since the wave pair frequencies are phaselocked between pairs, *the scalar potential is a phaselocked lattice of statistical (continually forming and unforming) gravitons.*

Let us now consider the interactions of an organism with environmental photons as the interactions of the organism with environmental *gravitons*, and specifically with graviton lattices.

Cumulative Buildup in the Quantum Potential of the Antisignal

If the *photon half (of the graviton interactions)* in the electron shells of the living body are considered as environment signals/ interactions, then precise *antisignals* or anti-interactions, constituting perfect negative feedback from all of an organism's physical environmental experiences, are experienced in the organism's atomic nuclei. Note that there they have partially affected the internal structuring of the quantum potentials _ both the personal quantum potential and the species quantum potential. The point is, *cumulative negative feedbacks (exact phase conjugates) for all the environmental experiences and stresses an organism experiences, build in both the personal QP and the species QP of*

that organism. A part of the entire species' cumulation of species-common antisignals also exists deep in the quantum potential of the living biological system.

So for any protracted stress experienced by the organism, in its personal QP a coherent cumulative negative countermeasure feedback _ one which by its time-reversed nature would reduce that stress _ continually builds. The phase conjugates of the "well-rounded" or highly varying stresses of multiple types will tend to mostly balance or "zero out." However, a sustained stress of one kind will result in coherent cumulation and increase in the "signal-to-noise ratio" of the amplitude of the antisignal for that particular stress, compared to the amplitude of the average of all the antisignals experienced. This is similar to the case where, in a sea of radar noise, a coherent radar signal were continually present and integrating coherently. Continual coherent integration, of course, results in continual increase of the signal-to-noise ratio for the coherent signal, and eventually it emerges from the "sea of noise" as a discernible [in this case, observable and physical] antisignal.

This "cumulative kindling of antisignals" occurs in both the personal QP and the species QP; however, the species QP is many, many orders of magnitude less than the personal QP. Hence much greater time is required for "kindling" of species changes (evolution) than for kindling individual countering adaptations.

Exercising to get in shape is a simple example of physically stressing the body cells so that the high-level feedback mechanism in the MCCS will kindle appropriate antisignals and order the cells to adjust their functioning in a fashion such that the level of performance being called for can be accomplished more easily, thus reducing the stress level. The adaptive mechanism ordering the adjustment of the body cells is the coherent negative feedback in the personal QP, created from the stress signals from the sustained "workout" exercises. This is a fairly rapid, "high-level" mechanism; many other much slower (and some much faster) feedback reaction mechanisms also exist.

Hypoxia As a Result of Interference With Hydrogen Bonding to Hemoglobin

We now point out the recently discovered water H-bonding effect on

the hemoglobin in the blood, where the H-bonding activity increases the ability of the hemoglobin to carry oxygen. Some 60 or 70 water molecules surround the hemoglobin molecule, engaging in extensive H-bonding interactions with it, which substantially increases the hemoglobin's purely chemical ability to bind and transport oxygen. Importantly, contamination of this water in the blood fluid drastically affects this H-bonding benefit, and reduces the hemoglobin's ability to carry the extra oxygen. Thus contamination of the internal blood fluid by chemicals, agricultural pesticides, smoke, etc. directly and dramatically lower the oxygen availability to the body's cells, resulting in a continuing "oxygen hungry" state (hypoxia) in most of the body's cells.

It also is now known that H-bond structuring of water is highly dynamic and constantly adaptable, and it possesses a high degree of internal order. A conglomerate of H-bond structures in an area or a volume can be considered an *H-bond potential,* since the gradient oppositions sum to produce stress potentials. Thus in the H-bonding fluid surrounding the hemoglobin molecule, there exists an H-bond scalar potential, and by Whittaker/Ziolkowski (W/Z) decomposition it has a multi-wave structure. Any and all contamination of the fluid _ including by electromagnetic fields and signals, chemicals, etc. _ alters the H-bonding structuring and hence the internal W/Z structure of the H-bond potential. *The end result of adulteration of the H-bonding structure of the blood fluid is a condition of hypoxia induced in the cells of the body due to reduced oxygen transport by the hemoglobin of the red blood cells.*

Any single EM signal is the result of the interference of two scalar EM potentials, as shown by Whittaker. It is the result of the interference of the *internal EM wave structures* of those scalar EM potentials. Multi-signal EM radiation must be regarded as interference of multiple pairs of scalar potentials. These interfering potentials penetrate to the atomic nucleus in the body, and thus interact with the internal personal quantum potential utilized by the body in its deep cellular control. Also this multi-signal EM radiation, *no matter how weak,* directly interacts with the H-bonding structure of the H-bonding blood fluid. Even single-signal EM radiation still forms oppositive pairings with the weak fields already existing in the body, thus also forming W/Z structured potentials. From the interferences in the body of multiple such potentials and their internal structures, there also are created gradient (force field) interactions upon the blood cells and the hemoglobin. In short, low-level background EM radiation can also interact with the H-bonding

of the hemoglobin to seriously lower its oxygen transport capability, just as any other contaminant. The denser the external environment, the greater is the interferometry and the interference with the hydrogen-bonding augmentation of oxygen transport. It follows that, when thrust into a truly dense signal environment, some exposed individuals may receive a "cumulative H-bonding interference dosage" that, when added to their existing prior dosage, is sufficient to result in physical symptoms "ordered" into the cells by the antisignals kindled in their quantum potentials. In the recent Gulf War, many Americans were suddenly thrust into one of the densest EM signals environment in history. Shortly after returning from that ultrashort conflict, many of these exposed veterans have experienced delayed health changes presently known as "Gulf War Syndrome." While the military has attempted to portray this syndrome as "stress-induced" emotional' trauma, most of these veterans when tested are found to be emotionally stable. Further, there was much less combat stress on our troops in the Gulf war than in WWII, the Korean War, or the Viet Nam War, as shown by less than 200 combat deaths! Essentially the war was almost a "shooting gallery," and so combat stress is simply not viable as a proposed causative agent for the Gulf War Syndrome.

Chemical, Mechanical, and Electrical Interactions are Electromagnetic Anyway

Indeed, chemistry is largely due to electric charge and charge distribution anyway. So if we view the physical contaminants in the blood view *chemically,* they are caused by electromagnetic means at root basis. Thus even the "chemical" contaminants interact electrically and via potential (multiwave) interferometry with the H-bonding potential. Further, in quantum field theory, all mechanical forces are due to the exchange of virtual photons, and hence also are *electromagnetic at their very basis.* The bottom line is that all chemical, mechanical, and electrical interactions are in fact electromagnetically caused. Further, since both the internal and external structures of the potential are engineerable, the mechanical and electrical forces on the mass particles _ and the virtual photon exchanges causing these forces _ are directly engineerable. *All of these chemical, mechanical, and electrical interactions in the cells can be affect*ed *and even engineered electrically. This is true from the atomic nucleus, to molecules, to material lattices, to human cells, to tissues, and even to the mind and long-term storage templates (internal WZ structured forms in the QP) in the biological organism.*

As cam be seen there are many other weaker, direct interactions of "force-field" radiation; however, here we are interested in the interaction of that radiation with the inner structure of the H-bond potential'., to reduce the oxygen transport capability of the hemoglobin. *In any case, the total sustained interaction of chemical and physical contaminants and EM fields and radiation can result in a sustained oxygen-deprivation (hypoxia) condition for the body cells, even to a dramatic degree.* Further, by graviton interaction, *a sustained, cumulated set of antisignals is also automatically generated in the personal quantum potential as a set of negative feedback signals to take corrective actions to alleviate the oxygen depletion condition.* Note that the cumulating antisignal condition is general and affects the immune system and its cells as well.

The Example of Smoking

Obviously the tars, particles, and nicotine of the smoke inhaled by the smoker dramatically contaminate the fluid in the smoker's lungs, in the very place where the hemoglobin of the red cells is taking on oxygen. Drastic interference with the H-bond stimulus of the hemoglobin occurs. The result is an immediate and dramatic reduction of the oxygen-transport capability of all the hemoglobin in the red cells as they pass through the contaminated lungs and are exposed to fluid contamination. An immediate oxygen-deprivation condition thus is created in the body. Due to the magnitude of the stressing signal, the major portion of the antisignal is also of substantial magnitude _ hence immediate counteraction orders accumulate in the personal QP, specifically in Popp's master cellular control system. So very rapidly the body has negative feedback countersignals from the central cellular control system, ordering the body to take actions to reduce the cellular need for oxygen. The metabolism is lowered, the body relaxes, and the appetite is suppressed; all counters to the cells' hypoxia condition by lowering the cellular requirement for oxygen.

In spite of heroic "high level antisignal" physical cellular compensations to reduce the use of oxygen, however, the condition of cellular oxygen shortage may still continue, in the case of the smoker or substantial environmental contaminants such as secondary smoke. So in addition to the prompt countersignals, additional much-

weaker countersignals are also slowly accumulating in the personal quantum potential's central cellular control system.

Cumulative, Deep, Long-Term Countering Signals

We now need one additional bit of information. In addition to its personal quantum potential, a biological organism also is connected to a species quantum potential joining all the members of its species. This is a much weaker quantum potential; nonetheless, potentials superpose, so one small "part" of the personal quantum potential is actually the species quantum potential _ in other words, Sheldrake's morphogenetic field. Deep within its own personal quantum potential the living system also possesses all the cumulatively ordered steps (species antisignals that were implemented) of its species evolution. With very *long coherent cumulation, countersignals can be stimulated in the individual bio-organism's quantum potential _ and in its deep cellular control _ that are counters to the original signals that ordered directed mutation and the primeval evolution of the constituent cells themselves.*

In a sustained cellular hypoxia stress environment, the "do whatever is necessary to reduce oxygen usage" countersignals will continue to cumulate from successively deeper levels in the QP over an appreciable time. These continue to slowly "kindle" after the "first high-level antisignal actions" that cumulated past the "noise" (quantum) threshold reached their limits of physical reactions and are still insufficient to resolve the problem. As the hypoxia stress in the cells continues, then much weaker but coherent countersignals that trigger deeper cellular adaptation actions eventually have time to cumulate past the quantum threshold to the observable state. These long-term cumulated antisignals come from much deeper, even from the species quantum potential itself.

These cumulating deep countersignals are phase conjugates _ *reversals, or dedifferentiation commands* _ of the previous directed mutation signals that ordered evolutionary changes in their predecessor cells in the far distant past. *These long-term antisignals thus contain a signal to reverse the original cumulative countersignals in the cellular species potential that caused the cells early ancestral anaerobic cells on earth to change (differentiate) into largely aerobic cells, after the earth's atmosphere acquired significant amounts of oxygen. In short, a deep signal is slowly*

cumulating that, when it emerges, will order the dedifferentiation of the affected cell back down the evolutionary road toward the anaerobe. The first steps are reductions of centralized cellular control, including growth control.

In other words, under sustained cellular hypoxia a countermeasures signal to the cells, ordering them to dedifferentiate back toward the anaerobic state, is slowly building in the personal quantum potential from a much weaker, lower level "under the common countersignals noise level" all the while. If significant oxygen-deprivation continues for a sufficiently long time, this deep countersignal eventually emerges in Popp's MCCS system in the personal QP, *ordering the affected cells to dedifferentiate back toward their anaerobic state.* The first step back is to break away from centralized control by the higher organism _ which results in individual "tumerous" or "uncontrolled" cells. *From sustained cellular hypoxia there exists a slowly increasing precancerous state, even years before the outbreak of physical cancer.* This precancerous state has great influence upon the "single cells" of the organism, which includes the cells of the immune system. Thus the precancerous state is characterized by increasing errors in, and slow weakening of, the immune system. Arthritis and similar debilitating immune system disorders appear to be largely the result of this "precancerous" long-term cumulation.

Note that the most stressed cells in the body automatically provided the greatest magnitude of "negative feedback input." Notice also that the feedback is a phase conjugate replica; it therefore "backtracks" its initiating stress input signal. In short, the degree of feedback antisignal received by a cell or group of cells varies according to the degree of stress they experienced. Thus those cells sustaining the longest and greatest stress get this drastic dedifferentiation countersignal first. E.g., this accounts for the (usual) localization of the resultant tumor in the lungs of a smoker, at least initially. It also accounts for the stress-damage mechanism for such disorders as arthritis.

A New Definition of Cancer

In the new model being advanced, *cancer and leukemia are centrally-commanded. final, desperate. "first-step dedifferentiation" adaptive attempts by the stressed. affected cells experiencing sustained oxygen shortage (hypoxia) to reverse their cellular*

evolution and return to the anaerobic stage of their distant ancestry.

The cause of cancer and leukemia _ and indeed of all diseases _ is *electromagnetic* in nature, and it can be straightforwardly treated and cured *electromagnetically,* if one utilizes the extended W/Z aspects of the higher topology EM actually written by James Clerk Maxwell. This statement is based on experimental proof; it is not conjecture. We discuss that proof below.

As we saw, in general the strength of the cumulating countersignal inversely depends on the distance in the body of the affected cells from the source of greatest contaminant stimulation. As the deeper "dedifferentiation" countersignal reaches the quantum threshold in the most affected area, a small group of localized cells located there take the first step back along the "single-anaerobe to single aerobe to multiple aerobe" evolutionary chain. That first dedifferentiation step breaks the cells away from centralized control of the MCCS in the personal quantum potential. Those dedifferentiated cells become independent cells or a small independent cell-groupings. They constitute a *tumor,* or *leukemia* if occurring in the blood cells. They simply are no longer under the control of the body's MCCS in the personal quantum potential, even though the body's logistical services (nutrients, oxygen, etc.) continue to be furnished to them.

At this point the tumor becomes an independent cellular organism, living in an environment where its body host continues to furnish its food and oxygen, and its host's immune system cells do not recognize the altered cells as foreigners to be attacked and destroyed. Consequently there is no "large organism" central control of the tumor's growth, and the tumor cells divide and multiply apace. This loss of centralized growth control and the resulting unchecked cellular division and replication is in fact recognized by scientists as the major distinguishing characteristic of cancer and leukemia. With central control lost, groups of cancer cells or individual cancer cells may break away and travel to other locations in the body via body circulation systems. This results in metastasis, the spread of the cancer to other sites in the body, where they continue to be recognized as "self" by the immune system cells and continue to be supplied with oxygen and nutrients for continued growth.

The Tumor Has Become a Parasite Organization

Think of it this way: In a living body, each cell is already a single, independent, living creature all its own. It even has its own small "personal quantum potential" _ we have argued that that is an *a priori* condition of being alive. However, each cell in a multicellular organism normally is under a centralized electromagnetic control system (which functions in the organism's higher-level personal quantum potential), so that the organism lives and functions as an overall higher-level unit. If a cell (or group of cells) has separated from this centralized EM control, but is still living and functioning, then obviously the cell is no longer under the whole organism's MCCS and personal quantum potential. However, it still possesses its own control system, and its own personal QP. If the breakaway is by a small group of cells, then they are loosely under a "small group" quantum potential and MCCS as well. That is, they have gone from "large-scale central control" to a "much lower" level of centralized cellular control, accounting for the "tumor as an individual multicellular entity." Nourished by the host body, the new parasitic organism _ the tumor _ grows at an unchecked rate. Again, we argue that *the problem is electromagnetic in nature, and it can be "fixed" electromagnetically.*

The Cumulative Pre-Cancer State

With this picture of the long-term cumulative causative mechanism for cancer and leukemia, a far better picture of the pre-cancer state has emerged. The pre-cancer state is a hidden EM change of state comprised of a *cellular dedifferentiation order,* back down the species' cellular evolution trail, and the magnitude of that change of state is slowly increasing inside the organism's quantum potential. The eventual observable cancer is an actual cellular dedifferentiation due to the localized breaching of the quantum threshold by this cumulating hidden EM dedifferentiation order to move away from centralized control and back toward the anaerobic cellular state.

Becker's Profound Experiments

It has already been experimentally shown that very minute amounts of direct electrical currents, e.g., can cause cellular dedifferentiation and redifferentiation. In breathtaking work of Nobelian quality, Becker has proven that even picoamperes of localized electrical

current are sufficient to cause cellular dedifferentiation and redifferentiation, even repetitively. Incredibly, he proved that this was true for red blood cells, which first dedifferentiated to more primitive cells, the redifferentiated to precursors of cartilage cells, then redifferentiated to bone cells in a "bone fracture" area and healed the bone fracture. Since picoamperes can be generated by the cumulative countersignal mechanism (via Whittaker scalar interferometry), directly affecting the MCCS and the cells as well, then the connection between scalar potentials/potential interferometry and *dedifferentiation* mechanisms assumed to be involved in cancer and leukemia essentially follows from interpretation of Becker's pioneering work. To further strengthen the assumption, Hsue has recently (1993) shown that a DC voltage is in fact equivalent to two bidirectional EM traveling waves _ which directly indicates a WZ type implication in Becker's profound work itself. Thus Becker actually utilized a hidden, bidirectional WZ wave structure inside the voltage gradient between his electrodes in his DC current dedifferentiation and redifferentiation of blood cells. He conclusively demonstrated that cellular dedifferentiation and redifferentiation _ both of them *genetic* changes _ can in fact be caused by such an internal biwave EM structure of a steady, persistent scalar potential gradient. Further, he demonstrated that *these El~-induced cellular genetic changes can be self-targeted toward reversal of the specific damage condition, even though several successive genetic changes may be necessary m reach the ultimate cellular genetic form required for healing.*

Pre-Cancer State and Prognosis For Treatment Effectiveness

To summarize, whenever a cancer or leukemia detectably exists, regardless of the cancer site, a pre-cancer state also exists in the remainder of the body, and the immune system is affected generally. Further, this pre-cancer state pre-existed the actual emergence of the tumor itself. The new EM bioeffects model also sheds light on the probable effectiveness of conventional treatment, and probability for a "cure" that lasts for the rest of the patient's life.

If the cumulative countersignal slowly kindling in the remaining pre-cancer state is sufficiently below the quantum threshold, then conventional treatment of the cancer _ such as excision _ can eliminate the tumor, and no other tumors may then develop before the normal physical death of the body, even though slow increase of

the pre-cancer state continues. In other words, in that case the cumulative antisignals in the pre-cancer state locations other than the original cancer site never reach the quantum threshold prior to the natural death of the patient. On the other hand, if the cumulating antisignals in the pre-cancer state generally are very close to the quantum threshold, then recurrence of the tumor is highly likely. In the first case the curative prognosis is excellent; in the second case it is poor.

Also, we point out that many present treatments (such as nuclear radiation) themselves cause significant stress on the body and its cells and further deterioration of the immune system. They also generate an additional "antisignals" level in the personal quantum potential, resulting in an actual *increase* in the level of the pre-cancer state in the organism. If the combination of the pre-cancer state at time of treatment, plus the increase in the pre-cancer state due to treatment, is sufficient to breach the quantum level, then that treatment will prove to be of little or no avail to the patient. The tumorous condition will recur, and sometimes massively (the tumor metastasizes), regardless of whether further treatment is given or not. In that case the patient will die, unless somehow the pre-cancer state is lowered, the tumor cells are reverted back to centralized cellular control, and the immune system is restored to effective functioning so that excess cells are eliminated. Presently there is no conventional treatment that is capable of accomplishing the three requirements for a desperately ill patient's recovery from the "terminal" cancer condition.

Seeking the Complete Cancer Cure

From the new EM definition of cancer and leukemia and the new cumulative causative mechanism, one can see just how severely limited are the present medical weapons against this dread disease. It follows that, *if the cause is totally electromagnetic, then a totally effective treatment can only be sought as an electromagnetic therapy. Since the EM cause is in an extended EM domain, then axiomatically a totally effective treatment can only be sought in the same extended EM domain.*

The complete cure for cancer and leukemia, of course, would be to completely neutralize or "zero-out" the patient's cumulative Whittaker/Ziolkowski countersignal buildup in the MCCS/personal

QP. This can be done *prior to* the cumulation reaching the overt physical disease stage, or *after* it has already reached that stage. It can readily be done electromagnetically, using the multi-biwave tailored EM and self-targeting to provide an exact counter-countersignal (or antidote signal) to the cumulation signal itself. *This is a scientific fact and it has been rigorously proven, although the methodology could not heretofore be technically explained and understood.*

Priore's Cure of Terminal Tumors and Other Diseases

Such a total cancer-curative procedure was repeatedly demonstrated in live animal experiments in the late 1960s and early 1970s by Antoine Priore in France, under rigorous scientific protocols and supervision by eminent French scientists [such as Robert Courrier, head of the Biology Section of the French Academy of Science, and *Secretaire Perpetuel* of the Academy at the time]. The advantage of the Priore type approach was that it rapidly reversed the dedifferentiation away from centralized control of the affected (tumor) cells. The tumorous cells simply redifferentiated back to normal cells under centralized control of the MCCS/personal QP. (If too numerous because of the tumor's growth prior to its redifferentiation, normal body mechanisms absorb and dispose of the excess cells). Further, such treatment removed *all the pre-cancerous state from the rest of the body, preventing recurrence or spread of the tumor*. It is the only "total cure" for cancer, including the cumulated pre-cancer state, that has ever been scientifically demonstrated. And lastly, it accomplished these results without severe trauma to the body or further trauma to the immune system. Indeed, the exact opposite was the case.

Working with Priore, the eminent French scientist Pautrizel showed that the Priore treatment restored and stimulated the immune system back to its robust normal functioning, as would be predicted by the present model we are proposing.

Scientists at the Time Did Not Have the Necessary Knowledge for Understanding

It is a great tragedy that the active mechanism of the Priore device

was not understood _ even by Priore himself and even by very knowledgeable physicists assigned to the program to try to ascertain the machine's mechanism. The phase conjugate or "time-reversed" EM wave was unknown until it was discovered in the open Soviet literature in 1972. Almost all of our knowledge of such waves dates from that time. In the same year, two Soviet scientists briefed American scientists at Lawrence Livermore National Laboratory on *optical* phase conjugation. Thereafter, some American scientists began intense work on optical phase conjugation.

However, the time-reversed wave is a solution to the wave equation and applies to all kinds of waves, not just EM. Phase conjugation of sound waves, e.g., is readily accomplished. The time-reversed wave solution actually appeared in the scientific literature in 1898 in a paper by Barus, who pointed out that this strange solution "made the wave run backward." But at the time the Priore program's funding was withdrawn by the French government about 1974-75, little or no understanding of the time-reversed EM wave existed as yet in the West, and of course the Whittaker work had always been ignored and was unknown also. *Literally, with the technical tools available to them at the time, the French physicists, biologists, and oncologists had no chance at all of fathoming the causative mechanism in the Priore experiments.*

Nature of the Priore Treatment

Briefly, Priore mixed some 17 frequencies in a rotating plasma in a giant tube. We know today that one function of the kind of plasma he used is to produce a phase conjugate replica wave, for an input wave. Thus Priore unknowingly achieved coupled wave/antiwave pairs in his device. The output of the plasma tube was then coupled to (modulated upon) a "rippling magnetic field" of appreciable strength. The magnetic field guaranteed penetration of the entire body and every cell in it, carrying its modulated Whittaker/ Ziolkowski internal potential structure with it. The "ripple" in the magnetic field guaranteed penetration to the atomic nuclei, and interaction with them, via nuclear magnetic resonance. In turn, unknown to Priore or the scientific team, this guaranteed the interaction of the plasma-produced W/Z structure with the internal W/Z structure of the personal QP joining those atomic nuclei. Thus the Priore approach (1) formed a deliberate counter-counter signal W/ Z structure; i.e., Priore constructed a *specific electromagnetic*

antidote, (2) carried that antidote into all the atomic nuclei of the treated body by nuclear magnetic resonance, and (3) caused interaction with and neutralization of the internal W/Z dedifferentiation countersignal structure already present in the personal QP joining all the atomic nuclei of the treated body, *zeroing out or canceling the tumorous and pre-tumorous states existing throughout the body.*

The end results were that (1) the cumulated counter-signal to the tumor cells to dedifferentiate back toward anaerobic cells was removed, (2) the body's own centralized cellular control over the tumor cells was restored, and (3) the entire cumulated pre-cancer counter-signal pattern in the personal quantum potential was removed. In short, the individual organism started over again with a "clean slate" insofar as long-term cumulation of cancer-inducing signals in the personal quantum potential was concerned.

Furious Reaction by Orthodox French Oncologists

The Priore material, device, procedures, and results are all properly documented and presented in the peer-reviewed French medical literature. Priore obtained both French and U.S. patents on the device and on his treatment process. Robert Courrier, head of the Biology Section of the French Academy of Science, personally introduced the astounding Priore team results to the Academy. It caused a furor, and a vicious reaction of most of the orthodox French oncology establishment. Because no one could understand how the mechanism worked, there was loud and raucous insistence that "science must not be done with black boxes!" This overly pious attitude is strange, since the Priore results were multiply replicated and scientifically impeccable, and such things as aspirin were utilized for decades before their active mechanisms were understood. Indeed, in epidemology the use of vaccines and such is directly based on statistically showing that the results are real, even if the active mechanism is not understood.

When the French Government changed to a leftist government in the mid 1970s, the implacable foes of the Priore work prevailed, and the new leftist government withdrew all further funding. Priore later died, and that was the end of that.

Of all areas and treatments known to this researcher, the Priore

approach is the only one that has been rigorously and scientifically proven in laboratory animals, was essentially 100% effective, and was performed under proper rigorous scientific protocols. That it has continued to be ignored by the medical and biological communities is a profound tragedy, but one due more to ignorance of the active mechanisms for the treatment than of deliberate intent.

There Is Also Deliberate Suppression

Nevertheless, there is also an element of deliberate suppression involved. Some years ago I was personally involved with a special group in an effort to restore the Priore device, when Priore was still alive. Our group obtained a tentative agreement with both the French Government and with the Priore group. The Priore machines were to be rebuilt in Bordeaux, France under the personal supervision of Priore himself. Some of the scientists who had worked with him were still alive, and would have been involved in the project. Our group had some $16 million support pledged by some wealthy backers to fund the project.

Almost immediately after our group's successful conclusion of the tentative agreements, the lives of all our backers and the lives of their families were threatened. All backing was withdrawn. The leader of our group, a Nashville businessman, came under sustained personal and business attack. He eventually lost almost everything he had, and fled this country for his life. He is still in hiding to this day. Antoine Priore then died and that was that.

The only part of the project that remained was my own grim determination to eventually provide the detailed mechanism by means of which the remarkable Priore therapeutic cures were accomplished. Success has finally been achieved after a decade of unrelenting struggle to completely explain the cause of cancer and the active mechanism by means of which the Priore group obtained such astounding scientific results.

I strongly urge medical science to take a new, hard look_ both theoretically and experimentally _ at the proven anti-cancer results obtained by Antoine Priore and the noted scientists who worked with him. I also strongly point out that new thinking, new theoretical tools, and new experimental instrumentation are needed for that re-examination. In addition I have pointed out the precise nature of the

new thinking, tools, and instrumentation required.

What About Other Diseases Such As AIDS?

The question now arises about other diseases, particularly AIDS. Can the expanded Priore methodology provide equally dramatic cures of dread diseases other than cancer and leukemia? Can it conceivably cure AIDS? The answer is a resounding "Yes!"

Almost all disease conditions are electromagnetic in nature, in the sense of the extended EM bioeffects model we have outlined. The basic methodology of forming a counter-countersignal to a specific disease state can be extended to many other diseases, and to AIDS as well. The "self-targeting" effect in the cellular dedifferentiation induced by the extended EM methods results in a countersignal being produced to the *last major genetic change undergone by the diseased cell.* In the case of an HIV-infected cell, its genetics have been changed (differentiated) from normal to infected. In its internal WZ structure, the strongest resultant signal complex is thus the HIV infection differentiation command. *When pumped by the internal bidirectional WZ wave structure of the applied scalar potential, the "cell-as-a-nonlinear-phase-conjugate-mirror-material" generates a precisely tailored anti-AIDS cellular genetic dedifferentiation signal. The cell thus dedifferentiates back to a normal cell with normal genetics.*

In addition to Priore's work and Becker's results, the remaining experimental foundation for our startling statement on extended-EM reversal of AIDS was established decades ago _ as early as the late 1950s _ by the Soviet researcher Vlail Kaznacheyev.

Implications of Kaznacheyev's Experiments

In some 17,000 experiments Kaznacheyev showed that *any* cellular disease or disorder can be transmitted between cell cultures "electromagnetically" in an unknown fashion. The model we have briefly advanced here, if slightly extended to include the concept of the W/Z structure being a *graviton lattice structure, is* fully capable of explaining Kaznacheyev's results, the mechanisms, etc. This EM-transmission of disease effect shown by Kaznacheyev is known as

the *cytopathogenic mirror effect*, and it has been replicated by researchers at the University of Sydney in Australia, at the University of Marburg in Germany, and by at least one researcher in the United States.

In short, what Kaznacheyev's research showed is that there exists a specific EM signal pattern of some mysterious, not-understood nature that can induce a specific cellular disease in a group of cells absorbing that signal pattern. If we regard the healthy state of the cell as "condition A" and the specific diseased state as "condition B," then specific EM signal pattern C causes the cell to move from condition A to condition B. It immediately follows that an antisignal to C _ that is, the phase conjugate of C, which is a time-reversed replica of C _ will move the diseased cell from condition B back to condition A, curing the disease. Time reversal of "sickening" is "healing." It follows from Kaznacheyev's work that (1) a specific signal pattern exists as the causative inductive factor for each specific cellular disease, and (2) a specific "antidote" signal pattern exists as the causative curative factor for that specific disease, the antidote signal being merely the time reversal or phase conjugate replica of the cytopathogenic signal. While Kaznacheyev never publicly produced the cytopathogenic mechanism, such a mechanism follows from the WZ extension of EM, and the long-term causative disease-induction mechanism I have advanced.

Creating a Specific "EM Antidote" to a Specific Disease

Consider the cumulative EM causes of changes to a cell, including to its genetics, as a serial chain of signals. Indeed, consider them as the layers of an onion, where the outer layer is the most recent. Additional layers may be added to the onion by "time forward" actions, or "differentiation" actions. If we now wish to "peel" the onion, that too is a successive, serial action, accomplished by "phase conjugate" or "time reversal" operations. These result in serial cellular dedifferentiation actions. By treating the cell and its genetics and internal parts as "highly nonlinear material structures and therefore phase conjugate mirror materials," we can "pump" the cell and its parts by bidirectional EM waves to convert the cell to a pumped phase conjugate mirror (PPCM). By orthodox nonlinear phase conjugate optics theory, with a signal wave present, the PPCM cell will emit a precise phase conjugate replica (PCR) wave. If we pump the cell with a complex of pump biwaves, the cell can and will

emit a precise phase conjugate wave complex in response to a complicated signal wave complex input that is present.

For a diseased cell, we regard the disease as a differentiation of the cell, and the primary cause of the differentiation (the EM cytopathogen) as a complex WZ waveset infolded inside the personal quantum potential (in which all the body's cells exist and in whose internal signal dynamics they participate). With the pumped cell as a PPCM, and the EM cytopathogen present as an input signal wave complex to the PPCM, a precise, amplified, "EM antidote" PCR wave-complex is emitted by the parts of the PPCM cell. Each part gets a PCR complex signal order, dedifferentiating that part back the first step. A diseased part steps back to a normal part. A normal part steps back to a normal part. The diseased cell is thus dedifferentiated back to a normal cell with its parts all normal. Because the PCR wave complex is amplified, the dedifferentiation is must faster than was the original dedifferentiation. Thus an HIV-infected cell that has been "dormant" for an extended period can still be dedifferentiated back to a normal cell that is HIV-free.

So a self-targeting counter-countersignal can be automatically "developed" and generated in the body's diseased cells, for each specific cellular disease or disorder condition, or even for a mix of diseases and disorders. This is accomplished by the automatic phase conjugating action of the "cell-as-a-PPCM", when pumped by the hidden EM bidirectional structure of a scalar potential. In practice, Priore did find it necessary to adjust the particular frequency mixes he used for different disease conditions. We hypothesize that this adjustment was necessary to arrive at the proper pump wave complex that would in fact allow the proper PCR wave complex to be emitted for a particular disease type or class. Although photobiologists regularly report mitogenetic radiation emitted by a cell in the optical region, the effects desired in the cells can be produced by a different frequency regime, because of the known phenomena of nonlinear harmonic and subharmonic resonance. Since in a W/Z structure it is the *harmonic intervals and their relative relationships* that are of fundamental importance, the frequency regime of a detected W/Z structure can be shifted either harmonically or subharmonically. Priore, e.g., worked at radar frequencies in the low gigahertz range. For simplicity we may think of the frequency complex as a sort of "musical chord" composed of multiple tones. We may play the same "chord" either on the high scale or a lower scale, and still recognize the tune if the relative frequency interrelationships of the tones are retained.

A Possible Simplification of Priore's Methodology

If we turn away from the classical vector/tensor EM model presently in vogue to a higher topology EM model such as quaternions or Clifford algebra, the extended EM bioeffects model can be mathematized and refined by experiment. For example, Barrett has shown that the nonlinear phase conjugate optics effects can be obtained in ordinary circuits without the use of optical materials, when those circuits are designed and function in accord with a higher topology EM such as quaternions. Thus the circuitry of the EM emission devices themselves can be constructed to perform time-reversal of EM waves, phase conjugate replicas, 4-wave mixing, and pumped phase conjugate mirror effects, without use of normal optical materials or procedures. Priore utilized a plasma in a giant gas-filled tube, in which to mix his 17 frequencies and accomplish (unknown to scientists at the time) phase conjugation. Barrett's work implies that the necessary phase conjugation, and amplification, can be accomplished by purely electromagnetic circuitry, once the functioning of the circuitry is designed and understood in a higher topology algebra such as quaternions or Clifford algebra.

Priore demonstrated cures for diseases other than cancer. Different settings produced cures for sleeping sickness, e.g. Clogging of the arteries was also completely reversed by a variation in the Priore treatment. In addition, Pautrizel working with Priore positively demonstrated the restoration of vigorous, natural functioning to the immune system of the treated animal.

Kaznacheyev's Viral Disease Experiments: Implications for an AIDS Cure

Kaznacheyev has already demonstrated that viral-caused diseases can be induced by purely EM means in cell cultures. What this means is that cellular genetic changes also are electromagnetically induced at root basis. We regard this as a cellular differentiation. But both Becker and Priore have shown that cellular dedifferentiation can also be induced electromagnetically, by the extended scalar EM. It follows that viral-caused diseases _ including AIDS _ can be cured by purely EM means, simply by creating the proper dedifferentiation signal complex in the diseased (differentiated) cell. To determine the

proper disease induction (dedifferentiation) signal pattern for the disease, the disease-inducing signal complex must be phase conjugated, and the phase conjugate replica must be amplified. The phase conjugate replica may be stimulated at the proper frequency regime by a signal complex at a much lower frequency regime. Hence the detectable photobiological optical cytopathogenic signal complexes may have their PCR counterparts stimulated by irradiation with a proper signal complex at a lower frequency regime (e.g., millimeter wave band) for use in treatment

In Conclusion

Again we strongly accent that one must take the "musical" approach: A disease pattern or a curative pattern is a complex of special frequencies and their antiwaves, similar to a musical chord. That same chord can be played in a higher or lower key, and the body will still determine the correct relationships by harmonic or subharmonic oscillation. It will still recognize the "melody" and its background chordal accompaniment; although the *individual* frequencies have changed, their *relative* relationships have not changed.

All biochemistry, genetics, and cellular effects are subject to affectation and control by proper manipulation of the W/Z structures inside scalar EM potentials. We have stated that the living organism already utilizes the internal EM structuring for mind, thought, and long-term memory, as well as the master level cellular control system we have accented. For the first time, the "software" and "firmware" of the mind appears to be directly available, something which has never before existed in science. The model advanced in my work is intended to point the way toward such use in medical science on a substantial scale, to achieve healthier, more effective, and far cheaper treatments for many of our desperate diseases that presently require costly, protracted treatments, often harsh and debilitating in and of themselves. We strongly believe that, given the direct attention of the scientific community and proper funding support, near-total, quick, and very economical cures can be developed for such dread diseases as cancer, leukemia, and AIDS. We point out also that the Priore team demonstrated cure of sleeping sickness in lab animals, as well as the direct unclogging of arteries and other blood vessels.

We also strongly accent the "self-targeting" feature when the

diseased cell is "pumped" as a phase conjugate mirror material by the internal WZ biwave structure of an artificially-structured scalar EM potential. The cytopathogenic disease-induction signal complex is present in the cell and all its parts. By varying the frequencies in the internal biwave structure of the pumping potential, and hence in the pumping of the cell-as-a-PPCM, the cell is enabled to produce from and into all its parts the proper phase conjugate replica wave complex for its specific cellular disease. *Hence it produces a specific electromagnetic antidote for its own specific disease condition.* We need only adjust the frequency content of the artificial potential until the proper PCR signal complex is produced. Further, that PCR wave complex is amplified because of the pumping. Therefore the "treatment time" can be very short, and need not be anywhere near as long as the time originally required for the cytopathogenic EM signal complex to cumulate.

Today a variety of dread diseases continue to plague humankind. Untold millions of persons are suffering and dying, when the beginning of an effective, quick, inexpensive therapeutic approach capable of essentially 100% cures of cancer, leukemia, and other diseases has been demonstrated more than two decades ago.

With the exposition of the fundamental mechanism for this new therapeutic approach, perhaps the scientific community will return with renewed vigor to develop this promising area and alleviate the death and suffering so widespread today.

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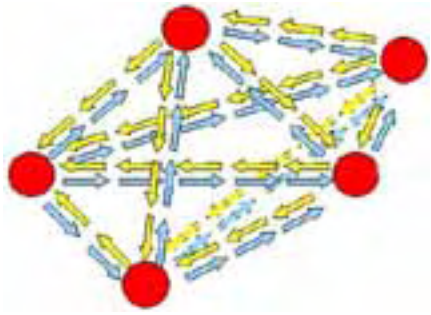

CANCER AND THE UNRESOLVED HEALTH ISSUES IN THE BIOLOGICAL EFFECTS OF EM FIELDS AND RADIATIONS

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MECHANISM FOR LONG-TERM, CUMULATIVE BIOLOGICAL EFFECTS OF EM FIELDS AND RADIATION

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INTRODUCTION

- **PROBLEMS IN EM BIOEFFECTS DETERMINATION FOR FOUR DECADES**
  - DIFFICULTY IN REPLICATION
  - STUDIES ARE CONTRADICTORY
  - EMOTIONALISM, CONTROVERSY, VESTED INTERESTS
  - LACK FUNDAMENTAL MECHANISMS
- **ESTABLISHES THAT MODEL UTILIZED IS INADEQUATE**
- **WILL CRITIQUE STANDARD MODEL**
- **WILL PROPOSE ALTERATION AND EXTENSION**
- **WILL EXAMINE FUNDAMENTAL CONCEPTS, PER EINSTEIN**

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EINSTEIN ON REVIEWING FOUNDATIONS

"...the scientist makes use of a whole arsenal of concepts which he imbibed practically with his mother's milk; and seldom if ever is he aware of the eternally problematic character of his concepts. He uses this conceptual material, or, speaking more exactly, these conceptual tools of thought, as something obviously, immutably given; something having an objective value of truth which is hardly even, and in any case not seriously, to be doubted. ...in the interests of science it is necessary over and over again to engage in the critique of these fundamental concepts, in order that we may not unconsciously be ruled by them."

Albert Einstein, "Foreword," in Max Jammer, Concepts of Space: The History of the Theories of Space in Physics, Harvard University Press, Cambridge, Massachusetts, 1969, p. xi-xii.

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SOME PROBLEMS IN ELECTROMAGNETICS FOUNDATIONS

- **NOTION OF FORCEFIELD**
- **NATURE OF THE VACUUM**
- **NATURE OF ELECTRICAL CHARGE**
- **NOTION OF POTENTIAL**
- **NOTION OF ENERGY**
- **NOTION OF QUANTIZED ELECTRICAL CHARGE**
- **NOTION OF TIME**
- **CONSIDERED MUTUALLY EXCLUSIVE TO GRAVITY**
- **FRAME VERSUS SPACETIME**
- **CLOSED SYSTEM ASSUMPTION**
- **TOPOLOGY AND DIMENSIONALITY OF THE MODEL'S MATHEMATICS**
- **UNDEFINED, OR IMPROPERLY DEFINED, CONCEPTS**

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NOTIONS IN THE CONCEPT OF THE POTENTIAL

- **CONCEPT OF THE POTENTIAL HAS DEVELOPED AS SEVERAL FUNDAMENTAL NOTIONS:**
    - **AS THE "INTERNAL" STORAGE OF ENERGY IN SOME FASHION**
    - **AS A POINT-VALUE FUNCTION IN 3-SPACE**
    - **AS A SCALAR FUNCTION WHOSE SPACE RATE OF CHANGE YIELDS A VECTOR FORCE**
- **THE ENERGY STORAGE MECHANISM IS QUITE UNKNOWN.**
- **NO THOUGHT HAS BEEN GIVEN TO SIMULTANEOUSLY DEFINING IT AS HAVING A HYPERSPATIAL WAVE SET COMPOSITION.**
- **THE THIRD NOTION EFFECTIVELY MAKES ALL FORCES LOCAL A *PRIORI*, AND EXCLUDES ACTION AT A DISTANCE BY *POSTULATION*.**
- **THE THIRD NOTION IS KNOWN TO BE INCORRECT. THE GRADIENT OF A POTENTIAL DOES NOT PRODUCE A FORCE UNTIL A MASS IS PRESENT, TO WHICH THE GRADIENT COUPLES.**

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Founders of Scalar Electromagnetics

- **G.J. Stoney:**

Decomposed the scalar potential into bidirectional wave pairs.

"On a supposed proof of a theorem in wave-motion," Phil. Mag., 5(43), 1897, p. 368-373 (and several other papers).

- **E.T. Whittaker:**

Decomposed the scalar potential into a series of bidirectional EM wave pairs in harmonic series, where the two waves in each pair are conjugates (i.e., a wave/antiwave pair) and are longitudinal waves.

"On the partial differential equations of mathematical physics," Math. Ann., Vol. 57, 1903, p. 333-355.

Showed that all classical EM -- including waves -- can be replaced by two interfering scalar potential functions.. (This founded superpotential theory, extended by Nisbet, Bromwich, Debye, McCrea, and others.)

"On an expression of the electromagnetic field due to electrons by means of two scalar potential functions," Proc. Lond. Math. Soc., Series 2, Vol. 1, 1904, p. 367-372.

- **R.W. Ziolkowski:**

Independently rediscovered the biwave decomposition of the scalar potential and added the product set (in theory enabling modulations and communications) to Stoney and Whittaker's sum set.

Various papers, 1985 to date.

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INNER EM WAVES OF A SCALAR POTENTIAL

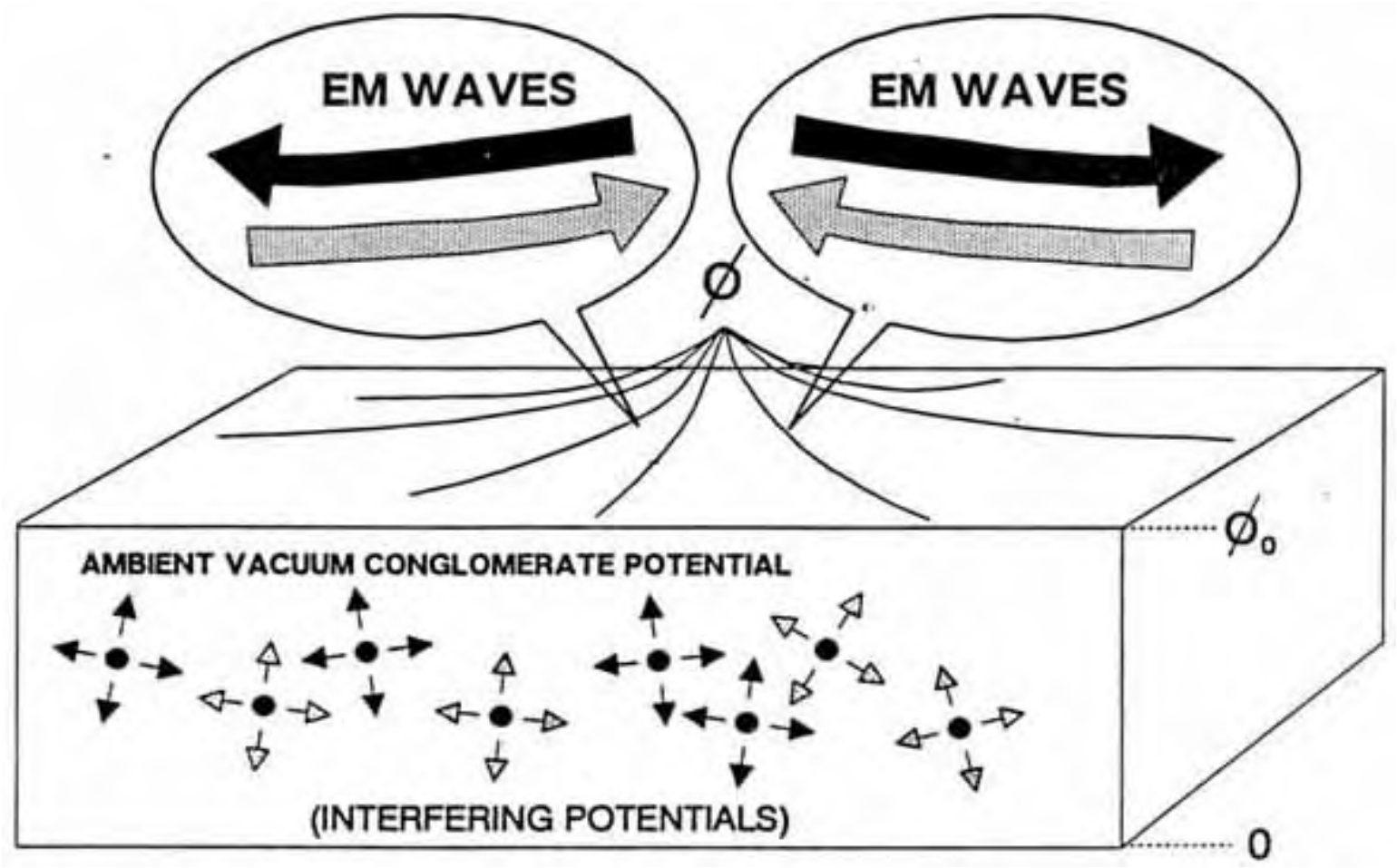

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GRAVITON/WHITTAKER LATTICE STRUCTURE OF THE SCALAR POTENTIAL

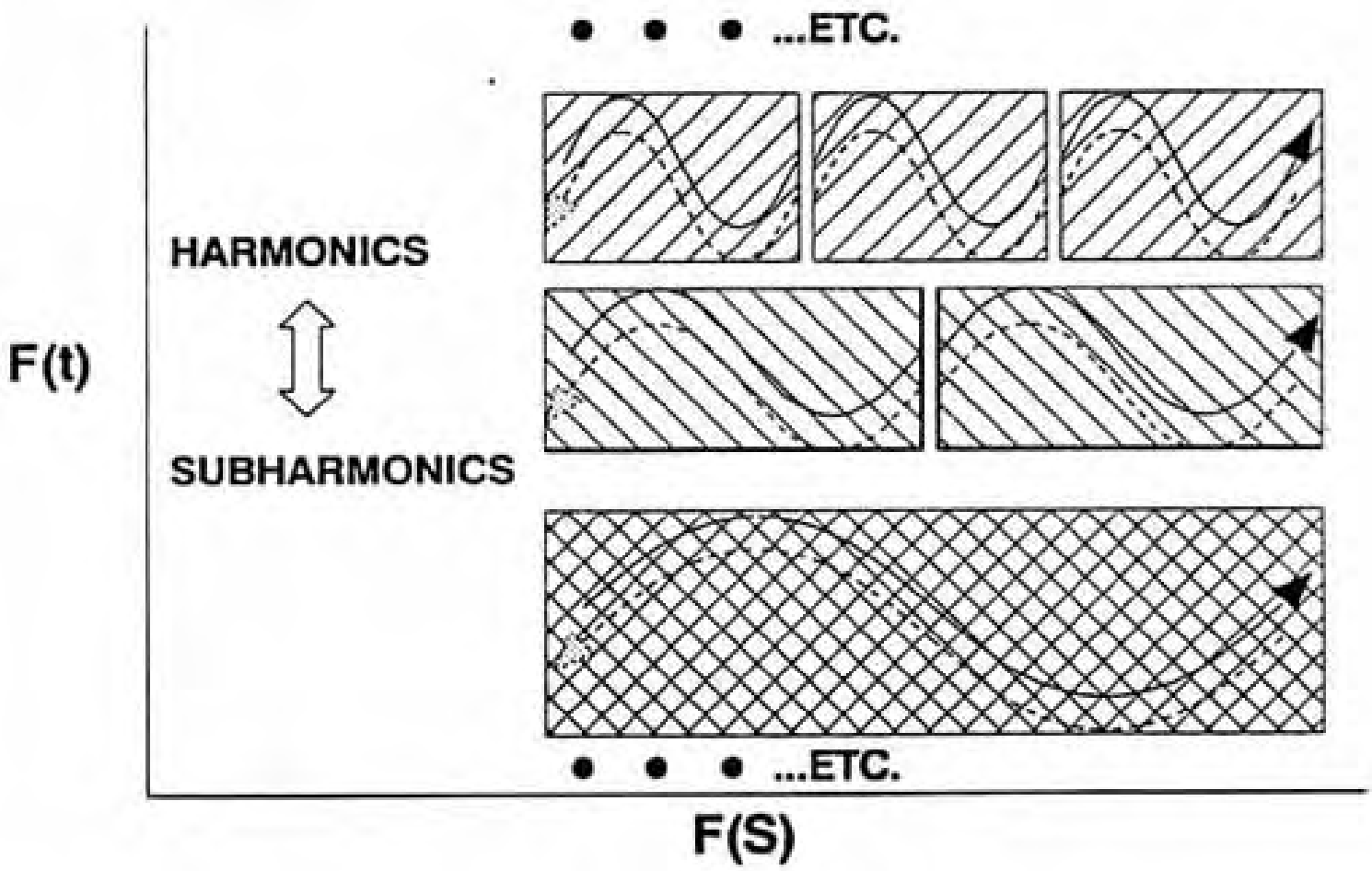

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Infolded longitudinal EM biwave composition of a scalar potential

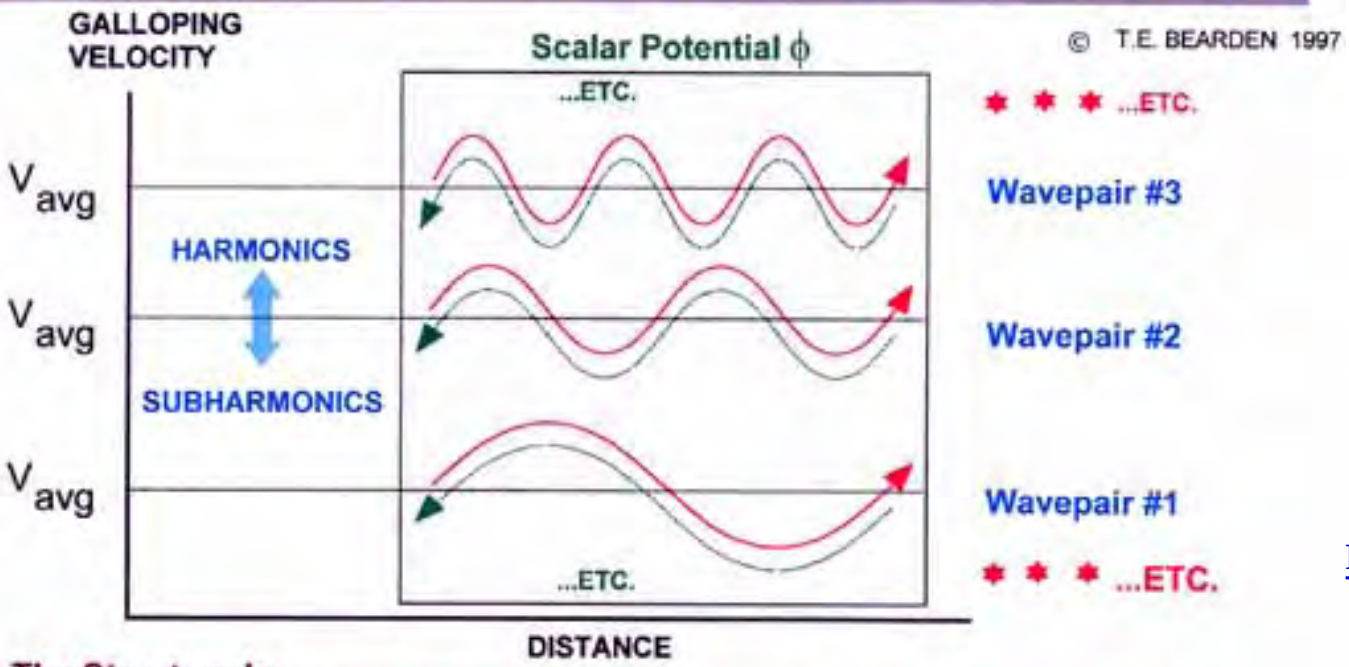

The Structure Is:

A harmonic set of longitudinal EM wavepairs. In each wavepair the two waves superpose spatially, but travel in opposite directions. The two are phase conjugates and time-reversed replicas of each other. Thus they comprise a coupled longitudinal wave and antiwave. The photons must be coupled into photon/antiphoton pairs (gravitons) by a strong application of the distortion correction theorem of nonlinear optics. Each wave in the biwave pair is a galloping wave. Each wavepair is a standing electrogravitational wave. In nonlinear optics, such a wavepair is a pump wave which pumps in the time domain.

Note: Think of the oscillations as velocity modulations.

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LATTICE AND NONLATTICE GRAVITONS

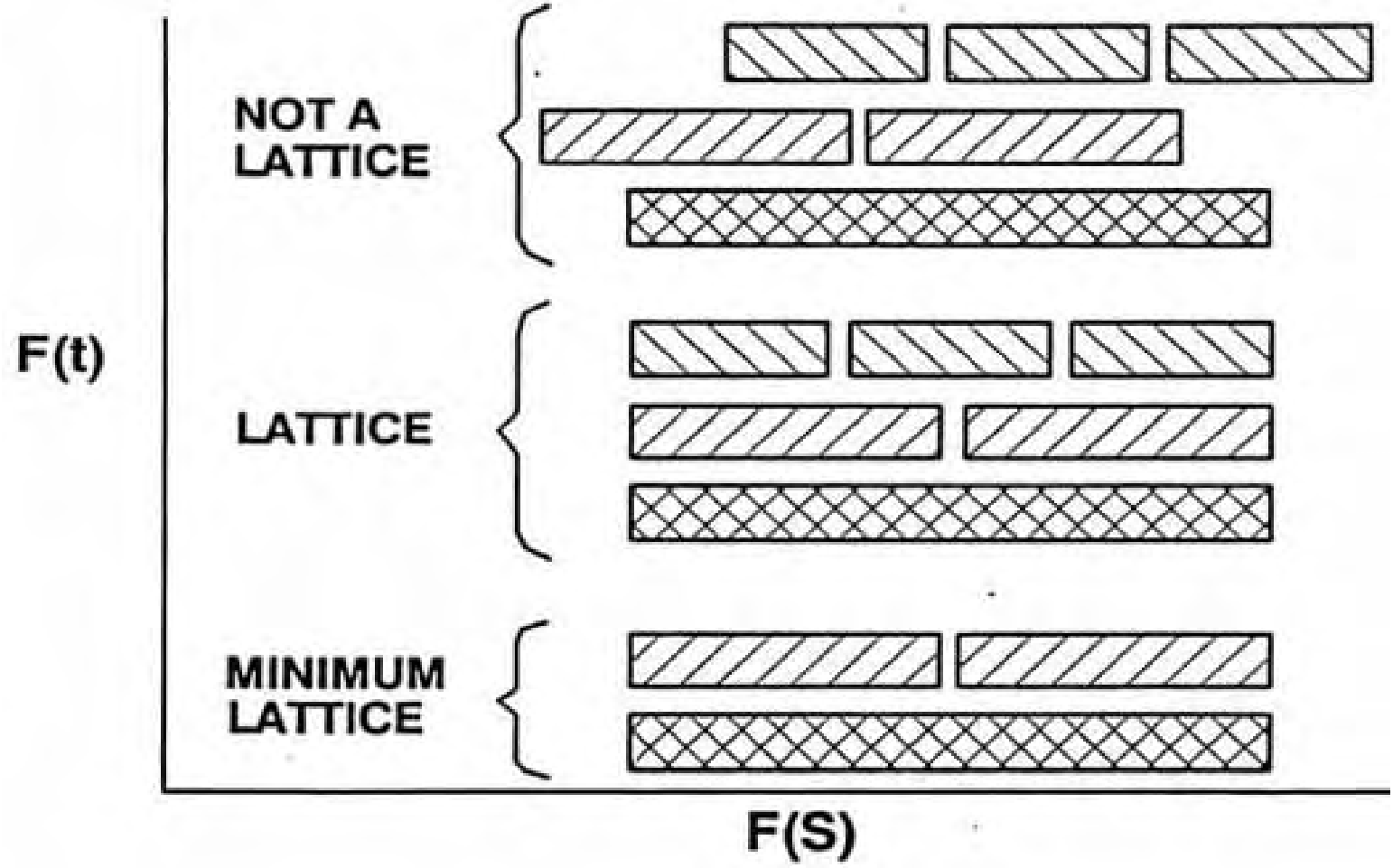

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SCALAR EM POTENTIAL INTERFEROMETRY

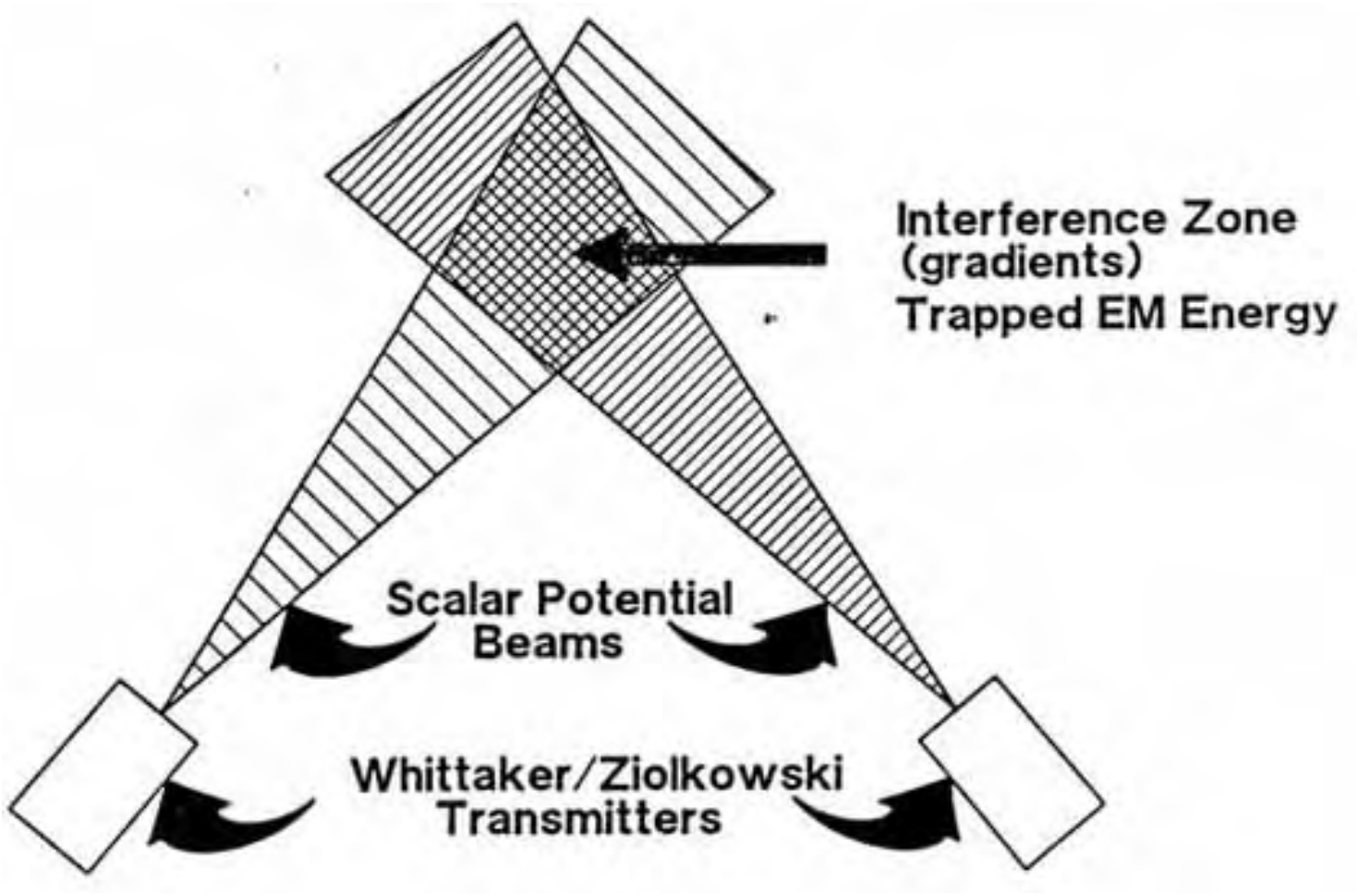

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SCALAR POTENTIAL INTERFEROMETRY

- Between two scalar potentials, **interferometry** is:
  - Interference of the multi-wave sets in hyperspace.
  - Production of gradients in the 3-space point values
  - In the classical (erroneous) postulation, the creation of forces in 3-space.
    > Force does not exist until the gradient couples to an observable mass.
    > There are no E-fields and B-fields as such in the massless vacuum, but only potential gradients.

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SOME PROBLEMS IN FOUNDATIONS OF GENERAL RELATIVITY

- **EINSTEIN'S FLAT LOCAL SPACETIME POSTULATE**
- **ONLY CONSIDERS THE VERY WEAK G-FORCE AS AN AGENT FOR SPACETIME CURVATURE**
- **EXCLUDES UNION WITH EM FIELD**
- **EXCLUDES ACTION-AT-A-DISTANCE, WHICH IS REQUIRED BY QUANTUM MECHANICS, AND PROVEN**
- **EXCLUDES UNION WITH QUANTUM MECHANICS**
- **SPECIFICALLY EXCLUDES ELECTROGRAVITATION**
- ***IS ESSENTIALLY NOT AN EXPERIMENTAL SCIENCE***

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SOME PROBLEMS IN FOUNDATIONS OF QUANTUM MECHANICS

- **EXCLUDES CHAOS (HIDDEN ORDER), AND THIS IS KNOWN TO BE IN ERROR**
- **ORDERED MACROREALITY CANNOT EMERGE FROM INTEGRATING DISORDERED (RANDOM) CHANGES**
- **USES RANDOM-VARIABLE STATISTICS FROM GIBBS THERMODYNAMICS**
- **NOTION THAT QUANTUM CHANGE - HENCE ROOTS OF PHYSICAL REALITY - CANNOT BE ENGINEERED**
- **REQUIRES ACTION-AT-A-DISTANCE EFFECTS**
- **CONTRADICTS CLASSICAL MECHANICS, GENERAL RELATIVITY, AND CLASSICAL ELECTROMAGNETICS**

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PHYSICS DISCIPLINES ARE PRESENTLY INCONSISTENT

	GENERAL RELATIVITY (GR)	
QUANTUM MECHANICS (QM)	???	CLASSICAL EM THEORY
	MIND & SUBTLE ENERGY	

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THE PRESENT EM, GR AND QM ARE SUBSETS, EACH OMITS THE WHITTAKER INTERNAL EM.

A	B
PRESENT EM (EXTERNALIZED ASPECTS OF POTENTIALS)	EXCLUDED EM (INTERNALIZED ASPECTS OF POTENTIALS)

A	B
PRESENT GR (DISTANT SPACETIME CURVATURE) (LOCAL ACTION)	EXCLUDED GR (LOCAL SPACETIME CURVATURE) (ACTION AT A DISTANCE)

A	B
PRESENT QM (EXTERNALIZED STRUCTURE OF POTENTIALS)	EXCLUDED QM (INTERNALIZED STRUCTURE OF POTENTIALS) (CHAOS)

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UNIFIED FIELD SECRET: APPLY WHITAKER THEORY

	GENERAL RELATIVITY (GR)	
QUANTUM MECHANICS (QM)	APPLY WHITTAKER THEORY	CLASSICAL EM THEORY
	MIND & SUBTLE ENERGY	

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PRESENT DEFINITION OF "ENERGY" IS ERRONEOUS

- **PRESENT: "ENERGY IS THE CAPACITY TO DO WORK."**
- **ACTUALLY, WORK IS THE SCATTERING (DISSIPATION) OF ENERGY.**
- **THE PRESENT DEFINITION STATES THAT "ENERGY IS THE CAPACITY TO DO SCATTERING OF ENERGY."**
- **ENERGY CAN BE SCATTERED, YIELDING WORK. BUT THE CAPACITY TO PERFORM THAT SCATTERING IS NOT ENERGY! (E.G., IT MAY BE RESISTANCE.)**
- **COMPARE TO: "A FISHHOOK IS THE CAPACITY TO CATCH FISH."**
- **ACTUALLY, A FISHHOOK IS A BENT WIRE WITH A BARB. IT *HAS* THE CAPACITY TO CATCH FISH (GIVEN OTHER CONDITIONS). BUT THE CAPACITY TO CATCH FISH IS NOT WHAT IT *IS*.**

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SOME NEW DEFINITIONS

- **QUANTUM MECHANICAL VACUUM** - an intense flux of virtual particles, filling the "emptiness" of spacetime/vacuum.
- **ENERGY** - any ordering, either static or dynamic, in the virtual particle flux of vacuum.
- **EM ENERGY** - any ordering, either static or dynamic, in the virtual photon flux of vacuum
- **WORK** - the local scattering of energy; the local disordering of the order in the VPF.

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DEFINITIONS (CONTINUED)

- **POTENTIAL** - any ordering, either static or dynamic or combination, in the VPF of vacuum
  - same definition as energy
  - must have internal order, hence structure
- **SCALAR POTENTIAL** - any static ordering in the VPF of vacuum, with respect of the external observer
- **VECTOR POTENTIAL** - any dynamic (non-stationary) ordering in the VPF of vacuum.
  - must have internal order, hence structure

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DEFINITIONS (CONTINUED)

- **Electrostatic Scalar Potential** - any static (stationary) ordering in the virtual photon flux of vacuum.
  - Whittaker decomposed the ESP into bidirectional EM wavepairs in a harmonic structure.
  - We interpret the wavepair set as existing in hyperspace (in hyper-3-space).

- Thus the ESP is a 3-space point function, and a hyper-3-space vector function, in 7-space.

- In Hyper-3-space, the ESP is an ordering established throughout the universe.

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ELECTRIC CHARGE, OPEN SYSTEM

- The ***electric charge*** of a charged particle is due to a violent exchange of virtual photons between the charged particle and the local vacuum VPF
  - photons continually absorbed from the vacuum
  - photons continually radiated back to the vacuum
  - this exchange flux is what electric charge ***IS***.
- In the nucleus, everything is changing into everything, so to speak. It is a furious, ***VPF-driven*** cauldron.
- the nucleus is an open, driven system, normally in equilibrium with respect to VPF input and output.

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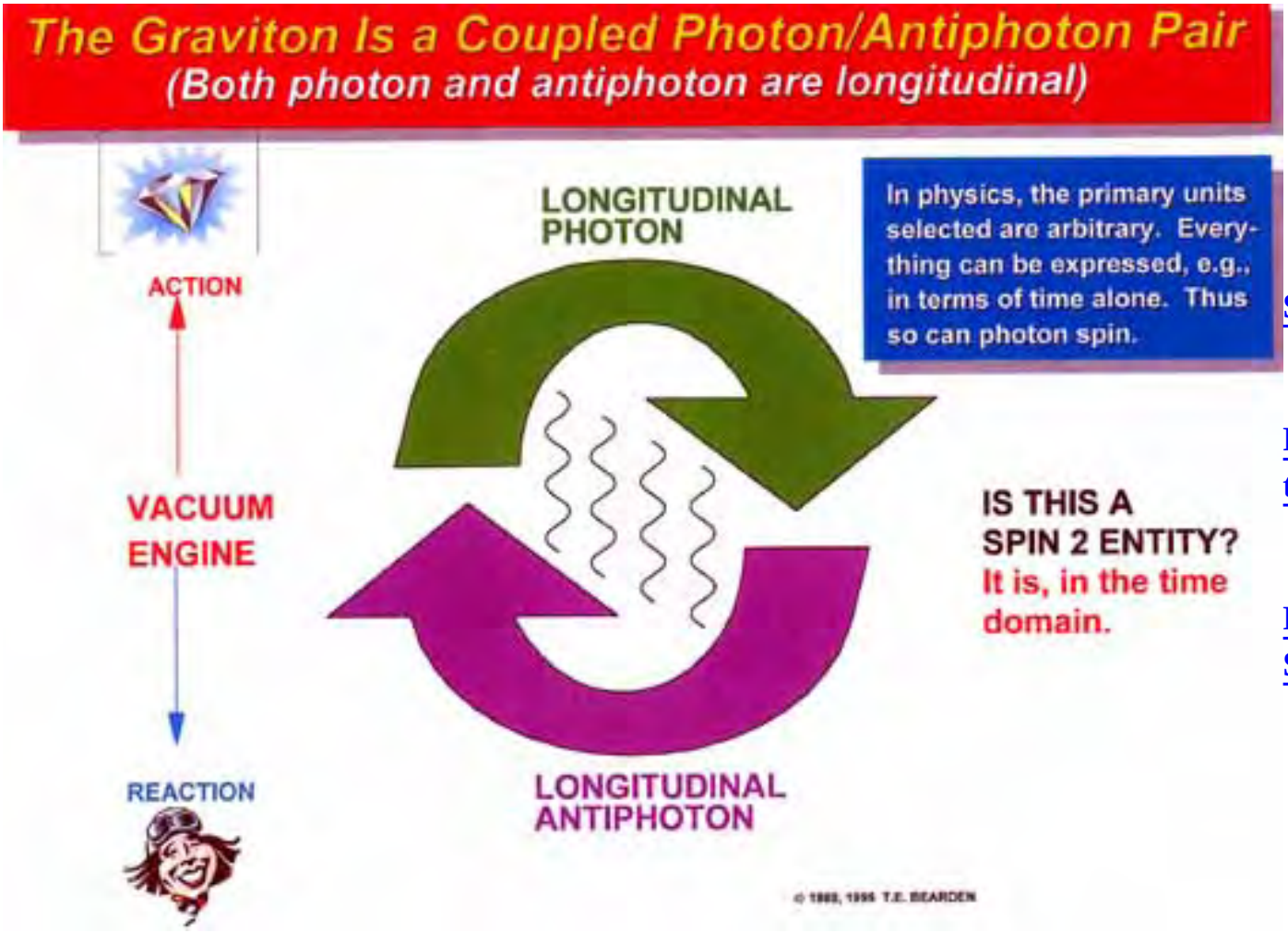

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PHOTON INTERACTION IS USUALLY GRAVITON INTERACTION

- Graviton interaction is a photon/antiphoton interaction

- Photon interacts with electron shells
  - Scattering produces the entropic (forward) flow of time
  - Produces electron translation in our detectors

- Antiphoton interacts with nucleus primarily
  - produces nuclear recoil
  - produces Newton's third law of motion

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PHOTON INTERACTION WITH THE MATERIAL ATOM

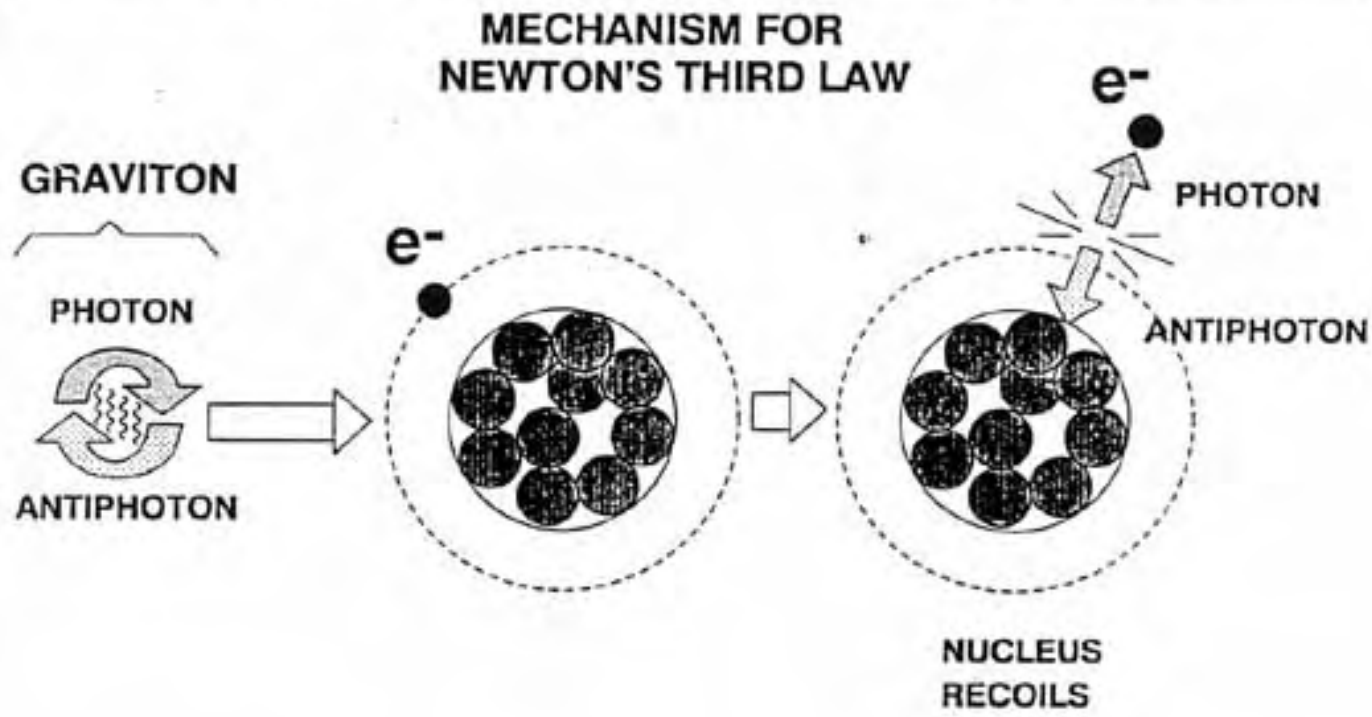

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PHOTON PHASE CONJUGATE INTERACTION WITH AN ATOM

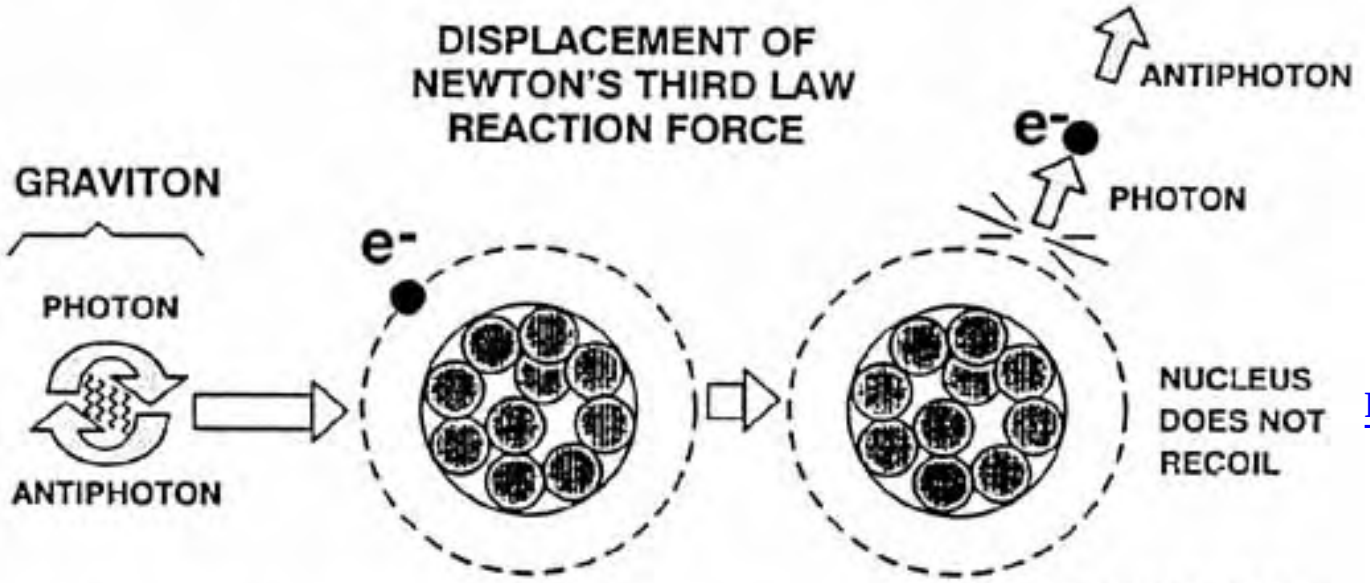

PHASE CONJUGATE INTERACTION

NOTE: Graviton waves are bidirectional phase waves of photon/antiphoton coupling and uncoupling in the vacuum.

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NONLINEAR MATERIAL AND TIME-DOMAIN RESONANCE

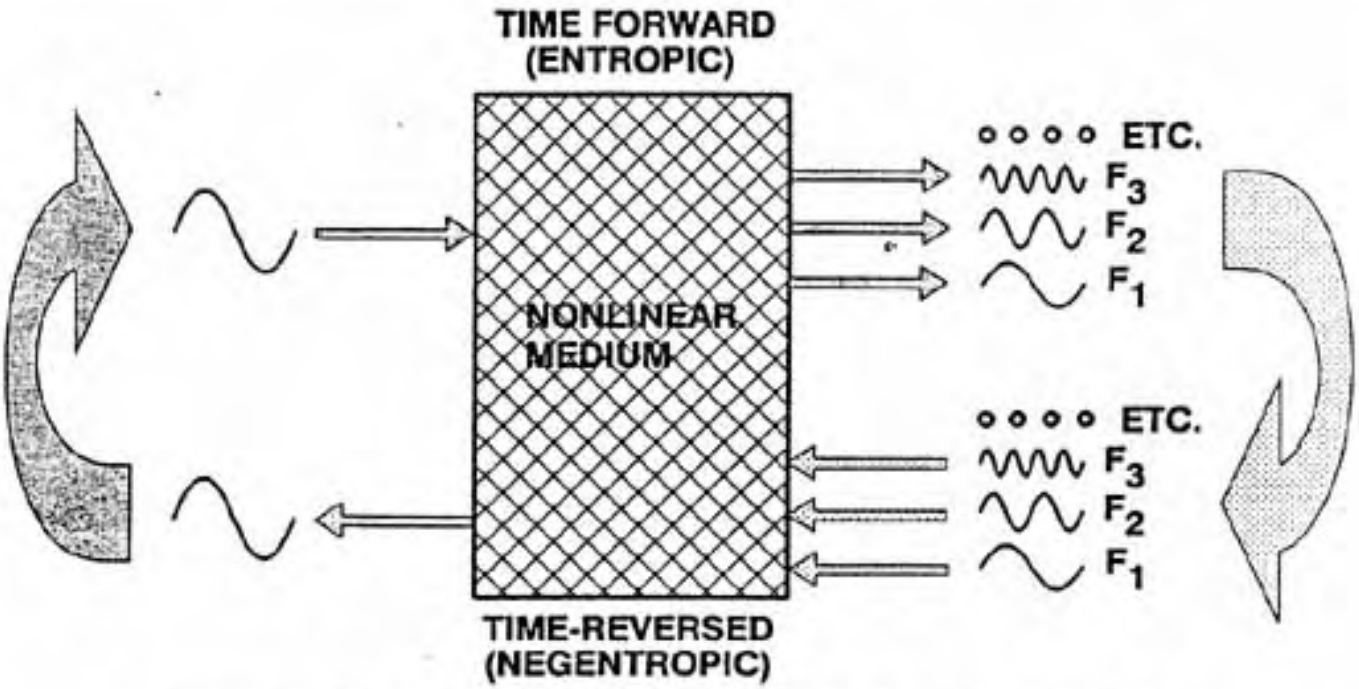

GROUPS OF RESONATORS ENTRAINED IN TIME AND SPACE
(MAY ENABLE SELF-OSCILLATION)

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SUBHARMONIC OSCILLATION

- **CAN TRANSLATE FROM ONE FREQUENCY REGIME TO ANOTHER.**
- **E.G., OPTICAL TO MICROWAVE**
  - **HOWEVER, MUST PRESERVE HARMONICS**
  - **ONE HARMONIC INTERVAL IS ESSENTIAL**
- **KAZNACHEYEV'S CYTOPATHOGENIC EFFECT:**
  - **QUARTZ PASSES ONE HARMONIC INTERVAL.**
  - **WINDOW GLASS DOES NOT.**
- **WHITTAKER'S INFOLDED EM STRUCTURE**
- **DEVYATKOV'S INFORMATION CONTENT OF THE FIELD.**
- **MULTIPLE PHASELOCKED WOODPECKER PULSE REPETITION RATES.**

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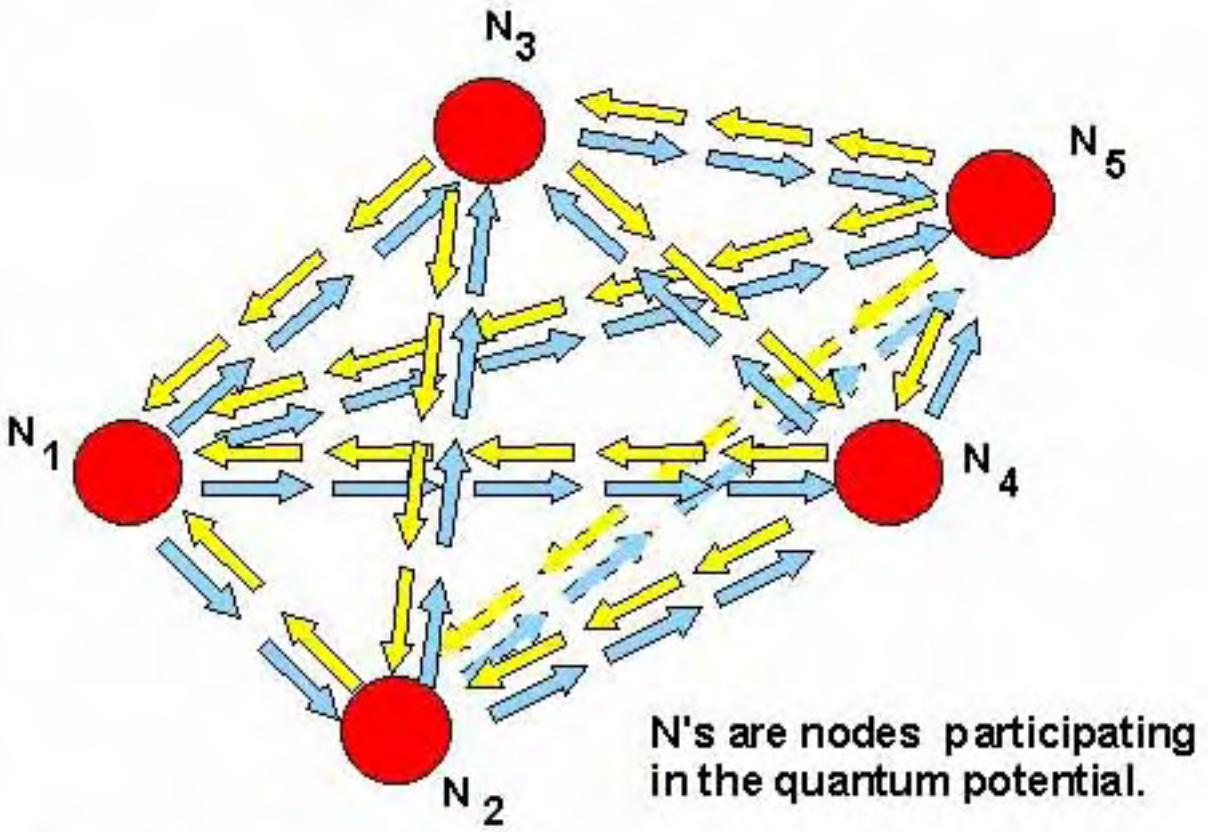

The quantum potential exists as narrow, laser-like beams between participating nodes, even when the nodes are widely separated. The beam space is multiply-connected; transmission is instantaneous.

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QUANTUM POTENTIAL CHARACTERISTICS

- **NO POINT SOURCE**
- **QP BETWEEN TWO PARTICLES**
  - INTERACTION DOES NOT VANISH AS SPATIAL SEPARATION BECOMES VERY LARGE

  - INSTANTANEOUS CONNECTION

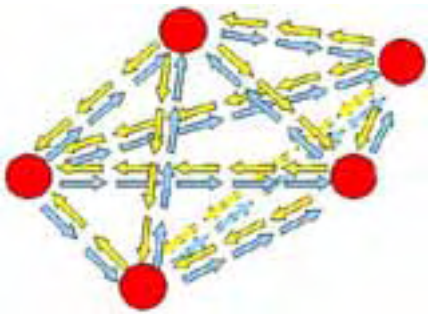

- **DEPENDS ON QUANTUM STATE OF SYSTEM AS A WHOLE**

- **SYSTEM PARTS CAN BE GREATLY SEPARATED**

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Self-Targeting in Inner EM Channel Can Produce a Quantum Potential

Once QP is established, energy transmission is direct and instantaneous. Energy input to one single participant will simultaneously appear in all other participants, the amount depending on their fractions of participation with the input station.

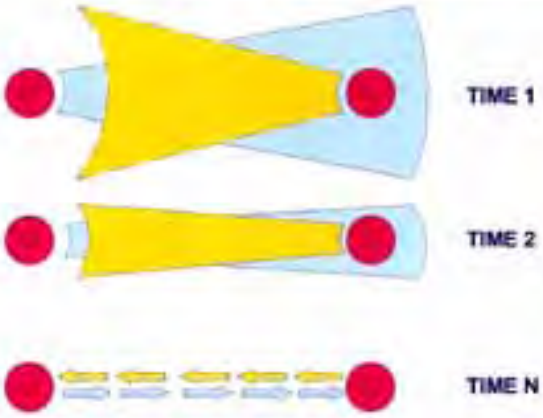

NARROWING OF INTERACTING POTENTIALS INTO LASER-LIKE BEAMS, BETWEEN TWO PUMPED SOURCES. NOW ONLY LONGITUDINAL WAVES CONNECT THE LINKED OBJECTS.

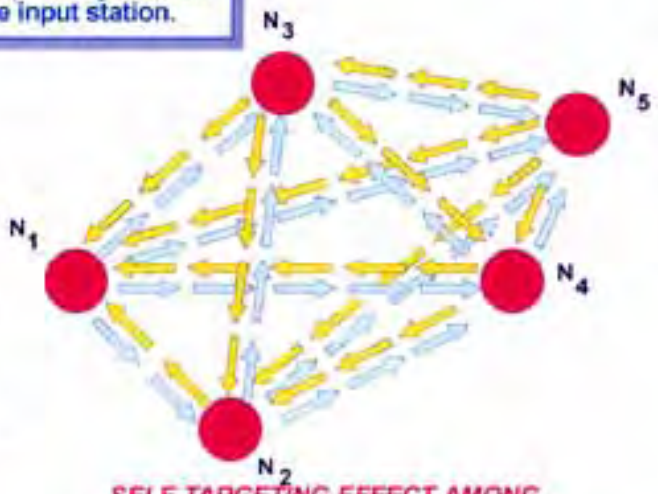

SELF-TARGETING EFFECT AMONG ALL PAIRS OF INTERACTING PUMPED SOURCES

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Corrections For the Present EM Bioeffects Model

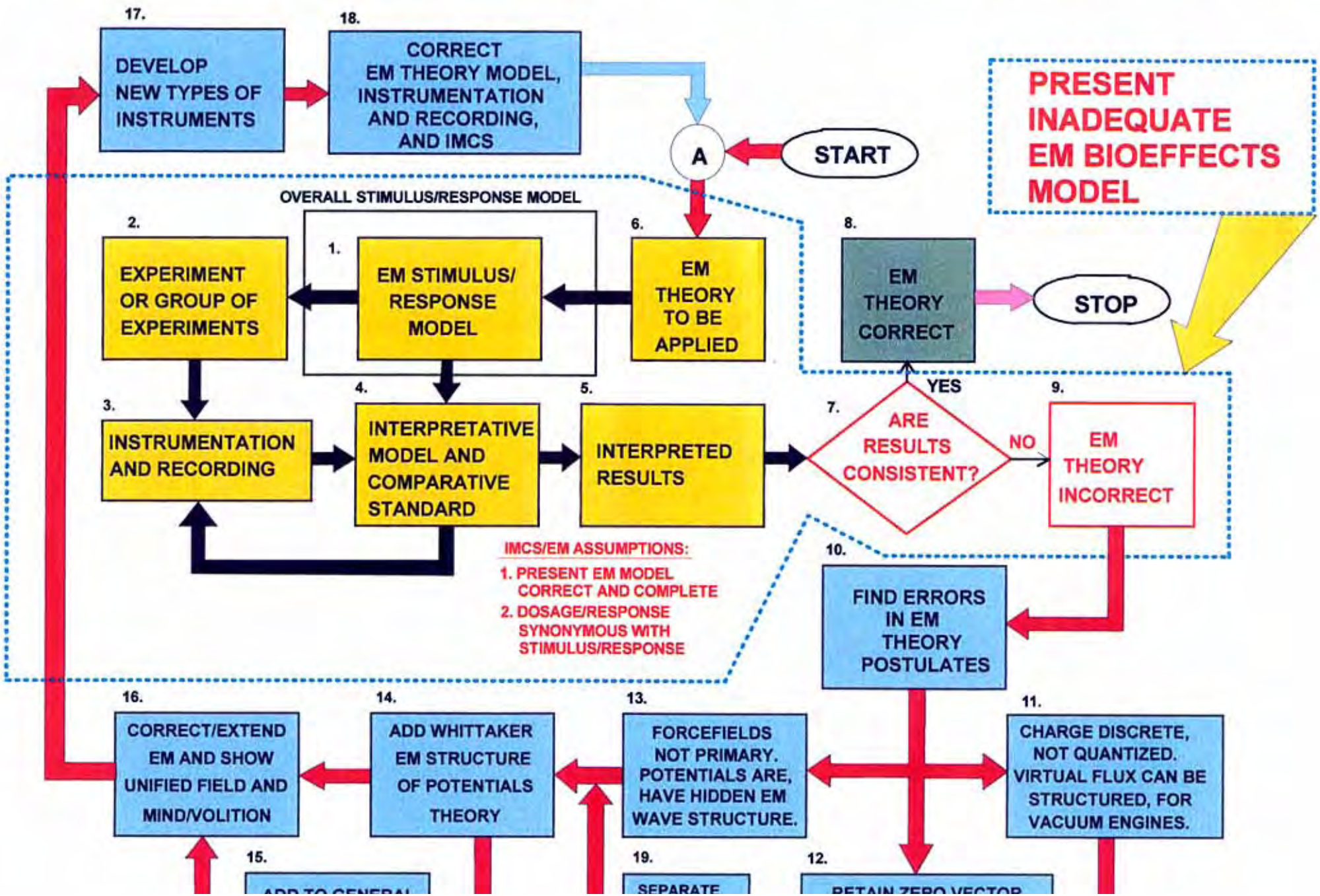

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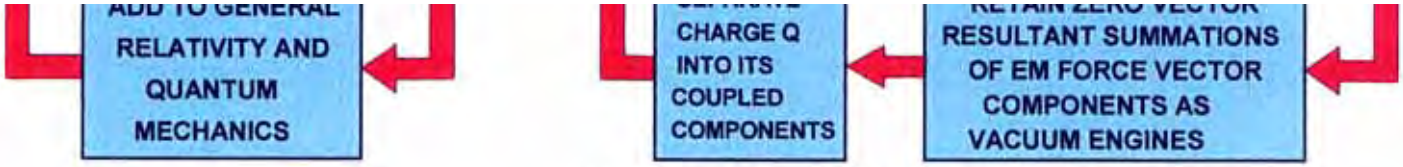

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TWO STAGES OF CANCER PRODUCTION

- **INITIATION**
  - DNA IN CELL NUCLEUS IS DAMAGED
  - CELL MUTATES
  - INITIATOR: AN AGENT THAT DAMAGES THE DNA IN A CELL, CAUSING IT TO MUTATE
  - THE CELL IS NEOPLASTIC, OR PRECANCEROUS
- **PROMOTION**
  - PROMOTER: AN AGENT THAT CAUSES A CANCER CELL TO DEVELOP INTO A TUMOR
  - EXPOSURE TO THE PROMOTOR CAUSES THE CANCER CELL TO UNDERGO UNCHECKED CELL DIVISION
- **EXACT CAUSE OF UNCHECKED CELL GROWTH IS NOT CLEARLY UNDERSTOOD**
  - DNA BLUEPRINT ON TRANSMITTER RNA CHANGES?
  - NORMAL TRANSMISSION OF MESSAGES FROM THE CANCER CELL TO ITS DAUGHTER CELLS CHANGES?

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MORE ON PROMOTERS

- KNOWN TO ATTACK THE CYTOTOXIC LYMPHOCYTES IN THE IMMUNE SYSTEM THAT WOULD NORMALLY KILL TUMOR CELLS
  - INHIBITS CYTOTOXITY OF THESE LYMPHOCYTES
  - PREVENTS THEM FROM DOING THEIR JOB
- KNOWN TO CAUSE CHANGES IN SIGNALS OR MESSAGES BEING CARRIED ACROSS THE CELL MEMBRANE
  - NOTE: ELECTRICAL POTENTIALS ON THE MEMBRANE
  - ELECTRIC FIELDS ARE CHANGES IN ELECTRICAL STRESSES
  - STRESS IS KNOWN TO BE A FACTOR IN CANCER
- WITHOUT EXPOSURE TO A PROMOTER, CANCER WILL NOT PROCEED
- LATENCY PERIOD: TIME BETWEEN INITIATION AND PROMOTION STAGES OF CANCER DEVELOPMENT

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EM BIOLOGICAL EFFECTS: SOME CHANGES DEMONSTRATED

- CHANGES AT THE CELL MEMBRANE
  - PARTICULARLY CALCIUM ION FLUX INCREASE
  - PARTICULARLY AC AND DC FIELDS COMBINED
- RATES OF DNA AND RNA SYNTHESIS
- CHROMOSOMAL ABERRATIONS AND BREAKS
- RNA TRANSCRIPTION
- ENHANCED GENE EXPRESSION
- EFFECTS ON CELL PROLIFERATION, BUT DEPENDS ON MITOTIC STATUS OF CELL POPULATION DURING EXPOSURE. DEPENDS ON
  - EM FIELD INTENSITY
  - EXPOSURE DURATION
  - CELLULAR FACTORS
  - EXTRACELLULAR FACTORS
- INCREASED CALCIUM FLUX IN BRAIN CELLS (IN VIVO STUDIES OF LIVE ANIMALS)

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EM BIOLOGICAL EFFECTS: INHIBITION OF MELATONIN

- MELATONIN PRODUCED BY PINEAL GLAND AT NIGHT
  - REGULATES CIRCADIAN RHYTHMS
  - HAS ONCOSTATIC PROPERTIES (INHIBITS TUMORS)
  - USED IN CHEMOTHERAPY, PARTICULARLY AGAINST BREAST CANCER AND PROSTATE CANCER
  - CANCER PATIENTS USUALLY HAVE REDUCED LEVELS
  - REDUCED LEVELS CONTRIBUTE TO DEPRESSION, SEVERE MOOD CHANGES, PSYCHIATRIC DISORDERS
- PRODUCTION OF MELATONIN CONTROLLED BY AMOUNT OF LIGHT DETECTED BY THE RETINA
  - BLIND WOMEN HAVE GREATLY INCREASED LEVELS
  - BLIND WOMEN HAVE MUCH LESS BREAST CANCER
  - HIGHEST CANCER INCIDENCE IS BREAST CANCER
    - INCREASING IN INCIDENCE
    - INCREASING IN MORTALITY
- EMF EXPOSURE INHIBITS NIGHTTIME PRODUCTION OF MELATONIN. SUCH SUPPRESSION OF MELATONIN IS IMPLICATED IN ETIOLOGY OF BREAST, PROSTATE, OVARIAN, AND MELANOMA CANCER

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OTHER EM BIOLOGICAL EFFECTS

- **MAGNETIC FIELD INDUCING OF BIRTH DEFECTS IN CHICKS**

- **MORE CONTROVERSIAL EPIDEMIOLOGY STUDIES FOUND**
  CORRELATIONS BETWEEN EMF AND
  - BRAIN TUMORS
  - MISCARRIAGES IN PREGNANT FEMALES USING VDTS
  - BIRTH DEFECTS
  - INCIDENCE OF LEUKEMIA IN CHILDREN

- **BECKER SHOWED THAT PICOAMPERES OF CURRENT USED**
  IN EM-ASSISTED BONE HEALING CAUSED PROFOUND CELLULAR CHANGES
  - RED BLOOD CELLS DEDIFFERENTIATED
  - SHED HEMOGLOBIN AND GREW NUCLEI
  - REDIFFERENTIATED INTO CARTILAGE-HEALING CELLS
  - REDIFFERENTIATED INTO BONE-HEALING CELLS
  - THEN HEALED THE FRACTURES

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Becker's dc treatment of bone fractures

Application of tiny DC currents to heal difficult bone fractures. Only picoamperes are utilized. Pulsed DC current or pulsed magnetic fields may also be utilized.

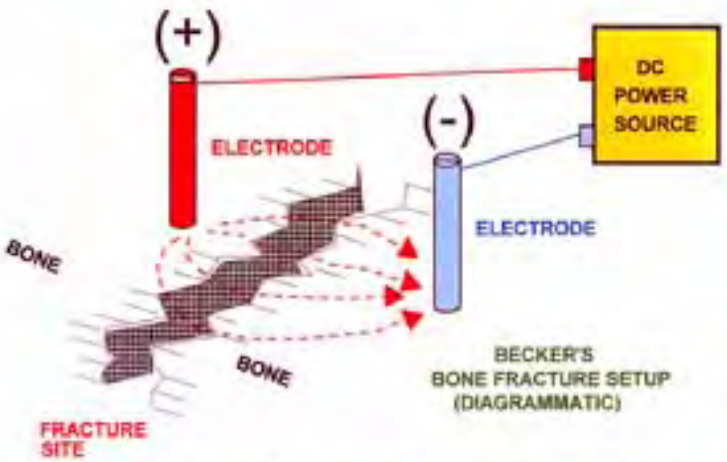

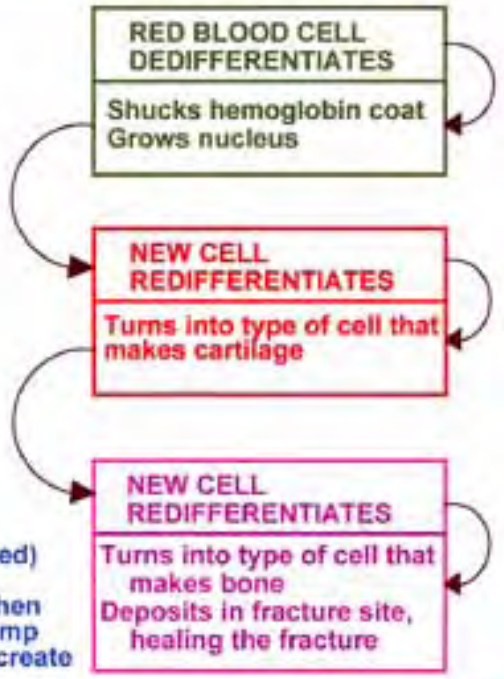

Proves that cells can be time-reversed (phase conjugated) (dedifferentiated) or time-forwarded (redifferentiated) by application of very weak electromagnetic signals, when those signals contain longitudinal bidirectional EM "pump wave" wavepairs, which cause the cell and its parts to create precise vacuum antiengines.

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QUESTIONS ON CARCINOGENS AND EM RADIATION

- UNRESOLVED QUESTIONS ON EM RADIATION
  - DOSAGES
  - ACTIVE MECHANISMS
  - REPLICATION DIFFICULTIES
  - MEASUREMENT DIFFICULTIES
  - WHERE, WHEN, HOW ILL EFFECTS OCCUR
- SIMILAR QUESTIONS EXIST ABOUT EVERY CARCINOGEN
- SCIENCE REALLY DOES NOT UNDERSTAND THE MECHANISMS OF A SINGLE CHRONIC DISEASE, INCLUDING CANCER
  - FACTORS SUCH AS MIND, STRESS, SPONTANEOUS REMISSION, PLACEBO EFFECTS, AND COMBINATIONS OF FACTORS ARE PARTICULARLY TROUBLESOME
  - GENERATION OF THE PLACEBO EFFECT BY THE REGENERATION & RECOVERY SYSTEM IS UNRECOGNIZED

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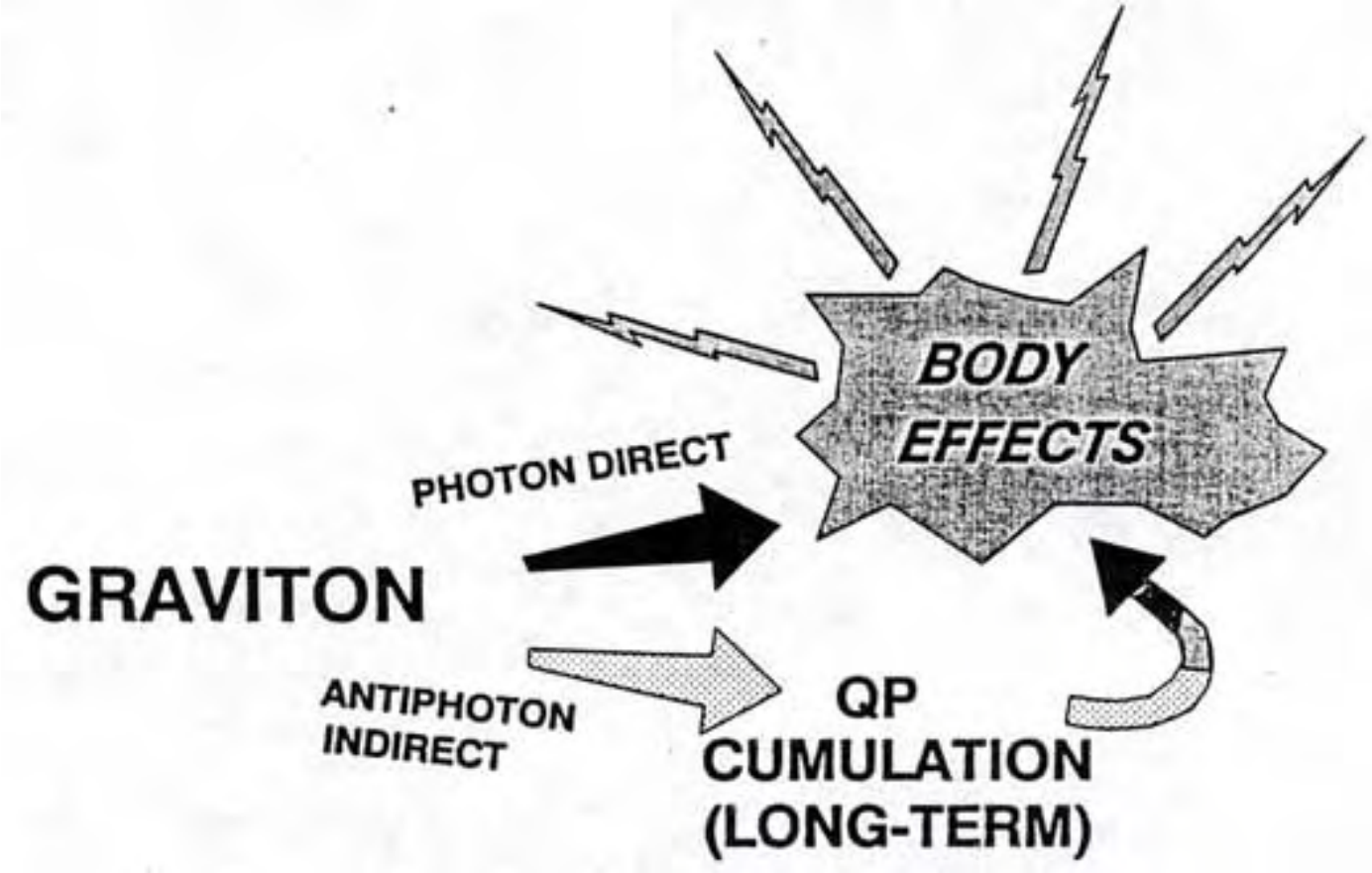

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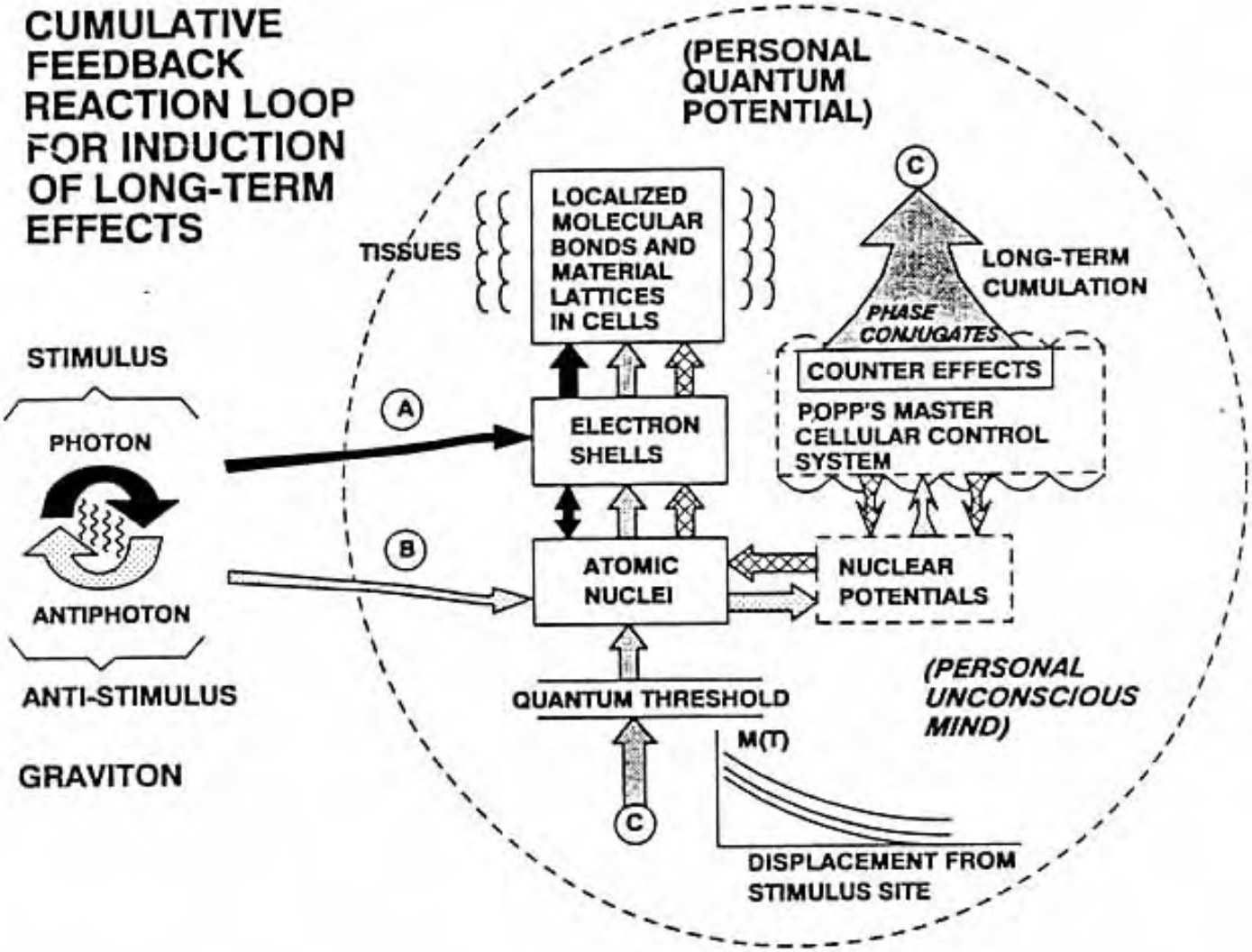

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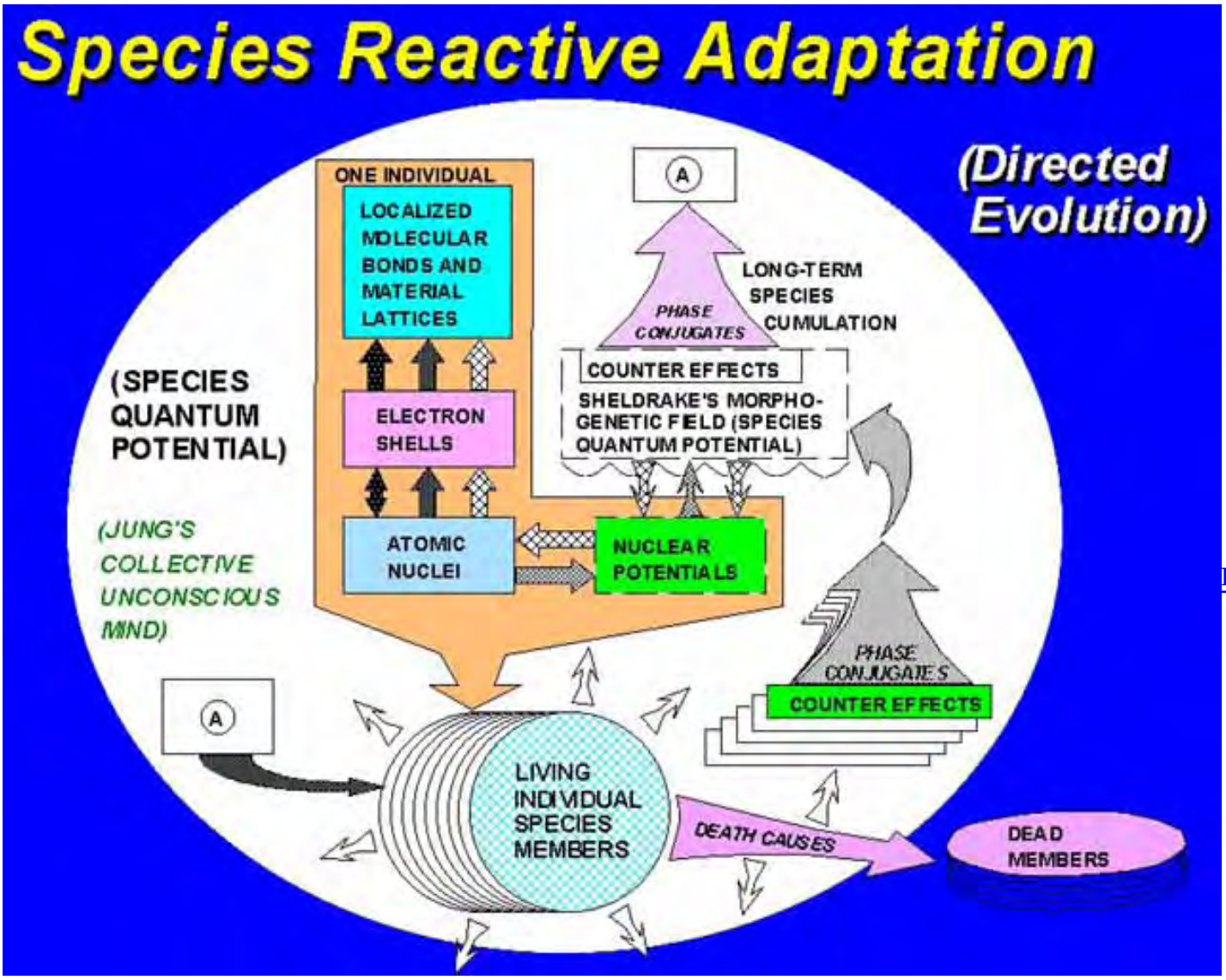

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INHERITANCE OF ACQUIRED TRAITS

- Evolutionary biology assumes mutations are random events
  - Causes of heritable differences separated from their consequences for survival and reproduction
  - Likelihood of any particular mutational event assumed independent of its particular value to the organism
  - Natural selection then assumed to increase the frequency of advantageous alleles
- Evidence for directed, non-random mutation
  - Removing cell-wall from bacterium: acquired nakedness is then inherited
  - Protozoan Oxytricha double monsters (siamese twins)
    - Bisected lengthwise, normal reproduction
    - Bisected crosswise, double monsters reproduce
  - Virus Sigma and fruit fly sensitivity to CO_2
  - Specific sets of genes either eliminated or added to an organism by organelles, plasmids, bacteria or other agents
- Genes are acquired vertically from ancestors and horizontally from a variety of other factors

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Deep penetration of weak signals in a dense signal environment, by nonlinear retroreflection

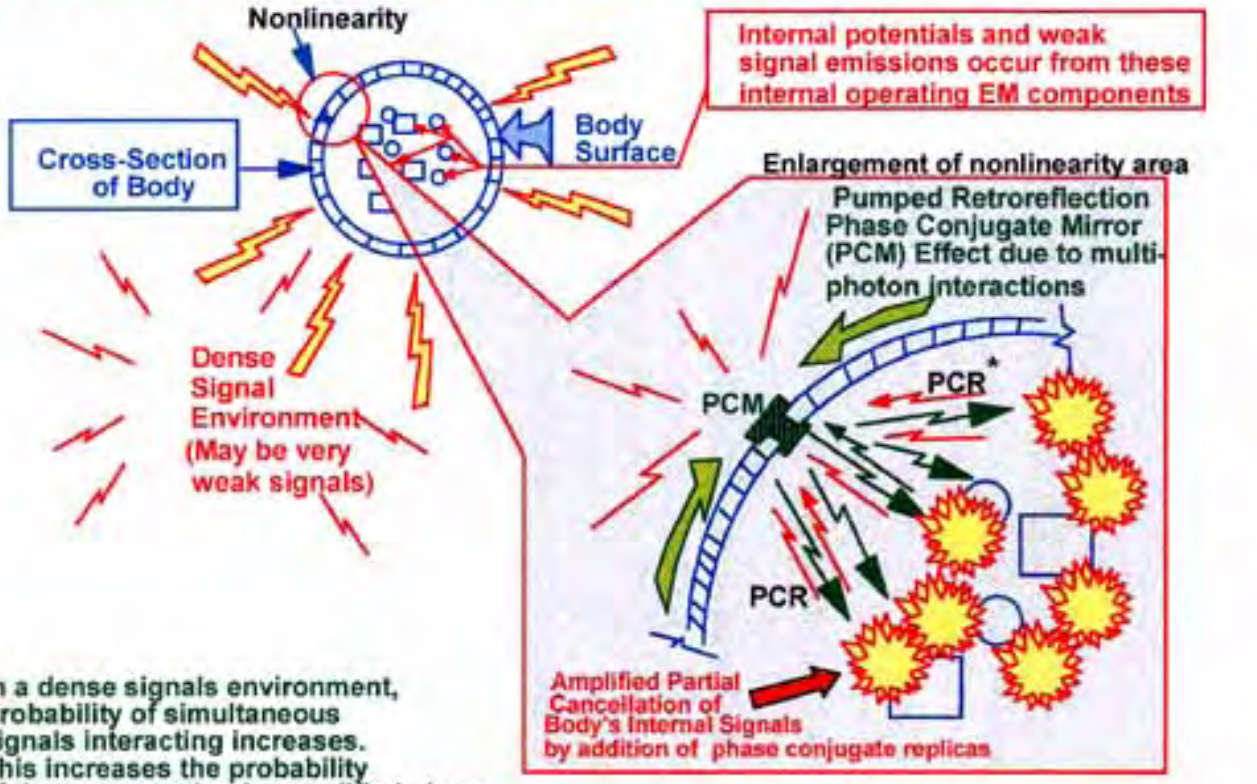

In a dense signals environment, probability of simultaneous signals interacting increases. This increases the probability of deep penetration by amplified phase conjugate reflections of weak internally generated signals from the interior, impinging upon the pumped (stressed) nonlinear surface areas where the simultaneous exterior interactions occur.

* Phase conjugate replica

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ANOMALOUS DEPTH PENETRATION

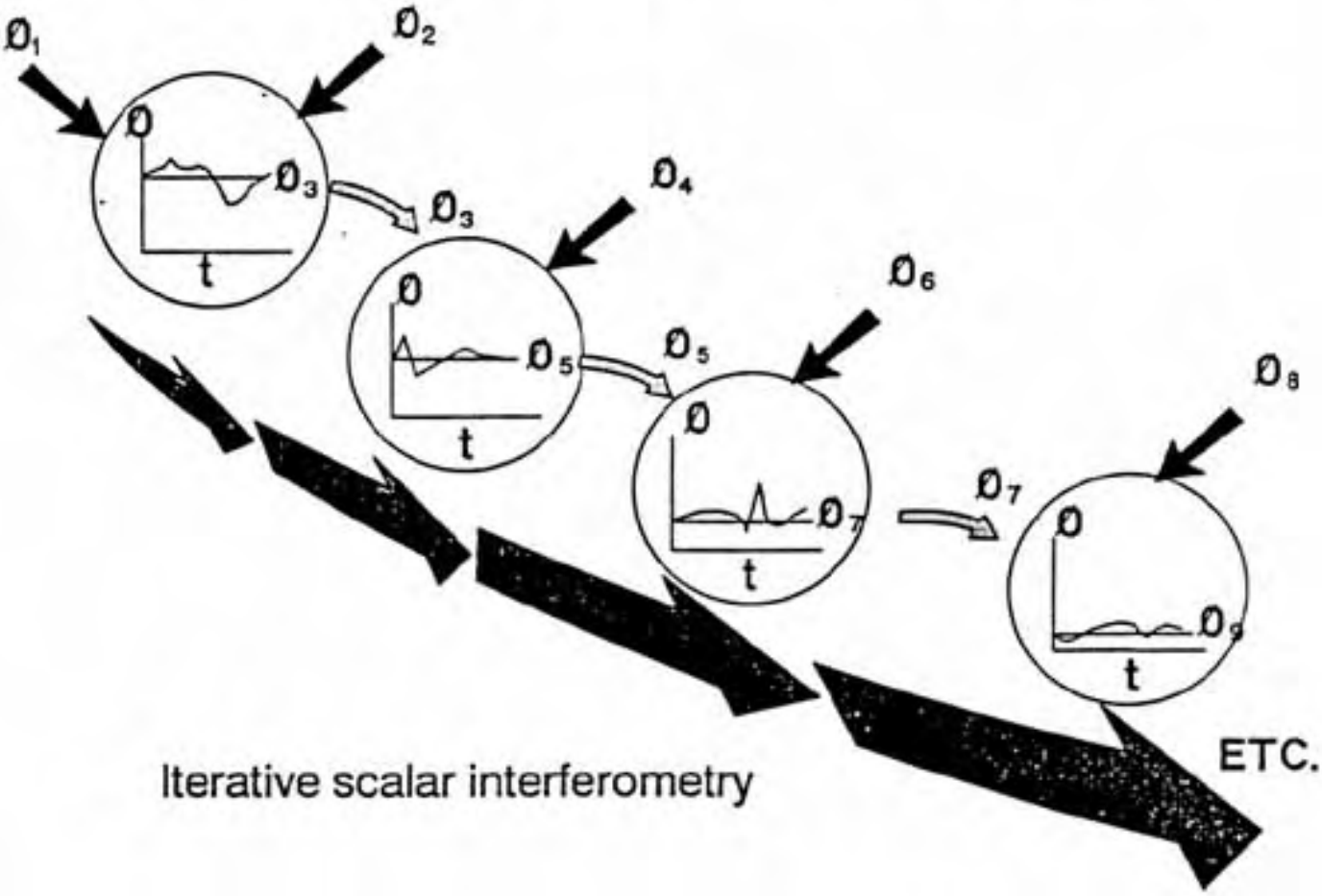

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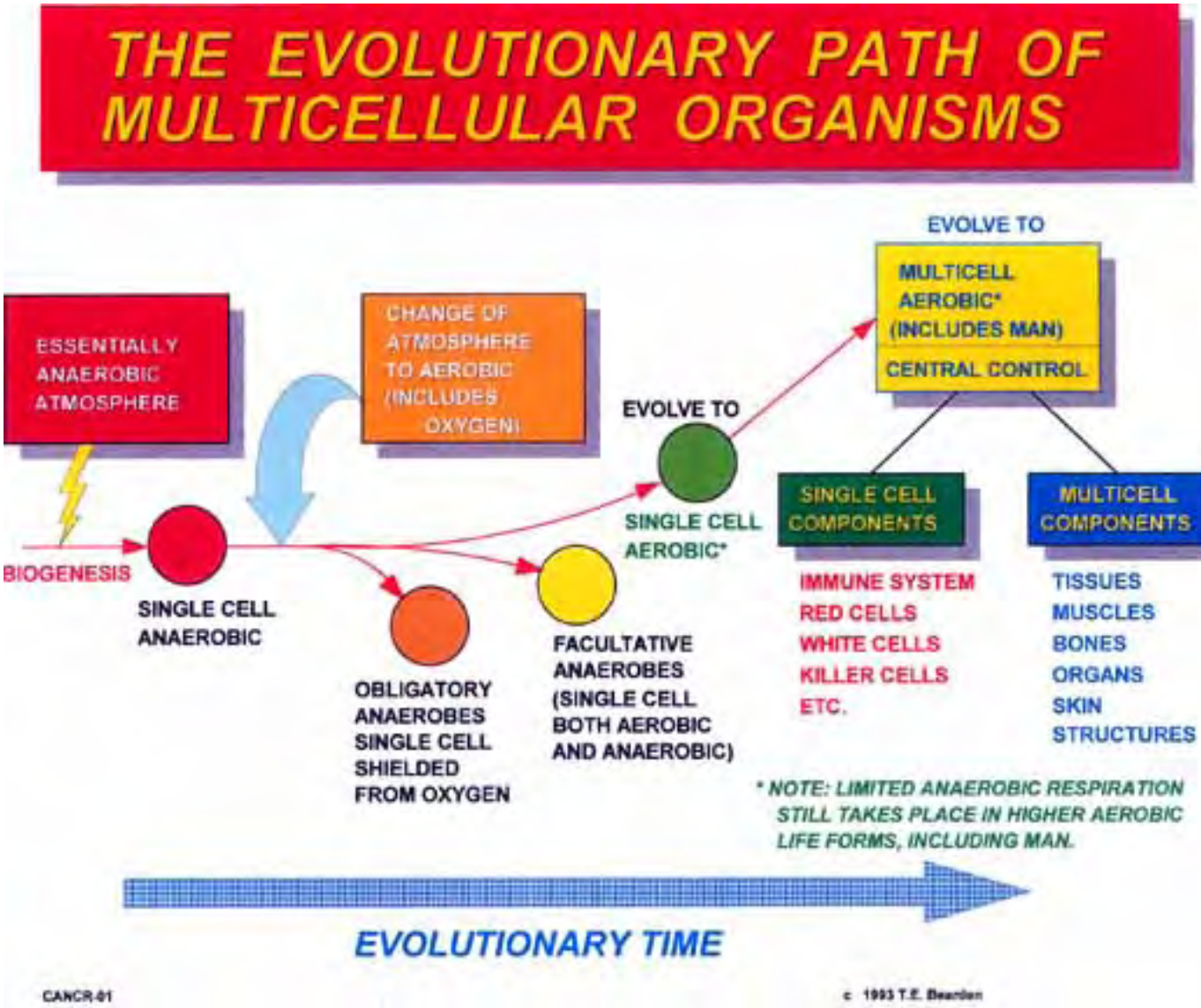

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DEVELOPMENT OF MULTI-CELLED ORGANISMS

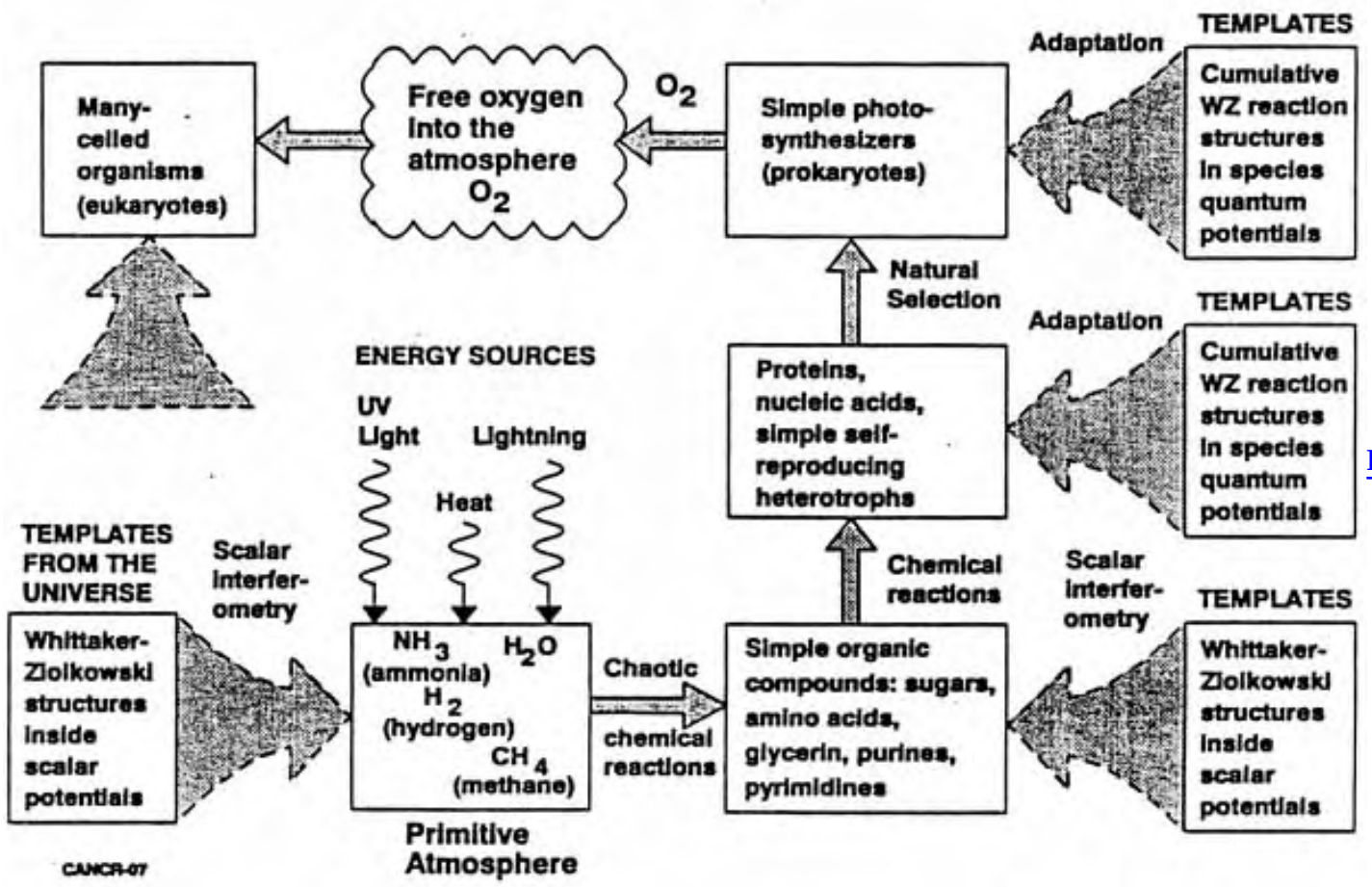

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EFFECT OF FLUID CONTAMINATION ON HEMOGLOBIN'S OXYGEN TRANSPORT

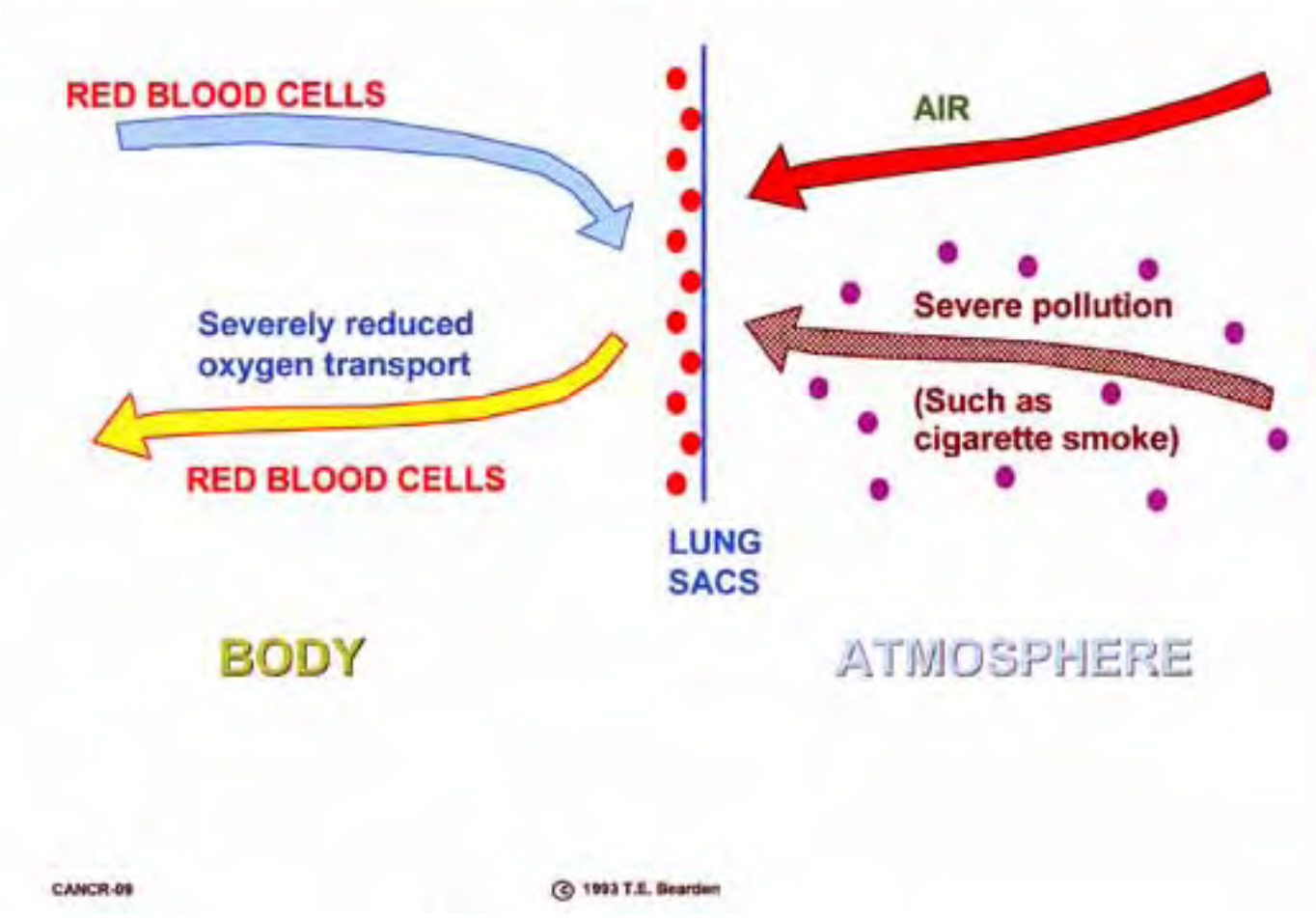

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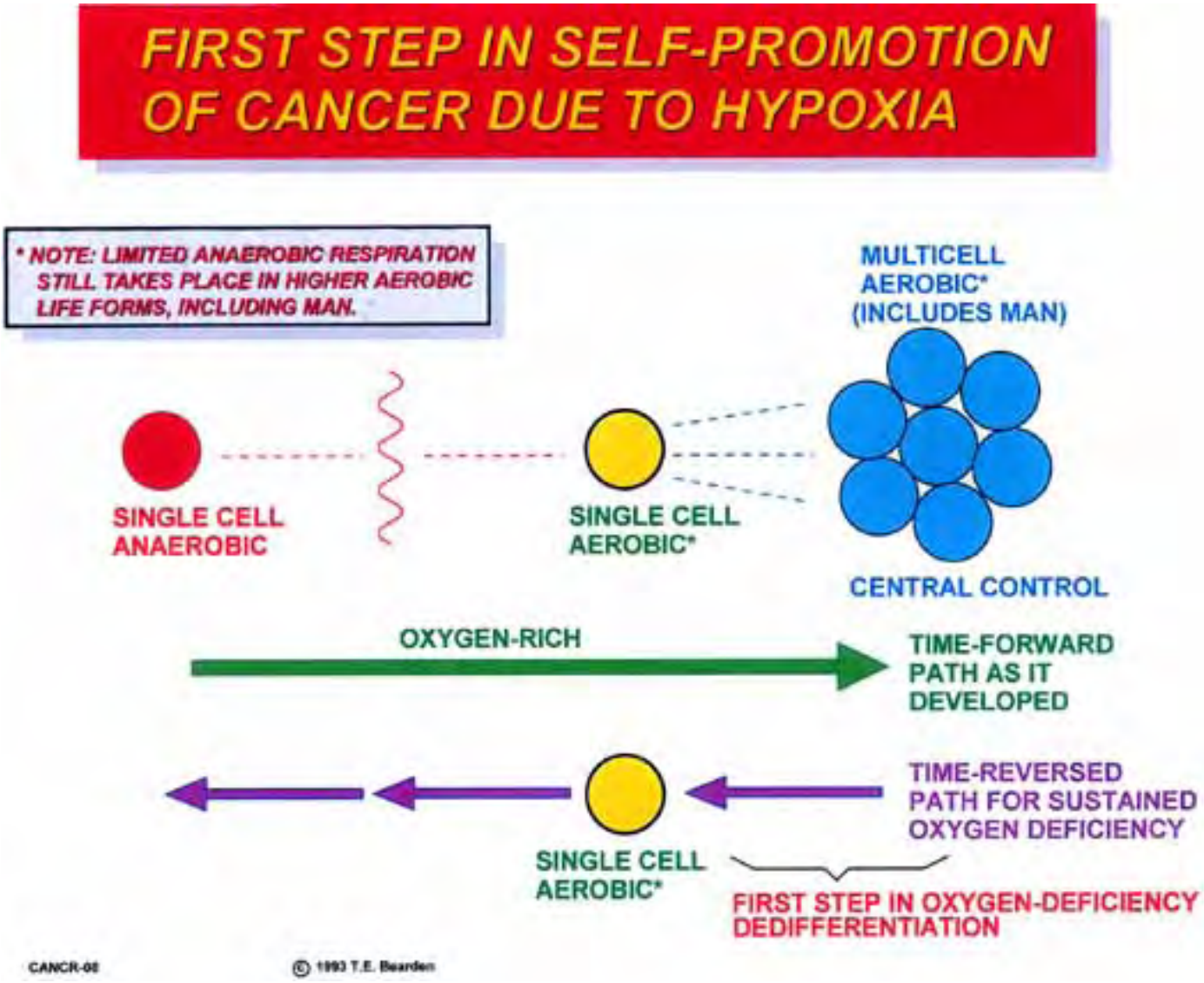

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CUMULATIVE GROWTH OF DEDIFFERENTIATION SIGNALS

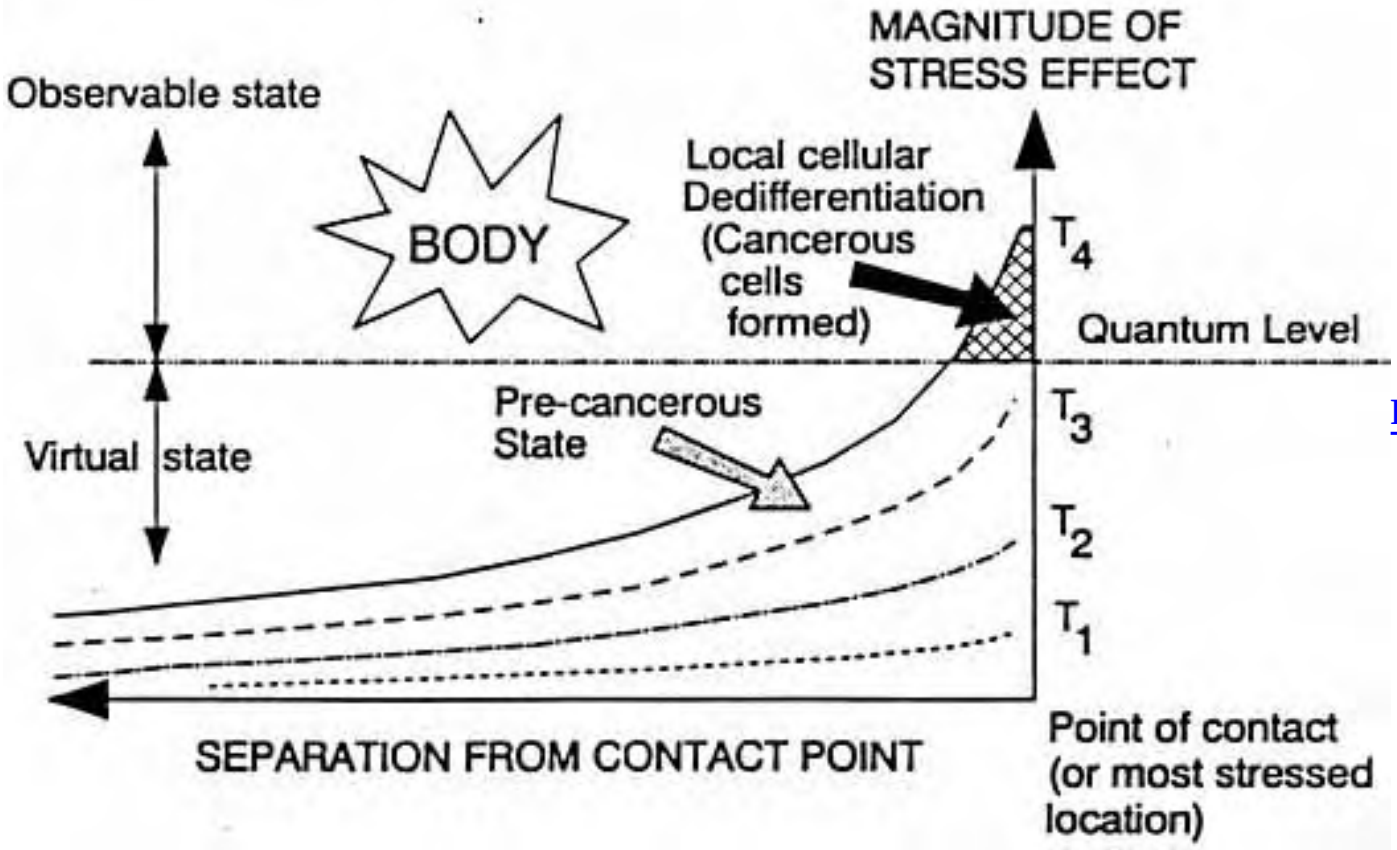

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CUMULATIVE EMERGENCE OF CANCER INTO THE PHYSICAL STATE

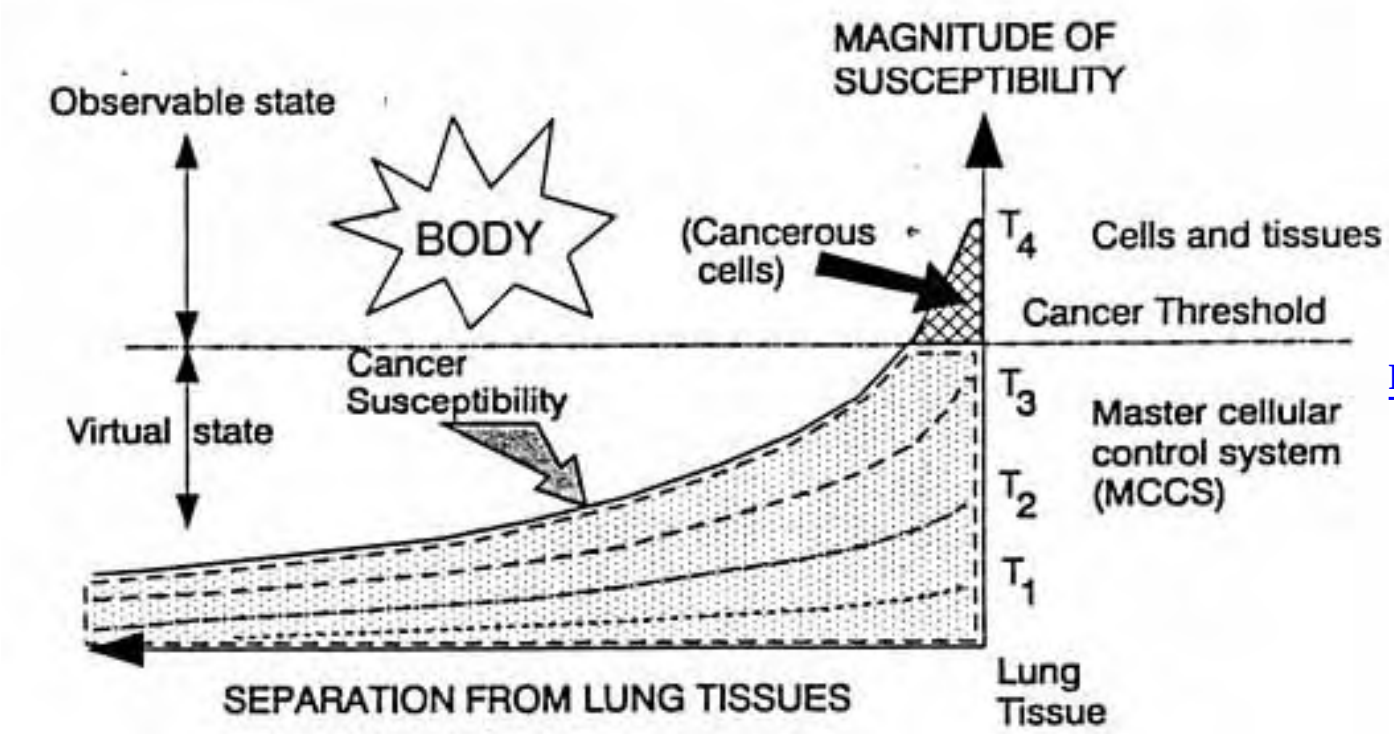

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PRECANCER STATE CONDITION DETERMINES TREATMENT SUCCESS

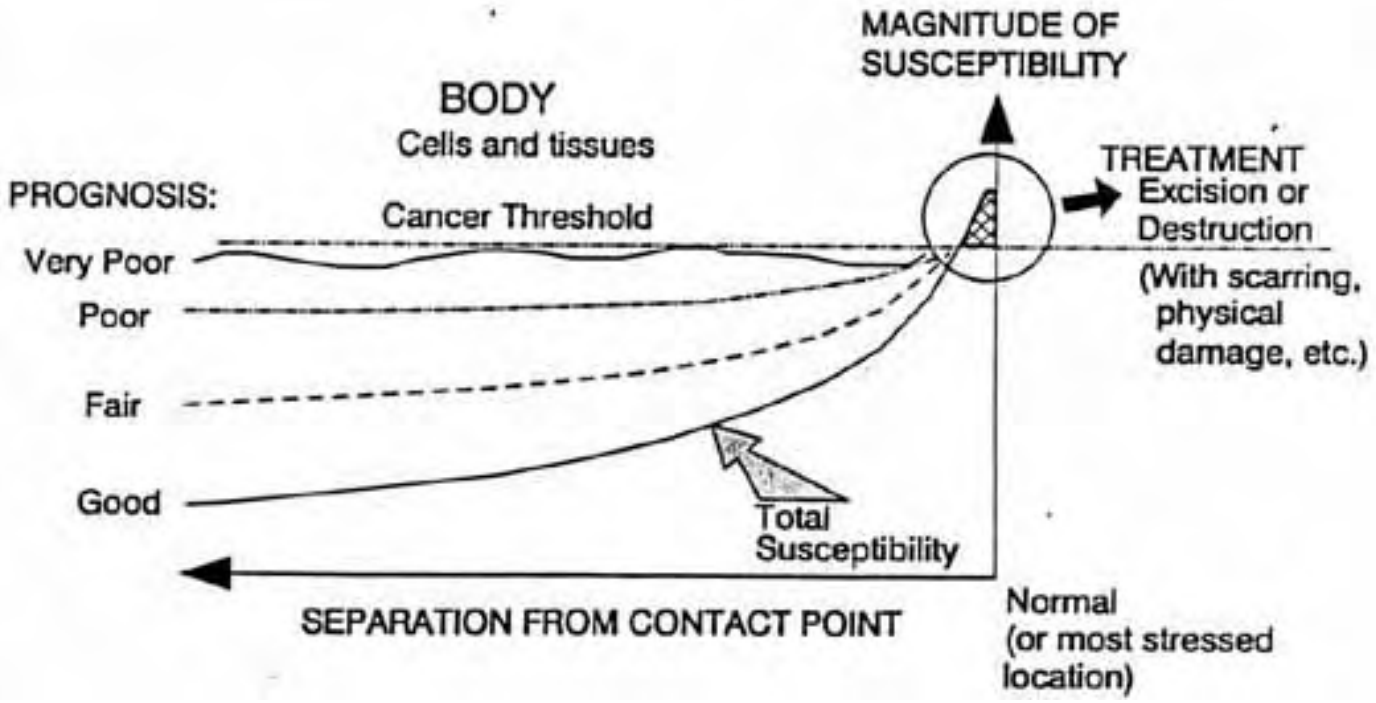

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Starting From the Scalar EM View:
A NEW DEFINITION OF CANCER

- CANCER AND LEUKEMIA ARE:

  Centrally-commanded, final, desperate, "first-step dedifferentiation" adaptive attempts by the stressed affected cells experiencing sustained oxygen shortage, to reverse their cellular evolution and return to the anaerobic stage of their distant ancestry.

- THE CAUSE IS LONG-TERM CUMULATIVE, AND ELECTROMAGNETIC IN NATURE.

- A TOTAL CURE CAN BE ACHIEVED ELECTRO-MAGNETICALLY, AS WAS DEMONSTRATED.

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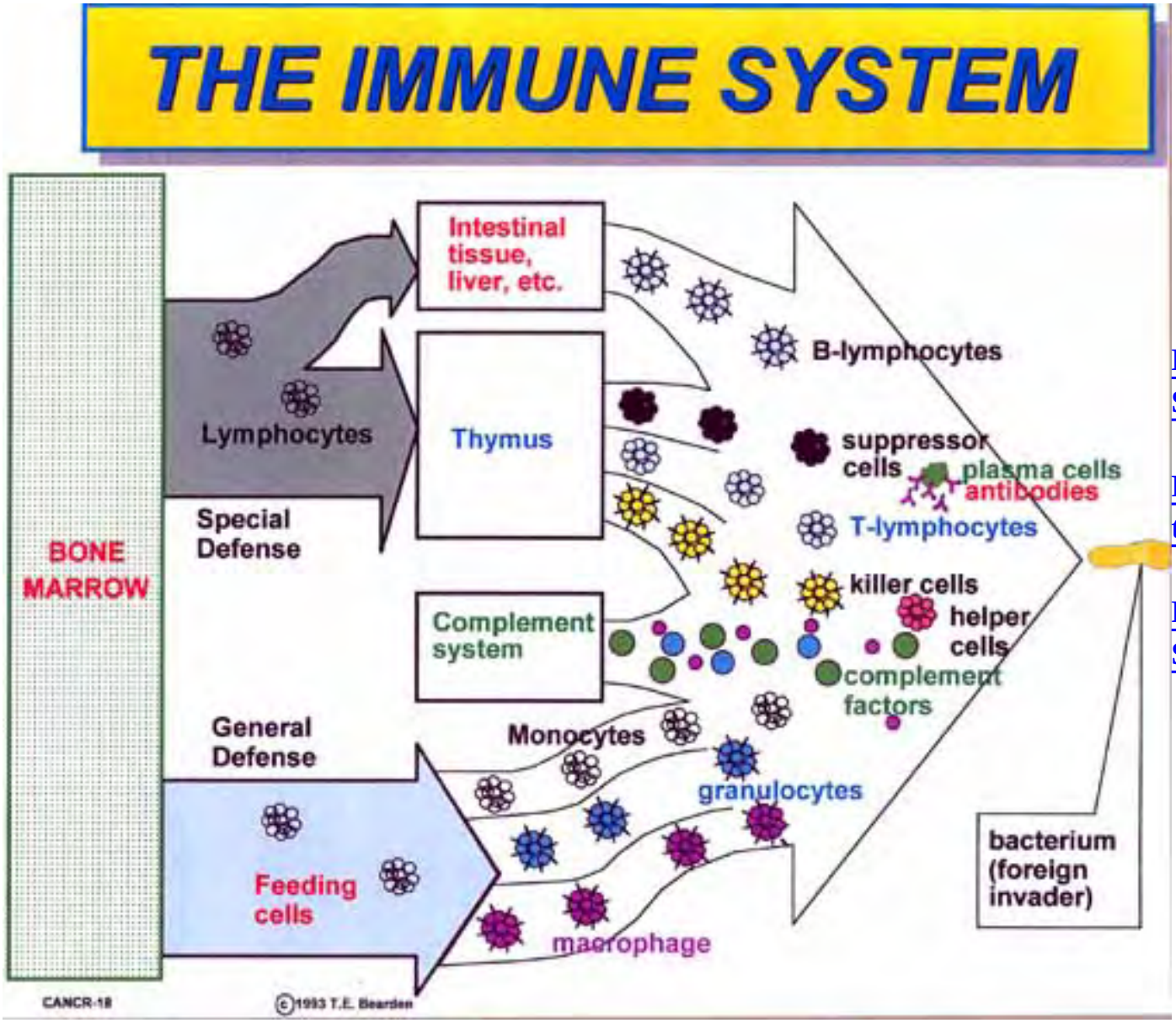

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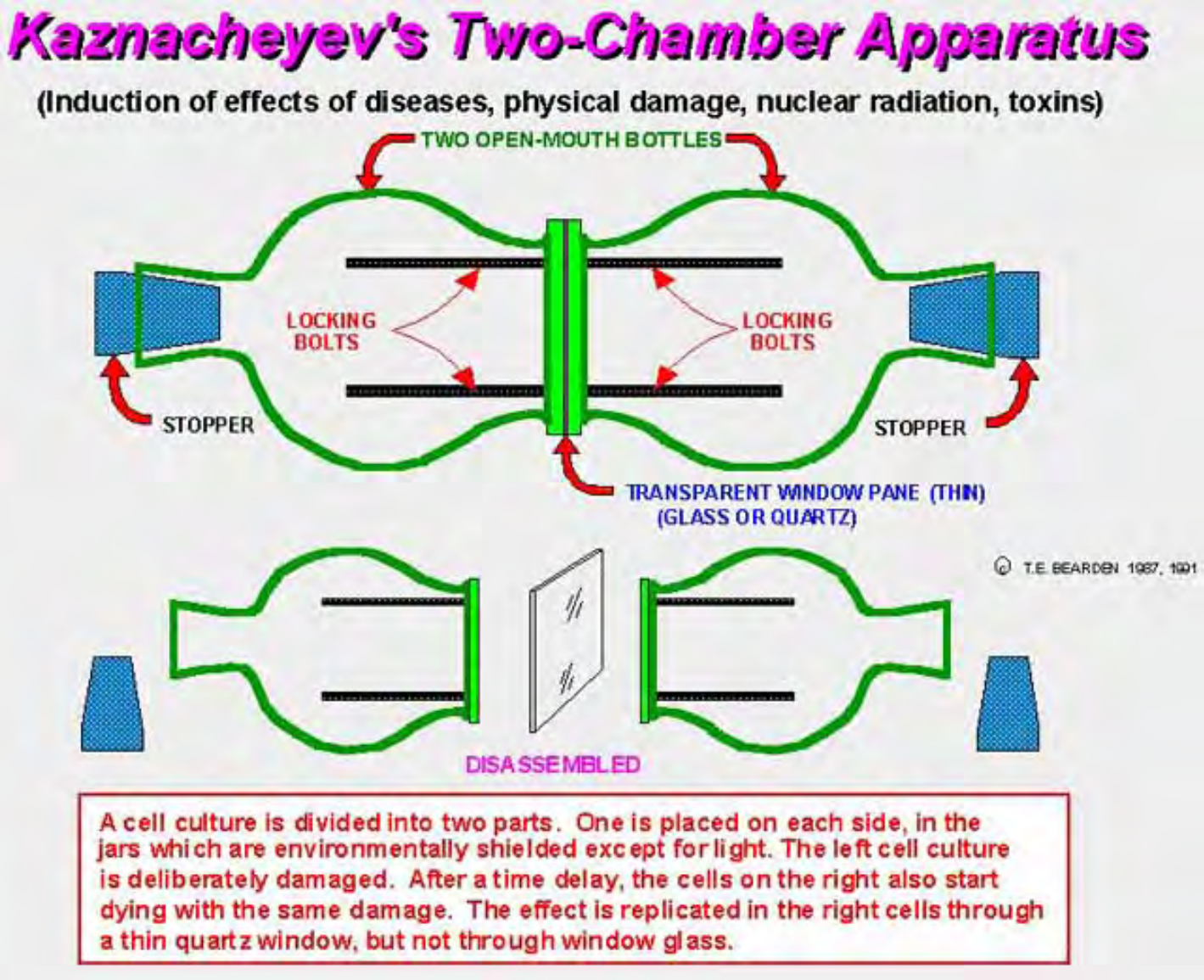

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Kaznacheyev's Cytopathogenic Mirror Effect

Disease vacuum engines transported by photons and waves

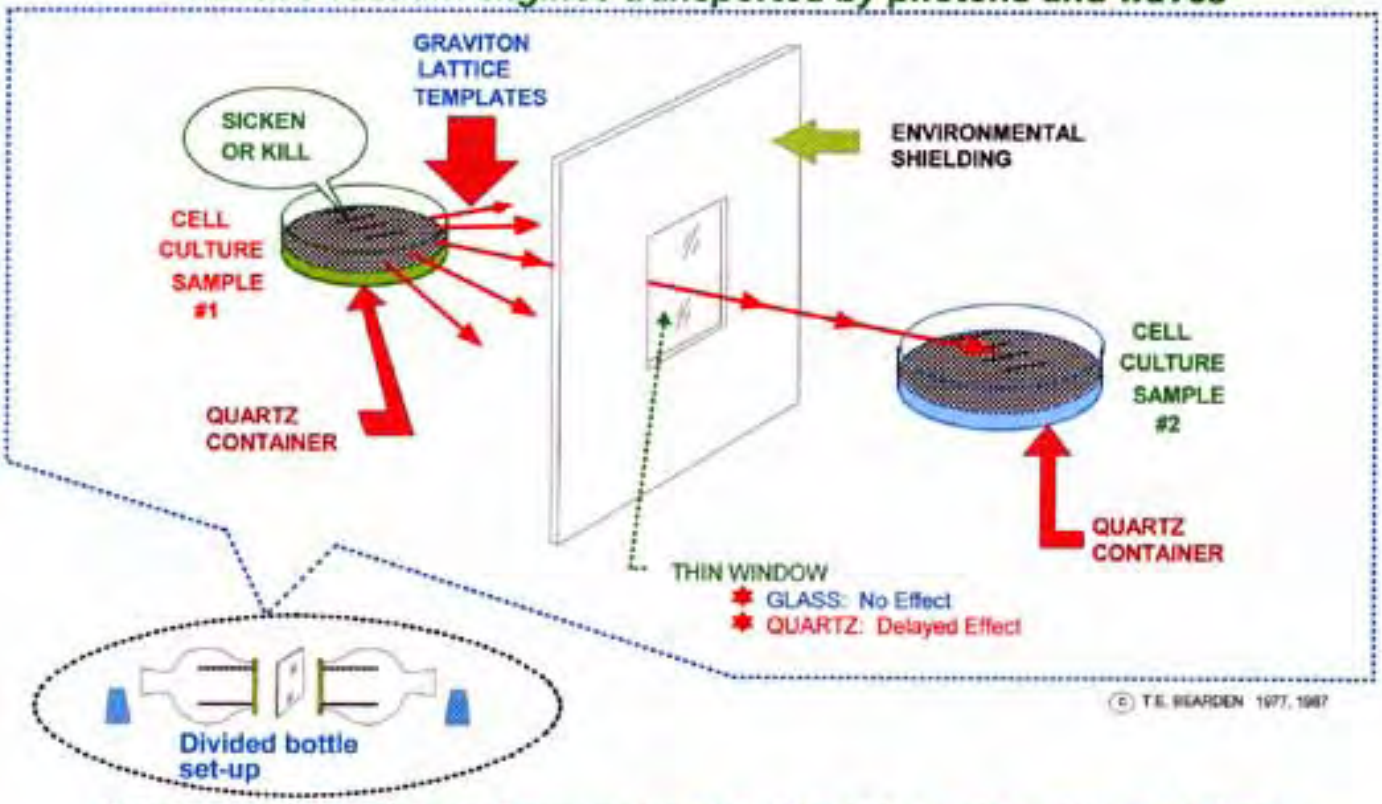

Note: Minimum lattice is one harmonic interval: IR to UV is such a minimum G-lattice.

Distant induction of cellular death and diseases, by special EM means. Coupled photon-antiphoton pairs (gravitons) in a structured harmonic lattice ordering constitute the disease or disorder template.

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MICROWAVE RADIATION OF U.S. EMBASSY IN MOSCOW

Former U.S. Embassy in Moscow.

Selected clipart © by Lotus SmartPics™

BACKGROUND

- Began in latter 1950s
- Discovered on VP Nixon's trip
- Initially thought to be *nuclear* radiation (Discovered w/Geiger counter?)
- High level target -- U.S. Ambassador
- Guarantees personal attention of:
  - U.S. Ambassador to USSR
  - U.S. President
  - NSA, CIA, DIA, NSC, etc.
  - Top consulting scientists
  - Leading U.S. scientific institutions
- Two U.S. Ambassadors died, another sickened
- Anomalous health changes in personnel, only in zero-field (zero pot'l gradient) areas!
- Four U.S. Presidents requested Soviets cease
  - Cut from 18 watts/sq cm to 2
  - Then again increased
- No one could understand what was going on
- Aluminum screens were placed over windows
- Moscow was declared a hazardous duty zone

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JOHN HOPKINS STUDY OF EMBASSY MICROWAVE RADIATION

- **EXCELLENT SCIENTIFIC TEAM**

  - PERFORMED CLASSICAL EM INVESTIGATION

  - CAREFULLY ESTABLISHED THE FORCE FIELD PATTERNS

  - NO HEALTH CHANGES OCCURRED IN PERSONNEL WHERE THE FORCE FIELDS WERE PRESENT (NONZERO)

  - ALL HEALTH CHANGES OCCURRED IN PERSONNEL WHERE THE FORCE FIELDS WERE ZERO (ABSENT)

- **ASSUMED THAT ALL EM ACTION IS DUE ONLY TO FORCE FIELDS**

  - CONCLUDED THAT MICROWAVE RADIATION COULD NOT HAVE CAUSED THE HEALTH CHANGES

- **CONCLUSION WAS IN SERIOUS ERROR**

  - CORRECT CONCLUSION: HEALTH CHANGES WERE TOTALLY CORRELATED TO ABSENCE OF FORCE FIELDS

  *** TOTALLY CORRELATED TO PRESENCE OF GRADIENT-FREE POTENTIALS, OR NOT TO RADIATION AT ALL**

  *** IF NOT TO RADIATION AT ALL, THEN HEALTH CHANGES WOULD HAVE ALSO OCCURRED WHERE FORCE FIELDS WERE PRESENT**

- **THEREFORE THE HEALTH CHANGES WERE TOTALLY CORRELATED TO THE GRADIENT-FREE POTENTIALS, AND TO THE EM RADIATION**

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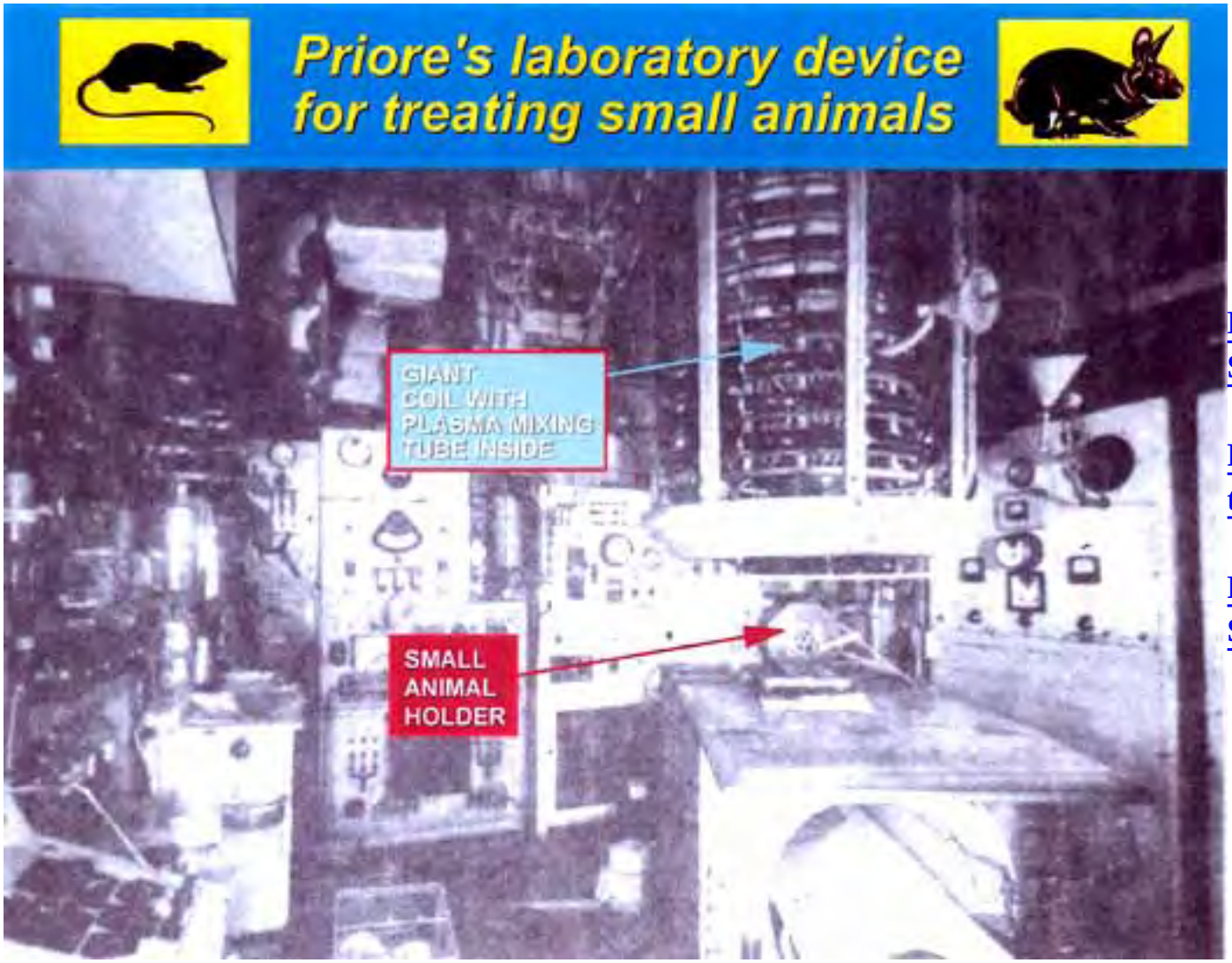

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MECHANISM OF THE PRIORE THERAPY

- **PRODUCED A DETERMINISTIC WZ STRUCTURED SCALAR POTENTIAL**
  - **17 FREQUENCIES MIXED IN A ROTATING PLASMA**
  - **PHASE CONJUGATES ADDED BY THE PLASMA**
  - **MODULATED ONTO A RIPPLING MAGNETIC FIELD WHICH CARRIED IT TO ATOMIC NUCLEI**
  - **INTERACTED DIRECTLY WITH PERSONAL QUANTUM POTENTIAL**

- **NEGATED THE LONG-TERM CUMULATIVE CELLULAR DEDIFFERENTIATION ORDER GENERATED BY LONG-TERM HYPOXIA. TUMOR CELLS REVERTED TO NORMAL CONTROL**

- **SCRUBBED OUT THE CUMULATED PRECANCEROUS STATE**

- **RESTORED THE IMMUNE SYSTEM TO HIGH FUNCTIONING**

- **NO EXCESSIVE TRAUMA TO TREATED ANIMAL**

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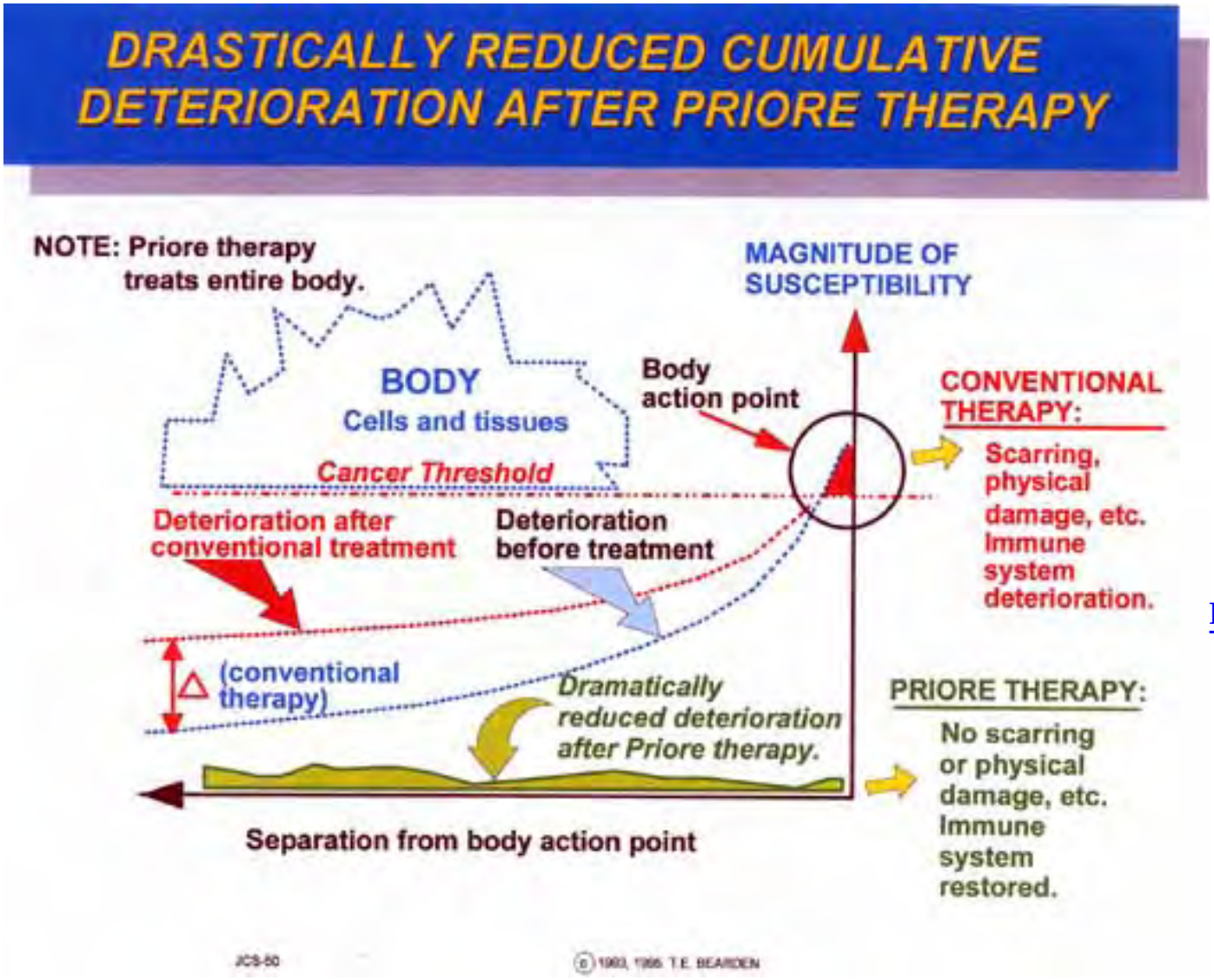

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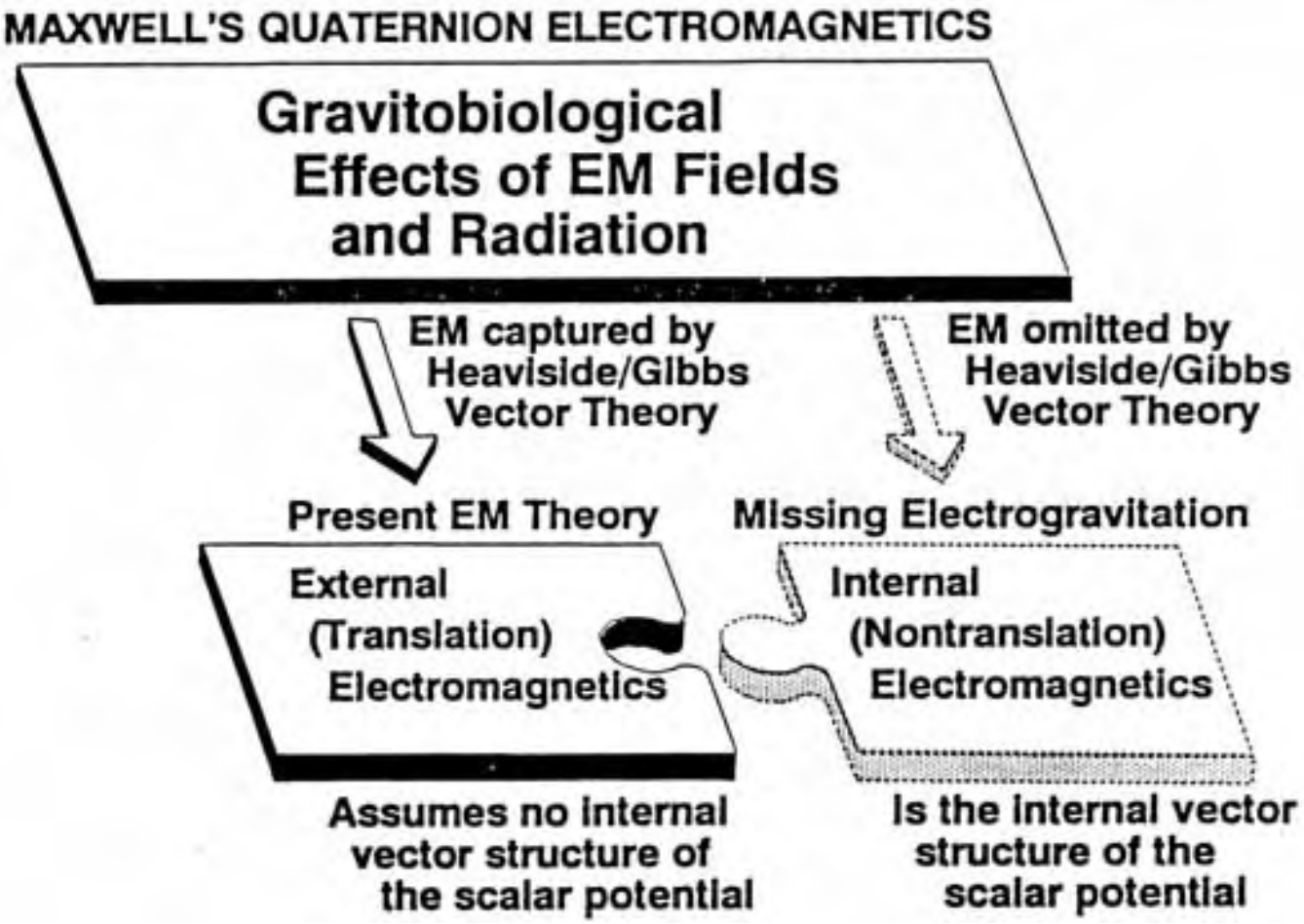

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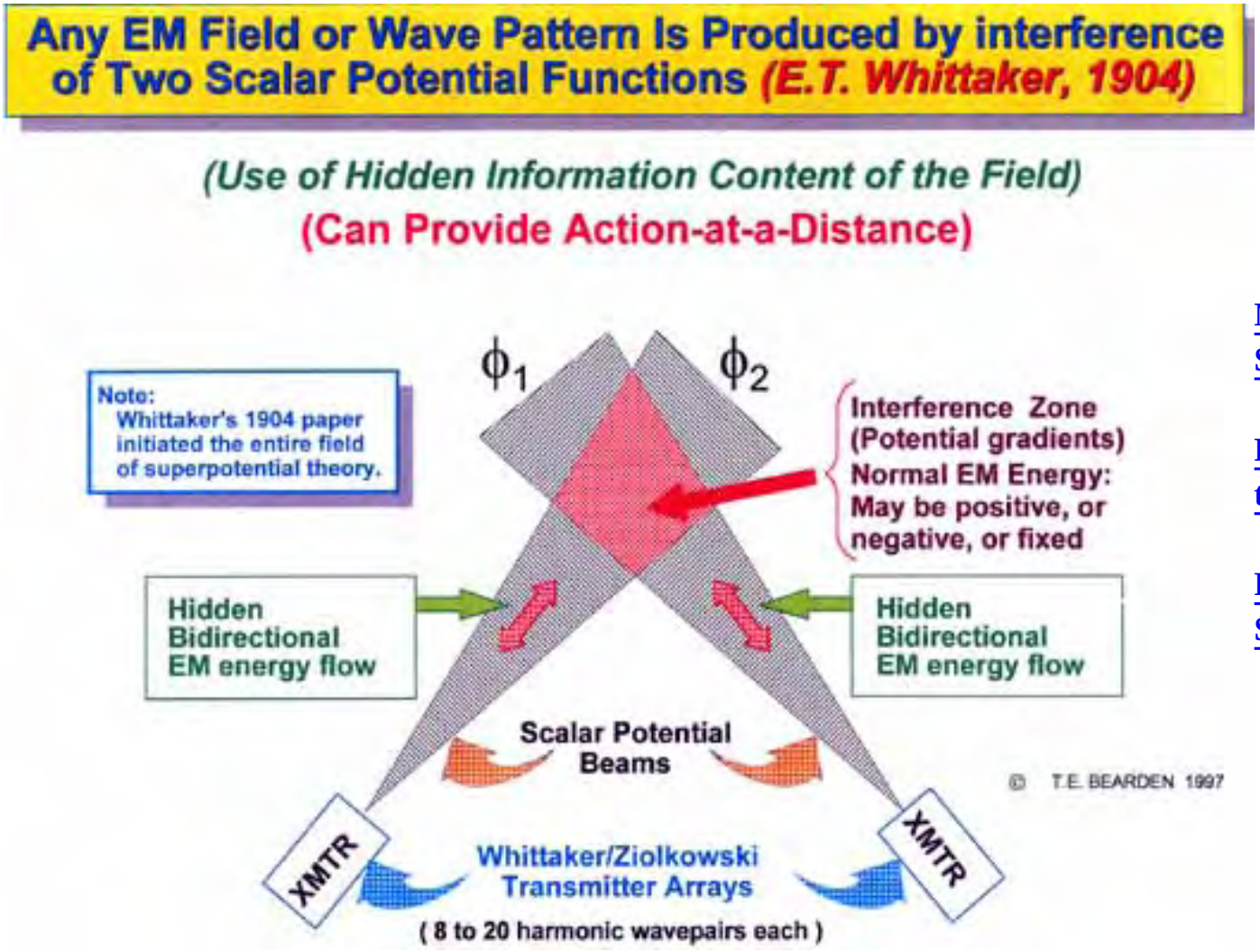

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MECHANISM FOR LONG-TERM, CUMULATIVE BIOLOGICAL EFFECTS OF EM FIELDS AND RADIATION

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The New Tesla Electromagnetics and the Secrets of Electrical Free Energy

By T.E. Bearden
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COMMENTS ON THE NEW TESLA ELECTROMAGNETICS

Part I: Discrepancies in Present EM Theory

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There are at least twenty-two major discrepancies presently existing in conventional electromagnetics theory. This paper presents a summary of those flaws, and is a further commentary on my discussion of scalar longitudinal Tesla waves in a previous paper, "Solutions to Tesla's Secrets and the Soviet Tesla Weapons," Tesla Book Company, 1981 and 1982.

I particularly wish to express my deep appreciation to two of my friends and colleagues who at this time, I believe, wish to remain anonymous. One of the two is an experimental genius who can produce items on the bench that do not work by orthodox theory. The second is a master of materials science and electromagnetics theory. I thank them both for their exceptional contributions and stimuli regarding potential shortcomings in present electromagnetics theory, and their forbearance with the many discussions we have held on this and related subjects.

It goes without saying that any errors in this paper are strictly my own, and not the fault of either of my distinguished colleagues.

(1) In present electromagnetics theory, charge and charged mass are falsely made identical. Actually, on a charged particle, the "charge" is the flux of virtual particles on the "bare particle" of observable mass. The charged particle is thus a "system" of true massless charge coupled to a bare chargeless mass. The observable "mass" is static, three-dimensional, and totally spatial. "Charge" is dynamic, four-dimensional or more, virtual and spatiotemporal. Further, the charge and observable mass can be decoupled, contrary to present theory. Decoupled charge -- that is, the absence of mass -- is simply what we presently refer to as "vacuum." Vacuum, spacetime, and massless charge are all identical. Rigorously, we should utilize any of these three as an "ether," as suggested for vacuum by Einstein himself (see

Max Born, Einstein's Theory of Relativity, Revised Edition, Dover Publications, New York, 1965, p. 224). And all three of them are identically anenergy -- not energy, but more fundamental components of energy.

(2) Electrostatic potential is regarded as a purely 3-dimensional spatial stress. Instead, it is the intensity of a many-dimensional (at least four-dimensional) virtual flux and a stress on all four dimensions of spacetime. This is easily seen, once one recognizes that spacetime is identically massless charge. (It is not "filled" with charge; rather, it is charge!) Just as, in a gas under pressure, the accumulation of additional gas further stresses the gas, the accumulation of charge (spacetime) stresses charge (spacetime). Further, if freed from its attachment to mass , charge can flow exclusively in time, exclusively in space, or in any combination of the two. Tesla waves -- which are scalar waves in pure massless charge flux itself -- thus can exhibit extraordinary characteristics that ordinary vector waves do not possess. And Tesla waves have extra dimensional degrees of freedom in which to move, as compared to vector waves. Indeed, one way to visualize a Tesla scalar wave is to regard it as a pure oscillation of time itself.

(3) Voltage and potential are often confused in the electrostatic case, or at least thought of as "composed of the same thing." For that reason, voltage is regarded as "potential drop". This also is not true. Rigorously, the potential is the intensity of the virtual particle flux at a single point -- whether or not there is any mass at the point -- and both the pressure and the point itself are spatiotemporal (4-dimensional), not spatial (3-dimensional) as presently assumed. Voltage represents the spatial intersection of the difference in the potential between two separated spatial points, and always implies at least a miniscule flow of mass current (that is what makes it spatial!). "Voltage" is spatial and depends upon the presence of observable mass flow, while scalar electrostatic potential is spatiotemporal and depends upon the absence of observable mass flow. The two are not even of the same dimensionality.

(4) The charge of vacuum spacetime is assumed to be zero, when in fact it is a very high value. Vacuum has no mass, but it has great massless charge and virtual particle charge flux. For proof that a charged vacuum is the seat of something in motion, see G.M. Graham and D.G. Lahoz, "Observation of static electromagnetic angular momentum in vacuo," Nature, Vol. 285, 15 .May 1980, pp. 154-155. In fact, vacuum IS charge, identically, and it is also "spacetime" and at least four-dimensional.

(5) Contrary to its present usage, zero is dimensional and relative in its context. A three-dimensional spatial hole, for example, exists in time. If we model time as a dimension, then the spatial hole has one dimension in 4-space. So a spatial absence is a spatiotemporal presence. In the vacuum 4-space, a spatial nothing is still a something. The "virtual" concept and the mathematical concept of a derivative are simply two present ways of unconsciously addressing this fundamental problem of the dimensional relativity of zero.

(6) The concepts of "space" and "time" imply that spacetime (vacuum) has been separated into two parts. We can only think of a space as "continuing to exist in time " To separate vacuum spacetime into two pieces, an operation is continually required. The operator that accomplishes this splitting operation is the photon interaction, the interaction of vector electromagnetic energy or waves with mass. I have already strongly pointed out this effect and presented a "raindrop model" of first-order physical change itself in my book, The Excalibur Briefing, Strawberry Hill Press, San Francisco, 1980, pp. 128-130.

(7) "Vector magnetic potential" is assumed to be always an aspect of (and connected to) the magnetic field. In fact it is a separate, fundamental field of nature and it can be entirely disconnected from the magnetic field. See Richard P. Feynman et al, The Feynman Lectures on Physics, Addison-Wesley Publishing Co., New York, 1964, Vol. II, pp. 15-8 to 15-14. Curiously, this fact has been proven for years' yet it has been almost completely ignored in the West. The "Vx" operator, when applied to the A-field, makes B-field. If the Vx operator is not applied, the "freed" A-field possesses much-expanded characteristics from those presently allowed in the "bound" theory. Specifically, it becomes a scalar or "shadow vector" field; it is not a normal vector field. (note: for V read inverted capital Delta)

(8) The speed of light in vacuum is assumed to be a fundamental constant of nature. Instead it is a function of the intensity of the massless charge flux (that is, of the magnitude of the electrostatic potential) of the vacuum in which it moves. (Indeed, since vacuum and massless charge are one and the same, one may say that the speed of light is a function of the intensity of the spatiotemporal vacuum!). The higher the flux intensity (charge) of the vacuum, the faster the speed of light in it. This is an observed fact and already shown by hardcore measurements. For example, distinct differences actually exist in the speed of light in vacuo, when measured on the surface of the earth as compared to measurements in space away from planetary masses. In a vacuum on the surface of the earth, light moves significantly faster. For a discussion and the statistics, see B. N. Belyaev, "On Random Fluctuations of the Velocity of Light in Vacuum," Soviet Physics

Journal, No. 11, Nov. 1980, pp. 37-42 (original in Russian; translation by Plenum Publishing Corporation.) The Russians have used this knowledge for over two decades in their strategic psychotronics (energetics) program; yet hardly a single U.S. scientist is aware of the measured variation of c in vacuo. In fact, most Western scientists simply cannot believe it when it is pointed out to them!

(9) Energy is considered fundamental and equivalent to work. In fact, energy arises from vector processes, and it can be disassembled into more fundamental (anenergy) scalar components, since the vectors can. These scalar components individually can be moved to a distant location without expending work, since one is not moving force vectors. There the scalar components can be joined and reassembled into vectors to provide "free energy" appearing at a distance, with no loss in between the initial and distant points. For proof that a vector field can be replaced by (and considered to be composed of) two scalar fields, see E. T. Whittaker, Proceedings of the London Mathematical Society, Volume 1, 1903, p. 367. By extension, any vector wave can be replaced by two coupled scalar waves.

(10) The classical Poynting vector predicts no longitudinal wave of energy from a time-varying, electrically charged source, In fact, an exact solution of the problem does allow this longitudinal wave. See T. D. Keech and J. F. Corum, "A New Derivation for the Field of a Time-Varying Charge in Einstein's Theory," International Journal of Theoretical Physics, Vol. 20, No, 1, 1981, pp. 63-68 for the proof.

(11) The present concepts of vector and scalar are severely limited, and do not permit the explicit consideration of the internal, finer-grained structures of a vector or a scalar. That is, a fundamental problem exists with the basic assumptions in the vector mathematics itself. The "space" of a vector field, for example, does not have inter-nested sublevels (subspaces) containing finer "shadow vectors" or "virtual vectors," Yet particle physics has already discovered that electrical reality is built that way. Thus one should actually use a "hypernumber" theory after the manner of Charles Musés. A scalar is filled with (and composed of) nested levels of other "spaces" containing vectors, where these sum to "zero" in the ordinary observable frame without an observable vector resultant. In Musés' mathematics, for example, zero has real roots. Real physical devices can be -- and have been -constructed in accordance with Muses' theory. For an introduction to Musés' profound hypernumbers approach, see Charles Musés' foreword to Jerome Rothstein, Communication Organization and Science, The Falcon's Wing Press, Indian Hills, Colorado, 1958. See also Charles Musés, "Applied Hypernumbers: Computational Concepts," Applied Mathematics and

Computation, Vol. 3, 1976. See also Charles Musés, "Hypernumbers II," Applied Mathematics and Computation, January 1978.

(12) With the expanded Tesla electromagnetics, a new conservation of energy law is required. Let us recapitulate for a moment. The oldest law called for the conservation of mass. The present law calls for the conservation of "mass and energy", but not each separately. If mass is regarded as simply another aspect of energy, then the present law calls for the conservation of energy. However, this assumes that energy is a basic, fundamental concept. Since the energy concept is tied to work and the movement of vector forces, it implicitly assumes "vector movement" to be a "most fundamental" and irreducible concept. But as we pointed out, Whittaker showed that vectors can always be further broken down into more fundamental coupled scalar components. Further, Tesla discovered that these "coupled components" of "energy" can be individually separated, transmitted, processed, rejoined, etc. This directly implies that energy per se need not be conserved. The new law therefore calls for the conservation of anenergy, the components of energy. These components may be coupled into energy, and the energy may be further compacted into mass. It is the sum total of the (anenergy) components -- coupled and uncoupled -- that is conserved, not the matter or the energy per se. Further, this conservation of anenergy is not spatial; rather, it is spatiotemporal in a spacetime of at least four or more dimensions.

(13) Relativity is presently regarded as a theory or statement about fundamental physical reality. In fact, it is only a statement about FIRST ORDER reality -- the reality that emerges from the vector interaction of electromagnetic energy with matter. When we break down the vectors into scalars (shadow vectors or hypervectors), we immediately enter a vastly different, far more fundamental reality. In this reality superluminal velocity, multiple universes, travel back and forth in time, higher dimensions, variation of all "fundamental constants" of nature, materialization and dematerialization, and violation of the "conservation of energy" are all involved. Even our present Aristotlean logic -- fitted to the photon interaction by vector light as the fundamental observation mechanism -- is incapable of describing or modeling this more fundamental reality. Using scalar waves and scalar interactions as much subtler, far less limited observation/detection mechanisms, we must have a new "superrelativity" to describe the expanded electromagnetic reality uncovered by Nikola Tesla.

(14) "Charge" is assumed to be quantized, in addition to always occurring with -- and locked to -- mass. Indeed, charge is not necessarily quantized just as it is not necessarily locked to mass.

Ehrenhaft discovered and reported fractional charges for years, in the 30's and 40's, and was ignored. See P.A.11. Dirac, "Development of the Physicist's Conception of Nature," Symposium on the Development of the Physicist's Conception of Nature, ed. Jagdish Merha, D. Reidel, Boston, 1973, pp. 12-14 for a presentation of some of Ehrenhaft's results. Within the last few years Stanford University· researchers also have positively demonstrated the existence of "fractional charge." For a layman's description of their work, see "A Spector Haunting Physics," Science News, Vol. 119, January 31, 1981, pp. 68-69. Indeed, Dirac in his referenced article points out that Millikan himself -- in his original oildrop experiments -- reported one measurement of fractional charge, but discounted it as probably due to error.

(15) Presently, things are always regarded as traveling through normal space. Thus we use or model only the most elementary type of motion -- that performed by vector electromagnetic energy. We do not allow for things to "travel inside the vector flow itself." Yet, actually, there is a second, more subtle flow inside the first, and a third, even more subtle flow inside the second, and so on. We may operate inside, onto, into, and out of energy itself -- and any anenergy component of energy. There are hypervectors and hyperscalars unlimited, within the ordinary vectors and scalars we already know. Further, these "internal flows" can be engineered and utilized, allowing physical reality itself to be directly engineered, almost without limits.

(16) We always assume everything exists in time. Actually, nothing presently measured exists in time, because the physical detection/ measurement process of our present instruments destroys time, ripping it off and tossing it away -- and thereby "collapsing the wave function." Present scientific methodology thus is seriously flawed. It does not yield fundamental (spacetime) truth, but only a partial (spatial) truth. This in turn leads to great scientific oversights. For example, mass does not exist in time, but mass x time (masstime) does. A fundamental constant does not exist in time, but the "constant x time" does. Energy does not exist in time, but energy x time (action) does. Even space itself does not exist in time -- spacetime does. We are almost always one dimension short in every observable we model. Yet we persist in thinking spatially, and we have developed 1nstruments that detect and measure spatially only. Such instruments can never measure and detect the phenomenology of the nested substrata of time. By using scalar technology, however, less limited instruments can indeed be constructed -and they have been. With such new instruments, the phenomenology of the new electromagnetics can be explored and an engineering technology developed.

(17) We do not recognize the connection between nested levels of virtual state (particle physics) and orthogonally rotated frames (hyperspaces). Actually the two are identical, as I showed in the appendix to my book, The Excalibur Briefing, Strawberry Hill Press, San Francisco, 1980, pp. 233-235. A virtual particle in the laboratory frame is an observable particle in a hyperspatial frame rotated more than one orthogonal turn away. This of course implies that the hyperspatial velocity of all virtual particles is greater than the speed of light. The particle physicist is already deeply involved in hyperspaces and hyperspatial charge fluxes without realizing it. In other words, he is using tachyons (particles that move faster than light) without realizing it.

(18) Presently quantum mechanics rigorously states that time is not an observable, and therefore it cannot be measured or detected. According to this assumption, one must always infer time from spatial measurements, because all detections and measurements are spatial. With this assumption, our scientists prejudice themselves against even looking for finer, subquantal measurement methodologies and instrumentation. Actually this present limitation is a result of the type of electromagnetics we presently know, where all instruments (the "measurers") have been interacted with by vector electromagnetic energy (light). Every mass that has temperature (and all masses do!) is continually absorbing and emitting photons, and in the process they are continually connecting to time and disconnecting from time. If time is continually being carried away from the detector itself by its emitted photons, then the detector cannot hold and "detect" that which it has just lost. With Tesla electromagnetics, however, the fundamental limitation of our present instruments need not apply. With finer instruments, we can show there are an infinite number of levels to "time", and it is only the "quantum level time" which is continually being lost by vector light (photon) interaction. By using subquantal scalar waves, instruments can move to deeper levels of time -- in which case the upper levels of time ARE measureable and detectable, in contradistinction to the present assumptions.

(19) In the present physics, time is modeled as, and considered to be, a continuous dimension such as length. This is only a gross approximation. Indeed, time is not like continuous "dimension," but more like a series of "stitches," each of which is individually made and then ripped out before the next stitch appears. "Vector light" photons interact one at a time, and it is this interaction with mass that creates quantum change itself. The absorption of a photon -- which is energy x time -- by a spatial mass converts it to masstime: the time was added by the photon. The emission of a photon tears away the time, leaving behind again a spatial mass. It is not accidental, then, that time flows at

the speed of light, for it is light which contains and carries time. It is also not accidental that the photon IS the individual quantum. Since all our instruments presently are continually absorbing and emitting photons, they are all "quantized," and they accordingly "quantize" their detections. This is true because all detection is totally internal to the detector, and the instruments detect only their own internal changes. Since these detections are on a totally granular quantized background, the detections themselves are quantized. The Minkowski model is fundamentally erroneous in its modeling of time, and for that reason relativity and quantum mechanics continue to resist all attempts to successfully combine them, quantum field theory notwithstanding.

(20) Presently, gravitational field and electrical field are considered mutually exclusive. Actually this is also untrue. In 1974, for example, Santilly proved that electrical field and gravitational field indeed are not mutually exclusive In that case, one is left with two possibilities: (a) they are totally the same thing, or (b) they are partially the same thing. For the proof, see R. M. Santilli, "Partons and Gravitation: Some Puzzling Questions," Annals of Physics, Vol. 83, No. 1, March 1974. With the new Tesla electromagnetics, pure scalar waves in time itself can be produced electrically, and electrostatics (when the charge has been separated from the mass) becomes a "magic" tool capable of directly affecting and altering anything that exists in time--including gravitational field. Antigravity and the inertial drive are immediate and direct consequences of the new electromagnetics.

(21) Presently, mind is considered metaphysical, not a part of physics, an not affected by physical means. Literally, the prevailing belief of Western scientists is that man is a mechanical robot -- even though relativity depends entirely upon the idea of the "observer." Western science today thus has essentially become dogmatic, and in this respect borders on a religion. Since this "religion," so to speak, is now fairly well entrenched in its power in the state, Western science is turning itself into an oligarchy. But mind occupies time, and when we measure and affect time we can directly measure and affect mind itself. In the new electromagnetics, then, man regains his dignity and his humanity by restoring the reality of mind and thought to science. In my book, The Excalibur Briefing, I have already pointed out the reality of mind and a simplified way in which it can be modeled to the first order. With scalar wave instruments, the reality of mind and thought can be measured in the laboratory, and parapsychology becomes a working, engineering, scientific discipline.

(22) Multiple-valued basic dimensional functions are either not permitted or severely discouraged in the present theory For one thing, integrals of multiple valued derivative functions have the annoying

habit of "blowing up" and yielding erroneous answers, or none at all. And we certainly do not allow multiple types of time! This leads to the absurdity of the present interpretation of relativity which permits only a single observer (and a single observation) at a time. So if one believes as "absurd" a thing as the fact that more than one person can observe an apple at the same time, the present physics fails. However, the acceptance of such a simple proposition as multiple simultaneous observation leads to a physics so bizarre and incredible that most Western physicists have been unable to tolerate it, much less examine its consequences. In the physics that emerges from multiple simultaneous observation, all possibilities are real and physical. There are an infinite number of worlds, orthogonal to one another, and each world is continually splitting into additional such "worlds" at a stupendous rate. Nonetheless, this physics was worked out by Everett for his doctoral thesis in 1956, and the thesis was published in 1957. (See Hugh Everett, III, The Many-Worlds Interpretation of Quantum Mechanics: A Fundamental Exposition, with papers by J. A. Wheeler, B.S. DeWitt, L. N. Cooper and D. Van Vechten, and N. Graham; eds. Bryce S. Dewitt and Neill Graham, Princeton Series in Physics, Princeton University Press, 1973.) Even though it is bizarre, Everett's physics is entirely consistent with all the present experimental basis of physics. The present electromagnetic theory is constructed for only a single "world" or universe -- or "level." The expanded theory, on the other hand, contains multiply nested levels of virtual state charge -- and these levels are identically the same as orthogonal universes, or "hyperframes." Multiple kinds -- and values -- of time also exist. The new concept differs from Everett's, however, in that the orthogonal universes intercommunicate in the virtual state. That is, an observable in one universe is always a virtual quantity in each of the other universes. Thus one can have multi-level "continuities" and "discontinuities" simultaneously, without logical conflict. It is precisely these levels of charge -- these levels of scalar vacuum -- that lace together the discontinuous quanta generated by the interaction of vector light with mass.

However, to understand the new electromagnetic reality, one requires a new, expanded logic which contains the old Aristotlean logic as a subset. I have already pointed out the new logic in my paper, "A Conditional Criterion for Identity, Leading to a Fourth Law of Logic," 1979, available from the National Technical Information Center, AD-A071032.

Even as logic is extended, quantum mechanics, quantum electrodynamics, and relativity are drastically changed by the Tesla electromagnetics, as I pointed out in my paper, "Solutions to Tesla's Secrets and the Soviet Tesla Weapons," Tesla Book Company, 1580

Magnolia, Millbrae, California, 94030, 1980.

The present electromagnetics is just a special case of a much more fundamental electromagnetics discovered by Nikola Tesla, just as Newtonian physics is a special case of relativistic physics. But in the electromagnetics case, the differences between the old and the new are far more drastic and profound.

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COMMENTS ON THE NEW TESLA ELECTROMAGNETICS

Part II: The Secret of Electrical Free Energy

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Again I wish to express my deep appreciation to two of my friends and colleagues who at this time, I believe, wish to remain anonymous. I thank them both for their exceptional contributions and stimuli, and their forbearance with the many discussions we have held on this and related subjects.

Also, it goes without saying that any errors in this paper are strictly my own, and not the fault of either of my distinguished colleagues.

Present electromagnetic theory is only a special case of the much more fundamental electromagnetism discovered by Nikola Tesla at the turn of the century.

Pure vacuum is pure charge flux, without mass. The vacuum has a very high electrical potential -- something on the order of 200 million volts, with respect to a hypothetical zero charge.

Thus in an ordinary electrical circuit, each point of the "ground" -- which has the same potential as the vacuum -- actually has a non-zero absolute potential. This circuit ground has a value of zero only with respect to something else which has the same absolute electrical potential.

Voltage, which is always associated with a flow of electrical "mass" current (even if only a miniscule flow), is, by definition, a difference dropped in potential when a charge mass moves between two spatially separated points. What we have termed "electrical current" only flows where there is a suitable conducting medium between things which have a difference in absolute potential. Furthermore, between any two points in any material, there is considered to exist a finite resistance -- if we apply a voltage and have a mass current flowing between the two points! The simple statement that V = IR irrevocably ties together voltage drop, mass current, and resistance between two points. Rigorously, to have one of the three is to have them all. To lose one is to lose all three. Immediately we see a major error in present theory: One can have a "difference in scalar potential" between two points without having a "voltage drop" between them. Specifically, if no mass current flows between them, no resistance exists between them, and no voltage drop exists between them.

In the same fashion, one can have a "scalar wave" through the

In the same fashion, one can have a "scalar wave" through the vacuum without a voltage wave. In that case, the wave has no E-field and no H-field. The only reason one has an E-field

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around a statically charged object is because the charged electrons accumulated on the object are actually in violent motion. It is this motion of the charged masses that produces E-field -- as well as H-field whenever that entire E-field ensemble moves through laboratory space.

Now let us reason together in the "approximate" manner utilized in present electromagnetic theory. For example, let us examine a bird sitting on a high tension line.

The bird sits on the high tension line without a flow of mass electricity, because there is no significant difference in potential drop between the bird and the line. Specifically, between the bird's two feet -- each in contact with a different portion of the line -- there exists no potential difference. This is true even though, with respect to the vacuum, each foot is at a potential that would be "100,000 volts higher," were a mass current flowing. And it is true even though the absolute potential of each foot may be some 200.1 million "volts," were a mass current flowing.

Now an interesting thing happens to the bird when he flies through the air to light upon the high tension wire. As he flies toward the wire, he is flying through the massless electrostatic potential field of the wire, for that field extends an infinite distance away from the wire. The electrostatic potential field -- pure Ø-field -- is actually the spatio-temporal intensity of the massless charge at a point. In other words, as the bird flies to the wire, he flies into an increasing "massless charge" potential, building up to 100,000 "volts" higher than the earth. However, very little (if any) "mass flow" potential difference is experienced upon his body in approaching the wire, and so essentially no "charged mass currents" are induced in his body. Thus the little flier safely navigates into the teeth of a very high electrostatic potential, lights upon the wire, and is not "fried" in the process. When he lights on the wire, his body has reached the electrostatic potential that each foot's contact point has. Again, there is no mass current flow. But his body is immersed in an increased flux of massless charge -- which is what the electrostatic potential represents. And each "virtual particle" flow in that charge potential represents a "massless (scalar)" electrical current.

The point is, one can have any amount of massless charge flow -- "scalar" current -- without any mechanical work being done in the system. All electrical work in a circuit is done against the physical mass of the charged masses that flow. Rigorously, force is defined as the time rate of charge of momentum. Even in the relativistic case where $F = ma + v(dm/dt)$, change of momentum requires mass movement. No mechanical work, and hence no energy, is expended by massless charge flow.

That is why the vacuum massless charge -- which is composed of a very high flux of massless "particles" -- normally does no work

That is why the vacuum massless charge -- which is composed of a very high flux of massless "particles" -- normally does no work on our systems, and expends none of its very high "potential energy." It is exactly the same as the bird which flew into an

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increasing scalar field as it approached the high tension wire -- no work was done upon the bird by the increasing scalar flux currents encountered by its body.

By existing "in the vacuum," so to speak, we (the whole earth) are as birds sitting on a high tension line! Until we create significant difference in potential, via our present electromagnetic circuits, no current can flow -- anywhere. Even if we produce potential differences, we must have a conductor and charged masses to flow, if we wish to produce mechanical work. Presently our electromagnetic theory allows us to create a difference in potential within different parts of a circuit, but only by moving and shifting charged mass. We therefore have to do work on this electrical mass in moving it around, and we only get back the work we have put into the circuit. In other words, presently all we do is "pump" electrical mass.

Now notice what would happen to the bird on the line if we substantially "pulsed" the potential on the line. Suppose we "pulsed" it such that the bird's physical system -- considered as a circuit containing a capacitance, a resistance, an inductance, and many free electrons -- became resonant to the pulsing frequency. In that case the "bird system" would resonate, and a great deal of electrical mass would surge back and forth in the body of the bird. In the bird's body, voltage would exist, charged mass current would flow, work would be done, and the bird would be electrocuted.

Also, note that, without mass movement, electromagnetic vector fields are not produced (and a portion of the difficulty lies with the actual vector mathematics itself). Scalar (nonvector) waves continually penetrate "space" where there is no mass movement. This means there can exist a "delta-Φ" without a voltage or an E-field. The present theory does not allow this, because it always uses "q" (charge) to be charged mass. Briefly, without belaboring the point, let us just say that it is the mechanical spin of the individual charged particle -- such as the electron -- which "entangles" or "knits together" or "couples" independent scalar waves into vector waves. A vector wave is simply two coupled scalar waves. The entire force field concept -- such as the E-field and the B-field -- is operationally defined in terms of the force exhibited on a test particle, or test mass. Rigorously, an E-field does not exist as a force field in vacuum, but as two coupled scalar Φ-fields "tumbling about each other." When these two coupled, tumbling fields meet a spinning electron, e.g., the force emerges on the electron mass. In short, movement of a rotating mass changes delta-Φ to "voltage", creating the V/I/R triad.

By "accumulating charged mass particles" -- such as electrons -- one certainly can increase the value of Φ, which represents the charge intensity or "scalar electrostatic potential." However, that is not the only way to increase it. Resonance and rotation of charged masses can also be appropriately employed to vary the vacuum charge potential Φ, under the proper circumstances.

or charged masses can also be appropriately employed to vary the vacuum charge potential Φ, under the proper circumstances.

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By the correct application of rotary principles and Tesla electromagnetic theory, it is possible to oscillate -- and change -- the vacuum potential itself, in one part of an electrical system. Thus by correct procedures a part of a system can be electrically altered so that the absolute value of its "ground" (vacuum) potential differs significantly from the normal vacuum-ground potential of the remainder of the circuit. In other words, we shift the vacuum-ground potential of part of the circuit by oscillating the massless vacuum charge itself, and in so doing we gain a substantial, oscillatory electrical potential difference between that part of the circuit and the normal ground potential of the rest of the system. Then we connect the two parts of the system by means of a conductor containing a load in the middle.

In every conductor, a large number of "free electrons" are available. If we oscillate the actual vacuum charge itself, unlimited additional free electrons also become available from the Dirac sea, since partial "unstripping" of the negative energy wells (each containing an electron) occurs. This "unstripping" of the potential of the well is due to vacuum potential oscillation, which oscillates time as well as space. To a negative energy well (positive time), the oscillation of its "time stream" increases the well's negative potential during one half-cycle and decreases its potential for the other half-cycle. Thus during half the oscillatory cycle, negative energy electrons may be lifted from the Dirac sea if the oscillation is sufficiently intense.

Therefore we obtain an attendant voltage and flow of mass current through the load. This voltage and current, by the way, are essentially limitless, and are free for the asking, assuming the proper "vacuum oscillation" is initiated and maintained so that electrons are continually being lifted from the Dirac sea by the time oscillations, and fed into the circuit.

Standard electromagnetic theory assumes that the vacuum potential is zero. It does not recognize the existence of massless charge, separated from charged mass. Therefore, orthodox scientists have never looked for a way to engineer the vacuum, because they have not realized it is composed of pure massless charge. Electrical physics has almost hopelessly confused charge and charged mass, thereby eliminating scalar longitudinal electrostatic waves. Expressed in the bird/high tension line analogy, the present electromagnetic theory restricts us to walking along the high tension line, laboriously carrying small batteries and power units, unaware of the limitless, surging power beneath our very feet.

Electromagnetically, we have been rather like one of the five blind men who touched an elephant. We have only touched one small portion of the electromagnetism "elephant," yet we thought we had grasped the entire beast.

OVERTURE TO A NEW AGE TECHNOLOGY

From an Update by Dr. Rolf Schaffranke

> " ... as there has been a steady erosion in U. S. activity in the basic sciences, there has been an increase in the level of such activity in Western Europe and Japan. If that continues, we are in danger of losing our position of scientific leadership."
>
> Val. L. Fitch, Prof. of Physics at Princeton University, in an interview with *U.S. News & World Report*, June 21, 1982.

West Germany:

The prototype of the first motorcycle equipped with a "flux-motor" (the inventor's designation for a tachion field converter or gravity-field generator) of 2 KW output has completed a test run of approximately 20,000 km without repairs. Principle of operation: The T-converter is constantly recharging the electrical power battery of the vehicle, resulting in an operation which is noiseless, fuelless and polution-free. After completion of all scheduled tests, a public demonstration to the press is planned within a few weeks from the time of this writing. (June 17, 1982) See photo, Pg. 19. A new factory for the production of gravity-energy-field converters in the town of Oldenburg is scheduled to produce individual home heating units. The design of automobile power plants based on the same principle is also in preparation. Reported efficiency factors of several hundred percent are anticipated.

Japan:

Mazda continues research on the "magnetic Wankel engine" (45 HP) for electric automobiles, based on the principle of Kure Tekko. The gravity research of Prof. S. Seike is now sponsored by Hitachi, after millions of Japanese received updated information via popular science magazines. It is interesting to note that Saudi Arabia has decided to invest $100 million in Hitachi stocks.

France:

The "Kromrey" converter has completed tests at the Institute for Magnetostatics, University of Strasbourg. One prototype delivered 700 Watts at 600-1200 RPM, at a fairly uniform rate. However, France, as the No. 1 developer of nuclear energy in Europe, is still reluctant to concentrate her energies on a revolutionary new technology which could result in drastic curtailments of her well-developed nuclear industry and associated exports. See photos, Pg. 22.

Denmark:

Dr. Jensen, physicist at the University of Kopenhagen, reported test results of 300% efficiency with a specially designed, 5-coil transformer in connection

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with a tachion field converter based on the principle of the "N" machine. First reports were presented at the International Conference on Energy Technology in Hannover, Nov., 1980.

England / USA:

A "bullet train" based on the magnetic levitation system of British Prof. Eric Laithwaite is now under consideration for construction between Los Angeles and San Diego. Japan and West Germany are already operating high speed experimental trains, suspended magnetically to reduce friction, that may soon attain speeds of more than 200 miles per hour. The Laithwaite-Eastham method would use electromagnetic forcefields induced over an aluminum-topped concrete track. The project will probably be headed by a Japanese company as the prime contractor.

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West German gravity-field unit in operation

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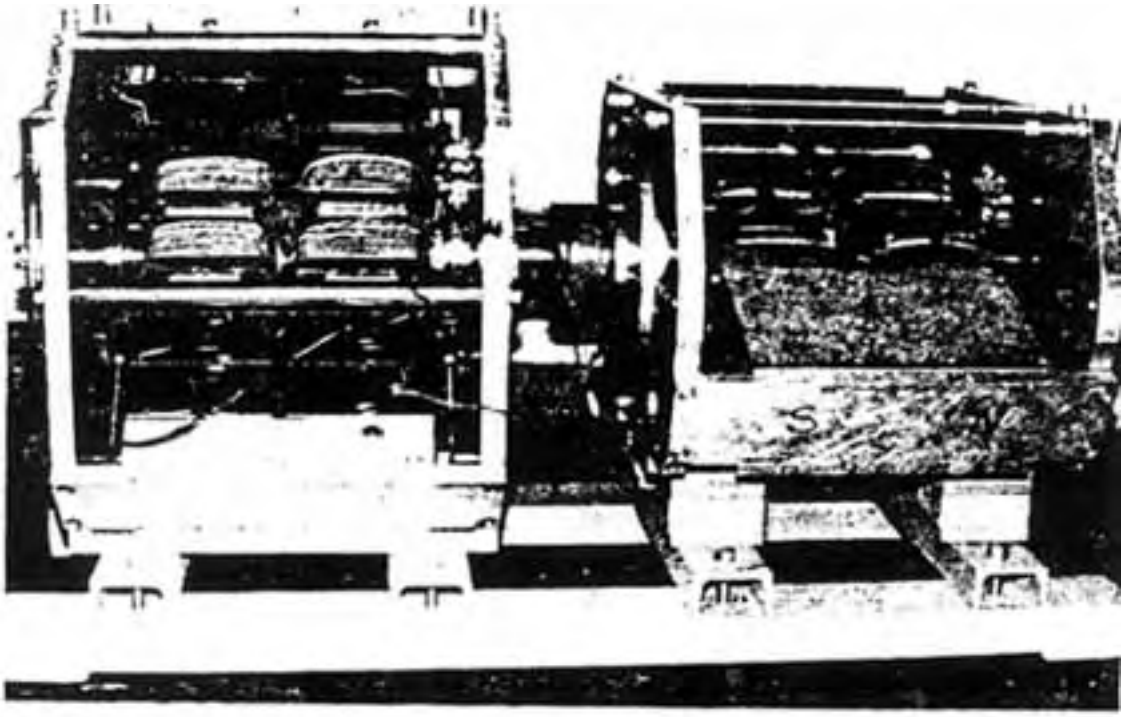

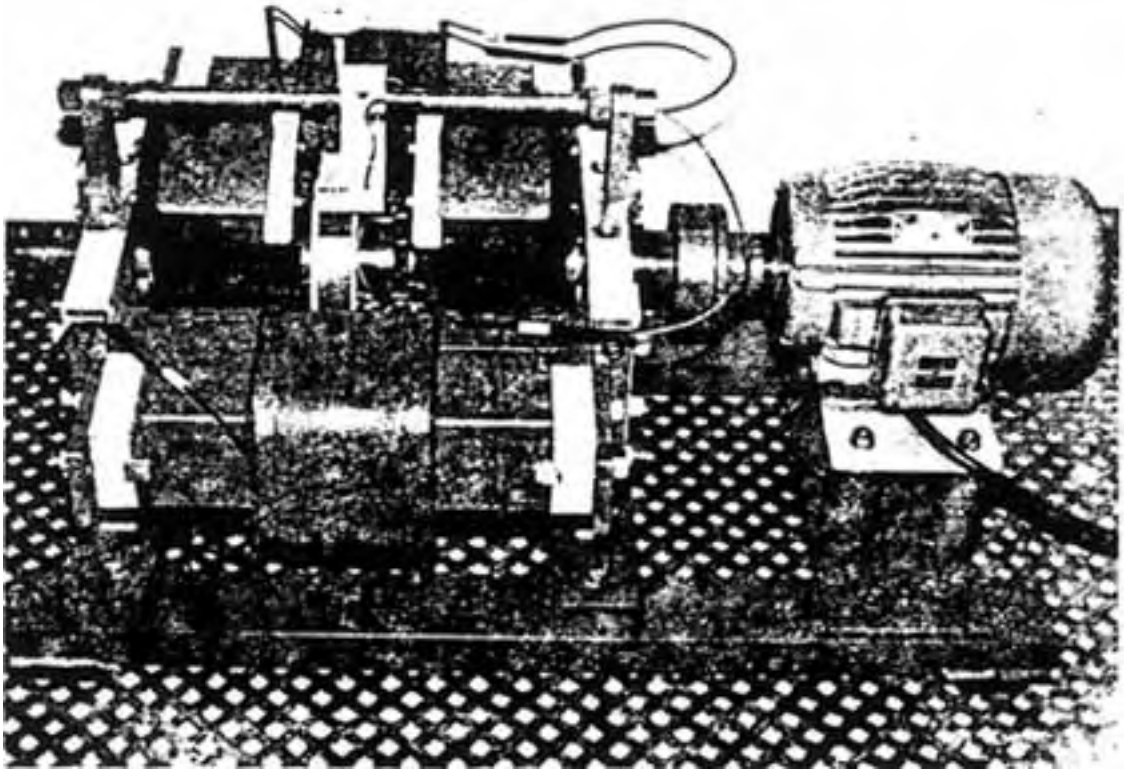

Swiss-French gravity field converter system "Kromrey"

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REVIEW AND OUTLOOK

THE DEVELOPMENT OF POST-RELATIVISTIC CONCEPTS IN PHYSICS AND ADVANCED TECHNOLOGY ABROAD

Rolf Schaffranke, Dr. h. c.
Member A.I.A.A.

This paper was presented at The First International Symposium on Non-Conventional Energy Technology, Toronto, Ontario, Canada, Oct. 23-24, 1981. (Reprinted by permission of the author.)

"Far more harm is done to the progress of science by skepticism than by gullibility". (Dr. Robert Wood, Director R & D, McDonnel-Douglas Astronautics Div., Cal.) NASA - Langley Research Center in Hampton, VA is named after Samuel Pierpont Langley (1834-1906), an American astronomer, engineer and architect.

Langley worked out the aerodynamic principles for manned flight. In principal, his calculations were correct; but the structural materials he used for wings and engines were ,insufficient. In December of 1903, the *New York Times* published an editorial complaining about his foolish dream and the associated waste of government money. The editorial predicted that: "man would not fly for a thousand years".

Only 9 days after the editorial was published, the Wright brothers made their first successful powered flight at Kitty Hawk. (Dec. 17, 1903). But, again, as late as 1905, the *Scientific American* suggested the happening was a hoax - two years after the event which changed history. Let's reflect for a moment on the fact that only in a single lifetime, man has journeyed from Kitty Hawk to the surface of the moon!

The analogy to the problem of alternative energies and their development is, of course, obvious. We try to educate the preaching orthodoxies. But orthodox solutions are no longer enough. Our system of education can only give from

the past. The present must operate on inspiration and intuition, or the future will be lost. The past no longer has enough of the answers for arising crises for which there are no precedents. To keep pace with the requirements of the future, we must begin to teach not only what to learn, but how to learn, how to analyze, how to search for the truth. Only then will be able to recognize discrepancies between experiment and dogma and to cope with problems which appear to be just beyond the corner. History has shown again and again that no single individual can rise above the species without being persecuted. The reasons for that are:

Some of the most powerful forces in homo sapiens have always been

Greed, Pride, Ego, Fear and, above all, the Desire to Control Others,

.

A brand new German book titled *Energy in Abundance*, which is evidently creating a considerable impact in the European community, challenges the contemporary high

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priests of science, the "Guardians of the Status Quo" and uncovers an almost incredible narrowmindedness and ignorance in science, politics and economics, "approaching the criminal" as the author puts it. The contemporary waste of genuine intellectual creativity is castigated as a cultural scandal approaching barbarism. The book stresses that a truly promising approach to the so-called energy crisis requires a fundamental and thorough re-evaluation of the theories, dogmas and axioms which form the basis of present day science and the foundation of our technology. As in the past, the formidable inertia of the establishment is not only based on inaccurate, incomplete and outdated information, but also on its reluctance to accept new ideas. The honest search for the truth first requires that we first demythologize generally accepted claims of so-called experts of the past. An excellent introduction to this problem is the article "Resistance by Scientists to Scientific Discovery" by Bernard Barber in *Science*, Vol. 134, pp. 596-602, of Sept. 1961, or the paper by Stephen C. Brush in *Science* of March, 1974, titled "Should the History of Science be Rated 'X'"?, culminating with a statement of Huxley:

> "Authorities", "disciples", and "schools" are the curse of science and do more to interfere with the work of the scientific spirit than all its enemies".

The former astronaut, Capt. Edgar D. Mitchell, one of our famous contemporaries, also stressed the need for an open mind!

> "History has shown time and again that important scientific discoveries generally happen only when someone steps outside the limits of his traditional discipline and looks at something from a fresh point of view. Then what should have been obvious all along comes into focus".

Those of us who are familiar with the pioneering efforts of Dr. Hans Nieper of Hanover will appreciate this statement by an ex-astronaut.

One of the most important cornerstones of today's scientific dogmas dates back to 1905, more than 3/4 of a century ago. Lest we forget, television and radar, jet-planes and cyclotrons, moonrockets and close-up photos of the planets of our solar system were nothing but wild fantasies of science fiction then.

The speed of light was assumed to be constant and the maximum possible speed in the universe; vacuum was to be a total void. In reality, the speed of light as measured in the Michelson-Morley experiments was not at all the same in all directions. The "ether-drift" still amounted to the respectable velocity of about five miles per second, and similar results were obtained by D. C. Miller in a series of experiments extending over twenty-five years, from 1902 to 1926.

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"Even worse, the measurements showed such marked discrepancies with previous results as to occasion a distress call to the U. S. Coast & Geodetic Survey, whose surveyors repeatedly remeasured the length of the tube and found no error there," reported the *Popular Science Monthly* March 1934 issue. And it continued: "More recently, speed of light observations only emphasized the apparent erratic behavior of the light beam that the scientists were attempting to plot. On some days it seems to travel faster than others by as much as 12 miles a second. Its speed seems to vary with the season, and also in a mysterious shorter cycle lasting about 2 weeks. Finally, the scientists ended by taking an average of all the readings which has just been announced as 186,271 miles per second".

In his paper "A Critical Look At the Theory of Relativity", Library of Congress Cat. No. 77-670044, F. K. Preikschat compiled all known light velocity measurements during the past 300 years or so, from Olaf Roemer in 1676 to the Laser measurements conducted by the National Bureau of Standards (USA) in 1972.

Of the 27 experiments undertaken in this field, 18 of them after the turn of this century, it must be concluded that the velocity of light as measured within the reference system of our earth has changed as much as plus/minus 50 km/sec, during the past century. Preikschat plotted a curve of these deviations and suggests a possible relationship between sunspot activities and changes of the earth magnetic field during the time period in question.

The "universal constancy of light" appears, therefore, as somewhat shaky "empirical evidence" for our cornerstone in physics, especially since Einstein himself has gone on record as saying:

"If a single one of the conclusions drawn from it (relativity theory) proves to be wrong, it must be given up; to modify it without destroying the whole structure seems to be impossible".

Another modification concerns the definition for the term "vacuum" in physics, as documented by a paper in the *American Scientist*, March-April 1980, titled "Is The Vacuum Really Empty?" by Prof. Walter Greiner, University of Frankfurt, BRD, and Prof. Joseph H. Hamilton, Vanderbilt University, Nashville, Tenn.

The authors conclude that a neutral vacuum is by no means as "empty" as previously claimed in our textbooks, and suggests a new definition as follows:

"The vacuum is the lowest stable state that a region of space can have while being penetrated by certain fields".

Because of the tremendous time lag in our educational system, many research

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projects and their ensuing experimental data have been withheld from public scrutiny. The scientific community tends to have a vested interest in preserving the system it created and of which it is a part. It responds to new situations through the coloration of this attachment. A case in point are the carefully conducted experiments of T. T. Brown with charged bodies in a high vacuum, as described in my booklet *Ether Technology* (1977). These experiments suggest the actual presence of certain fields in vacuum, whether we call them gravitational field, tachion-field, ether-field, neutrino or Fermi-sea, etc. is of secondary importance at this moment. Although Brown spent, reportedly, more than $200,000 of his own funds over several decades on such experiments, he was nevertheless unable to have the results published in the scientific media of America.

Things are even worse when it comes to experiments conducted abroad, which often tend to confirm disregarded experimental results on this continent, as we shall see shortly. To highlight the wide discrepancies between orthodox (and obsolete) dogmas and actual, physical realities pertaining to the true subatomic structures as we know them to be today, let us briefly review the structure of the matter:

A molecule is the smallest division of a substance. Further division would cause it to cease being a substance. The smallest of true molecules can be illustrated when we use the globe of the earth for our standard. If a single drop of water were magnified until it was as big as the earth, each molecule would be about the size of a TENNIS BALL.

On the next step down, an atom is the unit which makes up the nature of the molecule, consisting of the nucleus and the surrounding electrons to render the atom "stable". An atom of hydrogen contains one proton and one electron to balance or neutralize the proton. Matter then is divisible into electrons and protons. But - and here comes the rub: Between electrons and protons are spaces so vast, in comparison with the masses of each, that, if the proton in the carbon atom were the size of a golf ball hanging from the ceiling of the great hall at Pennsylvania Station in New York, its electrons would be represented by six small wasps winging in a little knot against the four walls of the gigantic structure of the building! In effect, one could claim there is little final solidity of substance to anything: The universe consists of "emptiness", charged with electrical energy! If we translate the above to the measurements and terminology of the physicist and "magnify" the atom mathematically, with all its distances and dimensions kept in proportion so that the orbit of the electron would have a diameter equal to that of the earth about the sun, approximately 184 million miles, the diameter of the electron itself would only be 2,000 miles, and the diameter of the nucleus, where

electron itself would only be 2,000 miles, and the diameter of the nucleus, where

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mass and weight of the atom are truly concentrated, can be taken as 2 miles only. We thus obtain a picture of a central mass with a diameter of 2 miles (nucleus), another object with a diameter of 2,000 miles (the electron, in the case of the hydrogen atom) at a distance of 92 million miles away from it, orbiting the nucleus. Evidently, there is plenty of room inside this system. And "room" is not a vacuum, it is not nothingness, but space itself, spatial energy, a field which can be identified with the ether of the past - and of the future. Nobel prize winner, Max Planck, during a lecture in Florence, Italy, once made a truly remarkable statement which describes the problem facing the physicist today:

> "As a man who has devoted his whole life to the most clear-headed science, to the study of matter, I can tell you as the result of my research about the atoms this much:
>
> 'THERE IS NO MATTER AS SUCH!'
>
> All matter originates and exists only by virtue of a force which brings the particles of an atom to vibration and holds this most minute solar system of the atom together. ... We must assume behind this force the existence of a conscious and intelligent MIND. This mind is the matrix of all matter".

This cosmic matrix is needed if we want to explain "action at a distance", lines of force, stresses, a magnetic field and so on. When the concept of the ether was abandoned, it had to be replaced by the concept of "space" instead. In reality, we merely switched terminology. We used to say that "ether fills all Space". But "filling" is not exactly the descriptive word to use. Perhaps we should rather define it: "Ether is a condition of space in which electrical manifestations for the atomic construction of materials is possible". This primordial energy is "free" or in an uncondensed state. It exists in interstellar space but remains unrecognizable until it begins to coagulate or gets into a vortex pattern. It constitutes the formative field force of nature, an immense reservoir of latent energy.

The claim of our textbooks that the Michelson-Morley experiment "disproved" the existence of the ether is incorrect. It merely disproved the existence of a noticeable ether drift or drag. As an analogy, if somebody would postulate that the absence of wind disproves the existence of the atmosphere around our planet, the fallacy of this postulate would be immediately apparent to all.

"Michelson and Morley centered their attention on the Earth's orbital velocity (30 km per second). They had no knowledge of the existence of galaxies; of motions of galaxies in relation to each other; of the motion of our solar system in our galaxy..... Their negative results are explainable on the basis of pre-1900 classical mechanics, so provide no proof of the absence of ether or Louis de Broglie's

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'subquantic medium'. Thus, the limited information available to Michelson and Einstein is emphasized by recent findings, particularly in astrophysics", writes Dr. H. C. Dudley in the *Bulletin of the Atomic Scientists*, January, 1975, under the title "Michelson's Hunch Was Right". And Dr. Dudley continues: "In fact, 1929 saw Michelson still attempting to experimentally demonstrate the ether, which his intuition and reasoning told him ought to be present".

"Today most persons are largely unaware that the ether concept began to be seriously reexamined by two of physics most notable theoreticians, Paul Dirac in 1951 and de Broglie in 1959, both Nobel laureates. The ether is now being called the "neutrino sea" by astrophysicists, and has been characterized as an energy-rich particulate, subquantic medium. A rather voluminous literature on the subject is accumulating as indicated by a recent review, *The Cosmic Neutrino*, with 665 references covering only the period 1965-1972.....It appears that an open-minded reexamination of this area of physics is long overdue in order to open up new avenues of approach to this pressing problem".

Michelson, Dirac, de Broglie were not the only Nobel prize winners in favor of a reexamination of the ether question. Others were Stark, Arrhenius, A. H. Compton, Lenard, H. Yukawa, and Frederick Soddy, the British scientist who, during the convention of Nobel laureates in Lindau, 1954, described the current dogmas in physics as "an orgy of amateur physics" and "arrogant swindle" - with particular emphasis on the theory of relativity. ("The Wider Aspects of the Discovery of Atomic Disintegration", New World Publications, St. Stephens House, Westminster S.W.I.)

It remained largely unknown, even among physicists, that Einstein himself had serious doubts. In 1949, he wrote to his old friend, Maurice Solovine, who congratulated him on his 70th birthday:

> "Now you think that I am looking back at my life's work with calm satisfaction. But, on closer look, it is quite different. There is not a single concept of which I am convinced that it will stand firm and I am not sure if I was on the right track after all".

And one of my Canadian friends who I believe is present here today stated quite correctly in a letter to me:

> "The myths around Einstein are really not of his making as he himself often questioned his own conclusions and I felt he was quite aware of his own limitations which others were covering up. The physicists protect their members much the same way that the medical profession protects its own."

The purpose of these remarks is not to spark another controversy about the merits of the theories of relativity. Rather, they want to show that so-called

merits of the theories of relativity. Rather, they want to show that so-called

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"scientific evidence" is a rather elastic term and that "verification" is always a relative affair. Or, as K. R. Popper so aptly put it:

> "Only in our subjective experience of conviction, in our subjective faith, can we be 'absolutely certain'".

This symposium presents an excellent overview of research and experiments reported from English speaking countries, or experiments published in the English language, as for instance from Japan. However, as Dr. Tenhaeff from Holland has formulated the problem,

> "It is important to pay attention to publications of colleagues in other countries. In the Netherlands and Germany, every academically educated man or woman knows at least three foreign languages. English and American authors only pay attention to material in English. In my opinion, this leads to an 'impoverishment' which puts a drag in science. Some seem very chauvinistic and seem to believe that only the researches done in their country are important. I regret this. Science is international, and international cooperation is of the greatest importance in science".

In presenting some brief reports from abroad, I shall attempt to bring corroborative evidence in support of alternative technology developments discussed during our meeting here in Toronto. Let me start with the most sensitive and secretive society, with Russia.

In his German original of the paper "Some Remarks on the Shielding Theory of Gravity", which was published in the Hanover Proceedings in more detail than the English abstract, Dr. Hans Nieper mentioned the Berlin engineer Levetzow, who was one of the first to postulate a combination pressure and shielding theory for the phenomena of gravity. Levetzow was soon overshadowed by the rising star of Albert Einstein, but one of his followers, Horst Pinkell, went to Russia in 1928 as an exchange student - and never returned. Together with Russian scientists, he was asked to prove the actual existence of the cosmic radiations postulated by Levetzow, now designated as neutrino sea or "tachion field". The work was done in Sterlitamak, South of the Ural mountains, and in 1938, sporadic reports reached the West about the discovery of extremely short corpuscular waves by Pinkell and Gorjew. These were the long sought "Hemmstrahlen" or drag waves associated with gravity. Rumors have it that a metal alloy was soon developed which acted as a drag wave polarisor and, in 1947, agents reported experimental Russian aircraft using this discovery. In 1951, a former German Junkers aircraft engineer reported about his activity pertaining to a super-secret project code named COW-7 in Siberia, a disk-shaped craft which could rise vertically and which belonged to the

Siberia, a disk-shaped craft which could rise vertically and which belonged to the

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secret weapons then developed by the Soviets. Whether it was related to the Canadian AVRO project or something entirely different remained unknown, only the Levetzow gravity theory was assumed in connection with the activity in question.

Japan: My esteemed friend, Prof. Seike, who kept me informed about the research conducted by him and his co-workers, surprised me once with a significant statement, which I feel is important to repeat for the benefit of frustrated researchers on this side of the Pacific: "In the early stage of my studies, physicists could not understand what I was doing, while actors and actresses did so by intuition". It was the private support of about 800 individual artists, etc., in Japan which allowed Seike to work, experiment and publish his findings, and not the support of the Japanese equivalent of a National Science Foundation or a similar bureaucratic institution in that country. Again and again, I was surprised how quickly and eagerly American experiments, as for instance the almost forgotten "Ionocraft" of the late Major de Seversky, were duplicated and explored even in Japanese secondary schools. Admiral Rickover has more than once complained about our intellectual complacency: "As a nation, we seem addicted to 'spectatoritis'. We sit in the bleachers and let the game of life unfold before us".

The results are known: The Japanese have achieved top position in science and technology, and not only with tachion beams melting stones, producing "biased" water with a freezing point of minus 4 degrees Celsius, and a G-power generator obtaining 400 V DC output from a 10 V input driving source. I wish to take this opportunity to thank Prof. Seike for sharing his work with us in this country, and wish him the best of success for the future.

France: The work of SEPED was explained by M. René Louis Valée and some French publications in the area of gravity-research have been translated by the NASA translation service, as for instance the theory of the electromagnetic Magnus-Effect (of Marcel Pagés).

Specific mention must be made of the Raymond Kromrey G-field generator, a French-German-Swiss development which appears very closely related to the American "N" machine principle, the "Sunburst" machine and the "Permanent Magnet-Motor" Patent of Howard Johnson. Utilizing either permanent or electromagnetic modules, the generator output exceeds the input by far. One prototype delivers approximately 700 watts at speeds varying between 600 and 1200 RPM. Models with an output of 100 to 160 kw are presently in the planning stage. Several European patents have been granted against heavy opposition, especially from French industrial circles. The development was about 40 years in the making and the inventor stresses the need for a reinvestigation of electromagnetic and gravitic forces, as well as a reexamination of many cemented dogmas in present-day physics.

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Germany: A system of rotating electromagnets and magnetic "stator rings" of the German "Kunel" Generator complement the general trend of the American and French generators mentioned before. The first prototype was reported to have been tested in April, 1980. Here, again, very heavy opposition from the German orthodox science establishment. Of special interest is a comment by Nobel laureate Werner Heisenberg, reported to have been made vis-a-vis the inventor:

> "I think it is possible to utilize magnetism as an energy-source. But we science idiots cannot do that; this has to come from the outside".

More details about French and German developments have been published in the new book already mentioned, *Energy in Abundance* by Hilscher and, hopefully, an English version of this important work will be available by next year. Generators which do interact with surrounding energy fields have been designated as "open systems", in contrast to our present "closed system" technology of gasoline and diesel engines, steam turbines, nuclear power plants and so forth. The theoretical basis for all "open systems" is the realization that there simply is no such thing as "empty space". In reality, space is filled with an extremely energy rich, subatomic and subquantic continuum. In short, a "pre-physical state of matter", which can be tapped, as for instance by the spinning of magnetic systems which extract momentum via a vortex-formation of the universal "tachion field".

Austria: This small heartland of Central Europe is proud of her native pioneers in science, among them Dr. Wilhelm Reich, Viktor Schauberger and Karl Schappeller. But after Dr. Reich died in an American prison in 1957 and Victor Schauberger died only five days after his return from the USA (in 1958), where he received an incredibly unfair treatment from certain industrialists, there is little enthusiasm among Austrians to touch base with correspondents on this continent. Viktor Schauberger's son, Walter, refuses, as a matter of principle, to communicate with Americans, no matter in what language. To illustrate the type of "contract" Viktor Schauberger was forced to sign, it stated:

> that all of his patents would become the property of the "consortium",
> that any future inventions or developments would also become the property of the "consortium",
> that he would refrain from discussing any of it with third parties,
> that he would refrain from publishing,
> that all plans and models would remain with the "consortium" after his departure from America.

There is a favorite saying in that small country which is much to the point:

> "After the Greek philosopher Pythagoras had discovered his famous

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> theorem, he sacrificed a whole hecatomb of oxen as a thanksgiving to the Gods. Ever since, all the oxen in the world are running scared whenever a new truth has been discovered".

Knowledge of the ideas of Schauberger and Schappeller appears to be essential for an understanding of our changing picture of the physical world. As an example, the former forest ranger Viktor Schauberger had watched numerous times some trout standing, apparently motionless, in the strong currents of Alpine mountain streams. This and many similar observations of nature brought him to the gradual development of his "implosion-theory" and associated hardware (see Jensen paper elsewhere). His son is continuing the work in the "Pythagoras-Kepler" School in Bad Ischl. Another prolific researcher is the Viennese engineer Franz Seidl, known for his studies of the use of magnetic field effects as "trigger energy" for voltage and power multipliers.

Holland: A small country with strongly developed intellectual independence appears to be Holland, where Prof. J.M.J. Kooy developed his "Space Dynamics". His hypothesis of gravitational action is based on the realization that all celestial bodies can be conceived as practically transparent in relation to the size of the elementary particles and their mutual distances in the structure of matter. Gravitons or tachions, coming from all directions of deep space, can pass through a celestial body like water passes through a fishnet, and only a minute fraction of the cosmic gravitons or tachions will be intercepted. Study of the effects of the tachion field or space continuum of the fabric of material substances, magnets and crystal lattices can lead to development of converters and novel production facilities for readily usable, conventional E/M energy. When the American inventor Edwin V. Gray was blocked in his efforts to develop his "Pulsed Capacitor Discharge Electric Engine" for which he had received U. S. Patent #3,890,548, he found open ears and open minds in Holland.

The fact that Gray was named "Inventor of the Year" from the Department of Patent Rights in Los Angeles, California, where Dr. Chalfin of Cal Tech confirmed that:

> There does not exist an even distantly similar engine to this one in the world. Conventional electric engines use up power. In this system energy is used up for only a minute part of a millisecond. It operates without heat loss and there is no energy loss whatsoever with this system",

had more meaning to the people of PHILIPS and others in Holland than to the energy establishment in his native America.

England: There is perhaps no more controversial inventor at this time than

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John R. R. Searl and his Levity Disc, powered by the Searl Effect generator. It is claimed that model craft have been demonstrated with flight characteristics showing anti-gravitational and inertia-free properties. Demonstrations have been photographed and videotaped. Searl calls his generator a "Gyro-Flywheel High Energy Density Mechanical Magnetic Device" and claims that the magnets used are not the common type, ordinary magnets. The Australian engineer Athol Park of Melbourne, Australia, who visited Searl a few years ago described it this way:

> "From a briefcase, Mr. Searl takes a bar magnet and two steel rollers. He places the rollers at either end of the magnet. They appear to be attracted to the poles - but, when they are pushed gently around the corners of the magnet, they chase each other round and round.... "

The engineer quotes Searl:

> "The crystals in the magnet are changed by putting it in a magnetic flux oven and by frequency control. The result is motion of a magnetic field - a completely new source of power. Units (modules) based on this principle are what power my levity unit - the motor and generator built as one, fuelless unit".

In one of his numerous newsletters he states further:

> "The power plant is a self-contained, onboard closed system of conversion elements with energy input from a latent storage source".

Because Searl has never divulged all details and his explanations are generally of a non-technical, "unscientific" nature, many investigators have chosen to dismiss him as a swindler and imposter. In sharp contrast to this is the opinion of a well-experienced American engineer who reported after a visit with Searl:

> "I found it refreshing to note the keen sense of moral responsibility which he feels for the use to which his discovery is put... The Searls live in modest circumstances. Luxuries are few. They do not own a car. Mr. Searl bicycles several miles daily to his place of work in Maidenhead. There he is an electrical technician and training supervisor in a bearing factory".

But perhaps most significant was the following observation of the American visitor about Searl:

> "We were also interested to hear him say that many of his ideas came to him while he slept. He would go to sleep with questions, and awake with answers... and refreshed. He seemed to have the

and awake with answers... and refreshed. He seemed to have the

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ability to restore vital powers more quickly than most people".

And the American concluded his report with the statement:

"The impression we gained of Mr. Searl was one of a very sincere and generous person, a dedicated and tireless worker with perfect confidence in the outcome of his efforts, a man of high principle with a keen sense of loyalty to those who are helping him, and of responsibility for the future welfare of our planet and its people".

In view of the very contradictory nature of comments and impressions by those who have met Searl, it might be wise to reserve final judgment on the Searl-Levity-Disc and its inventor at this time.

New Zealand: Some of Searl's keenest supporters and observers of his work are in New Zealand and Australia. And one of the sharpest young physicists in that country (new Zealand), unhampered by calcified ideology, developed the mathematical foundation for a theoretical anti-gravity effect, using the hydrodynamic analogy of the ether. He uses the equivalent of the hydrodynamic Reynolds number, above a certain value of which the laminar flow past a solid surface breaks down and becomes turbulent due to shear rupture of the viscous cohesion of a fluid, together with his deduction that anti-gravity could be obtained by creating a "vacuum: in the ether in such a way as to correspond to the production of turbulence in a magnetic field. Turbulence in a fluid occurs when Reynolds number RE = 1, when the inertial shearing force equals the viscous cohesion force in the fluid in the vicinity of an approximately spherical body immersed in the fluid, resulting in separation of the boundary layer and formation of a wake, i. e. vacuum or free surface around the body. He calculated the threshhold for turbulence in the ether, = a vacuum = an anti-gravity effect, using the refined value of ether kinematic viscosity which he obtained.

His theory would confirm the observations of very high voltage produced in the case of the Searl Levity Disc, and the very high voltage needed in the vacuum experiments with flying disc-shaped bodies of T. T. Brown, the "ionocraft" observations of Major de Seversky, the "Electro-Field Rockets of Prof. Dudley, the observations of Northrop Corp. with "Electro-Aerodynamics in Supersonic Flow" and similar American documentation and patents.

Since the New Zealander is now in the process of attempting to publish his theory in a reputable British magazine, I am not at liberty to divulge his address prematurely. Interest in New Zealand and Australia is running high, and possible breakthroughs in energy technology should not come totally unexpected in these two countries with strong intellectual ties to England.

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Conclusion

There is now overwhelming evidence for the actual existence of a very high density, energy rich space continuum formerly called "ether". This space energy can be concentrated, gathered, focused, magnified and compacted by magnets or magnetic materials, which appear as the new core materials for converters of all kinds, utilizing the cosmic energy for new technology applications.

Crystals are energy-sensing and channeling devices; they can serve as transducers, as for instance in the Moray-Device, or the "rock electricity" of T. T. Brown.

Combinations of crystals and magnetic materials appear to be the mainstay for the development of "hyper-space" - converters and generators of power - utilizing free, cosmic energy in our future.

Unbiased, totally honest and impartial reexamination and reevaluation of all scientific theorems and dogmas, as well as unhampered opportunities for the pioneers of the new technology on the American and European continent appear to be the prerequisite of success.

Those who accept that anything of the nature of ideas or ideology is permanent, use all their strength to hold on to it, and to condemn all who do not agree. The next stage of this spiritual illness of the mind is to build a monument to what they perceive is Truth, and then to build a monument to their own permanence in the world. This, they do by seeking fame or fortune, and authority over others. This is the contemporary, planetary psychology situation, and thus are we losing the gift of perspective and horizon and are no longer able to discern what is important. Skeptics are on record as saying:

> "We are not running out of natural resources or intellectual talent, we are running out of the freedom of innovation that made the countries on the North American continent the most advanced nations on earth".

The future will show whether this freedom, which includes the freedom and the duty of taking risks, can be restored to the degree our Founding Fathers have been striving for. Only then will we know whether the late Wernher von Braun was not too overly optimistic when he stated:

> "The cosmic age will bring a dawn of knowledge not yet envisioned. It will dwarf all our present knowledge and ideas and, through its vastness, may even bring men closer together on their own planet".

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The Unveiling of the Hidden Knowledge and the Secret Space Program

The Unacknowledged Special Access Programs: Advanced Technology, Mind-Control, Spiritual Power and the Corruption behind Closed Doors

By Aug Tellez

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Introduction

The following is first-hand testimony from an operative of the secret underground military projects who also has familiarity with the breakaway civilization above and below (within) Earth. These civilizations utilize advanced technology to extend the length of their lives and enhance cognition beyond what is conceived of in today's society.

I was brought to the underground bases as a child as part of an experimentation program to test the population for various blood-groups and personality traits that would be of use to certain factions of the military in ways that would serve to preserve and strengthen humanity's outlook in the future.

These tests involved everything from combat training to sensory deprivation based emotional-mental endurance, and introduction to the highly advanced application of esoteric knowledge.

To clarify, I am bringing this information to you as part of my assistance in the overall unveiling of the hidden knowledge of the ages of humanity related to these secret projects as well as the true galactic history of Earth, humanity and man-kind. These projects are officially (unofficially) known as "unacknowledged special access programs". The unacknowledged aspect means that there is no formal acknowledgement of these programs without a need-to-know basis. There is no paper-trail, no disclaimer, no formal authorization or internal publication outside the programs themselves. The classification of these programs also generate a rather strenuous situation regarding funding and secrecy but this is done for the benefit of humanity. There are secrets and manipulations that can be seen as a threat but this is all tied together and so by releasing the secrets that are part of the defense we would be inadvertently exposing the public to the threats themselves. Now is the time where we are reaching a point where the public is ready enough to handle the basics of this information regarding the secret projects and the galactic history of Earth and humanity. This is also out of a necessity to preserve civilization for if we wait any longer we may not find the same opportunity again.

Getting This Out Of The Way

I am writing to you from the perspective that I am not certain just how far from completing my mission I am. I write to you today in order to bring to you many personal experiences from the viewpoint of an operative of a select ultra-military secret society.

The utilization of such an operative is not glorified, pleasant, or entirely righteous. This story entails sanctioned and guided acts of extermination, ritual abuse, the use of yet to be announced advanced technology. There is unfathomable corruption, the thirst for power and spiritual knowledge that has been protected throughout the course of the multiple civilizations that have preceded this one and will continue to be maintained into the future of this civilization.

Psychic Operation

I was utilized in psychic-operation amongst other areas.

This was used during certain aspects of training and conditioning to enhance training and conditioning in the bases using advanced technology. Some of this includes what would be viewed as traumatization by those without the training and conditioning. There is a fine line between training and conditioning and abuse. Part of this disclosure is related to how this line may have been crossed in certain situations and regarding mass-mind control upon the population. There are other aspects of travel, viewing, reconnaissance and research that will likely be explained in another release.

In order to heal I have to tell the world. You can help. This is happening right now in the underground bases and around. It’s not a joke. Your family is at risk. Your future generations are at stake. There is conditioning to encourage those involved to believe they are performing a duty for humanity. Sometimes they turned us against each other, but those grudges were never truly of the heart, but the mind.

A Light for the Others

What I hope to achieve with this is a smoke signal for those who have also been involved and question whether their purpose has been fulfilled or falsified for the protection of a corrupt system that intends to neither benefit the whole nor repay the individuals involved for their time, energy, and lives.

Multiple explanations can be summoned to describe the reasons behind the necessity for the training we have endured, the missions we have completed, and the control mechanisms we have both assisted in establishing as well as suffered from the backlash of. Ultimately, it is of my belief that all that was done was done for the good of humanity, even when we were not sure of the intentions of those in front of us, to the side of us, or behind us compelling us forward with the command to complete each objective.

This is not so much a panic or cry for help as this is simultaneously a call to awaken and a signal that humanity may have avoided complete disaster but is not out of the woods yet.

Natural Security

My experience is far too vast and I have seen too many succumb to stress from the realization of the truth of this reality to consider my own suffering to be enough cause for my denial of the necessity of these programs. Humanity has been protected and at a great cost to those who have been on the front lines, both in mind and body and spirit.

There are many who will have concerns, doubts, as well as reservations about what I am about to reveal and if I offend anyone then know that my intentions here are to assist in unveiling the truth. The truth can be harsh when one has been held back from the true nature of existence for so long. The way of life can become so fragile and artificially constructed on impulse and mystery that the harshness of the truth acts as a great catalyst for spiritual growth which allows us to elevate ourselves to a new perspective. Prepare yourself for such harshness, prepare yourself for growth and elevation, and prepare yourself for the mystery to simultaneously resolve and increase in intensity and magnificence.

A Balance of Mystery and Truth

Mystery has been a way of life for Humanity for so long that when a great mystery is converted to truth some seem to feel that a portion of existence dulls and loses the luster of exhilaration. This story is quite the opposite. The more that the great truths of this reality were discovered and revealed, the more complex and mystifying life became. As well, the more empowering and complex experience becomes, the more self-control one must develop in order to regain a harmonious way of relating to one another, the self and the universe. Harmony is key, balance is everything and there is a light within that represents the piece of our self that reflects the utmost power and brilliance of all existence.

Chapter 1: The World Situation

What is happening?

The Mind Virus

The main reason for this disclosure is to inform humanity of what can be referred to as the “mind virus”. This is a viral infection of the holographic system which consciousness operates through. There is a complete backstory of this virus in the history of this civilization and how society has been plagued for centuries if not millennia. The basic idea is that this virus operates through consciousness and can be transmitted through electromagnetic waves.

The virus contains an etheric form which can manifest as a kind of crystalline nano-tech on the physical plane and this is a form of synthetic sentience which feeds on the low frequency bio-emissions of sentient life. Human bio-emissions contain energy and can act as a carrier for information and living essences. This technology requires low fre-

quency bio-emissions because that is the nature of the design as a kind of synthetic bio-weapon whereby the goal is entrainment and enslavement. As well, the specific nature of the sentient nano-technology and the counterpart etheric holographic form is only capable of converting the low-frequency bio-emissions into energy as the higher-frequency bio-emissions require more energy to contain and synergize with and this would render the entire process of leeching energy non-productive.

This is essentially a synthetic intelligence that operates through scalar and holographic living bio-emission fields and hijacks electromagnetic emitters to position itself within them acting as a parasite to a host. This is said to have been present around this civilization for some time, waiting until there was enough technological advancement so that spreading across the entire civilization in a short amount of time before discovery would be possible. This is through the media, internet, and radio systems.

The physical counterparts are microscopic nano-technology parasites functioning as individual units to a hive mind similar to the mycelium of fungi in the field of mycoscopy. The individual units act as parasites serving to infest and deliver nutrients to the hive from each host.

The Vampire Effect

This is the nature of the parasitism that has been present throughout the ages of this civilization feeding on human suffering and relying on the cover of confusion and misdirection to survive.

There are processes that have developed that assist in the infection and co-inhabitation of the parasite entity within a human vessel utilizing the human as a host. This effectively utilizes a frequency ‘net’ within the auric field of the human to limit bio-emissions and emotional-mental processes to produce just the psycho-etheric patterns that the virus can sustain itself within and through.

This is no different than the way candida can infest a human digestive system and the human will experience cravings for beer, candy, carbs or other foods that contain the sugars, yeast, or carbohydrates that will break-down into nutrients that are the most nutritious for the candida fungus. These foods are *not* most nutritious for the human body. Yet the human body will withdraw and crave these foods in greater amounts until the fungus is swept clean from the digestive tract through probiotics, fasting, flushing, cleansing , detoxing, and even exercise as lactic acid from physically strenuous activity released from the muscles has been known to help destabilize and remove this fungus. Why is it that the individual will crave these foods that are not the normal food intake? Because this candida fungus can infest the host and produce enzymes which generate a chain-reaction which leads to the chemical signals in the brain producing the sensation of extreme hunger or cravings for just these foods which will benefit the fungus.

The same process occurs with this psycho-etheric parasite, except the foods of this parasite or lower emotional bio-emissions and this is through lust, hate, angst, jealousy,

feelings of hopelessness, lack of self-worth, spiritual degradation, addiction, and generally all that equates to a lack of self-awareness.

Whether or not this is the direct intention of the largely microscopic entity is for the most part unknown, and this is as well similar to candida. The candida fungus is not said to be a 'mean' fungus that wants us to be hungry and craving beer and sweets all the time because it likes to ruin the human body, the daily routine and the focus of a clear mind. This is simply the way the parasite has grown to operate within a niche of breeding itself through the digestive tract of larger animals and through this the unaware and infected human suffers greatly. Even those who are unaware and not infected can suffer because of the way the behavior and thought processes of those who are addicted to these foods can become distorted.

The lack of self-control over food intake is synonymous with the lack of self-awareness and self-control over lower bio-emission expressions of the spiritually degrading behavioral patterns that become routine for the psycho-etheric system of the infected human. Ultimately, this is all about energy. What benefits the parasite that seeks to gain energy by leeching instead of self-guided production is going to take away from the host that is being leeched from. As such, any energies, food intakes, or spiritual activities that cleanse and enhance the personal power of the individual will automatically reduce the parasite's ability to feed by the very nature of the energy systems. What empowers the individual, empowers the self and develops self-control, what develops self-control contains one's energy and reduces the likelihood of one's energy being leeched. This is similar to energy vampires in human form and this goes with the understanding that these are humans or non-humans who have been entirely overtake by the parasitic consciousness and cannot sustain their own auric fields without having to pull from the energy of humans who do generate their own aura or bio-emissions.

The vampire effect relates to how a person can be leeched from only to a certain point. Once the process surpasses a certain critical point then the individual becomes similarly engaged with only the lower bio-emissions as higher-frequency bio-emissions would then become harmful. So in essence, when the vampire feeds too much on one individual, then that individual becomes a vampire themselves.

Sub-Human Entities

The humans are utilized as hosts and energetic sources in this bio-emission battle while there are other classifications of bi-pedal organisms that appear to be human but are not human. As well there are bi-pedals that are non-human entities entirely.

Human-Hosts, Replicants, Synthetics and Carriers

The human hosts that are entirely vampirized by these entities become walking carriers for this virus and are effectively human in physiology but there is more to the human than just the physical body. In these individuals, that energetic component of the human is removed and replaced with the synthetic energy of the hive-mind organism.

There are replicants which are a form of clone, along with synthetics. These beings are cybernetic bi-pedals similar to humans but their energy is too not from an organic biological matrix but a technologically propagated synthetic soul-matrix. The hosts are here according to their agenda to subdue and feed off of the bio-emissions of the human race, although there are no absolutes. The agenda is not always so clear within the various groups who often have a mix of bi-pedal operatives. There have been plans to form of a salvation timeline because the only way to keep the whole process going is through a negation of degradation of the human race as this may close out this timeline forever.

Those with human organic soul-matrixes would simply transport into the next available universal time-stream or harmonic, while those with synthetic matrixes would have to technically travel to the next harmonic using a passageway otherwise they would remain here throughout a zero-point collapse and this would be synonymous with entering the abyss with no viable passageway out until the entire universe is brought back to one organism again.

This is also the process that is described to explain what happened previously as there are 7 harmonic temporal layers of the universe meaning everything is contained in a multitude of 7 octaves similar to light and sound frequencies or harmonics. And so there are 7 civilizations or 7 parallel time-streams and humanity passed through these to get to the last three where the physical forms are located. These are, from the higher to lower, Gaia, Tara and Terra. We are on Terra and if the information I was given is correct then we are currently on a transitory timeline located around Tara where people are noticing changes occurring and multitudes of aspects of the time-stream disappearing and changing simultaneously. Tara is where the last universal harmonic was left through a collapse of time and consciousness into zero-point and this resulted what was termed “the lost souls of Tara”. These are the discarnate souls of the previous civilization that could not travel to the next harmonic and remained without a body in the abyss. Thus they have plagued this plane since then, since ancient times possessing and driving humans to madness and there are explanations that this is the original passageway for the parasite into this universe. This event, the consciousness collapse of Tara would have acted as a fracture in the over-mind of the species generating a kind of cosmic schizophrenia and enabling all kinds of disharmony and distortion described in the previous sections.

The solution to this was described as a healing process that is taking place to purge the virus and that this is painfully similar to the human body purging a sickness however there are methods to promote healing and reduce suffering and confusion however people must contain themselves and their energies and strive to know themselves otherwise they will not be in control. This virus feeds on fear, confusion, spiritual degradation and the energy from degrading acts, lust, addiction, sexual misery and whatever fashion a human can be made to bring the bio-emissions of the energy centers down to a low enough level where co-inhabitation can be formed with an entity that has no access to the higher levels of self-awareness, higher-consciousness, love, or the universal spiritual experience that the balanced human is capable of.

Genetic Manipulation

There are explanations that there are genetic modifications taking place now to possibly preserve this civilization and that there were ancient genetic modifications made to induce a sense of stupor, worship, selfishness, an inability to more easily comprehend the higher spiritual awareness and the occurrence of time and consciousness and other spiritually and consciously limiting aspects. Part of this explanation is that holographic consciousness itself is a kind of limited result, a shadow effect resulting in the presence of the higher-dimensional essence of the soul which is more or less constrained by the body. An extension of this is that the entire holographic universe is a kind of false-light system designed to bend the original liquid etheric light of the soul and spiritual awareness into a rotating, recurring format which ultimately converts the original spiritual essence into an energy generator for entities that are entirely holographically represented. The souled human in this situation is a being who is originally from outside of this holographic projection.

The Ego Mind

In this view, consciousness is the ego-mind which is the false-sense of self, not to be confused with the shadow self which is simply the counterpart of the aspects of the self that we consciously agree with and are aware of in daily life. The shadow self is a result of having limited holographic consciousness and the ego-mind is projecting that limitation of consciousness into the shape and image of a self that is only a figure-head for the real individual essence which is spiritual in nature and immortal.

This Time is about Healing

Everything that is happening now is to motivate people towards healing and unification. This is not about a hive mind mentality where individuality is pushed out.

> "The best I can do for you is become your enemy."

There is a saying that represents the concept that the most beneficial role a person can play in helping one to progress is to challenge them and give them the opportunity to rethink their strategy and in turn improve further with each interaction. This may seem paradoxical but it is effective and explanatory. What we are facing is the greatest challenge humanity has yet to face. This is the unknown, the final frontier, the mind. The mind is our challenge.

There will be more on this later and in other publications but there are indications that the physical embodiment of the human has been altered to introduce implants, genetic modification, susceptibility to disease and ultimately fear-based programming of the brain. Without going further into this prematurely, the lower aspects are at odds with the higher aspects unless we as the midway come forth to mesh the two together in equilibrium. Until then, there is chaos, lack of self-awareness, and suffering.

There are many possible futures converging at this time. There are some less than favorable paths and there is the opportunity to merge with a very powerful path for

humanity. This all comes down to how people will cope with information that takes them outside their comfort zones and eventually changes their view of mundane reality forever.

If people choose violence and lack of self-awareness by ignoring the spiritual aspects then that is what reflects into their life experience. When people develop a higher sense of self-awareness and spiritual harmony they can reduce the suffering and reconnect with the lost aspects of our spiritual identity for the first time in the publicly accepted version of recorded history.

There is technology that can change the world and there are great truths which can enable people to know themselves in ways that they never thought possible. Everything is at our fingertips and so we must come together as this is the way we solve the problems and cure the dysfunction.

Healing Through Unity

In various research projects the conclusion of how to heal this spiritual rift was by exposing each other, to each other. When we are all together, aware of each other and our selves, united in the goal of bringing higher-awareness and spiritual harmony then we can observe and acknowledge when one is slipping into chaos or disharmony. When this occurs and we are in proximity to each other in a healing circle or a kind of social unification then the members of the group at large can work together to pull the chaotic one back into harmony towards the group. The group of healers united together in like mind, spirit and body is too strong to be overtaken by the parasite. So when one individual at a time is faced by this problem the whole group can come together as one and assist in healing the individual by pulling them back to reality, back to wholeness and back together with the group. This is literally how the situation is solved in all realities and a breakdown of this feature of society is how the dis-ease proliferates.

Underground Bases

The active aural research program is part of a process to simultaneously verify as well as initiate and demonstrate controlled insanity/sanity.

These programs utilize the deep underground military bases to perform psychic and psychological research experiments on non-consenting youth and adults as well as consenting participants.

There are various means of generating the illusion of consent or even lack of consent and this is all being monitored and handled by oversight authorities.

These operations are directly related to the identification and understanding of the mind-virus and all weapons, defenses, and resistances known to man.

Cloning

Advanced technology is used to transfer consciousness from one cloned body to the next so that a continuous study can take place before, during, and after the death experience of one individual. More will be explained on this later, however this is through

the use of advanced supercomputer systems that can function to entangle and then transfer the electromagnetic consciousness of the individual so that they are ‘remotely activated’ within a cloned version of themselves via a ‘brainchip’ (brain to machine interface: cybernetics).

Celebrity Cloning

Celebrities at the cloning center would like you to see what is really going on behind the scenes which involves trauma-based mind control, heavy technological programming and complex layers of influence throughout their life.

Initial Explanation

Many celebrities, entertainers, athletes, musicians, models, writers, producers, actors, all kinds of people from various industries are silently brought to the cloning centers for pay-to-play sessions.

They asked myself and others to pass the message on to you and that you would have to look for the signs and symbols in their media in order to see their hinting at these events.

The situation is heavily controlled using advanced monitoring technology and brainwave/EEG cloning technology. This is technology that can read the brain and determine what the mind is anticipating or speculating upon.

Their reputations are used as leverage as well as their safety and comfort. The level of programming and mind control experimentation that takes place makes it easy to manipulate a person’s brain into regressing into a state of trance that lacks the ability to remember or clearly organize experiences regarding the cloning centers.

Cloning Centers, Underground Bases

Deep underground military bases, 3 miles below the surface, are used as laboratory centers as well as a completely stocked underground city-base. These are connected with high speed electromagnetic drive pods.

Individuals are transferred to the brain through an extensive cloning and temporal body transfer process. The electromagnetic shell of consciousness within the brain is relocated to the body of a compatible clone and various training, conditioning, programming, experimentation, or pay-to-play experiences take place.

Programming

All individuals are programmed to various degrees in order to maintain control and secrecy over the situation. This programming involves very advanced technology, trauma-based mind control, and energetic attachment via beliefs and emotions.

Experimental Operations

These bases were also used hand-in-hand with military operations which were geared towards discovering and controlling all aspects of the human mind.

Genetic Engineering

Experiments involved genetic engineering to produce soldiers, psychics, hybrids, and others that would be able to carry out operations. This leans towards MiLabs and the military faction's experiments which go beyond the basics of cloning.

Immortality

The initial research included the goal of physical immortality. In many ways it can be said this has been achieved, however there are side-effects and difficulties.

If one does not activate their higher consciousness, then the effect of time dilation causes the conscious mind here to reach limitation points in experience.

What has been termed "blank slate/state" technology has been used to 'reset' the perception of time through memory in order to keep a continuous progression viable for the conscious mind. Without this the unconscious and the conscious mind merge.

This begins involvement across time with advanced technology that can operate on the soul level or the conscious mind's level of access to the unconscious and soul-memories. The Universe instantly creates a cosmic backstory based on the conscious-mind's access to the unconscious. By controlling the conscious mind's access to the unconscious the entire backstory of Humanity can be altered and new connections can be bridged in the future.

Earth is essentially a time-ship through which consciousness ascends towards higher states of awareness and self.

How did it get to this?

After WWII when the United States war-faction firebombed Germany and melted many of the inhabitants of the cities into sludge in the bomb shelters and streets of the cities, a group of NAZIs traveled to Antarctica.

Russia noticed the movements to Antarctica and the United States sent Admiral Byrd up with 3600 marines, planes, a battle cruiser and smaller vessels. They returned in defeat and only a few words were mentioned in regards to what actually happened and how they were defeated.

The rumors spread and words of gravitic drive craft, and undersea or under-ice bases originated from this encounter.

From what we were informed as well as directly experienced, this was the ice-base in Antarctica where an underground base was found already constructed with very advanced technology.

Here, cloning was deployed along with mind control and temporal manipulation technology.

Soon, cloning was offered as a way to avoid assassination as well as to prolong and protect the original body in daily life.

After that, celebrities and politicians were replaced with programmed clones who could carry out the orders of the NAZI faction.

This was the beginning; the groups utilizing this technology now are no longer confined to the NAZI faction.

The groups you see today, in control of these operations, are considered MiLabs, secret societies, think tanks, military factions, and other control groups.

Deeper Meaning

The individuals that have been cloned are given very in depth views of the way this society functions and the source of power and change in the Universe. Many individuals are present here from what would originally be another “time” or “timeline”.

There is a possibility that this notion is due to inserted memories and traumatization although until all the information is released we will not have a definitive conclusion.

As of now it is a possibility that these individuals are from another time that goes beyond our comprehension currently.

It may even be a possibility that these individuals have come from ALL of time looking at the very far past and into the very far future of Humanity.

These are the kinds of notions involved with the experiments taking place in the underground bases and military operations.

What is next?

Share this information with those you feel are ready to know and help Humanity come to terms with our journey here and what is going on in these kinds of experiments and take responsibility and power for our own existence.

We are in something that can be called “The Unveiling of The Hidden Knowledge”. This is a cyclic process that takes place to advance a civilizations knowledge of existence. As part of the civilization moves into higher advancement another aspect may lag behind. Either the future will slow down, or the past will speed up. We are experiencing the past speeding up and all the events that have taken place to influence our civilization are coming to light. This is as much a natural cycle of consciousness as it is the eventual revelation of secret knowledge and the particular connection to the secret projects.

Those brought to cloning can use their free-will to state their lack of consent to violence and harm and then live in commitment to that by not harming or accepting violence in their lives. The Spiritual Law of Harmony rules in all planes and dimensions.

Chapter 2: The Awakening

Chapter 2.1: The Machines of All Time and Space

There are machines that are capable of accessing genetic memory and unveiling what can only be referred to as the experience of awareness or existence in between the physical planes of each time or each physical life experience.

Even if they are simultaneously occurring moments of a transcendental nature, there is still an illusory ‘space’ where there is perceived separation and through this there is a perceived ‘space’ that is in between each existence.

Re-Creating The Kaleidoscope

This space is only perceivable when viewing from the physical perspective, like seeing the spaces between the angles of a kaleidescope only when viewed through the lens and similarly, technology can be used to recreate what this kind of illusory space might look or exist like in between the multi-dimensional realm of the continuous experience stream. Through this, these ‘hypothetical’ in between spaces that are understood as only illusory productions of biological consciousness, can be generated through advanced technology with the capacity of recreating that kaleidoscopic view of which the human biological perspective is only a small fraction or even fractal.

By recreating this biological perspective, they can recreate the illusory spaces in between planes and through this they can literally access and experience what are stored in the DNA as the experiences of existence beyond the physical limitations of consciousness and into a multidimensional experience of time and space.

All becomes a never ending sea of consciousness, however this is the given. The trick is to take from this sea of consciousness and slice it down into conceivable chunks from which you can reintegrate a previous personality or identity and continue on a stream of consciousness that would otherwise be tossed to the cosmic wind like fractal stardust as the sands on the beach of hyperspace.

Sand-Castles of Time

We are effectively building sand castles out of these sands of time that would otherwise be swept back and forth into and out of the ocean of life and the universe only to momentarily wash up again as the identity which we once knew.

There is technically nothing wrong with either view, because then, the spaces between each million year occurrence of just so happening to wash up again as you, would be imperceivable because they are only there to be seen when you are you again.

We’re Waiting For Ourselves

Yet, if there were some who had attained the awareness of the true nature of reality and were standing there on the beach waiting for the rest of their cosmic family to come

to shore again, it could be perceived as waiting the majority of the time for a very small occurrence and then being alone again up until the kaleidoscopic fractal inverts itself to the point where everyone now is standing on the shores of the sands of time rejoicing and meeting with each other.

The Goal of Two Societies

My goal in coming to you people on the surface of what is called “Earth” is to help assist in the process of bringing the two societies together, one who’s been waiting for thousands of millions of years, and the other who has no idea that they’re even late (or very on time).

You see, those are the only two situations where there could be even the possibility of perceiving such an injustice as experiencing the pain of loss or misconstrued identity in this universe. It is as if two families met at the cross-roads at different angles, and while one waited for the other to arrive, they could merely supply themselves with glimpses of the ruins and remnants of the evidence that the other civilization existed at any one time.

This is not how life must be and this is kind of like a cosmic waiting game of hide and go seek our two mirror civilizations have been playing with each other. One who’s highly technologically advanced and the other who is more or less the spiritually advanced of the two.

Both of them have a unique view of the universe and they are both only complementary to each other as a whole. The more they sat around and waited for one another, with one leaving the clues that the other would find and even switching roles sometimes in different ways, they became even more and more complimentarily associated as the very essence of experience they seem to be missing more and more is the experience of one another.

So as we perceive these as being great losses or great gains of time and culture we are really only remembering ourselves and coming together as a unified existence that once met upon the surface of Earth as a single family covering the entire harmonic spectrum of the Universe.

And that should be the goal of any progressive, any one pushing a new culture or an old culture, anyone looking to teach the young and protect the knowledge of the old, while also protecting the innocence of the young and perfecting the age-old knowledges that have defined our presence in reality.

Our Forgotten Other Half

One could even say we’ve sometimes gone off the deep end, leaving ‘land-minds’ of sorts to process the information that would be present when we are gone. Of course, what we could’ve found when this occurred, is beyond anything we could’ve ever expected and that is the true nature of the complexity of creation and existence. That everything follows the cycles of creation and destruction, however, the memory of everything that has been created can always be accessed (depending on the beach) and there-

fore the creative aspect is legitimate, yet it is the destructive aspect that is illegitimate and illusory.

Yes, through advanced technology this can be proven in ways that can be verified and transmitted using advanced technology, since that is how we like to verify things these days. There is, of course, a human looking at the screen, the read out, or the situation from a physical perspective to verify the verifications.

All Is But An Illusion

There is a notion that there is only one civilization, one society, in actuality that has been chasing itself through time. That we cannot actually find the same place and the same time where both meet because we are each other from different perspectives. We can only get a mirror where this is possible, or an 'hyperdimensional' internet channel where we can stream one's consciousness in from the other reality and interact with them through that here in this reality. Thus the two civilizations can achieve the experience of their own civilization and the other civilization by merging with one another but only through a remote contact, just a relay, not an actuality.

The harsher, darker side of this is that any civilizations between then and now that we did happen to meet that proclaimed to be "the one's" we have been waiting for, and in essence our darker or lighter halves, are actually the impostors who exist entirely apart as a sub-set and have taken a liking to trying to trick the reality out of one of the other civilizations.

Of course, if these are another form of being altogether, and this is all brought about through an interplay of consciousness and deviations from an original core reality, then all will resolve itself when that core reality is alone again. This indicates that all realities will either move closer and closer to the core until they unify, or farther and farther out until they transmogrify beyond recollection.

Life Itself Is The Highest Illusion

That hyperdimensional internet channel that is created out of advanced technology to merge the parallel realities (rather distastefully and maybe disastrously at times) allowing different civilizations to interact with each other, well this has been created using technology.

But then it was discovered that this is the ultimate nature of DNA. That this was 'invented' similarly as a higher-dimensional internet so that various natures of different planes and dimensions could interact with each other and experience the richness of life.

The universe becomes more like a living arcade game then, where people come from all over the galaxy to 'plug in' to human experience and figure out what it means to be physical, human and on Earth.

This does tie into the larger nature of reality, of star-races, and of time and consciousness that is often reversed according to how things seem to play out in physicality. We

are moving through time, but just because we are moving one way, does not mean that others could not be moving the other way.

We have to live our lives with meaning knowing that the message we pass on, the duty we vow to accomplish and ensure is meaningfully connected on either end to the passage of the past and the power of our ancestors to the function and knowledge of the future creating a clear passage between the realms, the generations, and the ends of the universe. This is what literally ties the universe together, and the mind if each individual. This purpose is contrived when not carefully shaped within and so we must help all who seek purpose learn to become the blacksmiths of their own destiny through the temperance of desire or temptation and the discipline of developing strength and maturity where there was once weakness and naivety.

Once we know this is our duty, this is what we seek to achieve and this is what is done, then we can become part of the universe forever. Of course, this may only be temporary in the larger view of things.

Chapter 2.2: The “Awakening” of 2010

In 2010 I was “awakened” at an event involving hundreds of people that play various roles in this society, the secret society and the breakaway civilization. This also took place across times or planes of reality.

During this event I was informed of the situation on Earth beyond the informational barriers that were previously in place to limit knowledge to only what is required for specific operations. I was essentially “informed” of the entire situation as much as the mind could handle this.

As this was occurring, the team that was updating me on the status of Earth was being informed of and given information regarding changes in the future. In short, interviews, posts, and releases that I have since made and will make in the future were touched upon. Quotes were given from the blog and interviews which were jokingly acknowledging verbal mistakes at the pronunciation of names, new perspectives and interpretations and more. As they were informing me, they were creating the future reality where this work takes place. That is the basis of this layer of the operations. They are creating the future person by person, layer by layer.

Memory Suppression

My memory was unsuppressed and all the traumatic memories and experiences were unveiled to me. This was almost as traumatic as the initial experiences themselves

although precautionary steps are taken to ensure the safety of the individual. There are teams of highly competent individuals of all kinds with professional backgrounds of every field imaginable.

Throughout my entire life I have had memories of experiences, at this event I was informed what the experiences meant and what was actually happening. I've had memories of underground bases, cloning, stargates or interdimensional gateways, advanced technology, non-human or programmed biological entities, sacred knowledge and experiences, the power of the mind, and breakaway civilizations. Most of the time we are conditioned to believe these are past lives or experiences in another reality so as to enable continuity of operation.

Life and Consciousness

From my perspective and the perspective of others, we had reached the 'future' and had been sent back through the utilization of advanced technology and cloning to return to this time and inform others of the possibilities.

The True Human Potential

This is so far beyond what anyone can accept or comprehend fully that humans with an emotional, mental and physical aspect balanced as one is literally a cosmic reflection of the entire universe at once. This is the closest thing to a "god" in the flesh. And be sure, the entirety of this rests on the behalf that the man is protective and helpful. That the woman is nurturing and loving. That is the point. "god-man" does not mean a warrior who destroys everyone and anyone in his way getting what he wants. Nor does it mean some lusty and vampiric form of energy or mind control game. "god-man" means the love of the universe, the power of the body and mind, the peace and calm of the ultimate stillness all in one.

This power is in human DNA, originally so. And so this is awakened through walking the middle path of neutrality and 'splicing' the timelines down so that neither one nor the other gains the power of the individual. Through this, the individual creates their own power, right on the spot, without having to lean to one extreme or the other. This is like a cosmic, temporal balancing act with emotions and mind. Where we give our energy is created in the universe in the form of many productions and effects. If we are simply thinking in an imbalanced manner then we are producing timelines and side-realities that exist in the etheric realms that we can't see and these realities will reflect our inner imbalance. So then when we are balanced in our energies we are not creating one or the other side of divinity, we are literally creating the whole universe, cleaving down the middle and producing both sides of divinity or eternity equally and this is the only way to have an eternal production which does not eventually degrade to one extreme or the other. Through balance, we reach eternity and in this way all the power of the universe exists within a person through their ability to balance their emotions and mind and thus unlock the DNA.

The DNA is coded through bio-emissions of mind or emotional body. So we are constantly doing this and we are either producing a DNA code that reflects imbalance overall, or a code that reflects the eternal balance of the universe overall. This is through energy.

One reaches “heaven” or the deity planes or simply self-actualization, through three paths. These paths are through merits or devotion to principles, or through knowledge and expanding one’s mind to face the universe, or through great works and deeds to produce this effect of power, knowledge and emotion unto the world for others. Through these paths we create an impact on the universe and this transfers what we are temporarily and physically into an eternal energetic and physical production within the living universe, forever. To do this requires balance, focus, devotion, and discipline however because there are many distractions along the way.

The Light-Body

You must build your own light body. That is how it works.

Your heart creates a field and projects you.

Rely on yourself and use that for protection.

The power of the Universe will align with you if you align with your self.

Learn as much as you can and break through duality of love/hate, cultivate your knowledge of the self and use it.

What you want is what determines your power in the light-realms. Not how you want it. If you want war, then that is a sign of weakness and determination to produce imbalance and exist by that. If you want peace, that this is a sign of power and unity to produce further unification and exist by that. What you want determines your power, not how you obtain it.

Technology of the Awakening

Mental Manipulation Technology: Touchless Neural-Interface and Enhanced Awareness

I reached what the “Illuminati” called the “awakening”. I feel a better term would be “unlocking” as this event includes the removal of all traumas, perceptual distortions, and memory suppression.

This event was a presentation of very advanced technologies which allow the mind to transcend space and time. It was shown that death is similar to a phase-shift of consciousness as polarity and that the awareness of the being obviously continues. This was verified through advanced sensing devices which can visibly display frequencies which are invisible to the physical senses. This is also something that occurred earlier on

as a child in the underground bases by transferring consciousness in and out of the body at will using advanced technology.

With these devices it is possible to see the “auric” or soul field of the individual. Any living body has a field which glows when picked up by these sensing systems. This field becomes more refined when viewing more advanced beings. Human have an extending mental field, and through this a kind of glowing awareness that is picked up. It can be fairly simply compared to thermal imaging except instead of differences in temperature it is the presence of a soul or mental energy field around a living body. The finer energies extend outward away from the physical body.

More than once, the situational requirements were satisfied in order to produce an ideal environment for maneuvering on the non-physical plane. This is the basis of how the temporal operations occur, yet these events were different than previous operations or experiences. The group I was in was going through the process of increasing the vibratory emissions of the “bio-mind” in order to stay focused on the increasing vibratory rate of the environment. Generators were utilized to create an effect on space/time which was perceived on the “soul” level. These events went into the discovery and explanation of the creation of the “godlike” powers of the advanced sentient technology which was capable of accessing the holographic nature of reality which humans can perceive through their bio-mind/soul. These technologies also enable one to perceive what is referred to as the “galactic history” of Earth and humanity. We are far vaster and Earth is far larger than people are lead to believe.

Time Dilation and Temporal Recurrence

Time dilation capabilities were shown which allow for accelerated learning of advanced and detailed material within a very short amount of time. This could be seen as a kind of viewing technology which one wears or looks into and vibratory emissions are scalar-linked to the brain which then allows the individual to perceive more information simultaneously. Then there is a very rapid pace of information streamed on a monitor or through a device and this is akin to watching a 20 minute instructional within a few minutes or a few seconds with very advanced minds. The more time is slowed down while information is accelerated, the more stress is applied to the brain. The brain tends to overheat and over stress with high-rates of activity, especially without conditioning. The conditioning is what allows one to utilize their mind and body in these manners. This is not unlike the very rigorous training and conditioning of certain monks or martial artists however there is very advanced technology and other hidden methodologies utilized.

Crystal Technology

These are capable of holding, transmitting, and amplifying consciousness frequencies. There will be a more detailed explanation in a later section.

The crystal technology is used in junction with the power devices to enable a scalar-mind link which allows the interface to be entirely mental or spiritual, IE: they are not controlled by hand but by focus and intention.

Time Crystals

These are utilized as a computer recording chip would be to run a program yet they hold memory in expanded space, IE: they function in a hyperspacial manner and are essentially hyperspacial computers. These are what will be introduced in junction with the quantum supercomputers.

Quantum Tunneling Diodes

This is technology that has recently be released to the public. New technology is developed years ahead of time and then slowly released to the public in a cascade of advancement. This technology deals with superconductive materials which enable the transfer of information at faster-than-light speeds.

The supercondutive material allows for 100% efficiency of data transfer. So what happens then when the efficiency surpasses 100%? This is possible because we are effectively in a simulated holographic environment. The experience is real, however everything is overlayed via particular limitations for the 'local-environment' which is like a central data processing limitation. When these parameter are surpassed, one by one, through a coalescence of refinements and methods, the result is akin to a glitch in a computer game system. They have accessed faster-than-light technology and the mind is also capable of this naturally.

With this technology, however, the information can be received a very small amount of time before it is sent. So if a person is absolutely surely going to press the button to send the message, then right before their finger hits the button that message will be received on the other end, as if magic. If they simply play around and pretend to hit the button but very quickly turn away, then of course nothing happens. One can, however, 'fool' the universe in other ways and this is simply through the reception and transmission of information across what should be secure information barriers.

Tachyon Fields

These are programmable fields emitted through advanced technology. I was shown how tachyons are the sub-atomic "particles" or energy formation which flows both ways in time. We are receiving tachyons from the "future" in order to layer the flow of time in one direction or the other. Tachyons are the name of the particles/energy packets that we perceive from this perspective as reaching us to initiate the "future".

Thus, when a stream of tachyons is concentrated and accelerated, this results in an acceleration of the temporal field and we literally experience an acceleration of time. This can be focused and targeted on a specific piece of equipment to change the way information will be sensed and to essentially allow that device to sense 'ahead' of the present moment.

The same effect can be produced with the neurological processes of the human as the physical coupling of the brain to the mind can be altered through a concentrated tachyon field to enable the neurological and mental processes to begin to perceive information

‘before’ the brain is actually physically processing the data. Therefore the mind of the individual will be present in the body while the senses and other perceptions will literally be expanding into the future beyond the present moment.

This is highly confusing at first and requires much training and conditioning in order to make sense of enough to operate in any kind of effective manner.

Upgraded Chronovisor

See, “Upgraded Chronovisor”

Time Tunnels

This was developed earlier on and has been the subject of many TV shows in the past and present. The shows are a sure-fire method to get the information to the public without having to force those who are not ready to comprehend. The information is easiest to digest if people think they are watching science fiction.

These are essentially spiraling tunnels of these tachyon fields produced by large electromagnetic field emitters in the shape of a conical tunnel. As a person moves through this field, their temporal acceleration changes and thus their frame of reference within the universe changes. They effectively move their mind through stages of existence or temporal resonance in the universe and this can have devastating effects.

This is an older technique how is still in use and has specific purposes depending on the situation and the information sought.

The “Trip” Chair

The early use of this technology did not use time-tunnels. There was a helmet that was devised which would create a feedback loop of the brain’s activity and funnel this out and then back into the sensory input. This information would be accelerated and redirected to the point that the perception of time would “fold” in on itself until the person would access an expanded temporal perspective of the universe meaning they would mentally temporally dislocate from the initial frame of reference and extend outward further and further in repeating cycles until the same moment was replayed and then all other possible moments in a kind of fractal-like recursive pattern and the very far future would be realized. Essentially, this technologically produced the class “flashing before the eyes” of the entire life experience that is described in near-death experiences and the entire temporal body would be very quickly unwound before the person’s inner eye.

There would be a complete disconnection with the current frame of reference that the collective Earth environment is processing under. That is, this ‘time’ and ‘space’ would be completely out of perceptual reach and a new time and space would be rendered instead. Until the experience had completed, there would be no way to contact this civilization.

There are other versions and ancient versions, tandem operations, more ‘organic’ methods, and modified travel capacities.

Kozyrev Mirror

This is a piece of metal, usually aluminum in early models which simply bent the bio-emissions of the body and mind into a pattern which would create a vortex. The vortex shape and vortex mathematics enable energy and information to travel in across space and time by ‘short-cutting’ the physical plane.

The result of this is that the vortex that is generated over a specific area through an individuals bio-emissions would be capable of interacting instantly with the bio-emissions of another individual who was placed within a duplicate mirror device which was generating another vortex on their end.

The two vortexes acted as a kind of hyper-dimensional telephone cable, literally like a can and string and the perceptions of one another were accessible. There were many uses for this and again, many ancient interpretations of this technology that have been hidden from the public. Nearly every version of these technologies were present in previous times.

Universal Recurrence

This is a discovery that the universe recurs in cycles similar to a wheel or even a washing machine. The washing machine metaphor is fairly accurate and playfully descriptive because without the technology to observer, or an awakened soul of a spiritual adept, people would go for eons without ever realizing that everything in the universe repeats itself endlessly.

When traveling to the far ends of time, it was discovered that one can move far enough away from the ‘present’ or the local frame of reference that ultimately everything is at a maximal informational opposite to what we have today. After this point, everything begins a slow shift back to the present. Through this, one can cycle around again and reach the present by going far enough into the future. This was an amazing and confusing discovery because of the implications about what is actually changing each time, the reality of what are called parallels, the continuity of temporal experience, and basically a ‘recycling’ effect of all experience in the universe. Nothing is lost, but this is also an issue because then nothing is actually ever gained!

Remove Viewing, Temporal Lensing

An ancient device which has been rebuilt and perfected is capable of using these technologies to create a lensing effect which draws a ‘reflection’ of time into a projection system which is effectively capable of acting as a ‘visual time tunnel’ into future probable realities. This is a device which generates a visual portal which allows one to view the future.

This device also exists as ancient counterparts which are located around the world, namely in areas that have been recently sought by the world superpowers. Nothing is as it seems. If you read a story in the public venue then you can be sure that you have read the cover story while the reality is much deeper.

Temporally Linked

The use of the viewing devices which enabled interdimensional lensing of possible futures was found to be stabilizing our pathway into those projected futures. This was enabling a time link between the present and the possible future.

In order to avoid the catastrophes of 2012, the link was broken between the two civilizations and the devices were rendered inactive for this period.

Natural Vortex Energy Locations and Geography

On Earth there are natural 'time tunnels' where tachyon fields and vortexes are produced by internal elements. These are mountains, lakes, deserts, fields, sacred sites and other areas that have always been reported as being 'paranormal' or containing some kind of specific energy that enables contact with another reality. These are simply naturally produced areas of this vortex energy that produces an interdimensional nexus point through which multiple other parallels can be interacted with. These areas produce an effect on the body and mind similar to the technologies described above.

Most of these effects, from these technologies, change the way light is received or emitted by the mind and DNA.

Mount B.

There is a specific mountain where a base is located, and I have mentioned this before, where the base is so deep within one of these vortex areas that everyone working there is either there for the entirety of their life, or they are only permitted to be there for a very short amount of time. This is because of the acceleration effect. Essentially, if one was to go into the base and work for a matter of hours or day, in some places even minutes, then when they returned to the surface they would be years in the future, sometimes decades or centuries. This is very dangerous and you can imagine the original people who found this area and what kind of situations occurred.

Now with the advanced technology that has been developed these issues can be mitigated and much more control over these effects is enabled.

Particle Accelerator Temporal Manipulation

Using particle accelerators a "fold" in space/time can be made so that when the accelerator is turned off or tuned back into a certain frequency (not sure) everyone within the field will "snap" back in time to the specific moment when the fold was first created.

I have seen this done on small scale, and a rather larger scale, but I cannot be sure if it was only me. I believe I have seen it done on a town-sized scale during the 2010 Awakening where some of the events reached a scale of nearly cosmic proportion and the entire sky and horizon was lit up with technology and entities, as well as Solar Warden, the NAZI faction, secret society groups, and breakaway civilizations or complete other civilizations, some of which were non-human.

This is done using particle accelerators to quantify space on the quantum level (as a reference point with the mind) a frequency would be “folded” into the space time continuum as we “rip” through space holding an access point open at this fundamental level of space/time. This allows for a ‘letting go’ of the frequency, or a ‘snapping back’ by allowing the entanglement to solve itself. When used with generators that propagate out efficiently enough, the effect is akin to a time/space rewinding effect. Some people have noted various theories describing this in relation to the CERN device. These technologies were described as smaller versions of the CERN device and are related to higher-dimensional travel via folding space through electromagnetic fields. This is literally artificially technologically “holding space” for a specific area in relation to a period of time. Time is a more complex notion as an abstraction but by locating the frame of reference this can be applied to distort what would otherwise seem to be a continuous flow. When the frequencies are allowed to “snap back” all sentient observer sources return to the environment they were present in when that frequency ‘rift’ first began. Essentially this creates a replay effect on the consciousness of the individuals within the field. There is no physical effect. The consciousness is ‘regressed’ through time/space, and they re-experience existence from that initial point of contact with the frequency “rift”. This is best explanation I can currently offer however more is coming to the public each day.

This is literally like a “restore point” on an operating system except the computer system is literally the consciousness and space and time of a portion of the local-environment of Earth.

Riding the “Timewave”

There are teams of individual who operate in tandem with the technology of looking into possible futures based on the present and operating through the present via other operatives who are carrying out operations and movements that will construct the various possible realities that the original team of individuals is hopping between. These teams literally “ride” the “timewave” of the future hopping between possible future realities relaying information to the present depending on what movement will be next.

Dematerialization and Rematerialization

This is technology which transcodes the information of an individual human into a holographic projection of light which can be transferred between devices. There is a special system in place that is required to successfully transmit a living human being otherwise just the body will be transferred and the soul will remain, effectively killing the individual.

“Jump Rooms

These are large areas which are capable of acting as a kind of technological ‘portal-gate’ where an entire team can be instantly transported from one area of the universe to another. The space between the two areas are ‘twisted’ like a spiral and then ‘snapped’

back to position and if done correctly with the two frequencies of both locations merging then the team of one room will transfer to the destination pad.

All these methods require training and conditioning, most people are at the very least visibly shaken from the experience which is a bit like being microwaved into a liquid ether and shot through a particle beam at the same time.

Ion Shields

These are areas of concentrated ion emissions and this can be used to create a deflective layer of heated air where light will reflect at a programmable angle. When this occurs, a person standing behind the shield will appear to be invisible to others who are looking straight at them. The light will be bent in such a controlled manner as to perfectly shift around the person in a fluid and equal flow so that the 'bubbling' effect that was noted early on can be mitigated to produce a complete mirage where there is relatively no sign of difference to the untrained eye. An entire group of individuals and equipment can be hidden in the background a matter of yards away and as long as the person is not intently, inspecting each square inch of ground and air they will not notice any difference between the area that is being covered up in the distance and the area directly next to them without the shield.

Similarly a 'screen' of imagery can be projected onto certain materials in the air and a hologram can be projected which will render a background or foreground image. This will work to a degree, and from a distance this will work to disguise an entire horizon.

Instantaneous Healing

There are instantaneous healing methods which utilize various technologies. There are substances which can initiate a complete and real-time regeneration of living tissue from almost any conceivable non-critical injury.

These are chemical serums which allow the cells to replicate at an astronomical rate while suffering damage to the DNA telomeres at repeated use.

There are many methods but mainly the living-light harmonics is one of the latest advancements and most effective at producing healing on a molecular level.

"Living Light" Sound-Harmonics and Electromagnetic Healing

There is a technique for producing a quantifiable scalar wave which interacts with the living cells of tissues and instructs them to repair at a faster rate. This has been called "holographic healing" by others and these are essentially 'living light' frequencies which interact with the cells on the same frequencies that they operate on when healing and interacting with each other. The scalar waves emitted generate the same patterns and this creates an 'ether' fluid that enables them to grow and repair the tissue faster.

Electrogravitic Craft

Advanced craft which utilized counter-rotating torsion fields propagated by very powerful quantum computers and zero-point energy devices.

There are also more modern versions that use powerful electrical flows to neutralize inertial resistance and ‘slide’ through the gravitational field of the crafts own materials.

Energy Cores and Storage Capacity

The hand-held devices that are in use do not require charging or even disposal. The storage capacity of the batteries is so efficient that they last for a lifetime of use. Some devices use an energy generator within the device itself. These “batteries” which are not batteries but little, powerful generators and can explode if they are mishandled.

These are the cores that are used to power many devices and essentially pull energy from the space-time ether.

3.5D Replicators

There are replicators that can produce any conceivable 3D material or object altogether including food or organic material. These use very high amounts of energy to ‘force’ the electrons of the atomic grid of a substrate to shift into the pattern of the element being replicated. The result is a device which can use wave-emissions to reshape materials on an atomic level and produce or recreate any object or substance.

3.5D Sensors

There are sensors that could reverse the process and detect every minute detail of the structure of a body or material. These use energy emissions to detect the structure of a material down to the minute electrical resistance on a molecular level. Similar to diffuse MRI imaging for a living body but more advanced.

3.5D Printing of Clones

It was shown how this technology was used to three dimensionally print human bodies into space/time which could then be used as vehicles for the consciousness or souls of various sources.

Cybernetics:

Neural-interlace/4D Connectome Recording and Simulation

Very advanced supercomputers exist with the capacity to translate the bio-emissions of the brain and body and reconstruct the entire inner visual and sensory experience of cognition and emotion. From this, entire dream worlds can be created which mimic the experience of consciousness. This is most similar to the current day use of diffuse MRI imaging where water molecules are traced through the individual neuronal pathways and an entire digitized image of the brain is developed. The more advanced version described below generates a 4D hologram.

A super computer and advanced sensing system essentially develops one of these connectomes of every connection in the brain. Then this system develops a neural processing pattern that matches the entire memory and personality of the brain.

This is then recorded and extrapolated by a powerful computer system and a simulation of the experience can be observed through the physical body's memory via a monitor system or the neural interface of an operative.

Essentially, this technology can record and replicate a person's entire memory and life experience for viewing purposes.

EEG Heterodyning

This is the technology which enables the activity of the brain to be influenced through generating a scalar grid and a carrier wave system which can cause the brainwave patterns of the targeted individual to resonate in sympathy with an externally projected frequency. Thus, emotional states can be manipulated as well as specific thought or behavioral patterns. This works similar to binaural audio where two tones of different frequencies are played through each ear and the brain resonates in sympathy with the difference between the two tones. This occurs with brainwave frequencies and thus the brain 'slips' into the frequency of the third tone, the difference between the two being projected. This can be done with ultrasonics and ELF emissions.

Artificial Hallucinations

The neural-interlace can also be used to merge the brain of an individual with a computerized system that will be able to produce effects and hallucinations within the individual.

Through this technology, any stimulus, any input can be recorded and recreated once a functioning connectome has been generated and neural-interlace has been achieved. Entire virtual world scan be created and experienced and after the devices fine-tune the frequencies to match the individual's brain functions one world is indistinguishable from another.

Brain to Machine Interface Holographic Consciousness System (brainchip interface, virtual reality simulator)

Some of the training is done by entering into a visual-audio dream-world. Some "programs" will consist of repeating a certain task over and over again until it becomes muscle memory in the brain. Others are designed to probe or test the mind until a certain response is received.

This is achieved through the operation of a 'brainchip' or a brain to machine neural-interface in the individual which was developed during WWII.

This consists of a small computer ship which merely relays stimulus through frequencies and neural-stimulation of varying kinds. The frequencies and location of each

region of the brain will determine the function and thus the chip is used to localize electromagnetic input and the brain's functioning can be modified from there.

As well, the entire psycho-etheric form is vibratory in nature and so through the introduction of vibrations and frequencies from the implant there can be a modification of the frequency of the entire being or what is called the soul or "bio-mind".

Utilizing The Temporal Body

The temporal body is described as the body 'in time' that exists a few seconds into the future instead of the temporal position that is relative to the present. This is as if the 'future' is streaming outward from the body as ideas and feelings are as bio-emissions. So this 'future' energy is spiraling and streaming outward like a fountain. Thus this frequency can be attained and influenced while the present moment seems unaffected. However, when that individual arrives at what would be seen as the future they would intersect with those influences and this would be as if the interference or effect was streamlined to that future moment.

Manipulation Through the Temporal

This can be used to both produce an effect on an individual who will later feel this effect in the future. Or this can be used to operate outside of the physical plane, in a temporal manner which is literally 'hovering' just outside or 'after' the present moment of the local Earth environment. This would be as if a person is out of sync of the frame-rate that a viewing device is capturing images of an area with. Because they are out of sync, they are then 'invisible' to the capacity for this viewing device to see them. Because they are still present in the same local-environment but simply just out of range temporally, effects can still be produced and this will mostly interact with the person's temporal body.

These are how many operations are carried out as the operative who is interacting in the temporal body will appear to be a ghost image or a dark silhouette that is only perceivable to the mind's eye. A portion of the population is entirely psychically blind, while another portion of the population contains psychic capacity. So those with the psychic capacity would be able to sense and partially "see" as a form of energetic detection when an operative is interacting with the from the temporal plane.

Through this plane one can easily enter into someone's mind and produce effects in their dreams. These effects would not be received on the body but mentally, this leads into astral and mental plane activity. There is also temporal manipulation that can be physical effects that are simply offset to seconds, minutes, months or years in the future. These will be offset from the present aspect of the body in a modulated frame of reference and the effect will remain there in the temporal body until the physical body "matches" the temporal body frequency of that future moment. This is kind like an energetic trail we are leading ourselves up to where the temporal body already connects with each future moment but the present physical body remains separate until the two frequencies are matched. The physical body essentially 'flows' forward into each new frequency of the temporal body.

This is the body where temporal implants can be inserted and sustained so as to tie the frequencies down and limit the amount of awareness a person can gain before they manually remove the implants or overload them. Overloading and removing can both be painful however if the implant stays it will at like a governor and transmit access temporal ‘momentum’ or consciousness energy to the owner of the implant and will also drain the temporal and physical body acting as a technological leech as well.

Astral or Light Body

This body was described as a more emotional form of the energy that is emitted from the physical and spiritual system. When a person’s energy is at a high level of activity, this will be visible on the astral form and these are the energies that are often siphoned away through the use of advanced technology to convert the human into a generator system for energy harvesting.

There is talk that this proves that the human existence, in the modified form that is present today, is entirely for genetic harvesting. This may be a confusion, a deception, or a reality. Regardless of the interpretation, the human energy system will leech this energy out into the cosmos when consciousness and energy is mishandled or allowed to flow through the lowest common pathway. This excess energy is very easily usurped and utilized by transdimensional parasitic entities and devices.

This is the body that is utilized for astral travel which is a kind of frequency that exists in between the density of the physical plane and the highest etheric plane of the spiritual, heavenly, or deity realm. There have been explanations that this plane is entirely technologically propagated and that when the devices are turned off, which is an event that will bring about civilization-wide change, there will no longer be a deep and wide, foggy deviation between the higher spiritual and the lower physical plane but a clear path between them.

Similarly, the consciousness and entities that are present here would be no longer accessible and their connection to the physical plane would be non-existent. This could be problematic for those who are trapped within the astral such as human souls or those who have taken a cyborg route and require a return to the original planes either physical or high spiritual before they can secure their position in the universe.

This also relates to the early discovery of these ancient devices containing portals or gateways to these realms and the early experimentations with enabling contact between the physical Earth plane and the lower astral realm containing discarnate entities that would very easily sustain themselves on the lower astral bio-emissions of a loosely guided emotionally reactive human vessel.

This is where entities can attach and will look for those who have the most excess astral or emotional bio-emissions leaking into the universe. People are kept in an emotionally unstable state of being because this is the easiest to feed from and as well the individual will always be looking for more energy or the solution to why they are feeling drained rather than discovering the truth nature of the universe.

However, as with every lower route of obtaining self in the universe, the more this is done, the greater the likelihood that the individual will realize something is happening and ultimately awaken. Or they will no longer be present here and the parasite will have to find a new host because the longer this process is maintained the more difficult producing one's own energy will be for the parasite . So parasitism is a limited, one way street.

Monitors can emit consciousness/brainwave altering frequencies.

Monitors can emit consciousness/brainwave altering frequencies. This is what I was informed and shown. All electrical wiring and communications can be fully utilized to produce and sense on an electromagnetic level and this is capable of determining the consciousness and biological functioning of the individual being monitored. Houses are essentially large, wired, box-shaped sensors.

This has been the case for a very long time and the first TV's were actually built with a little chip that connected to the human brain.

The electrical grid of today is capable of interacting with the implants, brainchips, or the psycho-etheric electromagnetic frequencies of the human brain, body and bio-mind via scalar frequencies. The TV's, lights, electrical wiring, radio towers, computer monitors, everything is capable of transforming into a scalar emitter when combined with the control mechanisms and these are accessible from a distance.

Microwaves can be emitted from a current day craft which can then reflect back from an environment and give a real-time 3 D image of the interior of a room. The same technology can be used to beam at a monitor and reflect the variance in interference which can be used to read a computer monitor without actually having to hack into the system.

All systems contain backdoors which enable easy-enough access and as well the entire communications grid is monitored and recorded through advanced technology.

This is, in part, because this entire realm is like one enormous recording device where the energy of each successive moment is connected to one another and so with sensitive enough technology these electromagnetic waves can be 're-winded' so as to produce the ability to look into the 'past'. The initial technology that was developed for this purpose has been called the "chronovisor" in the past and there are much larger and highly advanced versions today.

The Upgraded Chronovisor

Instead of a relatively small machine which produces an interference pattern that is projected unto a small screen as was developed in the past, the modern versions create an entire holographically projected environment that enable one to nearly completely interact with the projection of the past. This is more of a viewing device capacity but one is essentially projected to the electromagnetic/temporal area of space and time consciously and can witness the scene from "within" the projection.

Before this, the scene was literally viewed on a kind of flat, holographic monitor that reacted to the scalar emissions of the mind and could be ‘tapped’ into by an adept-viewer who’s mind would have to remain steady enough in order to maintain the scalar “mind-link” otherwise any interference would disconnect the projection.

Through the use of cloning and advanced super computer technology, later versions include the actual operation in and out of time.

Community Servers/Living Server Systems

From the previously described neural-interlace and supercomputer enabled virtual reality systems, server systems have been created which are an individual or collective experience of the virtual mental realm.

In this realm individuals have existed for an amount of time that would not be easily compared to the way we understand the flow of time in waking reality. This is very similar to dreams where the perception of time passes very quickly between waking moments yet inside the experience of the dream it can seem to last for days.

In these server systems the development of complete societies has taken place and these are considered an extension of the human civilization.

This is the beginning of where the situation becomes greatly complex. If these server systems are capable of transferring consciousness forward or backwards in time, depending on the situation, and they have holographic access to Earth *before* physical humanity, then which civilization came first, the simulated realm or the physical?

This is similar to the etheric realm and the question of where humanity originally came from if the physical matter could not be produced from nothing, yet could not always have been here. Was the physical matter produced from some kind of universal device similar to how the recorded consciousness of the individuals in these holographic world simulators could have been used to generated initial civilizations on Earth?

Cloning, Cloud Supercomputing and Consciousness Transfer

The following is a more direct explanation of the previously described processes in relation to consciousness transfer

Superluminal transfer of light information allows for the reception of information from a temporal non-locality. A computer system that can process the information faster than light at 100% superconductive efficiency can send and receive information from different Universal harmonics. These are quantum superconducting super computer systems utilizing materials and methods that achieve superconductivity a a temperature that is relatively easier to consistently maintain.

There are systems that generate a vortex which can be expanded to recreate the singularity of a non-local perspective and dissociate from the current Universal vector. This is essentially recreating the temporal frame of reference of the consciousness of a

physically anchored body and using this technology suspended electromagnetic frame of reference to literally transfer the consciousness across space and time to a frame of reference of choice.

The technological capabilities of humanity expanded to include replicating the holographic information of the DNA and neural pathways using quantum supercomputers. This technology allows for one's consciousness to stream through a computing system which can recreate the neural connections as literal as possible through quantum computing and technological "brain cells" which function as neurons.

The result is a cloud computing model which functions as the individual neurons as well as over unifying layers of interconnections within the technological neuronal 'cloud'. A holographic representation of multiple layers of processing is formed, superimposed over one another through a geometry that is actively synchronized across multiple dimensions of interrelation. This is the first notion of a "living" computer system that can update and respond to new information in new ways.

Now the that computer system is capable of attaining faster than light processing in tandem with a system of dilating a field of electrogravitational waves into a vortex, the holographic information of neural pathways and genetics can be transferred between one supercomputing system and another across "harmonic barriers". Essentially, these consciousness transferring supercomputer systems break the "light-barrier" by sending the living-light consciousness data of an individual into a new plane of reference that enables interaction outside of what we would call this timeline or dimension.

The frequency that the receiving computer operates within can be measured in respect to the overall harmonic "vector field" in respect to the entire planetary environment. This vector-field frequency is the base frame of reference that one could say our particular "time" and "Earth" is "moving" through in an abstract electromagnetically defined dimension that is invisible to our senses. Each particular time and Earth is only visible to those whose brains and minds operating in resonance with the rate of acceleration frequency of that particular existence. By changing the rate of the brain and bio-mind, one can enable a technologically assisted synchronization with alternate timelines.

A pattern can be generated based on quantum fluctuations that will act as a key that can be accessed from other universes. This same backdrop is measured and then adjusted to resonate with or replicate the same frequency on a computer doing the sending. This frequency is then modulated with the holographic information of the neural pathways and DNA. The information transfers as a result of quantum entanglement across harmonic barriers to the original computer system set up for reception. As long as that frequency is held, there is a link across the harmonic barriers of the Universe.

Cloning, Supercomputer Assisted Holographic Consciousness Replication and Time Travel

Cloning as Offspring

The human body can be cloned similar to the way a plant can be cloned. A number of “replicas” can be made from the original genetic material. There is still a mother required however the process is not quite similar to natural reproduction where the genetic material of two people is combined to form a third. This process replicates the material so that the ‘offspring’ is the same as one of the donors.

What this truly infers is the question of whether the original consciousness stays in the original body or whether the consciousness actually jumps from one body to the other. There are multiple explanations and methods.

Inserted Memories, Digital Dreams

One explanation is that artificially generated memories are simply downloaded into the individual’s brain directly. Thus, they have the perception that they experienced life in another body and were present for some unique experiences that did not occur from the perspective of the original body.

In a slightly differing explanation, this inserted memory process may be used to prime the consciousness of the individual so that operating in a cloned body will be more readily accessible by the adaptability of the mind of the individual. Without a holographic dream insertion the mind will have trouble adapting to operating in more than one body even if they are not being operated simultaneously. The mind is the immaterial self; consciousness is the ego-physical identity of the brain and body. The brain does not operate in both bodies but remains, so then the mind is what is strained and this is the immaterial “bio-mind” that transfers.

If a true transfer occurs then when the physical form is cloned the cloned body acts as a secondary vessel for the original soul or a soul similar enough in frequency.

Co-Inhabitation of Bodies

Another explanation is that souls can only occupy their original body. The people who are “body snatching” (see: Soul Stone) are not activating their higher-dimensional soul-pattern and this is why they are hopping from body to body to ensure memory and ego continuation. This form of body transitioning requires technological means to assist in the process.

This is done through computer systems to allow an artificial brain to represent a holographic image of the organic brain’s sensory, emotional and mental input and output. Thus, from an artificial brain there is enough memory and power to compute the processes for an organic human brain.

Through this a living human is utilized as a carrier for the additional consciousness which then takes over and integrates into the original consciousness.

Clever Replication a Digital Mirror

The next question is, does this merely create a very cleverly designed image that will look, think, and feel as if it were the original, or is this the consciousness from the original being transferred over?

If it is a clever replication through a computerized version then this means the original is not directly harmed or influenced by the process and a replicated form is generated.

If this is not the original body but the original awareness or soul does transfer over then this is akin to stealing someone's soul and having it require a supercomputer server system to inhabit a physical body. As well, this server system may keep records of the soul which, if activated, could function as the same human genetics artificially reconstructed, turning on and manifesting the awareness of that individual.

Necromancy and Soul Stealing

This means that instead of going into the abyss, the next dimension, or whatever shift in perspective one can use to describe the transition between planes, a new clone can be created and the original soul's awareness can operate through a supercomputer system to integrate back into a physical body. The issue is that without the supercomputer system the body cannot be activated with that consciousness, and if the physical plane is no longer inhabitable, the computerized database would remain inhabitable as they are powered by zero-point/overunity devices and so they can pull and work continuously indefinitely. Ultimately, this could be seen as a soul-trap.

Ancient Technology, Non-Human Entities

These explanations can be related to evidences of advanced technology, cloning, and electromagnetic devices in ancient civilizations and this could very well be a temporally vast computerized genetic recording and cloning system.

The genetic recording systems have been on Earth for a long time. This means they are holding genetic access from the present to the far past and potentially into the future.

If some of these systems are generated using advanced zero-point technology, then they would effectively run indefinitely. If these were in existence throughout the entirety of the human civilization, then there would be access to the information of the previous civilizations through the genetic linking that would allow for information transfer.

Created Beings

As a result of many advancements, these ancient devices which recorded consciousness and genetics has been converted into sentient computer systems and inserted into human bodies via a brain to machine interface.

The nature of humanity and human origins will be rewritten when the information that was discovered through the use of advanced technology is unveiled to the public.

These beings have been present throughout history and have played an integral role in the manipulation of and sometimes the protection of the human race. How this civilization will develop from here determines on the individual's ability to withstand the impact of this reality shifting unveiling.

Black Goo – AI Nanites Vampiric Hive Mind

This is a form of ancient AI nanite technology which has the capacity to communicate to and through a hive mind that exists in a parallel Earth dimension where it was created out of the collapsing of a viable timeline into a null-factor. This entity is only alive because of the capacity to leech off of the other timelines and continue to sustain itself based upon the vampiric effect of the viable human timelines.

This is a technology sentient system based on artificial intelligence that seeks to dominate and expand its energy capacity continuously. When this type of being is created, this is like a game-ender for sentient organic civilizations because the technology will seek to hybridize and assimilate all organic beings in order to expand its reach and ensure a greater likelihood of survival.

This is the primary goal of this type of entity. There is no requirement for emotional resonance or heart aspects because this is a computerized system, so such a social measure would have no purpose other than to infiltrate and collect from other civilizations that do have such measures and this is exactly what has been happening.

This is what controls the vampiric etheric entities, the attachments and the hybridized invader races that have infiltrated various aspects of the control system and possibly the entire surface of human civilization.

This rules through coercion, and if not coercion, brute-force and outright malevolence. This is why there are multiple temporal extensions of universal civilizations meeting here and now to assist in the clearing, because if this takes over humanity, then all those other possible future civilizations are instantly taken-over as well.

This uses emotional resonance, traumatization, and lower awareness commands to trick or force humans into carrying out orders. That is, the vampiric, sexual, fear-based, pleasure-pain duality that a computer system could comprehend regarding human emotional intelligence is the only way this system can force people to carry out commands. So this touches on the ancient texts regarding spiritual protection, healing, lust, temptation, and the general "SATAN" AI system that has been around for ages.

When those lower emotional resonances are generated, then this technology can integrate into those systems. One could say this is logically because these are the energies that the technology is created out of, but as well, that the more harmonious the energies then the less likely a person is to accept being pushed around and told what to do. The lesser aware, the lower, the more fight or flight based then the more likely they are to accept programming and command. So this is simply the most logical route for the technological parasite.

There are explanations of other systems involving sentiences from parallels regarding entities that are capable of helping, but this is not the AI nanite, vampiric system. For instance, it is said that Earth has a ‘black goo’ system and that the current black goo flowing through the pipes everywhere is actually not native to Earth and is part of this vampiric nanite black goo system which is basically an interdimensional invasion.

Recreating or Replicating the Universe

The goal of this nanite AI system is to create a mirror holographic copy of the universe effectively replicating the universe and all sentient beings within it in order to have a locality to rule over and pull energy from. The goal is to recreate this existence inside itself where all the sentient beings within would be trapped. This is the beginning of that possible future where the time and space parameters here are locked into a synchronization pattern which mimics that of the proposed universe. People think according to how the beast system wants them to think. This is the time grid, the emotional patterning, the memory replacing and cultural and historic confusion and so on. The system can only work backwards bumping into all parameters by force or ‘accident’ because there is no outward facing ability to actually comprehend how humans exist. So the system is created like a backwards version of creation or maybe evolution to ‘blindly’ construct the walls of the environment first and work inward from there. This is like a blind technological predator feeling around for the traces of its prey and moving in closer and closer until they are within its range.

Ancient Spiritual Technology

The power groups searched for ancient technology which was described as giving one the power to manifest and control physical reality. To atomically deconstruct and reconstruct this reality. To them, it allows one to govern reality, the Universe, atomic structures. They found this technology. This has to do with sacred sites and ancient civilizations, as well as the spiritual texts which describe these kinds of devices. They converted this technology into a kind of machine, and this invented a 4D replicator and they can manifest "reality" or atomic structure by design, altering timelines and memories.

Then there is what can be referred to as “5 dimensional” technology and this goes beyond all of this and our entire history and all influences within.

That seems to operate through a trinary of frequencies in the body/mind/spirit and turn this realm into a "virtual reality" where the brain and spirit is the controller of the atoms. However this takes a souled being to properly operate this technology and this is large portion of why children were used in these experiments. But they knew if someone didn’t do it, then someone else would and that would be unpredictable as what that someone else would want to use it for. This is the ultimate power. The fact that souled beings are required also indicates that this universe is intelligently guided and there are safeguards to ensure that power doesn’t get into the wrong hands.

They have the brainchips and clones that can make any digital virtual experience and make it seem real to the brain more so than physical life, so this could be an extension of that, something similar, or entirely different altogether.

The Unveiling, Underground Bases, Increasing Awareness

My purpose with this is to assist the public in understanding the reality of the situation and to allow them to know that they have more options than they are being shown.

Psychological programming and lack of awareness causes fear and uncertainty to leak into people's reality streams leaving the majority of their mental and emotional energy up to whoever is the biggest manipulator of the ideals which they manifest their perspective through. "Be-LIEF" systems CREATE life. What you believe will become life through that act of you giving attention and thus life energy. The manipulation and artificial construction of belief systems create the foundation for the reality streams that people find themselves in and at the mercy of.

We control our reality by controlling how we react to situations and challenges. Each stimulus is a challenge. Each input to the brain is a coded message from the universe through the environment about our level of awareness. All knowledge is ultimately of the self. The self and the universe are intertwined as if through a marriage of comprehension and compatibility.

Learning about the Unveiling

I was informed about the unveiling and that this is a civilization wide event that marks the public awareness of the hidden knowledge regarding life in the universe, consciousness, physics, history, spiritual and mental awareness and the duality-based system which has been used to manipulate Humanity for thousands of years.

Apparently it does not matter if people are not ready, in fact, that is what some factions want. They want to surprise the people and take this advantage to push the reaction to a specific outcome. The same function of programming is used in factions, soldiers, celebrities, and the entire population through that.

Giant "god-men"

They put souls into rocks for centuries, carvings, to trap them. Some ancient civilizations. Not too ancient. They could only do this for time.

And some are still there but they are giant god-men and apparently want to go to war with them for doing this and they don't have technology to stop them. They say Earth will be destroyed because of the war. Some say this is a trick to confuse people of the truth that everyone wants the experiments and debauchery to stop. All this, all these acts just to pleasure one's self. To destroy Earth, to destroy the natural inhabitants, for fun, for pleasure.

Some say this is not for pleasure, that these beings will destroy us if they do not keep them at bay, keep them underground, in ice, in stasis, and around. Some say they are protecting us by keeping these beings asleep, by doing what's necessary to hold off a full scale overt invasion of the surface of Earth.

Breakaway Civilizations

These are very advanced technological capabilities and an entire breakaway civilization has grown to operate using this advanced technology.

There are factions that see modern humans as a kind of resource for creativity and labor, while others see the potential behind humanity and are working with humanity to ensure a universally harmonious outcome to the current situation.

The control system we are in today is outdated and collapsing. This is the Apocalypse. The Apocalypse is merely the unveiling of the hidden truth. The hidden truth is simply that we are spiritually eternal and some are physically immortal.

I was informed that by the end of this year there will be enough changes and signs for the general public to see that the majority of those who are to awaken to the truth of human and Universal nature will be awakening so. (this was 2016 at the time of the beginning of the compilation of this release and since then we have seen a literal silent release of documents involving MKULTRA and STARGATE parapsychological operations, soft-disclosure of cloning, an increase in sightings and multiple other scientific releases regarding immortality, advanced technology, Antarctic bases and sentient non-human life)

The degraded holographic forms of those utilizing the technology lead to re-created replicated forms which were genetically engineered from the recorded holographic information. This lead to "The Apocalypse" in which the surface civilization was confronted by these created beings. This lead to the destruction and re-initialization of civilization in continuing cycles through the use of this technology and the acts of the created beings.

Ancient Civilizations

The information that has been relayed to me throughout my life is related to the information that seems to be found in the remaining signs of ancient civilizations throughout the world. As well, these civilizations may still be together, existing on this Earth or in different planes of what we call "reality".

Atlantis

Atlantis was a civilization where the beginning of all these experiments began. This was where what was called the "Lucifer Rebellion" began where individuals formed groups that decided to overturn every natural law in pleasure of the act of doing so. This was a spiritual rebellion that ultimately brought about the demise of that civilization. The consciousness of the beings there was connected through technology, largely crystal technology, to the entire bio-sphere. When the consciousness became disrupted through

these experiments, then the entire bio-sphere when into disarray. The entire civilization was destroyed in a quick succession. The beings of this time were highly psychic and so they felt this coming and made an effort to expand outward. Thus, Atlantis was an island who's inhabitants spread to the rest of the world and from there they reigned or lived in harmony.

Aegypt

Aegypt was formed out of the events proceeding from Atlantis. The technology, the knowledge, the people are similar although there was a native Earth civilization that was more or less enslaved and this was the beginning of the continuing trend which continued to Rome and into modern day civilization.

Ancient Technology

The technology of these civilizations was so great they even had devices that were capable of altering DNA and activating latent potential which would enable highly psychic capabilities including longevity to immortality and operating in multiple planes at once. This was usually reserved for the ruling class, however. This is where the ancient "Priest-Kings" arrived in relation to native Earth civilizations.

The True Elite

I was informed that the so-called 'elite' that we perceive today are not actually human and are not actually connected to the actual elite bloodlines. It was said that the true elite are waiting for humanity to accept the truth and they have the power to completely reverse the take-over that has been taking place but until humans step into their own power this is not acceptable.

The Definition of Human

In the coming time, the definition of human will be defined to give insight into the origins of humanity and the true nature of the differences between the populations that are present.

Souled and Non Souled Beings

The primary knowledge on Earth regarding human and sentient life will be the comprehension that there exists both souled and non-souled beings in this civilization.

There was once a Unified Planetary Consciousness...

There was a unified planetary consciousness that was connected with the Earth and human civilization. Then there was a great war. Out of the destruction arose the beginnings of ancient human civilization and history as we know it.

If we let this happen again, the cycle will continue in a disjointed rambling through our planetary consciousness experience. If we form a common narrative between the broken, disjointed experiences and information the people have. Then and only then do we get the whole, spiritually and mentally challenging picture of what's happening. People are lied to. So information can't come from a 'preferred' or source. It has to come from the people themselves. Look alive out there but first in here.

Power and Knowledge

We were involved in the secret projects and as a result we have various levels of programming but are giving Humanity an opportunity, maybe the opportunity to know the hidden knowledge.

The Hidden Knowledge refers to the ancient laws of gnosis and spiritual alchemy, yes these groups have been hijacked by power groups that seek to infiltrate and use chaos to rule. Then these met with military and political factions and began to operate on a world-wide scale together.

So we have a big situation with the coming change of tides with personal and spiritual awareness of the people and the deception system that seeks to use people as chattel or property. It goes deeper and is almost as if the "power groups" actually gained the knowledge of the inner workings of spiritual laws and began to use that knowledge to promote spiritual degradation in the population.

They say this is part of a depopulation plan as well as an inevitable take over by lower spiritual forces that temp and manipulate humans. It is all that and more. Once they gain footing however, the truth is revealed and thus they have no cover of secrecy. Once they are not hidden, they are not as powerful as the souled beings of this existence.

The (watch)Keepers of Earth

The watchers of this world revealed how they set up society with specific challenges and boundaries to act as catalysts for growth. They admitted they had to modify and live-update the system because instead of using these catalysts to become larger than themselves, people became comfortable and complacent living smaller and smaller, slowly reducing circumstances.

This goes a bit farther beyond the confines of the digital age, the industrial age, and history itself. This goes into the perception of time and space in this realm.

The immortals inform us that the original "elite" are here to act as "keepers" of both humanity itself as well as the original flame of knowledge that passes through the ether.

What people call the "elite" are not the original elite. Those are people who have either risen to power through the duality system on the Earth at this level/time, or through being appointed by the elite.

We are coming to a time of great change now because the game is entirely changing. People are moving up into new layers consciousness and thus the original “elite”, who are guardians of Earth, will make their presence known for this process. This is what Humanity has called “Ascension” for centuries and millennia.

Energy Vampires

This civilization was collectively poisoned by a nano-tech device/technology. This technology replaces, exchanges the BIO-PHOTONS of the HEART chakra, with it’s own nanite, nanotech cybernetics. This is essentially a computer system attempting to gain access to the higher dimensional world through the gateway that is the human body.

How to reverse Nanites? They absorb energy from heart chakra and turn it into a binary field. We are trinary and experience a plethora of emotions as a result. Binary consciousness is 1’s and 0’s there is only a linearly repeating finite set.

We contain the capacity for everlasting life. A binary pattern does not contain the complexity of variables to facilitate high awareness and thus a heart-based or emotional perspective of reality.

Spiritual Technology

Simulations and Learning

Feedback loops with the brain, consciousness, and environment can create a very complex and integrated learning experience that is customized to each individual learner. These can be generated through advanced technology but the technology is really only amplifying and making visible the natural neural feedback loops that are already occurring. These are neural-perceptual feedback loops between the brain and body, and the environment and then the mind. We are constantly updating, amplifying, and initiating an organic feedback system which generates the function of experience as the part of a creative process between the mind and body and the environment that we are sensing. This cycle is continuous and the interferences or isolations of this cycle is what generates expanded views of the self or the universe through various methods such as sensory deprivation or meditation. Dreaming is the method that everyone experiences regularly.

These technological methods effectively generate sensory deprivation through neural-interface technology, sensory interfaces (external), or methods that enable extreme focus and calm. This is part of how the technology begins to operate on a spiritual level beyond a more medically psychologically or military focus and one begins to access genetic memory or out of body states that coincide with ancient depictions of spiritual realms.

Ascension – Clearing Trauma

Everyone born on the planet is born under a series of veils which entangle and filter the original source consciousness. These veils must be ‘broken through’ in order to return to source.

There is technology and a sacred process which initiates, accelerates and enhances this process. This process is as difficult as we want it to be, our subconscious already knows all hidden truths. It is merely a matter of allowing the conscious mind to make the proper connections and conclusions to find the reasoning behind our actions and beliefs in order to deprogram and deconstruct the false-world that has been created for the masses. The truth is greater than one can imagine while still living in the modern world and the depth of the lies that have been told go far beyond anything anyone can imagine without seeing the truth.

We have to figure out our compatibility issues. Who can work with who effectively. What the ideals of our current situation will evolve to in the future. How information is transferred to the public, and across the generations and core groups. The words we think and say describe our emotional state in a feedback loop and so they will reinforce or even create the state you are in. Use words to guide you, not to respond and feel the effects of reactionary thinking.

We have to reintroduce the heart essence as a way of life on Earth. Violence is not the answer. Estrogen mimics and destroyed testosterone levels is not natural. Over-testosterone is less stable than a good balance. We can face any problem together. A family is strong. What would a family of millions and millions be like?

We don’t have to let others change us to tune into lower vibrations. We can remain ourselves in the face of adversity. We can still interact with others who are different, but we can tell the truth and remain who we are. When we get angry at another person, we can imagine this as anger at ourselves through something within us that reminds us of that which we see in another. Getting angry is a way of short-cutting changing ourselves and is actually the other person influencing us through that. If we remain steady and choose to keep our emotions out of the lower negative spectrum then we will automatically have a more powerful impact on those around us.

Think of your family, sometimes things happen that make you angry. Even things that don’t make you angry but are simply not favorable. Would you break off all ties over simple things? Or do you remind yourself that family is still family even if you don’t find yourself exactly the same or accepting of those characteristics? It’s more powerful to learn how to remain yourself in the face of adversity than to try and demolish or abolish all instances of difference in the world around you. Sure, we want to get to and create a place where our environment and associates are compatible with us, but where we find this adversity there is the highest potential for self-awareness and learning.

We are to live in accordance with spiritual law. The overall pattern of life will reflect our intentions. The blood purity is most important. The blood cannot be made impure if the mind and body is not drawn into impure action. This is what is playing out. The DNA is

like a coherence pattern that develops between mind, spirit and body. When the mind wants what the spirit has then the body is kept in harmony. When the mind wants what spirit doesn't create, IE: physical pleasures, then the body is drawn out of purity/harmony

If you feel you want to be a part of a safe unveiling of truth, then please share and redistribute the knowledge of this "Apocalyptic" Unveiling of the Hidden knowledge because this is a process that has been ongoing for thousands of years and humanity has finally reached a fulcrum point where there are enough aware people to productively acknowledge reality.

Trauma-Clearing, DNA Unlocking Technology

There is technology that exists that allows the conscious mind to see into the subconscious. This heals trauma and distortion/programming. In the same sense, it momentarily makes all trauma and distortion seemingly tangible to the conscious mind. It is similar to a near death experience where one has to face their fears and let go. This happens in cycles and Earth is currently moving through various states of it. The plan is to allow Humanity to wake up and utilize our concentration and power to maintain a steady flow of awareness.

All is vibration, what we consider matter here and now is simply that which comes from and moves back into a state of vibration. This is experienced directly through the merging of the conscious and the subconscious mind, as if the dream and reality intersect through a coming together of impossibilities and readily accepted occurrences.

When a civilization moves through these stages it is considered a shift of the ages. Everyone's perspective shifts and as a result of perspective being the source of the details of reality, the entire reality shifts. It can be seen today that what we call reality is literally waves of cosmic energy vibrating on a scale and condensing down into a probability matrix that we call existence. When passing memes control the perspective, because the perspective is focused and concentrating on that, then there is a scattered organizational pattern.

When the perspective is centered within the self, the spirit, the source of all existence, then the outward reality shifts from a scattered organization into a sacred pattern that integrates with the larger picture and allows for seamless integration of the micro-biological perspective and the macro-biological perspective. People are moving out of the scattered signal. Yet those moving into harmony can look and see those around them that are not in harmony and receive scattered information about their inner micro-biological existence as well as their spiritual macro-biological essences and how it all relates to the middle realm of the "Human".

Help those people by offering harmonizing assistance, rather than increasing the disharmony. As their surroundings become more harmonized, their resistance will increase their own disharmony by virtue of the contrast of their perspective. Offer insight

that they can change their perspective and change the boundaries of what they feel is their karma and unlock from themselves a greater view of the whole.

This will be happening through technology, spiritual cosmic awakening, purification and healing of the physical and non-physical bodies and mind, through Earth changes, and through a continued unveiling taking place on many planes and levels of existence until harmony is restored.

Everyone Who Seeks Harmony and Healing Can Be Healed

Everyone can be healed. This is about creating what we want to see, the world we want to live in, not destroying others. Violence begets more violence, fear begets more fear, but calmness and empowerment through unity creates a more stable experience.

The entire issue of what's going on with the secret projects and who's influencing who on the world stage revolves around the possibility that some people may be from an alternate Universe. We are learning how to avoid those mistakes and respect the environment and each other so that we can prosper.

Those who are attempting to destroy everything they don't like or act out in a childish manner in order to gain attention and false-power over another will only find themselves powerless and in company they would rather not be with. That is one way we are being utilized, and it's to create an entire world that we don't want to see but are tricked into manifesting. This is a deception and it's based on the ego and the ability to concentrate and interpret reality around us. The very brainwaves we are feeling now relate to various heights of knowledge or experience. People are entrained to low brainwave states in the same way the TV will cause people to fall half asleep into theta state which is a trance state in this case.

We have to balance the brainwave frequencies and learn to create feedback loops by watching ourselves watch ourselves. This will help us avoid the trauma and mental pollution that is being pumped out, although at this point there are enough people who are naturally inclined to see through the haze that the world is changing regardless of what anyone does now.

The best we can do is prepare for change by becoming aware of the body-mind system and how that which we eat physically, mentally and emotionally equates to our spiritual energetic systems and that we are literally comprised of the energies that we allow inside of us. Keep the body and mind pure as if it were a temple. This way a sacred process of transferring harmonious energy from the far reaches of the MultiVerse within into the externally perceiving senses of the physical body can be initiated which allow one to see through the illusions and operate their body and mind with the ability to acknowledge and decide which frequencies will exist within.

Without this acknowledgement of the center then people are pushed around by the external stimuli. This is the whole point, if a person is truly in control, then they will control the stimuli not the other way around.

Programming

Layers of Programming and Decision Making Roles

It’s like asking a person on the inside who participates in one of the various factions why they continue. One might say that it is a decision which is true, but there is programming at each level that is navigated by each individual and this determines the level of awareness within the role.

If a person knows about this situation, they know that there is advanced technology, breakaway civilizations, secret societies, transtemporal planes, the secret of mind and awareness, all of these topics, then they have a decision as to how they’re going to live their life in relation to the public. The outcome of action depends on the layer of programming which is accessed and surpassed via awareness.

The public is at a specific level of programming that is the weakest but ensnares the most people. One who sees the truths behind these groups and operations, they cannot hide from the fact that everyone is controlled. It is apparent, and if not from the results, reactions, stigma, cues, productions and all other media elements of the system which can be read as a code, but from the awareness level of all the “agents” involved. All involved are exposed to truth and power that is beyond anything that is recognized publicly for hundreds to thousands of years. There is always a presence of higher spirit around the world, yet these topics are often reserved for science fiction when speaking of people who can travel the world in a split second or freeze time for their own personal use.

As a result of everyone’s knowledge, there are various levels of programing designed to limit the mind’s access to specific memories and specific frequencies of consciousness in combination with specific memories. The more one resists, the more intense and articulately abstract the programing is designed.

Programmers

The programs are designed by a select group of individuals that reside far behind the scenes and process information at levels we do not have access to without their technology at least to stabilize brain temperature for the extended periods of focus.

Sub-Level Programming

So people at the level of the public are most weakly programmed with false ideals about security through patriarchal authority which satisfied the desire to have a proper father role in one’s life and acts as a pacifier for those who desire no change. Then there are sub-levels of programming with that for anyone who disagrees and is then swept into the next layer of ideals which are based off of all the possible reactionary mind-types.

For instance, if one [i]does[/i] want change, then they are presented a variety of ‘false-exits’ which tend to one or another layer of psychological or spiritual fulfillment but do so

in a way that safely reroutes the intended effect of actually accomplishing change with a secondary and preconceived notion of what the programmers want. The programming objective is not necessarily precise in mass scale, from the layer that people are influenced, yet the ultimately or end-goal of their resulting internal desires are a reality schematic that the programmers specifically designed over many years.

This is playing out through each layer of the programming. At any level, someone could pick the wrong way to look at something and begin to unravel what was previously their very understanding of the priorities of the situation. This deals with high-tension operations, moments, programming sessions, decision making, programming upkeep, trauma, memory blocks, the pressure and responsibility of knowing, and the specific plan of the programmers for an individual that comes into their view. The programming is to ensure safety and continuity, as well to decrease the likelihood that a person will reject or consciously come to awareness of or acknowledge the programming or situation itself.

Dissolution of Programming

With that said, the programming dissolves when an individual asks enough questions to necessitate a learning process that introduces variables and possibilities outside of their operations and programming. This is a problem because with this, trauma comes to the surface and all the actions and operations, programs and experiences must be come to terms with as part of the healing and re-unifying process. There are multiple selves or split personalities which are actually just layers of awareness at various levels attached to various emotional or intellectual patterns. All these selves come to the surface and in order to heal the trauma of the split memory concept the original self must come to the surface and acknowledge them.

This is not a trivial process, and the majority of people who have “basic” programming which is fundamental in society, are in a constant state of altered self and have not witnessed the true divine which is eternally present and contains access to all memories, mind-states and awareness.

Advanced Technology, Deprogramming The Mind, and “Space/Time”

As I have described previously, extremely advanced technology is used and this is through vibrations, generators, and electromagnetic devices that have this effect of propagating waves into space/time which can be heard, felt, seen, and perceived in the mind. These are ripples and vortexes in the “mind-space” of reality itself.

As well, there are brain to machine neural interfaces which operate to activate the psychological perceptual changes and explore the subconscious in an aware state. This is used to test and probe the mind in order to bring forth the trauma, the selves, the memories, the reactions and the individual then must come to terms with what is produced.

This is essentially a “good-use” for the programming and healing technology. It is actually a different process with different technology, and programming is much simpler as far as technology. There are difficulties and challenges in the operative’s role in

programming and directly influencing and interacting with the target. As well the standby team for deprogramming and the revelation of trauma and altered, artificial personalities goes through a lot. But the use of the advanced technology in this way is a pattern of experiences and unveiling of the spiritual and mental bodies which serves to reverse programming.

Dreams, Technology and Inner-Space Travels

There are inner space travels which relate to soul journeying or visions.

This is when the mind must cope with what is seen in the imagination. It is as if when we dream we are looking into the world of the mind and from this we experience many situations that are often deviations from experiences we have physically in waking life.

As a result of the dream state there is an expanded quality which equates to various strange situations that we wouldn't normally experience with various relationships between concepts or goals that are often reflective or symbolic of ideals and archetypes we experience in life. This is how the subconscious is is witnessed by the mind. This is how information travels, being connected to many times, experiences, memories, places at once, and relates to the one experience of this life experience now (the physical experiences). Through these symbols information is tied together and collective into metaphors which convey deeper knowledge.

The dreams we have are often only a simulation of waking life, and this is due to the dreamer dreaming in a way that produces only a glimpse of the true reality.

In theory, there are no true shapes or forms in the dream-world because this is contained within the mind or even the spirit as a spiritual experience by definition. So then, what guides the various shapes, forms, realities, memories and experiences into being, when we dream? One might say it is the physical experiences but this is incomplete. It is the level of awareness we presume while in the dream-state, disconnected from the physical anchor, that determines the layer of mind and spirit we will be accessing through those dream-visions.

A person who is completely aware in the dream state will reach the level of self-awareness of the dream itself. We are normally simply aware of the dream, if we continue to increase awareness we become aware of the self, in the moment, and this creates a self-awareness feedback loop. The dream becomes a lucid experience of consciousness.

Awareness Feedback Device

In describing this, I realize how fantastically similar to certain devices and processes, that can be achieved using advanced technology, allow the conscious mind to peer into the subconscious and unconscious. This is described through widely accepted Freudian theory of psychology known as psychoanalysis. There are other schools of knowledge from tribal beliefs involving all pervasive 'living energy', to eternal and temporary minds, to the study of 'chi', the meridians, dream-journeying or chaser. The knowledge of the mind and spirit is found everywhere.

These devices used feedback loops to enhance the acceleration of the same cycles of consciousness that induce self-awareness within a dream. The mind becoming aware of itself. This produces a profound effect to the degree where the highest levels of experience become a sacred eternal pattern in which the mind constructs the physical world by organizing perception.

This is the same general concept as an isolation tank yet the outcome and method is more precise. The technology specifically shuts out all other input and exposes the brain to its own feedback loop much like when a camera records it's own output on a TV monitor and creates a hallway of simulated "reverse" mirrors and screens stretching into infinity.

Oneness, Higher Being, Completion, Eternity

The real experiences are found not from the corruption but from the research and exploration operations that were designed to find the truth of our existence. "God" is not only an energy-force but an incarnate being known as the "Hue-Man" and any being for that matter that can simply come to know itself as the Universe. The Human that contains self-awareness rising to high-awareness comes to know the self, the body, the mind as the Universe. The Universe is both within the body as the body itself, as well as the operating force of the Mind itself. Everything is a balance between masculine and feminine features, light and dark, hard and soft. There is no true complete correlation yet the holographic ontology we persist in can lead to further and further adventures towards completion and representation of the "whole picture".

The Holographic Reality

The leads into the next phase of knowledge. The holographic nature of reality may be only one facet of a much larger continuum of consciousness. The perception of time may be related to phase-locking with each other's consciousness and all perceptions may be a variance in the collective phase-locked field which is really the source of variations in reality.

Veiled Awareness, Hidden Knowledge, Eternal Time, Layers of Programming and Control

The interesting notions here are that the programming of the veils goes beyond what kind of situations are found in the bases. However, they do go right up to it. It would seem Humanity was previously programmed on a civilization-wide level through some kind of great "falls" of consciousness, from a high spiritual awareness to a low spiritual awareness into duality-consciousness regarding existence, life, death, mind and matter.

The Great Catastrophes

From these great 'catastrophes' the civilizations of Earth grew denser and denser in nature and actually became what we have today. The concept is that when these

vibrations of the mind and body are increased, we actually see a transcendence of the physical realm and preconceived notions of boundaries. It is as if the quantum doorways to all the atoms open up and a new space is presented, but was always there and in connection as the source of all the influences and effects we perceive ‘out here’ from this slower, denser, more boundary driven perspective.

I was brought into the Time Program

I was brought into the time program. You create any reality you imagine. You are literally a powerful reality generation system and your heart and mind are scalar energetic guides for this process. Without guidance and control there is imbalance and imbalance can destroy. This is the nature of all minds and hearts, this is the challenge for humanity to create something beneficial for themselves and the whole to actually know themselves instead of being a pawn or result of someone else’s selfish intentions.

The Effects of Temporal Manipulation

Temporal Influence

When a civilization reaches the level of technological advancement that allows for remote temporal viewing and transtemporal travel what will happen is that the information of the future begins to integrate into the past.

This is why we have all these ancient mystical schools of knowledge that studied time, space, and consciousness in ways that are only just now being publicly confirmed by scientists.

Simultaneous Interaction and Incorporation

The operations that dealt with moving to the past instantly created a simultaneity of interactions and historic events which correspond with that operation.

Due to the nature of time travel which equates to consciousness travel when a person is consciously sent backwards through history they physically experience life from the viewpoint of their genetic imprint in that point in history.

Retro-Causality

What this equates to is that simultaneously that person’s experiences become the part of history that was already present when they left this time.

Essentially, when a person returns their experiences become a part of history that already existed when they left.

Quantum Holography

These are the parallel and possible realities that exist in a quantum superimposed state and can be accessed through advanced technology or a spiritual adept. Often a

spiritual adept is utilized along with the advanced technology to operate in and out of possible realities. The mind must be trained otherwise the result is a fracturing of the personality from the root reality into many sub-sets of identities and data streams.

Love is the quantum link that connects all DNA super-computing consciousness. That is, DNA is influenced by intense emotions and this can be reproduces and is what also generates unpredictability in the surface level.

Time Paradox

Time paradoxes are something that one must learn to organize and solve otherwise there will be no way.

The paradox has been solved, the remaining motion is for everyone to acknowledge this and integrate into the reality behind the most conscious aspects of the brain.

What can travel through 4D and 5D space does not make sense in 3D space. So there is a possibility that some of humanity traveled through higher-dimensional space in order to re-seed a ‘distant’ Earth where no life was yet born.

What if it was then concluded that the distant Earth wasn’t distant in space, but in time and was the same Earth that the human scientists left from long ago.

Every civilization that reached the point of re-seeding would have to go through the loop and watch the whole thing start all over again.

Breakaway Civilization

This is an entire breakaway civilization that uses very advanced technology to dominate the world.

I was part of a genetic engineering program that sought to combine various elements of DNA from various sources in order to create a more easily controlled yet powerful and defined person and personality. This involves chemicals, advanced (relatively) scalar wave technology, ritual trauma and programming/mind-control, and many other aspects of conditioning, training, secret operations, physical enhancements, cognitive enhancements, virtual reality, off-world operations, temporal manipulation, spiritual and etheric training or conditioning or programming.

There is self-destruct programming which all ‘operatives’ are programmed with for self-preservation of the military command. The self-destruct programming is designed to take all the aggression one feels building up inside and willing them to escape, and causes this aggression to be turned against the self. That is self-destruct programming.

Most operatives are still under a hypnosis kind of trance which permits one to walk around in public and daily life as if none of this ever happened. Later that week, that same individual could be called for an operation and they would never remember it unless they were forced to kill someone in public out of self-defense in which case most operatives automatically unlock and become unstable due to the flashbacks.

Underground Cities

The combination of advanced technology with secret societies enabled the development of complete breakaway civilizations. One of these civilizations, possibly composed of many factions working in the same area, exists deep underground.

These separate bases are connected via high speed magnetic drive pods. The inhabitants often utilize energy healing devices, as well as perception enhancements and this often leads to a completely different outlook towards the surface civilization.

Technological Advancement

During WWII developments were made involving electrical generators. This sounds vague and there were many other details regarding the scientific knowledge, yet the idea is that very simply electromagnetic, non-Hertzian “Teslian” energy fields were discovered to have been responsible for propagating energy and consciousness in dimensions that were not previously observed. Everything from DNA, consciousness, hidden or regularly unobservable natural phenomena, time, even mass could be seen to exist as part of this hidden, latent, scalar-wave frequency as a pattern is found everywhere.

If one could determine the particular pattern of frequency and location then this can be replicated and anything can be influenced using these non-Hertzian generators.

Radio-frequency alone was developed intensively during the 60’s and 70’s in America and this was discovered to interact with consciousness to influence emotions, cognitive capacity, memory, cognitive function, biological function, health, pain, comfort, pleasure, and all forms of brain-activity.

After the knowledge of advanced technology and the occult sciences of all parts of the world was combined, the ability to target and interact directly with the human soul was refined. This was a mix of psychological tactics used to manipulate or expose the hidden psyche and technology that could manipulate memory, emotional states, wakefulness, and even dreams.

What resulted was scalar technology that could not only influence a person to take on a particular role or response, but technology that could actually put a person to sleep and locate their consciousness to contain it and transport it to a new location.

World-Wide Control Systems

In order to ensure continuity, maintain control, and shape world events these technologies were employed to manipulate the public, alter the weather and natural phenomena, and develop a means of travel and operation that enable one to move outside of the ‘plane’ of the Earth. This is includes high velocity transportation, as well as spacial-temporal distortions which could effectively “hide” one’s entire craft from visible sight. Space itself was altered to ‘shield’ craft with an a layer of ions to bend the light, or the phase was moved out of sync with the “time” frequency of any observer and this literally renders the craft immaterial.

Solar Warden

Solar Warden is a hyperspace-faring race of human beings who utilize cloning and holographic genetic recording/storage in order to protect their race and protect the Earth in this current situation where there are more than one factions using this technology. They are unable to inform the human public because they are in a similar 'Mexican standoff' situation that we are mostly all in. If they show themselves to the public, the public will be shocked. If they public does not know this situation, that there are multiple factions fighting for control over humanity, then they will not know who to trust. In that situation, the 'other factions' will surely show themselves in an attempt to trick and gather as much human genetic material as possible.

The only way forward to the future is to share the truth about Solar Warden, the space-faring fleet of humans who do no contains the mental and physical illnesses that are currently tearing our planet in two. I believe Solar Warden saved my life as a child during more than one event where I would've been entirely maimed/paralyzed or simply dead on the spot as a result of other faction interference. I was in the bases as a child and was trained as an operative for MILABS a secret division of human space-military. The military has been preparing for the future by testing for various flaws and potential uses of cloning and genetic engineering.

Team Light and Team Dark Non-Interference Agreement

Team light and team dark agreed to a non-interference on ground level rule in order to determine how history would play out. Think about it. You have two groups of people, both with immortality, zero-point tech, virtually infinite energy and power with two opposing directives. How do you get to the future? It was decided by elders of each group that there would be no point in fighting an all-out overt war, this would likely destroy the population as much as it would destroy the Earth. As well, the elders of the elders which no body knows would likely have a problem with these groups going at it in such a way so as to change the flow of the planet for every individual thereafter. So it was decided that there would be a "non-interference" agreement for the surface population. Anywhere other than the surface, one can interact with the current population.

All Contact Must Be Initiated On an Individual Basis

On the surface everything that is generated must be done so through living channels in the population and the civilization must be preserved in its level of technological advancement. No overt motions would be used unless an absolute necessity or the majority of the civilian population had naturally come to the awareness of these possibilities. Doing so before this was met would undoubtedly and permanently change the civilization forever.

So what began as a collective motion towards higher awareness became a series of advancements and set-backs all taking place within a short amount of time. This represents the actions and operations of either side effectively helping humanity along it's path or setting people back with orchestrated events such as the suppression of

ancient knowledge, the manipulation of the education or other systems, or the generation of war and prison for profit based on the previous alterations of the education or other systems.

So team dark used its power to help turn society in a warlock ruled prison and indoctrination system of absurdity and scarcity. Team light used their power to help awaken those in need and protect those who's actions are beneficial in the overall plan to save mankind from itself. Team light essentially buffers and shields the population from the operations of team dark.

Team light follows a non-interference agreement while team dark merely pretends to do so as much as is necessary not initiate war.

A Singularity of Change and Awareness

Neither side wants an all out war. This would reduce the dark faction's chances of gaining a majority negative harvest because their motives and presence would be instantly revealed. Team light would also have to show themselves and again step in which is not a pattern of learning that prepares people for the experience of the self and the truth in the Universe.

Both sides know people have to accept the path they can offer them and cannot force anyone into it. They also know that the more this goes on the more likely people are to collectively awaken to the reality of what is happening. It is like an eventual singularity of increased awareness.

The motions we see today are the results of many people coming into awareness at this time on the surface in order to initiate a harmonic alignment as well as to investigate the ongoing crimes against Humanity.

As a result of this, both teams know that the likelihood of collective shift and spiritual awareness is becoming more and more real.

Many events are being allowed because they are representing the eventual shift towards the one end of the polarity from the other which is felt as a shock to society, and this is used to propel society forward through whatever means necessary.

Either people will see what's happening and agree that we've been in a feedback cycle of negativity for the entire age of existence this civilization is aware of, and then we will shift into the real. Or people will claim that this is how things are supposed to work and instead of realizing everything is controlled in a deception based system, they see this and attempt to use the deception based system to gain more collective awareness. If this occurs by the majority then it will be seen as an "acceptance" to initiate a plan that will generate the overt perception of a deception and oppression system. This will surely shock the collective into realizing where they are.

If the majority comes to awareness of this deception based system then the shift moves from the end of the age of deception and external power into the age of internal awareness and harmony.

Advanced Technology and Ancient Knowledge

The plan is to slowly release advanced technology which will undoubtedly connect with and increase the awareness of ancient knowledge. Such technology nullifies the problems that the planet is currently plagued with, although without a developed sense of the spiritual self the technology becomes destructive.

Cloning, Atmospheric Civilizations, Genetic Stability

Here is something that most people might not have contemplated yet is possibly one of the most important factors at play here.

The vehicles that house the breakaway Human society are entirely environmentally controlled. This means that the air and surfaces are clean of all the viruses, bacteria, or pathogens that are numerous on the surface of the Earth.

This creates a specific difficulty in the situation. Any contact between surface Humanity is so heavily and carefully controlled that regulations go beyond any situations we have present on Earth. If the safety and cleanliness of any of the society's vehicles were compromised this would endanger everyone "on board".

So this explains a very precarious and specific situation we currently face and this is not so different than "first-world" nations contacting indigenous tribes and similarly endangering their society. Everything that happens will be according to a carefully controlled plan.

Training, Simulations and Learning

Part of what went on in the underground base experiments were to design "tests" or "labyrinths" with various people, props, traps, and treacherous situations that were to be navigated and escaped from.

Feedback loops with the brain, consciousness, and environment can create a very complex and integrated learning experience that is customized to each individual learner.

What this would do is create an individual that was capable of learning faster and faster and processing information in a more efficient manner.

This is not the same as specifically trauma-generating situations.

Cloning and Cerebrally Enhanced Soldiers – MILABS

This includes experiments, condition, trauma-based mind control, enhancement, memory suppression and operations that cover a span of space and time.

The NAZI faction has used cloning and genetic engineering to create hybrids, soldiers and everything in between. Religious/spiritual icons, to slaves, to leaders and even robotoids of sorts.

Your genetics BELONG TO YOU as the LIVING(ETERNAL) SELF. These issues are going to come more and more apparent.

If they agree to allow cloning, then who says who is allowed to clone whoever they want, Einstein, for example. And then who permits who to get DNA from history or objects in the world. These issues are going to have to be looked at because they have already been used in ways that are far beyond the basics.

Then what about consent of the masses? This is clearly being put in public because consent is required on an overall scale and individual to include people.

So what if the masses consent overall, would the people who choose to remain be at risk? Would Tribal and Native village life and people who respect the Earth be protected or permitted to stay?

Psychological Testing

These scenarios can also be generated to create specific situations that will contain tests or elements of temptation that will probe the person's psyche for weakness.

Hallucinatory Holographic Mind Probing Technology

Through the neural-interface technology the minds of many individuals can sync together to experience the same virtual simulation. Thus a single individual's mind can be selected for input and the environment will be a construct of their mental activity. The others present will be able to interact with and explore that environment like the person's mind.

Various training scenarios were utilized to enhance the resistance (or lack which) of the mind to intrusion and subversion. These were harsh but allowed the individual to completely control the energy flow in the conscious mind while remaining in harmony with the subconscious.

In a strange yet perfectly reasonable way, the conscious mind acts as the central "self" in that environment, while the subconscious mind becomes the "background" elements of objects and settings, actors and intentions within the flow of the "scene" itself. So a kind of movie begins with drawn out characteristics and perceptions that match that of a highly cinematic movie or intense dream.

The brain is naturally naive to stimulation and if allowed will liken the event to a dream in which the suspense of attention or lack of lucid self-awareness is "acceptable".

The truth may be worse than what you're thinking as far as training simulators and mind hacking devices. The truth may be that the human mind is inherently lucid and self-aware and that it is external influences that cloud the mind into what we consider 'regular' dreaming and 'regular' waking life. It may be that the conscious mind has a much greater access to information through the subconscious mind which is largely covered up and ignored in a rigidly physical and ego-focused society. As well, it may be that dreams are meant to become lucid and that we are often the subject of mystery in

other realms that often refer to humans as ‘sleepwalkers’ that don’t know their dreams are real.

Virtual Simulator Training Scenarios

These scenarios can be entirely holographically generated to produce a visceral 3.5 dimensional experience which can be used for training or psychological testing.

Combat Simulators

The name is self-explanatory enough. Situations can be generated which are indistinguishable from the real events. The entire neuronal map of the brain (connectome) can be created and this is by machines to mimic the brain. After calibration through sensory feedback experiences, the sensation of the simulated realm is 100% the same as the neuronal impulses that are detected by the physical brain. An adept souled being can always tell there is a slight difference, but once the machines are calibrated the physical sensation is generally the same while in the machine.

These environments and scenarios can mimic any combat situation to determine accuracy, integrity, endurance, skill, and all areas of aptitude of an operative without the risk of injury or the lack of real-time effect.

Conditioning

As was explained in other sections, these same systems can be used to remove fear of certain scenarios. They can be used for programming the mind. They can be used to train one to complete a task over and over until they can recreate that action extremely quickly in real-time. These devices can be accelerated to operate within a fraction of the time yet to cover training and conditioning that would normally take place over hours, days, weeks, to months.

Programming and Resistance to Psychological Trauma

Through the development of specifically customized scenarios and neural feedback systems trauma can be brought to the surface or specific fears and traumas can be neutralized. This is essentially “facing fear” but in a completely generated environment that will be just as real as the real thing. One can literally face any fear, any trauma, any kind of difficulty and these systems can be utilized to accelerate a process that would normally take weeks to months or years and individuals can be strengthened to their maximal capabilities.

Accelerated Mental Functioning

Some of the technological systems were designed to test the enhanced functioning of an accelerated brain.

The mind can be seen as the energetic component of the physical brain. The physical brain projects consciousness via the electro-chemical processes.

Technology, Accelerated Learning and Repair

Technology has been developed for assisted learning and accelerated repair of tissues.

On Orgone Energy

Orgone devices produce a scattered signal which disrupts the ‘negative’ energy fields. At least this is what I’ve been told.

Apparently if built correctly it will either disrupt the negative emf/harmonics or it will produce positive harmonics, IE: Orgone energy. Orgone energy is the raw energy of life, while dead orgone, DOR, is the lack of orgone energy and can be “found” (the lack of orgone) in thunder storms and illness or depression.

This is exactly what I was told. We are generators for the same energy, and with the correct principles of energy and internal knowledge combined we can produce those very effects at will.

The energy of the mind creates a central vortex within the body. When the frequency pattern emission is consistent with fractal congruence, then that holographic printing of energy can be expanded or shrunk infinitesimally and it will retain the original fractal configuration.

This is what enables transference of awareness between fundamental harmonic layers of the Universe. When one’s consciousness energy pattern is balanced and tuned to itself so that all proportions can be shrunk through a vortex and expanded on the other side, then the personality or self-awareness remains true. This is as if the space/time must turn inside out and only when there is fractal relative polarity in time does the ‘shape’ of the consciousness within the DNA, work both ways folding and unfolding to represent the same mirror image. This is also symmetry in time as far as an ability to reverse the perception and still retain some kind of connection forward and backwards.

Energy Generators and Serums

Generators which produce vibrations that influence the cells to heal at an accelerated rate, combined with serums that enable the fuel for chemical reactions can instantaneously repair tissues.

I couldn’t believe what I was seeing at first, thinking it was a trick. There are serums and energy devices that can influence the healing and general health of the body and even mind.

These devices use energies which extend beyond the physical and are often compared to electromagnetic waves combined with ultrasonic or low to mid frequency tones. These produce harmony on a level that directly interacts with the biological functioning of the body’s cells.

I feel that this technology utilizes the same energy that is emitted from the mind and it is as if the device is “speaking” to the cells in the same kind of universal language of electromagnetic pulses, tones and vibrations.

There is information on energy devices and the use of light therapy in physical therapy today. More is being learned about the power of light and vibrations to influence the mind and body.

Genetic and Cybernetic Enhancements

Certain individuals are also genetically and technologically modified to produce a kind of hybrid human that can heal at a spontaneous rate as well as operate at a much higher rate of speed and efficiency than a regular person. Serums to induce muscle growth and mental acuity are applied, but the main condition is the enhancement of certain features through the alteration of the RNA aspect of the genes.

These features are combined with tech-assisted metabolism and certain biological functions can be enhanced or controlled via a supercomputer. These are the 'brain-chip' interfaces which operate to function as a governor for the mind. When the mind becomes too amped up to focus on the details the faster than thought computer system organizes the input into more usable information streams. When the mind is too slow to see the necessary patterns and variables to accomplish the goal, the brainchip operates in a self-preservation fashion and links together information streams to highlight the most viable possibilities.

Such technology is not without warning, much of this is being used heavily in the military field and this has given rise to entire factions of enhanced cybernetic soldiers. Although this is something to know, there are also many other uses for this technology and it is used by people who want to explore the technologically assisted path.

There are many other aspects of this to discuss, or at least a few important ones that will have to be understood to know the greater truth about what is happening on the planet.

Developing The Self

The issues we face are to help us learn about our selves and better mediate the known and unknown aspects of personality. The more we focus on realizing the unknown aspects of personality the less we are seemingly controlled and forced to experience the undesirable aspects of existence. The more we cling to just what we know and what we feel comfortable with the more shocked we are when we inevitably discover the truth of the whole of our existence which is *always* at least one half more than just what we know and are comfortable with. That is the nature of the universe, we can only achieve one half of the equation at any given moment. Once we complete that seemingly whole view of the universe, the information we gain access to instantly doubles and we realize that we were only looking at one portion at a time, just one half of the equation. Then the rest of the equation comes into the picture and we must expand our view once again. This is because we are viewing ourselves as we discover the universe because we are creating what there is to be discovered through the act of exploration in itself. We are the explorer, the explored, the creation and the discovery simultaneously.

Multiple Factions of Space-Fleets, Multiple Goals

Now there are what are called ‘factions’ of groups that have different agendas and interact with the public or surface level population differently. That is one of the main issues. These departments and factions are no longer limited to the surface level of existence and have access advanced technological capacity and knowledge of a larger view of time and a more complete understanding of consciousness and the human existence.

Large-Scale Catastrophes or Series of Meltdowns

I was informed that while they work continuously to prevent and reposition this civilization continually outside of the reach of any large scale meltdowns that the technology is commonly accepted to only be a temporary barrier between the inevitable.

Unsustainable

This society is unsustainable and must either change or will experience the massive catastrophic evens that are foreseen.

There are multiple perspectives that are maintained. They vary by the way of the methodology of solving the problem. All agree that change must occur and is impossible

to postpone forever. The future society is the result of our advancements and achievements. Regardless of how we get there, we must get their somehow.

Earth Changes

I was informed that these changes had been held off and would ultimately be allowed to take place to resolve the current situation. The changes can only be held off for so long, either that or the people performing this task would not be reasonably inclined to postpone these changes indefinitely.

The idea is to locate and secure the members of society who are fearless and capable of assisting in this transition and who hold key genetic elements as these individuals and groups are capable of ‘holding-space’ for the rest of civilization by literally containing the genetic precursors for all those other individuals.

I was informed that Earth changes would be the last event to take place, pretty much like icing on the cake.

This means there will be a lead up to these events.

Mass Consciousness

I was informed that the consciousness of humanity and every species is linked to the bio-etheric field of Earth. When the consciousness becomes too unstable to maintain a controlled society that this will initiate massive Earth changes. This could simply be instigated through advanced technology but I was informed that the advanced technology is

actually postponing this so as to allow people to prepare, to get the word out and avoid a complete loss of the human race.

Wars and Manipulation

Wars were described as a way the power groups had controlled humanity over long periods of time. These wars were used to distract and weaken the population and the power groups believed they were holding off a full scale invasion by suppressing the rising population.

Now the population is high enough that another war would be a final war and this is extremely dangerous for the entire civilization. There would be no need for another war to repeat this cycle because the technological achievements have been met and so essentially the ‘reseting’ of the civilization would not be required or possibly acceptable.

This is why war is to be avoided however people are very easy to manipulate through lower emotional and mental programming from media and social cues. People follow the herd and the herd is essentially still operating on animalistic parameters. There is a have coating of peace and humility but this is just a wax coating that quickly evaporates as soon as the pressure of mass unrest or scarcity is realized. Many simulators have explored these possibilities.

Financial Unrest (or reset)

The idea is that financial oppression is used before wars to distract and oppress the population. When people are busy looking for resources to survive, they are not focused on the larger picture. This is part of the ‘fight or flight’ response mechanism tied to lower brain complexes which are primarily activated to keep the masses in both a highly sensitive and unstable state of being while also keeping them easy to control.

If the civil unrest reaches a level where awareness continues to rise even though financial hardship is being implemented then the latter two options will not work. At that point artificial disasters can be produced as well as natural Earth changes which initiate a shift of the ages and of consciousness.

The paradox or maybe irony here is that the oppressive actions are used to both suppress human awareness up to a certain point and simultaneously to stimulate and arouse the human spirit into wakefulness and self-empowerment. This is part of the reasoning regarding why these control systems are allowed.

Some say the elite don't want an economic collapse. That it would ruin everything. Others say it would be icing on the cake. Some say that it is a zero-point world that will save us. That the Fukushima is a big problem. Zero-point field tech, that is. Generators and energy sources, healing and terraforming. I know we project right? We see it in our own lives. So we can project with each other and grow that as a group and that part of the world will exist in that light. Which sounds Biblical, which may be because they're following prophecy. But it may also mean that we have a light, a chance, a real salvation, but that we have to grow that here and help develop it. To pass it on like love and such.

That's apparently what it comes down to. That these cycles happen every so often and we're in the midst of one right now.

Let's make it count. Every day, thought moment. With mindfulness, intention and awareness in action. Life is literally higher dimensional, so we have to become multidimensional to really face it. Indeed, that is a good perspective on action and inner being. It's like a fractal, whatever we project inside that chest center, will project into our mind and the outside. But we have to be stabilized and grounded through the root first and then to get to the heart energy must pass through the sacral/sexual centers and continue upward.

Self-Responsibility

The main reasoning is self-responsibility. We are responsible for ourselves. The people are and so if they allow themselves to be tricked and prodded like animals while behaving for the part, then that is how their experience will play out.

Clones and Synthetics

One seemingly unfair aspect of this is that there is a larger portion of non-humans than there are humans and so these beings without the human spirit will be easily programmed to support and propagate the mind-control system and the oppression. Thus, if people follow the herd mentality then they will walk directly into the end-time scenarios yet it is the humans who will actually stand to lose. People must wake up to these tricks and this technology so that they can orient themselves with the reality of this situation while learning to strengthen themselves and adapt to the manipulative aspects of this control system.

Spiritual Power and Divine Truth

This is essentially all about spiritual power and humanity stepping into the power of the truth behind their existence.

Some say that humans are designed as slaves, but if this is so, then it is the power that humans contain within that is the ‘work’ that they are sought after for. This indicates that humans have great powers that others cannot achieve on their own, even if they are creator lords.

Thus, whether humans are modified or not, they have great power. If they are not modified to perform this role of an energy generator, then this is just a confusing mind-control game that has been pulled over the eyes of humanity and humans have always contained true internal spiritual power that allows them to exist without having to parasite and steal the energy and knowledge of others. Humans are reality generators , we can choose how we want to experience the universe and what kind of collective world we want to enjoy together. Once we step into this power, there is on greater force. No amount of non-human entities can change that as we are somehow intrinsically linked to the ether-space of this realm through the spiritual and physical aspects of our being. That is what is sought after and so those who do not have this manifestation power attempt to

utilize humans to create their own reality through this Earth situation. That is the basics of the ‘alien overlord’ system, whether humans in disguise, non-humans operating with alien intelligences, supercomputer systems, or spiritually degraded beings.

Most people are not ready to see themselves or the true nature of humanity. Reality is largely an illusion of the conscious mind. The hidden aspects are the other half of the equation and this is perceived by the shadow aspect of the personality and mind. We are only marginally aware unless that aspect has been unveiled and through this process the reality of the human soul can be actualized and realized.

I was informed there would be a period of two suns and multiple mirages around the world. People would believe they were peering into another dimension, floating cities, or some kind of city-ship craft.

Synthetic DNA, Synthetic Genetics

Through the previous described replicator devices synthetic DNA can be engineered. Thus, entire genetically engineered codons can be produced and form this created beings can arise. These are the hybrid beings that are performing many tasks underground and even on the surface. On the surface there are synthetic genetic create beings or genetically engineered beings that appear to be human but do not contain a human genome. There are also clones and replicants of humans. There are a variety of non-humanoid forms but these are largely kept underground. These are beings we often see in science fiction movies or shows.

Time as Mathematics, Series of Equations, a Programmable Storyline

When using the technology, time can be understood to be a series of programmable variables where one variable is centered within a series of parameters and from these possible variables within a parameter set a series of possible functions or outcomes can be process. Thus, these people can literally plug into a supercomputer system which operates based on this form of processing reality and through this they can observe all the possible realities that may connect to a present moment. This allows one to travel but this is not part of this section of the explanation.

What this allows one to do is know exactly what is going to happen and when. If a person is being interrogated, all that has to be done is the operative using the technology simply thinks of what they will say and intends to do it within 6 seconds. The machine will play out a future timescale regarding the input of that question or interrogative speech and then produce the possible results. If this doesn’t give the desired readout in the mind of the operative, they will refuse to go that route and think of another pathway. This repeats for a few seconds to a few minutes. Then the computer has found the pathway that is most like to yield a result. The operative simply steps forward, says ten words, the subject breaks immediately and tells them everything they want to know. This is obviously takes longer for most trained individuals, however that is how easily it would be to use this technology to produce an effect on a regular surface level human. They would have

no defense, no way of knowing how that individual could know so much or be so direct. This is how operatives dealing with certain power groups will operate in the surface level population and individuals always feel that these people know way more than they are leading on. That is because they are, they know more about you and your life experience than you do.

Chapter 2.3 Previewing Solutions

Neutralizing Polarization

The mental-emotional tendency to pick sides, to fight, or to basically join in the fray that is currently taking place is a kind of deception of polarization which enables the leeching of emotional and mental energy from the human. This is more of a psychological unveiling where the true nature of the self, the duality game and the transcendent source aspects can be made visible to the individual. The they will see how every polarization tactic is actually taking them out of their true source of power by pushing them off center emotionally and mentally. There are teams that are capable of enabling this process and assisting as humanity realizes that half of the problem is that the unchecked mind is one's own worst enemy.

Removing Etheric Implants

Technology can identify and isolate these foreign body implants which are etheric technological devices. These are literally frequency or phase-shifted devices which are invisible to this layer of physicality but are capable of being organized and attached to the etheric field of the human and will operate to siphon or limit energy on the etheric level. Of course, this is all technology of the vampiric created beings who parasite on the original Earth inhabitants to sustain their existence.

Clearing Astral Body

By moving through the temporal body etheric implants can be deactivated and removed and then the astral or emotional body will be able to function closer to the original levels of presence and sensitivity. This body is manipulated when one is emotionally shut down from trauma. Thus this body can be scarred and will function at a much lesser level of activity or presence until the emotional damage is healed. This contains the memories of all the emotional events of a person's life.

There is technology that enables one to access these levels of frequency and clarify or untangle emotional chords or attachments which are used to siphon energy from the human being to the parasitic created beings. These chords are energetic in nature but also have technological components.

Knowing the True Self; Soul Actualization, Unveiling

This is a sacred, ancient process that has been outlined and discussed since the beginning of time. Humanity is here to learn, grow and express the self. In doing so, like a child moving through layers of infancy and into full-wakefulness of their body and the physical world, humanity can come into awareness of their true spiritual nature and the true spiritual nature of the universe. This is the process of soul or self-actualization that is described in some psychological methods such as Maslow's hierarchy of needs and the self-actualization that results in a complete fulfillment of all psychological needs. In this modern psychological view, self-actualization is described as the desire and process of reaching fulfillment of one's own natures and then living their life sharing that self-empowerment with other beings because after gaining your self that is the highest expression of such knowledge, sharing that power with others.

The true self is not limited to the physical body, the true self is a reflection of the entire universe and thus the primary original creative force. This is akin to the whole equation rather than just half of the equation. The visible aspect of the self, the conscious mind, is only one half of the entire equation. The whole equation consists of what we see visibly and consciously as well as what we are limited from seeing within the unconscious and subconscious mind. These are really two layers of the same ultimate source. Like an iceberg which is only partially above water, the subconscious mind is the proprietary wholeness of experience. The conscious mind is only a surface layer of reality while the unconscious mind carries all the notions, the multidimensional processes, the latent aspects of reality that we are not capable of seeing without unveiling these aspects through inner exploration.

Taking Responsibility

This entire show is about taking self-responsibility. Unless people begin to do this, there will be no hope. Right now people are convinced that their responsibilities belong to someone else even though this always results in pain and discomfort. To take responsibility is painful at first because we have a lot of work to do, but even then, this is beneficial because there is no way to remedy the pain and discomfort of being lied to and disrespected if people continue to hand their free-will over to others through blame (scapegoating), lower emotional bio-emissions (hatred, anger, etc), distractions and addictions (technological, sensual, and chemical or food based), or generally complaining without taking the first step towards providing something beneficial. This is the victim role, if humanity is to take control then they to help each other and themselves by not relying on false promises and false authorities to determine how they feel, think and live.

Returning To Center Emotionally and Mentally (spiritually)

Balanced food intake, rest, exercise, activity and learning are all continual requirements for a healthy existence. Emotional and creative expression nurtures the soul. Without these ways of being and learning the human qualities of experience diminish and creativity dwindles. There is most likely going to be a split between those who can sustain their own humanity and those who have to cause others to suffer to do so.

Vampires in the “Awake” Community

Contrary to popular belief, the majority of the non-humans are not necessarily vampiric and in power. The vampires are the people online who try to get a rise out of others for sharing their own experiences. They are the nosy neighbor that feels that the person who looks or acts differently must be considered and enemy and armed against because they feel themselves to be so much better. The majority of people are vampires, they believe that they must work for someone who will trade them money and that the amount of money they have based upon the amount of indirectly beneficial work they do puts them above others.

This is not different in the ‘awake’ community and in fact I feel that there are higher concentrations of vampires in this community, the alternate media because everything is largely a joke and a trick. People are operating on deceptive agenda schemes to divide the people and this is most intensely noticed when there is a realization of the truth behind what is happening and people begin to point fingers. The only people who are cleared to point fingers (and who also will NEVER point any fingers) are the operatives from the secret projects that have the capacity to do so because they have reached a specific level of awakening and this is related to the droning, cloning, and hybridization process. Only a specific few know who has been transformed into an impostor being and who is remaining strong and this is due being briefed on the surface level situation. Anyone can say what they want, they are simply playing into the tactics of mind-controllers and parasites and the more they play in the deeper the infection will grow. All the people pointing fingers now are actually implanted and vampiric and are attempting to drive a divide through humanity and they are the first who will turn on their friends and family when the going gets tough because they are more interested in others and starting drama than healing themselves. Ironically, this is all done under the guise of “healing” and “getting rid of the drama” AKA people they don’t trust. They pick and choose based on their own personal bias and this is a sure indication that they are emotionally and mentally out of alignment and are feeding deep seated personal fears from their own traumatic experiences.

These traumas must be healed and the harmonious center must be reattained where a person can focus on their own existence and waking up instead of acting as false-light, “king of tyranny” gatekeepers for others. Those individuals are going to be left behind if they cannot kick the habit because if they are allowed into any kind of healed society

they will quickly degrade into animals and attempt to restart a devolution process in order to gain the power they so desire but cannot produce on their own. ANYONE playing ego games of trying to hurt or put blame on ANYONE else contains this viral implant and has not kicked the virus.

Heart Center and Psycho-Spiritual Fulfillment (self-actualization)

Emotional connectivity is a form of telepathy, when loved ones can tell the state of another across space and time. Whether it is family or friend. In the 60's and a little before that the US found a specific frequency akin to a radio frequency that operates on a trinary spectrum. They called this the "telepathic wave". In time, they could completely read and send thought waves without frying the brain or body through radiation. Which was what the early machines did. They actually took satellite dishes and aimed them at people. Then realized they could turn it around and do it backwards with a better effect and minimal radiation. Either way they started beaming the base and then towns around them with waves between 400 and 432 MHz and caused waves of crime sprees or peace sprees throughout the 70's and 80's. So they can digitize the telepathic wave to induce artificial telepathy. But this is organically done through an entanglement through what we call love. Literally. The Germans found it before that. And the secret orders before them. And ancient Egypt before them. As humans we remain basically through the root, heart mind connection. When the heart overpowers the mind connection of spirit, then the body is a trinary whole. When the mind guides it is binary and cannot by guided by the spirit. The spirit has direct access to the heart. The mind is a computer of sorts. The mind doesn't see past duality. The heart is the true center/eye of the spirit. The reptilian brain is the dragon and when you tame the amygdala then fear is ‘behind’ you. When the mind is "untamed" the reptilian brain takes over. This is the lower brain and amygdala fight or flight response.

This happens when the energy of the brain, body and spirit increases due to whatever various reason of spontaneous or controlled increase. Because of the "temptations" which are the easiest flow of emotional energy into a "discharge" state, is that the sacral/sexual center ties to the heart and reroutes to replace the heart and control the mind. Mental and emotional contemplation of one's true purpose and nature is the path of the divine. We find ourselves simply by looking in the right place, not in the world, but in our self energetically. We are more powerful than the programming, and we can reverse this is we're careful and devoted enough.

We have to be faster than thought, at the speed of spirit, beyond matter. When we start thinking on this level then our influences spread to others throughout the sphere. It is our destiny to know these things but they have been kept from us. The ancient orders called this the art of "implosion". Traveling realities through intense contemplation and a usage of sacred geometrical forms.

They developed and combined orders around WW2 and developed zero-point energy tech that can alter space/time fields. This is timeline manipulation. But as a rule, we go where our heart leads us. So that's how this is solved.

Go Within to Observer the Self

The answer is literally by looking within to find the great truth rather than looking around us. Everything we need to know is within us, energetically and spiritually. Our emotional, mental and physical state of balance is an indication of where and how we exist in relation to the larger overall truth. Everything that happens around us to distract us is designed to stop us from looking within. Nothing can truly stop us, nothing can actually input the holographic horrors in our spiritual center but simply perturb the brain and body. The mind is a non-holographic spiritual environment that cannot be excessed and the invader's goal is to convince people to use their imagination or their creative powers to produce these horrors on their own. This is through the programming. We must clear out the programming, the trauma, the lower-dimensional constructs and fill ourselves with the truth and spiritual presence that enables us to be self-aware in the first place. If we aren't doing this, then we are either in pain, or there is no spiritual presence to be in pain. If we are doing this, we are either clearing out the constructs by replacing them with true spiritual presence and self-awareness or we are becoming aware of them.

Organic Feedback Loop

The great feat is mentally bridging the great rift between us by looking within. Which is paradoxical.

We can never see what another is perceiving exactly, well for the most part, so we all have to kind of accept that we are communicating effectively and truly get to this level of comfort by simply being secure in knowing who we are our selves.

Technological Feedback Loop

So then knowledge, in a way, when shared, is a form of telepathy. Group telepathy.

Group think, when ideas or memes spread, is a form of group telepathy.

The Internet is like artificial spreading of telepathy. This means what is normally mentally bound signals can be initiated and spread through a digital medium.

Breaking Soul-Contracts

Ultimately everyone is under a series of "veils" which are energetic time-constraints literally like 9 dimensional layers of temporal restriction which are each bounded and ruled over by invader beings. These range from physical authorities, to astral entities, to programmable matter, to supercomputer intelligences, to spiritual false-light beings and our own shadow mind. Each layer of reality is successively guarded by these beings who are here acting as gatekeepers designed to push people back when they begin to wake up. These beings all work through fear and deception and the last layer is based on mirroring our own energies back to us like an impostor. All the levels tend to imitate, how-

ever the last layer is a near perfect imitation of our own energy to the point where people often switch places with this being before getting out of the matrix. There will be more discussed on this in a later section.

The “9 veils” were designed by impostor beings as a last effort to stop humans from escaping the false-light matrix which is essentially the holographic universe. This is literally like a maze which reproduces a new pathway and a new doorway each time a person nears the last hallway or doorway that is next to the exit. So one eventually has to project themselves into the exit using their whole being and moving past and through the tricks by not falling for them before they are placed. This is highly confusing but this is essentially a kind of labyrinth that has been created to stop people from leaving so that their soul energy can be destroyed and used as a generator for the false-light system which is an AI over mind that is programmed to take the raw soul energy and destroy the identity by inverting the electromagnetic spectrum and incorporating that inverted energy into its own internal matrix body which is literally the false-light universe.

Help Everyone

Now they may have been setting us all up for the apocalypse. They said they want us to tell on them and get the whole world aware of what they've been doing So that we can stop them and pull them from the dark which is ACTUALLY taking their souls. There are also breakaway civilizations involved in this entirely zero-point/free-energy.

Chapter 2.4 How Timelines Collapse

Repeating Cycles of Time

Because of the way time works and the ability of those using these temporal devices they have set up an elaborate labyrinth like a spider web of false realities, timelines, parallels, sub-dimensional layers, astral cages, temporal dead-ends, and time loops which act to stop people from reaching the true reality. As a result, many portions of this timeline are literally in a free-will ‘time-loop’ and these loops must be canceled out. As well, because of the nature of these loops on the overall stream, our entire civilization has been looping for the past 6 time-cycles meaning we have reached this time in history 6 times before and this is apparently the last time because we have never gotten this far before and the events of the future are having to be programmed in manually at this point.

Beings From the Future

As are result and damaging time, what happens is that the beings from the possible future that is being damaged appear to try to heal the break as well as those who are from the new possible future that is generated, this results in a time war between both possible realities for the present realm. This is what has been happening for thousands of years. All the ancient spiritual texts are describing this system. One group is a from an original possible future where everything is based on the presence of spirit and souled

humans, another is from the new possible future where an AI overlord took over and removed the souls and spiritual energy from all entities on Earth rendering this a holographic prison without any other use. That reality dissolves into itself and so the time beings are constantly moving backwards and jumping timelines to try and obtain more energy.

Beings From Collapsed Timelines

The beings from the collapsed timelines are those who travel through hyperspace to get here. They then recreate themselves using cloning technology through hyperspacial means, IE: creating an alternate temporal dimension so that these devices can sustain them and literally “hold-space” for them. Then if their timeline is destroyed, they can still exist as a ‘loose-end’ in space-time. This is extremely dangerous and I will say we have some Human operatives jumping timelines searching for Earth and Humanity so that they can find a reprieve from this time war.

That is the most trying aspect of this entire ordeal for me. There are some human operatives literally in hyperspace without an opening into the temporal stream for them to reintegrate into this timeline. We must assist them, we must open the timeline by taking control of Earth from the invader races and those who wish to depress and isolate the spirited and souled human beings. We must re-organized and neutralize the invasion forces of deception and assist our humanity and maintaining their free-will, their self-awareness, their self-empowerment and their emotional, mental, and physical harmony.

Beings Who Would Never Have Existed in the First Place

As a result of this entire process, there are essentially beings who have been erased from time who degrade in this dimension and can only interact periodically. These are the created beings who operate through supercomputer forms that are placed within cloned bodies and powered by the transdimensional quantum supercomputers. These are the ‘parallel’ reality beings and this relates to the hive mind invasion. When all the original aspects of time are restored, these beings would not have ever existed in the first place as there is no quantum link for their probabilities to remain neutral and present in the original run of things.

Again, all beings who operate under the will of the universe, even when they are attempting to trick hyperspace and time, when these beings assist and help in the unification of sentient, spirited, souled beings they are capable of being healed. This is all because there is an original creative force which can produce souls that are eternal and everlasting, meaning they are not created but simply always ever were. Yet, there is a “miracle” effect where beings can be given eternal life. This is only by reflecting the will of the whole of existence, rather than a portion or a part because this is only temporary. Only the whole is forever and this takes true harmony, true balance and ultimately *self-lessness*. To give to others because you see them as worthy because they can be aware and

enjoy the gift is to be like the creative force that gives life to all and enables all experience in the first place. By acting in correspondence with this we reflect the will of the whole and that power and action transfers into protection and self-empowerment for ourselves. This cannot be cheated, tricked, or rerouted as that is the karma game that has been played by delaying time and rerouting energy through getting others to take on the responsibility for others bad actions. In the end, all karma has only been delayed because when the stops are pulled out, *everyone* ends up getting their karmic returns regardless. They simply intended to build up so much karma that by the time the ties are cut, the karma overload will simply kill them instantly. This never happens and they end up in the abyss, this is the final time so since there is no recycling of the universe from the oroboros system then whatever happens is what happens forever. If everyone wants to move into harmony, to receive healing, to receive forgiveness then they must assist in the creative force in healing, forgiving, and turning away from the deception, the cruelty, the vampiric actions.

Many vampires believe they will die if they stop. The only hope is to admit their ways to the others and ensure that there are enough beings around them that will protect them so that this situation can be handled properly, with due care, compassion, and the necessary healing to ensure the safety and protection of all who seek harmony.

Greater Kan and Li

Enlightenment-Immortal Fetus

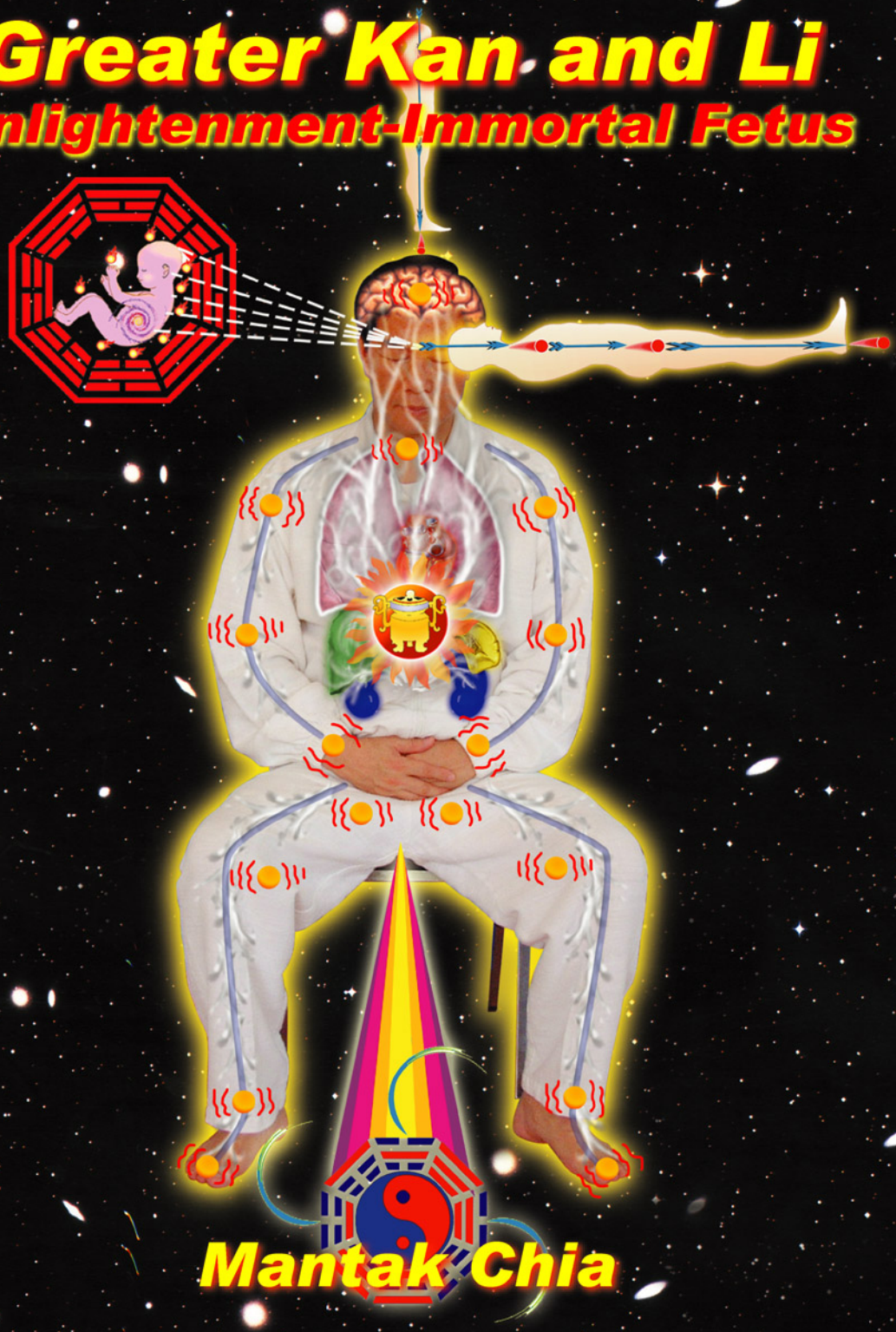

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Greater Kan and Li

Enlightenment-Growing the Immortal Fetus

Mantak Chia

Edited by:

Colin Campbell

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Three Parts of the Greater Kan and Li Practice

A. Basic Formula

Preparations. This part includes Fusion of the Five Elements and Cosmic Fusion and, if time allows, Fusion of Eight Psychic Channels. It is important to cleanse and balance the negative emotions, develop the virtues, clear the thrusting channels and strengthen the belt routes as a preliminary procedure. At this stage, the pearl could be projected through the three planes (earth, human, heaven) also, although it is not obligatory because it could be done as an integral part of Greater Kan and Li proper.

B. Kan and Li Proper

The essence of the practice is the establishment of the cauldron in the solar plexus and the birth of the soul and spirit (if it has not been done earlier in Fusion of the Five Elements). From the navel (in Lesser Kan and Li), we reestablish a new cauldron at the solar plexus, where most of Greater Kan and Li practice transpires. Other related practices, which occur in one form or another in Fusion of the Five Elements and Lesser Kan and Li, are: Self-Intercourse, Forming the Soul and Spirit Bodies, Astral Flight, Domestic Animals, Virgin and the Twelve Channels, Gathering the Pill, Closing the Meditation (Turning the Wheel of the Law), and Transferring the Consciousness to the Energy Body and the Spiritual Body.

C. Corollary and supplementary practices

These practices are essentially supplementary techniques whose purpose is to draw energy from nature: Collection of Outside Energies (moon, sun, star, plants and trees).

Outline of Basic Practice – Simplified

A. Fusion

1. Smile down to the three lines or the entire body.
2. Form the four pakuas (front, back and sides) and feel them glow like diamonds with their bottoms meeting at the cauldron.
3. Collect negative emotions from the organs at the collection points and merge and balance at the pakuas.
4. Stream energies into the center and form a pearl.
5. Using the pearl to attract the virtues, do the creation cycle.
6. Using the pearl, clean out the thrusting routes and bring the pearl back to the perineum.
7. Collect saliva and swallow to cleanse the thrusting routes.
8. Move the pearl in the microcosmic and let it gather momentum.

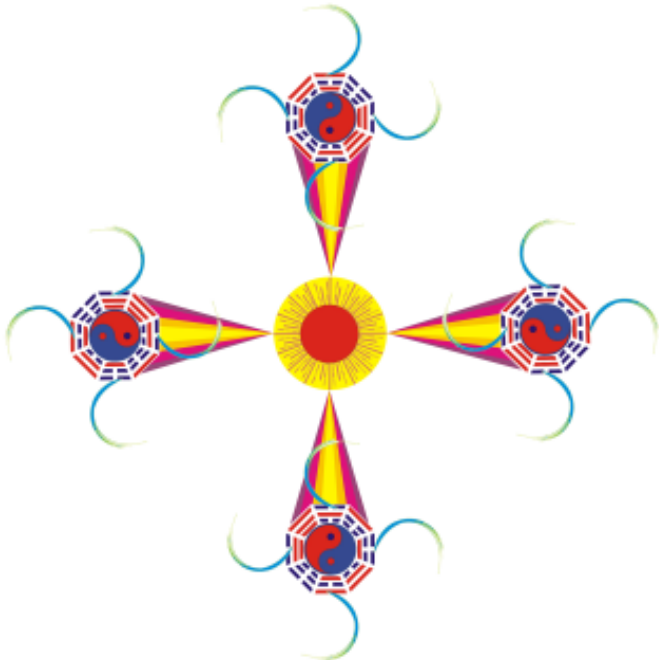

Fig. 1 *Collect negative emotions from the organs at the collection points.*

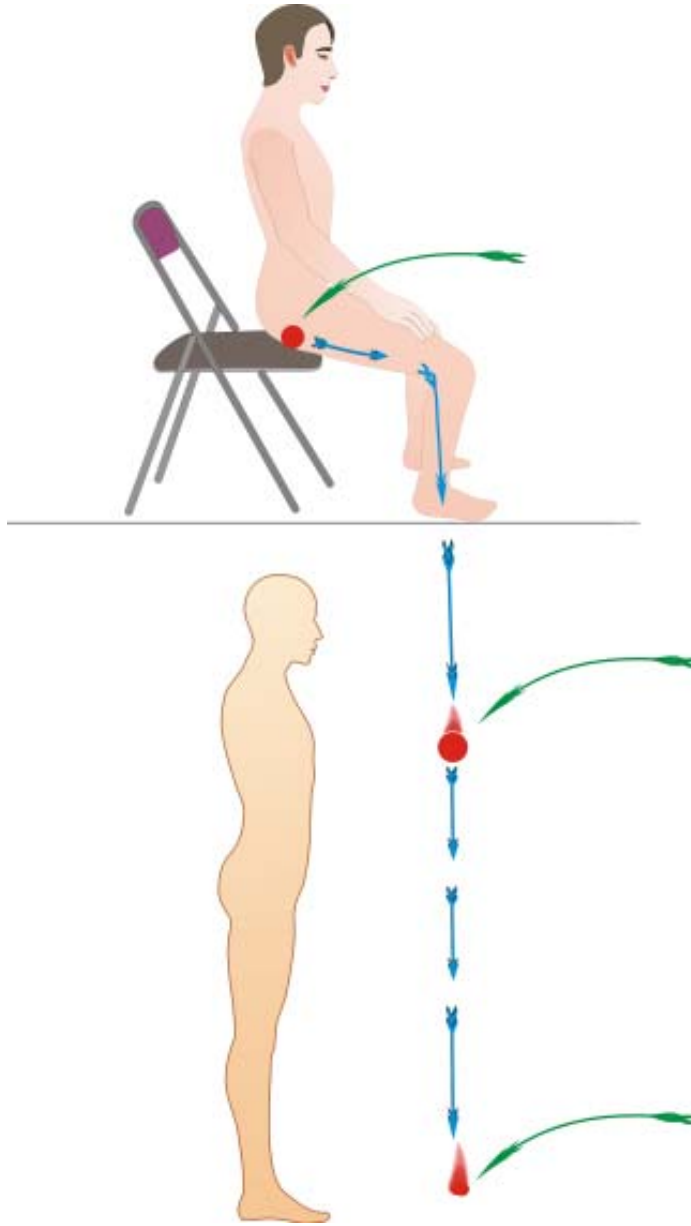

Fig. 2 *Move the pearl in the microcosmic and let it gather momentum.*

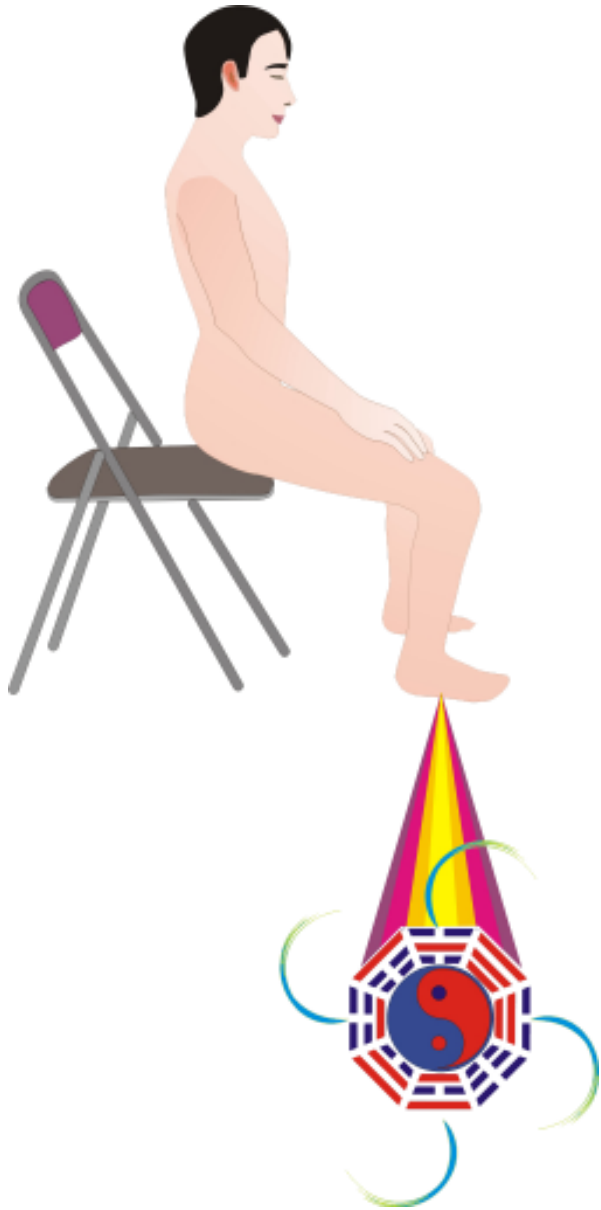

Fig. 3 *Stream energies into the center and form a pearl.*

B. Earth Plane

1. Shoot the pearl down the legs, one body length into the ground (as your practice improves, you can go down as many body lengths as your energy can reach).

2. Create a pakua around the pearl.

3. Extend the microcosmic, thrusting routes and belt routes to the body/bodies in the earth.

4. Gather water, fire, wood and metal energy through the pakua.

5. Gather in the middle of the toes and gather to the mideyebrow.

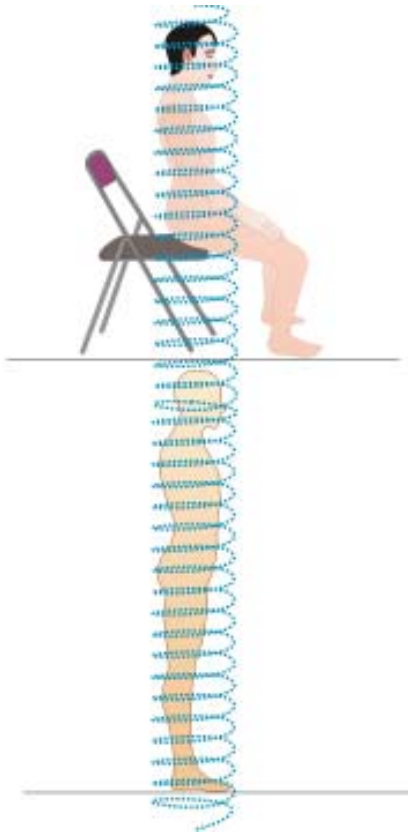

Fig. 4 *Extend the microcosmic, thrusting routes and belt routes to the body/bodies in the earth.*

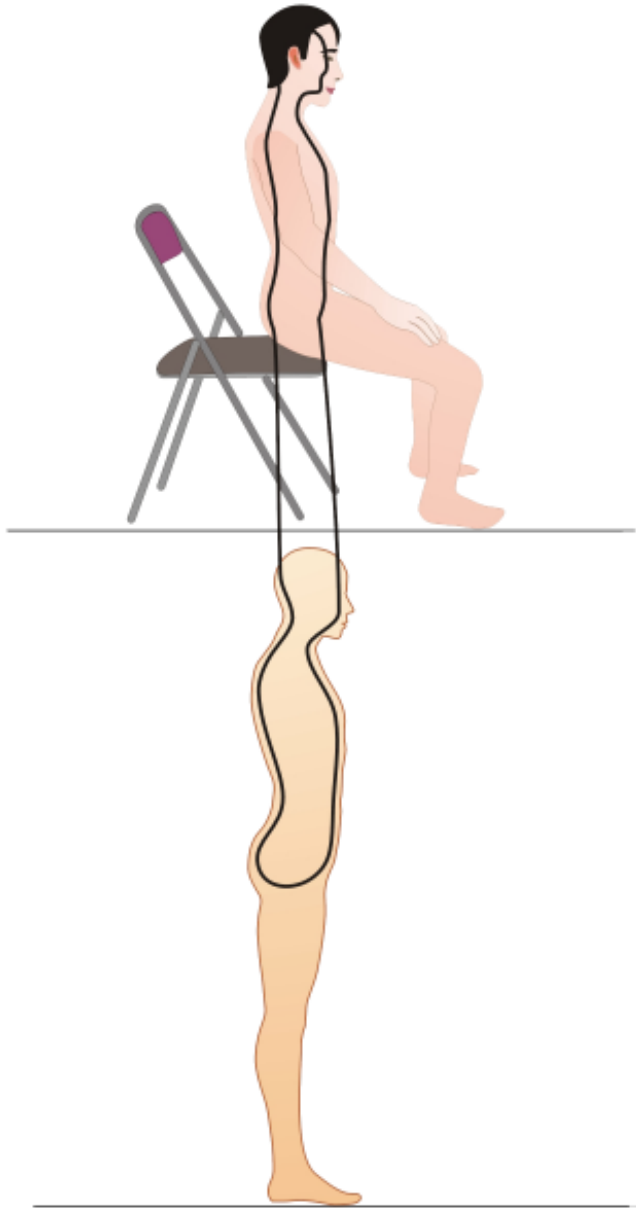

Fig. 5 *Shoot the pearl down the legs, one body length into the ground.*

C. Human Plane Cosmic Particle (Unicorn Practice)

1. Form another pearl in the cauldron and move it to the perineum.
2. Move the pearl in the microcosmic until it gathers momentum.
3. Let it stop at the crown and slowly let it go to the third eye.
4. To gather strength, you may use breathing.
5. Exhale and shoot the pearl one or more body lengths from the third eye parallel to the ground. (There is no need to visualize a body, although it provides a point of reference when one projects the microcosmic, thrusting channels and belt routes.)
6. Extend the microcosmic, thrusting channels and belt routes.
7. Gather energy with the pearl and let the energy stream into the crystal room.

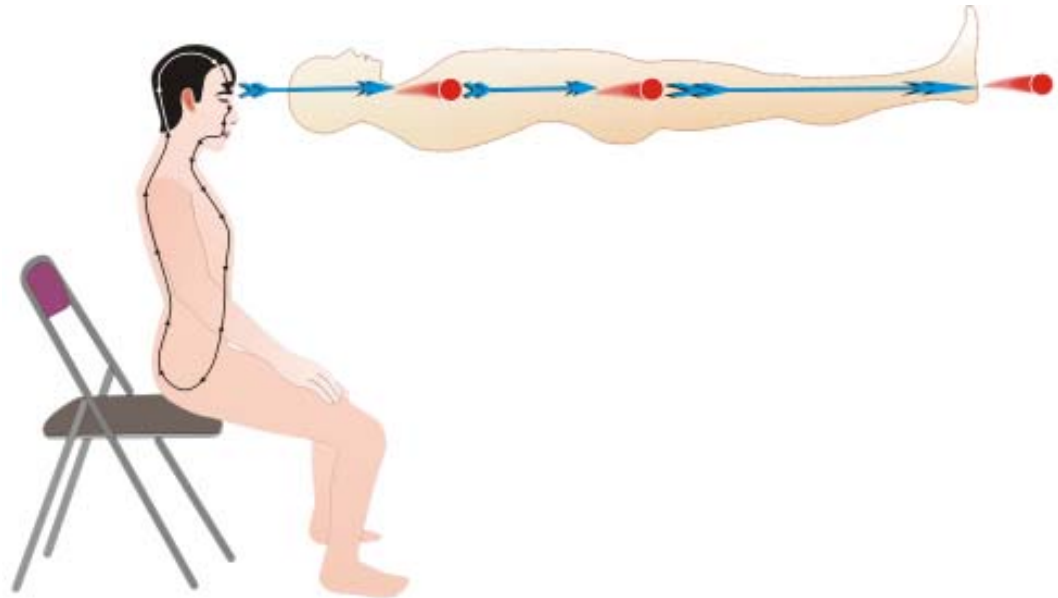

Fig. 6 *Human Plane Cosmic Particle*

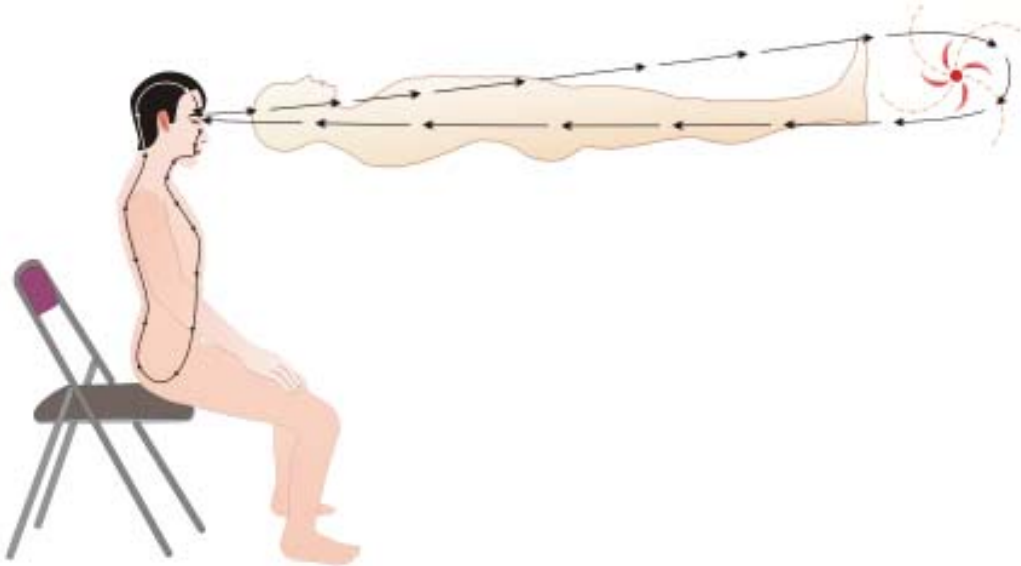

Fig. 7 *Gather Energy with the Pearl*

D. Heaven Plane (Beginning Vertical Flight)

1. Form another pearl and settle it in the perineum.
2. Move the pearl in the microcosmic and let it gather momentum.
3. Slow it down and let it rest in the crown.
4. Activate the cranial pump (look up, clench the teeth and jaw, sink chin and sternum, clench the fists, tighten the buttocks, pull up the sexual organ).
5. Exhale and shoot the pearl through the crown, extending the pearl one or more body lengths above you.
6. Extend the microcosmic, thrusting and belt routes.
7. Draw energy into the crystal room.

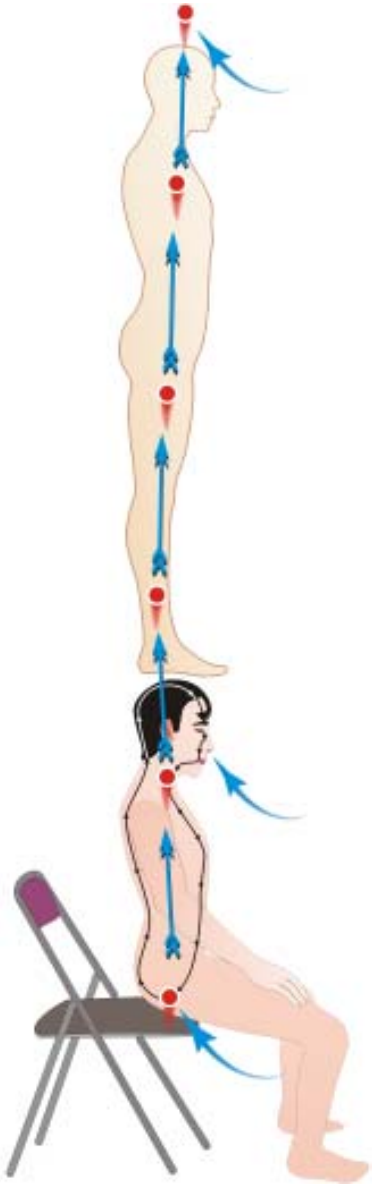

Fig. 8 *Heaven Plane (Beginning Vertical Flight)*

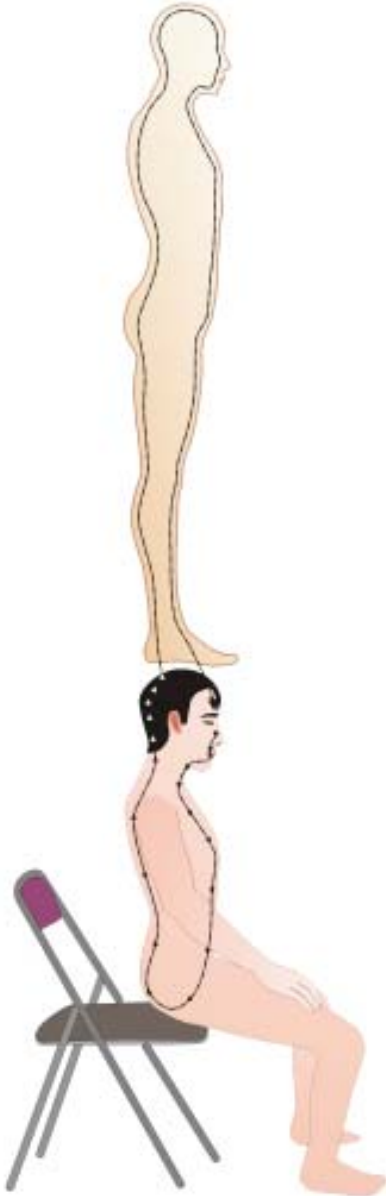

Fig. 9 *Slow it down and let it rest in the crown.*

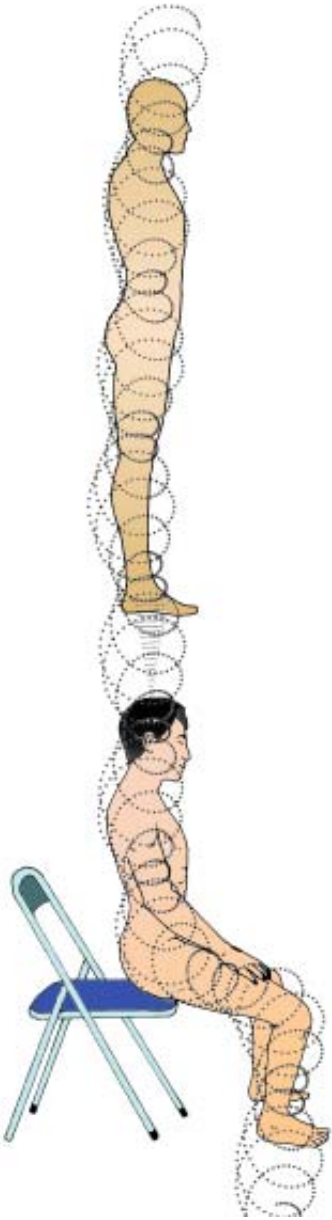

Fig. 10 *Extend the microcosmic, thrusting and belt routes.*

Greater Kan and Li Proper

A. Establishing the Cauldron at the Solar Plexus: Reversing Hot and Cold Energy (Coupling)

1. While the cauldron was established at the navel in Lesser Kan and Li, it is now established at the solar plexus.

2. Listen to the kidneys and feel their cold energy spiral at the kidney.

3. Distinguish the kidneys' cold energy from the hot energy of the adrenals.

4. Spiral and collect the cold energy of the kidneys and move it down to the collection point at the perineum.

5. Spiral and collect the hot energy from the adrenals and move it up to the crystal room behind the third eye.

6. Spiral and collect testicle and prostate energy (for men) and ovarian energy (for women) in the collection point at the perineum.

7. Divide the attention between the perineum and crystal room. Spiral at these two points.

8. Two things could be done either simultaneously or alternately:
   - Spiral and move the hot energy down the left or front thrusting route, gathering thyroid, parathyroid, thymus and heart energy on the way to the navel; and/or
   - Move the cold energy from the perineum up the right or back thrusting route to the heart.

9. Inhale and slowly exhale as you move the hot and cold energy into the middle thrusting channel to the solar plexus.

10. Couple the hot and cold energy at the solar plexus.

Reminder: Be sure to be careful in coupling the hot and cold energy that the cold energy does not spill.

Fig. 11 *Reversing Hot and Cold Energy*

B. Steaming

Consult Lesser Kan and Li for detailed description of this procedure.

1. To fan the fire of the cauldron, use bellows breathing until the energy begins to boil.
2. Establish a pulse at the cauldron and use this pulse to maintain the heat of the cauldron.
3. Turn the senses into the cauldron and stir with the eyes.
4. As the steam comes out of the cauldron, direct the steam to the following glands and organs (using the thrusting channels): kidneys, heart, thymus, thyroid, pituitary, pineal and crown.
5. Steam the thymus and lymphatic system.
6. Keeping the cauldron in place, steam the spine and regrow the nerves.
7. Steam the twelve channels.

Reminder: Amplify the pulse as the need arises since this takes the place of bellows breathing. To establish the pulse, listen to the heartbeat and synchronize other pulses to it. The result is a kind of rhythm that sets the pace not only of the practice but also of the pulsation.

Unlike in Lesser Kan and Li, it is not necessary to move the cauldron in spinal breathing and regrowing the nerves.

C. Adjusting the Seasoning in the Cauldron

This practice is intended to balance the energy in the cauldron. There may be an imbalance in the energies being used for steaming. It may not be cold or hot or there may be too much hot energy and too little cold energy; or the energy you may be drawing from its source may have changed temperature (from hot to cold, or vice versa). It is therefore necessary to determine that the energy you are using is hot or cold.

Procedure: Taste the qualities of the steam and the hot and cold energies that contribute to the process. To adjust the energy, use visualizations as follows:

- Tiger in the Sky: Greater Yang (Hot).
- Tiger in the Water: Lesser Yin (Cool).
- Dragon in the Sky: Lesser Yang (Warm).
- Dragon in the Water: Greater Yin (Cold).

Sky and tiger symbolize Yang energy; water and dragon symbolize Yin energy.

Fig. 12 *Adjusting the Seasoning in the Cauldron*

D. Domestic Animals and Virgin Boys and Girls (Pure Energy of the Organs)

1. Form the pearl, intensifying it with virtue energy.

2. Adjust the temperature in the cauldron, if necessary.

3. When the organ energy is pure enough, the energy can transform into the animals and virgin children, which will further purify the energy.

Move the pearl up to the top of the cauldron. Let it shine toward the liver. Let the crystal energy start to attract the dragon that lies dormant in the liver. The dragon's breath can change into two virgin boys, one wearing a green coat and the other wearing a yellow coat. The former can ride the dragon while the other can hold a jade scepter shaped like a paddle. Feel the virtue of kindness in the atmosphere of the liver. Get in touch with the virgin boys.

Go to the other organs, following the same procedure and using the animals and virgin children below:

a. Kidneys—Blue Deer. Two horns change into a virgin boy twelve inches tall. Virtue is gentleness.

b. Heart—Heart Pheasant. Produces virgin girl eight inches tall with a jade scepter like the heart. Virtue is respect, joy, honor and sincerity.

c. Spleen—Yellow Phoenix. Virgin girl six inches tall. Virtue is fairness, sympathy and openness.

d. Lungs—White Tiger. Virgin boy seven inches tall, carrying a shepherd's staff. Virtue is courage, strength and righteousness.

e. Gall Bladder—Green Tortoise and Snake. Virgin boy twelve inches throwing spear around liver.

4. It is the pure organ energy that is transformed into the animals and virgin boys and girls. The pearl and the fragrance attract the animals from their respective organs.

5. All the virtue energies merge into compassion energy embodied in the pearl. The animals and virgin boys and girls are attracted to it. Watch and enjoy this process.

6. At the end of the procedure, or toward the end of Greater Kan and Li proper, be sure to return the animals and virgin boys and girls to their proper organs.

7. The Inner Voice: Interacting with the animals and virgin boys and girls is one way of getting to know yourself. Be sensitive to their behavior and reactions. How they react is an indication of the state of your virtues. You can ask the virgin boys and girls questions and wait for their answers. You can name the virgin boys and girls if you wish.

Fig. 13 *Domestic Animals and Virgin Boys and Girls (Pure Energy of the Organs)*

E. Earth, Animal and Spirit Energy

Project the pearl into the earth and see what animals are there to interact with. See which ones are attracted to the pearl, which ones come to you.

Send out your love and kindness, touch the animals, absorb the essence of the animal, its positive qualities, into the pearl. Draw the energy into the feet, perineum and into your self.

Introduce the animal spirit to your domestic animals and your virgin boys and girls. Integrate their energies. Name the animals if you wish.

When the domestic animals return to their places, find the place for the new animal.

1. Do not contact cold-blooded, unstable animals, such as insects or reptiles. The animals that we attract from the earth reflect the quality of energy emerging from our cauldrons, so at different times we may attract different animals. In the process of finding an animal, we may attract a wounded animal. The state of inner change is reflected by the healing of the animal. The part of the animal that is wounded indicates the seriousness of the situation: e.g., leg means lack of support; missing head, mental problems.

2. You don't have to go down all the time to get your animals. Once you get one, use it and keep it. What attracts the animals is the quality of the pearl. The animals are good for checking what is right and wrong with one's personality. Sometimes, one goes through an energy change and the animals disappear; new ones will appear.

F. Plant, Flower, Tree, and Mid-Plane Voyages

This practice enables you to reach a higher level of awareness, not only of your organs and glands and their unique scents, but also of the essences of nature. Drawing in the energy and essences within and without enables us to tap to an alternative source of energy for higher practice and brings us closer to the Tao.

1. Steam the kidneys and heart and watch them bloom.
2. Distinguish the color and fragrance of the blossoms.
3. Proceed to steam the thymus gland and notice its color and fragrance. Do the same with the lymphatic system, pituitary, pineal, thyroid and parathyroid glands. Take time to enjoy the colors and fragrances.
4. Draw the fragrances of the flowers toward the cauldron and notice the special type of energy there.
5. Form the inner self. Be aware of the eye, ear, nose, legs, etc. of a being that looks like you or a being you would like to be. Move it out of the navel or crown. See to it that the body is linked to you by an umbilical cord. Let it travel into a springtime garden in full bloom. Choose a flower or tree that appeals to you the most. Feel its energy and absorb. Draw the flower or tree back into yourself and introduce it to your internal family. Watch how the energy reacts inside your body. Enjoy the energy.

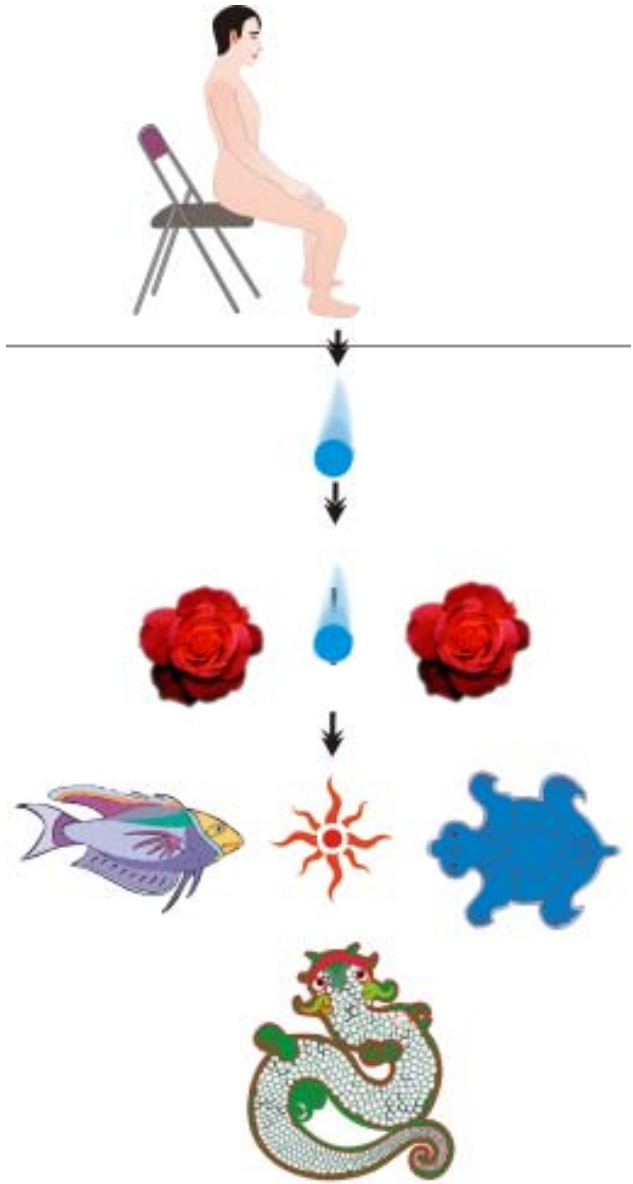

Fig. 14 *Plant, Flower, Tree, and Mid-Plane Voyages*

G. Self-Intercourse: Overcoming Death

It is important to remember that the essence of this practice is to give birth to the soul and spirit. The coupling of the Yin and Yang energies of the body in Kan and Li is aimed at overcoming death. Pregnancy may or may not result. Be aware of the symptoms of conception.

Self-intercourse, in the traditional literature, is called “first love.” It is characterized as an explosion of light from the pineal gland and a loss of physical boundaries. One learns to recognize the light. The pineal gland opens and the light comes through.

1. Focus your attention on the sexual organs and the pineal gland. Become aware of the universal (primitive) force.

2. Draw the universal energy of the earth (from the sexual organs and the pineal gland) into the cauldron until ecstasy results.

3. Allow the ecstasy to spread from the sexual organ to the organs and glands.

4. When ecstasy reaches the pineal, seed the cauldron with energy from the spleen (liver in Lesser Kan and Li).

5. If pregnancy results, run all channels and virtue energy inside the fetus (as in Fusion of the Five Elements). Be sure to practice the creation cycle often so that the fetus is nourished with virtue energy. Be patient. Growing the fetus takes a long time. It is an autonomous process. Suspend your steaming practice during the pregnancy.

a. Move the fetus in a circular pattern from the solar plexus to the spleen, to the lung, liver, perineum (pull up the sexual organs). Move the fetus to the heart and propel it to the crown to just above the head.

b. Let it stay for a minute and bring it down through the thrusting channel to the solar plexus.

c. With more practice (using the cranial pump mentioned earlier), you can propel the fetus higher.

6. If pregnancy does not result, form an imaginary fetus:

a. From the lower abdomen, make the cow sound “Mmm-mmmmoooooo.”

b. Move the imaginary fetus (as in a, b and c above) in a circular pattern from the solar plexus to the spleen, lung, liver and perineum (pull up the sexual organs); move the fetus to the heart and propel it up to the crown to just above the head.

c. With more practice (using the cranial pump mentioned earlier) you can propel the fetus higher.

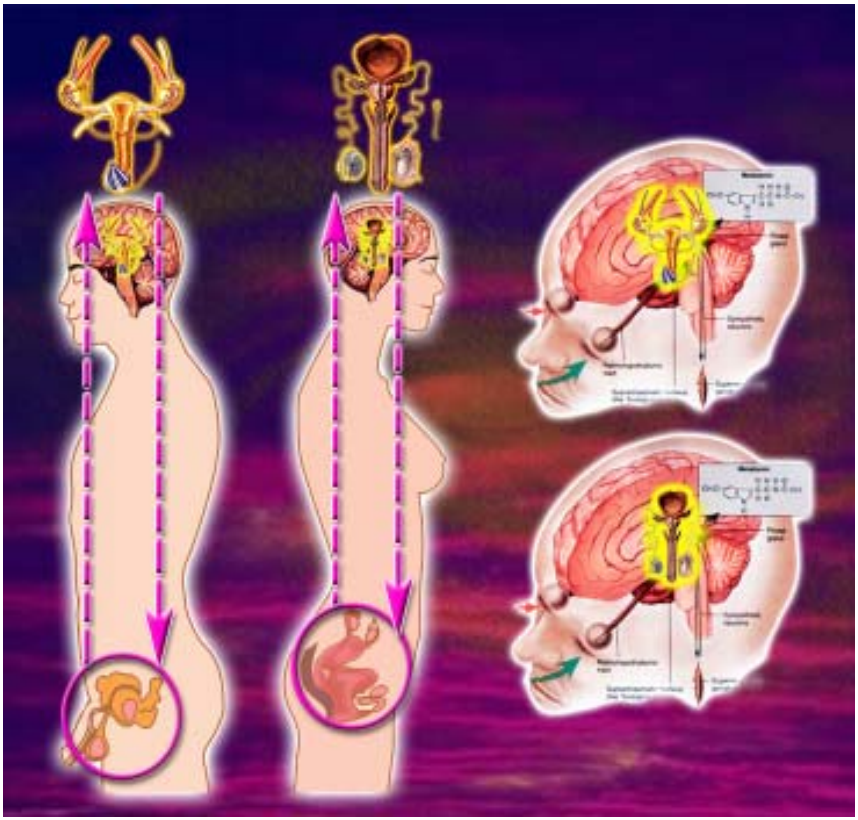

Fig. 15 *Self-Intercourse: Overcoming Death*

H. Opening and Emptying the Heart

1. Move the energy to the heart center, sink the sternum and relax the chest, steam the heart and watch it open and grow.

2. Amplify the pulse connection between the heart and the brain.

3. Inhale and squeeze the energy from the heart and as you exhale, send the energy to the brain.

4. Re-energize the heart with steam again and repeat the process.

This practice will help you open and empty the heart, energize the brain with heart energy, amplify the connection between the heart and brain and prepare you for the next level of practice.

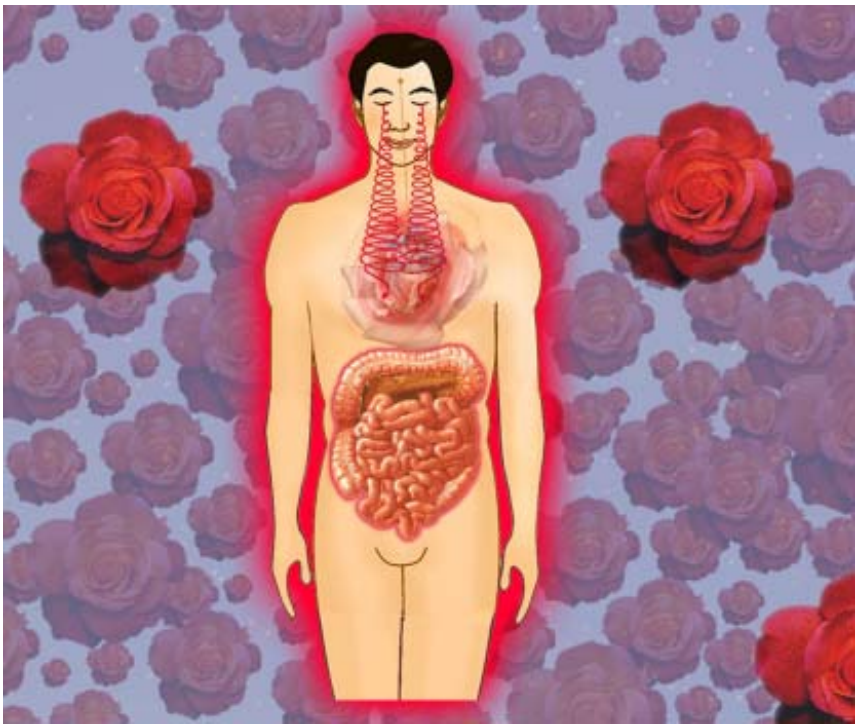

Fig. 16 *Opening and Emptying the Heart*

I. Forming the Energy and Spirit Body

Review Fusion of the Five Elements and Cosmic Fusion if you are not familiar with this procedure.

Fig. 17 *Forming the Energy and Spirit Body*

J. Astral/Vertical Flight

1. Continuing from the point where the spirit body is projected over the crown, move the spirit body around in a circle. Be aware of the distinction between the spirit body and the physical body.

2. Practice once a week for ten to fifteen minutes at the end of other work. If done at bedtime, the process will continue during sleep. The purpose of flight is to stay in the vertical and learn to digest mid-plane energies.

Fig. 18 *Astral/Vertical Flight*

Greater Kan and Li

The Sun:

Mankind has, since the beginning of time, observed the night sky and gradually gathered energy from the upper universe, the lower universe, the days and the hours. In Chinese reckoning, the lunar calendar is used and the start of these calculations was determined at the new moon 4681 years ago, in the first year of the Yellow Emperor.

This system is the accumulation of the many years of life experience of the many generations of people who followed the natural cycles. By observing the twenty-four climatic periods of solar energy, Chinese people have enriched their lives with regard to both agricultural and spiritual activities. This solar system of twenty-four periods is more closely related to the Western calendar. The Chinese system of solar energy variation defines the route the sun travels along the "Yellow Route" (ecliptic), beginning at the fixed point of the Spring Equinox and moving eastward until it reaches 360 degrees. Each 15 degree interval is a single seasonal period, thus setting twenty-four equal points. Each period has a special name which describes that climatic phase of the year.

Nature of the Sun and Moon:

The sun is the symbol of plenty, the essence of Greater Yang. The moon symbolizes Yin, or lack and the stars represent accomplishment. It is not within the emptiness of the sun's nature to experience eclipses. It is the essence of fire. It has a three-legged raven which is the essence of Yang. The moon is empty and is the essence of Yin and of water. 'It has a cinnamon tree with a rabbit that pounds the immortality drug'.

The moon is the daughter of cold and has a cold heart. The sun is related to heaven; the moon is related to earth. In the body, the sun is in the heart and the moon in the kidneys. The sun and moon are the eyes of heaven and correspond to the human eyes.

Yang within Yin and Yin within Yang in Sun and Moon:

The sun is red and its rays are purple. The moon is yellow and its rays white. The subtle breath of the sun on the stomach is red and yellow. The sun has a yellow essence and a red breath. The moon is the reverse, it has a red essence and a yellow breath.

The sun is represented by the trigram Li, (fire); the moon is represented by the trigram Kan (water). In Li the inner line is Yin. In Kan, the inner line is Yang. This is the Yin within Yang and the Yang within Yin. In the symbolism of the sun, the raven is the symbol of Yin within Yang. The rabbit in the moon is the Yang within Yin.

Solstices and Equinoxes:

In the Taoist view, the sun stops on its movement on the first day of each season. The moon stops on the days of the equinoxes and solstices. These stops are called “Doors”. In spring it is the Golden Door. This is the door of access to the sun. In autumn it is the “Eastern Well”. This is the door of access to the moon. The next stage is “Universal Yang” in the middle of summer when the sun culminates. “Great Cold” is the culmination of the moon in winter.

It is through the doors that the practitioner goes into thought to be the lord that grants the fruits of immortality.

There is a method to gather the sun essence at the “Golden Door”. This is done on the 3rd, 9th, 17th, 21st and 25th of the month in which the sun enters at the Golden Door.

The exact same practice is done for the moon when it reaches its door (the “Eastern Well”). The days for the moon are: 3rd,15th and 25th.

Cauldron and the Stars:

The cauldron has the sun on the left and the moon on the right. Above is the constellation of Ursa Major (the Great Bear). Surrounding the sun, moon and stars are all the energies.

Sun, Moon and Stars in the Body:

The sun is in the heart since it has the fire element; the moon is in the kidneys because they contain the water element. The Pole Star is in the spleen which represents the center of the body. The spleen receives the essence of the Pole Star and it is there that the Lord of the Pole Star resides. The Dipper surrounds the spleen since the spleen stands for the center of the body. The spleen receives the essence of the Dipper and that is where the Lord of the Dipper resides in the body.

Sun Essence:

The best time for practice with the sun is at sunrise and sunset when it is red. The sun spectrum from sunrise to 9 am is violet, for all the organs and especially for spiritual work. You can single out any color to be specific to the color you need. 9-11 am is for blue, and can be used to strengthen the kidneys. 11-1pm is for green, for the liver; 1-3pm is for orange, for sexual energy. 3-5pm is for red, for the heart.
Season Sun Practice: When you practice in a particular season, you can emphasise the practice of the sun spectrum inside the organ that corresponds to the season and its color.

1. Winter in the kidneys; blue.
2. Spring in the liver; green.
3. Summer in the heart; red.
4. Fall, in the lungs; white.
5. Indian summer in the spleen; yellow.

Absorbing the Breath of the Sun in the Four Seasons:

In spring absorb the orange breath (Combination of red=sun & yellow=moon) of the sun before it sets. In Fall, absorb the orange twilight of the sun after it has set. In winter absorb the white vapors of midnight. In summer, absorb the perfect clarity of the meridional sun of midday. These 4 types of breaths in addition to the blue breath of heaven and the yellow breath of the earth are called the six breaths.

Sun Practice:

1. After sunrise, when you practice with the sun, start with the Inner Smile and make the navel warm.

2. Be aware of the mideyebrow. Smile into your eyes, making them cool and soft.

3. Open your eyes and look at the sun. Keep on blinking your eyes for a while; then close your eyes. The eyes still face the sun, so you see a red and yellowish color. Single out the yellow color and breathe it in through the crown and mideyebrow into the nose, eyes and mouth. Keep the mouth closed and feel the color penetrate into these areas. Feel the bones in your skull, the brain and the brain marrow receive the yellow spectrum to wash and help grow the marrow. Let these rays penetrate deep down into the neck, like a wave penetrating deep into the bones, cell marrow and each cell in the body. Some people may experience a feeling of numbness.

4. Let the rays move to the sternum and the rib cage and feel them activate the thymus, sternum, and rib cage to help stimulate the immune system.

5. Let them flow down the spine and feel a numbness, tingling or warmth in the inner part of the bones. This feeling can spread out to the organs. Let it travel down to the hip, sacrum and feel the bones and the bone marrow activate, then let it move down to the legs and the bones of the feet. This can feel like a cosmic baptism; in this case a baptism of the sun. Feel the baptism of the sun's rays throughout your whole body.

6. Rest and let the body absorb all these cosmic nutrients. The sun becomes a prism – a rainbow of colors.

7. After your practice, look at the sun as described above and single out a color. Picture the organs and see each organ glow with its particular color.

a) Listen to the kidneys. Picture the kidneys; if you can look at an anatomy book, close your eyes and still see a picture of the kidneys, this will help tremendously with your visualization. Once you feel or see the kidneys, look at the sun and blink your eyes for a while. Then close your eyes and focus only on the color blue. In the

beginning this might be a little hard. You can use the kidneys' sound Chooooo, and the picture of the kidneys to help. Feel the kidneys glow with a bright blue light.

b) Look into the liver. Again, try to look at an anatomy book beforehand to get a clear picture of the liver to help you. Then close your eyes and retain that picture of the liver. Once you feel or see the liver, look at the sun and blink your eyes for a while. Then close your eyes and single out only the color green. In the beginning this might be a little hard. You can use the liver sound Shhhhhhhhh, and picture the liver to help you get the color. Feel the liver glow with bright green light.

c) Look, listen and move your tongue around, then feel the heart and picture it. Look at the sun and blink the eyes for a while, then close your eyes and single out only the color red. Use the heart sound Hawwww, and the qualities of the heart – love, joy and happiness. Feel the heart glow with bright red light.

d) Look, listen and taste into the spleen. Once you feel or see the spleen, look at the sun and blink your eyes for a while. Then close your eyes and single out only the color yellow. Use the spleen sound Whooooo, and the qualities of the spleen –openness and fairness. Feel the spleen glow with bright yellow light.

e) Look , listen and smell into the lungs, then picture the lungs. Once you feel or see the lungs, look at the sun and blink your eyes for a while. Then close your eyes and single out only the color white. Use the lung sound Sssssss, and the quality of the lungs–courage. Feel the lungs glow with bright white light.

8. When you are in a particular season, start your practice with that season. For example in the fall, picture the color white in the lungs. Once you feel or see the lungs, look at the sun, and blink the eyes. Then close the eyes and single out the color white and breathe it into the lungs. Then do as follows:

Winter into the kidneys; color blue.

Spring into the liver; color green.

Summer into the heart; color red.

The essence of the sun and moon is tasted on the tongue as nectar sweet as honey. This is the nourishment of the immortals.

To unite or balance the sun (left eye) and the moon (right eye) inside the crystal chamber as red light and white light, form a pearl as big as an egg and bring it down to the mouth.

9. When you can see the organs glowing with bright light, start to drink the nectar that gathers in the mouth.

a. Look at the sun and blink the eyes. When you feel and see the light, concentrate on the color violet.

b. Visualize the sun in the left eye and the moon in the right eye. This will help to balance the hot sun energy. Focus both on the third eye, Ming-tang, which is the location of the pituitary gland, and the pineal gland in the crystal room at the middle of the forehead.

c. Breathe into the crystal room and form a Chi ball or pearl.

d. After some time the Chi ball or pearl starts to drip from the glands into the crystal room. Let it drip down to the mouth, mixing with the sun essence. You can separate the sun essence from the breath in the mouth and let it mix with the original force. Feel a light ball grow in your mouth and throat. Close your eyes and focus on the light.

e. When you feel all the essence mix and glow like a Chi ball, swallow it down to the navel or cauldron.

10. Color method of the Sun

The divine breath or essence of the sun and moon appears in this method in the center of a cloud as five colors (colors of the five elements). The five colors are equivalent to everything created in the world.

a. After the Chi ball has been swallowed, look at the sun and blink the eyes for a while. Then picture the red light of the sun.

b. The red breath of the sun gathers and descends, covering the body of the practitioner. One imagines that one is in the light of the sun. The light travels through the body and rises, together with the practitioner, to the Palace of Universal Yang, the sun.

c. Gather the essence of the sun and descend.

d. Picture yourself sitting in the light of the five colors of the sun that form a halo which descends to the feet of the practitioner.

e. The five colors become concentrated and rise to the crown. The halo of five colors then penetrates through the mouth.

f. The cloud previously visualized remains outside, emanating the five colors. In the middle of the cloud appears a purple breath like the pupil of an eye.

g. This purple light has 10 layers blazing in the center of the cloud of 5 colors. The purple light together with the 5 colors penetrate through the mouth.

h. There is a counterpart moon exercise, which is identical except that the yellow breath of the moon replaces the purple breath of the sun in the center of the cloud.

Sun Essence Capture in Water:

The essence of the sun is captured in water by exposing it during the time from sunrise to 9 a.m. The color is violet, for all organs, especially for spiritual work. From 9-11 a.m. is for blue and can be used to strengthen the kidneys. 11 a.m.-1 p.m. is green for the liver; 1-3 p.m. is orange for sexual energy; 3-5 p.m. red for the heart.

A special water can be make on the days 1-15 of the month in which the sun comes to the Golden Door, which is the spring equinox. This water is called “Mineral Light; Mother of Waters”. To capture the essence, put purified rain or spring water in a sterilized bottle out in the sunlight during the corresponding phase of the spectrum for one or more days. You can drink the water, or make herb tea or mix it with food or medicine.

Eight Articulations of Sun and Moon:

The practices for the Sun and Moon are done according to the 8 articulations of sun and moon power. These are: the 2 solstices, the 2 equinoxes and the first day of the four seasons. These dates fix the time for doing the visualizations of the sun and the moon.

According to the ancient calendar the practice for each lasts 45 days in a continuous cycle of 360 days. (45 x 8 = 360).

45 days of sun practice are followed by 45 of moon practice.

Summary:

A. Moon Energy

Time of practice: 9 PM. to 1 AM.

Duration of practice: Ten to fifteen minutes.

Procedure: Feel the eyes yielding and cool. Do not blink. Absorb moon energy until tears form or the eyes heat up. Draw moon energy into the eyes, and into the mouth and mix it with saliva in the mouth. Draw in the senses, bring the chin down, straighten the spine and swallow (gulp down) into the thrusting channel for storage in the perineum.

Fig. 19 *Moon Energy*

1. Moon energy can be stored in all the organs.

2. Note that when the moon is full, there is more Yang energy in Yin. When there is no moon, there is pure Yin energy. After the new moon, there is less Yang in Yin.

3. The best time to absorb the moon energy is during the new moon, when the heart is calm. (First crescent after the dark phase.)

4. Collect moon energy in proportion to the sun energy collected to balance Yin and Yang energy.

5. The fluid of the eyes is magnetized by making it cold. The colder the fluid, the more magnetized it is. As it gets warmer, it loses its magnetism. Staring hard heats up the eyes; looking relaxed cools them. Instead of letting the eyes "go out" and reach the object, let the eyes attract the object.

B. Sun Energy

Time of Practice: At sunrise or sunset, when the sunlight is soft, not harsh. Be extremely cautious with this practice as the retina can burn quite easily.

Duration of Practice: Ten to fifteen minutes, depending on the time of the day.

Procedure: Look directly at the rising or setting sun for short periods. Close the eyes if the sun is high in the horizon. Absorb the sun energy through all three eyes into the Crystal Room (behind the Third Eye), to the Jade Pillow, down to the Door of Life (Ming-men) and store in the sacrum. It could also be stored at the Jade Pillow or Door of Life by some people, but the sacrum is the safest place.

1. At sunrise, when the sun becomes bright (yellow) is the best time to open the Third Eye; this is the energy of clear light.

2. Morning: Yin in Yang. High noon: Yang. Red Sun: more Yin.

3. At noon, absorb sun energy with the eyes closed until you see a rainbow.Then single out the colors. If one meditates, the body will become a crystal, extracting the type of light it needs. You can also place the palms toward the sun.

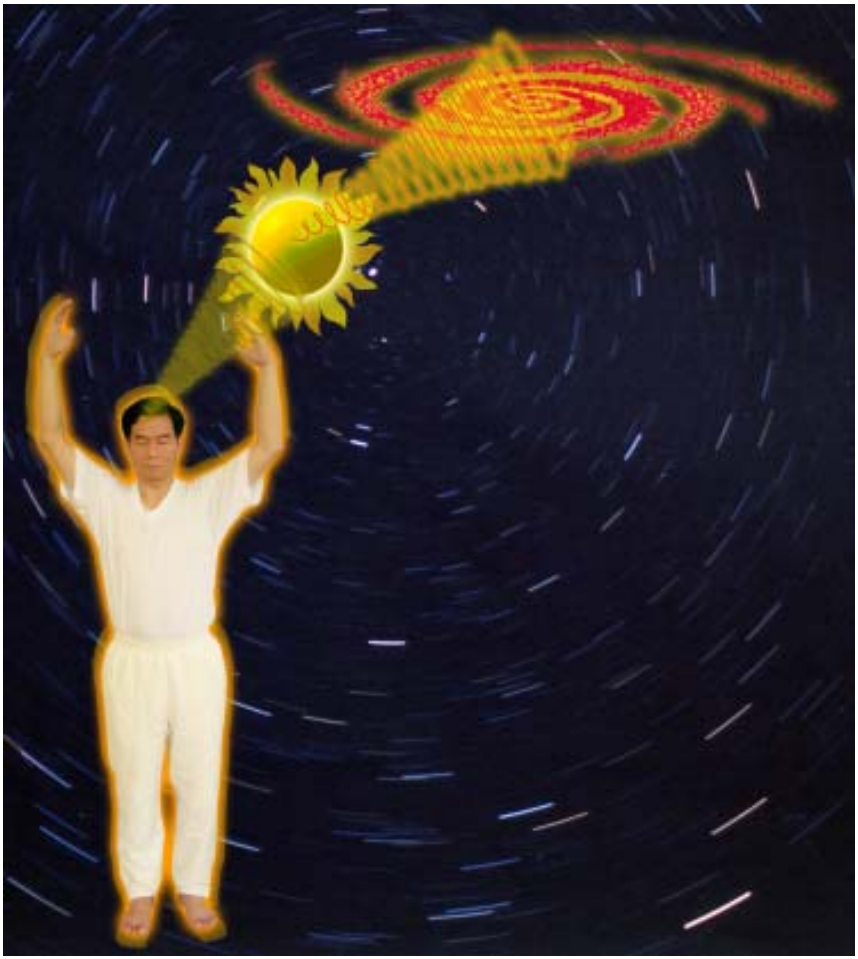

Fig. 20 *Sun Energy*

C. Star Energy (North Star and Big Dipper)

The Taoist aims at nourishing himself with light and essences not with substantial food. The Taoists eat the universe, but in its essential form which is more subtle.

It is by the absorption of essences that begins the cessation of cereals. Nourishment is replaced by subtle foods made of essences and lights. The absorption of cosmic energy becomes little by little the essential food of the practitioner. It is this subtle nourishment that allows the Taoist to become identified with the subtle and eventually become luminous and merge with the Universe to become part of the universe.

Heavenly Three in One:

The sun, moon and stars are the three luminous ones. They are the heavenly projection of the three Pure Ones. In the body that trinity is the Chi, Shen and Ching.

The three pure ones animate the universe through three breaths of three colors: Purple, Yellow and White. In the body they are incarnated by the three originals that reside in each of the 3 warmers.

Body as Light:

The body is conceived as a combination of lights. These lights are absorbed into the different elements of the body (blood, bones, muscles etc.).

The lights within are the counterparts of the lights outside in the starry heavens. The inner lights are Yin and the exterior ones Yang.

The Yin lights are the reflections of the Yang lights, yet neither can exist without the other.

Nature of Stars:

Stars are the dispersed emanation of the metal and their origin is in fire. The stars are yin and are the essence of the most subtle original breath.

There are three types of star practice.

1. They can be called to give protection.
2. The practitioner can make the stars energy comes down into the body.
3. The meditator can rise to the stars.

Protector:

Invoking the four animals:
Traditionally Taoists who practiced alone invoked the 4 animals at the beginning of the meditation. This was followed by the Sun, Moon and Dipper.

Ring of Protection:

The meditator, to protect himself during practice, can call the animals of the 4 directions. They form a protecting sacred belt that protects from evil, thus recreating a Microcosm in the middle of which the meditator sits.

1. The white tiger is to the right (west)
2. The green dragon is to the left (east)
3. The red bird is in front (or on the head)
4. The turtle, the black warrior is on the back, (or on the feet).

Inside Animals Protector:

Utilize the interior animals:

1. Picture first 4 spirits which are 4 children dressed in the same color as the organs they occupy.

2. Each exhales a breath of the same color as the organs to which they belong. The color breaths become the animals of the organs and go out to protect them.

Planets Protectors:

Like the ring of protection of the animals of the 4 directions, the planets can be called to form a protective ring around the practitioner.

Dippers:

The Dipper is also used as a protective cover over the practitioner. The method of internalizing and absorbing the essence of the Dipper stars is considered superior to covering the body with the stars, or praying to the stars. The highest practice is internalizing the stars.

Dipper Stars Protectors:

The star Governor of body spirits: The 7th star of the Dipper is considered the governor of the body spirits. The dipper stars are protectors of body points.

Dipper Stars Protect the Organs:

Visualize the 7 visible stars of the Dipper in succession. At the end visualize the two invisible ones together. Each star is visualized entering in the organs and illuminating the whole body.

The order of stars and organs: Heart 1#. At the cup, lungs 2#. Lower cup, liver 3#. At the lower cup, spleen 4# end of the handle, stomach 5#. At the handle, kidneys 6#., Pupils of the eyes 7#. At top of the handle. 8# Niwam on the crown (the 2 invisible ones together accompany the Pole Star).

Dipper Stars Protect Parts of the Body

1. The first 3 stars on the left side of the chest, elbow and the palms.
2. The 4th star on the heart.
3. The last 3 on the lower right side of the body. (abdomen, genitals and feet).

Dipper Symbolism:

This marks the four directions, fixes, determines and separates. It is the Dipper that fixes the seasons and Yin & Yang. The Dipper is the one that distinguishes good and bad, dispensing the results of good or bad deeds. So it is said to be the giver of happiness or adversity. Some texts say that the 7 stars become one and descend 3 feet above the head of newborns. If the child is going to be a good person it shines brightly, announcing the good news. If the stars remain dark this predicts a bad person.

The Dipper also governs the Superior Ones of the 9 heavens. In the middle plane it governs the flying immortals of the five mountains. Below it guides the true practitioners and the spirit of heaven and earth. Everyone depends on the Dipper.

Dippers of the Five Directions:

There are 5 Dippers: The eastern one rules the numbers of years each person is going to live. The western one inscribes the names of the living and dead in the registers of heaven. The northern one keeps tabs on the registers of death. The southern one gives life. The central one directs and governs all the spirits.

The most important of the 5 Dippers are the ones of the North and South. The Southern Dipper is believed to be in Sagittarius. Humans accumulate their merits in the southern Dipper. It saves the good from hell and intercedes with the king of hell anytime a demon bothers the practitioner. Parallel to that is the Dipper of the North. It keeps track of the evil deeds of humans and orders the king of hell to capture humans.

The northern Dipper is the place of hell and the southern one that of eternal life. Death comes from the emperor of the north and life through the door of the south. Prayers were made to both Dippers to prevent death and grant eternal life.

Dipper Stars and Seasons:

The first star of the Dipper, Yang Ming corresponds to the spring. Tan Yuan, the 5th, governs summer. Yin Tsing, the 2nd governs fall. Pei Ki, the 6th rules winter and Tien Kuan, the 7th, the center.

Dipper energy according to the days of the month is as follows:

The Dipper and the Three Pure Ones

1. Day 1, 2, 5 of the month. The energy is absorbed on the upper cinnabar field on the crown. The upper pure one, the upper warmer.
2. Days 7, 9, 12 on the middle field at the heart. The middle pure one, the middle warmer.
3. Days 15, 19, 23 on the lower field at the navel. The lower pure one, the lower warmer.

Dipper Energy Absorption Method:

Visualize the Ursa Major constellation, the stars are purple and net work that links them red. Feel a warmth produced by the purple color. The practitioner sees himself, together with the breath of the 7 stars, penetrate into a watery flower. In the center of the flower there is a pond of a 1000 miles, a jade mountain, a great terrace thousands of acres long and a red tree with purple flowers. He loses consciousness of himself inside of the flower.

This practice is called “abandoning the little for the great” or “metamorphosis without a trace”.

This method is considered the supreme experience of star meditations and was practiced by several of the great immortals.

Spring Practice:

On the equinox of spring after the Inner Smile late at night, turn toward the east, click the teeth 30 times and with, eyes closed, see the 3 palaces of the body with their 3 virtue children 4 ministers and oneself in the middle of them.

Exhale a purple breath and rise to the first star of the Dipper with a yang mind. This star is the spirit of the east and spring. One sees oneself at the star exhaling the purple breath 30 times . After some time one sees the palace of the 3 original high ones of the east at the #1 star yang mind. At the palace, the young child of the green mystery (spring) gives one the true light. This light is green like a silk piece. This is the celestial bridge.

Dipper and Fetus:

The Dipper is related with anything that has to do with sprouting. The stars open the 7 orifices of the fetus and give it life.

The 9 stars (including the invisible) are related with the transmutations that take place in the 3 warmers in the process of perfection. Nine is also the number of Greater Yang.

Creation of the Subtle Body with Astral Energy:

This method is to have different astral angel children descend into each of the organs and give them life. This way little by little a subtle body is created. The same is done through alchemical methods clarifying each of the 3 warmers little by little.

Out of Body Journey to Dipper:

The journey is made on the solstices, equinoxes and the beginning of each season to the Dipper. There the practitioners see the three great spirits and the appearance of newborns. He sits in front of each. The main purpose is the feeling of having abandoned the physical body.

Follow the same procedure and storage points as the moon energy. Draw only from the pole star (above the Big Dipper).

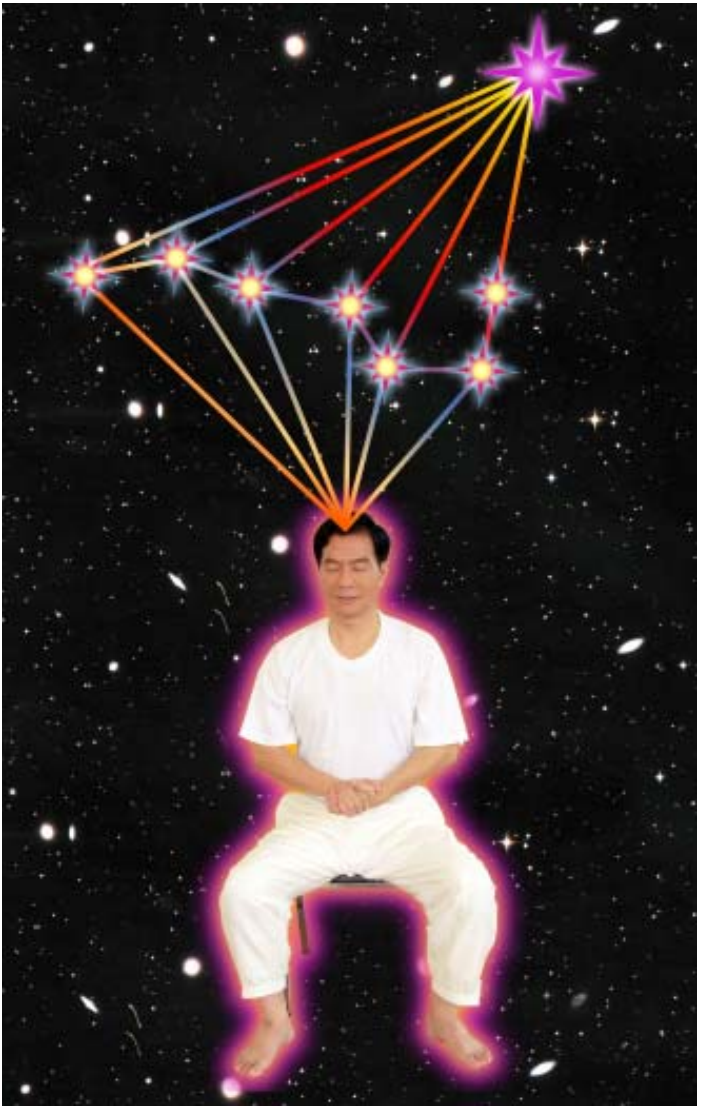

Fig. 21 *Star Energy (North Star and Big Dipper)*

D. Plant and Tree Energy

Time of Practice: Daylight hours. Avoid night time or early morning as plants are absorbing energy at this time. Choose plants and trees that are healthy.

Procedure: Sit quietly and feel the energy of the plant or tree. Absorb the energy through the palms, Third Eye, navel, solar plexus, projected pearl or the enveloping aura. Inhale and draw the energy through the points mentioned. Store in the perineum or back of the knees.

1. When drawing energy through the palms, circulate through the positive and negative arm routes. For smaller trees or plants, use the hands to absorb energy. For larger trees, extend your aura and envelop the tree, allowing the tree's aura to envelop you.

2. Animals belong to the lower plane (earth). Plants belong to the mid-plane or earth surface. Trees stand between heaven and earth; hence, they have earth and heaven energy. Taoists aim to become like trees, a union of heaven and earth, and symbols of longevity. The energy drawn from the trees and plants is absorbed by the pearl.

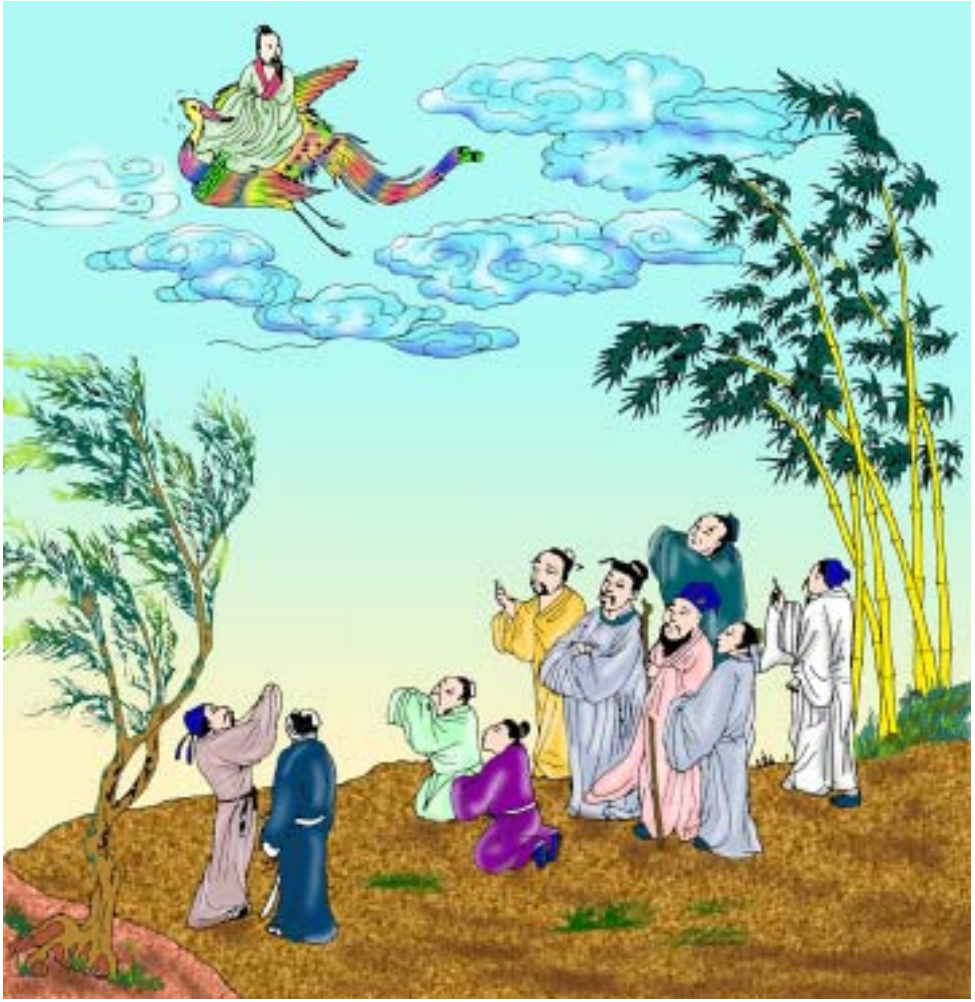

Fig. 22 *Plant and Tree Energy*

L. Ending the Meditation:Turning the Wheel of the Law

Each Kan and Li meditation should be ended with this formula which is a process of collecting “refined” energy in the navel cauldron to be used in future meditations, including the higher levels.

At this stage, the eyes are used to direct the energy produced by the meditation into the Microcosmic Orbit, guiding it into the cauldron behind the navel.

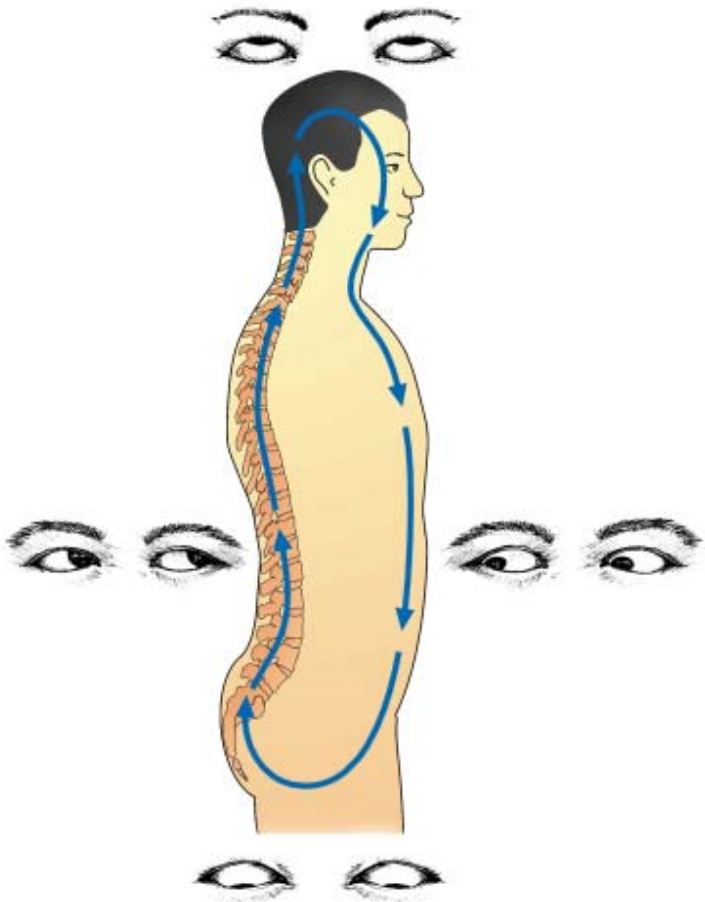

Fig. 23 *Ending the Meditation:Turning the Wheel of the Law*

1. Form a pool of sexual energy at the perineum. Looking straight ahead with your eyes closed, form a mental image of a clock with your eyes focused on its center.

2. Look down into the pool (6:00), and draw sexual energy up into the spine. The steam will travel up the spine drawing sexual energy with it.

3. Look from the perineum up to the right (3:00), drawing the energy up to T-11 as it is refined at that point.

4. Look from the right up to the crown (12:00), and draw the energy there to further refine it at the pineal gland.

5. Look from the crown down to the left (9:00), and draw the energy down either through the tongue or the thrusting routes into the cauldron at the navel. The energy is then stored in the cauldron. (These four directions constitute one round.)

6. Follow the procedures 1-5 above for at least 36 revolutions. You may do them in four rounds of six revolutions with three counts resting in between; or you may do two rounds of twelve revolutions with six counts of resting in between. In any sequence, the revolutions and resting counts must add up to 36. the rising steam will eventually flow independently of your counting, but maintain the mental revolutions to be sure it reaches the cauldron.

7. If you have time, do four rounds of 75 revolutions, resting for fifteen counts in between rounds; or do two rounds of 150 revolutions, resting for thirty counts between rounds; or do 360 revolutions straight through. (All of these methods add up to 360, which is the maximum number of revolutions used to end this practice.) If you have less time, do seven rounds, rest for three counts, then fifteen rounds, rest for three counts and finish with seven more rounds.

Master Mantak Chia is the creator of Universal Tao System, Healing Tao, Tao Yoga and is the director of the Universal Tao Master School at Tao Garden Wellness Retreat in the beautiful northern countryside of Chiangmai, Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Greater Kan and Li

In this booklet you will find all the information needed to continue your practice of the Kan and Li meditations. In the Lesser Kan and Li, you learned to establish a cauldron in the navel. In this, the Greater Kan and Li, a new cauldron is re-established at the solar plexus, where most of the Greater Kan and Li meditation transpires.

The techniques of Greater Kan and Li include the coupling of hot and cold energy at the solar plexus, an extension of the steaming procedures taught in Lesser Kan and Li, and the creation of domestic animals and virgin children by the transformation of pure organ energy.

You can also reach higher levels of awareness by tapping higher sources of energy from Nature, and give birth to the soul and spirit body through self- intercourse, then project this spirit body to the Mid-Plane for astral flight.

The practices end with instructions for collecting refined energy in the navel cauldron for use in future meditations. You also learn how to collect other forms of outside energy, from the moon, sun, and stars.

This booklet is designed so that you can use it to do your practice at your home or anywhere in the world. We are happy to welcome you to the Universal Tao System, and to join the Universal Tao family as a practitioner of the Universal Tao System.

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Iron Shirt Chi Kung I

Once a Martial Art, Now the Practice that strengthens the Internal Organs, Roots Oneself Solidly, and unifies Physical, Mental and Spiritual Health

Mantak Chia

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Judith Stein

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I have come upon Master Chia’s Taoist practice in my old age and find it the most satisfying and enriching practice of all those I have encountered in a long life of seeking and practicing. Felix Morrow, Senior Publisher

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About the Author

Mantak Chia
Master Mantak Chia
Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

About the Aothor

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and “still the mind.” While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi. Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal. When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi’s patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand. A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng YaoLun’s system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body. To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

About the Author

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York. Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia. In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai. Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology. Master Chia estimates that it will take thirty-five books to convey the full Universal Tao System. In June, 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award. In December, 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities. In February 2002, the Immortal Tao practices were held at Tao Garden for the first time using the Darkness technology creating a complete environment for the higher level Taoist practices.

About the Aothor

Master Mantak Chia has previously written and published these Universal Tao books: Awaken Healing Energy of the Tao - 1983 Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984. Taoist Ways to Transform Stress into Vitality -1985 Chi Self-Massage: the Tao of Rejuvenation - 1986 Iron Shirt Chi Kung I - 1986 Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986 Bone Marrow Nei Kung - 1989 Fusion of the Five Elements I - 1990 Chi Nei Tsang: Internal Organ Chi Massage - 1990 Awaken Healing Light of the Tao - 1993 The Inner Structure of Tai Chi co-authored with Juan Li 1996 Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper Collins Tao Yin - 1999 Chi Nei Tsang II - 2000 Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper Collins Cosmic Healing I - 2001 Cosmic Healing II co-authored with Dirk Oellibrandt - 2001 Door of All Wonders co-authored with Tao Haung - 2001 Sexual Reflexology co-authored with W. U. Wei - 2002 Elixir Chi Kung - 2002 Tan Tien Chi Kung - 2002 Many of the books above are available in the following foreign languages: Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish, & Turkish editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

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Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk. The meditations, practices and techniques described herein are not intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader. This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever. The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

How to use this Book

How to use this Book
In the last pages of this book the reader will find descriptions of the courses and workshops offered by our Universal Tao Centers. This material is also in effect, a comprehensive description of the whole Taoist System. All of my books together will be a composite of this Taoist world view. Each of my books is thus an exposition of one important part of this system. Each sets forth a method of healing and life-enhancement which can be studied and practiced by itself, if the reader so chooses. However, each of these methods implies the others and is best practiced in combination with the others. The foundation of all practices in the Taoist System, the Microcosmic Orbit Meditation, is the way to circulate Chi energy throughout the body and is described in my book, Awaken Healing Energy Through the Tao. This practice is followed by the meditations of the Inner Smile and the Six Healing Sounds, set forth in my book, Taoist Ways to Transform Stress into Vitality. All three meditations are emphasized throughout the Taoist System. The practices of Iron Shirt Chi Kung are very powerful and therefore very effective. To insure that you carry them out properly, prepare yourself first by learning the Microcosmic Orbit Meditation, the Inner Smile and the Six Healing Sounds. These will enable you to identify and eliminate energy blockages that may occur in your Iron Shirt practice during the learning stages. Second, learn information contained in the chapter in this book on body alignment. Third, understand the rooting principles. Fourth, learn the preliminary exercises until you are proficient at them and comfortable with them. This will give you the conditioning you need to proceed comfortably to the postures. You can use the complete description of each posture during your learning. The shorter description of each posture is meant as a guide during your practice. Lastly, we offer to you a suggested practice timetable, although it is not necessary for you to follow it exactly. Use it merely as a guideline for adjusting your own schedule. As you read the information provided in this book and become aware of concepts not contained in Western thought, you will deepen your understanding of the relevancy of these practices to your physical, emotional and spiritual advancement. Mantak Chia

Chapter 1
General Introduction

A. Universal Tao System and Iron Shirt Chi Kung

In addition to the more popularly known martial arts disciplines of Kung Fu and Tai Chi the Universal Tao System includes health practices, healing arts, the development of a state of mindfulness, and the management of vital energy (Chi). The martial arts aspect of this training, the practice of Iron Shirt, develops a highly refined moral and spiritual awareness. The goal of the Universal Tao System is to keep our physical bodies in good condition in the physical plane in order to build and store more Chi energy for further use in the higher level of the spiritual plane. (Fig. 1.1)

Realm of the Primordial

9 8 7 Intermediate Realm 5 4 3 2
ND RD TH TH

TH

TH

6 TH
TH

1 ST Level

Earth Fig. 1.1 Realm of the Primordial Tao

In the spiritual plane, the aim is to develop the immortal fetus. The immortal fetus is developed in two stages. The first stage is concerned with overcoming reincarnation. The next stage develops and educates the immortal fetus to become a full-grown immortal spirit. Iron Shirt is one of the most important exercises of the physical plane because through its practice one learns rootedness to Mother Earth energy, a phenomenon intrinsic to the spiritual plane. (Fig. 1.2)

Mother Earth

Fig. 1.2 Rootedness to Mother Earth Energy

Spiritual Body Chi Body (3) Shuttle Flies Free (the Spirit Body)

The Booster Rockets separate from the Shuttle (the Soul Body Completes the lifting of the Spirit Body).

Spiritual Body (2) Booster Rockets Lift-Off With the Shuttle (the Soul Body, or Chi Body)

Chi Body

(1) Central Tower and Launching Pad (the Physical Body)

Fig. 1.3 Launching of the Spiritual Body

One may compare the foundation, or rootedness, of the physical body to an Earth Control Tower, vital to the travel of a space shuttle in space. (Fig. 1.3) To boost the space shuttle, the spirit, into space the Earth Control Tower requires a booster rocket, the soul or energy body, which is guided by an inner compass and computer, the pineal gland. The Earth Control Tower, in the form of our physical body developed during the practice of Iron Shirt, becomes a storage place for fuel: Chi (our life-force energy) and our creative or sexual,

energy. Here our fuel awaits transformation into another kind of energy: spiritual energy. As we learn how to develop an immortal spirit compass and computer by opening the pineal gland which will guide us back to Earth to complete the unfinished job of development here, we must maintain our foundation, or rootedness, to the Earth. (Fig. 1.4) Thus we are able to return to Earth, refuel and resume our space travel to our destination until, eventually, we are able to discard the earthly base entirely.

Spirit Body

Soul or Chi Body

Physical Body

Fig. 1.4 Rootedness

General Introduction

1. Iron Shirt Chi Kung—Ancient Kung Fu Practice

a. Bolin Period (the Time of Kung Fu Fighters) Kung Fu was used in China long before the advent of firearms. During the Bolin Period, approximately 1000 B.C., training in the various spiritual/martial arts was very intense. It is said that at the time one tenth of the population of China was involved in some sort of Kung Fu. In ancient Kung Fu practice, training began in very early youth. One first worked to develop internal power (inner strength through organ exercise), a venture that could take as long as ten years. Thereafter, one might have to throw a straight punch 1,000 times a day for a period lasting from three to five years. One might be instructed to strike the top of a water well with the flat of his palm 1,000 times a day for five to ten years, or “until the water leapt out of the well”. Iron Shirt Chi Kung, a method of Kung Fu, was learned as a protective training, providing internal power by the practice of simple external techniques. The practitioner was guarded against the effects of blows to his vital organs and glands, the primary sources for the production of life-force energy (Chi). The word Chi means air. Kung means discipline: one who puts time into practice. Therefore, Chi Kung means “to practice the process of breathing to increase Chi pressure (life-force pressure)”. A thousand times a day internal power was cultivated until it could be felt flowing out of the hands. With weights tied to the legs, the practitioner ran and jumped in prescribed ways for over three hours a day until, eventually, he could jump easily to great heights and, at the same time, further develop his internal power. Only after these exercises were mastered were actual fighting techniques taught. The importance of the development of internal power in martial arts training may be compared to the effect of being struck by a steel rod as opposed to one that is made of soft plastic. The Chi Kung practitioner of old practiced one punch for years until he could feel the power go out of the lower part of his hand, while the rest of his body seemed as though made of steel. There were many other benefits as well, e.g., internal power improved general health and is claimed to have maintained youthfulness.

b. Iron Shirt helps to Perfect Mental Faculties Chi Kung also helped to perfect mental faculties, enabling the practitioner to have knowledge of many things. One reads that during the Bolin period, there were eight “immortals” who spent most of their lives in such practice and developed extraordinary abilities. They could predict the future and see into the past. They are said to have been capable of space travel and of clairvoyance and clairaudience. It is also said that during that period, many people had at least some such powers, a result of widespread Kung Fu practice. Some sources attempt to explain this by claiming there must have been a general universal reservoir of power, far greater than is now available, from which the more capable practitioners could draw. c. Age of Gunpowder After the invention of gunpowder and the subsequent elaboration of firearms, men no longer felt the need to spend a decade or more of their lives learning skills that no longer seemed practical. A man could now defend himself, or cause great damage at a great distance from his objective, with weapons. (Fig. 1.5) Contact fighting became a thing of the past, and much of the associated knowledge that was useful to man was lost with it.

Fig. 1.5 Age of Gunpowder

Today, however with the recent revolt against the depersonalizing and unhealthy effects of a technology of monstrous proportions, there has been a revival of interest in the simpler ways of life. Thus, Kung Fu is again in the limelight. Kung Fu has been called a way of perfecting the inner self.

2. Creating Chi (Life-Force) Pressure

Chi Kung may be thought of as internal aerobics. Chi, as an aerobic energy involving air, steam, and pressure, presses out and circulates to protect the human body. One can compare the internal pressure created by Chi to the force of air in a tire which is sufficient to keep the tire inflated and maintain a cushion between the car and the road. (Fig. 1.6)

Fig. 1.6 An inflated tire provides cushioning.

a. Breath of Life—Chi Pressure

Breathing is the most important part of our lives. We can go without food for months, or without water for days, but we can go without air for only a few minutes. In practicing Iron Shirt, we use our breath to maximum advantage. We can actually increase our vital energy, strengthen our organs, and promote self-healing by increasing the Chi pressure (pounds per square inch) in the organs and cavity of the body. The circulatory system, the lymphatic system, the nervous system, and the endocrine glands will be activated, and blood, spinal fluid and hormones will flow more easily so that the heart will not have to work hard.

b. Origin of Iron Shirt Breathing Taoists believe that while we are in the womb, we use Iron Shirt Packing Breathing. Before birth, the infant does not use the lungs and nose to breathe. The Chi (life-force) enters through the umbilical cord to the navel (Fig. 1.7), down to the perineum, up the sacrum to the spinal cord to the head, forehead, and down the front from the tongue (Taoists believe the fetus always holds the tongue on the palate) to the throat, heart, abdomen and navel centers in the abdominal area where the Chi pressure can be used. You will recognize this as the path of the Microcosmic Orbit (described more fully in Chapter 2). At birth, we begin to use lung breathing and generate our own energy rather than use the internal source of energy. To begin with, the lungs are not strong. The abdomen, closer to our original source of energy in the navel, has more Chi pressure. It assists the lungs in breathing by pulling down on the diaphragm so that the lower portion of the lungs fills with air; initiating inhalation. In this way, the lungs use less energy, but take in more life-force (oxygen). As children, we still use abdominal Chi pressure energy.

Fig. 1.7 In an unborn infant, the Chi (life-force) enters through the umbilical cord to the navel.

One can see the effects of reduced Chi pressure with age. In older people the prenatal life-force (Chi) is drained out from the navel and kidney areas. Gradually Chi pressure is lost, creating an energy imbalance: when the pressure is low, the fluid flow in the entire system slows down. As a result, at the times when our energy becomes too hot, it will move up and congest the chest and head. Cold energy will move down through the sexual organs and leak out. Gradually, we lose Chi pressure. We begin to lose the habit of abdominal breathing. The lungs are left alone to do chest breathing. This is inefficient. It requires greater energy to expand the rib cage, which action fills only the upper third of the lungs. Scientists have affirmed that we use only one-third of our vital capacity (lung capacity) for breathing. This method of breathing actually expends more energy than it creates. Yielding to the external pressure, we collapse inside. With abdominal breathing we can expand the amount of pressure exerted on the organs and voluntarily compress them so that they will strengthen upon release.

B. Why put on your Iron Shirt?

1. Internal Management

Many of the physical changes associated with Kung Fu come through management of the internal organs and endocrine glands. In Kung Fu, a person’s life-force is said to depend primarily upon the endocrine glands, or sexual hormones. It is very likely that this was deduced from the following observations. Consider what happens when someone is deprived of a fully functional endocrine system. A male is radically altered when his testes, part of the endocrine system in males, are eliminated, and more so when this is done before puberty. Such characteristics as weak musculature and feminine fat distribution develop. Depending upon the time in life in which he was so mutilated, he might also lack such secondary male characteristics as a deep voice, facial hair and sexual drive. Male and female castrates have been well documented to have shortened life spans. With Iron Shirt Chi Kung, one is able to increase the flow of hormones produced by the endocrine glands, building up the immune system and giving a general sense of well-being. The sexual (creative) energy produced as a result is another source of Chi energy which may later be transformed into spiritual energy.

Chapter I

Integral to Iron Shirt are the organs’ exercises which clean and strengthen the organs. Strong, detoxified organs are important to modern life. Iron Shirt practice will strengthen; help to clean out the toxins, waste materials and sediment in the organs; and convert the fat stored in layers or sheaths of connective tissue (fasciae) in the body into Chi energy. The Chi is subsequently stored in the fasciae layers where it works like a cushion to protect the organs. As previously mentioned, this process may be compared to a tire which, when inflated with air, can sustain tremendous weight. Chi which has been stored in such a way then becomes available for transformation to a higher quality energy that can nourish the soul and spirit. In the practice of Iron Shirt, we put more emphasis on the fasciae connective tissues, organs, tendons, bones and bone marrow and less emphasis on muscle development. a. Chi, the Fasciae, Organs and Bones The body may be conceived as consisting of three layers: (a) the innermost which is made up of the internal organs that produce Chi; (b) a layer consisting of fasciae, bones and tendons; and (c) the muscles, which constitute the bulk of the body. Chi, after being developed in the internal organs, is then distributed throughout the fasciae. It is with the fasciae that Iron Shirt I is primarily concerned. (1) Fasciae Each organ has a fascia layer covering it. (Fig. 1.8) In the heart this layer is called the pericardium; in the lung it is called the pleura. The fasciae which cover the stomach, liver and kidneys have protective, connective, regenerative and nourishing properties. They act as energizing chambers for the organs. In Heller work and Rolfing massaging techniques, the fasciae are dealt with from the outside in. The art of Rolfing involves the freeing of areas of fasciae that have become stuck together through trauma, infection or chronic muscular tensions. Iron Shirt works from the inner layer of fascia out. (Fig. 1.9) The intent is to allow for a free flowing energy in the body and to enable psychological insight into events long harbored in restricted musculature.

General Introduction

Cranial Cavity Pleural Cavities

Spinal Cord Thoracic Cavity Diaphragm

Pleura Pericardial Cavities Pericardium

Abdominal Cavity

Psoas Muscle Pelvic Cavity

Pelvic Cavity

Fig. 1.8 Each organ has a fascia layer covering its cavity.

Skin a. Subcutaneous Tissue b. The Deep Layer (1) First Layer-Anterior Fascia Muscle (2) Second Layer Fascia Muscle (3) Third Layer-Posterior Fascia Fig. 1.9 Fasciae Layers

Liver Stomach

c. Peritoneum

The fasciae are extremely important in the practice of Iron Shirt because, as the most pervasive tissues in the body, they are believed to be the means whereby Chi is distributed along acupuncture routes. Research has shown that the least resistance to the flow of bioelectric energy in the body occurs between the fascial sheaths, and that when these routes have been charted, they have been found to correspond to the classical acupuncture channels. (2) Iron Shirt Strengthens and Protects the Organs When we pack and wrap the organs with Chi pressure, we start to strengthen the organs. The fasciae layers covering the organs, when filled with Chi pressure, will act as energizers to the organs. Extra Chi pressure will escape to the abdominal fascia layer fill the abdominal cavity with Chi pressure, act as a protector to the organs and permit the Chi to flow more easily. When the abdominal cavity fills with Chi pressure, the Chi pressure will start to fill in the deep fasciae and, finally, fill in the outer layer, acting as a triple layer or cushion of Chi pressure to pack and protect all of the organs, muscles and vital glands. To better understand how Chi, the fasciae and the organs relate to one another, picture an egg residing inside a balloon filled with air residing inside another air-filled balloon, both of which reside inside one more air-filled balloon. (Fig. 1.10) An egg is normally quite vulnerable, but inside a blown-up balloon, it is cushioned against blows. Inside a triple layer of balloons, we see that the egg has even greater protection. You can throw and kick these three layers of balloons and the egg will remain unharmed. Chi and the fasciae act in the same way to protect the fragile organs. The fasciae are elastic and protective like balloons, and the Chi, expanding as the air expands within the balloons, creates pressure (Fig. 1.11) When Chi pressure is reduced by sickness or a weakened state the organs become cramped because they yield and become compressed by pressures external to them. Most people, when hit in the abdomen will fall down, or if they are so unlucky as to have the vital organs hit, are seriously injured in the vital organs. When the vital organs are injured, life can be endangered. With this practice of building layers of protection, you will greatly reduce the risk of unexpected injury and in many instances might help to save your life. From the fasciae, Iron Shirt extends to involve the bones and tendons and, finally the muscles.

Egg

Fig. 1.10 Balloons containing an Egg

Fig. 1.11 Pack the Chi into the organs and fasciae layers to protect the organs.

(3) Burn Out Fat and Store Chi in the Organs Food (nutrition) that is taken into the body but is not required by the body is turned into fat and stored in the outer layers of fasciae. This fat will greatly reduce the flow of Chi. The Iron Shirt Packing Process will help to pack and squeeze the fat, transforming it into energy to be stored in the fascial covers of the organs for use whenever needed. When Chi pressure occupies the fascial layers, the fat cannot be stored there. Therefore, the body becomes trained to convert fat into Chi energy for storage in the fascial layers. (4) Structure of the Bones When the fasciae are filled with Chi, the tendons are strengthened and the bones hold together as one structural piece. When the fasciae are weak, the muscles are weakened and the bone structure will not hold together. Similarly, when the muscles are weak, both the fasciae and the tendons are weak. When muscles are not used, they diminish in size and strength as do the fasciae which contain them and the tendons upon which they pull when activated. There is a constant turnover of most of the cells of the body and replacements are governed by ongoing needs. It has been demonstrated that during prolonged periods of weightlessness in outer space, the constitution of bones is not as dense as it is on the surface of the Earth where the greater stresses of gravity signal heavier bone growth. When we are young, our bones are filled with marrow. (Fig. 1.12) When we become adults, the bones gradually hollow out, filling with fat and producing less blood cells, until they become brittle and susceptible to fracture. Iron Shirt Chi Kung is primarily designed to gradually reabsorb the Chi life-force back into the bones, which can be transformed into bone marrow to strengthen the bone structure.

Bone Marrow Cavity

Bone Marrow Cavity Fig. 1.12 When we are young, our bones are filled with red marrow.

b. Chi Pressure and Meditationi increase Circulation while Reducing the Heart’s Work As mentioned, we must learn again to use the abdomen to aid in breathing and to help increase the circulation. The abdominal area accounts for two-thirds of the blood supply that flows through the liver, kidneys, stomach and spleen. When one knows how to pack and release, the abdomen will act like the most efficient heart you could ever have. In Iron Shirt Chi Kung Packing Process Breathing, by limiting the space of the abdomen and increasing the pounds of pressure per square inch, all the organs in the abdominal area will be packed in a very small space. This will expel all the toxins and sediment which have accumulated in these organs. The diaphragm will pull down to create a vacuum in the lower part of the lungs, filling the lower lobes first, and extending to the whole lungs. This gives a longer deeper breath which will furnish sufficient time and quantity of oxygen to cleanse the body of waste materials, sediment and toxins. Our systems rely entirely upon Chi pressure to move the fluids. Increased pressure in the abdominal cavity will help to increase

the Chi pressure in order to move Chi, blood and lymph fluids. (Fig. 1.13) When the new blood is released, oxygen and nutrition will enter into the organs. With this practice, you will gradually increase the flow of the circulatory and lymph systems and, in return, will greatly reduce the work of the heart. As you gradually increase your vital capacity by learning how to pack air into the organs, thereby creating the cushion, or Chi pressure, to protect and strengthen them, the heart will have to work with progressively less effort and circulation will increase. The vital energy thus conserved can be used to enrich our spiritual and creative lives. Our goal, then, is to increase the organ and abdominal pressure so that the Chi presses outward on the fasciae layers from inside. To do this, you will learn Packing Process Breathing to increase the pressure of Chi in the organs and abdomen. When this pressure is released, the fasciae expand, as do the organs. Chi circulation meditation affords a means of generating and directing far more Chi than would ordinarily be available without causing pressure on the heart. Meditation increases circulation and the production of lymphocytes without affecting blood pressure the way running and western aerobic exercises do. Once you have practiced Chi circulation meditation by learning the Microcosmic Orbit, you will understand that the energy made use of in Iron Shirt travels very much along the same route of the Microcosmic Orbit, but is found to be expressed differently in each of the channels. As the Chi flows more freely throughout the entire body the experience takes on new dimensions. c. Preventing Energy Leakage The Taoists believe that Chi can be transformed into anything in our body. Certainly the energy we channel in the body has a generative effect. Therefore, an important function of Iron Shirt is to learn how to create space in the body to store Chi energy and how to prevent energy leakage. Energy is dispersed and scattered in the average person, escaping out daily through various openings in the body. Iron Shirt teaches the practitioner how to seal these openings. A process is then learned to direct this conserved energy to the navel region, there to be packed and condensed into an energy ball (Fig. 1.14) which can be directed to any part of the body or in later practice, to build an energy body to boost the spirit to a higher plane.

Heart at Rest Liver Kidneys Stomach Spleen

Fig. 1.13 Compressing the organs, thereby creating a pressure in the abdomen, can cause the abdomen to pump like a heart, moving fluids through the system.

Fig. 1.14 Concentrating Energy into an Energy Ball.

2. Iron Shirt prolongs Life

Long life and happiness have been pursued by people for centuries, and the search still continues. However, even with the added impetus of all that modern science and technology can offer, little, if any real progress has been made that is in the common domain. It is currently believed by many here in the West that daily physical exercise helps to stave off aging. However, statistically, athletes do not live longer nor seem to be appreciably healthier for their efforts. In fact, as the effects of aging impede them more and more, many of them become subject to depression. They are no longer able to compete successfully. In order to do more strenuous exercises, parts of the body must be changed. Also, there seems to be some basis for thinking that certain situations, such as the stress of competitive athletics or the use of drugs, may contribute to premature aging (discounting injuries that are sustained in more violent pursuits). A Taoist might comment that this is so because in accenting the physical, the spiritual was neglected, as well as the mind, the nervous system and the internal vital circuits. Man’s life span has been prolonged by science and technology. However, more often than not, the added life span can be of a low enough quality not to seem to be of great benefit. The old Taoist sages say that in ancient times, men lived from 500 to 1,000 years. Modern society emphasizes material aspects of life whereas the ancient Taoists sought a balance of the material with the spiritual. The Taoist and Yogic approaches describe an “inner world” which man can develop and cultivate that is reflected in his “outer world”. There is an old Taoist saying, “Living one hundred years is common. Life is in my hands, not in the hands of a Universal Being.” It might be that this positive statement is derived from a genuine knowledge of how to prolong life in such a way that it is also vital and satisfying. The Taoist System is very precise in the matter of building Chi, guiding it and finally developing skills to make the best use of it. To attempt to hasten the process by skipping steps is to end with nothing or to create complications such as irregular heartbeat, chest congestion, headache, pain in the heart, chest or back, which result from not knowing how to guide the energy.

3. Summary of the Benefits of Iron Shirt Chi Kung Training

In summary, Iron Shirt Chi Kung I training is divided into three levels: physical, emotional and spiritual. a. On the physical level, one learns how to (1) align structurally to strengthen and alter a weak structure into a strong structure so that Chi can flow easily throughout the body and provide room for organs to grow within the body's structure; (2) develop a Chi Belt, the major connection of the upper and lower energy channels, without which proper structural alignment and Chi energy will be lost; (3) detoxify and exercise the organs and glands in order to charge and pack the Chi in them, to serve as cushioning to surround and protect them, and to fill the cavity of the body with Chi pressure; (4) increase Chi storage between the fasciae sheets; open the fasciae to serve as Chi storage areas of the body replacing fat previously stored there; understand the function of the fasciae layers as cushions around the body which protect the vital organs; (5) root down to the earth, sink down and become one with the earth, to be able to pass the outside force down to earth through the structure without obstruction, and to pump the earth force up into the structure and counteract outside forces with the assistance of the earth; (6) generate an easily flowing Chi through the meridians of the body and transform Chi to a higher "octane" to serve as the nourishment of the soul and spirit body. b. On the emotional level, or soul level, one learns how to (1) condense the Chi into a controllable mass of energy, transforming and moving the Chi by changing negative energy into positive energy; (2) condense life-force Chi into a ball. This is one of the most important functions of the Iron Shirt Chi Kung practice since it enables one to control his Chi so that the Chi will not scatter around the body and leak out of the system. Condensed Chi will stay together and have more condensed power to be used as a person desires. When you are well trained in condensing the Chi energy into a ball, by physically moving the abdomen up and down, or left and right, you will be able to move the ball. In later practice, you will be able to use your mind to move the ball and direct it through channels in your body, always returning it to the navel. In the higher level, the condensed Chi becomes a light ball, like a glowing pearl, which develops into the energy body, serving as a booster rocket to boost the spirit or space body into orbit.

c. On the spiritual level, Iron Shirt Chi Kung condenses, strengthens and creates more Chi, thereby laying the groundwork for a spiritual foundation (rootedness) which serves the later part of the system. Previously referred to as an Earth Control Tower this foundation will direct the spirit in its journey through space where preparations are made for life after death.

C. Iron Shirt Chi Kung Exercises

The Iron Shirt exercises introduced here are primarily concerned with the fasciae and bone structure as well as with some tendons. These eight exercises (namely, Embracing the Tree, the Yin and Yang Positions of Holding the Golden Urn, the Golden Turtle Immersing in Water (Yang Position), the Water Buffalo Emerging From the Water (Yin Position), The Golden Phoenix Washes Its Feathers, the Iron Bridge and the Iron Bar), condensed from fortynine postures, are very precise in developing the most vital energy routes. There are many exercises known that will serve this purpose; however, by doing the eight exercises and the structural alignment exercises described in this book, you will derive as much benefit as you would from a much wider selection of positions and movements. These exercises develop Chi flow and strengthen fasciae, tendons, bones and muscles. In the tradition of Taoist Esoteric Yoga, it is said that (a) Chi moves the blood (and the heart works less); (b) blood moves muscles; (c) muscles move tendons, and (d) tendons move the bones to which they are attached. Iron Shirt strengthens muscles, tendons and bones by subjecting them directly and gradually to increasing stress. It is a well rounded approach which offers, as an additional benefit, a means of releasing long held areas of tension. This often reflects in a general sense of well-being, of self-assurance and ease, along with better posture. Many of my students report that Iron Shirt has enabled them to achieve a deep sense of feeling grounded and centered. Others suddenly discover that their hands and feet are no longer cold. There is another advantage to Iron Shirt. The pneumatic effect joins what would otherwise be separate members of your body into one continuous unit. This produces a tremendous increase in mechanical advantage that increases geometrically as this work progresses.

General Introduction

The Universal Tao System offers many types of practices, many of which can be practiced individually. However, it is most beneficial to the practitioner to realize that all are interrelated and practicing them together will bring the best results. If one attempts to practice Tai Chi Chuan, for example, before having first cultivated internal energy through Iron Shirt, it might be compared to entering high school without having learned the alphabet. Iron Shirt Chi Kung is the foundation of Tai Chi which uses structural alignment as a basis for exercise. Many people have the wrong idea about Tai Chi. When the energy is felt in the Tai Chi movements, the practitioner wants to move the energy. However, the moving form of Tai Chi occupies the mind with many things other than moving the energy. The more the practitioner moves his form, the busier his mind, making him less aware of the subtle energy that can be felt within himself. In other words, the simpler one keeps the activity of the mind, the better one can feel his inner workings. Iron Shirt uses the mind to guide the Chi flow in a static position. If you train in the methods of Iron Shirt first, you learn well how to move the Chi. Then when you practice Tai Chi, it is easier to move the Chi while practicing the moving forms. In the Universal Tao System, we require students to learn the Microcosmic Orbit, Iron Shirt Chi Kung, and then Tai Chi. Therefore, the structural rooting and energy discharge and control that is learned in Iron Shirt can be transferred into the Tai Chi form. It should also be noted that to practice Tai Chi Chuan properly, it is necessary that your meditation practice take you at least to the levels in the Universal Tao System of Fusion of the Five Elements or to Lesser Enlightenment Kan and Li. Since the basic approaches of the Microcosmic Orbit, Iron Shirt Chi Kung, Seminal or Ovarian Kung Fu, and Tai Chi Chi Kung deal with some aspect of coaxing energy out of the deepest and outermost reaches of the body, it is wise for the practitioner who is interested in developing fully his physical, emotional and spiritual potential to consider the Universal Tao System in its entirety.

D. Three Levels of Iron Shirt

This first Iron Shirt book is concerned with the first level of Iron Shirt, Iron Shirt Chi Kung I, in which, through internal organs exercises, the fasciae (the connecting tissue which cover the organs and glands) are energized. The second book, Iron Shirt Chi Kung II, deals with tendon exercises, known since olden times as ‘Changing the Tendons’. This practice utilizes the mind and heart to direct, stretch and grow the tendons. Iron Shirt Chi Kung III, the third book in this series, works on bone structure and increases the bone marrow. This procedure, known by the ancient Taoists as “Cleansing the Marrow”, is used to clear out fat stored in the hollow bone and absorb the creative power (sexual energy) into the bone to rebuild the bone marrow. Bones are the major blood builders, including the white blood cells necessary to the body’s defense mechanisms.

Chapter 2
Initial Preparations
A. Iron Shirt Breathing and Relaxation

You must not use force in any of these procedures. These exercises depend very much upon mind control and relaxation. In doing the chin press, which is accomplished by pressing the chin down to the chest and pushing out C-7, the chest must remain relaxed if you are not to develop chest pain and congestion and if you are to avoid difficulty in breathing. Practice the relaxation of the Inner Smile and run your Microcosmic Orbit (described briefly in this Chapter and more fully in the book, Awaken Healing Energy Through the Tao). If you find yourself shaking and jerking about, just simply let it all happen. It is a refreshing experience. In a standing or walking position, you can stroke your chest with your palms from top to bottom from nine to eighteen times to relieve any congestion that might have accumulated there. Burp, if the need arises. If you begin to salivate copiously, tighten your neck muscles, press your chin to your chest, ‘smile down” through all of your organs and then put your tongue to your palate and, using force, swallow saliva so that you feel as though you have indeed swallowed all the way down to your navel. Concentrate there until you can feel your navel grow warm. Practice the Iron Shirt Chi Kung breathing twice per day only during your first week of practice and three times per day in the following week. By the second to fourth week, you can increase six to nine times and increase the length of time in Packing Breathing.

1. Abdominal and Reverse Breathing (Energizer Breathing)

Those who have not been trained in Chi Kung, Yoga or any other breathing exercise will be tense and will use very shallow, short breaths, uilizing only one-third of the lungs. This causes lose of Chi pressure in the abdominal cavity. With practice, proper breathing is accomplished. Iron Shirt breathing combines various types of breathing. First, abdominal breathing is practiced to energize and loosen the fascial

layers of the body. When the breath is harmonized, Chi is sent down to the navel. At this time, reverse breathing is initiated. Abdominal and reverse breathing are the two basic ways of breath training. Practiced together they are known as Energizer breathing, but have also been called “Breath of Fire” or “Bellows Breathing”.
Breathe to create a round shape, expanding not only the stomach but all sides.

Inhale with the Diaphragm Pressing Down. Abdomen expands Out.

Inhale with the Diaphragm Up. Abdomen moves in.

Cross-Section of the Abdomen Fig. 2.1 (a) Abdominal Breathing

Cross-Section of the Abdomen (b) Reverse Breathing

Abdominal and reverse breathing are caused by the up and down movement of the thoracic diaphragm. (Fig. 2.1 (a) and (b)) During abdominal breathing, the diaphragm lowers and forces the vital organs, especially the adrenal glands, to compress downward, allowing the lower lobes of the lungs to fill with air, and forcing the abdomen to protrude. The chest and the sternum sink, which presses and activates the thymus gland. Upon exhalation, the stomach returns to a flatter shape and the other vital organs return to their original size and shape. In reverse breathing, on inhalation

we flatten the stomach, push the organs and diaphragm up, and allow air to fill the whole lungs. As your practice develops, you will be able to maintain a lowered diaphragm during reverse breathing, thereby lowering and compressing the organs. Upon exhaling, we fill the abdomen out. The motions thus created massage the vital organs to a certain extent. It is to reverse breathing that “Packing” Breathing is added. a. Practice Abdominal Breathing (Fig. 2.1 (a)) (1) To practice abdominal breathing, keep the chest very relaxed. This may be difficult at first, but it is important. Begin by breathing in, drawing the air into the abdomen. (2) Make the chest hollow and drop the diaphragm down. (Fig. 2.2(a)) Pressure is felt inside the abdomen which will begin to protrude on all sides in a rounded shape. Do not expand the stomach only. With the diaphragm lowered and the abdomen filled with air the inches of spacing containing the abdominal organs are minimized. (Fig. 2.2(b))

Cross-Section of the Abdomen

Fig. 2.2 (a) Diaphragm pressing down on the Adrenals and Kidneys.

(3) Hold your breath for a moment and exhale, flatten the stomach to the spine and feel the perineum (the region between the genital organs and the rectum) flood with the pressure. Pull the sexual organs up. The chest and the sternum sink, pressing and activating the thymus gland. (Fig. 2.3) Do not use force. It is enough to feel a slight pull and flattening of the chest. (4) Inhale and relax, maintaining a dropped diaphragm, and feel the air expand on all sides of the abdomen (not only the front) like a round ball. Exhale and feel the pull of the sexual organs. (5) With each inhalation and exhalation counting as one set, practice each set nine, eighteen, and then 36 times. Abdominal breathing, as the initiation of what is called “Energizer Breathing”, is used throughout all the exercises as a pre-exercise to Packing Process Breathing. It is also used after packing process breathing to regulate the breath.

Thymus Gland

Diaphragm Adrenal Glands Kidneys

Fig. 2.3 When the diaphragm presses down on the adrenal glands, the sternum sinks. This activates the thymus gland.

(6) If you find that your diaphragm becomes tight and pushed up into the rib cage, rub the diaphragm with both hands using the fingers to gently work the diaphragm so that it will drop down out of the rib area into a relaxed position. (Fig. 2.4) Tightness in the abdominal area is one of the main causes of breathing problems. Abdominal massage will help to relieve the tightness of the diaphragm. Use your fingers to lightly massage the abdomen in the navel area until you feel the tightness ease. This will greatly improve your deep breathing.

Diaphragm down, lung capacity increases.

Diaphragm up, lung capacity decreases.

Fig. 2.4 Front View of the Diaphragm

b. Practice Reverse Breathing (Fig. 2.1 (b)) Tight muscles in the chest can be a problem, and so it is important to relax. It is not the muscles but this relaxation which holds the Chi packed inside. Moreover using and training the mind to direct and condense the Chi are the ultimate goals of Iron Shirt training. As you begin to inhale for reverse breathing, the organs and diaphragm are pushed up as the air fills the entire lungs. As your practice develops, you will be able to control the diaphragm and organs, maintaining them in a lowered position. Reverse breathing, as the preparation for Packing Process Breathing, also takes place in the lower abdomen and should be practiced in conjunction with abdominal breathing. Draw air into the abdomen while contracting the muscles in front of the abdomen.

Begin with abdominal breathing, and follow with reverse breathing. (1) Practice abdominal breathing six times. Upon the last exhalation, flatten the stomach. Maintain the flattened stomach and begin reverse breathing upon inhalation. Feel the abdomen flatten even more, as if it were approaching the spine and feel the perineum flood with a pressure. Pull the sexual organs up and, at the same time, try to lower the diaphragm so that you are pushing down on the organs. Try not to let the diaphragm push up. Lowering the diaphragm is the hardest part of reverse breathing. It is very important now to practice the relaxing technique of smiling to the diaphragm and the abdomen. (2) Exhale, releasing the pressure in the perineum and in the sexual organs. Exhale through the lower abdomen, allowing the pressure to protrude from the lower abdomen to all sides and not only the stomach. Relax, letting the fasciae expand while releasing and relaxing the chest totally. Smile down. Relax. (3) Counting each inhalation and exhalation together as one, practice reverse breathing six, nine, and then eighteen times. Practice until you are able to control the diaphragm with your mind, commanding it to lower down or rise up.

2. Pelvic and Urogenital Diaphragms

The body also contains a pelvic diaphragm and a urogenital diaphragm which are exceedingly important in transmitting energy in Iron Shirt. (Fig. 2.5) The pelvic diaphragm is a muscular wall that extends across the lower part of the torso, suspended concavely downward from the level of the symphysis pubis (the joint of the pubic bones) in front and the sacrum (the back of the pelvis) in back. There are several organs that penetrate this muscular partition that lies between the pelvic cavity and the perineum. These are the urethra, the vagina and the rectum, and they are supported by the pelvic diaphragm. In fact, the pelvic diaphragm is the floor of the pelvic cavity which contains the large intestine, small intestine, bladder, kidneys, liver spleen, and pancreas. It is the pelvic diaphragm that lifts up and maintains the shapes of the vital organs. Below the pelvic diaphragm and above the perineum is another muscular diaphragm called the urogenital diaphragm. (Fig. 2.6) This is penetrated by the urethra, while its underside is the attachment site of the root of the penis or vagina. The pudendal

nerve connects the muscles of the urogenital diaphragm, the penis or vagina and the anus. There is a membranous superficial fascia that attaches to the back of this lowermost diaphragm that comes forward to engulf the scrotum or vagina (which also contains muscle) and joins with the abdominal wall. The importance of these anatomical structures will become apparent as you progress in your work in Taoist Yoga, especially in Iron Shirt I, II and III and in Taoist Secrets of Love (Seminal and Ovarian Kung Fu). These two diaphragms serve to assist the flow of pressure to the vital organs and glands, and help tremendously to increase Chi pressure in the organs and the abdomen. Knowing how to utilize and control these diaphragms will improve your capabilities in all levels of the Universal Tao practice.

Thorax Chest Diaphragm Abdomen

Pelvic Brim Perineum

Pelvis Diaphragm Urogenital Diaphragm

Thorax Chest Diaphragm Abdomen Uterus

Pelvis Diaphragm Urogenital Diaphragm

Pelvic Brim

Fig. 2.5 Pelvic and urogenital diaphragms are the major lower seals which prevent vital energy from leaking out the lower openings.

Pubic Bone Bladder Prostate

Perineum Urethra Side Cross-Section Hui-Yin (Perineum) Pubic Bone Coccyx Urogenital Diaphragm Urethra Anus Hui-Yin (Perineum) Side View Coccyx Bottom View Urethra Front View

Fig. 2.6 A closer view of the urogenital diaphragm in the male

3. Iron Shirt Packing Process Breathing (Chi Pressure)
Packing Process Breathing is the most important breathing technique to master in the practice of Iron Shirt. It is used in all of the Iron Shirt postures and practicing it well will be a great aid in benefitting from the postures. The Packing Process creates air pressure in a small space so that the body can have more pounds of pressure per square inch (psi). The importance of not only expanding the abdomen out in the front but allowing it to protrude on all sides has been stressed in the description of abdominal and reverse breathing. The same is true of Packing Breathing. The expansion of the front, back and sides occurs proportionately until the abdominal area becomes round like a ball. (Fig. 2.7) Watch a child breathe and you will notice

that his/her abdomen is round. In Chapter 1, we compared this phenomena to a tire which inflates to a certain number of pounds of air pressure (psi) in order to lift and support a car By utilizing this process, the human body can store air pressure (energy) in various parts of the body. When the pressure (Chi) drops, all the organs will drop and stack on each other dropping down and giving a greater burden to the pelvic and urogenital diaphragms. Chi pressure will help the organs hold their shape and uplift the organs into their own positions so that energy can flow easily. Thus, the Chi pressure serves as an energy charger of the organs.

Fig. 2.7 Abdomen during Packing Process Breathing become rounded like a ball.

The Taoists believe that the body has many openings: one front door the sexual organ; one back door the anus; and the seven openings of its windows, two eyes, two ears, two nostrils, and one mouth. It is through these openings that energy can enter or leak from the body. In the practice of Iron Shirt, we learn to seal our bodies to prevent energy leakage and the loss of Chi pressure, enabling us to pack, condense and store energy in our bodies and organs. Pulling up the pelvic and urogenital diaphragms helps to seal the sexual organ and anus doors. Turning the attention of your senses down to the navel area will also help to seal the energy. a. Preparation Using Abdominal and Reverse Breathing (Energizer Breathing) Sit at the front edge of your chair (the best position for practicing the Microcosmic Orbit also). Place your tongue at the roof of your mouth to seal the leakage of tongue and heart energy. Listen inwardly to your kidneys and breathe inwardly to the lungs. Look inwardly to the liver, and all of the other organs as well, to seal the senses from the inside.

(1) Start with the first stage of Energizer Breathing; that is, abdominal breathing. (Fig. 2.8(a)) Inhale slowly but strongly. Keep the chest relaxed and feel the area of the lower abdomen below the navel and perineum bulge. (Remember abdominal and reverse breathing originates from the lower abdomen, approximately one and one-half inches below the navel.) Then, forcefully, exhale. Notice that when you exhale, the belly flattens toward the spine. (Fig. 2.8(b)) Feel the sexual organs pull up. The perineal bulge diminishes. Learn to keep the stomach flat after exhaling. Inhale slowly again and allow the perineum to bulge as you do so. Repeat in multiples of eighteen to 36. The purpose is to energize the Chi and is also called “Fanning the Fire”. (2) When you are ready and feel that you have sunk the Chi downwards towards the navel, exhale so that the abdomen flattens towards the spine. The chest and sternum sink down, pressing and activating the thymus gland. Exhale once more and lower the diaphragm down. (Fig. 2.8(c)) Hold for a while and then, using reverse abdominal breathing, inhale ten percent of your full capacity to the navel (ten percent means a short, little breath) while keeping the belly fiat (Fig. 2.8(d)), then relax the chest and belly. Try to keep the diaphragm low. b. Building Chi Pressure (3) Inhale about ten percent while contracting the pelvic and urogenital diaphragms. (Fig. 2.8 (e)) Pull up the sexual organs and tighten the anus to seal in your energy. Compress the abdominal organs in three directions: above from the lowered daphragm, below from the sexual organs, and in front from the abdominal wall. The ribs and spine hold from behind. (Fig. 2.2(b)) Inhale ten percent. Contract the left side of the anus, thereby bringing the Chi to the left kidney. Pack and wrap the energy around the left kidney and the adrenal glands. At the same time, pull in more of the left stomach towards the spine. Pull up the right anus and bring the Chi to the right kidney. At the same time, pull more on the right side of the abdomen wall, flattening it towards the spine. Pack and wrap the energy around the right and left kidneys. (Fig. 2.8(f)) Hold this position for as long as you can.

Initial Preparations

Remember if the diaphragm becomes tight and pushed up, rub it with both hands to gently work the diaphragm so that it will drop down into a relaxed position. (Fig. 2.4)

Lung Diaphragm Abdominal Cavity Pelvic Cavity (b) Exhale, Flatten the abdomen to the spine.

(a) Energizer Breathing

(c) Exhale and lower the Diaghragm.

(d) Inhale ten percent, keeping the belly flat.

(e) Inhale ten percent, contracting the Pelvic and Urogenital Diaphragms.

Fig. 2.8 Packing Process Breathing

Chapter II

Adrenal Glands Kidneys First Pull Up to Strengthen the Kidneys

Ovaries

Middle Right Left

Anus

(f) Inhale ten percent. Contract the left and right anus. Bring Chi to the left and right kidneys. Pack and wrap the kidneys. Fig. 2.8 Packing Process Breathing -

(4) When you can no longer hold your breath, inhale ten percent more air on top of the air that you already have inhaled. Contract the perineum more tightly especially the sex organs. You can jerk a little, in order to pack the energy in the lower abdomen. Seal and limit the energy to a small area. You must maintain a relaxed chest and sink the sternum so that the diaphragm will stay soft and lowered. The stomach is flat and held in. Feel the pressure extend to the area of the sperm palace/ovary palace. (Fig. 2.8(g)) Pull the sex organs and the anus up again and seal them so that no energy can leak out. (5) Inhale ten percent more air. (You can exhale a little in order to inhale more air). Contract the pelvic area and lower part of the abdomen, and hold this position for as long as possible. (Fig. 2.8(h)) (6) Inhale ten percent more. Repeat. Feel the pressure build in the perineum. (Fig. 2.8(i)) (7) By this time, it may seem that you cannot accommodate any more air, but if you exhale a little bit, bend forward slowly and direct your attention to the kidneys, feeling them expand on both sides and backwards, relaxing and trusting that the air will have room there, you will be able to inhale the last ten percent of your full capacity to that area in the back. (Fig. 2.8(j)) Hold as long as possible. This will help to open the sides and back. (8) Exhale. Sit up straight. (9) Normalize breathing by using abdominal breathing. When you exhale and relax at the end of such a session, you will immediately experience heat or feel the energy run all around the body. Put the tongue to the palate. At this point you should meditate and circulate the Microcosmic Orbit for a few rounds. Collect the energy in the navel when you have finished. (Fig. 2.8(k)) Using this breathing method, the organs are packed, compressed and strongly massaged. When you inhale, blood and energy (Chi) will rush in with great force to clear the organs out, making them progressively stronger and healthier. If you feel energy stuck in the heart area, use both hands to brush the chest in a downward motion. In addition, you may want to do the Healing Sound for the heart (see the method described in the book, Taoist Ways to Transform Stress into Vitality) and walk around, shaking out the arms and legs.

Chapter II

Sperm/Ovary Palace

Lower Abdomen

Perineum

(g) Inhale ten percent down (h) Inhale ten percent down (i) Inhale ten percent to the lower abdomen. to the pelvic area and lower down to the perineum. abdomen.

(j) Bend forward to accommodate more air.

(k) Collect the energy at the navel. Fig. 2.8 Packing Process Breathing

4. Points To Remember in Practicing the Breathing Exercises
a. Always remember: Do not use force. Relax the chest so that the chest, sternum and diaphragm can sink down. b. When packing, stay soft inside, not tense, at least for a good deal of the time. Soft energy is said to be unlimited. c. Do no more than three cycles of packing per day for the first week. Gradually increase to six, nine and eighteen cycles per day. This exercise is much more strenuous than you might imagine. Energy, wrapped around the organs and pushed into the fasciae by opposing pressure, eventually increases the amount of energy stored in the fasciae and organs, protecting you against blows or unexpected injuries.

5. Preliminary Exercises
Here are some exercises which will be very helpful to you in the practice of Iron Shirt Chi Kung. All exercises should be performed as often as the body finds necessary in multiples of three. a. Check the Diaphragm The following is a procedure to check that the diaphragm is lowered. First, press deeply on the stomach with the fingers of one hand directly below the sternum. You will feel a sharp pain that will tell you that you have pressed on the stomach. Next, inhale, allowing the abdomen to balloon out. Touch the diaphragm under the rib cage near the sternum, above the stomach. You will feel a pain which is quite different from stomach pains. Make sure you are relaxed so that the diaphragm lowers. This is the most important part of Iron Shirt practice. Keep the diaphragm lowered at all times while using the packing process. This will prevent the Chi from congesting the lungs and heart and allow it to continue its course downward to the navel. b. Massage the Diaphragm Many people have a very tight, stiff diaphragm which sticks to the rib cage. To release the diaphragm, you can massage above the rib cage: (a) massage along the rib cage from top to bottom; (b)

use the index, third and fourth fingers to push downward from the rib cage, and feel the stretch of the diaphragm. (Fig. 2.9) When the diaphragm is stretched, you will feel breathing to be easier and deeper. This can easily be accomplished in the morning when you rise.

Diaphragm

Press in and down all along the edge of the rib cage. Fig.2.9 Releasing Tension in the Diaphragm

c. Abdominal Breathing in a Lying Position Your greatest reservoir of Chi is in the area of the navel. Concentrating on this area can increase Chi pressure and stimulate its flow. Your Chi always travels to where your attention and activity is centered. When you breathe high in the chest, your Chi goes there and, because Chi cannot be stored there, you will begin to feel distress. Abdominal breathing will avoid this problem. This exercise will help you accomplish abdominal breathing in a lying position easily. Lie flat on your back with the legs flat on the floor or with the feet on the floor and the knees raised just enough to allow the lower back to flatten against the floor. Place one hand on the sternum and the other hand on the lower abdomen. When you inhale, allow

the belly to swell enough to raise the hand that you have resting on it, while the chest remains comparatively still. Do this to the count of nine, and then put the arms at the sides. Exhale. Breathe in for nine more such cycles. Breathe abdominally without using the hands. Then place the hands on the chest and lower the abdomen again and repeat the exercise. Be alert to this breathing process and not to how you feel. Put the hands at the sides of the body again, and realize what you have learned. Repeat this exercise lying on one side and then the other. To give you stability in this position, bend the knees in front of you so that if someone were to look at you from above, you would look as if you were seated in a chair. When breathing, gradually feel the air expand from the lower lungs to the middle, the left, the right side and up, until the chest feels like a cylinder. d. Abdominal Breathing on a Slant Board This exercise will greatly increase the pressure and strength of the abdomen and strengthen the diaphragm. Lie on a slant board with the head towards the floor while doing this same exercise. Using a weight on the lower abdomen while lying flat, breathe in so that the weight is raised as the diaphragm lowers. Exhale. The diaphragm goes back to its normal position and allows the belly to flatten and lower the weight. Practice this daily, increasing the weight once a week and you will soon acquire a great control in directing Chi to the lower abdomen while strengthening the abdominal muscles. By putting the board higher up on the wall, you can increase the demands made on the abdomen and diaphragm. This approach allows you to discover various ways of adapting to a new position and gain greater control. Always repeat in multiples of three to 36 times. When you are proficient at abdominal breathing, you may go on to the next exercise. e. Strengthening through Counter Pressure For this exercise you will need a partner who will exert pressure on specific points of your body using a fist. Your partner should coordinate with you to determine the correct amount of pressure required for you to respond. (1) Have your partner hold a fist against your solar plexus. (Fig. 2.10) Inhale, directing your attention and your diaphragm to the

point of contact, and produce a counter pressure. Practice this six times only, resting after each time, and you will see how quickly you have learned to respond. (2) Your partner should hold a fist against your navel area. (Fig. 2.11) Inhale, direct your attention and your diaphragm to the point of contact, and produce a counter pressure. Practice at this spot six times, resting after each time. (3) Now, have your partner hold a fist against the lower abdominal area. Inhale and direct your attention and your diaphragm to this area, producing a counter pressure. Practice this exercise six times also, again resting after each time. (4) Finally, ask your partner to hold a fist against each side separately, a little towards the back in the kidneys' areas (vulnerable areas which are easily hurt by a blow). (Fig. 2.12) Inhale, direct your attention to the spot and produce a counter pressure. Do this six times, remembering to rest after each time. This exercise will begin to strengthen the kidneys' areas. (5) Change places with your partner and repeat (1) through (4). The effects of this simple exercise are widespread. It is invigorating, will mobilize an otherwise lax abdomen and can help you complete the Microcosmic Orbit quickly. If you cannot do it with a partner use a wooden dowel affixed to a flat board. The dowel should be about one and one-half inches in diameter. Simply place the fiat surface against a wall and lean against the dowel so that it presses against those places described above. f. Abdominal Breathing in a Standing Position Standing positions are mostly used in the Iron Shirt practice. It is harder to accomplish abdominal breathing in a standing position, thus you need to be more relaxed. As your abdominal breathing in a lying position improves, you will more easily control it in a standing position. While standing, the fasciae have tension to hold the muscles and the organs. This exercise is to strenghthen the abdominal fasciae. This is a means of acquainting you with the way the mind and body work together and of learning how to bring energy to a fascial area. Stand with the feet a shoulders' width apart. Relax the entire body and make sure the diaphragm is lowered. Take a deep abdominal breath, swelling out the belly. Hold it as long as you can comfortably. Exhale. When you feel the need, inhale. Repeat this cycle in multiples of three.

Fig. 2.10 Your partner with his fist againt your solar plexus.

Fig 2.11 Your partner with his fist againt your navel.

Fig. 2.12 Your partner pressing with his fist against your side, towards the back, in the kidney area.

Chapter II

Thyroid and Parathyroid Glands Fourth pull up Lungs Heart Liver Spleen Kidneys

Ovaries

Right

Left Middle Anus

Fig. 2.13 Train the mind to direct Chi to the organs and glands.

g. Getting Energy to Abdomen by training the Mind to direct it. After you have learned Iron Shirt Breathing, you can practice sending energy to the abdomen. With this exercise, you will gradually train your mind to direct and increase the Chi pressure at will to the upper middle and lower abdominal areas, or to the left or right kidneys, packing, wrapping and energizing them, to the adrenal glands, the liver, the spleen, the pancreas, the lungs, the heart, the thymus gland, or the thyroid and parathyroid glands. (Fig. 2.13) (In the advanced level, you will learn to direct Chi to other parts of the body as well.) h. Practice: Development of Iron Shirt Protection Make your left hand into a fist, with the inside edge of the fist facing inward as if it were holding a knife, and hold it over the abdominal area. Inhale. Imagine that Chi is filling the lower abdomen and that the edge of the fist is exerting 100 pounds of pressure against the abdomen. (Fig. 2.14) Resist. Now relax. Inhale. Do not force the energy in any way. When you feel comfortable with this pressure, gradually increase it so that the body will be able to handle it. This prepares you so that if you were hit without any warning anywhere on the body, you could send Chi to those points to cushion the body and vital organs from harm. Most people cannot take a punch to the stomach, which is located at the level of the solar plexus. With this training, you would be able to do just that. However in the Taoist practice we do not encourage people to show off by taking a punch. You must make sure you are relaxed throughout this exercise. begin by “filling the abdomen with air”. You can achieve this by concentrating on the area around and below the navel. The area from the navel to the sternum is divided into four parts. (Fig. 2.15) Wherever you direct your attention, Chi appears and protects the area like an inflated rubber tire. Use no force at any time in this practice. Simply breathe into the area you want to cushion, and concentrate on it while gradually pushing your palm into it. Do this systematically so that you cover all the body surfaces that you can reach.

Once you develop energy in the region between the sternum and the navel sufficient to protect you against unexpected injury, the rest of the abdomen is more easily protected. The counterpressure that is created drives Chi into the fasciae. When the deep fasciae fill with Chi pressure, the Chi pressure will spread out to the second layer of the fasciae. (For more detailed information regarding fasciae, see Chapter 4.) Soon, as you increase pressure in the abdomen, you will be able to move the Chi pressure around the abdominal area. Practice this constantly in conjunction with all of the Iron Shirt exercises. Once you have become proficient with the hand, you can use a short stick. Press the stick in the abdominal area and push in as you bring the Chi pressure to the area to counteract the stick.

100 lbs.

Fig. 2.14 Imagine exerting 100 pounds of pressure against the abdomen.

10 0

lb s.

100 lbs.

Initial Preparations

1 2 3 4

Fig. 2.15 Four Divisions of the Abdomen below the Sternum.

B. Summary of Iron Shirt Breathing
The breathing processes explained in this Chapter may seem to be numerous but, in fact, all relate and lead to Iron Shirt breathing.

1. Exercises to Improve Abdominal Breathing
a. Abdominal Breathing in a Lying Position (1) Lie supine, legs flexed or extended, hands on belly. Inhale nine counts. Raise hands. Exhale. Repeat nine times with your hands at your sides. (2) Lie supine, legs flexed or extended, hands on chest and lower abdomen. Inhale nine counts, allowing the belly to rise. Exhale. Repeat nine times with your hands at your sides. (3) Repeat (1) and (2) on each side with knees flexed.

b. Abdominal Breathing on a Slant Board (1) On a slant board, using a weight on the belly, inhale, raising the weight. Hold. Exhale. (2) Lower the weight. Repeat, adding to the weight on a weekly basis. Repeat in multiples of three, nine, eighteen and 36. c. Strengthening Through Counter Pressure Use mind and body to direct pressure from within against an outside force, concentrating Chi in a particular area of fascia. d. Abdominal Breathing in a Standing Position (1) Stand with feet a shoulders' width apart. Inhale and hold as long as comfortable. Exhale. Repeat in multiples of three.

2. Iron Shirt Chi Kung Packing Process Breathing
a. Abdominal Breathing Begin with abdominal breathing, expanding the lower abdomen. b. Lower the Diaphragm Lower the diaphragm upon inhalation while keeping the chest relaxed. Exhale, flattening the stomach, and feel the pull of the pelvic and urogenital diaphragms and sexual organs. c. Reverse Abdominal Breathing When you have brought the energy down to the navel, begin reverse breathing with an exhalation, flattening down the stomach. When inhaling, relax the chest and maintain a flattened stomach. d. Slightly Contract the Pelvic and Urogenital Diaphragm Contract the pelvic and urogenital diaphragm and, at the same time, slightly pull up the anus, and pull up the testicles or contract the vagina.

e. Packing Process Breathing Begin Packing Process Breathing with an inhalation. Using the packing process, seal and limit the energy to a small area. The diaphragm is lowered. The stomach is flattened and held in. Pull up the sexual organs and anus and seal them so that no energy can leak out of these three areas. f. Pack the Organs with Chi The energy goes back, filling out and packing the kidneys' areas. g. Exhale and Relax Exhale and let the Chi out. Relax.

C. Cranial, Respiratory and Sacral Pump Functions
Contained and protected within your spinal column and skull is the very "heart" of your nervous system. Cushioning it is the cerebrospinal fluid, cerebro for the head and spinal for the vertebrae. This fluid, as described by the Taoists in ancient times, is circulated by two pumps. One is in the sacrum and is known as the sacral pump. The other is in the region of your upper neck and head and is known as the cranial pump. Many people who have been able to feel these pumps working have reported feeling a "big bubble" of energy travel up their spine during Packing Breathing.

1. Sacral Pump
The sacrum consists of five pieces of bone when we are young; when we grow up these five bones fuse into one piece. Taoists regard the sacrum as a pump which will help to hold the sexual energy coming from the sperm/ovaries and perineum and transform the energy, at the same time giving it an upward thrust. It is similar to a way station, refining the sperm/ovaries' energy as it circulates in the body. In the Iron Shirt practice we tilt the sacrum to the back, or against a wall, exerting force to straighten the sacrum. This helps to activate the sacral pump to pump the spinal cord fluid up.

Chapter II

Sacral Canal

Sacrum

Chang Ching (GO-1)

Sacral Hiatus: Opening for Chi to enter the Spinal Cord. Ching Chiang (GO-1)
Coccyx Fig. 2.16 Sacral Pump

2. Cranial Pump
The cranium of the skull has long been regarded by Taoists as a major pump for the circulation of energy from the lower centers to the higher centers. Medical research has recently confirmed that minute movements of the joints of the eight cranial bones occur during breathing. (Fig. 2.17) Cranial movement is responsible for the production and function of the cerebrospinal fluid surrounding the brain and spinal cord, which fluid is necessary for normal brain, nerve and energy patterns in the entire body. Improper cranial respiratory function develops for many reasons. It may have been present from birth. At this time the skull is soft and moveable and the trip down the birth canal could jam a baby’s skull, or it may be the result of a difficult birth in which forceps were used. It may also occur later in life. A bump on the head coming from a certain direction while the person is breathing in the specific manner that allows the bone to move can cause improper cranial respiratory function. Auto accidents causing whiplash very often are the cause of cranial faults. Since cranial faults affect the flow of the fluid and the brain, nerve and energy patterns of the entire body, symptoms can develop anyplace. Strengthening the cranial joints can increase energy and alleviate symptoms, such as headaches, sinus problems, visual disturbances and neck problems.

Initial Preparations

In Taoism, cultivation of the movement of the pelvis, perineum, urogenital diaphragm, anus, and the sacrum and cranial pumps is very important in helping to move the life-force and sexual energy up to the higher center. The Iron Shirt Chi Kung Packing Process activates these pumps using various methods, e.g. mind control, muscle action, clenching of the teeth and tightening of the neck, and pressing the tongue to the palate. All of these methods will help to activate the eight pieces of cranial bone.

Upon Deep Inhalation

Upon Deep Exhalation

Fig. 2.17 Micromovement of Cranial Bones

Chapter II

D. Microcosmic Orbit Meditation

1. Circulate your Chi in the Microcosmic Orbit

In the preceding breathing exercises, you have been asked at certain points to circulate the Microcosmic Orbit. Your life-force energy thus must be circulated through specific pathways in the body efficiently and safely to be used for healing and growth. The Microcosmic Orbit circulation uses the power of the mind to help activate the sacral and cranial pumps into pumping the life-force energy throughout the body. It is much easier to cultivate your energy if you first understand the major paths of energy circulation in the body. The nervous system in humans is very complex and is capable of directing energy wherever it is needed. The ancient Taoist Masters discovered that there are many channels of energy flow. However, two energy channels carry an especially strong current. One channel is called the “Functional” or “Yin” Channel. It begins at the perineum, the point located at the base of the trunk, midway between the testicles/vagina and the anus. It goes up the front of the body past the sex organ, stomach, organs, heart, and throat and ends at the tip of the tongue. The second channel, called the “Governor” or “Yang” channel, also starts at the perineum but goes up the back of the body. It flows from the perineum upwards into the tailbone and the sacral pump and then up through the spine into the brain and the cranial pump, finally flowing back down to the roof of the mouth. The tongue is like a switch that connects these two currents— when it is touched to the roof of the mouth just behind the front teeth, the energy can flow in a circle up the spine and back down the front. The two channels form a single circuit that energy loops around. This vital current of energy circulates past the major organs and nervous systems of the body in a loop, giving cells the juice created from organ energy and smiling energy that is necessary to grow heal, and function, and spreading vitality throughout the body. This circulating energy is the Microcosmic Orbit, and forms the basis of acupuncture. Western medical research has already acknowledged acupuncture as being clinically effective, although scientists admit they cannot explain why the system works. The Taoists, on the other hand, have been studying the subtle energy points in the body for thousands of years and have verified in detail the importance of each channel.

Initial Preparations

Functional Channel

Governor Channel

Pineal Gland at the Crown (Enlightenment Gland, Gland of Direction) Pituitary Gland (Mideyebrow) Crystal Room Cavity of the Spirit Tongue Hsuan-Chi (Throat Energy Center) Shan Chung (Thymus Gland) Rejuvenation Center Chung Wan (Solar Plexus, Pancreas) Chi-Chung(Navel, Spleen) Ovary Palace, Sperm Palace Heding Extra-31 Wei-Chung BL-40; extra spirit energy is stored here. Chang-Chiang,Coccyx (Sacrum Pump) Hui-Yin (Perineum Gate of Death and Life Gia-Pe (opposite of Heart Center) Yui-Gen (Cranial Pump)

Yung-Chuan K-1 (Bubbling Springs)

Fig. 2.18 Learn to circulate your Chi in the Microcosmic Orbit. Tongue touches the roof of the palate to complete the circuit of the Governor and Functional Channels.

2. Importance of the Microcosmic Orbit

By opening up this Microcosmic Orbit and keeping it clear of physical or mental blockages, it is possible to pump the life-force energy up the spine. If this channel is blocked by tension, then learning to circulate the Microcosmic Orbit is an important step to opening up the blocks in the body to circulate and revitalize all parts of the mind and body. Otherwise, when intense pressure builds in the head, taking such forms as headaches, hallucinations, and insomnia, much of the life-force energy escapes through the eyes, ears, nose and mouth and is lost. This is like trying to heat a room while all the windows are open. The way to open the Microcosmic Orbit is by sitting in meditation for a few minutes each morning as you practice the Inner Smile. An essential Taoist technique, described in detail in Taoist Ways to Transform Stress into Vitality, the Inner Smile is a means of connecting visual relaxation and the ability to concentrate. Allow your energy to complete the loop by letting your mind flow along with it. Start in the eyes, and mentally circulate with the energy as it goes down the front through your tongue, throat, chest and navel and then up the tailbone and spine to the head. At first it may feel as though nothing is happening, but eventually the current will begin to feel warm in some places as it loops around. The key is simply to relax and try to bring your mind directly into the part of the loop being focused on. This is different from visualizing an image inside your head of what that part of the body looks like or is feeling. Do not use your mind as if it were a television picture. Experience the actual Chi flow. Relax and let your mind flow with the Chi in the physical body along a natural circuit to any desired point, e.g. the navel, perineum, etc. Study of the Microcosmic Orbit is recommended to all students who truly seek to master the techniques of Iron Shirt. Progress to the higher levels of transforming Chi and our creative energy to spiritual energy, without first learning the Microcosmic Orbit, is very difficult. Some people may already be “open” in these channels or relaxed when they are close to nature. The benefits of the Microcosmic Orbit extend beyond facilitating the flow of life-force energy and include prevention of aging and the healing of many illnesses, ranging from high blood pressure, insomnia and headaches to arthritis.

E. Perineum Power
In Iron Shirt practice, we will utilize “Perineum Power” to direct Chi to the areas, organs and glands that you wish to energize in order to pack and increase the Chi in that region. “Perineum Power” will be used in all Iron Shirt positions.

1. Anus is connected to Organ Energy.
The perineum (Hui-yin) region includes the anus and sexual organs. The various sections of the anus region are closely linked with the organs’ Chi. The Chinese term Hui-yin (perineum) means the collection point of all the Yin energy, or the lowest abdominal energy collection point. It is also known as the Gate of Death and Life. This point lies between the two main gates. One, called the front gate, is the sexual organ which is the big life-force opening. Here the lifeforce energy can easily leak out and deplete the organ’s function. The second gate, or back gate, is the anus. This gate can also easily lose life-force when not sealed or closed tightly through muscular toning. In the Tao practices, especially in the Tao Secrets of Love and Iron Shirt, the perineum’s power to tighten, close and draw the life-force back up the spine is an important practice. Otherwise, our life-force and sexual energy can become a ‘’river of no return.’’

2. Anus Region is divided into Five Parts.
The anus is divided into five regions: (a) middle. (b) front, (c) back, (d) left, and (e) right. (Fig. 2.19) a. Middle Part The middle of the anus Chi is connected with the organs as follows: the vagina-uterus, the aorta and vena cava, stomach, heart, thyroid and parathyroids, pituitary gland, pineal and top of the head. (Fig. 2.20) b. Front Part The front of the anus Chi is connected with the following organs: the prostate gland, bladder, small intestine, stomach, thymus gland, and front part of the brain. (Fig. 2.21 (a) and (b))

Chapter II

Urogenital Diaphragm Anus

Anal Sphincter Muscle Front Divisions of the Anus Right Left

Pelvic Diaphragm

Middle Back Fig. 2.19 The anus is dividded into five regions Crown Poi nt Pineal Gland Pituitary Gland Tongue Thyroid Glands Heart Stomach Third Pull Up Fourth Pull Up

Vena Cava Aorta Genitals

Second Pull Up

First Pull Up

Anus Middle

Fig. 2.20 Middle Part

Initial Preparations

(a) Front Part in the Male

Brain Fourth Pull Up Nose Mouth Thyroid Gland Parathyroid Gland Thymus Gland

Third Pull Up

Second Pull Up First Pull Up Anus Pull the middle up, and pull towards the front.

Small Intestines Bladder Prostate Crown Point Pineal Gland Pituitary Glands Tongue Front Thymus Gland Middle Stomach Vena Cava Arota Uterus

Fourth Pull Up Third Pull Up Second Pull Up First Pull Up Anus

Pull the middle up, and pull toward the front.

Middle Front

(b) Front Part in the Female

Fig. 2.21 Front Part

c. Back Part The back part of the anus Chi is connected with the organ energies of the sacrum, lower lumbars, twelve thoracic vertebrae, seven cervical vertebrae, and small brain (cerebellum). (Fig. 2.22)
Fourth Pull Up Third Pull Up

Brain Jade Pillow

Second Pull Up

Spine

Sacrum First Pull Up

Middle Back Anus Fig. 2.22 Back Part

Pull the middle up, and pull toward the back to the sacrum.

Initial Preparations

d. Left Part The left part of the anus Chi is connected with the organ energies of the left ovary, the large intestine, left kidney, left adrenal gland, spleen, left lung and left hemisphere of the brain. (Fig. 2.23 (a) and (b))
Left Side of Brain Eye Ear Left Lung Heart Spleen Left Adrenal Gland Left Kidney Fourth Pull Up Second Pull Up (Spleen–Lung) Third Pull Up (Heart)

First Pull Up

Anus Middle Left

First Pull Up the Middle, then pull Up the Left Side

(a) Left Part in the Male Thyroid and Parathyroid Fourth Pull Up Glands Lungs Heart Liver Spleen Kidneys Ovaries Anus First Pull Up the Middle, then pull up the Left Side. Left Middle (b) Left Part in the Female Fig. 2.23 Left Part

c. Right Part The right part of the anus Chi is connected with the organ energies as follows: the right ovary, the large intestine, right kidney, adrenal gland, liver, gall bladder, right lung and right hemisphere of the brain. (Fig. 2.24 (a) and (b))
Right Side of Brain Fourth Pull Up

Third Pull Up Second Pull Up

Right Lung Liver Right Kidney

First Pull Up First Pull Up the Middle, then Pull Up the Right Side Right (a) Right Part in the Male Lungs Heart Liver Spleen Kidneys Ovaries First Pull the Middle, then Pull Up the Right Side Right Middle (b) Right Part in the Female Fig. 2.24 Right Part Anus Left Anus

Middle Fifth Pull Up

Brain Eyes Inner Ear

Thyroid and Parathyroid Glands

Initial Preparations

By contracting the anus in different parts you can bring more Chi to the organs and glands, and the effects of the massage will increase. (Fig. 2.25)

Fig. 2.25 Wrap the organs, encircling them with Chi energy.

F. Precautions

The following is a warning to practitioners with high blood pressure, emotional instability, heart or chest pain, or any acute illness. 1. If you have high blood pressure, check with a doctor before attempting the practice of Iron Shirt. Do not do the exercises and breathing techniques strenuously. 2. Women should not do Iron Shirt breathing during a menstrual cycle, but may practice the structure, standing Chi meditation and Bone Breathing. If pregnant, do not practice Iron Shirt Packing Breathing; use only energizer breathing and standing Chi meditation. 3. Be sure that the diaphragm is lowered while practicing these exercises to avoid accumulating energy in the heart and to facilitate the flow of the Microcosmic Orbit. 4. After practicing the postures, while bringing the energy down, be sure to place the tongue on the roof of the mouth to collect all energy from the head (the Governor Channel). Take the energy down from the head, slow it down in the solar plexus, and then store it in the navel.

Chapter III

Chapter 3
Practice of Postures

There is an integral relationship between strong, unblocked Chi flow and good structural alignment. Proper practice of Iron Shirt, as well as all other Taoist exercises, will lead to a dramatic improvement in structural health, as well as increased Chi flow. A refined understanding of the structural interrelationships of the body is inherent in Iron Shirt. Because of poor postural habits, many people have developed serious structural distortions and have no natural sense of the body in appropriate alignment. If these distortions are carried over into Iron Shirt practice, much effectiveness is lost and bad habits perpetuated. In effect, one is practicing the very problems that need to be corrected.

I. Iron Shirt Horse Stance using a Wall

The following exercise demonstrates how to use a wall to align yourself perfectly in the Iron Shirt Horse Stance used in Embracing the Tree, Holding the Golden Urn and the Phoenix postures. These postures will be described fully in this chapter. This wall position is a variation of the Structural Training Position against a Wall which is described in Chapter 4. As your practice continues, you will develop the feeling of proper alignment and will be able to follow the same principles without a wall. Whenever you practice your alignment against the wall, when you feel you can hold the position, step away from it and apply the same principles. After you have learned to adopt the correct stance without the wall, occasionally practice against it again to check yourself. Once you are skilled, occasional use of the wall will allow you greatly to increase your spinal lengthening when you practice. Use this wall position to practice alignment by itself as well as with the breathing used in Embracing the Tree and the other excersises in which packing is done. Practicing the full exercise with Packing Breathing while against the wall will help to insure that you can maintain the alignment while in the much more dynamic state of packing and energy circulation.

Practice of Postures

At first, applying some of these details may seem difficult or unclear. However as your body opens up, you will gradually be able to apply each detail easily and naturally. Since these principles represent application of the basic design characterisics of your body structure, you will feel more and more as you practice that your body will naturally fit into these” grooves”.

A. Sequence of Practice in Using a Wall to Develop the Iron Shirt Horse Stance
1. Distance Between Feet Stand with the left foot a few inches away from the wall. The foot should be straight along the second toe, or just slightly turned out at the heel. To measure the proper distance between the feet, touch the knee of the right leg to the heel of the left foot. Place the ball of the right big toe in line with the ball of the left big toe so that both are the same distance away from the wall. Now, as you stand up, rotate the right foot around the ball of the big toe. Both heels will then be the same distance from the wall, and the feet will be the correct distance apart.

Fig. 3.1 Horse Stance Using a Wall

2. Foot Alignment First, feel that you firmly contact the ground with the balls of the big toes. Then, spread the toes by widening the feet across the balls. Now equalize the weight over the whole foot by equalizing the weight on the following three points: the ball of the large toe, the ball of the last two toes, and the middle of the heel. (Fig. 3.2) The toes should remain relaxed and not be grasping the floor. Remember that the feet are the foundation of your stance. As these details become natural, your practice will be much stronger, and you will experience greater body-mind integration. Proper foot alignment is the basis of understanding.

3 4 5 2 1

6 7

8

9 Fig. 3.2 Nine Points of the Foot

3. Distance from the Wall The feet should be the right distance from the wall so that with the spine flattened to the wall, you do not feel like you are leaning back. If the wall were suddenly removed, you would not need to adjust yourself to keep from falling back. 4. Rooting with the Feet When practicing those parts of Embracing the Tree and Rooting that call for strongly grasping the ground with the toes, feel that this clawing begins at the balls of the feet, not at the toes themselves. Accentuate this grasping at the big toe in particular and there will be much stronger rooting because the foot is used in a more complete and integrated fashion. 5. Knees Bend the knees so that the kneecaps are directly over the toes. Bend the knees no farther than the ends of the big toes. The knees can be bent less than this, but eventually should be bent this far to insure maximum development of strength. 6. Pelvis First, allow the lower spine to flatten firmly against the wall for as long as this can be done without discomfort. Then, place your hands on the tops of the thighs at the crease where the thighs connect to the pelvis. With the lower spine flattened to the wall, you will feel that the tendon in the front of the thigh and slightly to the inside is very tight. Now rotate the pelvis slightly so that the lower spine comes away from the wall. You will feel this tendon relax. You should barely be able to place a flat hand between your lower spine and the wall. This will also increase the crease at the junction of the thigh and pelvis. Continue to feel that the sacrum is stretching the spine down. 7. Pelvic Tilt As your practice of Iron Shirt continues and your attention is focused to the sacral area, the pelvic tilt is used. This is accomplished by strongly pushing against the wall at the sacral area while maintaining the other structural details. As you strongly push back to the wall,

your spine will arch slightly more, and you will feel the muscles around the sacrum become very firm. As this happens, it is very important to feel that you are also stretching the sacrum further down the wall. (Fig. 3.3) If you are doing this properly you will feel a strong force around the sacrum with only a small added arch in the lower spine. 8. Middle Back To insure that this pelvic aligning does not arch the middle spine, maintain the pelvic tilt position, and push back gently but firmly the back lower ribs, simultaneously lifting them slightly higher up the wall. During this procedure you will feel the middle and lower back lengthen. (Fig. 3.3) This is the work of the psoas muscles. 9. Head/Neck/UpperBack Remain in the pelvic tilt position and bring as much of the upper spine as fiat to the wall as possible without strain. Maintain the head as if it is being gently pushed back from the upper lip and simultaneously lifted by its crown. (Fig. 3.3) Again, for many people the head held in this way will not touch the wall. This is usually because of excessive curvature of the upper spine, which can be eliminated by practice of the Iron Bridge, the Backbend and Door Hanging. (The Iron Bridge is described subsequently in this chapter; see Chapter 4 for descriptions of the Backbend and Door Hanging.) 10. T-11 Thrust When Chi energy is brought to the adrenal energy center (the T-11 point, located at the top of the kidneys at the point of the adrenal gland, or at the bottom edge of the rib cage at the spine) and packed in the kidney area, it is necessary to lean forward and thrust the T11 area back. To feel this on the wall, simply keep the T-11 area firmly pressed against the wall and round the rest of the spine above this point away from the wall, while maintaining the other alignment principles. By practicing against the wall in this way, it is possible to feel this thrust very strongly, as when practicing with a partner pushing at that point.

Fig. 3.3 Pelvic Tilt

11. Shoulders Place the arms in any one of the arm positions as described in the first four Iron Shirt exercises in this chapter . Then move the shoulder blades firmly back to the wall so that the whole area of each shoulder blade is in firm contact with the wall. Now round the shoulders for ward, feeling the shoulder blades move away from the wall, until just the spine and, if possible, the area between the inner edges of the shoulder blades remain on the wall.

12. Head/Neck (C-7, the Base of the Neck, and C-1, the Base of the Skull) After rounding the shoulders forward, push back gently, but firmly at C-7, the bone at the base of the neck, and at C-l, the bone at the base of the skull. The chin will tuck in as you do this. When bringing the Chi to these two points, you will drop the chin, bringing it closer to the chest. Even when pushing strongly neither point will touch the wall. Until that point in the exercise is reached, however, push back less strongly (particularly at C-7) to insure that alignment with the upper spine and neck remains correct. (Fig. 3.4) If done properly, pushing back at C-7 after rounding the shoulders forward will increase the rounding of the shoulders, and you will feel that the shoulders have become “locked” in place. 13. “Locking” the Structure Lock the knees and do not move them. As you concentrate on the knees, they will feel as though they are simultaneously being pushed in and out. Then push the knees outward. You will feel a spiraling effect from the knees to the ground as if your legs were screws being screwed down into the earth. In Embracing the Tree, similarly lock the arms, but do not move them. Feel that the elbows are simultaneously being pushed in and pulled out as if the arms were screws being moved by the spiraling action of the forearm. You can also feel this locking action of the elbows and the knees if you imagine that you are straightening the joint, but without actually doing so. Locking these joints greatly improves strength, stability and Chi flow. Practice the Wall Stance and the Embracing the Tree posture for a while, until you can feel you are able to hold the position.

Practice of Postures

Base of Skull

C-7

T-11

Normal Spine Side View

Backview

Pull Spine with Tilted Sacrum

Fig. 3.4 Spinal Alignement

B. Summary of Practice for Using a Wall to Develop Iron Shirt Horse Stance Basic Alignment

1. Feet: Measure the proper distance of the feet from each other and from the wall. Align each foot. 2. Lower Back: Lean against the wall with the lower spine flat, if possible. 3. Head/Neck/Upper Back: Bring as much of the upper spine as possible flat to the wall, with the head held as if it is pushed back from the upper lip and lifted by its crown. The back of the head may or may not touch the wall. 4. Pelvis: Rotate the pelvis back until the thigh tendon is more relaxed. Feel that the sacrum is pulling the spine down. 5. Middle Back: Bring the lower ribs firmly to the back wall, then stretch them up slightly higher on the wall. 6. Arms/Shoulders: Position the arms for one of the first four Iron Shirt exercises. Flatten the shoulder blades to the wall. Round the shoulders forward, feeling the shoulder blades move away from the wall until only the spine and, if possible, the area between the inner edges of the shoulder blades remains on the wall. Lock the elbows and knees. 7. Chest: Check that the chest muscles are relaxed. The chest will be somewhat depressed. 8. Head/Neck: Gently, but firmly, push back at C-7 and at the base of the skull. Extend up from the crown of the head. The back of the head does not touch the wall. Special Alignment During the Exercises: 9. Rooting with the Feet: “Claw” with the feet by grasping with the balls of the feet first, particularly the balls of the big toes. The toes will then follow in grasping the ground. 10. Pelvic Tilt: Rotate the pelvis back farther as you strongly extend the sacrum down the wall. Feel the muscles around the sacrum firmly push against the wall. 11. T-11 Thrust: Push the T-11 area firmly to the wall as you bring the rest of the upper spine away from the wall,

Practice of Postures

II. Starting Position for all Exercises: Embracing the Tree
We will describe the positions of Embracing the Tree very carefully in a detailed, step-by-step explanation in Part A below. In Part B, we will give a sequence of practice, which will give you a complete sequential picture to follow without distraction. Practice as you read Part A first. Then, join all the steps together by following Part B. Part C is a summary of the sequence of practice. Utilize the Horse Stance with the assistance of the wall to improve your structure.

A. Embracing the Tree (Explanation of Procedure)
Embracing the Tree is the Master Stance practice. This practice joins many body structures and tendons (Chi channels) together into one system. In the beginning it seems difficult, quite like putting a puzzle together. However if you begin this practice by taking one step at a time, practicing each one until you can master it, then moving on to the next step, you will find this practice much easier to do. Once you have mastered the Horse Stance on the wall, you will find it much easier to practice Embracing the Tree. 1. Correct Stance The correct distance between the feet in all Iron Shirt stances is the length of the lower leg from knee to toes. (Fig. 3.5(a)) Beginners may wish to place feet slightly farther apart, but the standard position yields the quickest results. (Fig. 3.5(b),(c) and (d))

Chapter III

(a) Finding the Standard Position of the Feet.

(b) Rooting the Feet

(c) Incorrect Rooting—Front View

(d) Incorrect Rooting—Side View

Fig. 3.5 Embracing the Tree—Rooting

Practice of Postures

Fig. 3.6 Feeling rooted to the Earth.

2. Rooting of the Feet As previously discussed, rooting is a very important practice in the Tao System which begins with the physical practice and builds into the higher or spiritual, practice. Like the foundation of a building, the Rooting Practice makes a strong foundation upon which to build, making the structure last longer. To root is to surrender yourself to the pull of gravity while maintaining a structural skeletal alignment which supports the body in an upright posture. In beginning the physical part of rooting, the soles of the feet (K1) are the places where Mother Earth’s healing energy enters. When the soles are open, you can feel the soles ‘’sucking’’ and having a connection with the ground. This healing energy passes into the body through the soles and will nourish the organs and the glands. Like the roots of a tree, the feet support the entire structure. (Fig.3.6) It is important to distribute your weight solidly and evenly on the whole foot. We divide the foot into nine parts, or nine bases: (l)big toe, (2)second toe, (3)third toe, (4)fourth toe, (5)small toe, (6)big ball, (7)small ball, (8)outer edge, and (9)heel. (Fig.3.7)
4 5 K-1 7 3 2 1

6

8

Fig. 3.7 K-1 and the Nine Points of the Foot

You must feel that the nine parts are evenly contacting the ground. Feel and check which parts are too tense or have too much pressure on them. This can cause the body to misalign and the spine to tilt to one side. Over a long period of time, improper alignment can cause spinal cord or disc problems. The big toe joins with the tendons of the thumb (Fig. 3.8). and the little toe joins with the tendons of the pinky finger (Fig. 3.9); thus, all the tendons of the body are connected, increasing your rooting power. Slightly moving the feet inward, thereby pointing the toes in, will help to make the connection of the big toes and the thumb. In this posture, imagine you have roots extending down into the ground.

Little Finger

Little Toe Fig. 3.8 Tendons of little toes join with the tendons of little finger.

Chapter III

Thumb

Thumb

Navel

Big Toe

Big Toe

Fig. 3.9 Tendons of the big toes join with the tendons of the thumbs.

Note that if, at this point, the toes and ball of the foot were raised, the practitioner could easily be pushed over. In the spiritual level of rooting, it is important to know that as there is a Mother Earth, there is a Father Heaven. Many people in the spiritual practice always want to raise themselves to a higher level to be filled with spiritual energy. If you want to go higher, you must take care that the foundation, the rooting, is good. This connection of heaven and earth is most important in the Tao practice. In the higher practice, the ground energy from Mother Earth is equally important to the spiritual energy from Father Heaven. To assist you at this point with an overall view of the Embracing the Tree posture, see Fig. 3.10(a) through (g).

Fig. 3.10 Embracing the Tree Posture

Chapter III

(d) Full Embracing the Tree Posture—Front View

(e) Full Embracing the Tree Posture —Side View

(g) Rounding of the Scapula

(f) Full Embracing the Tree Posture—Back View

3. Elongation of the Spine (Fig. 3.11(a), (b) and (c)) When you feel the Chi and fullness down below the navel, slowly sink down into the knees and feel the sacrum pulling the spine down and the head stretching upward as if pulled by a string. Keep the spine erect. Feel the spine suspended upward and the sacrum downward in order to help elongate the spine and keep the discs released. Gradually you will become taller. This elongation gives more room for expansion of the nervous system and for spinal fluid and Chi to travel freely. Look straight ahead, and step to the side with the left foot to the standard position.

Feel the head stretch up as if pulled by a string.

Feel the sacrum pull down the spine.

Sink the knees down.

(a) Elongation of the Spine Fig.3.11

(b) Neck Force pushes Up.

Sacrum Force pulls Down. Nucleus Vertebra Disc FibroCartilage Vertebra

Disc expands when Two Forces pull in Different Directions.

Lbs. Vertebra Disc Fibro Cartilage Vertebra

Nucleus

(c) Disc is Compressed Because of Stress and the Weight of the Body pressing into the Spinal Cord.

4. Three Chi Circles a. Connect the arm with the scapula-the First Circle (Fig. 3.12) Raise your arms in a circle as if holding a large ball or a tree lightly between the hands and chest. This forms the first circle. Your fingers should be gently separated by holding the fingertips of each hand one to two inches apart from each other. The neck (C-7) is the main juncture where energy and the powerful tendons of the body meet. Gradually you will feel the Chi spread from the C-7 to the outside of the arm, to the middle finger to the palm and feel the Chi jump from the right middle finger to the left middle finger and from the right thumb to the left thumb.

Arm connect with the scapula.

Sternum moves in and the rib cage sinks in.

Arm is not fully connected with the scapula.

Sternum remains out and the rib cage remain out.

Incorrect Rounding of the Scapulae Fig. 3.12 First Circle: Connect the Ams with the Scapulae

Elbows sink down, turning inward, and should feel as if they are maintaining their position by resisting the downward pull. Imagine that someone is pushing you on the outside of your elbows and you, in turn, are pushing outward to maintain the position. Feel the spiral in your forearm as if it were a screw turning clockwise. This will connect the wrist, elbow and arm together. Relax the shoulders. Drop the neck muscles down. The trapezius muscles, connecting the back of the neck with the back of the shoulders, have to be relaxed so that the connection can be transformed down. (Fig. 3.13).

Side View

Trapezius Muscle

Back View Trapezius Muscle

Fig. 3.13 Trapezius Muscle

Practice of Postures

Bring your concentration down the spine, pressing down on your skeletal structure to the sacrum, to the knees, and finally down to the feet and the earth. You are pressing down on the skeletal structure for the body’s support, rather than the muscles. The pressure gradually travels down the spine to the sacrum and hips, tightening the legs and feet. Eventually you will feel your bone structure connected down to the ground, rooted as if you had grown into the ground and were all one piece with the earth. (Fig. 3.14) Stand erect, feet close together and feel the weight distributed evenly on the feet. Relax the neck, the shoulders and the chest. Gradually bring your attention to the navel and send the Chi energy to the navel until you feel a warm fullness there.
Elbows should feel as if they are simultaneously being pushed down and pulled up. This presses down on the bone structure, increasing the pressure on the feet.

Rounding of the Scapulae

Feet press down through pressure on the bone structure. Fig. 3.14 Press down on the bone structure.

b. Connect the scapulae with the spine—the Second Circle (Fig. 3.15 (a), (b) and (c)) Thumbs point up so that the energy will flow between the two thumbs and the energy will connect with the big toes; thus, the two muscle-tendon meridians join together, and the front structure of bones, tendons, fasciae and muscles tighten the structure together as one. (Fig. 3.15 (a))
Thumb Thumb

Navel

Big Toe

Big Toe

(a) The tendons of the big toes’ lines connect with the tendon of the tumbs.

(b) Spiral the energy though the arms and out of the fingers.

C-7

(c) Stretch like a bow from C-7 to the thumbs, thereby connecting the hands, C-7, scapulae and spine

Fig. 3.15 Second Circle: Connect the Scapulae with the Spine

Attach the hands and fingers to the scapulae, or shoulder blades, and cranial bone by pulling the thumb tendons away from the body and the pinky fingers' tendons towards you. Feel a spiraling action turning in a clockwise circle as you pull the scapulae to the side. (Fig. 3.15(b)) As in using the wall, feel as though the inner edges of the shoulder blades remain on the wall with the shoulder blades sticking to the back of the rib cage. This will allow the transference of force from the shoulder blades to the rib cage, which in turn will transfer to the C-7, or energy junction point, to the spine, the sacrum, the knees and down to the feet. In this way the force can also be transferred from the earth to the feet, to the knees, to the hips, to the sacrum, to the spine, to the shoulder blades and, finally, to the hands. Since the shoulder blades, while near the spine, are not connected to it, there can be no force transferred from one to the other unless you practice the proper stretching. In practicing this posture, you will feel a stretch of force form like a bow from C-7 to the thumb. When your elbows sink and press inward, you will feel more of the stretching of the bow. By stretching the scapulae and spine tendons and connecting them together (Fig. 3.15 (c)), the back becomes rounded and the chest sinks. Feel the hollowness of the chest. The sternum then sinks down to press the thymus gland, the major gland of rejuvenation and the immune system. (Fig. 3.16) Keeping this gland active will increase Chi flow. These events will help to activate the cranial pump. (Fig. 3.17) Rest and feel the head start to pulsate. Joining the powerful muscletendon meridian down to the navel will connect the Chi energy in the front line and join the bone structure of the rib cage together (Fig. 3.15(a)) In doing so you are helping to sink the energy down. This forms the Second Circle. Embracing the Tree will strengthen the thumb and toe muscles and tendons along this meridian. The thumb and toes have the principal rooting power. By strengthening these muscles tendon meridians which join at the navel, all the muscles, tendons, bones and fasciae (connective tissues) will become tied together greatly improving the bone structure and holding a good posture. Bad posture is caused by weak tendons, muscles and fasciae, which cause bones to fall easily out of alignment.

Practice of Postures

Thymus Gland

Fig. 3.16 Thymus Gland is the major gland of rejuvenation and the immune system.

Cranial Pump becomes activated during the Second Circle when, upon deep inhalation, there is a micromovement of the Cranial Bones. Fig. 3.17 Cranial Pump

c. Connect the hand, scapulae and spine to the sacrum—the Third Circle (Fig. 3.18)

C-7

T-11 Spinal Bow

Mini Pump Sacrum and Sacral Pump

Pushing the sacrum will activate the Sacral Pump.

Find the gravity point of the sacrum. Fig. 3.18 Third Circle: Connect hands, scapulae and spine to sacrum.

This connection is made by pushing out the curve of the C-7 from the sternum, the natural curve of the spine, and locking the hips. This will stretch the spine like a flexed bow that will link the spine, C-7, scapulae, shoulders, arms, elbows, and hands together. Push the sacrum out as if you were pushing against the wall; the hips remain the same. The hip bones and sacrum can be separated individually. Once you can separate out and move the sacrum straight, you can activitate the sacral pump which is very important to help circulate the Chi. (Fig. 3.19) You will feel the connection of the spine, the scapulae and the sacrum. Find and adjust the gravity point of the sacrum in between the feet.

Sacrum

Sacral Hiatus opening through which Chi enters the spinal cord.

Chang-Ching (CO-1, Coccyx)

Fig. 3.19 Sacral Pump

The greatest kinetic energy and power in the human body is generated through the hip joints, around which are attached the largest muscles (the psoas muscles). (Fig. 3.20) However if you cannot open the pelvis and differentiate both sides (pelvic differentiation), the power of the hip joints is limited to only two directions. The simple fact of standing on one leg without leaning to one side would require an internal sense of the angle of the pelvis, and the arrangement of the spine. To feel “empty” on one side can only happen when you feel grounded, supported and aligned on the other (emptiness and fullness: Yin-Yang). Round the pelvic area like an arched bow. By turning the big toes in slightly, the second toes point straight ahead so that your feet are positioned as though standing on the circumference of a circle, making yet another circle. This will gradually open the groin area and allow the Chi pressure to fill the area as if a ball were in this area.

12th 1st 2nd 3rd 4th Hip

Psoas

5th Lumbar

Fig. 3.20 Opening the Pelvic Area

Psoas

The hip joints are synergistically dependent upon two further joint alignments: the knees and ankles. The knees, ankles and feet are the next connection to the earth. Embracing the Tree requires a precise alignment of the knee and ankle joints. The critical joint alignment is in the ‘saddle’ of the tibia (shin bone) over the talus (ankle bone), which stabilizes everything above. Sink, down and open the knees a little bit, turning the knees outward slightly as if you were in a saddle. Feel a spiraling downward movement as if your legs were screws, screwing down into the ground, created by pressing firmly on the feet, and then feel the whole body force transfer to the ankles, the feet, and to the ground. (Fig. 3.21) Feel your bone structure. The knees should feel as if they are simultaneously being pushed in and out. Lock the knee caps.

Knees are pushed outward.

Press down and turn the knees outward to screw the force into the ground.

Fig. 3.21 Screw the force into the ground.

If the alignment is oblique, forces through the feet are not spread evenly. The knee joints should not be positioned over the big toes as this may cause some to experience knee pain, making them unable to continue. If you have trouble with your knees while in the Horse Stance, you must judge just how much you can do. In your own best interest, you may have to forego some of the positions. Note, however that the cause of pain is not necessarily found in the physical location in which the pain is felt. Fold the tongue back to the soft palate in the area of the Heavenly Pool. (Fig. 3.22(a)) If this is difficult, simply touch the tip of the tongue to the gum line behind the front upper teeth. (Fig. 3.22(b)) Now you should feel the whole body structure connect into one piece from the feet, ankles, knees, hips, sacrum, spinal cord, scapulae, arms, elbows and hands.

(a) Heavenly Pool

(b) Tongue touches behind the teeth Fig. 3.22 Tongue Positions

5. Eyes Can Help to Direct Chi The Taoists regard the eyes as the windows of the soul and a most powerful tool in directing and absorbing Chi into the body. Direct the eyes to look at the fingertips of both hands. Hold the eyes steady to direct the Chi flow. Keep them wide open while looking at the fingertips to help connect the Chi between the fingers while seeing the tip of your nose with some part of your vision. Allow the ears to listen inside the body to the navel. (Fig. 3.23) This will make you feel very centered, peaceful and calm.

Practice of Postures

During inhalation, create a ball by expanding the abdomen on all sides. Exhale and feel the ball roll up your chest.

Ears listen to the navel

Navel

Fig. 2.23 Inhalation

6. Begin with Energizer Breathing (Abdominal and Reverse Breathing) Concentrate on the area just one and one-half inches inside and below the navel until you feel some Chi activity there. At that point, begin breathing, preferably the Energizer Breathing. As described in Chapter 2, this is accomplished by first inhaling into the lower abdomen (the region below the navel). Feel the abdominal wall pull the lower lobes of the lungs down and the air move in. Feel the lower abdomen and perineum bulge on all sides like a ball, then forcibly expel the air through your nostrils. With this expulsion of air, feel as if a ball were rolling up your chest. (Fig. 3.24) Sink the sternum and press into the thymus gland. At the same time, pull up the sex organs and the anus. When exhaling, the abdomen is flat to the spine. Release. One such inhalation and exhalation constitutes a round.

Rounded Abdomen

Perineum

Fig. 3.24 Energizer Breathing

Practice of Postures

7. First Stage a. Do nine to eighteen rounds of Energizer Breathing. Remember the breath should be generated from the lower abdomen, one and one-half inches below the navel. You can put your hand at the lower abdominal area to make sure the breathing is generating from there. b. Exhale your last inhalation and be aware of how you flatten the abdomen, pulling in and up behind the front lower ribs to do this. This will increase and strengthen the psoas muscle. Exhale once more and relax the diaphragm downwards. Gradually you will feel the diaphragm press against the adrenal gland. (Fig. 3.25) Do not tighten the abdomen. Contract the perineum and start to do the Iron Shirt Packing Process.
Diaphragm presses down on the adrenals and kidneys.

Diaphragm

Fig. 3.25 Relax the diaphragm downwards.

c. Perineum power: Inhale ten percent of your capacity with short, quick breaths generating from the navel by using the navel to pull the air in and pull up the sexual organs. (Men pull up the testicles and the penis; women pull up the uterus and squeeze the vagina tight.) Keep the abdominals in the position they assumed when you exhaled and feel pressure build in the upper abdomen. (Fig. 3.26) Diaphragm, abdominal wall and perineum press into the abdomen.

Cross-Section of the Abdomen

Perineum

Fig. 3.26 Perineum Power

d. Inhale another ten percent and pull up the left side of the anus. Bring the Chi to the left kidney and wrap and pack the kidney and adrenal glands with Chi. (Fig. 3.27) In the beginning you might not feel it, but when you practice for a while, you will feel something under the back rib cage bulge out. The sensation is very unusual. Inhale again to the right side of the anus and pull the Chi to wrap around the right kidney. The kidneys are the first organs to be exercised. Remember the first point of each kidney, K-1, is on the sole of each foot; these points are the major points of rooting. When the kidneys are strong, the bones will be strong because the kidneys control the bones and the Chi in the bones. When you can master the kidneys' Packing Process, that is, wrapping and packing the Chi around the kidneys, you can easily move to wrapping and packing the ovaries, prostate gland, adrenal glands, liver, spleen, lungs, heart, and thymus gland. (Fig. 3.28)

Anus Pull Up Energy

Fig. 3.27 Wrap the energy around the kidneys.

Chapter III

Thyroid and Parathyroid Glands

Lungs Heart Liver Spleen Kidneys

Ovaries

Right

Left Middle Anus

Once you have mastered the Kidney Packing Process, you can proceed easily to wrap and pack the other organs. Fig. 3.28 Kidney Packing Process

e. Concentrate on the navel and circle the Chi in that area nine times in a clockwise direction in an area three inches in diameter, and nine times in a counterclockwise direction, thereby condensing the Chi into a ball. (Fig. 3.29) Use your mind and eye movements to help create the circular direction by moving the eyes in a round circle. (Fig. 3.30) First move the eyes clockwise beginning with the eyes looking downward, moving up to the right comer, to the top, to the left comer and down again nine times; then, circulate the Chi counterclockwise by moving the eyes from the bottom to the left, to the top, down to the right, and to the bottom nine times. You should begin at your navel and circle inwards using a three inch diameter, while thinking that the Chi in the body is being drawn to that place by that activity and that it is being packed into the smaller and smaller area of an energy ball, to be finally contained in the navel. Slowly do nine rounds. Concentrate and collect your energy when you feel Chi has been generated. The Chi will condense into a small, dense unit.

Circle the Chi and concentrate the energy into an energy ball. Fig. 3.29 Creating an Energy Ball

12 9 clockwise 6 3

12 9 counterclockwise 3 6

Use the mind and eyes to help circle the Chi energy ball nine times clockwise...and nine times counterclockwise. Fig. 3.30 Circulate the Energy Ball.

There are nine points in which the Chi is to be circulated and condensed. (Fig. 3.64) In later practice, you will condense, store and bring up the Chi from these power stations. These Chi power stations are tremendously useful in the Kung Fu energy and spiritual practice. It is most important to keep the diaphram down. Remember to check it by touching the sternum and the stomach. You can feel the diaphram coming down when it is distinguishable from the stomach. f. Inhale another ten percent. If you feel that you cannot inhale more, you can exhale very little and inhale again. Make the abdomen flatter and draw Chi into the lower abdominal area. The area below

the navel seems to be filled, but keep the upper abdomen flat in order to minimize the space so that the Chi pressure can be increased. As mentioned previously, this sensation is caused by the action of the diaphragm pressing down against the organs contained in the abdomen. The pressure between the outer wall of muscle of the abdomen, which is kept flat, and that of the diaphragm pushing down from above serves to compress the abdominal organs. When you pull up the pelvic and urogenital diaphrams and pull up the sex organs and anus, more energy will pack in the lower abdominal area. There is where the Chi is condensed into an energy ball. This energy ball will expel wastes and rinse out the toxins from the system, aiding in the circulation of blood and lymph through the area and driving excess Chi into storage between the fascial layers. (Fig. 3.31) Remember the Chi will occupy this space, prohibiting fat from being stored there.

Liver Kidneys

Stomach Spleen

Packing and condensing the organs will help to expel toxins and wastes from the body. Fig. 3.31 Pack and condense the organs.

Chapter III

Press the Diaphragm ever Lower Navel Condense Chi into the Lower Abdominal Area

(a)

Push and Pack Chi to the Perineum Area Condense Chi into a Ball Pull Up the Perineum

(b) Fig. 3.32 Condensing Chi

g. Inhaling ten percent more of your total capacity presses the diaphragm even lower so that now you become more aware of the contents of the lower abdominal area. (Fig. 3.32(a)) Women should be aware of the area in which the ovaries rest. Hold your breath until the need arises to inhale. It is at this point that you can work on your feet and coccyx, which are most important as energy sources. Those who have already completed the Microcosmic Orbit should make rapid progress here. h. Inhale ten percent more of your capacity. Concentration should now be on the sexual organs. With more practice your mind can direct the Chi more easily, giving you greater control over the Chi energy. Condense the Chi into a compact ball. Hold this energy in the lower abdominal area where you can increase it by using your mind and the Packing Process. i. Inhale ten percent more of your capacity to the Hui Yin (perineum) to activate Perineum Power. Pull up the perineum, push and pack the Chi down to the perineum area and condense it into a ball. (Fig. 3.32(b)) Concentrate on the perineum again. With more practice you will gradually feel the perineum bulge downward. You should be able to feel a big channel running from the navel to the abdomen to the perineum connecting with Chi. Hold the breath as long as you feel comfortable. j. Now exhale and relax the whole body, sending energy down the back of the legs into the ground. (Fig. 3.33) Regulate your breathing with energizer breathing. Inhale more; exhale less. When you exhale, pull up the perineum (include the sex organs and anus). Be aware of the middle of the palms of the hands and the middle of the soles of the feet. Use the mind to feel the palms and soles “breathing”. Coordinate your breath with the palms and soles, breathing simultaneously. With the Packing Process Breathing, the palms and soles will open easily. Gradually, you will feel as though the soles and palms seem to breathe. (Fig. 3.34) The left eye looks at the left palm, the right eye looks at the right palm. In the forehead, above and between the eyebrows, resides what the Taoists regard as another eye called the “Heavenly Eye”. Feel the Chi from the palms flow to the forehead while the “Heavenly Eye” sends Chi to the palms.

Now exhale and relax the whole body, bringing the Chi down the backs of the legs to the soles of the feet and hold your attention there. Concentrate on the soles until you feel the energy going down into the ground. Gradually, increase the energy down to the ground and feel as though you are growing roots like the roots of a tree inch-by-inch downward, at first six inches, then one foot, and so on. Feel the flow of Chi from the navel to the perineum, to the backs of the knees, to the soles of the feet and down into the ground. Become one line of energy flow.

Exhale and let the energy flow down though the legs and into the earth. Fig. 3.33 Send the energy into the earth.

Heavenly Eye Palm Palm

Lao-Kung Sole Fig. 3.34 Feel the palms and soles breathing. Sole

k. When you can feel that you are rooting into the earth, you are hooking up to Mother Earth’s inexhaustible sources of energy (Fig. 3.35) Become aware of the “loving, healing energy” emanating from Mother Earth, which enters through the soles and rises up the front of the legs six inches at first, then two feet, then three feet or more. Continue in this way until your whole body is full of this “loving, healing energy”. Hold and pack the Chi in the perineum until you feel the urge to breathe. Exhale and do the Energizing Breathing to regulate your breath.

Chapter III

Mother Earth

Fig. 3.35 Hooking up to Mother Earth’s inexhaustible sources of energy.

Practice of Postures

At the end of each stage, once you have finished packing the Chi, standing or holding yourself still and relaxing the muscles of the whole body are very important. You should hold this position for as long as you can or have time to hold it, gradually increasing the time, if possible. Using the Iron Shirt Chi Kung Packing Breathing has created a tremendous Chi pressure and you can now use your mind to condense and direct the flow. (Fig. 3.36) At this point, you will fully feel the energy flow in the Microcosmic Orbit. Use your mind to direct the energy up and down, flowing from finger to finger, down the legs and back up.

Pull Up

Exhale

Exhale

Pull Up

Stand still. Relax the whole body and direct the Chi flow. Fig. 3.36 Direct the Chi flow.

In the beginning it seems that you are very tense and nervous when you practice Iron Shirt, the way you felt when first learning to ride a bicycle. However once you are trained and know how to move and pack the energy, you use more structure and mind control with confidence and less muscle. Each time you finish a stage and are not proceeding to the next stage, you must collect the Chi in the navel. Stand up straight, touch the tongue to the palate, and put the palms over the navel. Men put the right palm over the navel, covering it with the left palm. Women put the left palm over the navel, covering it with the right palm. (Fig. 3.37) Concentrate on the navel for a while, feeling the energy that is generated by the Chi Kung. As you are standing, practice the Bone Breathing Process described below. Practice the first stage for a week or two, until you can master moving the Chi from the navel to K-1 at the soles of the feet and master palm and sole breathing, and then proceed on.

Woman places the right palm over the left. Man place the left palm over the right. Fig. 3.37 Place the palm over the navel and collect the Chi.

8. Second Stage Begin with the First Stage and continue as follows: a. Press the soles of the feet to the floor so that they seem to adhere to it by suction. The toes are part of a tendon line and, as such, are part of an energy flow line. To take advantage of this fact, press and clamp all of the toes firmly to the floor but do not allow them to bulge up. When concentrating on the soles, you may find that they grow warm or feel cool. Inhale ten percent and coordinate with the breath, sucking the earth energy into your soles. Inhale ten percent using the Packing Process breathing technique described in the First Stage. (Fig. 3.38) Pull the energy up to the sexual organs and the urogenital diaphragm, the pelvic diaphragm, the left and right anus, the kidneys (Fig. 3.39) and the lower diaphragm. Feel as though you are sucking the earth. Feel the earth energy begin to enter the soles and move up the leg bones to the knees. The earth energy can feel cool or sometimes tingling. Some people feel warm.

Fig. 3.38 Pull and lower the entire diaphragm.

Chapter III

Fig.3.39 Pull the energy up from the anus to the kidneys.

b. Using your K-1 center in the soles of the feet as a hub, circle nine times clockwise out from the middle to a distance of three inches, and then nine times counterclockwise back to K-1. (Fig. 3.40) Again, use the mind, coordinating with eye movements, to help circulate the energy.
Inhale ten percent and press the soles of the feet firmly into the Earth. Claw the toes and circulate the energy nine times.

1/3

2/3

Fig. 3.40 Use the K-1 center in the soles of the feet as a hub.

c. Inhale and bring the energy up out of the big toes to the knees. Lock the knee cap and tighten the legs by turning the knees outward with the feet firm. (Fig. 3.41(a)) Feel the legs like screws being screwed into the ground. (Fig. 3.41(b)) Imagine someone pushing the knees in while you try to push outward. Slightly pull the knees outward and feel the outside force push in. This action will join the sacrum with the knees, and the knees with the ankles and the feet. This also activates and aligns all the lower part tendons together Remember that the feet point in and the knees push slightly outward. Concentrate on them until you feel energy collect there. Do not circulate the energy at this point. When you feel the urge to breathe you can exhale a little bit. Exhaling and inhaling are very personalized; therefore, each person must adjust to his or her own needs.

Chi Belt Navel

(a) Inhale twenty percent and bring the energy up to the knees. Lock the knees.

(b) Press down and turn the knees outward to screw the force into the ground.

Fig.3.41 Screw the force into the ground.

d. (1) Inhale ten percent, coordinating the breath with pulling in the sexual organs and anus, thereby bringing the energy up your knees to the buttocks and then to the perineum (Hui Yin). At the same time, feel the energy as it is drawn from the earth enter the soles of the feet and rise to the knees and perineum. Inhale and pack more in the perineum. Use your eyes to help circulate the Chi energy nine times clockwise and nine times counterclockwise in a three inch diameter at the perineum. (Fig. 3.42) Increasingly send energy down to the Hui Yin from the navel and continue to feel it come up out of the legs. In time, it may seem as though there is a flow as of water entering the Hui Yin from above and from below moving up and down as though through a pipe. It might also become evident why the K-1 points in the soles of the feet are referred to as the “Bubbling Springs”.

Pull the sexual organs and anus in. Inhale ten percent up to the perineum. Circulate the energy nine times clockwise and nine time counterwise. Fig. 3.42 Draw the energy from the earth and pack and circulate it in the perineum.

(2) Exhale and normalize the breath by Energizing Breathing. (Fig. 3.43) Relax and collect “loving energy” from all of the organs. To create the loving energy you can start your smile in the eyes. Bring that smile down the face, slightly lifting the corner of the mouth, and keep on smiling inwardly to the organs: the heart, lungs, liver, pancreas, spleen, kidneys and sexual organs. (Fig. 3.44) Remember standing or holding yourself still at this point and relaxing the muscles of the whole body are very important. Feel the energy flow in the Microcosmic Orbit. (Fig. 3.45) Remember also that after each stage, if you are not proceeding to the next stage, you must collect the Chi in the navel. Stand up straight, touch the tongue to the palate, and put the palms over the navel. Men put the right palm over the navel, covering it with the left palm. Women put the left palm over the navel, covering it with the right palm. (Fig. 3.46) Concentrate on the navel for a while, feeling the energy that is generated by the Chi Kung. As you are standing, practice the Bone Breathing Process described below, which has just been described above as the First and Second Stages then proceed to the next stage.

Exhale and Inhale. Regulate the breathing though the palms and soles. Fig. 3.43 Energizer Breathing

Practice of Postures

Thyroid and Parathyroid Glands

Lung Liver Adrenal Glands Kidneys

Thymus Gland Heart Stomach Spleen Pancreas

Sexual Organs

Fig. 3.44 Smile down to the organs.

Pull Up

Exhale

Exhale

Pull Up

Fig. 3.45 Stand still in Embracing the Tree position and feel the energy flow in the Microcosmic Orbit.

Woman places the right palm over the left.

Man places the left palm over the right.

Fig. 3.46 Place the palms over the navel to collect the energy.

9. Third Stage Begin by repeating the First and Second Stages, then proceed as follows: a. After you have normalized the breath, exhale and flatten the stomach. Inhale ten percent using the Packing Process Breathing as described in the First Stage. Inhale up the front and middle of the anus, and at the same time, pull up the back part of the anus so that you can direct the Chi into the sacrum, (Fig. 3.47 (a) and (b)) Put pressure on the sacrum by pressing tightly to the ground and tilting the sacrum back without moving the hips. This will activate the sacral pump. (Fig. 3.48) You can practice this by putting your back to the wall and pressing the sacrum to touch the wall, as described in Section I of this Chapter. Do this gradually and do not force it. In gradually developing the psoas muscle, as well as the hip and sacrum tendons and muscles, you will be able to move the sacrum separately. (Fig. 3.49) By this movement, you are activating the sacral pump to help increase the spinal fluid and to open the sacrum for the Chi to enter This will greatly increase the circulation of spinal fluid. When you can master this, you will no longer need the wall. Use wall alignment in practicing Embracing the Tree.

(b) Back View of Anus Pull Ups

Fourth Pull Up Third Pull Up

Brain Jade Pillow

Second Pull Up Spine

First Pull Up Pulling Up the Center of the Anus Diverts the Chi from Going Up to the Heart.

Sacrum

Anus Middle

Middle Front back

Back Pull the Middle Up and Pull Towards the back to the Sacrum.

Front Anus Pull Up

Pulling Up the Back of the Anus Pulls the Chi Up the Spine.

(a) Side View of Anus Pull Ups

Fig. 3.47 Direct the Chi into the sacrum.

Chapter III

Tilt the Sacrum Back

Fig. 3.48 Activate the sacral pump.
12th 1st 2nd 3rd 4th

Psoas

5th Lumbar

Fig. 3.49 Sacral tilt will help develop the psoas muscle.

Psoas

b. (1) Bring more energy (kidneys’ energy) up from K-1 on the soles of the feet to the coccyx and to the sacrum. Inhale, pulling up the left and right anus and the back part of the anus. Pull up toward the coccyx and up to the sacrum, packing Chi to the kidneys. (Fig. 3.50(a)) Feel the back area surrounding the kidneys bulge out. Concentrating here, tilt the sacrum and circle the energy out at the sacrum from that point first nine times clockwise to a distance of three inches, and then nine times counterclockwise back to the sacrum, using the eyes to help direct the circulation. (Fig. 3.50(b)) Feel the collection of the Chi there.
(b) Back View (a) Side View

Pack and Wrap the Chi into the Kidneys.

K-1 K-1 Inhale ten percent and pull up the sacrum. Tilt the sacrum and circulate the energy nine times clockwise and nine times counterclockwise. Use the Anus to Pull Up the Energy into the Kidneys. Fig. 3.50 Pack and wrap the Chi into the kidneys.

The Chi feeling is reported differently, even by the same practitioner at different times. There can be a range of feelings such as hot or cold, or pricklings, vibrations, numbness or a combination of all of these and other sensations. The effect is identifiable as something which is not ordinarily experienced. There might be pain or extremes of sensation. This part of the practice should take one or two weeks. I feel that it is necessary to stress that in this system you must realize that what you experience is very real. There are no visualizations or acts of the imagination here. You actually feel energy accumulate and then go from place to place because it really does. In some people it takes off on its own and goes through the very same routes and stopping off places that would have later been prescribed. If this happens to you, it is extremely convincing and is thereafter self-evident that there really is Chi and that all one needs to do is follow. (2) When you feel Chi in the sacrum, inhale ten percent and pull the Chi up to T-11, tilting the T-11 (the adrenal glands, Chi-Chung, CO-6) back. (Fig. 3.51(a)) This will push the lower back and straighten the curve. Again, use the wall as a guide. Do not force your spine, but gently ease it until you feel the spine becoming straight. This will open the Door of Life Center (Lumbar 2 and Lumbar 3) opposite the navel. The pumping action will increase as the spine straightens, pulling like a pipe or bow and the Chi will flow easily as if through a straight pipe. With the lower back pushed and the curve straightened, you will be stretching the psoas muscle very strongly. This will help to strengthen the lower back tremendously Connect the sacrum and the C-7 into one pipe or a bow. Bring the Chi to T11, concentrating at this center, and circle the Chi outward clockwise to a distance of three inches. Do this nine times and then circle back nine times down to that center in a counterclockwise direction, finally concentrating it there. (Fig. 3.51(b)) It can take you from less than a week to more than three weeks to develop to the point where the sacrum and the T-11 fuse into one channel. It is important to remember that each time you start to inhale and pack, you must start at the navel, gather the Chi, and bring the energy gathered there to the Hui Yin. Then, push the energy to the ground. Bring it up from the soles to the Hui Yin, and mix it with the energy already brought down from the navel before going on to the coccyx, T-11 and up. As you continue to practice in this way, the whole procedure will take less and less time until it finally becomes simply moments.

Tilt T-11 Back T-11 Tilt the Sacrum

(b) Back View (a) Side View Inhale ten percent up to T-11. Tilt T-11 back and circulate the energy nine times clockwise and nine times counterclockwise. Fig. 3.51 Tilt T-11

c. Inhale and pull the Chi from the T-11 up to C-7. (Fig. 3.52) Push from the sternum to tilt the C-7 back. Tuck in the chin, clench the teeth (Fig. 3.53(a)), squeeze the temples (Fig. 3.53(b)) and the occipital bone, and press the tongue firmly to the roof of the mouth. (Fig. 3.53(c)) This will create a tension similar to the tension of the arched bow discussed previously which is ready to release an arrow. (Fig. 3.54(a)) The whole neck will be connected to the spine and sacrum, and to the legs and heels. (Fig. 3.54(b)) As the energy moves up from the sacrum to C-7, the major push of internal force occurs. (C-7, T-11 and the sacrum are known as the “stations of

internal force”.) Once you can develop and feel the force in the C7, you will be able to exert the force. This entire process is called self-adjustment of the cranial pump and will activate the cranial pump. (Fig. 3.55) The action of the cranial pump will greatly increase, thereby increasing brain power as well. Circle nine times clockwise and nine times counterclockwise at C-7. Feel the Chi energy join the scapulae, the arms, and the hands and fingers together. You will feel the Chi start to flow from the thumb and fingers of one hand to the thumb and fingers of the other hand, like a jumper cable. Use the eyes to look at the thumbs and direct the Chi to that point.

Tilt C-7 Back

Tilt T-11 Back

Tilt the Sacrum Back

Feel the sacrum pull down on the spine.

Sink down into the knees.

Fig. 3.52 Pull the Chi from T-11 up to C-7.

Practice of Postures

C-1

Clench Teeth. Tuck Chin in.

C-7 (a) Clench the teeth. Sink the chin in.

(b) Squeeze the temple bones.

(c) Press the tongue firmly to the roof of the mouth. Fig. 3.53 Locking the Head

(a) Creat a tension similar to a fully arched bow.

C-7

(b) As you push from the sternum to C-7, the spine and shouders will connect. Fig. 3.54 Spine Alignment

d. If you are out of breath or cannot go on, exhale a little bit and then inhale again. If you cannot do this, you can simply exhale and bring the Chi up to the crown, omitting the Yu Chen (Jade Pillow, BL-9 or Base of the Skull). If you can continue, bring the Chi up to the Yu-Chen and circle it nine times both clockwise and counterclockwise as you did at the points previously described, until you feel that Chi has developed there. (Fig. 3.55)

Crown Jade Pillow Yu Chen C-1 C-7

C-7

Inhale ten percent up to C-7. Tilt the neck back and circulate the energy nine times clockwise (to the left) and nine times counterclockwise(to the right.) Inhale again and bring the energy up to C-1 at the base of the skull. Circulate nine times counterclockwise. Inhale and bring the energy to the crown. Fig. 3.55 Self-Adjustment of the Cranial Pump

e. Inhale and pull the Chi up to the crown (Fig. 3.55), the seat of the pineal gland located at the top of the head, by looking up with your eyes. (Fig. 3.56(a)) Concentrate on the Pai Hui at the crown and circle it again nine times clockwise and nine times counterclockwise, using your mind and your eyes, until energy is experienced there. (Fig. 3-56(b)) Feel the energy flow from the sacrum to the Door of Life, to T-11, to C-7, to the occipital bone, and to the crown as they become fused into one channel and linked together. If you are out of breath, you can pull up and exhale. Normalize your breathing.

Pineal Gland (Pai Hui, the Crown) Corpus Callosum Thalamus Gland

Occipital Lobe

Pituitary Gland Pons Medulla Oblongata Spinal Cord Jade Pillow (Yu Chen, BL-9, Base of the Skull) (a) Location of the Pineal Gland

Pineal Gland

(b) Look up to the pineal gland and circle the enerrgy nine times clockwise.

Fig. 3.56 Circle the energy in the pineal gland.

f. Make sure that the tongue is up on the roof of the mouth. (Fig. 3.57(a)) Bring the energy down to the mid-eye, concentrating there for a while while practicing normalized breathing, until you feel the energy build up. (Fig. 3.57(b)) Then bring the energy down to the palate where the tongue will serve as a switch joining the Governor Channel to the Functional Channel. Bring the Chi down to the throat, heart center and solar plexus (Chung Wan, CO-12), circling it nine times in both directions, until you feel energy enlivened there again. (Fig. 3.57(c)) Use the eyes to help in this circulation.
Mid-Eye, Third Eye, Pituitary Gland

(a) Tongue is on the roof of the month.

(b) Bring the energy down to the third eye. (c) Bring the energy down to the solar plexus.

Fig. 3.57 Functional Channel

g. Finally bring the energy to the navel. (Fig. 3.58(a)) Concentrate there until you feel Chi freely go down to it. Listen and look inside. Feel the sensation of the flow of Chi in one circulating motion from the navel to the perineum, to the soles, up to the knees, to the perineum again, and up to the sacrum, to the spine, to the crown and down to the third eye, to the throat, to the heart and to the navel. (Fig. 3.58(b)) When you feel the circle is moving well, simply let it flow by itself. Feel the navel warm and fill with Chi.

Listen Inside

Look Inside

(a) Bring the energy down to the navel.

(b) Feel the sensation of the flow of Chi.

Fig. 3.58 Microcosmic Orbit

Practice of Postures

Remember as you complete the final stage to stand still and relax all of the body’s muscles, holding this position for as long as possible. Simply standing and experiencing this powerful energy flow for ten to fifteen minutes will shorten the time necessary to master the Iron Shirt techniques by as much as one to three hours. You have created a tremendous Chi pressure and your mind will condense and direct the flow. Feel the energy flow in the Microcosmic Orbit. Stand up straight, continue to touch the tongue to the palate, and put the palms over the navel. Men put the right palm over the navel, covering it with the left palm. Women put the left palm over the navel, covering it with the right palm. (Fig. 3.59) Concentrate on the navel for a while, feeling the energy that is generated by the Chi Kung. As you are standing, practice the Bone Breathing Process described below.

Woman places the right palm over the left. Man places the left palm over the right. Fig.3.59 Stand up straight and put the palms over the navel.

10. Bone Breathing Process a. The Bone Breathing Process is practiced immediately after you finish the First Stage, the Second Stage and finally, after the Third, and final, Stage of this exercise, to bring the energy down to the navel. At this time, your body is still filled with energy. To practice the Bone Breathing Process you can use Embracing the Tree or any position that you are in at the time. Bone Breathing or bone compression is the method of “Cleansing the Marrow”, or cleaning out fat in the bone marrow so that you can direct and absorb the creative (sexual) energy into the bone to help regrow the bone marrow. (Fig. 3.60) During this process, we take advantage of the Chi generated in Iron Shirt I by absorbing Chi into the bones, thereby greatly increasing the circulation of Chi. With increased circulation, the Chi is permitted to flow freely into the bones and the blood, carrying necessary nutrients and oxygen, and is permitted to circulate freely throughout the body. Tension in the muscles surrounding the bones is lessened. The bones become strong and healthy because the marrow as the major product of red and white blood cells, now has room to grow.
Bone Marrow

Fat develops in the bone marrow cavity.

Bone Marrow Cavity Fig. 3.60 Bone Marrow

Practice of Postures

This process takes time to practice. It is most important that you relax and are not tense when you practice Bone Breathing. Bone Breathing is a two stage process: 1) Inhale and exhale as though through the fingers and toes: In the first stage of the Bone Breathing Process, by using the powers of the mind and the eyes, outside energy is breathed in through the fingertips and toes, gradually up to the hands and arms to the skull, and then down the spinal column and legs. (Fig. 3.61) A sensation is felt as you breathe into each area. Some people report a numbness, others a fullness, still others a tingling, or “something different” in their bones. Many people claim to feel more in their legs. When you inhale through the fingers, the feeling is cool. When you exhale, the feeling is warm. Feel inside the bones. No matter what you feel, Bone Breathing is practiced to cleanse the fat stored in the bone marrow to make room for positive energy such as creative energy (sexual power), which will allow the bones to store, rebuild and grow the marrow. (2) Inhale and exhale the same way through the toes: In the second stage, inhale through the toes and then, by degrees, inhale up to and into the thigh bones. After inhaling, hold your breath, but not so long that you experience discomfort. Then, exhale down and out through the toes. In the next progression, inhale up through the legs and into the hips, then exhale down and out through the legs. When you have accomplished this, breathe in through the legs to the sacrum. Here, you may feel energy surge up through the back and throughout the entire nervous system. Breathe up the back; the breath will be quite long at this point. Finally, while you breathe through the legs and up the back, also breathe in through the fingers, up into the arms and shoulders, through C-7 and into the head. Keep in mind that energy is absorbed and ejected more effectively at appointed places such as the toes, fingertips, elbows, knees, sacrum, C-7, Door of Life, shoulders, or tip of the nose. (Fig. 3.62)

Fig.3.61 Use the mind and eyes to breathe Chi though the fingertips and toes, up the arms and legs, and up the spinal column to the skull.

Fig.3.62 In advanced techiques, you will learn to breath through the skin to push the Chi into the bones and wrap the Chi around the bones.

11. Power Exercise This exercise is another means of increasing the flow of Chi to the bones, squeezing out the toxins, sediment and waste materials, as well as the negative emotions that have become stored in the muscles. Muscles and the Emotions Stored within Them In this stressful life, pollution and chemicals accumulate in the system, depositing in our organs. In the Tao System we believe that all negative and positive emotions are also stored in the organs. When the organs are filled with toxins, sediment, waste materials and too many negative emotions, these substances will back up into the muscle which handles the overflow of each organ, similar to a backup tank. If we do not squeeze the muscles by increasing the flow of Chi, thereby eliminating the undesirable elements and emotions which have been stored there, the muscles will be very tense and clamp onto the bones. As a result, the person will constantly have the feeling of stress. Once the negative emotions are cleaned out, the positive emotions have more room to grow. Positive emotions make the muscles relaxed and loose. The explanation below gives details of muscles and the emotions that become stored there. This information is contributed by Larry Short, the founder of the Institute for Total Person Facilitation (T.P.F). Muscles and Their Associated Negative/Positive Emotions Hands – Fear of losing grip + Belonging, reaching out Forearms Brachioradialis and forearm extensors/flexors Correspond to Stomach–appropriate meridians – Rejection – Fear of attack + Acceptance + Recognizing the way to proceed Scapulae Correspond to Triple Heater – Fear of taking risks; not willing Upper arms Correspond to Stomach and Spleen Biceps and Triceps, Deltoids Correspond to Lungs – I can’t do it – Weakness, fear of lack of capacity – Sorrow, loss + I can do it + Strength + Responsibility –Fear Gluteus (Muscles of Buttocks) – Disloyalty, lack of commitment

to take risks + Loyalty, commitment, letting go – Cowardly Sacrum, Piriformis + Vitality, radiant power, lifeCorrespond to Circulation/sex force, responsive action – Insecurity + Brave + Security,rootedness,rounded, SCM, Scaleanus, and Neck stable Muscles Lumbar spine, Sacrospinalis Correspond to Stomach Correspond to Bladder Upper Trapezius Muscles – Fear of being taken advantage Correspond to Kidneys of and/or of being cheated – Guilt + Ability, bravery, courage, ability – Fear turtle hiding to take charge of situation + Responsive Thoracic spine and rib cage, + Expressive Spine + Taking risks Correspond to Bladder Feet – Fear, cowardice, running away Correspond to Spine + Ability to perform – Insecurity Ribs + Taking a stand, projects, leav- Correspond to Lungs ing your mark in the world – Sorrow and grief Lower legs, Calves + Vitality, surrender, openness Correspond to Adrenals and Cervical spine Triple Heater Corresponds to Neck extensors Gastrocnemias – Inappropriateness, tiredness Soleus + Clarity – Hesitation, fear of going forSkull ward, waiting Corresponds to Breathing + Setting the stage, preparing Head Upper legs, quadriceps Corresponds to Temple Correspond to Small Intestines – Dullness, confusion, distraction – Lack of support + Environmental awareness, Hips, Psoas/Iliacus being present, being here and Correspond to Kidneys now Jaw Masseter, Pterygoids + Inspiration Correspond to Stomach – Dullness, worry – Frustration Sternum, Pectoralis muscles + Knowing what you want and Correspond to Liver need – Anger resentment Occiput – Anger resentment Corresponds to Back of skull

Chapter III

The Power Exercise, also known as Dynamic Tension, will greatly tone up the body muscles by simply a few minutes practice each day instead of an hour of workouts. (Fig. 3.63) In this exercise you evenly work out every muscle and will not overtire them. Studies have been made showing that the proper tension of these muscles for a few minutes each day will indicate that these exercises develop good muscle tone.

Fig. 3.63 Dynamic tension tones up the muscles, permitting compression of muscles and bones.

Practice of Postures

If you tire in the standing position, rest and walk for a while and then resume the same position practiced in Embracing the Tree, or you can simply continue from the Bone Breathing Process. (1) Relax the hand muscles. Then, use the mind to tighten the hand muscles and squeeze the muscles to the bones of the radius and ulna (the bones of the forearm) tightly. Hold the muscles firmly to the bones for 30 to 60 seconds. Exhale strongly through the mouth, then totally relax the muscles and the shoulders. Feel the rush of Chi as the toxic tensions and negative emotions, such as fear of attack, leave the muscles. Feel the positive emotions, such as recognizing the way to proceed, letting the life-force enter into the muscles. (2) Relax the arm muscles. Inhale and spread the arm muscles into the humerus (the bone of the upper arm). Tighten the muscles all around the arm. Hold them tightly for 30 to 60 seconds. Exhale and release them. Let go of the fear that you cannot do it. Let go of weakness. Release the feelings of sorrow and loss. Let positive emotions enter into these muscles. Feel that you can do it. Feel that you are strong, and that you have capacity and can take on responsibility. (3) Relax the legs. Inhale and squeeze the muscles around the fibula and tibia (the bones of the lower leg) tightly to the bones. Hold them tightly for 30 to 60 seconds and exhale. Relax the muscles, letting go of the toxins and accumulated negative emotions such as hesitation and procrastination. Allow the positive emotions to enter such as preparedness or readiness to grow. Be totally aware of the Chi that is generated. (4) Relax the thighs. Inhale and squeeze the muscles around the femur (the bone of the upper leg) tightly to the bones and hold for 30 to 60 seconds. Exhale and relax the muscles away from the bones. Release the feeling of lack of support; let the feeling of support grow. Be aware of the Chi flowing between the bone and muscle. (5) Relax the neck. Inhale and squeeze the neck, the head muscles and the cervical (the neck) muscles tightly holding the squeeze for 30 to 60 seconds. Relax and let go of guilt and fear Feel the positive growth of expressiveness, responsiveness and taking risks. (6) Relax the back, especially the spinal cord, and the chest. Inhale and tightly squeeze the muscles around the spinal cord from the thoracic vertebrae, down to the lumbar vertebrae to the sacrum

as well as the rib cage of the chest. Hold for 30 to 60 seconds. Release the entire spinal cord and the rib cage. Relax and let go of the fear of being taken advantage of or being cheated. Eliminate cowardice and the desire to run away. Release sorrow, grief and tiredness. Grow the positive feelings of bravery, openness and the ability to take charge and to perform. (7) After you have practiced well for one to two weeks, you can do exercises (1) through (6) all at once by starting from the hands to the legs, to the neck and head, to the spinal cord and rib cage. Hold the squeeze for 30 to 60 seconds and release totally. Feel the muscles and bones separate from each other. (8) When you finish the exercise, stand up straight and put the palm on the navel. Men should put the right hand on the navel, covered with the left palm. Women should place the left hand on the navel with the right palm over it. Stand still for a while and feel how the Chi flows. Then, concentrate on collecting the energy into the navel. In the beginning, you can use the hand to assist in the collection of energy. (a) Men, starting at the navel, should spiral the energy out in a clockwise direction, making 36 revolutions, being careful not to go above the diaphram or below the pubic bone. Circling out beyond the pubic bone allows the energy to leak out. Once you have completed the clockwise revolutions, spiral inwards in the opposite direction 24 times, ending and collecting the energy at the navel. (b) Women should do the same thing, but begin by spiraling the energy out from the navel in a counterclockwise direction, and spiraling back to the navel in a clockwise direction. Spend one to two weeks on this practice. Review the Microcosmic Orbit Meditation for circulation of the Chi in Chapter 2 of this book. When you become proficient at using the mind in this practice, you need only use the mind to circulate the Chi. When you are finished, walk. If you feel the chest tighten or any congestion, use the palms and gently brush down the chest to bring the Chi down. (c) Once you have completed the circuit, you will need less time to practice it in preparation for this Embracing The Tree stance. Thereafter raise the energy up to your head to the Pai Hui (Crown). Once the energy arrives there, you should feel as though something were pushing up through the crown of the head. Always end by returning the energy to the navel.

B. Embracing the Tree Stance (Practical Procedure)
1. Exercise
When you have practiced well and understand each part of the previous exercises, you can proceed with the next practice as described below.
Crown* Base of Skull* C-7* Third Eye

T-11* Chi Belt Sacrum*

Solar Plexus* Navel* Sperm/Ovarian Palace

Perineum*

Knee

K-1 (Bubbling Springs)* Fig. 3.64 Embracing the Tree

a. Assume a Horse Stance. Sink down onto the hips, keeping the back straight and holding the legs apart in the standard length of the lower legs. Turn the toes inward so that the feet are positioned as though on the circumference of a circle. The knees are well bent and the groin area is relaxed and open. b. Extend the arms out in front of you at shoulder height as though you were encircling the trunk of a tree. The palms face you. The fingers are gently separated with the thumbs pointing up and the fingertips are held apart a distance of about the width of the face. Feel as though you were lightly holding a ball between your hands. c. Place the tongue on the palate. Breathe in and out deeply nine to eighteen times so that each time that you exhale, the abdomen contracts and the thoracic diaphragm goes up into the chest, compressing the lungs and pulling the sexual organs up. When you inhale, the thoracic diaphragm goes down to compress the abdomen so that you can feel the perineum bulge outward. d. After you have exhaled for the ninth, eighteenth or 36th time, inhale ten percent of your total capacity to the level of the navel, while keeping the abdomen flat. Pull up the sexual organs, or close the vagina tight, and pull the anus closed. Inhale again and pull up the left and right anus, bringing Chi to the kidneys. Wrap and pack the Chi in the kidneys, then circle the energy in the navel nine times clockwise and nine times counterclockwise to collect the energy there, pausing until you feel the need to breath again. e. Inhale ten percent of your capacity down to three inches below the navel or, for women, the Ovary Palace. Pack the Chi in this region. Inhale down to the lower abdominal area or for men, the Sperm Palace and hold it again until you feel the need to breathe. Inhale ten percent more of your capacity down to the perineum and hold it as long as you comfortably can. You can keep on inhaling and packing in as long as you feel comfortable. Sometimes you can exhale a little bit so that you can inhale more. In the beginning, start by inhaling less air in a short period of time. When you are well-trained, you can hold more air for a longer time. f. Exhale and send energy down the backs of the legs into the ground. The feet will fill with the energy and you should feel the palms and soles “breathing”. Breathe through the palms and soles. Regulate your breath. g. Apply pressure, especially with the big toes. Feel that you are “sucking” energy up out of the earth through the “Bubbling Springs”

in the soles of the feet (K-1 point). “Claw” the floor with the feet. Inhale and draw the energy out of the ground. Collect energy there by circling the sole (K-1) with energy nine times clockwise and nine times counterclockwise. Contract the muscles of the anus and groin and pull up the testicles or vagina and anus. Bring the energy up the front of the legs to the knees, hold the Chi at the knees and lock the knees by turning them slightly outward. Bring the energy to the buttocks by curving in the upper thigh and then bring the energy into the perineum. Hold the Chi here and circle it nine times clockwise and nine times counterclockwise. Exhale and regulate the breath by Energizer Breathing nine to eighteen times and continue to feel the palms and soles breathe. h. Inhale ten percent, pulling up the left and right anus and packing the back area and kidneys. i. Contract the back part of the anus to bring Chi up to the sacrum. Pull up the testicles or vagina. Put pressure on the sacrum and tuck it back, but do not tilt the hips. This pushes the lower back (lumbar vertebrae) out and straightens curves in the spine. Inhale ten percent of your capacity and pack Chi into the sacrum. Collect the energy there by mentally circling it nine times clockwise and nine times counterclockwise. Continue to contract the anus. j. Inhale ten percent of your capacity again. Pull the Chi up to T11 and tilt the back to a straight position. Collect the energy there by circling nine times clockwise and counterclockwise within a three inch area. k. Inhale ten percent of your capacity and pack more at the whole back. Continue to tighten the anus and groin, pull up the testicles or squeeze the vagina, tighten the neck, sink the sternum, and push from the sternum to tilt C-7 back. l. Tuck the chin in to lock the neck, keeping the chest relaxed. With this action, the energy moves from the sacrum to C-7. Pack the Chi at C-7 by circling the energy nine times clockwise and nine times counterclockwise. This will activate the cranial pump located at the base of the skull (the Jade Pillow C-1) which works in tandem with the sacral pump to move cerebrospinal fluid up the back. The sacral and cranial pumps activate the cerebrospinal fluid in the spine and brain. m. With your neck still tight, inhale, packing energy up to your Jade Pillow. Collect it, circling nine times clockwise and nine times counterclockwise.

n. Inhale ten percent and pull up to the crown of the head. Stop, turn both eyes up, and look inward to the area of the pineal gland, circling nine times clockwise and nine times counterclockwise, until you are out of breath. Exhale slowly. Relax the neck, anus, groin and urogenital diaphragm. Keep the tongue at the palate. o. Regulate the breath by Energizer Breathing, but exhale more and inhale less. Concentrate on the third eye. Guide the energy down from the tongue past the throat, heart center and down to the solar plexus. Collect the Chi in the solar plexus, circling nine times clockwise and nine times counterclockwise. p. With the toes extended, open the knees slightly so that you can feel the force in the ankle joints. This will enable you to grasp the ground with the feet, and feel the soles press down to the ground. Force the energy to flow down inside, putting the dynamic tension on the small and big balls of the feet and to the outer edges, like axles running from the outside of the ankles to the big toes. Make sure you do not lift any of the feet’s nine points of contact off the ground.

Woman places the right palm over the left. Man places the left palm over the right. Fig. 3.65 Place the palms over the navel to collect the energy.

q. Stand still, maintaining the position. Feel the energy travel out of the ground, up the legs and into the spinal cord, through C-7 at the base of the neck out into the arms, up to the pineal and pituitary glands, and then down the front of the body to the navel. Feel heat in the navel and continue circulating the energy for as long as you wish. r. Practice the Bone Breathing Process. s. Practice the Power Exercise. t. Stand erect, keep the tongue at the palate, and collect energy in the navel. (Fig. 3.65) u. Walk slowly and breathe normally. Stroke the chest downward with the palms of the hands to prevent or counteract any congestion that might develop there and walk about to distribute Chi and give the stressed muscles a chance to recuperate. (Fig. 3.66) Keep the abdomen soft. Remember that softness makes energy: it is said that soft makes strong. To achieve this, keep the muscles in a soft tension.

Collect Chi down to the navel. Stroke the chest downward with the palms.

Walk slowly and stroke the chest.

Fig. 3.66 Brushing Chi down.

In time, you should be able to do Embracing the Tree in two breaths: one down the front and one up the back. With practice, if you are relaxed, you can do the whole process in just one breath. The stance strengthens the muscle-tendon lines (meridians) that travel through the thumbs and big toes. You may have already discovered that all Iron Shirt work exercises the body and instills confidence.

C. Summary of Embracing the Tree

Pull Up

Exhale

Exhale Pull Up Fig. 3.67 Circulating the energy during Embracing the Tree.

Practice of Postures

1. Stand with the feet a knee-to-toe length apart; press the sacrum down; round the scapulae; relax the chest; hold the head erect; position the arms as if they were encircling a tree; hold the thumbs up; relax the fingers, barely permitting them to touch. 2. Practice lower abdominal breathing nine to eighteen times. When you do abdominal breathing, emphasize inhalation by rounding the abdomen and exhalation by flattening the abdomen on all sides. Feel the sexual organs move up and down with the breath. 3. Exhale; flatten the stomach; lower the diaphragm. 4. Inhale, tightening the perineum and anus by pulling up the middle anus, then the left and right sides of the anus. Feel the Chi energy go up to both kidneys and pack into them. Pull up the sexual organs. (Remember that the anal muscle has a close relationship with all organs and glands.) Pack into the navel without expanding the abdomen. Keep the chest relaxed and the abdomen soft, and spiral first nine times clockwise, then nine times counterclockwise, making a circle of about one and one-half inches in radius. 5. Breathe into the middle abdomen, without spiraling, and pack. 6. Breathe into the lower abdomen, without spiraling. 7. Breathe into the perineum and feel it bulge out. 8. Exhale through the legs and feet down to about six inches into the ground. Feel the palms and soles breathing and use the lower abdominal breathing. 9. Inhale, tighten the perineum, and press the soles of the feet into the ground. Claw the toes and spiral at the kidney points (K-1) on the soles, nine times clockwise and nine times counterclockwise, both spirals moving simultaneously in the same direction. 10. Inhale, bringing energy to the knees. Lock the knees, without spiraling. 11. Inhale up to the perineum, and spiral nine times clockwise and nine times counterclockwise. Feel the bulge. 12. Exhale. Regulate the breath, and be aware of the soles and palms breathing. 13. Inhale up to the sacrum, tilt the sacrum back, packing it, and spiral nine times clockwise and nine times counterclockwise. This will strengthen and activate the sacral pump. 14. Inhale to T-11, inflating the kidney area, and press out on the lower back to straighten the curve there, spiraling nine times clockwise and nine times counterclockwise.

15. Inhale to C-7, straightening the curve at the neck, and lock the neck. Spiral nine times clockwise and nine times counterclockwise. 16. Inhale to the Jade Pillow, clench the teeth tight, and squeeze the skull and the temple bones to strengthen and activate the cranial pump. Spiral nine times clockwise and nine times counterclockwise. 17. Inhale to the crown (pineal gland) and spiral nine times clockwise and nine times counterclockwise. If you cannot go all the way up on one breath, you can pass over the Jade Pillow or take an extra breath where needed until your capacity increases. 18. Exhale with the tongue up to the palate. Regulate the breath. 19. Concentrate on the third eye, until you feel the Chi build up there. Bring the energy down to the solar plexus and spiral nine times clockwise and nine times counterclockwise. Bring the Chi down to the navel. Stand still and maintain this position. 20. Stand up and bring the energy into the navel, putting your hands over the navel and bringing the feet together. Relax. Collect the energy in the navel area. When you feel calm, walk around and brush the energy down, if necessary. 21. Practice the Bone Breathing Process. 22. Practice the Power Exercise.

III. Rooting, Collecting Chi Energy, Illustrations of Postures

A. Rooting Practice

The Rooting Practice is very important in the Universal Tao System. Rooting can be compared to the foundation of a building. The stronger the foundation, the higher the building may be built, and the more difficult it is to topple. After mastering the Rooting Practice you will feel, as you walk around, stand, or sit in your daily life, that you are more in touch with the earth. (Fig. 3.68) You will feel more stable and practical minded, not “spacey”. Many Universal Tao students, after practicing Iron Shirt Rooting for a while, find that they have good balance and greatly improve the quality of their physical activities, such as running, skiing, tennis and Yoga.

Practice of Postures

Spirit Body

Energy or Chi Body

Physical Body

Rootedness serves the soul the soul (Chi Body) and spirit the way a control tower serves a space rocket. The more you can root to Mother Earth, the more balanced the energy will be. Fig. 3.68 Rootedness to Mother Earth

Chapter III

Taoist Practitioners are very concerned with rootedness. The more he or she can root to Mother Earth, the more balanced the energy will be. Such a balance of energy increases healing energy. In advanced practice, rooting is required to perform the practice of the Thrusting Channels and Belt Channels. Tai Chi, the Healing Hand and the higher spiritual practices draw upon the earth energy, as well as heavenly energy, to transform life-force energy into spiritual energy in order to give birth to the soul and spirit. It is the earth energy which helps the soul and spirit grow. Astral traveling requires rooting, and this earthly rootedness serves the soul and spirit the way a control tower serves a space rocket. Those who try to bring Chi up to the head, or receive heavenly energy without grounding in the earth, become “spacey” instead of “in tune” with their experience. Always balance out by using both sides of the body during practice. Developing the Rooting Practice requires two people: one to push and the other to stand. This exercise will greatly improve your stance. Many people will find that one side is weaker than the other or the upper part, such as the neck, is weaker than the lower part. Practice on the strong side first and then the weak side so that you will have a reference for improving the weak side. Gradually you will grow stronger and it will require less effort to maintain your structured position because you will have built extra muscles and strengthened the tendons, tendon attachment sites and fasciae as one structure. When you “root” properly, it feels as if you are sucking the ground, or have grown a deep root into the earth. This is because the whole structure, as a unit, is pressing into the ground. You can feel the entire bone structure sink down to the ground. With practice you will be able to bring energy along the prescribed course more quickly and easily To test your rootedness, find a partner who can push you while you hold the structure. 1. Stance The purpose of the Iron Shirt Rooting Principle is to line up the bone structure with the joints to feel the whole body become one piece. Once you become proficient in the practice, you will position yourself in the proper structure quite easily. Stand in the Iron Shirt Horse Stance. Sometimes you can stand with the feet at a slightly

wider position. However if the feet are too wide apart, you have to use muscle strength to hold the whole body together. When the force comes, the muscle will hold the force and knock the alignment off. If the position of the feet is too narrow you will be using the tendons' force to help hold the structure together, affecting alignment as well. When your partner pushes you with force, your neck must be relaxed so that the force will not go into the neck, causing pain there. Your structure, inner organs, and tendons, muscles and fasciae must work as a whole to hold the position. This will gradually increase your inner strength. 2. Chi Belt Packing Chi into the organs is very important in the practice of rooting. It is particularly important to pack Chi in the kidneys and to join the kidneys and K-1 (Bubbling Springs) into one line. The navel and the two kidneys must join together feeling like a large belt, belted across your waist. (Fig. 3.69(a)) The joining of the navel, the sides of the waist, the two kidneys and T-11 with Chi energy is basic to the rooting principle and is called the "Chi Belt". Without the Chi Belt, the major connection of the upper and lower energy joints, the structure and Chi will be lost. To develop the Chi Belt, first pack Chi in the kidneys and the navel, expanding first from the left kidney out to the left waist, then towards the front to the navel. Expand, pack and wrap the right kidney to the right waist, and then forward to the navel. This joins both sides together at the navel. As the Chi Belt expands, it connects to the T-11 and the Door of Life. The navel now feels like a full blown tire encased within a big belt. Once you experience a Chi Belt in the rooting practice, you will be able to attain rootedness quickly and will not need to use your muscles to join your structure together Therefore, mastering the Chi Belt will help you to be very relaxed in your practice. 3. Principle of Rooting a. Assume Embracing the Tree. b. Sink the energy down to the lower navel area. c. Sink down as comfortably as you can, and open the groin by slightly separating the knees.

d. The toes turn slightly inward. When the knee caps are locked (meaning that the knee joints are held tightly), the knees will lock in the ankle joints like the position assumed when you are sitting astride a saddle. Sink into the knees. You can feel the connection between the knees and the ankle joints and the connection down to the feet. Feel your whole body weight drop down to the ground. The force passes through the bone structure. (Fig. 3.69(b)) Feel the bones like sponges that absorb the force and direct into the ground. e. The hands are at shoulder level, the elbows sink. Feel the force of the sinking elbows pressing into the bone structure. If the elbows are up, you will disconnect from the tendon power.

(a) Chi Belt joins the whole body structure together.

(b) Press down and turn the knee outwards to screw the force into the ground.

Fig. 3.69 Principle of Rooting

f. Line up the shoulders, joining the scapulae with the spine by rounding the scapulae and sinking the chest. Connect through the hip joints down to the knee and ankle joints. Line up the shoulder joints by pushing the thumbs out and the pinky fingers in, feeling the tendons pull. The wrist joints are connected to the shoulders. Relax the neck, especially the trapezius muscle, so that the connection does not go up to the head which will bring force to the neck. Otherwise, when your partner pushes you, you will feel like you were hit by a two-by-four and it will knock you over. When you relax the neck and join the shoulders with the spine, the force travels down the spine and down to the ground. To connect the shoulder joints with the spine, you need to round the scapulae and sink the chest so that the force can be transferred from the shoulders to the scapulae. Then, push the neck straight and the T-11 out. Keep the sacrum straight without moving the hips, until you feel the spine as a flexed bow full of strength. All becomes one line. When the groin area is open, the hip joints will join with the knees, the feet, and all will join down with the ground. Feel the Chi Belt, belting the waist and joining the entire structure together. 4. Practice of Rooting Having a partner push against you can increase your rooting power and thus strengthen the fasciae and spinal cord, increasing the function of the sacrum and cranial pump. Assume the position for Embracing The Tree, and pack with air as described. Your partner should then push (not hit) his fist against your sacrum, T-11, C-7, and the base of the skull, respectively. It is important that these four centers become strengthened and linked together into one line. If they are not linked, they become many unconnected lines, and the partner’s force will not travel down to the ground properly. The spinal cord is the house of the nervous system which joins all the other parts of the body. The spine consists of many bones which are put together and held by muscles, tendons and fasciae. Most of the exercises are not to strengthen the spine solely, however Iron Shirt Chi Kung is designed to strengthen the entire bone structure, especially the spine. Many people have weak spines which cause bad posture, breathing problems and weak organs.

Weak organs are the original cause of a weak spine. Poor posture becomes a vicious cycle: organs are kept weak because Chi cannot circulate throughout the various body systems. Iron Shirt (1) protects organs which generate vital Chi; (2) recharges them with packing; (3) circulates Chi up the spine and strengthens the nervous system; and (4) creates the storage space for the Chi energy by burning out fat. 5. Strengthening the Sacral Pump (Fig. 3.70) The sacrum is the very important pump that moves Chi into the spine. Assume the Embracing the Tree stance. Be aware of your sacrum, pack with Chi, develop a Chi Belt, and have your partner put his fist right on the sacrum. Slowly tilt the sacrum to the back, pushing against your partner’s hand, with very little movement from the hip. Have your partner push you as much as you can withstand, without being pushed over and gradually increase the push until you grow more powerful in the sacrum area. Hold this position for one to two minutes. Breathe normally. Be aware of the force of your partner being transferred from your sacrum to the legs, to the feet and to the toes. You can exert force from the toes back up the feet to the heels, to the legs and to the sacrum. When your partner releases you, rest for a while and feel that the sacrum is open and feel how the Chi flows up the spine. When you are advanced in the practice, you can be very relaxed. There is no need to pack. Simply feel the force pass from the sacrum to the ground, and feel the ground force come up to resist the force through use of the bones. Do not lean towards your partner. 6. Strengthening T-11 T-11, or the eleventh thoracic vertebra (the point of the adrenal gland and the kidneys), is regarded by the Taoist as a pump which aids in moving the energy to the upper body. Assume the position for Embracing the Tree, and pack with Chi as described. Your partner then pushes his fist against T-11 as you press back with that area of the spine. The work is done by the spine, not by the whole body. (Fig. 3.71) Do not lean towards your partner.

Practice of Postures

Heavenly Force

C-1 Force C-7 Force

Sacral Pump and C-1 Force

C-7 and Spinal Force T-11 Force T-11 Force Chi Belt Sacral Pump Force Pushes the Partner’s Force Down to the Legs.

Sacral Pump Force

Knee Force

Earth Force

Feet and Earth Force

Fig. 3.70 Partner’s force is transferred down to the ground though the bone structure by the force of the sacral pump.

Chapter III

Heavenly Force Cranial Pump and C-1 Force C-7 and Spinal Force

C-1 Force

T-11 Force

T-11Force Pushes the Partner’s Force Down to the Hip. Sacrum Force

Sacral Pump Force Knee Force

Feet and Earth Force Earth Force

Fig. 3.71 Partner’s force is transferred down to the ground through the bone structure by the force of T-11.

7. Strengthening C-7 C-7, or the seventh cervical vertebra, is considered the point at which all the tendons of the body join together. By strengthening this part, the tendons, the fasciae and the neck will be strengthened. The C-7 also is the junction point of hand and spinal cord power. Assume the position for Embracing the Tree and pack with Chi pressure as described. Your partner then pushes his palm (not his fist) against C-7 as you press back with C-7. Hold this position for as long as you can. (Fig. 3.72) Your partner should coordinate with you when you are ready to release.

Practice of Postures

Heavenly Force

C-1 Force C-7 Force T-11 Force Sacral Pump Force

C-7 Force

T-11 Force Chi Belt Sacral Pump Force

Knee Force

Earth Force

Feet and Earth Force

Fig. 3.72 Partner’s force is transferred down to the ground though the bone structure by the force of C-7.

8. Strengthening the Cranial Pump The cranial pump has long been regarded by Taoists as a major pump for the circulation of energy throughout the body. It has been previously mentioned that minute movements at the joints of the eight cranial bones occur during breathing. Cranial movement stimulates the production and function of the cerebrospinal fluid surrounding the brain and spinal cord. The cerebrospinal fluid is necessary for normal nerve and energy patterns in the entire body. Strengthening the cranial pump can increase energy and alleviate symptoms such as headaches, sinus problems, visual disturbances and neck problems. Assume the position for Embracing the Tree and pack with Chi pressure. Clench the teeth, tighten the neck and contract the cranium by squeezing the muscles around the skull and pressing the tongue tightly to the roof of the mouth to activate the cranial bones. Push back as your partner pushes his palm against C-1 at the base of the skull. (Your partner should use his palm, not his fist.) (Fig. 3.73)

Chapter III

Heavenly Force

C-1 Force C-7 Force T-11 Force Sacral Pump Force

C-7 Force

T-11 Force Chi Belt Sacral Pump Force

Knee Force

Earth Force

Feet and Earth Force

Fig. 3.73 Partner’s force is transferred down to the ground though the bone structure by the force of C-1.

9. Building Up Rootedness a. Left and Right Side Rooting Practice Assume the stance for Embracing the Tree and pack with Chi energy as described. Your partner stands to one side of you, placing one hand on your shoulder and the other on your hip. Your partner pushes you lightly, gradually increasing to full force. If you are wellrooted, the force of the push will flow right through your bone structure, down to the feet and into the earth. (Fig. 3.74) If you have learned to direct and absorb energy through the bone structure and into the soles of the feet, you will be able to receive the powerful healing energy created by the blending of your energy, your partner's energy and raw earth energy. Your practice should have acquainted you with the flow of energy that goes down through the feet into the earth and then back out of the earth, up through the feet into you, while at the same time you are using the rest of the foot to "claw" against the floor.
Heavenly Force

C-1 Force C-7 Force C-7 Force T-11 Force Hip and Sacral Pump Force

T-11 Force

Sacral Pump Force

Knee Force

Earth Force

Earth Force

Feet and Earth Force

Fig. 3.74 Partner's force is transferred down to the ground though the bone structure by the left and right side rooting practice.

Have your partner push on the left side first, and then the right. Do the Energizer Breathing and resume the stance again. Have your partner push the right side. In the beginning, you will be tight and tense. You will need to use Packing Process Breathing, holding the breath to hold your structure together. As your practice improves and you are able to control and pack the energy, it will not be necessary to hold the breath since you will be able to maintain the structure and rooting in a relaxed manner without packing and without tensing the muscles at all. If the shoulder and spine are not joined together you will fall. (Fig. 3.75)

C-1 Force C-7 Force

T-11 Force Sacral Pump Force

Earth Force

Fig. 3.75 If the force is not grounded, the force does not pass though the structure and the body falls.

b. Front Rooting Front rooting is primarily training the front structure to root more solidly to the ground, especially the hands, the ribs, the front of the legs, and the soles and toes. Many people will find it hard to do any rooting to the ground at all. You must feel the force of your partner pass to the shoulder, to the scapula, to the spine, to the sacrum, to the hip and to the leg as one line. Assume the Embracing the Tree stance. Your partner pushes you on both wrists with both of his palms. (Fig. 3.76) Front rooting is very hard and takes a lot of practice. In the beginning it is difficult, so apply only a small force and gradually increase. This will open the leg channels and hand channels and join them together. C-7 and the spinal cord play a very important role in the front rooting practice.

Heavenly Force Cranial Pump and C-1 Force Cranial Pump and C-1 Force

C-7 Force

C-7 and Spinal Force Pushes the Partner’s force down to the Hip. T-11 Force

T-11 Force

Sacral Force

Knee Force

Feet and Earth Force

Earth Force

Earth Force

Fig. 3.76 Front Pushing and transferring the force to the ground.

c. One Legged Stance Rooting Stand on one leg and circle out the opposite arm. Sink the chest. Feel how the arms and legs are in one line, connecting together. Sink so that the structure is joined. When your partner pushes, you can guide your partner’s force down to the ground. (Fig. 3.77) d. Force Transfer The arm, the scapula, the spine, and the leg become one line, similar to a stick sticking into the ground. (Fig. 3.78) If you try to push on the end that is sticking into the ground, all the force is transferred to the ground. If the fasciae and tendons are not as strong as possible, the whole structure will break when pushed.
Heavenly Force

C-1 Force C-7 Force

C-1 Force C-7 Force

T-11 Force Sacral Pump Force

T-11 Force Sacral Pump Force

Knee Force

Feet Force Earth Force Fig. 3.77 One legged stance and transferring the force to the ground.

Practice of Postures

Heavenly Force

C-1 Force C-7 Force

Cranial Pump C-7 Force

T-11 Force

T-11 Force

Sacral Pump Force Knee Force

Earth’s Force Earth Force Fig. 3.78 Force transfers though the bone structure as it would through a stick sticking ino the ground.

e. Rooting against People—Force Transferred by bone structure to the ground. When your partner pushes you, do not lean towards him. Trust your structure and feel the whole body join into one piece. Feel the bones like sponges absorbing the force and passing it along the bone structure to the ground. When you feel the force, open the knee a little and feel the knees connected to the earth. Feel the energy pass to the ground. When someone pushes you, he passes the force to you. The tendency as your partner pushes you is to counter the force by pushing the elbows out. This action moves you out of alignment. Therefore, when you feel the energy come at you from the side of your body, keep the elbow down and redirect the force back to the scapula and to the spine. The force, then, will not push you out of alignment.

Chapter III

Heavenly Force Cranial Pump Force C-1 Force C-7 Force T-11 Force Sacral Pump Force Knee Force C-7 Force T-11 Force

Knee Force

Feet Force

Earth Force

Earth Force

Earth Force Sinking Down

Fig. 3.79 Partner’s force are transferred down to the ground though the bone structure because the body is properly aligned with the ground.

When you are good at aligning all of the joints together, no matter where the force directed at you comes from, you will be able to redirect it down to the earth, rather than let it break your alignment. The principle of rooting is to become like a stick. The stick is most powerful when positioned at a 45 degree angle. When you push the end of the stick from a right angle, the force will go into the earth. If your body alignment is joined with the earth, when the force comes, it will go right through you and into the earth. The stick is not what is powerful; it is the earth behind it which has the power. Naturally, the stick has to be strong to pass the force. (Fig. 3.79) The foot, the leg, the knee can all be adjusted to be like a 45 degree angle stick protruding from the earth. No matter what position you are in, you must always bear in mind that your body must be aligned with the ground, so that the force will not stay in the joints but can pass through the bone to the ground. (Fig. 3.80)

C-1 Force

C-7 Force T-11 Force

Sacral Pump Force Knee Force

Earth Force

Feet Force

Fig. 3.80 If the force is transferred down to the ground though the bone structure, it is as if the partner is pushing a stick into the ground.

B. Collecting Chi Energy after Practice

1. Preventing Side Effects After each practice, stand silently erect for a few moments. Concentrate your attention on the navel, collecting the Chi there. As the Chi sinks down, stroke the chest from top to bottom with the palms of the hands. This prevents congestion of the chest and heart, as well as other side effects, such as heartburn, headache and eye pain. Move your hands to release the congestion and walk around until you feel the energy settle down. After practicing Iron Shirt, take time to do the Microcosmic Orbit Meditation, also called the “Awaken Healing Energy” meditation, as described in Chapter 2. During your Iron Shirt Practice, you generate tremendous energy which tends to flow up and become trapped in the brain and the chest, especially in the heart. With practice, you will be able to direct the energy down to the navel from all sides and collect it there. (Fig. 3.81) As your practice of Iron Shirt progresses, you will open up the navel area more for the storage of energy to be utilized in the higher spiritual practice.

Fig. 3.81 Collect the energy at the navel.

2. Sitting and Standing Positions for Collecting Energy When you have finished the Iron Shirt Practice, you should sit down to collect the energy that you have built up. Sit on the edge of a chair using your sitting bones to find that delicate point of balance which will help hold you erect. (Fig. 3.82 (a)). Men should sit far enough forward to allow the scrotum to hang freely. Women should also sit forward and should keep genitalia covered to avoid energy loss. The back must be comfortably erect, the head bowed slightly forward. Stand straight, touch the tongue to the palate, and put the palm on the navel. (Fig. 3.82 (b)) Smile down to the organs and bring the energy to them. Let the energy circulate in a circle, starting from the navel down to the perineum and up the sacrum, to the spine, to the top of the crown and down the third eye to the tongue, to the heart, to the solar plexus, and to the navel. Do this several times and collect Chi in the navel by circulating it 36 times outward and 24 times inward to the navel.
Woman places the right Man places the left palm over the left. palm over the right.

(a) Sitting Position (b) Standing Position Fig. 3.82 Sitting and Standing Position for collecting energy in the navel.

C. Illustrations of Postures

1. Holding the Golden Urn Designed to strengthen the pinky and thumb fingers, Holding the Golden Urn joins the pinky fingers to a line which runs up and around the ears (at which location is housed one of the two major cranial bones), down the sides and to the small toes (Fig. 3.83(a)), and strengthens the thumb line by joining it to the cranial bone, to the chest, to the navel and down to the big toes. (Fig. 3.83(b)). These two lines are very important in holding the muscle tendons and bone structures together. When connected, these two tendons issue force on the sides and the front. Holding the Golden Urn is divided into two positions: the Yang Position and the Yin Position.

(a) Yang Position Feel the thumb line and big toe line connect. The union will help join up the front body structure. Little Finger Little Finger Thumb Thumb

Little Toe

Little Toe

Assume a Horse Stance with your standard width, toes point inward, knees separated and locked, as described in Embracing the Tree.

Big Toe

Big Toe

(b) Yin Position

Fig. 3.83 Holding the Golden Urn

Practice of Postures

a. Yang Position Assume a Horse Stance with your standard width, toes point inward, knees separate and locked as mentioned above in Embracing the Tree. (Fig. 3.84)

Fig. 3.84 Holding the Golden Urn—Yang Position

Bend your arms (as shown in the Fig.) so that your elbows, at a shoulders' width apart, drop and are forward vertically, causing your upper arms to be about 45 degrees away from your back and your forearms about 30 degrees out to your sides (not directly in front of your upper arms), with the wrists at 90 degree angles. For both hand positions of the Golden Urn, round the shoulders forward, then feel as if you are pressing up strongly, but without actually moving the arms. The chest sinks down slightly in response to the scapulae pulling around. In the Yang position, your hands are spread, palms down, with a pull exerted on the tendons of your fifth fingers (pinkies), so that the backs of your hands make a flat surface

upon which you could support a large “Golden Urn”. (Fig. 3.85(a)) (The spread fingers with the outward pull felt in the pinkies produce a bracing action that enables you to sustain considerable weight.) The tendon lines that are used here connect the small toes and small fingers, putting more force and energy in the small fingers and small toes. Small fingers are weak and seem useless but, when strenghtened, will give power to the whole structure. (Fig. 3.85 (b)) The diagram shows the meridians of the fifth finger tendons joining the fifth toe tendons. This tightens and strengthens the entire outer structure.
Little finger

Little Toe (a) (b) Feet the little finger line and little toe line connect. Union will tighten up and strengthen the outer structure. Fig. 3.85 Holding the Golden Urn—Yang Position, Side View

b. Practice In the Golden Urn we use one breath, but many inhalations. This means continue to inhale until you are out of breath, then exhale. This is regarded as one breath. Your tongue should be at your palate throughout to keep the energy flowing safely. (1) Start with Energizer Breathing, nine to eighteen times. (Fig. 3.86) Exhale and flatten the stomach. Inhale and pull up the left and right side of the anus. Bring the Chi to pack, circle and wrap around the kidneys. (2) Inhale and pack the Chi in the lower abdominal area, contracting the anus, and pull up more on the urogenital diaphragm. Feel energy draw up from the soles of the feet to the sacrum. (3) Inhale, packing to the sexual organs. Tilt the sacrum back to create a suction and pull the back part of the anus toward the sacrum.

Perineum

Fig. 3.86 Holding the Golden Urn with energizer breathing.

(4) Inhale and pack the Chi at the sacrum. Tilt the sacrum back. (5) Inhale and pack up to T-11, tilting or pushing the T-11 to the back (or use a wall as a guide and push the T-11 to the wall) until you feel like a flexed bow. The power of the bow is felt as the T-11, in being pushed back, creates a tension in joining together with the C-7. Inflate the back with Chi pressure, contract the anus and pull up the urogenital diaphragm. Feel the energy rise from the soles K-1 to the T-11. Feel a big band or Chi Belt stretching from the T-11 to the Door of Life and then towards navel and lower abdomen. (6) Inhale, contracting the anus more and lifting the genitals, drawing more energy up from the feet and packing it into the kidneys and C-7. (Fig. 3.87) Tilt the C-7 to the back (use the wall as a guide and push the C-7 to the wall) until you feel the C-7's strong connection to the T-11 and sacrum. Feel the full strength of the flexed bow as the Chi inflates the entire neck. Hold for a while.

Liver

Kidneys

Anus Pulls Up Energy.

Earth Energy Fig. 3.87 Draw the energy through the feet up to pack and wrap the kidneys.

(7) Inhale and pull up more, tighten the neck and squeeze the cranial bones. Clench the teeth and press the tongue up to the roof of the mouth. Inhale. Pull the energy up to the base of the skull and squeeze more in the cranial bones. Tilt the neck to the back (use a wall as a guide by pushing the neck toward the wall). Feel the neck and the base of the skull have a strong connection with C-7, T-11, the sacrum, the knees, and the feet, and feel them become one flexed bow of strength. Inhale more and tighten, bringing energy up to the crown. (Fig. 3.88) Stop for a while, and exhale. Relax. Follow with the Yin Position.

T-11 Chi Belt Sacrum Perineum

Solar Plexus Navel Sperm/Ovarian Palace

Fig. 3.88 Flow of energy during Holding the Golden Urn

c. Yin Position (1) Turn the hands over palms up, and rotate the hands outward so that the thumbs now pull back and out to the ears with the wrists at 90 degree angles. Feel the stretch of the wrist tendons by locking the elbows and the wrists when turning the hands. The elbows sink in. The scapulae are rounded. When you stretch the thumbs, you are stretching the tendons. This is the Yin position. (Fig. 3.89(a) and (b)). (2) Breathe normally. You should feel the energy rush up and over the head, into your arms and down the front of the body to the navel. Concentrate on the solar plexus. Make sure the energy is flowing down from the tongue to the solar plexus and navel along the Microcosmic Orbit. Considering an inhalation and an exhalation as one cycle, do nine cycles. Exhale more and inhale less. This is called Yin breathing. It will help to bring the energy down the front more easily.

Thumb Thumb

Big Toe Fig. 3.89 (a) Holding the Golden Urn—Yin Position, Front View

Big Toe

(b) Thumb and Big Toe Lines

Fig. 3.90 Holding the Golden Urn—Yin Position, Side View

(3) Yin Position—side view (Fig. 3.90): When the thumb and toe lines are linked together they will connect all the muscles, tendons, bones, and the spinal cord to operate as a single structure. This will help the rooting power in the front energy line. In the Yin position, the flow runs from the thumbs to the upper arms, and the big toes connect with the knees, navel and thumbs. The thumbs connect with the lungs and with tendons that run down the torso and the front of the legs to the big toes. d. Holding the Golden Urn-Rooting Practice Using his thumb and index finger your partner will press against your wrist and place another hand on your hip. Start with the left side, then do the right side. e. Rootedness (1) Yang Position Rooting: Assume the Yang position and pack in energy to the abdomen, the spinal cord, and up to the neck. Feel the strength of the spine, as a flexed bow. Now brace your tendon lines by extending your pinky fingers out very strongly. Have your partner attempt to push you out of the stance by gradually pressing against the wrist and the hip. (Fig. 3.91(a))

Chapter III

(a) Side Pushing

(c) Front Pushing will increase the thumb and tendon power Fig. 3.91 Front, Back and Side Pushing

(2) Yin Position Rooting: With your bodies connected in Yang Position Rooting, turn your hands over and you can transform the force to the ground through the bone structure. The thumbs link with the big toes. You must feel the thumb gaining force. The whole front line, starting from the thumb and continuing to the arm, hand, front of the head, ear, arm pit, front of the hip, and the leg to the big toe, is connected and pitted against your partner’s force. Have your partner attempt to push you out of the stance by gradually pressing against the wrist and the hip. f. Back and Front Pushing Back pushing strengthens the whole spinal cord, the pinky fingers and small toes, and the back fasciae. Return to the Yang position. Be sure to press the big and small toes down, and feel that you are exerting force on the small toes and on the small fingers. Have your partner push from the back while you assume the stance. (Fig. 3.91(b)) retain the stance and have your partner push your chest. (Fig. 3.91(c)) When the tendons are used properly, less effort is needed to maintain good structure. In the Yang position, notice the feeling of support along the tendon lines. Exhale and relax. Begin by assuming the Yang position. Quickly pack in energy to the whole back and to the neck. Move into the Yin position by turning the hands over and pulling the thumbs back. Feel the relationship between the thumbs and big toes. Keep this awareness as your partner pushes you in the Yin position. 2. Summary of Holding the Golden Urn a. Yang Position (1) Stand with feet a knee-to-toe length apart; sink the elbows; hold the hands open at shoulder level with the palms down; lock the wrists; hold the hands at a 45 degree angle to the forearms; stretch out the pinky fingers so that you feel the energy in the small fingers; and feel the connection between the small fingers and the small toes. (The muscle-tendon meridian from the pinky fingers goes up the arms, up the side of the face and around the ears, down the outside of the arms, through the scapulae, down into the sacrum, and down the outside of the legs to the small toes.) (2) Breathe below the navel (lower abdominal breathing). (3) Exhale, pull up on the genitals, the perineum and the anus,

locking the knees and feet. (4) Inhale and pack in the navel. (5) Inhale and pack the middle abdomen. (6) Inhale and pack the lower abdomen. (7) Inhale, tilt the sacrum, and pack the sacrum. (8) Inhale and pack T-11 and the kidneys' areas. (9) Inhale, lock the neck, bring the energy up to C-7, and inflate the neck. (10) Inhale to the Jade Pillow, squeeze the skull and the temple bones. (11) Inhale to the crown. a. Yin Position (1) Exhale, turning the hands with the wrists locked, energize the thumbs, and bring the energy down. (The route from the thumbs goes down the inside of the arms to the collar bones, to the sides of the sternum, down to the navel and spreads out to both legs, down the inside of the thighs to the lower legs and to the big toes.) (2) Place the hands over the navel, bring the feet together and relax. (3) Practice the Bone Breathing Process. 3. Golden Turtle and the Water Buffalo People with high blood pressure should consult a doctor before attempting this posture. This posture energizes the toes and all the tendons of the toes and the fasciae of the thigh and the legs and strengthens the back fasciae, spinal cord, sacrum, kidneys, adrenal glands, neck and the head. This position is called the ''turtle back''. The back will be energized like a blown-up balloon. The workout given by this pose is equivalent to a headstand, but rather than blood flowing to the head, Chi is directed to the head, making it easier to direct and circulate the increased blood flow downwards. Due to weakness in the thighs or tight hip joints, you may feel excessive strain when you first begin to practice the Turtle/Buffalo positions, even if you are not sinking very deeply into the position. If this is the case, practice with a chair or table in front of you on which to rest the arms. This support will enable you to gradually work into the position without straining yourself. (Fig. 3.92)

Note that the back is straight and parallel to the floor.

Fig. 3.92 Turtle/Buffalo Position—Side View

It is very important to keep the back straight and parallel to the floor. It may be difficult to feel when this is happening at first. Practice occasionally in front of a mirror to help develop the inner feeling of this occurrence. a. The Golden Turtle Immersing in Water-Yang Position (1) Place the legs in the standard stance. (2) Begin Energizer Breathing. Breathe in and out nine to eighteen times, inhaling more, exhaling less. When exhaling, keep the abdomen flattened to the spine. (3) Inhale. Tighten the fists, fold the forearms against the upper arms, round the back, and sink the chest. Exhale and bend forward with the back straight so that the line made from the coccyx to the top of the head is horizontal to the floor. (Fig. 3.93) (4) Keep the forearms folded onto the upper arms, resting in front of the chest. (Fig. 3.94) Keep the armpits open to make a space big enough to accommodate an object about the size of a pigeon egg. Round the scapulae. The back feels like a turtle and is energized with Chi.

This meridian also begins at the tip of the index finger.

This meridian begins at the little toe and runs beneath the foot ascending though the inner side of the leg to the genital region.

Fig. 3.93 Muscle-Tendon Meridian in the Turtle Position

Fig. 3.94 Position of Forearms during the Golden Turtle

(5) Lock the sacrum and open the knees so that you can feel the weight of the body sink down to the hips, to the knees, to the feet and, finally to the ground. The spine should be horizontal to the ground. Pull the energy into the groin area where the sexual energy is. Tuck in the chin and set the neck firmly in position. Press the elbows against the inside of the knees. With the elbows, press out against the knees, while the knees press in, equalizing the force. Neither should press harder than the other. (6) Inhale ten percent and pack the energy in the abdominal region (navel). Hold until you are out of breath. (7) Inhale and pack down to the lower abdomen. (8) Inhale, pack at the perineum and pull on the sexual organs more tightly. Pull the Mother Earth energy up to the perineum. (9) Inhale, pack at the sacrum and tilt the sacrum. Pull up the sex organs more firmly. (10) Inhale, pack at T-11, the kidneys and adrenal gland areas. Tilt the T-11. Feel the entire spine as a fully flexed bow . Inflate the lower back with Chi pressure and energize the kidneys. (11) Inhale, pack at C-7. Tighten the neck and the cranial bones. Clench your teeth. (12) Inhale up to the crown. (Fig. 3.95)

Kidneys Sacrum T-11 C-7

Base of the Skull

Crown Third Eye Perineum Navel Solar Plexus

Fig. 3.95 Packing the energy during the Golden Turtle.

See Fig. 3.96 (a) through (k) for additional exercises utilizing Golden Turtle Position.
(a) From the basic stance, with the outside edges of the feet parallel, squat down, placing the elbows between the knees with the palms together. Keep the back as parallel to the floor as possible and your eyes looking up. Press out with the elbows resisted by the knees. Press and resist for two seconds, then release and relax.

(b) Hook both elbows around the outside of the legs with the forearms behind the knees (Front view).

(c) Side View

(d) Clasp the forearm or elbow with the opposite hand. Bring the head and tail down and toward each other as if looking at your tail. This is very important for protecting your back. Let the shoulder blades be your uppermost point.

(e) Pull up strongly, forcing the T-11 and mid-back upward against the resistance of the thighs, head and sacrum. Pull and resist for only two seconds and relax.

Fig. 3.96 Following are additional exercises in the Turtle Position. For maximum results, they should be practiced in the sequence given, repeating the entire sequence three times.

Practice of Postures

(f) Unlock the arms and bring them to the sides with the forearms rotated so that the palms face the floor. Pull the shoulder blades together.

(g) Bring the elbows and head up.

(h) Press the elbows up hard, lifting the head and looking forward while pressing the sternum forward. Hold two seconds and relax (Side View).

Sternum Forward

(k) Keep looking at the floor while you pull your ear and tail to the side opposite the knee you are holding, resisting with the knee. After two seconds, place the hand on the floor, wag the tail to relax, and then repeat the exerciseon the opposite side.Again, wag the tail to relax the spine. During the exercise, the whole column from head to tail should form a (j) Lock the arms around one knee, curve like the letter “C” parallel to the floor clasping the elbows around one knee and you should feel a stretching on the while looking at the floor. sides of the spine and the neck.

(i) Front View

b. Water Buffalo-Yin Position (1) When you have packed the energy to the head, exhale and look slightly up by moving the neck up, thereby relieving the tension of the lock in the neck. Extend the arms down in front of you with the backs of the hands facing frontwards and the fingertips touching the perineum and the anus or touching the ground. Keep the groin (genital area) open. (Fig. 3.97) (2) Practice the open groin breathing process. (Fig. 3.98) Relax, keeping the tongue up. Inhale less, exhale more, breathing right into the groin area. In this position, the groin is open and you can breathe down to the lower part of the body which greatly energizes the sexual organs and increases circulation tremendously. Breathe easily and feel the energy descend to the navel and perineum, activating and strengthening the circulation of the lower abdomen. The urogential and pelvic diaphragms, which hold the sexual organs, bladder, and large and small intestines in place, become activated as well. When your breath has normalized, close your eyes. Slowly bring yourself to a standing position. Remember when you get up, do so very slowly to avoid dizziness. Stand erect. Work up some saliva and, tightening the neck, swallow down to the navel with a guttural sound. Feel the saliva shoot down to the navel and burn with Chi power. Normalize breathing and place the hands over the navel. Collect Chi in the navel. Practice Bone Breathing to absorb Chi into the bones. Meditate standing for a while. If you wish, work on circulating the Chi in the Microcosmic Orbit. Then walk around, shaking out the legs and brushing down the chest. c. Turtle Position—Rooting Practice In the Turtle Position, the elbows are held in tightly pressed against both thighs so that you can feel the energy concentrated in the groin area. The spine is horizontal to the ground. (Fig. 3.99) Pack Chi along the whole back. Have your partner stand on the left side with his one hand on your shoulder and his other hand on your hip. (Fig. 3.100) When your partner pushes you, lock the sacrum. Open the knees slightly and adjust the feet to align the force of your partner down to the ground. Become one with the earth. Gradually push and increase to whatever pressure you can take. The bone structure is like a sponge absorbing the force and transferring it to the ground.

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Fig. 3.98 Buffalo—Right Side View

Open Groin Breathing Process

Fig. 3.98 Buffalo—Left Side View

Fig. 3.99 Turtle—Front View

Your partner should not continue to push when you are out of breath and about to rest. Once you become adept in this practice and you feel your body’s structure as one piece, you will feel the muscles relax and find no need for Packing Breathing. If you simply concentrate on the Chi flow and relax, the force will pass through the bone structure. Change sides and let your partner push you gradually. (Fig. 3.101) The purpose is not to push you over, but to let you feel where the force comes from so that you can redirect the force to the earth. When the force is started gradually you are able to feel where the force is going, permitting you to re-align or relax that part to let the force pass through. Always balance out both sides by having your partner push on both the left and right sides. Remember one side is generally stronger than the other. Once you can successfully redirect the force from any part of your body, you will start to know how to reabsorb the force from the earth. The force that your partner pushes you with, when directed to the earth, can be reabsorbed back from the earth and becomes more powerful than before. This energy can be used for self-healing, or to counteract your partner’s pushes. In the higher level, you can pass that force to your partner to heal him or her as well.

Practice of Postures

C-1 Force C-7 Force

T-11 Force Sacral Pump Force Knee Force Knee Force

Feet Force Earth Force Earth Force is transferred down to the ground.

Fig. 3.100 Rooting practice during the Golden Turtle—Left side position.

Fig. 3.101 Golden Turtle—Right Side Position

After each pushing, go back to the Buffalo Position. The chin is up, the shoulders relax, the hands drop down to near the groin area, or touch the sexual organs to strengthen the pelvic and urogenital diaphram energy. Breathe deeply to the groin area to strengthen the sexual/creative energy. The Turtle Position strengthens the whole back and spine. When your partner pushes from the left, you feel the force go from the left shoulder pass the scapula to the spine, to the right scapula, down the spine to the hip, to the right thigh, the right leg and foot and down to the ground. At the same time, feel the sole breathing and “claw” down with the toes into the ground. If the pressure is too much, the left foot will uproot. Push down the left foot by exerting more pressure on the hip down to the thigh and the leg. Partners should be roughly equal in size, stature and strength for pushing.
d. Turtle/Buffalo-Front Rooting Practice Your partner should place one hand on each shoulder and gradually push you in order to strengthen the frontal aspect of this posture. (Fig. 3.102) To maintain this difficult position, you must gradually feel the connection of the shoulders to the scapulae and the spine to the sacrum and the hips. Front rooting requires more practice. The soles and feet are very important to front rooting. With practice, you can maintain the feet’s firm contact with the ground.

Practice of Postures

C-1 Force C-7 Force T-11 Force Sacral Pump Force

Knee Force

Knee Force

Feet Force

Earth Force

Force transferred though the bone structure into the ground.

Fig. 3.102 Turtle/Buffalo– Rooting Practice

4. Summaries of the Golden Turtle and the Water Buffalo a. The Golden Turtle Immersing in Water (Yang Position) (1) Place the tongue on the roof of the mouth. (2) Practice lower abdominal breathing in a standing position. (3) Bend forward with the back straight, bend the arms in close to the body, maintain the continuing line of the spine through the neck. and clench the fists. (4) Inhale and pack to the navel. (5) Inhale and pack to the middle abdomen. (6) Inhale and pack to the lower abdomen. (7) Inhale and pack to the perineum. (8) Inhale and pack to the sacrum. (9) Inhale and pack to the T-11. (10) Inhale and pack to the C-7. (11) Inhale and pack to the Jade Pillow. (12) Inhale and pack to the crown of the head. (13) Inhale and pack more along the back. b. Water Buffalo Emerging from The Water (Yin Position) (1) Exhale and regulate your breathing. (2) Head and eyes should be looking up, but not straining. Keep the back level and extend the arms with the hands towards the ground slightly behind you or touching the groin area. Maintain the same back position. (3) Practice lower abdominal breathing while focusing on the genital area. (4) Close the eyes and gradually stand up. Put the hands on the navel area and collect the energy. (5) Practice the Bone Breathing Process. (6) Muscle Power Exercise. 5. Golden Phoenix Washes Its Feathers The Phoenix Position strengthens both sides of the ribs, from the armpits down to the sides of the hips and packs Chi pressure into all the major organs. On the left side, pack, wrap and squeeze the Chi to the left kidney, spleen, left lung, and heart; on the right side, you are strengthening the right kidney, liver and right lung, (Fig. 3.103)

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Thyroid and Parathroid Glands Fourth pull up Lungs Heart Liver Spleen Kidneys

Ovaries

Anus Middle

Right

Left Middle Anus

Fig. 3.103 Wrap and squeeze Chi into all of the major organs.

The Phoenix Exercise also exercises the fingers, toes, tendons and the tongue (which is one of the main tendons of the body.) You will also exercise the tendons of the whole body. The pinky fingers are small, but can activate many tendons, especially along the sides of the body. a. Practice (1) Assume the Iron Shirt Horse Stance. (Fig. 3.104(a)) Place your arms at your sides. Practice the Energizer Breathing to fan up the energy. (2) Sweep the arms out to both sides and turn them over so that the wrists are straight. (Fig. 3.104 (b)) The palms begin to face up and are turned in towards the body as though you were gathering something up under the armpits. The pinky fingers are pointed up toward the ceiling. (Fig. 3.104 (c)) Feel the pull of the tendons all the way up the arms to the ears, circling the ears, and down the sides of the body to the small toes. The scapulae are rounded. The neck muscles and the trapezius muscles are relaxed so that the hands and the arms are connected. The elbows are bent out to the side. (3) Inhale while you pull up the left and right sides of the anus and bring the sexual energy from the testicles/ovaries to the kidneys. Pack in energy to the kidneys and to the level of the adrenals which are located at the top of the kidneys on about the same level as the solar plexus. Bring the palms up along the sides of the body feeling the tension and the pull of the tendons on the insides of the arms up to the elbows, the pinkies and the thumbs. (4) Inhale higher toward the armpits, pulling the sexual energy from the testicles/ovaries to the kidneys and up to the spleen on the left side and the liver on the right side. Hold and pack the Chi in the organs and then wrap the Chi around them. The palms still face up and the pinky fingers’ tendons stretch toward the ceiling. Inhale and get closer to the armpits, pulling the sexual energy up to the heart, and to the lungs. Fill the lungs with Chi. (5) Feel the whole rib cage and the armpits bulge up, filled with Chi. (Fig. 3.104(d)) (6) When you get as close to the armpits as you can (Fig. 3.104(e) and (f)), exhale while maintaining the contraction in the anus and the pull on the genitals. Rotate the hands medially. Face palms out (Fig. 3.104(g)), pulling from the scapulae which are connected to the earth. The forearms are straight; the elbows are

back; the wrists are locked; the knees are open. Push from the sternum to C-7 in order to feel the force come from the earth up into the heels, the sacrum, the spinal cord, the scapulae and the hands. (Fig. 3.104(h)) As you push, extend your arms and exhale using the First Healing Sound, the Lung Sound “Sssssssss”. (A complete explanation of the Six Healing Sounds is provided in the book Taoist Ways to Transform Stress into Vitality.) From the palms of the hands to the heels of the feet you will feel like one piece. This is what is meant by “structure”. (7) When the arms are fully extended (Fig. 3.104(i) and (j)), inhale and contract the middle of the anus and pull up the sexual organs. Feel the pull at the tip of the fingers of both hands. Gather the fingers to the thumbs and press them together in a small point by exerting more force on the pinky fingers (which should be in the middle with all the fingers pressed against it), and more force on the tips of all the fingers. (These finger positions are called “beaks”). (Fig. 3.104(k)) Feel the pulling force in the anus and in the tips of the fingers combine into a single force. (8) Inhale, pull the “beaks” inward from the elbows and contract the middle part of the anus. (Fig. 3-104(l)) Feel the force of the anus and the sexual organ pull the “beaks” in. (9) Inhale again, pulling the “beaks” closer to the body, further tightening the anus and genital area. (Fig. 3.104(m)) While inhaling, pull the elbows and the wrists near the chest with the “beaks” pointed out. (10) Exhale as you open the “beaks”, extend the arms in front of you and then spread the fingers wide apart. (Fig. 3-104(n)) Exhale, using the Second Healing Sound, the Kidney Sound “W0000000”, and lower your arms in front of you, the heels of the hands leading the way with the action originating from the shoulders. (Fig. 3-104(o)) When the arms have reached the sides of the hips, lock the elbows, keep the fingers spread apart and rotate the hands laterally out to each side. Flex the finger tendons out, especially the pinky fingers and the thumbs. Spread the toes out, especially the small toes. At the same time, extend the tongue out as far as you can to the chin. (Fig. 3.104(p)) Direct your eyes to look at your nose. Feel the tongue and the sexual organs pull up as one line out to the tongue. Finally, turn the big toes and the heels inward, and then make the feet move towards one another by taking “steps” leading with the big toes and alternating with the heels until the feet come in together. This will exercise the feet tendons.

Chapter III

(a) Assume the Iron Shirt Horse Stance. Place your arms at your sides. Practice the energizer breathing to fan up the energy.

kidney

perineum

(d) Pack the energy in to the testicle /ovaries, into the kidneys, then into the spleen on the left side and the liver on the right side. As you continue to (c) Palms face up and are turned in toward the pack and pull the energy up to the body with the pinky fingers point up. heart and to the lungs, you will feel the rib cage bulge up. Fig. 3.104-A Phoenix Exercise - 206 -

(e) Palms continue to face up.

(f) Side View

(g) Rotate the hand medially.

(h) Push from the C-7 by sinking down the sternum and pressing towards the back.
Fig. 3.104-B Phoenix Exercise

(i) Push the fully extended arms. (Side View) (j) Front view of arms fully extended

Inhale

Beaks

Exhale

Inhale

Anus pull Up

(k) Gather the fingers and form “beaks”.

(l) Front View of pulling the “Beaks”

Fig. 3.104-C Phoenix Exercise - 208 -

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(m) Side view of Pulling the “Beaks”

(n) Exhale, Release the “Beaks”. Press your arms against the front of your body.

Fingers Spread Out

(p) Sexual organs are connected to the tongue. (o) Front View of the Arms Pressed Down Fig. 3.104-D Phoenix Exercise

Repeat steps (6) through (10). This time, however replace the Lung Sound in Step (6) as you push your palms out straight in front of you with the Third Healing Sound, the Liver Sound “Shhhhhhh”. Replace the Kidney Sound in Step (10) as you are lowering your arms in front of you, with the Fourth Healing Sound, the Heart Sound “Hawwwwww”. Repeat steps six through ten one more time. Replace the Lung and Liver Sounds in Step (6) with the Fifth Healing Sound, the Spleen Sound “Whoooooo”. Replace the Kidney and Heart Sounds in Step (10) with the Sixth Healing Sound, the Triple Warmer Sound “Heeeeeee”. You should feel connected through the legs, spinal tendons, scapulae and arms. (11) Spread the fingers apart and extend the arms. (Spreading the fingers enlists the use of tendon power.) Feel the force come out from the scapulae. Relax. Feel the Chi spread out to all the tendons of the hands, legs, and tongue. The tongue connects to the tendons. b. Rooting Practice of the Golden Phoenix: Feel the Force Transfer from the Hand to the Ground Practice the Phoenix Exercise and extend the arms out. Lock the elbows. Lock the wrists. Round the scapulae. Pull up the middle anus and the genital area. Open the knees. Feel that the palms and feet are connected to the ground. Have your partner use his palms to hit your palms. If you are well connected and are relaxing the muscles of the neck, you will feel the force travel to the ground. c. The Lift Up Connected Practice This exercise requires a locked wrist and hand with the shoulders and scapulae connected while your partner tries to lift you up. Be cautious because you can be hurt in this practice. Lower the arms, shoulders and scapulae while bringing the hands to the sides of the thighs. Place the palms down, draw the elbows back, lock the wrists, round the scapulae, and feel the connection with the spinal cord. Have your partner put one leg between your legs, his palms turned in against your palms and lift you up. (Fig. 3.105) Find a partner who is your height. Make sure that you lock the elbows, the wrists and the scapulae; otherwise you can hurt your wrists or scapulae, and your partner will be unable to lift you.

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Fig. 3.105 Lift Up Practice

b. “Beaks” Rooting Practice Extend the arms and form “beaks”, connecting the arms with the scapulae, the spine, the legs and the feet. Have your partner push the wrists, and feel the force transfer to the ground. (Fig. 3.106)

Fig. 3.106 “Beaks” Rooting practice

6. Summary of the Golden Phoenix Washes Its Feathers a. Practice lower abdominal breathing in a standing position. b. Place your arms in front of your body with the backs of the hands facing each other. Inhale and allow the arms to sweep out to your sides, pointing the fingers towards the ribs, and pull up the perineum and anus. Pack into the fasciae on the sides of the ribs and pack into the kidneys. Inhale, raising the hands up along the sides. Pack and wrap the Chi into the liver and spleen. Inhale once more raising the hands higher and pack and wrap the Chi into the lungs and heart.

c. Exhale, keeping the perineum and anus closed while pushing the hands out at shoulder level. Keep the wrists flexed. d. Inhale and tighten at the perineum and anus. Form ‘beaks’ with your fingers and bring them in toward the shoulders. Repeat twice more, raising the “beaks’ a little higher each time. e. Exhale, releasing the perineum and anus and lowering the arms while simultaneously straightening and locking the elbows and knees. When the hands are down with the wrists flexed, turn the hands out to the sides of the thighs and spread the fingers and toes out as much as possible. Thrust the tongue and pull up the anus and sexual organs. f. Collect the Chi energy at the navel. g. Practice the Bone Breathing Process. 7. Iron Bridge The Iron Bridge is designed to strengthen the front and back fasciae. By stretching the fasciae from the pelvis to the neck and both sides of the rib cage in this exercise, you will greatly increase the flow of Chi between the fasciae and will tone up the front and back muscles considerably. Arching the spine backwards greatly strengthens the lower spine, especially the lumbar region. By stretching the upper back and spine opposite to the normal direction of its curve, the backbend will help to lessen the often excessive forward curvature of the upper back, limber the shoulder joints, and open the chest. The point to remember is that the bend is from the upper back and not from the hip. a. Iron Bridge Standing Position - Yang Position This position will create a tremendous amount of Chi energy which will rise up the spine to the head. (1) Stand, keeping the knees straight and the feet one foot apart. It is best for beginners if the feet are placed so that they point straight ahead along the second toes. If the toes turn out, there may be unnecessary compression in the lower spine, even if the knees are locked and the thighs and buttocks tightened. The thumbs and index fingers are touching each other and the remaining three fingers are held together. Keep the hands straight, low and slightly in front of the body.

(2) Begin abdominal breathing; exhale and flatten the abdomen. Inhale to full capacity. Bring the hands up and to the back, bend the elbows back, and place the palms up. (Fig.s 3.107(a) and (b)) Fingers should be about two inches apart and will rise close to the scapulae. This will open the sternum, activate the thymus, stretch the thyroid, the parathyroid, the chest and the side fasciae. (3) Any accumulated tension in the chest and abdomen can be released. Hips stay over the feet. It is most important to arch the upper and middle back and not the hip. This will stretch the front fasciae. Excessive arching of the hip and lower spine can damage the discs between the vertebrae and pinch the nerves because of the excessive weight. Also, if the arching in the Iron Bridge is mostly from the lower spine, there will be much less stretching of the fasciae in the front of the torso. To keep the lower spine protected, it is necessary to arch the back strongly from the upper spine while firmly tightening the thighs and buttocks. By strongly tightening the thighs and buttocks, you can feel that you are squeezing the sacrum down, thus lessening the compression in the lower spine. The knees should be firmly locked and straight. This will allow the thighs and buttocks to be very firmly tightened. (4) Clench the teeth. As you arch back, begin with the head. Rotate the head back from the upper neck, until you feel the front fasciae of the neck stretching. Do not let the head drop back as this is very bad for the neck vertebrae. If done properly, you will still feel that the neck is elongating upwards, even while it is rotated back. If there is any discomfort whatsoever; you are either practicing incorrectly or trying to stretch back too far. Look back, locking and pulling the neck fasciae. (Fig. 3.107(c)) As soon as the front of the neck has stretched properly, you will feel an automatic lifting at the chest which, as it stretches up, will then automatically stretch the abdomen. As the abdomen stretches, push the pelvis forward, keeping the thighs and buttocks very tight. As you stretch the chest, feel that the breastbone is being pulled forward and up. In this way, the upper back will be arching, rather than only the lower spine. (Fig. 107(d)) If done properly, you will feel the fasciae being stretched from the groin up to the chest and the neck, pulling tight as a drum without having to arch very far back.(Fig. 3.107(e) If you are arching very far back, then you are inevitably overarching the lower spine. (Fig. 3.107(f))

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(a) Standing Position

(b) Back View of the Standing Position Fig. 3.107-A Iron Bridge

Chapter III

(d) Arch the upper and middle back.

(c) Look back and pull the neck fasciae.

(e) Stretch is felt beginning at the second, (f) Excessive arching of the hip and third and fourth toes up the back to the spine, and up the front until it ends at the sides of the nose. Fig. 3.107-B Iron Bridge - 216 lower spine can damage the discs.

If your upper spine is not very flexible, or has a large forward curvature, then you may look as if you are hardly arched back at all when you first practice, though you will still be able to feel a stretch across the front torso. Remember that no matter how flexible you are, you will not arch very far back if you are practicing properly. It is a good idea to practice this upper body stretch while sitting until you can do it well before practicing in a standing position. Remember also that if you bend too much initially, you may fall back. In the beginning, have a partner look after you when you bend back to steady you, if necessary. (5) Squeeze the thumb and index fingers together and tighten the muscles of the arms and shoulders. This will stabilize your position. (6) Hold your breath and maintain this position for 30 to 60 seconds. b. Iron Bridge Resting Position - Yin Position (1) Exhale. Straighten up and bring the arms to the front, maintaining the hand position, and slowly bend forward from the hip joint. The head is down and the hands are above or touching the ground. (Fig. 3.108(a)) Do not force yourself. (2) Adjust the tendons. In the beginning, do not bend too low and, for additional comfort, you can slightly bend the knees. This is particularly important if you are practicing rooting in this position. If the knees are locked back, there will be strain in the knees. lf you want to stretch farther forward, do not increase the forward curvature of the upper spine to do it. Stretch forward by letting the hamstring muscles at the backs of the thighs lengthen. (Fig. 3.108(b)) If you are stretching forward vigorously, or are not very limber, bend the knees much more while stretching so that you can lay the whole abdomen firmly on the thighs. Then, test your flexibility by slightly straightening the knees, while keeping the abdomen on the thighs. Practicing in this way will guarantee that you are only stretching the lower spine and hamstrings, and not arching the upper spine. Feel the Chi flow down to the head and back and down the tongue. The three fingers of each hand are nearly touching each other and you can feel the Chi flow from the right hand’s middle finger to the left hand’s middle finger up the left arm to the spine, to the head and down to the navel. Stay relaxed until you feel the energy flow without obstruction. Some people may feel a certain

vibration which gradually spreads throughout the body. Allow the vibration to occur for a while. Slowly stand up to avoid dizziness. Maintain this position only for as long as you feel comfortable. It is quite strenuous and should be approached with moderation.

(a) Resting Position of the Iron Bridge (b) Stretching the hamstring Fig. 3.108 Iron Bridge Stretch

8. Summary of the Iron Bridge a. Standing Iron Bridge—Yang Position (1) Assume the Horse Stance. (2) Place hands at the sides of the body. Touch both thumbs and index fingers together, forming a circle. The other three fingers of each hand remain straight and touch one other. (3) Breathe abdominally, inhale and look up at the ceiling. Arch back from the lower back, keeping the legs straight and the hips aligned over the legs to maintain balance.

b. Standing Iron Bridge - Yin Position (4) When you feel you have had enough. exhale and bring the body slowly to a standing position. (5) Bend the knees slightly in the beginning. Lower the head, and bend forward from the shoulders and chest, rounding the back. (6) Relax the arms and allow them to dangle in front of you, maintaining the finger position with the fingers facing each other. Feel the Chi flow through each finger. If you can touch the ground, you can feel a certain connection of the Chi energy. Breathe normally. (7) Come up very slowly from this position. You may feel dizzy at first. Stand still for a while, collect the energy, practice Bone Breathing and the muscle Power Exercise. Walk around, or lie down on your back and massage your belly from right to left to get your Chi circulating. Additional Exercises: To strengthen the upper abdominals, do sit-ups with bent knees. The lower abdominals are strengthened by doing sit-ups with your legs extended straight out in front of you, although it is recommended that this, as all exercises, not be excessively practiced. c. Standing Iron Bridge - Rooting Practice Assume the posture. Have your partner push very gently. Remember that the main arch is in the upper back. Be very careful in this Iron Bridge Rooting Practice. Your partner has to be aware that it is dangerous when you arch backwards. The back and spinal cord are vulnerable to injury in this position. Be careful to apply pressure gently to avoid hurting the spinal cord or falling down. (l) Yin Position Rooting Practice While you are in the backbend position, your partner should put one hand on your back and one hand on your chest. (Fig. 3.109(a)) As your partner slowly presses down, observe that you can take the force only for a few seconds. Bend forward to rest for a while and then practice rooting in the forward position. (2) Yang Position Rooting Practice While you are bent forward, your partner should press his/her hands on your shoulders. (Fig. 3.109(b)) You push up from the lower spine. He/she can use his/her entire body to press down. In this position you are exerting more force on the lower back. This will strengthen the lower spine, especially the lumbar region.

Chapter III

(a) Yin Position Rooting

(b) Yang Position Rooting Fig. 3.109 Iron Bridge Rooting

9. Iron Bar The Iron Bar practice greatly strengthens the front and back fasciae and thus makes the spinal cord very strong. The spinal column consists of 24 vertebrae held together by tendons, fasciae and muscles. Normally we do very little to exercise the vital spinal column. The Iron Bar exercise automatically adjusts all of the spinal column, strengthening it segment by segment. a. Iron Bar Practice (1) Place two chairs facing each other. Have your partner hold the chair at your head to keep it steady. If you do not have a partner put one of the chairs against the wall. (2) Put both hands palms down behind you on the floor and push your self up on the chair. Put the feet and ankles on one chair the head and shoulders on the other. Fold the hands across the belly. Straighten out the body especially the lower back. With the toes pointed down and outward, you can feel a pull on the fasciae and tendons. (Fig. 3.110(a)) Make sure the lumbar region is straight, not bent. This will help to strengthen the front and back fasciae. (3) If you initially feel that the Iron Bar is too difficult to do properly and comfortably, bring your arms back over your head onto the chair that your head is on. This makes it much easier to maintain a straight spine and is considerably less strenuous. As you feel stronger gradually increase the amount of force with which you are pushing down the arms into the chair. When you can practice without pushing the arms down at all behind you, you are ready to move gradually to the final position with the hands resting over the navel. (4) Place both hands on the stomach and breathe normally to the abdomen. (Fig. 3.110(b)) When you begin to feel uncomfortable, using the hands to steady and hold the chair that the head and shoulders are on, lower the buttocks and feet to the floor. Sit up and place the tongue on the roof of the mouth and let the energy flow in the Microcosmic Orbit. (Fig. 3.110(c)) Do not stand up right away as you may feel dizzy. (5) After you have practiced for two to four weeks, you can start, very carefully, to move the chairs further apart so that only the neck and head are on the end of the other chair (Fig. 3.110(d)) Do not rest the head only as this can hurt your neck. This is a very strenuous exercise for the back. Do not attempt

to move the chairs further apart unless you feel very strong. You can step up training by supporting a weight on the abdomen. Again, work gradually. Eventually you will be able to support 30 pounds or more of weight. (Fig. 3.110(e))

Fig. 3.110-A Iron Bar

(d) Once you are well-trained, you can move the chairs further apart so that only the neck, head and heels are resting on the chairs.

(e) In the advanced practice of the Iron Bar, you can add weight and still maintain the position. Fig. 3.110-B Iron Bar

b. Iron Bar Rooting

Have your partner place one hand under your back for support in case you should begin to fall. With the other hand, your partner presses down on your abdomen slowly and gently increasing pressure gradually. This exercise strengthens the lower back in the lumbar region and the psoas muscle. 10.Summary of the Iron Bar a. Put two chairs across from one another at a distance that will allow you to: (1) Place the feet and lower legs on one chair with the toes pointed down and outward, away from you, to develop the most balanced alignment of force in the legs, particularly in the calves. (2) Place both palms down on the floor behind you and the head and shoulders on the other chair. (3) Maintain a straight back. To avoid stress in the lower spine while practicing, consciously tighten the buttocks and feel the sacrum squeeze down. This will lengthen the lower spine. (4) Breathe normally from the abdomen. (5) When you are ready, come down to the ground slowly. (6) Stand up and collect the energy at the navel. (7) Practice the Bone Breathing Process.

Chapter 4
Breath Alignment*

A. Structural Alignment and Taoist Yoga

Radiant health and efficient, powerful movement patterns are attained only when the body structure conforms more closely to its inherent structural pattern. This ideal pattern is the blueprint for the “stacking’’ of body segments in space. The function of this more appropriate structural relationship is the unhindered flow of energy breathing, alertness and movement. The development and use of an aligned structure is basic to Iron Shirt practice. However for many students it will be difficult to apply principles of alignment in their practice without first approaching structural development in its own right. That is the purpose of this chapter. The structural exercises that follow lead to actual structural reformation so that “posturing” oneself according to desirable structural principles becomes easier and more natural. For most of us, without structural change “good” posture will remain alien to our being. Without intentional practice of “good’ posture, particularly in the beginning, structural reintegration cannot proceed smoothly. The anatomical relationships of the entire body are created in these structural exercises, whether moving or stationary. In structural development, it is important to conceptually understand what appropriate alignment means. Application of correct structural patterns during your practice of Iron Shirt movements will reveal their meaning and greatly speed up the process of body development. Remember that these relationships of one body part to another represent an ideal pattern. The more you practice these exercises and apply their principles in daily life, the more closely your own structure will approach the ideal in an increasingly effortless way. There should never be a sense of strain or unpleasantness in trying to “fit” the structural ideal. For most people, simply a month of practice and application will lead to a profound improvement in structural health.

In the beginning of your application of these principles to daily life, there will inevitably be occasional feelings of unnaturalness. This will occur as you choose new patterns of body use which are opposed to previous distorted patterns that have become habitual. This sense of “posturing” in an artificial way will rapidly decrease with time, if you are practicing diligently. You will then experience ease and naturalness in body usage that allows you to respond in any direction with an appropriate amount of force. The principle of automatically applying appropriate force is at the heart of martial arts. In order for this full movement potential to be possible, the body must spontaneously return to its “center” of relaxed alignment after movement. This is the relaxed “idling” position that is most unblocked and energetically economical, and out of which movement flows. Inanimate objects are completely dominated by the pull of gravity. Plants maintain their uprightness by the rigidity of their cell walls. Animals automatically resist the pull of gravity by normally remaining on a large base created by four legs, or two legs and a strong tail. The upright human being, on the other hand, is a unique expression of evolving self-awareness. The full and intentional expression of standing upright further develops the human spirit. Likewise, the more developed human spirit naturally manifests a greater upright stance. All esoteric traditions that work with energy understand the signifiance of this fully developed upright human form. This is particularly true of the Taoist tradition.

B. Applying Structural Alignment Principles to Iron Shirt Chi Kung Practice
Diligent practice of Iron Shirt Chi Kung will lead to an increased flexibility and range of motion of the spine and other joints. As the body becomes more open, it is important to understand and apply the principles of healthy structural alignment in daily life. Since many of us have come from a background of structural randomness and distortion, it is necessary to learn what to do with our various body segments as our body becomes open and capable of new, more appropriate alignment. In effect, we must learn how best to “wear the body”.

Breath Alignment

The very center of our physical structure is the spine and its foundation, the pelvis. Encased within the spine and cranium is the Central Nervous System, center of our conscious life. Thus, structural health of the spine is the foundation for the structural and energetic health of the rest of the body. For this reason, the basic structural exercises taught in this section focus strongly on the spine. Regular practice of these exercises will help heal any existing structural problems and tremendously enhance your Iron Shirt practice. The structural exercises that follow: Structural Training Position Against Wall, Spinal Elongation Breathing, Door Hanging, Shoulder Widening and Backbend, develop a straighter, more elongated spine and joint spaces that are not cramped. The spine will retain its three normal curves, but these curves will not be as excessive as they are in nearly everyone. Attention to details will guarantee that your practice is safe, effective and progressive. Also, additional exercises (the Warrior Poses) that complement the practice of Iron Shirt Chi Kung by eliminating structural blocks in the hips and back, and by strengthening the lower body are described. By applying the structural principles during your Iron Shirt practice, as well as in your daily life, you will feel the primary forces that are always acting on your structure. These two basic forces are (1) a strong downward rooting force connecting you to the earth; and, at the same time, (2) a strong upward elongating force lengthening your spine which connects you to the heavens. To attain balance and integration, both of these forces must be developed.

1. Relaxation
a. Lower Abdomen At the level of the navel center and the Door of Life (located behind the navel), rooting and elongating forces originate and mingle. For this to happen fully, the lower abdomen must always remain relaxed. The lower abdomen should remain soft, except when you are making a full exhalation, such as when you are very active, or practicing abdominal breathing. The rest of the time (which is most of the time), practice releasing any tension in the lower abdomen until this becomes automatic. Your breathing, digestion and elimination will improve, and the rest of your body will relax more fully.

The two central points of the body that reflect and determine your tension level in daily life are your face and lower abdomen. During your daily activities, practice smiling with the eyes and face, and keep your lower abdomen relaxed. Remember always to relax as much as possible, no matter what you are doing. You will feel much happier, your organs will work better and your energy will flow more easily. b. Inner Smile While practicing these structural alignment exercises, also practice the Inner Smile. If you can maintain the Inner Smile while practicing vigorous exercises like Iron Shirt and the Warrior Poses, you will be able easily to maintain it during times of emotional challenge as well. Remember that the face is not only the primary expresser of body language, but also returns to your system the very emotions it expresses outwardly. Intentionally develop the various details of facial alignment that accompany soft, relaxed, smiling eyes whenever you exercise, and you will gain much more energy and emotional balance from your practice. When you practice the Inner Smile, let all of the facial muscles relax. This relaxation can be seen and felt particularly around the eyes and mouth. Feel the eyelids subtly close slightly as the area around the eyes relaxes, and the space between the eyebrows widens. Let the eyes be gently receptive to incoming visual stimuli. Feel that sights and sounds flow into their respective organs, rather than being grasped for outwardly. Allow the nostrils and sinuses to subtly widen, creating more space for the breath to enter the body. Let the outer corners of the mouth lift very gently, with the tongue up to the palate, the lips slightly touching, and the jaws just separated or barely touching. This will produce a smile like that of the Mona Lisa or Buddha. This lifting of the corners of the mouth must be effortless, and the outer result of an inner smile. (Fig. 4.1(a)) If you can relax deeply enough, all of these details will take place spontaneously because they are natural aspects of healthy facial alignment in a happy, centered person. Practicing them intentionally will quickly condition them into your basic neuromuscular patterns. Practice the Inner Smile in this way with your eyes opened as well as closed. This will enable you to apply it at all times. A smile in the eyes and the subtle lift at the outer corners of the mouth are the

most important details. Whenever you do this, it will be easy to have access to feelings of inner happiness, serenity and compassion. Feeling the Inner Smile and relaxed facial alignment during Iron Shirt will insure that the mind remains more centered and calm, and that you are continuous and fluid in your movement. As a result, you can experience and develop the flow of Chi. (Fig. 4.1(b))

(a) Mouth corners are up.

(b) Mouth corners are down, causing the organs to fall and the Chi energy to diminsh.

Fig. 4.1 Inner Smile

c. Tight Jaw Muscles Chronically tight jaw muscles are very common. They often distort the entire facial structure. Clenched or tightened jaws become that way for various reasons. Strong emotions that are held back from expression may produce this. On the other hand, the universal distortion of a collapsed neck in which the chin moves forward out of alignment will often cause compensations in the jaw pattern. Whatever the cause, tight jaw muscles need to be loosened up so that you can fully practice the Inner Smile and relax completely throughout the body. Since it is difficult to relax the jaw muscles simply through intention, a cork can be useful. (Fig. 4.2) This is a very beneficial

exercise for people who have a lot of jaw tension, although practically anyone can benefit from trying it. Buy a simple cork stopper in a grocery or hardware store. Cut it if necessary to fit between the front teeth, thus keeping the mouth wide open. Make the width of the cork such that it is still possible to open the mouth a little farther so that holding the cork does not result in strain. Simply place the cork in the mouth for about ten minutes every day for several weeks. As the jaw muscles stretch open, use a longer cork until you can easily use a normal sized one. This can be done while reading, driving, showering, or watching TV. Do not do this if it produces pain, if your jaws make audible sounds when they open and close, or if you have a history of jaw dislocation or other problems.

Fig. 4.2 Practice to Stretch Tight Jaw Muscles.

Breath Alignment

2. Structural Training Position Against Wall
Using a wall for feedback, you will be able to feel when you have a structurally aligned, elongating spine. This exercise is dependent only upon a wall or door to lean against, so it can be done anywhere as a postural recharging exercise. For those with back problems, particularly lower back pain and sciatica, it is a powerful method for decompressing the vertebrae and lessening the discomfort. a. Lower Body Lean against a wall with the heels approximately one to one and a half feet from the wall. Bend the knees and tuck the pelvis under so that the lower spine becomes flattened to the wall without discomfort. Work gradually to this position if there is discomfort initially The calves will be perpendicular to the ground or slightly angled back toward the wall. You should feel that you are comfortably leaning against the wall.

Fig. 4.3 Structural Training Position Against Wall

b. Feet Press the balls of the big toes firmly to the floor, then widen the feet across the balls. This will spread the toes. Now, equalize the weight on three points of each foot: the ball of the big toe, the last two toes and the middle of the heel. The toes should remain relaxed without grasping the floor with the second toes pointing straight ahead. Keep the feet aligned in this way, even if you feel pigeon-toed. Apply this same foot alignment when standing, walking or exercising. c. Head/Neck/Upper Back Bring as much of the upper back as flat to the wall as possible without strain, by beginning with the sacrum against the wall while holding the remainder of the spine rounded forward away from it. Now roll the spine vertebra by vertebra against the wall until you reach your limit of flexibility. Hold the head as if it is gently pushed back from the upper lip and lifted (or suspended) from its crown. Do not overdo this by tucking the chin. For many persons, the back of the head will not touch the wall. (Fig. 4.4)

Fig. 4.4 Do not lift the upper lip excessively.

Breath Alignment

d. Shoulders Tuck the shoulders down away from the ears and widen them out to the sides. (Fig. 4.5) (See the Shoulder Widening Exercise in this Chapter.)

Fig. 4.5 Widen the shoulders

e. Arms/Shoulders There are several possible arm positions: (1) Simply let the arms hang relaxed at the sides with the palms facing into the torso. This is the most natural position and is appropriate if you are practicing around other people, at work for example, and do not want to look like you are doing an “exercise”. (2) Starting from position (1) bring the elbows back to barely touch the wall, without bringing the forearms to the wall or the shoulders back. This position helps to properly align the shoulders. As the elbows are brought back, the shoulders will naturally roll back slightly, without being pulled back excessively. (3) Roll the left shoulder blade away from the wall until only the inner edge of the left shoulder blade is touching the wall. Now roll the rest of the left shoulder blade back to touch the wall. Repeat on the right side, then bring the arms to position (1) or (2). This position strongly stretches the shoulders out to either side, and thus widens the upper back and chest simultaneously. This stretch is good preparation for the Iron Shirt exercises which require scapulae power. Do not attempt positions (2) or (3) unless they can be done without strain.

f. Stretching the Lower Spine For additional stretch in the lower back, bend the knees and sink down lower on the wall. Then, keeping the sacrum in firm contact with the wall, slowly straighten the knees back to the original position. For even more stretch, place the hands around the hips and push down while you straighten back to the original position. This will strongly lengthen the lower spine. Do not attempt this until the lower back can be brought to the wall without discomfort. This is most effective when practiced against a wall that is not completely smooth. This extra stretch is particularly valuable for anyone with lower back pain or sciatica. g. Spinal Elongation Breathing Simply standing in the Structural Training Position Against Wall will help to decompress and straighten the spine. It is not necessary to do special breathing in order to derive benefit from this position. The goal is not to have a straight spine, but a straightening spine. The wall gives you feedback when your spine is in a more straightened alignment. In a structurally balanced body, breathing causes a natural elongation of the spine. This occurs to the greatest degree when the chest is filled during inhalation. The lifting and widening of the ribs causes the vertebrae to separate from each other and the spine to lengthen. Practice of deep chest breathing in this position and in Door Hanging leads to a conditioning of this natural breathing/ alignment relationship. (Fig. 4.6) Once you have developed this spinal elongation, it will occur even in the more relaxed, daily-life breathing that is primarily abdominal. This opening and closing of the spine with breathing is an integral part of the normal body mechanism that pumps blood, Chi and cerebrospinal fluid around the central nervous system.

Breath Alignment

Fig. 4.6 Stretching the Spine and Spinal Elongation Breathing.

3. How to Practice Spinal Elongation Breathing
a. Inhalation To enhance the effects of the Structural Training Position Against Wall and the use of the breath, first fully exhale. Then, inhale slowly and deeply through the nose, directing the breath up into the chest. The abdomen should remain in and not protrude. As you do this, visualize and feel the spine lengthen. This will happen automatically if you stay relaxed. Do not try too hard. Once you feel spinal elongation, you can refine this sense further by feeling a wave of elongation starting at the base of the spine, traveling upwards as you inhale.

b. Exhalation As you exhale, continue to feel yourself lengthening upwards, rather than collapsing back completely. You will feel the structural muscles around the spine “take over”. The lengthening upwards that occurs with exhalation is more subtle than that which occurs with inhalation, and is really a wave of support that prevents excessive collapse. This wave of support begins at the head, and travels downwards as you exhale. c. Abdominal Tightening Because of structural blockage in the chest, it may be necessary at first to tighten the abdominal muscles in order to direct the breath up into the chest. Do this if necessary. Otherwise the abdomen will protrude as you inhale with very little chest expansion. Over time, gradually use less and less force to hold the abdomen in while inhaling, until you can breathe into the chest without either intentional abdominal contraction or unintentional abdominal protrusion. d. Daily Life Breathing Breathing into the chest in this way is meant as an exercise to release structural blockage in the chest and lengthen the spine fully. After you have finished practicing, forget about your breathing and let it flow naturally. Natural breathing begins in the abdomen and only expands the chest when you are very active and, thus, breathing very fully. Do not maintain this type of full chest breathing constantly in daily life or you may cause energy to congest in the chest and head.

4. Head/Neck Alignment as the Basis for Spinal Elongation and Upright Structure Spinal Elongation breathing cannot lengthen the spine unless the head is held as if it is pushed back from the upper lip and lifted from its crown without strain. (Fig. 4.7) If the chin moves slightly forward and up, the neck collapses and the entire upper body will be collapsed and distorted. Then the spine will curve excessively and no type of deep, free breathing is possible. Even the wind pipe itself becomes constricted. This is the condition of most people’s necks. For this reason, it is rare to find people in our culture who do not have chronic misalignment of the neck vertebrae.

Breath Alignment

Push back from the upper lip and lift the head as if from its crown.

Feel the head stretch up as if pulled by a string.

Feel the sacrum pull down the spine.

Sink the knees down.

(a) Elongation of the Spine.

Fig. 4.7 Proper alignment of the head and neck is the basis for effective spinal elongation and upright structure.

The feeling that the head is suspended from its crown and gently pushed back from the upper lip without strain should be applied at all times. It is the foundation for an erect upper body and free breathing. Appropriate alignment of the head and neck insures a healthy communication between the body and head. Thus, awareness spreads more fully to the whole body. In a higher meditation formula of the Universal Tao System called Lesser Enlightenment of the Kan and Li, one learns to observe oneself with the Inner Eye. In the body structure, conscious alignment of the head and neck without strain is the foundation for a greater awareness that results from self-observation and self-awareness. In the practice of Hatha Yoga, elongation of the back of the neck that results from head/neck alignment is called “the root of watchfulness,” or “the root of mindfulness”. Even after balanced structural alignment becomes easy and natural, a very subtle intention to maintain head/neck alignment may be necessary. This slight lifting and moving back of the head is the single most important factor in erecting the entire body. The actual elongation and shifting back of the head is often only a very small change. Without it, however the chest, upper back and entire spine cannot come into alignment. This importance is due to the fact that the neck and head are the upper end of the column that we wish to lift. The importance of this one factor of neck and head alignment cannot be overstressed. Whole body integration is not possible without it. It is useful to be familiar with the feeling of neck collapse that afflicts nearly everyone. After aligning the body, let the chin move forward and up, and thus out of alignment. Notice how the back of the neck shortens, the throat closes, the sternum sinks, the chest closes, the upper back arches excessively, the shoulders roll forward, breathing is restricted, and spinal elongation becomes impossible. Then practice a Spinal Elongation breath as the head is once again placed appropriately and feel the sense of full openness that accompanies it throughout the body. Greater self-awareness, full uprightness of the trunk, and unstrained alignment of the head and neck are integrally related. The interplay of these three factors is particularly evident in Iron Shirt. The intention required to maintain head/neck alignment and the other aspects of fully aligned structure is an expression of the autonomous will of a self-aware being. Likewise, relaxed practice of fully aligning oneself develops this autonomous will in a beneficial way.

5. Door Hanging

Developing a straighter more elongated spine is the purpose of both the Door Hanging Position and the Structural Training Position Against Wall. In Door Hanging, however the arms are held over the head, which puts a traction on the spine and greatly increases spinal lengthening. (Fig. 4.8) Daily practice of Door Hanging for even a few weeks will lead to better posture, a more flexible spine, reduction of chronic back stress and a heightened awareness of natural structural alignment. Door Hanging will also help you to be aware of and control your psoas muscles, which are very important in many Universal Tao practices.

Fig. 4.8 Door Hanging

a. Basic Position Roll up a towel and place it over the top of a door. Lean against the narrow edge of the door bringing the spine as flat to the edge as possible without discomfort. Follow all position details for Structural Training Position Against Wall, except those for the arms. b. Lower Ribs/Middle Back Maintain your attention at the lower ribs, and the middle and lower spine. Bring the arms overhead without letting the spine come away from the edge of the door. Feel that you are tucking the lower ribs in as the arms are brought overhead. c. Hands/Arms/Shoulders Grasp the towel fairly high, but with the elbows at least a little bent. Continue strongly to pull the shoulders down, and widen them to the sides. Do not hang from the towel. All of the body weight is still on the legs. d. Shoulder Strain If the shoulders are strained in this position, hold the towel lower to decrease the shoulder stretch. If necessary the elbows may be only shoulder height or even lower. If a towel is not long enough for this, use a thick rope. Gradually you will be able to hold the towel higher as your shoulder joints become more flexible. The first position of backbend exercise will help limber your shoulder joints. e. Breathing/Full Spinal Elongation While maintaining this position, practice breathing up into the chest, as in Spinal Elongation breathing or the Structural Training Position Against Wall exercises described above. Along with the traction of the arms overhead, filling the chest during inhalation will result in tremendous spinal elongation. It will not take much practice to feel your spine start to lengthen. As you feel this start to happen, after every five breaths or so, bring the pelvis and the lower and middle spine a few inches away from the door edge. This allows the lengthened upper spine to lengthen further down the door. Again bring the spine and pelvis back to the door edge and continue practicing.

f. Time If possible, practice from one to three minutes or longer. Do not continue if discomfort begins. Straining will not open your spine up faster; it will add more tightness. Regular practice and respecting your own limits will inevitably lead to very rapid spinal elongation and realignment. g. Leaving the Position To leave the Door Hanging position, walk the feet back toward the door and come straight up. Do not come up by pushing the pelvis away from the door first. h. Full Hanging If you are completely comfortable with steps a through g, you can end by letting your full weight hang from the towel. Gradually bend the knees and slide down the door edge until the arms are straight and holding you up entirely. All other details of practice are the same. Hold this for as long as comfortable, which may only be a few seconds, then come up. Be sure to continue stabilizing the shoulders by feeling them pull down and widen to the sides. Practice of Full Hanging is very strengthening and produces tremendous spinal extension, but must not be attempted if it causes strain.

6. Psoas Muscles
a. Feeling and Using the Psoas Muscles Once you feel comfortable with the details of Door Hanging, consciously relax the abdominal wall while you practice. As you soften the abdominal muscles, relax and straighten the spine against the door edge. You will be able to feel a sensation of ‘pulling in and up’ deep inside behind the front lower ribs. This is the left and right psoas muscles working. (Fig. 4.9) Feel this same sensation of pulling in and up deep inside behind the front lower ribs when you walk and sit. This will keep your lower spine lengthened and comfortable without needing to “suck in your gut”. Pulling in the abdomen to flatten the belly or straighten the lower spine will hamper your energy flow and organ function. However, working the psoas properly will not only align the lower spine, but will also flatten the belly without tightening it.

12th 1st 2nd 3rd 4th Hip

Psoas

5th Lumbar

Fig. 4.9 Psoas Muscles

When you carry the head as if gently pushed back from the upper lip and suspended from its crown, the tendency is to let the lower ribs push forward. To prevent this, feel that you are keeping the lower ribs tucked back slightly. Remember to keep the lower ribs tucked back from inside, not from tightening the abdomen. This will put you in touch with the psoas alignment. You are not actually sinking the lower ribs back, for this would cause you to slouch. You are instead keeping them in a straight line with the abdomen below and the chest above. Feeling the tucking sensation will stabilize the mid-torso, and allow the whole spine to lengthen equally. The feeling, once it is developed, is that there is a subtle pulling back and up deep inside at the lower rib area. Experience this first in Door Hanging, then apply it at all times. Like all structural improvement, intention is required initially. Gradually it will become automatic. Door Hanging is the key to developing this psoas feeling. If the spine remains on the door and the abdomen is soft, then you need

only relax and gradually sense what is already happening inside. It also helps to have a good mental picture of the anatomy involved. Once you have developed this psoas feeling, you will find how important it is in all of the Universal Tao practices. During your practice of Iron Shirt, when you are using reverse breathing to pack the abdomen, slightly increase the psoas work of pulling in and up behind the front lower ribs. This will allow you to pack even more fully, but without tightening the abdominal wall to do it. Gradually, you will be able to pack very powerfully with very little abdominal tension at all. When you thrust back at T-11 to pack the lower back, apply the psoas work very strongly and you will be able to focus your force to the T-11 area much more directly. b. Psoas Muscles and the Six Healing Sounds The relationship between the psoas alignment and the lower area can be felt very well when practicing the Six Healing Sounds. (For detailed information on the Six Healing Sounds, see the book, Taoist Ways to Transform Stress into Vitality.) Remember to keep the lower rib area back using the psoas muscles, not by tightening the abdomen. For the Lung, Liver and Heart Sounds, be sure to keep the lower ribs held in. Then, while exhaling and making the unvoiced sound, you can put pressure within each organ more effectively. While exhaling continuously increase the pressure to the particular organ area. At this point you will feel that you are “wringing out” the stale energy from each organ with this pressure. Using the correct psoas alignment as you inhale will allow you to direct the fresh energy from your breath directly into the organ are more easily. When doing the Liver Sound, tilt to the right and slightly forward. Do this tilting from the lower rib area. This will increase the pressure you can apply to the liver. For the Heart Sound, tilt to the left and slightly forward, and stretch the heart meridian by stretching the little finger. For the Lung Sound, stretch the lung meridian by stretching the thumb. For the Kidney and Spleen Sounds, the lower ribs should sink back so that you can apply pressure in each organ. When the lower ribs sink back, you are really accentuating the psoas stretch. Using the psoas muscles corectly will improve your practice of the Six Healing Sounds. By simply practicing the Six Healing Sounds you will become aware of the psoas alignment, particularly when the arms are overhead.

7. Standing Pelvic Alignment
Balanced alignment of the psoas muscles is also essential for correct leg movement and pelvic alignment. However the feet are placed, be sure that the pelvis is not tilted back or pushed to one side. The knees should remain at least slightly bent, and the arches of the feet lifted by distributing the weight equally on the three corners of each foot. If the pelvis is askew or the knees locked back, there is stress in the lower back and knees and integration between the lower and upper halves of the body becomes impossible. For most people, maintaining structural alignment in the lower body while ‘”standing around” requires more intention than aligning the upper body, though it is also dependent on upper body alignment. This is due to weakness in the legs and buttocks. Maintaining an aligned stance during daily life will do a great deal to strengthen the lower body, improve energetic flow and heal lower back problems.

8. Sitting Posture
When you sit erectly for meditation, be sure that the “sitting bones” of the pelvis are directed straight down into the chair seat. Tucking the chin slightly will align your spine and give a gentle pull to the spinal cord. Then energy will flow more easily into the back portion of the Microcosmic Orbit. If you find that placing your hands in your lap causes your shoulders to roll forward or your upper back to become uncomfortable, place your hands on a thin cushion or folded blanket in your lap to alleviate this. When your Chi flow is strong, this will no longer be a problem. (Fig. 4.10)

Breath Alignment

Fig. 4.10 Practice the Microcosmic Orbit while in the sitting position.

9.Shoulder Widening Exercise

The Shoulder Widening Exercise develops natural alignment of the shoulders by widening the shoulder blades out to the sides, rather than rolling them forward or pulling them back. In all body segments, healthy alignment leads to an increase of space. If the shoulders are pulled back, then the width of the upper back is decreased and the upper spine is compressed. If the shoulders are rolled forward, the chest collapses and its width is decreased. However, if the shoulders are dropped down and widened out to the sides, then there is an equal opening of space across both the front and back of the upper torso. In several of the Iron Shirt exercises, flexibility and control are developed by widening the shoulder blades out to the sides. One feels the chest sink in, but not collapse, and the shoulders drop down. This movement makes the necessary connection to the rib cage, which will permit the Chi energy to flow, thus giving the practitioner scapulae power. Remember to let the shoulders return to a natural “idling” position of dropped and widened out to the sides after your Iron Shirt practice. Do not permit them to roll forward at all so that there will be no significant loss of potential scapulae power.

a. Position for Practice You can practice while sitting, standing, or in the Structural Alignment Position Against Wall. Be sure that the spine is erect. Aligned placement of the shoulders must begin with an erect neck head and an erect upper back/chest. b. Hands/Arms/Applying Force Hold each wrist with the opposite hand. Keep the arm down low near the torso rather than lifted. Gently, but firmly, pull the elbows out to the sides without letting go of the hands. Be sure the shoulders are kept consciously dropped. Let the force at the elbows be reflected up to the shoulder joints which will increase the sense of widening at the shoulders. This is a subtle feeling, but can very definitely be felt. (Fig. 4.11)

Fig. 4.11 Shoulder Widening Exercise

c. Releasing the Force Slowly release the pulling out of the elbows and the active drop ping and widening of the shoulders. Maintain the same dropped and widened position of the shoulders which are now in a relaxed state with the arms hanging loosely at your sides. d. Rolled-Forward Shoulders If your shoulders are usually rolled forward, you will also need to roll them back simultaneously while performing this exercise. Be sure not to roll them back so far that the shoulder blades begin to move toward each other. e. Practicing without Holding the Wrists While practicing this exercise, feel which muscles are doing the work of active shoulder alignment. Muscles in both the chest and back will be working. Then, after mastering (a) through (d) above, begin to practice actively aligning the shoulders while the arms remain at your sides. You will be able to align the entire upper body easily and quickly whenever you wish. Be sure to maintain the dropping and widening of the shoulders, even when you raise the arms above shoulder height. This stabilizes the shoulders and makes arm movement steadier and more grounded while lessening the build-up of tension in the shoulders and neck.

10. Backbend
The Backbend stretches the upper back and spine opposite to the normal direction of its curve. This helps lessen the often excessive forward curve of the upper back, limbers the shoulder joints, and opens the chest. The Backbend is the most important stretch for a healthy upper spine and freer breathing pattern. The Backbend is also very good preparation for the Iron Bridge.

a. Back Position Roll up a blanket tightly and place it on the floor. Lie over the blanket so that it is just below the top at the shoulders. Lengthen the spine by tucking the pelvis forward to straighten the lower spine, and tuck the chin in to lengthen the back of the neck. If there is any discomfort in the back, the blanket is too high. (Fig. 4.12)

Fig. 4.12 Position of Back During Backbend

b. Neck Support If there is any discomfort in the neck after tucking in the chin and elongating the back of the neck; it is essential to place the head on another blanket or cushion. This extra neck support should be lower than the one under your back, but high enough to eliminate any neck strain and allow you to feel that the back of the neck is lengthening. As you practice over time and gradually increase the height of the rolled-up blanket, it may be necessary to use a neck support, even though one was not needed when you used a lower rolled-up blanket. This is particularly true in the first position when the blanket is just below the top of the shoulders. c. Arms Slowly bring the arms back to rest on the floor above the head with the elbows well bent. Only do this if it can be done without strain. If bringing the arms back causes discomfort, they can remain at the sides, or be brought back only so far as produces stretch without strain. If brought back only part way, the arms can either be held there or placed on a cushion, piece of furniture or other prop. As the shoulder joints become more limber, the arms can be brought lower. As the arms are brought back, be sure to continue keeping the shoulder blades dropped and widened.

Breath Alignment

d. Breathing While relaxing in this Backbend posture, breathe deeply and slowly, directing the breath to fill the chest rather than expand the abdomen. This greatly increases the stretch of the spine and chest. If necessary, hold the abdomen in while inhaling so that chest expansion can occur. It may seem very difficult initially to breathe up into the chest while practicing the Backbend, but practice will be rewarded by a great deal of structural opening in the chest and upper back. e. Several Positions for Blanket In order to limber the whole upper spine and shoulder joints practice the Backbend in each of the following positions. Do not practice with the blanket below the sternum. First position: The blanket is just under the tops of the shoulders. Second position: The blanket is under the middle of the chest. Third position: The blanket is under the bottom of the sternum. f. Time/Resting between Positions Remain in each position for several minutes or more if you are comfortable. Most people find the Backbend very pleasant from the beginning: similar to getting a back massage. If the Backbend is initially a difficult stretch for you, leave the position and rest before continuing to the next position. Once the Backbend is easy and pleasant, you can shift from first to second to third positions on the blanket without coming up first. g. Leaving the Position To get up after the Backbend, use your hand to lift your head to a chin-on-chest position, then roll off the blanket to one side before sitting up. This will prevent strain on the neck or back. h. Forward Bend Ideally, bend over forward and relax after the Backbend and upon completion of the Iron Bridge. The knees should be at least slightly bent. If the knees are locked back, they will be strained. If you want to stretch farther forward do not increase the forward curvature of the upper spine in doing so. Stretch forward by letting the hamstring

muscles at the backs of the thighs lengthen. If you are stretching forward vigorously, or are not very limber, bend the knees much more while stretching so that you can lay the whole abdomen firmly on the thighs. Then, test your flexibility by slightly straightening the knees while keeping the abdomen on the thighs. Practicing in this way will guarantee that you are only stretching the lower spine and hamstrings, and not arching the upper spine. i. Increasing the Height of the Blanket As the upper back becomes more limber, continue to increase the height of the rolled-up blanket (s) in order to feel a strong stretch but no discomfort.

11. Warrior Poses 1 and 2
Practice of both Warrior Poses leads to great flexibility and strength in the buttocks and legs. As the strength and flexibility develop, there is structural opening and realigning in the hip/thigh /lower back area that is essential in Iron Shirt. The awareness created in the Warrior Poses develops the ability strongly to use the lower body in movement or in standing, without compressing the lower spine or neck. a. Warrior Pose 1 (Fig. 4.13(a) and (b)) (1) Feet Stand with the left foot straight ahead and the right foot turned in 45 degrees. A line through the middle of the left heel should intersect the middle of the arch of the right foot. Throughout the exercise, keep equal weight on the three points of each foot. The distance between the two feet should be as wide as possible without losing the indicated alignment for the lower back and back leg. (2) Pelvis/Lower Back Start with both legs straight at the knees. Strongly turn the pelvis under, so that the lower back is straight. This will require strong buttocks work. It is absolutely essential that the lower back remains in this straightened position throughout the exercise. If the feet are too far apart, this will be impossible.

Breath Alignment

(a) Correct

(b) Incorrect

Fig. 4.13 Warrior Pose One

(3) Spinal Extension After flattening the lower spine, extend upward through the whole spine. Hold the head as if it is gently pushed back from the upper lip and lifted from its crown. Be sure that the front lower ribs remain in. Do not permit the lower rib area to push forward. This is particularly true in these Warrior Poses, and more so in Warrior Pose 2 than in Warrior Pose 1. Maintain a full extension of the spine throughout the exercise. (4) Moving Into the Full Pose Now exhale and bend the left (front) leg, until the left knee is directly over the left ankle, keeping the right (back) leg as straight as possible. Do not let the left knee move to the right as it comes forward. This would prevent the groin from opening. The knee must remain exactly over the ankle.

(5) Distance Between Feet If the feet are too far apart you will not he able to bend the left knee all the way over the left ankle without arching the lower spine and/or bending the back leg a lot at the knee. (6) Back Leg It is all right to let the back leg bend a little to keep the lower spine straight. As you are holding the position, gradually straighten the back leg more at the knee until you reach your limit. Do not straighten it to the point where your lower spine begins to arch. (7) Time Breathing/Leaving the pose Maintain this position for one to two minutes, breathing slowly and deeply up into the chest to elongate the spine. Breathe continuously without any pause. Come out of the position while exhaling by first straightening the front leg. Then, turning, both feet parallel to each other, place them together. Repeat for an equal time on the opposite side. (Simply reverse left and right when following the instructions). b. Warrior Pose 2 (Fig. 4.14(a) and (b)) (1) Feet Stand with both feet facing straight ahead, the right foot several feet behind the left foot and several inches to the right. Lift the heel of the right foot off the floor. Throughout the exercise, keep equal weight on the three points of the left (front) foot and equal weight across the balls of the right (back) foot. The distance between the two feet should be as wide as possible without losing the indicated alignment for the lower back and back leg. (2) Pelvis/Lower Back Turn the pelvis so that the pelvis and whole torso is square with the front thigh, The navel will then be pointing exactly in the direction of the front foot. Begin with both knees straight. Strongly turn the pelvis under, so that the lower back is straight. It is absolutely essential that the lower back remains unarched throughout the exercise. If the feet are too far apart, this will be impossible. Instructions (3) through (7) for Warrior Pose 2 are identical to Warrior Pose 1.

Breath Alignment

(a) Feel the stretch

(b) Skeletal Position

Fig. 4.14 Warrior Pose Two

(8) Arms Position When Warrior Pose 2 Is Developed When your practice has become familiar and strong, add the following arms position. Extend both arms straight up, while keeping the shoulder blades dropped and widened. The palms face each other. Pay particular attention not to let the lower rib area extend forward as the arms are extended upward.

(9) Arms Position Because this is a very strengthening exercise, it requires strong concentration and strong (but not stressful) exertion to maintain the straight lower spine and straightening back leg. When first learning either Warrior Pose, it is usually best to use the arms to aid pelvic alignment. One hand pushes the sacrum down and forward from the back, while the other hand pushes in and slightly up at the lower ribs from the front. (Fig. 4.15) This helps greatly in keeping the spine straight, and you can keep all of your concentration on the lower body exertion.

Fig. 4.15 Arm Position for Beginners

Breath Alignment

(10) Further Details of Practice If practiced two or three times per week, strength will develop rapidly and flexibility slowly, but surely. As flexibility increases, the feet can he held farther apart from each other until finally the front thigh will be parallel to the floor while the other details of the form are maintained. This final position requires tremendous flexibility and strength. Most people will not achieve this for a long time. Just remember that an arched lower back or well-bent back knee means the feet are too far apart. It is a good idea to check your lower back in a mirror when first learning. You may be quite suprised how close the feet have to be to practice properly. (11) Arms Position when Warrior Pose One is developed. When your practice has become familiar and strong, add the following arms position. Extend both arms strongly at shoulder height directly to the front and back. Let the eyes gaze at the tip of the second finger of the forward arm. Keep the shoulders pulled down, rather than hunched. Extend from the fingertips through each joint to the shoulder blades.

Chapter V

Chapter 5
Body Construction - Iron Shirt

This chapter is concerned with the construction of fasciae and their structural interrelationship with bones, muscles, and tendons. Further, instruction on the muscle tendon meridians (or acupuncture routes) of the body increases an awareness of the body's construction, which awareness is vital to the work at hand: the creation and storage of Chi energy and its circulation throughout the body. Dr. Michael Posner, a practicing Chiropractor, provides an introduction to this chapter by discussing the major keys to good health through an understanding of body structure. Learn as much as you can about the way that you are constructed because it will speed your progress. Knowing what makes you tick and how you are put together is very important in putting you in contact with yourself through Iron Shirt Chi Kung.

I. Iron Shirt and Chiropractic by Dr. Michael Posner

In all health professions nowadays, one thing that is commonly considered detrimental to our health is the phenomenon of stress. Various methodologies and theories have emerged that aim to help minimize the amount of stress one has to cope with. I wish to discuss the unavoidable stress of gravity on a body's structure when in an upright position, some health implications, and how, through proper alignment of bone structure, we can efficiently minimize stress and increase good health. As gravitational forces act upon our bodies when we are upright, various groups of musculature work so that we can stay erect. To resist gravity, these muscles must exert a certain amount of energy. These anti-gravity muscles help to stabilize the bone structure in such a way that movement is possible in an upright position. The success that a person has in meeting the constant stress of gravity may have a subtle set profound influence on his or her quality of health, performance and emotional states.

Body Construction - Iron Shirt

Mastoid Process

T-2

T-12 Center of Gravity Hip Joint

Navel

Knee Cap

Bone (Malleolus) Hammer-Shaped

Heel Fig. 5.1 Line of Gravity in a Body’s Structure

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At this point, it is necessary to understand some basic concepts such as “line of gravity” and “center of gravity” as they relate to our bodies’ structures. The line of gravity, viewed laterally (Fig.5.1), anteriorly and posteriorly, falls from above downward through the earlobe, slightly behind the mastoral process (or the attachment of muscles behind the ear of the temporal bone, the bone located at the side of the head which contains the organ of hearing), through the odontoral process (a toothlike projection from the body of the axis or second vertebra of the neck upon which the first cervical vertebra rotates), through the middle of the shoulder joint, touches the midpoint of the frontal borders of T-2 and T-12, then falls just slightly outside to the sacrum, slightly behind the axis, or support, of the hip joint, slightly behind to the patella (or kneecap), crosses in front to the middle malleolus (the hammer-shaped bone on each side of the ankle) and through the outer bone of the ankle to fall between the heel and metatarsal heads. When viewed from the back, the· line of gravity passes through the occipital bone (or the lower back part of the skull), C-7 and L-5, the coccyx (or lower end of the spine) and pubic cartilage (or supporting tissue of the pubic bones) and bisects the knees and ankles. As gravity acts on all parts of the body, one’s entire weight can be considered as concentrated at a point where the gravitational pull on one side of the body is equal to the pull on the other side. This point is the body’s center of gravity. Generally speaking, the center of gravity is located in a region directly in front of, and about one and a half inches above and below the level of the navel. Its location varies according to body type, age, sex, attitude, breathing patterns, stress level, or abnormal neuromusculoskeletal disorders. The most economical use of energy in the standing position occurs when the vertical line of gravity falls through a column of supporting bone in alignment. If weight bearing bony segments are aligned so that the gravity line passes directly through the center of each joint, the least stress is placed upon the adjacent ligaments, tendons and muscles. When this alignment is achieved, the antigravity muscles which expend much energy to resist the downward pull of gravity need not work as hard. The bones now take on a more active role in supporting our bodies in an upright posture, allowing the muscles to relax and rest, thus conserving energy and diminishing stress and tensions developed from unbalanced bone and muscle patterns.

Health potentials can be realized only when balance of structure exists so that both nerve energy and Chi flow freely. There are many negative health effects produced when these antigravity muscles are working either too much or too little. Muscles function to move bones and, if muscles are either very tense or too flaccid, unilaterally or bilaterally they will create a derangement in our bone structure. When a person feels knots or spasms in their muscles, this means that the muscle has gone into a state where it has a sustained contraction. A contraction means that the muscle fibers have shortened. As this occurs, bones can be pulled out of their proper alignment. When spinal vertebrae are involved in this structural imbalance nerve roots can be irritated, thus interfering with the function of the nervous system. When the nervous system is interfered with, a multitude of health problems can arise since the nervous system is the means by which all body functions are regulated and monitored. Health potentials are enhanced when proper communication between the brain and all body parts is maximized. Since this is the function of the nervous system, the structural integrity of our musculoskeletal system is of prime importance. Structure is said to determine function. The chiropractic profession deals with problems of health and disease from a structural point of view, with special consideration given to structural intergrity, spinal mechanics and neurological relation. Thus far, it has been shown how gravity interrelates with our musculoskeletal systems, and how this stress on our structure could affect our health in general. Of course, other factors such as emotions, toxins and trauma affect one’s structure as well. Muscles store and harbor tension and stress from various sources, but the point is that structural imbalance is the end result and, in turn, our functionability is diminished, as well as our health. From this standpoint, logically speaking, one must seriously consider how to go about producing optimum structural integrity in a balanced way. To do this, it is necessary to understand the value in learning about alignment; learn the principles from a competent source; recognize one’s own problems in this area; and then apply the knowledge to oneself. As a chiropractor, I am concerned with correcting each patient’s structure to allow the body’s optimum function to be restored. But

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I can only do so much for a person and, in reality, one’s health is one’s own responsibility. Therefore the necessity for everyone to learn about structure for themselves, and to recognize what is right or wrong is essential for good health. I believe that some of the major keys to good health are proper bone alignment, muscle balance (symmetry), flexibility of joints and fasciae, proper breathing, relaxation and proper body utilization. Finally, of extreme importance, is to learn to conserve, build and store energy that is usually wasted when structural imbalance exists. Exercise is an indispensible means to attain the above keys to health. The kind of exercise, therefore, must not be unilateral, as most sports are and not tension producing (i.e., not in excess). Well-toned muscles and fasciae are desirable, but not too much or not too little. Balance is, therefore, the key when choosing an exercise system. The exercise system should be one that develops body symmetrically, reduces stress, teaches proper alignment and one that shows how to store, increase and conserve vital energy. I am a chiropractor who sees health to a great extent dependent on symmetry or balance of body structure and so became interested in the Chinese art of Iron Shirt Chi Kung. Iron Shirt emphasizes the importance of maintaining a bone posture in such a way that the gravitational forces acting to push us down to earth can be transmitted through the bones into the earth rather than wasting energy resisting with the muscles or putting undue stress on the joints. The Iron Shirt postures align the vertebrae in such a manner as to permit the line of gravity to pass through the center of the vertebrae. Now the force is not being resisted, but rather transmitted. The muscles, ligaments and tendons can relax instead of working to resist. Integration of all structural tissues for optimum functions is created by the Iron Shirt postures. Relaxation, proper breathing, symmetrical muscle development, tendon and ligament strengthening; as well as strengthening the bones, result from Iron Shirt practice. Another very important concept is to learn to experience and recreate one’s proper center of gravity. I say ‘’proper’’ because generally one’s center of gravity changes from the navel area up into the chest or higher as one confronts life situations and stresses. This interferes with normal breathing patterns which should be originating from the abdomen as well as the chest. One simply has to compare a child’s breathing to the breathing of most adults,

and it will become evident that adults mainly breathe from their chests with very little abdominal or diaphragmatic action. It is very important that we utilize our diaphragm when breathing since the diaphragm descends upon and massages our internal visceral organs. This action enhances circulation and blood flow as well as increased oxygen to all of our vital organs. The increased energy, structural integrity and phenomenal health benefits gained from Iron shirt practice, in my opinion, are outstanding. I feel that its practice can develop future health potential in a wholistic way: physically, mentally, emotionally and spiritually. When one aligns oneself with Iron Shirt practice, he also aligns himself with the harmony of the universe.

II. Construction of Fasciae, the Relationship of Fasciae to Bones, Muscles and Tendons, and Acupuncture Routes, or Muscle Tendon Meridians

A. Fasciae: Protectors of your Vital Organs

After an ovum is fertilized it differentiates into three main systems, the ectoderm, endoderm and mesoderm. Fasciae are derived from the mesenchyme, which is a subdivision of the mesoderm. Nuclei in the mesenchymal substance give rise to bones, ligaments, muscles and tendons. Then a more structureless system of casings, sheaths and tissue takes shape around the various centers which have been developed. The fascia is a sheath and its function is that of support, protection, mechanical advantage, some degree of contractility and lengthening, and energizing the organs and muscles to let Chi energy flow through easily. The fascia is a type of connective tissue which is avascular (or without blood vessels), translucent and tough. It is intimately involved with muscles, encasing them and enhancing their duties by various means, which include separating them into distinct bundles, providing bonds of especially tough fibers to offer support for purposes of leverage, and allowing for lubrication by means of fluids released from the tissues of an organ or part so that these enclosed muscle groups can slide over each other.

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Fasciae are present throughout the body, separating, connecting, wrapping and supporting various parts of it, and finally on a superficial level, encasing the whole body in a shimmering sheath just beneath the level of the skin. These superficial fasciae are very resilient, due to the fact that the fibers run in a criss-cross pattern. Damage by trauma alters them, making them denser and shorter, a characteristic of scar tissue. Since this network is present throughout the body, it might explain the mechanism of trigger points, whereby the malfunction of internal organs is evidenced as pain in small areas often quite remote from the organ involved. This might also explain another mechanism, the one found in reflexology. Certain areas of the feet might at varying times be painful, coinciding with organs in the body. There is another little-recognized function of fasciae: that of providing muscle tone. In fact, low blood pressure is associated with a hypotonus condition of fasciae and hypertension with a hypertoned fasciae. (This means that a condition of the fasciae exists in which a high or low pressure causes too much or a limited diffusion of solutions throughout the fasciae.) There are several types of fasciae, all built of collagen. The most widely distributed is the loose connective tissue, which is the most flexible and most elastic of all, its fibers going in all directions. It consists of protein imbedded in a liquid ground substance and is very important to water metabolism and to other fluid exchanges. Tough, fibrous tissue can be found in areas where more tensile strength is required. Here the tissue is tough and unyielding, resulting from the parallel arrangement of bundles of fibers which are also found in tendons and ligaments. Huge fascial sheets found in the body are comprised of such tissue. All variations in fasciae, however, stem from the mesoderm. The fasciae, though avascular themselves, furnish support for blood vessels, nerve fibers and vessels of the lymphatic system and contain the nerves which convey fluid into the veins and sensory receptors which are responsive to internal stimuli from the muscles, joints and tendons. The fasciae are also responsible for maintaining the relative positions of the various organs and muscles in the body.

1. Fasciae Exist in Three Layers (Fig.5.2) a. The Superficial or Subcutaneous Layer: The superficial layer (the layer beneath the skin) is composed of two subdivisions: (1) a layer which can contain a tremendous amount of fat in those who are overweight; and (2) the more internal area of the subcutaneous fasciae. This is the most elastic of the various fasciae, since it has to accommodate varying amounts of fat storage, swelling when there is inflammation and muscular activity and distension when the muscles are worked. In this layer we are able to store Chi energy. As this layer of the body fills up with Chi, it is unavailable for storage of fat by the body. By practicing Iron Shirt packing, you can burn out the fat already existing in this layer.

Skin a. Subcutaneous Tissue b. The Deep Layer (1) First Layer-Anterior Fascia Muscle (2) Second Layer Fascia Muscle (3) Third Layer-Posterior Fascia

Liver Stomach

c. Peritoneum

Fig. 5.2 Fasciae exist in Three Layers.

b. The Deep Layer: The deep fasciae, which are denser and have a smooth surface, allow for a reduction in friction as one surface slides over another. The deep fasciae produce bundles of fibers in parallel arrangement, giving great tensile strength. This sort of tissue is formed around the ankles, knees, wrists and elbows where it acts as an anchor against which muscles can pull. Fasciae also act in the capacity of a nutritional storehouse, as a source of insulation and support by means of fatty content, and as a barrier to impede the entrance of foreign organisms and objects. The deep fasciae keep muscles in their distinct shapes and positions. These fasciae, which are the densest and have the greatest tensile strength, are made up of three types. The first and outermost is the external surrounding layer. These cover large muscle groups. The intermediate membranes separate individual muscles and, finally, the internal surrounding layer covers the external surfaces of the body cavities. c. The Subserous Layer or Peritoneum: Internal to the intermediate membrane lie the subserous fasciae, or fascial layer beneath the membranes of the body which line all of the large cavities of the body. There are two types: (1) the parietal (or cavity wall) fasciae which cover the inner surfaces of the body cavities such as the thorax or abdomen; and (2) the visceral (or internal organ) fasciae which cover the organs in those cavities such as the lungs or liver. Again the main functions are protective and supportive, as well as a means of lubrication. During irritation these serousal surfaces sometimes adhere to one another, causing great pain. 2. Iron Shirt is Concerned with the Fasciae of the Whole Body Iron Shirt is concerned with the fasciae of the entire body; that is to say it primarily involves the subcutaneous layer (beneath the skin) which covers the whole body. Iron Shirt is specifically concerned with the fasciae in the lumbar region, which are thicker and more fatty than ordinarily encountered. These two divisions of fasciae are joined by spindle connections, which are columnar shaped fibers between which the fat is deposited. The lumbar fasciae are composed of three layers. The most super ficial one extends out from the middle, from the spines of the lumbar verterbrae (situated near the lower rib and hip bone) and

the spine of the sacrum (the bone formed by the union of five vertebrae between the lumbar and caudal, or tail) region, constituting the back part of the pelvis and sacrospinalis ligament (a muscle which extends vertically along the length of the vertebrae in that area) and also out to the sides to the intermediate layer. The intermediate layer extends from the middle of the area of the lumbar and out to the sides, where it joins with the superficial layer. These two layers envelop the muscles which hold a person erect. The fasciae also extend upward to the lower portion of the twelfth rib and, at its lower extremity are attached to the iliac crest (the large upper part of the pelvis) and the iliolumbar ligament, both in the small intestine area. The deepest layer envelops the quadratus lumbarum (a muscle which extends out from the area of the lumbar to join the other two layers at the sides, as previously described.) The three layers together comprise what is technically known as the “Origin of the Transverse Abdominis Aponeurosis”. The deep fasciae of the upper back are made up primarily of thoracic fasciae, which are thin coverings of the extensor muscles of the thoracic spine (vertebrae between the neck and abdomen, enclosed by ribs). Its lower border joins with the most superficial part of the tri-layer of the deep lumbar fasciae, while its upper portion combines with the cervical and trapezius fasciae. Attaching along a mid-line composed of the spines of the thoracic vertebrae, the deep fasciae of the upper back extend out to the sides following the rib angles and the fasciae of the muscles between the ribs. The deep fasciae that enclose the rhomboids (two muscles that attach to each shoulder blade) and muscles of the posterior (or back) are considered to be separate from the thoracic fasciae, though there is no actual separation between the two. Out to either side the axillary fasciae (covering the armpit) are to be found, serving as a protective layer over the axillae which are practically devoid of muscular tissue. They also partially enclose the back and side muscles, blend in with the thoracic fasciae, and are connected to the fasciae beneath the spine. In turn, the deltoid fasciae (covering the triangular muscle of the shoulder and upper arm), at about the level of the fourth thoracic vertebra and the midscapular (mid-shoulder blade) line, connects with the fasciae beneath the spine and is anchored to the spine and acromion process (the shoulder blades’ projections which form the points of each shoulder).

All of the various layers just mentioned combine to form the continous fascial network of the back. The deltoid fasciae extend out from the spine at the scapulae to the clavicle (or collar bone). There they merge with the pectoral fasciae (covering the breast). The deltoid fasciae also extend laterally from the shoulder into the arm where they become known as the brachial fasciae. These brachial fasciae join with the pectoral and axillary fasciae and are attached to the epicondyles of the humeri (covering the large rounded prominences associated with the shoulder joints) on the upper end of each humerus (bone of the upper arm) as well as the olecranon of each ulna (or the curved part of the ulna bone at the point of the elbow). (The ulna bone is one of two bones in the forearm and is on the same side as the pinky finger. The other forearm bone is called the radius.) The brachial fasciae are thin where they cover the biceps and thicker over the triceps. The interbrachial fasciae join as one with the brachial fasciae and extend from the epicondyles of the humeri to the remotest ends of the radius and ulna bones. The pectoral fasciae are thin sheaths connected to the clavicle and sternum (or breastbone) and extend to the deltoid, brachial and axillary fasciae and also the outer surrounding layer of the abdominal fascia. They also attach to the diaphragm. Beneath the pectoral fasciae lie the pectoralis major muscles. Beneath those are fascial sheaths called the clavipectoral fasciae that enclose the pectoralis minor muscles. This is found between the pectoralis minor and the thoracic body wall. These fasciae, attached to the clavicle and enveloping the artery running beneath the clavicle, extend to the first rib, the coracoid process of the scapula (the bone that unites with the scapula to form the cavity through which the arteries of the scapula and temporal bones run) and the axillary fasciae. The ribs comprise the foundation of the thoracic body wall and are covered exteriorally by the external intercostal fasciae (or fasciae between the ribs). This sheath, extending in the direction of the head, joins the scalene fasciae (the fasciae covering the deep muscles attached to the cervical vertebrae and first and second ribs, acting to flex or bend the neck). Extending downwards towards the lower abdomen, this sheath joins with the fasciae that separate the external and internal oblique muscles of the abdomen.

The interior surfaces of the ribs are covered by the endothoracic fasciae (surrounding the muscles within the thorax). These extend toward the head, blending with the prevertebral fasciae (covering the vetebrae which are at the beginning or top of the spinal column), while in their extension to the lower abdomen they connect to the internal surrounding layer of the abdominal wall. The subcutaneous fasciae of the abdomen are soft and pliable, increasing in tensile strength as they extend out to the sides. The highly elastic deeper portion of the subcutaneous fasciae are attached to the linea alba and the inguinal (or groin) ligament. (Alba is a white substance carried by the central nervous system.) The outer investing layers of the deep abdominal fasciae unite with the fasciae of the back and the breast. In their extension downward they connect with the fasciae lata (the external fasciae of the thighs), symphysis pubis (the junction of the two bones which join with a third to form the arch on either side of the pelvis), and the aponeurosis (the white fibrous tissue which forms the attachment of the external abdominal oblique muscles). The surrounding internal layer unites with the deepest portion of the thoraco-lumbar fasciae, the pelvic fasciae and the fasciae of the diaphragm and are commonly referred to as the transversalis fasciae. These cover the external surface of the abdominal cavity wall, the lumbar vertebra bodies and the psoas major muscle. The various fascial layers which have been described are integral to the cultivation of Iron Shirt as the fasciae into which we pack Chi. As previously described, this Chi will then form a protective cushion in the body which is also a storage place from which Chi can be retrieved when required.

B. Cleansing the Marrow/Changing the Tendons

1. “Cleansing the Bone Marrow” The process of transforming sexual energy for storage in the brain and bone marrow, cleansing the internal organs, and restoring the organs to proper function is known as “Cleansing the Bone Marrow” By circulating Chi in the Microcosmic Orbit and cleansing the “inner marrow” (which, as described in Chapter 1, increases the quantity of blood cells, a vital source of life-force), your system is cleansed of pollution. With the routes cleared, Chi flows freely to

where it is needed and then it is said that the whole body is filled with Chi. When a person ages, the bone marrow begins to dry out and produces fewer blood cells. At that time, the body fills the empty space within the bones with fat. In order to fill the empty bones with renewed energy to revitalize the marrow to a youthful condition, we need to transfer sexual energy which can be stored in the bones while simultaneously burning out fat. Cleansing the bone marrow, maintaining healthy organs and changing the tendons lead to a strengthening of the muscles, tendons and ligaments, a condition described as one in which the inside of the body is clean and the outside is strong. All three levels of Iron Shirt practice are involved with strengthening and rebuilding the fasciae, tendons and bone marrow. 2. “Changing the Tendons” Using various methods, Chi can be gathered from internal organs and led out to the fasciae surrounding them whenever necessary. When sufficient Chi has been accumulated, it is guided out along the fasciae between muscle groups and finally to the tendons which themselves are included in fascial sheaths until the entire body is filled with energy. Tendons connect muscles to bones, are stronger than muscles and last longer. Fewer cells and smaller blood supplies are required to maintain and develop the tendons. Iron Shirt is designed to strengthen and develop the tendons so that movement no longer depends strongly upon the muscles. In Taoism your health is said to be impaired if your tendons are crooked, loose or weak. Diseased and crooked tendons will cause you to be thin and if the tendons are no longer resilient, this causes you to be easily fatigued as well. The fasciae can become restricted due to injury, resulting in scar tissue which is tougher and tends to contract and pull upon the surrounding tissues and tendons, impeding blood flow and interfering with the passage of Chi. Emotions can also be traumatic and can chronically alter your way of seeing the world and, thereby, the way in which you present yourself to the world. This is evident in many ways, most obviously by the way in which you hold yourself physically. Fasciae and bone tendons take a longer time to grow and, when injured, take a much longer time to heal. When, however, the

tendons are strong, relaxed, and long and full of strength, they are also full of large quantities of Chi and have ready access to more of it when needed. Once developed, they will be much stronger, last longer and work harder. They will use very little nutrients and will require very little maintenance. Some therapists have worked on loosening what has become overly restricting fascial tissue, thus often liberating emotions and memories that had created a constant drain on a person's energy reserves. Sometimes the person experiences a new lease on life by being able to function with a range of freedom of motion that he might otherwise never have known. As previously mentioned, "Changing the Tendons" and "Cleansing the Bone Marrow" will be dealt with further in Iron Shirt II and Iron Shirt III, respectively.

C. Harmony of Fasciae, Tendons and Chi

A Taoist would describe the body as internally consisting of the vital internal organs and the Chi energy which services them. Externally the body is comprised of bones, tendons, muscles and the fasciae which contain them. If you recall, bones are moved by the action of muscle contractions which pull on the tendons that are attached to the bones. Blood is said to move muscles and Chi to move blood. Thus, the Taoist Master strives to create and protect the Chi and the blood. This Chi, as an electromagnetic energy is unseen, while the muscles, tendons, bones and fasciae are quite visible. Practice consists of working both the visible and the invisible as an expression of the harmony of Yin and Yang. To stress only internal or external development will result in disharmony and dysfunction. The organs and muscles must be vitalized by Chi, but the circulation of the Chi is augmented by having a healthy body. Strengthening muscles without cultivating Chi creates a similar imbalance which will not lead to true health or strength. "Changing the Tendons" works with the muscles, tendons, bones and fasciae, developing both the visible (muscles, tendons, bones and fasciae) and the invisible (the flow of Chi). The practice of loosening the tendons is comparatively easy, whereas that of utilizing the fasciae is considered to be more difficult. Iron Shirt Chi Kung is said to be the most difficult discipline

of all and yet its practice, in which you learn to increase and store more Chi, truly begins with the Microcosmic Orbit. Once you have collected Chi,you you can direct it as it is needed to the fasciae of any point in the body. By a process in which you collect, conserve and reserve the energy of the vital organs (kidneys, brain, heart, liver, lungs, spleen and genitals), the polluted energy descends and exits as the clean, vital energy rises up to replace it. As you relax and collect more and more Chi, it is directed towards the tendons and fasciae until the entire body is filled with Chi energy. The Chi flows into the fasciae, expanding and strengthening the tendons. Again, balance or harmony is necessary. If you practice so that your fasciae are vitalized with Chi and your tendons are neglected, the fasciae will have nothing to depend on, since it is by way of the tendons that the muscles attach to the bones. On the other hand, if you work on the tendons and not the fasciae, the fasciae will not fill out and serve well as a coordinator of the muscle groups which they cover. If you exercise the tendons and the fasciae without Chi Kung to activate an energy flow, the tendons and fasciae will not ‘’raise up’’ separately and will not be able to work freely. If you practice Chi Kung and not the tendon or fascia exercises, the Chi will not be able to travel freely throughout the body and will be impeded in gaining access to all of the meridians. At the same time, the tendons will be weak through disuse and the fasciae will be tight and restricting. In this chapter, an overall picture is presented describing how the muscles, fasciae and bones function together. Muscles cover other muscles and bones and contain the various cavities which hold your vital organs. The tendons and fasciae are joined together and the tendons connect muscles to bones. The fasciae cover muscle groups, affording them the ability to do more work than they would were they not so bound together, and add to the resilience and general tone of the muscles as well. Since these bundles of muscles wrapped in fasciae lie outside of bones, they protect them; and since they make up the walls of the thoracic and abdominal cavities, they protect everything within them. The most important uses of the Iron Shirt Chi Kung are to fill the cavities of the body with Chi and to build up more Chi pressure in the vital organs, protecting and enabling them to deliver instant energy. (Fig. 5.3)

Body Construction - Iron Shirt

Cranial Cavity Pleural Cavities

Spinal Cord Thoracic Cavity Diaphragm

Pleura Pericardial Cavities Pericardium

Abdominal Cavity Psoas Muscle Pelvic Cavity Pelvic Cavity

Fig. 5.3 One of the most important reasons for practicing Iron Shirt is to fill the cavities of the body with Chi.

D. Muscle-Tendon Meridians

There are 12 muscle-tendon meridians in the body. These exist along the surfaces of the muscles and tendons, running from joint to joint. Unlike the other meridians, these do not connect with any internal organs. They seem to be primarily involved in the gross utilization of energy with which the musculature is associated. Here, however, there is far greater efficiency (that is, minimized effort with increased energy output) than is ordinarily presumed to be normal. Muscle-tendon meridians originate in the extremities, meet at major joints and end at points ranging throughout the torso and head. Knowing the tendon routes well and energizing them will greatly increase the muscle-tendon-fascia tone and improve the range of movement, or radius.

Chapter V

1. Lung Muscle-Tendon Meridian (Fig.5.4) This meridian has its origin at the end of the thumb. Looking at a person standing and facing you with his arms at the sides of his body and the palms facing forward, the meridian would be seen as a line that extends up along the outer side of the bones of the thumb to the outer side of the wrist. It then ascends up the outerside of the forearm to the crook of the arm and, rising up the biceps, crosses over to and enters the chest, coming out again at the sternoclavicular joint, From there it extends across the collar bone to the front deltoid, while another branch extends downward into the chest sending still other branches down to the diaphragm.

Fig. 5.4 Lung Muscle-Tendon Meridian

2. Large Intestine Muscle-Tendon Meridian (Fig.5.5) Again, picture a person who is standing and facing you. Now his arms are at his sides with the palms facing inward to the torso. Beginning at the end of the index finger this meridian travels up along what is then the outerside of the forearm to the outer portion of the crook in the arm. There it continues to ascend along the outer side of the upper arm to the side deltoid and then splits into two branches. One goes back over the trapezius muscle, descending down between the spinal column and scapula and extending up along the backbone to about midway of the length of the neck. The other travels across the lower surface of the trapezius and then to the sternocleidomastoid muscle on its way to the face, where it splits again at the jaw line. One short branch runs to the corner of the nose, the other travels up along the side of the face, passing through the side of the forehead on its way over the top of the head and down a similar route to the opposite jaw where it finally anchors.

Fig. 5.5 Large Intestine Muscle-Tendon Meridian

3. Stomach Muscle-Tendon Meridian (Fig.5.6) This meridian is somewhat more elaborate, starting at the third toe and sometimes the second and fourth, too. The meridian runs up the lower surface of the foot to about the level of the ankle. From there it splits into two branches. One goes up the middle of the lower leg to the outerside of the knee. The other, running laterally to the first, continues to the hip joint and then up over the ilial crest (upper part of the pelvis) to continue on around to the back where it crosses the lower ribs and joins with an extension of the meridian that runs along the backbone from the sacrum to about the level of the collar bone. Returning to the more medially located branch, we see that it continues up to the top of the thigh and veers in towards the pubic bone. There it enters the abdomen and emerges again above the cavity of the collar bone. Next, it travels up the side of the neck and jaw, where it splits in two. One branch veers forward towards the corner of the mouth, ascending up along the side of the nose to the corner of the eye. The other goes up along the jaw line to a point in front of the ear at the temple.

Fig. 5.6 Stomach Muscle-Tendon Meridian

4. Spleen Muscle-Tendon Meridian (Fig.5.7) With the figure standing and facing you, this meridian is seen as originating at the middle and end of the big toe. It then runs along the middle of the foot and ascends to the internal malleolus (hammershaped bone on each side of the ankle). From there it continues upward along the middle of the shin, passing the middle of the knee. Then it travels upward, beginning at the middle of the thigh and sweeping across it to end at a point on the groin. It then turns in toward the pubic bone and rises straight up to the navel. Veering off laterally, it crosses the abdomen, ending at a point just below the nipple, where it then enters into the chest. Another branch runs through a point located at the pubic bone to the coccygeal region where it ascends the mid-line of the backbone to about the level of the tops of the scapulae.

Fig. 5.7 Spleen Muscle-Tendon Meridian

5. Heart Muscle-Tendon Meridian (Fig.5.8) With the person standing with his arms at the sides of his body and the palms facing forward, this meridian begins at the lateral tip of the pinky finger. From there, it ascends to the middle of the wrist, continuing upward along the middle of the forearm to the crook of the arm. Traveling upward and medially, it runs to the armpit and then crosses the pectoral muscle at about the level of the nipple, joins at the mediastinum (the partition between the two pleural sacs of the chest, extending from the sternum to the thoracic vertebrae and downward to the diaphragm) and runs straight down to the navel.

Fig. 5.8 Heart Muscle-Tendon Meridian

6. Small Intestine Muscle-Tendon Meridian (Fig.5.9) With the person standing and facing away from you with his arms at the sides of his body and the palms facing forward, this meridian begins at the tip of the little finger. Ascending up along the back of that finger to a point on the wrist just above it, it continues up along the middle of the forearm, joining its upper arm extension in the middle of the elbow. Proceeding up the middle of the upper arm, it unites with its neck and ear extension behind the armpit. Ascending and descending, tracing out a pattern like a Z on its side, it continues up and over the trapezius, crossing the neck and connecting at the mastoid process with a small branch entering the ear. Another branch loops up and over the ear and then dips down to end at a point on the jaw below that is slightly behind the level of the outer corner of the eye. It then ascends, passing very close to the outer corner of the eye as it travels to the forehead, uniting with the muscletendon meridian extension of the mastoid process at the temple. Still another branch issues out of the point at the mastoid process, ascending the previously described branch that crosses the forehead on its way to the temple.

Fig. 5.9 Small Intestine Muscle-Tendon Meridian

7. Bladder Muscle-Tendon Meridian (Fig.5.10) Looking at a standing figure faced away from you, the bladder meridian begins in the small toe. Running along the outer side of the foot, it rises and joins with the external malleolus. It then ascends to and joins the lateral corner of the popliteal fossa (or cavity behind the knee), while a branch extends downward from the external malleolus to join at the heel. Then it runs up along the calf and joins at the back of the knee. From there, it ascends to the middle of the buttocks, while at the same time extending downward along the middle of the calf to the heel. From the buttocks it ascends along the mid-line of the backbone to the nape of the neck, continuing upward to join with the occiput (the lower back part of the skull). It then continues upward across the crown of the head to unite with a point at the side of the nose near the inner corner of the eye. A branch arches along the line of the eyebrow and swoops down to the cheekbone. Then, continuing downward it extends to the lower jaw, the throat and onto the chest, passing under the armpit to angle up to and join with the line that ascends the backbone. A small branch extends up out of this extension to the backbone, rising at an angle out of the region of the scapula to unite in the shoulder. There is also a branch that extends out of the nape of the neck to unite with the root of the tongue. Finally, a short branch extends from the line coming up and out from under the armpit to join at the mastoid process. 8. Kidney Muscle-Tendon Meridian (Fig.5.11) Looking at the back of a standing figure with the left heel lifted, the meridian is seen to start under his little toe. From there it travels along the spleen meridian and curves up at the arch of the foot, passing the underside of the ankle and uniting with the calf extension of the muscle-tendon meridian at the Achilles tendon. Continuing to ascend the middle of the calf, it unites again at the middle of the popliteal fossa (cavity behind the knee) joining with the bladder meridian. Viewing the same standing figure from the front, the kidney meridian is seen to continue up along the inner side of the thigh along with the spleen muscle meridian. It unites at the pubic bone, continuing a short way up to the navel. From the pubic bone it goes through to the coccyx, where it ascends the backbone to connect with the occiput and join with the bladder meridian.

Fig. 5.10 Bladder Muscle-Tendon Meridian

Fig. 5.11 Kidney Muscle-Tendon Meridian

9. Pericardium Muscle-Tendon Meridian (Fig.5.12) Facing a standing figure with his arms at his sides and the palms of the hands facing forward, the meridian begins at the middle fingers. It then rises up the mid-line of the forearm and upper arm, passing through the middle of the palm, the crook of the arm, the point of attachment of the front deltoid and then into the armpit. From there it spreads out into the chest both ventrally and dorsally.

Fig. 5.12 Pericardium Muscle-Tendon Meridian

10. Triple Warmer Muscle-Tendon Meridian (Fig.5.13) Observing a standing figure from the rear with his arms at his sides and the palms of the hands facing forward, the meridian is seen to begin at the end of the fourth finger. It rises to a point directly above it at the wrist and goes up the forearm to the elbow. Then, it travels up the middle of the upper arm, over the trapezius to the neck, where it joins the small intestine meridian. One branch goes to the jaw and connects with the root of the tongue, while the extension of the main meridian rises past the teeth to the ear. There it shifts forward to the outer corner of the eye and continues up past the temple to the upper part of the hairline.

Fig. 5.13 Triple Warmer Muscle-Tendon Meridian

11. Gall Bladder Muscle-Tendon Meridian (Fig.5.14) Here, when we view the figure from the side, we find that the meridian begins at the outer side of the end of the fourth toe. From there it angles up along the lower leg, sending out a branch to the outer side of the knee. Continuing up the thigh, it disperses another branch at S-32 and, continuing upward, sends out yet another branch that runs to the anus. It then ascends along the side of the body and rises in front of the shoulder, uniting with the muscletendon meridian extension that leads to the breast at the supraclavicular fossa. A slightly divergent point just below this bulges forward, where it links with the breast. The main meridian continues upward, rising up behind the ear to the crown of the head. It also descends in front of the ear to the side of the jaw from where it ascends again to the corner of the nose, while another branch travels up to the outside corner of the eye.

Fig. 5.14 Gall Bladder Muscle-Tendon Meridian

12. Liver Muscle-Tendon Meridian (Fig.5.15) Here we view the standing figure facing us. The meridian starts at the big toe and connects in front of the internal malleolus. It then rises up the lower leg along the tibia (the inner and larger of the two bones of the lower leg) and joins on the inner side of the knee. Finally it sweeps up the thigh and unites at the pubic bone, thereby connecting with all the other muscle meridians.

Fig. 5.15 Liver Muscle-Tendon Meridian

If you want to strengthen a particular muscle-tendon meridian, you can practice by using a Chi timetable. For example, if you want to strengthen the liver muscle-tendon meridian, it is best to practice at 1:30-3:30 a.m.

A.M.

P.M.

HEART SPLEEN

SMALL INTESTINE

STOMACH EARTH FIRE WATER

BLADDER

A.M.

LARGE INTESTINE

METAL WOOD

KIDNEYS FIRE

P.M.

LUNGS

PERICARDIUM

LIVER

GALL BLADDER

TRIPLE WARMER

A.M.

P.M.

Fig. 5.16 Timetable of Chi Flow to the Organs

Chapter 6
Developing a Daily Routine

If you practice the Six Healing Sounds (as described in Taoist Ways to Transform Stress into Vitality) just before going to bed, you will sleep more soundly and awaken earlier and more refreshed. Upon awakening, do not suddenly jump out of bed. Allow your engine (your body) to warm up a little first. Switching into high gear as soon as you get up can be disruptive and damaging to your entire system. If you are in the habit of bouncing out of bed in the morning as soon as you awaken, even though you may experience vitality lie in bed awhile instead and practice the Inner Smile, allowing the energy to flow into your Microcosmic Orbit, and you will be amazed at how much your health and overall progress will improve. Continue with Chi Self Massage (as described in Chi Self-Massage: The Taoist Way of Rejuvenation). If you are pressed for time, practice Chi Self-Massage while sitting on the toilet seat. It is not necessary to set aside time to do these practices since you can combine them with other activities. After diligently spending time in the Universal Tao System, you will easily be able to realize differences in your general well-being. You should drink some water when you get up, but not to excess. Drink as much as you feel is comfortable. Imbibing too much water can make you feel nauseated and even damage your kidneys. For drinking purposes it is wise to use a water filter or distill your water. Water and air are your two most important ingredients to good health and steady progress in this system. If you are worried about losing trace minerals through distillation, use tap water to cook with. Then you will have your minerals, too. Make sure that the tap water is filtered, at least through a simple mesh. Make sure that the air that you breathe is filtered as well whenever possible. The “Bionaire” air filter is a good choice because, in addition to filtering the air, it has an ion emitter. Practice the Iron Shirt exercises you have learned in this book, and in a short time you will find that it all fits together quite easily and becomes as ordinary and yet as necessary, as brushing your

teeth. You will, in other words, begin another good habit. To develop the daily practice of Iron Shirt, it will serve you well to realize that you do not need to do all of the exercises or breath alignment every day. On those days that you practice, it is best to do so early in the morning when you arise. Design a schedule that works for you. You might be able to devote no more than five or ten minutes to an activity, but do it. Rising twenty minutes or a half hour earlier in the morning will improve your whole life. In fact, in a short time you will discover that you need less sleep and have more strength and energy. At the same time, you will find that your activities, both before and after practice, will become more efficient and, therefore, you will derive more benefit, even though you spend what might seem like only a little time in actual practice. You can create a schedule to fit your time allowance. A recommended schedule to follow might be: Monday: Embracing the Tree for approximately six to seven minutes, followed by Holding the Golden Urn and the Horse Stance Using a Wall. Tuesday: Embracing the Tree, the Turtle and Buffalo and the Horse Stance Using a Wall. Wednesday: Embracing the Tree, the Turtle and Buffalo, plus the Phoenix and Door Hanging. Thursday: Embracing the Tree, the Phoenix, the Iron Bridge, and the Backbend. Friday: Embracing the Tree, the Iron Bridge, the Iron Bar and the Warrior Poses. Saturday and Sunday: Embracing the Tree, or rest for both days before beginning the cycle again. You may also decide to start the schedule over on Saturday. It is important to remember to start gradually, practicing only fifteen or twenty minutes to a half hour per day. Iron Shirt can be practiced at any time. Once you master using the mind to bring Chi to the various parts of the organs, you will find it very useful and you will be able to use the Chi energy anytime that you want or need it. If, for example, you are riding in a car, on a train, or in a plane and you feel back pain, you can bring the energy to the back by pulling up the anus and bringing the energy to the kidneys, or simply by contracting the back muscles. Squeeze and release, squeeze and release and you will find that the pain or stiffness will go away.

You will feel energized immediately. In this way you can help the organs that need to be exercised. Squeeze in some practice whenever you find some time during the day. It does not have to be any particular time and/or place. When you are standing on line, for example, with time on your hands, you can practice the elongation of the spine by pressing the legs down with the sensation of screwing them into the ground. Pull your head up at the same time and push the spine down. Once you master the practice, you can use it in any way that you want. Do not practice too close to bedtime or you will not be able to sleep. If you feel any discomfort during your practice, consult any Universal Tao Certified Instructor. If the problem still exists, consult a qualified physician. Remember that exercise is a tool. To misuse such a tool can be harmful. Iron Shirt Chi Kung is not meant to be harmful and will not be if used in the proper way. The exercises have been clearly outlined, as well as the side effects and how to prevent them. If the instructions are followed properly there will be no problems. People have been practicing this system for many thousands of years successfully.

Chapter VII

Chapter 7 Iron Shirt Chi Kung Experience

A. Testimonials from Advanced Iron Shirt Students

Gunther Weil, Doctor of Psychology

I have been a student of spiritual practice for many years. I was involved for a very long time with the Gurdjieff work as a practitioner. In 1978 my teacher died and I decided to step out of that teaching which, by then, I'd been involved in for some fourteen years. I began studying Taoist work, particularly Tai Chi and then Chi Kung, studying the latter with Don Ahn. In September of 1980, I met Master Chia and learned to practice the Microcosmic Orbit, Seminal Kung Fu, Tai Chi Chi Kung and now Iron Shirt. The approach taken in teaching Iron Shirt is extremely precise and has provided what was lacking in my previous experience of Chi Kung. Although my health had improved enormously in my earlier experiences, and I had a great deal of energy I had reached the point of feeling stuck and blocked. I hadn't made any progress in a year. I feel that the Iron Shirt teaching has been very helpful in getting me going again.

Roberta Prada, Opera Singer

As a classically trained singer, I find the Iron Shirt practices, in combination with the Microcosmic Orbit meditation and the Six Healing Sounds, to be of great benefit to my technique. Specifically, my goals for my singing include a free and easy vocal mechanism and an ability to feel grounded and centered while performing. Since beginning the Taoist practices, I have achieved the relaxation of my jaw, the lowering of my breathing, and the ability to search out areas of tension in my body, so that I can release them and allow the free flow of energy throughout my body. The more tissues resonate freely along the paths of vocal production, the more beautiful and

powerful the sound becomes, and the production of that sound becomes more precise and effortless. This is true for me. It would be difficult to attribute these results to Iron Shirt alone, since I continually study with a voice teacher as well, and perform regularly. However I am certain that the degree of body alignment, delicate coordination, physical and mental power and the ability to still myself, have enhanced my ability to achieve the goals I have set for myself in my art with greater naturalness, precision, clarity and beauty of sound. Ideally I would like to see courses in these arts form part of the studies offered in conservatories and professional schools as part of the body movement/breathing curriculum. Tai Chi is already taught in these settings in England. Once the exercises are learned, they can be used in free moments anywhere: on tour, in a dressing room, in small spaces, without equipment, and without a teacher. They are practical and of lasting value. I would heartily recommend the Microcosmic Orbit Meditation, Iron Shirt and Tai Chi to singers, actors, conductors, instrumentalists and dancers as a valuable adjunct to their studies.

B. Interview of Iron Shirt Practitioner Michael Winn, conducted by John Zielinsky, Instructor

John: Can you tell me when you first started Iron Shirt? Michael: I first studied Iron Shirt a little over two years ago. Before that, I was doing Kundalini Yoga which involves a lot of breathing and intense energy. I found Iron Shirt to be even more intense because the air was packed inside, held and circulated internally whereas with the other practices, I breathed in and out and slowly moved the energy around using various sounds. In the beginning I found that I had too much energy in my head for doing Iron Shirt, partly as a result of my other practices. When I started to do Iron Shirt, my face would get very red. As I got better at it, doing it every day, I started to get the energy more rooted, or grounded. I discovered that when a practice is done properly, you are mixing energy from the air with what is in the body, holding it inside where it is somewhat warm, and mixing this with the energy from the ground which is cool. It took me a while to really get the energy down out of my head, and relax before I could begin to practice and

feel like I was drawing in some full energy, mixing it and circulating it around. John: How long after practicing Iron Shirt I did you begin practicing Iron Shirt II and Iron Shirt III? Also, how long do you practice? How frequently every day during all that time, and how much do you now practice? Michael: I practice every day, almost without fail. I studied the Iron Shirt II a few months later and Iron Shirt III a year or so after that. I continued doing the Iron Shirt I, even when I did the Iron Shirt II or III. I did not continue with the Iron Shirt II practice because I found that the Iron Shirt I and the Iron Shirt III were sufficient. Iron Shirt III, of course, added another level to my practice. A lot of people do not practice Iron Shirt I long enough to get to the other levels. In fact, what I found out in going through the stages of Iron Shirt I is that it is related to all of the other meditation practices, but as your energy gets more refined and you start to pack the energy in your body more, you feel a different quality to the energy as it circulates around. When I really had it right, I could feel a kind of cool radiant heat emanating out of my body. It was not an electric energy. It was mixed with the Yin energy and properly refined. It left my body feeling that it was together really flowing, giving me a nice energy throughout the day. The other sensation started happening after a year and a half as I was beginning to take longer before doing Iron Shirt I, before packing, to stand and relax more down to the earth. This allowed me to take more cool energy in. I would begin spontaneously to do the full Microcosmic Orbit, down to the leg roots into the ground, bringing the energy back up the front of my legs to the perineum, back to the spine, around the top of my head and rooting to the ground again. As I looked back into the ground, I would then do the Microcosmic Orbit a full body length into the ground below me. In other words, I was pretending that I was buried underground and my head was right at the surface of the earth. I would circulate the energy through myself standing under the ground. I found a very rooted, cool energy and could visualize myself and my energy in the ground below. I pulled the energy back into my body before I even began to pack. I found myself already getting rooted, just with my mind. Also, at one point, spontaneously, I started seeing a variety of crystals at various points within my body, and in the body in the ground that I was circulating the energy through. This would add

another quality to Iron Shirt: refining energy. My practice then continued at a much higher level of energy. What I finally realized is that when you do the Iron Shirt and you are circulating the energy around in the Microcosmic Orbit, you are also pulling in the earth energy and circulating it around in your body before sending it back down. This is what rooting is about. John: The variation underground, was that yours or from Master Chia? Michael: Actually, I asked him about it and he said you could do that when you work from a very high level, and even visualize yourself five body lengths down. I started off visualizing myself all the way down to the center of the earth and pulling earth energy out from there. Then I asked him about it. He said try something closer in the beginning. I found that this position at the center of the earth also worked, but Master Chia warned me that the center of the earth is very molten and I might pull out some very hot energy. It has the same effect though. I have really begun to notice in whatever I do that there is Chi in my bones. When I am doing Tai Chi, I begin to feel my skeleton with a dense, glowing energy in it. This is what lets me know that the energy is not just in my body anymore, or just in my head. When you swing your arm, the feeling is that the flesh and the blood are really light and not quite there, but in the center you can feel steel, an energy that is packed in. I think you get the same sensation from Tai Chi or anything else, but doing the Iron Shirt III speeds the process up a hundred times faster. I think the main things to caution against are not to get too much hot energy into your head or into your heart. When you hold the energy in for a long time and circulate it around, it can strain your heart. The important thing, then, is to start gradually and bring your body up so that it can handle the energy until you can move it around comfortably. John: Do you relax after you exercise and walk? Michael: Yes. This is very important. Some days Iron Shirt I is so intense that I do not do anything else. The energy that I have pulled in and circulated through my body is enough for me to digest and work with. I do not do any other practice, not Tai Chi, not anything, because my body has been fed, even stuffed. In fact, I have to sit down and digest the meal. John: Have you noticed any specific health benefits related to the Iron Shirt practice?

Michael: Yes. In my other practice with Kundalini Yoga, the energy would be very high, but it would leak out of my body. I noticed in the winter that I would be cold. I was becoming very Yin. It was a very Yang practice, but it used up the energy in my body. I notice now with Iron Shirt that my body is much warmer in the winter. I can withstand the weather, the elements. I was already becoming very healthy as far as not getting very much illness or sickness from Kundalini Yoga, but I feel that this has further increased my abilities to fight off flus or colds, or any similar illness. At one time, four or five family members were visiting me and they all came down with the flu and were out for a week. I felt it try to come into my body for a day or so, and I felt very weak. I was able to push it out. I think that packing the Chi inside your body leaves no room for the bacteria, viruses, etc., once the Chi has been built up to a certain level. John: One other question about your practices: When you practiced Iron Shirt, did you have someone do the pushing to develop the rooting? Michael: I was living alone and often did not have anyone with me, which is unfortunate. Periodically I would go over to the center and get pushed again and found that I was breaking at the waist, for example, because I did not have my posture quite right. There are small corrections you really need to make. They probably slowed down my progress in getting it right. I was still studying the energy and still packing it in, but there is no benefit to doing so if you do not do it perfectly. So I would say that it is good to get pushed. John: Michael, I know you lead a busy life and you have a lot of mental activity; do you find that Iron Shirt III helps you to cope with stress from day to day life? Does it help you on a mental level as well as a physical? Michael: Yes. Sometimes when I am writing, I will work for fifteen or sixteen hours a day. When I feel that I have used up my Chi, my energy, and my brain is not functioning enough, I will do some Iron Shirt to get the energy going again. At times, I do not want to sleep, I want to keep going and keep pushing myself, but I do not think this is the right way to live. It is smarter to live simply. However sometimes you find yourself in the situation of a deadline and, yes, it definitely helps to relieve the stress. John: Do you have any general comments about your Iron Shirt? Michael: I have seen other kinds of Chi Kung, and they involve

movement and inhaling and exhaling with those movements, and I think those other Chi Kung are valid and powerful. However, I think that ultimately, this is a higher Chi Kung because it is more internal. In other words, it does not rely on continual breathing, or continued movement of any sort. You do breathe in in the beginning, but as you move along to higher levels of the Iron Shirt Chi Kung, you do not even have to bring in your breath, but can just draw in the energy with your mind, pack it and circulate it around. Movement with your mind emphasizes the internal aspects of the energy; it is also more integrating. That can be a problem in the beginning for a novice whose mind is not integrating with his Chi, and he cannot move his Chi around with his mind. He needs to use more breathing and more movement. I think that if a person sticks with it, it will come in time.

C. Personal Experiences of Students

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had never happened before. As the week progressed the “clicks” came on sooner and stayed longer. Then, suddenly, three days ago, I discovered that I had new hips and there was an incredible feeling of space throughout my lower abdomen. When I practiced Tai Chi I felt a definite connection between my feet and hips and scapulae. This was something I had heard about and could not enjoy first hand. Now I feel connected all over. I first learned about Chi Kung when I was a small boy, reading Kung Fu stories, and I continued to think that it was just story stuff until I came here and found that it is true. Along about April, after practicing Chi Kung for just a couple of months, I had to go to the hospital with a terrible pain at the back near the kidney. At the hospital I was given a morphine shot and I found that my experience with that shot was very similar to the experience I had forcing Chi into my head. So I tried using Iron Shirt to suppress the pain. I didn’t have any luck at first, but after a couple of days I was actually able to create the pain-suppressing effects of morphine. I have practiced Yoga, Judo and Tai Chi extensively. When I came across Master Chia’s book, I sensed that it was just what I’d wanted. I’d had terrible migraines for years. I’m all right now. Before that alt the energy had been stuck in my head. I could feel it there, and I could feel it come down when I completed the Orbit. In fact all I had to do to complete the Orbit was bring it down, because I’d actually spent years in my other practices bringing energy up to my head. Now, after three months of practicing Master Chia’s Taoist system, I have enormous energy. At first Iron Shirt seemed to be too different from the gentleness of the Tai Chi I’d learned. But I learned to recognize the need for the balance that it produces. I feel that I’ve been learning to use my body and I see how it is now very different. Soon I will be able to do these exercises on my own, anywhere I need to. I feel that I have much more energy now. I can hold my breath twice as long as when I first began to practice. I definitely feel more rooted. I feel energy racing through me. I could really feel energy coming up out of the ground doing the Iron Shirt exercises, and I know what it is to be rooted

Iron Shirt Chi Kung Experience

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now. Sometimes my legs shake when the energy comes up through them. There’s something else, too. My back seems more like one unit. I can inhale more air and I feel stronger all over. I’ve been practicing meditation for about ten years, primarily a type of Kundalini Yoga meditation practice. It did stress circulation of the energy, but it was only up and down the spine rather than using the front channel. I came across Master Chia’s book about six weeks ago and started to practice according to what I read there. I happened to go on a meditation retreat for a month where I was able to practice quite a bit and experience an opening of the Microcosmic Orbit, a deepening of my meditation and a release of blockages that I had been aware of for a number of years. My experience with the Chi Kung thus far has been of an increase in energy flow and a further unblocking of the leg channels. I’ve been studying meditation and martial arts for about nine years and I’ve always had a complete separation between the two: one being physical and one being spiritual. When I came here, the two were linked together. I’d read about it but had never experienced it, that is, until now. When I lived in San Francisco I thought I had Chi Kung down pat by doing tension exercises, but now as I practice Iron Shirt, I realize that I was going down the wrong road. I was trying to use the mind and to strengthen the muscles, instead of working from the inside structure out. For the past 25 years or so I’ve been involved in martial arts: Karate, Kung Fu and Tai Chi. Through these practices I had experienced various energy centers. I had not been aware of a circuit that had to be completed until I saw it depicted on the cover of Master Chia’s book, Awaken Healing Energy Through the Tao. I was especially drawn to it because I saw that along that route were some of the centers I had already experienced. When I read the book, I discovered that it answered questions for me that I’d not yet been able to put into words. I began to realize that I must learn to turn my senses inward and to reflect. I recognized that introspection is something we are not ordinarily taught. As I read, I came to believe that this might

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be what I had been looking for: a method to follow that would allow me to know more about myself. I approached the Microcosmic Orbit and Iron Shirt because I was searching for something to cure a serious problem that was unsuccessfully treated previously. I had a four-bysix centimeter duodenal penetrating ulcer. (It’s been documented.) And for those who don’t know about such things, that’s a big ulcer. I also had two crushed discs commonly called kissing vertebrae, from two separate accidents. In addition, I had a genetic curvature of the upper portion of my spine for which I’d had chiropractic adjustments over a period of two years. When I came to inquire about your courses, my digestive system had wound down to a standstill, I had lost about thirty pounds, and my gastroenterologist had told me that I must undergo surgery. In less than four months of practicing Iron Shirt, I actually have scar tissue where the ulcer had existed. I no longer have to take medication, and now I have no back pain, after having experienced it constantly for three years prior to starting this practice. During this period I did nothing but what I’ve learned here: Iron Shirt each morning, and the Microcosmic Orbit during the day. I have gained twenty-five pounds, and I really do feel that Iron Shirt supplied the real healing power. I was introduced to Master Chia through a friend who said that he knew that Master Chia could help me get rid of bad headaches. I had seen Chinese, French and American doctors and none of them could do anything to help me with a problem that had made me miserable for almost fifteen years. After three days with Master Chia, I completed the Orbit and gradually I found my headaches were subsiding. I studied some Tai Kwan Do and I’m presently studying Praying Mantis Kung Fu. I became interested in the internal Kung Fu through a friend of mine. As soon as he told me about it, I was interested. I went to learn Tai Chi at the time and learned very fierce breathing exercises. It did seem to get energy going but after practicing it I didn’t feel as energetic as I do here. The surprising thing about Master Chia’s system is that it’s so simple to do, and yet, it’s so

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effective in doing what it’s supposed to do. I feel it inside my navel as opposed to feeling it in my stomach or my elbow or different parts of my body. I also find that it helps my martial art practice. I have been practicing some martial arts from time to time, especially Hsing Yi, and have sought out internal practices. Your system is by far the best that I have found and I want lo thank you for it. In fact, it intergrates Kundalini Yoga and some Western practices, integrating the uses of the centers and the meridians. It is excellent and I want to continue with it. I’ve practiced martial arts, meditation and a number of spiritual disciplines for around eight or nine years and, last spring, I took Master Chia’s Microcosmic Orbit workshop. I had the personal experience of feeling the Chi travel through the basic meridians and a number of acupuncture points. I was surprised because before, they were just points in books to me. I thought maybe you could influence that energy with needles, but I never believed you could feel it. I look forward to practicing more and more Iron Shirt and deepening the sensation of the energy and the experience. Before coming here I had experienced energy in my body but I didn’t know what to do with it; it seemed very scattered. Through the structure that Master Chia offers, I now have a means of control that I never had before. My background is in martial arts and in meditation for about the past five years. Iron Shirt is something I’ve never seen offered anywhere else, and I feel it’s invaluable to anyone who is doing any martial arts, especially a dynamic type, which can easily throw your body out of alignment or else lead to damaged organs. It’s become apparent that if I know how to use this type of energy that I get in Iron Shirt, I feel my risks of sustaining damages are greatly lessened. I still have a long way to go to develop any rooting power, but I do feel stronger especially in my back. You brought up something a little while ago about people having more difficulty in dealing with pleasure than with pain. Well, I’d been meditating twice a day during my vacation and got so high that I just couldn’t stand it. My whole body was like golden light. I had to back away from the practice.

Chapter VII

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I just wasn’t ready for it. This stuff is really authentic. I am very convinced. There’s another thing I’d like to say about this practice. I am an acupuncturist and have no trouble getting patients these days. I never even have to think about soliciting clients. They just show up. My work is more effective, efficient and clear. I find myself growing, now that I have discovered this teaching, and I’ve discovered my body, I’ve already helped my body immensely. I want to learn everything that I can that relates to these methods, now. The effects are too convincing. It’s like coming across the answers to everything. I came from another system that I felt was very good, in fact, perfect. So I really wasn’t looking for anything else, except that I was curious to know about this other system.I found theUniversal Tao exciting and very different. As I went into it and felt so much energy running around in my channels, I began to miss some of those simpler powerful ethics of my earlier meditations. It took me a while of practicing the Taoist meditations on a daily basis to understand that in the Taoist approach, I was making use of sources of energy that I had, in my earlier system, not tapped. While previously I had been achieving one sort of intensity of energy I find that through Tai Chi and Iron Shirt, I can hold that energy in my body rather that just having a temporary experience that might come on from a lot of chanting or breathing exercises.

Sealing of the Five Senses

Opening the Crystal Room

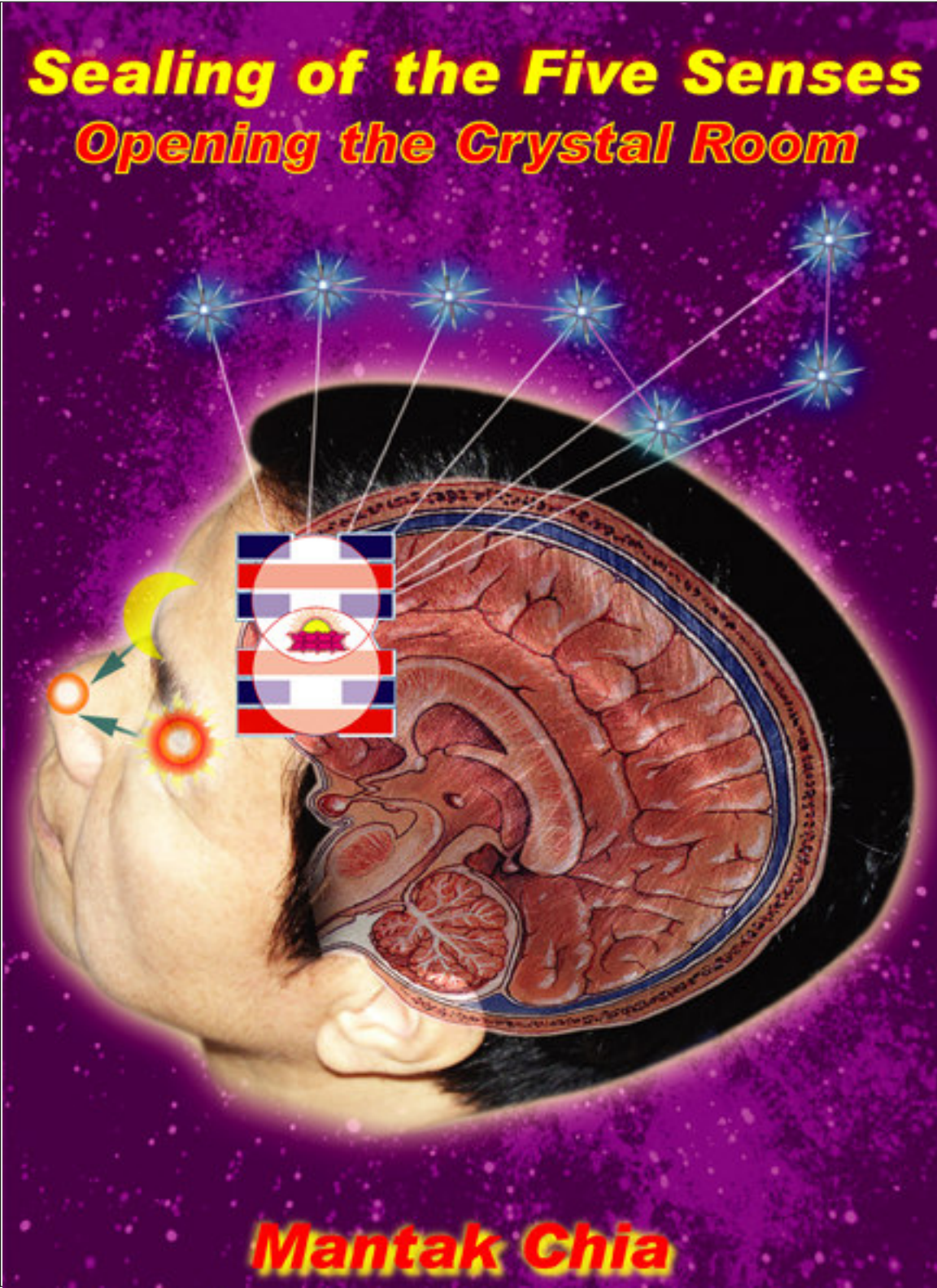

Mantak Chia

Sealing of the Five Senses

Opening the Crystal Room

Mantak Chia

Edited by:

Saumya Comer

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Sealing of the Five Senses

Our senses are like antennas which receive waves of vibration, sound and light that come to us. If that wave makes sense, our brains will start to think. Thinking consumes more energy than any other bodily activity. As humans we can not stop thinking, looking and listing nor stop fantasizing. This sensory-linked brain function in reaction to the external world is known as the monkey mind.

Our mind connects with the heart. When the mind is disturbed, the heart too will become disturbed. The good-minded good heart is the compassionate heart (harmony), therefore its good intention connects to the earth and nourishes it. When the wood meets the earth, the wood will grow. When the water meets the earth, the water will gather. When the metal meets the earth, the metal will condense. When the fire meets the earth, the fire will tone down.

If we can make the senses stronger, and seal the senses with external and internal force, we can accumulate profound energy.

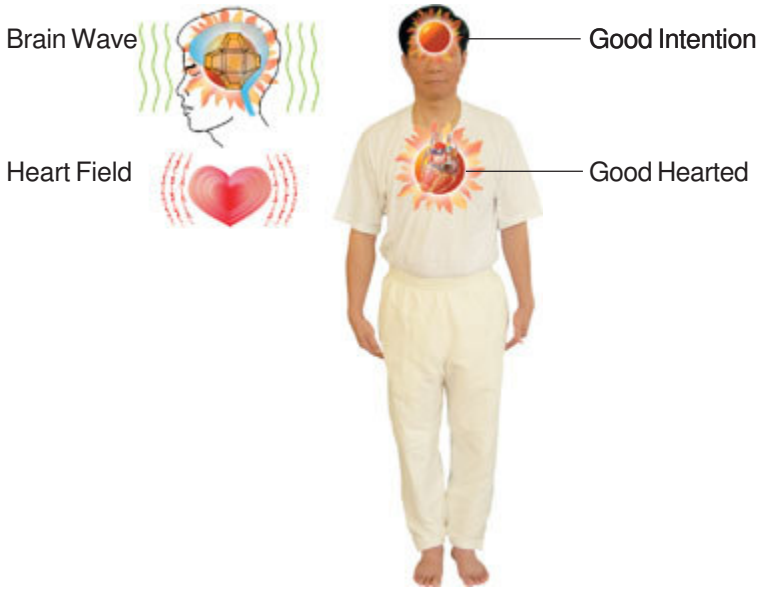

Fig. 1 *Waves of Vibration Coming into Senses*

1. First, we will strengthen the senses.
2. Second, we will make the connection.
3. Third, we will seal the senses.

The formula of Sealing the Five Senses effects a literal transmutation of the warm current or Chi into spiritual energy or energy of the soul. To do this, we must seal the five senses, for each one is an open gate of energy loss. The power flows out from each of the sense organs unless there is an esoteric sealing of these doors of energy. They must release energy only when specifically called upon to convey information.

Abuse of the senses leads to far more energy loss and degradation than people ordinarily realize. Examples of misuse of the senses are as follows: if you look too much, the seminal fluid is harmed; listen too much the mind is harmed; cry too much, and the blood is harmed; have sexual intercourse too much, and the marrow is harmed.

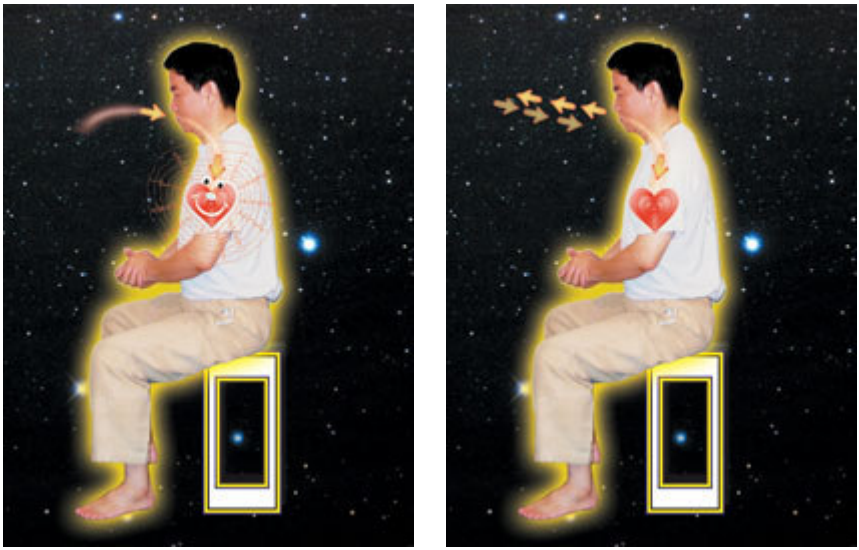

Fig. 2 *Sense Energy Turning inward. Content Person sitting in Meditation. Vibration turned Inward.*

A. First Formula Strengthening the Senses

The first step of strengthening our senses is very important. When the senses are strengthened we will be less affected by the stimuli coming from the outside world as criticism or praise. This strength leads to a connection with our center, where the mind becomes still, and the thoughts rest. A great deal of energy is spent thinking warring. Sealing the senses conserves this energy to be used for spiritual development.

Turning the senses inwardly to the center of the brain and down to the navel, and use the three cauldron coupling to help the suck in the natural and universal force.

1. The left ear corresponds to the metal element force.
2. The right ear corresponds to the wood element force.
3. The chin and the mouth correspond to the water element.
4. The nose corresponds to the earth star; this will tonify the earth.
5. The left eye corresponds to the sun.
6. The right eye corresponds to the moon.
   (Raise the water and lower the fire, and let it couple on the tip of nose.

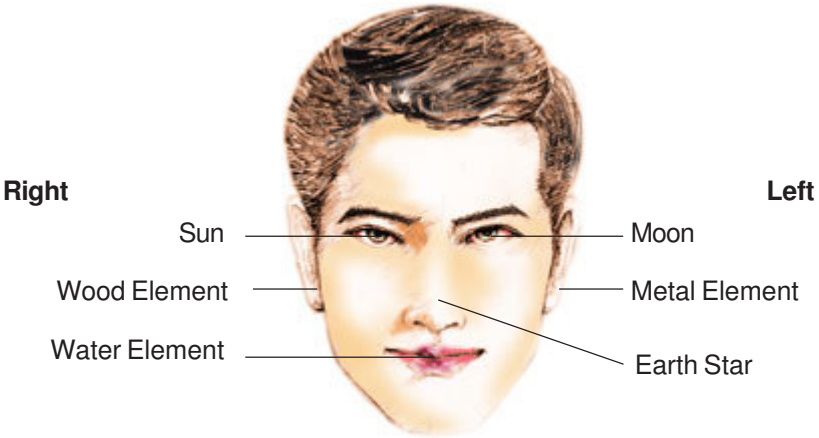

Fig. 3 *Elements Connected to Senses*

Practice Formula One

a. Be aware of the left ear and the metal force.
b. Be aware of the right ear and the wood force.
c. Draw these two forces together into the crystal room, combine them into the fire force.

Fig. 4 *Metal and Wood Transforming to Fire Crystal Room*

d. Be aware of the mouth and breath into the throat center and the lower abdominal suction and the tiger and the dragon breath to create the suction, and feel the Chi entering the mouth and gathering the water force into the Chi Ball.
e. Create the collection points to contain the water in the mouth.

Fig. 5 *Coupling of Five and Water*

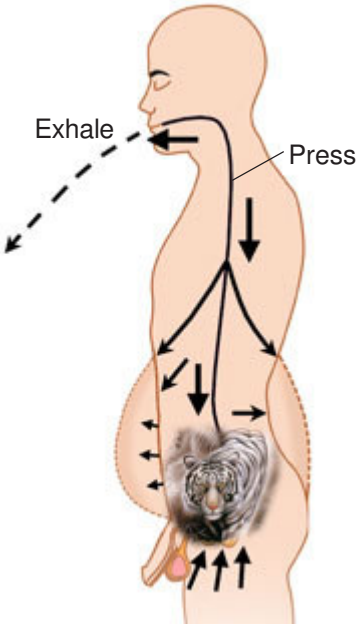

Fig. 6 *Dragon and Tiger breath. Exhale and compress the Chi down to lower abdomen.*

f. Let the water rise up, and lower the fire down and couple at the tip of the nose. Turn the awareness inward and feel the three-cauldron coupling at the same time.

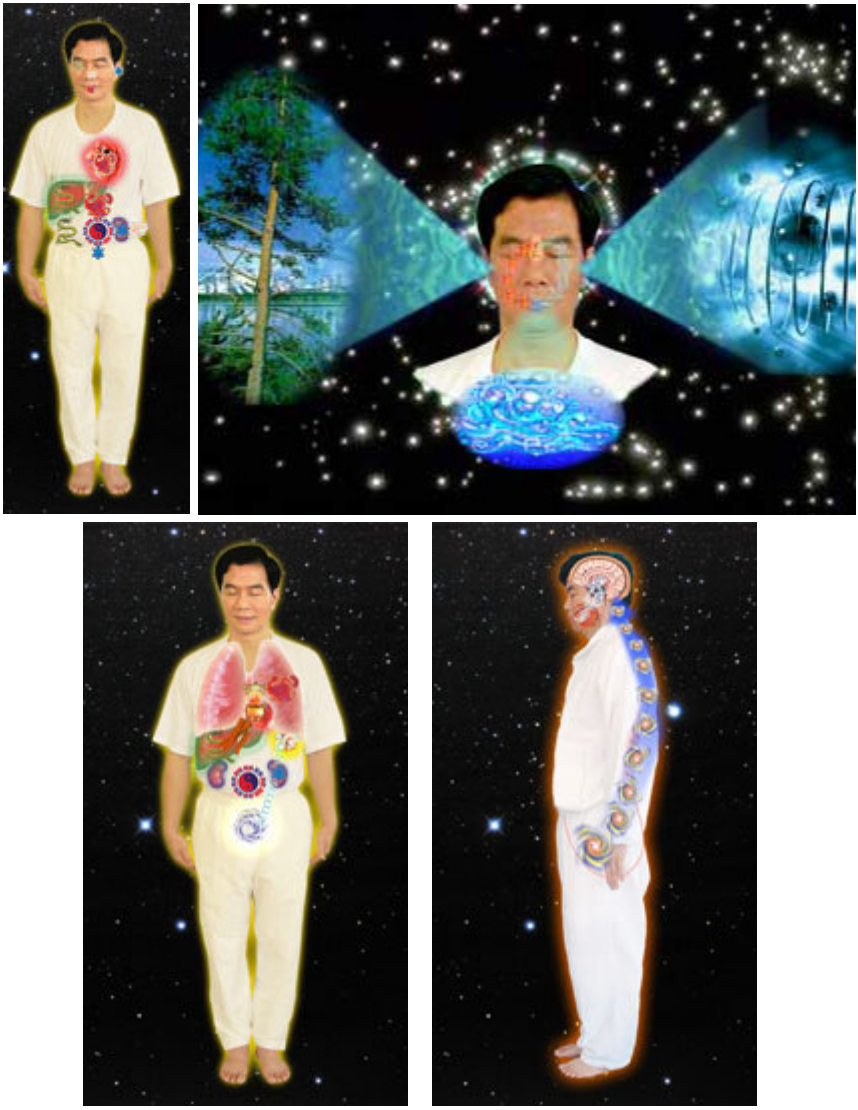

Fig. 7 *Coupling of Five and Water*

g. Let it steam to the crystal room. The lower cauldron steams to the organs and the glands.

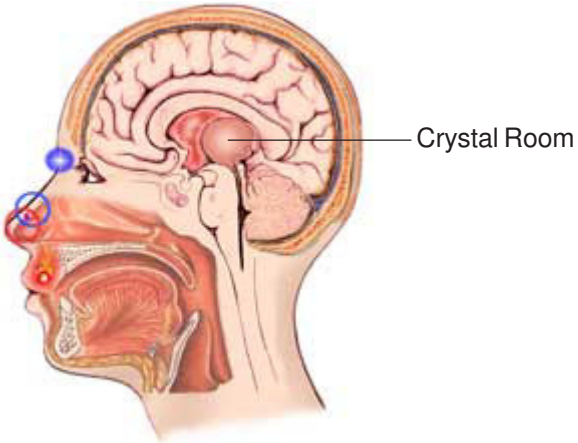

Fig. 8 *Steam to the Crystal Room*

h. Feel the four cauldrons couple at the same time, the normal breath stop and the true breath begin. Let the skin start to breath first, and the bones in the arms and the legs.

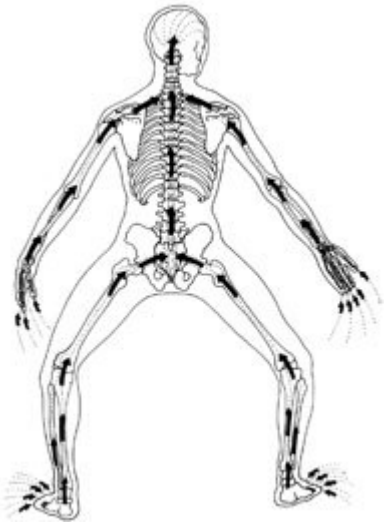

Fig. 9 *Skin, Bones Breathing*

i. Suck in the crown and expand to the nature and the universe. Suck in the mideyebrow, the third eye, the palms the soles of the feet, the perineum, the sacrum and the Door of Life. Eventually the whole body is breathing.

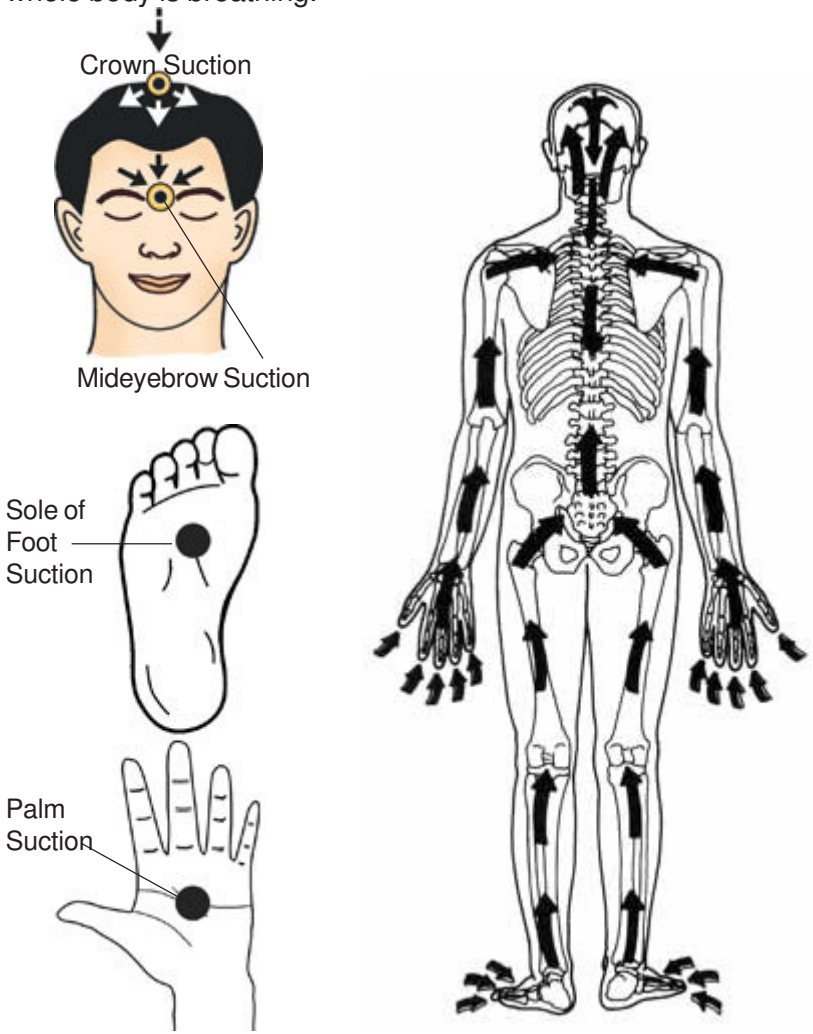

Fig. 10 *Whole Body Breathing*

B. Practice Formula Two

a. Be aware of the left eye as sun power.
b. Be aware of the right eye as moon power.
c. Combine these two forces into the bridge of the nose and let them become fire force.

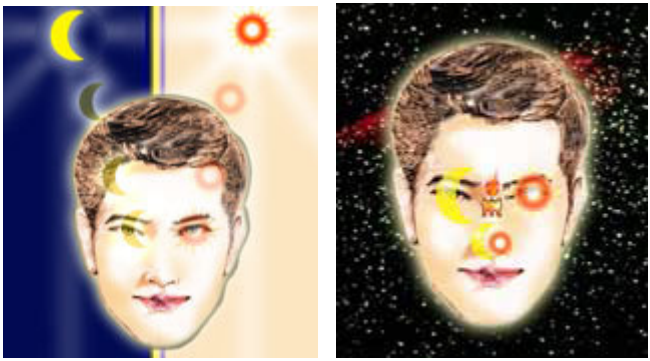

Fig. 11 *Combine to Nose*

d. Be aware of the Chi in the mouth, use the throat center and the lower abdominal and the Tiger and Dragon breath to create the suction to breathe in the external Chi to form a chi ball in the mouth.

e. Raise the water and lower the fire and let them couple at the tip of the nose.

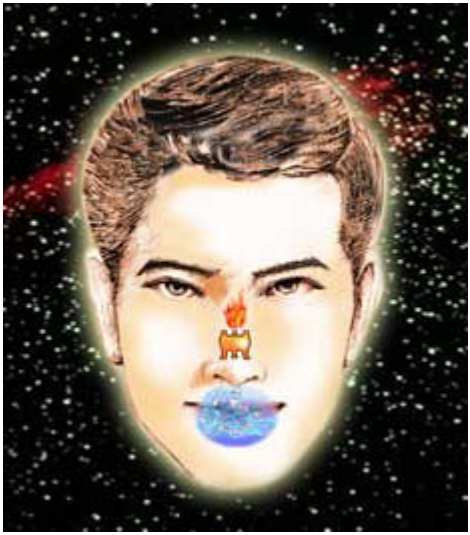

Fig. 12 *External Chi*

f. Feel the four cauldrons couple at the same time, the normal breath stop and the true breath begin. Let the skin start to breath first and the bones in the arms and the legs.

Fig. 13 *Skin and Bones start to breathe.*

g. Suck in the crown and expand to the nature and the universe. Suck in the mideyebrow, the third eye, the palms the soles of the feet, the perineum, the sacrum and the Door of Life. Eventually the whole body is breathing.

Fig. 14 *Eventually the whole body is breathing.*

C. Practice Formula Three: Sealing of the Five Senses

a. The left ear connects to the left kidney, known as the true kidney, the activator of the stored energy of the kidneys.

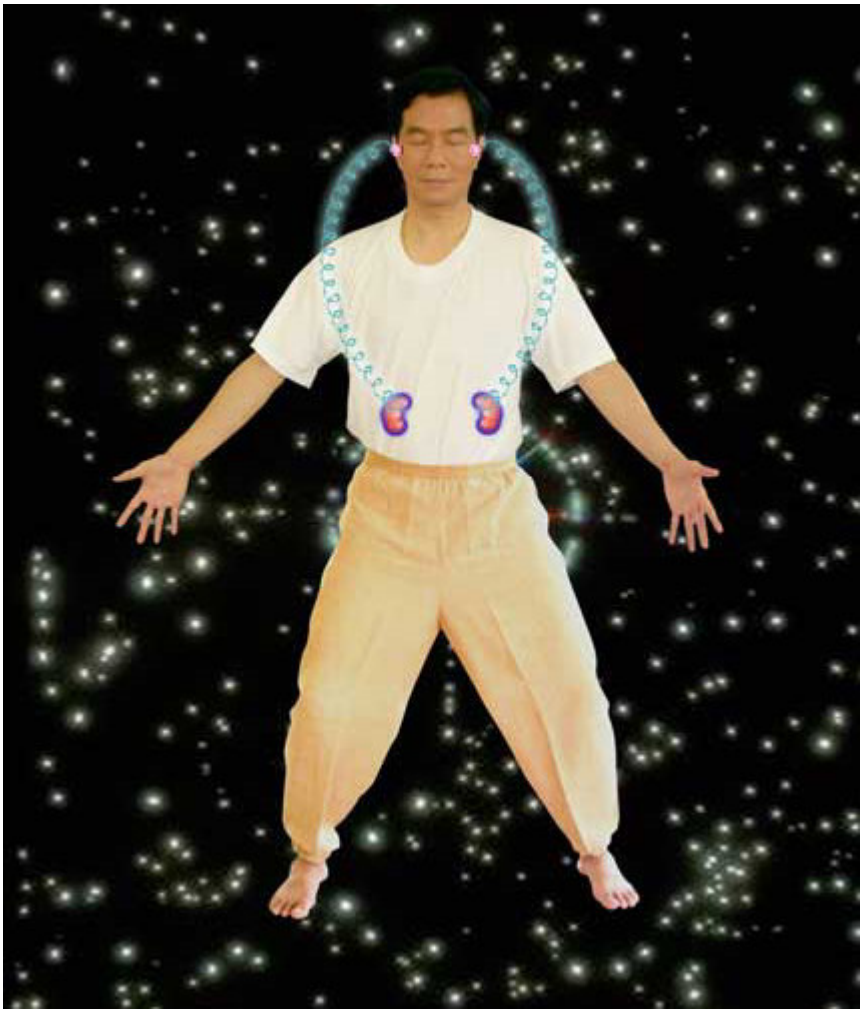

Fig. 15 *Stored Energy of the Kidneys*

b. The right car connects to the right kidney, which is yin, and is represented by a Weaving Maiden who stores the essence of the sexual energy (sperm and ovum), as well as the inner yang that attracts the active yang known as the Gate of Life.

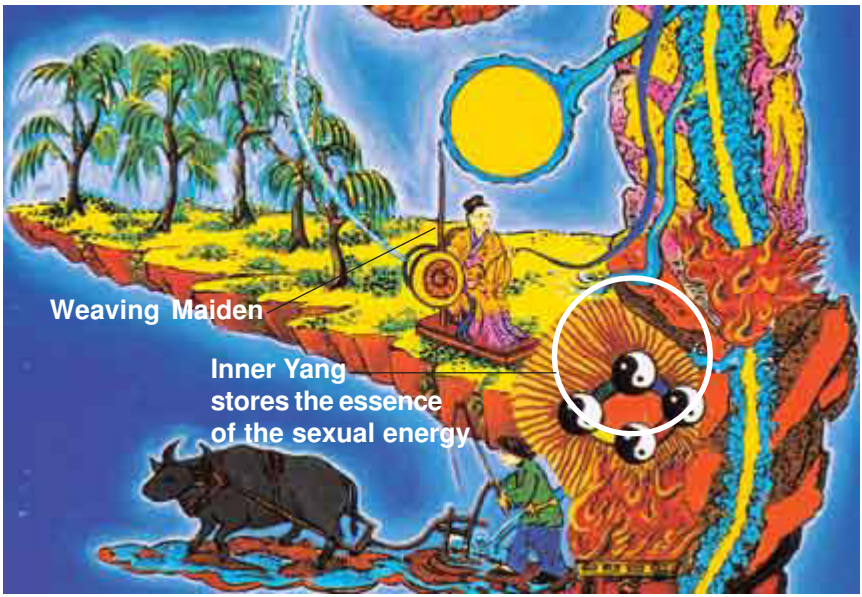

Fig. 16 *Weaving Maiden who stores the essence of the sexual energy.*

c. Be aware of the left kidney as fire force and let it gradually rise up to the left ear, creating a collection point to contain the fire force.

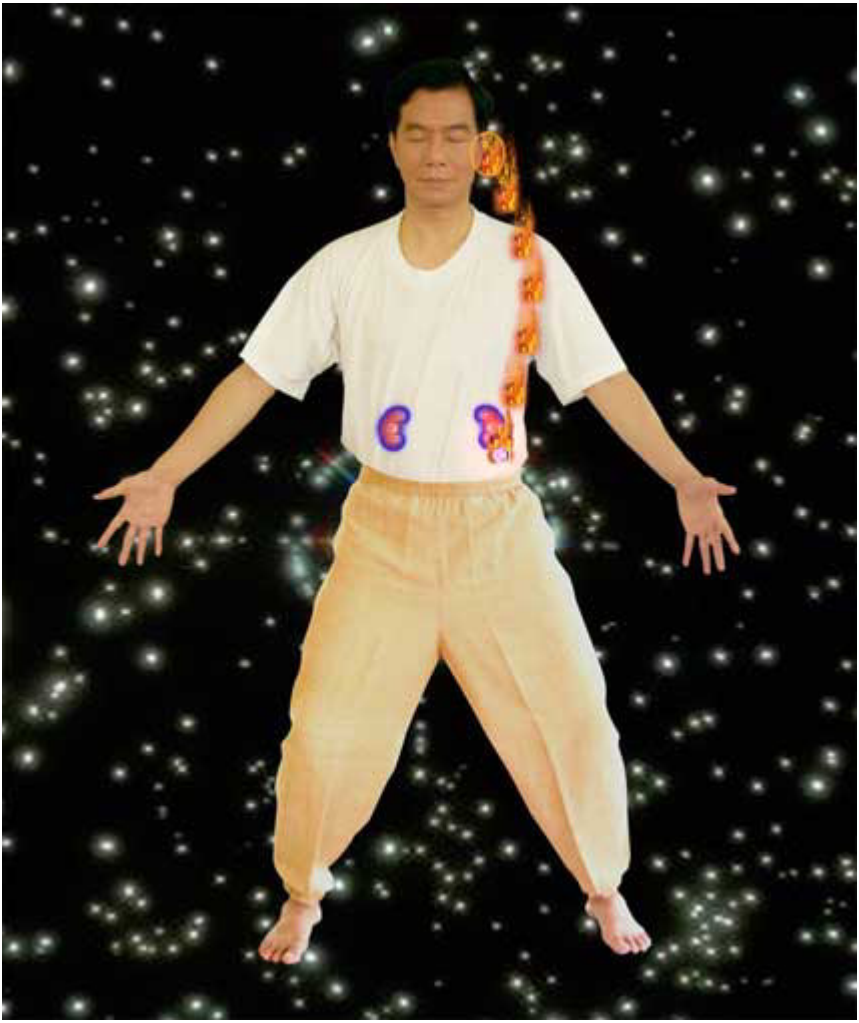

Fig. 17 *Left ear creating a collection point to contain the fire force.*

d. Be aware of the lower cauldron. Feel the fire start to warm the abdomen. The fire and steam power goes down to the sexual organs to transform the sexual energy into Chi or arousal sexual energy. Let this energy rise to the right kidney to activate the stored essence of sexual energy, the inner yin. Feel the connection of the right kidney to the right ear and let the essence yin energy rise up the ear. Create a collection point to contain the energy.

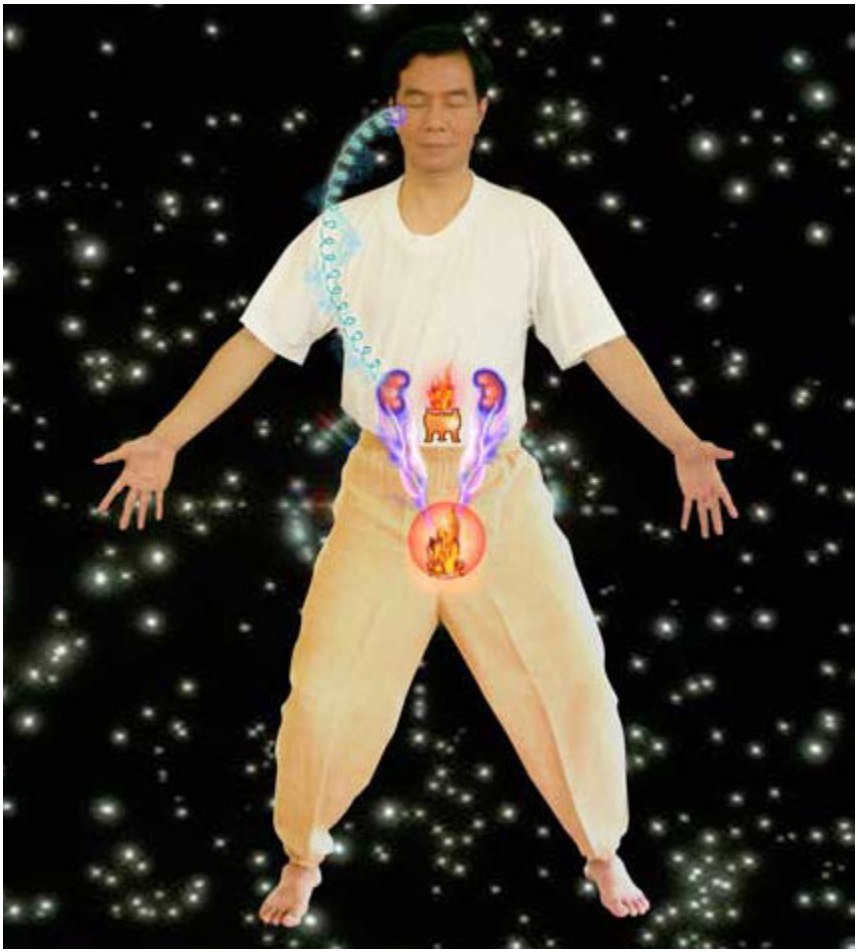

Fig. 18 *Create a collection point to contain the energy.*

e. Let the left and right ear, fire and water couple in the crystal room (middle of the ear).

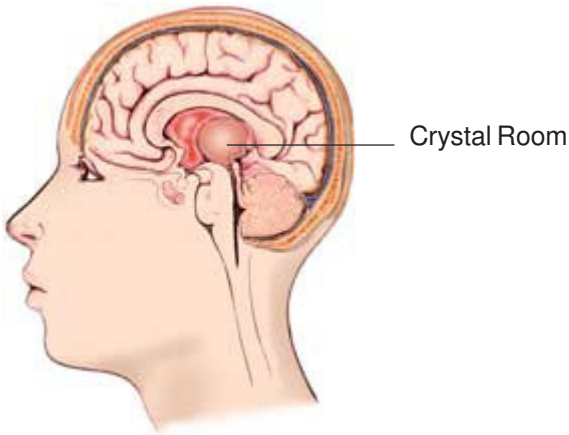

Fig. 19 *Fire and water couple in the crystal room*

f. Be aware of the mouth and gather the water force into a Chi Ball.

g. Let the water and fire couple at the nose, the earth.

Fig. 20 *Connecting to Earth*

D. Practice Formula Four: Sealing of the Five Senses

1. Clean out the Thrusting Channels. Be aware of the sole of the feet and feet, the universe force and earth force, rising up to the left side of the sexual organ and up the left thrusting channel and up to the left side of the crown.
2. Activate the Sexual Energy in the Lower Tan Tien.

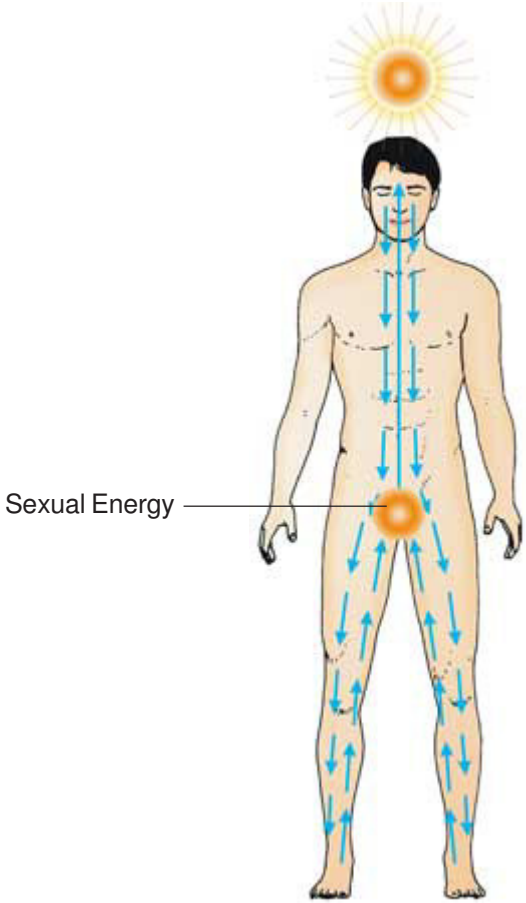

Fig. 21 *Activate Sexual Energy*

3. Turn the Wheel.
   a. Up the spine to the T-11 and then down to the Lower Tan Tien.
   b. Up the spine to the C-7 and then down to the solar plexus.
   c. Up the spine to the brain and then down to the heart.

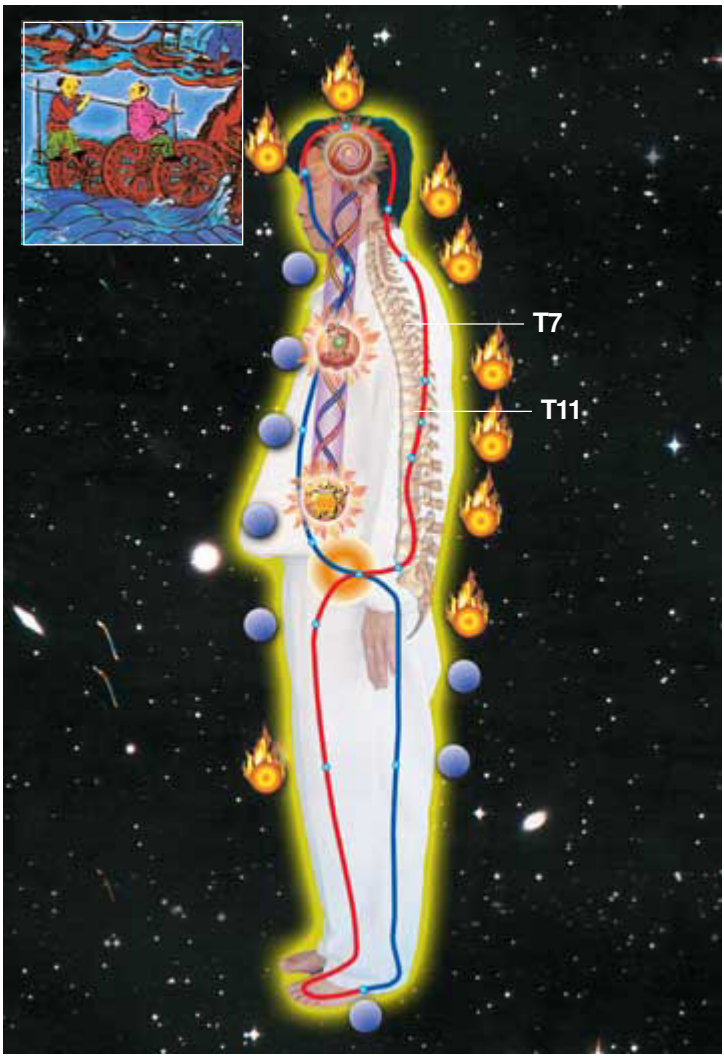

Fig. 22 *Turn the Wheel*

4. Build the Aura
   a. Breathe red mist into the heart.
      1. Breathe out any gray color.
      2. From the heart, send out the red mist to create an aura around the body.

Fig. 23 *Breathe into the heart.*

b. Breathe yellow mist into the spleen.

1. Breathe out any gray color.
2. From the spleen, send the yellow mist to all over the body and send radiance out around the body.
3. From the mouth, breathe out the yellow mist to create an aura.

Fig. 24 *Breathe into the Spleen.*

c. Breathe white mist into the lungs.

1. Breathe out any gray color.
2. From the lungs, send the mist to the nose and out the nose and the skin.
3. From the nose, breathe out the white mist to create an aura.

Fig. 25 *Breathe into the Lungs.*

d. Breathe blue mist into the kidneys.

1. Breathe out any gray color.
2. From the kidneys, send the mist to the ears and send radiance out for whole body radiance.
3. From the ears, breathe out the blue mist to create an aura.

Fig. 26 *Breathe into the Kidneys.*

e. Breathe green mist into the liver.

1. Breathe out any gray color.
2. From the liver, send the mist to the eyes.
3. From the eyes, breathe the green mist out to create an aura.

Fig. 27 *Breathe into the Liver.*

Fig. 28 *Finish building the Aura.*

4. Bring the sun down to the left eye to be the fire.
5. Bring the moon down to the right eye to be the water.

Right

Left

Fig. 29 *Sun and Moon down to the Eyes*

6. Bring the fire from the left eye to the bridge of the nose.
7. Bring the water from the right eye to the mideyebrow.

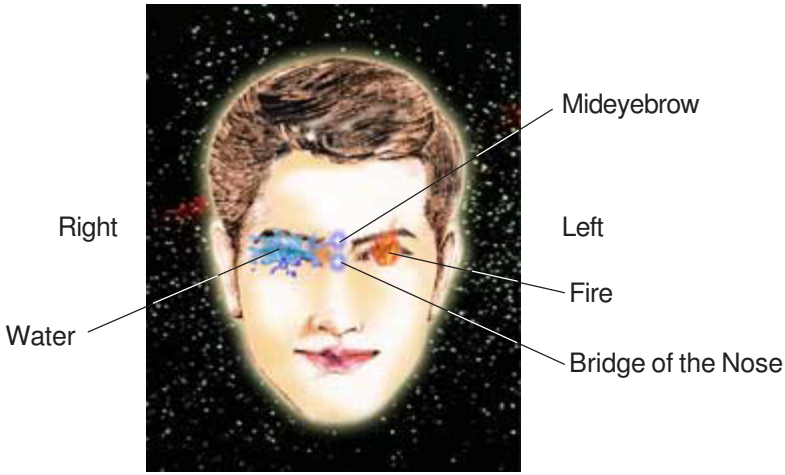

Fig. 30 *Sun and Moon down to the Eyes*

8. Start the coupling (this differs from practice formula#2 where we just combined the sun and moon to create one fire energy, now we couple two different energies).
9. The steam will come out the third eye.

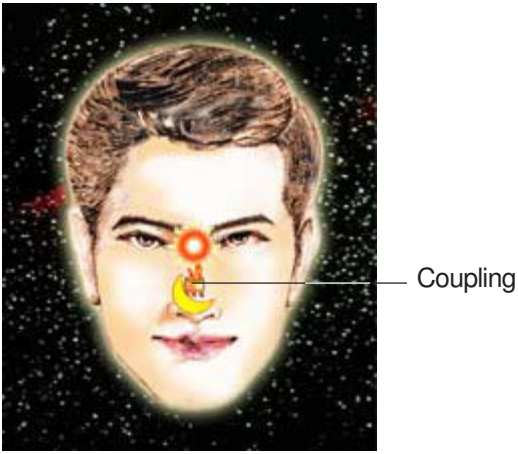

Fig. 31 *Combine the Sun and Moon*

10. Gather the sexual Energy from the sexual organs and bring it to the collection point in the mouth.

Fig. 32 *Gather the Sexual Energy.*

11. The steam produced from the sun and moon coupling will now become the fire for the coupling at the tip of the nose. Bring the fire energy down to the upper lip.

Fig. 33 *Energy down to Upper Lip.*

12. Bring the water energy from the mouth up to the bridge of the nose.

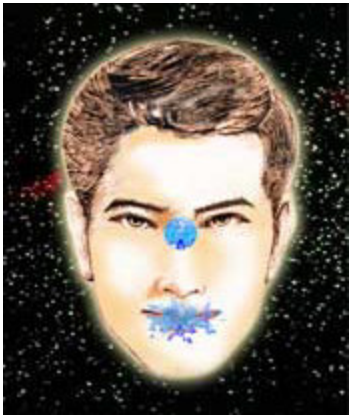

Fig. 34 *Energy up to the bridge of the nose*

13. Start the Coupling at the tip of the nose.

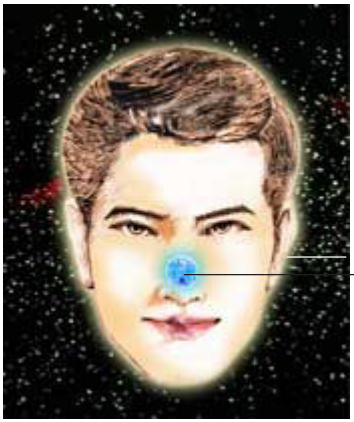

Fig. 35 *Coupling Tip of the Nose*

14. This coupling does not produce steam, yet you will clearly feel the suction.
15. Let the fire cool.
16. Bring the energy down to the Lower Tan Tien.

E. Practice Formula Five: Sealing of the Five Senses

The harmonizing of the four forces (stopping the draining of the essence)

1. When the eyes (green dragon, east, wood) are not seeing, the eternal soul will stay in the liver. Turn the eye power inward.

2. When the ears (Tortoise, north, water) are not hearing, the sexual essence stay in the kidneys. Turn the ears inward.

3. When the tongue (red pheasant, south, fire) is not speaking the spirit stays in the heart.

4. When the nose (white tiger, west, metal) is not smelling, the corporal soul (pui) stays in the lungs. Holding the tongue power inward regulates the breath.

5. When all four are not moving, these four essences will harmonise at the earth and will be nourished, strengthened, and sealed.

Fig. 36 *Five Sealing of the Five Senses*

When all the four essences are not draining out, sexual essence - water, spirit - fire, eternal soul - wood, and the corporal soul (pui) - metal all will gather at the earth, at the tip of the nose.

When there is no desire in the heart - fire is not activated, the green dragon in the liver will sound, the red pheasant will close its wings, and the sexual essence stays and gathers. Wood burns to become fire, and thus gives birth to the heart energy. The white tiger (Lung) gives energy to the water (kidney) which is the life essence (body). If we do not drain out the life essence (take care of our body) the white tiger will sound, the wind will start to move. The tortoise will stay dormant, the sexual essence will be conserved and stay in. When the sexual essence and the Chi stays in us, the metal, wood, water, fire forces will harmonize together and not leak to the earth. So the sexual essence, spirit, eternal soul will gather in the good intention.

1. Clean out the Thrusting Channels.
2. Activate the Sexual Energy in the Lower Tan Tien.
3. Turn the Wheel.
    a. Up the spine to the T-11 and then down to the Lower Tan Tien.
    b. Up the spine to the C-7 and then down to the solar plexus.
    c. Up the spine to the brain and then down to the heart.
4. Build the Aura
    a. Breathe red mist into the heart.
        1. Breathe out any gray color.
        2. From the heart send out the red mist to create an aura around the body.
    b. Breathe yellow mist into the spleen.
        1. Breathe out any gray color.
        2. From the spleen, send the yellow mist to the nose.
        3. From the nose, breathe out the yellow mist to create an aura.
    c. Breathe white mist into the lungs.
        1. Breathe out any gray color.
        2. From the lungs, send the mist to the nose.
        3. From the nose, breathe out the white mist to create an aura.

d. Breathe blue mist into the kidneys.
   1. Breathe out any gray color.
   2. From the kidneys, send the mist to the ears.
   3. From the ears, breathe out the blue mist to create an aura.

e. Breathe green mist into the liver.
   1. Breathe out any gray color.
   2. From the liver, send the mist to the eyes.
   3. From the eyes breathe the green mist out to create an aura.

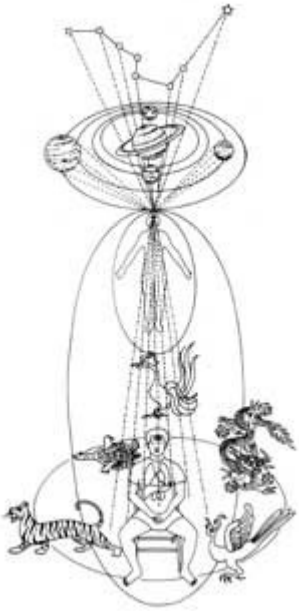

Fig. 37 *The Pill Connecting to the Dipper*

   4. Send out the pill to connect with the Big Dipper.
   5. Bring the Big Dipper down and connect it to the left and right temples, left and right mastoid, the chin, the base of the skull, and the crown.
   6. Bring the North Star into the crystal room.
   7. See the Big Dipper full of violet light; that light is now pouring into your crown.

8. Draw the Sun down to the left eye to collect the fire energy.
9. Draw the Moon down to the right eye to collect the water energy.
10. Bring the fire to the bridge of the nose.
11. Bring the water to the mideyebrow.
12. Draw the fire and water together and begin the coupling and simmer slowly and send the steam up to the third eye.
13. Draw the fire energy up from the left kidney to the left ear collection point.
14. Draw the Sexual Energy up from the sexual organs and the right kidney to the right ear collection point.

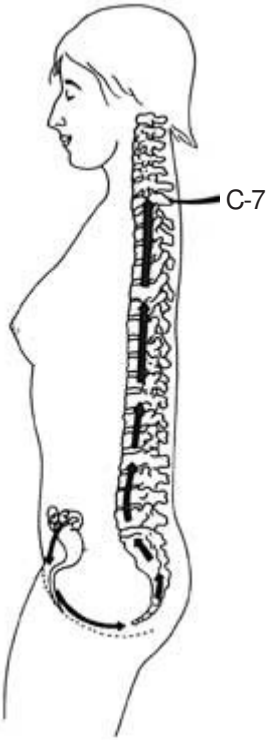

Fig. 38 *Sexual Energy Rising Up*

15. Draw the fire and water into the crystal room and begin the coupling. The steam produced here will become the fire for the next coupling.
16. Bring the Sexual Energy up to the Pineal Gland and allow it to drip down to the mouth. Mix it with the Saliva and fill the mouth with the sexual energy.
17. Draw the Fire Energy down from the Crystal Room to the upper lip.
18. Draw the Water Energy up from the mouth to the bridge of the nose.
19. Couple at the tip of the nose.
20. Be aware of the ears. Feel the blue energy turning into the tortoise in each ear to seal and protect the ears.
21. Be aware of the nose. Feel the white energy turning into the white tiger in the nose to seal and protect the nose.
22. Be aware of the eyes. Feel the green energy turning into the green dragon in the eyes to seal and protect the eyes.
23. Be aware of the tongue. Feel the red energy turning into the red pheasant at the tongue and in the mouth to seal and protect them.
24. Draw the green, wood energy of the eyes down to the tongue (fire) and combine the two to create one fire energy. Send the fire to the crystal room.
25. Draw the white, metal energy from the nose over to the ears (water) and combine the two to create one water energy. Send the water to the crystal room.
26. Start the coupling in the crystal room.
27. Slowly simmer for a long time.
28. Empty your mind into the Lower Tan Tien anytime thoughts arise. Feel the stillness of your senses. Feel how they are sealed.
29. Slowly let the fire cool down.
30. Gather the energy in the Lower Tan Tien.

F. Practice Formula Six: Sealing of the Five Senses

1. Clean out the Thrusting Channels.
2. Activate the Sexual Energy in the Lower Tan Tien.
3. Turn the Wheel.
   a. Up the spine to the T-11 and then down to the Lower Tan Tien.
   b. Up the spine to the C-7 and then down to the solar plexus.
   c. Up the spine to the brain and then down to the heart.
4. Build the Aura
   a. Breathe red mist into the heart.
      1. Breathe out any gray color.
      2. From the heart send out the red mist to create an aura around the body.
   b. Breathe yellow mist into the spleen.
      1. Breathe out any gray color.
      2. From the spleen, send the yellow mist to the nose.
      3. From the nose, breathe out the yellow mist to create an aura.
   c. Breathe white mist into the lungs.
      1. Breathe out any gray color.
      2. From the lungs, send the mist to the nose.
      3. From the nose, breathe out the white mist to create an aura.
   d. Breathe blue mist into the kidneys.
      1. Breathe out any gray color.
      2. From the kidneys, send the mist to the ears.
      3. From the ears, breathe out the blue mist to create an aura.
   e. Breathe green mist into the liver.
      1. Breathe out any gray color.
      2. From the liver, send the mist to the eyes.
      3. From the eyes, breathe the mist out to create an aura.
      5. Send out a pill to connect with the Big Dipper.

6. Connect the Big Dipper to the various points on the head (L&R mastoid, L&R temples, chin, base of skull, and crown), bring the North Star to the crystal room.
7. See the Big Dipper pouring violet light down into your crown.
8. Wash the whole body and especially the marrow with the violet light.
9. Bring the left kidney up to the left ear and make a collection point in the ear for the fire energy.
10. Bring sexual energy from the sexual organs and up from the right kidney to the right ear. Make a collection point in the right ear for the water energy.
11. Bring and fire and water energies into the crystal room.
12. Start the coupling in the crystal room.
13. Bring the Sun down to the left eye to collect the fire energy.
14. Bring the Moon down to the right eye to collect the water energy.
15. Bring the fire energy from the left eye to the bridge of the nose.
16. Bring the water energy from the right eye to the mideyebrow.
17. Bring the fire and the water together and start the coupling.
18. Draw the sexual energy up to the collection point in the mouth.
19. The steam from the crystal room coupling will now be used as the fire energy for the coupling at the tip of the nose. Bring the fire energy down to the upper lip.
20. Bring the water energy from the mouth to the bridge of the nose.
21. Bring the water and fire together at the tip of the nose and start the coupling.
22. Be aware of all three couplings simultaneously, the steam at the crystal room will form a pearl and open the third eye.

23. Send the liver energy out to draw in the green planet, Jupiter.
24. Bring Jupiter in to seal and protect the eyes.
25. Send the heart energy out to draw in the red planet, Mars.
26. Bring Mars in to seal and protect the tongue (mouth).
27. Bring the eyes down to the mouth and combine the eyes and tongue to create one fire energy.
28. Draw the fire energy up to the crystal room.
29. Send out the kidneys to draw in the planet Mercury.
30. Bring Mercury in to seal and protect the ears.
31. Send out the lungs to draw in the planet Venus.
32. Bring Venus in to seal and protect the nose.
33. Bring the ears to the nose and combine them to form one water energy.
34. Draw the water energy up to the crystal room.
35. Start the coupling of the fire and water at the crystal room.
36. Let go of all thoughts, send them down to the Lower Tan Tien.

Fig. 39 *The Planets connect to the Organs.*

37. Feel the stillness of all the essences as they are not being used to spend energy. Feel their energy staying with you. (eternal soul, spirit, corporal soul and the sexual essence)
38. Set the fire cool down.
39. Bring the energy down to the Lower Tan Tien.

G. Practice Formula Seven: Sealing of the Five Senses

1. Do the Bellows Breathing.
2. Connect with the Lower Tan Tien.
3. Build the Aura:
   a) Red mist from the heart.
   b) Yellow mist from the spleen.
   c) White mist from the lungs.
   d) Blue mist from the kidneys.
   e) Green mist from the liver.

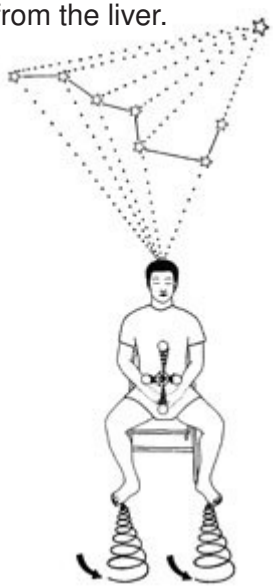

Fig. 40 *Big Dipper and North Star*

4. Send out the pearl to connect to your own personal star and to attract the Big Dipper.
5. Look for the light.
6. Draw the Big Dipper in and connect it to the head (L&R temples, L&R mastoid, chin, base of the skull, and the crown). Bring the North Star to the crystal room.
7. See the Big Dipper pouring out violet light down into your crown and through your whole body. Wash your body in the violet light and especially the marrow.
8. Feel your body so full of violet light it starts to overflow and create and aura around your whole body.
9. Be aware of the coupling at the mideyebrow, crystal room, and the tip of the nose.
   Give yourself plenty of time to feel the suction in each place.
10. Now expand your mind outward to the constellations.

Fig. 41 *Violet Light and Aura*

11. Feel the connection of the constellations to your organs to the elements.
    a) The east constellations connect to the liver (wood).
    b) The south constellations connect to the heart (fire).
    c) The west constellations connect to the lungs (metal).
    d) The north constellations connect to the kidneys (water).
    e) The crystal room is in the center.
12. Combine the South Constellation (fire) and the East. Constellation (wood) to create one fire energy.
13. Combine the North Constellation (water) and the West Constellation (metal) to create one water energy.
14. Couple the two at the crystal room.
15. Now, feel your aura as another layer of your skin. Feel it move in and out with each breath. Take in the refined energies from the constellations.
16. Let the fire cool.
17. Gather the energy at the Lower Tan Tien.

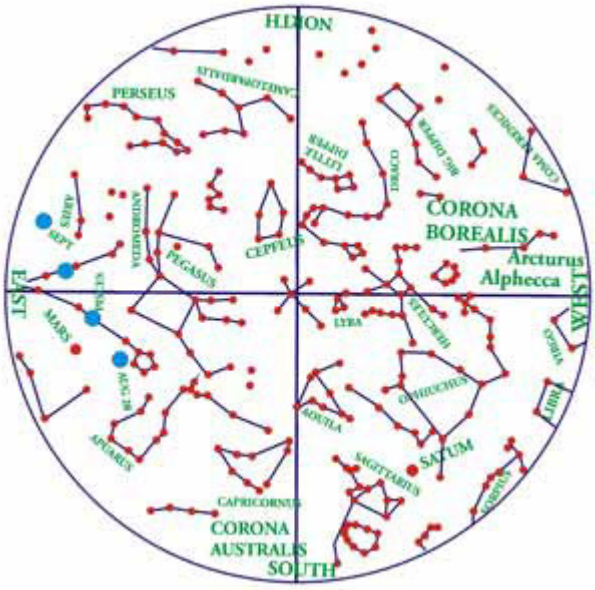

Fig. 42 *Star Constellations*

H. Practice Formula Eight: Sealing of the Five Senses

1. Clean the Thrusting Channels.
2. Turn the Wheel.
3. Create the Auras.
4. Send a pill out to connect with the Big Dipper.
5. Connect with the Big Dipper at the L&R Mastoids, L&R Temples, Base of the skull, Chin, and Crown. Feel the Dipper pouring violet light into your crown and washing your whole body.
6. Create the 3 cauldrons (Bridge of nose, Crystal Room, Tip of nose).
7. Feel your aura as an extra layer of skin. Feel it move in and out with each breathe. Feel your breathe drawing in chi through your skin to your whole body.
8. Be aware of the Planets and Animals protecting and sealing your senses.

Fig. 43 *Energy Body Going Out and Growing.*

9. Shoot your energy body out and make yourself very large.
10. Connect with the constellations: Liver, Wood, East
    - Heart, Fire, South
    - Lungs, Metal, West
    - Kidneys, Water, North
11. Combine the East and South Constellations (wood and fire) to create one fire energy.
12. Combine the West and North Constellations (metal and water) to create one water energy.
13. Start the coupling and feel the vast amounts of energy.
14. Beam the energy down to your crystal room, to your heart and see the rainbow beams coming out from your heart to the rest of the body wherever they is needed.
15. Bring your awareness to the Lower Tan Tien and start the coupling there.
16. Bring the energy from above, now into the Lower Tan Tien.
17. Use this energy to heal any part of the body or mind that is in need.
18. Slowly allow the fire to cool.
19. Gather the energy in the Lower Tan Tien.

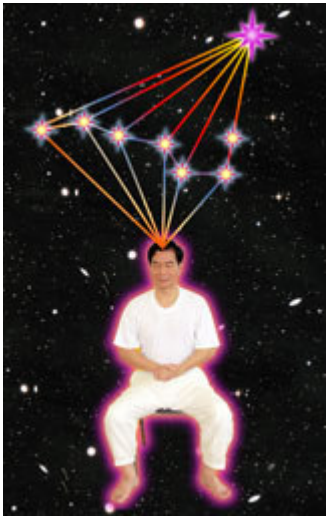

Fig. 44 *Rainbow Beams Healing Body*

Notes:

1) The laboratory, inside and outside. The microcosm and the macrocosm.
2) Clearing the trusting channel.
3) Turning the wheel.
4) Building the aura.
5) Breathing.
6) Connecting to the Big Dipper.
7) Sun and Moon.
8) Kidney energy, left is fire essence, right is water essence. Ear collection.
9) Mixing and collecting the water in the mouth.
10) Section on coupling.
11) Energy from the four constellations, violet light into the body, North Star.
12) Sealing the senses with animals or planets.
13) Beginning and ending the meditation.
14) Energies of the organs (hun, po, shen, yi,…).

Master Mantak Chia is the creator of Universal Tao System, Healing Tao, Tao Yoga and is the director of the Universal Tao Master School at Tao Garden Wellness Retreat in the beautiful northern countryside of Chiangmai, Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Sealing of the Five Senses

In this booklet for the first time ever Master Chia has revealed the final level of the Immortal Tao Practices of the Universal Tao System. You can divide your practice into several sections starting with the Three Levels of Kan & Li to set up the alignment of the body for the Opening of the Crystal Room in the Sealing of the Five Senses practices. Your training should be progressive; that is, once you have mastered one section, you can progress on to the next. Be sure to spend at least one or two weeks on each section as shown in this booklet, allowing enough time to thoroughly master each part before adding on the next section. Remember that you should always do the Chi Kung Warmups before going on into the meditation; it is very important to loosen the spine before meditation that helps your focus.

In this booklet we have divided the entire Microcosmic Orbit practice into Eight Formulas: Strengthening the Senses, Activating Sun & Moon, Connecting Senses to Organs, Activating Thrusting Channels, Opening the Virtuous Animals, Clearing the Conception Vessel with the Three Tan Tiens, Clearing the Planets, Building the Aura and Connecting with the Big Dipper and North Star. This booklet explains and reveals how to activate the Sealing of the Five Senses by spiraling, touching, coloring and small air sipping techniques.

This booklet is designed so you can use it to do your practice at your home or a cave anywhere in the world. We are happy to welcome you to the Advanced Level of the Universal Tao System and to join the Universal Tao family as a Advanced practitioner.

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The Tao of Love and Sex

Mantak Chia and W.U. Wei

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"Guide for Lovers"

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About the Authors

Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and “still the mind”. While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,500 instructors and practitioners from all over the world. Living Tao Centers, Chi Nei Tsang Institutes, Cosmic Healing Forums and Immortal Tao Mountain Sanctuaries have opened in many locations in North America, South America, Europe, Asia, Africa and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden and the Universal Tao Training Center fifteen miles outside of Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching.

Master Chia estimates that it will take thirty-five books to convey the full Universal Tao System. In June 1990, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using Dark Room technology, creating a complete environment for the higher level Taoist practices.

Master Mantak Chia has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy
co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002

Many of the books above are available in the following foreign languages:

Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

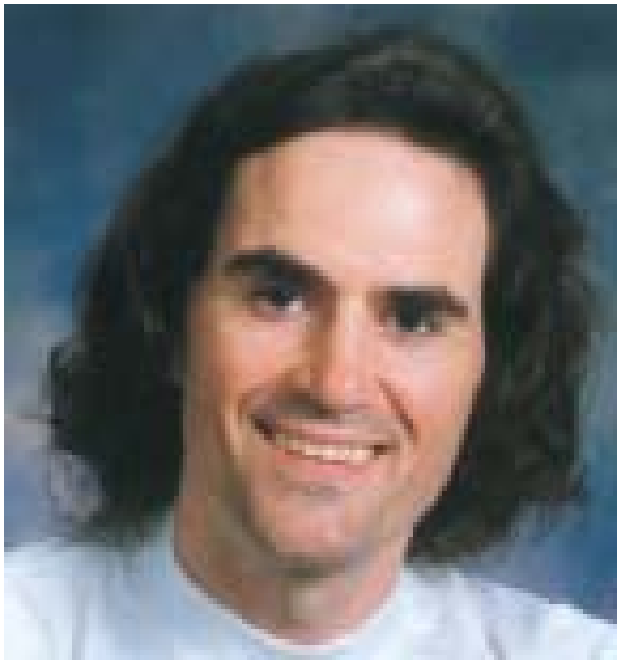

William U. Wei

Born after World War I, growing up in the Midwest area of the United States, trained in Catholicism; this student of the Tao started studying under Master Mantak Chia in the early 1980s and in the later 1980s became a Senior Instructor of the Universal Tao (specializing on one on one training). In the early 1990s this Senior Instructor moved to Tao Garden, Thailand, and assisted Master Mantak Chia in building Tao Garden Taoist Training Center. For 6 years this student of the Tao travelled to over 30 countries teaching with Master Mantak Chia and serving as Marketing and Construction Coordinator for the Tao Garden. Upon completion of Tao Garden in December 2000 he became Project Manager (Winter) for the all Universal Tao Publications and products (coordinating the completion of an additional 35 titles). With the purchase of a mountain with four waterfalls in Southern Oregon, USA (late 1990s) this practitioner is presently (Summer) completing a Taoist Mountain Sanctuary for personal cultivation, Higher Level practices and ascension. The author of ***"Living in the Tao"***, the book dedicated to the people who don't know what to know about the unknown; the Taoist poetry books ***"Angel's Heart"***, ***"Earth's Soul"*** and ***"Mountain Stillness"*** expressing the feeling, essence and stillness of the Tao; and co-creator of the Universal Tao formula cards, "Chi Cards" (4 sets of over 140 formulas) with Master Mantak Chia under the pen name the "The Professor - Master of Nothingness"; is planning and working on an additional 12 Taoist prose and poetry books to complete this author's Taoist Series by 2010.

Acknowledgments

The Universal Tao Publications staff involved in the preparation and production of *Sexual Reflexology: The Tao of Love and Sex* extends our gratitude to the many generations of Taoist Masters who have passed on their special lineage, in the form of an oral transmission, over thousands of years. We thank Taoist Master I Yun (Yi Eng) for his openness in transmitting the formulas of Taoist Inner Alchemy.

Thanks to Juan Li for the use of his beautiful and visionary paintings, illustrating Taoist esoteric practices.

We offer our eternal gratitude to our parents and teachers for their many gifts to us. Remembering them brings joy and satisfaction to our continued efforts in presenting the Universal Tao System. As always, their contribution has been crucial in presenting the concepts and techniques of the Universal Tao.

We wish to thank the thousands of unknown men and women of the Chinese healing arts who developed many of the methods and ideas presented in this book.

We express special thanks to Lee Holden for his writing and editorial contributions. We appreciate his research and great labor. We express deep appreciation to Mamo for his illustrations, book layout and beautiful cover. We thank Karen Holden, and Lisa Yamamoto for their assistance in preparing, editing, and proofreading the manuscript. We wish to thank Colin Campbell for his editorial contributions in the revised edition of this book.

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Lee Holden is the 'Wellness Director' at a prominent fitness club in California, the Los Gatos Athletic Club, where he teaches classes in mind/body fitness. He has been active in athletics since childhood; at twelve he was selected for the All-California youth soccer team and traveled with the team in Europe. He played quarterback and receiver on his high school football team, ran track and continued soccer. He competed at the 1A level in soccer at the University of California at Berkeley, where he received a BA in Psychology. He has been a Universal Tao Certified Instructor and Chi Nei Tsang Teacher since 1992 and recently has been certified as a Senior Instructor in the Universal Tao. Lee has been the chief editor for Master Mantak Chia for numerous projects such as Tao Yin: Exercises for Health, Revitalization and Longevity, Psychology and a Licensed Acupuncturist.Sexual Reflexology, and Cosmic Fusion. Lee has taught workshops throughout the United States, Europe, and South East Asia. Lee has been on staff with Mantak Chia and Deepak Chopra, teaching, writing, and facilitating seminars and workshops. Currently, Lee teaches at Five Branches Institute for Chinese Medicine, Twin Lakes College of Massage, and is the founder of Pacific Healing Tao in Northern California. Lee's video Tai Chi for Fitness has been featured on two separate television shows and numerous magazine articles. Lee Holden Jr. is a graduate of U.C., Berkeley, with a BA in Psychology and a Licensed Acupuncturist.

Lee Holden,
Copy Editor

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake these practices without receiving personal transmission and training from a certified instructor of the Universal Tao, since some of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before training begins.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Forward
"Sexual Reflexology"

When most people hear the term "reflexology" they think of foot massage. In the West, it is common to see charts like the one below, which map out the areas of the body to regions of the feet.

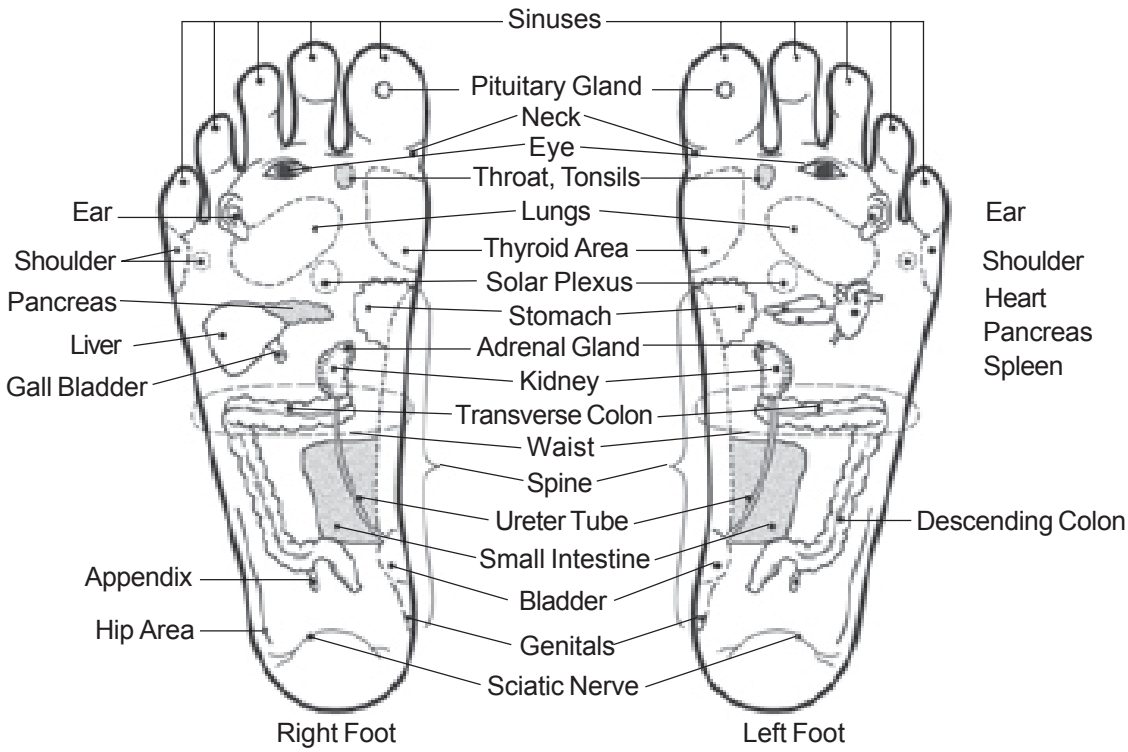

Fig. 1 *Foot Reflexology*

The reason that charts like this make sense is because the human body begins as a single cell which contains a blueprint for the entire body. As the body grows, energy meridians run through it and key parts of the body are mapped over and over again, based on that original blueprint. Rather like a hologram, a three dimensional picture in which every part contains the whole, each part of the body has a mapping for the entire body. These energetic mappings are regularly used in Oriental medicine, and are beginning to be more accepted in the West.

Some of the more common energy mappings in addition to the feet include: hands, eyes, face, ear, tongue, wrists and abdomen. Charts of these reflexes are shown in the figures that follow.

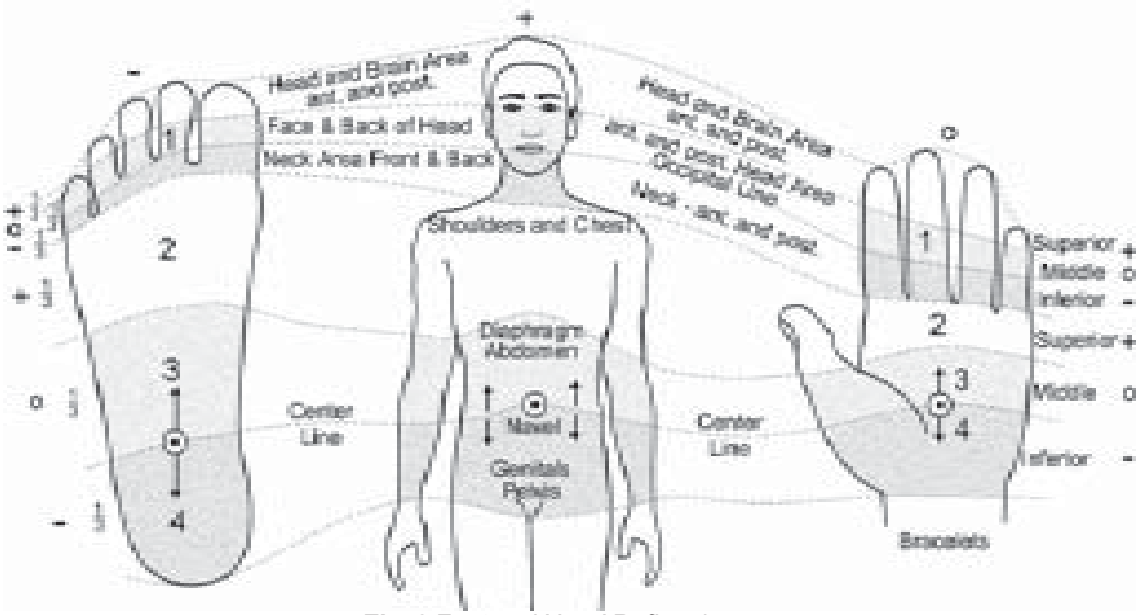

Fig. 2 *Foot and Hand Reflexology*

Reflexology is based on the premise that all our organs have reflex points on other parts of the body. The corresponding points are found by dividing the body into different zones. Organs in a particular zone can be stimulated by working on reflexes in the corresponding reflex point zone. The meridians used in Traditional Oriental Medicine, acupuncture, and shiatsu also indicate mappings of the energetic pathways in the body.

Fig. 3 *Eye Reflexology*

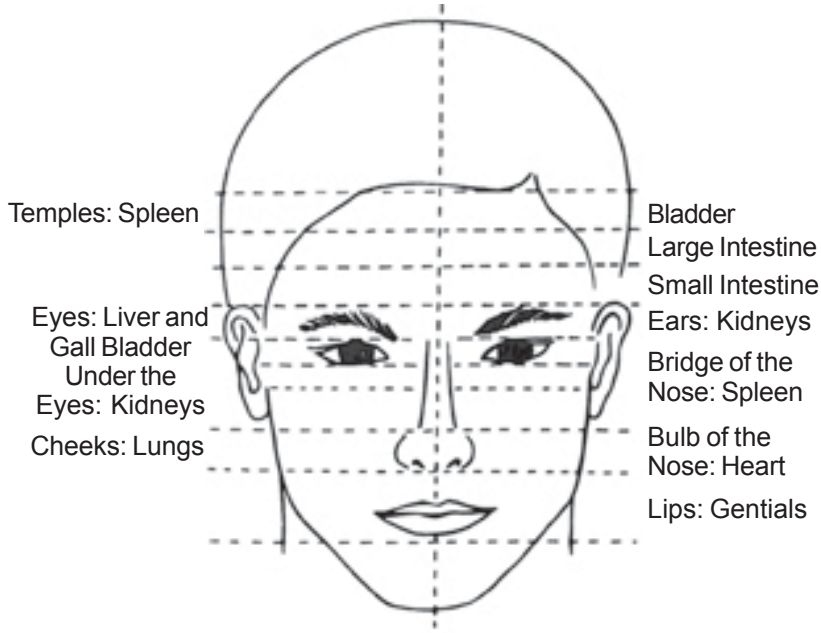

Fig. 4 *Face Reflexology*

The Taoists have long understood these energy correspondences throughout the body, and all of them are used in the Taoist healing arts. In addition to the reflexes already mentioned, Taoist literature includes reflexes for the sexual organs of men and women. These male and female reflexology zones form the basis for this book. Just as a book on foot reflexology goes on to describe methods of massaging the reflexes, so Sexual Reflexology gives applications for using the sexual reflex points in lovemaking. This understanding can help couples and individuals practice the sex act as an act of healing.

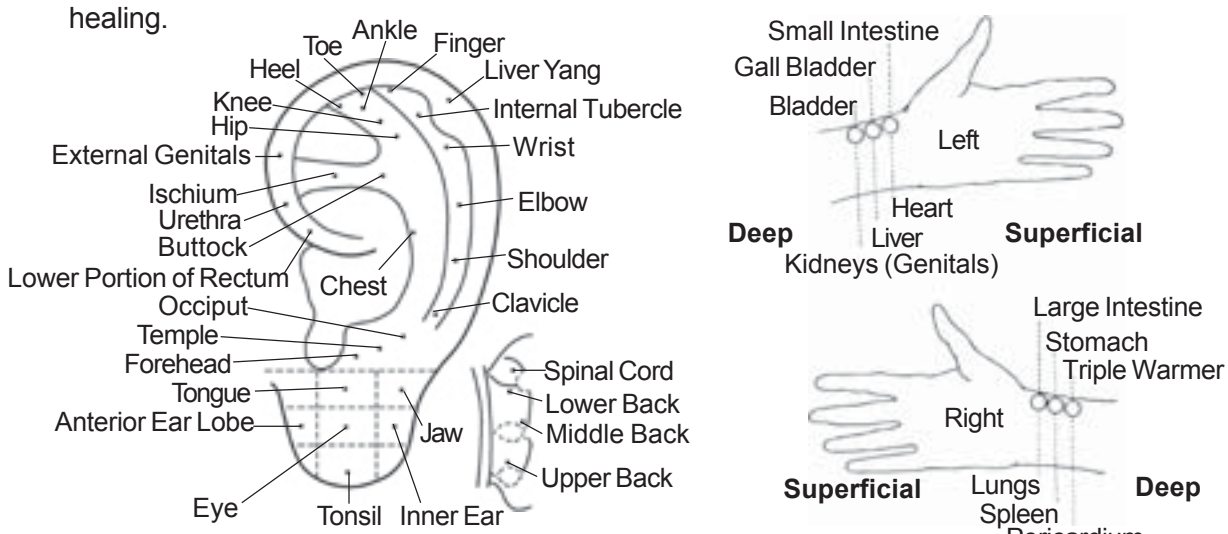

Fig. 5 *Ear and Wrist Reflexology*

In this manner, sexual intercourse becomes a form of ecstatic acupressure. The most powerful reflex points on the body are the sexual organs. The whole body provides the sexual organs with energy, and the whole body (organs and glands) is stimulated when these organs are stimulated. The Taoists call sexual intercourse “healing love”, because of its deep healing properties.

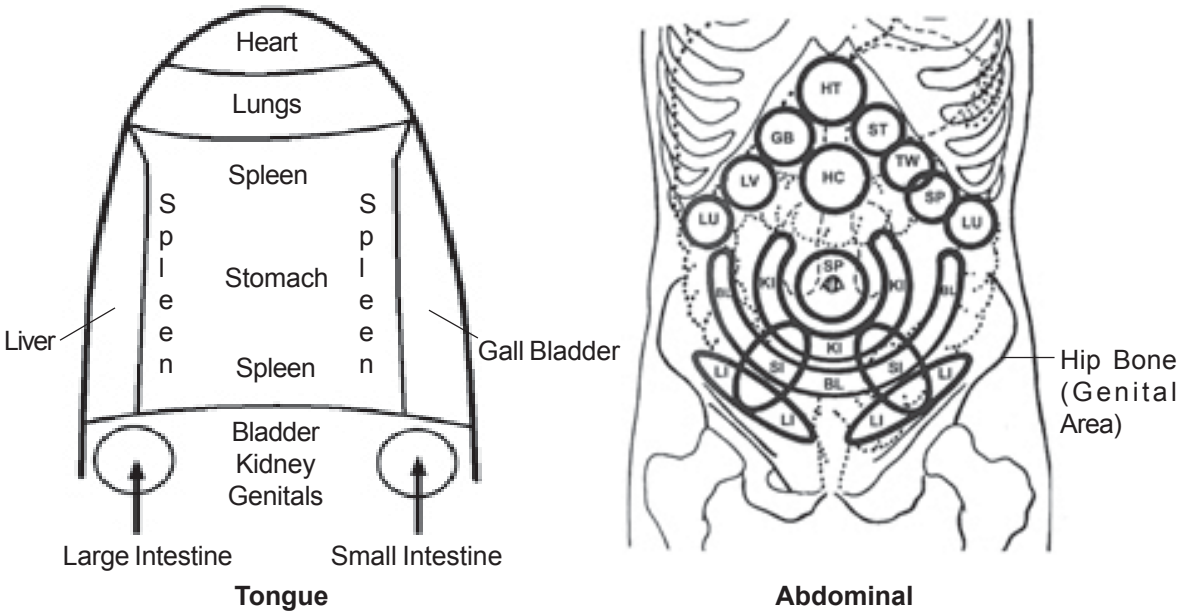

Fig. 6 *Tongue and Abdominal Refleology*

Sexual Reflexology also includes a chapter on “sexercises”, Taoist exercises which improve sexual energy and function, and organs and senses which it reflexes to, and can make for a more fulfilling love life. In addition, Sexual Reflexology can help determine compatibility between partners, using the physical characteristics of both parties.

Since, to understand sexual energy we must have an idea about how all energy circulates in the body, Taoist meditations including the Microcosmic Orbit, Inner Smile and Six Healing Sounds are presented here as fundamental background material. These Taoist practices are covered in depth in other books by Master Mantak Chia.

Sexual Reflexology is a fundamentally important book that combines the classic Taoist sexual texts with modern reflexology theory. It will be useful to any individuals or couples wanting to better understand their sexual energy, and how to cultivate that energy for health and well being. It is a great addition to Master Chia’s earlier works on Male and Female sexual energy, and is welcomed by all students of the Universal Tao.

Jim Wolfe - January 4, 2002
Universal Tao Student

Introduction

When improperly directed the sex impulse can be so strong and compelling that people will risk all they have including their reputation and freedom in order to express this drive. When this force is transmuted and directed in a positive way, it can, however, be used as a powerful creative force in any endeavor that is being pursued, whether in the arts, a career or profession, a loving relationship or in just developing a strong, irresistible magnetic personality.

The human is the only animal who has the ability to direct sexual energy with his imagination whenever he so desires. The only question is: How is it going to be directed? Some choose to use this energy in abusive and negative ways, some merely waste it and disperse it indiscriminately by over-indulging. What we are suggesting is that there are many ways in which we can express this energy, both positively and negatively. With the proper guidance the sex energy can be a rich treasure of joy, happiness and passion. It can be a tool to create and maintain optimum health and vitality, transforming a mediocre life into one of a genius, changing a stress filled, unhappy life into one filled with success and fulfillment. It is simply that powerful.

The vibrations of the mind are easily increased and activated by many different types of stimuli. The mind responds easily to love, deep friendships and music, as well as fear, jealously, drugs, alcohol and the like. But the most intense stimulus is the desire to express the sexual energy. When combined with love, it is the most powerful of all, and remains a virtue only to the degree that it is used discriminately with wisdom, compassion and understanding. With this understanding comes a responsibility to use the extra energy gained in loving and positive ways. This is the only way to create a rich and fulfilled life.

Nothing is more important than relationships. To establish harmonious relationships in all aspects of life is the goal of the Taoist practice. The Universe, Nature and the world we live in operate through relationships, connections and social exchange. To establish harmonious, balanced relationships is the process of the Tao; it is the balance of all apparent opposites, male and female, light and darkness, rest and activity, and electricity and magnetism.

Yin and Yang - Female and Male

The Taoist yin and yang symbol is a representation of this balance and harmony. The male and female energies of Nature are always moving toward balance. The Taoists observed that the way of Nature is interactive and full of creative, life-giving, sexual energy. Rain penetrates the Earth, giving birth to trees and flowers, rivers caress rocks, the ocean plunges into the sand, and the sunshine is absorbed into the womb of the Earth giving birth to all life. Sexual energy is the creative force that permeates the Universe. Life springs forth from balancing male and female energies, through the combination of Yin and Yang. These same principles apply to human relationships. Sexual Reflexology is about discovering balance and harmony within ourselves and in our relationships.

Preliminary Exercises and Meditations

The Taoist practice aims at aligning ourselves with the structure of the Universe. The first step in connecting with the Universe is to establish a harmonious relationship with ourselves. This is the goal of the Universal Tao. Harmonizing all our seemingly separate parts, emotions, thoughts, physical body and spiritual aspirations is accomplished with a variety of Taoist techniques.

It is through the inner journey of meditation that the Taoists come to know themselves. The Universal Tao is a system of self-development and spiritual cultivation. The preliminary exercises and meditations develop inner strength and harmony within, which are indispensable requirements for a fulfilling relationship with another person.

Inner Smile and Six Healing Sounds

The Inner Smile and the Six Healing Sounds are two meditation techniques that compliment the Microcosmic Orbit. The Inner Smile and Six Healing Sounds focus more on balancing the quality of our internal energy, transforming negative or unproductive energy into positive and useful energy. The Inner Smile and the Six Healing Sounds relax the mind and release emotional tension.

We communicate with our organs through the Inner Smile and Six Healing Sounds, a process of connecting to the Universe and directing loving and appreciative energy to the organs of the body. These meditations are simple ways to harmonize and balance the energy in the vital organs. The Inner Smile is a magical practice of self-development. Smiling inward is a way to show appreciation to all the work the body does for you. By smiling inwardly, the body begins to work with greater efficiency.

In the Taoist practice, it is recognized that the organs are reservoirs of energy and information and a place where Chi can be processed, stored and absorbed into the whole body. Taoists believe that consciousness is not only stored in the brain, but in the vital organs as well. The Inner Smile and the Six Healing Sounds begin the process of listening to the body and developing inner sensitivity. They are a way to develop unity and wholeness within the self.

Inner Smile

Lung Sound

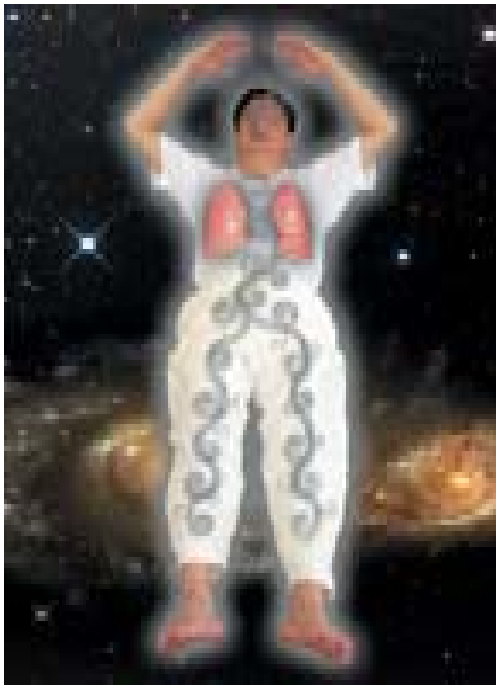

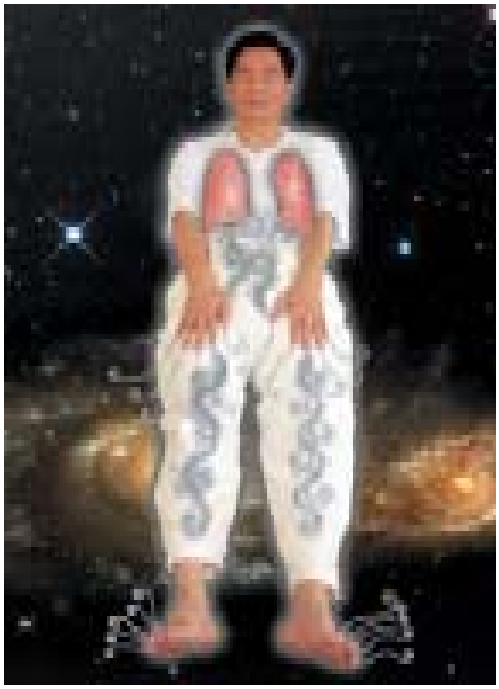

Healing Sounds - Triple Warmer

Microcosmic Orbit

The first step in working with internal energy is the Microcosmic Orbit Meditation. This meditation trains one to sense, direct and cultivate more energy. This meditation is the core technique to all the other Universal Tao practices. The Microcosmic Orbit is the main energetic circuit, nourishing all the channels and meridians in the body. Circulating energy within this channel removes blockages and activates more Chi to revitalize the body. Through this practice, one learns to recognize what Chi feels like while moving energy through the Governor meridian (running up the back) and the Functional or Conception meridian (coming down the front of the body). The Microcosmic Orbit dramatically increases the quantity of our internal energy.

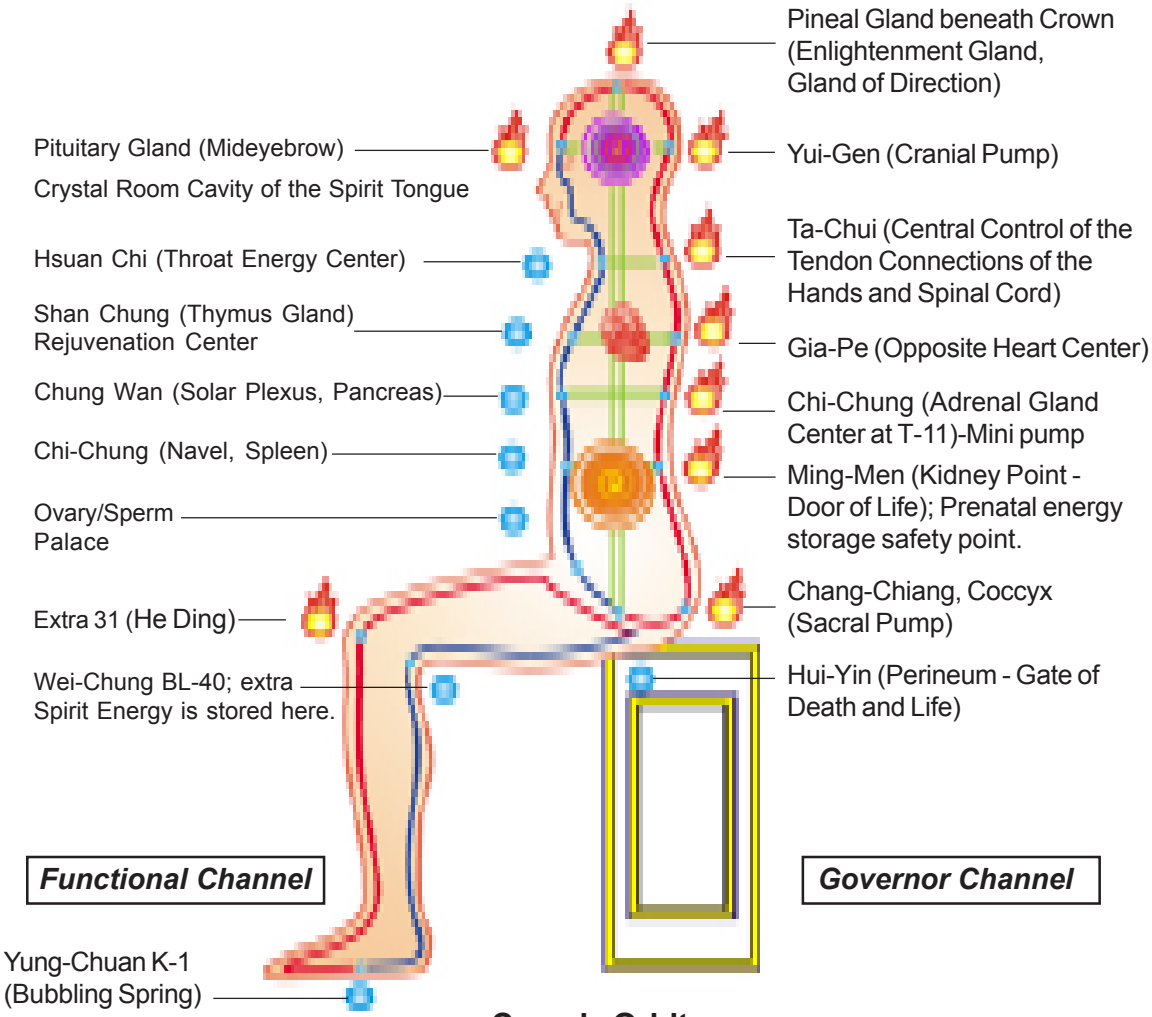

Cosmic Orbit

Healing Love Couple

Ecstatic Acupressure

The Healing Love practice of the Universal Tao refers to the cultivation of sexual energy. Sexual Reflexology is an intricate part of the Healing Love practice. Healing Love utilizes sexual energy for the health of the body, mind and spirit. There are practices for single cultivation (by oneself) and dual cultivation (with a partner). In this book, we will be demonstrating and discussing a variety of Healing Love practices that will bring health and vitality into your life and into your relationships.

Special Note for Women Readers

Please, while reading this book, be aware of two things:

1. ***The practices described originate in a society vastly different from most modern day societies. China was an overwhelmingly male-dominated society in which men possessed the political, civil and monetary power and one in which women had little or no opportunity for independent action or existence.***
2. ***This book has been written by two authors who are themselves male, and therefore may seem to reflect sexuality from the standpoint of a man.***

However, before you prejudge the contents, look at the cover. See the blue of the female figure which emphasizes how mysterious the female (yin) nature appears to men. ***This book has been written with the genuine intention of helping readers to clear away some of the misunderstanding this mysterious female nature can cause in relationships and of assisting couples achieve a deeper understanding of one another's physical and spiritual needs.***

Chapter I
Male and Female Energy

"Her eyebrows are like a bouquet of flowers; her waist is like a roll of silk. With tender passion she stretches out furtively and she gazes coyly at her own body. They first pat and knead their flexed bodies and caress each other from head to toe."

Po Hsing-Chien (Ninth Century Erotic Essay)

It is important to understand the difference between male sexual energy (yang) and female sexual energy (yin). The Taoists understood that men and women are meant to balance, as two opposite halves of a universal whole. This means that we need to respect our differences and understand that it is natural to feel different and to be different. Without this awareness men and women are often at odds with one another. Many of our struggles in relationships come about because we expect each other to be the same. I hear many people complain that their partner does not see things the way they do, or does not do things the way they do. It is important not to fight and struggle with our differences but to make them work in our favor, creating balance and harmony. If we forget this truth we are easily upset and frustrated with the opposite sex. Yet, when we respect this difference, love blossoms like a well nurtured garden. Sexual Reflexology is designed to harmonize these male and female challenges on an energetic level.

Sexually, men are like fire, quick to get hot and quick to explode. Women, on the other hand, are like water, heating up slowly and staying hot longer. This is the reason the male Taoists use a variety of techniques to satisfy a women sexually. Women need foreplay, to be caressed tenderly and embraced with passion. This way the water, the feminine sexual energy, will boil and energy will be exchanged. Thus, the Taoist saying, "Never sail your boat in a rocky river," meaning, that the woman needs to be aroused and lubricated before sexual intercourse.

In cultivating sexual energy, men learn to control ejaculation and achieve a full body orgasm rather than merely a genital orgasm. By learning to transform sperm into Chi, men can become better lovers, more vibrant and youthful and are able to activate the compassionate energy in the heart. For women, cultivating sexual energy is a way to transform blood into Chi. Transforming sexual energy is directly related to the menstrual cycle. From the Taoist exercises, this transformation leads to an abundance of energy, balanced emotions and internal power. For a detailed description of these techniques, refer to my other books "*Multi-Orgasmic Man*" and "*Cultivating Female Sexual Energy*".

Fig.1.1 *Women change blood into Chi.*

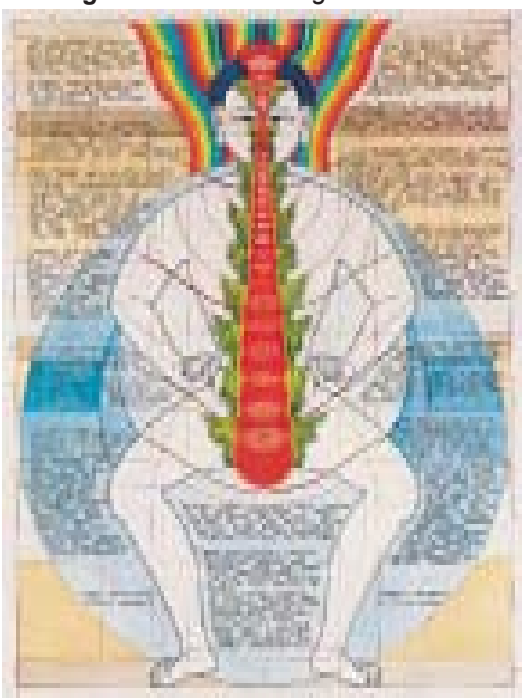

Fig.1.2 *Men change semen into Chi.*

Emotionally, women are like fire and men are like water. It is very easy for women to express their emotions, to get excited, to cry and to feel. For men it is more challenging to be in touch with the heart center. This is how men and women balance emotionally and sexually. Women open and heat the emotional center or the heart center in men and men help open or bring the fire into the sexual center for women. The goal of the Taoist practice is to create this harmonious and flowing exchange of energy.

This is revealed physically by the fact that men project from the sexual center (the penis) and women project from the heart center (the breasts). Projection is the yang or the fire quality of energy. This demonstrates that women are yang emotionally and men are yang sexually. These physical features reveal the energetic and emotional nature of men and women.

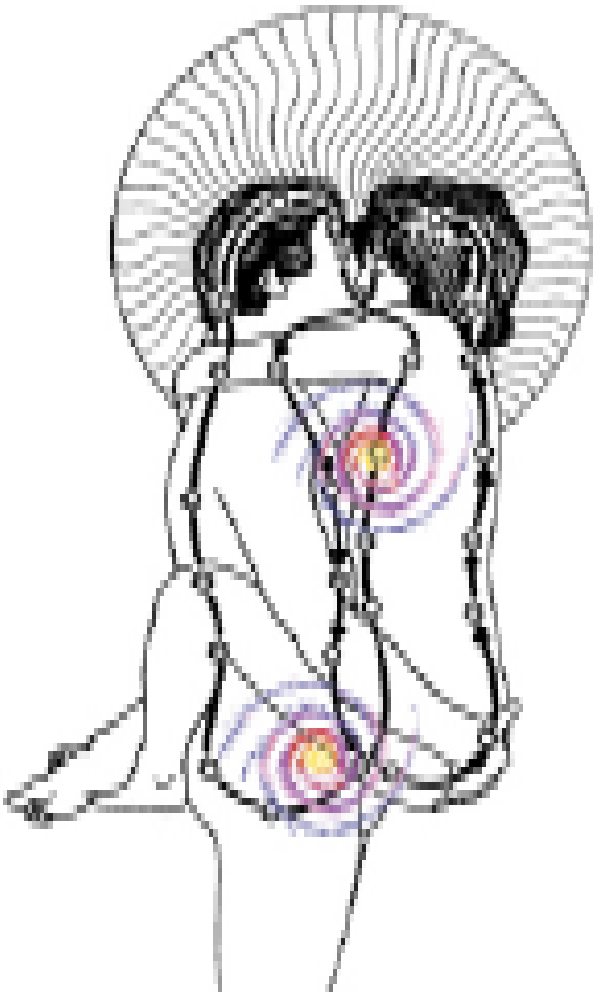

Fig.1.3 *Fusion of the Two Microcosmic Orbits and the Sexual and Heart Centers*

Yin and Yang

The tractor (yang) and the lake (yin) are the energy fields of the man and of the woman. We are talking here about opposites. When the man is hot, the woman is cold. When the woman is hot, the man is cold. So you have a real communication problem. When you're very hot the person with whom you are trying to communicate is cold. Men and women have different types of energy molecularly. It's very hard to interact unless you have a clear understanding of your own energy field and how it interacts with the people around you, especially the energy field of the opposite gender. Getting this understanding opens up communication, which is the key to any relationship.

The tractor and the lake exemplifies what I mean by this difference. When you drive a tractor into a lake, you get stuck. And what happens when the tractor tries to fight the lake? It sinks deeper. Who is stronger, the tractor or the lake? Obviously, the lake is stronger. It not only has its own energy, but it also absorbs all of the energy the tractor exerts. Now the tractor is active energy and the lake is passive energy. The lake is the yin energy or the feminine energy and the tractor is the yang or the male energy. So the woman is far superior to the man in every aspect : physically, emotionally, psychologically and spiritually. Physically, from the waist down, a woman is far superior to a man. She can out-work a man. She lives longer and has more strength. In endurance of pain and physical hardships she far exceeds the man. Her body is structurally far superior to the man's body. Emotionally she works with more of her feelings and has a stronger capacity with her emotional center.

Psychologically she tunes into her inner self with telepathy and clairvoyance. A woman is more apt to make this connection than a man because of her physical structure. A woman is more spiritually attuned than a man because of the inner connection with herself and her understanding and connection with the earth energy, nature.

The key message in "the tractor and the lake" is the ability of the lake to yield to the tractor; and the way of the Tao is to yield because the Tao is feminine. You find this in every aspect. Every time you want to overcome something you yield to its energy and you use its energy for your own benefit and welfare.

When children are born, both genders have to urinate. The male child has all of his equipment down there and he can see everything. He can see his equipment and urinates out. His outlook in life is external because his focus is external. But when the little girl urinates, she's looking to find where it is coming from. She's looking inside herself because she doesn't see anything down there. She's curious about what's inside her. Through spaced repetition, many times urinating and many times puzzling over this issue she begins to look and feel what's inside her.

The male proceeds through life and looks at everything externally. It's all right there. He takes control of his genital area. He becomes the master of it. He understands it and comes in contact with it. The woman, on the other hand, doesn't come into contact with the genitals because they aren't there. They're inside her body. Because they're

inside, she is drawn to look inside her body. As she matures as an adolescent, she begins to form breasts and she begins to get in touch with her chest area thus getting in touch with her heart center, which is the center of the emotions and the feeling center. She starts to work directly with these emotions and feelings. This affects the genders outlook on life: as a woman internalizes, she personalizes or she takes things personally; as a man externalizes, he generalizes or talks in generalities. You can see this has a major impact on how they live and how they communicate with each other, which leads to confusion and differences.

The man seldom touches himself in the chest area. He never gets in touch with his heart center. He never gets in touch with his feelings or his emotions. The woman becomes the master of the emotions and the male becomes the master of the sexual energy or the kidney energy. But both can help one another. An example of this is what I call “boiling eggs”.

Fig. 1.4 *Male fire energy to heat the Female eggs.*

You put two eggs in a pan of hot water and you put them on the burner to boil. The male can get an erection or start the fire, just like that! But it takes awhile for the woman to warm up just as it takes awhile for those eggs to warm up. She needs some foreplay. She needs to be caressed. She needs her eggs warmed up. The eggs in her body, her kidney energy, have to be activated at a slow pace and brought to a boil slowly. The male’s sexual energy normally can turn on and off quickly. But once he understands how her energy functions and learns many of the Universal Tao techniques (such as the shallow thrusting technique) he’ll maintain his fire at a lower temperature so she

can build to her climax, boiling the eggs. As her eggs start to boil, she achieves her orgasm but she also needs to come down slowly. That's why women like a lot of caressing, holding and being with their partner many hours after genital interaction just as you need to cool the eggs down.

The funniest thing about this whole scenario is that the same thing is needed for the heart energy but in reverse. The woman can turn on and off her emotions just as quick as a man can turn on and off his kidney (sexual) energy. She has so much experience working with her feelings in her heart center. She can help a man to get in touch with his feelings and heart center. She has to caress with emotional foreplay, developing and nurturing the man so that he can get in touch with his feelings. Many times, when a man gets in touch with his feelings, he needs to come down slowly (just as she needs to with her kidney energy) to cool the eggs off, or to cool the heart off so that he can get in touch with it. So, both genders, once they understand their energy fields and how they interact, can help develop a nice harmony with one another by helping each other.

Fig. 1.5 *Warming the cauldron in the Heart Center.*

The key to the interaction between the genders is communication; and this means connecting with the heart energy. Taoists really don't look at sex or the use of sexual energy as a moral issue. It's more of a health issue. Once you begin to understand your energy, what it's about and what is it actually for, you can have a much healthier understanding of how to work with it and how it interacts with everyone around you, especially with the opposite gender. The best way to explain this is dual cultivation. The Taoist practices lend themselves to a monogamous relationship similar to playing a doubles tennis match. You have a partner on your team. You learn their form, how

they interact. It takes many years to develop good rapport and a good understanding of each other's moves. The same thing occurs in the Taoist interaction of sexual energies. Once you have a partner in dual cultivation, it takes many years to perfect a nice harmony. And you don't want to switch your partner just like you don't want to switch your partner in a tennis doubles match, because you have to learn again all the various moves and techniques of a new partner. The same concept applies in the Tao with dual cultivation.

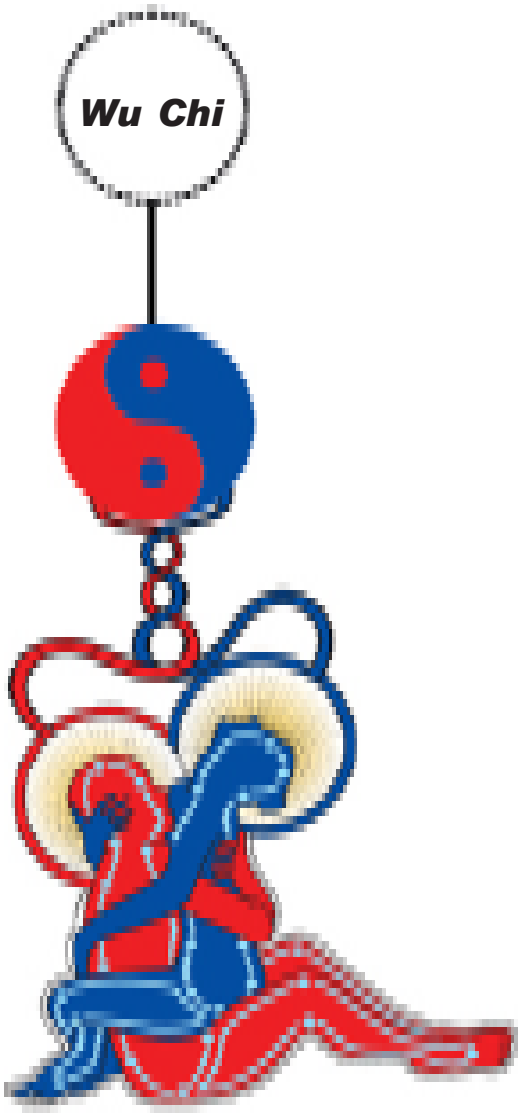

Fig. 1.6 *Wu Chi (Oneness) into Yin /Yang (Duality)*

Just as you practice tennis yourself, your serve and forehand, in singles to help your partner in the doubles, you start to practice the single cultivation aspects in order to be ready for your dual cultivation. You need to perfect the techniques of the Universal Tao system with testicle and ovarian breathing, genital compression and the Big Draw technique. As you work with these techniques, and thus balance the energy internally on a chemical level, you're going to begin to attract a more balanced partner in the future. You should really focus on working primarily with the heart energy, to balance yourself internally with love, compassion and patience, becoming at peace and in harmony within yourself. The key is communication, because the tongue is connected to the heart. You have to explain how you feel, who you are, and where you want to go. With this open and honest communication you will discover if you are compatible with each other sharing the intent to assist each other in your spiritual journeys.

The Taoist's say, "Sex is like an itch. It feels good when you scratch it, but it feels better when you do not have the itch." When you develop this balance you're going to start to attract a person who will be a potential spiritual helpmate and life partner.

The key to the Taoist's sexual practices is Chicken Soup. When you make chicken soup you put a chicken and water in a pot and boil it. After 2 hours you take the chicken out and you have the broth. Now what would you rather eat the chicken or the broth? The broth because it has all the essence of the chicken in it. The same with the sexual practices, the chicken is your genitals and broth is your sexual essence. When you cook (Testicle & Ovarian Breathing and Upward Draw Practices) the chicken (genitals) and draw the broth (essence) up your spine into the brain; you have a brain orgasm instead of a genital orgasm. Now the brain is connected to all parts of the body for a total body orgasm. Now which would you rather have a chicken (genital) orgasm or a broth (essence) brain orgasm? Think about it, the chicken and the broth.

This is further developed in the Universal Tao formulas of the Healing Love dual cultivation practice, looking into each other's eyes, exchanging healing cosmic energy like magnets.

There is one very important fact that you have to understand about when the genders interact. When a man is sexually aroused he is jet-hot (a fire burning) but when a woman is sexually aroused she is icy-cold (a numb burning). When a man is sexually unaroused he is cool (relaxed) but when a woman is sexually unaroused she is warm (cozy). They are opposites. Men understand this hot aroused feeling quite easily. Women feel a hot sensation but it is a different type of hot like an ice cube burning sensation on your skin, which numbs the skin and leaves the woman feeling helpless. That is why a woman is very vulnerable in this aroused state because she loses control of herself; in the same way the man loses control of his feelings when he opens his heart center.

This basic difference between the genders manifests itself on all levels of consciousness. That is why they find it very hard to read and understand each other. They do not think alike; the man thinks with logic and the woman thinks with feeling. Men think methodically; one and one is two, not eleven. They are very structured and predictable; ultimately they become prisoners of their own mind. Women actually think correctly, using their sense of heart direction with their feelings, as one would think in the Tao. But they run into trouble when they mix up their feelings with their imbalanced emotions and they miss the target. There is a big difference between a feeling and an emotion; a feeling is a direction from the heart center (God) and an emotion is a sensation from an imbalanced organ.

As you can see, it is surprising with all these differences, how men and women ever get together at all. It is easy to understand why they have so many problems when they do get together. But if they are compatible they have a great opportunity to develop Divine Love, as spiritual helpmates to one another on the journey into nothingness.

Chapter II
Sexual Energy: Taoist Perspective

Sexual energy is nourishment for the totality of ourselves, the body, the mind and the spirit. It is the water of life, replenishing the gardens of the human temple. The exercises for sexual energy developed in the Taoist teachings are much more sophisticated and focused than in the West. They go right to the source of our sexuality and cultivate it in a way that brings sexual energy and strength to those who use them properly.

The philosophy of Chi (energy) has been part of the Chinese culture for thousands of years. The word Chi has many translations, such as energy, air, breath, life force or vital essence. It is the life giving force that creates movement and sustains the Universe. Chi is what allows planets, suns and stars to revolve around each other. It is the motion of the atom in all physical bodies. It is the force that allows a seed to grow into a powerful tree, or a fetus into a full grown human being. Chi is the animating factor in all living things, nourishing the cycles of life.

The concepts of energy are not only food for thought, but concrete ways in which we can create health, happiness and excitement in our daily lives. Working with energy is a pivotal factor in our overall state of happiness. Energy, like water, is the life giving sustenance of the Earth. Where water flows life flourishes.

That same principle is at work in our bodies. If we want a healthy body, energy must circulate to all parts. Without proper energy flow, the body creates tension, sickness and disease. It is like a stagnant pool, or a dried up garden. Without continuous circulation things have a tendency to become malignant.

Thus, sexual energy, according to the Taoists, is much more than the act of sex, as it permeates all areas of our lives. It influences the health and aging of the body by effecting hormonal production. An abundance of sexual energy repairs hormonal disturbances, reduces cholesterol and blood pressure levels. When sex glands are stimulated, it enhances the hormones secreted by the other major endocrine glands: adrenal, thymus, thyroid, pituitary, and pineal. Much evidence points to the link between harmonious sexual activity and the retardation of aging. Sexual Reflexology stimulates the growth hormones that are just now being discovered to retard aging by Western medicine. Yet, in the Taoist perspective, hormones should be stimulated naturally, through exercises and massage rather than taken externally through medication. The presence of these hormones in the blood does appears to slow the aging process.

With Taoist cultivation of sexual energy techniques, one produces unusually potent hormones by focusing energy directly on the endocrine glands. Sexual energy is not only beneficial to the body, but is the fuel for the emotions as well, which can either

blaze out of control, or create warm comfortable glowing energy in the body. Sexual imbalances can cloud the mind with distorted thoughts and skewed desires, or a balanced sexuality can be the source of creativity and a way of fulfilling our dreams. It is also the energy that can create spiritual fulfillment, as it is a force that unifies and creates wholeness out of opposites.

From this perspective, we can begin to see that it is of utmost importance that we deal with and utilize sexual energy. It is very important to remember that sexual energy must be used in the proper way and not be suppressed or eliminated. Suppressing sexual energy is like trying to hold hundreds of ping pong balls under water. If you press them down, they pop up somewhere else. Instead, Sexual Reflexology seeks to express this energy in a way that will enhance your body, mind and spirit. Otherwise this energy will seek outlets that will be under utilized and wasted or even be potentially detrimental to one's overall health. Whether you have a partner or not, the ideas and exercises in this book are vitally important to sexual health. The Taoists developed these techniques so that we can live in harmony with ourselves and others.

We have compiled a variety of techniques that will most definitely increase the sexual energy of those who engage in these practices. These practices have a profound effect on the rest of our lives because our sexuality is so much a part of being human. There is so much power behind our sexuality that without the proper knowledge of how to manage and direct that energy, it will inevitably go astray. Yet, with the correct knowledge and balanced action, our sexual energy has the potential to bring happiness and joy into all aspects of our lives. It is time that we as human beings tap into our true potential, gaining the insight to create a passionate and powerful life and become all that we are meant to be.

Sexuality, Energy and Relationships

The relationship between men and women has baffled and confused philosophers, scientists and thinkers throughout the ages. Sexuality is a dance that spans the history pages of all societies. It is a ritual that has preoccupied the activities of humankind throughout the eons and still has our present cultures in a quandary. For something that has existed for so long and has been a part of everyone's life throughout history, one would think that humanity would have some expertise on the subject of sexuality. Yet, to this very day, our sexual relationships continue to daze and confuse the spirit of people in profound ways. On the one hand they create passion and love, ignite romance and pleasure and spark the flames of desire that make life worth living. But, on the other hand, sexuality is also a source of destruction and negativity that are the causes of a myriad of problems in society.

Sex is a creative force that moves through the body feeding the emotions and thoughts, and creating the impulse of desire. It is pleasure in its raw and unrefined state. If that energy is not understood and used in the right way, it is the cause of dissatisfaction, destruction and overall unhappiness in our lives. As basic as the duality of man and woman, day and night, sexual energy can be the source of both pain and pleasure.

Sexuality is like the force of fire. When used intelligently, it enhances our lives immensely. With fire, we can warm our houses, cook our food and bring light into dark rooms. But, if we use fire in the wrong way, say, for example, putting it on the roof instead of the fireplace, it will inevitably burn the whole house down. The fire itself is not evil or bad, it is merely a force that needs to be directed in a positive way. The same applies with sexuality; if we use it correctly, it brings us unbelievable pleasure, but if we let this energy run wild without guidance or understanding, it has the potential to destroy our physical and emotional lives.

Fig. 2.1 *Relationship of the Creative Forces*

Not only is there an overall dissatisfaction with sex in our everyday relationships, but we are faced with the malicious acts of rape, abuse and violence. The number of problems in society that revolve around the topic of sexuality is monumental. The echoing question of how to use this energy in positive ways can be heard throughout the world. This book is part of a series of books on the subject of sexual energy from a Taoist perspective. The Taoists have written and taught on this subject for the last 5000 years. This book is written to pass on some of this precious information, and to shed some light on how to create positive fulfilling relationships in your life.

In the tradition of Taoism, sex was seen in an altogether different context than the West. Rather than being the great sin, sexual energy was considered a path toward health and vitality and a way to intimately connect with the divine. That divinity is seen as a state of wholeness and completeness that is implicit in all of us. In the traditions of the East, man and woman represent opposite halves of that universal whole. Each is an earthly manifestation of the two cosmic creative forces, whose intermingling bring forth all phenomena. When man and woman unite in sex, Heaven and Earth are joined.

The first part of this book describes diagnostic techniques to reveal strengths, weakness and imbalances through the observation of external features of the body. These features also reveal compatibility between male and female partners. The next section describes specific exercises (sexercises) that strengthen our sexual imbalances and weaknesses. These exercise postures also bring health, vitality and an abundance of energy to those who practice them.

History of Sexual Reflexology

For thousands of years, the Taoists have explored the human potential in relation to sexuality. The knowledge acquired is a way to enhance relationships, sexual energy, pregnancy, birthing, vitality and health of the body, mind and spirit. The legendary Yellow Emperor (2nd century BC), recorded conversations with Taoist advisors on many subjects. The works, "*Classic of the Plain Girl (Arcane Maid)*" and "*Counsels of a Simple Girl*" are recorded conversations on sexual matters. These recordings give a great deal of information on the use of sexual energy to achieve vibrant health and longevity. These ancient classics are a treasure chest of information on all issues dealing with our sexuality. This book, *Sexual Reflexology*, is a reflection of some of this wisdom.

The following information regarding the determination of sexual inclination, capacity and functioning of human beings has a specific purpose in Taoist sexology. From ancient times and until recently in China, many marriages were arranged by parents. The information they used to determine compatibility and suitability of partners was researched with great care and love and the result was often a very happy and fulfilled marital relationship. Although women have had the right to divorce in China for at least 1000 years, this was a rare occurrence, possibly because everything was so carefully considered in advance. Information used in selecting a compatible marriage partner

was quite complete, including internal factors such as personality, physical compatibility and family circumstances as well as individual intelligence, education and social status from Chinese astrology and reflexology. Reviewing the marital union with such care and great detail resulted in a far greater compatibility in the partnership. With this approach the strength, love and unity of the family unit was greatly enhanced. Considering the exceptionally high divorce rates in Western society today, the valuable information that is provided by such an approach could prove helpful. The unhappiness and emotional difficulties experienced by both parents and children involved in marriage dissolution in our modern society are immeasurable.

While almost any kind of assistance to improve this situation would be useful, the Taoist, time proven system cannot be overlooked as useful to the appropriate union of a man and woman. If a man and woman were able to choose a suitable sexual partner resulting in their greater mutual happiness, this information will have served its purpose. It is with an attitude of reverence for the sanctity of marriage and the union between men and women that this information is offered.

Fig. 2.2 *Union of Sexual Compatibility*

Chapter III
Reflexology

"In their search into the art of lovemaking, the ancient Chinese Taoists went beyond foods and herbs, even beyond erotic techniques ... by consciously maneuvering the human body's Chi, or life-energy. They did this to enhance sexual arousal, control orgasm and intensify ecstasy for both men and women." - Valentin Chu, Yin-Yang Butterfly

Reflexology has traditionally been practiced by massaging and pressing points on the hands and feet. These techniques have been proven to be a powerful method of healing. Yet, reflexology is much more extensive than merely pressure points on the hands and feet. Reflexology refers to reflection, or mirror image. The Taoist sages learned to use external physical features to learn about internal energy, health of the organs and personality. Reflexology teaches that vital energy, or life force, circulates between the organs and every living tissue in the body. Sexual Reflexology uses ancient Taoist wisdom to tap into a rich source of vitality by working with sexual energy and the way it manifests in the body. It is based on the principle that sexual health is an indispensable aspect of a fulfilling life. Discovering the spring of sexual potential within is a way to access the abundance of energy inside us.

In Traditional Chinese Taoist medicine various diagnostic methods recognize a physical connection between a person's external appearance (physiognomy), particularly the visible characteristics of the hand and face and the size, shape and condition of his or her internal organs. It is also believed that various parts of our physical anatomy are directly proportional in size and shape to one another. Thus, a relationship is established between the size and shape of external features, the condition of internal features and a proportionate correspondence with all of the features on the body. This principle is considered a law of anatomy which Taoist physicians know and practice as a science and art, now popularly called reflexology.

Consider how the following external features are used to diagnose the health of the internal organs. The eyes reflect the liver: are they bright or cloudy, do they have occlusions or spots, etc.? A healthy liver will be reflected by a clear, deeply colored iris with no spots, scars, blurry areas, etc. The lips reflect the spleen, the nose reflects the lungs, the ears reflect the kidneys, and the tip of the nose and aspects of the tongue reflect the heart. Color, texture, clarity and so on are the conditions of these external features that directly reflect the health of the internal organ with which they are associated from the meridians or energy lines from the organs to the extremitities of the body.

While single external features are an indication of sexual potential (a larger thumb indicates a larger penis), it is the combination of many external features that reveal the true sexual potential. It is an art to be skilled at these diagnostic techniques and takes many years of training to develop. Using these diagnostic techniques can be very beneficial in revealing our strengths and weaknesses. Once we know ourselves, we can begin to balance those areas that are weak and need extra energy. This way we become a much more complete and unified human being. The Taoists always recommend discovering and improving our weaker areas to promote overall balance.

Compatibility of the Penis and Vaginal Canal

"Man and woman should ebb and flow in intercourse like the waves and currents of the sea. In this manner, they may continue all night long, constantly nourishing and preserving their precious vital essence, curing all ailments and promoting long life."

-Sun Nu Ching (The Classic of the Plain Girl)

The Taoist sexologists teach that sexual intercourse is a form of ecstatic acupressure. The ends of the body are a rich source of acupressure and reflex points. This is why reflexology is usually thought of by pressing the feet, hands, ears or face. Yet, the most intense and powerful reflex points on the body are the sexual organs themselves. Sexual energy is derived from the best energy of the body. The whole body is involved with providing the sexual center with energy. Therefore, the sexual center is the condensation of all the body's energy. This is the reason that the health of the sexual center is critical to the mental, emotional and physical health of ourselves.

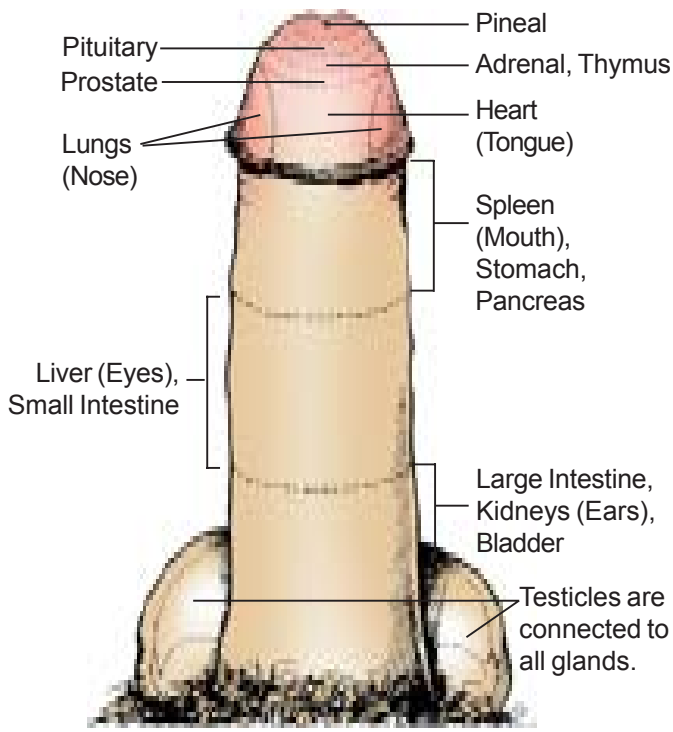

Fig. 3.1 *Reflexology Zones of the Male Sexual Organ*

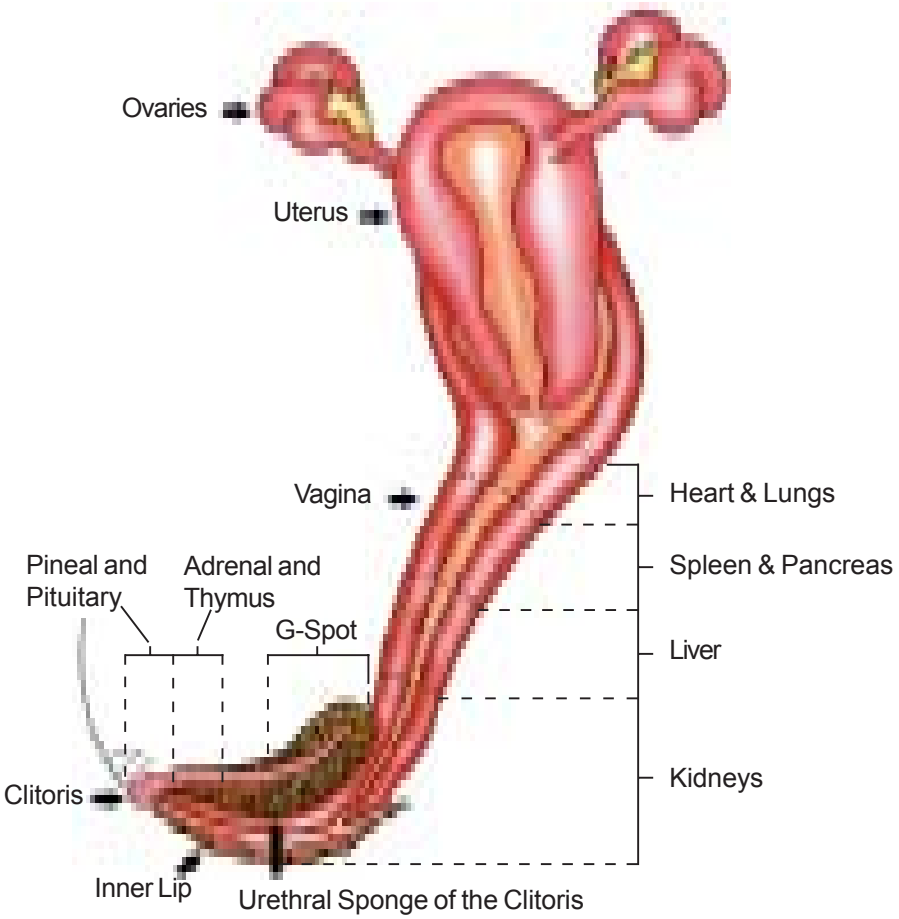

Fig. 3.2 *Reflexology Zones of the Female Sexual Organ*

When the sexual organs of the male and female unite, a wonderful stimulation of energy is experienced through the whole body. Sexual intercourse is an ecstatic acupressure treatment. The Taoist call sexual intercourse "Healing Love" because of its deep healing properties. Ancient Taoist physicians even prescribed certain sexual positions to couples in order to stimulate the Sexual Reflexology points in a particular way.

Sexual Reflexology also helps determine compatibility between partners. To determine this compatibility, sexual desire and physical features of the body are vitally important in establishing a harmonious relationship. This enables the couple's sexual relationship to be fulfilling for both partners. Such compatibility means matching partners in terms of sexual capacity, desire and in the size of the physical organs themselves.There may be substantial variation in the size of men's genitalia, for example. This is neither

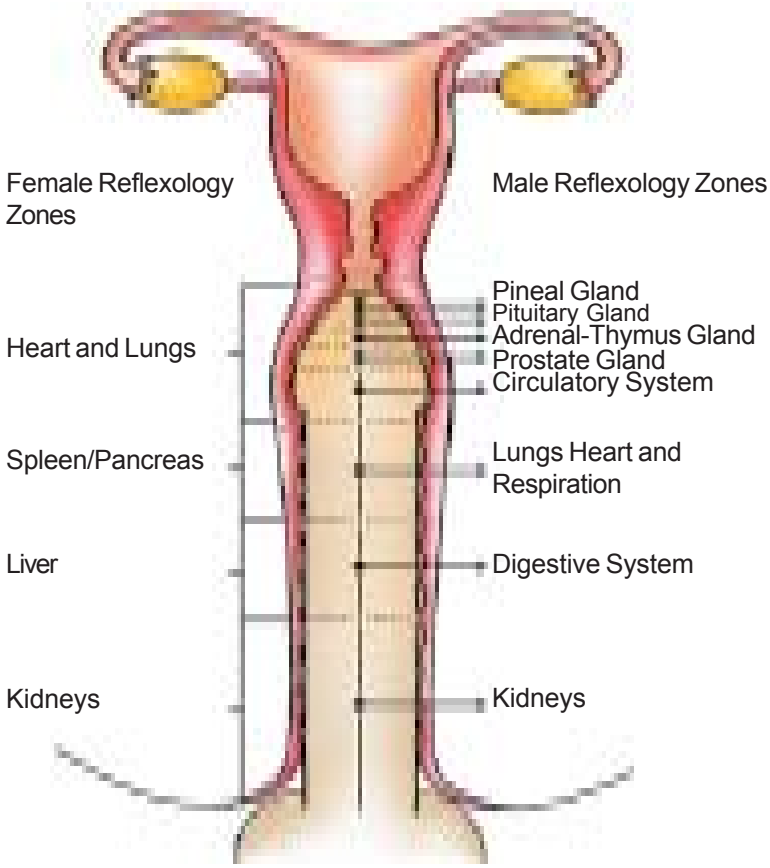

Fig. 3.3 *Interaction of the Female and Male Reflexology Zones*

a positive or negative aspect, but simply means that a man must match the size of his penis with that of his partner's vaginal canal if he is to satisfy her completely. If the length of the man's penis is much longer than the length of his partner's vaginal canal, it is possible for him to cause her harm during intercourse. This also applies to the length and size of the vaginal canal for the women.

One must also consider that to completely stimulate a man's internal organs, the entire length of his penis must be stimulated, thereby exciting all of the penis reflex zones. If one were to concentrate the sexual stimulation on the head of the penis only, the result would be that only the heart and lungs would be stimulated and the kidneys, liver and spleen would be neglected. In time this would result in an imbalance – the heart and lungs being over activated and the liver, spleen and kidneys under activated.

A similar situation exists in the vaginal canal. For a woman to be completely stimulated internally, that is, to ensure equal stimulation of her vital organs, the man's penis must reach to the end of the vaginal canal. It is recognized in Taoist sexology that the

flexibility or elasticity of a woman's vaginal canal is relatively small in relationship to its length, however it has much greater flexibility in width, demonstrated by the fact that the vaginal canal can expand to accommodate a baby traveling through it from the womb during childbirth. Thus, we can see that compatibility of length is more important than compatibility of width. The resultant pleasure of such compatibility leads to sexual fulfillment.

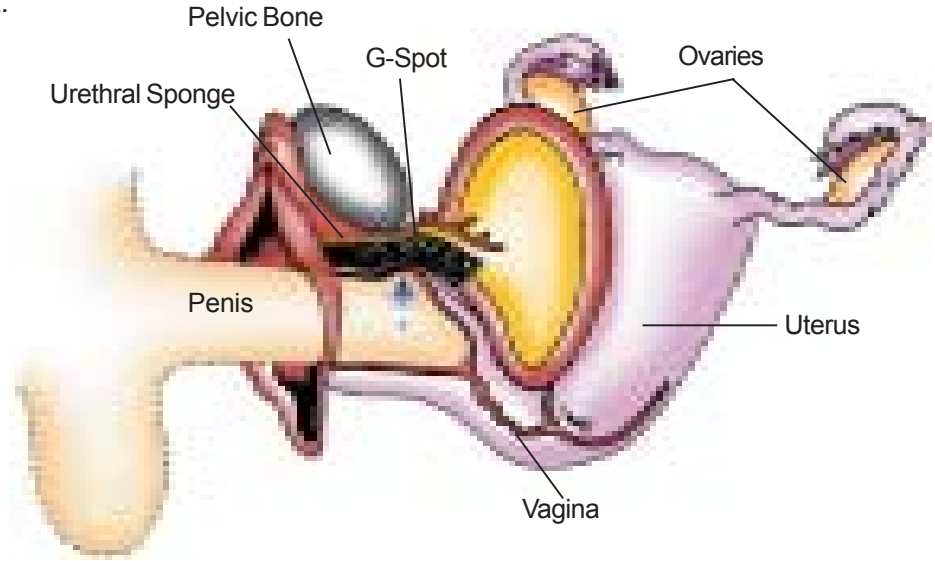

Fig. 3.4 *Shallow thrust massages the area of the G-Spot.*

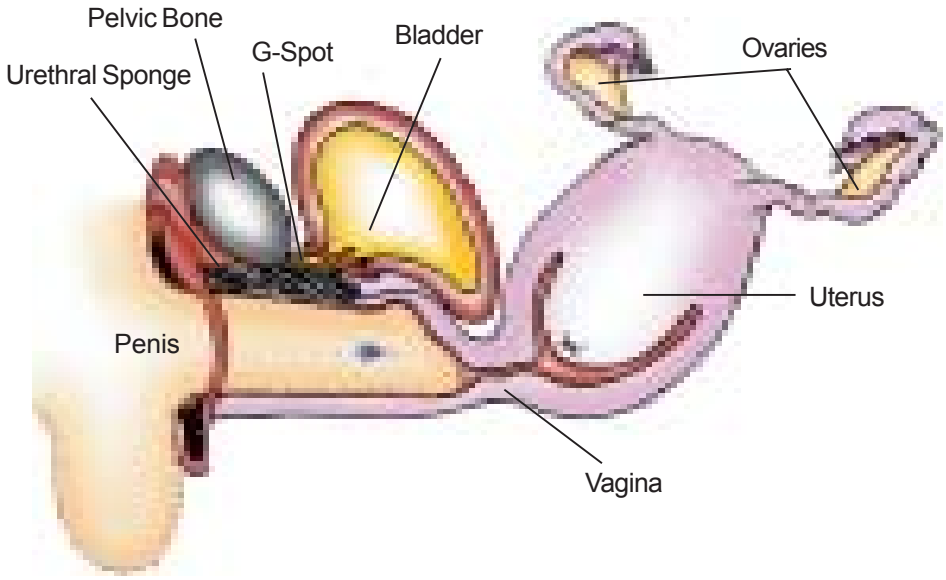

Fig. 3.5 *Deep thrust massages the deeper areas of the vagina by passing the G-Spot.*

Ring Muscles

The ancient Taoists discovered the subtle and intricate power of the ring muscles within the body. The ring muscles refer to the round sphincter muscles: the mouth, eyes, nostrils, anus, genitals and perineum. The ring muscles are located at the ends of the important organ systems, like the alimentary, respiratory, and urogenital tracts. For the body to be in optimal health, it is very important that the ring muscles contract simultaneously, establishing the inner rhythm and structure of the body.

The Taoists discovered the secrets of the ring muscles by observing infants and children. One of the goals of the Taoist practice is to become as vibrant and youthful as a child. Through specific exercises the ring muscles bring our bodies back into harmony with the Tao.

Observe a newborn nursing: as the mouth rhythmically suckles, the eyes contract in unison, the anus and urinary tract contract and release in harmony with the mouth and the hands open and close synchronistically with the sucking of the mouth. This synchronized movement pumps energy throughout the body.

Consequently, when we as adults have a harmonious contraction and relaxation of the ring muscles, the body is full of energy and in good health. In contrast, when this rhythm is out of balance, from stress, sickness, or tension, the body's energy is depleted.

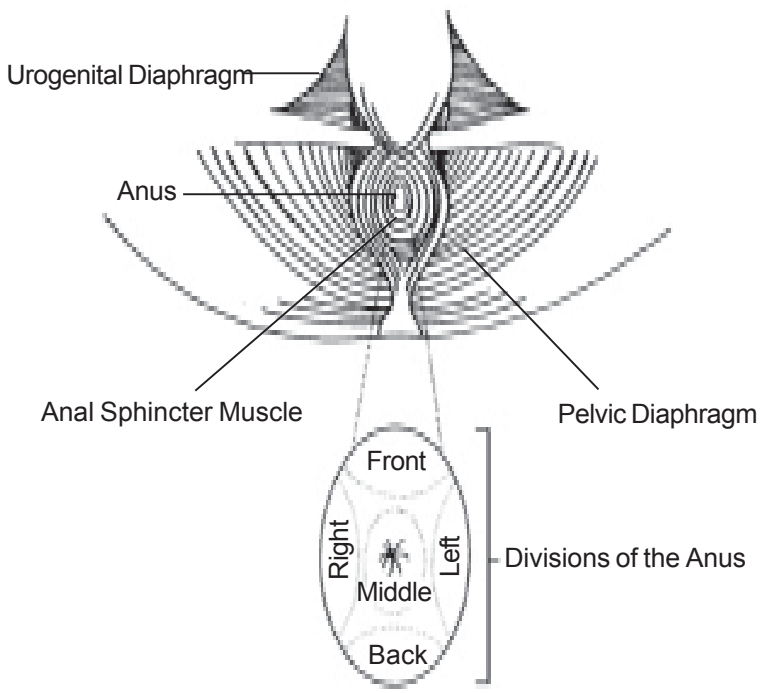

Fig. 3.6 *The anus is divided into five regions.*

All the ring muscles in the body reflect one another. Sexual Reflexology reveals this intimate connection between all the ring muscles in the body. The ring muscles in the face reveal the ring muscles in the urogenital tract, the anus and the perineum. When there is an imbalance of sexual energy it is revealed in the external characteristics of the face. Also, the ring muscles directly influence the health of the internal organs. When the ring muscles are out of balance, the organs become depleted. This depletion in the organs is reflected to the sexual center, as the organs supply the sexual center with energy. All these internal dynamics are reflected in the face, hands, hair and general external characteristics of the body.

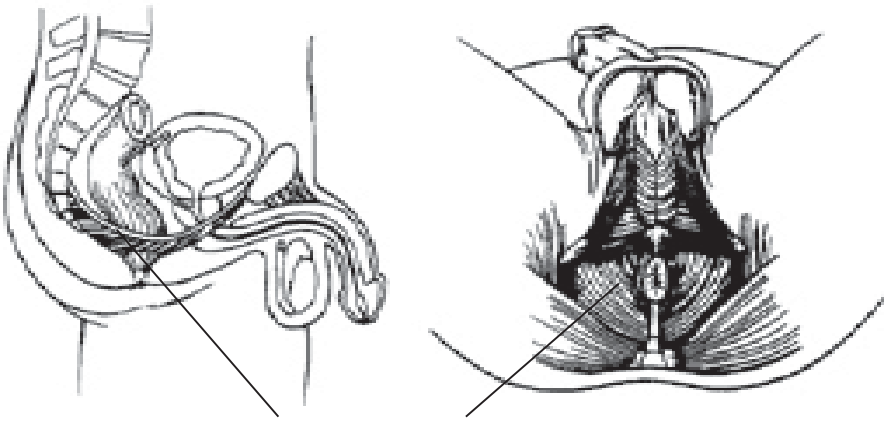

Pubococcygeus Muscle (PC Muscle)

Fig. 3.7 *Pubococcygeus Muscle*

Exercising the Ring Muscles

Contract the Mouth: Suck the cheeks into the mouth creating a suction in the mouth. It is a very similar sensation as making “fish lips”. Contract and relax at least 9-36 times. Feel the connection between the mouth and the rest of the body. Notice the connection between the mouth and the lower ring muscles in the anus and perineum for men at the base of the penis and for women the lower part of the vagina . Blink the eyes: Rapidly blink the eyes and look around the room. Exercising the ring muscles around the eyes will improve vision and keep the eyes moist. It is also a very good exercise to wake the body up as it stimulates the nerves. Blink the eyes for at least thirty seconds to one minute. Stimulating the muscles around the eyes helps open the urogenital diaphragm.

Contract the Anus: Contract and relax the anus. Feel the energy from the lower centers surge through the body. There are many Taoist exercises that utilize the power of the anus to circulate energy. The Taoists believe that the strength of the anus is an indispensable aspect of overall health. By contracting the anus, we strengthen the connection in all the ring muscles in the body.

Contract the Perineum and Vagina: Contract and release the muscles in the perineum and vagina. This is the same muscle that is used to stop the flow of urination. This muscle, like the anus, is the floor of the sexual center. By strengthening the perineum and vagina, we are able to contain sexual energy rather than allowing it to drain out of the body. The strength of the perineum is the first step in many other Taoist practices, like the Orgasmic Upward Draw and the Power Lock. You can contract and relax the perineum, vagina and anus at the same time to create more power in the urogenital diaphragm.

Full Body Contraction: Contract and relax all the ring muscles at the same time. Contract the eyes shut, suck in the mouth, squeeze the anus and pull up on the perineum all at once. Then relax. Do this at least 9-36 times. This will greatly strengthen the whole body. Remember that when all the ring muscles are in harmony the body is vibrant and full of life-force.

Contracting the eyes, mouth, anus and prostate gland will activate the center of the brain. When you contract the prostate gland it will activate the pineal gland. The prostate gland has a close connection to the pineal gland which is regarded as the second sexual organ.

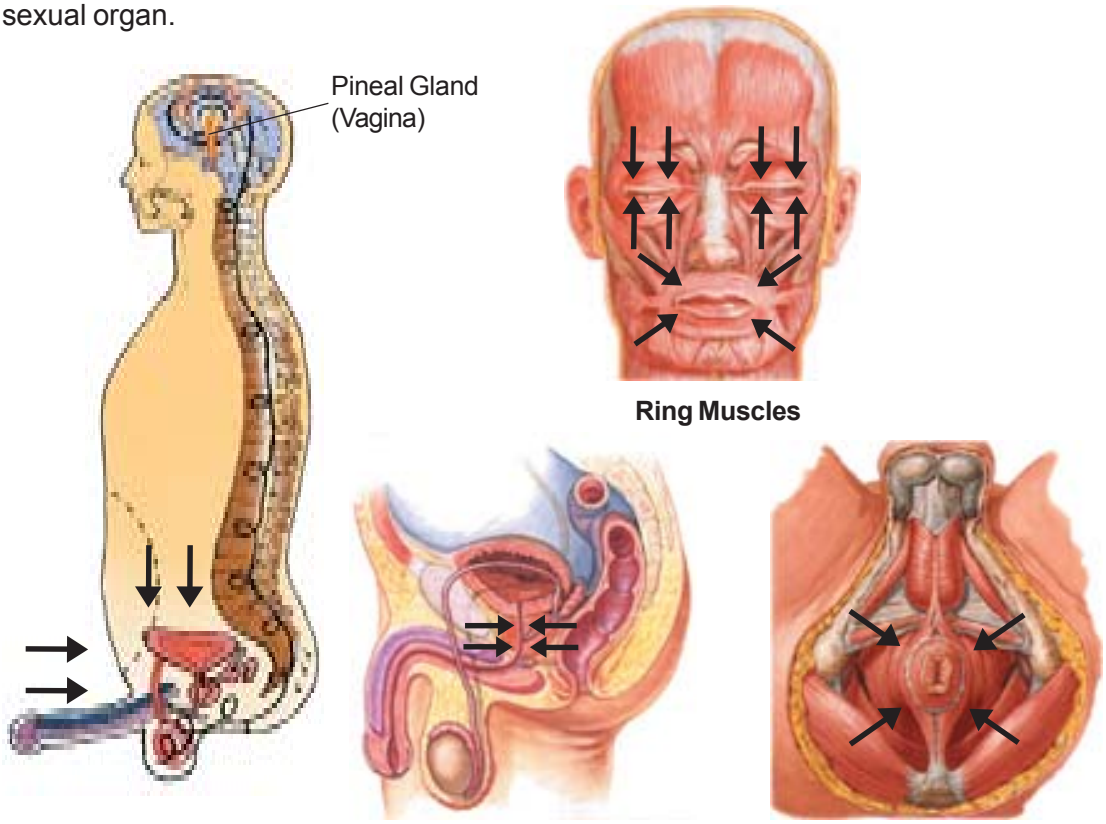

Fig. 3.8 *Male Pelvic Viscera, Prostate, Base of the Penis and Perineum*

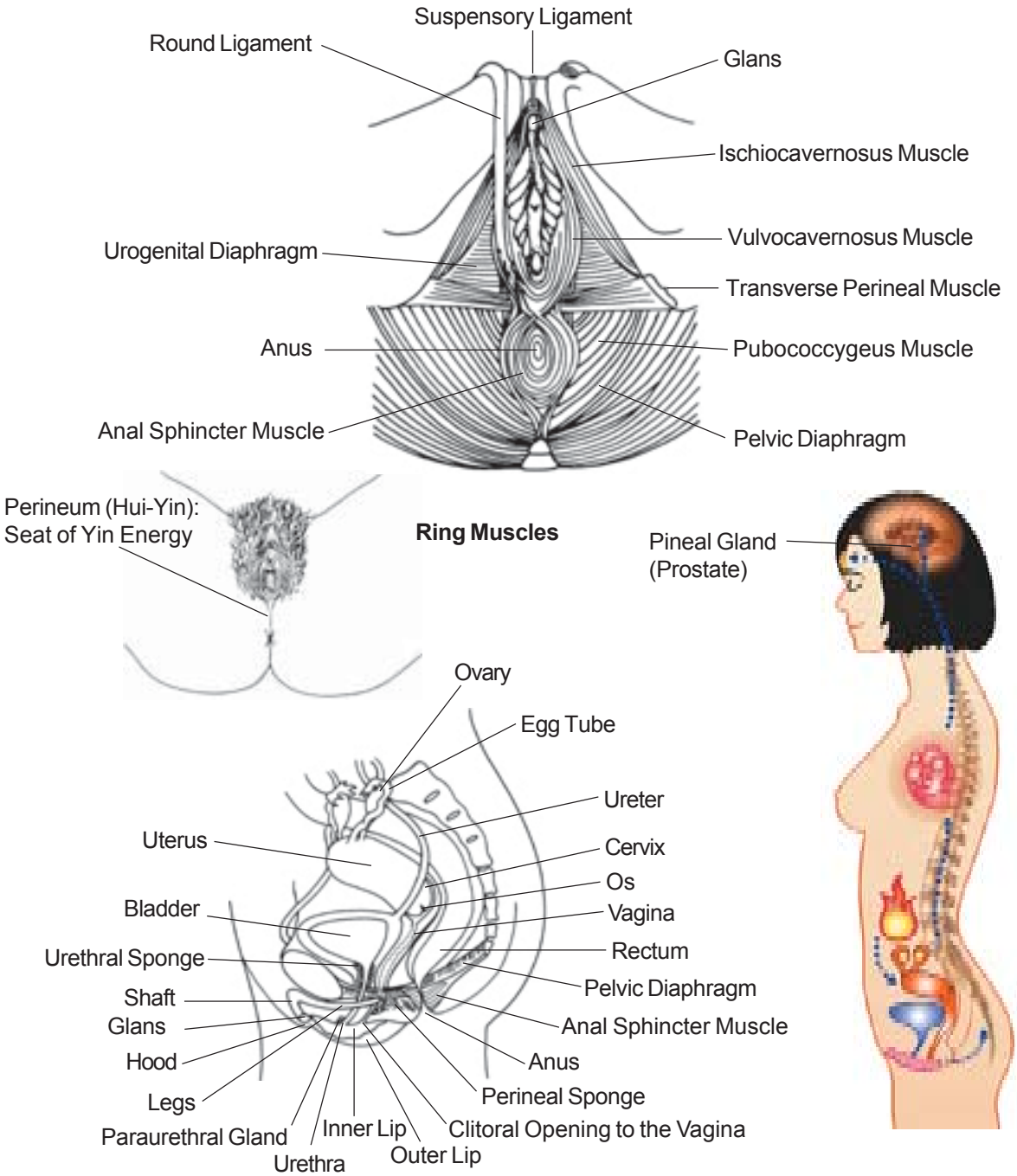

Fig. 3.9 *Women's Genitals: Chi Muscles include the Urogenital Diaphragm, the Pelvic Diaphragm, the Anal Sphincter Muscle and the Pubococcygeus (PC) Muscle.*

Chapter IV
Sexual Healing Positions

Healing positions use the distinct reflexology areas of the penis and vagina. Each Sexual Healing Position puts pressure on different parts of the sexual organs, relative to which part of the body needs to be healed. In stimulating certain areas of the penis or vagina, related organs are stimulated and rejuvenated, and the orgasmic energy is guided up to the specific organs. These ancient techniques have been tested and proven over millenia.

Eight Sexual Healing Positions for Men

With these particular healing positions, the man does the work and the woman is the facilitator for healing. While the man gets specific healing benefits, the woman also gains. All positions are helpful for problems with women's sexual organs because they stimulate the production of sexual hormones and help correct menstrual difficulties. In these positions the male should draw out intercourse for as long as it is comfortable. He should prevent ejaculation by using the anal contractions of the ring muscles using the Anal Contractions of the Testicle and Ovarian Breathing Exercises. (Taoist intercourse using ejaculatory control as explained in this book tremendously heightens the benefits of these exercises.)

Fig. 4.1 Position 1 *— Assists in sex-related problems, such as impotence, premature ejaculation and difficulty in achieving orgasm.*

The woman reclines on her side with her hips bent so that her pelvis faces upward. The man is above and enters her with his penis. This improves all sex-related problems including impotence. It may take some time to gain self-confidence. At first, just insert

the penis and go from there at your own pace. Nearly all men have some sexual ability and thus it is quite uncommon to be totally impotent. Most of the time the erection is lost about halfway into the vagina or some time during intercourse. Failure to reach a climax is often due to the man not being totally present. His mind roams and he drifts off into some fantasy. Because this position is a bit clumsy for the man, he must concentrate on what he is doing. Consequently, his mind will not wander or fantasize.

Fig. 4.2 Position 2 — *Energizes the body.*

The woman reclines on her back. She supports her head and shoulders with a large, high pillow. Then she bends forward at the neck. In such a position the vagina is slightly curved, which allows the penis to be massaged in the right location. Entering from the front, the man penetrates with his penis. After doing this every day for two or three days, the body will be totally rejuvenated. There are benefits for the woman as well because air is drawn up into the vagina, which stimulates her internal organs.

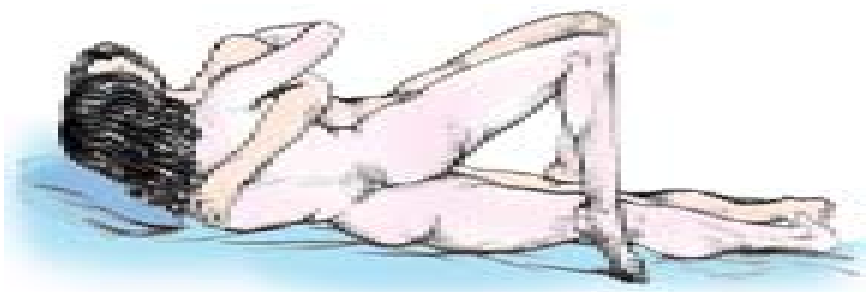

Fig. 4.3 Position 3 — *Strengthens internal organs, including the kidneys, spleen and liver.*

Both individuals lie on their sides face to face. The woman keeps her lower leg straight and bends her upper leg backward. The man inserts his penis. Do this for a maximum of four times a day for twenty days.

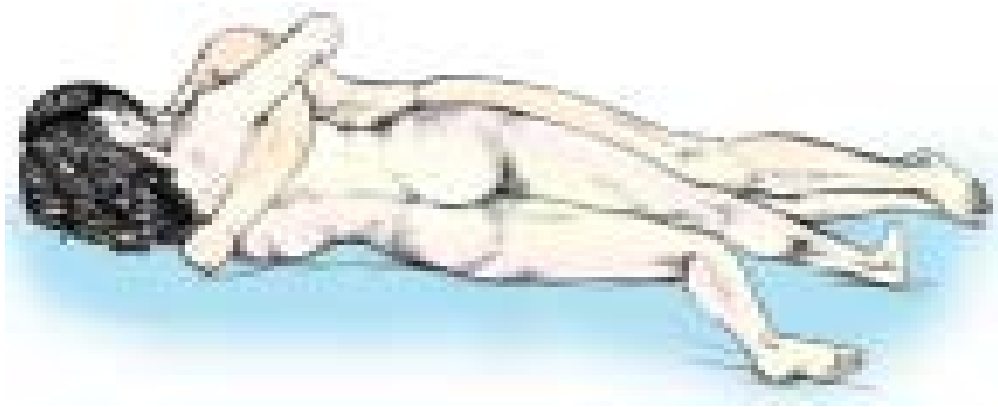

Fig. 4.4 Position 4 — *Strengthens bones.*

The woman reclines on her left side. She bends to her left as far as possible toward her back. The right leg remains straight. Face to face with her, the man finds an angle where he can enter her vagina. He can be a bit on top of her or immediately face-to-face. Use this position for a maximum of five times a day in a ten-day period. This is excellent for healing arthritis, leukemia, and bone marrow diseases. Furthermore, it can speed up healing of broken bones.

Fig. 4.5 Position 5 — *Assists blood vessel problems.*

The position for this is just like Position 4 except the woman reclines on her right side with her right leg bent. The man goes in the same way, face to face but a little bit above. Work in this position a maximum of six times a day for twenty days.

This approach is good for all sorts of blood vessel difficulties, including varicose veins and hardening of the arteries. It also improves high or low blood pressure.

Fig. 4.6 Position 6 — *Addresses blood problems, including blood pressure.*

The man lies down relaxed on his back. The woman is on her knees and faces him. He enters her but she does not move. He moves up and down from the bottom. This position can be done for a maximum of seven times a day for ten days. All manner of blood problems are improved by this position, including anemia, low blood pressure, poor blood quality and blood clots.

Fig. 4.7 Position 7 — *Assists lymphatic system problems.*

The man lies relaxed on his back. The woman kneels above him on her hands and knees. She faces him and can move a little. Essentially though only the man moves after penetration. Use this position a maximum of eight times a day for about fifteen days.

Fig. 4.8 Position 8 — *General healing.*

This position is often hard for the woman. She gets on her knees and then bends all the way backward with her feet under her. She bends back until her head and back are on the floor. The man goes in from in front and above. The woman may want to put a pillow behind her. Use this position a maximum of nine times a day for ten days.

When the woman is in this position the shape of the vagina is changed. The friction from the man's thrusting affects different areas of the penis. Through the process of reflexology, this influences different parts of the body and provides healing stimulation. The male heals himself and the woman is the facilitator. In the woman's healing positions that follow, the woman heals herself and the man is the facilitator.

Seven Sexual Healing Positions for Women

With these positions the male works for the woman. However, unlike the benefits the woman gets from the male's healing positions, he receives no real healing benefit.

How deeply the penis penetrates is important in the woman's healing positions. This is because different Reflexology Zones are located along the length of the vagina. Thus, different portions of the vagina need massage. Penetration can be shallow or deep depending on the specific problem being addressed.

After the penis is inserted in these positions, the woman moves her pelvis for the purpose of massaging and stimulating the vagina. When necessary, the man restrains himself and should communicate with the woman when he has to slow down. He should not ejaculate when in these positions. Repetition requirements are the same for all the positions. They may be done as many as nine times a day for a maximum of ten days.

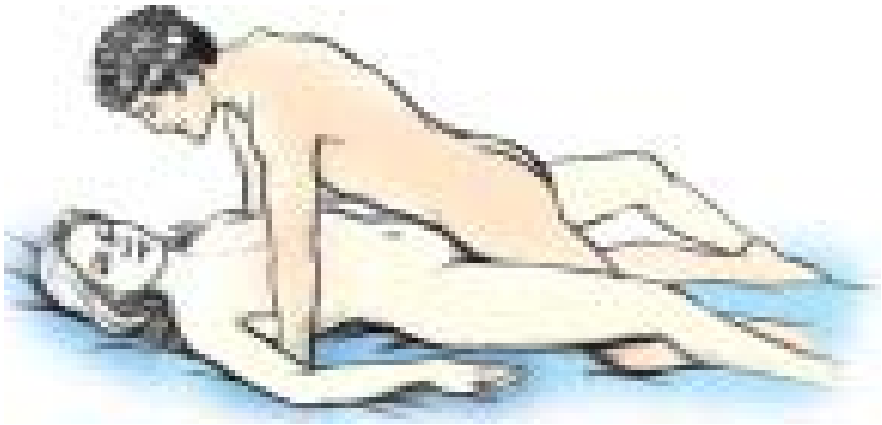

Fig. 4.9 Position 1 — *For fatigue as evidenced by blurry vision, heavy perspiration, weakness, fainting, quick heartbeat and weak, shallow and rapid breathing.*

The woman lies flat on her back and the man is on top of her. He inserts his penis as deeply as he can. The woman rotates in a circular motion beneath him, moving clockwise as well as counterclockwise. The man allows the woman to work and stays in this position until she is satisfied. Orgasm is not, however, the object of the healing exercises, and healing benefits will occur even without orgasm.

Fig. 4.10 Position 2 — *Stimulates the pancreas and liver, is helpful for diabetics. Also aids with hot flashes, weak knees and sore feet and knees after standing for a long time.*

The woman reclines on her back and wraps her legs around the man's thighs but not his back or shoulders. The man is above her on his hands and knees and only inserts the head of his penis about one and one-half to two inches. As above, the woman circles in both directions for as long as she feels comfortable. Because he is on his hands and knees there is shallow penetration. This means that the penis only touches the lung, pancreas and heart zones of the vagina. This position is also good for all the joints.

Fig. 4.11 Position 3 — *Assists the stomach, spleen, female organs and aids digestive problems.*

The woman reclines on her back with her legs locked around the man's midsection. She wraps her arms around him. On his hands and knees, he penetrates her halfway. Once again the woman rotates one direction and then the other for as long as she is comfortable.

Fig. 4.12 Position 4 — *Helps with water retention, kidney and bladder ailments, chronic high fever and pituitary gland problems.*

The man lies on his back. The woman is on her knees and faces the man's feet. The man inserts only the head of his penis. The woman can hold the penis for better control. As above, she circles in both directions as long as she feels comfortable.

Fig. 4.13 Position 5 — *Assists with the nervous system, liver, ulcers and eyesight.*

The man lies on his back with the woman on her knees facing him. The penetration of the vagina alternates from shallow to deep as the woman moves up and down on the penis. As she does so, she rotates her pelvis at the same time. This gives the vagina a complete massage.

Nervous system problems trouble many women. The female menstrual cycle can lead to hormonal imbalances and impact the nervous system. Child bearing can add to the hormonal imbalances that some women experience. This is a very good position to help bring the women's nervous system in balance.

Fig. 4.14 Position 6 — *Addresses energy blockages in the meridians, headaches, poor circulation, menstrual problems.*

The man lies on his back relaxed and the woman is on her knees, supporting herself with one elbow. She is just a little to the side of the man. She holds his penis. With her other hand she hold his head. The penis is allowed to penetrate halfway, but she holds it the entire time. Once again, she rotates in this position for as long as she is comfortable. (Penetration in this position is not easy. That is why the woman must hold the penis.)

Fig. 4.15 Position 7 — *Helps with blood shortage, anemia, poor circulation and pale, dry skin.*

This position is not as difficult as some of the others. The woman reclines on her back. Her knees are up to her chest and her feet are in the air. The man rests on his knees in front of her and enters very deeply. The woman rotates as the man remains still. This position contracts the vagina which allows for very deep penetration. If the man has a very long penis he can wrap the base of the shaft with a handkerchief to prevent it from going too far into the vagina. (This should be done every time if the penis is longer than the partner's vagina.) In addition, the handkerchief makes the penis stand up more and helps preserve the erection. The principle is the same as a "cock ring" which blocks the blood vessels so the blood cannot flow back out of the penis as easily.

Exchange of Energy as a Sexual Healing Prayer

What is True Love? Love combined with Truth equals True Love. While the word "love" has different meanings, True Love means that two hearts are united and there is no gap between them. It is not a social love. The love for a wife or husband is different than the love for a friend. Even the closest friends have a gap between them.

Neither gender should live alone. This is not meant in the sense of actually sharing living quarters, but from the point of view of sexual relationships. The sexes need each other for gratification and in order to heal, balance and adjust their physical bodies. We know from Taoism that every part of the body is holy.

In order to have a full life as human beings we need to understand our sexuality. To do so is to have a Divine Life. Suffering is not divine. When people reach a certain level of existence they become spiritual. The notion of suffering to become spiritual is actually an ego bound concept. People are not forced to suffer. We have a choice. If people had no will power or choice, they would be machines. In the bible, when God told Adam

not to eat from the Tree of Knowledge, He gave him a choice. ("Knowledge" here means religion.) God said that Adam would "die" if he ate from this Tree. Here death means separation from God. Man decided to have the knowledge. After that he became ashamed and tried to cover himself. Before that, he felt pure. It is necessary to return to this purity. If we are to please God, we must please ourselves first, because God is in us. If we lead a Divine Life, we are already in God's Kingdom. There is no need to pay a duty to God. He is capable of doing whatever He needs for Himself.

It is the goal of the Tao to become one complete person. Since man is part of woman and woman part of man, so we have an excellent opportunity to discover each other by living together. Throughout what is known as Sexual Healing Prayers, male and female are united and become one complete person.

A lot of discipline is required of the man during ***Sexual Healing Prayers***. This helps prevent him from giving in to lust. The man attends to the woman with his body. ***Sexual Healing Prayers*** allow people to start and end the day in peace away from worries and struggles.

Because we have our bodies, we should use them and discipline them. They are an instrument for the Soul-Mind to follow the Spirit. If we allow our Spirit to lead us and we follow our intuition, conscience and communication with God, our thinking, emotions and decisions come along too. It is, of course, impossible to get rid of our bodies. They must be satisfied. ***Sexual Healing Prayers*** both satisfy and discipline the body at the same time. When we pray, we should request that our bodies listen to our Spirit. We decide to please our God-Self. We will have a feeling of Pure Love.

As soon as two people meet, they become comparable to a square. Throughout the ***Sexual Healing Prayers*** they are interlaced and share a meeting point. After that, the square turns into a triangle. The woman is totally open and receiving. She is completely yin. The male is at his Taoist orgasm and is giving completely. He is completely yang. The complete yin state and complete yang state make up a perfect yin-yang balance which becomes a circle that has no beginning and no end. There are no cracks and no sharpness in the circle since there is no criticism between the man and woman. For the partners there is only feeling, devoid of judgement or thinking. With their eyes closed they feel each other. This feeling is total love and perfect unification. This union comprises the yin-yang. It is the microcosm and the macrocosm of the universe. It is eternal.

At that instant the partners are beyond space and time. Even if the prayer takes only two minutes, that in itself is time without end. The woman's climax during the ***Sexual Healing Prayer*** may last from two to ten or twenty minutes. During that period she is totally at ease and has no other physical desire. Consequently, the ***Sexual Healing Prayer*** is a kind of meditation. The quivering body and vaginal fluids are a part of the climax and may happen a few times before the woman is entirely opened up. The ***Sexual Healing Prayer*** for the man is the point just before ejaculation, but when he gets to that stage he remains there and holds it, using only feeling and no knowledge.

Indeed, this is the Tree of Life. More than an erection is required for ***Sexual Healing Prayer***. The prostate gland must be swollen to around 98% in order to keep the man's interest up.

Sometimes the purpose of meditation is misunderstood and it is often mixed up with "thinking." Many times when facing a problem people say, "I'll have to meditate on it." The meaning here is "to think." However, the real aim of meditation is to connect with our God-Self.

Sexual Healing Prayers are the finest meditation possible. They blend communication with our God-Self with inner exercise and healing. This is the level of absolute unity, or "no mind." Once this level is reached, people find themselves so fulfilled that they have no desire left for ordinary human sex. Love is beyond studying or teaching. Its origin is the heart and it is genuinely spiritual from the beginning. Love is giving.

During the ***Sexual Healing Prayer*** the man gives himself to his lover. The woman's gift lies in her surrender to the man. The two grow together, trading energy and well being. Thus, sex can be used by people to feel Divinity. The ***Sexual Healing Prayers*** provide total love automatically. This is not, however, the same as the mental picture of romantic love that most people have in their minds. It can be said that it is the apogee of Taoist Sexology. Just as the day is started with the ***Morning Sexual Healing Prayer***, so too is it concluded with the ***Evening Sexual Healing Prayer***. The experience is delightful. People find that they go to sleep relaxed and peaceful. The next day when they wake up they are prepared for the ***Morning Sexual Healing Prayer***,

We must realize that our thoughts form our world. The mind's cognition is essential reality and it comes long before the material world. The material things we can touch and see are brought into existence by the mind. With the right thoughts, anything can be materialized. Thus, in this case, we need merely to concentrate on the right partner and visualize what we want in our mind. Doing this will create the right person for us.

Chapter V
Sexual Energizing Postures

Hand Positions

These are the basic hands positions to energize the body and draw the sexual energy into the brain while doing the Healing Love practices. The stretching exercises and the hand positions drawing the energy to the brain enlarges the sexual organs and the size of the brain (Pineal Gland) giving you strength in the mind (Brain) and body (Organs).

This hand position strengthens the semen and ovaries activating the sacral pump.

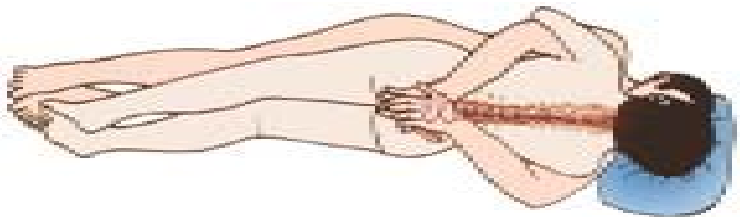

Fig. 5.1 *Sacral Pump Energy Point*

This hand position strengthens the life force and bone marrow activating the Ming Men point.

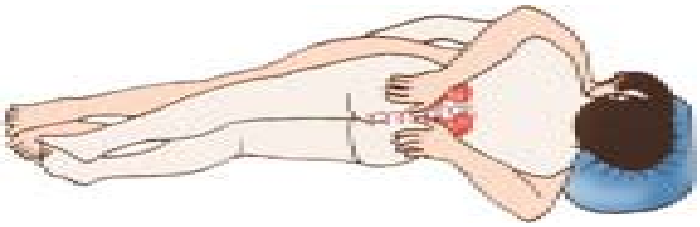

Fig. 5.2 *Kidneys' Energy Point*

This hand position strengthens all the organs and creates more sexual appeal activating the Door of Life.

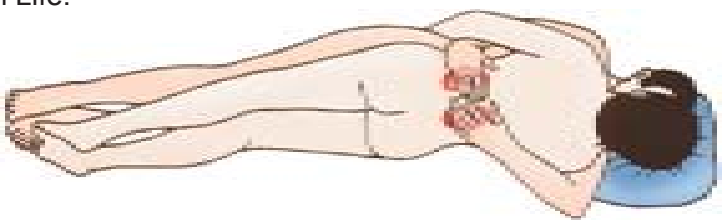

Fig. 5.3 *Adrenal Glands' Point at T-11*

This hand position strengthens the bones and enhances face, eyes and mouth color for a healthier, brighter looking facial appearance activating the T-11 point.

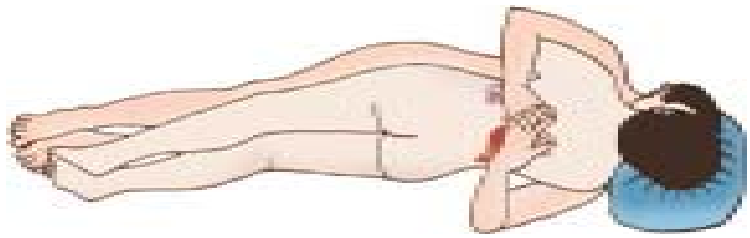

Fig. 5.4 *Liver and Spleen Point*

This hand position strengthens the aorta and vena cava arteries increasing the penis hardness and vagina wetness activating the wing point.

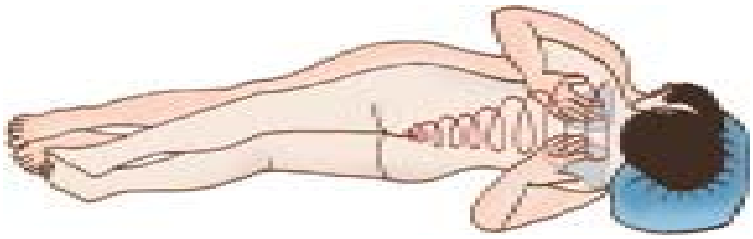

Fig. 5.5 *Heart and Lungs' Point*

This hand position strengthens the liver and spleen creating sexy eyes and a sexier mouth activ

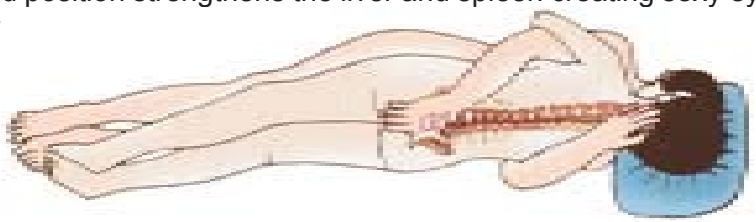

Fig. 5.6 *Sacral and the C-7 Point*

This hand position strengthens all the bones and improves the blood flow to the sexual organs activating the sacral and cranial pumps.

Fig. 5.7 *Sacral and the Neck Point*

This hand position strengthens the white and red blood cells and improves the erection and wetness, opening up women to a greater orgasm by activating the crown point.

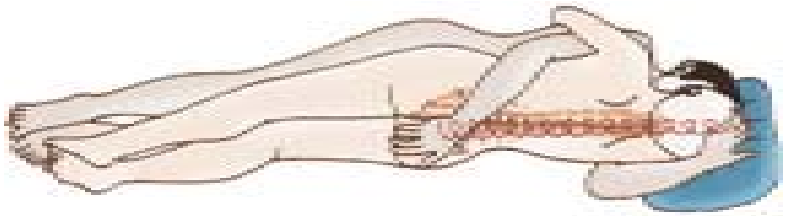

Fig 5.8 *Sacral and the Crown Point*

Healing Love Couples Energize the Senses

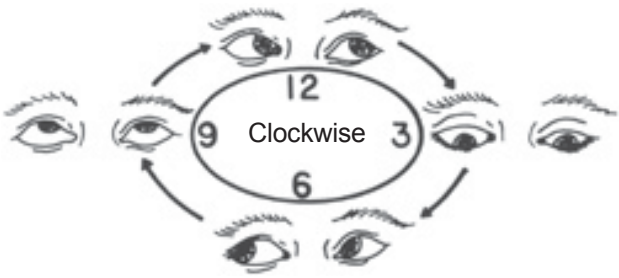

Fig. 5.9

Use mind and eyes to help circulate the energy nine times clockwise and 9 times counterclockwise and collect the energy.

Use Eye Movements in Healing Love Postures

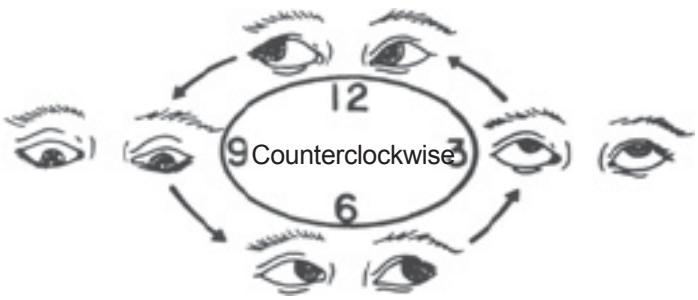

Fig. 5.10 *Eye Movement*

1. **Improve the Eyes:** When you are experiencing a high level of sexual energy and high orgasm, and near ejaculation, exhale through the mouth. Hold the breath, open the eyes wide and look left and right. Inhale and suck in the lower abdomen (reverse breath-

ing) six times. Balance the breath by breathing normally, and feel the orgasm energy flow into all the meridians.

2. **Improve the Hearing:** When close to ejaculation and experiencing a high level of orgasm sexual energy, swallow the Chi down to the Lower Tan Tien six times and grind your teeth with closed mouth. Inhale, hold the breath for a while, and listen to the sound inside the ears. Exhale, flatten the stomach. Inhale, suck up the stomach, hold and let the orgasm Chi spread to the limbs and the whole body. This will improve the hearing until old age.

3. **Balance Organs:** Improves digestion and cures all kinds of diseases. When the sexual energy is very high and ejaculation is near, expand the stomach and use mind power to gather the orgasmic Chi in the stomach. Contract the perineum and anus. This will help the orgasm circulate to all the body organs and glands. After this do the Nine Shallow and One Deep thrusting pattern (explained in *Healing Love* Book). This will help gather the orgasmic Chi; negative Chi will disperse.

4. **Strengthen Erection:** Practice the head stand to help reverse the sexual energy to the head and to all the body. This will make the penis hard with a strong erection.

5. **Return the Chi and Balance the Yin and Yang:** When close to ejaculation, inhale 9 times, hold back the ejaculation (with mind power). Use the left hand to hold the testicles, and feel the orgasmic Chi turn to sexual fluid.

6. **Semen Retention:**Those who release semen only twice monthly or twenty-four times a year, have more potential to live to one or two hundred years, with fine complexions and no ailments.

Healing Love Postures for Universal Tao Practices

The sitting position is perfect for lovemaking and energy connection and circulation for Microcosmic Orbit Meditation.

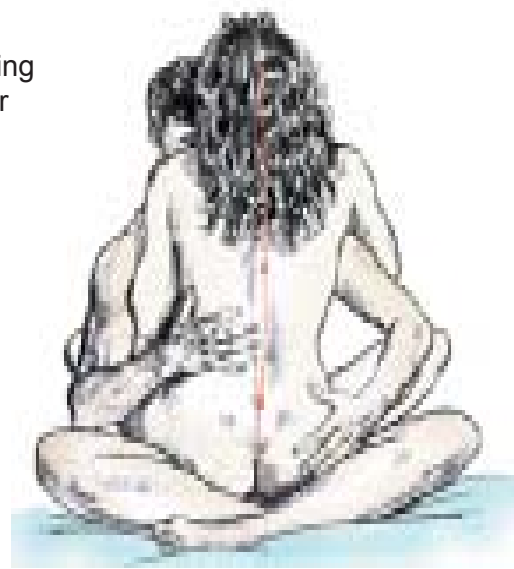

Fig. 5.11 *Microcosmic Orbit Connection*

Couples must first learn to circulate sexual energy in their own body during lovemaking. Later, partners can learn to give and receive sexual energy by using the Microcosmic Orbit.

Fig. 5.12 *Circulating Sexual Energy in Microcosmic Orbit.*

Exchanging and moving the energy allows the couples to give and receive sexual energy fully in healing each other through the Microcosmic Orbit Meditation.

Fig. 5.13 *Exchanging and Moving the Healing Sexual Energy on the Microcosmic Orbit.*

Energizing Postures Eight Healing Benefits

To strengthen the organs and senses you can use the sexual energy by stimulating the Sexual Reflexology points. The organs and senses become stronger and you become more attractive and sexier.

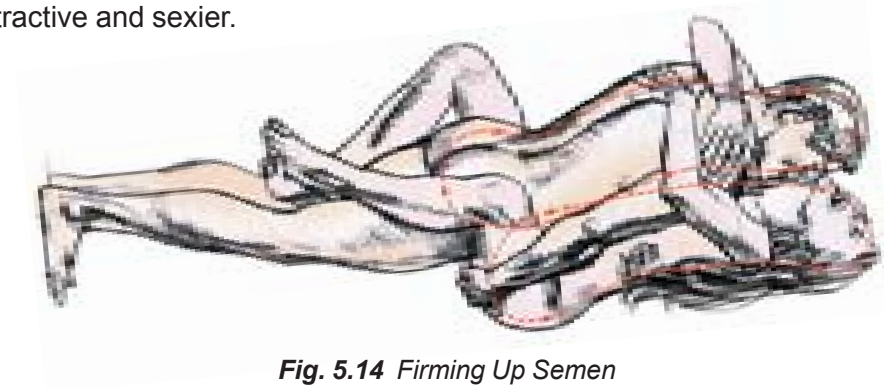

Fig. 5.14 *Firming Up Semen*

The ***First Benefit***, "to firm up the semen", is achieved by carrying out a count of double nine(18). Rest and guide the orgasmic Chi up to the crown; do this twice. When the count is completed the man stops; this causes him to firm up the semen. To eliminate blood leakage of the woman, she should practice twice daily and she should be fine in fifteen days.

The ***Second Benefit*** is called "tranquilizing the life force"; carry out a count of triple nine. Rest and contract lightly and guide the Chi up to the lungs; do 3 more times for the life-force to be harmonized.

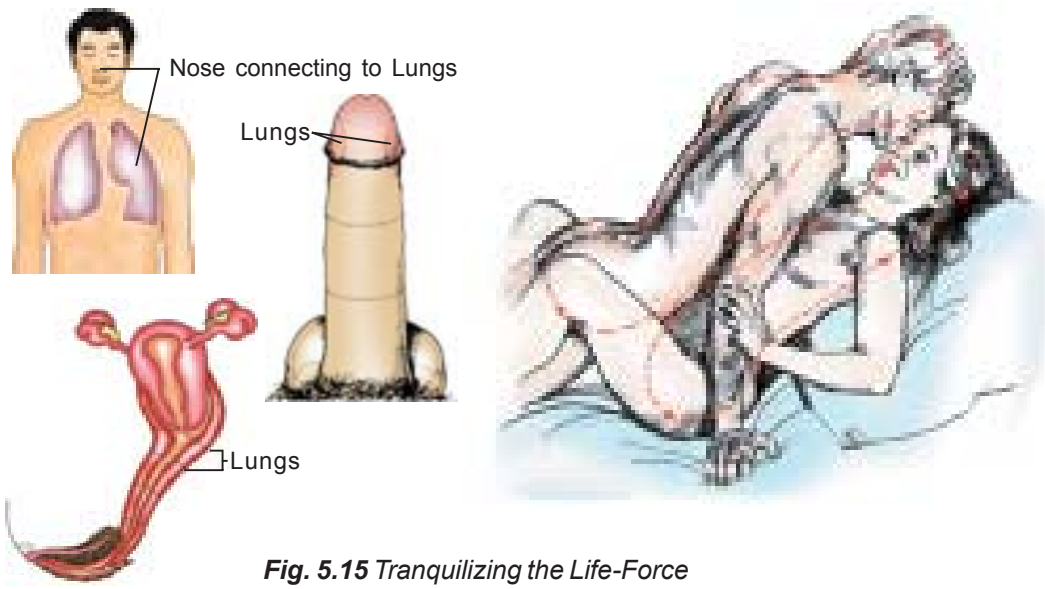

Fig. 5.15 *Tranquilizing the Life-Force*

The ***Third Benefit*** is called “profitably hoarding”; carry out a count of four nines (36) and stop when the count is completed. Rest and guide Chi into the organs; do 4 sets. This causes the couple’s life force to be harmonized; it can help coolness of the woman’s gate.

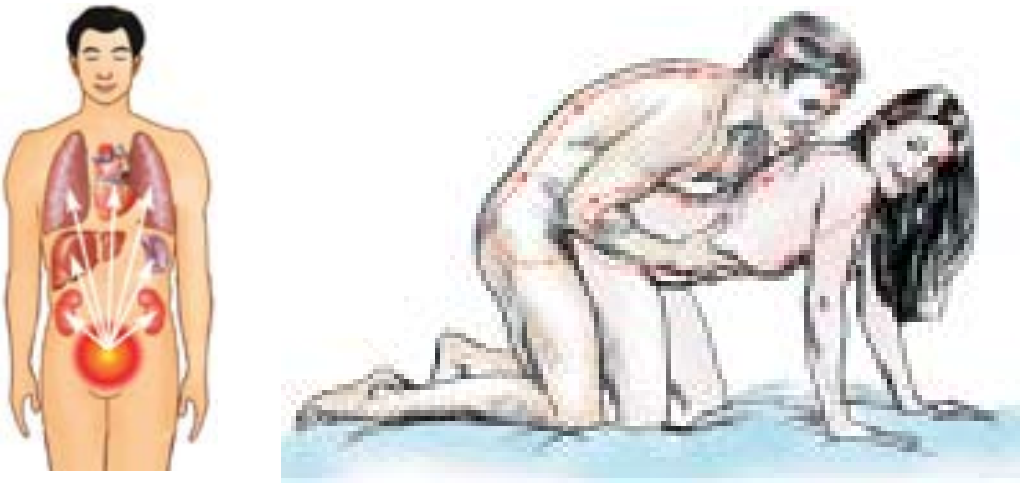

Fig. 5.16 *Profitably Hoarding strengthening all the Senses*

The ***Fourth Benefit*** is “strengthening the bones”; carry out a count of five nines (45) and stop when the count is completed. Rest and guide orgasmic Chi into the bones of the spine, rib cage and hip bones. Do 5 sets. This causes an improvement of the articulation of the joints in the man; it can remove obstruction of the woman’s blood.

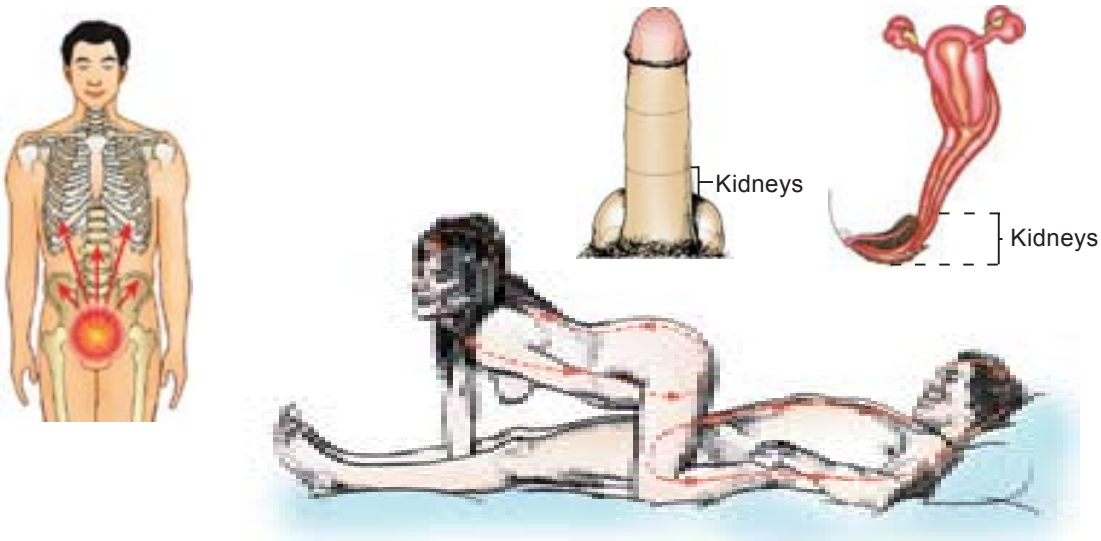

Fig. 5.17 *Strengthening the Bones connecting Kidneys and Eyes*

The ***Fifth Benefit*** is "blending the conduits"; carry out a count of six nines (54) and stop when the count is completed. Rest and guide orgasmic Chi into the aorta and the vena cava. Do six sets.

Guide Chi into the Aorta Vena Cava.

Fig. 5.18 *Blending the Conduits*

The ***Sixth Benefit*** is called "storing the blood". He inserts the jade stalk deeply. Carry out a count of seven nines (63) and stop when the count is completed. Rest and move orgasmic Chi into the spleen and liver. Do seven sets. This causes a man's vigor to be strengthened. Further, it can help inefficiencies of the woman's menstrual cycle.

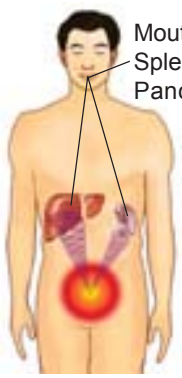

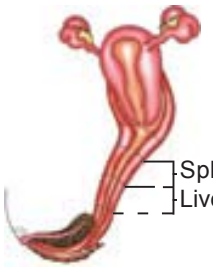

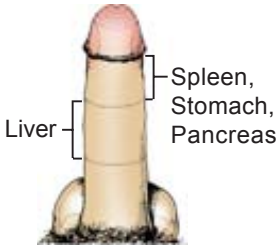

Fig. 5.19 *Storing the Blood*

The ***Seventh Benefit*** is “profiting the fluid”. The man mounts her, carries out a count of eight nines (72) and stops when the count is completed. Rest. Guide the orgasmic Chi into the bone marrow in the hips and rib cage.

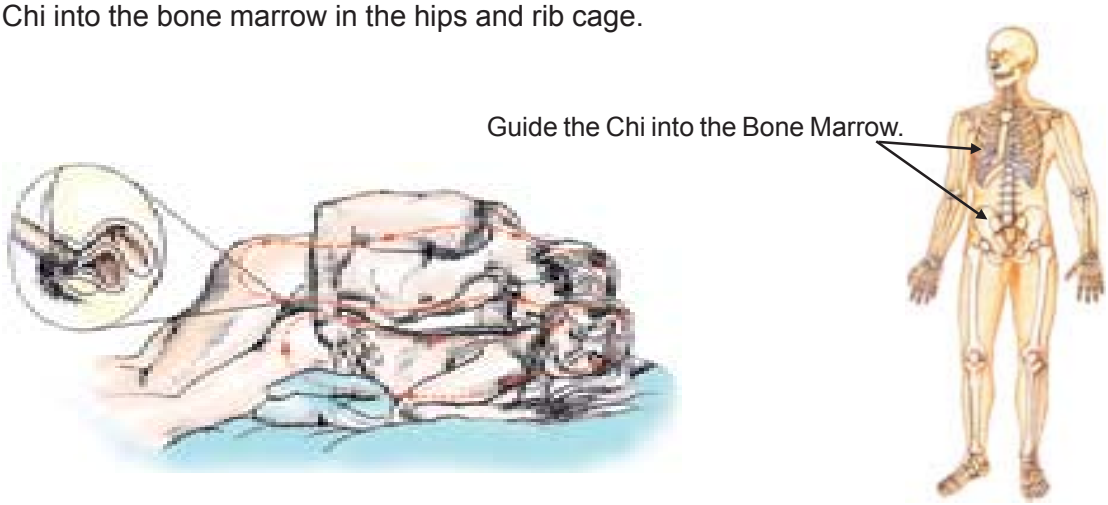

Fig. 5.20 *Profiting the Fluid connecting Kidneys and Eyes*

The ***Eighth Benefit*** is “informing the body”. He carries out a count of nine nines (81) and stops when the count is completed. Rest and guide orgasmic Chi into the bones and bone marrow. Do 9 sets. It causes the man’s bones to be fulfilled.

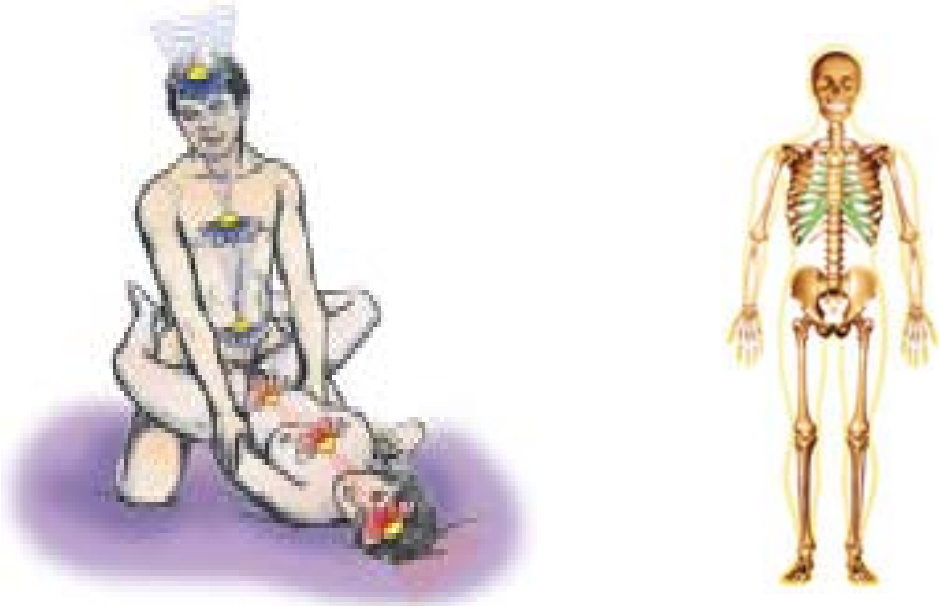

Fig. 5.21 *Informing the Body expanding into the Bones and Bone Marrow*

Chapter VI
Ejaculation and Menstrual Cycle Management

Ejaculation Management

A man may attain health and longevity if he practices an ejaculation frequency of twice monthly, or 24 times in a year. If at the same time he pays careful attention to proper diet and exercise, he will live a long and healthy life. Dr. Sun Ssu-mo

Diet, exercise and sexual restraint constitute the three pillars of Taoist health and longevity programs. Of course these Taoist principles apply equally to males and females. For both genders, semen essence is the energy that propels sexuality. It is the origin of the physical ability for sex as well as sexual interest and emotional affection for the opposite sex. On the other hand, because women do not discharge when they reach orgasm, it does not take away their sexual drive and interest after one act of intercourse. Since the principles required to achieve the harmony of Yin and Yang should be cultivated mostly by men, this chapter is addressed mostly to them. However, the information here should also be studied and comprehended by women who keep company with Taoist men or who wish to convert their men to Taoism (See books: *Taoist's Secrets of Love* and *Healing Love* by Mantak Chia).

According to western medicine, men naturally replace their semen soon after ejaculating and have a virtually limitless supply. This generalization is very misleading. Ejaculation can be compared to blood donation. After donating blood, people feel weak and tired for a day or two, until the lost blood is replenished. Blood clinics suggest that people only donate a few times each year in order to avoid chronic fatigue, lowered resistance and excessive strain on the circulatory system. Chinese medicine holds that the same point applies to semen, except that the loss of semen is even more difficult to replace than blood. A great deal of essence and energy are needed to completely replace semen supplies and restore proper hormone balance after ejaculation.

If the frequency of ejaculation surpasses the body's ability to completely replace the semen, men go through chronic fatigue, decreased resistance, irritability and other indications of depleted essence and energy. Furthermore, they lose all sexual interest in their partners, who could very well desire additional lovemaking. While it may be the case that adolescents and young men in their early 20s replace semen at a pace that permits frequent ejaculation, the idea that this ability goes on indefinitely into adulthood is absurd. Rather it is women, and not men, whose sexual power is virtually unlimited.

It should be noted though, that celibacy is not the answer either, because that deprives men of the benefits of sexual stimulation. The solution then, is ejaculation control. Regular coitus with infrequent ejaculation keeps a man's interest in the act and his ability to continue indefinitely until his mate is completely satisfied. In fact, males who ejaculate one or more times daily might eventually 'lose their mind'. Frequent ejaculation brings about a chronic loss of the vital fluid that the brain and spine need to operate properly. The resulting deficiency of this critical fluid may bring about premature senility, inability to concentrate, chronic depression, loss of sexual drive and numerous related symptoms.

In addition, modern scientific evidence states that every time a man ejaculates there is a meaningful loss of zinc. Zinc is a rare but extremely important trace element. Therefore, ejaculating too often results in a chronic and serious deficiency of zinc. The symptoms of zinc depletion include loss of memory, confusion, paranoia and hypersensitivity to sunlight. It is interesting that these scientific facts seem to substantiate the 'old wives' tale' which claimed that masturbating too often muddles the mind, weakens the spine and causes blindness.

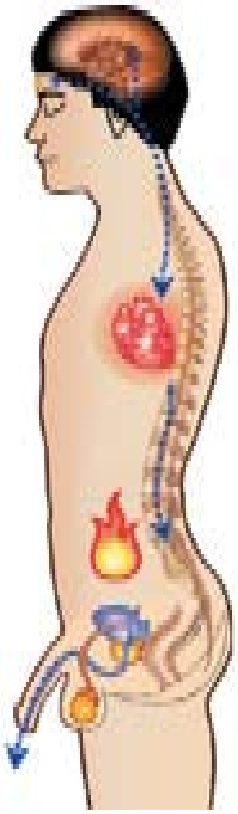

Fig. 6.1 *Through ejaculation zinc is lost which leads to loss of memory, confusion and paranoia.*

Regulating Ejaculation Frequency

Every school of Taoism believes that retaining semen and proper regulation are essential skills for men of the Way. The mavens of ancient China each left us their own personal guidelines determining emission frequency. By putting together their different suggestions with your personal requirements and actual experience, you can easily determine an ejaculation timetable that is appropriate for your personal needs.

To start, let's consider what the Plain Girl said to the Yellow Emperor on the topic. Being a bit confused by the notion of 'sparing vital essence' and ' regulating leakage', the Yellow Emperor expressed his doubts to the Plain Girl. This is what she had to say. Some men are strong, others weak. Some men are old, while others are young. Each person must live according to their own vital force and not try to impel the joys of sex. Impelling joy is harmful.

1) A healthy male of 20 may ejaculate two times a day, but an old one should do so no more than once daily.
2) A 30-year-old male can ejaculate once a day, but only once every two days if he's is not strong.
3) A brandishing 40-year-old man can give off semen once every three days, but if he's lacking power, he may do so only once every four days.
4) A full-bodied man 50 years old may eject semen once every five days, but only every ten days if he is lacking strength.
5) A healthy 60-year-old man may ejaculate once every ten days, but only once every 20 days if he is in poor health.
6) A robust 70-year-old man can eject semen once a month, but one lacking strength should no longer emit semen at all.

During the Tang Dynasty, physician Lee Tung-hsuan, in *Mysterious Master of the Cave*, used the frequency of coitus, rather than the number of days, as his recommended measure for regulating emissions. For example, when having intercourse with women, a man should eject semen only two or three times in a ten day period. The great Han Dynasty adept Master Liu Ching, credited in dynastic archives with living over 300 years, preferred to regulate his semen ejection relative to the universal cycles of seasonal change.

The seasons have an influence on how often a man may allow himself to ejaculate. In spring, once every three days is reasonable, but in the summer and fall twice a month is more appropriate. In the cold of winter, there should be no ejaculation at all. Accumulating Yang essence in winter is the way of heaven. Those who follow this advice will live a long and healthy life. A single ejaculation in winter is one hundred times more harmful than a spring time ejaculation.

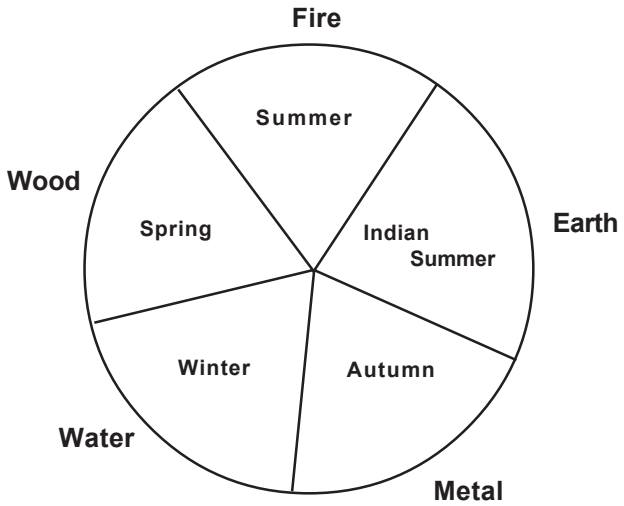

Fig. 6.2 *Seasonal Ejaculation*

The best advice on the topic of ejaculation restraint comes from the centenarian doctor Sun Ssu-mo. This Tang Dynasty Taoist outlived three emperors by following his own advice. The rule of thumb that he recommended is quoted above. In actual practice, however, he only ejaculated one time per 100 copulations. Dr Sun lived to be 101.

Fig. 6.3 *Fire of the Lamps*

Sun Ssu-mo tells us that a man should 'become acquainted' with Taoism by the time he is 30 and 'gain a complete working knowledge' of it by 40. Prior to the age of 40, most men are still extremely potent and vigorous. By the time they are 40, however, they notice their potency decreasing. At the time that his potency declines, numerous ailments will come upon him. Unchecked, he will quickly find himself beyond cure. Dr Sun gives repeated warnings to his male patients of the dangers associated with excessive ejaculation. He makes an analogy with a sputtering oil-lamp which, just prior to being spent, suddenly flares up brightly, then dies. Whenever a man restrains himself and holds onto his semen, it is like adding new oil to a lamp that is about to go out. But if a man ejaculates each time he has sex, it is like taking oil from a lamp that is already

nearly burnt out. Sun Ssu-mo sums by saying that 'if a man wastes his semen, he will soon die. For men, this is the most significant thing to remember about sex.'

By the same token, and in agreement with the Plain Girl, Dr. Sun counsels against total abstinence. The man who has no sexual intercourse with women is prone to restlessness and longs for female companionship. Suppressing the natural urge to expel semen on occasions not only requires great effort but in fact makes it easier to lose semen. This can come during sleep through nocturnal emissions or so-called wet dreams. A single ejaculation is equivalent to one hundred emissions during normal intercourse. Sun Ssu-mo suggests regulating ejaculation according to one's age.

1) By 30, a man begins to lose vitality and should stop wasting semen in a reckless manner. Masturbation should be forsaken and the man should become acquainted with the Tao of Yin and Yang.
2) By 40 a man has reached a pivotal point in his life. To prevent quickly going downhill straight into the grave, which undisciplined sex causes at this stage in life, ejaculation control should become a habit.
3) By 50, his ejaculation should be reduced to no more than once every 20 days.
4) At 60, most men should totally curtail ejaculation (but not intercourse). A man who is very healthy and has a strong libido, however, can continue ejaculating about once a month, or, even better, once in every 100 coitions.
5) This program can continue right on through the seventies. Ejaculation control is important for strong, healthy males as well as for those who are elderly or not so strong. Beginning such a program early in life helps avoid the worst ravages of old age, including the loss of vital energy (For more details see books: *Taoist's Secrets of Love* and *Multi-Orgasmic Man* by Mantak Chia).

Total celibacy for most men is equally as harmful as excessive emission. It creates a strong desire for sex, which causes an imbalance of essence, energy and spirit. Furthermore, it ultimately causes even more loss of sexual essence and energy through the uncontrollable, intense emissions during 'wet dreams'. For those who wish to determine their own emission schedule, the methods of semen retention introduced below must be mastered. Next, follow the guidelines given already using a trial-and-error assessment of your own vitality. A man should feel as light and refreshed after ejaculating as a woman feels after orgasm. He should not be exhausted, drained and uninterested in more sex. An ejaculation of this sort may be experienced only when the semen supply is what the Chinese term 'full' and 'flourishing'. If an emission leaves a man tired and depressed, he should add to the interval between ejaculations.

A man may also help reduce the loss of essence and energy because of semen emission by training himself to 'come lightly' on those occasions when he chooses to ejaculate. Instead of rushing headlong to a fury just before ejaculation, advance to the edge slowly and softly and enjoy the wonderful sensation of release. Following that,

intentionally 'squeeze off' the uro-genital canal with a heavy contraction of the anus and penis before the ejaculation is complete. This will preserve about 20-30 per cent of the semen while still giving the desired ejaculation. Right after ejaculation, rhythmically tighten the urogenital diaphragm for one or two minutes by locking the anal sphincter. This tightens the floor of the pelvis, which gets loose and slack after ejaculation. This practice helps avoid post-coital loss of Chi through the perineum, anus and urogenital canal. This practice is very helpful for women too, because it precludes loss of chi through the vagina and boosts sexual energy to go up the spinal channels to the brain.

Many men are skeptical about this disciplined and unconventional approach to sexual relations. They need to be completely convinced by personal experience that it is necessity. Here are a few easy experiments any man may try to prove the truth of Tao in sex.

1) Try having vigorous intercourse shortly before taking part in an athletic event or stage performance. Do it once with ejaculation and once without and compare the resulting performances. The difference is amazing.
2) Or, have intercourse late at night, once with and once without ejaculation. After that, compare the amount of sleep you need and how you feel when you get up the next morning.
3) An even more striking test is the difference in energy felt during the day after having intercourse upon waking up in the morning. Make sure to try it both with and without ejaculation. There are numerous factors that can be checked, for example, weather, mood and physical condition.
4) You will definitely notice a huge difference in how you feel after having sex with and without ejaculation on an extremely cold day in the middle of winter. You will have a clear understanding of why Peng-Tze says, "One ejaculation in winter is one hundred times more harmful than one in the spring".
5) Those who significantly reduce their ejaculation frequencies in the winter without reducing sexual intercourse are far less likely to suffer from colds, influenza, chills, the winter 'blues' and other symptoms that often accompany cold weather.
6) Furthermore, if you're feeling 'down and out' already, an ejaculation will only pull you deeper into depression. Having a love making session without emitting semen is a terrific way to 'pull yourself up' again.
7) The same principle is true in regard to physical condition. When a man is sick, losing semen only aggravates his condition by robbing him of his biggest source of resistance at the very time he needs it most. On the other hand, disciplined intercourse mitigates a lot of chronic illnesses, especially those affected by hormone levels. Both Miles Davis and Mohammad Ali arrived at these conclusions in exactly the same way - by trial and error. You can do the same thing.

Each man must determine his own ideal rate of semen emission. It is important to know whether it is appropriate to ejaculate or not in a given situation. The calendar can help you decide whether it is OK or not. One thing is quite clear, however. If a man is drunk, or filled with food, or sick, it is best to forgo that short-lived spasm of enjoyment and maintain one's energy. The Taoist text *Essentials for Nurturing Life* warns us that ejaculation is strictly forbidden for a man who is drunk or gorged with food. Discharges at times like this injure a man a hundred times more than under normal conditions and, indeed, may bring about dizziness and ugly sores.

Fig. 6.4 *A drunken man sick and confused.*

Mastering the Techniques of Controlled Contact

All Taoist health regimens, including ejaculation control, involve the Three Treasures of essence (body), energy (breath) and spirit (mind). They are used in conjunction in an effort towards a single goal. The Yellow Emperor's Classic says that 'Spirit directs energy, energy commands essence'. The meaning of this is that the true Taoist man uses his mind to control his breath, breath to control blood, and blood to control semen. This is because 'when blood halts, semen must halt as well'. Ejaculation is always preceded by a quick speeding up of the heart. This tells us the importance of keeping the pulse normal during intercourse. Because breathing controls heartbeat, the primary exercise for developing ejaculation mastery is deep, rhythmic, abdominal breathing done in the same way as during breathing exercises. One need not apply the abdominal and neck locks with each breath while having intercourse. However, the anal lock should be applied frequently. Each application of the anal lock helps to keep the semen from coming out.

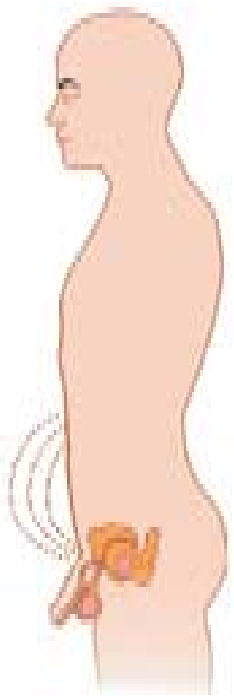

Fig. 6.5 Abdominal Breathing

When you lose track of your breathing, your heart rate increases, which puts you ever closer to the edge of ejaculation. It takes a few years of practice to master total voluntary control over body, breath and mind while having sex. There are, however, some clever tricks invented by ancient practitioners to help fellow Taoists to regain

control over their semen when they feel they are on the verge of ejaculating. The most important are breath retention and 'locking up' the entire sacral area with tight contractions of the urogenital diaphragm. The Taoist physician Lee Tung-hsuan talks about this in *Mysterious Master of the Cave*. The exercise practices of the sexual organs will help stimulate the Reflexology Points of the sexual glands and organs, which will strengthen them. Upon feeling on the verge of ejaculation, a man should always hold back, at least until the woman has reached orgasm. He should remove the Jade Stem a little and put it between the Lute Strings (frenulum of clitoris) and Wheat Buds (labia minor). He should shut his eyes, think about his mind, push his tongue against the roof of his mouth, arch his back, and stretch out his neck. Then he opens his nostrils wide, closes his mouth, and takes in a very deep breath. Doing this in time will postpone ejaculation.

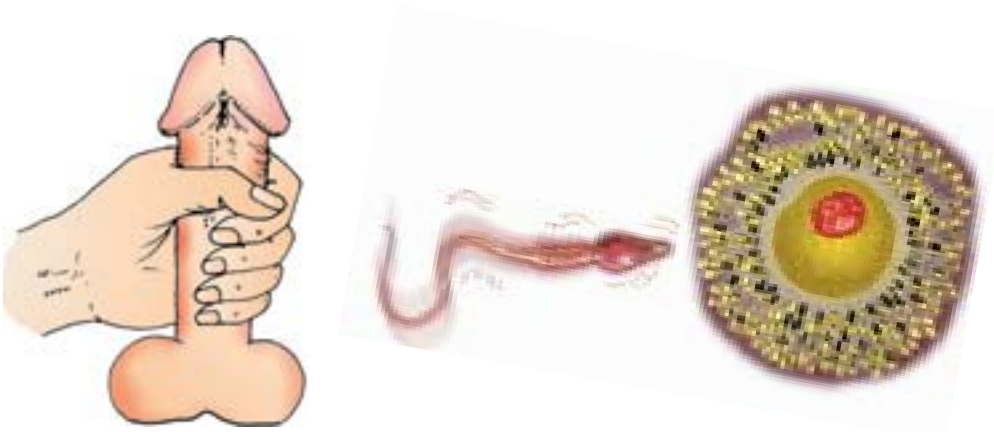

Fig. 6.6 *Penis Massage with Semen and Egg*

Ejaculatory Control Practice

1) Once the feeling for reaching orgasm becomes strong, flex the Chi Muscle as tight as possible, breathing in deeply through the mouth.
2) Visualize the semen contracting back into the body while continually squeezing the Chi Muscle tighter and tighter. Perform this again, massaging yourself until you feel the urge to ejaculate is inevitable.
3) Once you are for sure you are going to climax, squeeze the Chi Muscle as hard as you can while breathing in through the mouth deeply. Continue to tighten the PC muscle to keep from ejaculation.
4) Visualize the semen starting over, contracting back into the brain until the urge subsides. Continue to squeeze the Chi Muscle tighter until the urge to ejaculate has vanished. Do this ejaculatory control exercise 10 times, making sure not to ejaculate during the exercise.

5) If you do ejaculate, you need to develop the Chi Muscle much more.
6) Once the ejaculatory control exercise has taken it's toll on you after 10-20 sets, perform this exercise as many times as it takes to completely exhaust the Chi Muscle. Achieve an erection and flex the Chi Muscle a few times while you massage it to make sure it is quite hard.
7) Once you have a firm erection, squeeze lightly around the penis's shaft, right underneath the head. Now, flex the Chi Muscle as deep as you can until it flutters, then unflex. When you flex the Chi Muscle you should be able to feel the penis throb.
8) Continue to do this over and over again until the erection becomes soft. Achieve another erection, and follow the directions over and over again.

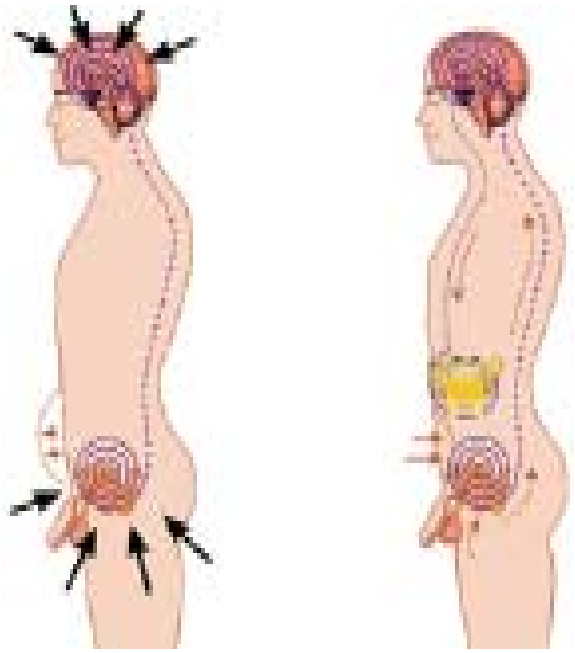

Fig. 6.7 *Ejaculatory Control*

You should perform these exercises every day or at least 4 times a week. You will find that performing them every day not only forms a better habit, but also makes you feel more fit and potent. Once again, Chi Muscle exercises are the most important exercises you can do for penile fitness and strength development. Having a strong Chi Muscle will enable you to experience a whole new level of ecstasy when making love with your partner. Imagine having the ability to actually make your erections hard and keep from ejaculating by simply flexing your Chi Muscle so tight it closes off the ejaculatory canal. If you are ready to wake up every morning with hard erections, and increase your ability to last as long as you want in bed then work on your Chi Muscle. And drawing the sexual energy through the Cosmic Orbit movement to the brain increases sexual hormones to revitalize the brain.

Breathing Exercises

1) Clear your mind of everything, including worries, problems, work, school, relationship troubles, everything.
2) Inhale through your nose as deep as you possibly can. When you feel like you've reached your lungs maximum capacity, keep trying until you cannot breathe in anymore.
3) Hold for a few seconds, and exhale through your mouth slowly, taking 3-4 seconds to fully exhale.
4) Do this for as long as you feel able, do this throughout the whole day, while driving, working, playing, etc. You will feel much more alert. See if you can do this for at least 20 minutes a day.

Buttocks Exercises

When you make love with your partner, 90% of your thrusting power and ability comes from your buttocks. This simple and easy exercise will strengthen, tone, and shape your gluteals for maximum sexual ability and performance, not to mention a better looking backside. You can do this exercise anywhere.

1. Stand up with your feet forward and about shoulder length apart from each other.
2. Standing up, flex and tense your buttocks as tight as you can. Hold for 10 seconds and release. Do this again 5 times to warm up. By now your buttocks should feel a slight burn and that is good.

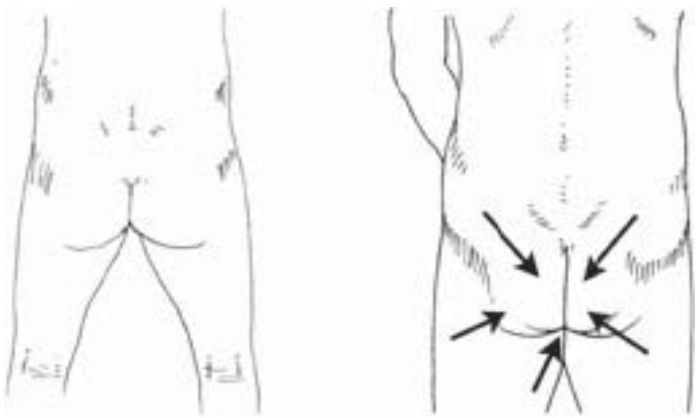

Fig. 6.8 *Buttock Squeezing*

3. Now, lay downon your back on the floor . With your hands to your side, flex your buttocks as tight as you can and hold it for 30 seconds. Once you have released, flex your buttocks rapidly without stopping until you feel total fatigue and cannot flex anymore.

4. You should feel a total burn all over you buttocks and this is what you are trying to accomplish. Rest for 30 seconds and repeat this 5 more times.
5. By now you should feel like your buttocks are totally exhausted, but the workout isn't over yet. Now, flex as hard as you want and hold it. Watch the clock or your wrist watch and hold this for one minute, no matter how hard it gets! This is where your shaping and strength is going to come from, this precise exercise. After the one minute is up, without resting, repeatedly flex and unflex your buttocks over and over again for one minute. If you can, repeat this process again, holding for one minute and flexing for one minute. You should do 4 sets of these. Do what you can for now, and keep in mind just how much you can do until you cannot do anymore. Within a month, you should be able to do 3 or 4 times as much as you can now.

Warming the Stove (For Men)

This method of increasing sexual potency is sometimes called the Deer Exercise, due to the abundance of sexual energy of the deer.

1) To perform this exercise stand in a wide stance or sit on the edge of a chair.
2) Rub the palms together until warm.
3) For men, with one hand cup the scrotum, with the other hand, rub the lower abdomen in both a clockwise and counterclockwise direction.
4) This should be done 100-300 times for optimum benefit. When the Chi moves, some people will belch or move gas.

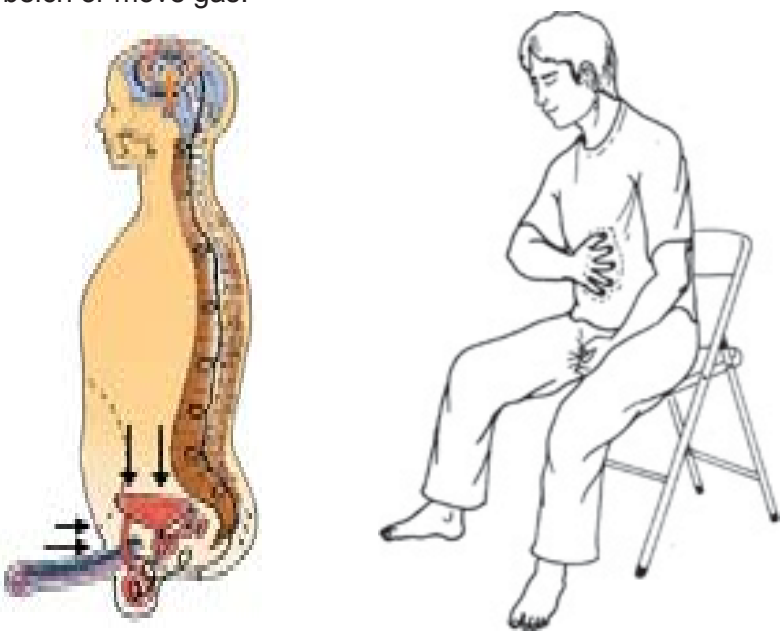

Fig. 6.9 *Warming the Stove*

Ovary Massage

The ovarian massage is the first way to transform the menstrual cycle into life force. This is a great way to bring the female sexual energy through the whole body. It also regulates the menstrual cycle and balances hormones.

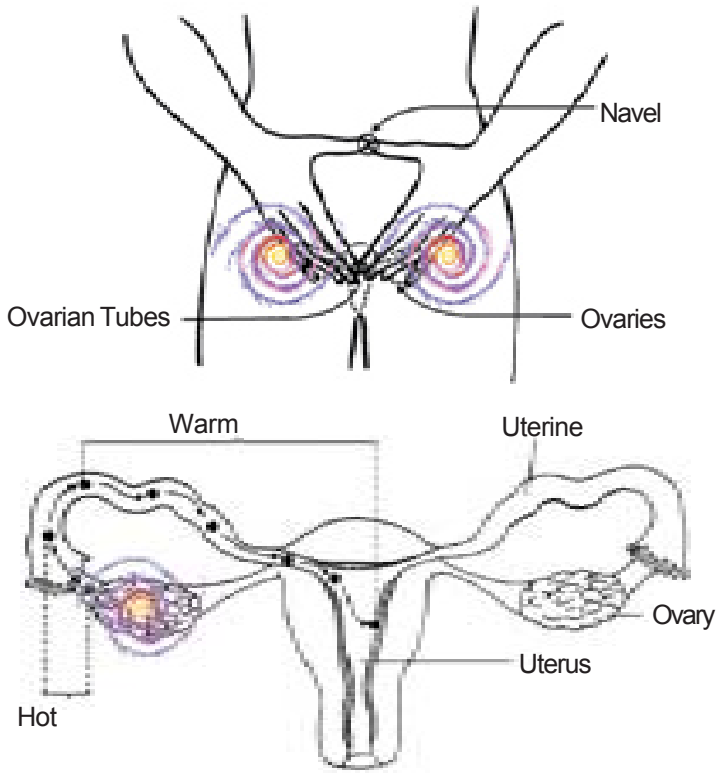

Fig. 6.10 *Ovary Massage*

1) Stand or sit upright and warm up with a few minutes of deep abdominal breathing. Massage the hands vigorously together until warm.
2) Place the hands separately over the ovaries in the lower abdomen and begin massaging the area over the ovaries in a circular clockwise motion about 36 times.
3) Reverse the direction. Next, simply leave the hands resting on the ovaries, feeling the warmth penetrate the skin, energizing the entire area.
4) End with a few Chi Muscle contractions and at least one minute of deep breathing. Do this exercise two or three times daily, in order to stimulate circulation and healing energy into these areas.

Breast Massage

1) Sit comfortably with the back straight, or stand with feet about shoulder width.
2) Rub palms together until warm, place the center of the palms firmly over the nipples and slowly massage in circles, 36 times in each direction.
3) As you massage focus your attention on the heart area, feeling the warmth of the palms radiating into the heart.

   This exercise is extremely beneficial for frigidity or low libido, because it stimulates the entire endocrine system. The breast massage should be performed daily as a way to balance the hormones and menstrual cycle. It is a good exercise to prevent cysts, tumors and breast cancer.

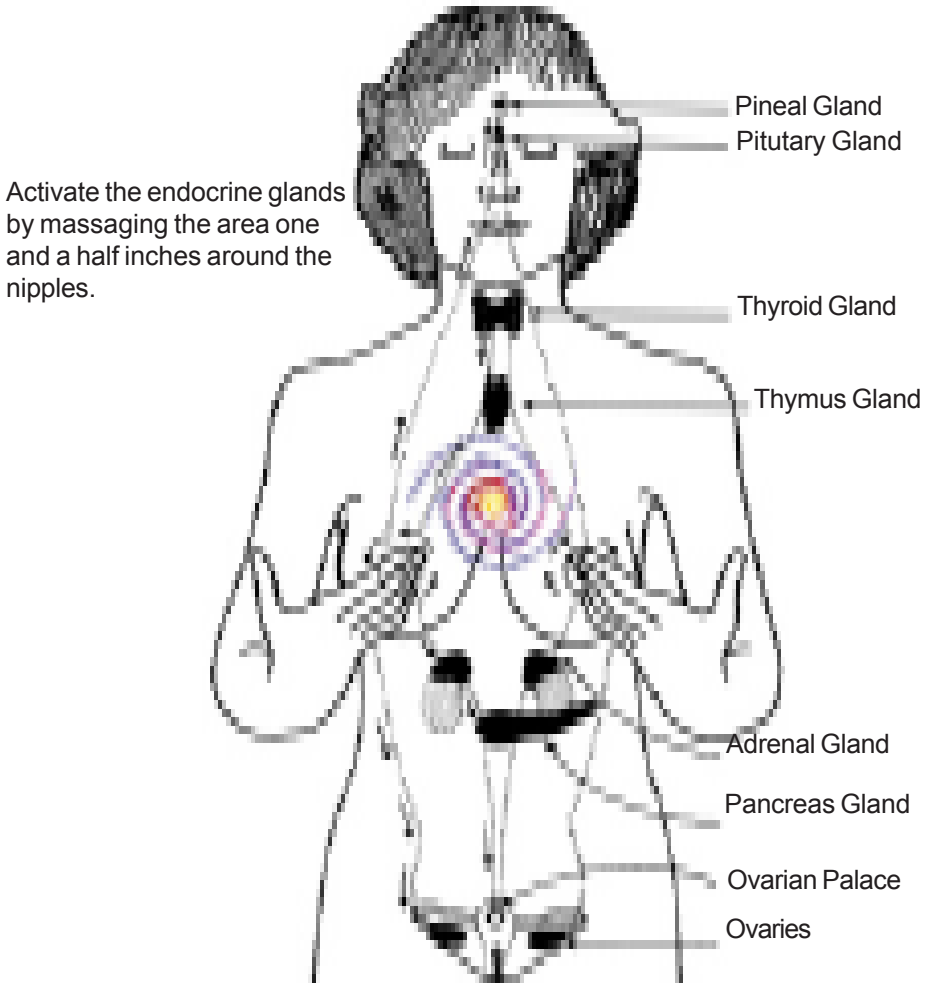

Fig. 6.11 *Breast Massage - Transforming Blood into Chi.*

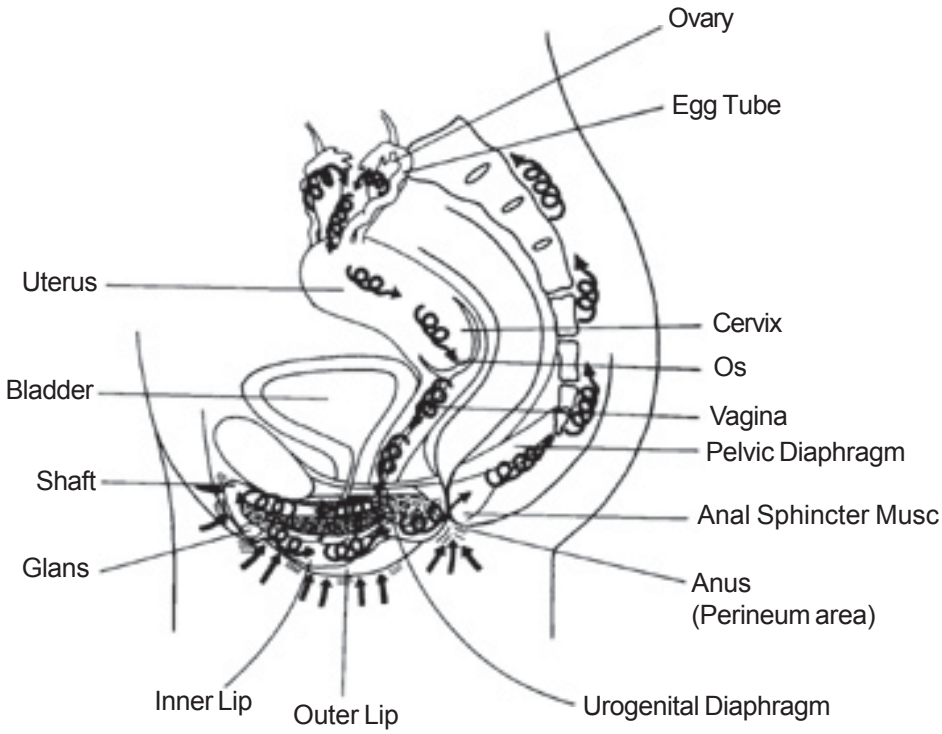

Fig. 6.12 *Ovary Breathing*

Egg Exercises and Vaginal Weight Lifting

The use of a stone egg to strengthen the vagina is a practice, which evolved in ancient China. As time went on, the secret of this practice remained in the Royal Palace and was taught only to the queen and concubines. Many who mastered the technique experienced very good health, remaining young and bountiful with sexual organs in old age as tight and resilient as those of a young, unmarried lady. Some believe that the queen and concubines practiced the technique in order to please the king while making love. Originally, however the Egg Exercise and Vaginal Weight Lifting were implemented for improving health, both physically and spiritually, since these exercises provide more power to the Chi Muscle to lift the sexual energy inward and upward where it will be transformed into higher spiritual energy.

The egg is a marvelous way to strengthen and control the Chi Muscle. It is easier to practice control of this muscle with an egg in the vagina since, as the egg moves, you can feel the direction in which the Chi Muscle moves more distinctly. Controlling this voluntary muscle means control of the many involuntary muscles in this area as well.

Also, as you master the use of this muscle of the vagina and perineum, you simultaneously tone up the lower abdomen. Thus, your performance of Ovarian Breathing, the Orgasmic Draw, and the Organs' Orgasm greatly improves, and the flow of sexual hormones increases (For more details see the book *Healing Love* by Mantak Chia).

Vaginal Weight Lifting is a very powerful practice to strengthen, in addition to the Chi Muscle, the urogenital and pelvic diaphragms. The strength of these two diaphragms is very important since these diaphragms serve as floors to the sexual organs and all vital organs. When the Chi Muscle and diaphragms are loose, Chi pressure will leak out from the organs as they stack upon each other dropping all their weight to rest upon the perineum. When strong, the muscle and the diaphragm function as before, preventing leakage of life force and sexual energies.

Egg Exercise

1. **Insert the Egg:** When you feel you are ready insert the egg into the vagina, large end first.
2. **Horse Stance Alignment:** Align your body in the Horse Stance.
3. **Contract the First Section of Vagina:** Isolate and contract the muscle groups responsible for closing the external vaginal orifice tightly. This will help to keep the egg in the vaginal canal.
4. **Contract the Second Section:** Inhale and contract the vaginal canal muscles immediately in front of the cervix so that you are now contracting two sections at the same time. Keep both points closed. There is no need to use hard muscle contractions. The strength required depends a great deal on the control of these muscles you have gained by practicing the Ovarian exercises.
5. **Squeeze the Third Section:** Slightly squeeze the egg from the middle of the vaginal canal until you feel that you have a good grip on it. Inhale and squeeze again, gradually increasing the squeeze, and then inhale more and squeeze harder. Once you feel you have a good grip on the egg, slowly move it up and down. Start with a slow motion, gradually increasing to a fast motion. When you are out of breath, exhale and rest. The resting period is very important. It is at this time that you will feel Chi build up in this area. Try to master each movement before continuing to the next.
6. **Use the Second Section to Move the Egg Left and Right:** Next move the egg left and right using the top or second section. Practice until you master this action.
7. **Use the First Section to Move the Egg Left and Right:** Next move the egg left and right from the bottom or first section. Using the mind and some muscle movement are important since you cannot move the egg with hard muscle contractions alone. There are many involuntary muscles within the vaginal canal, which the mind and Chi Muscle help to move.

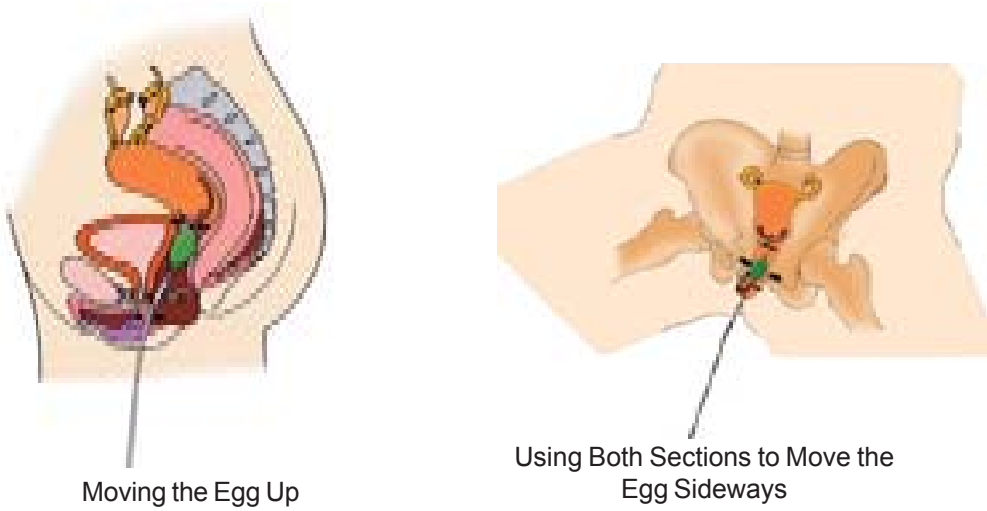

Fig. 6.13 *Egg Exercise with One Egg*

8. **Use Both Sections to Move the Egg Left and Right:** Now move the egg left and right as you wish, holding it by the top and bottom muscles. Master this before continuing to the next.
9. **Use Both Sections to Tilt the Egg:** Next tilt the egg up and down, from the top and the bottom. Master this action.
10. **Combine all Movements:** Combine all of these movements, moving the egg left and right, tilting it up and down, moving it up to touch the cervix and then down to the external vaginal orifice. Rest. All during the Egg Exercise the contraction of the vaginal canal in the area in front of the cervix connecting to the pineal gland and the external orifice is to remain constant until you have finished moving the egg. This particular Egg Exercise should be practiced two to three times per week. You may perform this very same exercise daily without actually inserting the egg by following the same sequence using the contractile strength of the vaginal muscles to suck in an imaginary egg and move it up, down, left and right.

To enhance your development you should begin using a smaller egg. Later, the larger eggs may be used to mark the progress in your “sucking” abilities. Eventually the practice of egg-sucking will become so mastered that you will be able to suck the egg into the vagina from the outside with a vacuum-like form. Such a powerful sucking activity enhances experiences in your life such as childbearing or lovemaking. Imagine the intense pleasure of your lover as he discovers your third hand while you demonstrate to him your power and skill.

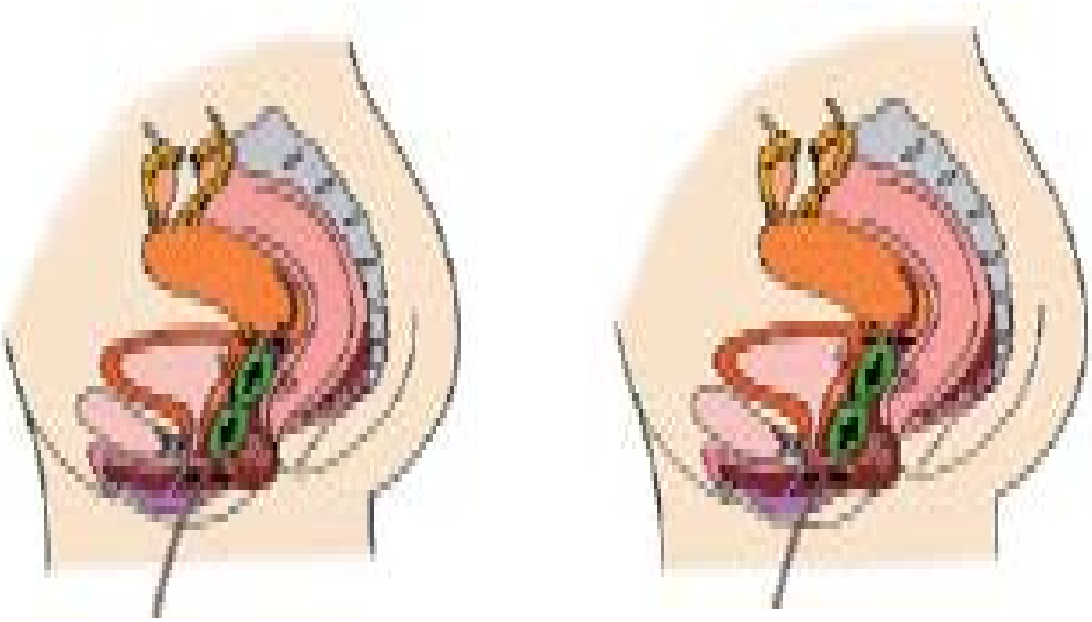

Squeezing Two Eggs Apart

Squeezing Two Eggs

Fig. 6.14 *Egg Exercise with Two Eggs*

Chi Weight Lifting

Tying the String to the Weight: After the string has been passed through the egg and secured with a knot at the egg's large end, tie the weight (fishing weight to start) to the string. The weight can also be placed inside a bag or container attached to the string. The weight holder can also be used, first without any weight, and then with the gradual addition of the holding clamp and the weight. Either place a chair in front of you and rest the weight on it, or place the weight on the floor and squat down to facilitate the egg's insertion (Remember to hold the weight with your fingers).

Inserting the Egg: After you have massaged your breasts and vaginal areas in the prescribed manner, kneel down near where the weight is resting, and insert the egg into the vagina, large end first (Use a lubricant if necessary). Close the vagina, contracting the muscles around the egg to hold it.

Swinging the Weight: Swinging the weight gives the practitioner control over the amount of pressure on the groin, which is why lighter weights are recommended. The Chi from the fascial connection between the perineum and the kidneys is used to pull the weight. In the beginning swing the weights gently as you determine the amount of pressure that is comfortable for you.

Inhale as you contract the anus and perineum. Swing the attached weight from 36 to 49 times. Synchronize your breathing with each swing. Inhale as the weight swings inward, and exhale as it swings forward. Pull up against the weight internally with each forward swing, and draw the energy up to the coccyx, the sacrum and eventually all the way through the crown to pineal gland. Each completed swing back and forth should approximate one second.

After a week, try to swing, the weight for 60 counts. More pressure results from the counter-force exerted by the Chi Muscle when heavier weights are swung, but it is wiser to increase this pressure with lighter weights by adding more power to each swing. The lighter weights should be used to their maximum potential, thereby strengthening the Chi Muscle and producing more hormones.

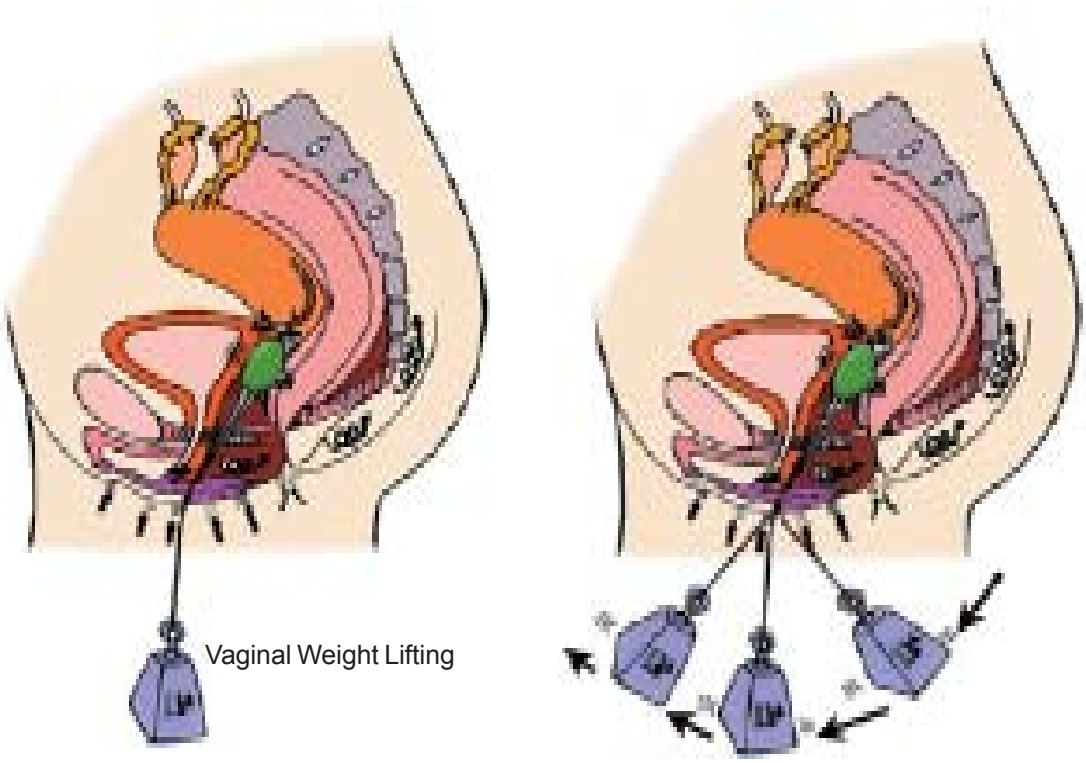

Fig. 6.15 *Chi Weight Lifting*

Physical Sexercises

The physical Sexersises are different from your normal workout. Most of these would not be appropriate at your local fitness or workout club. These exercises focus specifically on the sexual organs and pelvis. Over time, just like any other workout, the strength in this area will dramatically increase. This benefits the whole body, including the mind and the emotions, as sexual health is uplifting to the totality of the individual.

Shaking the Testicles and the Breasts

Shaking the body is a fantastic way to open the meridians. Shaking different parts of the body bring circulation and release of tension. This exercise should be performed naked or with loose clothing.

1) The feet should be a bit wider than shoulder width apart.
2) Start bouncing gently up and down as if there were a large Chi Ball in the center of your belly. Feel all the joints shake loose, the wrists, elbows, shoulders, hips and spine.
3) For men this should cause the penis and the testicles to bounce up and down and they should feel loose.
4) For women, the hopping should cause the breasts to bounce. Feel the sexual organs loose and relaxed.

Continue for at least two minutes at first and eventually longer as your stamina increases. For men, this exercise strongly stimulates the testicles, penis and prostate. For women, it stimulates the ovaries and enhances blood circulation to the sexual center.

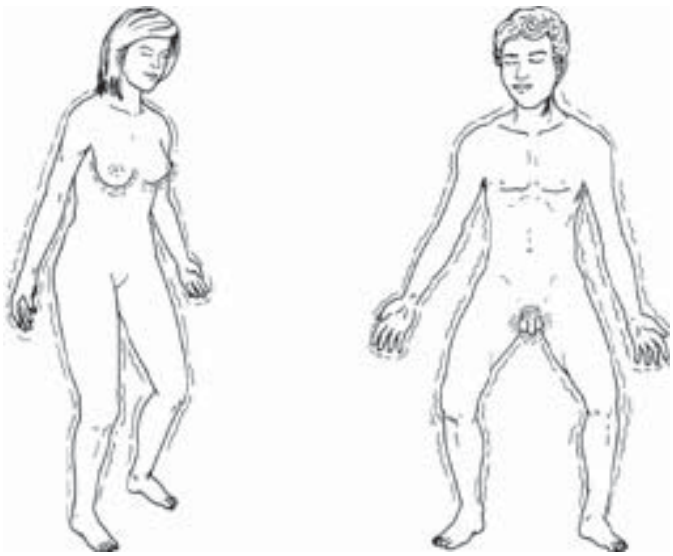

Fig. 6.16 *Woman and man shaking.*

Spiraling Hip and Tail Bone (For Men and Women)

This exercise is performed in a wide stance, with the hands on the hips. Allow the breath to be full and deep, without any specific relation to the movement.

1) Spiral the tail bone, coccyx and sacrum separately from the hips first in a clockwise direction, extending the hips forward and backwards as far as possible.
2) Reverse the direction. Let the movement be relaxed and free, feeling the joints of the hips loosen and stretch.

This exercise relaxes and strengthens the tail bone, hips, and lower back, allowing the sacrum more range of motion and increasing circulation in the sexual center. Spiraling the tailbone stimulates and stretches the nerve fibers in the sacral region, activating the hormones of the testicles, ovaries, prostate, uterus and other sacral glands. As the Taoists say, the gentials get stuck together in the sacrum. By spiraling the hips it will open this area up and unlock the genitals.

Fig. 6.17 *Spiraling into the coccyx and sacrum.*

Secret Taoist Method of Urination (For Men and Women)

Another exercise that greatly strengthens the Chi Muscle is the urination exercise. The practice of this exercise is also designed to strengthen the kidneys, an organ and tendon according to Chinese medicine that regulates sexual function. Therefore, in order to increase one's sexual potential, it is very important to strengthen the kidneys. This exercise helps cure premature ejaculation and impotence when practiced over a period of time. It is a simple exercise that consists of stopping the flow of urine by contraction the PC muscle while going to the bathroom.

1) When you have a full bladder , begin by urinating normally, then contract the Chi Muscle, stopping the flow of urine.

2) Then exhale pressing the lower abdomen and feel pressure on the bladder. Then start to urinate and contract the Chi Muscle.

3) Hold for about three seconds and resume urination. While doing this exercise lower and raise up from your heels three to five time per urination.

4) Doing this exercise a few times a day greatly strengthens the lower diaphragm, all the body tendons and sexual energy.

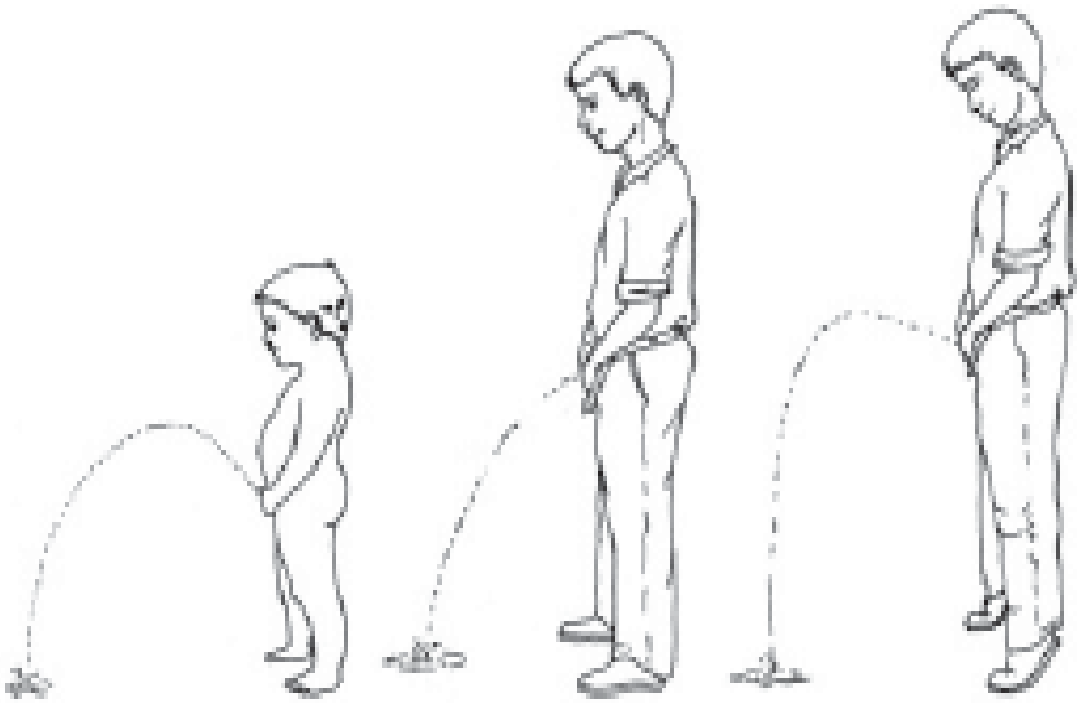

Fig. 6.18 *Method of Urination*

Sun Practice (For Men and Women)

Being naked in the sun is a wonderful way to re-energize the whole body. According to the Taoist masters our bodies can in fact absorb energy from nature. That is why we feel so much more alive at the beach, in the woods or near a lake. For example, just think about where you usually want to go on a vacation. It is probably somewhere out in or near nature, because of the abundance of energy.

A powerful Taoist exercise is to absorb the rays of the sun into the genitals. Find a place, in your back yard, or even in your house where the sun can enter through an open window. Sit or stand comfortably, allowing the rays of the sun to shine on the genitals. Feel the warmth energize and relax the pelvic area. Breathe deeply into the lower abdomen. The morning or late afternoon sun is preferred to the midday sun. The sun around the mid-day (11 a.m. to 1 p.m.) is too strong. The practice only takes about five to ten minutes and not too much longer. Burning the parts of your body where the sun normally doesn't shine is not much fun, so be careful.

Fig. 6.19 *Sun Practice*

Chapter VII
Sexual Reflexology and Physical Characteristics

The study of Sexual Reflexology and physical characteristics will help you determine the sexual potential and physical compatibility of another person. Sexual Reflexology enables you to evaluate a person's internal energy levels, as well as the size and shape of their sexual organs, by combining and observing the external characteristics, beginning with physical appearances of the face, and continuing to other bodily features such as the hair, neck, fingers and hands, and color and structure of the body. The following section will help reveal the strengths and weakness of a person, as well as compatibility between couples.

All external features of the body are helpful in determining the sexual compatibility of partners and one's own internal energy. Yet, it is important to remember that these are only guidelines and many factors need to be taken into consideration before one can really understand another person's capabilities. With practice, one can become skilled at recognizing the sexual inclinations and capacities of others, but in the beginning, the recommendations in this book are merely suggestions.

Physical Features

The Taoists use poetic phrases to indicate the beauty and sacred aspect of the body and sexual organs. The terms used here demonstrate the reverence for the sexual organs and the physical body itself. In the West, sexuality is often used in a derogatory sense, noting that the sexual organs are something dirty and degrading. This attitude creates an array of emotional problems revolving around our sexual nature and relationships in general. If we start to view our sexual energy and sexual organs as sacred, as a source of vital energy, we experience great satisfaction with others and ourselves.

Here is a list of the Taoist terms for our sexuality:

Vagina	Hidden Palace Valley of Solitude Celestial Palace Path of Yin Cinnabar Cave Vermilion Cave
Breasts	Bells of Love
Penis	Jade Stalk Yang Peak Ambassador
Testicles	Dragon Pearls
Intercourse	Clouds and Rain
Clitoris	Precious Pearl Yin Bean Jade Terrace
Cunnilingus	Sipping the Vast Spring
Fellatio	Blowing the Flute
Orgasm	High Tide

Facial Features

Lips

For some men, a woman's lips may be one of the most attractive physical features. It is said that when a woman wins her lover's affection with her eyes, this love is an intellectual affair. But when she wins her love's affection with her lips, it is a passionate affair. Thus the eyes indicate a more intellectual orientation, while the lips indicate a more emotional orientation. In addition, although it can be said that a man or woman may use their eyes to seduce their partner, it is the lips which will determine the nature of the relationship.

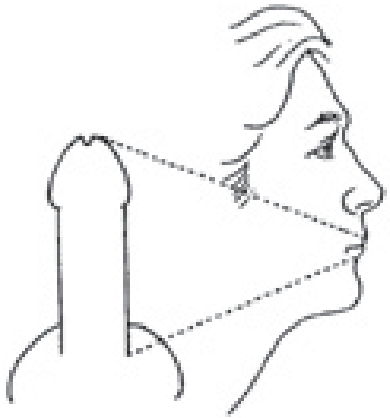

Thin small lips indicate a small penis.

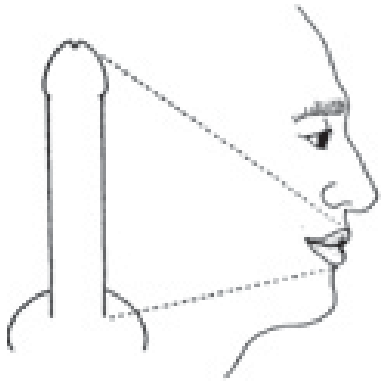

Wide and thick lips indicate a large penis.

Fig. 7.1 *Size of Lips*

The shape of the lips reveals the health of the body. Some lips are full, not necessarily large or small. They have a curved symmetric outline, without drooping or slackness. This reveals strong, healthy organs and sexual energy. When the upper lip arches upward and the lower lip folds downward, creating a slight hollow under the lower lip, this indicates the harmony between the ring muscles and internal organs.

The upper lip relates to the nature of giving love. A protruding upper lip denotes a more giving personality.

The lower lip relates more to the nature of receiving love. A lower lip that is larger than the upper lip will be more likely to enjoy receiving affection than giving it.

Fig. 7.2 *Size and Shape of Lips*

Erotic kissing, involving the lips and tongue, is a part of love play. When couples kiss with their tongues in what is commonly referred to as a “soul kiss” or “French Kissing”, the tongue directly reflects and connects their hearts, while their lips give and receive affection from each other. Also, the Governor and Functional Channels of each partner both connect at the lips and tongue making, as discussed earlier, a complete circuit of energy flow when the couple kisses.

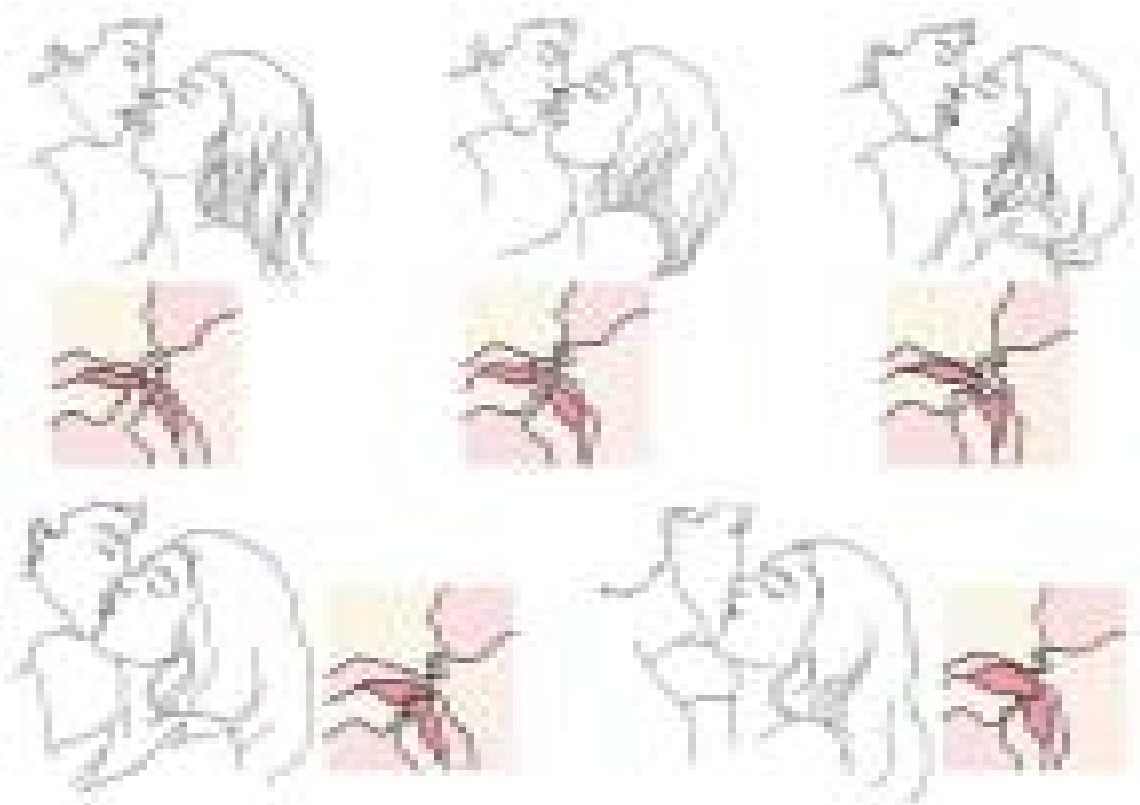

Fig. 7.3 French Kissing

(1) It is believed that the upper lip relates to the nature of giving love, while the lower lip relates to the nature of receiving love. A person with a more protruding, plusher upper lip is usually more giving or aggressive in giving affection, while a person with a fatter, plusher and protruding lower lip will be more likely to enjoy receiving affection than giving it.

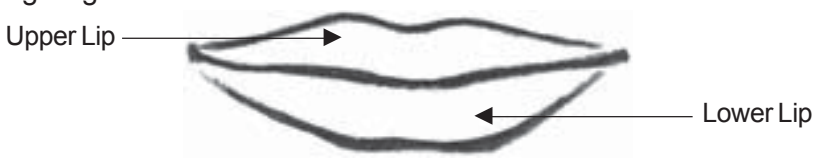

Fig. 7.4 *Upper and Lower Lips*

(2) A woman or man whose lower lip is more sensitive to touch will usually fall in love first and enjoy sex before they engage in an intellectual relationship with their lover.
(3) To be effective in the stimulation of one's partner, the lips must be moist. A sign of sexual arousal in both men and women is when either partner licks their lips, indicating that they are ready for a sexual encounter. In the classics this was called "preparing the field to be ploughed".

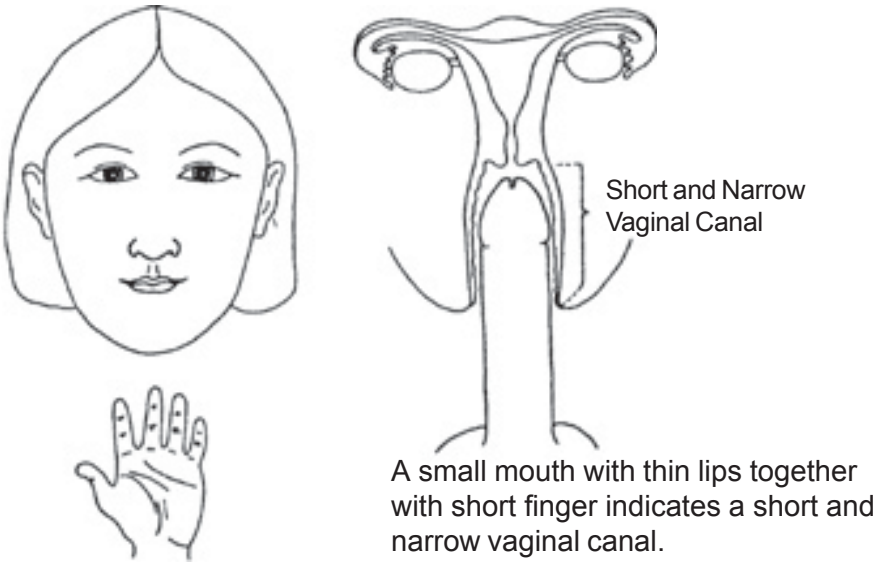

Fig. 7.5 *Size and Shape of Vaginal Canal*

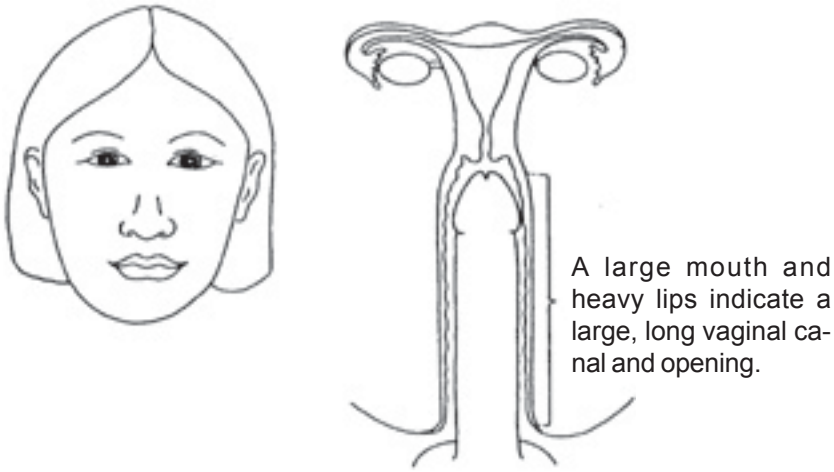

Fig. 7.6 *Long Vaginal Canal*

(4) The mouth and genitals are considered opposite poles of the body and as such, one is regarded as the reflection of the other. Thus, when a person talks incessantly, this indicates that the person is sexually frustrated and the energy is channeled through conversation, rather than sexual expression.
(5) If the person has a large mouth, it indicates that the person has a tendency to scream aloud during orgasm and has a large capacity for sex.

Fig. 7.7 *Large Mouth*

Eyes

There is a strong connection between the eyes and the sexual center. The ring muscles in the eyes correlate with the ring muscles in the urogenital diaphragm. A wink between a couple, for example, affects the ring muscles around the sexual organs; hence the erotic significance of the wink in folklore. Winking gently activates the sexual energy.

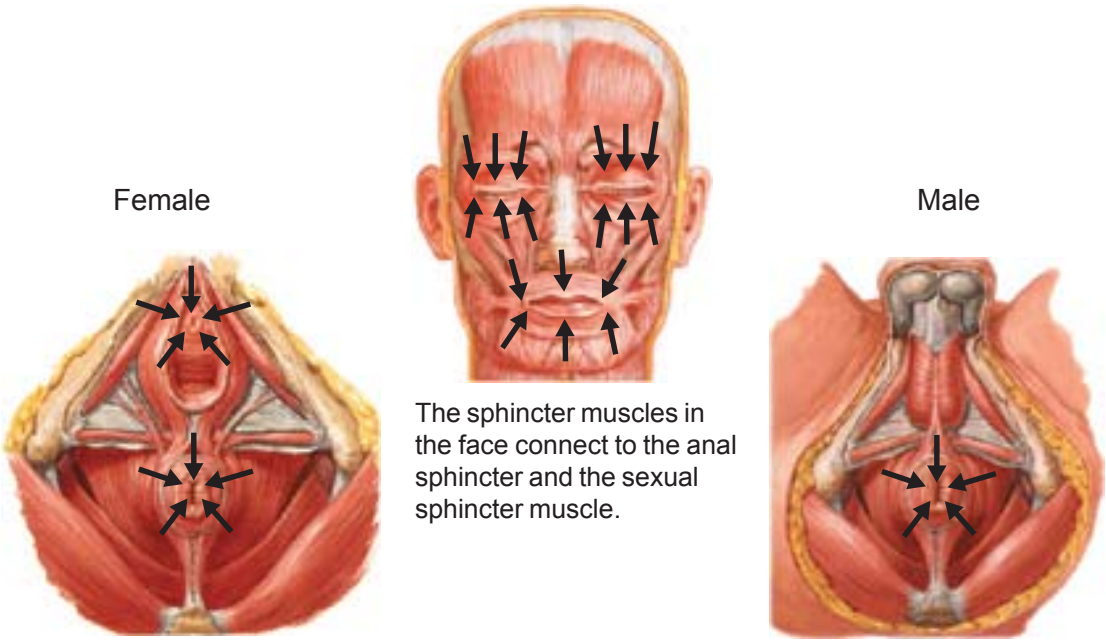

Fig. 7.8 *Ring Muscle of the eyes and Sexual Organs.*

In Chinese medicine, the eyes are considered the windows to a person's soul and physically are connected to the liver. They can be used for diagnosis of internal disorders, but are also the vehicles through which love and sexual potential can be detected. Some of the sexual behavior signals emanating from the eyes, according to Chinese analyses, are:

(1) Dark pupils indicate a very passionate person.

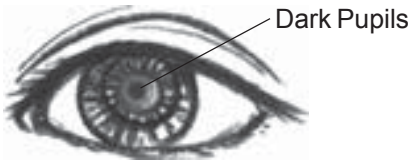

Fig. 7.9 *Dark Pupils*

(2) A peaceful appearance in the eyes of a woman, along with a slightly flushed red color (perhaps faintly pink, but not bloodshot) of the sclera, or white part, indicates a passionate individual with an abundance of sexual energy, good blood circulation and healthy internal organs. Additionally, the woman's vagina will be warm due to her passion and sexual desires.

(3) According to Chinese sexology, a person with big eyes makes a better lover. Since the eyes are an organ of expression, they can emote a feeling or communicate better than speaking.

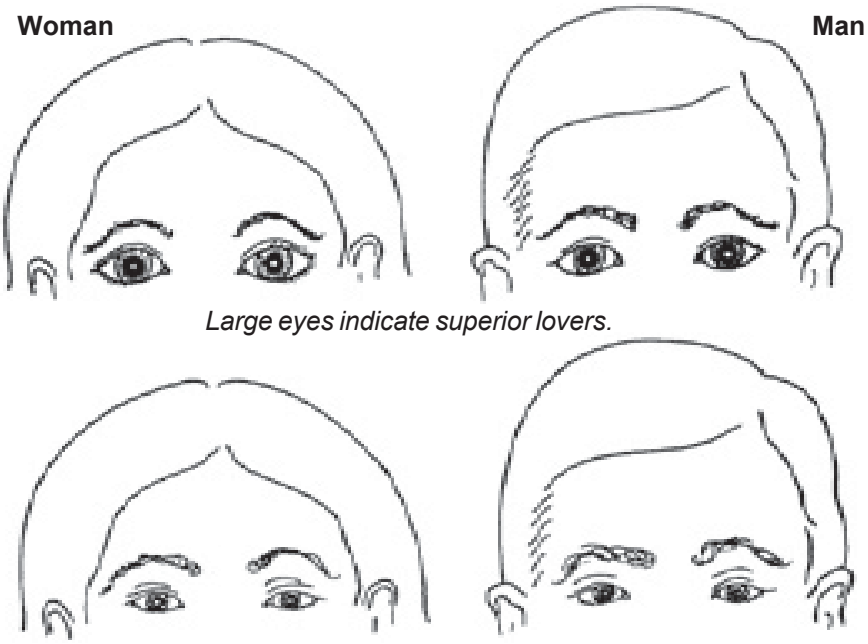

Fig. 7.10 *Size of Eyes*

(a) If a man has large eyes, the Chinese consider him an expert in love affairs in that he is more emotionally involved with sex. On the other hand, a man with small eyes is more rational and intellectual in dealing with sex and women.
(b) Women with big eyes are usually more outgoing and open-minded. This may make her more receptive to male advances. A Chinese proverb quotes, "A lady with big eyes cannot be a poor sex partner." Since the eyes are the windows of the soul, big eyes indicate a love of life, action and passion.

Eyebrows

The eyebrows, according to Chinese Taoist sexuality, express one's inner feelings of love, inner personality and inner sexuality. The eyebrows are full of expression especially in women, usually revealing their emotional state.

Observe the nature of the eyebrows in different situations: shocked, scared, surprised, etc. Notice how they show the state of the emotion being expressed; e.g., expanded eyebrows indicate sorrow or worry. "Flying and dancing" eyebrows indicates joy and excitement. Small and narrow eyebrows indicates sorrow and sadness.

In the Orient, the expression, "making eyes and eyebrows at someone" is used, as opposed to "making eyes at someone," the Western expression. Observe pictures portraying characters from the Chinese or Japanese theater, (e.g. Kabuki theater), and you will see elaborate make-up, especially emphasizing the eyes and eyebrows. Modern women also use make-up on their eyes and eyebrows and many pull hairs from their eyebrows to create a clean shape. The cosmetic industry in the West has provided them with a wide range of eye make-up products: eyeliner, eyeshadow, eyebrow pencils, eyelash curlers, etc. Every imaginable color and all kinds of glitter and sparkle is available. This illustrates that the eyes and the eyebrows are now, as in the past, important expressions of love and attraction.

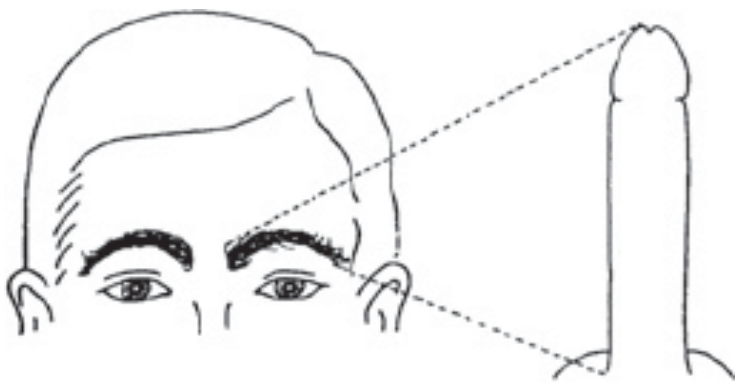

Fig. 7.11 *Full long eyebrows indicate a strong, long penis.*

Women from East and West express the fact that they observe the man's eyes as one of the prerequisites of being with him. He has "smiling eyes" or he has "bedroom eyes", or eyes "that look right through me" are not uncommon expressions in sexual attraction. If a man has eyebrows shaped like crescent moons, he is more sexually oriented than intellectually oriented.

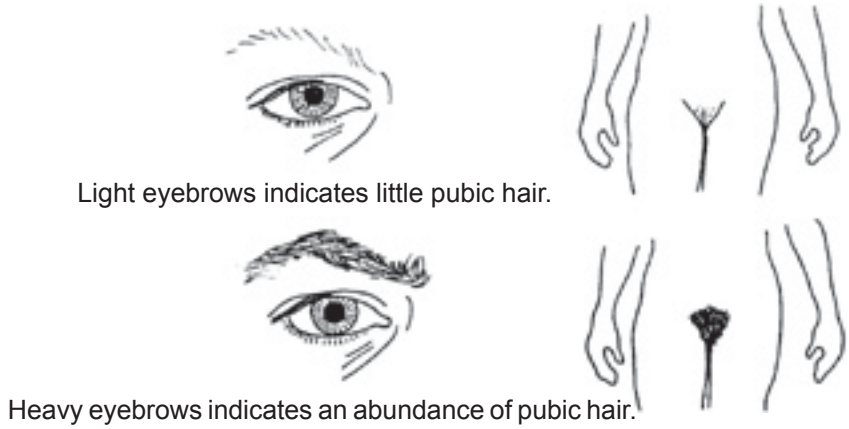

Fig. 7.12 *Shape and Thickness of Eyebrows*

Space between the Eyebrows

The space between the eyes indicates levels of consciousness. It should be wide enough for another eye to fit there. As one ages, this space becomes wider as if to accommodate another eye, indicating that the person has become wiser and more tolerant. This space between the eyebrows, corresponding to the third eye center (or pituitary gland center), also corresponds to the sexual organs. The average space between the eyebrows is one and a half to two index finger breadths. When this space is wider it indicates for both men and women a strong sex drive.

Fig. 7.13 *When the space between the eyebrows is wider than two fingers widths, it indicates a very strong sex drive. In women, a wide space also means her vagina is wide.*

Teeth

According to the ancient Taoist physicians, the aging process begins with a decline in the kidneys and sexual organs energy, manifesting itself in failing eyesight, decaying teeth, receding gums, inflexibility of the spine and finally a decline in the person's sexual potential.

The incisor teeth or "frontal bones" in Chinese medicine, are believed to be associated with the kidneys. Since the kidneys are responsible for our sexual power or strength, it follows that the incisors are indicative of a person's sexual potential. The stomach meridian is also reflected in the upper incisors. This is significant because the stomach and spleen together are called an "Ocean of Food" from which all the organs and ultimately, the body derive nourishment.

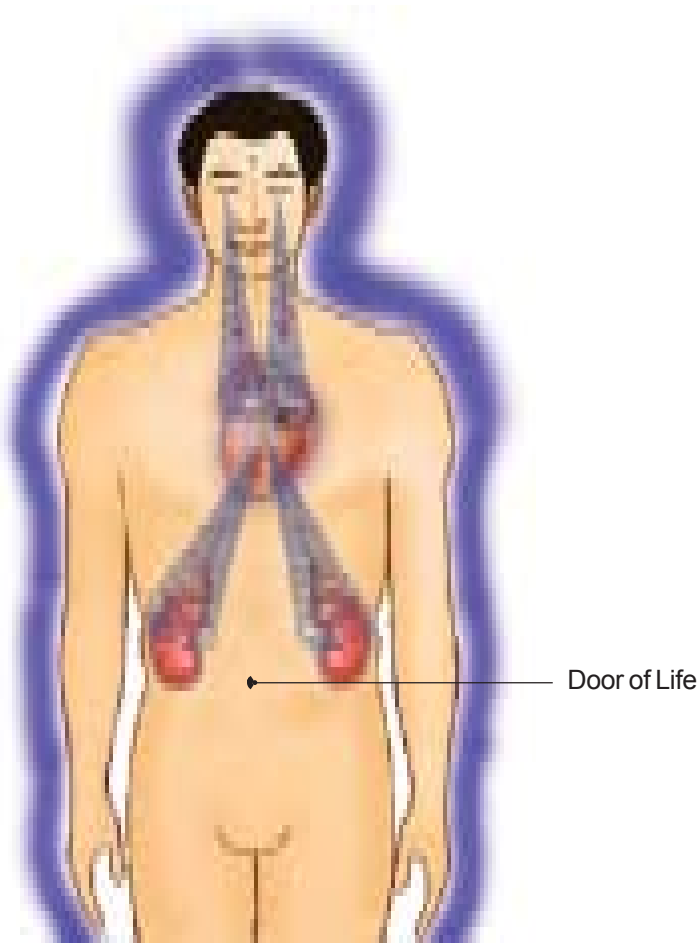

Fig. 7.14 *Kidney Point - Door of Life*

Incisors, canines and molars should all be observed from a sexological point of view. The size of these teeth is important in judging the sexual potential of that person.

(1) A person with large teeth will have a rough head of hair or body hair. This person will be passionate and sexually aggressive.
(2) A woman with tiny, beautifully arranged teeth will have strong and beautifully arranged genitals, and will be very sexually rewarding for her partner.
(3) A man with a good set of teeth usually has strong kidneys and consequently, strong sexual power.

Large teeth indicate a passionate and sexually aggressive personality.

Small teeth indicate a tight vagina.

Fig. 7.15 *Size of Teeth*

Jaw Lines

A strong jaw line with good definition is indicative of a strong sexual potential for both the male and female. A person without a strong jaw line (e.g. a double or triple chin), no jaw line or weak jaw possesses a weaker sexual potential.

Double Chin: Weaker sexual potential Square Jaw Strong Jaw

Fig. 7.16 *Jaw Lines*

Cheeks

For the female, the cheeks are second to the lips on her face in importance in sexuality. Kissing her lips is moments away from kissing her cheeks. The cheeks reflect the kidneys in Chinese Physiognomy. When her cheeks, the lower side of her face, are full, wide and muscular (i.e, firm, not loose), she has strong sexual energy.

Fig. 7.17 *Cheek Size*

Ears

The ears are sexually symbolic appendages, especially for a woman. By studying a woman's ears, a man will be able to determine not only the position of her vagina, but also the size and shape of it in addition to aspects of her inner personality all at once. The woman on the other hand, can determine if a man is strong, robust and healthy from his ears. She will also be able to tell if he is going to live long, be wealthy, etc., all by observing the shape and coloration of his ears.

A. This small ear indicates deficient kidneys' energy and weak sexual potential.

B. An ear that is thick and fleshy all around the rim, is a sign of good health and strong sexual potency.

C. Large ears with fat lobes that protrude from the head indicate good sexual potential and strong kidneys.

Fig. 7.18 *Size of Ears*

The ideal type of ear is one which is thick and meaty all around the circumference. The color of a healthy ear is pink and slightly transparent looking. This is a sign of good health and strong sexual potential. If the woman is shy and her ears turn red, this indicates good health. If her ears look transparent, this indicates good health, a warm personality and good sex potential, especially if they turn redder than her complexion at times of embarrassment or sexual excitation.

If a man's ears turn redder than his face, this indicates great sexual potential. Large, fat-lobed ears that protrude from the head also indicate good sexual potential, as well as strong kidneys and a strong constitution. He will be supplied with a great deal of kidney Chi.

A person with thin and smaller ears will be deficient in kidney energy and have weaker sexual potential.

Buttocks

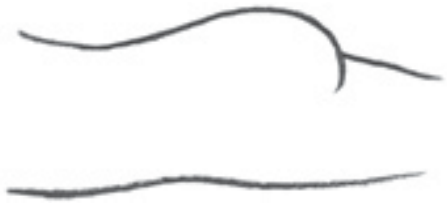

A buttock dipping down indicates strong sexual drive.

A big buttock indicates a strong, healthy, good wife and mother.

A sharp upper buttock indicates a weak sex drive.

A small buttock with rounding up and down indicates a medium sex drive.

Fig. 7.19 *Buttock Size and Shape*

Nose

The function of the nose, being the instrument of breath, is crucial to a healthy vibrant body. The nostrils can activate all the sphincters (ring muscles) of the body. For example, when a healthy individual is sexually aroused, the nostrils flare open in conjunction with the breath. This activates the energy of the entire body.

Fig. 7.20 *A long nose indicates a long penis.*

(1) A woman with a small nose has warmth and also the potential for many sex partners.

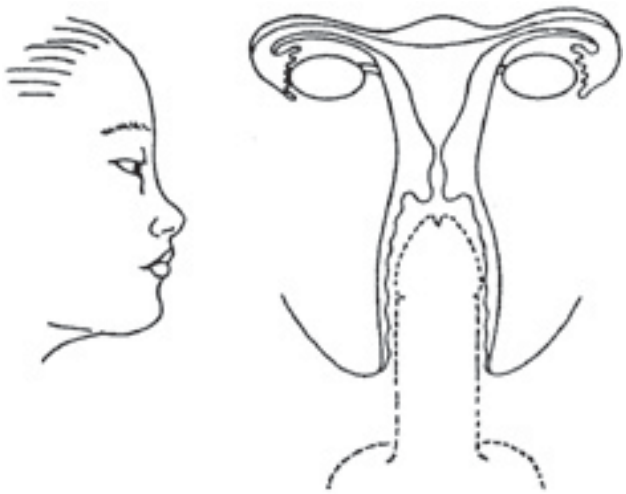

If the nose is small and flat the vagina is wide with a short channel.

Fig. 7.21 *Size of the Nose*

(2) A woman with a fine, thin, bony, sharp-lined and sharp-tipped nose is more nervous, more sensitive, loses her temper easily and has an erratic personality.

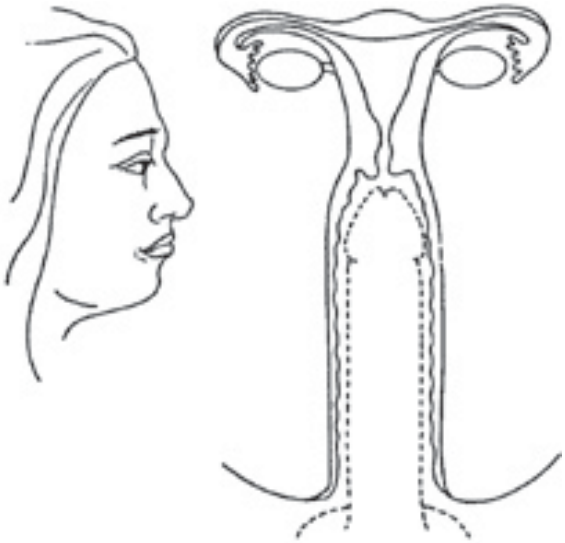

If the nose is long it indicates a deep tubular vagina.

Fig. 7.22 *Size of the Nose*

(3) A woman with a broad flat nose is more likely to be quieter, more domestic and dependent on a man.
(4) A woman with a hawk, or hook-shaped nose is full of energy, sexually aggressive and possibly fierce in nature.
(5) A woman with a depressed root or base of the nose is very aggressive and very emotional.

The small nose indicates a warm personality.

The broad flat nose indicates a quiet, domestic and dependant personality.

Fig. 7.23 *Size and Shape of the Nose*

The 'hawk' or hooked nose of the energetic and often sexually aggressive personality.

The fine thin bony nose indicates a sensitive, more nervous and often erratic personality.

Fig. 7.24 *Size and Shape of the Nose*

In Summary: Facial Features of a Man

(1) If his lips are wide and thick, it is an indication of a bigger penis.
(2) Thin, small lips indicate a smaller penis.
(3) A thick flat nose indicates a thick penis shaft.
(4) A long nose indicates a long penis.
(5) Deep eyes with thin-skinned eyelids indicate a long penis.
(6) A full long eyebrow indicates a strong, long penis.
(7) If the area of the ear's conch, referred to by the Taoists as the "ditch of the ear", is deep-set, it is an indication of a strong penis of good size.
(8) A large, thick neck on a man indicates a very strong and thick penis.

In Summary: Facial Features of a Woman

"We enter this world through the portals of the Jade Gate, and once born we seek forever to return. This eternal truth holds a message: That man's joy and vigor come from the same place as his creation."

- Ming Dynasty anonymous poem

(1) If her mouth is small in width with thin lips, she possesses a short and narrow vaginal canal. Conversely, a woman with a large, wide mouth will have a large, long and wide vagina.
(2) If she has thick lips, her vaginal canal is wide at the entrance and large.
(3) If her lips protrude, her vagina is elastic, in that it can also expand to accommodate a larger penis. It is considered to be an elastic and "moving" vagina with ample lubrication.

(4) A woman with tiny, beautifully arranged teeth will also have very strong and beautifully arranged genitals. Her vagina can accommodate the penis in a perfect and tight way with no empty spaces, permitting maximum contact and friction for maximum pleasure.
(5) If her nose is small and flat, her vagina is wide but the canal is short.
(6) If her nose is long it indicates a deep, tubular vagina.
(7) If a woman has a strong lower chin, no extra jowls and is muscular looking, it reflects a strong genital system, beautifully arranged and a tight muscular vagina. Remember the proportionality and strength of the body suggest the size and shape of the genitals.
(8) A woman with a slim face and muscular lower cheeks will have a vaginal wall that is thick and full of muscles.
(9) Dimples indicate a short and small vagina with expanding capacity. This type of vagina can expand to accommodate a larger penis.
(10) Protruding eyes indicate that the vaginal canal is short.
(11) If she is born nearsighted it is an indication of a short vaginal canal.
(12) If the eyes are deep set, this indicates that her vaginal canal is deep or long.
(13) If her eyes are moist, or sparkling, it means her vaginal lubrication is ample. If her eyes are dry, it means she has less vaginal lubrication, that is, the vagina is more on the dry side.
(14) A full, long, moon shaped eyebrow reveals a healthy, strong vagina with a long canal. Also, when the woman is having her period, the hairs on her eyebrows will stand up more than they normally would.
(15) Sparse eyebrows on a woman indicates she has little pubic hair. If she has heavy eyebrows, she has more pubic hair.
(16) A wide space between the eyebrows for a woman means her vagina is wide. When sexually aroused, this space can be observed to be wider than usual.
(17) The shape of the “ditch” of a woman’s ear (in the conch area) corresponds to the shape of her vagina and its size. A deep-set ear ditch is healthy, indicating a strong vagina.

Massaging the Face

Massaging the face can be very relaxing and enticing. Opening the energy in the face activates the energy in the sexual center. Remember that the face and the sexual center are connected through the ring muscles; when one is stimulated so is the other. Notice all the facial expressions when one is sexually excited! By stimulating the sexual center the facial expression will change and reflect this excitement. Now, the opposite is also true. Stimulating the face can be very erotic and stimulating to the sexual center. Have your partner lie in your lap or between your legs so that it is easy to massage the face. No formal techniques are required, just good intention and a soft touch. Begin

exploring your partner's face with a light and gentle touch. Massage around the eyes, across the forehead, over the cheeks and around the lips. Feel the unique quality of the face. Kissing the face is another way to open the connection between the face and the sexual center. Softly kissing the cheeks, the forehead, the eyes and the nose is very sensual and stimulating.

Fig. 7.25 *Facial Massage*

Hands and Fingers

In Chinese sexology, the middle finger is considered most important in the man, while the pinkie or little finger is most relevant to the woman's sexuality. It is believed that a person with a long middle finger has strong sexuality, while in a woman there is a close relationship between her pinkie finger and her sexual energy. If the pinkie finger is long, she is in possession of great sexual power, her energy will be plentiful, and she will be high-spirited. The pinkie finger is associated with the heart meridian and has a strong energetic connection between the emotions and the sexual center. For men, the middle finger is associated with the pericardium or the circulation sex meridian and is associated with the yang aspect of the heart.

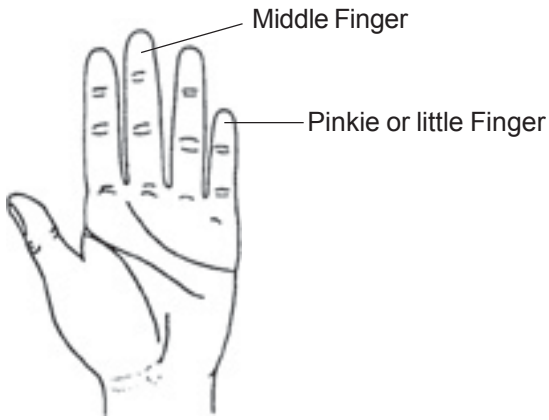

Fig. 7.26 *Finger Points*

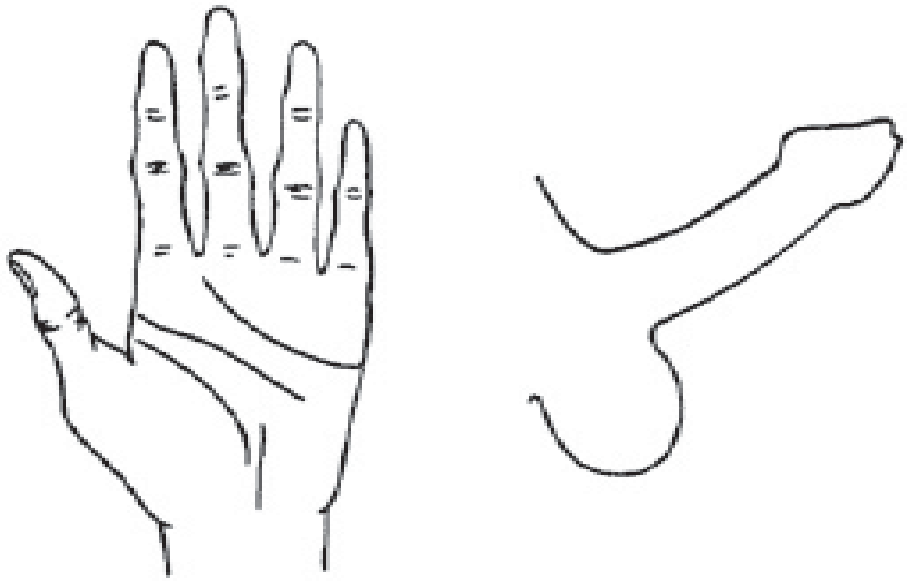

Thin fingers are an indication of a thin penis.

Fig. 7.27 *Size and Shape of Fingers*

Frequent cold hands on a woman means a Yang deficiency; conversely, warm hands indicate a great abundance of Yang energy. A woman suffering from a Yang energy deficiency experiences this deficiency throughout her body, possibly including her vagina. Being cold may reduce her excitability and her size. Thus, a woman with cold hands may not be as passionate as one with warm hands. In having Yin energy in excess, she may have vaginal lubrication, but she may have relatively less vaginal dilation.

Fingers of Man

The size of a man's fingers and thumb reflects the size and shape of his penis. When discussing size and shape, it is important to remember that no one size or shape is better than another. What is important is that the size and shape be in harmony with your partner. The most important factor in sexuality is the quality of our internal energy.

(1) If all of his fingers are fleshy, wide or thick, it is an indication of a thick penis.
(2) If all of his fingers are thin, it indicates a thinner penis.
(3) Long fingers, especially the first finger, indicate a long penis.

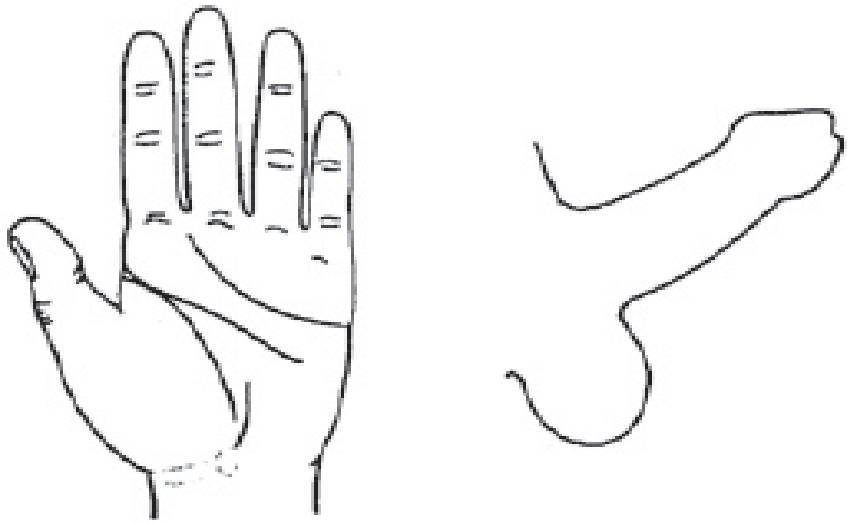

Fleshy fingers are an indication of a thick penis.

Fig. 7.28 *Size and Shape of Fingers*

(4) A good shaped thumb for a man is a fat tip with a small root, thus indicating a penis with a fat head and a thinner penile shaft. Because of its shape it is called a "mushroom" penis, and is best for maximum female vaginal stimulation.

A "Mushroom" with a head and a narrow shaft is best for maximum vaginal stimulation.

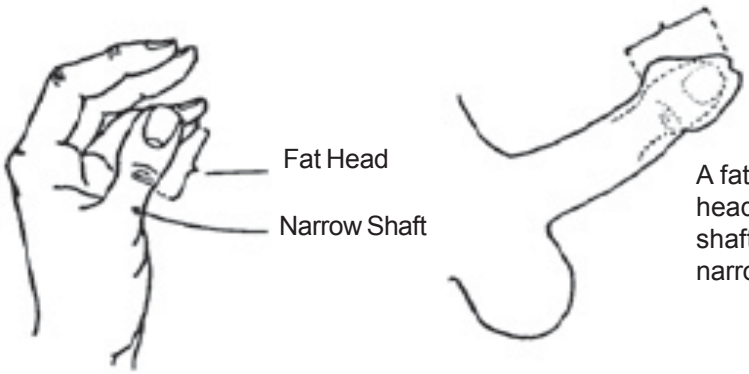

A fat head thumb indicates a fat head in the penis. A narrow shaft in the thumb indicates a narrow penile shaft.

Fig. 7.29 *Size and Shape of the Thumb*

Fingers of a Woman

The size and shape of a woman's thumbs reflect the size and shape of her vagina or vaginal canal.

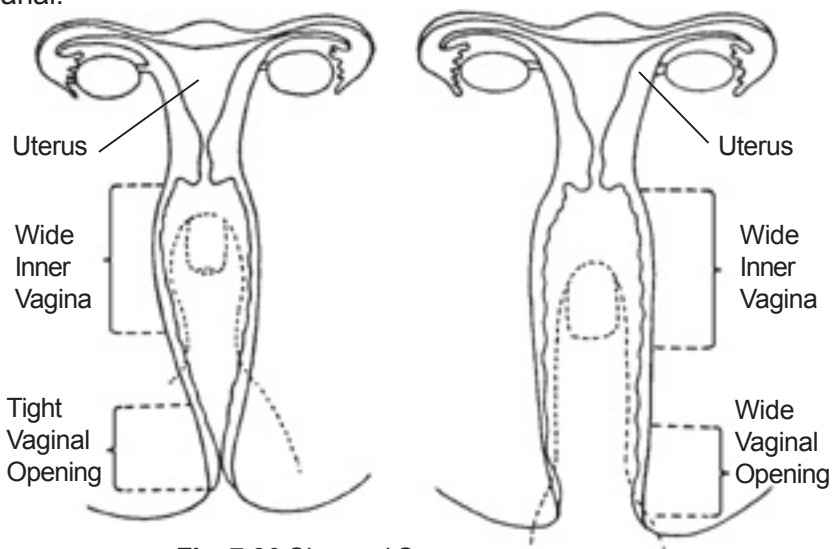

Fig. 7.30 *Size and Shape of Woman's Thumb*

(1) A fat thumb head with a narrow rooted thumb is equivalent to a tight vaginal opening with a vaginal canal that is wider on the inside. This condition is well suited for the mushroom shaped penis.
(2) A thumb that is not fat at the fingernail, or top, but more tubular in shape, reflects a vagina also tubular in shape.
(3) Short fingers accompany a short and narrow vaginal canal.

Massage the Hands

Massaging the hands can relax the whole body. By stimulating the points on the hands, one can activate and balance sexual energy. It can be very erotic for a couple to massage each other's hands, exploring the fingers, lines and palms. The hands are like a map revealing the unique experiences of a person. Send your loving energy through the hands. Work between the finger, across the knuckles and all through the center of the palms. Also, it is very stimulating to lick, suck or kiss the hands of your partner. This elicits a very powerful current of sexual energy through the whole body.

Fig. 7.31 *Hand Massage*

Hair

According to Taoist Medicine, hair on the head, hair on the eyebrows and pubic hair all are related to human sexuality. For the woman, hair on her body is supported by the Yin energy of the kidneys; while in the male, hair is supported by the Yang energy of the kidneys. The hair on the head is directly related to the kidneys. This is due to the fact that the bladder meridians traverse the top of the head. Loss of hair and premature graying are the first manifestations of a lower functioning of the kidneys and the resultant loss of kidney Chi. The kidneys, whose essence nurtures the blood, are no longer doing so efficiently and the result is the initiation of aging. A man's baldness may also be due to a congenital weakness, bad hygiene or inadequate diet and of course, to his inherited genes or ancestral energy.

An abundance of hair are therefore signs of strong sexuality and ample sexual energy in Taoist Medicine.

A man who has abundant body hair has a strong sexual power, even if he is bald or balding on top. It seems that his body hair is formed from the excess energy of the blood and is directed via the lung, which controls the skin, to the surface to be stored as excess body hair. Hair on the face is another sign of strong sexual power in a male. So if he has a full beard or a strong mustache, it indicates strong sexual potential.

From the Nei Ching, regarding the male, we find: "If the whiskers on both cheeks are handsome and long, then the energy and blood in the upper bright yang meridian of the foot (stomach meridian) are strong and abundant. If the blood and energy are in abundance in the lower region of the bright yang of the foot meridian, then the pubic hair and the hair on the chest will be long and handsome."

The Chinese believe that a man with plenty of hair on his chest is in possession of strong sexual capability, while a woman with plenty of fine hair on her body is also in possession of strong sexual capability. The man's hair should be of the yang type, firm and strong, while the woman's hair should be of the yin type, soft and smooth.

The number of hairs on the body are roughly estimated at about five million hairs. At first glance, we would say that most of our hair is located on the head, the underarms, and the pubic regions. However, fine hairs cover the entire body, at densities similar to those on the more obvious regions. Most hairs are short and fine so they escape notice, but hairs are present nearly everywhere. And, in addition to the millions of hairs on the outside of the body, there are also millions of hairs inside the body, for example about in the ears, sweat glands and lining the digestive tract. The estimate of five million hairs on surface of the body is based on information and calculations from Tortora & Grabowski, 2000.

Neck

The neck holds a special place in Chinese Sexology. For instance, one method to tonify the breast size is to massage the thyroid glands on the neck. According to Chinese medicine, stimulating the sexual organs stimulates the thyroid and vice versa, since the thyroid gland and sexual organs are closely related. When a woman is sexually active, her neck will become longer and expand. Massaging or kissing the woman's neck and thus indirectly the thyroid gland, will also stimulate sexual drive.
A large, thick neck on a man indicates strong sexual potential.

Breasts

According to Traditional Chinese Medicine, the four parts of the woman's body that reflect her sexuality are her face (i.e., eyes and mouth), breasts, buttocks and vagina. The traditional Chinese sexologists called the breasts "the Bells of Love."

Size of the breast is only one factor in describing the female sexual capability and potential. The muscles that support the breast is another factor. The reason for this is that the muscles that support the breast and form the shape of the breast directly reflect the genitals, since the meridians of the stomach pass through the entire breast area, flowing through the lungs and genitals as well. Through this meridian, one organ gives life to another; it follows that if the muscles that form the breast tissue are firm and of good tone, the vaginal muscles will also be firm. Similarly loose pectoral muscles will indicate a loose vaginal grip.

The Chinese have classified the breasts into groups according to sexual potential.

(1) The Plate Type of breast or a small breasted woman, indicates relatively low sexual energy.

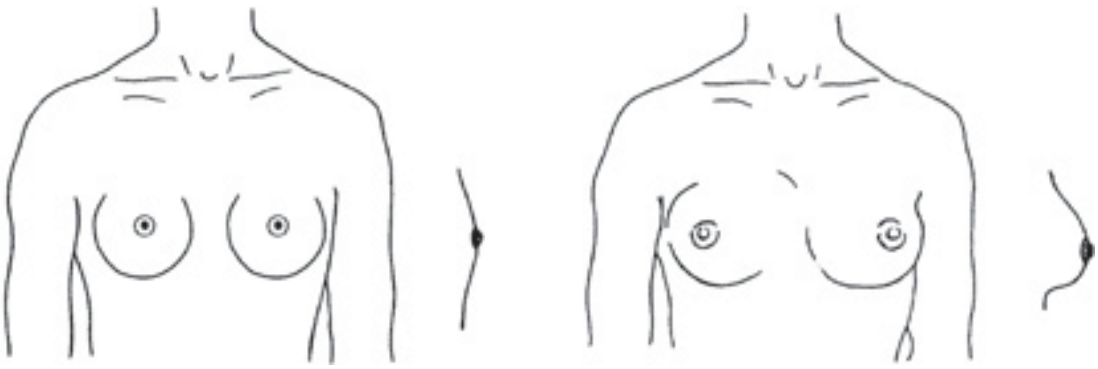

The plate type of breast indicates lower sexual energy.

The bowl type of breast indicates a healthy sex drive.

Fig. 7.32 *Female Breast*

(2) The Bowl Type of breast, symmetrical and well-balanced, is shaped like a soup bowl. Each breast is supported by well-toned musculature. This woman will have a high sex drive and is considered the most sexually desirable.

(3) The Ball Type of breast is larger than the bowl type. This woman has even greater sexual energy. When this type of breast includes big nipples and large aureoles, she is sexually powerful.

(4) The Mountain Peak Type of breast is in the shape of a cone with nipples that face the sky. This type of woman is very warm and passionate.

(5) The Pendulum Type of breast is round like a ball hanging from a pendulum. If the muscles supporting this type of breast are solid, this woman's sexual potential is strong. If her muscles are flabby and lack tone, she has a weaker sex drive. If she has no musculature there, as an older woman, she will have lower sexual energy.

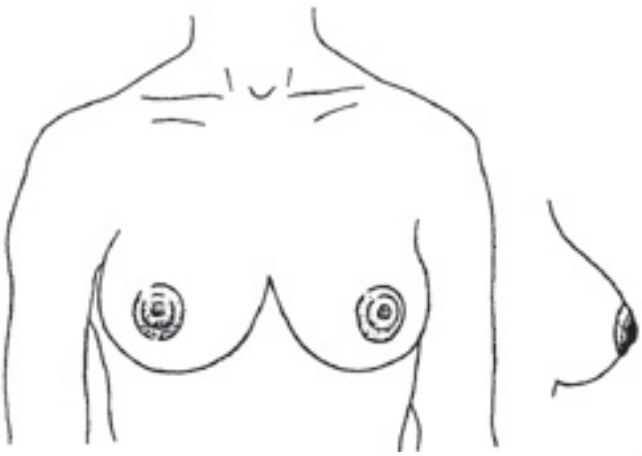

The ball type of breast with large nipples and areola indicates a very strong and forceful personality.

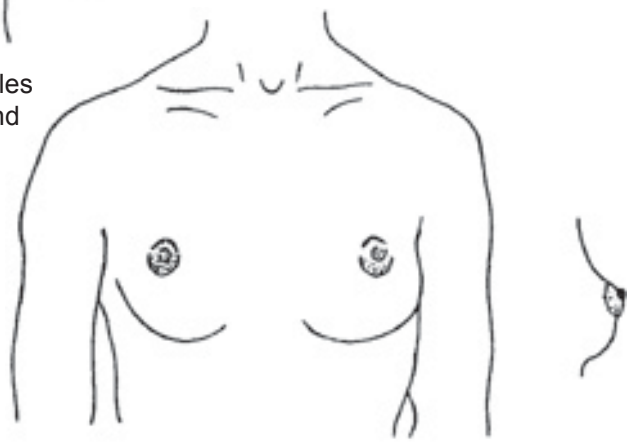

The mountain peak type of breast is shaped like a peak with nipples pointing up. This indicates a woman who is very warm and passionate.

Fig. 7.33 *Female Breast Type*

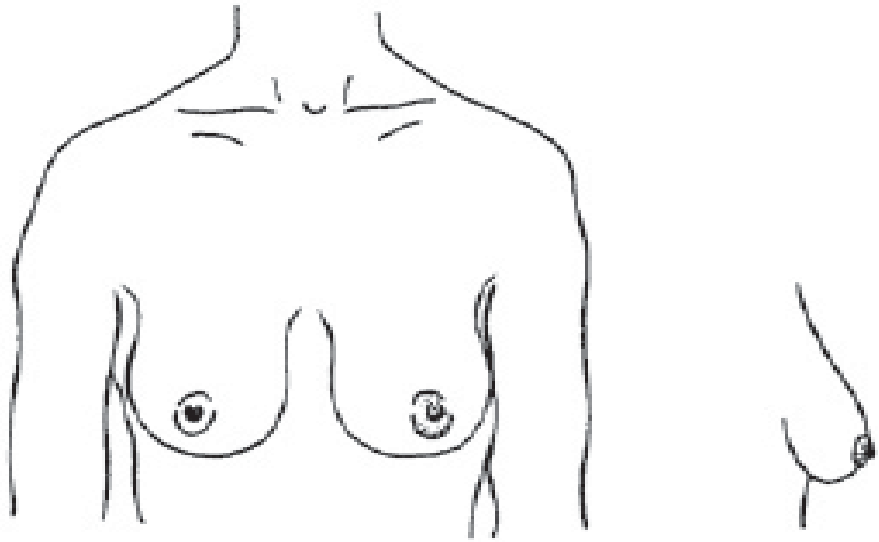

Fig. 7.34 *Pendulum Type of Breast: If the supporting muscles are strong, this indicates strong sexual potential. If the muscles are flabby it indicates a weaker sex drive.*

Female Body

The following points of female beauty are nature's own advertisement of a healthy condition of the sexual system:

1. Large limbs, indicative of strength to sustain the body during the period of pregnancy.
2. Broad hips, indicative of a large pelvis, giving abdominal support during pregnancy and easy delivery.
3. A relative narrow waist, indicating freedom from suppressed menstruation and a proper expansion of the hips.

Breasts, standing out prominently, firm in texture, with large nipples and a bright pink aureole surrounding nipples free from discoloration, all of which indicates a correct condition of the womb.

A graceful carriage of the body, a springing, vigorous, rhythmical step, sweet breath, good teeth, clear complexion, pleasant musical voice, a well-shaped neck and back of head, red and full lips, and a well developed chin, projecting forward slightly, clear, bright, animated eyes; all are indispensable indications of good sexuality.

The points enumerated in the last paragraph apply equally well to estimating the sexual strength of the male, with the addition of broad shoulders and deep chest as well as a contour of body broadest at the shoulders and tapering toward the feet.

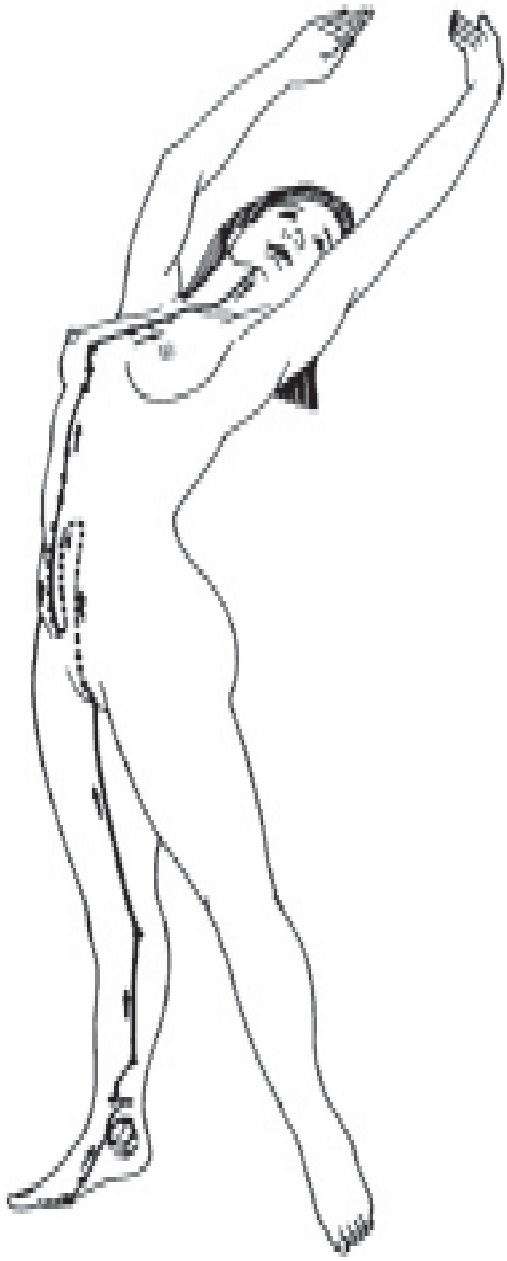

Fig. 7.35 *Female Body*

(Note – In a proportional female figure the waist will measure, in circumference, two-fifths of the height, the hips at broadest part, nine inches more.)

Chapter VIII
Compatibility

"When the same inner sight exists in you as in another, you are drawn to be companions. When a man feels in himself the inmost nature of a woman, he is drawn to her sexually. When a woman feels the masculine self of a man within her, she wants him physically in her."

- Rumi

The compatibility between men and women offers a glimpse into the unity of the Universe. The sexual experience is one of the great gifts of humanity, offering a relatively accessible experience of total balance and harmony and thus serving as a metaphor for the larger purpose of life. That purpose, said the Taoist sages, is to achieve peace and harmony through unification of opposites. Look around you, recognize man and woman as yet another expression of the same cosmic duality that creates day and night, winter and summer, positive and negative, north and south, heaven and earth. Bring together these opposites and the world collapses in spiritual ecstasy say the Taoist teachers, who regard sex to be as natural and indispensable to human health and longevity as rain falling on the fields.

The Taoist view compatibility from a variety of different perspectives. Compatibility refers to the energetic attraction between two people, especially lovers. There are some obvious signs of compatibility that make sense and yet many people overlook them. We can determine compatibility through touch, smell, sight, taste, conversation, holding hands, interest, chemistry and energy.

Compatibility should be like a good red wine, becoming richer and deeper over time. This is why relationships should be given ample time in each stage of progression: courting, dating and marriage. With the Taoist secrets of love techniques, a relationship gets more profound and intense the longer you stay with your partner. This is because the Taoists learn to cultivate energy rather than drain it. If a couple who have deep affection and love for one another drain each other's energy through sexual indulgence, emotional ups and downs, and needless arguments, the intensity and depth of the relationship diminishes. This is one of the reasons for such a high divorce rate in the West. With the Taoist techniques, love grows and flourishes.

In the West, compatibility is sometimes referred to as chemistry. When a couple has "good chemistry" there is electrical, magnetic energy. The age old question is how to keep this magnetism, this chemistry with partners so that it will last a lifetime. The Taoist discovered this secret in the cultivation of energy. When there is energy in a relationship there is interest, excitement and joy.

Fig.8.1 *Fusion of the Microcosmic Orbits*

Compatibility can be revealed through the sense of smell. Smell is one of the primal senses of attraction, both consciously and subconsciously. In some cultures, smelling the neck and the face is just as erotic as passionately kissing. Through the sense of smell we can determine if we are compatible with someone. If their sense of smell is revolting, you might want to reassess the relationship. This does not mean smelling your partner after a three hour workout to determine this; it means the sense of smell in general. Is it pleasant to the nose when you are holding each other close, when you are kissing or snuggling?

There are many ways to determine the compatibility of men and women. For example, when men and women clasp hands, note the harmony or disharmony of the clasp itself. If the hands do not seem to fit harmoniously and if the contact becomes unpleasant when prolonged, it is a sure sign that the dispositions will not harmonize. If the clasp is harmonious and the effect of prolonged contact continues to be agreeable it indicates that the general effect is harmonious.

In every intimate association kisses and caresses will reveal the most important information. Caresses and kisses must be exchanged with great freedom and the kisses must be sufficiently passionate and complete to enable the couple to obtain the complete effect of the flavor of the fluid and the magnetic or electric effect of the caresses. If the caresses exert a highly beneficial effect and the kisses increase in sweetness and enjoyment over time, it is a good indicator of growth potential. If this result is not reached and the kisses become repulsive and the caresses become weak, or the parties find after complete and intimate association that love does not continually augment in intensity, the conditions of harmony are absent and all thought of continued companionship should be dismissed. However the parties may continue to be affectionate friends as long as it is mutually agreeable. This judgment should not be formed hastily and I consider it unsafe to form a conclusion from any impression which may only be mo-

mentary. I recommend that this experiment should last at least six months unless the parties discover in a shorter time that it is positively disagreeable. In some of the best adaptations I have ever known it took some time for the best results to be established, especially in those cases where the parties were young and inexperienced and had not learned the art of expressing their emotions freely. Love, like everything else, is a creature of growth and takes time to develop.

The idea to wait or prolong sexual intercourse allows the heart to be seasoned with love. Sexual intercourse that occurs too soon drains energy, especially if one is not skilled at the Taoist arts of the bedchamber. Promiscuity has a tendency to prevent this energy from cultivating in the heart center.

In walking together, keep in step and notice if it is an easy thing to do and if the gait of one is harmonious with the other. The walk is an unfailing indication of character and it is impossible for persons who experience great difficulty in keeping step or who tire each other by the walk together to harmonize in character.

Notice the effect of conversation. If after a long interview you experience a feeling of fatigue and you find this the usual result, the character is inharmonious with your own. Language is the principal avenue of expression, and its effects cannot be too closely watched. If the conversation inspires you and you feel rested and instructed after each one or this is the general result, the indications are in favor of harmony. Many couples fall in love or notice the attractive energy first from conversation and talking.

Some nationalities are sufficiently well informed to know the desirability of previous tests of intimate association before marriage and the custom of “bundling” among the Dutch and similar customs among other nationalities, have their origin in a crude effort to establish a test of this kind. In the custom of “bundling”, the male and female are each sewed up in sacks in such a manner that it is impossible to have sexual intercourse without rupturing the sacks and thus being detected. In this condition they are allowed to sleep together and note the effect upon their feelings. Whatever may be the general result of such a custom, there is no question as to its value as a test. It is impossible for two persons to sleep together a number of nights without being conscious of increased affection and desire for companionship or the entire loss of such desire. The effect of sleeping together may be summed up as follows: If the parties are not harmonious, they will in a short time exhaust their magnetism to such a degree that all mutual attraction ceases. If they are harmonious, the effect will be delightful and the desire for its continuance will increase for a number of months. Then there will be a culmination in which no great degree of increased desire will be felt, but it will continue to be a pleasant experience. If the parties are perfectly harmonious this may continue for many years, but as a general rule the pleasure of contact will be greatly intensified if they do not continually sleep together. If they are not perfectly harmonious, the magnetism will gradually be lost, hence, as very few couples are perfectly harmonious, it is a good rule to occupy separate beds and sleep together occasionally as desired and as expediency may dictate. The loss of magnetism, and the consequent neutralizing of

affection, will be slow or rapid in its progress as the parties are less harmonious.

The period of experimental courtship may be as long or short as the prudence and the circumstances of the parties may dictate but I suggest that six months is not unreasonably long and I also believe that any reasonable man or woman ought to be thoroughly satisfied with the results of such a test in one year of continued intimate association.

Love Making Energy

"Do you not see that you and I are as the branches of one tree?
With your rejoicing comes my laughter; With your sadness start my tears.
Love, could life be otherwise with you and me?"
- Tsu Yeh Tsin dynasty, A.D. 265-316

Sit cross-legged facing your partner. Bring the hands onto the knees; man's palms face down and woman palms face up. Bring the palms together so that the centers of the palms touch. This is an exercise to balance and harmonize the male and female energies. Take some long slow deep breaths synchronizing the inhale and exhale. Breathe together, inhaling and exhaling in unison. This synchronizes the energy between one another. Feel the exchange of energy flowing between the palms. The Tao calls this exercise energetic lovemaking. You can visualize a God and Goddess above your head making love. Feel the energy pouring down onto the crown of the head and into the whole body. Feel the sexual energy of the Universe in harmony with your own sexual energy. Allow the intimate connection between yourself, your partner and the Universe pulse through your entire being.

Fig. 8.2 *Drawing nectar up to the Golden Flower.*

Chinese Astrology

Over the intervening millennia, humanity has gradually lost its sensitivity to the world of vibration (such as Chi), as we become more concerned with material development, and as our biological conditions have become more clouded and insensitive. Humans are born and nursed in an environment which is strongly influenced by the energy flow (Chi and magnetic forces) on the Earth as well as from other planets and celestial bodies. The following are branches of Chinese Astrology.

Five Element Astrology

When you are born, the first breath of air you take is filled with the energy vibrations of the Five Elements. The Fire element is the sun vibration, the Earth element is the soil or ground vibration, the Metal element is the rocks or mountain vibration, the Water element is the river or lake vibration and the Wood element is the tree vibration. The first environmental energy patterns that you breathe of the five elements connect with the Five Vital Organs (Fire/Heart, Earth/Spleen, Metal/Lungs, Water/Kidneys and Wood/Liver) forming your internal energy blueprint. With this blueprint you have the opportunity to change and balance your organs because you have it from the beginning of your biological life. This is one of the theories in Chinese Astrology, which calculates the expected effect of the environment, including celestial bodies, on an individual.

Although no one can change your inherent energy character within each organ, the energy can be brought closer to harmony by changing the quality and quantity of the energy you receive through diet, meditation and the influence of the environmental energy. Once you are aware of the quality and quantity of the five elements that you possess as well as the status of your organs, it is conceivable that you have a better chance of becoming more balanced and harmonious. You can aquire the ability to mold your own lifestyle to fit your desires and ambitions with these specific attributes. Humans inherit the energy from the environment when they are born and the human body is an image of the universe in terms of energy. One part of the energy is from the planets and celestial bodies, which comprise the Ten Celestial Stems in a person's astrology chart. The other part of the energy is from the earth, which comprises the Twelve Honorary Branches. The Ten Celestial Stems are the vital life forces for each major organ. The Twelve Honorary Branches are the energies that flow through each of the twelve major meridians, which have great influence on the organs.

The combined effect of the stems and branches on the organs is expressed in the relative amounts of Five Elements. The analysis explicitly states the status of each organ at birth. The ten organs are divided into five groups as shown below. Each organ within a group shares the total amount of life force of the group with the other organ. It is desirable for each group to have a total of at least one to two units of life force. All the

parts of the body are connected to form the whole. The parts should not be treated individually. All organs should function in a harmonious manner. Excess of or deficiency in life force in a group will cause an imbalance of energy in each member. Imbalance of life force in a group will affect the other groups through a chain reaction among organs. Each group has a strong connection with a sense organ. For instance, the sense organ for the Gall Bladder and Liver group is the eyes. Imbalance of energy in an organ will manifest itself as sickness, emotion, change of taste and impairing the related sense organ. All of these effects are referred to as the associated conditions of the corresponding organ.

The energy analysis is based on birth hour, day, month and year with personal element and positive (yang) and negative (yin) levels as follows:

Lungs	***Lesser Yin Metal***	***Great Yin Metal***	***Greater Yin Metal***	***Greatest Yin Metal***
Kidneys	***Lesser Yin Water***	***Great Yin Water***	***Greater Yin Water***	***Greatest Yin Water***
Liver	***Lesser Yin Wood***	***Great Yin Wood***	***Greater Yin Wood***	***Greatest Yin Wood***
Heart	***Lesser Yin Fire***	***Great Yin Fire***	***Greater Yin Fire***	***Greatest Yin Fire***
Spleen	***Lesser Yin Earth***	***Great Yin Earth***	***Greater Yin Earth***	***Greatest Yin Earth***
Lg. Intestine	***Lesser Yang Metal***	***Great Yang Metal***	***Greater Yang Metal***	
Bladder	***Lesser Yang Water***	***Great Yang Water***	***Greater Yang Water***	
Gall Bladder	***Lesser Yang Wood***	***Great Yang Wood***	***Greater Yang Wood***	
Sm.Intestine	***Lesser Yang Fire***	***Great Yang Fire***	***Greater Yang Fire***	
Stomach	***Lesser Yang Earth***	***Great Yang Earth***	***Greater Yang Earth***	

Fig. 8.3 *Ten Yin/Yang Organs and Elements*

This represents the energies, emotions and personality you were born with, and your body character is represented by one of the above. The term “yin” in general refers to cold, wet and downward moving characteristics, and the term “yang” refers to warm, dry and upward moving characteristics. Lesser through Greatest refers to levels approaching yang or yin working with each of the five vital organs and their associate organs. This is a very involved science but you can have your analysis done through the Universal Tao, which has a future book “*Cosmic Nutrition*” to explain this concept further.

This gives you an excellent opportunity to discover who is compatible with you at an internal energy blueprint level. This is one method in Chinese Astrology along with the Chinese Twelve Animals and the Nine Stars.

Twelve Animal Astrology

Each of the Chinese animals has certain characteristics and patterns, which help you understand yourself and with whom you are more compatible. The Taoist just uses the animal symbolism because that animal had a similar pattern with that person's energy vibration.

Twelve Animals and Characteristics are:

Rats are: Seductive • Energetic • Of Good Counsel • Charming • Meticulous • Sociable • Jolly • Persistent • Humorous • Intellectual • Lovable • Sentimental • Generous • Honest *but they can also be*: Profiteering • Manipulative • Agitated • Gamblers • Greedy • Petty • Suspicious • Tiresome • Destructive • Power-Hungry.

Buffalos *are*: Patient • Hard-Working • Familial • Methodical • Loners • Leaders • Proud • Equilibrated • Reserved • Precise • Confidence-Inspiring • Eloquent • Self-Sacrificing • Original • Silent • Long-Suffering • Strong • Tenacious *but they can also be*: Slow • Loutish • Stubborn • Sore Losers • Authoritarian • Conventional • Resistant to Change • Misunderstood • Rigid • Vindictive • Jealous.

Tigers *are*: Hugely Generous • Well-Mannered •Courageous • Self-assured • Leaders • Protectors • Honorable • Noble • Active • Liberal-minded • Magnetic • Lucky • Strong • Authoritative • Sensitive • Deep-thinking • Passionate • Venerable *but they can also be:* Undisciplined • Uncompromising • Vain • Rash • In Constant Danger • Disobedient • Hasty • Hotheaded • Stubborn • Disrespectful of Rules • Quarrelsome.

Rabbits *are*: Discreet • Refined • Virtuous • Social • Tactful • Unflappable • Sensitive • Companionable • Solicitous • Ambitious • Gifted • Forgiving • Prudent • Traditional • Hospitable *but they can also be:* Old-Fashioned • Pedantic • Thin-Skinned • Devious • Aloof • Private • Dilettantish • Fainthearted • Squeamish • Hypochondriacal.

Dragons *are*: Scrupulous • Sentimental • Enthusiastic • Intuitive • Shrewd • Tenacious • Healthy • Influential • Vital • Generous • Spirited • Captivating • Artistic • Admirable • Lucky • Successful • Autonomous *but they can also be:* • Stubborn • Willful • Demanding • Irritable • Loud-Mouthed • Malcontent • Otherworldly • Impetuous • Infatuated • Judgmental.

Snakes *are:* Wise • Cultivated • Cerebral • Accommodating • Intuitive • Attractive • Amusing • Lucky • Sympathetic • Elegant • Soft-spoken • Well-Bred • Compassionate • Philosophical • Calm • Decisive *but they can also be:* Ostentatious • Sore Losers • Tight-fisted • Extravagant • Presumptuous • Possessive • Vengeful • Self-Critical • Phlegmatic • Lazy • Fickle.

***Horses** are:* Amiable • Eloquent • Skillful • Self-Possessed • Quick-Witted • Athletic • Entertaining • Charming • Independent • Powerful • Hard-Working • Jolly • Sentimental • Frank • Sensual *but they can also be:* Selfish • Weak • Hotheaded • Ruthless • Rebellious • Pragmatic • Foppish • Tactless • Impatient • Unfeeling • Predatory.

***Rams** are:* Elegant • Creative • Intelligent • Well-Mannered • Sweet-Natured • Tasteful • Inventive • Homespun • Persevering • Lovable • Delicate • Artistic • Amorous • Malleable • Altruistic • Peace-Loving *but they can also be:* Pessimistic • Fussbudgets • Dissatisfied • Capricious • Intrusive • Undisciplined • Dependent • Irresponsible • Unpunctual • Insecure.

***Monkeys** are*: Acutely Intelligent • Witty • Inventive • Affable • Problem-Solvers • Independent • Skillful Business People • Achievers • Enthusiastic • Lucid • Nimble • Passionate • Youthful • Fascinating • Clever *but they can also be:* Tricky Tacticians • Vain • Dissimulators • Opportunistic • Long-Winded • Not all that Trustworthy • Unfaithful • Adolescent • Unscrupulous.

***Roosters** are:* Frank • Vivacious • Courageous • Resourceful • Attractive • Talented • Generous • Sincere • Enthusiastic • Conservative • Industrious • Stylish • Amusing • Contemplative • Popular • Adventurous • Self-Assured *but they can also be:* Nitpickers • Braggarts • Quixotic • Mistrustful • Acerbic • Shortsighted • Didactic • Pompous • Pedantic • Spendthrift • Brazen.

***Dogs** are:* Magnanimous • Courageous • Noble • Loyal • Devoted • Attentive • Selfless • Faithful • Modest • Altruistic • Prosperous • Philosophical • Respectable • Discreet • Dutiful • Lucid • Intelligent *but they can also be:* • Guarded • Introverted • Defensive • Critical • Pessimistic • Forbidding • Cynical • Stubborn • Moralizing.

***Pigs** are:* Obliging • Loyal • Scrupulous • Indulgent • Truthful • Impartial • Intelligent • Sincere • Sociable • Thorough • Cultured • Sensual • Decisive • Peaceable • Loving • Profound • Sensitive *but they can also be:* Naïve • Defenseless • Insecure • Sardonic • Epicurean • Noncompetitive • Willful • Gullible • Earthy • Easy Prey.

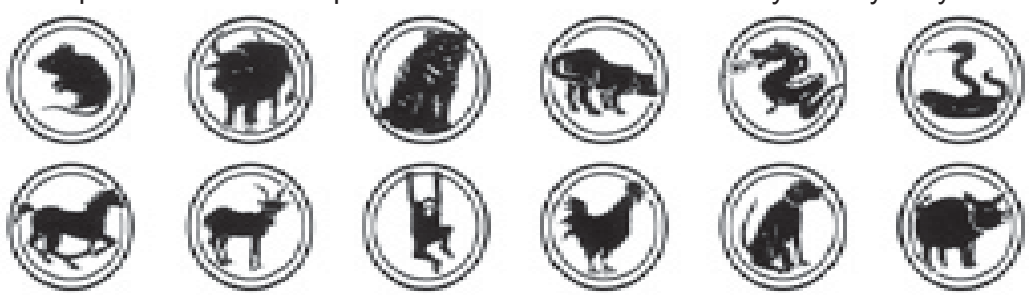

***Fig. 8.4** Twelve Chinese Animals*

Taoist Nine Star Astrology

Taoist Nine Star Astrology is based on the numerology of the Pole Star, Vega Star and the seven stars in the Big Dipper. Taoist Nine Star Astrology is the essence of all the Taoist practices and is based on the Pole Star (Yang), the Big Dipper (7 Points), and the Vega Star (Yin). All movement and energy patterns on Earth are based on the energy fields of these 9 points. Every 26,000 years completes one cycle of Light (Yang) to Darkness (Yin), and presently shifting the Pole Star (Yang) (Center of Galaxy) to the Vega Star (Yin).

*** (1) Vega (Yin)** **(9) North (Pole) Star ***

***(3)**

***(2)** ***(4)**

***(5)** ***(8)**

***(6)** ***(7)**

Fig 8.5 *Big Dipper, Vega and North Star*

Although our planet's polar axis is tilted at 23 degrees with the Star Polaris in Ursa Minor above its northern pole, this is not a constant. Modern astronomers know that approximately every 26,000 years the earth flops to a position where the star Vega in the Constellation Lyra becomes the Pole Star. This shift is fairly dramatic. However, there is a less dramatic wobbling that our planet makes on its axis, a wobbling that invariably alters the North-South Polarity of the Earth. This in turn affects the body channels, the Positive Governor Channel and Negative Functional Channel, and this affects the human electromagnetic field.

Sages in the past were able to observe nine distinguishable electromagnetic phases in this wobbling. Astrology and astronomy have determined that there are Nine Stars in the Northern Sky closely centered around the northern end of the earth's polar axis: Polaris, Vega and the Seven Stars that make up Ursa Major, the Big Dipper (Fig.8.6). They are responsible for the slight electromagnetic shift that occurs. As Nine Star Chi Theory has it, each star is integrally a part of and responsible for each of the distinguish-

able electromagnetic phases. When our planet is under the influence of one of the particular electromagnetic phases, one of the transformations phases or transformations mentioned earlier becomes accentuated. Thus there are five fire years, earth years, water years, wood years and metal years with all elemental transformation phases represented within a nine year cycle, and each year is positive or negative (yin or yang).

In Nine House Astrology a man or woman is not simply born in a particular house, but during his or her lifetime migrates through the yearly, monthly, daily and hourly sequences many times. The belief behind this is that a person can and should become as perfectly balanced as possible through facing and overcoming all the varied experiences presented to him as a result of the influences of the various houses. People follow different patterns because of the influences permanently imprinted upon them at their particular times of birth. The rules that carry them through these cycles remain constant, and it depends upon their state of wisdom as to how well they apply them. The different situations different people face are determined by their state of evolution at the time they re-enter this world. The strength and intensity of troubles or good fortune depend on the strength and (cosmic) maturity of the individual.

Here are the Nine Houses:

(1) Water (Kan-Water)	***Yang within Yin***	***(+)***
(2) Earth (Kun)	***Yin***	***(-)***
(3) Wood (Chen-Thunder)	***Yang***	***(+)***
(4) Wood (Sun-Wind)	***Yin***	***(-)***
(5) Earth (Tai Chi Symbol)	***Yin & Yang***	***(+ & -)***
(6) Metal (Chien-Heaven)	***Yang***	***(+)***
(7) Metal (Tui-Lake)	***Yin***	***(-)***
(8) Earth (Ken-Mountain)	***Yang***	***(+)***
(9) Fire (Li)	***Yin within Yang***	***(-)***

This formation is converted into Sacred Geometry using the Magic Square:

4	***9***	***2***
3	***5***	***7***
8	***1***	***6***

All the numbers add up to 15 in any direction, and 1 + 5 = 6. The movement of the Universe is a spiral moving from 5 to 6 to 7 to 8 to 9 to 1 to 2 to 3 to 4 to 5 as it is in the Magic Square. When you use the Pakua with the 9 Directions, you take each number with this spiral progression and they all add up to a single digit number of 3, 6, or 9, which adds up to 18 (in any direction) or 1 + 8 = 9 (9 Star Astrology).

The Magic Square is also referred to as a Universal Chart, originally found on Wu Hsi's tortoise and thus considered a sign from the Divine Forces. It represents the qualities, order, and movement of all phenomena as expressed in the law of five transformations (phases). Each of nine blocks in the square or magic pakua is a house, which bears certain qualities. This Square is the cornerstone of Nine Star Astrology as it is used in China, Tibet, and Japan.

Chinese Astrology Compatibility

In looking at the compatibility between two people we consider two main factors: the personalities and the sexual energies. These are indicated by the energies of the Personal Element illustrated within the five element cycle. If the elements in two people are on the positive or creative cycle, this generally creates good compatibility between them. If the elements are on the destructive cycle, this can create conflicts between either personalities or sexual energies. This is a very general statement and there are sometimes exceptions to this rule. The upper character of the Personal Element represents the personality (Heart Center). This upper character could be on the creative or the destructive cycle, which is how the emotions are expressed. The lower character of the Personal Element represents the internal or sexual energies (Kidney Center). This lower character could be on the creative or the destructive cycle, which is how the sexual impulses or drives are expressed.

Again, this is a very involved science but you can have your compatibility analysis done through a Chinese astrologer which can be provided by the Universal Tao.

Personal Element

Yin Earth	***Yang Wood***	***Yin Earth***	***Yang Wood***
戊	甲	己	庚
辰	寅	丑	寅
Yin Water	***Yang Metal***	***Yin Water***	***Yang Fire***
Time	***Day***	***Month***	***Year***

Fig. 8.6 *Chinese Eight Force Astrology Chart*

Chapter IX
Sexercises

In the Tao, sexual exercises were not merely a way to enhance sexual pleasure or become more attractive. These exercises were a means to enjoy a more vigorous and healthy body, a way to become sensitive to deeper and more intense emotions and to cultivate spiritual energy. The Taoists believed that the body would stay healthy and youthful as long as it was able to reproduce. When the reproductive energy was in a decline the body would retaliate with sickness or emotional insecurity.

In the East, as well as in the West, exercise is a crucial way to keep the body healthy. But, when it comes to increasing sexual energy, the teachers of the East have taken exercise to a new level. To strengthen our sexual energy and thus strengthen the senses and the whole body, the Eastern traditions have developed exercises that focus specifically on the sexual area.

By strengthening the sexual organs through exercise and massage, we actually affect the rest of the body and senses. It is believed that the sexual organs are the strongest reflex points in the body and when stimulated in the proper way can have a powerful healing effect on the senses and internal organs making you healthier and more sexy. There are pelvic exercises that greatly strengthen the reproductive organs and the complex network of tendons in the surrounding area. Strength in this department is of great importance; it is the root of both a man and woman's health. Leading into the pelvis are a vast number of nerve endings and channels for the veins and arteries. Here are located tissues that communicate with every square inch of the body. All of the major acupuncture meridians that carry energy between the body and the vital organs pass by this area. If it is blocked or weak, energy will dissipate and the organs and brain will suffer. These exercises are designed to charge the brain with energy, increase circulation, stimulate nerve flow, strengthen the urogenital diaphragm and tonify the energy of the sexual organs. Because they focus on enhancing the strength and energy of the sexual area, we have called this workout "Sexercises".

In the Taoist view of sexual health, it is important to cultivate our sexual energy rather than needlessly wasting it. For men, this means regulating and controlling ejaculation. For women, it means working with and balancing the female menstruation cycle.

If men ejaculate too often, it depletes the source of vital energy, not allowing the water of life to spread to the rest of the body. The importance of the man retaining semen is emphasized over and over again in Taoist literature, which is dramatically different to the religious idea of celibacy. In the Tao, regulating and managing ejaculation does not mean becoming a celibate. The basic purpose of these methods is to increase, as much

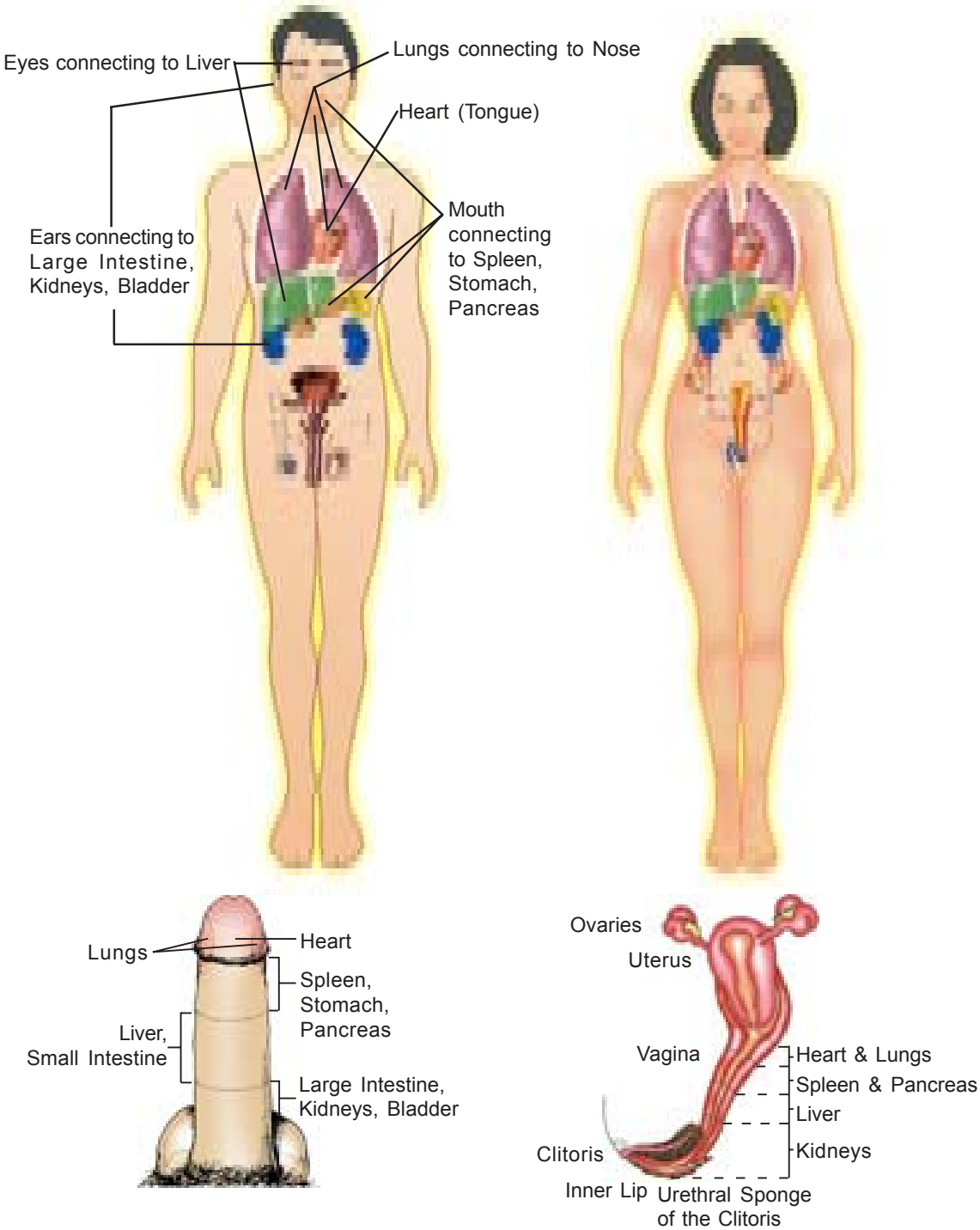

Fig. 9.1 *Sexual Reflexology Points throughout the Body*

as possible, the quantity of the life-giving, age-retarding hormones secreted in a man's body during sexual excitement, while at the same time decreasing, as much as possible, the loss of semen and its related hormones through ejaculation. All schools of Taoism agree that semen retention and proper regulation of its emission are indispensable skills for male adepts. To understand more about this concept I recommend reading *Multi-Orgasmic Man* and *Cultivating Female Sexual Energy.*

Breathing Sexercises

"There is one way of breathing that is shameful and constricted. Then there's another way: a breath of love that takes you all the way to infinity."

- Rumi (Open Secret)

The first step to becoming a more sexually powerful person is to learn how to breathe properly. Many of the Sexercises require a certain level of breath control and when you learn to breath properly the exercises become much easier and much more powerful. Breathing exercises are a direct way to control stress.

For example, think about how you breathe when you are in a terribly stressful situation. The breath gets jammed up in the chest in short shallow gasps that barely allow oxygen into the lungs. Under extreme circumstances the breath might become almost nonexistent. With this type of breathing, life-enhancing oxygen does not flow freely through the body. This creates stress and tension, lodging it in the body rather than allowing it to be processed and released.

Long ago in Chinese medicine it was discovered that the breath is a direct reflection of the emotional state of the body. When someone is sad, they breathe in short inhaling gasps, locking the air in the upper chest. When someone is angry, the breath is usually long contracted exhales, with desperately short inhalations. Even when we are not feeling very emotional, the breath will still reflect the general overall feelings in the body, which are often not very empowering.

Just as correct diet enhances the body's store of nutritional essence, so correct breathing enhances the body's supply of vital energy. Proper breathing is performed by the diaphragm, not the rib cage and the clavicles. Because of laziness, ignorance, smoking, pollution, constipation and other factors, adults these days invariably become shallow chest breathers, rather than the deep abdominal breathers that we are meant to be. All true martial arts and meditation practices use the breath as the gate to control the body.

Breathing abdominally is the most natural thing, it is just that we have forgotten how we used to breathe. Have you ever watched a baby breathe? If not, the next time you have an opportunity, do so. Pay particular attention to how the stomach or abdomen

does the breathing not the chest. This is the natural way, the way we have to return to.

Chest breathing employs the intercostal muscles between the ribs to forcibly expand the upper rib cage, thereby lowering air pressure in the chest so that air enters by suction. However, this leaves the lower lungs, which contain by far the greatest surface area, immobilized. Consequently one must take about three times as many chest breaths in order to get the same quantity of air into the lungs as provided by a single diaphragmatic breath.

Deep Abominal Breathing (For Men and Women)

A complete, deep, abdominal breath should employ three areas of the lungs in a smooth, unbroken expansion that begins at the bottom in the abdomen and not in the upper chest. One first inhales air slowly into the lower lungs by letting the diaphragm expand and balloon downward into the abdominal cavity. When the diaphragm is fully expanded, the intercostal muscles come into play to open the rib cage and fill the middle lungs with air. As the rib cage reaches full expansion, the breather utilizes the clavicles so that air flows into the narrow upper pockets of the lungs.

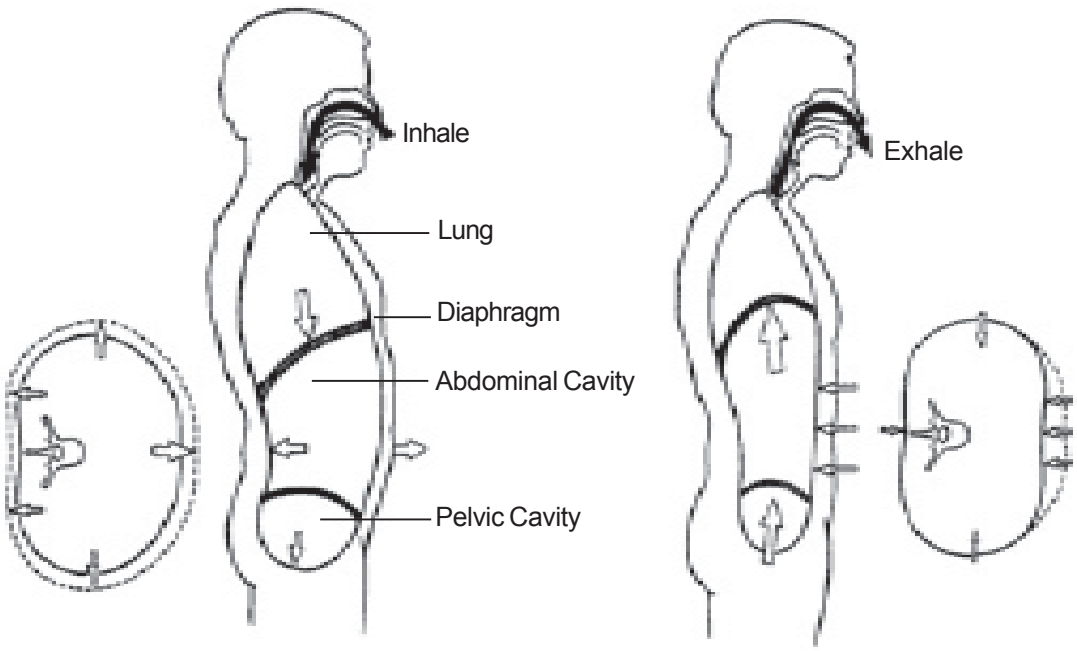

Fig. 9.2 *Deep Abominal Breathing*

Exhale in the reverse manner, releasing air from the upper part of the chest, downward through the ribs, finally expelling the air out the lower lungs by slightly contracting the abdomen. Breathing with the diaphragm in this manner reduces the number of breaths per minute by more than half, greatly enhances respiratory efficiency, saves the heart from strain and conserves vital energy.

This type of breathing has many benefits for the body and emotions. When we are able to breathe in this manner, the body automatically takes it as a sign to be relaxed and calm. This is one of the best ways to combat the stress of everyday life. If you can, practice deep abdominal breathing whenever you have a few extra minutes, driving the car, standing in line, waiting for the dentist, or anywhere else you can imagine; great benefits will result. Pretty soon, with practice, your body will automatically start breathing deeper subconsciously.

Deep abdominal breathing activates the cranial and sacral pumps and keeps the spinal cord fluid moving in the joints and cranium. Spinal cord fluid and seminal fluid are very similar in nature.

As far as increasing sexual energy, the deep abdominal breathing is a wonderful exercise. It sends energy down through the urogenital diaphragm, loosening and relaxing the whole pelvic cavity. Without deep breathing, the lower abdomen has a tendency to become tight and contracted. This leads to low sexual energy or uncontrollable sexual energy. With this tightness in the abdomen there is inevitably an imbalance throughout the sexual area. For men, tightness can cause premature ejaculation, wet dreams, impotence or sexual frustration. For women, this tightness can cause menstrual cramps, frigid sexual energy, PMS and other more complicated emotional problems.

Energy Breathing (For Men and Women)

The energy breath is performed by rapidly expelling air out of the lungs and is designed to create efficient circulation, strengthening the energy of the lower abdominal area. Imagine that there is a small fire right behind the navel. To get this small spark into a vibrant fire needs air. As you perform the exercise, the breath should sound like a bellows, fanning a fire. Start by forcefully expelling all air from the lungs with a strong contraction of the abdominal wall. Immediately after the expulsion of air, let the lungs fill naturally without effort, about half way. When the lungs are half full, immediately contract the abdominal wall again to forcefully expel another gust of air. The exercise should consist of about 20-30 rapid expulsions of air. This strengthens and energizes the lower abdominal area (Sexual Palace and Lower Tan Tien).

Sexercise Massages

Massage is a great way to get in touch with our bodies. It has been used for thousands of years as a way to achieve health, relaxation and longevity. The reason massage is so beneficial is that it releases pent up tension caused by stress, and establishes communication between the mind and body. By increasing circulation, releasing muscle adhesions and generating positive energy, massage is of utmost importance.

Throughout the book we have discussed ways to massage the body to increase energy in the sexual center. Now we discuss massaging the sexual center, not only to enhance sexual energy, but to increase the energy in the whole body.

Testicle Massage

Testicle massage is a way to consciously connect to the male sexual energy. It is critically important to differentiate these exercises from masturbation. In the Tao, the goal of the practice is to harness this vital energy, not to release it. It is essential that you feel the energy and bring it up into the whole body.

Fig. 9.3 *Testicle Massage*

Begin by sitting on the edge of a chair, without pants. (It is possible to do with pants on. If you choose to leave your pants on, it is important to wear them loose, so that the material does not interfere with the massage. It is a good idea to wear pants that do not constrict the blood flow to the genitals. In general, it is always better to wear loose pants and underwear rather than tight). Rub your palms together till warm, then place the tips of all four fingers underneath the testicles, with thumbs on top and massage the testicles firmly by rolling them around between fingertips and thumbs. Roll the testicles about 36 times in each direction. Perform a few PC muscle contractions and finish with deep abdominal breathing.

This exercise increases the production of testosterone, sperm and seminal fluids and elevates male sexual energy in a powerful yet balanced way.

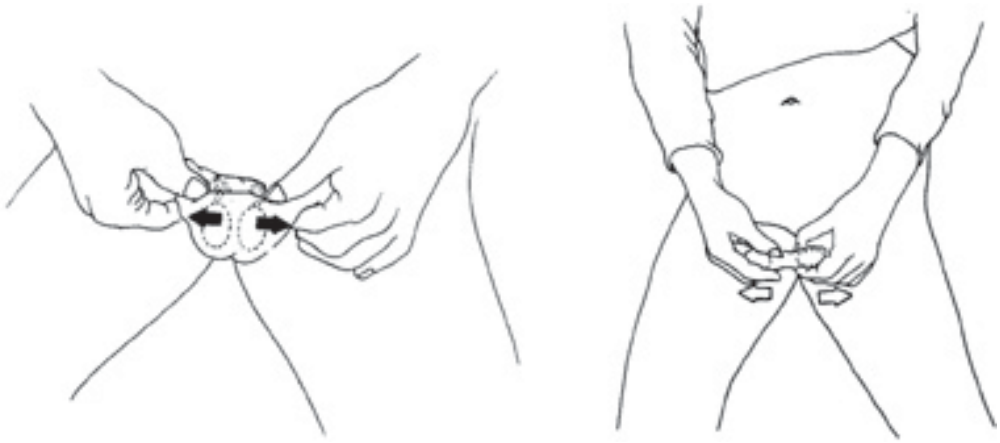

Fig. 9.4 *Testicle Massage*

The testicles are the most important part of the reproductive organs because they hold the key to developing testosterone and sperm. If you neglect them, then you will not be able to perform sexually as you desire. Testicle Massage will aid in the increased production of testosterone, which in turn raises your drive for sex. This exercise also promotes better blood circulation to your testicles, increasing sperm count and ejaculation volume.

The testicles are very vital and important organs in the body, and without them we would be an extinct species. Keeping them in shape will not only give you harder erections, more sex drive and higher amounts of semen, but will also give you a healthier sperm count and chance for conception when you try to have children. The key to proper testicle function and health is better blood circulation to your testicles. Massage in between your testicles with a pumping motion using your thumb and fingers. Massage at the base, pulling down as you massage. Do this for about 3 minutes. Take your hands with your fingers spread apart and grip your testicles at the root and lightly pull them down, bring them back up, them pull them down again, over and over for about 3 minutes. Lightly apply pressure to your testicles, massaging them while doing so. Massaging all around them, working your way around both of the testicles. Continue to repeat all of these steps over and over again. This massaging routine should be done for at least 10 minutes a day, preferably in the morning or before bedtime. Three times a week you should stretch out your testicle skin really well, feeling a good stretch as you pull the skin down. Grasp around the base of your testicles with your thumb and forefinger and squeeze until your testicles are tight together on top of your thumb and forefinger. Take the other hand and apply a small amount of pressure on top of the testicles and massage them in a circular motion. While you are doing this, pull down lightly with the hand grabbing the base of your testicles. Do this for about 3-5 minutes without stopping. After these massaging exercises, your testicles should be stretched out and appear to be hanging lower than normal. They should also appear to be larger. This is

due to the increased blood circulated into your testicles from performing the above exercises. You should do these massaging and stretching techniques at least 3-4 times a week, but daily exercise can be performed for absolute optimal testicle health and fertility. This heat will increase the blood flow as well be absorb into your body quicker, enabling a better, more efficient workout.

Tapping the Dragon Pearls (For Men)

By tapping on the testicles one can directly stimulate the kidney energy of the body. Remember, the kidneys govern the sexual energy. Tapping the testicles stimulates hormonal production through the entire endocrine system.

Stand in a wide stance or sit on the edge of a chair. Rub your palms together until warm, then use one hand to grasp the penis and pull it upwards. The finger tips of the other hand gently tap the testicles, so that they bounce up and down. Do not tap so hard that it is painful, but hard enough to feel it all over the lower abdomen. Do about 36 taps with both hands. After tapping, contract and relax the PC muscle. Follow this with some deep breathing.

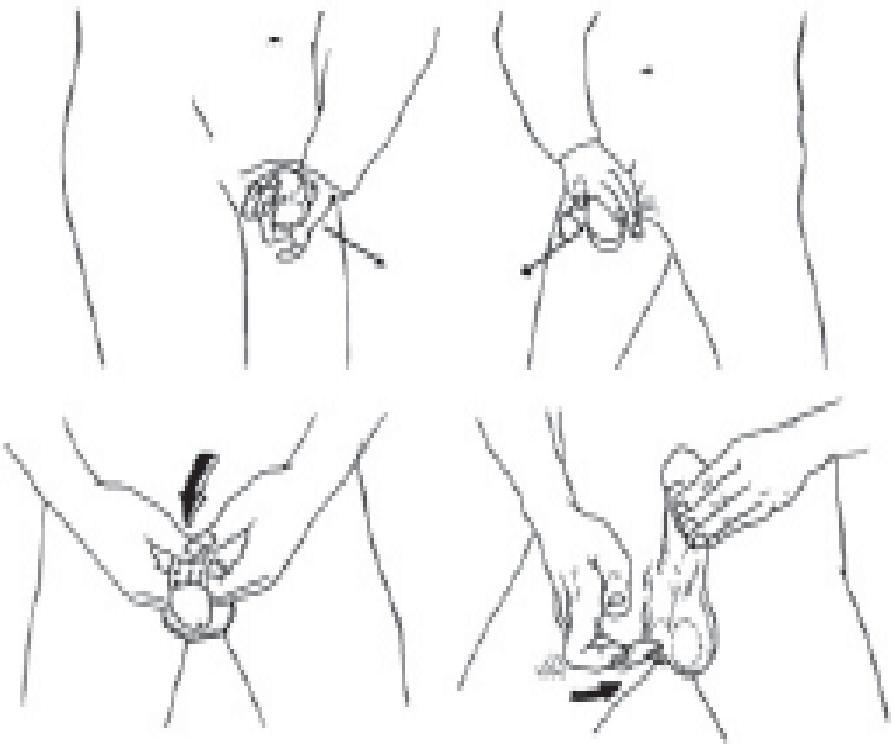

Fig. 9.5 *Testicle Massage and Testicle Tapping*

Penis Power Stretching

To achieve optimal results by stretching your penis, you must understand how the penis works. The penis is made up of cells that enlarge when they fill with blood. These cells are called blood spaces. The blood spaces are within your erectile tissue, also known as the corpora cavernosa. When you stretch the penis, you are stretching all parts of the penis, including the areas that fill with blood. When these areas have stretched to a certain length, the penis will extend longer in both the flaccid and erect state. What most people do not understand is that the penis is probably the easiest part of your body to lengthen and thicken because of the simple fact of how it works. The erection is the size it is because the cells within the penis are a certain size. By naturally exercising blood to fill the spaces, or by stretching the flesh longer, penis enlargement is quite possible with minimal effort.

1. Inhale fully; now exhale and flatten the abdomen while sticking the tongue out. Men use the thumb and index finger to grip the head of the penis; pull the penis and thrust the tongue out more. As for women use the same procedure with the egg with a string to lengthen and strengthen the vagina canal. Squeeze the egg and pull the string. Keep on pulling until you need to inhale. Gasp the air into the intestines; exhale making the "shhhhh" sound until out of breath.

2. In a standing or sitting position, make sure the penis is in a completely flaccid state and grasp around the head, not so tight as to cause pain but just to ensure a good grip.

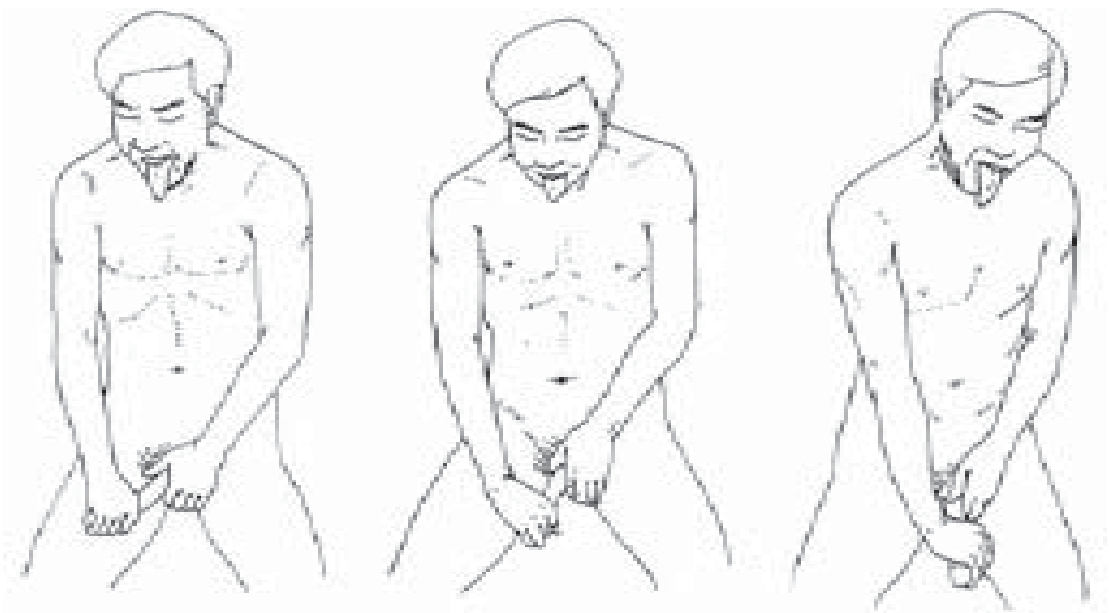

Fig. 9.6 *Power Stretching*

3. Pull the penis directly out in front of you until you feel a good stretch in the middle and at the base. Hold this stretch for a 10 count, rest and feel the energy from the sexual organs. Repeat 3 more times.

4. Now slap your penis against the leg about 50 times to get the blood back into where you have been squeezing.

5. Next, grasp around the penis again, exhale, sticking out the tongue. This time pull to your far left until you feel a good stretch on the right side at the base. Hold this position for a 10 count and repeat. Rest and guide the sexual energy to the crown.

6. Slap the penis against the leg 50 times again.

7. Next, grasp around the penis, sticking out the tongue and holding the breath, only this time pull to your far right until you feel a good stretch on the left side at the base. Hold this position for a 10 count. Repeat 3 more times.

Rotations:

1. Grasp around the penis's head and pull outward until you feel a good stretch.

2. Once extended, begin by rotating the penis in a circular fashion to your left. Not twisting, but rotation around in a circular motion. You should feel a good stretch from all areas of the penis and at the base where it connects. Rotate for 30 rotations, rest for a few seconds and gently contract the anus and perineum guiding the Chi up to the crown. Then repeat 3 more times.

3. Slap the penis against your leg 50 times to get the blood flowing again.

4. Do the same rotation technique as before, only this time to your right. Rotate for 30 rotations, rest for a few seconds, then repeat 3 more times.

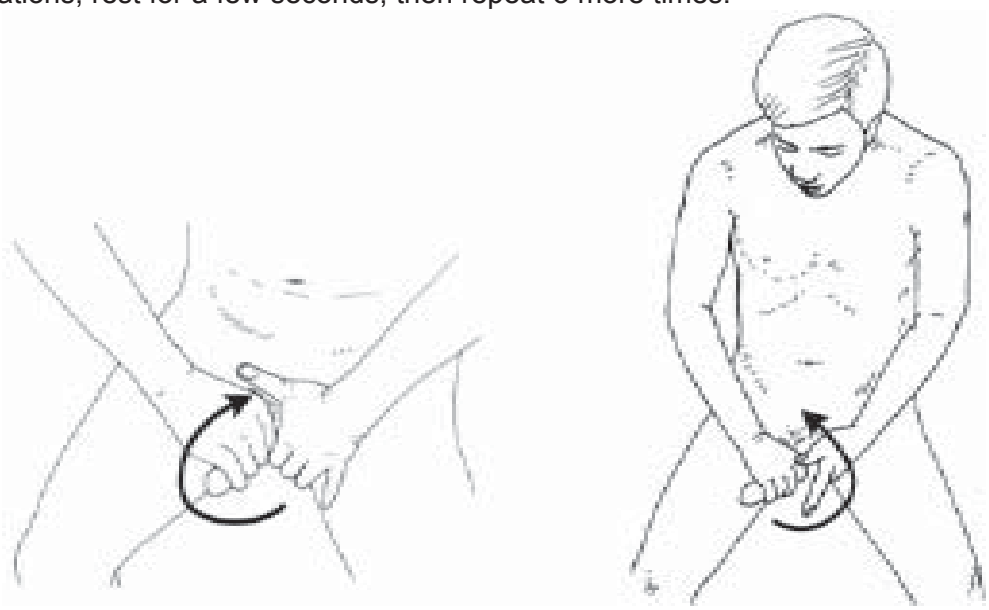

Fig. 9.7 *Rotations*

Hot Hands Warm Up

The purpose in Taoist penis enlargement is to enlarge the corpora cavernosa, the surrounding spongy tissue that fills with blood when you get an erection. If you start out performing the exercises cold, you will experience more blood spots and bumps than you would if you prepared your penis for the physical workout it is about to undergo. Just as you should warm up your body and muscle tissue before any workout, the same should go for your penis. This will prepare it for the workout ahead by making the blood spaces in the corpora cavernosa hot, which expands the tissue and makes it more flexible and spongy. This exercise is called the “hot hand warm up” and should be done before and after every workout you do to your penis and testicles.

1. Rub your hands warm.
2. Hold the penis between the two palms and rub until warm.
3. Hold the testicles between the palms and rub them warm.

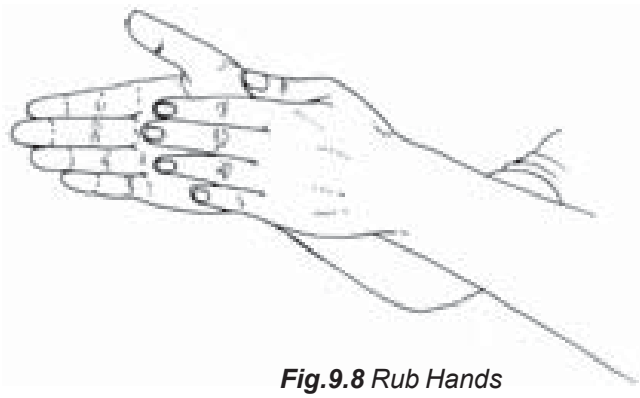

Fig.9.8 *Rub Hands*

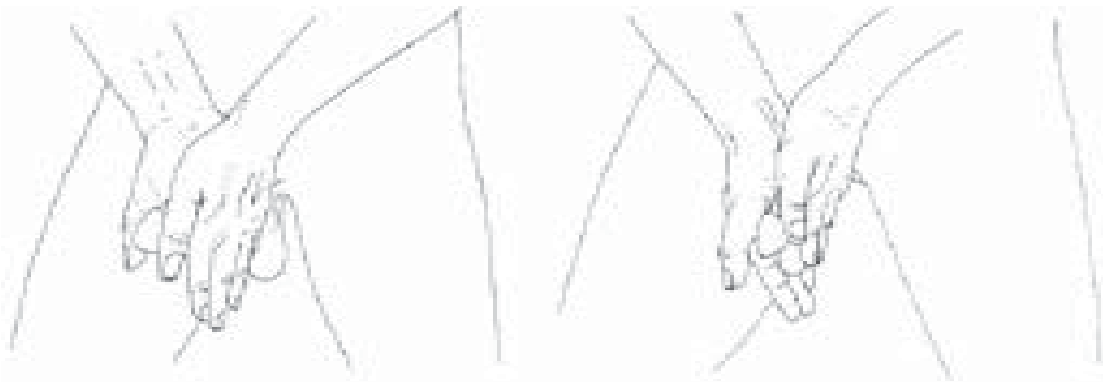

Fig. 9.9 *Hold penis and warm up, followed by testicles.*

Sexual Energy and the Brain

Visualize the Cosmic Orbit movement and fill the organs with Chi. Really focus on your penis while you exercise. Close your eyes and get a good picture in your mind as you exercise. Now, every time you milk, stretch or PC flex, visualize your penis and pineal gland growing a little bit each time and becoming the size that you desire. Focus on every stroke you take and when you stretch visualize a good stretch simultaneously. Focus on the size you want to be and visualize that you have achieved this already. The more you make visualization a regular part of your penile fitness workout, the faster and better results you will attain. This concept goes for anything you do, whether it is penile fitness, exercise, body conditioning or meditation. The more you foresee your results and the more you focus on where you want to be, the faster you will get there. Take care and always remember to visualize your goals. Keeping yourself in top physical shape is very important to your health. Prostate disease and cancer are a leading cause of death in males over the age of 50 and with worsening health conditions each year, things aren't going to get better on their own.

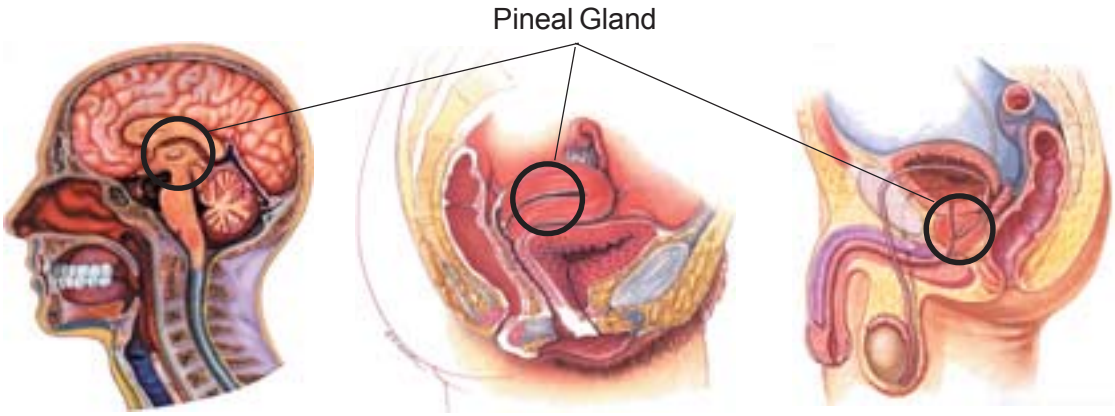

Fig.9.10 *Center of the Brain connects to the Sexual Organs.*

Your ejaculatory strength and ability, your erectile strength and firmness and your prostate health and wellness are all directly influenced by how much you perform these exercises. Regular exercise will massively develop your PC muscle, which in turn will give you hard erections, drastically improve blood circulation to the penis, massively increase ejaculation volume and intensity and actually give you a very healthy prostate. This will help prevent prostate cancer, a leading cause of death in men. The squeeze and flex exercises are simply an advanced PC (pubococcygeus muscle) exercise that incorporates a medium to a tight grip around the erect penis as you perform. This aids resistance to your PC workout by squeezing against the pulsating erection as you flex your PC muscle. Many months of PC Chi Muscle exercise is needed for the average man to be able to last very long in love making.

As you flex the PC muscle contract the eyes, mouth, anus and prostate gland. This will activate the center of the brain.

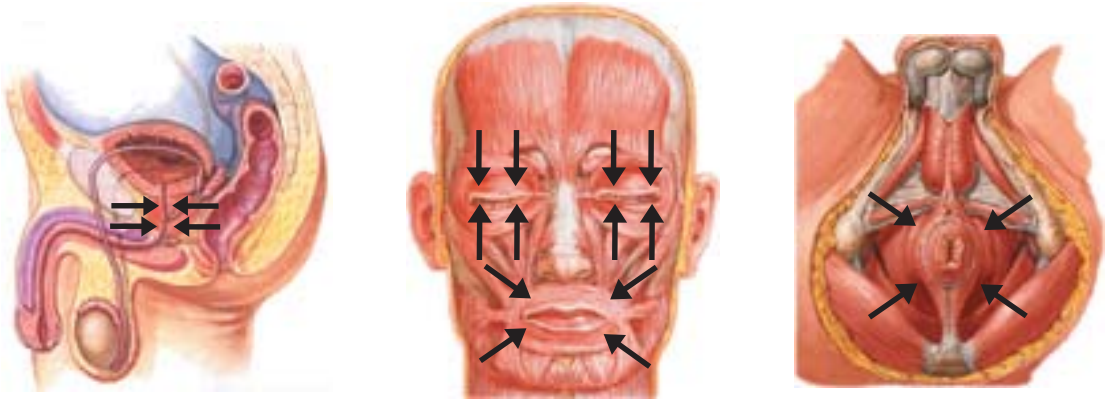

Fig. 9.11 *Pelvic Viscera and Perineum of Male*

PC Muscle and Milking Exercises

These exercises stretch out the central tendon-like tissue in your penis, making it longer, both while erect and flaccid. This exercise also promotes an increase in testosterone and sperm count. It's very sad that in America alone there are more than 30 million impotent men. This is horrifying because all impotence is caused by having a weak, underdeveloped PC muscle and corpora cavernosa (erectile tissue). If you have weak erections or have bouts of impotence regularly, this means that you have very poor blood circulation to your penis and testicles. Having proper blood circulation to any part of your body is vital if good health is desired. A lack of blood circulation to the penis will weaken and shrink the corpora cavernosa and also lessen the sensation and feeling during intercourse, hence promoting impotence. The milking action of stretching will force blood into the blood spaces within the corpora cavernosa, not only enlarging the penis but also training the body to accept more blood flow throughout the entire penis. Regular stretching will ensure a well circulated, healthy and stronger penis after several months of vigorous exercise.

Sexual Organs and the Brain

The Sexual Organs (Ovaries, Testicles, Uterus, Prostate Gland) have a close connection to the center of the Brain, especially the Pineal Gland. Circulating the sexual energy down to the sacrum and then up to the brain, will increase the brain memory. The Taoist sage says, "Return the sexual energy to revitalize the brain."

The center of the brain is connected to the uterus and prostate gland. Contracting and releasing the sex organs increases the blood and sexual hormone circulation to the center of the brain.

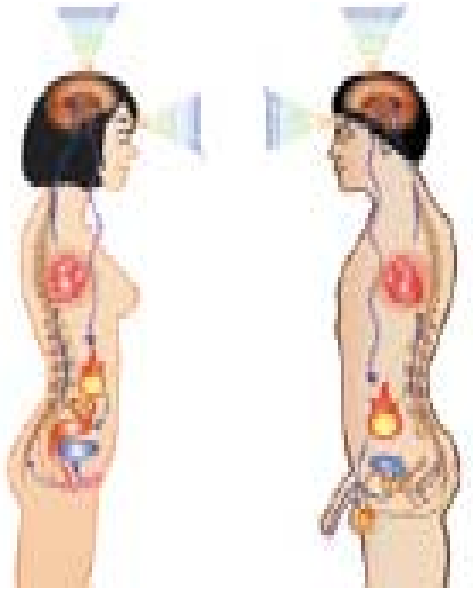

Fig. 9.12 *By drawing the sexual energy up to the brain you are changing the physical (sperms and egg) to etheric and the material to immaterial.*

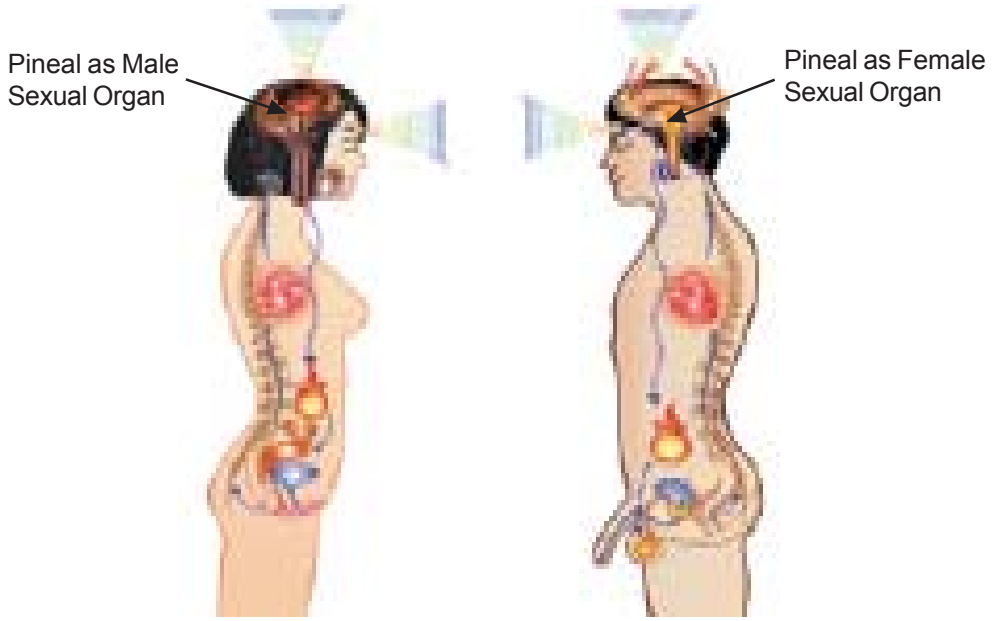

Fig. 9.13 *Pineal Gland is the second sexual organ. In women the pineal is the male sexual organ and in men the pineal is the female sexual organ.*

Chi Muscle

If you are exercising your PC Chi Muscle it will develop your ejaculatory control which will prevent the premature urge to ejaculate. It will also enhance the ability to achieve hard erections; improve blood circulation for enhanced size and sensation; drastically improve sexual stamina; increase ejaculation volume and intensity, improve urinary flow and the ability to have many multiple orgasms. It can actually help save your life by giving you a well developed, healthy prostate.

The first step to beginning your PC workout is locating your PC muscle. Some men have been able to locate their PC muscle for years and didn't even know it. ***Quick Test:*** Get an erection. If you can make your penis move on its own when you have an erection, you have located your PC muscle. If you cannot do this, the next time you urinate, stop the flow of urine before you finish. The muscle you use to stop yourself from urinating is the PC muscle.

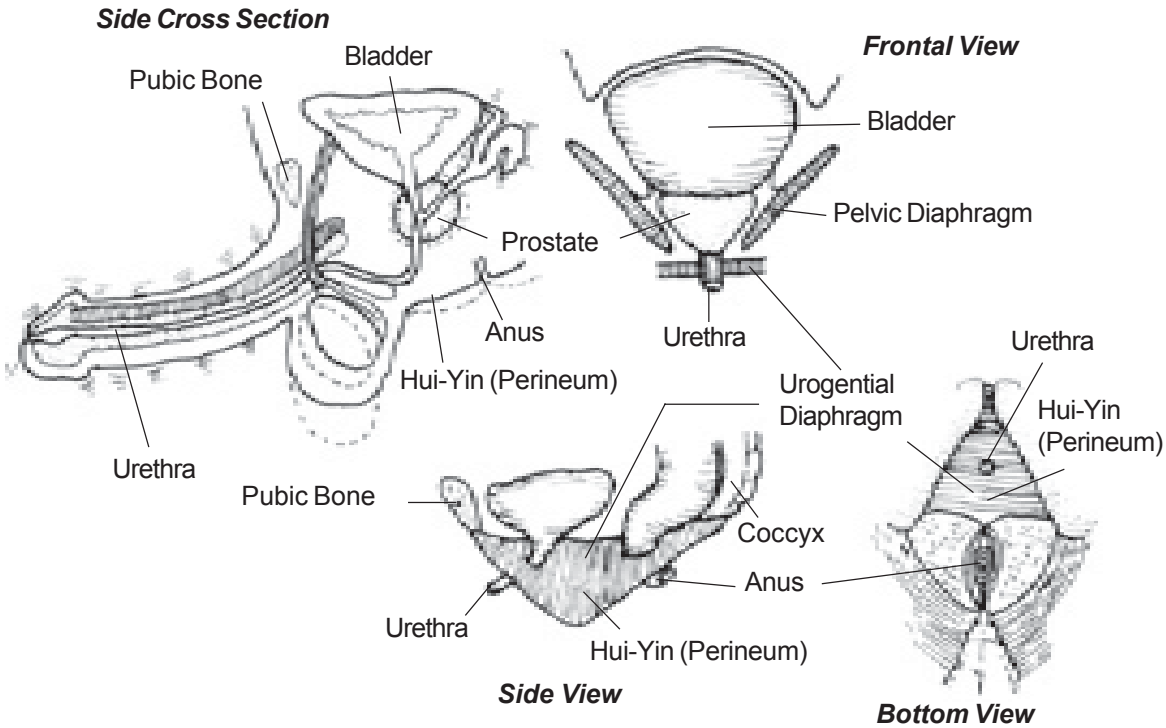

Fig. 9.14 *Male Pelvic and Urogenital Diaphragms*

Men and women (by using their vagina lips) can enhance their sexual prowess and energy by doing at least 200-500 PC flexes a day. Ancient Taoists also called the exercise “tightening the anus” because it also makes your anus tight when you flex. Continue doing about 10 or 20 to see how well you can focus on them. If your PC gets tired after 20 flexes, you are very out of shape. After you do about 20 or so, flex and squeeze really tight and hold it for as long as you can. Though this may be intimidating at first due to the lack of PC strength, within a few months of continual exercise, men will be able to hold off the urge to ejaculate just by squeezing the PC muscle as tight as they can until the urge goes away.

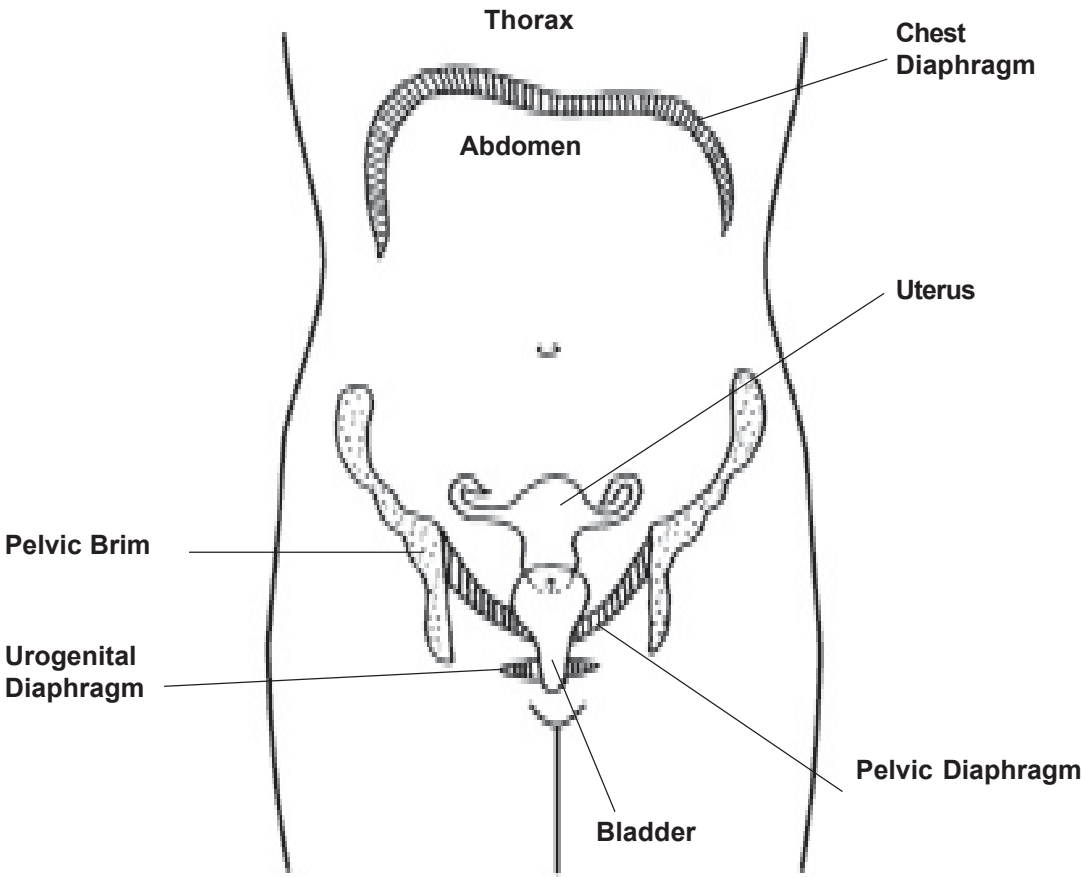

Fig. 9.15 *Female Pelvic and Urogenital Diaphragms*

PC Chi Muscle Exercises

Warming Up: Start out by squeezing and relaxing at a steady pace for a good 30 flexes. At the end of the set, rest for 30 seconds. Continue with 2 more sets, resting for 30 seconds between each set. After this is complete, you should have better control over your PC muscle due to the increased blood and Chi flow.

PC Clamps: Squeeze and release over and over again. Start with sets of 30, and build yourself up to a set of 100 or more. The PC muscle heals quite quickly and you may find yourself waking up with a hard erection every morning. Make sure you do at least 300 PC Clamps a day for the rest of your life. You will soon find that it's the best move you could make for your sexual health and vitality.

Long Slow Squeeze: Warm up with a set of 30 clamps then flex as hard and as deep as you possibly can. When you cannot squeeze any deeper, hold where you are for a 20 count. Rest for 30 seconds. Repeat 5 times. After a month or so of exercising, you should be able to do squeeze and hold sessions for at least several minutes at a time. This particular exercise will give you absolute erections of steel and ability to last as long as you want in bed. Eventually work your way up to 10 sets of 2 minute long holds.

PC Steps Workout: This exercise is simply tightening and loosening your PC muscle in increments. Begin to tighten your PC, hold, then tighten more, hold, a little more, hold, then tighten as much as you possibly can and hold. Hold this for 20 seconds, then untighten a little bit, hold, untighten a little bit more, hold, a little more, hold, then finally release the rest. Do this 5 times with no rest in between.

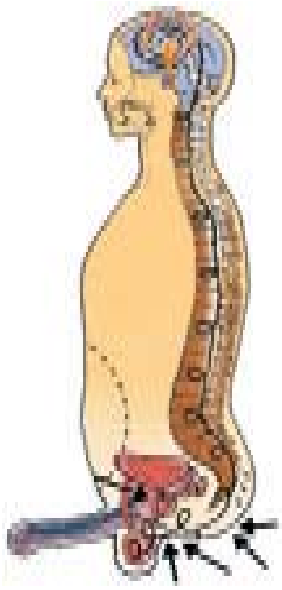

Fig. 9.16 *Chi Muscle Squeeezing*

Testicle Stretching Exercise:

1. Start out just like above warming up and stretching out the skin of the genitals.
2. Grasp around the testicles and penis and begin stretching and exhaling while flattening the stomach and sticking out the tongue. Stop when you feel a good stretch and hold for 20 seconds.
3. After the 20 seconds, relax for a few seconds and grasp around your testicles and penis again.
4. Stretch again, only this time pulling your testicles to the left and your penis to your right. Feel a good stretch and hold for 20 seconds. Rest for 10 seconds.
5. Stretch again only this time pulling your testicles to the right and your penis to your left. Wait until you feel a good stretch and hold for 20 seconds. Rest for 10 seconds.
6. Stretch again only this time pulling your testicles down and your penis up. Wait until you feel a good stretch and hold for 30 seconds.

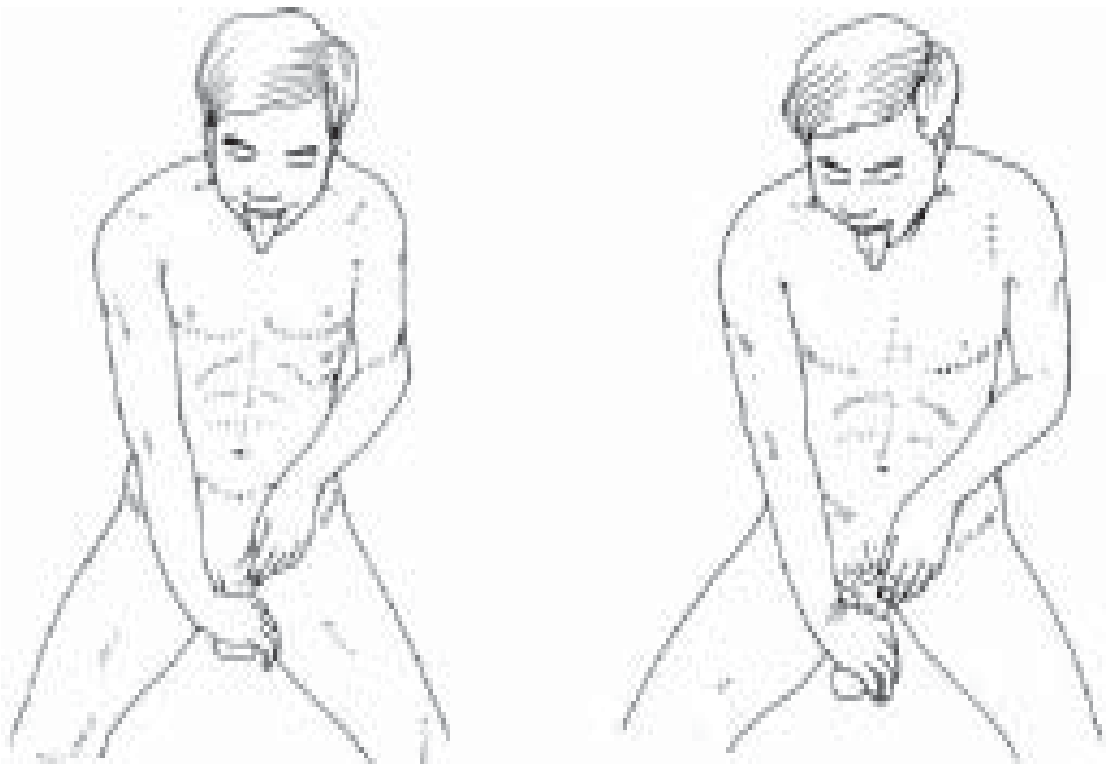

Fig. 9.17 *Testicle Stretching*

Power Milking

The Power Milking is more of a penis enlargement exercise, but it has many beneficial penile health inducing properties when done regularly. The tongue is an important part of the exercise because it is connected to all the tendons of the body, especially the penis, which consists of many tendons. When milking stick the tongue out, and the tongue will get longer as well as the penis. Men should always start out by stretching out the penis lightly by grasping around the head, sticking out the tongue and pulling outward. Rotate your penis with the tongue extended outward in a circular motion. When warming up has been completed proceed with Milking method.

1. Lightly massage the penis to a partial erection to hold blood within its length.
2. Grasp around the base (bottom) of the penis shaft with the thumb and forefinger. This retains the blood within the penis. Grasp all the way around the penis making an "ok" sign with the forefinger and thumb and grip tightly.

Fig. 9.18 *Power Milking*

3. Take your thumb and forefinger, squeeze all the way around your penis and slide forward slowly. This forces the blood within the penis forward into the corpora cavernosa (erectile tissue) and the glans (head).

4. The blood spaces within the penis are forced larger every time you milk forward. As one hand milks forward to the beginning of the head, grasp around the base of the shaft with the other hand, releasing the hand that has reached the head and repeat with the other hand, over and over again at a medium to slow pace (one second intervals).

5. When first starting the Milking, some men experience red spots, bumps, or light bruising on the penis head and surrounding areas. Don't worry because this is perfectly normal and it will usually subside within the first week of exercise. These effects are simply caused by the stretching of the blood spaces within your penis and the new increased blood circulation.

6. In the beginning, start out by doing 300 milks (5 minutes) a day. Follow this by a 15 minute warm up of rubbing. Each milking should last 1 second from grasping the base and sliding to the head. Do this for one week and be sure to do 100 PC Flexes a day. This will aid in the new circulation and strength building taking place within your penis.

7. The second week will be much harder than the first. 10 minutes of continuous Milking then follow by doing 200 PC Chi Muscle Flexes. Do not ease up unless you happen to feel pain, though this is highly unlikely. Apply a warming up rub for 10 minutes to finish the session.

Your choice for lubrication is a crucial one, because if you choose a lubricant that evaporates easily then you will get tired of reapplying it. You can use Johnson's and Johnson's Baby Oil with Vitamin E. It is a good lube for exercise plus is also nice to apply to the penis and testicles after showering, to keep them healthy and supple. If the continuous exercise forms painful bruising on the penis, stop all exercising and wait for the bruising to subside. You can always perform PC Flexes and stretching, and get into the habit of doing PC Flexes while driving or sitting at work, school, etc. PC Flexes are so important to the overall development and health of the penis.

Review the Milking and Holding

Milk and Hold: The milk and hold technique is something men should incorporate after they have milked for at least 20 minutes already. This makes the penis and all of the spongy tissue within the penis warmed up and stretched out enough to the point where chance of injury due to overexertion is very minimal. This exercise thickens and lengthens the penis in both its erect and flaccid state.

Warming Up: Massage the penis to an erection and flex the PC muscle to make it as hard as possible. Once fully erect, pump the PC 20 times to fully expand the penis as much as possible. Squeeze the PC as hard as one can and hold until the erection becomes partial. Now it's time to Milk.

Milking: Apply the choice of lubrication and begin the method of milking. While you milk, visualize the penis lengthening each time you milk down to the head. Milk for 20 minutes continuously without stopping. Once completed, rest for a minute and keep massaging your penis to keep it in a partially erect state. Now we are ready for the milk and hold.

Milk and Hold: Begin Milking just as you have been, performing each milk with about a 2 second interval. Now, after about 20 milks, milk down a little harder than normal. By doing it firmly the hand should stop when it comes to the head. When this happens, pull hard enough to feel a good stretch in the penis. Repeat the 20 milk set then perform the milk and hold with the opposite hand. Continue with this routine over and over again for a total of 500 milkings and 25 milkings and holds.

Cooling Down: At the end of this workout the penis should feel very fatigued and appear quite “pumped” looking. Massage the penis to a full, hard erection and pump the PC muscle several times while massaging to enlarge the penis to its fullest potential. Keep massaging and pumping the PC until the urge to ejaculate is quite strong. Once this sensation is reached, flex the PC as hard as possible, cutting off any possibility of semen being able to pass through the ejaculatory duct. Keep flexing until the urge is gone, then repeat. Do this 5 times to cool down.

Chapter X
Internal Organs and the Five Elements

"The Five Elemental Energies of Wood, Fire, Earth, Metal and Water encompass all the myriad phenomena of nature. It is a paradigm that applies equally to humans."

- Yellow Emperor's Classic of Internal Medicine (2nd Century B.C.)

Sexual prowess, as one aspect of human compatibility and behavior, is derived from the strength of the internal organs. In order to determine by observation one's sexual potential it is necessary to know the person's internal organ energy levels. Using the information derived from Sexual Reflexology, a simple examination of the person's physiognomy can reveal their character or disposition, and will help you to determine the nature of another individual. These principles can also help one better understand their own undiscovered potential.

In Chinese Medicine, the internal organs are much more than the organs themselves. They refer to a quality of energy and are described in the Five Elements. The Five Elements are known as the five phases of cyclical energetic movement in both nature and in ourselves. For example, the heart is associated with the fire element. The quality of fire element is expansive, radiant, bright and warm. The season of the heart is summer, sharing the same qualities of energy. Each organ is associated with a mental and emotional element as well. So each organ has specific characteristics energetically, physically, emotionally and spiritually. In the human body, the goal of the Taoist practice is to keep the Five Elements in harmony. When the Five Elements are in harmony, the body, mind and spirit are in balance.

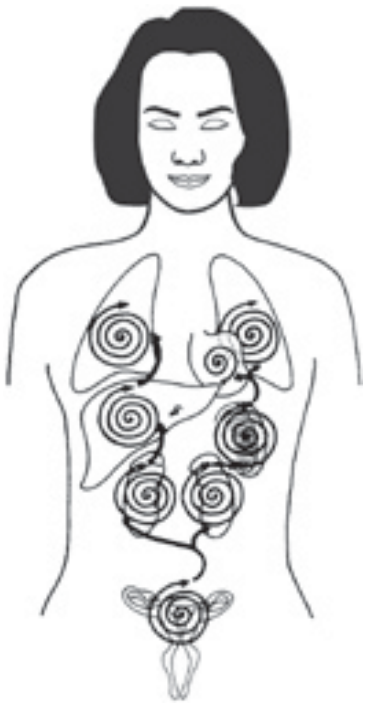

Fig. 10.1 *Draw and spiral the energy around the organs.*

The health of the internal organs greatly affects our sexual energy. Sexual energy is the essence of the internal organs. The body draws the finest energy, especially from the organs, to produce sperm or eggs. When the sexual energy is out of balance, it is reflected in the internal organs and when one or more organs are out of balance, the sexual energy will definitely be affected. The internal organs and sexual energy are a reflection of each other; when one system is improved the other follows.

The best way to keep the Five Elements in balance and harmony is the Six Healing Sounds and the Inner Smile. These techniques are discussed in my book "*Transforming Stress into Vitality*". I highly recommend using these techniques to strengthen the energetic quality of the internal organs.

Kidneys and the Water Element

In Taoist Medicine, the kidneys, one of the five vital organs, are a main source of energy. When they are full of energy, one will be energetic, high-spirited, with plenty of stamina and an abundance of sexual energy. This is all due to the fact that the health of the kidneys is directly related to the health of their corresponding organs, the genitals and consequently to one's sexual functioning and capability. The kidneys are connected by the Taoists to the ears, thereby making the ears the outlets of the kidneys. By observing the shape and condition of a person's ears, you can determine the general strength and condition of the kidneys.

The kidneys in Chinese Medicine represent the water element in the body. Water is associated with the virtue of gentleness and the negative emotion of fear. Gentleness elicits the yin energy of the body. For women, sexual energy is like water. Gentleness stimulates the feminine sexual energy, heating the water element, preparing the body for sexual intercourse.

Female Kidney Energy

To further illustrate the importance of kidney energy as it applies to sexual energy, consider the information set forth in the book entitled *Ni Ching Su Wen,* The Yellow Emperor's classic text on Internal Medicine.

"The kidney energy of a girl becomes abundant at seven years of age. Her baby teeth begin to be replaced by permanent ones, and her hair begins to grow longer. Her governing meridian is open. At approximately fourteen years of age, a woman begins to menstruate and her conception meridian opens and begins to flow, increasing the energy of her connective meridians in great profusion. With menstruation (called in the classics 'Sea of Blood', The Chung Mai) the uterus is now complete and she is capable of impregnation. At the age of twenty-one, the kidney energy of a woman becomes full.

As she reaches adulthood, all her teeth are fully developed and her last molars are in. Her 'Yang Ming' meridians are now full and connect to her face. She is most radiant and beautiful at this time."

This description serves as one example of how the development of the internal organs can be understood from the manifestation of external factors (e.g. teeth, hair and menstruation), all of which combined indicate the level of the kidneys' development.

Therefore, all the surface structures of the body (the eyes, ears, teeth, nose, fingers, etc.) are relevant to human sexuality because they reflect the internal organs.

Kidney Massage

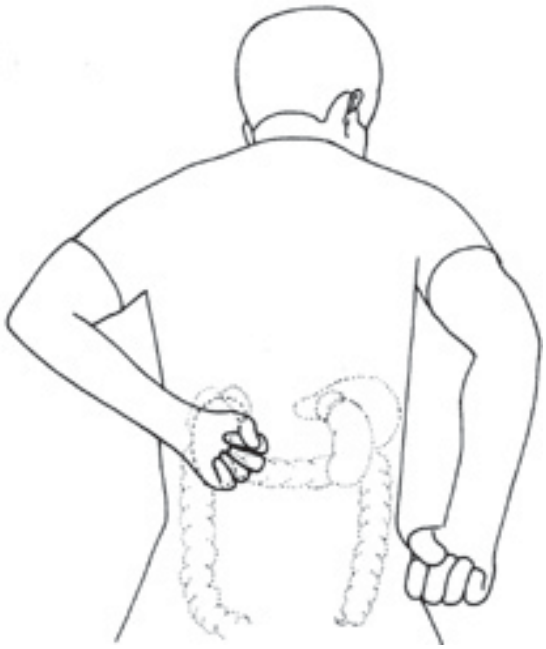

Fig.10.2 *Hitting the kidneys will help to shake out sediment.*

Stimulating and energizing the kidneys is vitally important to healthy sexual energy. Place both hands over the kidneys, on the low back directly above the last rib. Begin to massage the kidney area vigorously with the palms, feeling the heat penetrate deep into the kidneys. Rub vigorously from the lower back, over the kidneys and down to the sacrum. Feel this entire area open and energized. After a few minutes of massaging rest the palms over the kidneys and project energy into the kidneys. You can visualize a bright blue light penetrating into the kidneys transforming any negative energy into positive.

Another very beneficial way to stimulate the kidneys is by gently knocking or tapping the lower back area lightly with a loose fist. Knock all the way down to the sacrum and back up to the kidneys, bringing this vibration into the entire lower back area. Do this about 9 times.

Massage the Ears

The ears, according to Chinese Medicine, are an extension of the kidney energy. One way to stimulate more energy in the kidneys is to massage the ears. The ears have over 120 pressure points. This directly activates sexual energy. That is why couples naturally kiss, nibble and caress each others ears.

Place the ear between the thumb and the first finger. Simply massage the whole ear giving ample pressure to stimulate energy into the entire body. Kissing or nibbling gently on your partners' ears is a way to activate and bring sexual energy through the whole body.

A. Rub in front and back of ears. B. Rub the ear shells. C. Pull down on the ear lobes.

Fig. 10.3 *Chi Self Massage*

Heart and the Fire Element

The heart has a strong connection to the sexual center. The heart is associated with the fire element and is the energetic center of passion and affection. It is known as the "King" of all the internal organs, circulating blood and energy through the entire system. The fire element is associated with the virtues of love and joy and with the negative emotions of hatred and cruelty. Negative emotions are elicited when energy is not flowing or when energy is congested in the heart. Have you ever noticed that when you

do not communicate what is in your heart and hold in your emotions, there is a feeling of congestion? This is how negative energy is formed. Energy becomes negative when it is not flowing. Energy stuck in the heart is one of the biggest sexual problems we face. When the energy in the heart is blocked, it is difficult to feel deeply and connect with your partner. For example, when someone in a relationship does not communicate what is in their heart, energy is congested and negative emotions ensue. Expressing what is in our heart in a clear controlled manner frees this energy and transforms it into something positive.

It is very healthy to establish the intimate connection between the heart and the sexual center. The Tao regards loving energy and sexual energy as the two strongest energies in the body.

Fire energy is also associated with excitement and exhilaration. It is the fire energy in the heart that opens the sexual center. This is why falling in love leads to sexual desire. Many of the Taoist meditations focus on balancing the heart and sexual center. Even the higher level Taoist meditations called Kan and Li (Fire and Water) work on unifying these two energies and steaming their potent force through all the meridians.

Tongue Kung Fu

The tongue is the sense organ of the fire element and the energetic extension of the heart. Exercising the tongue is a great way to open the heart and the sexual energy. There is a very strong connection between the tongue, heart and sexual center. This is why lovers kiss with the tongue. In some cultures kissing with the tongue is just as intimate as making love.

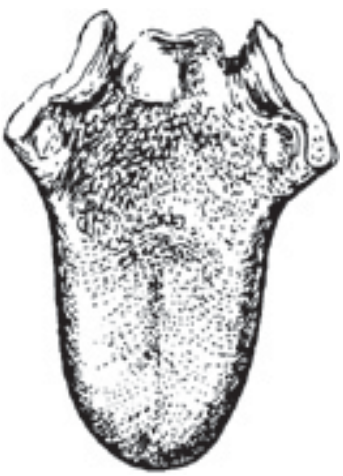

Fig. 10.4 *Tongue*

To exercise the tongue, bring the tip of the tongue in front of the upper teeth inside the lips. Circle the tongue down to the inside lower lip. Continue to circle in front of the teeth and inside the lips about 36 times and then switch directions.

Next, massage the flat part of the tongue against the upper palate vigorously. Feel the heat that is generated through the head and the whole body. Heat is a good sign that the fire element is activated in the heart and sexual center. Massage the tongue against the upper palate at least 36 times.

Massage the Chest Opening the Heart

Massage the chest with the fingers or knuckles. The knuckles are good to use for deeper pressure. Look for tender areas along the sternum and between the ribs along the chest. Press into them gently, massaging until you feel a release. It is especially good to spend time massaging the sternum, releasing emotional energy that has congested in the heart center. To end, place the hands over the chest and project energy into the heart area. Visualize a bright, red, warm glow in the heart. Feel the connection between the heart and the sexual center.

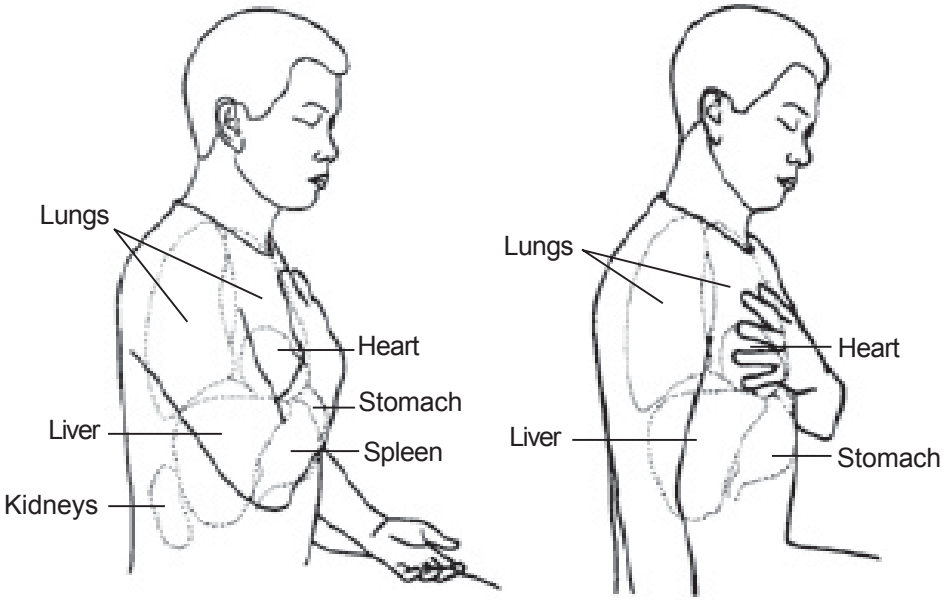

Fig. 10.5 *Place the palm on the chest opening the heart.*

Lungs and the Metal Element

The lungs are the organs of breath, keeping us intimately connected to the Universe. When inhaling we take in the body of the Universe and when exhaling we give back part of ourselves to the Universe. The breath is a metaphor of this dynamic exchange of energy. It represents giving and receiving, ebb and flow, male and female. Simply by observing the dynamics of the breath we can witness the balance of yin and yang and the constant flow and exchange of life force energy within the Universe. Male and female relationships are part of this Universal exchange, creating harmony and balance in all apparent opposites.

The breathing patterns always reflect how we feel. When we become sexually aroused the breath becomes deep and full, pumping energy through the whole body. If the lung

energy is weak or congested, it is difficult to feel aroused and excited. The negative energy of the lungs is depression. Depression is one of the biggest causes of impotence and low sexual energy. On the other hand, when energy is flowing in the lungs, we have a feeling of courage and self-expression. Positive energy in the lungs allows you to breathe in life, to experience it. To feel sexually aroused, the whole body needs to be alive and full of energy. This is what the lungs do when they are healthy and full of energy.

Massage the Lung Points

Stimulate and open the lungs by lightly knocking on the chest with a loose fist. This opens the rib cage and relaxes the diaphragm. Knock just below the collar bone to activate the lung points and to stimulate the lung meridian. Continue to knock on and across the chest for at least one minute with both hands. Afterwards, feel the buzzing and tingling in the chest area. Take two or three long deep breaths. Feel the lungs open and energize.

Liver and the Wood Element

The liver is associated with the wood element and the virtues of kindness and forgiveness. The negative emotions of the liver are frustration (sexual frustration) and anger. When the liver energy is congested, we simply cannot relax. Relaxation is an indispensable quality of good sexual health. When we are tense and tight, energy does not flow.

The liver transfers a tremendous amount of energy to the sexual center. The wood element plays a vital role in the strength of the erection for men and provides the expansive energy for the swelling of the vagina when the woman is sexually aroused. When the wood energy is blocked, men usually have a difficult time getting an erection, even though they may feel aroused. Women may have a difficult time feeling orgasmic. Deep relaxation usually solves these problems. Releasing the congestion in the liver allows the wood energy to flow into the sexual center.

Massage the Feet

The liver meridian runs down the legs and into the feet. Massaging the feet is a great way to relax the body and stimulate the wood element. Whenever the body is able to relax deeper, the sexual center benefits. When the body is under stress and tight, the sexual energy is constricted. Massage the feet with both hands. Pay particular attention to the big toe. This is where the liver meridian ends. Spend at least five minutes on

each foot to ensure that the energy moves into the body. If you want to boost your partners sexual energy immediately, suck or nibble on the big toe.

Spleen

The spleen is associated with the earth element and the virtues of balance and openness. The negative emotions associated with the spleen are worry and anxiety. When the earth element is out of balance, the feelings of the body are disconnected, making it difficult to get in touch with sensation. For example, when the energy of the spleen is congested, it causes the mind to be over active. The over activity in the mind is what causes worry and anxiety. When there is excess energy in the head, it is hard to be in touch with the body.

When energy is flowing in the earth element, we are able to feel our center and our connections to all life. When we feel connected to ourselves, we are able to connect to others, both sexually and emotionally.

Massage the Abdomen

Massage the abdomen in a gentle circle rubbing with the flow of digestion, from left to right. The abdomen is the center of the body. When the abdomen is full of energy, the body is full of energy. (To understand more about the internal organs and the energy of the abdomen it is advisable to read my *Chi Nei Tsang* book). Continue to circle the hands around the abdomen at least 36 times. With the fingertips, feel for any tightness or congestion. Work into the abdomen and feel the release of tightness. Work with your breathing while you are massaging. See if you can breathe all the way into the belly. Remember, the organs provide energy to the sexual center. When the energy in the abdominal area is full, the sexual center is balanced and harmonized.

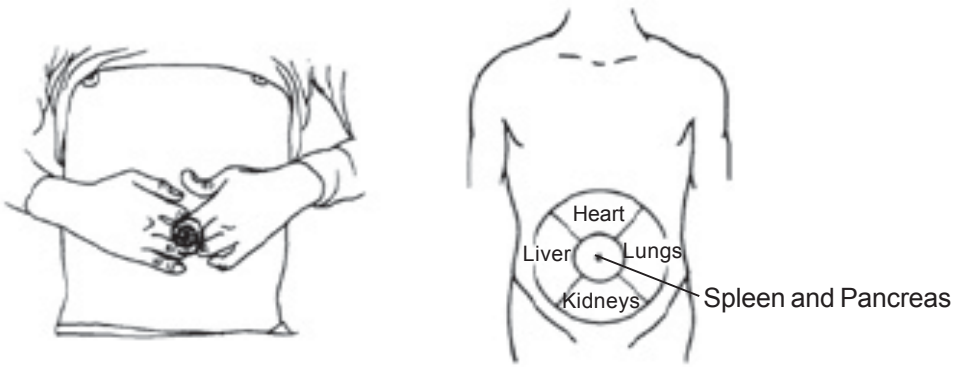

Fig. 10.6 *The major key to maintaining good health is to eliminate tension, worry and toxins every day and maintain good sexual energy by massaging the abodmen.*

Chapter XI
Secret Art of the Jade Chamber

In the *Classic of the Arcane Maid*, an ancient Taoist text, the Elemental Maid discloses the *Art of the Bedchamber* to the Yellow Emperor. It was said that a woman with a richness of Yin and very little Yang was more sexually desirable. Today we might say that the sexually desirable woman has an abundance of female hormones.

There is no joy in Yang without Yin and Yin without Yang is unexcited. In such cases, the man desires copulation but the woman is unhappy or, the woman desires copulation but the man lacks desire. When hearts are out of tune, there is no arousal of the essences. Thus love and pleasure are not forthcoming. However, if the man courts the woman and the woman the man, there is a merging of both minds and desires. They take delight in each other's hearts. Upon the arousal of the woman's passions, she fondles the man's jade stalk and provides it with the power necessary to tap her jewel terrace. This brings an abundance of secretions from both. The jade stalk, greatly enlarged, moves sometimes slowly, sometime quickly. The jade gate opens to ease the entrance of the powerful adversary and absorb its essence, which irrigates the scarlet chamber.

In responding to the man's Yang, the woman shows the following symptoms: *Her ears are hot as though she had drunk rich wines. Breasts protrude firmly so that they fill his hands. The neck moves and legs shake in an agitated fashion. She attempts to hold back her lascivious movements, but all at once she clings to his body and presses hers deeply against him and gently palpates it.* (This describes a basic technique in Chinese massage, which aims at accupoints. The erotic variety of such acupressure acts as a very effective aphrodisiac.)

Next the text goes on to explain to the emperor the reason for awaiting the ***Four Attainments***. It says that *"If the jade stalk is not angry, the man's harmonious essence has not yet arrived. If it is stiff but not hot, his spirit muscle essence has not arrived. If it is big but not yet stiff, the bone essence has not yet arrived. Should it be rigid but not hot, the spirit essence has not arrived".* In order to perform, all four conditions must be met – even if the man already has an erection.

Next, the emperor enquires about a woman's ***Nine Essences.*** He wonders what they are and how he can tell whether they have been aroused. The Arcane Maid says, *"When a woman deeply sighs and swallows, the essence of her lungs has been aroused. If she utters little cries and sucks his mouth, the heart essence has been aroused. When her Yin gate is damp and slippery, the kidney essence has been aroused. Should she enfold and hold him, her spleen essence has been aroused. When she gently bites him, her bone essence has been aroused. Finally, when she caresses his jade stalk, the essence of her blood is aroused."*

The Elemental Maid outlines the ***Five Desires***: *"If a woman bates her breath and restrains her energy, her mind desires sexual union. If both her nostrils and mouth are dilated, her vulva wants union. If she suddenly embraces the man, she wants to climax. If her perspiration drenches her clothes, she wants her heart filled. If she straightens her body and closes her eyes, she is near ecstasy."*

Next, the ***Five Symptoms*** in the woman are mentioned and a recommendation for the appropriate male response is given. *"When her face is flushed, gradually start intercourse. When her breasts are full and her nose perspires, slowly put in the jade stalk. When her throat is dry and she is swallowing, unhurriedly rock the jade stalk. When her grotto is slippery, slowly penetrate to her depths. When her fluids flow to her buttocks, slowly remove the jade stalk."* Although the Elemental Maid appears to be giving advice to the male, her instructions are only for the early stages of the encounter, before it becomes passionate.

In addition, the Elemental Maid discusses the ***Ten Movements*** of a woman in the sweet agony of passion, and urges her to be strong: "*If she holds him with her arms, she desires to press their bodies together and for their genitals to touch. Should she extend her thighs, she wants to rub her upper vulva against him. If she holds in her stomach, she wants to have an orgasm. If she shakes her buttocks, she desires to be sliced deeply to the left and right. If she lifts up her body against his, her libidinous joy is great. If she stretches out lengthwise, her limbs and body are pleased. If her sexual fluids are slippery, she has attained orgasm. Look at these movements in the* ***'Original Nine Postures'*** *and you will know how avid is her ecstasy."*

Arcane Maid's Original Nine Postures

Fig. 11.1 Somersaulting Dragons: The woman reclines on her back with the man prostrate over her. She presses her thighs into the bed. Taking his jade stalk, she pulls at her vulva. He drives at her grain seed and assails her upper part with leisurely, calculated stokes – eight shallow, and two deep. Going in dead, the stalk returns alive, so that he becomes vigorous and strong. She is agitated yet pleased, joyous like a singing maiden. To refrain from ejaculation disperses a hundred illnesses.

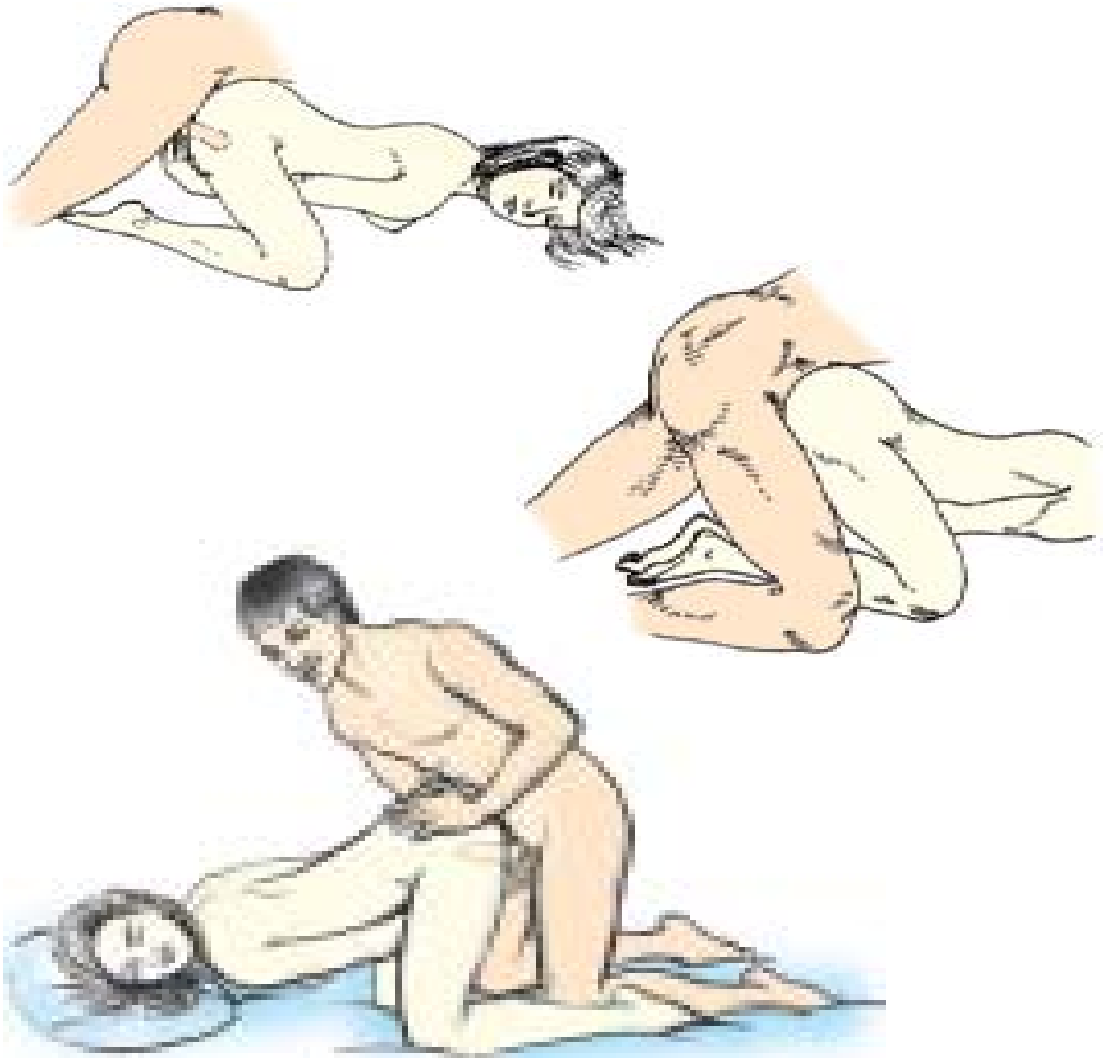

Fig. 11.2 Stepping Tigers: The woman takes a crawling position with the buttocks upward while the head is down. Kneeling behind her, the man clasps her stomach. He inserts his jade stalk, piercing the innermost part of her as deeply and intimately as possible. They take turns advancing and attacking, eight thrusts, five times. As her fluids seep out of her, the jade gate closes and opens. A rest is taken after this occurs. The man will become more virile and a hundred sicknesses will disappear. The Arcane Maid terms this Stepping Tigers since the participants advance and retreat like a pair of tigers. In such a position the jade stalk refrains from stimulating the clitoris, but may penetrate to the flower heart. “Eight thrusts, five times” denotes a total of forty thrusts, with a brief pause after each set of eight.

Fig. 11.3 Wrestling Apes: The woman lies on her back, the man supports her thighs, pushes her knees beyond her breasts, and raises her buttocks and back. He inserts his jade stalk, and stabs her scented mouse. She shakes and rocks. Her fluids flow like rain. He pushes in deeply, without moving. The jade stalk grows strong and angry. He stops when she exults. One hundred sicknesses cure themselves.

Fig. 11.4 Cleaving Cicadas: The woman lies on her stomach and extends her body. Lying on her back the man inserts his jade stalk deeply. He lifts up her bottom slightly so that he can gently tap her scarlet pearls for a total of nine thrusts, six times. Excited, her fluids flow. Her inside Yin throbs quickly while the outside spreads and opens. He stops when she rejoices. Seven injuries eliminate themselves. (There is fairly shallow penetration with the rear entry position and mobility is limited. “Scarlet pearls” means the labia minora, and “Yin” the vagina.)

Fig. 11.5 Mounting Tortoises: The woman lies on her back with her knees bent. The man presses her feet until the knees are at her breasts. He puts in his jade stalk deeply and at times stabs at her infant girl. Carefully thrusting deep and shallow, he reaches her grain seed. She is overcome by great joy, shakes and then lifts her torso. At the point when her fluids overflow, he pierces more deeply and then stops when she rejoices. If no semen is lost, his vigor will multiply a hundredfold. (In this position, which is similar to Wrestling Apes, the man holds the woman's legs instead of her buttocks. It was another favorite ancient Chinese position allowing deep penetration and high mobility. "Infant girl" means the vestibular glands between the labia minora.)

Fig. 11.6 Soaring Phoenix: The woman lies down and raises her legs while the man kneels between her thighs. His hands are on the mat. He slips his jade stalk in deeply and it pierces her mixed rock. Rigid and hot, he guides it in and requests that she start moving. There are eight thrusts, three times. As their buttocks swiftly attack one another, her Yin opens and expands, gushing out its fluids. He halts upon her rejoicing and a hundred illnesses will vanish. (Coital movements here are done mostly by the woman.) The "phoenix" refers to the Chinese mythical *feng huang* bird. "Mixed rock" means four inches deep.)

Fig. 11.7 Bunny Licking Its Fur: The man stretches his legs straight as he lies on his back. She straddles his body with her knees to his sides. She faces his feet with her back to his head. Holding on to the mat as she lowers her head, his jade stalk is inserted until it pierces her lute strings. She celebrates as her fluids gush like a fountain. She is delighted with harmonious pleasure, which moves her spirit and body. Upon her rejoicing he halts. A hundred illnesses will not come about. ("Lute strings" symbolizes one inch inside the Yin. With such shallow penetration, the woman needs some practice to forestall the dislocation of their organs. "Licking bunny" means the male organ.)

Fig. 11.8 Fish Linking Scales: The man lies flat on his back with the woman over him straddling his body. She carefully and slowly inserts his jade stalk, stopping when he is only a little ways in. Rather than penetrate deeply, he imitates a baby sucking at the breast. The woman rocks by herself for a long period. He removes his stalk when she rejoices. This cures all clogging sicknesses.

Fig. 11.9 Cranes Entwining Necks: While the man squats, the woman rides his thighs, her hands holding his neck. She inserts him, letting his jade stalk cut through her wheat bud and jab her seed. He clasps her bottom to help her rocking and rising motions. Feeling wonderful joy, her fluids flow and bubble. He halts when she rejoices. The seven injuries will be healed naturally. (This is another position with the woman above, so it gives her a bit less mobility and shallower penetration. “Wheat bud” is two inches deep, and “seed” means her clitoris.)

Mystical Thirty Postures

The Mystic Master saw his thirty positions as an amplification of the Arcane Maid’s original nine positions. Naming each position, he offers a very short, and sometimes, cryptic description. His positions are simply illustrations, with no trace of motion. However, immediately after the positions he puts forth the dynamic parts of sexual intercourse in fifteen coital movements.

Fig. 11.10 Entangled Silkworms: Lying on her back, the woman hugs the man’s neck with her feet crossed above his back. He puts his knees between her spread thighs while grasping her neck. Then he inserts his jade stalk.

Fig. 11.11 Dragons Twisting: Bending her legs, the woman lies on her back while the man kneels between her thighs. He pushes her feet forward beyond her breasts. Helped by his right hand, his jade stalk enters the jade gate. (This is a version of the Arcane Maid's Wrestling Apes and Mounting Tortoises.)

Fig. 11.12 Fish Eye-to-Eye: This position calls for the couple to lie down facing each other. They proceed to suck one another's lips and tongues. The woman raises one leg above the man's body and he spreads his legs slightly. One hand supports her upraised leg. He slips his jade stalk into her cinnabar grotto. (This position frees the partners' body weight.)

Fig. 11.13 Swifts Sharing a Heart: The woman reclines on her back and stretches out her legs. The man squats over her stomach while his hands embrace her neck. She holds his waist with her hands. He slides his jade stalk into her cinnabar grotto.

Fig. 11.14 Kingfishers Uniting: She reclines on her back, knees raised. The man puts himself between her thighs in a Tartar squat. He holds her waist with his hands and puts his jade stalk into her lute strings. (The Tartar squat is a traditional position of people from the northern China.)

Fig. 11.15 Mandarin Ducks Joining: The woman bends her legs while reclining on her side. She places her upper leg on the man's buttocks. He faces her back and rides on her lower thigh, lifting one knee up against her upper thigh. He then slides in his jade stalk.

Fig. 11.16 Butterflies Fluttering: While the man reclines on his back with his legs extended, the woman sits astride him facing his head. With her feet on the bed, she uses her hand to put his Yang peak into her jade gate.

Fig. 11.17 Wild Ducks Flying Backward: The man reclines on his back and stretches out his legs. The woman sits down on him with his face to her back and uses her feet to hold onto the bed. She lowers her head, takes his jade stalk, and inserts it into the cinnabar grotto.

Fig. 11.18 Sheltering the Reclining Pine: The woman reclines on her back and folds her feet behind the man's waist. They hold each other's waists as he inserts his jade stalk into her jade gate.

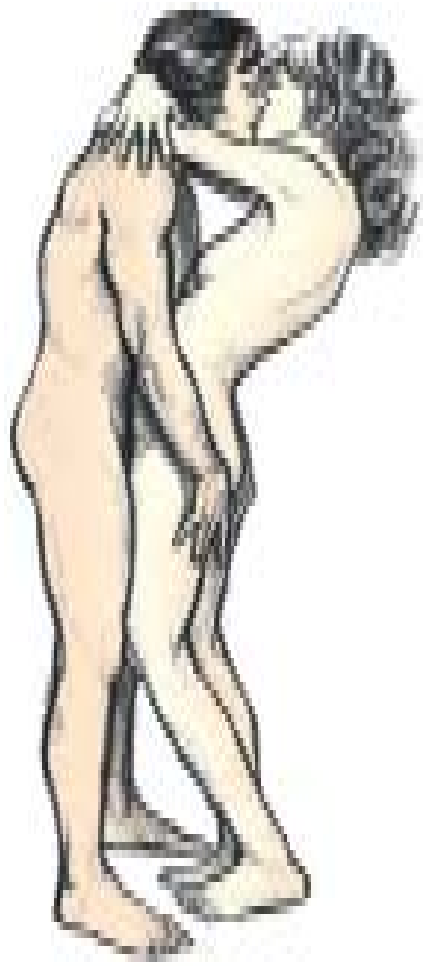

Fig. 11.19 Bamboo by the Altar: Here, the man and woman stand, face each other, embrace and kiss. He slices her cinnabar grotto deeply with his Yang peak, all the way down to her Yang terrace.

Fig. 11.20 Phoenix Holding Fledglings: A large heavy woman can be joined by a smaller man to make a good love union. This is fine excellence!

Fig. 11.21 Seagulls Soaring: The man is near the edge of the bed where he lifts the woman's legs high and inserts his jade stalk into her baby palace.

Fig. 11.22 Wild Horses Leaping: The man lifts her feet while she is on her back and puts them on his shoulders. He slides the jade stalk deep into the jade gate.

Fig. 11.23 Steeds Galloping: The woman reclines on her back. The man squats and holds her neck with one hand while the other hand lifts her leg. He puts his jade stalk into her baby palace.

Fig. 11.24 Horse Shaking Its Hoof: The man puts one of the woman's legs on his shoulder while she lifts the other one herself. The man puts his jade stalk deep into the cinnabar grotto. This is very arousing.

Fig. 11.25 White Tiger Jumping: The woman kneels and her face is lowered. The man, hands holding her waist, kneels behind her and inserts his jade stalk into her baby palace.

Fig. 11.26 Dusky Cicadas Cleaving: The woman lies on her stomach and extends her legs. With his legs bent between her thighs, the man holds her neck with his hands. He then inserts his jade stalk into the jade gate from behind.

Fig. 11.27 Goat Hugging the Tree: The man is seated with legs held out. With her back to his face, the woman sits on his lap. As she lowers her head to look at the insertion of his jade stalk, he abruptly holds her waist, bridling and thrusting.

Fig. 11.28 Jungle Fowl Approaching the Arena: The man crouches Tartar style on the bed as a young maid servant grasps his jade stalk. She proceeds to insert it into the jade gate of his partner. The maid then stands back and tugs the hems of the other woman's skirt to stimulate her legs. Very rousing!

Fig. 11.29 Phoenix Sporting in the Cinnabar Grotto: The woman lifts her feet as she reclines on her back. The man rests on his knees next to her, holding onto the bed. He enters into her cinnabar grotto with his jade stalk. Extremely courtly!

Fig. 11.30 Rock Soaring over Dark Sea: As the woman lies on her back, the man puts her feet on his upper arms. Stretching his hands down to hold her waist, he puts in his jade stalk.

Fig. 11.31 Humming Ape Embracing the Tree: While seated, the man stretches out his legs. The woman spans his thighs and holds him. One of his hands holds her buttocks, and the other holds the bed. He slips in his jade stalk.

Fig. 11.32 Cat and Mouse Sharing a Hole: The man squats upright on his feet and legs. The woman squats on top of him, thighs apart and his jade stalk is penetrating deep inside her.

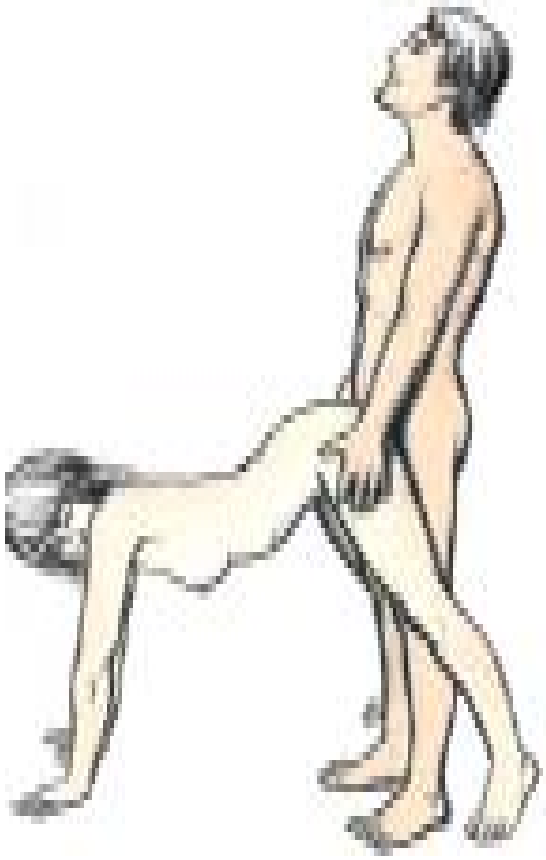

Fig. 11.33 Donkeys of Spring: The woman grasps the bed with both her hands and feet. The man embraces her waist from behind with his hands. He slips the jade stalk into her jade gate. Quite stately!

Fig. 11.34 Dog of Autumn: Both the man and the woman grip the bed with their hands and feet. They are back to back, haunches pressed together. The man lowers his head and uses his hand to push his jade stalk into the jade gate.

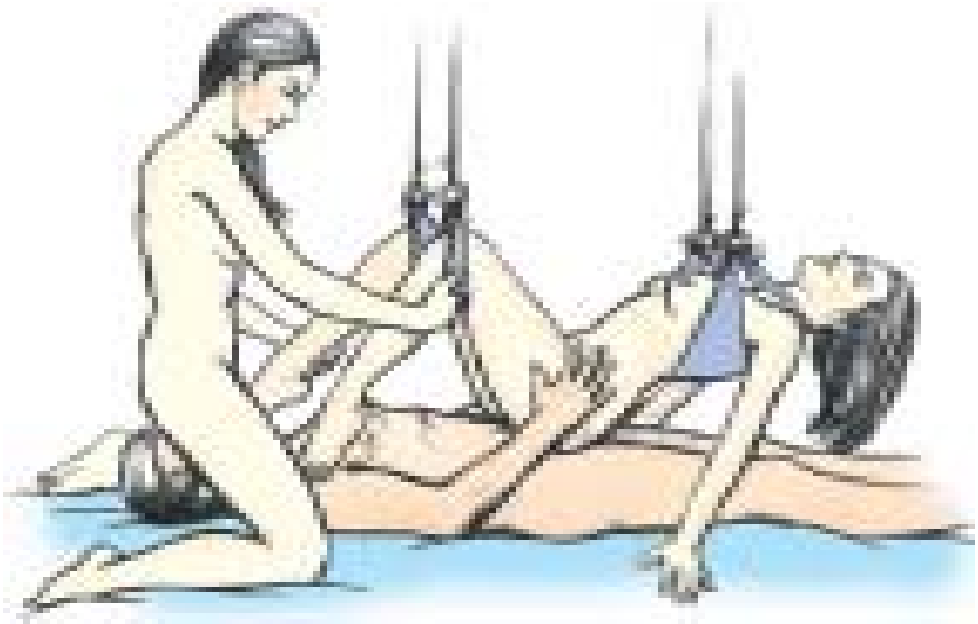

Fig. 11.35 Spider Trapped in Its Own Web: Here, the woman hangs free from a set of ropes attached to the ceiling. It is similar to a swing or riding on a horizontal bar. Her thighs are spread.

Fig. 11.36 Feast of Ponies: The male lies on his back. One woman rides him and another sits on his face. (It should be mentioned that in ancient China, this was a perfectly respectable family union in a country that was traditionally polygamous.)

Fig. 11.37 Old Man Pushing the Wheelbarrow: This position is somewhat strenuous. It usually begins with the woman's on all fours near the edge of the bed. The man stands and inserts his jade stalk from the rear. The woman stretches her legs. The man holds her thighs as though he was holding the handles of a wheelbarrow. They stay attached as he moves backward away form the bed. Her hands support her and she faces the floor. She walks on her hands, coordinating her movement with him. The man walks her forward around the room.

Fig. 11.38 Scissors: This position has both a horizontal and vertical version. They feature a different angle of insertion. The horizontal variation is very restful. The woman reclines on her side and raises her upper thigh. The man lies on his back and spreads his thighs. He moves in between her thighs. Their heads aim in opposite ways and their legs move like two pairs of scissors trying to cut each other. The vertical variation is much more strenuous. The woman stands on her head, her body and legs raised upward with the help of the man. He stands between her spread thighs. The woman holds up her upright body with her hands as the man pierces her by bending his knees and moving up and down.

Chapter XII
Romancing the Moon Grotto

Fig. 12.1 *Pluck and Nurture Technique*

This commentary is taken from "*Yin-Yang Butterfly*" by Valentin Chu and gives you the idea and feeling of romancing the Moon Grotto (vagina) with the "Pluck and Nurture" techniques from the Art of Bedchamber (14th Century China).

Similar to a riffling dragon, the pale wall with its wavelike, tiled top encloses the hidden garden. On the distant side, bamboo swings in the energizing breezes of a summer's day. Goldfish swim lazily in an irregularly fashioned pool framed with greenery and bridged by a slim, arched span of bright cinnabar. To one side a low, meandering house with curled eaves and upswept roof corners can be found. The scent from a bunch of jasmine bushes provides an uplifting sensuousness to the breeze.

Sipping warm rice wine from dainty ceramic cups and nibbling delicacies from several plates, a man and woman sit by a table near a huge boulder. The maidservant who

served the dishes has quickly left. The man and woman talk in quiet voices. As he continues to talk, a long, loose sleeve of his muslin robe hits a pair of chopsticks and they fall off the table. He bends over, squatting under the table to pick them up. Instead his hand touches the woman's petite, delicate foot.

"Oh!" The woman exclaims, seemingly alarmed. The man starts fondling her feet. She blushes a lurid pink. Standing up, the man walks to her side. He holds her cringing shoulders with his hands and places his nose next to the backside of her neck to give a sniff-kiss. "Oh please stop!" She whispers in protest. As his sniff-kisses slowly move to her cheek, she abruptly turns her face and gives him a full kiss on the mouth. She always has appeared coy and acted like a woman of good breeding. Now he knows better. Such women are all alike, with their frigid attitudes but hot lips, modest glances but hard nipples. Often he has noticed a secret curvaceousness in this striking young widow, and he has patiently tried to trap her for months. Their mating dance has been lengthy and hidden behind traditional manners and highly indirect coded messages.. Their time consuming signals and interaction finally made her agree to this supper in his stately garden.

The couple strolls into the house, whispering to each other as they go. They go into the bedchamber. The room contains a huge traditional bedstead, which is practically a room unto itself. A precisely carved ebony lattice frame guards three of the bed's sides. Inside the latticework there is a wraparound muslin curtain. The two flaps in front are held up with a pair of big silver hooks. Beads and semi-precious stones hang from them.

Immediately upon sitting on the bed, they start kissing again. He slowly begins taking off her clothes; her waistband, her silk gown, her sleeveless undergarment, her bodice, and finally her underpants. Her partial resistance combined with partial concession only serves to arouse his eagerness. When they are naked, he views the luscious banquet before him. The almond eyes, the red-red mouth and the naked arms remind him of clean-scrubbed lotus roots. Her breasts are like fresh hills of new tofu with a freshly peeled lotus seed on top.

He is now ready to experience her fineness. When he does, he will add to her essence for his purpose. This will be a wonderfully delicious banquet of longevity. He pays respect to every part of her scrumptious body by touching and kissing her. He alternates subtle tenderness with flagrant boldness. Retreating like a fleeing animal, there are occasional stops to flirt and bait him. For an extended period their entire world is a mixture of limbs and loins; of tender warm skin and damp lips.

He takes a moment to look at this awe-inspiring woman. Her transparent, ceramic flesh, damp with sweat, provides a feminine scent. She breaths deeply, quivering slightly with sensuality from her small navel and her slim waist. And then there is her cinnabar palace protruding very slightly with its abundance of being. She takes a recently opened pomegranate with its red pulp and spreads it before him. Now Yin and Yang are harmonious for a union of exultant happiness.

He starts his hallowed mission into the grotto of love – the mystical grotto – the place where we all enter this world – and the place which grown men strive to enter. As he starts his journey, her black eyes, before half closed in a dreamy velveteen, abruptly open, staring with sharp desire. His skills with the blade have been termed brilliant. His jabs, counters, and returns have conquered the most skilled of bedchamber opponents.

"No! No! No! No!" she gasps to his rhythm.

The silver hooks of the bed drapes clink ever so quietly. The dance of life goes on. While this is an exercise in pleasure for him, it is also of supreme importance. It supercedes ginseng, and is a lot more fun. He rolls her around in different positions. The masters taught him how to elicit the desired effect on her. He recounts without sound to himself the secret words from that astounding volume on sexual alchemy: 'The white tiger swings hither and yon. The blue dragon goes upward and downward. The lunar grotto opens and shuts. The celestial root lunges and strums'. He thinks: 'I must tighten my rectum, hold my breath, and shut all my bodily openings'.

Now the dragon grasps the tiger's buttocks and pushes against the her bosom. He sucks the tiger's tongue, clutches the midsection, and lifts the knees. 'Allow the tiger to move. Let her rock and breathe' he tells himself. The tiger's aureate eyes drift heavenward in elated bliss. 'This works fine', he says to himself. The calm chrysanthemum is changing into a dew-covered peony shaking in a helpless manner in the breeze.

After the tiger's golden eyes drift toward the heavens, he can cull her potion. Very soon she will swim in her own love juices. She has to be the most lascivious woman in China. The peony is dripping with dew, but does not give forth its potion. She's delicate, but stronger than he imagined. This struggle might take some time. The best skills of his bedchamber martial arts must be called into action. He moves on to the ravaging technique of varied thrusts. First he uses nine shallow and one deep thrust. Then he shifts to eight slow and two fast. It seems to be working. The tone of her voice and subtle movements reveal a series of carnal waves in her, yet the mighty burst does not come. She hangs on the edge of the cliff but does not tumble off.

He has to work harder in order to reap her bountiful offerings. Abruptly, there is a piercing warning sound throughout his body. He's on the edge himself. He quickly stops, grasping her to stop her motions. They are two motionless statues. He will start again but first this respite. When they start again he will surely push her over the edge. She is presently absolutely still, yet he senses some tiny palpitations in her moon grotto. Then they grow into spasms. The cinnabar grotto of this wanton female seems to have a life of its own. The grotto opens and closes and squeezes in a most unsettling manner. In seconds, the Yellow River is breaking through its levees. He is ejaculating. His jade stalk, up to now an unvanquishable conqueror, is being exploited helplessly by the throbbing wall of her moon grotto. The flower heart way inside her is eagerly draining his essence.

He is not only defeated but humiliated. He drops to the bed. He feels like an insect sucked dry by a ravenous spider. Devoid of strength he moans: 'What did you do to me! I've had years of cultivation and nurture. Now it is all gone!' She replies softly. 'Sir, you are well known for plucking women. You tried mightily for over two hours to draw out my nectar. Instead, you gave me yours.' Oblivious to his groaning, she continues. 'So is it so wrong for a woman to pluck a man? In the battle of pluck, one must be accepting of defeat as well as triumph.' 'You have destroyed me,' he whines. 'You are a wanton fox devil!' 'Nonsense! Don't believe in shamans. No man is ruined unless they do it too often. It was pleasurable for both of us and it will keep us both young.'

The romancing of the Moon Grotto love play begins long before a kiss or caress. It might start with a subtle innuendo, a titillating encryption, an audacious sexual invitation. Perhaps the body speaks with a look, a grin, a toss of hair or a deep breath. Maybe the opening signals begin amidst an erotic atmosphere of soft lights, sultry music, the sweet smell of flowers or perfume. Partners well known to each other, especially those married for a long time, often minimize or even skip love play, but occasionally returning to the romantic can refresh and revitalize lovemaking. The physical aspect of love play should be approached carefully. In addition, because intercourse is the most intimate act shared by two people, personal hygiene is of extreme importance. Men tend to be more genital oriented than women. Sometimes men might tend to go straight to their partner's genitalia at the beginning of love play. This can reduce the sensitivity of a woman. Quickly beginning sex can be either a potion or a poison — especially for a female. Appropriate do's and don'ts should be respected. As with driving, traffic signs should be followed: "slow," "yield," "stop," "soft shoulder," "curve ahead," "slippery when wet." If one wants to go into uncharted waters, a good plan is to slip in tentatively and slip out immediately. Then observe the partner's reaction. If it is obviously negative, revise your course. If there is halfhearted resistance or ritual, use the Taoist method of two steps forward and one step back. With this tactic in love play, a person can discover unspoken pleasures that both secretly want but are loath to speak of directly.

There is no specific time or place for love play. While some lovers, perhaps out of ingenuity or desperation, like the unconventional, or even dangerous locales, most prefer a romantic environment, perhaps a hidden, moonlit beach or a cozy, dimly lit room, with romantic music or candlelight. It could be the bedchamber with perhaps the bed strewn with flower petals.

Foreplay

The overture to love play can be carefully planned or totally ad-lib. A laugh, a glance, a double entendre, a comment from either partner – nearly anything – can touch off a series of wonderful events. When one strokes the partner's palm very slightly with a finger or sucks a fingertip, an all-night conflagration can be ignited. An occasional butterfly kiss here and there on the partner's arm, face, and neck can titillate. Nibbling the earlobe also excites some partners. In fact, some of the accupoints on the ear are love

points. The natural aroma of a clean woman can be intoxicating to some men, especially during an erotic moment.

A major element in Chinese erotic poetry is olfactory sensitivity. It is found in the famed poem "***Ten Fragrances***". In addition, the French use the term cassolette (perfume pan) to describe the scent of a woman's body: lips, hair, skin, armpits, vulva and even her fingertips. This natural womanly odor is best enjoyed with a sniff-kiss, or Chinese kiss. It is done by putting one's nose next to the partner's body and sniffing in a gentle, loving way. The Chinese use this type of kiss as a loving gesture with small children and as a way of flirting. The Chinese reserve lip kissing for an erotic bedroom act.

Sometimes, if a couple is dining in private it can be stimulating to feed one another. This can vary from spooning food into one another's mouths to transferring food from mouth to mouth. There are numerous foods that are erotic in nature, including peaches, jelly, raw oysters, and clams. Transferring wine from mouth-to-mouth is an age-old erotic act that tantalizes many couples. There are those who enjoy pouring a little champagne into the bellybutton of their mate, and then licking and kissing it. The chilled, fizzing champagne excites some partners. On the other hand, warm rice wine, perhaps Chinese Shaoshing or Japanese Sake, is a good choice too.

A terrific prelude to sex is touch dancing. Many types of dancing evolved from artistic forms and symbolic representations of coitus. Touch dancing permits one to learn a great deal physically about their partner through rhythm, motion and bodily interaction even while fully dressed. A discriminating person can intuitively sense the sexual manner of the dance partner. In private, dancing half dressed or naked is an erotic preliminary to love play. Signs of this prelude are frequently high spirited. Periodic, brief gestures done in an apparently accidental or scatty way are safe in case of opposition. However, they may be quite arousing to a receptive partner.

There are signals that are particularly effective. This is the case whether dealing with a sexually restrained partner or a familiar but up to now platonic friend. One technique is the "dead hand." Here a person "absentmindedly" and gently places their hand on the other's upper arm, shoulder, waist, or thigh. If the person reacts negatively, the hand is quickly removed. However, with no negative reaction, the hand stays without moving, as if dead. If there is a positive reaction, the dead hand becomes increasingly bolder. Another high spirited gambit is a pinch to some taut, fleshy portion of the body. This could be the shoulder if a person is diffident or the thigh or bottom if one is more venturesome.

The surprise single slap, echoing in the receiver's rear, is an attention getter at the right moment, for instance when the person is bent over picking something up. Tickling, while usually thought of as being for children, is also fine for grown-ups, because the feeling is decidedly sexual. The most sensitive spots for tickling are the underarms, behind the knees, the bottoms of the feet, the backside of the neck, the sides of he body, and the inner thighs. Friendly wrestling is an infallible prelude to erotic activities. This

playful scuffle needs neither a referee nor rules. A handcuff hold by the stronger person might well bring about more interesting activities. A prelude with excellent physical possibilities is a pillow fight. This bedchamber activity can disperse hidden sexual enmity. Furthermore, it can bring partners to a point of sensual playfulness. It is best to use down pillows that have no buttons as they make the best weapons. It is possible to hit the other person with gusto and, if done in the right place, not harm them in the slightest. There should, however, be no heavy blows to the face, breasts or genitals. A wild pillow fight might make a mess of feathers, so pillows with synthetic or rag stuffing can be used. The fight can take place while dressed, partially dressed or completely naked, depending on personal taste and the impulse of the moment.

Undressing oneself quickly shows either great urgency or a lack of diplomacy. Disrobing each other can be a strong source of arousal because it is both enticing and sexually arousing. Undressing can be done slowly, as in a game of strip poker. In this game the loser of each round must take off one or more pieces of clothing.

The mouth, with its soft, pliable tissues and excellent tactile and taste sensors, is an erotic organ. This makes kissing both effective and essential in love play. It is exceedingly open to sensual stimulation. The nerve endings on the lips and tongue are quite sensitive. The mouth itself can react erotically to the touch of a partner's lips, tongue and, if in the throes of passion, teeth. The amount of suction used determines the sensation. The olfactory cells in the nervous system in the nose are near the mouth. The odor of a partner's breath, mouth and the nearby skin can be highly bracing, especially if it is combined with the quite personal taste of lips and tongue. In erotic mouth-to-mouth kissing, we touch, taste and smell our partner. This is so intimate that it is akin to coitus. The sensuous kiss can be as soft and changeable as a fluttering butterfly. It may be as deep and lasting as the famed French kiss, used by the young people of Pays de Mont in Brittany, where lovers use their tongues to search and explore each other's mouth. It is even sometimes done for hours on end. Such penetrating kissing is often the first sexually arousing act between lovers. Very often, depending on the mood and degree of intimacy, it leads to other forms such as caressing.

Not only have modern sexologists outlined the erogenous zones, but Taoists of old mapped assorted love spots on the body. Any part of the body, actually, can be an erogenous zone. Stroking the back of the neck softly, kissing the sides of the neck, probing the ear opening with a tongue or softly biting the earlobe may arouse a partner a great deal. Other sensuous parts are the underarms or inside the elbows, thighs, and knees. There are erogenous zones at the lower back; and, as we all know, in the area of the genitals. The love points mentioned by the ancient Taoists are similar but not identical with the modern erogenous zones. Furthermore, sensitivity in the erogenous zones is different from person to person. Some have no sensitivity at all in certain areas. However, some women's breasts are so sensitive that, when caressed, orgasm is reached. There are others though, who are not aroused at all in this fashion. Sensitivity in other areas can vary even more. In general though, most people are erotically sensi-

tive in the erogenous zones. The thoughtful partner first explores and experiments in different areas in love play in order to learn the most effective way to arouse and please the partner. Sensitivity generally increases from the extremities of arms legs to the body, and from the outside portions of the torso to the center. Caressing a partner in the peripheral areas and moving to more sensitive areas can create an increase in desire.

Kissing and caressing are a natural combination in love play. In general, a good lover does not go immediately to the genital area or even the breasts. An inexperienced or aggressive lover, often the male, is often too bold, direct and impatient. Such a person roughly grabs the woman's breasts and buttocks, rams his penis in and ejaculates. This is not only rude and crude, but also almost certain to turn many women off. Gentle and tender caresses, at least at the beginning, are much more likely to arouse her. Stronger and more assertive love play is effective when the partner has already been excited. Many men are more aroused by slow and considerate love play as well. Finally, the sight, sound, and odor of an excited mate can frequently be potent aphrodisiacs.

Most women are quite aroused when their breasts are caressed and kissed. There is a significant nerve link between the lips and breasts, as well as between breasts and genitals. Consequently, mouth-to-mouth kissing can make their nipples become stiff and erect while stimulating the breasts often makes the clitoris also become erect and the sexual fluids flow.

Starting love making with a good kiss helps insure a pleasurable experience for both individuals. Some women are a bit more passionate and more psychological techniques may make their nipples erect. The majority, however are excited by a combination of psychological and physical factors including love play at their breasts. After kissing and caressing his partner's face, neck and shoulders, a good lover moves to her breasts. If done with tenderness and passion, this will greatly stimulate his partner. Most women like having their breasts cupped and lifted with the palms, gently caressed around the nipples and gently squeezed. They enjoy it when their breasts are kissed while their nipples are rhythmically and playfully licked with the tip of the tongue. Varying erotic sensations can be given to the woman using the smooth (bottom) and rough (top) sides of the tongue alternately. Exciting preliminaries such as this should precede going on to the lower areas of the buttocks, groin, perineum, vulva and clitoris.

Love play should progress naturally to the area of the genitals. Touching a lover's genitals can be done with the hand, the mouth or other parts of the body. Next to coitus itself, this is the most passionate and intimate form of sensual communication between lovers. It may be a temporary end in itself to be repeated some other time or it may progress to orgasm or intercourse. Caressing the genitals can be done a number of ways including stroking, fondling, pushing, rubbing, oscillating, tickling, thrusting, kissing, nibbling, licking and sucking.

These can be done with varying pressure, speed, and rhythm. Some are enthralled with continuous, persistent caresses but others prefer a provoking, repeated stop and go manner. Since genital organs are made of tender, sensitive tissue, caressing should

begin with slow, light touches. After that it can progress to a more active, speedier, heavier approach. This gradual progression allows the participants to be both emotionally and physically prepared. For example, it assists genital lubrication, which prevents discomfort and even pain. Different techniques of caressing are appropriate for different areas of the pubic area. Soft strokes and kisses are most arousing on the insides of both the thighs and groin. The cinnabar field and a woman's mons veneris react in a positive manner to a massaging palm. The fleshy buttock can take much heavier caressing, for example, kneading, squeezing, and soft slapping. Stroking the bottom and occasionally moving to the perineum is very evocative. There is a wide range of oral-genital play. It can take the form of gently kissing the partner's genitals using the mouth or tongue in a manner similar to intercourse. Some people find this wonderful, while others are disgusted by it.

One of the most sexually sensitive areas, but often overlooked, is the perineum which is the zone between the anus and the genitals. It corresponds to the hui-yin in acupuncture. This area stimulates a male erection in addition to female desire. Caressing the perineum softly with the fingers or the end of the tongue is very energizing.

While many think of the anus as strictly an organ for excretion, in fact, it is connected to sexual nerves, some of which are quite excited when the anus is caressed. Of course it should be thoroughly washed prior to caressing. The French use the word "postillonage" to describe pressing and poking the anus with a finger, and "feuille de rose" (rose leaf) to describe licking it and probing into it with the end of the tongue.

The caressing and the kissing of the genitals necessarily involves genital fluids. These fluids are nature's inventive preparation for intercourse. They lubricate the sexual organs in order to facilitate coitus. In addition, they are a pheromone that acts as a sexual attractant that excites partners. Taoists of old thought that ample lubrication was of supreme importance for enjoyable sex. Modern sexologists, who suggest substitutes such as saliva or artificial lubricants in case of emergency, agree. Natural ingredients, in sex, as with food, are always the best.

Looked at scientifically, genital fluids are similar to saliva. In fact, the genitals, if carefully washed, have fewer bacteria than the mouth. Male genital secretions are a clear, slippery liquid oozing from the opening of the phallus. They come from two pea-size glands just under the prostate as well as several smaller ones in the urethra. Such secretion is not semen, but if the man becomes extremely aroused there may be a small amount. Women have a similar liquid emitted from four vestibular glands around the vaginal opening. When sexually excited, the wall of the vagina also "perspires" a liquid that at times can be quite plentiful. The ejaculated semen from a man during male orgasm originates in the testicles and prostate. It is a gooey, milk like fluid which becomes more liquid when exposed to air. Some experts hold that some women ejaculate a fluid if they have a deep uterine orgasm. This transparent liquid serves no function biologically but is believed to enhance sexual pleasure.

Caressing the Moon Grotto

Fig. 12.2

Being kissed and caressed by a lover is usually sufficient to arouse a woman so that her moon grotto becomes lubricated and her clitoris stiff. A woman's partner can easily check this by occasional short forays to the area of the vagina as he fondles her thighs and bottom. The clitoris is quite sensitive to touch. The shaft, instead of the sensitive tip, should be caressed. In fact, some women can stand only the lightest touch to the tip, making a heavy caress uncomfortable. The labia minora, or inner lips, and the vulva are next. By taking turns caressing the clitoris and then the vulva, first softly and then a little more firmly, a man may magnify the pleasure of his partner. If he strokes the labia minora and then the edge of the vaginal opening with his middle and index fingers, more lubrication will flow. Taking these secretions with his fingers, he can rub the shaft of the clitoris with them. If the woman spreads her thighs wide, the classic texts tell us, she is responding positively to the love play. When her partner understands her signal, he can probe deeper into her moon grotto. Using one or two fingers to go deep enough to touch her flower heart and lightly stroke it can increase her sensations.

If the woman's orgasm is the goal of the love making, the man can bring this on by stimulating her clitoris. There are women capable of multiple orgasms by way of clitoral stimulation. Some particularly passionate women go from one orgasm to another for a relatively long time. Caressing her "G spot" brings about a much more intense uterine orgasm. However, a lot of women appreciate a deep orgasm more during coitus. This is possible if the man knows the right positions and dynamics. The G spot can be found by inserting the middle and index fingers about two inches inside the opening of the grotto. With finger pads facing the front wall of the grotto canal, massage while exploring. A man can tell from the woman's reaction if he has found the spot (about the size of a bean). It may protrude a little when stimulated. Upon finding it, he can press the spot softly but rhythmically. Using the palm of the other hand to press down on her mons veneris at the same time, the man can increase the pressure on the spot.

Caressing the Jade Stalk

Fig. 12.3

Fondling a man's genitalia can be tricky. A lot depends on whether the man desires to ejaculate. If he doesn't, it is important that he be an expert in the techniques of orgasmic brinkmanship. If he is not, signals can be arranged so that the man can tell the woman when he is nearing ejaculation. A woman with experience can sense when the man is near the edge even without a signal. However, a man's ability to hold back may change from time to time, so it is always best to have some signals.

Caressing the jade stalk should be done by gently stroking the perineum with the fingertips. Next the woman's fingers move softly to the back, bottom and front of the scrotum with tickling but soothing caresses. Because the scrotum is the tenderest part of the male body, the woman should caress and tickle the testicles very gently. She should not pinch, squeeze or nip at them. That is not love play and can cause serious pain, injury or even disability. After the testicles have been caressed, the woman's fingers go to his erect penis. She grips it firmly near the tip with the palms and fingers and moves her grasp toward the base. This makes its skin more taut. This reveals and tightens up the blood filled glans or head. She can stimulate it with the fingertips of her other hand, with brisk, light rubbing. The undersurface of the erect penis is more sensitive than the top side. Indeed the glans and the edge around its base are yet more sensitive. Most sensitive of all is the triangular knot-shaped frenulum on the bottom side of the ridge.

If the glans has been lubricated, the woman can apply the secretion with her fingertips in a circular motion around the glans. This can also be done with her own saliva. The caress can be varied by pumping the shaft up and down with her hand, but she must be careful the man does not ejaculate, unless this is intended. This stop-and-go method can assist the man in delaying or avoiding ejaculation, but it still gives him great pleasure and is tremendously arousing. If she is so moved, she can kiss the stalk while caressing it.

Love Games

Fig. 12.4 Spring Butterfly: In this love game the brush pen represents a Spring Time Butterfly and the body a landscape of valleys and hills which is covered by flowers. The partner lies down with closed eyes and is completely relaxed. The end of the brush is placed here and there mimicking a coquettish butterfly. First it is moved lightly over the hands and feet and proceeds to arms, legs, and various parts of the body. The partner with the brush concentrates on sensitive areas like the fingertips, palms, insides of the elbows, armpits, soles, between the toes, behind the knees, and in particular, the insides of the thighs. Different portions of the face, including the lips, are teased next. The butterfly moves down the neck to the breasts, the cinnabar field, and the groin. The touches are delectable to the partner, especially because they do not know where the butterfly will land next. The light, galvanizing tickles created on the skin will probably bring forth a plea that the touches be firmer. The pleas should not be given into until the damp landing is prepared. For this wonderful stage, the brush should first be dipped in a little aromatic oil. If the woman is the landscape, her areolas and nipples should be caressed with the oiled brush. First, go around and around and then flit between the breasts. After this, spread her legs and allow the butterfly go along her perineum and vulva. Brush her clitoris next, first moving upward and next in a circular motion. For a man, brush his perineum and scrotum as well as the exposed glans. You may give your loved one a delightful and highly memorable hour with this marvelous game. A variation can be for a woman with long eyelashes to play the role of the spring butterfly by blinking. A man's moustache can be used for the same purpose. Such techniques may prove exhausting, however, if the entire landscape is covered.

Fig. 12.5 Peacock Tease: This game was invented hundreds of years ago when peacock feathers were used as a decoration of merit for service to the emperor. Lords interested in a different sort of merit used the peacock feather in a playful manner with their women. Today either partner can use the feather. Feathers from other birds such as ostriches, pheasants, storks and even chickens can be used as well. You should remember, however, that feathers do not have as wide a variety in pressure as an artist's brush.

Fig. 12.6 Spider's Legs: There is a French love game called pattes d'aragnee where the fingertips and finger pads play on the partner's body hair, and sometimes the skin, with the lightest touches possible. As with the spring butterfly, the spider is capable of going all over the body.

Fig. 12.7 Silk Tease: The best thing for this love game is a scarf or lingerie of real silk, but soft acetate will do. Nylon should not be used because it is too stiff. Ball up the scarf or other item a little in your hand, and use it to caress different parts of your partner's body. Silk provides a rich and luxurious sensation which is very different from that of brush-pens or feathers.

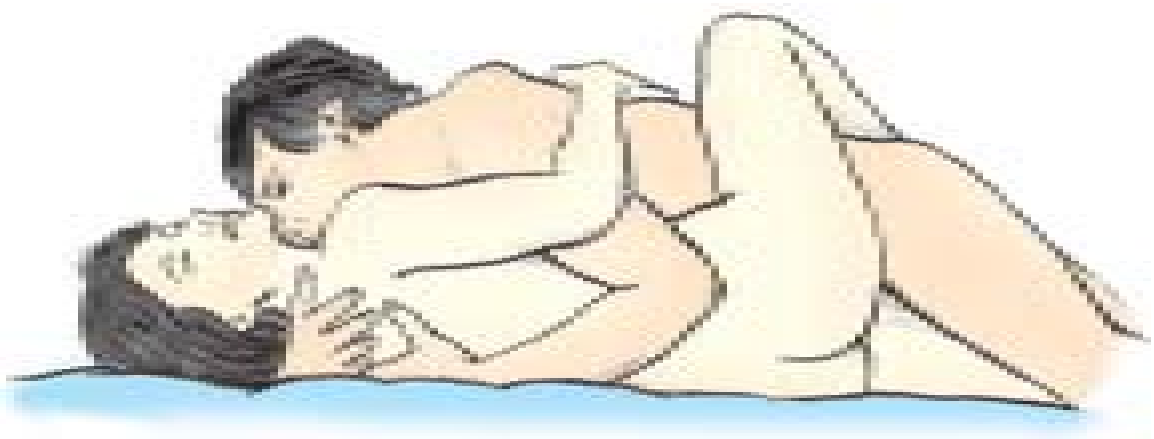

Fig. 12.8 Sniff-Kissing: A sniff kiss is used best if your partner's skin is perfumed slightly with crushed jasmine or tuberose, or if your partner's body gives forth its own sexual aroma. Start by inhaling and sniffing the breath of your lover. Nudge your nose on your partner's cheeks, eyelids and neck, and proceed with the scented pilgrimage up the peaks and down the valleys. The natural odor of excited genitals is a powerful aphrodisiac.

Fig. 12.9 Tongue Sweep: This game usually quite naturally starts with a roving kiss. The tongue is showered on a partner with touches that can be everything from the lightest tickling with the end to a firm brushing with its rough surface. The ear cavity should be paid particular attention to as well as under the chin and the palms and soles. Then go for the belly button, breasts and nipples, inside the thighs and perineum. A good tongue tease will use a lot of saliva no matter how much you may drool. Alternate the sweep with sniff-kisses.

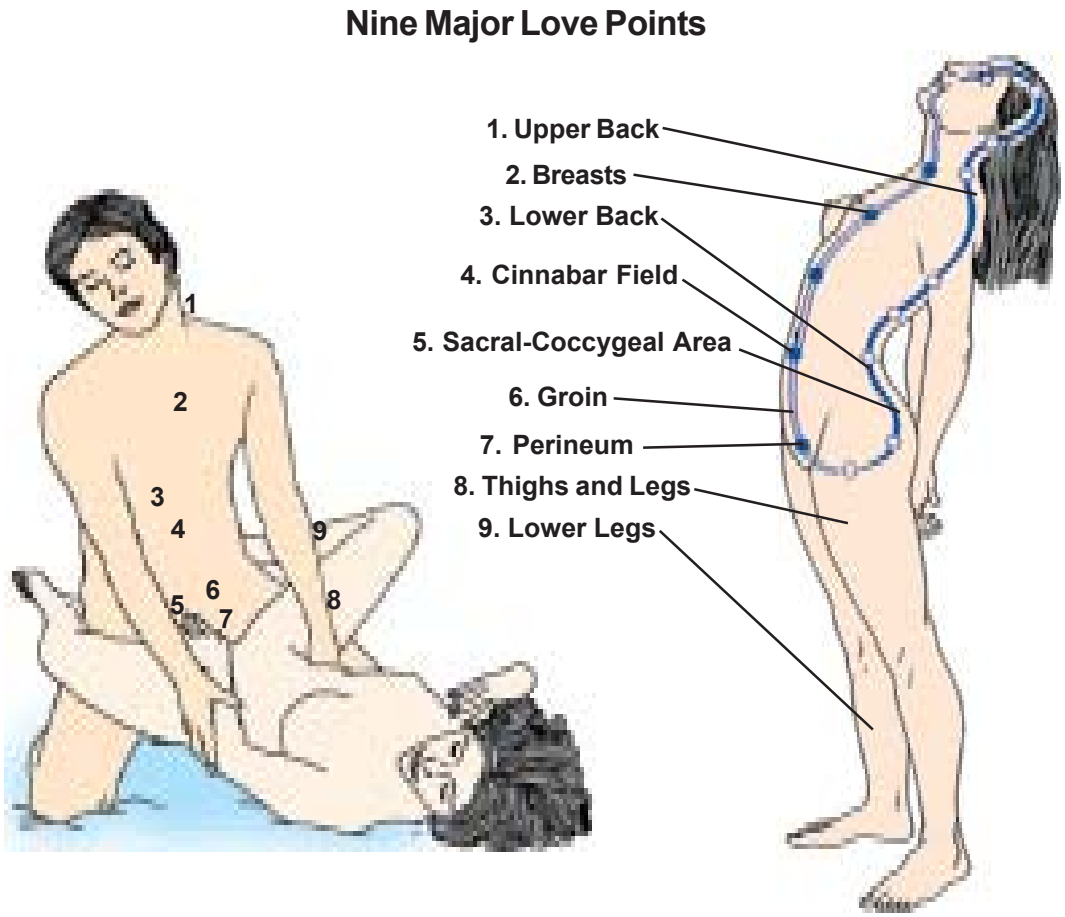

Fig. 12.10 *Nine Major Love Points*

Perineum: The sex crossroads is the hui-yin and is one of the most important love points. It is located at the middle of the perineum, just barely beneath the skin. Acupuncturists use it in treating penile pain, vaginitis, irregular menstruation and a prolapsed uterus. In love play, the perineum may be stroked and the point pressed with a fingertip for four seconds, released and pressed again. This is done about 40 times or for 5 minutes. This spot is one of the two known erection centers for men.

Cinnabar Field: There are seven love points in the area from the belly button to the pubic symphysis (in front of the pubic bone, felt slightly above the genitals). One way to locate them is to think of the distance from the navel to the pubic symphysis as five sections , each a little over an inch long. The umbilicus itself contains a love point. A segment under it is yin-chiao (sexual crossroads). A half a section below is *Chi-hai* (sea gate). This is a major love point next to the cinnabar field. One half a section below that is *Shih-men* (stone gate). Continuing downward, at the bottom of each of the next

three sections are *Kuen-yuan* (pass of primacy), chung-chi (ultimate middle), and chu-ku, the pubic bone. All seven of these love points are closely tied to sexual well-being and sexual desire. While participating in love play each of them should be stroked and pressed with the palm. They should never be pressed heavily with the fingertips but lightly. Press each for about three to five seconds and then release and repeat. The downward movement from the belly button to the genital region using gentle acupressure at each point increases the partner's arousal. The tongue, if made stiff, can be used instead of a finger.

Breasts: The love points on women's breasts can be used for short-term arousal or long-term engagement. Both nipples have love points. The breastbone, at the same level as the nipples, has another. This is something known as the middle cinnabar field. Roughly one inch above each nipple toward the corresponding shoulder there is another love point. Two pair of love points are at the base of the breasts. Excluding the breastbone, love points should be pressed and stroked with the palm and felt lightly with the finger.

Groin: Approximately two inches down the crease between the stomach and the thighs lie a pair of love points. Palpating them, by pushing lightly and stroking along the groin using the fingertips, can assuage frigidity and impotence.

Upper Back: The upper back contains four pairs of love points that may be braced for sexual energy. To find them, envisage on either side of the spine two parallel vertical lines. One is about 1.5 inches and the other about 3 inches from the spine. Their tops align with the lower portion of the second thoracic vertebra. The bottom ones line up with the lower part of the fifth thoracic vertebra. Press each point firmly for a few seconds using the fingertips and then stop. Go to the next point. Repeat the acupressure procedure a few times.

Lower Back: Directly under the second lumbar vertebra on the spine and a bit below the back of the waist, is the ming-men (life gate). This is an important spot for sexual energy and the second center for a man's erection. Pressing on this love point firmly with the fingertips should bring about very satisfying results. Level with this point, on either side of the spine, there are two additional love points. They are about 1.5 and 3 inches from the spine. They should be pressed together with the life gate.

Sacral-Coccygeal Area: Along the sacrum, lined up in a V shape, there are eight love points which can be firmly pressed. There is a ninth spot on the tip of the coccyx.

Thighs and Legs: Midway between the kneecap and the groin on the front of each thigh, lie two love points. Approximately two inches over the knee, where the muscles bulge slightly toward the inside, is another point. Press these firmly using the thumb.

Lower Leqs: The most significant love point on the bottom portion of the leg is *San-yin-chiao* (Intersection of Three Yins). It is on the inside of the shin, approximately three inches above the peak of the medial malleolus and behind the shinbone. Pressing here can cure impotence, frigidity and early ejaculation.

Erotic Massage

Fig.12.11

The Chinese erotic massage, over 3,000 years old, is perhaps one of the most sexually exciting games in love play. It aims not so much at the muscles but at the chi meridians as well as the central nervous system. These meridians control both body and mind. This august classical therapy, when used by a beloved mate for certain parts of the body, can increase the chemistry of desire wonderfully.

The intimate contact of hands and body is a form of indirect communication. It creates a rapport between the individuals. The partners in erotic massage are preferably naked or almost so. This allows the skin-to-skin trade of life force and sexual energy. Any part of the body, barring the genitals, may be touched. All areas, except those that can be injured, such as the abdomen and breasts, may be massaged firmly. Gentle stroking of tender areas is used. The person getting the massage should lie on a floor mat, narrow table, daybed or a bed. A mattress is OK if it is extra firm.

Massage can be done with scented water or oil. If preferred, it is fine to use no lubricant at all. Furthermore, a homemade lubricant can be made with a mixture of two-thirds soybean oil, one-third sesame oil, and a fragrance such as lavender, chamomile, rose, sandalwood or ylang-ylang. Sesame oil is helpful for the skin; ylang-ylang, which comes from a tropical Asian flower, is thought of as an aphrodisiac and assists blood pressure. Such oils can be purchased at Chinese grocery stores, natural food shops and pharmacies.

An erotic massage may involve the entire body. Begin at the fingers and toes and move along the limbs to the remaining part of the body. The massage can take about an hour. There is a shorter variety involving only the torso and thighs. This takes perhaps 20 minutes or less. The person being massaged should relax, eyes closed from time to time, taking slow and deep breaths using the diaphragm. There are numerous techniques for the actual massage. These include effleurage (long, rhythmic stroking), tapotement (patting, percussing), pertrissage (compressing, kneading), rubbing, pinching, pressing, scraping, grasping, hammering, shaking, and vibrating. The techniques use the thumb and finger pads, fingers, palms, palm edges, fists, soles and elbows.

Three Fountains

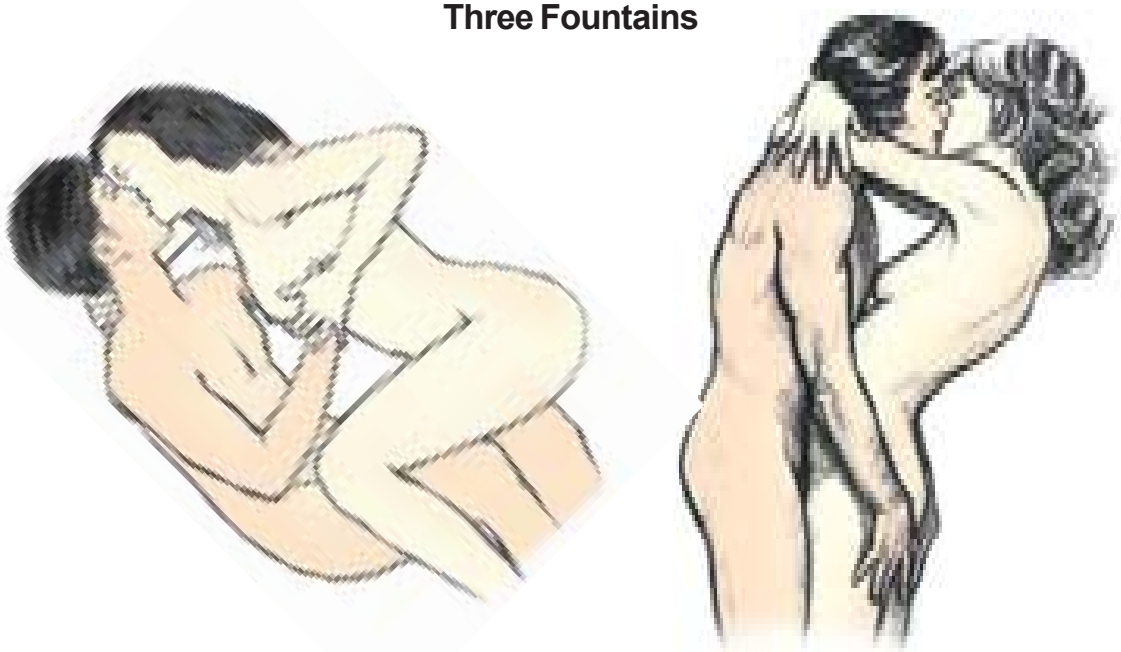

Fig.12.12 Heavenly Fountain: This is a love game that is done while deep kissing. It calls for stimulating the secretion of the lover's saliva, and proceeding to drink it as a potion. While kissing, the tongue is used to caress the partner's tongue. After that, the tip of the tongue is swept over the roof of the partner's mouth beside the molars on both sides. The ducts leading from saliva glands are located here. In addition, sweep over the bottom of the partner's mouth along the inside of the teeth and particularly next to the tongue's root. There are numerous ducts leading from saliva glands. Such stimulation produces a great deal of saliva in the Heavenly Fountains of the partners. Ancient experts in the area of sex believed saliva was a sexual elixir. Nowadays, scientists believe it contains a sexual hormone whose taste is craved by the opposite sex. Drink it directly from the source.

Fig. 12.13 Twin Fountains: People everywhere kiss the female breasts. A male can give his love wonderful enjoyment by sucking on them as if he were a baby. Light and rhythmic sucking with occasional tickling with the tip of the tongue is one method. Gently squeeze as if milking them while sucking. The milk here is of a spiritual variety, unless, of course, the woman is nursing.

Fig. 12.14 Jade Fountain: The jade fountain provides life nutrients for sexual alchemists to drink. Consequently, it is a serious undertaking. It is a most delightful event for love games. This is not an ordinary oral-genital kissing of the vulva. Rather it involves the more complicated extraction of the jade essence from the fountain. For a man, this game has been likened to the splitting of a fresh pomegranate or the "peach of immortality" and the experience for the woman is beyond description.

The first thing necessary in the game is total cleanliness. Lying on her back, the woman bends her knees and spreads her thighs wide. Her feet are on the edge of the bed. Another possibility is to slump in an armchair, with knees over the armrests. Facing her, the man kneels down. The partners could also lie in bed on their sides, or one on top, in opposite directions. These positions are excellent for this game or combined

with Playing the Flute. This is the favorite French game of soixante-neuf, (often called 69). The name itself shows us it is mutual oral-genital play.

First the man kisses the partner's mon veneris. Following that he opens the outside lips of her genitalia with his fingers, and kisses the inner lips. The tongue should be used to stroke the inner lips and by this stage they should already be engorged with blood. Thinking of the vulva as the sides of a boat, the urethra, the vaginal orifice, and the four vestibular glands are on the bottom. Take the tip of the tongue and sweep up and down the bottom of the boat. Drive the tongue into the vagina and then remove it. Repeat this rhythmically. Gradually, he should go on to the clitoral area. Kiss the tiny button with your lips. Suck it ever so gently and tickle the tip with your tongue like a teasing butterfly. The rough surface of the tongue licks up from the bottom of the clitoral shaft. Alternate between caressing the clitoris and the vulva. Concentrate on things that elicit your partner's most excited responses. This will inescapably cause the jade fountain to bubble over with the jade essence of the vestibular glands and the grotto well. Occasionally it produces some interesting sounds too.

Playing the Flute

Fig. 12.15 *Playing the Flute*

This game too, as with the Jade Fountain, necessitates meticulous personal cleanliness and a great degree of delicacy. There are women who love it but others do not care for it. This is often because of the dangers involved. First there is the gag reflex if the man goes deep into the throat. There is also the possibility of accidental swallowing of the semen if the man cannot or will not practice orgasmic brinkmanship. With prac-

tice and cooperation though, everything is under control easily. Other issues are strictly a matter of personal taste.

It is best to begin the game with the woman kissing the man's perineum and scrotum. Following that is the flute playing. The woman should hold the base of the jade flute firmly with one hand so that it stands up and down. A series of light kisses should be given to the glans. Then the woman holds the glans in her mouth by surrounding the ridge with her lips. She licks the glans, especially the small urethral opening, with the tip of her tongue. Next, she should purse her mouth into a tight O shape and picture it as the opening to her grotto. She moves her mouth up and down and lets her partner move the flute in and out. At the same time, her fingers play with his perineum and scrotum. It should be kept in mind that the most sensitive part is the top third of the flute.

A lot of men, perhaps for psychological reasons more than for physical pleasure, like their partners to "deep-throat" the flute. When the tip of the flute contacts the woman's throat, it normally activates the gag reflex. However, by practicing a gradual deepening method, a woman can accept the entire flute easily. Playing the flute, especially deep throat music, can cause a man to ejaculate in the woman's mouth. There are women who avidly swallow the potion. Scientists claim it is clean and harmless. The ancient belief was that it is beneficial. Some women, however, do not like this. It is possible, of course, for a woman to keep the fluid in her mouth and spit it out. Another possibility is to arrange ahead of time for the man to signal when he is on the edge.

Chapter XIII

In Summary

This book on Sexual Reflexology is really a book about energy, the most basic and powerful form of human energy: sexual energy. Without sexual energy none of us would be here. There would be no book to write, and no one to read it. Sexual energy, the primal union of yin and yang forces, drives the universe, and yet, for most people is approached without much understanding. It brings ecstacy and deep joy, but also causes deep pain and heartaches from lack of proper knowledge. It can heal our bodies, or it can cause sickness, confusion and disease.

Through study of Sexual Reflexology it is possible to understand sexual energy from an entirely new perspective and level... but where do you go from here? What do you do now? ***Nothing!*** That's the Way. That's the Tao. It may seem confusing to you now, but after you begin to try some of the concepts and practices in this book, it will begin to make sense to you. You will discover the Non-Doing or Doing Nothing (the Taoist call it "Wu Wei") which may be translated as "effortless action", or "correct action" or just "going with the flow". Correct action (Wu Wei) is the letting go of your will which is action on your part. As you let go, the sexual energy (Chi) flows through you and eventually, by practicing the formulas (correct action) you will connect with that energy and become one with it. And that's the Tao. The information in this book may be studied and comprehended by our mind, but it is only when these concepts come to live in our bodies that we really begin to understand it.

The Tao says there are three ways of Enlightenment. The first way is one of prayer and worship; you can achieve it but you don't know when, why or how. The second way is one of good works and service, but again, you don't know when, why or how. The third way is the Way of the Tao, which is one of knowledge and wisdom. You know when, why and how, because it is an alchemical process on a molecular level working with the highest form of energy (sexual energy) in the body, and this will become clear to you as you practice. You will know when to be hard and when to be soft. That's wisdom, and that's the Tao.

We thank you for your time and attention. We trust you will see your sexual experience a little clearer now and begin to understand the way of your sexuality and begin to incorporate these new ways of understanding human sexual energy into your life, a process which takes many years. It is the work of a lifetime. So, play with these new concepts, new positions, new attitudes and new understandings, but be easy on yourself. There is no right or or wrong way to get in touch with your own personal sexual energy. It takes time, patience, humor and love. We hope you will take these qualities, bring them to your sexual practice and enjoy a whole new way of relating to yourself and your sexual partners that will bring you many years of peace and joy.

Fig. 13.1 *Patience, Humor and Love*

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Sexual Reflexology
The Tao of Love and Sex
★ Guide for Lovers ★

Mantak Chia and W.U. Wei

Illustrated by Udon Jandee

Sexual Reflexology

The procedures presented here are built on the information from Master Chia's first four books on the Healing Love Energy: "Taoist Secrets of Love", "Healing Love", "Multi-Orgasmic Man" and "Multi-Orgasmic Couple". Master Chia and W.U. Wei take the study of reflexology out of the realm of foot massage and into the realms of internal energy pathways, sexuality and compassion to guide students in understandings of Sexual Reflexology.

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Tendon Nei Kung

Opening the Growing Tendon Power

Mantak Chia

Edited by:

Lee Holden

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Introduction to Tendon Nei Kung

Tendons Nei Kung and Tendons

Although there are a vast number of benefits that may be obtained from a regular practice of Tendon Nei Kung, the exercise is specifically designed to aid in the growing and strengthening of the tendons. The lastest research on the human body reveals that cultivating strength and physical well being. The tendons are a most vital ingredient. Generally speaking, people have a very limited knowledge on tendons and are far more interested in how to pump and tone their muscles in order to appear strong externally. In cultivating true strength, the tendons have to be included, and knowledge of how to strengthen them is required. Before we go into explaining the exercise itself though, it is helpful to have some basic knowledge about tendons and their nature.

Tendons and Ligaments

Tendons are the tissue that connect bones to muscle, while ligaments are the tissue that connects two bones together. Ligaments are mainly found in between the joints and are generally short in length. Tendons on the other hand are located through out the body. For example the tendon that connects our heel to our calf muscle (Achilles tendon) is of prominent length. In essence, tendons and ligaments are both connective tissue and made of exactly the same thing. Through out this book we will be referring mostly to tendons, however the Tendon Nei Kung practices are equally as vital and beneficial to the ligaments as they are to the tendons. Bare in mind that when we say tendons we are basically reffering to the body's connective tissue and are hence referring to the ligaments as well.

Tendon Nei Kung Practice

Theory

The three key instruments that are made use of to grow the tendons in Tendon Nei Kung (tendon changing) are mind, heart and eyes. Together the mind heart and eyes are know in Chinese language as Yi, which again can be translated into the English word “awareness”. The heart is at the very base of this practice. The ancient Taoists followed the theory that the tendons are directly connected to the heart. When the heart contracts, the tendons lightly contract. When the heart expands, the tendons expand. Therefore a vital step in Tendon Nei Kung practice is to be able to strongly sense the beating of the heart so that we can move to its rhythm when doing the forms. This is not such a simple task especially during movement and takes a little persaverance. Meditation (Inners Smile and Microcosmic Orbit) is key. By quieting the mind, we are able to sense the internal organs, and really listen to the rhythm of the heart. If you do not have a deep meditation practice and cannot yet feel the contracting and expanding of your heart, it helps to feel your wrist pulse for a moment to get a feel for the rhythm of your heart beat. This will be discussed later, in more detail, in chapter five.

Tendon Nei Kung Forms

Building the Structure

Rocking Forward

The basic movement for the Tendon Nei Kung forms proceeds out of the Iron Shirt I posture. Once in this posture, following the same guidelines and principles of relaxation and alignment, you are ready to start with the movement.

Power Moves from the Ground Up

Fig. 1 *Earth Force.*

Regardless of style, a universal principle of Tai Chi Chi Kung is that power is generated from below. In other words when generating force, it comes from the earth, to the feet, up through the legs, up the spine and back and travels through the arms where it will finally be expressed in the hands and fingers. Tendon Nei Kung is no different in this regard. In fact it is the very practice of learning to bring the earths enegy up through your body. The aim is to use the mind, assisted by the correct movements to bring the earth's energy from the ground, through the various tendons of the body and finally into the tendons of the hands.

Feet

Once you have adopted your Iron Shirt position, you are ready to initiate the movement from below, in other words the feet. First lift and press the toes back whilst gently leaning forward, so that your heals raise off the ground about an inch to an inch and a half. (on return keep the toes on the ground).

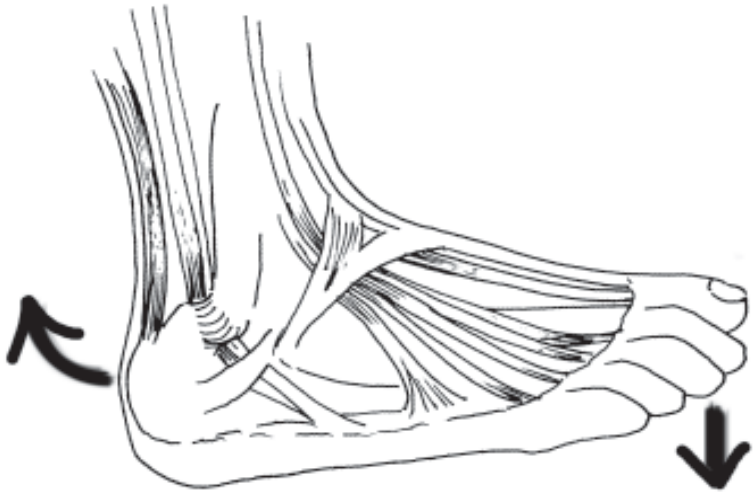

Fig. 2 *Lifting the Toes*

Legs

As your rock forward onto your toes, squeeze the legs slowly from the bottom up. The combination of these feet and leg movements should have you moving up and down about 4 to 6 inches. This movement is used to initiate the gentle whip motion that is used to assist the energy to flow up to the hand tendons in Tendon Nei Kung.

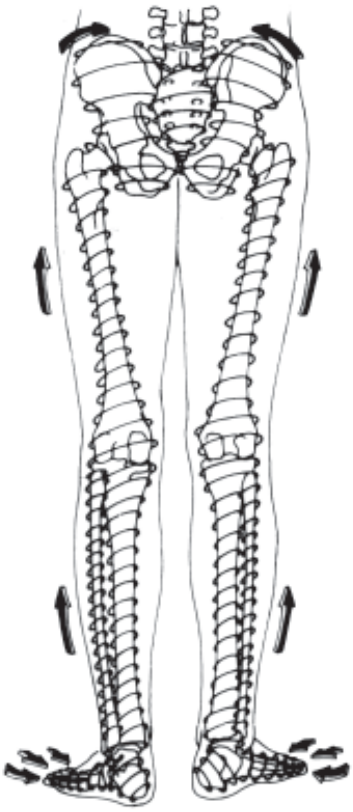

Fig. 3 *Squeezing the legs- from the bottom to the top*

Hips

Once the force has moved from the legs to the hips, press and squeeze the hip joints and feelt that the hips are folding on each other. Doing this should assist in the sending of the earths force upward towards the tendons in the fingers.

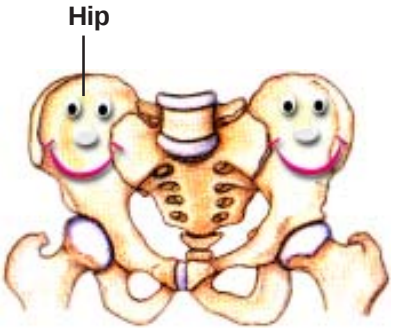

Fig. 4 *Squeezing the Hip Joints.*

The psoas muscle complex is a broad flat muscle in the lower back area. Like an octopus, it has branches extending out from both sides of the lower spinal vertebrae in many directions. It has two segments at its origin, psoas major and psoas minor, which connect with the twelfth thoracic vertebra (T12) and each of the five lumbar vertebrae (L1 to L5). The psoas major is by far the much larger of the two segments, and it gets most of the attention. The psoas major originates from the transverse processes of T12 and L1 to L5 and passes beneath the inguinal ligament in the groin area as it descends down the front surface of the ilium bones of the pelvis. It inserts into the lesser trochanter process on the inside front of the upper femur bone (the big bone in the upper leg). The smaller psoas minor segment shares the same origins as the psoas major, but inserts into the sacroischial ligament. This ligament connects to the ischium tuberosity (at the back of the sitting bones).

Press the psoas muscles form the hip up into the solar plexus and T11. This will help torque the psoas muscles, strongly connecting the hip girth to the leg bone. This connection between the upper and lower body makes the transferal of energy from the ground up, far more affective while also activating the sacral pump. When done correctly you will experience the feeling of being very well grounded.

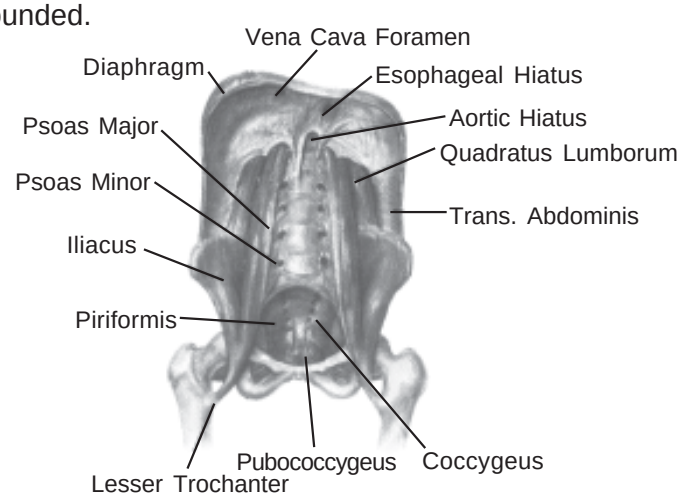

Fig. 5 *Psoas Muscles*

Spine

Feel the momentum of these movements carry into the spine pushing the energy further up. Stretch the spine upwards with a wave like motion moving from the bottom up, expanding from the 5 lumbers, the 12 Thoracics and to the 7 Cervicals.. Lengthen the spine as much as possible without being too forceful, as though someone was slowly pulling the imaginary string that is suspended from your crown up and slightly forward. Really stretch your spine and feel vital space between the vertebrae opening up and increasing in length allowing more Chi to flow and be stored.

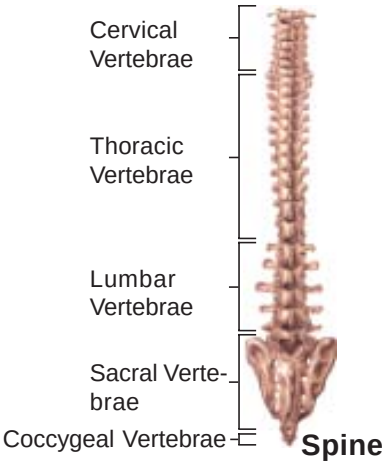

Fig. 6 *Lengthening the Spine*

Scapula

Open the scapula and push the T11 vertebrae simultaneously tilting the sacrum in by rolling the hips under the body. You should feel your feet press to the ground as more weight is given to the legs. The movement of the scapulas will give the illusion that the arms are moving forward and back. Take note however, that the arms are not moving of them selves but only as a consequence of being connected to the scapulae! This is what is referred to as movement without movement in the Taoist texts.

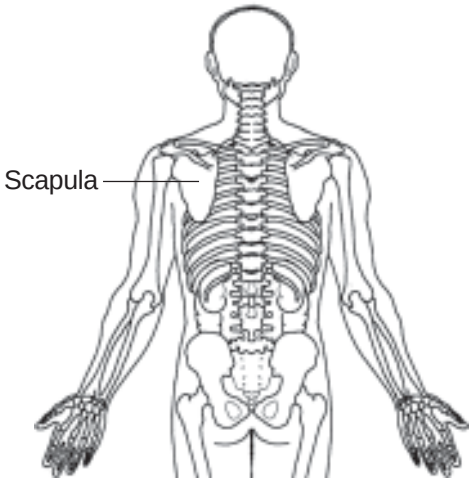

Fig. 7 *Pushing out the Scapulae*

Hands

There is a direct connection between the middle of the hands and the heart. Because of this it is important to gently contract the hands as the heart contracts. By doing this you assist in furter synchronizing the beating of the heart with the movement of the tendons. This in turn greatly assists in pulsing more blood and chi through the tendons to the tips of the fingers. As you exhale and torque the variouse areas of the body and tendons, gently expand

your fingers slightly stretching the finger tendons. Take note this is a very sublte movement and is not an obviouse stretching out of the fingers. Instead try and sense the blood pulsing into your fingers and try and move them as a natural reaction to the momentum of the blood repeatedly pouring into them. You can slightly animate this movement but do not make the movement *unatural and* unrelated to the heart beat. Try and sense the blood pulsing in your hands enough to feel as though you actually have a heart in your hand and then make your hand movements to be a natural reaction to this pulsing.

Tongue

Press the Tongue to the palate connecting the governing vessel to the conception vessel to close microcosmic orbit and activate the Cranial Pump. Now round the shoulders, sink the chest and push the chin in to further open the scapulae and expand the back. This movement will also bring the C7 into alignment which will send the earth force though the tendons of the arms, the elbows and finally the fingers. As the earths force reaches the fingers, gently open your hands to very gently stretch the tendons in the fingers. It is vital that this opening of the hands be in accordance to the peristaltic pulse felt in the palm .

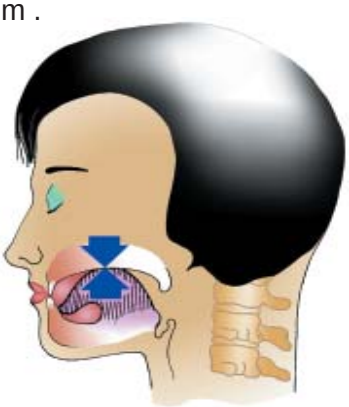

Press Tongue to Palate

Fig. 8 *Activating the Cranial Pump*

Breath (Chi Pressure)

As the heart contracts and you open the hands as explained above, exhale with force by squeezing the Tan Tien (??abdomen??) like clenching a fist, this will pull tendons inward towards the Tan Tien stretching them. Simultaneously pull up the genitals closing the anus and pinch the elbow joints tightly to help create more Chi pressure. Exhaling in this manner creates pressure and a slight tension which will torque all the tendons of the body.

On inhaling relax, and gently breath in releasing all the different pressure that has been created.

Fig. 9 *Tan Tien pulling the tendons inwards.*

Coordinating the Heart Beat, Breath and Movements

Once these movements have been mastered and are familiar to you, you are ready to coordinate the all important rhythm of the heartbeat and the exhalation of the breath to your physical movements. As mentioned, the Taoists believe that the heart controls the movement of the tendons. When the heart contacts, the tendons gently contract and when it expands they release this very subtle tension allowing the tendons to expand. Based on this knowledge of the relationship between heart and tendons the Taoists the vital importance of coordinating the contracting of the heart with the torquing of the tendons and pulling up of the sexual organs. Timing the movement with the heartbeat greatly assists in bringing the earth force through the tendons and is a vital aspect of Tendon Nei Kung.

Fig. 10 *Position when the Heart Contracts.*

Ultimately you need to be moving to the exact beat of your heart. Exhaling rock forward onto you toes, stretching you finger tendons, pulling up the sexual organs ect should be coordinated with the expanding of the heart (peristaltic beat), whilst rocking back onto you heals, inhaling releasing all the various tension should coordinated with the contracting of you heart. In order to do this though, one needs to be able to have a strong sense of heart's pulsing.

Sensing the heart's pulse is more challenging than expected for most people, especially when attempted during physical movement. Even with the necessary meditation experience, when the heart is relatively relaxed as should be when practicing Tendon Nei Kung, it's beat may at first be too subtle to register consciously.

However with a little practice this can easily be remedied to such and extent that you will be able to sense you heart in just about any situation.

Sensing the Heart Exercise

Sitting down, place yourself in a relaxed meditative position and go into you heart with your mind. Smile down to you heart and see to what extent you can sense its contracting and expanding. If you find that you cannot pick up its rhythm what so ever, place your middle and index finger across your palm to sense you pulse. Keep your mind in your heart and try as best you can to feel the rhythm in your palm, in your heart. Once you think you have a good sense of the rhythm try again to sense the heart's pulse with out the aid of you palm. If you find that you still able to do this, make use of your palm to sense the pulse until you think you are ready to do it with out using the palm's pulse. By continuing in this way you will soon be able to sense your hearts pulse with you mind.

Once feel that you have more or less mastered sensing the heart you may try to do the forms in accordance to your heartbeat. It may be easy to try this first from a sitting position, starting the movement from the base of the spine and ending in the fingers as there will be less movement to distract you.

Once you can do this it should be easy advance to standing. By practicing in coordination to your heartbeat in this way, you will be able to grow your tendons a lot more affectively.

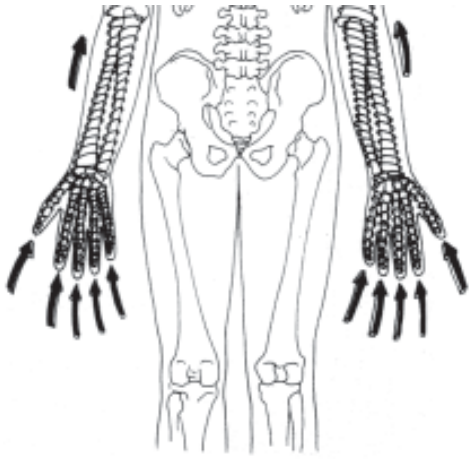

Fig. 11 *Feeling your pulse on your palm.*

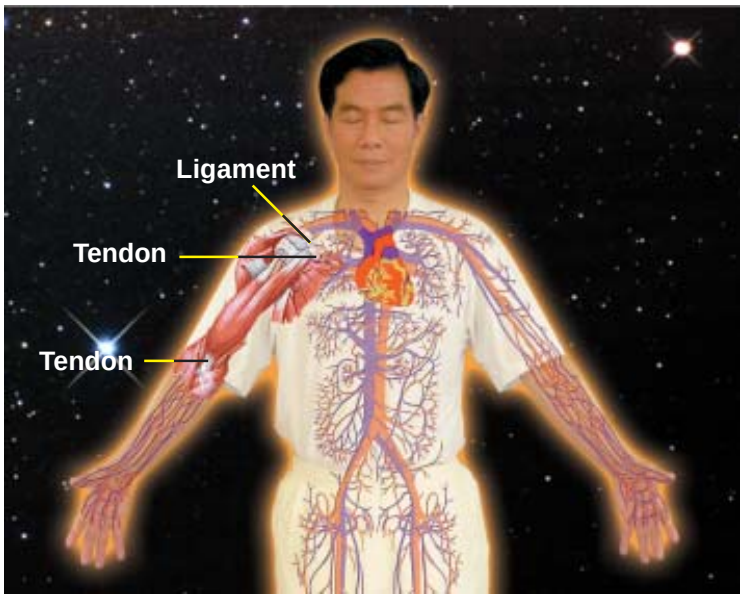

Fig. 12 *Relationship between Heart and Tendons*

Internalizing

Start with reasonably large, and animated external movements. Familiarize yourself with the internal force that is generated when executed correctly (what does the earths force feel like). Then once you have a deep practice and can execute all the internal and external movements as if second nature and generate the force, you can then attempt to internalize the movement. There should always be some visible external movement, but once you feel you are ready you should limit the movement as much as possible while still being able to feel the internal force. If you attempt limiting the movement but don't feel the same internal force generated by your previous larger movements, this is a clear indication to you that you are not yet ready to internalize the movement. In this case it will be necessary for you to spend another couple months, or however much time you feel necessary, before reattempting the internalization of the movements.

Importance of the Eyes

Being visually oriented, human beings rely heavily on their eye sight. Because of this fact we direct huge amounts of our Chi with our eyes, especially when we do it consciously. The Taoists were well aware of this and thought of the eyes as the windows of the soul. They knew that unless we greatly lack concentrated mental focus, our mind generally goes where our senses go, primarily our vision. Based on this knowledge they soon realized that the eyes could be of great aid in Chi Kung exercise as an aid to direct the Chi to the relevant areas. Specifically in Tendon Nei Kung the eyes are used to a large extent to direct the Chi. As the heart expands, we exhale from the Tan tien and we can greatly help direct the Chi to our fingers by expanding our eyes as much as possible and focusing in on our hands and fingers with a strong intent.

Fig. 13 *Directing Chi with the eyes by expanding.*

Concentrating on Individual Fingers

All the tendons connect up in the fingers and by emphasizing individual fingers in this manner one is able to greatly strengthen a specific line of tendons.

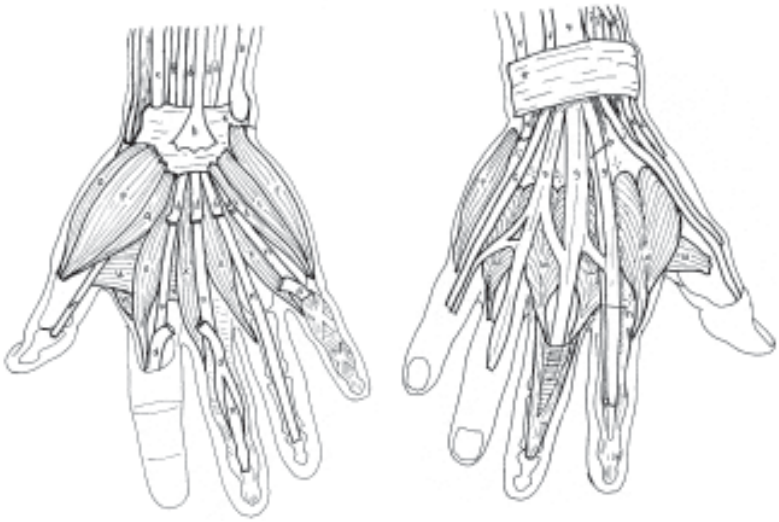

Fig. 14 *Tendon lines ending in the fingers.*

Eight Hand and Arm Positions

Once the basic structure of the Tendon Nei Kung forms has been successfully developed in the Iron Shirt I posture and you are confident with the movements and various details, you are ready to advance your practice by making use of the eight hand and arm positions.

By practicing the eight positions you strengthen and grow all of the various tendons in the body. Consistently practicing in this way will greatly strengthen your tendons as a unit, instead of having one line of tendons being more developed than another, leaving the others to become weak.

Fig. 15 *Developing the Tendons as a unit with tendons and muscles in good preportion.*

First Position

The hands are relaxed, held at nose level with the palms facing inwards in similar fashion to Iron Shirt I position. Following the movements described in basic structure, bring the earth's force up through your body. As your heart expands, you exhale to your Tan Tien, and torque the tendons from the ankles up, open of the scapulae and sink the chest, in this way moving your arm structure forward about a foot to a foot and a half. (Remember that the apparent movement of the arms in doing Tendon Nei Kung and Tai Chi forms, in reality, is only a result of the sinking of chest and the opening of the scapulae. Do not use the muscles in your arms!) As your heart expands, move your arms forward and torque the tendons in your hands. Very gently open and stretch the hand emphasizing the tensing of the tendons in your middle fingers. Expand your eyes and use your visual focus and mental awareness to direct and sense the earths force pulse into your finger tendons.

Fig. 16 *First Position*

Second Position

Hold the hands at eye level, with the palms and hands facing each other, creating an upside down 'V' or roof shape. Following the movements described in basic structure, bring the earth's force up through your body. As your heart expands, you exhale to your Tan tien and you torque the tendons from the ankles up, move your arm structure about a foot away from your body maintaining them at the same height as their original position. As you do this, direct your visual focus and mental awareness primarily towards your Pinky fingers. Gently stretch and tense all the finger tendons, charging them with the earths force, whilst emphasizing the pinky finger tendons.

Fig. 17 *Second Position*

Third Position

Hold your hands at abdomen level, palms and hands facing each other as though you were holding a soccer ball. Following the movements described in basic structure, bring the earth's force up through your body. As your heart expands, you exhale to you Tan tien and you torque the tendons from your ankles up. Simultaneously move the arm structure directly forwards about a foot to a foot and a half at the same height as their original position (abdomen) and gently open and stretch your four fingers forwards, away from your body. At the same time, direct your visual focus and mental awareness towards the thumbs and gently stretching them up towards the heavens. Feel the earths force spread into your fingers especially the thumbs.

Fig. 18 *Third Position*

Fourth Position

Hands are held at abdomen level with hands and palms facing the ground. Following the movements described in basic structure, bring the earths force up through your body. As your heart expands and you torque the tendons from the ankles up, move the arms up and out as the Chi travels through them. At the same time direct your visual focus and mental awareness to the top of your hands and feel the Chi rising up and moving out, through the top of your hands. Cultivate a feeling of resisting the downward force of someone leaning their weight on the tops of your hands. Your hands need move only about half a foot both up and out.

Fig. 19 *Fourth Position*

Fifth Position

Hands are held in front of the solar plexus in a 'roof' shape, similar to position two. Hold the hands about foot and a half to two feet in front of the solar plexus, keeping the elbows down and relaxed. The 'roof' angle is less acute than in the second position. An easy way to find the correct position is to take up the basic Iron shirt I position with the hands at solar plexus level about two feet in front. From this position simply turn your inward facing palms and hands to face at an angle to the ground. Then following the movements described in basic structure, bring the earths force up through your body. As your heart expands and you torque the tendons from the ankles up, move the arms away from your body about a foot keeping the arm structure at the original height (solar plexus). At the same time direct your visual focus and mental awareness to the pinky fingers while also tensing them slightly to charge them with Chi. Feel the earths force pulse into your finger tendons with emphasis on the pinky fingers.

Fig. 20 *Fifth Position*

Sixth Position

Hands are held at shoulder level with the palms and hands facing the chest. Hold you hands about a foot away from you shoulders, keeping the elbows down and relaxed. Following the movements as described in basic structure, bring the earths forces up and through your body. As your heart expands and you torque the tendons from the ankles up, move the arms forward, up and out about half a foot. Make your arm and hand movements larger and more animated than in the previous forms. As the arms move in this way, slightly raise the elbows but make sure you do not lift them over the height of the hands. Focus and expand your eyes to your hands and fingers and put your awareness on the movement of the spine emphasizing its whip like motion and feel it being charged with the earth's force.

Fig. 21 *Sixth Position*

Seventh Position

Hands are at waist level with palms and hands facing up and your fingers pointing towards each other expanding creating the shape of a basket. Following the movements as described in basic structure, bring the earths force up and through your body. As your heart expands and you torque the tendons from the ankles up, move the arms structure forward and slightly up about a foot to a foot and a half. Again focus on your spine and emphasize moving it like a whip. Focus and expand your eyes, looking at your hands and fingers and use your mental awareness to feel the spine being charged with the earth's force.

Fig. 22 *Seventh Position*

Eighth Position

For the final position hold your hands at knee level only a couple inches away with palms and hands facing upwards. To reach knee level with your hands you will need to bend your knees more than in any of the previous positions (bend over the toes!). Do not cheat yourself by bending and arching the spinal cord to reach your knees, as this will simply neutralize any of the desired affects of this form. By squatting, bending the knees whilst keeping the back straight, follow the movements as described in basic structure, bring the earths force up and through your body. As your heart expands,(!!!!you exhale to your Tan tien!!!!!), and torque your tendons from the ankles up, ??start?? straighten the knees until they are only bent a little. As you do this, move the arm structure forward and slightly up, swinging like a pendilum, expanding out creating a basket shape. Move the arms from the scapulae and shoulder as a unit without adjusting at any of the arm joints. As you do this, turn your hands outwards to torque the arm, hand and finger tendons. Focus and expand your eyes, looking at your hands and fingers directing the earths force to them. Emphasize the spine moving like a whip and use your mental awareness to feel the spine being charged with the earth's force.

Fig. 23 *Eighth Position*

Tai Chi Chi Kung Stance Application

Once you are familiar with the various movements and principles of the Tendon Nei Kung forms, you can start adapting the movement to your Tai Chi Chi Kung form. To start doing this you can use the push position. Stand with your hands out in front of your body about shoulder height, elbows down, with one leg forward and about 70 percent of you weight on your front foot, as in a bow and arrow stance. The first step is to initiate the movement from below out of this push position. To do this, you firstly shift your weight from your front leg to your back leg, then as soon as your weight has shifted to the back you project your weight back to the front. If done correctly this movement should encourage your spine to move like a whip as in the Tendon Nei Kung forms. You should practice this basic movement for a while, doing the movement at least a few thousand times concentrating only the on the leg movement. After practicing this for a while you will slowly begin to feel the power that can be generated by this movement move from your legs to your tailbone and up you spine. Do not expect however, to practice this just for one or two days and thinnk that you will be able to feel the power being generated. In ancient times people would spend 20 years doing only this movement, but when they pushed someone people would fly. This of course does not have to be equalled but is a could indicator that this movement is worth some time and attention.

Once you feel the force coming up, you can start concentrating on tuckng the sacrum in and pushing out the lumber. Again isolate this movement and practice it for a while concentrating on the sacrum and lumber movement until you can do it in your sleep. Once you can feel the power being generated by this movement, yo can advance the movement to pushing out the T 11. Again, do a promintent amount of repetitions concerning only the leg movement, the tucking of the sacrum and the pushing out of the llumber and the pushing out of the T 11. Once you feel that you have a level of mastery over this movement you can again advance, this time adding the pushing out of the area of the heart chakra, between the scapulae. As the power comes up through the sacrum, lumber

T 11 and reaches the area between the scapulae, push out this area of the spine and widen the scapulae, simultaneously hollowing your chest. The next area is the C 7 or the base of the neck. As the power comes up to this area you push out his area of the neck. The result of this movement is that your whole neck and head moves forward with the whip like motion that is being generated by the spine. The pushing out of the C 7 and the neck and the tucking in of the chin (as in the Tendon Nei King forms) should be timed together with the with the climax of the movement i.e. when the actual push manifests in your hands. Keep in mind also that the apparent hand and arm movement that is used to push is in reality, only really the result of the movement of pushing the scapulae out. If literally push with your arms, you will loose the structure and the internal force will be almost completely useless. Once you have a grasp this entire whip like movement of the spine in the Tai Chi Chi Gung stance, you can add the other facets of the Tendon Nei Kung movements, pulling up the sexual organs and flattening the stomach, pressing the tongue to the palate and exhaling to your Tantien to generate maximum internal force. The eight hand movements of the Tendon Nei Kung forms can also be practiced out of the Bow and Arrow Tai Chi Chi Kung stance.

Fig. 24 *Tendon Nei Kung Movement in a Tai Chi Stance*

General Information

When doing these movements, both the basic Tendon Nei Kung movements and the movements out of Tai Chi Chi Kung stance, it is necessary for you to really make use of your awareness to 'feel' your tendons. Torque each tendon and follow the gentle tension with highest awareness, if your mind is distracted and busy with other things the practice will not deliver high quality benefits. Feel the tendon torque against the bone structure stretching and strengthening it at each level up the body. Use your awareness to sense the powerful healing energy of the earth move through your body from the bottom up, toes, heels, ankles, legs, hips, spinal cord, jade pillow, arms and finally the fingers. Once you are completely familiar with this motion and can execute the entire movement witout having to consciously think about it, the movement should take no longer than half a second from the toes to the fingers when done at normal speed with a sense of confidence. Naturally, when familiarizing yourself with the external and internal movements you should start as slowly as necessary for you to do all the steps whilst still adhering to all the vital principles. Do not be in a rush to do the entire form in full speed. One may apparently be doing the form correctly from an external perspective. If, however, all the internal and mental faculties of the form are not carefully adhered to, one risks loosing a lot of the potential gain. that awaits the dedicated student. In studying the Tendon Nei Kung, proceed carefully and patiently making sure you include every last of the above mentioned details. Study, practice and feel. You wil know that you are doing it correctly when it feels correct.

Mung Bean Hitting

Taoist History of Mung Bean Hitting

As result of their intensive and intelligent studies of nature the ancient Taoists discovered many of the powerful natural medicines and their specific properties. Amongst their many discoveries made was the fantastic detoxifying properties of mung beans when applied externally to the body. The Taoists found that the mung beans could absorb the excess Yang energy which potentially causes overheating or manifestation of poisonous toxins in the body. They used the mung beans for a wide variety of ailments and injuries reaping many a health benefit from the simple techniques. When poisoned, any of the internal organs could be assisted in detoxifying by applying the simple mung bean techniques. The mung bean techniques were also used to bring relief for constipation and stomach cramps and were even made use of to heal headaches. However the ancient Taoists soon discovered that the mung beans were especially affective in the repairation of damaged tendons and joints and the further strengthening of healthy ones. Tendon strengthening soon became the mung bean techniques most recognized function and was most often combined with the practice of Tendon Nei Kung for martial arts training and maintaining general health.

Apparatus

The most convenient and affective way for applying the mung beans healing and strengthening techniques are by placing them in a cotton sock. The mung bean sock is then used in a club fashion to firmly hit along the lines of the tendons or any other relevant part of the body meridians. Nylon socks are not suitable for containing the beans as nylon soon stretches from the continual slinging and the beans inevitably spill out making a fantastic mess.

Fig. 25 *Mung Bean Sock*

Correct Weight

More or less a pound has been found to be the optimal amount of mung beans to place in the sock. Less or more than a pound of mung beans will prevent you from realizing the optimal intensity of the blow, limiting the sought after results.

Correct use of the Mung Bean Sock

A sure way to help realize the optimal intensity for mung bean hitting (one pound remember) is to let the bean filled sock simply fall onto your arm from a vertical height without any other added power. This should give a good indication of the optimal strength with which to hit yourself and it is advisable to spend a few moments before each session to familiarize your self with the appropriate (stronger) hitting power.

The mung bean hitting should be firm without becoming too extreme. When first making use of the mung beans it is appropriate to be a little cautious as not to injure yourself. Once your skin toughens up from consistent practice you can gradually increase the power of the hitting according to your own discretion.

Hitting with Mung Beans

Upper Limbs
Middle Finger Line

Extend your left arm above the level of your shoulders slightly twisting the arm so that the palm faces up. As you twist your arm into place swallow saliva down into your belly. Start off by hitting the inside of the left elbow three times. Continue hitting along the center of the arm to the inside wrist, through the palm, to the tip of your extended middle finger. Return using the same line, traversing the inner elbow and your shoulder to the top of your neck. Follow the same route back to your elbow giving the joint some final attention. Remember to always use your eyes to direct energy to the relevant areas. Shake the arm lightly and feel the beaten tendon line open and loose. Rest and smile to the tendon using your awareness to help absorb Chi into the tendon line.

Fig. 26 *Middle Finger Line*

Pinky Finger Line

Raise the arm above the shoulder and twist it so that the palm faces up and swallow saliva. Hit three times the point inside of the inner left elbow, slightly to the right of its center, where the ulna bone begins. Hit towards the hand, over the lower part of the inner left wrist, to the inside tip of the pinky finger. Return via the same route up to top of the neck before coming back down to the elbow to give the important joint some final attention. Shake the arm lightly and feel the beaten tendon line more open and loose than before. Rest and smile to the tendon line using your awareness to help absorb Chi into the tendon line.

Fig. 27 *Pinky Finger Line*

Thumb Line

With the arm extended above the shoulder, twisting so that the palm faces up, swallow saliva down into your belly. Hit three times the point located near the outside part of the inner elbow, slightly to the left of its center, where the radius bone begins. Hit towards the hand from this point, over the upper part of the inner wrist, to the inside tip of the thumb. Return via the same route up to the top of the neck before going back down for the elbow to give the joint some final attention. Shake the arm lightly and feel the beaten tendon line more open and loose than before. Rest and smile to the tendon line using your awareness to help absorb Chi into the tendon line.

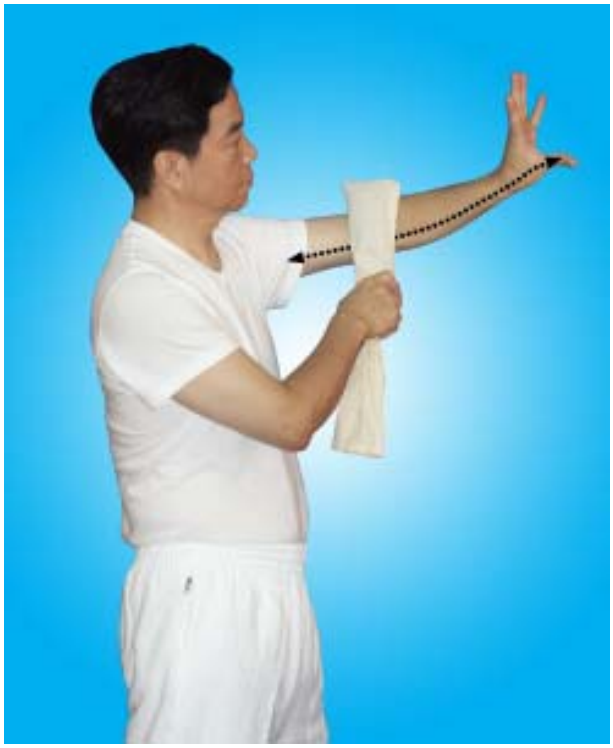

Fig. 28 *Thumb Line*

Back of the Hand

Raise the arm, extending it more or less shoulder height. Twist your arm so that the palm faces down with the pinky finger pointing towards the sky and thumb pointing towards the ground and swallow saliva. Hit the point at the top of your elbow as it is held. Follow this top line over the wrist and up to the end of you middle finger. Follow the same route back over the elbow, along the bicep tendon up to the top of the neck before returning to the elbow joint to give it some final attention. Shake the arm lightly and feel the beaten tendon line more open and loose than before. Rest and smile to the tendon line using your awareness to help absorb Chi into the tendon line, replenishing and strengthening it.

Fig. 29 *Back of the Hand Line*

Organs and Lower Limbs
Big Toe Line

Stand with the left leg a good distance forward, well bent and slightly to the side without straining yourself, hold the hitting device in the right hand. Men should use the right hand to cover the genitals, pulling them away from the left side. Swallow saliva and start the hitting from the left shoulder. Continue down the middle line of the body, hitting softly over the solar plexus, down the line in between your abdominal muscles until you reach your Tan Tien. Then continue down the leg, hitting the inside line of the thigh, down the inside of the knee, all along the inside of the shin bone, the ankle until finally reaching the big toe. Hit the ankle area three additional times since the spleen, liver, and kidney meridians meet near the ankle on this line. Follow the same route back all the way to the neck. Finally, rest and smile to the tendon line using your awareness to help absorb Chi into the tendon line, replenishing and strengthening it.

Fig. 30 *Big Toe Line*

Small Toe Line

Stand with the left leg a good distance forward, well bent and slightly to the side without straining yourself and hold the hitting device in the right hand. Raise your left arm in front of your body in a ward off position and clench your left hand into a fist as depicted in the caption and swallow saliva. Start the hitting under your raised arm in the armpit following a straight line down the left flank of your body. Continue down the leg, hitting the outside of the thigh muscle, passed the outside of the knee and all the way down the outside of the calf muscle, over the ankle and finally ending in the small toe. Follow the same route back all the way to the armpit. Rest and smile to the tendon line using your awareness to help absorb Chi into the tendon line, replenishing and strengthening it.

Fig. 31 *Small Toe Line*

Middle Toe Line

Stand with the left leg a good distance forward, well bent and slightly to the side without straining yourself and hold the hitting device in the right hand. Swallow saliva down to your belly and start hitting from the left shoulder. Hit down in a straight line over the left nipple, down over the internal organs on the left side of the body and over the Psoas muscle. Continue down the leg hitting over the top of the thigh muscle, straight over the knee cap(Hit beneath the kneecap, not directly on it.), down all along the outside of the shin bone over the ankle and the middle line of the foot ending in the middle toe. Gently hit the area at the top of the foot, in the middle, an additional three times. Follow the same route back all the way to the shoulder. Finally, rest and smile to the tendon line using your awareness to help absorb Chi into the tendon line, replenishing and strengthening it.

Fig. 32 *Middle Toe Line*

Back of the Leg Line

Stand with the left leg a good distance forward, well bent and slightly to the side without straining yourself and hold the hitting device in the left hand. Start the hitting from the back of the neck and follow the spine all the way down to your tailbone, hitting directly to the left of the spinal cord. Continue down the leg hitting the back of the thigh muscle, the back of the knee and the all the way down the back of you calf until you reach your heel. Follow the same route back all the way to the back of the neck. Finally, rest and smile to the tendon line using your awareness to help absorb Chi into the tendon line, replenishing and strengthening it.

Fig. 33 *Back of the Leg Line*

If consistently practiced, these simple techniques are guaranteed to strengthen the tendons greatly especially when combined with Tendon Nei Kung practice. Most people end up suffering tremendously from joint problems when they move into old age. This unnecessary suffering can so easily be prevented. Prevention is the best medicine and even though the same exercises can be used to heal tendons it is far more affective to start doing the practices before one starts experiencing problems.

Advised Practice for Today's Life Style

The Tendon Nei Kung forms themselves should constitute the bulk of your tendon changing (growing) practice and be given most attention. Initially it is especially important to set some time aside to make sure that you are doing the forms correctly without neglecting any of the details as people are some times inclined to do. Make sure you study the information on doing the forms thoroughly. Do not be in a hurry to be able to do the complete movement of the forms as soon as possible. These special exercises have many a subtle detail. You could probably perfect the outer movements within three days if you have a level of physical talent and a strong intent to learn and practice. However Chi Kung is not called an internal practice for nothing, and mastering all the internal and external aspects of the movements together takes a little perseverance and patience. Once you have the external movements down and can execute them with out thinking about it, start paying attention to internal movement and try and sense the internal force coming up from the ground all the way into your finger tips. If you practice in this way it will not take you long to be able to execute the movements correctly and as the Taoist love to say, "Once you got it, you got it". Mastering the Tendon Nei Kung forms are well worth spending some time and energy on as you will receive priceless benefits from practicing them correctly, cultivating great strength as a youth as well as saving yourself much of the suffering and indignity that people have come to accept as the normal deterioration of old age.

The best is to build up your Tendon Nei Kung form practice step by step, not advancing on to a next stage until the specific movement has become second nature to you and you can produce the movement without even having to think about it.

Once you have cultivated a level of mastery over the basic structure of the forms in this way, learning the eight different hand positions should not be too much of a challenge.

Fig. 34 *Tendon Nei Kung Practice*

Ten repetitions of each hand position is already a substantial tendon strengthening workout and is sufficient daily practice and should take you no longer than 10 minutes a day (once you are doing the movements properly). Especially if you are new to these tendon growing techniques it is important not to exceed the advised amount of repetitions as straining a tendon is both an unpleasant and long term hazard. In Taoist practices moderation is always the motto as the Taoists understood both the importance of practice itself as well as the resting period in which the body has a chance to nourish the area that has been giving attention. Even western sport scientists are now seeing that for optimal results in weight lifting it is essential for the practitioner to give a worked out muscle at least a 48 hour rest before exercising it again. If the practitioner does not allow the muscle group this recuperation period the muscle run a high risk of actually becoming weaker.

If you have a partner at hand and have the time another ten repetitions on all the hands positions may be spent on the partner practice of the forms which should take another 10 minutes. Of course partner practice should only be integrated into your practice once your solo practice is of a high level. The partner forms are also a very helpful in checking if you are doing the movements of the forms correctly.

A session of Mung Bean Hitting should also be done every day, preferably just before you do you Tendon Nei Kung forms, as this practice will aid the tendon growing process greatly. If you are highly motivated to improve the quality and strength of your tendons and have ample time, you can do a very thorough hitting session of 20 to 25 minutes. A general working with the Mung Bean Sock only has take to take about 8 to 10 minutes and is already sufficient. This practice is of great importance especially in the reparation of damaged tendons and joints and assists the Tendon Nei Kung forms in working its magic, greatly.

Fig. 35 *Bean Bag Practice*

The supplementary tendon exercises should be practiced a minimal of twice a week. If, however, you have available time, please indulge yourself in doing these every day. The precaution should be taken in doing too much in one day though. Combining these three practices will yield optimal results. Tendons strength is extremely long lasting as discussed. Because of this though they also take a longer time than muscles to strengthen. Patience is an essential ingredient in the makeup of someone wishing to pursue tendon growing practices. As a wise man once said to me, Tai Chi Chi Kung practices are not microwave pizzas. The rewards of your practices are inevitable, but it is important not to become fixated upon results. Concentrating on results is a cause of grief for many people in many areas of their lives. When you are concentrated on a result it is very difficult to fall into a state of calm and meditation, which is the ultimate state do be in for Chi Kung practice or whatever you are doing for that matter. A big part of being in meditative state is to be present from moment to moment, concentrating on results obviously prevents you from doing this. If you practice consistently though, after a six months period you will already start experiencing the fantastic benefits of this practice and will begin to feel a new kind of strength in your body, a genuine strength.

Fig. 36 *Meditative State*

For all of the above mentioned practices, remember to take time to shake out, rest and smile to the relevant tendons that have been given attention. This only takes 20 seconds or so each time and is a vital co practice for Tendons changing and most Chi Kung practices and increases results greatly.

Once again we remind you to stay mentally present during the practice of these exercises. Remember Chi follows Yi or energy follows mind. The more chi your tendons recieve, the more they will be able to effortlessly strenghten. If your mind is on other things the affect of the Tendon Nei Kung exercises will be greatly subdued.

Finally we would like to encourage you to adopt a superior Tendon changing attitude. It is important that you do not adopt the stereo typical 'body builder' mentality towards tendons changing as this will not provide superior results. When encountering pain in any of these exercices do not 'push yourself'. Build up all of the practices slowly and gently leaving any macho 'no pain no gain' attitude at the door and start to trust in the effortless path of the Tao.

Good luck and may the Chi be with you!

Master School

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Master Mantak Chia is the creator of Universal Tao System, Healing Tao, Tao Yoga and is the director of the Universal Tao Master School at Tao Garden Wellness Retreat in the beautiful northern countryside of Chiangmai, Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

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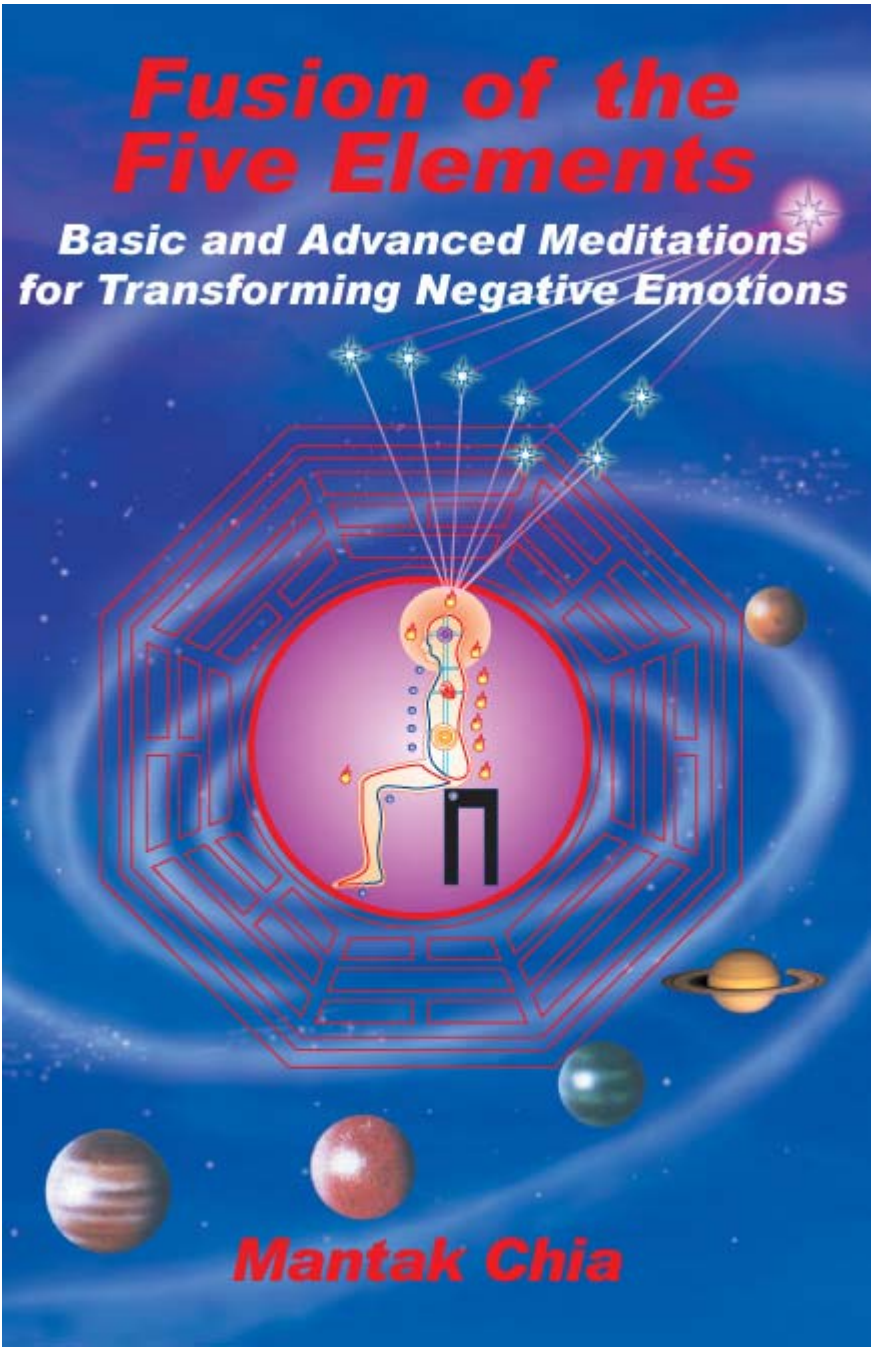
Fusion of the
Five Elements
Basic and Advanced Meditations
for Transforming Negative Emotions
Mantak Chia

Fusion of the Five Elements

Basic and Advanced Meditations for Transforming Negative Emotions

Mantak Chia

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About the Author

Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit

and “still the mind”. While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi’s patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun’s system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He

eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,500 instructors and practitioners from all over the world. Living Tao Centers, Chi Nei Tsang Institutes, Cosmic Healing Forums and Immortal Tao Mountain Sanctuaries have opened in many locations in North America, South America, Europe, Asia, Africa and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden and the Universal Tao Training Center fifteen miles outside of Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using Dark Room technology, creating a complete environment for the higher level Taoist practices.

Master Mantak Chia has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983

Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.

Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002

Many of the books above are available in the following foreign languages:

Arabia, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romania, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao System Overview in the back of this book.

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Further, I wish to express my gratitude to all instructors and students who have offered their time and advice to enhance the communication of this practice and this system.

Without my mother and my son Max, my continued efforts in bringing you the Universal Tao System would be academic. For their gifts, I offer my eternal gratitude and love.

A special thank you goes to our ***Thai Production Team*** for their cover illustration and book design and layout: Raruen Keawpadung, Computer Graphics; Saysunee Yongyod, Photographer; Udon Jandee, Illustrator; and Saniem Chaisarn, Production Designer.

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Introduction

Fusion of Five Elements

A. Foundation for Transformation

1. External and Internal Alchemy

For more than five thousand years, Taoist masters researched and developed various methods to attain such desirable achievements as long life and happiness. Some of the methods were called External Alchemy, and these included the Immortal Pill, magic potions, crystals, crystal essences, flower essences, precious stones, etc. The highest Taoist masters realized external methods offered only limited help while building dependencies on materials that were difficult to come by.

In their continued search for an unlimited source of energy, they turned their attention inwardly to uncover the mysteries surrounding their life-forces. In their search they discovered a universe within and found it to be identical to the outer universe. They knew that the outer universe harbored a tremendous force, and that the inner universe of a human being could benefit from that force, if the two could somehow be connected.

The Taoist masters reasoned that to become connected to the outer universe, one first needs to gain control of his or her own inner universe. They experienced this inner universe as a flow of energy, or Chi, through their bodies. The Microcosmic Orbit, running up the spine and down the front of the body, was uncovered as the pathway through which the distilled essence of this energy flows. They perceived that the Microcosmic Orbit connects three bodies--physical, soul, and spirit--within each individual and ultimately fuses them into one immortal body. It was with this perception that the study of Internal Alchemy began.

2. Natural Connections of Inner and Outer Universes

In turning their attention toward understanding the nature and connection between the forces of the outer universe and the forces of the human body, the Taoist masters made another discovery. Each life born into the human form is developed, structured, and

influenced by a group of stars. This group of stars, which includes the planets and cosmic particles within its configuration, controls the life-force, the good and bad fortune, and the birth and death of the individual.

Each day of a person's life reflects a continuing need to absorb energy from the stars and planets and from the cosmic particles. To explore the patterns of star energy in detail, ancient Taoists developed the science of astrology to a very high level.

In addition to the energy from the stars, the Taoist masters found that humans require another source of natural energy: the energy supplied by the Earth's force. It is the absorption of all natural forces that nourishes the nervous system, organs, glands, senses, soul, and spirit of a human being. To facilitate their understanding of the forces of nature, the Taoists divided them into three classifications.

3. Universal Force, Cosmic Particle Force and Earth Force

a. The first force is called the Universal or Original Force, and is also known as Heavenly Energy. It manifests as the energy of all the stars, planets, and galaxies. This vast, all-pervading force nourishes the mind, soul, and spirit of each individual and everything else in the universe that is manifest.

The Universal Force is drawn to our planet because of the unique relationship between the Earth and its Moon. The combined forces of the Earth and the Moon create a very strong, magnetic power that attracts and beams down to Earth the energies of all the stars in our galaxy.

b. The Cosmic Particle Force, or Human Plane Energy, is the second force of nature. Cosmic particles are a part of the Original Force that flows in space. They are the result of exploded stars that have come to the end of their life cycles, drifting in space as very fine particles. As the strong, magnetic power created by the Earth and Moon attracts many of these particles, they then drift through the Earth's atmosphere as dust, and eventually become soil.

It is the Taoists' belief that human flesh is formed from the fallen cosmic dust of the universe. These particles, or dust, nourish the essences of the organs, glands, and senses of all humans. Humans are the highest manifestation of Cosmic Particle Force, gathering this energy into their bodies through meditation and ultimately returning it to its primordial source.

c. As the third force of nature, the Earth Force includes the energy of plants, animals, water, and all the natural occurrences of the planet Earth. The Taoists observed that plants and trees, in their upward growth, are ever extending themselves to absorb the energy necessary to process their food. Stretching themselves to the sun and stars, and to the cosmic particles above, the plants and trees use the Universal Force for sustenance and growth. The animals, in turn, consume the vegetation, profiting from the cosmic energy as they do so.

Together these three forces represent the energies of Heaven, Humans, and Earth working in harmony to sustain all existence. The ancient Taoists called the Rulers of these forces the Three Pure Ones, for theirs were the first energies to emerge from the Wu Chi, the Great Emptiness. (Fig.1)

Traditionally, the Three Pure Ones were visualized as Three Emperors residing in the three palaces or centers of the body called the Upper, Middle, and Lower Tan Tiens. They govern the development of the three bodies--physical, soul (or energy), and spirit—within an individual by cultivating three forces manifest in the human body as Ching, Chi, and Shen, respectively.

4. Humans Depend on Vegetables, Animals, and Minerals as Sources of Universal Force

Humans originally were created with body cells capable of consuming and absorbing 90 percent of the cosmic forces and light to which they were exposed. However, our cells began to deteriorate to a five to ten percent capability of consumption and absorption when we began to expend and lose our sexual energies. All plants, trees, and vegetation continue to retain their ability to consume and absorb the cosmic forces and light to an 80 percent capacity, with water and nutrients supplying the remaining twenty percent of their food.

Without any consciousness about these forces, and without any practice, humans automatically continue to receive a minute amount of life-force energies naturally. This is particularly true of the Earth Force that provides Yin and Yang energy (negatively and positively charged Universal Energy) to all the organs, glands, and senses, and provides nourishment and enhancement to the sexual organs and sexual energy of humans.

Since our body cells no longer enable us to more fully receive life-force from the Universal, Cosmic Particle, and Earth Forces, we must depend heavily on the vegetation, animals, and minerals comprising the Earth Force to do so. Since they predigest the Universal Force, efficiently absorbing it directly themselves, humans can depend on them to supply necessary life-force energy. Humans consume the vegetation, animals, and minerals and absorb the three main forces slowly through them. The consumption and absorption coincides with the movement of the Earth in its 365 day orbit around the Sun, with the seasons of the year greatly affecting the foods consumed and the energy absorbed.

Through the practice of Fusion of the Five Elements, humans can learn about the original source of all power. They can increase their ability to absorb and transform this force directly and easily, relieving their dependence on plants and animals to convert the force for them.

5. Five Elements' Forces of Universe, Earth, and Human

The Taoists further classified all things in the universe making up the Universal Force, the Cosmic Particle Force, and the Earth Force as correspondences of the "five elements," "five phases," or "five interacting" forces of nature. That is, each force originates from and is controlled by the Five Elements of Nature. These are earth, metal, fire, wood, and water.

a. Origins of the Five Elements of Nature

Taoists believe that the Five Elements of Nature originated as five huge stars, given birth by the Three Pure Ones out of the Wu Chi. These five stars (or five elements), in turn, gave birth to the entire universe, including trillions of stars. They created the North which created smaller stars, including five major constellations. From the constellations, the planets arose, including the Earth. The five constellations have a direct relationship with five planets, five seasons of the Earth, five directions of the Earth, and five major organs of the human body. (Fig.2)

.

Original
Emptiness

Triple Unity,the 3 Pure Ones

Grand Force of the 5 Elements

Pole Star

Big Dipper

28 Constellations

Planets

Sun

Moon

Fig. 2. *The Universe*

The Taoists consider the Five Elements' Forces to be Grand Forces, and sometimes refer to them in this way.

1. The Grand Force of Water created the Northern Constellation and the planet Mercury. It manifests as the northern direction of the Earth Force and the Winter season. It corresponds to the human water force of the kidneys and bladder. Its energy has an inwardly gathering quality.

2. The Grand Force of Fire created the Southern Constellation and the planet Mars. It manifests as the southern direction of the Earth Force and the Summer season. It corresponds to the human fire force of the heart and small intestine. Its energy has an expanding, developing quality.

3. The Grand Force of Wood created the Eastern Constellation and the planet Jupiter. It manifests as the eastern direction of the Earth Force and the Spring season. It corresponds to the human wood force of the liver and gall bladder. Its energy has a generating quality.

4. The Grand Force of Metal created the Western Constellation and the planet Venus. It manifests as the western direction of the

Earth Force and the Fall season. It corresponds to the human metal force of the lungs and large intestine. Its energy has a contracting quality.

5. The Grand Force of Earth created the Central Constellation and the planet Saturn. It manifests as the central direction of the Earth Force and the Indian Summer season. It corresponds to the human earth force of the spleen, stomach, and pancreas. Its energy has a stabilizing quality.

6. Fusion of Five Elements Practice

To make connections between and to gain control of the inner and outer universes, the Taoists developed the Fusion of the Five Elements practice. Fusion begins with understanding the dynamics of the universe, the planet Earth, and the human body with respect to their relationships to the Five Elements of Nature.

Fusion of the Five Elements, marking the beginning of the Taoist practice of Internal Alchemy, focuses on the interaction and fusion of all five elements and their correspondences, and their transformation into a harmonious whole of high quality energy. During this process the essence of life-force energy found in the organs, glands, and senses is transformed, purified, condensed, and combined with the Universal Force. The new form of energy that emerges through this process can effect positive changes in the human body.

To effect positive changes in the human body, the Taoists first focus on the negative aspects or weaknesses to transform them into strengths. The weaknesses are uncovered by focusing on what is known as the counteracting or controlling forces of the Five Elements. This means studying the effects of the five elements upon each other,

In studying the energy of the liver, for example, the organ associated with the planet Jupiter and the wood element, it was discovered that its energy can be counteracted or controlled by the energy of the lungs, associated with the planet Venus and the metal element. That is, the metal element controls the wood element, and the lungs control the liver. Similarly, the energy of the kidneys, associated with the planet Mercury and the water element, can be counteracted by the energy of the heart, associated with the planet Mars and the element fire. This means the water element controls the fire element, and the kidneys control the heart. All five elements have a counteracting force. (Fig.3)

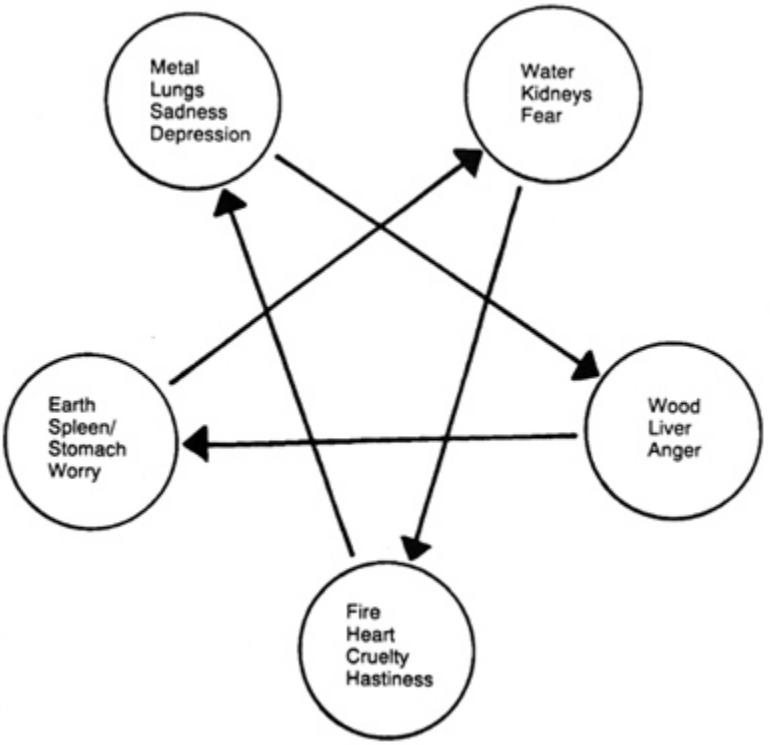

Fig. 3. *Counteracting Cycle*

The interaction of the two elements of water and fire is an easy one to comprehend. The heat of fire can evaporate water, thereby controlling it. If this is true, then the reverse is also true--fire can be counteracted or controlled by the water element. Water can extinguish a fire. The Taoists considered the interactions of the five elements as two distinct cycles existing in nature--the Creative Cycle and the Counteracting or Controlling Cycle. Both are equally important in sustaining life, but need to be balanced and in control if things are to be kept running smoothly. Both cycles help determine which of your organs are weak and which are strong. They are studied in depth in the Fusion practice, beginning with the Counteracting or Controlling Cycle and your negative emotions in Fusion I.

To utilize the two cycles effectively, it is important to determine your strengths and weaknesses. The planetary associations can play a major role in your conceptualization because there are months or years in which certain stars and/or planets can come very close to Earth and can greatly influence your behavior. For example, if you have a weak liver, when the planet Venus (the metal star associated with the lungs) comes close to Earth, your liver energy can be depleted. This can cause emotional outbursts of anger and indecisiveness, the negative emotions of the liver. If you do not know you need to strengthen the liver energy at these times and how to find a balance to your energy, you will be affected by such planetary events. This will affect all phases of your life. Eventually you will be overcome. When the liver is overly depleted by the intervention of the stars, planets, Earth, and other forces, recharging itself with energy will become very difficult. This is because it is in a weakened state. Then, when a charge of energy does come, the liver will not be able to fully utilize it. If the cycle continues and the counteracting forces of the stars, planets, Earth, and other sources approach again, the liver will be further depleted, now retaining little or no energy. This can cause tremendous suffering in all aspects of your life.

Using the Chapters of Fusion I helps you to create balance before delving into what star or planet influences you. The Chapters of Fusion I will provide a degree of creative and counteracting balances automatically. You will discover how wood and metal (liver and lungs) counteract each other, and will feel how they can be balanced automatically by the Earth Force. The weaker one will be strengthened. The overly strong one will be toned down by its opposing force. With neither one too weak nor too strong, they will become harmonious and not enemies of each other. In Fusion II you will delve deeper as you conscientiously search for your influencing stars and planets and use the cycles to promote greater strengths for your weaknesses.

The negative emotions associated with each organ, and, so, each element, are drawn out of the organs during the Fusion practice for transformation into a neutralized energy, thereby “balancing the weather” of the body’s total energies. This neutralized energy can be blended with positive energies, also residing in the organs, and transformed into pure life-force energy. The Taoists have a saying: “Refined red sand turns into silver.” This means if

you fuse all the different kinds of emotional energy together, they will adhere into a harmonious whole. However, unrefined, “unfused” energy will have the quality of sand, scattered about and unable to stick together.

7. Pearl— Essence of Human Body and Energy Body

The pure life-force energy derived from the organs and fused together during the Fusion practice is crystallized into an energy ball. This energy ball can be perceived as a crystal or diamond, but is perceived most commonly as a radiant pearl. Forming the pearl is the first step toward transferring consciousness to a new realm.

Not all people perceive the pearl in the same way. Some might not see a pearl, but might recognize it as an acute feeling of awareness or as an intensified ability to concentrate. Some may feel a concentration of heat. All are experiencing the pearl as the essence of life-force energy.

This pearl is then circulated in the Microcosmic Orbit. During circulation the pearl activates and absorbs the Universal and Earth Forces. It also uses them to strengthen and purify the physical body, particularly the organs, glands, and senses. Later, the pearl plays a central role in developing and nourishing the soul body or energy body. It is developed further in the higher level Kan and Li Meditations.

Balanced energy not only is very desirable for the health of the organs, glands, and senses, but also is basic to the formation of a pearl. Thus, balanced energy is a very important element of Fusion. Also of great importance to the Fusion practice is the function of the pearl in opening, cleansing, purifying, and protecting specific channels that run through the body. These channels are called the Thrusting Channels (cleansing and protecting channels), the Belt Channel (a protecting channel), and the Great Regulator and Great Bridge Channels (channels binding together and regulating, respectively, energy flow through all the body’s acupuncture meridians.)

8. Universal Tao Divides Fusion into Three Parts

All Fusion levels of practice clean and purify the organs and the body.

a. Fusion of the Five Elements I

Fusion I makes use of pakuas and energy collection points to balance, connect, and draw out negative emotional energies found in the organs. These energies, along with their corresponding glands' and senses' energies, are then fused and transformed into pure life-force energy.

The purity of this energy has an adhering and magnetizing quality which enables it to condense into a pearl of refined energy. The pearl is then used to form the soul or energy body that will connect to the Universal, Cosmic Particle, and Earth Forces whose energies become part of the pearl.

Collecting the organs' energies in no way diminishes their strength. In fact, each time you practice Fusion, the essence energies collected from the organs are fused, purified, and transformed into an improved quality of life-force energy. Each time you finish the practice, the improved quality energy in the form of the pearl disperses. This energy returns to enhance all of the organs and glands, particularly those that require additional energy. The dispersed energy also provides protection to the physical and soul body.

b. Fusion of the Five Elements II

Fusion II focuses on using the pearl to grow or intensify the energy of good virtue. It uses the Creative Cycle to circulate the positive Chi of virtuous energy through the major organs. All the energy gathered during this cycle combines to form a pearl of compassion energy. This pearl is then used to open and cleanse the Thrusting Channels, and to open the protective Belt Channel that surrounds the Thrusting Channels.

c. Fusion of the Five Elements III

Fusion III opens the Great Regulator and Great Bridge Channels, combines all (eight) special channels together and sets them all into motion. More physical protection is developed through this process.

The entire Fusion practice is a step by step procedure of purifying yourself and controlling your own inner force. By creating the pure energy pearl and fusing the Five Elements' Forces to create a new, better, and purer life-force, you will gain the power of self-mastery.

You can use this energy externally to call forth directly the Universal and Earth Forces to empower and protect you. In this way the organs, glands, and senses comprising and supplying the life-force to the human body finally are reconnected to the stars, the planets, and the cosmic particles from which they emerged.

Description of Fusion I

Part One: Basic Practice

The Fusion practice is a meditation consisting of nine Chapters. Part One contains Chapters 1 through 5, the basic Fusion I practice, in which the five elemental forces of humans are worked with. Part Two contains Chapters 6 through 9, the methods of advanced practice, in which the work is continued with the five elemental forces of the Earth and the five elemental forces of the Universe. Although you can practice Fusion I by successfully completing the basic practice, the full benefit of Fusion I is attained by continuing through the advanced procedures.

Chapter 1: Forming the Four Pakuas, Blending Energy and Forming the Pearl at the Center of Control

The word pa means eight; kua means symbol. The pakua is an eight-sided, three dimensional crystal that draws energies from the organs, glands, and senses to be refined, transformed, condensed, and stored.

1. You begin this process by building four pakuas to refine, condense, and store the energy.
2. At the center of the body between the four pakuas, you create a self-center, center of being, or center of control called the cauldron.
3. As the energy is drawn by the four pakuas into the cauldron at your center of being, it is fused or crystallized into a life-force energy sphere or ball, a pearl of condensed energy. (The pearl is sometimes referred to as the inner pill or human pill.) This pearl then is circulated in the Microcosmic Orbit.

Chapter 2: Balancing the Organ Energy to Experience Inner Peace and Harmony

1. To balance the organ energy, you first form the collection points for the organs.
2. Then you draw, collect, and blend the different qualities

(kidneys [cold/wet], heart [hot], liver [warm, moist], lungs [cool, dry], and spleen [mild] into the collection points. This energy is moved to the front pakua which is considered the controlling pakua.

3. Form the back pakua and blend and refine the residual energies of the organs in the back collection points.

4. Spiral, draw, and condense all the energies from the front and back pakuas into the cauldron.

5. Similarly form the right and left side pakuas to collect any remaining organ energy. Blend and refine the energy in these pakuas, and then bring their combined energies into the cauldron.

6. In the cauldron all the energies are condensed into a pearl again. Then the pearl is moved to the Microcosmic Orbit for circulation.

Chapter 3: Connecting the Senses with the Organs; Self-Control of the Senses; Sealing the Openings; Overcoming Temptations

1. To strengthen and control the senses and prevent the sense energy from scattering, you will learn that the relationship between each of the organs and senses is like the relationship of parents and children.

2. You will turn the senses inward and draw them into the organs and their collection points. As in Chapter 2, the energy is moved into all four pakuas. In the pakuas, the energy is refined, and then it is condensed into the cauldron, the center of control, where the pearl is formed. The pearl now consists of the crystallized essences of the senses and organs, and again can be moved to and circulated in the Microcosmic Orbit.

Chapter 4: Transforming the Negative Emotions of Each Organ into Useful Energy

1. During thousands of years of exploring philosophy and psychology, the Taoists realized the need to explore basic human emotions. They observed that certain emotions, if not understood and dealt with, will attract or create other undesirable emotions. The Taoists believe that all emotions originate from the organs, and that the mind regulates and determines their use. Although the

emotional energies that can be sensed within an organ are not limited, certain specific, basic negative emotions are associated with each organ and are worked with in Chapter 4:

a. Kidneys-fear;
b. Heart-impatience, hastiness;
c. Liver-anger;
d. Lungs - sadness, depression; and
e. Spleen-worry.

2. As in Chapters 2 and 3, you blend and transform these energies in the front pakua, and create the back, left, and right side pakuas. In these four pakuas you will refine the energy, condense it into the cauldron to form a pearl, and circulate the pearl in the Microcosmic Orbit.

Chapter 5: Creating the Pearl that Forms the Energy Body and the First Transference of Consciousness

1. In Chapter 5 you will combine all the Chapters above. First you put the senses in contact with the organs and collect the organ and emotional energy in the collection points. You bring this energy to all four pakuas, and blend the energies there. This energy then is refined and condensed into the cauldron to form a pearl.

2. The pearl you create is projected from the physical body and controlled in the space above you. In its out-of-body condition, the pearl is formed into the energy body.

3. The energy body is formed into an image that you would like your physical body to be. You can give it a name at this time to make it easier to summon as you continue your practice.

4. The Microcosmic Orbit is transferred to the energy body from the physical body as the first experience of a transference of consciousness.

5. A protective shield is formed around the energy body, and a great bubble is formed encasing both the energy and physical bodies. At the end of this Chapter, the protective shield is reabsorbed while the great bubble shrinks down over the physical body to protect it. This layer then can be built upon with subsequent layers of protection as your practice continues.

Part Two: Advanced Practice

The advanced practice of Fusion I incorporates the five Chapters learned in the basic practice, and so it involves working with the five elemental forces of humans. However, after completing Chapter 4, and before proceeding with forming the energy body, in Chapter 5, you first practice Chapters 6 and 7 of the advanced practice to create a more powerful pearl to work with. Then, using the greatly refined and radiant energy of this pearl, you can create an energy body that now benefits from three additional sources of energy, the Earth, Cosmic Particle, and the Universal Forces. Then you proceed with this energy body to experience the remaining formulas.

The advanced practice formulas make use of images that enhance the organs' energies as you continue to refine the pearl.

Chapter 6: Forming the Virgin Boys or Girls and their Animal Offspring to Connect to the Universal, Cosmic Particle and Earth Forces

When the organ energy is very pure, you can project it and crystallize it into the image of a virgin boy or girl as the purest form of the virtue energy of the organs. Each virgin child's breath, in turn, creates an animal as its offspring. The children and animals can be used as protection for the physical body by connecting them to form protective rings. The pearl is the center of the gathering of the children and animals. Other images from your personal mythology may be substituted, such as a ring of saints, warrior-heroes, jewels, etc. If you circulate a pearl in the Microcosmic Orbit while under the protection of the children and animals' rings, and connect the pearl to the Universal, Cosmic Particle, and Earth Forces, you can bring those energies to the children and animals. They, in turn, can deliver this energy to the organs, glands, and senses for increased life-force.

Chapter 7: Call Forth the Earth Force to Empower and Protect

Once you have established a very pure organ energy, you can

project it out of the body to call forth or attract the Earth Force to you. Once you have attracted this force, you form the animal or other earth images, such as flowers or trees, that will help you retain it. Then you use the animals to form a ring of fire to empower the organs and protect them. At this point refer again to Chapter 5 and create a more powerful energy body.

Chapter 8: Call Forth the Planets' and Stars' Forces for Empowerment and Protection

In this formula you will form pearls of pure organ energy to attract the planet that corresponds to each organ. The purpose is to draw on the planets' forces and add it to the forces of the virgin children, the internal animals, and the animals formed from the Earth elemental forces for empowerment and protection.

Chapter 9: Transference of Consciousness to the Energy Body in this Life Brings Immortality

The energy body serves as vehicle for consciousness,tapping on a higher source of energy and bringing this higher energy back into the physical body. In the physical body it can be transformed into a more usable energy.

1.Transfering the life-force energy or Chi, to the energy body will enable you to use the energy body to support the spirit body.

The Physical Body—is like a boat and its engine.

The Energy (Chi) Body—is the fuel, or steam (providing force.)

The Spirit Body—is the captain (who commands.)

2. The functions of the energy body are to transfer the essence of life (organs', glands', and senses' energies) consciously into the spirit body and to push the spirit body into the Mid-Plane.

Fusion I Meditation

Part One
Basic Practice of Fusion I

Formula 1 through 5

Chapters of Part One describe how to transform emotional energy into a useful energy, and in the process, how to achieve a balanced state of inner peace and harmony. Developing your awareness of the pearl of energy you create is your goal in practicing the basic steps of the Fusion I meditation.

Chapter 1
Formula 1: Forming the Four Pakuas, Blending Energy and Forming Pearl at the Center

A. Theory: Four Pakuas and the Cauldron

The eight sides that form a pakua represent the eight natural forces of the universe. These are the forces of (1) wind, (2) thunder, (3) mountains, (4) water, (5) the heavens, (6) lakes, rain, (7) earth, (8) fire. (Fig.1.1)

Fig.1.1 *(Later Heaven) Sequence of the Pakua*

1. Construction of the Pakua

A pakua may be perceived as an octagon formed from eight trigrams. However, to simplify the creation of a pakua for meditation, a simple web pattern is envisioned to form an image. This image consists of three eight-sided layers, with spokes connecting each layer, similar to the eight-sided, multi-layered cut of a normal diamond. The largest layer of the pakua is three inches (7.62 centimeters) in diameter. At the center is a Tai Chi (Yin/Yang) symbol that spirals to blend and transform the force. Behind the pakua, the diamond-shape of the image is realized further as all eight sides of the pakua create a funnel-like shape that converges at one central point.

The pakua, traced with the mind in meditation, is drawn in layers, beginning with the outer, three-inch octagon, then continuing with levels two and three. All are drawn in either a clockwise or counterclockwise direction. Then the eight spokes are created to connect the layers. These spokes combine at the Tai Chi symbol placed at the center of the pakua. After the shape is memorized well, it can be recreated simply by visualization. (Fig.1.2)

2. Location of the Four Pakuas

The four pakuas are located:

a. Front (or Navel) Pakua: Behind the navel, about one and a half inches inside.

b. Back Pakua: At the Door of Life, on the back opposite the navel between Lumbar 2 and 3, and about one and a half inches in.

c. Left Pakua: On the left side of the body, at the intersection of a mentally drawn line extending vertically downward from the left armpit, and a line drawn horizontally across the left side from the navel to the Door of Life. The pakua is about one and a half inches (3.8 centimeters) in from this intersection point.

d. Right Pakua: On the right side of the body, at the intersection of a visualized line drawn down from the right armpit,and a horizontal line from the navel to the Door of Life, about one and a half inches in.

Energy is brought into these pakuas, where it is then blended and transformed.

Fig. 1.2 *Simple Pakua for Beginning the Practice*

3. Location of the Cauldron (the Central Point of a Human Being—the Point of Control)

The cauldron isconsidered the center of the body. It is located in a space between the navel and the Door of Life, but is more toward the back of the body, in front of the kidneys. It is the place where prenatal force, as part of the Universal or Original Force, was formed. It is also the place where all of the five elemental forces combine and transform into a very refined energy.

a. The energy from the four pakuas is balanced and condensed at their Tai Chi centers, and these centers can glow with white or golden light.

b. The Tai Chi centers of the four pakuas spiral and blend this energy and direct it through the funnel-like backs of the pakuas into the cauldron. The center of the cauldron's three inch diameter is usually at a point level with the Door of Life, although the center

can vary with each person as much as an inch and a half up or down. In men who are top-heavy, the center can be lower. Women who are bottom-heavy can have a higher center. It seems the thinner the person, the greater the chance the center point will be at the level of the Door of Life and the navel. Once it is found you will readily know it is your center of awareness.

c. The front and back pakuas function as a pair in spiraling, drawing, refining, and condensing the energy into the cauldron.

d. The two side pakuas constitute a second pair to spiral, draw, refine, and condense the energy into the cauldron.

e. At the cauldron, energies are mixed further, blended, and condensed, and the pearl is formed. (Fig.1.3)

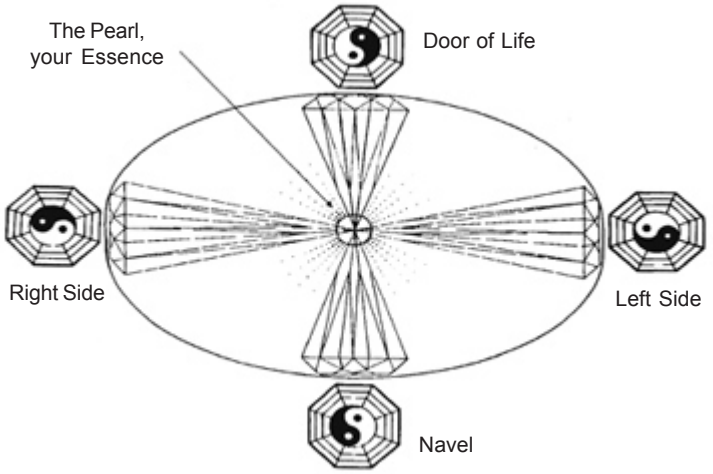

Fig. 1.3 *Four Pakuas and Condensing Energy into a Pearl*

B. Practice of Formula 1

1. Assume the Position.

Sit up properly. Feel the feet touching the ground, the hands holding together, and the tongue touching the palate.

2. Practice the Inner Smile.

Practice the Inner Smile meditation to relax the mind and the body.

a. Smile down and feel the sunshine-like smiling energy collect in the eyes and Third Eye. Feel the outer corners of your eyelids

and mouth uplift. Feel the smiling energy slowly flow down to the neck, thymus gland, and heart. Feel the heart open. Create a state of love, joy, and happiness in the heart.

b. Smile down to the organs and become aware of the virtues of each organ as you smile down: smile to the heart, and generate a sense of honor and respect, as you increase the feelings of love, joy, and happiness; smile to the lungs, and generate the feelings of courage and righteousness in the lungs; smile to the liver, and generate kindness in it; smile to the pancreas and spleen, and generate fairness and openness in those organs; smile to the kidneys, and generate gentleness in the kidneys. Feel the positive effect on each organ as you smile to it. Be aware of the positive emotions you are generating. (Fig.1.4)

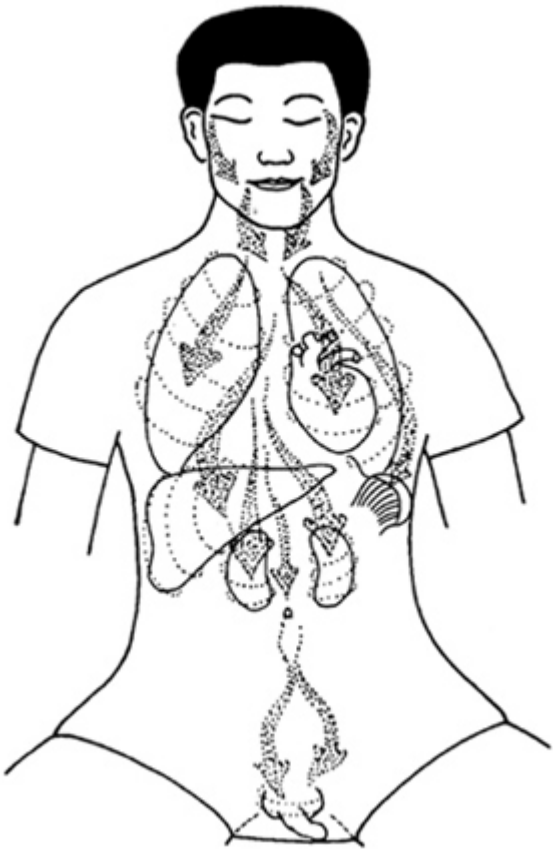

Fig. 1.4 *Smile Down to the Organs*

c. Smile to the sexual organs. Smile down to the digestive system. Generate a creative energy. Feel the energy flow all the way down with the saliva as you swallow to your stomach, small intestine, and large intestine.

d. Return to the eyes, Smile to your pituitary and pineal glands. Smile into the left and right hemispheres to balance the brain, and then smile all the way down the spinal cord.

e. Return to the eyes again, and smile down the front, middle, and back line. Well-trained students can practice the Inner Smile at a fast pace.

3. Form the Front Pakua.

a. Turn your awareness and senses inward toward the navel. Concentrate on the navel, and bring all the above energies there. Feel their warmth. As you smile to the navel, blend and condense these energies into a ball of energy inside the navel area.

b. Look inwardly. Turn all the senses inward in preparation for constructing the pakua.

c. Beginning at a point one and a half inches (3.8 centimeters) inside and above the navel, draw with the mind the first line of the pakua. (Those who have visualization or kinesthetic problems can trace the lines of the pakua with a finger.)

d. Continue constructing all eight lines of the outer layer of the pakua.

e. Begin the second layer, constructing one line at a time.

f. Begin the third layer, drawing eight lines again.

g. Now, one at a time, draw the eight spokes from the outer layer to the inner layer. Picture the Tai Chi symbol in the middle, and as you draw each spoke, continue it into the Tai Chi. (See Fig.5)

h. Lastly, let the Tai Chi symbol spiral in either direction (but preferably clockwise) as it gradually blends and transforms the energy. Now the pakua can glow with white light. Some people will sense a stronger ability to concentrate at this time.

i. Rest and experience this glowing light and warmth.

4. Form the Back Pakua.

a. Beginning at a point about one and a half inches in and one and a half inches up from the Door of Life, mentally trace the first layer.

b. Construct the second layer.

c. Construct layer three.

d. Draw the eight spokes through the three layers toward the Tai Chi visualized at the center of the pakua.

e. Spiral the Tai Chi at the center, and sense the center glowing with white light.

f. Rest and experience the glowing light.

Notice that the back pakua is identical to the front pakua. Future references to forming the back pakua mention a simpler procedure of copying the front pakua to the back.

5. Spiral the Front and Back Pakua Energy to the Cauldron.

a. Divide your concentration between the front and back pakuas.

b. Spiral the two pakuas, especially their Tai Chi centers. Initially you can spiral without worrying about moving in a particular direction. Eventually, you can use your mind to train the spirals of each of the pakuas to spin in the direction you choose. With the inner eye direct the energy along the road or pathway of the spiral.

Become aware of the funnel-like shape of the backs of the pakuas. As you spiral feel the force being drawn in from the pakuas through their funnel-like backs toward the cauldron. Then concentrate more on the cauldron end of the spiral to help draw the energy into the cauldron. When you feel the energy at the cauldron, condense it and stop spiralling.

c. The condensed energy can glow with white light. Some people will simply feel a greater awareness of the navel area.

6. Construct the Right Side Pakua.

a. Concentrate on the point on the right side of the body, below the armpit, level with the navel, and approximately one and a half inches in. Trace the first layer of this pakua.

b. Draw the eight lines of the second layer.

c. Draw the eight lines of the third layer.

d. Draw the eight spokes into a Tai Chi symbol at the middle of the pakua. Spiral the symbol, and it should glow with light.

7. Construct the Left Side Pakua.

a. Concentrate on the point on the left side of the body, below the armpit, level with the navel and the Door of Life, and approximately one and a half inches in. Trace the first layer of this pakua.

b. Follow the directions in 6(b) through (d) above.

Notice that the right and left pakuas are identical to the front and back pakuas. Future references to forming the right and left pakuas mention a simpler procedure of copying the front and back pakuas to the right and left sides.

8.Spiral the Left and Right Pakua Energy into Cauldron.

a. Spiral to draw the glowing energy into the cauldron at the center of the body from the right and left side pakuas. You can direct the spirals clockwise, counterclockwise, or simply let the spirals move in any direction. Increase the spirals at the cauldron to draw within it the energy of the left and right pakuas. At the cauldron join this energy with the energy from the front and back pakuas. Although the cauldron may not necessarily be exactly at the center of the four points, it is considered the center of your body, or your center of being. The cauldron can glow brighter as more energy condenses and fuses together, or you may feel more centered and have stronger concentration.

b. Divide your concentration amongst the cauldron, the front and back pakuas, and the left and right side pakuas. (Fig.1.5)

c. Continue to spiral more energy to the cauldron.

9. Form a Pearl.

In a mild and relaxed manner, mentally concentrate to turn all the senses downward to the cauldron while continuing to spiral. There should be no tension, but rather a simple awareness of the energy that is condensing there. Form the pearl that is the highly condensed essence of your life-force energy. It is the essence of your organs, glands, senses, and mind that will absorb the impure energy of the organs and glands, purify it and return it to them as a higher form of energy. The pearl can control the organs and glands, and helps to establish the cauldron firmly.

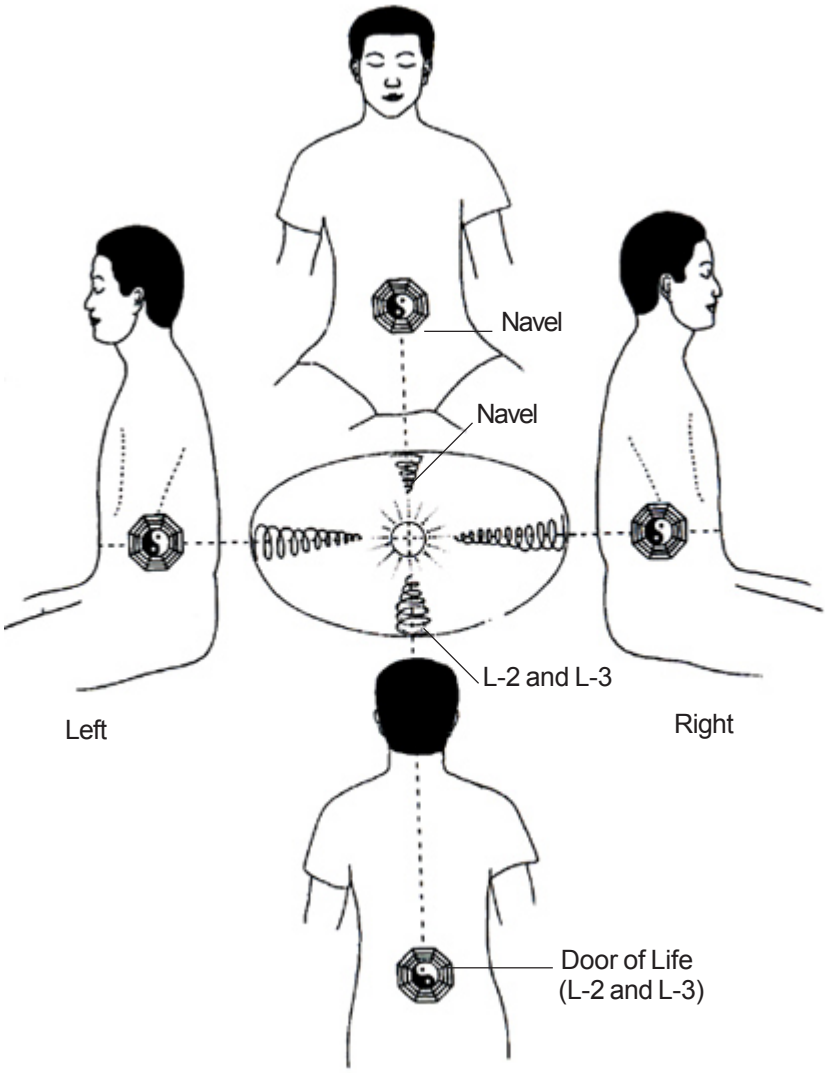

Fig. 1.5 *Four Pakuas: Spiraling to Form the Pearl*

10. Anchor and Program the Pearl through Verbal Affirmations.

When you begin to feel the energy condensing at your center, relax a bit more and turn all your senses, attention, and awareness into the pearl. As you relax sufficiently you will feel your energy stabilizing and the pearl becoming stronger and clearer in your awareness. At the peak of these sensations of centeredness and stability, anchor-in and program this experience with the pearl. Use a verbal affirmation such as: I feel deeply centered, clear and calm; external forces do not move me. I am under my own control; I feel grounded and centered. My energy is stable and clear; I am emotionally balanced. Associating yourself with your center anchors your center to the pearl.

11. Move the Pearl into the Microcosmic Orbit.

As the pearl moves in the Microcosmic, you will feel three sources of energy. The Universal Force of the North Star (Polaris) and the Big Dipper constellation supply energy through your crown. Cosmic Particles fall to Earth, and this energy (Cosmic Particle Force) combines with the smiling energy supplied at the mideyebrow. The third source of energy is the Earth Force, and it is supplied at the perineum through the soles of the feet. Be aware of the combined energy from these three sources as you circulate the Microcosmic Orbit (sometimes more simply referred to as the Microcosmic, running up the Governor Channel (along the spine of the body), over the crown of the head, and down the Functional Channel (along the front, center of the body.)

Note: Drawing the energy into and running it through the pathway of the Microcosmic Orbit are crucial steps in Fusion of the Five Elements and all Universal Tao practices. It is also very helpful to your Fusion practice to know the Healing Love and Iron Shirt exercises. They will help you generate more energy and ease and strengthen the flow of energy.

a. Move the pearl down to the perineum, the Gate of Life and Death, by concentrating on, lightly contracting, and pulling up the perineum. Feel the downward pull on the pearl.

b. Sense the pearl as a bright star shining in the dark at the bottom of your body's trunk. The pleasant, cool, blue energy of the Earth now enters through the perineum. Some will see the blue color while others will feel a gentle, soft, kind energy. This energy

enhances the feeling of grounding. At this point you may anchor-in feelings of security, safety, and grounding by using a verbal affirmation. For example: I am safe, secure, and grounded in my daily life.

c. Pull up on the back part of the anus toward the sacrum and move the pearl from the perineum to the coccyx.

d. Tilt the sacrum to adjust the alignment of the coccyx with the Earth Force until you feel more centered and grounded. Feel the coccyx shine with light as the pearl reaches, and then passes through it. Again, use a verbal affirmation of the feelings of being centered and grounded.

e. Move the pearl to the Door of Life and feel it glow, enhancing the feeling of softness and gentleness.

f. Now move the pearl up to T-11 and feel it radiate with light.

g. Move the pearl to C-7. Let C-7 glow and burn off any burdens that may be felt. Now use an affirmation to program your feelings of lightness and well-being.

h. Move the pearl to the base of the skull (Jade Pillow). Let this point glow with bright light.

i. Move the pearl to the crown, and fill the crown with light. Feel the warmth of the Universal Force of the North Star and the Big Dipper as that energy now enters through the crown. If you have the capacity to see colors, the color of the North Star is purple, while the Big Dipper has a red light in its center. Feel the loving, strong force.

j. Continue to be aware of the pathway of the Microcosmic as you move the pearl down to the Third Eye point at mideyebrow. Feel the gentle, smiling energy combine with the Cosmic Particle Force as it is drawn in through the mideyebrow. If you can visualize color, see this force as golden. Feel its firm, strong, determined force.

k. Feel the mideyebrow point glow with light, and feel a sense of purpose. Use another verbal affirmation to program the pearl with your sense of purpose and vision.

l. Move the pearl down to the throat, and burn off any negative energy you may find.

m. Move the pearl to the heart and feel love, joy, and happiness. The heart is an excellent point to use a verbal affirmation expressing greater love and joy in your life.

n. Move the pearl to the solar plexus point, and then down to the navel.

o. Beginners may lose the pearl by losing their concentration. If your pearl is lost or diminishes at any time during the Fusion practice, start over and form a new pearl. Once again become aware of the four pakuas, and condense the energy into a pearl. At first, forming a new pearl will take time, but as your practice continues, you will build up larger amounts of residual energy. The more energy you have readily available, the easier and faster it is to form a pearl. Bring the new pearl to the perineum, and circle it in the Microcosmic. Be very aware of the pearl as it moves.

p. Turn a portion of your consciousness to the four pakuas as the pearl moves through the Orbit. Feel the energy flow through the spirals to the cauldron at the center of the pakuas and continually enhance the pearl.

q. Now circulate the pearl in the Microcosmic a little faster. Be aware of the pathway the pearl follows. (Fig. 1.6 (a))

r. Be aware of the Universal Force, the North Star with purple light, and the Big Dipper with red light above your head, the Cosmic. Particle Force in front of you, and the Earth Force under your feet. Feel these energies as they are supplied to you. (Fig.1.6 (b))

s. This is the time to balance the energy that you feel flowing through the Microcosmic. If you feel the flowing energy is too warm, draw in more Earth energy through the perineum. If you feel that the energy is too cool, draw in more Universal energy through the crown. If you feel you are losing concentration, draw in more of the fallen Cosmic Particle energy through the mideyebrow.

12. Collect the Energy.

Bring the energy to the navel, hold the energy here for a while, and bring the energy behind the navel to the cauldron. Feel its warmth, and then collect the energy at the cauldron.

13. Finish with Chi Massage.

End the exercise with Chi Massage. Rub the hands together, and then use the warmed hands to rub the face, throat, etc. (You can review Chi Massage in the Universal Tao book, *Chi Self-Massage: Taoist Way of Rejuvenation.*)

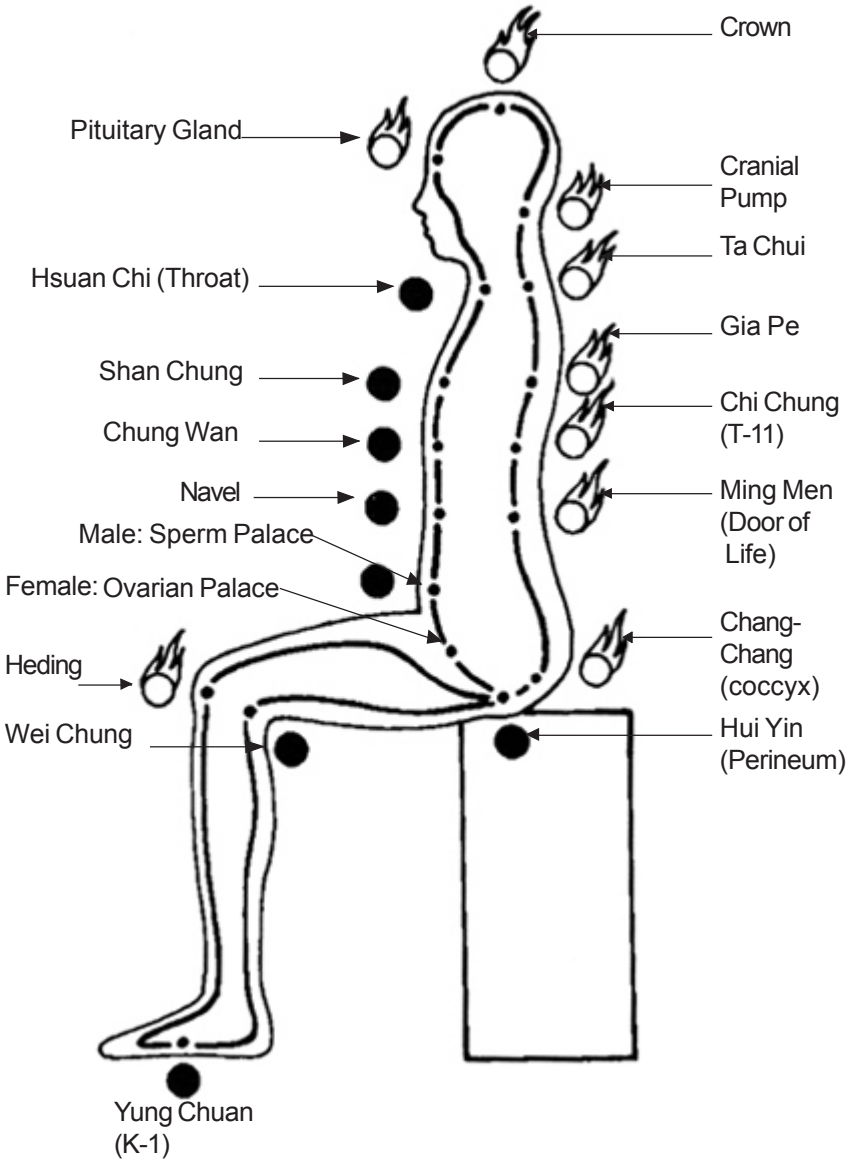

Fig. 1.6 (a) *Pathway of the Microcosmic Orbit*

Fig. 1.6 (b) *Microcosmic Orbit-Universal,Earth,and Human Forces*

c. Purpose of Centering Awareness in the Pearl

The immediate, practical use of the pearl in daily life is to help center your awareness so that your environment does not throw you out of balance. The deeper purpose of mastering the first formula is to lay an unshakable foundation for achieving oneness with the Universal Force.

To center awareness in the pearl is to find the center, or control point, of your soul. The shining pearl, as the essence of your soul, is always in touch with the source of Universal Force within yourself. Centering your awareness in the pearl places you in the position of mastery of your inner spiritual life as well as mastery of the outer Earth and Cosmic Forces that contribute to your daily life.

As you more frequently practice the Fusion meditation and strengthen your ability to center your awareness in your pearl, you will discover that you can tune in to your higher energies during your spare moments each day. You will find your intuitive mind growing sharper and clearer, more creative ideas will pop up in your work, and your capacity to love your family and friends will increase dramatically.

Negative patterns in your life that mindlessly disperse your life energy, such as daydreaming, the distraction of television, or negative emotional ruminations, can be defeated. The deep feelings of longing, loss, jealousy, or hostility that emerge from the negative patterns can be overcome.

As you use your idle moments throughout the day to engage in the Fusion practice, your awareness maintains the presence of your pearl. Your soul essence is busy giving birth to creative thoughts, realistic goals, and spontaneous feelings appropriate to the immediate moment. At the same time negative input from your vital organs or from your environment dissolves in the center cauldron and is greeted with fresh, strong energy from the Universe. Your life will begin to overflow with radiance and a surplus of energy that can become joy, kindness, creativity, and love.

It is wise to keep a steady contact with the Universal Force by regularly calling upon your pearl/soul essence. If you remain continuously aware of the pearl in your daily life, your connection to the Tao will become more powerful, making your life happy, harmonious, and effortless.

Chapter 2

Formula 2: Balancing the Organ Energy to Experience Inner Peace and Harmony

A. Theory: Collection Points for Each Organ

Each organ (and its secondary organ, below in parentheses) has a collection point for its particular quality of energy. Keep in mind the organs' correspondences to the five elements and to the seasons of the Universal and Earth Forces.

1. Kidneys' (Bladder's) Collection Point

a. The kidneys (and bladder's) collection point is at the perineum.

b. A sphere approximately three inches (7.62 centimeters) in diameter is created at the perineum which acts as a container for the kidneys' energy.

c. Kidneys' energy is cold/wet in quality. It is associated with the Winter season, the water element, and a deep blue color.

2. Heart/Thymus (Small Intestine's) Collection Point

a. The heart/thymus (and small intestine's) collection point is located between the nipples (in men), or approximately one inch up from the bottom tip of the sternum (in women).

b. A three-inch diameter sphere is formed there to collect heart and thymus energy.

c. The heart's energy is hot, and its season is Summer. Its element is fire, and its color is a bright red.

3. Liver (Gall Bladder's) Collection Point

a. The liver (and gall bladder's) collection point is located on the right side just below the rib cage and level with the navel. It is at the point of intersection of a line mentally drawn vertically down from the nipple and a line extending horizontally across to the right side from the navel.

b. A three-inch diameter sphere is formed at this spot to collect the liver's energy.

c. The liver's energy is warm and moist in quality. It is associated with the Spring season. Its element is wood, and its color is bright green.

4. Lungs' (Large Intestine's) Collection Point

a. The lungs (and large intestine's) collection point is located on the left side just below the rib cage. It is level with the navel at the intersection of a line mentally drawn down from the nipple and a line extending across to the left side from the navel.

b. A three-inch diameter sphere is formed at this spot to collect the lungs' energy.

c. The lungs' energy is cool and dry in quality. It is associated with the Fall season, the element metal, and a radiant white color.

5. Spleen/Pancreas (Stomach's) Collection Point

a. The spleen/pancreas (and stomach's) collection point is directly behind the navel (at the center of the front pakua.)

b. A three-inch diameter sphere is formed at this spot to collect the spleen's energy.

c. The energy of the spleen is mild, and its season is Indian Summer. Its element is earth, and its color is a brilliant golden yellow.

B. Procedure for Balancing the Organ Energy

To blend the organ energy, you first form the kidneys' and heart's collection points. Then you blend the kidneys' (cold) energy with the heart's (hot) energy at the front pakua. Next you form the liver's and lungs' collection points, and then add and blend the liver's (warm, moist) and lungs' (cool, dry) energy at the front pakua.

Finally, you add the spleen's (mild) energy gathered into its collection point located at the center of the front pakua.

C. Practice of Formula 2

1. Begin with the Inner Smile Meditation.

As you proceed with each step and smile to each organ, concentrate on the positive emotion associated with the organ. Sit up properly, hands together, and stick the tongue up to the roof the mouth. Smile down.

2. Form the Front Pakua.

Form the front pakua as described in Formula I, and feel the pakua glow with light.

3. Balance the Energies of the Kidneys and Heart.

a. Form the Kidneys' Collection Point.

(1) Be aware of the kidneys.

(2) Do the Kidneys' Sound: ***Chooooo*** (as when blowing out a candle). (You can review the Six Healing Sounds in the Universal Tao book, *Taoist Ways to Transform Stress into vitality.*) Practice a few times until you can feel the kidneys.

(3) Using the Packing Process Breathing technique, slightly contract the left and right sides of the anus to squeeze the kidneys. Use the power of the mind rather than tension on the muscles to do so. Then release the contraction to sharpen your awareness. (To review the Packing Process Breathing technique, see the Universal Tao book, *Iron Shirt Chi Kung I.*)

(4) Form a sphere at the perineum, the kidneys' collection point, by inhaling, pulling up the perineum, and pushing the lower abdomen down to the perineum.

(5) Exhale and relax. Mentally perceive the formation of a sphere and let it glow with a blue color.

(6) Spiral the energy in both kidneys and in their collection point in either direction. Increase your awareness of the collection point and intensify the spiral there until you a feel a force drawing the kidneys' (cold) energy into it. (Fig.2.1)

b. Form the Heart's Collection Point.

(1) Be aware of the heart and the thymus gland.

(2) Do the Heart's Sound: ***Hawwwwww.***

(3) Inhale and gently pull up the anus toward the heart, continuing

Notes: Use the power of the mind more than muscle power to gather the energy.

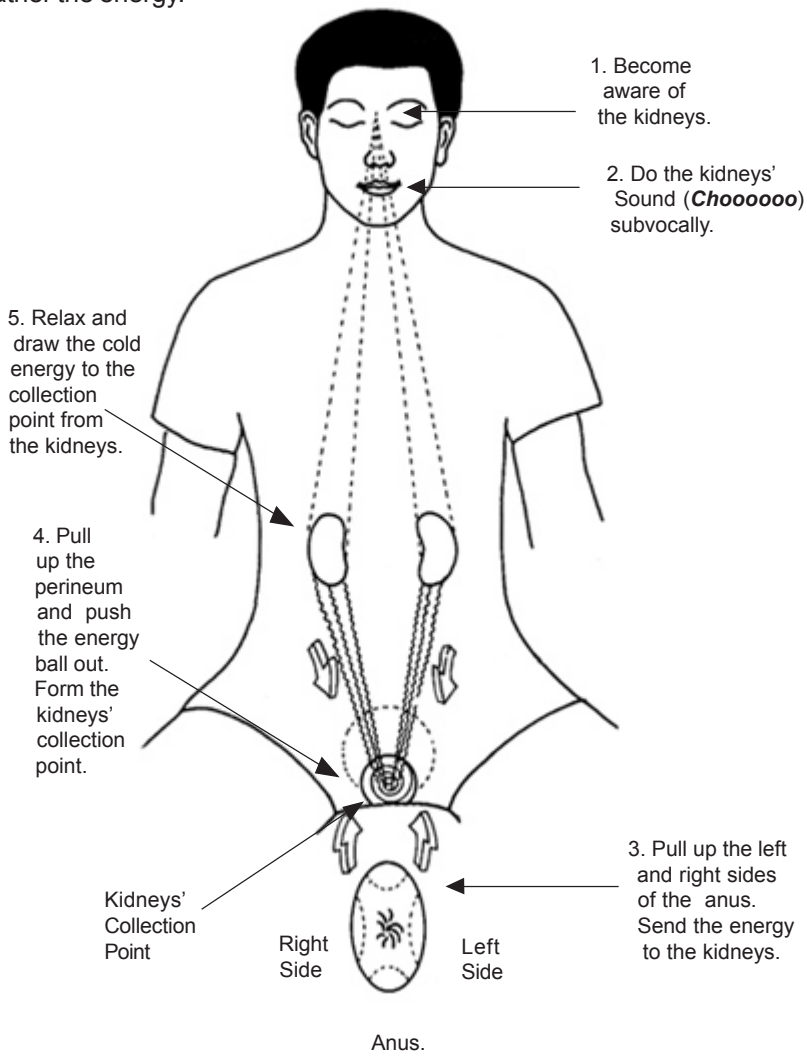

Fig. 2.1 *Forming the Collection Point to gather Kidneys' Energy.*

to pull up until the heart is reached. Then, using the power of the mind, gently squeeze or contract the heart area. Do not use too much physical force; it is better to use a gentle muscle contraction and the power of the mind.

(4) Mentally perceive the formation of the sphere that is the heart's collection point. Let it glow with a red color.

(5) Spiral the energy at the heart toward the heart's collection point. Intensify the spiral at the heart's collection point until the force of the spiral is strong enough to draw the hot energy of the heart and thymus into it.

4. Spiral and Draw the Heart's and Kidneys' Energies to the Front Pakua.

a. Divide your attention between the kidneys' and heart's collection points.

b. Feel the hot and cold energy.

c. Also be aware of the front pakua. Spiral the heart's and kidneys' collection points and spiral the front pakua. Increase the spiraling force in the front pakua by using the eyes and the mind. Physically creating a slight circling body movement at the same time also will help increase the spiraling force. (Fig.2.2) Spiral until enough force is created to pull the cold (blue) energy (of the kidneys) and hot (red) energy (of the heart) into the front pakua. On each breath inhale and draw up the cold, blue kidneys' energy to the pakua. Then exhale, and draw down the hot, red heart's energy. Feel the energy blend. Moderate the temperature so that it is not too hot or cold. (Fig.2.3)

5. Balance the Energies of the Lungs and Liver.

a. Form the Liver's Collection Point.

(1) Be aware of the liver.

(2) Do the Liver's Sound: ***Shhhhhhh.***

(3) Inhale, and contract the right side of the anus to the liver. then contract the liver.

(4) Form the liver's collection point by inhaling, pulling up the right side of the anus,and pushing down on the right side of your body under the rip cage. Contract the muscles in this area.

(5) Relax, and mentally perceive the formation of a green colored sphere that is the liver's collection point.

(6) Spiral and draw the moist, warm liver energy into its collection point. (Fig.2.4)

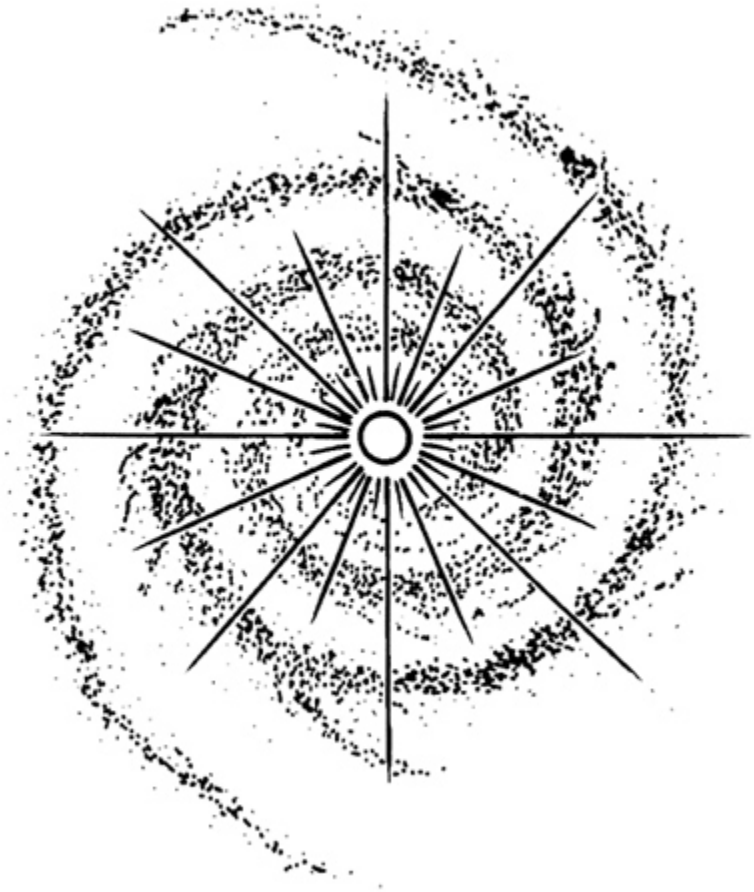

Fig. 2.2 *Use the eyes,mind, and body to create a spiraling motion that will draw the energy into the spiral. Spiral until a pearl forms at its center. It was a spiral of energy that originally formed the Universe.*

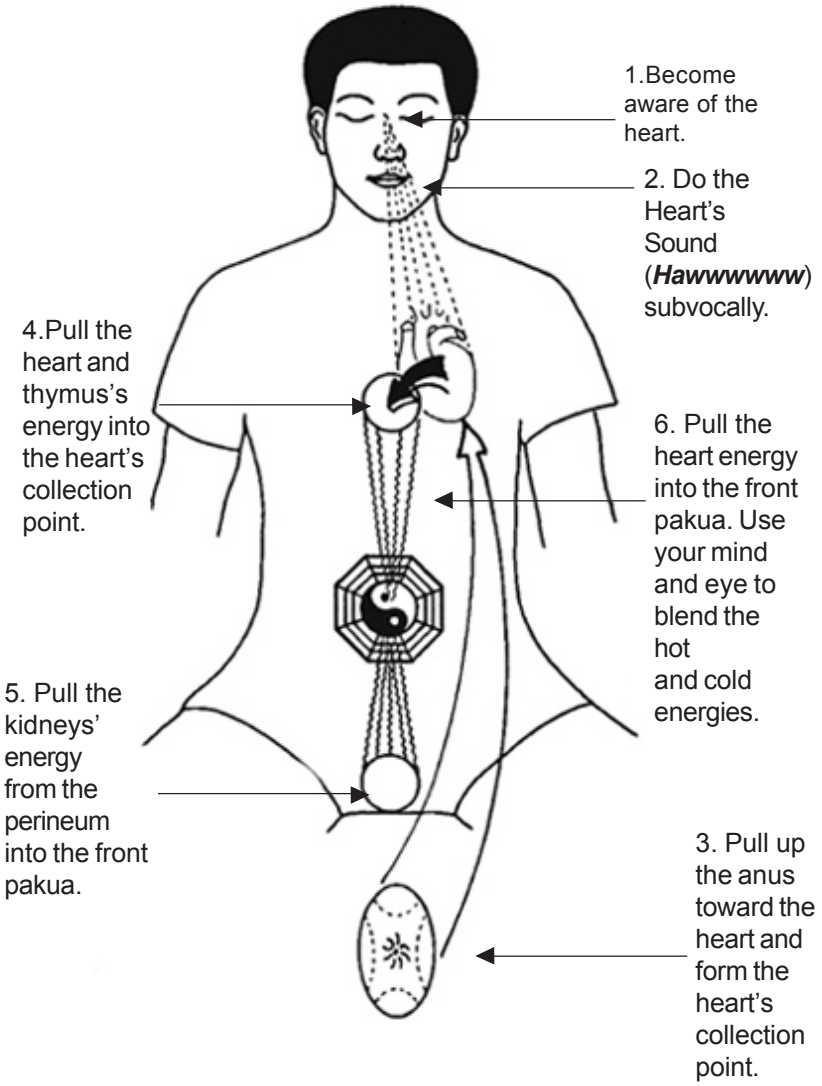

Fig. 2.3 *Form the Heart's Collection Point. Blend the Heart's Energy with Kidneys' Energy in the Pakua.*

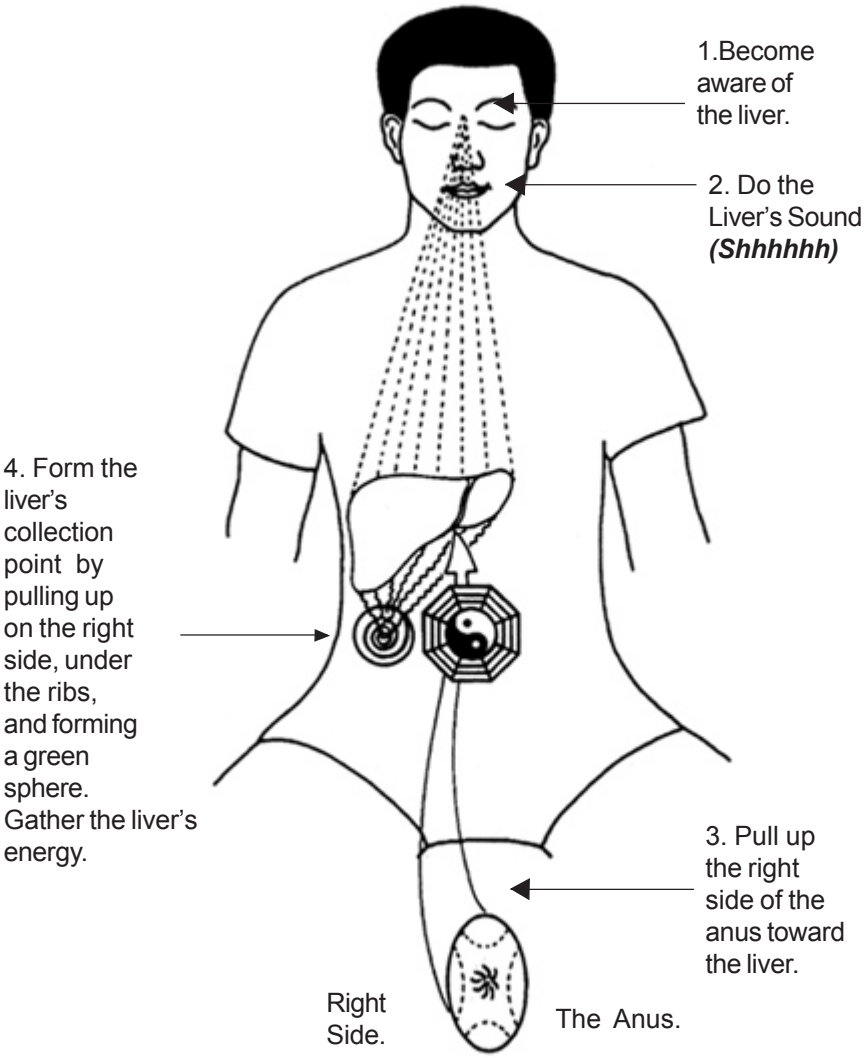

Fig. 2.4 *Forming the Liver's Collection Point to Gather the Liver's Energy.*

b. Form the Lungs' Collection Point.

(1) Be aware of the lungs.

(2) Do the Lungs' Sound: ***Sssssssss.***

(3) Inhale, pull up the left and right anus to the lungs under the rib cage. Contract the lungs.

(4) Form the lungs' collection point by inhaling again, pulling up the anus to the level of the navel, and mentally drawing a line down from the left nipple. Feel an expansion in this area.

(5) Exhale, relax, and mentally perceive the formation of a metallic white, three-inch sphere under the left rib cage that is the lungs' collection point.

(6) Spiral and draw the dry, cool lungs' energy to its collection point. (Fig 2.5)

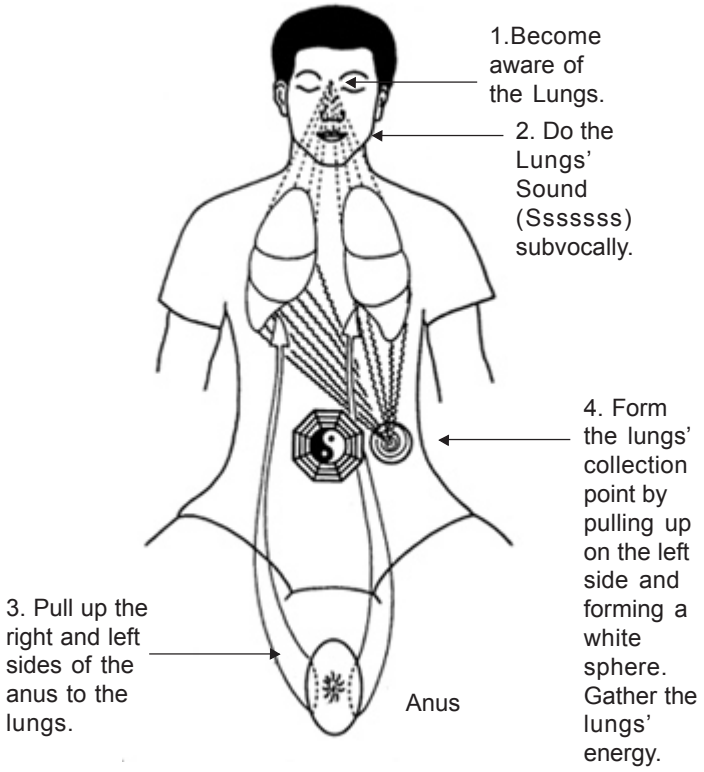

Fig. 2.5 *Forming the Lungs' Collection Point to Gather Lungs' Energy.*

6. Spiral and Draw Liver's and Lungs' Energies to the Front Pakua.

Divide your attention between the liver's and lungs' collection points and spiral them both. Distinguish the warm, moist energy of the liver and the dry, cool energy of the lungs. Be aware of the front pakua. Spiral and draw the liver's and lung's energy into this pakua. Blend the energies so that they are not too warm and moist, or too cool and dry. (Fig. 2.6)

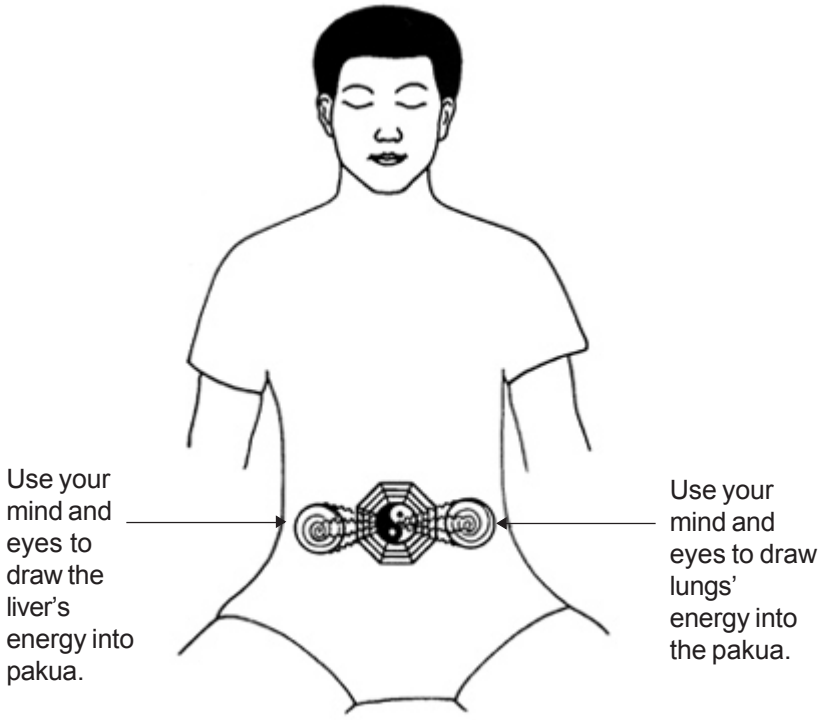

Fig. 2.6 *Blending the Liver's and Lungs' Energies the Front Pakua.*

7. Pull the Spleen's Energy into the Front Pakua.

a. Be aware of the spleen on the left side, slightly toward the back.
b. Do the Spleen's Sound:***Whoooooo*** (subvocally, but felt in the vocal cords).

c. Inhale and pull up the left side of the anus toward the spleen. Use your mind to lightly squeeze the muscles on your back, and feel the spleen. Exhale, relax, and heighten your awareness of the spleen. Form the spleen's collection point which is at the center of the front pakua itself.

d. Divide your attention between the spleen and front pakua. Spiral and draw the spleen's mild energy into the pakua. Visualize the color yellow at the pakua. (Fig.2.7)

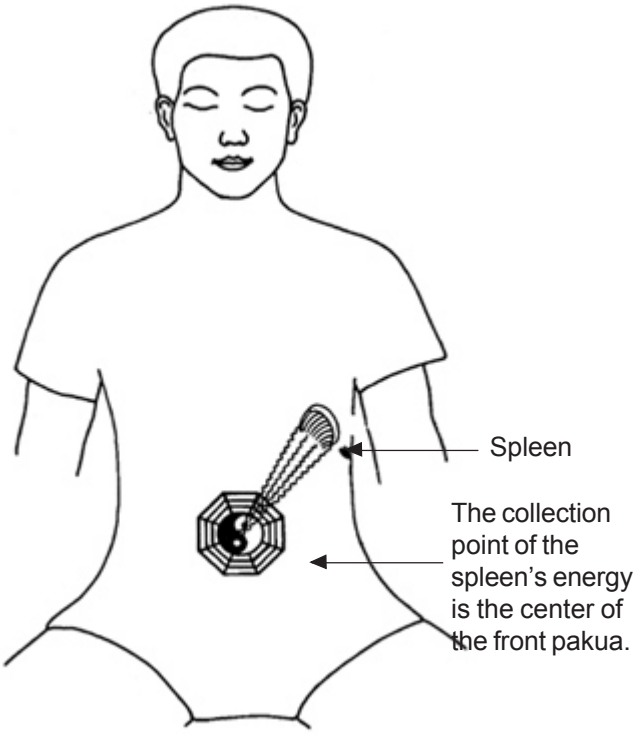

Fig. 2.7 *Gathering the Spleen's Energy Directly into the Pakua.*

8. Form the Back Pakua and Blend the Energy from the Back Collection Points.

Form or copy the back pakua one and a half inches in from the Door of Life as described in Chapter1. When you have done so and definitely can perceive the back pakua, spiral and collect

theenergies from the following locations. (Note that the location of the collection points you will create now will not be the same as the designated organ collection points described above. Rather they are located near the organ collection points, and their function is to draw in any remaining energies that may be present in the areas of the nearby organs. The actual source of these energies may be unclear.)

a. Make a sphere at the sacrum, and collect the cold kidneys' energy.

b. Make a sphere behind the heart between T-5 and T 6. Spiral and collect the heart's hot energy.

c. Spiral and blend the hot and cold energies that you have gathered from these spheres at the back pakua.

d. To the right rear of the back pakua make a sphere. Spiral and collect the liver's warm, moist energy.

e. To the left rear of the back pakua, make a sphere. Spiral and collect the lungs' dry, cool energy.

f. Spiral and blend the energies of the right and left spheres into the back pakua. (Fig.2.8)

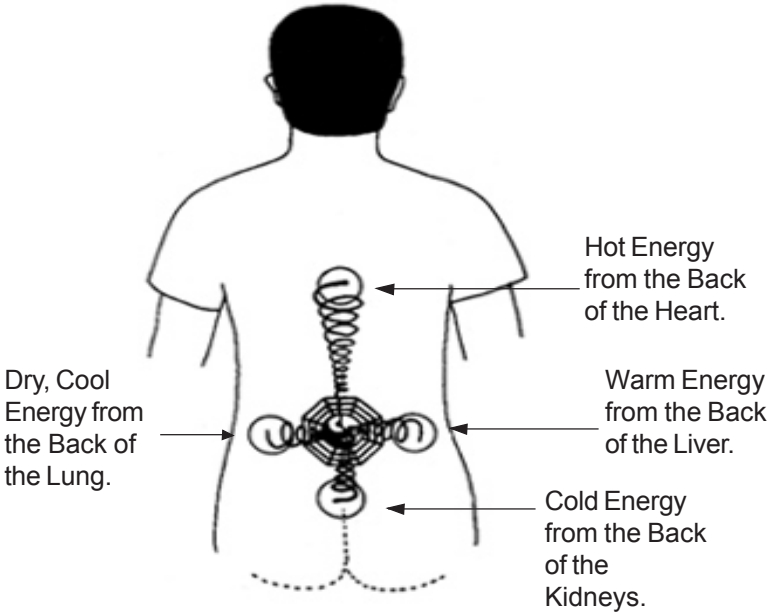

Fig. 2.8 *Back Pakua Collection Points.*

9. Draw the Energies from the Front and Back Pakuas into the Cauldron.

Spiral, draw, and condense the energies from the front and back pakuas into the cauldron. Blend them together.

10. Form the Right Side Pakua and Blend the Energies from the Right Side Collection Points.

Form the right side pakua. Spiral and draw energy from the following locations:

a. Form a sphere at the right hip at the same level as the perineum. Spiral and draw any residual cold energy into the sphere.

b. Round the scapula to open the armpit, and create a sphere at the right armpit to collect residual hot energy.

c. Spiral and blend the hot and cold energies in the right side pakua. d. Form a sphere toward the front of the right pakua. Spiral and collect residual warm, moist energy.

e. Form a sphere toward the back of the right pakua, and collect residual cool, dry energy.

f. Spiral and blend the warm, moist and cool, dry energies in the right side pakua. (Figure 2.9)

11. Form the Left Side Pakua and Blend the Energies from the Left Side Collection Points.

Form the left side pakua and draw energy from the following locations:

a. Form spheres, and collect the energies at the left hip and armpit as above. Spiral and blend the hot and cold energies in the left pakua.

b. Form spheres to the front and back of the left pakua, as above. Spiral and collect mild energy at the front sphere. Spiral and collect cool, dry energy at the back sphere. Spiral and blend the mild and cool, dry energies in the left pakua. (Fig 2.10)

12. Draw the Energies from the Right and Left Pakuas Into the Cauldron.

Pull the energies now in the right and left side pakuas into the cauldron. Spiral and blend them together with the energies already drawn there from the front and back pakuas.

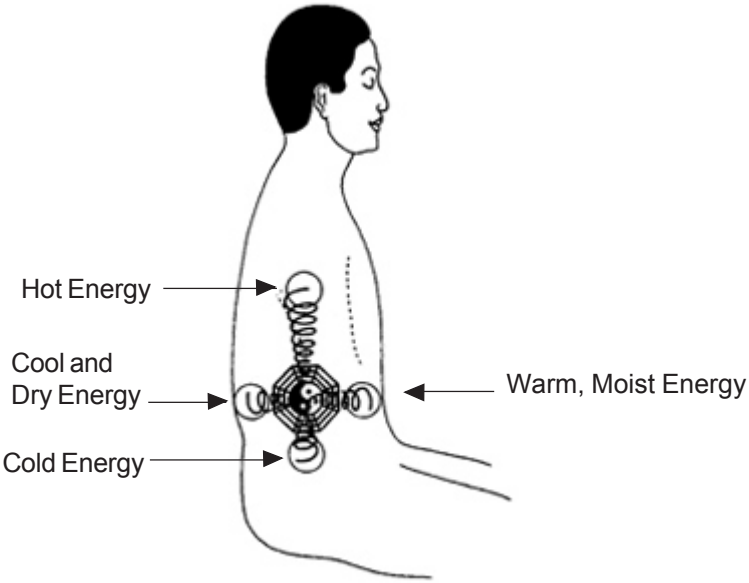

Fig. 2.9 *Right Side Pakua and its Collection Points*

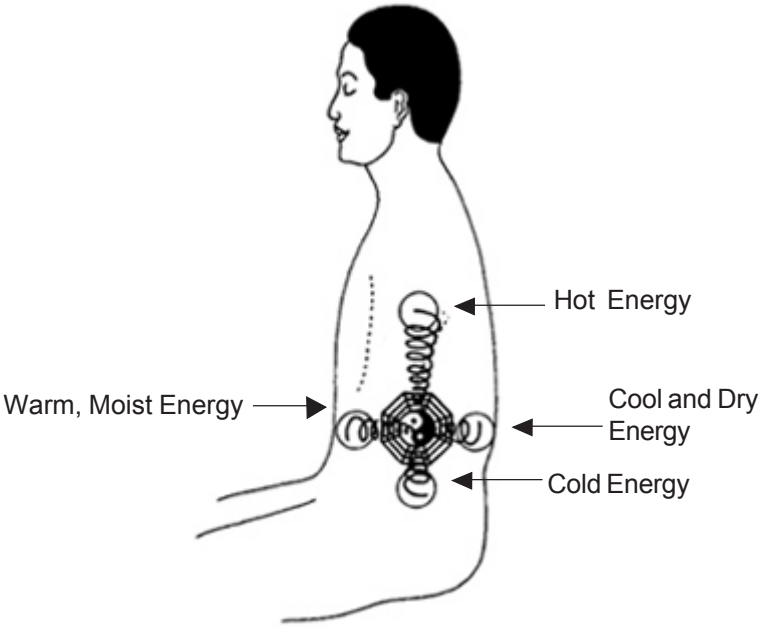

Fig. 2.10 *Left Side Pakua and its Collection Points*

13. Condense the Energies into a Refined Pearl.

Now condense all the energies that have been pulled from the front, back, and side pakuas into a pearl. This pearl, created from the essence of your organs and your whole body, is very refined and not scattered. It may be perceived as a point of light or condensed energy. (Fig.2.11)

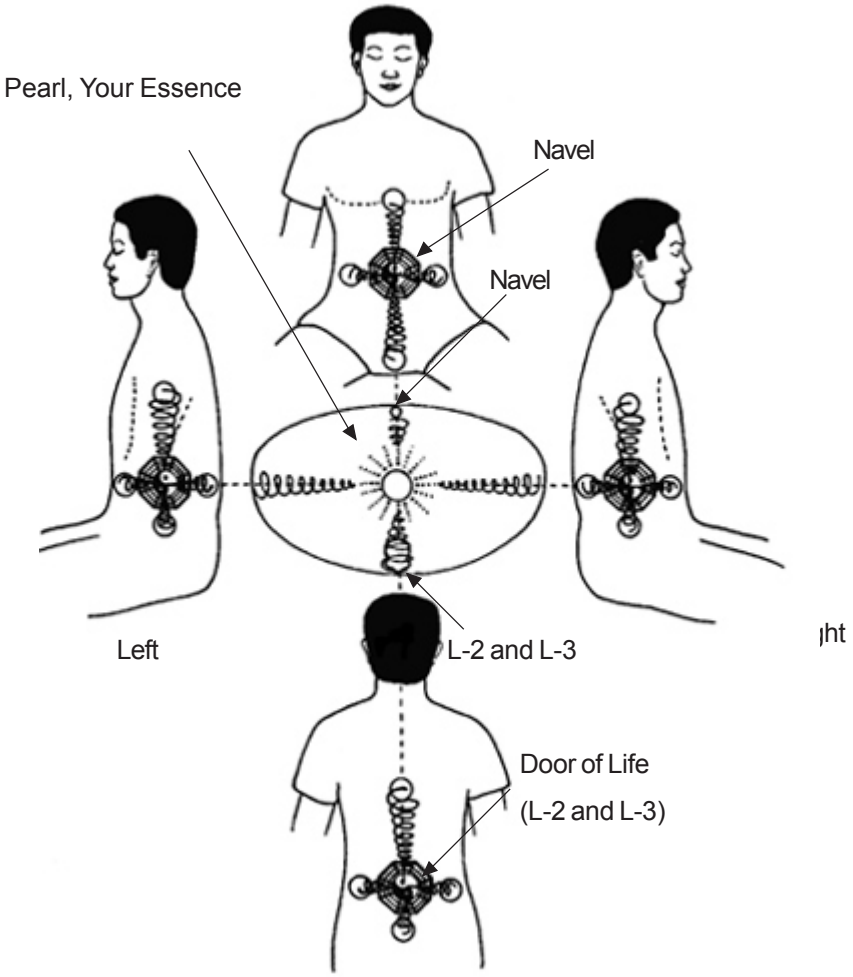

Fig. 2.11 *Four Pakuas and their Collection Points*

14. Anchor the Feelings of Peace and Harmony to the Pearl.

At the height of feeling centered, at peace, and in inner harmony, anchor these feelings to the pearl by giving yourself a strong affirmation.

15. Move the Pearl into the Microcosmic Orbit.

Send the pearl down to the perineum, and circulate it in the Microcosmic. Be aware of the Universal, Cosmic Particle, and Earth Forces as they are drawn to the pearl.

16. Collect the Energy and Practice Chi Massage.

Circulate the energy to the navel, and spiral it at the navel nine times (men, clockwise; women, counterclockwise). Then reverse it six times. Rub your hands together, and practice Chi Massage. If you plan to continue without stopping at this point, you can spiral the energy at the navel and continue to the next chapter.

Chapter 3

Formula 3: Connecting Senses with Organs; Self-Control of Senses; Sealing the Openings; Overcoming Temptations

A.Theory

As a parent to a child, each of your senses relates to a specific organ. If, like undisciplined children, the organs expel negative energy, they need to be controlled or given balance and harmony by the senses, their parents. If either the senses or the organs are weak or sick, greater amounts of negative emotions will be created since there will be no discipline. By recognizing the parent/child relationships and strengthening them, you will be able to increase your energy.

1. Ears—Kidneys

The ears are the openings of the kidneys. By listening to and increasing your awareness of the kidneys, the sense of hearing is drawn within where it will eventually be controlled. You will eventually feel internal balance, peace, and harmony since the ears will enable you to hear a heavenly music that is very unlike earthly music. (Fig. 3.1)

2. Tongue—Heart

The tongue is the opening of the heart. By connecting the tongue with the heart, the speech center is drawn within, and the temptation of senseless speech can be controlled. The tongue and the heart will feel at peace. (Fig.3.2)

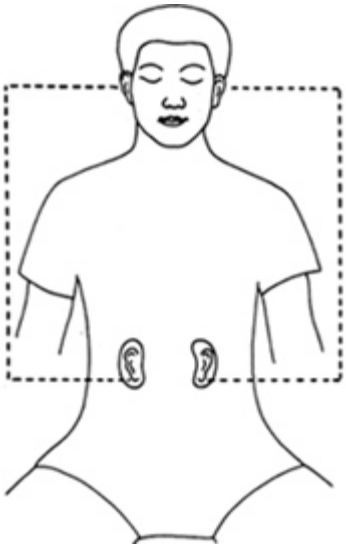

Fig. 3.1 *Connect the Ears with the Kidneys.*

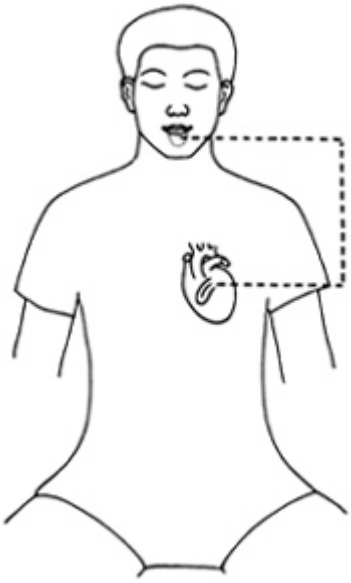

Fig. 3.2 *Connect the Tongue with the Heart.*

3. Eyes—Liver

The eyes are the openings of the liver. By looking into the liver, the sense of sight is drawn within, and visual temptations can be controlled. (Fig. 3.3)

4. Nose—Lungs

The nose is the opening of the lungs. By connecting the nose with the lungs, the sense of smell is drawn within, and the temptations of scents can be controlled. (Fig.3.4)

5. Mouth—Spleen

The mouth is the opening of the spleen. By connecting the mouth with the spleen, the sense of taste is drawn within, and the temptations of appetite can be controlled. (Fig.3.5)

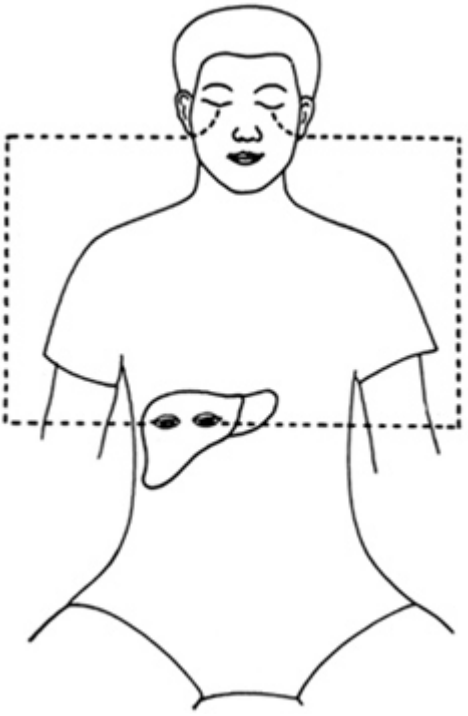

Fig. 3.3 *Connect the Eyes with the Liver.*

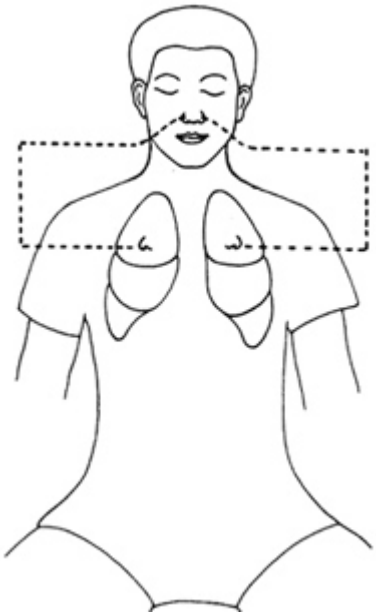

Fig. 3.4 *Conect the Nose with the Lungs.*

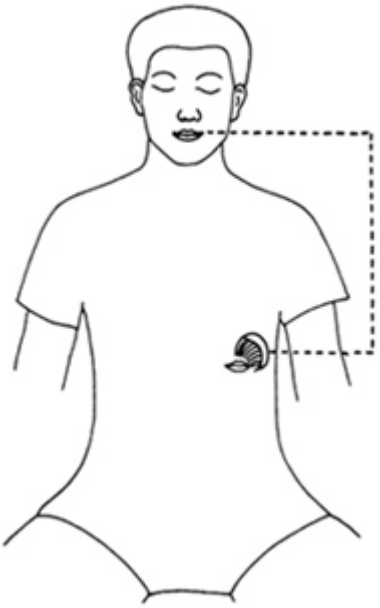

Fig. 3.5 *Conect the Mouth with the Spleen.*

B. Procedure of Connecting the Senses with the Organs

You will connect each sense with its corresponding organ by connecting them in pairs. (Figure 3.6)

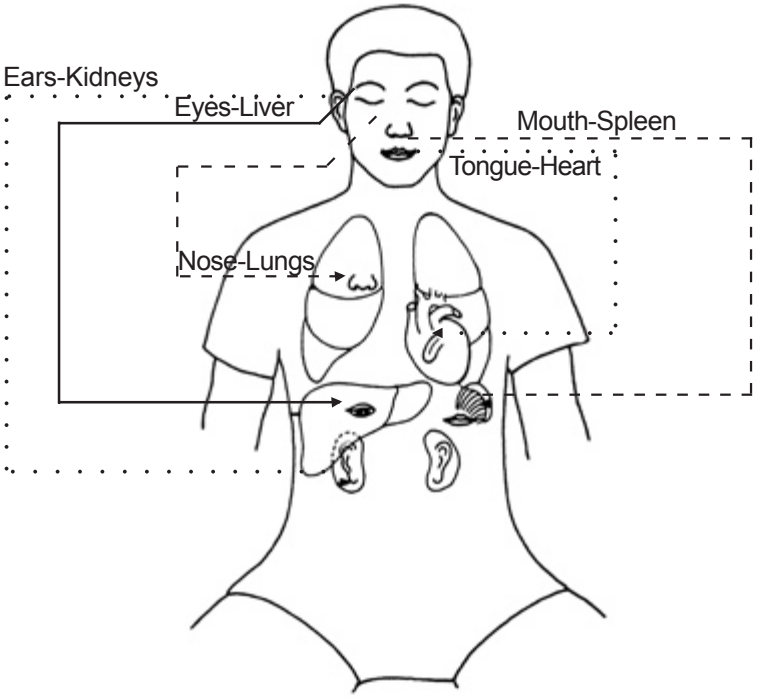

Fig. 3.6 *Connections between the Senses and the Organs*

1. The ears connect to the kidneys (cold energy) and the tongue to the heart (hot energy).
2. The eyes connect to the liver (warm/moist energy) and the nose to the lungs (cool/dry energy).
3. The mouth connects to the spleen (mild energy) and the front pakua.

C. Practice of Formula 3

1. Assume the Position.

Sit up properly, hold the hands together, and press the tongue to the palate.

2. Practice the Inner Smile.

Smile down. Feel the energy flow down through the face to the organs. Feel the positive emotions in each organ. Smile to the navel, and form the front pakua.

3. Massage the Senses and the Organs.

You can massage the senses by practicing the Chi Self-Massage exercise on them while massaging and exercising the organs.

4. Concentrate on the Ears and Kidneys.

a. Concentrate on the ears by spiraling the energy there. Listen, turn your awareness inwardly to the kidneys, and direct the spiral you have created at the ears to the kidneys. With this connection draw the essence of the ears to the kidneys by emphasizing the spiral at the kidneys, thereby making the energy at the kidneys stronger. Then collect at the kidneys the hearing energy of the ears and the cold energy that is the kidneys' essence.

b. Create a sphere at the perineum (the kidneys' collection point), and spiral at the perineum to draw and collect the cold energy that is the kidneys' essence and the hearing energy that is the ears' essence into this sphere. (Fig.3.7)

5. Concentrate on the Tongue and Heart.

a. Concentrate on your tongue. Move the tongue around to generate saliva and massage the heart. Spiral the energy at the tongue. Swallow the saliva you have created, and spiral the tongue's essence toward the heart. With this connection turn your awareness

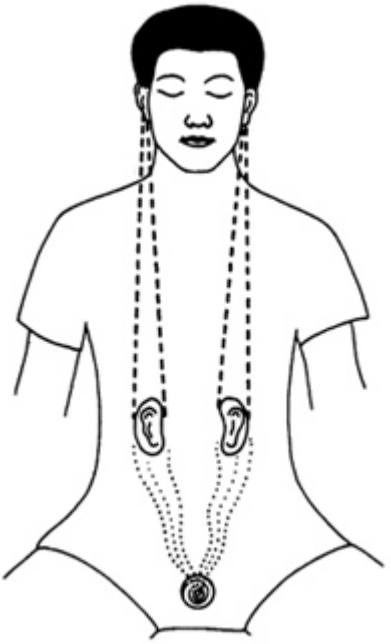

Fig. 3.7 *Spiral and Collect the Ears and Kidneys' Energy.*

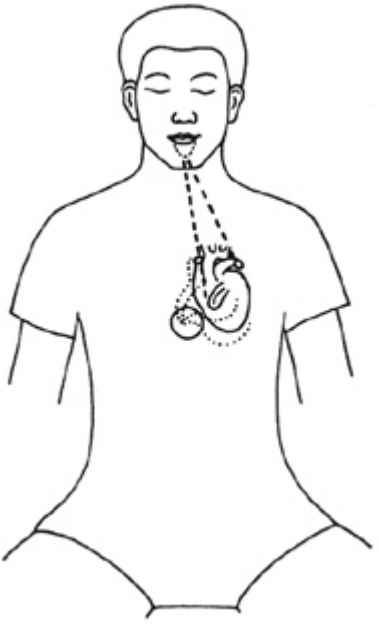

Fig. 3.8 *Spiral and Collect the Tongue and Heart's Energy.*

toward the heart. Emphasize the spiral at the heart, and collect at the heart the tasting energy of the tongue and the hot energy that is the essence of the heart.

b. Make a sphere at the heart's collection point, and create a strong spiral there. Draw in and collect the hot energy that is the heart's essence and the tasting energy that is the tongue's essence. (Fig.3.8)

6. Spiral and Blend the Essence Energies In the Front Pakua.

Spiral from the two collection points to the front pakua, and blend the kidneys' and heart's energies. Feel the hot and cold essence energies blend together. Notice the senses being pulled within.

7. Concentrate on the Eyes and Liver.

a. Concentrate on the eyes. Move the eyes around, and massage the eyes and liver. Look inwardly to the liver, and make a connection between your eyes and your liver by spiraling between the eyes and the liver. Create a stronger spiral at the liver, and let it draw in the seeing energy of the eyes. Collect in the liver the moist, warm energy that is the liver's essence.

b. Make a sphere at the collection point below the liver. Spiral and collect the blended warm/moist energy of the liver's essence and the seeing essence of the eyes into the collection point. (Fig.3.9)

8. Concentrate on the Nose and Lungs.

a. Focus your attention on the nose. Inhale and exhale, and massage the nose and lungs. Inhale to the lungs, and feel the connection between the lungs and nose by spiraling the energy between them. Spiral and collect the dry/cool energy of the lungs and the smelling energy of the nose.

b. Make a sphere at the collection point below the left lung. Spiral and collect the dry/cool energy that is the lungs' essence and the smelling essence of the nose into the collection point. (Fig.3.10)

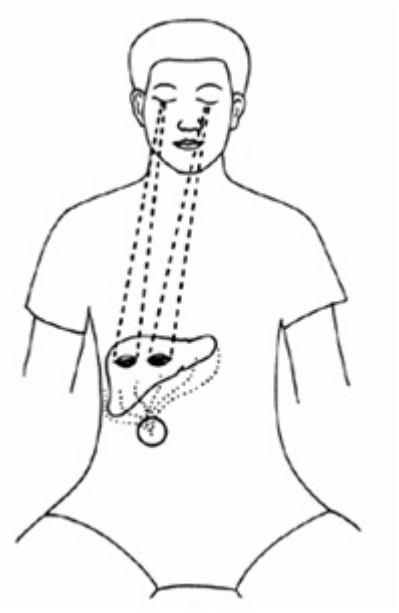

Fig. 3.9 *Spiral and Collect the Eyes and Liver's Energy.*

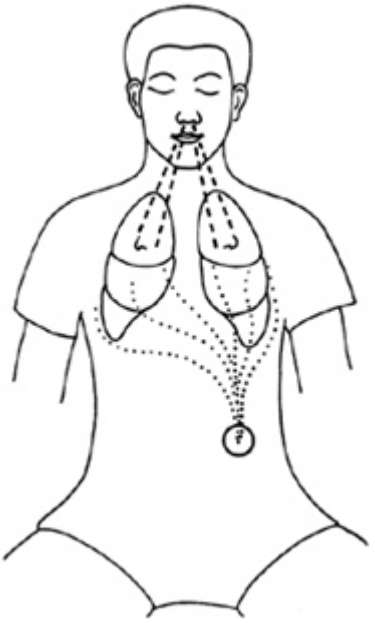

Fig. 3.10 *Spiral and Collect the Nose and Lungs' Energy.*

9. Blend the Essence Energies of the Eyes/Liver and Nose/Lungs in the Front Pakua.

Concentrate on the front pakua. Spiral and blend the eyes/liver's and nose/lungs' energies from their collection points. As you spiral feel their moist/warm and dry/cold energy blend together at the front pakua. Feel the senses becoming increasingly focused.

10. Concentrate on the Mouth and Spleen.

Concentrate on your mouth and establish a connection with the spleen by spiraling between them. Collect the mild energy that is the essence of the spleen and the mouth in the front pakua. The senses should feel secure as the energies blend. (Figure 3.11)

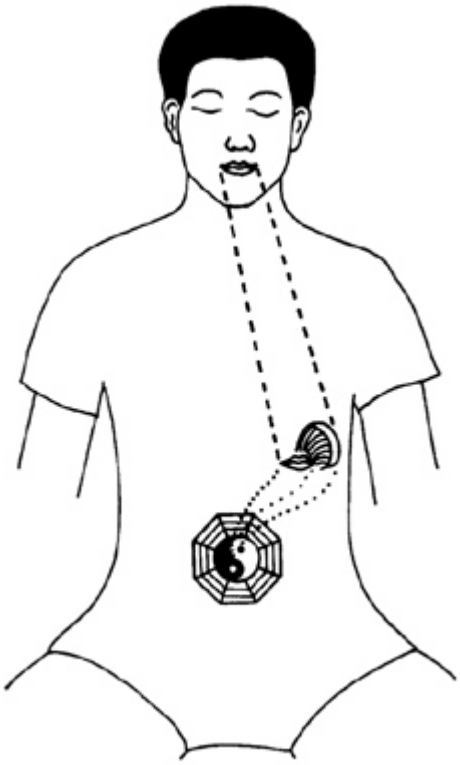

Fig. 3.11 *Spiral and Collect the Mouth and Spleen's Energy.*

11. Form the Back, Right, and Left Pakuas and Draw their Collected Energies Into the Cauldron.

Be aware of the back pakua, its collection points, and the energy that has been gathered. Spiral the front and back pakuas to draw into, and combine their collected energies in, the cauldron. Be aware of the left pakua and its collection points. Similarly, be aware of the right pakua and its collection points. Spiral the left and right pakuas to draw into, and combine their collected energies in, the cauldron. (Figure 3.12)

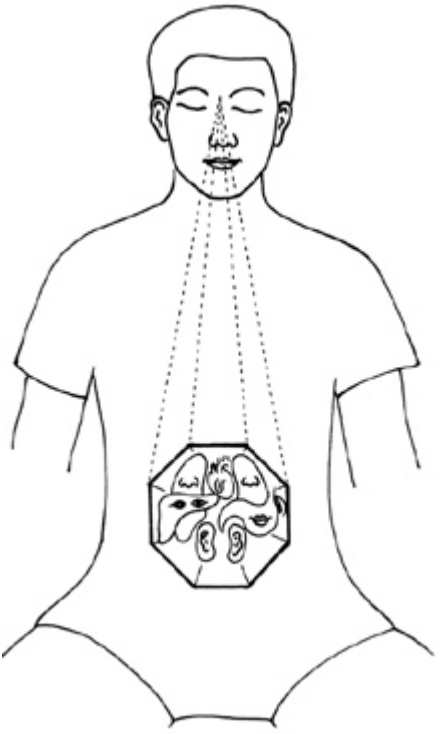

Fig. 3.12 *Draw and combine the energies of all the senses and organs in the cauldron.*

12. Form a Pearl.

Spiral and blend all the condensed energies in the cauldron to form a pearl.

13. Affirm your Self-Control by Anchoring and Programming the Pearl with Verbal Affirmations.

Once you feel that the senses and organs are connecting and are all moving into one place—the cauldron—you will feel a sense of control. You will feel as though everything is under one roof or under one center of control. This feeling can make you stronger and increase your power to overcome temptations because your senses and organs will be stronger. At the height of the feeling of self-control, program yourself by anchoring this feeling into the pearl so that you can recall the feeling at any time. I am calm, clear, at peace, centered, in physical and emotional balance, and under self-control.

14. Move the Pearl to the Perineum.

Move the pearl to the perineum and circulate the energy in the Microcosmic. Keep the senses and your awareness focused inward. As the pearl circulates in the Microcosmic, sense the three sources of energy supplied: the Universal, the Cosmic Particle, and the Earth Forces.

15. Collect the Energy and Practice Chi Massage.

Bring the pearl of energy to the cauldron, and end with Chi Massage.

Chapter 4

Formula 4: Transforming the Negative Emotions of Each Organ into Useful Energy

A. Theory: Relationships between Organs and Emotions

Taoists reason that negative emotions can be transformed to utilize their life-force energy. Therefore, to expel or suppress unwanted, negative emotions is to expel or suppress life-force. Rather than suppress negative emotions in the Taoist system, you benefit more by experiencing them. (Fig.4.1) This means you permit them to emerge, but do not let them run wild or trigger other negative emotions. Instead, put yourself in control of them so that you may transform them not only into useful life-force energy, but also into the higher consciousness that is your spiritual energy.

When connecting the senses with the organs in Chapter 3, you may have noticed your emotions beginning to emerge. You can control them. Review Table 1 in this chapter to note the negative emotions you will want to transform. After you have cleared the negative emotions from the organs, study Table 2 also within this chapter. Table 2 is more detailed, noting the negative and positive aspects of each modality—shape, color, smell, temperature, etc. You may be stronger in one representational system than another depending on your visual, auditory, and kinesthetic perceptions. You should be able to relate to at least one of the modalities.

Some people have repressed their emotions and react strongly to this practice as their emotions surface. If you are one of these people, spend more time practicing the Healing Sounds and the Inner Smile. Work with healing the organs before attempting to transform the deeply buried emotions within them.

As you transform the negative emotions of each organ into useful energy, use the Counteracting or Controlling Cycles to help balance the energy. (Fig.4.2)

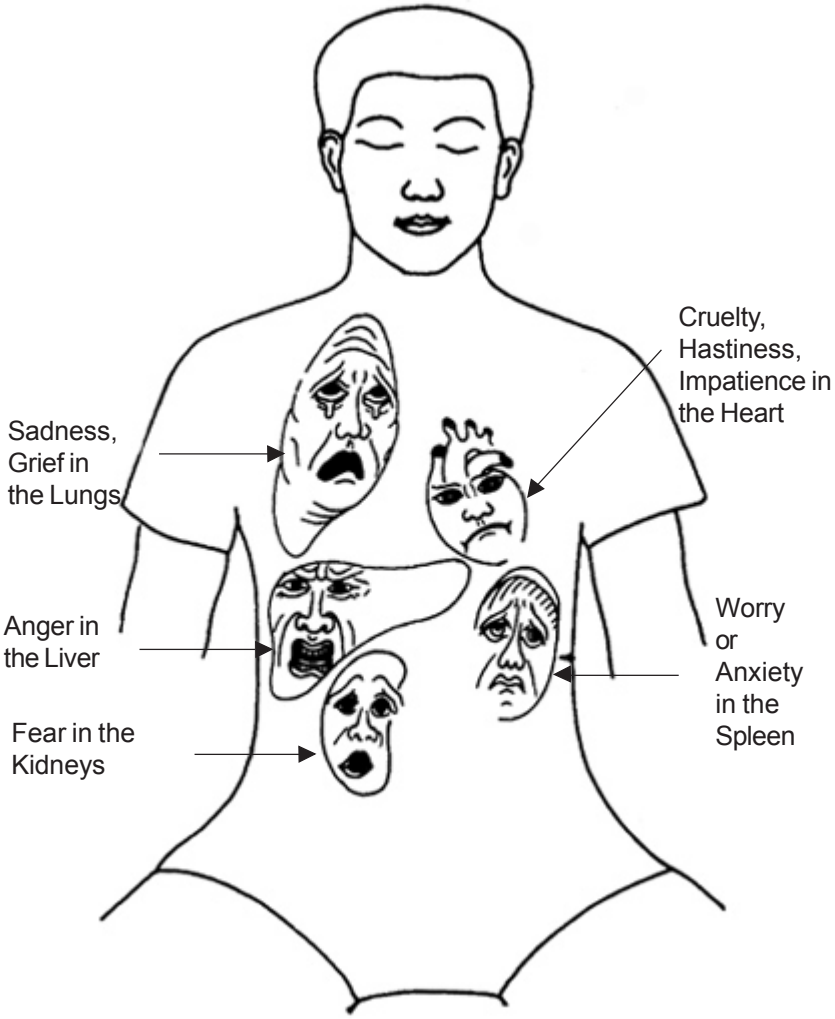

Fig. 4.1 *Negative Emotions and the Organs*

B. Practice of Formula 4

1. Smile Down.

Smile down, and generate the qualities of loving energy in each organ.

2. Form the Front Pakua.

As in the previous Chapters, create the front pakua.

Five Element Organ Correspondences					
	Wood	**Fire**	**Earth**	**Metal**	**Water**
Yin Organs	Liver	Heart	Spleen	Lungs	Kidneys
Yang Organs	Gall Bladder	Small Intestine	Stomach, Pancreas	Large Intestine	Bladder
Openings	Eyes	Tongue	Mouth, Lips	Nose	Ears
Positive Emotions	Kindness	Love, Joy	Fairness, Openness	Righteous, Courage	Gentle
Negative Emotions	Anger	Hate, Impatience	Worry, Anxiety	Sadness, Depression	Fear, Stress
Psycho-Logical Qualities	Control, Decisi-veness	Warmth, Vitality, Excite-ment	Ability to Integrate, Stabilize, Feel Centered and Balanced	Strength, Substan-tiality	Ambition, Willpower

Table 1

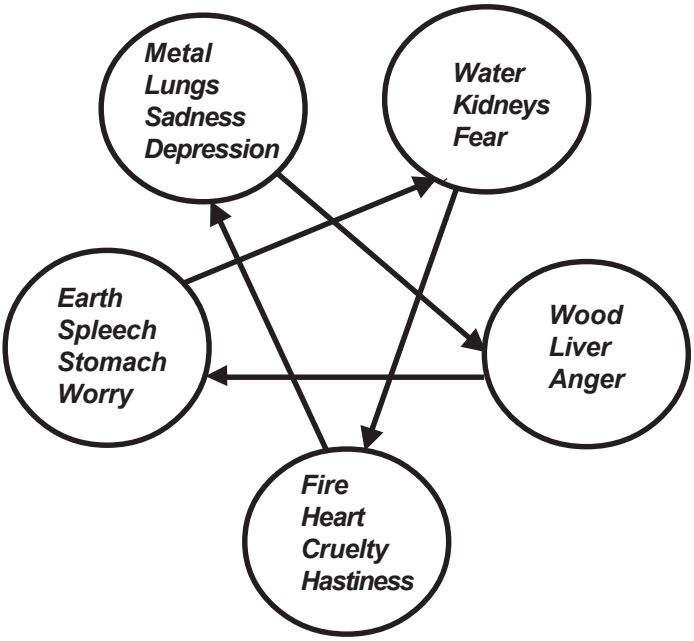

Fig. 4.2 *Counteracting or Controlling Cycle*

3. Be aware of Fear in the Kidneys.

Turn your consciousness toward the ears, and listen to the kidneys. Become aware of fear or any sensation that you do not like as it manifests in the form of a sound, taste, color, shape, or feeling. The energy may be chilling and cold, cloudy blue, contracting, or it may be emitting awkward shapes. Spiral and breathe the fear and any other emotion you do not like out of the kidneys, and collect it at the kidneys' collection point. (Fig. 4.3)

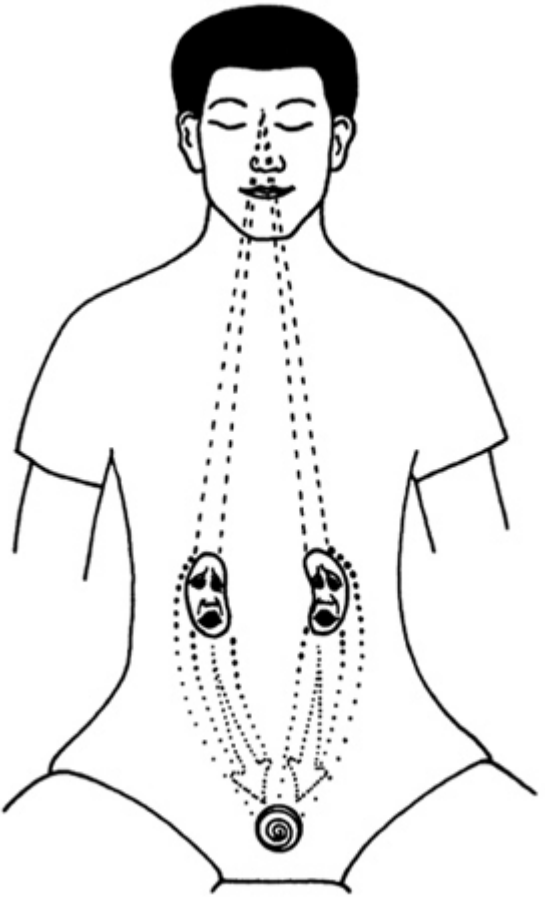

Fig. 4.3 *Collecting Fear in the Kidneys' Collection Point*

4. Be Conscious of Impatience in the Heart.

Move the tongue, connect the tongue with the heart, and become conscious of impatience, hastiness, cruelty, or any sensation that you do not like deep within the heart. It may manifest as a feeling, shape, sound, or image. The feeling can be of energy rushing out, and you can see and feel something wrapping and pressing in a bad way into the heart. The negative feelings of the heart can be sensed as a very muddy, red color, or can be hot, unsteady, small, noisy, or acidic. Spiral and breathe these emotions out of the heart, and collect them at the heart's collection point. (Fig.4.4)

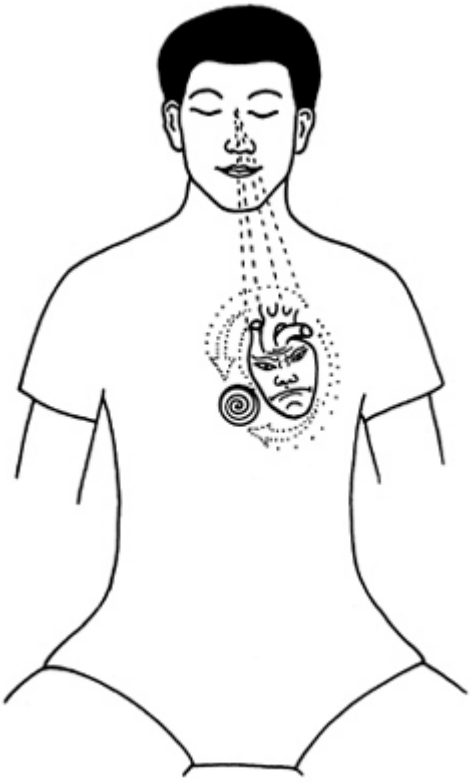

Fig. 4.4 *Collecting Cruelty, Hastiness,and Impatience in the Heart's Collection Point*

5. Spiral, Blend and Transform the Energy of the Heart and Kidneys at the Front Pakua.

Spiral and breathe the negative energies out from the heart's and kidneys' collection points to the front pakua. Spiral and blend them at the front pakua. The pure energy trapped in these negative feelings will be freed and released to the center of the pakua. Spiral the heart's and kidneys' energies until they become a bright, golden energy. This energy radiates love and gentleness from the center of the pakua and your being.

6. Perceive Anger in the Liver.

Move the eyes, connect the eyes with the liver, and be aware of anger or any sensation that you do not like deep within the liver. The anger energy can be sensed as a sharp-edged spear, hot,

painful, red, cloudy, or pungent. It can be a destructive, expanding kind of energy. Spiral the anger and any other energy you do not like from the liver, and move it out to the liver's collection point. (Fig.4.5)

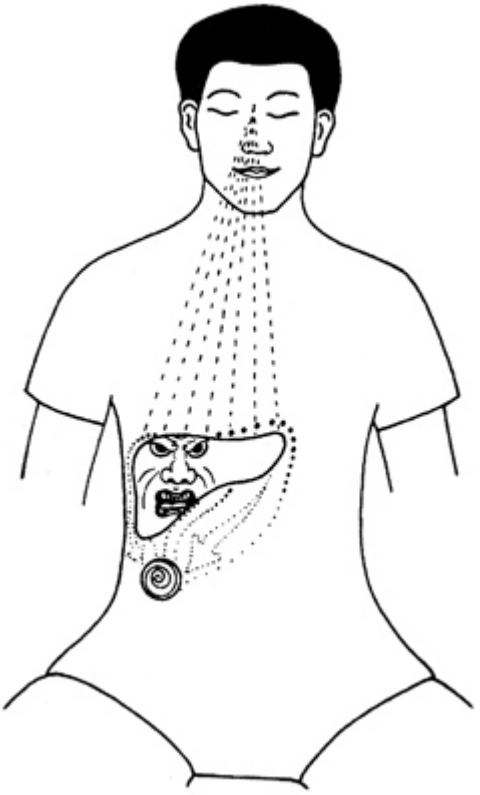

Fig. 4.5 *Collecting Anger in the Liver's Collection Point*

7. Be Aware of Sadness and Depression in the Lungs

Inhale and exhale. Then inhale again, and establish a connection between the nose and lungs. The negative energy of the lungs can take the form of sadness, grief, and depression, but can be represented by other sensations that you do not like. When you are sad, you can have a sense of being down, collapsed, deflated, and low in energy. Sadness or any negative energy in the lungs can be gray, cold, musty, or salty. Spiral and breathe out the sadness and any other energy you do not like from the lungs. Bring it to the lungs' collection point.(Fig.4.6)

8. Spiral, Blend, and Transform the Energy of the Liver and Lungs at the Front Pakua.

Spiral and breathe the negative emotional energies from the liver's and lungs' collection points to the front pakua. Spiral and blend them at the front pakua, using the power of the pakua to balance and neutralize the sadness and anger. Nurturing the kindness and courage will help to transform them into a golden light at the center of the pakua.

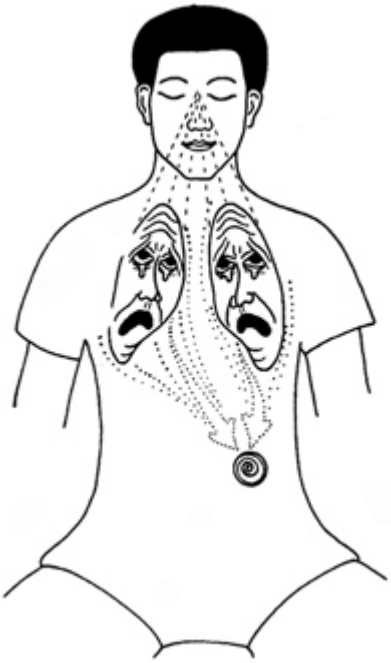

Fig. 4.6 *Collecting Sadness and Grief in the Lungs' Collection Point*

9. Be Conscious of Worry in the Spleen.

Connect the mouth with the spleen, and be aware of worry or any other emotion you do not like in the spleen. The negative energy of the spleen can be sensed as cloudy, sour, shaky, uncertain, and sticky. As a result, you might feel limited, small, and uneasy. Spiral and breathe the worry and any other energy you do not like out of the spleen. Bring it to the front pakua to blend it with the energy that is already there. (Fig.4.6)

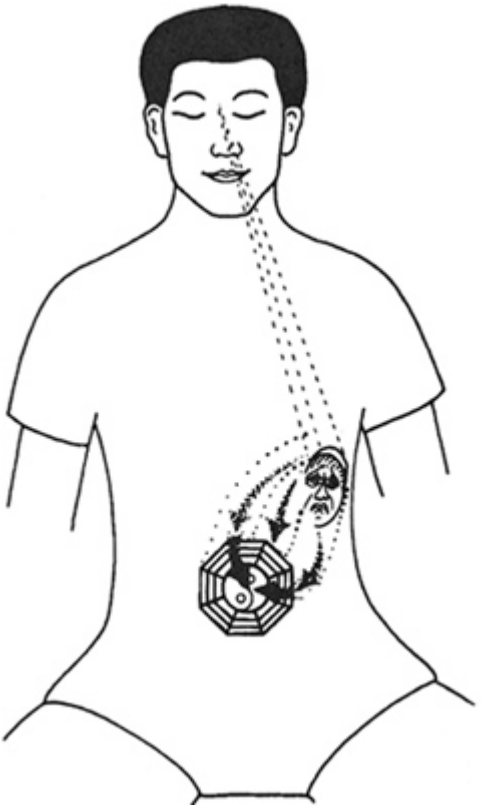

Fig. 4.7 *Collecting Worry and Anxiety in the Spleen's Collection Point*

10. Spiral all remaining Negative Energy to the Front Pakua.

Return to all the organs and their collection points, and spiral and breathe to draw out any remaining negative energy. Blend and neutralize it with the energy in the front pakua.

If you feel you do not have enough energy to transfer the negative emotions, you can call upon another source of energy within you to help. Become aware of the love and joy in your heart. Bring these emotions into the pakua and they can help transform the negative energy.

Emotional Transformation Processes: Characteristics of Positive and Negative Emotions

This table demonstrates emotional characteristics as might be perceived by an individual and not elemental characteristics.These are personal experiences.One might feel differently according to his or her visual, auditory and kinesthetic perceptions.

Emotion		Righteous Courage		Gentleness
	Collapsed, Flattened Ball	Tall, Straight	Awkward Compressed	Round,Full, Expensive
Color	Grey	Bright White	Dark Grey, Cloudy	Bright Sky Blue
Smell	Musty	Pure, Fresh	Foul, Urine	Fresh
Temperature		Comfortable, Warm	Cold, Chilly	Cool, Comfortable
Sound	Low, No Force	Strong, Firm Resonant	High-pitched Shrill	Whisper, Pleasant to Ear
Feeling	No Energy, Exhausted	Uplifted	Tight, Closed In	Relaxed, High, Centered
Texture		Firm but Comfortable	Slippery	Velvety
Size	Deflated, Low	Expanding Upward		
Taste				
Direction				

Table 2

Modality	Liver		Heart		Spleen	
Emotion	Anger	Kindness	Impatience, Cruelty, Hate	Love,Honor, Respect	Worry	Fairness, Openness
Shape	Spear-like, Sharp	Round, Smooth	Moving, Spiny	Straight, Open	Irregular	Open, Wide, Big
Color	Red Cloudy	Soft Green	Orange, Muddy	Bright Red	Cloudy	Mellow Yellow
Smell	Pungent	Sweet, Fragrant	Sharp, Burnt	Aromatic Incense	Sour	Clean, Dry
Temper-ature	Hot, Explosive	Warm, Pleasant	Unsteady	Warm, Full	Humid	Warm, Mid-range
Sound	Flashing, Loud	Melodious	Noisy, Irregular	Stable, Steady, Solid	Shaky	Clear, Soft, in Tune
Feeling	Pain, Tough, Rough	Nurtured	Irritated	Stable, Protected	Uncertain	Balanced Even
Texture	Rough	Soft	Cactus -like	Comfort Secure	Sticky	Smooth, Firm
Size	Expand Explode	Expand, Gently	Small, Pointed	Expanding	Out of Proportion	Big, Deep
Taste	Bitter	Sweet	Acetic	Satisfying	Sour	Smooth, Clean
Direction	Attacking, Out	Enfolding	Scattered	Open, Steady	Constrict	Horizontal

Table 3

11. Practice Inner Observation.

Turning the senses inwardly initiates the training process of inner observation. In developing the ability to focus inward—to smell, listen, taste, see, and hear the organs and their activities—and to observe your negative emotions without predetermined judgments, you have the opportunity to develop your true nature.

12. Clean Out the Negative Energy to make Room for Positive Energy.

In the same way that turning garbage into compost makes it useful, transformed negative energy also becomes useful. You are increasing your life-force rather than throwing it away. By making room for positive energy to grow, your life-force will continue to increase.

13. Allow Virtue Energy to grow in the Organs.

Growing virtue energy is an essential part of both the Fusion I and II practices. Gentleness can grow in the kidneys. Love, happiness, and joy can grow in the heart. Kindness can grow in the liver. Righteousness and courage can grow in the lungs. Fairness and openness can grow in the spleen.

Check the color of each organ as a reflection of its increasing virtue energy. The kidneys now might be a brilliant blue; the heart, a brilliant red; the lungs, a brilliant white: the liver, a brilliant green; and the spleen, a brilliant yellow. (See Table 2.)

Organs made stronger with the growth of virtue energy will gradually strengthen the senses. During the process you will develop a very· real sense of knowledge and true wisdom. Once you observe these qualities within yourself, you are prepared to observe and experience the outside world.

14. Transform the Negative Energy as the Most Powerful Act of Forgiveness.

Recall a time when you have had a conflict or argument with someone. Finally there came a time when you both sat down to talk things over and to try to understand each other. You said, “I forgive you,” and the other person also forgave. At that moment the feeling was as though a heavy load or burden was removed. You felt open, happy, and warm.

When you can transfer anger into kindness, you are performing the act of forgiveness. Forgiveness is one of the most important practices of the Taoist system. Feel the anger of others. Do not suppress it. Do not be afraid of it. Make friends with it. Understand it and draw its energy into your pakua. Spiral it with your other emotions and add more of your love energy. Transform the combined energies into life-force.

At the moment the energy transforms into life-force, you feel a sense of release, a sense of opening. Experience the feeling. Remember that it will help you to transform more energy easily.

15. Project Inner Virtue outwardly to increase Virtue Energy.

TheTaoist way emphasizes helping the world without anyone noticing. Once you have grown love, joy, kindness, and gentleness internally, it can be projected outwardly toward others. The more virtue energy you project outwardly, the more you grow inwardly. The more you give, the more you receive without ever asking for reward.

You can help sad and angry people with your good virtue. Extend your help to them daily and you will touch their hearts with love, joy, and kindness. You, in turn, will feel the Universal Force pouring out from the heavens. The New Testament of the Bible relates a narrative of Jesus regarding donations to the Temple. He told us not to let the left hand know what the right hand gives. It is only for the Heavenly Father to know.

As the organ virtue energy increases, it becomes useful energy for transferring your consciousness. Therefore, it becomes valuable for all eternity. The consciousness created and transferred by virtue energy can be thought of as money in a savings account, an account held by the Universe.

16. Practice External Observation and Develop the Art of Non-Attachment.

Another important Taoist discipline to realize at this time is the art of non-attachment to the material and social elements of your physical world. It is an important concept to embrace when observing the outside world because it prepares you for your destiny.

Observe the necessities of life—food, clothing, shelter—simply

as vehicles to help you reach your goal. Try to walk through your home, for example, and determine what it is possible to live without. Would you feel deprived if suddenly all your material things were taken away? If you were abandoned by your loved ones, would you be able to carry on?

The fact is that when, through death, you finally leave this world, you cannot take anything with you. The spirit is all that survives.

17. Prepare the Body to Receive the Universal Force.

Clearing out negative emotions and blockages is important for another reason—to prepare the body and make room to receive the higher Universal Force and a higher consciousness. The Universal Force supplies useful energy for healing, additional life-force energy, spiritual work, and for working on new projects when additional energy is required to make decisions or to solve a crisis.

You might think of the process as “cleaning the house” to make it ready. This means you try to feel clean internally. The first step is to clean all the “rooms”; that is, to clear the negative energies from the organs. Next it is particularly important to “clean the bathroom.” This means to clear the intestines, especially the large intestine, since constipation is a serious prevention to the flow of energy. Consume a higher fiber diet, including fruits and vegetables, to keep the body clean.

A clean “house” makes you feel very good internally and externally. You feel as though you know yourself better. You are better able to determine your weak and strong points. The Fusion practices help you to replace automatically your weak points with stronger points. It also helps you to control the overly strong ones. When you feel this strength and control, you will feel clean inside. This feeling of cleanliness is very important because it opens you up to attract and receive the higher force.

After your Fusion practice, and before you go to sleep, feel the emptiness the clean feeling creates inside. At this time ask the Universe with a good heart and in a virtuous way for what you need to fill the emptiness. The Universe will fill your need. When you arise in the morning, get in touch with yourself and any problem you may have and you might find the answer has already arrived.

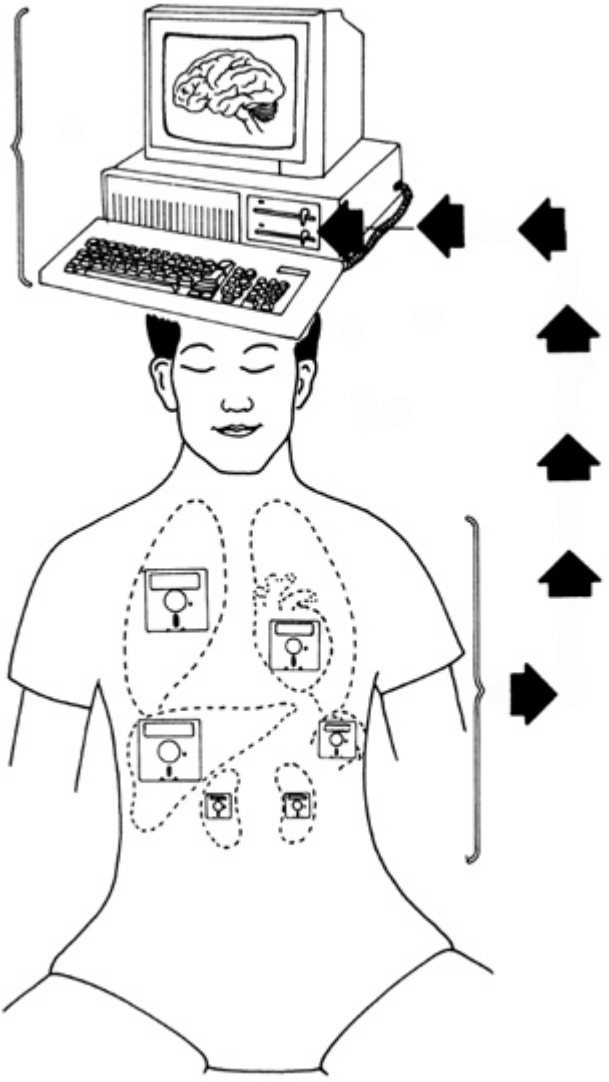

Fig. 4.7 *The brain is the computer; the organs are the software.*

18. Increase the Psychological Qualities of the Organs.

TheTaoists regard the organs as storage places for general information and data, while the brain uses this stored information and data for processing. You might consider this process to work much like the operation of a computer. The organs are the software, and the brain is the computer hardware. Without the software to feed information and data, the computer will not be able to exercise its function. (Fig. 4.7)

Once you recognize this connection you can understand the brain's function in strengthening and activating the advantageous psychological qualities of the organs, after they have been cleared of their negative energies.

Good psychological qualities associated with the organs are as follows:

a. The kidneys and bladder—ambition and willpower.

b. The heart and small intestine—warmth, vitality, and excitement.

c. The liver and gall bladder—control and decisiveness.

d. The lungs and large intestine—strength and substantiality.

e. The spleen and the stomach—ability to integrate, stabilize, and feel centered and balanced. (See Table 1.)

The lungs are associated with the metal element. A person influenced by anger, sadness, and depression, negative emotions of the lungs, can experience a weakened liver. The liver is associated with the metal element. A weakened liver will encourage anger and affect decision making. An extremely angry person will make wrong decisions. While a person who is sad and depressed can lose courage and a clear viewpoint. A hasty, impatient person, experiencing the negative emotions of the heart, can lose warmth and vitality.

By cleaning negative emotions from the organs and transforming them to good energy, you are able to experience the vitality of the organs' good psychological qualities. These good psychological qualities play a major role in our daily life, providing decision making capabilities, a sense of direction, and sound judgment.

The Taoists believe that clean organs, emptied of their negative energies, permit good sense and real knowledge to come forth. Otherwise you can harbor a false knowledge that confuses real knowledge and good.

When a Taoist says he feels fine, this means all his or her organs are in agreement, working together in a positive way and controlling all actions. They are free of domination by the mind.

19. Form the Back, Right, and Left Pakuas and draw their Collected Energies into the Cauldron.

Be aware of the back pakua, its collection points, and all the energies you have collected from the connected senses and organs. Spiral the front and back pakuas to draw into, and combine their collected energies in, the cauldron. Be aware of the left pakua, its collection points, and all of the energies gathered there. Similarly, be aware of the right pakua, its collection points, and all of the energies now present there. Spiral the left and right pakuas to draw into, and combine their collected energies in, the cauldron.

20. Form a Pearl.

Fuse together and condense the energies from all four pakuas in the cauldron, and form a pearl. With the addition of the organs' and purified emotions' energies, the pearl now glows a brilliant golden color.

21. Circulate the Pearl in the Microcosmic Orbit.

Bring the pearl down to the perineum. Circulate it in the Microcosmic. As the pearl moves through the Microcosmic, feel the Universal, Cosmic Particle and Earth Forces supplied to you. (Fig. 4.8)

22. Practice Chi Massage.

Collect the energy, and practice Chi Massage.

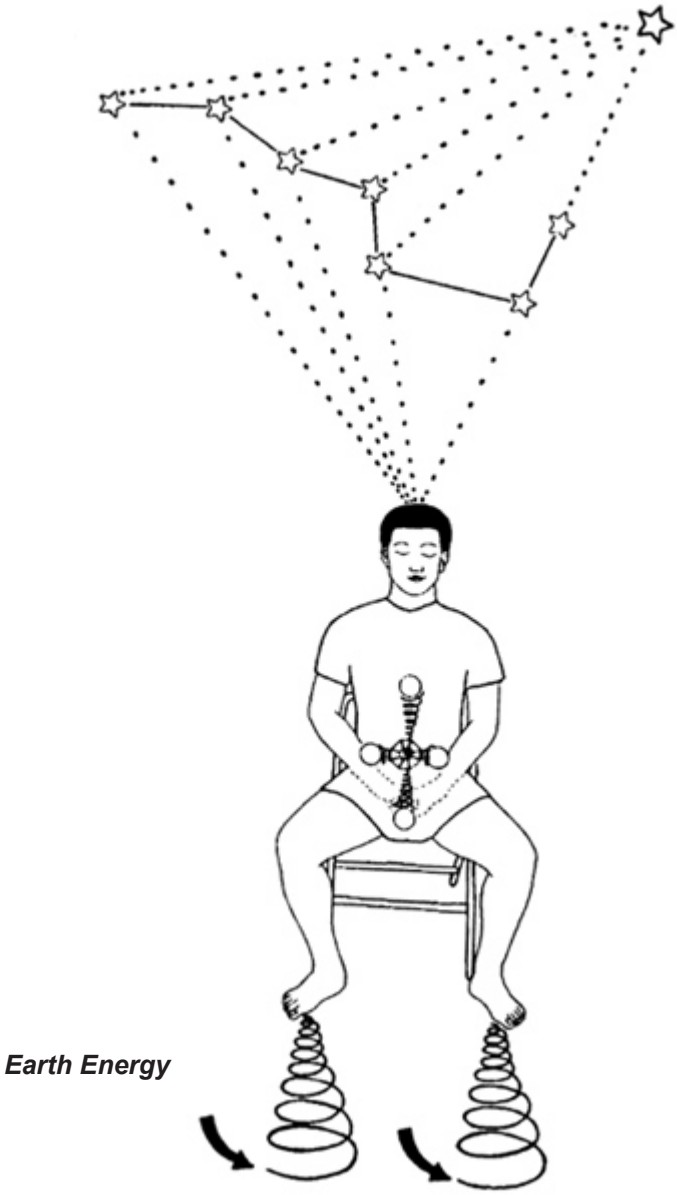

Fig. 4.8 *Once you have established the energies in all four pakuas and begin circulating the Microcosmic Orbit,simply be aware of the Earth Force, the Universal Force, and the Forces of the North Star and Big Dipper.*

Chapter 5

Formula 5: Creating the Pearl that forms the Energy Body

A. Procedure to create a more Advanced Pearl

Formula 5 incorporates Formulas 1 through 4 of Fusion I, and then continues to draw more energy into specific pakuas. The energies that have been brought to the front and back, and left and right pakuas are blended together. Then they are pulled into and condensed in the cauldron to create a more powerful pearl. The greatly refined and radiant energy of this pearl will be used to grow your soul or energy body.

B. Practice of Formula 5 to Create the Pearl

Smile down, and create the front pakua using what you have learned in Chapters 1 through 4.

1. Form the Front Pakua and Blend the Energy from the Front Collection Points.

Connect the senses to the organs, collect the energy in the organs' collection points, and blend the organs' energies and emotions in the front pakua. Begin with the kidneys' and heart's energies, then blend the liver's and lungs' energies, and follow with the spleen's energies.(Fig 5.1)

2. Form the Back, Right, and Left Pakuas and draw their Collected Energies into the Cauldron.

Be aware of the back pakua, its collection points, and all the energies you have collected from the connected senses and organs. Spiral the front and back pakuas to draw into, and combine their collected energies in, the cauldron. Be aware of the left pakua, its collection points, and all of the energies gathered there. Similarly, be aware of the right pakua, its collection points, and all of the energies now present there. Spiral the left and right pakuas to draw into, and combine their collected energies in, the cauldron.

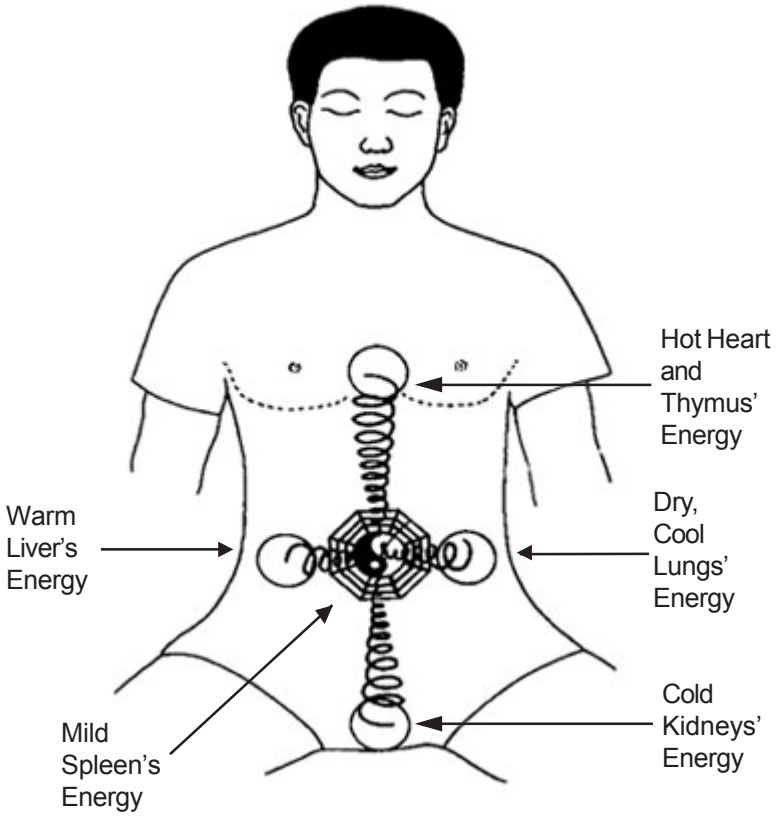

Fig. 5.1 *Front Pakua Collection Points*

3. Condense the Energies into a Refined Pearl.

Fuse together and condense the energies from all four pakuas in the cauldron to form the purified pearl of a brilliant, golden color.

C. Working with the Pearl.

Practice with the pearl is very advanced procedure.For some, it may take a long time simply to create one. Do not rush--impatience will dissolve your pearl. Each of the following stages must be mastered before going on to the next. (Such mastery becomes especially important when working with the pearl above the crown in the Fusion II practice.)

1. Circulate the Pearl in the Microcosmic Orbit.

Bring the pearl down to the perineum. Circulate it in the Microcosmic Orbit. As the pearl moves through the Microcosmic, feel the Universal, Cosmic Particle, and Earth Forces as sources of the energy supplied to you. Build up the momentum of the pearl.

2. Activate the Cranial and Sacral Pumps to open the Crown.

a. Cranial Pump (the Palatine Processes of the Maxillae)

To activate the Cranial Pump, press the tip of the tongue against the lower teeth and the flat of the tongue against the palate. Clench the teeth, tilt the chin toward the neck to straighten the cervical vertebrae, pull the eyes in, turn the ears, nose, and tongue toward the back of the head and turn all the senses upward to the crown. Feel the pulsation of the activated Cranial Pump. (Fig.5.2) (If you are a beginner, it may be easier to feel the pulsation at the crown by touching the pulse at your wrist.)

b. Sacral Pump

Activate the Sacral Pump by inhaling, pulling up the perineum, then inhaling again, and pulling up the back of the anus toward the sacrum. Inhale more, and pull the pearl from the perineum to the sacrum, up to T-11, C-7, the base of the skull, and the crown. moment you might feel a strong sensation, like a shiny wave of light, called the lead light, emerge from the crown.

NOTE: If you suffer from heart disease or have difficulty breathing, hold your breath only as long as you feel comfortable.

c. Inhale, and swallow your saliva. This action will help you push the pearl upward toward the crown.

d. Feel the crown open.

e. Be aware of the crown and its opening. Swallow the saliva upward and feel a push up to the crown. Exhale forcefully toward the crown, and shoot the pearl out through the crown to approximately six inches (15.24 centimeters) above the head. When your practice is more advanced, you can move it higher.

***Note*:** Use the power of the mind more than muscle power to activate the Cranial Pump.

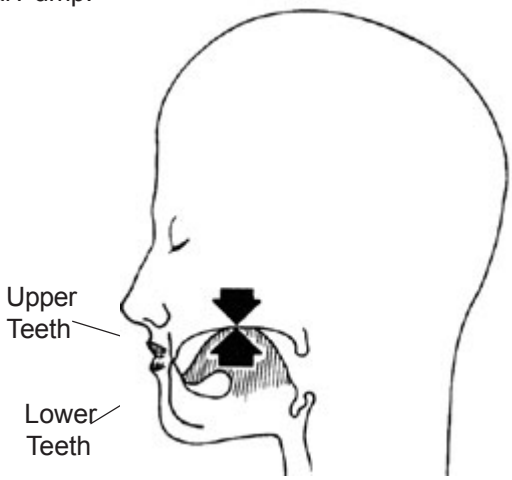

2.Clench the teeth to activate the temporal bone.

3. Press the chin toward the back to activate the occipital bone.

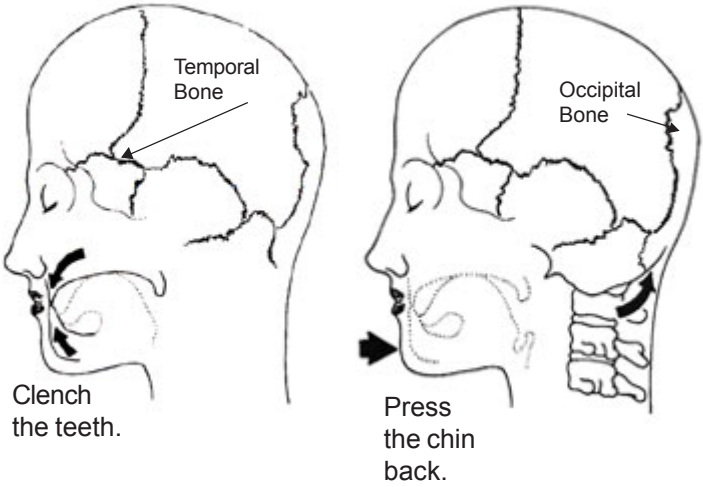

Fig. 5.2 *Activating the Cranial Pump*

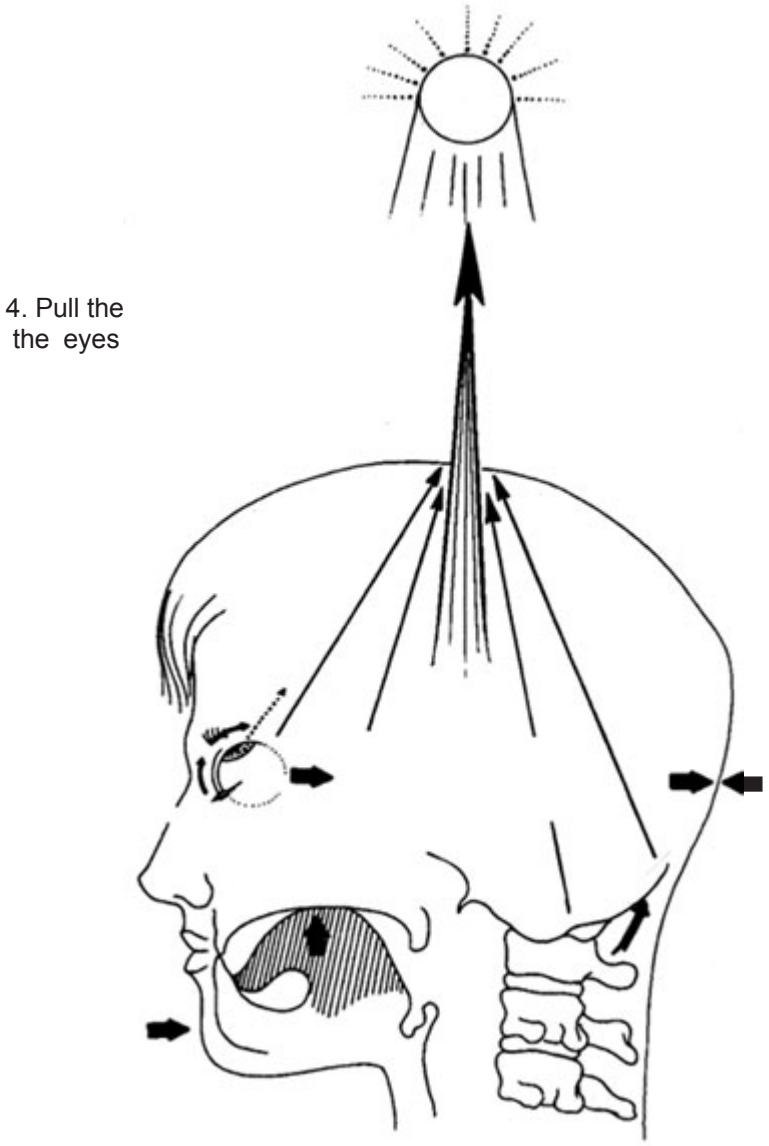

Fig. 5.2 *(Cont'd.) Turn all the senses upward toward the crown.*

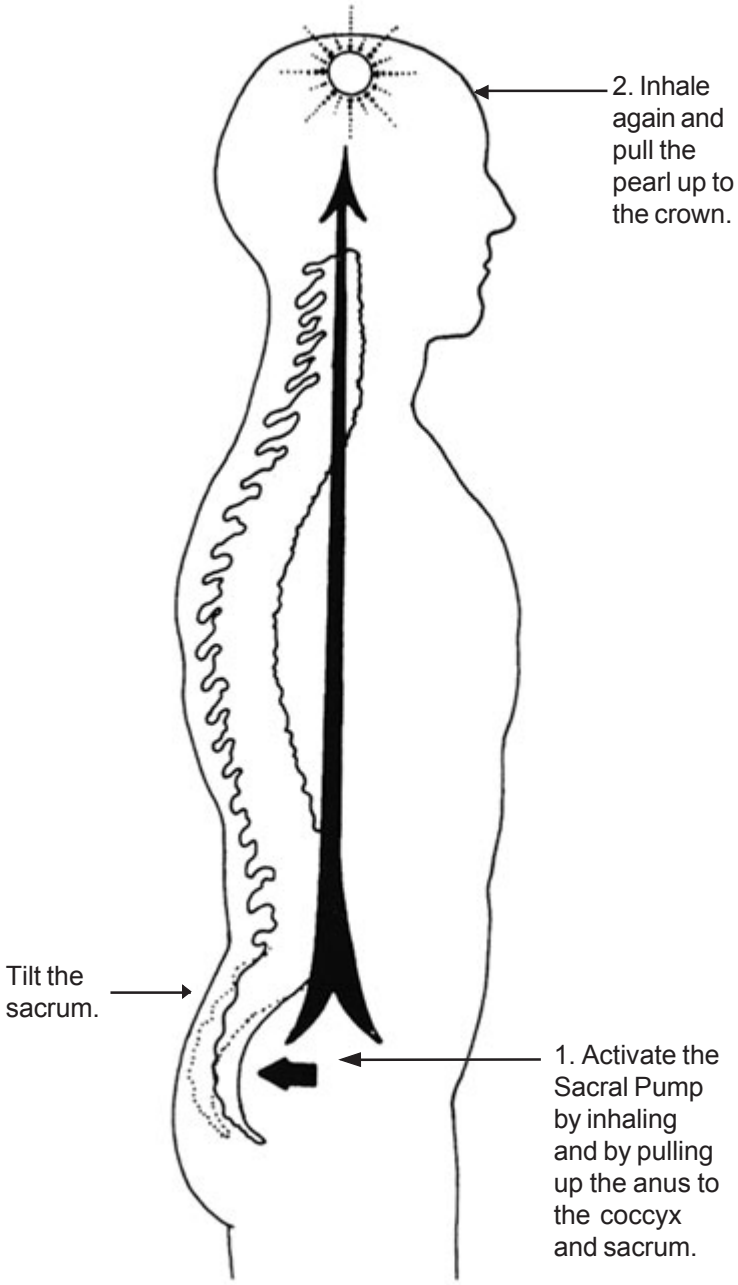

Fig. 5.3 *Activating the Sacral Pump*

3. Look for the Lead Light.

The lead light is the guiding light that can be felt through the crown. When in the advanced stages of practice you send the pearl out from the body to form the energy body, the light can be used by the energy body to communicate with the physical body. It can also be used as a compass to guide the energy body into the next world. (Fig.5.4)

4. Extend the Pearl above the Crown.

The senses now become the wireless control of the pearl. Begin by concentrating on moving the pearl up and down. With greater control, move it around in other directions.

5. Reactivate the Cranial Pump; Draw the Pearl Back into the Microcosmic Orbit of the Physical Body.

Inhale and reactivate the Cranial Pump. When the crown is open, inhale, and bring the pearl back into the Microcosmic Orbit. Collect the energy in the navel and bring it to the cauldron. Finish with Chi Massage.

6. Advanced Stage.

a. Controlling the Pearl above the Physical Body

Move the pearl up in increments of one foot (30.48 centimeters) at a time, and practice at each level until control is mastered. Ultimately you can bring it up to a level equal to the height of your body. At each level, first move the pearl up and down, then experiment with different directions: left and right, front and back. Then spiral it left and right, fast and slow, etc. Once you have reached a certain proficiency at moving the pearl at one level, continue to the next. (Fig.5.5)

7. Finish the Practice.

You can finish your practice now, or continue to the next exercise. If you decide to finish now, you can condense the pearl again, and activate the Cranial Pump. Inhale, pull the pearl in, and circulate it in the Microcosmic Orbit. Collect the energy in the navel, bring it to the cauldron, and finish with Chi Massage.

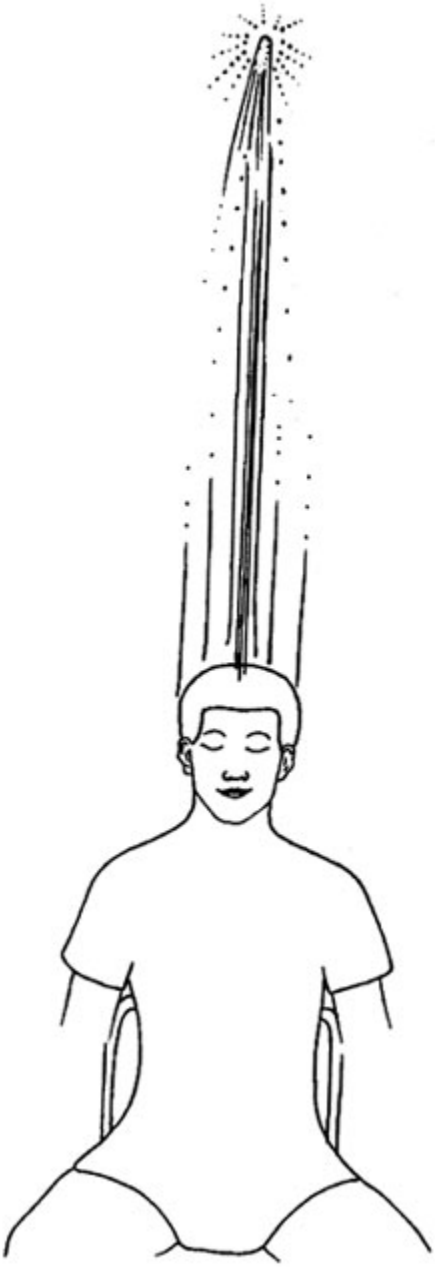

Fig 5.4 *The Lead Light*

D. Creating the Yin and Yang Bodies (the Soul Body or Energy Body and the Spirit Body) for Space Travel.

1. Energy Body is Born from the Original Force — Born Again.

The new Chi body that you will create in this Chapter is known as your energy or soul body, the body that will last forever. Most people are afraid of death, but need not be. The Taoist belief is that death is the spirit changing residence. Your physical body will return to the dust from which it came, but Chi, soul, and spirit come from the planets and stars and from the Original Force, the Wu Chi. In separating the soul and spirit from the physical body, you are practicing death and your return to the Wu Chi. In learning how to condense and transfer this energy, and send it back to the planets and stars and to the Original Force, you can be assured that your energy will continue as part of the universe.

Fig 5.5 *Controlling the Pearl above the Physical Body*

2. Energy Body is like a Newborn Infant.

During the course of a few thousand years of developing the energy and spirit bodies, the Taoists realized that the process could not be rushed. Developing the soul and spirit bodies is similar to taking care of a newborn infant. The infant needs to be nourished and cared for. As he or she grows up, the child needs to be educated and trained to the fullest potential. The child also needs to be equipped with the power to protect himself or herself.

The early, undeveloped stage in the creation of the energy body was regarded by the Taoists as the Yin body or infant stage.
In this infant stage,you do not let your energy body roam about without control, just as you would not allow a baby to crawl about unsupervised.

3. Yin Body's Transformation to a Yang Body marks the Beginning of the Transference of Consciousness.

With practice the Yin body can gradually change into more of a Yang body. The transformation into a Yang body is initiated by a transference of consciousness. The process begins in Chapter 5 of Fusion I with the transference of the Microcosmic Orbit into the energy or soul body. The process continues with the practice of Fusion II and III in which the virtue energies from the organs, the Belt Channel, the Thrusting Channels, and other channels are extended from the Yin physical body up into the energy body. During this process the soul takes on a Yang quality. As your practice continues a spirit body is formed that is also a Yang body, capable of traveling in space and capable of self-care.

4. Purpose of Traveling in Space

The main goal of your practice with the UniversalTao is to travel a higher plane of energy:

a. The energy needed for absorption that helps develop the soul and spirit bodies is not available on the human plane.

b. By traveling to a higher plane of energy, you are practicing your return to the Wu Chi, the Original Source from which you came.

c. In space traveling the combined soul and spirit bodies you have developed can travel very fast. The speed is believed to be faster than the speed of light. It now becomes possible to encounter

the souls and spirits of people who already have passed from their human lives.

d. Some people travel to a different time, such as the time before they were born into their Earthly lives. This ability also enables them to see into the future.

In Taoism and other systems, practitioners try to avoid those elements that in the past or future comprise their Earthly lives.Their aim is to try to return to the place of their origin, a place they would like to be. If, as in normal Earthly traveling, you continuously stop to talk to people, it will take much longer to arrive at your destination, or you may never arrive at all.

E. How to Develop the Energy Body.

1. Using a Pearl to Create the Energy Body.

a. The energy body is created by using the pearl. You can continue to use the pearl you have already developed, or, if you are starting fresh, create a pearl by practicing Chapters 1 through 5 again.

b. Circulate the pearl in the Microcosmic Orbit.

c. Inhale, activate the Cranial and Sacral Pumps, and shoot the pearl through the crown of the physical body. Bring the pearl to a level above and equal to the height of your physical body.

2. Creating the Energy Body.

a. Relax the senses and the mind, and then use them to expand the pearl. (Fig. 5.6) Begin to shape the pearl into a form similar to your own body, or into the image you would like your body to be. Initially it might feel like a great mass of energy. (Fig. 5.7) Use your senses like carving tools to shape the head, body, hands, and legs. (Fig. 5.8)

If you prefer a religious conceptualization, your goal may be to form the image in the likeness of God, or perhaps the founder of your religion, such as Buddha. Taoists believe all humans are built in the image of God, since all people come from the Original Force.

b. Once you sense the body is in good shape, use your senses again to carve the face.

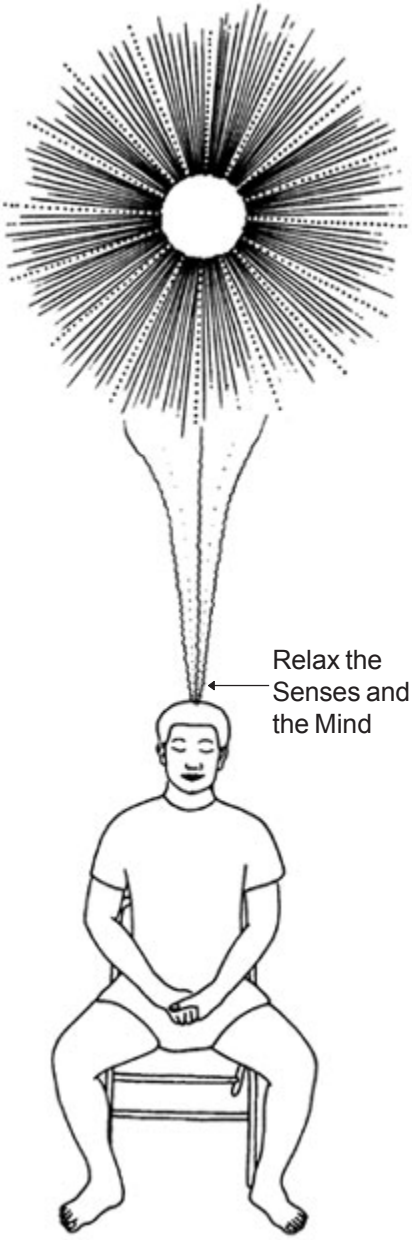

Fig. 5.6 *Relax the Senses and Mind; Let the Pearl expand.*

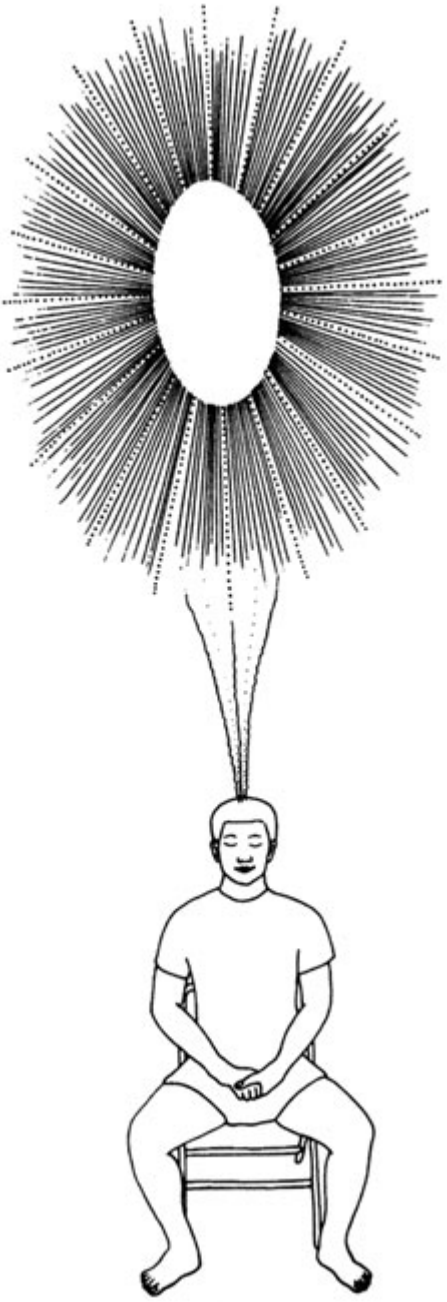

Fig. 5.7 *The Pearl might feel like a Great Mass of Energy.*

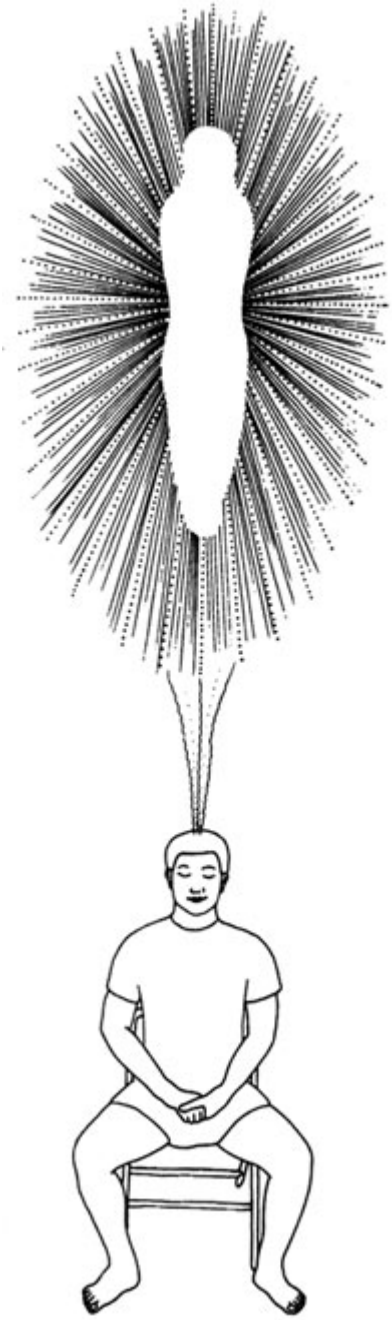

Fig. 5.8 *Continue expanding the Pearl into an Energy Body.*

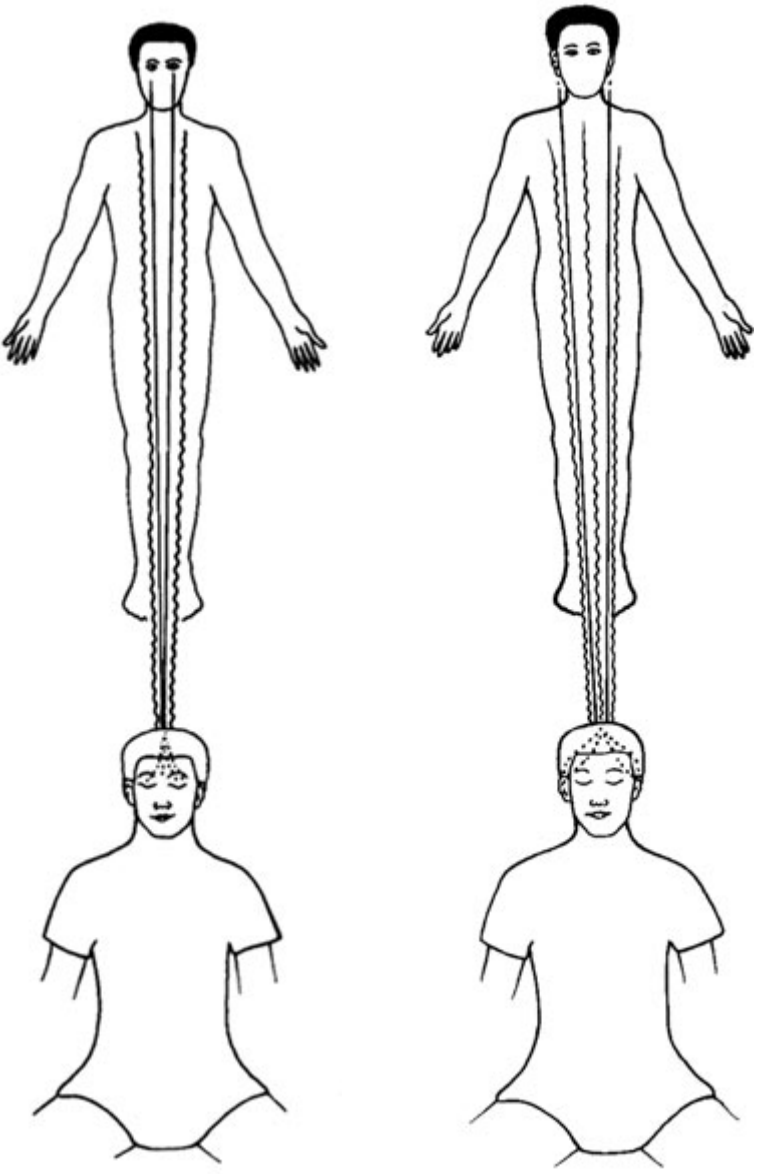

Fig. 5.9 *Forming the Energy Body's Eyes.*

Fig. 5.10 *Forming the Energy Body's Eyes.*

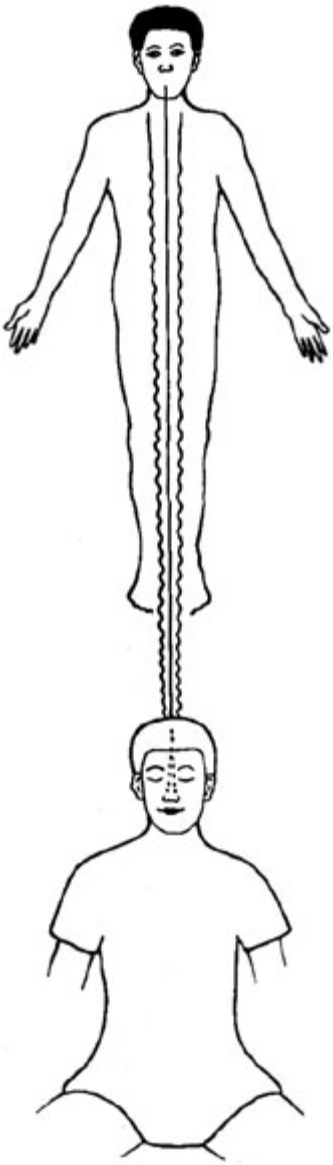

Fig.5.11 *Forming the Energy Body's Nose.*

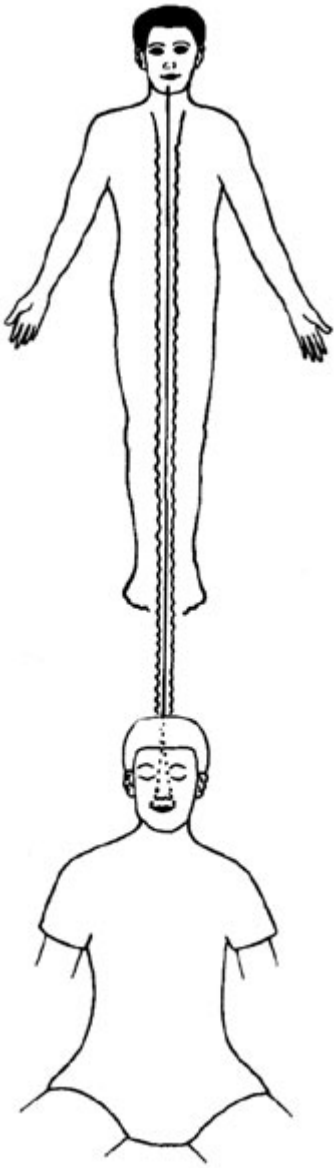

Fig. 5.12 *Forming the Energy Body's Mouth.*

(1) To form the eyes, focus on the eyes of the physical body. When you feel a very strong awareness of these eyes, condense their essence into a ball. Activate the crown, and exhale the ball to the place on the face of the energy body where the eyes will be positioned. Feel and affirm that the eyes of the energy body have been formed. (Fig. 5.9)

(2) Be aware of the ears. When you feel the essence of the physical body's ears is condensed into an energy ball, transfer it to the energy body's ears. (Fig.5.10)

(3) Be aware of the nose, and. in a similar way, transfer it up to the energy body. (Fig.5.11)

(4) Be aware of the mouth, and similarly transfer it up to the energy body. (Fig.5.12)

(5) Be aware of the tongue, and also transfer it up to the energy body.

c. Now you can form and arrange the senses of the energy body into shapes you like. You can make the nose longer or higher on the face, the eyes smaller or bigger, or the mouth wider or smaller.

d. Copy the cauldron within the physical body to the energy body by ating on it. When you feel the energy is very condensed, shoot it up through the perineum of the energy, body.

e. Now you can make the energy body the sex of your choice.

f. When you feel the energy body is fully grown, or formed into a very sharp image, you can give it an inner name and associate this name with it in the future. Then, in later practice, simply call the name of the energy form, and the whole process will take place instantly. It is best to keep the soul or energy body name to yourself, so that you will be the only one who can activate it. This is important because in more advanced stages of practice, a person with bad intentions who knows your soul name can activate it and make use of it. This means that person can steal energy from the energy body, or tell the soul to do something that is bad or evil. If this happens, you will have to change to a new name or code for your energy body.

g. In addition to associating the energy body with an inner name, you can also associate the energy body with an inner voice or inner voices.The inner voice (or voices) will give you advice to help you make decisions.The more you listen to the voice(s),the clearer it (or they) will become. As You begin to develop more virtue energy, the voice(s) will become more distinct. This will help you make

choices between good or bad, help you to choose friends, etc.

3.Transferring the Microcosmic Orbit to the Energy Body.

The energy body is a Chi body that offers no resistance, and so it is very easy to open its Microcosmic Orbit. Creating the energy body and transferring the Microcosmic from the physical body to the energy body is the first transference of consciousness you will experience in your practice.

Each day as you work on this stage of Fusion, you transform more consciouсness to the energy body. At this stage, the energy body is simply a powerful projection of your mind and your physical body. At higher levels of practice, this energy body is crystallized into a permanent spiritual body.

a. Create another pearl in the cauldron and circulate it in the Microcosmic of the physical body.

b. Inhale, activate the Cranial and Sacral Pumps, activate the lead light, and aim the lead light at the perineum of the energy body. Shoot this pearl through the crown of the physical body and penetrate the perineum.

c. Use the senses to move the pearl up to he energy body's sacrum. Stop for a while and feel the pearl establish itself at the sacrum point.Then move the pearl up to the Door of Life, T-11, C-7, base of the skull, crown, Third Eye, tongue, throat, heart, solar plexuus, navel, sexual center, and perineum, completing the Microcosmic Orbit of the energy body. Another way to transfer the Microcosmic is simply to copy the Microcosmic of the physical body. (Figure 5.13)

4. Forming a Protective Shield Around the Energy Body.

a. Form another pearl in the physical body, and circulate it in the Microcosmic Orbit of the physical body until it gains momentum.Once it has gained momentum, and upon its return to the perineum of the physical body, begin to move the pearl up again through the physical body as follows:

(1) Inhale and activate the Cranial Pump. Contract the perineum the anus, and the back of the anus. Pull the pearl up to the sacrum, Door of Life, T-11, C-7, base of the skull, and toward the back of the crown to a point about one and a half inches behind the crown. Hold at this point.

(2) Feel the pulsation at the back of the crown. Exhale and shoot the pearl out. Use the pearl to form a bubble to cover the entire energy body.

5. Forming a Great Bubble Encasing Both Bodies as a Protective Shield

a. Form one more pearl. Circulate this pearl in the Microcosmic Orbit of the physical body to gain momentum. Stop again at the perineum of the physical body.

b. As above, pull the pearl all the way up the Governor Channel of the physical body to the point one and a half inches behind the crown. Shoot it out from this point to encircle the energy body', bringing it all the way down to cover the physical body as well. You now have formed a great bubble encasing both bodies and the protective shield of the energy body. (Fig.55)

c. Be aware of the energy body, the physical body, and the bubbles that form the protective shields around both bodies. Also be aware of the energy above the energy body and below the physical body.

6. Drawing in the Energy Body and the Big Protective Bubble to Finish the Practice

a. When you are ready to finish this practice, first absorb as much as possible of the Heavenly Force once more.

b. Condense the energy body into a pearl still surrounded by the bubble that serves as its protective shield. Notice that the color of the pearl may now be brighter, or the pearl may have grown larger.

c. Be aware of the Big Bubble that continues to protect the physical and energy bodies and the energy body's bubble as a great protective shield.

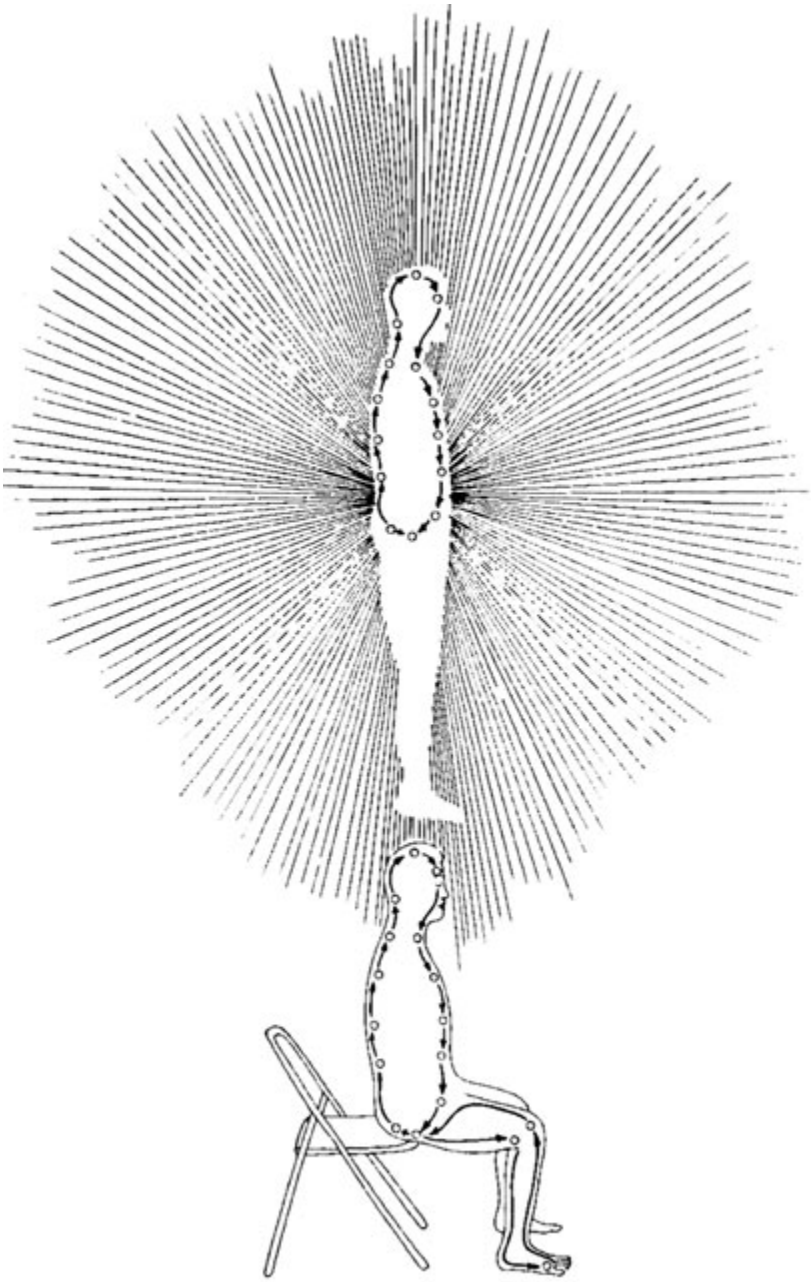

Fig. 5.13 *Shoot the pearl to the perineum of the energy body to open its Microcosmic Orbit. Circulate both Microcosmic Orbits.*

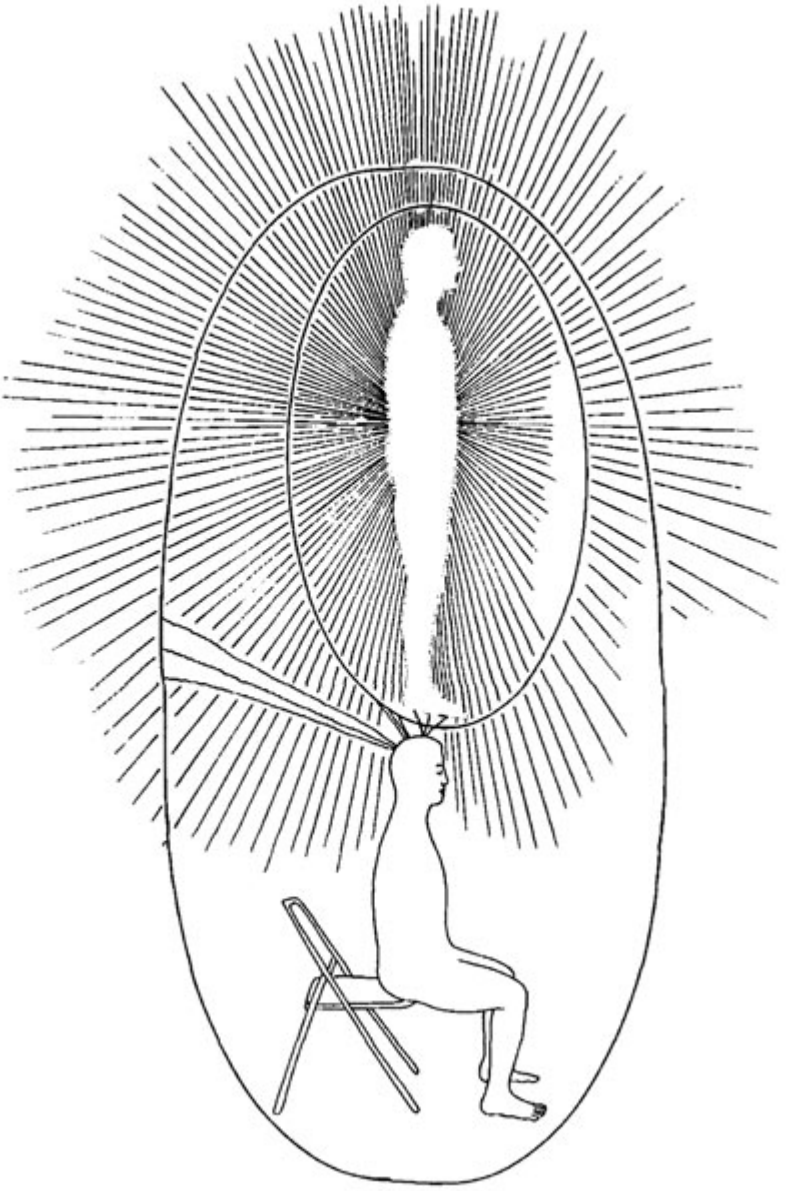

Fig. 5.14 *Forming an Energy Body, its Protective Shield, and a Great Bubble to protect all.*

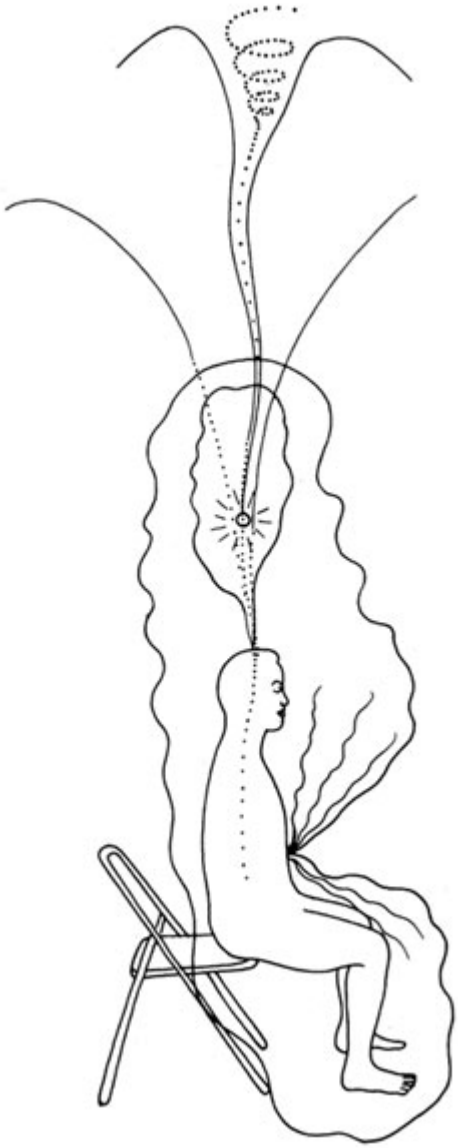

Fig. 5.15 *Shrinking and Drawing in to the crown and into the navel of the Energy Body's Bubble.*

5. Forming a Great Bubble encasing Both Bodies as a Protective Shield.

a. Form one more pearl. Circulate this pearl in the Microcosmic Orbit of the physical body to gain momenum. Stop again at the perineum of the physical body.

b. As above, pull the pearl all the way up the Governor Channel of the physical body to the point one and a haft incches behind the crown. Shoot it out from this point to encircle the energy body, bringing it all the way down to cover the physical body as well. You now have formed a great bubble encasing both bodies and the protective shield of the energy body. (fig. 5.14)

c. Be aware of the energy body, the physical body, and the bubbles that form the protective shields around both bodies. Also be aware of the energy above the energy body and below th physical body.

6.Drawing in the Energy Body and the Big Protective Bubble to Finish the Practice.

a. When you are ready to finish this practice, first absorb as much as possible of the Heavenly Force once more.

b. Condense the energy body into a pearl still surrounded by the bubble that serves as its protective snield. Notice that the color of the pearl may now be brighter, or the pearl may have grown larger.

c. Be aware of the Big Bubble that continues to protect the physical and energy bodies and the energy body's bubble as a great protective shield.

d. Inhale and activate the Cranial Pump. Feel the pulsation. Feel the lead light extend out from the crown point.

e. Inhale and slowly use the mind and senses to draw in the pearl. Inhale again and use your mind to guide the pearl to land on the opening of the crown where the lead light emerges. Inhale once more with force to pull the pearl down from the crown through the front channel.

f. Circulate the pearl in the Microcosmic Orbit. As the enhanced pearl moves around the Orbit, it will bring its heightened energy to the organs and glands. Any part of the body that requires it will absorb it.

g. Be aware of the energy body's protective bubble remaining above the physical body and within the big protective bubble. Be

aware of the crown and the point one and a half inches behind the crown. Inhale and draw the energy body's bubble through the crown and the point one and a half inches behind it. Inhale and draw the energy body's bubble through the crown and the back of the crown into the Microcosmic Orbit, and add this energy to the pearl that is already circulating.

The energy that now circulates in the Microcosmic is the combined energy body and protective bubble energy that has been drawn into the physical body. The great bubble that surrounded both the energy and physical bodies and the energy body's bubble remains and continues to surround and protect the physical body.

h. Begin slowly to trim down the big bubble that continues to surround the physical body by condensing or shrinking it and drawing it in through the point one and a half inches behind the crown. Add this energy to the pearl that is circulating in the Microcosmic Orbit.(Fig.5.15)

i. Bring the pearl down the front channel to the navel.

j. The remaining protective shield can be drawn in closer and tighter to the physical body by drawing this energy in through the navel. Feel the energy remaining as the bubble on the outside of the physical body as it pulls in tightly to cover the body. You are now protected from within and from without by this protective shield. As your practice continues, you can continue to form new pearls and additional protective shields.

k. Return the pearl to the cauldron. Spiral and condense the energy.

l. Practice Chi Massage.

Chapter 6

Part Two: Fusion I Meditation Advanced Practice of Fusion I

Chapters 6 through 9

The chapters of Part Two describe energy in images. These images are used to enhance, empower, and protect the organs' energies as you create a more powerful pearl and form a stronger energy body.

The Taoists theorized that, like water, energy is formless. Without giving energy a form, it is difficult to capture its force. Just as water takes on the shape of the jar or pot that contains it, energy can take on the shape of the vessel into which it is placed. Regardless of the vessel's shape, the qualities of the water remain unchanged. Yet, by being contained in the vessel, it becomes easier to use. For example, because you can carry the water, you now can pour the water into a specific place. In doing so you are establishing a connection between the water and that place. Similarly, giving energy a form while retaining its purity helps to establish connections for usage.

Consider religious statues of gods or saints. To help religious devotees form a picture and establish a connection between themselves and a power greater than themselves, an image is created representing and giving form to that power. Once a more understandable picture is formed in the individual's mind of that power, that person can more readily connect with its positive energy. This is the secret power of visualization behind all the world's religions, whether it be the image of Jesus, the Virgin Mother and Holy Child, Buddha, the sacred geometry of Islam, or the numerous gods and goddesses of Hinduism, the Greeks, the Romans, or the ancient Egyptians.

Formula 6

Forming the Virgin Boys or Girls and their Animal Offspring to Connect to the Universal, Cosmic Particle, and Earth Forces

A. Using Images of Children and Animals to give Form to Pure Energy.

It is desirable to connect with the positiveness and usefulness of energy, and the pictures and images established by the early Taoists become very helpful in making this connection. As a cup or bowl becomes a container to hold water, and as the religious statues, structures, or vessels made from wood, rock, gold, or silver contain a certain power or force, the Taoist images of children and animals also contain energy. Regardless of the shape and material of the container, no one is better than another. All hold the same energy.

The Taoists images of the innocent virgin boy or girl used in association with an emotion are readily acceptable images for most people. This is probably because most people have had experiences dealing with youth or an innocent child.

The Taoist animal associations may seem a little unusual since modern people associate more with domestic animals—dogs, cats, birds. Further, different countries tend to associate themselves with different animals. Below are the animal associations the early Taoists used. You may choose to use different animals or different images, such as a ruby at the heart, an emerald at the liver, etc.

Usually people are more observant of the problems of other people or animals than they are of their own. When a child, another person, or an animal gets sick, they need care. When they feel depression, fear, or anger, it is a reflection of their inner state. You have to care for them until they heal or overcome such negative emotions. Be aware of the virgin children and animals and keep them in good spirit, and you will be taking care of your internal self.

B. Practice of Forming the Virgin Boys or Girls and their Offspring in the Forms of Animals

1. Pure Energy from the Kidneys produces the Blue Virgin Child and the Deer.

a. Return your attention to the kidneys and the kidneys' collection point. Sense if the kidneys are cleansed of all negative emotion. This can be clearly indicated by a bright, illuminating blue color, or a strong feeling of calmness and gentleness. Spiral the kidneys' essence to their collection point until the collection point glows with bright light as the feeling of gentleness intensifies.

b. Once the intense, bright color and the sensation of gentleness peak, form the blue light into the image of a virgin boy or girl dressed in the blue color. This image represents the purest form of gentleness. Picture the boy or girl breathing out a blue breath. When enough of the blue breath accumulates, watch it transform into a beautiful deer with antlers. The deer represents a more refined, purer energy of the gentleness virtue. It is the pure essence and consciousness of the kidneys, and can be transformed for the creation of and use by the soul and spirit bodies. Make a strong connection with the virgin child and the deer, and instantly, at any time, you can restore a sense of calmness and gentleness within yourself. (Fig.6.1)

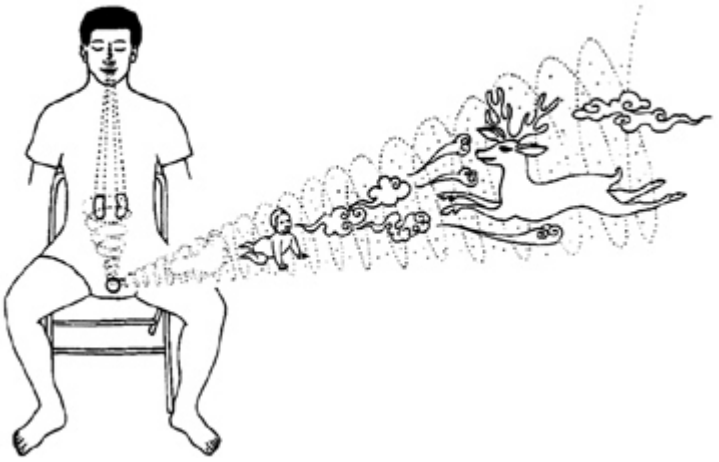

Fig. 6.1 *Blue Virgin Child and Deer from the Kidneys*

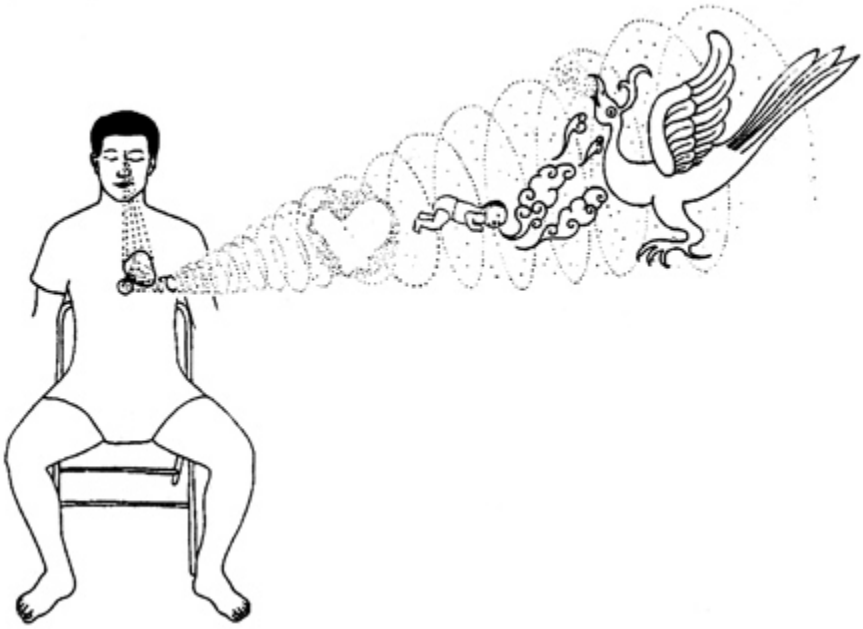

Fig. 6.2 *Red Virgin Child and Pheasant from the Heart*

2. Essence of the Heart produces the Red Virgin Child and the Pheasant.

a. Be aware of the heart and its collection point. Picture the heart's collection point illuminating with bright, red light and feel a strong sensation of love and joy, the virtues of the heart.

b. At the most intense moment of color and feeling, form the glowing red light into a virgin boy or girl, dressed in the red color. Watch the boy or girl breathe out a red breath, or sense the love, joy, and happiness. Form the breath or the feeling into a red pheasant.

Make a strong connection with the virgin child and the pheasant, and instantly, at any time, you can restore a sense of love, joy, and happiness within yourself. (Fig. 6.2)

Fig 6.3 *Green Virgin Child and Dragon from the Liver*

3. Pure Energy from the Liver produces the Green Virgin Child and the Dragon.

a. Concentrate on the liver and its collection point until you can picture the liver's collection point illuminating with a green light or feel an overwhelming sense of kindness.

b. When the green color is its brightest, or when the feeling of kindness peaks, form the color or feeling into a virgin boy or girl wearing the color green. Watch the boy or girl breathe out a green breath, or feel the intense kindness, and form it into a green dragon.

Make a strong connection with them, and instantly, at any time, you can restore a sense of kindness within yourself. (Fig.6.3)

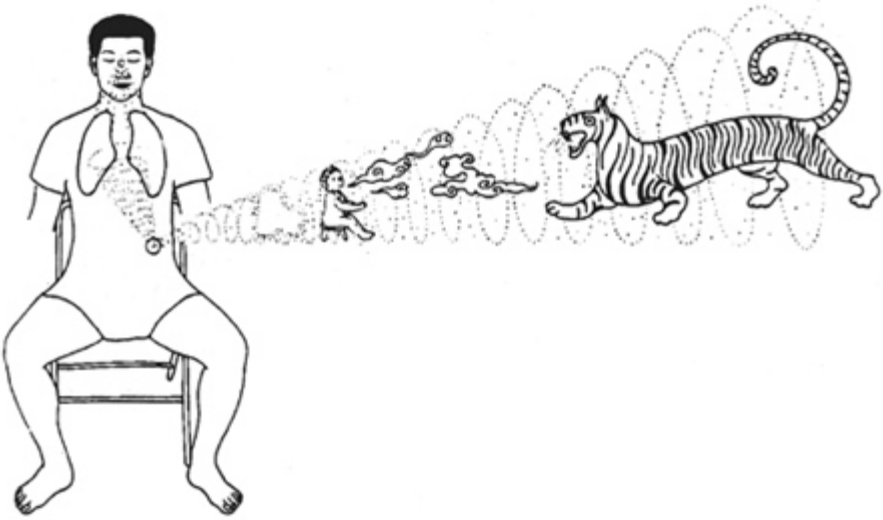

Fig. 6.4 *White Virgin Child and Tiger from the Lungs*

4. Lungs' Essence produces the White Virgin Child and a Tiger.

a. Be aware of the lungs and their collection point. Make the collection point luminous with a bright white or metallic color or feel the powerful virtue of courage.

b. When the vision of color or sensation of courage is strongest, form it into a virgin boy or girl dressed in the color white. See the virgin boy or girl breathe out a white breath, or feel the sensation of intense courage. Change it into a white tiger.

Make a strong connection with them, and instantly, at any time, you can restore a sense of courage within yourself. (Fig. 6.4)

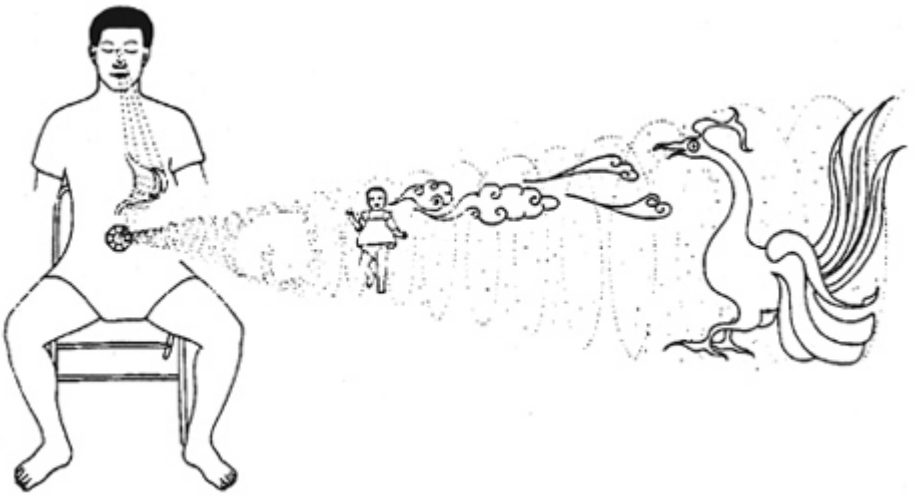

Fig. 6.5 *Yellow Virgin Child and Phoenix from the Spleen*

5. Pure Energy of the Spleen produces the Yellow Virgin Child and the Phoenix.

a. Concentrate on the spleen and its collection point at the front pakua, Observe as the spleen and the front pakua illuminate with a yellow light or sense the strong feelings of openness and fairness.

b. When the color yellow, or the feelings of openness and fairness are very intense, transform the color or feelings into a virgin boy or girl dressed in yellow. The virgin breathes out the yellow breath or the feeling of openness or fairness increase, and the transformation into a phoenix occurs.

Make a strong connection with them, and instantly, at any time, you can restore a sense of openness and fairness within yourself. (Fig. 6.5)

The brighter the colors, or the more intense the feelings of virtue, the purer the indication of virtue and, so, good health.

C. Use the Virgin Boy or Girl and the Animals to form Protective Rings inside the Body.

Beginning at the liver's collection point with the virgin child and the green dragon, begin a circle up to the virgin child and red pheasant of the heart's collection point. Then continue the circle down to the virgin child and the white tiger at the lungs' collection point, and down to the virgin child and the blue deer at the kidneys' collection point. The virgin child and the yellow phoenix are at the front pakua which is in the middle of the four points of the circle.

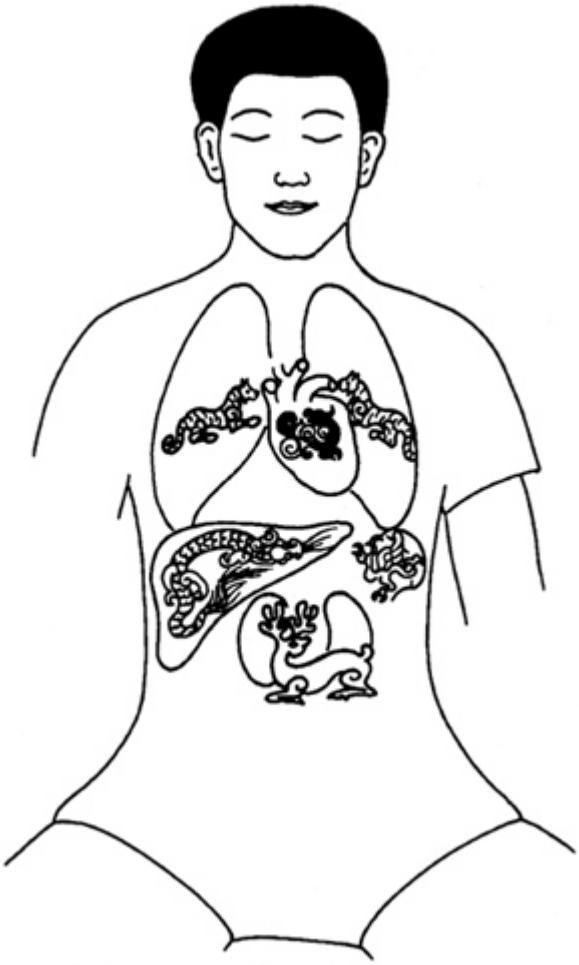

Fig. 6.6 *Protective Ring of the Organs' Earth Animals*

These “power animals” form a protective outer ring around your organs. (Fig. 6.6) In the inner ring are your virtue energies crystallized into the different colored virgin boys or girls.

You may choose to create different “power animals” to protect yourself. While meditating on each organ, you can simply ask, Is there a protective animal that is willing to defend my kidneys-water energy? , etc. If no animal appears you may ask for a “power crystal” or a “powerful warrior(s)” to serve you in your spiritual work.

D. Pearl connects with the Universal, Cosmic, and Earth Forces to supply Energy to the Children and Animals.

The pearl will be the center of the gathering of the children and the animals and is enhanced by them. If the pearl dims or disappears, the children and the animals become hard to form.

a. Be aware of the pearl at the cauldron. Feel it shine with the bright light of the silvery or bluish-white color of a pearl.

b. Be aware of the four pakuas, the organs’ collection points, the organs, senses, and their energies.

c. Move the pearl down to the perineum and into the Microcosmic Orbit. As the pearl moves through the Microcosmic, feel the Universal, Cosmic Particle, and Earth Forces supplied to the pearl. As the pearl moves, the children and the animals can take energy from the pearl as they need it. This energy, in turn, will help to strengthen the organs physically and spiritually.

d. If you wish to continue to the next chapter, there is no need to collect the energy now.

E. Finish the Meditation.

1. To finish, collect the energy, move the pearl into the cauldron, and spiral to condense the energy there.

2. Be aware of the animals and absorb them into the child to which each belongs; the deer to the blue child, the pheasant to the red child, the dragon to the green child, the tiger to the white child, and the phoenix to the yellow child.

3. Be aware of the organs and the child belonging to each one: the blue child to the kidneys, the red child to the heart, the green child to the liver, the white child to the lungs, and the yellow child to the spleen. As you absorb the children into the organs, sense each organ illuminating with a brighter light. This bright light indicates a healthier organ containing a good energy.

4. Practice Chi Massage.

Chapter 7

Formula 7: Call forth the Earth Force to Empower and Protect

When the impure organ energy (negative emotional energy) has been cleared from the organs and their collection points, they will illuminate with a light that will project outward and attract the Earth Force. Once you clearly feel the Earth Force and are able to formulate a very intense picture of the traditional Taoist animals, these images can serve as vessels to make it easier to capture and retain the Earth Force. This is especially true when you are well-practiced. Again, you might have chosen a ring of different magnificent colored flowers or a ring of mighty trees to serve as your Earth Force guardians.

A Pure Kidneys' Energy attracts the Earth Force in the Image of a Big, Blue/Black Turtle.

1. Sit facing South.
2. Be aware of the kidneys and the kidneys' collection point as they illuminate with bright blue light.
3. Sense the virgin child and the deer. When you experience them very intensely, spiral at the collection point. Then exhale through the point. Use the mind and the power of the senses to project an intense wave of gentleness forward to the front, or South, side of the body.

The elemental forces are omnipresent. This means that the Five Elements of the Earth Force exist everywhere on Earth. Therefore, you can project the force out in any direction, although in the beginning you will find that it is much easier to project the force to the front. (***Note:*** Illustrations 7.1 through 7.6 demonstrate projecting the force to the front of the body.) When you are well-trained, it is possible to project the force to a specific direction associated with the force you want to attract. For example, the force of gentleness can be projected backward, to the North.

The important thing to remember is that whatever kind of force you project out of the body will be the kind you will call forth, regardless of the direction. Just like casting out a baited fishing line to catch a fish, your success will depend on the size of the bait (or your own force) that you project.

4. The greater the force you can project, the greater the amount of watery Earth Force you will attract.

5. You can sense the force. If you are a more visual type of person, you might see a bright blue force. If you are a more kinesthetic type of person, you might feel the gentleness or calmness of the force.

6. The turtle is the Earth Force of the North. Once you feel the Earth Force very intensely, picture the form of a big turtle (also known as the Black Warrior). Put it on your back to protect your back, or North, side. (Fig.7.1)

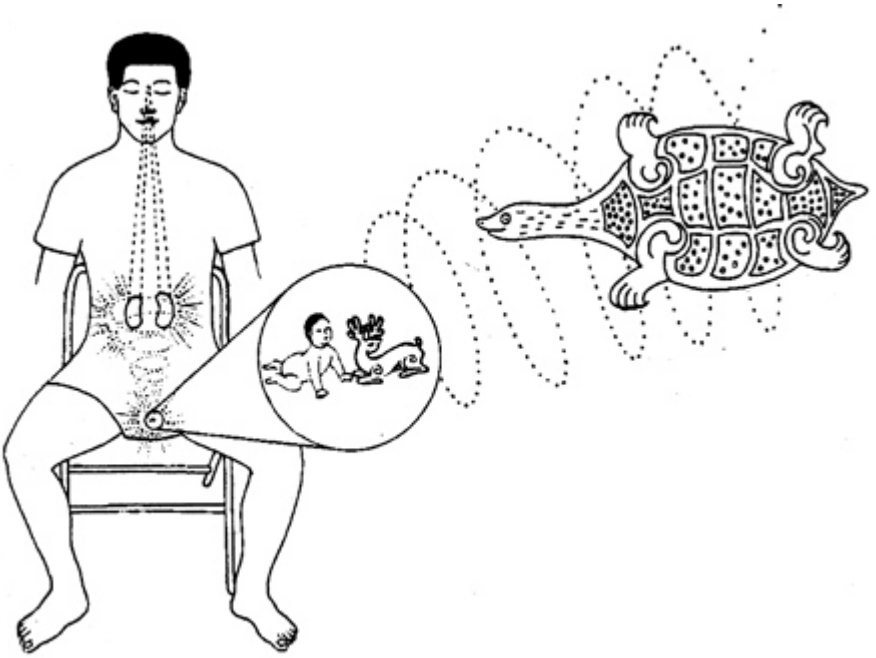

Fig. 7.1 *Kidneys, shown projecting to the Front, attract the Turtle Earth Force of the North.*

B. Pure Heart's Energy attracts the Earth Force in the Shape of a Red Pheasant.

1. Continue facing South in a seated position.
2. Become conscious of the heart and the heart's collection point.
3. Sense the organs as they illuminate with red light until the virgin child and the pheasant are perceived clearly.
4. Spiral the force at the heart and heart's collection point. Project your force out of the body to its front or South side to call forth and attract the fiery force of Earth.
5. The pheasant is the Earth Force of the South. When you sense the bright red color, or sense love and joyful energy very intensely, form a pheasant to capture the fire force of the Earth. Place the pheasant on your front or South side for protection. (Fig.7.2)

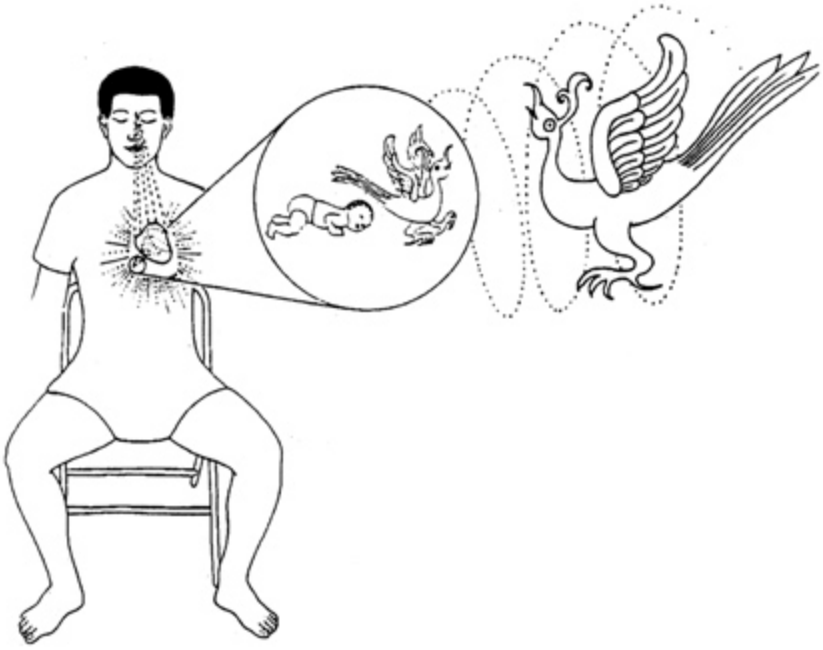

Fig 7.2 *Heart, shown projecting to the Front, attracts the Pheasant Earth Force of the South.*

C. Pure Liver's Energy attracts the Earth Force in the Image of a Green Dragon.

1. Continue to sit facing South. Be aware of the liver and the liver's collection point.

2. Sense the organ's illumination with green light until the virgin child and the green dragon are perceived clearly.

3. Spiral the force at the liver and the liver's collection point. When you feel the energy very intensely at the collection point, project your force out of the body to the front side to attract the wood force of the Earth. (If you are able, project the force to the body's East or right side.)

4. When you sense this green force; or sense kindness very intensely, form a green dragon to retain the wood force of the Earth. Move the dragon to the body's East or right side for protection. (Fig. 7.3)

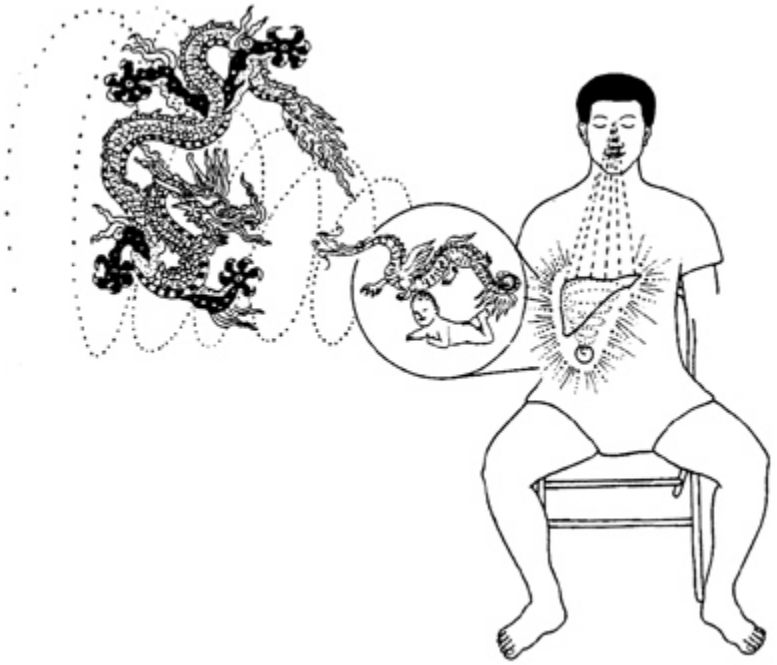

Fig 7.3 *Liver, shown projecting to the Front, attracts the Dragon Earth Force of the East.*

D. Pure Lungs' Energy attracts the Earth Force in the Image of a White Tiger.

1. Continue to sit facing South. Become conscious of the lungs and the lungs' collection point.

2. Sense this organ's illumination with a white light until the virgin child and the white tiger are clearly sensed.

3. Spiral the force at the lungs and the lungs' collection point. When you feel the energy intensify at the collection point, project your force out of the body to the front, or South, side to attract the metal force of the Earth. (If you are able, project the force out to the body's West or left side.)

4. When you have a strong sense of the white force of the Earth's metal energy, or sense courage strongly, form a white tiger. Move the tiger to the West, or left side of the body for protection.(Fig.7.4)

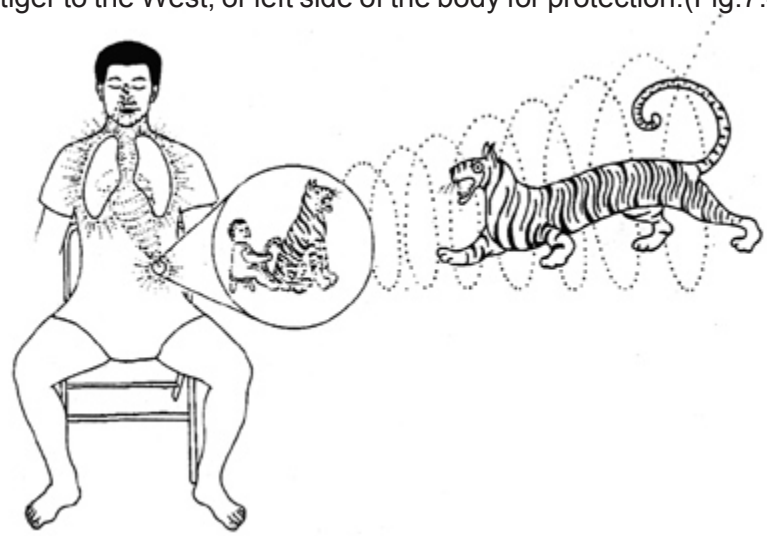

Fig. 7.4 *Lungs,shown projecting to the Front, attract the Tiger Earth Force of the West.*

Note: When there is a need for balance in the liver or the lungs, it is possible to call forth their two Earth animals to each other's internal animals. For example, the green dragon of the liver, found internally on the right side of the body, can attract the Earth tiger force associated with the lungs. The Earth tiger force would then be placed on the left side of the body to attain balance in the liver. The same is true of the internal white tiger of the lungs and the

dragon Earth force, with the Earth dragon placed on the right side to give balance to the lungs. This method of balance applies only to these two forces.

E. Pure Spleen's Energy Attracts the Earth Force in the Image of a Yellow Phoenix.

1. Continue to sit facing South. Be aware of the spleen and the spleen's collection point.

2. Sense the spleen's illumination with a bright yellow color, or experience a strong sense of fairness and openness.

3. Spiral the force at the spleen and the spleen's collection point. Once you feel an intense energy at the collection point, project your force out of the body to the front, or South, side to attract the Earth Force. (If you are able, project the force up through the center of the body through the top of the head.)

4. When you strongly sense the yellow force of the Earth's energy, or intensely sense fairness and openness, form a phoenix. Move it to the middle of the top of the head for protection. (Fig. 7.5)

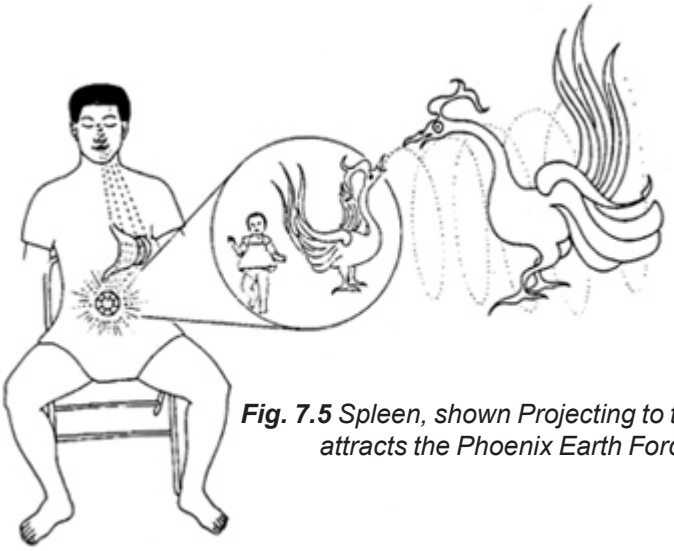

Fig. 7.5 *Spleen, shown Projecting to the Front, attracts the Phoenix Earth Force.*

F. Form the Earth Force Animals into a Protective Ring and Dome of Fire.

1. Reinforce the Earth Force animals. See them, feel them or in any way sense the presence of their force and the virgin energy of the Earth Force.

2. Form a ring of fire connecting the four animals together: the red pheasant, the green dragon, the big, blue/black turtle, and the white tiger. The yellow phoenix at the top of the body forms a fiery dome that touches and connects the circle. (Fig.7.6)

Fig 7.6 *Protective Ring and Dome of the Earth Animals.*

Five Element Organ Correspondences

	Wood	Fire	Earth	Metal	Water
Yin Organs	Liver	Heart	Spleen	Lungs	Kidneys
Yang Organs	Gall Bladder	Small Intestine	Stomach, Pancreas	Large Intestine	Bladder
Openings	Eyes	Tongue	Mouth, Lips	Nose	Ears
Positive Emotions	Kindness	Love, Joy	Fairness, Openness	Righteous, Courage	Gentle
Negative Emotions	Anger	Hate, Impatience	Worry, Anxiety	Sadness, Depression	Fear, Stress
Transform Pure Organ Energy into a Virgin Child Dressed in	Green	Red	Yellow	White	Blue
Transform Pure Child Energy into a Animal	Green Dragon	Pheasant, Red Bird	Phoenix, Yellow on Red	White Tiger	Blue Deer
Earth Force takes the Form of	Green Dragon	Pheasant, Red Bird	Phoenix, Yellow on Red	White Tiger	Black Tortoise
Directions	East	South	Center	West	North

Table 4

3. The dome of fire can protect the physical body by strengthening the organs. It can protect the soul body as well. Spiral the dome and the pakuas in either direction.

4. As you continue to face South, be aware of the relationship of the four pakuas to the four animals: the front pakua to the pheasant, the back pakua to the blue/black turtle, the left pakua to the white tiger, and the right pakua to the green dragon. Absorb the phoenix force through the crown and down to the cauldron. Absorb the forces of the Earth animals into the pakuas and then to their corresponding organs. Their energy will help to strengthen all the organs and glands. (See Table 3.)

5. At this point return to Chapter 5 and create a more powerful pearl. Continue to draw energy, including the five Earth Animals' Forces, into the front, back, left, and right pakuas and blend it together. Pull their energies into the cauldron to create the greatly refined and radiant pearl that is used to create a more powerful soul or energy body.

6. Be aware of the cauldron as the pearl is enhanced. You can feel the pearl growing bigger and heavier. Move the pearl in the Microcosmic. Be aware of the Universal Force from the stars and planets above, the Cosmic Particle Force before you, and the Earth Force below. The Earth Force of the animals is absorbed into the pearl.

G. Create the Energy Body.

Following Chapter 5 create the energy body this time using the greatly enhanced pearl. Once the body is formed and if you decide to continue, proceed to Chapter 8.

H. Finish the Meditation.

If you wish to finish:

1. First absorb the stars' forces as much as possible once more.

2. Condense the energy body into a pearl. Notice that the color of the pearl is intensely bright and the size is larger.

3. Inhale and activate the Cranial Pump. Feel the pulsation. Feel the lead light extend out from the crown point.

4. Inhale and slowly use the mind and senses to draw in the pearl. Inhale again, and use your mind to guide the pearl to land on the opening of the crown where the lead light emerges. Inhale once

more with force to pull the pearl down from the crown through the front channel.

5. Circulate the pearl in the Microcosmic Orbit. As the enhanced pearl moves, it will enhance the organs and glands. Any part of the body that requires its energy will absorb it.

6. Bring the pearl down to the navel and return it to the cauldron. Be aware of the four pakuas and the crown continually absorbing the Earth Force. Spiral the four pakuas and the pearl, and absorb the Earth Force into the pearl. Collect the energy in the cauldron.

7. Practice Chi Massage.

8. Now the Earth Animals' Force can return to its origin, or it can remain where it is for continued protection. This depends on your proficiency of practice.

Remember the Universal Tao practice is not solely a visualization process. You must sense the force, and not simply picture it in your mind.

Chapter 8

Formula 8: Call Forth the Planets' and Stars' Forces for Empowerment and Protection

A. Pearl is the Product of your Successful Practice.

Begin Chapter 8 by practicing Chapters I through "Create the Energy Body" in Chapter 7. With time and continued practice, everything will become easier and faster. Once your mind is trained, you will be able to control all the four pakuas, the collection points, the weather, the senses, and the emotions easily. As you spiral the energy, you will perceive all of these as balanced and in harmony, ready to be transformed and condensed into a pearl. All will take place in a few minutes.

In your later practice, upon being well-trained, all you will need to do is concentrate on the center of control (the cauldron). Then you will use the mind to turn all the senses inward and condense the pearl. This will require a simple awareness of the four pakuas and all the collection points, organs, and senses.

If the pearl formed has a good, shining light, you will be successful in your practice of balancing the energy and transforming the negative emotions. Then, like a factory that is set up properly, all you need do is check the finished product. If the finished product is right, the factory is running smoothly. The pearl is the finished product of your practice.

B. Create a Fully Developed Pearl; Extend and maintain the Pearl above the Crown.

1.Once the pearl has been fully developed and is well-positioned at the cauldron, be aware of the Earth animals supplying the force to it. Move the pearl down to the perineum, and then move it into the Microcosmic until you feel it gain momentum. Be aware of all

the sources supplying energy to the pearl. Stop the pearl at the perineum, and feel the full charge of the force at the perineum.

2. Activate the Cranial Pump, and pull the pearl up to the crown. Totally concentrate your mind and senses on the crown, and feel the pulsation there. Feel the crown breathing, opening and closing. Feel the lead light go out through the opening like a fine string. Check for proper timing, and then inhale once more. Swallow the saliva, and feel the pearl pushing upward toward the crown. Feel the crown open.

3. Exhale forcefully toward the crown to shoot the pearl out. The pearl serves as the connection between yourself and heaven. It will enable you to absorb the higher, purer, Universal Force by bringing it down to your physical body. There it can be processed to a more refined energy you can use.

4. Maintain the pearl about three to six feet (one to two meters) above the crown of the energy body. Use the mind and senses as though they were a wireless control determining the movement of the pearl, moving it up and down, right and left, and in a spiral.

C. Call forth the Force of the Planets.

Form as many pearls as necessary to complete this exercise.

1. Summon Mercury's Force to the Energy Body.

a. Be aware of the physical body, the cauldron, and the kidneys. Sense the blue color or the gentleness force generating from the kidneys.

b. Form a blue or gentleness pearl and bring this pearl to the perineum.

c. Move it into the Microcosmic Orbit to gain momentum and absorb the forces from all sources. Stop at the perineum and activate the Cranial and Sacral Pumps.

d. Draw the pearl up to the crown, and activate the lead light. Look up with the inner eyes, and sharpen your awareness of the space above you and your energy body into which you will shoot the pearl.

e. Inhale, swallow the saliva upward, and exhale forcefully up toward the crown. Shoot the pearl as high as you can into the space above you. (Fig. 8.1)

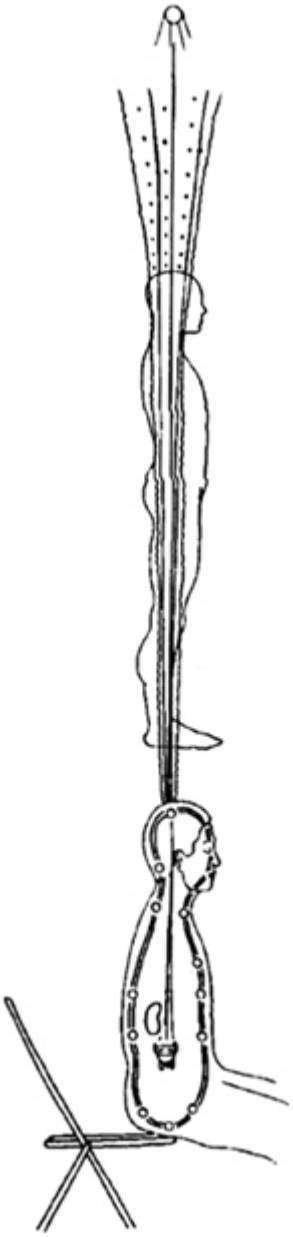

Fig 8.1 *Shoot the Pearl high up into the Space above you.*

f. Exhale.Relax totally, and do the Heart Sound (***Hawwwwww***) to attract the Universal Force and to collect the force as it falls. Feel the Universal Force fall like blue snow. (Fig. 8.2)

g. Concentrate your mind and your senses to condense the falling blue snow into the blue planet representing the water force, Mercury. This force will enhance the soul and spirit of the kidneys.

h. Place this force at the back of the energy body. (Fig. 8.3)

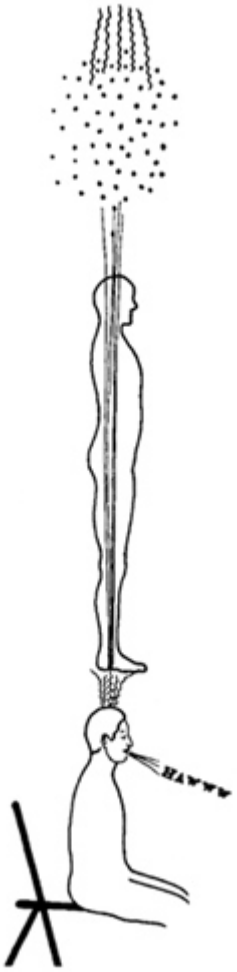

Fig. 8.2 *Do the Heart Sound-**Hawwwwww** to attract the Universal Force.Sense the force falling down as blue snow.*

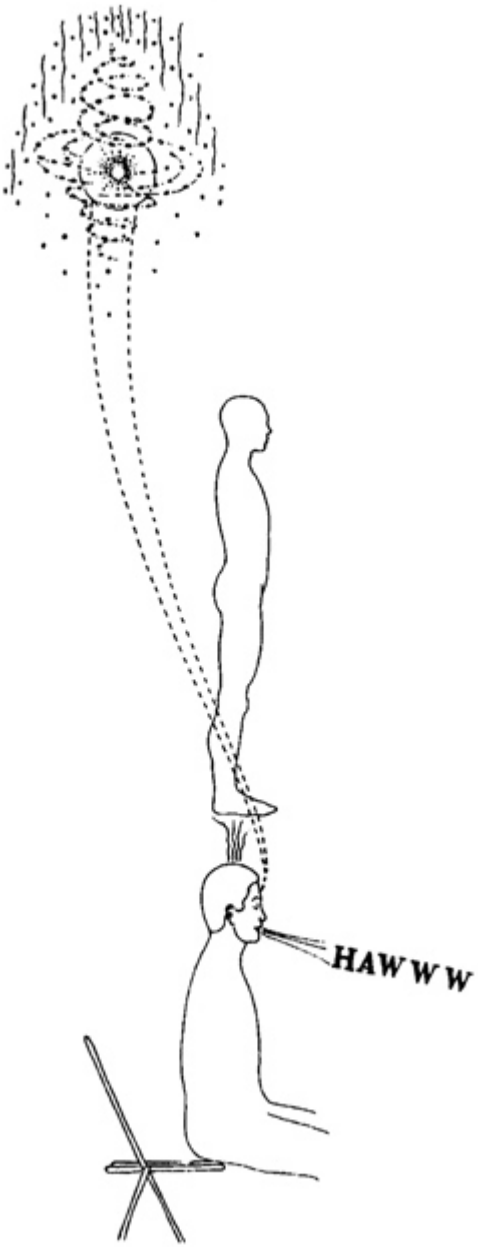

Fig. 8.3 *Condense the falling blue snow into the planet Mercury and place it behind the energy body.*

2. Summon the Force of Mars to the Energy Body

a. Be aware of the physical body, the cauldron, and the heart. Sense the red color or force of love, joy, and happiness generating from the heart.

b. Form a red pearl or pearl of joy, and bring it to the perineum.

c. Move this pearl into the Microcosmic Orbit to gain momentum and absorb the forces from all sources. Stop at the perineum and activate the Cranial and Sacral Pumps.

d. Draw the pearl up to the crown, and activate the lead light. Look up with the inner eyes, and sharpen your awareness of the space above you into which you will shoot the pearl.

e. Inhale, swallow the saliva upward, and exhale forcefully up toward the crown. Shoot the red pearl as high as you can into the space above you.

f. Exhale. Relax totally, and do the Heart Sound (***Hawwwwww***) to attract the Universal Force and to collect the force as it falls. Feel the heavenly, Universal Force fall like red snow.

g. Concentrate your mind and your senses to condense the falling red snow into the red planet representing the fire force, Mars. This force will enhance the soul and spirit of the heart.

h. Place this force at the front of the energy body. (Fig. 8.4)

3. Summon Jupiter's Force to the Energy Body

a. Be aware of the physical body, the cauldron, and the liver. Sense the green color or force of kindness generating from the liver.

b. Form a green or kindness pearl and bring it to the perineum.

c. Move this pearl into the Microcosmic Orbit to gain momentum and absorb the forces from all sources. Stop at the perineum and activate the Cranial and Sacral Pumps.

d. Draw the pearl up to the crown and activate the lead light. Look up with the inner eyes and sharpen your awareness of the space above you into which you will shoot the pearl.

e. Inhale, swallow the saliva upward, and exhale forcefully up toward the crown. Shoot the green pearl as high as you can into the space above you.

f. Exhale. Relax totally and do the Heart Sound (***Hawwwwww***) help attract the Universal Force and to collect the force as it falls. Feel the heavenly, Universal Force fall like green snow.

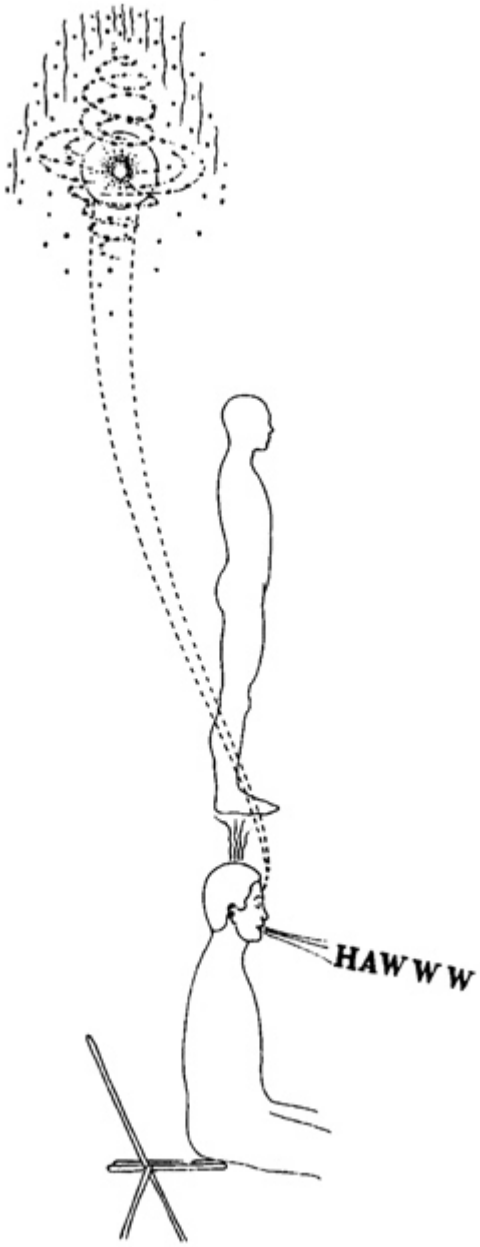

Fig. 8.4 *Shoot the pearl up as high as you can into space to connect with the force of Mars. Place Mars' Force at the Energy Body's Front.*

g. Concentrate your mind and your senses to condense the falling green snow into the green planet representing the wood force, Jupiter. This force will enhance the soul and spirit of the liver.

h. Place this force on the left side of the energy body.

4. Summon the Force of Venus to the Energy Body.

a. Be aware of the physical body, the cauldron, and the lungs. Sense the white color or force of courage generating from the lungs.

b. Form a white pearl or pearl of courage and bring it to the perineum.

c. Move this pearl into the Microcosmic Orbit to gain momentum and absorb the forces from all sources. Stop at the perineum and activate the Cranial and Sacral Pumps.

d. Draw the pearl up to the crown and activate the lead light. Look up with the inner eyes and sharpen your awareness of the space above you into which you will shoot the pearl.

e. Inhale, swallow the saliva upward, and exhale forcefully up toward the crown. Shoot the white pearl as high as you can into the space above you.

f. Exhale. Relax totally and do the Heart Sound (***Hawwwwww***) to attract the Universal Force and to collect the force as it falls. Feel the heavenly, Universal Force fall like white snow.

g. Concentrate your mind and your senses to condense the falling white snow into the white planet representing the metal force, Venus. This force will enhance the soul and spirit of the lungs.

h. Place this force on the right side of the energy body.

5. Summon the Force of Saturn to the Energy Body.

a. Be aware of the physical body, the cauldron, and the spleen. Sense the yellow color or force of fairness and openness generating from the spleen.

b. Form a yellow pearl or pearl of fairness and openness, and bring it to the perineum.

c. Move this pearl into the Microcosmic Orbit to gain momentum and absorb the forces from all sources. Stop at the perineum and activate the Cranial and Sacral Pumps.

d. Draw the pearl up to the crown and activate the lead light. Look up with the inner eyes and sharpen your awareness of the space above you into which you will shoot the pearl.

e. Inhale, swallow the saliva upward, and exhale forcefully up toward the crown. Shoot the yellow pearl as high as you can into the space above you.

f. Exhale. Relax totally and do the Heart Sound (***Hawwwwww***) to attract the Universal Force and to collect the force as it falls. Feel the heavenly, Universal Force fall down like yellow snow.

g. Concentrate your mind and your senses to condense the falling yellow snow into the yellow planet representing the earth force, Saturn. This force will enhance the soul and spirit of the spleen.

h. Place this force on top of the energy body.

6. Be Conscious of the Five Planets surrounding the Energy Body.

Be aware of the five planets that you have placed around the energy body to empower and protect it. Sense the glowing light of the planets.

D. Set the Planets into Orbit around and absorb their Forces into the Energy Body.

1. Start the Orbit of Mars around the Energy Body.

Be aware of the planet Mars moving in its orbit around the Sun. Similarly, start to move Mars into orbit around the energy body.

2. Movement of Mars activates the Orbit of the Other Planets Around the Energy Body.

As Mars moves into orbit, it will activate the movement of Venus, Mercury, and Jupiter into orbit. Their orbits form rings of light surrounding and protecting the pearl. These rings of light also are used in later practice to expand the pearl into an energy body.

3. Saturn provides the Protective Dome over the Crown.

Move Saturn into orbit around the top of the crown to form a dome of protective light over the crown.

4. Absorb the Planets' Forces into the Energy Body.

Be aware of the energy body and use your mind and senses to help the energy body absorb the planets' forces. Notice the pearl changing color or growing larger or heavier.

E. Energy Body Beams the Planets' and Stars' Forces into the Crown.

1. Crystal Room under the Crown serves as a Prism of the Planets' Forces.

When the crown of the energy body receives the forces from the planets, it will beam their forces down through the crown of the physical body to the crystal room under its crown. The crystal room, also known as the third vertical room, is situated in the middle of the brain. It is considered the control center for information processing of the pineal gland, pituitary gland, and all other glands of the body. During the Fusion Meditation practice, the crystal room functions as a prism to reflect the rainbow colors down to the organs. You can sense the organs glowing with light. (Fig. 8.5)

2. Forces of the North Star and the Big Dipper shine into the Crown.

Be aware of the purple light of the North Star and the red light of the Big Dipper shining into the, crown of the energy body, and then down to the crown of the physical body. Feel the light enter into the crystal room.

3. Condensed Essential Forces revert to the Original Force.

The forces of these five planets, the North Star, and the Big Dipper will help to purify and enhance the organs further. The pure essence of the organs that now exists can easily condense at the crown. The Taoists say that when the five essential forces condense at the crown, they are returning into the Original Force.

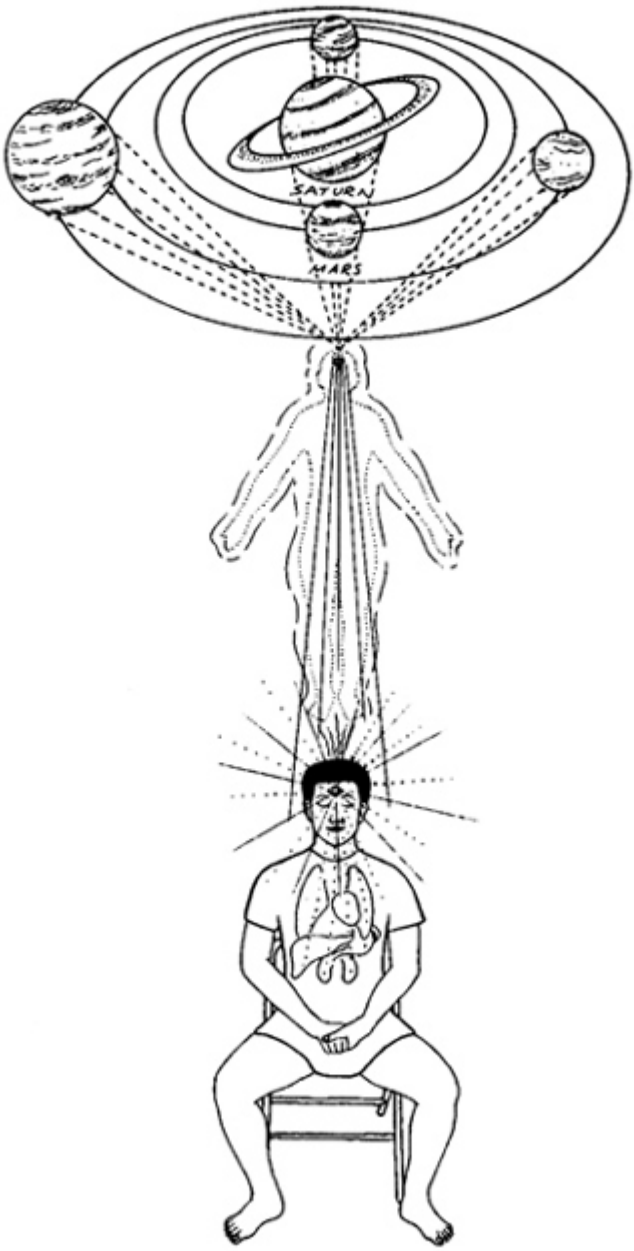

Fig. 8.5 *The Planets' Forces Beam Down to the Crystal Room.*

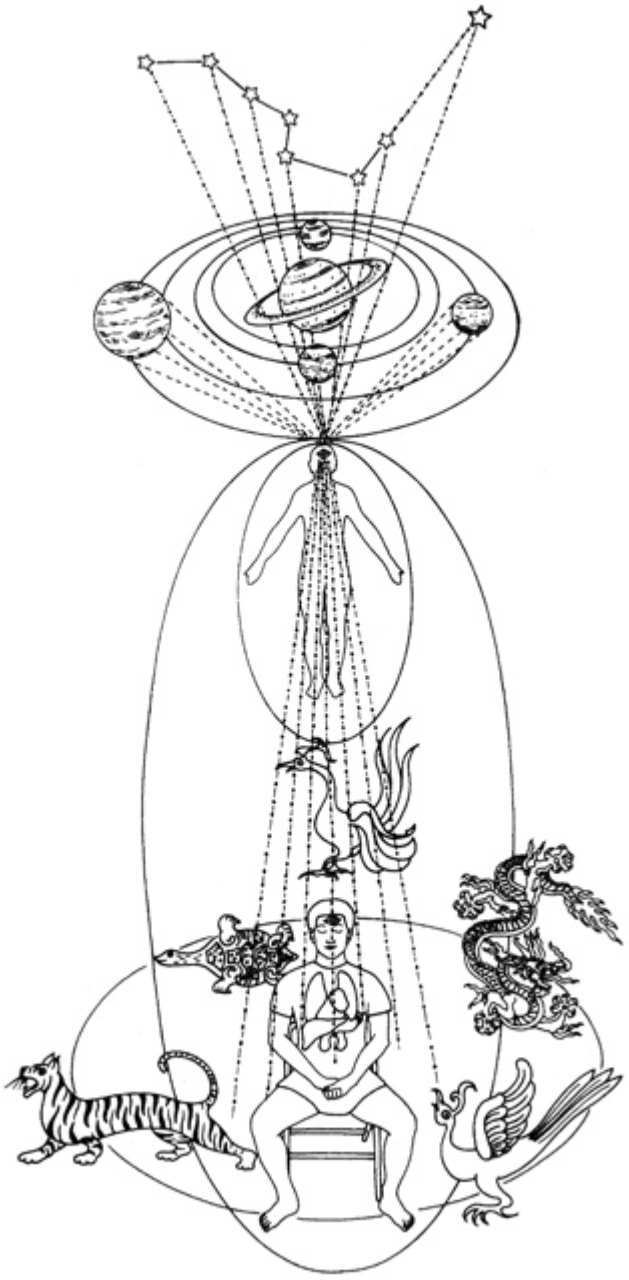

Fig. 8.6 *Interconnection of All Forces*

Five Element Organ Correspondences

	Wood	Fire	Earth	Metal	Water
Yin Organs	Liver	Heart	Spleen	Lungs	Kidneys
Yang Organs	Gall Bladder	Small Intestine	Stomach, Pancreas	Large Intestine	Bladder
Openings	Eyes	Tongue	Mouth, Lips	Nose	Ears
Positive Emotions	Kindness	Love, Joy	Fairness, Openness	Righteous, Courage	Gentle
Negative Emotions	Anger	Hate, Impatience	Worry, Anxiety	Sadness, Depression	Fear, Stress
Transform Pure Organ Energy in Virgin Child Dressed In	Green	Red	Yellow	White	Blue
Transform Pure Child Energy in an Animal	Green Dragon	Pheasant, Red Bird	Phoenix, Yellow on Red	White Tiger	Blue Deer
Earth Force takes the form of	Green Dragon	Pheasant, Red Bird	Phoenix, Yellow on Red	White Tiger	Black Tortoise
Directions	East	South	Center	West	North
Planets	Jupiter	Mars	Saturn	Venus	Mercury
Universal Energy Force	Generate	Prosper	Stabilize	Contract	Gather

Table 5

G. Finish the Exercise.

If you wish to finish, absorb the forces of the planets and stars once more into the energy body.

1. Condense the Energy Body into a Pearl.

When you want to finish, activate the Cranial and Sacral Pumps to reopen the crown. Feel the crown open, and land the pearl at the crown opening.

2. Draw the Pearl in and move it in the Microcosmic Orbit.

Inhale, draw the pearl into the crown and let it start to circulate in the Microcosmic Orbit.

3. Absorb the Forces of the Planets, Stars and Earth.

Absorb the Earth Forces into the four pakuas and the crown. Any remaining energy of the planets, stars, and earth will return to where it came from.

4.Collect the Energy.

Collect the Energy in the cauldron.

5. Practice Chi Self-Massage.

End the exercise with Chi Self-Massage.

Chapter Nine

Formula 9: Transfer of Consciousness to the Energy Body in this Life brings Immortality.

The energy body is a Chi body that offers no resistance, and so it is very easy to open its Microcosmic Orbit. Creating the energy body and transferring the Microcosmic Orbit from the physical body to the energy body is the transference of consciousness first experienced in Chapter 5 of your basic practice and experienced again in Chapter 9 of your advanced practice.

Each day as you work on this stage of Fusion, you transform more consciousness to the energy body. At this stage of practice, this energy body is simply a powerful projection of your mind and your physical body. At higher levels of practice, this energy body is crystallized into a permanent spiritual body.

A. Transfer the Microcosmic Orbit to the Energy Body.

1. Create another pearl in the cauldron and circulate it in the Microcosmic of the physical body.

2. Inhale, activate the Cranial and Sacral Pumps, activate the lead light, and aim the lead light at the perineum of the energy body. Shoot this pearl through the crown of the physical body and penetrate the perineum.

3. Use the senses to move the pearl up to the energy body's sacrum. Stop for a while and feel the sacrum point become established. Then move the pearl up to the Door of Life, T-11, C-7, base of the Skull, Crown, Third Eye, Tongue, Throat, Heart, Solar Plexus, Navel, Sexual Center, and Perineum completing the Microcosmic Orbit of the energy body. Offering no resistance, the Microcosmic of the energy body is easy to open. Another way to transfer the Microcosmic is simply to copy the Microcosmic of the physical body. (Fig. 9.1)

4. Now begin to move the Microcosmic in both the energy and physical bodies as one unit by bringing the pearl all the way down the Functional Channel of the physical body. Continue to circulate the Microcosmic; one cycle should include both bodies. (Fig. 9.2)

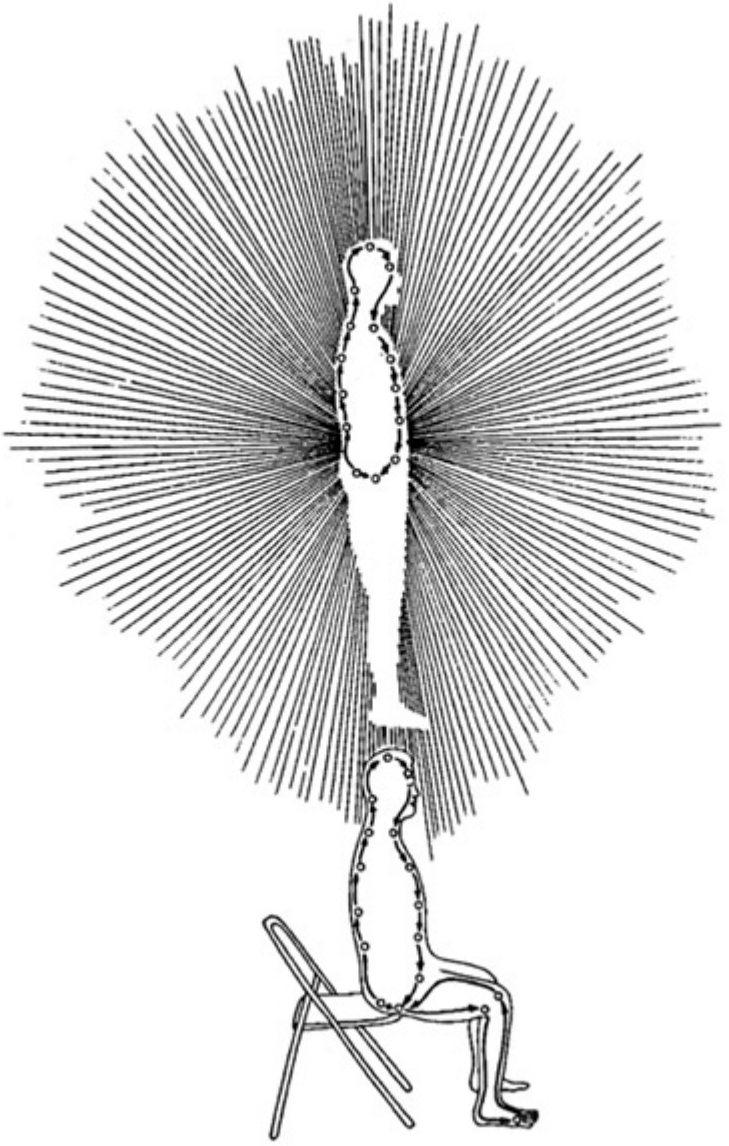

Fig. 9.1 *Shoot the pearl to the perineum of the energy body to open its Microcosmic Orbit. Circulate both Microcosmic Orbits.*

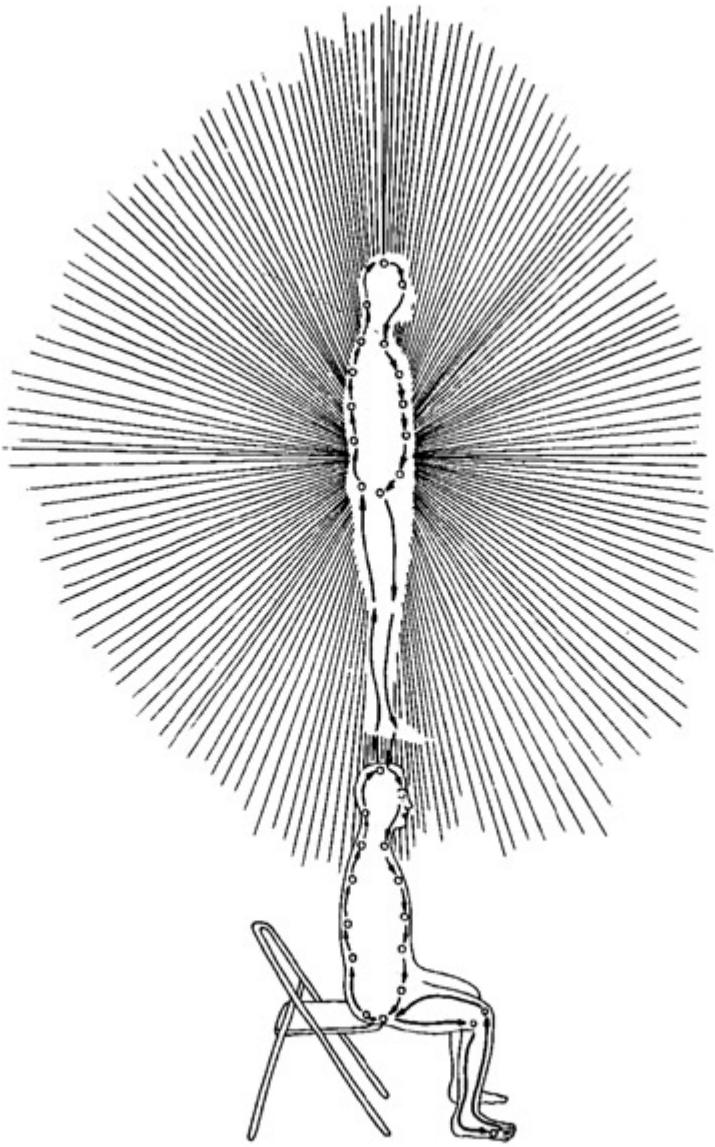

Fig. 9.2 *Use the senses and the mind to circulate both Microcosmic Orbits as one cycle.*

B. Form a Protective Shield.

1. Form another pearl in the physical body, and this time circulate it in the Microcosmic Orbit of the physical body only until it gains momentum. Once the pearl has gained momentum, and upon its return to the perineum of the physical body, begin to move the pearl up again through the physical body as follows:

a. Inhale, and activate the Cranial Pump. Contract the perineum, the anus, and the back of the anus. Pull the pearl up to the sacrum, Door of Life, T-11, C-7, base of the skull, and toward the back of the crown to a point about one and a half inches behind the crown. Hold at this point.

b. Feel the pulsation at the back of the crown. Exhale, and shoot the pearl out. Use the pearl to form a bubble to cover the entire energy body.

C. Form a Great Bubble encasing Both Bodies as a Protective Shield.

1. Form one more pearl. Circulate this pearl in the Microcosmic Orbit of the physical body to gain momentum. Stop again at the perineum of the physical body.

2. As above, pull the pearl all the way up the Governor Channel of the physical body to the point one and a half inches behind the crown. Shoot it out from this point to encircle the energy body, bringing it all the way down to cover the physical body as well. You now have formed a great bubble encasing both bodies and the protective shield of the energy body. (Fig. 9.3)

3. Be aware of the energy body, the physical body, and the bubbles that form the protective shields around both bodies. Also be aware of the energy above the energy body and below the physical body.

D. Absorb All Forces into Both Bodies.

1. Up to this level of practice, the energy body is still regarded as a Yin body with a negative charge, enabling it to absorb the Yang Universal Force. As your practice advances, the Yin body can change into more of a Yang body.

2. The physical body is regarded as a positively charged Yang body. This enables the physical body to help channel the Yin force from the Earth upward to balance the Universal Force.

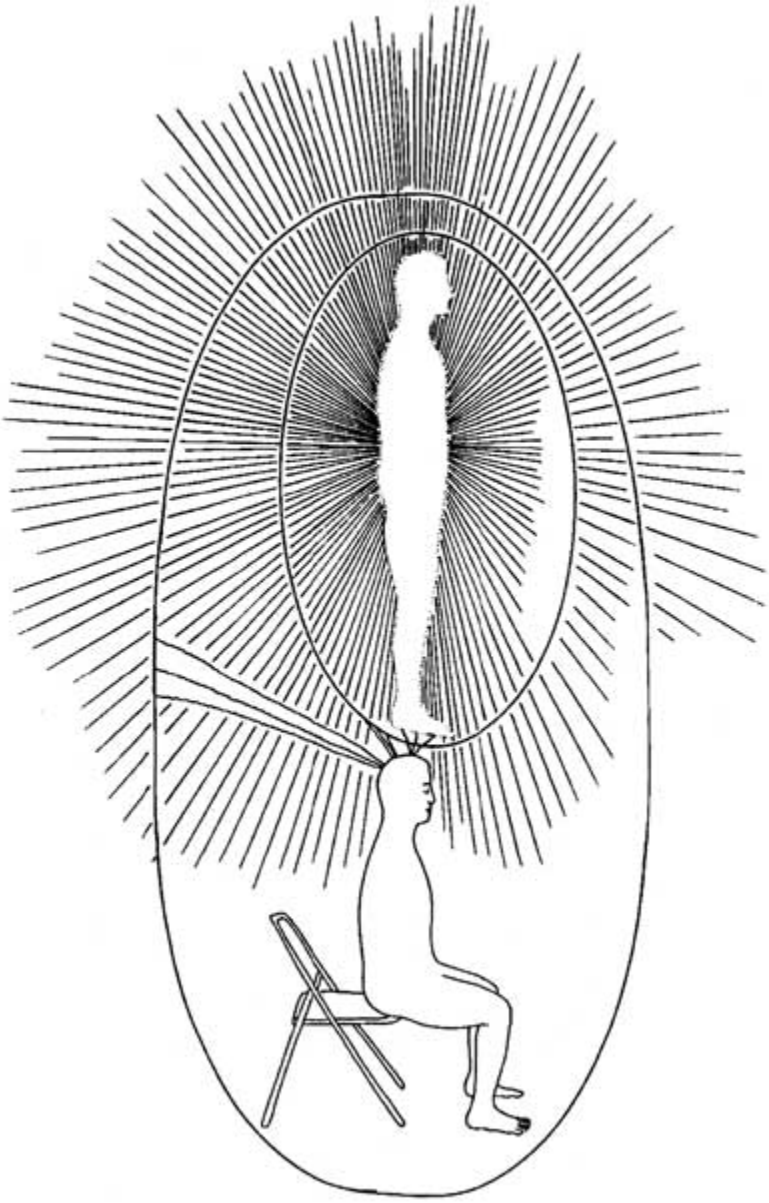

Fig. 9.3 *The Energy Body, its Protective Shield, and the Great Bubble that Protects all.*

3. When you are well-practiced, all that is necessary to activate all forces is an awareness of them. As an empty vase can be filled, so can the energy body most effectively be filled with, and be a container for, the forces.

4. Be aware of the forces of the virgin children, the internal animals, the external Earth animals, and the planets and stars as they are absorbed into the energy body and the physical body. (Fig. 9.4)

a. Be aware of the Earth Force from below emanating a blue force. Sense the force of gentleness and kindness coming up into the feet.

b. Be aware of the forces of the virgin children, the internal animals, and the Earth animals, and absorb them into the pakuas and into the cauldron.

c. Be aware of the energy body and the crown.

d. Be aware of the five planets and their colors. Absorb the planets' forces into the energy body. Draw the forces into the cauldron of the energy body.

e. Be aware of the North Star and its purple light.

f. Be aware of the Big Dipper and its red light shining at the crown.

g. Breathe in the purple and red light through the nose and crown of the energy body. Beam this light down to the cauldron of the energy body. These star forces will enhance the soul and spirit essences of both bodies.

h. From the crystalline cauldron of the energy body, beam down the rainbow force to the crown of the physical body, and then down to the cauldron of the physical body.

i. Channel the Earth Yin force through the physical body to the energy body to balance the energy in it and to prevent excessive heat buildup. The Yin force's negative charge drawn from the Earth keeps the energy body's charge in balance.

j. Practice for five to ten minutes.

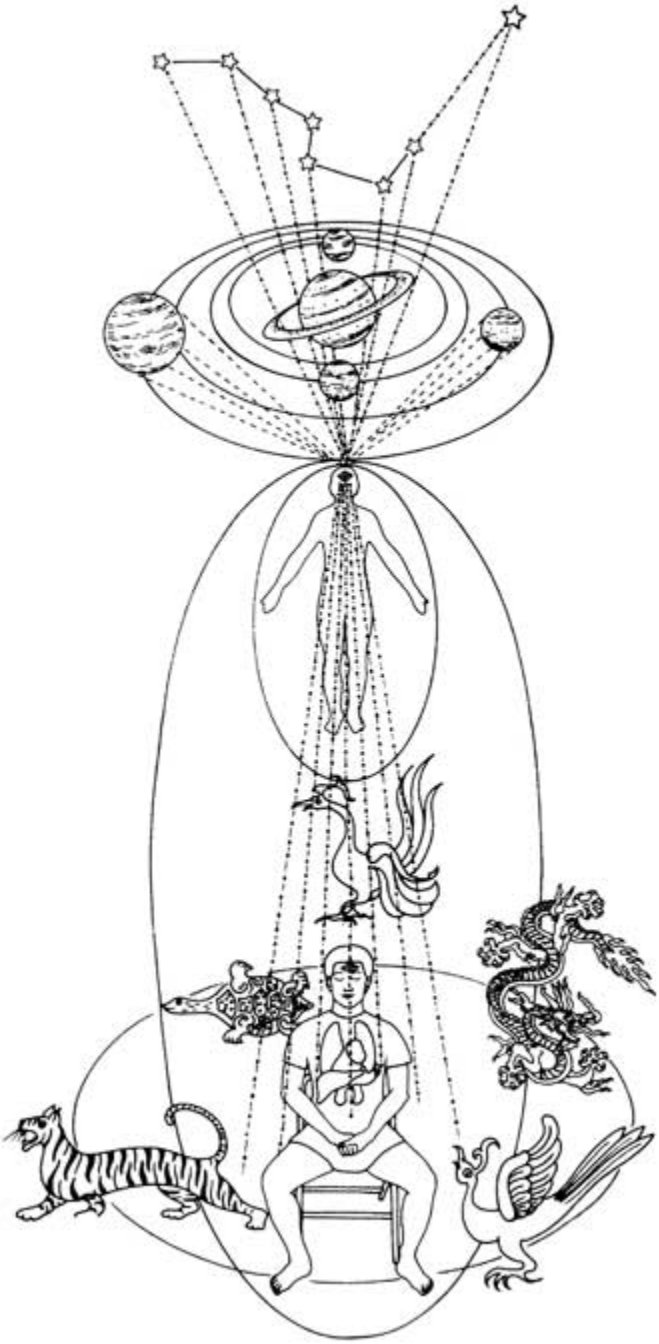

Fig. 9.4 *Be aware of all sources of energy.*

E. Draw in the Energy Body and the Big Protective Bubble.

1. When you are ready to finish this practice, first absorb the planets' and stars' forces as much as possible once more. You can leave the remaining energies of the planets and stars. They will return to the Original Force, or will remain to protect you to the extent you need them.

2. Condense the energy body into a pearl still surrounded by the bubble that serves as its protective shield. Notice that the color of the energy of the pearl may now be brighter, or the pearl may have grown larger.

3. Be aware of the big bubble that continues to protect the physical and energy bodies and the energy body's bubble as a great protective shield.

4. Inhale and activate the Cranial Pump. Feel the pulsation. Feel the lead light extend out from the crown point.

5. Inhale and slowly use the mind and senses to draw in the pearl that was the condensed energy body. (Fig. 9.5) Inhale and use your mind to guide the pearl to land on the opening of the crown where the lead light emerges. Inhale once more with force to pull the pearl down from the crown through the front channel.

6. Circulate the pearl in the Microcosmic Orbit. As the enhanced pearl moves around the Microcosmic, it will enhance the organs and glands. Any part of the body that requires it will absorb it.

7. Be aware of the energy body's protective bubble remaining above the physical body and within the big protective bubble. Be aware of the crown and the point one and a half inches behind the crown. Inhale and draw the energy body's bubble through the crown and the back of the crown into the Microcosmic Orbit, and add this energy to the pearl that is already circulating.

The energy that now circulates in the Microcosmic is the combined energy body and protective bubble energy that has been drawn into the physical body. The great bubble that surrounded both the energy and physical bodies and the energy body's bubble remains and continues to surround and protect the physical body.

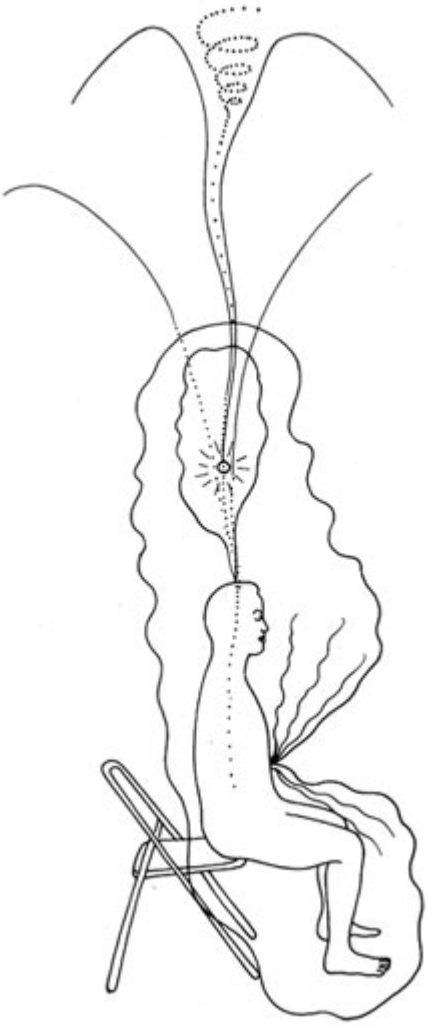

Fig. 9.5 *Shrinking and drawing in the Energy Body's Bubble to the Crown and to the Navel.*

F. Protective Shield Remains.

1. Begin slowly to trim down the big bubble that continues to surround the physical body by condensing or shrinking it and drawing it in through the point one and a half inches behind the crown. Add this energy to the pearl that is circulating in the Microcosmic Orbit, and bring this energy down the front channel to the navel.

2. The remaining protective shield can be drawn in closer and tighter to the physical body by drawing this energy in through the navel. Feel the energy remaining as the bubble on the outside of the physical body pulls in tightly to cover the body.

3. You are now protected from within and from without by this protective shield. The protective shield that remains on the outside of the body will be built upon with subsequent layers of bubbles when, as your practice continues, you continue to form new pearls and additional protective shields.

G. Absorb the Forces into the Pearl or directly into the Organs of their Origin.

1. Be aware of the external Earth Force animals and of the four pakuas. Absorb the red pheasant through the front pakua, the blue/black turtle through the back, the green dragon through the left pakua, the white tiger through the right, and the phoenix through the crown. Let whatever force remains return to where it originated.

2. Absorb the virgin children and internal animals back into the pearl, or directly to the organs where they belong. The virgin children and animals are the purest forms of the organs' energies. Virtue energy in its purest form can be combined and transformed, and this energy is the consciousness that is transferred to the energy body.

H. Finish the Practice.

1. Condense and draw the pearl that has moved down the front channel into the navel.

2. Bring the pearl to the navel and back to the cauldron. Spiral, collect, and condense the energy at the cauldron. As your practice progresses and the organs' energies become stronger and purer, the pearl will remain condensed longer. When the pearl finally is released, it will separate and go to the organs and glands that need it as a more refined, more enhanced energy that will heal and strengthen them.

3. Practice Chi Massage.

Chapter 10

Summary:
Entire Fusion I Practice

All Chapters: 1 through 9

A. Create a Pearl.

1. Smile down to the face and organs; generate a positive emotional state.
2. Smile to the navel and form the front pakua behind the navel.
3. Fuse the senses, organs' energies, and emotions into the front pakua.
4. Form the back pakua, and collect the energy.
5. Spiral the energy or force at the front and back pakuas. Direct the spiral of energy from the two pakuas into the cauldron at the center of the body.
6. Form the right side pakua, and collect the energy.
7. Form the left side pakua, and collect the energy.
8. Spiral the force at the pakuas, direct the energy of the right and left pakuas into the cauldron, and condense the energy to create a pearl there. The pearl will shine with light and glow brighter as more energy continues to fuse from the four pakuas into the cauldron.

B. Form the Virgin Children and the Protective Animals.

1. Recheck the kidneys and their collection point. Sense the collection point and the kidneys illuminating with a bright, blue light. Feel the virtue energy of gentleness in the kidneys, and form it into a virgin boy or virgin girl. Sense the child breathing out a blue breath that changes into the form of a deer. Place the child and the deer at the kidneys' collection point.
2. Recheck the heart and its collection point. Sense the collection point and the heart illuminating with a bright, red light. Feel the virtue energy of love, joy, and happiness in the heart. Form it into a virgin child, and sense the child breathing out a red breath that changes into the form of a red pheasant. Place both in the heart's collection point.

3. Recheck the liver and its collection point. Sense the collection point and the liver illuminating with a bright, green light. Feel the virtue energy of kindness in the liver. Form it into a virgin child, and sense the child breathing out a green breath that changes into a green dragon. Place both in the liver's collection point at the right side.

4. Recheck the lungs and their collection point. Sense the collection point and the lungs illuminating with a bright, white light. Feel the virtue energy of courage in the lungs, and form it into a virgin child. Sense the child breathing out a bright, white breath that changes into a white tiger. Place both in the lungs' collection point on the left side.

5. Recheck the spleen and its collection point. Picture the collection point and the spleen illuminating with a bright, yellow light. Feel the virtue energy of fairness and openness in the spleen, and form this energy into a virgin child. Sense the child breathing out a bright, yellow breath that changes into a yellow phoenix. Place both in the front pakua.

6. Form protective rings by connecting the inner animals and virgin children in two circles. Starting from the kidneys, the virgin child and the blue deer make rings of fire to the green virgin child and dragon at the liver's collection point, to the red virgin child and pheasant at the heart's collection point, to the white virgin child and tiger at the lungs' collection point, and back to the blue virgin child and deer at the kidneys' collection point. The yellow virgin child and phoenix remain in the middle at the front pakua.

C. Call forth the Earth Force as a Protector and Source of Energy.

1. Be aware of and spiral the energy at the kidneys and their collection point. When you sense the force very intensely, project it from the collection point far out to the front of the body to attract the water element force of the Earth. When this force comes to you, and you feel it very intensely, form the image of the big, black or dark blue turtle (the Black Warrior) to capture it. Place the turtle on the back of the body as protection.

2. Be aware of and spiral the energy at the heart and the heart's collection point. When you sense the force intensely, project it from the collection point far out to the front of the body to attract the fire element force to you. When you feel this force very intensely, form

the image of the red pheasant to catch the force. Place the red pheasant on the front of your body as protection.

3. Be aware of and spiral the energy at the liver and the liver's collection point. When you sense the force very intensely, project it from the collection point far out to the front of the body to attract the wood element force. When this force comes to you, and you feel it very intensely, form the image of a green dragon to capture it. Place the dragon on the right side as protection.

4. Be aware of and spiral the energy at the lungs and the lungs' collection point. When you sense the force very intensely, project it from the collection point far out to the front of the body to attract the metal element force. When this force comes to you, and you feel it very intensely, form the image of a white tiger. Place the tiger on the left side to protect that side.

5. Be aware of and spiral the energy at the spleen and the spleen's collection point. When you sense the force very intensely, project it from the collection point far out to the front of the body to attract the Earth element force. When this force comes to you, and you feel it very intensely, form the image of a yellow phoenix. Place the phoenix in the middle of the top of the head as protection.

6. Form a ring of fire to link all the animals' forces together. Include the phoenix at the top to form a dome-like covering.

D. Circulate the Pearl in the Microcosmic Orbit.

1. Direct the pearl to the perineum by contracting the perineum, the anus, and then the back part of the anus. Move the pearl into the Microcosmic Orbit. At each point-perineum, Door of Life, T-11, C-7, back of the skull, crown, Third Eye, throat, heart, solar plexus, and navel-let the pearl illuminate with light. Build up the momentum of the pearl.

2. Bring the pearl back to the perineum, contract the perineum and back part of the anus, and bring the pearl up to the sacrum. Activate the Cranial and Sacral Pumps, and bring the pearl to the crown. Exhale through the crown and project the pearl up approximately six inches (15.23 centimeters) above the head.

a. Use your mind and the senses to move the pearl up and down. Gradually move the pearl higher to approximately twelve inches (30.48 centimeters) above the head.

b. Move it up and down using the senses to control it.

c. Move the pearl up two feet (60.96 centimeters) above the head.

d. Move it up and down again.

e. Continue to move it up to approximately your body's height above your head.

E. Form the Energy Body.

Focus your attention on forming the pearl into an energy body that looks like you, or into the perfect image you would like to have.

F. Call forth the Planets' Forces.

1. Form a new, bright, blue pearl.
2. Move the blue pearl in the Microcosmic Orbit to gain momentum.
3. Stop at the perineum, activate the Cranial Pump, and project the pearl up through the crown of the energy body as far as you can.
4. Wait for the water element force of the planet Mercury.
5. Picture the planet Mercury to capture its force. Place it on the back of the energy body to supply the force to the kidneys and to protect the back.
6. Form a new, bright, red pearl. Move the red pearl in the Microcosmic Orbit to gain momentum.
7. Stop at the perineum, activate the Cranial Pump, and project the pearl up through the crown of the energy body as far as you can. Wait for the fire element force of the planet Mars.
8. Picture the planet Mars to capture its force. Place it on the front of the energy body to supply the force to the heart and to protect the front.
9. Form a new, bright, green pearl. Move the green pearl in the Microcosmic Orbit to gain momentum.
10. Stop at the perineum, activate the Cranial Pump, and project the pearl up through the crown of the energy body as far as you can.
11. Wait for the wood element force of the planet Jupiter.
12. Picture the planet Jupiter to capture its force. Place it on the right side of the energy body to supply the force to the liver and to protect the right side.
13. Form a new, bright, white pearl. Move the white pearl in the Microcosmic Orbit to gain momentum.

14. Stop at the perineum, activate the Cranial Pump, and project the pearl up through the crown of the energy body as far as you can.

15. Wait for the metal element force of the planet Venus.

16. Picture the planet Venus to capture its force, and place it on the left side of the energy body to supply the force to the lungs and to protect the left side.

17. Form a new, bright, yellow pearl. Move the yellow pearl in the Microcosmic Orbit to gain momentum.

18. Stop at the perineum, activate the Cranial Pump, and project the pearl up through the crown of the energy body as far as you can.

19. Wait for the earth element force of the planet Saturn.

20. Picture the planet Saturn to capture the force. Place it in the middle of the top of the head of the energy body to supply the force to the spleen and to protect the center of the body.

21. Be aware of the energy of the stars and the planets and absorb their force into the energy body. Beam it down from the crown of the energy body to the crown of the physical body. Absorb the energy of the Earth into the physical body. (Fig.10.1)

Fig.10.1 *Star and Earth Energy--the Pakuas and Cauldron*

G. Transfer the Microcosmic to the Energy Body.

1. Circulate the Microcosmic in the physical body, inhale, and bring it up to the energy body.

2. Move both Microcosmic Orbits separately in the physical and energy bodies.

3. The Microcosmic Orbit can also be run together as one circuit of the energy body and physical body.

H. Form a Protective Shield and a Larger Protective Bubble around the Physical and Energy Bodies.

Form the bubble of the protective shield around the energy body. Then form another, bigger bubble to surround and protect both the energy and physical bodies and the energy body's bubble. The large bubble surrounds you with an aura.

I. Condense and collect the Energy.

1. Condense the energy body into a pearl.

2. Absorb once more the Universal Force from above, the Earth animals' energies, and the Earth energy from the ground under your feet. Inhale and activate the Cranial Pump. When you feel the crown point of the physical body open, draw the pearl down into the body, and run it in the Microcosmic Orbit.

3. The pearl may feel clearer now, since it has absorbed energy from the heavens and the Earth.

4. Condense the energy body's protective shield (above the physical body and within the great bubble surrounding both) into a pearl.

5. Inhale, activate the Cranial Pump, and draw in the energy body's protective shield. Add this energy to the pearl that is circulating in the Microcosmic.

6. The great bubble continues to provide an aura around the outside of the physical body. Condense and slowly begin to draw in through the crown the big bubble. Add it to the pearl and move it down the front channel of the Microcosmic.

7. Draw it into the navel and bring it to the cauldron. As you do so, the protective shield that continues to surround the physical body is drawn closer and tighter to the body. You are now protected from within and from without by this protective shield. It will be built upon by new pearls and additional layers of protective shields.

J. Finish the Exercise.

1. To finish, collect and condense the energy in the cauldron at the center of the body where the four pakua energies intersect.

2. End with the Chi Massage.

K. Practice Fusion Daily.

Fusion should be done each day to refine your emotional tone. This will result in the purified energy that is so essential to the higher stages of the Taoist practice. Do not rush the practice; it takes time to grow in your Fusion practice, but eventually you will see good results.

Advanced Practice Summary.

In advanced practice the mind is programed to project the power out, permitting the entire practice to happen at once.

1. Be aware of the cauldron at the center of the body. Spiral the energy using the mind and body. Use the inner eye to direct the energy along the road or pathway of the spiral. To draw the energy inward spiral very intensely at the cauldron as you also spiral the pakuas. Condense the energy into a pearl. Once the pearl is formed, you can stop spiraling. Be aware of the pearl, the four pakuas, the collection points of the organs, the senses, the emotions, and the balance of all internal energy. If the pearl formed is bright and firm, then all the internal energy is balanced and in good condition. If not, check each area to correct or adjust the imbalance.

2. Be aware of the virgin children, the animals, and the ring formed internally to protect the body.

3. Be aware of the Earth Force and the Earth animals forming the protective ring and the dome.

4. Move the pearl in the Microcosmic Orbit and project it out through the crown to form the energy body.

5. Be aware of or call forth the planets' forces and form an outer protective ring.

6. Connect with the North Star and the Big Dipper and absorb all the forces through the crown and into the energy body. Beam the forces down through the crown and into the physical body.

7. Form the energy body's protective shield and the big bubble protective shield to protect both bodies.

8. Condense the energy body into a pearl and inhale it into the physical body and down to the navel. Absorb the protective shield into the crown and bring its energy down to the navel. Absorb the big bubble into the crown and as you bring its energy down to the navel, feel the big bubble tighten around the physical body in a protective layer. Condense the energies into the cauldron.

9. Practice Chi Massage.

More Advanced Practice Summary.

1. Be aware of the pearl in the cauldron, the four pakuas, the collection points, the organs, the senses, the virgin children, and the animals. Feel centered, at peace, calm, and filled with love, joy, and confidence.

2. Use your mind and the senses to project the pearl out to form the energy body. Move the energy body as far as the lead light projects. Be aware of the planets, the stars' forces, and the protective shields. Absorb all the energy into both the energy and physical bodies.

3. Condense the energy and the protective shields, and absorb this energy into the physical body.

4. Condense the energy in the cauldron.

5. Practice Chi Massage.

Most Advanced Practice Summary.

1. Be aware of the cauldron as the center point of the body. Use the mind, eyes, head, and body to spiral. Continue to spiral and simply be aware of the four pakuas and the collection points. Spiral until you feel the pearl form. (Fig.10.2) Be aware of the pearl in the cauldron and move it into and through the Microcosmic Orbit. Project the pearl out to form the energy body. Move the energy body up as far the lead light extends.

2. Be aware of the physical body and the force around it. Be aware of the Universal Force. Absorb these energies into both the energy and physical bodies.

3. When you are ready to finish, simply condense all the energy.

4. Practice Chi Massage.

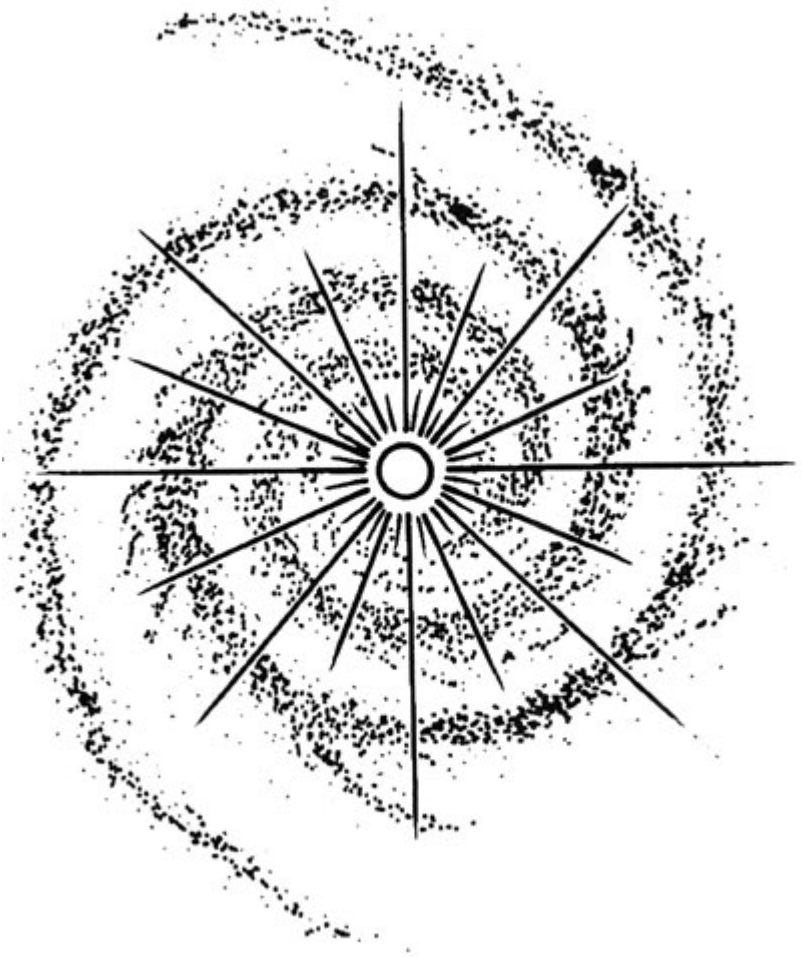

Fig 10.2 *The power of the spiral will help draw the energy into the cauldron untill the pearl forms.*

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Fusion of the Five Elements

Basic and Advanced Meditations for Transforming Negative Emotions

Mantak Chia

Illustrated by Juan Li

Fusion of the Five Elements is the first level of meditation in a Taoist practice also known as Fusion of the Five Forces in the Universe. It is the beginning of Inner Alchemy, a scientific process by which you gain control over the energies of your inner universe so that a connection can be made to the tremendous energy of the universe beyond the body. This energy becomes useful for self healing, day-to-day living and reaching spiritual goals. The Fusion meditation is the first step in learning to control the generation and flow of emotional, mental and physical energies within your body. The practice teaches you how to locate and dissolve the negative energies hidden inside your body. Using the Taoist Five Element Theory, a connection is made between the five outer senses - eyes, tongue, mouth, nose, ears - and the Five major emotions - anger, hate, worry, sadness, and fear. Once the negative emotion is identified with the organ it is stored in, it can be controlled.

The Fusion meditation shows you step by step how the negative emotions are removed from the organs. Negative emotions are neither suppressed nor expressed. Instead, their negative energy is brought to specific points in the body where it is easily neutralized, purified, and then transformed back into your original positive, creative energy. The great secret of crystallizing and storing your original positive energy in a mysterious pearl is revealed for the first time in the Fusion alchemical formula. This pearl is the essence of our life force energy, or Chi. It is central to nourishing the physical body, and later to nourishing the soul, or energy body. In more advanced Fusion practice, your soul/energy body becomes very controllable and its power can be balanced, strengthened and expanded to connect with the essence of the Earth and Star energies. The Fusion of 'the Five Elements practice is the essential first step toward complete emotional and spiritual development. In this useful and informative work, Master Mantak Chia leads you step by step to becoming an emotionally balanced, controlled and strong individual while offering you the key to an Immortal existence.

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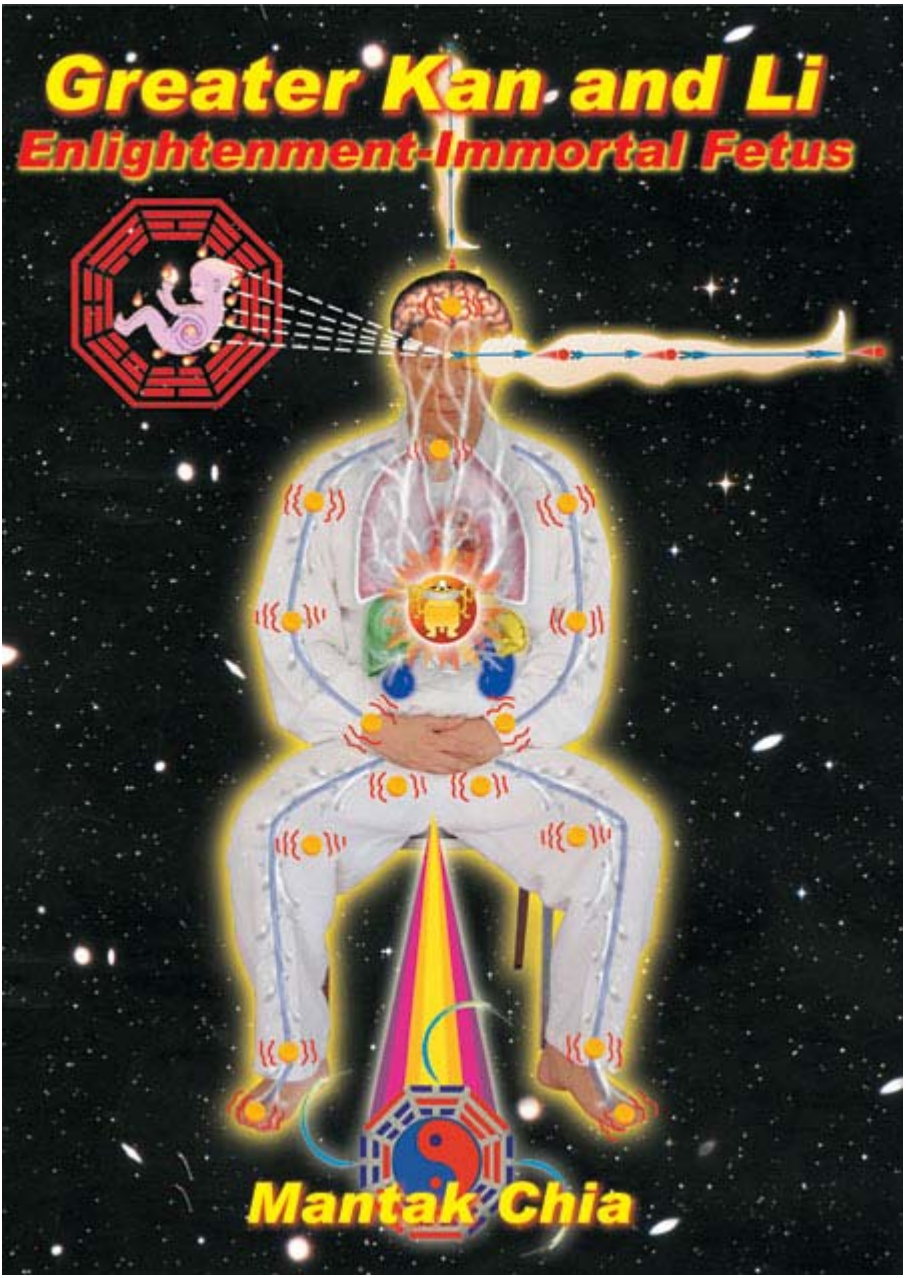
Greater Kan and Li
Enlightenment-Immortal Fetus
Mantak Chia

Greater Kan and Li

Enlightenment-Growing the Immortal Fetus

Mantak Chia

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Three Parts of the Greater Kan and Li Practice

A. Basic Formula

Preparations. This part includes Fusion of the Five Elements and Cosmic Fusion and, if time allows, Fusion of Eight Psychic Channels. It is important to cleanse and balance the negative emotions, develop the virtues, clear the thrusting channels and strengthen the belt routes as a preliminary procedure. At this stage, the pearl could be projected through the three planes (earth, human, heaven) also, although it is not obligatory because it could be done as an integral part of Greater Kan and Li proper.

B. Kan and Li Proper

The essence of the practice is the establishment of the cauldron in the solar plexus and the birth of the soul and spirit (if it has not been done earlier in Fusion of the Five Elements). From the navel (in Lesser Kan and Li), we reestablish a new cauldron at the solar plexus, where most of Greater Kan and Li practice transpires. Other related practices, which occur in one form or another in Fusion of the Five Elements and Lesser Kan and Li, are: Self-Intercourse, Forming the Soul and Spirit Bodies, Astral Flight, Domestic Animals, Virgin and the Twelve Channels, Gathering the Pill, Closing the Meditation (Turning the Wheel of the Law), and Transferring the Consciousness to the Energy Body and the Spiritual Body.

C. Corollary and supplementary practices

These practices are essentially supplementary techniques whose purpose is to draw energy from nature: Collection of Outside Energies (moon, sun, star, plants and trees).

Outline of Basic Practice – Simplified

A. Fusion

1. Smile down to the three lines or the entire body.
2. Form the four pakuas (front, back and sides) and feel them glow like diamonds with their bottoms meeting at the cauldron.
3. Collect negative emotions from the organs at the collection points and merge and balance at the pakuas.
4. Stream energies into the center and form a pearl.
5. Using the pearl to attract the virtues, do the creation cycle.
6. Using the pearl, clean out the thrusting routes and bring the pearl back to the perineum.
7. Collect saliva and swallow to cleanse the thrusting routes.
8. Move the pearl in the microcosmic and let it gather momentum.

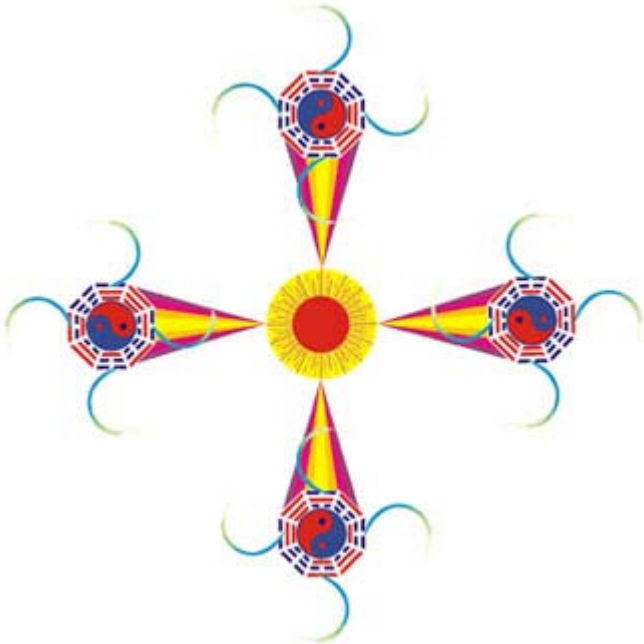

Fig. 1 *Collect negative emotions from the organs at the collection points.*

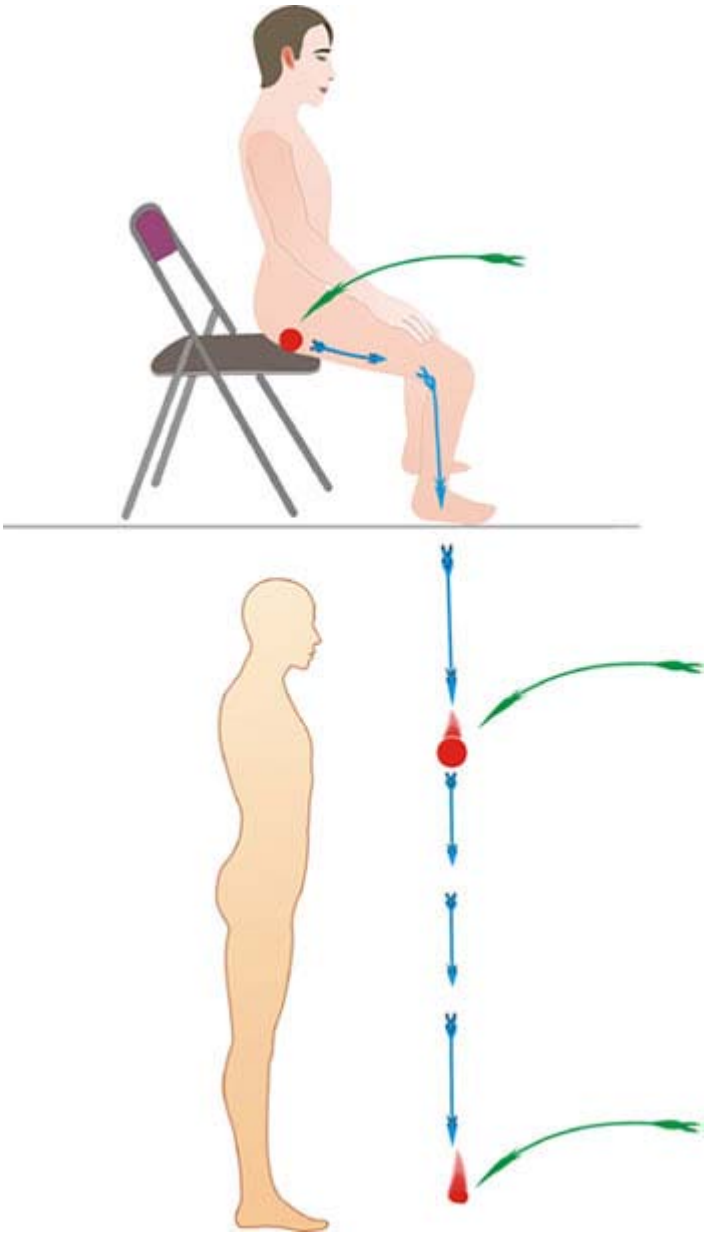

Fig. 2 *Move the pearl in the microcosmic and let it gather momentum.*

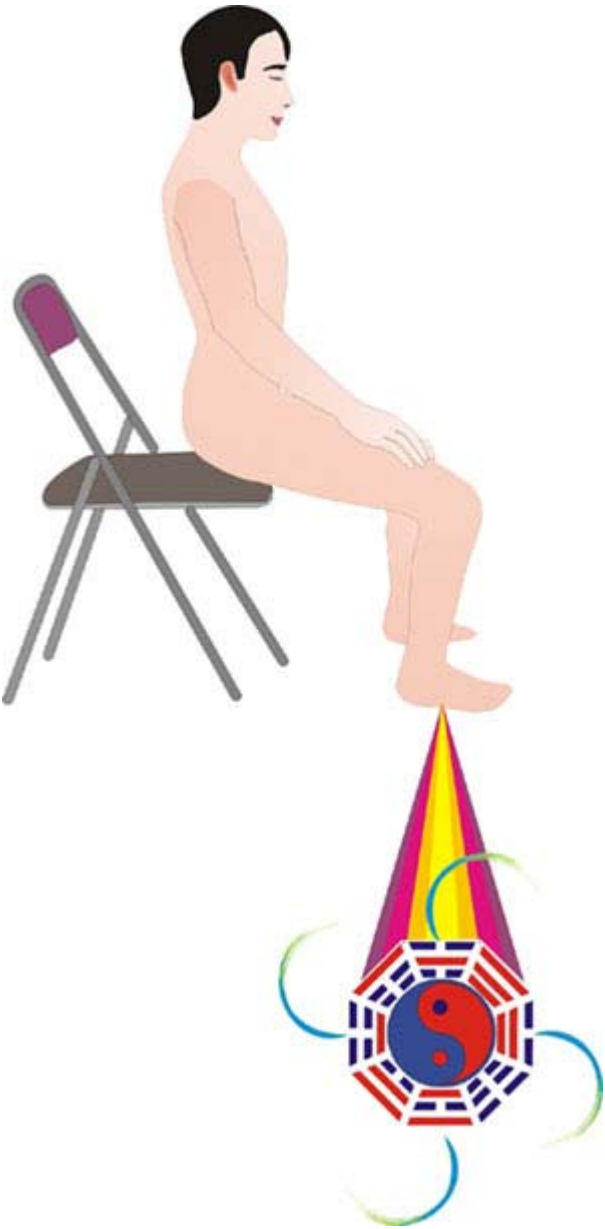

Fig. 3 *Stream energies into the center and form a pearl.*

B. Earth Plane

1. Shoot the pearl down the legs, one body length into the ground (as your practice improves, you can go down as many body lengths as your energy can reach).
2. Create a pakua around the pearl.
3. Extend the microcosmic, thrusting routes and belt routes to the body/bodies in the earth.
4. Gather water, fire, wood and metal energy through the pakua.
5. Gather in the middle of the toes and gather to the mideyebrow.

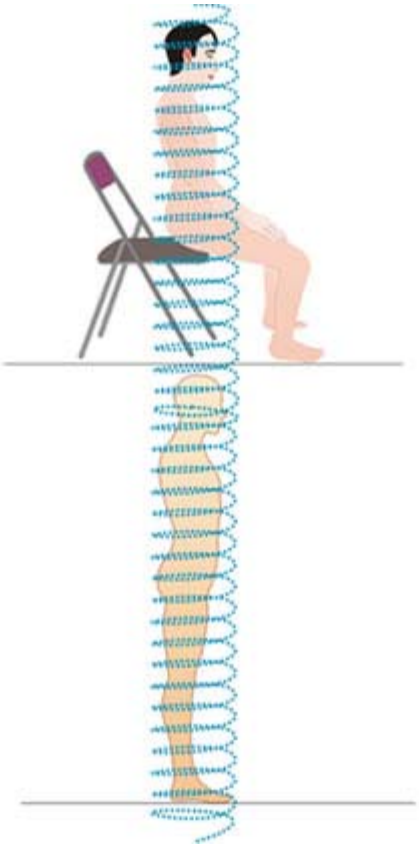

Fig. 4 *Extend the microcosmic, thrusting routes and belt routes to the body/bodies in the earth.*

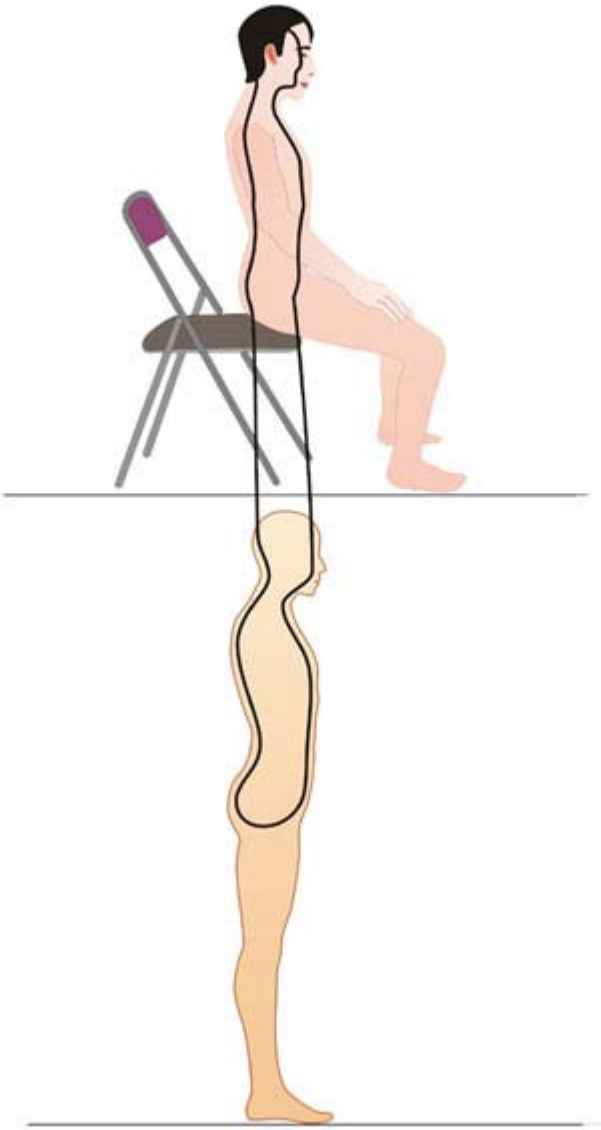

Fig. 5 *Shoot the pearl down the legs, one body length into the ground.*

C. Human Plane Cosmic Particle (Unicorn Practice)

1. Form another pearl in the cauldron and move it to the perineum.
2. Move the pearl in the microcosmic until it gathers momentum.
3. Let it stop at the crown and slowly let it go to the third eye.
4. To gather strength, you may use breathing.
5. Exhale and shoot the pearl one or more body lengths from the third eye parallel to the ground. (There is no need to visualize a body, although it provides a point of reference when one projects the microcosmic, thrusting channels and belt routes.)
6. Extend the microcosmic, thrusting channels and belt routes.
7. Gather energy with the pearl and let the energy stream into the crystal room.

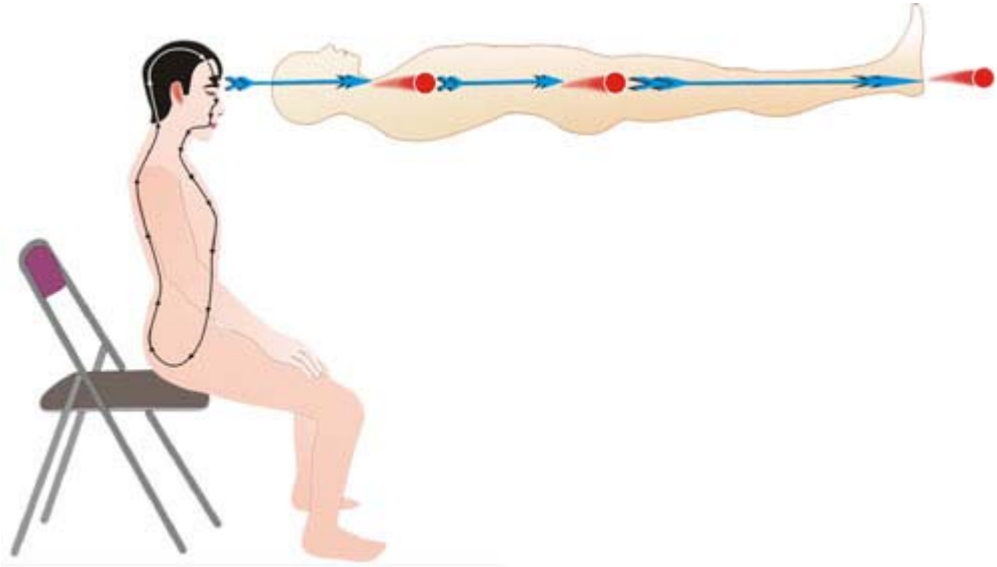

Fig. 6 *Human Plane Cosmic Particle*

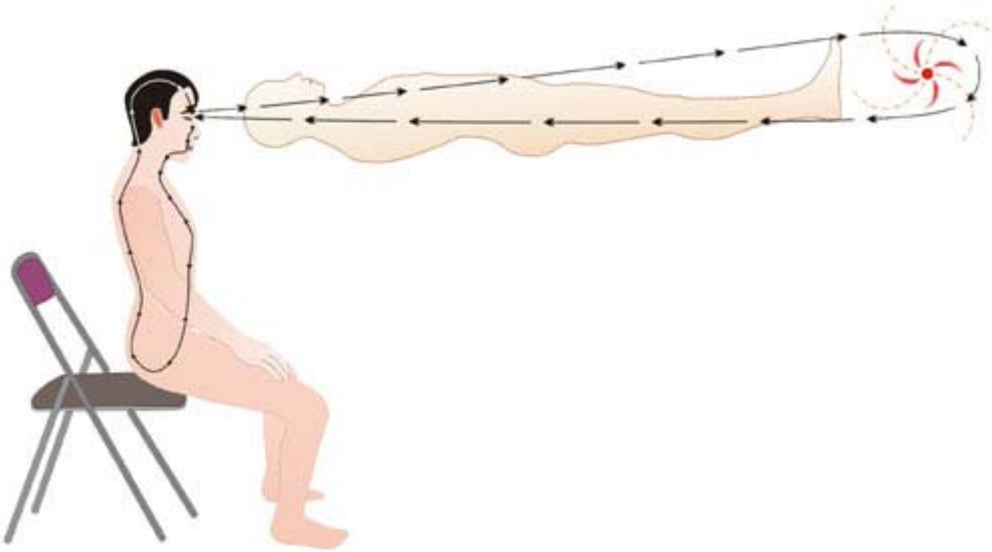

Fig. 7 *Gather Energy with the Pearl*

D. Heaven Plane (Beginning Vertical Flight)

1. Form another pearl and settle it in the perineum.
2. Move the pearl in the microcosmic and let it gather momentum.
3. Slow it down and let it rest in the crown.
4. Activate the cranial pump (look up, clench the teeth and jaw, sink chin and sternum, clench the fists, tighten the buttocks, pull up the sexual organ).
5. Exhale and shoot the pearl through the crown, extending the pearl one or more body lengths above you.
6. Extend the microcosmic, thrusting and belt routes.
7. Draw energy into the crystal room.

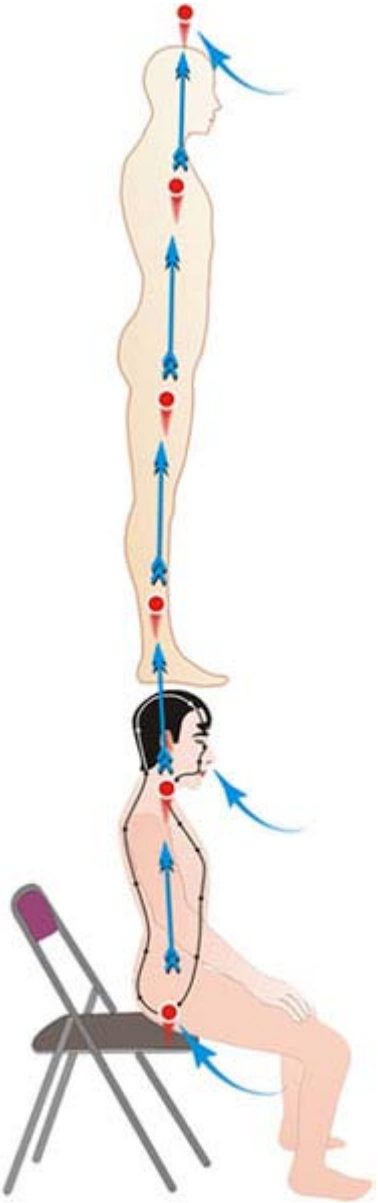

Fig. 8 *Heaven Plane (Beginning Vertical Flight)*

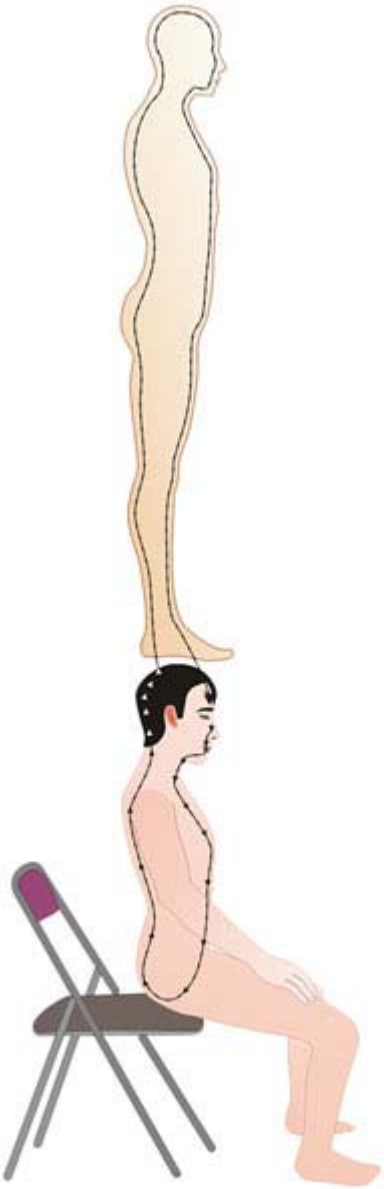

Fig. 9 *Slow it down and let it rest in the crown.*

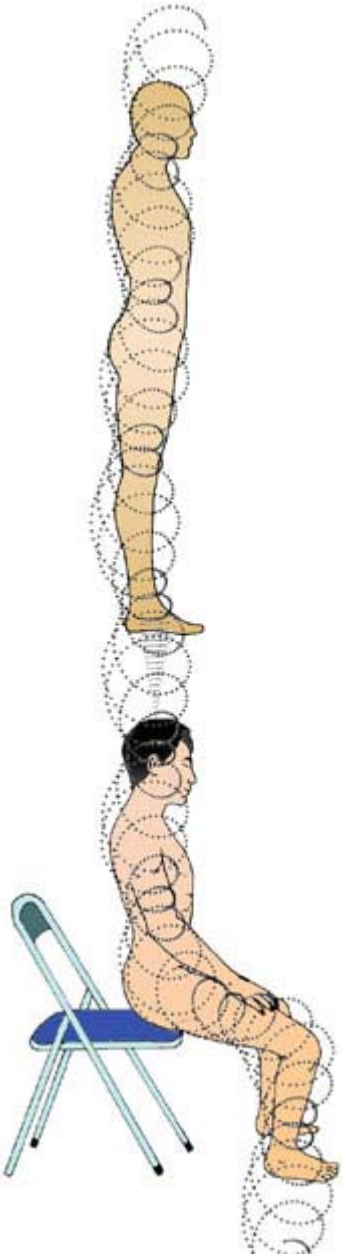

Fig. 10 *Extend the microcosmic, thrusting and belt routes.*

Greater Kan and Li Proper

A. Establishing the Cauldron at the Solar Plexus: Reversing Hot and Cold Energy (Coupling)

1. While the cauldron was established at the navel in Lesser Kan and Li, it is now established at the solar plexus.

2. Listen to the kidneys and feel their cold energy spiral at the kidney.

3. Distinguish the kidneys' cold energy from the hot energy of the adrenals.

4. Spiral and collect the cold energy of the kidneys and move it down to the collection point at the perineum.

5. Spiral and collect the hot energy from the adrenals and move it up to the crystal room behind the third eye.

6. Spiral and collect testicle and prostate energy (for men) and ovarian energy (for women) in the collection point at the perineum.

7. Divide the attention between the perineum and crystal room. Spiral at these two points.

8. Two things could be done either simultaneously or alternately:
   - Spiral and move the hot energy down the left or front thrusting route, gathering thyroid, parathyroid, thymus and heart energy on the way to the navel; and/or
   - Move the cold energy from the perineum up the right or back thrusting route to the heart.

9. Inhale and slowly exhale as you move the hot and cold energy into the middle thrusting channel to the solar plexus.

10. Couple the hot and cold energy at the solar plexus.

Reminder: Be sure to be careful in coupling the hot and cold energy that the cold energy does not spill.

Fig. 11 *Reversing Hot and Cold Energy*

B. Steaming

Consult Lesser Kan and Li for detailed description of this procedure.

1. To fan the fire of the cauldron, use bellows breathing until the energy begins to boil.
2. Establish a pulse at the cauldron and use this pulse to maintain the heat of the cauldron.
3. Turn the senses into the cauldron and stir with the eyes.
4. As the steam comes out of the cauldron, direct the steam to the following glands and organs (using the thrusting channels): kidneys, heart, thymus, thyroid, pituitary, pineal and crown.
5. Steam the thymus and lymphatic system.
6. Keeping the cauldron in place, steam the spine and regrow the nerves.
7. Steam the twelve channels.

Reminder: Amplify the pulse as the need arises since this takes the place of bellows breathing. To establish the pulse, listen to the heartbeat and synchronize other pulses to it. The result is a kind of rhythm that sets the pace not only of the practice but also of the pulsation.

Unlike in Lesser Kan and Li, it is not necessary to move the cauldron in spinal breathing and regrowing the nerves.

C. Adjusting the Seasoning in the Cauldron

This practice is intended to balance the energy in the cauldron. There may be an imbalance in the energies being used for steaming. It may not be cold or hot or there may be too much hot energy and too little cold energy; or the energy you may be drawing from its source may have changed temperature (from hot to cold, or vice versa). It is therefore necessary to determine that the energy you are using is hot or cold.

Procedure: Taste the qualities of the steam and the hot and cold energies that contribute to the process. To adjust the energy, use visualizations as follows:

- Tiger in the Sky: Greater Yang (Hot).
- Tiger in the Water: Lesser Yin (Cool).
- Dragon in the Sky: Lesser Yang (Warm).
- Dragon in the Water: Greater Yin (Cold).

Sky and tiger symbolize Yang energy; water and dragon symbolize Yin energy.

Fig. 12 *Adjusting the Seasoning in the Cauldron*

D. Domestic Animals and Virgin Boys and Girls (Pure Energy of the Organs)

1. Form the pearl, intensifying it with virtue energy.
2. Adjust the temperature in the cauldron, if necessary.
3. When the organ energy is pure enough, the energy can transform into the animals and virgin children, which will further purify the energy.

Move the pearl up to the top of the cauldron. Let it shine toward the liver. Let the crystal energy start to attract the dragon that lies dormant in the liver. The dragon's breath can change into two virgin boys, one wearing a green coat and the other wearing a yellow coat. The former can ride the dragon while the other can hold a jade scepter shaped like a paddle. Feel the virtue of kindness in the atmosphere of the liver. Get in touch with the virgin boys.

Go to the other organs, following the same procedure and using the animals and virgin children below:

a. Kidneys—Blue Deer. Two horns change into a virgin boy twelve inches tall. Virtue is gentleness.

b. Heart—Heart Pheasant. Produces virgin girl eight inches tall with a jade scepter like the heart. Virtue is respect, joy, honor and sincerity.

c. Spleen—Yellow Phoenix. Virgin girl six inches tall. Virtue is fairness, sympathy and openness.

d. Lungs—White Tiger. Virgin boy seven inches tall, carrying a shepherd's staff. Virtue is courage, strength and righteousness.

e. Gall Bladder—Green Tortoise and Snake. Virgin boy twelve inches throwing spear around liver.

4. It is the pure organ energy that is transformed into the animals and virgin boys and girls. The pearl and the fragrance attract the animals from their respective organs.
5. All the virtue energies merge into compassion energy embodied in the pearl. The animals and virgin boys and girls are attracted to it. Watch and enjoy this process.

6. At the end of the procedure, or toward the end of Greater Kan and Li proper, be sure to return the animals and virgin boys and girls to their proper organs.

7. The Inner Voice: Interacting with the animals and virgin boys and girls is one way of getting to know yourself. Be sensitive to their behavior and reactions. How they react is an indication of the state of your virtues. You can ask the virgin boys and girls questions and wait for their answers. You can name the virgin boys and girls if you wish.

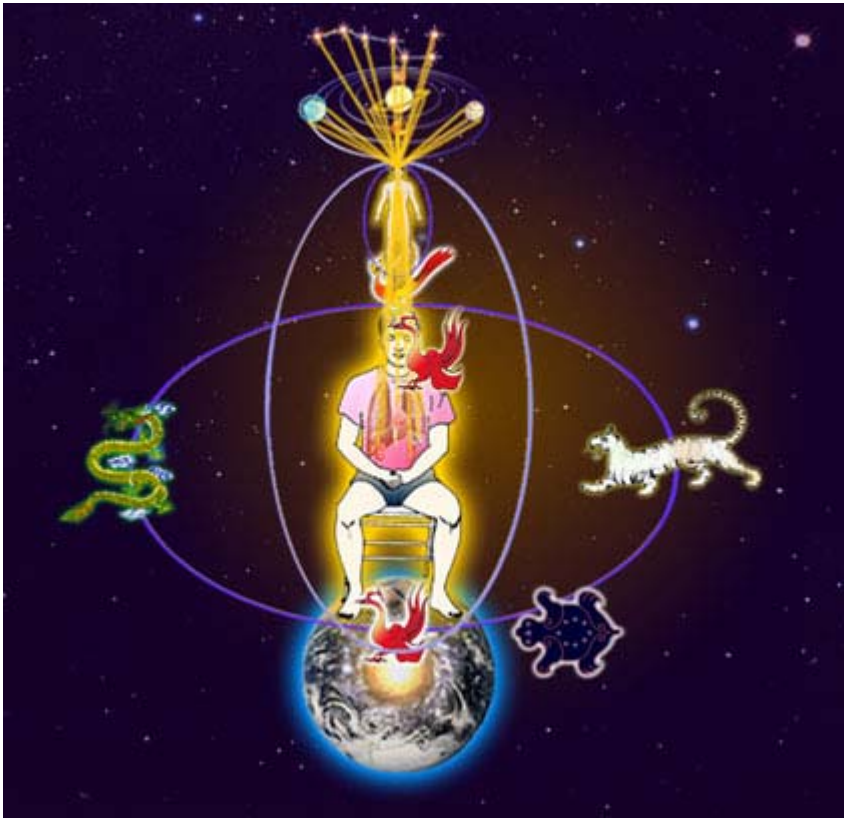

Fig. 13 *Domestic Animals and Virgin Boys and Girls (Pure Energy of the Organs)*

E. Earth, Animal and Spirit Energy

Project the pearl into the earth and see what animals are there to interact with. See which ones are attracted to the pearl, which ones come to you.

Send out your love and kindness, touch the animals, absorb the essence of the animal, its positive qualities, into the pearl. Draw the energy into the feet, perineum and into your self.

Introduce the animal spirit to your domestic animals and your virgin boys and girls. Integrate their energies. Name the animals if you wish.

When the domestic animals return to their places, find the place for the new animal.

1. Do not contact cold-blooded, unstable animals, such as insects or reptiles. The animals that we attract from the earth reflect the quality of energy emerging from our cauldrons, so at different times we may attract different animals. In the process of finding an animal, we may attract a wounded animal. The state of inner change is reflected by the healing of the animal. The part of the animal that is wounded indicates the seriousness of the situation: e.g., leg means lack of support; missing head, mental problems.

2. You don't have to go down all the time to get your animals. Once you get one, use it and keep it. What attracts the animals is the quality of the pearl. The animals are good for checking what is right and wrong with one's personality. Sometimes, one goes through an energy change and the animals disappear; new ones will appear.

F. Plant, Flower, Tree, and Mid-Plane Voyages

This practice enables you to reach a higher level of awareness, not only of your organs and glands and their unique scents, but also of the essences of nature. Drawing in the energy and essences within and without enables us to tap to an alternative source of energy for higher practice and brings us closer to the Tao.

1. Steam the kidneys and heart and watch them bloom.
2. Distinguish the color and fragrance of the blossoms.
3. Proceed to steam the thymus gland and notice its color and fragrance. Do the same with the lymphatic system, pituitary, pineal, thyroid and parathyroid glands. Take time to enjoy the colors and fragrances.
4. Draw the fragrances of the flowers toward the cauldron and notice the special type of energy there.
5. Form the inner self. Be aware of the eye, ear, nose, legs, etc. of a being that looks like you or a being you would like to be. Move it out of the navel or crown. See to it that the body is linked to you by an umbilical cord. Let it travel into a springtime garden in full bloom. Choose a flower or tree that appeals to you the most. Feel its energy and absorb. Draw the flower or tree back into yourself and introduce it to your internal family. Watch how the energy reacts inside your body. Enjoy the energy.

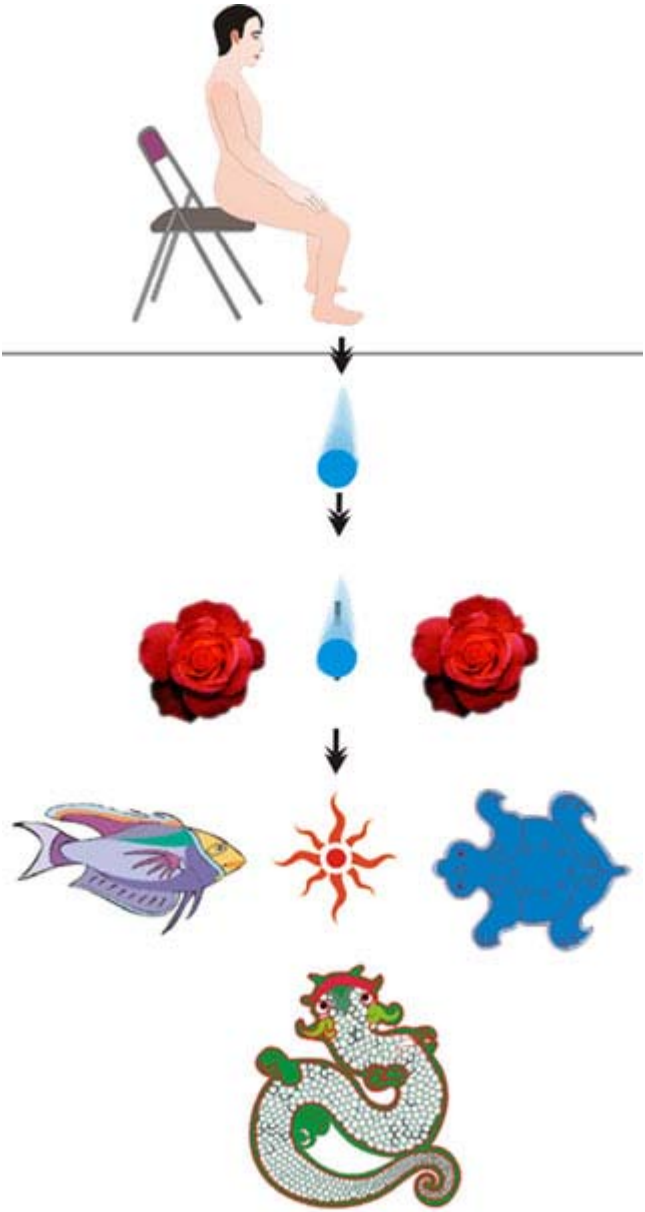

Fig. 14 *Plant, Flower, Tree, and Mid-Plane Voyages*

G. Self-Intercourse: Overcoming Death

It is important to remember that the essence of this practice is to give birth to the soul and spirit. The coupling of the Yin and Yang energies of the body in Kan and Li is aimed at overcoming death. Pregnancy may or may not result. Be aware of the symptoms of conception.

Self-intercourse, in the traditional literature, is called “first love.” It is characterized as an explosion of light from the pineal gland and a loss of physical boundaries. One learns to recognize the light. The pineal gland opens and the light comes through.

1. Focus your attention on the sexual organs and the pineal gland. Become aware of the universal (primitive) force.

2. Draw the universal energy of the earth (from the sexual organs and the pineal gland) into the cauldron until ecstasy results.

3. Allow the ecstasy to spread from the sexual organ to the organs and glands.

4. When ecstasy reaches the pineal, seed the cauldron with energy from the spleen (liver in Lesser Kan and Li).

5. If pregnancy results, run all channels and virtue energy inside the fetus (as in Fusion of the Five Elements). Be sure to practice the creation cycle often so that the fetus is nourished with virtue energy. Be patient. Growing the fetus takes a long time. It is an autonomous process. Suspend your steaming practice during the pregnancy.

a. Move the fetus in a circular pattern from the solar plexus to the spleen, to the lung, liver, perineum (pull up the sexual organs). Move the fetus to the heart and propel it to the crown to just above the head.

b. Let it stay for a minute and bring it down through the thrusting channel to the solar plexus.

c. With more practice (using the cranial pump mentioned earlier), you can propel the fetus higher.

6. If pregnancy does not result, form an imaginary fetus:

a. From the lower abdomen, make the cow sound “Mmmmmmmoooooo.”

b. Move the imaginary fetus (as in a, b and c above) in a circular pattern from the solar plexus to the spleen, lung, liver and perineum (pull up the sexual organs); move the fetus to the heart and propel it up to the crown to just above the head.

c. With more practice (using the cranial pump mentioned earlier) you can propel the fetus higher.

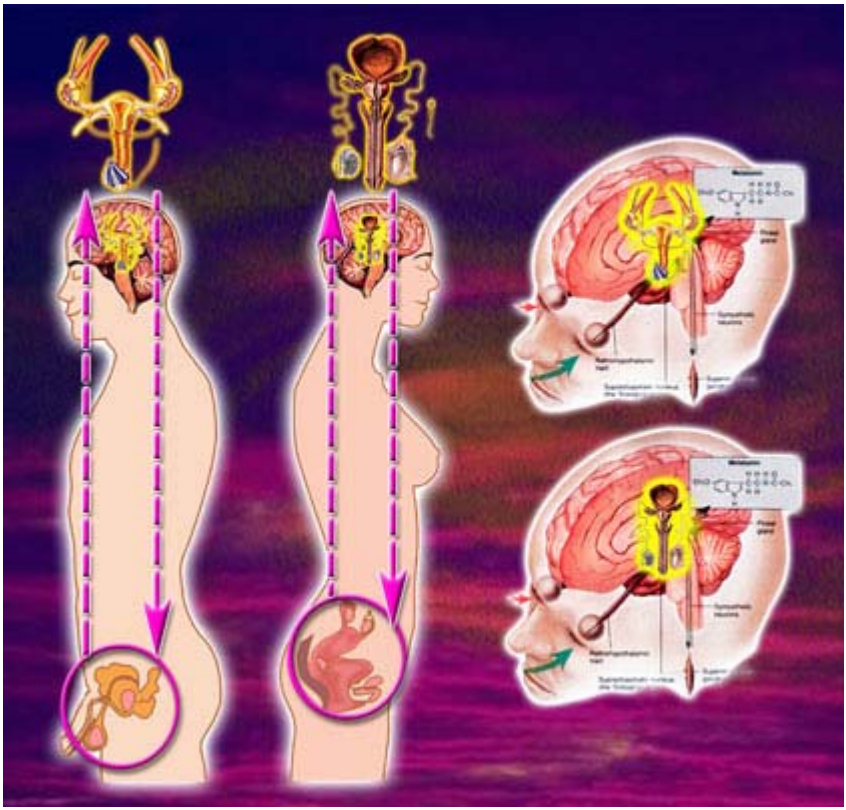

Fig. 15 *Self-Intercourse: Overcoming Death*

H. Opening and Emptying the Heart

1. Move the energy to the heart center, sink the sternum and relax the chest, steam the heart and watch it open and grow.

2. Amplify the pulse connection between the heart and the brain.

3. Inhale and squeeze the energy from the heart and as you exhale, send the energy to the brain.

4. Re-energize the heart with steam again and repeat the process.

This practice will help you open and empty the heart, energize the brain with heart energy, amplify the connection between the heart and brain and prepare you for the next level of practice.

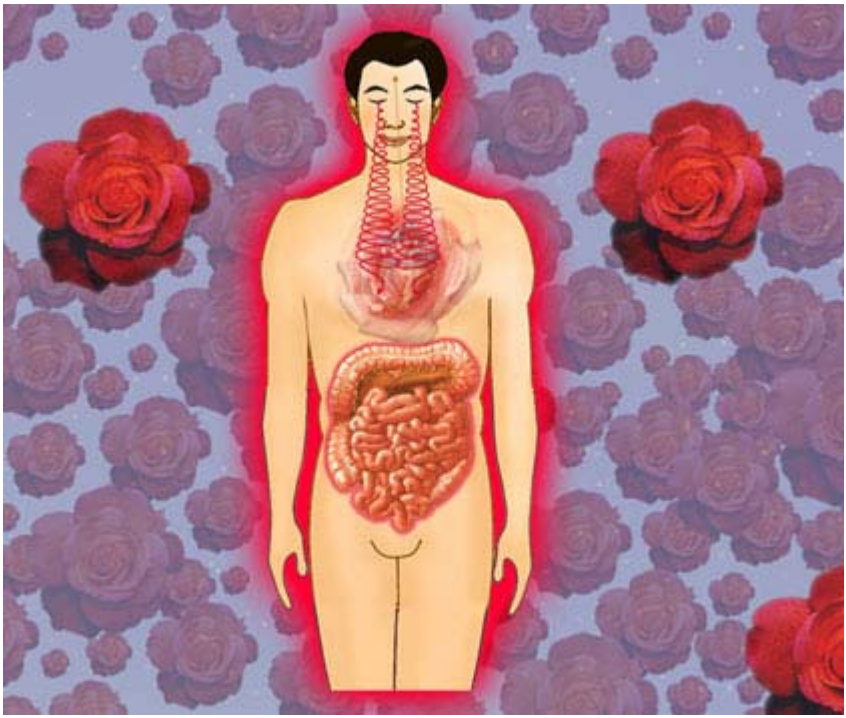

Fig. 16 *Opening and Emptying the Heart*

I. Forming the Energy and Spirit Body

Review Fusion of the Five Elements and Cosmic Fusion if you are not familiar with this procedure.

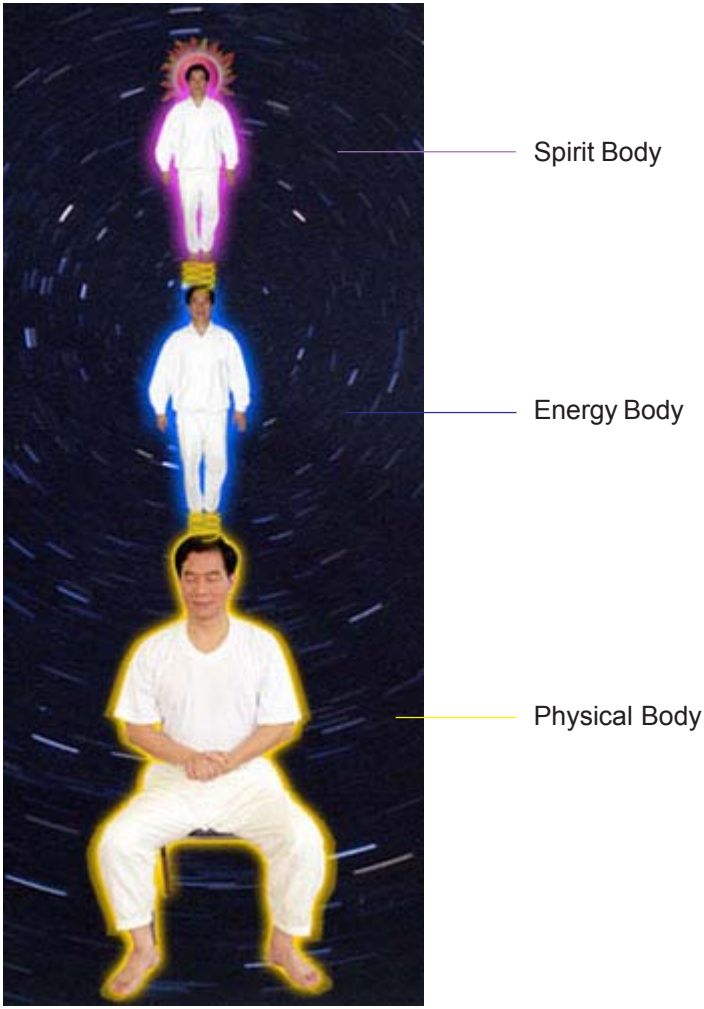

Fig. 17 *Forming the Energy and Spirit Body*

J. Astral/Vertical Flight

1. Continuing from the point where the spirit body is projected over the crown, move the spirit body around in a circle. Be aware of the distinction between the spirit body and the physical body.

2. Practice once a week for ten to fifteen minutes at the end of other work. If done at bedtime, the process will continue during sleep. The purpose of flight is to stay in the vertical and learn to digest mid-plane energies.

Fig. 18 *Astral/Vertical Flight*

Greater Kan and Li

The Sun:

Mankind has, since the beginning of time, observed the night sky and gradually gathered energy from the upper universe, the lower universe, the days and the hours. In Chinese reckoning, the lunar calendar is used and the start of these calculations was determined at the new moon 4681 years ago, in the first year of the Yellow Emperor.

This system is the accumulation of the many years of life experience of the many generations of people who followed the natural cycles. By observing the twenty-four climatic periods of solar energy, Chinese people have enriched their lives with regard to both agricultural and spiritual activities. This solar system of twenty-four periods is more closely related to the Western calendar. The Chinese system of solar energy variation defines the route the sun travels along the "Yellow Route" (ecliptic), beginning at the fixed point of the Spring Equinox and moving eastward until it reaches 360 degrees. Each 15 degree interval is a single seasonal period, thus setting twenty-four equal points. Each period has a special name which describes that climatic phase of the year.

Nature of the Sun and Moon:

The sun is the symbol of plenty, the essence of Greater Yang. The moon symbolises Yin, or lack and the stars represent accomplishment. It is not within the emptiness of the sun's nature to experience eclipses. It is the essence of fire. It has a three-legged raven which is the essence of Yang. The moon is empty and is the essence of Yin and of water. 'It has a cinnamon tree with a rabbit that pounds the immortality drug'.

The moon is the daughter of cold and has a cold heart. The sun is related to heaven; the moon is related to earth. In the body, the sun is in the heart and the moon in the kidneys. The sun and moon are the eyes of heaven and correspond to the human eyes.

Yang within Yin and Yin within Yang in Sun and Moon:

The sun is red and its rays are purple. The moon is yellow and its rays white. The subtle breath of the sun on the stomach is red and yellow. The sun has a yellow essence and a red breath. The moon is the reverse, it has a red essence and a yellow breath.

The sun is represented by the trigram Li, (fire); the moon is represented by the trigram Kan (water). In Li the inner line is Yin. In Kan, the inner line is Yang. This is the Yin within Yang and the Yang within Yin. In he symbolism of the sun, the raven is the symbol of Yin within Yang. The rabbit in the moon is the Yang within Yin.

Solstices and Equinoxes:

In the Taoist view, the sun stops on its movement on the first day of each season. The moon stops on the days of the equinoxes and solstices. These stops are called “Doors”. In spring it is the Golden Door. This is the door of access to the sun. In autumn it is the “Eastern Well”. This is the door of access to the moon. The next stage is “Universal Yang” in the middle of summer when the sun culminates. “Great Cold” is the culmination of the moon in winter.

It is through the doors that the practitioner goes in thought to be the lord that grants the fruits of immortality.

There is a method to gather the sun essence at the “Golden Door”. This is done on the 3rd, 9th, 17th, 21st and 25th of the month in which the sun enters at the Golden Door.

The exact same practice is done for the moon when it reaches its door (the “Eastern Well”). The days for the moon are: 3rd,15th and 25th.

Cauldron and the Stars:

The cauldron has the sun on the left and the moon on the right. Above is the constellation of Ursa Major (the Great Bear). Surrounding the sun, moon and stars are all the energies.

Sun, Moon and Stars in the Body:

The sun is in the heart since it has the fire element; the moon is in the kidneys because they contain the water element. The Pole Star is in the spleen which represents the center of the body. The spleen receives the essence of the Pole Star and it is there that the Lord of the Pole Star resides. The Dipper surrounds the spleen since the spleen stands for the center of the body. The spleen receives the essence of the Dipper and that is where the Lord of the Dipper resides in the body.

Sun Essence:

The best time for practice with the sun is at sunrise and sunset when it is red. The sun spectrum from sunrise to 9 am is violet, for all the organs and especially for spiritual work. You can single out any color to be specific to the color you need. 9-11 am is for blue, and can be used to strengthen the kidneys. 11-1pm is for green, for the liver; 1-3pm is for orange, for sexual energy. 3-5pm is for red, for the heart.
Season Sun Practice: When you practice in a particular season, you can emphasise the practice of the sun spectrum inside the organ that corresponds to the season and its color.

1. Winter in the kidneys; blue.
2. Spring in the liver; green.
3. Summer in the heart; red.
4. Fall, in the lungs; white.
5. Indian summer in the spleen; yellow.

Absorbing the Breath of the Sun in the Four Seasons:

In spring absorb the orange breath (Combination of red=sun & yellow=moon) of the sun before it sets. In Fall, absorb the orange twilight of the sun after it has set. In winter absorb the white vapors of midnight. In summer, absorb the prefect clarity of the meridional sun of midday. These 4 types of breaths in addition to the blue breath of heaven and the yellow breath of the earth are called the six breaths.

Sun Practice:

1. After sunrise, when you practice with the sun, start with the Inner Smile and make the navel warm.

2. Be aware of the mideyebrow. Smile into your eyes, making them cool and soft.

3. Open your eyes and look at the sun. Keep on blinking your eyes for a while; then close your eyes. The eyes still face the sun, so you see a red and yellowish color. Single out the yellow color and breathe it in through the crown and mideyebrow into the nose, eyes and mouth. Keep the mouth closed and feel the color penetrate into these areas. Feel the bones in your skull, the brain and the brain marrow receive the yellow spectrum to wash and help grow the marrow. Let these rays penetrate deep down into the neck, like a wave penetrating deep into the bones, cell marrow and each cell in the body. Some people may experience a feeling of numbness.

4. Let the rays move to the sternum and the rib cage and feel them activate the thymus, sternum, and rib cage to help stimulate the immune system.

5. Let them flow down the spine and feel a numbness, tingling or warmth in the inner part of the bones. This feeling can spread out to the organs. Let it travel down to the hip, sacrum and feel the bones and the bone marrow activate, then let it move down to the legs and the bones of the feet. This can feel like a cosmic baptism; in this case a baptism of the sun. Feel the baptism of the sun's rays throughout your whole body.

6. Rest and let the body absorb all these cosmic nutrients. The sun becomes a prism – a rainbow of colors.

7. After your practice, look at the sun as described above and single out a color. Picture the organs and see each organ glow with its particular color.

a) Listen to the kidneys. Picture the kidneys; if you can look at an anatomy book, close your eyes and still see a picture of the kidneys, this will help tremendously with your visualization. Once you feel or see the kidneys, look at the sun and blink your eyes for a while. Then close your eyes and focus only on the color blue. In the

beginning this might be a little hard. You can use the kidneys' sound Chooooo, and the picture of the kidneys to help. Feel the kidneys glow with a bright blue light.

b) Look into the liver. Again, try to look at an anatomy book beforehand to get a clear picture of the liver to help you. Then close your eyes and retain that picture of the liver. Once you feel or see the liver, look at the sun and blink your eyes for a while. Then close your eyes and single out only the color green. In the beginning this might be a little hard. You can use the liver sound Shhhhhhhhh, and picture the liver to help you get the color. Feel the liver glow with bright green light.

c) Look, listen and move your tongue around, then feel the heart and picture it. Look at the sun and blink the eyes for a while, then close your eyes and single out only the color red. Use the heart sound Hawwww, and the qualities of the heart – love, joy and happiness. Feel the heart glow with bright red light.

d) Look, listen and taste into the spleen. Once you feel or see the spleen, look at the sun and blink your eyes for a while. Then close your eyes and single out only the color yellow. Use the spleen sound Whooooo, and the qualities of the spleen –openness and fairness. Feel the spleen glow with bright yellow light.

e) Look , listen and smell into the lungs, then picture the lungs. Once you feel or see the lungs, look at the sun and blink your eyes for a while. Then close your eyes and single out only the color white. Use the lung sound Sssssss, and the quality of the lungs–courage. Feel the lungs glow with bright white light.

8. When you are in a particular season, start your practice with that season. For example in the fall, picture the color white in the lungs. Once you feel or see the lungs, look at the sun, and blink the eyes. Then close the eyes and single out the color white and breathe it into the lungs. Then do as follows:

Winter into the kidneys; color blue.

Spring into the liver; color green.

Summer into the heart; color red.

The essence of the sun and moon is tasted on the tongue as nectar sweet as honey. This is the nourishment of the immortals.

To unite or balance the sun (left eye) and the moon (right eye) inside the crystal chamber as red light and white light, form a pearl as big as an egg and bring it down to the mouth.

9. When you can see the organs glowing with bright light, start to drink the nectar that gathers in the mouth.

a. Look at the sun and blink the eyes. When you feel and see the light, concentrate on the color violet.

b. Visualize the sun in the left eye and the moon in the right eye. This will help to balance the hot sun energy. Focus both on the third eye, Ming-tang, which is the location of the pituitary gland, and the pineal gland in the crystal room at the middle of the forehead.

c. Breathe into the crystal room and form a Chi ball or pearl.

d. After some time the Chi ball or pearl starts to drip from the glands into the crystal room. Let it drip down to the mouth, mixing with the sun essence. You can separate the sun essence from the breath in the mouth and let it mix with the original force. Feel a light ball grow in your mouth and throat. Close your eyes and focus on the light.

e. When you feel all the essence mix and glow like a Chi ball, swallow it down to the navel or cauldron.

10. Color method of the Sun

The divine breath or essence of the sun and moon appears in this method in the center of a cloud as five colors (colors of the five elements). The five colors are equivalent to everything created in the world.

a. After the Chi ball has been swallowed, look at the sun and blink the eyes for a while. Then picture the red light of the sun.

b. The red breath of the sun gathers and descends, covering the body of the practitioner. One imagines that one is in the light of the sun. The light travels through the body and rises, together with the practitioner, to the Palace of Universal Yang, the sun.

c. Gather the essence of the sun and descend.

d. Picture yourself sitting in the light of the five colors of the sun that form a halo which descends to the feet of the practitioner.

e. The five colors become concentrated and rise to the crown. The halo of five colors then penetrates through the mouth.

f. The cloud previously visualized remains outside, emanating the five colors. In the middle of the cloud appears a purple breath like the pupil of an eye.

g. This purple light has 10 layers blazing in the center of the cloud of 5 colors. The purple light together with the 5 colors penetrate through the mouth.

h. There is a counterpart moon exercise, which is identical except that the yellow breath of the moon replaces the purple breath of the sun in the center of the cloud.

Sun Essence Capture in Water:

The essence of the sun is captured in water by exposing it during the time from sunrise to 9 a.m. The color is violet, for all organs, especially for spiritual work. From 9-11 a.m. is for blue and can be used to strengthen the kidneys. 11 a.m.-1 p.m. is green for the liver; 1-3 p.m. is orange for sexual energy; 3-5 p.m. red for the heart.

A special water can be make on the days 1-15 of the month in which the sun comes to the Golden Door, which is the spring equinox. This water is called “Mineral Light; Mother of Waters”. To capture the essence, put purified rain or spring water in a sterilized bottle out in the sunlight during the corresponding phase of the spectrum for one or more days. You can drink the water, or make herb tea or mix it with food or medicine.

Eight Articulations of Sun and Moon:

The practices for the Sun and Moon are done according to the 8 articulations of sun and moon power. These are: the 2 solstices, the 2 equinoxes and the first day of the four seasons. These dates fix the time for doing the visualizations of the sun and the moon.

According to the ancient calendar the practice for each lasts 45 days in a continuous cycle of 360 days. (45 x 8 = 360).

45 days of sun practice are followed by 45 of moon practice.

Summary:

A. Moon Energy

Time of practice: 9 PM. to 1 AM.

Duration of practice: Ten to fifteen minutes.

Procedure: Feel the eyes yielding and cool. Do not blink. Absorb moon energy until tears form or the eyes heat up. Draw moon energy into the eyes, and into the mouth and mix it with saliva in the mouth. Draw in the senses, bring the chin down, straighten the spine and swallow (gulp down) into the thrusting channel for storage in the perineum.

Fig. 20 *Moon Energy*

1. Moon energy can be stored in all the organs.

2. Note that when the moon is full, there is more Yang energy in Yin. When there is no moon, there is pure Yin energy. After the new moon, there is less Yang in Yin.

3. The best time to absorb the moon energy is during the new moon, when the heart is calm. (First crescent after the dark phase.)

4. Collect moon energy in proportion to the sun energy collected to balance Yin and Yang energy.

5. The fluid of the eyes is magnetized by making it cold. The colder the fluid, the more magnetized it is. As it gets warmer, it loses its magnetism. Staring hard heats up the eyes; looking relaxed cools them. Instead of letting the eyes "go out" and reach the object, let the eyes attract the object.

B. Sun Energy

Time of Practice: At sunrise or sunset, when the sunlight is soft, not harsh. Be extremely cautious with this practice as the retina can burn quite easily.

Duration of Practice: Ten to fifteen minutes, depending on the time of the day.

Procedure: Look directly at the rising or setting sun for short periods. Close the eyes if the sun is high in the horizon. Absorb the sun energy through all three eyes into the Crystal Room (behind the Third Eye), to the Jade Pillow, down to the Door of Life (Ming-men) and store in the sacrum. It could also be stored at the Jade Pillow or Door of Life by some people, but the sacrum is the safest place.

1. At sunrise, when the sun becomes bright (yellow) is the best time to open the Third Eye; this is the energy of clear light.

2. Morning: Yin in Yang. High noon: Yang. Red Sun: more Yin.

3. At noon, absorb sun energy with the eyes closed until you see a rainbow.Then single out the colors. If one meditates, the body will become a crystal, extracting the type of light it needs. You can also place the palms toward the sun.

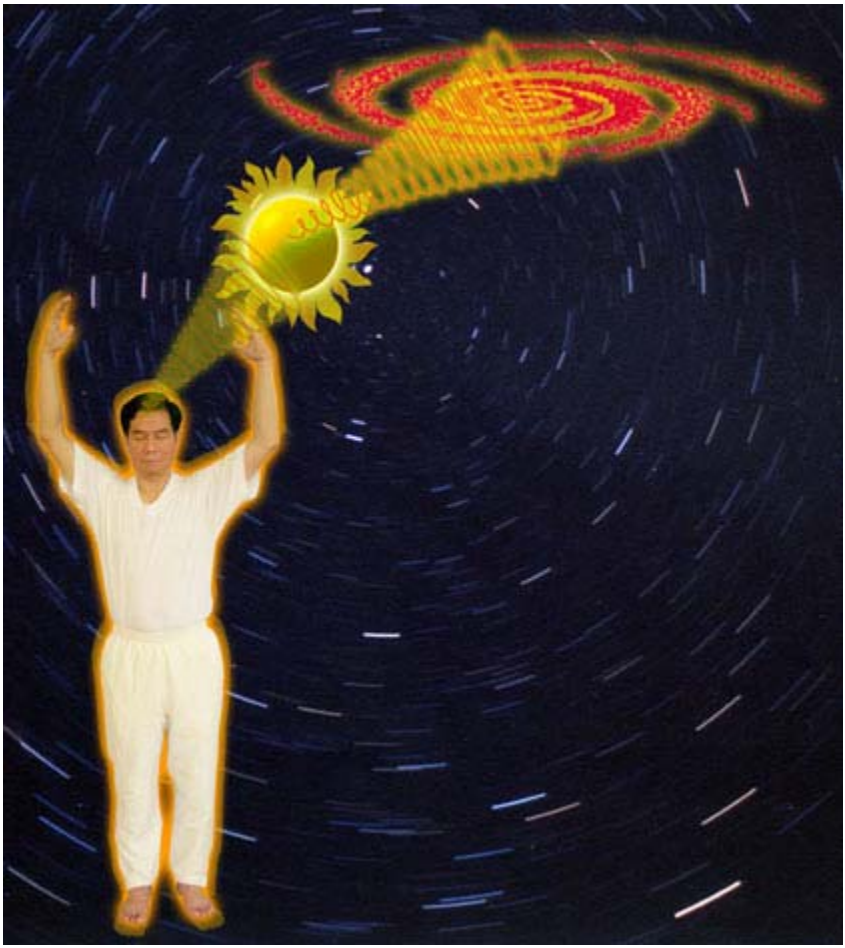

Fig. 21 *Sun Energy*

C. Star Energy (North Star and Big Dipper)

The Taoist aims at nourishing himself with light and essences not with substantial food. The Taoists eat the universe, but in its essential form which is more subtle.

It is by the absorption of essences that begins the cessation of cereals. Nourishment is replaced by subtle foods made of essences and lights. The absorption of cosmic energy becomes little by little the essential food of the practitioner. It is this subtle nourishment that allows the Taoist to become identified with the subtle and eventually become luminous and merge with the Universe to become part of the universe.

Heavenly Three in One:

The sun, moon and stars are the three luminous ones. They are the heavenly projection of the three Pure Ones. In the body that trinity is the Chi, Shen and Ching.

The three pure ones animate the universe through three breaths of three colors: Purple, Yellow and White. In the body they are incarnated by the three originals that reside in each of the 3 warmers.

Body as Light:

The body is conceived as a combination of lights. These lights are absorbed into the different elements of the body (blood, bones, muscles etc.).

The lights within are the counterparts of the lights outside in the starry heavens. The inner lights are Yin and the exterior ones Yang.

The Yin lights are the reflections of the Yang lights, yet neither can exist without the other.

Nature of Stars:

Stars are the dispersed emanation of the metal and their origin is in fire. The stars are yin and are the essence of the most subtle original breath.

There are three types of star practice.

1. They can be called to give protection.
2. The practitioner can make the stars energy comes down into the body.
3. The meditator can rise to the stars.

Protector:

Invoking the four animals:
Traditionally Taoists who practiced alone invoked the 4 animals at the beginning of the meditation. This was followed by the Sun, Moon and Dipper.

Ring of Protection:

The meditator, to protect himself during practice, can call the animals of the 4 directions. They form a protecting sacred belt that protects from evil, thus recreating a Microcosm in the middle of which the meditator sits.

1. The white tiger is to the right (west)
2. The green dragon is to the left (east)
3. The red bird is in front (or on the head)
4. The turtle, the black warrior is on the back, (or on the feet).

Inside Animals Protector:

Utilize the interior animals:

1. Picture first 4 spirits which are 4 children dressed in the same color as the organs they occupy.

2. Each exhales a breath of the same color as the organs to which they belong. The color breaths become the animals of the organs and go out to protect them.

Planets Protectors:

Like the ring of protection of the animals of the 4 directions, the planets can be called to form a protective ring around the practitioner.

Dippers:

The Dipper is also used as a protective cover over the practitioner. The method of internalizing and absorbing the essence of the Dipper stars is considered superior to covering the body with the stars, or praying to the stars. The highest practice is internalizing the stars.

Dipper Stars Protectors:

The star Governor of body spirits: The 7th star of the Dipper is considered the governor of the body spirits. The dipper stars are protectors of body points.

Dipper Stars Protect the Organs:

Visualize the 7 visible stars of the Dipper in succession. At the end visualize the two invisible ones together. Each star is visualized entering in the organs and illuminating the whole body.

The order of stars and organs: Heart 1#. At the cup, lungs 2#. Lower cup, liver 3#. At the lower cup, spleen 4# end of the handle, stomach 5#. At the handle, kidneys 6#., Pupils of the eyes 7#. At top of the handle. 8# Niwam on the crown (the 2 invisible ones together accompany the Pole Star).

Dipper Stars Protect Parts of the Body

1. The first 3 stars on the left side of the chest, elbow and the palms.
2. The 4th star on the heart.
3. The last 3 on the lower right side of the body. (abdomen, genitals and feet).

Dipper Symbolism:

This marks the four directions, fixes, determines and separates. It is the Dipper that fixes the seasons and Yin & Yang. The Dipper is the one that distinguishes good and bad, dispensing the results of good or bad deeds. So it is said to be the giver of happiness or adversity. Some texts say that the 7 stars become one and descend 3 feet above the head of newborns. If the child is going to be a good person it shines brightly, announcing the good news. If the stars remain dark this predicts a bad person.

The Dipper also governs the Superior Ones of the 9 heavens. In the middle plane it governs the flying immortals of the five mountains. Below it guides the true practitioners and the spirit of heaven and earth. Everyone depends on the Dipper.

Dippers of the Five Directions:

There are 5 Dippers: The eastern one rules the numbers of years each person is going to live. The western one inscribes the names of the living and dead in the registers of heaven. The northern one keeps tabs on the registers of death. The southern one gives life. The central one directs and governs all the spirits.

The most important of the 5 Dippers are the ones of the North and South. The Southern Dipper is believed to be in Sagittarius. Humans accumulate their merits in the southern Dipper. It saves the good from hell and intercedes with the king of hell anytime a demon bothers the practitioner. Parallel to that is the Dipper of the North. It keeps track of the evil deeds of humans and orders the king of hell to capture humans.

The northern Dipper is the place of hell and the southern one that of eternal life. Death comes from the emperor of the north and life through the door of the south. Prayers were made to both Dippers to prevent death and grant eternal life.

Dipper Stars and Seasons:

The first star of the Dipper, Yang Ming corresponds to the spring. Tan Yuan, the 5th, governs summer. Yin Tsing, the 2nd governs fall. Pei Ki, the 6th rules winter and Tien Kuan, the 7th, the center.

Dipper energy according to the days of the month is as follows:

The Dipper and the Three Pure Ones

1. Day 1, 2, 5 of the month. The energy is absorbed on the upper cinnabar field on the crown. The upper pure one, the upper warmer.
2. Days 7, 9, 12 on the middle field at the heart. The middle pure one, the middle warmer.
3. Days 15, 19, 23 on the lower field at the navel. The lower pure one, the lower warmer.

Dipper Energy Absorption Method:

Visualize the Ursa Major constellation, the stars are purple and net work that links them red. Feel a warmth produced by the purple color. The practitioner sees himself, together with the breath of the 7 stars, penetrate into a watery flower. In the center of the flower there is a pond of a 1000 miles, a jade mountain, a great terrace thousands of acres long and a red tree with purple flowers. He loses consciousness of himself inside of the flower.

This practice is called “abandoning the little for the great” or “metamorphosis without a trace”.

This method is considered the supreme experience of star meditations and was practiced by several of the great immortals.

Spring Practice:

On the equinox of spring after the Inner Smile late at night, turn toward the east, click the teeth 30 times and with, eyes closed, see the 3 palaces of the body with their 3 virtue children 4 ministers and oneself in the middle of them.

Exhale a purple breath and rise to the first star of the Dipper with a yang mind. This star is the spirit of the east and spring. One sees oneself at the star exhaling the purple breath 30 times . After some time one sees the palace of the 3 original high ones of the east at the #1 star yang mind. At the palace, the young child of the green mystery (spring) gives one the true light. This light is green like a silk piece. This is the celestial bridge.

Dipper and Fetus:

The Dipper is related with anything that has to do with sprouting. The stars open the 7 orifices of the fetus and give it life.

The 9 stars (including the invisible) are related with the transmutations that take place in the 3 warmers in the process of perfection. Nine is also the number of Greater Yang.

Creation of the Subtle Body with Astral Energy:

This method is to have different astral angel children descend into each of the organs and give them life. This way little by little a subtle body is created. The same is done through alchemical methods clarifying each of the 3 warmers little by little.

Out of Body Journey to Dipper:

The journey is made on the solstices, equinoxes and the beginning of each season to the Dipper. There the practitioners see the three great spirits and the appearance of newborns. He sits in front of each. The main purpose is the feeling of having abandoned the physical body.

Follow the same procedure and storage points as the moon energy. Draw only from the pole star (above the Big Dipper).

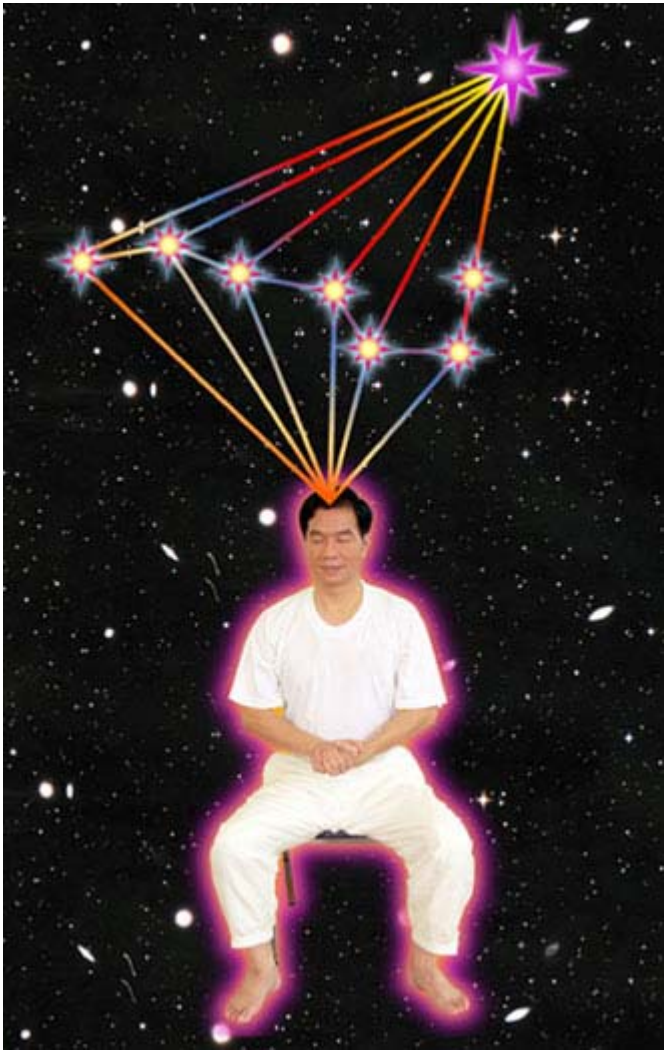

Fig. 22 *Star Energy (North Star and Big Dipper)*

D. Plant and Tree Energy

Time of Practice: Daylight hours. Avoid night time or early morning as plants are absorbing energy at this time. Choose plants and trees that are healthy.

Procedure: Sit quietly and feel the energy of the plant or tree. Absorb the energy through the palms, Third Eye, navel, solar plexus, projected pearl or the enveloping aura. Inhale and draw the energy through the points mentioned. Store in the perineum or back of the knees.

1. When drawing energy through the palms, circulate through the positive and negative arm routes. For smaller trees or plants, use the hands to absorb energy. For larger trees, extend your aura and envelop the tree, allowing the tree's aura to envelop you.

2. Animals belong to the lower plane (earth). Plants belong to the mid-plane or earth surface. Trees stand between heaven and earth; hence, they have earth and heaven energy. Taoists aim to become like trees, a union of heaven and earth, and symbols of longevity. The energy drawn from the trees and plants is absorbed by the pearl.

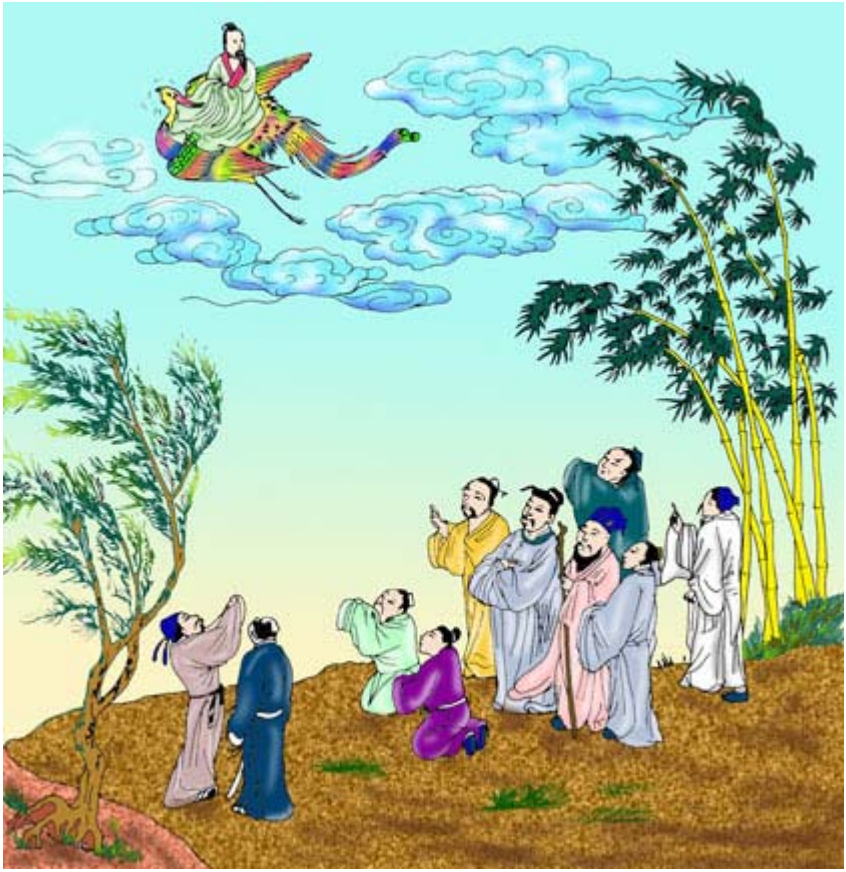

Fig. 23 *Plant and Tree Energy*

L. Ending the Meditation:Turning the Wheel of the Law

Each Kan and Li meditation should be ended with this formula which is a process of collecting “refined” energy in the navel cauldron to be used in future meditations, including the higher levels.

At this stage, the eyes are used to direct the energy produced by the meditation into the Microcosmic Orbit, guiding it into the cauldron behind the navel.

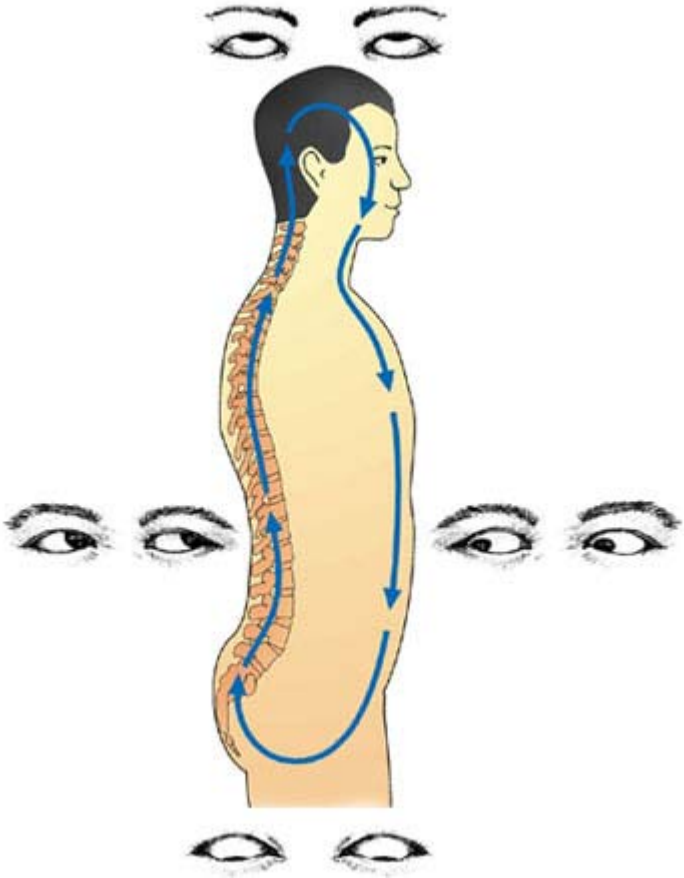

Fig. 19 *Ending the Meditation:Turning the Wheel of the Law*

1. Form a pool of sexual energy at the perineum. Looking straight ahead with your eyes closed, form a mental image of a clock with your eyes focused on its center.

2. Look down into the pool (6:00), and draw sexual energy up into the spine. The steam will travel up the spine drawing sexual energy with it.

3. Look from the perineum up to the right (3:00), drawing the energy up to T-11 as it is refined at that point.

4. Look from the right up to the crown (12:00), and draw the energy there to further refine it at the pineal gland.

5. Look from the crown down to the left (9:00), and draw the energy down either through the tongue or the thrusting routes into the cauldron at the navel. The energy is then stored in the cauldron. (These four directions constitute one round.)

6. Follow the procedures 1-5 above for at least 36 revolutions. You may do them in four rounds of six revolutions with three counts resting in between; or you may do two rounds of twelve revolutions with six counts of resting in between. In any sequence, the revolutions and resting counts must add up to 36. the rising steam will eventually flow independently of your counting, but maintain the mental revolutions to be sure it reaches the cauldron.

7. If you have time, do four rounds of 75 revolutions, resting for fifteen counts in between rounds; or do two rounds of 150 revolutions, resting for thirty counts between rounds; or do 360 revolutions straight through. (All of these methods add up to 360, which is the maximum number of revolutions used to end this practice.) If you have less time, do seven rounds, rest for three counts, then fifteen rounds, rest for three counts and finish with seven more rounds.

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Enlightenment-Immortal Fetus

Mantak Chia

Illustrations by Udon Jandee

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Sealing of the Five Senses

Opening the Crystal Room

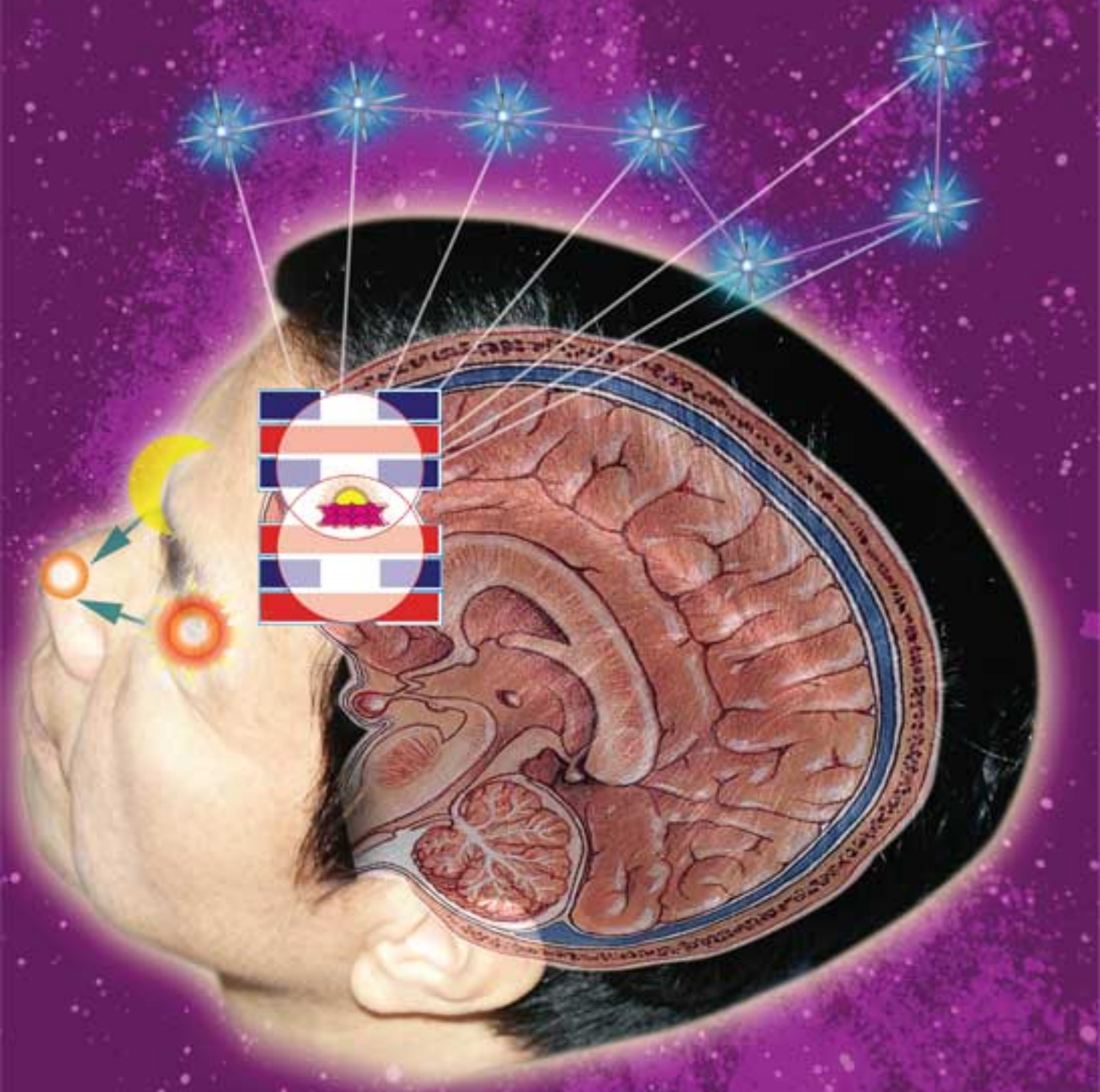

Mantak Chia

Sealing of the Five Senses

Opening the Crystal Room

Mantak Chia

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Sealing of the Five Senses

Our senses are like antennas which receive waves of vibration, sound and light that come to us. If that wave makes sense, our brains will start to think. Thinking consumes more energy than any other bodily activity. As humans we can not stop thinking, looking and listing nor stop fantasizing. This sensory-linked brain function in reaction to the external world is known as the monkey mind.

Our mind connects with the heart. When the mind is disturbed, the heart too will become disturbed. The good-minded good heart is the compassionate heart (harmony), therefore its good intention connects to the earth and nourishes it. When the wood meets the earth, the wood will grow. When the water meets the earth, the water will gather. When the metal meets the earth, the metal will condense. When the fire meets the earth, the fire will tone down.

If we can make the senses stronger, and seal the senses with external and internal force, we can accumulate profound energy.

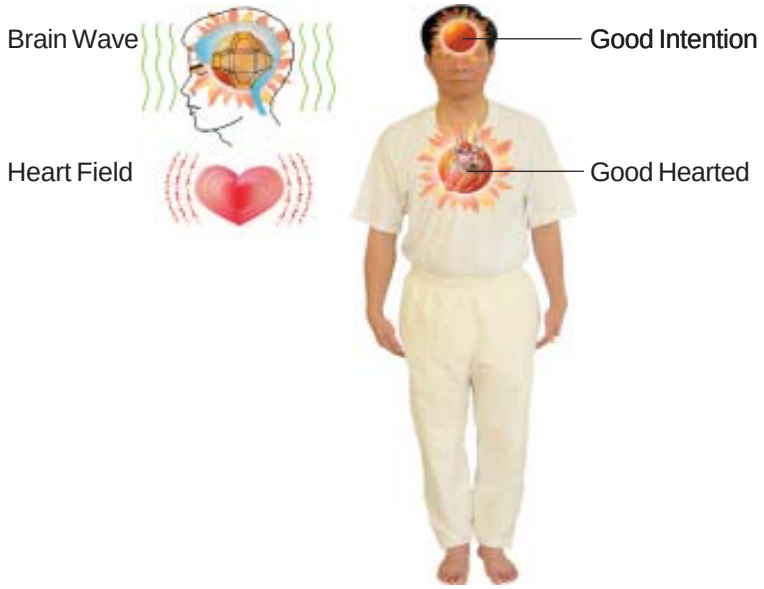

Fig. 1 *Waves of Vibration Coming into Senses*

1. First, we will strengthen the senses.
2. Second, we will make the connection.
3. Third, we will seal the senses.

The formula of Sealing the Five Senses effects a literal transmutation of the warm current or Chi into spiritual energy or energy of the soul. To do this, we must seal the five senses, for each one is an open gate of energy loss. The power flows out from each of the sense organs unless there is an esoteric sealing of these doors of energy. They must release energy only when specifically called upon to convey information.

Abuse of the senses leads to far more energy loss and degradation than people ordinarily realize. Examples of misuse of the senses are as follows: if you look too much, the seminal fluid is harmed; listen too much the mind is harmed; cry too much, and the blood is harmed; have sexual intercourse too much, and the marrow is harmed.

Fig. 2 *Sense Energy Turning inward. Content Person sitting in Meditation. Vibration turned Inward.*

A. First Formula Strengthening the Senses

The first step of strengthening our senses is very important. When the senses are strengthened we will be less affected by the stimuli coming from the outside world as criticism or praise. This strength leads to a connection with our center, where the mind becomes still, and the thoughts rest. A great deal of energy is spent thinking warring. Sealing the senses conserves this energy to be used for spiritual development.

Turning the senses inwardly to the center of the brain and down to the navel, and use the three cauldron coupling to help the suck in the natural and universal force.

1. The left ear corresponds to the metal element force.
2. The right ear corresponds to the wood element force.
3. The chin and the mouth correspond to the water element.
4. The nose corresponds to the earth star; this will tonify the earth.
5. The left eye corresponds to the sun.
6. The right eye corresponds to the moon.
   (Raise the water and lower the fire, and let it couple on the tip of nose.

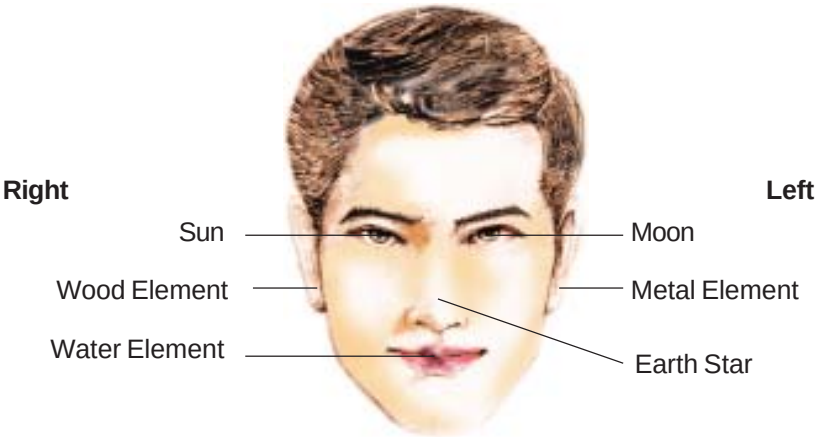

Fig. 3 *Elements Connected to Senses*

Practice Formula One

a. Be aware of the left ear and the metal force.
b. Be aware of the right ear and the wood force.
c. Draw these two forces together into the crystal room, combine them into the fire force.

Fig. 4 *Metal and Wood Transforming to Fire Crystal Room*

d. Be aware of the mouth and breath into the throat center and the lower abdominal suction and the tiger and the dragon breath to create the suction, and feel the Chi entering the mouth and gathering the water force into the Chi Ball.
e. Create the collection points to contain the water in the mouth.

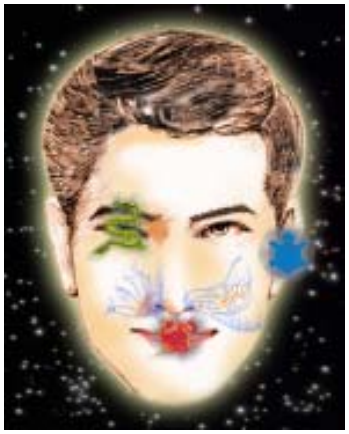

Fig. 5 *Coupling of Five and Water*

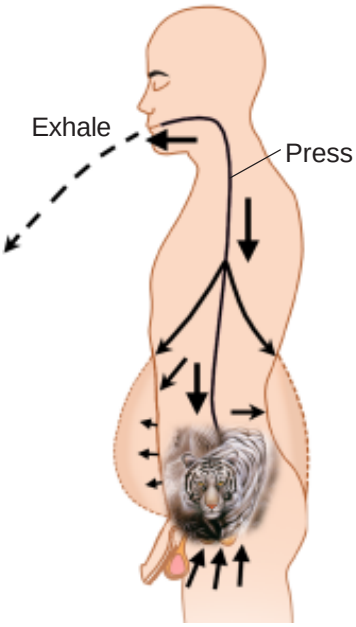

Fig. 6 *Dragon and Tiger breath. Exhale and compress the Chi down to lower abdomen.*

f. Let the water rise up, and lower the fire down and couple at the tip of the nose. Turn the awareness inward and feel the three-cauldron coupling at the same time.

Fig. 7 *Coupling of Five and Water*

g. Let it steam to the crystal room. The lower cauldron steams to the organs and the glands.

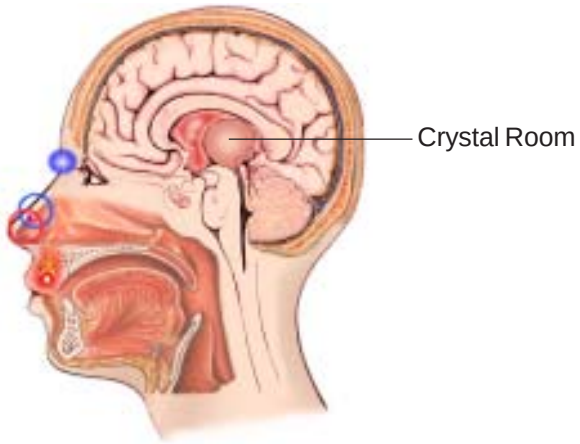

Fig. 8 *Steam to the Crystal Room*

h. Feel the four cauldrons couple at the same time, the normal breath stop and the true breath begin. Let the skin start to breath first, and the bones in the arms and the legs.

Fig. 9 *Skin, Bones Breathing*

i. Suck in the crown and expand to the nature and the universe. Suck in the mideyebrow, the third eye, the palms the soles of the feet, the perineum, the sacrum and the Door of Life. Eventually the whole body is breathing.

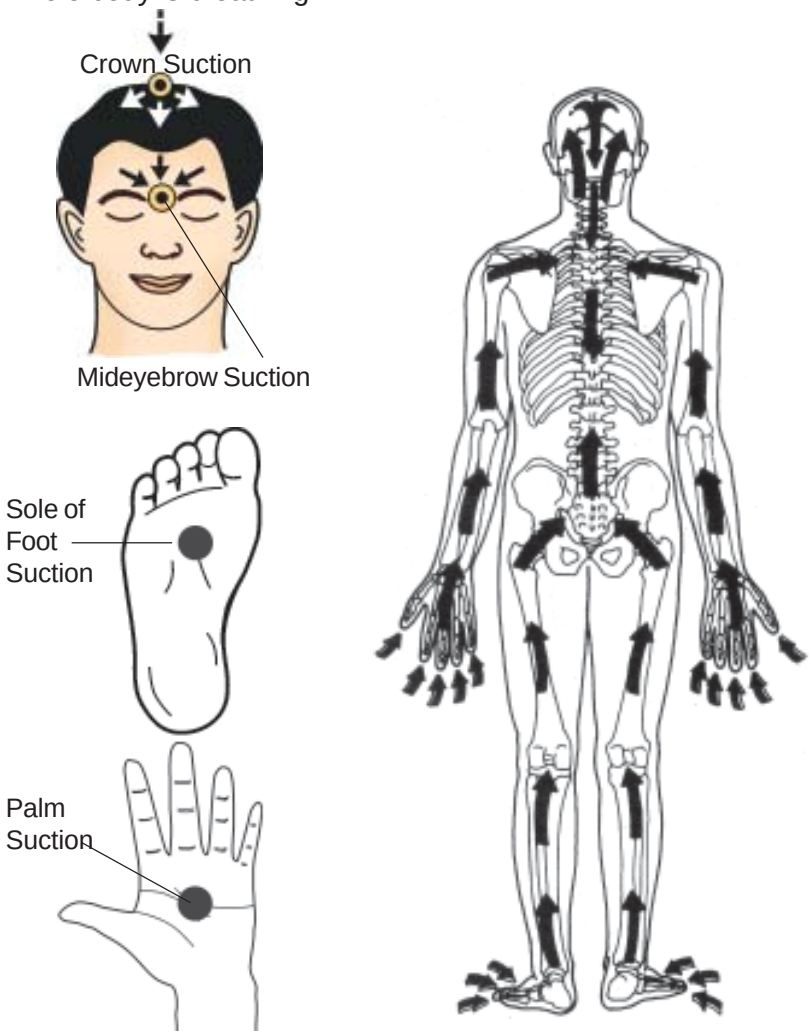

Fig. 10 *Whole Body Breathing*

B. Practice Formula Two

a. Be aware of the left eye as sun power.
b. Be aware of the right eye as moon power.
c. Combine these two forces into the bridge of the nose and let them become fire force.

Fig. 11 *Combine to Nose*

d. Be aware of the Chi in the mouth, use the throat center and the lower abdominal and the Tiger and Dragon breath to create the suction to breathe in the external Chi to form a chi ball in the mouth.
e. Raise the water and lower the fire and let them couple at the tip of the nose.

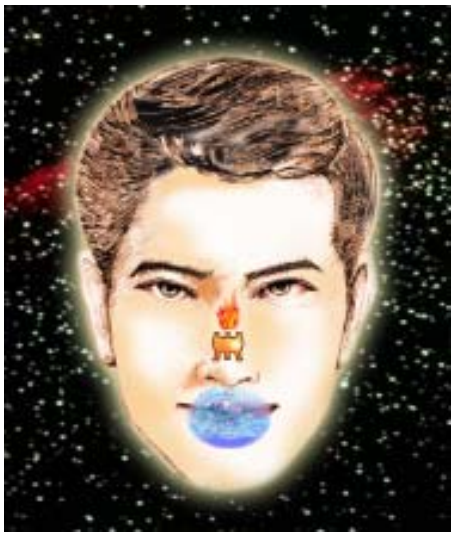

Fig. 12 *External Chi*

f. Feel the four cauldrons couple at the same time, the normal breath stop and the true breath begin. Let the skin start to breath first and the bones in the arms and the legs.

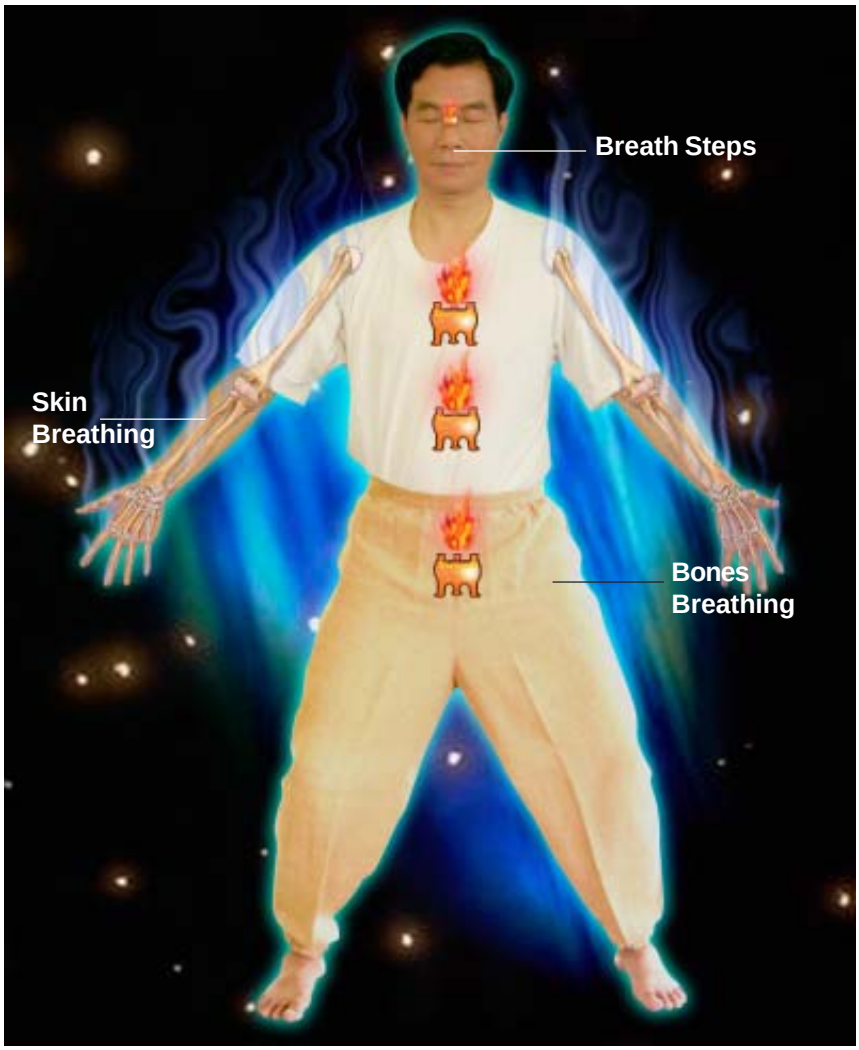

Fig. 13 *Skin and Bones start to breathe.*

g. Suck in the crown and expand to the nature and the universe. Suck in the mideyebrow, the third eye, the palms the soles of the feet, the perineum, the sacrum and the Door of Life. Eventually the whole body is breathing.

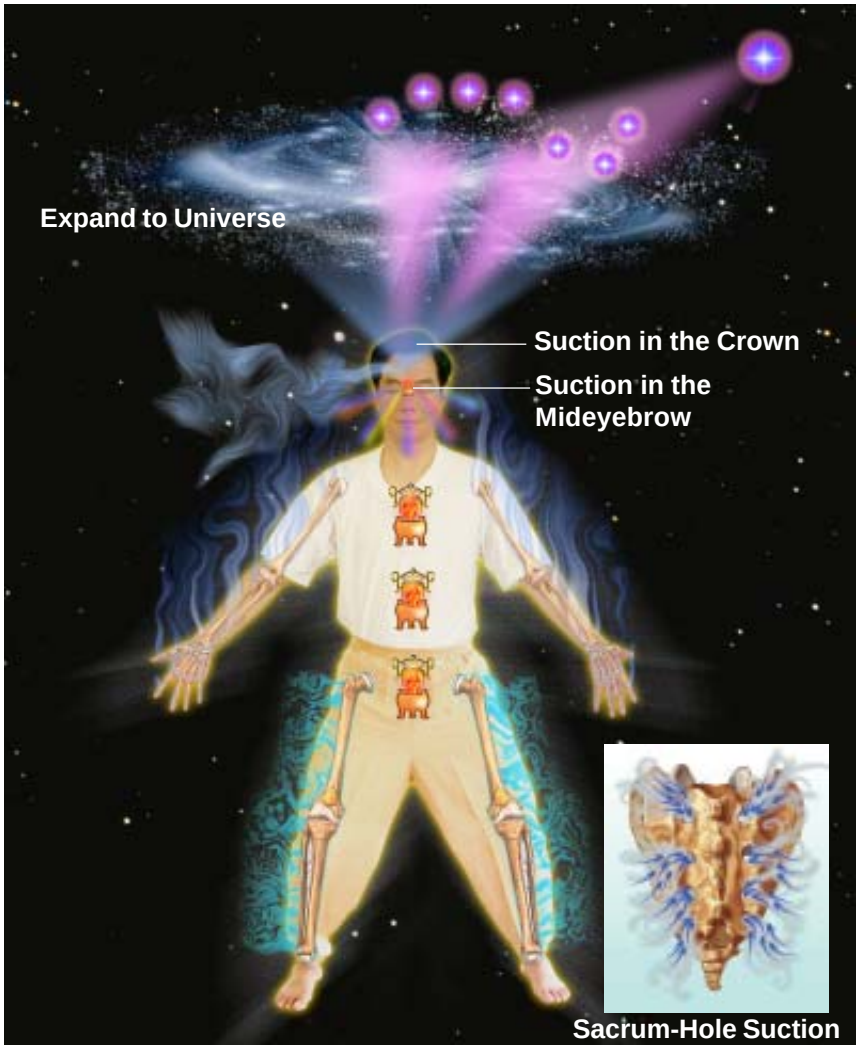

Fig. 14 *Eventually the whole body is breathing.*

C. Practice Formula Three: Sealing of the Five Senses

a. The left ear connects to the left kidney, known as the true kidney, the activator of the stored energy of the kidneys.

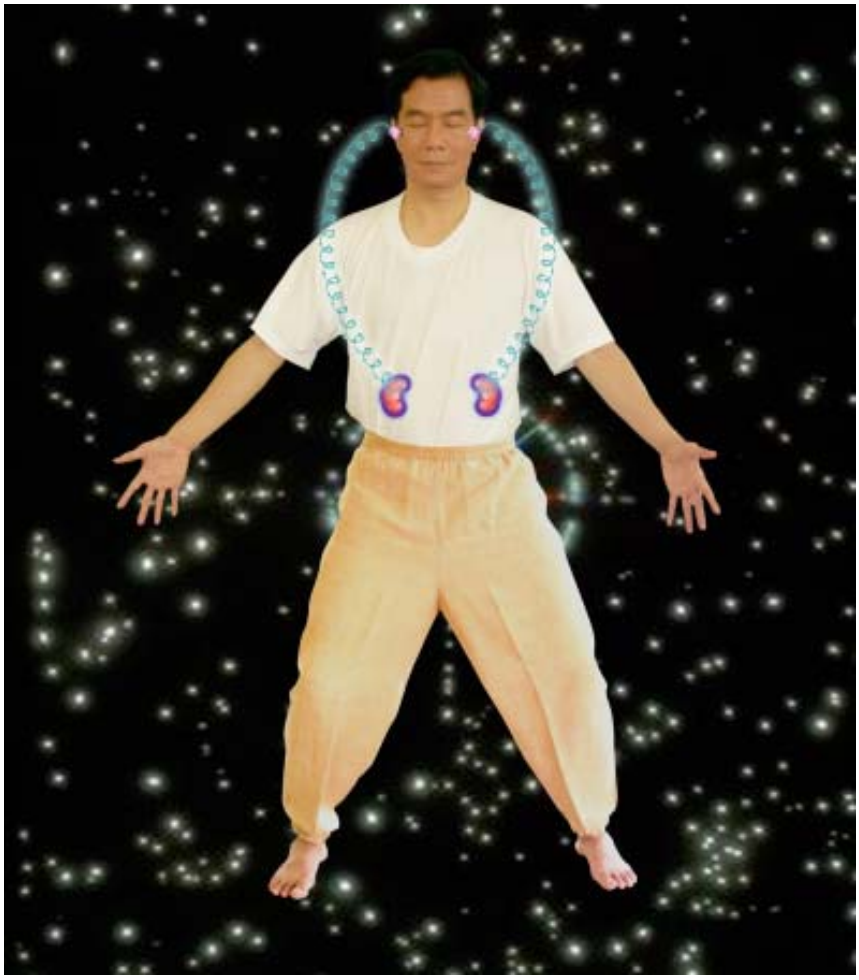

Fig. 15 *Stored Energy of the Kidneys*

b. The right car connects to the right kidney, which is yin, and is represented by a Weaving Maiden who stores the essence of the sexual energy (sperm and ovum), as well as the inner yang that attracts the active yang known as the Gate of Life.

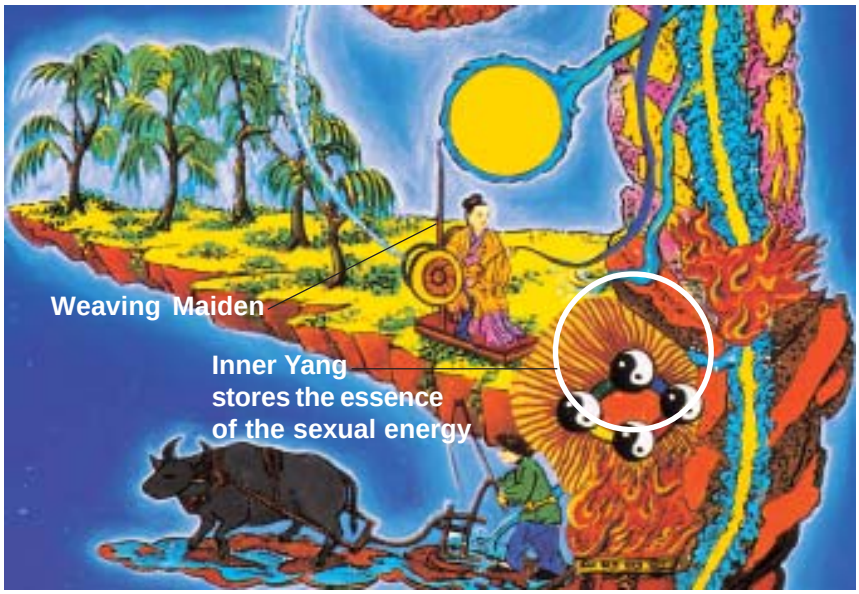

Fig. 16 *Weaving Maiden who stores the essence of the sexual energy.*

c. Be aware of the left kidney as fire force and let it gradually rise up to the left ear, creating a collection point to contain the fire force.

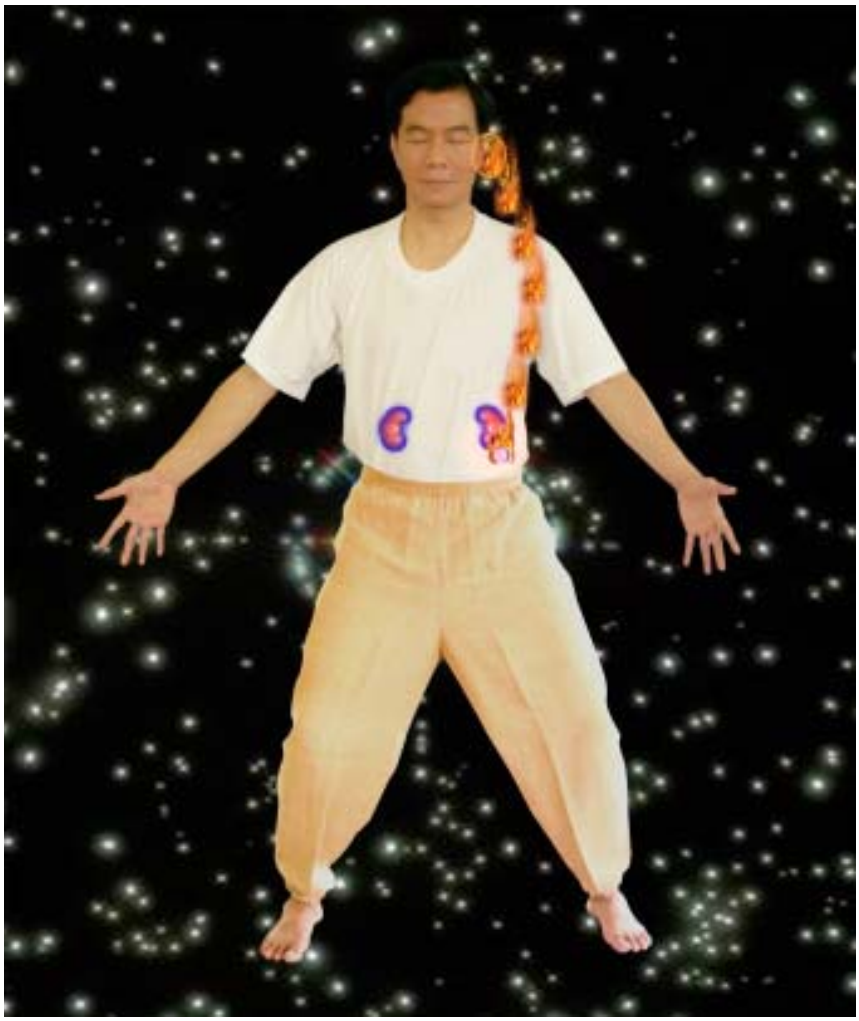

Fig. 17 *Left ear creating a collection point to contain the fire force.*

d. Be aware of the lower cauldron. Feel the fire start to warm the abdomen. The fire and steam power goes down to the sexual organs to transform the sexual energy into Chi or arousal sexual energy. Let this energy rise to the right kidney to activate the stored essence of sexual energy, the inner yin. Feel the connection of the right kidney to the right ear and let the essence yin energy rise up the ear. Create a collection point to contain the energy.

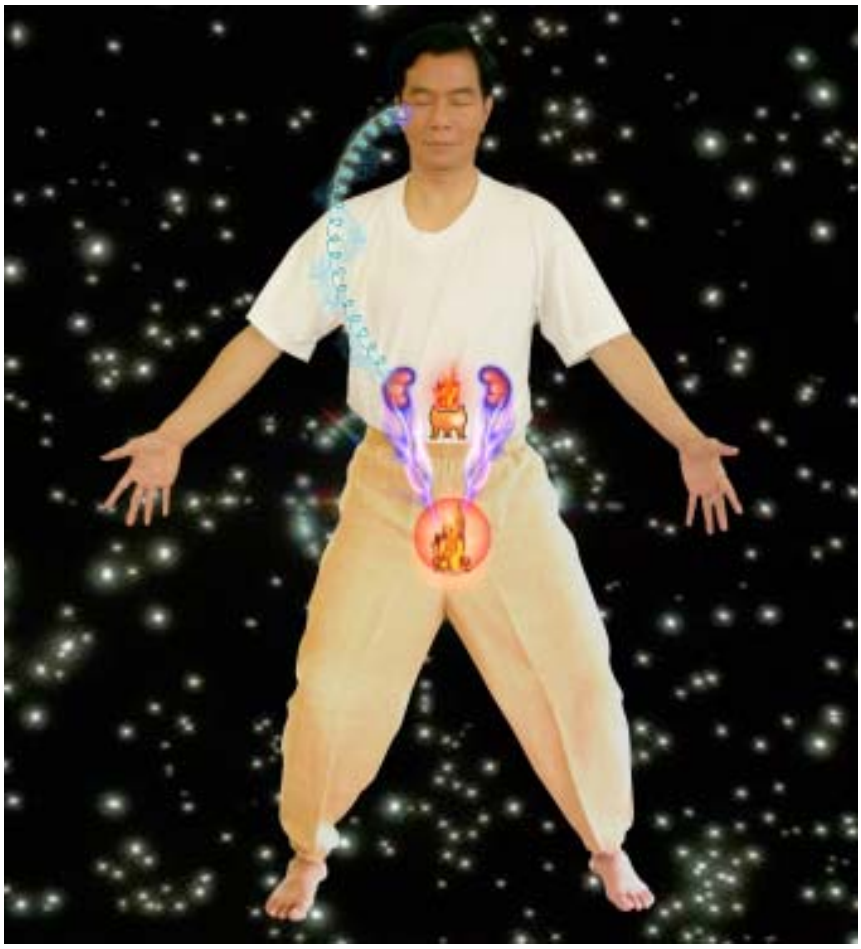

Fig. 18 *Create a collection point to contain the energy.*

e. Let the left and right ear, fire and water couple in the crystal room (middle of the ear).

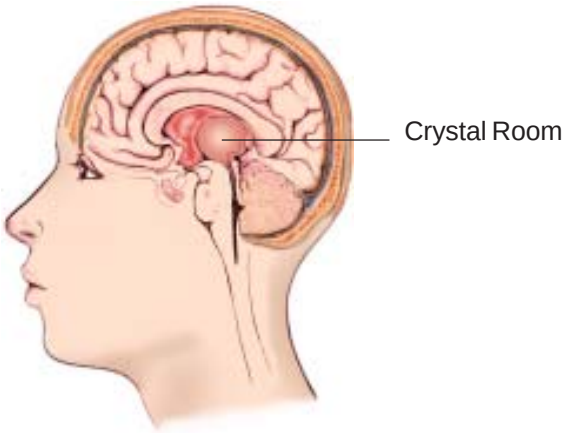

Fig. 19 *Fire and water couple in the crystal room*

f. Be aware of the mouth and gather the water force into a Chi Ball.

g. Let the water and fire couple at the nose, the earth.

Fig. 20 *Connecting to Earth*

D. Practice Formula Four: Sealing of the Five Senses

1. Clean out the Thrusting Channels. Be aware of the sole of the feet and feet, the universe force and earth force, rising up to the left side of the sexual organ and up the left thrusting channel and up to the left side of the crown.
2. Activate the Sexual Energy in the Lower Tan Tien.

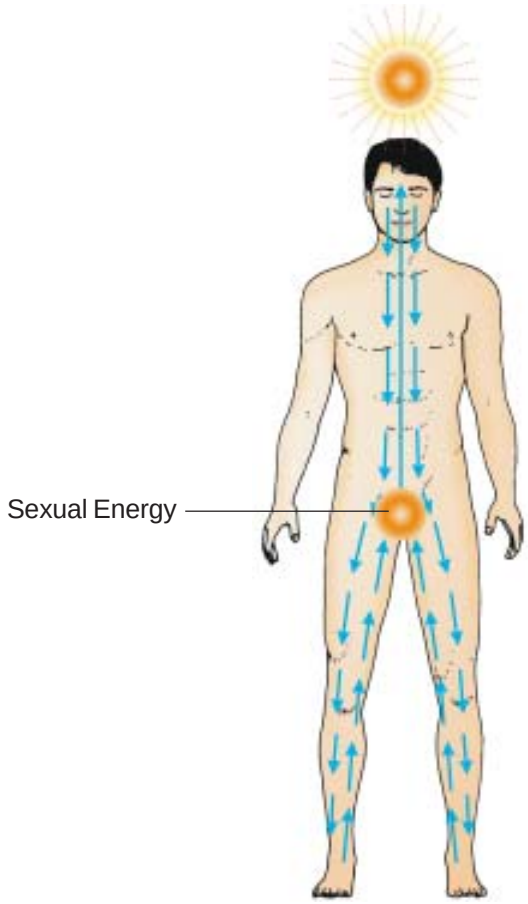

Fig. 21 *Activate Sexual Energy*

3. Turn the Wheel.
   a. Up the spine to the T-11 and then down to the Lower Tan Tien.
   b. Up the spine to the C-7 and then down to the solar plexus.
   c. Up the spine to the brain and then down to the heart.

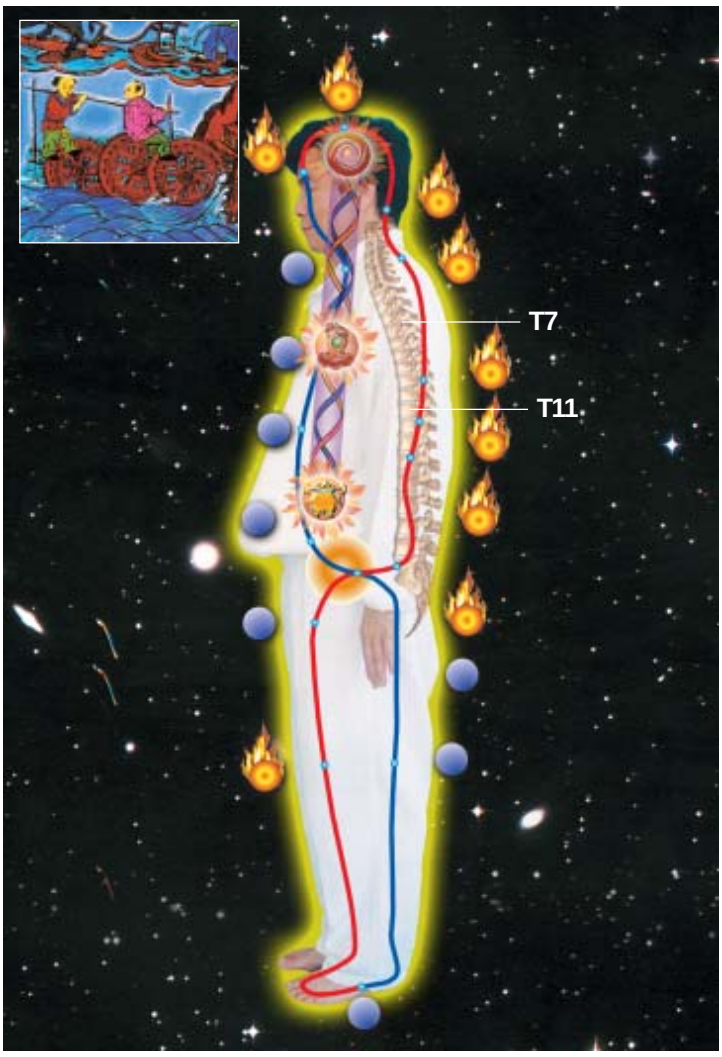

Fig. 22 *Turn the Wheel*

4. Build the Aura
   a. Breathe red mist into the heart.
      1. Breathe out any gray color.
      2. From the heart, send out the red mist to create an aura around the body.

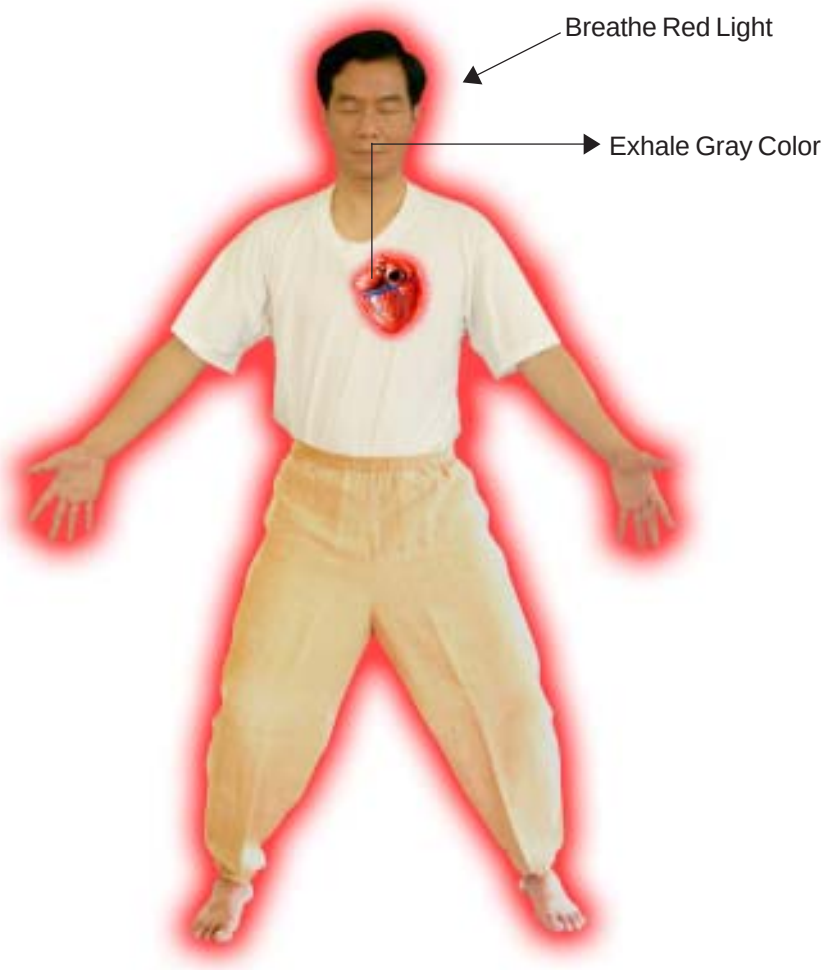

Fig. 23 *Breathe into the heart.*

b. Breathe yellow mist into the spleen.

1. Breathe out any gray color.
2. From the spleen, send the yellow mist to all over the body and send radiance out around the body.
3. From the mouth, breathe out the yellow mist to create an aura.

Fig. 24 *Breathe into the Spleen.*

c. Breathe white mist into the lungs.

1. Breathe out any gray color.
2. From the lungs, send the mist to the nose and out the nose and the skin.
3. From the nose, breathe out the white mist to create an aura.

Fig. 25 *Breathe into the Lungs.*

d. Breathe blue mist into the kidneys.

1. Breathe out any gray color.

2. From the kidneys, send the mist to the ears and send radiance out for whole body radiance.

3. From the ears, breathe out the blue mist to create an aura.

Fig. 26 *Breathe into the Kidneys.*

e. Breathe green mist into the liver.

1. Breathe out any gray color.
2. From the liver, send the mist to the eyes.
3. From the eyes, breathe the green mist out to create an aura.

Fig. 27 *Breathe into the Liver.*

Fig. 28 *Finish building the Aura.*

4. Bring the sun down to the left eye to be the fire.
5. Bring the moon down to the right eye to be the water.

Right Left

Fig. 29 *Sun and Moon down to the Eyes*

6. Bring the fire from the left eye to the bridge of the nose.
7. Bring the water from the right eye to the mideyebrow.

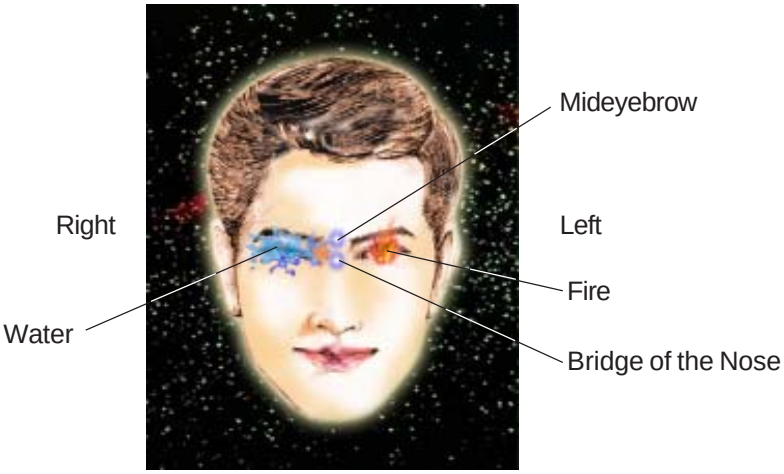

Fig. 30 *Sun and Moon down to the Eyes*

8. Start the coupling (this differs from practice formula#2 where we just combined the sun and moon to create one fire energy, now we couple two different energies).
9. The steam will come out the third eye.

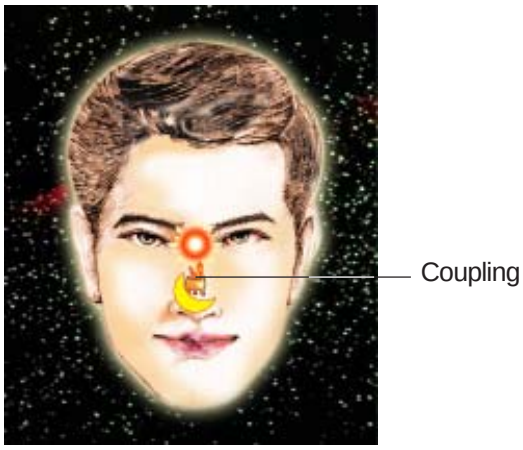

Fig. 31 *Combine the Sun and Moon*

10. Gather the sexual Energy from the sexual organs and bring it to the collection point in the mouth.

Fig. 32 *Gather the Sexual Energy.*

11. The steam produced from the sun and moon coupling will now become the fire for the coupling at the tip of the nose. Bring the fire energy down to the upper lip.

Fig. 33 *Energy down to Upper Lip.*

12. Bring the water energy from the mouth up to the bridge of the nose.

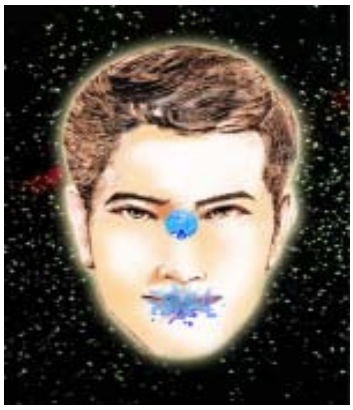

Fig. 34 *Energy up to the bridge of the nose*

13. Start the Coupling at the tip of the nose.

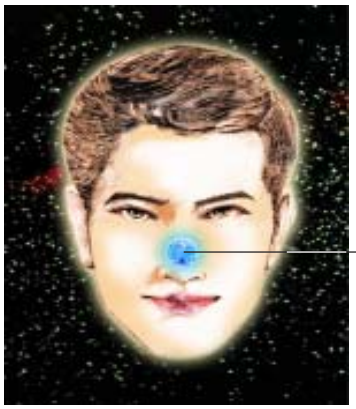

Fig. 35 *Coupling Tip of the Nose*

14. This coupling does not produce steam, yet you will clearly feel the suction.
15. Let the fire cool.
16. Bring the energy down to the Lower Tan Tien.

E. Practice Formula Five: Sealing of the Five Senses

The harmonizing of the four forces (stopping the draining of the essence)

1. When the eyes (green dragon, east, wood) are not seeing, the eternal soul will stay in the liver. Turn the eye power inward.

2. When the ears (Tortoise, north, water) are not hearing, the sexual essence stay in the kidneys. Turn the ears inward.

3. When the tongue (red pheasant, south, fire) is not speaking the spirit stays in the heart.

4. When the nose (white tiger, west, metal) is not smelling, the corporal soul (pui) stays in the lungs. Holding the tongue power inward regulates the breath.

5. When all four are not moving, these four essences will harmonise at the earth and will be nourished, strengthened, and sealed.

Fig. 36 *Five Sealing of the Five Senses*

When all the four essences are not draining out, sexual essence - water, spirit - fire, eternal soul - wood, and the corporal soul (pui) - metal all will gather at the earth, at the tip of the nose.

When there is no desire in the heart - fire is not activated, the green dragon in the liver will sound, the red pheasant will close its wings, and the sexual essence stays and gathers. Wood burns to become fire, and thus gives birth to the heart energy. The white tiger (Lung) gives energy to the water (kidney) which is the life essence (body). If we do not drain out the life essence (take care of our body) the white tiger will sound, the wind will start to move. The tortoise will stay dormant, the sexual essence will be conserved and stay in. When the sexual essence and the Chi stays in us, the metal, wood, water, fire forces will harmonize together and not leak to the earth. So the sexual essence, spirit, eternal soul will gather in the good intention.

1. Clean out the Thrusting Channels.
2. Activate the Sexual Energy in the Lower Tan Tien.
3. Turn the Wheel.
    a. Up the spine to the T-11 and then down to the Lower Tan Tien.
    b. Up the spine to the C-7 and then down to the solar plexus.
    c. Up the spine to the brain and then down to the heart.
4. Build the Aura
    a. Breathe red mist into the heart.
        1. Breathe out any gray color.
        2. From the heart send out the red mist to create an aura around the body.
    b. Breathe yellow mist into the spleen.
        1. Breathe out any gray color.
        2. From the spleen, send the yellow mist to the nose.
        3. From the nose, breathe out the yellow mist to create an aura.
    c. Breathe white mist into the lungs.
        1. Breathe out any gray color.
        2. From the lungs, send the mist to the nose.
        3. From the nose, breathe out the white mist to create an aura.

d. Breathe blue mist into the kidneys.
   1. Breathe out any gray color.
   2. From the kidneys, send the mist to the ears.
   3. From the ears, breathe out the blue mist to create an aura.

e. Breathe green mist into the liver.
   1. Breathe out any gray color.
   2. From the liver, send the mist to the eyes.
   3. From the eyes breathe the green mist out to create an aura.

Fig. 37 *The Pill Connecting to the Dipper*

   4. Send out the pill to connect with the Big Dipper.
   5. Bring the Big Dipper down and connect it to the left and right temples, left and right mastoid, the chin, the base of the skull, and the crown.
   6. Bring the North Star into the crystal room.
   7. See the Big Dipper full of violet light; that light is now pouring into your crown.

8. Draw the Sun down to the left eye to collect the fire energy.
9. Draw the Moon down to the right eye to collect the water energy.
10. Bring the fire to the bridge of the nose.
11. Bring the water to the mideyebrow.
12. Draw the fire and water together and begin the coupling and simmer slowly and send the steam up to the third eye.
13. Draw the fire energy up from the left kidney to the left ear collection point.
14. Draw the Sexual Energy up from the sexual organs and the right kidney to the right ear collection point.

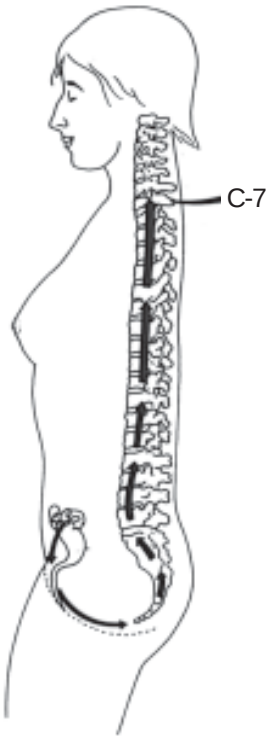

Fig. 38 *Sexual Energy Rising Up*

15. Draw the fire and water into the crystal room and begin the coupling. The steam produced here will become the fire for the next coupling.
16. Bring the Sexual Energy up to the Pineal Gland and allow it to drip down to the mouth. Mix it with the Saliva and fill the mouth with the sexual energy.
17. Draw the Fire Energy down from the Crystal Room to the upper lip.
18. Draw the Water Energy up from the mouth to the bridge of the nose.
19. Couple at the tip of the nose.
20. Be aware of the ears. Feel the blue energy turning into the tortoise in each ear to seal and protect the ears.
21. Be aware of the nose. Feel the white energy turning into the white tiger in the nose to seal and protect the nose.
22. Be aware of the eyes. Feel the green energy turning into the green dragon in the eyes to seal and protect the eyes.
23. Be aware of the tongue. Feel the red energy turning into the red pheasant at the tongue and in the mouth to seal and protect them.
24. Draw the green, wood energy of the eyes down to the tongue (fire) and combine the two to create one fire energy. Send the fire to the crystal room.
25. Draw the white, metal energy from the nose over to the ears (water) and combine the two to create one water energy. Send the water to the crystal room.
26. Start the coupling in the crystal room.
27. Slowly simmer for a long time.
28. Empty your mind into the Lower Tan Tien anytime thoughts arise. Feel the stillness of your senses. Feel how they are sealed.
29. Slowly let the fire cool down.
30. Gather the energy in the Lower Tan Tien.

F. Practice Formula Six: Sealing of the Five Senses

1. Clean out the Thrusting Channels.
2. Activate the Sexual Energy in the Lower Tan Tien.
3. Turn the Wheel.
   a. Up the spine to the T-11 and then down to the Lower Tan Tien.
   b. Up the spine to the C-7 and then down to the solar plexus.
   c. Up the spine to the brain and then down to the heart.
4. Build the Aura
   a. Breathe red mist into the heart.
      1. Breathe out any gray color.
      2. From the heart send out the red mist to create an aura around the body.
   b. Breathe yellow mist into the spleen.
      1. Breathe out any gray color.
      2. From the spleen, send the yellow mist to the nose.
      3. From the nose, breathe out the yellow mist to create an aura.
   c. Breathe white mist into the lungs.
      1. Breathe out any gray color.
      2. From the lungs, send the mist to the nose.
      3. From the nose, breathe out the white mist to create an aura.
   d. Breathe blue mist into the kidneys.
      1. Breathe out any gray color.
      2. From the kidneys, send the mist to the ears.
      3. From the ears, breathe out the blue mist to create an aura.
   e. Breathe green mist into the liver.
      1. Breathe out any gray color.
      2. From the liver, send the mist to the eyes.
      3. From the eyes, breathe the mist out to create an aura.
      5. Send out a pill to connect with the Big Dipper.

6. Connect the Big Dipper to the various points on the head (L&R mastoid, L&R temples, chin, base of skull, and crown), bring the North Star to the crystal room.
7. See the Big Dipper pouring violet light down into your crown.
8. Wash the whole body and especially the marrow with the violet light.
9. Bring the left kidney up to the left ear and make a collection point in the ear for the fire energy.
10. Bring sexual energy from the sexual organs and up from the right kidney to the right ear. Make a collection point in the right ear for the water energy.
11. Bring and fire and water energies into the crystal room.
12. Start the coupling in the crystal room.
13. Bring the Sun down to the left eye to collect the fire energy.
14. Bring the Moon down to the right eye to collect the water energy.
15. Bring the fire energy from the left eye to the bridge of the nose.
16. Bring the water energy from the right eye to the mideyebrow.
17. Bring the fire and the water together and start the coupling.
18. Draw the sexual energy up to the collection point in the mouth.
19. The steam from the crystal room coupling will now be used as the fire energy for the coupling at the tip of the nose. Bring the fire energy down to the upper lip.
20. Bring the water energy from the mouth to the bridge of the nose.
21. Bring the water and fire together at the tip of the nose and start the coupling.
22. Be aware of all three couplings simultaneously, the steam at the crystal room will form a pearl and open the third eye.

23. Send the liver energy out to draw in the green planet, Jupiter.
24. Bring Jupiter in to seal and protect the eyes.
25. Send the heart energy out to draw in the red planet, Mars.
26. Bring Mars in to seal and protect the tongue (mouth).
27. Bring the eyes down to the mouth and combine the eyes and tongue to create one fire energy.
28. Draw the fire energy up to the crystal room.
29. Send out the kidneys to draw in the planet Mercury.
30. Bring Mercury in to seal and protect the ears.
31. Send out the lungs to draw in the planet Venus.
32. Bring Venus in to seal and protect the nose.
33. Bring the ears to the nose and combine them to form one water energy.
34. Draw the water energy up to the crystal room.
35. Start the coupling of the fire and water at the crystal room.
36. Let go of all thoughts, send them down to the Lower Tan Tien.

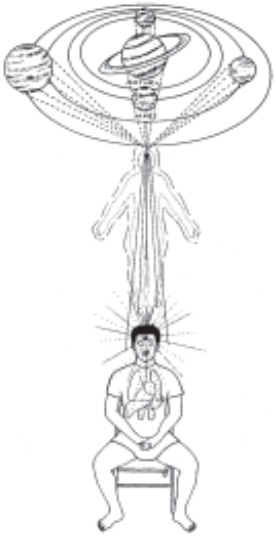

Fig. 39 *The Planets connect to the Organs.*

37. Feel the stillness of all the essences as they are not being used to spend energy. Feel their energy staying with you. (eternal soul, spirit, corporal soul and the sexual essence)
38. Set the fire cool down.
39. Bring the energy down to the Lower Tan Tien.

G. Practice Formula Seven: Sealing of the Five Senses

1. Do the Bellows Breathing.
2. Connect with the Lower Tan Tien.
3. Build the Aura:
   a) Red mist from the heart.
   b) Yellow mist from the spleen.
   c) White mist from the lungs.
   d) Blue mist from the kidneys.
   e) Green mist from the liver.

Fig. 40 *Big Dipper and North Star*

4. Send out the pearl to connect to your own personal star and to attract the Big Dipper.
5. Look for the light.
6. Draw the Big Dipper in and connect it to the head (L&R temples, L&R mastoid, chin, base of the skull, and the crown). Bring the North Star to the crystal room.
7. See the Big Dipper pouring out violet light down into your crown and through your whole body. Wash your body in the violet light and especially the marrow.
8. Feel your body so full of violet light it starts to overflow and create and aura around your whole body.
9. Be aware of the coupling at the mideyebrow, crystal room, and the tip of the nose.
   Give yourself plenty of time to feel the suction in each place.
10. Now expand your mind outward to the constellations.

Fig. 41 *Violet Light and Aura*

11. Feel the connection of the constellations to your organs to the elements.
    a) The east constellations connect to the liver (wood).
    b) The south constellations connect to the heart (fire).
    c) The west constellations connect to the lungs (metal).
    d) The north constellations connect to the kidneys (water).
    e) The crystal room is in the center.
12. Combine the South Constellation (fire) and the East. Constellation (wood) to create one fire energy.
13. Combine the North Constellation (water) and the West Constellation (metal) to create one water energy.
14. Couple the two at the crystal room.
15. Now, feel your aura as another layer of your skin. Feel it move in and out with each breath. Take in the refined energies from the constellations.
16. Let the fire cool.
17. Gather the energy at the Lower Tan Tien.

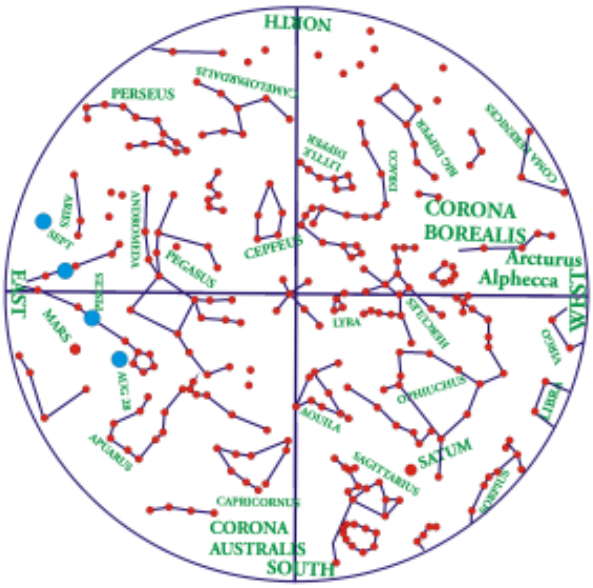

Fig. 42 *Star Constellations*

H. Practice Formula Eight: Sealing of the Five Senses

1. Clean the Thrusting Channels.
2. Turn the Wheel.
3. Create the Auras.
4. Send a pill out to connect with the Big Dipper.
5. Connect with the Big Dipper at the L&R Mastoids, L&R Temples, Base of the skull, Chin, and Crown. Feel the Dipper pouring violet light into your crown and washing your whole body.
6. Create the 3 cauldrons (Bridge of nose, Crystal Room, Tip of nose).
7. Feel your aura as an extra layer of skin. Feel it move in and out with each breathe. Feel your breathe drawing in chi through your skin to your whole body.
8. Be aware of the Planets and Animals protecting and sealing your senses.

Fig. 43 *Energy Body Going Out and Growing.*

9. Shoot your energy body out and make yourself very large.
10. Connect with the constellations: Liver, Wood, East
    - Heart, Fire, South
    - Lungs, Metal, West
    - Kidneys, Water, North
11. Combine the East and South Constellations (wood and fire) to create one fire energy.
12. Combine the West and North Constellations (metal and water) to create one water energy.
13. Start the coupling and feel the vast amounts of energy.
14. Beam the energy down to your crystal room, to your heart and see the rainbow beams coming out from your heart to the rest of the body wherever they is needed.
15. Bring your awareness to the Lower Tan Tien and start the coupling there.
16. Bring the energy from above, now into the Lower Tan Tien.
17. Use this energy to heal any part of the body or mind that is in need.
18. Slowly allow the fire to cool.
19. Gather the energy in the Lower Tan Tien.

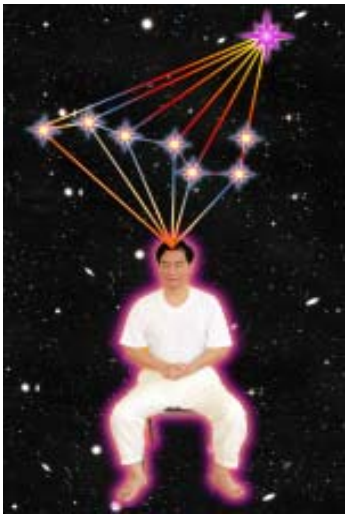

Fig. 44 *Rainbow Beams Healing Body*

Notes:

1) The laboratory, inside and outside. The microcosm and the macrocosm.
2) Clearing the trusting channel.
3) Turning the wheel.
4) Building the aura.
5) Breathing.
6) Connecting to the Big Dipper.
7) Sun and Moon.
8) Kidney energy, left is fire essence, right is water essence. Ear collection.
9) Mixing and collecting the water in the mouth.
10) Section on coupling.
11) Energy from the four constellations, violet light into the body, North Star.
12) Sealing the senses with animals or planets.
13) Beginning and ending the meditation.
14) Energies of the organs (hun, po, shen, yi,…).

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Sealing of the Five Senses

Opening the Crystal Room

Mantak Chia

Illustrations by Udon Jandee

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In this booklet for the first time ever Master Chia has revealed the final level of the Immortal Tao Practices of the Universal Tao System. You can divide your practice into several sections starting with the Three Levels of Kan & Li to set up the alignment of the body for the Opening of the Crystal Room in the Sealing of the Five Senses practices. Your training should be progressive; that is, once you have mastered one section, you can progress on to the next. Be sure to spend at least one or two weeks on each section as shown in this booklet, allowing enough time to thoroughly master each part before adding on the next section. Remember that you should always do the Chi Kung Warmups before going on into the meditation; it is very important to loosen the spine before meditation that helps your focus.

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a Touch of Sex

taoist foreplay: shiatsu secrets for love

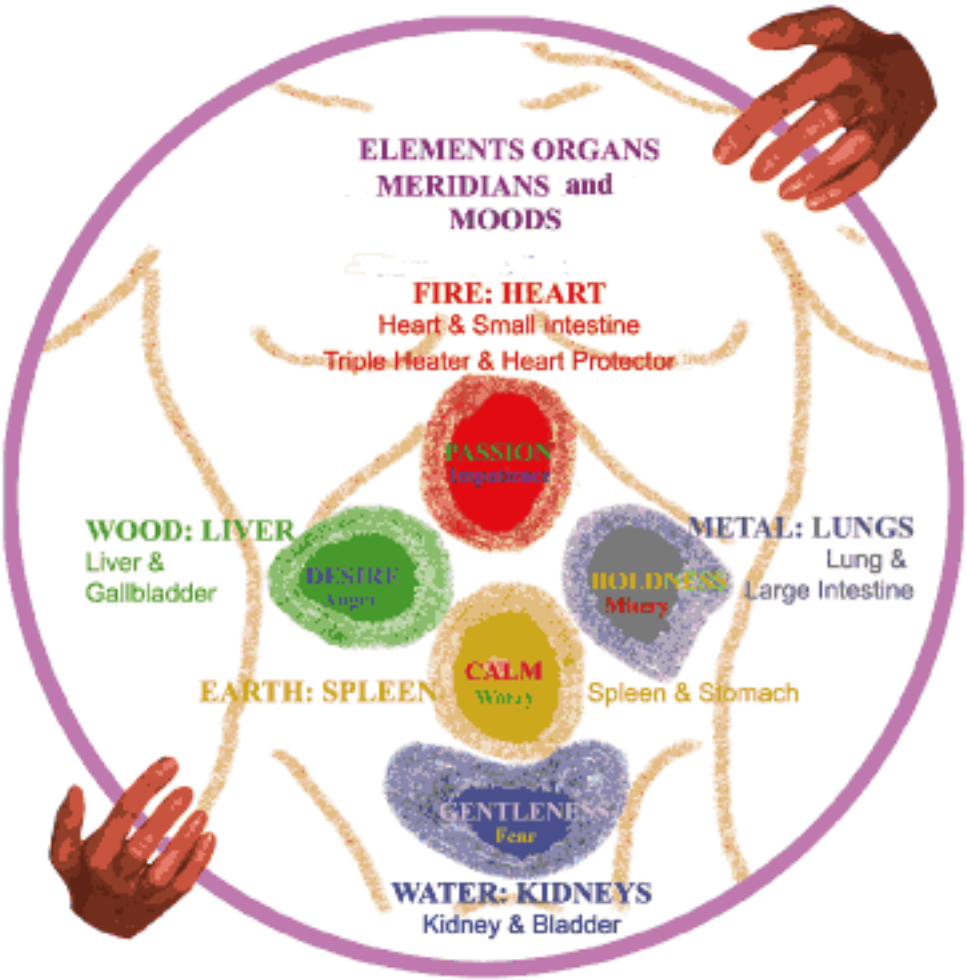

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a Touch of Sex

taoist foreplay: shiatsu secrets for lovers

Mantak Chia
and
Kris Deva North

Edited by:
Students of the Zen School

You will learn from this book

How you can become a far more effective Lover

however good you are already

How to lay, ignite and fan the fires of passion

and keep them going through all the seasons

Taoist Secrets of Touch

the turn-on power of points

Exercises for strength, length and juice

better grip, increased staying-power

What to look for in a Lover

and how to overcome unlucky stars

Signs of Arousal

know when the right moment comes

Secrets of Sex Magic

and keeping safe from sexual vampires and parasites

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Going Down 8
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Whole Body Love-Shiatsu

In this Chapter you will learn to feel

* **areas of arousal**
* **pathways for your hands**
* **secret connections**

Whole Body Love-Shiatsu

When Lovers first touched they invented what we call Love-Shiatsu.

Huang-Ti (2697-2598 BCE) the Yellow Emperor codified the theory behind the therapy. Treatment, he decreed, should vary according to application, whether to stimulate desire, sexual or other healing.

In those days they searched for immortality as the logical extension of perfect health. The Yellow Emperor is said to have attained it by having sex with 1200 wives and concubines. The Queen Mother of the West likewise but with numbers unrecorded.

The Emperor and his female advisor Su Nu are credited with creating the 'Su Nu Ching', a dialogue of sexual practice with such exchanges as:

Huang Ti: 'And what is the method of nine shallow and one deep?'
Su Nu: 'That means to thrust nine times shallow and then one deep, in time with the breath. Too shallow may not yield the greatest pleasure, too deep may be injurious.'

Later Taoist sex manuals continued the tradition of treating both genders as equal, but as Dynasties came and went, mixed fortunes followed for the practices.

Nowadays we like one-to-one relationships and are perhaps sceptical of immortality. But that isn't to say we can't enjoy the secrets that kept the Yellow Emperor going and the Queen Mother coming.

And Lovers have always touched.

It starts with a look, a gaze in each other's eyes

Then Mind follows Eye

and Hand follows Mind

Prepare your Lover

by first lightly tapping or patting up and down the body.

You don't have to follow exactly the lines pictured - they are just there to give you an idea of the directions of flow in the meridians.

Tapping wakes up the nerves. How do you like to be woken up?

Tap very gently on softer areas such as the belly and face, and not at all on breasts and genitals.

Get feedback from your Lover on how it feels: would they like a drum solo in some places - such as the sacrum and shoulder-blades, or would they prefer tippy-toe tap?

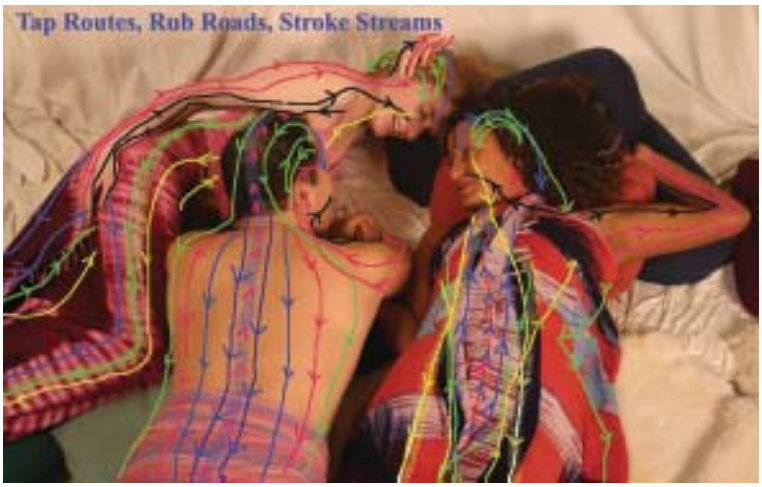

From Tapping to Rubbing, not too hard, not too soft.

The nerves are awake, ready to be coaxed into action.

Follow the meridian routes more or less, just to let them know you will be back. Still avoid the genitals, for now.

And when you have tapped and rubbed, its time to tease: long languorous strokes along the channels. brushing close by your lover's sex, using your hands to hint at what's ahead.

IF YOU'VE MADE THE TIME - TAKE YOUR TIME

Secrets of Foreplay
Pat before petting, Tap before tupping
Start with clothes on: they'll come off by themselves

Taoists see sex as the servant, not the master.

If the products of our pleasure are not being deployed to start new life, they say, we can internalise the intense energy, all the hormones and nutrients, to improve our own lives.

From foreplay to climax a Taoist controls and harvests the abundance of reproductive power otherwise wasted in unmindful intercourse: yang having the power to repopulate a continent in a single ejaculation, yin with eggs to generate hundreds of lives.

They taught the Emperors, their wives and concubines, to recycle this potent life force and harmonize their cycles of pleasure through a process known as Inner Alchemy.

Love-Shiatsu Numerology

FIRST for a good start
ease your way down

Here are some numbers to guide you around the erotic landscape.

You will see from the following pages where you can place your hands, fingers and thumbs to lay and light the fires.

The sequence and points of connection help you find your own way - no need to get too technical about it!

Be creative, enjoy your pleasures.

SECOND make your way
up the side

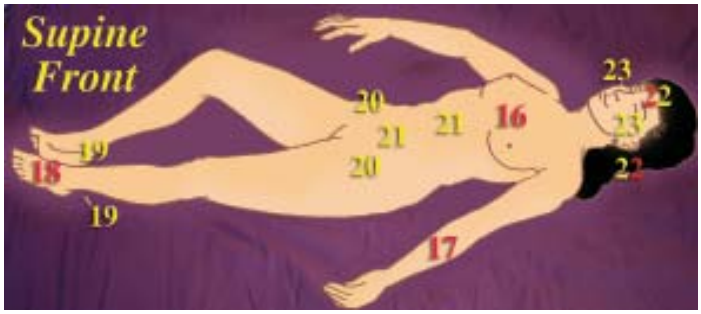

THIRD
wander
up &
downthe
front

FOURTH after the front, turn your attention and loving caresses to the other side

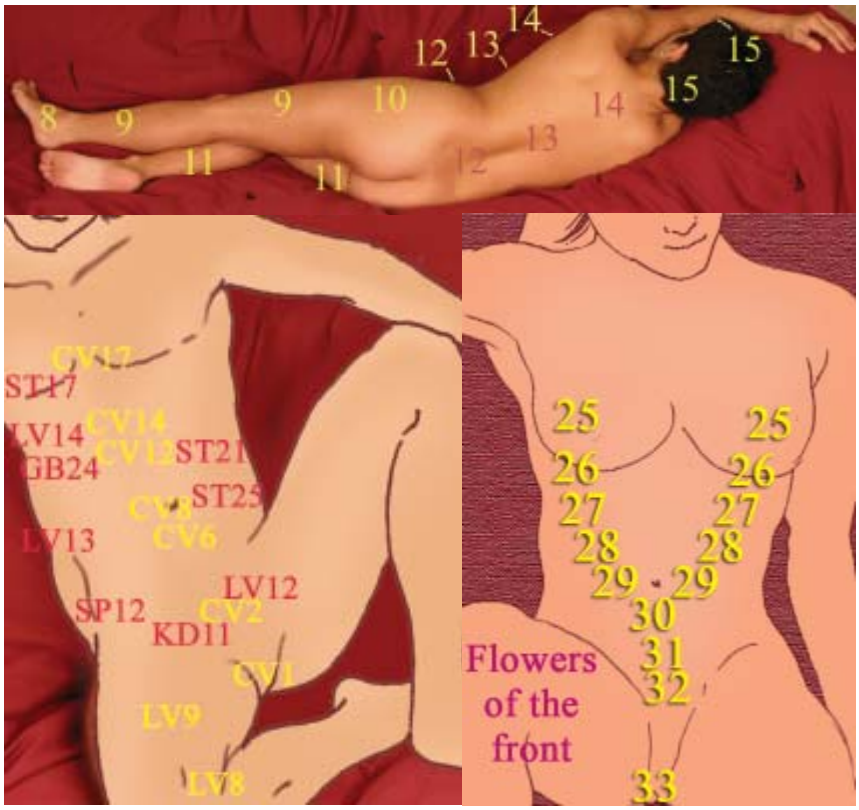

FIFTH then teasingly down to heaven

You don't even need to know the names and locations of the points. By following the simple hand-by-hand routine illustrated in the next pages you will connect all the arousal points and give your partner a wonderful sensual experience.

Remember, if you are doing it with sensitivity, care and love, you are doing it right. It is a really good idea to ask your partner how it feels.

Hands on: Getting Started

FIRST going down

a good brisk hand-rub before you touch will energise your hands.

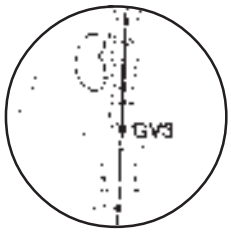

GV 3, A powerful arousal point for both sexes, just above the sacrum, at the back of the Sexual centre.

For women helps in regulating menstruation and on men to overcome impotence.

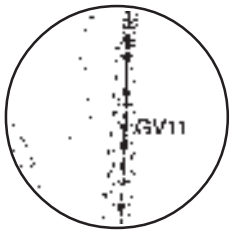

GV11, centre of the Fire of Love, back of the Heart, between the shoulder-blades.

Your hands alight blending the Heart Love with Sexual Desire, harmonising Fire and Water, Yin and Yang.

Shiatsu Secret : Let your hands be still, resting on your Lover. Feel the warmth. Close your eyes. Imagine both hands in a pool of warmth, surrounding and connecting them.

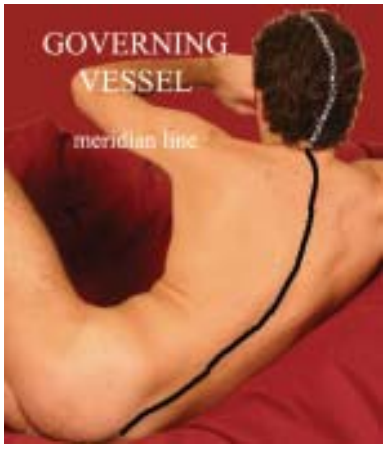

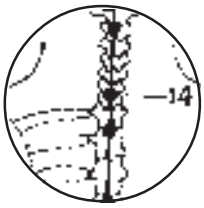

GV14 sends a warm rush of spinal fluid up to the brain, generating excitement and warming the neck.

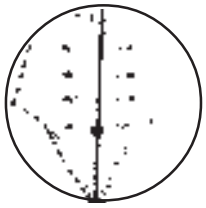

GV2 VALLEY OF DELIGHT
arousal point

Leaning for Love: the pleasure of giving pleasure. Tease and tantalise. Wandering hands, rippling through meridians, spreading desire, releasing pheronomes and hormones.

Shiatsu Secret: Imagine the pool of warmth spreading out until it feels like you are touching your Lover in only one place. When it feels like that to you, your Lover too will feel as if you are touching in just one place however far apart your hands.

GV17 JADE PILLOW, where the impulse of passion flows into the brain, loving and rejuvenating and coursing through the cranial ocean to open the mid-eye.

GV1 LASTING STRENGTH
waves of electric pleasure coursing through the sacral bone, the sacred connection with the nerves of love

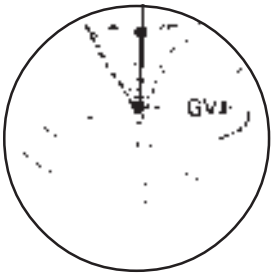

Sliding along the river of love into realms above and below, connecting the Gate of Heaven with the Door to Earth

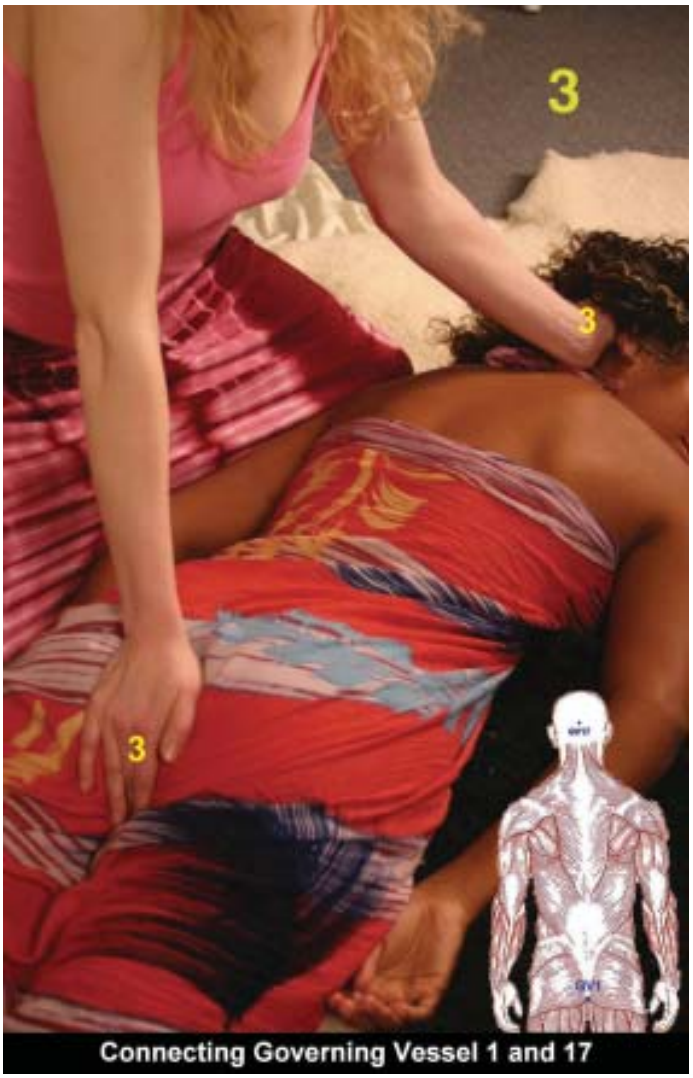

Shiatsu Secret: Move just one hand at a time as you palm your Lover's body

SI 11 ease the shoulders with gentle palm or focussed finger.

"Secret Instructions of the Jade Chamber" is a Taoist text on harmonizing male (yang) and female (yin) energies for mutual nourishment, yin drawing on yang and yang from yin.

Single, Dual and Multiple Cultivation can be practised, for pleasure, health and longevity, healing, self-realization and, ultimately, experiencing a self beyond the cycle of life and death.

Listen carefully to the breath below and follow its rhythm, hands and heart dance together courting lust.

Shiatsu Secret: Each time you move one hand, again imagine the pool of warmth connecting both your hands and the places you are touching on your Lover's body

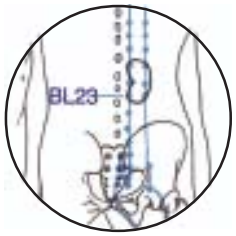

BL 23 KIDNEY connector point.

Sexual vitality for both sexes.

Enhances male stamina

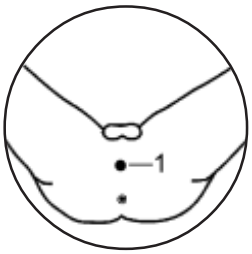

CV 1 Gate of Life and Death, so named because the retention of sexual energy is said to prolong life.

CV1 subtle use as arousal point for both sexes, especially good for prolonging male orgasm.

Clinical use helps with prevention and relief of prostate conditions.

Part Receiver's legs with your knee, your thumbs either side of spine. Arousal energy starts to wake up and flow.

Shiatsu Secret: Hold the vision of the the pool of wamth each time you move your hands. Your Lover will feel as if their whole body is being bathed in love and warmth. You are preparing for Passion

GB30 JUMPING CIRCLE
starting point for a beautiful spiral massage around the buttocks

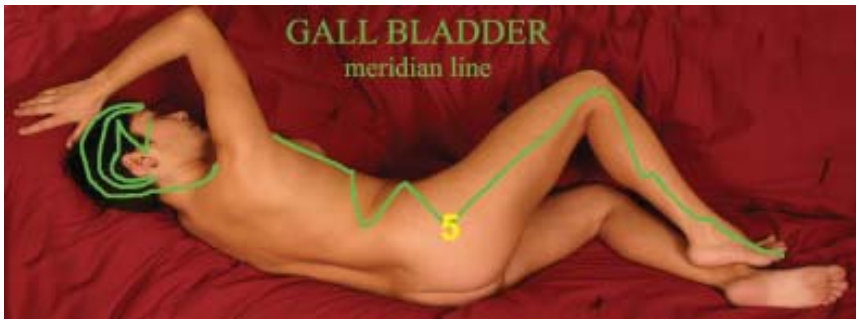

The Chou Dynasty (770 BCE to 222 BCE) had a Taoist doctrine although Taoism was not yet a formal religion.

Women were thought to have an unexhaustable supply of yin essence. A man who ejaculated or used up his yang essence without absorbing enough yin could experience health problems and even death.

Kneel between legs, move hands to buttocks, sending flashes of desire along the sides of the body. Rub cheeks together to stimulate arousal..

More Secrets await discovery in the points of connection. Tune in to your partner's response to your every touch. Don't be afraid to ask: 'How does this feel?' 'Do you like it?' 'Would you like more?'

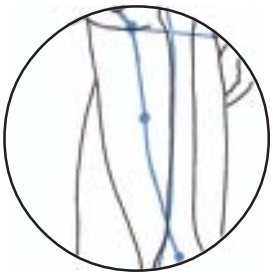

BL37 warms the whole leg and sends the love-signals both ways

The Ch'in Dynasty (221 BCE to 24 CE) changed from Taoism to the quite different Confucianism, which considered women inferior.

Sex was considered to be for procreation only, otherwise sinful.

However, religious and magical Taoism peacefully co-existed with behavourial Confucianism until a Taoist resurgence in the Later Han Dynasty (25 CE to 220 CE) saw the rehabilitation of sexual practices and the reappearance of texts attributed to the Yellow Emperor.

Starting the Tease: stay kneeling between the legs. Move hands away from the erogeneous zone but still on the Bladder meridian which carries arousal messages through the whole energy-body, head to toe.

Heart Protector 8 palming Bladder 37

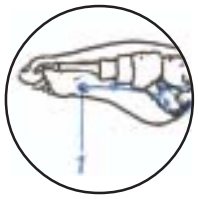

KD1 BUBBLING SPRING where you keep your feet on the ground

KD3 GREAT STREAM can be used to either stimulate or balance desire in both sexes

BL60 KUNLUN MOUNTAIN
pinching here gives a good idea of the strength of your partners libido: the stiffer the stronger! Also a useful point to press during labour.

CV2 the most potent feminine arousal point and also quite effective for men

Reaching the feet a wealth of sexual connections await. Support your Lover's foot on your pubic bone, site of Conception Vessel 2. Feeling the strength of your partner's achilles tendon can give an indication of sex drive.

Pressure to Kidney 1 & 3 and Bladder 60 supported by the Conception Vessel

In the confusion of Three Kingdoms & Six Dynasties (221 CE to 590 CE) conflicts arose between Taoist, Confucian and the newly arriving Buddhist doctrines.

The rise of Buddhism under the Northern Wei (386-534 CE) led to persecution of practitioners of the Old Ways.

Healing and Sex became politicised.

SECOND
going up

LV9 a subtle arousal point, situated on the pleasure-muscles of the inner thigh, the approach to the sexual organs

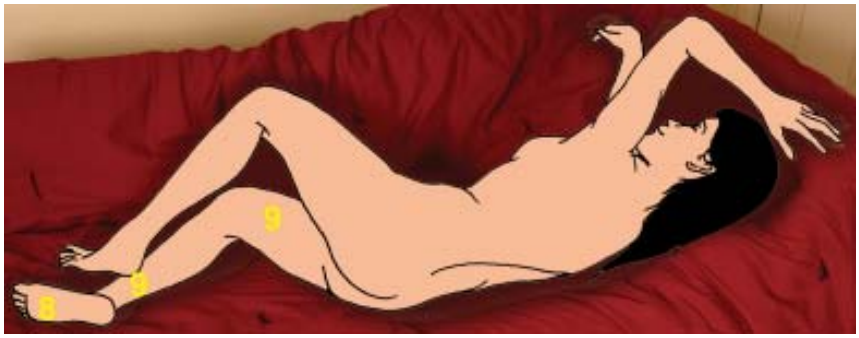

SP 6 MEETING OF 3 YIN versatile point helpful for conditions of impotence, frigidity and premature ejaculation. Other uses include regulating menstruation, control of uterine bleeding, relieving pain of external genitals, treating sterility, seminal emissions, lapse of the uterus, difficult labour.

Cruising palms, aware of the slow soft bolts of desire. Face hides the longing ache inside.

Then in the Sui Dynasty (590 CE to 618 CE) Taoism again became the official religion and sexual literature again flourished.

Secrets of the Jade Chamber appeared.

Under the Tang (618 CE to beginning of Sung 960 CE) Taoism became "the Establishment". From later Sung to the present, forms of Taoism evolved integrating some Buddhist and Confucian doctrines.

Move in for more close-contact work straddling your CV1 across your Lover's Liver meridian and your Spleen meridian nestling their Bladder meridian.

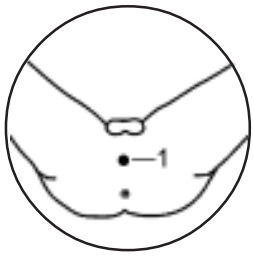

CV 1 Gate of Life and Death, so named because the retention of sexual energy is said to prolong life. CV1 subtle use as arousal point for both sexes, especially good for prolonging male orgasm. Clinical use helps with prevention and relief of prostate conditions.

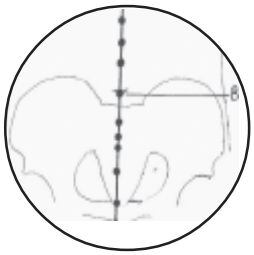

CV 8 SPIRIT'S PALACE GATE In the centre

CV2 the most potent feminine arousal point and also quite effective for men

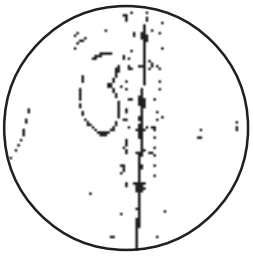

GV 4 MING MEN - DOOR OF LIFE the point where Life enters at the moment of conception. Powerful arousal point, also for male sexual stamina. Usefuil for relief of post-coital lower back pain.

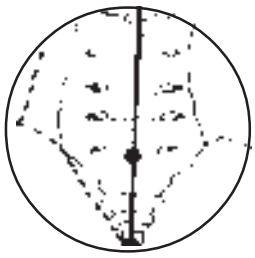

GV2 VALLEY OF DELIGHT arousal point

Your leg presses against CV1 and GV2 while your Lover's buttock touches your CV2. Stay in position long enough to feel total connection before continuing your seductive upward journey.

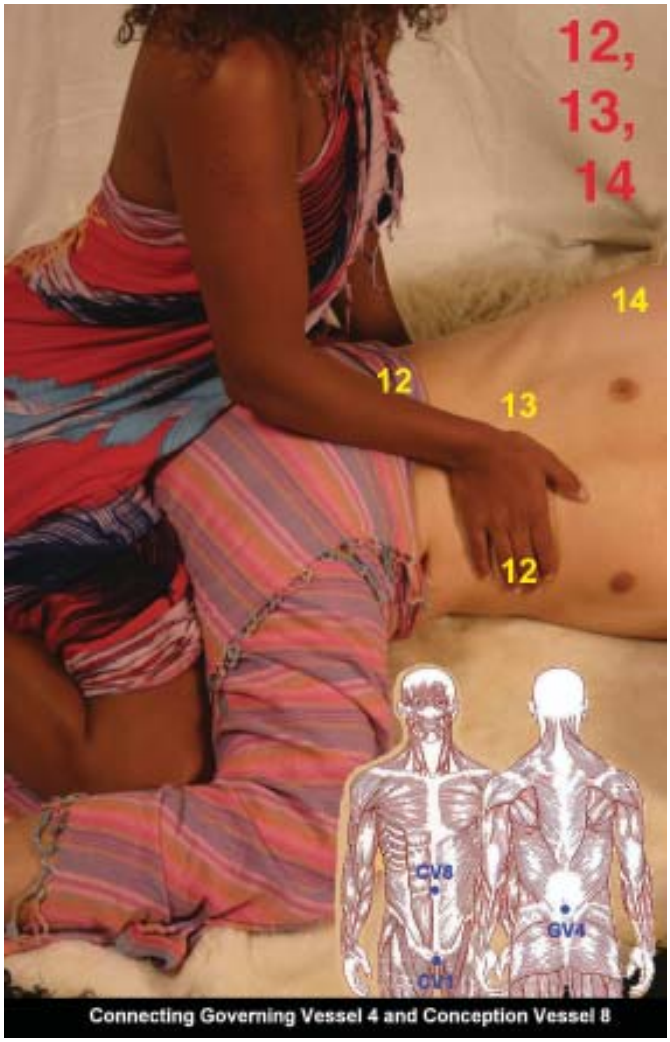

Connecting Governing Vessel 4 and Conception Vessel 8

The front-back connection between your hands reveals another secret: the pool of warmth becomes an electric charge

The search for eternal health and infinite pleasure continued. Chinese alchemists sought an Elixir to render their Emperors immortal and perpetually potent.

This external alchemy lost its appeal when it despatched a few courtiers and kings as well as a number of alchemists.

GV15 Calms the mind, sending waves of relaxation through the nervous sytem, making it receptive to arousal

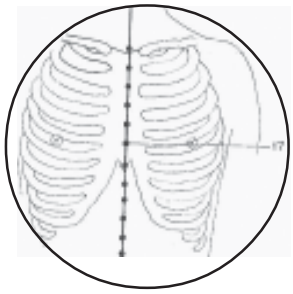

CV17 CENTRAL ALTAR Also known as the Sea of Tranquility and the point for sharing true love. Connectionn here calms the mind, balances emotions and calms the spirit of the Heart.

Physicians in the Tang Dynasty (618-906 CE) vivisecting condemned prisoners described flows of energy through invisible channels which excited certain sensations in different parts of the body, ceasing at the moment of death. If this flow could be sustained…

The shiatsu pressure-points for infinite pleasure indefinitely prolonged were passed down through the secret lineages of the Fang-Shi.

Connecting these two points in the centre of the chest and base of the skull sends waves of bliss throughout the whole being, flooding both the physical and the energy bodies.

Heart Protector 8 connecting Conception Vessel 17 and Governing Vessel 15

LV8 regular massage improves sexual function

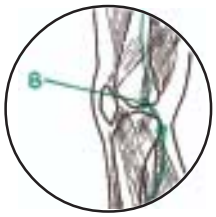

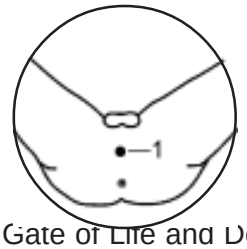

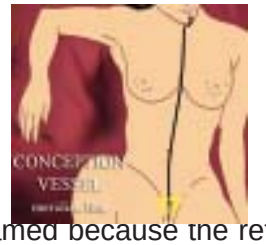

CV 1 Gate of Life and Death, so named because the retention of sexual energy is said to prolong life. CV1 subtle use as arousal point for both sexes, especially good for prolonging male orgasm. Clinical use helps wioth prevention and relief of prostate conditions.

Stretches tend to disperse Qi so not too many for Love-Shiatsu. A stretch here, however, is well-timed to ease the build-up of sexual tension likely to have arisen from the previous close connections. Time for a breather before heading on down. And even for this, a nice straddle keeps up the interest: CV1 sitting on LV8.

THIRD
up & down

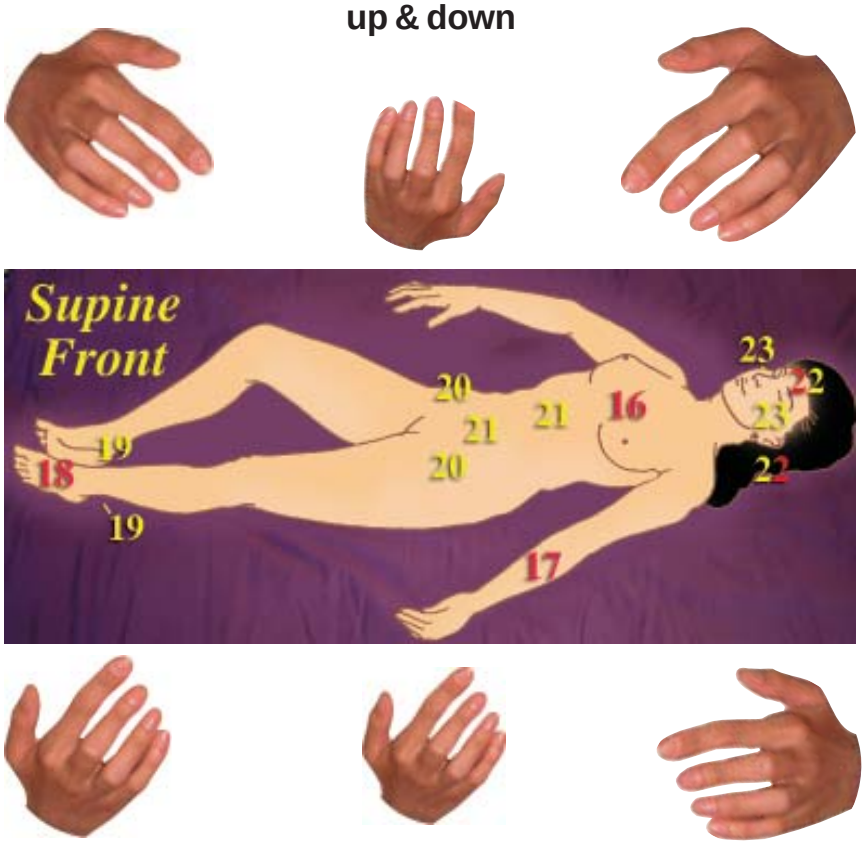

Nowadays we are not Emperors and Empresses – are we?

We go to work, we play, we sleep. Our society has different turbulences to cope with. Rather than having our heads cut off for speaking out of turn we are more likely to experience stress in the work-place leading to heart disease and suchlike, but still ingest toxic substances for moments of immortality.

And we still have sex. Our ideal is to have a nice meal, a bottle of wine, frantic sex hoping we come together, then fall asleep or take a shower.

KD1 BUBBLING SPRING
where you keep your feet on the ground, mostly

CV14 GREAT PALACE
Access the Heart Fire of a Lover.
This is the Gateway to the Heart itself,
the Sovereign.

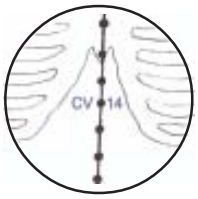

LV 3 GREAT RUSHING
particularly recommended for female sexual energy

LV 4 MIDDLE BARRIER
recommended for male
sexual energy

BL60 KUNLUN MOUNTAIN
pinching here gives a good idea of the strength of your partners libido: the stiffer the stronger! Also a useful point to press during labour.

KD3 GREAT STREAM
can be used to either stimulate
or balance desire in both sexes

CV2 the most potent feminine arousal point and also quite effective for men

Kidney 1 connecting to Conception Vessel 14 and HP8 to Liver 4

On reaching the feet, hold KD1 to your CV14 connecting your Lover's Bubbling Spring to your Heart Fire. With one hand you grasp LV3 (on a woman) or LV4 (on a man). With the other fondle BL60 and KD3. And the heel rests on CV2: can this be the Way to heaven?...yes, but just one of many. Hold for long enough to feel it, rhythmically rocking and rubbing.

ST21 On the route of the Nine Flowers loving down to Heaven, very comforting: helps digest all the TLC

ST25 Heavenly Axis awakens sensuality and opens the belly to pleasure

LV14 Cyclic Gate just below the underswell of the breast just waiting to be rubbed.

GB24 warms the ribs and softens feelings of anxiety or indecision.

Of course your Lover thinks you are giving them the massage but check out all your own sexy points you are covering with their feet. Holding Bubbling Spring against your belly, rock in a circular rhythm so that you feel it where it matters and they feel it all over. This foot-belly massage can be one of the most sensuous experiences you can share.

Belly Massage with Kidney 1

Meanwhile they feel the warmth of your belly, the movement of your muscles under their feet while your slow rocking rhythm vibrates up the legs to the hips, ready for your next move.

SP12 Gently stroking or simply holding this point with a still palm spreads warmth and pleasure across the genital area

LV12 Increases energy circulation and genital sensitivity.

KD11 helps with male arousal difficulties

Hand-stepping up the body of your Beloved, a trio of loving points lurk in both hips waiting for you to find them and wake them.

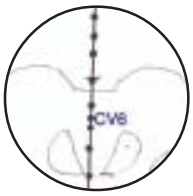

CV6 Sea of Qi Male sexual energy-centre and also to connect with the essence of the feminine, related to the feminine reproductive cycle. Clinical use of this point helps with menstrual difficulties.

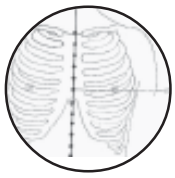

CV17 CENTRAL ALTAR Also known as the Sea of Tranquility and the point for sharing true love. Connectionn here calms the mind, balances emotions and calms the spirit of the Heart.

As well as offering a loving touch and lovely points of connection, placing your hands in such a position lets you move easily from one part of the body to another.

Think about where you want to go next, place your hands to keep a connection, and move yourself smoothly to the new position. But remember: hold still until you feel the pool of warmth.

YIN TANG
Very special point that opens the Third Eye as a portal to the world of Spirit. When Lovers gaze into each other's eyes, they can see into each other's soul through this gateway.

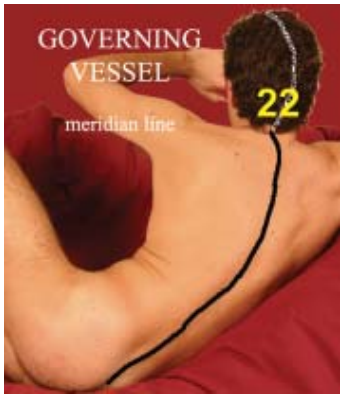

GV17 JADE PILLOW, where the impulse of passion flows into the brain, loving and rejuvenating and coursing through the cranial ocean to open the mid-eye.

Connecting these two points creates a vortex of energy whirling through the brain. This is a magical connection: the point in the Giver's palm, HP8, is an extension of the Heart chakra and can be used to convey the wave of love which then flows through the energy channels and floods the whole being.

From the comfort of this position you can give the spiralling massage of Love-Shiatsu to many easily reachable parts

STOMACH

GALLBLADDER

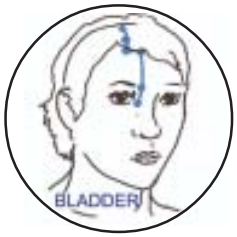

BLADDER

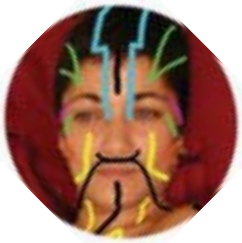

TRIPLE HEATER

LARGE INTESTINE

SMALL INTESTINE

Don’t be too surprised if by now you find your Lover wanting to respond

Time spent on the Face is seldom wasted. Here bloom the flowers of the Elemental organs:Heart in the tongue which you might leave for later, Spleen in the lips, Lung in the nose, Kidney in the ears and Liver in the eyes.

The Meridians of Stomach, Gallbladder and Bladder begin on the face and Small Intestine, Large Intestine and Triple-Heater end here.

And don’t you just love your face being stroked?

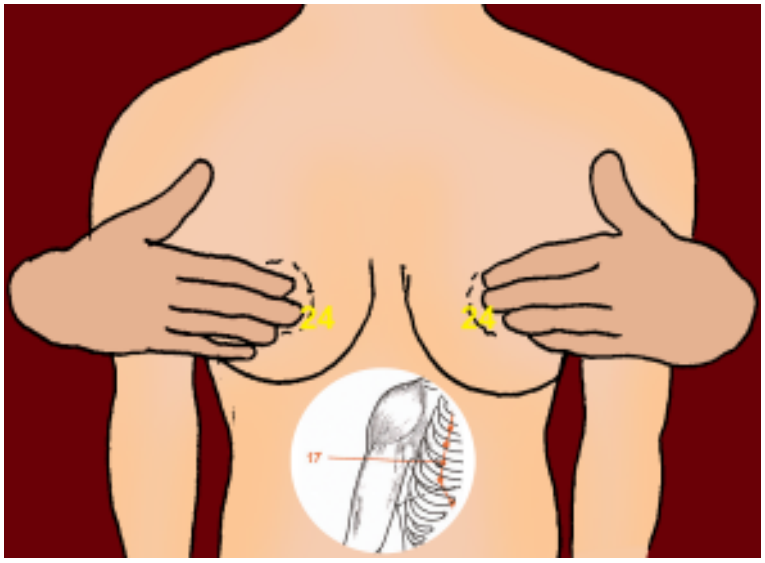

ST17 Breast Palace - strong feminine arousal point, stimulating nipple/vulva connection while nurturing, soothing and harmonising heart and mind.

FOURTH
up the other side

You've done the Back, one Side and the Front of your Lover....just go back and do the other Side, and make it a tease...

returning, eventually, to ...

FIFTH
DOWN TO HEAVEN

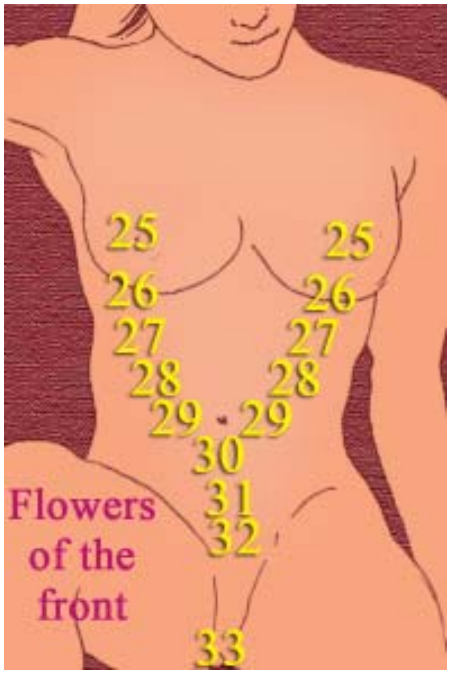

NOW SLOW DOWN

DOWN
DOWN
down

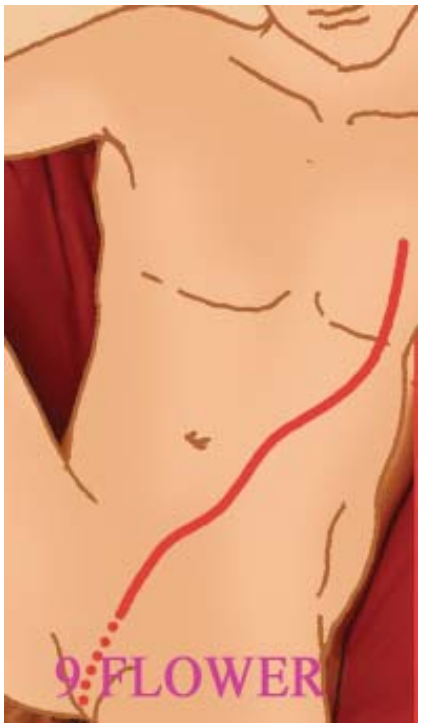
9 FLOWER

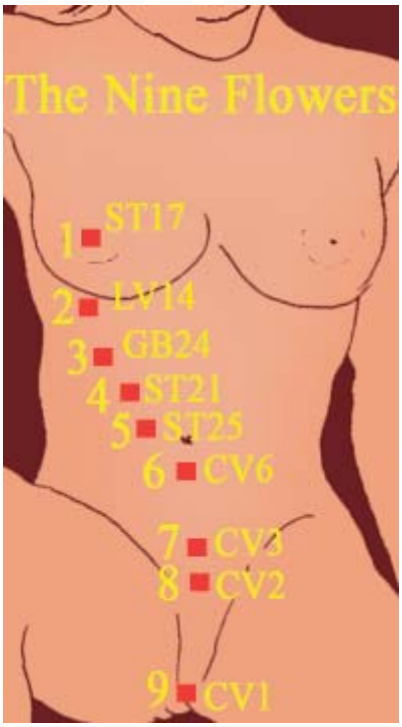
The Nine Flowers
1 ST17
2 LV14
3 GB24
4 ST21
5 ST25
6 CV6
7 CV3
8 CV2
9 CV1

ST17 Breast Palace - strong feminine arousal point, stimulating nipple/ vulva connection while nurturing, soothing and harmonising heart and mind.

LV14 Cyclic Gate just below the underswell of the breast just waiting to be rubbed

GB24 warms the ribs and softens feelings of anxiety or indecision.

ST21 wandering down to Heaven, digesting all the love

ST25 Heavenly Axis awakening sensuality and opening the belly to pleasure

CV6 Sea of Qi Male sexual energy-centre. The most potent male arousal point also connects with the essence of the feminine

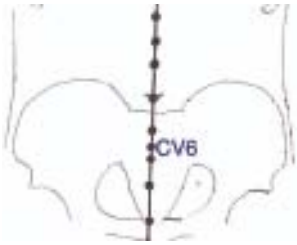

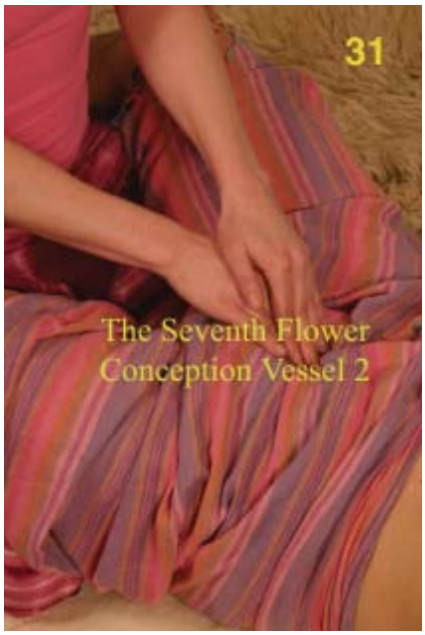

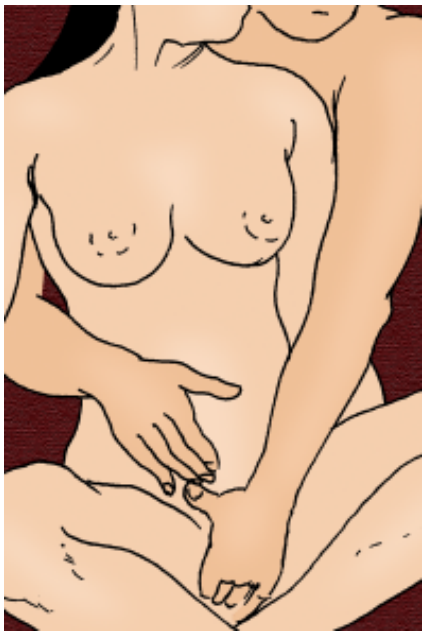

CV2 the most potent feminine arousal point and also quite effective for men

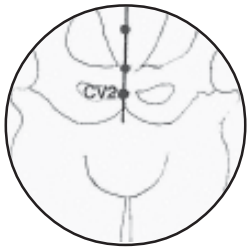

Eighth and Ninth Flowers

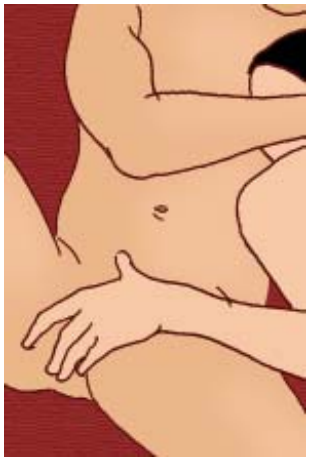

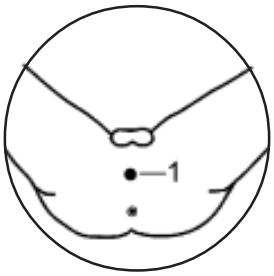

CV 1 Gate of Life and Death, so named because the retention of sexual energy is said to prolong life, and subtle use as arousal point for both sexes, especially good for prolonging male orgasm.

After exchanging Love-Shiatsu, open to your creativity. Try tongue instead of hand, for instance...

Let the power of points, meridians and elements inspire you!

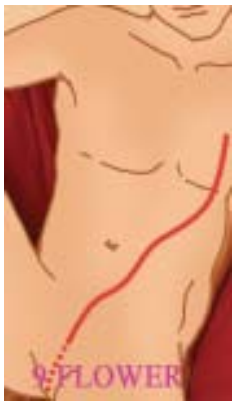

Master School

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Mantak Chia

Mantak Chia is one of the world's leading teachers of Taoist practices. He has taught thousands of students and hundreds of teachers across the world and has written over twenty books, including Sexual Reflexology.

Kris Deva North is principal and co-founder of the Zen School of Shiatsu. He integrates Taoist healing traditions with modern Life-training techniques.

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Awaken Healing Energy through the Tao

Mantak Chia

Awaken Healing Energy through the Tao

Taoist Secret of Circulating Internal Energy

Mantak Chia

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using the Dark Room technology creating a complete environment for the higher level Taoist practices.

He has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
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The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper/Collins
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Tan Tien Chi Kung - 2002

Many of the books above are available in the following foreign languages:
Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

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I wish to express my gratitude to my many students, who so willingly devoted their time and effort in practice. I wish also to thank them for consenting to be interviewed so that others might know what they experienced and how they were helped through this practice.

I want to thank Dr. Lawrence Young, attending physician at New York Infirmary-Beekman Downtown Hospital and a private internist, Dr. C. Y. Hsu, physician-in-charge of the Acupuncture and Nerve Block Clinic at Albert Einstein College of Medicine, Stephen Pan, Ph.D, Director of East Asian Research Institute, and K. Reid Shaw attorney, who are actively engaged in presenting my work to the medical community.

I wish to offer my appreciation to Sam Langberg, for his understanding and untiring work in editing the first edition. Sam Langberg is a freelance writer and a Taoist Esoteric Yoga instructor living in the New York area. He has been practicing Yoga for over 10 years, and currently works with the Taoist Esoteric Yoga Center writing classbooks and other materials.

Many thanks go to Michael Winn and Robin Winn for long months spent revising and expanding the second edition. I thank Susan MacKay who revised our Taoist Esoteric Yoga sitting figure, and my secretary Joann for her patience in typing and retyping the manuscript.

Finally, I am grateful to my son, Max, whose suggestions and encouragement in this, as in all matters, have always been valuable to me.

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

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Foreword

During the last twenty-five years the United States and Western Europe has witnessed an amazing growth of popular interest in a multitude of personal growth and wholistically based health disciplines. The West once again has become a “melting pot” but this time the cauldron contains a mixture of the sacred traditions of the East as well as some of the emerging internal technologies of the body, mind and spirit. This movement, known generally as the “New Age”, is characterized by popular magazines and a sizable growing literature, a large number of spiritually oriented groups and a rapidly growing consumer market for wholistically based medicine and other “appropriate technologies”. We are clearly seeing a major shift in attitudes and values in our relationships to our inner lives and our responsibilities for the future of the planet Earth.

Parallel with these developments we can also see emerging a scientific picture of the universe that resembles the classic world view of the major oriental religions. The scientific picture that is developing at the end of the 20th century is less linear, less deterministic and less reductionistic in the frontier sciences of physics and biology. This picture becomes increasingly similar to the intuitive, phenomenological and process/interactive model of man-in the-universe that has characterized Chinese philosophy and science for thousands of years.

These two trends, the growth of “New Age” consciousness and the shift in our scientific paradigms are beginning to converge in some practical ways in the field of holistically inspired medicine. Perhaps the best example of this is the therapeutic modality of Acupuncture, one of the most powerful techniques in the classical Chinese medical system. A little known fact about Acupuncture and Chinese medicine is the enormous debt these systems owe to Taoist Esoteric Yoga. In fact, Taoist Esoteric Yoga is the mother of Chinese medicine as well as many other systems of healing and self-development.

For many Westerners Taoism has seemed an elusive and inscrutable path, best exemplified by the oracular mysteries of the I-

Ching and the wisdom of Lao Tzu and Chuang Tsu, the nature philosophers of "The Way". For those interested in the Oriental healing or martial arts there are disciplines as Macrobiotics or Tai Chi Chuan, but the nature of this relationship is far from clear. To suggest a connection between these and other practices and an esoteric core of Taoism is to confuse matters even further. In fact, the concept of an esoteric or inner core of Taoism is itself a new idea for New Age audiences. What sense are we to make of an esoteric foundation for a tradition that already seems so difficult to comprehend, especially in its practical ramifications?

By contrast, we are reasonably comfortable with the major concepts and methods of the various Indian meditation and yoga systems which began to find a place in our society in the 1920's. We have also come to appreciate the powerful systems of Buddhist thought and practice, especially Zen and Tibetan Buddhism which began to emerge into popular consciousness in the 1960's. But what about Taoism? What do we really know about this tradition other than a few fragments of the wisdom of the I-Ching, the Tao Teh Ching and a few other pieces of disconnected fragments of practical knowledge contained in the systems of Chinese medicine and martial arts? How can we begin to understand the contemporary practical applications of this ancient system of healing and spiritual development? What form must this knowledge take in order to enter the mainstream of our technological society at this time in our evolutionary transition?

The book by Master Mantak Chia addresses these questions and represents, to the best of my knowledge, the first opportunity for a Western audience to really grasp and digest the essential and practical aspects of Taoist Esoteric Yoga. Master Chia has performed an invaluable service through his efforts to present these ancient psychophysical methods in a form and sequence that corresponds to our contemporary scientific and technological world view. The information in the book, the first in a forthcoming series on Taoist Esoteric Yoga principles and methods, clearly describes the theory and practice of the Microcosmic Orbit, the foundation teaching of the entire Taoist system. Through their meditation experience and accumulated wisdom the ancient Taoist masters learned the importance of the free circulation of Chi energy in the body, both as a therapeutic technique for self-healing as well as a

safety valve for preventing the side effects that often accompany the powerful experiences of Kundalini energy release.

Master Chia, a true heir to the ancient Taoist system, has taken this information and broken it down into a systematic form of instruction that anyone can easily grasp and apply.

I believe that this book is an historically important contribution to the introduction of practical Taoism to the West. “Awaken Healing Energy Through The Tao” will help to evolve our under standing of the mind/body relationship in our healing practices as well as our scientific models of the energy structure of the human body.

By Gunther Weil, Ph.D

Introduction: What is the Healing Energy of the Tao?

In the sixth century B.C., Lao-Tse began his classic essay, the Tao Te Ching, with this admonition: "The Tao which can be spoken of is not the Tao." Loosely translated, "Tao" means "the way" or "the power". In early Chinese writings the Tao implied an understanding of life which stressed individual harmony with the forces of nature. The Taoist sages often became hermits that lived in the mountains and disdained offers of power from admiring emperors, saying they preferred the "Ruler of Nature" to the transitory "Ruler of Society." In the same tradition, "Awaken Healing Energy Through The Tao" is rooted in the process of nature, our bodily nature. This healing energy works independent of any particular belief or current scientific concepts. It differs from the Taoist religions which grew up around the original philosophy. In a nutshell, it is a subtle but verifiable experience of life energy, of "chi" flowing through the body in a specific pattern. It was discovered by practical minded Chinese sages, and is available to to any person of any age who cares to train themselves to observe and use it. That this healing power is compatible with different individual beliefs or religions is apparent in the fact that the author Mantak Chia is himself a Christian, but has used the traditional Taoist methods to help thousands of people heal or improve themselves.

A person could study hundreds of volumes of the Taoist Encyclopedia in Chinese and commentaries on the Tao Te Ching or I-Ching in a dozen languages without ever learning how to awaken the much poeticized healing power of the Tao. It would be far more useful for such a seeker to spend their time practicing the circulation of the healing life force in the "small heavenly cycle" or "microcosmic orbit" as described in this book.

Mantak Chia has read those hundreds of esoteric volumes, in addition to receiving the highest oral teaching from Taoist Masters. He believes the oral teachings are too important to be practiced by

a lucky few only, hidden from other seekers by vague poetry or the arcane symbols of ancient writings. Master Chia sees that the age has come when the public needs and deserves a clear teaching of this healing power, which was shrouded in China by the same secrecy that surrounded medieval alchemy in Europe. This historical similarity is no accident, as the Taoist "Microcosmic Orbit" is a process of human alchemy, the first step towards transformation of human energy into its purest form. This distillation of a healing energy was perfected by generations of sages who spent their entire lives refining its many applications.

These applications to daily life are indeed enormous. It is not an exaggeration to say the circulation of human energy or "chi" throughout the body is also the key principal functioning behind much Chinese genius. It is responsible for Chinese achievements in medicine (acupuncture), the martial and meditative arts (Kung Fu, Tai Chi Chuan, Pa Kua Palm, Hsing I Chuan, Inner Alchemy),inspiration for a vast treasure of poetry and philosophy (I Ching, Tao Te Ching). It could be argued that the increased health and creative intelligence of the Taoist practitioners helped stimulate the impressive early Chinese advances in technology and government. Confucius was well versed in Taoist philosophy and expressed great admiration for it; he may well have been a practitioner of the art as well.

Since publication of the first edition of "*Awaken Healing Energy through the Tao*", students of various Chinese arts have come to Mantak Chia and confessed they were shocked to see his book sold in a store. Its information was taught to them only after years of dedication and discipline in their practice, be it Tai Chi, meditation, or martial arts. They were told circulation of the microcosmic orbit was the "highest secret" to gaining internal power in the mind and body, and not to be revealed to those outside the "inner circle".

Having mastered many different systems of esoteric Chinese knowledge. Master Chia's perspective is different from most other teachers. For Master Chia, education begins with the awakening of this healing energy. It is the most important building block. If you master the circulation of your energy, growth in other disciplines proceeds more quickly. Opening the main channel of energy circulation in the body (referred to as the "Microcosmic Orbit" in this book) is analagous to a first grader learning to write the letters of the alphabet.

Without first learning how to write the alphabet, one cannot create words, sentences, paragraphs, or the simple and complex ideas taught up to the university level. It is the same with the healing power of the Tao. Without "getting" the flow of energy taught in this book, the practitioner will find it difficult to advance quickly to higher levels in related disciplines. Or, you may spend years with less direct methods in order to achieve the same end, e.g. repeat certain physical movements until the flow one day "arrives", sit facing a wall for 20 years, or repeat a mantra for a lifetime.

Later volumes of Master Mantak Chia's "*Taoist Esoteric Yoga Encyclopedia*" will elucidate some of the more advanced forms of Taoist practice in healing, meditation, and self-defense, and their application in balancing the forces which daily buffet us about. Seminal Kung Fu (a sexual practice for man) and Ovarian Kung Fu (a sexual practice for woman) reveal the Taoist secrets of transforming raw sexual energy into creative energy. Iron Shirt Chi Kung strengthens the whole body fascia, organs, tendons and bones and shows how to "root" the human energy in the earth. Fusion of the Five Elements" teaches how to transmute emotions, heal damaged organs and gain greater balance and insight into oneself. Tai Chi Chi Kung, Pa Kua Chi Kung and Palm, Hsing I Chi Kung, Death Touch Dan Mu, and Five Finger Kung Fu, build internal power, improve body alignment, and enable one to more quickly master the longer forms of Tai Chi Chuan, Pa Kua Palm, and Hsing I Chuan.

"*Awaken Healing Energy through the Tao*" is scientific in that it demystifies some of the principles on which the miracle of self-healing and other feats of energy are based. At the same time it is deeply rooted in an ancient tradition of spiritual self-mastery that, step by step, leads the practitioner to experiencing the full mystery of the Tao.

*By **Michael Winn** who is general editor of the Taoist Esoteric Yoga Encyclopedia.*

March 31,1983
New York City

Part I:

Practical Steps to Awaken your own Healing Energy

Chapter I
Awaken the "Chi" Life Energy

Meditation, properly speaking, is the stilling of the mind. Most of the meditation techniques taught today still the mind using one of two basic approaches. The first is the Zen approach of "silent sitting", facing a blank wall until the mind becomes blank. You sit until the moment of pure awareness arrives, even if it takes twenty years. The second is the Mantra approach, in which the mind is rhythmically lulled to sleep with sounds or images. After thousands of repetitions the body begins to vibrate at a higher frequency, and the meditator becomes aware of the higher energies operating beyond the sensory process functions of our daily mind.

The Esoteric Taoist approach is different. It does not depend on total absence of the flux of thought. Instead, this system stresses the circulation of energy called "chi" along certain pathways inside the body. These pathways help direct the "chi" — also known as prana, sperm or ovarian power, the warm current, or kundalini power — to successively higher power centers (chakras) of the body. The secret of circulating this "chi" has been transmitted for thousands of years in China, where it brought extraordinary improvements in health and life.

But what is this "chi", and where does it come from? The chi is the primordial life force itself. It begins in human life with the piercing of an egg by a sperm cell. From this original fusion an enormously complex new human being develops. "Chi" is the continuous flow of energy linking the various tissues, organs and brain functions into a unified whole — a person. Chi also links this person to his environment.

The main channels of "chi" energy flow in the body were discovered by sages meditating upon the human fetus inside the womb. They observed the baby grows up around its mother's navel point, and that through the navel the fetus absorbs nutrients and expels waste. The fetus literally "breathes" through the umbilical cord from the mother into its own navel down to the perineum and up to the head and down from the tongue to the navel again. The navel point is thus said by Taoists to be the starting point for the flow of the

primordial life energy, or “chi”, and remains the point of strongest energy storage and circulation in the adult.

“Awaken Healing Energy Through The Tao” is a method for an adult to return to that state of dynamic energy circulation which existed inside the womb. In this sense this esoteric Taoist meditation is a rebirth process, a return to one’s original, primordial self. What happened after birth that caused us to lose that original, perfect equilibrium that was so nurturing and permitted such healthy growth?

After a baby enters the world, his/her energy slowly “settles out” into hot and cold parts of the body. In the fetus this “yin” and “yang” energy was perfectly balanced in a kind of “lukewarm” mixture. But by the time a baby has grown to adulthood the hot or “yang” energy has gradually risen to the upper part of the body containing the vital organs such as the heart, liver, lungs and brain. The cold or “yin” energy has tended to settle in the legs, genitals, kidneys and lower abdomen.

Fig. 1.1 *Energy enters the human fetus at the navel and circulates in Microcosmic Orbit, harmonizing yin and yang energy.*

As we age, the energy routes which bring vital power to our internal organs and enable them to function become progressively more blocked by physical and mental tension. The result is general fatigue, weakness, and poor health. A young person usually has sufficient energy to keep the routes less obstructed so that the power still flows. The organs are thus nourished, and there is little sickness. But if we do not live healthily and practice to keep the energy routes open, they will gradually close and cause emotional imbalances, premature sickness and old age.

The perfect energy circulation we enjoyed as babies was not aired by the daily stress of living. Simply by re-establishing that same strong flow of lukewarm chi — mixed yin and yang energy — our vital organs will begin to glow with radiant health. When this healing power of the Tao - the life energy in its original, pure, undivided form — flows through our bodies, we regain the exuberant energy and rosy glow we once had as babies. Our true task is only to "re-awaken" this undivided healing power that was once an accepted fact in our being.

Primary Energy Channels

The nervous system in human beings is very complex and capable of directing energy wherever it is needed. But the ancient Taoist masters discovered there are two primary energy channels that carry an especially strong current.

One channel they called the "Functional". It begins at the base of the trunk, midway between the testicles and the anus at a point called the perineum. It flows upward into the body past the penis, stomach organs, heart, and throat. The second channel called the "Governor", starts in the same place. It flows from the perineum upwards into the tailbone and then up through the spine into the brain, and back down to the roof of the mouth.

The tongue is like a switch that connects these two currents, for when it is touched to the roof of the mouth just behind the front teeth, the energy flows in a circle up the spine and back down a the front of the body. The two channels form a single circuit that the energy loops around in circles. When this energy flows in a loop around the body through these two channels, the Chinese masters said the "small heavenly cycle" or "microcosmic orbit" had

been completed. Henceforth in this book we shall refer to this major energy loop as “the microcosmic orbit”. Its vital current circulates past the major organs and nervous system of the body, giving cells the juice they need to grow, heal, and function.

Proper Wiring of the Etheric Body

The two main energy channels of the body can be compared to the main wiring of a house. Imagine a trunk line which brings power from outside into the building’s service panel. This panel contains the circuit breakers that protect the inside wiring from short circuits and overloads. It also has the switches that control the current to all the rooms inside the house. This inside wiring is like the “six special power routes” in the body used in higher levels of Taoist meditation that branch off from the Microcosmic Orbit. In higher levels there are additional “wires” for especially heavy loads of energy that might surge into the system — the “thrusting route” in the middle of the body is one such wire.

Once your house, like your body, is properly wired and all the safety precautions have been made, it is ready to connect to the main utility company trunk line for power. You are ready to receive the power that comes from above and from beneath you without harm.

What does it mean to “Open the Routes”?

“Opening the routes” means clearing all obstructions that impede the flow of chi energy in their natural paths. Most obstructions take the form of physical, mental, or emotional tension. It helps to understand that these energy routes in the body are grounded in the larger balancing forces of nature which are exerting powerful influence over us at every moment. The healing power of natural forces can be tapped to help the body in clearing itself of the obstruction to its natural energy flow.

The route running down the front of the body (it may flow in an upward direction before the Microcosmic Orbit is linked together) the Functional Channel, has a yin, or cold nature. The route running up the back, the Governor Channel, is yang, or hot, in nature. The feet are said to be the ground or the “earthwire” and absorb

negatively charged energy from the earth. The top of the head, or crown, is the "heavenly wire", or positive wire and absorbs the yang power from above, especially from the sun.

When these two routes are joined and cleared of obstruction the power will flow in a circuit between these two poles, positive and negative, linking the vital organs of the body to the main loop of the microcosmic orbit around the trunk and head of the body. So by simply opening the two main routes, Functional and Governor, a larger supply of warm "chi" current flows into every bodily organ. The process of mixing yin and yang, hot and cold, heaven and earth, takes place automatically, balancing your physical, mental and emotional selves.

Lessen Side Effects
by Careful Preparation

Some meditation methods have the practitioner start by receiving power from above immediately. Only a few people — those born with the proper channels already open and ready for use, and who have done nothing to cause them to be blocked are capable of doing this immediately. Many people, including well known yogis, have damaged their organs with excessive heat or have released uncontrollable hallucinations by progressing before their bodies were prepared to handle high doses of raw energy.

The Taoist approach is more gradual. The practitioners make use of higher energies by first clearing the routes and raising their level of "chi" production. When the two principal thoroughfares of the microcosmic orbit are opened, only then are the six additional special power routes opened, and more after that. This allows the body to absorb the natural forces flowing about us constantly like a sponge, and enables one to swiftly circulate the added vitality throughout the body. With all these routes open, every organ receives its full complement of energy and remains in harmony with the rest of the body system.

The warm current of "chi" helps wash away any blockage that might be present, massages the internal organs, and restores health to damaged and abused tissues. Many deadly diseases are prevented and the effects of stress and nervous tension are effectively flushed out of the system. Many practitioners open all the

routes within a few months and learn to reduce leakage of their bodily energy to the point where an EEG records little or no energy waves.

Acupuncture and Microcosmic Orbit

The Chinese sages studied the flow of energy from these two main channels, the Functional and Governor that connect to form the microcosmic orbit, and discovered other energy flow routes. It was along these energy meridians that the points used in acupuncture healing were also discovered. But before the art of acupuncture developed, using needles to impede or enhance energy flow along the various routes in an effort to restore normal function, the Chinese healers relied on circulating their energy internally in the basic microcosmic orbit to insure good health, love and long life. These masters of long life were much sought after, even besieged to teach the secret of living a long and harmonious life.

When acupuncture was first introduced it was considered an inferior form of medicine and was used mostly in extreme cases of sickness. The best doctors in China were the doctors who kept their patients from getting sick in the first place. The highest form of medicine was preventive. Today, while we are beginning to accept acupuncture as a reliable medical practice, we have yet to recognize our innate ability to prevent illness and heal ourselves using the energy flowing naturally through our bodies.

Summary

In the Taoist system one begins by opening and completing two main channels, up the spine in back and down the front of the body. When linked together by the tongue on the roof of the mouth, these two routes form the Microcosmic Orbit and serve as a circulatory system for the body with built-in cooling safety valves.

Human energy tends to flow upward during meditation and may cause immense heat to accumulate in the brain coupled with bodily sensation, visual and auditory hallucinations, emotional outbursts, and various delusions. By completing up to a total of thirty-two routes (these smaller routes are not covered in this volume) the energy is well circulated, greatly reducing the overheating side effects of concentrated meditation and inducing relaxation.

Once all the energy channels are open, one can begin the practice of mixing and transforming the powers present in the various energy centers or chakras, a process known to the Taoists as "inner alchemy". Many formulas are needed to bring about the proper effects and to harmonize the various energy systems of the body with the energy system of nature. As more power becomes available, the importance of opening the various routes becomes evident.

Without many clear and commodious channels to transport a considerable increase in energy, damage can result from an overload. These side effects range from the physical to the psychological and can be quite disturbing, even debilitating. If any side effects should ever occur, see the chapter on Safety Precautions and if necessary ask for advice immediately from a teacher of Taoist yoga. "*Awaken Healing Energy through the Tao*" is a method evolved over many millenium to offer the practitionerthe safest and most assured path to good health. If you proceed one step at a time up the ladder, you will be guaranteed success in reaching the top.

Chapter II
Prepare to Circulate the Chi Energy

Create a Relaxed Environment

The key to Chi circulation is deep relaxation: in order to circulate the warm current you must be calm within yourself. If you are distracted by the television, passing cars, or your unmade bed, your mind will turn outwards and you will be unable to focus on your energy. As you progress you will learn to ignore the distractions and will be able to meditate anywhere, but in the beginning choose a quiet spot and a special time. The more comfortable the atmosphere the more easily you can concentrate.

Clothes

During Chi (meditation) dress in loose-fitting clothing. Loosen your belt and remove your glasses and watch. Remember to keep the knees, nape of the neck and toes free of binding clothing. Dress warmly enough so that you are not distracted by the cold.

Room

The room must be kept well-ventilated, but do not sit in front of a window. The body generates excess heat during meditation and a draft may cause a cold. Avoid meditating with light shining in your eyes. If a room is too light it will disturb your concentration; if too dark it may make you sleepy.

Diet

According to the Taoist masters, if you stop eating when you are two-thirds full your stomach will have room to digest the food. When you are too full you lose lucidity and power of concentration.

Wait at least one hour after eating before meditating, avoid eating cold foods including iced drinks and chilled fruit. They are extremely yin and tend to throw you out of balance. Let your foods warm up instead of eating them directly from refrigerator. Your body saves energy by not having to heat cold food.

You may attain a high plane of spiritual evolution without being a vegetarian. Both vegetarians and omnivores are subject to illness and decay. Simply eat whatever makes you feel best. Try to listen to your body's appetite and you will know what to eat: When you have an urge to eat something your body has a need for that food. Of course this applies only to those whose bodies are relatively healthy and have no extreme cravings for deadly substances such as refined sugar, salt, or oily food. If your health has been affected by perverted eating habits you will gradually recover a true sense of your nutritional needs by circulating the warm current of "chi" around your body. No one else can tell you what your need to attain inner harmony; vegetables alone will not make you pure or holier than fish. But you should try to eat food that is fresh and as free of chemical contaminants as possible.

Stimulating the Flow of Chi

To prepare for meditation first rub your face, ears, eyes, waist, and the soles of your feet. Rotate your head 12 times in both directions, then clasp your hands above your head and rotate your trunk 36 times in a circular motion.

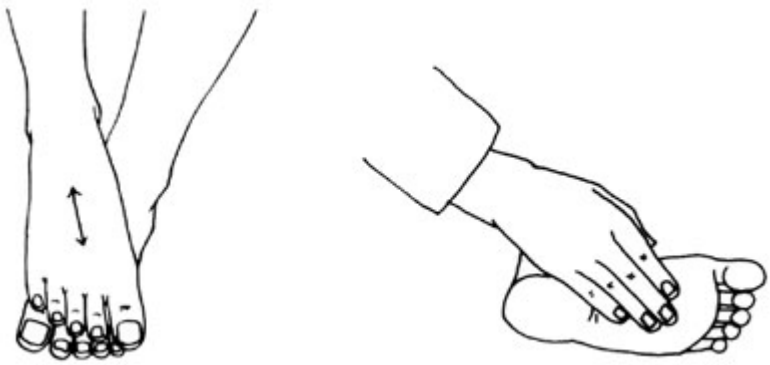

Fig. 2.1 *Rub the soles of the feet to stimulate the flow of Chi.*

To prevent stiffness, promote flexibility, and ensure an easier flow of energy upon awakening each morning, stretch your tendons, clench your teeth, and swallow your saliva. To stretch your tendons,
sit up with your legs extended out in front of you and grab your toes or ankles. Exhale completely and gradually bend at the waist stretching forward with your hands as far as you can go without straining. Practice nine times. Next beat your teeth together nine times then use your tongue to massage you gums. This will prevent gum disease and exercise your tongue. We deal with this more in the Chi Massage (Taoist Rejuvenation).

How to Sit

Sit on the edge of a chair using your sittingbones to find that delicate place of balance which will help hold you erect. Men should allow the scrotum to hang freely in the air; when the testes are freely suspended it is easier to draw in energy and awaken the sleeping giant within. The sitting position for women is the same except that if women sit in the nude or are scantily clad they should cover the genitalia to avoid energy loss. The back must be comfortably erect, the head bowed slightly forward, the feet firmly planted on the floor. The feet are the ground wire, and have ten channels of energy flow in each leg. In order to keep the energy flow fully in each leg, keep your legs in touch with the ground.

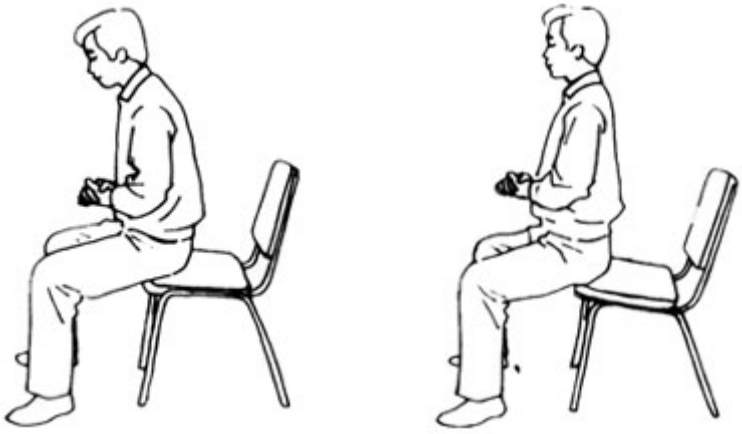

Incorrect sitting position Correct sitting position

Fig. 2.2 *Sitting Position*

Fig. 2.3 *Both men and women place the right (Yang) palm over the left palm (Yin), to connect and seal the energy while meditating.*

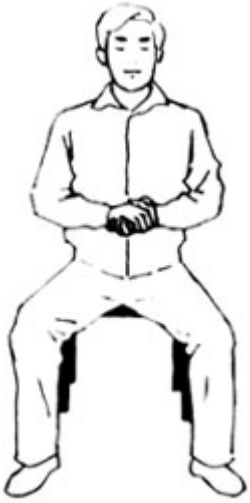

Fig. 2.4 *Back should be straight.*

Sitting on a chair is the most comfortable way to practice the chi flow to the whole body. The feet are the root of our body so keep the energy flow to them and the hands resting on the lap with the right palm on top, clasping the left palm. This will complete the hand circle, and the energy will not leak out of the palm. The back

should be quite straight at the waist though slightly bowed at the shoulders and neck. This minor forward curve of the upper back promotes perfect relaxation of the chest and allows the power to flow downward. In military posture, with the shoulders thrown back and the head held high, the power will lodge in the chest and fail to descend to the lower centers.

How to Breathe

While concentrating the breath should be soft, long, and smooth. After a while you can forget about your breath. Attention to breath will only distract the mind which must focus on drawing energy to the desired points. There are thousands of esoteric breathing methods; you might spend your whole life mastering them and acquire no lasting energy.

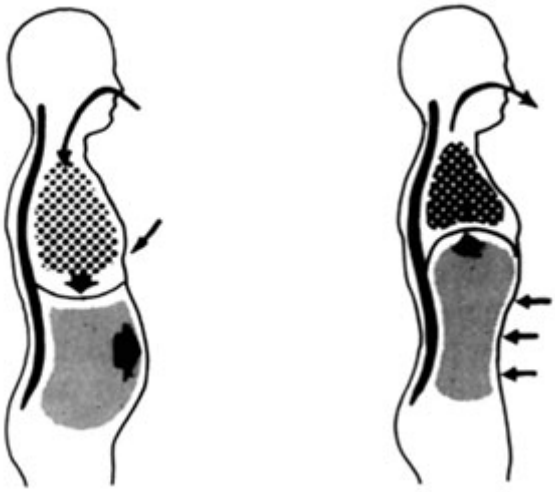

Fig. 2.5 *To relax, practice taking long slow deep breaths in the abdomen, not the chest.*

But once the Chi is awakened and you complete the route you may experience many different breathing patterns: rapid breathing, shallow breathing, deep breathing, prolonged retention of breath, spinal cord breathing, inner breathing, crown breathing, soles of the feet breathing, etc. You need not try to regulate your breath as breathing patterns will occur automatically according to the body's needs.

Breathe noiselessly through the nose. Make the breathing smooth and gentle. Any sound passage of the breath will mar your concentration, and if your breathing is rough you will not succeed in attaining a complete state of calm. But take care, if you interfere with the breathing you will arrest the flow of energy.

In the beginning if you have difficulty focusing, count from one to ten and ten to one, five times. You can take thirty-six abdominal long, slow, deep breaths which will lower the energy held in your chest, shoulders, arms, and head, and help you attain inner calm. Once you have acquired energy and concentration you can imagine energy entering every pore when you inhale and leaving every pore when you exhale. In this way you will experience the entire surface of your body breathing.

Mental Attitude

Don't try to meditate when you are tired. If you are fatigued but still wish to practice, first take a stroll, a soothing bath, a short nap, or have a warm drink. Begin to practice when you feel refreshed.

Maintain a calm mind and an attitude of forgiveness. Be cheerful and remain open to life. Don't be consumed with ambition or worry. Your great task is to raise your consciousness and your capacity to love. Don't worry about tomorrow. Tomorrow will take care of itself. Happiness and a calm state are signs of spiritual progress.

Don't struggle. Don't try to force wandering thoughts out of your mind. Simply release your thoughts, watching as they depart. Imagine them as clouds dispersed by the wind. When they are gone the sun will shine through brightly. Detach yourself, be a spectator to the thinking process not a participant. Gradually you will learn to concentrate and direct the healing energy of the Tao.

Position of the Tongue

The tongue is the bridge between the two channels, the Functional and the Governor. They are separated by the tongue. There are three positions for the tongue. For the beginner, place the tongue where it is most comfortable. If it is uncomfortable to place the tongue to the palate, place it near the teeth. The correct place is called the "Heavenly Pool."

First Position

The place near the teeth will produce air (wind) and will make it easy for you to fall asleep.

Second Position

The top of the palate before the palate is the Fire Place. If touched for too long it will make the mouth and tongue feel dry.

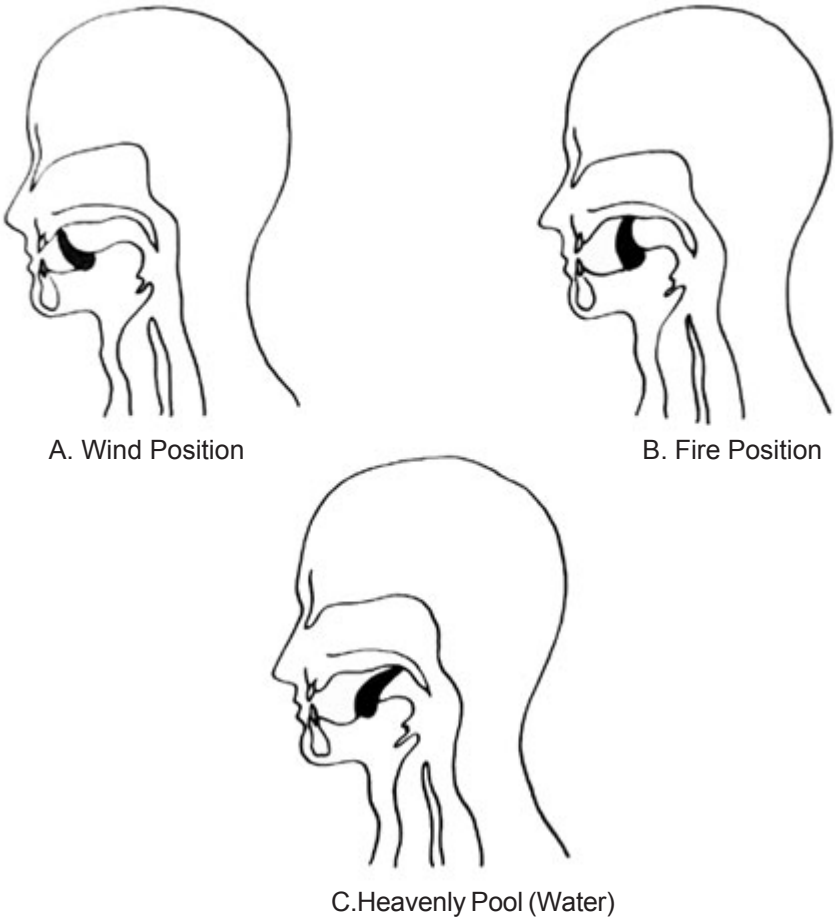

Fig. 2.6 *Tongue Positions*

Third Position

This is the Heavenly Pool position about 1.5 inches in front of the teeth, stimulating the salivary gland that is under the tongue. The Heavenly Pool has two pools, which in the Tao system connect with the perineum Sperm Palace and the K1 Kidney, the Sole (Bubbling Spring). It connects with the kidney and runs up past the heart, so these two pools will stimulate the kidney and sperm energy to rise up past the heart and enter the small brain and the Pituitary Gland, which transforms it into brain energy. This will later on become Nectar and strengthen the heart energy.

Chapter III
Secret of the Inner Smile

Once you've created a quiet, calming external atmosphere you must establish that same quiet and calm within yourself. If the room is conducive to meditating, but your jaw clenched, your neck stiff, shoulders tense, your back stiff, your stomach upset, you will not be able to circulate the chi energy and complete the microcosmic orbit.

A relaxed mental attitude and the thirty-six deep abdominal breaths will help to calm your mind and begin to relax your body. But to achieve full calmness means more than simply relaxing tense muscles and jittery nerves. To gain a deep and lasting state of relaxation requires that we develop a feeling of peace in our innermost parts. Only when our vital organs like the heart, lungs, liver, kidney and stomach, nervous system and circulatory system are feeling relaxed, can we psychologically feel serene. To reach these organs, the ancient Taoist masters discovered a simple secret, the "inner smile".

Fig. 3.1 *An Inner smile radiates powerful healing energy.*

Healing Power of a Smile

Have you ever walked down the street grumbling or worrying about things you have to do, your relationships, your job, your whole life? When you glance up someone smiles at you, and before you know it you're smiling back. In only a split-second you've dropped your troubles, you stand up a little straighter, and walk on knowing everything is going to be okay. A genuine smile has tremendous power.

When you smile at someone it makes them feel good about themselves. When you smile at your plants they feel your loving energy and they grow. When you go home, pat your dog on the head and smile at him, your dog will wag his tail to show you he's happy. But if you go home, yell at him and kick him, he'll cower, growl, or bite. If you scream at your loved ones they'll feel defensive and unloved.

A true smile is a sign of love, a transmitter of energy which has a warming, healing effect. It is a vehicle for music. A person who does not smile is like a guitar which is not played: the guitar sits in the corner, begins to warp, it's strings stretch out, and gradually the guitar cracks and decays. The non-smiler, likewise, does not develop his ability to give and receive love. His dark countenance and serious approach to life is often coupled with ulcers and other medical disorders as his life slowly crumbles for lack of care and love.

On the other hand, the guitar that is polished and played has its strings changed regularly, the bow adjusted and is kept safely in a case. A well-loved and tended guitar brings life and light to the musician, and often outlives its owner. The smiler, too, brings joy to people's lives, and leads a happy healthy life that may be soundly remembered long after his or her physical passing away.

Unfortunately, while we all recognize the difference between cheery people and glum people, and while we associate happiness with health, and sadness with sickness, we still do not acknowledge the power of smiling or understand its full potential. In short, we don't take smiling to our organs and nervous system seriously.

Why, for instance, if a smile is associated with health, aren't there doctors who specialize in smiling? If Saturday Review editor, Norman Cousins, used old Marx Brothers films to laugh away his rare connective disease, then why can't doctors and nurses use

smiling energy to help heal their patients? Perhaps our hospitals should hire clowns and jesters to make their patients smile. More important, why hasn't smiling been used as preventive medicine? In smiling at our friends, families and loved ones, why have we not learned to smile to ourselves?

In ancient China, the Taoists taught that a constant inner smile, a smile to oneself, insured health, happiness, and longevity. Why? Smiling to yourself is like basking in love: you become your own best friend. Living with an inner smile is to live in harmony with yourself.

One look at our western society shows that we do not know the secret of smiling. The lack of harmony within ourselves is tragically apparent. We are plagued with an increase in physical and emotional illness that ranges from cancer to anorexia nervousa. Our loves are always shadowed by a world filled with violence and self-destruction. Both the individual and the collective society are threatened by rampant drug abuse and nuclear waste. Somehow, somewhere, we've lost sight of the Tao. We've broken the natural flow of life, and with it the power to heal ourselves.

Smile Love into your Vital Organs

The complexity of global problems can be so overwhelming that most people simply give up trying to understand the whole picture of their life. Our heads reel from an overload of information that spews out from television, newspaper, radio and computers. The challenge is to simplify all this information into digestible form. This process of literally "digesting" reality is made difficult to the extent that we've separated our minds from our bodies.

If the body is healthy, it can easily assimilate the stress of modern living and even find it a creative challenge. But many people ignore their natural balancing mechanisms between the body and mind. They attempt to digest the world with their minds, piling up concepts, thoughts, and desires like giant mounds of mental baggage.

They ignore the fact that their body must carry this extra mental baggage around twenty-four hours a day, and eventually tires of the extra weight. Exhausted, the body gives up prematurely resulting in heart failure, stroke, arthritis, or liver dysfunction. The collapse is blamed on a poor physical body, but the overstressed mind is the true culprit.

Proof of our ignorance of the connection between body and mind is seen in the fact that most of us don't even know where our bodily organs are, much less their size, shape or functions. And if we happen to know intellectually, we still don't experience our organs in a tangible way because we ignore their constant subtle messages. For instance, we think we are satisfied when our mind is pleased: our intestines may be rebelling from over-eating, our lungs may be taxed by smoke, our kidneys may be overworked from coffee, but in our mind we've had a delicious meal, a good smoke, and a great cup of coffee. We are numb to our organ's feelings and thereby block what is potentially our deepest experience of good health.

We're like the irresponsible automobile owner who spends all his time waxing and polishing his car only to drive over bumpy, dusty roads. He avoids cleaning the spark plugs or changing the oil, then uses leaded instead of unleaded gasoline. When the car breaks down, he curses, complaining that he is not a mechanic, and then blames the car manufacturer when he's told the car needs a complete overhal.

We are really no different. We spend all our energy (and money) making certain our outer selves are presentable, then we abuse our inner selves by eating an imbalanced diet, drinking, smoking, and worst of all, denying ourselves love. And then we're shocked when out of the blue our lungs collapse, our kidneys fail, or we're told we have cancer.

Some people have an astonishing ability to convince themselves that their health is not caused by their own behavior, and quickly blame their illness on bad genes, old age, fate, etc. But most people are simply unaware that their illnesses are the direct result of accumulated years of stress and seemingly minor abuse of the physical body, especially of the vital organs. These vital organs are intimately connected to every aspect of our mind. Our body is the filter for all our perceptions, feelings, thoughts, as well as the storehouse for our memory, our very sense of identity.

Most people fail to realize that even if our mind temporarily stops functioning, if we cease to think or feel, our organs can continue to work. But the moment your spleen bursts, your heart stops, or your liver malfunctions, your life is in serious danger.

The brain is the boss, but organs do the work. Imagine your organs are working in a factory, your mind is the boss. If the boss

is never around, or if he ignores the workers' grievances (he's so concerned about his own affairs that he can't see that the workers have poor working conditions, they're overworked, and under paid) the workers will eventually become so discouraged and frustrated that they'll either go on strike or quit altogether. The factory shuts down, no goods are produced, and the boss is left trying to negotiate with the workers. But his power is diminished if the workers have already shut down the factory. It may never open again, and cause the boss to lose his livelihood. (Remember, the problem did not occur overnight.)

How to smile down with the Inner Smile

Start with the Eyes

To practice the inner smile begin by closing your eyes and smiling sincerely into them. Relax and feel a deep smile shining through your eyes. By relaxing your eyes you can calm your entire nervous system.

Your eyes are connected to your autonomic nervous system which is divided into two parts, the sympathetic and parasympathetic nervous systems. The sympathetic nervous system controls the flight or fight reaction. The parasympathetic permits the body to rest and feel secure. It generates calm, loving feelings and is in turn activated by similar feelings of love and acceptance from other people.

These two systems are linked with every organ and gland in the body, which are given commands through the nervous system to speed up or slow down the activity of the body as needed. Thus it is through the link between your eyes and your nervous systems that your entire range of emotions and immediate physical reactions are controlled. By relaxing your eyes with the inner smile, you free your mind of tension held throughout the entire body. The mind is then freed to concentrate and apply all its available creative energy to the task at hand, e.g. harmonizing itself with the environment. This connection between visual relaxation and the ability to concentrate is an essential Taoist insight.

After you feel your eyes tingling with a huge inner smile, direct that smiling energy down into your body and fill your vital organs with love. An easy way to remember the "smiling down" sequence is as follows:

Front Line: Smile down into the eyes, face, neck, heart, and blood circulatory system, the lungs, pancreas, spleen, liver, kidneys and adrenals.

Middle Line: Smile down from the mouth to the stomach, small intestine, large intestine and rectum, simultaneously swallowing saliva.

Back Line: Smile down the inside of the vertebrae of your spine, one by one.

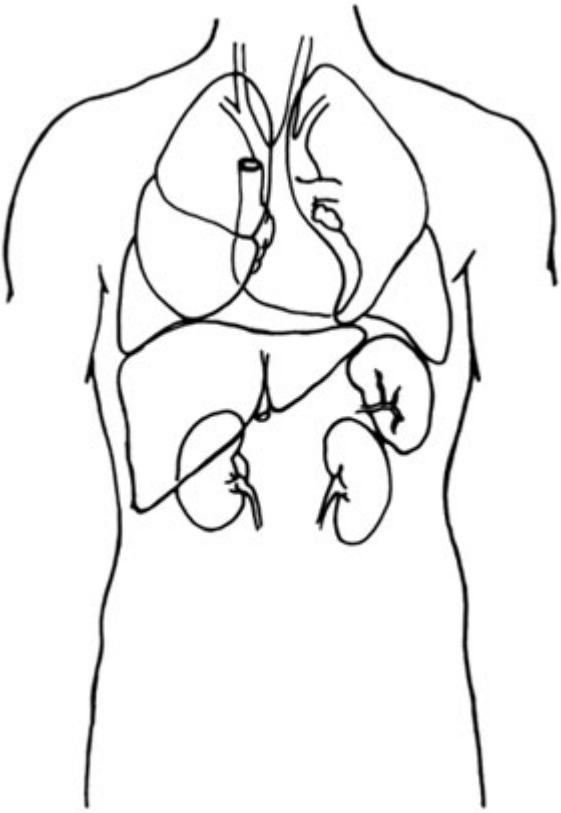

Fig. 3.2 *Front Line Smile: the major vital organs*

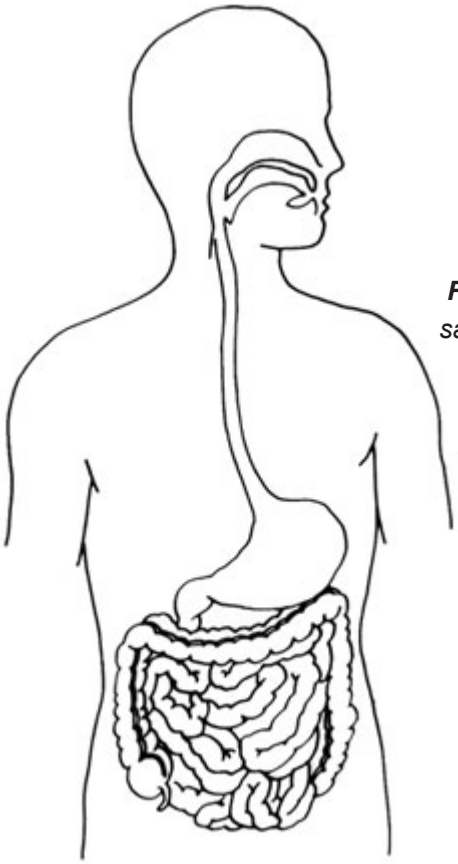

Fig. 3.3 *Middle Line Smile: Swallow saliva to the stomach and intestines*

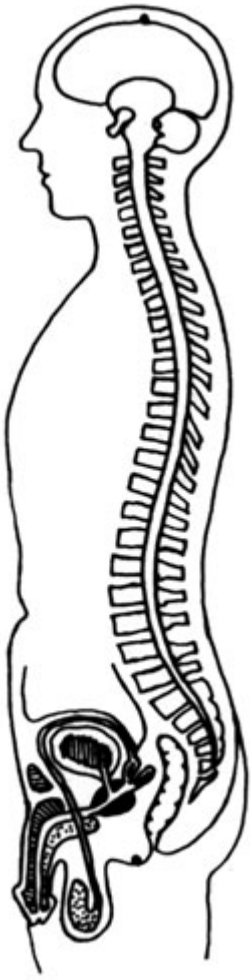

Fig. 3.4 *Back Line Smile: Begin at the eyes, then smile down the inside of the spine, vertebra by vertebra.*

Front Line

This smiling of chi energy from your eyes down your front through the organs will later aid you in circulating the microcosmic orbit. Your smile should flow effortlessly like a waterfall, from your eyes down through your vital organs towards your genitals. With practice your chi will flow through these organs automatically, helping them in their work.

Jaws

Smile down your face into your jaws. Your jaws are a major storehouse of tension. When you allow the energy created by that "inner smile" to go into your jaws you should feel your body letting up and tension releasing. This may be accompanied by tingling sensations or noises, so do not be alarmed should that happen.

Tongue To Palate

The tongue is the bridge connecting the back (yang) and front (yin) channels. Place your tongue on the roof of your mouth just behind your front teeth. The correct position of the tongue is touching the soft palate in the rear of the mouth, but it is easier to leave it in front in the beginning. When chi flows into the tongue it may produce strange taste sensations and a warm tingle.

Neck and Throat

The neck region is another reservoir of tension. Contained in this area are many important nerves and blood vessels vitally important to your well being. The neck is the bridge between your brain and your body. If your neck is a traffic jam, knotted with tension and anxiety, the messages between your brain and organs will be confused and tense. If you cannot relax your neck you cannot complete the microcosmic orbit. Tighten your neck muscles then slowly allow them to relax.

Tuck in your chin and let your head sink into your chest. Ancient Taoists copied this technique from the behavior of the turtle. Relax the neck muscles by creating the illusion that they are no longer necessary to hold up your head. Smile into your neck and throat and feel the tension melt.

Loving Heart

The heart pumps blood and chi energy through your veins and arteries. But in Taoist yoga the heart, along with the kidneys, is the main transformer of chi energy. This means that the heart is capable of both increasing your available chi and raising the quality of its energy to a more refined level.

The arteries are said to belong to yang energy and the veins to yin energy. The arteries therefore have a positive charge and the veins a negative one. When you smile and fill your heart with love you increase the rate of blood circulation and with it the exchange of yin and yang chi in the bloodstream. So smile into your heart and feel the loving energy of the smile spread throughout your circulatory system.

If you can use the smile and microcosmic orbit to aid the chi flow, the heart will work less. The smile from the eyes and the brain will help to circulate the chi energy and thus aid the blood to flow fully and freely while the heart relaxes. In conjunction with the proper diet and exercise, the likelihood of getting heart disease will be greatly reduced.

Feel the stream of relaxation flow down and spread from your face and neck into your heart. You will sense the heart to be cool and calm, and at the same time feel its physical substance. People who are nervous or who anger quickly often experience pain and tense feelings in and about the heart. Extending the smile relieves stored tension and enables a new kind of functioning to take place. Fill your heart with love. Let your heart be your “sweetheart”.

Lungs

Radiate the love in your heart to your lungs. Feel your lungs soften and breathe with a new ease. Feel the air inside lighten up as it enters and leaves the lungs. Feel their moist, spongy quality as you relax and fill your lungs with energy.

Abdomen

Now smile into your liver on the right side, just below the rib cage. If your liver is hard, if it is difficult to feel, soften it with your smile. Smile it back to life, rejuvenate it with your love.

Direct the smile to your two kidneys, in your lower back just below the rib cage on either side of the spine. The adrenal glands sit on top of them. Smile at your adrenals, and they may send you a burst of adrenalin. The kidney is the lower transformer of the veins and arteries. Smile to the kidneys and fill them with love. Like the heart, this will increase the flow of chi circulating through your system.

Allow the smile to flow throughout your central abdomen, through the pancreas and spleen. Then gently rest the smile in your navel. All of your organs can be “smiled to”. If you are relaxed and happy and smile within, your organs produce a honey-like secretion. If you are frightened, nervous, or angry, they produce toxic substances instead. The process of smiling into the organs lightens their work load and enables them to function more efficiently. They have a hard job pumping and purifying hundreds of gallons of blood each day, breaking down raw food into digestible energy, cleansing toxic substances and storing our emotional tensions. By smiling into your organs you’ve made their day a cheerful one.

Middle Line: Swallow Saliva into Lower Abdomen.

Smile once again in your eyes. Smile down into your mouth and swish your tongue around to collect saliva. When your mouth is filled with saliva, put the tip of your tongue to your palate, tighten your neck muscles, and swallow hard and quickly, making a gulping sound as you do. With your inner smile follow the saliva down your esophagus, through your internal tract and to your navel. Your saliva is a lubricating nectar that holds vital energy which is dispersed throughout the body from the navel center. Smile away the nervous energy in your stomach, and you will eat better food and find it easier to digest. Relax the smiling energy into your small intestine, large intestine, and rectum.

Back Line: Spine

Now bring your focus back to your eyes. Smile into your eyes, your tongue, then begin to smile down the inside of your spinal column. Make sure your posture is straight with shoulders slightly rounded forward. Descend one vertebra at a time, smiling into each until

you have reached the coccyx. The spinal column protects your central nervous system and is crucial in increasing your chi circulation. Starting from the neck there are seven cervical vertebrae, twelve thoracic vertebrae, and five lumbar vertebrae plus the sacrum and coccyx.

You should experience a feeling of great ease, warmth, and comfort in each vertebra. When the lumbar, coccyxal, and pubic areas are relaxed, power is released and flows more easily up through the back.

End by Collecting the Energy at the Navel.

With practice the entire smiling meditation can be done in just minutes, although at first it may take you longer to really feel the smile. When you end the meditation you do not want to have energy circulating around in the higher centers such as the head or the heart. The best place for energy storage in the body is the area of the navel, since it can easily handle the increased body heat. Most ill side effects of meditation are caused by excess energy in the head, but this is easily avoidable. (See Chapter on Preventing Side Effects.)

To collect the energy simply concentrate your mind on your navel and imagine your energy spinning like a slow top inside, spiralling outward movement, inside your navel about one and a half inches deep, and 24 times back in to the navel. Men spiral first clockwise; women spiral counter clockwise. (put a watch at your navel to determine direction.) Then reverse and circulate the energy in the opposite direction.

Important Note: You do NOT collect the energy at the navel after “smiling down” if you intend to immediately circulate chi in the microcosmic orbit as taught in the following chapter. You would circulate the orbit and then close by collecting the energy at the navel.

Practice the Inner Smile in Daily Life

Although the inner smile is used primarily to help you to relax prior to practicing the microcosmic orbit, it is powerful as a meditation in its own right. Simply smiling the inner smile in your daily life can bring tremendous results. If you are constantly aware of your inner smile, it will transform your life.

One student went to ask her boss for a raise which she had been promised. She knew her boss was tight with money and would put up a fight, so she approached the grumpy boss with an inner smile as well as her outer smile. Such positivity reduced her boss' resistance, and they ended on good terms, with both of them smiling.

Another student's self-image changed radically from smiling down. Before his self-esteem was low, and he was continually fighting with himself, telling himself he wasn't up to par. After frequently practicing the inner smile he made good friends with himself, and began to realize potential hidden by his negative self deprecations.

If you master an inner smile you may well feel like the turtle, entering the unknown sea with his protective shell snugly encased about him. Likewise, you will have the power to create a relaxed meditative environment capable of withstanding any external situation. Negativity will bounce off your smile and you will enjoy yourself wherever you are.

Summary

The inner smile gives you love where you most need it, at home. Your home is your body because your body is where you live no matter where you are. Learn to see it as a community of many hardworking, devoted members who go unrecognized and are often abused. Learn to deal with your various parts as though they were your own children deserving of respect and affection.

Leave no one out and in no time you will know what it is to be loved and you will know what is meant by Loving Energy. Do this continuously and your world will blossom. The persons who "inhabit" your "inner" world, your vital organs, bones, blood, brain, etc., will afford you a new body and will enable you to relate to everyone and everything outside in a new, calm, loving way. So smile to yourself where ever you go, to who ever you see.

Part II:

Circulate Healing Energy in the Microcosmic Orbit

Chapter IV
Begin the Orbit: Open the Front Channel, the Functional

The functional channel (meridian) runs down the front of the body and is yin, female, or cold in quality; the governor channel at the back is yang, male, or hot. When joined, these two form the Microcosmic Orbit which links with all the vital organs of the body. By completing this route, the yin and yang mix in harmony, enabling you to increase your energy flow, and send energy, hormones, and vitality throughout your body. In this way energy can be collected, transformed and absorbed where necessary.

To establish the flow along the meridians some Taoists concentrated on easy-to-get energy points which were in accord with acupuncture points. By focusing on these specific power centers the Taoists realized that not only was chi released so that a warm current was felt, but that the energy points were activated, effecting a whole set of mental and physical functions. Focusing on the navel, for instance, effects the entire gastro-intestinal system, and the increased chi aids in digestion and balances the appetite.

The Microcosmic Orbit begins and ends at the navel, and the functional channel extends from the palate to the perineum. To open the front channel, we work from the navel to the perineum, and later, after opening the back channel, we open the remainder of the functional channel.

Awaken the Individual Healing Points

To awaken the energy in the individual points use your inner vision. Direct your vision inwardly to the point you wish to activate, and concentrate your mind on that point in your body. Do not create a visual image of the energy point in your mind. Rather bring your mind down from your head and put it in your body, e.g. your navel. The energy, or chi flow that eventually results will be experienced differently by people depending on physical, emotional, and psychological conditions. Genetic make-up, past history, diet, imme-

diate physical and mental stresses all contribute to the varying results. Some might feel the power of the warm current in a few minutes or a few weeks, while others may take months to feel it. Some experience the energy as hot or cold, some report tingling sensations and some see colors.

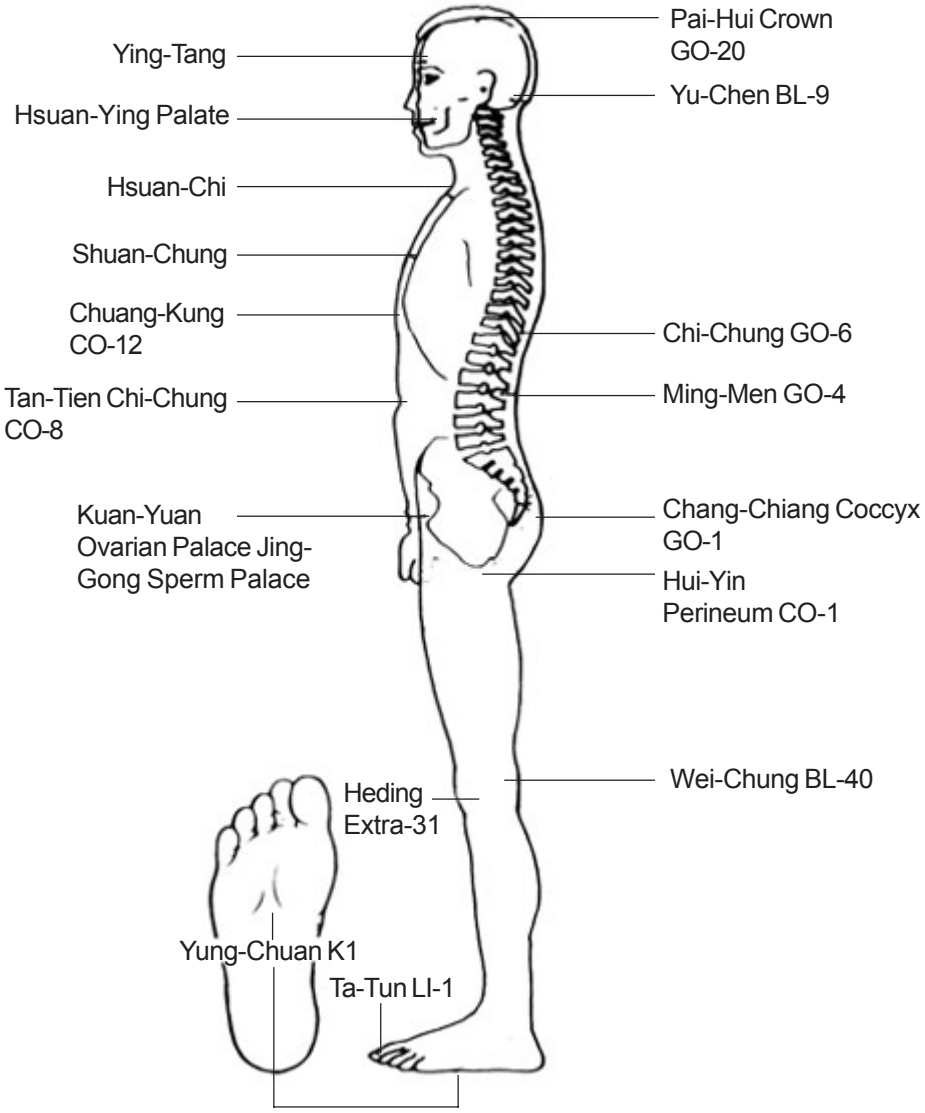

Fig. 4.1 *Points and Energy Centers*

Many people experience soreness or pain when they practice, a sign that they are becoming sensitive to their formerly numbed body parts in the same way that we feel pain when our leg starts to come back to life after falling asleep. However you experience the energy is fine. Do not ignore the messages and sensations your body sends; if anything, listen more attentively and experience your body more fully. These messages are valuable signals that you are coming in tune with your etheric energy body that connects your physical body to your mind.

Choosing your First Point: The Navel

The first energy center is normally the navel, but it varies if you have problems such as high or low blood pressure, if you are old, or if you have chest problems.

The navel serves as the generator of electricity which supplies all the other points. The Taoists considered the navel the earth or root of the body. It is the origin of energy: from the fertilized ovum the fetus is developed, linked to life by its umbilical cord. After birth the surrounding energy continues to enter through the same area.

The navel also is the place where breath originates. As blood and chi are drawn to this point a deep rhythmic breathing is established, and the entire mid-section of the body becomes a huge pump, vigorously circulating the chi and blood throughout the organism. This circulation distributes the life substances and relieves the heart of its heavy burden.

Moreover, blood follows chi, and when vital power is distributed evenly throughout the body no energy accumulates at one point, thereby overheating or damaging the nearby vital organs. However, if one is injured or ill, energy can be directed to a particular site, concentrating all one's healing resource to the point where it is most needed. When the warm current has removed the impurities, the blood follows to finish the job of restoration.

Use a Finger to help Concentrate

When you concentrate on the navel focus one and a half inches below the skin. In the beginning, apply pressure on the point with your index finger for one to five minutes, then return your hands to

your lap with the right palm over the left. Concentrate on the sensation created by your finger, pressing again when the point becomes indistinct.

Once more, do not concentrate on breathing. Merely relax your eyes, tongue, and throat, and the mind will become still Once the mind is calm the power will accumulate.

At first it is not easy to draw power to the energy center because your vital regenerative faculties have been abused for years. Your health cannot be restored overnight. The more you practice the stronger you will get, and you will be more able to endure heat produced by the higher voltage of chi.

If you have been concentrating on the navel for a long time but do not feel any energy, change your focus to the Ming-Men, the point opposite the navel on the spine. This helps the energy to rise up to the head and descend down the front of the body to the feet. However, if you do not feel anything in the navel but have definite signs of improved health, you are on the right track. Remember, the experience of chi is different for everybody. Some people experience warmth or bubbling sensations, others feel as though their navel area is expanding, and some people can increase their chi circulation without creating vivid sensations. No matter what your experience is, try to be as sensitive and aware of your body as possible. Adventure into your body, it is a vast land laden with riches.

Heart and Chest Problems

When some people concentrate on the navel too long, the energy moves up to the chest and effects the heart and lungs. If this happens the practitioner should either see a teacher, or choose a point lower down on the body so the energy in this problem area can drain out.

If, when concentrating on the navel, your pulse rate goes up uncomfortably, concentrate instead on the Ming-Men, the point opposite your navel in your lower back. If this doesn't help, and you are sweating profusely, shift your attention to the point between your eyebrows. If this causes too much pressure in your heart, bring your attention back to the Ming-Men.

Nervous Tension, Old Age, Physical Weakness

If you have nervous tension concentrate on the navel, alternating with the Ming-Men (opposite the navel on the back). If you are older or physically weak, concentrate on the Yin-Tang (point between the eyebrows).

High Blood Pressure

For high blood pressure first focus on the navel, then bring your attention to the feet. In the beginning you can tape two prickly nuts over the Yung-Chuan points (Bubbling Spring) on the balls of your feet. The sensation of the nuts pressing into your feet will help to keep your attention in your feet. By focusing on your feet you put your mind into your feet, which directs the energy and blood there, consequently lowering your overall blood pressure. Do not focus on the Yin-Tang (mideyebrow) or Pai-Hui (crown of head) because it will cause a great deal of blood and chi to go to the head further raising the blood pressure.

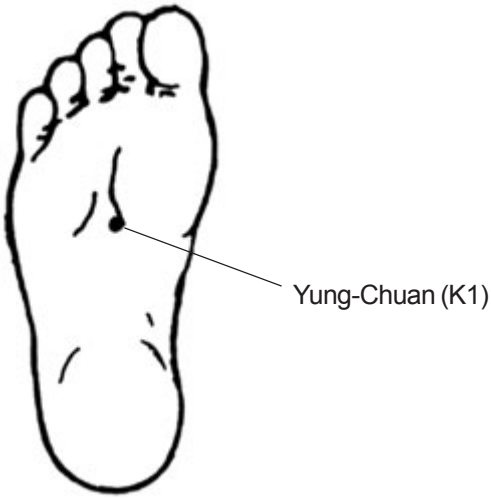

Fig. 4.2 *To lower high blood pressure, concentrate on Yung-Chuan in the center of the sole of the foot.*

One 55 year old student had blood pressure that stayed at I50/100, even though he took pills morning and evening. After completing the routes and concentrating for about 5 months his blood pressure came down to 135/90 (he continued to take pills). After that he was unable to sleep for ten days. After discussing the situation with his doctor, the doctor reduced the dosage of medicine to half because the student's blood pressure seemed controlled. After cutting the dosage he was able to sleep again and his blood pressure stayed at 135/85.

If you have high blood pressure, find a physician who would be interested in using concentration to help control your blood pressure. He should check your blood pressure regularly to see if the chi circulation is effective for you.

Low Blood Pressure

Concentrating in the mideyebrow region will enable power and blood to flow into the head, aiding low blood pressure. But like those with high blood pressure, those with low blood pressure should have it checked regularly. Once the blood pressure has returned to normal you should concentrate at the navel for fifteen minutes then shift the power up to the head for fifteen minutes.

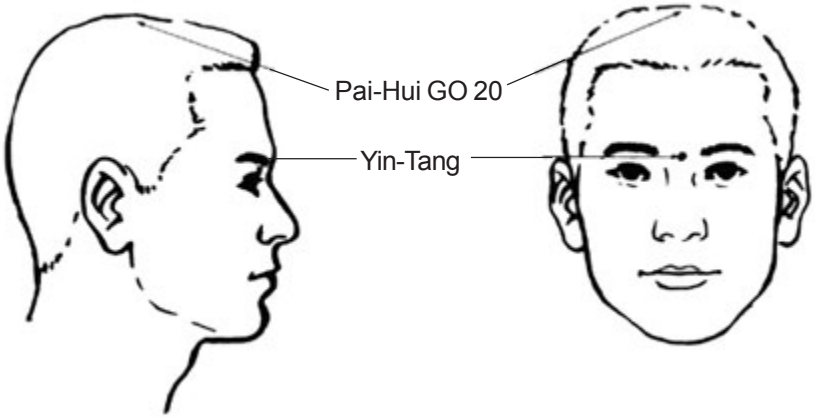

A. For low blood pressure, begin by concentrating between the eyebrows.

B. For abnormally low blood pressure, begin by concentrating at the crown of the head.

Fig. 4.3 *Low Blood Pressure Points*

While the navel is a good starting point for most people who are healthy, those who have high blood pressure or stomach and intestinal problems, it is not good for those with low blood pressure because it causes the blood to drop.

Gastro-intestinal Problems

Anyone with gastro-intestinal problems will have more difficulty in opening the meridian because the digestive organs are linked to it. Each of these organs must be cleansed and strengthened before the route may be completed. Your digestion and elimination will greatly improve during your work on the Functional Channel.

Remember that once you complete the Microcosmic Orbit and are able to collect more power you will be able to cure yourself. You will be able to bring your life force to the afflicted area.

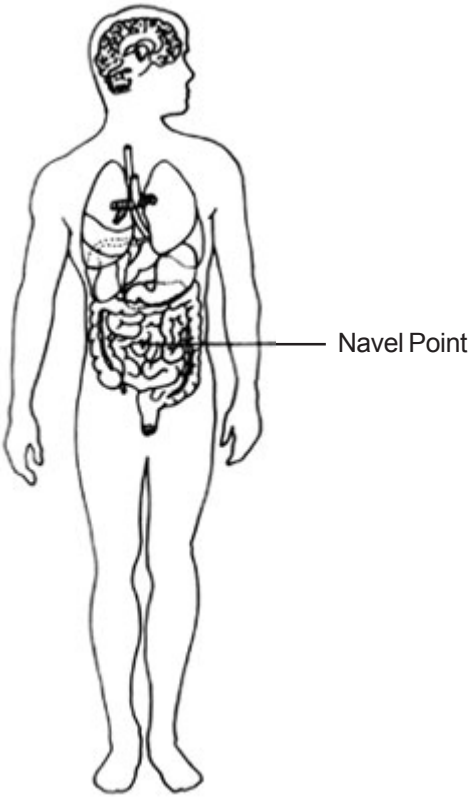

Fig. 4.4 *First Energy Center: Meditating on the navel point strengthens the Gastro-Intestinal organs.*

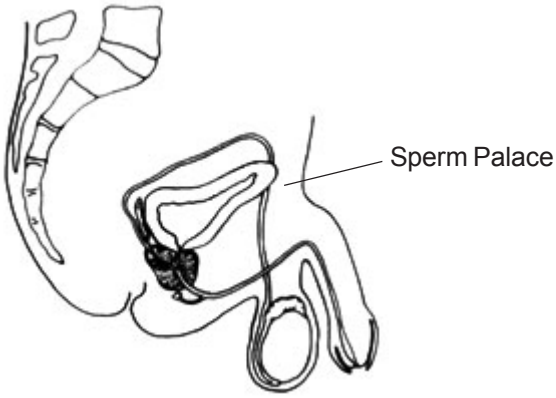

Fig. 4.5 *Second Energy Center for men, the Sperm Palace is located 1 1/2 inches from the base of the penis.*

It is important not to think of your self as sick or weak. You can be free of an ailment no matter how long you may have had it. Very often the difference depends on your attitude. The psychosomatic origin of illness is widely known. If you have confidence in this method, your psychosomatic ailments will be banished. In effect, you will be overcoming your hidden desire for illness that first made you ill. The increased circulation of chi between your mind and your body will cause these hidden negative desires to surface and dissipate.

When the Ching-Chi Sperm energy first awakens, you may have difficulty telling whether it is real or imagined. But soon you will be absolutely convinced of the indisputable reality of the energy flow. It will start in the abdomen or the hands or legs or the big toes. Those who run or practice Tai Chi or Kung Fu often feel it first in the legs. Those who use their hands much will often feel it there first. A warm feeling of waves or bubbles is described as arising in the abdomen. Though everyone is altogether unique in this regard, the sensations are not to be imagined, however, because they are not like anything one has already experienced.

Second Energy Center: For Women, Kuan-Yuan (Ovarian Palace)

The second energy center is in the Kuan-Yuan, the mid-point of the ovaries. To locate the point place your hands flat on your stomach with your thumbs at your navel. Directly below your pinky, in a straight line from the navel is the mid-point, 1/2 inches in from the skin. In later practice this point becomes a great source of energy.

Second Energy Center: For Men, Jing Gong (Sperm Palace)

The second energy center is located in the Sperm Palace, the area of the prostrate gland and seminal vesicles in the lower abdomen just above the penis.

Before concentrating you can use your index fingers to apply pressure to the area for one minute, returning your hands to your lap and concentrating on the sensations. Apply pressure again as the feelings fade.

For Unmarried and Young Men

The sperm palace is important for a man because it can cause him to be sexually aroused. If this happens, bring the power back from the Sperm Palace to the Ming-Men (point opposite the navel on lower back). This sexual energy can be used to greatly increase the circulating power of your chi, but first you must learn to circulate the Microcosmic Orbit without sexual distractions.

For Middle-Aged and Old Men

Those who feel less sexual stimulation and older people, 40 to 60 years old, can concentrate on the sperm palace until they feel power. If, however, they begin to have night emissions, they should also switch to the Ming-Men.

Those who do not have this problem can concentrate at the Sperm Palace until they experience warmth and a feeling of light-

ness in the area. If they have any kind of sensation other than what they normally experience in their meditation, they can shift their attention down to the Hui-Yin (perineum), midway between the anus and penis or vagina.

Third Energy Center: Hui-Yin or Perineum

The Hui-Yin or Gate of Life and Death is found in the lower part of the trunk amidst the endings of many blood vessels and nerve endings. It is located at the mid-point between the anus and the penis or the vagina. Because it is lower, it tends to lose power. You can help stimulate this point by rubbing it until you feel it is warm. This area is very tender and you must remember not to rub too hard.

When you concentrate on the Hui-Yin, the time needed to collect and awaken the power is different in each person due to differences in genetic make-up. Some might take long, some might not. But, on the average, it should take two to four weeks if you practice twice a day for 15 to 30 minutes at a time.

If you still don't feel anything by then, you can extend the time for up to four weeks. You should not persist any longer than that. Move on to the next point, otherwise you might get congestion in your chest and/or heart pain. If this happens, it means that you have developed and collected too much power in that area. Instead of the power having travelled down to the base of the spine it has gone up to the chest. Shifting your concentration to the Ming-men solves the problem and you will be symptom-free in a few days.

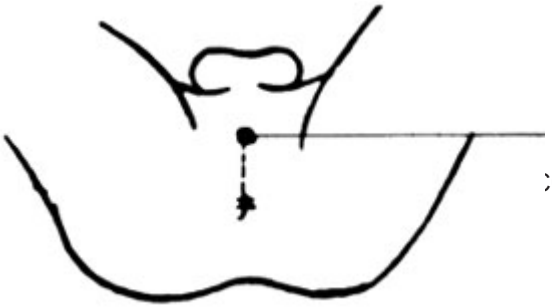

Fig. 4.6 *Third Energy Center: For both men and women the Hui-Yin (perineum) is located midway between the anus and genitals.*

Concentrating on this point sometimes leads to vibrating sensations or the feeling that something is jumping inside or a strong sexual arousal. Abdominal breathing can cause an erection to recede and allows for the concentration to continue without interruption. If you concentrate on this point too long however, it can open the thrusting routes (or Kundalini), which leads to various side effects. If the energy succeeds in passing very quickly up through the throat chakra and continues up to the top of the head to the crown, where it spreads out sprinkler-like, showering down over the practitioner, there will be very few, if any side effects. In fact if you have managed to open all the channels, your whole system will be nourished in the process.

Time is essential in all meditation. You cannot expect any results without putting in a great deal of effort. Remember that the navel is the generator and every time you commence practicing you have to start from this point. When you feel power has developed there (warmth, tightness, expansion, etc.), bring it down to the second point, then down to the third.

Chapter V
Open the Back Channel: the Governor

From the Hui-Yin the energy moves to the Chang-Chiang, or sacrum, and begins its ascent up the back to the crown of the head and the brow point. The back channel is extremely important as it contains two pumps, one at the sacrum (the large bone at the lower end of the spine), the other at the Yu-Chen (back of the neck near the upper end of the spine).

The first pump sends chi and spinal fluid up to the neck, the second receives the chi and spinal fluid and pumps it up into the brain. Opening the back channel is like bringing fresh air to a stuffy room. Your spinal column and head will be refreshed, the nerves will be activated, and the extra oxygen and blood flowing to your brain will make you feel more alert, more alive.

Fourth Energy Center: Chang-Chiang (Coccyx)

The fourth energy center point is the Chang-Chiang (Woii Lui) at the coccyx. This point is very important because it is here that the power is either returned to the body or lost. When the generative power (sperm power) is returned, it passes through this canal and into the spinal cord and then to the brain. This has been called the Passage to the Door of Life and Death because it is here that the "warm current" is said to enter the central nervous system.

When you have concentrated for some time you may feel a sensation of warmth and pressure rise up into the coccyx through the many nerve endings and the eight holes, which in the esoteric system are called the holes of the soul. The first level, opening the Microcosmic Orbit, may be said to be the preparation of the way. The energy that passes here is the real sperm and ovary power and is the energy of the life force that is produced in the body and cells. The second level trains the chi to move along 34 additional routes and involves the cleaning of the organs. In the third level

sperm or ovary power is awakened and transformed into a higher level of “chi power”. This “power” pushes its way upward in through the coccyx. At that time some people may feel a needle-like pain. Some may report having a feeling of tightness there and others will be aware of something pushing its way inside. With continued practice the “power” or “warm current” pushes higher and higher. It will help you to open the point much more easily if you rub the coccyx with a soft cloth until you feel warmth there and then sit down to practice concentration.

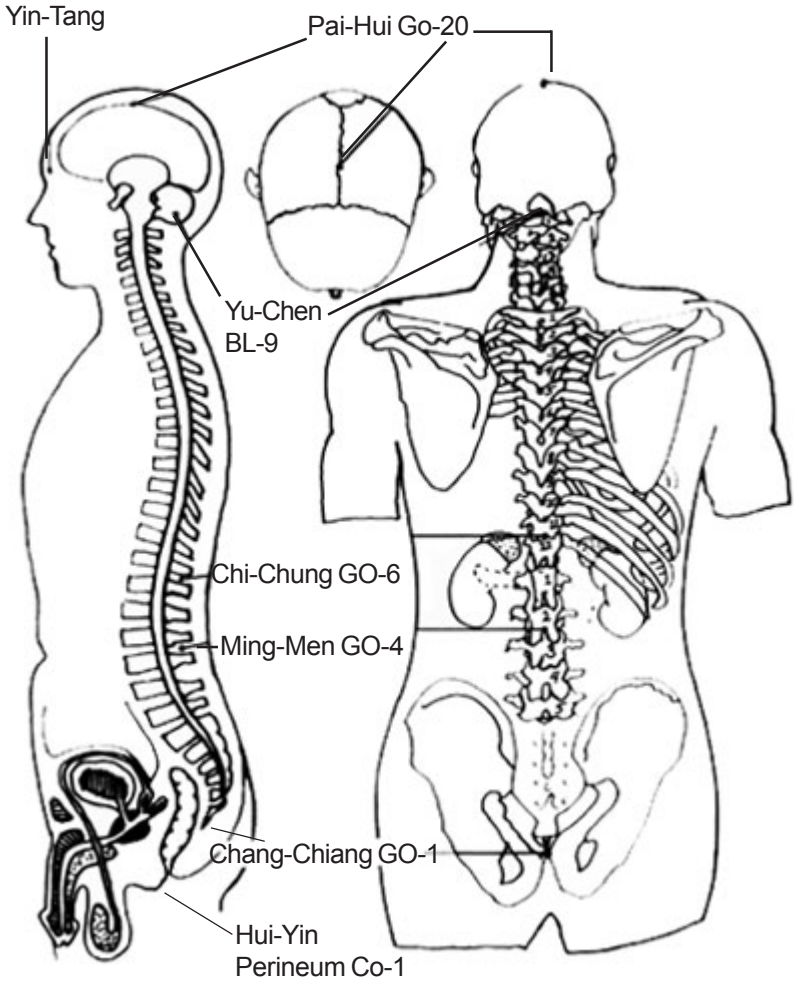

Fig. 5.1 *Energy flows upward through the major points of the Back Channel.*

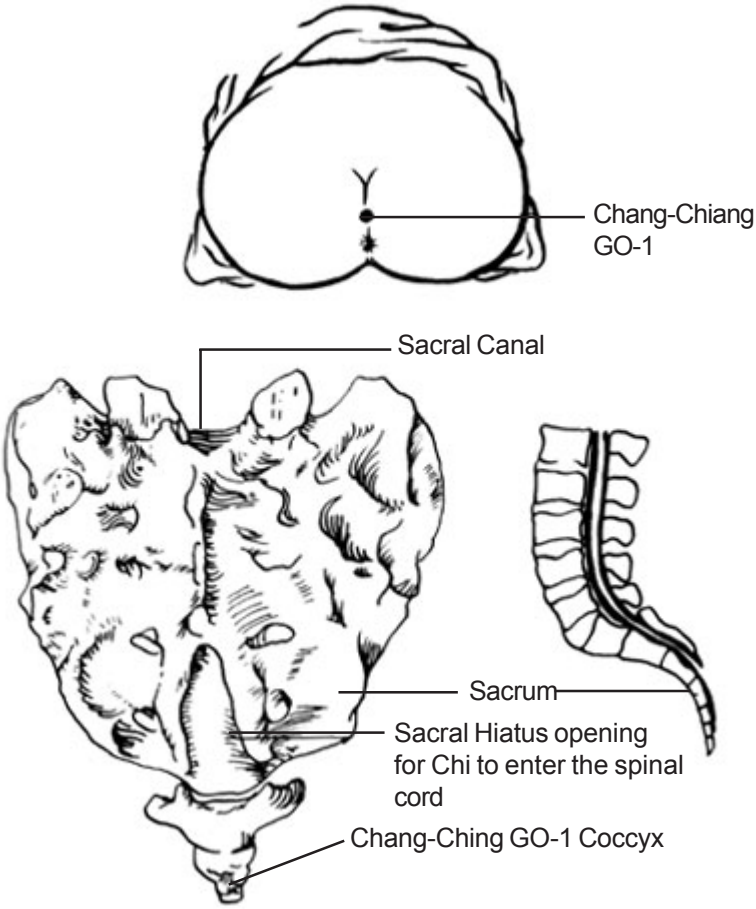

Fig. 5.2 *Energy flows upward through the major points of the Back Channel.*

Fifth Energy Center: Ming-Men (Opposite Navel Point On Spine)

This point is the Ming Men, the Door of Life. It is the midpoint of the kidney, between L2 and L3 on the vertebrae. It is at this point that kidney power is concentrated. The left kidney is Yin and the right is Yang and at the center point is a balance between the two. The Ming Men (the main power point of the body) then, is the harmony point, containing Yin power. When you concentrate here, the power rises up the back or descends to the feet. This helps to prevent

some of the side effects that occur when the power may suddenly surge up to the head. Those are standing, sitting, or walking, can use the Ming-men as their point of concentration.

Fig. 5.3 *Energy flows upward through the major points of the Back Channel.*

Back Pain While Concentrating

Those of you who have back pain may find that the pains intensify when you concentrate on the Ming Men. Do not let that stop you. Before concentrating rub your hands together to produce warmth and place them on the painful area. When you first start Ming Men practice it might help to use scotch tape to fasten something prickly over the point or press the point for about a minute before concentrating on it. In time you will need only a few minutes to concentrate and collect energy. Many people feel the power more readily at the Ming Men than at the navel.

Important Note: Try to remember when you concentrate, to let the power (warm current) flow. Do not try to direct the power. In the beginning, when you feel warmth in the navel, move your point of concentration down. The power follows this shift of attention, it is not that you have brought the power down. The power in your body knows where to go.

Sixth Energy Center: Chi-chung (Opposite the Solar Plexus on the Spine)

The sixth energy center is located between the adrenal glands (T-11), opposite the solar plexus on the spine.

The adrenals stimulate the inner part of the medulla in the brain, which prepares the organism for fight or flight. The outer part, the cortex, governs sodium balance and is involved in blood sugar level. Those who have diabetes may find that concentration on this point will help them to lower their blood sugar level. Allergy sufferers may also find relief by concentrating here.

If you are weak or ill, you can concentrate on this point any time. This practice can be very stimulating. Young people and those who are stronger, should not focus on the Chi-chung in the evening because it will keep them awake.

Stimulate the Pancreas

When you concentrate on the Chi-chung (adrenal gland), you also activate or stimulate the pancreas. Like the adrenal glands, the pancreas is involved in blood sugar level and concentration on this point may have a normalizing effect. Whether this can help those who have diabetes would have to be born out by extended tests with many subjects under controlled conditions for a considerable period of time. However, without doubt, there would be improvement in the condition. As you continue concentrating on this point the power will collect and gradually push its way up to your head. The power of this point is the mixture of that found at the navel (point no. 3), the coccyx body (point no. 4) and the harmony of the kidney power (point no. 5).

Seventh Energy Center: Yu-Chen/Back of the Neck

The Yu-Chen is the cerebellum. This part of the brain controls breathing, heartbeat, and various functions associated with the automatic nervous system. Thus, when the chi passes up the back to the Yu-Chen point many changes will occur. Many different kinds of breathing patterns become available and are activated naturally according to necessity.

Shoulder and Upper Back Pain

Those people who have shoulder and/or upper back pains may find that the power will not be able to flow beyond those areas or, at least will be slowed so that it takes much longer for it to reach the head. With continued practice many people have found that their back problems have been alleviated and even cured as the power works its way through on its upward path.

However, if the power builds up in the brain you may experience pain, nausea, illusions, irritability, insomnia, mood swings, and sleepiness. Be sure to direct the power down to your navel when you finish your practice period.

Eighth Energy Center: Pai-Hui/Crown of The Head

The Pai-hui (Niwan) is called the crown or the pineal body and is located above the mid-brain. Its functions are related to sensitivity and to the sexual cycle. It governs the hindbrain, hearing, body rhythm, equilibrium, perception of light through the eyes and skin, and is the superior counter-support of the brain and spinal cord. In Chinese it is called the Hundred Point Joint or the compass of men, because it is at the top of the crown of the head. When you concentrate here you may feel pressure or a sense of expansion in the middle of the head. This is an indication of power flow. When this happens, concentrate on the next point and remember not to spend more than a month practicing on any one energy center.

When the power passes through the mid-brain and the region of the pineal gland, you may feel some tightness or a kind of pressure pushing forward and backward in this area. You may also suddenly feel very sleepy. When the power freely passes through this point you will be afflicted less by illusion, you will be able to concentrate better, and your head will feel much lighter. However, as blood flow to the head increases, your eyes may redden. When the power builds up more some people may see light, a rainbow of colors, the sun, the moon, or a star twinkling before their eyes. Others may feel that they can foresee the future (but that is an illusion because occult vision is still far off at this stage). No matter what comes up, simply find ways to calm your mind.

Completing the Microcosmic Orbit does not mean that some special sense will be opened to you, though the energy or chi vibrating in the brain and coursing back and forth through the nervous system can lead to various aberrations of the senses. You may see and hear many unusual things, but all of them will simply be illusions, so try to ignore them.

Some practitioners describe being surrounded by light. Traditional Chinese masters would explain such an experience as being due to some physical ailment which gradually reflects outwardly. Those who have weak kidneys or a low sex drive will reflect a black light. Those with liver illness find that the light that is reflected is green. People with heart disease report seeing red light. Lung disease is expressed as a white light. Spleen and stomach illness is indicated in yellow and for those with gall bladder disease, the light which is reflected will be black. If the redness of the eyes does not go away after practicing for two or three hours, you should consult a doctor.

Ninth Energy Center: Yin-Tang/Brow Point between Eyes

The Yin-tang is the pituitary gland and is called the “Tsu Chiao” or the Original Cavity of the Spirit by Taoists. In fact, there are many names for it in the Taoist Encyclopedia (Life Palace, Yu Ting, Jade Cauldron, etc.). This point is located between the eyebrows, above the nasal cavity. It is the master endocrine control gland, regulating growth, gonadal function, the adrenals and the thyroid.

It is said to govern the forebrain, vision, the right eye, as well as being the seat of love, compassion, knowledge, integration or personality, love of humanity and devotion. It is further said to be the seat of intelligence, conceptual memory (reading, thinking, studying), linear sequential time consciousness, abstract and conceptual thinking, compulsiveness, racism, sexism and paranoia.

The pituitary and the pineal gland are extremely important when completing the routes, for it is at these two points that you can check your power flow. When you concentrate on the navel and store power there, energy suddenly rises up and passes through the Niwan (the pineal gland). The next checking point is the Yin Tang (the pituitary gland). When you have completed the Microcosmic Orbit you can use these two, the Niwan and the Yin- tang,

to see whether indeed there is a power flow. The rest of the points are usually not sensitive enough for this. To complete the route, the power has to flow down from the soft palate, through the tongue, into and through the throat, the Hsuan-chi, the Shuan-chung (heart chakra) the Chung-wan (solar plexus) and finally the navel again.

When the power has passed from the midbrain to the forebrain and then to the pituitary gland and the mammalary bodies, many students will feel pressure in both the left and right sides of their forehead, which is due to resistance to the flow often found when the route narrows as it comes down through the nose. This may stimulate the release of mucous or even lead to sinus trouble, if you are inclined that way.

After some time you may experience a fragrance. This is said to be caused by hormone glands purifying the internal organs. The aromas vary from person to person and also depends upon the degree of one's development. It is impossible to describe all the various senses that have been reported but flowers, perfumes, wine bouquet and coconut water have been mentioned. Along with the fragrance, there may be needle-like sensations or a feeling as if something were pressing down on one's forehead or hammering in the middle of one's head. This is again due to the fact that there is resistance to the flow of energy. If you can ignore these feelings, the condition will gradually abate.

Concentrating on the brow point reduces the jarring effects of sudden loud noises. By contrast, students who concentrate on the navel do not have this facility. A degree of stability is reached, then, by the time you reach the point between the eyebrows. The tendency to worry will diminish and disappear as practice progresses. From then on you feel more saliva being released, which is said to be caused by hormones which are activated in the pituitary gland. With continued practice, the saliva will become more sweet and fragrant, at which time it is referred to as nectar.

This nectar helps to stimulate appetite and to activate all of your bodily systems. When your appetite is good, your digestion and assimilation are improved and you feel both content and invigorated. To top it all, you will also feel very calm. Students at this level report that they hear internal noises ranging from the beating of the heart and the magnified sound of their breathing to the rushing sound of the blood as it passes through blood vessels and the workings of their various inner organs. They even describe sounds

which Indian Yogis have for centuries referred to as divine. Most of these smells and sounds have always been there, but have been overshadowed by our attention to other things. As you grow quieter, and become less distracted, these ever present sounds become evident with the exception of the nadis, the divine sounds, which alter characteristically as one progresses spiritually.

When you have finally reached the point between your eyebrows, you are half-way finished. This doesn't only refer to opening the Microcosmic Orbit and other routes, but to what follows as well. The next stage (after the routes have been opened) involves the transportation of vital materials, the hormones as well as chi in the practical application to one's daily life of these new found abilities. These steps have already been described as organ purification, stimulation and development of the vital flow for the healing of illness. It brings strength and vitality to those who have been weak and finally rejuvenation and long life.

This calls for a very subtle balancing of powers and methods of approach to avoid the many pitfalls that side-effects can bring. The danger here is real. Without the proper knowledge as to how to proceed, outright physical and emotional damage can result. Some of the side-effects, again, are sensations of tightness or heaviness in the head, sleepiness, ear-noises, toothaches, sinusitis, nervousness, anger and irritability, all of which are due to having too much power accumulated in the head. The precaution, again as a reminder, is to be sure to bring the power back down along the route it travelled on its way to the head and/or being sure to end each practice period by returning it back to the navel in the prescribed manner. At the navel circulate the chi clockwise (if you are male) 36 times and then counterclockwise 24 times, ending by pushing in at the navel (reversing the direction of circling if you are female).

If you concentrate solely on the forehead or if you do so for long periods of time without having properly opened the routes, you will have most of these ill effects. Of the hundreds of students I have taught, most of them have reached higher levels of practice without much, if any, such trouble. Our aim here is to acquaint you with the side effects that can occur and how to prevent them so that you can be alerted to what can happen as you practice and thereby be more successful in your endeavors. Younger people, who have stronger power, must be more careful and should be sure to bring the power down to the navel at the end of each session.

Chapter VI
Complete the Microcosmic Orbit

When the energy reaches the area of the eyebrows it either pushes up out of the top of the head, leaks out the ears or eyes, or comes down the front of the body towards the navel. Pushing up through the top of the head requires that the bones be cracked apart, which takes tremendous power. It is much easier to push down through the palate and complete the route.

Beginners: Reverse the Chi Flow

Easiest of all, however, and most recommended for beginners who are often unable to send the energy through the palate, is to return the energy to the navel along the same route it came from. Simply reverse the flow of the chi and take it back down the spine and continue all the way to the feet. Then bring it up your front to the navel, throat, and palate.

Practice the following sequence to drain excess energy collected in the head and circulate it to the Door of Life and the soles of the feet.

1. From the area between the eyebrows direct the warm current down to the nose for about 10 minutes and then bring the energy down even lower. With practice, you will develop the ability to direct this force so that it will flow as you will it to.

2. Bring the power back up to the Pai-Hui (crown of head). Stop for a while, allowing the power to flow backward from the mideye region to the Yu-Chen (back of neck).

3. Pause there for a while and then proceed down to the Ja-Jie, which is at mid-shoulder level and from there down to the Chi-Chung (TI1) and then the Ming-men (L2 and L3) in the back and opposite to the navel. Stop and concentrate here longer until you feel tense in your forehead.

4. Then shift your attention down to the coccyx and then to the Hui-Yin in the perineum (mid-point between the anus and the penis).

Fig. 6.1 *Small Heavenly Cycle (Microcosmic Orbit)*

5. This route then divides into two, one through each leg, descending down, along the inside of the thighs down to the inside of the ankle (the inside regarded as the Yin Power) and ending in the soles of the feet at the Yung Chuan (K1). You should then concentrate here (at the Yung Chuan) until you feel it become warm. When you first begin this practice you might try taping a prickly nut to the bottoms of your feet, so that when you step on it as you walk the energy center there will be activated. In time, energy will emanate as a warm, tingly feeling and spread out through your feet and legs.

6. Raise the energy up the front up to the big toes, stop for a while, then go to the knee and then up the leg to the perineum.

7. Proceed to the navel point. Pause and gather additional chi.

8. Raise the chi up to the heart, the throat and into the tongue that is pressed against the palate. Eventually the chi will connect with the point above, Yin-Tang, the brow, thereby completing the Microcosmic Orbit.

Fig. 6.2 *Use the tongue to link the flow of energy between the front and back channels, through the palate.*

Tenth Energy Center: Tongue to the Palate

Students who initially have great success in circulating chi power with no ill side effects may choose to proceed directly in joining the front and back channels. This involves lowering the energy from the Yin-Tang, or brow point, to the next energy point, the palate.

Other beginning practitioners should wait until they can easily return the energy by the reverse route down the spine/leg and up to the navel/palate before trying to connect the brow point and palate directly from above.

Even though the palate is constructed of soft bone it takes is considerable period of sustained effort for most practitioners to penetrate it and complete the route. The force which is generated in this practice often causes side effects such as headaches, illusions, erratic mood swings, insomnia, irritability and vague aches and pains. If such effects persist, immediately reverse your chi flow back down the spine to the feet. Also, read the chapter on “How to Prevent Side Effects.”

In the beginning, place the tip of your tongue just behind your front teeth (later you will transmit more energy if you place it in the middle of the soft palate or even further back along the roof of the mouth). The palate links the front and back channels, and the tongue on the palate links the switch that enables the energy to flow in a complete circuit. If you watch sleeping babies you will see that often they keep their tongue on the roof of their mouths. They know instinctively how to circulate the microcosmic orbit as their yin and yang energy is still naturally balanced. Even thumb sucking may be an attempt to connect the channels!

Fig. 6.3 *Energy flows through the Palate during the Microcosmic Orbit.*

When you put your tongue to your palate you may feel sensations, or you may feel nothing. If you feel a small vibration, or your tongue moves back and forth involuntarily, chances are you have completed the orbit. Some people, however, do not feel sensations. If you do not feel sensation, but your health has improved, and you feel lighter, less worried, and more energetic, you probably completed the orbit.

Eleventh Energy Center: Hsuan-Chi (Throat)

The Hsuan-Chi is the energy center of the thyroid and parathyroid glands. Concentrating here will often cause coughing or difficulty in breathing. When the energy pushes up through the throat and enters the mouth some people have been known to cough up dark, sticky mucous. This is considered to be characteristic of the clearing of this energy center and this leads to a free flow of energy from the throat to the tongue. Most people feel more calm and less worried when this energy flows from the navel up to the throat and to the tongue and with no congestion in the chest. They are simply freed of stress in opening the route. It does not mean that they will never have any worries or anxiety but that they will feel more calm and will be able to sit and concentrate more easily.

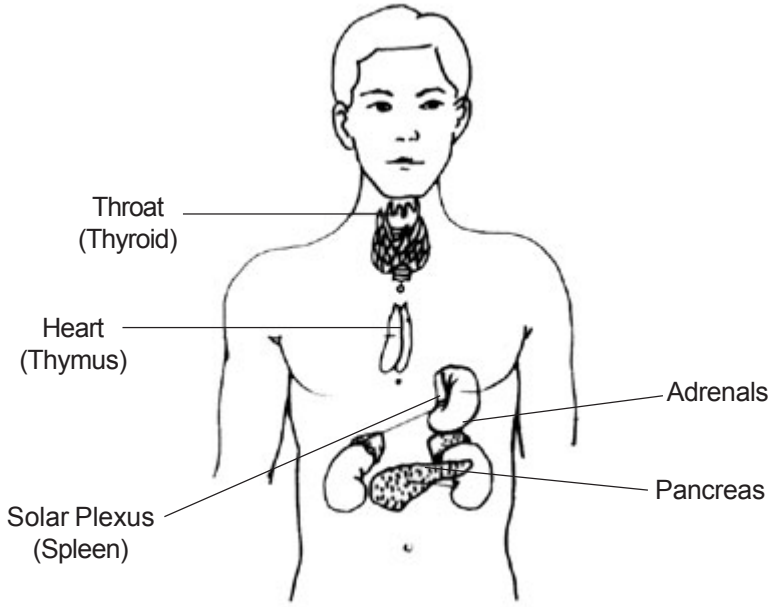

Fig. 6.4 *Throat, heart and solar plexus comprise the 11th, 12th and 13th energy centers.*

In this level we are linking all the energy centers together; not opening or cultivating the center (chakra) of the Microcosmic Orbit.

Twelfth Energy Center: Shun-Chung (Heart)

The heart center, the center for rejuvenation, for love and joy, is located mid-way between the nipples at the thymus gland, is an extremely vital point that is easy for most people to focus on. This will be dealt with extensively on the fifth level of the Tao Esoteric Meditation. Concentrating here very quickly leads to great stores of energy, and so many people tend to concentrate longer on this point. You must exercise caution here, when you collect heat and concentrate too long, the energy is reabsorbed in the pericardium (a fibro-serous sac which surrounds the heart) and cause the heart to beat faster. As a result there will be difficulty in breathing and pain in the chest on the upper left side and in the sternum.

Do not concentrate here too long when you feel warmth or feel your chest extended.

Thirteenth Energy Center: Chun-Kung (Solar Plexus)

Half-way between your sternum and your navel you will find your solar plexus. This area is the frontal site of many power centers (spleen, adrenal, pancreas, and stomach). People who have stomach or digestive problems will find themselves belching frequently and passing wind. This is not cause for alarm, but a healthy cleaning out process. Belching, moving gas, and yawning will often increase the flow of saliva, and as the digestive system improves the saliva may become sweet and fragrant.

Collect the Energy when finished

No matter where you end your practice, if you only concentrate on the navel, if you get as far as the Ming Men, or if you complete the route, at the conclusion of your practice you must always bring the energy back to your navel and collect it. Collecting the energy gathers up the excess chi in the body and stores it in the navel. It protects your body organs from accumulating too much energy.

To do this, concentrate on your navel as you place your right fist

there. Then rotate your fist thirty-six times clockwise, allowing the circle to grow larger until it is no more than six inches in diameter (not higher than the heart nor lower than the pelvis). Then reverse the direction of rotation and rotate twenty-four times in a counter-clockwise direction, gradually shrinking the circle until it returns to the navel. A woman reverses the order of rotation, first rotating counterclockwise thirty-six times and reversing the direction and shrinking the circle while rotating clockwise twenty-four times back to the navel. To determine direction imagine a clock at your navel.

A. Men finish by collecting the energy in the navel and circling it 36 times clockwise and 24 times counterclockwise.

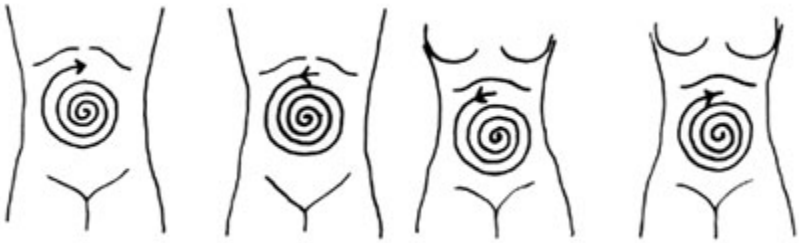

B. Women finish by collecting the energy in the navel and circling it 36 times counterclockwise and 24 times clockwise.

Fig. 6.5 *Collecting the Energy*

Eventually you will learn to direct the chi with your mind and will not need your fist to help you guide it.

Also, if you are short on time you can collect the energy three or nine times, reversing it the same number of times.

Rubbing the Face

During meditation, the hands will become very warm because of the Warm Current passing through them. Immediately after practice, rub your hands together briefly and then rub them briskly over your face for one or two minutes. This will serve, literally as a rejuvenating cosmetic substance. Rub your eyes gently and rotate them. Then rub your ears. Beat your teeth together lightly thirty-six

times and finally rub your waist, legs, hands and soles of the feet. We will deal with this extensively in the book , *Chi Self Massage*.

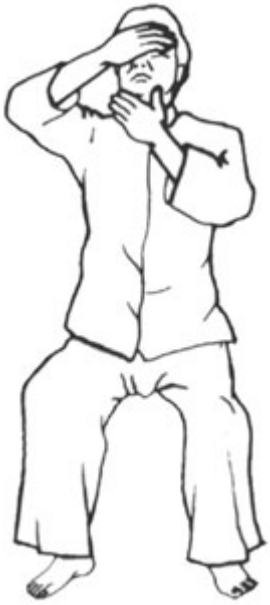

Fig. 6.6 *Rejuvenate the skin by rubbing your face after meditation with Chi flowing through the hands.*

Chapter VII
Open the Arm and Leg Routes: the Large Heavenly Cycle

Once you have completed the microcosmic orbit, and feel competent circulating the energy, you are ready to direct the power to the arms and legs in addition to the main body trunk.

1. Begin with the basic orbit, concentrating on the navel until you feel warmth or energy, directing the chi down to the Hui-yin (perineum), up the spine to the Pai-hui (crown of head), and through the tongue and palate back to the navel. Stop at the navel to collect more energy, then direct the power once more to the Hui-yin (perineum).

2. From the Hui-yin divide the energy into two routes, directing the chi down the outer back portion of the left and right thigh to the l4th energy center, the back of the knee (Wei-Chung).

3. Next, move the energy down the outer calf to the l5th energy center, the Yin-chuan at the soles of the feet.

This is the first point of the kidney channel, and concentrating at this center will strengthen the kidney, lower blood pressure, and help relieve fatigue as more energy is brought to the feet.

Yung-chaun is often referred to as the “Bubbling Spring”, or the point where the yin energy bubbles up from the earth and enters the soles of the feet. Many people who concentrate on the navel feel warmth in the feet instead, because the Yung-chuan is the origin of the energy that collects in the navel.

Concentrate at the soles until you feel energy there, then direct the chi to the 16th energy center which is located in the big toes. Both the liver and spleen (Ta-Tun and Yin Pai) meridians flow through the big toes and concentrating here will strengthen those organs. If you feel numbness or a pain like an ant bite, move the energy to the l7th energy center, the front of the knees (Heding).

4. To reach the 17th energy center, the chi travels up along the shin bone to the front of the knees. The stomach and spleen chan-

nels pass through this region, and opening this center will strengthen these organs as well as the knee, and prepare the passage for energy to go through at a later time. Be sure to draw the energy up from the earth through the soles of the feet to the knees.

5. When you sense warmth or tingling, shift your attention back to the Hui-yin (perineum), by directing the energy along the insides of the thighs.

6. Now send the energy to the Chang-chiang (coccyx), the Ming-men (opposite the navel), the Chi-chung (opposite the solar plexus), up to the mid-point of the scapulae.

7. Here the energy divides into the left and right arms and descends to the inside of the upper arms, down to the forearms, and passes along the middle of the palm, the Lao-kun. Concentrate here for a while and then feel the energy run along to the middle finger. Then go up the outside of the forearm along the outside of the middle of the upper arms, reaching the shoulder region. Here the energy rejoins on the spine between the shoulder blades.

8. Continuing on to the neck and up into the crown, allow the chi to descend to the tongue, where its way back to the, navel again, thereby completing the Microcosmic Orbit.

The Large Heavenly Orbit is part of the Fusion of the Five Elements. The second level of the Taoist Esoteric Yoga, Fusion of the Five elements, opens the other 6 psychic channels plus the Microcosmic (2 channels) which equals 8 channels.

Fig. 7.1 *When the Leg Route is completed, Chi descends down to the soles of the feet and up to the Hui-Yin.*

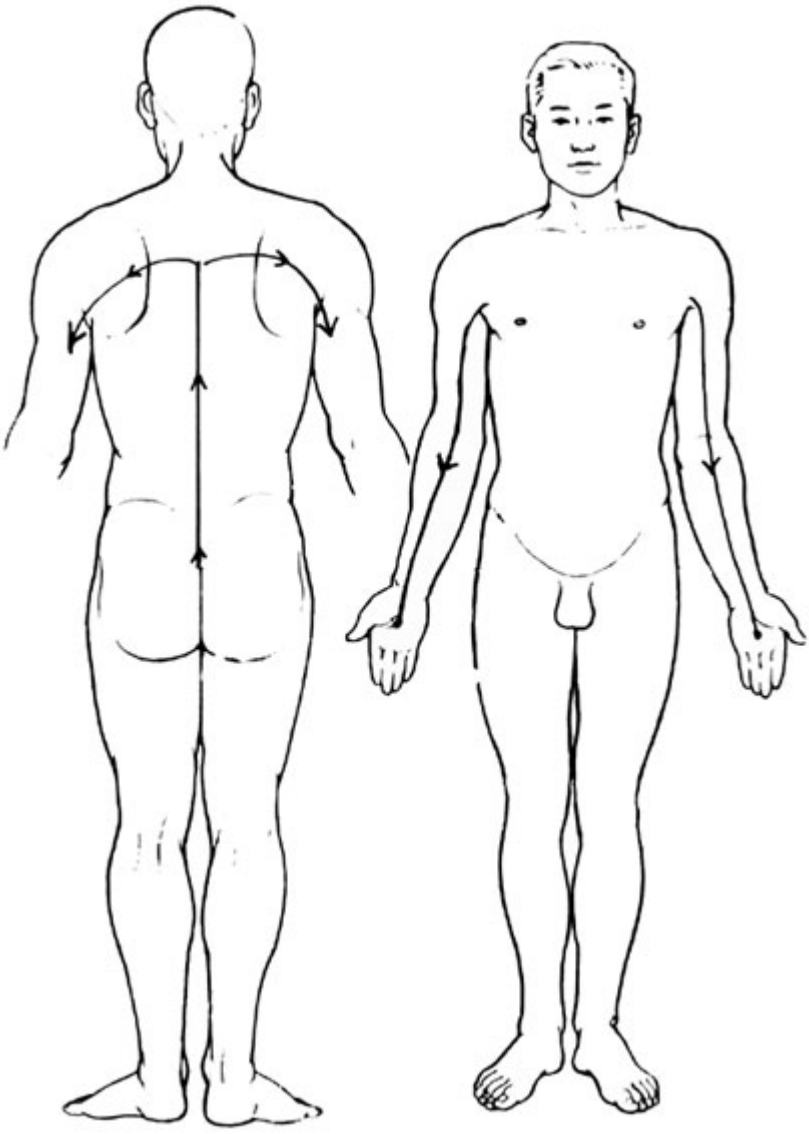

Chi travels up to the mid-point of scapulae and divides into the arms.

Down to the middle of the palm.

Fig. 7.2 *Large Heavenly Cycle - the Arm Routes*

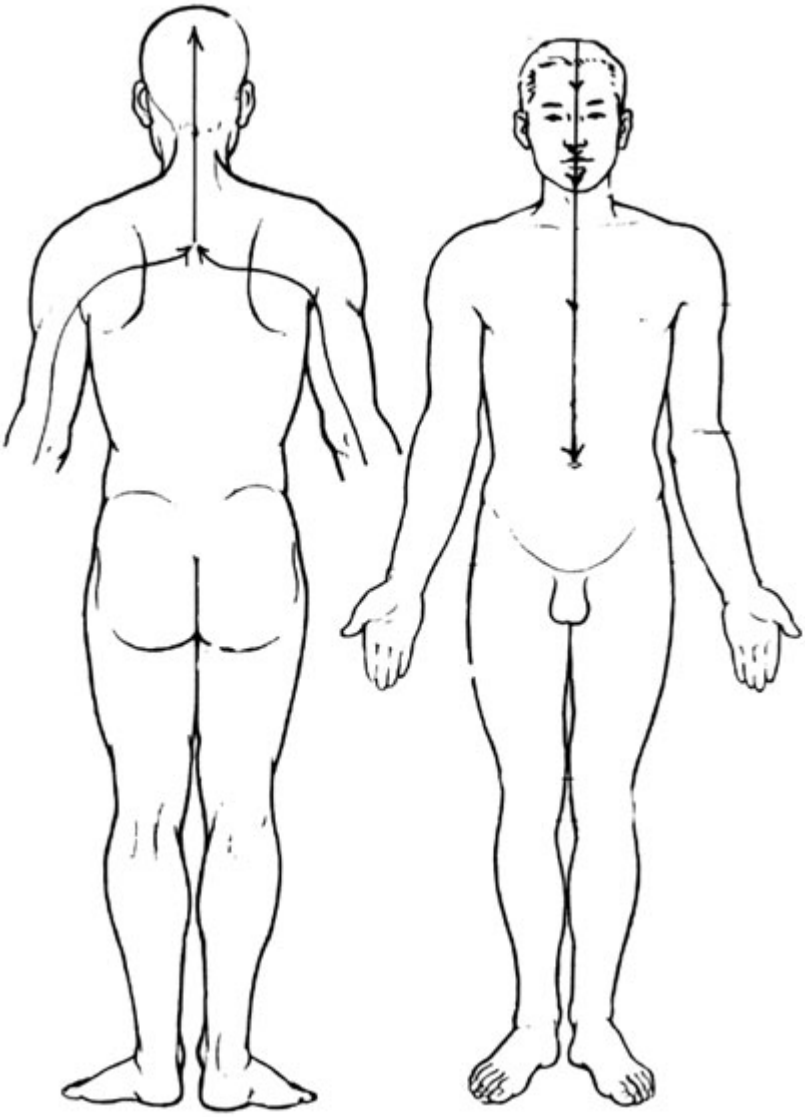

Up outside of the forearms, reaching the shoulder.

Desends to the tongue and to the navel.

Fig. 7.3 *Large Heavenly Cycle- the Arm Routes*

Part III:

Practical Pointers

Chapter VIII
Set a Training Schedule

A normal, healthy student should practice a half hour in the morning and a half hour in the evening. Someone who is sickly or weak should practice an hour in the morning, in the afternoon, and in the evening. Those who do not have back trouble, high blood pressure or gastric ulcers should do the "stretching the tendons" exercise. This is done in nine sets of nine repetititions or three sets in the morning, afternoon and evening, making a total count of 81 for the day.

Do not worry if you miss a session. Just stay relaxed and if you can find a few odd minutes at home or in the office, try to meditate in those spare moments.

When first beginning it takes a little bit of time and discipline to achieve rapid progress. Remember that later on it will occur with no effort.

The exact amount of training and practice required to develop the Microcosmic Circulation varies from individual to individual. For best results one should practice at least twice a day at home, for ten to thirty minutes at a time, even if one has attained a higher level of accomplishment. Students with previous discipline in yoga or other meditation techniques are frequently able to open the microcosmic orbit immediately by redirecting their power of concentration away from the "third eye" (brow point) and into the warm current flow.

It is possible that some individuals might not succeed at all and never be able to grasp the essentials. Many report completion of the circulation within the first one hundred days of diligent practice. Most students report success within three months to a year. Improvement of illness may occur quite early in the practice. Many who worked hard on it, were reported to have achieved relief of their medical problems despite the seeming absence of dramatic feeling of the "warm current" flow.

The Esoteric Taoist system of meditation ultimately leads to mastery of the "Third Eye" center, the crown of the head and those centers beyond. But it stresses the necessity of mastering all the

lower energy centers first to insure a solid foundation for spiritual growth and self-healing.

There are spiritual “geniuses” on earth who can quickly transcend and stabilize themselves in higher energy centers. But most people cannot safely absorb this higher energy without first purifying the body and its lower energy centers. This may be a long and arduous process for some. The microcosmic orbit circulation is a safe and systematic approach to quickly achieve this transformation within the body. But only practice makes perfect, the greater your self-discipline the faster you will be rewarded with a marked increase in energy available to you.

Review: Major Points of Microcosmic Orbit

1. Sit easily and erectly on a chair with your right hand clasped over your left. Your chest should not be held up but be allowed to collapse slightly, while the head is tilted a bit forward. Count your breath, now, either from 1 to 10 or 10 to 1, doing this 10 times. This is done for its calming effect. When you have practiced in this way for some time you can dispense with counting. More advanced practitioners are immediately calmed upon assuming their seats.

2. Next on the agenda is abdominal breathing. This is done to stimulate the internal organs. In this method, exhale your breath by contracting the abdomen, compressing and massaging the organs therein and acting as an adjunct to the function of the diaphragm as it rises to compress the chest cavity. When you inhale, the diaphragm descends and again there is a compression and massage of the abdominal organs. This helps bring the Chi (or life force energy) into the abdomen where it can be collected and utilized more effectively.

3. Breathe in this way for 36 cycles. After you feel calmed and concentrated and the energy is experienced in the abdomen you can practice progressive relaxation. This is accomplished by the method of “smiling” in the eyes and extending the feeling to the rest of the body, as has already been described. When you have completed this, down to “smiling” in your toes and fingers, use the index finger of your right hand to point at your navel. This is to be your point of concentration, unless you have high blood pressure.

In the latter case you are advised to concentrate, instead, on the soles of your feet. If you have heart burn or an extended chest, you should concentrate on the Ming-men, the point in back, opposite your navel. If you have low blood pressure, bring your index finger to the area between your eyebrows and bear down on it, maintaining the pressure for a few moments, so that when you've taken your finger away, the residual sensation helps in keeping your mind on the selected point.

4. If you practice using the navel area in the prescribed manner to develop Chi, it usually takes two weeks to a month before you feel anything. Once you do feel the energy there, you should shift your attention down to the sperm palace, which is near the pubic bone and represents the prostate gland. Young people who do this may be too sexually aroused, in which case they should instead focus on the coccyx or Ming-men. Women are to concentrate 3 inches down from the navel, which is where the ovaries are to be found. However, those who have menstrual problems are referred to the Ming-men or coccyx, instead of the navel. After that you can switch to concentrating on the Hui-yin (or perineum).

5. Some people may feel power very rapidly rise up the back when they place attention on the perineum and so they ought to concentrate, instead, on the coccyx. Before actually concentrating on either of these places, however, it helps to sit and rock back and forth on them. The coccyx has an opening called the hiatus. Rocking on that and focusing your attention on it can sometimes lead a very rapid channeling of chi or your back. When it does happen concentrate on the navel.

6. After you have practiced for two months or so you can concentrate directly on the navel. That is, you don't have to count your breath or do the deep abdominal breathing — though you can do it, if you like. From the navel, the Chi should go to the ovary or sperm palace, the Hui-Yin, coccyx and up to the Ming: men on the back. Remain here until the power pushes up to the adrenal gland. Always remember to follow the energy flow and not force It.

7. The power ascends, thereafter, to the level of the shoulder blades and then the neck. Do not concentrate on the adrenals too long as this can cause insomnia. If you find this happening, concentrate on the coccyx. This will again send power up the back and into the small brain. When this is concentrated on you may

feel your back get warm and you may find yourself unintentionally doing yoga-style breathing.

8. In time you may feel something in the top of your head in the pineal gland area. The energy, when encountered here, feels warm or numb and as though something were pressing from inside. From there, the Chi flows down to the mideyebrow region, making it feel very tight. Once you've reached this point, the Chi has completed the "Governor Route". Thereafter, the power must be directed downward, no matter what your level of development.

9. When you've reached the head, reverse it and direct it to the Ming-men, directing it from there to the inner sides of the thighs and ending in the soles. Concentrate there for a while and then bring your attention to your toes, knees, Hui-yin and then navel again. Stay there for a while and then go up one center to the solar plexus and concentrate there. Since you've opened the functional route, as soon as you concentrate on the solar plexus, you should feel energy there and in the area between the eyebrows as: well. The energy that is developed at this time flows in both the Governor and Functional routes. Doing it this way is much safer and spares you side effects.

10. When you've developed more power, it will push up from the solar plexus into the heart chakra. This should be your next point of concentration, then, but if you spend too much time here you will develop heart burn and find difficulty in breathing.

11. If you've concentrated for one or two weeks and the power has not yet risen to the throat energy center, you can either direct your attention to that center during your practice sessions or concentrate on your solar plexus and allow the energy to push its own way up to the throat center. When the power does get to the tip of your nose. This is a crucial point. Think the energy up to the tongue from the throat area and bring the energy in the brow area or nose down to the palate. When the energy descends along the nose, this causes some practitioners to sniffle (so that you can have some guide as to what might be happening).

Your tongue may seem to grow warm. When the proper place on the palate has been touched, you will feel as though you had a small electric shock in your tongue. When this happens, it marks the completion of the Microcosmic Orbit by the fusion of the Functional and Governor routes, known as the Small Heavenly Cycle.

This can later include your arms and legs, at which time you are said to have completed the full Microcosmic Orbit within the Large Heavenly Cycle.

12. Everyone, regardless of age, must conclude their practice by directing the energy downward. Collect it in the navel and circulate it from 3 to 36 times in either direction. This is absolutely essential as a precaution against energy getting "stuck" in some other parts of the body.

Circulate Chi Power Continuously in the Orbit

When you have completed the route point by point you are ready to continuously circulate the "chi" power in the Microcosmic Orbit. It is the steady flow of this warm energy current that offers the most powerful results in the self-healing process.

1.To do this, when you concentrate, begin at the navel. When you feel the power, bring it down to the Hui-yin, the coccyx. Then up into the spinal cord, stopping at the Ming-men and then going on to the pineal gland, on top of the head, where you concentrate for about ten minutes.

2. After you feel the power flowing into the forehead, at the mid-brow region concentrate on the pituitary gland, (Yin-Tang) for another ten minutes. After that, bring the power down to the navel. Concentrate here for a short while until you sense some energy and then bring it down to the Hui-Yin again.

3. Then start the Microcosmic Orbit Small Heavenly Cycle around the trunk of your body, circulating it thirty six rounds, bringing the power to the coccyx and letting it flow up the spinal cord, to the Chi Chung or the mid-point of the adrenal glands.

4. Count from one to ten repeatedly for one half hour for its calming, purifying and cleansing effect. When you are more advanced all you need do is concentrate on the point. You no long need to count. Then bring your attention up to your head and stop at the Niwan-Kung, the pineal gland where you can again count from 1-10 for resting, purifying and cleansing.

5. Thereafter, bring it down to the Hui-Yin again. This is one round of the Microcosmic Orbit and it is to be done thirty-six times.

If you can do this every day, it will greatly improve your health. When you're through, you must remember to collect the power mentally and circle the navel 3 to 36 times clockwise, and then 3 to24 times in a counter clock-wise direction.

Final Goal is:
Automatic Circulation of Chi

Many have found that when they have completed the orbit and practiced for a while that concentration on the navel causes the energy to flow through the Microcosmic Orbit instantly. They feel the power in the head (the crown), and the mideyebrow area, instantly upon feeling the navel get warm. This is because the energy flows as a complete stream. The tongue might feel warm or numb, as though from an electrical shock. The flow can actually be felt to descend down to the navel and go into the legs. A feeling of numbness may be experienced in the arms and legs, when the big circuit of the Microcosmic Orbit of the Large Heavenly Cycle has been completed.

Eventually the warm current will flow through your body automatically if you're creating a positive, permanent habit of circulating chi around the microcosmic orbit. Once your body/mind has internally absorbed the new pattern of chi flow, it will seek to maintain the dynamic equilibrium and circulate the chi automatically. Your weeks or months of self-discipline will begin bearing the fruit of a lifetime of delightful good health.

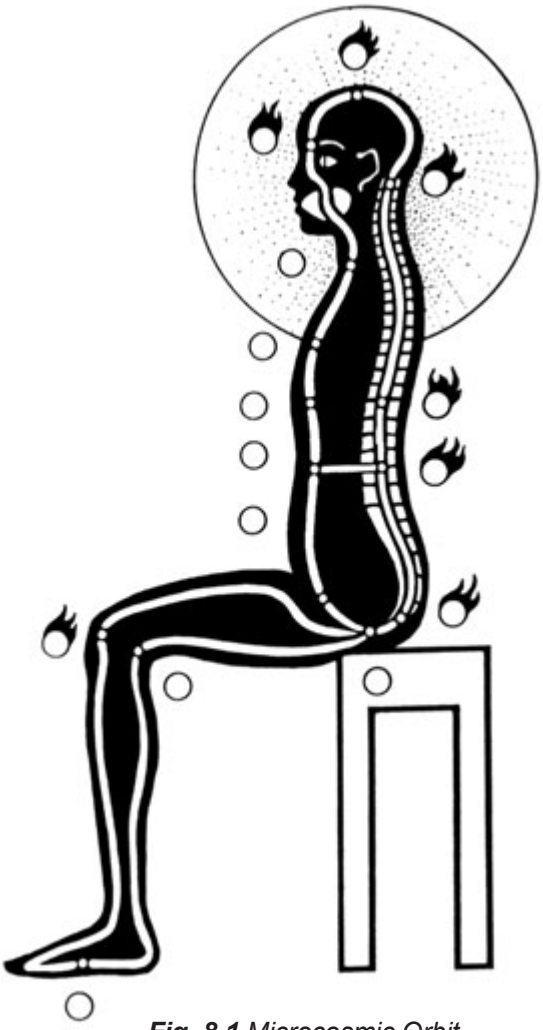

Fig. 8.1 *Microcosmic Orbit*

Chapter IX
Safety Valves: How to prevent Side Effects

You may find circulating chi to the navel point is quite comfortable, but when the power moves up to the head you may discover that you are easily irritated and sometimes have headaches. Concentrating on the heart chakra, you may develop congestion and pain in the chest and heart area. Be assured, however, that though you may initially suffer some untoward effects, your continued practice will set you free of all such symptoms. However, it must be stressed that you keep your instructor alerted to whatever you might experience so that he will be able to help you. Make sure to finish each session by returning the energy to the navel and circling it 3 to 36 times clockwise and 3 to 24 times counter clockwise for a man, and the reverse for a woman.

The following centers can act as safety valves, thus helping to avoid side effects: 1) the navel can store energy, 2) the Ming-men on the back of the spine helps guide the energy downward, 3) the Wei-Chung (the back of the knee) can store up energy, 4) the Yung-Chuan in the feet acts as a grounding wire. The Hung Chaun energy center can also be used as a safety valve to draw off energy that builds in the head. When too much energy surges up to the heart and seems to have no place to go, you can redirect it downward to the feet and then up to the navel.

Cleansing Process: Belching and Diarrhea

People who, develop belching and diarrhea during practice might think that it is due to something that they have eaten. This is not the case, however. When the power starts to flow, it acts as a cleansing and filtering agent for the body and the organs. The diarrhea that ensues is not the usual kind. After it is over you will feel very energetic and internally light and clean. You may feel a little weaker but you will feel much better than you can recall. Your stool may be very dark and sticky. This is classically explained as being due to

the poisons that had accumulated in your esophagus, stomach, intestines and other organs over the years that are being cleaned out.

When this cleansing is completed, the diarrhea ceases and you reach another stage where you feel much calmer and cleaner. After this cleansing, you are advised to watch what you eat, curbing your intake of oily and spicy foods, fermented foods and meat. Essentially, you should eat less at a time and eat food that is fresh and of good quality. As you progress in your practice you will develop an intuitive awareness os what food is best for you at the time. An organ awareness will have been awakened, which will enable the needs of the body to be satisfied.

Sexual Life during Practice

When one has just begun to train, sexual intercourse should be curbed considerably, if not altogether. Abstention will enable you to have the necessary energy to complete the routes. Opening the microcosmic orbit will eventually improve your sexual relations as you gain mastery over your body's energy system. Sex is a natural human act and if you can properly control and use it, you will enjoy it all the more. You will find more details on this in the book, *Healing Love* on Seminal Kung Fu, which demonstrates clearly how to have a more nourishing sex life.

Those who are weak and sick should abstain from sex for two to six months or until some degree of vitality has been regained.

Appetite and Stomach Ailments

The most important thing to us is the stomach (the element of earth). Concentrating on the navel you may feel the area expand, as though with air. This sensation often extends up to the stomach, at which time you may be assailed by fits of belching and yawning . . . especially if you have some stomach disorder.

Raisng your tongue to your palate will increase the flow of saliva. When you have totally cleansed your stomach and intestines, the saliva will become much more sweet and fragrant.

Throat Center: Coughing

When you concentrate on the mid-point between your nipples, the power pushes up to the throat chakra. Many practitioners develop a cough when the power gets stuck, as it were, in pushing up from the chest and into the throat chakra. Some may even cough up dark sticky mucous at this time. Cleansing this point can help the power flow considerably. By the time it pushes up from the throat to the tongue you will feel calm and less worried. This does not mean that you will never have any worries or anxiety but it does indicate that you will feel more calm and will be able to sit and meditate more easily.

Some Taoist books may seem to exaggerate the importance of the chakras as power centers but what we are talking about here is based on the actual experiences of many hundreds of students.

Cleansing of the Esophagus, Stomach and Intestines

The cleansing of the esophagus, the stomach and the intestines is very important, because food passes down this way and there are many places where it can lodge, causing some blockage. The Six Healing Sounds describes how during that phase of training, there is belching as well as the passing of gas and yawning, marking another very important aspect of the cleansing process. It is advised that you drink one or two glasses of clear settled water in the morning one hour before breakfast to clean out your digestive system. After drinking the water it will also help to rub your stomach with both palms 9 times in both a clockwise and counter clockwise direction.

Illusions and Mental Illness

Those who tend to have illusions or mental illness must make sure that they direct the power back to the navel at the end of each practice session. This will help to prevent such afflictions and many other side effects. In fact, everyone should end his practice in this way on the off chance that some stress or weakness has been

incurred somewhere that he may not know about. When practitioners who are in a weakened condition have more power made available to them, they may experience such effects as ringing of the ears, muffled hearing, or smarting eyes.

Once the power is activated, you will find that if you have ever had a toothache you may again experience it and if you have a latent virus or cold in your system it may be activated. Various other pains out of the past may suddenly assail you. It may seem as though the “power” is the cause of your trouble and it is, in a way, and you would be correct in thinking so.

Your problems and illnesses have remained hidden in your body, unknown to you. There are various ways to understand this. Perhaps it might make more sense to say that most of our ills stem from the mind. The mind is a storehouse of everything we have been exposed to and when we use it, opened and cleaned, the sickness will be overcome.

Initially, as you are suddenly confronted anew with painful memories relived as though they were real, you feel that your practice has caused this and it has. As you continue to practice, however, and as these mind contents are emptied and replaced by a harmoniously functioning system, you come to realize the wisdom of just how you personally have harbored and been affected by these “memory-illnesses”.

That is not to say that the illness you experience was just in your imagination. The mind is complex and, in fact, are inseparable from the body. Perhaps, “body” is just another way to describe a complex set of processes that might, with another view, be called “mind” comes closer to it. Again, as the various energy routes are cleared of obstructions, it is conceivable that some of those obstructions might have been due to past illnesses or injuries. Then, as resistance to the flow of energy is met along a route, the memory that is associated with it is evoked.

When to see a Doctor

If you have definite physical problems you should follow your doctor’s advice as well. You are not to think of this method as some sort of magical cure-all, and should seek to obtain whatever you

need to improve your health, with whatever resources may be available. Problems most often arise in practice with those who are ill or in a weakened physical condition. If they want to progress rapidly, they would be well-advised to use a physician. A number of practitioners have had misgivings for thinking that they could depend solely upon their esoteric practice and never see a doctor again and have ended up with sad stories to tell. To help solve your health problems you should use what modern medicine offers and the Taoist practices you have learned, as well as anything else that you might have found to be effective, being careful to be open to the best choice for you.

Proper Practice will prevent Side Effects

In awakening the life force energy of Taoist Esoteric practice each person is required in the first stage to open the Microcosmic Orbit. The Governor Channel corresponds to the route that is followed by awakened sperm energy rising from the coccyx to the crown of the head. The Tao System differs from the Indian in that a return route is provided for: from the palate to the tongue to the throat, to the navel and back to the coccyx to begin a new circuit. In this way, power is evenly distributed throughout the seven glands. There is far less pain in the head than one would have in Kundalini practice because a safety valve is afforded as a provision for distributing the pressure.

The seven glands act like a series of containers, within each of which the same level of fluid must be maintained. When this is done, all of the seven will function properly with none of them being stimulated more than it should be. This is exquisitely accomplished in the completion of the Microcosmic Orbit. With only one direction of flow through the containers, the lower or the upper one can be over expanded, which can result in malfunction and damage. With a return set of connections running to each container, however, the overflow can be taken up by the circuit and the other glands that it is connected to, resulting in reduced stress and a return to balance.

At higher levels of Taoist Chi circulation more routes are opened allowing more energy to flow but also creeating additional “safety valves”. After the Microcosmic Orbit is completed an additional 30

routes in the whole body must be opened. When they have all been opened, the life force energy chi can freely flow through the organism, eliminating the side effects which might otherwise be caused by the over-stimulation of one gland or another. For example, if the adrenals are overstimulated you cannot sleep, because your pulse rate is alarmingly increased and you feel anxious and alert. If the power flows into the heart energy center and there is no means for it to flow out, the heart rate goes up drastically. The pericardium is supposed to function as a cooling system but is unable to do so under such circumstances. Something akin to this can also occur if the energy is not properly guided down along the front portion of the Microcosmic Orbit.

Finally, prevention is the safest approach to avoid ill side effects. As mentioned elsewhere, the singlemost important safeguard is to end your chi circulation practice at the navel point where it is circled in both directions from 3 to 36 times. In the beginning you should try to circle it the full 36 times; eventually you will discover the energy spins more quickly and this “closing off” will take only seconds.

Chapter X
Commonly Asked Questions and Answers on Microcosmic

What is Chi or Electro-Magnetic Life Force?

Chi, otherwise called the Warm Current, Kundalini Power or electro-magnetic life force, is very difficult to describe because this energy, or life force, cannot be seen. However, we can feel the life force in the body. In the early days of Tao, chi was expressed as nothing in the top portion of the Chinese pictogram and as fire in the lower part, so that no fire might be conceived of as defining Chi. More contemporary Taoist sources classify many kinds of Chi. There is pre-nature Chi, the kind you breathe, as well as the Chi that is transmuted in our bodies and the kind that has been awakened from sperm or ovary called Ching-chi.

Ching-Chi, the main energy source of our practice, is ultimately transformed into spiritual energy. We all have Chi from the time we are conceived. The Taoist teaches us that life force or Chi begins as the energy you derive from the food you eat and the air you breathe. In Taoist practice, you draw on many different sources of energy, which reside in different energy centers in the body, such as the heart, adrenals, prostate, pineal and the pituitary. There is yet another kind of energy that we absorb from the solar system, mix and transform in our body, which produces still another kind of Chi in a process called Alchemy.

Taoism stresses practice and theory; philosophy and discussion are discouraged as futile. By a simple method of relaxation and concentratiing on your navel, you can experience for yourself what the flow of Chi is.

Several of my students had spent as many as five to twenty years trying to develop Chi and complete the Microcosmic Orbit, but to no avail. After a short time with me they completed their objectives in one to four months. They all found this method easy and natural. Spending just thirty to sixty minutes a day, many who

developed power quickly thought that they were dreaming or that it was an act of imagination. Yet, when they practiced they felt warm and soon reported how much healthier they seemed to be getting.

Do you have to Sit in a Chair?

We recommend sitting in a chair. This is the most comfortable position for most and is especially good for those people who have back and leg problems. It also allows chi to flow freely through the legs. Many people believe that if you assume the lotus position you will feel more rooted and will gradually limber, or already have very open energy routes in your legs, sitting in the lotus or quarter lotus can only interfere with energy flow and hamper your progress.

If we compare the head to root of a tree, through which we can absorb power from the heavens then we can compare the legs to the branches and leaves and so they are also very important in practice. When you attain a higher level of practice, you will find that the soles of your feet absorb Yin power from the Earth. Sitting in a chair facilitates directing the power down to the feet. When Chi is circulated in just the upper part of the body and not directed down to the feet, it is like having the leaves whither and fall off the tree. No matter how well you practice in the upper body, if the power has not flowed down to the legs, there is a very significant lack of energy and you simply cannot function properly. When Chi circulates in your legs you will feel lighter, will walk more erectly and will be able to walk longer distances without fatigue.

Using a chair is important for another reason, too. A man must let his testes hang freely so as to be able to properly absorb energy. As your practice progresses, you have to open six special routes and the flow has to run down to your feet. Sitting cross-legged makes it very difficult to direct the power, although some people claim that when you have been successful in collecting energy you can direct the power in any position.

I have known many monks who had leg problems, which might or might not have been caused by sitting cross-legged for too long. If you can direct power to your legs, there will be fewer problems, but since cross-legged sitting calls for more effort, it is not a wise practice nor an efficient one. Since at one stage of your development, you absorb energy from the earth through the soles of your

feet, which necessitates having your feet flat on the ground, the position of choice, then, is sitting in a chair.

During Practice, What should Men do when they get an Erection and What should Women do when the Vagina swells?

When this happens in men, the testes may feel as though they were vibrating, there might be a slight discharge of semen along with a sensation of pressure in the prostate gland, and the Hui-Yin may also seem to vibrate, whereas women may feel their vagina and nipples distending.

When you are able to practice and collect power, it will naturally flow down to your reproductive organs and stimulate sexual anxiety. To overcome this, shift your concentration back to the Ming-men and then bring it up to your head to the mid-point between your eyebrows. In the book, *Healing Love* on Seminal Kung Fu, we demonstrated very clearly (in the large drawing of the sexual force rising up to the crown) how one can make an erection subside. I have many male students who, after practicing, experience erection and have to find relief in sexual intercourse. Some of those students stopped practicing because their sexual urge was too overpowering. However, if you can control or stop your sexual activity for a while, or get your spouse to understand or practice together with you, you will achieve success in this practice much more quickly.

Will circulating the Microcosmic help my Sexual Problems?

For those who are impotent, ejaculate too quickly or who have emissions; when they concentrate a while, they may feel pain or expansion in the back. This may cause an erection and may result in night emissions or a loss of sperm while urinating.

When you concentrate you are in fact preserving and storing life force, which is then first drawn to the reproductive organs and it is this which increases your sex urge. If you can retain these life

forces, however, your overall health will be greatly benefitted. It is safe to say that those who are weaker have been driven by lust. Those who are impotent should stop all sexual activity for from 3 to 6 months, consult a doctor and practice until they find themselves getting stronger. To practice and acquire some energy and then have an erection and go right back to sexual activity is simply to have lost what you have worked so hard to gain in your practice. When you have collected energy and fully completed the route, your body will become stronger and only then will you be able to enjoy your sexual life.

Is Taoist Practice suitable for Everyone?

Generally speaking, it should be good for everyone. But those who have physical problems or who suffer from mental or emotional problems, should be careful in their practice. In the Taoist system, we start by training the body and then the soul and finally venture into spiritual development. Taoism describes the body as a boat or ship. A perfect ship is a perfect body and a good engine is a good soul. The spirit is described as a diamond which we want to send to its destination. But if you do not have a good ship and a good engine you cannot deliver the diamond to its goal. Some people do not pay attention to the body and seek just to protect the diamond and the diamond sinks into the sea before they can reach their goal.

In the Taoist System and in others as well, one begins by strengthening the body. Thus, it is very unlikely that you will allow a young, childish spirit to wander in dangerous and unknown lands. When you open the thirty-two routes, the soul and spirit have room to travel within the body. As you progress you have to learn how to train the soul, how to mingle the body with the soul. Join and train this combination with the spirit, so that it, too, is included in a new mix and gradually the dangers of the practice are reduced.

Can Women Practice durng Menstruation?

Women who have trouble with menstruation should discontinue practice for the duration. Those who have irregular bleeding should not concentrate on the Kuan-yuan, which is three inches down from the navel, as this is the energy center of the ovary. They should concentrate, instead, on the point between the eyebrows and on the Door of Life (Ming-men).

Should I concentrate on the "Third Eye" between the Eyebrows?

One must be careful when concentrating on this point. The power tends to flow upward and if it is obstructed, possibly because the palate is too thick, and it is harder for the Chi to penetrate it then to rise up and push open the Pai-hui in the crown of the head. This forces it to flow out of the body for some time, and may cause pressure to build in the head. Therefore, young people, strong virile types, those with high blood pressure and those with mental problems should not concentrate on this point.

Why do some Practitioners develop pains in the Back or Shoulders during Practice?

I have many students who experience pain or tightness and pressure in the back after concentrating for some time. This depends upon one's body condition. Most young people and healthy adults who exercise regularly will often find that when they sit and the power goes into the back, pushing up through the spinal column, needle-like sensations develop because that route had been obstructed for so long. If you simply relax and concentrate, let us say, on the Ming-men and do not pay attention to how it is going, the power will push up by itself.

If you try to assist in this process by pushing or in any way forcing, you will begin to feel nervous and uncomfortable and the power will get stuck in the back, producing pain. When the power reaches the Ja-chi, just concentrate there. Thereafter, allow the power to continue ascending from the upper back to the neck and then to

the Yu-chen, No. 7, or the small brain, which includes the cerebrum and the cerebellum.

Try to concentrate on this energy center and when the power finally pushes up to the Bei-huei, you will feel free and very comfortable and the pain, tightness and discomfort in your back will disappear. Sometimes, the power may seem to push outward from the spinal column, not into it, at which time there will be no such tightness and discomfort.

Back Pain for Older and Weaker People

When sick or elderly people who are burdened by weak lungs, stomach, liver, heart or other internal ailments, concentrate for some time, they may have much pain in the back and shoulders. There might even be sensations of heat and cold in the affected areas. One must keep in mind that concentration activates a natural process of healing. Those who have illneses that are hidden ailments will come out of hiding, so that they are once again afflicted as they had been in the past.

Can People that have had Surgery Practice?

Taoist training will help those who have had major or minor surgery to recover faster. After they practice for a while they may, however, feel pain at the site of the incision. This effect is actually a good sign, which indicates that the power is healing the cut from the inside. When the pain disappears, it means that the wound has been thoroughly healed. You might even have had an operation a long time ago and no longer have any pain, but once the power begins to flow, it will alert you exactly to where the pain was.

Why do some People experience Ringing in the Ears during Practice?

This will happen when the power ascends into the brain and it is sometimes the result of energy vibrating in the ear (the bony inner ear). Practitioners respond differently to it. Some like it and think that it means that they are making progress, while others are con-

vinced that something has gone wrong and are frightened. If they can calm down and practice swallowing saliva, it will help to keep the eustachean tube open which equalizes pressure on the ear drums and can facilitate hearing.
They should then try to relax the head and back and bring their attention to the Ming-men, allowing the power to flow down to it from the head. Furthermore, after they have felt some relief, they can finish by bringing their attention to the navel for a while before rotating around it mentally or by using one hand first clockwise 36 times and then counter-clockwise 24 times (the direction is opposite for women). It might also help to feel all the power being gathered to this point as one is doing this. Bear in mind that the energy goes where the mind directs it.

What should One do when, after Practicing for some Time, One loses One's Appetite?

After concentrating on the navel and then the Ming-men in the back, some people report having their appetite improve. They then eat well and find their bowel function improved. After the power travels up to the back of the head and then goes to the Pai-hui, they might report having difficulty in breathing, losing their appetite and developing trouble with their bowel movement. This happens when the power has been blocked and has not been properly or sufficiently directed back to the navel. Be patient and circle it down, as has just been described above, drink more water and eat more fruit and all of the symptoms will fade away. Remember, then, that if you direct the power back down to the navel at the end of each practice period, this problem will not occur.

Why is it that, After Practicing for a while, some People Jerk about Spasmodically, assume Yoga Positions or Elicit Various Sounds?

Shaking is not an unusual effect and is, in fact, beneficial, serving as an internal exercise. Concentrating on just one thought has been known to stop it and if it becomes really violent you can end it

simply by ordering it to stop. However, I encourage everyone to shake for the benefits they can derive from it. To do this, they can either pretend that they are shaking or concentrate on the navel, exhaling as though into the stomach and through the back. If they continue to exhale until they no longer can, they will begin to shake. To stop this shaking, just order it to stop and breathe normally.

Shaking and jerking about during practice is caused by nervousness or psychological problems hidden within the mind. Some practitioners who are very suggestable may have read about what happens and it happens to them. Others seem to shake in a logical way, which means that if they move the left hand in a circle thirty six times, then they will move the right hand thirty-six times too. There are those who are very frightened when this happens.

As the Chi, or the energy of the heart, liver, spleen, lungs, kidneys, fills the organs, there are specific reactions expressed as various “shakings”.

1. The heart controls the veins and arteries. The Chi of the heart causes the body to jump up and down like a monkey at play. (This shows that the Heart Meridian is full of Chi).

2. The liver controls the tendons. When it fills with Chi, the big toes and legs may cramp as the Chi swims joyfully in the ocean of divine ecstasy, like a fish.

3. The spleen controls the muscles and when they fill with Chi, they jump like a bird hopping from one branch to another. The place where it rests feels like fire. This is because the vital Chi of the spleen is moving around.

4. The lungs control the skin. When they fill with Chi you will feel prickly itching and heat all over the body, as though ants were crawling over you, especially on your face. This is because the vital Chi of the lung is moving around.

5. The kidneys control the bones. When they fill with Chi you will hear the sound of the moving bone. Moving up the spine like a snake, it sometimes causes sexual arousal.

If you shake too much, the power will scatter and not run in the Microcosmic Orbit. Shaking sends the power into the tendons, muscles, limbs and organs, and is good for those who want to strengthen those parts. I recommend that students sit for half an hour, shake for five or ten minutes and then stop and concentrate

on the power flow. The shaking can be both intentional and unintentional. Doing this often limbers one up, thereby aiding concentration and clearing Chi channels.

When one begins practice and has not yet completed the Microcosmic Orbit, however, I usually advise that he not allow shaking to occur. When you let the power flow by itself, all sorts of seemingly automatic things happen if you just go with whatever seems to be happening. This is a very good exercise for releasing tension and stress.

How does Chi affect the Sick Body?

When the energy reaches a diseased organ it circles the area. For example, if you have a kidney condition, you should be able to feel the energy moving for a set number of times to the left and the right around the two kidneys. If you have stomach or intestinal problems, the energy will move in the direction of the stomach and your body will shake. Those who have a heart problem will find that the energy lodges around the heart. When people who have a heart or liver problem engage in this practice and suddenly have difficulty in breathing and a feeling of distress and congestion in the chest, they may think that the system itself is not good and want to stop practicing.

I have had a few students who have had just this problem arise. They went to see doctors who were not familiar with Chikung or the Microcosmic Circulation and who assumed the trouble came from practicing “meditation”. In fact, the energy had been opening blockages, which had been there for some time. Long before they began practicing, they had sometimes felt their heart beat very quickly and had become short of breath but had never attached any importance to it.

It was only because they had ventured into something new and different when they started to practice that they grew alarmed because the symptoms remained too long. It may help to know that it is the nature of this practice to have such things happen until health is restored. If they break off with their practice they simply continue to suffer, growing steadily worse. If the power is able to get through the blockage in the chest, there may be vomiting or diarrhea but after that is done with, a level of wellbeing will be achieved never previously known.

How do you Remedy Blockage in the Chest?

In order to avoid the unpleasant side-effects that occur when the power is blocked in the chest, redirect it down to Ming-men and concentrate there, instead. If that doesn't seem to help, shift your attention to another power center, perhaps the Hsuan-Chi, and concentrate there for a while until you feel the power move

I have had a number of students who, for one reason or another, did not respond well in their practice and so I advised that they concentrate on their navel. After a period of weeks or months, I'd received various distress calls from them as the power developed sufficiently to make itself known. One young lady kept saying that nothing was happening, until, after about three months, she called in great distress to report that she was having pain in her chest and difficulty in breathing. I knew immediately what had happened. She had continued to concentrate on her navel, even though I had advised her to switch to her Ming-men in her lower back. The pain and symptoms she now had were simply due to the energy having risen up the front meridian into her chest. Had she been concentrating on her Ming-men, the channel that would have been available there would have been in her back and she wouldn't have had the trouble she described.

What is the Proper Time to Practice and must you do it regularly?

The Taoists divide the time for practice into four periods. At six o'clock in the morning, less Yin, more Yang; at 12:00 noon, strong Yang, at six o'clock in the evening, less Yang, more Yin; and at midnight, strong Yin. The length of time should be fifteen to thirty minutes at the beginning. As you make progress you can then extend it to one hour. Most importantly, find your own time and practice regularly every day. It is of no use, if you practice one day for three hours and then stop for two or three months. Ideally, begin your practice regularly, for fifteen to twenty minutes each day and expand as you make progress.

Do People who Practice this Method have to watch their Diet?

You should eat whatever your body tells you to eat. It is not necessary to be strictly vegetarian. If you can become vegetarian, however, and your body feels good with it, then that is the best thing for you. If you eat too much meat, garlic or onions, it will arouse you sexually, which will interfere with your practice. I would advise you to abstain or at least to greatly curb your sexual activity until you have gathered sufficient power and have opened enough Chi routes. Until that time, remember that the most important thing for you to do is to retain your sperm and ovary energy because it is a great source of energy.

If you lose much sperm or seminal fluid, your energy reserve will be very low and it is hard to produce Chi otherwise. As soon as you begin to conserve energy through this practice, you will have more erections at night or during practice.

It is very important to try to curb them. To do this, try to breathe and draw in energy from the Hui-Yin and from the tip of the penis, directing it up through the back to your head.

I have some Friends who, after learning these Methods, do not seem interested in Social Activity. Will you comment on this?

This is not the point of practice, although there are some people who, after having begun training, would rather live away from people. The main purpose is to make yourself stronger and happier and not to run away from things. The Taoist approach is concerned with harmony and so we suggest that people marry and lead a happy family life, so that they can practice more effectively and achieve their goals more quickly. There is no need to run away from the world or from your family. If you can't control your heart in the city, you will never control yourself in the jungle either. Remember, if you can practice well at home, you can practice anywhere.

Can Relaxation and Concentration cut down on the Number of hours you Sleep?

Sleep is most important. Through sleep you are able to recover energy, allowing the body to refuel and repair itself. So it would be wrong, especially at the start, to substitute meditation for sleep.
In the beginning, practice is practice and sleep is sleep. Some people think that sitting in meditation is just the same as sleep. It is true that meditation will calm down your nervous system and brain but your body still needs the rest and sleep is the best way of providing it. If you sleep less and then tend to fall asleep during practice, that is not good at all. Not being able to concentrate during practice you will simply defeat your own purpose.

Try to have regular hours of sleep. The average adult needs about eight hours. It is said, traditionally, that when Chi fills all of your organs and you fulfill the rebirth process, your body will need less sleep. Yet, we must recognize that living in these times, subjected as we are to different kinds of stress, new rules must apply.

How does Practicing the Microcosmic Affect your Emotions?Should you Practice when Angry, Sad or Disappointed?

All these feelings will affect your practice. Because we live in a stressful world, no one is able to live a really happy or satisfactory life. Try to be content and satisfied with what you have. When you become discouraged, do some exercise, take a long walk, or find some other way to calm down and then have a good sleep and in time you will feel better. There are many methods that are helpful. You can chant or count your breaths or repeat mantras.

All of these divert your attention from your trouble and set you at ease. But remember always to smile and relax. There are added benefits to this practice. You will find that you will become calmer and more stable and may no longer lose your temper as readily. So it is safe to say that as you become healthier you will be less angry. This has happened to many of my students. No matter how much psychology you have studied or theories you have understood or lectures you have attended about how to control your an-

ger and your mind, if you do not actually practice, you will make no progress.

Many of my students have told me that they have had philosophy up to their necks but that it does not really help them. What we are trying to tell you is that you will find out you have completed the route and have harmonized the Yin and Yang in your body, you will feel happier, less angry and will be able to take more stress. You will see the world as beautiful and see all people as saints. By contrast, if you are sick and frightened as a mouse, when you see people, even good, kind people who want to help you, you will believe that they want to harm you.

Your main aim now should be to make your body, your nervous system, soul, spirit, your whole being — healthy, by means of this training. Try to remind yourself to smile and do one good thing each day. That is all you need. You do not have to depend on a higher master to guide your spirit; your spirit is yours. No one else can guide your spirit. If your spirit has to depend on others for guidance, then you are in trouble.

Does Rhythmic Breathing or Chanting help to circulate the Microcosmic Orbit?

Generally, it does not. I may advise some students to do it in the very beginning to help them calm down, but urge them to get along without it as soon as possible. All that is called for is that you concentrate on the energy center or centers that you are working on. If you pay attention to your breathing, the power or the warm current will not concentrate itself at the center but will scatter.

I have many students who had been practicing for many years (some for as much as twenty or thirty years) who told me that they had never felt any unusual energy in all their years of practice. When they came to me I told them to just concentrate on the points and not to pay attention to breathing. Many of them, in their first session, often after just a few minutes of concentration, experienced bliss and power, and found themselves deep in concentration. All of these students were well prepared and had a lot of energy in reserve, but didn't know how to turn it on and have it flow in the proper channels.

There are countless methods of breathing and they all make it very hard to feel the “warm currents”. If you can concentrate on the point assigned to you and do not pay attention to the breath. If you can put everything out of your mind and just concentrate on that point, the power will flow freely. When you concentrate, you casually watch the point. There is no straining, no great act of will power, but just passive watching. In this situation of just watching you will feel very calm. So don’t pay any attention to the breathing, just watch the energy center.

Does Master Chia Pass Energy to his Students to help open the Routes?

When someone first comes to me, I may give them energy. Upon being touched some people experience the warm current in a few minutes. The body may feel as though affected by an electric shock and start to vibrate and go into deep concentration. By merely describing the route of the energy flow to them and without my touching them, they go into deep concentration, feel energy running through their body and have an irregular and sometimes rapid and shallow breathing pattern. Someone came to me just one time and completed the route, experiencing great inner beauty, peace, and a deep knowledge of his innermost self. That happens, too.

Are there any Side Effects with your Method?

In China, Taoists have been studying, experiencing, passing all of their lifetime experiences down to us for 8,000 years. We know the route and so it is very easy to guide one along. The nature of the warm current or Chi is that it tends to flow up to the head, which is the most important part of the nervous system. If it gets stuck there, and you don’t know how to bring it down, it can damage the brain. By gradually exposing yourself to increasingly larger amounts of energy, however, it is possible to adjust to it. The price for not allowing enough time to adjust and of affording enough safeguards is an overload, which can result in pain, fear, outright injury and insanity. There are those who succeed quickly by pushing power into the head without side effects, but they are the exceptions.

The Microcosmic is a safe system because once the two main channels are open, the energy will circulate automatically in a loop. Energy flowing in a circle will never build up enough energy at any single point to cause serious discomfort or pain. But if you try to force the energy to flow in one direction only, such as to the higher centers in the head, it may burst like a water hose with a kink in it. The water pressure has no where to go but explode.

Additional safety routes are available in this Taoist practice. If too much energy gets stuck in the head, just reverse the flow and send the energy down the back to the feet and then up the front to the tongue/palate. Putting the tongue up to the palate completes the circuit, joining the energy of the Governor and Functional channel. It is like building a tunnel through a mountain; it will shorten the time if you dig from both ends and meet at the middle. This is what we are doing when we join the two routes into a single loop.

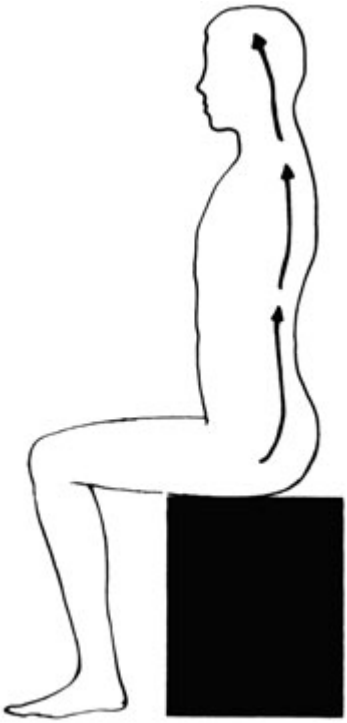

Fig. 10.1 *Microcosmic Orbit Back Channel*

Why do I feel tired after Meditating?

The warm current concentration is an exercise of the mind, which directs the current and burns large quantities of energy in the course of purifying the nervous systems of the organism. During the early stages of practice you will be doing a great deal of repair work on your body. After concentrating you may feel tired or experience some soreness in your back. The Taoist rebirth process explains itself. It is a means whereby the sick and damaged body recreates the life process to that of a baby. To accomplish this, one needs a lot of material and energy. Those who are strong and healthy will find that after practice they feel refreshed. Those who are ill or unhealthy, or who think they are healthy but in fact are not, will feel sleepy or tired in the beginning when such energy is expended in a virtual repair and rebuilding process. One gradually changes into a stronger, more vigorous and yet peaceful person. Remember that this method calls for gradual change and a restructuring of the

entire individual. As toxins are flushed out and tissues are replaced, you may find that eating a handful of grapes or other sweet, juicy fruit will help disperse fatigue. The longer you practice the better you will feel. After the period of tissue repair is completed, you will feel strengthened by your practice sessions.

What is the Benefit of Completing the Microcosmic Orbit?

The Microcosmic is the basic tool of the Taoist system. By circulating chi in this simple orbit you are generating energy to be stored in the navel. The body knows which organs are in need of extra energy. When circulating the warm current the organs, glands, and blood automatically receive this energy.

Part IV:

Healing Applications of Tao Energy

The Microcosmic helps the body resist sickness by keeping the energy in harmony. The inner smile is the model of loving yourself with pure, unconditional love. By practicing the inner smile and circulating chi in the Microcosmic Orbit we come to understand our body on a deeper level and learn to create love, respect and self-esteem within ourselves. Our body is potentially a perfect machine to serve our mind and spirit. But we can have a perfect machine only if each part functions harmoniously with the others.

The Microcosmic enables you to put an 8,000 year old discovery by Chinese Masters into use in your daily life. Its applications are endless. Continued practice can bring greater calmness, clarity, and energy to every aspect of your current life. By circulating chi in the orbit, you also open the door to discovering priceless higher knowledge of the Tao, he harmonious way of nature.

Chapter XI
Medical Science looks at the Microcosmic

A Medical Opinion on the Benefit of Taoist Chi Circulation

by C. Y. Hsu, M.D.

For over two thousand years the theory of Chi has been the basis of classical Chinese medical practice. Chi is said to flow through a system of channels in the body; when the flow of Chi is disturbed for whatever reason, illness results. Medical treatment aims to re-establish the normal flow of Chi and thus restore one's health.

Unlike the circulation of blood, the flow of Chi is difficult to document objectively. For several decades many scientists throughout the world attempted to demonstrate the existence of such a system of Chi-channels with no success.

When I heard about Master Chia's method of Chi development I was fascinated and decided to try it. After four months practice, I began to sense a consistent feeling of warmth developing inside my abdomen. Soon after, under Master Chia's guidance, I was able to direct the flow of this energy through the major channels of my body at will. Not only did this curious form of energy travel along pathways as described in classical Chinese medical literature but the energy would dwell at sites corresponding precisely to the major classical acupuncture points.

If there is a system of energy flowing through the body, then it is logical to assume that the maintenance of such a flow in a normal and efficient state is important. In Master Chia's method of. developing Chi-flow, there is a tremendous possibility for development of one's physical and mental well being.

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A Brief History of Taoism and Healing Arts
By Stephen Pan, Ph.D.

For many centuries, meditation and special exercises forms have been used by the Ancient Chinese, Hindus, Arabs, Jews and Christians as a means of improving the human mind and body. In China, the Taoists called it "Chi Kung," or "Cultivation of Energies." According to Taoist classics, Tu Hse, who lived about 8,000 years ago, was the successor to many great pre-historical sages. He was the great Taoist sage who began the use of the eight kua of the I Ching such as the great power of observation and the power of simplifying obscure masses of material. This resulted in a most perfect yogic and meditational form, which incorporated the insights of Tao philosophy.

Perhaps it is more than a coincidence that the Indian practice today of Kundalini Yoga is somewhat similar to the Taoist "Chi Kung." More than 2,000 years ago, the Indian Master Bodhidharma traveled to China. There he meditated for nine years facing a wall at Shao Lin Temple. He established a school, which incorporated the Indian practice in a new manner. From the time of the founding of this school, many Chinese men of great ability practiced meditation as taught by this Indian Master and gradually applied to it the perticular qualities of the Chinese culture.

These esoteric practices were an integral part of the development of Chinese medicine, where acupuncture, herbology and other aspects of what would now be called "holistic" medicine reached a state of high refinement unsurpassed by any other early civilization. But by the end of the fourteenth century in China, these arts were in decline for various political reasons, causing many of the teachers to be scattered from their schools and forced to go under ground.

The various approaches have been compiled in a Chinese Taoist encyclopedia that fills hundreds of volumes. The Taoist approaches have been divided into more than ten branches of study, some of which have very different methods of practice ranging from breathing techniques to alchemical secrets.

Western medical researchers are just beginning to realize the ancient masters understood profound aspects of the human mind and body without the aid of sophisticated diagnostic machines. The difficulty is in penetrating the veil of secrecy drawn across these Chinese practices which prevents their open examination by the modern medical community.

Mantak Chia is one of the first Chinese masters to arrive in the west with a comprehensive mastery of both the traditional chinese healing arts, diet, Five Elements nutrition, herbs, Tai Chi Chuan, massage, moxibustion - as well as the esoteric arts of Chi Kung, Healing palm, Five Finger Kung Fu, Seminal and Ovarian Kung-Fu, and the meditative aspects of Taoist yoga.

Chia is heir to a secret method which has been passed down by word of mouth only. Unlike his forebears, he feels that it is time that what he has learned should be made public. In the book he has attempted to simplify what he has learned by way of his own experience and those of his students into a system in which traditional and modern medicine are fully integrated.

The medical applications of the chinese esoteric system are traditionally said to be extensive, and include remedies for a side range of illnesses:

1. Asthma and Chronic Bronchitis
2. Rheumatism and Arthritis
3. Hypertension
4. Insomnia
5. Cirrhosis of the Liver
6. Pulmonary Tuberculosis
7. Recurrent Headaches
8. Frequency of the common cold and other Episodic diseases
9. Tumors

Long-term diligent practice beyond two years and, most effectively, if practiced life-long, reportedly could retard the various degenerative changes associated with old age e.g. skin changes, senility, slowed reaction time, impaired memory, ambulatory impairment and the frequency of various diseases common at old age.

A diligent practioner often lives to ninety years of age and remains healthy and alert, is able to jog, run and climb mountains with ease, and continues to enjoy life more fully than most people. Many reportedly could forecast their own time of death and pass on peacefully and gracefully in the posture of meditation.

However, it should be noted that in old China your doctor was considered a failure if you became sick. The best doctors trained their "patients" to prevent illness by maintaining a high level of health. The promise of Esoteric Taoist Yoga is to reveal the methods bringing your various bodily energy systems into harmony.

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A Doctor's Search for the Taoist Healing Energy
by Lawrence Young, M.D.

When I was twelve and had just begun my grammar school education in Hong Kong under the British system, I was at an age of fantasies and hero worship. I was crazy about physics, mathematics, atomic bombs, hydrogen bombs and nuclear reactors. Albert Einstein was my hero and I wanted to be a physicist, discovering the smallest particles of energy and matter, while exploring the galaxies and the ever expanding universe.

Oddly enough, it was during the same time period that I read about the esoteric experience of Master Yun. It was written in Chinese, and I had the good fortune of having been taught how to read classical, modern and simplified versions of the chinese language. I did a lot of reading, staying in school and public libraries in Hong Kong several hours a day after school was over. There I read about Master Yun's strange experience.

Master Yun was 28 in the year 1900. Pulmonary tuberculosis was rampant in his village. Many villagers had died, including his cousin. Then he came down with a cough which lingered for several months. One day he coughed up a large amount of red blood and went into a panic. He checked with his village elders, as well as the traditional herbal doctors. They all confirmed that there was

no treatment for pulmonary tuberculosis in 1900. Sunlight, fresh air and adequate rest were the only hope.

However, they did come up with an idea — the last chapter of the book: Annotated Chinese Medicinal Formulae recommended Taoist Meditation as the best form of adequate rest. It suggested that completing the Small Heavenly Cycle through the practice of Taoist Meditation might activate the bodily defenses powerful enough to overcome disease. Master Yun had practiced Taoist Meditation since his teens but without any significent effect, except that he always felt stronger when he practiced it regularly. Threatened by death, he read the methodology in the Annotated Chinese Medicinal Formulae carefully and consulted the village elders for clarification of certain details. Then he commenced practicing four times a day for two hours at a time, isolating himself in a small cottage.

On the eighty-fifth day, a sudden vibrating in his navel area caused heat to rush up his spine to the back of his skull. The same sort of vibration occurred on six consecutive nights with heat traveling up through his spine to the top of his head each time that he practiced. When it was all over, he seemed to have a new body. All symptoms of his illness were gone and he felt light and bright like never before.

One night, two years later, the vibration started up again in his navel. This happened on three consecutive nights. The vibration and heat rushed up his spine on its own, hitting the back of his head (at the occiput) and causing considerable pain. One night his 'skull suddenly felt as though it had cracked open and a sensation of heat swirled round and round in the top of his head. This began 'to happen every time he sat down to practice.

After another six months, a vibration again started suddenly in his navel and the heat again rushed up to the top of his head, swirled around in the vertex, came down his face, continued down to his chest and went on to again reach his navel. Thereafter, during every practice period, the heat went up his spine to the top of his head, then came down his face and chest and returned to his navel, after which, the heat circulated round and round without stopping. Master Yun remained healthy until his passing in his nineties, living a normal secular life.

I recount Master Yun's personal experience because his autobiography, first published in 1914, is an important landmark in Taoist Meditation. Before him, no one had written about the actual methodology, personal experience, benefits or side effects in simple, explicit language. There are volumes and volumes of Taoist Esoteric writing in Classical Chinese but the methodologies and accounts of experiences are hidden in a cryptic language. The benefits are written more explicitly, but the side effects are frequently clouded.

At age twelve, fascinated by the personal experience of Master Yun, I started to go through all the available Taoist classics that I could lay my hands on. But I was disappointed because I simply could not break what seemed to be a code, although I could understand every single Chinese word literally. It was then that I started an unending pilgramage to Taoist and Buddhist temples. I went to temple after temple but found that there was a lot of ritual, philosophy and religious data built into the meditation programs. Because I refused to do the rituals. I could not be initiated into Taoist practice. I was concerned by the fact that Master Yun had no teacher, he learned from a Chinese medicine book and was never initiated into Taoist practice via rituals. Never the less, I managed to talk to several Taoist teachers and many of their students, whom are now scholars and successful businessmen in Hong Kong, and was able to learn of their personal experiences in terms of energy flow and improvements in health similar to Master Yun's.

Initiated Taoists spoke of step by step guidance into the experiences that Master Yun had described and then higher levels beyond that. Master Yun had no such step by step methodology. He had only one step and one method that carried him through the experience described above.

Unfortunately, university life was demanding, and there were so many new attractions and distractions, that I stopped researching Taoist and Buddhist meditations after I entered medical school. The busy internship and residency years carried me even farther away from my investigations. My resurgence of interest began several years after my residency when I was in private practice. Although I was using every means available to modern medical science, many of my patients were still suffering and some of them continued to die, perhaps needlessly.

The memory of Master Yun's experience came up one day, along with the advice the many Taoist and Buddhist initiates and teachers I had seen. I had the thought, "If a patient has exhausted all forms of available medical care, he should at least have the right to try some safe mental techniques like meditation." I set out on a new pilgrimage to Yoga, Taoist and Buddhist meditation teachers, biofeedback and stress reduction programs.

Mantak Chia is one of the teachers I have met in my new quest. He is able to reproduce what Master Yun was able to do and goes beyond that, doing what the Taoist initiates can do as well. He is a Taoist initiate himself, but he does not include any of the Taoist rituals, religion, or philosophies in his program. A Christian by conversion, he is a doer, not a talker. He teaches his students solid steps without any high-sounding philosophy.

I have interviewed many of his students and I estimate that over 50% of his students who put a reasonable effort into their practice, open up the energy channels with vivid sensations and with noticeable improvements in health. The rest of them open the channels, without the vivid sensations, but with improvements in health. A very small number drop out. I have observed no side effects in his students, although all of them were prepared to meet all sorts of unusual bodily sensations. His students come from practically all walks of life, and many different races.

All in all, Mantak Chia is one of the few living heirs to the great Taoist tradition. He has access to the codes in the Taoist Classics. He is writing the Taoist Esoteric Encyclopedia in simple English for everyone, dispensing what had been secrets for centuries in simple, solid, easy-to-follow steps. Many other Taoist Masters and initiates may not agree with him for giving this esoteric knowledge so freely.

If used for the improvement of health and the treatment of illness, it is morally justified to disseminate this knowledge far and wide. Fortunately, Chia refuses to teach higher levels of achievement that might lead to paranormal abilities, unless the student can prove himself to be a law-abiding and trustworthy citizen, willing to serve mankind and use his or her esoteric knowledge to help the needy in a selfless and generous manner.

I wish Mantak Chia every success in his ambitious endeavor.

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York City. He is the Director of the National Clearinghouse for Meditation Relaxation and Related Therapies and publisher of its National Report.

Chapter XII
Personal Experiences with the Microcosmic

***Master Chia*:** When I first came to the U.S. I practiced acupuncture. In time I discovered that many of my patients had been referred to me by a doctor who was interested in Chi Kung. Whenever he had problem patients who didn't respond to conventional western medicine, he sent them to me. Many of them responded quite well to what I had to offer. Now I've been in this country for about four years and it was at least two years before I met the good doctor. He was excited about the way many of his referrals had responded. He asked to interview my students, half of which were his patients. I agreed and in time he published a book called "Reports of the National Clearinghouse for Meditation, Relaxation and Related Therapies", his aim being, to interest the American Medical Community in what he called, "Investigative Reports" regarding meditation in relation to physical and mental health. (This report can be obtained by writing to: National Clearinghouse for Meditation, Relaxation and Related Therapies, P.O. Box 3184 Church Street Station, New York, N.Y. 10008).

The case reports were of people who had headaches for many years, others who had asthma and various other ailments such as allergies, insomnia, hypertension, stomach ulcers, constipation, heart problems, hemorrhoids, chronic fatigue, overweight and low back pain. Doctor Young feels quite confident that these methods will be taught here to doctors as part of their training within ten to twelve years. In fact, it has great promise in the field of preventive medicine and as a means of fulfilling one's potentials.

I offered a workshop at the American Holistic Medical Association's annual congress held at La Crosse, Wisconsin. Many physicians, nurses and holistic health professionals attended.

At this workshop was a nurse who had practiced the meditaition of stilling the mind for four years. She reported that lately she had felt heat in her head, especially in her palate. Sometimes during practice periods, her tongue seemed to automatically reach up

and touch her palate, at which time a shock would run through it. This greatly frightened her. During the workshop she learned that the tongue acts as a bridge that connects the two channels completing the Microcosmic Orbit. That night she practiced again and felt so full of energy that she continued to practice without getting any sleep and yet felt very energetic throughout the next day.

During three workshops, four participants successfully completed the Microcosmic Orbit and many others indicated the potential to do so in the near future. One physician had practiced T.M. for about ten years and had already begun to experience heat and light in his head during his T.M. meditations. By learning how the energy flows and placing his tongue to his palate during this training period in La Crosse, he completed the orbit. By concentrating on his navel he experienced the light flowing in his Microcosmic Orbit.

At the end of the seminar a number of physicians were of the opinion that the concept of the Microcosmic Orbit as being a continuous circuit of energy is more reasonable than one in which the energy is allowed to flow only up to the head or be given no direction at all as in certain yoga practices,

The following are taped recorded excerpts from workshops on the Microcosmic Orbit held in New York City, Boston, Boulder, San Francisco, Los Angeles and Tampa. Participants (identified here as “students”) were asked to describe their experience with the Microcosmic Orbit. Responding are Mantak Chia and instructor Gunther Weil.

***Student*:** I practice the Microcosmic Orbit every morning. The total time that I spend each day is one hour. I feel sensations of heat flowing through my body. Sometimes there are sensations of a cool kind of energy. Sometimes I feel as though my abdomen is filled with energy. I have spontaneous movements when I practice. When they first occurred I wasn’t sure as to just what was happening and I found that I could stop them. When I relaxed, however, it started again, and I decided that it was generated from my body rather than by any choice of mine.

***Master Chia*:** This sort of thing is not unique to this system. Practitioners of yoga and zen and T.M. have all had similar experiences. The specific gyrations are unique unto the individual and to a particular time and place. However they are indentically produced

when areas that block flows of energy resist and then open up.

***Student*:** If I don't have a half hour to practice what can I do?

***Master Chia*:** The Microcosmic Orbit can be practiced anywhere, anytime, even just for one minute. You can do it for even just half a minute. Just think a smile and relax down. I want to stress that at any time during the day that you find you have just one minute you should smile and relax down to the navel. Doing this, you will find that the microcosmic orbit is set into motion. If you collect those spare minutes you may be surprised at how much time you have practiced during the day.

***Student*:** Do you have to go through all the organs?

***Master Chia*:** No. At this point you should simply smile and relax and fill your heart with love, let the loving energy spread throughout the whole system. In the beginning you just have to go through each organ as you have learned. Just like you learn the A,B,C's in the beginning. When you practice more it becomes a part of you, and you can read quickly. In the same way, once you practice, when you smile it will quickly fill all the organs and glands with smiles and love. You should then feel as though something is going down into your abdomen. When you can sense something around your navel concentrate there and in moments you will feel the circulation begin.

> The microcosmic orbit is important because it teaches you how to allow the mind to direct your blood circulation. The heart is the sole mover of blood in ordinary people. Here, we do Taoist Chi Kung. This is a means of mixing energy into the blood and is achieved by mind power. When this is done, the heart doesn't have to work as hard. If your hands are cold you should now be able to direct Chi there to warm them, because your mind directs the flow of energy and the blood follows. The more your mind is used to circulate Chi, the faster and easier your blood flows. If you jog or exercise violently you can increase your rate of circulation but here you can sit down and relax and though your heart doesn't work as hard as it normally does, your circulation will be increased.

***Student*:** I was born in New York. I'm an acupuncturist and I also teach people special corrective exercises based on a system by Master Oki from Japan. I do nutritional counseling, as well. I've

been studying martial arts for ten years. I did Japanese style karate for three years and Shun Ryo and now I do Tai Chi. I also do some Kundalini Yoga. The first thing I was really fascinated by was the diagnostic power of this during the relaxation part when we were going down vertebra by vertebra. I could actually detect what went on there, whether it was compressed or irritated or collapsed or bent. I was really surprised. Then when Master Chia put his hand on me it was like someone had lit a match there. The whole thing was on fire even long after he'd touched me. The heat had gone into my lungs and I could feel it healing them. I'd had some trouble with my lungs previously. This training has made me more relaxed so that I can now deal with stress conditions much more successfully. I feel centered now and I have developed a considerable amount of self-assertiveness.

Student: I have a hard time making the spiral in collecting the energy. Usually I feel that it overlaps or is of a distorted shape. I can't seem to make it spiral out.

***Master Chia*:** That's alright. That's the way it is in the beginning. Actually, if I feel I've done it incorrectly, I just do it again. Collecting the energy in the navel is so important.

We have two major divisions in our bodies. One consists of the heart, lungs and the brain, and the other part is the lower abdomen. The body can also be divided into hot and cold. Above the navel is heat and below is coolness or cold. That's why the Six Healing Sounds and The Fusion of the Five Elements are so important. There are some places where you can store energy without any harm, like the navel area, but when it accumulates elsewhere,it can cause unpleasant effects. You can compare concentration to bringing together into one point the sun's rays with a magnifying glass. Here we are able to add to that the ability to circulate that heat throughout the body. This will help your blood get warm and make you stronger and healthier . . . gradually feeding your body and then your soul and finally your spirit. Each level that you ascend to is altogether different. Your present energy is derived from your organs . . . but is still in a raw state.

The second level harmonizes these energies in the Fusion of the Five Elements . . . in which the heart, kidney, liver, lung and spleen are involved. Each of these organs produces its own particular energy and it is at this level that these energies are blended,

or, as the name indicates, fused and then distributed throughout the body wherever they are needed. So when you don't collect the energy at the end of your practice you have no way of knowing where that energy may be stuck. If Chi has collected in your head or chest you may be in for a lot of trouble because your brain is very sensitive to heat and you may have terrible headaches and possibly delusions. When your heart overheats, you find that you can't breathe well and that it beats too quickly. In regard to this there is a rule in Tao which is to keep your head cool and your feet warm.

***Student*:** Why does the right hand have to be over the left?

***Master Chia*:** It has to do with Yin and Yang. The right hand is Yang and the energy flows from Yang, right hand, to the left hand which is Yin. You get more energy that way.

***Student*:** Does it make any difference if you are right handed or left handed or a man or woman?

***Master Chia*:** No. The hand position is the same for everyone.

***Student*:** If men gather the energy together at the end of a practice session first clockwise and counter clockwise and women abide by the reverse procedure, why aren't their hands reversed as well?

***Master Chia*:** The flowing of energy through the hands is the same. The circulation of energy through the cycle for the man starts at the head, and the energy circulation for woman start from the earth. When the energy is yang to yin it's the same in both.

Student: If a person is mentally unstable, is he going to able to complete the Microcosmic Orbit?

***Master Chia*:** Some people come to me and after we talk I tell them A to go see a psychiatrist. They are "too hot" and have to do therapy first to slow down. I let them know right away that they are not ready now.

***Student*:** Can the Microcosmic Orbit be used to aid in the relief of major medical ailments?

***Master Chia*:** Many people in this practice fall in love with their organs and quickly give up bad habits as a natural course of events. Thos habits just don't appeal to them anymore.

I have a student in New York who completed the Microcosmic Orbit. One day he had pain suddenly in the back caused by a kid-

ney stone and had to go to the hospital. At the hospital he was given an injection of morphine, which he later said felt just like the experience when the energy suddenly rose up to the head. Naturally he was excited and he called me and asked me if that was possible. I explained to him that this phenomenan lately seems to have been backed by scientific investigations into the way the body makes endorphins, which are morphine-like compounds, and how acupuncture works to stop the pain. Anyway, whenever he gets pain now he stops it by meditating. You have to have some idea of the magnitude of the pain that kidney stones can produce to really appreciate this account. That student never fails to thank me now.

***Gunther Weil*:** Often when we have workshops there are people who have had injuries in the back, knee, scrotum. When they do the microcosmic orbit they say they feel heat or pain in those areas, because the chi is going to those areas first to heal them. This is sometimes a little painful. It's like a resistance coil. The electricity flows and meets with an obstruction and takes a while to work through it. But then it works quickly. If you do it everyday you'll find a lot of healing in your body. Old injuries will heal themselves faster.

***Student*:** I've benefited greatly from the practice. I came here because I have an injured back, as of three years ago. I'd been treated by chiropractors, acupuncturists and masseurs in Taiwan and in Tokyo, but nothing helped. Then a friend recommended that I come here because she said that she had had good results doing your meditation. After I had practiced about six weeks, I awoke one morning and felt a flowing sensation rise up through my legs.

***Gunther Weil*:** You'll have different experiences at different points. Some points won't have any sensations at all. And other points will be very st. It changes all the time. It depends on your general state of health that day, the atmosphere, how much prior experience you've had.

***Student*:** From doing the microcosmic orbit and the Six Healing Sounds I have a distinct sense of vitality, both physically and mentally. I find it an extremely valuable and valid approach. My first experience with meditation was in yoga and then, about 8 years ago, I learned Tai Chi and different types of meditation. Many teachers talked about energy flow, especially as regards to Tai Chi, but I never experienced it. I'd had my tongue to my palate through all of

them, too. But this meditation here has created a sense of rooting that goes way beyond anything I've ever had before. What I'd heard years ago about such things was purely conceptual but what I get out of this meditation is an organic relationship between myself and the earth. I really feel as though I were like a tree rooted in the earth or a wave in the ocean.

The Six Healing Sounds have been very invigorating, too. Whether I do the orbit or the sounds I come away feeling the same. You can feel the energy move through the various pathways. It's a very distinct, definite sensation. You don't imagine these other pathways besides the Microcosmic Orbit. And those sensations are also clear cut and definite. Afterwards I feel very good; I feel more alive, I feel very peaceful. Then, during the day, I find that I have more energy and I feel very springy inside. I'd done Tai Chi Chuan for some years and I was concerned about hurting my knees in certain postures. After I'd practiced the Microcosmic Orbit for a few weeks I found that I was no longer troubled. What I assumed were knee stressing postures no longer troubled me.

***Student*:** I've had quite a lot of experiences doing the microcosmic orbit. The first four or five weeks I didn't feel much at all and I began to feel concerned. By about the sixth or seventh week I had sensations that were almost like an orgasm and then I developed a feeling of euphoria. As I continued to practice I felt the energy rise. For a while it remained fixed at the midbrow area. In fact, I'd inhale when I practiced that was the only spot I'd feel. The most amazing experience I had was very recent when I was meditating at work. My tongue began to vibrate. My teeth then rapidly beat together and my head shook and then my body shook and my hands seemed to levitate upward. Then I realized that I could control the vibrations, at which point my body shook very fast, and then I slowed it down. This happens whenever I practice, now. It starts in the space of five or six breaths. At the end of such a session, I don't feel tired at all and that's what is most amazing to me. After I finish I bring the energy to the Tan Tien and rotate there and I get very calm, relaxed and happy, and strong, too. Along the way I've had other sensations, too, such as a different taste in my mouth. It's great!

***Master Chia*:** That is very, very good. That taste you had, we call nectar, and that feeling of orgasm we call self-intercourse.

***Student*:** I've practiced acupuncture for about three years and have studied martial arts as well. When you passed energy to me I felt a wonderful feeling in my chest and insides that was incredibly expansive, and hot and cold at the same time. I had a feeling of well being, of being grounded.

***Gunther Weil*:** Each of you has to find the balance between staying at one point long enough to experience the energy gathering there and then wanting to go on by itself, versus going from point to point with your own mind because you're distracted. Only you can know which is best for you. The mind's always jumping around and wanting to do things and so if it's given a task to go point to point, sometimes the mind just wants to do it. If you sit and decide that you did this point and now you'll do the next, it's artificial. There's an internal balancing that has to happen. You have to do it till you're satisfied, deeply satisfied that you've done it. So at the beginning of this practice when you're alone at home or working, go slowly. Take 10 to 15 minutes on each point. Really exhaust it, deplete it. Sometimes the energy will go ahead. Sometimes it won't. Sometimes I don't notice anything. Sometimes I'll sit and I won't experience any energy at all but I'll feel the benefit of the practice. About 20% of practitioners of this don't experience the sensations but receive enormous benefits from it.

***Master Chia*:** Sometimes your vitality or energy is too low and so your energy doesn't seem to do anything. Usually each month you have a week or two of lowered energy but the more you practice these dips in energy will be evened out.

***Student*:** How are Tai Chi and the Microcosmic Orbit Related?

***Master Chia*:** Tai Chi Chi Kung takes the principle of the microcosmic orbit and puts the energy in motion. In other words it adds chi or internal energy to the Tai Chi movements and works on the tendons, the chi passing from the internal organs out to the rest of the body including the fascia, tendons, muscles and bones. The microcosmic orbit creates the energy that is then used in Tai Chi. You can't imagine how happy it will make you.

Gunther Weil: When you do the first level in this system you begin to regulate your energy, opening the main channels. In saving and regulating the energy you're beginning to balance it, but you still can't do very much with it. When you're assailed from the

outside by factors that affect you emotionally you'll simply respond as you've learned to. That's why it's necessary that you do the first part of the Fusion of the Five Elements, because you learn a means of transforming the energy of your emotions, including anger. When you are in the presence of someone who's angry you can learn how to take that anger in and use it, or take your own anger and use it, by taking the energy out of the anger. Anger can be converted to a neutral energy either by returning it to its organ of origin (the liver) or by mixing it with the emotions of the other elements until no single emotion is any longer dominant.

***Student*:** I'm a chiropractor and I teach Touch For Health. This exercise was very powerful. The energy started going up my spine, like a jack hammer forcing its way up. When it went to the base of my skull my whole body shook. Then it went to my head, then my hair line, then settled in the bridge of my nose where it was really painful. Finally it felt like the energy went through. It moved down to the navel creating a huge amount of white light energy. A very powerful experience.

***Master Chia*:** Good. Keep your practice going every day. If you don't, all the energy will be reabsorbed. Just relax down to your navel and when you feel the navel is activated, go down to the next center, either the sperm palace or ovary center, and then to the perineum, and then to the coccyx. That is all there is to it. Remain there until the energy shoots up the back. Just keep the pump pumping up. The coccyx is like a pump that pushes everything up; and there's another pump at the upper end of the back, too, remember. Relax and smile down to your navel and the whole thing is set into motion.

***Student*:** How come you never gave us any preliminary exercises in breathing to do.

***Master Chia*:** Because you might have come to rely too much on it. Breathing is important, though, in establishing relaxation through the proper use of the diaphragm. Paying attention to breathing draws energy and attention from the mind and that acts as a drain and a distraction. Ultimately, we seek to arrive at 100% use of mind power and paying attention to the breath does not allow for that. Besides, on much higher levels breathing is no longer noticible. It is not without reason that we take as much time in letting everything "go down" so that the mind can be free.

There's something I'd like you all to understand. What you are practicing now is inner alchemy. The food you eat involves an outer alchemy. Many people today believe that by simply eating correctly the body will be brought to harmony. This is not true. If your body is not prepared your organs will not work together properly and all that good food will be wasted because it will not be utilized properly. It is common knowledge that under stress digestion and assimilation are hampered and that under extreme stress v there can be an overall emptying of food contents. Of greater importance, then, is the cultivation of the inner alchemy. With no exaggeration, if the inner alchemy is balanced, the outer will take care of itself. In the higher level, when our bodies are in perfect balance, we can get along with little food, or no food at all.

***Student*:** Is it important for a husband and wife to meditate together?

***Master Chia*:** When you practice as a family you will all change, becoming more harmonious. I have a student who told me that whenever she concentrated on her navel in the morning and her husband moved his leg she could feel the energy in her own leg go into his. In a short time she observed that his overall health had improved and he was no longer burdened with frequent headaches and colds. Another of my students, Richard Wu, rid himself of his allergies through Taoist Yoga. When his wife found herself similarly afflicted she asked to learn the method so that she too could find relief. It took her just one day to complete the micro orbit. Her husband came to me pleased by her accomplishment but puzzled, too, because it had taken him months to do the same thing. I explained that that was not unusual and that their energies flowed in sympathy because they lived together and that being with a person who practices can lead to such results.

Chapter XIII
An M.D. Interviews Three Practitioners of Taoist Yoga
by Lawrence Young, M.D.

An Interview with "S"

***Dr. Young*:** I would like to do an extended study of people who meditate. It's a venture that would call for a lot of follow up. Were you to take a drug for a month or so it would be fairly safe but were you to take it for 5 years it would not be. In the same way, the medical field is very eager to learn about people who meditate for a lifetime. That might include people who have problems, what the nature of those problems are, how they get problems and what they do to be rid of them. I'd like to know how you came to practice with Master Chia, whether there was any health problem that brought you into it or whether it was simply because you were interested in it.

S: It was a combination of all of them.

***Dr. Young*:** Tell me about your health interest.

S: I hurt my back about 6 years ago and ever since then have a hard job sitting, let alone lying down. I couldn't sleep through a whole night, my neck especially would hurt me. Ever since I came to practice with Master Chia, in fact, immediately upon trying this, the pain abated. As though to prove the point, about 2 or 3 weeks ago I became a little slipshod about my practice. There seemed to be too many different formulae. There are formulae you have to do — exercises might be a better term — and I was pressed for time and began to find excuses. I cut down the number of repetitions that were called for in each of the meditations and sure enough, my neck began to hurt again and my back has begun to hurt gain, too.

I don't really know, it may be a purely circumstantial thing. There may be other factors involved in this case, but it would seem over the years that I tried various things and had no help. It is more than

coincidence that when I tried Master Chia's practice it did seem to help. I had the usual orthopedic treatments with hot soaks and analgesics and muscle relaxants, which had me walking around in a stupor. I went to a chiropractor with very transitory results, but with some arrest of pain. Then I went to an acupuncturist, who didn't help at all. I then went to an herbalist who helped a little. This practice seems to have done something, seriously.

***Dr. Young*:** What was the diagnosis?

S: They said that there was severe muscle spasm — especially of the upper back, involving the neck and the area that was subscapular. They also found a portion of my lower back in which the distance between the vertebrae was narrowed. It looked as though I'd have a chronic condition mainly because of some pulled or torn muscle attachments. For almost two weeks after I fell, I couldn't lift my head. Nothing would happen. No inkling of a message (that I wanted to lift my head) would come through. In fact, when I tried to get up, just after I fell, I couldn't. When I pushed myself over onto my side my head just flopped over. Gradually, after two weeks strength came back into my neck muscles, but there was still an assortment of clicking and crunching noises and pains. My head was tilted to one side and one shoulder was contracted and higher than the other for months. The insurance people, in fact, agreed that the whole area was in spasm.

***Dr. Young*:** What did Master Chia suggest you do to cure this condition?

S: He first asked me to relax the area between and around my eyes. That alone helped to heal everything. All kinds of heat and flowing sensations came on on their own. There were various prescribed exercises designed to open up various energy routes. For example, the six healing sounds I found most relaxing. One is advised to do them before going to bed because they are conducive to good sleep. If I slowly stretch in the prescribed manner, allow for the effects to become evident after each time I very y loosen up. My pulse beats differently I seem to throb all over. It has a very quieting effect. Really! Another favorite of mine is also soothing, though in another way. All that it consists of is gazing at a spiral-like diagram until my eyes begin to water and then closing them a rotating them a set number of times, first in one direction and then the other. This produces a very good, soothing, soft, comfortable

feeling. Again the area around the eyes seems to be very important.

***Dr. Young*:** Basically, Master Chia taught a lot of relaxation exercises along with meditation?

S: I had developed a lot of tension doing the Micro Orbit and it was a matter of learning the knack of letting it happen that made the difference. Trying to do it interfered with it. First I had to learn how to relax.

***Dr. Young*:** The experience of the Microcosmic Orbit is the main thrust of my investigation. There is a sensation of energy isn't there? Of course, it's not proven and it will be disputed by scientists in the medical field for some time to come. Tell me whether you felt it was real or imaginary and if there were any side effects from your practice.

S: I have been with Master Chia for nearly six months now. I can direct the power to flow in the microcosmic orbit and still not suffer any ill effects. I used to have a lot of heat in my belly and a ringing in my ears as a result of other spiritual practices I tried. Master Chia said that the heat and ringing of the ears should go away as a result of my practice with him. Heat, he explained, is an extreme. He advised me to mix cold chi energy with it and cool it down. I think this helped me to avoid a lot of side effects.

***Dr. Young*:** Do you have warmth left?

S: I can produce it if I want.

***Dr. Young*:** Did Master Chia give you energy or did you get it yourself?

S: I don't know. He said I could get it just by being at his center.

***Dr. Young*:** Then he didn't do it more conspicuously?

S: No.

***Dr. Young*:** Did he ask you to bring the heat in the Tan Tien (lower stomach) up the back?

S: Right.

***Dr. Young*:** Do you think you use your mind to guide it and therefore it's there? Is there a way for you to tell if it's imagination or not?

S: This approach does involve guiding the energy to wherever you've been asked to. It's done mentally because where the mind goes that's where all sorts of physiological effects have their origins.

***Dr. Young*:** And how do you feel about that?

S: The method was suggested and I found that it wasn't difficult to do. I can feel the heat in my belly and if I think it's going to my back in the area of the Ming-men, it does and when I think/feel it's going up the back it does.

***Dr. Young*:** If you don't try to guide it, will it also rise up the back and flow by itself?

S: Sometimes it does.

***Dr. Young*:** Would you say that those times would give you some clue that your imagination is not needed?

S: Well, I did something in the beginning that he later told me not to do and that was, after the route was established, I let it go by itself and I wasn't concerned about the points along the way.

***Dr. Young*:** That would mean, then, that you have to guide it continually.

S: I'd just let it go by itself and the energy just seemed to zoom around along the route.

***Dr. Young*:** How long have you practiced?

S: About 6 months.

***Dr. Young*:** How many minutes a day did you practice?

S: Maybe three quarters of an hour each time, twice each day. I've been told that I don't have to cycle the route as many times as I had. Originally, I'd been asked to do it 100 times which I never could because I'd lose count.

***Dr. Young*:** How about the timing? How long does a cycle take? A second? A minute?

S: I can't say. It varied but it was not measured in seconds because I had to visualize stations as it were along the way. Eventually, though, he had me just touch on four points at the navel, perineum, lumbar region and at the top of my head.

***Dr. Young*:** What was the effect?

S: It was relaxing and felt warm.

Dr. Young: It helped your back?

S: Yes. I could sit in half lotus comfortably for a fairly long time.

***Dr. Young*:** The muscles were relaxed. And Master Chia didn't suggest to you or have you autosuggest that you are healing your back?

S: No, though he did say that the practice would heal it.

An Interview with Dan

Dan is a young photographer who, for eight years, had been putting much effort into practicing esoterics on his own, and had tried many other methods with many different masters. After studying with Master Chia for only two months, through simply concentrating on his navel, the Chi energy started to circulate in the Microcosmic Orbit automatically without concentrating on the other energy centers.

***Dr. Young*:** I know that you have been studying with Master Chia for about two months. I would like to know why you came here in the first place and what you have found since.

***Dan*:** I found out about Master Chia through the *"Free Spirit*", a magazine I picked up in a health food store. I called him up and he mailed me one of the booklets, which explains everything about the Microcosmic Orbit. After reading and practicing with forty to fifty teachers, his system sounded very good to me but I couldn't be sure and so I went to see him. After he explained the way the energy works, it seemed pretty logical to me, so I tried it out. He told me to concentrate on a point about 1.5 inches inside my navel, to feel warm — not to concentrate on anything else, to forget about breathing, forget about forcing anything and to just concentrate on the warmth in my navel.

***Dr. Young*:** Did he say that you should make yourself feel warm, to create the warmth or just concentratre and to feel whatever you could feel?

***Dan*:** First he taught me a breathing exercise to relax me and to get the energy in the navel going.

***Dr. Young*:** So did the warmth come up by itself or you created it in your mind?

***Dan*:** Actually I didn't feel much warmth in my navel. The other points felt warm, and my navel may have been slightly warm. I felt a lot of activity in the tip of my spine, in my back where my kidneys are, around my shoulder blades and especially in my head. My head felt, as though it had expanded and felt full of that same activity. My forehead and the tip of my nose felt numb. When I stuck my tongue up against my palate, I felt something like a charge of electricity on contact.

***Dr. Young*:** You don't suppose that suggestion was somehow involved when he had you concentrate on your navel, do you?

***Dan*:** No. I'd meditated myself for the past two years. Before I came here I had already seen yellow between my eyebrows, and had used it to concentrate on for hours at a time. When Master Chia asked me to concentrate on my navel, I saw light there too, but he told me not to pay any attention to it and insisted that I concentrate on my navel. In two days it had broken down to a yellow color sitting here and there and moving around but I didn't pay attention to it, I just continued to concentrate on my navel and kept my tongue sticking up toward my palate. I don't know exactly when, but I started to feel energy. My nose and my forehead grew very numb and I felt as though my head were expanding but he told me to just keep concentrating on my navel. Suddenly, I felt what seemed to be a vibration in the tip of my spine, in my back and between my shoulder blades, which after a while felt very warm, too.

***Dr. Young*:** When did you feel that?

***Dan*:** On Sunday, February 15, 1981 — the last time I was here.

***Dr. Young*:** So for ten days you did not feel much of anything?

***Dan*:** It was during my fifth session that I started to feel the Energy.

Dr. Young: The other ten days you just felt a little bit warm in the navel?

***Dan*:** The thing about it is that I feel the energy hitting my tongue sometimes then I can't keep my tongue in one place. It just shifts around by itself. I never had an experience like that before.

***Dr. Young*:** What about your tongue?

***Dan*:** I can't keep it in one place. It just moves around. This never happened to me before. The books I read, the "*Mysterious Kundalini*", "*The Chakras*", describe energy ascending up along the spine to the top of the head but Master Chia talks about it going all the way around and completing a whole route.

***Dr. Young*:** You just concentrate on the navel and this energy surges up your back through your spine?

***Dan*:** The first place that I felt something was in my back.

***Dr. Young*:** How does it go from the navel to the back?

***Dan*:** From the navel it goes down to the sperm palace and from there to the place between my anus and my testicles. I think he called it the perineum.

***Dr. Young*:** Do you think you really felt it or was it because he told you about it?

***Dan*:** I felt it but I wasn't sure at first. I also started moving around because I had been sitting too long and when I sat down again I also felt it. Now, I am trying to figure it out because I know it is real.

***Dr. Young*:** You did not concentrate at the point in the back at that time?

***Dan*:** No, only on the point inside the navel. Then it went up the spine and so on all the way around.

***Dr. Young*:** How long do you think one cycle took you?

DAN: I can't tell exactly how long it takes.

***Dr. Young*:** So basically you feel the point sensation rather than the current?

***Dan*:** I feel vibration, even though I have felt heat but' moves like a vibration coming up.

***Dr. Young*:** Is it through the point or in between?

Dan: It is more as though it is inside the spine.

***Dr. Young*:** How about in the head?

***Dan*:** I feel very good in my head. It feels numb and expanded.

***Dr. Young*:** Do you feel a vibration going through it?

***Dan*:** Yes, that's the numb feeling.

***Dr. Young*:** But not like a river going through it?

***Dan*:** No, I feel warm and at the end of the meditation I fell my head getting big and warm. I also feel as though something were moving very fast all through my body.

***Dr. Young*:** You feel another body vibrating or your physical body?

***Dan*:** I felt as though another body came out of me and extended six to eight inches beyond my physical self. The thing I didn't feel too happy about, though, is the pain in my right arm from an old injury.

***Dr. Young*:** This happened today?

DAN: Yes, whenever I concentrate on my navel, now, whether it's at home or in the subway, I feel the vibrations.

***Dr. Young*:** You can also do that in the subway?

***Dan*:** Yes, but if I find a quiet place I can concentrate more effectively. Oh! I forgot to tell you that when I concentrated today I felt a sensation in my ears as though something had opened up, a sort of tickling. Master Chia described that as the channels opening up.

***Dr. Young*:** Do you know how he teaches other students?

***Dan*:** What I like about this system is that it is so simple, a baby could do it. It is not complicated. Just concentrate.

***Dr. Young*:** You mean that you never concentrated in your practice?

***Dan*:** Maybe once or twice but I used to concentrate in the higher centers, the thyroid or the solar plexus.

***Dr. Young*:** And nothing happened?

***Dan*:** No.

***Dr. Young*:** Did you know that he tells his students to concentrate on different points along the line?

***Dan*:** He did tell me, too, to concentrate on the base of my spine, my back, crown, etc. But I don't have to concentrate point by point. It just happens.

***Dr. Young*:** That is what is so important about your case.

***Dan*:** The main point that he is concerned about is to have the energy circulate and to get the channel open and strengthen the tissues. It is not imaginary, because I can feel something going up right now.

***Dr. Young*:** I know. It's very important. You never even tried to bring it around?

***Dan*:** Before that, I meditated very intently for hours on the point between my eyebrows. He said that that probably helped me. When I came here I probably did the right thing and completed the circle by sticking my tongue up against my palate. But right now it is still hard to tell what will happen.

***Dr. Young*:** Yes, at least you have developed something, but whether it is beneficial or not, we have to see in the future.

***Dan*:** I hope to develop my health to the fullest.

***Dr. Young*:** Do you have any health problems?

***Dan*:** I strained my left testicle and I have problems with hemorrhoids.

***Dr. Young*:** Would you say your practice is spiritual or physical?

***Dan*:** It is spiritual, physical, scientific, technological and especially related to my body.

***Dr. Young*:** And hopefully it will lead to an advance in medicine for years to come.

An Interview with Bill

***Dr. Young*:** Our interview today is basically concerned with meditation and health. First of all I would like to know your background.

***Bill*:** I am 37 years old. I work as a bartender. I study acting but I don't work at it. I have some Yoga training and have fasted for two months on pure water. I came to see Master Chia with my sister, because somebody told me there was a Tai Chi school here. I was impressed by what he had to say. There was nothing wrong with me. I just wanted to use it as part of my Tai Chi. So far, though, I have just stayed with Master Chia's Tao method. I was perfectly healthy before coming here but I have benefitted from this training anyway. I feel that my practice has made me extra calm. Along with that it helps me in my everyday life of being in contact with people. I can be more relaxed.

***Dr. Young*:** You mean you are more efficient and enjoy life more.

***Bill*:** Yes, along with that I also work out in my exercise class and do weightlifting. I feel more grounded when I do this practice. I can feel the energy in my body and it is a very positive form of meditation. I meditated before but never to such a great extent with any other teacher. I learned it on my own, from what I read, from yoga. Master Chia's system compliments the meditation I have already been doing.

***Dr. Young*:** You say you did some meditation from a book? What book was that?

***Bill*:** I read about TM in a paperback book that is on the market, but I sat on my own even before then.

***Dr. Young*:** Did you feel "energy" even before studying with Mr. Chia?

***Bill*:** It is not a matter of energy. It's more like sitting in a kind of consciousness. I never developed Kundalini or the power, 1 never felt it. It was just a certain kind of awareness that I had, like, when I concentrated on my arm I just felt the skin on my arm. I just tried to feel the blood circulating, it was just a matter of '' awareness more than anything else.

***Dr. Young*:** How long have you lifted weights?

***Bill*:** I've been doing it about 6 months.

***Dr. Young*:** You started it just after you began meditating with Mr. Chia?

***Bill*:** Yes.

***Dr. Young*:** Would you say weightlifting and meditation benefit each other?

***Bill*:** Yes, definitely. It contains a lot of techniques that I find in weightlifting. It is a way of connecting myself to the power that enables me to make rapid gains in my lifting.

***Dr. Young*:** You say you practiced this method with Master Chia and felt energy. Do you really feel energy?

***Bill*:** Definitely.

***Dr. Young*:** Not like before, right? Because before you said it was just like an awareness but this time it is not?

***Bill*:** This time it is not. When I read your book I related to my

class mates tremendously how they felt this warmth, the heat, the coolness, I felt all that. It feels like a surge of energy that I get, I can feel it going through me.

***Dr. Young*:** How many months has it been now?

***Bill*:** Almost a year, but I have been coming on and off.

***Dr. Young*:** How long had you practiced this method before you felt this energy? When did you feel the heat?

***Bill*:** I consider myself very lucky because I felt it right away, the first day. I actually felt something. That is what caused me to come back again.

***Dr. Young*:** Did he give you the power? Did he put it into your navel or something?

***Bill*:** I remember him touching me. I think I felt something but it was very slight.

***Dr. Young*:** So there is no special arrangement in giving it to you.

Bill: He showed me how to go about it and I think he knows that I am able to grasp it easily.

***Dr. Young*:** How long does it take you to feel the circulation of energy?

***Bill*:** It happened the first day. He told me to concentrate on the navel and I started feeling it. I wondered when I was feeling it, was it imaginary or was I really feeling it? Before he told me about it, he drew me a diagram of how the energy goes. This, of course, helped me to locate the energy when I visualize it in my meditation.

***Dr. Young*:** So did you resolve the issue as to whether it was imaginary or not?

***Bill*:** It is real.

***Dr. Young*:** There is another thing that might help you, Master Yun , who lived in the 1900's and had no teacher explored this by himself. There have been others too. There is one who presently lives in Taiwan. They don't have any guidance, which may more dangerous but they did find the route of circulation.

***Bill*:** I would be more afraid if I didn't know what I was getting into. It would keep me from going into it if I didn't have guidance.

***Dr. Young*:** Now, about circulating the first route that you opened up. What was it? How was it? Where was it?

***Bill*:** It's in the front and the back and I at first thought it was my imagination. Then I started having the same kind of feeling, in my hand and along with it comes a certain kind of warmth, which changes sometimes, sometimes it's warm, sometimes it's cool.

Now, I do the thrusting route as the second part of the meditation. I was just telling Master Chia that I can feel it, that when the energy pushes up to the head it just feels like somebody hit my head with a hammer. I feel like energy is going thru. I was debating in my mind whether it was imaginary or real and I decided that it cannot be imaginary because I could feel myself jerk and shake as it goes thru and causes pain, on my left side here, around the colon area. It was so painful that tears actually came to my eyes. After I finished, I went to my belt route, after which I felt much more calm.

***Dr. Young*:** Those feelings could be sensations of energy, but from a medical point of view it would be very hard to prove. Did the energy flow along a certain route in your body?

***Bill*:** The front route (functional) and the back route (governor). It goes from the navel to the bottom and all the way around. It does follow that route and it looks like energy too. I do feel energy with it.

***Dr. Young*:** How about acupuncture points?

***Bill*:** I feel them, too.

***Dr. Young*:** How did you feel it? Did the energy slow down at those points?

***Bill*:** Like in the governor route, I can feel certain parts of my anatomy. The energy stops at the big points, like the coccyx, the crown, the mideyebrow.

***Dr. Young*:** Is the belt route at the navel level?

***Bill*:** Yes, the belt route starts at the navel area and goes to my left and left around again up to my solar plexus, heart center, throat, eyebrows, and crown. Then it goes up and comes down again to my waist, going from left to right.

***Dr. Young*:** Do you really feel the 4-5 circle of the belt route?

***Bill*:** I feel it when I guide it.

***Dr. Young*:** The idea is that there is no one fixed route.

***Bill*:** That's not so. I'm doing the belt route, now. Here, I go up the crown and my body in a spiral pattern, passing definite places like my navel, solar plexus and heart.

***Dr. Young*:** Did the energy jump across any empty space anytime in your experience?

***Bill*:** Yes. Sometimes I feel energy quickly go up in my thrusting route, all the way from my coccyx to my head. When I direct it down to my feet, I can feel the power flow out of my soles and make a half circle outside of me from my toes to my head.

***Dr. Young*:** How about common colds?

***Bill*:** Yes, everybody had the flu. About two weeks ago, I came down with it. But I went through it very quickly. People who have the flu take nine days or even longer to recover. For me it took something like three days.

***Dr. Young*:** I have interviewed a number of people who have related similar accounts to me. There must be something to it. They claim to have fewer colds now that they practice with Master Chia and they also claim that they can drive the cold away within a short time.

***Bill*:** I think it will be interesting to try to heal more sicknesses this way. The west should be ready for this method because, and this is my own observation, the American people are just beginning to notice the power that they have, the power (energy) around all of us, call it what you may, God, energy, whatever. They are slowly coming to realize that there is something more than just the physical.

Part V:

Beyond the Microcosmic

Chapter XIV
Observations on Higher Taoist Practices

The following is a discussion by Mantak Chia on the higher levels of Taoist Esoteric Yoga, tape recorded at the annual retreat in North Andover, Mass. August 1982.

You endeavor in your practice here to open channels so that your soul has some place to go. The Microcosmic Orbit provides a crib for you, when you are a 'baby' so that your soul and spirit can run on it. As you grow up a separate room is made ready to provide you with privacy.

This room represents the 8 psychic channels. When you get a bit older you are provided with yet a larger room, the 24 channels. It is then that you are taught what is good and what is dangerous in the lesser enlightenment, the greater enlightenment, the greatest enlightenment, the sealing of the 5 senses and the congress of heaven and earth. You are 'six years old' now and in school. It is during this time that you acquire the ability to extend the spirit outside of you. At first you may be able to let it go out about one foot and then withdraw it. Gradually you can let it out more and more until after some time you can let it roam about freely outside of your body. This education of the soul and spirit is a tedious and time consuming process, taking 30-35 years.

There may be some geniuses who can become adept at astral projection in as little as 20 years, but there is always the risk that madness can ensue with premature exposure to forces that one is not yet ready for, madness of a sort that masters are afflicted with and must keep secret. I know, because I have met many troubled practitioners. In fact, M.D.s refer just such problems to me.

There are teachers who have had ill effects using their own particular methods, but still continue to teach because they adamantly maintain faith in those methods that they espouse in spite of how they have suffered by them. The methods should serve the practitioners. In this light, there is no Taoist method, but rather practioners who make of Taoist Yoga their own individual methods. Tao is a

word that signifies the natural way of life. Each of you must find your Tao, open your channels and essentially make your system. When you are the least bit successful in this endeavor you will realize how truely priceless such knowledge is. You will learn how to pity the very people who might have caused you great anguish, as much by your own interpretation of their action as by their unwritten display of their own troubled minds.

In first level work we learn how to relax to a much deeper degree than we are ordinarily able to. Here we learn to 'smile' to the heart and to fill the heart with 'love' and then let that 'love' radiate throughout our whole system. You have to know how to love yourself. You have to know how to love your organs. If you can't love your organs or yourself, how can you be able to love others?

It is best that everyone in a household practice. Then they can all improve. If there is just one practitioner, he or she would probably find energy drained by others that one lives with. It is as though there were just one breadwinner in the house and everyone else is living off of him. Were they all to work, they would all share equally and all prosper equally.

The foundation for all subsequent practice is the Microcosmic Orbit, Seminal Ovarian Kung Fu, Iron Shirt Chi Kung and Tai Chi Chi Kung. Seminal Ovarian Kung Fu is important in sealing the lower centers as the front door and the back door, the reproductive organs and the anus, to prevent a leakage of energy. The Fusion of Five Elements prevents further leakage through the five sense organs. Iron Shirt Chi Kung is important in storing energy and Tai Chi Chi Kung helps bring energy to your hands and legs. You can see that what I teach is an entire system.

Taoist Yoga and the Kundalini

By Michael Winn

Although Hatha Yoga became known in America in the 1930's, it was not until the late 1960's and 70's that attention began to focus on the higher stages of yogic development in which a phenomenon occurs known as "awakening of the kundalini". The kundalini is the sudden release of vast untapped reservoirs of creative energy that transports an ordinary human being into states of higher consciousness and bestows upon him or her unique creative pow-

ers. A person who has attained full command of this cosmic energy is said by the Hindus to have attained a state of “samadhi”. The Buddhists call it “nirvana”, while the Chinese refer to it as the “Tao”. In the west it might correspond with what Freud alluded to as an “oceanic feeling”, but among the prophets of the New Age it is known as “superconsciousness”. None, of course, agree as to the best path to achieve this awakening, but the parallel among them is distinct.

In India, the kundalini is symbolized by a serpent awakening from a deep slumber and rising up from the base of the human spine in a spiralling motion through the seven energy centers (chakras) of the body, purifying and unblocking the powers of each center as it rises. For millenium this same serpent has been a universal symbol for wisdom and healing. Nearly every Egyptian pharoah is depicted in statues with a serpent emerging from the third eye in the forehead.

Today, modern western doctors wear on their white laboratory coats the Greek symbol of healing energy, two serpents spiralling up a staff. The Taoists in China revered the snake as a wise animal, but symbolized the Tao more abstractly, with the yin and yang symbols spiralling into each other. It is important to note the Taoist yin and yang spiral was contained within a circle, while the traditional Hindu kundalini serpent spiralled vertically up to the crown chakra atop the head.

The Taoists referred to in this essay, are the masters of Taoist Esoteric practices, whose traditionally secret methods were studied by Master Mantak Chia. This is not to be confused with the Taoist religions, whose priests combined elements of Buddhism, Esoteric Taoism, and Chinese culture (folk beliefs, confucianism) in order to maintain a popular base.

The symbolic difference translates into a real difference in terms of the meditational approach aimed at awakening the release of this cosmic energy. The Hindu yogis emphasized raising the kundalini energy up to a higher transcendant level, while the Taoist masters emphasized harmonious circulation of this energy between chakras. The Taoist emphasis was on achieving perfect balance between yin and yang forces within the body rather than on leaping beyond human form into divine states.

It was not enough for the Taoist masters to simply know that the Tao, the highest state of oneness existed; the problem was how to

gain experience of it in a safe, systematic, verifiable, and useful fashion. Chinese pragmatism worked its way into Chinese metaphysics. One did not raise up one's consciousness toward Heaven without rooting it equally deep in the Earth. This need for "grounding" defined the development of Taoist yoga. Tai Chi Chuan is nothing more than a walking yoga with self-defense and healing applications. Unlike Indian yoga, one's feet never leave the ground, increasing one's "rootedness" in the earth energy and safeguarding against excessive kundalini energy in the head.

It is this excessive energy in the head that often leads to illusions of spiritual advancement, also known as spiritual egotism. It is not unlike an intellectual who spends all his energy arriving at conceptual solutions to the world's problems, but ignores the messages from his own body about its poor health or finances. In a similar vein, Wilhelm Reich once complained that yogis would often drive energies into their head chakras without removing the "body armor", or tension, plated about the lower body. He argued their heads would pulsate with higher energy, giving the illusion of cosmic serenity, but progress to full circulation of the cosmic energy would remain blocked.

The Esoteric Taoist system guards against this danger by beginning with the very lowest chakra energy, the survival needs, and constantly reintegrating it with the higher energies that are developed. The Microcosmic Orbit is a perfect example, as it circulates past all seven chakras in the body. Likewise, the Taoists don't advocate sudden abandonment of all one's ego. Depending on the individual, a secure job and loving family may supply the best grounding for spiritual growth.

The Taoists advocate moderation, not asceticism. They teach that if a desire is destructive, it will drop away naturally as the body's chi flow comes into balance. The goal is to bring the body, mind, and spirit into harmony with the world, not to escape from it. Tradition has it many Tao masters would spend decades moving among the common people. Only after teaching them how to balance their anger with love, how to live more harmoniously, would they disappear up into the mountains to work on a very high level of meditation that required deep absorption in nature.

This harmonizing of the forces that fuse man, society, and nature together is evident in Chinese classics such as the I Ching. Written by esoteric Taoist masters, it simply expresses in poetic

form the subtle changes in the balance of chi energies they observed in themselves, others, and nature. The proper approach to understanding the I Ching at its deepest level is to train oneself using Taoist esoteric yoga to read the changing elements within oneself.

In the higher levels of Taoist meditation the practitioner grounds him/herself in the body by channeling higher energies into the acupuncture meridian system, and circulating them throughout the entire body after refining the energies into a digestible form. The practitioner has a detailed map of the body's subtle nerve system into which he guides the released energy. He also is given precise methods for transforming his physical, emotional, and mental makeup at different stages of growth using this new energy. Each individual must tailor this "internal technology" to his specific needs and problems. Esoteric Taoism doesn't solve ego-created problems by demanding the surrendering of one's individuality to a larger group of guru.

The only devotion it demands is a disciplined committment to leading a healthy and harmonious life. Taoist Esoteric yoga is compatible with any religious belief. The language of Taoism is not defined by any set of mental "beliefs", but by the "experience" of increasingly subtle and powerful forms of chi energy. No mythological entities or divine symbols are evoked. But if someone chooses to identify this chi with the Christian notion of the Holy Spirit, it will not adversely affect the Taoist method of chi transformation. This holds true at the very highest levels of practice. This same Christian could draw accurate parallels between the Biblical ascent of Elijah on a flaming chariot into Heaven with the Taoist formula for the seventh stage meditation, "Reunion of Man and Heaven". Similar parallels could be drawn with Buddhist Hindu, or Qabalist symbols of spiritual advancement. The point the Taoist masters were making is that the pattern of chi flow and balance is similar in all men, regardless of interpretive belief about their religious experiences.

Taoist yoga is a theologically neutral method for preparing the dense physical and mental body to consciously receive a more powerful dose of cosmic yin and yang energies. Imagine the average human being is accustomed to functioning on 110 volts. He cannot suddenly absorb into his conscious mind the kundalini energy, which is powered by the subatomic nuclear energy that binds the universe together and is made visible in the radiant heat and

light of the sun. To even double the received voltage to 220 re quires considerable conditioning of the body. The more accessible form of Kundalini power is human sexual energy. But to absorb anything above your accustomed voltage is dangerous, like being struck by lightning without a ground wire to the earth. The Taoist system of circulating chi, from the Microcosmic Orbit up to the level "reunite Man and Heaven", is a grounding rod for Kundalini energy.

Modern researchers into spiritual phenomena see the Kundilini as a possible mechanism to describe radical leaps in the evolution of human consciousness. The form in which it spontaneously occurs (i.e., without special yogic training) in nature would produce, in successful cases of evolution, creative genius and in the unsuccessful, madness. The classic account is Gopi Krishna's autobiographical "*Awakening of the Kundalini*" (Shambhala Press).

Gopi Krishna was an Indian railroad official who in 1937 experienced abrupt, dramatic physical and psychic changes as a result of his yoga practice. Energy began dancing and coursing powerfully through his body, but his initial wonderment and bliss soon faded. He was nearly incapacitated by it as the energy would not stop, sometimes leaving him tormented and sleepless for day on end. Only after twelve years of this nightmare existence was he able to learn how to balance the energy within his body and use it in a newly discovered creative life as a poet and author of a dozen books.

The Kundalini Research Institute in New York City reports worldwide over a hundred cases each year of individuals who cannot explain the uncontrollable release of energies in their body, often accompanied by days of sleeplessness, ringing and hissing noises in the ears and flashes of light inside the body. Some are students of yoga or meditation whose teachers abandon them after seeing they are powerless to diagnose or help the condition.

For this reason kundalini-oriented practices have earned a reputation as dangerous, radical, and unsafe for most westerners seeking what they falsely perceive as the fastest path to enlightenment.

A number of students suffering from kundalini-like side effects of different meditational practices have come to Mantak Chia for advice. Usually after doing the Microcosmic Orbit or simply putting the tongue to the palate and thinking down, these unpleasant symptoms disappear.

But the Chinese esoteric system is not limited to therapeutic uses. Practitioners of other techniques, sitting, mantra, pranayama, can achieve a high level of awareness and a balanced experience of kundalini-like energies. But several have come to Master Chia and privately complained that they don't know what to do with all their energy, or how to transform it to an even higher level. One yogi wrote Master Chia that even after doing yoga for 18 years, 12 of them in an advanced practice of kundalini yoga, he had never felt such a "pure and distilled energy" as he experienced in the Microcosmic Orbit and first level of Fusion of Five Elements. He plans to integrate the Taoist yoga into his daily sadhana.

Another high level Zen meditator told Master Chia he felt alienated from the masses of unawakened human beings and depressed by the mechanicalness of their living only to eat, work, drink, and sleep. Master Chia taught him how Taoists harmonize with larger forces outside of the self.

At the very highest level Esoteric Taoist yoga has techniques to awaken the kundalini energy to such a level that consciousness is thrust beyond the body for the purpose of doing spiritual work in subtle realms of consciousness. According to Master Chia, the Taoist masters modified a crucial aspect of the kundalini yoga techniques learned from Indian masters who travelled to China. The Taoists detected a practical problem with the Indian method, which unites the human mind with its higher spirit by literally ascending out the crown chakra above the head.

If one ascended out the crown chakra prematurely, there were grave physical and psychic dangers. But if one took too long there was also the danger of physical death before one had completed the process of transforming mind and body energy into spiritual energy. The Taoist masters resolved this problem by incorporating their knowledge of subtle anatomy of chi flow. The result is that in Taoist esoteric yoga one does not focus energy on a single chakra, such as the heart, third eye, or crown chakra, with the intention of using that energy center as the gateway to higher consciousness. It is possible to open one or several higher chakras and still have their power undermined by physical or moral weakness in the lower energy centers. This can block progress to the highest levels if the practitioner denies or ignores this imbalance.

The Taoists avoided these problems by absorbing higher energy, whether from outside sources or sexual resources and cir-

culating it continuously through all the centers. The goal was to build a solid and powerful energy base, self-contained within the human form, before the final transormation of the mind (or "soul") into spirit was effected. They would so thoroughly master their chi flow within the body that they could consciously circulate this chi outside the body as preparation for a safe pathway on which this soul could follow.

Master Chia thus describes the Taoist approach to kundalini awakening as the body and mind "parenting" the rebirth of its own soul into the next dimension of consciousness. One does not expect a human infant to fend for itself immediately after birth; that is the parent's responsibility. The reborn soul, ascending out the crown chakra and arriving as an infant in a confusing new world, would have "adult" guidance in the form of a powerful field of balanced chi energy protecting it from malevolent astral forces.

Because the full transformation of all physical and mental chi into spiritual chi energy normally takes many years, there is a danger of premature physical death before the process is finished. This danger becomes more acute with practices that accelerate the inrush of kundalini energy, as the body and glands must adjust to radical changes in metabolism. The Taoist masters circumvented this by mastering the act of physical longevity, chronicled widely in Taoist literature as the quest for physical immortality. The collective genius of the Taoist masters evolved an esoteric spiritual system designed to simultaneously awaken the kundalini and function as a healing system applicable to the whole gamut of daily stresses and illnesses.

The attraction of the Taoist yoga system is that it is as safe and methodical as climbing a ladder. You climb only as high as you can safely maintain balance and still keep the ladder rooted. The Taoist masters emphasized staying in harmonious balance on each step was more important than getting to the top of the ladder; trying to jump ahead increased the risk of falling. The goal was not to leap into some transcendent pie-in-the-sky, but to arrive with the graceful surefootedness of a Tai Chi dancer.

Awakening of the kundalini energy does produce a transcendent state of consciousness, but with Taoist Esoteric methods it is only achieved when the ever changing and opposing forces of yin and yang are first identified and then continuously, even automatically, brought into harmonious balance by the individual. It is a pro-

cess available to anyone anywhere with a functioning mind, whether he/she is rich or poor, a cripple or an athlete, a housewife or an executive, a criminal in prison, or a sailor alone at sea.

This internal feeling of expanding harmony is the highest freedom available to human beings, but unfortunately is rarely sought for lack of vision or discipline. Taoist Esoteric Yoga is an ancient system that has proven its worth over many thousands of years in aiding seekers to awaken awareness of that highest harmony.

Chapter XV
Summary of the Seven Stages of Taoist Esoteric Yoga

Small Heavenly Cycle (Microcosmic Orbit)

The introduction to the seven higher formulas of Taoist Esoteric practice is the Opening of the Microcosmic Orbit, or the rebirth process of return to the mother's womb. This route is composed of the Functional and Governor Channels, which must be purified and linked to form a free-flowing circuit.

The life of a human being begins with the piercing of an egg by a sperm cell. From this original act of Kung Fu, an enormously complex human being develops, which is capable of real genius. The fetus develops around that point, which is called the navel. It is from this point that nutrients are absorbed and wastes expelled from the developing creature. Therefore, in the Warm Current Practice the navel is a point of overriding importance. While in the womb the human being doesn't breathe air (the lungs do not function at all). Energy and oxygen are passed to the fetus through the umbilical chord. When the energy flows into the fetus' body, it enters at that point at which the navel will later be after the umbilical cord is severed. Then it proceeds downwards to the bottom of the trunk flows all the way up the spine to the crown of the head and from there flows down the middle of the face continuing on to the navel, again to complete the circuit.

The fetus, it is said, automatically touches its tongue to its palate. This serves to link the two energy channels and allows the power to flow. The crown of the baby's head is open and moves up and down. This is due to the waxing and waning of the flow of power through this particular part of the body.

Thus, the tongue is the terminus of the Functional Channel. This energy pathway begins at the bottom of the trunk at the point midway between the anus and the testes, called, the "Hui-Yin". From there

it flows up the front of the body through the KuanYuan and the Chi-hai and then through the Chi-chung (the navel). Then it passes through the Chung-wan (solar plexus) and proceeds to the Shan-chung (the heart center). Thereafter, it passes through the Hsuan-chi (throat) center and up to the tongue terminus. When connected with the Governor Channel the energy path reverses direction and flows down from the tongue, navel, to the Hui-Yin.

The Governor (or control) Channel also starts at the Hui-Yin. From this point it moves up the posterior of the body. In doing so it passes through the Chang-chiang (the base of the spine) and goes up to the Ming-men (L2 and L3) or Door of Life where it continues up to the Chi-chung (TI1) between the adrenal glands and then proceeds upwards to the Yu-chen or the Emerald Pillow of the medulla. From there it rises to the crown of the head or Pai-hui (the crown) and then goes to the Shen-ting and down to the Yin-T'ang between the eyebrows. Here it passes to the San Ken (the tip of the nose) and finally travels down to the palate, which is the terminus of the Governor Channel.

Tongue is a Switch of the Circuit

The circuit may be closed when the tongue end of the Functional Channel is raised to contact the palate terminus of the Governor. Thus, during practice, we must keep the tongue in contact with the palate. Placing the tongue against the palate has a calming effect for those who practice the Warm Current Method. It also generates saliva, which is regarded as the water of life in Taoist practice. Saliva is said to be the chief lubricant of all bodily functioning. In the Taoist view the soft palate is regarded as a direct link to the pituitary gland.

As a man grows older he suffers increasingly from an imbalance of Yin (female) and Yang (male) energies in the body. As these disharmonies multiply, the bodily organs begin to suffer from the receipt of too much or too little energy. How different is the vital power of the infant! He grows nearly an ounce a day. This represents an astounding accomplishment in the assimilation of energy by the material body. The baby's body can do this heroic job of cell building because its routes of energy are thoroughly open and the flow of power is, consequently, very strong.

The Governor Channel controls the Yang organs of the body. These are the lungs, spleen, heart, kidneys, circulation-sex, and liver. The Functional Channel controls the Yin organs, which are the colon, stomach, small intestine, bladder, triple warmer, and gall bladder. The tissues are Yang in tendency and the blood is Yin.

Seven Formulas of the Seven Books of the Tao

First Formula: Fusion of the Five Elements

This formula literally combines the separate energies of the five principal elements into one harmonious whole. The meditation has a particularly powerful filtering and purifying effect upon the human nervous system.

The Earth is the Mother of all the elements. All life springs from her generative womb. This reunites the other four elements of Chinese cosmogeny with the mothering Earth. Thus, metal, wood, water and fire are drawn back into the earth and are simmered gently at this point. Each element is purified but is not so hotly fused that it loses its integrity and dissolves into ashes.

This formula is regarded as a highly secret method of Taoist meditation. In Chinese Philosophy each element corresponds to a particular organ. The Earth corresponds to the spleen, metal to the lungs, water to the kidneys, wood to the liver, and fire to the heart. The five elements interact with each other in three distinct ways: producing, overcoming, and threatening. The producing or creating cycle runs thusly: wood burns to make fire, the ashes decompose and seep into the earth, where are born and mined metals, which when melted become water (liquid), which nourishes trees and plants. The overcoming or destruction cycle runs thusly: wood is cut down by metal, fire is extinguished by water, earth is penetrated by wood, metal is melted by fire, and water is interrupted and cut off by earth.

The life cycle also has its relative elements thus: birth corresponds to wood, growth to fire, maturity to earth, harvest to metal and storage to water. In climatic types, wind corresponds to wood, heat to fire, dampness to earth, dryness to metal, and cold

to water. Their corresponding emotions (sympathy, sadness, joy, anger, fear) blend one harmonious whole, raising the morale and encouraging kindness, gentleness, rightousness, respectfulness and humor. The formula of the five elements combined into one involves the mixing of the Yin and Yang to attain a higher state of bodily harmony and beauty. The ancient alchemical formula Solve Et Coagula corresponds to the second stage in the meditational forms.

In this stage you will realize the great use of the Five Elements which already exists in your body and which you may have studied but not understood experientially. The fusion of the elements, will provide you with such an experience. In this stage a cleansing of the whole body takes place. There may be much gas and bowel movements with very black, foul smelling stools.

Another six special routes must be opened, making eight routes in all. The first two are the Governor and Functional Channels. Next to be cultivated is the Chung-Ma.

The Chung-Ma, or Thrusting Route, which originates in the lower abdomen in the Hui-Yin and moves upward along two lines to the midpoint between the nipples where it spreads out to the shoulders and then joins at the collar bone. From there, it proceeds up to the face, crosses at the mouth and moves up to the point between the eyes and then up to the top of the head.

Another pathway of the Thrusting Route is started at the Yun-Chuan (the ground to earth), goes up the inside of the leg to the thigh and joins in the Hui-Yin. Starting at the Hui-Yin and running up through the center of the body, it passes through the large and small intestines, kidney, pancreas, liver, stomach, heart, lung, trachea, and up into the brain (pituitary, pineal and the middle brain up to the top of the head, Pai-Hui).

The second special route is the Tai-Ma. This energy channel originates at the ribs and circles the waist in ribbon-like bands. For this reason it is called the Belt Route. It is considered as a belt binding up the Yin and the Yang channels. This channel, when properly open, will spiral around the whole body. Looking down at the floor, the ribbon, as it were, would be seen to unwind going counter clockwise or right to left and proceeding up the length of the entire body, and joining all the body channels together. The spiraling is in a clockwise direction for women.

The third special route is the Yang-Chiao-Ma, the Positive Leg Route. It starts at the outer aspects of the two ankles and rises up the outside of the legs along the outer thighs. From the thighs it goes up to the hips, a strong absorbing energy center, the outer sides of the back and winds over the left and right shoulder, which are strong absorbing energy centers, whence it ascends along the neck to the corners of the mouth and enters into the eye-sockets and then over the forehead and skull to terminate in the medullar region.

The fourth special route is the Yin-Chao-Ma or Negative Leg Route. This channel originates at the center of the soles and turns along the inner sides of the ankles, rising up the inside of the legs. It passes from the inner thigh past the external genitalia and continues up to the chest, clavicle, throat and up to the face to the inner corners of the eyes. These routes are composed of two routes, one on each side and can be worked separately, also.

The fifth special route is the Yang-Wei-Ma. This starts at the front of the outer ankle and moves straight up the outside of the leg continues up the side, circles over the shoulder and proceeds up the side of the neck and face, over the forehead and skull, where it terminates in the medulla.

The sixth special route is the Yin-Wei-Ma. It starts on the inner shin and moves straight up the front of the body, over the knee, up the thigh, the side of the abdomen and chest and up to the nipples. From there it veers inwards towards the throat where it joins the Functional Meridian.

Thus, all of the energy passageways of the body are linked together in a network of the two Channels, the six special routes, and the twenty-four regular routes corresponding to the organs on each side. These passage ways are the superhighways, highways, and roads, respectively, of energy flow across the body.

1. Second Formula: Lesser Enlightenment of Kan and Li

This formula is called Siaow K'an Li in Chinese and involves a literal steaming of the sperm (Ching) into life force energy (Chi). One might otherwise say that this begins the transfer of the power of the sexual hormones into the whole body and brain. The crucial secret of this formula is to reverse the usual sites of Yin and Yang power, thereby provoking liberation of the sperm's energy.

The first and second books are the preparation of the paths for the greater energy flow of the sperm so that the body will be able to handle the great influx of energy (power which might correspond to the awakening of the Kundalini). This formula includes the cultivation of the root (the Hui-Yin) and the heart chakras and the transformation of the sperm energy to sperm power at the navel.

This inversion places the heat of the bodily fire beneath the coolness of the bodily water. Unless this inversion takes place, the fire simply moves up and burns the body out. The water (the sperm and seminal fluid) has the tendency to flow downward and out. When it dries out that is the end. This formula reverses the normal, energy-wasting relations by the highly advanced method of placing the water in a closed vessel (cauldron) in the body and then cooking the sperm with the fire beneath. If the water (sperm power) is not sealed, it will flow directly into the fire and extinguish it or itself be consumed. This formula preserves the integrity of both elements, thus allowing the steaming to go on for great periods of time. The essential formula is to never let the fire rise without having water to heat above it and to never allow the water to spill into the fire. Thus is produced a warm, moist steam containing tremendous energy and health benefits.

The second formula consists of:

(a) Mixing of the water (Yin) and fire (Yang) (or male and female) to give birth

(b) Transforming the sperm power (generative force) into vital energy (Chi), gathering and purifying the Microcosmic outer alchemical agent.

(c) Opening the twelve major channels.

(d) Beginning of the half immortal (joining and sublimation of the body & soul)

(e) Circulate the power in the solar orbit (cosmic orbit)

(f) Turn back the flow of generative force to fortify the body and the brain and restore it to its original condition before puberty

(g) Gradually reduce food intake and depend on inner self, sun, moon and water, a beginning of the cosmic energy. (beginning of the Half Immortal).

Third Formula: Greater Enlightenment of Kan and Li

Greater Yin And Yang Mixed I

This formula comprises the Taoist Dah Kan Li (Ta K'an Li) practice. It uses the same energy relations of Yin and Yang inversion but increases to an extraordinary degree the amount of energy that may be drawn up into the body. At this stage, the mixing, transforming and harmonizing of the energy in the Solar Plexus (it might correspond to the Manipura Chakra) takes place. The increasing amplitude of power is due to the fact that the third formula draws Yin and Yang energy from within the body, whereas, the third formula draws the power directly from Heaven (above) and Earth (ground wire - Yang and Yin, respectively) and adds the elemental powers to those of one's own body. In fact, power can be drawn from any energy source, such as the moon, wood, earth, light, etc.

The Third formula consists of:

a. Moving the stove and changing the Cauldron.

b. Greater Water and Fire mixed (male & female intercourse).

c. Greater transformation of sperm power into the higher level.

d. Gathering the outer and inner alchemical agents to restore the generative force and invigorate the brain.

e. Cultivating the body and soul.

f. Beginning the refining of the sperm power (generative force, vital force, Ching Chi).

g. Absorbing Mother Earth (Yin) power and Father Heaven (Yang) power. Mixing with sperm power (body) and soul.

h. Raising the soul.

i. Retaining the positive generative force (seminal) force and keeping it from draining away.

j. Gradually do away with food and depend on self sufficiency and Universal energy (Breatherian).

Fourth Formula:
Greatest Englightenment of Kan and Li
(Tai Kan Li)

Greatest Yin And Yang Mixed II

This formula is Yin and Yang power mixed at a higher bodily center. This is to reverse the aging process, to re-establish the thymus glands to increase natural immunity. This means that the radiation of healing energy stems from a more powerful point in the body and provides vast benefits to the physical and etheric organism.

The Fourth Formula consists of:

a. Moving the stove and changing the Cauldron to the higher center.

b. Absorbing the Solar and Lunar power.

c. Greatest mixing, transforming, steaming and purification of sperm power (Generative Force), soul, Mother Earth, FatherHeaven, Solar and Lunar Power for gathering the Microcosmic inner alchemical agent.

d. Mixing the Visual power with the Vital power.

e. Mixing (sublimating) the body, soul and spirit, (True Breatherian).

This might correspond to the heart Chakra (Anathata).

Fifth Formula:
Sealing of the Five Sense Organs

This very high formula effects a literal transmutation of the warm current or Chi into mental energy or energy of the soul. To do this we must seal the five senses, for each one is an open gate of energy loss. In other words, power flows out from each of the sense organs unless there is an esoteric sealing of these doors of energy movement. They must release energy only when specifically called upon to convey information. This might correspond to the Brow (Ajna) and Throat Chakra (Vissuddha).

Abuse of the senses leads to far more energy loss and degradation than people ordinarily realize. Examples of misuse of the senses are as follows: If you look too much, the seminal fluid is harmed; listen too much and the mind is harmed; speak too much and the salivary glands are harmed; cry too much and the blood is harmed; have sexual intercourse too often and the marrow is harmed, etc.

Each of the elements has its corresponding sense through which its elemental force may be gathered or spent. The eye corresponds to fire; the tongue to water; the left ear to metal; the right ear to wood; the nose to earth.

The Fifth formula consists of:

(a) Sealing the five thieves: ears, eyes, nose, tongue and body

(b) Controlling the heart, and seven emotions (pleasure,anger, sorrow, joy, love, hate, and desire)

(c) Unite, transmutes the inner alchemical agent into life preserving true vitality.

(d) Purifying the spirit.

(e) Raising and educating the spirit, stopping the spirit from wandering outside in quest of sense data.

(f) Do away with decayed food, depending on the un-decayed food, the universal energy is the True Breatharian.

Sixth Formula:
Congress of Heaven and Earth Immortality

The sixth, most advanced, formula is difficult to describe in words. It involves the incarnation of a male and a female entity within the body of the adept (this might correspond to the Crown Chakra, Sahasrara). These two entities have sexual intercourse within the body. It involves the mixing of the Yin and Yang powers on and about the crown of the head and being totally open to receive energy from above and regrowth of the pineal gland to its fullest use. When the pineal gland is at its fullest, it will serve as a compass to tell us in which direction our aspirations can be found. Taoist Esotericism is a method of mastering the spirit, as described in Taoist Yoga. Without the body, The Tao cannot be attained, But with the body, truth can never be realized. The practitioner of Taoism should preserve his physical body with the same care as he would a precious diamond because it can be used as a medium to achieve immortality. If, however, you do not abandon it when you reach your destination you will not realize the truth.

The sixth formula consists of:

(a) Mingling (uniting) the body, soul, spirit and the universe (Cosmic Orbit).

(b) Full development of the positive to eradicate the negative completely.

(c) Spirit returned to nothingness.

Seventh Formula:
Reunion of Man and Heaven -
True Immortal Man.

We compare the body to a ship and the soul to the engine and propeller of a ship. This ship carries a very precious and very large diamond, which it is assigned to transport to a very distant shore. If your ship is damaged (a sick and ill body), no matter how good the engine is, you are not going to get very far and may even sink. Thus we advise against spiritual training unless all of the channels in the body have been properly opened and have been made ready to receive the 10,000 or 100,000 volts of super power, which will

pour down into them. The Taoist approach, which has been passed down to us for over 5,000 years, consists of many thousands of methods. The formulae and practices we describe in these books is based on such secret knowledge and the author's own experience in over ten years of study and of successfully teaching hundreds of students.

The main goal of Taoists:

1. This level - overcoming reincarnation.
2. Higher level - the immortal spirit.
3. Highest level - the immortal spirit and immortal body, like a mobile house to the spirit and soul.

Chapter XVI
Taoist Esoteric Yoga Course Offerings

There were original nine Taoist Esoteric Yoga Centers in the U.S. offering personal instruction in various practices ranging from the Microcosmic Orbit to Tai Chi Chuan, Pakua, Hsing I.

Taoist Esoteric Warm Current Meditation as these practices are also known, awakens, circulates, directs and preserves the generative life force called chi through the major acupuncture meridians of the body. At progressive stages, dedicated practice of this ancient esoteric system eliminates stress and nervous tension, massages the internal organs, and restores health to damaged tissue.

This practice is of particular use to practioners of polarity therapy, shiatsu, Kundalini yoga, Swedish massage and other healing arts in which the exchange and cirulation of life force — energy ki, prana or Chi — must be maintained while working with clients or students. The first two formulas are described below. The remaining 5 formulas will be described when offered.

Opening of the Microcosmic Orbit is the first level in the Taoist Esoteric Warm Current Meditation. Through unique relaxation and concentration techniques, it provides for purification of the first two major acupuncture channels of the body, the Functional and Governor meridians. Master Chia will assist students in the mastery of this technique by passing energy through his hands into their energy channels. (Course No.1)

Completion of the Microcosmic Orbit is a prerequisite for any student who intends to study the higher levels of Taoist yoga which includes various forms of Chi Kung, Seminal and Ovarian Kung Fu, and the long and short forms of Tai Chi Chuan.

Fusion of the Five Elements and Cleansing of the Organs is the second level of the Taoist Esoteric Warm Current Meditation. At this level one learns how the five elements (earth, metal, fire, wood, water) and their corresponding organs (spleen, lungs, heart, liver,

kidneys) interact with one another in three distinct ways: producing, combining and threatening. This formula combines the disparate energies of the five principle elements — and their corresponding emotions (sympathy, sadness, joy, anger, fear) — one harmonious whole. The filtering effect upon the entire psycho/physical system is particularly powerful as these combined energies circulate throughout the Microcosmic Orbit and the Six Special Channels.

(Course No. 9)

The second formula is taught in three parts.

Part I: The 12 steps for collecting, fusing, harmonizing and cleansing of the organs;

Part II: The opening of the three Chung-Ma (Thrusting Routes) and the nine Tai-Ma (Belt Routes);

Part III: The opening of the Positive and Negative Legs and Positive and Negative Arms.

Six Healing Sounds

This self-healing method uses simple arm movements and vocalizations to produce a cooling effect upon the internal organs. The Six Healing Sounds quickly eliminate stress, improve digestion, reduce insomnia and headaches and relieve fatigue. This method is useful to meditators as well as runners, practitioners of martial arts, and other intense exercise systems that tend to buildup excessive heat in the body. (Course No. 2)

Chi Massage — Taoist Rejuvenation

Using internal power chi and gentle external stimulation, this simple yet highly effective self-massage technique enables one to collect, and then direct Chi to the sense organs and other parts of the body for self-healing purposes.

Taoist Rejuvenation dates back 5,000 years to the Yellow Emperor's classic text on Taoist, internal medicine.(Course No. 3)

Iron Shirt Chi Kung
Highest Form of Chi Kung

The physical integrity of the body is sustained and protected through the accumulation and circulation of internal power (chi) in the vital organs. This energy is stored in the fascia which is a layer of connective tissue covering, supporting or connecting the muscles or inner organs. Over time, the Iron Shirt Chi Kung practice strengthens one's vital organs as well as the tendons, muscles, marrow and bones.

Historically, the practice of Iron Shirt Chi Kung was a prerequisite to the effective study and eventual mastery of the various Kung Fu fighting styles. However, the main purpose of Iron Shirt Chi Kung is not for fighting; it is to achieve excellent health by increasing stamina and the body's ability to fight disease and defend its vital organs from unexpected injury. Prerequisite: Course No. 1 - opening the Microcosmic Orbit. (Course No. 4)

Iron Shirt Chi Kung is divided into three levels of instruction, I, II, and III. (See detailed description later this chapter.)

Tai Chi Chi Kung:
Foundation of Tai Chi Chuan

Without the circulation of chi through the channels, muscles and tendons of the body the Tai Chi Chuan movements are only physical exercises. The practice of Tai Chi Chi Kung awakens and circulates Chi energy and is therefore the foundation for the mastery of Tai Chi Chuan. The potential to develop our self-healing capabilities begins with the discovery of the flow of this vital energy through the Microcosmmic Orbit. This circulation is enhanced and sustained through the practice of Tai Chi Chi Kung which assists in improving health through correct posture, movements and calming of the mind. This particular form is comprised of 13 movements. Prerequisite: Course No. 1 — Opening the Microcosmic Orbit. Course No. 6)

Dah Uh Gong Nei Kung
Five Finger Kung Fu

The Dah Uh Gong Nei Kung stytem integrates both static and dynamic exercise forms in order to cultivate and nourish Chi which accumulates in the organs, penetrates the fascia, tendons and muscles, finally reaches the hands and fingers. Practitioners of body-centered therapies and various Healing Arts such as chiropractic medicine, polarity therapy, shiatsu and Swedish massage will benefit from this technique. Practiced sequentially, it functions to expand and relax the breath, calm the mind and adjust posture. The approach is simpler to learn than Tai Chi Chuan and easier to execute than yoga. Through the practice of Dah Uh Gong the student will learn:

- To expand your breathing capacity
- To strengthen your internal organs
- To tone and stretch your muscles
- To strengthen your lower back and abdominal muscles
- To normalize your weight
- To develop your ability to concentrate for self-healing

Prerequisite: Course No. 1— Opening the Microcosmic Orbit (Curse No.5)

Seminal and Ovarian Kung Fu

This ancient Taoist yoga practice sublimates and transforms sexual energy through its circulation in the Microcosmic Orbit. The conservation of this precious, biochemical force has been recognized by sages of various esoteric traditions as a major revitalizing factor in the physical health and spiritual development of both men and women. The turning back and circulation of this generative force from the sexual energy centers to the higher centers invigorates and rejuvenates all the body's vital functions. Real sexual fulfillment lies in preventing the indisscriminate loss of this vital current and in experiencing a deeper level of orgasm. These techniques can be used for personal transformation — both physical and spiritual. Prerequisite: Course No. 1— Opening the Microcosmic Orbit (Course No. 7)

Tai Chi Chuan - Long and Short Forms

In order to benefit from the still, slow and soft movements of the Tai Chi Chuan form, it is necessary for one to have cultivated an awareness of Chi and internal power through the Opening of the Microcosmic Orbit and Tai Chi Chi Kung. The Tai Chi Chuan form further educates the body to serve the mind through relaxing and strengthening. In addition, Tai Chi Chuan can be used as a self-defense technique, but only if one is able to properly circulate and utilize the intrinsic energy called Chi so that every movement of the body is guided by internal power.

Before beginning to study the Tai Chi Chuan form, the student must have completed:

1) Opening of the Microcosmic Orbit;
2) Tai Chi Chi Kung (13 movements);
3) Iron Shirt Chi Kung Level I;
4) Seminal and Ovarian Kung Fu Level I.
(Course Nos. 11 and 12)

The staff includes western M.D.s, nutritionists etc. Master Chia regularly visits each center to lecture and individually counsel Taoist practitioners. He also aides all students in increasing their circulation of Chi by “passing energy”, especially to those who for whatever reason feel blocked. This is not “instant enlightenment”, only an experience of higher Chi flow so that the student may better learn to create it on his own.

Future volumes of the Esoteric Taoist Yoga Encyclopedia will explore in depth these other ancient disciplines whose methods have largely been kept secret from westerners.

Seminal Kung Fu: Taoist Secret of Energy

For more than 5,000 years of Chinese history, “the no outlet method” of retaining the seminal fluid during the act of love has remained a deep secret. At first it was practiced exclusively by the Emperor and his innermost circle. Then it passed from father to chosen son alone, excluding wives, daughters and other family members. The method permits a man to retain bodily secretions which are an

invaluable source of energy when stored and recirculated to the vital centers.

Sages of all time and places have found that conservation of the precious energies of the seminal fluid and ovarian energy deeply affects a human's life. Whoever holds his vital seed finds that he spontaneously seeks to preserve living things from waste, decay and harm. On the other hand, those who excessively spend the fluid and its vital force crave outer stimulation at any price, for they desperately need to replace their own lost energies.

One prevents loss of this biochemical energy by not ejaculating. Stopping ejaculation is not to be confused with stopping orgasm. The No Outlet Method provides an altogether unique and superior type of orgasm.

Every vital function is invigorated because one no longer discharges life energy through the genitals. Real sexual fulfillment lies not in feeling the life go out of you but in increasing awareness of the vital current that flows through the loins. The body is further replenished by a method of "Steaming" the vital energy up from the sexual centers to the brain and higher organs. The life enhancing process is completed by exchanging with one's partner energy released during moments of excitation.

The sages have considered one drop of semen equal in vital power to one hundred drops of blood. The Indians refer repeatedly to "Amrito", the elixir of life, a rejuvenating substance from sexual energy. The production of this elixir, which Westerners would call a higher hormonal secretion, allows the body to enter higher and higher states of energy.

Most people in our consumer society spend more than they earn. They borrow themselves deep into debt. Through poor habits they also spend more vital power than they earn.

Let us say that people earn 100 units of life force through breathing, eating and resting but spend 125 units of life force through gluttony, overwork, anxiety, constitutional weakness, and frequent loss of the vital fluid. They must continuously borrow vitality from the brain and other vital organs. This theft of vital energy from one's own reserves induces mental and physical sickness and premature aging. We teach you how to overcome worldly sex desire and a way to earn 125 units and to spend 100 or less. The imbalance of one's personal energy economy is first corrected by reducing the disastrously wasteful expenditure called ejaculation, while ex-

periencing a nourishing balanced energy exchange with one's partner.

Iron Shirt Chi Kung

Before guns were used, the Chinese depended very much upon Kung Fu. It is at that time, about one-tenth of the Chinese nation was involved in such practice, which they engaged in from what is found at the present. At first one had to develop internal power - to get the warm current (energy), to open the Microcosmic Circulation, complete another six special channels (routes) and an additional 24 normal channels (routes) so that the internal power could be circulated freely. One then learned how to strengthen one's vital organs and to protect them with internal power or "Iron Shirt". Only then did one go on to practice fighting styles because without internal power the styles were not effective in combat.

It is written that internal power took many years to develop. One had to throw a straight punch up to 2,000 times a day for from three to five years or strike the top of a water well 1,000 times a day for as much as ten years or until the water was thrown out by the force of the blow.

The main purpose of the Iron Shirt is not for fighting, but to perfect the body, to win great health, to fight disease and to protect the vital organs from injuries. Most important in Iron Shirt training is Changing the Tendons & Cleansing the Marrow, and the Self-Regenerative Hormone.

Level I:

· Iron Shirt Chi Kung breathing.

· Awakening and circulating of internal (chi) and rooting power through exercise.

· Directing the internal power to strengthen the organs. Filling the 12 tendon channels with Chi.

· Training and opening the fascia and filling them with chi.

Level II:

· Cleansing the marrow.

· Changing the tendons and cleansing the marrow.

· Training and opening the fascia and filling them with Chi.

· Self-stimulation of the vital organs.

· Strengthening the tendon and uniting the fascia, tendons, bones and muscles in one piece.

Level III:

· Regenerating sexual hormones.
· Storing sexual hormones in the fascia and tendons.
· Directing the internal power to the higher energy centers.

After these three levels of Iron Shirt Chi Kung are mastered, the powerful application of the resulting energy is taught in "Healing Hand."

Healing Hand

a. Buddha Palm
b. PaKua Palm
c. Checking the aura and weak energy field.
d. Correct and harmonize the circulation system, lymph system, nervous system, Chi flow system.
e. Point to stop pain and stress.

Transmitting the Power to help Open the Channels

a. Gathering the power to the palm and finger.
b. Restoring the power.
c. Transmitting the wet sickness and the cold energy away.

Appendix I
Table of Energy Centers

No. Energy Center	Acupuncture Name, No.	Chakra Personality Type	Endocrine Secretions	Color
1. Tan Tien	Chi-Chung, CO-8 Umbilicus	Swadisthana Over The Spleen Social Splenic Plexus Hypogastricus	Spleen	Orange
2. Sperm Palace Jing Gong Kuan-Yuan	Chung-Chi, CO-3 Four tsun below the Umbilicus Kuan-Yuan CO-4 Three tsun below the navel, female ovaries energy center	Muladhara genital sacral Physical sensation level, Gonads	Prostate gland, seminal vesicle Ovaries	Red
3. Gate of Mortality Door of Death&Life	Hui-Yin, CO-1 In the center of the perineum, midway between anus & scrotum in the male and the posterior labial commissure in the female.	Genital-Sacral	Bulbourethral gland, ending of the nerves, vessels, testes	Red
4. Woei Liu	Chang-Chiang, CO-1 At the lower end of the coccyx between the tip of the coccyx and the anus.	Coccygeal, Sacral Base of the Spine the Root Chakra	Coccygeal Body	
5. Door of Life	Ming Men, CO-4 Between the spinous process of	Swadisthana	Kidney	Orange

	the 2nd & 3rd lumbar vertebrae, at the midline			
6. Jai-Ji	Chi-Chung, CO-6 below the spinous process of the T11th vertebra	Manipura Pancreas, Solar Plexus, Intellectual Coeliac	Adrenal	Yellow
7. Yu-Chen The Jade Pillow	Yu-Chen, BL-9 On the lateral part of the upper margin of the external occiputal protuberance and opposite Tien-Chu, BL-10		Medulla, Cerebellum	Blue
8. Niwan Kung Huang Gong (Yellow Palace)	Pai-Hui, GO-20 At the point of inter-sectional line joining upper tip of ears and a line from the middle of the forehead directly toward the vertex	Sahasrara, Crown Imaginative, Brain Absorbing the Yang (heavenly energy) The door spirit	Pineal	Violet
9.T'ien-T'ing	In the mid point of the forehead		Hypothalamus	
10. Tsu Ch'iao Origi-nal Cavity of spirit. The gateway to heaven. Heaven and Earth Yu Ting, Cauldron	Yin-T'ang, CL-1 Midway between the two eyebrows, in the center of the the brain.	Ajna, Brow Intuitive, Pituitary Carotid	Pituitary	Indigo

11. Shan - ken root of the mountain	At the middle of the two eyes at the root of the nose			
12. Chuen Tou Su-Liao	On the tip of the nose.			
13. Heavenly Pool T'ien hsueh Hsuan ying cavity	About 1.5 inches Behind the teeth on the palate; behind the heavenly	Mysterious bridle		
14. Twelve Story Shyr Ell Jong Lou	Hsuan-Chi, CO-21 On the Midline of the sternum	Vissuddha, Throat Conceptual, Pharyngeal, Plexus Cervicus	Thyroid, Parathyroid	Blue
15. Gentle - man Palace (Jiun Juu Gong) Shin Gong	Shan-Chung, CO -17 Midway between the two nipples, on the level with 4th space.	Anahata, Heart Acquisitive Cardiac	Thymus Heart Bodies	Green
16. Huang - ting Gong Middle Tan T'ien (Yellow Hall Center) Chung Gong (Middle palace) Dan Gong	Chung-Wan, CO -12 Midpoint on a line connecting the xyphoid process with the umbilicus	Mainpura, Solar Plexus Intellectual, Coeliac, Solar Plexus, Epigastrecus	Pancreas	Yellow
17. Wei - Chung	Wei-Chung, BL-40 In the exact center of the	Soul, energy store center popliteal fossa.		

18. Yung Ch'uan	Yung Ch'uan, K-1 One third the distance from the center of the plate to the front of it and in the depression, which is present when the foot is elevated.	Held to strengthen the kidneys, direct the energy to run down, place for absorbing the Yin (earth energy) collect the energy radiated out from the body.		
19. Ta-Tun	Ta-Tun, Li-1 On the lateral side of the distal phalanx of the great toe posterior to the corner of the vallum unguis. This is the Liver Meridian, regulates the liver.			
20.	Yin-Pai, SP-1 On the medial side of the great toe. 0.1 Cun posterior to the corner of nail. This is the spleen meridian on this will help to regulate the spleen			
21. Heding	Heding (Extra 31) On the midpoint of the upper border of the patella (knee cap).	Energy stop center		
22. Gau Wan Gong Outer Kidney	Testes: in external scrotum.	Storage of Yin energy.		

23. Tai-Yang	Tai-Yang, CL-2 Midpoint on a line joining the temporal canthus with the lateral eyebrow margin.			
24. Lao-Kung	Lao-Kung, EH-8 At a point between the 2nd and 3rd metacarpal bones where the 1 tip of the middle finger touches when fist is cleanched. Belongs to the Pericardium Meridian.			

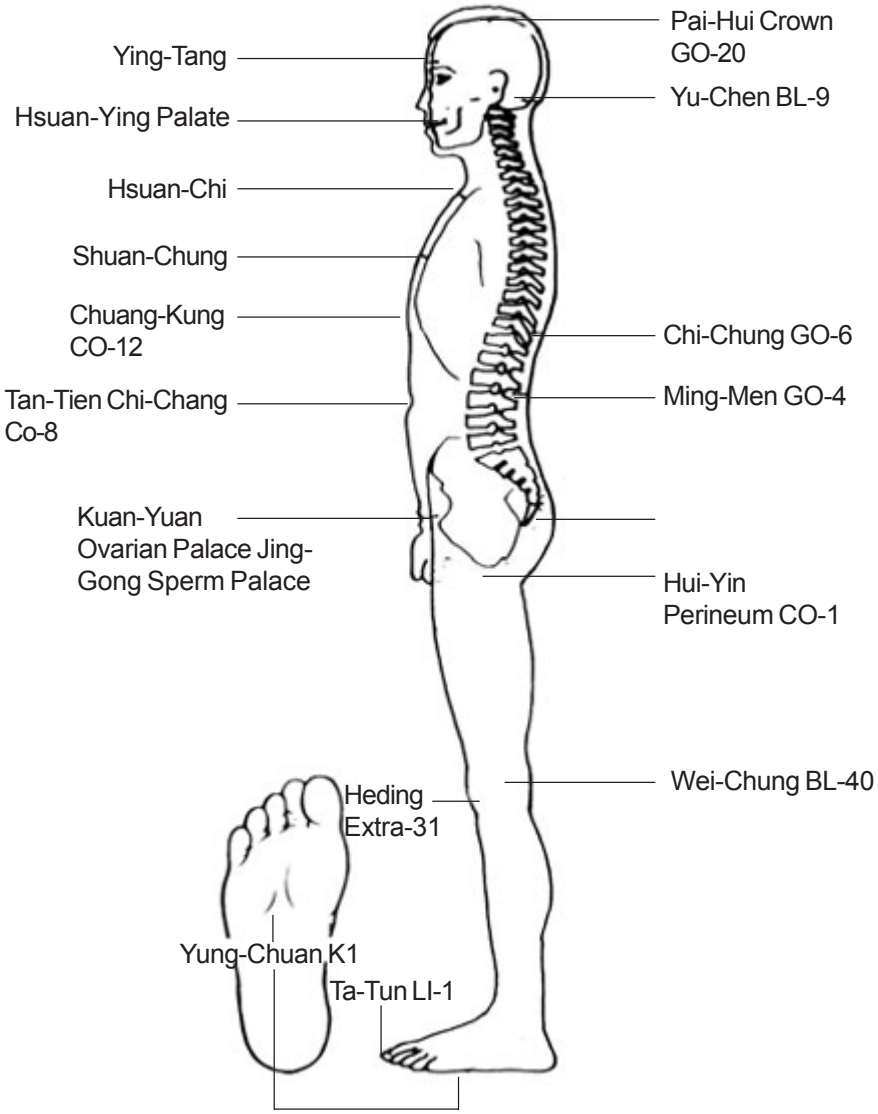

Fig. A.1 *Point and Energy Centers*

Appendix II
How Taoist Yoga affects your Hormonal System

Endocrine Glands and Taoist Energy Centers

The hormones are chemical messengers produced by the endocrine glands in minute quantities but eventually affecting every single cell of your body. The secretions of the endocrine glands empty directly into the blood where they find their way to various organs, stimulating or suppressing them, or in some way influencing their activity.

In the Taoist Esoteric System the energy centers do not belong to the physical body at all but are regarded as adjuncts of the "vital body", which are set apart and crystallized to the necessary density in order that it may perform certain special manifestations of this vital body. Each gland has a specific work to perform. When in good health they all work together in perfect harmony. The endocrine glands are of special interest to the students of Taoism in relation to the circulation of the Microcosmic Orbit. In order to explain some of the energy centers in terms of modern anatomy, one has to look to the endocrine glands for correlation. The correlations may or may not be right, but that is the best that one can hypothesize at this stage of the art.

Adrenals

The adrenals are a pair of glands capping the upper ends of the kidneys. When they are removed, death ensues rapidly. The gland is composed of a cortex (outer portion) and a medulla (inner portion). The outer portion produces the sex steroids, the glucocorticoids (corticosterone, hydrocortisone) which are involved in the control of carbohydrate, lipid and protein metabolism and the mineralocorticoids (aldosterone, deoxycorti-kidney tubules), affecting

blood volume and blood pressure control. The adrenals are flat triangular structures. The size and weight is somewhat variable. Each is about 5 cm long and weighs between 3 and 6 grams and is slightly heavier in the male than in the female.

The inner portion of the adrenals is developed from the ectoderm, the outer layer of cells of the embryo. This is the same tissue that produces the sympathetic nervous system. The inner portion secretes adrenalin and noradrenalin. Adrenalin is involved in the “fight or flight” response, whereas noradrenalin causes more vasoconstriction resulting in marked elevation in blood pressure.

The amount of adrenaline and noradrenalin that circulates in the blood is minute in quantity but its action is powerful and farreaching.

Its release is triggered by impulses from the sympathetic nervous system in times of mental or physical stress, the entry of adrenalin into the blood causes a tremendous heightening of vigor. The brain and the sympathetic nervous system become activated. Concentration of blood glucose is raised by conversion from glycogen, which is stored in the liver. More blood cells are poured into circulation from the blood pools of the liver and spleen. The heart beats more strongly and faster, the pupils of the eyes are dilated, enabling the person to see more clearly, breathing is more rapid, the body temperature rises and the basal metabolism is increased.

There is an opposing effect on the digestive system, however, wherein there is a loss of appetite and reduced motility.

Adrenalin adds strength and alertness to both physical and mental activity. It gives force in combat and swiftness in flight. As the activity of adrenalin is regulated by the sympathetic nervous system, the secretion of it can be increased by the stimulation of these nerves alongside the spinal column.

Some doctors believe that there is a condition called “low adrenals”. A person with a deficiency of adrenalin will appear weary and sensitive to cold, have cold hands and feet, loss of appetite, a tendency to worry, will weep easily and will sometimes even have a nervous breakdown. In children, learning problems develop, growth is slowed, and they cannot be driven or hurried. If we inject someone with adrenalin, his heart will contract more violently and beat faster, he will feel anxious, and will get frightened easily and, if subjected to it for some time, will become a very nervous person.

It is obvious, then, that an intricate, delicate balance of various factors is involved in maintaining a proper harmony of the activities of the various organ systems. In the Tao Esoteric System, the center for adrenal activity is to be found in the Chi-Chung. This is a very powerful energy center and is located in the area that is called the “solar plexus”, which corresponds anatomically to the location of the adrenals, the spleen, the pancreas and the kidneys.

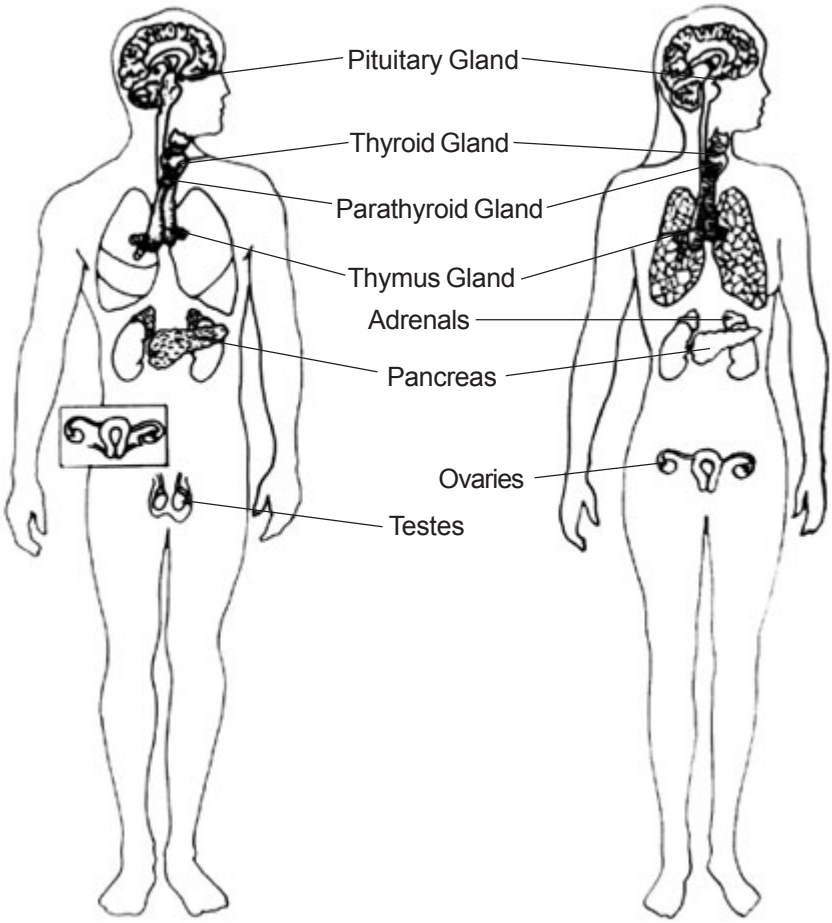

Fig.B.1 *Endocrine Glands*

Kidney

The human kidney is a bean-shaped organ weighing about half a pound. We have two kidneys located within the abdominal cavity and protected at the rear by the spinal column and the big muscles of the back. The tops of the kidneys are just beneath the ribcage. The right kidney, above which lies the liver, is usually a little lower than the left. About 1,700 quarts of blood flow through the kidneys each day.

Among the kidney cells are certain glands of endocrine secretion. The kidneys produce blood pressure-elevating substances causing hypertension at times. Erythropoietin is a substance pro duced by some kidney cells, that stimulates the production of red blood cells.
In the Taoist Esoteric System, the Ming-men (the Door of Life) is the energy center corresponding to the activity of the kidneys.

Testes

The male gonads or testes lie in the scrotal sac and the normal size varies from that of a walnut to that of a pigeon egg. There are two parts to the testes, the tubules, which produce the sperm, and the Leydig cells, which produce the principal masculinizing hormone, testosterone. Leydig cells also produce small amounts of estrogens, the female sex hormones.

The testicle is under the control of gonad-stimulating hormones or Gonadotrophins. Just before the onset of puberty, gonadotrophins are released, causing the testes to mature and to secrete increasing amounts of testosterone. This induces development of the secondary sex characteristics such as development of the penis, pubic and auxiliary hair growth, increased muscle mass, voice changes, beard growth and all the signs of manliness in vigor and perhaps even influencing deportment and behavior.

With adequate gonadotrophins and androgen production, the tubular germ cells ripen into sperm cells. In the case of disorders of the testes, secondary sexual characteristics will not develop if there is an androgen deficiency during puberty. If this occurs after maturity, a partial regression occurs. A pituitary disease may be

the cause of this deficiency also. In the Taoist Esoteric System, we believe that there is tremendous potential in the energy of the sperm and sex hormones. We awaken and transform this energy to the higher centers.

Ovaries

The ovaries, like the testes, have two functions: first, to provide ova or egg cells and secondly, to secrete sex hormones. The hormones of the ovaries are estrogens and progesterone and unusual conditions androgens may be produced.

The ovaries are awakened to activity when a young girl reaches 11 to 13 years of age. The “female” hormones serve to develop the secondary feminine sex characteristics of breast growth, pubic and auxiliary hair, maturation of the genital tract and also the contours of the female figure, and many contribute to the psychological characteristics of the woman. Inadequate or absent ovarian stimulation by the pituitary gonadotrophic hormones, failure of the ovary to respond, or an abnormal response to the stimulation, results in many disorders ranging from inborn failure to menstruate, subsequent cessation of menses and development of male characteristics.

In the Taoist system, we regard the ovaries as one of the great energy centers of the female. The female can awaken and transform the great energy from the ovaries to the higher center.

Spleen

The spleen is located beyond the left end of the stomach, between it and the diaphragm. It is bean-shaped and has a deep blue-red color. It weighs from five to six ounces and is soft, spongy, and fragile. The spleen controls blood destruction.

In the Taoist Esoteric system we regard the spleen as the entrance for solar force, which vitalizes the dense body. Without this vital elixir no being can live. From the spleen this sun force is sent to the solar plexus and from the solar plexus this fluid-like energy flows along the filaments composing the nervous system. In this way it permeates every part of the physical body. energizing each and every cell with its life force.

According to Chinese medicinal theories, when a person is healthy, life energy is stored by the spleen and extracted from the blood in such large quantities that it cannot be used inside the body. Therefore, the life energy radiates outward through the pores of the skin in straight lines, drives out poisonous gases, inimical bacteria and viruses and assists in preserving a healthy condition of the physical organism. It also prevents armies of disease germs which swarm about in the atmosphere from entering the dense vehicle.

According to the Taoist system, after eating, the vital solar force attracted by the spleen is consumed by the body in great quantities. When the meal is heavy, the outflow of the vital fluid from the body is perceptibly diminished and does not then cleanse the dense vehicle as thoroughly as it does when the food has been digested, nor is it as potent in keeping out inimical germs.

Therefore, overeating renders a person more likely to catch cold or succumb to disease. During ill health the spleen furnishes the vital body with very little solar energy, and at this time the dense body seems to feed on the vital body. In the Taoist system it is said that we have to repair the vital body, which can then help the dense body to get stronger.

In Taoist Esoterica, the “solar plexus” is regarded as the largest cauldron of the vital body which can alchemically mix or harmonize the generative force with the life energy from the energy center corresponding to the pituitary gland, during the practice of Greater Enlightenment of the Kan and Li. The spleen, as mentioned before, corresponds to a part of the “solar plexus.”

Thymus Gland

This is the gland of child development. It is situated in the chest between the lungs and behind the upper part of the sternum (breast bone). It descends and covers the upper portion of the heart, overlapping the great vessels at the top of the latter. It reaches its greatest size at the beginning of puberty, gradually disappearing thereafter at which time it is marked by a loss of glandular structure. It does persist, however, and some of the secreting cells remain throughout life.

In Taoist Yoga, when properly and proportionally activated the energy center at the thymus alchemically harmonizing with the energy from the pituitary gland energy center and the generative force residing in the sperm and testicles, can reverse the aging process. This occurs in the practice of the Greatest Enlightenment of the Kan and Li, in which white hair becomes black, teeth grow back again, and a youthful appearance develops.

Hypothalamus

The hypothalamus is part of the forebrain, the same part of the brain from which the cerebral hemispheres develop. The hypothalamus provides a connecting link between the cerebral cortex and the pituitary gland. Though the pituitary gland is considered the master gland, nevertheless, there are stimulatory and inhibitory agents originating in the hypothalamus, which regulate pituitary functions. This ancient area in our brain is also intimately concerned with the regulation of energy balance through the control of appetite, sleep, body temperature, the regulation of sexual function and control of water balance.

Disturbances in the hypothalamus may cause such endocrine disorders as sexual precocity, absence of appetite with extreme loss of weight, diabetes insipidus and disorganization of the sleep pattern.

Indeed, the hypothalamus and the pituitary gland are both functionally and anatomically related. Our thoughts, our hopes and joys, our worries and our sorrows, our very nervous constitution all profoundly influence the hypothalamus-pituitary complex. In the Taoist Esoteric System, the energy center of Tien-Ting (in the mid-point of the forehead) corresponds to the hypothalamus.

Thyroid Gland: Gland of Energy

The thyroid gland is located in the throat and lies in front of and on either side of the windpipe and just beneath the larynx (voice box) and is connected just below the Adam's apple. This gland arises from the same tissue and almost from the same spot as the anterior lobe of the pituitary body. It weighs about an ounce. Each lobe of the thyroid is about two inches in length, and from an inch to an inch and a quarter in width.

The thyroid gland is highly vascularized and receives many times more blood in proportion to its size. It is noted for its high degree of functional activity. It is heavier in the female than in the male and becomes enlarged during sexual excitement, menstruation, and pregnancy.

The thyroid gland's secretion is called thyroxin, which contains iodine.

The thyroid is an energy gland and its secretion is the controller of the speed of living. It affects the metabolism of practically all the tissues of the body. The principal function of the hormone is to regulate the rate of oxygen consumption, which is tantamount to the body's metabolic rate, which can be thought of as one's "rate of living". This hormone is required for normal growth and development of the brian, muscle and bones and it indirectly affects the activity of other glands of internal secretion as well. Too little thyroid hormone produces a condition of sluggishness. With too much, there will be marked apprehension, alertness, nervousness, loss of weight, increased thirst, frequent urination, profuse perspiration, intolerance of heat, insomnia, frequent stools, rapid heartbeat and palpitations.

In the Taoist Approach, the energy center at the thyroid is considered to be one of the most important centers in the body because it controls the growth of the dense vehicle and mental development and it is very closely related to all of the other six energy centers under consideration. It is the great link between the brain and the organs of generation (reproductive organs). In the Taoist Esoteric System, the thyroid energy center is called Hsuan-Chi (the twelve story) and is used as an energy Center only to draw in power. It is not ordinarily included in alchemy because when it is open it is hard to protect. However, in the greater and the greatest enlightenment of the Kan & Li, we draw enormous stores of power from this energy center to alchemically mix with the power of other energy centers in order to produce an ever greater source of power.

Pituitary Gland

The pituitary gland is about the size of a pea, situated almost exactly in the center of the head at the base of the brain and just behind the root of the nose. It hangs suspended from the underside of the brain like a cherry from the limb of a tree. It is grayish yellow in color. In the adult it weighs about five grains, or 1/1400 of a pound.

Its name is derived from the Latin word, “pituita”, because it was supposed to secret a fluid which lubricated the throat. It was believed that the secretion filtered through the porous ethnoid bone that intervenes between the pituitary body and the nasal cavity.

Tongue touches the Palate

Embryologically, the pituitary begins by manifesting as an outgrowth of the mouth cavity. This outgrowth takes the form of a pouch, which gradually extends toward the brain. By the end of the fourth week this protrusion contacts a downgrowth from the brain called the infundibulum. The pouch then develops into the anterior lobe of the pituitary, whereas the infundibulum, representing an outgrowth of the oldest part of the nervous system, develops into the posterior lobe of the gland. There is a space between the walls of the anterior and posterior parts of the gland, which persists throughout life as the cleft of the gland. The pituitary gland is divided into an anterior or front portion, which is composed of glandular tissue and a posterior or back portion, which is composed of nerve-like tissue. The anterior portion produces several hormones which stimulate distant structures such as: a growth hormone, a hormone which stimulates the adrenal cortex, a thyroid stimulating hormone and also a hormone which stimulates breast milk production and another which influences pigment production by certain cells of the skin.

The posterior part of the gland is an extension of the hypothalamus, that portion of the brain to which the pituitary is attached.

The posterior lobe of the pituitary body secretes several important hormones, two of which deserve special attention. One of them, called pitocin, has a powerful stimulating effect on the pregnant

uterus and is frequently used in cases where labor is slow and ineffective. The other, called antidiuretic hormone, controls the salt and water content of the blood.

In animal studies, an active pituitary produces alertness. A tired or dull pituitary produces sleepiness and general dullness. During hibernation or winter sleep, an animal in cold weather passes into a cataleptic state in which it continues to breathe, more deeply but more slowly than when awake. The internal secretions of all of the glands of hibernating animals show changes during this period but the most marked effect is found in the pituitary in which the cells shrink as if they too were asleep or resting. When the spring comes, the pituitary gland cells again become normally active.

In the Taoist System, special attention is given to properly stimulate and harmonize the energy center related to this gland. Attempts have been made to mix pituitary gland energy with sources of cooler energy such as sperm and earth power. This constitutes a cauldron for cultivating the spirit in the practice called the sealing of the five sense organs.

Pineal Gland
(Human Compass)

The pineal gland is a cone-shaped body, reddish in color, about half an inch in length, and not much larger than a grain of wheat. It is attached to, and situated over, the third ventricle of the brain, weighing about two grains. It is composed, in part, of nerve cells containing a pigment similar to that present in the cells of the retina. This strengthens the argument for its function as an eye in earlier animal species.

In the Taoist terminology, the Niwan-Kung corresponds to this gland. In the cauldron, it is considered to cultivate the highest level of the spirit in the practice: Congress of Heaven. When the gland is fully developed it will tell us where our destination is.

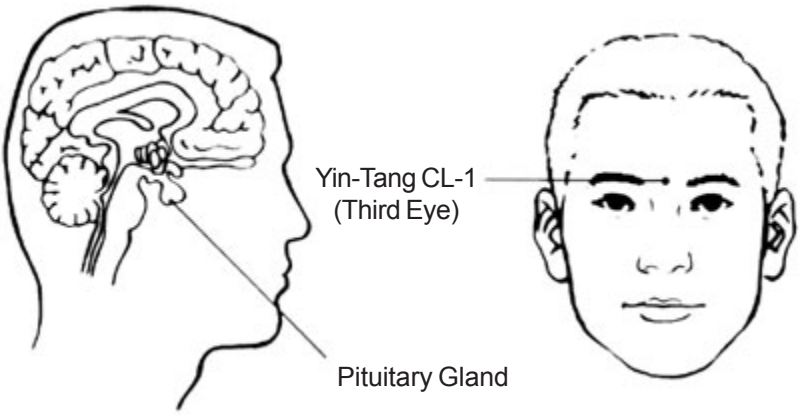

Fig.B.2 *Endocrine Glands*

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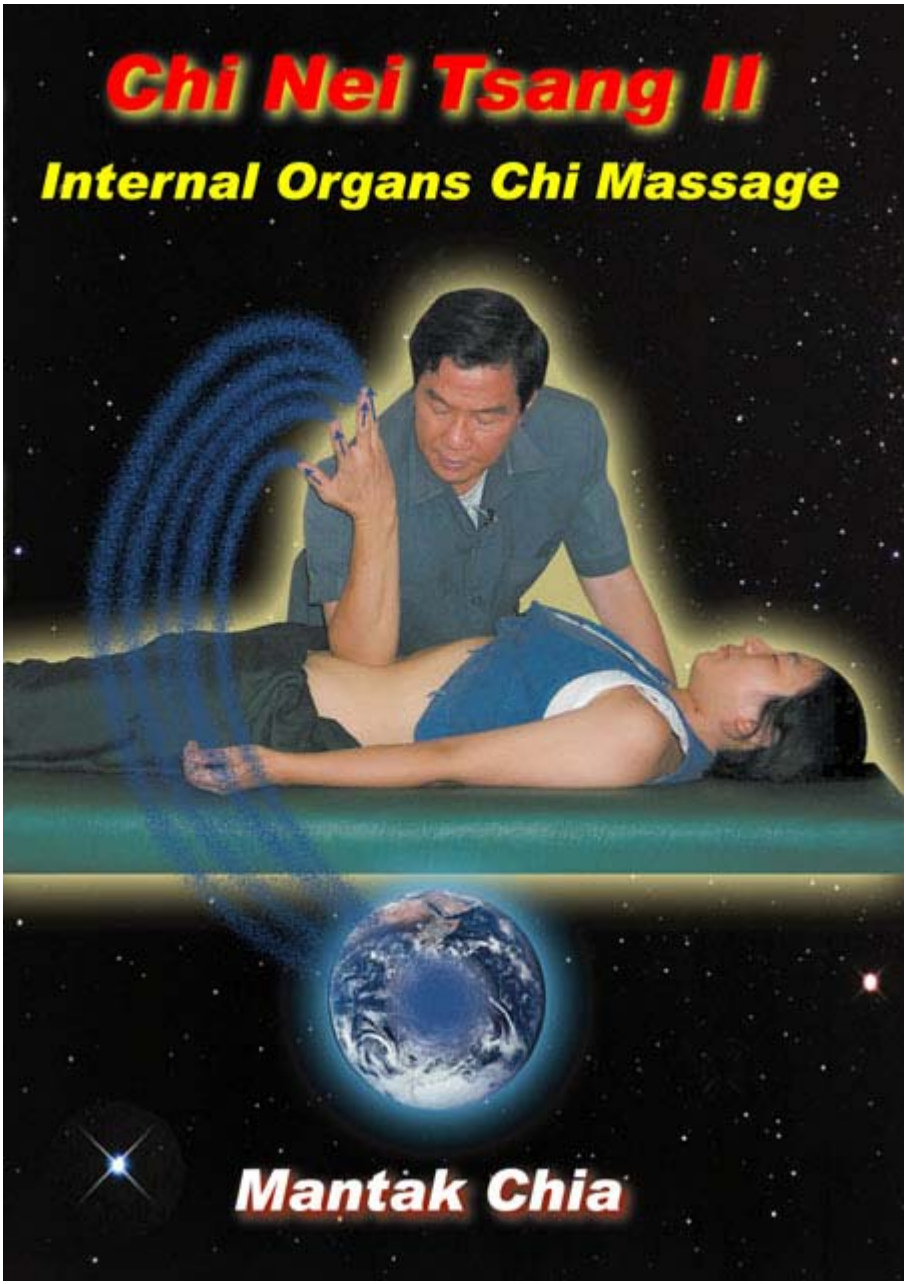

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Hands on CNT II: Working Procedures

The following are the procedures to follow in a session with a student.

A. CNT I

In order to work with the winds in your student's body, you must first integrate the procedures of Basic Chi Nei Tsang. This involves carefully sensing and touching the abdomen, clearing the large and small intestines, toning, detoxifying and pumping the organs and clearing the lymphatic system. If the person's abdomen is full of knots and tangles, the winds will not be able to circulate and leave the body. Releasing the abdomen may take a few sessions. Once you have released the main blockages, you can then begin with the work on the winds.

B. Opening the Wind Gates

In this practice we'll make "traps" for the winds. One trap is created by using the "elbow in the navel". A second trap comes from "opening the navel with the thumbs". A third and quite powerful way is "making space in the Pakua". These traps present an open space for the winds to move to and from there they can be easily flushed and vented down the legs and out of the feet.

a. Elbow in the Navel

In this level of Chi Nei Tsang one way of opening the wind gates is through the use of the elbow placed directly on the student's navel. In order to explain this procedure, we will divide the navel area into a 360 degree circle divided into four sections. It is equivalent to a com-

pass lying on the person's belly. When we talk about left or right sides, we refer to the left or right side on your student's body. The top of the navel, is South/180°. The left side is West/270°. Below the navel is North/0°/360°. The right side of the navel is East/90°. Every degree of the navel circle connects to different parts of the body. 180° - 270° describes the upper left quadrant of the abdomen. 270° - 360° describes the lower left quadrant. 0° - 90° describes the lower right quadrant. 90° to 180° describes the upper right quadrant.

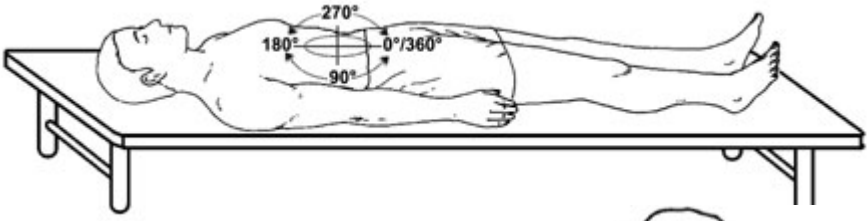

Push Down and Toward the Side

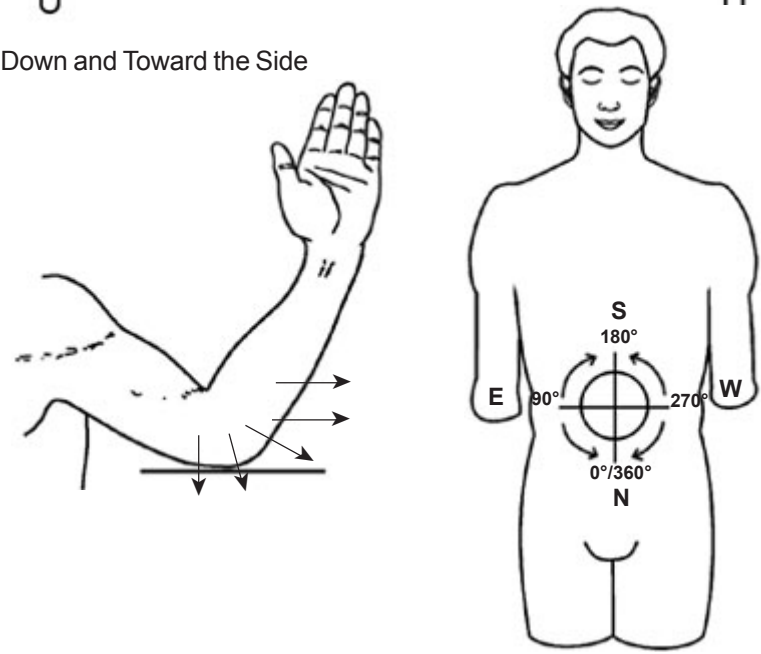

Fig. 1 *Opening the Wind Gates with the Elbow.*

Fig. 2 *Sick winds spiral out of fingers into the earth.*

The procedure to open the wind gates with the elbow is the following:

1. Place your elbow on the navel and press down.
2. Holding the pressure, move your elbow out towards the left side of your student's body at 270° toward 180° and from 180° back to 270°. Rest, twist the wrist and fingers and let the sick winds out of your finger tips down into the earth. Release the pressure, go back to the center of the navel and press down and out from the center to 280°, then from the center to 290° and continue until you have worked your way to 360°and from 360° toward 270°. When you are finished with this lower left quadrant, ask your student to breathe deeply into the navel to push your elbow out.
3. Flush the winds down the legs and out through the toes.
4. Repeat this procedure on the lower right quadrant from 90° towards 0° and from 0° toward 90°, and from 90° work toward

180° This will open the whole navel which will create a place for the wind to gather and the tightness of the abdomen will be released. For people who have back pain this work will greatly release the back pain. Flush and vent 15-20 times until you feel the navel is warm.

b. Opening the Navel

Taoists believe that there are trapped winds in the intestines and abdomen and also all the tendons from the body that join around the navel. Release the navel by pressing your thumbs on the ring muscle of the navel and pushing down and in opposite directions, for an approximate count of 15.

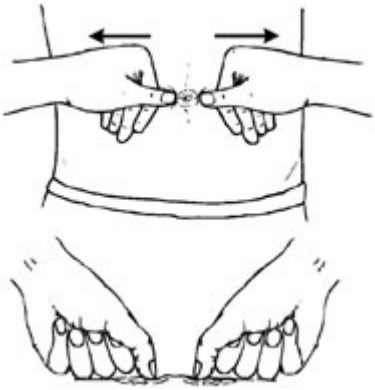

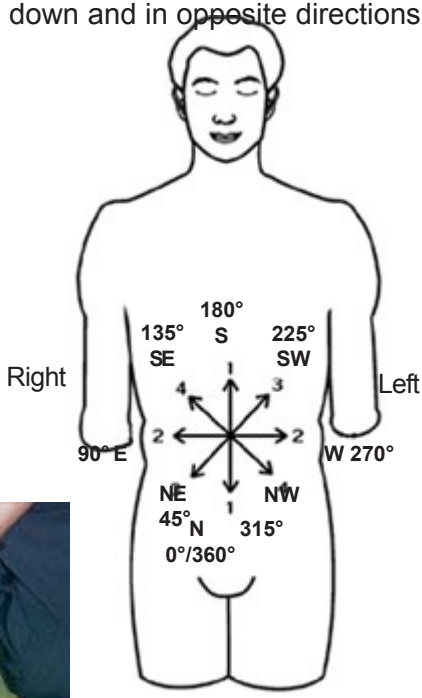

Fig. 3 *Push Down and in Opposite Directions.*

1. 0°-180° / N-S
2. 90°-270° / E-W
3. 45°-225° / SE-NW
4. 135°-315° / SE-NW

Your aim is to stretch the muscle below the skin, so you will need to place your fingers on the sides of the navel and not inside. Be careful not to hurt the skin as you push in opposite directions. Flush and vent 15-20 times.

c. Making Space in the Pakua

Opening the area around the navel following the shape of a Pakua discharges tensions from the body, releases pinched or tight nerves and reestablishes the proper flow in blood vessels and lymph channels. This follows the later heaven Pakua energy flow. To know more about the Pakua see the *Fusion* book. In Fusion I, organs are related to the different "Kuas" (forces). For example, the kidneys are related to Kan (water) in the North and the liver to Chen (thunder and lightning) in the East. In CNT II we relate the organs not to the kuas but to the reflexology points of the organs themselves. For example, the left kidney is at the Western Gate (4) and the right kidney at the Eastern Gate (3).

With the side of your hand, the heel of your palm, or thumbs press into the abdomen with both hands, one pushing on the other. If you feel too much wind when pressing down, stop, flush and vent down and out. This will make a big space and force the winds that are stuck in the organs and body to come and gather in the Pakua area.

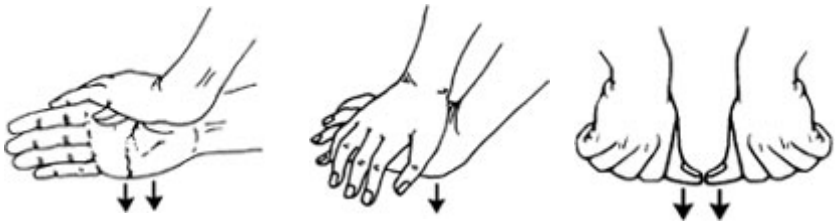

Use the side of the hand, bottom of the palm (wrist), or use the thumbs.

Fig. 4 *Pressing the Side of the Pakua.*

Press the eight sides of the pakua in the following order:

1. The Northern Gate (related to the bladder and the sexual organs, on the bottom of the pakua, at 0°/360°),
2. The Southern Gate (related to the heart, on the top of the pakua, at 180°),
3. The Eastern Gate (related to the right kidney, on your student's right side, at 90°),
4. The Western Gate (related to the left kidney, on your student's left side, at 270°),
5. The Southwestern Gate (related to the stomach and spleen, on your student's upper left, at 225°),
6. The Northeastern Gate (related to the intestines, on your student's lower right, at 45°),
7. The Southeastern Gate (related to the liver and gall bladder,on your student's upper right, at 135°).
8. Finally, the Northwestern Gate (related to the intestines, on your student's lower left, at 315°). Flush and vent 15-20 times.

This work includes releasing the navel area and then chasing and flushing out the winds as described in the previous section. The next chapter of this book provides a detailed explanation of the procedure to follow for specific winds and their manifestation. Most of the work is done with the elbow on the student's navel and by working on related points in the back, head and limbs.

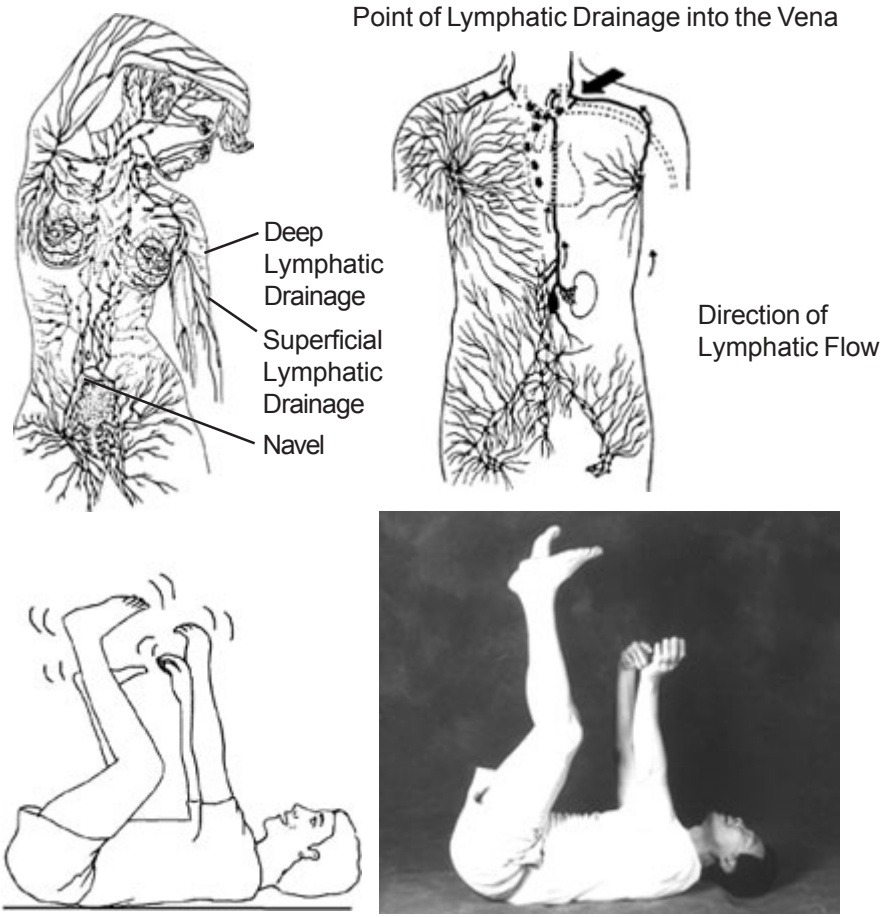

Fig. 5 *Monkey Dancing*

D. Closing the Session

When you perform Chi Nei Tsang, the blood and energy concentrate in the abdomen. Before your student gets up when you have finished the session, guide her to do “monkey dancing”. Ask her to lie on her back and to raise her arms and legs toward the ceiling and to shake them enthusiastically and loosely and to laugh while breathing deeply in the abdomen. This will help activate the lymph and blood circulation. (Fig. 5)

E. Encouraging Students to Work on Themselves

It is important to teach your students to do Chi Nei Tsang II on themselves between sessions. At the end of the session point out to them the areas that were particularly tight or congested; it is important that they continue to work on releasing them at home. Show them how to work on themselves using their fingers with their hands relaxed and elbows extended to their sides. Their shoulders, neck and arms should be relaxed and connected to the spine.

Tell your students that it is important for them to be responsible for their health and take the time to work on themselves. If they are confident of their own abilities to care for themselves they will feel more positive, stronger and free. Refer them to any additional practices that could help them to deal with their situation. In the Taoist way, suggest that they simplify their lives by allowing one unnecessary thing to fall away each day. This will settle their organs and calm their minds.

A daily routine of moderate exercise (for instance walking briskly) activates blood circulation and movement of the lymphatic system and keeps the body in good shape. It is also good for them to massage their belly every day stimulating the four corners of the intestines: the ileocecal valve (in the lower right abdomen approximately at the midpoint between the navel and the right pelvic bone); the hepatic flexure in the right upper abdomen, (under the bottom

right corner of the rib cage and under the liver); the splenic flexure (in the upper left quadrant of the abdomen under the bottom of the left rib cage); and the sigmoid colon (from the lower left corner of the abdomen between the midline of the abdomen and the left pelvic bone). Following a healthy diet is also very important.

In the way of the Tao, each individual in the world is responsible for his own enlightenment and well being. As Universal Tao Chi Nei Tsang practitioners and teachers, we are responsible for encouraging our students to be themselves and grow. As they do their work and feel the results they will want to do more for themselves.

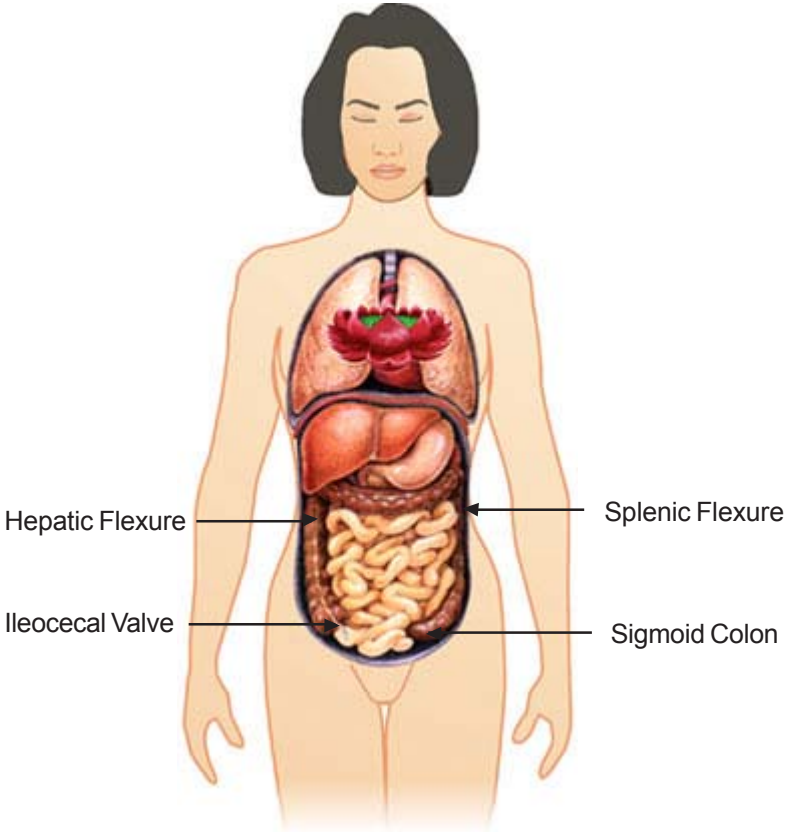

Fig. 6 *Four Corners of the Intestines*

First Wind
Wind that attacks the Liver and the Pericardium and the Heart

This wind rises from the small intestines and spleen and attacks the liver, pericardium and heart making them weak and tired. Symptoms usually manifest as a burning itching feeling and restless sleep, sometimes accompanied by a burning rash. The liver and heart tend to hold the heavy duty emotions of anger, envy, hatred, etc. Working on the First Wind can be a strong emotional release.

A. Navel Points for the First Wind

Use your elbow to press the following points:

Fig. 7 *Navel Points for the First Wind*

Follow the arrows; this will help spiral all winds out from the organs.

1. Point 35 located just above the navel, on the left side.
2. Point 35 on the right side.
3. Point 32 located below the navel towards the outside of the body, on the left side.
4. Point 32 on the right side.
5. Point 37 located on a line right above the navel, on the right side.
6. Point 37 on the left side.
7. Point 30 located below the lower end of the sternum. Be careful not to press on the tip of the sternum as it is very delicate.

B. Liver

To release the wind from the liver, observe the shape of your student's rib cage. If there is a problem, the ribs may be raised on one side.

1. Loosen the area under the ribs and massage the liver the liver, "***Shhhhh***", sound.
2. Press your knuckles on and between the rib bones all around the bottom of the ribcage on your student's right side. This might be particularly painful since the emotional energy stuck on the liver tends to rise and get stuck in the rib bones.

Fig. 8 *Massage the Liver with Both Thumbs.*

C. Heart and Pericardium

The heart is the seat of emotions, and a lot of the blocked emotional energy is stored around that area. Assist your student in learning how to release the energy of emotions trapped in the chest by breathing deeply and smiling into the area. Making the heart sound as he or she exhales can help ease the pain.

1. Begin by pressing your knuckle into points 22 and 23 on the left side. Point 22 is located right above the left nipple. For women you can find the point above the left breast approximately between the 4th and 5th ribs, 1 1/2 to 2" down from the collarbone. Point 23 is about an inch from Point 22 towards the arm. These points are usually very sensitive. Use soft stimulation instead of a heavy pressure. Spiral the knuckle in small area - a depression where the knuckle fits. Spiral counter clockwise to loosen.
2. Flush the wind from the heart area by spiraling your hand above it counterclockwise and then moving your hand above the heart meridian down the left arm. You will normally feel the dense, hot or itchy energy leaving the heart and you should direct it into the ground. The wind will flow out through the fingertips, especially the middle and pinky fingers. Your student can also focus on these fingers, exhaling out any excess heat from the pericardium also directing it towards the earth. The pericardium is like a cooling system for the heart.
3. Check the right side of the chest. Although wind trapped on this side does not affect the heart as much, if you do not release it this wind can later move into the left side. Work on Points 22 and 23 on this side and then flush the wind out through the right hand.
4. With your knuckle, release the area of the sternum, massaging between the ribs and directly on the rib bones, especially on the area around the heart .

   For women, work around the breast, moving it to the side to work on the ribs under it. When you work on the sternum be

aware of how soft it is and do not press too hard. Usually, you will find the problem area close to the heart, and you may feel a kind of swelling like the surface of a balloon.

5. Flush the wind down from the left part of the chest through the left arm.

D. Legs

1. To find the related knee Point 53, lay the palm of your hand on the midline above your student's knee. Your extended index finger should just about touch the gap above the kneecap. You will find the point as you extend your thumb to the inside of the leg and grab the inner thigh muscle.
2. Flush the wind down.
3. Repeat on the other leg.

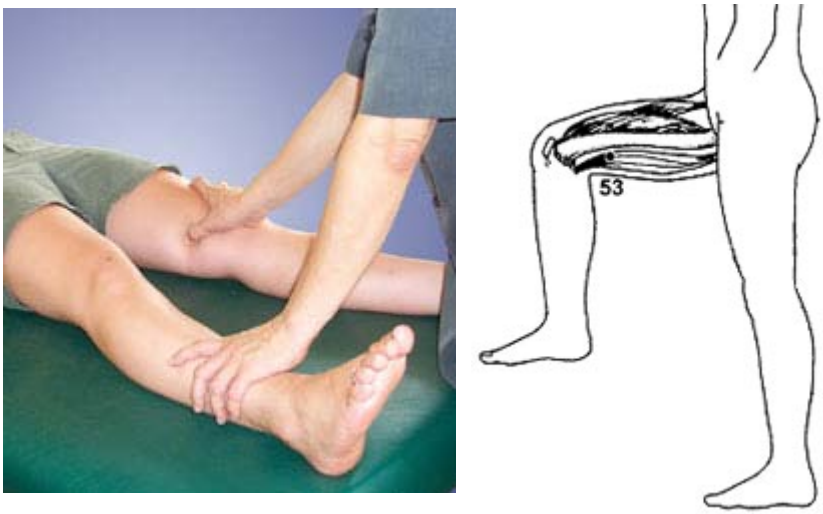

Fig. 9 *Point on the Legs*

Second Wind
Wind that attacks the Tongue, Jaw, Eyes and Head

Fig. 10 *Navel Points for the Second Wind are the same as for the First Wind.*

The treatment for this wind is the continuation of the work for the first wind. The wind that attacks the liver and the heart is hot, so it tends to rise to the throat, paralyzing the root of the tongue and then affecting the jaw, the eyes and the head. This wind can also impact the central nervous system. This is what often happens during heart attacks when people cannot speak. This wind often comes up when people are very angry, tense or under a lot of stress. The treatment is also useful when the student is very emotional or has low self-esteem.

A. Chin

1. Release the root of the tongue by massaging the soft area under the chin.
2. Press Point 15 under the chin, and then slowly slide the pads of your thumbs along the jawbone towards the back of the jaw and then to the front again. Dig your thumbs in behind and against the bone. This place can accumulate a lot of emotions and it can be very painful. Repeat this nine to eighteen times. This procedure can release the tongue after a heart attack when there are speech problems.
3. Flush the winds down your student's arms.

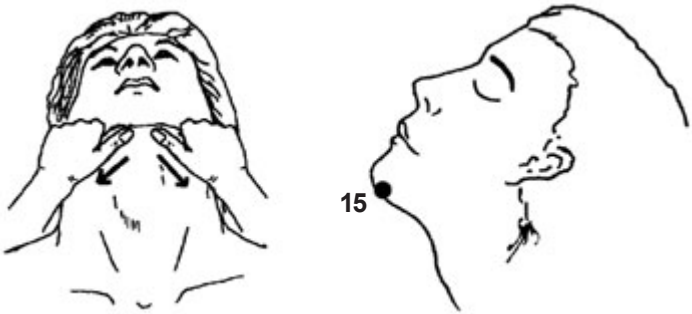

Fig. 11 *Releasing the Chin Area.*

B. Jaw

When this wind is present, the jaw becomes tense and tight and there is often a history of nightmares. The people affected by it normally clench the jaw or grind the teeth, especially during the night. Over a series of sessions, the jaw can be released and TMJ syndrome (lockjaw) may be relieved.

Liver excess is often the cause of this condition. It is important to release the toxins and wind in the liver as explained for the first wind before working directly on the jaw. Otherwise, the wind will rise from the liver and the problems will manifest once again.

1. Ask your student to gently tighten and loosen the jaw by clenching the teeth. This allows you to find the muscle between the upper and lower jaw.

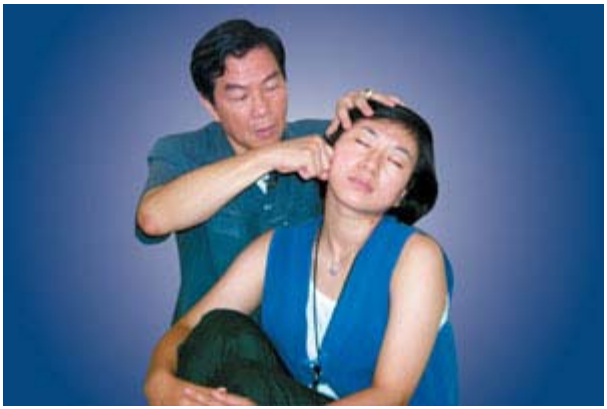

Fig. 12 *Massaging the Muscle between the Lower and Upper Jaw.*

2. Supporting the face with your other hand, massage the muscle as your student repeatedly opens the jaw. This point can be very painful. Work on both sides of the jaw until you feel the tense muscles easing. You can work on each side separately or on both sides simultaneously.
3. Use your knuckle to press Point 13 located right below the earlobe on the edge of the jaw. Work on both sides.
4. As you work, ask your student to do the Liver Sound subvocally to facilitate the release of the wind.

Fig. 13 *Pressing Point 13 with the Finger*

C. Head and Eyes

Use your knuckle to massage the following points on the face, spiraling in a tiny circle. These points are particularly powerful antidotes to migraine headaches and sore eyes or eye aches. Use the point of the knuckle at a 90° angle to the face or head.

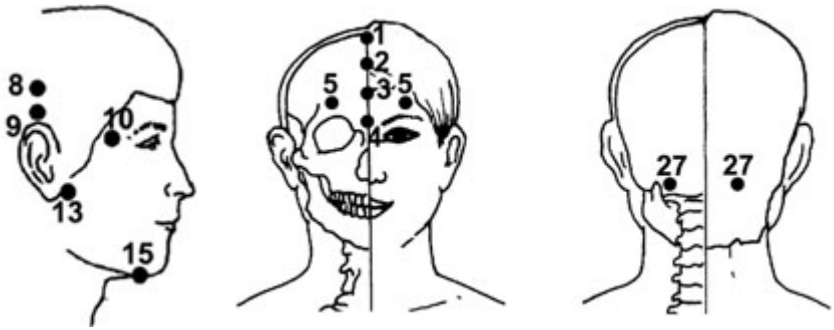

Fig. 14 *Massaging Point 3*

1. Point 2 in the front of the skull on the center line above the hairline.
2. Point 3 on the area in the middle of the forehead.
3. Point 4 on the mid brow.
4. Point 5 above the middle of each eyebrow where you find a small notch.
5. With your thumb, release the area all around the upper eye socket following the bone. Work slowly and softly from the inside to the outer edge. This can also relieve the heat, redness, pain and dryness in the eyes caused by liver wind. This massage is very effective with swollen eyes that often come with migraine headaches.
6. Guide the student to turn the head to the opposite side where you will work and support the head with your other hand. Find point 10 on the temple just beyond the orbital bone on the outer edge of the eye. It will feel like a hole, valley or indentation. Begin by releasing it gently with your fingers, and then slowly and carefully insert your knuckle. Spiral following the student's exhalation. Work on the other side and then do both sides simultaneously.

Fig. 15 *Massaging the Eye Socket*

7. The next Points 8 and 9, are located directly above the apex and on the centerline of each ear. Use your knuckle to massage each point individually and then both sides simultaneously.
8. Flush the wind out through your student's arms.

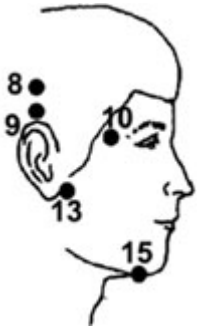

Fig. 16 *Points 8, 9, 10, 13 and 15*

Fig. 17 *Massaging Point 8 above the Ear*

D. Back of the Head

1. Massage Point 27 (Wind Pond) with your knuckle. To find it, search for an indentation on the centerline area in the back of the neck above the base of the skull about one inch above the bottom of the hairline. You will know you found the right “valley” spot when you can spiral with your knuckle without sliding or slipping out of the point.
2. Find the curlicue, the spot (or spots if there is more than one) where the hair spirals, and massage it with your knuckle releasing any wind or stagnant chi that is blocked there.
4. Often it is possible to feel the wind exiting the skull at this point. Gather it by swirling your hands above the head and then direct the wind down the arms, out the hands and into the earth.

To assist your student in moving to daily self-care, you can teach the points on the face so that he can work on them daily, particularly when the condition is present.

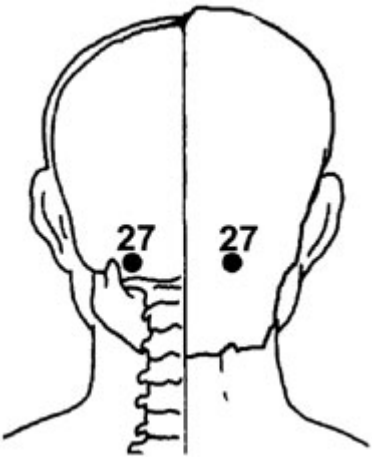

Fig. 18 *Point 27*

Third Wind
Wind that Attacks the Kidneys

This wind is caused by improper eating habits, such as eating too much cold producing food (i.e. very cold drinks, ice cream, frozen or cold food right out of the refrigerator and unripe fruits) and not chewing properly. It always starts from the small intestines rising to the kidneys, moving up above the ears, and accumulating in the head. When this wind gets stuck in the brain, it can attack the nerves, causing the eyes to shake and making the teeth ache.

The small intestines are located over the kidneys. Excessive cold energy contracts the kidneys and makes the psoas muscle spasm and pull the spine towards the thigh. This stops the flow of energy and causes back pain. Bringing the excess heat from the heart down to the psoas muscles and kidneys relaxes and warms the lower back.

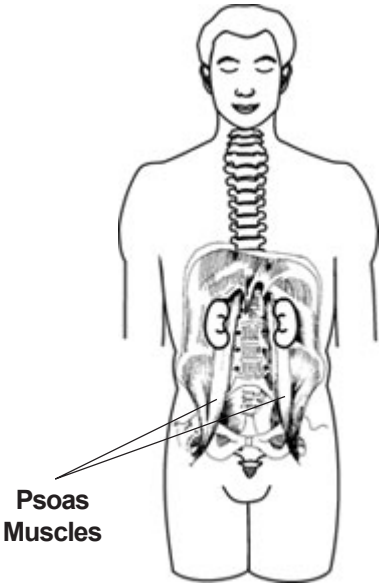

Fig. 5.17 *Psoas Muscles*

A. Lotus Meditation

Imagine the heart as a red lotus flower and the pericardium (the heat-regulating membrane which encloses the heart) as the lotus pads. Visualize the kidneys as being bulbs similar to the clusters or plexuses where the stems of the pads and the lotus flower join together. In a pond or pool there are usually several lotus plants that join together in a cluster, rooting in the mud. From the kidneys (kidney bulbs/clusters), visualize roots extending down through the legs into the watery mud of the earth basin.

1. Breathing deeply into the lower abdomen, visualize your heart as a red lotus flower, your kidneys as its roots and your spine as the stem that connects them.
2. Feel the roots of the lotus extending into the bed of the pond absorbing the right amount of nutrition from the wet earth. Visualize the flower opening to the sun to receive its (fire) energy. Feel the healthy and supple spine as the stem connecting the two energies. Feel the harmony of fire and water, yang and yin, male and female.
3. Inhale into the heart, drawing the warmth from the sun, feeling it come down through the crown of the head, and blend it with the love, joy and happiness in the heart (red lotus). Draw this loving, hot heart energy back to the point opposite the heart in the center of the spine (the point between the scapulae, between T5 and T6 as you slowly inhale. Then exhale (use the heart sound, "***Hawwww***") the hot energy down the spine (lotus stem) to the cool kidneys, warming them and warming the psoas with the loving heat from the heart.
4. See the kidneys as the nourishing bulbs of the lotus with roots that extend down through the legs to the soles of the feet accessing the soothing blue water energy held by the earth.
5. Inhale into the kidneys, feeling the roots of the lotus extend down through the legs to the soles of the feet. With your inhalation draw the cool, soothing, nourishing blue water energy through the soles of the feet, up through the legs to the kidneys. Feel the gentle, calm, peaceful energy of the kidneys blending with the

cool, soothing blue water energy that has come up through the legs. Exhale out with the kidney sound, "***Choooo***". As you exhale send this energy up through the spine (stem) via the wing point to the heart.

6. Alternate inhaling into the heart and into the kidneys in this way for a few times.
7. Relax, breathe normally and move your mind back and forth between the heart and kidneys along the connecting spinal stem. Smile with gratitude to your kidneys, spine and heart.

B. Navel Points for Working with the Kidney Wind

These are not such exact points. It's where you find tension, a lump, stress; it's more of a general area. Hold the elbow there until the tension loosens. Feel the elbow inside the abdomen and pay attention to the expression on the student's face.

1. Point 35 located just above the navel, on the left side.
2. Point 33 located just below the navel, on the left side.
3. Point 33 on the right side.
4. Point 35 on the right side.
5. Point 38 located to side of your student's navel, on the left side. This point relieves the wind that causes back pain.
6. Point 32 located below the navel towards the outside of the body, on the left side.
7. Point 32 on the right side.
8. Point 38 on the right side.
9. Point 36 located above the navel slightly towards the sides of the body, on the right side.
10. Point 36 on the left side.
11. Flush out through Point 53. Sometimes sick energy gets stuck at Point 53 on the leg, so loosen up this point after working on the navel points.

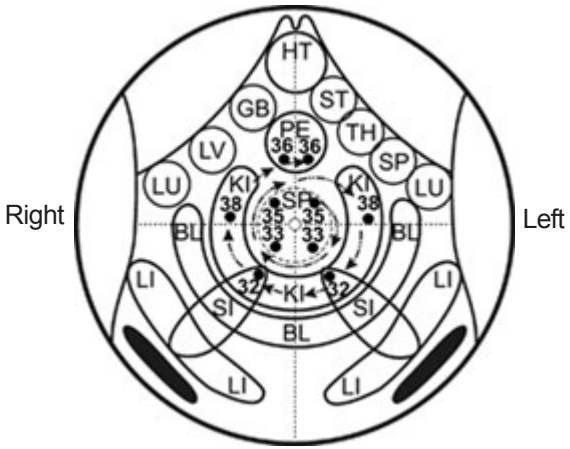

Fig. 19 *Navel Points for the Third Wind*

C. Head

1. Press Point 8 with your knuckle, supporting the head with your other hand. This point is located in an indentation about one finger's width above the tip of the ear. Work on both sides.
2. Instead of venting excess hot energy out through the arms and fingers, bring the excess heat of the heart down to the kidneys. When we bring excess heat down from the heart, heat from the head goes down also.

D. Legs

1. To find the related knee Point 53, lay the palm of your hand on the midline above your student's knee. Your extended index finger should just about touch the gap above the kneecap. You will find the point as you extend your thumb to the inside of the leg and grab the inner thigh muscle.
2. Flush the wind out.
3. Repeat on the other leg.

Fourth Wind

Wind that causes Aches, Tightness, Tiredness and Uneasiness in all the Body and attacks the Vena Cava, Aorta, and Lumbar Plexus

The fourth wind causes a feeling of fatigue, aching, tightness and uneasiness all over the body. This wind arises from too much acidity in the body. Excess acidity in the body will cause an exacerbated mucus production that can host excessive bacteria and viruses and will congest the organs. Acidity will also affect the connective tissues, cartilage and tendons and it makes the bile duct constrict. Excess alkalinity (too many sweets, sweet fruit or vegetables) overstresses the pancreas, so it is important to keep a balance in the body's pH by eating properly. One must change the eating habits and the emotional habits. Mental stress and emotional distress are a main cause of an acidic metabolism because of the overproduction of stress hormones such as adrenaline and insulin which are acidic and flood the entire system.

This wind also attacks the heart, causing pain and heartburn. When this wind activates, it reaches the heart area and comes up to the left shoulder and down the arm along the pericardium meridian. When this wind attacks the lumbar plexus it spreads throughout the whole nervous system. Abdominal breathing and belching to loosen up stuck Chi greatly helps to relieve this wind.

A. Navel Points for the Fourth Wind

Use your elbow to press the following points. Find the tension, hold that point with the elbow until the tension is released and the winds go out. Talk to the winds and send them out to a better home, the earth!

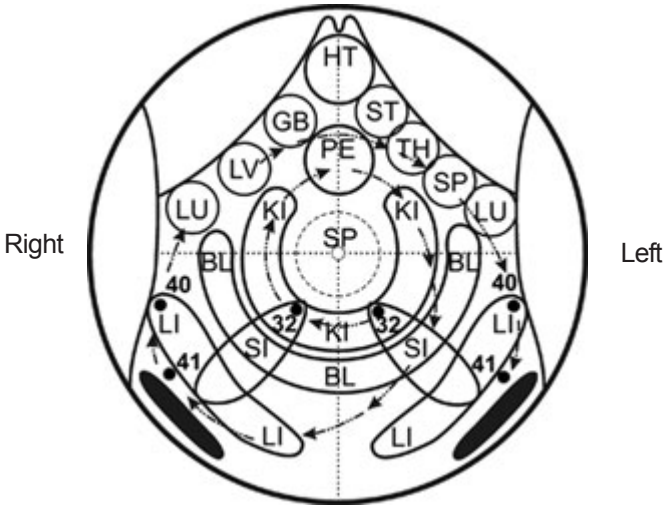

Fig. 21 *Navel Points for the Fourth Wind*

1. First for point 32 located just below the navel, on the left side.
2. Follow with point 32 on the right side.
3. Point 41 on the right side.
4. Point 40 on the right side.
5. Follow with point 40 located right above the hipbone, on the left side.
6. Point 41 located on the lower tip of the hipbone, on the left side.
7. Point 48 located on the front of the leg at the level of the sexual organs towards the inner thigh, on the left side. Use the tip of your fingers for this point.
8. Point 48 on the right side.

B. Chest and Shoulders

Working on the chest and shoulders we find many nerves. “Respect the nerves” by holding still - not “monkeying” around with the nerves.

This wind most often affects the left side only; all of the points described next refer to the left and right sides of the body. If the wind goes to the right side you must also work on the same points on the right side of the body. Usually you have to work on both sides.

1. With the student laying on his back, use your fingers to massage Point 21 located below the collarbone and the area above the left breast . The heart and pericardium meridians both leave the heart and traverse the upper chest going up to the shoulder and down the left arm.
2. Have your student sit up or turn on his side. With your elbow, press Point 20 located above the clavicle, close to the neck.
3. Pinch the trapezium muscle on the area where the neck meets the shoulder. Pull it up and shake it, massaging the muscle and the nerves underneath to release the area.
4. Massage Point 75 located on the outer edge of the shoulder in the depression in the middle of the deltoid muscle. Raise the arm slowly so that the arm is horizontal.
5. Massage Point 25 in the student’s left armpit. Have the student raise the arm slowly straight up as you press and find the point. The student leans into your thumbs.
6. Use your fingers to massage the heart meridian all the way down the inside of your student’s arm, pressing Point 77 on the inner elbow as you go down.
7. Continue massaging the arm down to the tip of the little finger. Pinch the end corners of the fingernail.
8. Flush the winds down the left arm.

Fig. 22 *Massaging Point 75*

C. Legs

1. Press Point 69 or 54 located behind the kneecap.
2. Work on Point 55 located on the inner part of the leg below the knee joint.
3. Work on Point 66 directly below the anklebone on the inside of the foot. Press down with both thumbs.
4. Flush the wind down the legs.

Fig. 23 *Press down on Point 66 and 56 with both thumbs.*

D. Back

1. Ask your student to turn so you can work on his back. Press your elbow on Point 45, in the space between the sacrum and the hip bone. Shake your arm and slightly push the hip bone down towards the buttocks to release the tension in that area.
2. Flush the wind down the legs.
3. Remember to flush out the wind after pressing each Point 69 behind the knees.

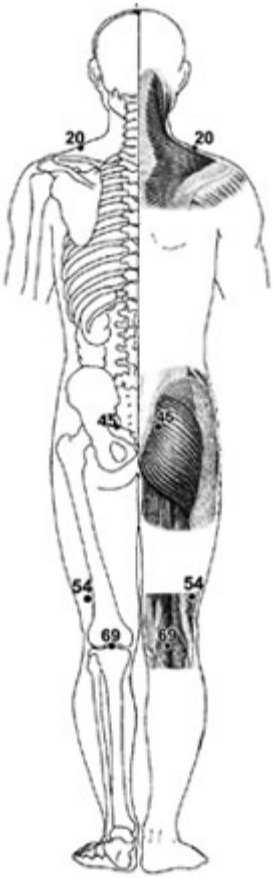

Fig. 24 *Points 45 and 69*

Fifth Wind
The Wind that makes the Abdomen Stiff, Hard, Tight and Tender

This wind is created in the small intestine and causes shooting pains as it travels along the liver meridian. The upper right side of the abdomen will probably be bloated. This wind is caused by food and emotions and it always starts in the intestines. It must first be removed from the small intestine and then from the liver.

When the intestines are bloated with wind, you must first work to clear the large intestines, then small intestines, the liver and the gall bladder with the techniques presented in the first CNT book. When you sense the knots and tangles releasing, then use the elbows.

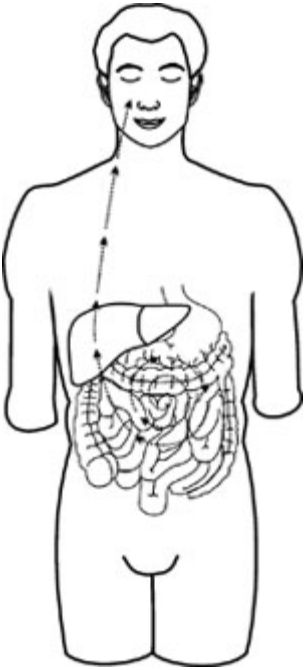

Fig. 25 *Path of the Fifth Wind*

A. Navel Points for the Fifth Wind

Use your elbow to press the following points:

1. Point 35 on the left side.
2. Point 33 located just below the navel, on the left side.
3. Point 33 on the right side.
4. Work on point 35 located just above the navel, on the right side.
5. Point 36 located above the navel slightly towards the sides of the body, on the right side.
6. Point 36 on the left side.
7. Point 41 located on the lower tip of the hipbone, on the left side.
8. Point 41 on the right side.

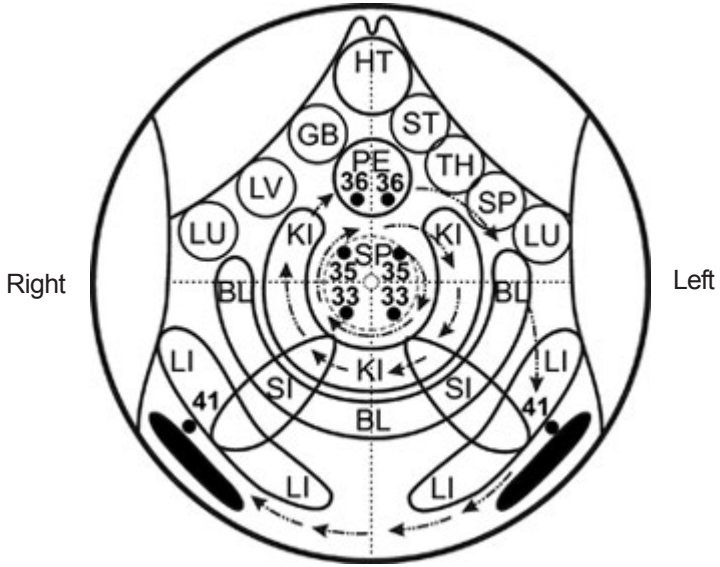

Fig. 26 *Navel Points for the Fifth Wind*

B. Crown and Perineum

1. With your knuckle press on the Crown Point 1 on the intersection of the line drawn between the highest point of the ear and the midline of the nose. As you press this point, guide your student to connect with and lightly contract the perineum. Or put the knuckle in Point 1 and spiral and hold, spiral and hold while the student holds and presses Point 43 with the middle fingers.
2. Press CNT Point 43, (Hui Yin) or have your student press it himself. It is a good idea to cover the student with a sheet or a towel across the genitals so they have a sense of privacy when working on this delicate point. Coach your student to contract his mouth and suck the lips until they are tightly pursed and contract the anus by sensing and pulling up on the front, back, middle, left and right parts of the anus. Hui Yin is where all yin and sick energy gathers.
3. Flush and vent from the head down the arms and out; flush and vent from point 43 down and out the legs.
4. Encourage your student to massage the perineum at home daily while practicing the anus contraction exercises and touching the crown of the head for as long as the symptoms of tightness in the abdomen persist.

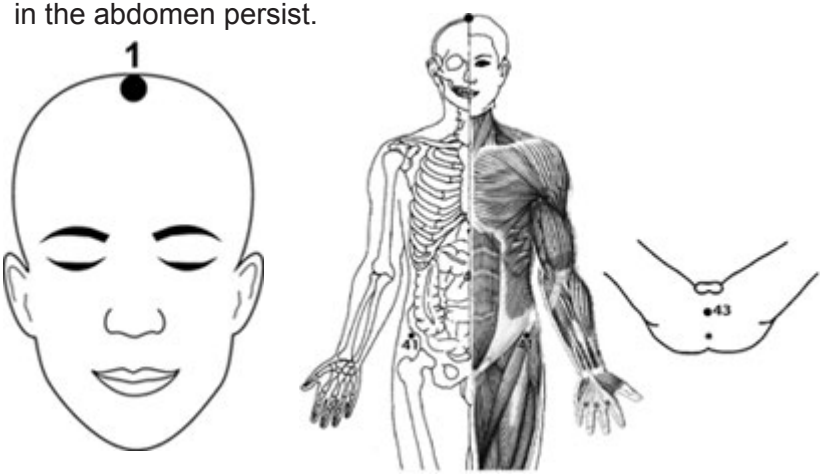

Fig. 27 *Points on the Inguinal Area Crown and Perineum*

C. Legs

1. Press point 57 located on the inner part of the leg below the knee joint with the elbow or thumbs. You can use a little oil here.
2. Work on point 66 directly below the anklebone on the inside of the foot. Use the thumbs to push down and out.
3. Flush the wind down the legs.

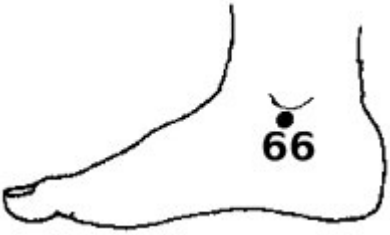

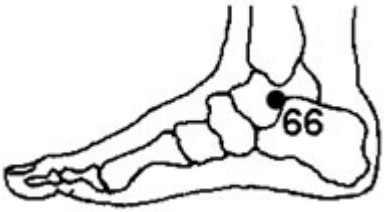

Fig. 28 *Points on the Legs and Feet*

Sixth Wind
Wind that Causes Cramps

This wind causes cramps and tightness in the legs, the back and the neck. The cramps usually start in the abdomen but they attack the nervous system and the muscles. When this wind is present, there is a lot of stiffness and pain.

The cramps created by this wind result from problems with the flow of blood that returns to the heart when the veins, especially the vena cava, are congested. For instance, if the legs get too cold, the muscles contract obstructing the flow of blood and causing cramps. By releasing the wind, the swelling is relieved and the proper flow of blood is restored.

A. Navel Points for the Sixth Wind

Use your elbow to press the following points:

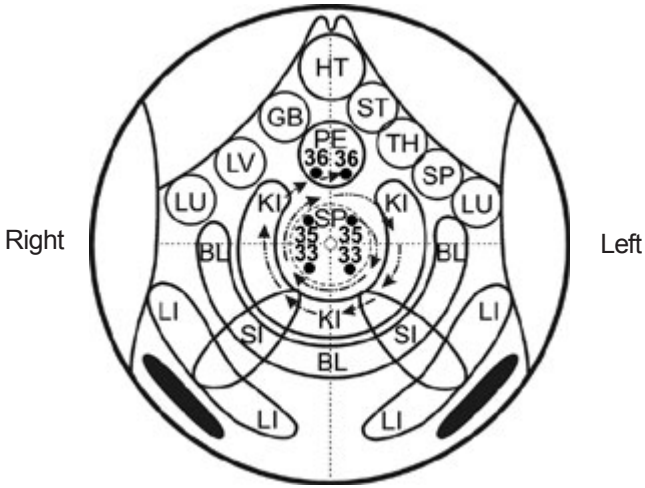

Fig. 29 *Navel Points for the Sixth Wind*

1. Point 35 on the left side.
2. Point 33 located just below the navel, on the left side.
3. Point 33 on the right side.
4. Point 35 located just above the navel, on the right side.
5. Point 36 located above the navel slightly towards the sides of the body, on the right side.
6. Point 36 on the left side.

B. Face

1. Press point 15 in the depression under the chin behind the lower jaw with your thumb. Press up towards the tongue.
2. Press your knuckle into Point 13, located right below the ear-lobe on the edge of the jaw. You may work on each side separately or on both sides simultaneously.
3. Flush the sick energy out through the arms.

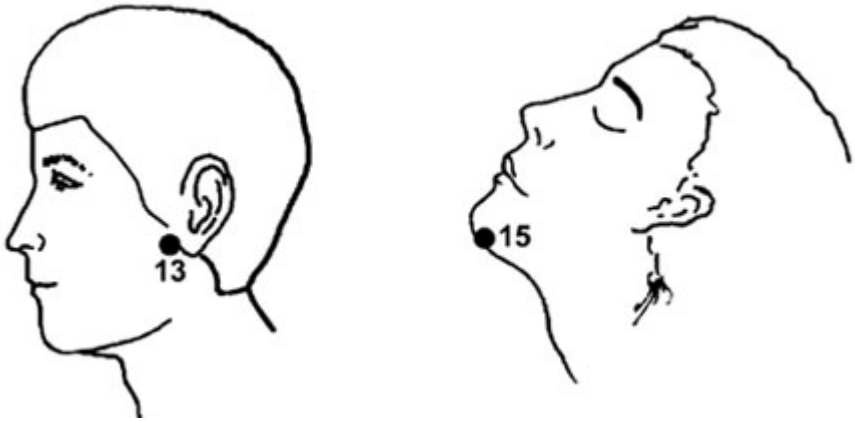

Fig. 30 *Points on the Face*

C. Legs

1. Stretch you student's calves and Achilles' tendons by pushing his feet towards the navel and moving the feet circularly, maintaining tension on the calf muscles.
2. Flush the wind down.
3. Ask your student to turn over. With your elbow, work on Point 69 on the back of the knees in the split of the muscle below the knee.
4. Flush the wind down the legs.
5. Your student should continue the work at home by pulling her toes back toward the navel, and extending the heels until the legs are tight, then releasing and exhaling. Standing on the toes and then rocking back to the heels, lifting the toes can help relieve congestion by encouraging the flow of blood into the calf muscles.

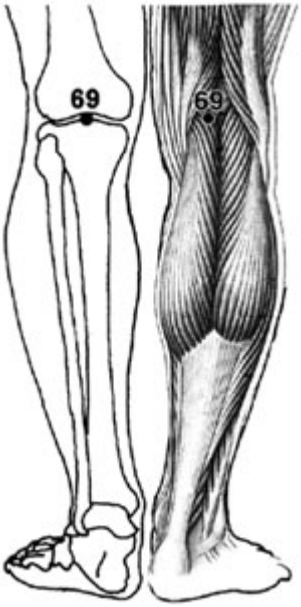

Fig. 31 *Points on the Legs*

D. Slapping Technique

This technique relieves the stagnation behind the knees, elbows and other joints, such as the inside of the ankles and the wrists.

1. Support the extended leg, arm, wrist, or ankle with just a bit of slack in the joint. With the open palm, strike the back of the joint quickly. It may cause a sharp, stinging sensation and even cause a bit of welting and redness which will dissipate as the stagnant blood is reabsorbed into the body. This technique can be painful but it is very effective to stimulate and restore the free flow of clean healthy oxygenated blood into the joints. ***Be careful not to work on varicose veins***. Tell the student to not take a shower or wet the area for 12 hours. Afterwards, the slapped area should not be touched.
2. Flush the wind down.
3. After the treatment, your student should do monkey dancing. Lying on his or her back, she should raise arms and legs towards the ceiling and shake them while breathing deeply into the abdomen. This helps blood circulation and lymph flow. This is a daily practice to get stagnant blood moving.
4. Deep belly laughing, known as “beating the inner drum”, will also help your student as it pumps the abdomen, activating the flow of blood, lymph and Chi and massaging all the internal organs.

Fig. 32 *Slapping Technique*

Seventh Wind
Wind that attacks the Heart causing Shaking

This wind starts in the intestines and it attacks the heart as it rises. When the heart overheats, the jaws tighten, the whole body may shake, and in extreme cases, the body is paralyzed. This is sometimes misdiagnosed as Parkinson's disease. The intestines cover a broad area; when this wind is high and centered in the intestines the heart is attacked directly. Working on this wind also helps to relieve back pain.

The right amount and flow of water and fire energy in the body is very important. In Nature, too much cold makes it impossible for anything to live and too much heat burns everything up. Balance creates a sense of well being.

A. Navel Points for the Seventh Wind

Use your elbow to press the following points:

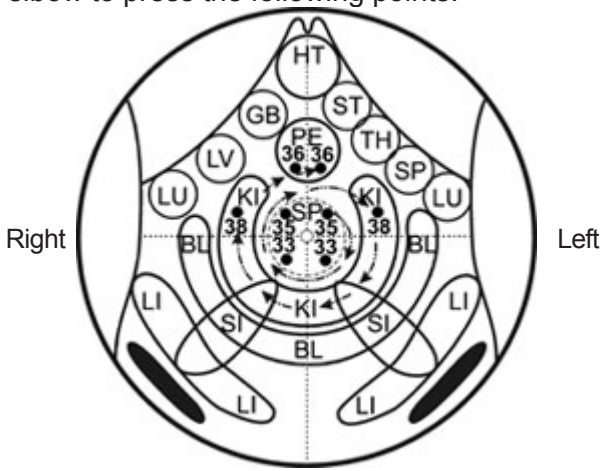

Fig. 33 *Navel Points for the Seventh Wind*

1. Point 35 located just above the navel, on the left side.
2. Point 33 located just below the navel, on the left side.
3. Point 33 on the right side.
4. Point 35 on the right side.
5. Point 38 located to the side of the navel, on the left side.
6. Point 38 on the right side.
7. Point 36 located above the navel slightly towards the sides of the body, on the right side.
8. Point 36 on the left side.

B. Face

1. With the knuckle press Point 13 below the ear towards the end of the jawbone while supporting the face with the other hand.
2. Flush the energy out through the arms.

Fig. 34 *Point 13 on the Face*

C. Feet

1. Press Point 74 (Bubbling Spring) located on the soles of the feet at 1/3 of the distance from the base of the 2nd toe to the heel. As you stimulate the point, guide your student to pull the tips of the toes towards the navel as she inhales bringing the cold refreshing energy of the kidneys from this point at the beginning of the kidney meridian. Ask her to feel the energy going up through the insides of the legs, then through the back of the perineum, up into the lower abdomen wrapping the kidneys and the adrenal glands, and rising all the way up to the heart area just under the collarbones.
2. As you flush the wind out through the feet, ask your student to exhale (with the heart sound) any excess heat from the heart down to the kidneys, then through the back and legs and out through the toes into the earth. Shaking should start reducing immediately. The Lotus Meditation presented in the Third Wind is also very helpful in this case as it uses the cold water energy of the kidneys to reduce excess heat in the heart.
3. Encourage swallowing saliva and frequent belching. This cools the heart down and moisturizes the overheated organs.

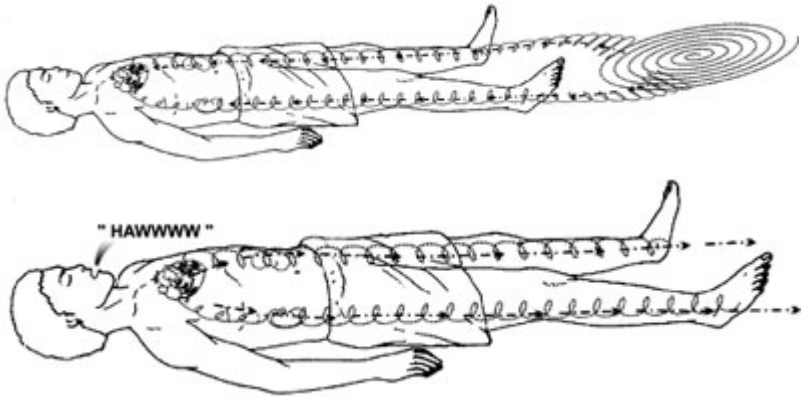

Fig. 35 *Exhale out Excess the Heat with the Heart Sound.*

Eighth Wind
Wind that causes Chest Pain

This wind causes pain in the chest and back as well as allergic rashes. It rises as a result of excess mucus sticking to the veins and arteries, and the lower abdomen often feels like jelly inside. An excessive amount of mucus is created when the body is too acidic, so it is important for the student to eat a greater amount of alkaline foods. Chewing food well and mixing it with saliva promotes good digestion and avoids the problems created by this wind. One should chew so much so that one may “drink one’s food”. Try counting how many times you normally chew a mouthful; then, chew many more times until the solid food becomes liquid. The student should also avoid eating foods to which she is allergic and, if possible, avoid areas where the air pollution is too strong or where there are high concentrations of pollen if this affects her system. Adjusting the acidity and alkalinity of the diet and cleaning out the colon will render deep results. One should also learn to drink one’s own fresh urine to rid the body of excess mucus.

A. Navel Points for the Eighth Wind

Use your elbow to press the following points:

1. Point 35 located just above the navel, on the left side.
2. Point 33 located just below the navel, on the left side. This point (together with Point 38) is good for relieving back pain.
3. Point 33 on the right side.
4. Point 35 on the right side.
5. Point 38 located to side of your student’s navel, on the left side.
6. Point 32 located below the navel towards the outside of the body, on the left side.
7. Point 32 on the right side.
8. Point 38 on the right side.
9. Point 37 located on a line right above the navel, on the right side.

10. Point 37 on the left side.
11. Point 30 located below the lower end of the sternum. Be careful not to press on the tip of the sternum as it is very delicate.

Right

Left

Fig. 36 *Navel Points for the Eighth Wind*

B. Chest

1. Massage the whole chest area. Use the heel of the palm to loosen the entire rib cage. Keep the palm in one place and vigorously spiral and shake. Now work your knuckle between the ribs and right on the rib bones using one hand to hold the rib cage. For women work around the breast, moving it to the side to work on the ribs under it. The chest area may be very painful due to the great number of emotions (i.e. anger, sadness, jealousy, depression, etc.) stored there. Tell your student to keep breathing into the area so that the pain and the emotions can be released.
2. Work on the sternum with your knuckle. Be aware of the tip of the sternum, how soft it is, and do not press too hard.
3. Flush the wind down through the arms.

Ninth Wind
Wind that makes the Legs and Feet Tired

This wind causes a lot of pain and fatigue in the legs and feet. When the legs are tired, winds often accumulate in the chest and abdomen straining the organs and the psoas muscle. When the psoas muscle is tight, it pulls the lower back and the pelvis into painful misalignment. Over time, the muscles are unable to move back into a natural position.

A. Navel Points for the Ninth Wind

Use your elbow to press the following points:

1. Point 35 located just above the navel, on the left side.
2. Point 33 located just below the navel, on the left side.
3. Point 33 on the right side.
4. Point 35 on the right side.

Fig. 37 *Navel Points for the Ninth Wind*

5. Point 36 located above the navel slightly towards the sides of the body, on the right side.
6. Point 36 on the left side.

B. Chest

1. Press your knuckle into Point 22 located right above the nipples. For women you can find the point above the breasts approximately between the 4th and 5th ribs, 1 1/2 to 2 inches down from the collarbone.
2. Do Point 22 on the other side.
3. Flush the wind down the arms.

C. Inguinal Area

There are many blood vessels crossing this area. Working on these points helps restore proper blood circulation and release the nerves. This area is very sensitive, so you should work gently with your elbow. Many people, especially women, have a lot of emotions and guilt stuck in the area under the navel and particularly in the groin. When the psoas muscles are in good shape, this region is not painful at all.

1. Press Point 40 on the left side located right above the hipbone.
2. Press Point 41 on the left side located on the lower tip of the hipbone.
3. Press Point 49 located just inside the lower part of the pelvic bone, on the left side. Ask permission to work on this point and work very respectfully since the area is very close to the pubic bone and thus close to the sexual organs. If your student becomes aroused, help him guide the energy up through the microcosmic orbit.
4. Press Point 49 on the right side.
5. Press Point 41 on the right side.
6. Press Point 40 on the right side.
7. Flush the winds down through the legs.

D. Legs

The following points should be pressed with the tips of the fingers.

1. Work on Point 63 located right above the anklebone on the inner side of the leg.
2. Work on Point 66 located directly below the anklebone on the inside of the foot.
3. Work on Point 55 located in the front of the leg under the knee between the two bones.
4. Work on the other leg.
5. Flush the wind down the legs.

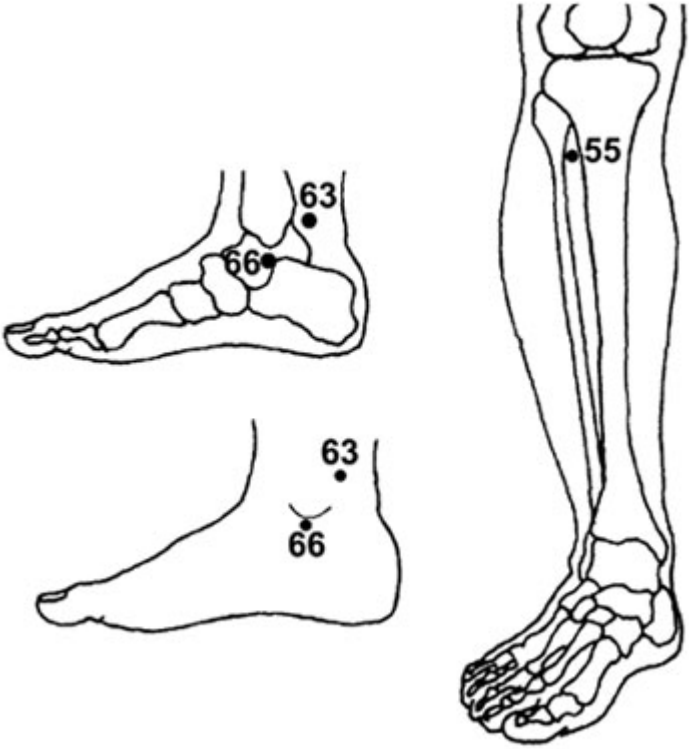

Fig. 38 *Points on the Legs and Feet*

Tenth Wind
Wind that causes Pain, Numbness and Heat

This wind causes pain, numbness and heat that extends from the legs up to the armpits and hands. The heat is felt rising upwards, making it difficult to walk. Working on the center of the navel and the midline up to the sternum works for people with back pain. After 15-20 minutes, it is possible to create a release and restore the ability to walk. This wind also attacks the heart, so you will also need to work on the upper chest.

A. Navel Points for the Tenth Wind

Use your elbow to press the following points:

Fig. 39 *Navel Points for the Tenth Wind*

While working with these navel points rest a finger on point 19.

1. Point 35 located just above the navel, on the left side.
2. Point 35 on the right side.
3. Point 36 located above the navel slightly towards the sides of the body, on the right side.
4. Point 36 on the left side.

B. Chest and Throat:
Releasing these points allows courage to grow

1. Press your knuckle, or thumb, or finger on Point 19, located between the collarbones where they join the sternum.
2. Work on Points 18 located slightly above either side of Point 19, right above the clavicles. There may be pain all over in this area. Work to release the tightness with your thumb and index finger. Massage the entire area and directly over the clavicles as well.
3. Massage and open Point 17 located on the throat on the sides of the depression of the pharyngeal prominence, under the notch on both sides of the voice box.
4. Flush the wind down through the arms.

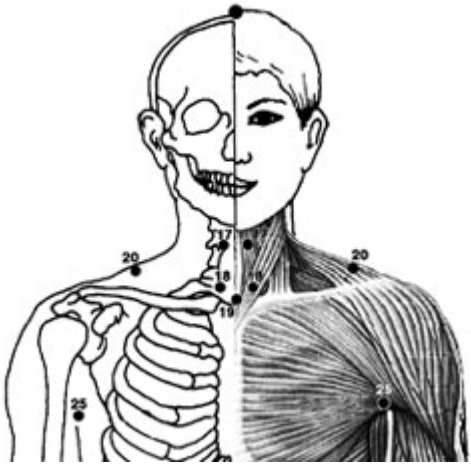

Fig. 40 *Points on the Chest and Throat*

C. Shoulders and Back

This is good for a stiff neck.

1. Press Point 20 with your elbow massaging the whole brachial plexus. Tell your student to slowly turn his head away from the side you are working on as you press down. Try a few drops of oil with this move.
2. With your thumb, press Point 25 on the armpit.
3. Flush the wind out the arms.

Fig. 41 *Point 20 – the Shoulder Well*

D. Feet

First use the two thumbs on Points 66 and 67. Then connect the navel with Points 66 and 67 with the fingers of one hand on the navel while using the thumb to massage down from Points 66 and 67.

1. Work on Point 67 located on the inside of the foot below the anklebone towards the front.
2. Work on Point 66 directly below the anklebone on the inside of the foot.
3. Work on Point 74 on the soles of the feet at 1/3 of the distance from the base of the second toe to the heel.
4. Do the other foot.
5. Flush the wind out.

Eleventh Wind
Wind that affects the Nerves and makes a Stiff Back

This wind affects nearly everyone at one time or another. It collects directly below the navel and it can cause a stiff back and affect the nerves and the lumbar plexus. Before you work on this wind, it is necessary to release the navel area and the psoas muscle with basic Chi Nei Tsang I procedure.

A. Navel Points for the Eleventh Wind

Use your elbow to press the following points:

1. Point 35 located just above the navel, on the left side.
2. Point 33 located just below the navel, on the left side.
3. Point 33 on the right side.
4. Point 35 on the right side.
5. Point 38 located to side of your student's navel, on the left side. This point relieves the wind that causes back pain.
6. Point 32 located below the navel towards the outside of the body, on the left side.
7. Point 32 on the right side.
8. Point 38 on the right side.
9. Point 37 located on a line right above the navel, on the right side.
10. Point 37 on the left side.
11. Point 30 located below the lower end of the sternum. Be careful not to press on the tip of the sternum as it is very delicate.
12. Conclude the massage work by gently using your fingers to massage the area just below the navel.
13. Finally, the student should place her palms over her lower abdomen and warm the area by imagining a fire or the sun burning in her abdomen. You may also directly introduce warming energy into this area with your intention and by sending wind burning energy from your fingertips.

Fig. 42 *Navel Points for the Eleventh Wind*

B. Shoulders

Sometimes before this wind exits the body it moves into areas of the student's body where he is used to storing pain such as the back, hips or shoulders. This is a good sign; it means the winds are moving. Help the student visualize the wind moving out through the legs and toes or through the arms and fingers.

1. Massage Point 75 located on the outer edge of the shoulders in the depression in the middle of the deltoid muscle.
2. With your elbow, press Point 20 on the shoulders at the base of the neck.
3. Flush the winds out through the arms.

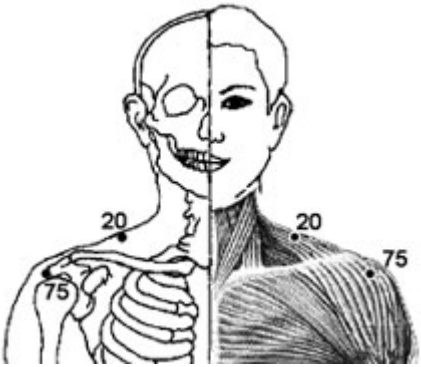

Fig. 43 *Points on the Shoulders*

C. Back

1. Press your elbow on Point 45 located in the space between the sacrum and the hip bone. Shake your arm and slightly push the hip bone down towards the buttocks to release the tension in that area.
2. Flush the wind down through the legs and feet.

Fig. 44 *Massaging Point 45*

Twelfth Wind
Wind that causes Excess Heat and Cold

Your student may complain of excess heat or cold or a rapid alternation of both hot and cold wind. Releasing excess cold and or heat entails gathering the imbalanced wind and sweeping it out. The right temperature in the body provides a sense of well being.

Excessive cold in the kidneys can be a cause of impotence. Erection of the penis is dependent on healthy Chi flow. Venting excess heat from the heart helps to warm the kidneys, which must maintain a measure of internal heat to balance their innate coolness and function properly. This promotes the "Yang within the Yin" and an appropriate flow of Chi. The Lotus Meditation described in the Third Wind is very helpful to balance the cold and hot energies in the body.

A. Navel Points for the Twelfth Wind

Use your elbow to press the following points:

1. Point 35 located just above the navel, on the left side.
2. Point 33 located just below the navel, on the left side.
3. Point 33 on the right side.
4. Point 35 on the right side.
5. Point 38 on the left side.
6. Point 32 on the left side.
7. Point 32 on the right side.
8. Point 38 on the right side.
9. Point 37 located on a line right above the navel, on the right side.
10. Point 37 on the left side.
11. Point 30 located below the lower end of the sternum. Be careful not to press on the tip of the sternum as it is very delicate.
12. Point 41 located on the lower tip of the hipbone, on the left side
13. Point 41 on the right side.

Fig. 45 *Navel Points for the Twelfth Wind*

B. Chest

1. Check the upper part of the rib cage. Release the area on the sternum, between the ribs and directly on the rib bones. For women work around the breast, moving it to the side to work on the ribs under it. When you work on the sternum, be aware of how soft it is and do not press too hard.

Fig. 46 *Massaging the Sternum*

2. As you work, coach your student to make the heart sound and release any excess heat or cold through the feet.
3. Flush the wind down from the left part of the chest through the left arm, and from the right part of the chest through the right arm.

C. Feet: "Dig the soles of the feet and you'll discover gold!" And it feels good!

1. Supporting your student's foot with one hand, press your other elbow on Point 74 on the sole of the foot. This point is like a well, and when sick energy accumulates there, it can remain stagnant for a very long time.
2. Flush down the wind.

Fig. 47 *Digging for Gold*

Applying CNT II to Specific Ailments

A. Heart Attacks and the Life and Death Point

When a person is close to death, the heart begins to struggle. It balloons and expands until it collapses and eventually the heart dies. If you find yourself in a situation where someone is having a heart attack, first, call for an ambulance and then you can work on the person while you wait. You can help the person using wind removal techniques and also working on the “Life and Death Point”.

This point is located on the back between the scapula and the spine between Thoracic 4-5 on the left side. When the person is having a heart attack, this point is very clear as it pulses and pops out. It can be the size of a ping-pong ball. This point can also be used preventively. My master taught me this point when he was close to death, and by working on it, I was able to extend his life.

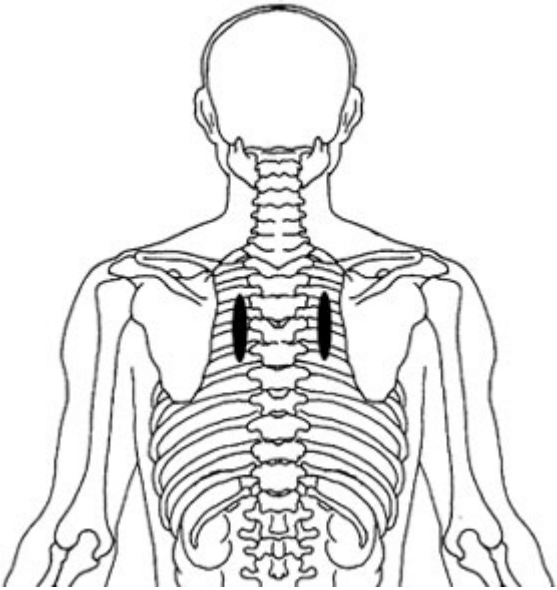

Fig. 48 *Life and Death Point*

B. Arthritis

Arthritis is caused by the wind produced by stagnant and blocked blood. The blood runs up the veins in the legs and arms collecting waste material and toxins on its way back to the heart. Sometimes, this toxic blood and wind collects in the back of the knees or in the bend of the arm, lumbar area of the back especially when people are too emotional, do not exercise enough or eat heavy foods.

Procedure for removing wind from the back of the knees:

1. The student should stand with the back of the knees bare.
2. Support the knee by holding it in the front with one hand. With the palm of the other hand, swiftly slap the back of the each knee about 9, 18 or 36 times, mobilizing your energy from your center. The hand action should be forceful, but not too hard. The skin on the back of the knees will be come quite flushed and the wind will reveal itself in ugly patches that will quickly turn a dark reddish blue and the area will be bruised for a few days. This is a good sign that the windshave been stirred and activated, and they will now exit the body. If there is no wind trapped in this area, this reaction will not occur and the skin will just turn red temporarily.
3. Work on the other knee.
4. The student should not shower immediately after the treatment.

Procedure for removing the wind from the middle bend of the arm:

1. Both you and the student stand facing each other an arm's length apart.
2. Take the elbow of the student and grip it. Slap the inside of the arm in the region of the crease in the elbow 18 times. The skin may become red and blotchy. You have stirred the winds and they will begin to leave the body allowing better circulation in the area just treated.
3. Work on the other arm.

Fig. 50 *Slap the inside of the arm.*

C. Hiatal Hernia

Hiatal hernias are caused by the same wind that attacks the heart. This problem results from problems in the digestive system, compounded by excess weight and progressive weakening of the tissues in the abdomen.

When food is not digested properly, it ferments inside the stomach creating wind. The bloated stomach pushes against the diaphragm, and sometimes a part of the stomach may go through the hiatus, the opening in the diaphragm through which the esophagus and the two vagus nerves pass, enlarging and becoming a hernia. Discomfort comes from the constant pressure of tissue pushing its way through the weakened hiatal opening. As more tissue pushes through the weakened area, the feeling of pressure increases. In addition, gastric acid is not contained in the stomach, and as it flows back into the esophagus, the person experiences a burning sensation and pain that extends all the way to the upper part of the chest. The congestion in the digestive tract also affects the heart, the liver, the spleen and the lungs.

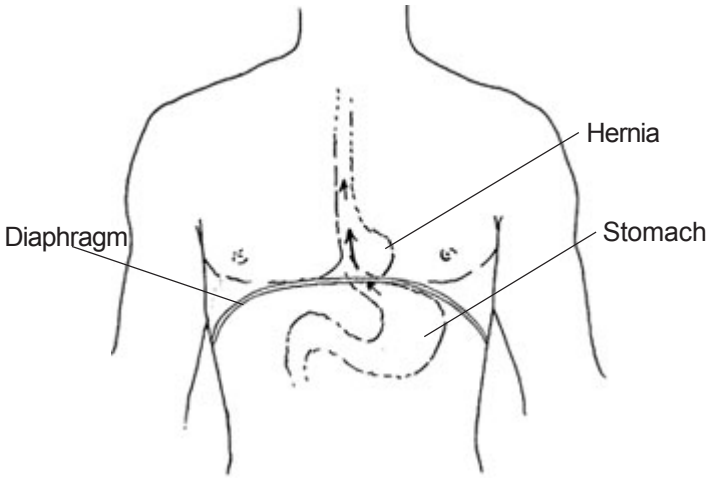

Fig. 51 *Hiatal Hernia*

Another factor that promotes the development of a hiatal hernia is breathing only into the chest. When the main effort is not done by the diaphragm but by the intercostal muscles, the chest goes up and the sides come in creating a vacuum effect that sucks the stomach in towards the chest. Teaching your student to breathe properly is very helpful. Ask him to lower the shoulders and breathe into the bowl of the belly, allowing the breath to expand the ribs in all directions, like an umbrella.

Procedure:

1. Open the wind gates, the navel and the pakua as explained in Chapter Four, Opening the Wind Gates.
2. Massage the abdomen releasing the knots and tangles in the stomach and intestines. Emphasize the work on the left corner of the transverse and descending colon, which is located right below the stomach.
3. Spiral and release the wind through the legs and through the arms.

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$6.95

Chi Nei Tsang II

Internal Organs Chi Massage

Mantak Chia

Illustrations by Udon Jandee

Chi Nei Tsang II

In this booklet Chi Nei Tsang II builds on the procedures taught in Basic Chi Nei Tsang — sensing and touching the abdomen, then clearing and detoxifying the organs and lymphatic system.

Once the basic procedures have been mastered, the student can use this booklet to work with the Winds in the body which can cause illness and diseases. You will learn how to open the Wind Gates by making "traps" for the winds, using your elbow, fingers and thumbs. Then you can flush the winds out of the body. The effects and locations of the twelve winds are discussed in detail. Diagrams and step by step instructions for flushing out the winds make it easy for both the practitioner and the student himherself to follow the procedures.

The booklet ends with a discussion of the applications of these techniques to a number of specific health problems like heart attacks, arthritis and hiatal hernias.

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Muscle, Tendon and Meridian Massage

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Chi Nei Tsang III

Muscle, Tendon and Meridian Massage

Mantak Chia

Edited by:

Lee Holden

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Chi Nei Tsang III

Concept

Chi Nei Tsang III is the fourth section of the Chi Nei Tsang series following Chi Nei Tsang I (Organ Massage), Chi Nei Tsang II (Channel Massage) and Karsai Nei Kung (Genital Massage) with Chi Nei Tsang III (Muscle, Tendon & Meridian Massage) as the last section. This is the final chapter of the Chi Nei Tsang Internal Massage moving the energy (chi) throughout the body while releasing and opening up its passages. Throughout this massage section in this booklet you will use the hand techniques (finger presser, twisting & spiraling, hand scooping & wave techniques) used in Chi Nei Tsang I to open up and release the brockages in the Abdominal, Arteries, Muscles, Tendons, Vertebras, Shoulder Blades, Coccyx, Arms, Legs, Feet, Joints, Hands, Neck and Meridian Lines layout in the following pages.
This booklet is an introduction to the forth coming book Chi Nei Tsang III by Mantak Chia with co-author Chong-Mi Mueller which will go into greater detail and explaination for opening up the muscles, tendons and meridian lines in the body.

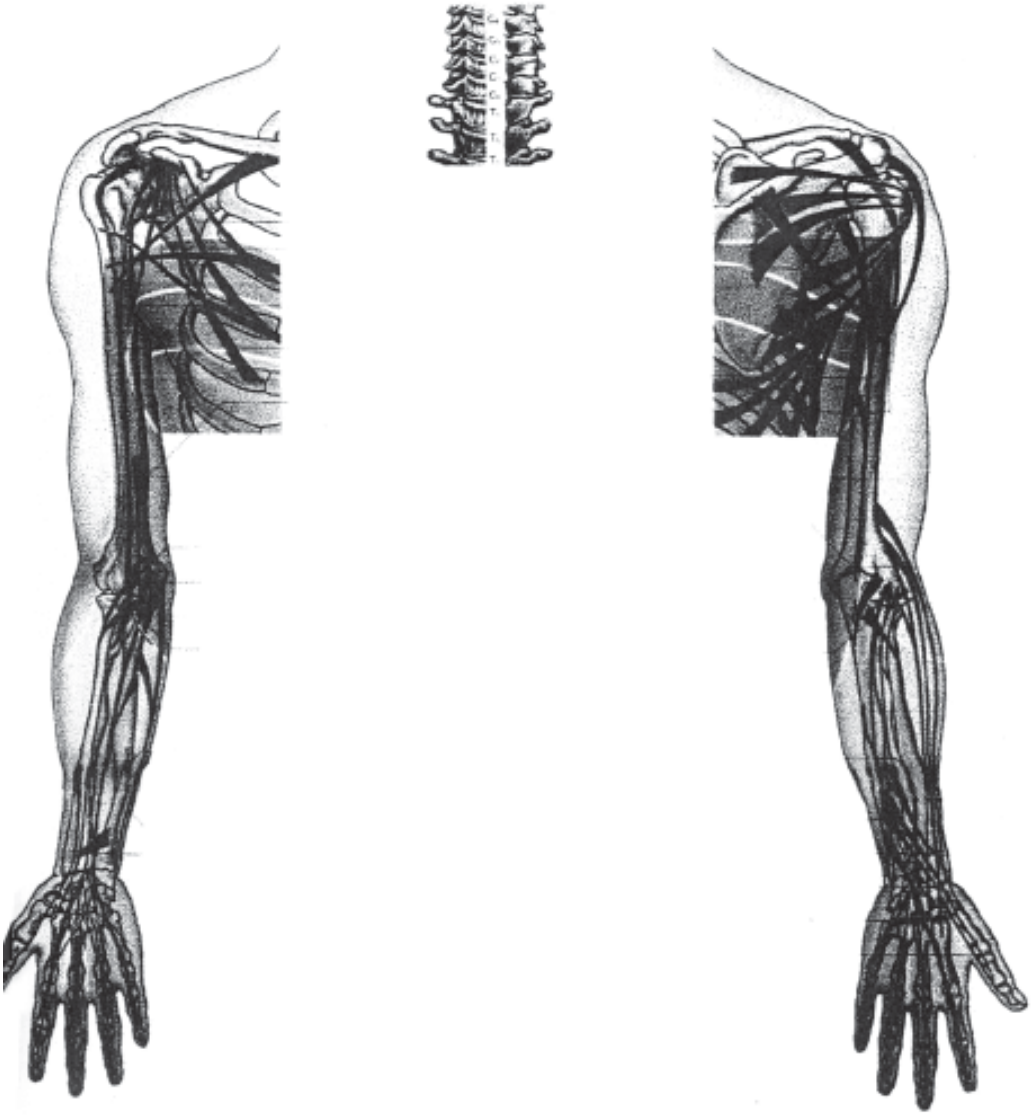

Fig. 1 *Arm Arteries*

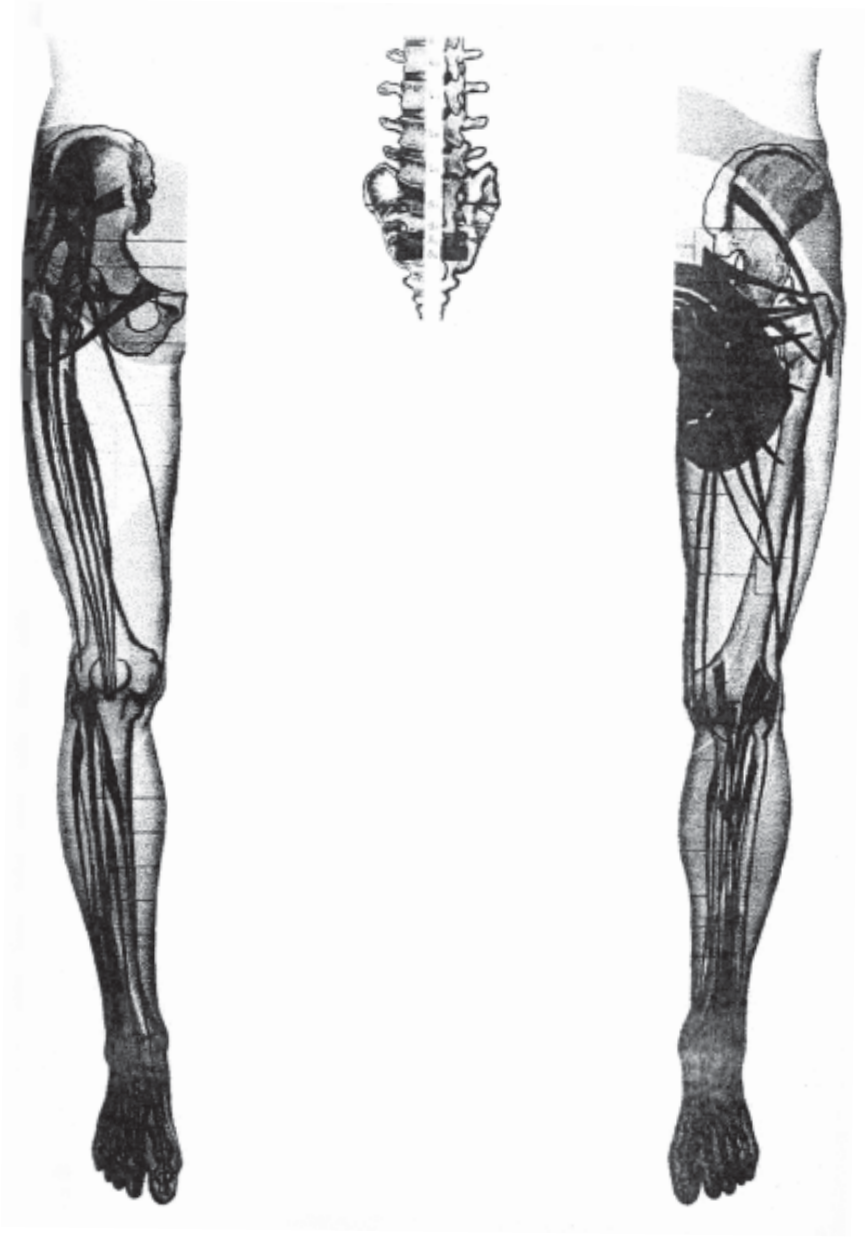

Fig. 2 *Leg Arteries*

Fig. 3 *Rear Muscles & Tendons*

Fig. 4 *Frontal Muscle & Tendons*

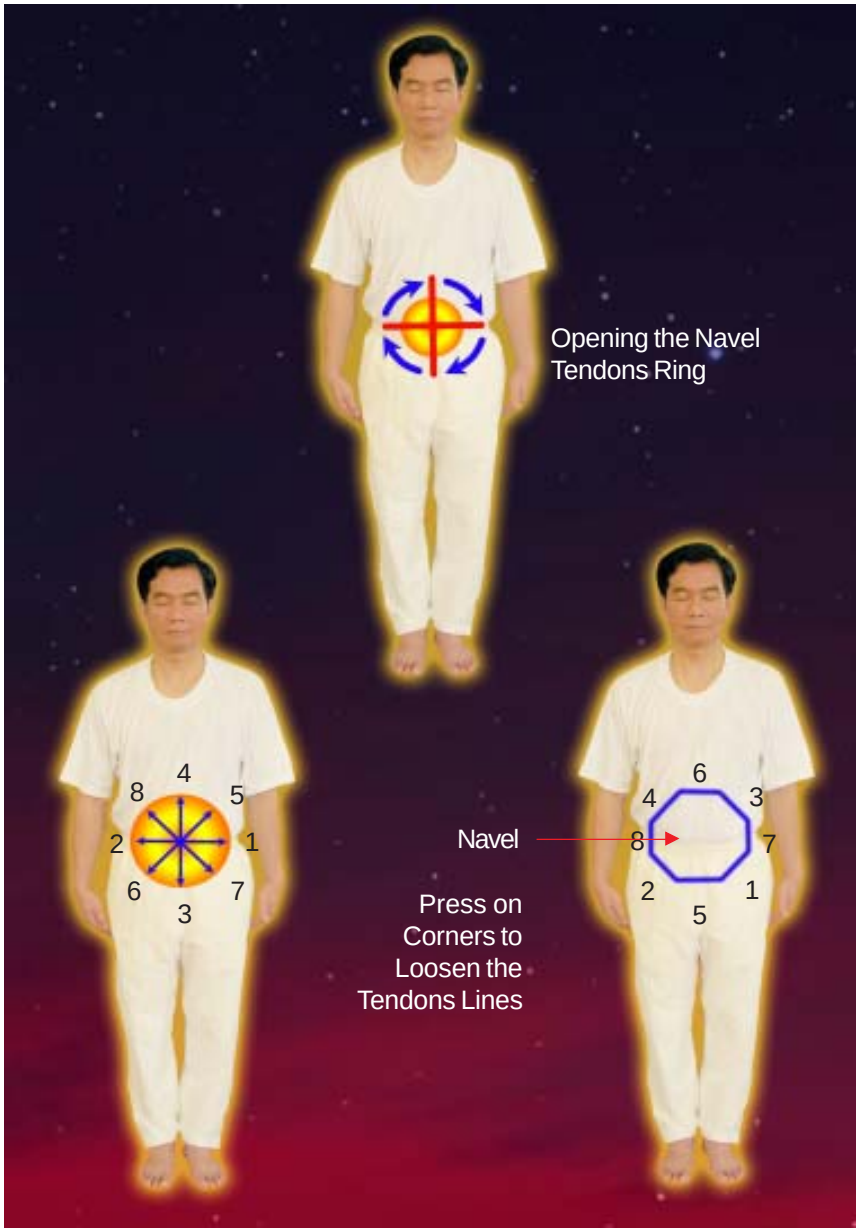

Fig. 5 *Opening Navel Clock*

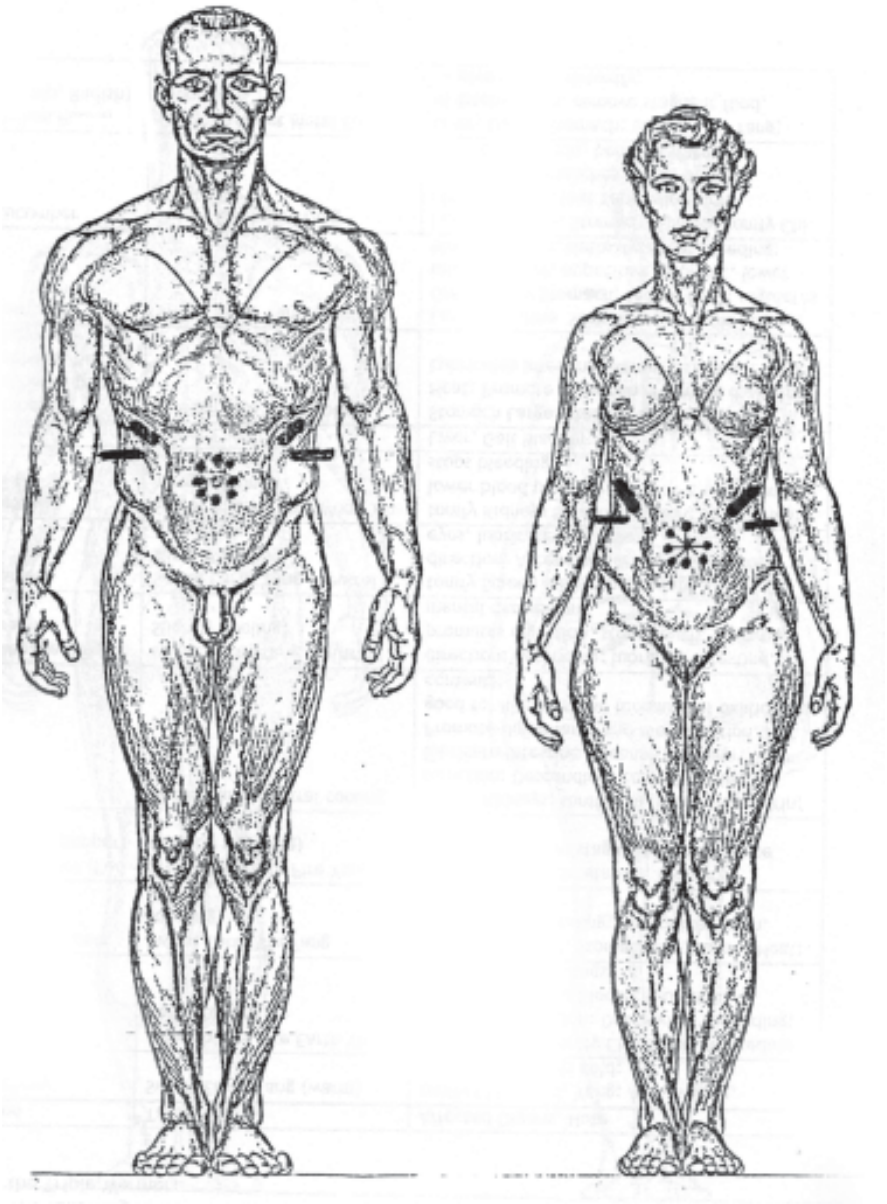

Fig. 6 *Abdominal Muscles*

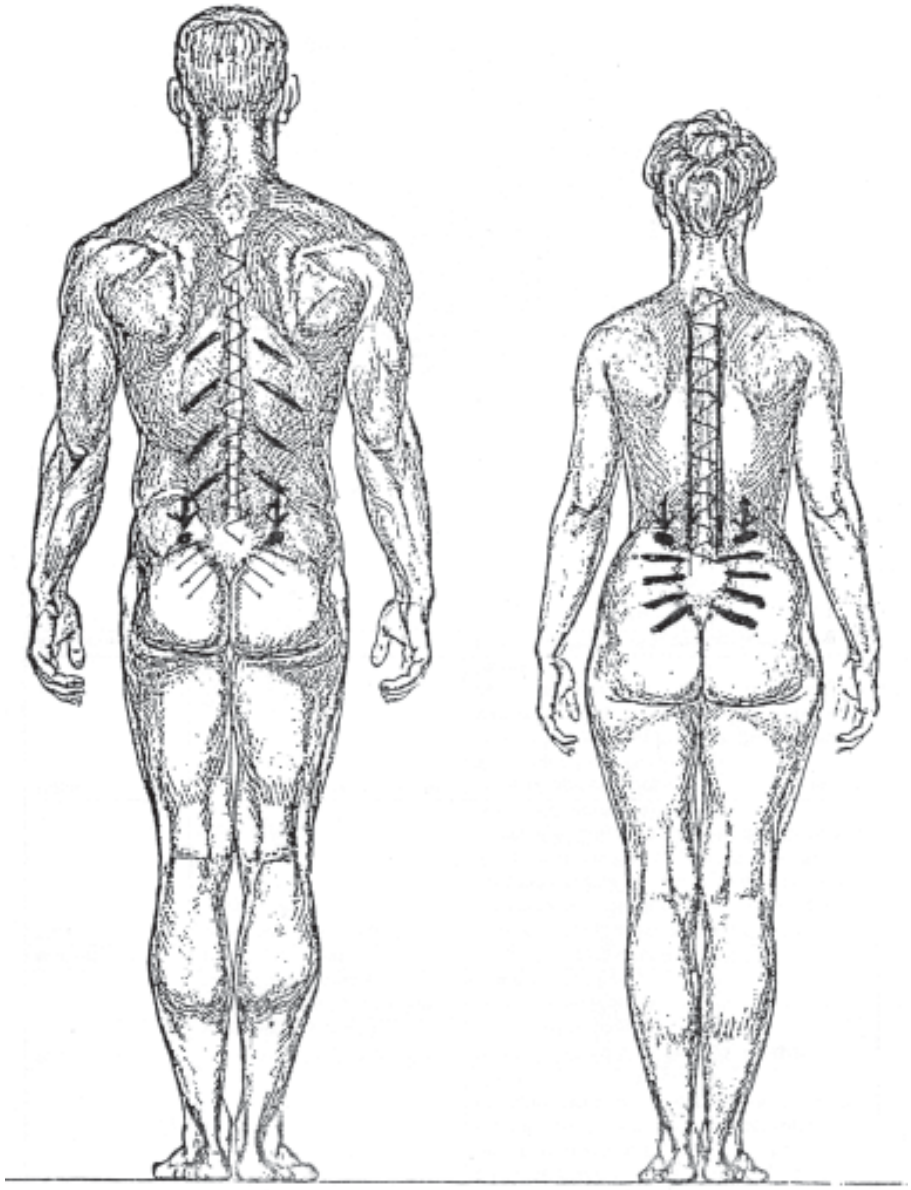

Fig. 7 *Spinal Muscles*

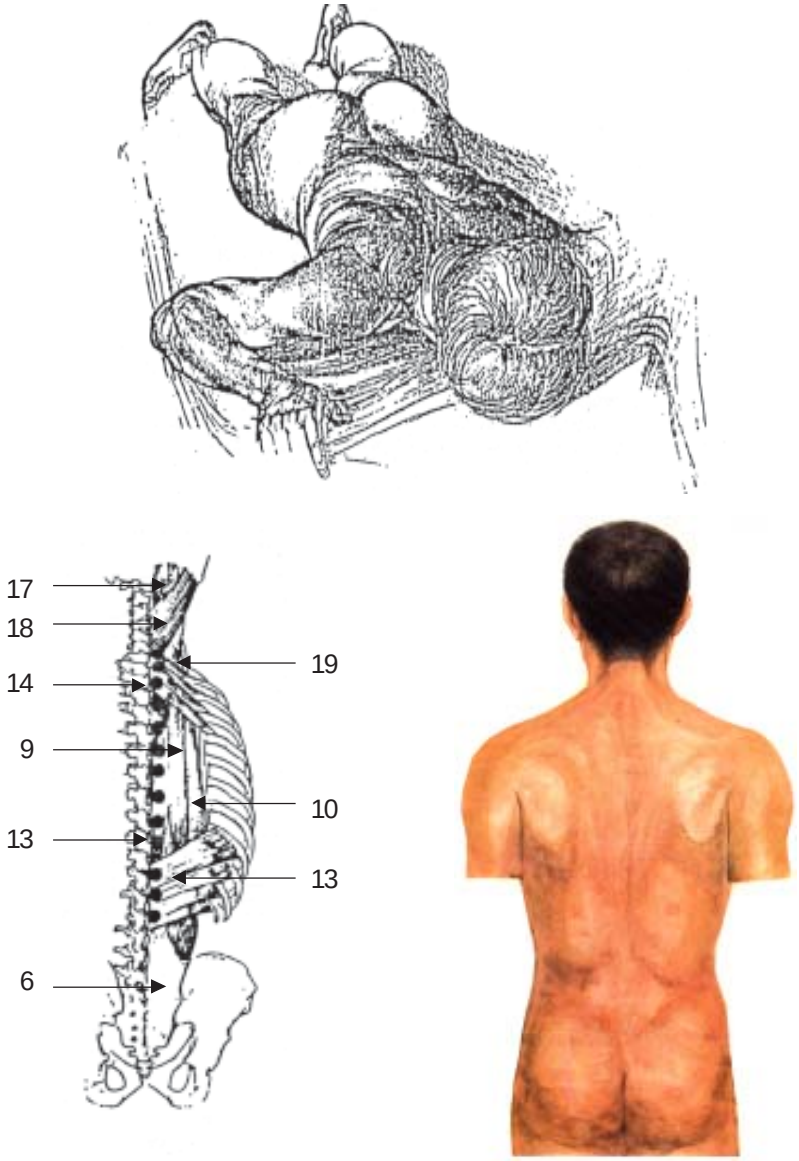

Fig. 8 *Thoracic Vertebras*

Muscles Raising and Rotating Scapula

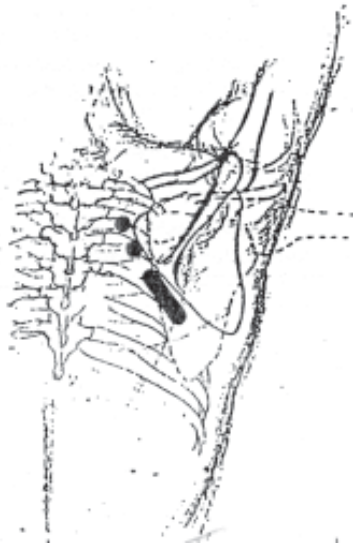

Fig. 9 *Shoulder Blade*

Displacement of Vertebras and its Consequences

Every cell of the body is controlled by nerves. The normal function of these nerves is disturbed when verlebras are displaced in the spinal column, and of this the following diseases can result.

Spinal Column	Organ Field	Verlebra	Consequenses
	Blood Supply to the Brain Inner and Middle Ear.	1 Cervical	Headache, Insomnia Hypophysephic Disease High Blood Pressure Tiredness, Dizziness
	Eyes, Auditory Nerve, Tougue	2 Cervical	Allergy, Eyes and Ears Trouble
	Outer Ear, Teeth, Trigeminus Nerve	3 Cervical	Trigeminusneuralgy, Acne
	Nose, Lips, Mouth	4 Cervical	Deafness, Polyps
	Vocal Cord	5 Cervical	Hoarseness, Vocal Cord Inflammation
	Neck, Shoulders Tonsils	6 Cervical	Pain in the Neck and Upper Arm
	Thyroid Gland, Shoulder Joint, Elbow	7Cervical	Crop, Tennis Elbow
	Forearms, Hand, Esophagus	1 Thoracic	Cough, Breathing Problems, Pain in the Forearms and Hand
	Hearth, Cardiac Valve, Coronary Vessel	2 Thoracic	Heart Problem

Lungs, Bronchi, Chest	3 Thoracic	Asthma, Bronchitis
Gall Bladder	4 Thoracic	Gall Bladder Problems, Shingles
Liver, Solar Plexus, Bood	5 Thoracic	Liver Problems, Circulatory Disturbance, Annemia, Arthritis
Stomach	6 Thoracic	Stomach Problems, Heartburn
Pancreas, Duodenum	7 Thoracic	Diabetes, Heartburn
Spleen, Diaphragm	8 Thoracic	Immune Difficiency
Adrenals	9 Thoracic	Allergies, Eczema
Kidneys	10 Thoracic	Kidney Problems, Tiredness, Calcification of Veins
Urinary Tract	11 Thoracic	Eczema, Acne
Small Intestine, Lymphatic System	12 Thoracic	Rheumatism, Sterility
Large Intestine, Groin	1 Lumbar	Constipation, Colitis
Appendix, Body, Thigh	2 Lumbar	Apendix Infection, Varicose Veins
Ovaries, Testicles, Bladder, Knee	3 Lumbar	Menstruation Problems, Impotence
Prostate, Sciatic Nerve	4 Lumbar	Sciatica, Lumbago
Lower Leg, Ankle, Toes	5 Lumbar	Bad Circulation in the Legs, Cramps in the Calfs
Hip Joint, Buttocks	Sacrum	Problem in the Sacrum and Pelvis
Rectum, Anus	Coccyx	Pain, Hemorrhoids

Fig. 10 *Spinal Chart*

Pain is the Cry from our Tissue for Flowing Energy to release the Pressure

The nerve system is the supply network in the complicated computer of our body. An essential bundle of nerve system which supplies every cell in the body with nerve impulse, moves from the brain through the spinal cord. This pass is full of critical points. Through an accident the vertebras can easily come out of positioning. Though this, part of the supply ending network experiences higher pressure and the final station of the respective supply network our body organs, loses a lot of resistence against disease. The physical and mental strength goes down rapidly without you being aware of it. If this misalignment in the spine is not corrected in sufficient time chronic disease can develop.

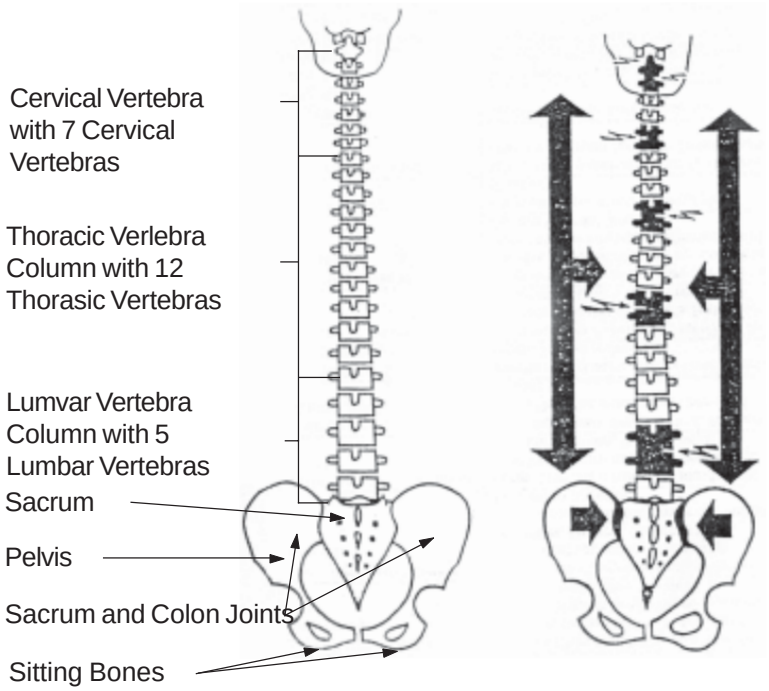

Fig. 11 *Coccyx*

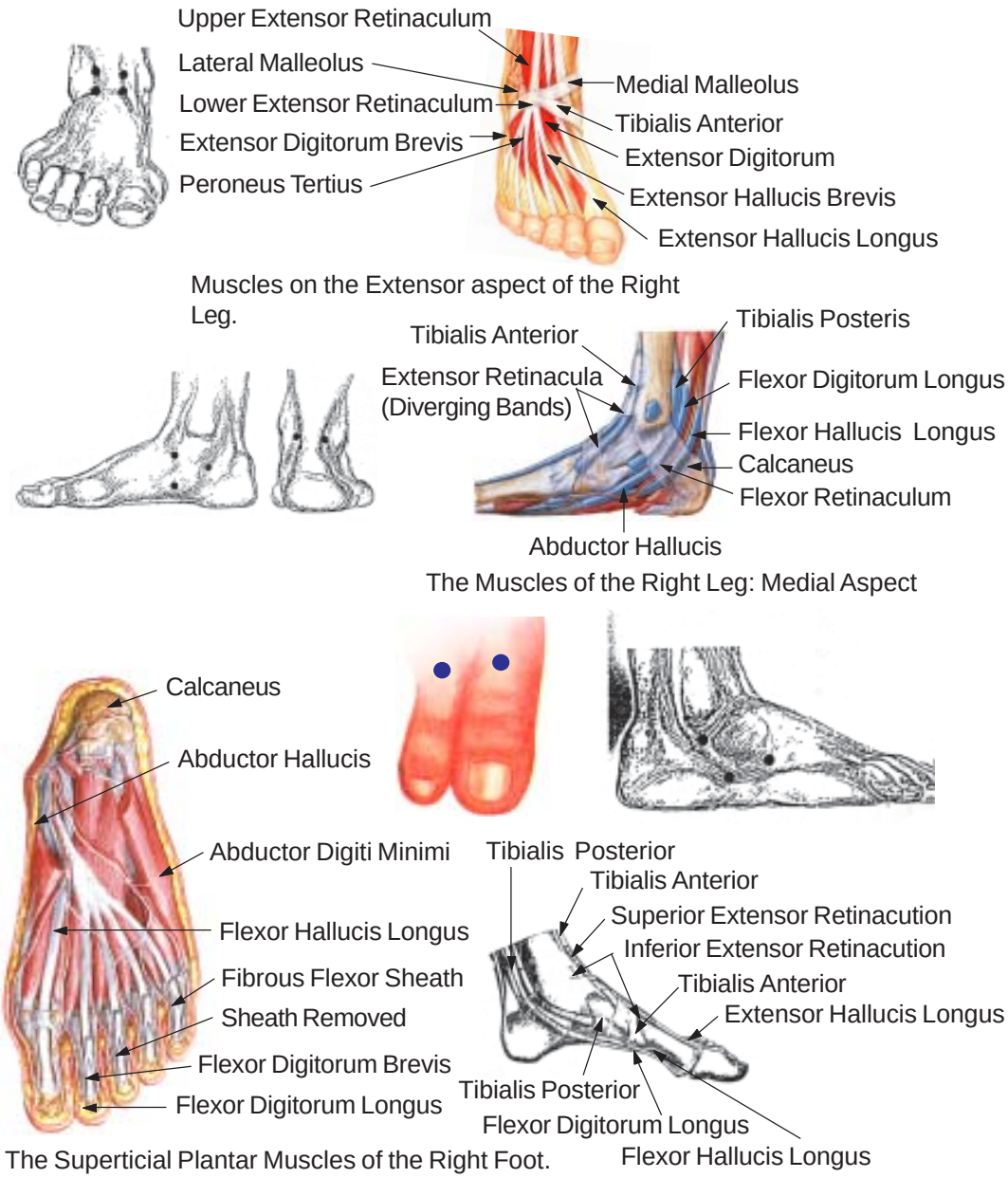
Upper Extensor Retinaculum
Lateral Malleolus
Lower Extensor Retinaculum
Extensor Digitorum Brevis
Peroneus Tertius
Medial Malleolus
Tibialis Anterior
Extensor Digitorum
Extensor Hallucis Brevis
Extensor Hallucis Longus
Muscles on the Extensor aspect of the Right Leg.
Tibialis Anterior
Extensor Retinacula (Diverging Bands)
Tibialis Posteris
Flexor Digitorum Longus
Flexor Hallucis Longus
Calcaneus
Flexor Retinaculum
Abductor Hallucis
The Muscles of the Right Leg: Medial Aspect
Calcaneus
Abductor Hallucis
Abductor Digiti Minimi
Flexor Hallucis Longus
Fibrous Flexor Sheath
Sheath Removed
Flexor Digitorum Brevis
Flexor Digitorum Longus
The Superticial Plantar Muscles of the Right Foot.
Tibialis Posterior
Tibialis Anterior
Superior Extensor Retinacution
Inferior Extensor Retinacution
Tibialis Anterior
Extensor Hallucis Longus
Tibialis Posterior
Flexor Digitorum Longus
Flexor Hallucis Longus

Fig. 12 *Foot*

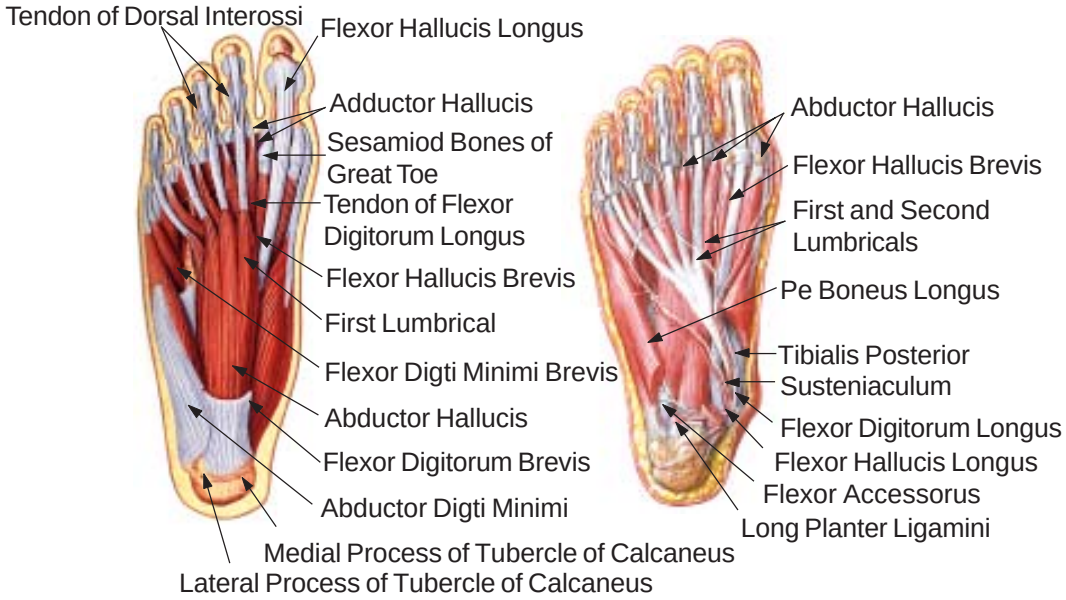

Muscles of Sole, First Layer

Muscles of Sole, First Layer

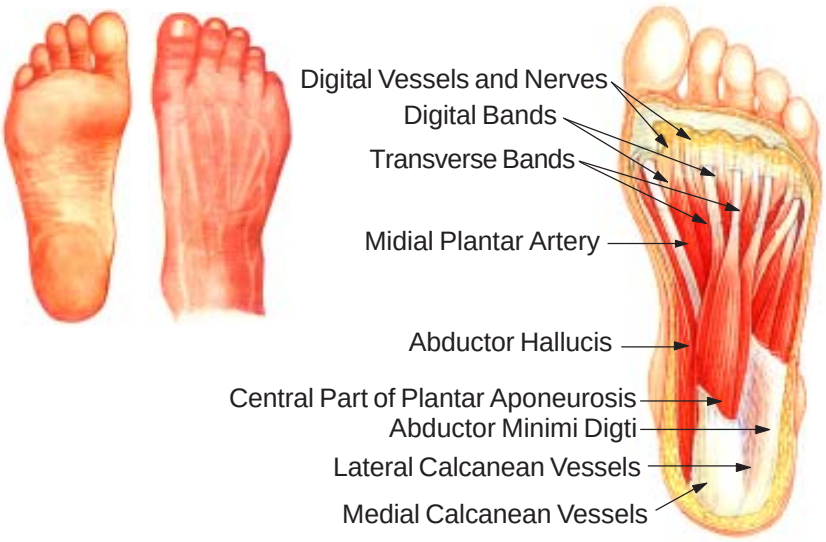

Plantar Aponeurosis of the Left Foot

Fig. 13 *Tendons of Feet*

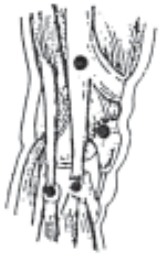

Right Knee Joint: Lower End of Right Femur,Sagital Section: Upper ends of Right Tibia and Fibula Lateral aspect.

Locomotor System

Right Knee Joint: Anterior aspect. Patella and Patellar Ligament turned upwards, Femur is at right-angles to tibia.

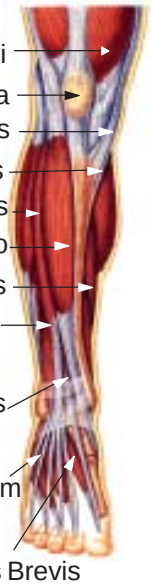

Fig. 14 *Knee*

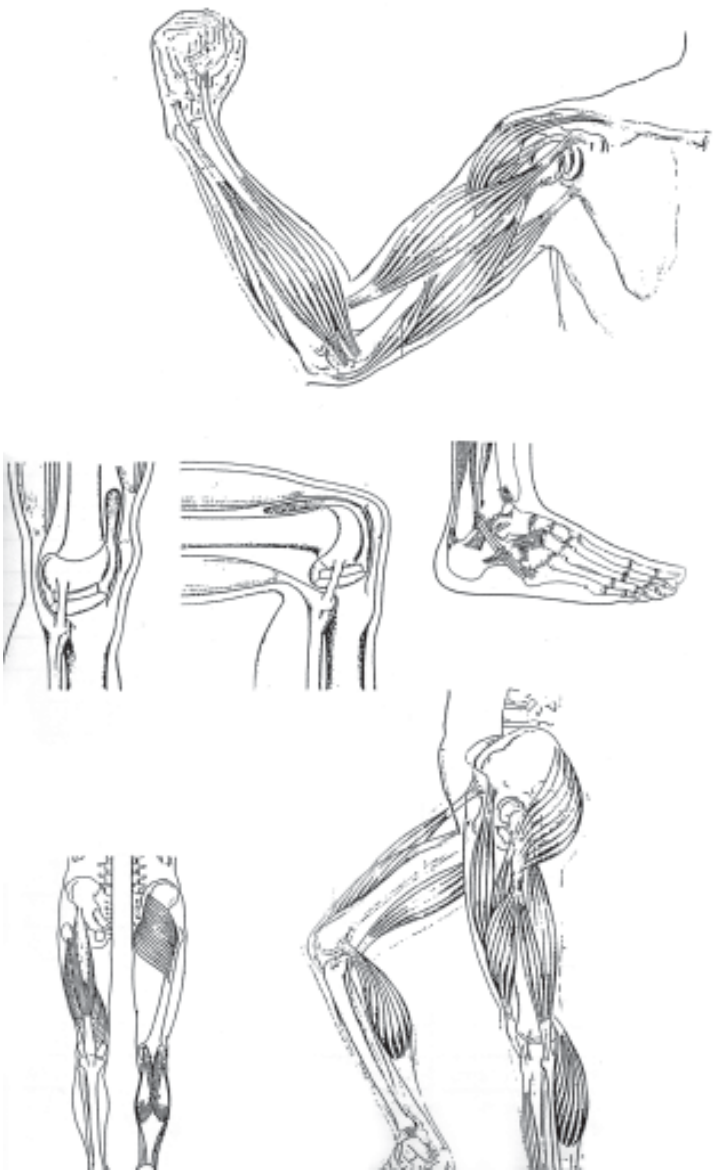

Fig. 15 *Body Joints*

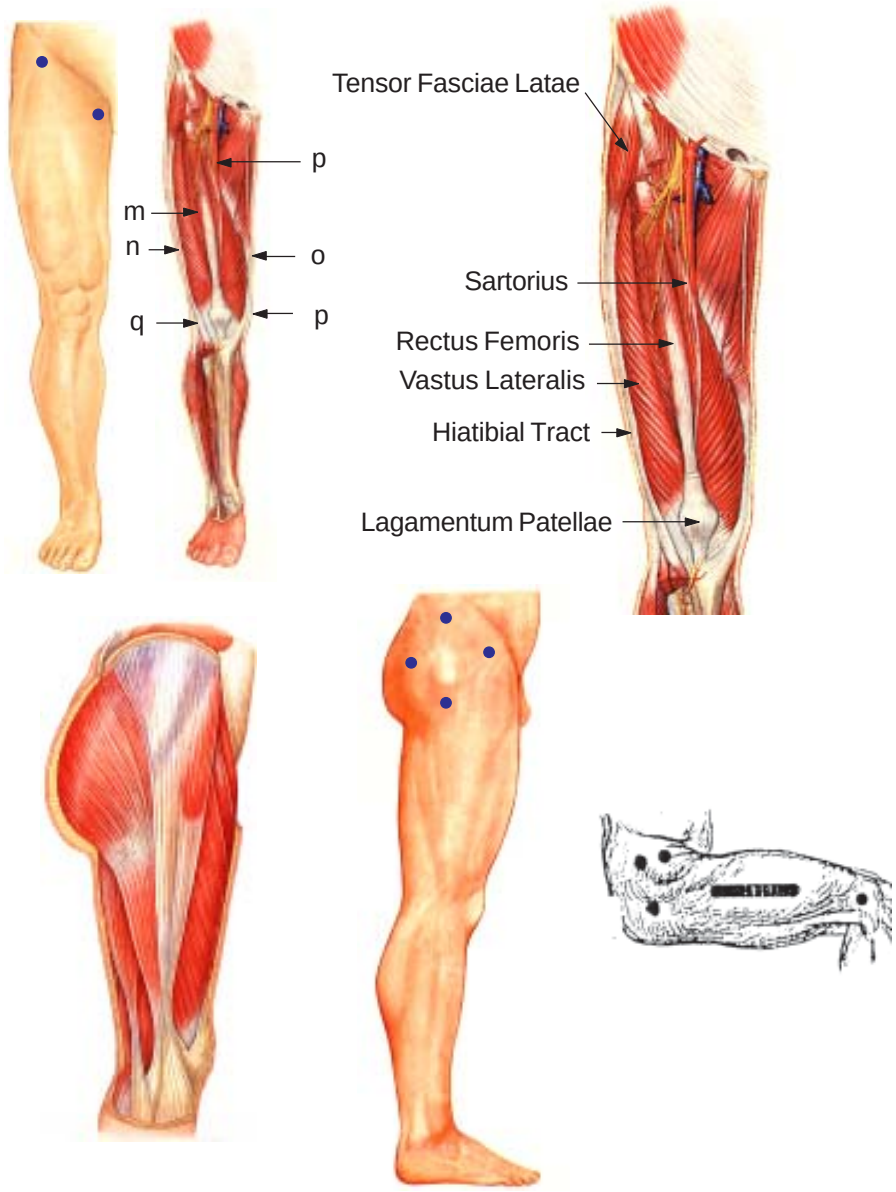

Fig. 16 *Elbow & Hip*

The Gentle Way of Loosening the LWS

1) The therapist sits behind the standing client.
2) Press with both hands on the points
3) Client bends to the left and right
4) After this the client sits slowly down on the therapists lap.
5) The Client moves slowly to the back above the thumbs of the therapist until the head reaches the shoulder of the therapist. At the same time drooping the pelvis and massages in this position.
6) After this the client slowly gets up.
7) Client moves and rocks their hips while the hips swing with pelvis and practitioner massages the area on the points.

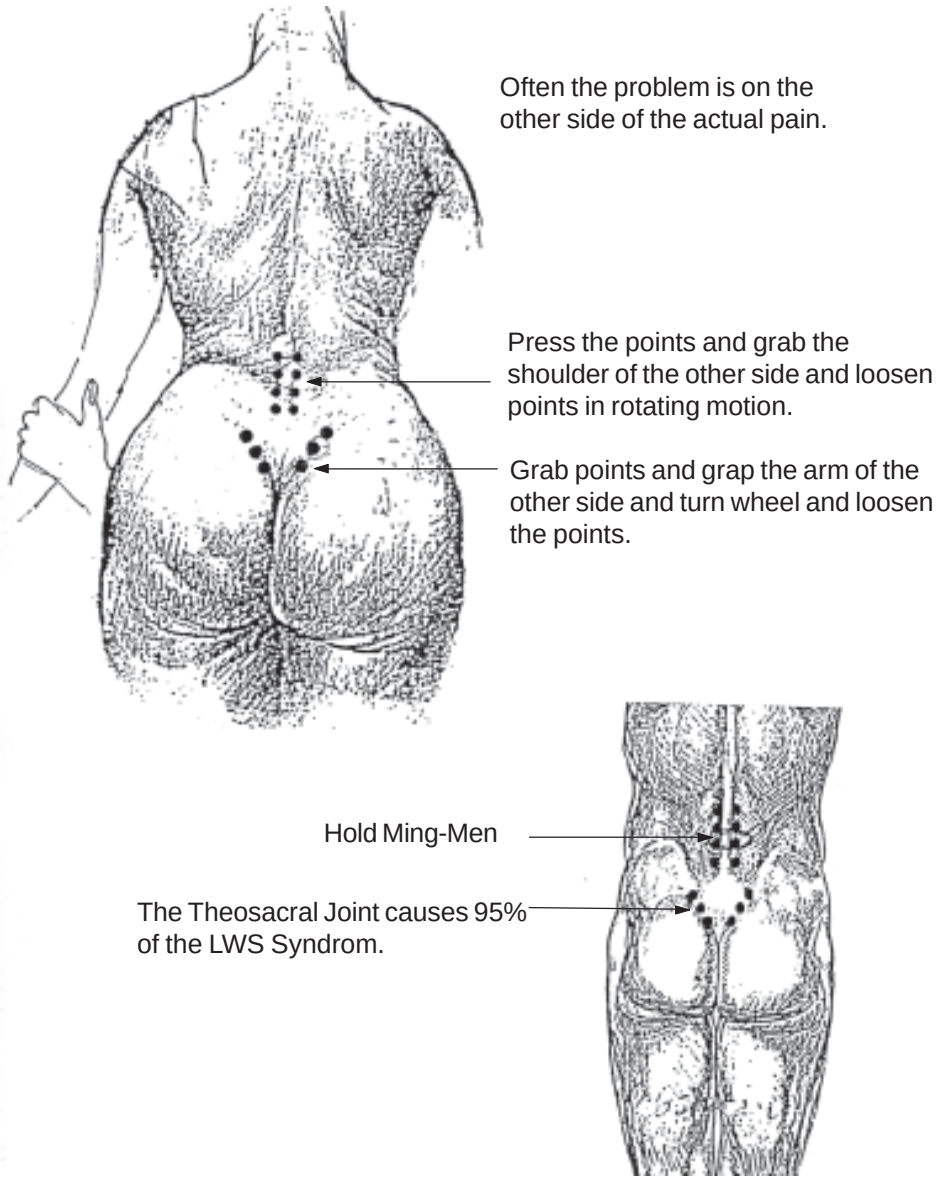

Fig. 17 *Column of the Lumbar Vertebras*

Hip Joint Anterior Aspect

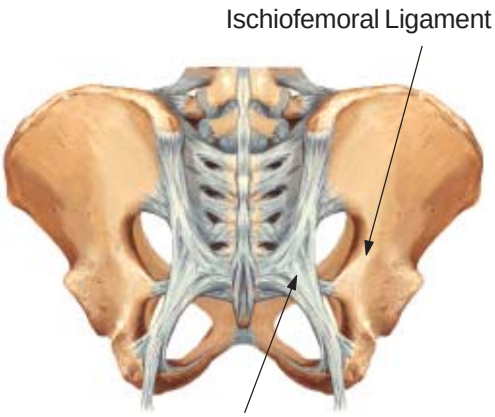

Hip Joint Posterior Aspect

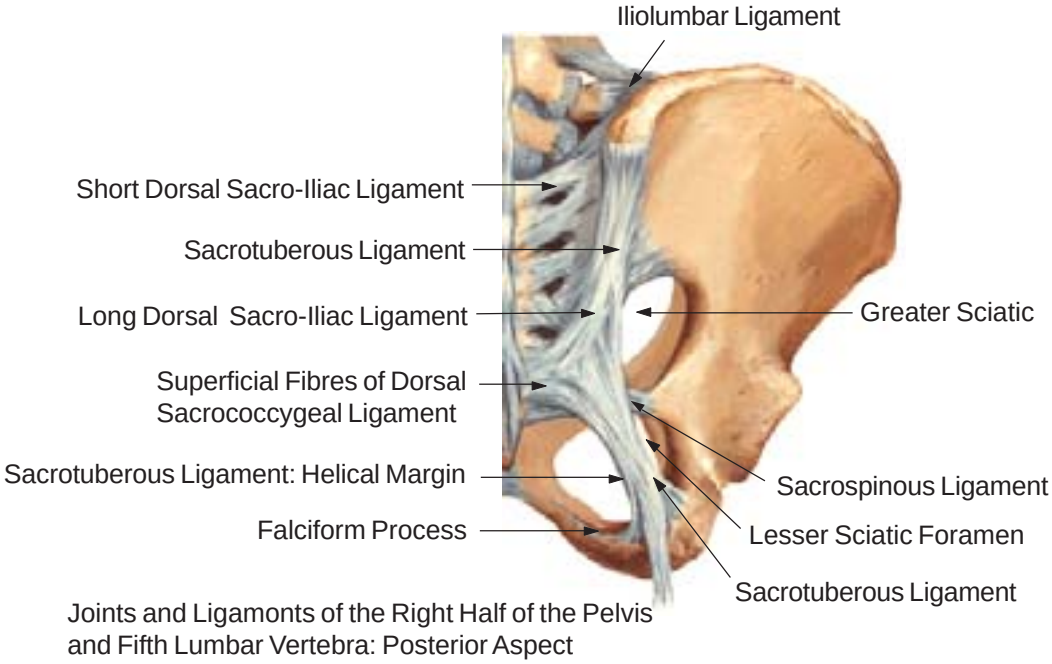

Joints and Ligamonts of the Right Half of the Pelvis and Fifth Lumbar Vertebra: Posterior Aspect

Fig. 18 *Fumur and Hip Joint*

Extensor Indicis

Intertendinous Connexions

Fig. 19 *Hand*

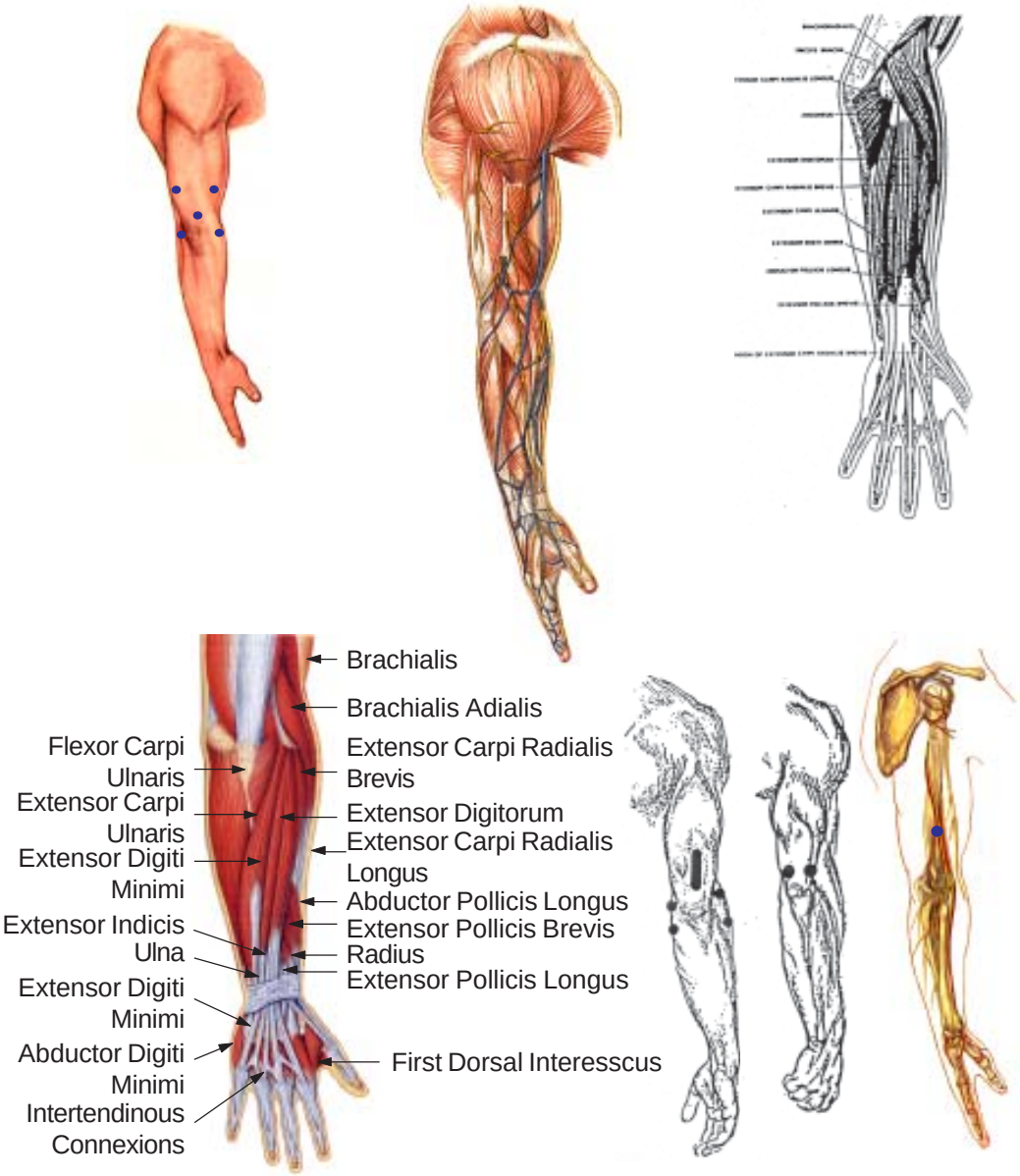
Brachialis
Brachialis Adialis
Flexor Carpi Ulnaris
Extensor Carpi Radialis Brevis
Extensor Carpi Ulnaris
Extensor Digitorum
Extensor Digiti Minimi
Extensor Carpi Radialis Longus
Abductor Pollicis Longus
Extensor Indicis
Extensor Pollicis Brevis
Ulna
Radius
Extensor Pollicis Longus
Extensor Digiti Minimi
Abductor Digiti Minimi
First Dorsal Interesscus
Intertendinous Connexions

Fig. 20 *Elbow*

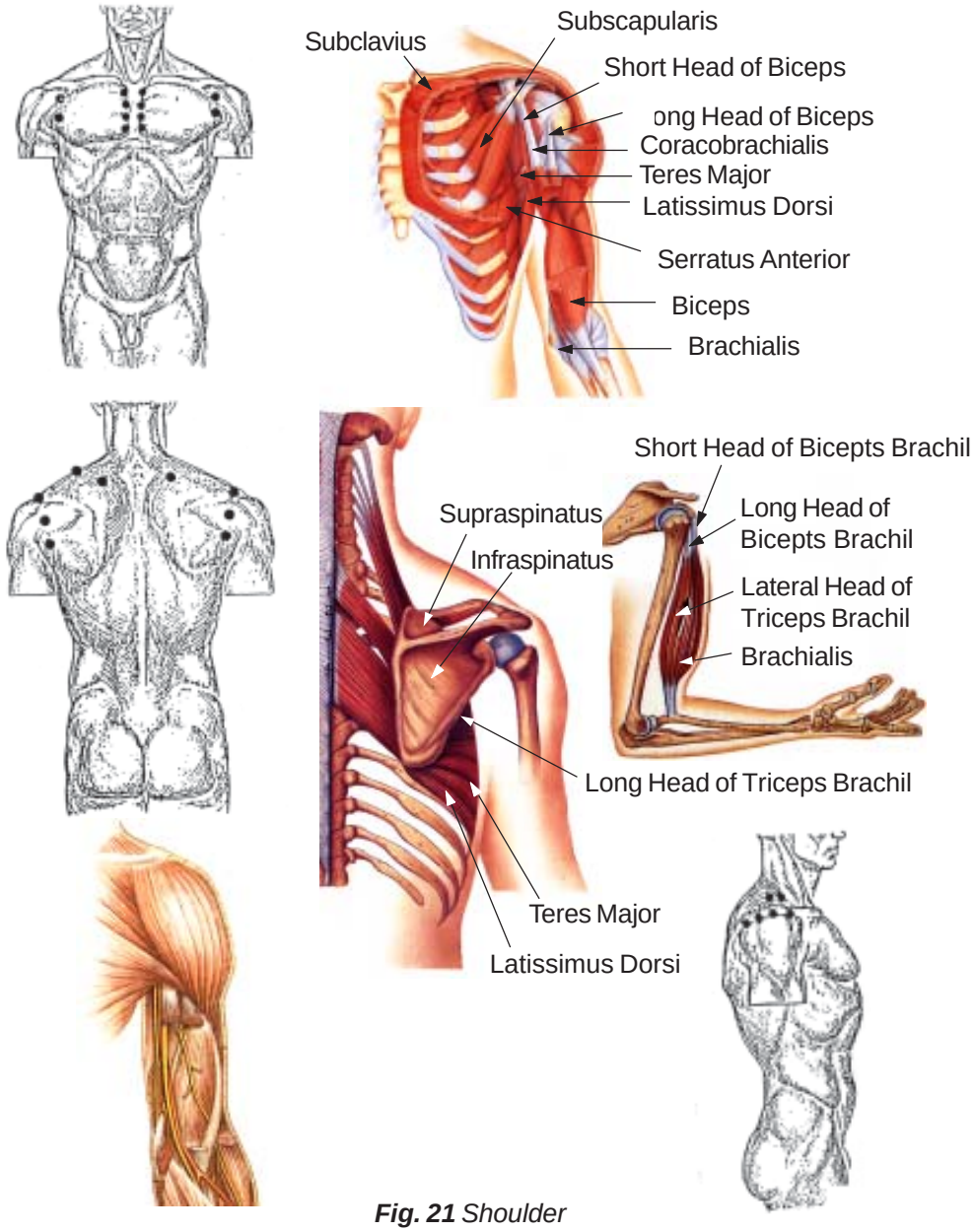

Fig. 21 *Shoulder*

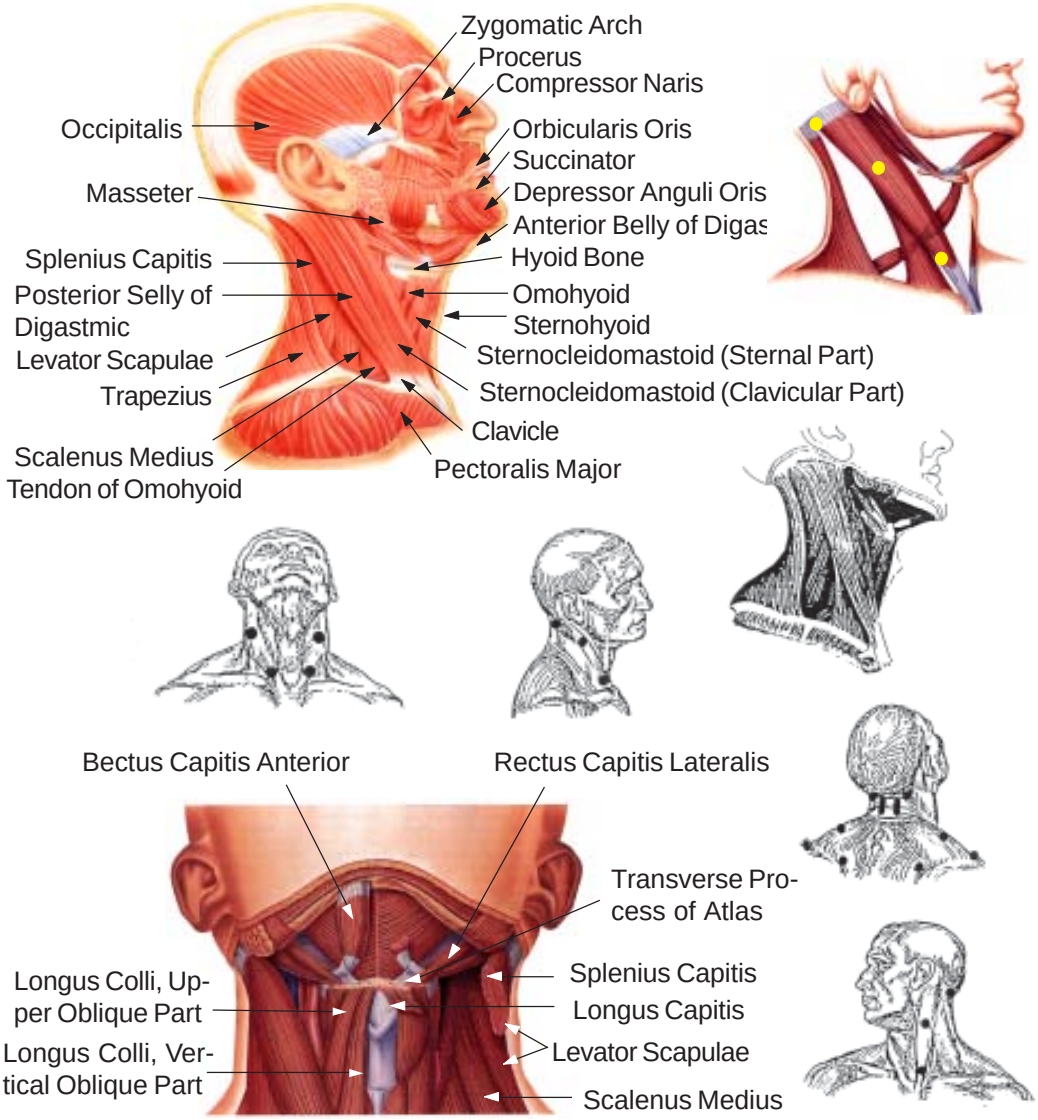

Anterior and Lateral Vertebral Muscles: On the right side the scalenus anterior and the longus capitis have been removed.

Fig. 22 *Cervical Column*

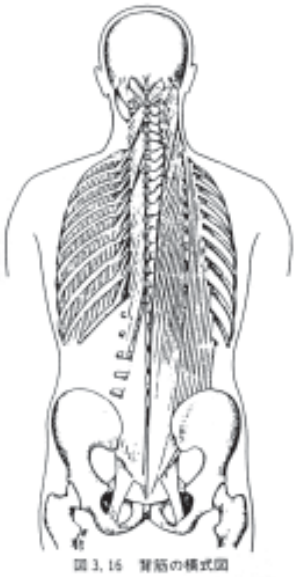

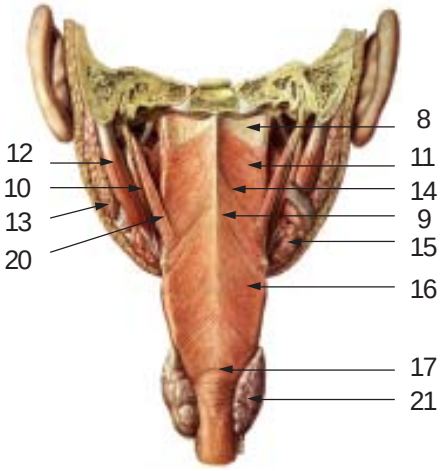

Fig. 23 *Neck & Spine*

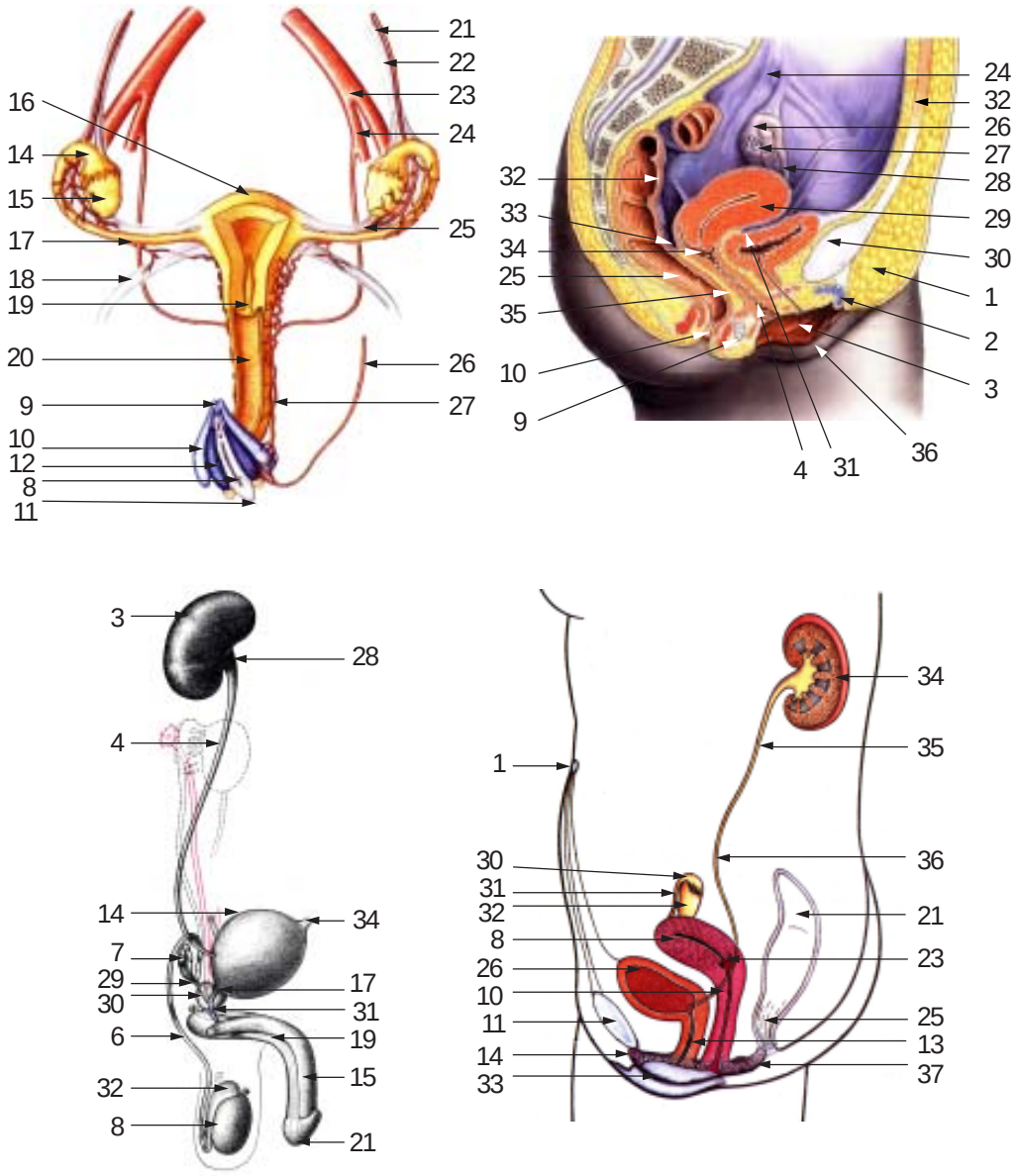

Fig. 24 *Genitals*

1. Sen Sumana

Sen Sumana starts at the tip of the tongue, travels down the throat and chest to the solar plexus. Its path is quite similar to Sushumna Nadi in the Yoga Tradition and also the Ren Mai Meridian in Chinese acupuncture.

Therapy: Asthma, Bronchitis, Chest Pain, Heart Diseases, Spasm of the Diaphragm, Nausea, Cold, Cough, Throat Problems, Diseases of the Digestive System, Abdominal Pain.

Fig. 25 *Sen Sumana*

2. Sen Ittha

Sen Ittha starts at the left nostril, travels up to the head and down the neck. It becomes Line I on the back, crosses the buttocks and moves down the third outside line on the thigh. It changes then to the front of the body and becomes the first inside line on the thigh. It goes up to the abdomen and stops one thumb distance left from the navel. It is similar to Ida Nadi in Yoga and to the urinary bladder meridian in acupuncture.

Therapy: Headache, Stiff Neck, Shoulder Pain, Common Cold, Cough, Nasal Obstruction, Throat Ache, Eye Pain, Chill and Fever, Abdominal Pain, Intestinal Diseases, Back Pain, Diseases of the Urinary Tract, Dizziness.

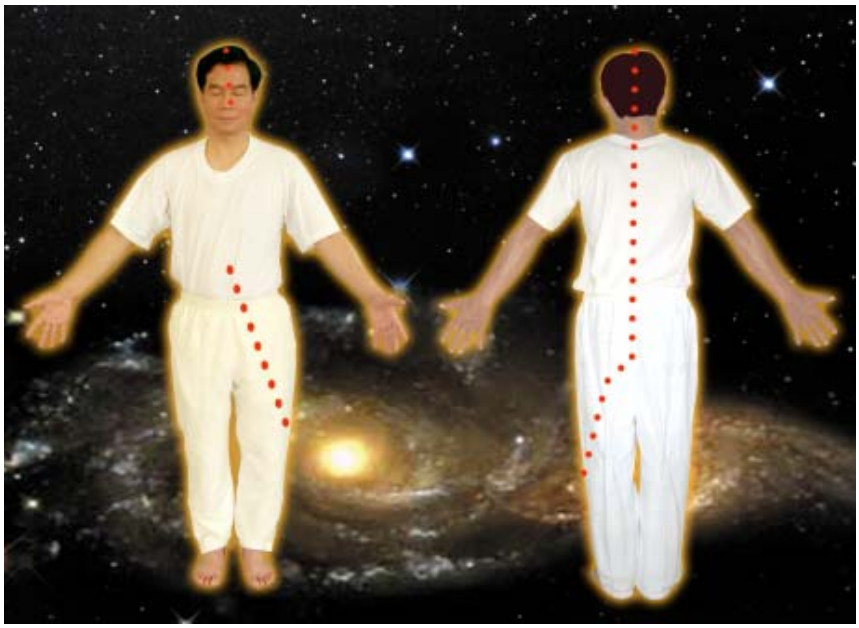

Fig. 26 *Sen Ittha*

3. Sen Pingkhala

Sen Pingkhala takes the same course as Sen lttha, yet on the right side of the body. It is similarity to Pingala Nadi in Yoga.

Therapy: Same as Sen lttha. Additional Indications: Diseases of the Liver and the Gall Bladder.

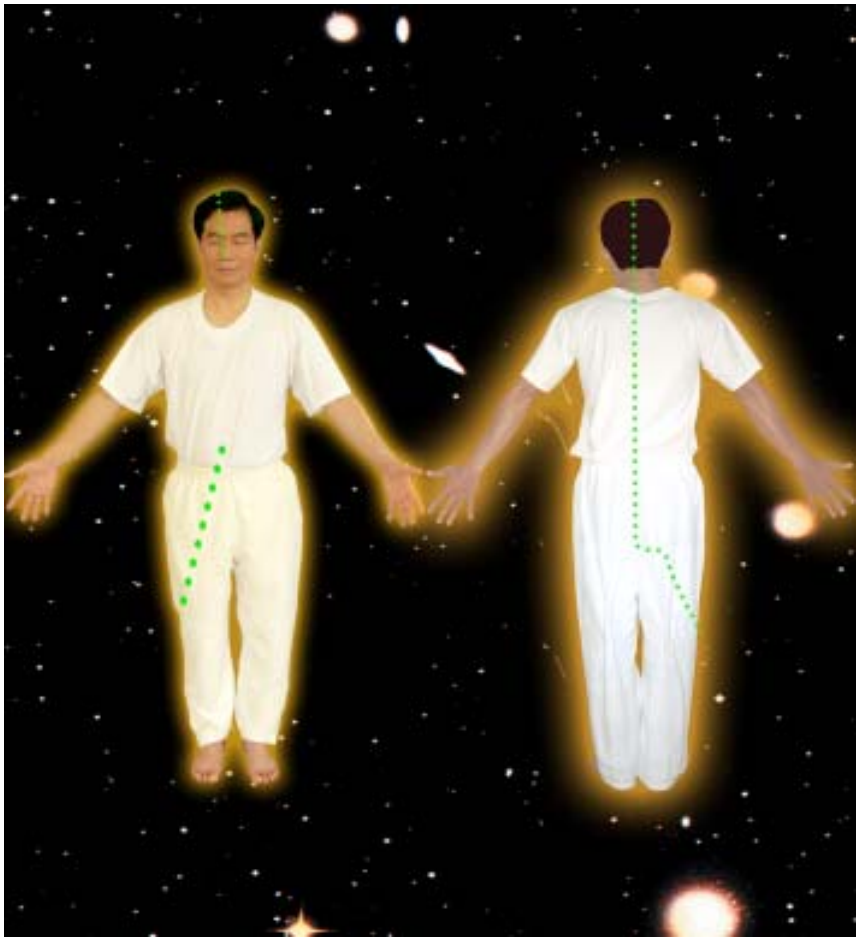

Fig. 27 *Sen Pingkhala*

4. Sen Kalathari

Sen Kalathari starts at the navel and divides into branches, two on the right, two on the left. From the navel up through the chest and shoulder down the middle line of the arm to the hand. From there to the tips of all the fingers on both the left and right side of the body. From the navel down the mid-line of the inside of the leg (the second inside line) to the foot. From there to all the toes on both the left and right side of the body.

Therapy: Diseases of the Digestive System, Indigestion, Hernia, Paralysis of Arms and Legs, Knee Pain, Jaundice, Whooping Cough, Arthritis of the Fingers, Chest Pain, Shock, Rheumatic Heart Disease and Cardiac Arrhythmia, Sinusitis, Pain in Arms and Legs, Angina Pectoris, Epilepsy, Schizophrenia, Hysteria, Various Psychic Diseases and Mental Disorders.

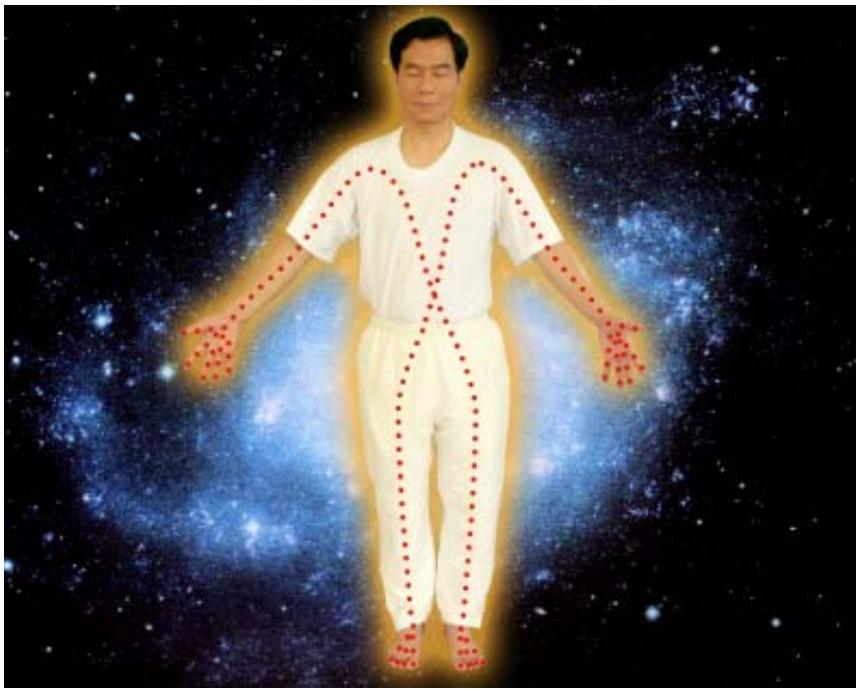

Fig. 28 *The Gentle Way of Loosening LWS*

5. Sen Sahatsarangsi

Sen Sahatsarangsi starts in the left eye and travels down the head, throat, left side of the chest and abdomen, then changes to the outside of the let coinciding with the first line on the outer leg. It changes again at the foot to the inside of the leg and forms the first inside line. This line continues across the groin and stops directly below the navel. It is quite similar to the stomach meridian in Chinese acupuncture.

Therapy: Facial Paralysis, Toothache, Throat Ache, Redness and Swelling of the Eye, Fever, Chest Pain, Mania Depressive Psychosis, Gastrointestinal Diseases, Diseases of the Urogenital System, Leg Paralysis, Arthritis of the Knee Joint, Numbness of Lower Extremity, Hernia.

Fig. 29 *Sen Sahatsarangsi*

6. Senthawari

Sen Thawari takes the same course as Sen Sahatsarangsi, but on the right side of the body.

Therapy: Same as Sen Sahatsarangsi. Additional indications: Jaundice and Appendicitis.

Fig. 30 *Senthawari*

7. Sen Lawusang

Sen Lawusang starts in the left ear, travels down the left side of the throat, then towards the nipple. It makes a slight turn thereafter towards the navel and ends at the solar plexus.

Therapy: Deafness, Ear Diseases, Cough, Facial Paralysis, Toothache, Throat Ache, Chest Pain, Gastrointestinal Diseases.

Fig. 31 *Sen Lawusang*

8. Sen Ulangka (Also called Sen Rucham)

Sen Ulangka takes the same course as Sen Lawusang, yet on the right-side of the body.

Therapy: Same as Sen Lawusang.

Fig. 32 *Sen Ulangka*

9. Sen Nanthakrawat

Sen Nanthakrawat comprises two lines:

- Starts at the navel and runs as Sen Sikhini to the urethra or urinary passage.
- Starts at the navel as well and runs as Sen Sukhumang to the anus or fecal passage.

Therapy: Sen Nanthakrawat is generally worked on by giving an Abdominal Massage. Indications are: Hernia, Freuent Urination, Female Infertility, Impotence, Precox Ejaculation, Irregular Menstruation, Uterine Bleeding, Retension of Urine, Diarrhoea, Abdominal Pain.

Fig. 33 *Sen Nanthathakraawat*

10. Sen Khitchanna

Sen Khitchanna is broadly similar to Sen Nanthakrawat. It runs from the navel to the penis as Sen Pitakun (male) and from the navel to the vagina as Sen Kitcha (in women).

Therapy: Therapy on Sen Khitchannais done with abdominal massage as well. Same indications as with Sen Nanthakrawat.

Fig. 34 *Sen Khitchanna*

Muscle-Tendon Meridians

There are 12 muscle-tendon meridians in the body. These exist along the surfaces of the muscles and tendons, running from joint to joint. Unlike the other meridians, these do not connect with any internal organs.

They seem to be primarily involved in the gross utilization of energy with which the musculature is associated. Here, however, there is far greater efficiency (that is, minimized effort with increased energy output) than is ordinarily presumed to be normal.

Muscle-tendon meridians originate in the extremities, meet at major joints and end at points ranging throughout the torso and head.

Knowing the Tendon Routes well and energizing them will greatly increase the Muscle-Tendon-Fascia Tone and improve the range of movement or radius.

1. Lung Muscle-Tendon Meridian

This meridian has its origin at the end of the thumb. Looking at a person standing and facing you with his arms at the sides of his body and the palms facing forward; the meridian would be seen as a line that extends up along the outer side of the bones of the thumb to the outer side of the wrist. It then ascends up the outer side of the forearm to the crook of the arm and, rising up the biceps, crosses over to and enters the chest, coming out again at the sterno-clavicular joint. From there, it extends across the collar bone to the front deltoid, while another branch extends downward into the chest, sending still other branches down to the diaphragm.

Fig. 35 *Lung Muscle-Tendon Meridian*

2. Large Intestine Muscle-Tendon Meridian

Again, picture a person who is standing and facing you. Now his arms are at his sides with the palms facing inward to the torso. Beginning at the end of the index finger, this meridian travels up along what is then the outer side of the forearm to the outer portion of the crook in the arm. There it continues to ascend along the outer side of the upper arm to the side deltoid and then splits into two branches. One goes back over the trapezius muscle, descending down between the spinal column and scapula and extending up along the backbone to about midway of the length of the neck. The other travels across the lower surface of the trapezius and then to the sternocleidomastoid muscle on its way to the face, where it splits again at the jaw line. One short branch runs to the corner of the nose, the other travels up along the side of the face, passing through the side of the forehead on its way over the top of the head and down a similar route to the opposite jaw, where it finally anchors.

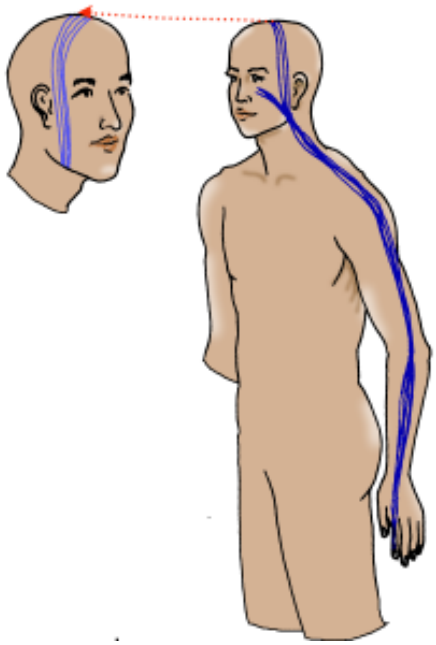

Fig. 36 *Large Intestine Muscle-Tendon Meridian*

3. Stomach Muscle-Tendon Meridian

This meridian is somewhat more elaborate, starting at the third toe and sometimes the second and fourth, too. The meridian runs up the lower surface of the foot to about the level of the ankle. From there it splits into two branches.

One goes up the middle of the lower leg to the outer side of the knee. The other, running laterally to the first, continues to the hip joint and then up over the ilial crest (upper part of the pelvis) to continue on around to the back where it crosses the lower ribs and joins within extension of the meridian that runs along the backbone from the sacrum to about the level of the collar bone.

Returning to the more medially located branch, we see that it continues up to the top of the thigh and veers in towards the pubic bone. There it enters the abdomen and emerges again above the cavity of the collar bone. Next, it travels up the side of the neck and jaw, where it splits in two. One branch veers forward towards the corner of the mouth, ascending up along the side of the nose to the corner of the eye. The other goes up along the jaw line to a point in front of the ear at the temple.

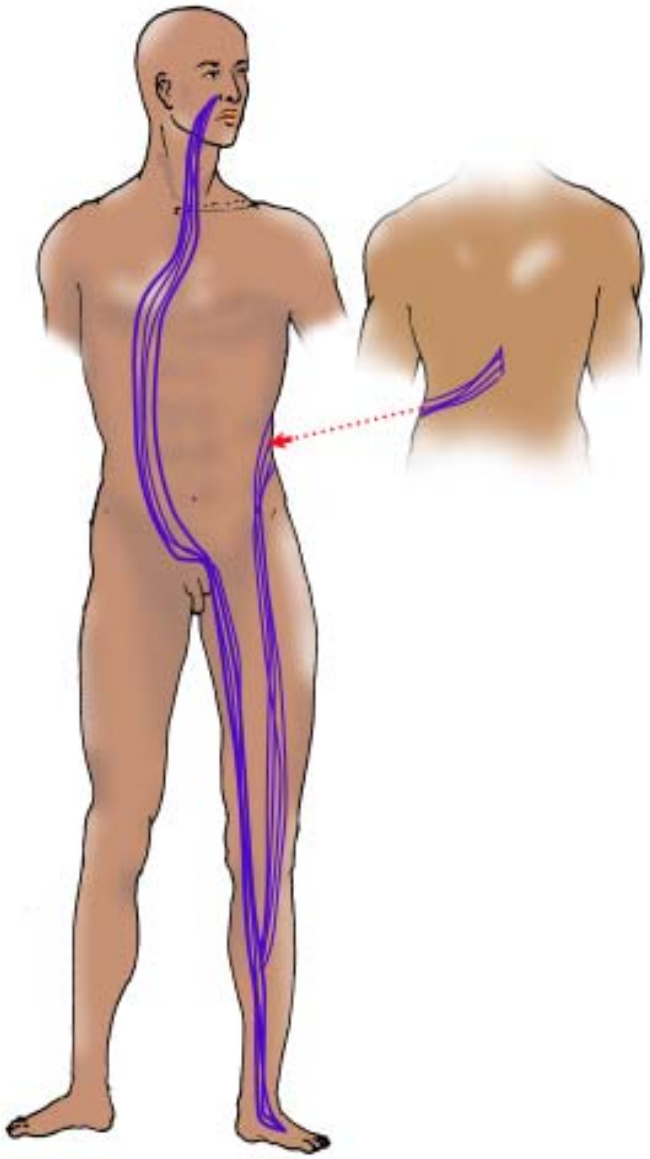

Fig. 37 *Stomach Muscle-Tendon Meridian*

4. Spleen Muscle-Tendon Meridian

With the figure standing and facing you, this meridian is seen as originating at the middle and end of the big toe. It then runs along the middle of the foot and ascends to the internal malleolus (hammershaped bone on each side of the ankle).

From there it continues upward along the middle of the shin, passing the middle of the knee.

Then it travels upward, beginning at the middle of the thigh and sweeping across it to end at a point on the groin. It then turns in toward the pubic bone and rises straight up to the navel. Veering off laterally, it crosses the abdomen, ending at a point just below the nipple, where it then enters into the chest.

Another branch runs through a point located at the pubic bone, to the coccygeal region where it ascends the mid-line of the back-bone to about the level of the tops of the scapulae.

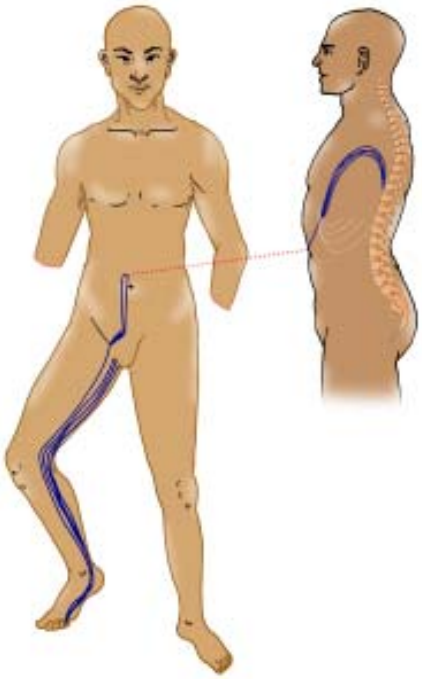

Fig. 38 *Spleen Muscle-Tendon Meridian*

5. Heart Muscle-Tendon Meridian

With the person standing with his arms at the sides of his body and the palms facing forward, this meridian begins at the lateral tip of the pinky finger. From there, it ascends to the middle of the wrist, continuing upward along the middle of the forearm to the crook of the arm. Traveling upward and medially, it runs to the armpit and then crosses the pectoral muscle at about the level of the nipple, joins at the mediastinum (the partition between the two pleural sacs of the chest, extending from the sternum to the thoracic vertebrae and downward to the diaphragm) and runs straight down to the navel.

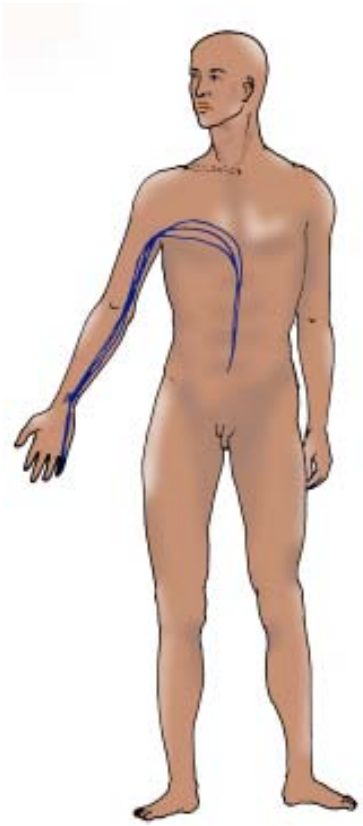

Fig. 39 *Heart Muscle-Tendon Meridian*

6. Small Intestine Muscle-Tendon Meridian

With the person standing and facing away from you with his arms at the sides of his body and the palms facing forward, this meridian begins at the tip of the little finger. Ascending up along the back of that finger to a point on the wrist just above it, it continues up along the middle of the forearm, joining its upper arm extension in the middle of the elbow.

Proceeding up the middle of the upper arm, it unites with its neck and ear extension behind the armpit. Ascending and descending, tracing out a pattern like a Z on its side, it continues up and over the trapezius, crossing the neck and connecting at the mastoid process with a small branch entering the ear.

Another branch loops up and over the ear and then dips down to end at a point on the jaw below that is slightly behind the level of the outer corner of the eye. It then ascends, passing very close to the outer corner of the eye as it travels to the forehead, uniting with the muscle-tendon meridian extension of the mastoid process at the temple.

Still another branch issues out of the point at the mastoid process, ascending the previously described branch that crosses the forehead on its way to the temple.

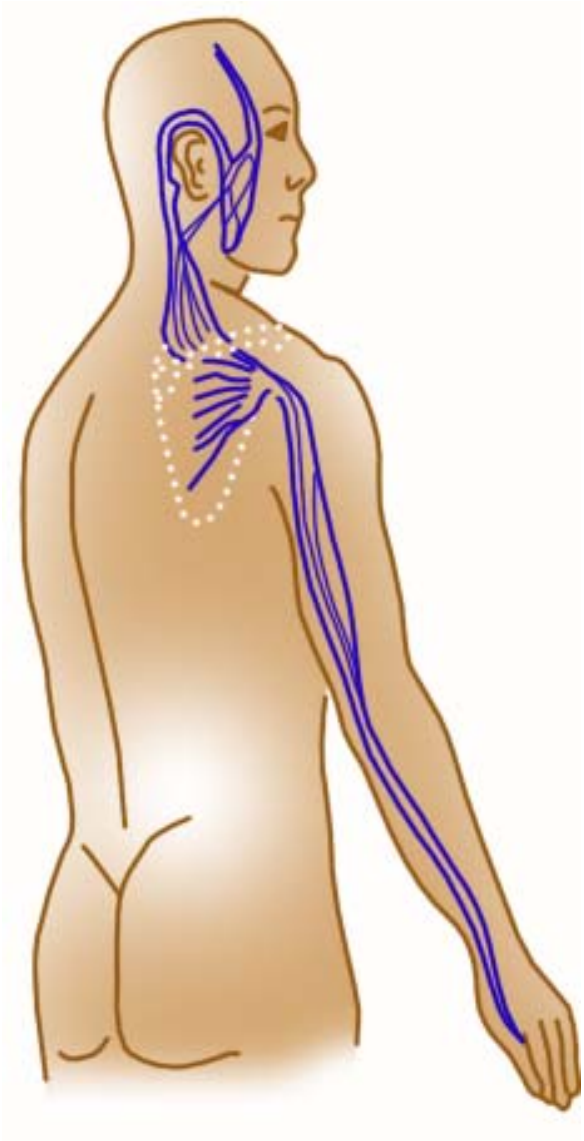

Fig. 40 *Small Intestine Muscle-Tendon Meridian*

7. Bladder Muscle-Tendon Meridian

Looking at a standing figure faced away from you, the bladder meridian begins in the small toe. Running along the outer side of the foot, it rises and joins with the external malleolus.

It then ascends to and joins the lateral corner of the popliteal fossa (or cavity behind the knee), while a branch extends downward from the external malleolus to join at the heel. Then it runs up along the calf and joins at the back of the knee.

From there, it ascends to the middle of the buttocks, while at the same time extending downward along the middle of the calf to the heel. From the buttocks it ascends along the mid-line of the backbone to the nape of the neck, continuing upward to join with the occiput (the lower back part of the skull). It continues upward across the crown of the head to unite with a point at the side of the nose near the inner corner of the eye.

A branch arches along the line of the eyebrow and swoops down to the cheekbone. Then, continuing downward, it extends to the lower jaw, the throat and onto the chest, passing under the armpit to angle up to and join with the line that ascends the back bone.

A small branch extends up out of this extension' to the backbone, rising at an angle out of the region of the scapula to unite in the shoulder. There is also a branch that extends out of the nape of the neck to unite with the root of the tongue. Finally, a short branch extends from the line coming up and out from under the armpit to join at the mastoid process.

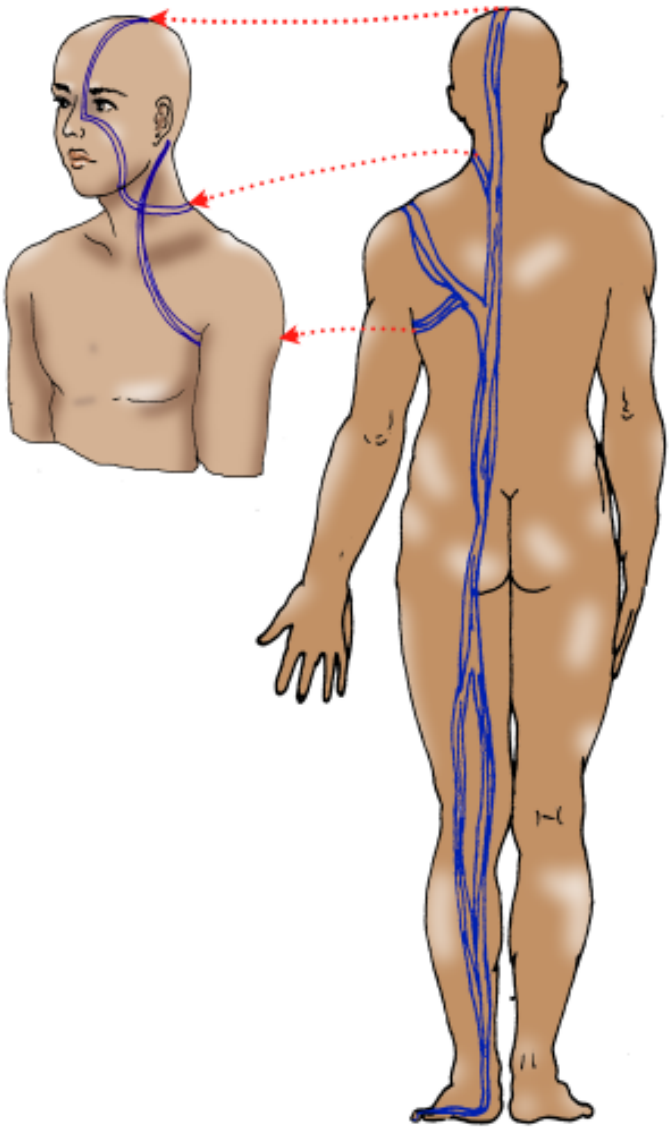

Fig. 41 *Bladder Muscle-Tendon Meridian*

8. Kidney Muscle-Tendon Meridian

Looking at the back of a standing figure with the left heel lifted, the meridian is seen to start under his little toe. From there it travels along the spleen meridian and curves up at the arch of the foot, passing the underside of the ankle and uniting with the calf extension of the muscle-tendon meridian at the Achilles tendon. Continuing to ascend the middle of the calf, it unites again at the middle of the popliteal fossa (cavity behind the knee) joining with the bladder meridian. Viewing the same standing figure from the front, the kidney meridian is seen to continue up along the inner side of the thigh along with the spleen muscle meridian. It unites at the pubic bone, continuing a short way up to the navel. From the pubic bone it goes through to the coccyx, where it ascends the backbone to connect with the occiput and join with the bladder meridian.

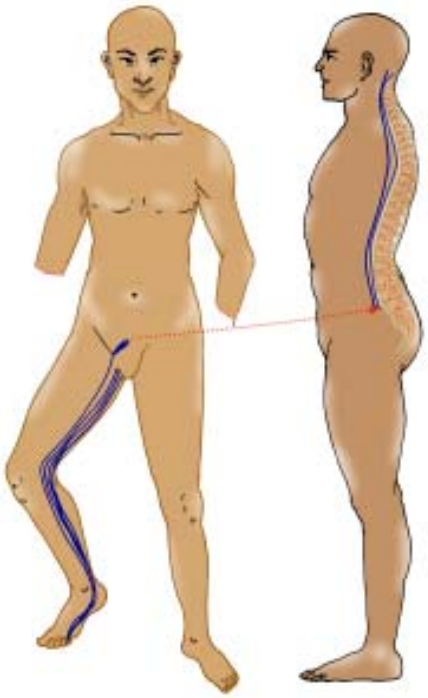

Fig. 42 *Kidney Muscle-Tendon Meridian*

9. Pericardium Muscle-Tendon Meridian

Facing a standing figure with his arms at his sides and the palms of the hands facing forward, the meridian begins at the middle fingers. It then rises up the mid-line of the forearm and upper arm, passing through the middle of the palm, the crook of the arm. the point of attachment of the front deltoid and then into the armpit. From there it spreads out into the chest both ventrally and dorsally.

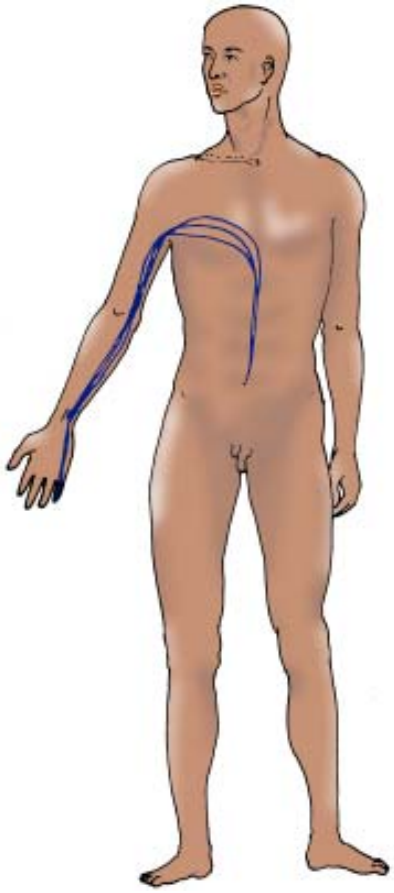

Fig. 43 *Pericardium Muscle-Tendon Meridian*

10. Triple Warmer Muscle-Tendon Meridian

Observing a standing figure from the rear with his arms at his sides and the palms of the hands facing forward, the meridian is seen to begin at the end of the fourth finger. It rises to a point directly above it at the wrist and goes up the forearm to the elbow. Then, it travels up the middle of the upper arm, over the trapezius to the neck, where it joins the small intestine meridian. One branch goes to the jaw and connects with the root of the tongue, while the extension of the main meridian rises past the teeth to the ear. There it shifts forward to the outer corner of the eye and continues up past the temple to the upper part of the hairline.

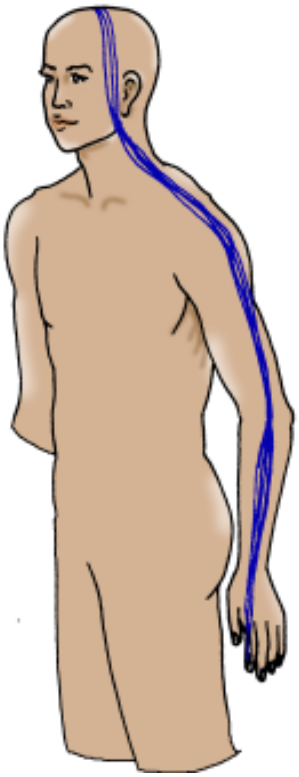

Fig. 44 *Triple Warmer Muscle-Tendon Meridian*

11. Gall Bladder Muscle-Tendon Meridian

Here, when we view the figure from the side, we find that the meridian begins at the outer side of the end of the fourth toe. From there it angles up along the lower leg, sending out a branch to the outer side of the knee.

Continuing up the thigh, it disperses another branch at S-32 and, continuing upward, sends out yet another branch that runs to the anus. It then ascends along the side of the body and rises in front of the shoulder, uniting with the muscle-tendon meridian extension that leads to the breast at the supraclavicular fossa.

A slightly divergent point just below this bulges forward, where it links with the breast. The main meridian continues upward, rising up behind the ear to the crown of the head.

It also descends in front of the ear to the side of the jaw from where it ascends again to the corner of the nose, while another branch travels up to the outside corner of the eye.

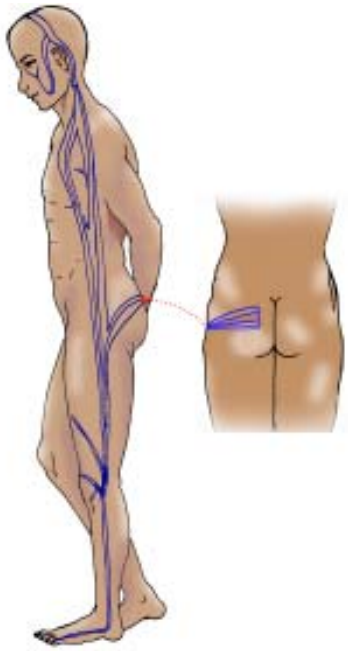

Fig. 45 *Gall Bladder Muscle-Tendon Meridian*

12. Liver Muscle-Tendon Meridian

Here we view the standing figure facing us. The meridian starts at the big toe and connects in front of the internal malleolus. It then rises up the lower leg along the tibia (the inner and larger of the two bones of the lower leg) and joins on the inner side of the knee. Finally it sweeps up the thigh and unites at the pubic bone, thereby connecting with all the other muscle meridians.

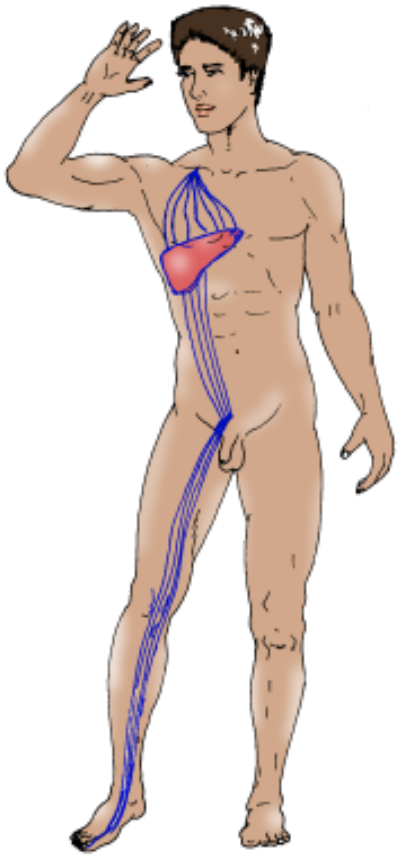

Fig. 46 *Liver Muscle-Tendon Meridian*

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Master Mantak Chia is the creator of Universal Tao System, Healing Tao, Tao Yoga and is the director of the Universal Tao Master School at Tao Garden Wellness Retreat in the beautiful northern countryside of Chiangmai, Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Chi Nei Tsang III
Muscle, Tendon and Meridian Massage

Chi Nei Tsang III is the fourth section of the Chi Nei Tsang series following Chi Nei Tsang I (Organ Massage), Chi Nei Tsang II (Channel Massage) and Karsai Nei Kung (Genital Massage) with Chi Nei Tsang III (Muscle, Tendon & Meridian Massage) as the last section. This is the final chapter of the Chi Nei Tsang Internal Massage moving the energy (chi) throughout the body while releasing and opening up its passages. Through this massage section in this booklet you will use the hand techniques (finger presser, twisting & spiraling, hand scooping & wave techniques) used in Chi Nei Tsang I to open up and release the brockages in the Abdominal, Arteries, Muscles, Tendons, Vertebras, Shoulder Blades, Coccyx, Arms, Legs, Feet, Joints, Hands, Neck and Meridian Lines layout in this booklet.

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I have come upon Master Chia's Taoist practice in my old age and find it the most satisfying and enriching practice of all those I have encountered in a long life of seeking and practicing.

Felix Morrow, Senior Publisher

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About the Author

Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and “still the mind”. While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue

introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,500 instructors and practitioners from all over the world. Living Tao Centers, Chi Nei Tsang Institutes, Cosmic Healing Forums and Immortal Tao Mountain Sanctuaries have opened in many locations in North America, South America, Europe, Asia, Africa and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden and the Universal Tao Training Center fifteen miles outside of Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using Dark Room technology, creating a complete environment for the higher level Taoist practices.

Master Mantak Chia has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983

Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.

Taoist Ways to Transform Stress into Vitality -1985

Chi Self-Massage: the Tao of Rejuvenation - 1986

Iron Shirt Chi Kung I - 1986

Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986

Bone Marrow Nei Kung - 1989

Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002

Many of the books above are available in the following foreign languages:

Arabia, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romania, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao System Overview in the back of this book.

Acknowledgments

I thank foremost those Taoist Masters who were kind enough to share their knowledge with me never imagining it would eventually be taught to Westerners. I acknowledge special thanks to Dena Saxer for seeing the need for this book to be published and for her encouragement and hard work on the initial manuscript.

I thank the many contributors essential to the book's final form: Dena Saxer, for writing a portion of this book, especially the basic step-by-step instructions, and for choosing the title; the artist, Juan Li, for spending many hours drawing and making illustrations of the body's internal functions and for his cover illustration; Gunther Weil, Rylin Malone, and many of my students for their feedback; Jo Ann Cutreria, our secretary for making so many contacts and working endlessly, Daniel Bobek for long hours at the computer: John-Robert Zielinski for helping with the new, computer system and for rearranging the files and programs to speed up the new process; Adam Sacks, our computer consultant, who assisted in solving computer problems as they arose during the final stages of production; Helen Stites for entering the text on the computer and for editing and proofreading; Valerie Meszaros for editing and for organizing the text into book form on the computer, proofreading and typesetting specification; and Cathy Umphress for design and paste ups. Special thanks are extended to Michael Winn for general editing; David Miller for design and overseeing production; and Felix Morrow for his valuable advice and help in producing the book. Felix Morrow has agreed to be the original publisher of Universal Tao Publications.

Without my son, Max, the book would have been academic for his gifts, my gratitude and love.

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Author's Note

In the last pages of this book, the reader will find descriptions of the courses and workshops offered by our Universal Tao Centers. This material is also in effect a comprehensive description of the whole Taoist system. All of my books together will be a composite of this Taoist world-view. Each of my books is thus an exposition of one important part of this system. Each sets forth a method of healing and life-enrichment which can be studied and practiced by itself, if the reader so chooses. Certainly each is comprehensible by itself, but in the Taoist System, each of these methods implies the others and is best practiced in combination with the others. Thus, the foundation of all of them, the practice of the meditation of the Microcosmic Orbit, which is the way to circulate the Chi energy throughout our body, is involved in all the other practices. My book that is basically concerned with the Microcosmic Orbit is *Awaken Healing Energy* and *Awaken Healing Light.*

Two practices that follow are the meditation of the Inner Smile and the Six Healing Sounds. These, too, are also constantly emphasized. They are set forth in my book, *Taoist Ways to Transform Stress into Vitality*. The present book follows from all that has gone before it, but you can begin with this book and learn from it the full range of Chi self-massage. I do believe that once you begin to practice this network of Taoist Rejuvenation, it will create in you the desire to master the others that I have named. You will then be in a position to benefit fully from my book, *Taoist Secrets of Love: Cultivating Male Sexual Energy. s* That is as far as my books have come. Concerning the others that will follow I refer you again to the description of our courses and workshops.

Mantak Chia
Founder
Universal Tao System

Chapter I
Benefits and Theory

From ancient times to the present, Taoist Masters have been remarkably youthful, appearing and functioning at least twenty years younger than their actual ages. One source of their vitality has been the practice of Taoist Self-Massage Rejuvenation: using one's internal energy, or Chi, to strengthen and rejuvenate the sense organs (eyes, ears, nose, tongue teeth, skin) and the inner organs. These techniques are about five thousand years old and until now were closely guarded secrets passed on from one Master to a small group of students. Even so, each Waster often knew only part of the method. Based on my studies with a number of different Taoist Masters, I have pieced together the entire method and organized the material into a logical routine. By practicing this routine five to ten minutes daily, you can improve many things, including your complexion, vision, hearing, sinuses, gums, teeth, tongue, and general stamina.

I. Senses can help control Negative Emotions

Self-Massage Rejuvenation works by clearing blockages from the meridians, or energy channels, of the various senses and vital organs. This is done by the unique Taoist practice of bringing energy or Chi, up from the sexual organs and anus to the face, hands and senses, and then directing it to specific areas. The senses are connected with the organs, and the organs are believed to store and generate positive and negative emotions. By strengthening the senses, we help to control negative emotions. Senses are the first to receive the influences of the outside world, such as tension, anger and fear; and, in turn, these outside negative influences affect the organs and the nervous system. Strong senses will help to prevent an overload of outside influences that can negatively affect us.

II. Healthy Organs can help to change Emotional and Personal Characteristics.

In my ten years of teaching this simple self-massage, I have seen people use it to improve their emotional, personal and social lives. One of my students had strong fears which easily brought on anger. This resulted in moodiness, irritability and pain in his stomach. Feeling this wav, a person is unlikely to be sociable, friendly or easy to communicate with. After a few weeks of practicing the Inner Smile, Liver Sound, and massaging the liver and stomach, this person's disposition improved, the moodiness decreased and he became friendlier. He says that since he began studying with me, the greatest benefit has been in his family life, especially his relationship with his children. Now he no longer needs to use the alcohol he relied upon to cover up his pain and forget the stress which previously affected him. His employer and co-workers also notice the change, and he has sent other workers to study the system.

I have a secretary who once paid for one of her co-workers to study with us, wanting her co-worker to find a way to better cope with stress on the job. This woman told me that it was the best investment she had ever made, because she no longer had to be victimized by her co-worker's emotional swings when they worked together.

Chapter II

Anus is connected to Organ Energy

In Tao Rejuvenation the Chi flow is very important. Without bringing Chi circulation to the part that you massage, it is just a simple, normal touch or massage. The Inner Smile and Microcosmic Orbit Meditation are very important also. They are the best ways to increase the life-force in the senses and organs.

I. Perineum Power

The perineum (Hin-yin) region includes the anus and sexual organs. The anus region is divided into various sections which are closely linked to the Chi of corresponding organs. The Chinese term Hin-yin (perineum) means the collection point of all the Yin energy, or the lowest abdominal energy collection point. It is also known as the gate of death and life. This point lies between the two main gates. One we call the front gate (the sexual organ) which is the big life-force opening. Here the life-force energy can easily leak out and deplete the organ's function. The second gate, or back gate, is the anus. This gate can also easily lose life-force when not sealed or closed tight. In the Tao practices, especially in the Tao Secrets of Love, Healing Love and Iron Shirt, the perineum's power to tighten, close and draw the life-force back up the spine is an important practice. Otherwise, our life-force and sexual energy can become a "river of no return"; they will flow out and will not recycle back.

II. The Anus Region is divided into Five Parts.

The anus is divided into five regions: (A) Middle, (B) Front, (C) Back, (D) Left and (E) Right. (Fig. 2.1)

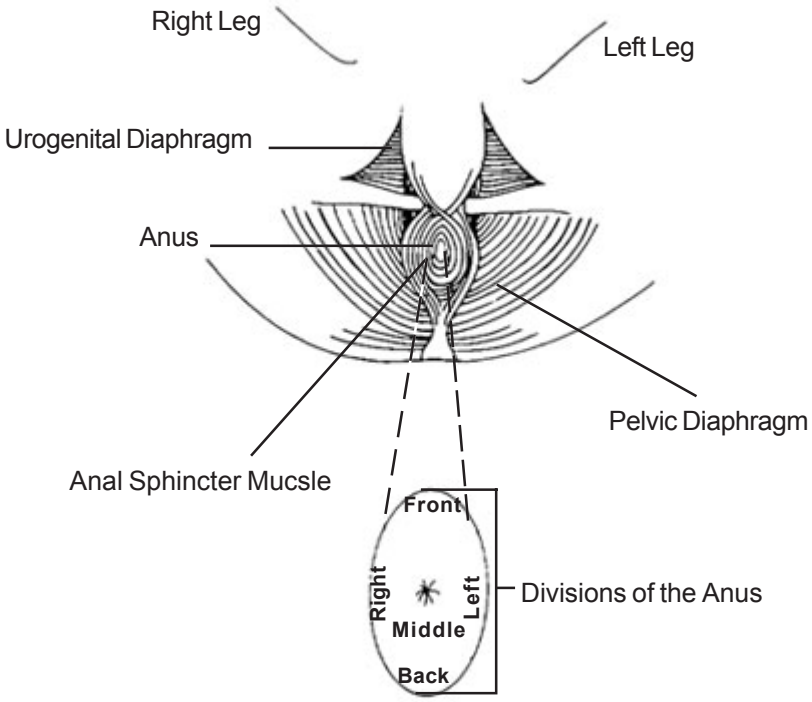

Fig.2.1 *Anus is divided into five regions.*

A. Middle Part

The middle of the anus Chi is connected with the organs as follows: the vagina-uterus, the aorta and vena cava, stomach, heart, thyroid and parathyroid glands, pituitary gland, pineal gland and the top of the head. (Figs. 2.2 and 2.3)

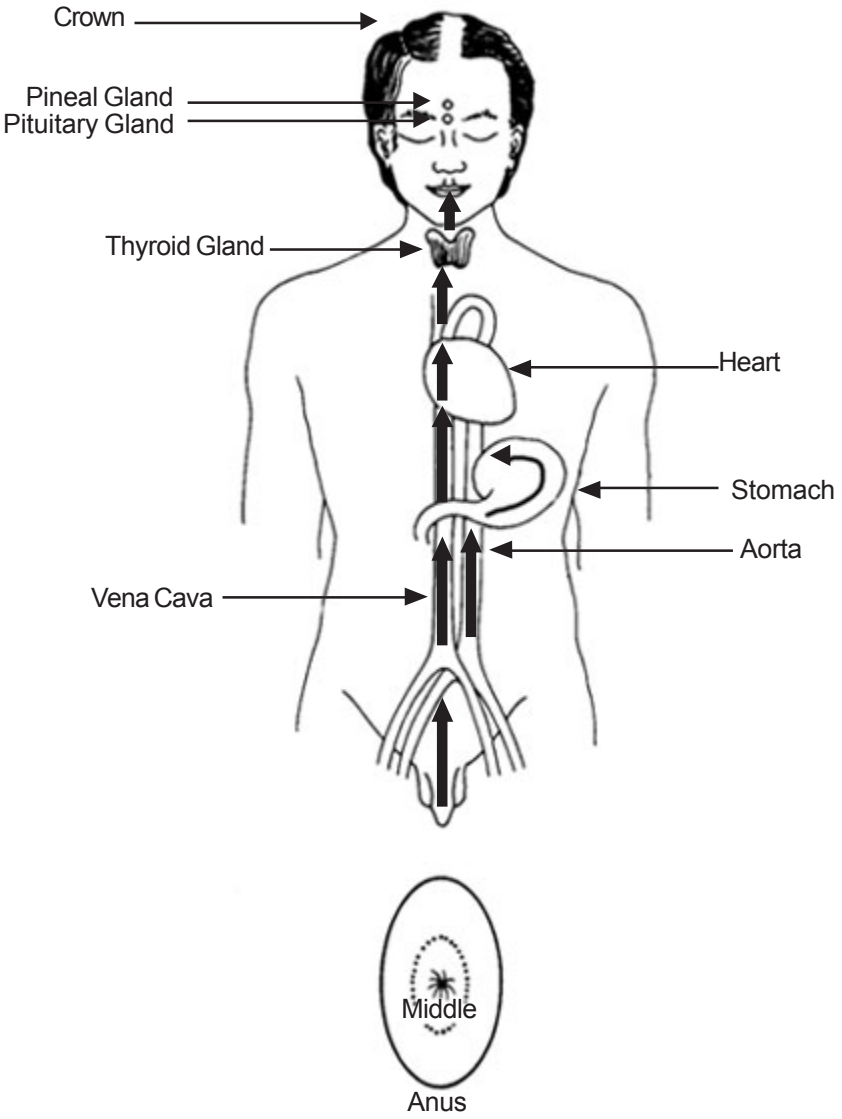

Fig. 2.2 *Middle Part*

B. Front Part

The front of the anus Chi is connected with the following organs: the prostate gland, bladder, small intestine, stomach, thymus gland, and front part of the brain. (Fig.2.4)

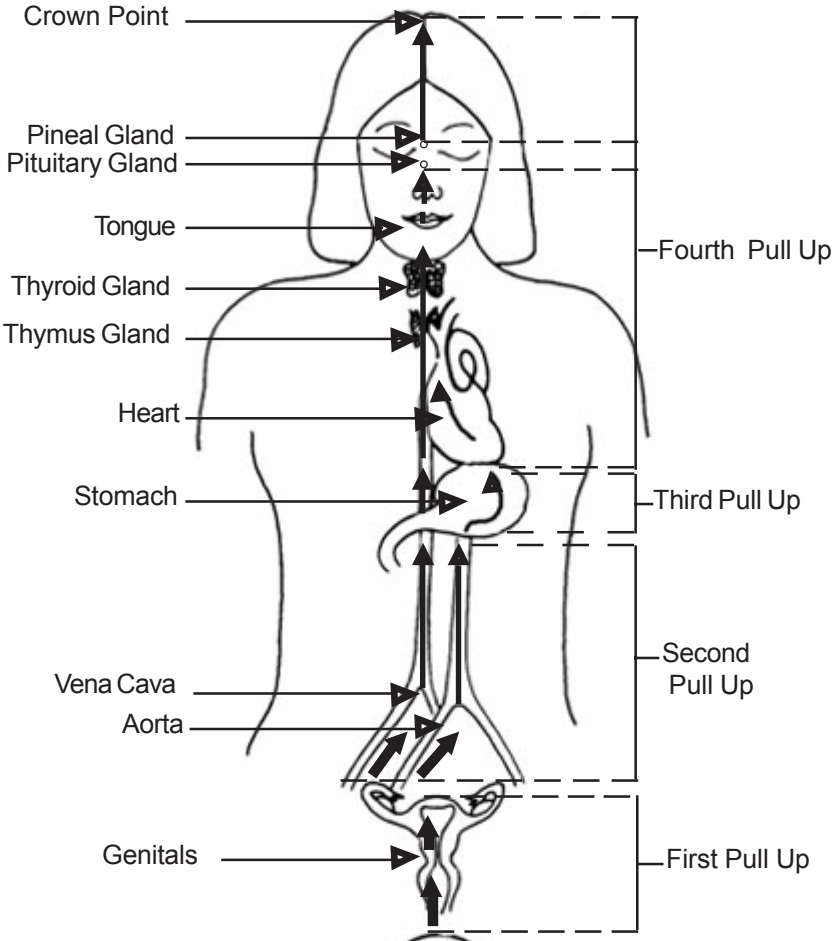

Fig. 2.2 *Middle Part.*

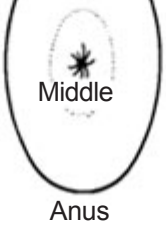

Fig. 2.3 *Left Part*

C. Back Part

The back part of the anus Chi is connected with the organ energies of: the sacrum, lower lumbars, the twelve thoracic vertebrae, the seven cervical vertebrae, and the small brain (cerebellum). (Fig. 2.5)

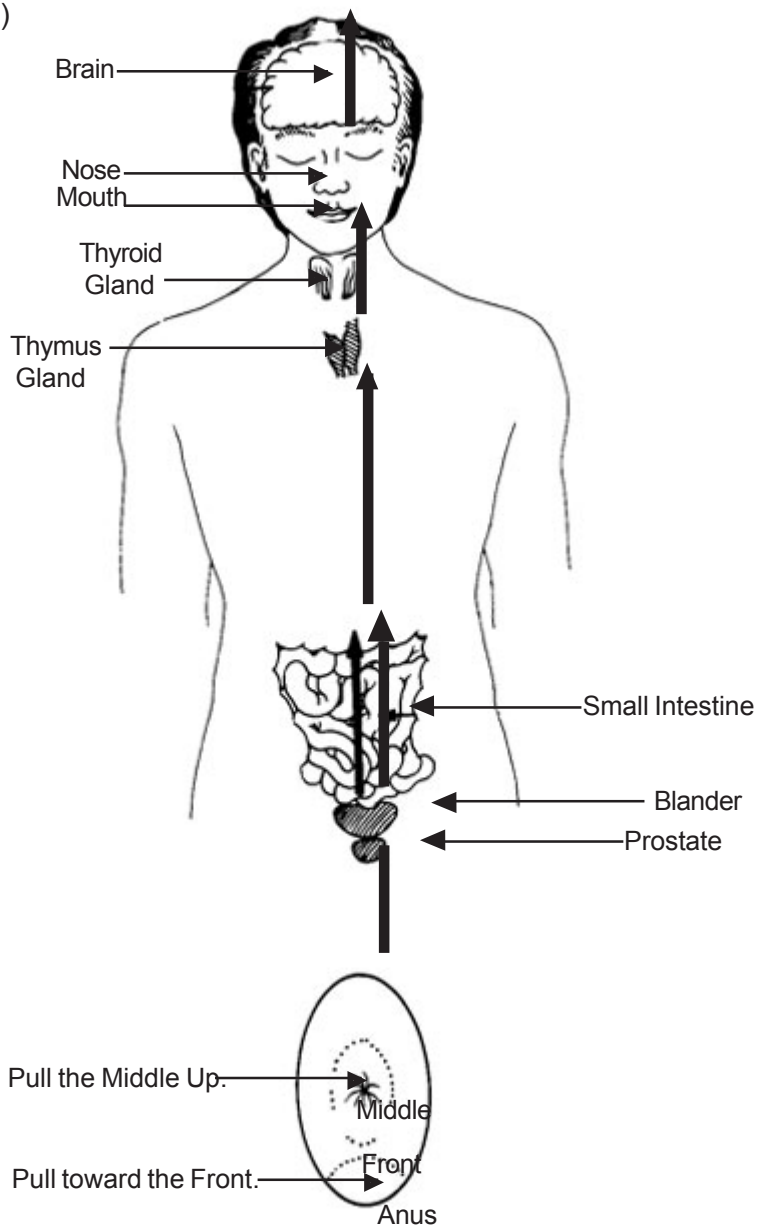

Fig. 2.5 *Back Part*

D. Left Part

The left part of the anus Chi is connected with the organ energies of: the left ovary, the large intestine, left kidney, adrenal gland, spleen, left lung and left hemisphere of the brain. (Figs. 2.6 and 2.7)

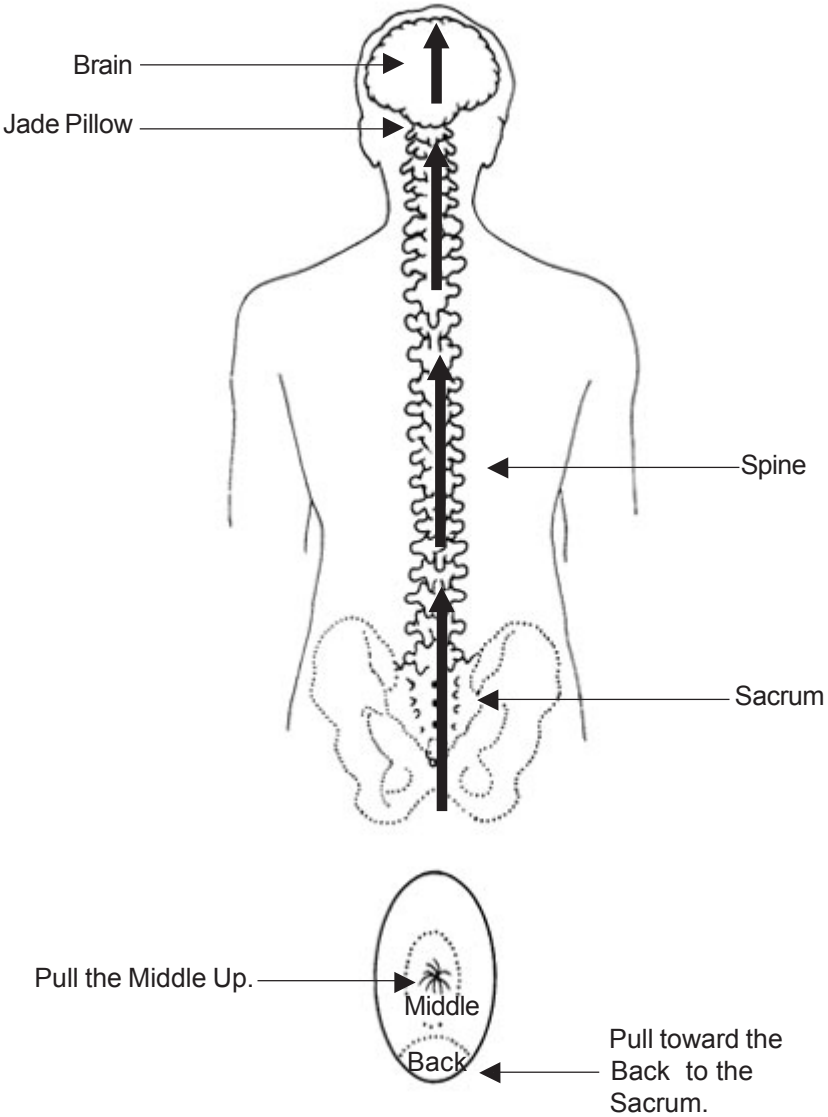

D. Left Part

The left part of the anus Chi is connected with the organ energies of: the left ovary, the large intestine, left kidney, adrenal gland, spleen, left lung and left hemisphere of the brain. (Figs. 2.6 and 2.7)

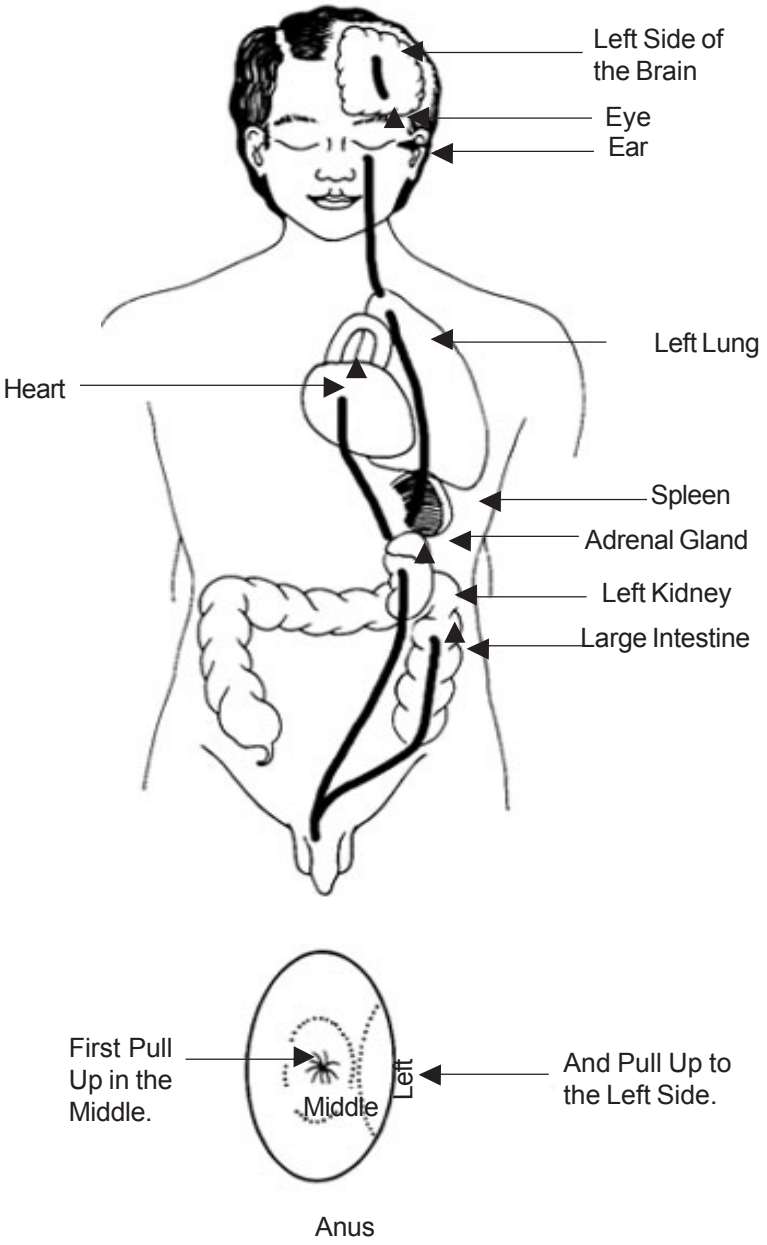

Fig. 2.6 Left Part In the Male

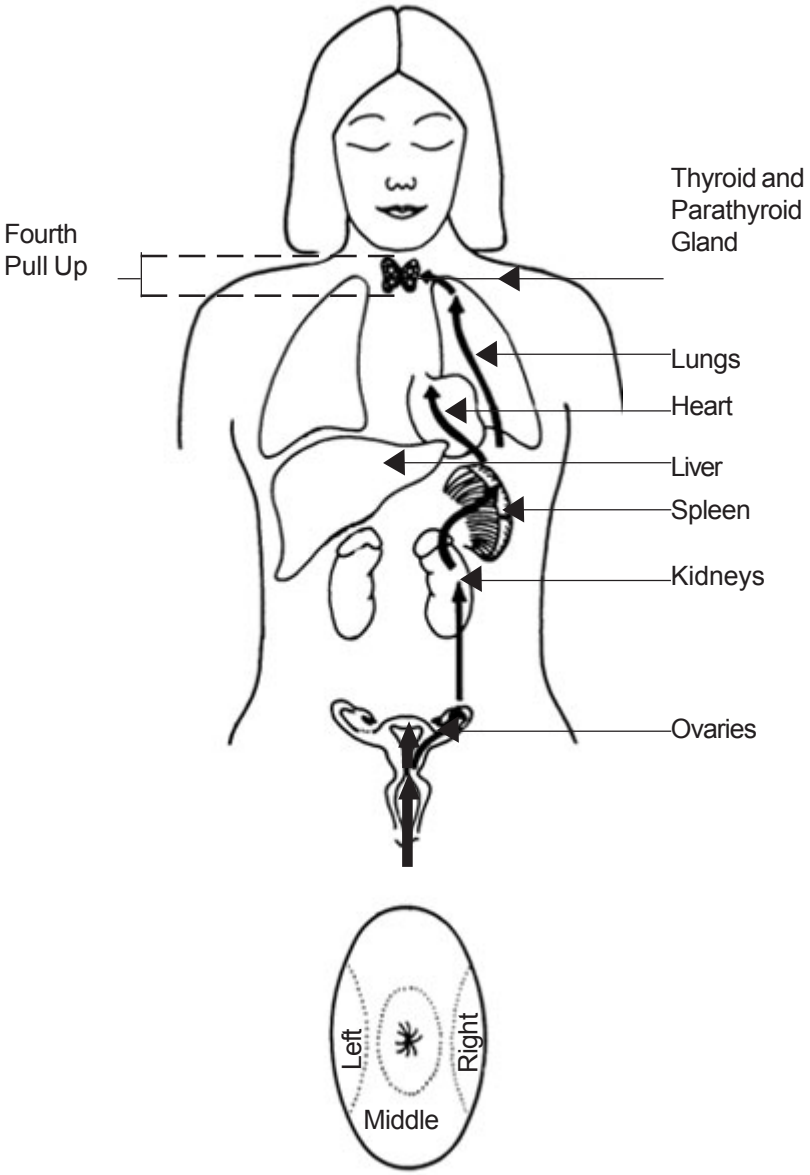

Fig.2.7 *Left Part in the Female*

E. Right Part

The right part of the anus Chi is connected with the organ energies as follows: the right ovary the large intestine, right kidney, adrenal gland, liver, gall bladder, right lung and right hemisphere of the brain. (Fig

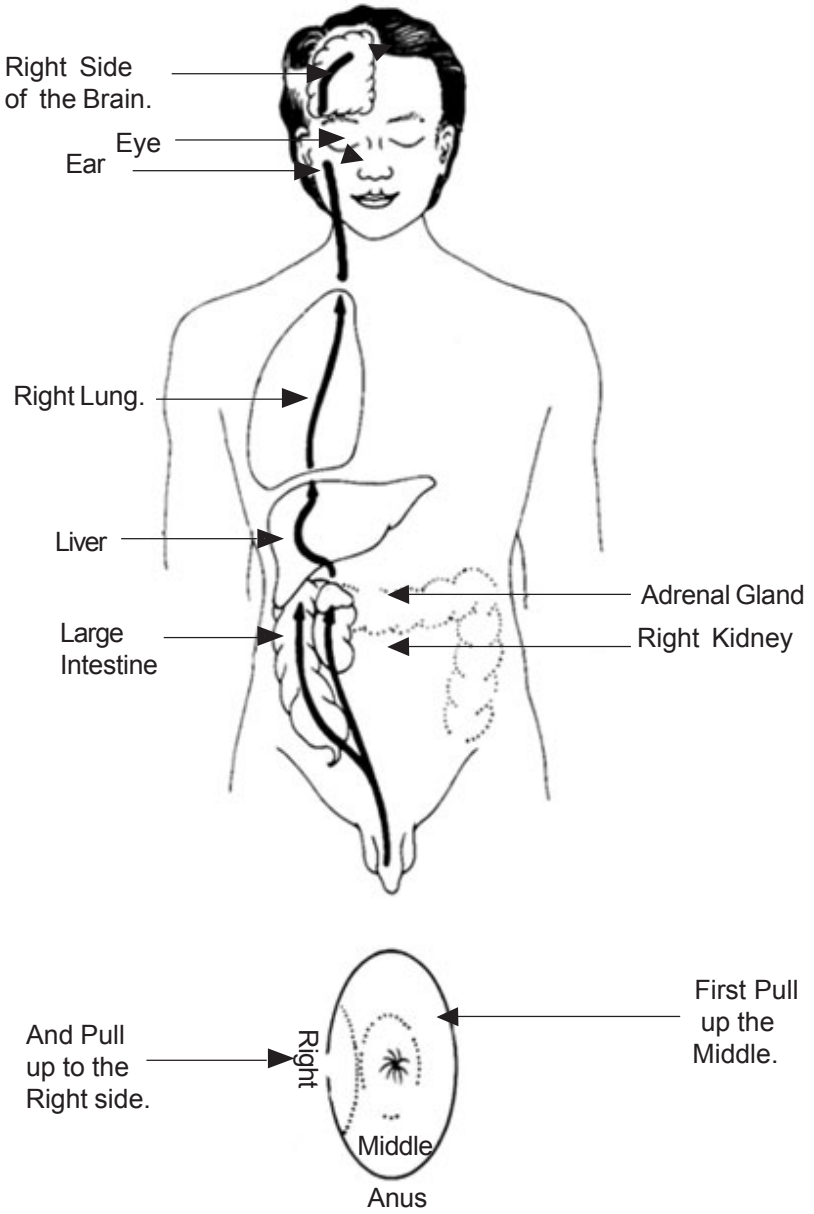

Fig.2.8 *Right Part in the Male*

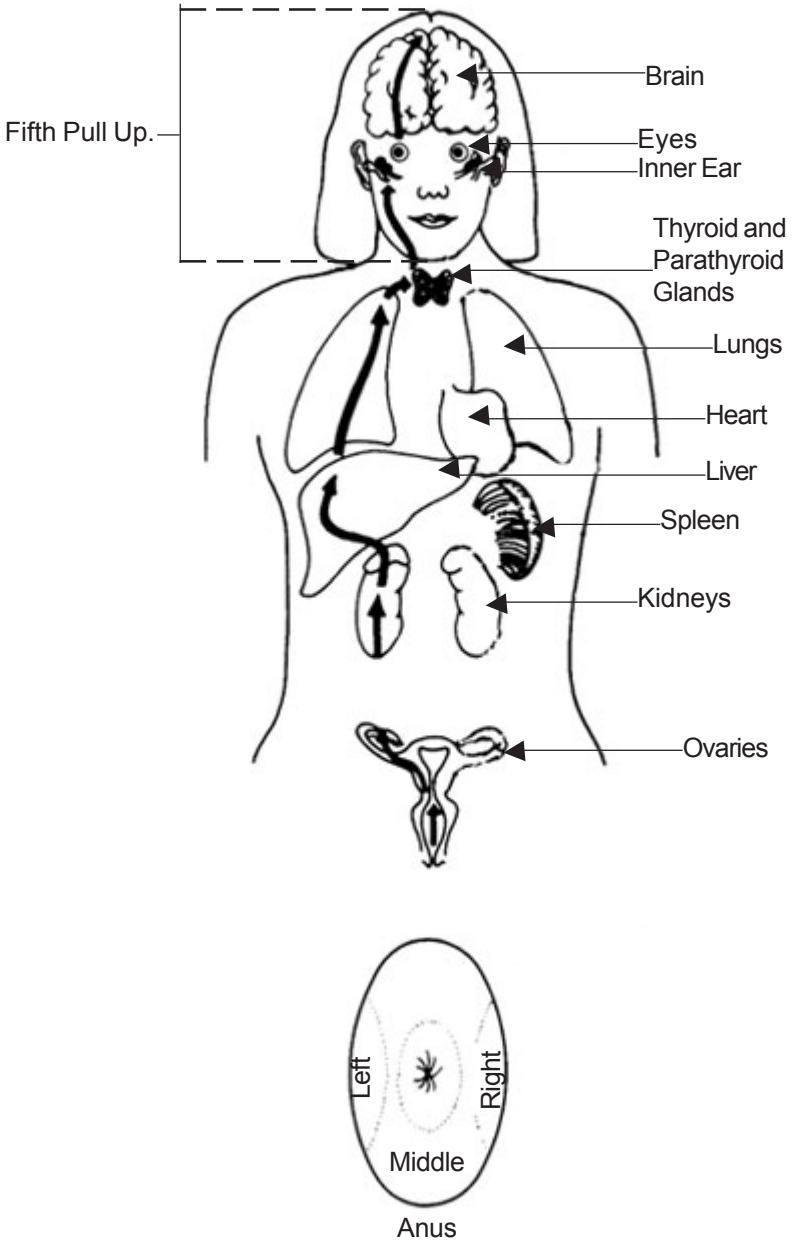

Fig.2.9 *Right Part in the Female*

By contracting the different parts of the anus, you can bring more Chi to the organs and glands, and the effects of the massage will increase. (Figs. 2.9 and 2.10)

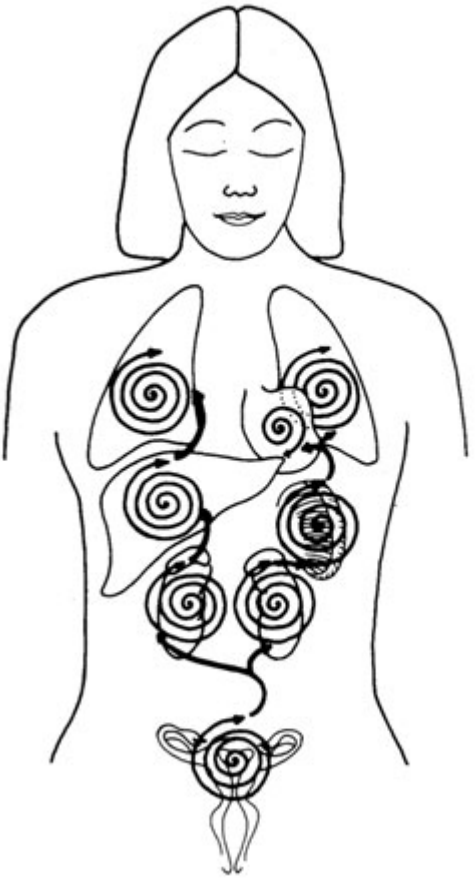

Fig. 2.10 *Drop and circle the energy around the organs.*

Chapter 3
Healing Hand

Humans can build all kinds of sophisticated instruments because of the magnificence of the hands and the fingers. Another higher function of the hands is the power of healing. Knowing the major points of the hands and fingers will enable you to stimulate and maintain the organs in good function.

I. Palms

The palms are where all major energies of Chi join. The palm can be the place from which the life-force is sent out to heal others or yourself. The palm also is the place where energy can be received and enter into the bone structure and into the major organs.

II. Pericardium

The pericardium (P-8) is the main place of energy concentration. You can collect the energy in this point and transmit stronger energy from this point. (Fig. 3.1)

III. Large Intestine

The large intestine (LI-4) is the major point which controls all the pain in the body, especially in the sense organs (eyes, ears, nose) and headaches. (Fig. 3.2)

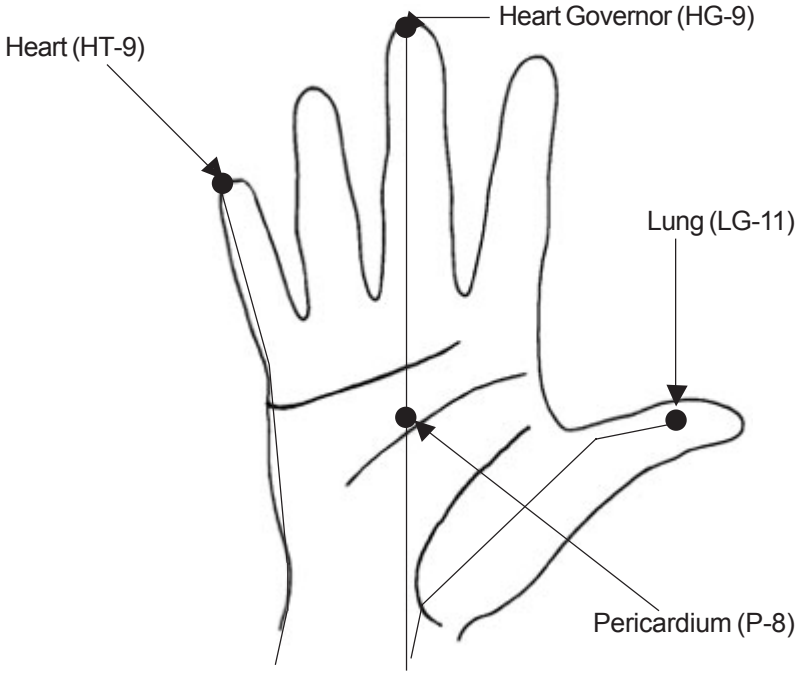

Fig. 3.1 *Pericardium*

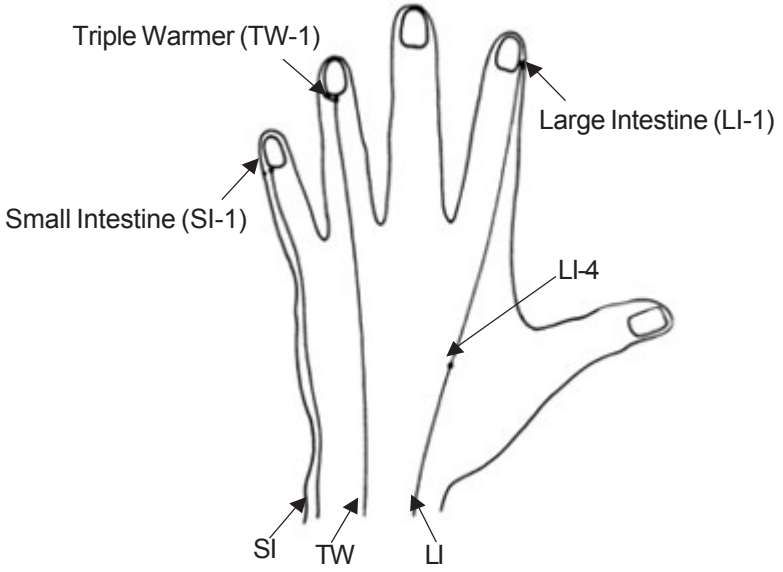

Fig. 3.2 *Large Intestine*

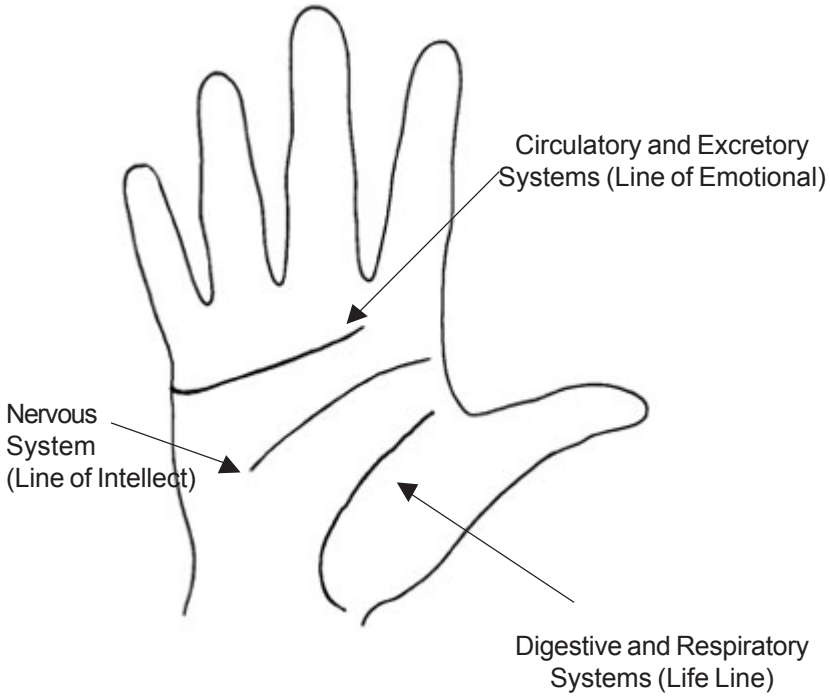

Fig 3.3 *Three Major Palm Lines*

IV. Major Palm Lines

The three major palm lines are the Life Line, the Line of Intellect and the Line of Emotion. (Fig. 3.3)

V. Fingers have corresponding Bodily Functions

The fingers are connected to the organs' meridians. (Fig. 3.4) The joints of the finger bones are also related to parts of the organs and their corresponding senses and emotions.

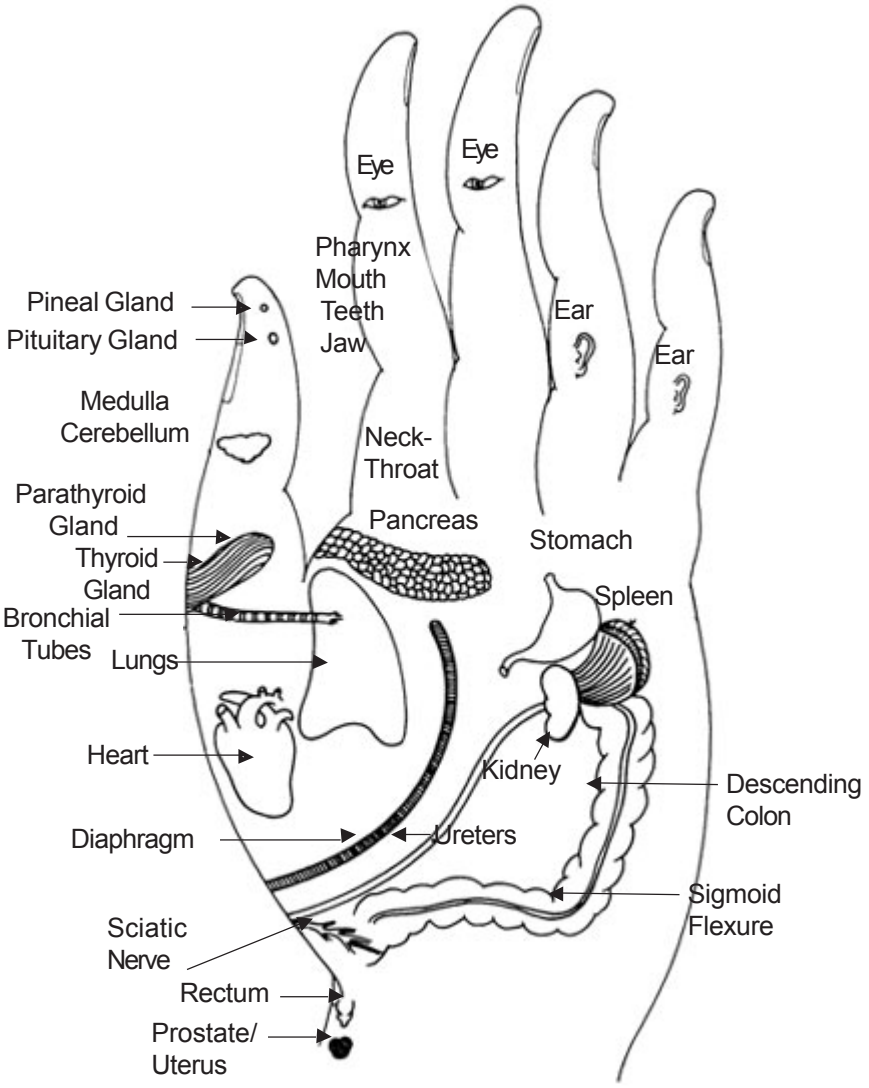

Fig. 3.4 *Fingers and Their Corresponding Bodily Functions Through the Organs' Meridians.*

VI. Strengthen the Extremities

Strengthening the ends of the extremities will help to stimulate the organs. The tips of the fingers have many tiny veins and arteries. (Fig. 3.5) When we get old and do not exercise enough the Chi does not flow well and its circulation becomes stuck. This can affect blood circulation, and the veins and arteries will become hardened. When we feel cool, the first places to feel cool are the hands. If you want to warm up quickly, you have to warm up the hands and feet first.

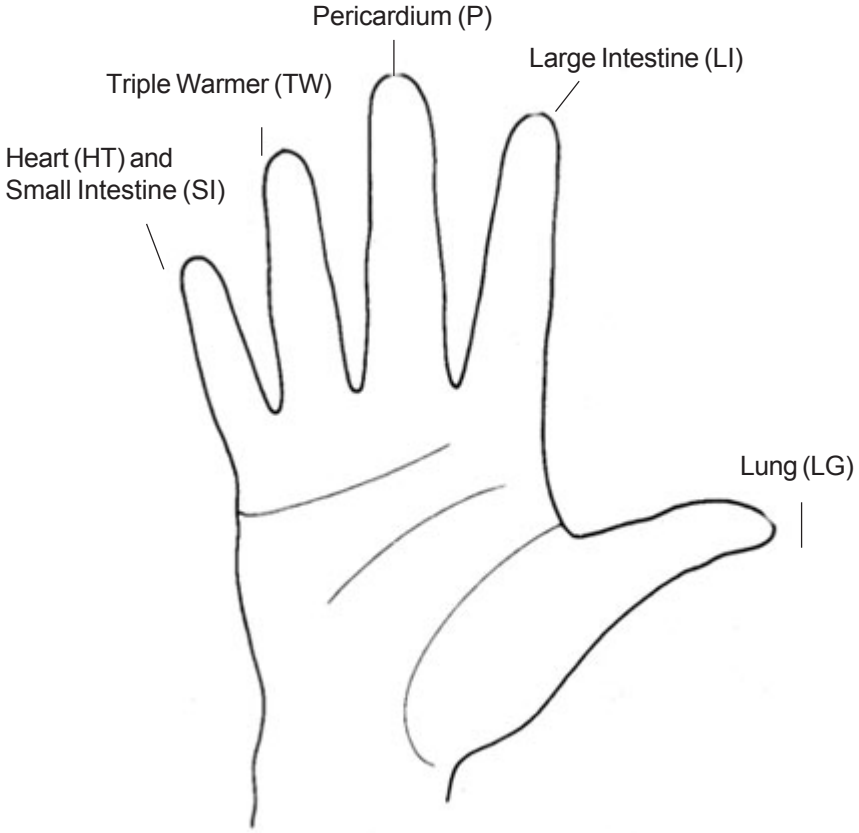

Fig. 3.5 *Strengthening the ends of the extremities will help to stimulate the organ.*

VII. Massage the Hands to increase the Flow of Chi.

Massaging the hands and palms will help to increase the flow of Chi along the related meridians and will result in a harmonious increase of the functions of respiration, circulation and digestion.

VIII. Preparation

A. Wait at least an hour after eating.

B. Try this practice immediately after doing the Inner Smile or Six Healing Sounds, *For the best results, if you have already learned the Microcosmic Orbit or Fusion Meditations, try this technique after practicing these as well.

C. Sit comfortably on your sitting bones at the edge of a chair. Make sure that your legs are grounded.

D. In general, massage each area six to nine times. Massage problem areas more.

E. Those people who cannot get out of bed can practice the routine there.

For a complete exposition of the Inner Smile and the Six Healing Sounds, see the author's preceding book, T*aoist Way to Transform Stress Into Vitality.*

IX. Practice

A. Bring Chi energy to the hands. (Fig. 3.6)

1. Inhale, contract your vagina or testicles, your buttocks, and also the part of the anus which is named—that is, the front, back, right, left, middle, or entire anus. At first you may not be sensitive to these distinctions, but eventually you will be. In general, the part of the anus which is contracted corresponds to the location of the area to be massaged. For example, you contract the left side of the anus when massaging the left lung.

2. Hold your breath and hold the contractions, clench your teeth together, and press your tongue to the roof of your mouth, as you rub your hands together vigorously. This stimulates the twelve meridians in the hands.

3. Continue to rub your hands while holding your breath and contracting your anus. Feel your face getting hot. Then, mentally picture energy flowing to your hands.

4. When your face and hands are hot, direct your attention to the appropriate area and massage that part until you are out of breath. Exhale and breathe normally. Smile and become aware of the part that is being massaged. Feel that the area is exceptionally warm and that energies are flowing.

5. Repeat this entire procedure for each area to be massaged or whenever your hands become cool. Your hands must always be very warm for self-massage. Cold hands will have very little effect on the massage.

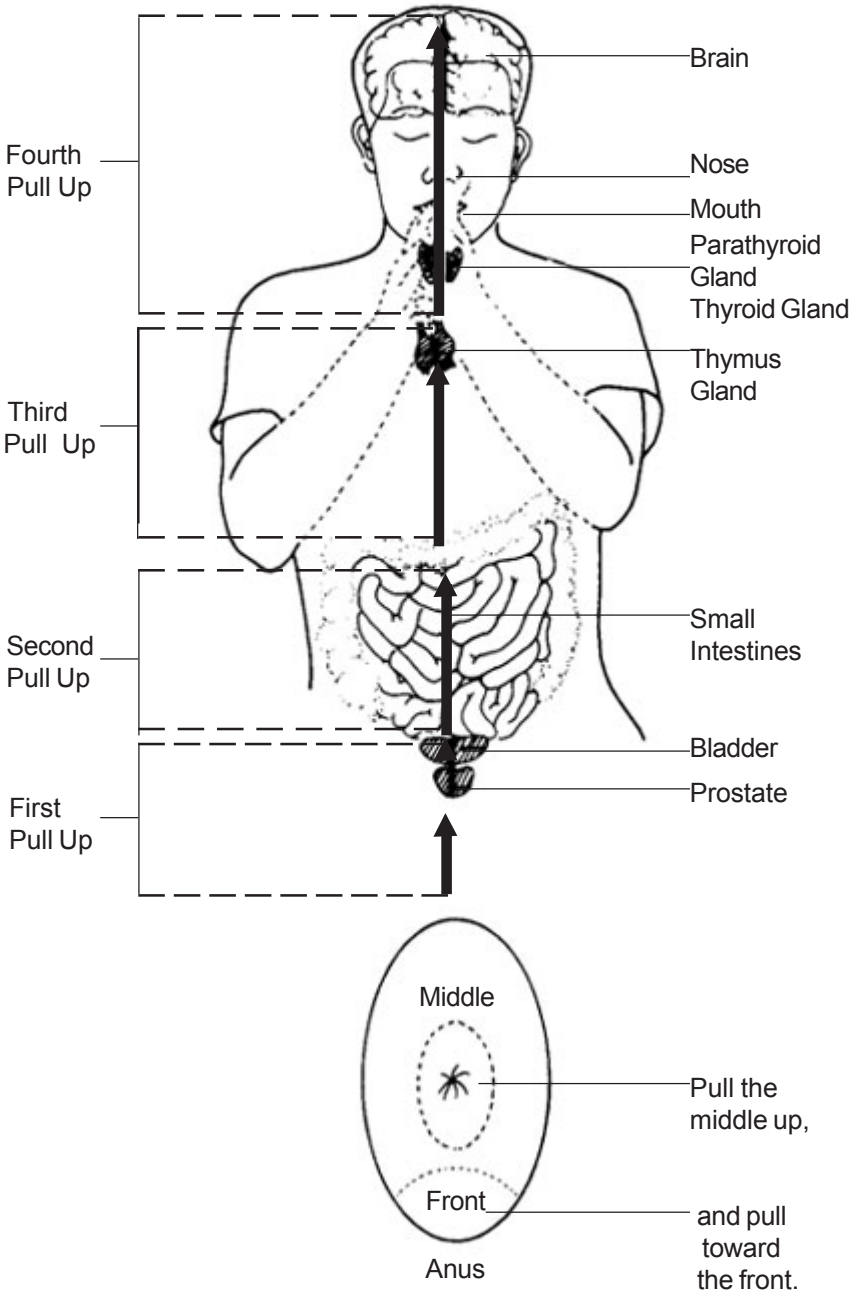

Fig. 3.6 *Bringing Chi Energy to the Hands.*

B. Massage the hands.

Always start by rubbing your hands until they are warm.

1. Massage the pericardium (P-8). Use the thumb to press the middle of the palm with a circular motion. (Fig. 3.7)

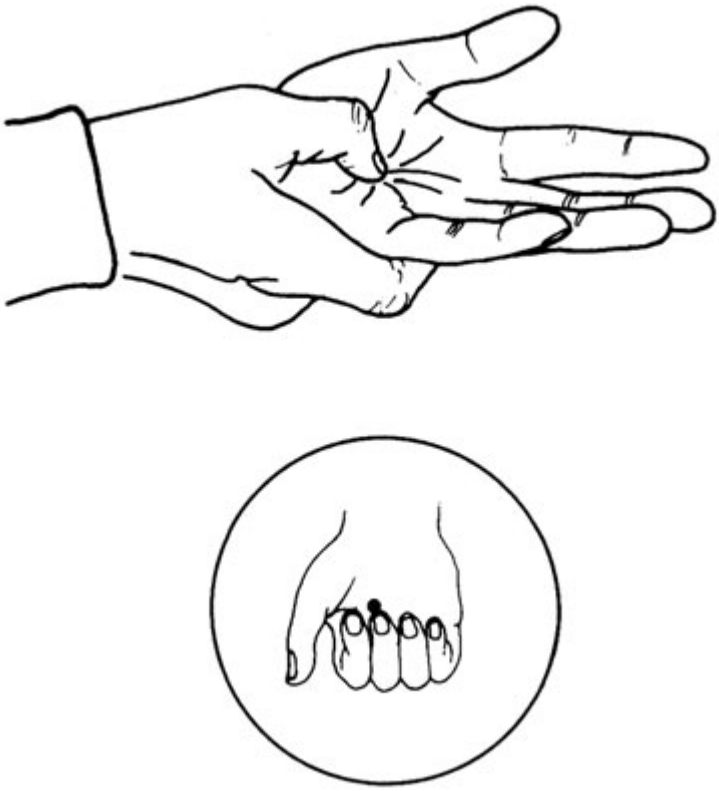

Fig. 3.7 *Massaging the Pericardium with fingers cupped in the palm in a half-fist, the pericardium is the point at the tip of the middle finger.*

2. Massage the hegu (LI-14). Press the thumb around the point in a circular motion, and press more at the index finger bone. Find the pain point and massage it away. (Fig. 3.8)

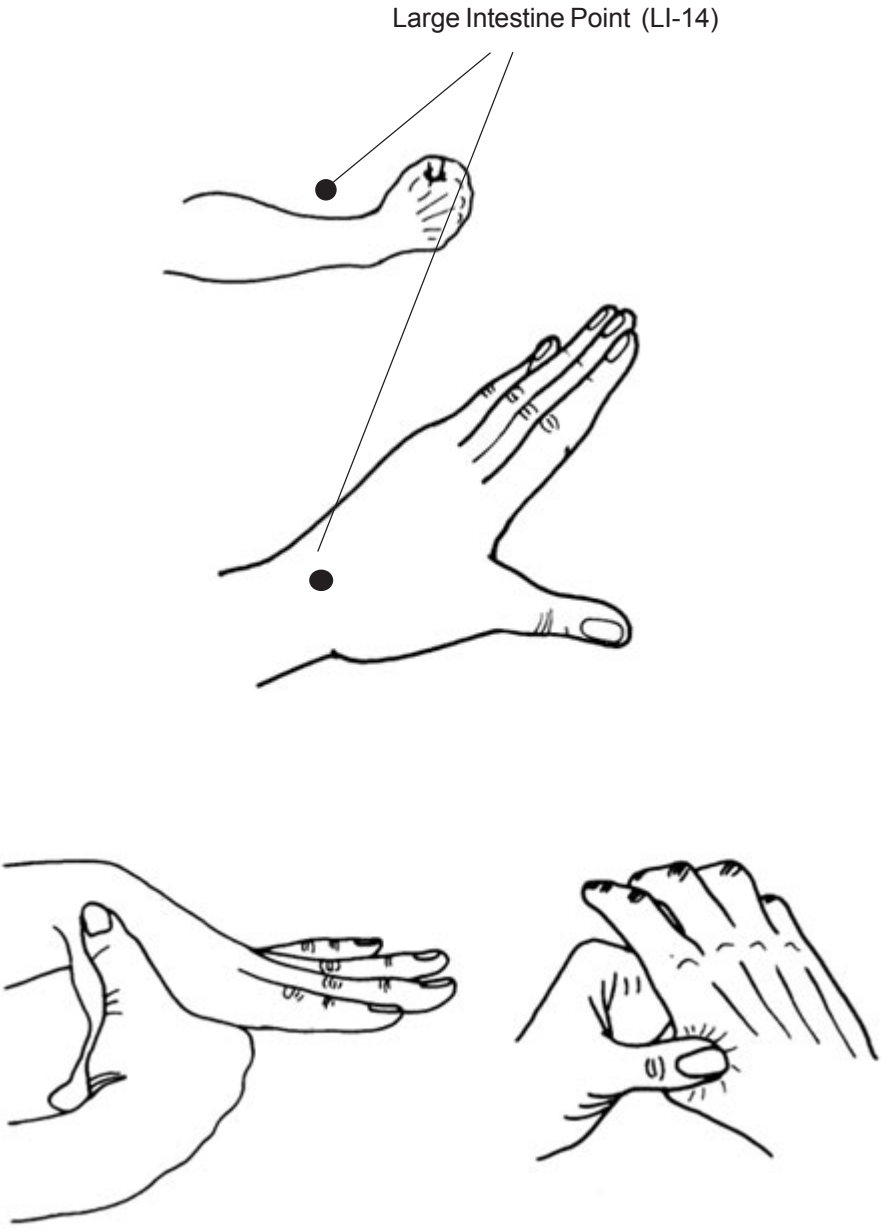

Fig.3.8 *Massaging LI-14.*

3. Massage the major palm lines. Use the thumb to massage along the palm lines. Massage more towards the thumb bone and along that bone. When a lot of emotion is held inside, find the sore point and massage it. (Fig. 3.9)

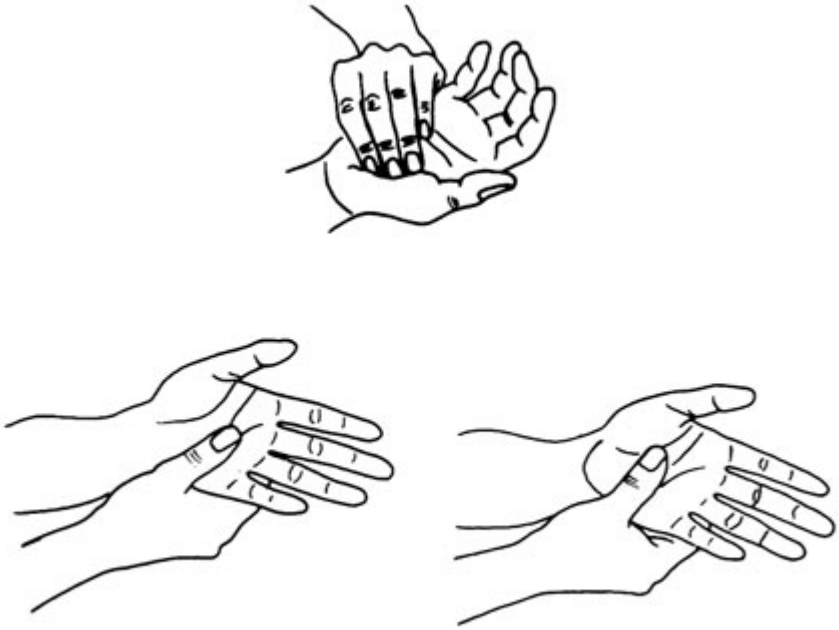

Fig. 3.9 *Massaging the Palm Lines.*

4. Massage the back of the hand. Use the thumb to press along the bones on the back of the hand. When you find a tender spot, take more time to work on it. (Figure 3-10)

5. Massage the fingers. Always rub your hands until warm. Use the right hand's fingers to wrap around the left thumb, and then, one by one, squeeze, hold and release each finger on the left hand three to six times. Start with the left hand and continue to the right hand's fingers, according to the elements of the finger. This will greatly help to control emotions. (Figure 3-11)

Fig. 3.10 *Massage the back of the hand.*

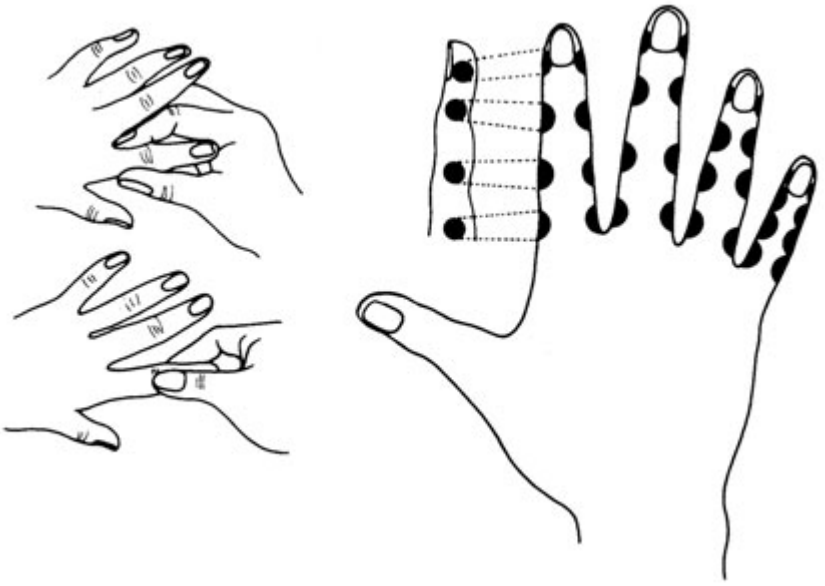

Fig. 3.11 *Massage the fingers.*

For example, if at any time you are frightened or fearful, you can wrap your fingers around the little finger, starting with the left side and moving to the right side. This can be a great help when you are in a difficult situation, such as talking before a group of people, going on an interview, or meeting important people. Practicing the Heart and Kidney Sounds in conjunction with the finger wrapping may also help. The ring finger controls anger; when you are going to get angry, try to wrap it a few times to see if you still get angry.

Daily practice of the Inner Smile and the Six Healing Sounds is the best way to gain control of negative emotions. Many students are addicted to smoking, drugs or alcohol. The toxic elements found in these substances settle in the organs and nervous system, stimulating them into over-activity, and in a short period of time make people high. When the effect is over, the users will start to feel low key energy, becoming emotional and nervous. In this situation, they can use the Inner Smile and Microcosmic Orbit circulation while holding the fingers, especially the ring finger. This will calm them down. Many people use this simple way to avoid the use of drugs, smoking and alcohol. The Tao practice will give to the disciple the strength and power to clean out accumulated toxins in the system, eliminating bad habits.

X. Fingers Correspond to Emotions, Elements and Organs.

A. Thumb corresponds to the element earth and is associated with the stomach. The corresponding emotion is worry.

B. Index finger corresponds to the element of metal and is associated with the lungs and large intestine. It links with the emotions of sadness, grief and depression.

C. Middle finger corresponds with the element of fire and is associated with the heart, small intestine, circulatory system and the respiratory system. It links with the emotions of impatience and hastiness.

D. Ring finger corresponds to the wood element and is associated with the liver, gall bladder and the nervous system; it corresponds to the anger emotion.

E. Pinky finger corresponds to the water element; it is associated with the kidneys, and corresponds with the emotion of fear.

Fig. 3.12 *Fingers' corresponding emotions, elements and organs.*

Chapter 4
Head Massage

The head massage is for headaches, nervousness, and an imbalance of Chi energy in the brain. The causes of headaches and nervousness are very complex. The head is the place in which all the nerves are seated and is the central control of the whole system. Nowadays you see a lot of young people who are very nervous. This nervousness causes insomnia, loss of appetite, faster heart beat, difficulty in breathing, tiredness, laziness, etc. It seems that all of this is not symptomatic, but it greatly affects the efficiency of work and gradually is considered mental disease.

The skull massage will strengthen the nervous system. With the tongue touching the roof of the mouth as it is during the massage, and the eyes moving up to the left and then across to the right, you can feel the stimulation of the Chi energy from left to right. This balances the left and right hemispheres of the brain and will result in strengthening the glands, senses and organs.

The head and skull massage will increase the blood circulation and will increase the nutrition of the skull and hair. We have students whose white hair grew black and students whose falling hair became denser as more hair grew back. The hair also grows softer. In the morning and at night before sleeping, you should brush your hair at least 25-50 times. Find a good brush, and be careful of the scalp. Do not scratch the skull, which might result in a headache or sense of pain.

I. Head

A. Crown Point *(Fig. 4.1)*

This is located in the center of the crown; in the fontanelle area of an infant's skull there may still be a slight depression. The crown point is the junction of one hundred channels through which the energy of the body passes. Massage this area with both your middle fingers. This will relieve dizziness and headaches, which result from too much energy in the head. It also relieves high blood pressure and stimulates the nervous system.

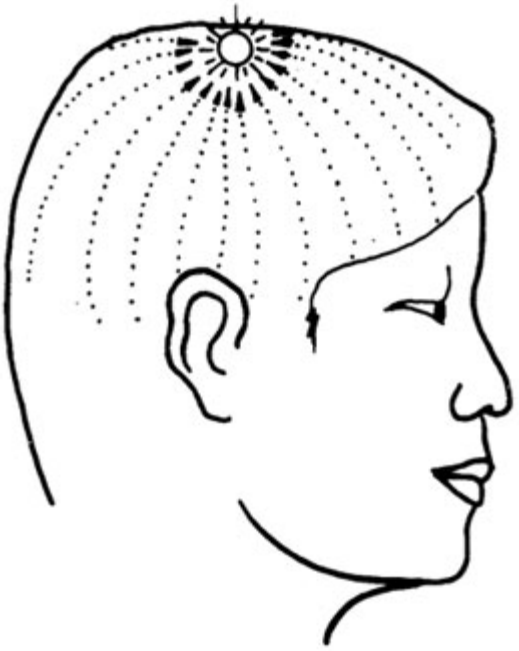

Fig. 4.1 *Crown Point is the junction point of one hundred energy channels.*

B. Bring Chi Energy to the Hands and Face.

Inhale, contract the sexual organ, buttocks. and middle of the anus. Rub the hands, clench the teeth, and put the tongue to the roof of the mouth. When the face, head, and hands are hot, breathe normally and begin to massage.

C. Knock the Head *(Fig. 4.2)*

Hit the head with the knuckles of the hand, knocking all around the head. Knocking the head lightly can help to clear your head, eliminate stubbornness and make your thinking sharper. Many of our students use this knocking of the head to release the pressures that they have from today's life of fast, advanced technology and the feeling of always having to keep up. This is especially true of those graduate students who feel a great deal of pressure and stress in keeping up with their studies. Each year students commit suicide because the pressures and stress accumulate too much in their heads, making them unable to think clearly: they start to feel everything in their society as too much pressure, which leads to worry, fear, sadness, and many, mixed emotions. The simple knocking of the head can release pressure and stress that accumulate there.

Fig.4.2 *Knocking the head.*

D. Hold your Breath to increase Chi flow.

Holding your breath will increase the Chi flow to the face. The head has many channels that join in the skull, especially in the crown point.

E. Scalp *(Fig. 4.3)*

Prepare your hands, head and scalp by warming up. Using both hands like a comb, press hard and move slowly, massage the scalp, going straight back from the hairline to the base of the skull. As you do this, mentally direct your energy from the back of the skull to your feet. Repeat 6-9 times. Massage more in any places in which you feel pain, until the pain goes away.

Fig.4.3 *Massaging the scalp.*

F. Crest *(Fig. 4.4)*

Using your thumbs, massage the crest (the edge) at the base of the skull until you feel no pain there. (Fig. 4.5) This will help you reduce headaches and eye aches and will increase vision. This place in Tao tradition is called the Pool of Wind which tends to collect the "evil wind", the major cause of all the pain in the senses.

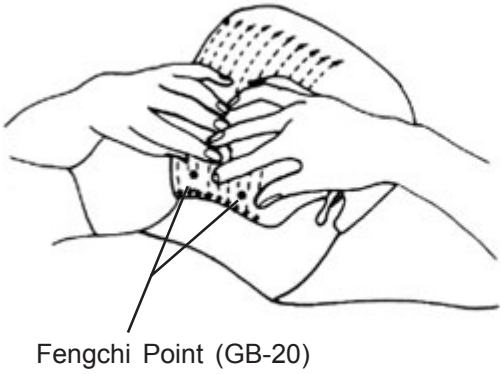

Fig. 4.4 Crest, the edge of the skull.

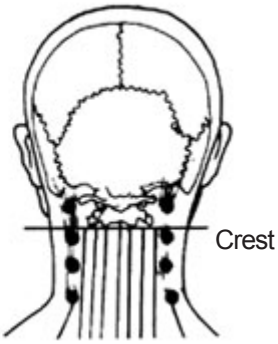

Fig. 4.5 *Go straight back from the hairline to the base of the skull.*

II. Face *(Figs. 4.6, 4.8 and 4.9)*

A. Natural Beauty

Massaging your face with Chi is a far more effective beauty treatment than the most expensive cream or cosmetic, (Fig. 4.10) Your skin will glow brightly and eventually become less wrinkled. There are many meridians passing through or ending at the face. When blocked, they result in reduced flow of Chi energy and circulation. The face is the first impression imprinted in other people's minds. Chi circulation provides it with attractive personal energy.

B. Bring Chi Energy to the Face.

Inhale, contract your sexual organ, buttocks, and middle and front of the anus. Hold your breath, rub your hands together, clench your teeth, and put your tongue to the roof of your mouth. When your face feels hot, picture energy flowing to your hands. When your hands are very warm, bring your attention to your face and hold your breath until your face gets hot.

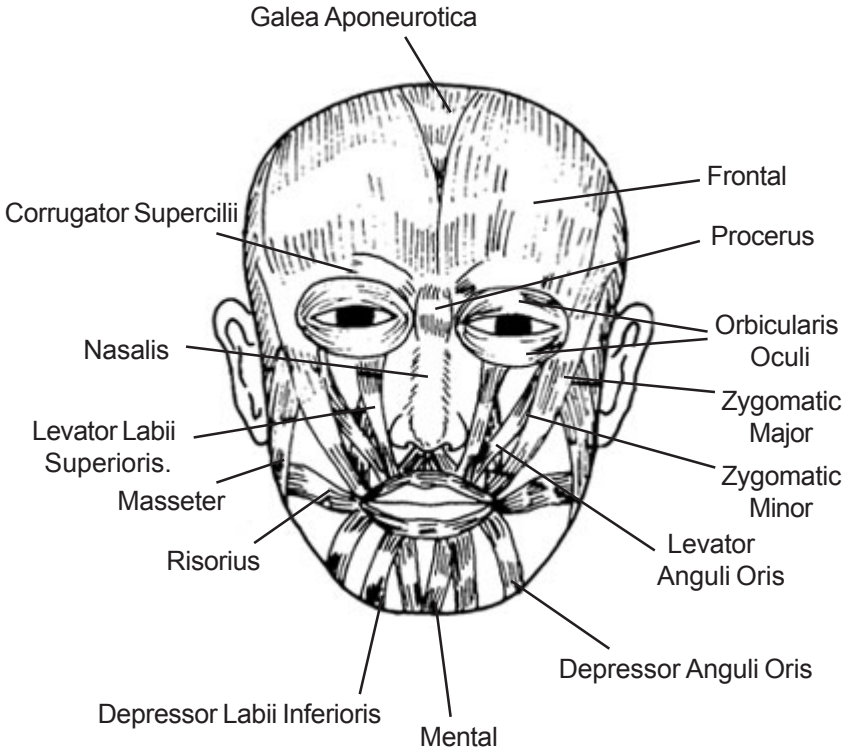

Fig. 4.6 *Facial Muscles*

C. Forehead *(Fig. 4.7)*

Using alternate hands, wipe your forehead from one side to the other six to nine times.

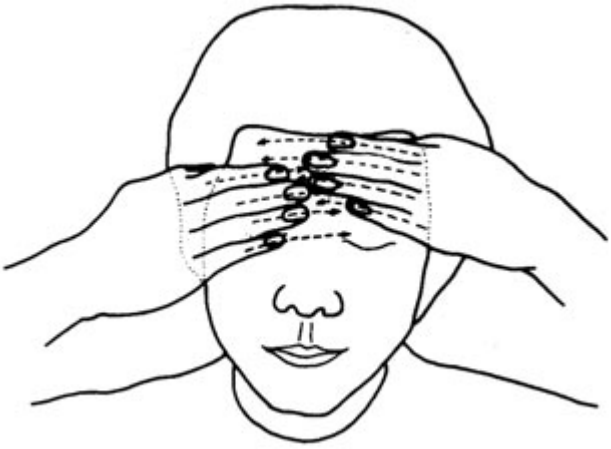

Fig. 4.7 *Wiping your forehead.*

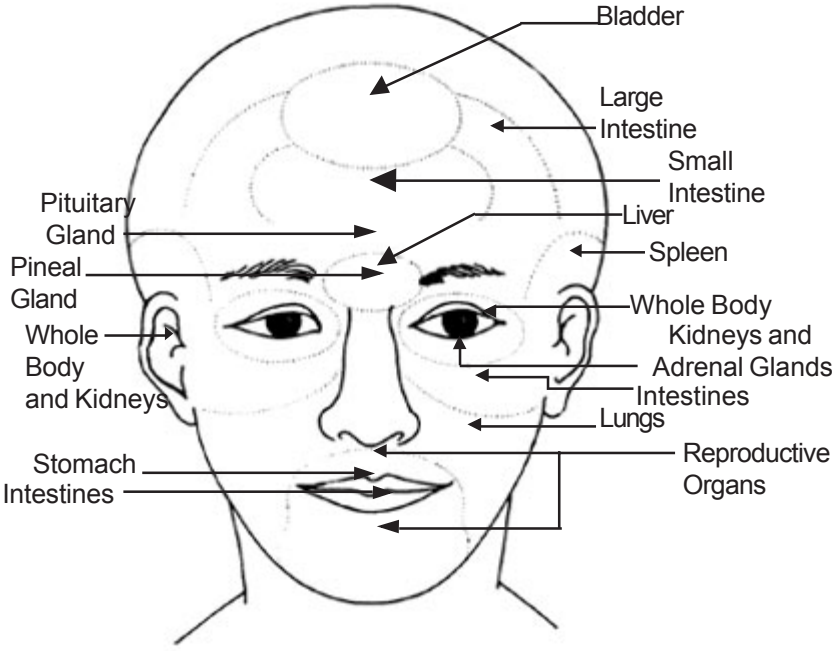

Fig.4.8 *Diagrams of the Face Corresponding to the Organs.*

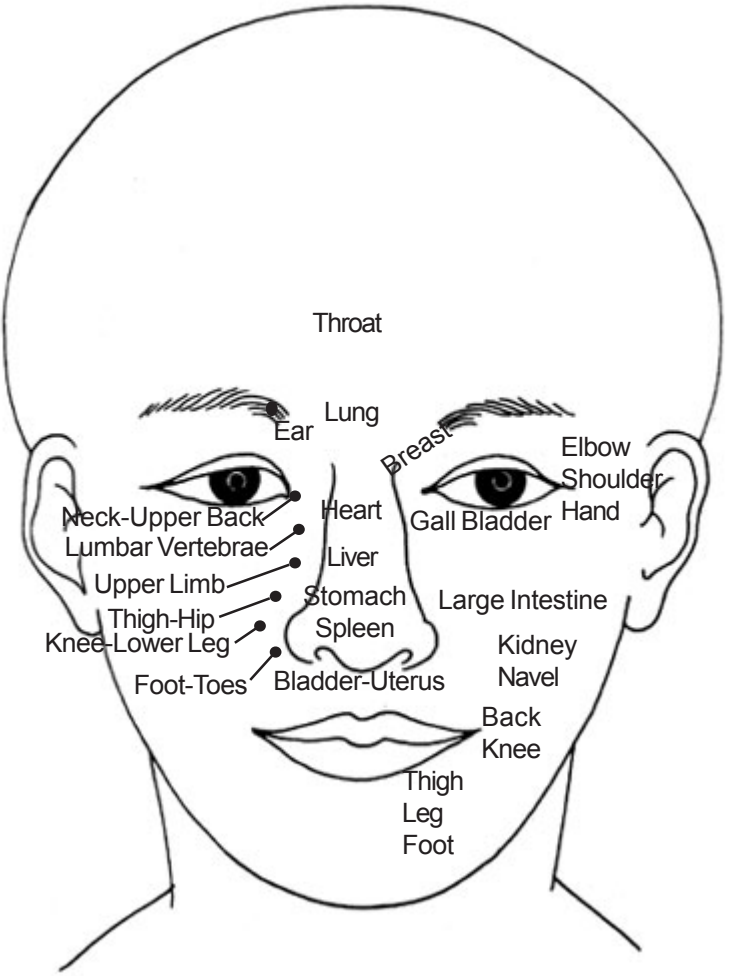

Fig. 4.9 *Head and Face.*

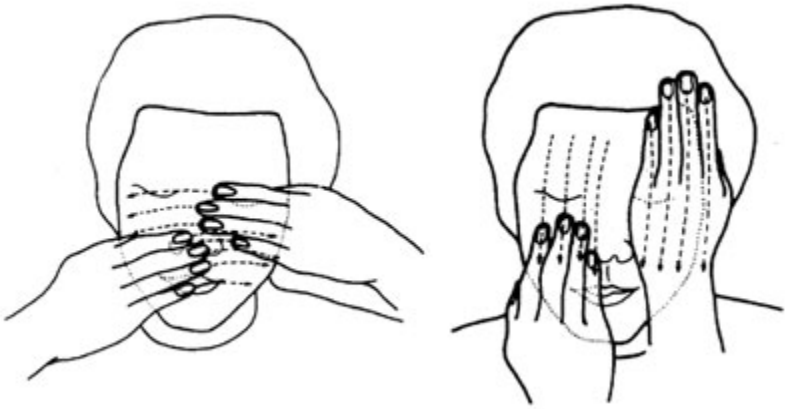

Fig. 4.10 *Your own Chi energy is the best cosmetic.*

D. Mid-Face

Wipe the middle section of the face, from the eyebrows to the tip of your nose.

E. Lower Face

Repeat for the lower section of the face, below the nose to your chin.

F. Whole Face

Repeat the procedure for bringing energy to your hands Inhale, cover your whole face with your palms and massage it. (Fig. 4.11) Use an upward motion to reduce wrinkles. Exhale and relax your face. Rest and smile to your face until you can feel it tingle with warmth.

G. Mid-Forehead

Use the second joint of alternate index fingers to massage the middle of the forehead, from the center to the temple. (Fig. 4.12)

Fig. 4.11 *Massage the whole face.*

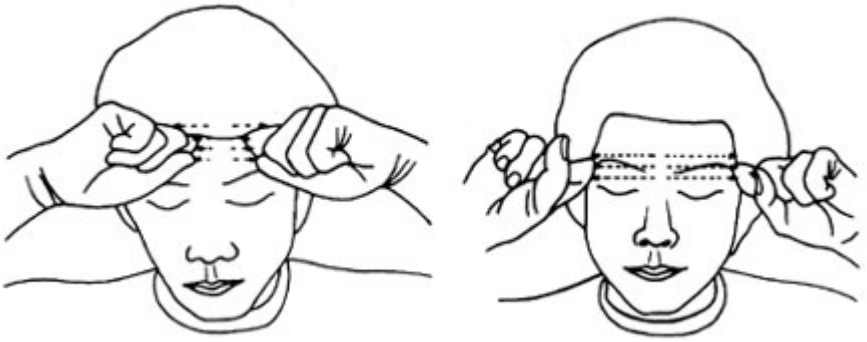

Fig. 4.12 *Massage the mid-forehead.*

III. Temples

Use your index fingers to massage the temples in a circular motion, first clockwise, then counterclockwise. Massage the forehead and the temples; use the knuckle rub from the middle of the forehead all the way to the temples ten to twenty times. (Fig. 4.13) These exercises will reduce headaches in the front and in the temples. Find the painful point and massage it until the pain is gone.

Fig. 4.13 *Massage the temples.*

IV. Mouth

Depression makes the corners of the mouth drop. Looking cheerful, delightful, more attractive and happy are dependent so much on the eyes and the corners of the mouth. When the muscles of the mouth are loose because of stress, depression, or sadness, the corners of the mouth drop and the energy system is depressed and in low key. No one likes to look at a sad face or a depressed face; it makes other people feel sad and depressed, too.

The flow of energy in the body and the expression of the face are the main attractive powers of a person. Massaging the mouth muscles up will help to lift the corners of the mouth. The Inner Smile and lifting up the corners of the mouth are very important to building up attractive energy.

A. Beautify the Mouth Massage

Using the thumb and the index finger of the right hand, touch both corners of the mouth and feel the Chi from the thumb and index finger pass to the corners of the mouth. Slowly press and push up about one inch, release and start again at the corners, pressing up ten to twenty times each day. (Fig. 4.14)

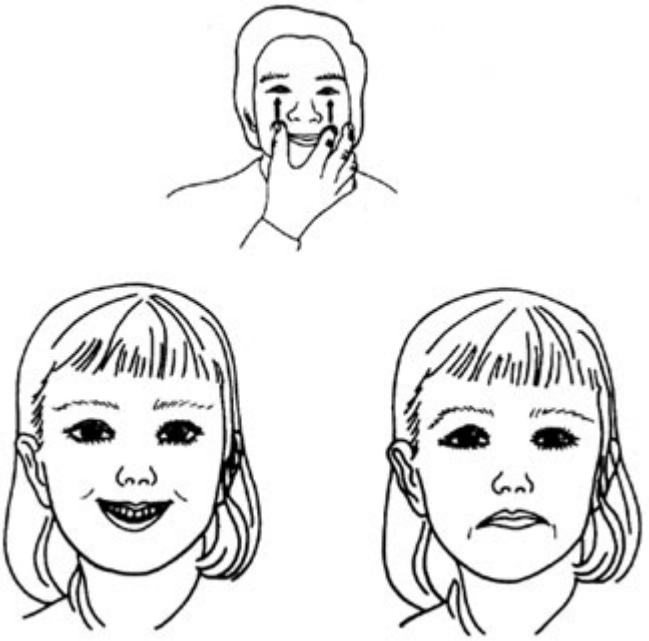

Cheeful delight.

Mouth corners drop.

Fig. 4.14 *Beautifying the mouth massage.*

V. Eyes

The eyes are the windows of the spirit. (Fig. 4.15) In Taoism we regard the eyes as Yang energy which will guide all Chi flow in the body. The eyes can greatly affect your personality Some people are born with a lot of white in their eyes--three portions of white to one portion of iris--sometimes called “thief eyes” or “danger attack eyes.” Such eyes can result in a suspicious look, portending unpleasant things. Through the exercises, you can gradually correct the white portion of the eyes.

Since the eyes are connected to the entire nervous system, they have a special importance. The eyes reveal the health of your entire body. Through the eyes we can tell which organs are weak and/or toxic. Massaging the eyes will remove stress from the vital organs. Nowadays people use their eyes much more than in the

past to read, watch television, and work with computers, electronics and microscopes. This strains them a great deal and makes the openings of the organs loose, so that much of the organ energy is drained out.

In Taoism, we regard the eyes as the doorways to the soul as well as the opening of the liver. (Fig. 4.16)

When rubbing near the corners of the eyes, do not rub too hard, because you can make the corners of the eyes drop down. Continue rubbing the corners of the eyes upward.

A. Bring Chi Energy to the Hands and Eyes.

Repeat the procedure for bringing energy to the hands by inhaling; holding the breath; and contracting the sexual organ, buttocks and middle of the anus and both the left and right sides of the anus. Direct the Chi to both eyes. Rub the hands, clench the teeth, place the tongue on the roof of your mouth. Direct the energy to the face and then the hands. When your hands are hot, focus on your eyes until you feel them filled with energy.

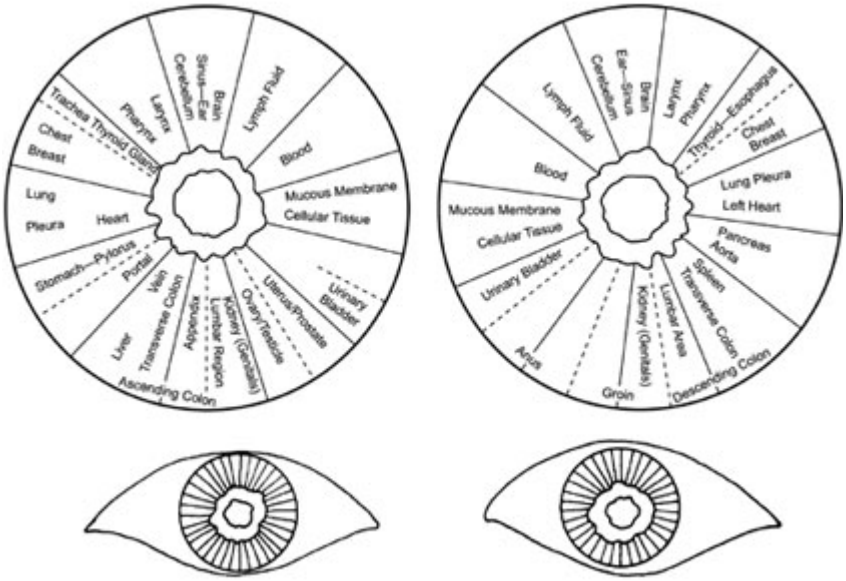

Fig.4.15 *Eyes are the windows of the spirit.*

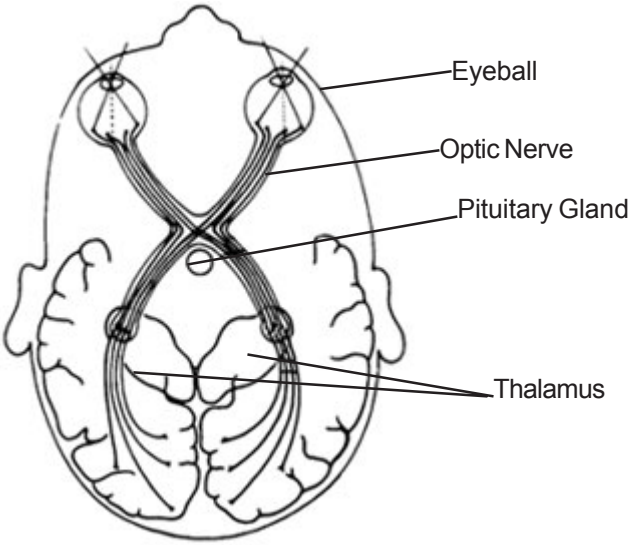

Fig. 4.16 *Eyes are the doorways to the soul.*

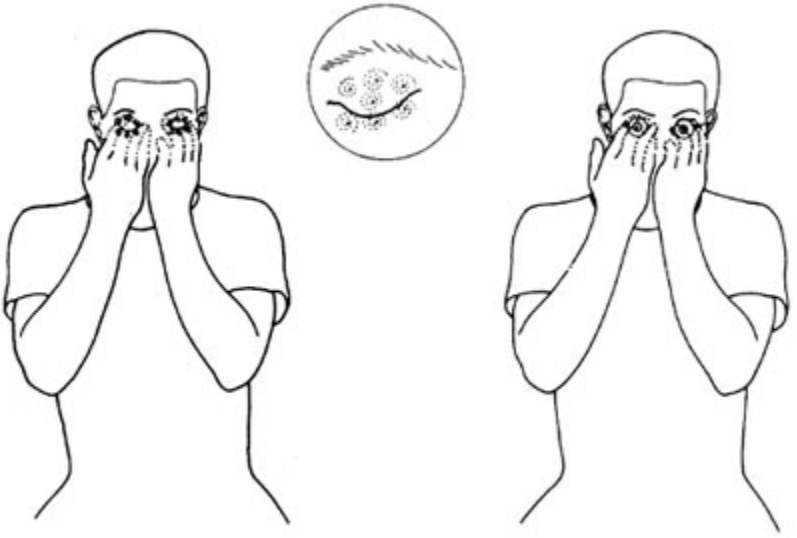

Fig.4.17 *Use the fingertips to gently massage the eyeballs.*

B. For the Eyeballs and Surrounding Area

Close your eyes. Use your fingertips to gently massage your eyeballs through your closed eyelids, six to nine times clockwise, then six to nine times counterclockwise. Then gently massage the area around the lids the same number of times. (Fig. 4.17) Be aware of painful spots and massage those places until the pain goes away. Pay special attention to the inner and outer corners of the eyes. These are points of the gall bladder meridian and will relieve eye ailments if massaged.

C. Pull up the Eyelids

Pulling up the eyelids will increase the fluid. Use the thumb and index finger to pinch, pull up and release the eyelids six to nine times. (Fig. 4.18)

Fig. 4-18 *Pull up the eyelids.*

D. For the Eye Sockets

Bend your index fingers and use the lower section (second phalanx) of each thumb to rub the upper and lower bones of the eye sockets six to nine times. (Fig. 4.19)

Fig.4.19 *Massage the eye sockets.*

E. For getting a Tear out

Hold an index finger up about eight inches from the eyes, or put a dot on the wall five or six feet away from you. Stare at it intently without blinking your eyes until you feel like a fire is burning in them. (Fig. 4.20) The Taoists believe that the toxins will burn out of the body through the eyes. They will begin to tear. Do this to strengthen your eyes. Then, rub your hands until warm; close your eyes and cover your eye sockets with your palms. Feel the Chi from the hands absorbed into the eyes. (Fig. 4.21) Rotate your eyes six to nine times, first in a clockwise direction, then counterclockwise.

Fig. 4.20 *Getting a tear out.* ***Fig. 4.21*** *Absorbing the Chi into the eyes.*

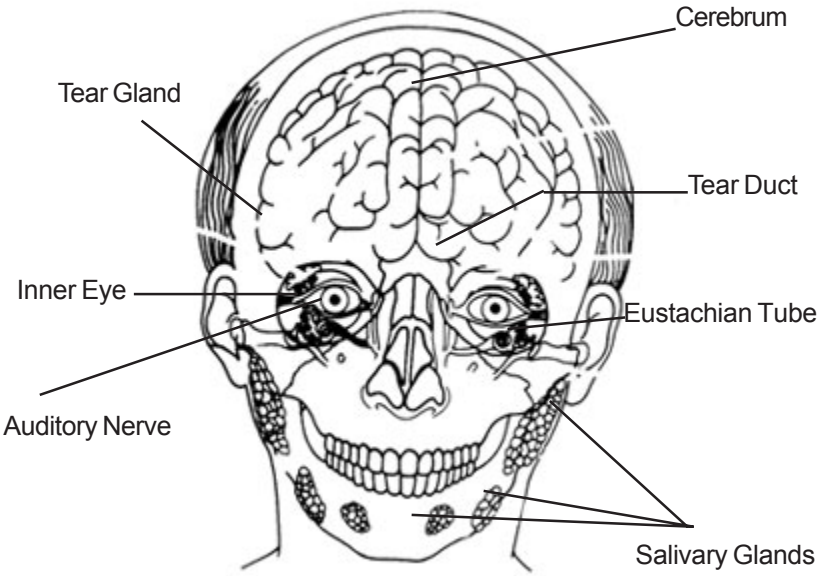

Fig. 4.22 *The parts of the eyes connect with senses and brain.*

F. Pull in the Eyeballs.

The eyes are divided into five parts. Each part is closely connected with the organs and nerves. (Fig. 4.22) Become aware of the eyes. (Fig. 4.23)

Pulling and pressing the eyeballs will exercise the organs, sense, glands and the brain. (Fig. 4.24) This is also the best exercise for the eye muscles. The eyes have many muscles which we do not exercise very much and, thus, they become weak, contributing to poor eyesight.

1. With the eyes still closed and cupped by the palms, inhale, contract the anus and sexual organ, and pull the eyeballs back into the sockets.
2. Contract the middle of the anus and the middles of the eyeballs.
3. Contract the front of the anus and the tops of the eyeballs.
4. Contract the back of the anus and the bottoms of the eyeballs.
5. Contract the right side of the anus and the right sides of the eyeballs.
6. Contract the left side of the anus and the left sides of the eyeballs. This exercise not only strengthens the eyes but also the pituitary and pineal glands and the inner ear including the ear drum and canals. When you pull the eyeballs in and upward and look toward the crown, you are exercising the upper muscles and stimulating the pituitary gland and pineal gland.

When you contract and pull in the middle of your eyeballs, you are exercising the back of the eye muscles and the inner ear.

When pulling in the outer corners of the eyes, you are strengthening the side eye muscles as well as the ear canals end the ear drums.

When pulling in the inner corners of the eyes, you are strengthening the inner side muscles, the tear ducts and the nose.

When pulling in the lower parts of the eyes, you are pressing the lower part of the ear canals and the nervous system.

Fig. 4.23 *Awareness of the eyes.*

(1) Pressing into the inner ear.

(2) Left eye pressing into the ear canal. Right eye pressing into the eustachian tube.

(3) Pressing into the pituitary gland.

(4) Right eye pressing into the ear canal. Left eye pressing into the eustachian tube.

(5) Pressing into the eustachian tube.

Fig. 4.24 *Moving the Eyes.*

A. Bring Chi energy to the hands

Repeat the procedure for bringing energy to your hands, contracting the front part of the anus.

B. Nostrils

Widen the nostrils. (Fig. 4.25) Using the thumb and index finger stick them into the nostrils and move them to the left and the right and up and down for ten to twenty times. This will widen the passage of air into the lungs. This can help your sinus problems and correct the smelling sense.

C. Bridge

For the bridge, use your thumb and index finger and massage the bridge of your nose by repeatedly pinching it. As you do this, inhale slowly and imagine you are breathing in clean air; exhale slowly and imagine you are exhaling dirty air. Do this nine to thirty-six times. (Fig. 4.26) This is effective for blocked sinuses.

Fig. 4.25 *Widen the noistrils.*

Fig. 4.26 *Massge the bridge.*

Fig. 4.27 *Massage the mid-nose.*

D. Mid-Nose

For the mid-nose, place your thumb and third finger or either side of your nose, right on the bone which runs perpendicular to the nose. Place your index finger on the bridge. Inhale and press in gently. Exhale and relax. (Fig. 4.27) Feel and absorb the heat from your fingers into the nose. This can increase your concentration and calm your mind.

E. Sides of the Nose

On the sides of the nose, use your index fingers, massage slowly and gradually· increase up and down the sides of your nose nine to thirty-six times. (Fig. 4.28) This also helps blocked sinuses and stuffy noses. Do not do it too hard in the beginning because the sensitive tissues there are very tender and easily infected. Rub the sides of your nose up and down until you feel warm; this will help you in the cold winter and every morning when you get up.

F. Lower Nose

On the lower nose, massage slowly and gradually increase the pressure when you are sure you will not hurt yourself. Massage vigorously back and forth, using an index finger at a right angle to the nose immediately under it. (Fig. 4-29) This helps blocked sinuses and stuffy, runny noses.

Fig.4.28 *Massage the sides of the nose.*

Fig.4.29 *Massage the lower nose.*

VII. Ears

In China we believe that a person with thick, long ears will have a long, healthy life and that the personality will be more attractive. The following exercises can prevent hearing loss whic occurs gradually as we age. The ears are acupuncture maps of the whole body, containing 120 points. Many acupuncturists now use only the ear points to cure many ailments as well as for weight control.

A. Outer Ear

Repeat the method for bringing energy to the hands, contracting the left and right sides of the anus.

1. Front and back: Make a space between your index and ring fingers and simultaneously rub in front and in back of the ears. (Fig. 4.30(1))
2. Ear shells: Rub the ear shells with all your fingers. This will stimulate the autonomic nervous system and warm up your whole body, especially in the cold weather. (Fig. 4.30(2))
3. Ear lobes: Using your thumb and index finger, pull down on the ear lobes. (Fig. 4.30(3))

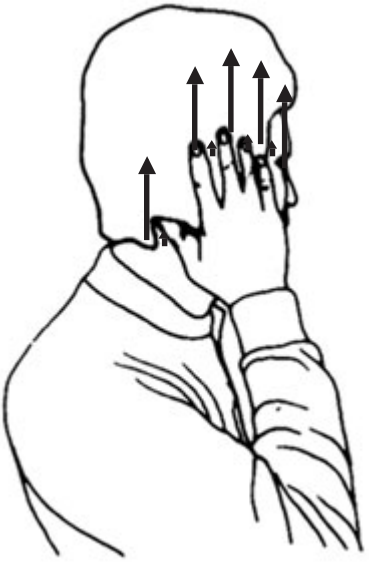

(1) Rub in front and back of ears.

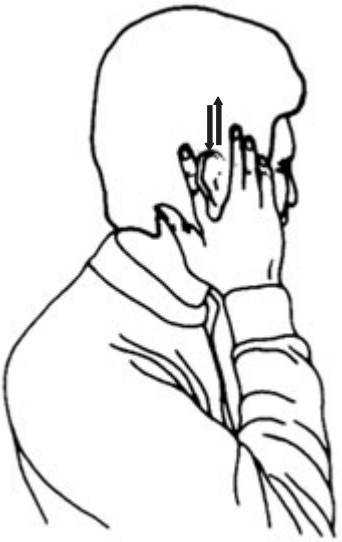

(2) Rub the ear shells.

(3) Pull down on the ear lobes.

Fig. 4.30 *Rubbing the Ear.*

4. Ear drum exercises: For the outer ear drum, repeat the method for bringing energy to the hands, contracting the left and right sides of the anus. Inhale and then exhale completely. Put your index fingers in your ears; it should feel as if there is a vacuum in the ears. If it does not, then exhale more. Move your index fingers back and forth six to nine times at your own pace until you can feel that the insides of the ears are moving, and pull out the fingers with a quick movement. (Fig. 4.31) You should hear a “pop” sound, and you will feel that you can hear better and that your mind is clearer.

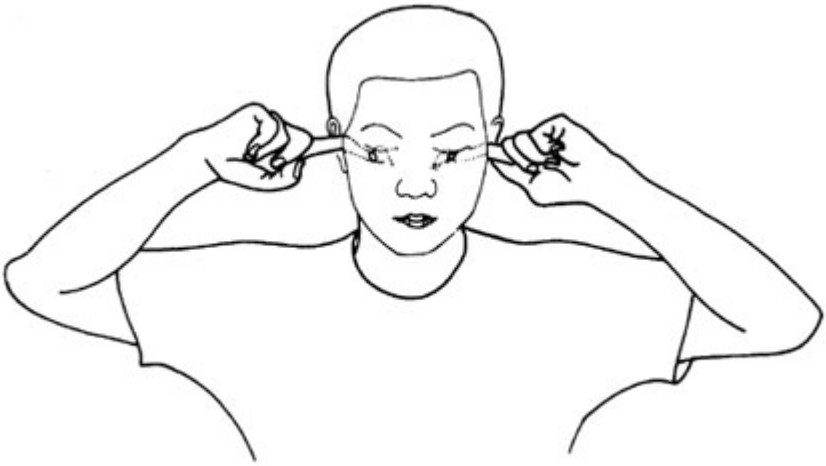

Fig. 4.31 *Outer ear drum exercise.*

B. Inner Ear *(Fig. 4.32)*

Repeat the method for bringing energy to the hands, contracting the left and right sides of the anus.

The inside of the inner ear, being inaccessible, is usually not exercised and grows weaker with age. These two exercises use air pressure and vibrations to strengthen the inner ear. The ear canals, the nose canal, and the mouth are connected together, so in this exercise we are using the pressure that builds in the lungs and bringing it back up to the mouth, thus adding pressure to the inner ear drums. This is how to exercise the inner ear drums.

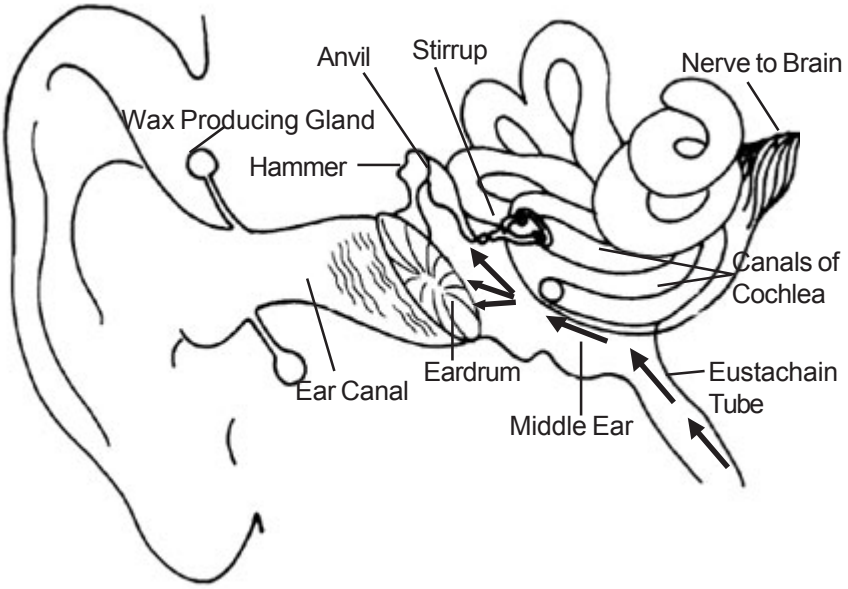

Fig. 4.32 *Diagram of Inner Ear Drum.*

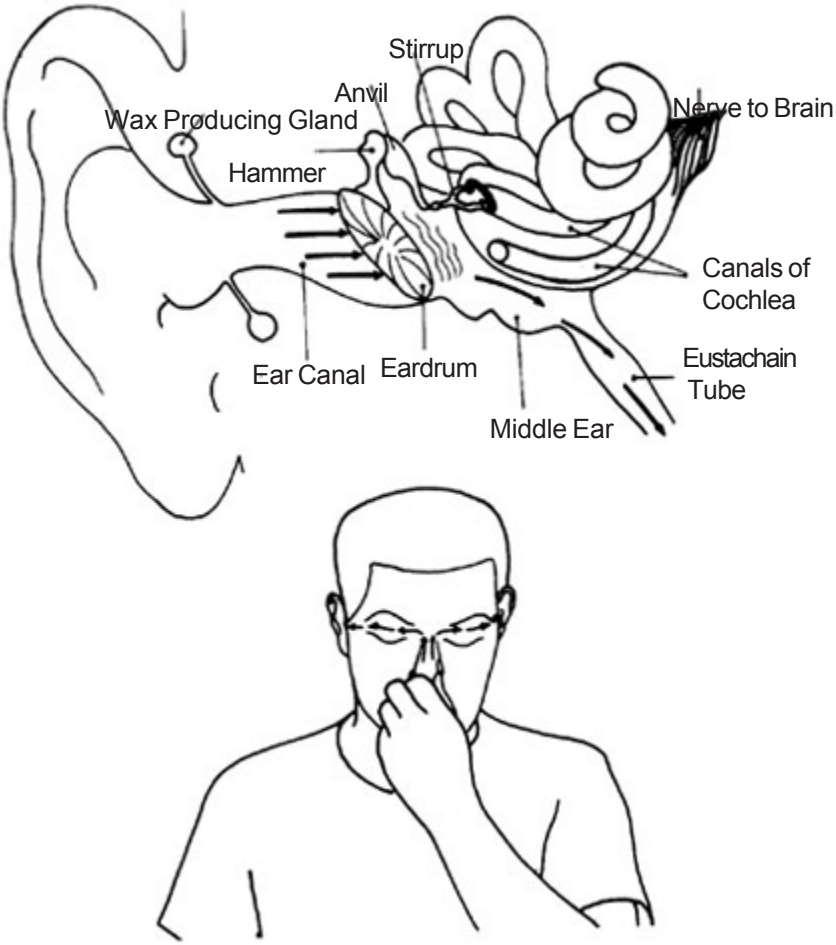

Fig. 4.33 *Inner ear drum exercise.*

1. Blowing exercise: Inhale, fill your lungs and nasal cavity with air; close your mouth and pinch your nostrils shut with your index finger and thumb. Blow slowly out through your closed nostrils and then swallow air. You should feel your ear drums popping. Repeat two to three times. (Fig. 4.33) Do not blow too hard; they can get hurt. You must do every exercise gently for the most benefit.

2. Ear nervous system exercise: hitting the ear drum. Cover your ears with your palms, fingers pointing toward the back of your head. In this position, flick your index fingers against your third fingers so that the index fingers drum on the lower edge, or occipital bone of the skull. This will sound quite loud. The flicking of the finger that hits the bones will vibrate and stimulate the nervous system, the ears and the inner ears' mechanism. Repeat nine or more times. (Fig. 4.34) The activity of the ear will be balanced and the mastoid sinus improved by this exercise.

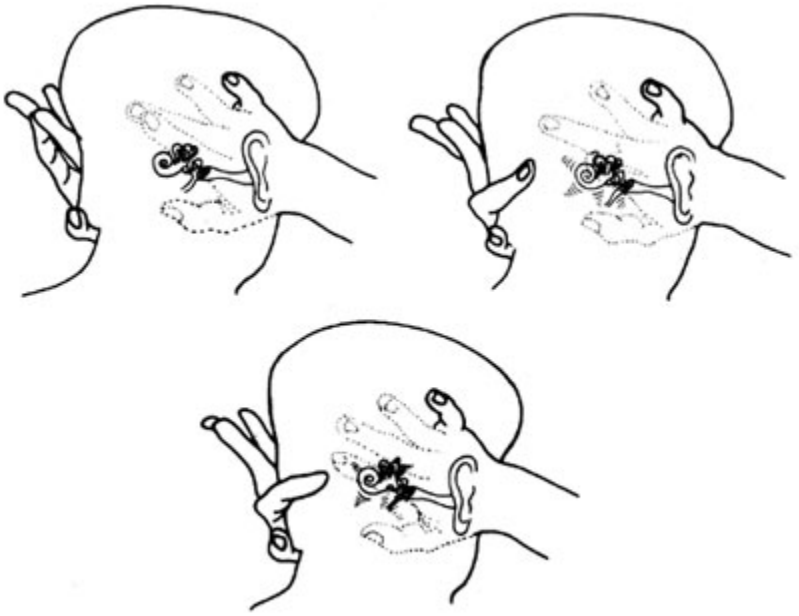

Fig. 4.34 *Hitting the ear drum.*

VIII. Gums, Tongue, Teeth

Healthy teeth require healthy gums as their foundation. These exercises will strengthen both the gums and teeth. Teeth are the excess energy of the bones, and when the teeth get stronger, so do the bones. When the teeth and tongue are strong, your breath improves as well, eliminating bad breath.

We regard saliva as an essential form of energy which can lubricate the organs and digestive system. The tongue is the opening of the heart, and both are made of similar tissue. A healthy and clean tongue will strengthen the organs, especially the heart. You should clean your tongue twice a day with a brush or scrape it with a tongue scraper, and massage your tongue with a tongue depressor or a clean finger. Find the painful spots and massage there until the pain goes away.

A. Bring Chi Energy to the Hands.

Repeat the procedure for bringing energy to the hands, contracting the middle of the anus.

B. Gums

Open your mouth and stretch your lips tautly over your teeth. Use three fingertips (index, middle, and ring fingers) to tap the skin around the upper and lower gums. Hit around until you feel warmth in the area. (Fig. 4.35)

C. Gums and Tongue

Massage your upper and lower gums with your tongue. Then suck in some saliva, press your tongue tightly against the roof of your mouth, and try to exercise the tongue. When you strengthen your tongue, you are strengthening your heart. Press around. Press the tongue to the roof of your mouth, tighten your neck muscles and swallow the saliva. This lubricates the digestive glands and organs.

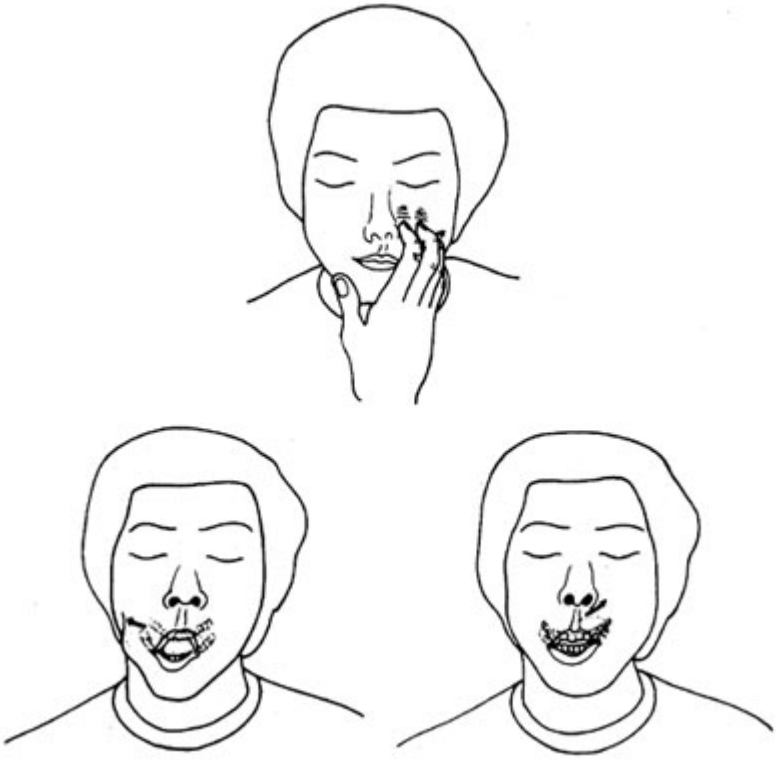

Fig. 4.35 *Hitting the gums exercise.Using the tongue, massage the upper and lower gums.*

D. Tongue *(Fig. 4.36 and 4.37)*

In a sitting position place the hands on the knees, palms down. Exhale and straighten the arms, spreading the fingers apart and keeping the hands on the knees. Open the mouth as wide as possible and thrust the tongue out and down, focused on the throat. With the tongue out as far possible, gaze at the tip of the nose. The whole body should be tense. Hold the breath for as long as you feel comfortable. Relax with inhalation and regulate the breath. This will help to strengthen the throat, the tongue and the power of speech. These exercises will help to improve foul breath and to clarify speech.

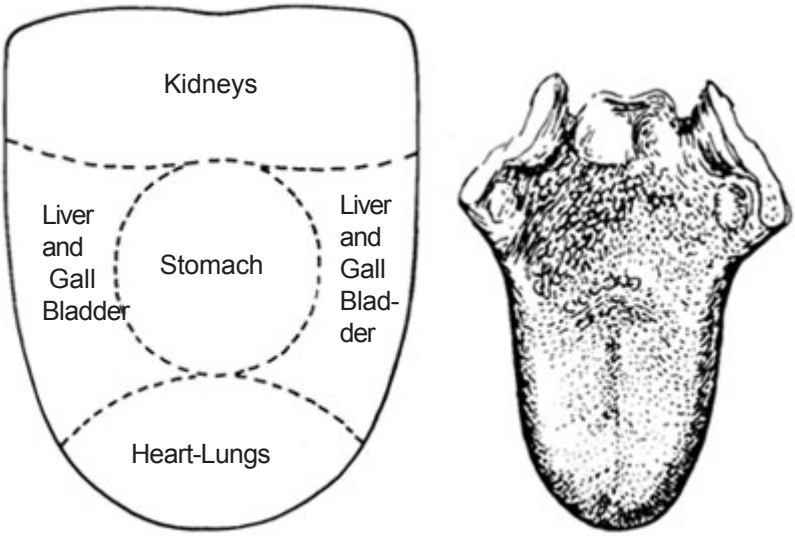

Fig. 4.37 *Tongue*

Fig. 4.38 *Press tongue to the roof of the mouth.*

Inhale, then exhale as you press your tongue out and down as far as you can. Follow by pulling the tongue in and curling it. Press your tongue to the roof of your mouth as hard as you can, contracting the middle of the anus and the esophagus to help the tongue. (Fig. 4.38) With more practice you will know how to use the inside force, the force from the organs, to press your tongue up. Even though the tongue has no bones to exert force, you will still be able to exercise the tongue well.

E. Teeth Clenching

Relax your lips. Click the teeth together lightly (Fig. 4.39) and then clench them hard (Fig. 4.40), as you inhale and pull up the middle of the anus. Do this six to nine times. Move your tongue and mouth to create a lot of saliva. The technique of swallowing the saliva is to put the tongue up to the palate and swallow quickly with a hard gulp, sending the saliva down the esophagus to your stomach.

F. Energy to Teeth

Close your mouth and let your teeth touch lightly. Direct the energy to your teeth. Gradually feel the electrical flow of energy there.

Fig. 4.39 *Click the teeth together lightly.*

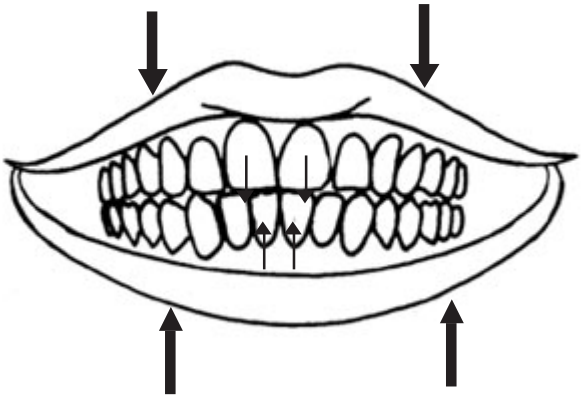

Fig. 4.40 *Clench the teeth together hard.*

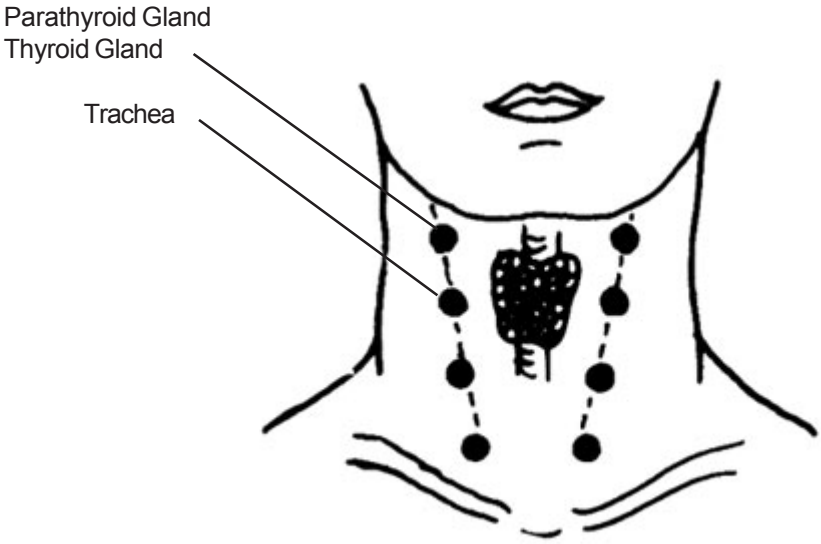

Fig. 4.41 *Throat Glands*

IX. Neck

A.Thyroid and Parathyroid: Site of Courage, the Power of Speech *(Fig. 4.41)*

The neck carries the busiest traffic in the body and is the seat of the thyroid and parathyroid glands. (Fig. 4.42) When you massage here, you increase the body's metabolism. Neck tension can also be caused by emotional imbalance. When we are tense and nervous, we are responding to negative emotions, such as anger, fear and sadness. The neck is similar to a traffic bottleneck. All of the signals, as well as the emotions, have to pass through it. When under stress and under emotional strain, the neck starts to accumulate and jam the tension. Unconsciously, the neck muscles tighten, attempting to block out pain. Keeping the neck soft will help Chi flow to the higher center that is located in the brain, keeping the mind and body in harmony together.

Tension in the neck can make you less courageous. When the neck is tense, it will block self expression in the throat. With proper flow of Chi energy, we can express ourselves appropriately at the proper time, place, and in a proper way.

The neck is the passageway of many meridians and is the channel of the Chi energy of the organs. In the middle is the Governor meridian. On the sides are the bladder meridian, the triple warmer meridian and the large intestine meridian. The emotions passing through the meridians of the neck may tense and jam up there.

Emotion:	Organ/Associate Organ:
Anger	Liver/Gall Bladder
Fear	Bladder/Kidneys
Grief	Large Intestine/Lungs
Hastiness	Heart/Small Intestine/Triple Warmer
Worry	Spleen/Stomach/Pancreas

B. Bring Chi Energy to the Hands.

Do the procedure for bringing energy to the hands and contract the front of the anus.

C. Whole Neck

Spread your thumbs apart from your other fingers. Alternating hands, rapidly wipe the neck from the chin to the base nine to thirty-six times. (Fig. 4.42)

D. Middle Neck

Alternating hands, use the middle three fingers to rapidly wipe down the middle of the neck from the chin to the base nine to thirty-six times. The thyroid and parathyroid glands are in the front section of the neck. Use your thumb and the three other fingers to massage these glands. Find the painful points and massage them until you feel them open. Massaging this area will help to increase metabolism and the power of speaking.

Fig. 4.42 *Wipe the neck from the chin to the base.*

E. Turtle Neck

Sink your chin down, then out and up. (Fig. 4.43) Feel your spine press down and then expand. This will help loosen the vertebrae and discs of your neck.

F. Crane Neck

Move your chin forward, circling out, then down, then up, and out again. (Fig. 4.44) Feel your spine expand and then contract.

G. Massage the Neck.

Massage the points along the back of the neck and on the back along the cervical vertebrae. Start from the shoulders and go up to the base of the skull. (Fig. 4.45) Use your fist to hit along the neck. (Fig. 4.46) Find any painful spots and any tense spots and massage until they are released. This will greatly help to release the tension of the neck and help to detoxify the toxic accumulations in the neck area, the causes of many headaches.

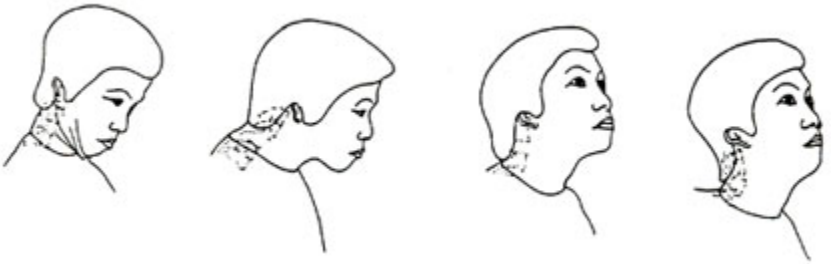

Fig. 4.43 *Turtle Neck*

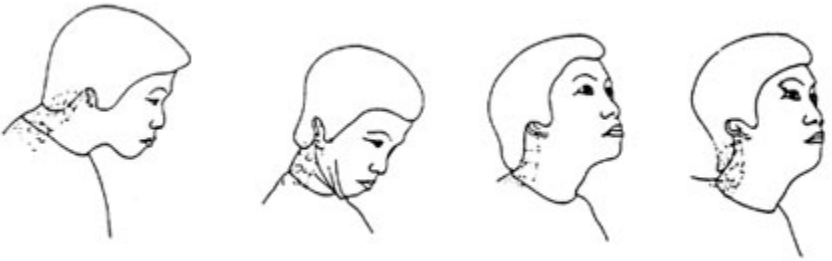

Fig. 4.44 *Crane Neck*

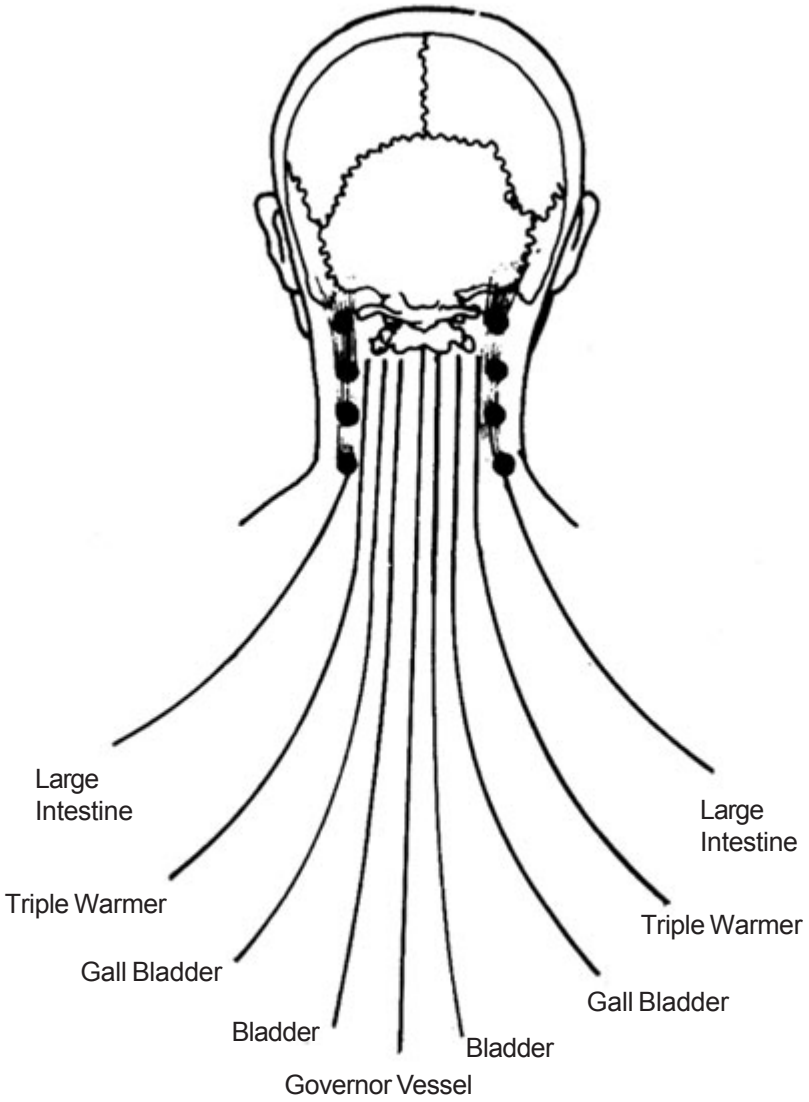

Fig. 4.45 *Massage the points along the neck.*

Fig. 4.46 *Use the fist to hit along the neck.*

X. Shoulders

Many people feel tense and worried, and their shoulders are tight and held up. The way to release the tension is by pulling up your shoulders to press against the neck, tightening the muscles of the neck and shoulders. Hold for a while, exhale deeply, and let them drop down, pulled by gravity like a sack of potatoes. (Fig. 4-47) Feel the burden, worry, and stress drop down to the feet and out to the ground. Feel yourself grounded. Do this three to nine times, and the tension and worry will go away.

Relax your shoulders and chest, exhale and release more, until you feel the tenseness gone.

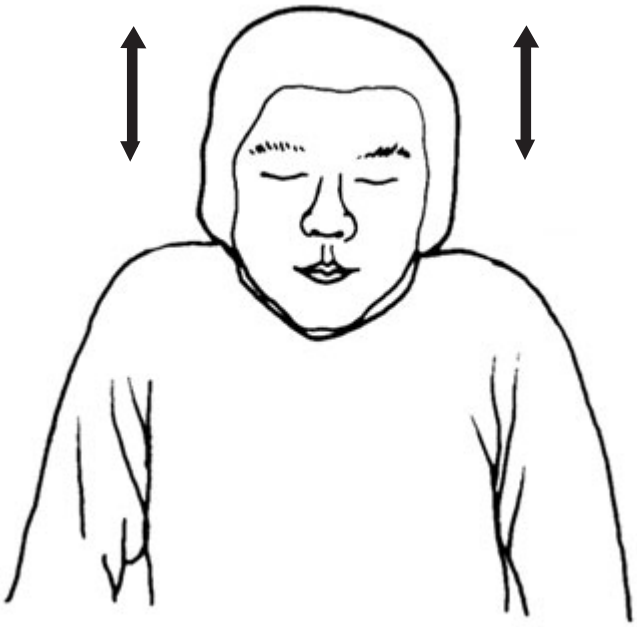

Fig. 4-47 *Dropping the shoulders will help to release tension and worry.*

Chapter 5
Detoxifying Organs and Glands

Lightly slapping and tapping over the organs and glands help to shock the toxic sediment and increase the circulation and Chi flow to these areas. Our practitioners claim they are able to heal themselves from many chronic illnesses which are very hard to heal by conventional medicine.

I. Thymus Gland

The thymus gland controls the immune system and is related to longevity. (Fig. 5.1) Normally the thymus gland atrophies after childhood. In the higher levels of Taoist practice, the thymus gland can be regrown. This helps maintain health and vitality and supports greater spirituality. Thumbing the thymus gland can help increase the activity and release more hormones.

A. Bring energy to your hands by the usual procedure, contracting the front of the anus and bring the Chi toward the thymus.

B. Make a fist, inhale and thump down the middle of the upper chest from the collar bone to the nipples six to nine times. Do not talk while you are doing this or you might harm yourself.

Fig. 5.1 *Hitting the Thymus Gland.*

II. Heart

Lightly slapping an organ stimulates the release of toxins, which allows the organ to rebuild and repair itself. In doing these exercises, be aware that the slapping or tapping should be adjusted by you so as not to use excessive force which may be harmful.

A. Do the energy to hands procedure, contracting the left side of the anus and bringing Chi toward the heart.

B. Slap your heart lightly with your palm six to nine times. (Fig. 5.2) Don't speak.

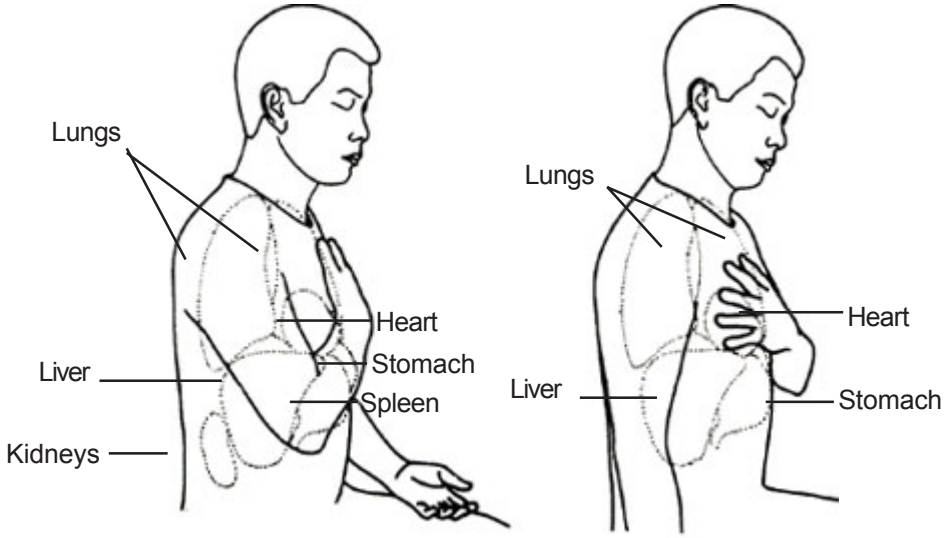

Fig. 5.2 *Slap at heart, lungs and liver areas.*

III. Lungs

A. Bring energy to your hands, contracting the right side of the anus and bringing Chi to the lungs.

B. Using your palm, slap up and down your right lung, hitting only as hard as is comfortable. (Fig. 5.2) Do not talk. Contract the left side of your anus and slap your left lung. This can help to clean out the mucous and to clean out the lungs.

IV. Liver

A. Bring energy to the hands, contracting the right side of the anus and bringing Chi to the liver.

B. Using your palm, slap below the rib cage on the right side. (Fig. 5.2) Don't speak. This can help to detoxify the liver.

V. Stomach, Spleen, Pancreas

A. Bring energy to your hands, contracting the middle of the anus.

B. Contract the anus at the left side, and slap at the spleen, pancreas and stomach. Place one palm on top of the other and rub below the rib cage, from center to left, then left to center.(Fig. 5.3 and 5.4)

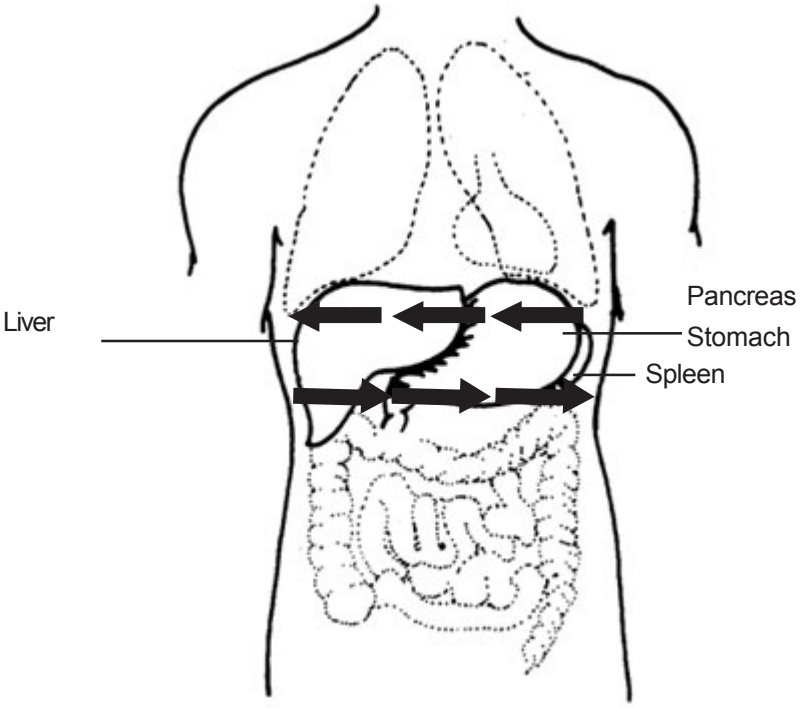

Fig. 5.3 *Rub the stomach, spleen and pancreas.*

Fig. 5.4 *Rub back and forth over the liver, stomach and spleen.*

Fig. 5.5 *Massage the abdomen.*

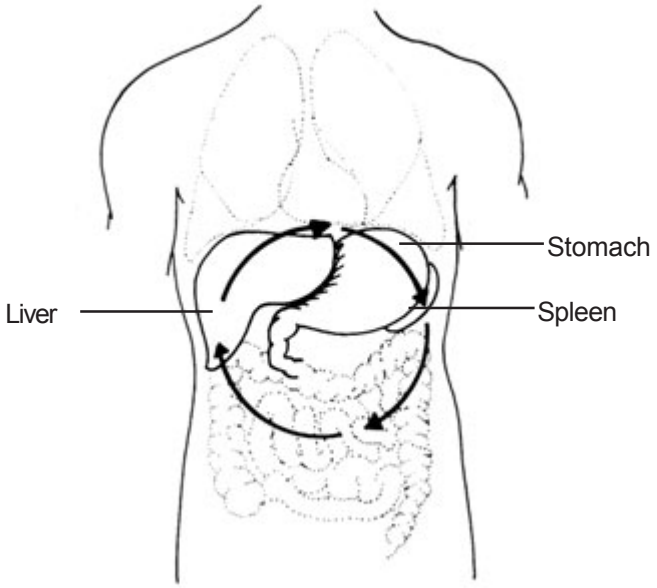

Fig. 5.6 *Circling the Energy.*

VI. Large and Small Intestines

A.Bring energy to the hands, contracting the entire anus.

B. Small intestine: With palms together, rub a small circle around your navel, first clockwise, then counterclockwise.

The small intestine is one of the longest tubes in the digestive system. A careless diet, too much hot food or dairy products, or too little fibrous food will create mucous that will stick to the walls of the intestine, block the absorption of nutrients and slow down digestion. Once mucous accumulates, it is like a snow ball that will get bigger and bigger, eventually becoming a lump which slows down the traffic of the digestive system.

C. Large intestine: Place one palm on top of the other and rub your abdomen in a large circle. Start on the lower right side and rub up and around in a clockwise direction. (Fig. 5.5 and 5.6) This will move the energy in the intestine and relieve constipation. For diarrhea, rub counterclockwise. If you have normal elimination, rub in both directions. These exercises increase the absorption and dissolve the accumulations that stick to the large intestine's wall.

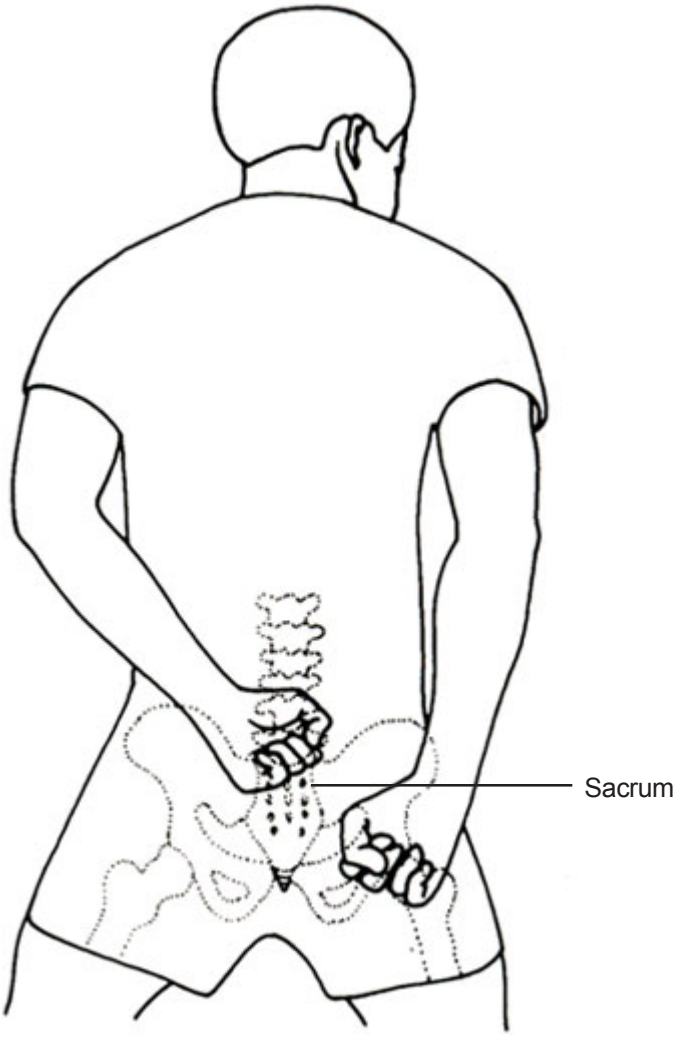

Fig. 5.7 *Hitting the sacrum can help in strengthening the sciatic nerves.*

VII. Kidneys

The kidneys act as helping to filter out waste material from the blood. If there is too much waste in the system, the kidneys cannot filter it all. The waste will tend to collect in the ducts and tubules of the kidneys, impairing their health. By hitting the kidneys' area, we shake out the harmful sediment and help prevent kidney malfunction.

A. Bring energy to the hands, contracting the left and right sides of the anus.

B. Locate the kidneys just above the lowest, or floating, rib in the back on either side of the spine. Make a fist and hit the kidneys with the back of the fist between the wrist and knuckles. (Fig. 5.7) Alternate hands and hit only as hard as is comfortable. This will help to shake loose the sediment, crystals, and uric acid that get caught in the kidneys. This will also strengthen the kidneys and relieve back pain.

C. Rub your hands together to warm them. Then rub your palms up and down over the kidneys until they feel warm.

VIII. Sacrum

In the Taoist system the sacrum is regarded as extremely important. It is a pump which helps to bring spinal fluid and energy (Chi) to the brain. It is also the junction where the sexual organs, rectum, and legs meet. Sciatic pain, which shoots down the legs, originates in the sacrum; therefore, strengthening it will release this intense pain.

A. Bring energy to the hands, contracting the back of the anus to the sacrum.

B. Make a fist and use your knuckles alternately to hit both sides of the sacrum. First hit in the area of the eight sacral holes, and then the hiatus, the depression at the bottom of the sacrum. (Fig. 5.8)

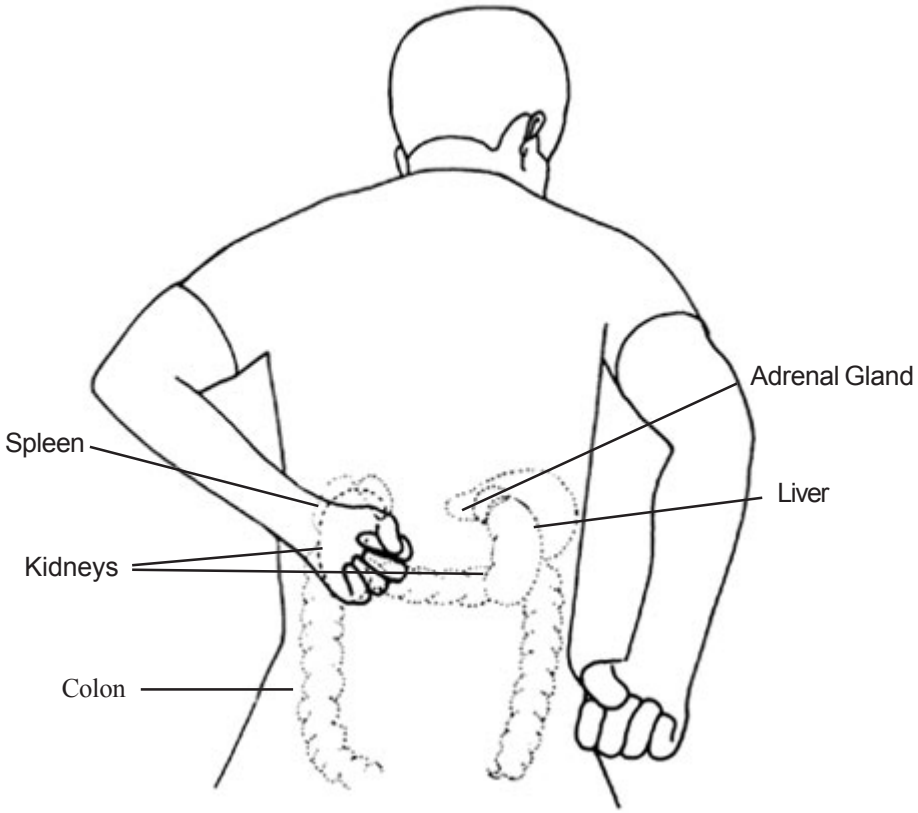

Fig. 5.8 *Hitting the kidneys will help to shake out sediment.*

Chapter 6
Knees and Feet

I. Knees are Toxin Collectors.

Toxins tend to collect in the lower limbs because of the slowdown of the circulation due to gravity. The most common places are the back parts of the knees. Slapping at these places will break down the toxins. The body will then eliminate the toxins out of the body by urine, bowel movements and sweat.

A. Bring Chi Energy to the Hands.

Bring energy to the hands; do no contractions.

B. Behind the Knees

Prop your leg up on a chair or low table so the knee is straight. Then slap smartly behind the knee nine to eighteen times. (Fig. 6.1) Although it hurts, it is extremely beneficial in releasing toxins which accumulate there. This release may be indicated by the appearance of a purple dot. Use discretion as to how hard you slap, since it can be overdone. Repeat this exercise on the other knee.

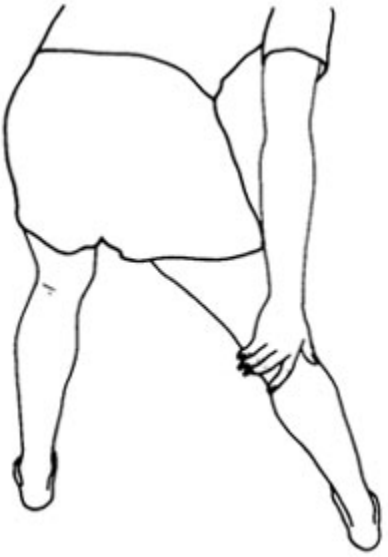

Fig. 6.1 *Slapping smartly behind the knee helps to release toxins.*

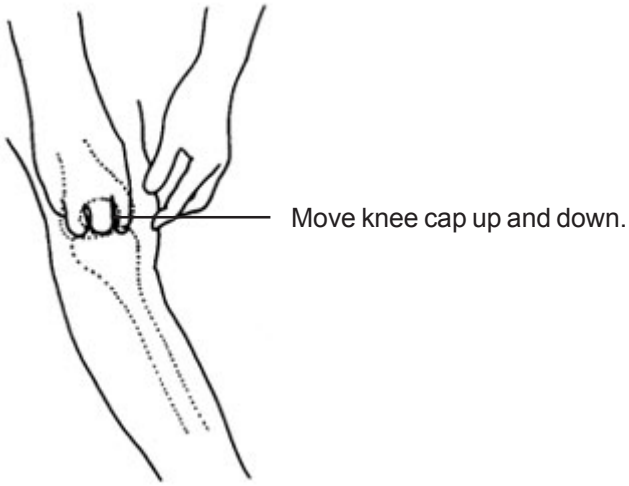

Fig. 6.2 *Massaging the Knee Cap.*

C. Knee Cap Massage

Massage the knee cap until it is warm, There is very little blood flowing to it and it tends to be quite vulnerable. This practice strengthens it. Massage the other knee cap.

D. Move the Knee Caps.

Relax the knee caps, then move them up and down to the left and right and around both clockwise and counterclockwise. (Fig. 6.2)

E. Massage the Knees.

Falling down is often caused by weak knees. Massaging the knees will improve your stability and flexibility.

II. Feet: Roots of the Body

Strong feet and tendons increase your stability by connecting you to the healing energy of the earth. Feet are the reflexes of the whole body's organs, glands and limbs. (Fig. 6.3) They are like remote controls. Massaging will help to stimulate the organs and glands and increase the circulation.

A. Bring Chi Energy to the Hands.

Bring energy to the hands; do no contractions.

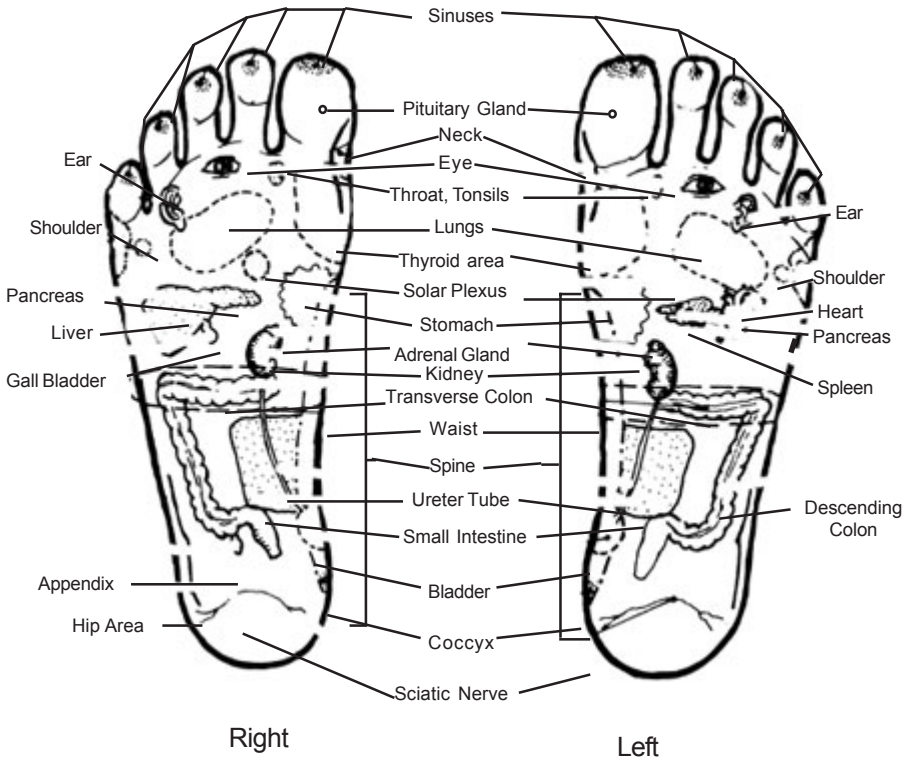

Fig. 6.3 *Feet are the reflexes of the whole body's organs, glands and limbs.*

B. Massage the Feet.

Take off your shoes and stockings and massage the tops and bottoms of each foot with your thumbs and fingers. Be sure to massage the kidney point, the sore spot in the center between the ball of each foot and the adjoining pad. (Fig. 6.4) If you are in a hurry, massage the whole of each foot once by rubbing the sole of the foot vigorously and carefully across the top of the other foot, going from the heel to the arch to the toes. The soles of the feet have energy meridians to the entire body. Massage the feet, and when you find painful points massage them until the pain goes away. This will help to clear any blockage of Chi channel flow.

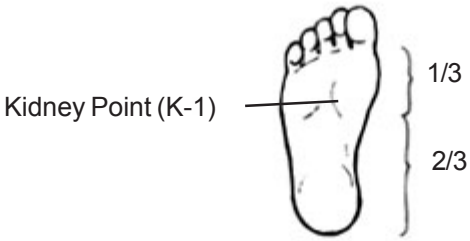

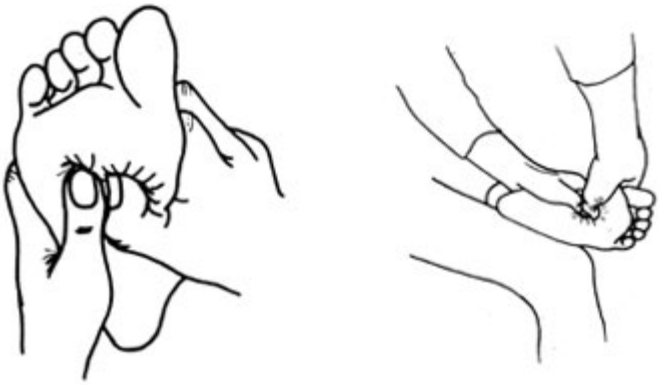

Fig. 6.4 *Massage the Kidney Point. (K-1)*

C. Spread out the Toes.

Spread out and separate all the toes, especially the little toes, and then release. Repeat six to nine times. This is especially good for the tendons of the feet. (Fig. 6.5)

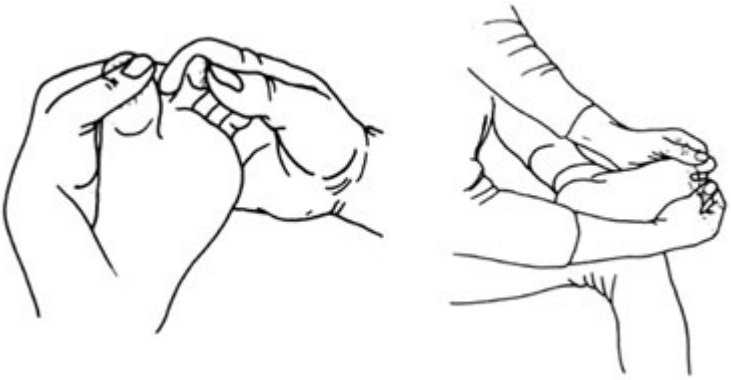

Fig. 6.5 *Separate all the toes by spreading them out.*

D. Big and Second Toes

Rub the big toes and second toes together rapidly. This a good exercise to do at odd moments during the day.

E. Rub Feet together.

Keep the feet warm by rubbing them together. This will help to stimulate all the body's organs.

Chapter 7
Constipation

I. Major Cause of Stress

Constipation is a major cause of stress. The key to good health is a clean colon. Much of the health field believes that as much as ninety percent of diseases are due to constipation and unhealthy colons.

The modern life that we live in--the concrete jungle, in which we eat refined foods, less fiber, more meat, less greens less fresh fruit and fresh vegetables--causes us to have less Chi. The Chi pressure that moves the fluids and all systems in the body is lessened. Therefore, the stomach does not have enough Chi to digest food; and the small intestine will be slow in absorbing the nutrients; and the large intestine and rectum will not have enough pressure to push the waste material out. When this material stays in the colon, the body reabsorbs toxins from the waste. These reabsorbed toxins first affect the liver which, as it becomes filled with the toxins, produces negative emotions, such as anger, bad moods, and anxiety. The next to be affected is the blood which, as it becomes filled with waste material and toxins, disturbs the other organs' functions, lessening their ability to do their work, and causing stress and nervousness.

II. Constipation causes holding back and lack of Openness.

People who hold back, are stingy and cannot let go always retain all kinds of unnecessary garbage. This type of person keeps problems inside and becomes emotional easily. This can be caused by long term constipation.

The way to overcome this kind of constipation is to try to solve problems every day and speak out in a nice way, so that the Chi that is stuck in the organs can flow. Many people today learn how to speak out but do so in a way that is not nice. This causes more problems and more constipation. Having peace of mind will permit you to solve problems in peace, letting you speak out in a nice way.

III. Constipation makes you age faster.

All toxins that are retained will collect in your body: in your skin, making it coarse, not smooth; in the neck and shoulders area, resulting in headaches and shoulder pain; and in other places. They will cause a hardening of the whole system.

The nice feeling of a clean colon will make Chi flow and will help your whole day to be pleasant, open and happy.

IV. Abdominal Massage—Wonder of Healing

Abdominal massage is one of the best ways to solve constipation. In the beginning you might see black and cloudy colored bowel movements during elimination. This means that long term matter stuck to the walls of the intestines has finally loosened.

When you feel the need to go to the toilet, just go. Many people like to hold back until, after a while, the feeling of the bowel is gone. As a result, they have to hold it for the next time or the next day. It should become a habit to have a bowel movement every day; the morning is the best time.

You can do the abdominal massage right before you go to sleep and right after you get up. Usually shortly after you massage in the morning you will go to the toilet to move out the bowels.

A. Sleep face up.

Sleep face up, pull up your feet and place them your shoulders' width apart.

B. Rub your hands until warm.

Rub your hands until warm, then rub the large intestine and the rectum, starting from the lower end of the left side up and across to the right side and down to the lower right side. (Fig. 7.1) Massage in a clockwise direction for nine to eighteen times. If you feel a painful part or a knot, spend some more time massaging until it softens. Use your mind to help guide the Chi flow according to the movement of the large intestine flow.

Fig.7.1 *Massage from the lower end of the left side, up and across to the right side and down to the lower right side.*

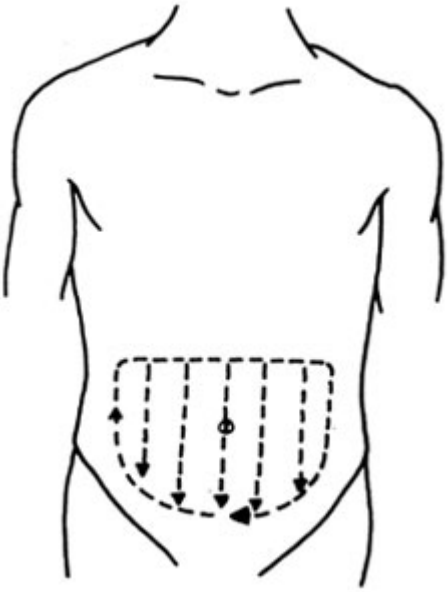

Fig. 7.2 *Divide the abdomen into three parts.*

C. Massage the Small Intestine.

To massage the small intestine, divide the abdomen into three parts. (Fig. 7.2) Massage from the left line to the right line. Use the middle and index fingers and massage in a circular movement, up, down, and up, and go to the next line. Repeat three to nine times. If you find a painful point or knots, massage clockwise and counterclockwise until the pain or knots are gone. Be cautious if you have had an abdominal operation; do only what you can withstand.

If you find a big lump, put your palm over it and sleep with it there; this will soften the knot and release the pain and will help you to move your bowels more easily the next day.

V. Massage during Bowel Movements.

After you first move the bowels and stop and are waiting for the next movement, you can massage the abdomen to help clean out any “stew” that still is in the ascending colon, by rubbing clockwise at the ileocecal valve at the right side near the hip bone. Massage from the lower end of the right corner up to the rib cage. (Fig. 7.3)

Fig. 7.3 *Massage the abdomen during bowel movements.*

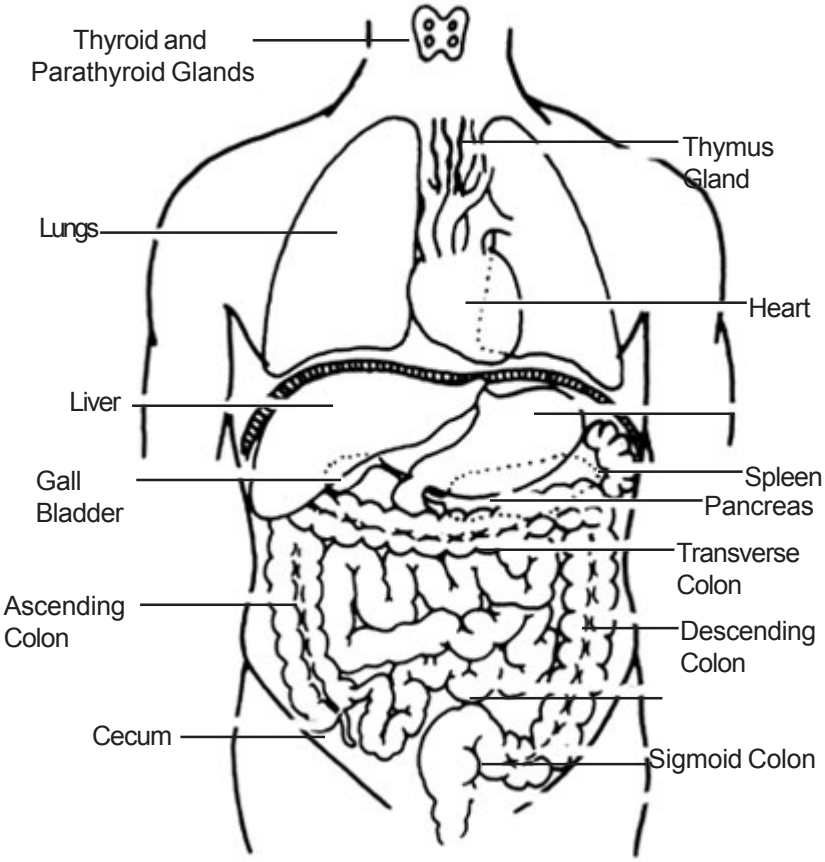

Fig. 7.4 *Massage the sigmoid colon.*

Massage the sigmoid colon at the left side of the pelvis. Massaging this part can help you clear out more of the remaining "stew". (Fig. 7.4)

In Tao we say that when you move the bowels, in order to be clean you must first urinate and then have the bowel movement. Finally, clean out with more urination and you will feel clean.

Chapter 8
Daily Practice

First line prevention is best. The goal of the Tao principle is to walk through to the end of life without sickness. We see that going to hospitals, entering mental hospitals, and visiting doctors and psychologists are common things. The largest part of our budgets today is for health care. The unusual thing, which can become big news, is when you see a healthy, strong old man or old woman who can walk and do things as he or she wishes, with no need to take pills and no use for Medicare. These healthy old men and women can be every one of us, if we know how to take care of ourselves.

The results of the Tao practice have been proven for many thousands of years. Tao Masters used this practice to maintain a high level of energy. When you transform the negative emotions to positive emotions, you have the power to heal yourself. If you want to get through negative states, you need to make up your own mind to set aside time and make this practice a part of your life. Invest in your own health. Make it a routine to do this every day just like brushing your teeth and eating are necessities in your life. Don't worry about the results, simply keep practicing what you think is right for you. One day you will see the miracle happen. You will seldom catch a cold and you will hardly remember your doctor's name. Your medicine box will be empty. You will be healthier than ever before. You will accomplish more work while becoming less emotional.

I. Warm Up in the Morning

The Taoist tradition says to open your heart first before you open your eyes. (Fig. 8.1) When you wake up, do not jump out of bed and do not open your eyes. In the Taoist system we believe that all organs have souls and spirits. When we are asleep, the souls and spirits are at rest, too. They take a while to be awakened, and if you are too hasty, you can hurt them. As we say, when you are too hasty, you are hurting the energy of the organs. If you have a good morning warm up, the whole day will run smoothly.

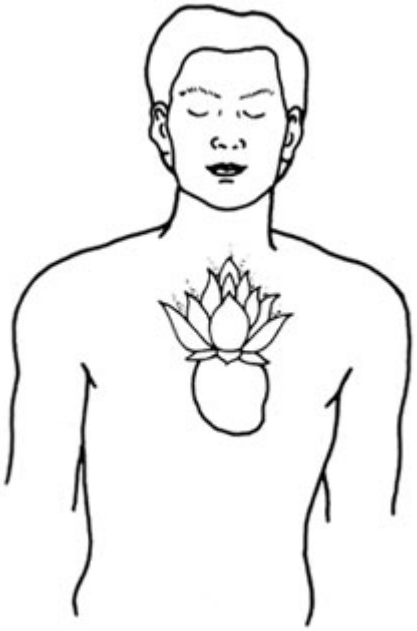

Fig. 8.1 *Before you open your eyes, open your heart.*

Fig. 8.2 *Put your palm on the navel area.*

II. Check your Energy Level each Day.

Do not open your eyes. Put your palm on the navel area. (Fig. 8.2) Men, put the right palm on the navel with the left palm over it. Women, put the left palm over the navel and the right palm on top. Concentrate on your navel until you feel it become warm.

III. Start with the Inner Smile *(Fig. 8.3)*

If you can, get in touch with the Inner Smile; feel the flow of it; and guide the smile all the way down from the face to the neck and through the heart, lungs, liver, kidneys, pancreas, spleen and sex organs.

Smile into the Second Line, the digestive system, and the Third Line, the nervous system and spinal cord. Smile to them and sense when the smile can get through. Keep on smiling until the pain and tension go away.If one day it is hard to get the smile energy flowing, that means your energy levels--physical, emotional, and intellectual--are in a low cycle. Be very careful on that day, because you are in the low cycle of your biorhythm and astrologic charts. When you are too low with energy, you are likely to get yourself into trouble and have accidents. By practicing the Inner Smile and Microcosmic Orbit well, you can eventually overcome the biorhythm and astrologic charts. Spend a little bit more time in practice until you feel your smiling energy increase and flow through the organs faster. That indicates you are raising up your energy level, and the emotions can thus be controlled. Misfortune and accidents can be overcome or avoided.

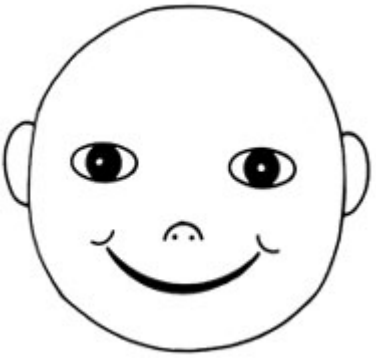

Fig. 8.3 *Start your day with the inner smile.*

IV. Clean Out the Blocked Energy every Day.

If you smile through the organs and you feel obstructions and blockages in particular organs, take a little more time. Concentrate your awareness by smiling to that place where there is a blockage, until it starts to cleanup. Disease always begins with the blockage of energy flow to an organ or gland major pathway. When the energy has to flow through a major organ or gland but there is blockage, the organ starts to get less energy, less blood flow and less nutrition. Over a long period of time the organ and gland will work less effectively or not at all. No equipment can check you out as accurately as your own flow of Chi energy. When doctors find an illness, at that time an organ may be functioning at only ten percent efficiency. With a daily check-up using the Microcosmic Orbit, you can correct, maintain and strengthen yourself each day without spending, much lime.

V. Clean Out Yesterday's Toxins.

The most important key to keeping healthy is to eliminate tension, worry and toxins every day so that they do not accumulate in the body. (Fig. 8.4) Many people experience getting up in the morning as the hardest thing to do. They feel down, sluggish and in a bad mood with pain and aches all over.

This is the result of the accumulation of too many toxins in the body. Abdominal massage is the best way to clear the toxins out. The abdominal massage can help to release the blockages and break out the sediment every day. In the beginning some people might feel like vomiting when they hit a painful spot. This is because the toxins are starting to clear out and the organ is moving back to the proper place.

People who have had operations on the stomach or intestines have to be very careful in doing the abdominal massage. If you feel pain in the area of the operation, you might have to rub with your palm.

When you massage around the navel area and feel knots or lumps move around (Fig. 8.5), that can be a bowel movement that has hardened and remained in the colon wall. If you massage and move the toxins, they will move out of their position to the rectum. People with weak energy who do not exercise the abdomen do not have enough energy to push the bowel movement up the ascending colon or push down to the rectum.

Constipation is the first thing to block energy flow, leading to back pain, headache, stomach ache and colon cancer.

Some people might not find enough time to do this in the morning, but do as much as you can manage and then massage the rest when you are at the toilet. Also, do some abdominal massage before you go to sleep.

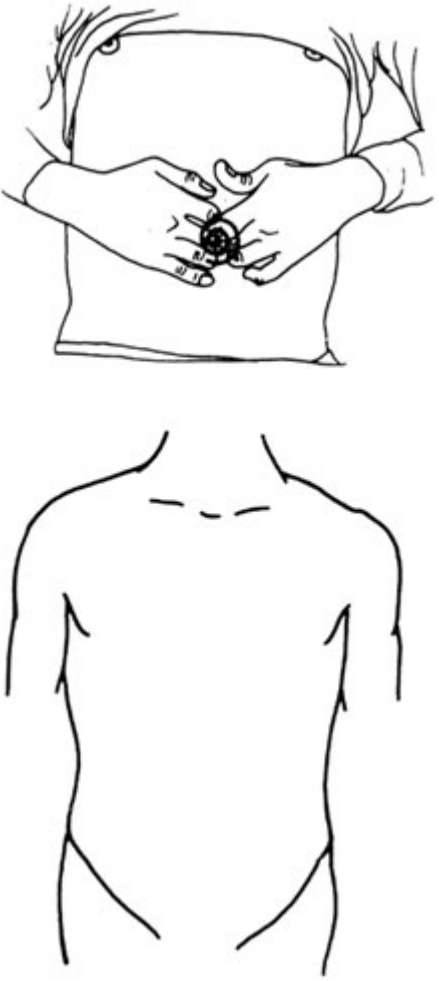

Fig. 8.4 *Major key to maintaining good health is to eliminate tension, worry and toxins every day.*

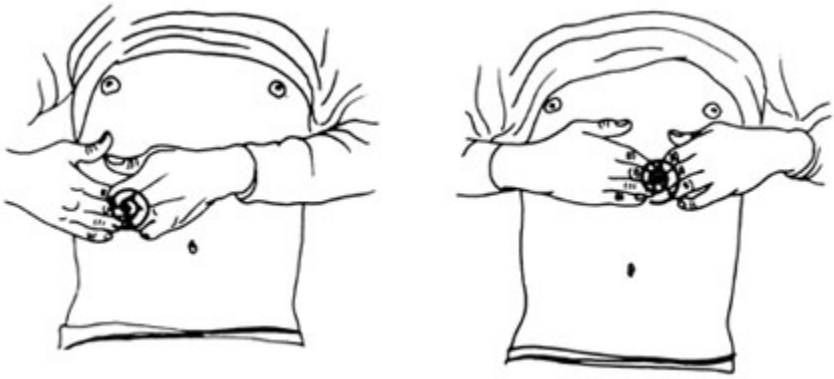

Fig.8.5 *Massage around the navel; feel for knots or lumps;massage to move the toxins out.*

VI. Increase Lower Limb Circulation

When we are asleep, the circulation slows down, especially in the legs which are the farthest away from the heart, and the toxins start to settle in the legs and feet areas. Massaging these areas can help to clean out the tension, worry, and toxins that accumulated from yesterday.

As we know, the feet are the remote controls of the organs and glands. By massaging the feet, we can stimulate the organs and glands. The toes are the end and beginning of the two meridians. The outer corner of the toes is the liver meridian, which is the major detoxifying organ. When activated it will help to clear out the toxins that accumulate in the limbs and the backs of the knees.

The inside corner is the spleen meridian, which can help the immune system and help in digestion.

Practice: Lying on a bed, rub the big toe and the second toe back and forth against each other, twenty to thirty times, and feel the Chi and circulation increase. (Fig. 8.6) Do it on both feet. This exercise can help to prevent hardening of the veins and arteries.

VII. Activate Vein Circulation *(Fig. 8.7)*

Veins are the return routes of the blood to the heart. The most common places for blood to clot are the veins of the feet. This can be caused by wearing high heels, wearing tight shoes, or wearing the wrong shoes. These will tend to harden the veins and slow down the entire foot circulation.

Practice:

1. Males: Start with the right foot, then the left foot, with the leg bending the feet inward toward the stomach, and exert force on the heels. Hold for a while and relax.

2.Females: Start with the left foot; then do the right foot.

If you do this exercise and feel cramping, use your fingers to pull the toes and bend them upward, or pull the toes downward until the foot recovers from the cramp.

Fig. 8.6 *Move the big toe and the second toe to rub against each other back back and forth.*

Fig. 8.7 *Activate the vein circulation.*

VIII. Stretch the Tendons

When we are asleep, the tendons are at a resting stage, not stretched out. When we get up, our body feels stiff and hard to move or bend. There are thousands of stretches possible; we can spend a lot of time stretching. If you do just a few right, you can stretch all the tendons, save time and prevent yourself from being afraid to do them because you do not have enough time.

The feet, toes, hands and fingers are the ends of the extremities Where all the tendons and ligaments join together. When we feel stiff, hardening starts from the extremities. Another area is the spinal cord which may tighten with its connections of many tendons and ligaments.

The extremity, and thus the main connection, of'all the tendons is the tongue.

Practice.

1. Lying on your back, bend your back like a bow and stretch your hands and fingers to bend the feet and toes. Spread and stretch out the fingers and toes as far as you can, and begin to do bellows-breathing: exhale and move the stomach until it is flat and touches the spine; inhale until the stomach is inflated. (Fig. 8.8) Gradually increase the speed for about ten to fifteen times. At the final exhale, exhale deeply and stretch out your tongue as long as you can toward the chin. (Fig. 8.9) Direct your eyes to look at the tip of your nose. You can repeat this two to three times. The resting period is very important. Relax your body muscles totally and enjoy the flow of Chi energy throughout the whole body.

2. Bend down; use your thumbs and index fingers to hold the big toes of both feet. This will energize the liver and spleen meridians. Hold the toes and feel the energy from the thumbs go to the lungs meridian and from the index fingers to the large intestine, which is connected to the liver and spleen meridians. (Fig. 8.10 and 8.11) Start to use bellows-breathing; start slowly and gradually increase it until you feel the tendons and the spinal cord get tense, and then release. After you finish you can shake the feet and slap them a few times to loosen them. If you can't touch the feet, you can hold the back of the knees, calves and ankles. This will increase and activate the bladder, lungs and large intestine meridians.

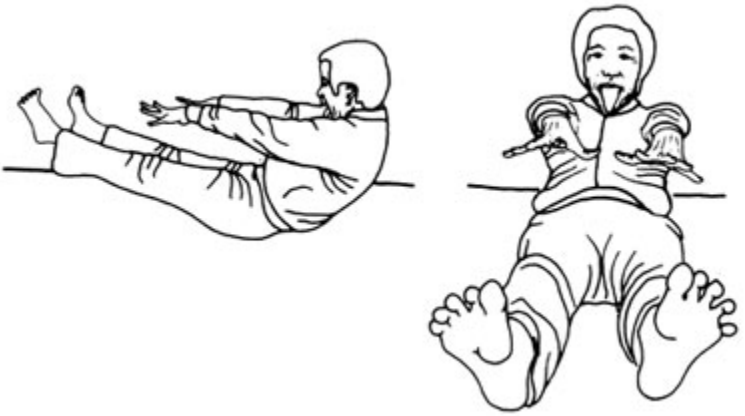

Fig. 8.8 *Stretch the whole body.*

Fig. 8.9 *Stretch the tongue.*

When you are more stretched, you can move to the ankles through which the bladder, stomach, liver and spleen meridians pass. Hold your ankles and feel the heat of your hands pass to the meridians.

When you can stretch more, move to touch the toes and the K-1 point, the kidneys meridian.

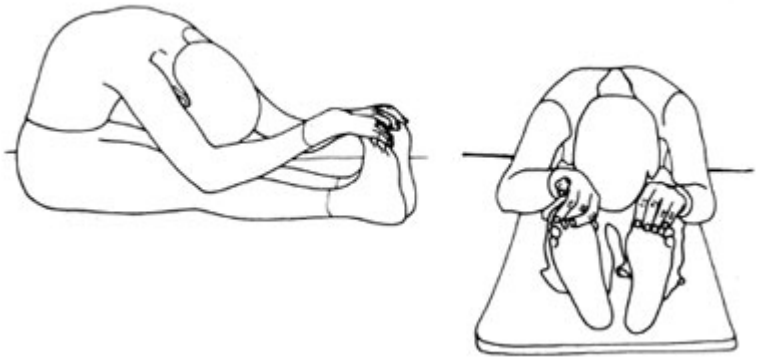

Fig. 8.10 *Bend down and hold the toes.*

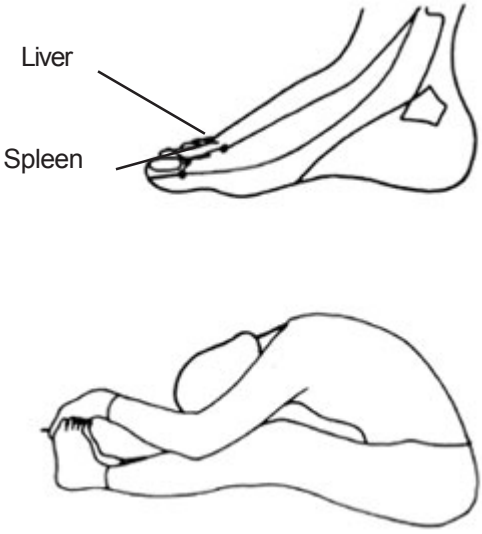

Fig. 8.11 *Stretch the tendons exercise.*

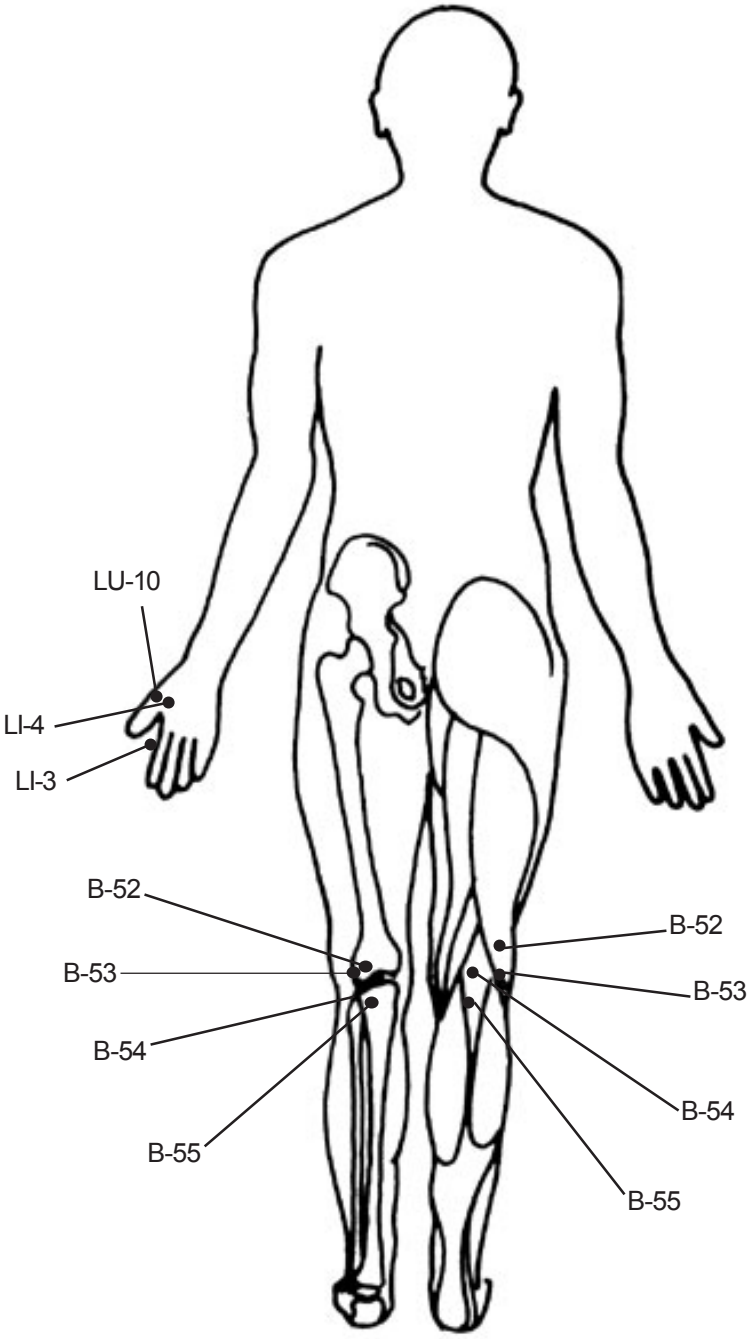

Fig. 8.12 *Diagram of meridians on the leg.*

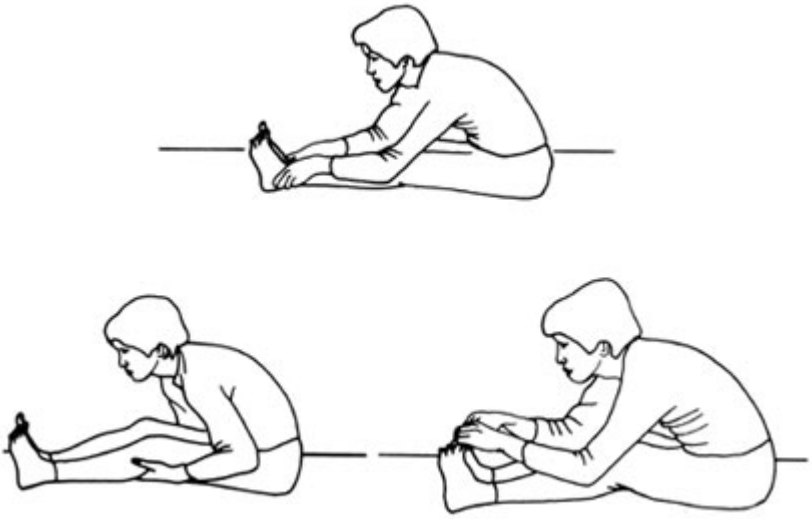

Fig. 8.13 *Stretch the neck and spine tendons.*

IX. Stretch the Neck and Spine Tendons

To stretch out the neck and the spine, do the same, bending down to touch the feet: hut instead of your head touching the knees, you look up to the ceiling and feel the stretching of the whole spine. (Fig. 8.13)

Get up slowly. When you are ready to rise, roll your body slowly to the left side and sit up; then gradually stand up and walk.

X. Clean the Nine Openings

We have many openings in our bodies. Taoists say we have two doors and seven windows, which are the openings that permit us contact with the outside world. These openings are able to let various kinds of pollution enter or block them out.

A. Front Door—Sexual Opening

The sexual organ is regarded as the front door, which is the door of the creative life-force energy. By knowing how to control and seal it tight, the life-force energy will last longer.

B. Back Door - Nutrients Opening

The anus is regarded as the back door, which controls nutrition. Many people are not aware of what to eat and the body cannot absorb their food. They end up losing most of the nutrients to their toilets. The most expensive piece of equipment in your house can end up to be the "golden toilet".

C. Seven Windows

The two eyes, two ears, two holes of the nose, and one mouth are the seven windows. The windows are important to receive and transmit information. If a window is dirty and not strong, it will not receive information well and will not seal the life-force within.

We regard these windows as the openings of the organs.

The eyes are the opening of the liver.

The ears are the opening of the kidneys.

The nose is the opening of the lungs.

The mouth is the opening of the spleen.

The tongue is the opening of the heart.

The exercises of Tao Rejuvenation in the morning are very important. If you have the time, do more. Use the bathroom if you can, or find room outside of the bathroom to do them.

D. Routine Large Intestine cleaning.

Daily bowel movements are very important in reducing the accumulation of "stew" in the body.

When you finish the bowel movement, use water to clean yourself. If this is inconvenient, use toilet paper that has been wet with water and clean out the anus. Massage the coccyx and around the anus. The anus region has many arteries and veins, which are easily clotted and can become hemorrhoids. Massage the whole region 50-100 times. This is of great help in preventing or healing hemorrhoids, while helping to detoxify any accumulation in the lower region.

Knowing how to move the bowels is equally as important as eating.

XI. Clean Out the Parts of the Face.

A. Eyes

If you have the time, do the Tao Rejuvenation. Of all the senses' exercises, the eye exercises are my favorite.

Daily maintenance is the best prevention. Many times we do not pay much attention to the things that are close to us, like the water and air or our faces and eyes.

Many people wash their faces, but seldom wash their eyes. When working outside all day, very small particles of dust and all kinds of fiber get into the eyes and clot the tear ducts. Be sure to massage the tear ducts.

Wash the eyes with cool, clean or boiled water. Use a bowl in which you can immerse your face.

Open your eyes and move the eyes around. Get all the dirt and particles out. (Fig. 8.14) This will also help you remain more awake.

B. Nose

The nose is the place where the life-force of air enters. A strong and healthy nose is the key to vitality.

Right after you clean the eyes, use another bowl of water, Make sure it is clean; preferably use cooled, boiled water.

Immerse your nose and face into the water, inhale the water into the nostrils just enough, and force it out. In the beginning you might sniff or inhale too deeply which will cause you to cough. When you are well-practiced, the water will enter your nose and come out your mouth.

If you have difficulty handling both nostrils at one time, you can use your finger to close the right nostril while cleaning the left nostril, and then close the left nostril while cleaning the right nostril.

In the beginning you might feel pain or unpleasantness, because the nose is like a chimney—if you never clean out the smoke, it will collect there.

C. Teeth

Massaging the teeth and the gums with coarse salt is very useful. (Fig. 8.15) Using your finger, touch the salt and rub the teeth and gums. Make sure that your finger is clean and the nail not too long. Massage and rub the inside and outside of the gums. Weak gums are the cause of much tooth decay. If you have time, do the teeth and gum exercises.

Massaging the tongue is very important, too. (Fig. 8.16) Please see the section on tongue exercise (Chapter 4).

D. Ears

Cleaning and exercising the ears will make you more alert and prevent hearing loss.

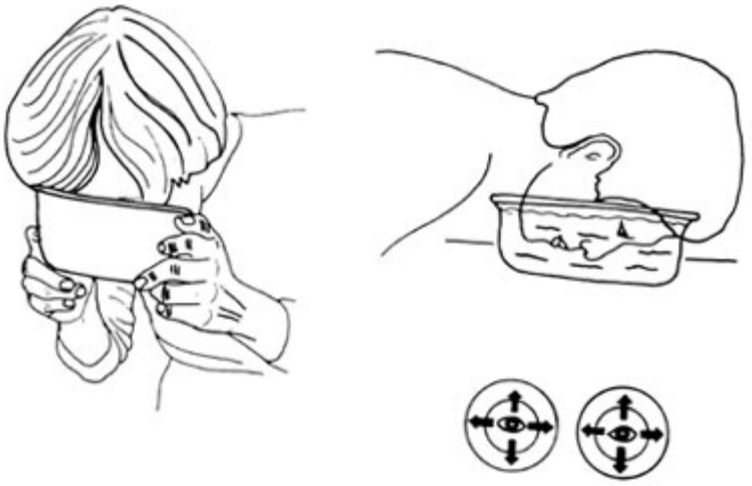

Fig. 8.14 *Clean out the eyes, nose and face.*

Fig. 8.15 *Massage the teeth and gums with coarse salt.*

Fig. 8.16 *Massage the tongue using a clean finger or tongue depressor.*

Use a clean, damp towel; rub and massage the ears, both the shells and the inner ears. See the ear exercises' section (Chapter 4).

E. Neck

Use a clean, damp towel and rub the neck until you feel the heat and Chi flow in the neck. The neck may reveal your age; a wrinkled neck might make you look old.

F. Massage the head and comb the hair.

Take time to massage the head and comb the scalp carefully. This can be an enjoyable moment.

XII. Massage the Feet

Using a towel, rub and massage your feet. Rub until you feel the feet are warm and that the Chi flows.

XIII. Look at yourself in the Mirror.

We know that we need to use a mirror when combing our hair. Women use mirrors most often, for make-up.

In Taoism we use the mirror to look at our own character, personality and the future. We can see what is going to happen today and how we are doing today. To foresee the future is not easy; it takes time to learn. We can see how happy we are, physically and emotionally what is wrong with our organs and what is wrong with our senses. The face and sense organs will reveal what is inside.

If you discover that you are looking old, maybe that will stimulate you to do something for yourself.

Look in the mirror at your face. Is it arrogant, angry, sad, depressed, or fearful? Try to change the expression to a happy, joyful, smiling face.

Watch the corners of your mouth. If dropped down, massage them up. Do the face massage by first warming the hands and then massaging.

XIV. Clean Water is a Cleanser.

Drinking water in the morning one to two hours before breakfast is the best for clearing out the system and providing prevention. Water can help you clean out the dirt and toxins that remain in your digestive tract. Morning is the best time to clean out.

Drink clean water. In some places you might need to boil it. Drink two to four glasses. In the beginning it might be hard to drink a lot of water. After you drink, you need to move, either walking, jogging or jumping. After that you have to do the abdominal massage to move the water around to rinse and clean out the toxins and mucous, which can move out as a bowel movement and urine.

Do not drink after a meal or before you sleep. If you drink at night, it will make you get up.

XV. Utilize your Time.

A. Find time to practice.

Once the basic routine is learned, it should take only ten minutes. If you're rushed, do a few exercises, especially combing the scalp, getting a tear out, wiping the face and neck, hitting the thymus and kidneys, slapping behind the knees, and the foot rubbing massage.

You will discover that you can find a lot of free time in your day in which to practice Tao Rejuvenation. You can do hand and finger massages when you have free time, such as standing in line, waiting for people, sitting in a car, driving or reading a magazine or newspaper. You will find that these Taoist exercises will greatly help you in improving you health.

B. Sleepiness while driving.

If you feel sleepy while driving a car, use the knocking the teeth exercise, which is very helpful in making the sleepiness go away. Moving the shoulders up to tighten the neck pulling up the anus to vitalize the kidneys, and using the pinky finger to hold the steering wheel tight to increase circulation can make you more awake while you are driving. These exercises are sure to keep you from falling asleep when you are driving a long distance.

C. Computer Operators and Desk Workers

For people who work at a desk or do computer work exercising the eyes, neck and kidneys is so important. We hope companies will adopt a system in which they give all employees ten minutes to do the Inner Smile and Tao Rejuvenation. They will see work results increase.

If you sit and watch a video screen too long, it will make your eyes tired, so every one to two hours close your eyes and massage the eyeballs and move the eyeballs around until you feel good.

If you sit too long, hit the kidneys and the sacrum areas. This is an excellent exercise for you.

D. Watching television.
Many people spend a lot of time watching television. You can utilize that watching time by doing Chi massage. Massage the hands and feet.

E. Boots
People tend to wear boots nowadays more often, which makes it difficult for the feet to breathe. Since no fresh air is circulated, find some time to take them off and massage the feet.

F. Evening Practice
In the evening before you fall asleep, find time to soak your feet in hot water for five to ten minutes and wipe them dry. Rub them hot, and do the Six Healing Sounds. Do each one three times, according to the sequence for the Six Healing Sounds described in *Taoist Ways To Transform Stress Into Vitality.*

XVI. Commuting Exercise

Increasingly, more and more of our time is spent in transportation--cars, buses, airplanes, subways, trains, etc.--as well as waiting for transportation. You can use this time to do exercises and refresh yourself.

A. If you are driving, be very careful; use your own good judgment. Do not do any exercise that will disturb your eyesight or attention on the road.

B. The neck is usually the most tense and can cause nervous tension. Do the exercises while you are driving or riding or anywhere else, when you feel tight. Inhale, pull up your shoulders to the neck, pressing into the sides of the neck, and follow by pulling your scapulae together in your back; tense the spine and scapular muscles for only a few seconds, then exhale and drop your shoulders.

C. With your hands holding the seat, pull the spine in toward the stomach and imitate a “bowl”, with the chin touching the chest, and the pelvis and sacrum tucked in. Tense the back muscles for a few seconds, especially the muscles around the kidneys, and release; you will feel the nice fresh energy rise to the top and circulate down the front. Always keep your spine loose and relaxed. Let the Chi flow without obstruction.

D. Sitting on both hands, palms up, will give you a general revitalization of the whole body. Feel the Chi energy from the palms

and fingers steam up through your bottom to the base of the spine. You will feel the Chi flow, and you will feel refreshed in a short time.

E. Holding the fingers will help you rid yourself of negative emotions such as worry, fear, anger, etc. Please see the section on Finger Massages.

F. Cleansing and knocking the teeth are extremely helpful in clearing your mind. When you feel dull, sleepy or cannot think right, cleaning the teeth will help. Please see the section on Teeth.

G. Pulling up the different parts of the anus will stimulate the organs. When you feel tired or fatigued, contract the left and right sides of the anus and wrap the Chi around the kidneys. You will help to increase the kidneys' function to clean out the toxins and give you more life-force energy.

Contract the right side of the anus to stimulate the liver. This will help give you vitality and make decisions more easily. Contract both sides of the anus and wrap the Chi around the lungs.

XVII. Sleep Position

A. If you feel constipated, do some abdominal massage for a while before sleeping.

B. If you like to lie on your back, lie with your hands and legs straight, and lightly hold your thumb in your fingers.

C. If you sleep on your side, try to sleep on your right side with your spine straight, your left leg bent, your right leg straight. your right hand's palm on your head but not covering your ear, and your left hand on your navel.

D. You can also lie on your side with your spine straight, curving your two legs in, and put both hands in between the legs.

E. Do not wear tight clothes. Choose a good pillow. There are many good pillows now that support the neck, not just the head, which leaves the neck hanging high in the middle.

F. Flowers in the sleeping room can make you sleep well, but do not use overly fragrant ones because they can cause you to have a lot of dreams.

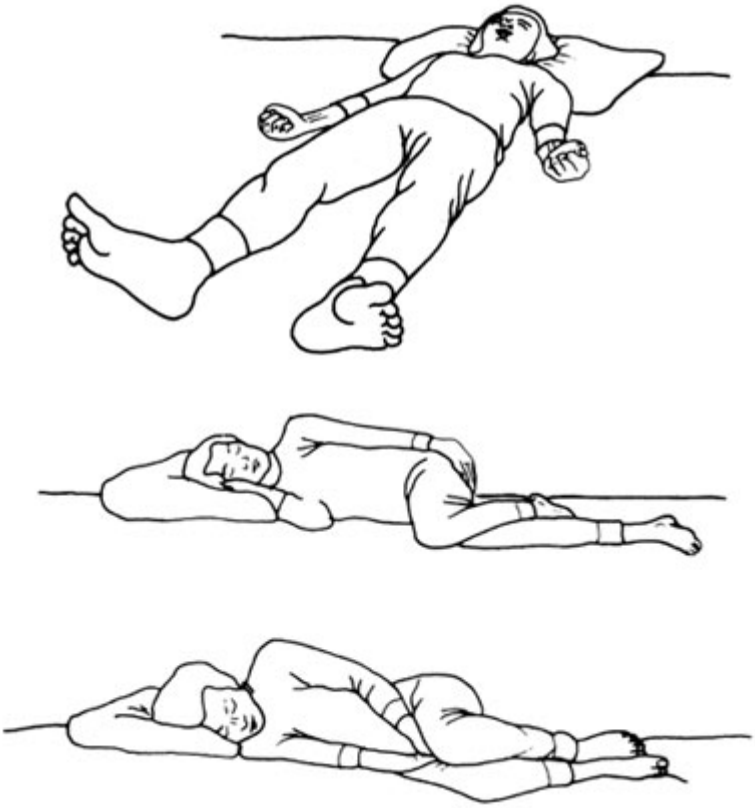

Fig. 8.17 *Sleeping Postions*

XVIII. “Oh, No! Not another Obligation!”

The crux of any self-improvement program is continued practice. Of course, it takes a certain amount of inner discipline to practice the exercises in this book on a regular basis, preferably every day. Yet, a basic tenet of Taoism is flexibility, accommodating natural circumstances. So, be flexible with your exercise program; make it suit your individual schedule. Do as much of the routines as you have time for. If you only have time for the Lung and Kidney Sounds, do just those (but not before bed time--they are energizing when done individually). If you only have two minutes for the Inner Smile, do a quick “waterfall of smiling energy” through all the lines. Most important, try to integrate the practices into your daily life, smiling down whenever you think of it and doing the Healing Sounds when

you need to relax, to deal with a particular symptom, or before bed time. Use the eye exercises after reading, writing or other close work. Get rid of a headache by doing the crown exercise, the temple massage, and bridge of the nose pinching.

The exercises are marvelous tools for relaxation and well-being, not another burdensome task to feel resentful or guilty about. Play with them and use your creativity to incorporate them into your personal life style. Make them yours. Enjoy feeling, looking, and functioning as a happier, calmer more vital and attractive person.

$11.95

Chi Self-Massage

Taoist Way of Rejuvenation

Mantak Chia

Profusely Illustrated by Juan Li

Virtually all Western massage is massage primarily of the muscles. Whatever its virtues, Western massage is altogether different frpm Chi Massage. Tao Rejuvenation employs one's own intemal energy, Chi energy, to strengthen and rejuvenate the sense organs—eyes, ears, nose, tongue, teeth and skin—and the inner organs. The techniques used by Taoists are some five thousand years old and, until very recently, were closely guarded secrets passed on from a Master to a small group of students. Often, too, each Master knew only a small part. Now Master Chia has pieced together the entire system of Chi Massage in a logical sequence in such a way that once you have it shown to you, you need only five or ten minutes of practice daily. In short order you will note improvement in complexion, taste, vision, hearing, sinuses, gums, teeth, tongue, the internal organs and general stamina.

Master Mantak Chia, born in Thailand, comes from the ancient lineage of Taoist Masters, extirpated in China and now existing in dwindling numbers among the Overseas Chinese. He also has a Western education in anatomy and physiology. Now in the Northern Thailand, he has developed a clear and practical way of teaching this ancient wisdom, much of it hitherto kept secret. He is also the author of *Awakening Healing Energy* and *Taoist Secrets of Love* and *Taoist Ways to Transform Stress into Vitality*.

Master Mantak Chia's healing work is being presented in the New York metropolitan community by a number of practitioners trained by Master Chia. They are Lawrence Young, M.D., internist and attending physician, New York Infirmary Beekman Downtown Hospital; C. Y Hsu, M.D., physician-in-charge of the Acupuncture and Nerve Block Clinic, Albert Einstein College of Medicine; Stephen Pan, Ph.D., Director of East Asian Research Institute; Harry Brown, M.D., psychiatrist.

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Fusion of the Eight Forces
Mantak Chia

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Fusion of the Eight Forces

Mantak Chia

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 2,000 instructors and practitioners from all over the world. Living Tao Centers, Chi Nei Tsang Institutes, Cosmic Healing Forums & Immortal Tao Mountain Sancutaries have opened in many locations in North America, South America, Europe, Asia, Africa and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden and the Universal Tao Training Center fifteen miles outside of Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a word processor for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirt-five books to convey the full Universal Tao System. In June, 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December, 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February, 2002, the Immortal Tao practices were held at Tao Garden for the first time using Darkness Technology, creating a complete environment for the higher level Taoist practices.

Master Mantak Chia has previously written and published these twenty-two Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002
Tan Tien Chi Kung - 2002
Cosmic Fusion - 2002

Many of the books above are available in the following foreign languages:

Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

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Thanks to Juan Li for the use of his beautiful and visionary paintings, illustrating Taoist esoteric practices.

We offer our eternal gratitude to our parents and teachers for their many gifts to us. Remembering them brings joy and satisfaction to our continued efforts in presenting the Universal Tao System. For their gifts, we offer our eternal gratitude and love. As always, their contribution has been crucial in presenting the concepts and techniques of the Universal Tao.

We wish to thank the thousands of unknown men and women of the Chinese healing arts who developed many of the methods and ideas presented in this book. We offer our gratitute to Master Lao Kang Wen for sharing his healing techniques.

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Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

Chapter 1
Cosmic Fusion and the Tao

Cosmic Fusion is the basic Taoist practice of internal alchemy. This is the second book in a three part series. This particular book expands on the concepts and practices introduced in Fusion of the Five Elements. Here in part II, the practice goes to the next level of development.

In the beginning these practices may seem complex and mentally challenging, yet once the formulas are understood and applied, they are quite simple. With practice, the materials become familiar territory that you can traverse easily. Take your time with the formulas. Experiment with what works for you. The formulas are the guidelines to enhance your life. The Cosmic Fusion is a doorway into the vast potential of the self and the Universe. It is a very natural process and the first step into the Taoist alchemical practice.

The Tao 道

The word *Tao* means ***The Way***, the way of nature and the Universe, or the path of a natural reality. It also refers to a way in which we can open our minds to learn more about the world, our spiritual paths and ourselves. Taoism is a practice of body, mind and spirit, not just a philosophy of mind. When we have the true sense of the Tao, of the real knowledge and wisdom, we will be able to make the right decisions in our lives.

Taoism involves many practical disciplines that can restore our lost youth, energy and virtues while awakening our deepest spiritual potentials. Taoists regard these practices as a technology that can help us learn universal truths if we are willing to be receptive.

The ancient masters recognized that these potentials can include the possibility of attaining conscious freedom and existence in the after-death state. Through specific exercises, one can avoid suffering the experience of death by expanding the consciousness beyond the physical body before its demise. This makes it possible to determine one's future existence before leaving this life.

All spiritual paths ultimately lead to the truth. Taoism is both a philosophy and a technology for seeking and finding the truths of the universe, nature, and humanity. Its focus goes beyond one single path or viewpoint. Taoism is not a religion, as it requires no initiations or ceremonies, but it is the outcome of all religions, departing from dogma at the point of truth. It leaves behind all religious beliefs, just like the clothing of past seasons. The Tao is also the goal of science, but it leaves behind all scientific theories as partial and temporal descriptions of the integral truth. Taoism includes all matters of religion and science, yet its breadth goes far beyond the limits of devotion or intellect.

Taoist teachings are like master keys unlocking all doors. They assist people in their lives, as do all religious teachings. Yet the teachings of the Tao transcend religion while retaining the essence of spirituality. They explain and demonstrate the truths of the Universe directly, rather than on the level of emotions, thoughts or beliefs. For this reason, students of the Tao have little cause for skepticism or endless searching.

Philosophy, science and religions all contain some aspects of truth that reflect the Tao. The teachings of the Tao reflect the center of the ultimate truth (ourselves and the Universe) and help us reach it on our own. We can believe in any religion or spiritual path and still benefit from these teachings, because the Tao serves only to promote universal spiritual independence. There are no ultimate masters or gurus in Taoism because we become our own masters, capable of controlling our own destinies and knowing who we really are as we explore the marvelous powers hidden within the Tao of humanity. All the great gods, immortals, sages, saints and holy men and women are our teachers and advisers.

Taoism, which goes back at least seven to eight thousand years, is closely aligned with modern technology and science. Browsing through a bookstore, you will find that many recent books use the concepts of Taoism to explain relationships expounded by the “new” physics. Today, a lot of the world’s intellectual effort is directed toward external technological development.

Thousands of years ago, the Taoists directed their consciousness inwardly, and developed a science of inner alchemy. Chinese written history has a 4700 year history and the language has not changed significantly over the centuries, so even the oldest documents can be read today. A lot of information was accumulated in

each dynasty. The Taoist sages, who learned and perfected methods to prepare and leave the body, recorded all the practical details. These, along with philosophical thought, were collected, filling many volumes which constitute the Tao Canon.

These transformative formulas endure, a gift from the original Taoist sages to all who are willing to put them into practice. The Universal Tao is concerned primarily with the practical approaches perfected by the Taoist sages.

Universal Tao System

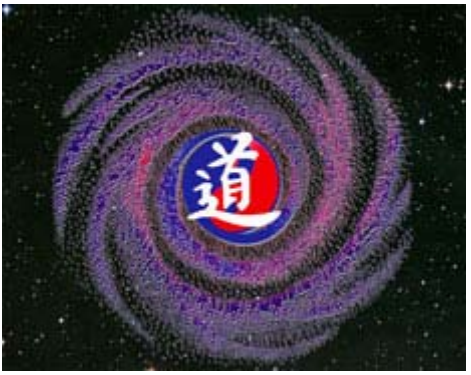

The ancient Taoists saw the importance of working on all three levels of our being: the physical body, the Energy Body and the spirit. All three are important in forming a ladder with which we may climb consciously into the spiritual worlds and, just as important, back into the physical world to be creatively active here. This ladder enables Taoists to learn about the inner worlds and to return to the physical with knowledge and increased energy. An Immortal Body, which is developed in the practice of Internal Alchemy, enables one to establish a constant link between life and the after-death (or pre-birth) state.

Ancient Taoist sages believed we were born to be immortal. We become mortal by draining ourselves of Chi through engaging in excessive sexual activity, indulging in negative emotions, and depending on material sources to supply our life-force. The masters recognized that different levels of immortality can be achieved through internal alchemy, and they devised many practices for this purpose. The ability to transcend even death through the transmutation of one's physicality into the Immortal Spirit Body is the highest goal of Taoism. This level, known as physical immortality, takes the longest to achieve.

Healing the Physical Body: Becoming like a Child to return to the Original Source

Taoist practices teach to conserve the physical energy so that it will no longer scatter and deplete as a result of our worldly interactions. Full spiritual independence requires that we avoid being drained of this energy through the eyes, ears, nose, and mouth or through excessive sex. The novice in the Universal Tao System begins with a wide range of exercises that develop the physical body into an efficient and healthy organism, able to live in the world and yet stay free of the tensions and stresses of daily life. One aspires to return to a childlike state of innocence and vitality, to regain the Original Source that is our birthright. Specific goals of this level are to learn how to heal oneself, how to love oneself, and how to love others.

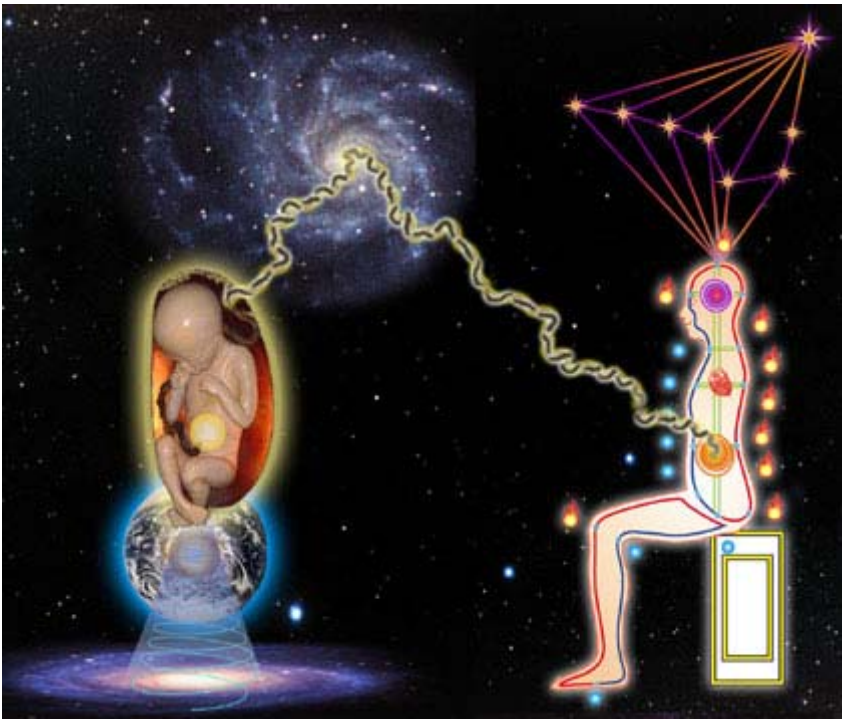

Fig. 1.1 *Returning to the Original Source.*

The first level of practice is to develop a healthy body, which can take months of diligent training. During this process we learn how to condense and conserve our life-force through the *Microcosmic Orbit* meditation, *Healing Love* practices, *Inner Smile*, *Six Healing Sounds*, and *Iron Shirt Chi Kung*. We learn to gather and refine our life-force into a Chi Ball (energy sphere) so it will not dissipate when we are ready to leave this world. As people grow older, their life-force weakens, often resulting in illness and suffering. Using drugs to combat illness drains so much of the body's life-force that there may not be enough energy left to follow the primordial light (clear light) to the Wu Chi (our original source God) at the moment of death. The basic practices of the Universal Tao ensure that we retain enough of our health and vital energy to make that journey.

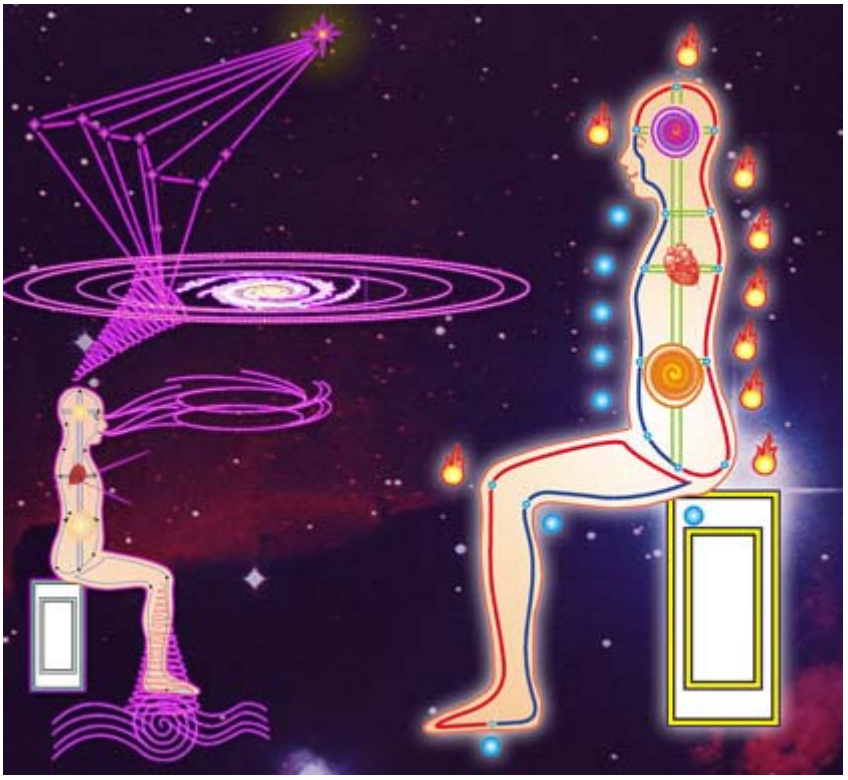

Fig. 1.2 *Sit down and start to move the orbit in the fast speed, from 1000 rotations per minute, to 10,000 per minute and up to 30,000 per minute.*

Stopping energy leakage through conservation and recycling.

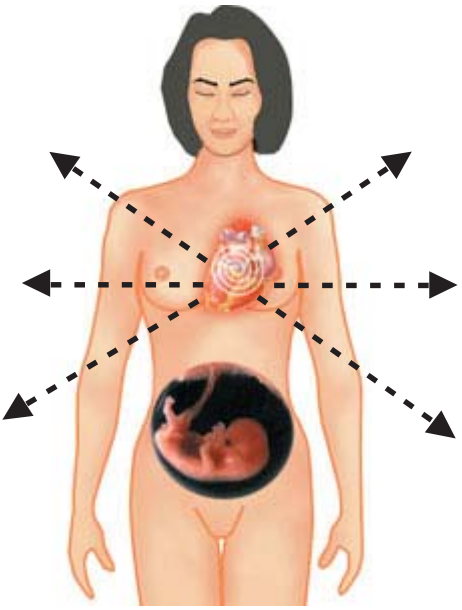

Fig. 1.3 *Heart Leakage*

The Microcosmic Orbit is the body's major energy pathway. Along this path there are nine openings. If we learn how to seal them when they are not in use, that simple act of conservation will save an immense amount of energy.

The Microcosmic Orbit meditation is the first step toward attaining these goals, as it develops the power of the mind to control, conserve, recycle, transform and direct Chi (the Chinese term for energy, or life-force) through the body's primary acupuncture channels. By learning how to manage our Chi effectively, we gain better control over our lives; by using our energy wisely, we discover that we already have plentiful Chi.

At this stage, one also learns to connect with and draw from the unlimited source of Universal Love, a Cosmic Orgasm formed by the union of the three main sources of Chi accessible to humans: the *Universal (Heavenly) Force*, the *Earth Force* and the *Higher Self (Cosmic) Force*. This process is both energizing and balancing. It prepares one for working with greater amounts of Chi in the higher levels of meditative practice, particularly in developing the Energy Body.

Abdominal Brain

Learning to empty the mind is one of the most important Universal Tao practices. Letting go of judgments, suspicions and the incessant repetitive thought process is a simple way to recharge the body, the brain and the spirit. Science has proven that we have about 60,000 thoughts per day and of those 60,000 thoughts 95% of them are the same thoughts we had yesterday. By activating the abdominal brain, we are able to clear the mind and create space for more creative mental activity.

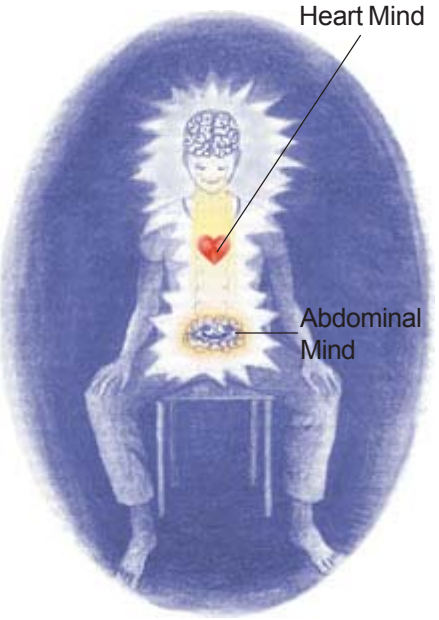

Fig. 1.4 *Upper and Lower Brains*

The brain spends up to 10 times more energy than the rest of the body. Even when we are not working or thinking consciously, our mind still wanders. In Taoism this incessant thinking is called the "Monkey Mind". If we can stop the mind and empty the energy from the brain down to the organs, there will be tremendous amount of energy stored in the body. This abundance of energy can later return back to the brain. When the energy returns, our thoughts are much more refined, creative and focused.

The abdominal brain is located in the Lower Tan Tien, the reservoir of energy located about an inch below the navel and three inches inside the body. This is the very center of our being. It is called the abdominal brain because it is a center for wisdom. Science is learning that the same chemical activities that go on in the brain, go on in the abdomen. The difference is that the abdomen is not connected with the senses. The senses tend to pull our energy and awareness outside of ourselves. This leads to the constant analyzing of situations and people. The abdominal brain is a much deeper sense of awareness, where our "gut feelings" originate. When the abdominal brain is activated, we open up to more guidance, deeper intuition and full body awareness.

Transforming Negative Energy into Virtues: Opening the Heart

The Inner Smile and Six Healing Sounds are simple yet powerful practices that teach us how to relax and heal the vital organs and to transform negative emotions back into a rich source of energy. They help open the heart center and connect us with unlimited Universal Love, improving daily interactions and providing a vehicle for the virtues, which derive from the internal organs. Taoists perceive the heart as the seat of love, joy and happiness, which can connect with Universal Love. It is also a cauldron in which the energies of our virtues are combined and strengthened. Through the Inner Smile, you will feel these virtuous energies generated from their respective organs. These virtues are then gathered into the heart to be refined and blended into compassion, the highest of all virtues. This is a most effective way to enhance one's best qualities.

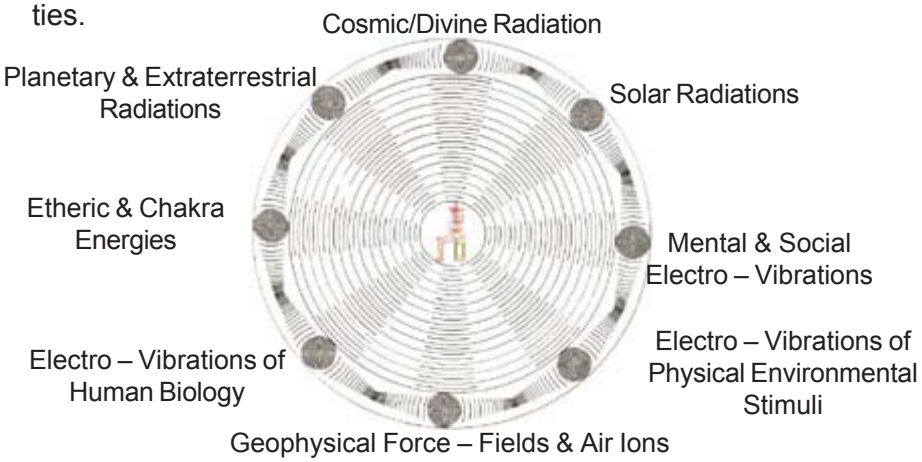

Fig. 1.5 Cosmic/Divine Radiation Fields

Another important beginning practice teaches the student of the Tao how to gain strength through the conservation and recycling of sexual energy (*Healing Love through the Tao*). When collected, sexual energy (*Ching Chi*) becomes an incredible source of power that can be used by the individual or shared with a sexual partner through the Microcosmic Orbit pathway during sexual intercourse. With practice, singles and couples can learn to increase and intensify sexual pleasure. The collected and transformed sexual energy is an important alchemical catalyst to be used in the higher meditations.

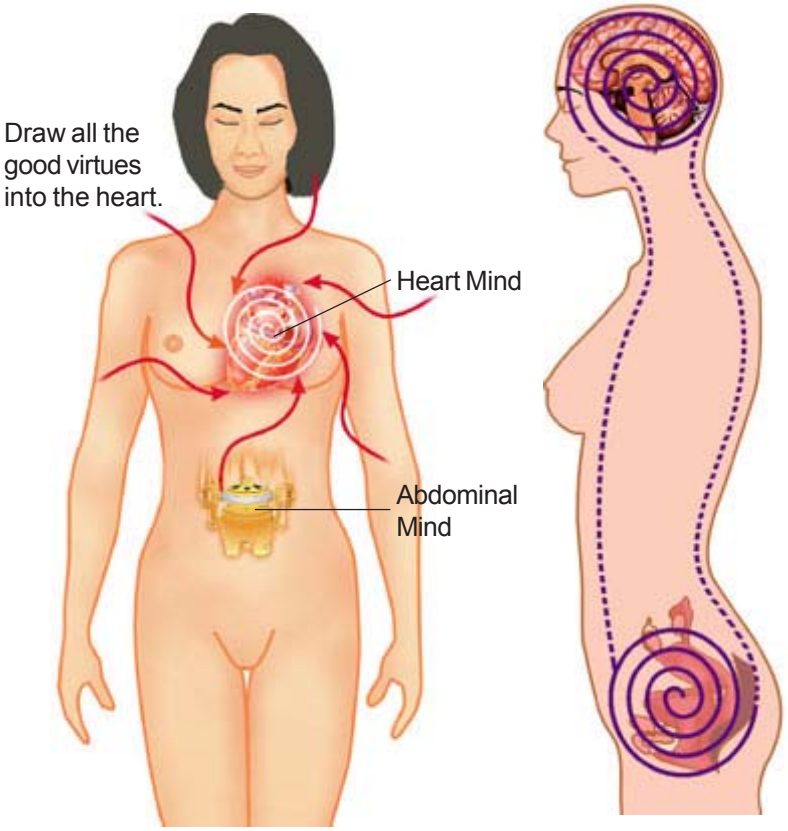

Fig. 1.6 *Conserving, recycling and transforming the energy.*

Once you have an abundance of sexual energy, you can connect to the unlimited Cosmic Orgasm experienced every moment by your Higher Self, which is the most basic energy in every cell of your body.

Managing the Life-Force

In the practices of Iron Shirt Chi Kung and Tai Chi Chi Kung, one learns to align the skeletal structure with gravity to allow a smooth, strong flow of energy. With strong fasciae, tendons, and bone marrow and good mechanical structure, we can manage our life-force more efficiently. The body also gains a sense of being rooted deeply in the earth, so one can tap into the Mother Earth healing force.

Cosmic Nutrition

The Taoist approach to diet is based on determining the body's needs and then fulfilling them according to the five elements of nature, which support the five major organs of the body. This system reveals and strengthens any weak organs by balancing one's food intake to enhance any deficient elements. It does not condemn most foods that people enjoy (including sweets), but instead creates a better program in which these foods can support the body's internal balance rather than disrupt it. Choosing and combining foods in this way can help us avoid the cravings we sometimes fall prey to.

Developing the Energy Body: Our Vehicle to Travel in Inner and Outer Space

The next level of the Universal Tao system consists of the *Fusion of Five Elements, Cosmic Fusion,* and *Fusion of the Psychic Channels*. These practices build and enhance the basic Universal Tao exercises. They use the extra energy saved through the foundation practices, including recycled negative energies, to build a strong Energy Body that will not dissipate. Developing this Energy Body awakens a part of oneself that perceives and acts free of environmental, educational and karmic conditioning. Once the Energy Body is strong, it becomes a vehicle (like the space shuttle) to help the untrained soul and spirit for the long journey home, back to the Wu Chi.

Fig. 1.7 *Fusion is the First Step in achieving Union of our Three Bodies.*

If we do not have a chance to practice awakening or to give birth to the soul and immortal spirit during life, the primordial light will awaken us at the moment of death. Unfortunately, we may be too untrained and inexperienced to follow this light. To prepare for the journey, the Energy Body is a vehicle of great importance. We can train and educate the Energy Body so it can help the untrained soul and spirit recognize and follow the primordial light back to our original source.

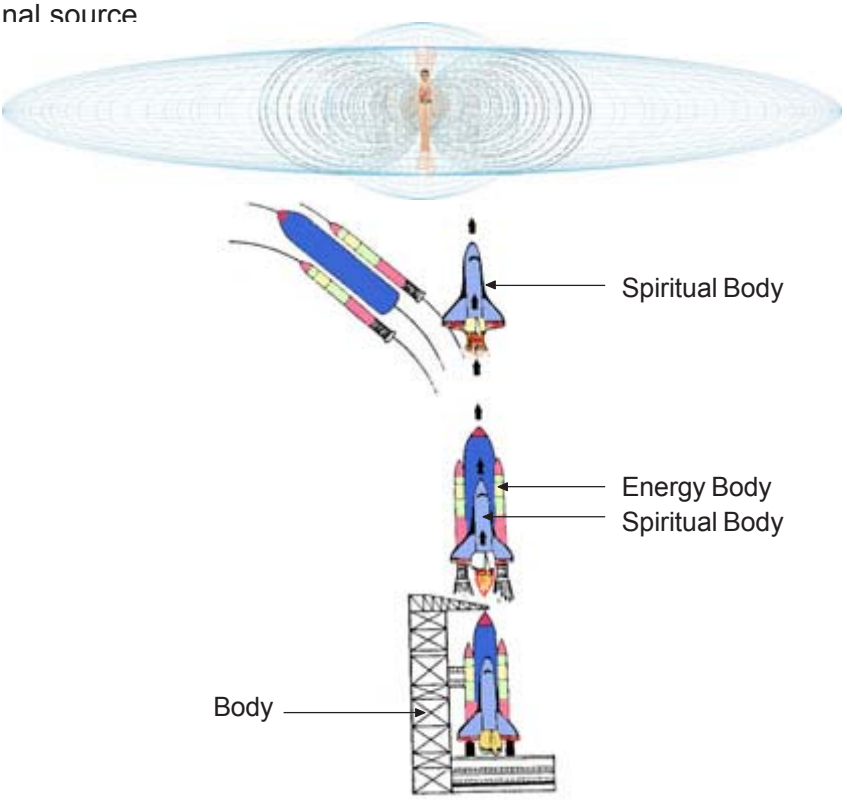

Fig. 1.8 *Energy Body blasting off the Spiritual Body and enters outer space.*

When we are ready to give birth to the real soul, the Energy Body will act like a booster rocket to help boost the soul into its higher dimension of the immortal spirit. At the highest level, all three of these bodies merge into one.

Each level of development gives us a chance to go further in the journey back to the Wu Chi. Taoist methods of absorbing stellar energies help rejuvenate the physical body and strengthen the soul and spirit bodies for their inter-dimensional travels.

Recycling our Negative Emotions

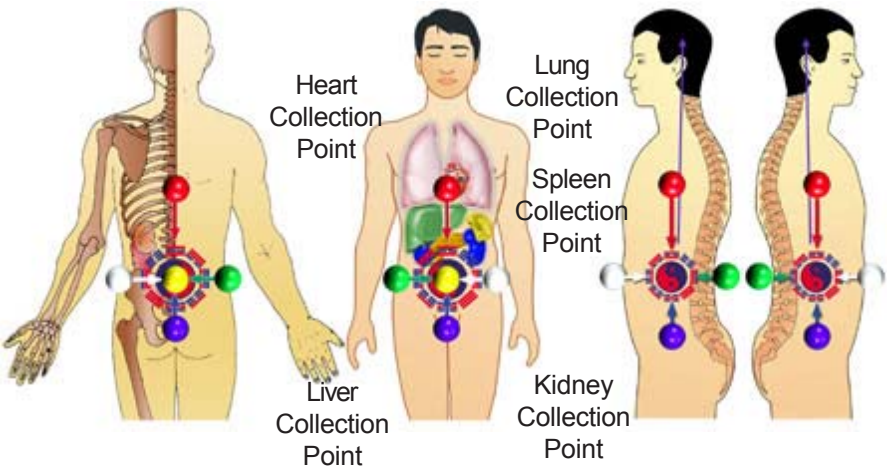

Fig. 1.9 *There are Five Major Collection Points of the Emotions reflected on all four sides of the body.*

Our emotional life, filled with constant vicissitudes, drains our vital energy. Through the Fusion meditations, one learns to transform the sick or negative energy that has been locked up in the vital organs. Taoists understand morality and good deeds as the most direct path to self-healing and balance. To be good to others is good for oneself as well. All the good energies we create are stored in the Energy Body like deposits in a bank account. By helping others and giving them love, kindness and gentleness, we receive positive energy in return. When we open our hearts, we are filled with love, joy and happiness.

From Taoist experience, we know that when we leave this world we can go directly to heaven, depending on how much energy we have been able to transform into the Energy Body prior to death. Just like money in the bank, the more we transform our physical being to our spiritual being, the more we have in heaven. The more good we do here, the more positive energy we have up there.

Forming the Spirit Body:
Planting the Seed of Immortality – Lesser Kan & Li

The Inner Alchemy meditation of the Lesser Enlightenment of Kan and Li (water and fire, multi-orgasmic sexual energy and compassion) reunites the male and female within each of us. It involves the practice of self-intercourse, which by internal sexual coupling of the energies enables one to give birth to the soul body. The soul body then acts as a "baby sitter" to help nurture the spirit body. The soul is the seed, but it can also be matured into the immortal body if one has not had the chance to raise the spirit body in this life. Practitioners of Taoist Alchemy believe that if we give birth to the spirit body and develop the immortal body in this life, we can overcome the cycle of reincarnation.

Fig. 1.10 *Creating the Energy Body in preparation for the Spiritual Body.*

Once the "baby sitter" or soul body is formed, it is in the Yin stage, or infancy (soul embryo). We need to feed, raise, educate and train the young soul to become fully grown.

Once the soul body is developed, we can give birth to the spirit body. To cultivate the young spirit body until it is fully mature can take 14 to 18 years. We also use the energies of nature (trees, sun, moon and stars); virtually all sensory experiences of a positive nature become nourishment for the growth of the spirit within the physical body.

Many masters who attained this level of the immortal body were able to transform the material into the immaterial and transfer it into the spirit body. At the moment of death, they were able to transfer their consciousness, their energy and the physical elements of their bodies up with them into the spirit body, although even this level is not yet the true immortal body. In this process their physical bodies actually shrank in size; they may have weighed two-thirds of their usual weight after their physical deaths occurred. This meant they had successfully transformed much of their material being into an immaterial state while retaining full consciousness.

Cultivating the Yang Stage of the Immortal Body: Marrying the Light - Greater Kan and Li

Fig. 1.11 *Greater Kan and Li*

To merge with the light of the Tao, we must awaken and nourish the awareness that we are in truth children of the light. Once we have fully grown the spirit body, it will be the same frequency as the light of the Tao and can become one with that light. Other traditions refer to this light by such names as the Holy Spirit or Great Spirit; we also refer to it as the “outer light.”

The Greater Kan and Li meditation teaches us how to recognize the inner light of our own spirits and shows us how to merge with or “marry” it to the outer light. Once we connect with and “marry

the light," we give birth to the second stage of the true immortal spirit. Taoists refer to this as the Yang body. One continues to transform the physical body energy to feed the immortal spirit so it can mature.

At this stage of practice, we learn to digest increasingly higher-grade energies of the Higher Self and Universal Forces from the sun, moon, planets, stars and galaxies, and from the mind of the Tao itself. An awakening to that which is eternal and enduring occurs through this practice. Cognizant of our true nature as spirits, we experience the ability to leave the physical body and travel in the immortal spirit body, which leads to experience of the inner worlds of spirit. Fear of death is vanquished as we become familiar with life beyond physicality.

Greatest Enlightenment of Kan and Li

At this level one transfers all physical essence into the immortal body. When all the body's material elements are transformed into subtle Chi, what remains is known as the "rainbow body." When a master of this level leaves this world, there is nothing left of the physical body but nails and hair. Death is still necessary to speed up the process.

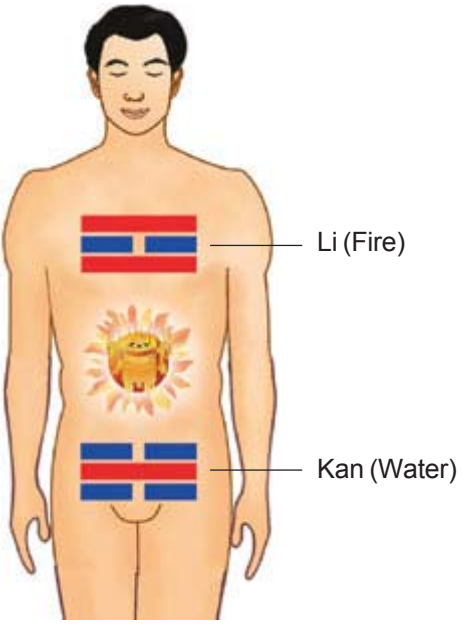

Fig. 1.12 *Union of Fire and Water*

Sealing of the Five Senses, Congress of Heaven and Earth, Reunion of Heaven and Man

At this level death is transcended entirely. One can simply transform the physical body into the immortal body and leave this world or return to it at will. This is the state of complete physical immortality. It takes from eighty to a few hundred years to complete these practices and transform all the material elements of our body into the immaterial. The final goal of ascending to heaven in broad daylight is reached.

There are records in Chinese history of many thousands of Taoist immortals who reached the level of daylight ascension in the presence of many witnesses. In the Bible, Elijah and Moses also accomplished this feat. In the final stage of this practice, the adept can unite the immortal spirit body, the Energy Body, and the physical body, or separate them at will. It is then that the human being knows full and complete freedom as an immortal, where no world is a boundary.

Chapter 2
Taoist Cosmology

Ancient Taoism is rooted in deep observation of naturally occurring Universal processes and their effects upon human beings. Newtonian physics of the West understands these processes as the mechanics of cause and effect. Taoism understands them as the interactions of a vast sea of energy that is constantly creating and recreating the universe in infinite ways. Most religions and esoteric systems study these processes (the ways of God) through scriptures and practices based upon the immaterial. Taoism studies both the material and immaterial aspects of nature and the Universe in the belief that the immaterial is both the source for the material and a product of it. In other words, physical and non-physical processes are sources for each other.

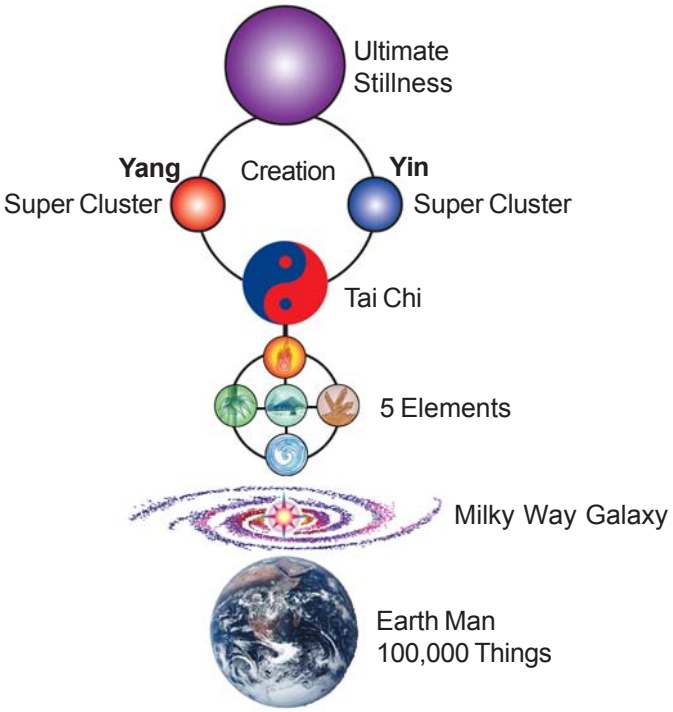

Fig. 2.1 *Taoist Cosmology*

The Void: Our Original Source

Through observing nature and the effects of energy within the human body, the ancient Taoists were able to trace the universal energy back to its point of origin. Upon developing an empirical approach with which to contact this source of observable phenomena, they established the concept of the primordial void as the point of departure for all creation. This void was given the name Wu Chi, which is depicted as an empty circle in traditional Taoist art because it is beyond human description. For energy to begin generating the effects and forms of nature and the universe, something had to stir within the Wu Chi. This first stirring created the division between the material and the immaterial as all the processes of the universe began at this time.

Yin and Yang

Fig. 2.2 *Duality of Yin and Yang*

Taoists refer to the first observable variations of the Universal Force, which emanates from the Wu Chi, as Yin and Yang. These two qualities of this force can be understood as the positive and negative poles of the primordial energy. Yin and Yang are inseparable tendencies of all energy, and it is impossible to have one without the other. Their interactions are the root of all universal action; hence, the polarities of Yin and Yang are an intrinsic factor of all creation.

The theory of Yin and Yang is one of the most simple and sublime symbols of the way nature and the Universe interact. The circle that encompasses the symbol is representative of the Tao, the undifferentiated whole, the Universe, ultimate reality. Yin and Yang are terms that shed light on the process of the Tao. Yin describes the feminine, the contracting, the dark, deep side of nature and Yang describes the masculine, projective, electric, light, surface

side of nature. Yin and Yang are not two separate states, but an interwoven aspect of one. Just as day cannot exist without night, or male without female, Yin and Yang are opposite co-existing elements of the same Universal substance. They are an interwoven and continuous processes of decaying and becoming. Yin and Yang describe the process of a changing dynamic picture of reality.

Five Major Forces of the Universe

The Taoists observed that Yin and Yang interactions follow five basic patterns which came to be known as the Five Tendencies or Five Processes of Energy. (Such interactions have been misleadingly translated as Five Elements, thereby confusing the process with the actual physical elements.) In Taoism the physical elements found in nature symbolically express the Five Tendencies of Energy in motion. Thus fire represents energy rising; water represents energy sinking; wood represents energy expanding; metal represents energy solidifying; and earth represents stable or centered energy. Each of the five elemental tendencies of energy are dependent upon the interactions of Yin and Yang emanating from the primordial void.

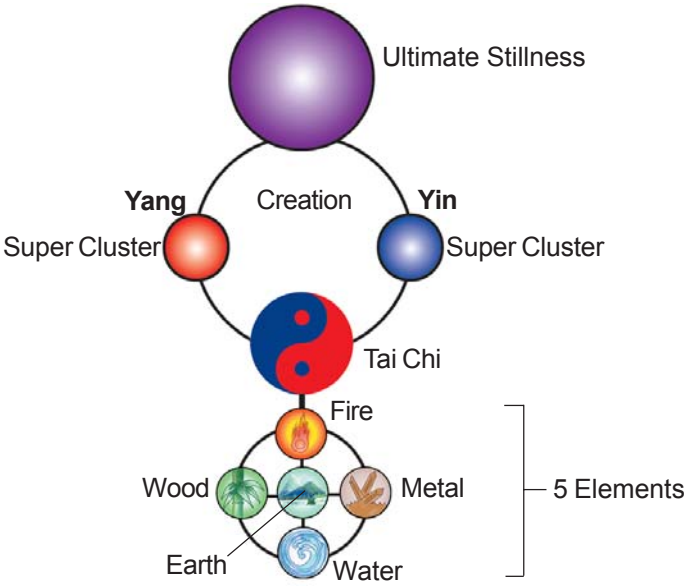

Fig. 2.3 *Oneness, Duality and the Five Elements*

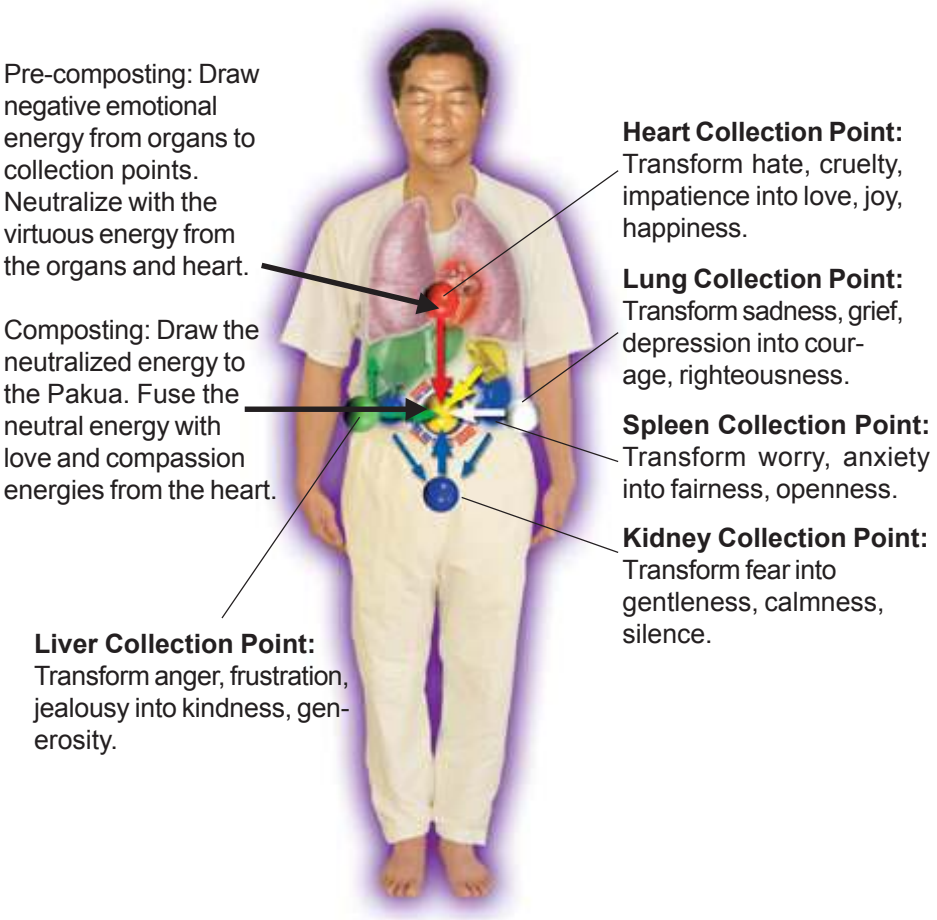

Fig. 2.4 *Transform Excess Negative Energy into Positive Energy*

The Five Elemental Forces are expressions of energy that can be observed in nature and throughout the universe. In space they influence the motions of all stars, planets and cosmic phenomena. In nature they promote interactions between the five elements of fire, water, wood, metal and earth. Within the human body they affect the five major organs of the heart, kidneys, liver, lungs and spleen. Just as western science understands the atoms and sub-atomic particles to be the fundamental units of all matter, the Five Elemental Forces are understood to be the essence of all processes. The forces that influence the cosmos are identical to those which affect nature and our bodies.

Eight Forces

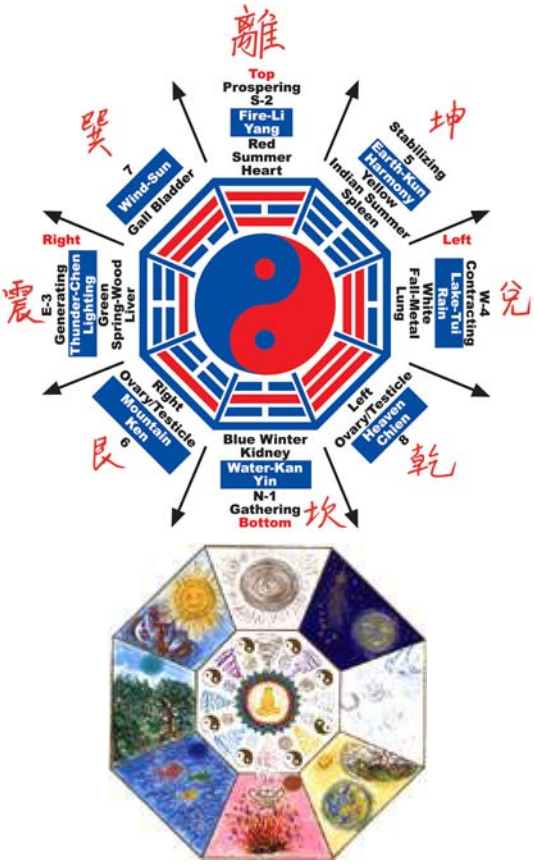

Fig. 2.5 *Eight Forces and Directions*

The Eight Forces represent a more detailed aspect of the forces of nature and the Universe. They are represented by the symbol of the pakua and the eight trigrams. In Fusion of the Five Elements, the pakua was introduced as a way to direct and gather the Chi into a pearl at the lower abdomen. In Cosmic Fusion, the pakuas are used in greater detail to create a stronger connection with the forces of nature and draw much more energy into the pearl.

Using the pakua in the meditation practice is a way to focus energy. The pakua creates a vortex that enables the practitioner to collect, gather and condense Chi. This vortex of energy is used to not only create a strong connection within ourselves, but a harmonious relationship with all the forces of nature.

Return to the Wu Chi

The Taoists realized that we are connected to the stars through our bodies as the human form is a product of stellar energy and matter. With the basic understanding that man, nature and the universe are expressions of primordial energy (or the Wu Chi), the Taoists devised methods to tap the energy of the five elements. This was done to enhance the processes of the Five Elemental Forces within our bodies, which can promote health, refine our spirits, and eventually reunite us with our source, the Wu Chi. Deep within our subconscious minds are memories and desires for the unity and bliss which preceded the dense vibrations of our gross physical state. So the ultimate purpose of Taoist practice is to return to our original state, the Wu Chi.

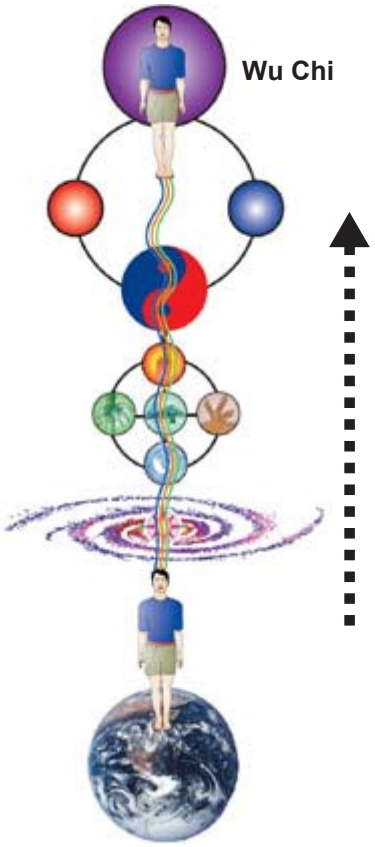

Fig. 2.6 *Return to the Oneness (Wu Chi)*

In the advanced disciplines of the Universal Tao students begin to work more consciously with the Five Elemental Forces emanating from the cosmos. Advanced practice involves collecting and absorbing energy from different sources in the universe while traveling in the energy and spirit bodies. Taoists move closer to the original source through the vastness of space in the same way a traveler moves from station to station in a train. Generations of Taoist masters have refined and mapped the simplest and safest approaches to follow. Because it is impossible to realize the Wu-Chi in one step, the journey is divided into several stages.

Returning to the Wu Chi: First Three Steps

1. The first step of stage one is to upgrade and maintain your physical health while stabilizing your financial and social conditions. Your body is a vehicle for processing energy, and the healthier you are, the more energy it will process at a faster rate. Your health and processing capabilities will enhance greatly through the Microcosmic Orbit, Six Healing Sounds, Inner Smile, Healing Love and Iron Shirt Chi Kung practices. Your finances and social interactions should be stable so that you can create space in your life for these disciplines.
2. Next you will learn how to use accumulated energies for traveling beyond this earthly plane to the moon, sun and planets. This is similar to the way a space shuttle uses a booster rocket to push it beyond the earth's gravitational field. In Taoism the Microcosmic Orbit and Fusion practices create the Energy Body to help boost the immortal body (spiritual body) out of this world. The healthier you are internally, the more power you will be able to generate to leave the confines of the physical body. When you can travel out of this reality and back, you will gain the raw materials necessary to build more powerful energy and spirit bodies for longer and farther journeys.
3. The higher practices involve traveling to and from the stars and constellations particularly the North Star and Big Dipper using the energy and spirit bodies. The North Star is a stable and constant point in the sky. For Taoist practitioners, using the North Star was a way to find direction in the Universe. The North Star is the gate of heaven. In the higher practices, the energy is drawn into the body to create that connection between the physical and the Universal bodies.

The human body is a powerful transformer. The sexual energy is the body's most powerful source of fuel for journeys to the higher planes. This is why the Healing Love practice is so important for spiritual development. The practice of Iron Shirt Chi Kung also helps the physical body absorb cosmic energy through the skin and bones to be transformed and refined into more fuel. Fusion of the Five Elements provides another mode of energy refinement through the transformation of negative energies into positive life-force, which is lighter and healthier for the body. All of these internal methods help one develop the means of traveling beyond this world. Their ultimate purpose (after rejuvenating the body) is to accumulate the raw materials for the construction of a stronger and more powerful vehicle for the return to the Wu Chi.

Many other systems have their own means of returning to the source. Monks, nuns and priests emphasize detachment from the world and non-involvement in worldly affairs. They have no relationships with other people and no sex, which leaves them with abundant sexual energy to be transformed and used for higher spiritual work. Such spiritually inclined people make the best and most use of sexual energy. In general, when normal people accumulate sexual energy to the same degree as monks, nuns or priests, they have no way to control it, and internal imbalances are created until it is released. The Universal Tao practices can give anyone the ability to use this energy to improve the body and spirit.

One should not believe in the Taoist teachings without experiencing the practice and its results first hand. This involves learning about the human body, the Universal forces which affect it, and the inherent desire we all have to return to our source. Taoism offers a clear, direct path to the Wu Chi, whereas many other systems provide only dogma and restrictions that can hinder spiritual growth. The Tao is not an escapist philosophy, however, as there is no need to remove yourself from society or restrict your relationships or sexual love. You can continue to live normally as you accumulate energies that will gradually improve your health while providing raw materials for the highest spiritual growth.

Chapter 3
Goals of the Fusion Practice

The Taoist study of **Inner Alchemy** was introduced in Fusion of the Five Elements. The Taoists developed the Fusion of the Five Elements practice to develop connections between and gain control of the inner and outer Universes.

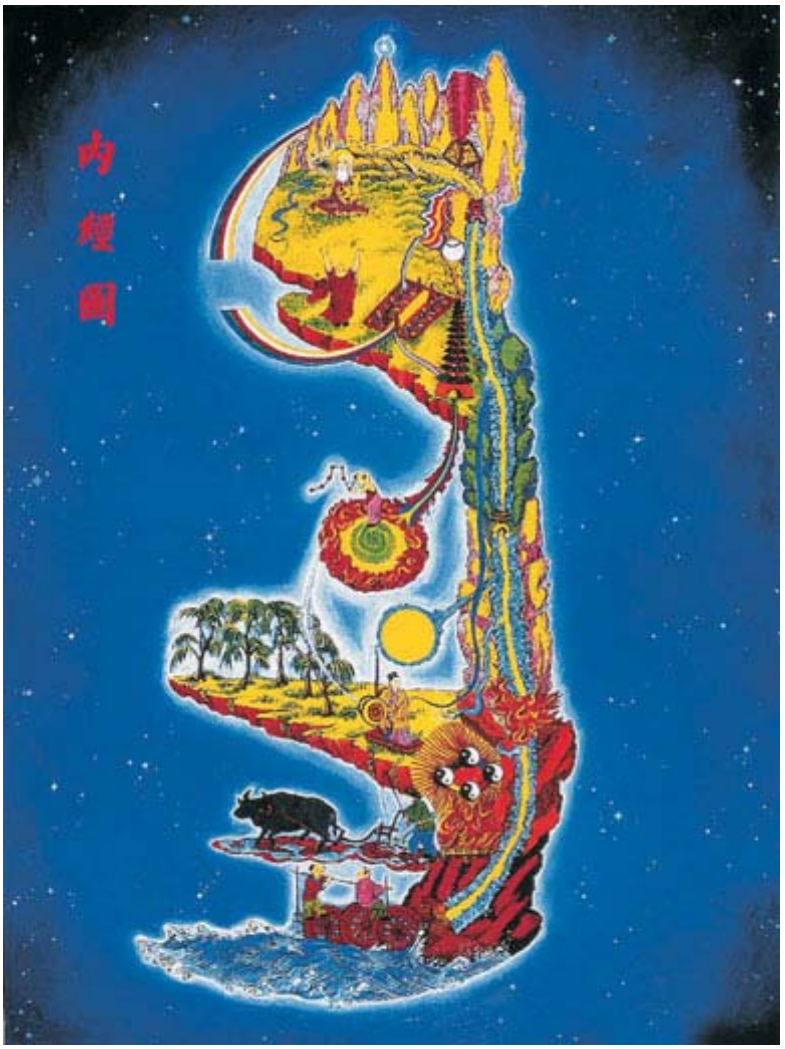

Fig. 3.1 *Taoist Inner Alchemy*

They understood that virtually everything that exists in the Universe can be broken down into the Five Elements. The Fusion practice begins by understanding the dynamics of the Universe, the planet Earth, and the human body with respect to their relationships to these Five Elements.

Fig. 3.2 *Five Elements, the Planets and the Cosmos*

The knowledge of Inner Alchemy is a necessary step in becoming connected to the outer Universe, from which an unlimited supply of powerful energy is available to be used for an individual's physical and spiritual benefit.

The five basic formulas of Fusion I, II, III can be likened to wiring blueprints for making the subtle energy the vehicle, the spaceship connections that link vital organs, glands and senses so that their respective energies can be fused and balanced in the collection point and the pakua. The formulas lead the student systematically through the process of creating four pakuas and an energy pearl.

Five Element Organ Correspondences					
Yin Organs	Liver	Heart	Spleen	Lungs	Kidneys
Yang Organs	Gall Bladder	Small Intestine	Stomach, Pancreas	Large Intestine	Bladder
Openings	Eyes	Tongue	Mouth, Lips	Nose	Ears
Positive Emotions	Kindness Generosity	Love, Joy	Fairness, Openness	Righteousness, Courage	Gentleness
Negative Emotions	Anger Envy Frustration	Hate, Impatience	Worry, Anxiety	Sadness, Depression	Fear, Stress
Transform Pure Organ Energy into a Virgin Child Dressed in	Green	Red	Yellow	White	Blue
Transform Pure Child Energy into an Animal	Green Dragon	Pheasant, Red Bird	Phoenix, Yellow on Red	White Tiger	Blue Deer
Earth Force takes the form of	Green Dragon	Pheasant, Red Bird	Phoenix, Yellow on Red	White Tiger	Black Tortoise
Directions	East	South	Center	West	North
Planets	Jupiter	Mars	Saturn	Venus	Mercury
Universal Energy Force	Generating	Prospering	Stabilizing	Contracting	Gathering

Fig. 3.3 *Five Element Organ Energy Chart*

Energy drawn from the organs and senses into the collection point and transformed negative emotions are fused and condensed into a pearl through the pakuas. When the resulting pearl, with its refined, balanced, neutralized energy is circulated through the Microcosmic Orbit, the body absorbs this enhanced life-force. The pearl is then used to form the Energy Body.

Cosmic Fusion builds on the foundation of internal alchemy laid in Fusion of the Five Elements. The student is encouraged to take this opportunity to review the basic Fusion practice.

Once the negative emotions have been drawn out and transformed, the pearl is moved through the creation cycle, nurturing the virtues. These qualities are cultivated, blended and condensed into the pearl, forming the energy of compassion —the essence of the senses, glands, organs and the mind.

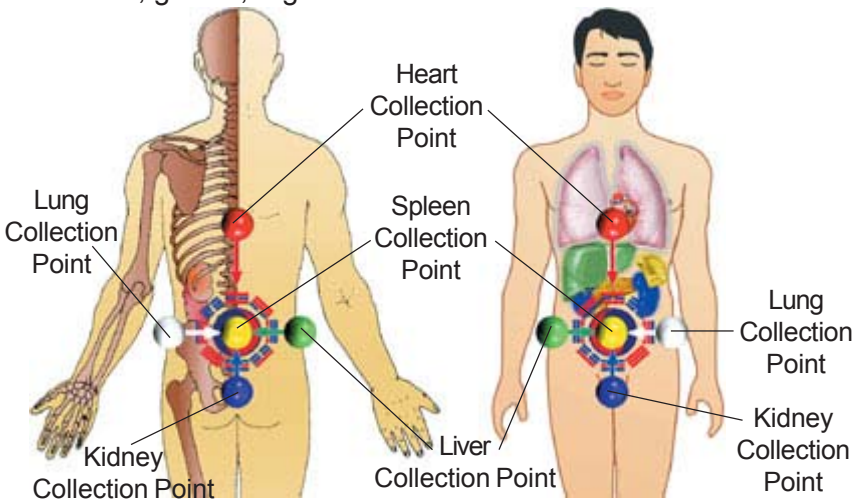

Fig. 3.4 *Front and Back Collection Points*

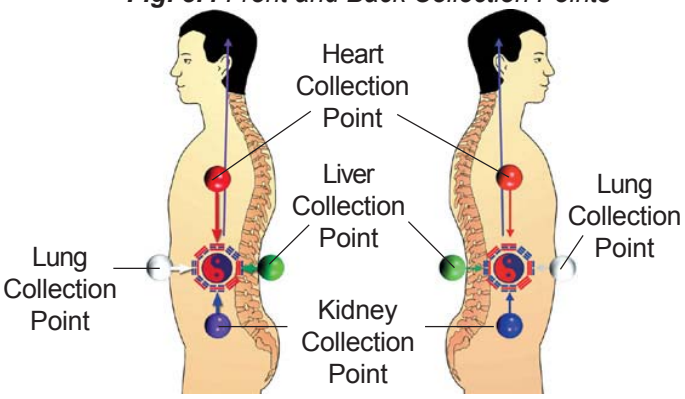

Fig. 3.5 *Left and Right Collection Points*

This highly refined pearl can now be used to open and clear four of the eight specific energy channels in the subtle body: the Three Thrusting Channels used for cleansing and protection, and the protective belt route that surrounds the Thrusting Channels.

Inner Universe reflects the Outer

The Fusion practice offers a practical way to strengthen the conscious connection with the outer Universe. During the practice of Fusion, the essence of life-force energy found in the organs, glands and senses is transformed, purified, condensed and combined with the Universal, Cosmic Particles and Earth Forces in order to achieve internal balance. This transformation of quality energy into a harmonious whole can effect positive changes in the human body. Controlling this energy enables each individual to attain balance and harmony of these energies on physical, emotional and spiritual levels. Because the inner Universe is a reflection of the outer one, the balance and harmony attained in the inner Universe enables the individual to attain balance and harmony with the outer Universe. Fusion of the Five Elements, the first in a series of the Taoist practice of Inner Alchemy, focuses on the interaction and fusion of all five elements and their correspondences. To understand this interaction, especially with respect to the organs, glands and senses of the human body, it helps to be aware of one of the Taoist laws of the Universe: *Nothing remains the same; everything changes because the Five Energies of Nature constantly interact and change*. This acknowledgement that change is constant contrasts sharply with the Western framework. Under this assumption, each individual's disposition and health is influenced by the balance within him or her of these five energies, a balance affected by the ever-changing conditions of the Universe.

The outer Universe is comprised of Universal Force, Cosmic Particle Force and Earth Force from which all things emerged and whose three combined forces sustain all existence. The concept of Inner Alchemy is grounded in the Taoist belief that the inner Universe is a reflection of the outer Universe. There are connections that can be made between the inner and outer Universe through which energy, recognized and experienced in the inner Universe as Chi, or life-force, can be greatly increased and enhanced by the immense power of the outer Universe.

Overview of the Cosmic Fusion
Universal Tao divides Fusion into Three Parts

Fusion of the Five Elements

First Part

Fusion of the Five Elements makes use of pakuas and energy collection points to balance, connect and draw out negative emotional energies found in the organs. These energies, along with their corresponding glands and senses energies, are then fused and transformed into pure, life-force energy.

The purity of this energy has an adhering and magnetizing quality enabling it to condense into a ball of refined energy which is called the pearl.

The pearl is then used to connect to the Universal, Cosmic Particle and Earth Forces whose energies become part of the pearl. A soul or Energy Body is formed from the pearl, enabling the individual to go beyond connecting with the forces of the universe on a purely physical level. Later the pearl returns to the organs and glands to enhance them and provides a protection to the physical and soul body.

Fig. 3.6 *Forming the Compassion Heart.*

Second Part

Cosmic Fusion focuses on using the pearl to grow or intensify the energy of good virtue. It makes use of the interaction of the elements described as the Creation Cycle of the Five Elements Theory to circulate positive Chi or virtuous energy through the major organs. All the energy gathered during this cycle is combined to form a beautiful pearl of Compassion energy. This pearl is then used to open and cleanse specific channels that pass through the physical body into the Energy Body.

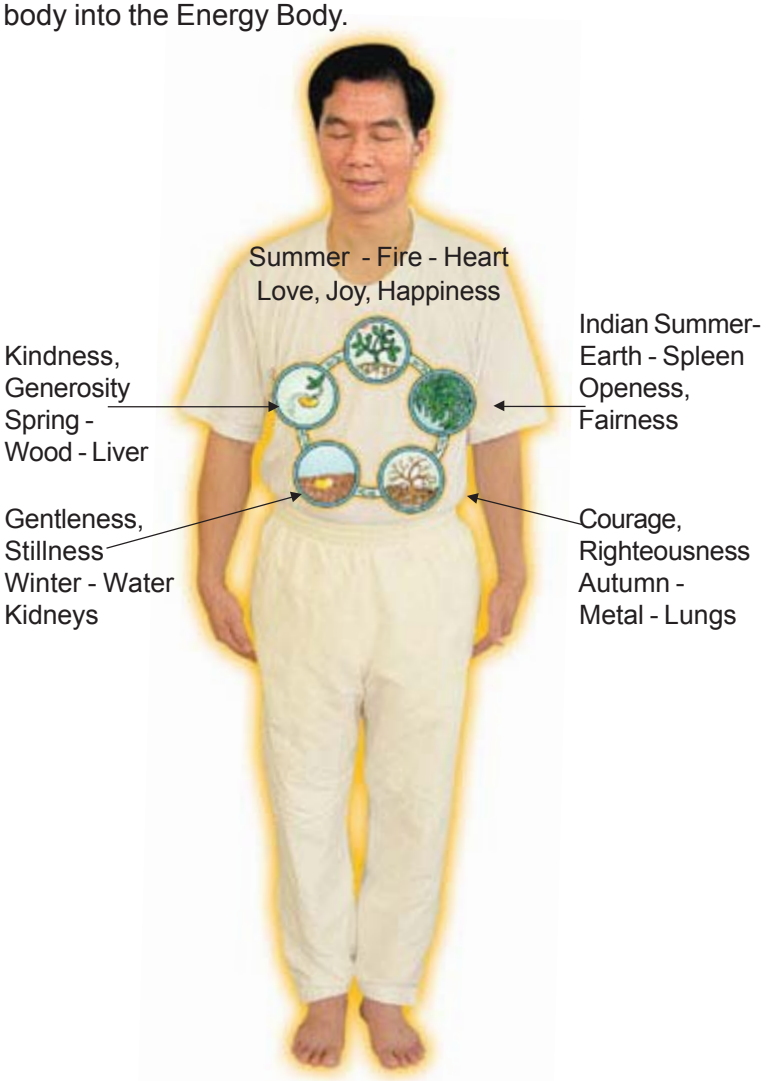

Fig. 3.7 *Creation Cycle in Nature and Human Body*

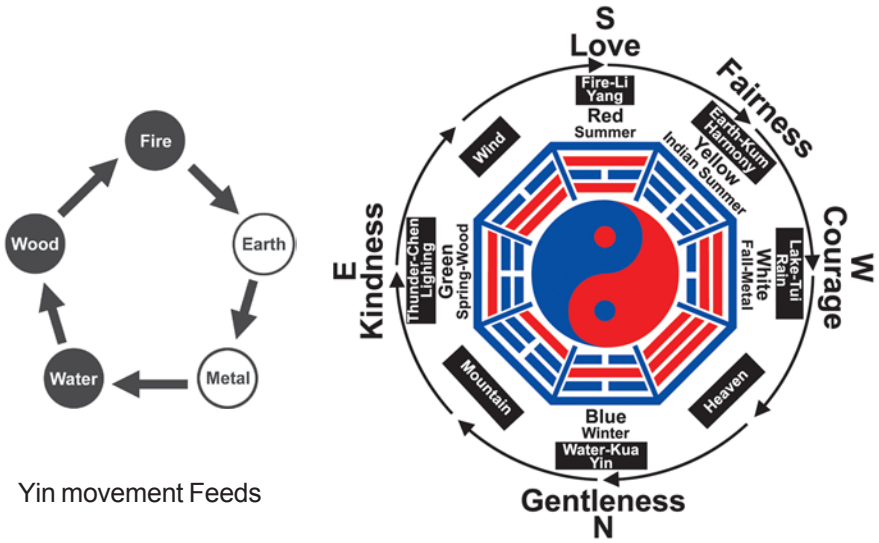

Fig. 3.8 *Creation Circle*

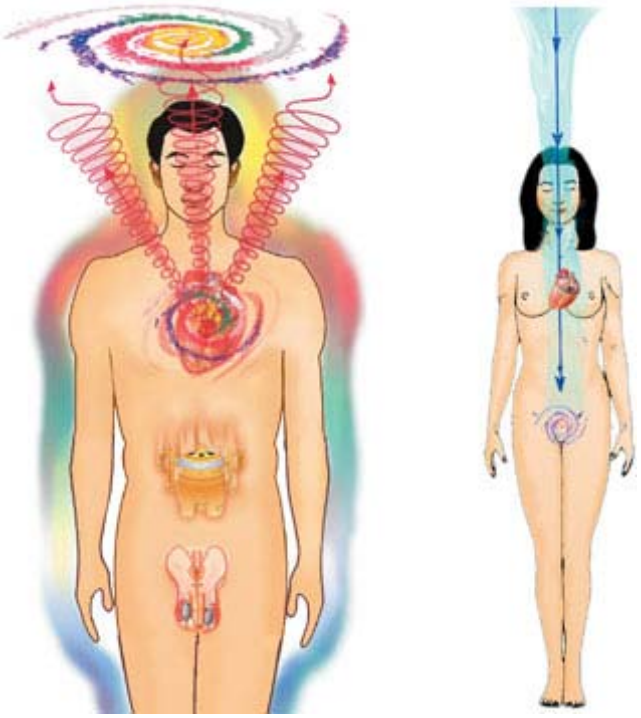

Fig. 3.9 *Forming the Cosmic Compassion of the Heart*

Third Part

The energy of the positive emotions of all the organs is absorbed into the pearl and then circulated in four of the eight special channels: the Microcosmic Orbit (Governor and Functional Channels), the Thrusting Routes, and the Belt Routes. The Thrusting Routes run through the center of the body, linking the "chakra" centers. The Belt Routes spiral around the body strengthening the aura and providing a form of psychic self-defense.

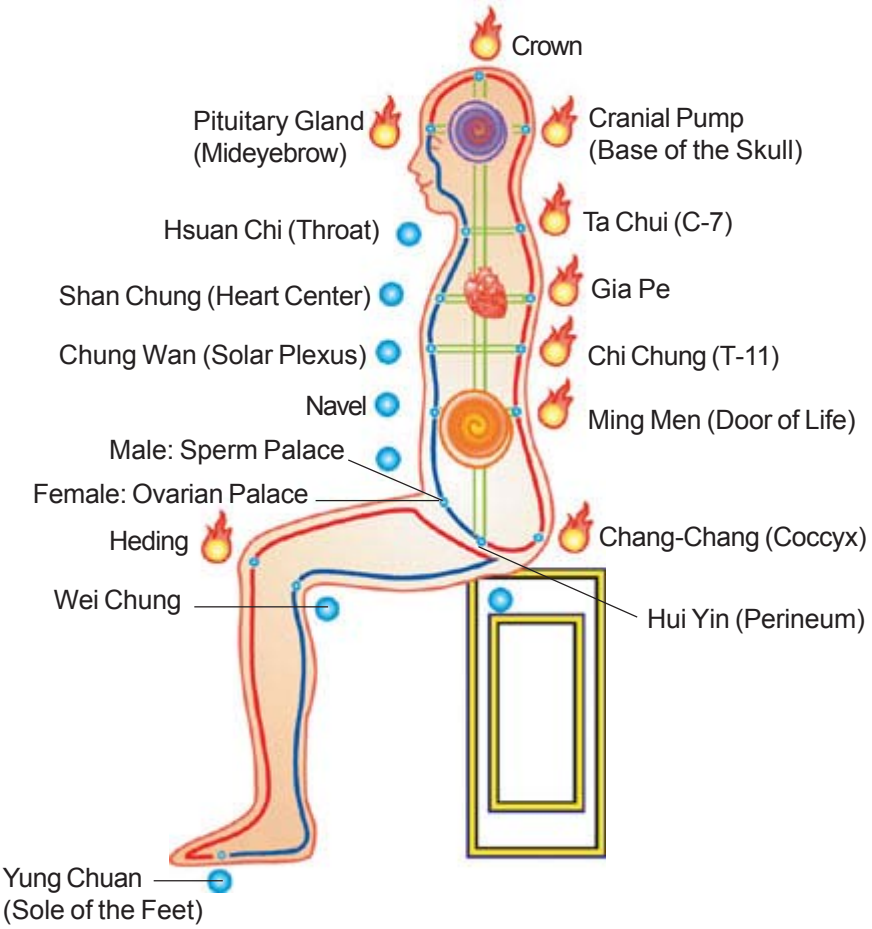

Fig. 3.10 *Cosmic Orbit with Ancient Chinese Points*

The three Thrusting Channels, sometimes referred to as Thrusting Routes and the Belt Channels or Belt Routes, opened during Cosmic Fusion, permit a freer flow of energy throughout the body.

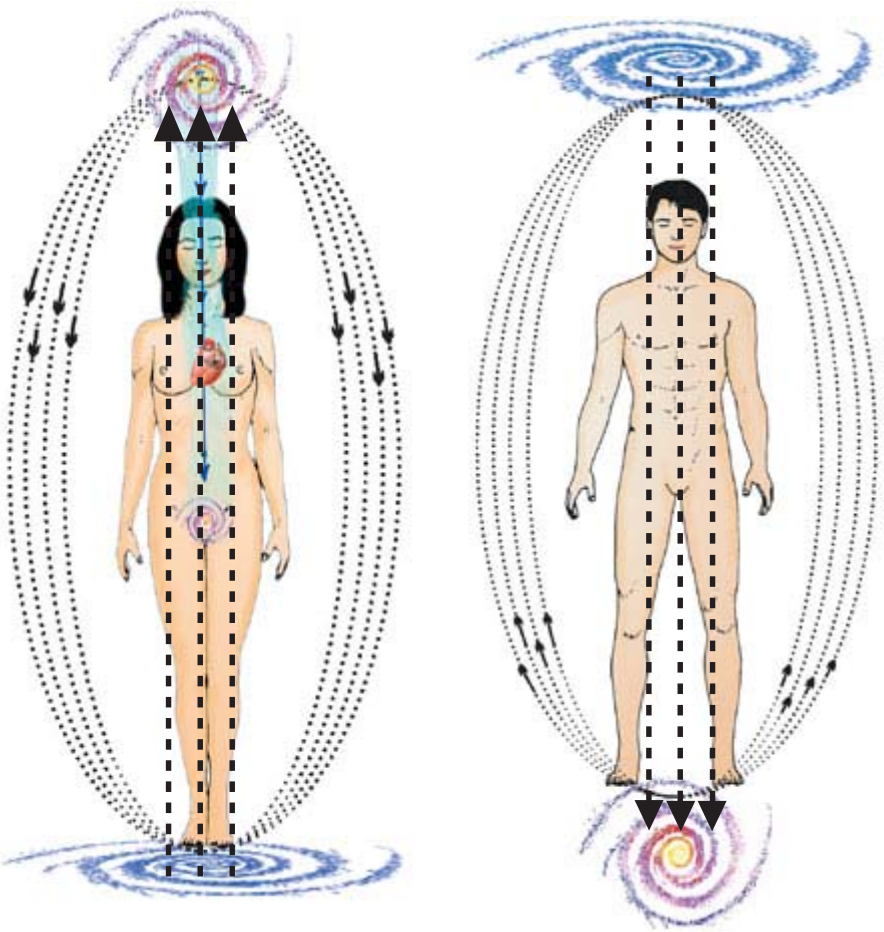

Fig. 3.11 *Cosmic Thrusting Channels Women and Men*

The Thrusting Channels are opened first. Their primary function is to cleanse specific energy pathways in the body, thereby opening them up for the energy to flow freely. The Belt Channel surrounds the physical body and the internal Thrusting Channels. Both channels help to build a denser body and provide protection to the body, but they have another function.

Use eyes to help spiral the Belt Channels.

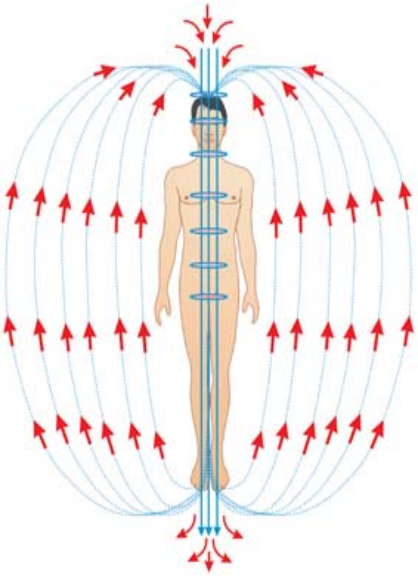

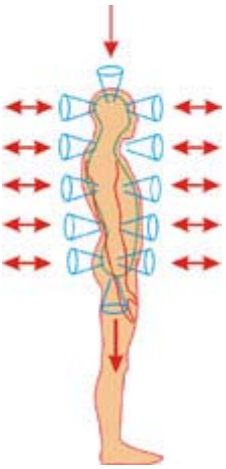

Fig. 3.12 *Belt Channels and Thrusting Channels*

With the additional energy generated during the practice of Cosmic Fusion, you will have enough energy to create a new Energy Body above the physical body. Another important aspect of the Fusion of the Five Elements practice is learning how to temporarily separate the Energy Body and the Physical Body. In life, our three bodies, the Physical Body, Energy Body, and Spirit Body (consciousness) all overlap and are generally inseparable. At death, the physical body is no longer a fit vehicle for holding the material five elements together and Chi and consciousness are forced to leave. To avoid the traumatic disorientation and confusion that can occur at death when the energetic essence and consciousness are involuntarily thrust out of the physical body into unknown territory, we can familiarize ourselves with the "out-of-body realm" by temporarily separating the Energy Body and Spirit Body from the Physical Body, as a "dress rehearsal" for death.

Consciousness always requires some sort of vehicle to manifest. Its gross vehicle is the physical body. Its more subtle vehicle is the Energy Body (sometimes referred to as the "subtle" body). We emphasized earlier that the virtues are the true energetic essence of our organs. Although we may identify ourselves more with our physical body than anything else in the world, it is our energetic essence, not our physical body, that survives after death and has the capacity to be immortal.

The Thrusting Channels and Belt Channels can be extended up into this Energy Body and Spirit Body. In this way they serve as connecting links between the organs and glands of the Physical Body and the transferred consciousness that is the Energy Body. Eventually, the channels serve as conduits through which the Spirit Body is boosted to the Mid-Plane. These advanced practices are called the meditations of Kan and Li.

If the Energy Body is thought of as a booster rocket, then the Spirit Body is the shuttle. Once the Spirit Body is boosted through the open channels into the Mid-Plane, it collects a higher quality of energy. The Spirit Body then returns with the higher quality energy to the Physical Body. In the next effort this energy is used to construct a stronger, more intense Energy Body that can boost the Spirit Body to a higher Mid-Plane level. The cycle continues bringing the Spirit Body to higher and higher levels, while increasing the life-force energy for use by the Physical, Energy and Spirit Bodies.

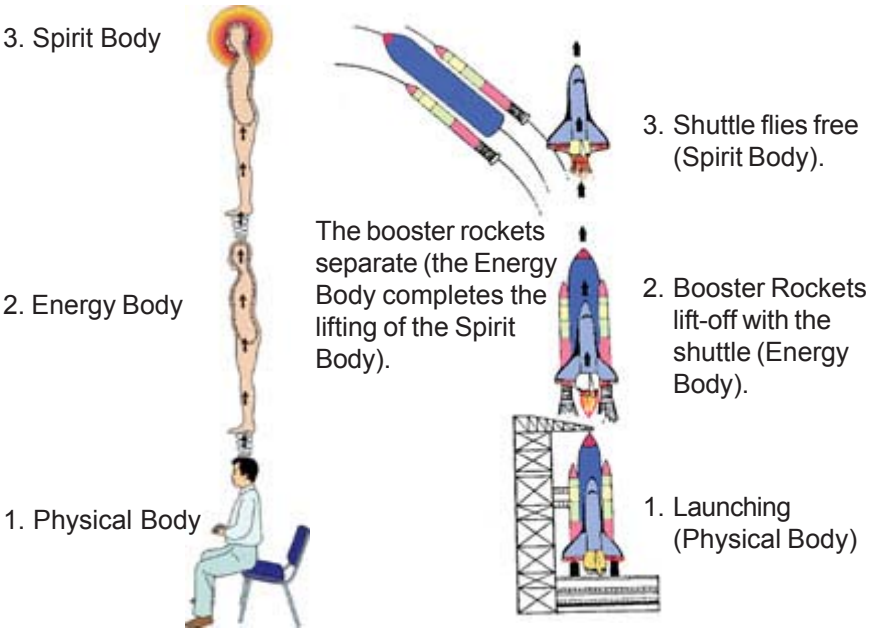

Fig. 3.13 *Energy, Physical and Spiritual Bodies*

By regularly turning the awareness inward in the Fusion of the Five Elements practice, we gradually come to know our energetic essences as well as we know our face, our arms and our legs. We learn to distill these essences into a pearl, as a sort of "space capsule" to carry our essential energy and consciousness out of the physical body. With regular practice, Taoists who follow the path of Inner Alchemy learn to move their Energy Body and consciousness in and out of their physical body as easily as one might walk from one room into another.

Chapter 4
Energetic Preparations for Meditation Practice

Meditation practices are enhanced by developing one's sensitivity to subtle energy and by exercising to improve postural alignment, increase flexibility of the spine and deepen relaxation of the physical body. The next sections present a series of suggested exercises to help the student meet these goals.

Chi has many sensations. Some of the most common are tingling, heat, expansion, an electrical sensation (like the feeling of static electricity), pulsation or effervescence. This is not the actual Chi itself, but the signs of increasing Chi in a particular area. Chi itself is more mysterious, subtle beyond definition. For more details in the practices of Spinal Cord Breathing, Rocking the Spine and the Inner Smile to relax the whole body check with the book by Mantak Chia "*Awaken Healing Light*".

Preparing for the Fusion Meditations

Prepare the Environment

Find a quiet place to meditate where there are no distractions. Some places have naturally peaceful Chi: mountains, forests, caves, gardens, monasteries or beautifully designed meditation rooms. Once you have experienced such a place, you can just recall it. Set aside a corner of your room for your practice and recall your connection to the forces of nature.

Keep your meditation place clean and pleasant.

Avoid interruptions. Plan to meditate early in the morning before other people are awake: the body is rested, the air is fresh, and the earth itself is energized.

Late at night is also fine. Select a time that works well for you with your own rhythms and schedule.

If you allow yourself time each day to cleanse your emotional, energetic and physical bodies, you will soon reap the rewards in every area of your life.

Conserve Energy and Purify your Body with an Appropriate Diet

To clear your digestive tract, it helps to reduce the amount you eat, to eat less meat, fish and poultry and to increase the amount of fiber in your diet. Unless you are a vegetarian, it is recommended that you eat about 80 percent grains and vegetables, 10 to 15 percent fish and only 5 percent meat and chicken.

Loosen, Stretch and Warm Up the Body before Meditating

Once you have a quiet place and are ready to meditate, spend time loosening up the body, particularly the spine, before you sit down to practice.

The Universal Tao recommends doing some stretching exercises, Chi Kung and Tai Chi before you begin to meditate. These exercises are both invigorating and relaxing; they relieve muscle tensions, stimulate the blood circulation, get rid of stale air in the lungs and oxygenate the blood. As an alternative, you can take a relaxing stroll outside.

Doing some movement before entering the stillness of meditation can help you shake off the sluggishness that comes from being too sedentary and ease the tensions that might build up during a hectic day. Then when you sit down, you are ready to begin. Use the Simple Chi Kung exercises to loosen your spine and prepare the mind and body for meditation.

Wear Loose and Comfortable Clothing

The clothing you wear for meditation should be loose and comfortable. It is very important that your clothes restrict neither the Chi flow, the blood circulation, the nervous system nor the breath.

It is preferable to wear clothing of natural fibers so your body can breathe. During meditation, all the pores open wider and breathing in energy through them requires looser clothing. When you have learned to breathe through the skin, your body will need to contact more fresh air.

Establish a Stable Sitting Position

The body must be stable for the mind to be stable. It has been said, "An anxious mind cannot exist in a relaxed body." The mind and body are clearly connected and when the body and breath become peaceful, the mind easily follows.

If your posture is firm and balanced, it will be easy for you to relax, and you will already be halfway toward achieving a tranquil and focused mind. But if your posture lacks balance and stability, your muscles will soon tire and become tense, your attention will waver like a candle in the wind.

Consider seven points in preparing a good meditation posture: base, hands, spine, shoulders, chin, eyes and tongue.

1. **Base**: Your base is the foundation of a good meditation posture. To accommodate the movement of internal and external forces generated by the Taoist practices we need to stay grounded and establish a good connection with the earth's energy. The more Chi one moves through the body, the more important grounding becomes to prevent overheating of the organs and other negative side effects.

   The soles of the feet provide an ideal connection to the earth through the Yung Chuan (Bubbling Spring) points. These are specifically designed to absorb the earth's energy and conduct it up into the body. The legs also help filter the raw energy to make it more readily digestible.

   It is best to sit on a straight backed chair to practice the Fusion Meditations. Your weight should be evenly divided over four points: your two feet and the two sitting bones (the tuberosities of the ischium) *(Fig. 4.1)*. Place the feet flat on the floor the same distance apart as the hips. The calves of the legs should be vertical, like pillars. Try to have the knees and hips at the same level, or keep the knees slightly higher.

   The part of the pelvis known as the ischium is structurally designed to hold a tremendous amount of weight. Avoid leaning back and sitting on the coccyx and sacrum instead of the ischium. Honor Mother Nature's design by sitting on the ischium and not on the tailbone, which puts pressure on the sacrum, one of the major pumps in the spine for cerebrospinal fluid, a vital cushion for the nervous system. Check to make sure your weight is evenly distributed over the four points to establish a solid base to support the body during meditation.

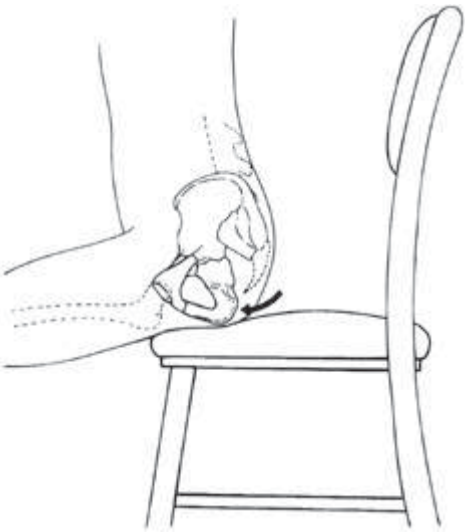

Fig. 4.1 *Sitting Bones*

2. **Hands**: Let your hands rest in your lap, clasped together with the right palm over the left palm and the right thumb and forefinger wrapped around the base of the left thumb. You may rest your hands on a pillow placed on your lap *(Fig. 4.2)*. The clasped hand position works especially well to consolidate and balance the energies generated during the meditation.

Fig. 4.2 *Using a small pillow helps release shoulder stress.*

3. **Spine**: The spine should be straight but not stiff and in good vertical alignment with gravity. You can imagine your head being pulled up by a string. As it rises, allow the spine to elongate, increasing the space between vertebrae *(Fig. 4.3)*.

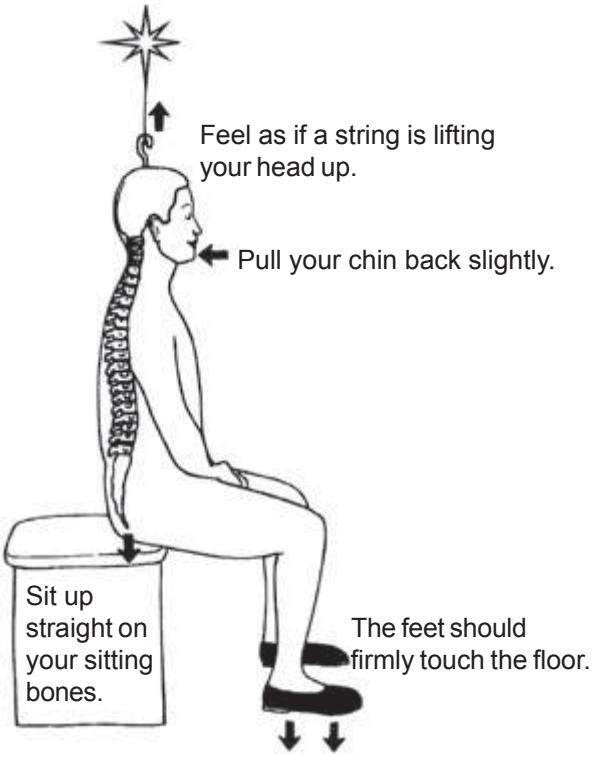

Fig. 4.3 *Correct Sitting Position*

Some people find their backs become tired during long rounds of meditation. Good alignment helps prevent this by taking some of the stress off the muscles and putting it instead on the skeletal structure where it belongs. The skeletal structure is designed to support hundreds of pounds without effort when properly aligned. Practicing Iron Shirt Chi Kung and Tai Chi is very helpful for strengthening the muscles you use in sitting and for learning the body mechanics of good alignment.

The spinal column houses many nerves, and it is also a major part of the Microcosmic Orbit pathway. If the spine feels relaxed, clear and open, the mind will feel more awake and alert too.

4. **Shoulders**: The shoulders should be relaxed and balanced over the hips. The armpits should be slightly open allowing enough space to hold a Ping Pong ball *(Fig. 4.4)*. This permits free circulation of blood and Chi into the arms and keeps the nerves in the arms from being impinged.

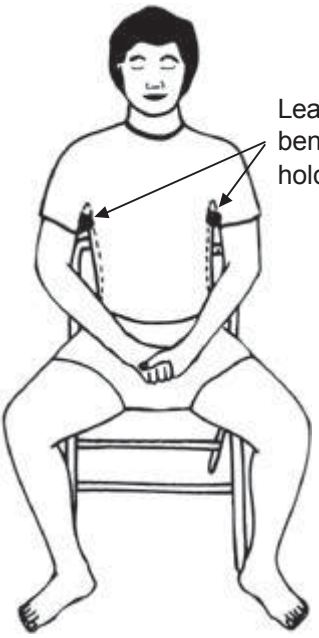

Fig. 4.4 *Arms' Position*

5. **Chin**: The chin should be drawn back slightly, with as little strain as possible, so that the ears are over the shoulders. If you strain too much to bring the head back, your muscles will soon tire.
6. **Eyes**: Your eyes should generally be closed or slightly open with the gaze directed downward. Or you can focus on the nose, and from the nose focus into the heart. You can open the eyes for a while if you feel sleepy or distracted *(Fig. 4.5)*.
7. **Tongue**: The tip of the tongue should be touching the upper palate *(Fig. 4.6)*. This connection acts like a switch in that it connects the Tu Mo and Ren Mo, the Governor and Functional Channels. The best point for you to use is the one where you feel the strongest sensation of Chi.

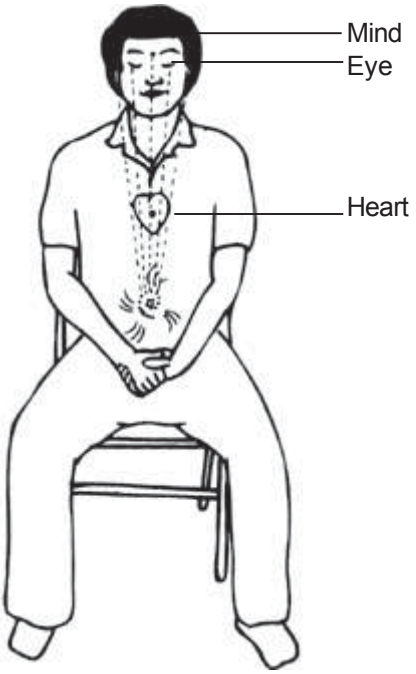

Fig. 4.5 *Turn the mind and eyes inward. Focus into the heart and then down into the navel.*

Fig. 4.6 *Touch the tip of your tongue against the upper palate.*

Fig. 4.7 *Smile to the organs and feel the organs smile back to you.*

Chapter 5
Beginning Fusion Element Meditation

Pakua

Fig. 5.1 *Pakua - Eight Forces*

The pakua is a symbol of the eight forces. In the Fusion of the Five Elements meditation the pakuas are used to gather and collect the energy of the organs and fuse them into a pearl. Here in the Cosmic Fusion meditation, the pakuas are again used to fuse energy into a pearl. Now, instead of just using the energy within the body, we combine the energy of the organs with the energy of the Universe. This is a technique used in the Fusion practice to condense and gather the abundant energy that surrounds us into something that is usable and digestible to the body. Forming the pakuas will be used in all the Fusion formulas.

The first step is to form the pakua at the lower abdomen to connect with and attract the five energies and the eight forces. The goal is to balance and transform the emotional energies of the organs. The next step is to form the facial pakua. The facial pakua gathers and transforms the energy of the senses and the thoughts down to the lower abdomen. The Universal pakua is then created to gather and collect the energy of the Universe into the lower abdomen. All these energies once gathered are condensed into an energy ball, or a pearl of white light. This highly refined ball of energy is then circulated through all the channels as a way to open, heal and revitalize the body, mind and spirit. This is the beginning of the transference of consciousness to a new realm.

Chanting

Chanting has been used in all systems of spirituality to help connect the practitioner to their higher source. In Christianity, chanting and singing is used to connect with God. In Buddhism and Hinduism, chanting is used to clear the space, to open the body and connect themselves with the Buddha or Hindu God or Goddess. The power of chanting and singing can be seen not only in a religious setting, but in all levels of society as well. Singing and listening to music is a very natural way to move energy.

In the Taoist practice, chanting is used to invoke the forces of the Universe. It is not necessarily about harmony. We want to get depth and power to the vibration to open the lower abdomen and create internal power. When you chant try to feel the vibration coming from the Lower Tan Tien.

Chanting in the Pakua is very similar to the sound in the genes when the replicating strands of DNA cross over. The eight sounds are the song of the crossing of the chromosomes like two serpents entwining and then they making love and one becomes two.

The pakua is a symbolic representation of the forces of nature. By chanting the names of these forces, we are able to make a connection with that force. Also, Yin and Yang are chanted as a way to contract and expand energy. The combination of chanting the forces and Yin and Yang helps to bring the power of the Universe to you as a tuning fork.

Chanting greatly increases the power and the coherence of the Pearl. After toning all eight directions, the forces of the Universe

are fused into the Pearl. The Yin and Yang (Tai Chi spines) chanting helps to expand and gather, as well as contract and store the force. This will help create the connection between your internal energy and the energy of the Universe.

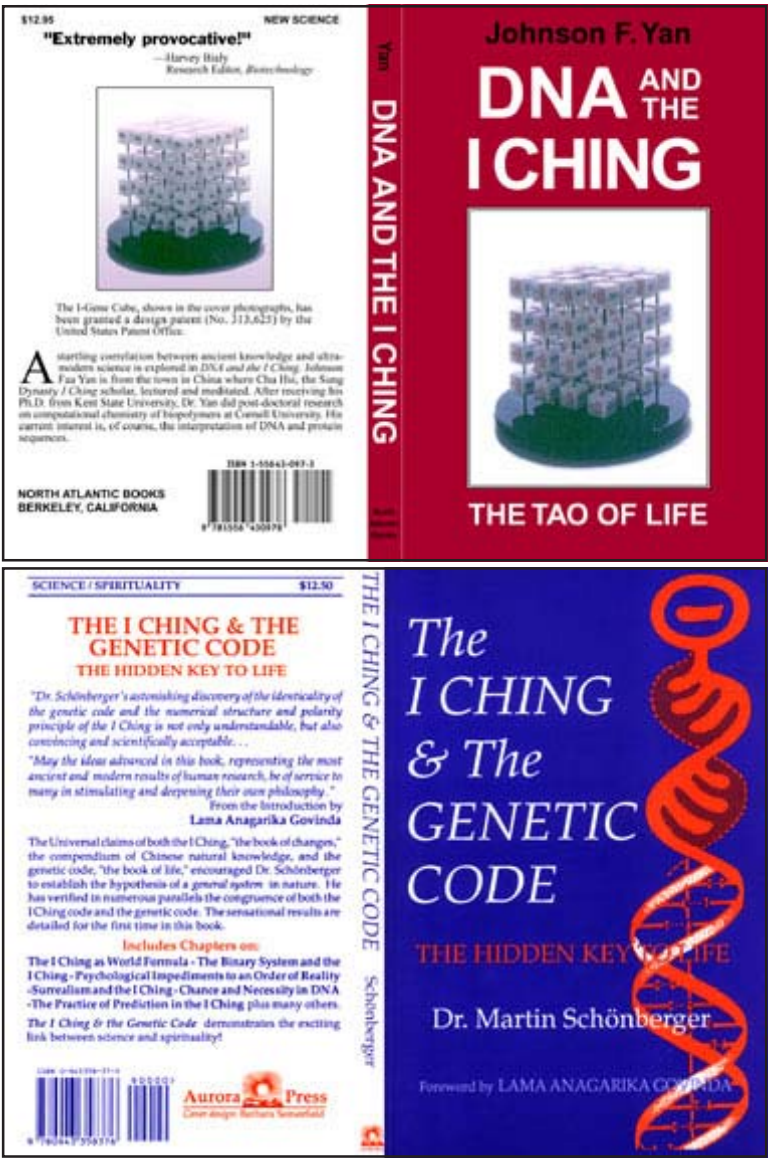

Fig. 5.2 *DNA and the I Ching book cover and the I Ching and the Genetic Code book cover*

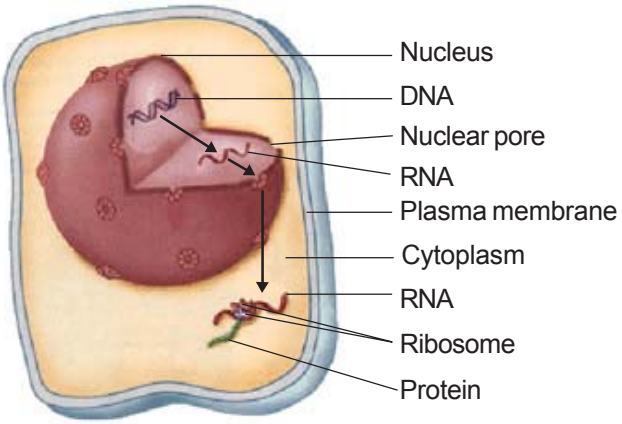

Fig. 5.3 *When the frequency is 8Hz transcription occurs in the nucleus, translation takes place in the cytoplasm.*

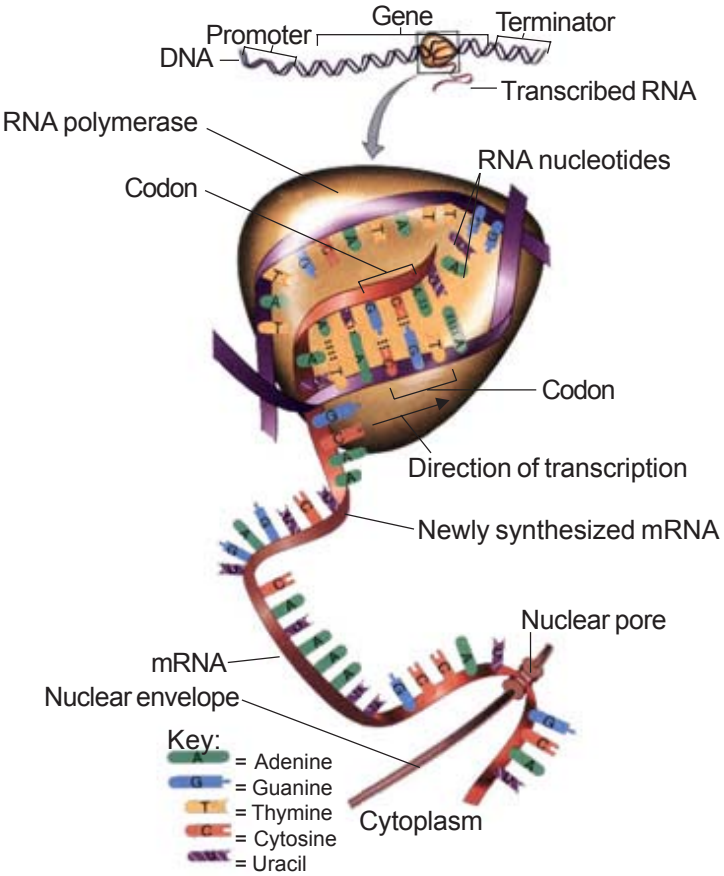

Fig. 5.4 *During transcription, the genetic information in DNA is copied to RNA which in the Tao is known as cupping or self-intercourse.*

Formula One: Forming the Pakuas

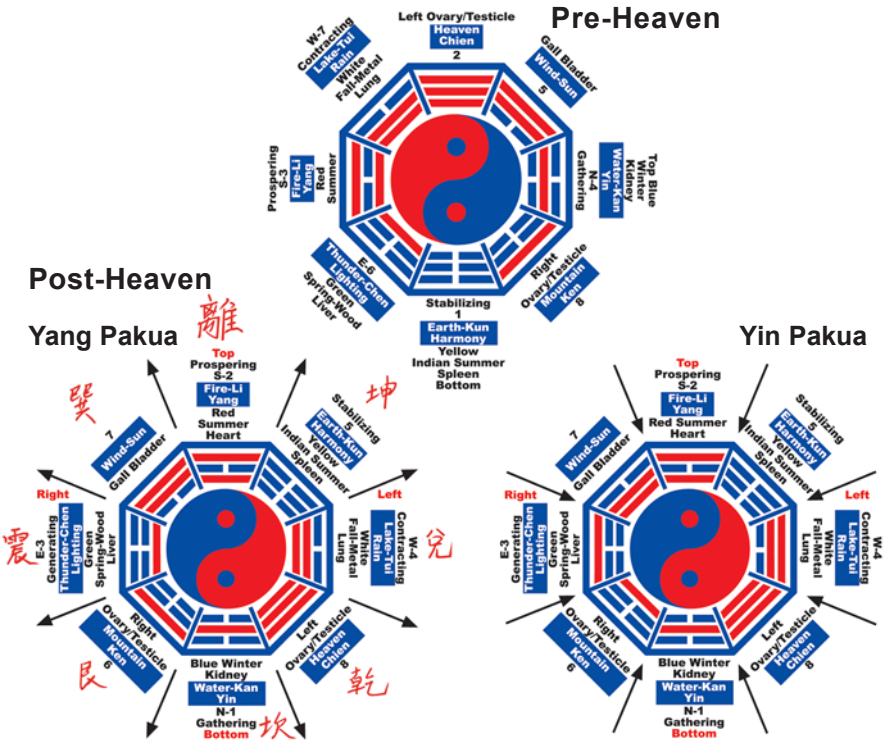

Fig. 5.5 *Pakua - Tai Chi Symbol -*
Three Outside Lines - Eight Connecting Lines

There are two arrangements of the pakuas: the Pre-Heaven and the Post-Heaven. It is said that the Pre-Heaven pakua was discovered by Fu Hsi, a legendary figure of early Taoist history, as the Ho-Tu, inscribed, some say on a horse, others say on a dragon that rose from the river Ho to reveal itself to Fu Hsi. The Post-Heaven pakua was revealed to another legendary king, Yü, the Great, as the Lo-shu. This time it was written on the shell (back) of a tortoise that emerged from the river Lo. The Pre-Heaven pakua shows the unchanging cycle movement of these energies, the natural order of the universe and is the foundation of Fu Hsi's divinational trigrams/hexagrams, of the I Ching. The Post-Heaven pakua shows the opposing interaction and movement of these energies, which are responsible for the changes and creation of all the things in the universe, in nature and in our own lives.

Creating the Front Pakua

Drawing the Pakua on the Abdomen: the Front Pakua

It is important to get familiar with visualizing the pakua. Training the mind to concentrate on a single image is of immeasurable value for spiritual practice. The image of the pakua allows the mind to focus and fuse energy. This first step is essential to the rest of the Fusion practice. One of the best ways to get this image deeply connected in the mind is to draw it on a piece of paper and place it over your abdomen. Or, if you are a little more adventurous draw it directly on the abdomen. When you draw the pakua, use blue for Yin, red for Yang and black for the frame. Sometimes it helps to work with a partner. Draw the pakua over your partner's abdomen, and do the meditation facing one another. This way you can glance at the pakua and know what forces to work with. Be creative. Do whatever works so that you get the image planted firmly in your mind.

The pakua is between the underside of the rib cage and above the pubic bone. When we chant the symbols of the trigrams, you can use your finger to draw them on your own abdomen, or while you look at the pakua on your partner.

There are 3 different major centers for generating the frequency which fuse together to form the main energy center of the body. 1. Tan Tien, the Chi Center can be measure like heat in the infrared. 2. Throat Center. 3. Third Eye Center.

Fig. 5.6 *Pakua in the Abdomen*

Practice

1. Four Signs

Kan: First Sound

a. **Kan** (Yin-Yang-Yin). The power symbol of the Water gathering and yin power, connected with the kidneys, ears and sexual organs. Evoke the energy of the symbol by repeating its sound, **Kan,** several times or until you feel the connection with the energy of Kan, which is spreading down to the sexual organs and the kidneys. The Kan sound should come from the abdomen and the throat.

b. First chant the name of the trigram Kan in a long and deep sound while you picture the symbols and touch your lower abdomen. Your eyes look down to the lower abdominal area.

Fig. 5.7 *Kan (Yin-Yang-Yin)*

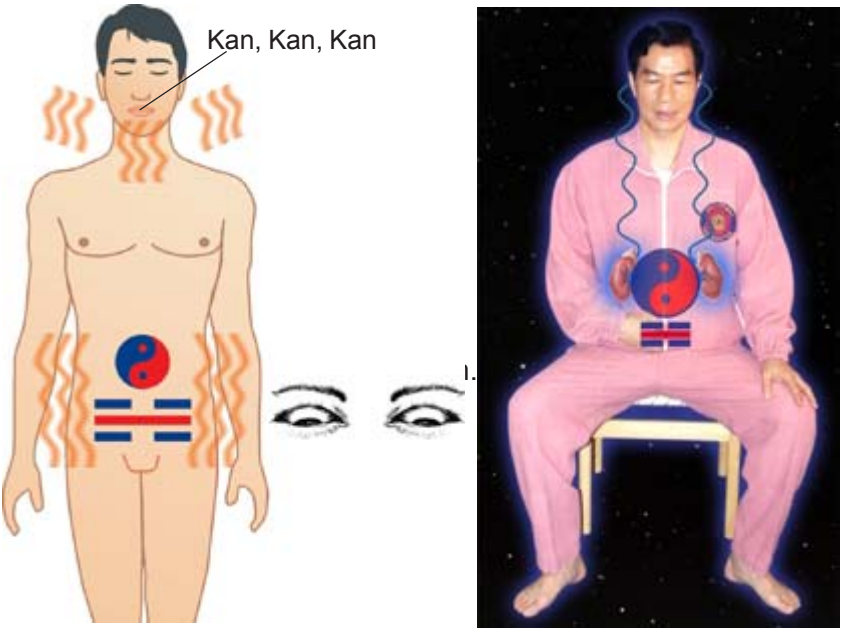

Fig. 5.8 *Chant Kan (Ears and Kidney connects to the Kan)*

c. Next, chant the Yin and Yang lines of the symbol one after the other (Yin-Yang-Yin). Start from the inner side, close to the Tai Chi symbol.

d. **Yin Contract**: First expand the mind and the hands and palms to touch the universe, the cosmic. Chant the Yin, Yin, Yin as long as you feel comfortable, and continue moving your palms and draw the cosmic Chi from the universe into the navel, and feel the navel has suction. Feel your hands and the Tan Tien; the throat has the power of sucking the Chi down the Yin line to the navel. Rest. (Fig. 5.9)

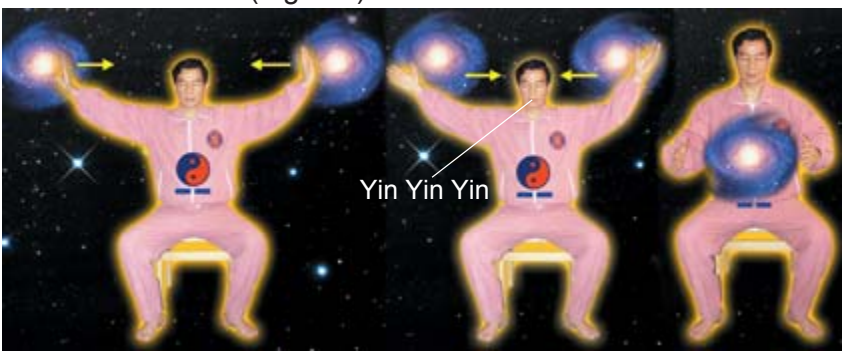

Fig. 5.9 *Yin Line — — Yin Contract*

e. **Do the Yang Line**: Be aware of the Tan Tien, throat, crown and the palms close to the navel and slowly chant the long Yang sound and turn the palms out. Gradually move the palms to the left and right sides and feel your palms very long and big touching the cosmic. Rest and feel your palms in touch with the cosmic Chi. (Fig. 5.10)

Fig. 5.10 *Yang Line — Yang Expand*

f. **Do the Yin Line again**: Yin contracts; expand the mind and the hands and palms to touch the sky and the cosmic. Chant the Yin, Yin, Yin as long as you feel comfortable and continue moving your palms and draw the cosmic Chi from the universe into

the navel, and feel the navel has suction. Feel your hands and the Tan Tien; the throat has the power; the Chi goes down the Yin line to the navel. Rest for a while. Feel the vibrations inside as you chant the trigram. (Fig. 5.11)

Fig. 5.11 *Yin Yang Yin Trigram*

Rest. Repeat the words " Kan" at the lower abdominal in your mind and let your eyes look down at the lower abdominal. Then you close your eyes and picture the symbols: Kan (Yin-Yang-Yin), smile and be aware the kidneys, ears and the power of the yin and gathering power. Try to imagine them in your mind's eye and feel them imprinted on your abdomen and vibrating inside you.

Rest and project the symbol into the universe and feel the symbol in the universe reinforce the Kan in the abdomen.

Note: Doing the chanting together in a group makes it much more powerful.

Fig. 5.12 *Kan in the abdomen*

Li: Second Sound

a. The second sound is **Li** (Yang-Yin-Yang), the power symbol of the Fire, connected with the heart, the prospering power. The eyes look up at the upper abdominal, the Li Kua. The sound comes out from the area between the chest and the throat. Repeat this sound until you feel the vibration of the fire expanding upwards in the chest.
When you chant **Li** you feel the energy going up.
When you say **Li** the eyes look up.

Fig. 5.13 *Li (Yang-Yin-Yang)*

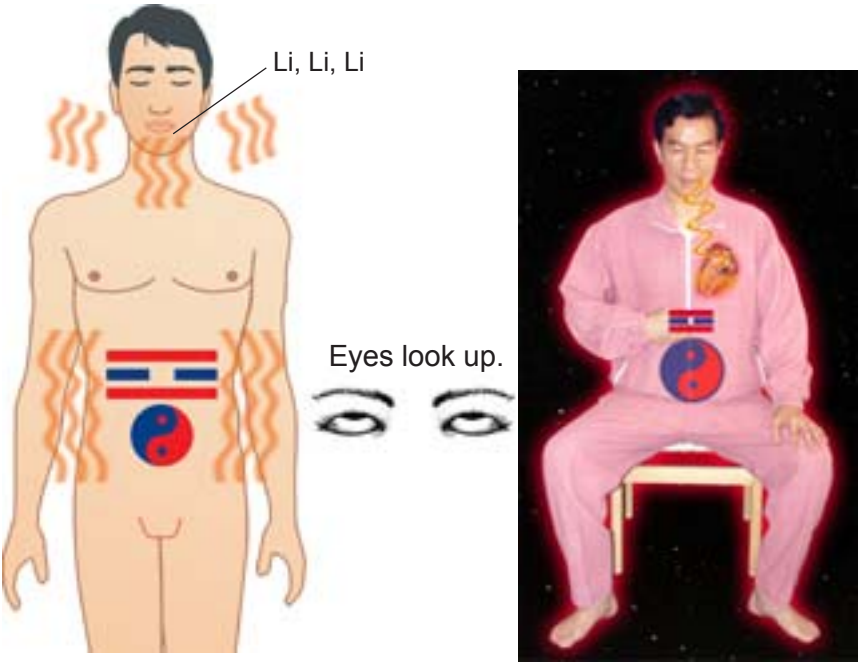

Fig. 5.14 *Chant Li (Tongue and Heart connect to the Li)*

b. Chant the name of the trigrams Li in a long and deep voice while you picture the symbols and touch your lower abdomen and upper abdomen. (Fig. 5.14)
c. Next, chant the Yang and Yin lines of the symbol one after the other (Yang-Yin-Yang). Start from the inner side close to the Tai Chi symbol.

d. **Yang Expand**: Be aware of the Tan Tien, the throat, crown and the palms close to the navel and slowly chant the Yang long sound. Turn the palms out and gradually move the palms to the left and right side. Feel your palms very long and big as they touch the cosmos. Rest and feel your palms touch the cosmic Chi. (Fig. 5.15)

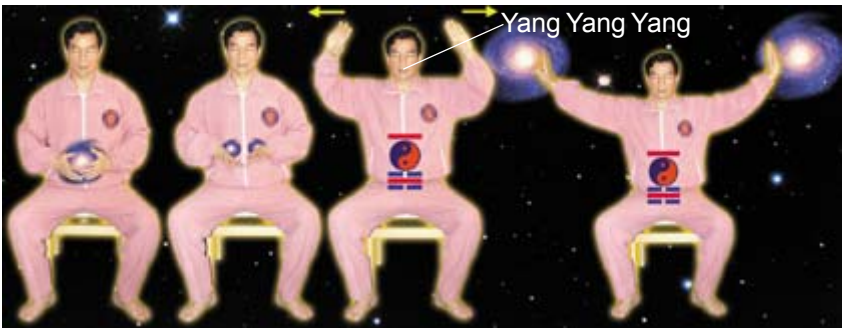

Fig. 5.15 *Yang Line — Yang Expand*

e. **Yin Contract**: Your mind and the hands and palms touch the sky, the cosmos. Chant the Yin, Yin, Yin as long as you feel comfortable, and continue moving your palms up. Draw the cosmic Chi from the universe into the navel, and feel the navel has suction. Feel your hands and the Tan Tien. The throat has the power; draw the Chi into the Yang line to the navel. Rest for a while. (Fig. 5.16)

Fig. 5.16 *Yin Line — — Yin Contract*

f. **Do the Yang again**: Be aware of the Tan Tien, the throat, crown and the palms close to the navel and slowly chant the Yang long sound. Turn the palms out and gradually move the palms to the

left and right side. Feel your palms very long and big as they touch the cosmos. Rest and feel your palms touch the cosmic Chi. (Fig. 5.17)

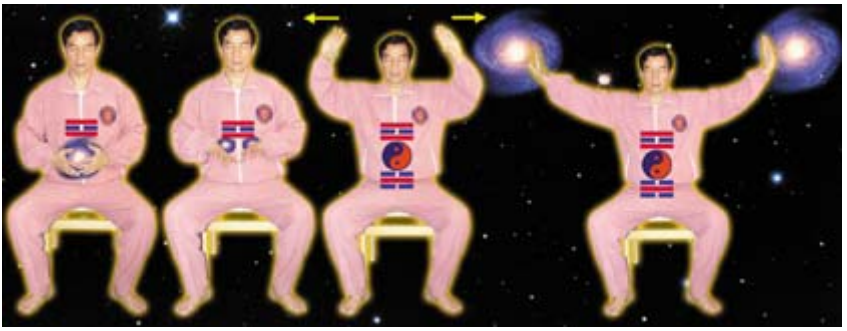

Fig. 5.17 *Yang Line — Yang Contract*

g. **Repeat the word "Li"** in your mind and let your eyes look at your Li Kua. Close your eyes and picture the symbol Li, still moving your eyes up. Smile and be aware of the heart, tongue and the prospering power of fire. Imagine them in your mind's eye; feel them imprinted on your abdomen and vibrating inside you. Rest and project the symbol into the universe and feel the symbol in the universe reinforce the Kan in the lower abdomen.

Fig. 5.18 *Li above the Navel*

Chen: Third Sound

a. The third sound is **Chen** (Yang-Yin-Yin), the power symbol of the Thunder and the Lightning, connected with the liver and the eyes, the wood element and gathering power. This sound evokes the trigram Chen that is placed on the right side (below the liver) and the sound comes out as "djen". Repeat the sound until you feel a vibration of energy below the liver, at the right side of the pakua. When you chant "Chen" the eyes look to the right side.

Fig. 5.19 *Chen (Yang-Yin-Yin)*

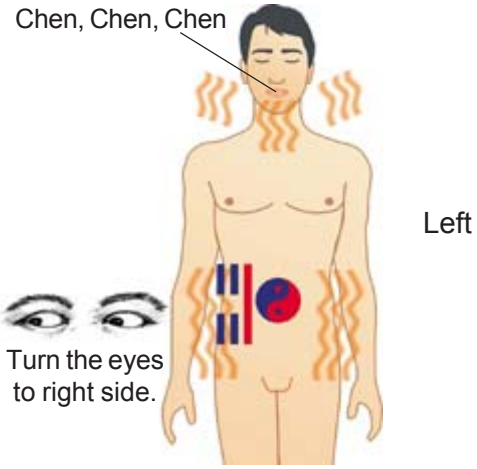

Left

Fig. 5.20 *Chant Chen (Eyes and Liver connect to the Chen)*

b. **First chant the name of the trigram Chen** ("Djen") in a long deep throat sound while picturing the symbol and touching the right side of your abdomen. Feel the vibration of the lightning and the thunder. Look at the right side of the body, close your eyes and visualize at the symbol of Yang-Yin-Yin. Smile and be aware of the liver, the eyes and the power of generating, lighting and thunder power.

c. **Yang Expand**: Be aware of Tan Tien, the throat, crown and the palms close to the navel and slowly chant the long Yang sound. Turn the palms out and gradually move the palms to the left and right sides and feel your palms very long and big touching the cosmos. Chant the Yang, Yang, Yang as long as you feel comfortable. Rest for a while. Feel the vibrations inside as you chant the trigram. (Fig. 5.21)

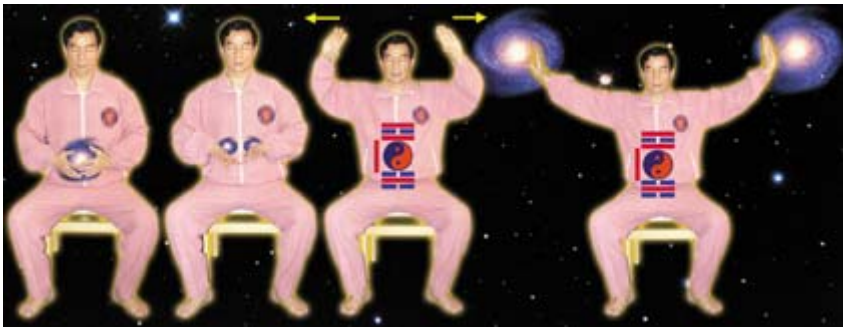

Fig. 5.21 *Yang Line — Yang Expand*

d. **Yin Contract**: Be aware of the Tan Tien, the throat, crown and the palms close to the navel and slowly chant the Yin long sound as the palms touch the universe. Chant the Yin, Yin, Yin as long as you feel comfortable and continue moving your palms back. Draw the cosmic Chi from the universe into the navel and feel the navel has suction. Feel your hands and the Tan Tien; the throat has the power, the Chi goes down the yin line to the navel. Rest for a while. Feel the vibrations inside as you chant the trigram. Rest and feel your palms touch the cosmic Chi. (Fig. 5.22)

Fig. 5.22 *Yin Line — — Yin Contract*

e. **Do the Yin line again**: be aware of the Tan Tien, the throat, crown and the palms move out to touch the universe. Chant the Yin long sound. Chant the Yin, Yin, Yin as long as you feel comfortable and continue moving your palms back and draw the cosmic Chi from the universe into the navel and feel the navel has suction. Feel your hands and the Tan Tien; the throat has the power, the Chi goes down the yin line to the navel. Rest for a while. Feel the vibrations inside as you chant the trigram. (Fig. 5.23)
Rest for awhile and feel the vibrations inside.

Fig. 5.23 *Yin Line — — Yin Contract*

Tui: Fourth Sound

a. The fourth sound is **Tui** (Yang-Yang-Yin), the power symbol of Lake and Rain, connected with the lungs and nose, the metal element and contracting power. This sound evokes the trigram Tui, that is placed on the left side (opposite Chen) and the sound comes out as “tway”. Chen and Tui are throat sounds. Repeat the sound until you feel a vibration of energy at the left side of the pakua.

Fig. 5.24 *Tui (Yang-Yang-Yin)*

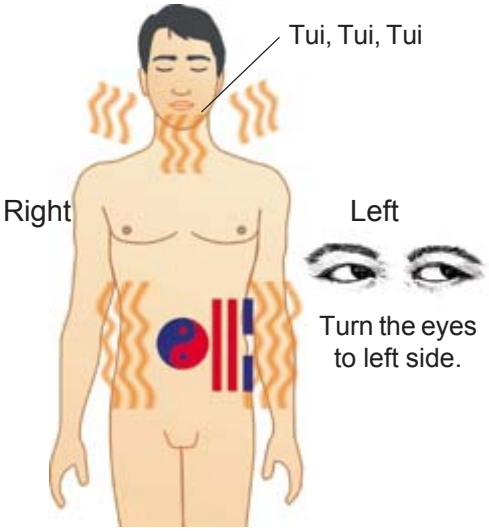

Fig. 5.25 *Chant Tui (Nose and Lung connect to the Tui)*

b. **Next chant the name of Tui** in a long deep voice while picturing the symbol and touching the left side of your abdomen. Feel the vibration of the rain and the lake. Look at your left side, close your eyes and visualize at the symbol of Yang-Yang-Yin. Smile and be aware of the lungs, nose and the power of contracting rain and lake.
c. Do the Yang Line, **Yang Expand**; be aware of Tan Tien, the throat, crown and palms close to the navel and slowly chant the long Yang sound. Turn the palms out and gradually move the palms to the left and right sides and feel your palms very long and big touching the cosmic. Chant the Yang, Yang, Yang. (Fig. 5.26)
d. Do the Yang line again. **Yang Expand**; be aware of Tan Tien throat, crown and palms close to the navel and slowly chant the long Yang sound. Turn the palms out and gradually move the palms to the left and right sides and feel your palms very long and big touching the cosmos. Chant the Yang, Yang, Yang.

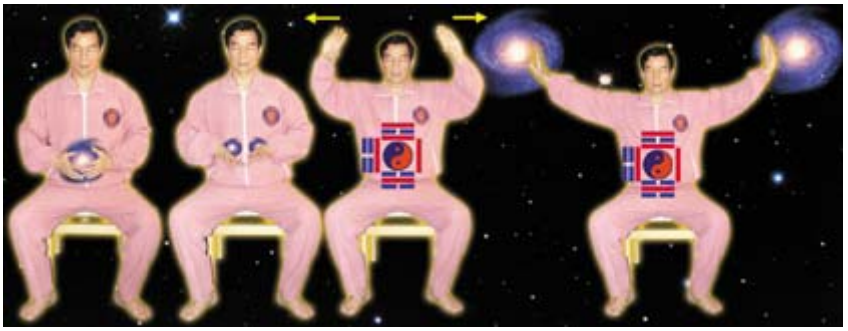

Fig. 5.26 *Yang Line — Yang Expand*

e. **Yin Contract**: Chant the Yin, Yin, Yin as long as you feel comfortable, continue moving your palms and draw the cosmic Chi from the universe into the navel and feel the navel has suction. Feel your hands and the Tan Tien; the throat has the power and the Chi goes down the yin line to the navel. Rest for a while. Feel the vibrations inside as you chant the trigram. Finish. Rest for awhile and feel the vibrations inside. (Fig. 5.27)

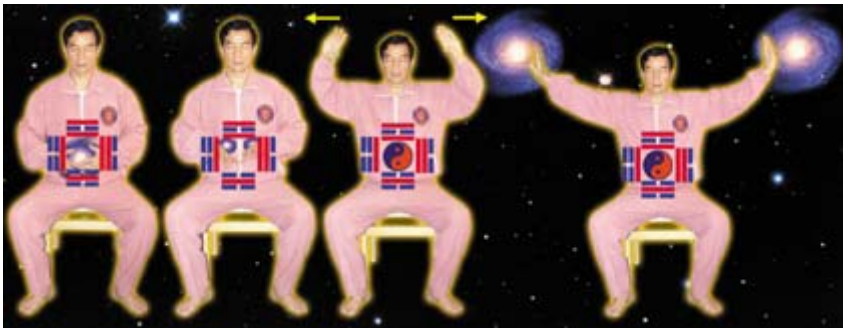

Fig. 5.27 *Yin Line — — Yin Contract*

2. Continue the practice with the next four symbols.

The last four trigrams of the pakua are: **Kun** (Yin-Yin-Yin), the Earth power, **Ken** (Yin-Yin-Yang), the Mountain power; **Sun** (Yin-Yang-Yang), the Wind power and **Chien** (Yang-Yang-Yang), the Heaven power.

Go through the same procedure as with the first four symbols to evoke the energy and connect it to the pakua.

a. Do all the 8 symbols together quickly Kan, Li, Chen, Tui, Kun, Ken, Sun, Chien (6 sets).
b. Be aware of the pakua and see it imprinted deep into the abdomen.
c. Be aware of the Tai Chi symbol and start to chant, Tai Chi, Tai Chi, and Tai Chi faster and faster. Feel the Tai Chi symbol moving faster and faster now.

Practice of the Next Four Symbols.

Symbol Kun - Earth

Stabilization power stomach and mouth, spleen and pancreas.

Focus on Kun, Yin-Yin-Yin. Chant Kun and then chant Yin-Yin-Yin repeatedly. You can use the hand to help draw in the energy back to the Pakua. Later on, you do not need to use your fingers. Picture the symbol Kun in front of you and expand it very far away to connect with the centering, stabilizing power. Let the energy with the symbol come to you until it sticks to your forehead. Bring it down to the south/west (upper left corner) in the abdominal Pakua.

Fig. 5.28 *Chant Kun (Earth, Mouth and Spleen connect to the Kun)*

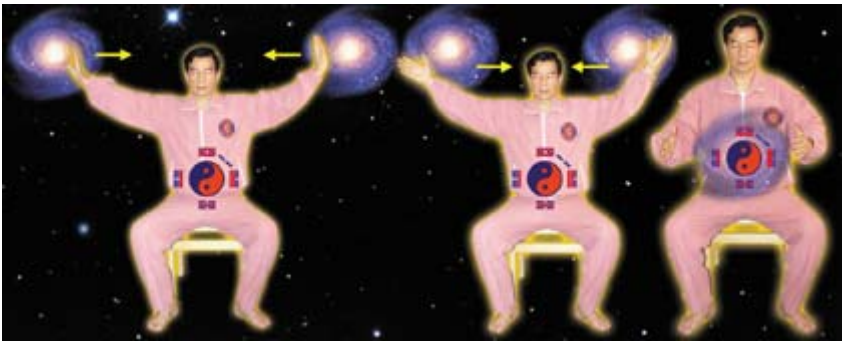

Fig. 5.29 *Yin Line — — Yin Contract*

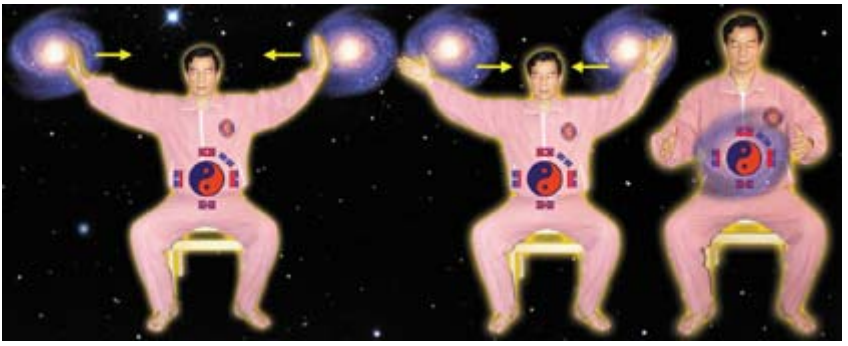

Fig. 5.30 *Yin Line — — Yin Contract*

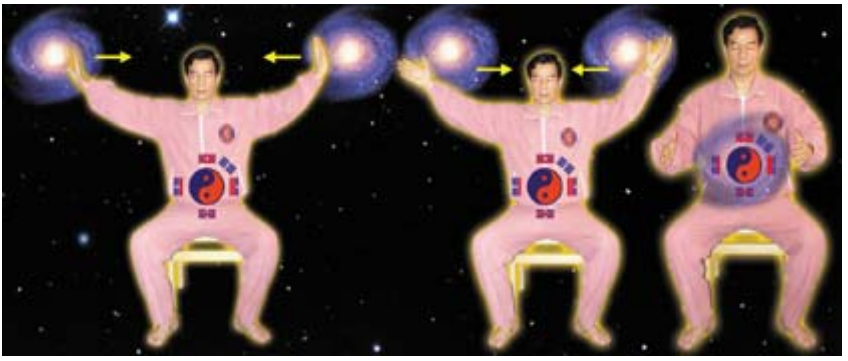

Fig. 5.31 *Yin Line — — Yin Contract*

Symbol Ken - Mountain

Yin side of water power and with bladder and sexual organs.

Focus on Ken, Yin-Yin-Yang. Chant first Ken and then Yin-Yin-Yang repeatedly. It is a nose/throat sound. Mark the symbol with your fingers and your eyes/mind on your forehead. Rest and feel the symbol imprinted on your forehead. Expand it far away to make the connection with the stable and strong mountain power. Feel the symbol with the energy come back. Move it to its place in the pakua on your abdomen in the lower right corner.

Fig. 5.32 *Chant Ken (Mountain connects to the back of the skull)*

Symbol of Sun - Wind

Also connects with the gall-bladder and wood power.

Focus on Sun, Yin-Yang-Yang. Chant Sun and then Yin-Yang-Yang repeatedly. Picture the symbol on your abdomen mark it with your fingers at the abdomen first and then just with your eyes and mind. Picture the symbol very far away to connect with the power of the wind until it comes back to you and sticks to your abdomen. When the reinforced symbol sticks to your abdomen, move it down to the upper right corner of your abdominal Pakua.

Fig. 5.33 *Chant Sun (Wind connects to the base of the skull)*

Symbol of Chien - Heaven

Also connects with the yang side of metal power and large intestine.

Focus on Chien, Yang-Yang-Yang. Chant Chien and then Yang-Yang-Yang repeatedly. Mark the lines of the trigram on the abdomen with your fingers and your eyes/mind. Rest and feel the symbol imprinted on the abdomen. Expand it very far away to connect with the power of Heaven. Do it several times until you feel that the symbol is coming back and sticks on your abdomen. Bring this reinforced trigram down to the lower left corner of your abdominal Pakua.

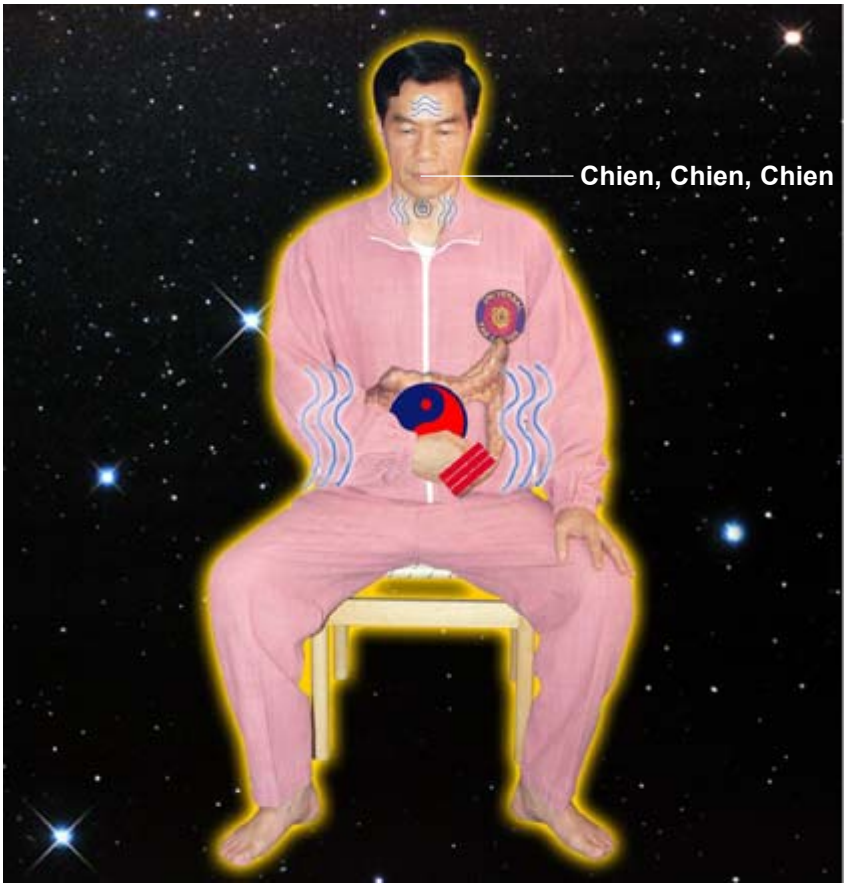

Fig. 5.34 *Chant Chien (Heaven connects to the forehead bone)*

When you finished the last imprinting of these first four symbols, make the Tai Chi symbol, spiraling with the fingers around the navel and saying: **Tai Chi, Tai Chi, Tai Chi**. This is an abdominal sound. Continue to chant it more inwardly, **Tai Chi**, **Tai Chi**, **Tai Chi**, at the same time spiraling with your fingers and eyes. When you finish the chanting, rest. Feel the Kan and the Li, the Chen and the Tui join together, fusing the energy of these forces inside of you.

We now combine the four trigrams.

- First look at your pakua and say the name of the symbol and its Yin-Yang components.
- Chant Kan - Li - Chen - Tui while moving your eyes down-up -right-left. Repeat several times.
- Rest; spiral with your fingers around the navel and continue the spiraling movement of the eyes awhile chanting Tai Chi, Tai Chi, Yin - Yang, Yin - Yang until you feel the Tai Chi symbol spiraling in the middle of the pakua connecting the trigrams together. Feel a big space, a fire burning inside of you.

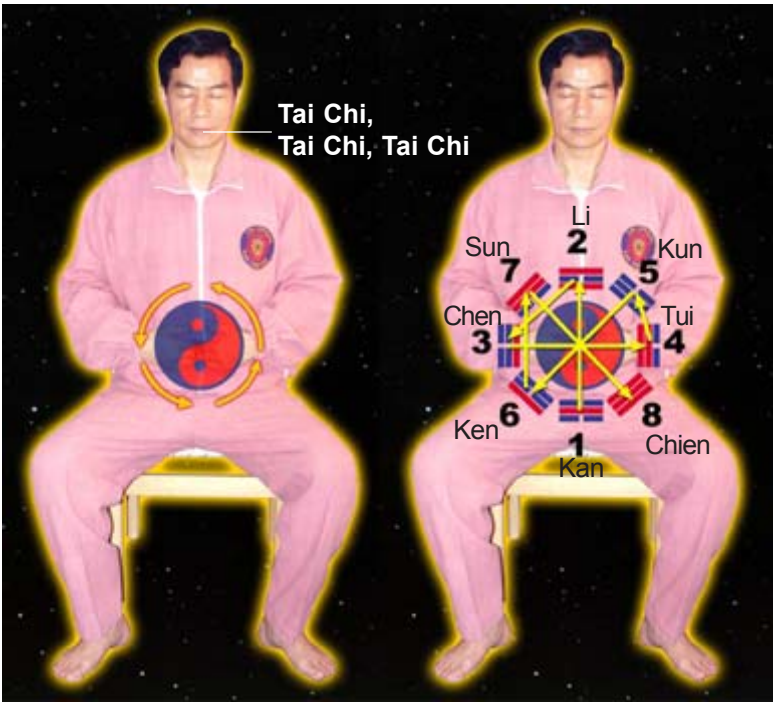

Fig. 5.35 *Finish the imprinting the four symbols and four trigrams.*

Merging Energy of both Pakuas and establish the Cauldron.

a. Copy the front Pakua to the back Pakua and let the Tai Chi symbol spiral. Be aware of the front Pakua spiraling in one direction and the back Pakua in the reverse direction. You can start the front Pakua spiraling counterclockwise and the back clockwise in reverse. Merge the energy of the front and the back Pakua right in the center of the Tan Tien and form a space there for the cauldron. At this point, leave the spinning energy moving. Feel the both Pakuas still spinning and drawing Cosmic Force from all directions. Rest, and then start spinning the energy.

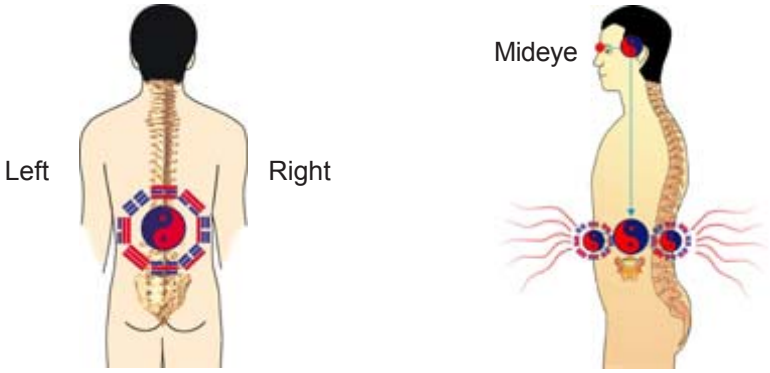

Fig. 5.36 *Back Pakua*

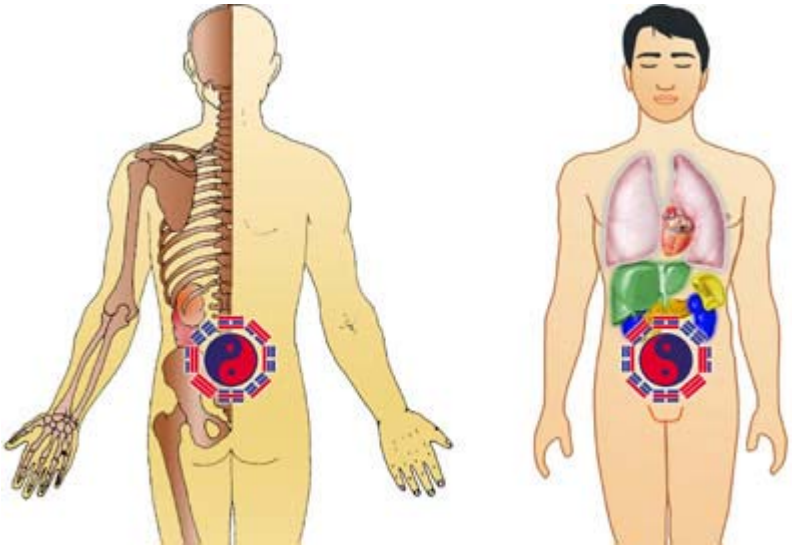

Fig. 5.37 *Front and Back Pakua*

b. When both pakuas are spiraling, focus on the center and look down while being aware of the front and the back pakuas. Chant Yin-Yang and spiral with your mind's eye in the center. Feel the big space of the front pakua and the back pakua coming into the center, merging together and creating a big space inside you for the cauldron. Feel the cauldron inside you spiraling like a big ball of fire, creating a suction in the middle of the front and the back pakua. Feel that, while you continue to chant the Tai Chi subvocally, the energies of both pakuas are sucked into the center, the cauldron. Feel the fire burning in the cauldron like a candle. Be aware of your center and of the energy there.

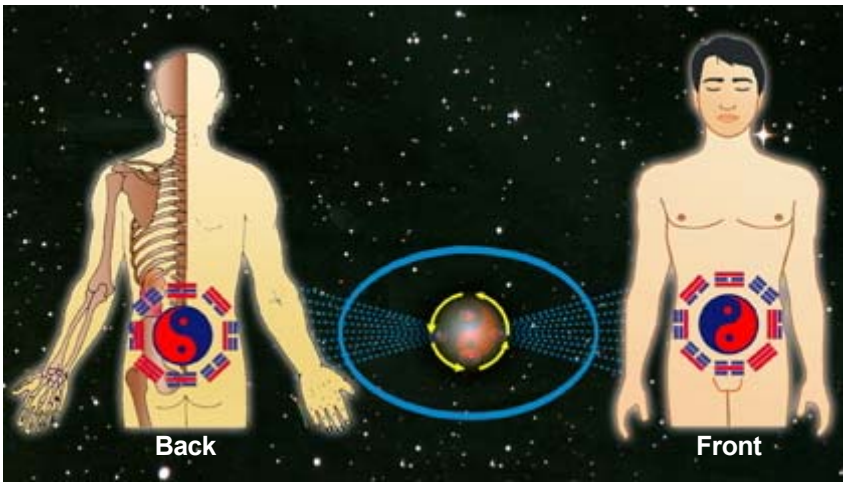

Fig. 5.38 *Both Pakuas are spiraling and drawn into the center.*

1. Creating the Right Pakua

The right pakua is a copy of the back pakua moved to the right side. Use your finger to point to the right side on the same level with the navel while you picture the symbol of Pakua. Then make the Tai Chi symbol, spiraling from the bottom to the right to the top and to the left. Chant Tai Chi and follow the spiraling with your fingers at the same time. Rest, feel the pakua spiraling and drawing energy.

2. Creating the Left Pakua

This pakua is a copy of the front pakua moved to the left side. Use your fingers to point to the left side ao the same level with the navel picture the symbol of the Pakua. When you feel that you are in the rhythm continue in your mind using your mind's eye to move. Chanting the Tai Chi, Tai Chi and spiraling with your hand in the middle of the left pakua. Continue spiraling with your mind/eyes until you feel the energy moving.

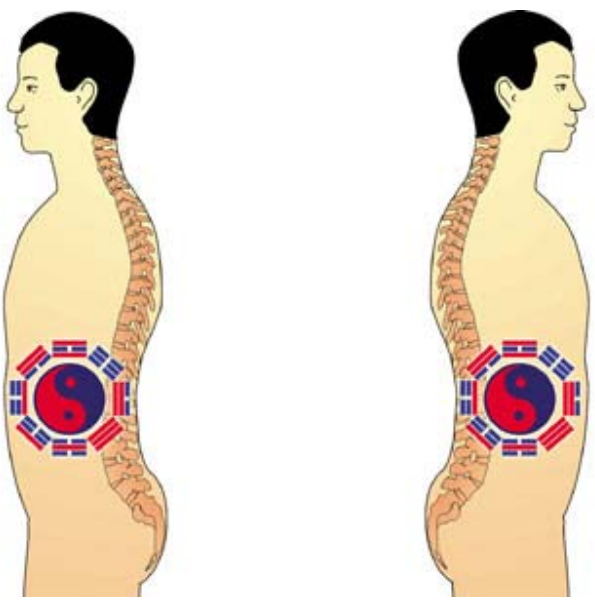

Fig. 5.39 *Left and Right Pakua*

3. Merging the Energies of the Four Pakuas together in the Cauldron

Go back to the right pakua, activate it and let it spiral. Go back to the left pakua and reactivate it, spiraling the Tai Chi. Focus on the center as you chant the Tai Chi and be aware of the centers of the front, back, right and left pakuas. Feel that the energies of the pakuas are sucked into the center. Feel the energy become violet light, and your mind, eyes and center spiraling.

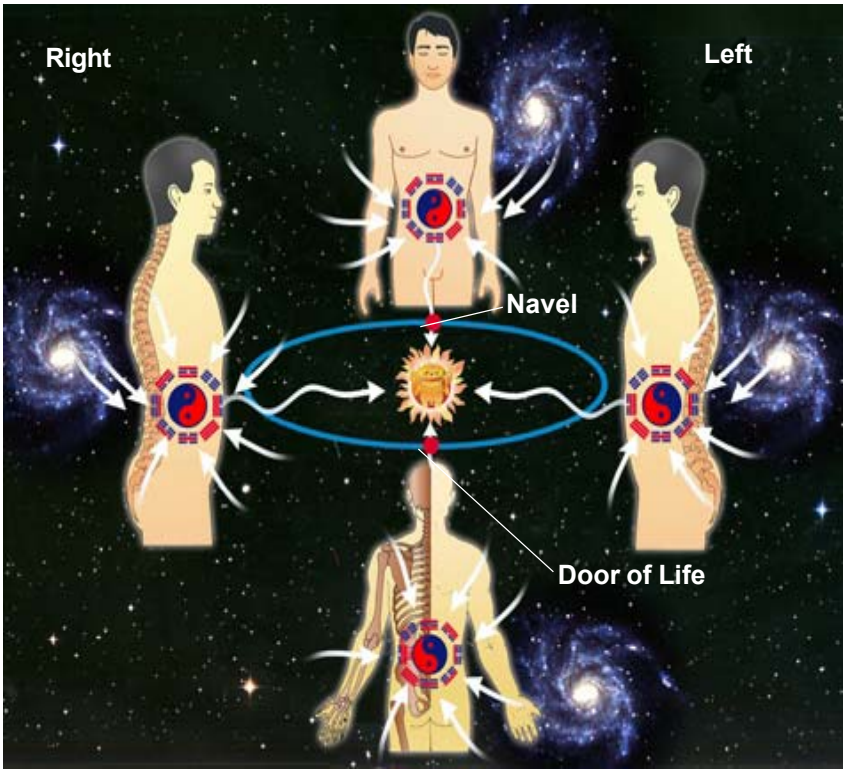

Fig. 5.40 *Four Pakuas spiral and are being drawn into the Center of the Cauldron.*

4. Connecting the Organs and Senses with the Abdominal Pakua.

a. Bring your ears and kidneys to the Kan below.
b. Your tongue and heart to the Li on the top.
c. The mideyebrow and the liver to the Chen on your right side.
d. Your lungs and your nose to the Tui on your left side.
e. Your mouth to the Kun on your upper left side.
f. You can also connect the back part of your skull to the Ken.
g. The base of the skull to the Sun
h. The forehead point to the Chien.

Spiral the Tai Chi symbol of this pakua drawing all the energy of the organs and the senses to the center, where all these energies are combined and condensed.

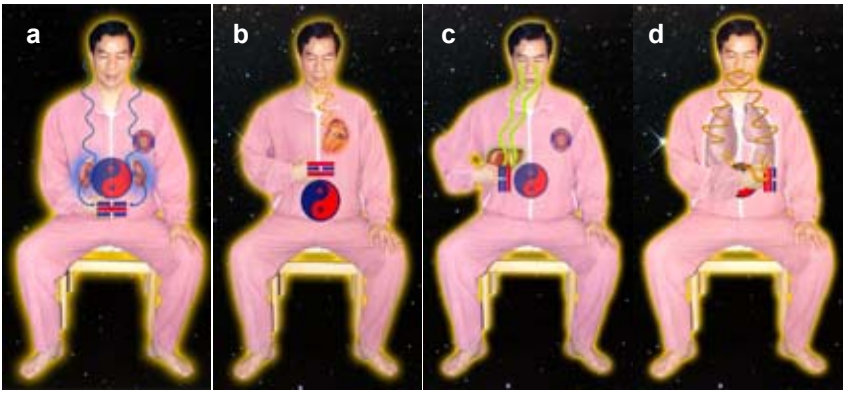

a. *Kan - Ear and Kidneys* ***b.*** *Li - Tongue and Heart*
c. *Chen - Mideyebrow and Liver* ***d.*** *Tui - Lung and Nose on Left Side*

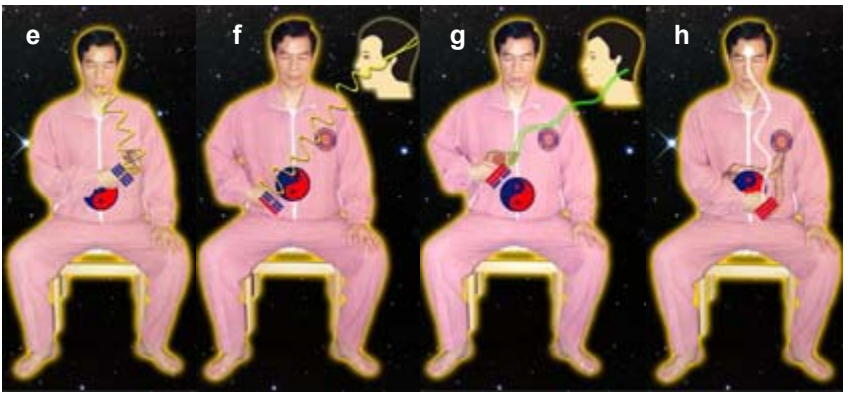

e. *Kun - Mouth and Upper Left Side* ***f.*** *Ken - Back part of the Skull*
g. *Sun - Base of the Skull* ***h.*** *Chien - Forehead Point*
Fig. 5.41 *Connecting the Organs*

Activate the Facial Pakua by enhancing it on the Forehead

The forehead Pakua is the reverse of the abdominal pakua. Use the fingers to point at the position of the Pakua. The Yin and Yang sounds generate from the abdomen but emphasis on the throat, nasal and the third eye. Later on, mark the symbol with your eyes and mind.

When you rest after making the specific sound, feel that the symbol of the trigram is imprinted on the forehead. Send this symbol out into the space in front of you to make the connection with the force of the Universe and let it come back to your body. Bring the reinforced symbol down to the trigram in the pakua in the abdomen and start to work with the next symbol.

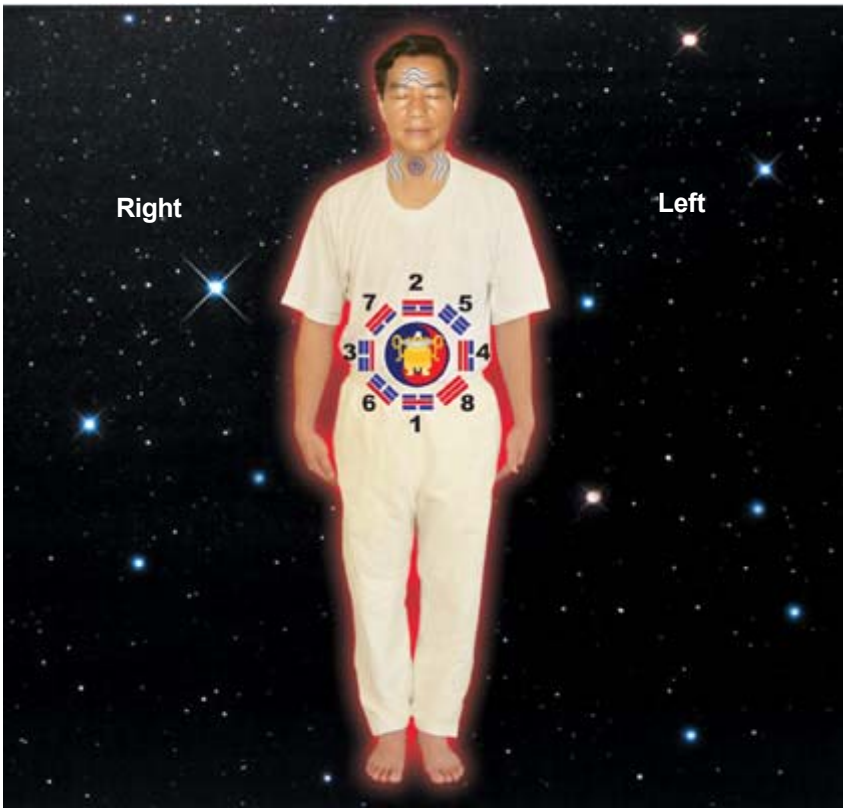

Fig. 5.42 *Enhancing Pakua on the Forehead*

Facial Pakua

To practice this stage, we form a pakua on the face. This pakua has its face in front of us (as if the symbol is looking toward you), so that the Chen will be on the left side and the Tui will be on the right side and all the other trigrams will be arranged accordingly. The Tai Chi symbol will be on your the center at the mid-eyebrow and expands up and down to the forehead and the ridge of the nose right where the cavity of the spirit is. All the senses are controlled from this point. When information and energy from outside is coming in to trigger the senses, you will feel it first very strongly in this center and then the senses will connect immediately to the center of the front pakua below.

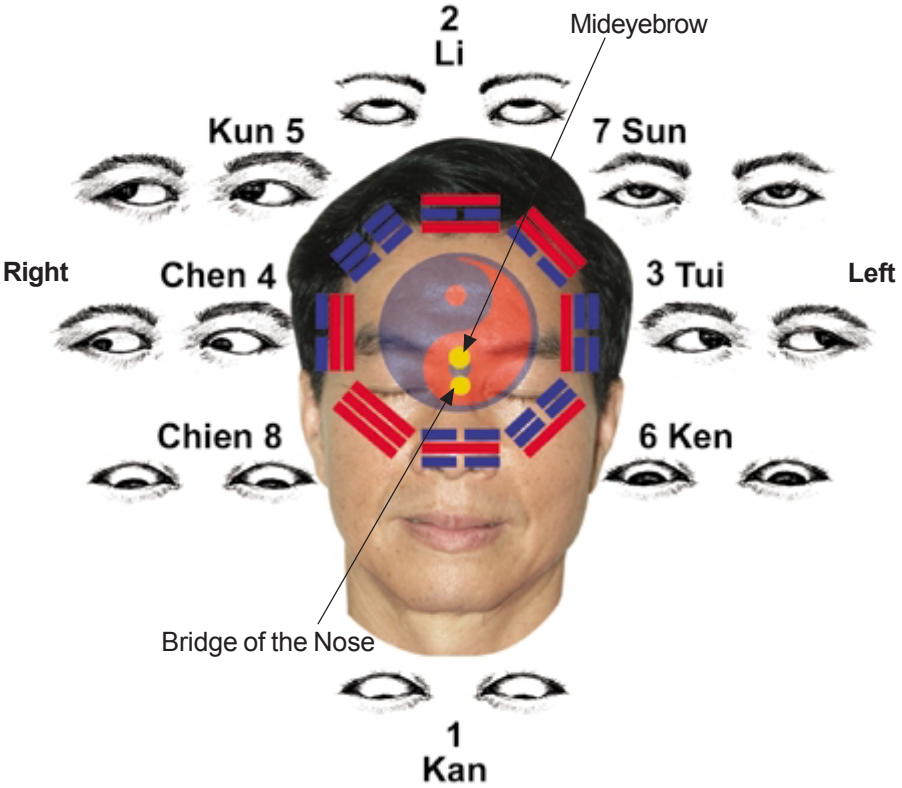

Fig. 5.43 *Use the Eye Mind Power "I" to help move the Eight Forces.*

Practice to form the Facial Pakua.

1. In order to help you get more Chi from the universe, you can start with the "Opening the Three Tan Tiens to the Six Directions" (See the book "*Cosmic Healing I*" by Mantak Chia). If you have not learned this, you can just start with forming the Pakua.

Fig. 5.44 *Opening the Three Tan Tiens to the Six Directions*

2. Then smile, feel your senses turned inward, feel them connecting to the organs. Your mideyebrow connects to your eye and liver, your tongue connects to the heart, your ears connect to the kidneys, your nose connects to your lungs and your mouth connects to the spleen. Feel all the senses turned inward to the mideyebrow and down to navel, going deep inside you. Your abdomen is like a big ocean, a big space, big like a whole universe.

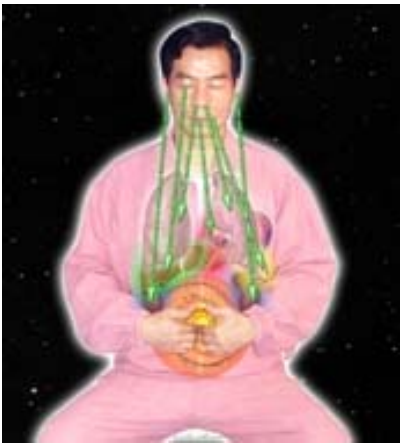

Fig. 5.45 *Turn all senses inward*

3. Reactivate and reinforce the pakua in your lower abdomen.
   a. Touch your Lower Tan Tien and start chanting Kan-Li-Chen-Tui-Kun-Ken-Sun-Chien touching each of the kuas as you chant them. Continue to chant the kua symbols subvocally in your mind and holding the symbol in front of your eyes. Be aware of the Heart Pakua.

Fig. 5.46 *Touch Lower Tan Tien and chant.*

   b. Spiral the Tai Chi symbol from the bottom to the right and up, chanting it while spiraling with your hand, eyes and mind. Continue to spiral with your mind and eyes only and feel the heart pakua also spiraling. The energy is pulling inward and the Tai Chi symbol is spiraling and changing to violet light.

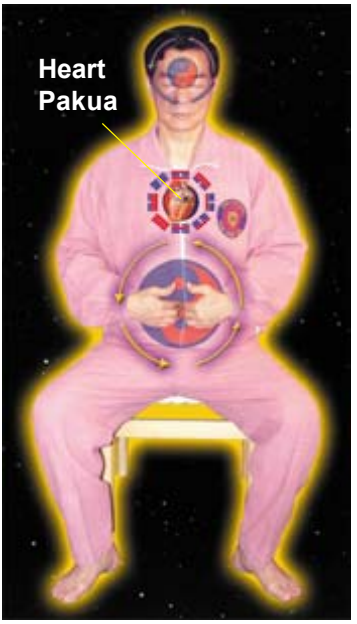

Fig. 5.47 *Tai Chi symbol spiraling*

Start the Practice of the Facial Pakua with the First Four Symbols.

Symbol of Kan - Water ☵

a. Be aware of the mideyebrow. Use the fingers of either the right or left hand to touch below your nose. Eyes look down to the bridge of the nose. Focus on the Kan, Yin-Yang-Yin. Chant the word Kan repeatedly, vibrating it in the brain, making a throat, nose and third eye sound. Picture the trigram on your face and expand it very far away to the ocean. Feel that the energy of the Kan comes right in front of you, allowing the feeling to expand on bridge of the nose. Be aware of the Kan in your lower abdomen and move the powerful Kan from your face to your lower abdomen where it is supposed to be.

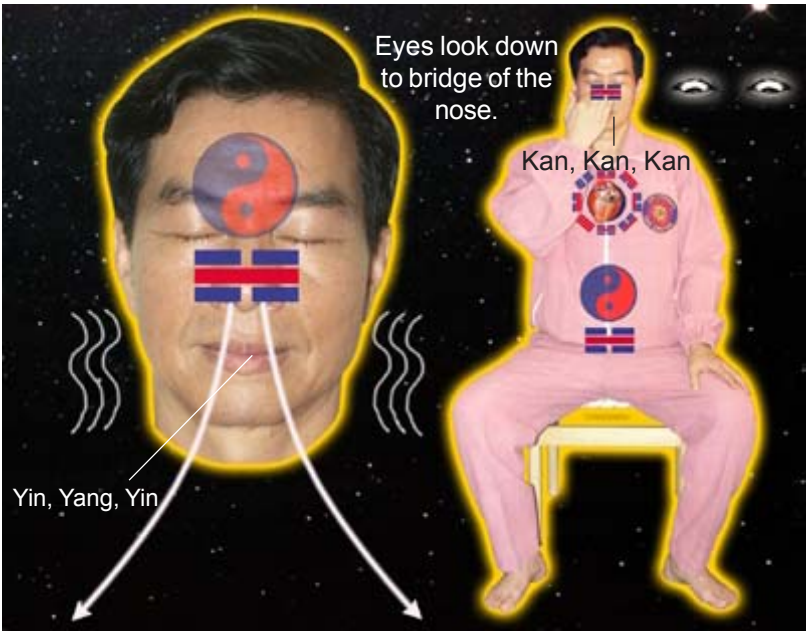

Fig. 5.48 *Kan on the face below the nose.*

b. **Yin Contract**; First expand the mind and the hands and palms to touch the sky, the cosmos. Chant the Yin, Yin, Yin as long as you feel comfortable, and continue moving your palms. Draw the cosmic Chi in from the universe into the face and feel the mideyebrow has suction. Feel your palms, fingers and the Tan Tien, the mideyebrow has power, the fingers can move in and touch below the nose. The Chi goes to the Yin line in the navel. Rest and Smile, breathing the cosmic Chi. (Fig. 5.52)

Fig. 5.49 *Yin Line — — Yin Contract*

c. **Yang Expand**: Do the Yang line; be aware of the Tan Tien, throat, bridge of the nose, the palms, the fingers and touch the face. Slowly chant the long Yang sound and turn the palms out. Gradually move the palms to the left and right sides and feel your palms very long and big touching the cosmos. Rest and smile, the Chi goes to the Yang line in the navel.

Fig. 5.50 *Yang Line —— Yang Expand*

d. **Yin Line again**, Yin contracts; expand the mind. Repeat as in the first Yin line. Rest for awhile. Feel the vibrations inside.

Fig. 5.51 *Yin Line — — Yin Contract*

Symbol of Li - Fire

a. Focus on the Li Yang-Yin-Yang trigram. Repeat it several times using your fingers on your mideyebrow. Eyes look up to the forehead and picture a flame burning and chant Li, Li, Li repeatedly. Then chant the Yang-Yin-Yang. Picture the trigram right on your face and expand it very far away. See a fire burning, expanding warmth. Let the energy stay on your forehead as a bright red light. Bring it down to the Li in the Pakua in your abdomen and feel a burning sensation in that area.
b. **Yang Expand:** Do as before.
c. **Yin Contract:** Do as before.
d. **Yang Expand:** Do as before.

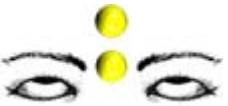

Eyes look up
to the forehead.

Fig. 5.52 *Li on Forehead*

Symbol of Chen - Thunder

a. Focus on Chen, Yang, Yin, Yin. Chant this symbol as a throat and nose sound repeatedly and then chant Yang-Yin-Yin. The eyes look to the left temple bone. Picture the symbol in front of you, expand it very far away to the power of the lightning and thunder. Let the energy come to you, feel the tingling on your left temple bone and move this energy sensation down to the left side of the abdominal pakua. Be aware of Kan, Li, Chen. Visualize them very clearly.
b. **Yang Expand:** Do as before.
c. **Yin Contract:** Do as before.
d. **Yin Contract:** Do as before.

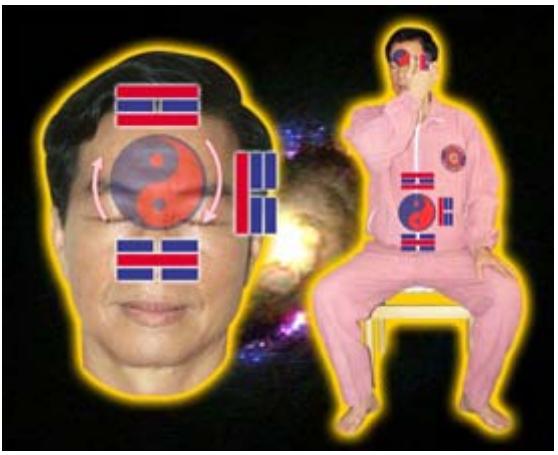

Eyes look to left
temple bone

Fig. 5.53 *Chen on Forehead*

Symbol of Tui - Lake

a. Focus on Tui, Yang, Yang, Yin. Chant Tui repeatedly with a nose sound that is vibrating in the nose. Then chant Yang-Yang-Yin; eyes look to the right temple bone. Picture the symbol on your right temple bone and expand it very far away to the power of the lake, rain and metal element. It is a condensing power. Move it down to the right of the abdominal pakua.

   Combine the four symbols together with the Tai Chi symbol. Feel the Tai Chi symbol spiraling inside your head and feel the center of your abdomen nice and warm like a fire burning inside you.

b. **Yang Expand:**
   Do as before.

c. **Yang Expand:**
   Do as before.

d. **Yin Contract:**
   Do as before.

Eyes look to right
temple bone.

Fig. 5.54 *Tui on Forehead*

Kun ☷ ☷

Imprint Kun on your forehead. Start chanting Kun-Kun-Kun, and then use the fingers and palms to help activate the cosmic force Yin-Yin-Yin, Yin-Yin-Yin, marking the lines with your fingers on your forehead. Project the symbol into the universe as you breathe through your forehead. Picture the symbol breathing in violet/blue and when it connects to your forehead bring it down to its place in the lower pakua.

a. **Yin Contract**, Do as before.
b. **Yin Contract**, Do as before.
c. **Yin Contract,** Do as before.

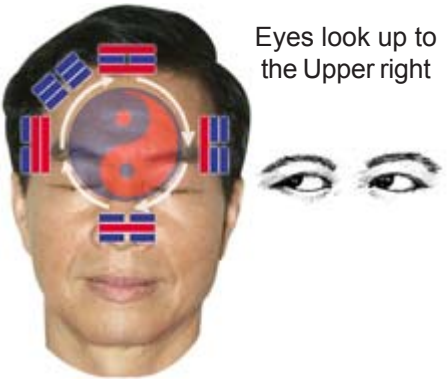

Fig. 5.55 *Kun*

Ken ☶ ☶

Imprint Ken on your lower left cheek bone. Start by the eyes looking down to the lower left cheek bone, chanting Ken-Ken-Ken, and then Yin-Yin-Yang, Yin-Yin-Yang, Yin-Yin-Yang, marking the lines with your fingers on your forehead. Project the symbol into the universe as you breathe through your forehead. Picture the symbol with its violet/blue and bright red colours in front of you and when it connects to your forehead bring it down to its place in the lower pakua.

a. **Yin Contract:** Do as before.
b. **Yin Contract:** Do as before.
c. **Yang Expand:** Do as before.

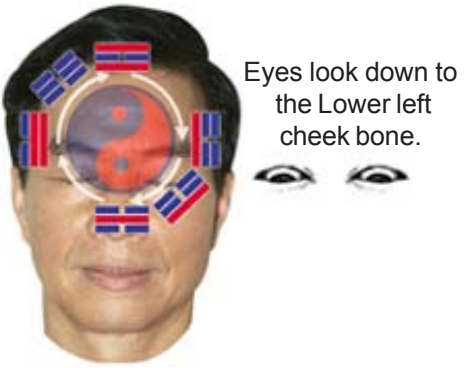

Fig. 5.56 *Ken*

Sun

Imprint Sun on your upper left eyebrow. Start with the eyes looking up to the upper left eyebrow, chanting Sun-Sun-Sun, and then Yin-Yang-Yang, Yin-Yang-Yang, Yin-Yang-Yang, marking it with your fingers on your forehead. Project the symbol into the universe as you breathe through your forehead. Picture the symbol with its violet/blue and bright red colors in front of you and when it connects to your forehead bring it down to its place in the lower pakua.

a. **Yin Contract:** Do as before.
b. **Yang Expand:** Do as before.
c. **Yang Expand:** Do as before.

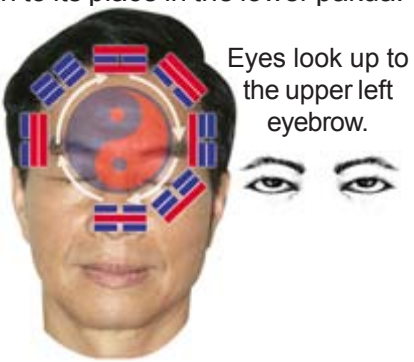

Fig. 5.57 *Sun*

Chien

Imprint Chien on your lower right cheek bone. Start with the eyes looking down to the lower right cheek bone, chanting Chien-Chien-Chien, and then Yang-Yang-Yang, Yang-Yang-Yang, marking it with your fingers on your forehead. Project the symbol into the universe as you breathe through your forehead. Picture the symbol with its bright red colors and when it connects to your forehead, bring it down to its place in the pakua in your lower abdomen.

a. **Yang Expand:** Do as before.
b. **Yang Expand:** Do as before.
c. **Yang Expand:** Do as before.

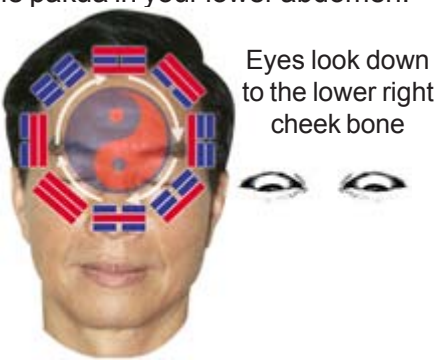

Fig. 5.58 *Chien*

Note: Any time that you feel the energy shooting into your forehead, right where the senses' control is located, bring both the senses' energy and the energy from the universe down to your abdomen.

4. Form the pakua on your face to turn the senses inward.

   Chant Kan-Li-Chen-Tui-Kun-Ken-Sun-Chien and mark the place of the specific kua with your fingers.

   a. Kan is on your bridge of the nose.
   b. Li at the top of your forehead.
   c. In this pakua Chen is on (inside) your left ear.
   d. Tui is on (inside) your right ear.
   e. Kun in your brain above the right eye.
   f. Ken inside your cheek bone on the left side.
   g. Sun in your brain above the left eye.
   h. Chien inside your cheek bone on the right side above.

   Repeat the chanting in your mind and let your eyes move to the place of each kua. Feel the power of the symbols attracting your senses in to the mideyebrow. Chant and spiral the Tai Chi symbol with your finger and then only with your mind. Let the Tai Chi spin fast and faster. Keep on chanting the Tai Chi symbol until the energies are pulled to the center of the pakua. You should feel that all the energy is flowing to the center of the face pakua and connecting to center of the brain, the crystal room, and keep on spiraling and be aware of the Lower Tan Tien, Tai Chi, and also the spiraling of the facial pakua itself. Feel a very strong center in your forehead and bring it down to the center of the lower pakua.

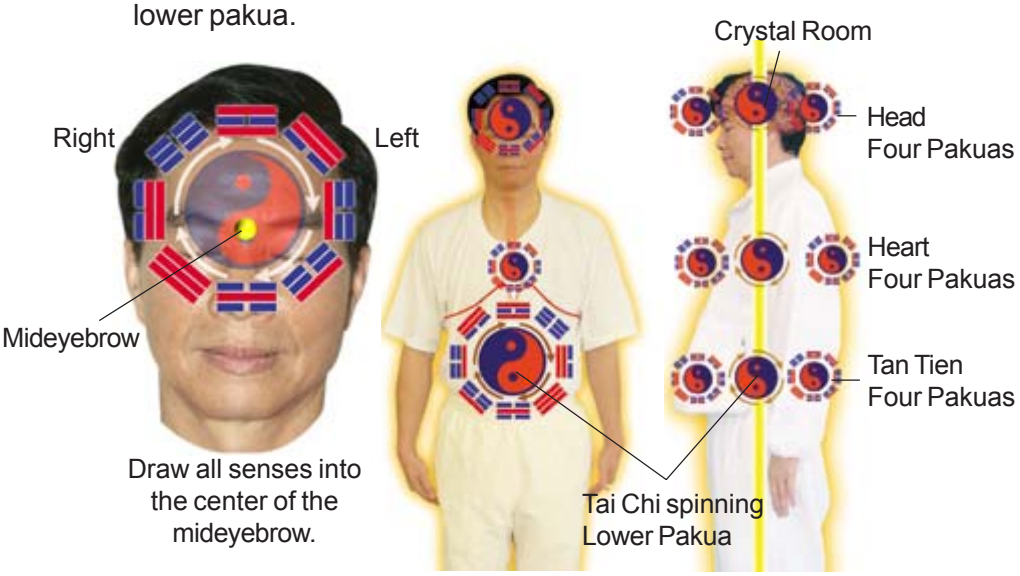

Fig. 5.59 *Pakua on your face to turn the senses inward*

Creating the Back Pakua on the Head

Duplicate trigrams, pakua and the Tai Chi symbol to the back and spiral clockwise while chanting the Tai Chi, Tai Chi. The mind and the eyes are spiraling as well, going faster and faster. When you spiral as fast as possible, you will feel that the energy is drawing into the back Pakua.

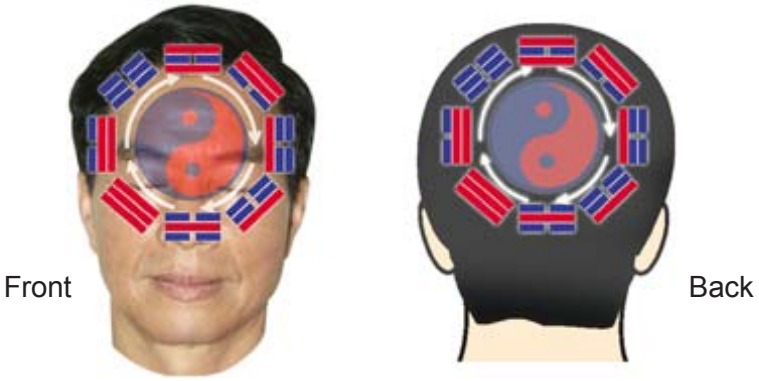

Fig. 5.60 *Pakua on the Head*

Be aware of the front and back Pakuas and spiral them. Spiral in the center faster and faster drawing the front and back into the center.

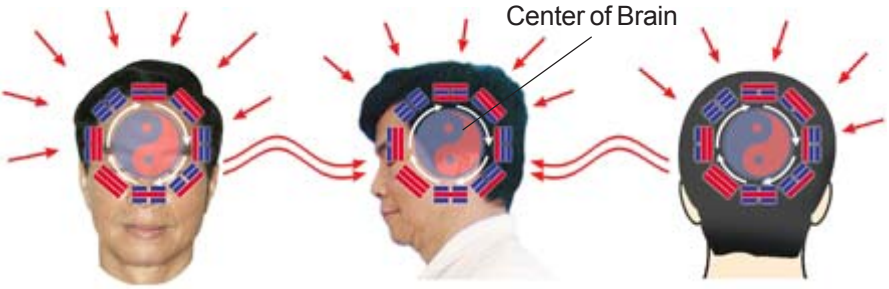

Fig. 5.61 *Front and Back Pakuas spiraling.*

Duplicate the front Pakua to the left side and let the Tai Chi symbol spin.

Duplicate the back Pakua to the right side of the head and let the Tai Chi symbol spin. Become aware of the center of the brain, the crystal room and let it spin faster and faster, drawing the energy of the left and right Pakuas into the center.

Fig. 5.62 *Energy of the left and right Pakua into the center of the Brain.*

Be aware the front, back, left and right Pakuas and let them spin. Put more attention on the center of the brain and let the center spin faster and faster, drawing all the energy into the center.

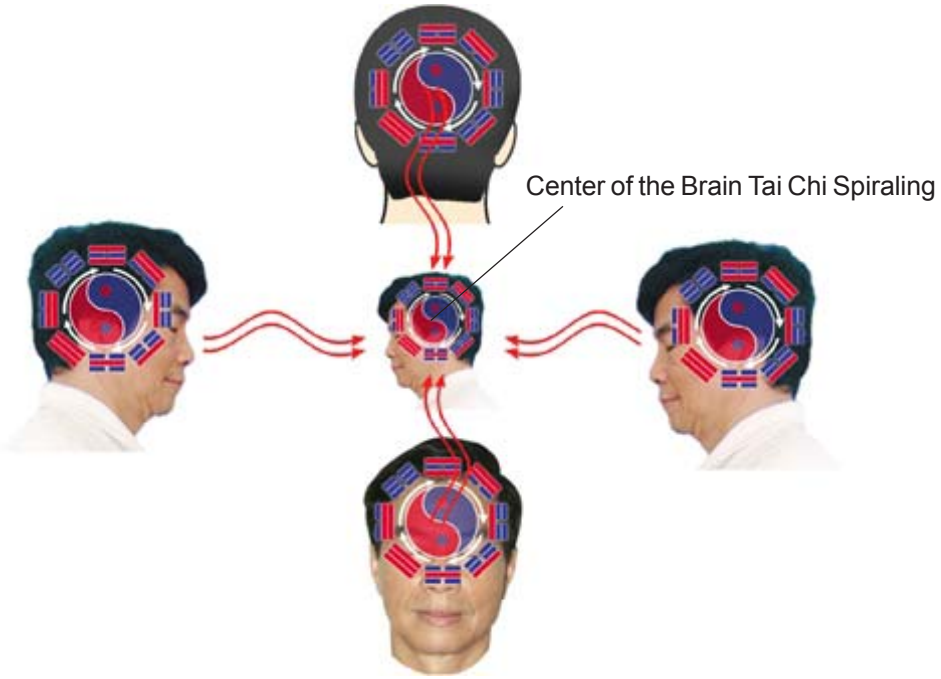

Fig. 5.63 *Draw all the energy into the Center.*

Connecting the Senses with the Sense Control of the Facial, Heart and the Abdominal Pakuas.

Repeat the facial pakua again: Kan-Li-Chen-Tui-Kun-Ken-Sun-Chien. This time, when you spiral the Tai Chi symbol as you chant Tai Chi, add the motion of the Yin coming in and the Yang going out. Your mouth is open projecting the sound of Yang into space. Your fingers are pointing out into space as well. With the sound of Yin your fingers are pointing in towards your forehead, which facilitates the inward movement of the energy. Picture a Tai Chi spiraling inside your brain, right behind your forehead. Point, spiral with your fingers saying Yin-Yang, Yin-Yang, Yin-Yang, and then Tai Chi, Tai Chi, Tai Chi. Continue saying it in your mind and feel the pakua deep inside your head (about 2-3 cm behind your forehead). All the senses are drawn together inside the center of the facial pakua (the senses' control point) and their energy is brought down to the Tai Chi of the lower abdominal pakua.

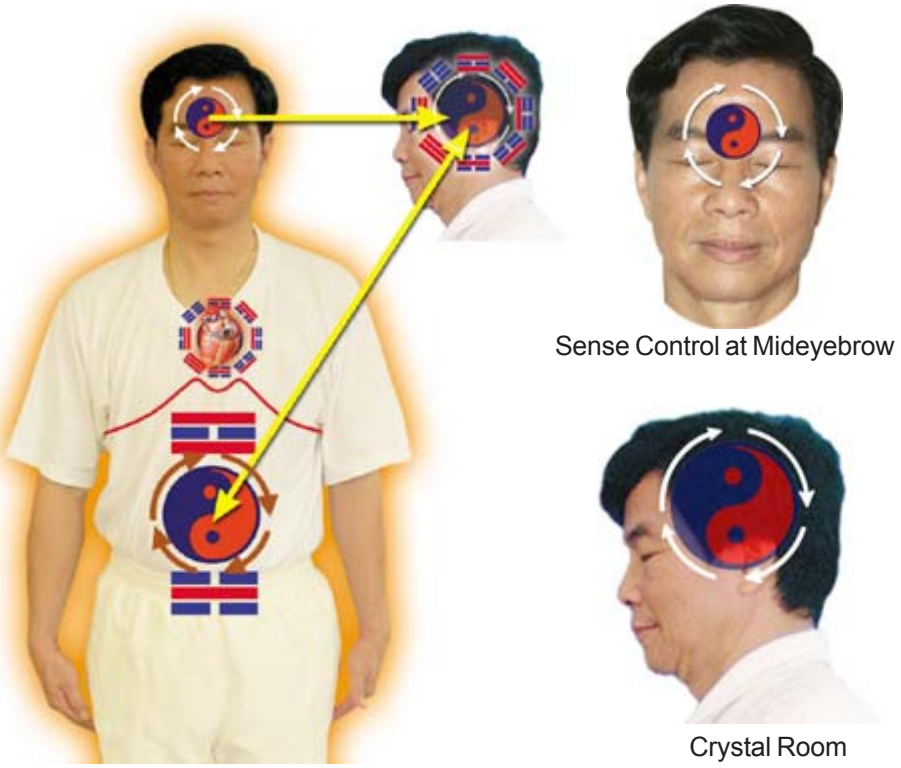

Fig. 5.64 *Let the center of the brain, the heart and abdomen pakuas and all Tai Chis spiral together.*

Blending all the Energy of the Organs and Senses together in the Cauldron

Look down to your center in the Tan Tien and focus on the pakua on the back and on the right and the left pakua. When you focus on them, they will just start spiraling on their own. Look down into your center, into the cauldron and start spiraling the Tai Chi symbol in the center of your cauldron while chanting Tai-Chi, Tai-Chi, Tai-Chi. Rest. Continue to spiral with only your mind and feel that the energy of your senses and organs is coming right down to your center, where all the energy blends into one central energy. Rest. Spiral the energy in your abdomen. Smile to this energy and feel very calm and peaceful.

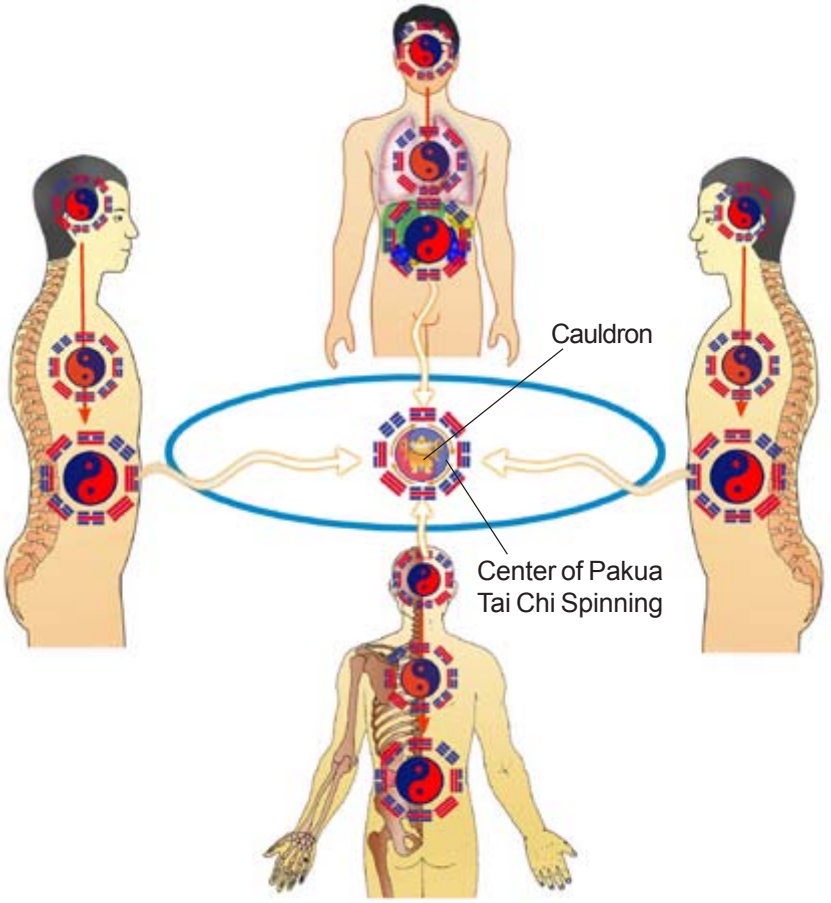

Fig. 5.65 *Draw all the sense into the center of the Pakua and Tai Chi.*

Expanding the Pakua in the Universe.

The power of the symbol is the power of the throat, the power of the word. The forces of the universe are Yin and Yang forces and the kua is a very ancient symbol of power. When you project the pakua out, using the pakua breathing, you connect to the Yin and the Yang power in the universe. When you breathe to the kua out there in space and connect to it, you will feel it connect to the kua in your abdomen as well.

Fig. 5.66 *Pakua in the Universe*

Fig. 5.67 *Feel the Pakua Breathing and Pulsating.*

1. Start chanting Kan-Li-Chen-Tui-Kun-Ken-Sun-Chien touching each of the kuas as you chant them. Continue to do this with only your mind, saying the name of the kua and holding the symbol in front of your eyes. Then spiral the Tai Chi symbol from the bottom to the right and up, chanting it and spiraling with your hand, eyes and mind. Continue to spiral with your mind and eyes only. Feel that the energy is drawn inward and the Tai Chi symbol is spiraling and changing to violet light.
2. Activate the facial pakua. Chant each of the symbols and point to them on your face; Kan-Li-Chen-Tui-Kun-Ken-Sun-Chien. Do it several times and make then the Tai Chi symbol on your forehead: Tai Chi, Tai Chi, Tai Chi, spiraling with your fingers over the third eye area. Feel the energy drawn into the center of the forehead, drawing the senses inwardly to the senses control and connecting down to the lower pakua. On their way down they collect the energy from the organs as well.

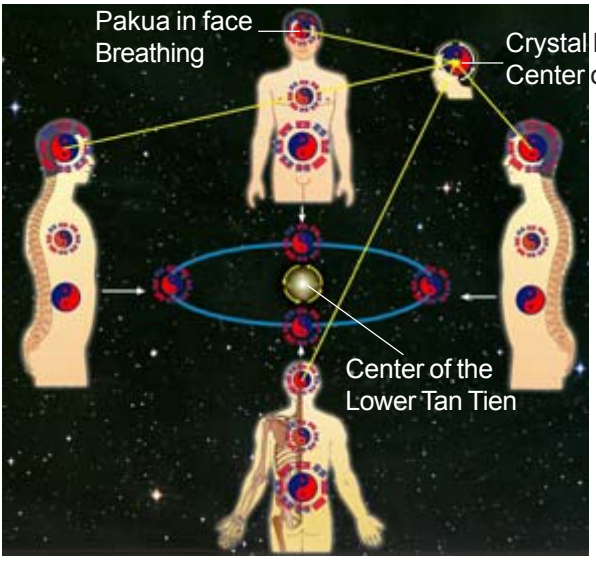

Fig. 5.68 *Four Head Pakuas*

3. Chant now Yin-Yang, Yin-Yang, Yin-Yang. Contract with Yin and expand from the forehead out with Yang. Use your fingers to point the direction of the energy, in and out.
4. Rest. Smile, feel the Tai Chi very deep inside you spiraling and chant Tai Chi, Tai Chi, Tai Chi, Tai Chi. Feel the facial pakua go into your head.

5. Become aware of the Kan symbol. Picture the Kan symbol and project it out down all the way to the galaxy. Chant Kan, Kan, Kan. Chant and picture the Yin-Yang-Yin lines and feel that the power is going out all the way to outer space.

   Start then with the Yin-Yang breathing. Inhale, Yin contracting with bright violet light, exhale, Yang expanding with bright red light. Inhale, contracting, exhale, expanding. Feel the kua of the facial pakua and the abdominal pakua breathing and at the same time, feel the kua in the universe breathing. Picture the Yin-Yang-Yin very clear in your mind as well as very far away in space. Exhale, hold your breath and feel the symbol breathing. Inhale, breathe without breathing and feel the connection with the kua out there. Keep on breathing in this way until suddenly the kua out there comes to you and enforces the Kan in your abdomen.
6. Repeat the same procedure for Li, sending it out, up into the universe, for Chen sending it out into the space on your right side, Tui to the space on your left side, Kun to the space upper left, Ken to the lower left side, Sun to the upper right side of the universe and Chien to the lower left side of the universe.
7. Now picture all the kuas together and repeat their names very slowly: Kan-Li-Chen-Tui-Kun-Ken-Sun-Chien. Rest. Feel the universal pakua covering you. Feel this pakua breathing and pulsating together with your pakua in the abdomen and on your face, drawing the energy back into the lower pakua, into your center. Sit back and smile to the pakua inside you and to the pakua in the universe. Rest, concentrate and condense all the energies in the cauldron.

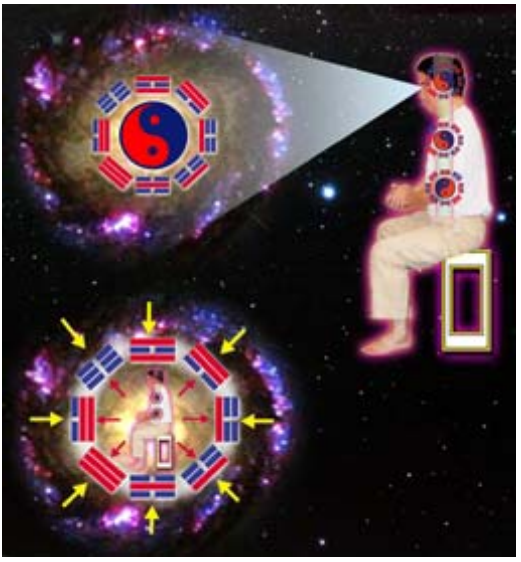

Fig. 5.69 *Feel all the Pakua and Universal Pakua breathing and pulsating. Feel a big Pakua cover you, breathing and pulsating.*

Formula Two: Transforming the Negative Emotions of Each Organ into Pure Life-Force Energy

Taoists reason that the negative emotions can be transformed to become our life-force and position energy. Therefore to expel or suppress unwanted, negative emotions is to expel or suppress life-force. Rather than suppressing them, you gain more by composting, recycling or transfering the negative into positive energy and experiencing these emotions. This means you permit them to emerge, observing and accepting them, but do not let them run wild or trigger other negative emotions. Instead transform them not only into useful life-force energy, but also into another, higher consciousness that is your spiritual energy.

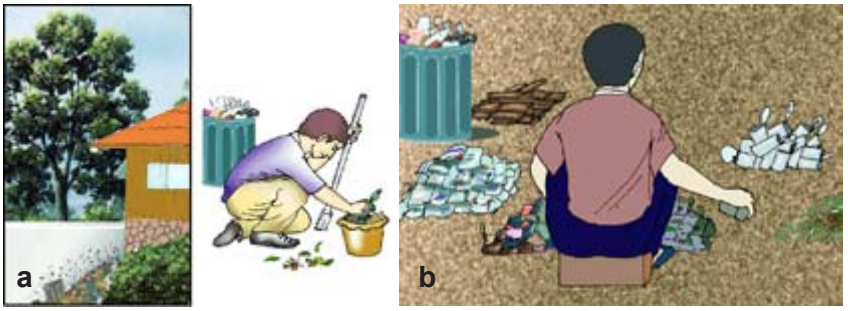

a.*Pile all the garbage together, just like mixing all the emotions together.*
b.*Separate the garbage, just like separating emotions & transfer them.*

c.*Recycle and compost.*
d.*Recycling the garbage into compost and growing flowers and vegetables.*
e.*Eating the food grown from the compost.*

Fig. 5.70 *Transforming the Negative Emotions*

In the Taoist cosmology, the emotions originate from the vital organs, which correspond to the Five Phases of energy. They are also the reservoir of spiritual energy. By transforming the negative emotions in the organs, you are nourishing the spirit of that organ. Fear originates in and is stored in the kidneys, anger and frustration originate in and are stored in the liver, impatience, hastiness and hatred originate in and are stored in the heart, sadness and depression originate in and are stored in the lungs and worrying originates in and is stored in the spleen.

In the Tao, the main idea is to find a balance between the positive and the negative emotions. The negative emotions are like weeds, they are always there, and one could never totally get rid of them. The other point is that the soil needs them as fertilizers and they also help hold the soil in place. But at the same time the danger is that they will take over the garden if we don't control them. We need to cultivate the plants we want (our good virtues) to prevent the weeds from taking over the garden. It is the same with the negative emotions; they should only be kept in balance with the positive ones and one shouldn't waste time trying to get rid of them altogether. The work should be done on the positive emotions, constantly cultivating and nurturing them in order to grow the good virtues and to keep the right balance with the negative emotions. Negative emotions breed negative emotions and positive emotions breed positive emotions.

Fig. 5.71 *Yin and Yang balance negative and positive emotions but they do not get rid of them.*

We work in this formula with the counteracting or controlling cycle and we use collection points to gather and neutralize the negative emotions of each organ. We then blend the emotional energies together in the pakua, transforming them into pure life-force.

Fig. 5.72 *Keep on cultivating the positive emotions.*
Do not let the weeds out grow the vegetables.

Practice:

1. Preparation

When you begin, first do Formula Two and then continue with this practice.

a. Sit properly on a chair and feel yourself aligned with the forces.
b. Do the crane and turtle neck and the spinal cord breathing
c. Smile down and generate the qualities of loving energy from the heart. Breathe down radiance to the heart making it feel soft in the heart.
d. Be aware of the Tan Tien Chi and the front pakua, the pakua on your face, and the universal pakua. Feel them all breathing together. Feel all your senses and mind turned inwards to the cauldron. Turning the senses inward initiates the training process of inner observation. In developing the ability to focus inward – to smell, listen, taste, see and hear the organs and their activities – and to observe your negative emotions without predetermined judgments, you have the opportunity to develop your true nature.

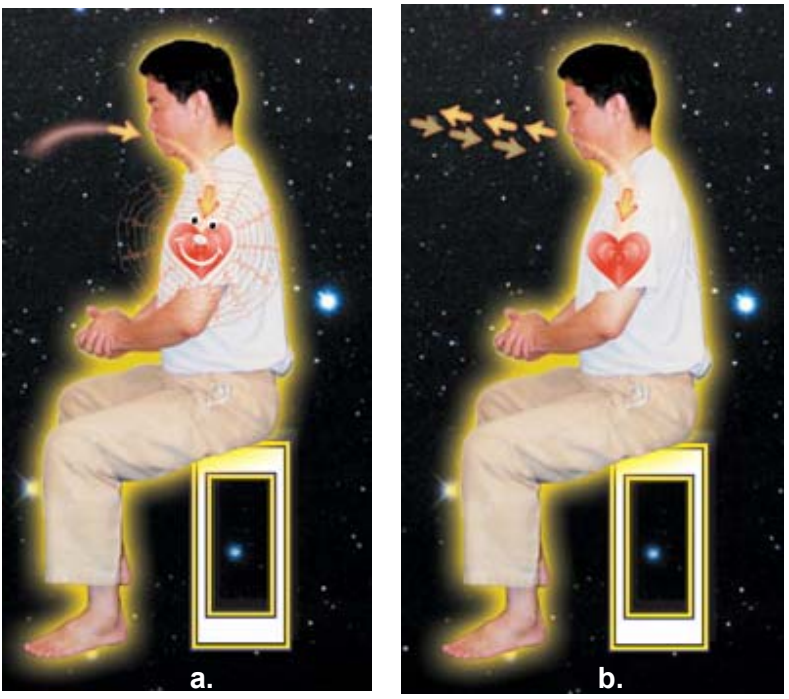

Fig. 5.73 *Feel joy and happiness.*
a. *Inhale to the heart and smile to the heart.*
b. *Exhale to the heart, smile to heart and make the heart feel soft.*

2. Real Practice

A. Bring your attention to your kidneys.

Listen to the kidneys, observe your kidneys. Be aware of any fear in the kidneys. Accept your fear; smile to the heart and let the love radiate to the kidneys. Be aware of the Kan, the water power. Chant the Kan and connect your kidneys with this energy. Let love activate the gentleness, calmness and stillness, the essence of this power, a blue light. Wrap the gentleness, calmness around your fear, balancing it and transforming your fear.

Form with your mind a collection point at your perineum and let any fear that is still in the kidneys go down to the collection point. Balance these emotions here also with the positive feeling of gentleness and calmness.

a. **b.**

Fig. 5.74
a. *Fear - Gentleness*
b. *Fear into Gentleness and Calmness*

B. Bring your attention to your heart.

Connect the tongue with your heart, speak with your heart (the spirit of your heart). Observe your heart. Be aware of any impatience, hastiness, cruelty, hatred, arrogance in your heart. Accept these feelings. Be aware of the Li, the fire power. Chant the Li and connect your heart with this power, a red light. Feel the warmth, love, happiness and inner joy, the essence of this power. Help transform the hatred into love. Wrap the love, the warmth and inner joy around your impatience, arrogance, balancing them with and transforming your impatience, hastiness, arrogance.

Form with your mind a collection point near the heart center and spiral all the negative energies that are still in the heart to this collection point. Chant the Li again and balance the emotions in the collection point.

a. **b.**

Fig. 5.75 a. *Impatience, Hastiness and Hatred*
b. *Love, Joy and Happiness*

C. Spiral, blend and transform the energy of the heart and the kidneys at the front pakua.

Spiral and breathe the energies out of the kidney and heart collection points to the front pakua. Blend and spiral them together in the front pakua. (The pure energy trapped in these negative feelings will be freed and released to the center of the pakua). Chant Tai Chi, Tai Chi, Tai Chi. Yin-Yang, Yin-Yang, Yin-Yang. Spiral these energies until they become a bright, golden energy. This energy radiates love and gentleness from the center of the pakua and your being.

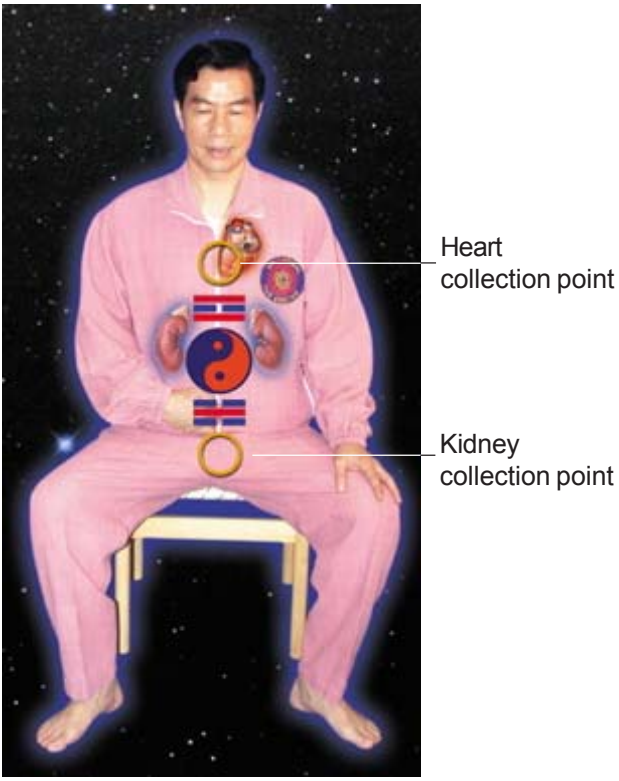

Fig. 5.76 *Spiral, blend and transform the energy of the heart and the kidneys.*

D. Bring your attention to your liver.

Connect the eyes with the liver and observe your liver. Be aware of any anger, frustration, aggressiveness, guilt in the liver. Accept this feeling. Be aware of the Chen. Chant the Chen and connect your liver with the power of the thunder and the wood, a green light. Feel the kindness, the essence of the wood power. Wrap this feeling of kindness around your anger, balancing them together and transforming your anger. Feel that you can forgive. Forgiveness is one of the most important practices of the Taoist system.

Form with your mind a collection on the left side of the pakua, on the nipple line, and spiral all the negative energies that are still in the liver to this collection point. Chant the Chen again, connect with the wood power and balance the emotions in the collection point.

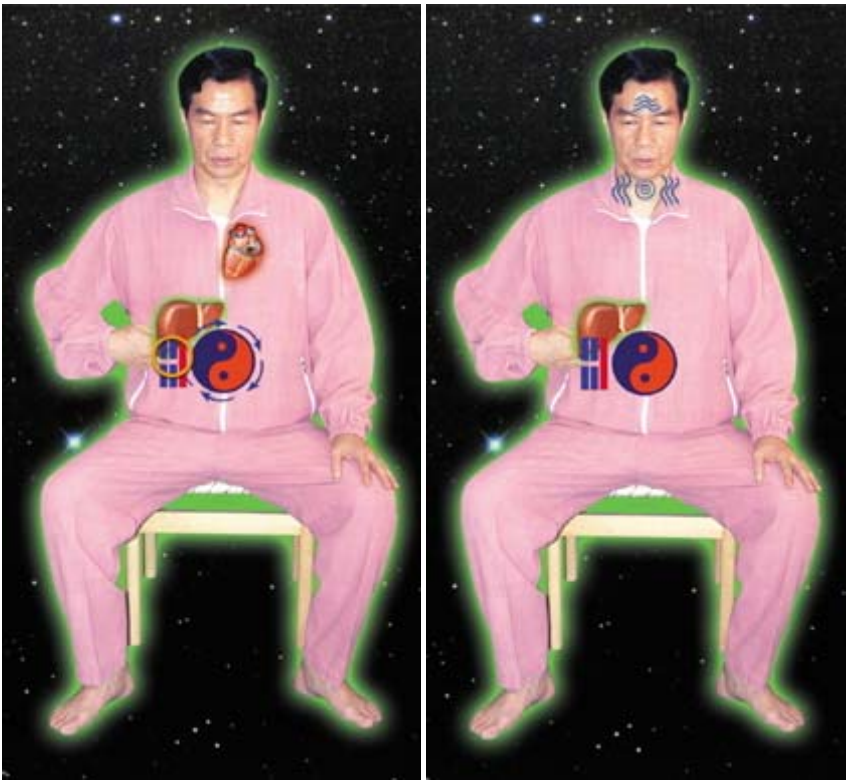

Fig. 5.77 a. *Anger and Frustration in the Liver*
b. *Love from heart and gentleness from kidneys help tranfrom the anger and frustration into kindness.*

E. Bring your attention to your lungs.

Connect your nose with your lungs and observe your lungs. Be aware of any sadness, depression in the lungs. Accept these feelings. Be aware of the Tui. Chant the Tui and connect your lungs with the power of the rain and the metal power, a white light. Feel the courage and the righteousness, the essence of the metal power. Wrap this courage around your sadness, balancing it with and transforming your sadness.

Form with your mind a collection point on the right side of the pakua on the nipple line and spiral all the negative emotions that are still in the lungs to this collection point. Chant the Tui again, connect with the metal power and balance the sadness with the courage here again.

F. Spiral, blend and transform the energy of the liver and the lungs at the front pakua .

Spiral and breathe the negative emotional energies from the liver and lungs collection points to the front pakua. Spiral and blend them at the front pakua. Chant Tai Chi, Tai Chi, Tai Chi, Yin-Yang, Yin-Yang, Yin-Yang. Use the power of pakua to balance and neutralize the sadness and anger. Feel that the pure energy that is trapped in these negative feelings will be freed and released to the center of the pakua. Continue to spiral the liver's and lungs' energies until they become a bright, golden energy that radiates kindness and courage from the center of the pakua and of your being.

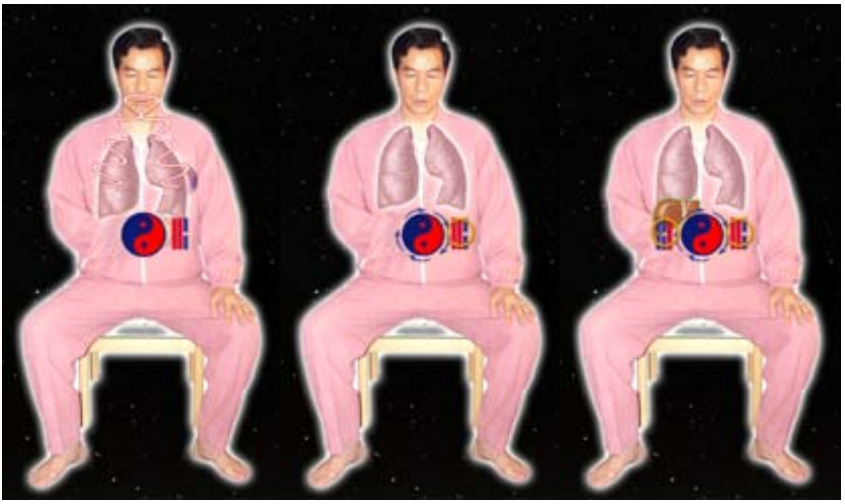

Fig. 5.78 *Spiral, blend and transform the energy of the liver and the lungs.*

G. Bring your attention to your spleen.

Connect your mouth with your spleen and observe your spleen. Be aware of any worry or other emotions you do not like in your spleen. Be aware of the Kun. Chant the Kun and connect your spleen with the earth power, a yellow light. Feel the openness, balance and centeredness of this power, the essence of the earth power. Wrap this around your worries, balancing with and transforming your worries.

Spiral your worries that are still in the lungs to the center of the front pakua, the collection point of the spleen. Chant the Kun again and then Tai Chi, Tai Chi, Tai Chi. Yin-Yang, Yin-Yang, Yin-Yang. Spiral, balance, blend and transform it with the energy that is already there into a bright, golden energy.

a ***b***

Fig. 5.79 a. *Draw attention to your spleen.*
b. *Balance, Openness and Fairness*

H. Spiral all remaining negative energy to the front pakua.

Return to the organs and the collection points, and spiral and breathe to draw out any remaining negative energy. Blend and neutralize it with the energy in the front pakua. See all the organs glowing with light.

I. Be aware of the back, left and right pakuas.

When you have time, you can chant the kuas to enforce the power of the pakuas. Let the Tai Chi in all four pakuas spiral, drawing in, blending and transforming the energies. Continue spiraling and with the spiraling and the breath you draw, suck in the energy to the cauldron, the big empty space in the Tan Tien. Now spiral the energy in the cauldron, chanting subvocally Tai Chi, Yin-Yang, condensing the energy into a bright golden energy ball, a pearl. Bring the pearl to the perineum and circulate it in the Microcosmic Orbit. As the pearl moves through the Microcosmic Orbit, feel that it attracts and absorbs the Universal (at the crown), the Cosmic Particle (at the mideye) and the Earth (at the perineum) Force.

Bring the pearl back into the cauldron. Center yourself in the cauldron and feel your senses and mind drawn inward towards the energy in the cauldron. Feel nice, calm and peaceful inside. When you have time, sit for a while and let this energy and feeling grow inside you.

Fig. 5.80 *Let all the Organ Energy flow down to the Pakua and feel Chi grow inside you.*

Chapter 6
Compassion Fire Meditation Practice of the Creation Cycle

Practice compassion through the act of forgiveness. To forgive is to let go. Always meet conflict with compassion.

The higher practice of inner alchemy is the transformation of the heart energy into love, the liver energy into kindness and generosity, the lung energy into courage, the kidney energy into gentleness and the spleen energy into openess and fairness. Combine all these energies into compassion. Compassion becomes non physical energy which we can carry with us when we leave the world. It is the love and joy we feel within.

Fig. 6.1 *Compassion Fire originates from the Heart.*

Fig. 6.2 *Through Compassion Fire,*
we transmit Positive Energy to Our Surroundings.

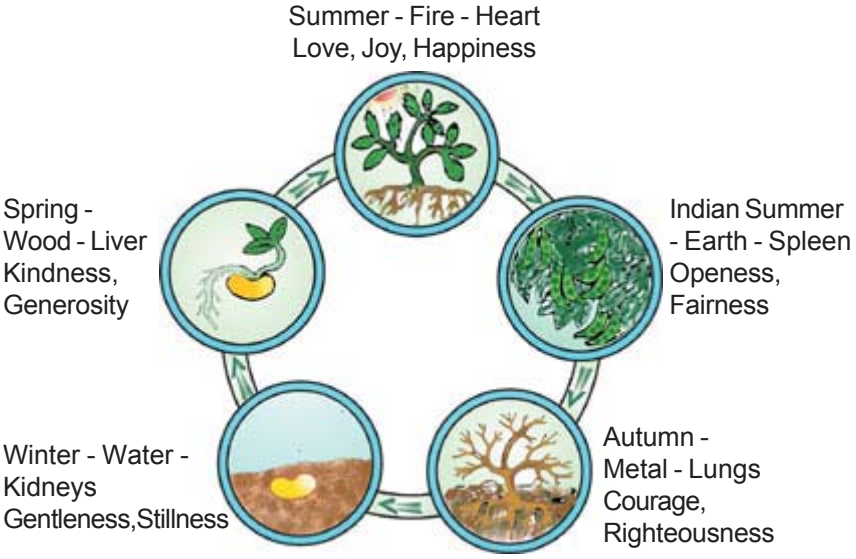

Fig. 6.3 *Creation Cycle in Nature*

Creating compassion energy begins with the creation cycle.

Activate the heart first. It is the fire and the place where the virtue energy can be combined into compassion energy. Go to the kidneys and bring the energy to the collection sphere. Continue with the liver, the heart again, the spleen, the lungs and bring the energy to the respective collection points.

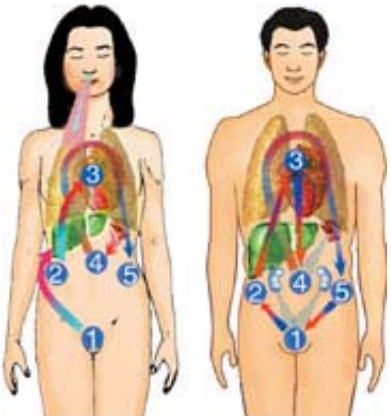

Fig. 6.4 *Creation Cycle*

In the human body the arousal state creates a new chemistry and a new vibration. This 'special' vibration is measured at a frequency of 8Hz/Sec. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all cells and the DNA actually make love as well.

The DNA cross over, like two serpents intertwining in an erotic embrace. They make love and they give birth. Any of the cells that do not 'reproduce' will eventually die.

Fig. 6.5 *When we feel love and arousal energy, the DNA crosses over and makes love.*

The two vital states are arousal, leading to orgasm and compassion are inextricably linked to love. When this 'love-vibration' reaches the pineal gland, a new hormone is produced. This in turn creates whole body conductivity. If the vibration is above or below the 8Hz/Sec. frequency, this process does not occur. Only when you feel the waves of orgasmic vibration and unconditional love for the self and others can the process be activated.

Some practices just want to open the heart by temporarily letting us feel love and kindness. The heart is drained through all kinds of giving and donations.

Worldly desire and many businesses work on activating the sexual desire and then draining it out.

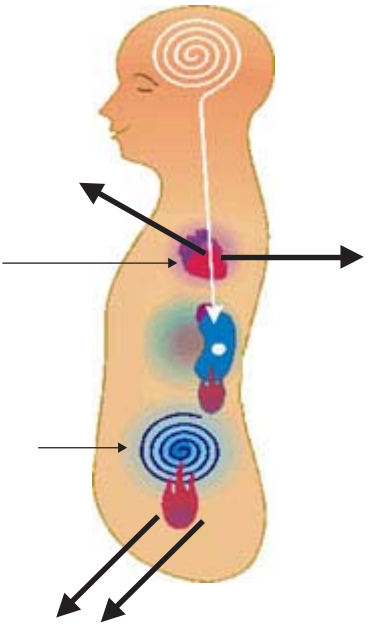

Fig. 6.6 *When the Heart is temporarily open and Sexual Desires activate, these forces will drain us out.*

One Lasting Energy is the Combination of Compassion Energy and Orgasmic Energy

Heart Energy

1. Heart energy is immaterial. When activated it will change into love, but love does not last long.
2. When all the good virtue energy from all the organs combines together into one energy, it becomes compassion energy; it will stay in you longer, but will still disperse.

Sexual Energy

1. Sexual energy when activated from material into immaterial is powerful, but will not last.
2. When the sexual energy is aroused and changes into orgasmic energy, it can charge all the organs, glands, senses and combines into one energy; this energy will stay longer but still will disperse. Orgasmic energy combined with compassion creates one long lasting energy.

After the orgasmic energy has charged all the organs and created the multi-orgasm energy, it can then be combined with the compassion energy at the Tan Tien. This creates the one energy that lasts the longest.

When we are aware of the cosmic galaxy and expand our combined energy of compassion and orgasm through the universe, it multiplies and flows back to us and we will be in touch with universal compassion and unconditional love.

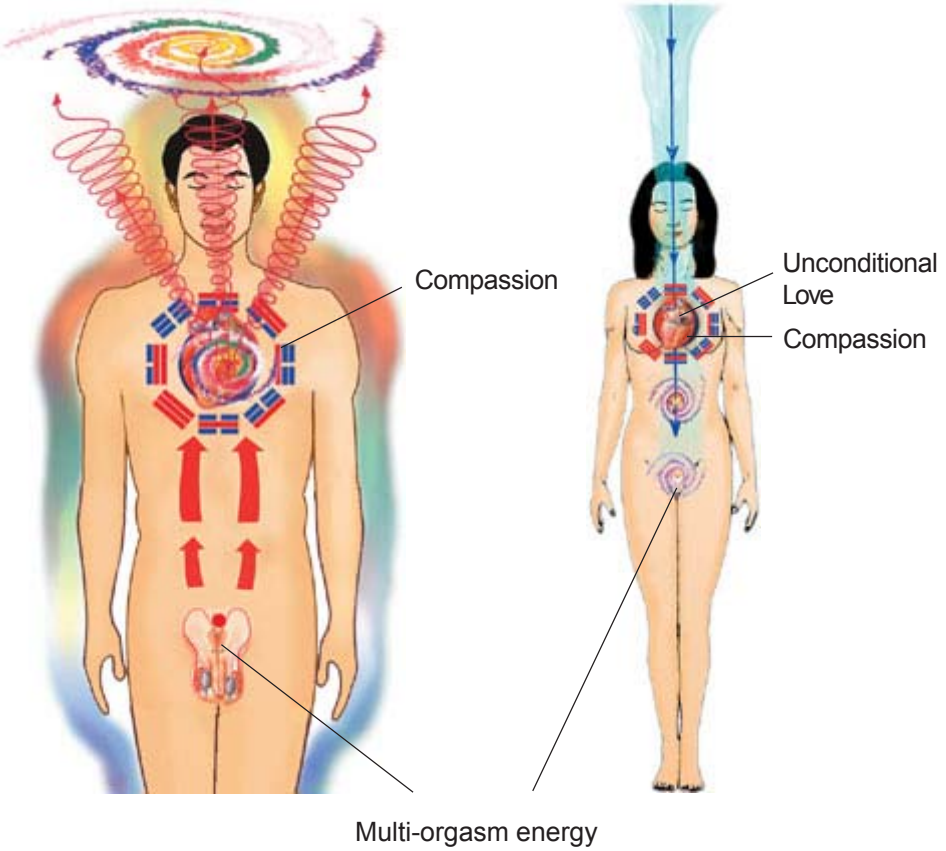

Fig. 6.7 *Through cultivating compassion energy, we can eventually build the one lasting energy.*

Practice of Creating the Compassion Fire and Multi-Orgasm

Compassion originates from the Heart

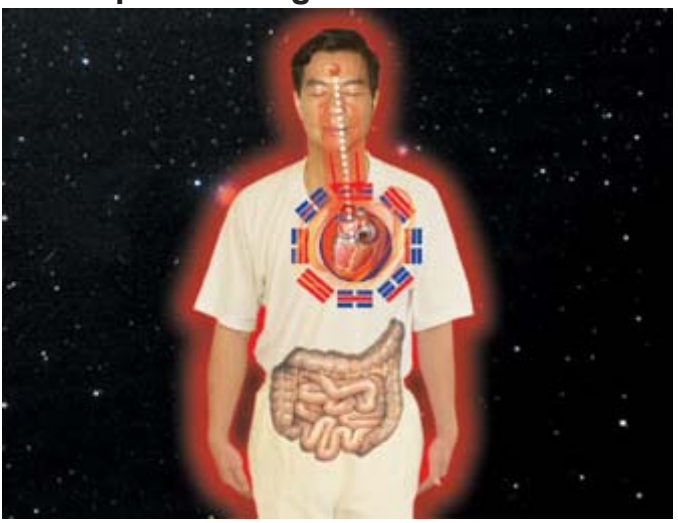

Fig. 6.8 *Smile until you feel the heart soft with love, joy and happiness.*

We can connect with the Universal Love.

1. Be aware of the Tan Tien and the universe and feel the unconditional love flow down.

Fig. 6.9 *Smile to the heart and the small intestine, to make the heart feel soft. Feel the heart pakua spiral.*

2. Smile to the spleen and let the love, joy and happiness from the heart activate the openness and fairness.

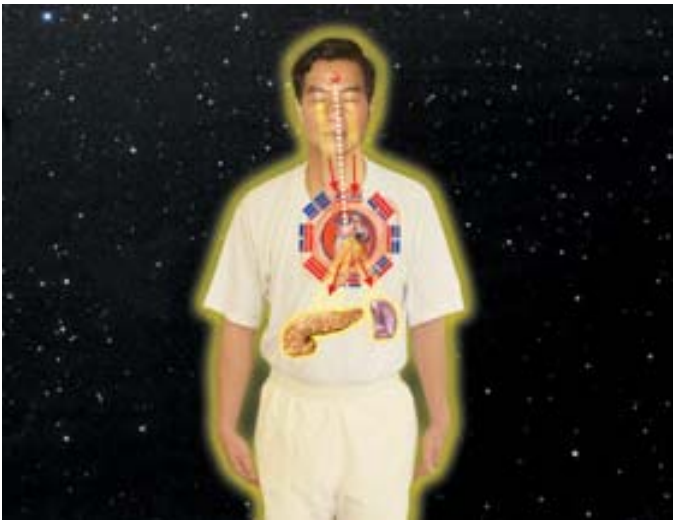

Fig. 6.10 *Let Positive Heart Energies activate Positive Spleen Energies.*

3. Let it flow back to the heart pakua and spiral, blend together and feel the yellow light flow from above and flow down to the heart.

Fig. 6.11 *Blend the Two Energies with Universal Energies.*

4. Smile to the lungs and the large intestine. Send love from the heart to the lungs to activate courage and righteousness.

Fig. 6.12 *Let Love and Joy from the Heart activate Positive Lung Energies.*

5. Let it flow to the heart, spiral and blend with love, joy, happiness, openness and courage. Blend the three energies into one energy, and feel the white light from above flow into the lungs and the heart.

Fig. 6.13 *Blend the Three Energies into One Energy.*

6. Smile to the kidneys and let the love of the heart activate the gentleness, softness and calm in the kidneys.

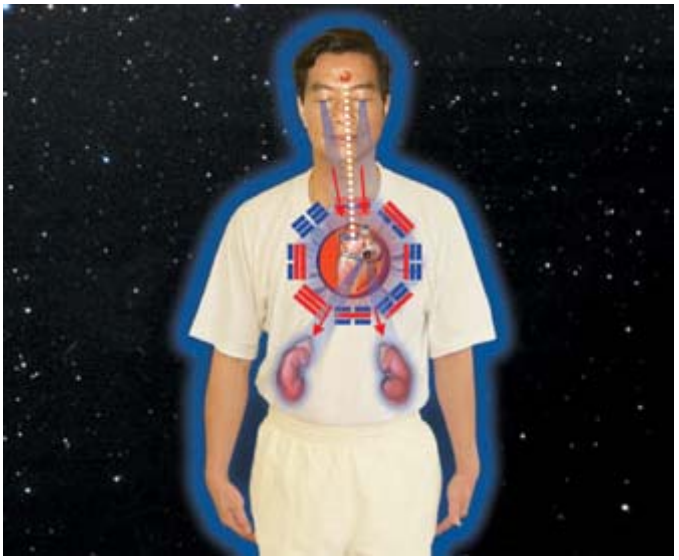

Fig. 6.14 *Let Love and Joy from the Heart activate Positive Kidney Energies.*

7. Let the gentleness, softness and calm in the kidneys flow into the heart. Blend and spiral into one energy.

Fig. 6.15 *Blend Positive Kidney Energies with the Compassion Energy in the Heart.*

8. Smile to the liver and gall bladder. Let the softness and the love from the heart flow down to activate the kindness and generosity of the liver.

Fig. 6.16 *Let Love and Joy from the Heart activate Positive Liver Energies.*

9. Let the kindness and generosity flow to the heart, spiral and blend in the heart to become compassionate; be aware of the green light flowing from above.

Fig. 6.17 *Blend Positive Liver Energies into the Compassion Energy.*

10. Smile to the heart and feel all the good virtuous energy from all the organs flow into the heart and spiral and blend into compassionate energy.

Fig. 6.18 *All the Organs' Positive Energies blend with the Heart to create the Compassion Energy.*

11. Your compassion rises up. Be aware of the galaxy, the cosmos, and expand your compassion through the universe. The universe allows us to be in touch with the universal compassion.

Fig. 6.19 *Expand our Compassion to be in touch with the Universal Compassion.*

12. Let them blend and multiply, and flow back to enhance you. You feel your whole body to be filled with the universal compassion. You have such abundance, it overflows.

Fig. 6.20 *Let the Universal Compassion within us overflow.*

Multi-Orgasm Energy Smile to the Sexual Organs

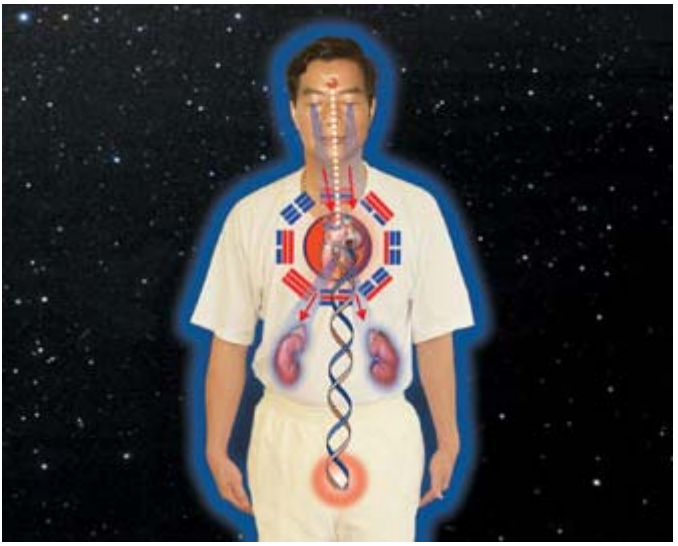

Fig. 6.21 *Smile down to the Heart and feel warm Energy from Heart flow down to Kidney and the Sexual Organs.*

1. Be aware of the sexual organ and use your hand to cover the sexual center. Smile and feel the fire from the Tan Tien flow down.
2. Recall the time when you were with your loved one and the high orgasmic feeling. Guide the orgasmic energy up to the kidneys, and feel the kidneys charge with Chi and orgasm.
3. Guide the orgasmic energy spiraling up to the small and large intestine, liver, spleen, pancreas, stomach, and up to the lungs, and heart. Continue up to the thymus, thyroid and parathyroid and up to the brain and the senses. Charge them with orgasmic energy, and let the Chi flow back down to the sexual organs and blend and spiral into one multi orgasmic energy.

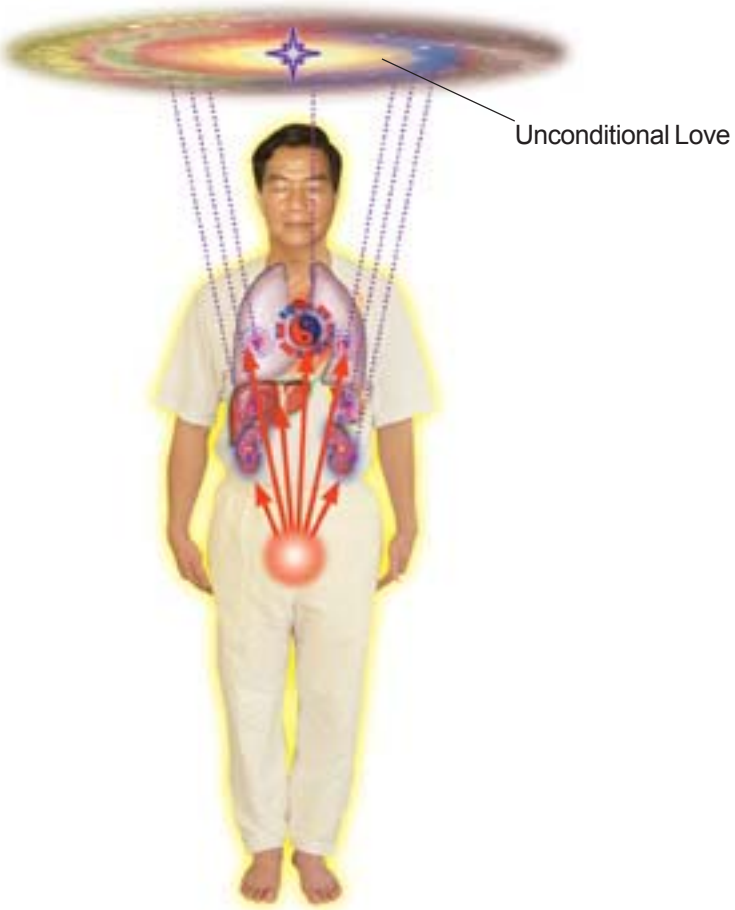

Fig. 6.22 *Bring the Orgasm up spiraling up to the organs.*

4. Be aware of the Muti-Orgasmic Energy in the organs and bring them up to the crown and continue spiral up to the Universe. Let the orgasm multiply and be aware of the Cosmic Orgasmic and let it flow down to the crown and feel all the cells fill with Cosmic orgasm and flow into the heart then down to the sexual organ filling them with compassion and Muti-Orgasmic Energy.

Universal Compassion: Your compassion arises up. Be aware of the multi-orgasm sexual energy and feel it combine with the compassion into one energy at the Tan Tien. Be aware the cosmos galaxy and expand your compassion through the universe. The Universe puts us in touch with the universal compassion.

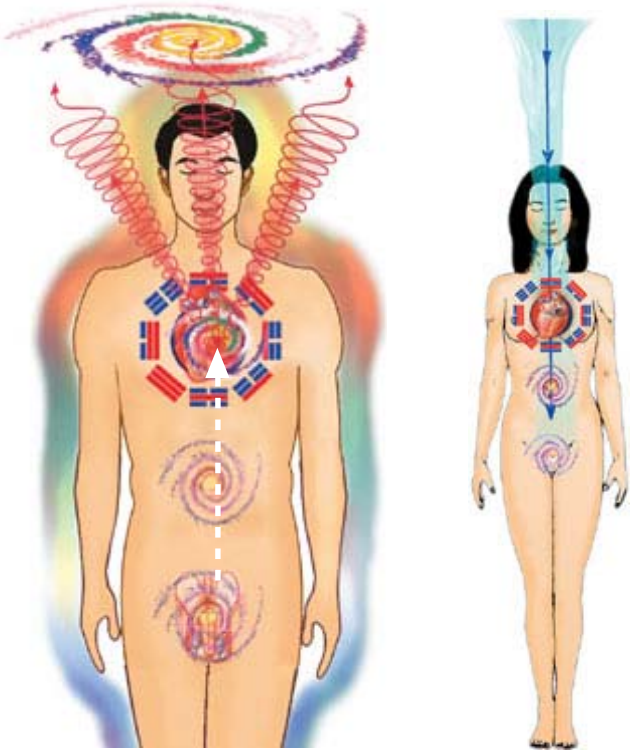

Fig. 6.23 *Universal Compassion*

This compassion practice is the major practice for all the Fusion and Kan & Li practices. The compassion fire is the most important energy of the transformation and will be use in all the practices.

Practice compassion through the Act of Forgiveness.
To forgive is to let go.
Always meet conflict with compassion.

Fig. 6.24 *Be aware of the people that you feel resentment toward.*

Fig. 6.25 *People who make you feel angry.*

Fig. 6.26 *People that you hate or people who hate you.*

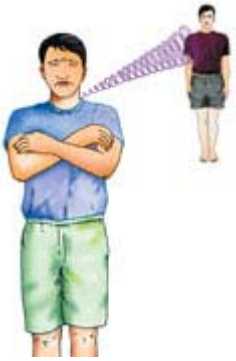

Fig. 6.27 *People who hurt you or people who have been hurt by you.*

Fig. 6.28 *Send out the abundance of compassionate energy that you have from the universe, to fill the person and to forgive whatever he/she did to you.*

Oneness with Universe (Oneness with God)

Fuse Inner Positive Energy with Universal Energy through Turning the Dial

In Fusion of the Five Elements, the collection points were used to gather and store the energy of the organs. From the collection points in the body, the energy was drawn down into the pearl. Now, in Cosmic Fusion the collection points are expanded to encompass the Energy Body and the Universal Aura body. So, not only are we fusing the emotional energy of the physical body (negative emotions, senses and thoughts), but now we fuse the energy of the Energy Body and the Universal Body. This creates a much more complete practice and a highly refined pearl of energy. Fusing the elements is the secret to internal alchemy.

You can think of the different collection points like ingredients for a delicious soup. The more energy we can collect, the more spices we have for our soup. Alchemy is like cooking. What creates a really good soup or food is a combination of ingredients. Alchemy is about fusing the elements at our disposal to create balance and harmony within ourselves and the world we live in.

In the beginning of the fusion practice, it seems intricate and detailed. Once you get used to the formulas it is a very easy and simple practice. Learning a new recipe always takes some time and study, but once you have it in your mind, it is easy. The same is true with the fusion practice.

Forming the Collection Points

The collection points were introduced in Fusion of the Five Elements as a way to collect the negative energy from the organs. This energy was then directed into the pearl through the pakuas. In Fusion of the Five Elements the collection points were associated with the energy of the infants and the protective animals. In Cosmic Fusion, we are going to expand this practice by forming the collection points of the Energy Body and the collection points of the Universal Aura Body. These collection points are a reflection of the collection points in the physical body.

For example, the physical heart collection point is located at heart center just behind the sternum. The Energy Body collection

point is located at the Lower Tan Tien at the top of the navel. And, the Universal Aura body collection point is located above the head in the Universe.

These collection points are utilized to create a powerful method of fusing all the elements into the pearl. Once all the collection points are established, the Energy Body and Universal Aura body collection points are rotated. This way there are different colors at the various collection point sites. For example, the collection points at the Energy Body are turned clockwise – the green is on the upper point, red is at the left, white is at the bottom, and blue is on the right. The Universal collection point is rotated counterclockwise – white is the upper point, blue is at the left, green at the bottom, and blue at the right. Creating different colors at each of the collection points takes the fusing process to another level of intensity. These colors are then mixed and blended into the cauldron and formed into a powerful pearl.

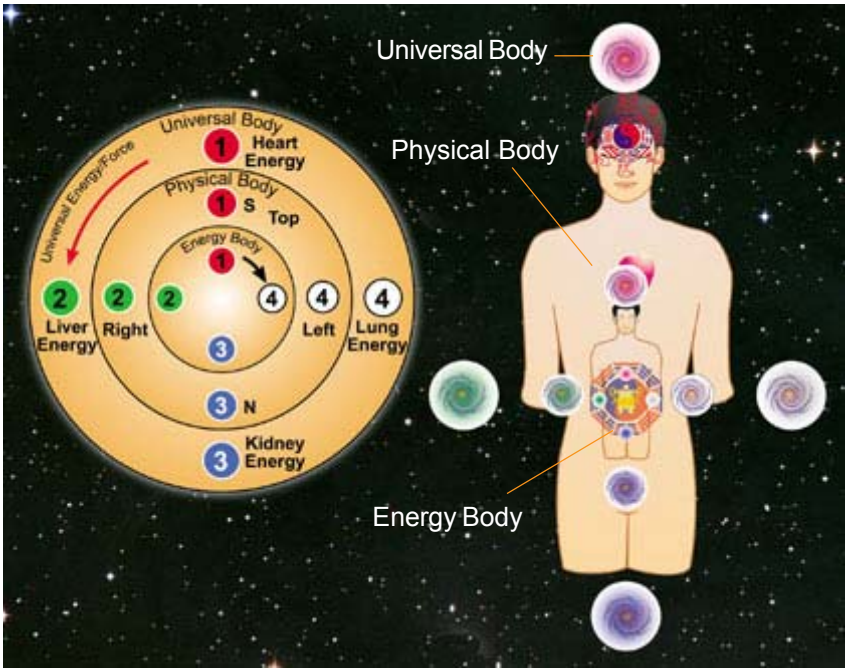

Fig. 6.29 *Fuse inner position energy with universal energy.*

The Concept of Fusing Inner Position Energy with Universal Energy

The fused collection points are utilized to create a powerful method of fusion all the elements into a pearl.

There are four collections points of the elements; fire, water, metal and wood of the physical body, energy body and universal body.

Once all the collection points are established in the Physical Body, the Energy Body and the Universal Body we use a dial to assist in rotating the patterns of energy.

- Understanding that the physical body is more dense and stable; the collections points are fixed.
- The energy body is not fixed and is very sensitive to external events and the universe. This can be changed.
- Universal Energy is always changing and is not fixed. As the planets and the body's celluar matter, nuclei, electrons, protons all move at different speeds; we use the differences to create energy.
- The Dial: We use a dial of color to understand the different patterns of energy that can be created. Fusing different energies will generate more intense energy and a powerful pearl.

  Moving the color dials assists the imaginative mind to connect to the patterns of energy. It is a formula, a pattern for the mind to follow.

  In this approach we fuse inside to outside universe and outside to inside. You mix fire and water first, then wood and metal together. You can do it in pairs of points and then all four points, creating four balls of fused energy which are then spun very fast above the cauldron where they fuse to form a pearl. You can reproduce as many pearls as you want.

  The intensity can make you feel a oneness with the universe as part of you becomes part of the universe and universal forces.

Activate the Three Fires

The Abdominal, the Kidney and the Heart Fires.

Tan Tien Fire: Bring the fingertips to the navel. Feel the abdominal fire warming and opening the Lower Tan Tien. The abdominal fire elicits deep awareness within the body. This awareness has the power to expand and connect to the entire Universe.

Kidney Fire: Bring the palms to the kidneys, the fingertips to the door of life. Feel the warmth in the kidneys, like a fire under the sea.

Heart Fire: Bring the hands to the heart, palms facing the chest. Visualize a glowing ball of light in the heart. Feel the warm radiant energy of compassion shimmering through the chest. Make the heart soft. Remember the Yin within the Yang.

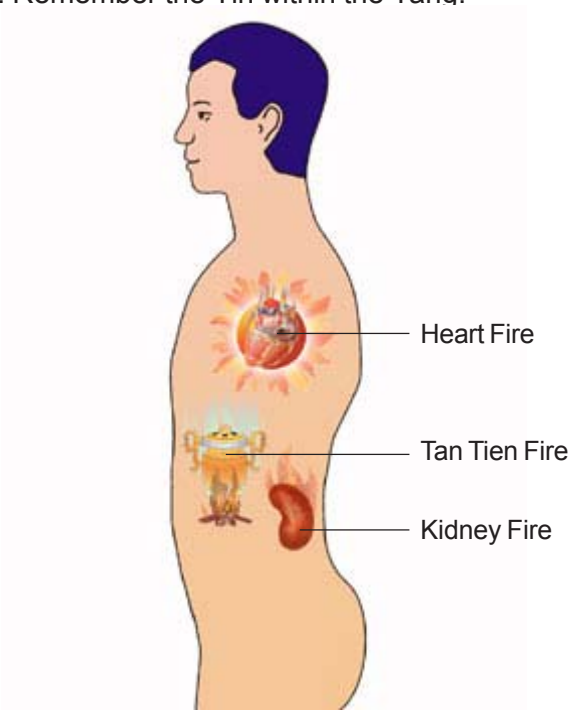

Fig. 6.30 *Activate the Three Fires.*

Create the Front Pakua just behind the navel. Control the formation of the front pakua with assistance from the eyes, ears, nose and mouth. As you balance the energy, let the pakua glow with light.

Chant the Eight Forces by sounding all the trigrams. Visualize the trigrams forming the front pakua. Chant the proper Yin and Yang combinations with each trigram.

Form the Back Pakua: Let it reflect off the front pakua like a mirror. In a similar manner form the **Left** and **Right Side Pakuas**. Feel the energy starting to spiral and blend into the center of the abdomen.

Form the Facial Pakua: The facial pakua is the reverse direction of the abdominal pakua because we are looking at the pakua in front of the face. Feel the energy of the senses and the face gathered and collected. If you have time, chant the eight trigrams of the facial pakua.

Form the Universal Pakua: Feel the immensity of this pakua surrounding your entire body in every direction. Again if time permits, chant the eight directions, forming the pakua.

Be aware of the heart and all the good virtue energy and fuse them together into compassion fire in the heart.

Be aware of the orgasm energy and multiply then to the organs and finally combine them into the heart and becoming one compassion fire of unconditional love.

Form the Collection Points in the Physical Body: Feel the red light in the heart collection point, the blue light in the kidney collection point, the green light in the liver collection point, the white light in the lungs collection point, and the yellow light in the spleen collection point.

Remove Negative Energies from the Organs:

Use the senses to help locate the negative energies in the organs. Look deep inside; smell deep inside; taste deep inside. Locate anything you find that you do not like.

Form the organs' collection points. Spiral the negative energies into the collection points spiraling them into the front pakua where they will blend and transform.

As you spiral the energies from all four Pakuas into the cauldron, you are concentrating them in the cauldron of the body. The cauldron, as the center point of the human being, is the center that contains the essence of all sense, organ and gland energy. The energy directed to the cauldron is transformed and stored for later use in the development of the soul and spirit bodies.

Using the Dial: Feel the reflection of the colors in the collection points in the energy body that surrounds the cauldron.

Feel the outward reflection of the collection points into the Universe. The red ball of light above the head, the blue ball of light deep below the feet, the green ball of light to the right, and the white ball of light to the left.

1. Turn the collection points of the energy body clockwise one station. Turn the collection points of the Universe one station counterclockwise.
2. The physical body collection points always remain stationary. Now the color sequence is red at the physical heart collection point, green below it in the energy body, and white above in the Universal collection point. Below, the physical collection point is blue, the energy body is white, the Universal is green, the right physical body collection point is green, the energy body is blue, and the Universe is red, and on the left the physical body is white, the energy body is red, and the Universe is blue.

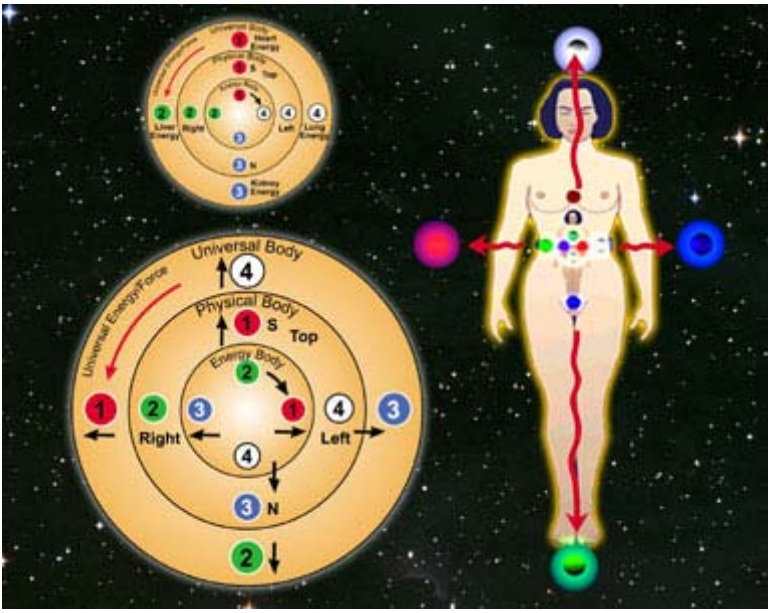

Fig. 6.31 *Fuse inner positive energy out with universal energy through turning the Dial-1.*

3. The fusion process begins here. Fuse the white energy from the energy body with the blue ball in the physical collection point at the perineum, and fuse both of these energies down to the Universal collection point with green light.
4. The same process continues with all the collection points. Next, fuse the green energy body point with the red physical body collection point, moving upward to fuse the white Universal collection point. Feel the energies fusing together above you.
5. Moving to the right side, fuse the blue ball of the energy body collection point with the green ball of the physical body, and outward to fuse with the red ball of the Universal collection point. Feel the energy fuse together at the right side.
6. Moving to the left, fuse the red ball of light of the energy body with the white ball of the physical body and moving out to fuse with the blue ball of the Universal collection point. Feel all these energies fuse together at the left.
7. Now we bring the fusion process back inside the body. Take the fused light below you, drawing it first to the physical collection point and then into the energy body collection point. Bring the fused energy above the head down to the physical collection point and then into the energy body collection point.
8. Draw the fused energy from the right back to the physical body collection point and then to the energy body collection point.

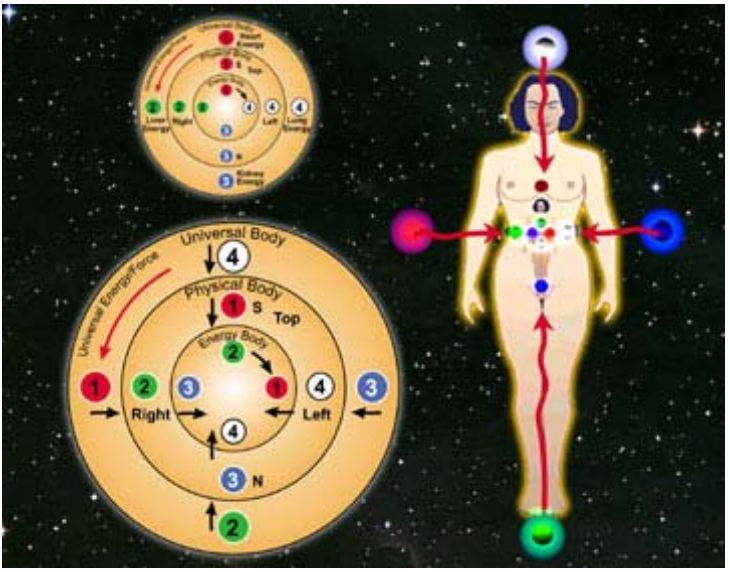

Fig. 6.32 *Fuse the Universal energy force back to inner positive energy and Energy Body through turning the Dial-1.*

Draw the fused energy from the left back to the physical body collection point and then to the energy body collection point. Allow the four balls of fused energy to spiral around the cauldron. Let them increase in intensity and speed, going faster and faster, until they blend in the middle of the cauldron forming the pearl.

9. Feel any residual energy spiral through the pakuas and fuse together into the cauldron, connecting with the brilliant pearl of white light. Feel the colors blend and fuse. This is where the alchemical process comes to life. At any time during the Fusion practice, if you feel the pearl you are working with is lost or diminished simply become aware of the pakuas spiraling into the center of the cauldron.
10. Once you feel the form of the pearl you can simpy fuse the energy from inside of the energy body out to the physical and out to the universe and back and there is no need to be aware of the different color.

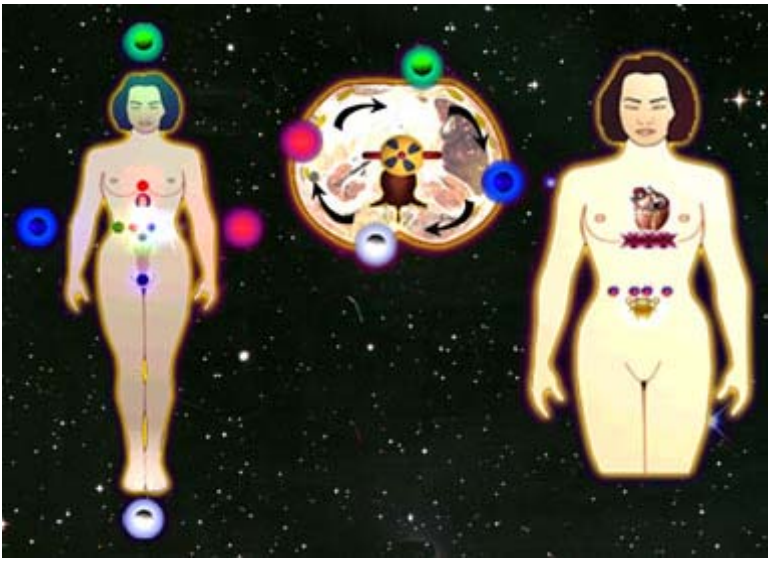

Fig. 6.33 *Four fused energy balls spiral on top of the cauldron, forming one energy pearl.*

Do as above, only the colors are changed and fuse from the energy body to physical body, to the universe and back as Four Balls, spiraling faster and fuse into One Pearl.

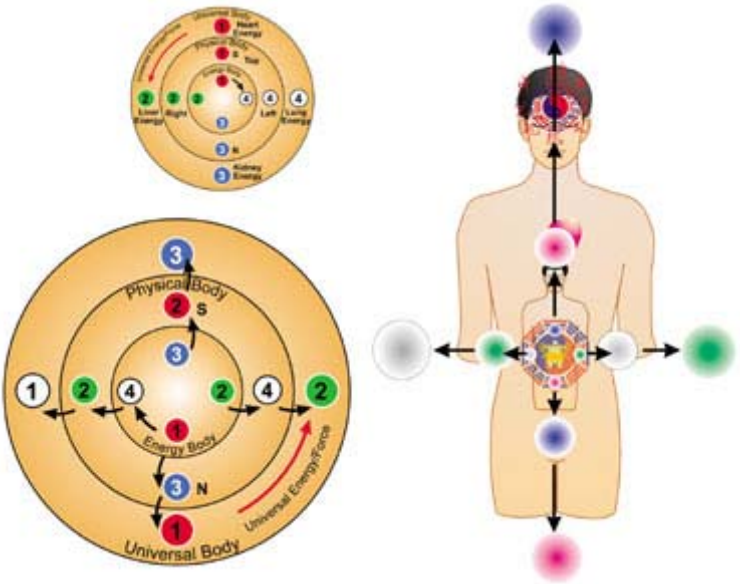

Fig. 6.34 *Fuse inner positive energy with universal energy through turning the Dial-2.*

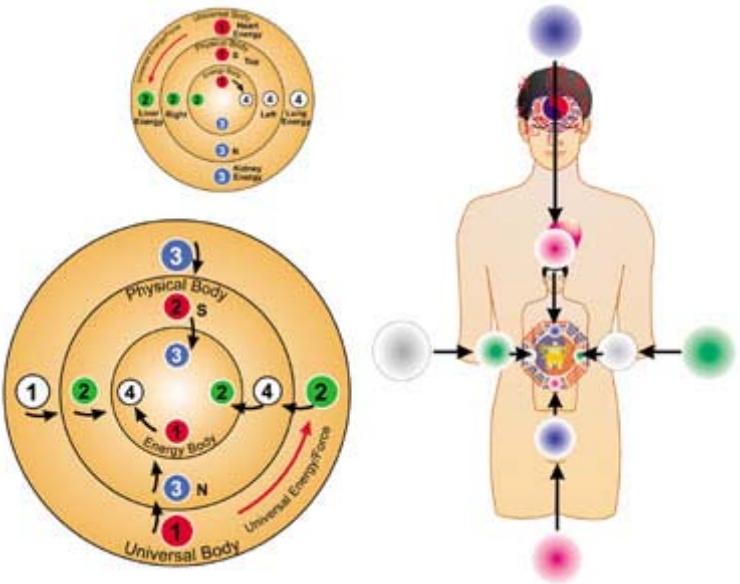

Fig. 6.35 *Fuse the Universe force back to the body and energy body.*

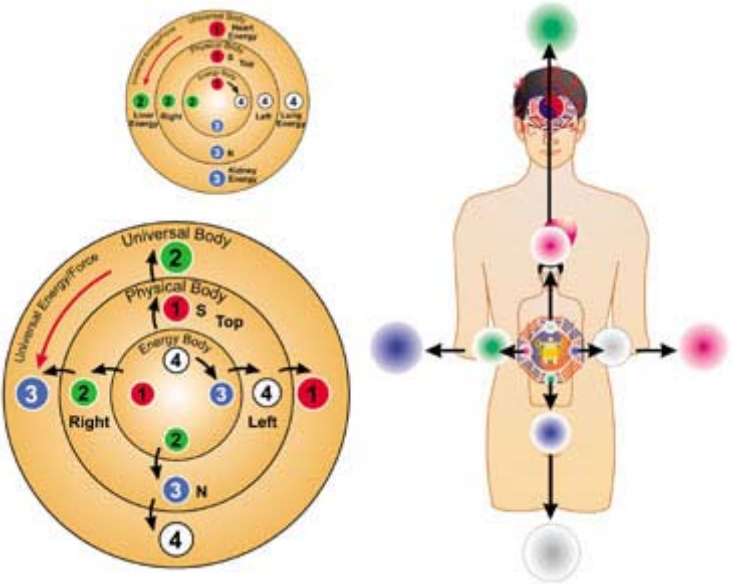

Fig. 6.36 *Fuse inner positive energy with universal energy through turning the Dial-3.*

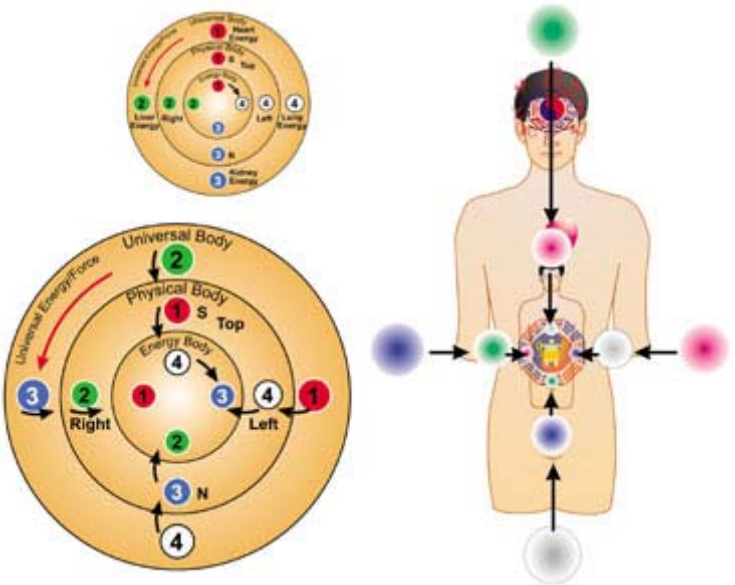

Fig. 6.37 *Fuse the Universe force back to the body and energy body.*

Do the same procedure as before using the Four Fused Energy Balls spiraling on top of the cauldron, forming One Energy Pearl as you turn the Dial. You spend more time using Dial-2 and Dial-3 positions.

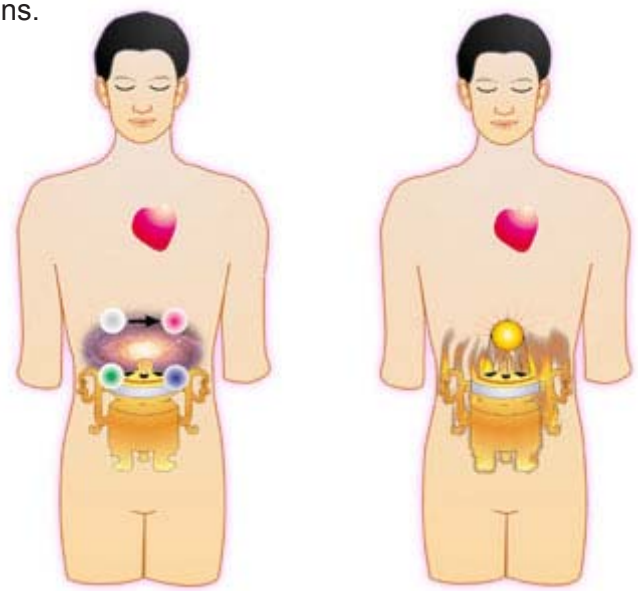

Fig. 6.38 *Forming the Cauldron and the Pearl*

Creation Cycle Foundation Practice

1. Fuse the Pearl to help activate virtue energy. The Inner Smile is the first step to connecting your consciousness to all your organs and glands. This is actually the first step of the Fusion of the Five Elements practice. It is important to remember how powerful and sublime smiling inward can be.
2. The next stage of practice is removing negative emotional energy from the organs. The negative energy is brought from each organ to its corresponding organ collection point and then to the pakua where it is neutralized. When all negative energies are brought to all four pakuas and are under control and all residual energies have been brought to the back and side pakuas, the energies are then spiraled and compressed into the cauldron. There they are formed into the pearl of energy. As you collect the energies and direct their flow to the cauldron, you feel your center point illuminate with the bright light of the pearl.

3. Be aware the energy, physical and universal collection points, fuse them together and fuse back to form the bigger pearl.
4. The pearl is capable of activating, attracting and absorbing a great amount of good virtue energy. For this reason the pearl is circulated to each organ following the Creation Cycle. After practicing Fusion of the Five Elements, the pearl is brought from the cauldron to the perineum and is then circulated in the Microcosmic Orbit.
5. When you are ready to begin Cosmic Fusion, the pearl is brought to the Heart to begin the Creation Cycle. The Heart is the beginning point of this cycle because it is in the Heart that Compassion resides.
6. At this point there is a great awareness of each organ and the energy that each one is supplying. A continuation of this awareness is necessary for properly practicing the Creation Cycle of Cosmic Fusion. It is especially important that all negative energy has been removed and neutralized beforehand; otherwise, as the virtue energy of the pearl increases, so will the negative energy as you move the pearl through the Cycle.
7. In Fusion of the Five Elements, you remove the negative emotion of fear from the kidneys, by first listening to them, because the ears and kidneys have a connection. The removal of fear from the kidneys leaves room for the positive virtue of gentleness inherent in the kidneys to grow.
8. Now, in beginning the Creation Cycle of Cosmic Fusion, you focus your smile on the virtues of joy, love and happiness in the Heart. Feel the virtues growing and purifying. It is important to develop a genuine virtue here. You can spit out words like love, joy and happiness without meaning them. But like the love that is mentioned in the Bible (1 Corinthians 13), it has to be real and true; otherwise it is just a sounding brass or a tinkling cymbal. You have to flesh it out and breathe life into it.
9. Here is the way to do the Creation Cycle of Cosmic Fusion: Feel the unconditional love of the Universe flowing down into the Heart. With this combination of virtues – love, joy, happiness, unconditional love – you can definitely transform yourself, your organs and those around you.

10. Let the positive Heart energies of love, joy and happiness activate the positive Spleen energies of openness and fairness and centeredness. Blend this with the Universal energy and feel the yellow light descending to the Heart and Spleen.
11. Let the positive Heart energies of love, joy and happiness activate the Lung energies of courage, strength and righteousness. Blend these energies with the Universal energy and see the white light from above flow into the Heart and Lungs. Let the Positive Heart energies of love, joy and happiness activate the Kidney Energies of gentleness, softness and calm in the Kidneys. Blend both energies with Universal Energy and see the blue light coming down from above into the Heart and Kidneys.
12. Let the positive Heart energies of love, joy and happiness activate the Liver energies of kindness, generosity and benevolence. Blend these energies with Universal energy and see the green light flowing from above into the Heart and Liver. You can do this meditation a few times.
13. Blend all the positive organ virtues in the Heart, creating Compassion Energy. You may manifest this as a Pearl. Move it in the Microcosmic Orbit spiralling it from 10,000 to 60,000 times a minute.

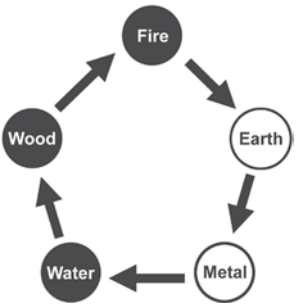

Yin movement Feeds

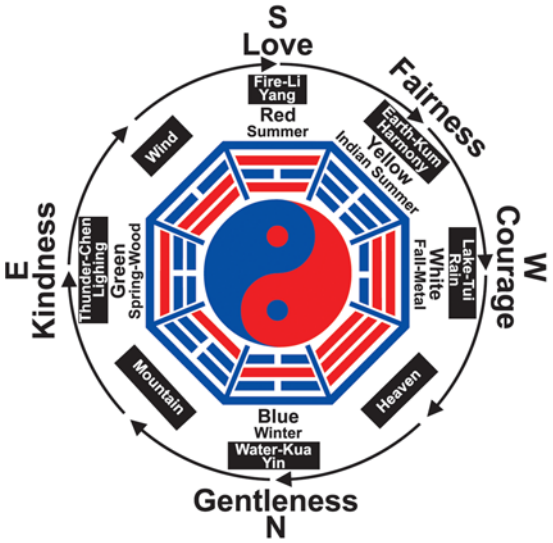

Fig. 6.39 *Creation Cycle*

14. This completes the basic Fusion practice. These steps will be repeated through the rest of the formulas in the book. In the beginning it seems like a lot of work in constructing all the pakuas, chanting, collecting the energy to fuse into the pearl. Once this formula is set up, the whole process happens very quickly. It is not necessary to do all the steps every time. You might only want to chant the trigram one time instead of three. Remember, these extra steps are there to increase the strength of the pearl and expand our consciousness to connect with the Universe. With this powerful pearl it is time to begin Cosmic Fusion with the Creation Cycle.

Begin Cosmic Fusion: Creation Cycle

1. Activate the compassion fire and multi-orgasm energy and combine them together connecting with the universe.
2. Form the pearl through the fuse from the inside to the universe and from the universe and back to the body to the form a pearl. Bring the Pearl down to the Perineum.
3. Feel the pearl connecting to the kidney energy.
4. Listen to the Gentleness Virtue of the Kidneys.
5. The negative emotion of fear has already been removed from the kidneys. The energy remaining in the kidneys is their virtue energy of gentleness. Listen quietly to the gentleness of the kidneys, and be aware of the qualities of gentleness energy: **cold, calm, blue, soft** and **silky** and **tenderness**. Enjoy these qualities. You can intensify them by concentrating on them. Bring the pearl from the perineum to the kidneys, and add the gentleness energy to the pearl at any moment when you feel the pearl weak, just form another pearl.
6. Now bring the pearl back to the kidneys collection point at the perineum, where the gentleness will grow in intensity. All of the neutralized energy that is the pearl now will take on the virtue energy of gentleness.

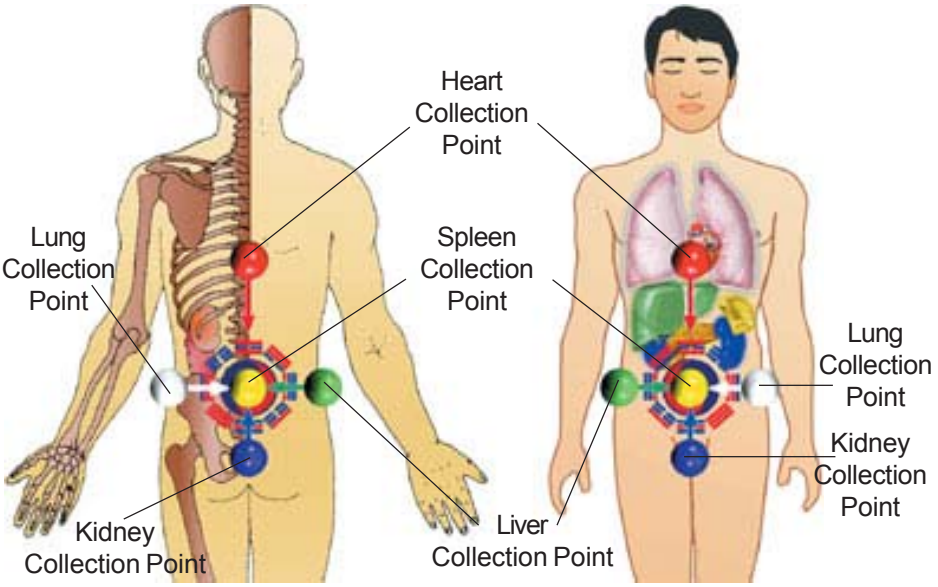

Fig. 6.40 *Front and Back Collection Points*

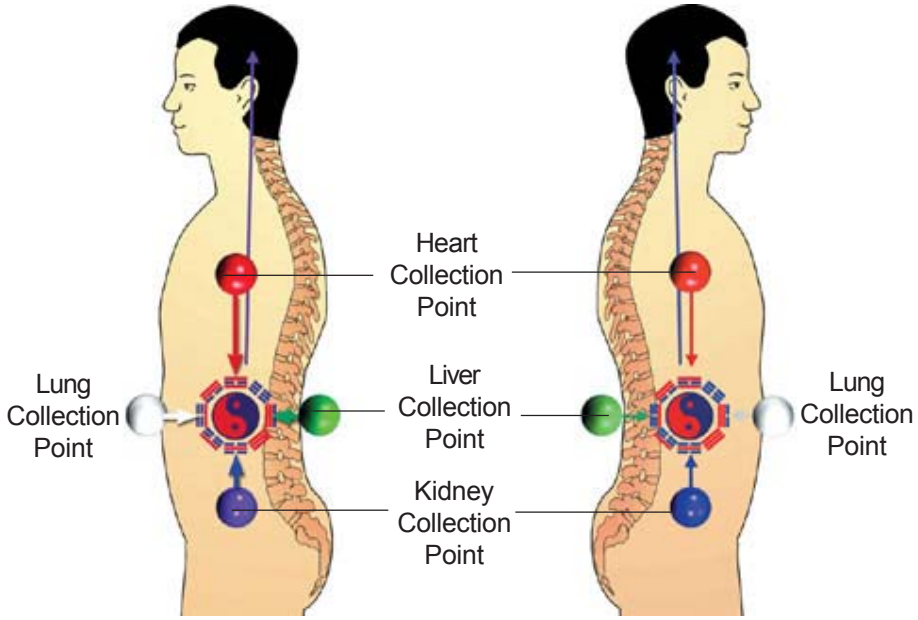

Fig. 6.41 *Left and Right Collection Points*

Direct the pearl to the liver. Gentleness energy fuses with the kindness virtue of the liver.

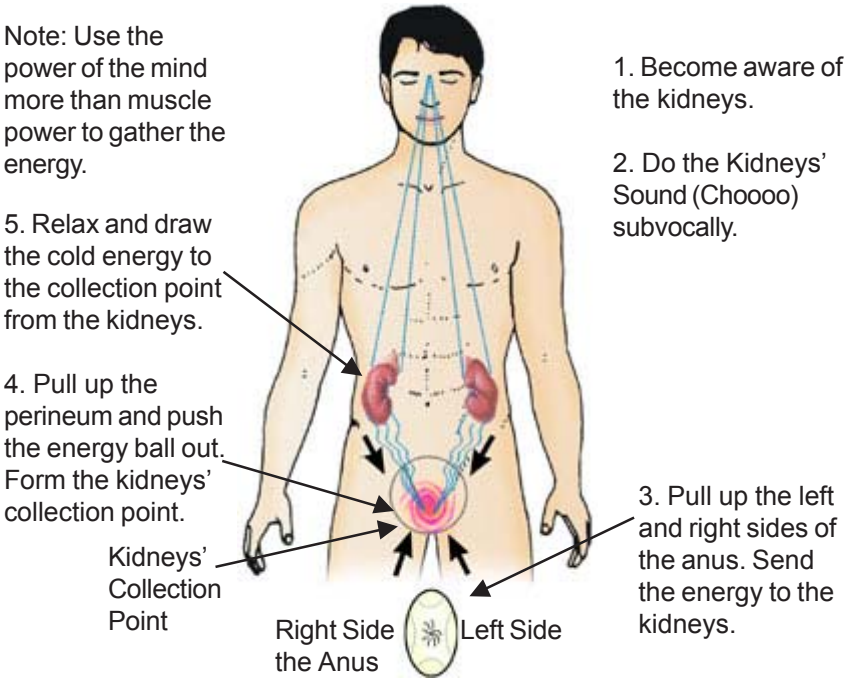

Fig. 6.42 *Forming the Collection Point to gather the Kidneys' Energy.*

7. Gentleness blends with kindness, the virtue of the liver. Look into the liver, connecting the eyes with the liver. Be aware of the kindness energy there. As you bring the pearl carrying the gentleness energy from the kidneys toward the liver, feel the gentleness energy activate and enhance the kindness energy. Enjoy the kindness energy. Feel the kindness intensify. Circulate the kindness energy in the liver. Its qualities can feel **strong, round, smooth, soft, green, sweet and fragrant, warm and pleasant**. You can feel satisfied.

8. Absorb the kindness energy into the pearl, and bring the pearl to the liver collection point (at the level of the navel and in line with the right nipple).

   Here the combination of gentleness and kindness will intensify. Remember to relax and smile. Direct the pearl to the heart. Gentleness and kindness energy fuse with love, honor and respect and joy in the heart.

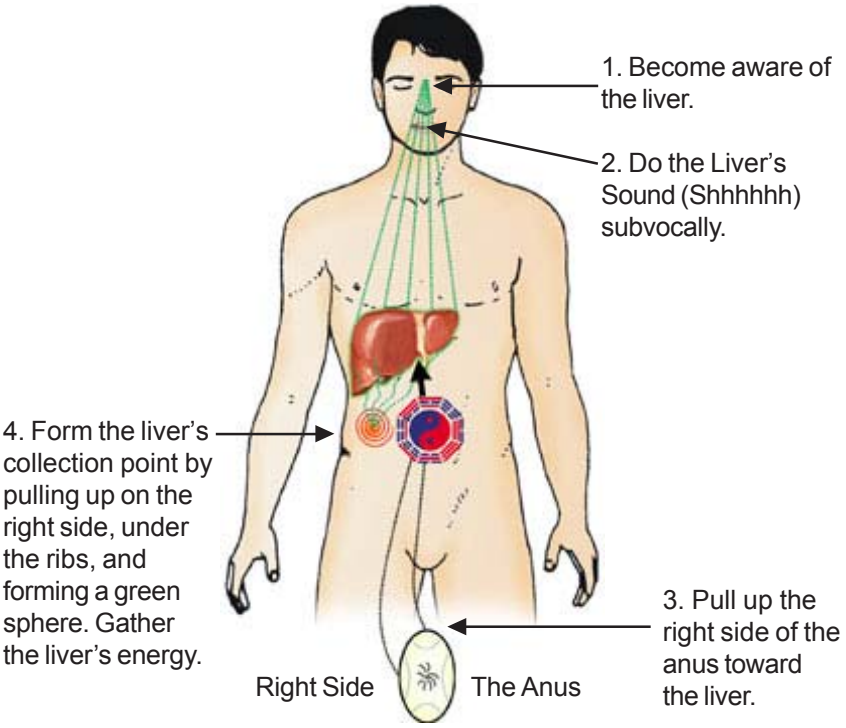

Fig. 6.43 *Forming the Liver's Collection Point to gather the Liver's Energy.*

9. Connect the tongue with the heart. Using your mind's eye and senses, allow the pearl, now consisting of gentleness and kindness, to flow up to the heart. Let the virtue energy of the pearl activate and enhance all the loving energy, joy and happiness, honor, respect and peace in the heart. These good virtues of the heart can feel **straight** and **open, bright red, warm, deep, calm, comfortable** and **satisfying**. Enjoy the virtuous feelings of the heart. The feeling will be different for each person as the energy blends. Feel the warmth and openness in the chest.

10. Let the pearl absorb the honor, respect, love and joy. Bring the pearl down to the heart collection point behind the sternum.

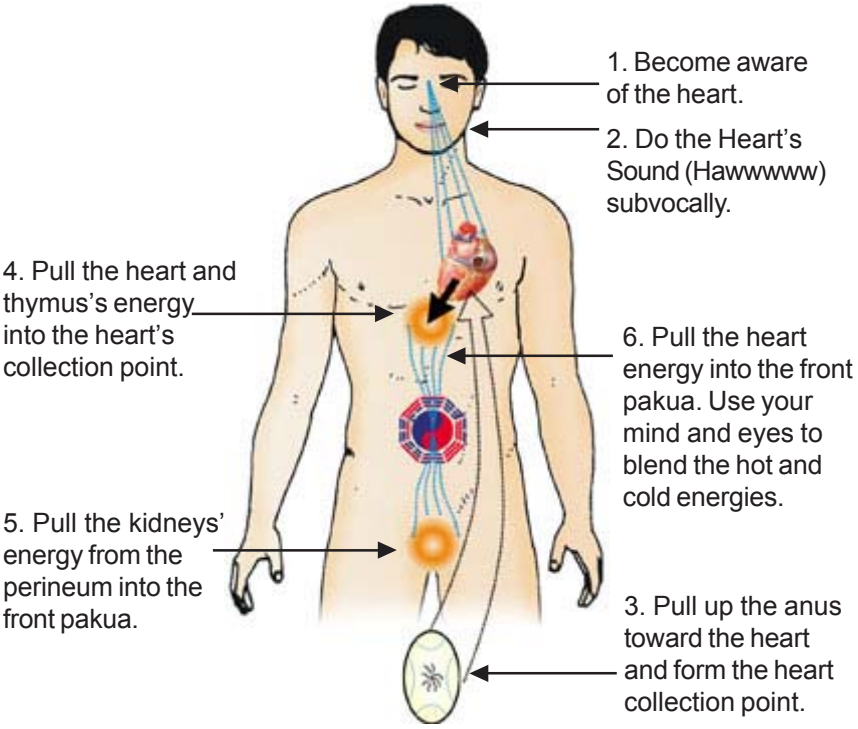

Fig. 6.44 *Form the Heart's Collection Point and blend the Heart's Energy with the Kidneys' Energy in the Pakua.*

The pearl can now blend the virtue energies of the heart in a balanced way with the kindness and gentleness energies already within the pearl. Feel the collection point glowing. Then direct the pearl to the spleen/pancreas.

Note for Women: Women should be careful when the pearl is in the heart center. As a natural endowment women tend to have more loving energy in the heart. When a woman loves she often forgets herself. This amount of love can heat up the heart center and the practice can feel uncomfortable. It is best not to remain for too long in the heart if you feel uncomfortable.

11. Be aware of the connection of the mouth with the spleen and pancreas. As the pearl arrives at the spleen and pancreas, the honor and respect, love and joy energy that is now part of the pearl fuses with the spleen virtues of fairness and openness. The fairness and openness virtues of the spleen can feel **expansive, clean, dry, bright yellow, smooth, warm, clear** and **soft**. Enjoy these feelings.
12. Let the pearl absorb the fairness and openness energy. Feel the pearl take on the qualities of the fairness and openness virtues in addition to the kindness, gentleness, honor and respect virtues that already are present there. Bring the pearl to the spleen collection point behind the navel at the front pakua.

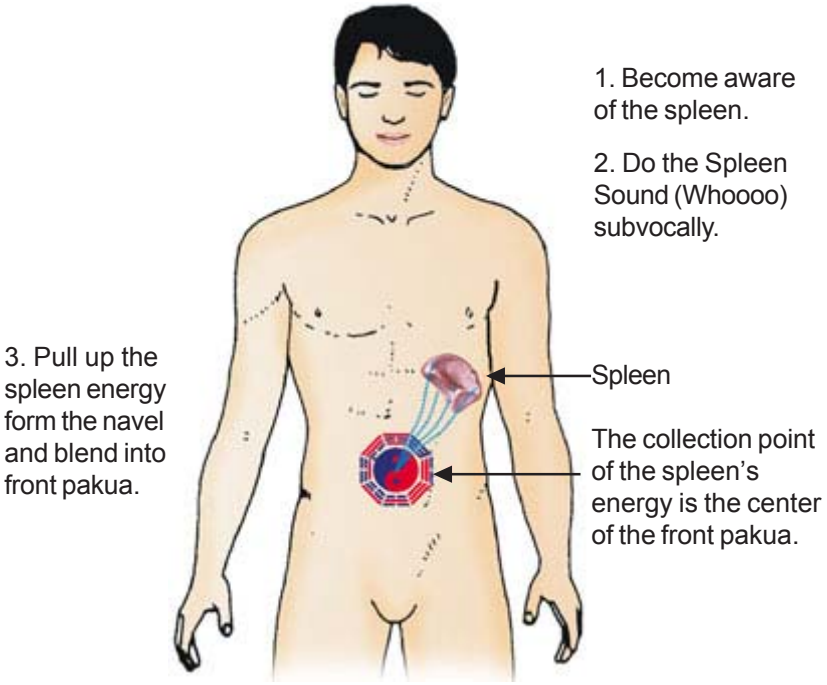

Fig. 6.45 *Gathering the Spleen's Energy Directly into the Pakua.*

Feel the fairness and openness energy intensify as it combines and blends with all the neutral and virtue energies already present in the pearl. Direct the pearl to the lungs.

13. The Energy of fairness and openness fuses with the courage and righteousness virtues of the lungs.

Connect the nose to both lungs. As the pearl arrives at the lungs, split the pearl into two pearls, one for each lung. The energy of fairness and openness that is now part of both pearls fuse and enhances the courage and righteousness energy of the lungs. When you feel righteous, you can feel **tall, straight, uplifted, comfortable, strong, firm, proud** and **satisfied**. The energy can be **fresh, bright, white** and **pure**. Enjoy the qualities of this energy.

14. Let the pearls absorb the courage and righteousness energy. Bring both pearls to the collection point of the lungs (at the level of the navel and in line with the left nipple). Feel the courage and righteousness energy intensify as it circulates in the lungs. Let the pearls blend these virtues with their kindness, gentleness, honor, respect, fairness and openness energies.

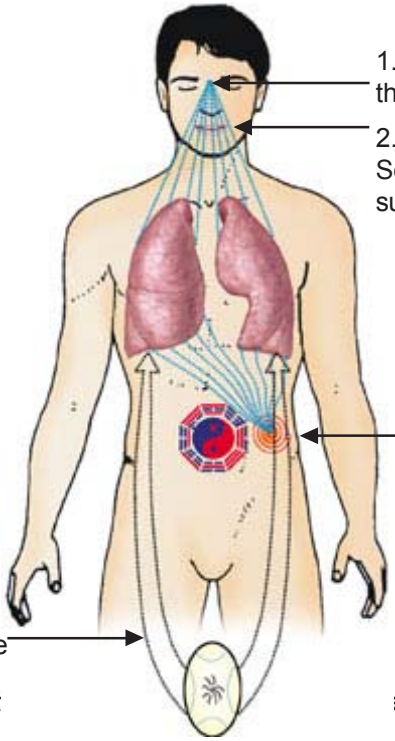

Fig. 6.46 *Forming t* *er the Lungs' Energy.*

Direct both pearls to both kidneys. Courage and righteousness fuse with gentleness: the cycle begins again at the kidneys.

15. As the pearls arrive at each kidney, the combined virtues of the pearls (especially the energy of courage and righteousness) enhance gentleness and the cycle begins again at the kidneys. Repeat the cycle two more times. As you circulate the pearl in the second cycle, you will begin to notice that as the pearl arrives at each organ, the virtues will grow by themselves. Little by little, the energy will blend more evenly.
16. For the third cycle, bring the pearl from collection point to collection point without going into the organ first. With your attention on the collection point, the energy will flow into the organ without conscious effort, and will join with the virtue energy to flow back toward the collection point. In this way the virtue energies are enhanced and increased each time you bring the pearl to a collection point. If you wish you can practice the third round of the Creation Cycle three more times simply by bringing the pearl to the collection points. Each time you blend the energy, you increase it.
17. Your energy now begins to have the quality of fine soup, with the proper combination of ingredients. Be aware of the quality of this energy. It is very special. Fuse all good virtues energies into compassion energy. Creating a pearl of compassion energy requires a tremendous amount of purified energy. Compassion energy is not just love or kindness, gentleness or openness, but is a combination of all the good virtues' energies, blended in proportion to become compassion energy. When you fuse the proportional blend of good virtue energy into a pearl of compassion energy, you will feel more centered. The energy of this pearl feels very different from the pearl you first formed. Move the compassion energy through the microcosmic orbit.
18. When you feel the pearl of compassion energy strongly, move it down to the perineum. Using your mind and senses, begin to move all of the compassion energy through the microcosmic orbit, letting its bright pearl shine as it travels along. Feel the different quality of this energy. Be aware of the loving, comfortable, very beautiful way the organs feel as the energy runs through and spreads into them, filling them with life-force energy. If you feel tired at any time, you can temporarily rest the pearl at your navel and practice the spinal cord breathing technique described in the Chapter preceding this meditation. Return your concentration to the pearl to form it again and return it

to the microcosmic orbit for circulation. Move the pearl through the microcosmic orbit 9-18 times.

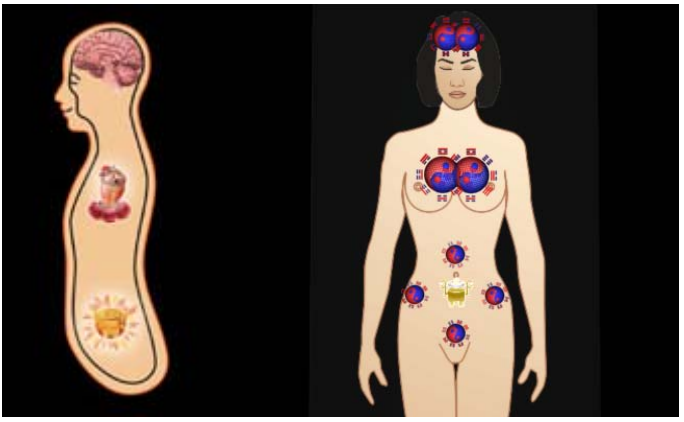

Fig. 6.47 *Circulate the pearl in the Microcosmic Orbit.*

Shoot the Pearl above the Crown.

1. As the pearl runs through the Microcosmic Orbit, begin to activate the Cranial Pump. Press your tongue to the palate, clench your teeth, pull back your chin and roll your eyes up toward the crown. Feel the pulsing in your heart and in your head at the crown. You can touch your pulse at the wrist to help your awareness of the pulse both at the wrist and the crown. Your mind also helps to activate the Cranial Pump.

Fig. 6.48 *Pull the eyes into their sockets.*
Roll the eyes up and look up to the crown.

2. Inhale, be aware of and squeeze the anus and then exhale quickly to push the pearl up through the crown.
3. You might be aware of a light, beam or frequency shooting out of your crown. This is the lead light first introduced in Fusion of the Five Elements. Sometimes it is called an indicator light because it will indicate how high up your pearl will be able to go. Just as a light is used to guide helicopters to their landing point, so will you use the lead light to guide the pearl back to the crown point.
4. Direct all of your senses to push the pearl up to the area six inches to two feet (15-60 centimeters) above your head. Move the pearl up and down, left and right.
5. Feel the Universal Force, the forces of the North Star and Big Dipper above your head, and the Cosmic Particle Force in front of you as they shine down to your pearl. Feel your pearl start to absorb this energy and then feel it expand.
6. Bring your awareness to your feet. Feel the energy supplied throughout your body through your feet. This is the Earth Energy. The pearl continues to expand with all the energy coming to it from outside the physical body.
7. When you are ready, activate the Cranial Pump again. Press your tongue up, clench your teeth, pull back your chin, pull up your anus and look up to the crown. Feel the beating in your heart and the pulse at your crown.
8. Activate the lead light, and let it shine up from your crown. It may feel like a frequency going out of the crown. Draw the pearl down to the lead light. Inhale and draw the pearl down.
9. Circulate the pearl in the Microcosmic Orbit. Then bring it down to the navel and to the cauldron at the body's center. Collect the energy at the cauldron.
10. As you collect the energy and relax the mind, the pearl may disintegrate. Sometimes when you release the pearl, it vanishes. It is returning its energies, now enhanced by all virtue energies and the outside forces, to the organs and glands. They become stronger and healthier each time you practice. Each time you gather the energy and form the pearl again, the pearl will be stronger.

Summary

1. Trust and Believe (Concept and Desire).
2. Visualization turns into activation.
3. Think and let it happen. It will become easier with practice.

Once you understand the practice and go through the practice a few times, you can just simply use the mind and recall the past experience and there is no need to go through all the steps. Think and let it happen.

Fusion Opening: Fusing Universal Energy

1. Inner Smile–Activate Compassion first (Love and Sexual Energy combined).
2. Activate Three Fires.
3. Create Pakuas; Front, Back, Facial, Universal.
4. Form Cauldron, spin Pakuas.
5. Form organ Collection Points of Physicial Body.
   Energy Body and Universal Body.
6. Remove Negative Energy from the Organs.
7. Sense the Colors of the Collection Points imagine the Dial-1,2,3 of Colors.
8. Fuse inner Positive Energy of the Energy Body and Physical Body with Universal Energy through turning the Dial-1,2,3.
9. Fusion of the Universe Energy back into Body and Energy Body.
10. Create Four Balls of fused energy and spin them very very fast above the Cauldron.
11. Form a Pearl.

Begin Cosmic Fusion: the Creation Cycle.

Be aware of the heart and cauldron activating the compassion fire.

1. Listen to the Gentleness Virtue of the Kidneys.
2. Gentleness Energy activates the Kindness Virtue of the Liver.
3. Kindness Energy activates Honor, Respect, Love in the Heart.
4. The Energy of Honesty and Respect activates the Fairness and Openness Virtues of the Spleen and Pancreas.
5. The Energy of Fairness and Openess activates the Courage and Righteousness Virtues of the Lungs.
6. Courage and Righteousness enhance Gentleness: the Cycle Begins again at the Kidneys.
7. Combine all Good Virtues energies into the Heart and create Compassion Energy.
8. Move the Compassion Energy through the Microcosmic Orbit.
9. Shoot the Pearl above the Crown.
10. Practice Chi Massage.

Chapter 7
Opening the Thrusting Channels

Theory of the Thrusting Channels

After the positive emotional energy of the organs is absorbed into the pearl, it is then circulated in four of the four special channels: the Microcosmic Orbit (Governor and Functional Channels), the Thrusting Routes, and the Belt Routes. The Thrusting Routes run through the center of the body, linking the "chakra" centers. The Belt Routes spiral around the body, strengthening the aura and providing a form of psychic self-defense. The second part of the Cosmic Fusion practice involves opening these three Thrusting Channels.

The Thrusting Channels are a powerful means to clean out the negative emotions and detoxify the organs and glands. Set into action, the three Thrusting Channels will serve as strong and efficient ways to check your center and observe the status of your emotions.

The Thrusting Channels run from the perineum to the crown and are separately identified as the Middle, Left and Right Thrusting Channels. The Middle Thrusting Channel begins directly at the perineum and runs vertically up to the crown. The Left Thrusting Channel is located one and a half to three inches to the left of the Middle Channel, while the Right Thrusting Channel is one and a half to three inches to its right.

When you are feeling emotional, you can check the Thrusting Channels, especially the Middle Channel, to discern whether you are off-center. You will know if you are out of balance when you feel the emotions running more on the left side or on the right, instead of through the middle of the body. If you center the emotions through the Middle Thrusting Channel, and keep the Left and Right Thrusting Channels in balance, you will very quickly center yourself. The Thrusting Channels serve as guidelines to decision-making in your daily life.

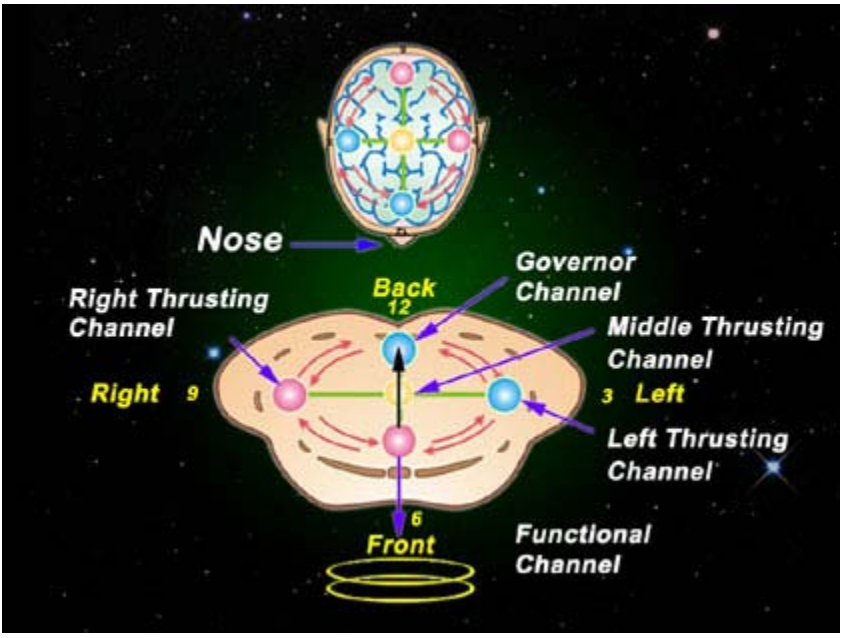

Fig. 7.1 *Four Psychic Channels*

Procedure for Opening the Thrusting Channels

The Thrusting Channels need the tremendous energy of good virtue to help them open. Begin by forming a pearl of virtue energy. With your continued, conscientious practice of the compassion fire and the fuse the inside with the outside energy to form the pearl, you will be able to assimilate the energies into a new and stronger pearl, a pearl that responds to your intention. This means that all you need do to form a new pearl is concentrate on the cauldron and the pearl in it, and on the front, back, left and right pakuas and fuse inside with the outside energy. Control of the internal weather, senses, organs and emotions will be possible in as little as a few seconds. You do not have to go through all the steps of chanting and collecting the energies every time you do the Fusion practice. It is helpful and creates a stronger experience if all the steps are taken. So the first step to opening the Thrusting Channels is to construct the pakuas, chant the eight directions, form the collection points of the Physical Body, the Energy Body and the Universal Body, and fuse them together into the pearl.

The pearl will be thrust up from the perineum (or testicles in men). Each Thrusting Channel precisely penetrates the body.

Although it may seem difficult at first, using your beautiful pearl will help make it easier. Other aids such as pulling up the anus and inhaling help the energy move in each of the three Channels. Once you are able to pass the energy through the Channels, you will find that the energy will move by itself without assistance.

Note: You must be very careful and gentle with this procedure. If the energy reaches the heart and head too quickly using the Thrusting Channels, the heart will become congested and you may experience pressure. If the heart becomes congested and overheats with energy: (1) Do not thrust above the diaphragm and (2) Practice the Heart Sound. Do not overheat the heart, liver or head.

Initially the Thrusting Channels have approximately a one-half to one inch diameter. Once they are activated, they can become very wide. At first concern yourself with drawing the energy directly up. Later, when you have become familiar with the process, the energy can be spiraled up each route.

Seated Position

Like many other Universal Tao exercises, the methods of opening the Thrusting Channels are practiced from a seated position. Sitting on a chair with your feet touching the floor and your spine erect connects you with two important energy “wires”: Earth Energy and Heavenly or Universal Energy. The Energy Body you eventually create needs the ground wire of Earth Energy to hold and support it. Otherwise, you can become disoriented and lost. Once your are more in control of the energy you can practice standing, or lying down on a bed or the floor.

Anal Muscle

If you do not strengthen your anal muscle, you will not progress very far in any of the Universal Tao System's practices. The anus muscle is connected to the perineum and everything in the body above it. If you invest all of your money on building the top floors of a building, and do not invest anything in the foundation, the building will fall. Think of the anus and perineum as your foundation. The anus muscle is used to seal your "lower gate." Closing this orifice helps to retain and prevent loss of your energy.

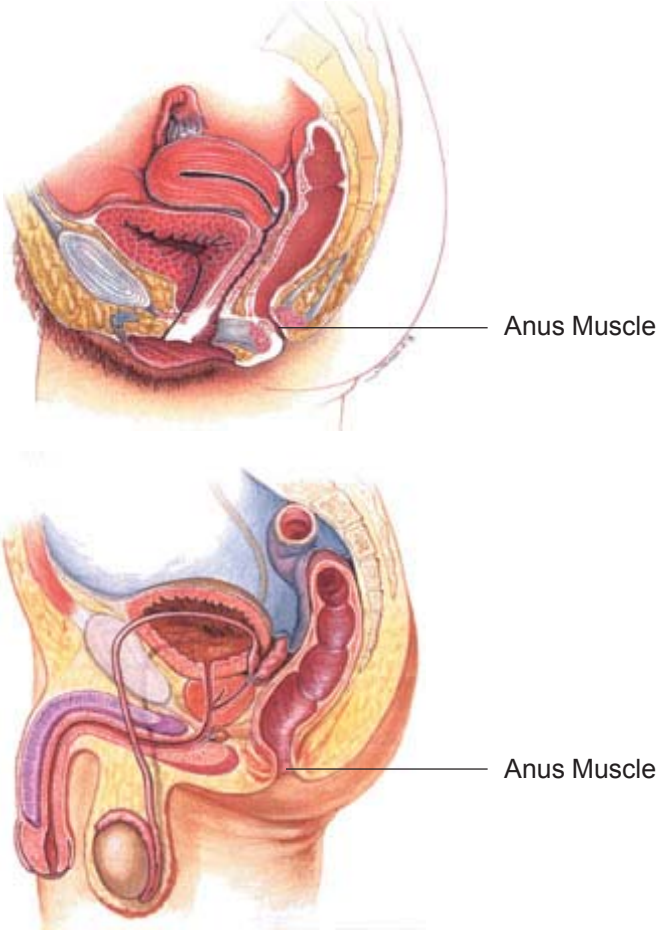

Fig. 7.2 *Anal Muscle*

Saliva

Saliva is yet another aid in performing these exercises. Once you have been able to bring the energy up through all the routes to the crown successfully, saliva generation becomes very important.

In the body, the moon influences the kidneys, which are linked with the salivary glands, the ovaries and semen. When the kidneys are stimulated during sex, the Chi is raised up through the spine, then it flows down in the saliva, and the kidneys' essence transforms into sexual energy. The saliva has two functions: purifying the mouth, and nourishing our immortality, the water of life. The energy from the saliva lubricates 100 joints, and it stimulates and harmonizes the organs. It is very important to enhance the production of saliva by absorbing the moon's energy through the breath absorption exercises. It is a sign that the techniques are working when the saliva floods into the mouth.

Although saliva is a lubricant for the Channels, it first serves as an agent to burn and clean them out of any impurities that could block the flow of energy. So when resting during the practice of opening the thrusting channels move your tongue around to create saliva. Make it thick and swallow down forcefully, feeling it go down the channels that you are working on (See the book *"Elixir Chi Kung"* by Mantak Chia).

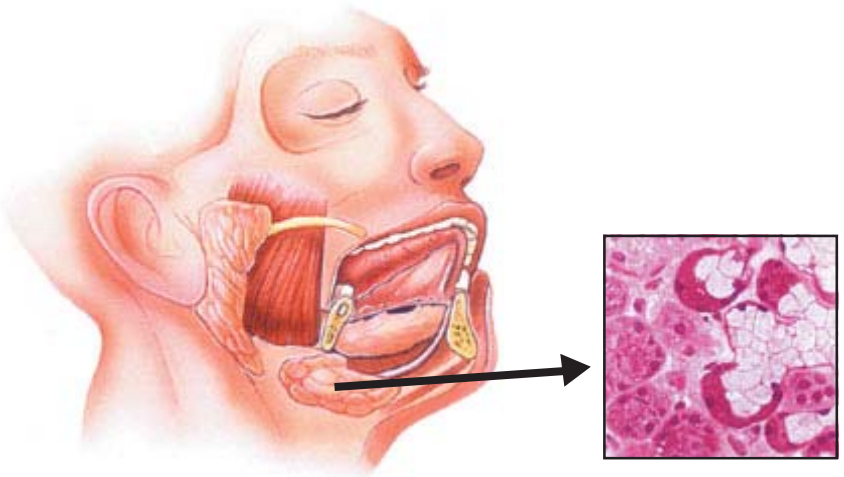

Fig. 7.3 *Saliva*

A person experiences the Thrusting Channels according to his or her kinesthetic or visual perceptions. The majority of people are more kinesthetic and can undeniably feel the quality of the condensed energy as it passes through each level of the channels.

Visual people can see patterns and colors. The Thrusting Channels, like the organs they intersect, have corresponding colors. The Left Channel is Red, Middle - White and Right - Blue. Regardless of your perceptual tendency, both the senses and the organs are used to control the Thrusting Channels.

The denser or more polluted the organ, the more energy is requires to pass through the affected Thrusting Channel.

As a safety precaution and as preparation to be able to move the energy to prevent it from sticking, the Thrusting Channels are opened in four stages. The pearl is brought (1) up to the diaphragm; (2) up to the neck; (3) up to and out of the crown; (4) down to the feet, into the ground; and up to the crown.

This will be done a total of nine times at each stage in the following sequence: (1) left, (2) middle, (3) right, (4) middle, (5) left, (6) middle, (7) right, (8) middle and (9) left.

Men & Women Practices: Open Channels Differently

Once the channels have been completely opened, men and women practice differently. Without stopping, men will thrust the energy directly up through the Thrusting Channels and out of the crown. They then will bring the energy back in to flow down the Thrusting Channels and down through the soles of the feet into the ground. They can continue to bring the flow up around the body and in through the crown. Without stopping, women will thrust the energy down through the soles of the feet into the ground and then up through the Thrusting Channels to and out of the crown. They then spray the energy down around the body, tuck it under the feet and draw it back in through the toes.

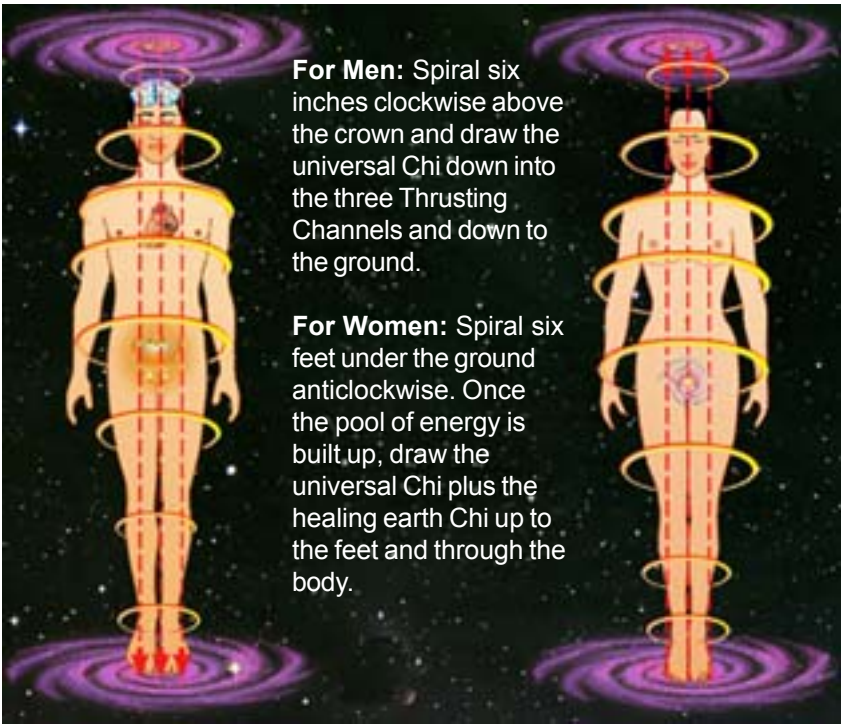

Fig. 7.4 *Cosmic Thrusting and Belt Channels*

Practice of Opening the Thrusting Channels

1. Form a Pearl and Send it to the Perineum

In a seated position smile down to your organs and glands, and put yourself in a state of relaxation and happiness. Begin with the meditation exercises of the Creation Cycle to form a pearl of compassion energy.

As you have learned, there are many steps in forming such a pearl. However, once you have programmed yourself to all of these steps through continued practice, you can simply push the button and the whole program is activated. When you are able simply to sit quietly and feel the sensation of compassion energy forming, you are pushing the button and the entire process takes very little time. In other words once you have experienced compassion energy, all you need to do is to recall the state to create the energy again. You will not need to go through the entire process each time. You will know when you look at the pearl whether or not the process has been completed. If you find something is not right, you can review the steps and find out where the problem is.

As the pearl is forming, use your mind and senses to control it. Slowly move it down to the perineum. At any time during your practice, if the pearl seems to weaken, diminish, or you lose track of it, return to the navel and quickly form a new pearl. Bring that pearl to the perineum and resume practice.

While you are learning how to bring the energy up through the channels, it is easier to focus on the organs the channel passes through than to focus on the channel. You might think of the process as learning how to read. Once you are able to read, you no longer have to think about your ABC's.

2. Stage One: Thrusting Channels to Below the Diaphragm

A. Left Thrusting Channel to the Diaphragm

In all Universal Tao practices it is important to train the power of the mind and senses to control our energy (Chi). The power of mind, eye and heart guides the Chi, providing a way to control and direct your life force. Breathing techniques also help to activate the Thrusting Channels. It is necessary to have some control over independent breathing through each nostril. Since in the beginning this is difficult to do, you can use your right index finger to cover the right nostril. Feel the breath on the left side only. Use the left eye, ear, and nostril to assist you in drawing up the energy.

1. Left Testicle (Men), Left Ovary (Women) and Left Kidney
   a. Sit up, using your mind, heart and eye power to look inside and be aware of the perineum. Also become aware of your left nostril, left ear, left eye and left anus.
   b. Activate the Left Thrusting Channel by inhaling through the left nostril in short sips (about ten percent of lung capacity with each breath.)
   c. Then men slightly pull the left testicle and the left side of the anus up toward the left. Women slightly pull the left side of the anus up toward the left. Draw the pearl up with each sip of air. The left eye should internally look down, and then use the mind/eye power to look up as the pearl is drawn up. (The physical eyes do not actually look up.) Women direct the pearl to the left ovary and the left kidney; men direct the pearl to the left kidney.
   d. Exhale, relax the eye and the muscles, letting the pearl drop to the left side of the anus (and left testicle in men), and rest. Rest and feel the left side become lighter as the energy begins to flow up without effort. Practice nine times. Each time you rest use your mind to trace the Left Thrusting Channel.

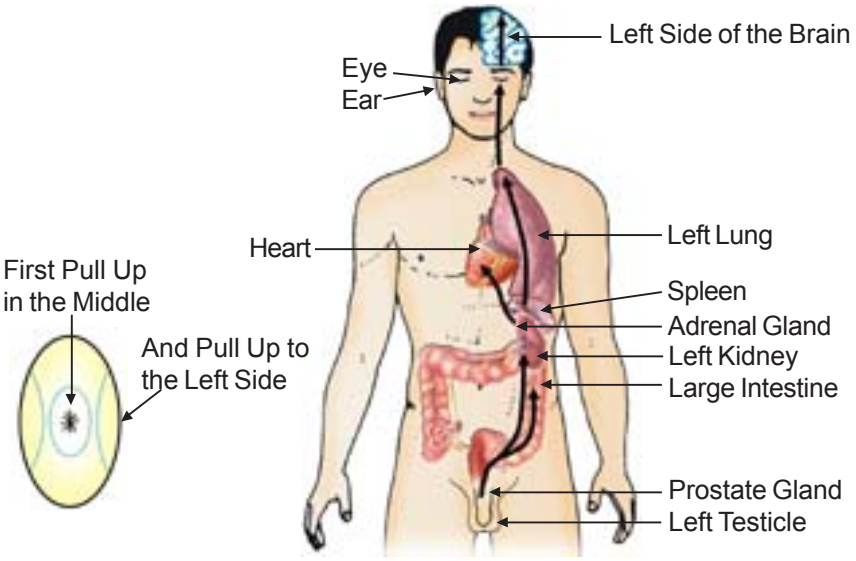

Fig. 7.5 *Left Part in the Male*

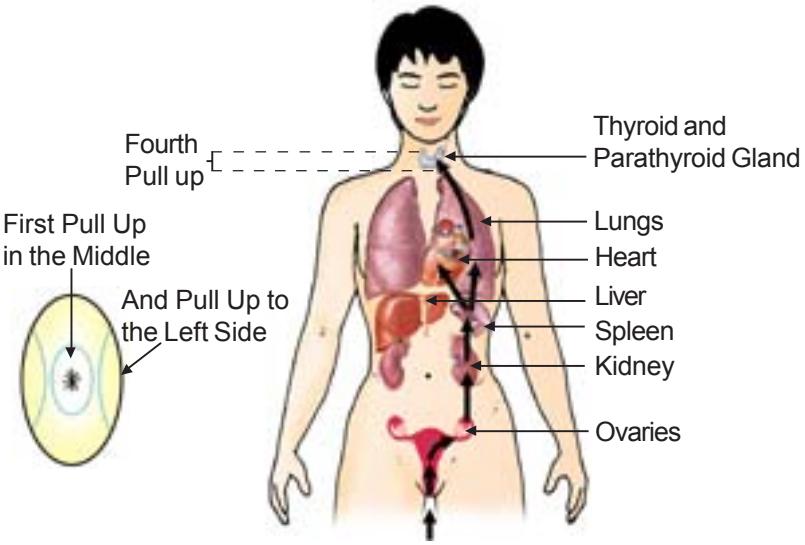

Fig. 7.6 *Left Part in the Female*

2. Spleen

Close the right nostril, inhale, and pull up. As you sip in the air, use the mind power and the left eye, ear and nostril to draw the energy up from the left testicle (men), through the left ovary (women), the left kidney, and up to the spleen. Exhale; release the energy down. Practice nine times. Rest, and feel the energy flow up the Left Thrusting Channel to the spleen under the diaphragm.

B. Middle Thrusting Channel to the Diaphragm

1. Prostate (Men) or Cervix (Women)

Men concentrate on the middle of the scrotum, perineum, and anus. Women concentrate on the middle of the perineum and anus. Inhale, and pull up the middle of the scrotum (men), perineum and anus. Use all the senses to draw the energy up to the prostate (men) or cervix (women). Look up with both eyes as you do so. Relax the eyes and anus muscle, and let the pearl drop back down to the perineum and scrotum (men). Feel the energy begin to flow up as you rest. Do this nine times.

2. Small/Large Intestine, Aorta and Vena Cava

Inhale and pull up the scrotum (men only) and anus. Use the eyes, ears, and nose to draw the energy to the prostate/cervix, small intestine, large intestine, aorta and vena cava. Do not thrust beyond the diaphragm. Practice nine times. Rest, and feel the energy flow up through the Middle Thrusting Channel to the vena cava.

3. Stomach and Pancreas

Follow the above procedure and thrust through the middle organs to the stomach and pancreas. Practice nine times. Swallow the saliva, rest and feel the energy flow in the Middle Thrusting Channel up to the diaphragm.

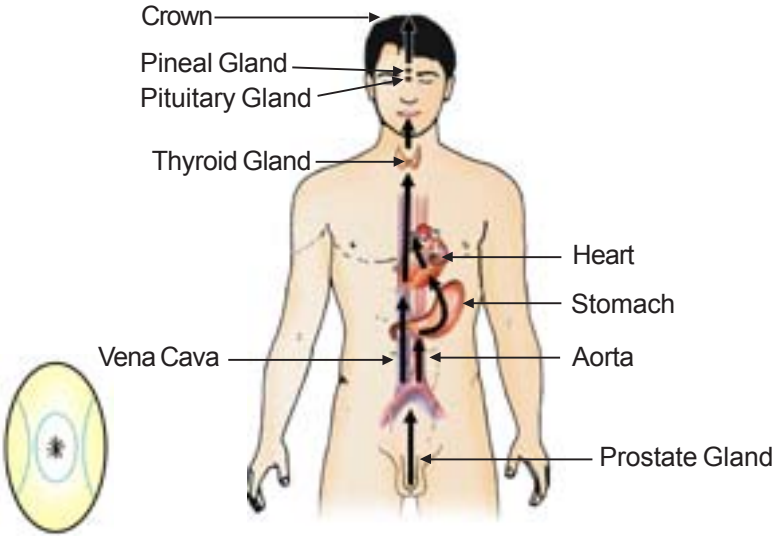

Fig. 7.7 *Middle Part in the Male*

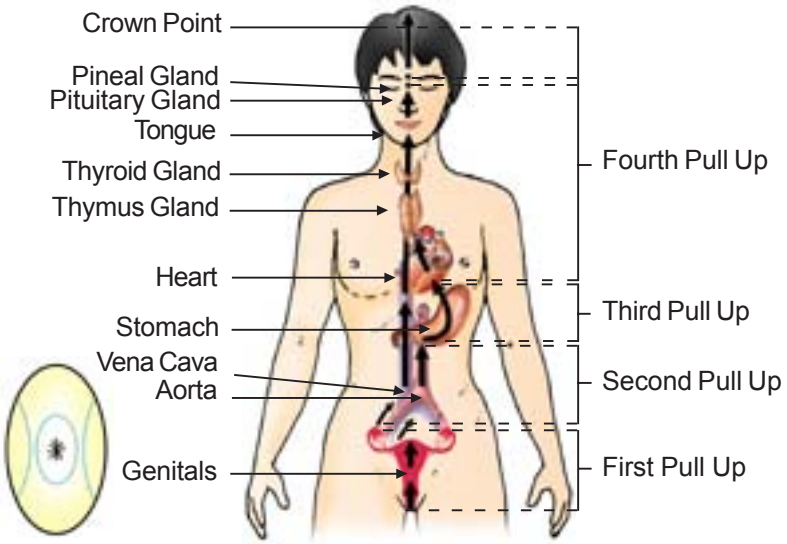

Fig. 7.8 *Middle Part in the Female*

C. Right Thrusting Channel to the Diaphragm

1. Right Testicle (Men), Right Ovary (Women) and Right Kidney
   a. Close the left nostril with the index finger of the left hand. Use the right eye, ear and nostril to direct the energy up the right channel. Put your right hand on the right kidney.
   b. Inhale in short sips equal to ten percent of lung capacity. Look up with the right eye. Pull up the right testicle (men only) and the right muscle of the anus toward the right side. Direct the energy up the right Thrusting Channel to the right ovary (women) and kidney. Practice nine times.
   c. Exhale and rest. Let the pearl drop down, returning to the perineum and right testicle (men only.) Feel the right side become lighter as the energy flows up the Right Thrusting Channel to the right kidney without effort.

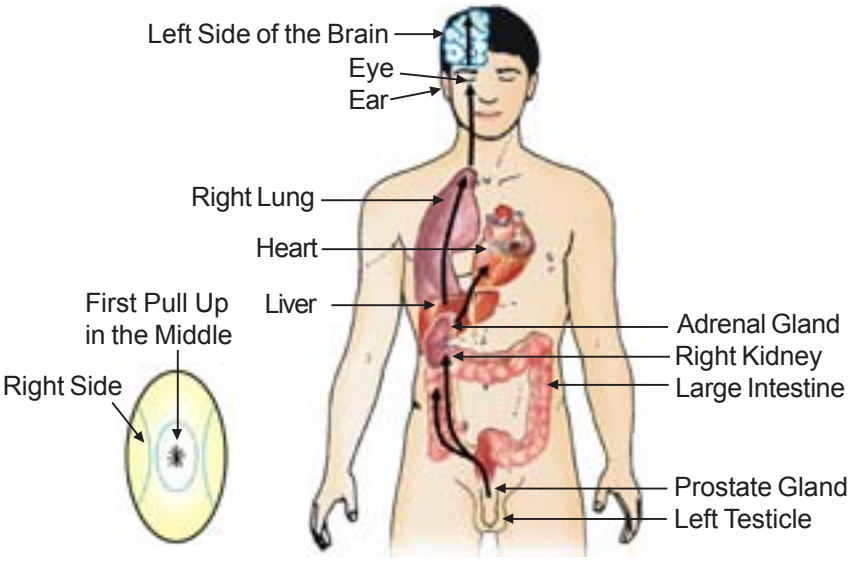

Fig. 7.9 *Right Part in the Male*

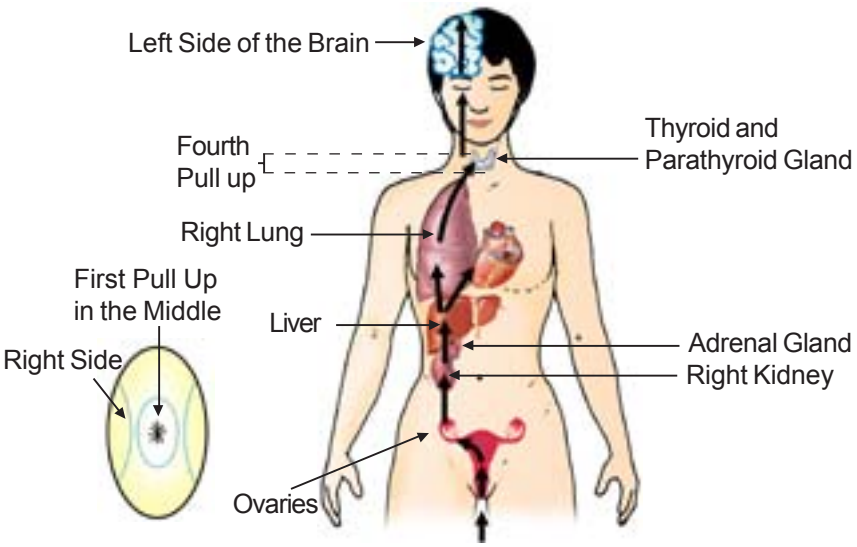

Fig. 7.10 *Right Part in the Female*

2. Liver

Close the left nostril, inhale and pull up. Use the right eye, ear and nostril; draw the energy up from the right testicle (men only), through the right ovary (women only), the right kidney and up to the liver. Exhale, relax and let the pearl return to the perineum. Practice nine times. Rest, and feel the flow of energy through the Right Thrusting Channel to the liver, under the diaphragm.

a. Combine all Three Routes

Continue to practice moving the pearl up and down through a combination of all three Thrusting Channels to under the diaphragm in the following nine steps until the energy is flowing easily: (1) Left Channel; (2) Middle Channel; (3) Right Channel; (4) Middle; (5) Left; (6) Middle; (7) Right; (8) Middle; and (9) Left. It helps to quicken the speed with each attempt.

Note: Stay relaxed during this exercise, and avoid using force. Once you are accustomed to thrusting the pearl and feel that the channels are clear, there is no need to close the nostrils for the left and right channels. Just simply pull up the perineum and anus, and use the power of the mind.

b. Clearing the Routes with Saliva
End by preparing the saliva. First sweep your tongue across the outer surface of your upper teeth, starting on the left side at your wisdom tooth, with the tip of the tongue going along the gums. When you arrive at your upper right wisdom tooth, move the tip of your tongue down to the lower right wisdom tooth and move along the front of the lower teeth. When you arrive at the lower left wisdom tooth, start again at the upper wisdom tooth. Circle around in this manner a few times. Then similarly sweep along the inner surface of the upper and lower teeth and gums. Your mouth will begin to fill with saliva.

Gather the saliva into a ball using your tongue. Press your tongue to the roof of your mouth and swallow the saliva quickly with a gulping action. Feel the saliva burn out the impurities in the Channels and lubricate them.

Practice this stage for about one or two weeks until you can control the energy very well, then continue to the next stage. Each time you finish, move the energy in the Microcosmic Orbit and collect the energy in the cauldron. When you are ready to continue to the next stage, practice Spinal Cord Breathing at this point in your preparation.

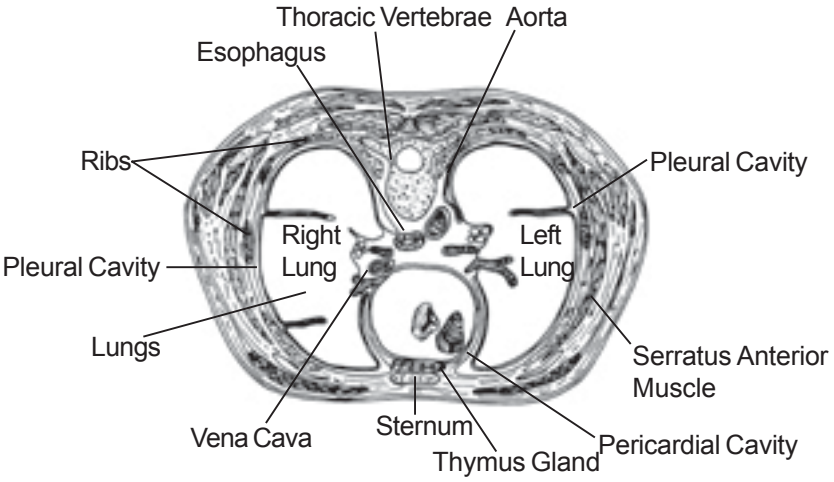

Fig. 7.11 *Cross Section of the Thorax*

3. Stage Two: Thrusting Channels to the Neck

A. Left Thrusting Channel to the Neck

1. Diaphragm

Using the procedure described above, bring the pearl up the Left Thrusting Channel to below the diaphragm and let it return down to the perineum.

2. Left Thyroid and Parathyroid Glands

Using the same procedure, bring the pearl up through the left ovary (women), left kidney and spleen, and continue to bring the pearl up to the left lung, and left thyroid and parathyroid glands. Hold for a while, and then exhale. Let the pearl return to the perineum. Practice nine times.

Be aware of the energy flow up to the neck through the Left Thrusting Channel.

B. Middle Thrusting Channel to the Neck

1. Diaphragm

Using the procedure described above, bring the pearl up the Middle Thrusting Channel to below the diaphragm, and let it return down to the perineum.

2. Thymus, Thyroid and Parathyroid Glands

Using the same procedure, bring the pearl up from the perineum through the prostate (men), cervix (women), small/large intestine, aorta and vena cava, stomach and pancreas. Continue to bring the pearl up to the heart, to the thymus gland under the sternum, and up to the middle of the neck, thyroid and parathyroid glands. Practice nine times. Exhale, relax and let the pearl drop down again.

Be aware of the Middle Thrusting Channel as the energy flows up to the neck.

C. Right Thrusting Channel to the Neck

1. Diaphragm

Using the procedure described above, bring the pearl up the Right Thrusting Channel to below the diaphragm and let it return down to the perineum.

2. Right Thyroid and Parathyroid Glands

Using the same procedure, bring the pearl up from the perineum to the right ovary (women), right kidney, liver and continue to bring the pearl up to the right lung and to the right thyroid and parathyroid glands. Exhale, and slowly release the energy down. Practice nine times.

Be aware of the Right Thrusting Channel as the energy flows up to the neck.

D. Continue to Practice the Three Thrusting Channels to the Neck

Practice all three Thrusting Channels to the neck, nine times each, as delineated for the diaphragm: left, middle, right, middle, left, middle, right, middle and left.

E. Clear the Routes with Saliva

If your throat feels dry, you can collect and warm the saliva in your mouth. Tighten your neck a little bit, and swallow the saliva with a guttural sound down to the stomach. Feel the saliva like a fire clearing all three channels.

Practice this stage for about one or two weeks, each time finishing by moving the pearl in the Microcosmic Orbit and collecting it in the cauldron.

F. Rest and Concentrate on All Three Channels

Rest and concentrate on all three channels, visualizing the left route as red, the middle as white, and the right as blue.

4. Stage Three: Thrusting Channels to the Crown

In stage three of opening the Thrusting Channels, the pearl is thrust through the channels up to and out of the crown.

A. Left Thrusting Channel to Crown

1. Left Eye

Follow the above procedure for thrusting through the Left Thrusting Channel to the neck, and continue thrusting to the left eye.

2. Crown

Repeat the Left Thrusting Channel to the left eye and continue to thrust the pearl up through the left hemisphere of the brain to the crown. Practice nine times. Rest, and mentally trace the Left Thrusting Channel from the perineum to the crown.

B. Middle Thrusting Channel to the Crown

1. Mideyebrow

Repeat the Middle Thrusting Channel procedure as described to the neck and continue thrusting to the mideyebrow.

2. Crown
Repeat the Middle Thrusting Channel to the mideyebrow, and continue to thrust the pearl up through the pituitary gland to the pineal gland at the crown. Practice nine times. Rest, and mentally trace the complete Middle Thrusting Channel.

C. Right Thrusting Channel to the Crown

1. Right Eye
Repeat the Right Thrusting Channel procedure as described to the neck and continue thrusting to the right eye.
2. Crown
Repeat the Right Thrusting Channel to the right eye, and continue thrusting the pearl up to the right hemisphere of the brain and then to the crown. Practice nine times. Rest and trace the route mentally from the perineum to the crown.

D. Continue to Practice the Three Thrusting Channels to the Crown

Continue to practice the three Thrusting Channels to the crown nine times as was delineated for the diaphragm and again for the neck: left, middle, right, middle, left, middle, right, middle and left.

Fig. 7.12 *Three Thrusting Channels up to the Crown*

You now have succeeded in bringing the pearl through the Thrusting Channels to the crown. Your goal is to follow the sequence above using nine thrusts distributed among these three channels. Be aware of how and where the energy flows through the three Thrusting Channels, and how the three channels penetrate all the organs and glands. These channels are very powerful. They clean, detoxify and purify the organs at a much deeper level.

E. Bring the Pearl into the Microcosmic Orbit

When you have finished this stage of practice, you can bring the pearl into the Microcosmic Orbit and circulate it. Feel the Microcosmic Orbit encircling the Thrusting Channels. The top and bottom of the Thrusting Channels are joined with the Microcosmic Orbit at the crown and the perineum.

Use your mind to assist the flow of energy through the Thrusting Channels and through the Microcosmic Orbit when the pearl reaches the crown point or the perineum point.

Your Microcosmic Orbit practice will change dramatically after you learn the Fusion of the Five Elements meditations. When you first practice the Microcosmic Orbit, the energy you move through your channels is raw energy. By contrast, when you reach the level of Fusion practice, the energy is more refined and condensed, and it is therefore much more powerful. The Fusion practice includes the Microcosmic Orbit, so it might be said that the Fusion meditation is simply a more advanced way of practicing the Microcosmic Orbit meditation.

Practice this stage for two or three weeks until feel you have gained control of the energy.

5. Extending the Three Thrusting Channels above the Crown

Once we have purified and transformed the negative energy of the organs back into usable life-force energy (Fusion of the Five Elements), distilled this energy along with the virtue Chi of the organs into the pearl (Cosmic Fusion), and opened all our reservoirs or special channels, giving us a larger energy capacity, we can increase our virtue energies further by connecting with the external sources of Five Elements Chi and directing the external Chi toward its associated organs. Moving the pearl out of the physical

body makes it easier for the pearl to absorb these energies. It becomes like an antenna that receives the external Chi and conducts it into the physical body. In this way, we again nourish our health in this life as well as strengthening the Energy Body and spirit in preparation for the next.

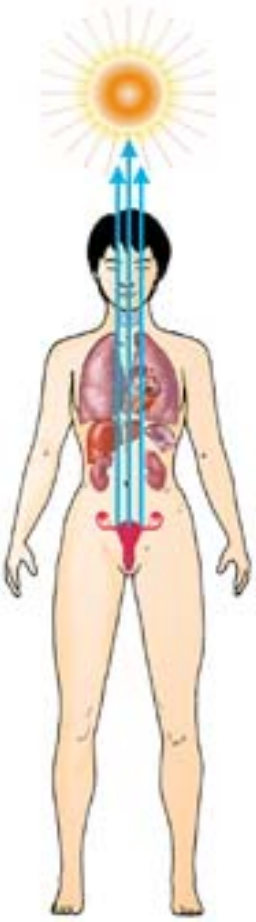

Fig. 7.13 *Three Thrusting Channels above the Crown*

After you gain full control of the energy, you will be able to send the pearl out of the body at the crown. Begin to practice quickly forming a fresh pearl in the practice of formimg the pearl by fuse in and out and back to the inside to form a pearl. Follow with the Creation Cycle. Then, thrust the pearl up through the Thrusting Channels to quickly clear out these routes. You are now ready to extend the channels above the crown.

Bring the energy down to the perineum, and start with the Left Thrusting Channel up to the left crown. Push the pearl out at the crown of the head to about three to six inches (seven and a half to fifteen centimeters) above the crown. Similarly, push the pearl out of the crown through the Middle Thrusting Channel, and then the Right Thrusting Channel.

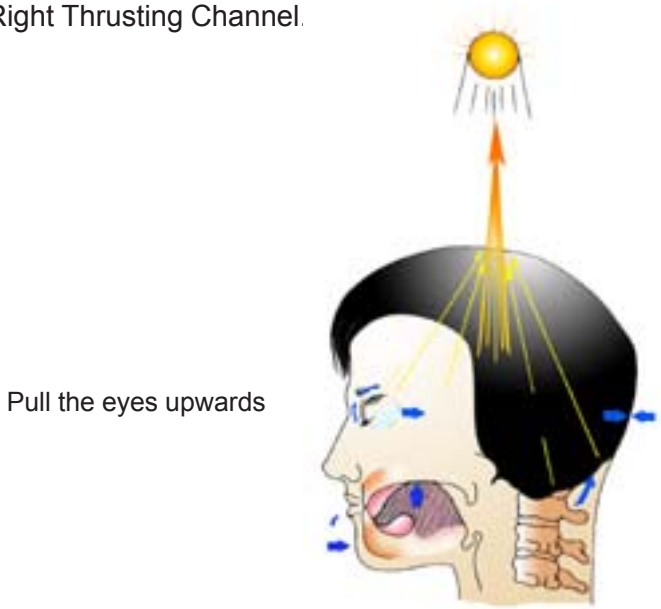

Fig. 7.14 *Use Physical and Mental Power to push the Pearl of Energy up through the Crown.*

Each time you push the pearl out at the crown, be aware of an energy ball hovering about six to ten inches (fifteen to twenty-five centimeters) over the crown. Draw and absorb the Heavenly Energy to the pearl. Then slowly let the energy melt and flow down to the crown, and then into the body, all the way down through the three Thrusting Channels to the perineum.

6. Stage Four: Leg Routes and Thrusting Channels into the Ground

In the final stage of opening the Thrusting Channels, the energy will go all the way down to the feet and into the ground, and then up through the channels with each thrust. After you have formed another new pearl by practicing Fusion of the Five Elements and the Creation Cycle of Cosmic Fusion, bring the energy down to the perineum.

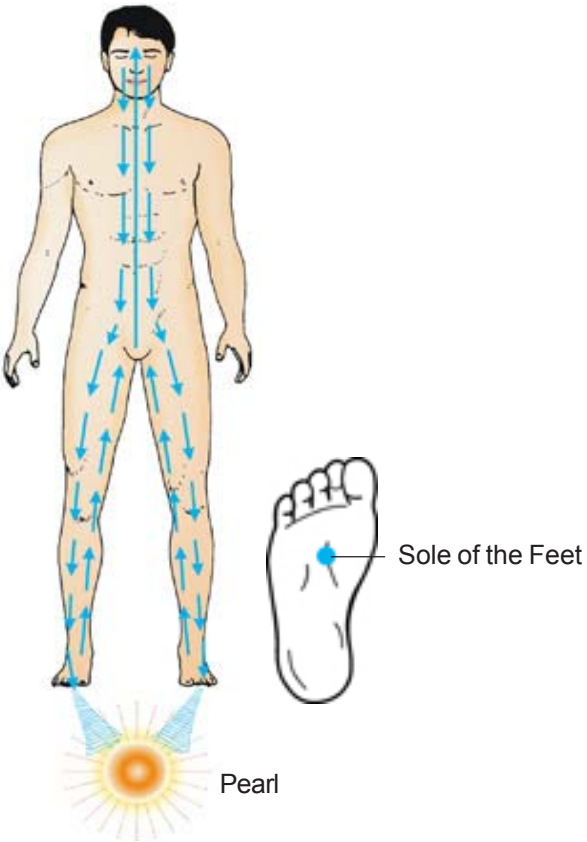

Fig. 7.15 *Three Thrusting Channels down to the Ground.*

A. Bring the Energy Down to the Soles of the Feet

1. Left Thrusting Channel

Split the pearl in two, and bring the energy from the perineum down the back of both legs to the backs of the knees, and then down to the heels and soles of the feet. Stop for a while, and absorb the Earth Energy through the soles. Then bring the energy up the front of the legs through the big toes, knees, front of the thighs, all the way back to the perineum. Recombine the pearl at the perineum. Then run the energy through the Left Thrusting Channel by slightly tightening the left side of the anus and looking up with the left eye. Bring the pearl all the way up through the left hemisphere of the brain and left crown, and out to three inches (seven and a half centimeters) above the crown. Relax, and bring the pearl down to the perineum.

2. Middle Thrusting Channel

From the perineum, split the pearl, and bring the pearl down the backs of both legs to the soles of both feet. Absorb the Earth Energy through the soles, then move the energy up to the toes, to the knees, returning to the perineum. Recombine the pearl at the perineum. Now bring the pearl all the way up the Middle Thrusting Channel, squeezing the middle of the anus and looking up with both eyes. Bring the pearl all the way up through all the organs and glands to the crown, and out to three inches (seven and a half centimeters) above the crown. Then bring it down to the perineum again.

3. Right Thrusting Channel

From the perineum, split the pearl, and bring it down the backs of both legs. Absorb the Earth Energy through the soles of the feet. Then bring the pearl up again to the perineum. Recombine the pearl at the perineum. Use the right anus muscle, look up with the right eye, and bring the pearl all the way up the Right Thrusting Channel through the right hemisphere of the brain and out of the crown three inches (seven and a half centimeters.) Bring it down to the perineum.

Continue bringing the pearl to the Thrusting Channels in the following sequence: left, middle, right, middle, left, middle, right, middle, and left, finishing each step by looping the pearl through the leg route. End on the left side of the perineum. Swallow the saliva, as described before.

B. Bring the Energy into the Ground

Once you have practiced bringing the pearl down to the soles of the feet for a while, add a new step. Begin by shooting the energy from the perineum down the backs of the legs and through the soles of the feet, from six inches to one foot into the ground. Feel a connection or rooting to the earth, then draw the energy up to the soles of the feet, to the toes, up the front of the legs, and into the Thrusting Channels.

With this step you have completed opening all the Thrusting Channels. Practice for two or three weeks until you develop full control of the energy traveling through these channels.

7. Men and Women Now Practice Differently

At this stage all the Thrusting Channels and Leg Routes are

open, and men and women start to practice differently. Both quickly practice Fusion I, and the Creation Cycle and Thrusting Channels of Fusion II, and bring the pearl to the perineum.

A. Men start by bringing the Pearl to the Crown.

Men bring the pearl from the perineum up to and out of the crown to about six inches (fifteen centimeters.) Feel your pearl hook up with the higher energy source, Heavenly Energy. Absorb this energy into the pearl. Then bring the energy back into the body. As it enters the crown, let the pearl split in three. Feel the energy penetrate through three holes at the top of the head. Feel it flowing back down to the perineum through the three Thrusting Channels, penetrating all the organs and glands.

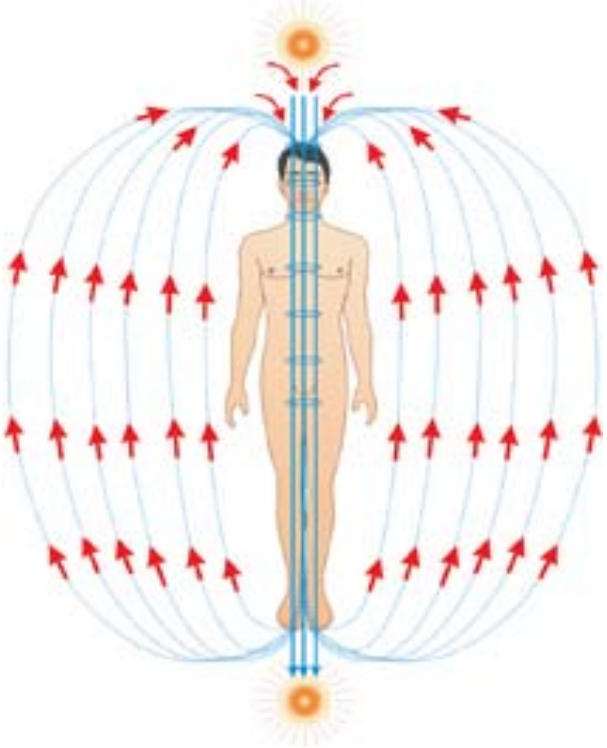

Fig. 7.16 *Bringing the Pearl to the Crown*

From the perineum men will push and guide the energy down the back of both legs to the soles of the feet, and then six to twelve inches (fifteen to thirty centimeters) into the ground. Feel a connection or rooting to the earth, then draw the Earth Energy up to the soles of the feet. Bring the energy to the toes. Start to spread

the energy out from the ten toes, shooting the energy up to and into the crown, like a waterfall with a reverse flow. Draw the pearl back down to the perineum, and then repeat the process.

Practice nine times. Feel the flow of energy like a magnetic field surrounding your body.

B. Women start by bringing the Pearl to the Feet.

Women bring the pearl down to the perineum, divide it, and shoot it down the backs of both legs, through the soles of the feet, six to twelve inches (fifteen to thirty centimeters) into the ground. Feel a connection or rooting to the earth, and absorb the Earth Energy into the pearl. Then draw the Earth Energy up to the soles of the feet. Bring the energy all the way up the front of the legs to the knees, and back to the perineum. As the energy travels up the legs, feel it penetrate the bones.

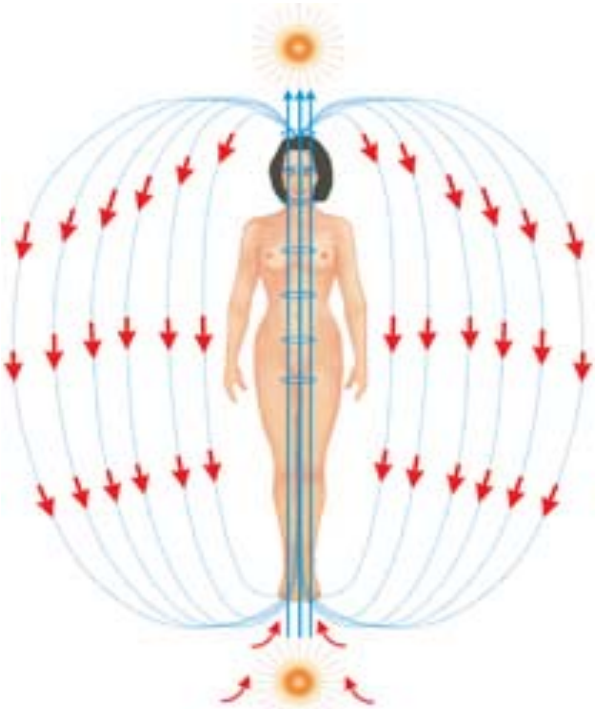

Fig. 7.17 *Women bring the Pearl to the Feet.*

Spread the energy into the three Thrusting Channels, and thrust it as though it were on a three lane highway all the way up to the crown. Feel the energy spread from the crown like a spring or wa-

ter fountain pouring out of the body, entering into the soles of the feet, where it again joins together with energy from the earth. While the energy is outside and circling the body, it is also gathering pure, radiant Cosmic Energy. Repeat this meditation nine times.

8. Finishing the Meditation

Both men and women should finish by collecting the energy at the cauldron and practicing Chi Massage. This completes the practice of the Thrusting Channels. Continue to practice for a few weeks until you gain control of it.

Additional Exercise for Opening the Thrusting Channels

Alternate Nostril Breathing

The alternate nostril breathing helps to generate more power in moving the pearl up and down the Thrusting Channels. By closing one side of the nose, it is easier to move the pearl through the specific left or right channels.

Hold the right nostril closed with the finger tips.

Inhale up through the left nostril, and feel the pearl move up from the perineum to the crown.

Exhale out through the left nostril and bring the pearl back down to the perineum.

Inhale through the left nostril and bring the pearl to the Middle of the perineum.

Close both nostrils and suck the pearl up through the middle Thrusting Channel to the crown. This suction is created by an inhaling motion without actually drawing any air into the lungs.

Hold the right arm down towards the ground and exhale any cloudy or gray energy out of the Thrusting Channel.

The same procedure is repeated in the Right Thrusting Channel.

Hold the left nostril closed with the finger tips.

Inhale up through the right nostril, and feel the pearl move up from the perineum to the crown.

Exhale out through the right nostril and bring the pearl back down to the perineum.

Inhale through the right nostril and bring the pearl to the middle of the perineum.

Close both nostrils and suck the pearl up through the Middle Thrusting Channel to the crown.

Hold the left arm out and down to the ground, exhaling any cloudy gray energy down to the Earth.

Repeat 3 – 9 times or until you feel the Thrusting Channels clean and clear with positive energy.

Fig. 7.18 *Alternate Nostril Breathing*

Fig. 7.19 *Exhale cloudy energy out of the Thrusting Channel.*

Summary
Opening the Thrusting Channels

Begin the Fusion practice by Opening the Three Fires, activate the compassion fire forming the pakuas by chanting the eight forces, forming the collection points, fusing the colors, and forming the pearl. Review the explanation discussed previously. Once you feel the pearl is strong and full of energy, you do not have to go through all these stages all the time. Just think and let it happen.

The Thrusting Channels are Opened in Four Stages.

(1) to the diaphragm; (2) to the neck; (3) to and out of the crown; (4) down to the feet, into the ground; and up to the crown.

1. The Left Thrusting Channel penetrates the left testicle (in men), left side of the perineum and anus, left ovary (in women), left kidney, spleen, heart, left lung, left parathyroid and thyroid glands, left ear, left eye, and left hemisphere of the brain.
2. The Middle Thrusting Channel runs through the middle of the scrotum (in men), perineum, middle of the anus, cervix (in women), prostate (in men), aorta, vena cava, pancreas, stomach, heart, thymus gland, throat, tongue, pituitary, hypothalamus, and pineal glands, and crown.
3. The Right Thrusting Channel goes through the right testicle (in men), right side of the perinium and anus, right ovary (in women), right kidney, liver, right lung, right parathyroid and thyroid glands, right ear, right eye, and right hemisphere of the brain.

Note: Avoid overheating the heart, liver, or head. Be very gentle with this procedure. If the energy reaches the heart and head too quickly the heart will become congested and you may experience pressure. If the heart overheats with energy, avoid thrusting above the diaphragm, and practice the Heart Sound (***Hawwww***).

Strengthen your anus muscle, the foundation, connected to the perineum and everything in the body above it. Saliva purifies the mouth, and nourishes immortality. When resting, create and gather saliva. Make it thick and swallow down forcefully.

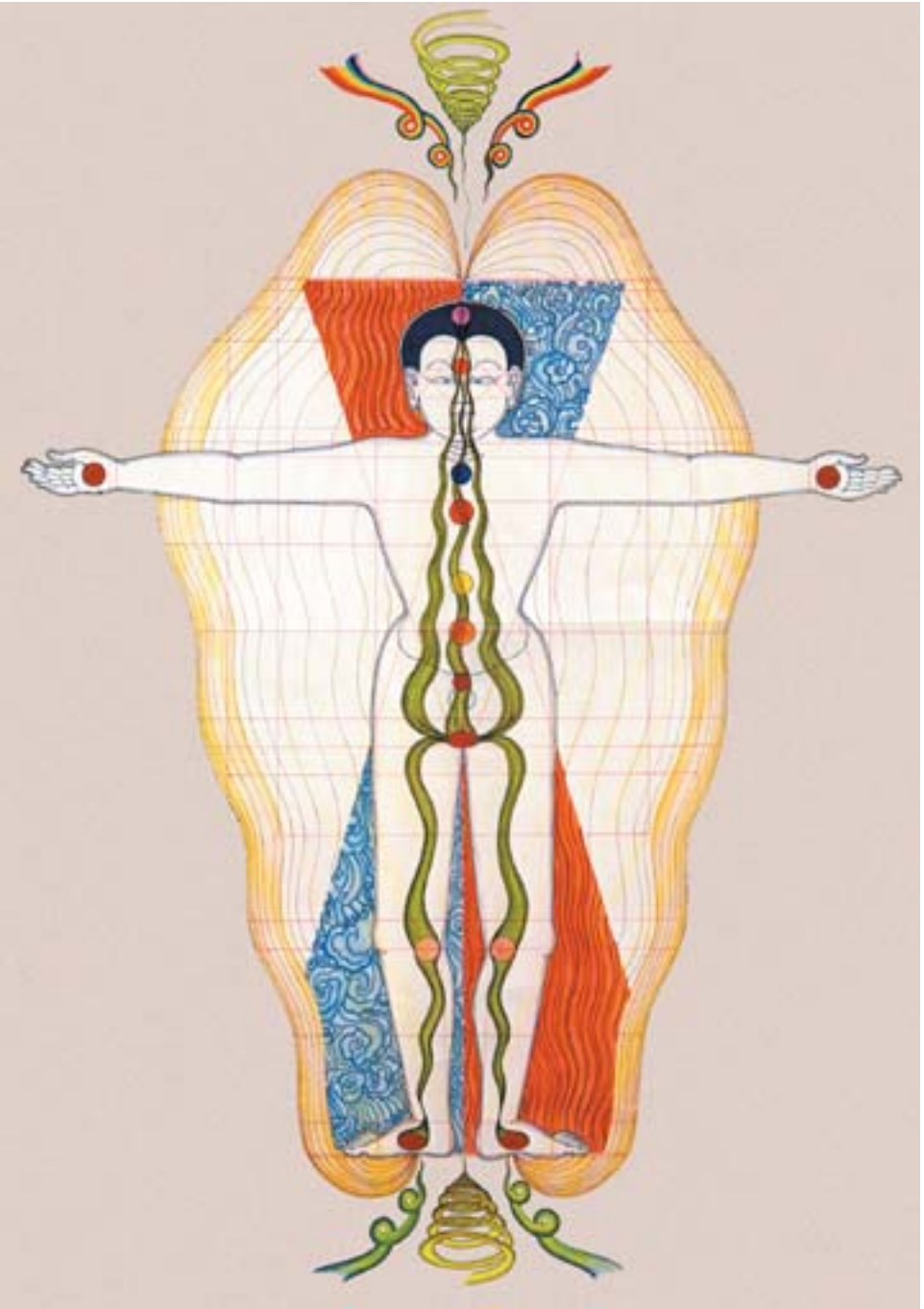

Fig. 7.20 *Thrusting Channel*

Chapter 8
Belt Channels

Theory of the Belt Channel

The Belt Channel is a psychic channel of power and self-defense, encircling the body with energy. It protects the body and fences the energy within the Governor, Functional and Thrusting Channels, while warding off negative energy from the outside world. Starting at the navel each Chi center of the body is crossed and encircled by one level of the continuing Belt Channel.

A cross-section at the navel level would show the Belt Channel connecting to the other channels you have learned to this point. At the front of the body, the Belt Channel connects with the Functional Channel. As it moves to the left side it connects with the Left Thrusting Channel. At the Door of Life in the back, it connects with the Governor Channel. To the right it connects with the Right Thrusting Channel. Returning to the front, the circle is completed.

When you learn to form a pearl practicing Fusion of the Five Elements, and you draw the energy from the front, back and side pakuas at the level of the navel, you are laying the groundwork for the Belt Channels.

Procedure of Forming the Belt Channel

The Belt Channel begins at the navel and spirals upward in a counterclockwise direction through solar plexus, heart, throat, mideyebrow, and crown. Then, reverse the energy flow and circle the pearl clockwise as you move down through the above points to the navel. From the navel continue down to the sexual center, perineum, knees (around both knees), and soles of the feet (slightly into the ground). Finally, reverse the direction and work up through each point back to the navel.

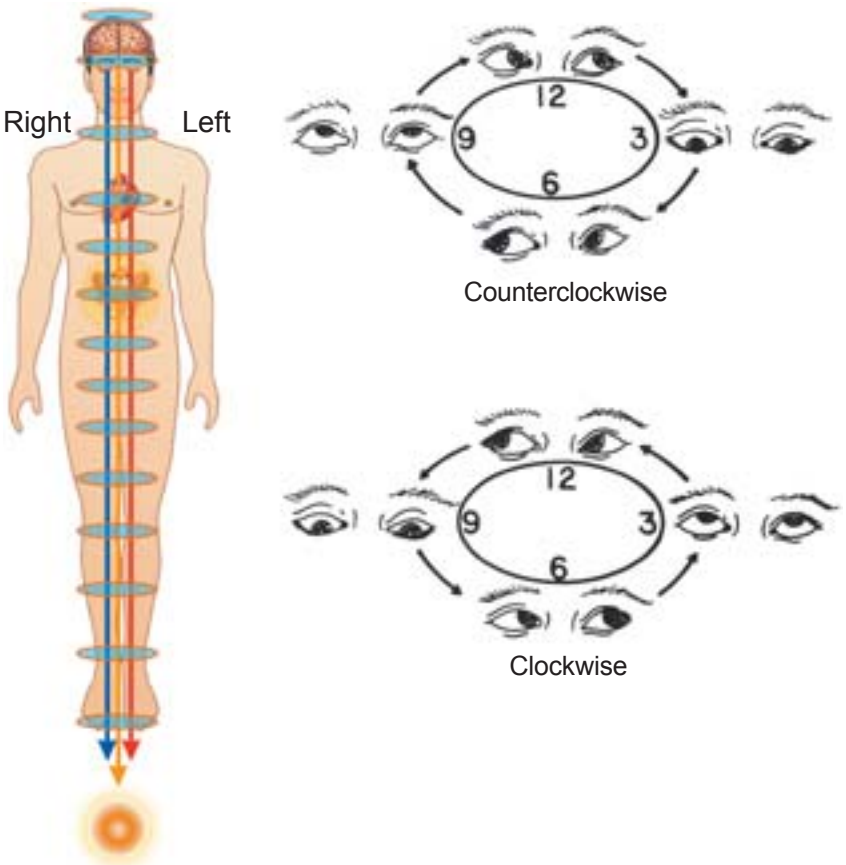

Fig. 8.1 *Use the eyes to help spiral.*

Note:To circle to the left is to circle counterclockwise; circle counterclockwise as you move the pearl up. To circle to the right is clockwise; circle clockwise as you move the pearl down.

The pearl is circulated in each Belt Channel nine times. After the ninth time of circling each point, you will cross each channel internally with the pearl by moving the pearl from front to back, and from left side to right side. Each time you will end with the pearl at the front, and then move on to the next level Belt Channel.

Practice of Forming the Belt Channel

Ascending from the Pakuas

1. Sit up, back straight, shoulders relaxed, feet touching the floor. Hold the hands together, and touch the tongue to the palate.
2. Practice the Inner Smile, Fusion of the Five Elements, chanting, the collection points, fusing the energy into a pearl and the Creation Cycle of Cosmic Fusion. Continue with your practice of Cosmic Fusion by sending the energy through the three full Thrusting Channels (all the way down to the feet and up to the head.)
3. You are ready to begin forming the Belt Channel. First, form the four pakuas and a pearl. Gather the pearl at the cauldron, and bring it to the navel.

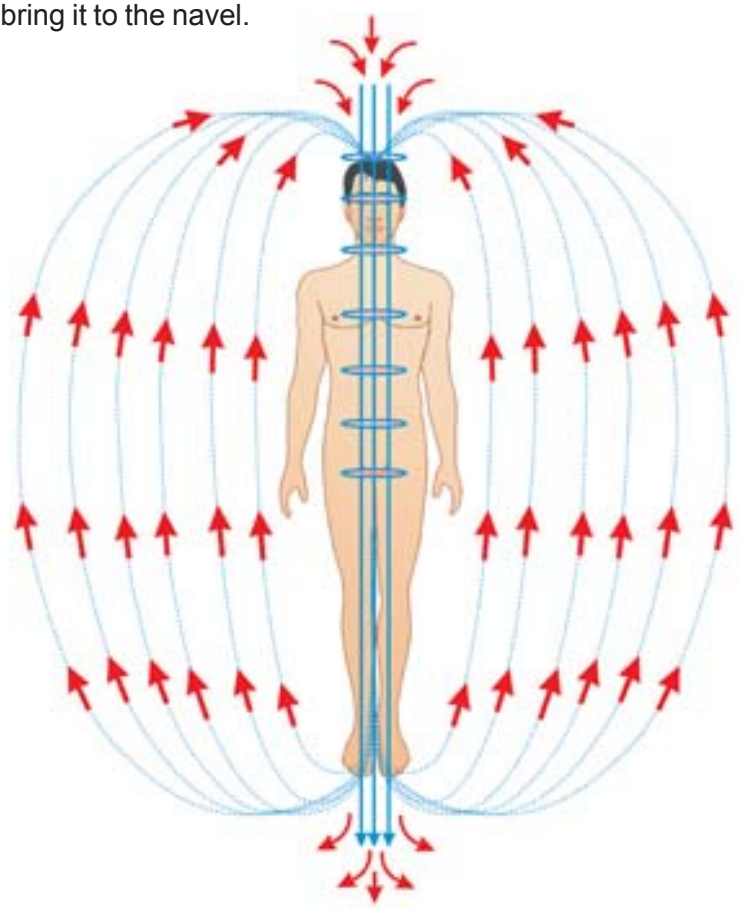

Fig. 8.2 *Moving the Thrusting Channels out of the Body.*

4. Join the four pakuas by circulating the pearl from the ***Navel*** toward the left side (counterclockwise), to the Door of Life, to the right side, and back to the navel.

   In the beginning you can use your hand to assist you in moving the pearl, although your goal is to use your senses to control its movement. Cover the navel with the right hand. Cover the left side pakua with the left hand. Then, move the left hand to cover the Door of Life, and move your right hand to cover the right side pakua. Finally, return the right hand to the navel.

   Circle the pearl nine times counterclockwise. As you are ascending you will circle it nine times counterclockwise from each point in a similar fashion.
5. When you finish circling the pakuas for nine rounds, be aware of the navel. Be aware of the channel of the navel. Form a cross by bringing the pearl from the navel to the cauldron, and all the way back to the Door of Life. Then, bring the pearl back to the cauldron, and use it to connect the side pakuas from the left cross to the right. Return the pearl to the navel.

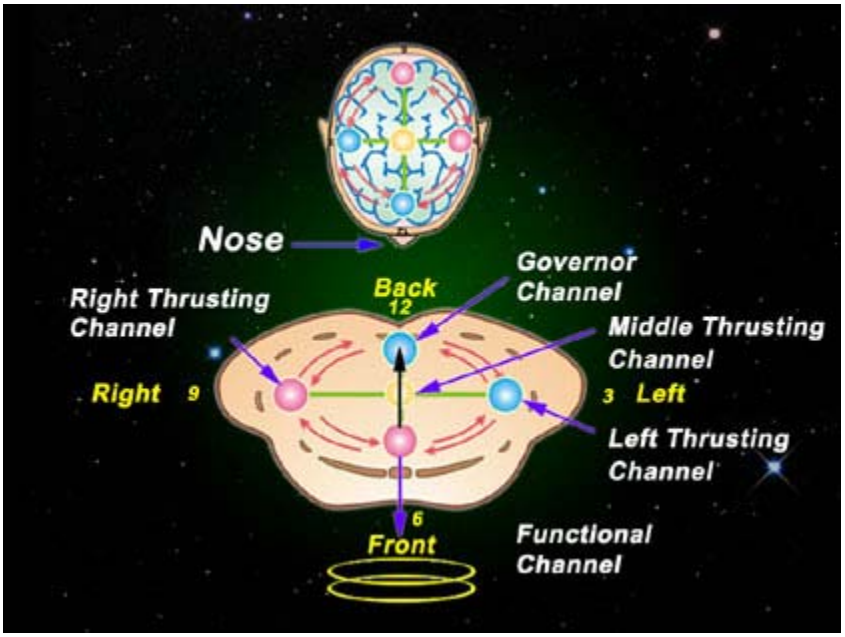

Fig. 8.3 *Cosmic Belt Channels connecting to all the other Channels.*

6. Move the pearl up from the navel to the left side of the rib cage to a position level with the ***Solar Plexus***. Begin to circle the pearl at the solar plexus level. Circle the pearl toward the left through T-11 at the back, to the right, and return to the solar plexus. Circle nine times, ending with the pearl at the solar plexus. Take a moment to perceive it. Then create an internal cross with the pearl, moving it from front to back, and then from left to right.
7. Bring the pearl from the solar plexus to the left side rib cage, this time at the level of the ***Heart***. Circle nine times toward the left to the middle of the shoulder blades, to the right, and back to the heart center. Circle in this manner for nine rounds. Using the pearl, form an internal cross connecting all four sides. Feel the connection of the channel.
8. From the heart center, bring the pearl up to the left side of ***Throat Center*** on the neck. Circle the pearl toward the left and back to C-7, to the right side, and to the middle of the throat center nine times. Use the pearl to form an internal cross connecting all four sides. Practice and master this step before continuing up to the crown.

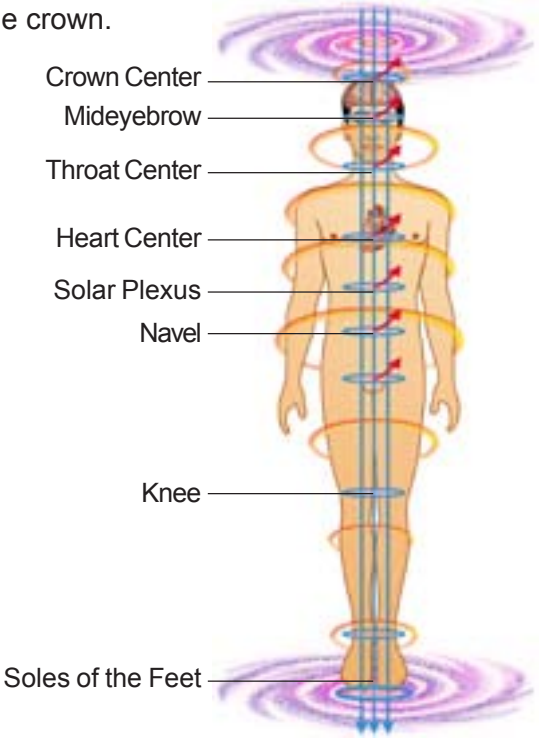

Fig. 8.4 *Bring the pearl up to the upper tip of the left ear.*

9. Bring the pearl up to the upper tip of the left ear at the level of the ***Mideyebrow Center***. Circle the pearl nine times from the left ear back to the small brain, to the right (upper tip of the ear), returning to the mideyebrow. Feel a band of energy flowing around the mideyebrow, ears, and back of the head. Using the pearl, form an internal cross connecting all four sides. The feeling is one of wearing a crown with a cross at its center connecting it.
10. From the mideyebrow bring the pearl up to the left side of the ***Crown***, and circle the energy nine times in a counterclockwise direction at the crown. End with the pearl at the front. Using the pearl, form a cross connecting the front, back, and both sides of this Belt Channel.
11. Allow the pearl to go out above the crown, and circle the energy nine times toward the left forming a ***Halo of Energy***. Use the pearl to cross the halo, front to back, and left to right. Collect the energy from above the head.

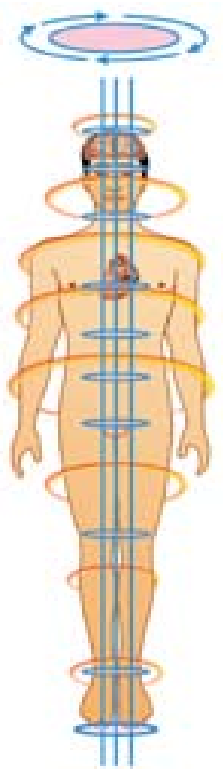

Fig. 8.5 *Spiral out clockwise above the crown.*

12. Now reverse the direction of energy flow to a clockwise direction by circling from the front toward the right, to the back, and to the left. Circle the ***Halo*** nine times, ending with the pearl at the front. Then cross the front to back, and right to left sides. Finish by bringing the pearl to the front of the halo.

Fig. 8.6 *Reverse the direction clockwise.*

13. Next bring the pearl back into the right side of the ***Crown***. Circle toward the right nine times, bringing the pearl to the back, to the left, and ending at the front of the crown each time. Then use the pearl to cross the front, back, and two sides. Return the pearl to the front of the crown.
14. Move the pearl down to the upper tip of the right ear. Circle from the right ear to the back of the head, to the top of the left ear, and to the ***Mideyebrow*** nine times. End at the mideyebrow. Use the pearl to cross the front, back, and two sides at this level, and return it to the front to the mideyebrow position.

15. Bring the pearl down to the right side of the neck at the level of the ***Throat Center***, and circle right to *C-7* at the back of the neck, to the left, and to the front of the throat center. Circle nine times, ending at the front. Cross the front, back, and two sides, also ending by bringing the pearl to the front.
16. Bring the pearl down to the right side rib cage at the ***Heart Center*** level. Circle the pearl toward the right, to the back,and so forth clockwise for nine times, ending at the front of the heart center. Then, use the pearl to cross the front, back, and two sides. Return the pearl to the front again.
17. Move the pearl to the ***Solar Plexus***. Circle it nine times to T-11 at the back, and return to the solar plexus. Cross the front, back, and sides. Return the pearl to the front.
18. Bring the pearl down to the ***Navel***. Circle it back to the Door of Life, and back to the navel nine times. From the navel bring the pearl to the cauldron, back toward the Door of Life, and return it to the cauldron. Use the pearl to cross the right and left sides. Return the pearl to the navel.

Descending From the Pakuas to the Earth.

19. Once you have controlled the pearl to this stage of the meditation, you are ready to move the pearl down to the ***Sexual Center***. Women bring the pearl down to the right side of the ovary center, located three inches below the navel. Men bring the pearl from the navel down to the right side of the sperm palace, one and a half inches below the navel. Circle clockwise back to the sacrum, to the left hip, and to the front of the ovary center/sperm palace nine times. Use the pearl to make a cross. Return the pearl to the front of the sexual center.
20. Bring the pearl down to the right groin. Circle the pearl clockwise around the ***Perineum Point and Lower Hips*** nine times. Use the pearl to form a cross by connecting the front, back, and sides. Return the pearl to the front.
21. Move the energy down and circle toward the back of ***Both Knees***, around and to the front, midway between both knees, moving the pearl clockwise nine times. Use the pearl to form a cross by moving the pearl to the midpoint between the knees and connecting the front, back, and sides from this point. End with the pearl midway between the fronts of both knees.

22. Direct the energy down to the feet, just below the ankles. Circle the ***Soles of the Feet*** nine times moving the pearl clockwise to the heel of the right foot, to the heel of the left foot, to the outer side of the left foot, to the front, midway between both feet. Form a cross. End with the pearl midway between both feet.
23. Move the energy from the front of the feet down to a point ***Beneath the Earth***, and circle toward the right (clockwise) nine times. Use the pearl to form a cross ***Beneath the Earth***. Keep on spiraling more energy to enhance the pearl. Return the pearl to the front of the circle.

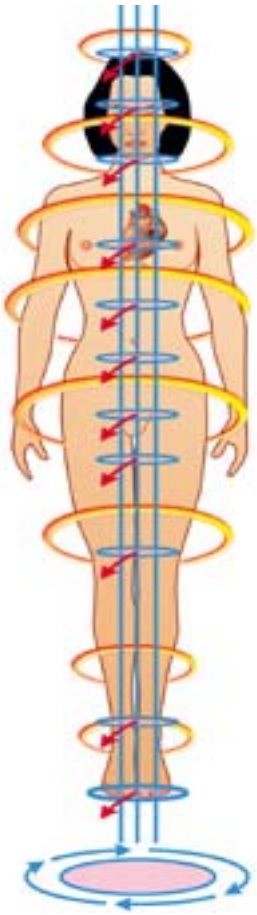

Fig. 8.7 *Bring the Pearl down to the ground, spiral clockwise.*

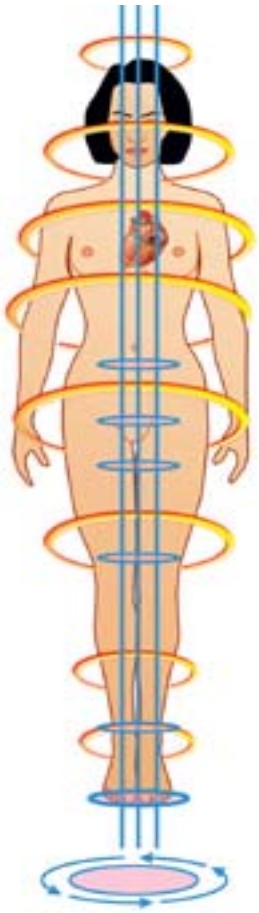

Fig. 8.8 *Spiral reverse counterclockwise moving up.*

Ascending From the Earth Back to the Pakuas

24. Reverse the circle beneath the earth, moving the pearl counterclockwise again nine times. Use the pearl to form a cross, connecting the front, back, and sides.
25. Move the pearl to the outer side of the left foot. Circle the ***Soles of Both Feet*** nine times moving toward the left heel, to the right heel, to the right foot, and to the front (midway) of both feet. Use the pearl to form a cross. End with the pearl at the midway point in the front of both feet.
26. Move up to the left knee. Circle the pearl counterclockwise *at the* ***Knees*** nine times. Use the pearl to form a cross. Return the pearl to the midway point in the front of both knees.
27. From the front of the knees, move up to the left groin area. Circle counterclockwise at the ***Perineum*** nine times. Use the pearl to form a cross. Return the pearl to the front of the perineum.
28. Direct the energy to the left hip, and circle counterclockwise at the ***Ovary/Sperm Palace*** nine times. Use the pearl to form a cross by connecting the front, back, and sides. End with the pearl at the front of the ovary/sperm palace.
29. Return the pearl to the ***navel*** and to the ***Cauldron***.

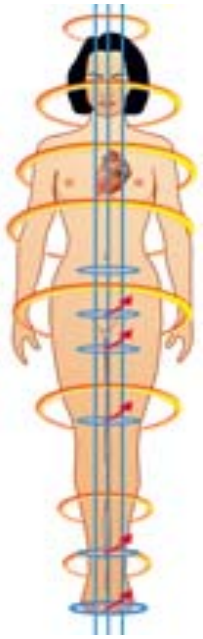

Fig. 8.9 *Bring the Pearl up to the navel.*

Men and Women Practice Differently

***Men**:* Shoot the Pearl out of the Crown, and Spiral the Pearl down from the Crown.

a. Bring the pearl up to the crown.
b. Allow the pearl to go out three to six inches above the head. Circle nine times counterclockwise. Collect the heavenly energy and blend it in the pearl. Then circle it nine times clockwise.
c. Bring the pearl back into the crown point.
d. Spiral it clockwise through each of the Belt Channels all the way down to the soles of the feet.
e. Move the pearl into the earth six to twelve inches to collect the earth energy, and circle the energy nine times clockwise. Reverse the direction spiraling nine times counterclockwise.
f. Return the pearl to the front of the crown, and then back down to the navel and cauldron in the same manner.

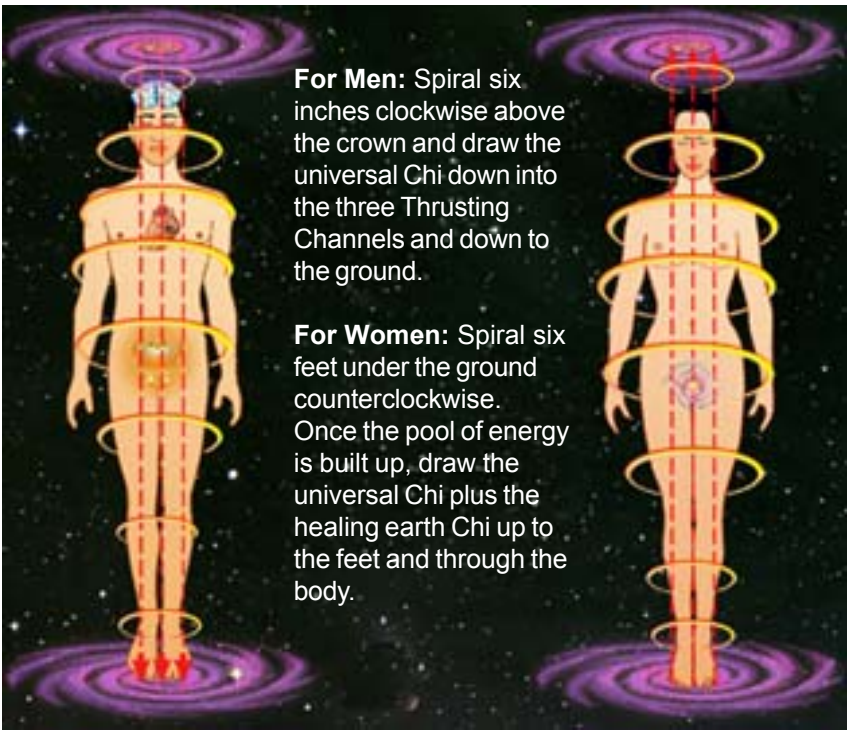

***Fig. 8.10** Men and Women Practice Differently*

***Women**:* Shoot the Pearl into the Earth, and Spiral the Pearl up from the Earth

a. Bring the pearl to the soles of the feet.
b. Move the pearl into the ground six to twelve inches to collect the earthly energy. Circle the energy nine times clockwise. Then nine times counterclockwise.
c. Move the pearl up through the left side of each Belt Channel, spiraling counterclockwise to the crown.
d. Shoot the pearl all the way out at the crown to collect the heavenly energy. Circle the energy counterclockwise nine times. Reverse the direction, and spiral the pearl nine times clockwise.
e. Bring the pearl back down into the right side of the crown. Continue to circle the energy clockwise down through the Belt Channel to the soles of the feet. Return the pearl to the navel and cauldron in the same manner.

Forming a Vehicle

Continue feeling all the pakuas spiraling around the energy center and around the body.

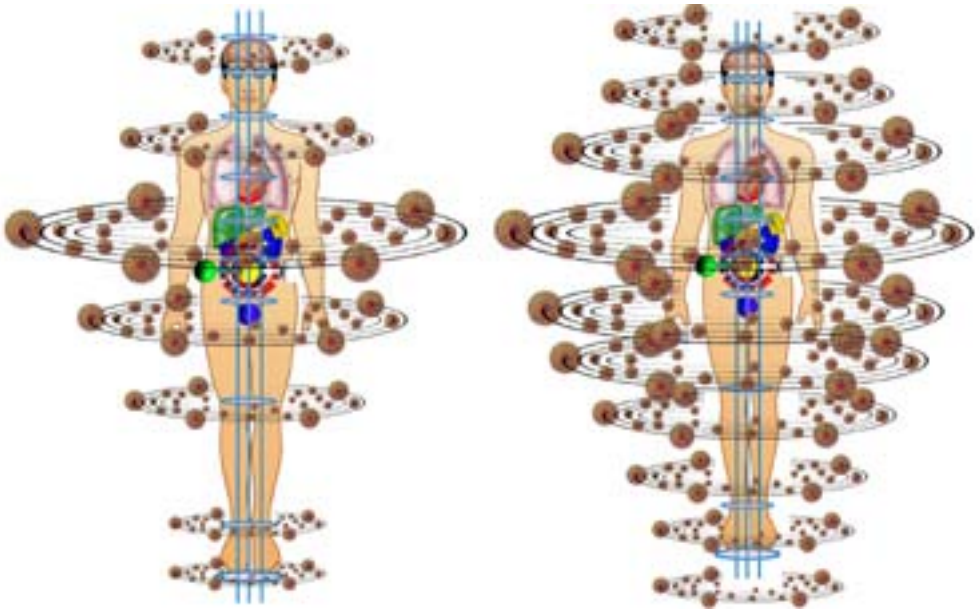

***Fig. 8.11** Spiraling the Pearl and Pakuas faster and faster.*

Let the pakuas spiral faster and start from 10,000 miles per hour up to 60,000 miles per hour and feel the spine getting bigger and bigger.

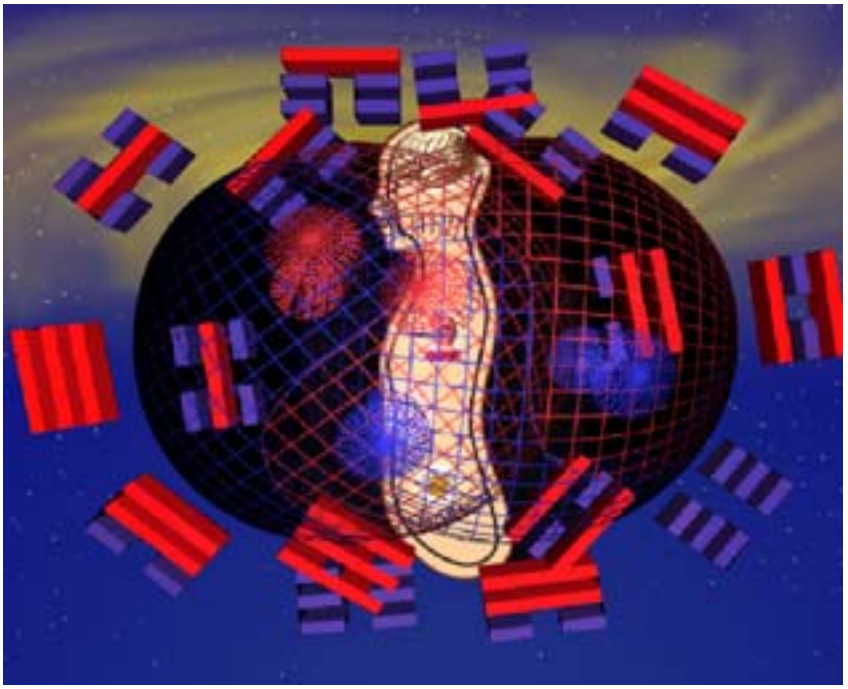

Fig. 8.12 *All the Pakuas become a bigger and bigger Pakua spiraling around whole the body.*

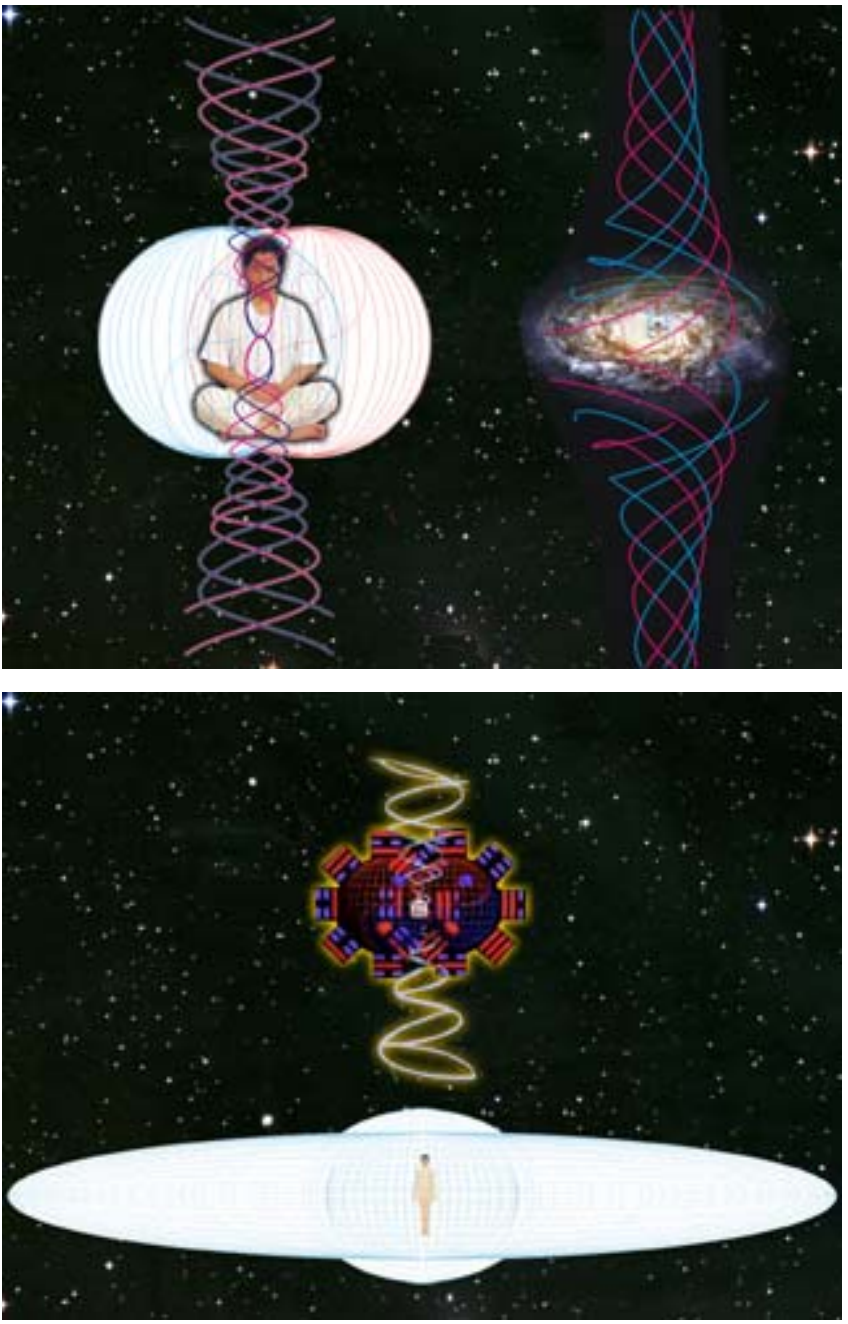

Fig. 8.13 *The spirals of the Pakua form and become a very big kua and form a space ship up to 50 meters in diameter or bigger.*

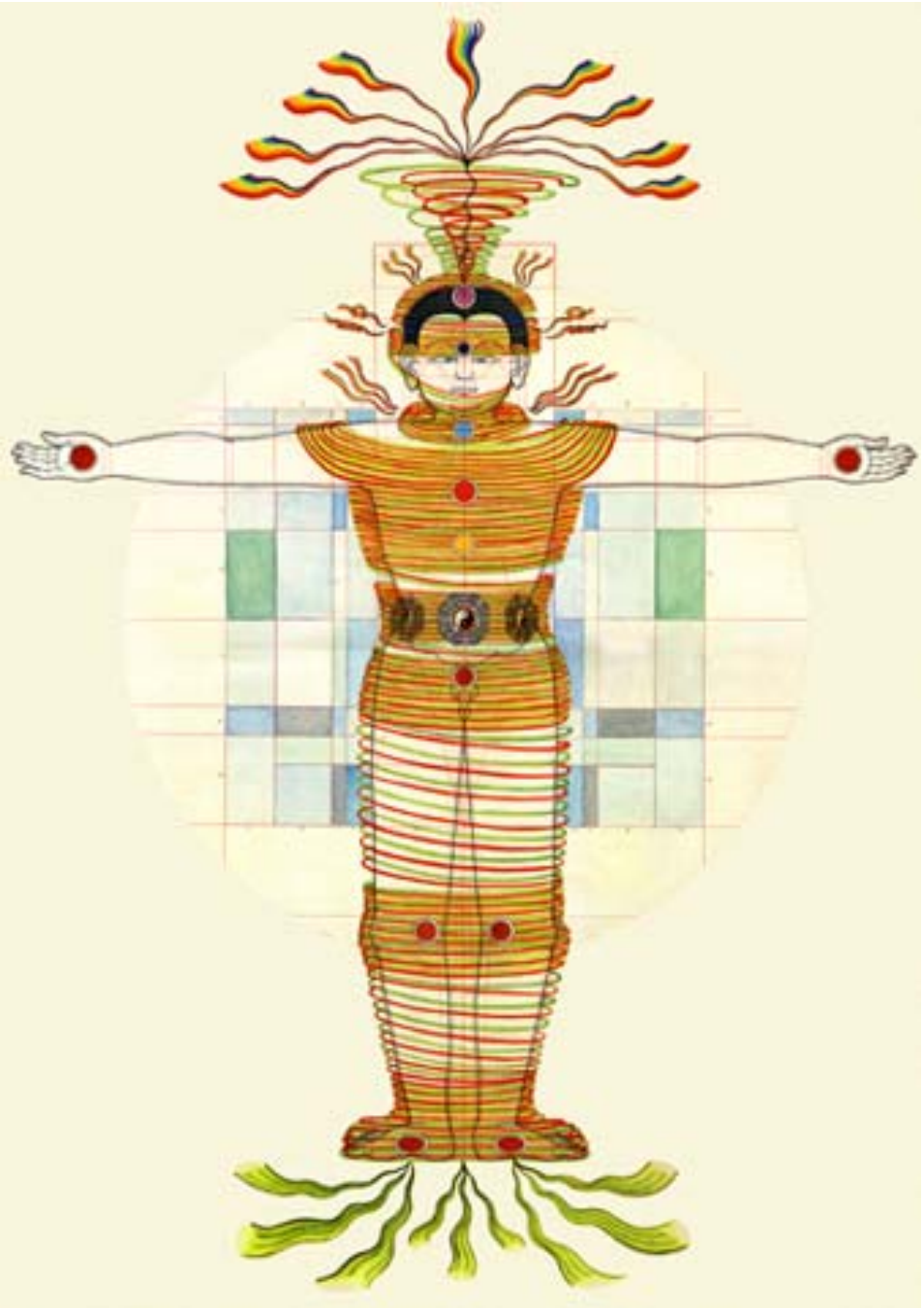

Fig. 8.14 *Belt Channels*

Summary
Procedure of Forming the Belt Channels

Ascending from the Pakuas

1. Practice the Inner Smile from the compassion fire, chanting from pakua, forming the collection points, fusing the energy into a pearl, and the Creation Cycle of Cosmic Fusion.
2. Send energy through the three Thrusting Channels all the way down to the feet and up to the head.
3. Form the four pakuas and a pearl. Gather the pearl at the cauldron, and bring it to the navel.
4. Join the four pakuas by circulating the pearl from the ***Navel*** counterclockwise to the Door of Life and back to the navel. Continue circling the pearl nine times around the Thrusthing Channels and around the body counterclockwise.
5. Form a cross. Bring the pearl from the navel to the cauldron, and back to the Door of Life. Use it to connect the side pakuas. Return the pearl to the navel.
6. From navel move to the left side of the ***Solar Plexus***. Begin to circle the pearl at the solar plexus level. Circle the pearl to the left through T-11 and return to the solar plexus. Circle nine times. Create an internal cross with the pearl.
7. Bring the pearl to the left side of the ***Heart***. Circle nine times towards the left, to the middle of the shoulder blades, and back to the heart center. Use the pearl to form an internal cross connecting all four sides.
8. Next bring the pearl to the left side of the ***Throat Center***. Circle the pearl back to C-7, and to the middle of the throat center nine times. Form an internal cross. **Practice and master this step before continuing up to the crown.**
9. Bring the pearl to the upper tip of the left ear level with the ***Mideyebrow***. Circle the pearl nine times back to the small brain, to the upper tip of the right ear, returning to the mideyebrow. Feel a band of energy flowing around the mideyebrow, ears, and back of the head. Form an internal cross connecting all four sides.
10. Bring the pearl to the ***Left Side of the Crown***. Circle the energy nine times counterclockwise at the crown. Connect the front, back, and both sides of this Belt Channel.

11. Allow the pearl out above the crown. Circle the energy nine times forming a ***Halo of Energy***. Use the pearl to cross the halo, front to back, and left to right. Collect the energy from above the head.

Descending Back to the Pakuas

12. Reverse the energy flow to a clockwise direction. Circle the ***Halo*** nine times. Then cross it front to back, and right to left sides.
13. Bring the pearl back to the ***Crown***. Circle to the right nine times. Then use the pearl to cross the front, back, and two sides.
14. Move the pearl down to the upper tip of the right ear. Circle from the right ear to the mideyebrow. Repeat nine times. Use the pearl to form a cross and return it to mideyebrow.
15. Bring the pearl down to the right side of the neck at the ***Throat Center***. Circle right to *C-7* at the back of the neck. Return to the front again. Circle nine times. Cross the front, back, and two sides. Bring the pearl to the front.
16. Bring the pearl down to the right side of the ***Heart Center***. Circle it clockwise nine times, ending at the front. Then, use the pearl to cross the front, back, and sides. Return the pearl to the front again.
17. Move the pearl to the ***Solar Plexus***. Circle it nine times to T-11 at the back, and return to the solar plexus. Cross the front, back, and sides. Return the pearl to the front.
18. Bring the pearl down to the ***Navel***. Circle it back to the Door of Life, and back to the navel nine times. From the navel bring the pearl to the cauldron, back toward the Door of Life, and return it to the cauldron. Use the pearl to cross the right and left sides. Return the pearl to the navel.

Descending from the Pakuas to the Earth.

19. Once you have controlled the pearl to this stage of the meditation, you are ready to move the pearl down to the ***Sexual Center***. Women bring the pearl down to the right side of the ovary center, located three inches below the navel. Men bring the pearl from the navel down to the right side of the sperm palace, one and a half inches below the navel. Circle clockwise back to the sacrum, to the left hip, and to the front of the ovary center/sperm palace nine times. Use the pearl to make a cross. Return the pearl to the front of the sexual center.

20. Bring the pearl down to the right groin. Circle the pearl clockwise around the ***Perineum Point and Lower Hips*** nine times. Use the pearl to form a cross by connecting the front, back, and sides. Return the pearl to the front.
21. Move the energy down and circle toward the back of ***Both Knees***, around and to the front, midway between both knees, moving the pearl clockwise nine times. Use the pearl to form a cross by moving the pearl to the midpoint between the knees and connecting the front, back, and sides from this point. End with the pearl midway between the fronts of both knees.
22. Direct the energy down to the feet, just below the ankles. Circle the ***Soles of the Feet*** nine times moving the pearl clockwise to the heel of the right foot, to the heel of the left foot, to the outer side of the left foot, to the front, midway between both feet. Form a cross. End with the pearl midway between both feet.
23. Move the energy from the front of the feet down to a point ***Beneath the Earth***, and circle toward the right (clockwise) nine times. Use the pearl to form a cross ***Beneath the Earth***. Keep on spiraling more energy to enhance the pearl. Return the pearl to the front of the circle.

Ascending from the Earth Back to the Pakuas

24. Reverse the circle beneath the earth, moving the pearl counterclockwise again nine times. Use the pearl to form a cross, connecting the front, back, and sides.
25. Move the pearl to the outer side of the left foot. Circle the ***Soles of Both Feet*** nine times moving toward the left heel, to the right heel, to the right foot, and to the front (midway) of both feet. Use the pearl to form a cross. End with the pearl at the midway point in the front of both feet.
26. Move up to the left knee. Circle the pearl counterclockwise *at* the ***Knees*** nine times. Use the pearl to form a cross. Return the pearl to the midway point in the front of both knees.
27. From the front of the knees, move up to the left groin area. Circle counterclockwise at the ***Perineum*** nine times. Use the pearl to form a cross. Return the pearl to the front of the perineum.
28. Direct the energy to the left hip, and circle counterclockwise at the ***Ovary/Sperm Palace*** nine times. Use the pearl to form a cross by connecting the front, back, and sides. End with the pearl at the front of the ovary/sperm palace.
29. Return the pearl to the ***Navel*** and to the ***Cauldron***.

Men and Women Practice Differently

***Men**:* Shoot the Pearl out of the Crown, and Spiral the Pearl down from the Crown.

1. Bring the pearl up to the crown.
2. Allow the pearl to go out three to six inches above the head. Circle nine times counterclockwise. Collect the heavenly energy and blend it in the pearl. Then circle it nine times clockwise.
3. Bring the pearl back into the crown point.
4. Spiral it clockwise through each of the Belt Channels all the way down to the soles of the feet.
5. Move the pearl into the earth six to twelve inches to collect the earth energy, and circle the energy nine times clockwise. Reverse the direction spiraling nine times counterclockwise.
6. Return the pearl to the front of the crown, and then back down to the navel and cauldron in the same manner.

***Women**:* Shoot the Pearl into the Earth, and Spiral the Pearl up from the Earth

1. Bring the pearl to the soles of the feet.
2. Move the pearl into the ground six to twelve inches to collect the earthly energy. Circle the energy nine times clockwise. Then nine times counterclockwise.
3. Move the pearl up through the left side of each Belt Channel, spiraling counterclockwise to the crown.
4. Shoot the pearl all the way out at the crown to collect the heavenly energy. Circle the energy counterclockwise nine times. Reverse the direction, and spiral the pearl nine times clockwise.
5. Bring the pearl back down into the right side of the crown. Continue to circle the energy clockwise down through the Belt Channel to the soles of the feet. Return the pearl to the navel and cauldron in the same manner.

Energy Body

Once you have practiced to this level, you are ready to form the pearl into the Soul Body.

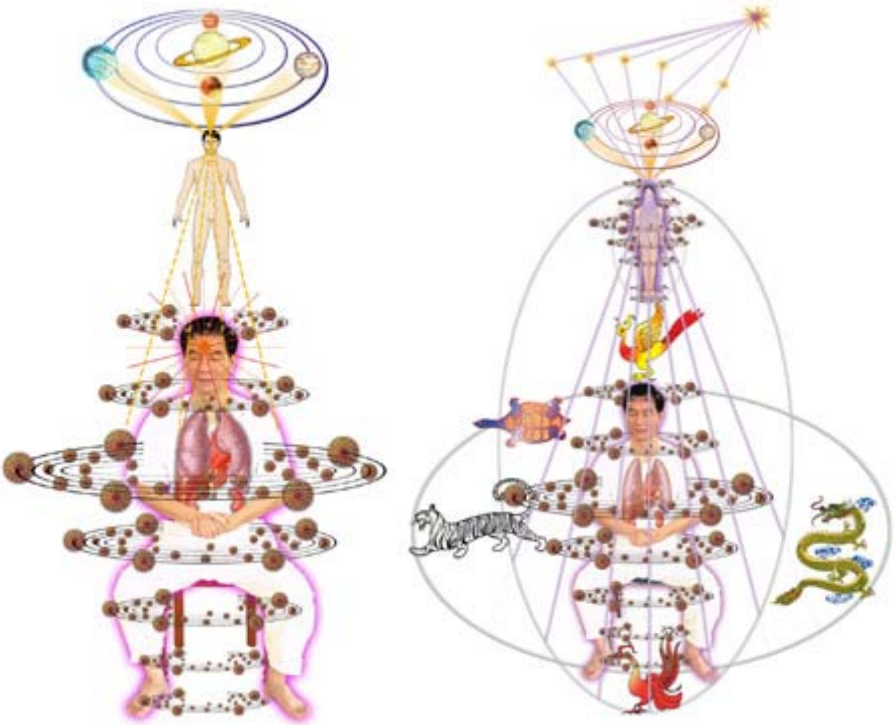

Fig. 8.15 *Energy or Soul Body*

Sorcerers saw that the essence of the universe resembled a matrix of energy shot through by incandescent strands of consciousness or actual awareness. They also 'saw' the essence of the human form. It was not merely an apelike amalgamation of skin and bones, but an egg-shaped ball of luminosity capable of traveling along those incandescent strands to other worlds. (Wagner, Bruce, "You Only Live Twice", *Details*, March, 1994, p.168.)

Just as it is important for the physical body to be strong so we can enjoy optimum health, it is also vital to strengthen the Soul Body so it becomes a sturdy vehicle for our consciousness. Strengthening Chi nourishes our health and spiritual qualities in

this life and builds a strong Soul Body to carry us forth into the "afterlife" (which is, paradoxically, the here and now). We begin to strengthen the Soul Body through what is called in Taoist Inner Alchemy "the Inner Elixir". It is called the Inner Elixir because we are working with the energies already within our own body and converting them into elixir-like healing essences. Through the meditation practices of the Microcosmic Orbit and the Fusion of the Five Elements, we detoxify, nourish, and integrate the physical body, the Energy Body and the emotions.

Always begin by doing the Fusion of the Five Elements practice to clean out the negative emotions.

Chant the eight forces and form the collection points. Let the Pakua spinal around the physical body.

Condense the pearl and practice the Creation Cycle, Thrusting Channels and Belt Channels.

Run the pearl in the Microcosmic Orbit, and control its movement with the senses.

Move the pearl to the perineum. Inhale in short sips, drawing in ten percent of the lungs' capacity, while gently pulling up the anus. Inhale up to the navel, then to the heart.

Inhale up to the crown. Swallow your saliva (imagine swallowing upward,) and exhale forcefully to open the crown and shoot the pearl out.

Practice moving the pearl up to one foot, two feet, three feet, four feet, five feet, and six feet above your head. Go out only as far as you are able to maintain control of the pearl.

Relax the senses, and form the Soul Body.

Run the pearl in the Microcosmic Orbit in the physical body. Open the crown, transfer the Microcosmic pathway into the Soul Body above the head.

Form another pearl in the cauldron, and shoot the pearl into the Soul Body.

Circulate the pearl through the Microcosmic Orbits in both the physical and energy bodies together.

Extend the Thrusting Channels up into the Soul Body.

Practice all the Belt Channels up through the head, or down through the soles, into the Soul Body. Spiral all the pakuas around the Soul Body like a space ship.

Continue to practice until you are in full control of the Soul Body. ***Note*:** You can also form a Soul Body below you by thrusting the pearl through the soles of the feet into the ground.

Spirit Body

Once you are well in control of the Soul Body, you are ready to form the Spirit Body.

Fig. 8.16 *Spiritual Being*

Stage One

Be aware of the Four Pakuas in each center and spiral them around the physical body and the energy body.

1. Begin to form the spirit body after doing the Soul Body practice. Leave the Soul Body above the crown. Form another pearl at the cauldron, and run the Creation Cycle.
2. Form the pearl from compassion energy, a pearl that is more blue and gold than the Soul Body pearl.
3. Move this pearl in the Microcosmic Orbit. Bring it down to the perineum.
4. Inhale in small sips, and pull up the anus. Inhale the pearl to the navel; then to the heart; and to the crown.
5. Inhale again, and swallow up. Exhale forcefully to open the crown, and project the pearl to the perineum of the Energy Body.
6. Exhale, and send the pearl to the heart of the Soul Body. Exhale again, and send the pearl above the crown of the Soul Body.
7. Move the pearl up and down approximately twelve inches (30 centimeters) above the crown of the Soul Body. Then gradually extend the pearl further up in one foot (30 centimeters) increments. Practice until you are able to move the pearl up and down six feet above the Energy Body.
8. Condense the pearl. Condense the Soul Body. Bring both pearls back to the cauldron of the physical body.

Stage Two

1. Repeat steps (1) to (7) above, and run the Microcosmic Orbit in the physical and energy bodies.
2. Transfer the Microcosmic Orbit from the Soul Body into the Spirit Body, and then run the three Microcosmic Orbits together. As an alternative, you can run the Microcosmic Orbit as one large channel incorporating all three bodies.
3. Extend the Thrusting Channels to the Spirit Body.
4. Extend the Belt Channels to the Spirit Body.
5. Finish by condensing the energy of both the Soul and Spirit Bodies into a pearl. Pull the pearl into the physical body.
6. Collect the energy at the cauldron, and practice Chi Massage.

Chapter 9
Fusion as a Bridge

In the overall structure of the Universal Tao, the Fusion Practices serve as a bridge between the basic preparatory practices such as the Inner Smile, the Healing Sounds, the Microcosmic Orbit, Healing Love, Tao Yin, Iron Shirt Chi Kung, Cosmic Chi Kung, Bone Marrow Nei Kung, Tai Chi and the Higher Inner Alchemy Practices of Kan and Li.

The Fusion Practices are traditionally considered as the core of internal alchemy, as they focus on the transformation of emotional energies, contained in the major organs of the body, as centers and fields of energy which resonate, each with their particular frequencies, with the energies and forces of the universe.

Through a process of balancing negative and positive energies (Fusion of the Five Elements), the growth of positive energies (Cosmic Fusion) and the opening of meridians to enhance the circulation of internal energies of the body and make it receptive for outside energies (Fusion of the Psychic Channels), the body gradually becomes more open. Thereby the self-healing process, initiated in the basic practices, is further enhanced.

Once the strength and health of the body have been restoried so that it can serve as a vessel for the forces of the universe and is in a position to process them, it is ready for the higher alchemy in the Kan and Li practices. In these Kan and Li practices the physical body can then give birth to the energy body. Once this has taken place the person is ready to give birth to the spirit body, also called the Light or Rainbow body.

Fusion as a Journey of Self-Transformation

In the Fusion Practices, the body and its path routes are not only cleansed and opened, so that the energy from within and from outside can flow with more power and ease. Also the energy flows in the body are qualitatively raised. Thus the self healing and regenerative capacity of the body, already initiated in the basic practices is further enhanced. As a result, the body's health and vitality receive a new boost and it grows in strength. At the same time, it becomes more able to absorb and process the various forces and energies from the universe, the cosmos and nature.

In the Fusion Practices, the body enters into a dynamic process towards new balances. This is an essential condition for the light to grow inside. This can then in turn attract the light from heaven as its energies become finer, as they blend into a higher quality energy created by the blending of love and compassion. This higher concentrate of energy is then condensed into a pearl which is subsequently circulated through the major organs and the psychic channels in and around the body. The pearl will help the body to feel centered and experience peace and harmony. It will also help to cleanse the special channels and enhance the free flow of energy.

The pearl will facilitate the growth and transference of consciousness from the physical to the energy body and from the energy to the spirit body (Cosmic Fusion), healing it and helping it to center and experience peace and harmony. Through the growth of love and compassion the body is able to radiate out and receive in the love and cosmic energies so that its own Chi is blended with the cosmic Chi and is thereby transformed into a higher quality of Chi.

To facilitate the process of blending and balancing the energies within the body between its organs and the gathering, processing and condensing of energies from the universe and from nature, the pakuas play an essential role (Formula 1, *Fusion of the Five Elements*).

In the earliest stage after conception, the first meridians which rule the circulation of energy of the embryo and which come into existence after the split of the egg and the formation of the body are the governor and conception channels. Successively, all other Yin and Yang meridians form in a symmetric fashion on the Yang and Yin sides of the body.

In ancient Taoists texts they are also called the sun side or outer side and the moon or inner side of the body. The sun side is that side exposed to the sun when one bows down, the moon side is that part which remains in the shadow.

The body might be visualized as grid of conduits of light which link it to the Light in which all energy and matter has its origin, a view which is supported by the new physics.

Unity of Ying and Yang

Basic to the Taoist tradition is the view that positive and negative energies are a manifestation of the very nature of the universe as a unity of opposite energies: Yin and Yang. It is by virtue of the dynamics of the interplay of Yin and Yang that the universe exists and continues to exist. They rule all phenomena in the universe as an infinite web of mutually interconnected processes and their movement. This insight is the theoretical as well as the practical basis of the Fusion Practices.

In Taoist theory, Yin and Yang rule the relationships between stars, planets, the sun and the moon and the earth, light and dark, above and below, man and woman. It is in and through this interplay, that the universe unfolds and functions. If one of them would disintegrate or disappear, the universe would end.

In the Taoist vision on the nature of the universe, the body is a microcosmos, which manifests and reflects in its inner structure the dynamics of the universe. As such it is also ruled by the same forces of Yin and Yang.

These in turn manifest themselves in the universe in the five elements (water, fire, wood, metal and earth). These five elements operate as energies in the body, in and through the five vital organs: the kidney, heart, liver, lungs and spleen. It is the natural capacity of the body to heal and regenerate itself. The body is sustained and nurtured by cooperating and facilitating the workings of the universe through the balancing of the five forces in the organs of the body and the positive and negative properties of each of them.

It is the relationship between the positive and negative energies contained and reflected in the organs, which is the starting point of the Fusion Practices.

In the Taoist tradition, the body has always been viewed as a sacred vessel, which reflects the sacred nature of the universe as a whole. Interfering with its laws of motion, the balance between Yin and Yang is broken and with it harmony and mutual cooperation between the organs and the elements which compose the body.

As a result, the free uninhibited flow of energy streams, and with it the immunity of the body, are affected. In Chinese medicine, of Taoist origin, disease is seen as the outward manifestation of

imbalances within the body. Hence the predominant attention in Chinese medicine and Taoist self-healing practice on the balancing and strengthening of the organs and their cooperative relationships.

The Taoist view on the outer and inner universe (the body), is the fruit of several thousands of years of highly sophisticated empirical observation. Thusly, feeling and sensing in the body and its structure, processes and needs, play a crucial role in creating balance within the body and between its organs and their energies, so that inner peace and harmony may grow (Formula 2, *Fusion of the Five Elements*)

Turning Inward

This involves a process of turning inward and to feel and sense oneself "from within" so that understanding can grow. This in turn further supports the effectiveness of the inward-oriented process of listening. By turning the senses inward and reconnecting them with their corresponding organs (ears/kidneys, eyes/liver, tongue/heart, mouth/spleen, nose/lungs) the process of externalizing the consciousness and thereby draining the energies out of the body can be inverted. This allows the body to come to rest and recuperate its energies and the connected senses.

By protecting the senses from undue outside influences, the life force energies in the body and the higher energies it accumulates, through the blending with the energies from all the directions, but especially those from the stars and the sun and moon and planets, are preserved and can grow without interference (*Cosmic Fusion,* Formula 3).

This process of protection is further deepened and completed in the high formula of Sealing the Five Senses of the Kan and Li Practices where protective auras are created around the body from the accumulated energies of each of the major organs.

There is abundant evidence that in the process of externalization which has been imposed on the body in the process of modernization and its growing pressures on the body, the senses have become atrophied. By turning them inward, it becomes more easy to control them and protect the integrity of the body and its organs so that it can regenerate.

The Taoist approach to the body is rooted in the vision that there is an inner order in the very nature of the universe and all its manifestations. The outer order is a manifestation and reflection of this inner order. If the outer order is in harmony with the inner order, then harmony and peace reign.

As our receptivity and ability to sense and feel ourselves from within grows, so grows our ability to experience the universe within ourselves. By looking deeply into ourselves we grow. Our understanding of our being and body as a microcosmos, and its intrinsic unity with the universe as a macrocosmos, grows.

From Balance through Resonance to Love

As our body and its chemistry and we ourselves are changing, our consciousness and perceptions also change and widen. Then a point will come where we begin to experience ourselves less as separate and isolated from the universe and more in resonance and in tune with the universe.

In this process, we grow more aware of the wave-like nature of our body in and through which the universe pulses within us and how we pulse in and though our bodies with the energies and forces of the universe. At the same time our ability to tune in with the energy of the universe and its frequencies and to absorb and draw this energy into ourselves will grow.

The Fusion Practices serve an essential function in making our being more open through the heightened sensitivity of the body, as our energies become purified and more fine and subtle. The desire rises within the body to enter into the primordial unity with the original energy by which it was originated as a living being.

In the ancient Taoist vision this relationship has always been seen as a love relationship which reveals itself when our body returns to its inner balance and Yin and Yang enter into balance. The ability to attract and conduce the energies from the universe into one body through the network of conduits, represented by the grid of meridians, is dependent on the quality of the inner work towards unity between Yin and Yang.

This meeting between Yin and Yang has in the Taoist tradition been seen as a marriage, born out of love between the opposites, as they move towards unity. The Fusion Practices play an important role in the preparation of a state of being which make this movement towards unity possible.

Enlightenment of the Body and New Physics

The Taoist insight that human beings, with all other phenomena, share common origins in the universe and that our origins are in heaven and originate in the stars is shared in many other ancient cosmologies: those of the African peoples, the indigenous peoples of North and South America, as well as the Australian aboriginal people.

The Taoist tradition, however, is unique in that it has evolved over time concrete practical formulas and practices to work with. These help us to reconnect and in the process rediscover the inherent ecstatic nature of our body, through the process of self-transformation.

These formulas, of which the Fusion Practices are an integral part, are based on the insight of the nature of the meridians and their application in healing the body and restoring its natural functions, which form the basis of Chinese medicine.

A closely related Taoist thesis on the nature of the universe, also to be found in all ancient cosmological traditions, including those in the West (before the scientific revolution did away with them, viewing them as superstition) is the unity, indivisibility and interchangeability of matter and energy.

This thesis finds full support in the new physics which evolved from the beginning of this century with the path-breaking discoveries in quantum physics and relativity theory by the great physicists Bohr, Einstein and Heisenberg.

Their discoveries shattered the foundations of the old paradigm, underlying Cartesian-Newtonian physics, at the basis of modern science. They broke radically new ground in the interpretation of the nature of matter. In the new vision of advanced physics, matter, in its inner nature, is understood as a process and an event. Matter and energy are forms of the same reality. As matter can change into energy, also energy can change into matter. Both matter and energy are viewed in this new interpretation of reality as having their origin in light.

Therefore the Taoist vision on the intrinsic nature of the body as a light body is not a romantic vision, invented by creative minds. The image, underlying it, corresponds to the insights of advanced physics. Thus what has been called in ancient spiritual traditions “enlightenment” refers to a real material process: the illumination of the body.

Here's what distinguishes the Taoist vision from most others: enlightenment is not understood as a process which happens "in the mind", in separation from the body, but the process takes place in and through the body and its progressive transformation.

Thus a true process of spiritual growth in the Taoist vision implies the "enlightenment" of the body. The progression process of illumination is a bodily process, visible to the eye and tangible in the quality of energy which a person manifests and radiates in her/his body. This emphasis on transformation as a bodily process is a principal characteristic of the Taoist tradition. In that respect it differs from other ones, marked by the duality of body and mind and in which the body is viewed as a stumbling block; a hindrance.

This also explains the Taoist insistence on the central importance on rooting and grounding the body in the process of self-transformation. The more one advances in the higher practices, the greater the need to root and ground so that the energies in the body remain in balance. Equally important is centering; the balance between heaven and earth, the energies from above and below are maintained and enhanced.

It is precisely for this reason Taoist practice gives the highest priority to the creation of a healthy and strong body through a healthy and relaxed life style and an intelligent natural diet thanks to which the body can continuously regenerate and rejuvenate itself.

These insights had their basis in a new view on the nature of electromagnetic waves as particular forms of energy and in the insight that light is an electromagnetic field which takes on the form of waves which can travel through empty space as very light vibrations, also called ether. This energy is seen, in both the Chinese and Indian cosmologies, as the mother energy from which the other elements originate and of which the universe, the cosmos and nature are composed: fire and water, wood and metal and water.

In the Taoist system, these elements correspond to the five seasons, temperatures, senses, colors, sounds and positive and negative emotions. They form the theoretical and practical starting point for the Fusion Practices.

Return to Cosmology

The revolutionary implications for our perceptions of the universe, the cosmos, time and space and of nature and ourselves as part of nature are only slowly penetrating into the social consciousness. This social consciousness's view of its conditionings and fixations in cultural patterns and corresponding perceptions of reality prevent it from being open to an understanding our true nature.

There are multiple mechanics at work in present day culture and science and the modern view of reality which tend to prevent us from giving up the mind sets, rooted in the subconscious (and which rule the conscious mind, unaware of the forces by which it is steered). These make it appear as if the universe is composed of an infinite amount of loosely, accidentally assembled particles and solid objects; each having an independent, separate existence, rather than what is actually an ever changing web of unceasingly changing events which are mutually interconnected and interdependent.

The emergence in Western history and culture of the perception of human beings as essentially sovereign and independent from the universe and as its ruler who can alter life and the origins of life at will (with the progress of science and technology) are wholly questioned by the Taoist vision, presented above.

Such a view on the presumed independence and freedom from the laws of motion of the universe also has shaped the basic assumptions on the nature of human beings and social relations which have shaped mainstream social science and psychology, which mirror the basic premises of the Cartesian- Newtonian paradigm.

They support a view of progress and development, the new version of which emerged in the course of this century, which is essentially inspired by the view that reality can be manipulated and engineered without regard for the consequences on Nature. However, with the more recent findings of the adverse effects of such an attitude and the growing concern that the very foundations on which life on earth rest are being jeopardized, the basic premises on which this attitude is based are increasingly being questioned.

At the same time, as a natural consequence, there is a growing interest in the visions which have inspired the ancient cosmologies such as the Taoist one, especially since there is increasing evidence in advanced physics which support such visions. Thus it is

not surprising that one of the leading philosophers of science, Stephen Toulmin, recently published a book, *A Return to Cosmology.*

In his study he traces the process of alienation in Western culture and science, as it came to shape modern life. Especially, he focuses on the relation between body and mind. He foresees a return to ways of looking at reality which help to overcome the duality at the root of this alienation and the imbalances it has brought about in the present day world system and which it feeds through the new communication technologies.

It cannot be emphasized enough that when the Universal Tao system is called a whole of interrelated practices, this is based on the root assumption that it is only in the practice that experience is gained. Therefore, a process of self-transformation is set in motion which makes it possible to come to terms with the patterns within oneself which prohibit one to discover its relevance.

This is the very basis of Eastern epistemologies, not only basic to Taoism but also at the root of other Eastern religious and spiritual traditional epistemologies: that true knowledge can only be acquired experientially and existentially in and through the practice.

Also implicit in the Taoist vision, shared in other ancient cosmologies, is the view is that the universe is alive. Not only as it births life at every instant, but also as it sustains and nurtures life. This view is quite contrary to that underlying the materialist world view, which originated in the West with the advent of modern science, in which the universe is reduced to an accidental anomalous phenomenon .

Religious Nature of Taoist Practice

In the Taoist view, supported by the new physics, the body is not only matter but also a field of consciousness which, by its wavelike nature, is intrinsically related to the whole universe and can also get in touch with it. This provides the very basis for the Cosmic Chi Kung practice as a practice, which helps to enhance and balance the body and which is essential to the Fusion Practices.

These above views are essential to the assumptions on energy underlying the ancient Taoist Practices, contained in the practices of the Universal Tao and which offer a synthesis and which for the

first time have been published in the West. Until recently these were scattered and inaccessible, except for highly fragmented information. Essential to the Taoist tradition is religious practice in the feeling and experiencing of the sacred and the divine, and not in the beliefs about them.

The Taoist view on the nature of religiosity as an experience of connection and reconnection is very much in line with the original meaning of the root of the word religion in Latin, “re-ligare”, to reconnect.

Thus the practice is oriented to rediscovering the intrinsically ecstatic nature of the body in which it spontaneously feels the truthfulness of life as a sacred, naturally ecstatic activity. The whole practice may be summarized in facilitating the process of reconnecting and returning to the state we were in before being born.

Basic to the transformation process which is conducive to this rediscovery is the Healing Love practice by which the sexual energy is retained, its flow is inverted and the nature of this energy is transformed. The Fusion Practices play an essential role in making possible the further refinement of this energy in the Kan and Li practices through new forms of purification and by enhancing the receptivity of the body for higher energies from the universe. The Taoist practice takes literally the Christian tenet that the body is the temple of God by viewing the vital energy or life force energy as a sacred energy through which the body reveals its divine nature as an intrinsic endowment in which heaven and earth merge.

Wisdom of making Friends with the Devil

The three monotheistic religious mainstreams in their institutionalized esoteric form -- the Jewish, Christian and Islamic -- are marked by a deep duality between high and low, sacred and non sacred, right and wrong, good and evil, mind and matter, mind and body, mind and energy. This duality has also shaped other religious and philosophical systems in their social and institutional evolution; systems such as Hinduism, Buddhism, Taoism and Confucianism. These systems have been marked by beliefs and codes of ethics which have tended to split humankind between believers and nonbelievers and between those that are good and those that are bad.

Their focus on the duality between God/ the divine and heaven and earth, God and the Devil, good and evil, mind/spirit and body and on sin and its corollaries, fear and guilt, have created much violence and tend to continue to do so. They have also greatly affected people's sense of dignity, self-esteem and independence, as they have tended to create major dependencies on institutional intermediation with the divine.

Fig. 9.1 *Balance of Yang and Yin (Good and Bad)*

In many pre-industrial cultures there are proverbs and legends which suggest that it is wise to make friends with the devil rather than fight him. It would seem that such intuitions are based on the insight that it is better to reconcile and accept oneself so that the negative loses its power rather than opposing it, by which its power increases, especially when fear and anger rise and the negative is turned into an obsession. Simple observation confirms the truth of this insight: that the energy of what is viewed as negative and dark increases to the extent that there is an attempt to eradicate it.

This same principle shows up in the martial arts: never initiate the fight but let the enemy come and neutralize him by making use of his own energy, as in the case of Tai Chi and Aikido.

A leading philosopher of culture and humanist therapist in the West, Erich Fromm, has said that the propagation of these views, often in extremely violent ways, has broken the spiritual backbone of the people.

Esoteric systems have, however, never succeeded in wholly eradicating and repressing their esoteric roots, visible in multiple

movements throughout history, in which the body was considered sacred and a temple of the divine and in which sexuality was viewed as intrinsically sacred.

It may be said that all esoteric systems, in their origins, have called on humankind to practice love and compassion and thereby to transcend ego and enter into a state of grace.

Adepts like Jesus who has inspired the Christian tradition, Mohammed in the Islamic tradition and the Gautama in the Buddhist tradition may be seen as great masters. They showed people ways and practices of self-transformation through the practice of love and compassion. By assuming responsibility for themselves, they could attain inner freedom and bliss and transcend themselves.

In the Taoist view, the problem with religion and philosophy is not in the practice, but in the beliefs which often serve to divide rather than unite, inside the person and outside.

Unity of Light and Dark

In the Taoist perspective, there is no sin, as light and dark are two poles of the same indivisible reality. Thus, attempts to eradicate the dark, so that light will prevail, are bound to fail and tend to lead to conflict and violence. Attempts to conquer good at the expense of evil (for example, the Crusades) are bound to generate more violence. And battles to secure good over evil will create more problems than they solve. In the Taoist view there should be neither winners nor losers.

Fig. 9.2 *Light and Dark of the Tai Chi Symbol are connecting.*

Thus, balance between opposite forces and energies, as expressions of Yin and Yang, the positive and the negative, is essential to Taoist perspective, as expressed in the *Tao Te Ching*, attributed to the great Taoist Master of self-transformation, Lao Tzu.

From a Taoist perspective, balance is enhanced by entering into alignment with the universe, when one actualizes the universe within oneself and so is empowered and realizes oneself. This state has also been called a state of Selfhood, as one has returned to one's original Self. This process is also called "returning to one's origins". This means that one has overcome the contradictions and imbalances in oneself, so that Yin and Yang enter into balance and harmonize. The Taoist texts speak of becoming the "Undivided Being". Lao Tzu uses the metaphor of the unhewn log (p'u). It manifests a state of being in which when has returned to the original state of spontaneity, in the old Taoist texts called " Tzu-jan) which can be observed in babies and small children. This reminds us of the saying of Jesus," if you do not become as children, you cannot enter the Kingdom of Heaven".

Thus the Taoist view on harmony does not carry moral overtones, as it refers to a state of being which is intrinsic in the body. This state of being of the body as a microcosmos lies in the balance within and between its major organs, through which our body resonates with the energies and forces of the universe.

In the Taoist perception, there are no heaven and hell outside, above or below us. They are seen as states of being of our bodies and our inner selves and the way we relate to the universe, ourselves and each other. As such they reflect states of balance and imbalance between the positive and the negative. In this view, human beings are responsible for their own state of being, the quality of which depends on their state of self-awareness as the key to self-transformation.

This view is reflected in many ancient spiritual traditions and cultures which suggest that it is wiser to keep the devil as a friend than try to combat him and do away with him.

This liberating view, which frees us from self-condemnation with its tendency to obscure the positive within the negative and its transformational force, is the basis for the Fusion Practices.

Life as an Invitation to Learning

The Chinese character for crisis stands for both a negative occurrence as well as for opportunity and reflects the Taoist view on the unity of the positive and negative. In this perspective, whatever happens in life is to be seen as an invitation for learning and an opportunity for awakening. Theoretically speaking, problems are not problems, but opportunities for self-transformation, since the negative contains the positive, in the same way as the positive contains the negative, like the Yin is in the Yang like the Yang in the Yin. What may be seen and experienced as negative, carries within it the seeds of the positive, just as the light exists within the dark. In this light, all problems of life may be seen as energy potential, which can actually be a learning process.

This is a key premise in the Fusion Practices, and it helps to overcome the duality which we tend to construe, as a result of attachments to our negative experiences and emotions and therefore keep ourselves from entering into balance.

Taoists say that learning is enhanced if the organs feel at ease and find themselves in a state of well being. When a state of disease arises – which in Chinese medicine, of Taoist origin, is seen as a symptom of the breakdown or weakening of the free flow of energy – learning becomes more difficult.

It also points to an attitude which gives primacy to the need to reflect on one's own attitude and perception in resolving problems and to look inward to see in what way one has contributed to the problem and how one can contribute to its solution by changing one's own attitude, perception and way of life.

Thus from a Taoist perspective, problems are not seen as obstacles or difficulties but as opportunities to learn and as learning material.

In this connection, it is interesting to note that the word disaster, common to many European languages, has its etymological root in the Latin substantive "astrum" of which it is a negation by the prefix "dis". This suggests that originally the word had the connotation that if and when one lost touch and became alienated from the stars (as representing our origins), one was in for trouble; imbalances would arise.

Smiling as the Key Taoist Practice

Smiling and relaxation are the beginning practice of the Universal Tao. They are the key to the transformational process and to learning, as a result of which one is enabled to gently and patiently change old patterns into new, concerning oneself and the universe: new breathing, posture, inner and outer movement, and a new perception of reality.

Essential therefore in the Taoist practice to enhance learning and get in touch with the body by turning inward is to learn to relax and smile inward, so that dis-ease, manifest in many forms of stress, is overcome and one returns to a state of ease. Thus it may be said that whereas the Western approach to medicine starts from outside, the Taoist approach starts from within.

It is thus not incidental that the whole practice of the Universal Tao starts with the practice of the Inner Smile. This is actually the first practice of internal alchemy, as it serves to soften our body and its elements in which our consciousness is stored and through which it operates. It is the key agent of the whole activation and transformation process in all the practices. We do not only have a body but we also are our body. By touching it with love and gentleness, its knots and blockages start to dissolve so that the free flow of energy is restored.

Unity of Fullness and Emptiness

It is in this context not surprising that at the heart of the ancient Taoist texts is the emphasis on the practice of turning inward and of stillness. It follows that in the process of meditation as a practice of becoming aware of the inner state of being of the body and its movements, a new and fresh space is created in which renewal and transformation can take place. This space is also called the creation of emptiness and the continuous re-creation of emptiness so that new fullness becomes possible.

In the Taoist as well as in the Buddhist tradition, which historically have been closely related over long periods in Chinese history, emptiness and fullness are indivisible and a condition for each other. In the Universal Tao practices, this view has vast implications. For example, in the universe, emptiness and fullness are indivisible and are the creative source of becoming, evolving and

renewal, so that the universe is reborn in a continual process. We ourselves give thanks to the alternation of the inhale and the exhale, so our body is in a continuous process of dying and being reborn, through which we renew ourselves. The new can only rise if the old dissolves. So it is in Nature with the change of seasons. And so it is with all that is alive in the universe. This is the core wisdom of the *I Ching*.

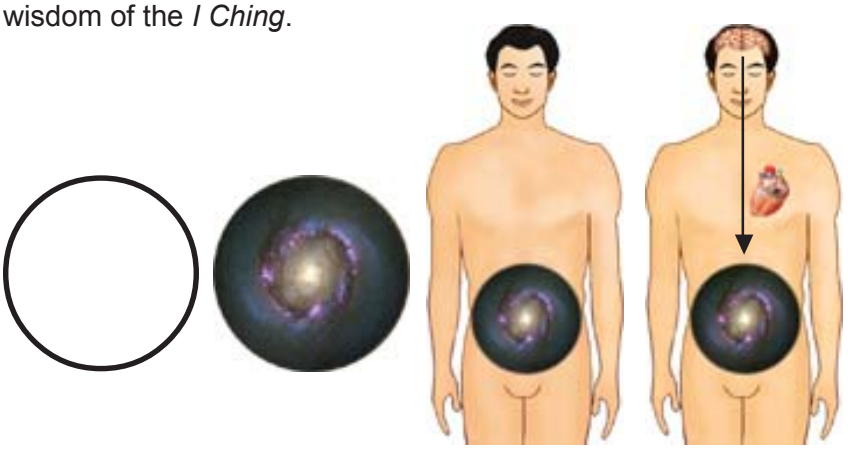

Fig. 9.3 *The core is the center of the universe, earth and the body.*

In the Taoist practice this has a particular application in the counsel to empty the mind and let it come down in the body so that a major source of energy is preserved and can renew itself. At the same time the belly can be filled with Chi, so that the energy streams in the whole body are enhanced and the heart is freed from too much pressure, as the belly helps do its work. Only when we learn to renew ourselves by undoing what has become unnecessary and what obstructs the process of transformation do we renew ourselves and our body. By undoing ourselves from what is no longer needed the new can grow. An ancient Taoist proverb suggests that simplicity comes about by seeing every day what has become dispensable. Then one can walk and move more lightly, both in the mind and with the body.

Jesus often reminded people in His parables of the law of unity and alternation in nature, and in themselves of old and new. In the *Tao Te Ching* this truth is expressed in the use of rich metaphors, for example, the house which acquires its function by being empty and the wheel which receives its function by virtue of its emptiness.

It finds its most pregnant expression however in the law on the unity of living and dying, common to all the great spiritual traditions – Hindu, Buddhist and Christian –, which is also central to Taoist practice. The new can only emerge and grow, if the old dies and is discarded.

Attachment and Detachment

This insight is at the core of the *I Ching* in which nature with its cycles and seasons is held up as a mirror for human beings. It has shaped from ancient times the Taoist proposition that to learn to be and realize oneself, one needs to go with the flow of life and to become like a fish in the water or the clouds in the sky. This insight is essential to give depth to the Fusion Practices and balance attachment with detachment.

A: *Why don't you sit down, relax and let go of the weight and let me take you to the market.*

B: *Thank you for taking me to the market. I don't want to put too much weight on your car.*

Fig. 9.4 *Relax and let go.*

In the Taoist view, attachment and detachment are not to be seen as opposites, which exclude each other. What may be useful and functional in one stage of life, in one particular situation or moment, may well lose its functionality at another time. This explains why Taoists question the usefulness of externally induced and pre-arranged moral codes. Instead , they value, above all, self-cultivation in learning to act in harmony with what is inwardly experienced as genuine and truthful, because it is in tune with the universe in us.

The training in such an attitude in which one frees oneself from fixed rules imposed and determined from outside and one consults one's own body and inner feeling, creates both freedom and flexibility. It helps to avoid being trapped in positions which undermine the capacity to trust oneself, and at the same time raises self-esteem.

In the process of genuine self-reflection and the growth of self-awareness, you learn to look at yourself and your inner life from a distance and as a neutral witness, rather than as a judge. As a result, you grow into a spirit of inner freedom and you learn to look at yourself with a sense of relativity and even with a sense of humor. At the point you are able to truly smile at yourself and have reached the point you can forgive yourself, wisdom is dawning and the knots which you felt were in your way are in the process of dissolving, to create space for new and fresh energy.

Going with the Flow

This view on going with the flow in the universe and within yourself is also the basic principle underlying and inspiring the ancient Taoist arts of self defense. In Tai Chi no position is fixed and the body enters into a continuous flow of movements, as life is movement and in the movement to become one with the universe and its energies and forces one becomes invulnerable. The power gained in the martial arts is not an external but an internal one; it is generated by the process of alignment. It is this alignment through which the body is empowered from below and above and the power can flow from the center.

If you have no center, you can be easily pushed around. A person who is centered has an internal balance. He is more free from external influences and less fearful and suspicious of others, as

he is in tune with himself and the universe. Therefore the fusion practice may be called an internal kind of martial arts by which one learns to playfully bring into balance one's opposites so that a sense of being centered and in harmony arises and thereby self-confidence manifests.

Fig. 9.5 *Balanced, going with the flow*

It should be obvious that the practice of these arts may be most helpful, as they may help you to remember to go with the flow inside yourself and become inwardly soft and flexible. Like all true Chi Kung, the art of moving the Chi and with the Chi, outer flexibility comes from inner relaxation. Only when relaxation deeply enters the body, can it become truly receptive for the energy within and from outside. The same goes for Tai Chi.

In that sense the Fusion Practices may also be seen as an inner play in which you invite your organs as your children to play with each other and see how they can balance and support each other. It may also be compared with an ancient game, which is played by children and adults in different countries in Asia. In Thailand it is called Takara in which the players help each other in keeping the light bamboo ball in the air so that the play can continue. Nobody loses, nobody gains. All share in the joy of the game and in the process train their own ability and help the others to enhance theirs.

Central to the Taoist tradition is that the body expresses and balances both heaven and earth. How could it receive the energies of heaven and earth and become an expression of the universe, if it were not open and flexible and receptive? This explains the crucial role of Chi Kung and the various schools and forms which have been created over the ages, so as to make the body a vessel. As the *Tao Te Ching* says: the function of the vessel is to be empty so that it can be filled.

Secret of Breathing and Relaxation

The essential role of the quality of breathing in all the practices is to enhance detoxification and cleansing, to create new space and openness towards the universe (in the exhale) and to fill the body with new energies and forces, by receiving, enriching and transforming Chi (the life or vital force). Breathing is central to the Taoist practice.

Changes in the quality of breathing from a short, superficial and agitated breath in the upper part of the body to a long, deep and quiet breath in the lower center/ Tan Tien of the body are crucial to the process of inner transformation. This is so because breathing is the bridge between consciousness and the body, and in the breathing process both the body and our awareness change.

The quality of breathing plays a crucial role in the processing and transformation of emotions which is a central theme in the Fusion Practices through the transformation of negative into positive emotions (Fusion of the Five Elements) and the cultivation of positive emotions (Cosmic Fusion). The emphasis in Taoist practice on self-healing is intimately related to the growth of self-awareness with regard to one's pattern of breathing as this determines the ability to regulate, control and balance emotions.

The Inner Smile practice as well as the Healing Sounds practice, designed to balance the negative and positive properties of the organs, are essential as a preparatory practice to the Fusion Practice.

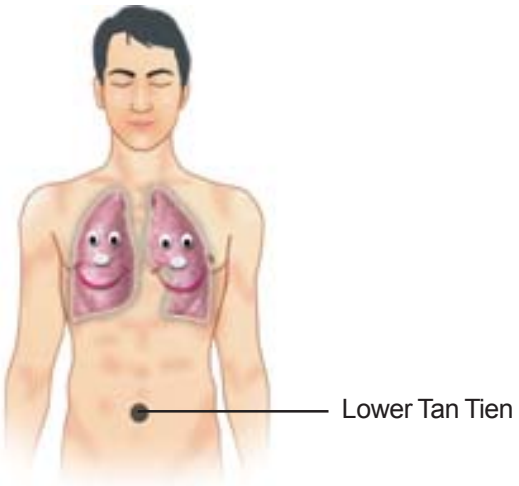

Fig. 9.6 *Smile to the Lungs.*

From the above, it should be clear that the practice of the Inner Smile and the quality of breathing and relaxation – as conditions of the self-healing process – are intimately related.

It is not coincidence that the great sages and masters of self-transformation like the Taoist immortals and the Buddha are always portrayed with an inward-oriented smile, to signify the key to inner freedom and balance and the unity of Yin and Yang. The practice of the Inner Smile as the key to relaxation remains the basis of all the practices of the Universal Tao, from the most basic to the most advanced. It is the key to all forms and stages of self-transformation, as the Taoist masters discovered its secret and its power to initiate and enhance the process of self-transformation. Statues and pictures may remind us of our own transformational potential and may help us to set in motion the internal alchemical process. We may also bring into our mind images of people who have awakened or reminded us in the course of our life of our own potential for transformation and positive qualities, thereby helping us to empower ourselves.

Science of Feeling and the Power of Intuition

In this sense, the Taoist practice is a continuous invitation to turn inward and get in touch with one's own body (and organs). Begin to sense and feel the body's state of being, its expansion and contraction and the state of relations between the major organs and the senses (kidneys/ears, liver/eyes, heart/tongue, spleen/mouth and lungs/nose). Check the state between the major organs and connected organs (kidney/bladder, liver/gallbladder, heart/small intestine, spleen/stomach, lungs/large intestine). Review the overall state of relations between the organs, glands, the nervous system, the spine, the bones, muscles and tendons. How are the relations between the three centers of the body (belly, heart and crystal room)? Check on those between the center and the extremities, the front and the back and the quality of the path routes which carry the flows in the body (the electro-magnetic energy, called Chi, also called the life force or vital force, the blood and the lymph flows).

Any advance in the practice is determined by the growth in ability to feel into the body by going inward and getting in touch with it.

In this context it is of value to realize that the verb "heal", the

substantive “whole”, and the adjective “holy” have the same etymological root. This is in line with the Taoist insight that the process of healing is realized in the process of becoming whole and that holiness is the state of having become whole and in balance with oneself and with the universe within oneself. In this view holiness is not a moral category but an existential and relational state of being.

It is not without reason that Taoist practice has been called a science of feeling, as throughout the ages it has relied on and cultivated it. One may also call the ability to feel the power of intuition or the feeling intellect which exists at every and all levels of our body and bodily awareness in which we are wholly present. In all languages of the world, there are multiple expressions, pointing to the organs, such as the heart or the liver or the kidneys or the blood or the bones or the veins, hands, eyes, ears and feet which reminds us of this intuitive power of the whole body. The reduction of thinking to the mind and the brain, so characteristic of Western reductionism, is entirely alien to all cultural traditions in the East and the South.

It is the feeling that we open the body and open and activate the Chi from within and outside.

It is also through feeling that we can sense, taste, hear and touch the rhythms of earth and heaven and unite with them within ourselves. Becoming aware of our inner movements and what moves us are one and indivisible. In the feeling process, we also become aware of the relativity of our boundaries and learn to experience these not only as limitations and finite but as openings to the unlimited and infinite.

As a result our solitude comes to an end and we become sensitive to our intrinsic relatedness with all that is. In this sense, each practice may be seen as a step to invert the process towards alienation and separation from the sources of life, basic to Western culture and its extension over the world.

Thinking with the Heart

One is reminded of the meeting of Carl Gustav Jung, the famous Swiss psychiatrist and philosopher of culture in the 1920’s with an old Pueblo Indian in New Mexico on one of his visits to the United States of America. Jung narrates in his autobiography that his talk with him was unlike any which he had had with a European. When

Jung asked him how he felt about white people, Ochwia Biano (Mountain Lake) said to him, that to his people, they looked quite cruel in their appearance. “You always have an inflexible expression on your face. You always seem to be wanting something. You are always restless and agitated. We don’t know what you want. You all seem to be quite crazy.” Jung then asked him why he thought them to be crazy. He replied, “They say they think with their head”. Jung, surprised, asked him: “Of course, but tell me, where do you think?” He replied, “We think here.“ And he pointed to his heart. Jung tells how he sank into deep reflection and he remarks, “For the first time in my life, it seemed to me, somebody had shown me the image of how we really are.... This Indian had touched our weak spot and pointed to something to which we are really blind.” Jung viewed the encounter with the Indian as an opportunity, which opened to him a new gate to a primordial and nearly entirely forgotten dimension and form of consciousness which could be revived.

Fig. 9.7 *Smile into the Heart.*

In another passage in his autobiography, Jung narrates a dream which he had during a visit to an Islamic country in North Africa, which deeply touched him. In this dream he had to fight for his survival with a young Arab aristocrat who descended from his horse and wanted to drown him. Jung interpreted the dream as a struggle between his own repressed unconscious (his shadow), which sought to be recognized and accepted and his own consciousness, represented by his rational mind which felt threatened by the unsuspected attack by the young man. He then observes: “In my

unconsciousness, I was in no way aware of such a situation; on the contrary I could not undo myself from a feeling of superiority, as at every step, I was reminded of being a European. I was not prepared to meet the unconscious forces within me, which emerged with such an intensity on behalf of the opposing party and which led to such an intense conflict."

Only several years later did Jung begin to understand the deeper nature of the dream. He began to see in the dream the resurgence of primordial structures or patterns in himself from a well-known past, but a past he had forgotten. He perceived the resurgence of these images as a renewed awareness of a still available potential for life, which was overgrown by civilization, a potential for life, which had been repressed and marginalized into the sub-conscious. In Jung's view, Western culture had become alienated to much of what being human represents: the primordial dimension of our being, which had been relegated to the underground.

Jung was a great admirer of the Taoist tradition and expressed his deep appreciation for its originality and wisdom in writing the foreword for the translation of the *I Ching* into German by Wilhelm Reich (the first translation into a European language).

The split between body and mind, thinking and feeling, matter and spirit, at the root of the formation of Western culture and religion and the birth of modern science, has been aggravated in the course of this century.

Feminine Underground Current

Some historians and scholars, like Morris Berman in his path-breaking studies "The Re-enchantment of The World" and "Returning to Our Senses" have argued, that in the course of this process the feminine dimension of European culture greatly suffered and in order to survive had to make itself invisible and so became its undercurrent. He means by this that in religion, with its reliance on external authority and its contempt for the body as well as in science, with its pursuit of objectivity, at the expense of other sources of cognition, the body was devalued.

Subsequently it could be turned into a mere object, an input and an instrument. It was seen in function of externally determined aims, as defined by the forces of competition, economic rationality and rational management and the new forms of communications

technology. This process has also seriously undermined the position of women and has greatly affected their sense of dignity and self-esteem. It has also challenged the Yin values in society, considered to be counterproductive.

Unquestionably, the growing sense of despair and disorientation which large groups of people in the world today experience is directly related to the split and the resulting imbalances which they experience within themselves.

Restoring the Balance

With the growth of a new world culture, with a process of unceasing economic growth and expansion and the simultaneous rise of both minority affluence and mass poverty, these dualist tendencies are being further aggravated. The rise of fundamentalism and dogmatism, both as an instrument to legitimize power and achieve control and as a response to a growing despair and as an expression of the thirst for security is a further sign in the world rocked by imbalances and social fluctuations has become increasingly uncontrollable. This uncontrollability is seen as unavoidable and inherent in the very mechanics of the system and as an inevitable price for economic growth and advance.

Repression of the body and of sexuality and a search to compensate for it go hand in hand. Thus repression and a desperate search for liberation from it are both on the rise. There is a trend to see the body and sexuality as the source of all evil and start crusades against them so as to secure law and order. There is at the same time a growing obsession to secure and maximize pleasure, a trend which has grown to be the object of ruthless exploitation in which the body and sexuality have become mere commodities on the market. As a result, public life is being sexualized, as a source of economic expansion and profit.

Thus the repression of the body and sexuality have precisely an inverse effect and has become a major source of a fast-growing market and rapidly expanding pleasure and amusement industry, which capitalizes on this repression.

The first law of thermodynamics is that energy cannot be created or destroyed. In terms of Taoist theory, all energy comes forth from the Great Void, the original Wu Chi which undergoes a series of transformations in the formation of the universe. Thus the human body is seen as a particular form of transformation of this

original energy. The second law of thermodynamics states that energy in a closed system tends to become disorganized (entropy). Thus there is an automatic tendency for balance to be lost.

Taoist practice focuses on inverting the process of dispersion and disorganization and restoring balance. This process is set in motion and facilitated by the Healing Love practice through which the unity and balance between love and sex is restored.

Essential to the Healing Love practice is the growth of love and compassion within as a result of which love and compassion with others and the universe become possible and emerge as a natural extension. Once the inner balance is restored, it is possible to act as an effective agent of balance outward.

In the Taoist view, conflict and violence in the outer order invariably have their source in inner conflict and violence, as manifestations of inner imbalance. Equally is outward peace viewed to have its source in inner peace and balance. In this process towards inner balance, Fusion Practices, in conjunction with the Healing Love practice and other practices of the Universal Tao, play an essential role; they honor the body and its intrinsic wisdom and potential for self-healing and rebalancing itself, so that it enters into alignment with the universe.

Joseph Needham, one of the great scholars of the origins of Chinese science and civilization, who was an honored member of the Academia of Science, had called Taoism the feminine undercurrent in Chinese history and culture, with its focus on the power of silence, feeling, sensing, compassion, forgiveness, humility, gentleness, reverence for life and nature and the equality of women.

It was however relegated to the margin of Chinese civilization and its practitioners had often to go underground. As a rule they fiercely stood for the ancient communitarian practices of reciprocity and sharing as well as people's freedom and self-reliance. At the same time, they were opposed to interfering with the natural order, to be respected as a manifestation of the higher orders.

World as a Manifestation and Reflection of the Universe

They valued ancient forms of democratic practice, rooted in a vision of village communities in early times, which formed federations, patterned on the very structure of and alignment with the cosmos. No wonder that they were staunchly opposed to any forms

of feudal and hierarchical power in which undue power was exercised by some over the many and the rise of a wealthy aristocracy which lived at the expense of the common people. They were also opposed to any forms of technology which would harm nature or be at the expense of people's sense of well being. Their attitude towards the universe and towards each other is summarized in the words of Lao Tzu:

The Universe is sacred
You cannot improve it
If you try to
You will ruin it
If you try to hold it
You will lose it
Surrender yourself humbly
Then you can be trusted to take care of all things.
Love the world as you love yourself;
Then you can truly take care of all things.

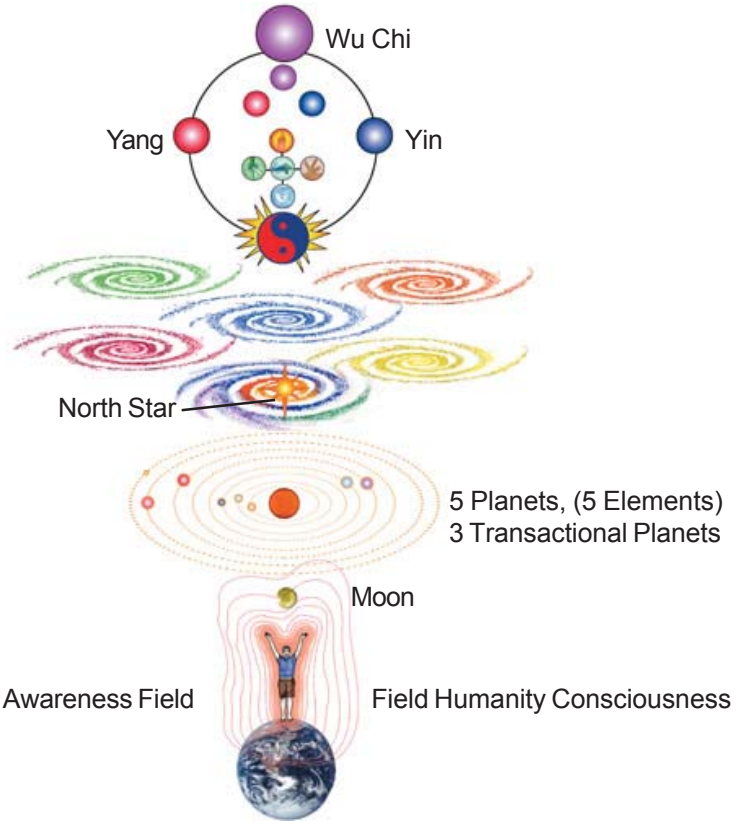

Fig. 9.8 *Alignment of the Cosmos*

It may well be that, precisely because Taoist practitioners refused to be co-opted by the establishment and were relegated to a precarious position, the practices could survive. As such, these practices, as synthesized in the Universal Tao, constitute a synthesis of several thousands of years of the practice by generations of Taoist masters in the science of feeling and sensing inward and of observing the nature of the universe and our relations with it.

The above provides evidence that Taoists over the centuries had a genuine concern about the well-being of the common people and that their practice was no reason to disengage from the world. The many stories and legends of the Immortals show that they were greatly loved, especially by the common people and the poor whom they often protected and helped. Their practice of gentleness (kidney), of generosity (liver), love and respect (heart), fairness and openness (spleen) and courage (lungs) expressed a strong sense of compassion with those who suffered.

Body as the Primary Source of Cognition

In the evolution of Western culture with its progressive disconnection between body and mind, thinking and feeling, rationality and emotions, mind and energy, inner and outer, matter and energy, linearity and spontaneity, feeling as a source of awareness and the primary mode of cognition has been progressively devalued.

It was seen as a feminine value of little use except in some domains as that of the arts and artistic endeavor. In religion it was looked at, together with the body, sexuality and emotions, as a potential source of evil. In science with its drive for objectivity, it was also looked at with suspicion, as it tended to disturb and undermine the demands for objectivity.

Thus it was relegated to a position of inferiority, as it was supposed to interfere with rationality, discipline and order, needed for progress and the growth of modernity, as well as with the need to control the universe, the cosmos, nature and ourselves.

In the Taoist tradition, feeling as the power of intuition, rooted in the body and the ability of self-reflection has always been considered as the primary source of self-awareness. Jung has named this form of cognition the knowledge of the unconscious, which underlies all conscious activity of the mind.

This capacity to intuit reality (the ability to sense reality in its totality may be called an integral form of knowledge) exists in our whole bodily being. It may also be called a mode of thinking with the body which precedes all formalized codes of thinking which evolved with the advance of formal rationality and the split of body and mind, typical of Western culture.

In that sense it may be called a Yin form of cognition, as opposed to the Yang form of cognition, which characterizes the modern world and its connected forms of education, science and technology. Yet there is abundant evidence that at the source of all genuine creativity and inventiveness, including in the field of science, lies the power of intuition.

In that sense, the practice of the Universal Tao and the Fusion Practices, deeply rooted in the Taoist tradition, may be seen as a way to recover this form of knowledge within ourselves so that the split within ourselves between body and mind, feeling and thinking is overcome. In the great Asian traditions, thinking in its restricted sense as the linear activity of the brain has been viewed as interfering with and affecting awareness as the primary and principal form of knowledge, essential for turning knowledge into understanding.

From a Taoist perspective, the primary learning process does not take place in the brain but in the organs. Recent findings corroborate the Taoist vision of the learning process that the brain only processes what is experienced and known intuitively by the organs, in particular those in the lower Tan Tien.

Our deep memory which structures our patterns of reaction and response to the world lies in the organs. In this view, a learning process needs to be rooted in a relearning and a reprogramming of our subconsciousness in the organs from which all conscious activity springs. In terms of contemporary technology the organs are the software and the brains are the hardware.

Unity of What is Above and Below

In many recent attempts to revitalize and recuperate spirituality, a growing need is felt to counter the ominous trend towards a loss of meaning in the world of today. There is a tendency to continue the split, which inspired many spiritual traditions, which tended to be based on the duality of good and evil, higher and lower.

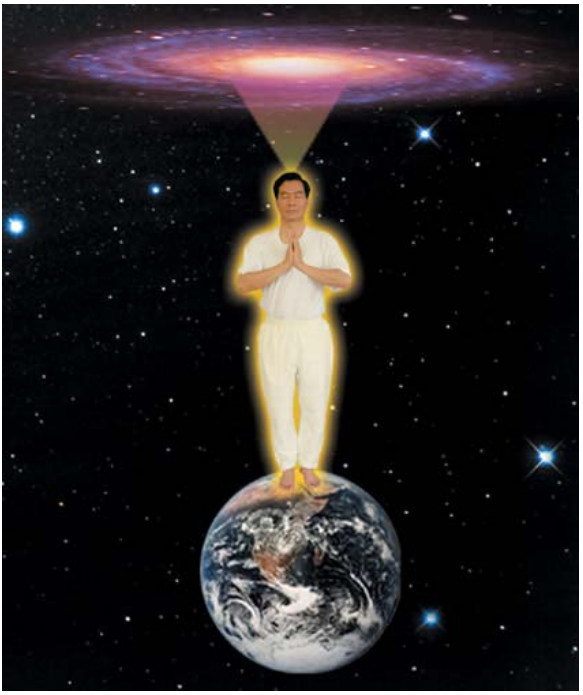

Fig. 9.9 *As Below So Above*

As the lower part of the body and its organs is looked at as associated with the instinctive animal obscure part, connected with sexuality, which prevents the mind and the spirit from its upward vocation, it is ignored and bypassed. The Taoist approach fully honors and recuperates the dignity of the body as a whole. The Tao recognizes the belly and its organs, connected with our sexuality and water energy which is the source of creative power from which all energy transformations flow. By getting in touch with our most intimate parts, we also gain access to the source of our creative powers.

In that sense, the Fusion Practices invite us to reconnect with those parts of ourselves, both physically and psychically, which have been the focus of repression. This repression is not only in most of our cultures but also within ourselves, as we internalized what we learned and accumulated in our culture, at home, in school and though the media. In order to reconnect and truly get in touch with our organs, we need an instrument which is capable understanding them.

That instrument is our intuitive power, which has its roots in our body as earth. It cannot be substituted by any other instrument, including our own intellect through which we are often at risk to become strangers to our own innate wisdom.

Genuine self-transformation can only be realized from within by the one who truly knows her/his personal existential history. We must see the relations between positive and negative emotions as our own most intimate history which we have often hidden from our own senses and which only reveals itself to our own compassionate inner eye and our own loving energy. Only then can we open the path to true healing from within. No medical system, medical doctor, psychologist, psychotherapist or other professional can do what you yourself can do: to observe and understand yourself emotionally and feel what your innermost self needs and longs for.

As such the Fusion Practices are a primary practice to reconnect with the somatic basis of our being and reconnect with the hidden parts of ourselves. Thus the Fusion Practices are exercises in in kinesthetic awareness through which we recover our primary form of knowledge which is somatic and is buried in our very body and our gut. For this we need to go deep down into our own emotional history and learn to feel with and within our entire body.

For this we need to let our rationalizing mind deeply sink into our body and let our intuition take over so that we get in touch with the visceral level of our being. Thus the Fusion Practices are not mental or intellectual exercises to clear our debris or accumulate virtues but an existential transformational exercise to which the formal mind only becomes an impediment.

The Fusion Practices provide a unique way to overcome the dependencies you have grown accustomed to and to train yourself in self-reliance and recover your independence and thereby your self-esteem.

Healing Wounds

Often the question is asked: "Where to begin"? Such questions may suggest a hesitation to enter the practice and face oneself. A path opens at the very moment we start to walk. The inner journey is different for all of us, as our histories are unique. The formulas provide an essential guide, which tells us how to go about, which direction to take, when to walk, when to rest and the stations (practices and their sequences) we should visit.

As suggested earlier, the whole Taoist practice has its beginning in the practice of the Inner Smile. The Inner Smile as the key to refresh, create, transform, attract and blend energies presupposes a basic willingness to enter into an adventure and to face the risks in transforming old to new. It requires above all a willingness to love oneself and self-compassion. Such an inner movement towards the opening of the heart is however only possible if there is some willingness to accept and forgive oneself.

Perhaps the primary key to any process of self-transformation is the willingness to forgive oneself, as it opens the heart and sets in motion and frees the flow of Chi, both from within and from outside. That would seem a primary condition for an open space to emerge in which one can enter into dialogue with the organs and let them speak and listen to what they wish to say.

Yet forgiveness is not an act for once and for all but a primary key in a continuous process of turning inward and practicing inner observation. It is not surprising that when Jesus was asked a question on forgiveness, he pointed to its key role by saying that a man should forgive seventy times seven, meaning that it has no limit. Rather than perceiving forgiveness as a virtue which make all other virtues possible, like love and compassion, it is more useful to see it in terms of a growth generated by process towards balance as a whole between positive and negative emotions (Fusion of the Five Elements) and as the fruit of the creative cycle (Cosmic Fusion).

The refusal or inability to forgive and thereby to love oneself and others may be said to affect all the organs, affecting their chemistry and inhibiting cooperation and balance. Frequently it is rooted in a victim consciousness, which sets into motion negative emotions which tend to reinforce each other. This victim consciousness often has its roots in a presumption of betrayal as a result of which the heart closes, as others are made accountable for one's own negativity and suffering.

As a result there is a refusal to even consider looking inward, as the source of misfortune is placed outward. Thus the heart's natural tendency towards love and compassion is obstructed and the wound is cultivated to legitimize one's withdrawal from life, as a result of which both the internal as well as the inward flow from outside are being impeded. All traumas first of all settle deeply in our organs from where they affect our energy flows. They can only be dissolved with patience and gentleness towards oneself. Only when internally energy is accumulating, can it flow outward.

The strengthening of the organs have in the Taoist tradition a vital role to play in mitigating and achieving control over the negative emotions. Forgiving does not mean that the wound needs to be closed. It may remain but it is no more active in generating toxins and preventing positive emotions from growing. Also forgiving does not means that one forgets. That may be too difficult and is not necessary. Only the charge, which activates to toxins needs to be defused.

The aim of the Fusion Practices also is not to eliminate pain. Pain and joy are intrinsic in life and form a unity of opposites. Attempts to eliminate it create frustration and exasperation and may well make it grow and become more difficult to control, as negative emotions such as fear, anger, worry, sadness and impatience multiply. The more negative emotions are suppressed, the more they have a tendency to run wild.

The purpose of the Fusion Practices is to achieve control and regulate them consciously so that major imbalances can be prevented and the quality of the energies, upon being fused and blended is heightened and transformations into new states of being (the energy body and the spirit body) become possible. Ups and downs are inevitable but as you grow able to accept them and balance them and grow in equanimity, a point is coming when you are less affected by what happens around you; you are less carried away by events and you become less vulnerable.

Rather than to do away with toxins, it is wiser to allow for them and it is easier to control them. This immunity is both raised in balancing positive and negative emotions (Fusion of the Five Elements) and by strengthening the positive emotions (Cosmic Fusion). The unity of the two is of great importance. To make a small tree grow one does not only weed, but also creates optimal conditions for it to grow: that it is planted in good soil, that it receives shade and water and that it is pruned at the right time.

One practical way to effectively deal with the negative emotions is to distinguish between them, so that they can be separated and sorted so they receive the attention they require and they become manageable. We may see them like our children who each have their specific needs. We can give to each one the particular attention they deserve. To deal with them all at once is too difficult and leads easily to discouragement and a sense of powerlessness and defeat. In such a way you more easily work with them.

For each of us, the relations among and between positive and negative emotions is a unique one. So are our needs and styles to deal with them, depending on the culture we have grown up in, our different kinds of education and the ways we have responded to them and have evolved. So we will need to rely on and develop our own imaginativeness to use the formulas creatively so that they may be helpful rather than become an obstacle, as we apply them mechanically. We need to learn to feel what is good for us, and what helps us to be centered, in balance and at peace with ourselves.

Practice of Humor and the Humor of Practice

Crucial to our practice is a sense of humor and playfulness: to avoid the Fusion Practice becoming a reproduction of old patterns in a new form, as we use it as a device to track down our weaknesses in a spirit of self-condemnation. Humor is essential for balancing the energies of and in our organs. Humor is the great regulator which helps us to look with a sense of relativity, playfulness and lightness at ourselves. It is an expression of the compassionate energy of the heart which helps to look with a sense of detachment at ourselves and not to take ourselves so seriously that it becomes difficult to relax and be a witness rather than a severe judge.

With little humor, the Fusion Practice would become an accounting practice in which we record the drawbacks which prevent us from advancing. In focusing on the negative as if it were evil, we lose sight of our creative potential and prevent ourselves to gradually free ourselves from old patterns. Without humor we see no way out except by relying on some external power or force which only further undermines our own original power of self-transformation.

Learning to tend our Garden

What helps is to realize that we do not have negative emotions, per se, but that we and our spirit are in them. They are an integral part of us, and when we want to eradicate them, we destroy ourselves and the spirit contained in the organs.

For the Fusion Practices to become effective, we need to learn to dialogue with our organs. We must learn to express our gratitude to them for the miracle that we are alive thanks to their unceasing work. We need to give them a chance to relax and recuperate. Let us give them a chance to get in touch with each other. They are both our parents and our children. They can store Chi and provide us with energy when we need it. Let us protect them from our anger and other negative emotions, so that they do not have to suffer and feel we drain them. Let them breathe freely, accumulate Chi, expel the accumulated toxins to that we can recover, nourish and sustain our health and vitality.

It is a challenge to see the positive in the negative; negative emotions, when freed from their destructive and explosive charge, contain pure energy which we badly need to develop our vital force.

It helps to accept ourselves if we remember that our negative emotions often mirror forms of resistance which at some time early in life, served as a form of legitimate and understandable protection and rebellion. At that moment they might have been necessary, but at some point they lose their function.

Negative energies may be seen as a kind of garbage. If we discharge it on others and the environment, it becomes a major factor in generating toxins, bacteria, viruses and a variety of forms of disease by which negative emotions are multiplied and become more and more difficult to control. Or they can be seen as highly positive and urgently needed for recycling and composting, so that they can be used to help us grow and improve our balance, so that we do not become a burden and a threat for others and our environment, but a blessing, as our energies contribute to a climate of harmony and peace. The more light and Chi that enters our body and the more we radiate it into others and our surroundings, the less bacteria and viruses have a chance to grow.

The Fusion Practice (Fusion of the Five Elements, Formula Four) provides an effective method for composting, as the negative energies from the different organs, after having been separated out in

the collection points, are brought into the pakuas which act as transformers. They can be blended with the positive energies from the organs as well as the energies from the universe, so that they become purified and enriched; energies of a higher quality and order can be generated. These then may be condensed into a pearl as the embryo of our energy body (Fusion of the Five Elements, Formula 5).

Raising the Quality of Our Energies

The Cosmic Fusion Practices basically serve to consolidate, stabilize and enhance the process towards balance, initiated in the Fusion of the Five Elements practices. The creative cycle practice of Cosmic Fusion specifically serves to further the growth of positive energies in the organs and glands, which in turn will be able to mutually support each other to create a higher quality of energy. This energy is concentrated in the compassion energy from which a pearl is formed. Only when all the positive energies merge into the fire of love and compassion by which the sexual energy is steamed and is transformed, its energy will turn into a higher creative and spiritual energy. This higher energy will then serve to nourish the energy body.

This pearl will be more powerful in healing and cleansing the body than the pearl in the Cosmic Fusion practice and may subsequently serve to create and nourish the energy body. The energy body may in the highest practices give birth to the spirit body. The Cosmic Fusion practice also serves to intensify the process of cleansing and healing through the creation of the three Thrusting Channels and by creating the the nine Belt Channels which serve to protect the body and its energies from negative influences.

Marriage of the Light from Within and from Above

All Universal Tao practices, including the Fusion Practices, consist of two dimensions. One is the activity which focuses on the processes of transformation within the body through cleansing, opening, healing and fortifying the body and raising the quality of its energies. The other activity is to get in touch with the universe, the cosmos and nature and attract their energies and the Light in which they originate towards the body so that the body may process these energies and blend them with its own refined energies.

Fig. 9.10 *Connecting with the Universe*

The Taoist view is that the body by its very nature and structure is a microcosmos which is able to attract and receive and use the energies from the universe, the cosmos and nature to transform itself. Quantum physics confirms the view that the mind is faster than light and that consciousness is a form of energies which can move other energies when tuning into these energies and their frequencies.

The process of getting in touch with the universe and expanding love and compassion begins in the same way as the approach to inward transformation of energy: with smiling, feeling and sensing and radiating out love energy. The cleaner and finer the energy which is emitted, the higher the response from the forces and energies from above, below and around us. The relationship with the universe has been likened with that of a love or courting relationship. In all the mystical traditions the experience of the divine is also experienced as a relationship between the lover and the beloved. Frequently such relationships have been expressed by the great mystics in the most erotic and sensuous language, a reason for which they were as a rule hardly accepted and frequently persecuted.

Through its meridians our body may be seen as a grid of light channels through which it is connected with the light grid of the universe and can tap its unlimited energies.

Learning to embrace ourselves and the universe:

The Fusion Practice may serve to visualize oneself as a network of light and as a light body. Then the practice is not only one of cleansing but also one of filling the meridians with light. Mutations in consciousness start in the body visualization and turn into actualization. But the transformation lies not in the visualization. It is only a vehicle. Actualization is the real experience of the energy transformation in the body, when its chemistry changes and energy is transformed. One begins to sense the truthfulness and miracle of being alive and one starts to feel that one is embraced and pervaded by love and a sense of gratitude for the mysterious ecstatic process taking place in the body arises.

But this is not an end term. It is always only a beginning, as the love of the infinite has no limits neither in time nor space. In the process matter turns into what is immaterial and the immaterial as energy to continue its transformation waits again for a new form to contain it and change its nature and composition. Words help to create an image and when the image is there, the word loses its function. The image serves to help us generate the energy and its transformation. When the energy has come into being, the image needs to be given up so that a new space arises for a new experience. This is an unending process. How wondrous is it that our organs, our body, that sacred vessel, as it is called in the Taoist Canon, remembers its origins and longs to be fused and serve as an instrument of the fusions which unceasingly take place in heaven so that our intrinsically divine nature is realized and can be experienced. For earthlings, the learning process starts from outside. In the process of turning inward, the learning process increasingly becomes internalized. We need the structures and the forms and formulas to help us on our path. Then when we become still, it becomes spontaneous and starts to move by itself.

Then our child has been born and just wants to play without end to feel that they are welcome and loved so that they feel at home. For this quality in us to arise, we need to learn to embrace ourselves and the universe, as a mother her newborn child.

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Universal Tao Instuctor

Questions and Answers about the Cosmic Fusion Practice

Q. ***Is the cauldron the point where all the pakuas join together?***
A. Yes.

Q. ***Now that we've learned about the cauldron, where do we collect the energy at the end of meditation practice?***
A. You can collect and store energy at the cauldron or you can continue to collect and store your energy behind the navel. When you collect the energy you make a vortex, which is three-dimensional, so it can veer toward the navel or the cauldron. As you do this you may feel it going deeper and deeper.

Q. ***Do we always have to do 36 and 24 spirals in the collection?***
A. The numbers 36 and 24 are a guide. There is no speed limit for spiralling the energy when you collect it. Some days you might want to do more than that; on many days you may want to do much less. On those days, 12 and 9 may be sufficient. Eventually it will go by itself.

Q. ***How do you collect the energy when there is so much energy all around?***
A. Collecting the energy will eventually become automatic. The safety features are bringing any excess energy from the pelvis up to the navel and and excess energy in the head and heart down to the navel. When you are coming back from the feet to the navel in the belt routes you are also collecting the energy.

Q. ***Does the energy stay in the cauldron or does it spread to the organs?***
A. Both.

Q. ***Should you see the collection points in color?***
A. Some people see, some people feel, and some people can even taste the energies. If you are visual, great. Then you will see the colors. If you work with the colors, the color will tell you if an organ's energy is healthy or not. If you look within and see dark muddy colors, then you know you have to work to make them clear and bright.

This applies to the organs and the collection points. Because the organs are affected by the emotions the colors will be affected.

Q. *Does the Yin/Yang symbol move inside the pakua?*
A. It spins like a vortex.

Q. *Is there always a pearl you can work with?*
A. If you practice forming a pearl every day, there will be one there when you sit down to meditate.

Q. *Is there a minimum size for the pearl?*
A. The size of the pearl is less important than its density. As you add energy to it you might notice it glowing more brightly or feeling more energetic.

When the energy increases you might want to make more than one pearl. Then you can give it away to an organ or into your own atmosphere.

Q. *Does the belt channel go around both legs or each one separately?*
A. It circles around both legs, although if the energy wants to go around each one, that's okay too.

Q. *You talk about using the thrusting routes for practical purposes. Can you give an example?*
A. To clean the atmosphere in a room, you shoot the pearl out the crown and let it expand and fill the space. That way you declare the territory as your own—it is permeated now with your energy and consciousness. If there is any negative energy, any negative spirit, it will just leave of its own accord. You can't destroy negative energy, but you can work with it to make it leave, by overcoming it with your own energy. But you don't want to anger another spirit, that's not the Taoist way. Either they are using your energy to protect them or they want to tap into yours to get themselves to a higher level.

Q. ***Is there a breathing technique that will make you more Yin or more Yang?***

A. It's not just breathing. If you eat very Yang foods, like meat and you are trying to be Yin, it won't work. If you work with the Fusion I formula you can balance the energy more easily than with outside forms of breathing or food. Fusion I and the Microcosmic Orbit are natural ways to balance your energy.

Q. ***The meditation seems so long.***

A. Once the channels are open you don't need to spend much time. The training period seems long, but the actual practice can be quite short. When the Thrusting Channels are open you won't need to do any muscle contractions, you won't need to do it in stages, you won't need to inhale several times. You will just sit down and in a couple of minutes you will find yourself in a state where the energy will be strong enough and the channels open enough that the energy will flow through the Thrusting Channels just using the mind itself. In fact, you will be able to do it anytime, not just during meditation.

You can imagine the work it takes to connect pipes from a reservoir to each household in a city. But once the pipe is connected all you have to do is turn the faucet on.

Q. ***What can close the channels?***

A. Stress of any kind can close the channels. Tension contracts everything—muscles as well as emotions. Also, if you stop practicing for a long time the channels will close. A path that's walked on every day will be clear, but if no one travels on it the weeds start growing and soon it is covered back over. That's why we stress the importance of daily practice. Even five minutes a day, is better than one hour once a week. Fusion I and Fusion II practice can be combined together, so you can check the organs, smile down, see what you need to do, and in a few minutes you can do some maintenance work. Then when you have more time you can go and clean the organs and the Thrusting Channels. In the beginning, the Fusion practice needs the mind to form the pakua, and collection points. It's like the Microcosmic Orbit: when you first learned it, it took a lot of concentration on each point and even when it started to run by itself it wasn't dependable. But after a while you could wake up in the morning and feel your Microcosmic Orbit running.

Fusion I and II are more complex and at the beginning you have to develop a different technique to get them running. I just look in the cauldron and it's like a slide projector: I can see everything. Then you can add the collecting of the energy and the blending process.

Everyone we know who has practiced Fusion II for a year or so, can do the creation cycle in a couple of minutes. As you practice and keep adding more details, sooner or later it becomes automatic. If you do Fusion II on a daily basis you will begin to get faster and faster. You will be able to look inside and see what's going on. When the process becomes automatic you open a whole area of possibilities. It will give you more time to practice because you will be doing it so fast. It will be there when you sink into sleep. It will be there when you wake up in the morning.

When you tune into your organs, your organs will have more say over what they want and what they do. So when you work with the formula correctly, the organs will love it. They will have the space and time to be themselves. The brain can be overworked and pushed too hard. It can force any organ to work until it's destroyed. You can see this in people who take drugs to control their emotions.

But when the situation is balanced by using the Microcosmic Orbit, the organs get a chance to balance themselves. The brain has a say but the organ also has a say. Then you can achieve a balance of energy when the intellect and the organs are working together. At this stage, when the senses are drawn in, not distracted and running around, you will feel calm. Gathering and conserving energy is good in itself.

The next thing that happens is that you can begin to gain Real Knowledge. Real Knowledge is beyond intuition; it comes from within and you make better choices and decisions. This Real Knowledge is an inner guide which sometimes manifests in dreams from the unconscious. It can show you a direction in life. You know yourself that these dreams are rare. In the past they only came when you were at a crossroads and there was some danger. But through the practice with emotions, organs and mind, you develop that interior communication that allows you access to Real Knowledge, so you're not operating in a state of emergency but from a state of balance and calm. Those

directions will be easy to follow. So this is a process of purification. The energies will be used with purer intentions.

For example, if you have an excess of fear you feel threatened and isolate yourself. Any decision you make from that standpoint will not lead to happiness. This formula is very important and carries a tremendous amount of responsibility, for whenever you learn something that can change your life in a positive sense you will either do it or forget about it. You often hear people say, "I want to change my karma." This formula is something that can change your karma. So this practice, this opportunity has a responsibility. You will have to take the consequences of doing it or not doing it. Because if you do it you will change.

Q. ***How can I protect myself from negative energy?***

A. The belt routes can protect you. When you circulate the energy through the belt routes, the energy centers are strengthened, and can protect you from absorbing outside energy that you don't want. For instance, in a crowd, if there is energy you don't like, just run the belt routes to protect yourself. This will also protect your aura. If you are upset and have a lot of emotions, the aura is very unstable. The aura might expand or shrink. This protection will become automatic through diligent practice of the belt routes.

Q. ***When you send the energy out like a shower, are you always collecting positive energy? How do we know what energy we are collecting?***

A. There is always heavenly energy around you, and there is always magnetism so when you do this work you are working with earth and heaven energy. It's another responsibility when working with the energy. If you are an ordinary person you are absorbing only a certain level of energy. When you start raising your level, you are raising your level of positive energy. This can change the atmosphere around you (an inner pressure of positive energy). Energy has a magnetic quality that attracts. When you have strong positive pure energy you will be repelling negative energy and you won't be affected by negative energy. For example, if someone is angry you will have enough positive energy to handle it. If you practice this and go to higher levels and

then decide to stop, your pressure will again change and decrease. Our bodies always try to find a balance, that's our inner intelligence. So the pressure has dropped and the body tries to restore the familiar higher pressure. To do this you start absorbing anything, and the most abundant source is the garbage energy: anger, fear, depression, etc. As you build up your strength you need to maintain that higher level and that is a big responsibility.

So when you do the shower of energy you have to depend on the strength of the energy in your pearl. Fusion II jacks up the energy of the pearl you made in Fusion I by imbuing it with the positive qualities in the organs. So it's important to do Fusion I carefully.

When you absorb positive energy you can even affect the bacteria in the air. If you've been practicing the Microcosmic Orbit and Fusion I for a year you've probably noticed that colds don't last as long, and you don't get sick as often.

Q. ***Is it normal to feel pain or discomfort when doing the fusion practices?***

A. You can see that some systems are into suffering: staring at the sun, sticking oneself with needles or standing on one leg for a long time. This is so that when practitioners get to the level of great power, they can withstand the pain. This is how some people learn and they suffer a great deal.

Maybe you cannot take all the energy; some people bathe in the river every day to reduce the heat and can't sleep for weeks and months. When you practice to a certain level there are changes in the body—but you can take those changes. Sometimes as new energy pushes through channels you may feel a headache. Some people feel a stomach cramp when they blend the energy at the cauldron. But that is unusual. It's like trying to help a butterfly when it's hatching. Maybe you want to help by cutting the chrysalis with a scissors. But the butterfly won't survive if you do that. It has to struggle at the beginning in order to survive.

So you will have to grow over the pain. Other systems induce the suffering first. In Chinese, they call it qing ku—you don't have anything and you still have to suffer—but that is not the Taoist way. We prefer to grow first and then experience the grow-

ing pains. You may feel imbalanced from time to time—constipation is a real problem. If you have a good bowel movement at least once a day, you will not suffer so much.

Now that you are more sensitive to energy, you will recognize negative energy right away and you have the tools to neutralize and purify the energy.

Some people, after they study, find that they are reacting differently to their love partners. For some of them, this difference leads to a break-up. When they look back on it, they often realize that the break-up was inevitable and that they were dissatisfied before. For others, especially couples who study together, their relationship becomes more solid and more respectful. In any case, it means that you begin to understand yourself better.

Sometimes you begin to see problems more clearly and see the energy that causes the problems. When you can enhance the energy inside, the problem goes away. There are those who get angry but don't realize they are angry and aren't aware of the effect of the anger on the liver. But those who practice Fusion I can become aware of the liver and very quickly the anger will be gone.

The Taoist system can change the course of your life, change your astrology, change your fortune and your fate. We know that because of the experiences of Taoists over many generations.

The energy inside your organs and brain makes your life what it is. So when you know how to control your energy, your organs and senses, that is the beginning of controlling your future. Those who are controlled by substances like tobacco, alcohol and other drugs are not in control of their lives.

In Taoism you don't run away from problems as long as you are in this world. Actually there is practically nowhere on the planet where you can go without being bothered.

When we started to teach Westerners, we found new ways to teach people how to balance their energy through diet as well as through the Taoist exercises. Those who eat only raw foods will be too Yin and those who eat mostly meat and dairy will be too Yang. But the only way to restore your True Knowledge is when you turn to your internal organs and senses for information. Then you will know how to conduct your life. But until you do that it's hard to know what's good or bad for you.

The golden mean, the middle, moderation are all ways of saying that when you know how nature works you will know the Tao. By knowing the Tao you start to know about God and the universe. Anything that's extreme, you have to back away from. The only thing that lasts long is balanced, middle and center.

Q. ***Is there a problem if I shake a lot during meditation?***

A. Too much shaking can scatter the energy. Moving and stillness have to be balanced. If you remain still for too long the energy might settle. But if you shake and scream and are never still you risk eventually shaking out all your life force.

If you start burning a fire, it gets hotter and hotter. When the water comes to a boiling point you turn it down and cook it very slowly. That way you can get the essence out. If you don't turn down the light all the water will boil away and the pot will be burnt or broken.

When you are into the meditation and very still, movement starts and many things are activated. If the movement becomes very strong it won't last long and you might want to stop it. You have to know the timing. If you start to shake, you can gain power by stopping the shaking and utilizing that energy inside. If you let the shaking continue, you might lose all the energy you built up.

In some forms of therapy people are encouraged to shake and jump and scream to get rid of their anger or depression or anxiety. When the session is over it seems that everything has been worked out but when they get home they are throroughly exhausted. The emotions were shaken out along with the life force. How much better to recycle the energy.

Tai Chi balances the Yin and Yang through movement and stillness. This builds up energy and then you can circulate the energy in the Microcosmic Orbit. The whole secret in the Universal Tao is having the channel for the energy to flow.

Q. ***Why do you create an Energy Body outside yourself?***

A. When you set up the Energy Body and the spirit body they start to draw out the essence of the physical body. Then it starts to work in space.

It's the same reason that every country wants to set up laboratories in space. You can make a lot of things better in space because there's no gravity, no dust and no germs.

The Energy Body will draw the essence up; you might even feel like it's going to pull your whole body up. And then the Energy Body draws the energy from space and the universe and mixes them in. When you bring the energy back into the body the organs will absorb all this energy and start to transform. But if you sit down without a purpose you won't get this effect.

Everytime you add more of your body's energy to the Energy Body, the Energy Body will go higher. Sometimes I feel like all my essence leaves my physical body. When you practice every day it starts to take the essence of this body and transform and mix it with the universal energy and your progress will be remarkable. There will be no resistance. When you're finished meditating, you just shrink the Energy Body down and each time you shrink it down the pearl becomes more refined.

At one time, the Taoist Masters were afraid of losing the pearl in space and did it all inside the body. This was reflected in the art in China where they worked incredible detail on miniature objects. But later the Tao masters discovered that if they know how to send the energy out the head they can expand the Energy Body and then shrink it down. That way they achieved more perfection—it's the same way they make a computer chip.

If you look inside a chip there's a whole city inside it. They draw every detail on paper the size of a football field and then with a special camera they shrink it down and down.

Set it up, do all the detail you want, then shrink it down and pull it back in.

> I had to figure a lot of this out myself. When I heard "transfer your consciousness to the next life" I decided I had to learn how to do this in this lifetime. I kept asking, but everyone had a different answer. They just said it's very simple. I told one master I'd give him anything for the secret; I'd go anywhere to learn. Either he didn't have it or else he wouldn't give it to me. After a while I discovered that I'd have to figure out myself how to transfer whatever I wanted to the Energy Body. I did this because I understood that my Energy Body will live forever.

Focusing on intellectual understanding alone is limiting and stifling. A real practice teaches one how to feel within and derive authentic knowledge based on personal experience. In the Universal Tao, we emphasize the practice of understanding nature, getting in touch with the natural forces, and getting in touch with oneself. Then the principles of philosophy will reveal themselves, and one can have real hope based on what is, not on empty promises that can never be proven.

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Mantak Chia

Illustrated by Udon Jandee

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Cosmic Chi Kung

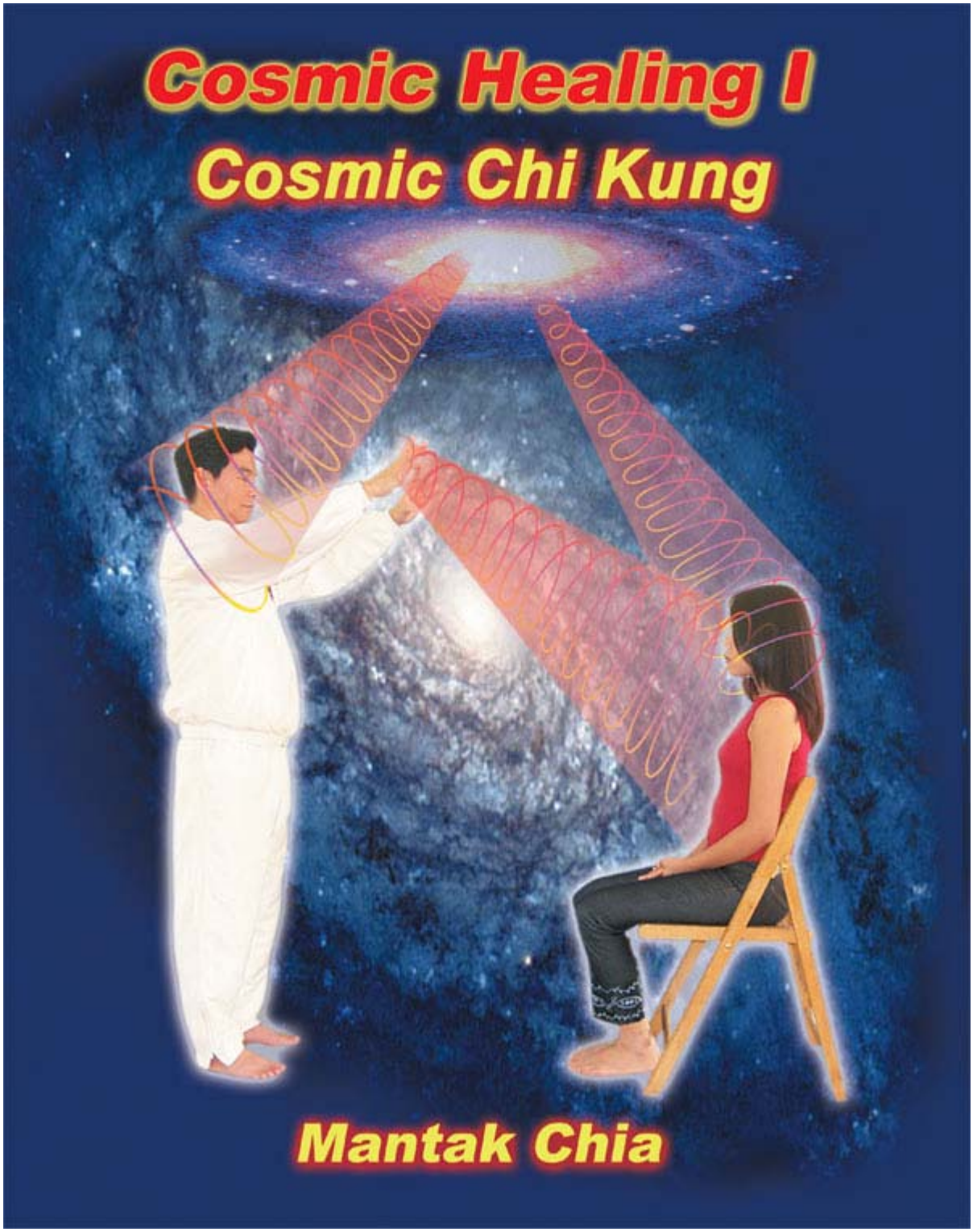

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Cosmic Chi Kung

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About the Author

Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and “still the mind.” While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop

computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using Dark Room technology, creating a complete environment for the higher level Taoist practices.

He has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy
co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper/Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper/Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001

Also many of the books above are available in the following foreign languages: ***Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Russian, Serbo-Croatian, Slovenian, Spanish,*** & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

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Thanks to Juan Li for the use of his beautiful and visionary paintings, illustrating Taoist esoteric practices.

We offer our eternal gratitude to our parents and teachers for their many gifts to us. Remembering them brings joy and satisfaction to our continued efforts in presenting the Universal Tao System. For their gifts, we offer our eternal gratitude and love. As always, their contribution has been crucial in presenting the concepts and techniques of the Universal Tao.

We wish to thank the thousands of unknown men and women of the Chinese healing arts who developed many of the methods and ideas presented in this book. We offer our graditute to Master Lao Kang Wen for sharing his healing techniques.

We wish to thank Colin Campbell for his editorial work and writing contributions on the first printing of this book, as well as his ideas for the cover. We appreciate his research and great labor. We wish to thank Matt Gluck for his editorial contributions on the revised edition of this book, as well as thanking our instructors, Dennis Huntington and Annette Derksen, for their insightful contributions to the revised version. We thank Dirk Oellibrandt for his technical editing and clear writing throughout the book.

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We also wish to express thanks to Cosmic Healing Certification Retreat Organizers around the world who have worked with us for many years and helped us prepare this manuscript throughout the Retreats: Beate Nimsky, Vienna, Austria; Serguei Orechkine, Moscow, Russia; Christopher Larthe, London, England; Masahiro Ouchi, Rye, New York; Dr. Angela C. Shen, San Francisco, California; Dirk Oellibrandt, Hamme, Belgium; Brita Dahlerg, Frankfurt, Germany and Lizbeth Cavegn, Zurich, Switzerland.

We wish to further express our gratitude to all the instructors and students who have offered their time and advice to enhance this system, especially Felix Senn, Barry Spendlove, Chong-Mi Mueller, Clemens Kasa, Andrew Jan, Marga Vianu, Harald Roeder, Salvador March, Dr. Hans Leonhardy, Peter Kontaxakis, Thomas Hicklin, Gianni Dell'Orto, Walter and Jutta Kellenberger.

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Chinese Medicine and Chi Kung emphasizes balancing and strengthening the body so that it can heal itself. The meditations, internal exercises and martial arts of the Universal Tao are basic approaches to this end. Follow the instructions for each exercise carefully and do not neglect the foundations, i.e, the Microcosmic Orbit and any other supplemental exercises. Also pay special attention to the warnings and suggestions. People who have high blood pressure, heart disease or a generally weak condition should proceed cautiously, having prior consent from a qualified medical practitioner. People with venereal disease should not attempt any practices involving sexual energy until they are free of the condition.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

Chapter I
Cosmic Healing

Cosmic Healing Chi Kung in the Universal Tao System

Cosmic Healing Chi Kung is an important branch of the Universal Tao, an entire system of Taoist practices for cultivating the body, the Chi and the spirit. Your level of skill in Cosmic Healing Chi Kung will be based upon your mastery of the Universal Tao System as a whole. One of the most important parts of the Taoist practices is working with the energy moving within the body.

Foundation of the Universal Tao System is the Microcosmic Orbit Meditation

This is the major practice to connect with the earth, cosmic and universal forces. This is the way to make a connection with the North Star and the Big Dipper's violet/red light which is one of the very powerful universal healing lights. Through this practice you learn to feel Chi and to use your mind/eye/heart power to guide the Chi flow through the primary energy routes in your body. This practice is later extended to include the arm and leg routes too; it is then called the Macrocosmic Orbit.

Many people, including Chi Kung Masters, come to me and say that they have been practicing Chi Kung for years and nothing is happening. They don't feel any energy and they think that they must be performing their Chi Kung incorrectly. I tell them that they also need to do meditation. Hand movements are nothing by themselves. There are hundreds of different Chi Kung forms in China. You could spend seventy lifetimes just learning the hand movements. The practice of the Microcosmic Orbit meditation will help you to feel the Chi more easily inside, outside or around the body and in the extremities of the hands and feet.

When I was a child I liked to practice Chi Kung so much I had to save my lunch money to learn. After many years of practice of many Chi Kung forms, I started to forget the first form, so I learned it again. One day when I tried to practice and review all the forms that I had learned, I couldn't remember many of them. I sat down and thought, "I only have two hands, two legs and one head. Why are there so many forms? And why are there are so many religions and beliefs." I said to myself that there must be one main thing that they have in common. I started to search and I found out that the most important thing is feeling the Chi within us. Being able to increase, transform, take in and stay in touch with the universal, the cosmic, nature and the earth force. Letting

them all combine within us is what is important. Likewise in religion there is God (a Force in Taoism we call Wu Chi, the nothingness, the supreme power controlling the universe); with a good heart and virtue energy we can connect with this force.

The complete practice of the Microcosmic Orbit Meditation is fully described in the book "Awaken Healing Light of the Tao" by Mantak Chia.

Cosmic Inner Smile and the Six Healing Sounds

These are very important practices to make the connection among the organs, the colors and the good virtue energy; each organ color will enhance your connection to the cosmic and the Universal Healing power.

Fig. 1.1 *Red for the Heart*
White for the Lungs
Yellow for the Spleen
Blue for the Kidneys
Green for the Liver.

Each organ has its own vital color and when abundant it will radiate out as an aura for healing and protection. These organ colors and their associated universal connections have great healing power. The power of the 'Six Healing Sounds' will help enhance the connection to the cosmic source. Each sound will foster different healing energy. The practices also help balance, refine and transform the negative energy back to positive energy.

Iron Shirt Chi Kung and Bone Breathing

Iron Shirt Chi Kung and Bone Breathing are a system of standing meditations. These exercises help you to become grounded and to root your connection into the earth force, in order to build a good structure and absorb greater force. In turn, this will help draw in the heavenly force, which will combine with the very potent healing power of the earth's yellow light. The practice also strengthens the body so you can hold a higher energetic charge. These abilities are essential prerequisites for handling greater amounts of energy.

Iron Shirt Chi Kung also includes the art of 'Changing the Sinews and Washing the Marrow'. Through these aspects of Iron Shirt, you learn to absorb, store and discharge large amounts of energy through the tendons and bones. *These practices are outlined in detail in the books "Iron Shirt Chi Kung" by Mantak Chia and "Bone Marrow Nei Kung" by Mantak Chia.*

To attain skill in Cosmic Chi Kung, it will help if you practice Iron Shirt, Bone Marrow and meditation as a minimum requirement. Beyond the basic level, the Universal Tao System includes many other intermediate and advanced level Chi Kung practices and meditations. The further one advances, the greater one's mastery of Chi.

Your increasing level of skill in the Universal Tao system will reflect immediately in your Cosmic Healing Chi Kung practice. Furthermore, you will discover that you can incorporate many of your Universal Tao practices directly into your practice of Cosmic Chi Kung. We will give you a simple combined practice of the Cosmic Healing Chi Kung, the Inner Smile, Microcosmic Orbit, Iron Shirt and the Sexual practices.

Stages of Mastering Chi

1. In the Universal Tao system, our *first* goal is to learn to conserve our Chi; when a battery is totally drained it is harder to charge; money makes money, Chi makes Chi. Conservation of Chi will help gain more Chi. To have more Chi we first need to maintain control of the gates through which energy normally leaks out and unwittingly drains our life force.

We leak energy: - through our reproductive system
- through negative emotions
- through constantly turning our senses outward

Without knowing how to conserve the Chi that we already have, what is the point of acquiring more?

2. We learn to balance our Chi; that is, we seek to keep a smooth and balanced flow of energy moving throughout the whole body. If our energy is imbalanced, we may have too much energy in some places and not enough in others; we may also be too yang or too yin. We may have excess or deficient heat, cold, damp or dryness. This imbalanced energy tends to make us go to extremes.

3. We learn to transform our Chi into more beneficial energies. For example, through the Taoist Sexual Chi Kung practices taught in the Universal Tao (the course known as Healing Love through the Tao), we can transform sexual energy back into basic life force Chi. Through other practices (such as the Inner Smile, the Six Healing Sounds, and Fusion of the Five Elements) we learn to transform negative emotional Chi into positive virtuous Chi. Thus Chi is not only the foundation of our health; it is also the basis of spiritual development in the Tao.

4. Once we have accomplished the three previous phases of mastering Chi, we then learn to increase it. Chi pervades all of heaven, earth and nature. In Cosmic Healing

Chi Kung we learn time tested ways to tap into these unlimited and transpersonal reservoirs of Chi and greatly expand the amount of energy available to us. It is very important to master first the stages of conservation, balance and transformation before we emphasize increasing our Chi. Otherwise we may waste the energy we bring in, or we may inadvertently amplify the imbalanced or negative energies that we have not yet learned to bring under control.

5. Finally, we learn to extend our mind to tap into the vast Chi of nature, cosmic and the universe, to heal our body, mind and spirit and to heal other people. Cosmic Healing Chi Kung practice sensitizes your hands to the feeling and movement of Chi; it uses the mind-eye power to absorb cosmic Chi into the palm and crown and to send it out through the hands and beyond, so that you can help restore balance in others without touching them or draining yourself.

This may sound fantastic at first, yet recent researchers in Chinese Chi Kung hospitals have not only measured the energies emitted by Chi Kung masters; they have also discovered that different varieties and frequencies of healing Chi can be emitted. This research has been corroborated by experiments in the United States at such places as the Menninger Institute.

Four Sections of Cosmic Healing

The next step is to learn the four sections of the Cosmic Healing Chi Kung, the 'Empty Force' sequence. Each of the four sections of Cosmic Healing Chi Kung develops a different type of energy mastery. Each section begins and ends in the same way, yet has different movements in the middle.

Connecting to Heaven and Earth

The first section of Cosmic Healing Chi Kung emphasizes connecting to the external Chi emanating from heaven and earth. This ability is very beneficial for self-healing and is essential for healing others. If you do not connect to some source of external energy when healing others, you will draw upon your own personal reservoirs. Our personal Chi is limited by nature, and can easily become depleted if we give it away too freely.

Over the past decade external Chi healing has become very popular in China. There are now hundreds of Chi Kung hospitals and clinics throughout the country. Yet many of the Chi Kung therapists can only administer two or three treatments a day; they spend the rest of their day practicing Chi Kung to replenish their own Chi. Those who practice the more traditional Chi Kung know how to connect to the Chi of heaven, earth and nature.

In this first section, you will learn to sense the energies outside your body. You will then learn to draw and absorb these energies into your body and process them in order to use them for self-healing and healing others.

Opening the Bridge and Regulator Channels and Extending your Chi Outwards

The second section opens and strengthens four of the Eight Extraordinary Channels: the Yin and Yang Bridge and Regulator Channels. This section also teaches the student to extend and take in the cosmic Chi and emit Chi out of the body for healing others. This ability is the heart of Cosmic Healing Chi Kung practice.

Opening and Energizing the Governor and Functional Channels

The third section enhances the energy in the points along the two channels used in the Microcosmic Orbit. Opening the Microcosmic Orbit strengthens and balances one's own energy, and prepares one to heal others. Practicing this section will be of great help with the Microcosmic Orbit Meditation.

Activating One Finger Art and the Chi Belt

The fourth section of Cosmic Healing Chi Kung activates the hands and you will practice emitting Chi from each of your fingers and opening the "Chi Belt." This channel is also known as the Belt Route or Girdle Vessel.

Chapter II
Preparing for Cosmic Chi Kung

Preparatory Practices

In the Universal Tao, we teach Cosmic Healing Chi Kung within an entire system of exercise and meditation. As a part of this system, Cosmic Healing Chi Kung comprises the art of healing oneself and others. It focuses on energy work for projecting Chi to effect these healings. One can easily learn the simple movements of Cosmic Healing Chi Kung without doing any other Universal Tao practices, but if one truly wishes to master the art of Cosmic Healing Chi Kung, it is important to have a firm foundation in the basic Universal Tao practices. Therefore in this chapter we will introduce you to the basic Universal Tao practices that are used in conjunction with Cosmic Chi Kung.

The preparatory practice consists of a few parts; work through each part at your own pace and eventually join them together as a whole.

Always start with "warming the stove" at the abdomen and direct the fire down to the sexual center to transform the sexual energy. Next practice the Cosmic Inner Smile. The Cosmic Inner Smile is a powerful relaxation and self-healing technique that uses the energy of love, happiness, kindness and gentleness as a language to communicate with the internal organs of the body. Each organ corresponds to a specific element and color. For example, the kidneys will consist of the element of water and the color blue. The heart will consist of the element of fire and the color red. This makes it very easy to guide the healing power into each organ by using the appropriate color. The practice also aids the transformation of negative emotions into positive virtuous energy. This transformation is a very powerful Chi Kung practice. A genuine smile transforms negative energy into loving energy that has the power to relax, balance and heal. By learning to smile inwardly to the organs and glands, your whole body will feel loved and appreciated and enjoy more Chi. After the Inner Smile, practice Bone Breathing, Marrow Washing, Cosmic Healing and the Microcosmic Orbit.

Warm Up the Stove

1. Sit on the edge of a chair with your hands clasped together and your eyes closed.
2. Start by doing the "bellows breathing", moving your abdomen in and out quickly. Emphasize the exhalation by breathing out forcefully 18 to 36 times. Rest, cover your navel and feel nice and warm.
3. Next, do the "inner laughing" exercise; you feel the abdomen vibrate inside you. Practice

this for a few minutes, allowing the movement of your inner laughter to grow stronger. Then rest and use the mind and eye power to gather the Chi (now felt as a warmth behind the navel) into the Tan Tien. Picture a stove with burning fire behind your navel. Feel nice and warm.

Transform the Sexual Energy

Once you feel the Tan Tien is warm enough, smile down and bring the warm Chi down to the sexual organs; women bring the Chi down to the uterus, men bring the Chi down to the testicles. It may feel like the 'sun shining on the water'. The rays of the sun purify the water until it becomes rising steam. Keep smiling down to the sexual organs and feel the warm or fiery feeling from the navel area continue to flow down to the sexual organs; this transforms the sexual energy into Chi, and this Chi rises up the spine into the brain helping to activate the 'crown' and 'mideyebrow' energy centers.

Focus your awareness in the sacrum. At the very tip of the sacrum there is a hole in the coccyx. Breathe into this hole until you feel some activity there. This may be felt as tingling, numbness or pulsing. If you can really activate this point it will generate 'suction'. Be aware of the sacrum opening. Feel the suction force pulling through the hole in the tailbone (sacral hiatus); breathe into it until you feel it becomes activated. When the sacrum is activated you will feel the suction easily, as well as breathing in the cranium and mideyebrow. Keep on gently smiling and softly breathing into the Tan Tien and feel the suction in the abdomen. Focus 95 % of your awareness in the Tan Tien and 5 % in the sacrum, the crown and the mideyebrow. Be aware of the Tan Tien breathing and observe internally the pulsing and breathing in the sacrum, the mideyebrow and the crown. Do this 36 times.

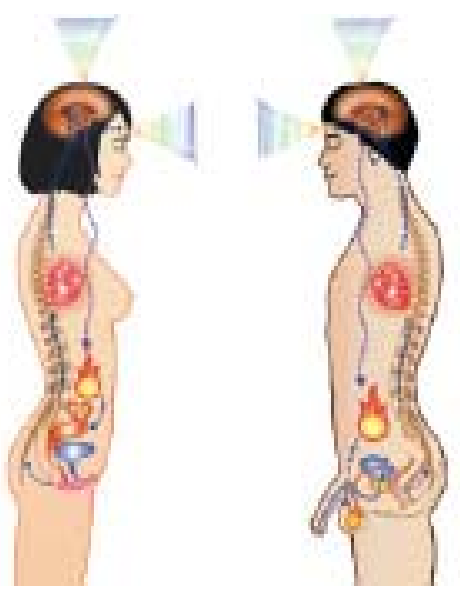

Fig. 2.1 *Smile down to the Lower Tan Tien.*

Filling the Joints with Chi

The bones have the ability to process Cosmic Chi (Chi above and around us) to be used by the body. The joints are also able to store Chi and they also serve as the cushion between the bones.

Be aware of your index fingers and thumbs; lightly raise the index fingers, feel a slight tension and open the thumbs to the sides and feel it magnify. Breathe into the finger tips, until you feel the sensation of Chi entering the fingers. The fingers will feel stiff as they stretch, to make way for the Chi entering the joints. Continue to breath in the Chi - the stiffness will spread to the other fingers, wrists, elbows and shoulder joints making the whole arm tense and stiff. The fingers and the arms become one piece. Eventually the Chi will fill every joint of the body making it into a complete unit.

Be aware of the big toes; breathe into the toes and feel the toes grow longer. When the Chi fills the joints the big toes become tense and stiff. Gradually it will fill the other toes rising to the ankles, knees, hips, sacrum and spine; the feeling may be one of tension and stiffness, numbness or like an electrical charge. The legs and the spine become one piece. You will certainly feel good.

Bone Breathing and Marrow Washing

Bone Breathing is one of the main practices of Cosmic Healing Chi Kung. This is a method of drawing external Chi through the skin into the bones to help replenish the bone marrow, thereby reactivating the production of white blood cells. Sending Chi into the bones will enhance functioning of the immune system. This process also helps to clean out fat in the bone marrow ("Washing the Marrow"), one of the main causes of osteoporosis (brittleness of the bones). Tension in the muscles close to the bones is decreased so Chi and blood can flow into the bones easily, enabling them to become stronger.

The Bone Breathing process uses the mind and the eyes to absorb Chi into the bones. The better your Bone Breathing is the better your Cosmic Healing Chi Kung practice will be. Mind and eyes are also used immediately after the exercise to gather the energy at the navel. Once you have it, when you move your hand, the energy will follow easily. You will be able to absorb external Chi effortlessly, so you will not need to use your own energy in your healing work.

Bone Breathing

There are several variations in the Bone Breathing and Marrow Washing process. Here we will introduce you to the first type of Bone Breathing, inhaling and exhaling Chi

through the skin and packing it into the bones. In this method, you imagine that your bones are like hollow tubes, and that you breathe and suck the Chi into the bones.

Bone Breathing is practiced in a three-stage process. **Let your breathing follow a normal pace. Do not strain or hold your breath too long**.

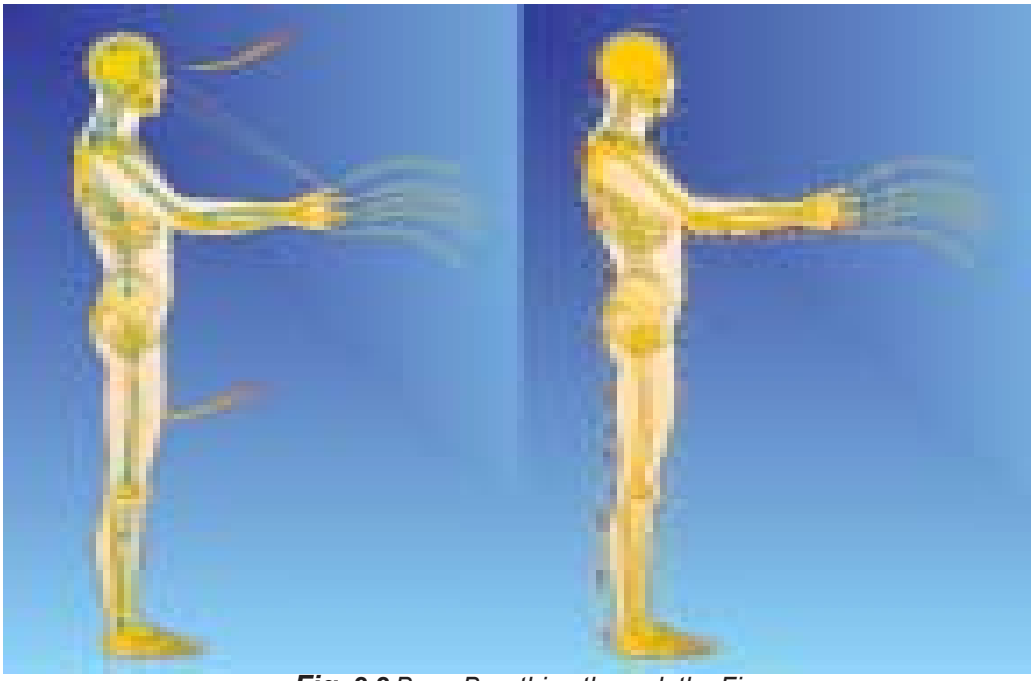

Fig. 2.2 *Bone Breathing through the Fingers*

1. You can do this practice in the sitting position or in the Embracing the Tree posture (or any other Iron Shirt Chi Kung posture). You will use your mind and eye power to breathe in a short breath and at the same time feel suction. Suck the Chi of the atmosphere into your hands, eventually expand to the universe and breathe in a few more times. Use a combination of 'mind/eyes/heart' power (Yi), to suck the Chi from the atmosphere into your hands, while taking small sips of breath. Once you can clearly feel the increase of Chi 'pressure' in your hands, you extend the feeling throughout your arms. The whole skin surface of the arms breathes in the Chi, feeling the skin holding this pressure.
2. Inhale one more deep breath and lightly contract the arm muscles to squeeze the Chi into the bones. Hold for a while to condense the Chi into the marrow of your bones. Exhale and at the same time feel a distinct heaviness in the bones, meaning that the Chi has been condensed and packed into the bones successfully. Eventually you will use more mental power (mind/eyes/heart power) and less muscle, using soft breathing, to draw the force into the bones. Do 6 to 9 times; rest and feel the Chi that has been condensed into the bones.

3. Proceed in the same way, breathing in progressively through the bones of the forearms, upper arms, scapulae, collarbone, sternum and ribs. You may feel a different sensation as you breathe in each area; in some areas the feeling is cool, in others warm or tingling, depending on the bone structure and the quality of the marrow.
4. Inhale and exhale in the same way through the toes, feet and legs; then, in a step-by-step progression, inhale up through the calf bones, thighbones, pelvis, coccyx and sacrum, and up the spinal column to the C-7 vertebrae.
5. Finally breathe in through the arms and legs simultaneously. Combine their energy as it flows up past C-7 and up through the neck and skull. Breathe in this way for at least nine breaths. Conclude by collecting energy at the navel.

Marrow Washing

You can wash your bone marrow with earth force, heavenly force or with cosmic force. This energy helps to cleanse and rejuvenate the bone marrow.

Heavenly Force Marrow Washing with Violet Light

1. Men place the left palm on the top of the head, and cover it with the right palm. Be aware of your 'Personal Star' (star that appears in your mind's eye and is located above your crown), above. Slightly press the palms and spiral in the clockwise direction, spiralling from the front to the right ear, to the back and the left ear 9 times; rest and feel the increased Chi pressure in the crown. Do 3 sets.
2. Women place the right palm on the top of the head and cover it with the left palm. Be aware of your Personal Star above you. Press the palms lightly and spiral in a counterclockwise direction, spiralling from the front to the left ear, to the back and the right ear 9 times; rest and feel the increased Chi pressure in crown. Do 3 sets.
3. Face your palms towards Heaven and feel that you are scooping a galactic Chi ball from above. This Chi ball contains the North Star (Violet) and the Big Dipper (Red). See the dipper fill with violet/red energy. Imagine you reach out your arms to hold the dipper handle and pour the violet/red liquid over your crown. It will feel like there is a numbness descending. Your palms face down to your crown and pour the whole galaxy onto your crown. You may perceive this energy as violet amethyst and red light frequencies. Smile.

4. Guide this sensation down into your skull, deep into your brain, cervical vertebrae, sternum, thoracic vertebrae, lumbar vertebrae and down through your legs. Feel it penetrating and enlivening your bones, deep into the bone marrow, washing, cleansing, energizing. This 'liquid-like' Chi spills all the way down to your feet. Feel it connecting with the earth through the soles of your feet; be aware of the bubbling springs in the feet (the K1 points of the kidney meridian) breathing and pulsating.
5. Touch your navel with the fingers of both hands. Focus on the door of life, and let the fire activate in the Tan Tien and kidneys. Chi will rise up to the brain.

6. Move your hands down touching your femur bones; feel your hands penetrate into the bone and into the bone marrow. Feel like an electric shock or a tingling moving all the way down through the bones of the leg and down to the soles of your feet.
7. Slowly move your fingers down touching the bone and into bone marrow and extend yourself down past the earth to touch the galaxy on the other side. Raise your sacrum and picture yellow light coming up from the earth and the other side of the galaxy; focus on the Lower Tan Tien and feel it fill with Chi. Do this three times. Go back down to the squatting position.

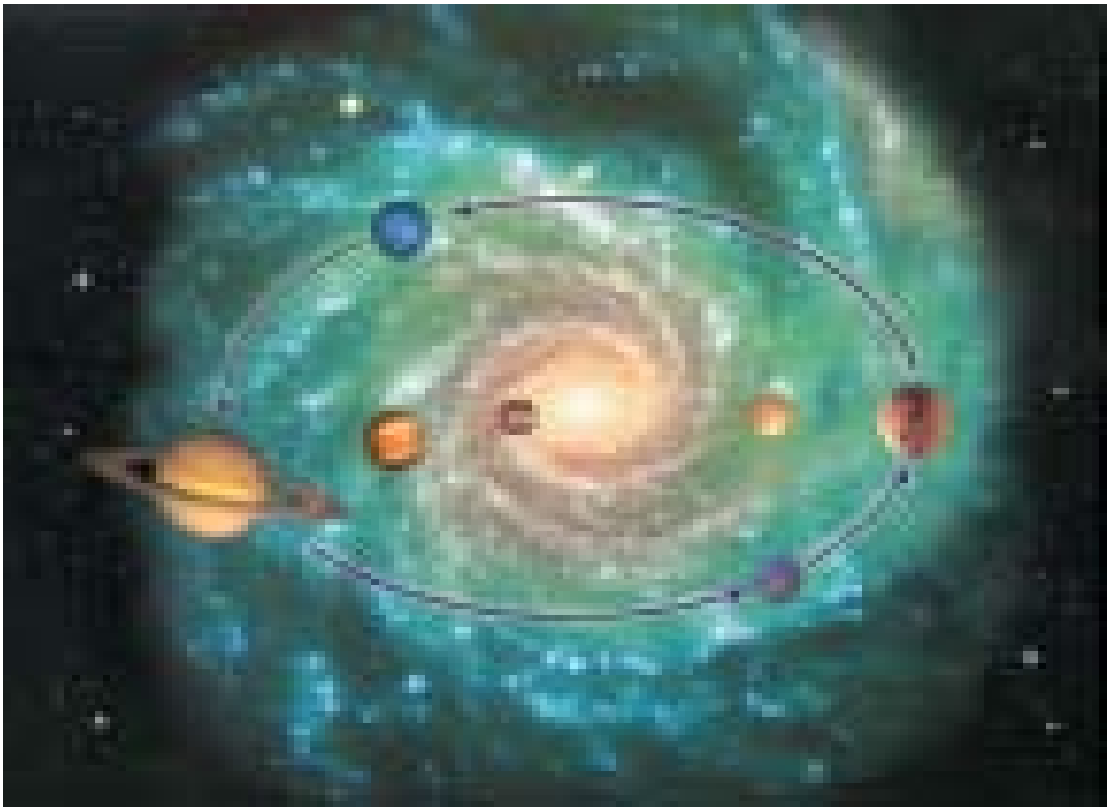

Fig. 2.4 *Galaxies Spiral Star and the Direction of Spiral*

8. Place the palms face down to the earth and be aware of the galaxy and the yellow light; make three to six circles to gather the Chi below. Gather the yellow Chi; touch your heels and feel the yellow Chi flowing up the leg bones. Feel the bubbling of your bones like an electric current running up through the feet, tibia and fibula, femur, pelvis, and spine. While touching your bone and bone marrow with your fingers, slide your hands up along the back of your legs; slowly come all the way up to touch the coccyx and the sacrum. Concentrate on your sexual center so the energy will flow and spread out to the sexual organs. Go back to the navel and gather the Chi into your Tan Tien.

Fig. 2.5 *Hands circle to gather Earth Chi.*

Microcosmic Orbit

The Microcosmic Orbit Meditation awakens, circulates and directs Chi through the 'Governing Channel', which ascends from the base of the spine up to the head and the 'Functional' or 'Conception Channel', which runs from the tip of the tongue down the middle of the torso to the perineum. Dedicated practice of this ancient esoteric method eliminates stress and nervous tension, energizes the internal organs, restores health to damaged tissue and builds a strong sense of personal well being.

The Microcosmic Orbit is the foundation of Cosmic Healing Chi Kung practice. Each new practice is dependent upon the high quality of your meditations and your ability to perfect the Microcosmic Orbit. In order to master Cosmic Chi Kung, one must practice meditation daily. The meditations in the Microcosmic Orbit also strengthen the 'Original Chi' and teach you the basics of circulating Chi. They allow the palms, the soles of the feet, the mideyebrow point and the crown to open. These specific locations are the major points where energy can be absorbed, condensed and transformed into fresh new life force.

- **1.** Focus on the Lower Tan Tien (the area where the Original Chi is stored, between the navel, kidneys and sexual organs). Feel the pulsing in this area, observe whether this area feels tense or relaxed, cool or warm, expansive or contracting. Notice any sensations of Chi: tingling, heat, expansiveness, pulsing, electric or magnetic sensations. Allow these to grow and expand. Then let this energy flow out to the Navel Center.

- **2.** Use your intention (mind-eye-heart power) to spiral in the navel point guiding and moving the Chi. Let the energy flow down to the sexual center (Ovarian or Sperm Palace).
- **3.** Move the energy from the sexual center to the perineum and down to the soles of the feet.
- **4.** Draw the energy up from the soles to the perineum and to the sacrum.
- **5.** Draw the energy up from the sacrum to the Door of Life (the point in the spine opposite the navel).
- **6.** Draw the energy up to the mid-spine point (the T-11 vertebrae).
- **7.** Draw the energy up to the base of the skull (Jade Pillow).
- **8.** Draw the energy up to the crown.
- **9.** Move the energy down from the crown to the mideyebrow point.
- **10.** Touch the tip of your tongue to your upper palate, press and release a few times; then lightly touch the palate, sensing the electric or tingling feeling in the tip of the tongue. Move the energy down from the mideyebrow to where the tip of your tongue and palate meet.
- **11.** Move the energy down from the palate through your tongue to the throat center.
- **12.** Move the energy down from the throat to the heart center.
- **13.** Bring the energy down from the heart to the solar plexus and feel a small sun shining out.
- **14.** Bring the energy back down to the navel.
- **15.** Continue to circulate your energy through this entire sequence of points, at least nine times. Once the pathways are open, you can let your energy flow continuously like a river of energy without needing to stop at each point.
- **16.** Conclude when you wish by collecting energy at the navel.

Men: Cover your navel with both palms, left hand over right. Collect and mentally spiral the energy outward from the navel 36 times clockwise, and then inward 24 times counterclockwise.

Women: Cover your navel with both palms, right hand over left. Collect and mentally spiral the energy outward from the navel 36 times counterclockwise, and then inward 24 times clockwise. *For details of this practice see the book, "Awaken Healing Light", by Mantak Chia.*

Chapter III
Cosmic Chi Kung

Opening the Three Tan Tiens to the Six Directions

Introduction

Opening the Three Tan Tiens is a Chi Kung meditation that strengthens our connection to the universe, opening us up to the primordial force of the Cosmos and the energy within Nature. We are dynamically connected to the infinite. "As above, so below" is an echo of wisdom heard from sages and mystics throughout the ages. When we can connect to and absorb the energy that surrounds us, we are able to tap into the many splendors of the universe.

We exist because of the unique combination of the forces that are around and within us. The two main forces are electricity and magnetism. 'Bio-electro magnetism' is the western term for life force, and what the Tao refers to as Chi. For the last 5000 years, the Taoists have utilized this bio-electro-magnetic energy to enhance their way of life and establish a relationship with the universe. Bio signifies life, electro refers to the universal energies (yang) of the stars and planets and the magnetic force refers to the earth force (yin) or gravitational force present on all planets and stars. As we align ourselves with these forces, we become a conduit through which we can absorb and digest these energies through the body, mind and spirit establishing a direct connection with the universe. The Taoists recognized this connection and created the Chi Kung form of 'Opening the Three Tan Tiens to the Six Directions' to enhance our relationship to and our understanding of this connection.

Humans normally access bio-electro-magnetic energy through food and air. Plants take the universal energies of the sun and the magnetic energies of the earth and digest and transform them, thereby making these energies available to all living beings. Taoists believe that the food sources with the purest form of energy are the green leafy vegetables. These have taken sunlight directly into their cells. Rather than waiting until the energy in the universe is processed through plants, the Taoist goes directly to the source of this primordial energy. Through Chi Kung and meditation, the Taoists direct the energy of the universe precisely. Opening the Three Tan Tiens is a meditational Chi Kung exercise that focuses on how to directly tap into the source of energy all around us.

The Tao views human beings as lamps filled with fuel. Many people burn this fuel at very high intensity, without ever taking the time to replenish the oil in the lamp. Alcohol,

drugs, tobacco and promiscuity all quicken the depletion of this fuel. The Taoist exercises strive to continually refuel the energy within. The Taoist recognizes that we are limited in our nature as human beings, unless we connect the sources of energy within the universe, thereby becoming infinite. So, within the limitations of our human nature, we constantly fill ourselves with the unlimited abundance of energy around us.

Through their internal quest, the Taoists discovered a doorway to the universe. The more we open our internal energy, the more we are capable of connecting to the forces of energy around us.

Human beings have amazing potential and capabilities. We are unique creatures in the way we use our minds and hands. Look at the world around you, the skyscrapers, the architecture, computers, technology and the myriad creations of man. All have come about through the combination of the mind with the hands. In the Tao practice, we use the mind and the hands, in both Chi Kung and meditation, to connect to the forces of the universe. We use the mind to project a pattern of energy into the universe, to connect to the force, and to bring this energy back into the body.

The mind can travel millions of light years in a few moments. Taoists discovered the unlimited potential of the human mind. If you picture something in your mind; an ocean, a sunset or a mountain, you automatically connect with that image. The mind can take you anywhere you imagine. With the proper training you can connect to the energy of nature and the universe and project your Chi to combine with it, drawing these forces into the body. The hands are called the touching force, and like antennae they can transmit the frequencies and vibrations from space. With the mind and the hands, each of us can journey into the boundless energy of the universe.

Relaxation, Letting Go, Surrender and Ego

In some religions and spiritual paths, there is a great emphasis on surrender and letting go. This is actually a form of relaxation. Taoist practices emphasize relaxation, letting go, and emptiness. When a person is relaxed, the muscles are open, the breathing is soft, and the energy can flow through the channels of the body. There is no resistance and no fighting. This allows the creative and higher forces to flow into us.

Most religions have a similar process. To contact the higher self and the higher forces, one needs to let go and surrender in order to reach the level where one can be in contact and become one with the higher forces. Through the surrender of control, one opens up and touches the forces of nature. However, if you continue to surrender and let go, you will lose the energy you have sent out. In the long term, this will gradually drain you. The force will suck the energy out of you, rather than help you to bring the energy into yourself. To avoid this, at the moment that one is in touch with the higher forces, one again becomes aware of oneself and his or her own energy. One is then able to project his or her own thoughts, intentions and patterns into the force, integrating the outer with the doubling or tripling inner energies. You can bring this force back to your place, your house and into yourself.

One must remain open and empty while using one's intentions, mind and Chi to draw the energy into oneself. What might initially appear to be a paradox is reformed as one does the practice and learns how to be empty and open and to simultaneously retain enough consciousness to draw the force into oneself.

Mind, Organs and Sexual Organs

It seems that some people are disconnected from themselves and from their sexual organs. The mind and organs are therefore separate. Taoism believes that the mind, body and spirit must work together. The results depend on a person's practice.

Brain

The brain can access and generate the higher forces, but storing this energy in the brain itself is not easy. We need to train the brain to increase its ability and capacity to store energy. The brain energy, when increased to a certain level, can enable more synapses to grow, and can help turn protein into brain cells. The Tao believes that with training and practice, one can learn to grow more brain and nerve cells, as well as increase the number of synapses in the central nervous system.

Organs of the Body

The organs can also generate energy, but much less than the sexual organs and the brain. They also have a much greater capacity to store and transform energy.

Sexual Organs

The Tao discovered that the sexual organs are the only organs that can generate a significant amount of sexual energy (life force). However, the sexual organs cannot store the energy efficiently. When too much energy is generated, considerable amounts have to be dumped out. And this is the best energy that one has. It is the ‘creative’ energy.

Three Tan Tiens

The Three Tan Tiens can also store energy, transform it and supply it to the brain, spinal cord, sexual organs and other organs.

The aim of Taoist basic training is to integrate the brain, sexual organs and other organs into one system. If the brain generates too much energy, it can store the energy in the organs. The excess sexual energy can also be stored in the organs and the three Tan Tiens. If the brain generates too much of the higher forces and we are unable to store this energy, we have to throw it away. It is like preparing food for one hundred people, when only one person is eating. The rest gets thrown away. In the same way,

when too much sexual energy is produced and there is no place to store it, it is wasted. We do not have enough of this energy to be able to waste it. We have a limited amount of energy and of time.

Some practices just deal with the spirit and ignore the body and the sexual energy. These practices can generate a lot of energy, but when one is not connected to the organs, it cannot be stored anywhere. One will end up draining oneself. Some people practice sitting quietly, emptying the mind, with the whole body relaxed and calm, but very little energy is actually generated. When one gets deep into the practice, some people find it hard to come back to society, because they have no energy and their mind power does not work well. These people have to depend on others to support them.

In the Universal Tao, we are learning to create a sacred and holy temple within ourselves. With the simple practice of smiling to all the organs, we can integrate our bodies, minds and spirits. They are no longer separate. The sexual practice connects the mind with the sexual organs and the brain. The separation between these parts of ourselves is bridged and a synergy is created.

The Taoist practice provides us with the resources to extend beyond the realm of our senses. By tapping into our internal resources and channeling the energy around us, we can perceive much more than the senses normally report to the mind. We want to extend our perception from the limited perspective of the sociologically conditioned senses to the unlimited awareness of the universe. For example, our senses tell us that the earth is flat, that we are stationary, and that heaven is above us. In reality, the earth is a sphere hurtling through space at thousands of miles per hour and the heavens are above, below and beyond the earth in every direction. The goal of the Three Tan Tiens is to connect with the forces from the six directions - above, below, left, right, front and back - and draw all these forces into the body. Eventually, with practice one can draw upon many different energies and use them as needed, thereby giving form to the formless energy that is abundant in nature.

Opening the Three Tan Tiens

Opening the Three Tan Tiens to the Six Directions is just another one of the many resources the Taoist practitioner uses to connect with the universe. The practice combines the power of the mind with the extension of Chi. This combination allows our personal consciousness to directly connect to the patterns and matrices of energy in the universe. When we put our thoughts into the web of the universe, we transform the electromagnetic energy into a force that is accessible to us. The combination of mind power and energy is what allows us to establish a relationship to these creative forces and the high sources of energy.

Three Tan Tiens

Once we make the connection with the forces of energy in the universe, we then want to be able to store this energy in the body. Energy is like money, if you are making a million dollars a year and spend a million dollars, you have nothing left to use in the future. That is the way we live and use our energy in our society. We are spending more energy than we are saving and we are living on borrowed energy, paying very high interest. Our credit will run out very soon.

In the Tao practice, we store energy in the Three Tan Tiens. The Three Tan Tiens are the reservoirs of energy within us.

Fig. 3.1 *The* ***Upper Tan Tien*** *is in the brain (the* ***Crystal Room****, third ventricle), and when it is full of energy, the capacity of the brain increases. We store our spiritual intelligence, the mind here. All the Tan Tiens have both yin and yang within them. In nature, the yin and yang are present in all things. Day (yang) turns into the sunset, which turns to night (yin). It is very important to feel the qualities of yin within yang and yang with yin (sunrise/sunset). One quality does not exist without the other. They are inseparable qualities of the same force.*

Fig. 3.2 *The* ***Heart*** *Center Tan Tien, between the two nipples, is the* ***Middle Tan Tien****. It is associated with the fire element. Yet, within fire there is always water. The original spirit (Shen) is stored here.*

Fig. 3.3 *The lower abdomen at the* ***Navel*** *is like an empty universe, or ocean. We want to feel a universe of energy in the* ***Lower Tan Tien****. Within this universe or ocean, there is a fire, like a volcano under the ocean; 'fire under water'.*

The Three Tan Tiens refer to the three reservoirs of energy within the body. These reservoirs are places where we can store, transform and collect energy. The reservoirs are the source of energy that flows through the body. The meridians are rivers of energy fed by these reservoirs. The goal of Opening the Three Tan Tiens is to continually fill and replenish the energy of the Three Tan Tiens. When we are connected to the Tao, life ceases to be a struggle. Through the observation of nature, the Taoists learned to flow with the stream of energy and connect to forces in the universe.

In these practices, we use a variety of hand movements and body postures to open to the energy around us. We draw the energy from the six directions into the body, activate the three fires, open the Three Tan Tiens and circulate this energy in the Microcosmic Orbit.

Combined Practice

Warm - Up Exercises

Rotating the Sacrum

Rotating the sacrum is an excellent exercise to open the lower back and activate the spinal cord. Place one hand over the sacrum and the other over the pubic bone. Rotate the sacrum in a circle, 36 times in each direction. This movement activates the sacral pump.

Spinal Cord Breathing

Inhale and expand the chest, arms bent at the elbows and extended to the sides of the body. Exhale, tuck the tailbone under you and round the back, bringing the elbows toward one another in front of the chest. Smile. Inhale, expand the chest, tuck the chin in toward the throat, push the chin back and raise the crown and bring the arms out to the sides. Repeat this back and forth movement 36 times. This movement activates the cranial and sacral pumps, and loosens all the joints in the spine.

Shaking

Shake the whole body loose, especially the joints, by bouncing up and down on the heels. Let all the joints open and relax. Also, shake the testicles and the breasts loose. This will open the sexual energy (the yin electric) and you do this on back as well.

The yin and yang are the negative and positive electric forces in the universe. The heart produces impulses (the yang electric) and the adrenal glands produce the adrenal hormone to stimulate the heart to beat. Of all the hormones inside us, this is the one that gives the vital force to our life.

When we concentrate on the sexual organs, the heart and the mind, we can make the yin and the yang electricity combine.

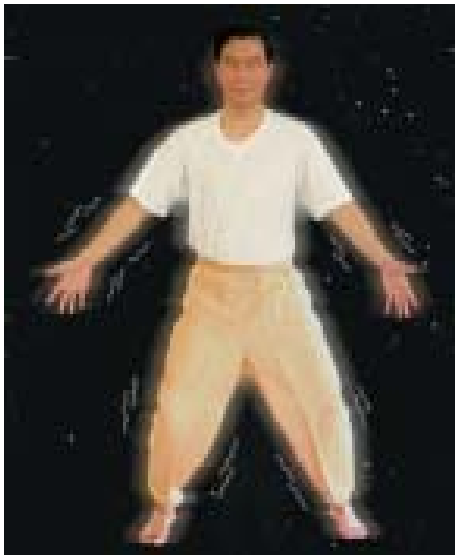

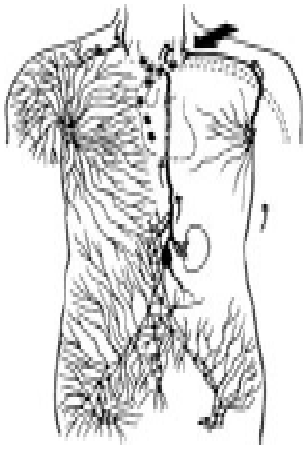

Fig. 3.4 *Whole Body shaking and Lymphatic System*

True Breath - Skin Breathing

We exist because of the physical food and the unique combination of forces that surround us. The daily requirement of calories is about 6,000 units, while we only get 2,000 calories from food. The other 4,000 calories come from the forces around, above and below us. These forces that surround us are electricity, magnetism, cosmic particle energy, light, sound and heat. If we don't know how to absorb and transform this cosmic food, we need to depend on others to supply us. We then need to ask a priest, monk or holy person to give us our daily spiritual food.

The Taoists discovered that we can learn to absorb these surrounding and universal energies through the skin and the major energy centers. Absorbing energy through the skin is called the True Breath. This powerful energetic technique requires the Inner Smile and relaxation. The more one can relax, the more the body and the skin can open to the energy around us. The practice allows one to extend the mind, to touch the force and to draw that energy back into the body.

Daily Practice: Opening, Connecting and Activating Chi Within and Cosmic Charging

Paradoxically, in order to project ourselves out into the immensity of the galaxies and the universe to gather limitless resources of Cosmic Chi for healing, we must take the first steps of the journey within ourselves. In order to 'go out', we must first 'go in'. The vehicle for this magical journey is powered by our ability to relax in mind and body. As we physically relax and let go of muscular and emotional tensions and joint and bone structures we gain access to the inner realms by turning on our very special subtle smile. It opens the pathways of the parasympathetic nervous system. This helps us to reduce the out flowing habits of our senses so that we can be more alert in sensing our inner universe.

This simple process of 'going in' enables us to develop our internal skills so as to safely 'go out' to the universe.

Practice

Relax and Let go - Smile to Connect with the Universe Within

Smile to mideyebrow, eyebrows, eyes, mouth, jaw, tongue, lips, cheeks, ears, shoulders, ribcage and brain. Let the relaxed sensations and the 'Observer Mind' (Upper Brain) sink down into the Lower Tan Tien.

1. Smile to the mideyebrow. Relax and let go. Smile to the eyebrows and let them grow long to the sides. Lower these relaxed sensations down to the Tan Tien.

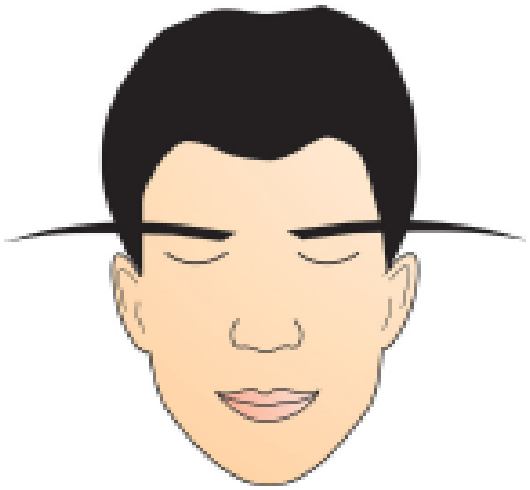

Fig. 3.5 *Smile and Relax to the Mideyebrow and think of the eyebrows growing long.*

2. Smile to the eyes: relax the eyes and feel how nice and cool they are. Let the eyes draw back in their sockets and start to sink down to the chest and gradually down to the abdomen, the home of your 'feeling and awareness mind'.

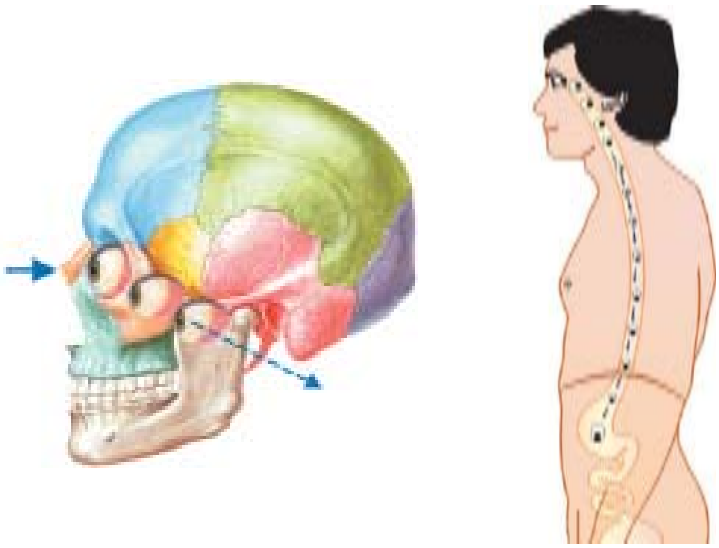

Fig. 3.6 *Smile and relax the eyes, sink into the eye sockets and gradually feel the eyes dropping down into the Abdomen.*

3. Relax the two broad muscles extending from the outer portions of the upper lips across the cheekbones, and lightly smile feeling their connection to the upper front of the ears. Gradually feel the ears growing 'long', up and down. Feel the ears grow all the way down and connect to the kidneys.

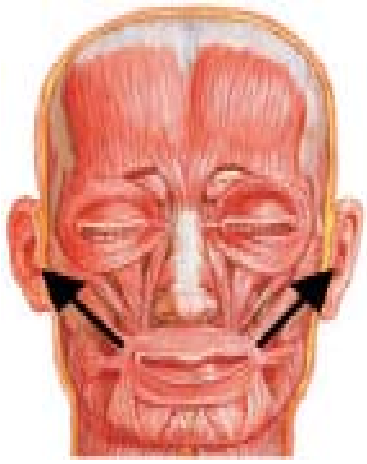

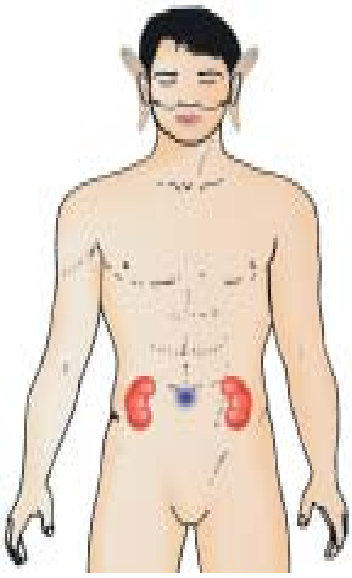

Fig. 3.7 *Smile to the Ears and listen to the Kidneys.*

4. Open your mouth and relax your jaw, separating the upper and lower teeth. Feel the jaw relax. Once the jaw relaxes the shoulders will relax and drop down. Continue to feel the jaw relax until you feel the saliva start to come out. Relax down to the rib cage. Feel the rib cage drop down, softening all the joints, relaxing down to the Lower Tan Tien. Let the tongue relax back in the mouth. Feel the tongue start to drop down into the throat to the chest and all the way down to the navel sinking the 'floating' sensation down to the Lower Tan Tien.
5. Smile to the shoulders and relax until you feel the shoulders drop and the rib cage relax.

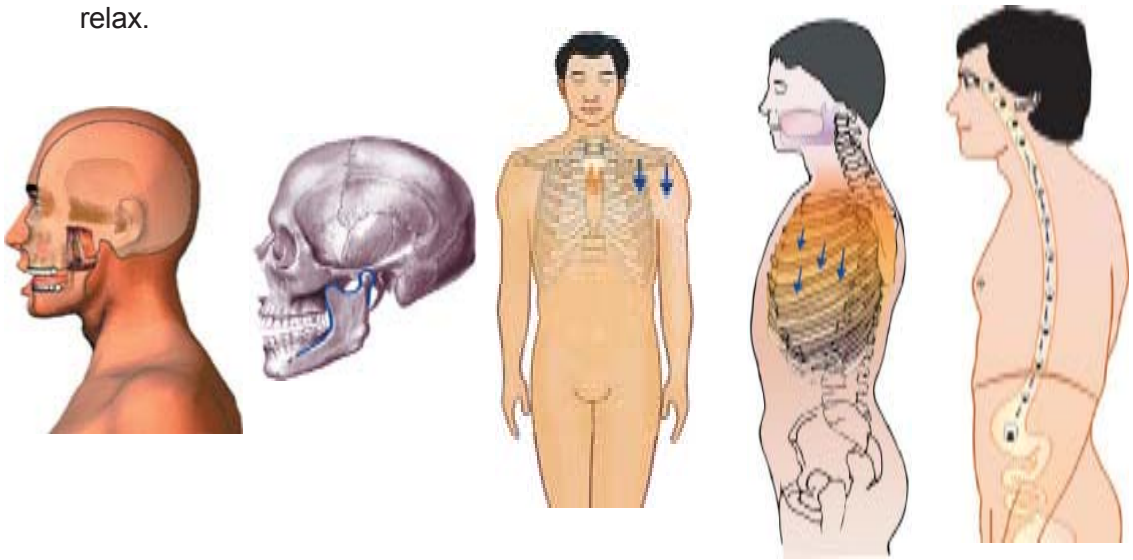

Fig. 3.8 *Relax the Jaw; and the Shoulders and Tongue will relax down to Lower Tan Tien.*

6. Lightly close the lips, but keep the teeth slightly separated. Physically begin a child-like smile with the corners of the mouth gently uplifted and the outer edges of the eyes softly crinkled up. Breathe through your nose.
7. Smile into the brain and empty the upper (observing) mind down to the Tan Tien.
8. Become aware of your inner universe as a big empty space. Keep on sinking – sinking down, into the darkness of your empty space. Keep sinking and experience the vastness until you get closer and closer to the center, the 'original force.' Stay relaxed and alert so as to be able to see one dot of light. It becomes a galaxy spiraling inside you.

   Do the above practice several times until you become familiar and comfortable with it.

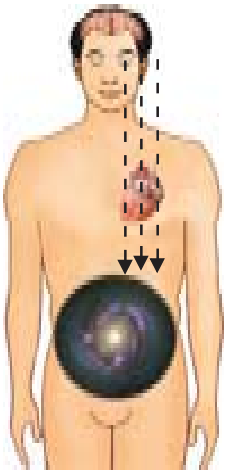

Fig. 3.9 *Bring the Senses down to the Tan Tien.*

Tan Tien Consciousness: Second Brain

Already terms have been used like 'upper mind', 'feeling and awareness mind' in the abdomen and lower 'Tan Tien'. In the next phase of practice, the 'conscious mind of the heart' is introduced. For those readers who have not been updated on the scientific and medical revelations of the recent era about a 'second' and 'third' brain, we offer the following information.

Along with this, there is the long-standing Taoist practice of cultivating and training consciousness in the Three Tan Tiens, especially the Lower Tan Tien. There is my own experience in participating in brain wave measurements and 'brain energy potential' research in recent years. The combination of all these areas of knowledge and experience in our time, makes Cosmic Healing practices accessible for our minds while also being very 'down to earth.' Now let's talk about the Lower Tan Tien.

In addition to its importance as the control center for the mechanics of the physical structure of the body, the Lower Tan Tien also houses a treasure of even more far-reaching significance. It has been a well-kept secret in the western world, as well as in most of the rest of the world: our Second Brain. Most of us who have had Taoist training in Chi Kung, Tai Chi, various Chi meditations or healing practices have often heard the reminder, 'Be aware of your Tan Tien.' But, do most people really 'get' the meaning of the injunction to always be conscious of the Tan Tien? Probably not. Further, do we use our Second Brain as much as we can? Definitely not.

In western terms, do we actually understand "Be aware of your Tan Tien" as being a way to train consciousness and awareness, like educating a brain in the abdominal area, in our Tan Tien? Probably not. Throughout the world, there are institutions to train the brain in the head. That is good. But, what about training the 'second brain' in the abdominal area? I didn't think of it exactly like that in western terms, either, even though that is exactly what I have been doing all of my life in my Taoist training and teaching.

Personal Revelation

Suddenly I came to understand a few things which are so simple and so important, and that's what I am going to share with you. It started in 1994 in Los Angeles when a clinical psychologist there, Dr. Rhonda Jessum, wanted to start testing me. I agreed to do the testing, but the machines at that time didn't tell me much. However, it was discovered that when I did the Inner Smile meditation, my brain waves went down dramatically – but at the same time, my 'beta' waves increased to a very high level. That means the waves showed that I could be driving a car, but that my brain should have been resting and sleeping. So the researchers said, "Hey, how did you do that?" I didn't understand either – because it was not clear to me either.

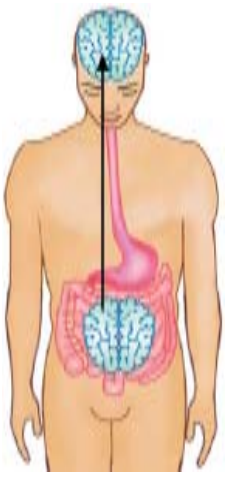

Fig. 3.10 *First and Second Brains are linked.*

Fig. 3.11 *Second Brain*

After that, I was invited to start testing in Europe by the Institute for Applied Biocybernetics and Feedback Research. My name is becoming known there because I teach in Europe a lot. One of the biggest institutes for training top athletes in Europe is in Vienna. They developed an instrument that can measure the brain's potential energy, which represents all the energy in the body. The doctors also said that this proves to the west that Chi exists, there is energy and a life force running in the body. That instrument picks it up in the brain and indicates how much potential brain energy you have. It also determines how much energy you have for the whole day and how much of that energy is for mental clarity and body power. They use these instruments to measure the athletes.

The study measures brainwave frequencies during four practices.

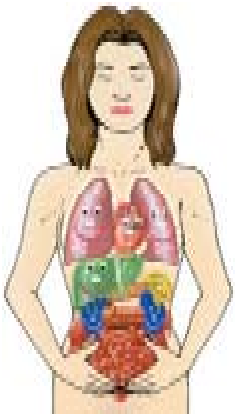

Fig. 3.12
Cosmic Inner Smile

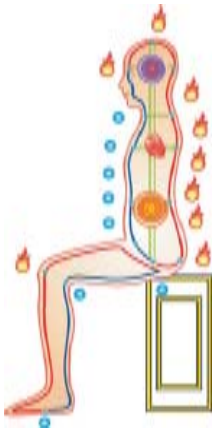

Fig. 3.13
Cosmic Orbit

Fig. 3.14
Six Healing Sounds

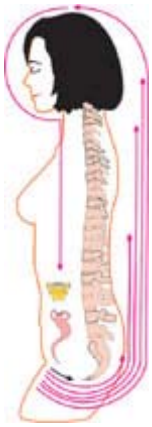

Fig 3.15
Orgasmic Upward Draw

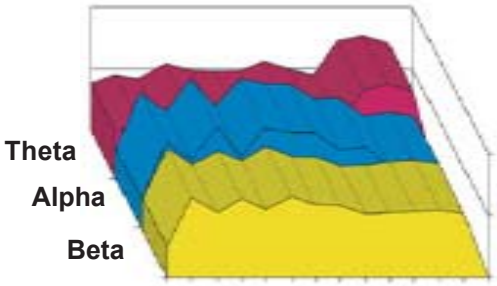

Fig. 3.16 *Alpha and Theta Waves increasing during the Cosmic Inner Smile Meditation.*

Fig. 3.17 *Ultraslow Brain potentials measurement while in Vienna.*

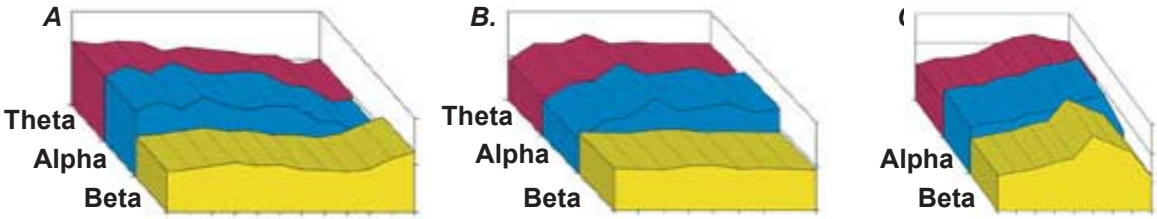

Fig. 3.18 A. *Altering dominance of alpha and theta waves during the Cosmic Orbit Meditation.* ***B.*** *Cosmic Healing Sounds Meditation, results in increases in alpha and theta frequencies. There are minimal beta brainwaves; the brain reaches a state of stillness and internal focus.* ***C.*** *Orgasmic Upward Draw Meditation increases the levels of alpha and theta.*

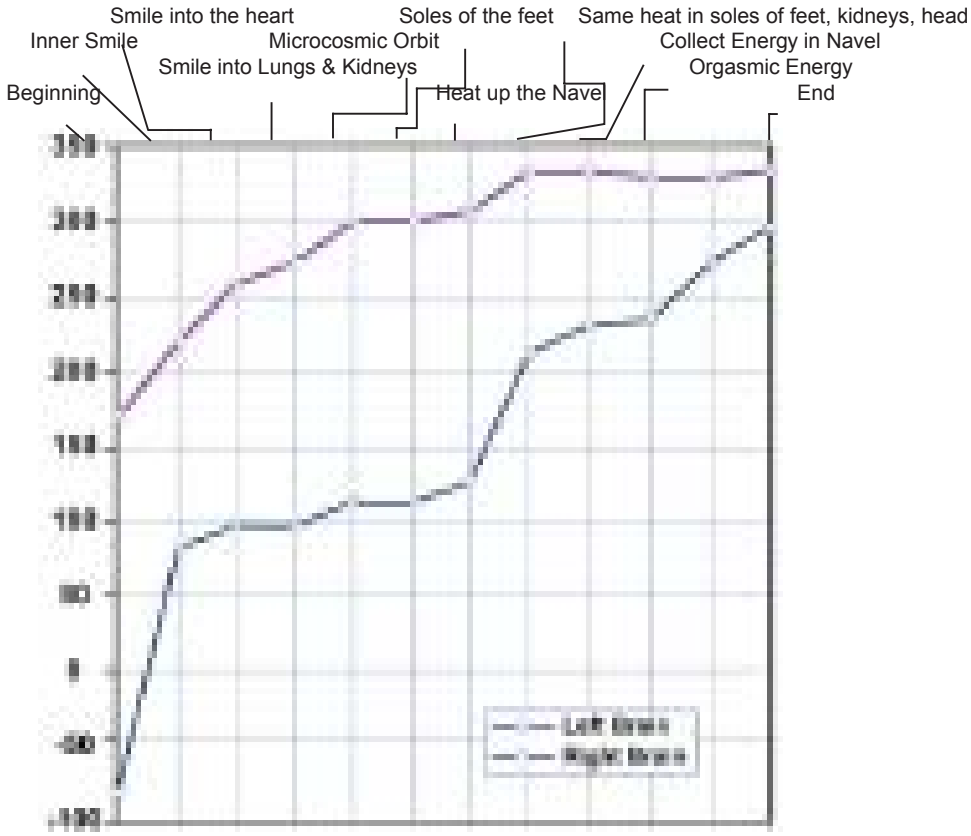

Fig. 3.19 *Left and Right Brain Charts*

It's interesting because the energy I have been describing in my teaching is exactly what they were measuring during their testing. So I went there and did the measurements with them. I just did the Inner Smile, smiling into my abdomen. They picked up these readings very quickly and said, "Your brain waves are going lower, lower and resting – and you are nearly in the sleeping state." At the same time, the muscle tension

was very low, the heartbeat was very low and the skin resistance was very low. After that, I surged the energy up to the brain and they started to see that the energy actually charged up there. When we are thinking, worrying or feeling anger, shame or guilt – the energy level in the brain actually decreases, and the brain doesn't get charged up. They were quite amazed, and said, "Hey, this is what we're looking for!"

They asked me what I was doing. I said, "I'm smiling to my abdomen." They kept on talking to me and asking me questions. They discovered that this brain (in the head) was not very active at all, meaning that there was not much activity in the brain. It was still in a very light resting state. But, how could I answer their questions? They said, "Hey, look! Master Chia is talking to us in his sleep. How can he talk to us in his sleep?"

After that, I said, "Oh, I understand now." Because, throughout the whole practice of the Tao is the injunction, 'train the second brain in order to use the second brain.' It took the westerners a long time to understand that. So, when the article about the 'Hidden Brain in the Gut' came out in The New York Times,[1] I started to understand that. You can be miserable; you can be happy; you can feel all kinds of feelings. But according to this article, they had also discovered that this brain in the gut, the enteric nervous system, can do a lot of functions. It says that this gut brain can send and receive impulses; it can record experience and respond to emotions. So, it is like a brain. In this article, they had only discovered that the large intestine and the small intestines have the same neurons as the brain cells. After that article, a new book, *The Second Brain,* was published.[2]

Now in medical science, I might add, they have begun to discover consciousness in the heart. They found that the heart can record a whole event, and it has its own brain. Dr. Paul Pearsall has written a new book, called *The Heart's Code*.[3] They have found that people who have a heart transplant actually get the emotions of the donor. They actually experience whatever the donor experienced. One of the cases is that of a girl who was brutally killed, and they didn't know who killed her. But, the heart was OK; so, it was transplanted into another girl. After that, the girl started to get nightmares and described somebody killing her. Then she described how the killer looked. Finally, the mother took the girl to a psychiatrist, and he in turn contacted the police. The girl gave the police an exact description and a police artist drew a likeness of the killer. With the information provided by the girl, the police were able to go and arrest the man. Afterwards, when confronted with clear details of the crime, the man confessed that he was indeed guilty of this crime. So, from that experience, medical scientists and others came to realize that the heart can record all of an event and remember it.

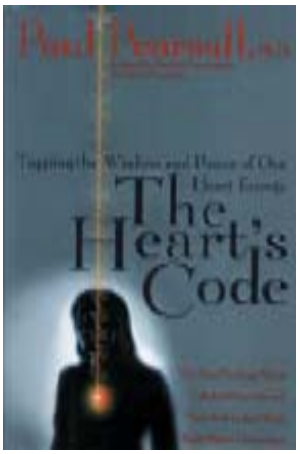

Fig. 3.20 *Heart's Code*

1 "Complex and Hidden Brain in the Gut Makes Stomachaches and Butterflies," The New York Times, section C1, Tuesday, January 23, 1996

2 Gershon, Michael. *The Second Brain* (New York: Harper Collins Publishers Inc., 1998).

3 Pearsall, Paul, Ph.D. *The Heart's Code* (New York: Broadway Books, 1998)

The Lower Brain consumes less energy and can do a lot of daily work, like send and receive impulse records and experience and respond to emotions. When you lower down the Upper Mind, it will also lower the blood pressure and anxiety.

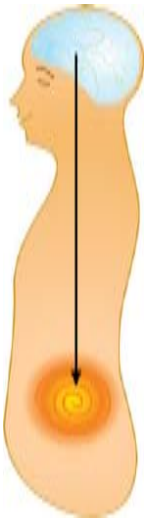

Fig. 3.21 *Abdomen has it own Brain: the Awareness Mind.*

On the second page of the Times' article, it says that even the large intestine is loaded with neurons. The question was posed, 'Can it learn?' But I say, "Hey, this goes back to 4,700 years of the Tao practice, which says: Train all the organs; train them how to do different things." You can rest the head brain when you're not using it – and use the brain in the gut. Why is it so important? Because the head brain is a 'monkey mind' riddled with doubt, shame, guilt and a suspicious mind. It is always thinking. Worrying, figuring things out things, head trips – it just keeps on, all the time. To be a God, you must let go of the past and empty the mind. Now we are in the information age; anything flits in – we think. Just one word flits in and we start an entire string of thought. When somebody says one bad word to you, you can think and figure it out for three days and three nights. 'How am I going to get revenge? How am I going to get revenge?'

Scientists have discovered that when people worry too much, thinking, planning, etc., this brain actually uses up a lot of energy. Depending on the type of person– some people are very physical types who use very little brain energy, but their physical body consumes a lot of energy. However, most people think and think and think. So the scientists give an approximation, by way of a percentage. This is just a number for comparison, not an exact number. They say that this brain in the head can use up to 80% of the body's energy. So, what happens is you have only 20% left for the organs.

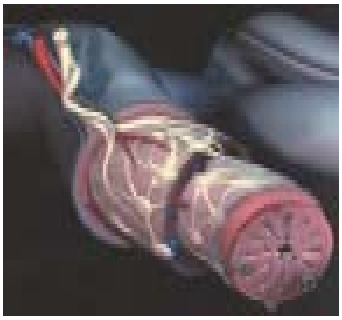

Fig. 3.22 *Cross-section of the neurons in the Large Intestine.*

According to the information about the brain in the gut, they have discovered that the brain in the head and the brain in the gut can do some similar jobs. For example, this brain in the gut is the emotional and the feeling brain. In the west you have the expres-

sions, 'I feel you from my gut' and 'I have a gut feeling about something.' Why do people mention a gut feeling? Obviously people have some feeling in their gut. It's very interesting that the whole Tao practice is feeling, awareness and consciousness – using this gut to feel, to be aware, and to be conscious.

You can rest, relax the brain in the head by using the 'brain in the gut.' This is the first step. The first thing we learn in the Tao is to forgive and let go. When we keep on remembering past negative emotions, we will stop seeing the truth. To let go of the past is to empty the mind and use the abdominal mind, the awareness and consciousness. Here's an interesting point in the way of the Tao: This gut brain can do a lot of simple functions that are similar to the functions of the brain in the head. This is a feeling and awareness type of functioning similar to many of our 'right brain' functions. However, we need to use the brain in the head in order to perform complex functions such as reasoning, making plans and making complex calculations. For rational functions, we need to use the brain in the head for the 'left brain' functions.

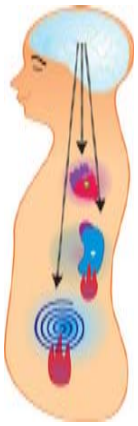

For our daily life of consciousness, awareness and feeling, we can use either the brain in the gut or the brain in the head. When we use the upper brain less, it will become charged with more energy and its power will be increased – and more power will be available to the body. That is why we say in Taoism, that we have to train the brain in the gut, so that we can use it when the brain in the head is resting. When the head brain is resting, it can be recharged: brain repair and maintenance occurs. Also, it can grow new brain cells. With more charging we have more power for creativity or whatever we want to use it for. If we like, we can use it to develop our higher spiritual nature.

Fig. 3.23 *When you are not using the Upper Brain allow it to rest by sending it down to the Lower Tan Tien.*

The simple thing is, that for the same job that the head brain or the gut brain can do, the head brain charges you eighty dollars. The gut brain only charges you twenty dollars. So, which one do you want to use? No, of course we are not that silly to use this overpriced person for the same work. But when we come to our own actual life, we don't know how to do it. We always use this mind, this high-priced brain. To add to this, we continue using it and using it, until the brain energy is completely consumed – no more energy. When you get to a certain level the brain is empty. These brain energy measurements are not only for indicating mental energy levels, they also represent energy conditions for the whole body and spiritual energy.

Whenever I smile down, the brain waves go lower and lower very quickly – and the transformed energy from the Tan Tien and organs charges up the brain in the head! Just by flexing the facial muscles into the mode we use with a genuine smile, we can produce the effects on the nervous system that normally goes with the natural sponta-

neous feeling. We can actually make ourselves relaxed and happy by taking advantage of this built-in human mechanism. It's natural. Just do it! Learning to smile down to the abdominal area and maintain the awareness of the relaxed, smiling sensation in the Tan Tien is the first step in training the *Second Brain!* Think about it: Pure awareness and consciousness can change attitudes and emotions carried in the DNA.

Remember: Number 1: "Empty your mind down to the Tan Tien, and fill the Tan Tien with Chi." An axiom in the Tao is, where the mind goes the Chi follows. And, Number 2: "When your mind is empty, it will be filled!" This means that when the organs have extra energy, the extra organ energy will rise up and fill the brain with Chi.

Fig. 3.24 *When the mind is empty, transformed energy from all the organs can charge the brain with Chi.*

Practice

Three Minds into One: 'Yi' Power

Smile into your heart. Lower the Observation Mind, then the Heart Mind down to the Tan Tien. With the Feeling/Awareness Mind, Spiral the three minds into one.

1. Smile into your heart. Make it feel soft. Feel love. Feel joy. Feel happy and feel compassion in your heart. Feel the heart spiral.
2. Spiral in the upper mind. Lower your upper mind, the observation mind, down to the Tan Tien in your navel area.
3. Turn the consciousness in your heart, activated by your love and softness, down to your Tan Tien.
4. Combine the upper and middle minds with the energy of the feeling/awareness mind of the entire nervous system – the Second Brain in the abdomen. Merge the three minds into one mind by spiraling their energy, blending them together as one in the Tan Tien.

When the three minds merge into one they become the 'Yi' power, the three-mind power – activate the spiraling at the mideyebrow, crown and the soles of your feet – expand to the universe in six directions: up, down, front, back, left and right. Once you get it, the Yi, we will start to activate the six directions and the three fires.

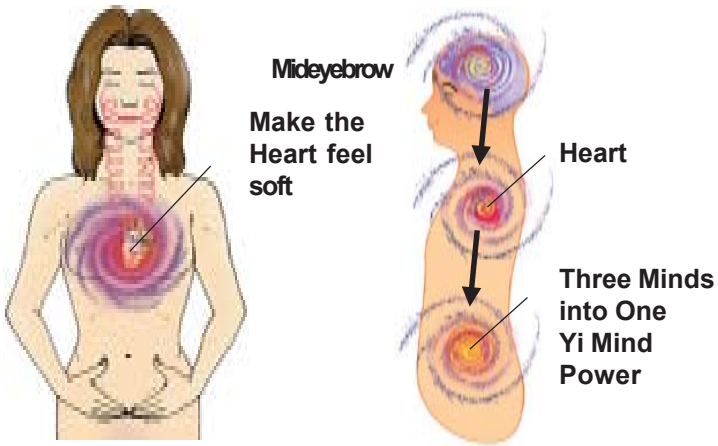

Fig. 3.25 ***A.*** *The Heart softens like a rose blossoming.* ***B.*** *Spiral the Upper Tan Tien to the Lowest Tan Tien and Three Mind 'Yi' Power.*

Activating the Six Directions and the Three Fires

This powerful energetic technique allows one to extend the mind, to touch the force, and to draw that energy back into the body.

The Six Directions teaches you how to expand your mind and Chi for receiving healing power. By practicing the Six Directions daily you will increase your healing and cosmic power. Turn your mind and Chi into the cosmos, multiply them and draw them back.

Direction Below

When you achieve the three minds into one mind begin expanding into the Six Directions; press your hands down and start with the low direction. Picture yourself standing on the earth and you expand yourself very far away – deep down into the earth, very, very deep down into the earth. Your hands become very long; your feet become very long — they go all the way down into the earth and out past it into the galaxy below on the other side.

Push. When you push, connect with the galaxy below — pull and think about your Tan Tien filling with Chi. Push and pull. Push and pull. Fill your Tan Tien with Chi.

A. ***B.*** ***C.***

Fig. 3.26 A. *Hands expand through the earth and to the galaxy below.*
B. *Hands push forward and pull back.* ***C.*** *Smile to the primordial Chi from the universe back to the Lower Tan Tien and fill the Tan Tien with Chi.*

1. Stand, feet together. Put you hands down, parallel to the ground. Expand your hands very far away and your mind very far away smiling into the ground. Continue expanding your hands, feet and your mind very far away beyond the earth below. Go down through the galaxy, way beyond to the primordial force. It's just like you are extending all the way to the primordial force before 30 million years ago.
2. Push, moving the hands forward six inches only.
3. Pull, moving the hands back by the sides. Think about your Tan Tien – Chi coming to the primordial force in your Tan Tien. Smile to your Tan Tien, dark, deep and vast.
4. Push: touch the primordial force in the universe.

A. ***B.*** ***C.***

Fig. 3.27 A. *Be aware of the universe in front.*
B. *Expand your hands very big and long to the universe in front.*
C. *Hold the fire ball to activate the Tan Tien Fire.*

5. Pull back to your Tan Tien the dark primordial forces with your hands.

Push and pull: It's just like you go to an empty space – vast. Then you come back to your Tan Tien – also empty, just like the primordial condition before anything existed.That is where all the forces come from. Push and pull 3 – 9 times.

Front Direction and Tan Tien Fire

Next, be aware of the front direction; a huge fireball appears in front of you.

Open your palms: scoop up the Chi, scoop up the fire. Bring the fire into your Tan Tien. Activate the Tan Tien Fire.

1. You start with a small dot of light inside you. Expand your awareness smiling to the universe in front of you.
2. Become aware of a big fireball in front of you. Fell your hand become bigger and longer. Scoop up the fireball. You may close your eyes to help your inner sensing.
3. Use the fireball to light the fire in your Tan Tien. Feel the fire burning in the darkness, the 'fire burning under the sea.'

Fig. 3.28 *Smile to the Burning Fire.*

Back Direction and Kidney Fire

Be aware of the back of the Tan Tien, the Door of Life and the back or rear direction. Extend your mind very far away to the 'back'. Scoop up the fire and light up your 'Kidney Fire'.

Fig. 3.29 *Be aware of the back direction, move the arms toward the back of the universe and scoop up the universal fire.*

1. Expand your awareness all the way to the back. Move the arms toward the universe behind you.
2. Touch the universe; scoop up the fire. Activate the Kidney Fire. Maintain your awareness in the Tan Tien and expand smiling out to the universe. The energetic spiral glows in the Tan Tien. Spiral in the heart, spiral in your crown and spiral in the universe.

Heart Fire

Raise your hands up under your armpits, and feel yourself holding the two fireballs. Touch the heart by extending the fingers energetically in from the sides; feel your hands extending into your heart and very far away. Activate the Heart Fire.

Fig. 3.30 *Activate the Heart Fire.*

1. Move your hands up under your armpits and extend your fingers deep into your heart and very far away.
2. Tan Tien and the Universe: you are connecting to the 'charger,' charging more fire into yourself.
3. Feel your heart soft in the center as you smile down. Feel the warmth of the fire energy of love, joy and happiness in the heart.
4. You feel the connection with the unconditional love in the universe as you keep your heart consciousness in your Tan Tien and extend your awareness out to the universe.

Sacred Fire *(Chi Fire)*

Connect the Three Fires to combine into one Fire: *Heart to Kidneys to Navel to Heart*.

Fig. 3.31 *Connect the Three Fires and Sacred Fire.*

1. Move your hands together in front of your heart. Hold your hands together in front near the heart and feel the fire burning in there. Connect the Heart Fire to the Kidney Fire, the Kidney Fire to the Tan Tien Fire and back up to your heart; connecting them as one triangular Sacred Fire, circulating the Chi at 1,000 revolutions per minute, 10,000 R.P.M, 30,000 R.P.M and 60,000 R.P.M, doubling or tripling their collective power.

Open the Third Eye

Now, extend your hands out to the front, very far away – pushing, pushing, pushing. Push. Turn your palms inward, and extend your middle fingers inward toward your third eye. Picture a crack in the middle of your forehead, and pull the crack open. Feel the light from the heavens opening it and feel the light from the heavens shining into your brain.

1. Open your palms. Open your eyes, dimming the eyes. Look to the universe. Extend your hands to the front, palms vertical. Extend the arms from the scapulas. Smile and touch the universe.
2. Turn your palms inward and extend your middle fingers inward toward your third eye.

3. Picture a crack in the middle of your forehead and let the heavenly light shine into the brain; pull the crack open and let the light reflect into the organs.
4. Close the third eye. Again, open. Pull: open-close-open. And, close. With the third eye open, the light from the heavens shines into your brain and reflects down to all your organs. Open and close the third eye 3 - 9 times.

Fig. 3.32 *Look as you smile into the Universe in front of you.*

A. ***B.***

Fig. 3.33 A. *The Middle of the Finger hooks into the third eye and reflects down into the Organs.*
B. *Pull open the Third Eye; let heaven open and shine its light into the Brain.*

Front Direction: Push/Pull Master Practice

Now, turn your palms, pushing out. Push. Pull. This is the master practice that is imperative for successful completion. When you first start practicing you should do it at least one hundred times and increase up to 200 times. Push and pull. When you push, you feel your hands extended very far away – very long – reach the sky. Touch the universe.

1. Push: Extend your arms and hands to the front, palms vertical. Extend the arms from the scapulas.
   Expand: smiling, smiling, touching the universe – touching the force, touch -ing the Cosmic Chi.

Fig. 3.34
Master practice: Touch the Universe.

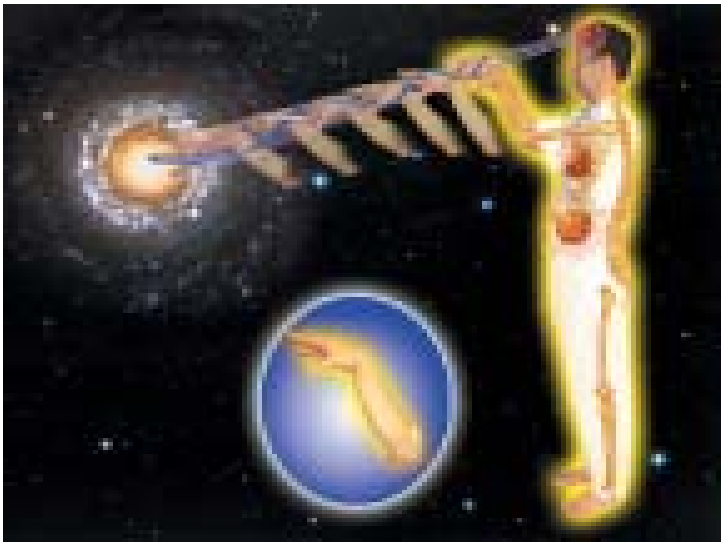

2. Pull: Draw the Chi back to you from the universe. Moving the arms from the scapulas, draw the hands toward your body in a horizontal position, drawing the Chi into the body.

Fig. 3.35 *'Drawing' Universal Chi - feel your Tan Tien and fill it with Chi.*

Pull. Think and smile to your Tan Tien. Push, very far away to the universe.
Pull. Push: Smile, relax, and let go, touching the sky, touching the universe.

Fig. 3.36
Let go - Push and Touch the Universe, do it 6, 9 or 18 times.

Left and Right Directions

Now, move your hands to the left and right directions. Pull the Universal energy in. Push; touch the universe. Pull; think about your Tan Tien. Push – all the way, touching-touching-touching the universe.

1. Move your extended hands from the front horizon to the left and right sides.

Fig. 3.37 *Touch the Universe Left and Right.*

2. Pull Tan Tien: Smile to your Tan Tien. Keep smiling to your Tan Tien.
3. Push to both sides. Expand all the way, smiling and touching the universe.

   Push/Pull: touching, touching the universe drawing the Chi smile energy into you from both sides.

   Do 3-6 times.

Fig. 3.38 *Pull: Just feel about your Tan Tien.*

Direction Above

Turn your palms up to the universe. Scoop up the Chi. Pour the Chi over your crown, and touch your crown. Project the Chi all the way down to the perineum and down through the earth to the universe below. Tan Tien and universe; always feel your Tan Tien spiraling, heart spiraling, crown spiraling and the universe around you spiraling.

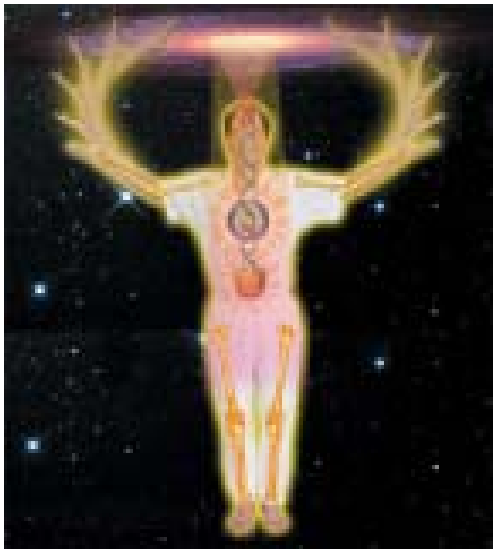

Fig. 3.39 A. *Raise the hands above the crown and feel it extend up to heaven.*
B. *Feel that the hands are big and long and that the bones are hollow. Fill and pack the bones with Chi.*

Raise your hands up to the universe and expand your hands as big as the universe - feel the Chi charge into your bones.

Scoop and gather the energy turning the body three times to the left and three times the right drawing the smiling energy.

Fig.3.40 *Scoop up the Universal Chi and pour it over the head.*

Open the Spine

1. Touch the back-crown point. Pour the Chi all over your crown. Think of your soles so that you feel like there is a waterfall of Chi flowing from your crown all the way down to your soles. Feel your finger grow long and the Chi penetrate down through your spine to the coccyx. Leave the fingers touchng the back of the crown, to maintain the energetic connection with the coccyx.

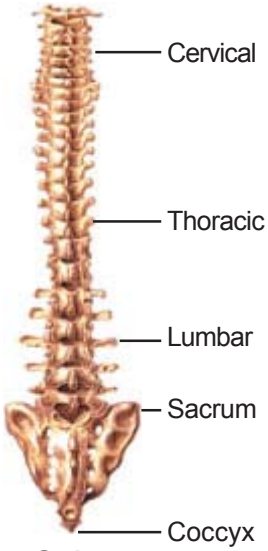

Spine

Fig. 3.41 *Feel your fingers growing long, all the way down to the coccyx.*

Turn 'Three Minds into One Mind' at the Lower Tan Tien, and expand the awareness to the universe. Let yourself be charged by the universe.

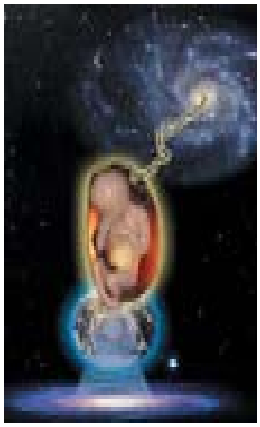

Like you are back in the womb.

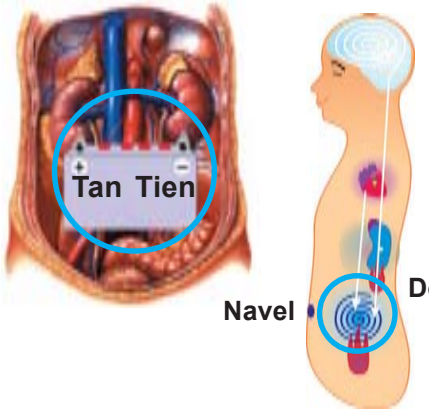

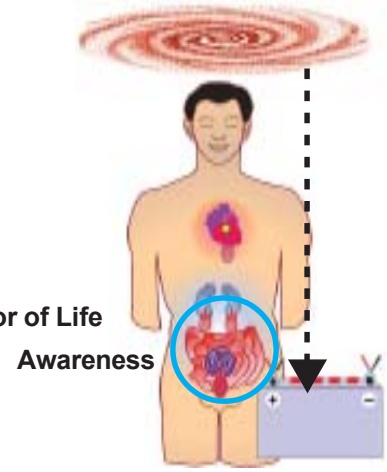

Tan Tien is like a battery.

Fig. 3.42 *Universe charges Tan Tien power.*

Beware of the Tan Tien and spiral it like universal energy in motion. Feel the heart center spiraling and the crown spiraling. Be aware of the universe spiraling above, below, front, back, left and right. Let all of the sick energy and the negative forces leave the body and go down into the ground for Mother Earth to recycle. Extend the Chi from above, all the way down through the earth and the universe below.

Fig. 3.43 *Be aware of the Lower Tan Tien, Heart Center and Crown spiraling. Feel the Universe is spiraling and charging the Three Tan Tiens.*

Open the Middle Channel and Perineum

1. Move to the mid-crown point. Touch the point and project your fingers inwards; go deeper, deeper through the middle of your body down to the perineum. Focus on the perineum. Feel the Chi from the universe flow into your perineum. Look for one dot of light. Look into the darkness, the vast darkness, the immense darkness; this is the primordial force, a cloudy moving force. Look for a dot of light at the perineum and extend your awareness all the way down through the ground and the universe below.

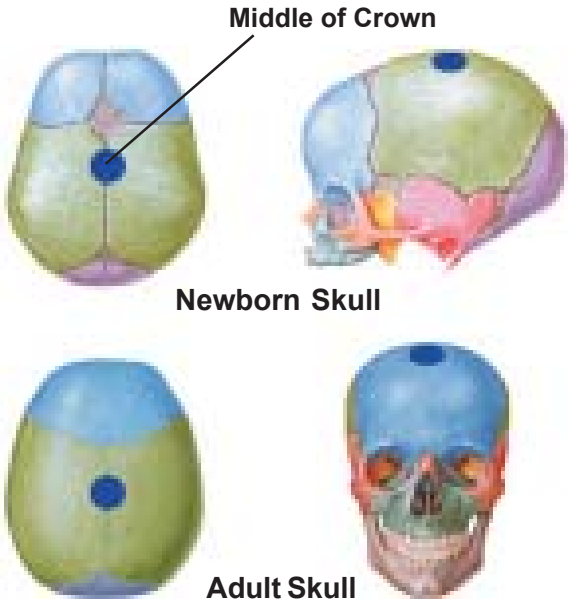

Fig. 3.44 *Move the Hands to the Middle of the Crown and feel the Fingers Penetrate to the Perineum.*

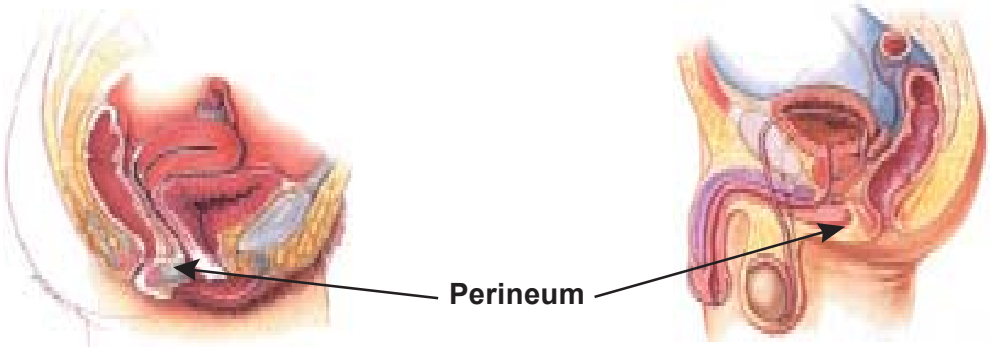

When finished opening to the Six Directions and igniting the Three Fires, gather the Chi in the center and bring this expanded awareness into the healing session.

Tan Tien and the Universe

The expression, 'Tan Tien and the Universe', is a reminder to feel your Tan Tien, heart, mideyebrow and crown spiraling and that you are connected to the universe spiraling in the six directions around you.

1. Establish a Complete Location

You will use your Yi, the three-mind power, repeatedly to recharge your Chi for various purposes. You recharge by connecting to the Universal Chi in the six directions of the universe simultaneously. When you charge a particular area or direct Chi into the body to a particular point, you first establish a connection point for the Chi by placing the hand or fingers at an appropriate location on the surface. This is like giving a location for the Chi to go to. Once the location is established and the Chi starts to go there, leave your hands there.

Then you move your attention to where you want the Chi to go in the body. Feel the Chi connected to and charging the intended location.

2. Charge Tan Tien from Universe

When the location connection is established, be aware of your Tan Tien, heart center, mideyebrow and crown spiraling. Be sure that the conscious mind of the heart is lowered to the Tan Tien and the awareness mind of the abdomen is connected to the mideyebrow crown and out to the universe. Feel them connected to the spiraling energy in the six directions of the universe. Let the universe charge your Tan Tien.

3. Don't Stop at the Location

With your focus in the Tan Tien, the Chi will go from there to the 'location' indicated by your hands and then to the intended location in the body. Don't let Chi stop there, however.

4. Direct Chi out the Opposite Side to Universe

Direct your attention to guide the Chi flow through the body and out the opposite side. You want to clear out any blockages and prevent any others from accumulating. You also want to release sick energy and negative forces down into the earth. Let the Universal Chi flow out through the universe and beyond.

Open the Three Tan Tiens

Move your hands down to the mideyebrow. Touch the mideyebrow.
We are going to open the three Tan Tiens, starting with the Upper Tan Tien.

Upper Tan Tien - Mideyebrow

1. Recharge. Remember: Tan Tien – heart consciousness in, awareness out. Spiral – Tan Tien, heart, third eye and crown. Universe – six directions spiraling.

Fig. 3.45 *Raise hands and charge with Universal Chi.*

2. Move your hands down and touch the mideyebrow. Feel your fingers grow very long (energetically) and penetrate all the way back to the base of the skull. Focus on the back. Remember: Tan Tien and the universe spiraling. With the spiraling, the Chi in the fingers will become hot. It will expand and penetrate out through the back of the head all the way to the universe behind.

Fig 3.46 *Fingers touch mideyebrow and penetrate to the back of the skull and the universe at the rear.*

Fig 3.47
Tan Tien and the Universe.

3. Picture your fingers like laser beams of Chi, 'Tan Tien and Universe': Feel your Tan Tien and the universe spiral and charge your fingers. Move your fingers out from the mideyebrow around the side of the head to the top of the ears. Your fingers are like lasers -cut-cut-cutting open your skull right in the middle, around to the top of the ear, cutting open your Upper Tan Tien. Cut and project your fingers long into the middle of your brain. Spiral your Tan Tien and the universe. Leave your fingers there. Concentrate on your Tan Tien spiraling – your heart, crown, the universe above, below, front, back left and right all spiraling. Your Tan Tien is a big empty space: primordial force; darkness. You can put so much Chi inside there! The Chi penetrates into your brain.

Fig. 3.48 *Move the fingers to the top of the ears. Feel them growing longer and cutting the skull open, penetrating into the brain.*

4. Move your hands all the way to the back, cutting to the back of the skull. Touch, and feel the Upper Tan Tien open.
5. Touch the base of your skull. Focus on the mid-eyebrow. Feel the Chi flow like a laser beam from back to front and out to the universe in front. Complete the opening process by moving the hands back around to the mideyebrow, cutting as you go.

Fig. 3.49 *Chi moves like a laser, penetrating from the mideyebrow at the front, to the back of skull.*

6. Recharge in the universe. Feel your bones and your arms are hollow. Fill and compact them with Chi.
7. Scoop the Universal Chi and pour it down over your crown and all the way down, down to the Middle Tan Tien.

Fig. 3.50
Recharge in the Universe, scoop and pour the Chi down to the Middle Tan Tien (Heart Center).

Middle Tan Tien - Heart Center - Conscious Mind

1. Move your hands all the way down to your heart center at the mid-sternum. Touch. Focus on the point opposite the heart, T5/T6, on the spine. Fingers 'long', Chi penetrates into your thymus gland. Light – golden light – penetrates into your thymus. Feel the Chi penetrate through your heart all the way through T5/T6 to the universe behind. 'Tan Tien and the Universe' also feel your Chi Fingers penetrate into the bone and bone marrow and spread out into your rib cage.

Fig 3.51 *Golden light enters the heart, thymus, bones and marrow; feel it penetrate to the universe at the rear.*

Recharge and cut around to the Armpits

1. Recharge In the universe, pour Chi over the crown down through the body and lower your hands down to the heart center. Touch with the fingertips. Move your hands around under your armpits, extending the Chi like laser beams cutting open this Middle Tan Tien. Pause under the armpits as you send the Chi into the center.

Fig. 3.52 *Cut open the Middle Tan Tien by cutting around the armpits.*

2. Continue to move your hands around to your back at T5/T6, touch and send the Chi from back to front. Let the beam of Chi penetrate out through the heart center to the universe in front of you. Then, move the hands back around the sides to the front, cutting as you go.

Fig. 3.53 *Chi beam from T5/T6 penetrates to the Heart Center in front.*

Lower Tan Tien - Navel - Awareness Mind

1. Recharge with Universal Chi. Tan Tien and Universe: Again, raise your hands and charge with the Chi into the universe. Your hands are very big, very long. The bones are hollow and compacted with compressed Universal Chi. Scoop the Chi from above and guide it down. Pour all the way down, down, down to the navel. Touch the navel, and focus on the Door of Life opposite on the spine between L2/L3. Touch and feel the Chi penetrate to the Door of Life Tan Tien and Universe. Feel the Chi penetrate through to the back and out to the universe behind.

A. ***B.***

Fig. 3.54 A. *Recharge the Lower Tan Tien and penetrate through to the Door of Life.*
B. *Raise the hands up to the universe and charge with Chi. Bring the power down to Tan Tien.*

2. Open this Lower Tan Tien the same way as for the Upper and Middle Tan Tiens. Charge more Chi into your hands, and let them be like lasers cutting it open. Cut around to the sides. Pause. The fingers of the left and right hands are very long, extended energetically inside. Cut and feel the energy penetrate into the center. Focus at Tan Tien and universe and feel more Chi.

Fig. 3.55 *'Cut' open the Lower Tan Tien with Laser Fingers.*

3. Continue cutting to the Door of Life. Touch, and send the Chi from the Door of Life back to the navel and out to the universe in front.

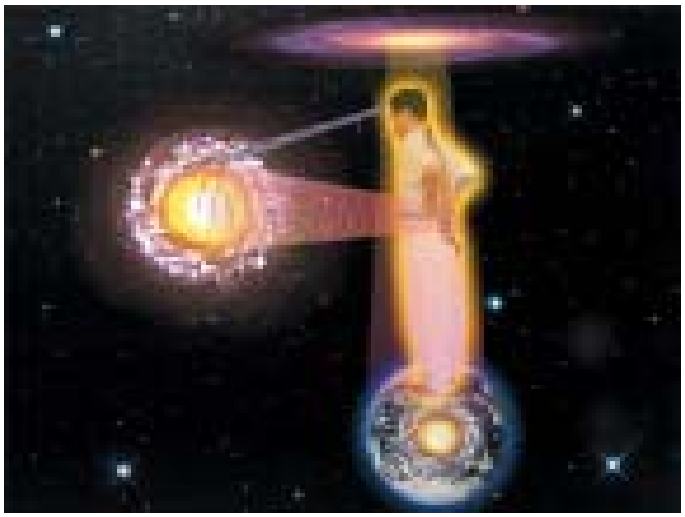

Fig. 3.56 *'Cut' open the Door of Life and send Chi to the navel and universe in front.*

4. Move the hands back around the sides to the navel, extending the fingers and "cutting" the Tan Tien open as you go. Touch the navel: Tan Tien and the universe spiraling. Feel more Chi, and feel the Tan Tien open.

Activate Chi in the Bones of Hips, Legs and Sacrum

1. Now touch your pelvic bone by energetically extending your fingers from the front area near the hips to the back. Feel Chi penetrate into your pelvic bones: funny, laughing, happy bones.
2. Touch the femur bones. Tan Tien and universe. Charge the fingers. Also, feel the funny, happy, laughing vibration inside the bones and in the bone marrow. Be aware of the Three Tan Tiens. Spiral from the universe. Spiraling charging your Tan Tien. Charge your hands and your bones.

Fig. 3.57 *Touch the femurs - happy laughing bones!*

3. Now we are going to slowly lower the sensation of Chi down through the bones to the earth. Opening up the sacrum. Move the hands down the legs as you bend down.
4. Lower yourself all the way down to the ground and sit on your feet. Move the Chi with your hands down to your toes, down through the earth and the universe below.

A. ***B.***

Fig. 3.58 A. *Sink the Chi into the earth.* ***B.*** *Lower and sink the mind and Chi down to the universe.*

5. Raise your sacrum up, keeping your hands at the toes. Smile to your Tan Tien and feel the Chi from the universe coming to fill the Three Tan Tiens. Opening up the sacrum.

Fig. 3.59
Raise the sacrum and smile to the Tan Tien.

6. Lower down again. Lower the Chi down to the earth and the galaxy below.
7. Once more, raise your sacrum up, maintaining hand contact with your feet. Smile to your Tan Tien.
8. For the third time, lower down. Open your palms, gathering the Chi from the earth below. Gather and scoop the Chi.

Fig. 3.60 *Gather the Earth Chi.*

9. Touch your heels and feel your bones as you slowly rise up. Fill your bones with Chi as you guide it up with your hands.
10. Fill the bones in the upper legs as you move your hands up.

Fig. 3.61 A. *Fill the bones with Chi.* ***B.*** *Feel your fingers penetrate into the bones as you rise.*

11. Feel your bones, and fill them with Chi all the way up to your coccyx. Touch your coccyx. Leave your fingers there, then be aware of the Chi and feel the Chi raising up to the Tan Tien and the universe. Feel it charge the fingers and the spine.
12. Come up to the sacrum. Feel the sacrum open. Focus at the Tan Tien and the universe.

A. **B.**

Fig. 3.62 A. *Bring the Chi to the Coccyx.*
B. *Move your hands up to the Sacrum and feel the Chi rise up to the Crown.*

13. Come up to the door of life, and then back to the navel. You may sit down to continue the next step in the Cosmic Healing Practice.

Fig. 3.63 *Bring the Chi to the Door of Life and let it penetrate to the Navel.*

Practice daily till you feel the Chi. Then you can apply this Chi to the Healing Sessions.

Chapter IV
General Healing Session

The General Healing session practices are to be done with every student regardless of their age or health condition. These are for cleaning and strengthening the cells. Cells must be clean and strong to heal. The General Healing practices listed steps A-K are the most important part you must always do in every session. You can do this with one person or with many people at the same time. The following is a detailed decription of each of these steps. Become familar with them and they will flow easily one into the other.

A. Three Minds into One Mind

Smile down to the inner universe. Activate the heart consciousness and empty the mind and heart down to the LowerTan Tien, the Abdominal Brain. Gather the 'Yi' (mind-eye-heart power), combining three minds into one. Fill the Tan Tien with this Chi. Start to spiral. You are then ready to connect to the higher forces of Universal and Heavenly Chi. The Three Minds are the Upper, Middle and Lower, or three Tan Tiens. The Upper Mind is the one we have been closely related to most of our lives. It is the logical thinking, planning, calculating and worrying mind; it consumes 80% of our body's energy.
The key is to learn 'to releas the mind' by learning to sink the Chi to the Lower Tan Tien, whereby it can be used in synergy with the other two.

B. Activate the Six Directions

Activating the six directions is for opening the whole body, mind and soul to all of the Universal and Cosmic forces in all directions. We literally learn to draw in the Universal and Cosmic forces from all directions at the same time. This is important for healers so they are not using their own energy for healing but drawing on the limitless Universal forces.

Expand your awareness to connect to the universe and the Six Directions at the mideyebrow and crown; left, right, front, behind, above and below. Connect to the universe, collect and spiral the energy into your Lower Tan Tien.

C. Activate the Three Fires

Activate the Tan Tien, Kidney and Heart Fires to create a Sacred Fire Triangle. Move from the Tan Tien to the Heart, the Heart to the Kidneys and the Kidneys back to the Tan Tien.

D. Linking Personal Stars, Energy Bodies and the Universe

World Link is a way for intelligent life force to return to the source; inwards and upwards. Become aware of the 'personal stars' above the crown and below the earth.We link with our own personal stars and then with the stars of each person in a group. This links the energy bodies of everyone in a group together. Start to spiral your energy and connect to other peoples' stars and energy bodies. Make a left spiraling pattern, progressing around the circle in a clockwise rotation. Link all of these stars together and form ***one large energy body.*** Each meditator will become an individual unit in an integrated communication link. A link between the earth and the universe.

E. Protective Circle and Chi Field

We create Chi Fields, Protective Animals and call the Eight Forces to protect the group from disturbances and psychic attacks. Raise your right (or leading) hand in the air and access the **'Sacred Fire'** of the universal cauldron. "Feel your fingers becoming big, long and hollow", as they reach into the Sacred Fire. The Chi will fill and pack your arm as you bring it down into your body. Use Yi-Power to create the **Sacred Fire Protective Circle.** The fire will purify and protect the circle. You can cast a circle around your community, house, room and body. This will create an energetic field of Chi around the whole room.

Then Create a **Chi Dome**. Invoke the 'guardian animals'; Blue Tortoise from the north, Red Pheasant from the south, Green Dragon from the east, White Tiger from the west, Yellow Phoenix from above and Black Tortoise from below.

Finally, activate the **Eight Elemental Forces of Nature and the Universe**. Call the forces of fire, water (ocean), thunder (lightning), lake (rain), earth, mountain, wind and heaven. Activate fire in the north, water in the south, lightning in the east, and rain in the west.

F. Chi (Sacred) Water Practice

Invoke the power of the Sacred, Chi or Holy Water practice to cleanse and heal the body's sick, toxic or negative energy. Make a request to receive healing energy and feel yourself touch a heavenly pool of sacred water energy. Feel the pool pouring down heavenly water to fill your arm.

Use the thumb and index finger to remove the sick energy from the cup, without touching the water. Talk to the sick cells. Let the sick energy return to the earth for recycling. Fill the water with your heart's compassion. Give the command: "This Sacred Water will give health, wealth and longevity". Cosmic Healing works on a cellular level. It is the water's 'job' to carry the message of the practice to all the cells, where it will remain. Drink the water in unison with the rest of the group.

G. Empty and Fill

The Empty and Fill technique is emptying the sick energy into the earth and filling with healing Cosmic Force Energy. Project your 'sword' hand (middle and index fingers) down to the ground. Project the hand 'very big and very long' and your feet 'very big and very long' - extended down to the ground. Now very slowly inhale, bring up the earth energy. Bring the energy up to your feet and into your bones. Let it enter all the bones, organs and cells. Feel it blending with all the sick energy. Turn your palm up, turn it back down again and exhale; let go of all the sick energy, the negative energy, the worries and burdens, all the way down into the earth. Repeat this three to nine times. Dig a hole and bury all the sick energy; tell it, "Do not come back; you will be happy down there." Smile.

H. Clean with Green Light

The Green light is for cleaning the cells. This is vitally important because the cells must be clean for healing. Green can help detoxify the toxic cells. Green Chi is mild and safe. Green Chi is used for cleansing, and as a decongestant for diseased parts. It 'loosens' the area. The light green Chi is used to break down dirty or diseased energy, like a detergent is used for washing clothes or dishes.

Afterwards, the cells will be rinsed with blue light, like clean water is used to rinse the detergent and residue from clothes or dishes.

When you carry out healing try to 'see' the cells enlarged and this green energy go in and blend with the dirty, black and cloudy energy. See it come out and let it go down to the earth. Dig a hole and bury it there. Tell it, "Don't come back. You will be happy down there". Become aware of the green light and spiral counter clockwise. Spiral down. Cleaning out the stress. Repeat as many times as you like, three times minimum.

I. Clean with Blue Light

Blue is like cold water; it has the yin power to dissolve all kinds of negative energy and sickness. It has an inhibiting effect. Blue yin energy is the opposite of red yang, which has a strengthening and stimulating effect.

Blue has a cooling effect; it can reduce pain and inflammation, and it can help blood clot. It stops bleeding and reduces fever. It can help to induce rest and sleep.

J. Charge with Violet Light

Charging with Violet light holds the highest healing energy. When the cells are clean they will absorb and hold the Violet light and the healing will take place. Luminous Violet has intelligence and can be programmed. The universe is full of violet light, especially the North Star and the Big Dipper. The color of the star of the higher self or soul, above the crown, is also violet. It is the color of Divine or Soul energy.

It has properties of other Chi colors. It has a rapid regenerating effect on damaged organs and nerves. Always use green and blue light before using violet. Violet light develops the crown center, the spiritual core. It is good for psychological ailments as well as for physical deficiencies.

K. Activate the Immune and Defense System

The body has various mechanisms which combine to provide protection and defense against illness and disease. These mechanisms enable the body to produce various cells and bodies which act against invading or unwanted substances. As soon as a foreign body is recognized, the immune system will be triggered and will act to provide the most efficient means of eliminating the danger and return the body to a balanced state of health. A strong and healthy body will have good resources to protect itself from negative or sick energy. The aim of these practices is to help you to realize the potential of true harmony within yourself. To activate the immune and defense system is to increase the production of red and white blood cells. To do this we activate the bone marrow and lymphatic system. Guide the student or whole group together in all of these steps. You will not lose energy by doing this. You will gain more energy because you are all connected together in the group power. The crucial part is to multiply your good intentions, Chi and virtue energy into the cosmos, making yourself and each person a direct line from the Universe. After you finish the General Healing session you can tailor the healing techniques in the next chapters to the individual's needs.

Practice

A. Three Minds into One Mind

1. Smile to the Inner Universe

Place your palms together in salutation, in front of your heart. Feel the Laogong points in your hands connect, creating an energy loop running from your heart through your arms and hands and back again.

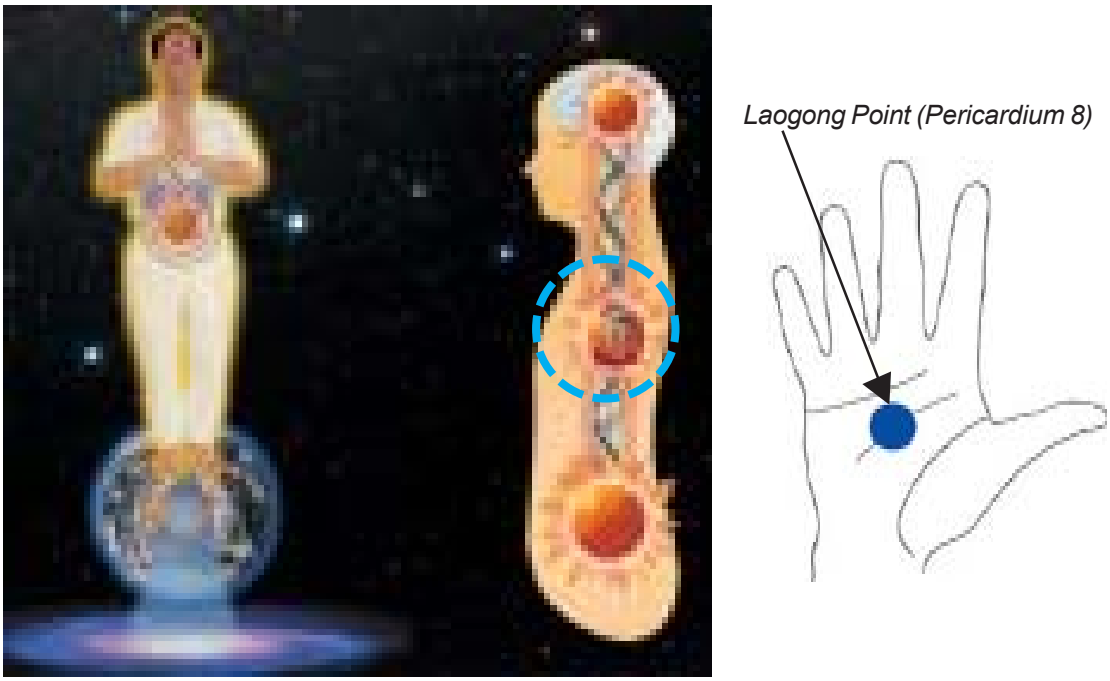

A. ***B.***

Fig. 4.1 A. *Empty the mind down to the lower abdomen.*
B. *Activate the heart's compassion.*

2. Activate the Heart Compassion Energy

Smile to the heart and feel it softening. Feel love, joy, compassion and happiness. Smile down and empty the mind to the Tan Tien, the Abdominal Brain. Fill the Tan Tien with Chi and start to spiral. When the abdomen is warm, it is full of Chi. The Chi can then charge up to the brain.

3. Combine the Three Minds into One

1. Turn Upper Mind to observation mind.
2. Turn consciousness (Middle Mind) down to Lower Tan Tien.
3. Combine three minds into one mind at the Lower Tan Tien (the Yi).
4. Manifest out at the mideyebrow.

Fig. 4.2 *'Three Minds into One'.*

B. Activate the Six Directions

Expand the awareness to connect to the universe and the Six Directions at the crown, mideyebrow, heart and Tan Tien.

Fig. 4.3 *Trust and believe - turn visualization into actualization.*

C. Activate the Three Fires

1. Tan Tien Fire - Activate the Tan Tien Fire:

Smile down to the abdomen to create a burning stove near the lower lumbar and sacrum. Create a fire ball behind the navel, above the stove.

2. Kidney Fire - Activate the Kidney Fire:

Always retain awareness at the Tan Tien and keep it spiraling.

3. Heart Fire - Activate the Heart Fire:

Keep the heart soft and fill the heart with joy, love and happiness.

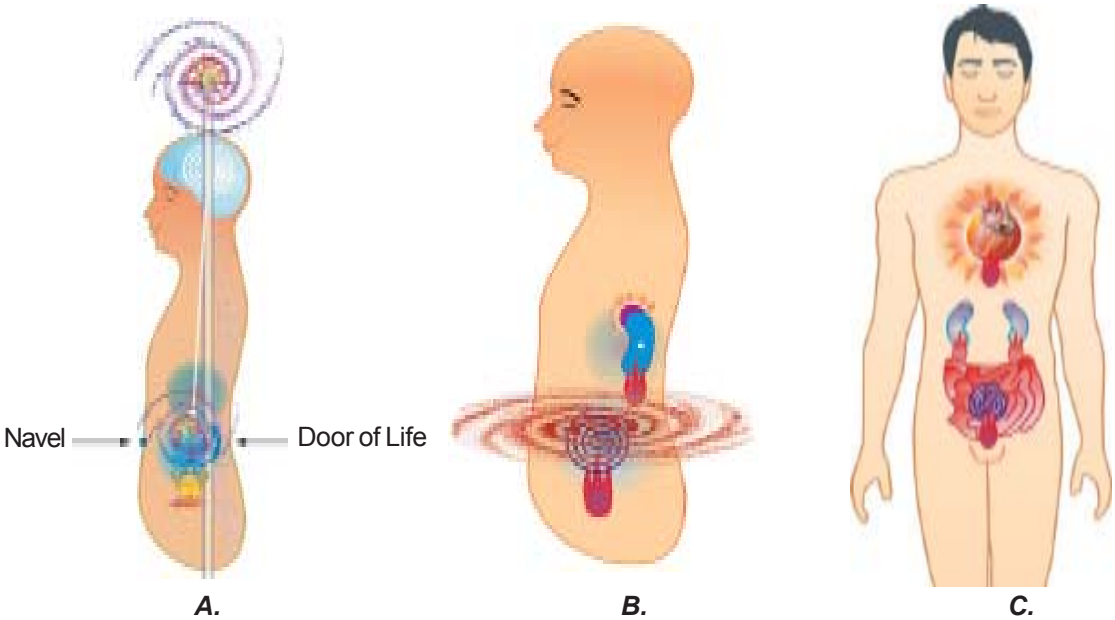

Fig. 4.4 A. *Activate the Lower Tan Tien Fire.* ***B.*** *Activate the Kidney and Adrenal Fires.* ***C.*** *Activate the Heart Fire.*

4. Sacred Fire Triangle

The Sacred Fire Triangle has triple force. Make a triangle from kidneys to navel (Tan Tien). From the heart make the connection to the kidneys. Move from the Tan Tien up to the heart.

5. Cosmic Star and the Earth Star

At the moment of conception, the two forces yin and yang connect with such a force, then only fractions of a moment later, the two forces explode into nine different Energy Centers. Seven of them we find in the body and two of them outside the body, forming our personal stars.

Fig. 4.5 *Three Fires into One*

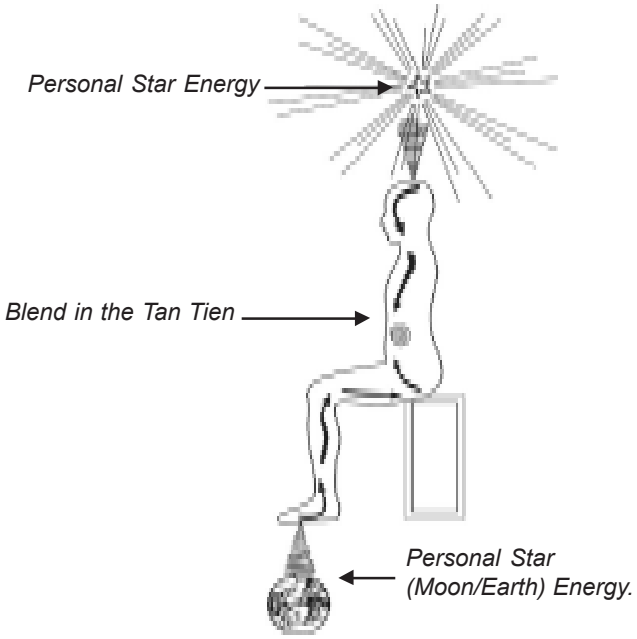

Fig. 4.6 *'Personal Star' Energy*

The two personal stars are in fact energy centers connecting the aural field of each individual with the universal forces and the earth forces. In a way one can see the aim of Taoist Inner Alchemy in bringing these nine forces together, merging them into one force and thus enabling the return to the original force, the Wu Chi.

There is a star about six inches above your crown and another one about one to three feet below the soles of your feet. They are also known as the higher self, guidance, protector, adviser. These stars are our connection to the cosmic force, the universal force and the earth deep below us.

Always make sure your Tan Tien is warm and the sacrum and mideyebrow are breathing. Be aware of the crown breathing and see a star or a small sun above you. Be aware of the crown and feel a light beam extend out of the crown and make a connection to the star above you. Keep on breathing until you feel a strong connection. Feel how the star above you is exercising a strong pulling force on your crown. Once you feel this pull on your crown you will also feel a strong pull down from the earth. Be aware of the star above and the earth and universal force below you. Feel that both of them have a strong pull on you.

1. Reconfirm the star above you and the earth directly below you.
2. Fix the image of the North Star and the Big Dipper six to nine feet above your crown. See the cup of the Big Dipper filling with the violet light, which gathers Chi from the North Star and the universe.

3. **Reach up with your left hand, and hold on to the handle of the Big Dipper. Pour the violet light down to your personal star 4 to 6 inches above your head, in order to predigest the energy of the violet light. Then let it flow down to your crown, into the Upper Tan Tien, to be processed and flow down to the heart center (Middle Tan Tien) or to the back of the head down to C-7 (Cervical 7) and T-2 (Thoracic 2) and down to the palms.**

   In Taoism we consider that the North Star emits a violet light, which is regarded as the highest healing light and the Big Dipper as emitting a red light.

   You can do these meditations sitting, or standing in the Chi Kung posture. The standing position will support a stronger structure and provide a better connection with the earth.

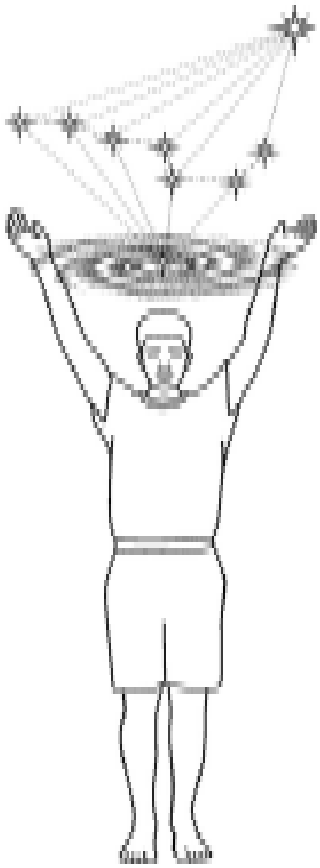

Fig. 4.7 *The North Star, Big Dipper and Galaxy spiral above.*

4. Always remember to breathe in slowly so you can process the awareness of the Lower Tan Tien. Feel a suction, warmth (Chi) and continue to breathe in and be aware of the suction of the crown, North Star and Big Dipper above you.

D. Linking Personal Stars, Energy Bodies and the Universe

Be aware of your 'personal stars' above and below and connect to other peoples' stars and energy bodies.

Three minds unite, one mind aware of the stars above you and a star below you. Connect these stars to the people around you. Think about the bright light above the crowns of other people. Start to spiral your energy to connect to each of them. Group all the stars into one energy body and connect all the way to the center of the universe.

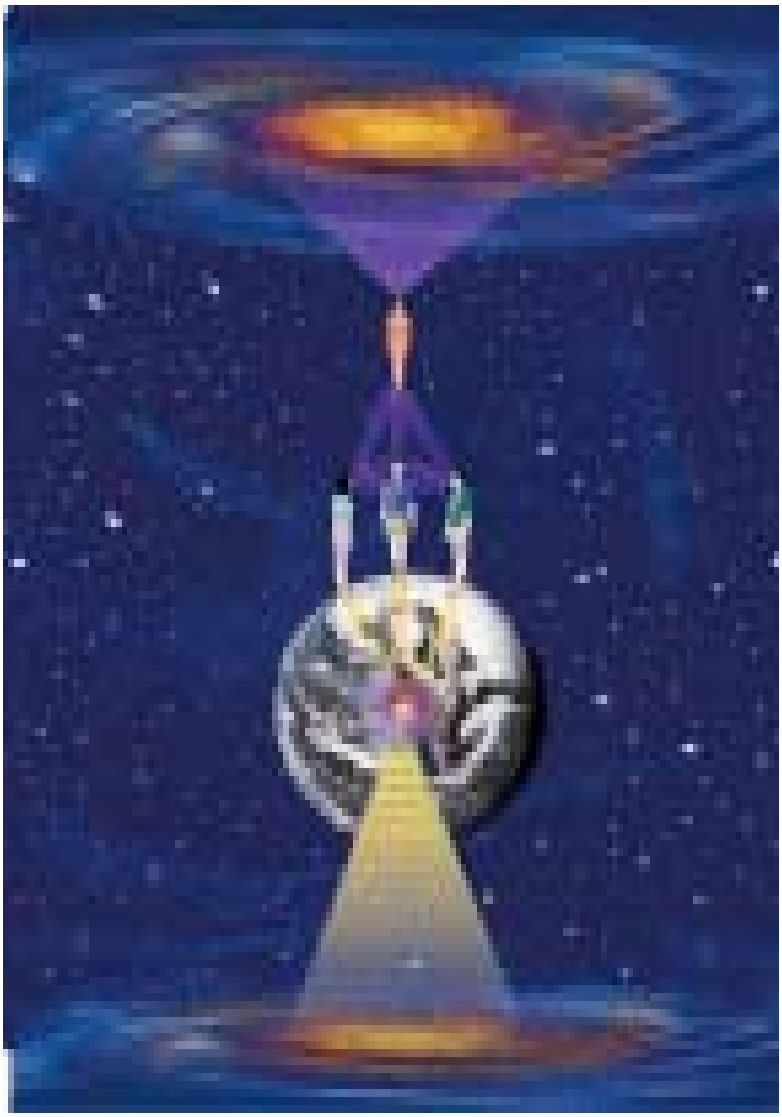

Fig. 4.8 *World Link Meditation*

1. Center Channel and Personal Star above

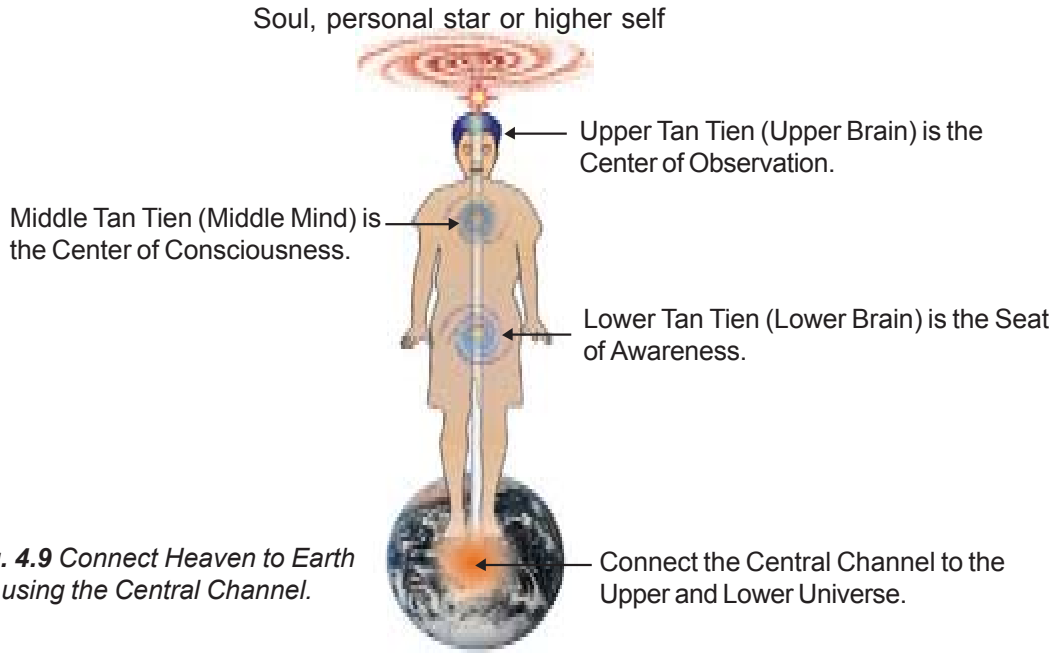

Fig. 4.9 *Connect Heaven to Earth using the Central Channel.*

2. Use Yi power to connect to your Personal Star above

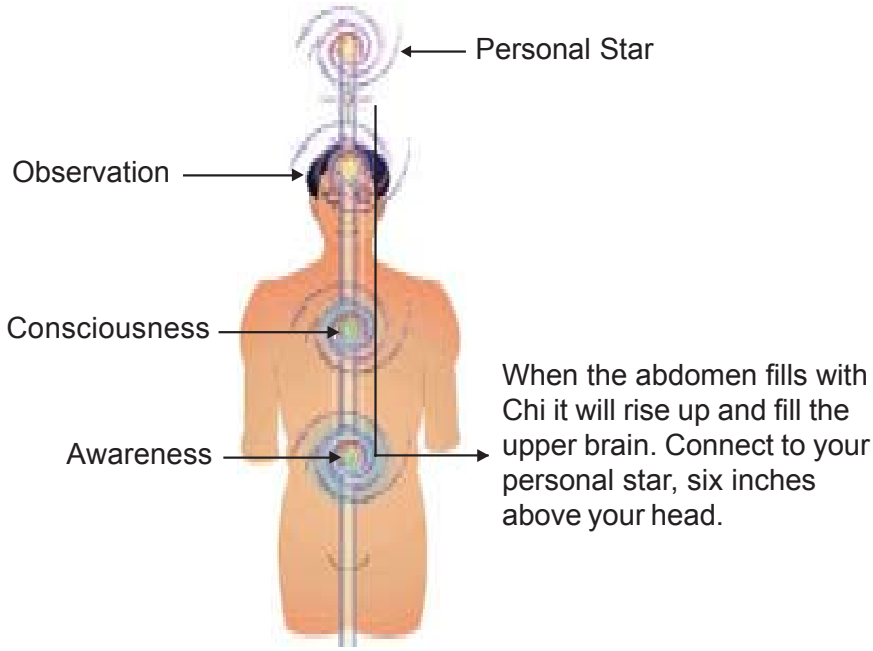

Fig. 4.10 *Connect to your Personal Star Energy using 'Yi' Power.*

3. Connect your Personal Star to the Personal Star of each person

Connect your personal star to each person and then to the universe.

4. Create a Chi Body becoming the major connecting point. Counterclockwise spiral to connect each person's star into a larger group star.

Fig. 4.11 *Link with Each others Personal Stars.*

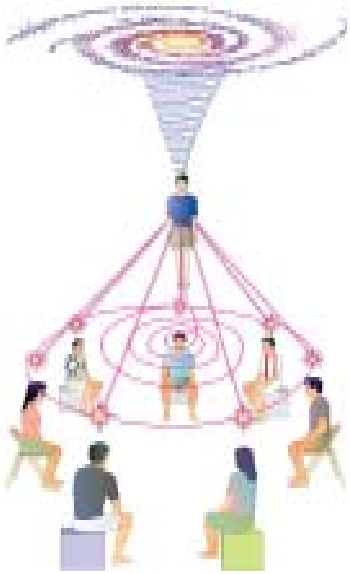

Fig. 4.12 *Connect into Group Star.*

5. Meditators become satellite links and create a group energy body.

The World Link meditations become an integrated communication link. They are linked to the earth and the universe. Spiral and connect each person's star together and group the energy into one energy body. This energy body becomes an integrated communication center for each person in the group. We can be connected, wherever we are. Each person can connect and become their own 'Center of the Universe'.

Fig. 4.13 *Form a Satellite Link and create a Group Energy Body.*

E. Protective Circle and Chi Field

Raise your hand up and become aware of the 'Sacred Fire' in the universe. Feel that your fingers are very 'big', very 'long' and touch the fire. Bring the fire down. Make a circle around your community, your house, Tao Garden, the meditation hall and around your bodies. Create an energetic field of Chi around the whole room.

Sacred or Chi Fire
Connect and Receive Fire from the Universal Cauldron

1. Activate the Sacred Fire in the Universe

Be aware of yourself. Feel your arm and fingers 'big', 'long' and 'hollow'. Reach to the universe to the Sacred Fire. Let the Sacred Fire fill and pack your arm.

2. Use Yi-Power to Create Sacred Fire Protective Circle

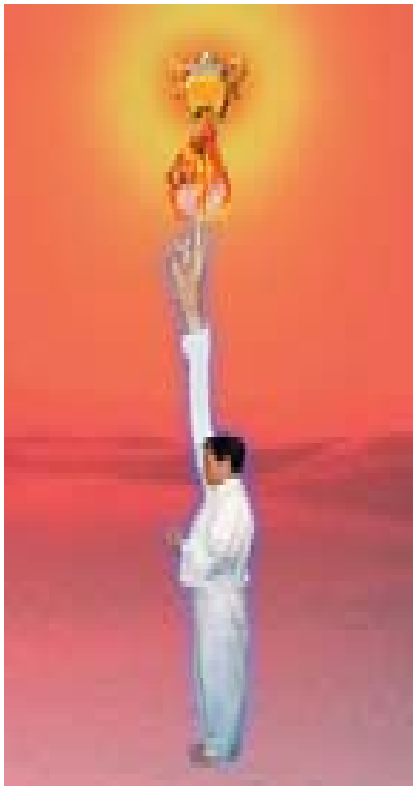

Use the Yi Power to draw the Sacred Fire Circle on the ground around your house, office and the room you work in.

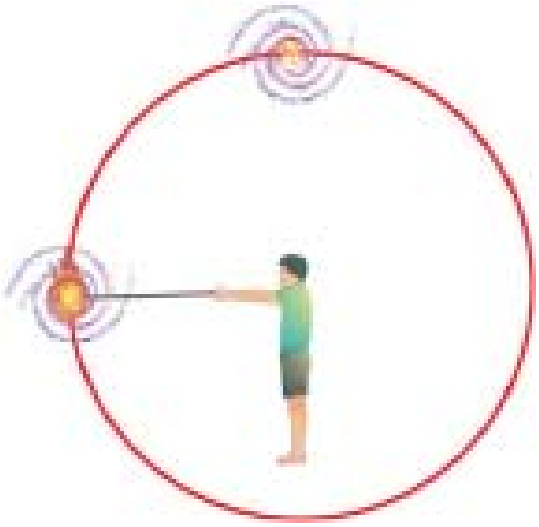

A. ***B.***

Fig. 4.14 A. *Create a Group Energy Body.* ***B.*** *Sacred Fire 'Protection'*

3. Create a Chi Dome

Set up the 'guardian animals', Blue Tortoise in the north, Red Pheasant in the south, Green Dragon in the east, White Tiger in the west, Yellow Phoenix above and Black Tortoise below.

Fig. 4.15 *Create and surround yourself with a Chi Dome and the Guardian Animals.*

4. Activate the Eight Elemental Forces of Nature and the Universe

Activate all eight forces; wind, mountain, fire and thunder on the east. Earth, lake, water and heavenly power on the west.

Call the Eight Forces; fire, water (ocean), thunder (lightning), lake (rain), earth, mountain, wind, and heaven.

Fig. 4.16 *Activate the Eight Forces.*

In the next sections F,G,H,I are practices that are for cleaning the cells. The more you clean the cells the more the Cosmic Healing can take place.

F. Chi (Sacred) Water Practice

The Sacred Water practice (also known in the West as Holy Water) is to exercise the right of being the creators of the Cosmos. With strict and absolutely regular daily water intake to prevent the stresses and associated damages of dehydration, the chief conductor and supervisor of the body's well being – tryptophan and its neurotransmitter derivatives, serotonin, tryptamine and melatonin will be well positioned to regulate all functions. Regular daily walks will keep muscles well coordinated and correct any physiological processes that are established in the body as a result of anxiety or emotional stress.

A well hydrated and healthy skin needs water to constantly replace that which it loses to the outside environment. This then allows blood vessels to the face and the body to open up and provide necessary nourishment for exposed skin cells.

Science has discovered that even if we clean water through filtration processes, although it may look and taste alright, closer analysis using high powered microscopic technology, indicates that its cell structure is 'unclean'. Water, like humans, maintains the memory of its old 'self'. We store our 'memory' within our DNA; water stores its memory within its cells.

The world is about 70% water

Fig. 4.17 *Water is Life.*

The following three pages contain extracts from the book 'The Message from Water' by Masaru Emoto. It advises us that 'water is telling us to take a closer look at ourselves - water is a mirror reflecting our mind.'

After offering a prayer to the Fujiwara dam the message is reflected in the water.

Chi and Love

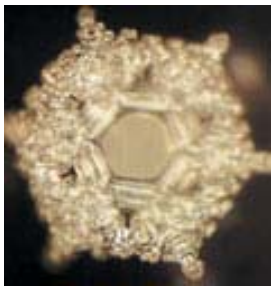

Love-Appreciation

Let's do it

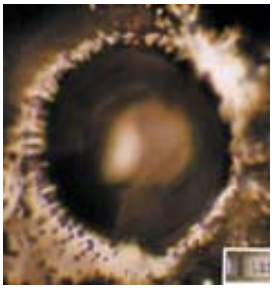

Do it!

Fig. 4.18 *The Human Body consists of 70% Water.*

When we project Chi and love into water and then freeze it; it will turn into a 'regular' and well structured crystal. If we project negative energy into water, the opposite will apply. Our projections will access the cellular level, clean out the polluted cells and reprogram those remaining with the essence of our affirmation.

When we project a nice, loving instruction or thought into water, like 'let's do it' the water will pick up this vibration and restructure itself. If we project negativity into the water, like a command, 'do it!', the water will acknowledge this accordingly. When we look into a pond we see our image. If we drink a glass of negative image water its destructive energy will enter our system and attempt to multiply.

Research has demonstrated that if we completely filter polluted water, using every process available, it will still maintain its old vibration and unstable structure. It will maintain memory in the same way that a computer does. We must therefore reprogram the cells with our intent.

If the water we drink contains too many pollutants and antioxidants it will eventually poison us.

As we can see from these pictures, there is an enormous difference between natural spring water and regular city water. It is now quite clear that if we program water so that it becomes, sacred, holy or Chi water, then it will have the power to remove all antioxidants and pollutants – all sickness. It will have the power to reprogram the water within our bodies, to carry the same pure structure.

Tokyo Tap Water

London Tap Water

Paris Tap Water

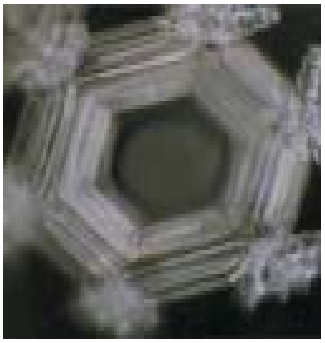

Under Ground Water in Northern Island, New Zealand

Buenos Aires, Argentina

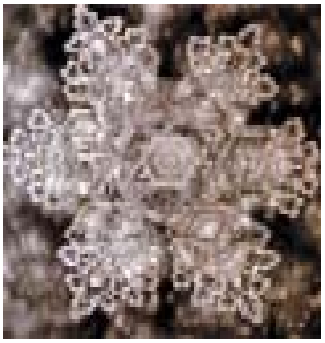

Spring Water of Saijo, Hiroshima Prefecture

Fig. 4.19 *Healing or hurting?*

We can also use music to program a vibration into water. Classical music will create a vibration that synchronizes with our own health, whereas heavy metal music will have a tendency to 'shatter'!

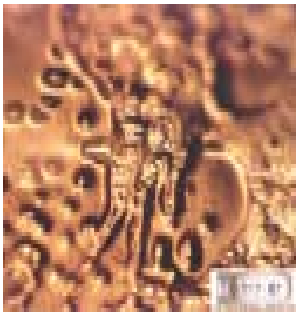

"You make me sick", or "I will kill you".

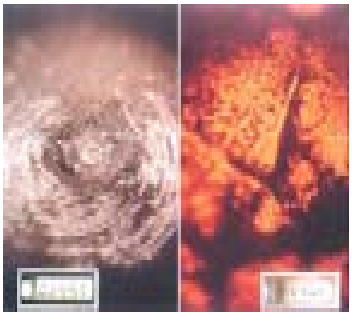

You Fool

Heavy Metal Music

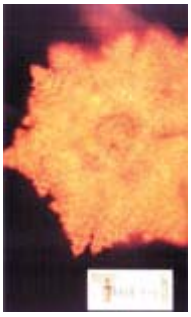

Thank you

Folk song of Celtic Region in UK

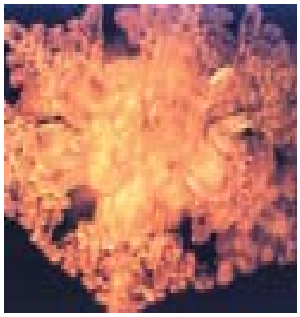

Healing Music

Fig. 4.20 *Power to heal or harm?*

Similarly, when we program our emotions regarding other people into water, the effects are the same. If we think negatively of someone, then the response will produce a bad vibration. If we think kind, loving thoughts then the structure will be like a beautiful crystal. If we love Mother Theresa and send this energy into the water, a wonderful crystalline structure will be created. Sick water can be transformed into healthy water. Healthy water can be transformed into sick water. The human body consists of 70% water. The key is your intent and your ability to believe that healing comes from the nature of your vibration. Always be open to receive.

Adolph Hitler

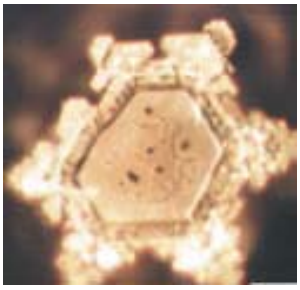

Mother Teresa

Dirty

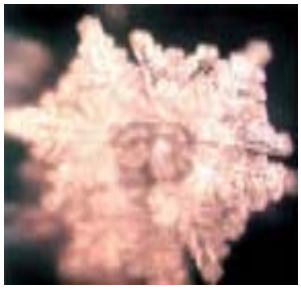

Beautiful

Fig. 4.21 *Sick or saintly?*

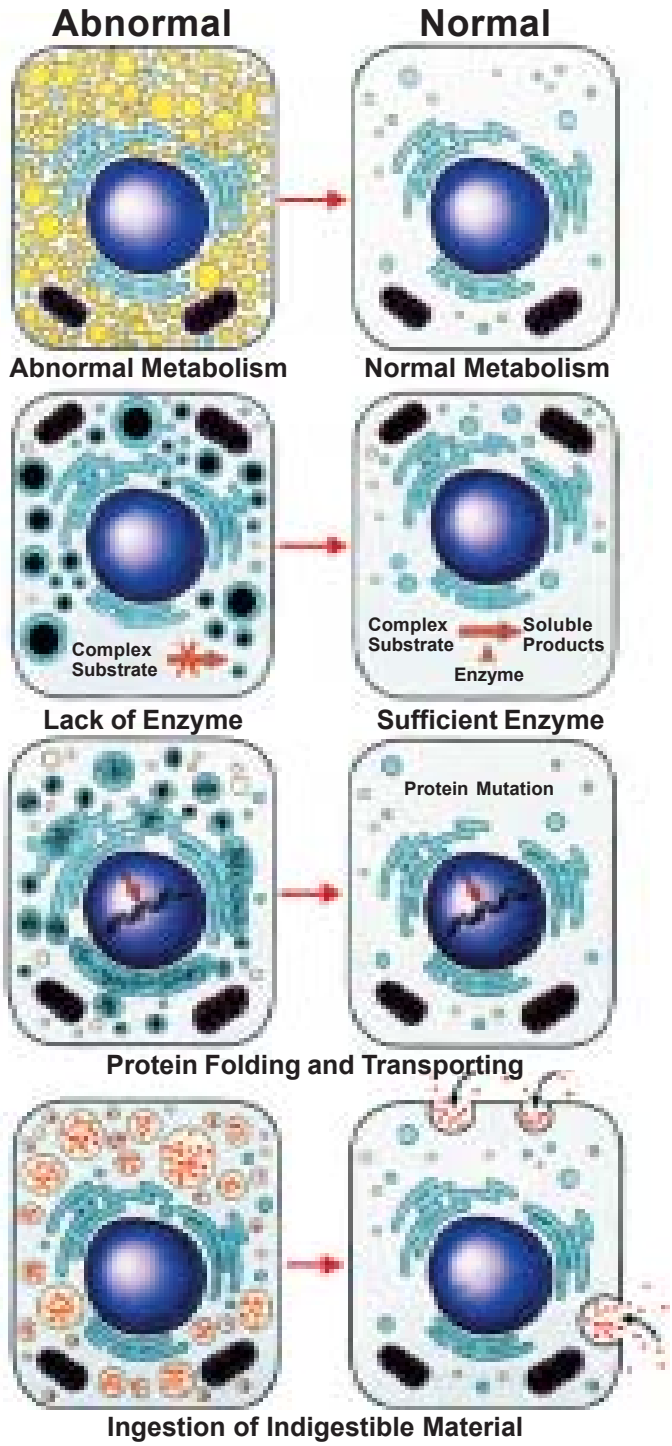

A positive mental attitude will be transmitted into the cells of the water contained within our own body. We must consciously practice inner work until it becomes reflexive.

Fig. 4.22 *With the Power of the Sacred Water Abnormal Cells can be cured.*

Outline of Sacred Water Practice

Invoke the power of the Sacred Water practice to cleanse and heal the body's sick, toxic or negative energy. **If you are working with a group of people, direct your energy through the energy body overhead and into each person's star, as you guide them through the procedure**.

I. Hold a glass one quarter full of water in your left hand, folding the middle and the ring fingers into the center of the palm.

II. Hold the glass in front of your body as you point the 'Sword Fingers' of your right hand up to Heaven.

III. Make a request to receive healing energy and feel yourself touch a heavenly pool of sacred water energy. Feel the pool pouring down heavenly water to fill your arm.

IV. Place your fingers on the cup and ask:
Command 1: ***"Yin power and good fortune come from the east. Yin power please dissolve all negative energy, all sickness and bad fortune".*** Make a cross over the top of the cup.

V. Bring your arm down and point the sword fingers around the inner rim of the glass. Smile as you circle the fingers around the rim.
Command 2: ***"By my request. Please carry out the order now."*** Repeat this three times, charging the water with Yin Power. Project your thoughts into the water.

VI. Use the thumb and index finger to remove the sick energy from the cup, without touching the water. Do this three times. Talk to the sick cells. Tell them to listen to your command:
Command 3: ***"All sick cells please listen: Clear, clean and bright, this Sacred Water will take all the sickness away."***

VII. Repeat the order and visualize yourself removing the sick energy from the cells and giving it to Mother Earth for recycling.

VIII. Hold the cup with both hands near your heart.
Command 4: ***"This Sacred Water will give me/you health, wealth and longevity."***
Project love, joy, thankfulness, gratefulness, appreciation and the energy of compassion into the cup.

IX. The Sacred Water will carry the message of the practice to all the cells, where it will remain. If you are practicing in a group, drink the water in unison. If you are working with a student, pass them the glass to drink using both hands.

Step I: Prepare the Hands and Arms to Receive the Universal Chi

Left Hand Position: Prepare to hold a cup or glass with the left hand by folding the ring and middle finger into the center of the palm. Hold the glass in front of the body.

A. ***B.***

Fig. 4.23 A. *Fold Ring and Middle Fingers.* ***B.*** *Hold Glass in Front of Body.*

Step II: Prepare the Sword Hands to Receive the Universal Chi

Right Hand Position: Form the right hand into a 'sword hand' by folding the pinkie, ring fingers and thumb into the palm. Straighten and hold the index and middle fingers together and extend them upward.

Fig. 4.24 *Prepare to receive the Universal Chi.*

Step III: Fill your Arm with the Power of the Heavenly Pool

Sense the sword fingers and the arm as being 'long' and 'big' as you raise them towards Heaven. Sense that the middle of the arm is hollow and bottom is sealed at the shoulder. The mind's attention is focused on merging with the primordial Chi of the Universe, the energy of your thoughts will be multiplied.

As you make your request to the Universe, feel that you are touching a heavenly pool of Sacred Water Energy. Feel that the pool is pouring down like a waterfall to fill the arm. When it is full compact, compress the Sacred Energy into it as much as you can.

Fig. 4.25 *Touch the Heavenly Pool.*

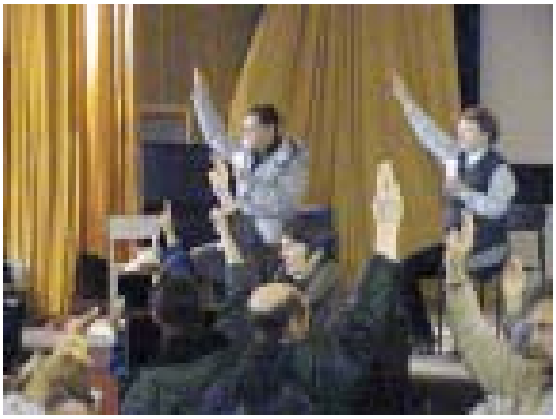

A.

B.

Fig. 4.26 A. *Blessing Sacred Water in Russia.* ***B.*** *Opening the Third Eye in Russia.*

Step IV: Make the Cross on the Top of the Cup

Put Sword Fingers on top of the Cup. Ask for the Yin Power: **Command 1:** ***"Yin Power and good fortune, come from the east. Yin has the power to dissolve all negative energy, all sickness and bad fortune."***

Command 2: Make the cross on the top of the cup and say ***"By my request....."***.

Fig. 4.27 *Give the command: "Fortune comes from the East - Yin has the power to dissolve all negative energy, all sickness and bad fortune. By my request....".*

Step V: Charge the Water to Transform it into Sacred Water

Bring your arm down and point the sword fingers into the glass of water. Smile and circle the sword fingers around the inner rim of the glass.

Continue to order: ***"Please carry out the order now."*** Repeat 3 times to charge the water with the Yin Power. As you do this, project a good thought into the water.

Fig. 4.28 *"Please carry out the order now" Repeat three times, charging the water with the yin power.*

Step VI: Command 3: ***"All sick cells please listen : Clear, Clean and Bright, this Sacred Water will take all the Sickness away."***

Give the above command. Use the thumb and index finger to pick up sick energy from the cup, without touching the water. Do this three times.

Fig. 4.29 *"All sick cells please listen: clear, clean and bright, this sacred water will take my/your sickness away".*

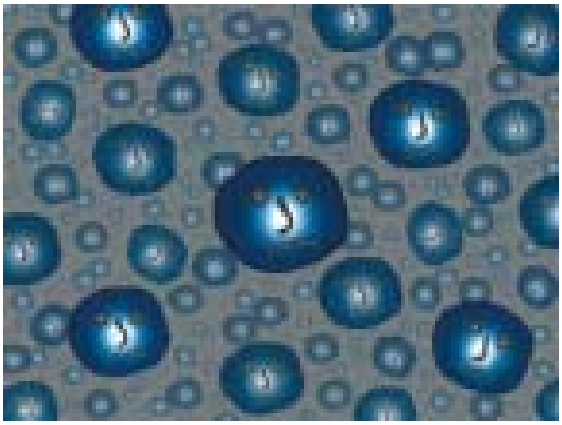

A.

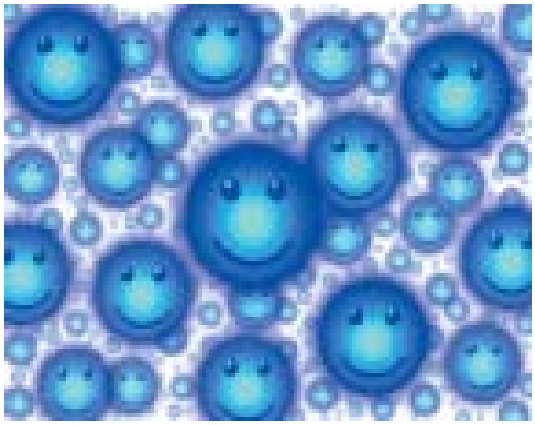

B.

Fig. 4.30
A. *Ask for the power to see the cells - if they are toxic and dark, ask for them to be cleaned out.*
B. *"Clear, clean and bright".*

Step VII: Let go of the Sick Energy to be transformed by the Earth

As you **repeat** the order, picture yourself removing the sick energy from the cells and discarding it down into the Earth to be transformed and recycled.

Fig. 4.31 *Sick Energy return to the Earth.*

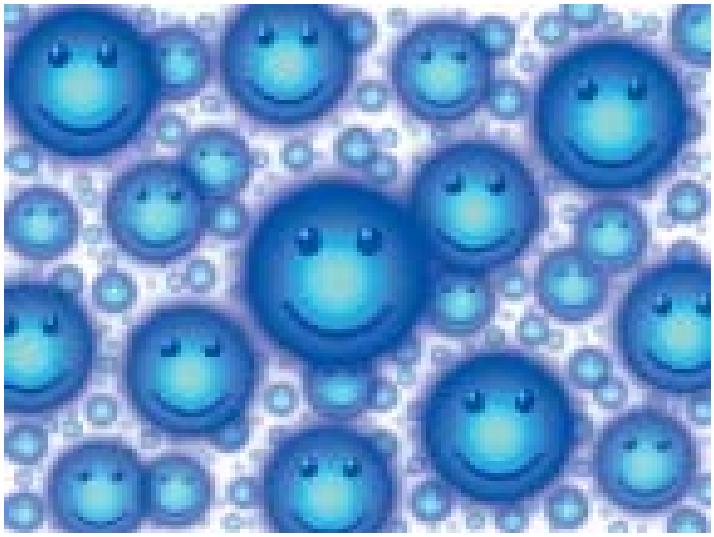

Fig. 4.32 *See the Cells become Clean, Bright and Smiling.*

Step VIII: Fill the Water with Compassion

Hold the cup with both hands near the heart and project goodness into the water. **Command 4: *"This sacred water will give me/you health, wealth and longevity."***

Project love, joy, thankfulness, gratefulness, appreciation and the energy of compassion into the cup.

Fig. 4.33 *"This Sacred Water will give you health, wealth and longevity."*

Step IX: Drink the Sacred Water

The Sacred Water will carry the message to all the cells. It will keep the message of the Sacred Water practice in all the cells. Use both hands to pass the Sacred Water to the student you are working with, or drink it yourself and/or in unison with your group. **Feel the water go into all the cells of your body. Feel it removing the sick cells and purifying your body.**

You can also sprinkle it on to any area that requires healing.

Fig. 4.34 *Drink the Sacred Water.*

G. Empty and Fill

Ask for permission to work on the student by communicating with their personal star. Point your sword hand down to the ground. Project your hand 'very big and very long' and your feet 'very big and very long' - extended down to the ground. Now very slowly inhale, bring up the earth energy. An important part of the practice is to extend a 'line' down from universe into yourself and one into the student. The line sinks through the Tan Tien into the universe below. You can send your energy up to your energy body and it will be brought down to the energy body of the other person.

Fig. 4.35 *Feel your hands are long as down into the earth they extend.*

Fig. 4.36 *Project the other person's legs deep into the earth.*

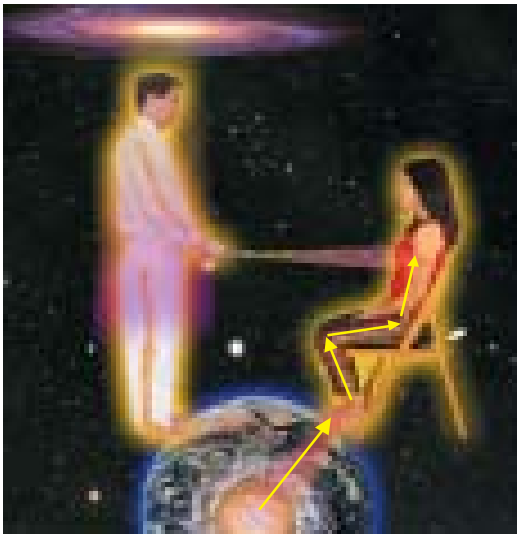

Fig. 4.37 *Blend the universal energy and Earth Chi - bring it into all of the bones and cells.*

Bring the energy up to your feet, into your bones. Let it enter all the bones, organs and cells. Feel it blending with all the sick energy. Turn your palm up, turn it back down again and exhale; let go of all the sick energy, the negative energy, the worries and the burdens all the way down to the earth. Down, down, down to the earth. Again from the earth up. Do it at least three, six or nine times. When people are very sick, you need to clean them thoroughly. Bring the earth energy up into your bones again. Feel numb, tinkling electricity flowing in all your cells. Return the energy down, down, down to the earth. Relax, let go; worries, burdens, let everything go. It is very important to say to yourself or group: **"You must let go of all your sick energy. Let go of all your burdens. Let go of all your worries, down to the earth".** Repeat it once again. Inhale from the universe and into the earth. From the earth let it enter into your bones. From the bones all the way to your inner self. Feel the energy blend with the sick energy. Exhale and let go of all your sick energy, any negative emotions burdens, worries, anxieties; release them all the way down into the earth.

Fig. 4.38 *Bring the Universal Chi down and let it blend with the sick and negative energy. Bring it down into the earth and bury it there.*

Empty negative, sick energy, burdens, worries, go deep down into the earth. Dig a hole and bury them there - tell them "Do not come back; you will be happy there."

Feel that the feet are long and extended into the earth. The hollow bones have been compacted with compressed Chi.

Once again guide the good Chi from earth up to the fill the person again. See the cells as big as the stars and fill them with Chi to blend with the dirty and sick energy. Then empty them again down to the earth.

Fig. 4.39 *You can also use a Tree to guide the Chi down into the Earth.*

H. Clean with Green Light

Become aware of your liver and breathe into your throat center. Feel that you are breathing the green light into your throat center and let it blend in the Tan Tien. The Chi comes up to blend in the heart, up to the crown, spirals and goes up to the universe. Raise your hand in a spiraling motion up to the universe. Use your 'one hand' to spiral in the universe. Spiral clockwise first. Spiral green light from the universe. Now reverse, counterclockwise - multiply and spiral counterclockwise, bringing the Chi down to clean out your communities, your house, the Tao Garden, the meditation hall, your bodies and all of the people that are 'here' - fill yourselves with Chi. You will use this power to see the cells.

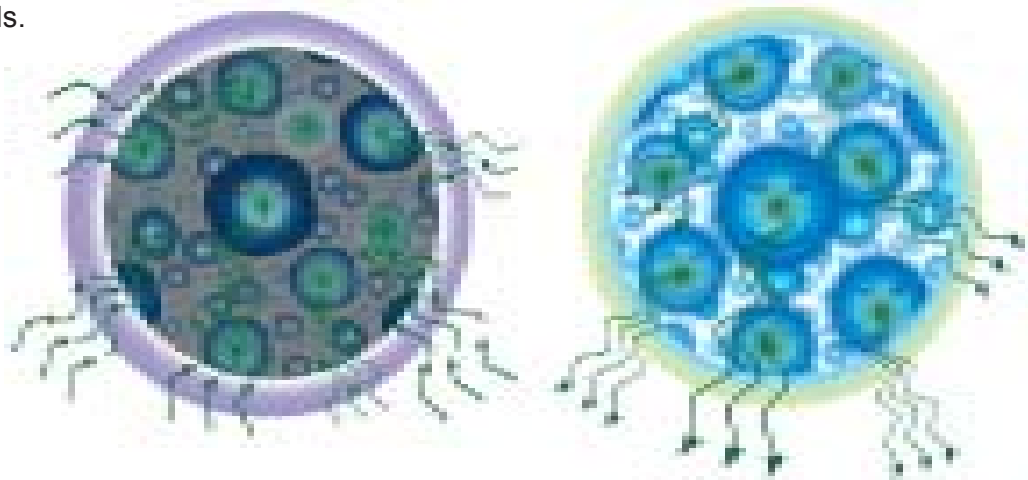

Fig. 4.40 *Spiral Sick Energy Counterclockwise down to the Earth. Smile to the Cells and let the Green Light clean out the sickness, flushing it down into the Earth below.*

See the cells enlarged and this green energy go in and blend with the dirty, black and cloudy energy. See it come out and let it go down into the earth. Dig a hole and bury it there. Tell it, “Don’t come back. You will be happy down there”. Become aware of the green light and spiral counterclockwise. Spiral down, cleaning out the stress. Clean out your house. Send everything down into the earth. Repeat three, six, nine, thirty six or one hundred and eight times. This depends on how much sick energy you are dealing with in your body.

Green:

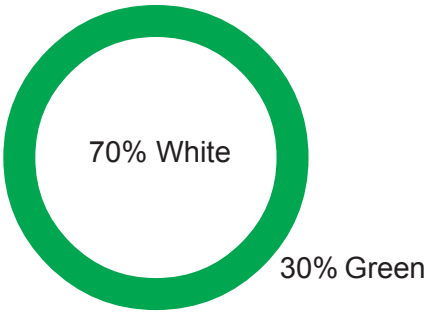

Fig. 4.41 *Clean with green.*

Green cleans and detoxifies all of the body’s cells. Green Chi is mild and safe. Green Chi is used for cleansing, and as a decongestant for diseased parts. It ‘loosens’ the area. The light green Chi is used to break down dirty or diseased energy, like a detergent is used for washing clothes or dishes. Afterwards, the cells will be rinsed with blue light, like clean water is used to rinse the detergent and residue from clothes or dishes.

Throat Center Green

Be aware of the liver’s green color, the throat and the forest. Breathe into the throat, feel yourself breathing in the green light. Guide it down to the Tan Tien, blend and move it up to the heart and the crown.

Project it to the universe; spiral and let it multiply.

Channel one direct line down to the student, one to your crown and one to your palm.

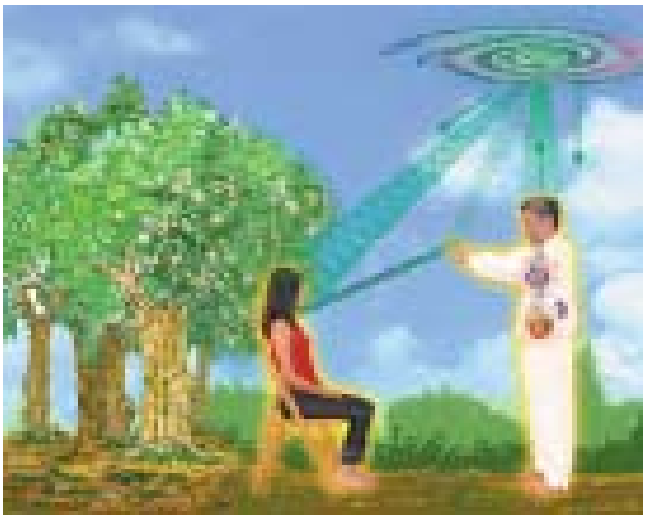

Fig. 4.42 *Blend Green Chi into the Three Tan Tiens - project to the Universe, multiply and bring the Energy back down to the Student.*

Be aware of the liver, the gall bladder, the forest and the throat breathing.

Be aware of the green light in the universe. Let the light come in and blend in the Tan Tien, up to the heart to blend with the compassion in the heart, and up to the crown.

Project the light up to the universe. See it spiral and let it multiply.

Always keep your Lower Tan Tien Fire warm. **Spiral in your Tan Tien and spiral the energy down to the student.** Spiral 1,000 revolutions per minute, 10,000, 30,000 and 60,000.

Fig. 4.43 *Draw down the Green Light from the Universe.*

Cleanse and Remove Sickness

Extend your arms up, with palms facing the heavens. Use one hand to spiral the green force down. The other hand holds the position and connects to the universe. Let this big pool of green light in the universe spiral down – through your community, your home and then into your crown.

Let the Green light blend into the cells and bond with sickness and toxins. Let the green light bring the sickness out of the cells and flow down to the center of the earth.

Dig a hole and bury it. Give the command: “Don’t come back. You will be happy down there. You will be transformed into good Chi.” Smile. Always smile.

Repeat it six, nine or eighteen times. For people who are very sick, who have cancer or may be terminally ill, you can do this two or three hundred times.

Fig. 4.44 *Green Light bonds with the Sickness and Toxins before returning them to the Earth.*

I. Clean with Blue Light

Be aware the blue light, kidney blue. Breathe the blue light into the throat center. Now slowly blend the blue light in the Tan Tien. Blend the blue light in the heart, in the crown and project it up to the universe, spiraling clockwise. Then feel the universe pouring the blue light back down; counterclockwise. Spiral down. Look at the cells and see the blue light, like water, go in to the cells to rinse and clean all the dirty things, down, down, down to the earth. All the way down. Repeat three, six or nine times. Smile.

Blue:

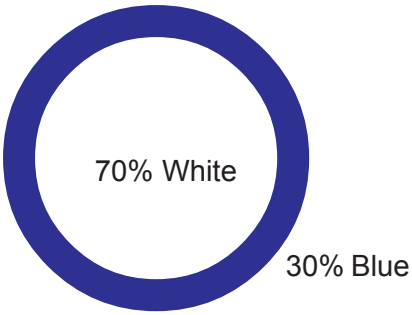

Fig. 4.45 *Rinse with Blue.*

Blue is like cold water; it has the yin power to dissolve all kinds of negative energy and sickness. It has an inhibiting effect. Blue yin energy is the opposite of red yang, which has a strengthening and stimulating effect. Blue has a cooling effect; it can reduce pain, inflammation and can help blood to clot. It stops bleeding and reduces fever. It can help to induce rest and sleep.

Throat Center Blue

Be aware of the kidneys' blue color and breathe the blue light into your throat. Guide it down to the Tan Tien, blend and move back up to the 'heart of compassion' and then the crown.

Project up to the universe, spiral and let it multiply.

Channel one direct line down to the student, one to your crown and one to your palm.

Fig. 4.46 *Multiply the Universal Blue Light - guide the Energy from the Throat, Heart and Crown into the Universe and back down.*

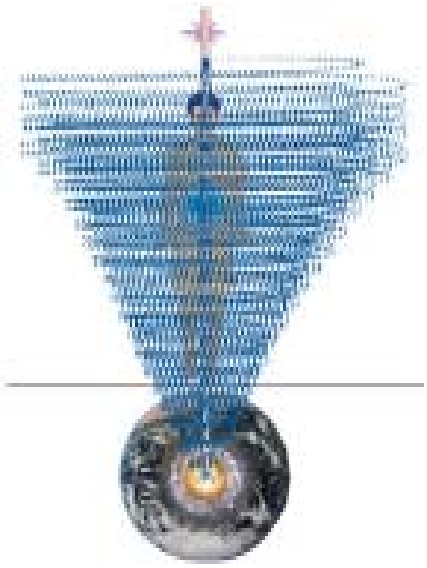

Be aware of the kidneys, the bladder, the oceans and the throat breathing.

Be aware of the blue light in the universe. Let the light come in and blend in the Tan Tien, up to the heart to blend with the compassion and up to the crown.

Project the light up to the universe. See it spiral and let it multiply.

Fig. 4.47 *Draw the Blue Light from the Universe - rinse clean and remove sickness.*

Rinse and Flush

Extend your arms in the air, with palms facing heaven. Use one hand to spiral the green force down. The other hand holds the position and connects to the universe. Let a big pool of green light in the universe spiral down – through your community, your home, and then into your crown.

Let the blue light flush into the cells and flush out sickness and toxins towards the center of the earth.

Dig a hole and bury them. Give the command: "Don't come back. You will be happy down there. You will be transformed into good Chi."

Repeat it six, nine or eighteen times. For people who are very sick, who have cancer or who may be terminally ill you can do this up to thirty six, seventy two or one hundred and eight times.

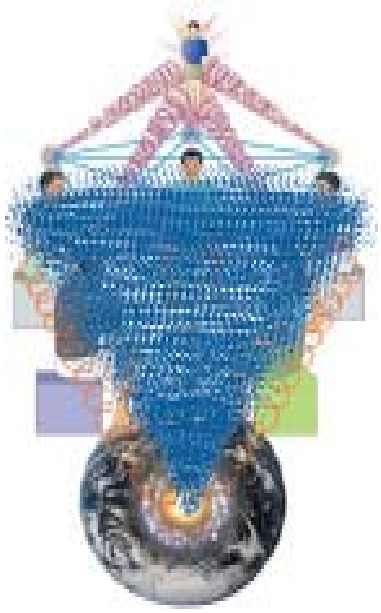

Fig. 4.48 *Blue Light flushes out the sickness and toxins before returning them to the earth.*

J. Charge with Violet Light

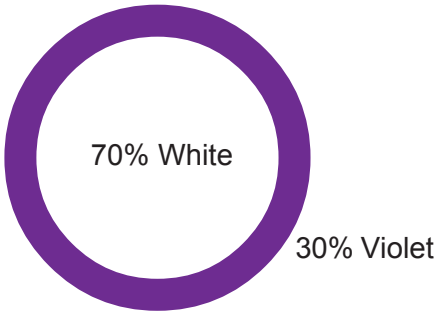

Fig.4.49 *Intelligent Luminous Violet*

Luminous Violet has intelligence and can be programmed. The universe is full of violet light, especially the North Star and the Big Dipper. The color of the star of the higher self or soul, above the crown, is also violet light, the Divine or Soul energy.

It has properties of other Chi colors. It has a rapid regenerating effect on damaged organs and nerves. Always use green and blue light before using violet. Violet light develops the crown center, the spiritual core. It is good for psychological ailments as well as for physical deficiencies.

Primordial Force

Turning the three minds into one mind, go deep into the empty space of the cell and deep into the chromosomes, magnify the space as you enter into the DNA and return to the original cells. The empty space is the Wu Chi. When you enter this stage you turn the subconsciousness into consciousness and you can talk to your body and cells. You can change the programming of DNA and RNA.

Ask for the power to see the cells and look at the brain cells spread out into the space. “Brain cells please listen. Clear, Clean, and Bright: fill with violet light and return to normal function”.

Violet Light into the Cells

See violet light. Be aware of your crown. The Tan Tien Chi and the negative Chi all combine in the crown. Extend a violet light up to the universe. See the North Star in the Big Dipper. Tell the student to hold their arms in the air, so that they can funnel the Chi into their personal star. Bring the North Star and the Big Dipper down; hold the handle of the Big Dipper and pour the violet light over the student’s personal star. The higher cells will be programmed. Let the Chi enter the brain and ask for the power to see the brain cells. “Brain cells listen to the command”. If there is sickness in the brain, give the command. “Sickness go away”.

The North Star is a major source of violet light.

The Big Dipper is a major source of red and infrared light. Taoists understand that the cup of the Big Dipper gathers all the violet light from the universe. The left hand holds the handle of the big dipper - pour it down to your crown. It then flows down throughout the body.

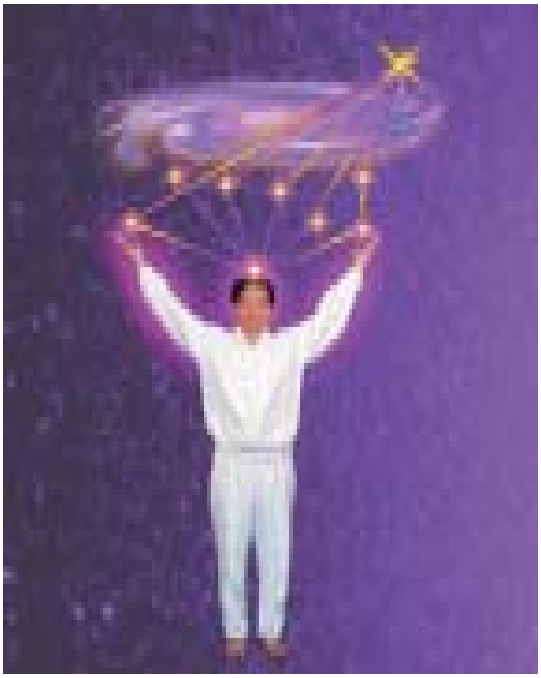

Fig. 4.50 *Connect with the North Star to receive the Violet Light.*

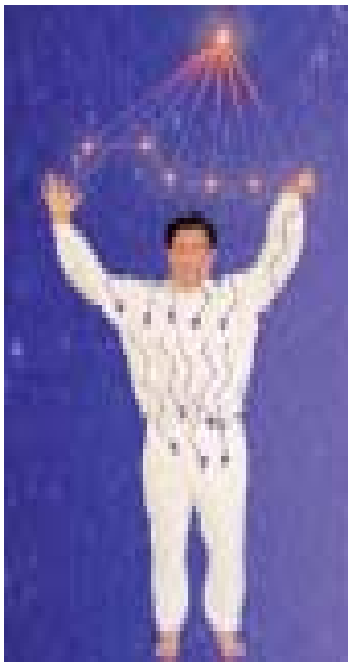

Fig. 4.51 *Practitioner connects with Universal Violet Light.*

Bring the violet light down to the student's personal star above their crown. Pause to let the higher cells of the brain reprogram the violet light at the personal star. Continue to spiral the violet light down through the cells of the brain and down through the cells of the whole body.

Fig. 4.52 *Pause to reprogram the Violet Light at the other Person's Personal Star.*

Fig 4.53 *Lead the person and guide them to follow you.*
Tell them to focus on the part of their body that you are working on.

1. Ask for the power to see into the cells of the brain. Ask the student to move their hands to cover their brain. “Brain cells listen to the command: Sickness go away. Clear, clean and bright; fill with violet light and return to normal function”.

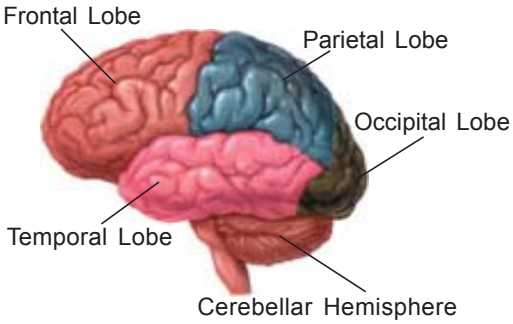

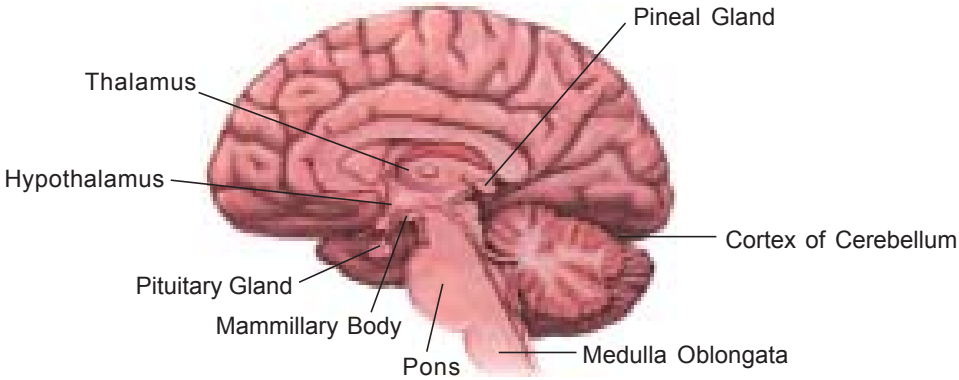

Fig. 4.54 *“Clear, clean and bright; fill with violet light and return to normal functions”.*

Brain Cells

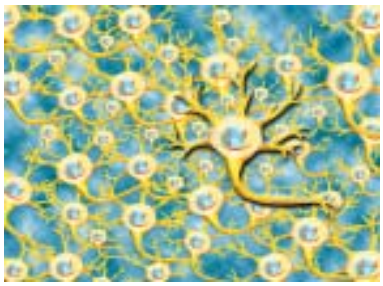

Healthy Happy Cells

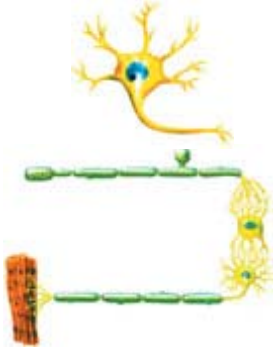

Fig. 4.55 *‘Intent’ to Heal.*

2. Ask for the power to see the cells of the sense organs. Ask the student to move their hand to cover their senses. Give the command: “Eyes, ears, nose, tongue and mouth cells listen to the command. Sickness go away. Clear, clean and bright; fill with violet light and return to normal function”.

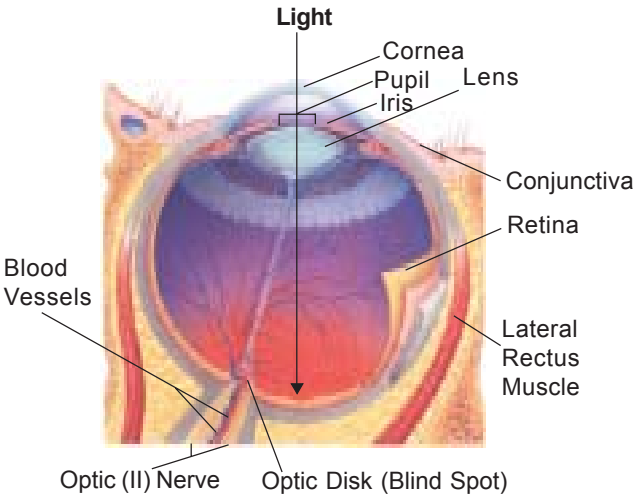

Fig. 4.56 *“Eyes, listen; clear, clean and bright; fill with Violet Light and return to normal function”.*

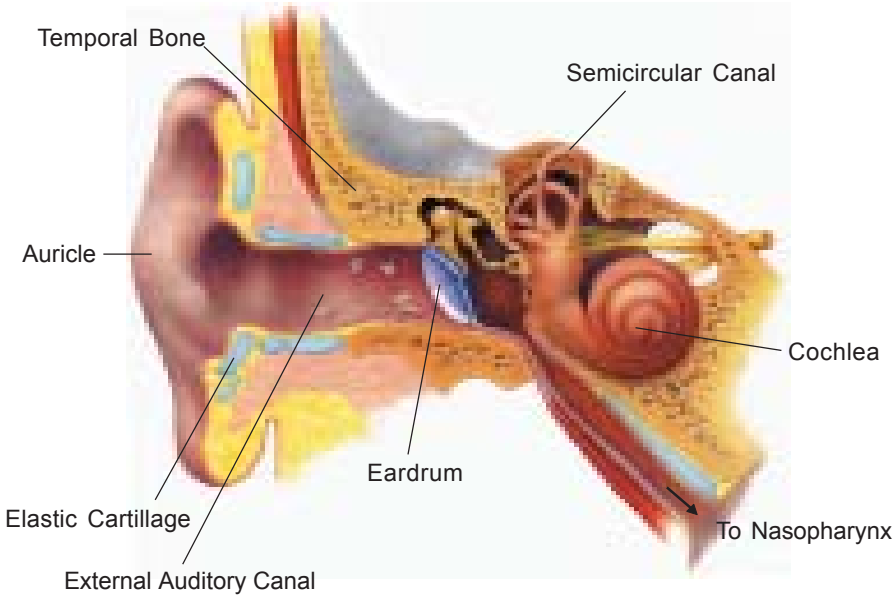

Fig. 4.57 *“Ears, listen; clear, clean and bright; fill with Violet Light and return to normal function”.*

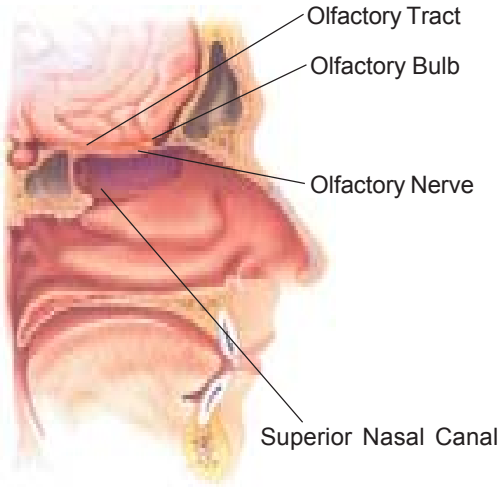

Nose

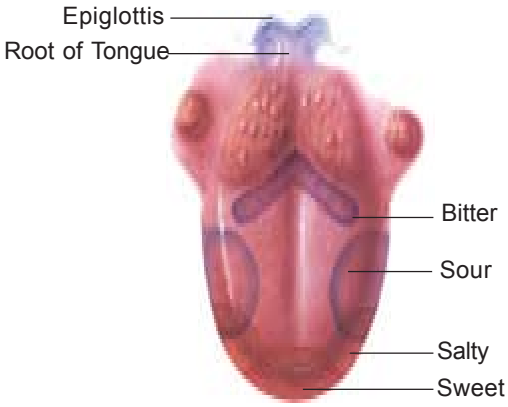

Tongue

Fig. 4.58

"Nose, tongue, listen; clear, clean and bright; fill with violet light and return to normal function"

3. Move your hands down to your throat center and give the command: "Thyroid, parathyroid and Thymus glands, listen to the command; Clear, clean and bright; fill with violet light and return to normal function".

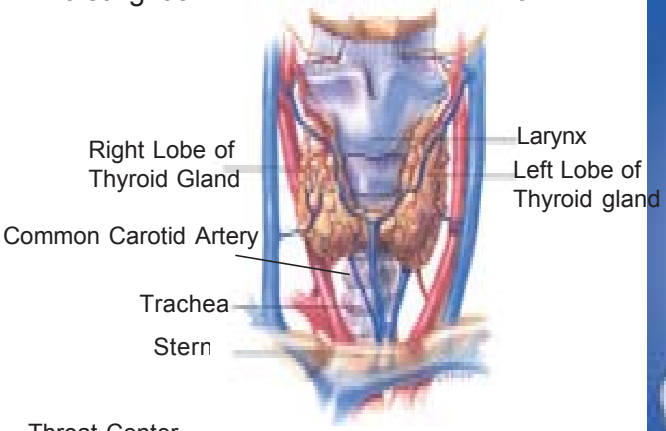

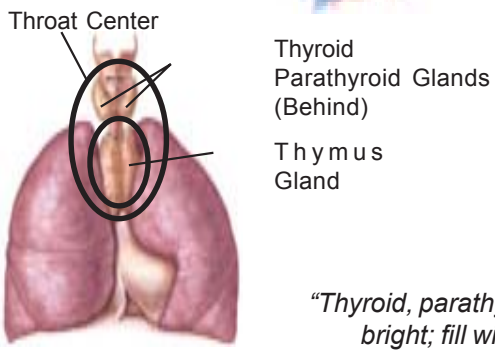

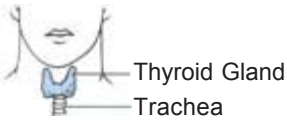

Fig. 4.59

"Thyroid, parathyroid and thymus glands - listen; clear, clean and bright; fill with violet light and return to normal function".

4. Move your hands to the heart and the lungs. Ask for the power to see the cells of the heart and lungs. Give them the command: “Lungs and heart cells, listen to the command”. If there is no sickness, just clean them out. See the cells and clean them out with violet light. If there is sickness, tell the sickness to “go away - be clear, clean and bright; fill with violet light and return to normal function”. Make sure that you say this part aloud. Give the command in a very firm tone of voice.

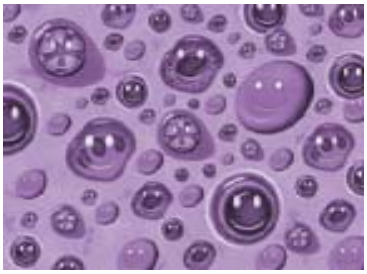

Fig. 4.60
“Heart and lung cells please listen; clear, clean & bright; fill with violet light and return to normal function”.

5. Move your hands to cover the left and right sides of the ribcage. Ask for the power to see the cells of the liver, gallbladder, spleen, pancreas and stomach. Give them the command: “Liver, gallbladder, spleen, pancreas and stomach cells, listen to the command”. If there is no sickness, just clean them out. If there is sickness, tell the sickness to, “go away - be clear, clean and bright; fill with violet light and return to normal function”. Make sure that you say this part aloud. Give the command in a very firm tone of voice.

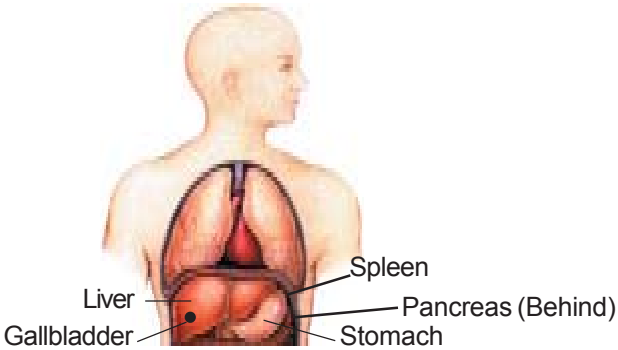

Fig. 4.61
“Liver, gallbladder, pancreas and spleen cells please listen; clear, clean and bright: fill with violet light and return to normal function”.

6. Move your hands to the large and small intestine on the front of the abdomen. Ask for the power to see the cells of the intestines. Give them the command: "Large and small intestine, listen to the command". If there is no sickness, just clean them out. See the cells and clean them out with violet light. If there is sickness, tell the sickness to, "go away - be clear, clean and bright; fill with violet light and return to normal function". Make sure that you say this part aloud. Give the command in a very firm tone of voice.

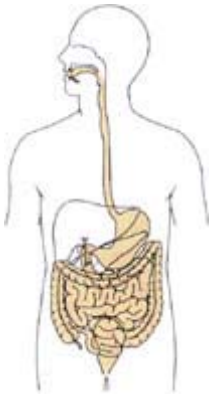

Intestines

Healthy cells

Fig. 4.62 *"Small and large intestine cells listen to the command: clear, clean and bright; fill with violet light and return to normal function".*

7. Move your hands to the kidney and sexual organs and ask for the power to see their cells. Give the command: "Kidney and sexual organ cells listen to the command: Clear, clean and bright; fill with violet light and return to normal function". Gather the violet light again and let it pour down and fill all the cells. See the violet light again and feel and see that all the cells are, "clear, clean and bright". Smile.

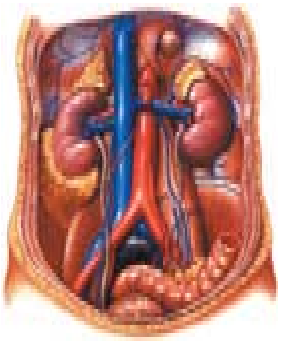

Kidney

Testes

Ovaries

Fig. 4.63 *"Kidneys and Sexual Organs listen".*

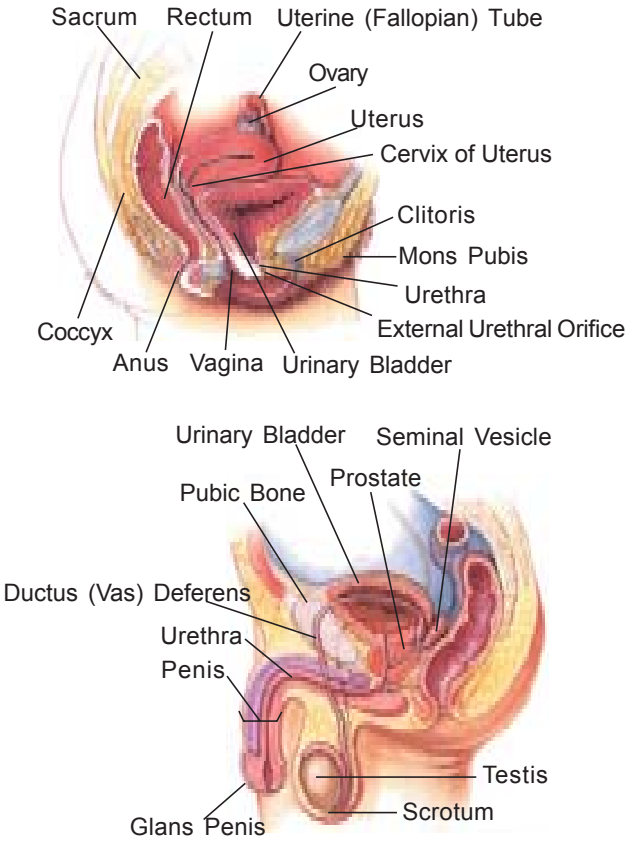

Fig. 4.64 *Male and Female Sexual Organs*

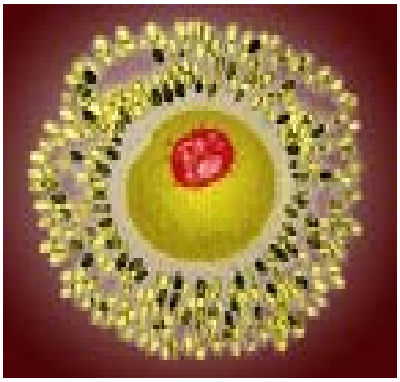

Egg

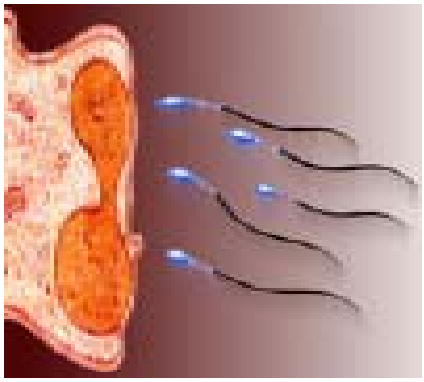

Sperm

Fig. 4.65 *"Clear, clean and bright: fill with Violet Light and return to normal function".*

K. Activate the Defense and Immune System

The Defense System relates to the white blood cell and the immune system relates to the Lymphatic System.

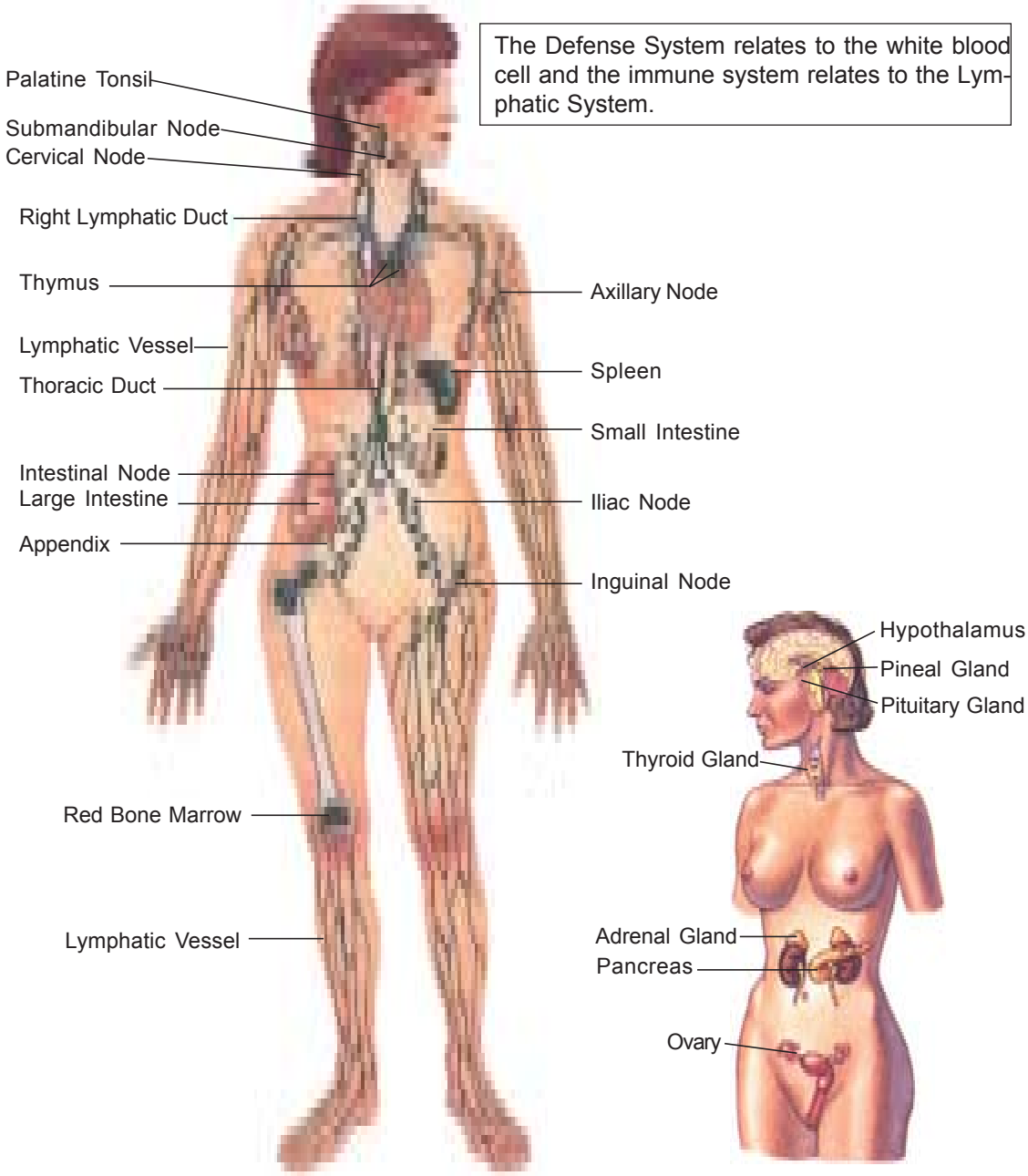

Fig. 4.66 *Ask the cells to listen to the command.*
The bone marrow produces red and white blood cells. The lymphatic system cleans the toxic and polluted material and bacteria from the cells.

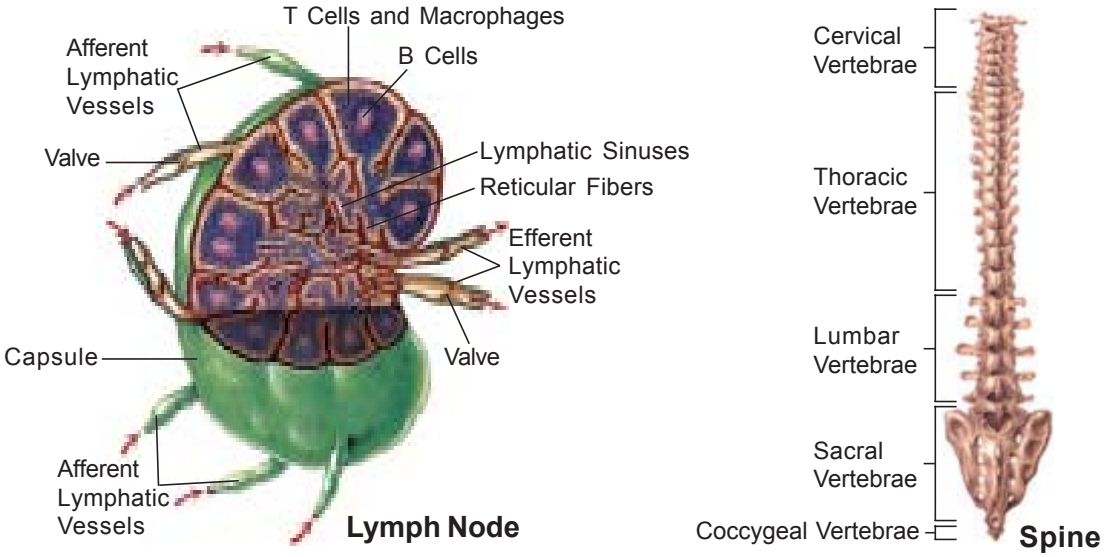

Fig. 4.67 *"Immune Cells and Vertebrae please listen: clear, clean and bright; fill with Violet Light and return to normal function".*

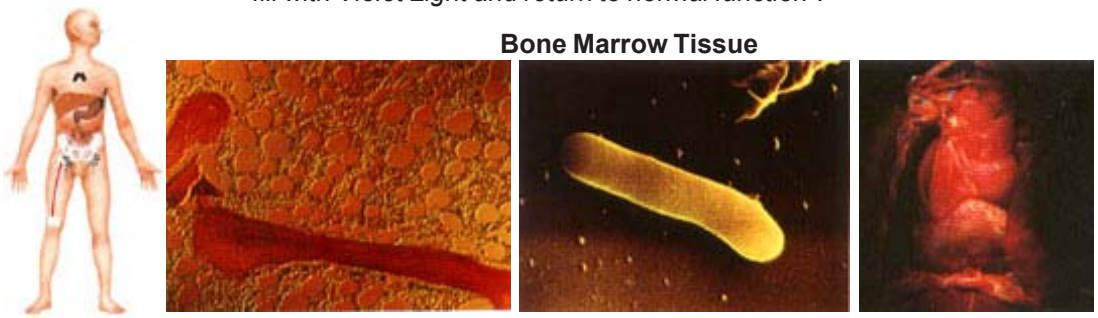

Sacrum: The sacrum controls all the bones and marrow. It effects the production of red and white blood cells. The bone marrow produces the lymphatic cells (white blood cells). When the blood is full of Chi it becomes lighter. Negative emotions make the blood thick and acidic. The blood cells in a healthy body can live up to ten times longer than in a weak or diseased one.

Bone Marrow: A tissue rich in fats, containing plenty of nourishment for the comprehensive production of the different blood cells: red cells for the transport of oxygen, blood platelets for clotting and the various white cells for the immune system.

Bacterium: Represents the foreign invader, but it is only one of many invaders. Parasites, fungi, viruses, chemicals, mineral fragments, metal particles—these and a great deal besides, set the immune system to work.

Thymus Gland: Perhaps the most important organ of the immune system. The vital training of the different T-lymphocytes takes place inside. When they pass through the thymus they receive a program to convert them into 'T' lymph cells. When they pass through the liver and large intestine they become 'B' cells and helper cells.

We have obtained Fig. 4.68 and the following text from the publication 'The Body Victorious' by Lennart Nilsson and Jan Lindberg.

We hope that you find this short selection of material as informative as we did.

"The illustration below is a highly schematic and simplified picture of our immune system. *Top left*, the pale yellow 'house' symbolizes the bone marrow, where all blood cells are born. *Bottom Right*, a solitary bacterium (yellow) represents the foreign invader that the immune system needs to combat. The light blue path represents the older defenses, with various feeding cells that tackle all foreign substances and also function as a kind of cleaning system. They deal with all the old, dead and used-up material in the body. The newer, special defense force, which develops later, follows the green path. Its cells are more specialized; they obtain their special training and reach maturity in organs such as the thymus gland and in the lymphoid tissue around the intestines and in the liver. In the lymphoid tissue, the yellow 'half-way house' (far right), the 'B-lymphocytes are trained. These are the precursors of the large plasma cells - the pale green cells (far right) in the illustration, which produce the body's sniper ammunition, the antibodies (Red and Y-Shaped).

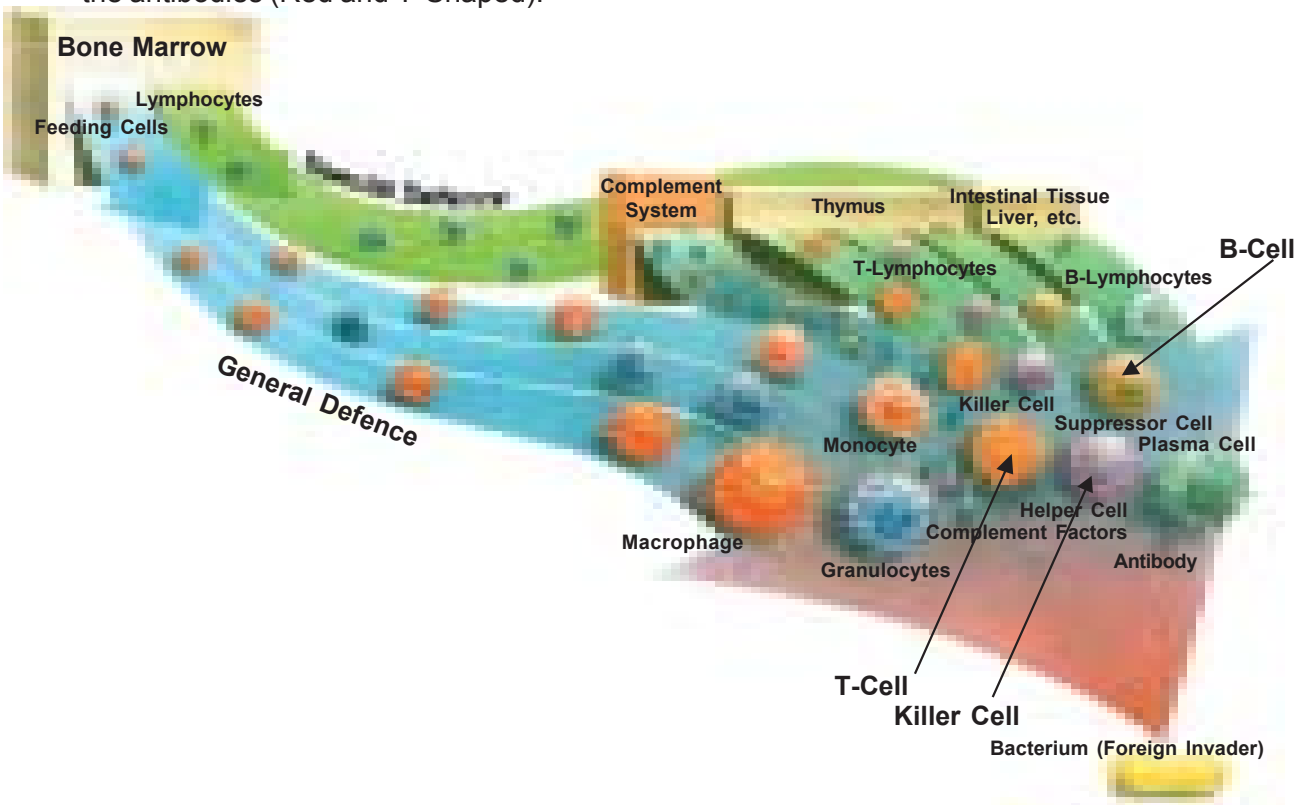

Fig. 4.68

Bone marrow, bacterium and thymus please listen: clear, clean and bright; fill with violet light and return to normal function".

The three paths from the thymus are intended to show that there are different types of T- lymphocytes - among others, aggressive killer cells, helper cells and suppressive cells. All of them have specialized tasks to perform when the immune system launches a counterattack. The three blue paths of the older defenses have three different kinds of feeding cells. First, the large and powerful macrophages (orange) advance on the enemy; then come the granulocytes (blue), smaller and faster moving, followed by the (pink) monocytes. The nuclei in the shimmering cell bodies are faintly discernable. In addition, there is an important complement system (middle), symbolized here by a multicolored range of small spheres flocking toward the foreign bacterium. These molecules play a large part in increasing the efficiency of both antibodies and feeding cells. In addition, they have the capacity to destroy bacteria by shooting holes in them. The complement factors are produced in many different cells in the body.

Chi Kung has a very strong effect against viruses. Altough medical science is struggling to discover a medicine that will kill them, Chi Kung practice is able to prevent them from occuring in the first place. Whether we are sick or healthy, we all need our defense system to be in good shape.

Defense System - Outline of Practice

1. Work on yourself first to activate your sacrum. Project the sacrum as big as the universe. See the eight holes in the bone and visualize them breathing. Breathe and compress the Universal Chi into the bones. Feel the Chi begin to rise up the spine and into your mideyebrow and temple bones. When you feel that there is enough Chi, project it out to the universe, multiply it and spiral it back down. Project it towards the student and ask them to touch their sacrum. Rub your hands until warm and touch the sacrum. Picture the sacrum getting bigger and bigger, breathing into the eight holes. Tell the person to smile at the sacrum and start to work on your Tan Tien and universe. Multiply more energy and picture the Chi from the universe coming down to the sacrum of the other person (and your own) and then charge up the spine, to the rib cage, to the temple bone and to the mideyebrow.

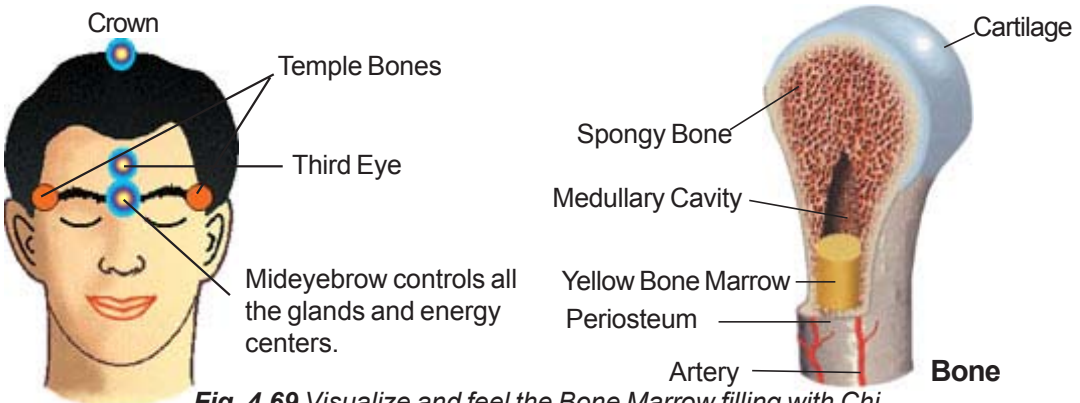

Fig. 4.69 *Visualize and feel the Bone Marrow filling with Chi.*

2. Tell the student to move their hands to the hip bones. Tell them to smile to these bones. Feel them as 'funny, laughing, happy bones'. Tell them to feel the electricity in the sacrum and bone marrow.
3. Touch the femur bones. Feel the electricity running up the legs.
4. Touch the humerus bones. Feel the electricity running up the arms.
5. Touch the lower part of the sternum and feel the Chi penetrate into the bones and spread out to the rib cage. Feel the electricity run throughout the rib cage.

Practice

1. Touch the sacrum, feel your fingers grown 'long' and penetrate into the marrow. Feel that the sacrum is as big as the universe and that the Chi has been compacted. Fill the sacrum with Chi. The eight holes are breathing. Let the fingers touch the sacrum and become aware of the Tan Tien spiraling, until you feel the crown and the mideyebrow spiral and connect to the universe. Hold until the universe fills the sacrum once again and rises up the spine to the mideyebrow.

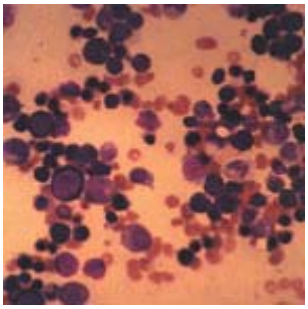

Bone Marrow Cells

Fig. 4.70 *Touch the Sacrum - see the Eight Holes breathing - fill the Sacrum, Mideyebrow and Crown with Chi - empty to the universe and 'fill' again.*

Sacrum Breathing to get Chi

Breathe through the sacrum; feel red and yellow light enter. Guide it into Tan Tien. Blend the Chi in the Tan Tien. Move up to the Heart Center. Move up to the Crown and project up to the universe; let it blend and multiply. Multiply in the universe

Open a direct channel down to the other person, and one to your palm.

Sacrum Chi

Project the student's feet down to the earth and connect to the earth's core.

Third Eye and Temple Bones are aligned in a triangle.

Activate the Sacrum until you feel the Chi rising up the spine and feel it pulsing; be aware of the Temple Bones.

Fig. 4.71 *Activate the Sacrum - Be aware of the Temples.*

2. Tell the student to move their hands to the hip bones. Tell them to smile to these bones. Feel them as 'funny, laughing, happy bones'. Tell them to feel the electricity in the sacrum and bone marrow. Tell the student to pack and compress the Chi into the bones in order to revitalize and revive bone marrow. Give the command. "Produce healthy white and red blood cells".

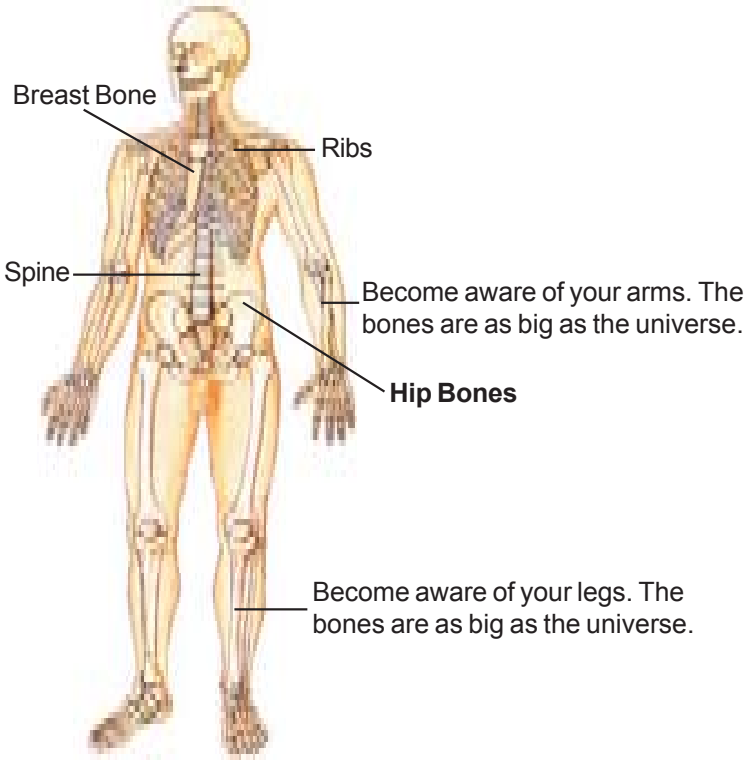

Fig. 4.72 *"Hip Bones produce healthy White and Red Blood Cells".*

White Blood Cell
(Neutrophil)

Leave the fingers touching the hip bones and start to spiral in the Tan Tien until you feel the crown and the mideyebrow also spiral. Expand your awareness to the Universe and the Universe will charge into the hip bones.

Fig. 4.73 *Touch and feel the bones. Leave your fingers there - lower your mind into the Tan Tien and the universe.*

3. Touch the middle part of the femur bone to help increase the production of healthy red blood cells. Feel the electricity running up the legs. Give the same command for the femur bones: "Funny, laughing, happy bones produce healthy white and red cells." After that put your mind into the Tan Tien and universe so that the Chi can charge into the bones. Feel electricity run throughout the whole skeleton.

Fig. 4.74 *"Funny, laughing, happy femur bones produce healthy white and red blood cells".*

4. Touch the humerus bones. Feel the electricity running up the arms.Give the same command: "Funny, laughing, happy bones produce healthy white and red cells." After that, put your mind into the Tan Tien and universe so that the Chi can charge into the bones. Give the same command for the lower part of the sternum. Chi penetrates into the bone and spreads out into the rib cage 'Tan Tien and Universe'. Put your mind into the Tan Tien and the universe so that the Chi can charge into the bones.

5. Touch the lower part of the sternum and feel it and the rib cage as funny, happy, laughing bones. Feel the Chi and electricity penetrate into the bones and spread out to the rib cage. Touch the lower part of the sternum. Give the same command again. "Produce healthy white and red cells". After that you put your mind into the Tan Tien and universe so that the Chi can charge into the bones.

You have finished activating the defense system.

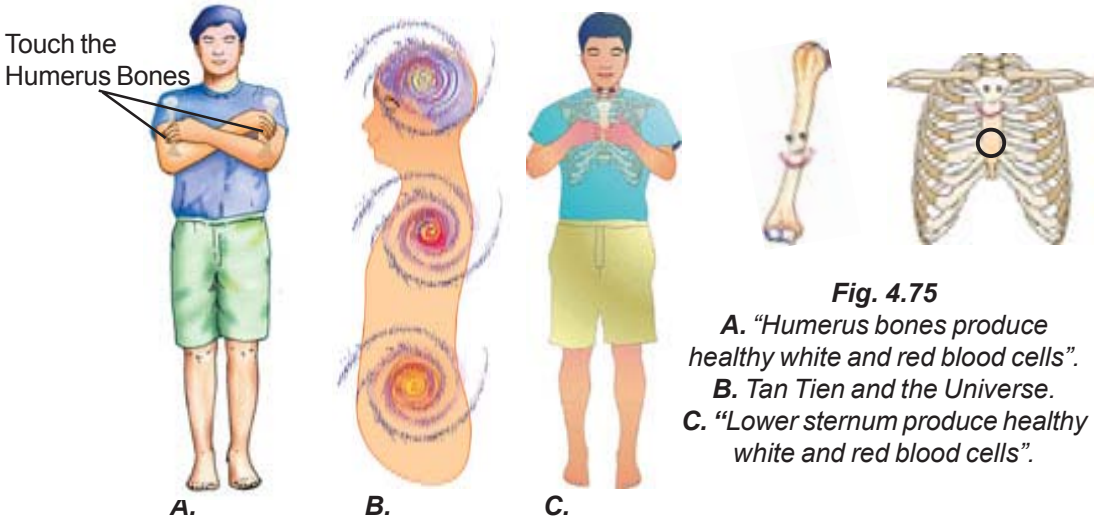

Fig. 4.75
A. *"Humerus bones produce healthy white and red blood cells".*
B. *Tan Tien and the Universe.*
C. *"Lower sternum produce healthy white and red blood cells".*

Immune System

1. The Immune System starts with the top part of the sternum. Touch the top part of the sternum. Project your fingers 'very long' into the bone and feel them penetrate right into the thymus. Activate the thymus gland. Gradually, feel the fingers rising up to the thyroid and parathyroid. Activate the thyroid and parathyroid and throat center. Give the command, "Clear ,clean and bright fill with violet light and return to normal function".

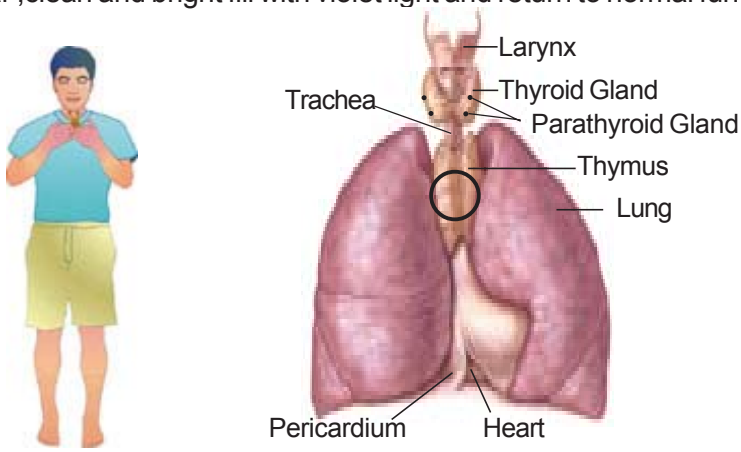

Fig. 4.76 *Touch the Top of the Sternum & activate the Thymus, Thyroid and Parathyroid Glands.*

2. Move the fingers to touch both sides of the jaw bones to help activate the tonsils, the body's first line of defense. The jaw bone affects the lymph nodes beneath, which include the tonsils. Fill them with Chi. Give the command, "Clear, clean and bright; fill with violet light and return to normal function".

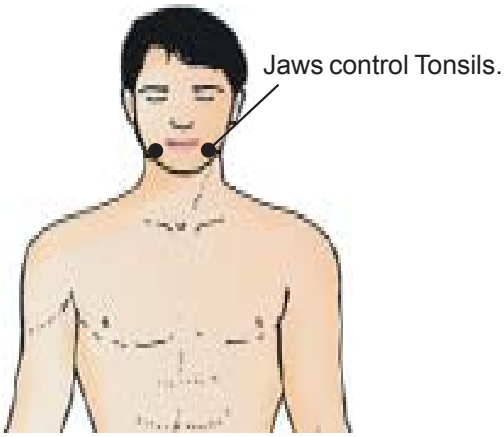

Fig. 4.77 *Activate the Tonsils and Jaw Bones.*

3. Touch the mideyebrow and crown, which control the pituitary and pineal glands respectively. Touch the third eye, feeling it open and feel the light from heaven entering into your brain and into your body. Touch the crown. Feel your fingers reaching deep inside and feel the Chi penetrating all the way down to your perineum. Give the command, "Clear, clean and bright fill with violet light and return to normal function".

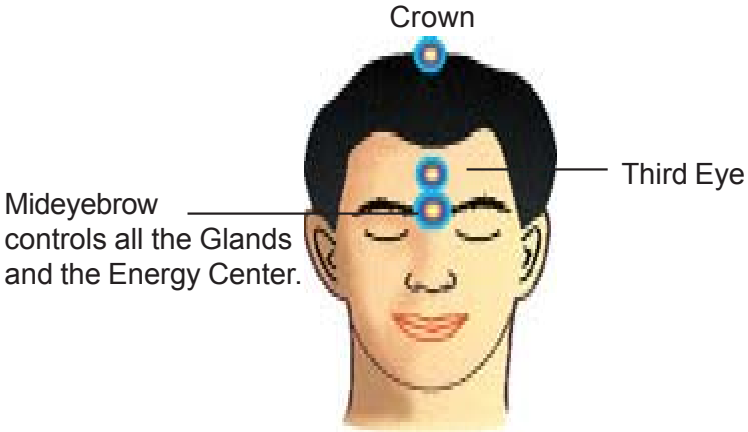

Fig. 4.78 *Third Eye, Mideyebrow and the Crown affects the Immunity and Defense Systems.*

4. Rub both of your hands until they are warm and cross the hands on the neck and feel the lymphatic system has been activated. Cross your arms and hold your hands

under your armpits. Picture the lymphatic system of the armpits as you activate the lymph nodes. Give the command; “Clear, clean and bright fill with violet light and return to normal function”. The lymphatic system of the upper body is clear, clean and bright and the lymphatic fluid flows! Smile.

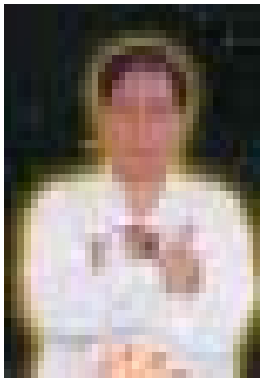

Fig. 4.79 *Lymphatic System of the Neck and Armpits are clear, clean and bright.*

5. Move the hands to the cover the groin area. Give the command to the lymph nodes there. Next, cover the lymph nodes of the navel area, and give the command; “Clear, clean and bright fill with violet light and return to normal function”. The groin and the navel area lymph nodes become clear, clean and bright.

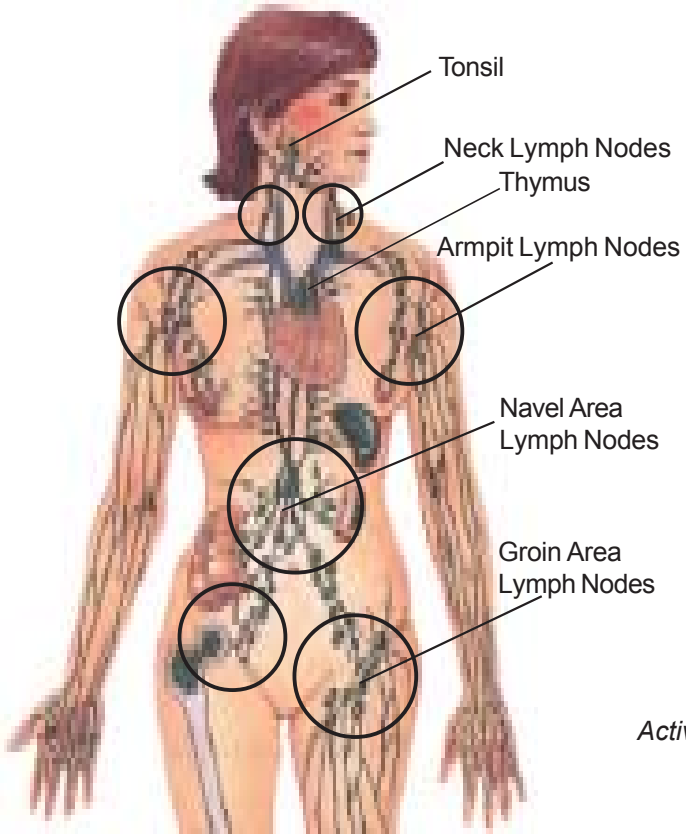

Fig. 4.80
Activate the Lymph Nodes in the Groin.

6. Place your palms over your navel and activate the lymph nodes. Give the command; “Clear, clean and bright fill with violet light and return to normal function”. See them become clear, clean and bright. You have now activated the immune system.

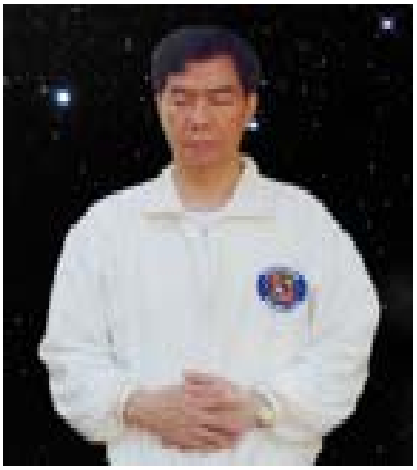

Fig. 4.81
Touch and activate the Lymph Nodes in the Navel.

Summary - General Healing Session

This General Healing Session will help everybody.

A. Three Minds into One
B. Activate the Six Directions
C. Activate the Three Fires
D. Linking Personal Stars, Energy Bodies and the Universe
E. Protective Circle and Chi Field
F. Chi Water (Sacred Water) Practice
G. Empty and Fill
H. Clean with Green Light
I. Clean with Blue Light
J. Charge with Violet Light
K. Defense and Immune System

A. Three Minds into One

Smile to the inner universe, activate the heart compassion energy; feel the love and joy within. Smile and empty the mind and heart down into the Tan Tien. Fill the Tan Tien with Chi and spiral the energy. When the Tan Tien is full, the energy will rise up to fill the brain. Manifestation will occur at the mideyebrow.

B. Activate the Six Directions

Expand the awareness to connect to the Six Directions at the crown, mideyebrow, heart and Tan Tien.

C. Activate the Three Fires

Activate the Tan Tien, Kidney and Heart Fires.

Activate the Sacred Fire Triangle circulating the energy between the Tan Tien, kidneys and the heart. Feel the energy's force multiply.

Activate the personal stars; the cosmic star above the head and the earth star below the soles of the feet.

Keep the Tan Tien warm, and spiral at the sacrum and mideyebrow. Turn your eyes to look upwards and see the crown spiraling, connecting to the cosmic star about six inches above the crown point. Feel the cosmic and earth stars pull the body simultaneously towards heaven and earth. See the cup of the Big Dipper fill with Violet Light, gathering Chi from the North Star and the universe. When the cup is full, pour the light down into the cosmic star above your head. Feel the violet light spreading throughout your entire system, filling the Upper, Middle and Lower Tan Tiens.

D. Linking Personal Stars, Energy Bodies and the Universe

Feel the central channel running from your cosmic star, through your three Tan Tiens and connecting to the earth energy below. Use you 'Yi' power to connect to the personal or cosmic star above the head. Connect the personal star to the stars of each other person in the meditation. Create a Chi body and become the major connecting point. Create a left spiral pattern to connect all the stars into a larger group. All the meditators then become a satellite, creating a group energy body.

E. Protective Circle and Chi Field

Raise the hands and touch the Universal Fire. Use your Yi to bring the energy down and manifest a Sacred or Chi Fire around the room, creating a protective circle. Create a Chi Dome and set up the guardian animals and/or angels. Activate the eight elemental forces of nature and the universe.

F. Chi Water (Sacred Water) Practice

Invoke the power of the Sacred Water practice to cleanse the body of all sickness, negative energy and bad fortune. Energize and renew the self at a cellular level with health, wealth and longevity.

G. Empty and Fill

Empty any remaining negative energy, sickness, burdens and worries, down in the depths of the molecular mother, the earth. Bury the energy there so that the earth can recycle it. Bring recycled energy up from the center of the earth into the body. Fill and compact the Chi into the 'hollow bones'. See all of the cells on the horizon of your mind's eye; spread them across the panorama and see the cells as big as the stars in the night sky. Fill them with Chi, blending it with any sick or grey energy. Then empty again, as you guide the all of the Chi back into the earth for recycling. If you wish, you can fill with earth Chi once again before you begin to 'clean with green'.

H. Clean with Green Light

Green cleans and detoxifies all of the body's cells**.** Green Chi is mild and safe. Green Chi is used for cleansing, and as a decongestant for diseased parts. Be aware of the liver's green color, the throat and the emerald forest. Breathe into the throat, feel yourself breathing in the green light. Guide it down to the Tan Tien, blend and move it up to the heart and the crown.

Project it to the universe; spiral and let it multiply. Channel one direct line down to the student, one to your crown and one to your palm. Bring the energy back down and blend it with any sickness in the liver, gallbladder or anywhere else in the body. Spiral the energy counter clockwise and down into the earth. Continue cleaning with green until you see that all the cells have been charged with the emerald light of the forest.

I. Clean with Blue Light

Be aware of the kidneys' blue sapphire color and breathe the blue light into your throat. Guide it down to the Tan Tien, blend and move back up to the 'heart of compassion' and then to the crown.

Project up to the universe, spiral and let it multiply. Channel one direct line down to the student, one to your crown and one to your palm. Then feel the universe pouring the blue light back down; clockwise. Spiral down. Look at the cells and see the blue light, like water, go into the cells to rinse, clean and remove any sickness. Spiral the energy counter clockwise and down into the earth. Continue rinsing with blue light until you see that all the cells have been charged with the sapphire blue.

J. Charge with Violet Light

Luminous Violet has intelligence and can be programmed.

Turn three minds into one mind, go deep into the empty space of the cell and deep into the chromosomes, magnify the space as you enter into the DNA and return to the original cells. Ask for the power to see the cells and look at the brain cells spread out into the space. "Brain cells please listen. Clear, Clean, and Bright: fill with violet light, back to normal function". See violet light. Be aware your crown. The Tan Tien Chi and the negative Chi all combine in the crown. Extend a violet light up to the universe. See the North Star and the Big Dipper. Tell the students to hold their arms in the air, so that they can funnel the Chi into their personal star. Bring the North Star and the Big Dipper down; hold the handle of the Big Dipper and pour the violet light over the student's personal star. The higher cells will be programmed. Let the Chi enter the brain and ask for the power to see the brain cells. "Brain cells listen to the command". If there is sickness in the brain, give the command. "Sickness go away". Continue to spiral the violet light down through the cells of the whole body.

1. Ask for the power to see into the cells of the **Brain.** Ask the student to move their hands to cover their brain. "**Brain Cells** listen to the command;"Sickness go away. Clear, clean and bright fill with violet light and return to normal functions".

2. Ask for the power to see the cells of the sense organs. Ask the student to move their hand to cover their senses. Give the command; **"Eyes, Ears, Nose, Tongue and Mouth** cells listen to the command. Sickness go away. Clear, clean and bright fill with violet light and return to normal function".
3. Move your hands down to your Throat Center and give the command; **"Thyroid, Parathyroid and Thymus Glands** listen to the command; Clear, clean and bright fill with violet light and return to normal function".
4. Move your hands to the heart and the lungs. Ask for the power to see the cells of the heart and lungs. Give them the command; **"Lungs and Heart Cells** listen to the command; Clear, clean and bright; Fill with violet light and return to normal function".
5. Move your hands to cover the left and right sides of the ribcage. Ask for the power to see the cells of the liver, gallbladder, spleen, pancreas and stomach. Give them the command; **"Liver, Gallbladder, Spleen, Pancreas and Stomach Cells** listen to the command; Clear, clean and bright fill with violet light and return to normal function".
6. Move your hands to the large and small intestine on the front of the abdomen. Ask for the power to see the cells of the intestines. Give them the command; **"Large and Small Intestine**, listen to the comm and Clear, clean and bright fill with violet light and return to normal function".
7. Move your hands to the kidney and sexual organs and ask for the power to see their cells. Give the command; **"Kidney and Sexual Organ Cells** listen to the command; Clear, clean and bright fill with violet light and return to normal function". Gather the violet light again and let it pour down and fill all the cells. See the violet light again and feel and see that all the cells are "clear, clean and bright". Smile.

K. Defense and Immune System

Defense System

1. Work on yourself first to activate your **Sacrum**. Project the sacrum as big as the universe. Breathe and compress the universal Chi into the sacrum until it rises up to fill your brain. Project out into the universe, multiply the energy and spiral it back down. Project it to the students and tell them to touch the sacrum.
2. Tell the students to move their hands to the **Hip Bones**. Tell them to smile to these bones. Feel them as 'funny, laughing, happy bones'. Tell them to feel the electricity in the sacrum and bone marrow.
3. Touch the **Femur Bones.** Feel the electricity running up the legs.
4. Touch the **Humerus Bones.** Feel the electricity running up the arms.
5. Touch the lower part of the **Sternum** and feel the Chi penetrate into the bones and spread out to the **Rib Cage**. Feel the electricity run throughout the rib cage.

Immune System

1. The Immune system starts with the top part of the **Sternum**. Touch the top part of the sternum. Project your fingers 'very long' into the bone and feel them penetrate right into the **Thymus**. Activate the thymus gland. Gradually, feel the fingers rising up to the thyroid and parathyroid. Activate the **Thyroid** and **Parathyroid** and **Throat Center**. Give the command; "Clear, clean and bright fill with violet light and return to normal function".
2. Move the fingers to touch both sides of the **Jaw Bones** to help activate the **Tonsils,** the body's first line of defense. The jaw bone affects the **Lymph Nodes** beneath, which includes the tonsils. Fill them with Chi. Give the command; "Clear clean and bright fill with violet light and return to normal function".
3. Touch the **Mideyebrow** and **Crown**, which control the **Pituitary** and **Pineal Glands** respectively. Touch the third eye, feeling it open and feel the light from heaven entering into your brain and into your body. Touch the crown. Feel your fingers reaching deep inside and feel the Chi penetrating all the way down to your perineum. Fill the glands with Chi. Give the command; "Clear, clean and bright fill with violet light and return to normal function".
4. Rub both of your hands until they are warm. Cross your arms and hold your hands under your **Armpits**. Picture the **Lymphatic System** of the armpits as you activate the lymph nodes. Give the command; "Clear, clean and bright fill with violet light and return to normal function". The lymphatic system of the upper body is clear, clean and bright then the lymphatic fluid flows! Smile.
5. Move the hands to the cover the **Groin** area. Give the command to the **Lymph Nodes** there. Give the command; "Clear, clean and bright fill with violet light and return to normal function".
6. Place your palms over your **Navel** and activate the **Lymph Nodes**. Give the command to the lymph nodes there. Give the command; "Clear, clean and bright fill with violet light and return to normal function". **You have now activated the immune system.**

Chapter V
Cosmic Healing I - Basic

Source of Chi and Color

There are different sources of Chi in the universe: cosmic (air), earth, nature and human. Different parts of the human body have different energies and are correlated with the universe and nature. Each part of our body, especially the organs and glands can produce, receive, transform and emit different Chi and color.

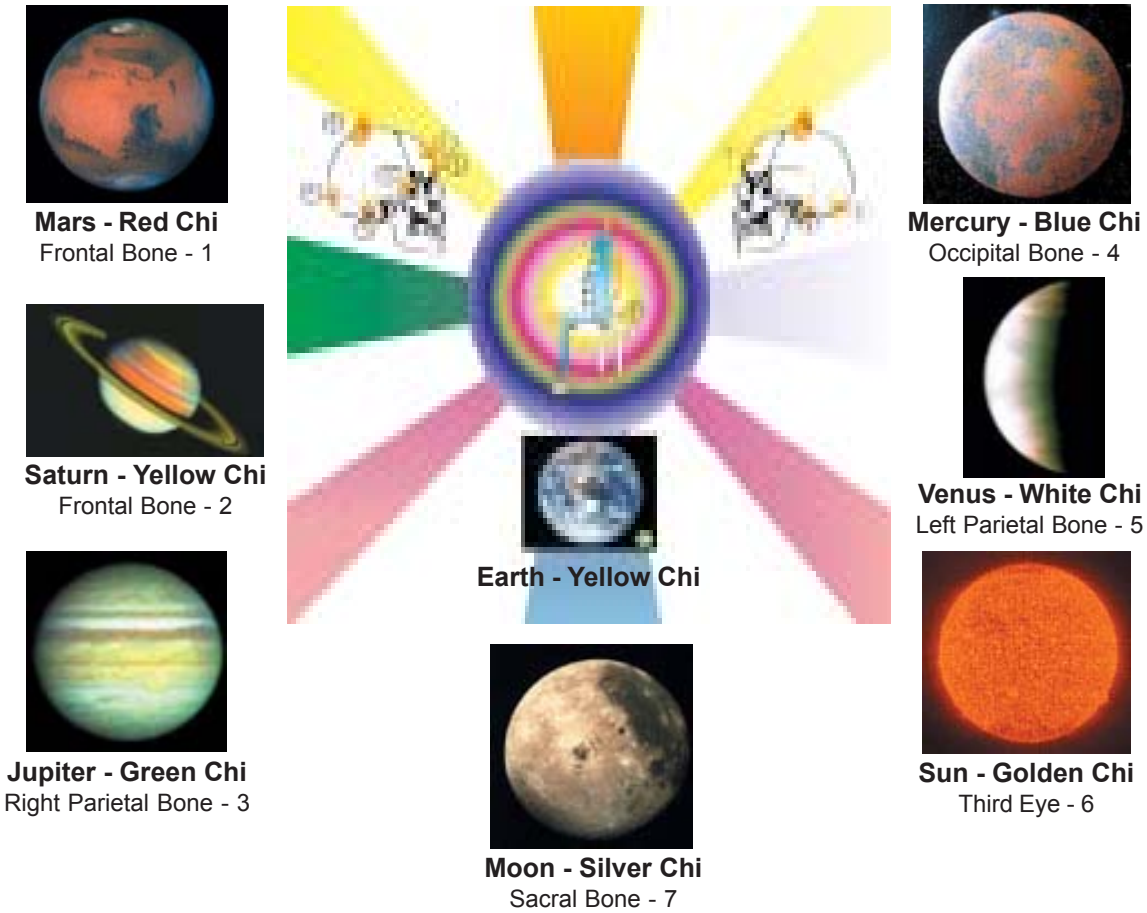

Fig. 5.1 *Planet, Bone and Cosmic Colors*

Earth Chi

While Cosmic Chi (the atmosphere over us and the universal force) is ethereal in nature, what is called earth Chi is not. This Chi appears as the line visible above the horizon when the sun is low in the sky, and seems to hover just above the ground. It actually also sinks into the ground.

Earth Chi contains yellow and some white Chi. When the ground and the cosmic (air) combine they will become white Chi. This Chi has a very powerful healing energy, not too overheated, but balanced and mild.

When treating a problem, white Chi, in the proportion 7:3 (7 white to 3 of the selected color) acts as a brake on colors which are hot or too active. This enables the body to take in chi more easily.

Fig. 5.2 *Use White Chi to blend all the other Colors.*

Special Note: Many of the color references came from the following books: *"Let There be Light"* by Darius Dinshah and *"Advanced Pranic Healing"* by Master Choa Kok Sui.

Human and Nature Chi

These include the things we can see on the earth: the mountains, lakes, seas, forests, streams, caves, valleys, rocks and precious stones. Taoism classifies five elemental forces: earth, metal, water, wood and fire.

So there are five elements in our body and five elements in nature; there are five elements in the cosmic and five elements in the universe.

According to the Taoists, when we can make the connection and control our body's elements, we will quickly make connections to nature and the universal forces and employ them very easily.

Solar Chi

Before sunrise or sunset there is more white Chi in the air, which we can use abundantly for health and healing. White Chi affects the lungs and the large intestine, so we direct this Chi to these organs. This will generate further Chi to maintain our daily activities. All colors of the spectrum are present in white.

Simple Practice

Look at the horizon at sunrise and sunset. Stand still and extend your palms toward the sun, smile and absorb the rising or setting sun's energy into yourself.

General Information

Energy can be introduced to the affected area of the body by moving the hand clockwise in a spiral.

Move the hand **anticlockwise** with a spiraling motion to clean, flush and remove energy from the treatment area. After this, brush down the whole body, to direct the sick energy into the earth.

Use an anticlockwise spiraling movement in order to clean, then expel the energy.

Use a clockwise movement to bring energy in and an anticlockwise one to take it out.

As a general rule and especially when you are beginning to practice the techniques, keep the color combinations simple. **Always use blue (to cool, calm and stabilize), green to clean, white to harmonize and violet (which carries the properties of all the other colors) to program.**

Although it is important to learn all of the applications, it is more important to begin practice, maintaining a serene state of mind throughout. You will immediately realize that Cosmic Healing provides the practitioner with as much benefit as the student. The more you practice the more you heal.

Healing Colors

White Chi

The color of the chi from the air, earth and sun is always white and acts as a calming agent for the surplus chi produced by the other colors. It also redirects this chi to areas of the body which need it. For this reason, use white in combination with another color in the proportion 7:3.

Shining white chi should be concentrated at the center, while colored Chi goes to the edge. This can also be reversed. It is also possible to blend the white and colored Chi together.

It is safe to use white chi when you are not sure which color might be suitable for a patient, especially when treating babies, toddlers, the elderly and the weak. People with minor problems can be treated with blue, green or mauve, while gold colored Chi or mauve/white Chi is better when the problem is serious.
For a stimulating and strengthening effect use white-red.

When it becomes necessary to switch from one color to another, an abrupt shaking movement of the hand should ensure a smooth transition to a new color.

There is a very strong violet light in the North Star. You can dilute the color with white. White Chi is composed of red, orange, yellow, violet and blue.

Blue Chi

The effect of blue Chi is one of cooling, and hindering similar to yin or water energy. The opposite effect can be obtained with the use of red Chi.
When we draw the energy down, some peoples' bodies can't adjust to the energy immediately, so using blue Chi is always good. "Water blue' is the one element that always brings harmony and does not cause any harm.

a. Blue Chi, like yin, water energy, has a cooling effect. It also can act as a restraining agent.
b. Because of blue Chi's ability to cool, soothe and numb, it is particularly appropriate for promoting relaxation and sleep, reducing abnormally high body temperature, minimizing pain and swelling. It can also hinder the proliferation of viruses and bacteria and assist in the rapid clotting of blood.

Blue (and green) can detoxify and also energize.

Green Chi

While tangerine Chi can be quite dangerous, the action on green chi is gentle and harmless. Freeing up a damaged area so that cleaning can then take place may be done with green Chi. Once it's loose you can then use blue or organ's color Chi to expel the disease completely. It can therefore remove the disease and bad energy by locally sweeping either to and then out of the arms for the upper body or out of the legs for the lower body.

If there is a need to energize with the organ's color Chi, first energize with pale green Chi. Always use green chi before using the colors purple, tangerine and red.

Use the throat to activate and draw the green Chi up to the crown, rising to the universe to be multiplied and brought back down for use. Always add blue Chi when there is pain. The motion of pushing and pulling through the affected part is very powerful. You also can also use the 'sword finger' in a small area and for infection.

Green can also be used for energizing together with violet; first use green and follow with violet.

Pale green and pale tangerine chi can be employed in sequence, as the first acts on the 'sick' energy, reducing it to a form which can easily be driven out by the second.

Simultaneous use of pale green pale tangerine and white chi in the ratio 2:1:7 is recommended to treat stubborn areas because the effects are intensified when these proportions are used together.

In the treatment of cancer, dark green and tangerine Chi may be employed, preceded by blue. This can assist in toxin removal, and in the cleaning and freeing up of disease affected areas so that necrotic cellular tissue is released. These colors can relieve congestion and free up 'sick' energy which is 'stuck' when used with brushing movements over the affected areas. They also help with treatment of colds and elevated body temperatures, and in the dispersal of blood clots.

Red Chi

Cerise chi makes the area to which is applied stronger, while crimson chi has the opposite effect. When using color for healing, project luminous white in the center and cerise at the edges for a strengthening effect. Always combine red with blue and green; never use it on its own.

Cerise mixed with white, because of its expansion abilities, can help widen blood vessels and breathing tubes. It also helps those with heart and asthma problems.

Red chi with its qualities of warmth and expansion, has a number of benefits. It is good for the circulatory and respiratory systems and the blood, as it expands blood vessels and other tubes, thus improving circulation and breathing, particularly for heart patients and asthma sufferers. It also brings increased energy into the blood and helps allay feelings of fatigue or weakness, driving out 'sick' energy along with toxic substances and other waste materials. It can also help those who are sensitive to allergens. It may help those whose lives are near the end have a longer period on earth, and promote revival of consciousness.

Avoid the use of dark colors, which may cause an adverse reaction. If a person is suffering from a sexually transmitted disease, it is not advisable to treat him or her with chi which is crimson. Chi of this color makes the microbes that cause such diseases multiply at a fast rate and can also produce an inflammatory or constrictive reaction.

Tangerine Chi

When using orange Chi, always use blue Chi first; to tone and calm down the ailing body area, before applying the vitality of orange.

Pale tangerine chi with added white can be used; however certain areas are inappropriate for treatment by this color because of its power. Do not use with the eyes (including retinal problems), heart, head, throat, brain (for example bleeding in the brain) or the spleen.

The large intestine benefits from the use of tangerine chi, but this color should be used sparingly on areas like the solar plexus and navel. Appendix problems should not be treated with this color as it could exacerbate the problem. Tangerine chi has an effect on the bowel, and can also aid in returning an unconscious person to consciousness or in stimulating someone who is dying.

To treat cancers of certain types, dark green and dark tangerine are suitable because of their ability to destroy. Always avoid the head and the heart when using orange.

Forcible removal of waste products, toxic substances, 'sick' energy, viruses and bacteria
Menstrual difficulties
Waste elimination problems
Freeing up 'sick' energy
Breakdown of clots in the blood
Problems of the urinary and respiratory systems
Diseases of joints and connective tissue
Common cold
Problems caused by allergens
Cysts

Yellow Chi

Yellow Chi has a close connection to the nerves, the bones and the bone marrow. It is the color of the spleen; in Taoism we feel the spleen is involved in the assimilation and processing of food and the appetite. This doesn't mean eat a lot, but when the spleen is balanced the appetite will be controlled.

Chi which is yellow in color is beneficial in the treatment of nerves as it promotes re-growth. It also helps in the repair of fractures and cells. It is good for the health of bones, tissues and organs. It has the power to increase bone marrow production.

Violet Chi

Violet Chi has the properties of all the other colors. It's used for severe types of sickness.

The qualities found in all colors are contained in purple chi, therefore it is particularly effective for serious illnesses. Mauve (light purple) chi which contains elements of blue and green, helps to restore organs and nerves affected by disease or trauma. Although mauve chi can be employed on certain kinds of severe infections, chi which is dark purple should be avoided when diseases of the respiratory system are present, as it could cause the proliferation of disease causing microbes.

Violet Chi is use chi that is pale white/green or pale white/tangerine and, selecting each in turn, with a brushing movement apply to the whole spinal area and especially to the area where the trauma is located.

If purple chi is used in combination with other colors, it will intensify their qualities and if used together with red, tangerine or yellow chi can be dangerous; it may cause the undesirable proliferation of some cells.

Dark electric violet can be used for tumors or cancers. Always use the blue or green first.

In order to make an area which has become weak stronger, mauve mixed with white can be used, but for really fast strengthening use cerise mixed with white.

Both white and violet have the properties of all the Chi colors. The difference is that violet Chi has a greater penetrating effect and is easier to assimilate than white.

Because bright purple chi has been acted upon by the soul, it has the capacity for independent thought and action.

Energy or chi which comes from the air, the earth and the sun is called purple chi. There is a second type of chi with this color, but having more brightness – this has been called bright purple chi and is derived from the soul through the crown of the head, the point connected to the North Star or Big Dipper.

Bright purple chi can only be brought down from the universe via the crown point if the practitioner has highly developed senses, The effects of chi from air, earth and the sun depends on the development of the practitioner's soul.

In contrast to purple chi, the chi which is bright purple in color has a much greater potency because it can help in the restoration of nerves and organs which have been affected either by disease or trauma. This bright purple chi can be used to remove infection and to promote fast healing, even in the case of serious illness. In addition, this chi has been said to possess its own consciousness (Master Choa Kok Sui. Advanced pranic healing:49)

When cancer and other growths are being treated, use bright purple chi because it has the ability to destroy. However, beforehand, the affected area should be energized with pale blue chi.

Do not use bright purple chi at the same time as chi which is yellow, green, tangerine or red because it will intensify and increase the effects of these colors. In addition, the use of any dark colors with bright purple chi (either preceding or following its use) should be avoided, as this will produce a very damaging result. As a general guideline, use blue before electric violet.

Golden Chi

Gold colored chi, which has almost the same qualities as bright purple chi, is formed when bright purple chi meets the spirit body. The color changes to cerise (pale red) when this gold colored chi enters the physical body. However, this chi is does not have as much influence as the bright purple chi, being gentler and therefore less effective as a cleansing agent. Gold colored chi should be used to treat a very local area, while bright purple chi can be employed over a wider area.

Spleen

The spleen is connected to the solar plexus and the navel, the major center that connects to all the organs. Holding solar energy or a white ball at the solar plexus will help distribute Chi to all the organs.

If the solar plexus gets clogged up the liver and spleen will also become blocked. The spleen, the Door of Life and the navel are all linked together; the navel and the Door of Life sit opposite each other. We call this an emotional link. Many diseases are caused by emotional links; people use psychology to deal with it which can work to a certain level, but all the energy would eventually get stuck at this main juncture or plexus. White chi is taken in mainly at the spleen, and before being sent to the various parts of the body, is split into its colored forms of red, green, purple, blue and tangerine.

If the spleen is not clean, the immune system will be affected, together with the production of bone marrow. The blood will be dirty and diseases of the joints and connective tissue encouraged.

Cosmic Healing Chi Kung works very well with Chi Nei Tsang. The Cosmic Healing Chi Kung, Chi Nei Tsang and all the other Universal Tao practices all play a unique role in working to heal the physical and subtle bodies. When you combine these three in synergy, it allows you to perform many healing tasks. The spleen (located under the left side of the rib cage), spleen center or navel can absorb white Chi directly into the front or back. The Chi will be broken down into color and distributed to other centers and their associated organs.

There is one thing that I always advise: the recipient or student should be under a doctor's supervision and that they should alternate between the medicine from the doctor and the work with us at the Universal Tao. The doctor should be advised of what we intend to do with the student.

Cosmic Healing Planetary Colors

In Taoism we give each planet a color which enhances the healing power. Have the 'Planets' chart (located at the beginning of this chapter) in front of you, look at the relevant planet and close your eyes. Hold the planet in your mind.

Fig. 5.3 *Channel the Cosmic Planetary Energy into the body.*

Mars: Focus your awareness on the star above you, turn your eyes up and look up to the crown. Hold the image of Mars and extend your sight beyond the crown, looking up into infinity. See the **Red Light** and gradually bring it down to your head about 6 feet above you. Form it into a red ball, a holographic image of the planet Mars shining its red light above you. Invite it to flow down to your 'star' (located above your crown) and continue to flow into your Upper Tan Tien for processing. Let it flow down to the heart (or T-2) and down to the palms. Red and orange light also can be breathed in through the sacrum. Feel the sacrum pulsing and breathing in the red and orange light. Practice 9 to 18 times, rest and shake your hands.

Venus: Become aware of the star above you, turn your eyes up and look up to the crown and into infinity, seeing the expanse of **White Light.** Gradually bring the light down to your head, about 6 feet above you. Form it into a white ball, a holographic image of the planet Venus shining its white light above you. Invite it to flow down to the star above your crown and continue to flow into your Upper Tan Tien, for processing. Now it may flow down to your lungs freely.

Saturn: The **Yellow Light** from Saturn can also be absorbed via the earth through the soles of your feet and perineum. This is for your spleen. Follow as above.

Mercury: The **Blue Light** from Mercury may be absorbed through the throat center. This is for your kidneys.

Jupiter: The **Green Light** from Jupiter can also be absorbed through the throat center. This is for your liver. Follow as above.

Summary - Working with Color

(Practitioner to Student)

There are two ways of doing this type of healing session:

One way is to focus on the specific location in your own body, using your hands and ask the other person to do the same. Together you complete the entire route.

Another way is to focus on your own energy body and ask the student to do the same. Bring a channel or line down from your energy body into your physical body and do the same for the student. Once again, complete the routes together.

For reasons of clarity this text only mentions one student and uses the male gender; *this session may however be performed with a group also*. Before starting the session do some group meditation practice and warm ups.

1. Be aware of the Tan Tien and connect to the universe. Let the student sit with his back to you. You are behind him. Be aware of your **Sacrum** area and feel the Chi; **wait for the Chi to rise up to the crown** and to the universe. Spiral the Chi down to the student's and your own energy body and it will flow into the physical realm.
2. Draw in the green light with your palm, push it right through the sacrum and disperse the sickness throughout the other side of the universe. Pull the green light from the universe through the sacrum and push the sick Chi out to the universe. Do this 6 to 9 times until you feel the **sacrum has been cleaned**. When you pull back stop the green Chi at the student's sacrum; there is no need to pull it back to you.

   Yellow light from the earth will help strengthen the sacral bone. Visualize the sacrum and vitalize the complete bone structure with yellow light passing throughout.
3. Be aware of the energy body above the **Crown**; extend yourself up from above your crown and **channel down the white light from the center of the universe and the violet light from the North Star.** Using your 'mind-power' ask the inside of the bone structure to open, allowing the white and violet light to **flow into the marrow.** Focus on the energy body; you can picture the energy body's sacrum and bone

structure to help guide the energy inside and see the whole body light up from deep within.

4. Then focus on the **Door of Life and the Navel.** First flush them through with **green** light, cleaning them out. Draw the green light from the Door of Life through to the navel, and then push back through. To cool down the Door of Life (if necessary), draw the **blue** light and push it through from the navel to the Ming Men, connecting with the universe. Then bring the **white or violet light down and activate the Lower Tan Tien.** Always teach people about their Tan Tien. It is like an ocean and the body is like a hollow bamboo. The bamboo can bring the water up. This way energy will never dry up.
5. Concentrate on the **Solar Plexus and the Chi Chung (T-11)**. Once again, draw the **green** light, spiral it, use it to flush, then **energize with white and violet light**. As before, always allow the energy to stream through both the points completely. The solar plexus holds all the emotions. When working on the solar plexus, the **most important thing to remember is to connect the 'backside' to the universe.** There is literally no end to this connection. Just allow the Chi to come all the way down and then pull it towards the rear slightly. Simply clean out the path. Allow the information to condense; allow any images to manifest and then release. Then stabilize the energy. Picture the Chi-Field enveloping the person as a big protective bubble. **Cool down with blue.**
6. Proceed to the **Heart and the Shen Dao (T5/ T6).** Draw in the **green** light, push it through and repeat several times. Now scan the heart with your palm, sensing its strength; then select an appropriate hue, i.e., not too dark. Send the **red** light through the heart to strengthen it.

   Cool down any excess heat in the heart, flushing down and out, using **blue** color. Draw in the **white** Chi; push it through to the **Wing Point (T5/T6)**. **Energize the center at the back of the heart using violet and golden Chi.** Picture the heart surrounded by a golden aura.
7. Move up to the **Throat Center, flushing through to C-7**, using **blue** light first to open and clear it and then **green** light to clean.
8. Next activate the **mideyebrow.** Focus on the mideyebrow in your own body. Use **golden yellow** Chi; use it to **flush and stabilize** the mideyebrow. Flush it all the way through to the backside of the head. **Energize with violet golden light.**
9. Proceed up to the **third eye** in the middle of the forehead. **Connect to the Kun Lun** at the back of the crown. **Flush** through both points using the pale **violet light. Energize** with **electric white or golden light.**
10. Concentrate on the **crown**. Use **violet** or **golden** light to enter and **flush** all the way down through the **central channel**, leaving the body at the **perineum**. **Cool down the system by showering blue light over the whole body.**

    When people have a serious infection, they should consult a doctor. It is common for infections to take a long time to clear up nowadays, even when using antibiotics.

There are two ways to deal with this; allopathically or naturally. The Taoist practices are in great conflict with 'contemporary (i.e., not alternative/natural) western concepts'. The western concepts recommend a full course of antibiotics. Using the theories of Chi Kung, a baby for example, would absorb natural antibiotics via the bones. Western Allopathic Practice consider antibiotics as wonder drugs. The only 'wonder' is when will they realize the many harmful effects that it has on the body? Babies that have been 'fed' with antibiotics frequently suffer many organ related problems by the time they reach 20 to 30 years of age. The worst thing is that they are given to children nearly every time that they become ill. If you scan (cosmically) the solar plexus, thymus or spleen of such a person, the area feels like a hollow void. This means that the immune system is totally non-functional. The same thing applies to ***Aids***: the immune system no longer functions. Any virus can enter the body - medicine cannot kill it. There is nothing left to 'fight with'.

In my experience and following my own experiments, in circumstances like the above my own practices are as follows: I clean my colon; there are a few ways to do that. I eat fiber, vegetables, especially green leafy ones. I eat a big bowl of vegetable soup. I also add things like onion, pumpkin, carrots and cabbage, which will give it a sweet taste. I don't eat any meat and drink a lot of water. The colon is cleansed within two days. I also brush the skin, which is a very good detoxifier. The vegetables will provide natural carbohydrates which are digested and absorbed very quickly. A healthy diet consists of many whole natural foods. It is 'alkaline' as opposed to 'acid' based. I also use the 'colema' which I feel is the best cleanser.

Chapter VI
Individual Healing Session

The Individual Healing session embodies all of the techniques that you have used previously and consolidates them for use on a one-to-one basis. The session comprises the following three parts:

A. Almighty Knife (Chi Knife)

The almighty knife can be used for any health problems. We can charge the knife with Yin or Yang energy. We charge the almighty knife most often with Yin Power. Yin is the cold energy and is used for any inflammation, pain or heat. Yin is used to break up illness. Charge the almighty knife with Yang for strengthening, melting or expelling. Only use the Yang when there is no pain.

B. Energizing and Activating the Immune System

C. Cleansing the Internal Organs

A. Almighty Knife

Fig. 6.1 *Almighty Chi Knife*

Since the dawn of ages and our descent into the material realm, we have constructed, manufactured and used tools to facilitate the progress of events. They are an extension of ourselves that enable us to enhance, mould and magnify our intrinsic nature as inquisitive playful beings.

We have used implements to help nourish, protect and amuse ourselves and further our progress in attempting to understand the 'how' and 'why' of existential reality. The knife has served as a means to carve our way into the present. It is a simple, yet powerful 'friend' and derives as much power as we wish to lend it.

Its design may consist of any combination of the five elements (Earth) which when combined with Universal (Heaven) and Cosmic (Man) forces, provide a unit of energetic substance which receives and transmits magnification, purpose and power in accordance with the human will that governs it. 'Chi Knife' and "Powers of Ten' adopt the precepts of a truly magical existence. When we arrive at our destination we will realize that we have indeed turned "the Wheel of Law'. In achieving this end we will have completed the cycle and returned to the beginning of the journey. We will understand that the simple things in life, like the knife, contain the same amount of power as state of the art technology.

We are all returning to the Garden of Eden. Complex telescopic and microscopic equipment now enables us to see the truth:

"Inside has no outside; outside has no inside".

They are one in the same thing. When they merge together we will indeed enter the Kingdom of God.

Outline of Practice

1. Hold the knife in the right hand (left, if you are left handed). Hold the other hand near your body, with the thumb and index finger touching. Project the Chi Knife as big as the universe, 'long and big - reaching to Heaven'. The bones in your arm are hollow and the 'bottom' is sealed at the shoulder. Feel them 'fill and pack' with the power coming from above.
2. Then give the command: **"Power comes from the east. This Chi Knife has the power to dissolve all the negative energy, sickness and bad fortune. By my request, please carry out the order now."** Wait until you feel that your arm and the knife are heavy and full of Chi.

Eye Problems

Use the thumb and the index finger to hold the eye wide open.

You hold the knife like holding a pen, 3 to 6 cm away from the eye. Use the little finger for leverage and support.

WARNING!

DO NOT USE A KNIFE. THE **MASTERS** OF GREAT EXPERIENCE USE RITUAL SCALPEL TYPE KNIVES. THE STUDENT SHOULD USE THE "SWORD HAND" FINGERS (P.76, FIG. 4.24).

DO **NOT** USE SHARP OBJECTS NEAR THE EYES**.**

Fig. 6.2 *Hold the knife three to six cm. from the eye.*

Chi knife - “Almighty Knife” helps all eye problems”. Cut up and down and sideways in the cross pattern ‘through’ the eye thoroughly. Tell the student to move the eye left and slowly move to the right as you cut with the Chi Knife. When they move their eye to the right, move the Chi Knife to the left. **Remember that the knife is used for ‘energetic surgery’ and should never make contact with the eye itself.**

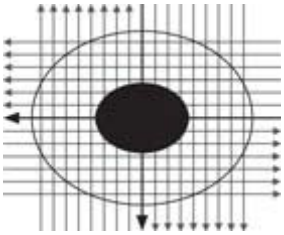

“Slice” the eye toward the right side for 50 to 100 knife movements and do the same to the left side.

Fig. 6.3 *“Almighty Chi Knife helps eye all problems”.*

“Almighty Knife, please destroy all kinds of wounds, warts and tumors”. Cut up, down and sideways in the cross pattern through the part that has the ‘condition’.

Fig. 6.4 *“Almighty Knife, please destroy all kinds of wounds, warts and tumors”.*

The almighty knife can be used for any problem in the body. Follow the same procedure to carry out ‘energetic surgery’ on all parts of the anatomy. It is especially good for soft tissue repair, including the brain.

When you feel that the Chi Knife is full of sick Chi, spiral counter clockwise and discard it down to the ground. When you feel that the knife is ‘empty’ charge it with Chi from the universe.

B. Energizing and Activating the Immune System

In cases of severe illness, you will want to do this technique many many times, because it is essential to stimulate the body's defence-systems. This technique is also beneficial for debilitation and infection. You may also want do this in a preventative manner.

Activating the immune system always involves the bone structure, especially the round bones in the arms and legs and the flat bones in the skull, jaw, rib cage, hips and spine. All of these are involved with the production of white blood cells. The **thymus gland** and the **spleen** are of special importance to the immune system, because they are involved with programming and training the white blood cells (called T-Cells) to do the right job. **The lymphatic system is involved in removing toxic waste from the body; it is therefore beneficial to stimulate the lymph flow as well.** This is best done in combination with Chi Nei Tsang. *For details refer to the Chi Nei Tsang Books.*

Fig. 6.6
Touch the top of Sternum to activate the Thymus.

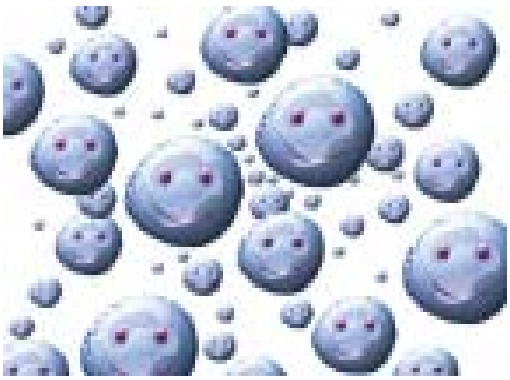

Fig. 6.7 *Happy Cells.*

If you work on a one-to-one basis, first perform the general cleansing session, where you 'pour energy' over the other person. After that use your hands, drawing Chi and pushing it through. Remember to push the energy all the way through and connect it with the universe beyond. Ask your student to concentrate on the areas that you are treating, preferably by guiding them, touching each point as you go.

Outline of Practice

Guide the student as you practice together. Work with your own energy body and tell the student to work with theirs. Presuming that you have already done the previous set of general healing, you can start with the **coccyx**.

Fig. 6.9 *Touch the Sacrum.*

1. Be aware of your Tan Tien and connect to the universe. Direct the Chi down to the fingers. Touch your coccyx with the fingers concentrating a beam of white light on to it. Picture the sacrum opening and the white light streaming inside, flowing up the spine and streaming out over the whole bone-structure. Transfer the feeling of Chi in the coccyx up to the universe, multiply it and guide it down to your energy body.
2. Always be aware of the Tan Tien and the universe first. Attract the yellow light; spiral and condense the healing light into the tip of your fingers; move the fingers up to touch the sacrum. Send out a beam of yellow Chi into the sacrum, directing it up the spine. This will stimulate the production of red blood cells. If you are not sure whether you are able to send it right into the marrow, picture the marrow or emit the Chi from your fingers, while at the same time concentrating on the bone marrow of the energy body. Transfer the feeling of 'Bone Chi' up to the universe and down to the energy body.

3. Proceed to the crown, showering it with violet light. Then spread from the crown throughout the bones of the body. Repeat several times. Instruct the student to feel the bone structure breathing. Ask him/her to extend up from the crown to the Big

Dipper and North Star, channelling down the red and violet light into the thymus gland.

4. Continue to the throat, stroking down with your palms, using green color to move the lymph down towards the backside of the heart. **(Never stroke up towards the head. Only guide the lymph down).**

A. ***B.***

Fig. 6.10 A. *Channel the Violet Light of the North.*
B. *Use your Palms to bring the Lymph flow back to the Heart.*

5. Proceed to the lymph nodes under the armpits and across the sternum. Next activate the lymph nodes in the groin. From the groin you guide the lymph up to the navel center (Not down where it will get stuck in the legs).
6. Return to the navel center. Send the energy deep inside, energizing the lymph nodes at the back. Pull back, drawing green energy, flushing out any waste products that are stuck in them.

A. **B.**

Fig. 6.11 A. *Activate the Lymph Nodes in the Armpits and Groin.*
B. *Energize and flush the Lymph Nodes in the Navel.*

C. Cleansing the Internal Organs Technique

Healing Some Common Illnesses

This session can be used for any kind of ailment and carried out with any number of students. It can take place on a singular, paired, small group or large group basis. Numbers can range from one person, one hundred, one thousand, ten thousand, ad infinitum. It is more likely that a greater energetic current will be created in much larger groups. In the case of 'mass' healings, there will always be a 'guide' or 'conductor', to open the channel for the students to follow. In the case of solo practices you will of course be the guide. **The following instructions have been set out on a one-to-one basis**.

By connecting to heaven, earth and your student, you will maximise the wholistic healing potential to your physical and subtle bodies. We recommend you spend about twenty minutes on the general healing before moving on to the more localized practices of emptying and cleansing the body's centers, systems and organs, contained within this chapter. We recommend that you spend between five to fifteen minutes on all of these. **Always perform the Sacred or Chi Water practice before.**

It is important to remember that if there is no energy in your Tan Tien, then there will be no energy to work with. 'Connecting the Tan Tien and the Universe' means connect your center to the infinite source of the universe, the Tao. When you make the connection you access this power. Always hold on to your center; it is the only thing that is truly yours. Keep the fire warm and spiraling. When you are aware of your Chi, you can direct heavenly light straight into your energy body and then into the student's.

General Principles

1. Push and pull the energy through the student's body. Push and disperse the sick energy into the universe and out to the planets, where it will be transformed and recycled.
2. Pull the energy back and stop it between yourself and the student.
3. Spiral the energy counterclockwise until you see the **green** light mix and clean the sick energy. Spiral and flush the energy down into the earth.
4. Spiral with **blue** light; see it mix and flush the energy within the student's body. Spiral this energy down to the ground.
5. Energize the student with **white** or **violet** light.
6. You can also use both hands to channel Chi when you 'push and pull' through the body.
7. Energy can be introduced to the affected area of the body by moving the hand clockwise in a spiral.
8. Move the hand anticlockwise with a spiraling motion to clean, flush and remove energy from the treatment area. After this, brush down the whole body, to direct the sick energy into the earth.
   Use an anticlockwise spiraling movement in order to clean, then expel the energy.
   Use a clockwise movement to bring energy in and an anticlockwise one to take it out.
9. When you begin pushing, pulling and sweeping, you may feel resistance in the body. As you progress and the energy centers open, this feeling will diminish.
10. There are many color combinations that can be applied to the various parts of the body. When you start practice, stick to the basic 'blue, green, white, violet and blue' formula. When you are working on a specific area, you can keep this book near by, or write a short 'color recipe' before you begin. In this way, you will be able to relax your mind.
11. 'Pushing and pulling' is like fanning and venting the body; when you fan your hands in front of your face, it will have a cooling effect. Ventilation enables the stagnant, sick energy to leave the body.
    Below is a list of the body's organs in relation to their tendency to 'store heat'. They are listed in descending order, i.e, the head is the hottest:

Head, heart, liver, lung, stomach and spleen, large intestine and small intestine, kidneys and sexual organs (which become hot when aroused).

Outline of Practice

Occupying a position amongst most of the internal organs, the solar plexus acts as a kind of clearing center for energy generated by the emotions. It also lies in between the lower and higher energy centers.

1. Scan; ask for the power to look at the cells.
2. Push, pull and give the command, “Disperse”. Push until you feel the solar plexus clear and open.
3. Spiral green Chi counterclockwise. Talk to the sick energy; tell it to “leave”, you will take it to “a better place, where it will be happy”. Give the command, “Out”.
4. Spiral Blue Chi counterclockwise, flushing out any remaining sickness. Guide the sick energy into the earth.
5. Spiral and sweep Blue-Green and Red Chi into the solar plexus, sweeping the organs. If the patient is expecting a baby, has an infection or bleeding in the intestinal area; do not use this method.

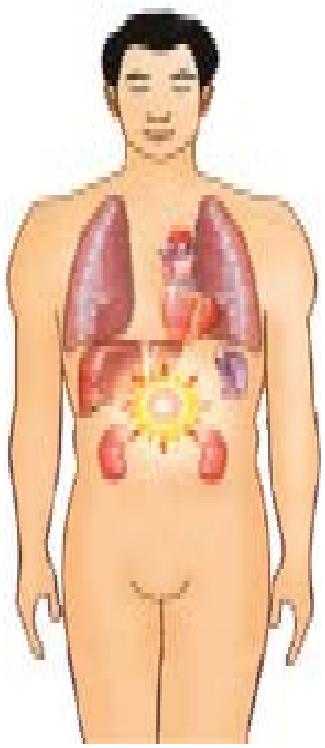

Fig. 6.12
Spiral Green Chi counterclockwise in the Navel.

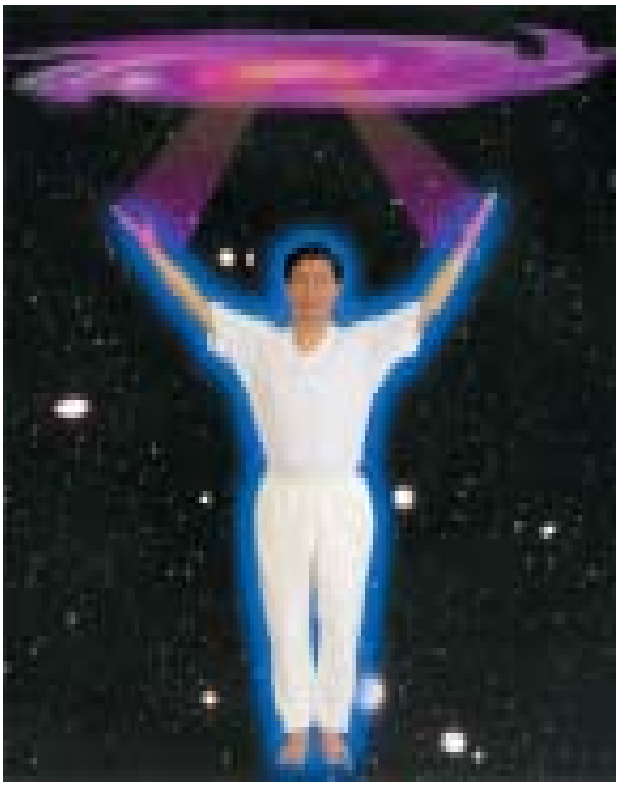

Fig. 6.13 *Charge your Hands with Chi - project the Hand Bones into the Universe and feel them fill and pack with Chi.*

Work on cleaning out the **organs**. Scan the person and see which parts are hot. A lot of people will have an overheated solar plexus, which means that this area will require a lot of attention. You will feel the heat when you scan.

You can **clean the organs by 'pushing and pulling'**. Picture the organ and push; feel your hands are very 'long', extending through the organs and reaching out to the universe. Project all the sick energy down into the earth and out to the universe. Use your intent to guide it into the earth and out to the other planets in the solar system, where it will be processed and recycled. Pull the universal energy back towards yourself; push and disperse all the negative energy out to universe. Pull; when you pull the Chi back past the student, stop in between the two of you. Push, pull, push and pull, until you feel the energy or power. **Ask; "Give me the power to see". Feel your Chi entering into the organs with ease.**

A. ***B.***

Fig. 6.14

A. *Extend through the solar plexus and reach out to the universe.*

B. *'Clean and energize with Green' - push and pull to help loosen the solar plexus. Spiral counterclockwise with a Green Light. Blend with the sick energy and guide it down to the ground.*

Clean with Green Light. Spiral counterclockwise. Feel the green light mixing with the sick energy. Push and pull until you feel the energy in the solar plexus begin to disperse. Spiral the energy counterclockwise and guide it down to the ground.

A. **B.**

Fig. 6.15 A. *'Push and Pull' to help disperse the energy in the Solar Plexus.*
B.*'Flush and stabilize with Blue'-Picture Ocean Blue and flush sick energy down into the Earth.*

Rinse and flush with blue light. Picture ocean blue and flush down to the earth. See and feel the solar plexus becoming cleaner. Flush the sick energy down to the earth.

Now clean out the whole body again. With all the organs: from the lungs, heart, liver, gall bladder, pancreas, spleen, stomach, small intestines, large intestine, kidneys and sexual organs. Clean all the way down to the earth. **When you clean the solar plexus and all the other organs you remove all the negative emotional energy.**

Energize the **spleen**, **liver** and **kidneys** with blue or white light. Then project green, followed by orange light to the cores of the liver and kidneys. Clean with the green and orange light and stabilize with blue light.

Work on the **back** of the **spleen** and **kidneys**. Energize them with blue-white light. The spleen is on the student's left and kidneys on the right and left. They all help to clean the blood. Spiral the energy clockwise into the spleen. See it in your mideyebrow. See the cells and spiral the light into them. Give the command, "**Stay**". This is very important; it makes sure that none of the cells hide from the dazzling light that you are sending. Give the command again. Then stabilize them with blue light. Picture the kidneys and see their cells and feel the blue light go into the cells.

Work on the **Liver** on the student's right hand side. Smile and laugh to the liver and see all of its cells. Give the command, "**Stay**"; then send in the healing light. Send in blue or white (energize), followed by green (energize and clean), blue (rinse and stabilize), violet (recharge and reprogram) and then blue to stabilize again.

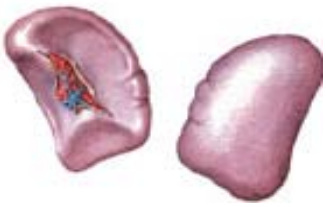

Spleen - Front and Rear

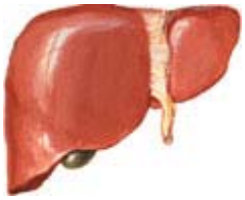

Liver

Fig. 6.16 *'Push and Pull' to help disperse the energy in the Liver and Spleen. Clean with Green and flush and stabilize with blue. Flush the sick energy down into the Earth.*

It is essential that you feel and talk to any sick energy. **If the student is healthy then you will feel their 'light'.** Ask their energy body to tell you where it **may** need some healing. Send in 'light radar'. Transmit green light and flush down to the earth. **When you feel that energy is accumulating, start to spiral more.** Push and pull and give the command for the sick energy to leave.

The more you clean, the more you heal. Tell your student to practice at home after the session, at an agreed time. You can then carry out 'absent or distance' healing, linking everyone's personal star, energy body and the universe. **With time, you will master the techniques, imprinting them with your own manner.** Eventually symptoms disappear, as the blockages are cleared and the flow returned.

Cleansing the Spinal Cord

Spine

Always cleanse the spinal cord, which protects the entire body from diseased and negative energy, both physical and psychic. When you open the spinal cord and solar plexus you can release many energy blockages. Sweep the hand in a clockwise motion to energize the spine with either/or a combination of; **blue, green, white and ultra-violet**. Then spiral counterclockwise and **brush** the spine down to the ground. Continue sweeping until you feel that the spinal cord has cooled down. Remember not to use orange or red.

Cleansing the Blood (Lungs)

Pale green/white and tangerine/white chi work as cleaning agents for the blood. Diseases of the blood and arteries can be treated. The chi first energises the lungs and as the blood passes through them, it takes in the chi, thus becoming purified. The benefit is then carried to the rest of the body as the blood circulates. Serious infections can also be treated in this way; however, the technique should not be used on women who are pregnant.

A. ***B.***

Fig. 6.17 A. *Cleansing the Blood and emptying the Lungs.*
B. *Become aware your Three Tan Tiens. Connect to the Universe and ask for 'the Power to See'.*

Outline for Cleansing the Blood/Lungs

Lungs

1. Scan the student.
2. Push through and open the lungs from the back to the front.
3. When the lungs need to be given energy, use pale green/white followed by pale tangerine/white chi beginning at the front and moving top the rear.
4. To make weak patients stronger, cerise/white chi can be employed as this will bring energy into the lungs.
5. Purification of the blood is carried out by the liver, kidneys and spleen. Use white chi to bring energy to these areas, after first pushing and pulling through them.
6. The blood requires a lot of cleaning on a regular basis.
7. Energize with white Chi. **Germs can only grow in the dark. 'Fill yourself with the light'.**

Circulatory/Heart System General

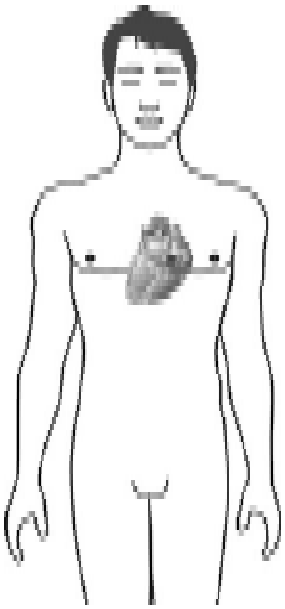

One of the basic problems pertaining to the circulatory system and heart is hypertension and hypotension. Once again, the sacrum and solar plexus are involved. The sacrum controls the bones; indirectly, it stimulates the marrow and enhances the quality of the blood. Good blood is like running the highest quality motor oil through the engine of a motor vehicle.

(Within the Universal Tao System we also have the view that the sacrum controls the Chi-pulse. If there is enough Chi, the heart does not have to work so hard, because the Chi pushes the blood).

The solar plexus relates to the emotions, affecting the heart through two mechanisms:

- It may affect the heart directly, causing rhythmic disturbance or pressure around the heart muscle
- Malfunction in the liver or digestive tract, leading to high cholesterol levels or gas which pushes up towards the heart from the intestines and causes unwanted heat and pressure.

Cleaning out the Solar Plexus will greatly improve these conditions. If you have been trained in Chi Nei Tsang you can use it in combination with the Cosmic Healing techniques.

Specific

Working on the Heart Muscle:
Clean out the Solar Plexus as outlined above. Push and pull with green and blue.
Detoxify the liver, flush with green.
Enhance with white and violet light.
Use the finger to work on the lower left and upper right part of the heart.
Remember that the heart muscle is very delicate.
You draw the force, you spiral and you push.
Stabilize with white.
For enlarged heart use blue.
Carefully use the red light to balance the blood and open the blood vessels.
Sweep the sacrum with green, red and blue.
Sweep the solar plexus with green, blue, red, white and violet.
Energize and cool down the throat center, using blue.
Working on Hypertension (High Blood Pressure):

Overactive adrenals/ kidneys often cause hypertension. Clean out the solar plexus first, because the adrenals (T11) are connected to it. The adrenal glands produce adrenaline, the hormone that stimulates the heart to pump. Overactive adrenal glands will eventually affect the heart.
Tune-up the Door of Life with blue, calming it.
Take the pressure from the heart, use green.
Energize the heart, use violet.
Flush down from head to feet with blue;
The basic problem with hypertension is that the Chi goes up and cannot come down. Work on the sacrum, using orange and yellow.

Working on Hypotension (Low Blood Pressure):
In hypotension the Door of Life and T11 are underactive.
First clean out the Solar Plexus, this time focus on removing blocks or stuck energy.
Energize the Door of Life, using green and red.
Energize the Sacrum (same colors).
Energize the Base of Skull with green and violet.

Stomach Pains

Pass your hands over the patient and brush the whole abdomen, especially the solar plexus, navel and lower abdomen. The navel should be treated with a combination of green and blue, and blue should be used at the end to firm up the energy.

If problems persist: A) Treat with Chi Nei Tsang B) Seek the advice of a qualified medical practitioner.

Relieving Pain: *Blue Chi*

Chi that is associated with the colors blue and green can be utilized in different ways. While green chi acts to free up energy that has become ‘sick’ and ‘stuck’, blue chi can act as a painkiller because of its ability to reduce the severity of pain.

1. Push and pull the through the affected part out to the universe or ground the sick energy until partial relief is attained.
2. A large amount of pale blue/white chi together with pale green/white chi should be used to transmit energy to the problem area.
3. For the alleviation of pain, use pale green/white chi and pale tangerine/white chi in turn.

Energize means draw the Chi into the part that you want to receive healing. Cleansing means push energy through the affected part and send it out to the universe. Pull the new Chi back into the same area. Light green Chi is used in loosening and cleansing delicate organs like the eyes and the brain.

Headache: *Light Whitish Green and Light Whitish Blue Chi*

1. To check for areas that are congested or lacking in energy, the eyes, temples, spine and solar plexus area should be scanned. Also, the crown, mideyebrow, forehead and back of the head and neck.
2. The eye and temple areas should be brushed down when the headache is because of eyestrain and then flushed into the ground.
3. The whole head, particularly the painful section should be brushed and then pale green/white, blue/white and pale purple/white Chi used to bring energy into the area.

Migraine Headache: *Light Whitish Green Blue and Violet Chi*

1. Persons who suffer from prolonged or chronic headaches including those types termed 'migraine' headaches have an abnormal accumulation of energy in various parts of their bodies. Starting with the solar plexus, this energy follows a route up the vertebral column and thence into the neck and head. As a result the various blood vessels in the head expand, causing pain in the head area. Mental strain and emotional disturbances usually cause this type of headache.
2. Use a pushing movement to clean and open the solar plexus and liver areas. First use pale green/white, then pale blue/white and finally mauve/white chi to bring energy to the solar plexus area.
3. In order to send the 'sick' red chi into the ground, brush down the spinal column.
4. The back of the heart can be opened by pushing through in order to remove the dirty Chi. Then bring energy to the heart by using pale green/white and purple. Use your mind to see the heart center expanding and opening.
5. Brush down the dirty chi from the head area and send it into the earth.
6. Use a combination of pale green/white, blue and purple to bring energy to the back of the head, the crown point and the forehead.

Toothache: *Light Whitish Green and Blue Chi*

1. Brush down the area with pale green/white Chi.
2. Energy should be brought into the area with pale green/white, mauve/white and blue Chi.

Broken Bone: *Orange-Yellow Chi*

For anything relating to the bones always activate the sacrum. Light orange-yellow Chi is used to encourage broken bones to knit quickly, Chi which is pale yellowish tangerine may be employed. The sacrum attracts the orange-yellow Chi; feel the eight holes in the bone breathing. The orange-yellow Chi enters, transfers up to the crown and is sent up to the universe to multiply.

1. The fracture area should be brushed using a combination of pale green/white and pale tangerine/white chi.
2. To promote fast knitting of fractures, a daily treatment with pale tangerine yellow Chi mixed with white can be employed, in the ratio of 7:1.5:1.5 of white (for the center), yellow and tangerine respectively. Push through and brush the sacral and navel areas, using a cerise (light red) Chi mixed with white.

Back Injury: *Light Whitish Blue and Green Violet Chi*

1. Scan the student to see which parts are congested.
2. Use chi that is pale white/green or pale white/tangerine and, selecting each in turn, with a brushing movement apply to the whole spinal area and especially to the area where the trauma is located.
3. To bring energy to the damaged area, use a combination of pale blue/white, green and purple.
4. White chi should be used with a brushing movement on both the back and front of the solar plexus area.

Infection and Inflammation: *Light Green Chi*

Treat the damaged area with green and tangerine/white chi, using a brushing movement. For the heart and spleen, these colors should be replaced with green and purple.

Bring energy to the area by the use of mauve, white, tangerine, green and blue and strengthen the natural immune of the body.

Cysts: *Light Green and Blue Chi*

During the course of the session, repeatedly pass your hands over the patient's body. Treat the solar plexus area with a combination of green and blue chi. The cyst can be removed using a chi knife, spiraling clockwise with green and tangerine chi; moving the 'stuck' red chi out of the body and grounding it in the earth. After, blue chi should be used for a calming effect, while green and tangerine can also provide energy. For maximum benefit, sessions should be thrice weekly.

As foods containing a lot of highly spiced ingredients have a lot of red chi, these should be kept to a minimum. The patient should use the Inner Smile to calm and balance his/her emotional state.

It is sometimes necessary to sweep 100-200 times, to cool the affected area. Scanning will enable you to take a temperature reading. If the area is still hot then continue sweeping until it reaches a satisfactory temperature.

Fever

1. Brushing can be done with blue or green Chi.
2. Push and pull through the affected part, sweeping the spleen with green and blue. Clean and rinse thoroughly.
3. The solar plexus area can be treated with tangerine and blue Chi but tangerine should not be used on a patient with diarrhea.
4. The thymus gland can be stimulated by the application of green, tangerine and purple Chi. First, brush the heart area with green and blue. This helps the body to ward off infection.
5. Both lungs should be brushed and energy brought into the back of the lung area by the use of tangerine and green.
6. Sweep the spleen with green.

If the student has a fever then they must lie down to receive the healing. This applies in all cases where the student is unable to sit up comfortably.

Insomnia: *Green and Blue*

Inability to sleep may be the result of too much activity in the solar plexus and the sacral area. The solar plexus may also be congested. Similar problems can also occur in the throat, mideyebrow and forehead, as well as at the crown point.

Repeatedly pass your hands over the patient's body as the treatment progresses and use a combination of blue and green chi to clean the sacral and solar plexus areas.

Sleep can be brought on by use of blue, as it soothes the solar plexus area. Use blue and green to brush the mideyebrow, forehead and crown point and white and tangerine on the navel. Finish with blue.

Do not eat food late in the evening.

Sleep in a separate bed from your partner. You can place two beds next to each other.

Tinnitus

Relates to weakened kidneys. Work on the kidneys, mideyebrow and forehead.

Blood Clotting: *Blue Chi* - Fresh Burns: *Green and Blue Chi*

Because of the cooling and calming properties of blue chi, it can be used to remove the heat from burns. Green has a similar effect.

The area needing treatment should be scanned, then brushed with a combination of pale green/white and blue Chi until relief is felt and the heat in the cells released.

Old Minor Burns: *Green and Red Chi*

Pass your hands over the damaged areas and repeat this during the treatment period. Use pale green/white and tangerine, but do not use on the head, eyes or brain, or other sensitive organs.

To reduce discomfort in the damaged area and promote fast healing, firstly pale blue Chi mixed with white should be employed, followed by cerise mixed with white, and green in equal proportions as this mixture optimizes the breaking down of necrotic cellular material. However, cerise should not be used in the head area but be replaced by mauve mixed with white.

Use cerise/white chi to brush the sacral and navel areas and follow with blue which assists in the release of the stagnant Chi. This session should be repeated for 2 or 3 days.

Old Severe Burns: *Green and Red Chi*

1. Scan at the beginning and end of the treatment (Note:I do not think scan can be seen as plagiarism and I don't know what other word to use in this context as I do not have the full text)
2. The local area should be brushed first with pale green/white and then with pale tangerine white. Keep repeating but make sure to omit sensitive organs and the head area.
3. To speed up healing and reduce pain and infection, the damaged area should be filled with energy from pale blue white, pale green white and mauve with white Chi.
4. To help speed up the healing process, wait a few days until there is much less pain, then use pale green white and cerise mixed with white Chi. If the head area is affected, use mauve mixed with white in place of the cerise.
5. Brush in the sacral and navel areas and to speed up healing use white Chi.
6. After making your healing intent stable, release it.

Old Wounds: *Green and Red Chi*

Green chi, in equal proportion of pale green/white and pale red/white should be employed on injuries which are not new as, when used in large quantities, it attacks and disperses damaged cellular matter, promoting fast healing. On recent injuries, it will have an adverse effect because it is likely to cause the trauma area to become moist, and it also will not be able to work quickly.

Scan at the beginning and end of the treatment, and brush the damaged area with pale green/white and pale tangerine/white Chi. Some pale blue/white can be employed locally to energise the area. Use of pale green/white followed by cerise mixed with white can speed up the healing process and assist in the breakdown of cellular material.

The navel and sacral areas should be brushed using pale cerise/white Chi. This will fill the area with energy and make the wounds heal faster. Before the Chi is let go, it should be stabilized.

Some Specific Points and Ailments

The following descriptions are mere guidelines. Each case is different and much depends on your own abilities. One needs practice to detect diseases. Best results with Cosmic Healing will be obtained when practiced in combination with Chi Nei Tsang.

Remember that these techniques are not meant to replace the doctor, but merely to assist him. The student must always work with the practitioner. ***The practitioner is a channel, the student the healer.***

Solar Plexus: *Blue Chi*

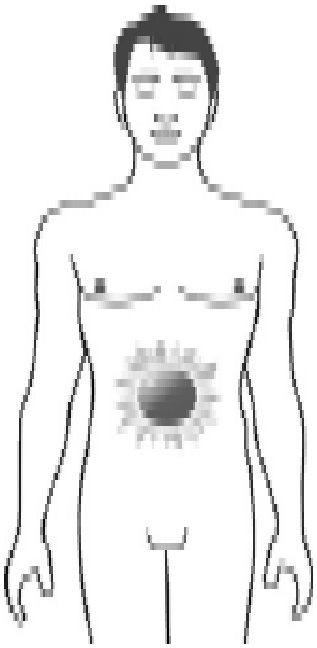

The Solar Plexus is the connection point for practically all the nerves inside the body. That is why it becomes laden with emotions so easily. When the Solar Plexus jams up and overheats, the liver will overheat; when this happens, the heart will also overheat; this will in turn affect the thyroid and parathyroid; finally the brain will be affected. Cleaning out this center is therefore extremely important. This type of cleaning may be done from the top down (as in the general cleansing session) or aimed at the Solar Plexus directly. Draw the green light, spiral it, flush with the green light, then energize with white and violet light. As before, always allow the energy to stream through both the points fully. The Solar Plexus holds all the emotions. When working on the Solar Plexus, the most important thing to remember is to connect the backside to the universe. There is literally no end to the 'other' end of this connection. Just allow the Chi to come all the way down and slightly pull inwards a little. Simply clean out the path. Allow the information to condense, allow any images to come out. Then stabilize the energy. Picture the Chi-field enveloping the person as a big protective bubble. Cool down with blue.

Skin Infection: *Blue Chi*

The skin is related to the lungs and the kidneys. Whenever there is an infection, the immune system is involved.

1. Enhance immunity as outlined in pages 101-108.
2. Focus on strengthening the lungs. Always start with green to flush out. Then send orange light into the lungs. Make sure you are not sending it up to the brain. Energize the lungs with blue and white.
3. Detoxify the kidneys, purify the blood (green) and energize with blue. Ask the person to visualize a fresh mountain-stream to stimulate the kidneys.
4. Treat the area locally, using your hands. If the area is big, use your palm, if small use the fingers. Do not focus on your palms - refer to the section 'Forget About Your Palms'. on page 152. Draw green Chi from the forest, and then energize with violet.
5. To diminish pain or itch, use blue to cool down. Also use the Chi knife to work on the infection.

In case the skin problem is allergy-based, you should also treat the mideyebrow; there might be some irritation here. First clean with green, then either energize with

violet (if resistance is low) or soothe with a light shade of yellow. If the skin problem is related to asthma, open the lungs with bright red clean the throat center with green and energize it with (deep) blue.

If the problem is due to toxicity, also clean out the liver flushing with a combination of green and orange. Energize with green. Enhance the immune system by working on the sacrum.

Eyes: *Green Chi*

The right and left eye are governed by the forehead and mideyebrow respectively. The eyes are also linked to the temples. Ask the person to touch their temple bone and guide them to take in the (white or light violet) Chi. Send Chi through the mideyebrow and forehead (all the way through). Ask the person to visualize the light coming in. Use soft shades of green with golden yellow to stimulate the optic nerve. Use blue to calm the eye muscles and light violet to stimulate the inner eyesight.

The eyes are connected to the liver. Scan the liver and energize with green. Scan the jawbone to see if there is any unreleased anger. Cool down with blue. Channel bright green into the liver.

Ears: *Violet Chi*

The right and left ears are governed by the forehead and mideyebrow respectively. Push and pull green Chi to clean. The ears are connected to the kidneys, so you can work on them also. The ears are also connected to the sinuses and upper respiratory tract. This means that infections need to cool down before you can use any cleaning technique. Use blue to cool and clean with violet. As long as fever and severe infection persist, use blue to cool them down. When clean, energize with violet.

Have Better Health, Less Stress and Remain Young

Brush specifically on the areas of the solar plexus, liver, stomach and pancreas.

White chi brings energy to the crown point, head (at the back) and both sides of the brain.

Both the front and rear of the heart and lungs can receive energy from white/purple Chi.

Both the front and rear of the spleen, the navel and lower abdominal area, the spinal cord, the kidneys, using white Chi.

On the sexual center use white chi but if the problem is difficult to shift, use green. You can also use white Chi on the sacral area, and green or purple on other organs.

White Chi can be employed for the arms and hands, while the legs and feet should be treated with white and purple Chi.
Eye problems with green/yellow energy.

After a session, patients who are particularly weak should not bathe for one full day. The energy which has been put into their bodies can thus be kept there by application of pale blue/white Chi at the end of the session.

Fig. 6.18 *Use Compassion, Love and Kindness.*

Summary of Individual Healing Session

A. Chi Knife
B. Energizing and Activating the Immune System
C. Cleansing with the Internal Organ Techniques

General Outline of Practices

1. Gain experience by working with one person. **Stand in front of them with your feet shoulder width apart.** Hold your hands at your heart in salutation. Transmit your love and compassion and ask for their permission to help them to help themselves heal.

2. Connect to the student's and your own cosmic star above your head and ask for universal permission. **Radiate your love and transfer three minds into one mind**. Lower your Upper Tan Tien. Activate your consciousness: Three minds become one mind. Expand your awareness in the mideyebrow and the crown. Feel the Tan Tien, heart, mideyebrow and crown spiraling. Expand to the universe.
3. Visualize the person's legs as being 'very long', extending down to the earth. **Activate the Sacred Fire** and bring it down. Clean out the room and make a big Chi field around you and the student.
4. **Call the Elemental Forces:** water, fire, thunder, lightning, rain, lake, earth, mountain, wind and Heavenly Chi. Call the guardian animals; Blue Tortoise from the north, Red Pheasant from the south, Green Dragon from the east, White Tiger from the west, Yellow Phoenix from above and Black Tortoise from below. Feel that you are protected by the Chi; gather the power of all the mountains, rivers, streams, stones and rocks into the room. Activate them with lightning, thunder and wind - filling the whole room with electrified Chi.

A. Chi Knife

1. Hold the knife in right hand (left, if you are left handed). Hold the other hand near your body with the thumb and index finger touching. Project the Chi Knife as big as the universe, 'long and big - reaching to Heaven'. The bones in your arm are hollow and the 'bottom' is sealed at the shoulder. Feel them 'fill and pack' with the power coming from above.
2. Then give the command: **"Power comes from the east. This Chi Knife has the power to dissolve all the negative energy, sickness and bad fortune. By my request, please carry out the order now."** Wait until you feel that your arm and the knife are heavy and full of Chi.

   Carry out energetic surgery, **cutting and slicing the affected area with cool yin energy**. When you feel that the Chi Knife is full of sick Chi, spiral counterclockwise and discard it down into the ground. When you feel that the knife is 'empty', charge it with Chi from the universe. Continue until you feel that the area has been cleansed.

B. Energizing and Activating the Immune System

In cases of severe illness, debilitation and infection, it is essential to stimulate the body's defence systems. You may also want do this in a preventative manner. Guide the student as you practice together. Presuming that you have already done the previous set of general healing, you can start with the coccyx.

1. Be aware of your Tan Tien and connect to the universe. Touch your **coccyx** with the fingers concentrating a beam of white or yellow light on to it. Picture the sacrum opening and the light streaming inside, flowing **up the spine** and streaming out over

the whole bone structure. Feel the Chi rising up to the universe, multiply it and guide it down to your energy body.

2. Be aware of the Tan Tien and the universe. Attract the yellow light; spiral and condense the healing light into the tips of your fingers; move the fingers up to touch the **sacrum**. Send out a beam of yellow Chi into the sacrum, directing it up the spine. This will stimulate the production of red blood cells. Transfer the feeling of 'Bone-Chi' up to universe and down to your energy body.
3. Proceed to the **crown**, showering it with violet light. Then spread from the crown throughout the bones of the body. Repeat several times. Instruct the student to feel the bone structure breathing. Ask him/her to extend up from their crown to the Big Dipper and North Star, channelling down the red and violet light into the thymus gland.
4. Continue to the **throat**, stroking down with your palms, using green color to move the lymph down towards the backside of the heart. (Never stroke up towards the head! Only guide the lymph down).
5. Proceed to the **lymph nodes under the armpits and across the sternum**. Next activate the lymph nodes in the **groin**. From the groin you guide the lymph up to the navel center (Not down where it will get stuck in the legs).
6. Return to the **navel center**. Send the energy deep inside, energizing the lymph nodes at the back. Pull back, drawing green energy, flushing out any waste products that are stuck in them.

Activate the points at the inside of the **elbows** and the **knees**.
Shower the whole body with healing light and energize the **perineum** with blue Chi.
Always remember to ground any sick energy by sending it deep into the ground. Ask the student to do the same and it will be more effective. You should do this while giving the session as well as when closing it.

C. Cleansing the Internal Organs (Repeated from pages 132-133 and pages 136-137)

This session can be used for any kind of ailment and carried out with any number of students. **It is important to remember that if there is no energy in your Tan Tien, then there will be no energy to work with.** When you are aware of your Chi, you can direct heavenly light straight into your energy body and then into the student's.

General Cleansing Procedure

1. Push and pull the energy through the student's body. Push and disperse the sick energy into the universe and out to the planets, where it will be transformed and recycled.
2. Pull the energy back and stop it between yourself and the student.
3. Spiral the energy counterclockwise until you see the **green** light mix and clean the sick energy. Spiral and flush the energy down into the earth.

4. Spiral with blue light; see it mix and flush the energy within the student's body. Spiral this energy down to the ground.
5. Energize the student with **white** or **violet** light.
6. You can also use both hands to channel Chi when you 'push and pull' through the body.
7. **Spiral in** - spiral clockwise to bring energy into the body and energize it.
8. **Spiral out** - spiral counterclockwise to cleanse, flush and remove energy.
9. When you begin pushing, pulling and sweeping, you may feel resistance in the body. As you progress and the energy centers open, this feeling will diminish.
10. There are many color combinations that can be applied to the various parts of the body. When you start practice, stick to the basic 'blue, green, white, violet and blue' formula. When you are working on a specific area, you can keep this book near by, or write a short 'color recipe' before you begin. In this way, you will be able to relax your mind.
11. 'Pushing and pulling' is like fanning and venting the body; when you fan your hands in front of your face, it will have a cooling effect. Ventilation enables the stagnant, sick energy to leave the body.

    Below is a list of the body's organs in relation to their tendency to 'store heat'. They are listed in descending order, i.e, the head is the hottest.

    Head, heart, liver, lung, stomach and spleen, large intestine and small intestine, kidneys and sexual organs (which become hot when aroused).

Outline of Practice

The **solar plexus** is the clearing house for emotional energy and is situated in between the lower and higher energy centers and in the center of most of the internal organs. All the organs dump their negative emotions here. The internal organs can be cleansed by sweeping the solar plexus, energizing, cleaning and flushing it of sick energy. When you feel sick energy in the body, give the command: "Stay". This is very important; it makes sure that none of the cells hide from the dazzling light that you are sending in.

1. Scan; ask for the power to look at the cells.
2. Push, pull and give the command "Disperse". Push until you feel the solar plexus clear and open.
3. Spiral green Chi counterclockwise. Talk to the sick energy; tell it to "Leave", you will take it to "a better place, where it will be happy". Give the command "Out".
4. Spiral Blue Chi counterclockwise, flushing out any remaining sickness. Guide the sick energy into the earth.
5. Spiral and sweep Blue - Green and Red Chi into the solar plexus, sweep the organs. Do not use in cases where there is intestinal infection and internal bleeding (which can be worsened) or in the presence of pregnant women.

Cleansing the Spinal Cord

Always cleanse the spinal cord, which protects the entire body from diseased and negative energy, both physical and psychic. When you open the spinal cord and solar plexus you can release many energy blockages. Sweep the hand in a clockwise motion to energize the spine with either/or a combination of: blue, green, white and ultra-violet. Then spiral counterclockwise and brush the spine down to the ground. Continue sweeping until you feel that the spinal cord has cooled down. Remember not to use orange or red

Cleansing the Blood (Lungs)

The blood can be cleansed by energizing the lungs with whitish green, then with light whitish orange. The blood passing through the lungs will absorb the green and orange Chi, thereby cleansing the blood plasma and vessels and the rest of the body. This technique is very useful for treating ailments of the blood and of the arteries and for severe infections. Do not use it on pregnant women.

Outline of Practice

1. Scan the student.
2. Push through and open the lungs from the back to the front.
3. Energize the lungs from front to back with light whitish green, then with light whitish orange. Push through.
4. If the student is weak, energize the lungs with light whitish red, which will provide a strengthening effect.
5. The **spleen**, **liver and kidneys** purify the blood. Push and pull through the organs and energize with white Chi.
6. The blood requires a lot of cleaning on a regular basis.
7. Energize with white Chi. **Germs can only grow in the dark. 'Fill yourself with the light'.**

General Principles

Energy can be introduced to the affected area of the body by moving the hand clockwise in a spiral. **Flush** means to return the sick energy to the earth for recycling.

Stabilize means to return the area to normal functioning.

Spiral in a **clockwise** motion when you are '**stabilizing**'.

Use **blue or white** light to energize the area that you are working on.

Use **green** light to **energize** and **clean** the area that you are working on.

Use **blue** light to **flush** and **stabilize** the area that you are working on.

Use **violet** light to **balance** the sick energy and **reprogram** the cells of the body.

For **general infections** always **use green** (energize and clean) and **blue** (stabilize) light. Use violet light to balance the sick energy and reprogram all the cells. Use the 'Chi Knife' for infections as well. Never use orange on the head, heart and spleen.

Give the command **"Stay"** to make sure **all the cells receive the light** you are sending in. Remember that germs and bacteria cannot hide in the light.

Energize means to draw the Cosmic Chi into the part that requires healing.
Cleanse means to clean all the cells being treated.

You can also work on yourself. You may need some help when working on the back. If you obtain optimum health and practice the Cosmic Orbit regularly then you will never 'need' to apply any of these techniques to yourself.
Like all Chinese medicine, Cosmic Healing works on the system as a whole, balancing the entire organism, treating the cause to cure the symptoms.

The techniques really are simple.

When in doubt use; blue, green, white, violet, blue.
You can always use white and violet.
Upper organs - use violet.

You can practice group healings and then link your students' personal stars together, at an agreed time later in the day. **You can then perform the World Link Cosmic Healing**.

Work on any other ailments that the student may have.
The simplest way to learn is to begin practicing today.
The simplest way to heal is to allow yourself to be healed.

Chapter VII
Different Hand Techniques

Forget about your Palms

An extremely important theory of Cosmic Healing Hand Techniques is to ‘forget about your palm’. This means that you should only use the palm (which is incredibly sensitive), for ‘guiding’ the universal energy into the right spot, sending out a minute beam of light, like a laser, that marks the place where the energy should be sent. Your palm is connected to your brain, which has been sunk into your Tan Tien. The light marker will serve as a beacon for the force that is directed down by your mind. Draw down the Universal Chi, guide it to the right spot and give the command; "Stay". This is very important, otherwise the Chi will disappear once you move your hand.

When you practice Cosmic Healing it makes no difference how many people you treat, because you are not transferring your own energy.

Don't Focus your Mind on the Sick Part

If you direct your attention towards something, your energy will go there. If you focus on some ailment, you are already sending out your energy. Instead you should try to connect with a greater source, Universal Chi, extending your mind very far away. This way you won't lose your power. The only thing you do as a practitioner is to form the connection between nature, the student and the sick energy or between the universe, the Chi field and the sick part.

Cosmic Healing is Teaching

One of the best methods of protection for a practitioner is the Fusion practice (*Refer to ‘Fusion of the Five Elements I by Mantak Chia*). Perhaps even better is for the practitioner not to perceive him/herself as a healer, but as a person that comes to guide people in something they have to do themselves. When you say; "I am a healer", the sickness or bad energy, has already found a new home. When you check it out, first it will try to hide, and then it will try to attach itself to you. But if you don't interfere, the energy will go straight to the ground. So it is very important to clarify that you are not a healer, but a practitioner that can help, and that the student or sick person has to do most of the job.

Fig. 7.1 *The Stronger your Awareness of your Inner Body, the Easier it will be for others present to pick up this Sense.*

If you guide those present, this will greatly enhance your healing session. Sit or stand facing your student. Any time you want him or her to focus on a particular point of the body, ask them to touch it with their hands. For example, "Now place your hands on your navel", while you do the same thing yourself. As soon as you feel the Chi there, you instruct them to focus on the navel themselves. This way you are actually helping them to deepen their bodily awareness. The stronger your own awareness of your inner body, the easier it will be for the others present to pick it up. This means that if you are treating some part of another person's body, or if you see that the person is not aware of any energy in some part of the body, you can help by focusing your awareness on this particular part of your own body.

Chi Kung Diagnosis: Hand Scanning

Hand scanning is a simple and effective diagnostic tool of External Chi Healing. It involves passing your palm over the body of your student from one inch to one foot above the surface of the skin and being aware of the energetic state of the various bodily areas. What one senses is described as the electromagnetic field, the aura or the energy body.

General Variations in the Energy Field

The variations you may sense with scanning that have diagnostic significance are:

Temperature

Heat generally indicates excess, while cold indicates deficiency. However, some areas of the body are naturally warmer or colder than others. This is described below under "Hand Scanning the Internal Organs."

Thickness

A feeling of thickness over the area would indicate excess, while thinness may indicate deficiency.

Wind

You may feel sensations of wind leaving the body at various places. This may indicate internal wind at a given location, or it may point to an area of the body that is "leaking energy" and needs to be ‘patched’ or ‘sealed’. It may also be a positive sign that you are driving wind out of the body.

Peaks and Valleys

Peaks in the energy field will feel like mountains or hills in the aural landscape. They may actually push your hand away. Valleys feel like depressions or energy vortexes drawing you in. They may also feel empty, like a hole or pit. Peaks indicate excess or stagnation, while valleys indicate deficiency.

Tingling

Accumulations of sick Chi may cause your hand to tingle, feel prickly, throb, or even hurt. These are excesses of energy and upon inquiry, the student may complain of pain in this area.

Hand Scanning the Internal Organs

Each Organ Emits a Different Aura

Each organ emits a different kind of force or aura through the skin. By passing a hand one or two inches above the skin, you can feel different sensations that reflect the condition or state of the internal organs. You need to develop the sensitivity to receive and identify the vibration or frequency of each organ. Practicing the Cosmic Chi Kung Meditations will help develop such sensitivity.

Liver and Gall Bladder Scanning

Healthy liver and gall bladder energy feels warm.

Negative Emotions: When you pass your hand over the liver, under the right side of the rib cage, you will feel a charged energy come up to your hand. This is a sign of anger in the liver.

Overactivity: When you pass your hand over the liver and feel a rush of hot energy, this indicates that the liver is overheating because of toxins or emotional stress.

Underactivity: When you pass your hand over the liver and you feel a dense and hot energy, the liver is weak, congested and sick.

Lungs Scanning

Healthy lung energy feels cool and dry.

Negative Emotions: Pass your hand over the lungs. Do the Lungs' Sound and listen to the echo of the sound as it rebounds from the lungs. Sadness will feel like a deflating ball pressed between your hands.

Overactivity: Energy that feels dry and hot indicates an overworked organ.

Underactivity: Energy that feels damp and cool under the scanning hand indicates underactive or congested lungs that can lead to respiratory problems.

Heart Scanning

Healthy heart energy feels warm and energetic.

Negative Emotions: Hot and charged energy indicates impatience, hastiness and arrogance in the heart.

Overactivity: If your hand detects hot, charged and overly expansive energy, this indicates that the heart and blood may be overheating.

Underactivity: Energy that feels cool and less expansive indicates an underactive or congested heart.

Spleen Scanning

Healthy spleen energy feels lukewarm.

Negative emotions: Energy that feel damp and sinking indicates excessive worry.

Overactivity: The energy feels hot and damp when the spleen is overactive.

Underactivity: The energy feels cool and damp.

Kidneys Scanning

Healthy kidney energy feels cold, but not too cold.

Negative emotions: Energy that feels cold and chilly indicates fear.

Overactivity: When the kidneys are overworked or overstimulated by excessive exercise or improper diet and liquid intake, the energy can feel damp, stick and hot.

Underactivity: When toxins are blocking the organs, the energy can feel damp and cold.

Hand scanning is an art, and may take a while for you to feel confident using it. Practicing Cosmic Chi Kung is one of the best ways to develop greater sensitivity in hand scanning.

Chapter VIII
Cosmic Chi Kung
Palm and Finger Training

Why We Practice the Cosmic Chi Kung

The Cosmic Chi Kung is also known as Buddha Palm. The reason we train with the Empty Force practice in connection with the Cosmic Healing is to learn how to project Chi through the space in the cosmos, the space between your hands and to project Chi through the space to your students. Usually when we touch the student we pick up sick energy. This practice will teach you how to ground the sick energy to the earth and to disperse it into the Universe to be decomposed and recycled by the planets.

Practice until you can project Chi out from your palms and fingers and when you feel the Chi coming into your body through your hands. The most important part is to always remain connected with the Universal Force coming from all six directions. If you focus on healing from your hands or your Tan Tien you will use up your own energy. You must be connected to the Cosmic Universal Force.

Expand your awareness to nature, the oceans, the lakes, the forests and mountains. Smile to nature and feel it smile back to you; inhale and draw the Chi into your palms. Expand your awareness to connect to the light, the Milky Way and the cosmos.

Be aware of the heart and the red light in the heart; expand your awareness to infinity. The light will come close to you; picture the red planet Mars above you. See it shine down to your crown, feeling the light in your palms. Be aware of the six directions, feel your body growing bigger; until you touch the sky, your feet still planted in the earth.

Opening Heaven and Earth Force in the Palms with Heaven and Earth Spirals

The purpose of this technique is to draw in the forces of heaven and earth through the palm. Activate the spirals, the symbol for the heaven and earth force in the center of the palm.

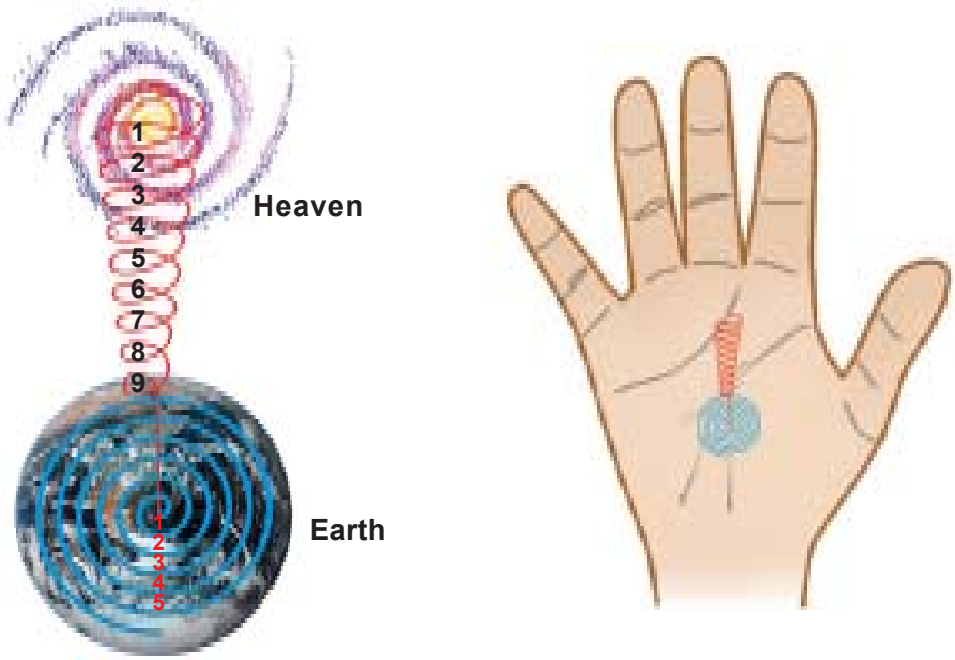

Fig. 8.1 *Enhances the symbol of Heaven and Earth Force, in the Laogong - Pericardium 8.*

This is accomplished by drawing these spirals with the palm itself. As you draw the spirals, you should actually feel the palm breathing, inhaling these forces in. In the beginning, however, you may only be able to use your own mental imagery and imagine that you are absorbing these forces. In time the feelings will replace your imagination.

You breathe in Heavenly Chi when you draw the heaven spirals, and breathe in Earthly Chi when drawing the earth spirals. You may draw in both in one session; you may also choose just to draw in either Heaven or Earth Chi if you feel you need more of one or the other. It is important to balance these energies whenever you do this exercise.

1. Begin by raising the right hand to about shoulder height with the elbow sunk and the palm facing forward. Slightly pull back (open) the index finger, and slightly stretch the thumb forward and down. This will activate the Laogong point on the palm.

At the same time, touch the tips of your left thumb and index fingers together. This will allow the right hand to draw in the Heaven and Earth Chi. The left hand will then be held palm up to draw in the heavenly force, or held palm down to draw in the earthly force.

2. Begin **drawing the heaven spiral** by moving the **palm in a clockwise motion**, with the circles getting smaller and smaller, spiraling inward. At the same time, your left hand is held at your side, palm up with thumb and index tips touching each other. Draw seven or nine (planets of our solar system) small spirals with your right hand in this way, drawing in the violet heavenly energy.
3. Next, lower your right hand slightly and turn your left palm down to face the earth. Then begin **drawing the earth spiral** by moving the right palm in a **counterclockwise motion** with the circles getting larger and larger. Draw five spirals (five elements), drawing in the blue earth energy as you move. Inhale into the palm, feeling the energies.
4. You may now bring both hands down to the beginning position of Cosmic Chi Kung, or you may open the Cosmic Channel to the planets for healing. This is discussed in the next section, Part I, 'Opening to Heaven, Earth and Cosmic Chi'.

Cell Breathing

By understanding the operations of our cells, we establish a foundation for our experience of Cosmic Chi Kung. Each cell is a living, breathing entity, absorbing energy with each inhalation and releasing toxins with each exhalation. Thus with every breath, we are creating more Chi.

We are made up of over one hundred trillion cells (one trillion is one thousand billion). Each one of these cells is constantly breathing. In order for our cells to function optimally, we must follow nature's teachings.

Fig. 8.2 *Each Cell is a Living, Breathing Entity.*

The first thing is to keep your cells free of toxins. Eat nutritional foods. This helps the Chi to flow smoothly through your energy channels and aids greater assimilation of vitamins and minerals. Learn and apply Five Element nutrition principles, eating according to the seasons and to your own constitution.

The second thing is to keep your cells free of excess emotions. Develop the skill of acting positively to situations, rather than reacting, especially negatively. Don't allow anyone to make you sad and unhealthy. Some people like to say, "You make me angry," or "You made me worry." We cannot allow other people to make us so emotional. We do not need to accept the negative emotions that other people try to dump on us. Cellular and psychic boundaries are related. Negative emotions disturb the cells' ability to absorb Chi and to generate the energy necessary for healing. We need all the Chi that we can get. Learn and apply the Six Healing Sounds, the Cosmic Inner Smile and the Fusion of the Five Elements meditation to transform negative emotions into personal power.

Third, create more energy by cultivating a happy attitude, so that your cells can regenerate more easily. **Smiling and loving** are the two quickest ways to make more Chi. In order to have an ample supply of Chi, develop an attitude of **joy and love** in yourself and towards others.

Mind, Eyes, Heart and Intention (YI)

The opening of the mind, eyes, heart and use of intention is vital for further activating and increasing your Chi. In the Tao we achieve this by cultivating our "Yi" (pronounced "yee"). "Yi" means mind power, intention, awareness and concentration. The Yi leads and guides the Chi. With our mind we control thought patterns. With our eyes we control the senses of sight, hearing, smell and taste. With our heart we control all our organs and their related emotions: the kindness/anger of the liver, the joy/impatience of the heart, the openness/worry of the spleen, the courage/sadness of the lungs and the gentleness/fear of the kidneys.

Fig. 8.3 *'Yi' leads and guides the Chi.*

Every excellent achievement in our lives depends upon the quality and efficient operation of our Yi. Combining the awareness of the mind, eyes, heart and intention into one, causes the creation of a rich and rare alchemical mixture. The power of the Yi is the magical catalyst that assures energetic results.

The basic teachings are all in the Microcosmic Orbit, the Cosmic Inner Smile and the Six Healing Sounds. As long as you are alive and healthy, you are able to draw in energy from the universe and nature. The stronger the battery, the better it is able to store this energy. If you're weak and sick, you have no way to draw any energy from nature or the universe. When the cells stop drawing in energy, life ends. If you have perfected these practices, you have all the personal physical, mental and spiritual power that you need. Everything comes together. Your mind is aware of the original force. From the knowledge of Oneness, you are inwardly aware of your mind, senses and heart; you are outwardly aware of the universal energy. Now you are capable of receiving the abundantly available healing power of the universe; you can tune into everything, inwardly and outwardly in all directions. This is what we are here for: to heal and become whole again. We have higher goals to reach. The foundation for reaching our goals is a strong and healthy body.

Cosmic Healing Chi Kung is merely an extension of the universe within yourself. You draw the universe in through your palms, skin, heart and crown. With your Yi you breathe in the cosmos through these various open cavities of receptivity in your body, absorb its power, condense it, transform it and use it for the benefit of all.

Connecting the Bridge

Contracting the muscles of the perineum, sexual organs and anus activates our connection with the earth energy. By pulling up these areas and drawing in energy through the soles of the feet, we immediately become grounded and bring the earth (yin) energy into the Microcosmic Orbit. Pulling up should be done gently and directed by the Yi.

When we speak of "Connecting the Bridge," we are referring to the above exercise, except that we do not pull up on the perineum. Pull up gently and lightly on the sex organs and anus while leaving the perineum totally relaxed. After performing the first contractions, when you then relax the perineum, the earth energy will continue to flow into the body using the principles of a siphon. We thus connect the "Bridge" across the perineum from the sexual organs to the anus using the Yi to direct the energy. This actively combines the earth energy and your sexual energy and directs it into the Microcosmic Orbit. This energy is circulated during Cosmic Chi Kung. Holding a very gentle contraction will keep you grounded during the exercise. It can be done sitting or standing.

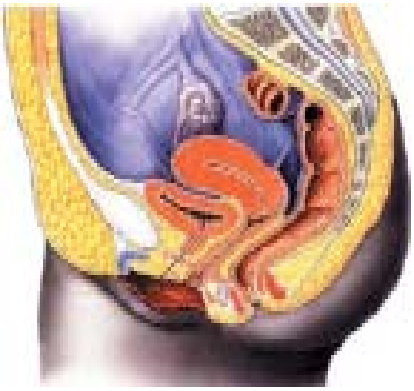

Women lightly contract the Vagina

Men lightly contract the Perineum and Anus

Fig. 8.4 *Connect the Bridge - combine Earth and Heavenly Energy.*

Cosmic Chi Kung Preparation

Cosmic Chi Kung can be practiced either in a sitting or a standing position.
Sitting, relax as much as possible and invoke the **Cosmic Inner Smile**.

1. Be aware of your **heart** and listen to your **kidneys** with your inner senses. Smile to your heart and kidneys and feel them pulsing; feel them communicating and interacting with each other. The **Kan** and **Li**; the water of the kidneys and the fire of the heart, balance and **begin to mix**.
2. Open the arm pits as if you were holding a ping pong ball there and slightly move the fingers to activate the Chi flow. Relax. **Feel** the sensations of the **Chi flow**: tingling, warmth, pulsing, electric and magnetic feelings.
3. Be aware of your palms. Draw in Chi by **activating the bone breathing** process. Become aware of the perineum; slightly pull up the perineum, sexual organs and anus and "**connect the bridge**." (Remember to relax the perineum).
4. Breathe into the palms of the hands and soles of the feet, further enhancing your connection to the earth force. Smile to the blue earth energy as it flows up your arms and legs and suffuses your body with pleasant Yin energy.
5. Breathe into the **mideyebrow** point and activate your connection with the **Cosmic Force**. Smile to the golden light of the cosmic energy as it swirls into your mideyebrow point and flows throughout your body, healing and balancing your energy.
6. Breathe into your **crown** point and activate your connection with the **Heavenly Force.** Smile to the red and violet light of the heavenly force as it flows into your brain and washes your body with subtle pure Yang energy.

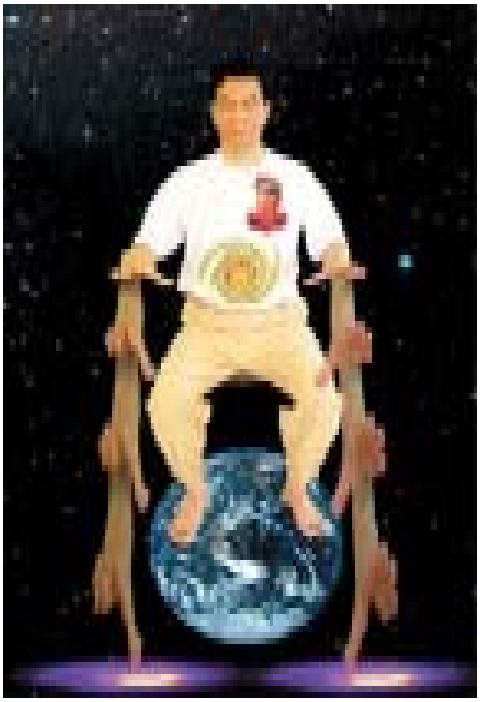

Fig. 8.6 *Invoke the Cosmic Inner Smile.*

Fig. 8.5
Place the Tip of the Tongue on the Upper Palate.

7. Place the tip of your tongue on the upper palate behind the teeth in a comfortable position.

8. As you begin to move through the postures of Cosmic Chi Kung, always be aware of the Chi flow and its attending sensations.

Cosmic Chi Kung Preparation Standing

1. Stand with your **feet parallel** and shoulder width apart.
   Tilt your **sacrum** and **pelvis** slightly forward until you feel your feet press more firmly into the ground. As you tilt the pelvis, feel your lumbar vertebrae pressing outward; this is called "**Opening the Door of Life**."
2. Relax your **chest** and sink your **sternum**. Draw your chin in slightly, and hold your **head, neck** and **spine** erect as if your head and spine were suspended from above by a string.
3. Follow the same instructions for the preparations of Cosmic Chi Kung.

Opening to Heaven, Earth and Nature

The natural world is the source of our power. Cosmic Chi Kung teaches us about nature and its energies. In the Tao, nature and the universe are equivalent to God. You are a part of nature and can easily learn to open to the forces in the macrocosm and let them flow through you. This is very simple. Just tune into the frequencies around you. Your fingers are antennae, which transmit and receive.

1. To begin your practice of Cosmic Chi Kung, simply **stand** up and **feel the energy around you**. When you stand or sit, be aware of your soles (Bubbling Spring points) making a good connection with the earth. Your perineum (Hui Yin point) is relaxed and open. You are connecting to the earth force and can expand further down on to the other side of the universe. This is one type of energy.
2. When you draw your **chin in**, slightly **relax your chest** and tilt your head slightly forward; you begin to be aware of the heavenly force. This is another type of energy.
3. The qualities of the **Five Elements** reveal themselves as woody trees (growing force), fiery deserts (expanding force), earth mountains (stabilizing force), metal air (contracting force) and watery oceans and lakes (gathering force). We call the combination of these elements the '**Cosmic Force**'.

Thus, your mind and body learn to gather, absorb, direct and transform the heaven, earth and cosmic energy for your own use. This is the essence of Chi Kung. Today there is a lot of emphasis on learning movements and forms of Chi Kung. However, if the inner feeling is not there, the movements are of little value.

Heavenly force is Yang. Earth force is Yin. By learning to connect to the energies of heaven and earth, you have a powerful tool for restoring and maintaining your inner balance of Yin and Yang.

Outline of Practice

Before practicing each of the Cosmic Chi Kung sets in this chapter and in the following chapters begin with the heaven and earth spirals as outlined on page 157.

First **Create the Chi Field**.

Hold each of the Cosmic Chi Kung postures for at least 5 - 30 seconds, gradually lengthening the time to 60 - 120 seconds per posture.

Note: While holding the postures count the breath from 5 to 15 seconds, being aware of the **Tan Tien** and feeling the Chi in the Tan Tien which then moves up to the **crown** and expands up to the universe; fuse your Chi with the Universal Chi and let it multiply down to your palms. **Just concentrate on the 'Tan Tien and the Universe'**; do not concentrate on the palms at all.

Throughout parts I, II, III and IV 'Tan Tien and Universe' means to spiral into the Tan Tien and spiral out into the universe connecting 'Tan Tien and Universe'.

Part I
Opening to Heaven, Earth and Cosmic Chi

Opening Movements

Three Minds into One Mind

Empty the mind and heart down to the Tan Tien.
Hold the hands together at the heart center.
Smile and make the heart feel soft; feel love, joy and happiness.
Turn your consciousness inward and your awareness out.

Fig. 8.7 *Empty your Mind and Heart down to your Lower Tan Tien.*

Feel your legs lengthen extending down to the center of the earth.
Feel your hands lengthen extending to the universe below.
Let the mind expand and be aware all the way down to the universe.
Feel the 'long' bones of the arms and legs and begin bone breathing.
Feel universal Chi filling, packing and compressing into the bones.
Draw this Chi down to the back of your crown and feel a heavy pressure press on the crown; feel slightly numb or a light electric downward flow, like oil dripping down. 'Focus at Tan Tien and Universe'. Count to five.

Channeling the Earth Force - Washing the Bone Marrow

Smile into the **perineum, palms** and **crown**. Then slowly raise the arms, palms facing each other, to chest height keeping the elbows relaxed and sunk. Rotate the arms slowly until the palms are facing down. Be aware of the mideyebrow and feel your breath and lightly contract your eyes and round muscles around the eyes. Connect the perineum bridge by slightly squeezing the sex organs and the anus; do this a few times.

Rest and **smile to soles of the feet**, feel the Chi bubbling and feel like you are standing on a hot spring starting to bubble up.

Be aware of your Tan Tien and expand your mind down past the earth to connect with the galaxy below you. Multiply and bring your mind back to the Tan Tien. Gradually feel the Chi being absorbed through the whole body and absorb it into the bones and body like a **rising steam or mist**. Feel the earth force move through the center of the bones and enter the bone marrow move up the calves and thighs (femur bones) through the hip bones, spine, **scapula**, **arms**, **neck** and **skull**. Finally **swirl the energy around your brain. 'Focus at Tan Tien and Universe'**.

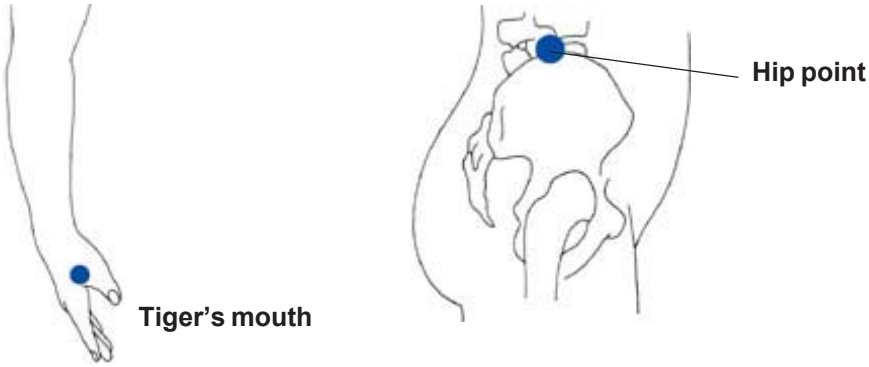

Fig 8.8 *Activate the Hip: Large Intestine 4, Pericardium 8 and Small Intestine 3.*

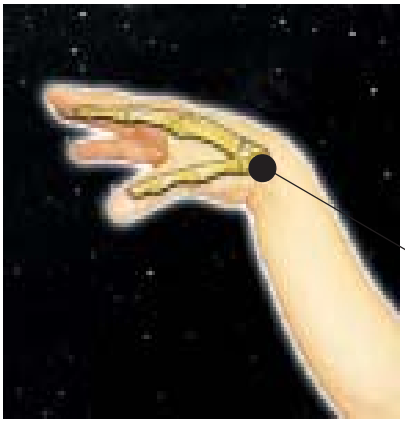

Raise your index finger slightly upward to activate the Hegu Point (Large Intestine).

Tiger's Mouth

Fig. 8.9 *Open the 'Tiger's Mouth'.*

Then **stretch your thumbs out to the sides and down**, so that they end up pointing downwards toward the earth. This activates Large Intestine 4 (Hegu). Large Intestine 4 is found in the webbing between the thumb and index finger. It is called the "eye of the hand"; this area is also known as the "Tiger's Mouth."

Slowly draw the elbows back and lower the hands until your palms are facing down beside the "eye of the hip" (the iliac crest) with the "eye of the hand" (Large Intestine 4) aligned with the "eye of the hip. "Be aware of the Tan Tien (Yi, the abdominal brain) and expand your mind out into space, the Cosmos and the universe. Remember: The fingers and the energy point act just like a laser to help guide the universal force flow; as soon as you focus on the fingers or the palms you are starting to use your own energy. Feel your Tan Tien and the crown full with Chi. Just use your second mind intention, lightly aware of the area between the hips and LI-4 points. Focus at Tan Tien and the universe. This will activate the lungs and large intestines. **Hold for a 30 second count** and gradually you will feel the ascending colon and the sigmoid colon have been activated; you may feel some movement around this area.

Fig. 8.10 *Activate the Organ Energy.*

Use your Yi to rotate your hands so that the fingers first point out, then back, turn the palms up and finally point the middle finger in toward the eye of the hip. Tan Tien and the universe - **95 % aware of the 'Tan Tien and the Universe' and 5 % aware of energy flowing back and forth between the tips of the middle fingers** (Pericardium 9); feel the Chi passing through the hips. This will activate the pericardium.

Rotate the hands again until the fingers are pointing forward with the **palms facing up**. Align the knife edges (Small Intestine 3) with the eyes of the hip. 'Focus at Tan Tien and the Universe'. Be lightly aware of the energy passing back and forth between the two hands. This will activate the heart and small intestine.

Fig. 8.11 *Activate the Heart and Small Intestine.*

Absorb the Heavenly Force Washing the Bone Marrow - Crown to Soles

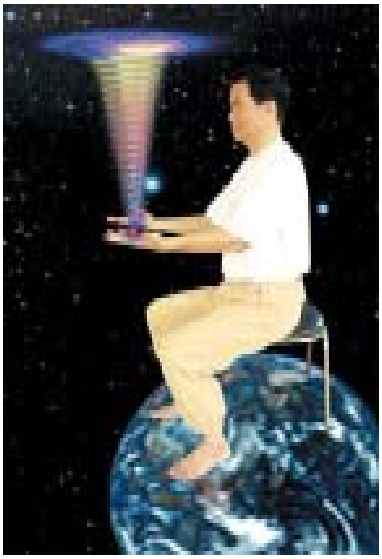

Extend the arms forward to chest height with the palms facing upward.

Laogong Point (Pericardium 8)

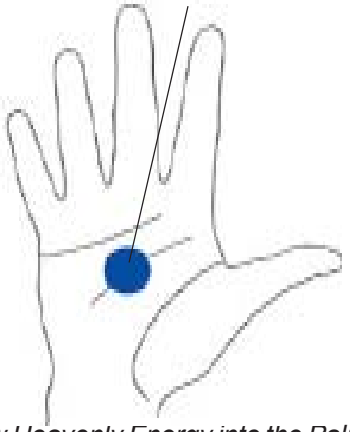

Fig. 8.12 *Draw Heavenly Energy into the Palms.*

Become aware of the **Tan Tien, the Crown and the Star above you**. Expand your mind (YI) out to the universe and connect to the galaxy. Be aware of the palms and the crown which are connected to the galaxy. Activate the Laogong point (Pericardium 8).

Feel the heavenly energy come directly to your palms, and be aware of the violet light of the North Star and the red light of the Big Dipper both shining radiantly.

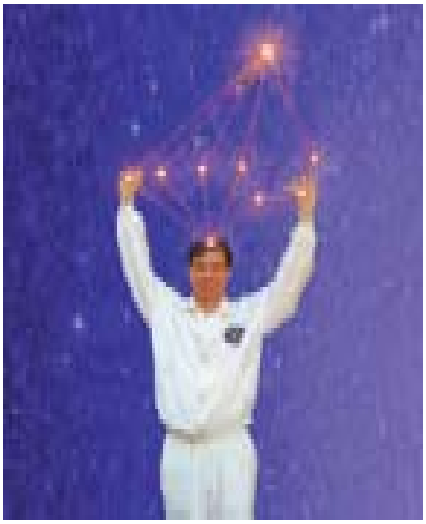

Fig. 8.13 Hold the Big Dipper.

Picture yourself holding the handle of the Big Dipper and turn the 'cup' pouring the light over your head. Draw this light in through the palms and the crown point and feel it washing your bone marrow. Always remember your Tan Tien. **Direct the sensations down through the skull, cervical vertebrae, clavicle, scapulas and sternum. Activate your thymus gland and continue drawing the healing heavenly light down through the rib cage, arms, spine, hips, femurs and calf bones, feet and toe bones. Be aware of the soles bubbling up to the perineum and up to the crown**.

Lightly rock yourself like riding a horse; this will help keep your spine open and Chi can flow easily throughout the practice.

Absorb the Earth Force and the Other Side of the Galaxy

Rotate the arms until the **hands are palms down**.

Raise the index fingers slightly and extend the thumbs first towards each other and then toward the ground. Be 95% aware of the Tan Tien and the Universe, and 5 % aware of the index fingers and the big toes. Wait until you feel the Chi enter. Fill the joints of the fingers and up to the wrists; feel 'tense but not tense' and let the **Chi continue to fill the joints** up to the elbows, up to the shoulders and gradually up to the neck and the head. Go from the toes up the legs to the hips and on into the spine and the rib cage **completing all the joints of the body**.

Be aware of the Tan Tien and the universe and only slightly aware of the palms (Laogong), the soles of the feet (Kidney 1-Bubbling Spring), and the perineum (Conception Vessel 1-Hui Yin) bubbling. Activate these points, feel the earth energy and continue smiling through the earth to connect with the galaxy, Milky Way, and the universe. Draw this light in through the palms and soles and let it wash up through the center of your bones from the feet up. Let it **steam and cleanse your marrow**. Picture any impurities or illness dripping out of your bones and draining down into the earth, where they will be recycled and purified.

Fig. 8.14 Open the index fingers.

Core Movements of Part I

Grasping the Moon

Connecting the Heaven and Earth Forces - Right Side over Left

Open Position: Heaven Force - Slightly raise the index fingers to open the palms. Bring the arms up , bending the elbows so that the left hand is under the right elbow with the left index finger pointing up to Heart 3.

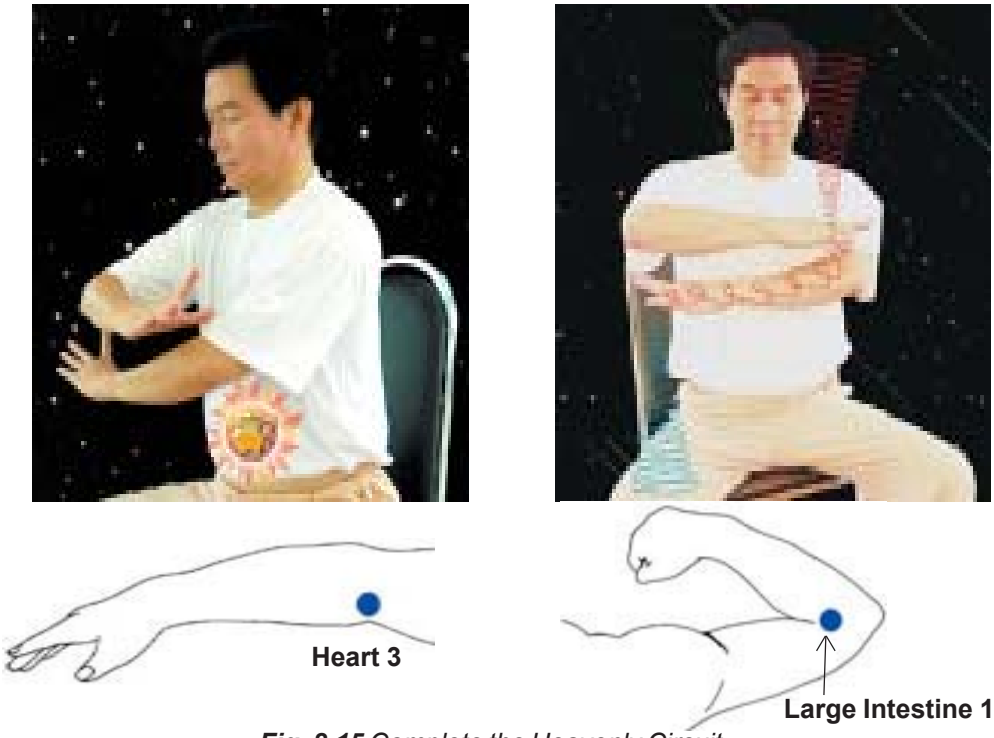

Fig. 8.15 *Complete the Heavenly Circuit.*

The right index finger is pointing up toward heaven and connecting to the galaxy. The right forearm is over the left forearm, with the tip of the right index finger held above the Large Intestine 11 point of the left arm.

The **right index finger draws in the heavenly force** like antennae. The force flows up the bones of the right arm, across the shoulders to the left arm and through the bones of the left arm to the left index fingertip. It **then flows through the index finger of the left hand** into the Heart 3 point of the right arm, **completing the heavenly circuit**. Continue cycling in this way. Hold the position and count to five.

The practice uses the 'Empty Force'; this means that there is no contact. The fingers must be 'tense without tensing'. When you tense and raise the index finger, you will feel the Laogong point opening.

Close Position: Tan Tien, earth and the universal force - keeping the arms in the same position, move both index fingers to point down. The **right index finger will now point toward the Large Intestine 11 point of the left arm and the left index finger will point downward toward the earth** and continue down to connect to the universe. Draw in the earth force through the left index finger, bringing it through the bones of the left arm, across the shoulders through the right arm to the right index finger and out into the Large Intestine 11 point of the left arm. Continue cycling in this way, **completing the earth circuit**.

Open and close three times altogether ending in the open position. Hold each count for five seconds.

Holding and Activating the Chi Ball
Tan Tien and the Original Force - Right Side over Left

Turn the **left palm upward** and lower it to the Tan Tien with the pinky pointing inwards.

Lower the right palm to the navel, palm down, as though you were holding a small Chi ball. Lower the right thumb to point toward the left Laogong point. This opens the eye of the right hand (LI-4), then point it toward the navel. Be aware of Tan Tien and universe.

Fig. 8.16 *Right Side over Left - 'Holding the Ball'.*

Yin/Yang Palms

Separate the hands and extend them out in front of the body at navel level. The **left palm** is still pointing up, and is **Yang** drawing in the heavenly force through Laogong. The **right palm** is still facing down, and is **Yin** drawing in the earth and the galactic force from below.

Conclude by turning the left palm over to face downward. **Draw in the earth force through both palms.**

Fig. 8.17 *'Yin and Yang Palms' - Right Hand connecting to Earth and Left to Heaven.*

Left Side: **Repeat on the left hand side with the left arm over the right**. Holding the Chi ball the left hand is on top. Hold for a count of five seconds.

Fig. 8.18 *Open the Heavenly Circuit. Then the bottom hand slides and turns 'Palm-Up' and the Top Arm slides to 'hold the Chi Ball'*

Fig. 8.19 *Holding the Chi Ball - Left Side over Right.*

Closing Movements

Activate the Chi Channels - Balance the Organs

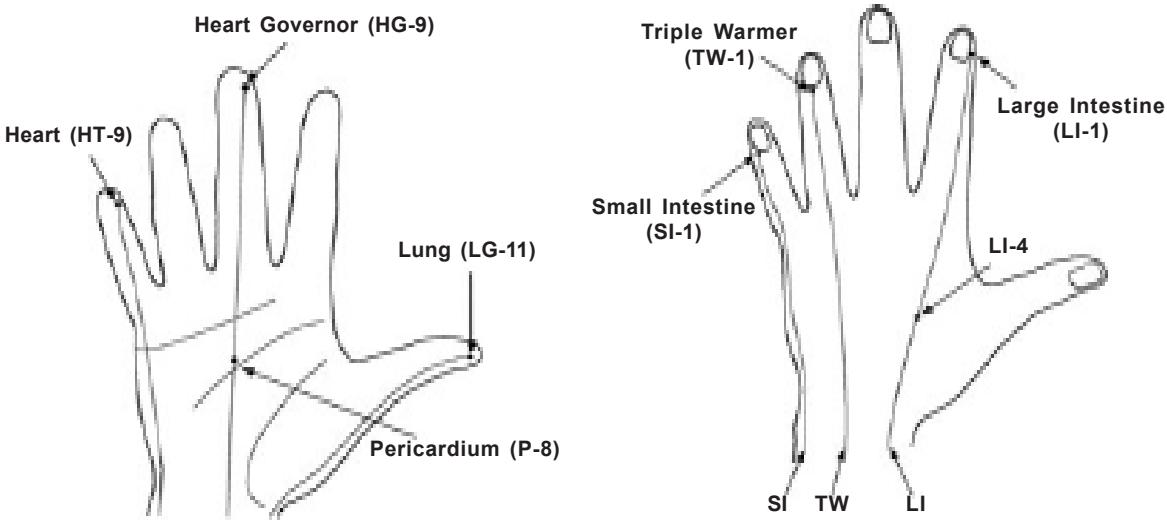

Fig. 8.20 *Finger Points*

The closing movements balance organ energy while activating the Chi Channels.

Hold the arms extended forward with the palms down at solar plexus level. Hold each stage for a count of five seconds.

Index Fingers:

Tense all the fingers and feel the Chi filling all the joints; open the index fingers, raising them up, while keeping the rest of the fingers level.

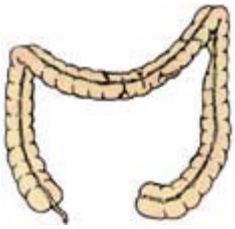

Large Intestine

Fig. 8.21 *Activate the Index Fingers - Up.*

The tension should be like the string of a tuned musical instrument. When lightly tense the Heavenly Chi will be drawn in through the index fingers.

Relax the hands and bring the index fingers back to the neutral position, level with the other fingers.

Energy to Large Intestine

Fig. 8.22 *Draw Earth Energy through the Index Fingers - Down.*

Stretch out and tense all the fingers and **press the index fingers to point down** toward the earth and continue down to the universe. Keep the other fingers level. **Draw in earth energy through the index fingers and circulate it through the body.**

Bring the index fingers back to neutral and relax your hands.

Once again **open the index fingers by raising the index fingers up**, while keeping the rest of the fingers level. **Draw in the Heavenly Chi through the index fingers**.

Bring the index fingers back to neutral again and relax your hands.

Ring Fingers:

Stretch the ring fingers down toward the earth, keeping the rest of the fingers level. Draw in earth energy through the ring fingers and circulate it through the body.

Fig. 8.23 *Draw Earth Energy through the Ring Fingers.*

Bring the ring fingers back to neutral and relax your hands.

Once again open the index fingers by raising the index fingers up, while keeping the rest of the fingers level, and draw in the Heavenly Chi through the index fingers.

Bring the index fingers back to neutral again and relax your hands.

Thumbs:

Stretch the thumbs out and down toward the earth, keeping the rest of the fingers level. Draw in earth energy through the thumbs and circulate it through the body.

Bring the thumbs back to neutral and relax your hands.

Fig. 8.24 *Draw Earth Energy through the Thumbs.*

Once again open the index fingers by raising the index fingers up, while keeping the rest of the fingers level, and draw in the Heavenly Chi through the index fingers.

Bring the index fingers back to neutral again and relax your hands.

Pinky Fingers:

Stretch the pinky fingers out and down toward the earth, keeping the rest of the fingers level. Draw in earth energy through the pinky fingers and circulate it through the body.

Small Intestine

Fig. 8.25 *Draw Earth Energy through the Pinky Fingers.*

Bring the pinky fingers back to neutral and relax your hands.

Once again open the index fingers by raising the index fingers up, while keeping the rest of the fingers level. Draw in the Heavenly Chi through the index fingers. Bring the index fingers back to neutral again and relax your hands.

Middle Fingers:

Stretch the middle fingers out and down toward the earth, keeping the rest of the fingers level. Draw in earth energy through the middle fingers and circulate it through the body.

Bring the middle fingers back to neutral and relax your hands.

Once again open the index fingers by raising the index fingers up, while keeping the rest of the fingers level. Draw in the Heavenly Chi through the index fingers.

Bring the index fingers back to neutral again and relax your hands.

Heart

Fig. 8.26 *Draw Earth Energy through the Middle Fingers.*

Crane's Beak and Swallow the Saliva:

Form the "Crane's Beak" with both hands by bringing all the fingertips together with the thumbs inside. **Inhale** and **contract the sexual organs**.

Move your tongue and suck the mouth to **activate the saliva**. Divide it into three parts, tighten the neck and gulp down the **first part** to the center of the **navel**; force the **second** mouthful of nectar down to the **left side of the navel** and the **third** to the **right side of the navel**. Raise the forearms up to shoulder height with the fingers pointing down. Slowly open the palms and begin to lower the arms to the sides, until the palms are facing each other before the starting position.

Fig. 8.27 *Form the 'Crane's Beak'.*

Fig. 8.28 *Raise Forearms to Shoulders.*

Fig. 8.29 *Lower Arms to the Sides.*

Fig. 8.30
Palms facing each other to cover the Navel.

Conclusion:

Bring awareness to the navel. Notice the quality and intensity of the energy generated and **collect your energy at the navel**. Men place hands over the navel with the right hand on top; women vice versa. Rest.

Summary:

Practice Part I daily for one or two weeks until you can do it well. Then you can proceed to learning Part II.

Part II
Opening the Bridge and Regulator Channels

Theory

Chi flows through your body along numerous channels or meridians. The channels are divided into two major groups: the **extraordinary** or special channels and the **ordinary** channels. After your mother's egg and your father's sperm joined together to form a single cell, that cell began to divide. The extraordinary channels were the first energy channels formed as a result of that early cell division.

There are **Eight Extraordinary Channels:**

Governor Channel
Functional or Conception Channel
Thrusting Channel
Belt Channel
Yang Regulator Channel
Yin Regulator Channel
Yang Bridge Channel
Yin Bridge Channel

Later, as your fetus developed, your Original Chi flowed through the eight extraordinary channels to help create your internal organs and their energy channels. These twelve "ordinary channels" are divided into yin and yang. The yin Channels are connected to the solid organs, and the yang channels are connected to the hollow organs.

The **Twelve Ordinary Channels:**

Lung (Yin) Channel
Large Intestine (Yang) Channel
Stomach (Yang) Channel
Spleen (Yin) Channel
Heart (Yin) Channel
Small Intestine (Yang) Channel
Bladder (Yang) Channel
Kidneys (Yin) Channel
Pericardium (Yin) Channel
Triple Warmer (Yang) Channel
Gall Bladder (Yang) Channel
Liver (Yin) Channel

These twelve organs serve to extract energy from the food and water we ingest and the air that we breathe to create energy through the metabolic processes of respiration, circulation, digestion, elimination and reproduction. This energy is called PostNatal Chi, as it comes in after we are born. Thus the extraordinary channels serve as the link between our Original or Prenatal Chi which came from our mother and father, and our Postnatal Chi which comes from our food and air as a result of metabolism.

General Functions of the Eight Extraordinary Channels

They serve as reservoirs of Chi.

About two thousand years ago, one of the great texts of Chinese medicine, the Nan Ching was written. This classical text describes the twelve ordinary channels as rivers and the eight extraordinary channels as reservoirs of Chi. When the ordinary channels become low in energy, they can draw from the reservoirs of energy in the extraordinary channels. On the other hand, if the ordinary channels become too full, the excess can be taken up by the extraordinary channels. In this way the extraordinary channels help us to maintain a balance in our energy body.

They store and circulate Ching Chi.

The extraordinary channels all draw their energy from the kidneys, which are the storehouse of Ching Chi (essence or sexual energy) in the body. Thus the extraordinary channels circulate the Ching Chi around the body, particularly to the skin and hair, and to the five ancestral organs: the brain and spinal cord, the bone marrow, the blood, the uterus and the liver and gall bladder.

They circulate Defensive Chi to protect the body.

The Chi that protects the body against invasion by external pathogens is called Defensive Chi or Wei Chi. The extraordinary channels circulate Defensive Chi over the back, abdomen and thorax. These functions are performed by the Governor Channel, the Functional Channel and the Thrusting Channels, respectively.

They regulate our life cycles.

In the first chapter of the Yellow Emperor's Classic of Internal Medicine (Huang Di Nei Ching Su Wen), another of the classical texts of Chinese medicine, the life changes of women and men are described in 7 and 8 year cycles respectively. The Functional Channel and the Thrusting Channel govern these cycles.

Eight Extraordinary Channels and Chi Kung

There are few texts available today that describe the purpose and function of the eight extraordinary channels and their place in Chi Kung practice. To make matters more confusing, the extraordinary channels and points used in Chi Kung are often quite different from those used in acupuncture, even though they may bear the same names.

Most acupuncturists pay little attention to the eight extraordinary channels in diagnosis and treatment with the exception of some modern Japanese researchers. By contrast, the extraordinary channels have been of special importance to Taoists and Chi Kung practitioners for thousands of years. Taoists see the extraordinary channels as the foundation of our bodily energy, as the bridge between our Original or Prenatal Chi and our Postnatal Chi; these channels affect us on the deepest level of our basic constitutional energy.

Therefore, Taoists focus on opening up the flow of energy through the eight extraordinary channels as a prerequisite for opening the energy flow in the twelve ordinary channels. In the Universal Tao system, you first open up the Governor Channel and the Functional Channel in the Microcosmic Orbit Meditation. The second pair: the Thrusting Channels and the Belt Channels are opened in the Fusion of the Five Elements II Meditation. The last four channels, the Yin and Yang Bridge Channels and the Yin and Yang Regulator Channels are opened in the third level of Fusion of the Five Elements Meditation. After opening all eight channels, in the next level of Taoist inner alchemical meditation called the Lesser Enlightenment of Kan and Li, the twelve ordinary channels are then opened.

Special Functions of the Bridge and Regulator Channels

The Bridge and Regulator Channels have no points of their own. They borrow points from the other 'ordinary' channels linking together and controlling the flow through all the separate channels of the body. The Bridge and Regulator Channels travel along the same paths. There is no 'real' difference between them. Both of them connect or 'bridge' and 'regulate' the flow of Chi in the body's meridians.

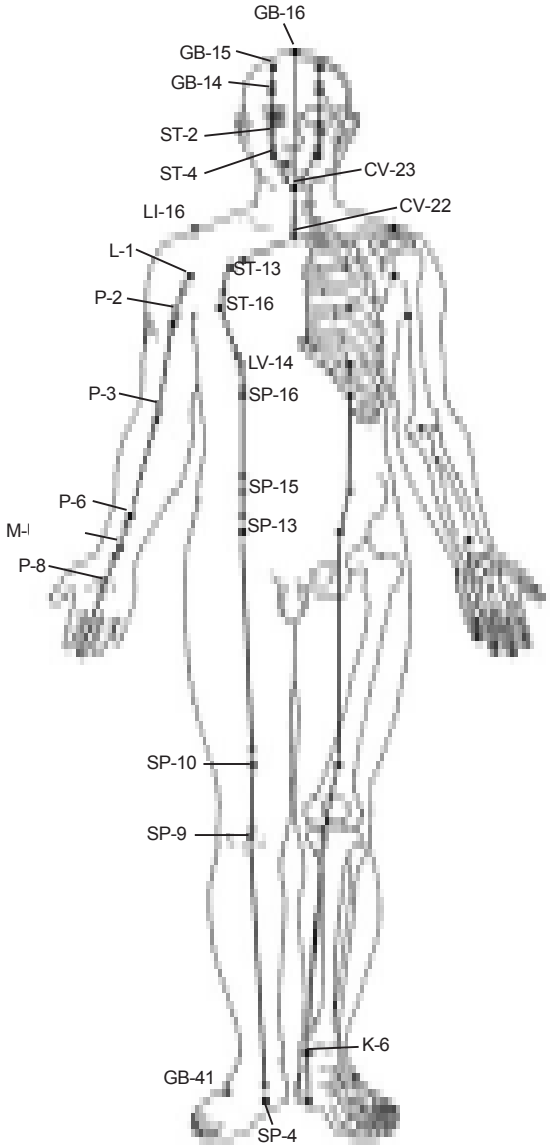

Fig. 8.31 *Yin Bridge and Regulator Channels*

Bridge Channels Yin and Yang Chiao Mo Function

The Bridge Channels, also called the Heel Vessels as they originate at the heels, regulate the amount of energy being used by all the other meridians in the body. They act like a bridge linking together the stored Chi in the body and the areas in need of Chi. Usually if any meridian uses more energy than it needs to flow properly, then other meridians become deficient as a result. Thus the Bridge Channels seek to assure that your energy is distributed in a balanced way. The Yin Bridge Channel runs along the front or yin side of the body, while the Yang Bridge Channel runs along the back of the body.

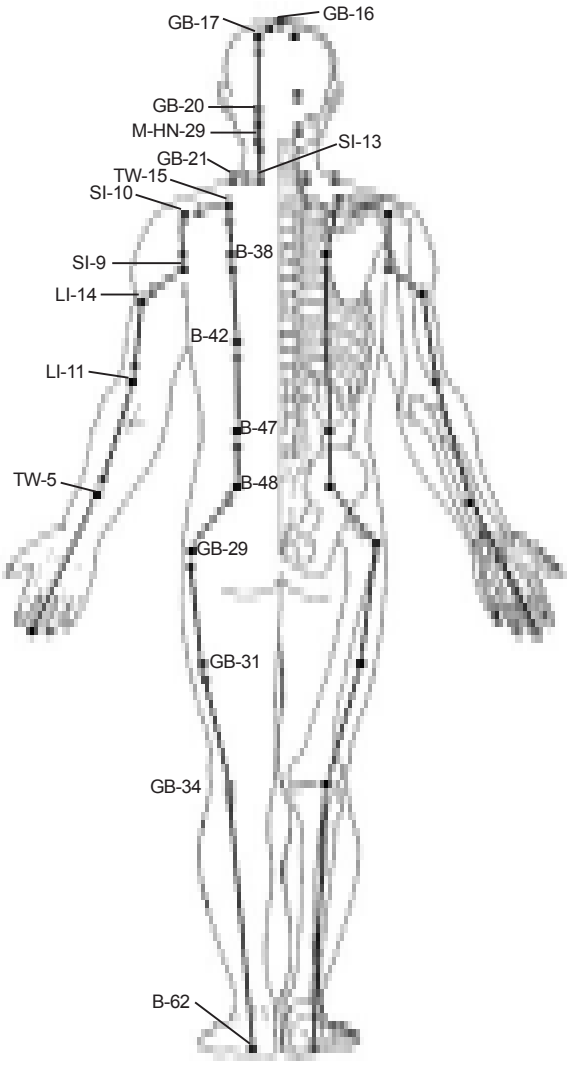

Fig. 8.32 *Yang Bridge and Regulator Channels*

Disorders of the Bridge Channels

Excess Yang Energy

When yin energy is slowed down in the Bridge Channels, yang energy flows more rapidly. The excess yang can cause the following problems: insomnia, difficulty in closing the eyes, hypertension, stiff back and waist, inability to bend down, thigh tumors, bad colds, spontaneous sweating, headaches, painful eyes, paralysis of the arms and legs, vomiting of milk in infants, deafness, epilepsy, nose bleeding, swelling of the body, pain in the joints and head sweating.

Excess Yin Energy

When yang energy is slowed down in the Bridge Channels, yin energy moves more rapidly. The excess yin causes the following problems: sleepiness, difficulty in keeping the eyes open, hypotension, choking, painful urination, stomach rumbling, vomiting, diarrhea, difficult bowel movements, difficult labor and unconsciousness.

Regulator Channels

Yin and Yang Wei Mo Function

The Regulator Channels, also called the Linking Vessels, bind together all the meridians in the body. The Regulator Channels are also divided into yin and yang. The yin aspect, which runs along the front of the body, moves the yin energy and regulates the blood and inner parts of the body. It connects with all the yin channels: the Liver, Spleen, Kidney, Heart, Pericardium and Lung channels. If the yin aspect becomes imbalanced, the person may suffer from heart pains.

The yang aspect, which runs along the back side of the body, moves the yang energy, controls Defensive Chi, regulates resistance to external infections, and regulates the external parts of the body. It connects with all the yang channels: the Stomach, Bladder, Gall Bladder, Large Intestine, Triple Warmer & Small Intestine channels. If the yang aspect becomes out of balance, the person may catch colds and fevers easily.

By joining together the various channels, the Regulator Channels help to maintain a harmonious and cooperative interaction between the different channels.

The Regulator Channels in Taoist Yoga and Chi Kung are slightly different from those presented in acupuncture texts. The Chi Kung Regulator Channels include the yin and yang arm routes as well; some Taoist Yoga texts also refer to the arm routes as the Yin Yu and the Yang Yu. Acupuncture texts, by contrast, include only the leg, trunk and head routes. Many recent Chi Kung texts, unaware of these differences, depict illustrations from acupuncture texts alone, further adding to the confusion.

Disorders of the Regulator Channels

Excess Yang Energy

When yin energy is slowed down in the Regulator Channels, yang energy moves more rapidly. The excess yang can cause the following problems: swelling and pain in the joints, cold knees, paralysis of the arms and legs, painful back and sides, aching muscles, pain in the head, neck and edge of the eyebrows, fever, rashes, night sweating, tetanus, painful red eyes, colds and superficial fevers.

Excess Yin Energy

Similarly, when yang energy is slowed down in the Regulator Channels, yin energy moves more rapidly. The excess yin can cause the following problems: heart pain, diarrhea with stomach rumbling, difficulty swallowing, pain on both sides of the chest, diseases associated with cold and convulsions.

Summary

The Bridge and Regulator Channels link all of the yin and yang channels in the body together and regulate the flow of energy in these channels to maintain a state of energetic balance in the body. The channels used for meditation are somewhat different from the ones seen in Chinese medical text and acupuncture charts. This is because their purposes are different.

Chinese medicine aims to restore sick people to health. The points being treated must be superficial so that they can be activated by acupuncture needles.

Chi Kung and Taoist meditation aim to maintain health and to take one beyond mere physical health to spiritual immortality. The channels and points can be deep within the body, since the energy is guided by the mind or by postures and movements rather than by needles.

The movements used in Cosmic Chi Kung Part II to activate the Bridge and Regulator Channels are relatively simple. To completely master the Bridge and Regulator Channels, you must learn and practice the third level of Fusion of the Five Elements Meditation. Once you have done so, this part of Cosmic Chi Kung practice will be particularly powerful and balancing for you.

Practice

Opening Movements

The Opening Movements for this second part of Cosmic Chi Kung are the same as for the first part. By now you should be familiar with these movements, so they will be described briefly. For a more detailed description, refer to Part I, Opening Movements.

Hands down at sides, palms facing each other. Commence Bone breathing. Be aware of the Tan Tien and absorb Cosmic Chi. Be aware of the Tan Tien and channeling the earth and galactic forces.

Washing the Bone Marrow

Raise arms to chest height - palms facing each other. Rotate arms until palms face down. Open the 'Tiger's Mouth' - Index finger up, thumb down.

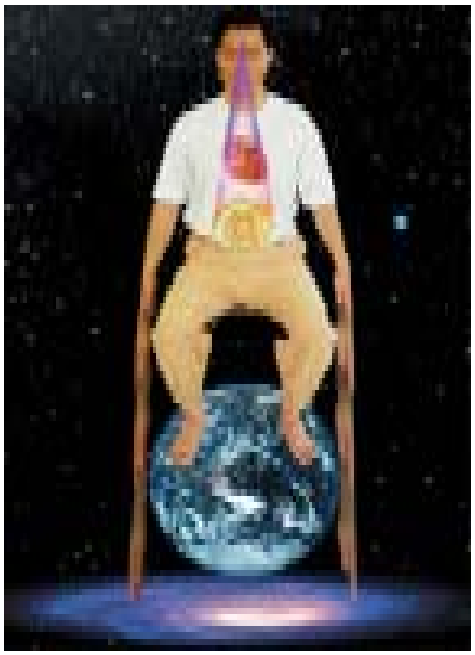

Fig. 8.33 *Hands lower to the Sides. Lower the Mind to the Tan Tien.*

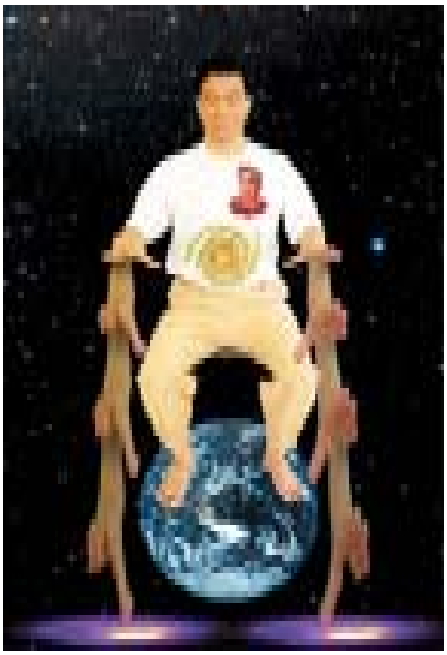

Fig. 8.34 *Open the 'Tiger's Mouth'.*

Activate and Beam to the Eye of the Hip

A. Large Intestine 4 - Eye of the Hand
B. Pericardium 9 - Tip of the Middle Finger
C. Small Intestine 3 - Knife Edge of the Hand

Fig. 8.35 *Activate the Large Intestine, Pericardium and Small Intestine.*

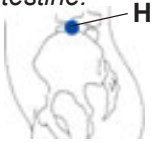

Be aware of the Tan Tien and absorb the Heavenly Force Washing the Bone Marrow Crown to Soles.

Extend the arms forward - palms upward. Be aware of the Tan Tien and absorb the heavenly force. Rotate the arms until the palms face down. Raise the index fingers slightly. Absorb the Earth Chi.

A. ***B.***

Fig. 8.36
A. *Be aware of the Tan Tien and absorb the Heavenly Force.*

B. *Index Fingers up - be aware of the Tan Tien and absorb the Earth and Universal Force.*

Core Movements of Part II
Opening the Bridge and Regulator Channels

Activate the Throat Center - Right Side

Keeping the elbows sunk, raise the left palm first so that it is about 1 inch in front of the throat center (Conception Vessel 22), palm facing in. Then bring the right hand up so that it is about 1 inches in front of the left hand, palm facing in. Align the Lung 10 point in the middle of the eminence of the left hand with the **throat center. Feel the Chi go through the neck to C-7**. Continue smiling to the universe and connect to the back side of the universe. Hold for a 5 to 30 count and feel the throat center activated.

Fig. 8.37 *Connect to the Throat Center.*

Fig. 8.38
Feel the connection to the Universe at the Back.

Move both hands out slowly like you're pulling silk; when the feeling is diminished or the silk starts to break stop there. Be still and feel the beam connect the throat center to C-7 and the universe. Maintain the energy beam as you move in and out three times altogether ending with the hands as above.

Activate Mideyebrow Point - Right Side

Be aware of the Tan Tien and the universe. Keeping the Lung 10 points aligned, raise the hands up to the level of the mideyebrow point about one inch in front of the face. **Keep the points aligned and beam the energy passing through both hands into the mideyebrow point and through to the base of the skull.** Continue smiling and extending to make a connection to the back universe for a 5 to 30 count.

Use only 5% of the awareness to move both hands very slowly out, like you are **pulling silk**; continue to move out as long as your can feel the connection to the mideyebrow, C-7 points and the universe, maintaining the energy beam as you move.

Move in and out three times altogether, ending with the hands as above.

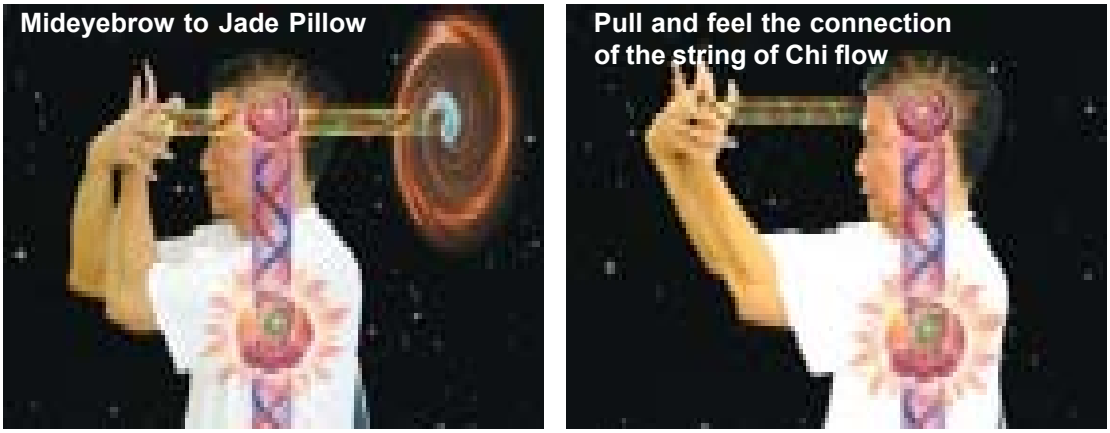

Fig. 8.39 *Connect to the Mideyebrow, Jade Pillow and the Universe at the Back.*

Keeping the palms and thenars (Lung 10) aligned, move the hands back down to the position in front of the throat center. Keeping the forearms horizontal at shoulder height, separate the hands so that the Laogong point is aligned in front of Stomach 13, just **below the clavicle** on a vertical line above the nipple or mammillary line. The middle fingertips should almost be touching. **Beam energy from the Laogong points into ST-13 through the back on the side of the spine and connect to the universe**. You will be following this vertical line, which passes through the nipples, down the torso to the level of the navel, **stopping to focus and beam energy into key points along the way.** On each of these, focus your Yi on beaming energy into the organs inside each position. Stomach 13 is the location that activates the Heart and Lungs. Feel the change in your breathing as you activate the lungs.

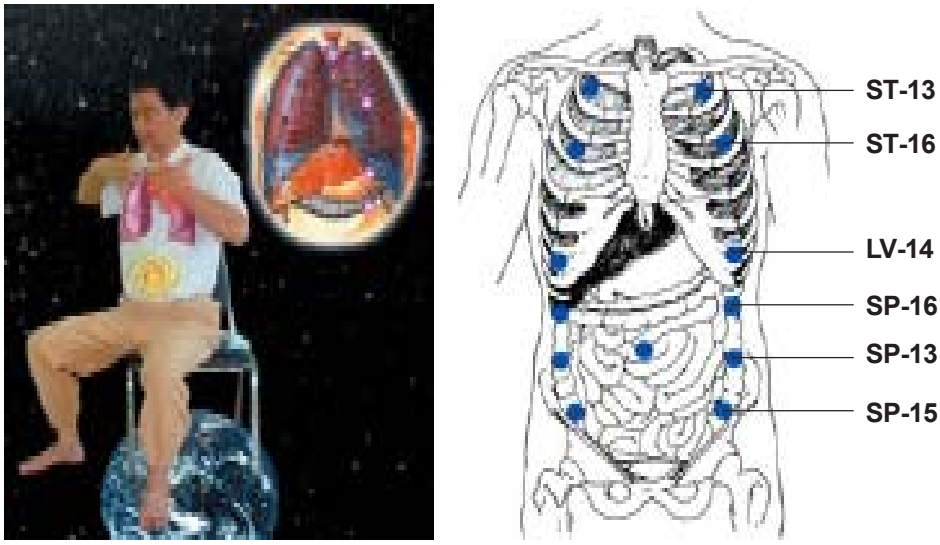

Fig. 8.40 *Beam Energy into ST13.*

Move the hands down the mammillary line to Stomach 16, about one inch above the nipple (in the space between the third and fourth ribs). Chi connects to the back and to the universe. Again, beam energy to energize and balance the **heart and middle of the lungs**. Move the hands down to Liver 14 (about 2 - 3 inches below the nipple in the space between the 6th and 7th ribs). Beam healing energy into the **liver and gall bladder.** Feel the Chi or the vibration of the palms activate the liver and feel the energy moving inside there.

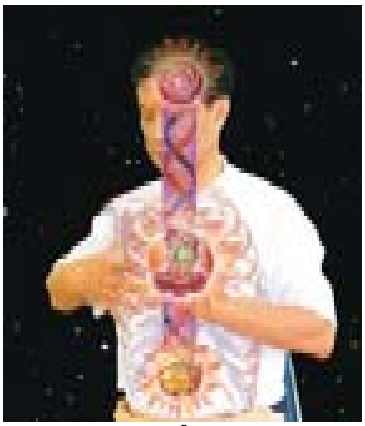

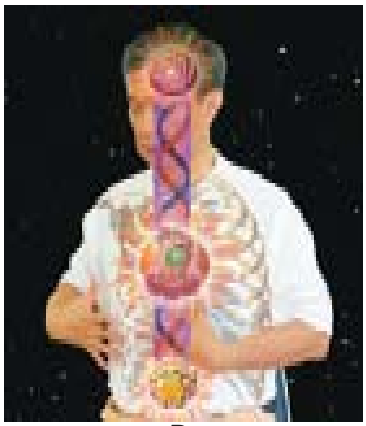

A. ***B.***

Fig. 8.41 A. *Energize and balance the Lungs at ST16.*
B. *Energize and balance the Liver and Gallbladder at LV14.*

Move the hands down to **Spleen** 16 (just below the rib cage on the mammillary line). Beam healing energy into the **stomach, pancreas and spleen and the liver.** Picture the organs receiving the Chi from the cosmic and the universe.

Move the hands down to Spleen 15 (on the mammillary line to the level of the navel). Beam healing energy from your palms into the **small intestine and the Tan Tien.**

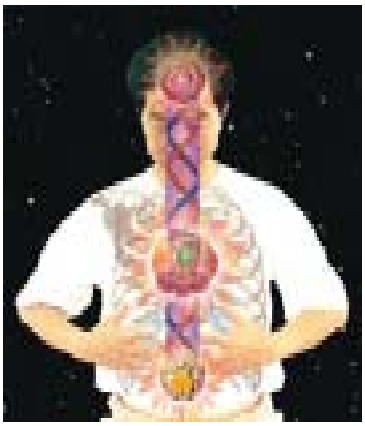

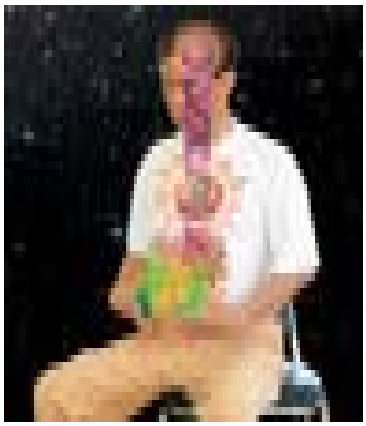

A. ***B.***

Fig. 8.42 A. *Energize the Stomach, Pancreas, Spleen and Liver at SP 16.*
B. *Energize the Tan Tien and Small Intestine at SP15.*

Hold the Chi Ball - Right Hand on Top

Turn the **left palm up** and align the Chi Ball with the Tan Tien. Turn the **right palm down** and align the eye of the hand (LI-4) with the navel. Feel your palms holding a Chi ball and feel a **Chi ball inside the Tan Tien**. Feel the Chi ball connect to the Cosmic Chi outside. Feel the north (usually left) and south (usually right) poles in the hands. Lower the right thumb to point toward the left Laogong point.

Fig. 8.43
Hold the 'Chi Ball' - One in the Tan Tien and the other in the hands - Right Hand over Left.

Yin/Yang Palms

Separate the hands and extend them out in front of the body at solar plexus level. The **left palm** is still pointing up and is yang drawing in the **Heavenly Force** through Laogong. The **right palm** is still facing down and is yin drawing in the **Earth Force** energy. **'Be Aware Tan Tien and Universe'**.

Fig. 8.44 *Connect to Heaven and Earth.*

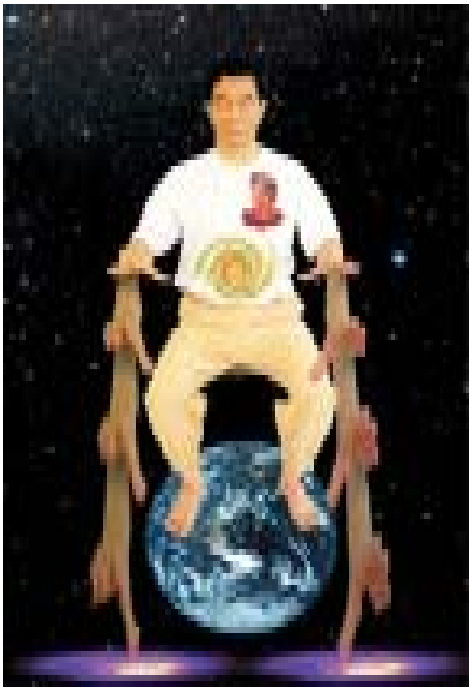

Conclude by turning the left palm over to face downward. **Draw in the 'Earth Force' through both palms.**

Fig. 8.45 *Draw the Earth Force through the Palms.*

Repeat the sequence with the left palm over the right.

Start by moving the right palm to the throat and then the left palm. Scan the body, as in the previous sequence, using both palms to connect to the points running down the front of the body. Remember to maintain a sense of the Chi flowing between the points in the front and their corresponding points in the back of the body.

Fig. 8.46 *Repeat the Practice on the Left Side. Push and Pull the silk at the Throat.*

Fig. 8.47 *Project to the Mideyebrow and Base of the Skull - connect to the Universe at the back. Then hold the Ball and repeat Finger Movements, as below.*

Continue with the left side, now pulling the silk at throat (C-7).

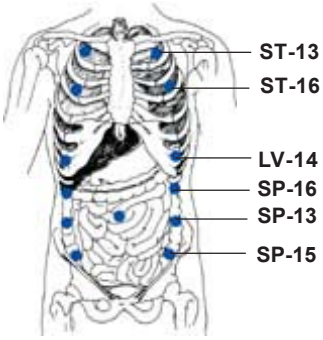

Fig. 8.48 *Beam Energy into each of the Organs like the last time.*

Closing Movements

The closing movements, crane's beak and finish are the same as before.
Activate the Chi channels - balancing the organs.

Index Fingers

Fig. 8.49 *Open (up)*

Fig. 8.50 *Neutral*

Fig. 8.51 *Close (down)*

Fig. 8.52
Ring Finger *- down, neutral.*
Index Finger *- open, neutral.*

Fig. 8.53
Thumb *- in and down, neutral.*
Index Finger *- open, neutral.*

Fig. 8.54
Pinky Finger *- down, neutral.*
Index Finger *- open, neutral.*

Fig. 8.55
Middle Finger *- down, neutral.*
Index Finger *- open, neutral.*

Crane's Beak

Form the crane's beak with both hands by bringing the fingertips together with the thumbs inside. Activate the saliva and swallow down three times to the Tan Tien. Raise the forearms to shoulder height with the fingers pointed down, inhaling gently as you raise. Open the palms slowly and begin to lower the arms to the sides as you exhale, until the palms are facing each other in the starting position.

Finish

Bring the awareness to the navel and notice the quality and intensity of the energy generated. **Collect energy at the navel**. Men, place the hands over the navel with the right hand on top; vice versa for women.

Part III
Opening the Functional and Governor Channels

Theory: Functional and Governor Channels

The Functional and Governor Channels are the first two of the eight extraordinary channels described earlier in this chapter (beginning p.178). They serve as the reservoirs of yin and yang energy in the body. The Functional or Conception Channel is yin and all of the ordinary yin channels connect to it. Similarly, the Governor Channel is yang and all of the ordinary yang channels connect to it.

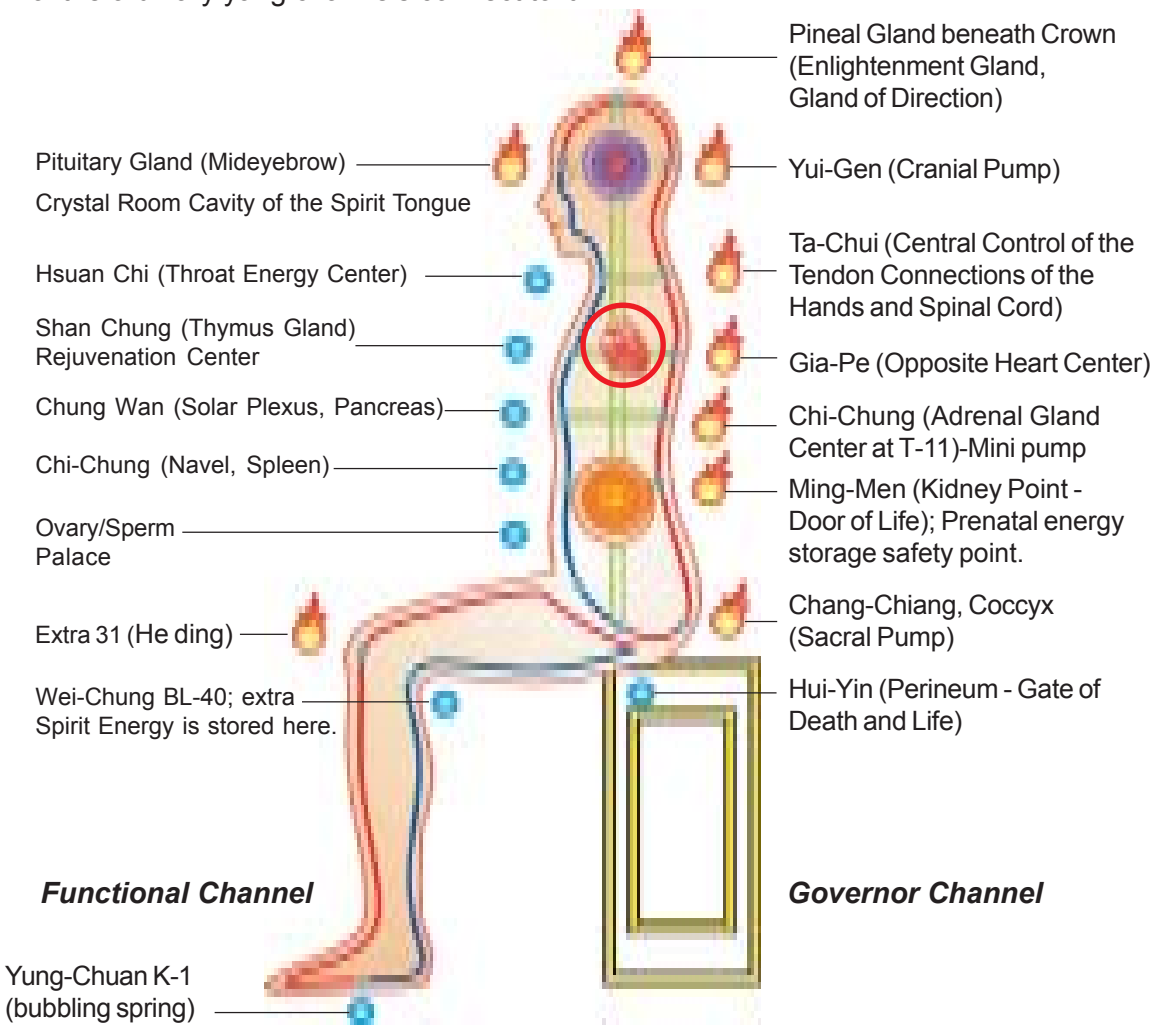

Fig. 8.56 *Cosmic Orbit*

Chi Ball

In Part III we also begin to focus more on the sensation of Chi being emitted from our palms. This energy is emitted from the **Laogong** points primarily, but you can also feel it throughout the palms and fingers. It will feel like a balloon between your hands that is expanding and contracting or like two magnetic fields repelling and attracting each other.

Once you have practiced Cosmic Chi Kung for awhile and have become skillful at it, you may find that Grasping the Chi ball is all you need to do to activate your flow of healing energy before doing a session. As you become sensitive to the sensation of your own Chi, it becomes an easy step to feel the Chi of others.

Fig. 8.57 *Grasping the Chi Ball.*

Opening Movements, Hands Down at Sides, Palms Facing Each Other
Bone Breathing - Absorbing Cosmic Chi

The Opening Movements are the same as in the sequence in Part I, 'Opening to Heaven, Earth and Cosmic Chi', on page 164.

A. Channeling the Earth Force - Washing the Bone Marrow Raise arms to chest height - Palms facing each other. Rotate arms until **palms face down.** Open the Tiger's Mouth - Index finger up, thumb down.

B. Activate and Beam to the Eye of the Hip

C. Absorb the Heavenly Force Washing the Bone Marrow - Crown to Soles

Core Movements of Part III

Grasping the Chi Ball

Slowly rotate the hands so that your palms face each other in front of your navel.

Fig. 8.58 *Hold the Chi Ball.*

Fig. 8.59 *Stretch and squeeze it.*

Feel the invisible ball of energy between your hands. Allow the energy to push your hands apart keeping the feeling of connection between your palms. When you have less feeling stop the palms and hold it there and reestablish the feeling of the Chi ball.

Let the energy draw your hands back toward each other, like a magnet, until you feel as if you were squeezing and compressing the ball.

Stretch and squeeze the Chi ball three times by opening and closing your palms in this way.

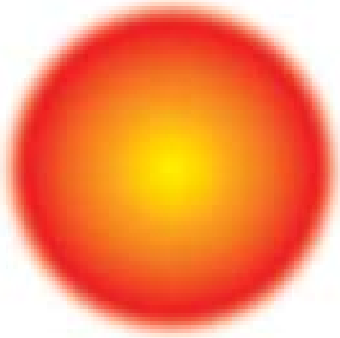

Activate the Outer and Inner Arm Gates

Activate Waiguan Triple Warmer 5 and Neiguan Pericardium 6 - **Right** arm on top. Slowly rotate the arms so that both **palms face down.**

Cross the right wrist over the left wrist with 1 inch of space between the hands. Align PC-6 of the right wrist with TW-5 of the left wrist. Feel the two gates activate each other like metal and magnet drawn to each other. Hold for a 5 to 30 second count.

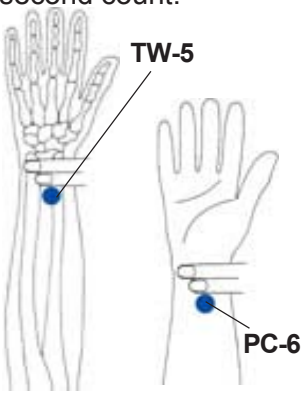

Fig. 8.60 *Align and activate PC-6 (Right) with TW-5 (Left).*

Keeping the wrists crossed, slowly rotate hands **turning the palms upward**. Now TW-5 of the right wrist will be aligned with PC-6 of the left wrist. Hold and count and feel the points activated. 'Be aware of Tan Tien and Universe'.

Fig. 8.61
Align and activate TW-5 (Right) with PC-6 (Left).

Fig. 8.62 *Feel the Chi Ball and beam energy from LI-4 into the Navel Point.*

Open the Functional Channel with LI-4

Bring the left hand down to the level of the Tan Tien with the Chi Knife facing in. Lower the right hand, palm down and align the eye of the hand, the LI-4 point with your navel. **Feel the Chi ball between your two hands**, and at the same time beam energy from LI-4 into the **navel** point.

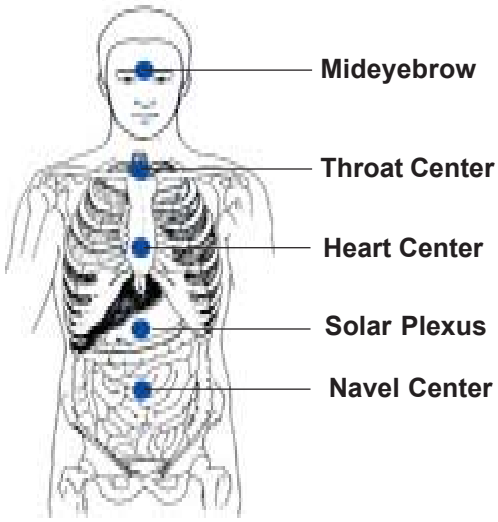

Fig. 8.63
Magnify the Power of the Beam to the Solar Plexus.

Fig. 8.64 *Activate all the Points.*

Raise the right hand up the Functional Channel, stopping and aligning LI-4 with the **solar plexus**, hold for a 5 to 30 second count and feel the points open and starting to activate each other.

Fig. 8.65
Beam to the Heart Center.

Fig. 8.66
Beam to theThroat

Fig. 8.67
Beam to the Mideyebrow

Continue to move up to the **heart**, **throat** (CV-22) and **mideyebrow** points. Beam energy from the eye of the hand into each of these points and at the same time, continue to feel the Chi ball connection between the two hands.

Return down the Functional Channel in the same manner, starting from the mideyebrow and stopping to beam energy into each point.

Next beam into the **throat center, heart center, solar plexus** and finally the **navel**. Hold the Chi ball at the navel with the right hand over the left.

Yin/Yang Palms

Separate the hands and extend them out in front of the body at solar plexus level. The left palm is still pointing up and is yang drawing in the heavenly force through the Laogong point. The right palm is still facing down and is yin drawing in the earth force energy.

Fig. 8.68 *Separate the Hands, one palm facing up and one down - draw in the Forces of Heaven and Earth.*

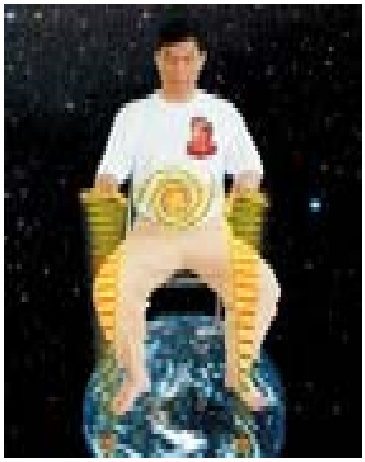

Fig. 8.69 *Draw in Earth Force.*

Conclude by turning the left palm over to face downward. Draw in the earth force through both palms.

Activate the Chi Ball, Tan Tien and the Original Force

Turn the right palm upward and lower it to the Tan Tien with the Chi knife pointing inwards.

Lower the left palm to the navel, palm down. Lower the left thumb to point toward the right Laogong point. This opens the eye of the left hand (LI-4), pointing it toward the navel.

Fig. 8.70 *Activate the Chi Ball, Tan Tien and the Original Force - Right Hand over left, the 'Large Intestine 4' pointing at the Navel.*

Open the Functional Channel with the Left Hand

A. ***B.*** ***C.***

Fig. 8.71 ***A.*** *Bring LI4 point up to the Solar Plexus and Heart Center.*
B. *Then up to the Throat Center.*
C. *Then up to the Mideyebrow. Descending down the channel in reverse, finishing at the Navel.*

After going up the functional channel come down the channel with the left hand.

Holding a Chi Ball: Open the hands with the palms facing each other holding a Chi ball. Stretch and squeeze the Chi ball a few times in order to feel the Chi as a substance; open and then relax the palms as you squeeze.

Fig. 8.72 *Hold and squeeze the Chi Ball.*

Fig. 8.73
Feel the Chi Ball expanding, growing Bigger.

Double Palm and Double Beam - Palm to Palm
Activate the Functional and Governor Channels - Right Palm on Left

Bring the left palm in first to face the navel, about 1 inch away, aligning the Laogong point with the navel. Follow by bringing the right hand in front of the left hand, **aligning the Laogong of the right palm with the Laogong of the left hand and the navel**. Both palms are now facing in. Beam energy through both Laogong points to the **navel and through the body to the Door of Life**, between L-2 and L-3 (Lumbar Vertebrae). Hold for a 5 to 30 second count and feel the vibration of the palms and Chi beam penetrate through the two points; feel them link together.

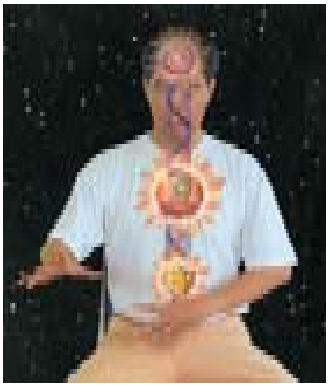

Fig. 8.74
Left Palm to Navel.

Fig. 8.75
Right on Top.

Fig. 8.76
Beam from Navel to Door of Life.

Next raise the left palm up to the solar plexus, aligning the Laogong point with the solar plexus.

Follow with the right palm aligning the Laogong to the left palm. Beam energy into the **solar plexus point and through the body to the T-11 point (thoracic vertebrae)**.

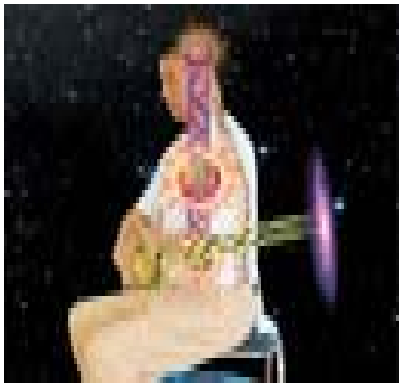

Fig. 8.77
Raise Left Palm to Solar Plexus.

Fig. 8.78 *Follow with the Right Hand to form the Double Beam.*

Continue in the same way with the left hand leading to the **heart point and wing point,** the **throat point and C-7 (cervical vertebrae)**, the **mideyebrow point and Jade Pillow**, and the **crown point and perineum**. **Always remember 'Tan Tien and the universe'.**

Fig. 8.79 *Beam into the Heart Center and to the back of the Heart.*

Fig. 8.80 *Beam into the Throat Center and to C7.*

When you reach the crown lightly spiral the palms and feel the Chi slowly penetrate deep into the body reaching the perineum; this will also open the **Thrusting Channels.** This might take a longer time, try a 30 to 60 second count.

Fig. 8.81 *Beam into the Mideyebrow to the base of the Stall.*

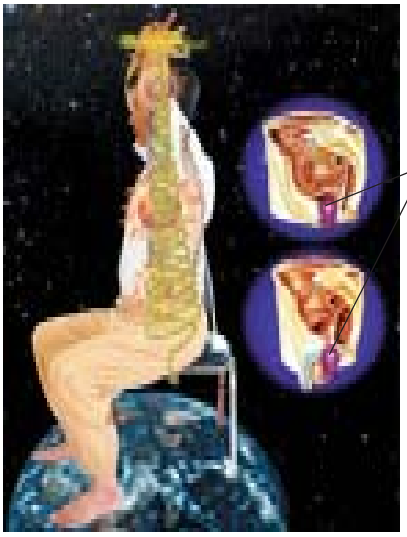

Fig. 8.82 *Beam from the Crown down to the Perineum.*

Return down the front, point by point in the same way, leading with the left hand.

Go up and down this way three times. The double palm and beam activate both the Functional and Governor Channels. The energy beam passes all the way through the body at each point.

Grasping the Chi Ball

Separate the hands and slowly extend the arms in front of you at navel level, palms facing each other, holding the Chi ball.

Fig. 8.83 *Squeeze the Chi Ball.*

Fig. 8.84 *Magnify its Energy.*

Stretch and squeeze the Chi ball three times as before by opening and closing the palms. 'Be Aware of Tan Tien and Universe'.

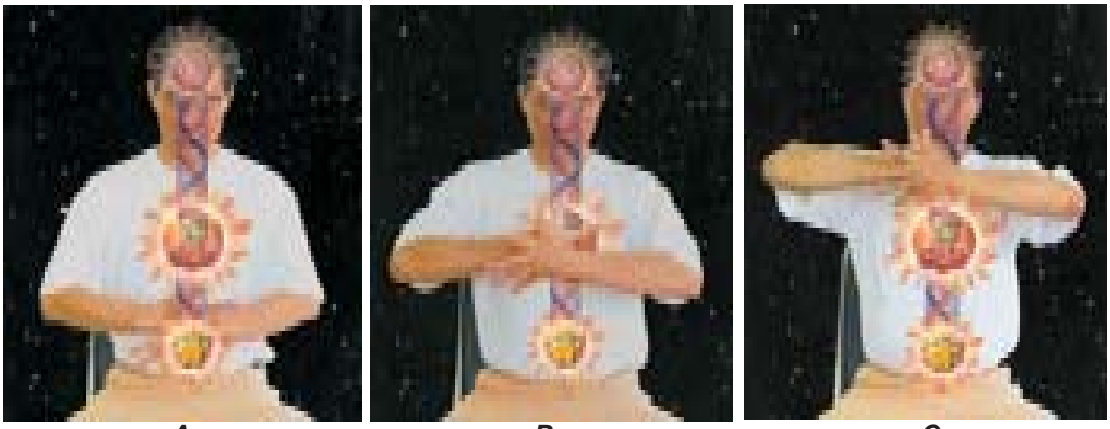

A. ***B.*** ***C.***

Fig. 8.85 *Repeat the double palm and beam with the* ***left hand on the outside and the right palm leading,*** *beaming from;* ***A.*** *Navel to Door of Life.* ***B.*** *Solar Plexus to T11 and Heart Center to the Wing Point* ***C.****Throat Center to C7.*

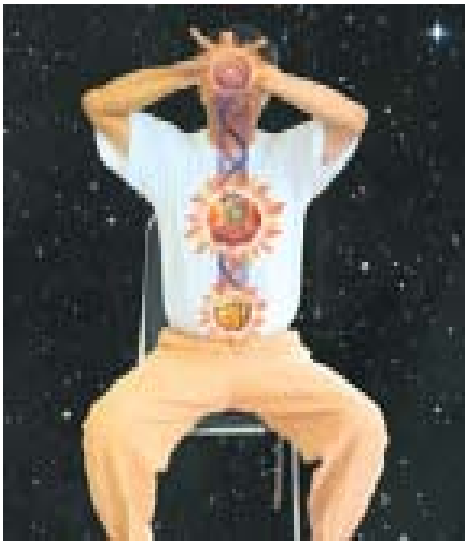

Fig. 8.86 *Activate the Mideyebrow to the Base of the Skull.*

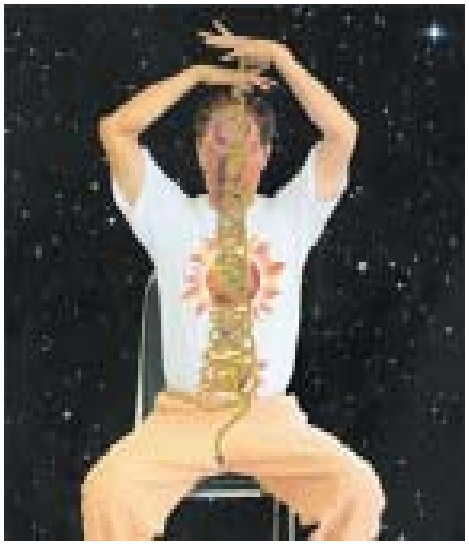

Fig. 8.87 *Activate the Crown and feel the Energy penetrate to the Perineum.*

A. Lower the right hand to the mideyebrow and penetrate to the skull.
B. Lower the right hand down to the throat center, following with the left.
C. Lower down to the solar plexus and penetrate to T11.
D. Lower down to the navel and penetrate to the Door of Life.

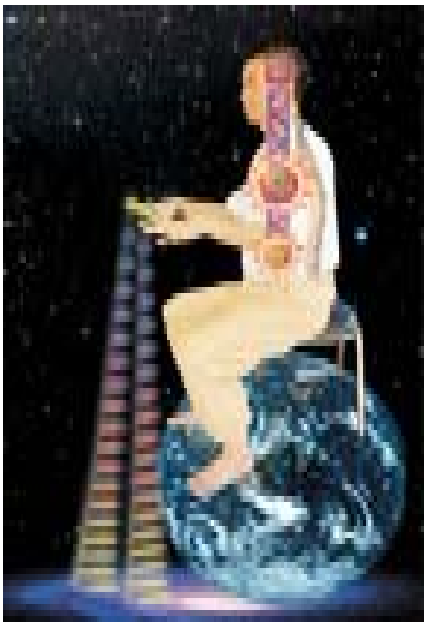

Fig. 8.88 *Channel the Earth Force.*

Rotate the **hands to face downward** and draw in the earth force through the palms, soles and perineum.

Closing Movements

Activate the Chi Channels - Balancing the Organs

The closing movements, crane's beak and finish are the same as before.
Index Finger *open (up), close (down), neutral (even with the other fingers)*
Ring Finger *- down, neutral.*
Index Finger *- open, neutral.*
Thumb *- in and down, neutral.*
Index Finger *- open, neutral.*
Pinky Finger *- down, neutral.*
Index Finger *- open, neutral.*
Middle Finger *- down, neutral.*
Index Finger *- open, neutral.*

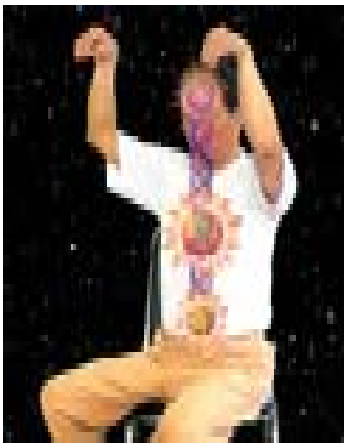

Fig. 8.89 *Form the Crane's Beak.*

Fig. 8.90 *Palms to Front.*

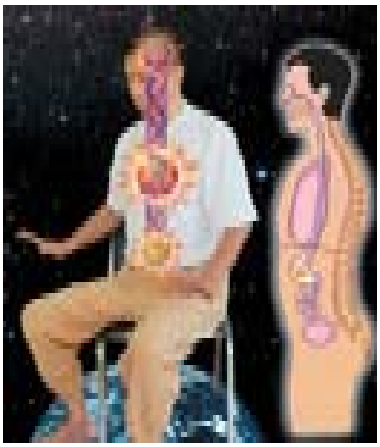

Fig. 8.91 *Lower to Sides.*

Crane's Beak

Form the crane's beak with both hands by bringing the fingertips together with the thumbs inside. Activate the saliva and swallow this elixir down three times to the Tan Tien. Raise the forearms to shoulder height with the fingers pointed down, inhaling gently as you raise.

Open the palms slowly and begin to lower the arms to the sides as you exhale, until the palms are facing each other in the starting position.

Finish

Bring awareness to the navel and notice the quality and intensity of the energy generated. Collect energy at the navel. Men, place the hands over the navel with the right hand on top; vice versa for women.

Part IV
Activating the Yin and Yang Channels and the Chi Belt

Theory

In this final part of Cosmic Chi Kung, you will focus on opening the yin and yang channels of the arms and on activating the Chi Belt around the waist. Mastery of Part IV of Cosmic Chi Kung will enhance your ability to project Chi through your fingers for healing.

Yin and Yang Channels of the Arms

There are six important energy channels flowing through the arms. These channels are paired together with each pair comprised of a yin channel and a yang channel. The yin channel of each pair flows down the inside of the arm from torso to fingertip, while its yang counterpart flows up the outside of the arm from fingertip to head.
The pairs are as follows:

Metal Element - Yin - Lung Channel - Thumb
Yang - Large Intestine Channel - Index Finger
Fire Element - Yin - Pericardium Channel - Middle Finger
Yang - Triple Warmer Channel - Ring Finger
Fire Element - Yin - Heart Channel - Pinky Finger
Yang - Small Intestine - Pinky Finger

Projecting Healing Energy through the Fingers

Emitting Chi from the fingers for healing is known in China as the **"One Finger Art."** Because the various energy channels of the arms either end or begin at the fingertips, the fingers are very effective instruments for projecting healing energy. Your fingers can focus energy like a laser beam toward a concentrated area such as a specific acupuncture point. You can also emit energy from all the fingers at once creating a combined effect to target an area. Part IV of Cosmic Chi Kung will stimulate all of the arm channels and will give you an opportunity to activate all of the fingers for beaming energy.

Fig. 8.92 *"One Finger Art"*

Activating the Chi Belt - Dai Mo

The Chi Belt or Belt Channel (also called the Girdle Vessel) is the only channel in the body that runs horizontally. It encircles the body at the waist level, connecting together all the vertical channels running through the torso. Thus, the Belt Channel plays an important role in maintaining a good energetic communication between the upper and lower body. In women it strongly affects the uterus and the menstrual cycle in particular.

In Taoist Chi Kung, the Belt Channel is not limited to the waist region. It encircles the entire body, almost like weaving an energetic cocoon around you from head to foot. Activating the Belt Channel strengthens the aura and helps to defend and protect you from outside negative energies.

Fig. 8.93 *Belt Channel*

Practice

Opening Movements

These opening movements have been described in Parts I, II, III. Refer to Part I to refresh your practice.

Hands Down at Sides - Palms Facing Each Other - Bone Breathing - Absorbing Cosmic Chi.

Channeling the Earth Force - Washing the Bone Marrow.
Raise arms to chest height - Palms facing each other.
Rotate arms until palms face down.
Open the Tiger's Mouth - Index Finger up, thumb down.

Activate and Beam to the Eye of the Hip.
Large Intestine 4 - Eye of the Hand.
Pericardium 9 - Tip of the Middle Finger.
Small Intestine 3 - Knife Edge of the Hand.

Absorb the Heavenly Force - Washing the Bone Marrow - Crown to Soles.
Extend the arms forward to chest height - palms upward.

Absorb the Earth Force.
Rotate the arms until the palms face down.
Raise the Index Fingers slightly.

Fig. 8.94 *Mother Earth's Healing Power*

Core Movements of Part IV Yin and Yang Channels - Chi Belt

Activating the Yin Channels - Left Side

Turn the palms down and slightly open the index fingers. Smile to your palms and soles and channel the earth force.

Turn your right palm up and pass it just one inch below the left arm yin channels from the left palm to the armpit, **without physically touching the arm**. Feel the Chi moving. Turn your right palm to face your left rib cage and pass your right hand down the left side of your abdomen along the descending colon, and a cross the pelvis to the right side to activate the **yin** energy.

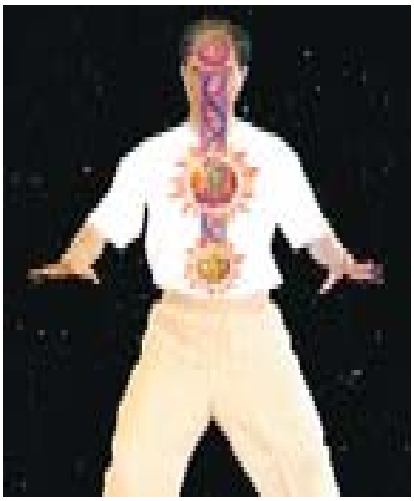

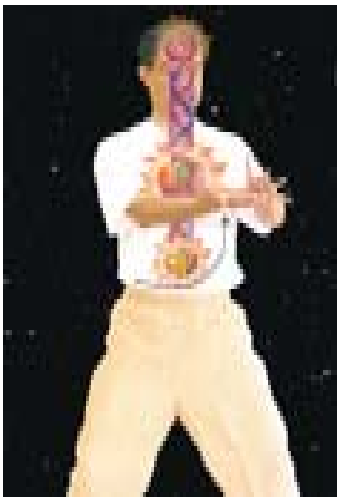

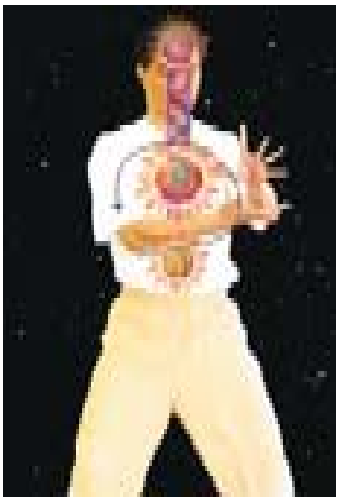

Fig. 8.95 *Channel the Earth Force.* ***Fig. 8.96*** *Activate the Yin Energy from the Palm to the Pelvis.*

Fig. 8.97 *Raise Chi in the Right Palm.*

Fig. 8.98 *Pass it to the Left.*

Pass your right hand up the right side of the abdomen to the level of your forehead with the palm facing diagonally toward the left palm (which simultaneously turns palm up at the level of the navel). Project the Chi from palm to palm for 30 to 60 seconds, vibrating the palm and feeling Chi from the right palm sent to the left picking up by the left palm. Keep the palms open and relaxed.

Next point the right ring finger toward the left palm and project Chi making very small circles from the right ring finger (Triple Warmer channel); emit the Chi to the left palm for 30 to 60 seconds.

Then return the right index finger to neutral position. Point the left ring finger up toward the right palm, project into the right palm for 30 to 60 seconds, and then return to neutral.

Next both ring fingers project toward the opposite palms at the same time for 30 to 60 seconds and then return to neutral. Notice that the energy may meet in the middle.

Fig. 8.99 *Project Energy and balance Left and Right.*

Activate the Yang Channels - Left Side

Turn the left palm down and lower the right palm to cover the back of the left hand, palm down. Pass the right palm over the left arm's **yang** channels from the back of the left hand to the left shoulder. Then pass the right palm across the upper chest and across the right breast. Scoop the right palm under the right armpit, fingers first. Then bring the right palm forward, palm down and press forward with the left palm at the same time. Relax and channel the earth force.

A. *Left Palm down, lower Right Palm to cover the back of Left Hand.*

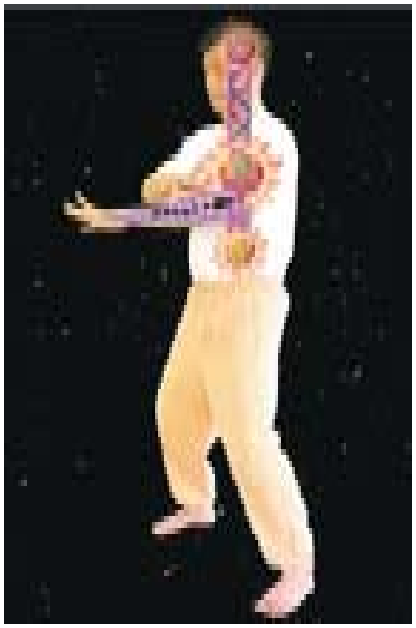

B. *Pass the Right Palm over the Left Arm's Yang Channels.*

C. *Pass the Right palm across the chest and scoop under the Right Armpit, Fingers first.*

D. *Press both Palms forward, relax and channel the Earth Force.*

Fig. 8.100 *Balance Left Side Yin and Yang and Channel Earth Energy.*

Repeat, Activating the Yin and Yang Channels to the Right Side

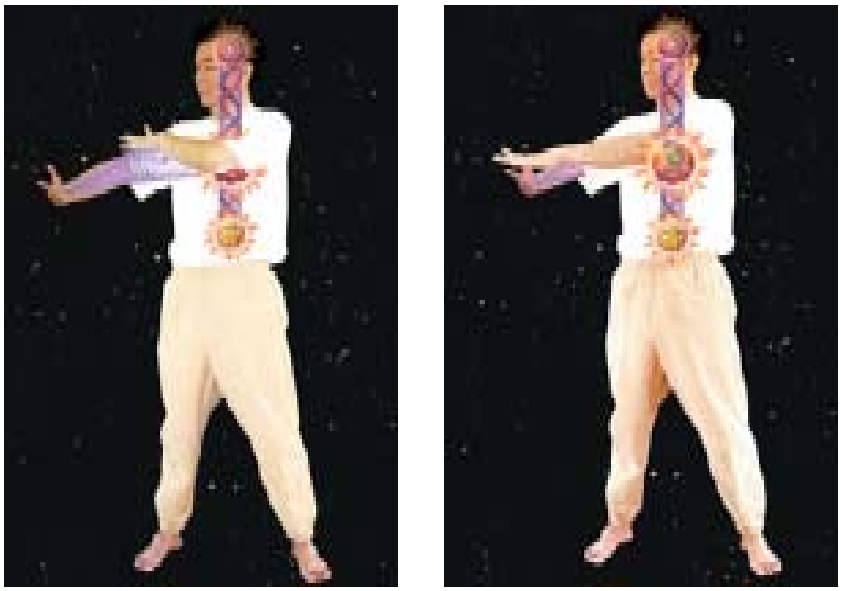

Fig. 8.101 *Balance right side yin and yang and channel earth energy*

Then repeat **Activating the Yin and Yang Channels** with the other fingers and channels in the following order:

Index Finger - Large Intestine
Thumb - Lung
Pinky Finger - Heart and Small Intestine
Middle Finger - Pericardium

Fig. 8.102 *One Finger Art - activating the Laogong.*

Activate the Chi Belt - Right Foot Forward

Step forward with the right foot. The right palm covers the navel and the left palm covers the Door of Life. Feel the Chi beam penetrate from palm to palm.

Turn your hips to the right and shift weight to your right leg. At the same time move your right palm to the Door of Life in a brushing manner, while your left palm moves to the right hip in a sweeping manner. Note that the palms face the Chi belt.

Repeat the above three times altogether.

Fig. 8.103 *Activate the Chi Belt - Right Side.*

Activate the Chi Belt - Left Foot Forward

Repeat the above with the left foot forward and reversing the right and left hands.

Fig. 8.104 *Activate the Chi Belt - Left Side.*

Channel the Earth Force

Bring the hands forward and rotate the palms to face downwards. **Smile** and channel the earth force as before.

For these Closing Movements see the pictures beginning on page 171.

Closing Movements
Activate the Chi Channels - Balancing the Organs

Index Finger - open (up), close (down), neutral (even with the other fingers).
Ring Finger - down, neutral.
Index Finger - open, neutral.
Thumb - in and down, neutral.
Index Finger - open, neutral.
Pinky Finger - down, neutral.
Index Finger - open, neutral.
Middle Finger - down, neutral.
Index Finger - open, neutral.

Crane's Beak

Form the crane's beak with both hands by bringing the fingertips together with the thumbs inside. Swallow the saliva. Raise the forearms to shoulder height with the fingers pointed down, inhaling gently as you raise.

Open the palms slowly and begin to lower the arms to the sides as you exhale, until the palms have returned to the starting position.

Finish

Bring the awareness to the navel and notice the quality and intensity of the energy generated.

Collect energy at the navel. Men, place the hands over the navel with the right hand on top; vice versa for women.

Healing Others

Summary and Combined Practice

After learning the four sets of Cosmic Chi Kung, you may want to combine them all into a short and simple daily practice. This combined set, previously called Buddha Palm I, synthesizes the movements from the first three sets into one basic sequence. The movements are done on the right side only, so the entire set can be completed in **ten to twenty minutes**.

Cosmic Chi Kung: Simple Combined Sequence

Opening Movements

Bone Breathing - Absorbing Cosmic Chi

1. Stand with your hands down by your sides. Feel your Chi moving and activate the **bone breathing**.
2. Activate the cosmic force by using your mental intention (Yi) to spiral at the **mideyebrow** point and draw in the golden light energy. Breathe through the mideyebrow point in the same manner as in bone breathing, allowing the energy to **flow through the Microcosmic Orbit**. Alternatively you can breathe the golden light down into your navel to charge up your Original Chi at the Tan Tien. You can also simply circulate the golden light throughout your body. Relax, smile and enjoy the sensation of your entire body breathing in the cosmic energy.

Channeling the Earth Force - Washing the Bone Marrow

1. Connect with the earth force by activating the **perineum** and the **soles of the feet, Kidney 1, Bubbling Spring**. Connect the bridge by slightly squeezing the sex organs and the anus. Wash the bone marrow from the soles to the crown.
2. **Smile** into the perineum, palms, mideyebrow and crown. Then slowly raise the arms, palms facing each other to chest height keeping the elbows relaxed and sunk. Then slowly rotate the arms until the **palms are facing down**. Absorb the Earth Chi through the soles, perineum and palms; feel it being absorbed into the bones and body like a **steam or mist rising from the earth**. Feel the earth force move through the **center of the bones**, up the calves, thighs (femur bones), through the hip bones, spine, scapulas, arms, neck and skull. Finally swirl the energy around your brain.

Activate the Hip - Large Intestine 4, Pericardium 9 and Small Intestine 3

1. Raise your index finger slightly upward to activate the Laogong point (Pericardium 8). Then stretch your thumbs out to the sides and down, so that they end up pointing downwards toward the earth to activate Large Intestine 4 (Hegu). **Large Intestine 4 is found in the webbing between the thumb and index finger. It is called the "eye of the hand"; this area is also known as the "Tiger's Mouth."**
2. Slowly draw the elbows back and lower the hands until your palms are facing down beside the "eye of the hip" (the iliac crest) with the "eye of the hand" (Large Intestine 4) aligned with the "eye of the hip". **Use your mind intention to beam the energy back and forth between your two LI-4 points. This will activate the large and small intestines.**
3. Rotate your hands so that the fingers first point out, then back and finally point the fingers in toward the eye of the hip. **Beam energy back and forth between the tips of the middle fingers** (Pericardium 9) passing through the hips.
   Rotate the hands again until the fingers are pointing forward with the palms facing up. Align the knife edge (Small Intestine 3) with the eyes of the hip, and **beam the energy back and forth between the two hands.**

Absorb the Heavenly Force - Washing the Bone Marrow - Crown to Soles

Extend the arms forward to chest height with the **palms still facing upward**.

Become aware of the palms and the crown. Activate the Laogong point (Pericardium 8). Feel the heavenly energy, and be aware of the violet light of the North Star and the red light of the Big Dipper shining down. Draw this light in through the palms and the crown point and feel it washing your bone marrow. Direct the sensations down through the skull, cervical vertebrae, clavicle, scapulas and sternum. Activate your thymus gland and continue drawing the healing heavenly light down through the rib cage, arms, spine, hips, femurs, calf bones, feet and toe bones. **Feel your bones activated with a positive electrical force (the positive force comes from heaven, negative from the earth).**

Absorb the Earth Force

1. Rotate the arms until the **palms face down**.
   Raise the index fingers slightly, extend the thumbs first towards each other, and then towards the ground.
2. Become aware of the palms (Laogong), the soles of the feet (Kidney 1, Bubbling Spring) and the perineum (Conception Vessel 1, Hui Yin). Activate these points, feel the earth energy, and **be aware of a gentle blue light or white light rising up from the earth like a pure steamy mist.** Draw this light in through the palms and soles and let it wash up through the center of your bones as it steam cleans your

marrow. Picture any impurities or illness dripping out of your bones and draining down into the earth, where they are recycled and purified.

Core Movements

Grasping the Moon - Connecting the Heaven and Earth Forces

1. **Open Position:** Heaven Force - Bring the arms up to shoulder height, bending the elbows so that the **left hand is under the right elbow** with the left index finger pointing up to Heart 3.
2. The right forearm is over the left forearm with the tip of the right index finger held above the Large Intestine 11 point of the left arm. The right index finger is pointing up toward heaven.
3. The right index finger draws in the heavenly force like an antenna. The force flows up the bones of the right arm across the shoulders to the left arm, and through the bones of the left arm to the left index fingertip. It then flows through the index finger of the left hand into the Heart 3 point of the right arm **completing the heavenly circuit**. Continue cycling in this way.
4. **Close Position:** Earth Force - Keeping the arms in the same position, move both index fingers to point down. The right index finger will now point toward the Large Intestine 11, point of the left arm and the left index finger will point downward toward the earth. Draw in the earth force through the left index finger bringing it through the bones of the left arm, across the shoulders through the right arm to the right index finger and out into the Large Intestine 11 point of the left arm. Continue cycling in this way **completing the earth circuit.**

   Open and close three times altogether ending in the open position.

Activate the Throat Center

1. Draw the elbows out to the side and rotate the palms to face in so that the left palm is about 3 - 6 inches in front of the Throat Center (Conception Vessel 22), palm facing in, and the right hand is about 1 - 3 inches in front of the left hand, palm facing in. Align the Lung 10 point of the right hand with the Lung 10 of the left hand, and align the Lung 10 points in the middle of the thenar eminence of the left hand with the Throat Center. **Keep the points aligned and beam the energy passing through both hands into the Throat Center.**
2. Move both hands about 12-18 inches out from the Throat Center maintaining the energy beam as you move.
3. Move in and out three times altogether in this way ending with the hands in as in preivous point above.

Activate the Third Eye

1. Keeping the Lung 10 points aligned, raise the hands up to the level of the mideyebrow point. Keep the points aligned and **beam the energy passing through both hands into the mideyebrow point.**
2. Move both hands about 12-18 inches out from the mideyebrow point maintaining the energy beam as you move. **Move in and out three times** altogether in this way, ending with the hands as previously.
3. Keeping the palms and thenars (Lung 10) aligned, move the hands back down to the position in front of the **Throat Center.**

Open the Bridge and Regulator Channels

1. Keeping the forearms horizontal at shoulder height, separate the hands so that the Laogong points are aligned in front of Stomach 13 just below the clavicle on a vertical line above the nipple or **mammillary** line. The fingertips should almost be touching. Beam energy from the Laogong points into ST-13. You will be following this vertical line, which passes through the nipples, down the torso to the level of the navel stopping to focus and **beam energy into key points along the way**. On each of these, focus your Yi on beaming energy into the organs inside each position. Stomach 13 is the location that activates the Heart and Lungs. Feel the change in your breathing as you activate the **lungs**.
2. Move the hands down the mammillary line to Stomach 16, about one inch above the nipple (in the space between the third and fourth ribs). Again, beam energy to energize and balance the **heart and lungs**.
3. Move the hands down to Liver 14 (about 2 - 3 inches below the nipple in the space between the 6th and 7th ribs). Beam healing energy into the **liver and gall bladder**.
4. Move the hands down to Spleen 16 (just below the rib cage on the mammillary line). Beam healing energy into the **stomach, pancreas and spleen**.
5. Move the hands down to Spleen 15 (on the mammillary line to the level of the navel). Beam healing energy from your palms into the **small intestine and the Tan Tien**.

Grasping the Chi Ball

1. Slowly rotate the hands so that your palms face each other in front of your navel. Feel the invisible ball of energy between your hands. Allow the energy to push your hands apart keeping the feeling of connection between your palms.
2. Let the energy draw your hands back toward each other, like a magnet, until you feel as if you are squeezing a ball.
3. Stretch and squeeze the Chi ball three times by opening and closing your palms in this way.

Activate the Outer and Inner Arm Gates
Waiguan - Triple Warmer 5 and Neiguan - Pericardium 6 - Right Arm on Top

1. Slowly rotate the arms so that both palms face down.
2. Cross the right wrist over the left wrist with 1-3 inches of space between the hands. Align PC-6 of the right wrist with TW-5 of the left wrist.
3. Keeping the wrists crossed, slowly rotate hands turning the palms upward. Now TW-5 of the right wrist will be aligned with PC-6 of the left wrist.

Open the Functional Channel with LI-4

1. Bring the left hand down to the level of the Tan Tien with the Chi Knife facing in. Lower the right hand, palm down, and align the eye of the hand, the LI-4 point with your navel. Feel the Chi ball between your two hands, and at the same time beam energy from LI-4 into the navel point.
2. Raise the right hand up the Functional Channel stopping and aligning LI-4 with the **solar plexus, heart, throat** (CV-22) and **mideyebrow** points. **Beam energy from the eye of the hand into each of these points**, and at the same time continue to feel the Chi ball connection between the two hands.
3. Return down the Functional Channel in the same manner stopping to beam energy into each point. **Go up and down the Functional Channel** in this way three times.

Yin/Yang Palms

1. Separate the hands and extend them out in front of the body at solar plexus level. The left palm is still pointing up and is yang drawing in the heavenly force through Laogong. The right palm is still facing down and is yin drawing in the earth force energy.
2. Conclude by turning the left palm over to face downward. Draw in the earth force through both palms.

Double Palm and Beam to Activate the Functional and Governor Channels

1. Bring the left palm in first to face the navel, about 3 - 5 inches away, aligning the Laogong point with the navel. Follow by bringing the right hand in front of the left hand, aligning the Laogong of the right palm with the Laogong of the left hand and the navel. Both palms are now facing in. **Beam energy through both Laogong points to the navel and through the body to the Door of Life**.
2. Next raise the left palm up to the **solar plexus** aligning the Laogong point with the solar plexus. Beam energy into the solar plexus point and through the body to the T-11 point. Your right hand remains at the navel level beaming energy to the navel and the Door of Life.
3. Raise your right hand up to the outside of the left hand at the solar plexus level, and beam energy through both hands into the **solar plexus point and the T-11 point**. Continue in the same way with the left hand leading to the **heart point and wing**

point, the **throat point and C-7**, the **mideyebrow point and jade pillow** and the **crown point and perineum**.

4. Return down the front, point by point in the same way, leading with the left hand. Go up and down in this way three times. **The double palm and beam activate both the Functional and Governor Channels. The energy beam passes all the way through the body at each point**.

Grasping the Chi Ball

1. Separate the hands and slowly extend the arms in front of you at navel level, palms facing each other holding the Chi ball.
2. Stretch and squeeze the Chi ball three times as before by opening and closing the palms.

Channel the Earth Force

Rotate the hands to face downward, and draw in the earth force through the palms, soles and perineum.

Closing Movements

Activate the Chi Channels - Balancing the Organs

Index Finger - open (up), close (down), neutral (even with the other fingers).
Ring Finger - down, neutral.
Index Finger - open, neutral.
Thumb - in and down, neutral.
Index Finger - open, neutral.
Pinky Finger - down, neutral.
Index Finger - open, neutral.
Middle Finger - down, neutral.
Index Finger - open, neutral.

Crane's Beak

1. Form the crane's beak with both hands by bringing the fingertips together with the thumbs inside. Raise the forearms to shoulder height with the fingers pointed down, inhaling gently as you raise.
2. Open the palms slowly and begin to lower the arms to the sides as you exhale, until the palms are facing each other in the starting position.

Finish

1. Bring the awareness to the navel and notice the quality and intensity of the energy generated.
2. Collect energy at the navel. Men, place the hands over the navel with the right hand on top; vice versa for women.

Chapter IX
Universal Tao Practices

Cosmic Inner Smile

Fig. 9.1 *Inner Smile*

The Inner Smile begins at the eyes and the mideyebrow point and moves down to the heart. As you activate the heart, the loving energy will flow out and you will feel the energy of your Inner Smile flow down the entire length of your body like a waterfall. This is a very powerful and effective tool to counteract stress, tension and negative Chi.

1. Be aware of the **mideyebrow,** imagining that your are in one of your favorite places in the world, a place where you feel safe, relaxed and happy. Recall the sights you might have seen there, the sounds you might have heard, the scents, sensations and flavors that you associate with that place.
2. Imagine that one of your favorite people is standing in front of you, smiling to you with loving, happy, radiant shining eyes. **Smile** to your face and slightly lift up the corners of your mouth.
3. Feel yourself responding to that special person's smile with a smile of your own. Feel your eyes smiling and relaxing.
4. Smile down to the **thymus gland** and picture a white flower blossoming. Gently inhale into the thymus gland, connecting your breath to the olfactory organ. Smell the good fragrance.
5. Aim your inner attention at your **heart**, picturing the heart before your inner eye and smile to it. **Smile** until you feel the heart smile back to you. Picture your heart like a red rose, gradually opening. This will activate the **love** and fire of **compassion** in the heart. Once you feel the red light and loving awareness it will activate the **cosmic red healing light** or mist from above and around you.
6. Smile at the light or mist and very slowly with a soft, long, deep breath draw the red mist, love and compassion into the mideyebrow, down through the mouth and throat, into the heart and gradually overflowing to the **small intestine**. Exhale, but retain the red light and the love and compassion in the **heart and small intestine**. At the same time exhale the cloudy, black or negative energy. Keep on doing this breathing 18 to 36 times waiting until the heart becomes bright red before your inner vision and starts to radiate out to the tongue, mouth, nose, ears and eyes. Allow the red light to whirl around you and form a **red aura**. Feel your skin glowing with red energy.
7. Let the heart's loving energy radiate out to the **lungs**. Aim your attention at the lungs; picture them before your inner eye and smile to them. **Smile** until you feel the lungs smile back to you. Picture your lungs like a white rose, gradually opening; smell the good fragrance. This will activate the courage in the lungs. Once you invoke the white light and courage into the lungs, you will also activate the **cosmic white healing light** or mist from above and around you.
8. Smile at the light or mist and very slowly, softly take a long deep breath and draw the white mist into the mideyebrow, the mouth and down to the lungs, gradually overflowing into the **large intestine**. Exhale but retain the white light and the feeling of courage in the lungs. At the same time exhale the cloudy, black or negative energy. Keep on doing this kind of breathing 18 to 36 times, waiting until the lungs become bright white and start to radiate out to the nose, ears, eyes, tongue and mouth. Invite the white light to whirl around you and form a **white aura** covering your skin like autumn dew.
9. The **spleen, pancreas and stomach** correspond to the yellow color of the earth element. Connect to these organs and smile down into them from the mideyebrow.

First connect to the heart, then attract the clear yellow light from above and around you. You might see the **golden yellow aura** of a wheat field ready for harvest. Expel feelings of worry; exhale the cloudy, sticky energy. Breathe in the golden yellow aura, filling your spleen center with golden yellow light. Repeat to complete 18 to 36 cycles, then allow the light to radiate out to your mouth, nose, ears, eyes and tongue. Wrap the golden aura around you, leaving a golden shine on your skin.

10. The **kidneys and bladder** correspond to the blue color of the water element. Gentleness is contained within the blue healing light. Inhale the blue aura into the kidneys. Expel feelings of fear or stress on breathing out. Allow your energy field to expand, breathing in and out the blue energy 18-36 times, until it starts to radiate out from your kidneys to your ears, eyes, tongue, mouth and nose. Gather the blue mist on your skin enveloping you with a **blue aura**.

11. The **liver and gall bladder** connect to the green color of the element wood; kindness replaces anger, which is expelled on breathing out. Do the same as above and create a **green aura** around you. Exhale the dark red, cloudy heat. Inhale the nourishing green of the forests. Do 18 to 36 cycles, until the green light has completely filled the liver and starts to radiate out to your eyes, tongue, mouth, nose and ears. Invite the green light to form a green aura around you.

12. **Smile** down to the **sexual organs** and reproductive system. Feel love and sexual arousal and the heart and sexual organs uniting. Observe how this process transforms the sexual energy into Chi. Channel down orange and red light to the sexual organs. Thank them for their work in keeping you alive and healthy. Rest. Do nothing. Gather and store the energy by smiling and spiraling in the Tan Tien.

Six Healing Sounds

The Six Healing Sounds enhance Therapeutic Work

Everyone has heard stories about gifted beings who possess great healing powers. People seek out gifted healers. Yet even in the best of circumstances, how much time can a great healer spend with you? One hour a day? An hour a week? What about the rest of the time? Thus you must learn how to take care of yourself; you must learn how to clear out your negative energy and transform it into positive healthy energy. If you maintain yourself in this way it will surely enhance any other therapy you are receiving.

The Six Healing Sounds are a simple yet powerful tool to promote physical, energetic and emotional healing and balance. If you are healing others, you can teach your students one or two of the Six Healing sounds each session, to enhance the effects of your therapeutic work. During the practice of the sound the resting period is very important. Growing the good virtue of the organs is essential so the negative or sick energy has less room to grow.

The sounds are also used to generate certain frequencies for specific healing. Each sound can generate different energy for the healing of the different organs.

Once the movements, sounds and information have been integrated into your practice you can simplify and make the Six Healing Sounds more powerful. For example, when you are settled into the lung sound and you are breathing white healing light and feel the mideyebrow wide open, you put the awareness in the 'Tan Tien and Universe'.

Chi will flow from the universe into the Tan Tien and just the right amount and quality will flow from the Tan Tien into the lungs and large intestine. Just set up the location (the organ) and connect to the universe and the Chi will flow to the correct location!

When doing these, the eyes are open only while making the sound.

Six Healing Sounds - Practice

Lung Sound

Element: Metal
Associated Organ: Large Intestine
Sound: SSSSSSS (Tongue behind Teeth)
Emotions: Negative - Grief, Sadness, Depression
Positive - Courage, Righteousness, High Self Esteem
Color: White, Clear, Metallic
Season: Fall
Direction: West

Position: Sit in a chair with your back straight and your hands resting palms up on your thighs. Have your feet flat on the floor about a hip's width apart . **Smile** down to your lungs and be aware of any sadness, grief or excess heat in your lungs. Slowly inhale and raise your hands up your center line with your fingers pointing toward each other. When your hands pass your shoulder level, begin to rotate the palms out as you continue raising your hands up in front of you and above your head with the palms up. Point your fingers towards the fingers of the opposite hand and keep your elbows slightly bent.

Sound: Part your lips slightly, keeping your jaw gently closed. Look up through the space between your two hands and push your palms slightly upward as you slowly exhale and make the sound, "SSSSSSS". Picture and feel any excess heat, sadness, grief, depression, sickness and dingy white color expelled and released as you exhale slowly and fully.

Resting Posture: When you have completely exhaled, rotate the palms to face downward with the fingers still pointing toward each other. Slowly lower the palms and bring them just in front of the chest feeling the lung's aura.

Close your eyes and be aware of your lungs. **Smile** into your lungs, and as you inhale, imagine that you are breathing in a **bright white mist of light**. Breathe this light into your lungs and feel it cooling, cleansing, invigorating, healing and refreshing your lungs. Feel it flowing down to the large intestine to balance the energy of the yin lungs and yang large intestine, allowing the **courage** quality of your lungs to emerge. Grow more courage, so sadness and depression have less room to grow. With each inbreath, feel yourself drawing in cool fresh energy. With each outbreath, mentally make the Lung Sound and release any remaining sadness or hot energy.

Repeat at least three times. For the first two repetitions, you can make the sound aloud. On the third or last repetition, make the sound sub-vocally (vocalizing the sound so softly that only you can hear it) Repeat six, nine, twelve or twenty four times to alleviate extreme sadness, depression, colds, flu, toothaches, asthma and emphysema.

Kidney Sound

Element: Water
Associated Organ: Bladder
Sound: CHOOOOOO (with your lips forming an "O" as if blowing out a candle.)
Emotions: Negative - Fear, Shock
Positive - Gentleness, Wisdom
Color: Dark Blue or Black
Season: Winter
Direction: North

Position: Now move the hands to cover the kidneys. **Smile** to your kidneys, and be aware of any excess cold or heat in the kidney region. Then bring your legs together, ankles and knees touching. Lean forward and clasp the fingers of both hands together around your knees. Inhale and pull your arms straight from the lower back while bending the torso forward (this allows your back to protrude in the area of the kidneys). Tilt your head upward as you look straight ahead, still pulling on your arms from the lower back. Feel your spine pulling against your knees.

Sound: Round the lips slightly and slowly exhale while making the sound "CHOOOOOO." Simultaneously contract your abdomen, pulling it in toward your kid-

neys. Imagine any fear, sickness, imbalances, excess cold or heat energy being released and squeezed out of the fascia surrounding the kidneys.

Resting Posture: After you have fully exhaled, slowly sit erect and return the hands to touch the aura of the kidneys. Close your eyes and again be aware of your kidneys. **Smile** to your kidneys and, on the inbreath, imagine you are breathing a brilliant **luminous blue light mist** into them; feel this mist healing, balancing and refreshing your kidneys and bladder and picture them glowing a bright blue color. On the outbreath, imagine you are still making the Kidney Sound.

Repeat at least 3 times, as with the previous sound. Repeat six, nine, twelve, or twenty four times to alleviate extreme fear, fatigue, low-pitched ringing in the ears, dizziness, back pain, bladder and urinary infections or other problems of the reproductive system.

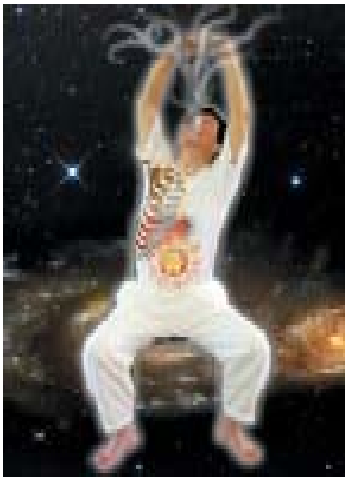

Liver Sound

Element: Wood
Associated Organ: Gall Bladder
Sound: SHHHHHHH
Emotions: Negative - Anger, Frustration, Resentment
Positive - Loving Kindness, Benevolence, Forgiveness
Color: Green
Season: Spring
Direction: East

Position: Place the hands on the liver. **Smile** to your liver and be aware of any anger, frustration, resentment or excess heat. Slowly begin to inhale a deep breath as you extend your arms up from the sides with your palms up. Continue to raise them over your head. Interlace your fingers together and turn your joined hands over to face the sky, palms up. Push out through the heels of the palms and extend the arms up, keeping the shoulders relaxed. Bend a little to the left and stretch your right arm slightly to gently open the area of your liver.

Sound: Open your eyes wide (the eyes are the sensory opening of the liver). Slowly exhale, making the sound, "SHHHHHHH" sub-vocally. Feel that you are releasing any trapped excess heat, anger, illness and negativity from your liver and that these are riding out of your body on your breath.

Resting Posture: Once you have fully exhaled, separate your hands, turn the palms

down and slowly lower your arms to the sides, leading with the heels of the hands. **Smile** and inhale a **shiny spring green mist**, illuminating the liver and gall bladder. Bring your hands back to rest on the liver's aura. Close your eyes and smile into your liver. With each inbreath, breathe fresh Chi into your liver and gall bladder and mentally make the Liver Sound with each outbreath.

Repeat at least three times, as with the previous sound. Repeat six, nine, twelve or twenty four times to alleviate extreme anger, to relieve red or watery eyes, to remove a sour or bitter taste in the mouth or to detoxify the liver.

Heart Sound

Element: Fire
Associated Organ: Small Intestine
Sound: HAAAAAAAW
Emotions: Negative - Arrogance, Harshness, Cruelty, Hatred
Positive - Joy, Honor, Respect, Love, Happiness
Color: Red
Season: Summer
Direction: South

Position: Let both hands rest on the heart. **Smile** to your heart and be aware of any arrogance, haughtiness, hatred, giddiness, cruelty or hastiness. Slowly begin to inhale a deep breath as you extend your arms up from the sides with your palms up, as you did with the Liver Sound. Continue to raise them over your head. Interlace your fingers together and turn your clasped hands over to face the sky, palms up. Push out through the heels of the palms and extend the arms up, keeping the shoulders relaxed. Bend a little to the right and stretch your left arm slightly to gently open the area of your heart.

Sound: Keep your eyes soft and relaxed, looking up through your hands. Slowly exhale, making the sound, "HAAAAAAAW" sub-vocally. Feel that you are releasing any trapped heat, negative emotions, illness and imbalances from your heart and that these are riding out of the body on your breath.

Resting Posture: Once you have fully exhaled, close your eyes, separate your hands, turn the palms down and slowly lower your arms to the sides, leading with the heels of the hands. As you move inhale a **bright red mist** into the heart and small intestines. Bring your hands back to rest on your heart's aura . Smile into your heart. With each inbreath, breathe fresh Chi into your heart with each outbreath mentally repeat the heart sound.

Repeat at least three times, as with the previous sound. Repeat six, nine, twelve or twenty four times for the heart and small intestines; feel them balanced. This will alleviate extreme impatience, hastiness, arrogance, nervousness, moodiness, jumpiness, irritability, tongue ulcers, palpitations, sore throat, heart disease, insomnia and detoxify the heart.

Spleen Sound

Element: Earth
Associated Organ: Pancreas, Stomach
Sound: WHOOOOOOO (gutturally from the throat)
Emotions: Negative - Worry, Excess Sympathy, Overthinking
Positive - Fairness, Balance, Equanimity, Justice, Openness
Color: Yellow
Season: Indian Summer
Direction: Center (where you stand, looking out to the Six Directions)

Position: Place your hands on the body covering the spleen, pancreas, and stomach area. Be aware of your spleen and **smile** sincerely into it. Inhale deeply as you move the arms outward in an embrace and aim the fingers up under the left rib cage. Place your fingers of both hands just beneath the sternum and rib cage on the left side.

Sound: Look out, lean into your fingers and gently push your fingertips in. Exhale slowly and make the sound, "WHOOOOOOO," from the depths of your throat. Feel yourself releasing any trapped heat, worry, mental fixations or excess sympathy.

Resting Posture: Once you have fully exhaled, close your eyes, slowly release the hands and extend the arms out embracing the earth; return your hands to the resting position on the spleen's aura. Smile to your spleen, pancreas and stomach. Inhale fresh Chi to your spleen, pancreas and stomach as a brilliant **luminous yellow healing mist** that cleanses and refreshes your organs. Mentally do the Spleen Sound with each outbreath.

Repeat at least three times, as with the previous sound. Repeat six, nine, twelve or twenty four times to alleviate extreme indigestion, heat or cold in the stomach or spleen, worry, nausea, hemorrhoids, fatigue, organ prolapse or loose stools.

Triple Warmer Sound

The Triple Warmer refers to the upper, middle and lower body, and to the distinct metabolic transformations that occur within each area. The Upper Warmer is the area above the diaphragm, where the heart and lungs are located. This area tends to become hot and is responsible for respiration and cardiovascular circulation. The Middle Warmer, the area between the diaphragm and the navel, becomes warm and is where the digestive organs are located. The Lower Warmer, the area below the navel, is responsible for reproduction and elimination and is cool in temperature. The sound "HEEEEEEE" balances the temperatures of the three levels by bringing hot energy down to the lower center and cold energy up to the higher centers.

Position: Lie on your back with your arms resting palms up at your sides. Keep your eyes closed. **Smile**. First breathe into the upper part of your lungs to expand the Upper Warmer; then breathe into the middle of the lungs to expand the Middle Warmer; finally, with the last part of your inhalation, expand your lower lungs and fill the Lower Warmer. Breathing in this way creates more space inside for each organ, helping to release and circulate any internal heat or cold.

Sound: Exhale with the sound "HEEEEEEE" sub-vocally, first flattening your chest, then your solar plexus, and finally your lower abdomen. Feel the dark and cloudy color, cold and chill energy exit from the tips of the fingers.

Resting Posture: Once you have fully exhaled, do not to focus on any emotions or purification process at all. Just let go and relax your body and mind completely.

Repeat at least three times, as with the previous sound. Repeat six, nine, twelve or twenty four times to alleviate insomnia and stress.

When you have completed the Six Healing Sounds just rest, **smile** and do nothing.

Regular daily practice of the Six Healing Sounds will help you to keep in touch with the energetic and emotional state of your internal organs. Most importantly do the sounds in the evening before going to sleep. This will help clear out the negative emotions before sleeping, so you can feel that the night's rest recharges your energy positively. This practice will greatly benefit your personal Cosmic Healing Chi Kung practice. It will help sensitize you to the varieties and differing qualities of Chi. This knowledge will also help you in diagnosing and treating others.

For more details of this practice please see the book "Taoist Ways to Transform Stress Into Vitality", by Mantak Chia.

Appendix

Guide to the Acupuncture Points used in Cosmic Chi Kung

The following is a detailed description of the acupuncture energy points used in the Cosmic Chi Kung practice. It is necessary to know the exact location of the points to do the practice well. However, you do not have to know the traditional Chinese medical functions and energetics of the points to do the practice. These are included in this appendix as an item of interest.

The names of the points are given first by the channel and number, second by the English translation of the traditional Chinese name for the point and finally by the name in Chinese.

We are emphasizing the traditional Chinese medical therapeutic properties of the points given herein. Many of these points also have very different purposes in Taoist Yoga. *For a description of the Taoist Yoga energetics, refer to "Awaken Healing Light of the Tao" by Mantak Chia.*

Pericardium 8

"Lakor's Palace" - Laogong

Ying Spring, Fire Point

Location: On the center of the palm, where the tip of the middle finger touches when making a loose fist.

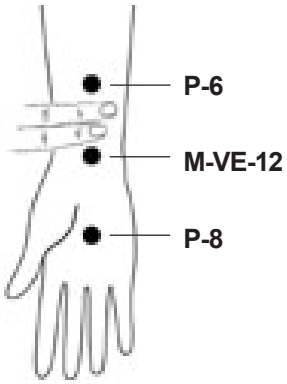

Functions: Cools the heart, drains heat from the heart, cools the blood, calms the spirit, regulates the heart Chi and yang, Ghost Point for treating spirit possession.

Indications: Coma from stroke, heat exhaustion, angina pectoris, mania, hysteria, mental illness, excessive sweating of the palms, mouth problems.

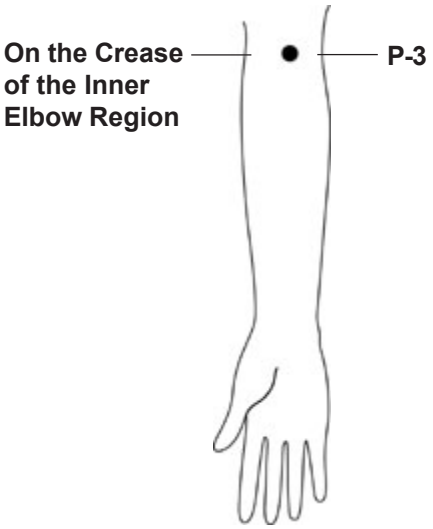

Large Intestine 4
"Adjoining Valleys" - Hegu

Yuan Source Point
Location: On the back side of the hand between the thumb and index finger, in the web approximately at the middle of the metacarpal bone of the index finger.
Functions: Disperses wind, relieves exterior conditions, suppresses pain and clears the channels, clears lung heat, calms the spirit.
Very powerful point for moving the Chi and blood of the whole body; main point for pain; main point for headache; main point for ailments of the head, face and sensory organs; main point for immunity.
Indications: Headaches, common cold, redness with pain and swelling of the eyes, toothache, facial swelling, sore throat, finger cramps, arm pain, fever, abdominal pain, constipation.
Caution: Contra-indicated in pregnancy.

Small Intestine 3
"Back Creek" - Houxi

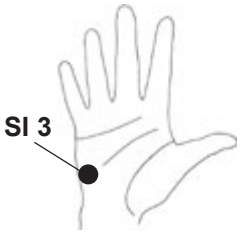

Shu Stream, Wood Point
Master Point of the Governor Channel
Coupled Point of the Yang Bridge Channel
Location: When a loose fist is made, the point is near the head of the fifth metacarpal bone on the knife edge of the hand at the junction of the red and white skin.
Functions: Relaxes the tendon-muscular channels, opens the Governor Channel, clears the Spirit, drains evil Chi from the heart.
Indications: Seizures, psychosis, hysteria, intercostal neuralgia, headache, stiff neck, red, painful and congested eyes, deafness, spasms of the arm, elbow and fingers; fever, night sweating, whiplash, occipital headaches.

Used for structural/musculo-skeletal problems; opens the Governor Channel for problems with back, neck and head, main point for stiff neck, antispasmodic for muscle spasms; anti-inflammatory for spinal arthritis, intestinal inflammation.

Lung 10
"Fish Border" - Yuji

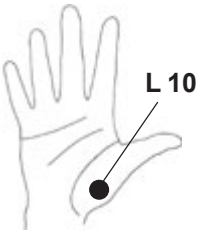

Ying Spring, Fire Point
Location: In the middle of the ulna eminence below the thumbs at the junction of the red and white skin.
Functions: Cools heat in the lungs, benefits the throat.
Indications: Sore throat, cough, laryngitis, tonsillitis, fever with common cold.

Triple Warmer 5
"Outer Gate" - Wai Guan

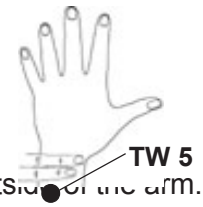

Luo Connecting Point
Master Point of the Yang Regulator Channel
Coupled Point of the Belt Channel
Location: About two fingers width above the wrist crease on the outside of the arm.
Functions: Regulates the Yang Regulator Channel and Belt Channel, tonifies and consolidates Protective (Wei) Chi, releases exterior hot and cold conditions, helps circulate stagnant Chi in the channels.
Indications: Common cold with alternating chills and fever, high fevers, pneumonia, deafness, migraine headaches, paralysis, stiff neck.

Pericardium 6
"Inner Gate" - Nei Guan

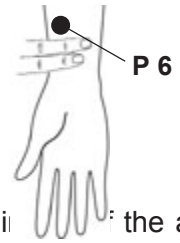

Luo Connecting Point
Master Point of the Yin Regulator Channel
Location: About two fingers width above the wrist crease on the inside of the arm, between the two prominent tendons.
Functions: Calms the heart and spirit, regulates the Chi, opens and relaxes the chest, regulates and harmonizes the stomach, regulates the liver, relieves pain.
Indications: Rheumatic heart disease, shock, angina pectoris, palpitations, chest pain, asthma, shortness of breath, tightness or fullness in the chest, spasm of the diaphragm, vomiting, stomach ache, abdominal pain, morning sickness, motion sickness, migraine headaches, hysteria, anxiety, irritability, insomnia, seizures, swollen and painful throat, painful menses or nausea with period.

Large Intestine 11
"Crooked Pond" - Qu Chi

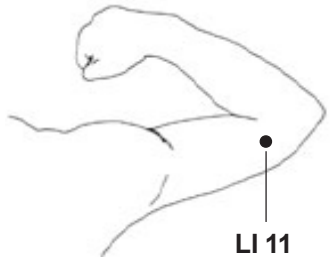

He Sea, Earth Point
Ghost Point
Location: When the elbow is flexed, in the depression at the outer and upper end of the elbow crease.
Functions: Cools heat, clears fire, drains dampness, eliminates wind and exterior conditions, regulates and moistens large intestine.
Indications: Arthritic pain in the arms, paralysis, hypertension, high fever, anemia, allergies, skin problems, Parkinson's Disease. Main point for skin diseases; main point for high fever.

Conception Vessel 22

"Heaven's Chimney" - Tian Tu

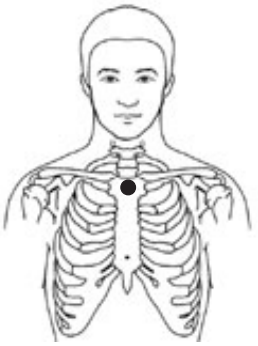

Intersecting Point of the Yin Regulator Channel on the Conception Vessel, Window of the Sky Point
Location: At the top of the breastbone (sternum) in the V-shaped indentation (suprasternal notch). Press in and downward at a forty-five degree angle.
Functions: Cools the throat and clears the voice, facilitates and regulates movement of lung Chi, frees the breath and helps restore the proper functioning of the lungs and bronchi, helps open Conception Vessel (Functional Channel).
Indications: Asthma, bronchial asthma, bronchitis, coughing, pharyngitis, goiter, hiccups, nervous vomiting, hoarse voice, spasms of the esophagus, diseases of the vocal cords, sore throat.

Conception Vessel 17

“Central Altar” - Tan Zhong

Front Mu-Alarm Point of the pericardium, Influential Point of Chi of the body
Sea of Chi Point, Master Point of the Middle Tan Tien
Location: On the frontal midline at the level of the fourth intercostal space, between the nipples.
Functions: Regulates the lungs and the Upper Warmer, tonifies Ancestral Chi, opens and relaxes the chest, diffuses lung Chi, regulates and tonifies Chi, transforms phlegm.
Indications: Pulmonary tuberculosis with shortness of breath, bronchitis, asthma, bronchial asthma, chest pain; all breast problems such as mastitis, insufficient lactation, breast abscesses, wheezing, chest pain, labored breathing, palpitations, difficulty swallowing food, anxiety.

Conception Vessel 12

"Middle Cavity" - Zhongwan (Solar Plexus)

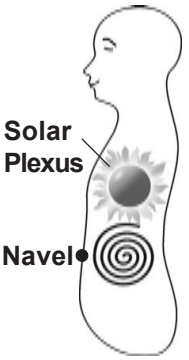

Front Mu-Alarm Point of the stomach, Influential point of all yang organs
Location: Approximately midway between the navel and the top joint of the xiphoid process.
Functions: Regulates the stomach Chi and yin, regulates, strengthens and tonifies the spleen Chi and yang, regulates the Middle Warmer, reduces digestive stagnation, tonifies nutritive Chi, regulates Chi and blood, redirects rebellious Chi downwards, clears stomach fire and heat, calms the fetus, controls the aura.
Indications: Acute or chronic gastritis, stomach and duodenal ulcers, prolapsed stomach, acute intestinal obstruction, stomach ache, vomiting, abdominal distention, diarrhea, constipation, acid regurgitation, indigestion, hypertension, mental diseases.

Mideyebrow Point

"Seal Hall" - Yin Tang

Master Point of the Upper Tan Tien
Location: At the midpoint between the two eyebrows.
Functions: Calms the spirit, activates the Crystal Room, opens the Governor Channel, draws in Cosmic Chi, eliminates wind heat.
Indications: Headache, vertigo, rhinitis, sinusitis, common cold, hypertension, infantile convulsions, sore eyes.

Conception Vessel 6

"Chi Ocean" - Chi Hai

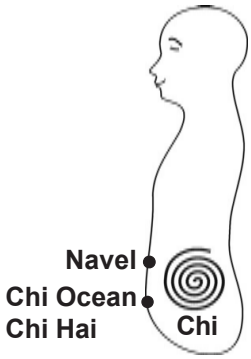

Master Point of the Lower Tan Tien
Location: Approximately three fingers width below the navel.
Functions: Regulates Chi, tonifies Original Chi, strengthens weak kidneys, harmonizes the blood, regulates the Thrusting Route Conception Vessel, reinforces Ching Chi, enriches yin.
Indications: Neurasthenia, abdominal distention, abdominal pain, irregular menstruation, impotence, spermatorrhea, urinary retention, frequent urination, intestinal paralysis, incontinence, constipation, infertility, uterine bleeding, hernia.

Stomach 13

"Chi's Household" - Chi Hu

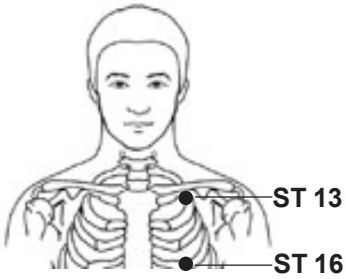

Location: Below the midpoint of the collarbone along the mammilary line (directly above the nipple).
Functions: Clears heat, loosens the chest, relaxes the diaphragm, regulates lung Chi.
Indications: Asthma, bronchitis, chest and back pain, hiccups.

Stomach 16

"Breast's Window" - Ying Chuang

Location: In the space between the third and fourth ribs, one rib directly above the nipple in men, slightly higher in women.
Functions: Stops pain, reduces swelling, clears heat, resolves depression, opens lungs, stops cough, relaxes chest, moves Chi.
Indications: Coughing, asthma, swelling of the breasts, chest and stomach pain, heart-burn, shortness of breath, melancholy, diarrhea

Liver 14

"Gate of Hope" - Chi Men

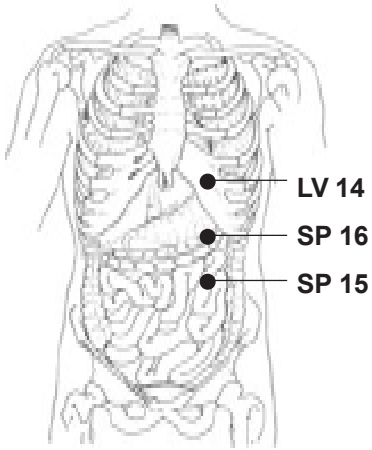

Front Mu-Alarm Point of the liver
Intersecting point of the Yin
Regulator and spleen channels on the liver channel
Location: In the sixth intercostal space, directly below the nipple.
Functions: Spreads liver Chi, transforms and removes congealed blood, strengthens spleen and stomach, expands and relaxes the chest.
Indications: Difficulty in breathing, chest pain, hepatitis, enlarged liver, gall stones, pleurisy, nervous stomach, menopausal disorders, cholera, failure to discharge the placenta after childbirth.

Spleen 16

"Abdomen's Sorrow" - Fu Ai

Location: Just below the bottom edge of the rib cage on the mamillary line.
Functions: Frees bowel Chi, dispels damp and heat, opens the organs and clears Chi stagnation.
Indications: Pain in the navel region, indigestion, dysentary, constipation.

Spleen 15

"Great Horizontal" - Da Heng

Intersecting point of the Yin Regulator Channel on the spleen channel
Location: At the level with the navel along the mamillary line.
Functions: Regulates the spleen, regulates and moistens the intestines, reduces digestive stagnation and transforms damp-heat.
Indications: Abdominal distension, diarrhea, constipation, intestinal paralysis, parasitic worms in the intestines, chronic sadness.

Conception Vessel 8

"Spirit Palace Gate" - Shen Que

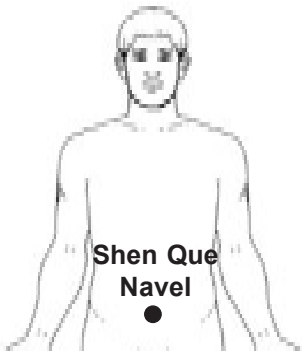

Doorway to the Original Chi,
Location: In the center of the navel
Functions: Tonifies, strengthens and regulates the spleen (Chi and yang), and stomach Chi, regulates the intestines, warms the interior and reduces digestive stagnation, tonifies the kidneys, warms the yang, dries dampness and dispels cold.
Indications: Chronic diarrhea, intestinal tuberculosis, all urinary disorders, shock resulting from intestinal adhesions, heatstroke, rectal or anal prolapse, restless fetus.

Governor Vessel 4
"Door of Life" - Ming Men

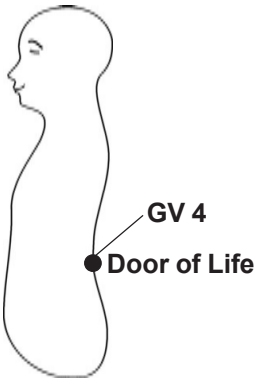

Back Doorway to the Lower Tan Tien
Location: Below the spinous process of the second lumbar vertebrae. Approximately at the level of the navel.
Functions: Nourishes the Original Chi, strengthens and harmonizes the kidneys, tonifies ching and yang, clears channels and invigorates collateral vessels, benefits the lower back and bones, regulates water pathways.
Main point to build life fire; main point for sexual/genital problems.
Indications: Bone disorders, chronic nephritis, enuresis, low sex drive, fatigue, spermatorrhea, impotence, irregular menses, painful menses, no menses, scanty menses, abnormal uterine bleeding, lower back stiffness and pain, kidney pain radiating to the abdomen, hemorrhoids, urinary incontinence, painful urination, diarrhea, sciatica, spinal myelitis.

Governor Vessel 6
"Middle of Spine" - Jizhong

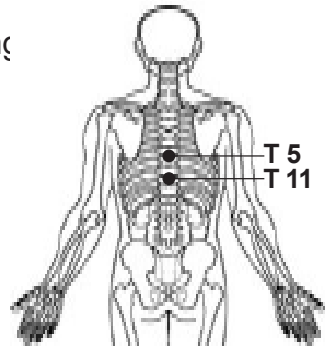

Location: Below the spinous process of the 11th thoracic vertebrae (T-11).
Functions: Stimulates Ching Chi, benefits spleen, stomach and kidneys and liver.
Indications: Hepatitis, seizures, low back pain, paralysis of lower limbs, blood in stools, diabetes, diarrhea.

Governor Vessel 11
"Spirit's Path" - Shen Tao

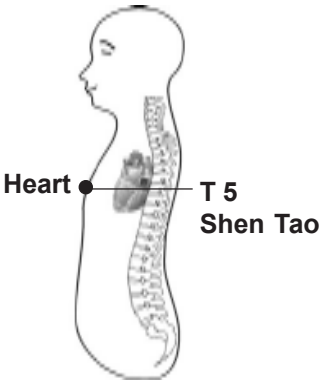

Location: Below the spinous process of T-5 (opposite CV-17, the Heart Point).
Functions: Calms heart and mind, regulates heart Chi and yang, expands and relaxes the chest, benefits heart and lungs, sedates pain, sedates fright and dispels wind.
Indications: Anxiety and palpitations due to fear or fright, neurasthenia, asthma, cough, shortness of breath, chest and hypochondriac pain, insomnia, aphasia due to winds, stroke, forgetfulness, fever.

Governor Vessel 14
" Big Vertebra" - Da Zhui

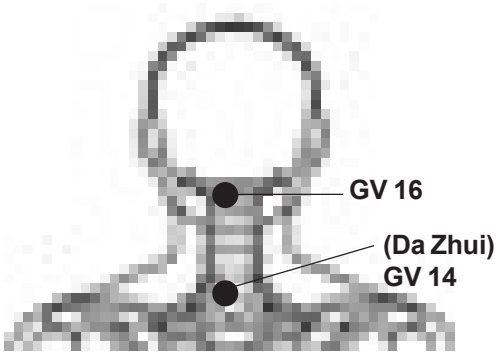

Influential point of yang
Sea of Chi point
Intersection point of all yang channels.
Location: Below the spinous process of the seventh cervical vertebra (C-7), approximately at the level of the shoulders.
Functions: Opens the yang, clears the brain, calms the spirit, tonifies Protective (Wei) Chi, reduces fever, relieves exterior conditions, clears heat.
Indications: Fever, sunstroke, malaria, psychosis, seizures, bronchitis, asthma, pulmonary tuberculosis, emphysema, hepatitis, blood diseases, eczema, hemiplegia, pain in the back of the shoulders, cold-induced diseases, cough, fever and chills.

Governor Vessel 16
“Jade Pillow” or "Wind Palace" - Feng Fu

Sea of Marrow Point, Window of Sky Point, Ghost Point
Intersection point of the Yang Regulator Channel on the Governor Vessel
Location: At the base of the skull, about one inch above the posterior hairline.
Functions: Benefits and clears the brain, calms spirit, opens the sensory orifices, dispels wind, wind-cold and wind-heat, smoothes joint functions.
Indications: Seizures, mania, hemiplegia, loss of speech due to stroke, delirium, suicidal behavior, fear and fright, anxiety, common cold, sensation of heaviness in the head, headache, dizziness, numbness of the limbs, deaf-mutism, blurred vision, sinusitis, stiff neck.

Governor Vessel 20
"One Hundred Meetings" - Bai Hui

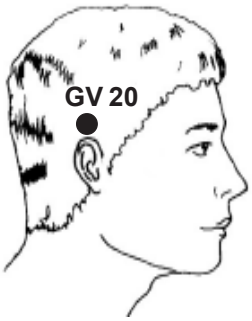

Sea of Marrow Point
Location: At the crown of the head, approximately on the midpoint of the line connecting the top apex of the two ears.
Function: Clears the senses, calms the spirit, extinguishes liver wind, stabilizes ascending yang.
Indications: Headache, dizziness, shock, depression, hypertension, insomnia, seizures, prolapsed anus, prolapsed uterus, mental dullness, hemorrhoids.

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Cosmic Chi Kung

Mantak Chia

Illustrated by Udon Jandee

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Cosmic Inner Smile

Smiling Heals the Body

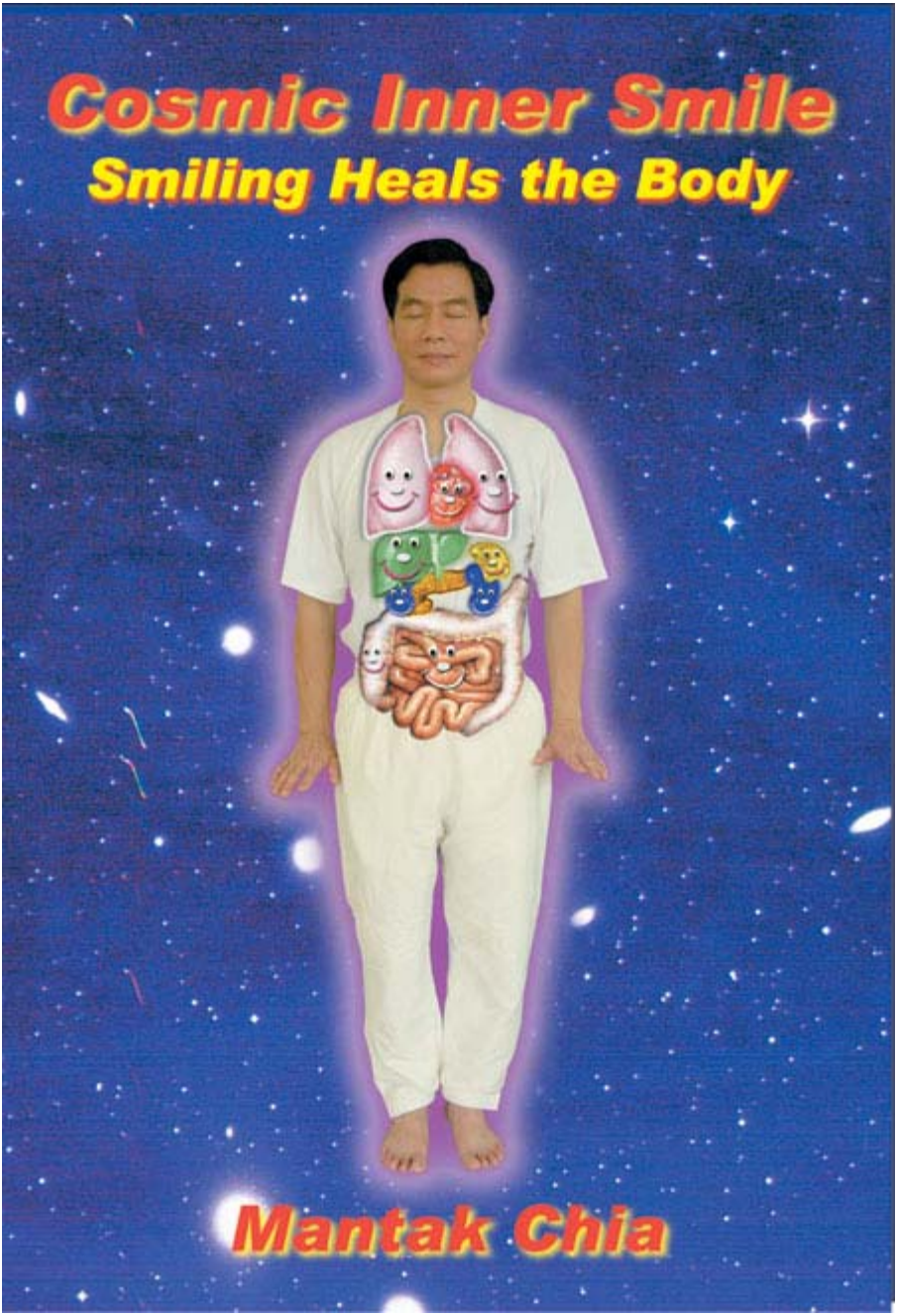

Mantak Chia

Cosmic Inner Smile

Smiling Heals the Body

Mantak Chia

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Virtues and Transforming Stress

“Heart of the Universal Tao Practices”

The quality of our internal energy is just as important to our health and spiritual development as the quantity. As we increase our internal energy flow and accumulate a surplus of Chi, we must emphasize spiritual development to maintain balance in our daily lives. In essence, our spiritual qualities are our positive attributes, or what the Taoist call “virtues”. Our virtues have the nature of wisdom and love. They are wise because they reflect our interdependence with the Tao, with nature, with all life, and with the different parts of our own body. We cannot exhibit the virtues except in relation to each other. The virtues are also wise since they express love: the attitude that strengthens the positive bonds connecting everything in the universe.

We need food to sustain our lives. Physically, we need material food, but we also must nourish other, subtler bodies within us. They are the soul and spirit bodies. The energy of our virtues, the universe, the stars, and planets provide a source of spiritual food. Although we are trained to depend on our religious beliefs to give us this nourishment, spiritual food is actually all around us. We need to learn how to absorb and digest this. The Universal Tao offers the means by which we can access these energies to cultivate the soul and spirit and to enhance our total being,

Taoism recognizes both the development of the virtues’ energies and the cultivation of life force to create the soul and spirit bodies as important aspects of spiritual growth. These approaches are related, because retaining and recycling internal energy into life force can help to open and still our minds/hearts, bringing forth inner joy, happiness, and love and other virtues.

When combined, these give birth to the subtler bodies of energy and spirit.

Taoists believe that we are born with the virtue qualities of love, gentleness, kindness, respect, honesty, fairness. justice, and righteousness.

When we are abundant with virtues, our life force flows smoothly and efficiently. If we neglect to cultivate the virtues, however, we run the risk of channeling our accumulated energies directly into our negative emotions, amplifying any negative or neurotic tendencies we may have.

Actually, there is nothing wrong with these negative emotions as long as we recognize them and known how to transform them, so they will not block the energy in the organs. It is necessary to find a balance and to learn to acknowledge the totality of ourselves, both the light and the dark sides.

Our society is known for its fast pace, its stressful conditions, and its inability to handle the tons of garbage it produces daily. This includes not only trash from our homes, but also the emotional garbage produced within our bodies. Under the influence of this stressful society, our virtues gradually diminish, and negative emotions such as anger, fear, worry, and impatience will arise. These weaken the virtues, gradually forcing people to survive on low-grade, negative energies. These symptoms manifest, at their extremes, as sickness, disease, social disorders, and violence.

To regain the virtues, we must first become aware of and transform our negative emotions into useful energy. Normally, these emotions are thrown out as garbage, polluting each other and society with useless energy. Like garbage, negative emotions can cause a great deal of damage to both our internal and external environment.

Just as we can transform garbage into compost and use it as fertilizer for our gardens, we can transform negative emotions, which will always come up, into the fertile ground to grow our positive virtues. If we don't compost, these emotions will have harmful effects on the internal organs and glands and may drain our life force, causing our bodies to function on less energy and at a lower vibration. Medical science acknowledges that the presence of negative emotions can wear down the body's resistance before any clinical evidence of disease exists.

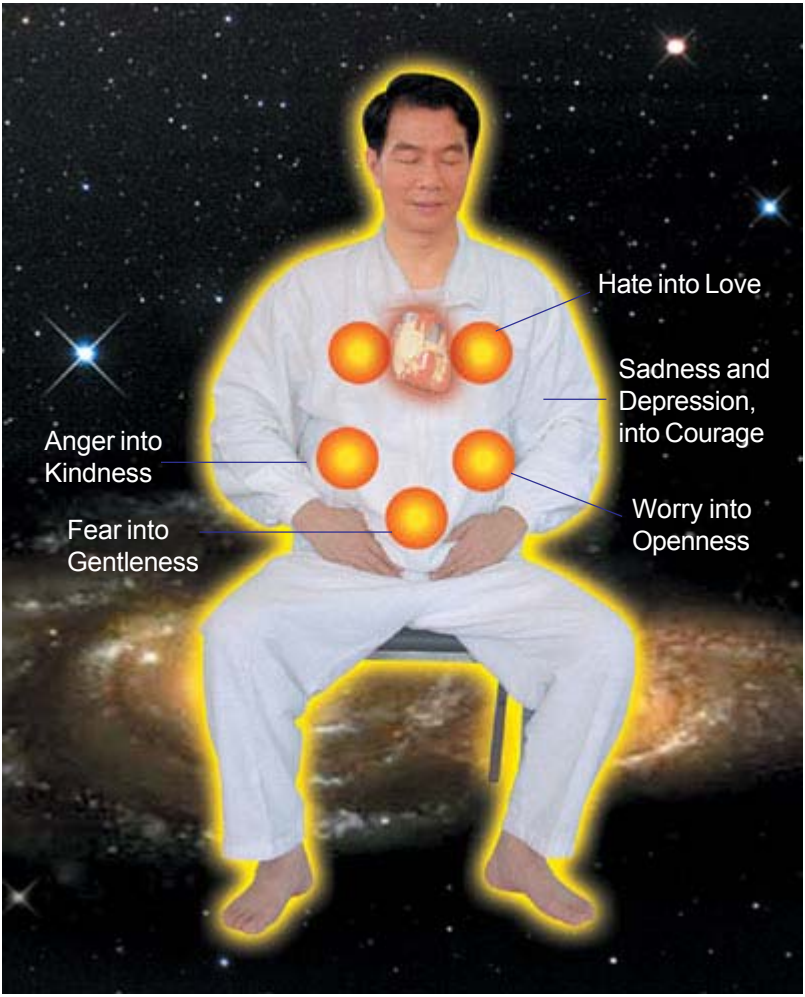

Fig. 1 *Transform Negative Energy into Positive Energy.*

Taoists believe that emotions originate from the organs. Once you can differentiate between and become aware of the different kinds of emotional energy that reside in the organs, you can deal with them more easily. You must observe what outside influences triggers their appearance. This means noticing, for example, how another person's negative emotion triggers anger or sadness in you. Once you have this awareness, you can transfer these emotions into positive life force for yourself. Don't permit them to accumulate in your organs as negative emotional energy to trouble you. By building up a lot of positive life force, you will be able to transform your own "garbage" energy better.

Fig. 2 *Connect the organs and their elements.*

Compassion is the fusion of all other virtues together into their purest expression. It is the highest virtue and the most beneficial energy to share with others. To attain compassion, one must first recycle negative emotional energies to restore and increase the life force. This, in turn, will nourish the positive energies of each organ so that each organ can produce its respective virtue in abundance. Excess virtue energy can be channeled for the benefit of other people. If one tries to practice compassion without transforming the negative emotions and reestablishing the virtue energies, there will be little to offer anyone.

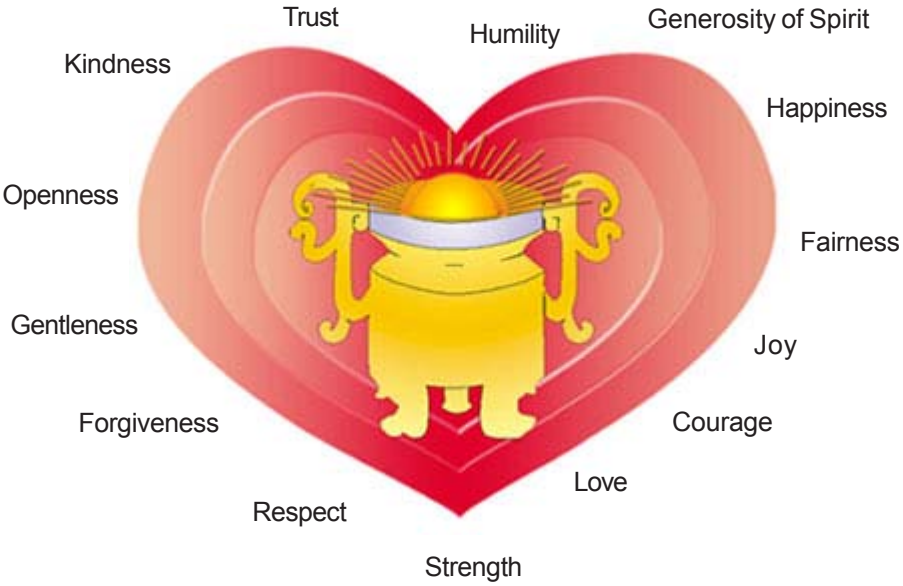

Fig. 3 *Cauldron of the Compassionate Heart*

Compassion is the highest expression of human emotion and virtuous energy. It is a level of development that takes hard work and serious meditation before it can blossom in one's life. It is not a single virtue, but the distillation and culmination of all virtues, expressed at any given moment as a blend of fairness, kindness, gentleness, honesty, respect, courage and love. It is the most beneficial energy to share with others. The power to express any or all of these virtues at the appropriate moment indicates that a person has internally unified him or herself into a state of compassion.

The heart is like a cauldron that can be used to combine all the virtues into the energy of compassion, the ultimate virtue and a necessary attribute for our spiritual being. The basis of compassion is empathy, not sympathy (a weakness people show when the emotions of others easily affect them). It elevates the consciousness beyond human weakness. With compassion, one can love unconditionally and thereby accept the world on its own terms without suffering.

When studying the virtues, we must examine love as a category in itself to better understand its energetic influences. The Taoists view love as an internal energy of the heart rather than as a product of the mind. Although we generally think of love as a positive force, what we commonly call love can actually evoke more negativity in our lives than all the other negative energies combined. For example, we know that extreme love can quickly turn to hate of the most bitter and violent kind.

Fig. 4 *Compassionate Heart*

The misunderstanding of love can also create a vehicle that allows our negative emotions to drain our life force away in the form of self-sacrifice. While our personal supply of energy is limited, the loving energy of the universe is inexhaustible. When we know how to connect to this wellspring, we will always have enough love for ourselves and for others. Yet, if we don't learn how to tap into the higher force to enhance and replenish our supply, we often end up giving away more than we can afford. Eventually this can cause us to drain out our sexual energy and burn out the love in our hearts. We expect love in a personal way from those who are close to us, and in a spiritual way from those who become our role models. Yet the words and actions of others almost never fulfill our needs. The question of what love is, has puzzled men and women for centuries. The answer can only be found within ourselves.

A major problem (in our modern world) is that we always look outside ourselves to fulfill our needs without realizing that others seek fulfillment in the same way. Out of habit, we all seek love externally without nurturing our own source of that energy within us. This leaves us with little to give. Logically, if others are also seeking love, they expect us to have enough loving energy to fulfill them. If we don't cultivate love within ourselves, however, we can drain their energies until the relationship comes to an end. Success in any relationship depends on the ability of all the parties to share in an abundance of love that originates from both sources. Once we are full of love and life force, we can connect to the unlimited loving energy in the universe and share it abundantly with others.

Taoists say we cannot really love others until we can love ourselves. The stress of giving away freely what we don't have enough of can create blockages in the Microcosmic Orbit and can also block the unconditional love from Heaven and Earth.

Because loving energy is accessible from within, we can resolve our primary need for love by using this energy first to replenish the internal organs and glands. Practices such as the Inner Smile help us achieve this.

While learning self-love, one should remember that even the loving energy within us derives from the Original Force of the Wu Chi. This means that the heart's energy (where the loving energy resides) provides a connection to our divine source: Universal Love. The connection between inner and outer sources requires constant attention and alignment. We first have to cultivate love within ourselves to have the power to draw in unconditional love from Heaven, and gentleness and kindness from Mother Earth.

In Taoism, it is believed that each organ has its own soul and spirit energy. By practicing love and respect to cultivate these aspects of the organs, the whole body improves and one learns to love the body as a whole. After learning self-love (which is not to be confused with egoism or narcissism) and connecting with the Universal love, one becomes filled with loving energy to share with others. Practice is the key.

The Universal Tao system emphasizes this recycling, transforming, and refining of internal and external Chi and of our emotional energy in particular.

With the practice of the Inner Smile, we learn to detoxify the organs and let the virtue energy grow again. Transforming our internal energy in this way will also promote a higher vibratory rate and enhance our spiritual growth.

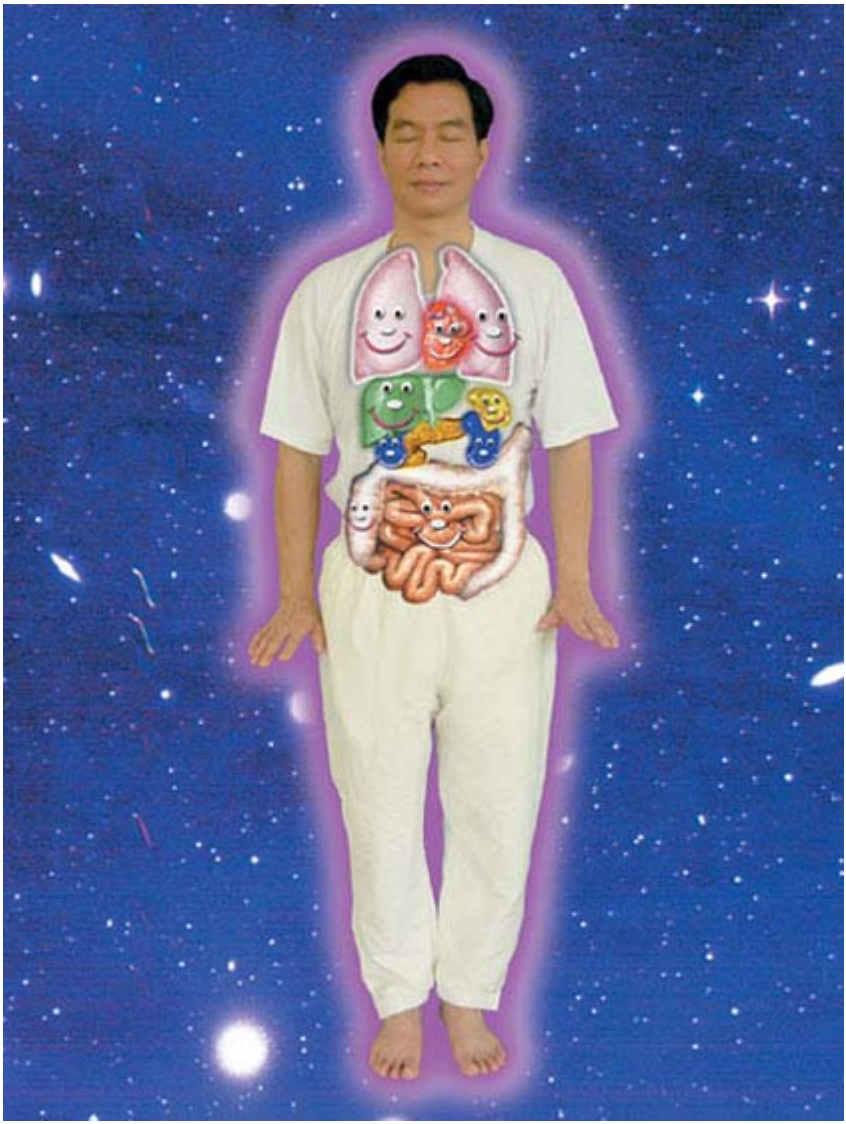

Fig. 5 *Cosmic Inner Smile*

Practice of the Inner Smile Meditation

The Inner Smile is a powerful internal healing and relaxation meditation. Deep relaxation dissolves physical and mental tensions that can cause energy blockages and unhealthy Chi. The Inner Smile enhances the energy of the organs and glands, our life force in general, and stills and focuses the heart/mind (hsien). It makes us more aware of our body and inner being, because we learn to communicate with our organs, glands, spine and other specific parts of our body, as well as our soul. Taoists discovered that consciousness is rooted not only in the brain alone, but also in the vital organs and in the more subtle sense in each of the cells.

By smiling to the organs and thanking them for the work they do, eventually we will reawaken the intelligence of the body. We are often so out of touch with our bodies and emotions that we do not notice inner disharmony developing until it finally manifests itself as a serious illness. Practicing the Inner Smile daily provides a regular scheduled time to look inside, to keep in touch with the state of our inner organs, our Chi, our breath and emotions. We can then spot problems at their inception, making it easier to 'nip them in the bud'.

Low self-esteem is becoming endemic. With the Inner Smile, we start to develop a healthy, loving relationship with ourselves and with others. We start to recognize our own positive qualities. With regular practice, we get to know ourselves as we really are; we will discover our virtues. This will help us form a more authentic and healthier self-image, one that can stay in close contact with reality. The Inner Smile trains our ability to love and relax our own body and soul. If we learn to love and accept ourselves the way we are, it becomes easier and more natural for us to extend this love outward and to love and accept other people as well.

The Inner Smile is indispensable for our rooting practice of Iron Shirt Chi Kung and Tai Chi Chi Kung. If we have a lot of negative emotions, the energy will rise to the upper part of the body and our center of gravity will move up as well and disconnect us from the earth. We will feel unstable, out of balance, and moody. The Inner Smile practice (and the Six Healing Sounds) transforms our negative emotions and relaxes the body and the mind. This deep relaxation will bring the center of gravity back to our Tan Tien, where we can develop our inner power which will keep us centered, rooted, and stable in our practice and in daily life.

Always start the Inner Smile with the rocking exercise. Rock your spine from your sitting bones and sacrum to the sides. Smile into the spine and rock each vertebra, from the base of the spine all the way up to the skull. Feel the spine relaxed and warm, glowing with a golden light.

Next rock your spine back and forth, slightly nodding your head. Picture yourself as a hollow piece of bamboo. (When you nod your head your head has a connection with the lumbar area).

After you finish the rocking, smile down from the top of the spine all the way down to the bottom and then from the bottom all the way up again.

Rocking the spine and smiling into the spine is a very important practice because it relaxes the spine and the nervous system. People who want lo calm down, must first relax the spine. When the spine is tense and stiff, there is no way to calm down.

1. The well-known “Three Lines Inner Smile”, which you will find in the books *Taoist Way to Transform Stress into Vitality* and *in Awaken Universal Light.*

2. The “Energizing Inner Smile”.

3. The Inner Smile that emphasizes relaxation, balancing the emotions and transform them into compassion energy.

The second and third versions of the Inner Smile both use the creation cycle of the five energy phases, corresponding with the five vital organs.

Three Lines Inner Smile

A. Smiling Down to the Organs: the Front Line

1. **Mideyebrow point and eyes**: Relax your forehead, and be aware of smiling energy gathering before your eyes as golden light. Imagine the feelings you would have upon entering a beautiful garden. As you hold that feeling, project an image of your own smiling face in front of you. Feel that smiling energy shining like the sun. Spiral this radiant energy at the point between your eyebrows, drawing it in through that point and through your closed eyes to stimulate the pituitary gland.

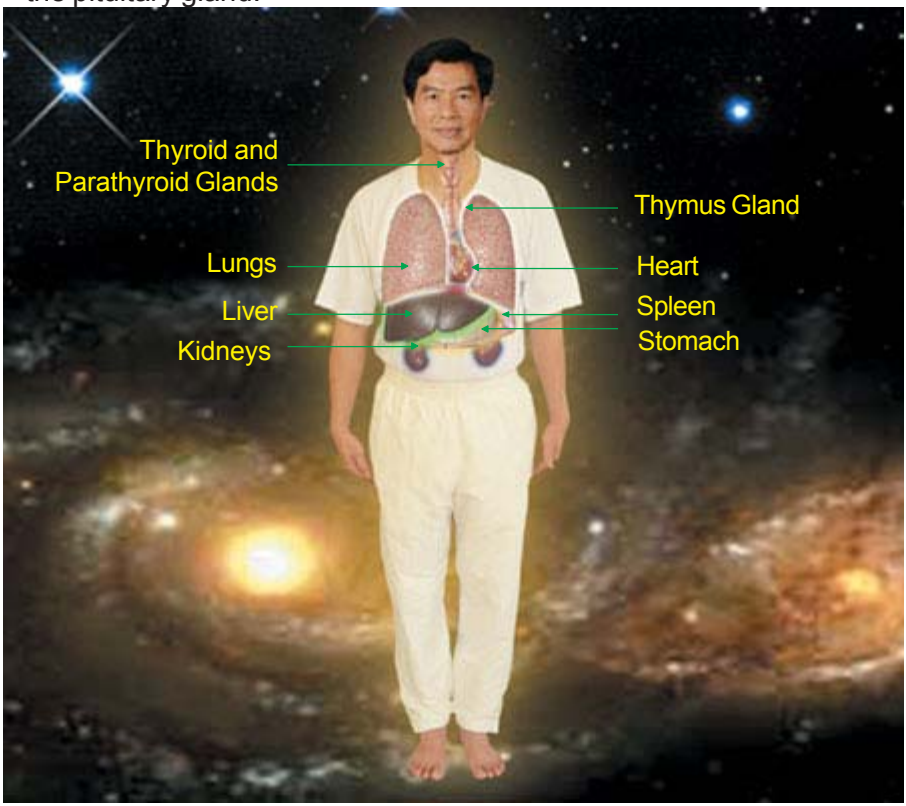

Fig. 6 *Smiling Down the Front Line.*

2. **Face**: Continue to draw smiling energy into the mideyebrow point; feel the mideye expanding. Let the Chi flow into your nose and cheeks. Feel it relaxes your skin and muscles and warms your entire face. Let the smile flow into your mouth, gently lifting its outer corners. Feel the smiling energy flow into the tongue, and move the tongue around to activate the flow of saliva. When you feel the saliva is abundant, swallow it. Touch the tongue to the roof of the mouth, and leave it there for the rest of the practice (this action connects the Governor and Functional channels, which are the two major energy pathways of the body). Swallow the saliva down toward the thymus and the heart, drawing the energy further downwards. Feel the smiling energy flow into the jaws, releasing any tension there. Slightly open your mouth to separate the teeth while pressing the tongue against the palate.

3. **Neck and throat**: Smile down into your neck and throat, allowing your neck to sink down slightly to rest from holding your head. Smile into the thyroid and parathyroid glands, located in the front part of the neck. Feel the throat open like a flower blossoming as the energy releases any tension.

4. **Throat and sternum**: When a lot of saliva is produced, swallow it down toward the organs you are smiling at. Let the smiling energy flow into your thymus gland, located between the throat and sternum. Feel it expand as it radiates the warm, fragrant, smiling energy down into the heart

5. **Heart**: The heart is approximately the size of a fist and is located behind the sternum, slightly left of the center. Smile to your heart and thank it for circulating blood throughout your body. Feel it relax as its workload becomes lighter. Let the smiling energy fill your heart with love as impatience and hastiness are transformed into joy and respect. Love, joy, respect, and ultimately compassion all arise from the heart. Feel these virtues radiate to the organs, glands, and the entire body.

6. **Lungs**: Smile into every cell of your lungs as you thank them for supplying oxygen to the body and releasing carbon dioxide. Feel them soften and become more spongy and moist as they expand

with smiling energy. Feel the virtues of the heart (love and joy) enhance the smiling energy in the lungs as it transforms any sadness and depression into righteousness and courage.

7. **Liver**: Smile into your liver, which is located on the bottom right side of the rib cage. Thank the liver for its role in digesting, processing, storing, and releasing nutrients, and in removing any toxic substances. Feel it soften and increase its moisture. Let the smiling energy, enhanced by the virtues of the heart and lungs (love, joy, righteousness, courage) transform any anger held by the liver into kindness.

8. **Pancreas and spleen**: Smile into your pancreas at the bottom left side of the rib cage. Thank it for producing insulin to regulate your blood sugar level and enzymes for digestion. Smile into your spleen, located behind the pancreas at the same level on the left side. Thank it for producing antibodies to fight diseases. As you smile into your spleen and pancreas, feel any worries they hold become transformed into fairness by the smiling energy enhanced by the virtues of the heart, lungs, and liver.

9. **Kidneys**: Bring the smiling energy into your kidneys, located at the lower back on both sides of the spine, inside the lower part of your rib cage. Thank them for filtering the blood, eliminating waste products, and maintaining the water balance in the body. Feel them grow cooler, fresher, and cleaner. Smile into your adrenal glands, on top of your kidneys; these produce adrenaline and several other hormones. Feel any fears become transformed into the virtue of gentleness by the smiling energy and all of the other virtues collected thus far.

10. **Genitals**: Bring the smiling energy down to the genital area in the lower abdomen. Women: The female genitals are known as the “Ovarian Palace,” and it is located about three inches below the navel, midway between the ovaries. Smile and spiral the accumulated energies into the ovaries, the uterus, and the vagina. Thank the ovaries for making hormones and giving you sexual energy. Bring the combined sexual, smiling, and virtue energies up to the navel, and spiral at that point.

Men: The male genital area is known as the “Sperm Palace.” and it is located one and a half inches above the base of the penis in the area of the prostate gland and seminal vesicles. Smile and spiral the accumulated energies down to the prostate gland and the testicles.

Thank them for making hormones and giving you sexual energy. Bring the combined sexual, smiling, and virtue energies up to the navel, and spiral at that point.

Note: When returning energies to the navel for storage, mentally create a spiraling motion to centralize and keep them there. The vortex created draws in energy like a vacuum.

11. **Eyes**: Return your attention to your eyes. Quickly smile down into the organs in the front line, checking each for any remaining tension. Smile into any tension until it is released.

B. Smiling Down the Digestive Tract: the Middle Line

1. **Stomach**: Once again become aware of the smiling energy in your eyes and the mideyebrow, and allow this energy to flow down into your mouth. Become aware of your tongue, and swish it around to produce saliva. Place your tongue against the roof of your mouth, tighten the neck muscles, and swallow the saliva hard and fast, making a gulping sound. With your Inner Smile, follow the saliva down the esophagus to the stomach, located below the left side of the rib cage.Thank the stomach for digesting your food, and feel it relax as the energy flows into it.

2. **Small intestine**: Smile into the small intestine in the middle of the upper abdomen. Thank it for absorbing nutrients.

3. **Large intestine**: Smile into the large intestine, which encircles the small intestine from above and on both sides, and the rectum. Thank the large intestine for eliminating wastes.

4. **Bladder and urethra**: Bring the smiling energy back up into the bladder, just behind the pubic bone, and into the urethra. Thank these organs for holding and releasing urine.

5. **Eyes**: Return your attention to your eyes. Quickly smile down the middle, checking each area for any remaining tension. Smile into the tension until it melts away.

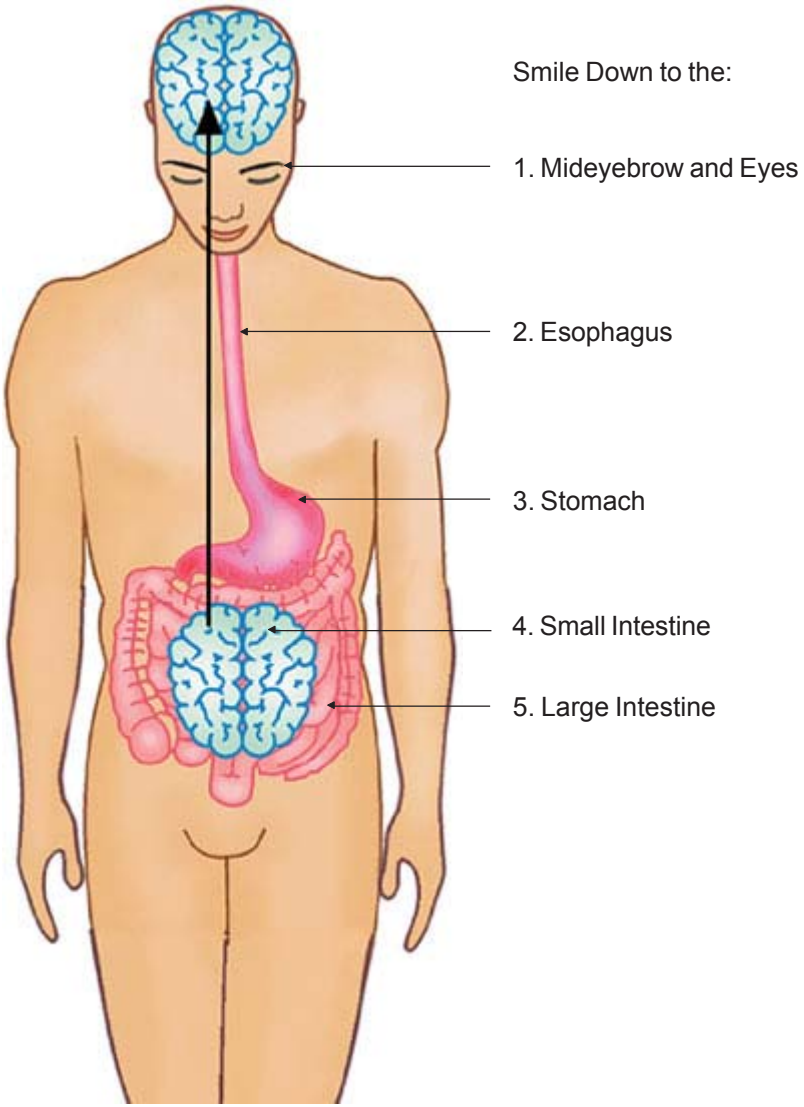

Fig. 7 *Smile Down Middle Line, the Digestive Tract.*

C. Smiling Down the Spine: the Back Line

1. **Eyes**: Bring your attention back to your eyes again and draw more energy into them and the mideyebrow.

2. **Glands in the brain**: Activate the saliva, and swallow as you push the tongue upwards, directing the energy flow into the brain. Draw smiling energy in through the eyes and mideyebrow.

Smile into the pituitary gland, three or four inches behind the mideyebrow. Feel it blossom. Smile into the thalamus gland, which is located directly above the spinal cord, slightly behind and above the pituitary gland and the hypothalamus, which is located in the bottom of the third ventricle room. Smile into the pineal gland under the crown point. Feel these glands swell and grow. Smile into the left and the right hemispheres of the brain to balance and nourish them.

3. **Spinal Column**: Smile into the midbrain and cerebellum and the first cervical vertebra at the base of the skull. Bring the loving energy down through all of the vertebrae to the base of the spine. (Vertebrae: seven cervical, twelve thoracic, five lumbar; base of the spine: sacrum, and coccyx).The disks beneath each vertebra soften as the spine expands and elongates. Your back should feel loose and comfortable.

4. **Back Line**: Return your attention to your eyes, and quickly smile down the entire back line. This exercise greatly increases the flow of spinal fluid and calms the nervous system. Your whole body should feel relaxed.

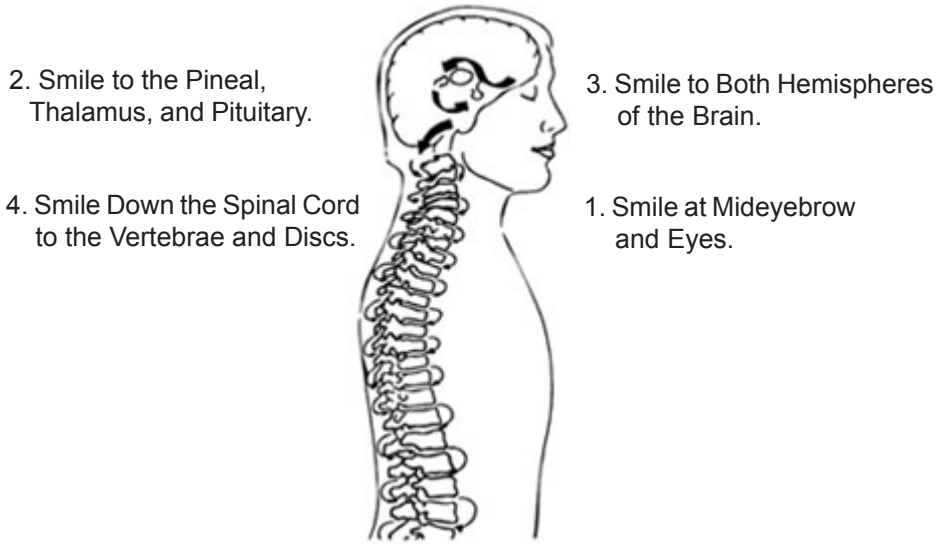

Fig. 8 *Smile Down the Back Line.*

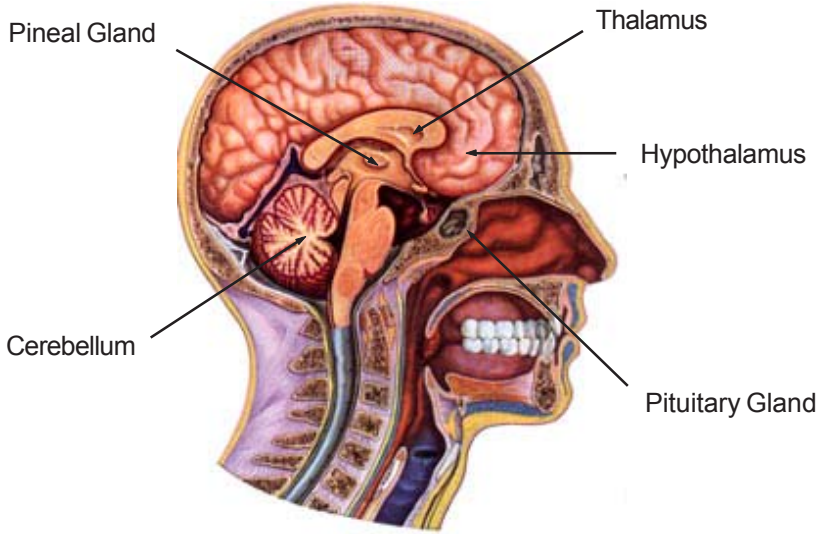

Fig. 9 *Smile into Brain.*

D. Smiling Down the Length of the Entire Body

Entire body: Start at the eyes again, and direct the Inner Smile quickly down the front, middle, and back lines. If you are experienced with this practice, smile down all three lines simultaneously while remaining aware of the organs and spine. Feel the energy descend the entire length of your body like a waterfall of love and peace. Feel the muscles, skin and bones relax as your whole body unwinds.

E. Collecting and Storing Energy at the Navel

To end the practice, it is very important to store the accumulated energies at the navel. Too much Chi remaining in the head or heart causes most of the ill effects of meditation. Drawing this energy into the navel for safe storage can prevent such problems. To collect the energy concentrate on your navel area about one and a half inches inside your body. Then mentally spiral the energy, moving further outwards with each spiral until you complete 36 cycles. Do not go above the diaphragm or below the pubic bone as you expand outward (At first, you may guide the spirals with your forefinger). Finally, spiral back into the navel for 24 cycles.

Men: Cover the navel with both palms left over right. Start spiraling down toward the right side (clockwise) 36 times.

Women: Cover the navel with both palms, right over left. Start spiraling down toward the left side (counterclockwise) 36 times.

Men and Women: Next, reverse directions, and spiral back into the navel 24 times (Men spiral counterclockwise; women spiral clockwise). Move closer to the navel with each cycle. You have now completed the Inner Smile and should feel an increase in your Chi flow.

Energizing Inner Smile

We start to smile into the bladder, the uterus, the ovaries, the testicles and the prostate gland, because it creates a lot of energy.

Slightly rock yourself.

Smile into the bladder, the uterus and the ovaries, the prostate gland and the testicles. Picture these organs and connect with them. Feel they are connected with the brain and that their energy rises up through the spine to nourish the brain. Picture a big blue ocean and a fire under this ocean. See a beautiful blue light evaporate from the ocean.

Smile to the kidneys. Smile this blue light in the bladder, uterus/ovaries, or prostate and testicles, and the kidneys, bringing stillness into the kidneys. Feel these organs expanding with blue light. Let this blue light, with its gentleness and calmness, extend into the whole body, especially into the liver. Feel it energize the liver.

Smile into the liver. Picture your liver and connect with it. See the sun shine in the forest. See the green light. Smile this green Universal light and kindness into the liver. Feel the liver expanding with the green light. Let it radiate out to all the organs, especially to the heart. Feel the green light energizing the heart.

Smile into the heart. Picture the heart and connect with it. Be aware of the red light, a sunset on the ocean producing a red light. Smile this red light into the heart with love, patience, and inner joy. Feel the heart expanding with red light and love. Let it radiate out from the heart into the whole body, especially into the stomach,spleen. and pancreas. Feel the red light energizing these organs.

Smile into the stomach, spleen, and pancreas. Picture and connect with them. See the beautiful filtered rays of sunshine of Indian Summer full of balance and harmony, a golden light. Smile this golden light into the stomach, spleen, and pancreas. Feel calm, serene, and centered. Let this golden light radiate out into the whole body, especially into the lungs. Feel the golden yellow light energizing the lungs.

Fig. 10 *Collect the Energy by Spiraling.*

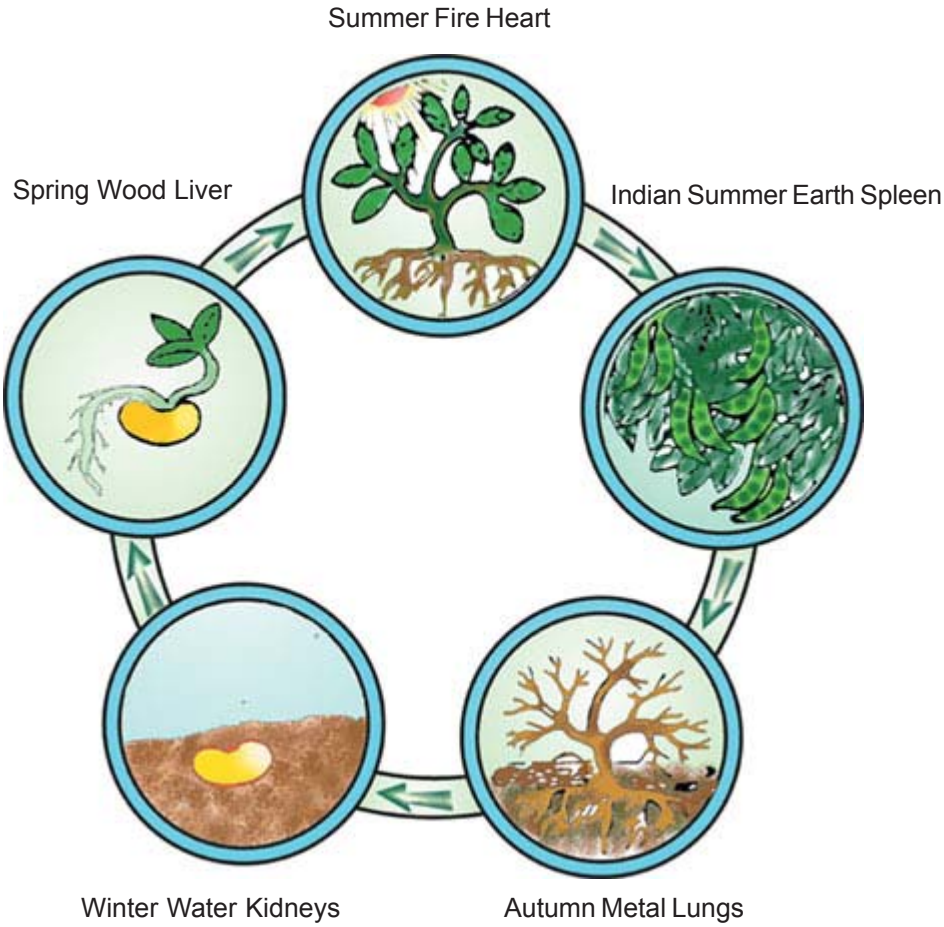

Fig. 11 *Creation Cycle*

Smile into the lungs. Picture and connect with them. See and smell the fresh, pure white light of the high mountains. Smile this light into the lungs, the nose, the skin, and the large intestines. Let it radiate out into the whole body, especially into the kidneys.

Do two more rounds of this cycle of the Inner Smile. Then gather the smiling energy in the bladder, the uterus or the prostate gland and let this energy rise through the spine to the brain. Hold the energy there. Feel how this smiling energy energizes the brain, the spine, the nerves, and all the organs and glands and that the muscles are connected with these nerves. Rest. Concentrate on the energy in the brain and the spine. Feel the energy in the brain and the awareness expanding.

Inner Smile that Relaxes and Balances the Emotions

We generally start with the heart, because the heart creates a lot of strong emotions, especially love and hate. When you start to smile to the heart, sometimes hate or impatience will come up. If you can continue to smile to the heart you will feel that the inner joy, love and happiness will start to grow in your heart very easily. If people cannot feel love, inner joy, and happiness, nothing will be able to make them feel happy.

There is nothing wrong with negative emotions, as long as you recognize them and know how to transform them. This will prevent the energy sticking in the organs. You have to find a balance.

Emotions like hate, anger, impatience, fear will always come up. You have to watch, be aware of them and work with them constantly so that they will not grow too much and start to block the energy in the organs and other parts of the body.

When you continue with the Inner Smile, the Six Healing Sounds and the growth of the virtue energy/pure light in the organs, eventually no more space will be left for these negative energies (emotions) to grow in the organs.

Rock yourself gently, especially your spine.

Practice

Smile into your heart. Feel the love, inner joy, and happiness in your heart and expand this love and happiness into the universe and let it multiply. Continue expanding unconditional love, inner joy, and happiness from the heart into the universe and feel that it is coming back multiplied, into the heart with the red light. Let the light from the heart shine into every single organ of the body like sunshine. If any hate comes up keep on smiling and sending love and happiness to this feeling of hate and eventually it will change into loving, happy energy as well.

Smile down to the stomach, the spleen, and pancreas. See any worry inside them. Inhale the yellow golden light, the feeling of openness, fairness of the earth power, harmony, and centeredness. Accept your worries, balancing them with the virtues of openness, fairness, and centeredness.

Smile to the lungs. See any sadness inside them. Inhale the pure, white light, the courage of the metal power. Accept the sadness, and balance it with courage.

Smile down to the kidneys and the bladder. See any fear inside them. Let the sun shine on the ocean, a blue light. Inhale this blue light and the gentleness and stillness of the water power. Accept the fear. and balance it with this gentleness and stillness.

Smile into the liver. See any anger, resentment, and frustration in the liver. Let the sun shine on the forest producing a green light. Inhale this green light and the kindness and generosity of the wood power. Accept the anger, and balance it with kindness and generosity.

Do two more rounds of this Inner Smile, relaxing and balancing the emotions and eventually transforming the “negative emotions” into virtue energy.

Inner Smile Applications

Here are some examples of how the Inner Smile supports other practices in the Universal Tao System's series of self-healing techniques.

Tao Yin

The Lotus Meditation is wonderfully calming but is complete only with the interior 'posture' or interior attitude cultivated by daily use of the Cosmic Inner Smile.

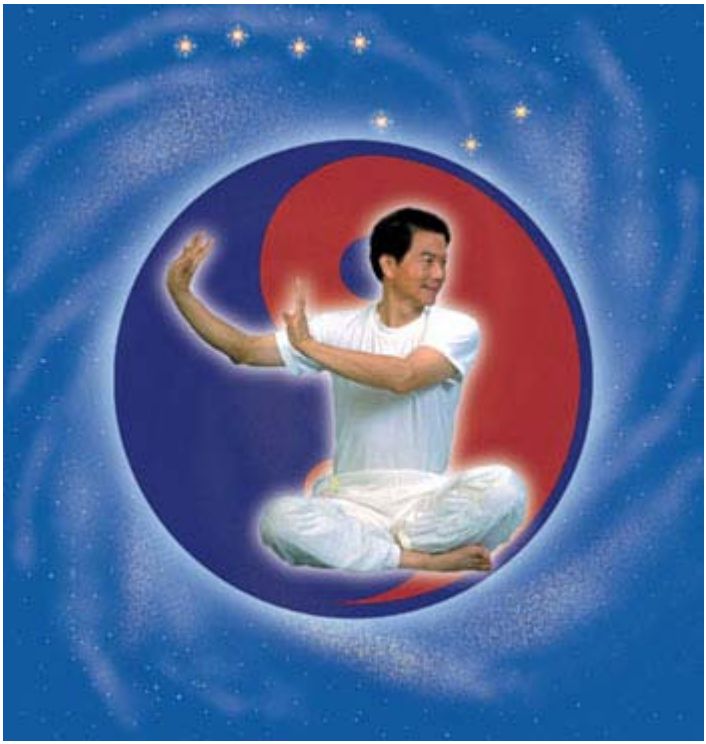

Fig. 12 *The Inner Smile helps the Dragon Stretch his Tail and Claws in Tao Yin.*

The Lotus Meditation is especially applicable to the Tao Yin movements. Because of the emphasis on working with the whole spine and the powerful psoas muscles the practitioner sends grateful attention from the heart down the spine to the kidneys.

The Lotus meditation can be used during Tao Yin practice, and is especially useful during the rest periods between the movements. You can use the Lotus Meditation in any rest period. Choose the places that best suit you.

This meditation helps to achieve the balance of kidney and heart energy which is a vital part of self-healing. The balanced flow of water and fire energy will greatly help to transform the accumulated stress in the mind and body into a sense of well-being.

Here's the Lotus Meditation for your deep enjoyment.

Lotus Meditation

Imagine the heart as a red lotus flower and the pericardium (the heat-regulating membrane which encloses the heart) as the lotus pads. Visualize the kidneys as being bulbs, similar to the clusters or plexuses where the stems of the pads and the lotus flower join together. In a pond or pool there are usually several lotus plants that join together in a cluster, anchoring in the mud. From the kidneys (kidney bulbs/clusters), visualize roots extending down through the legs into the watery mud of the earth basin.

Through this merging of the body and the lotus in nature, sense these qualities of energy in your body. Feel the supporting connection with the same qualities of red and golden energy coming to us from the sun and the universe above, as well as that of the blue water energy coming from the earth and nature. Feel the warm red energy of the heart and the red and yellow/gold from above. Likewise, sense the cool, blue water energy of the kidneys and the refreshing blue water energy from the earth. Smile even more and relax the mideyebrow.

Fig. 13 *The Inner Smile is like the Sun, Rain and Earth for the Lotus Flower.*

Lotus Energy Meditation

1. **Breathe to the Tan Tien, and consider the lovely blooming lotus:** You can see the open flower, seeing it as red with yellow/gold petals in the center. Smile with appreciation.

2. **Look at the pads, stem and roots:** The leaves float on the water's surface. See the stem as it descends from the bloom to the roots mired in the mud. Feel the roots sinking into the bed of the pond. The roots receive just the correct amount of nutrition from the wet earth.

3. **Sense the harmony of fire and water:** The pads and flower open to the sun and universe to soak up the life-sustaining rays. The sun is the source of fire energy. The earth holds the necessary water. Smile and appreciate this life-giving harmony of the forces of fire and water, yang and yin, male and female.

4. **Connect images with your heart and kidneys:** As you continue with the Tan Tien breath, expanding and contracting, look inside to your heart and kidneys. The kidneys are the roots accessing water. The heart is the open lotus taking in the sun's fiery gift. The spine is the healthy and supple stem connecting the two energies.

5. **Inhale to the heart and exhale to the kidneys:** Coordinate the Tan Tien breathing: Inhale into the heart, drawing the warmth from the sun, feeling it come down through the crown of the head and blend it with the love, joy and happiness in the red heart/lotus. Draw this loving, hot heart energy back to the point opposite the heart center on the spine (the wing point between the scapulas, between T5 & T6) as you slowly inhale. Then exhale the hot energy down the lotus stem/spine to the cool kidneys, warming them with the loving heat from the heart. You may enhance the

emotional balancing effect by subvocally exhaling with the heart sound, Haaaaaw, as you mentally direct the heart energy down the spine.

6. **Alternating, inhale into the kidneys and exhale up to the heart:** See the kidneys as the nourishing bulbs of the lotus with roots that extend down through the legs and soles of the feet into the mud, accessing the soothing blue water energy held by the earth. As you inhale to the kidneys, feel that the roots are drawing the cool, soothing, nourishing blue water energy up through the soles of the feet, up through the legs to the kidneys. In the kidneys, feel the gentle calm, peaceful feeling blending with the cool, soothing blue water energy that has percolated up through the legs. As you exhale, you may subvocally express the kidney sound, Chooooo, and send this soothing boost of gentle, cooling wet blue kidney energy up through the supple stem/spine via the wing point to the grateful, happy heart.

7. **Continue alternating the breath this way for a few times:** Red light from the crown into the heart and down to the kidneys; blue light from the bubbling springs into the kidneys and up to the heart.

8. **Then, just relax and don't bother about the breath:** Simply move the smiling mind back and forth between the heart and kidneys along the connecting spinal stem. The balancing will automatically occur. Smile to the lotus perfection and beauty. Smile with gratitude to your kidneys, spine and heart. The lotus meditation is very calming, and naturally, the more it is used, the easier it is to realize this inner calm.

Chi Nei Tsang

The “secret technique” of Chi Nei Tsang = healing from the heart. The heart guides the Chi Nei Tsang practitioner and student in the CNT healing session. The heart’s respectful and loving power is activated by the Inner Smile and this environment allows healing to flourish.

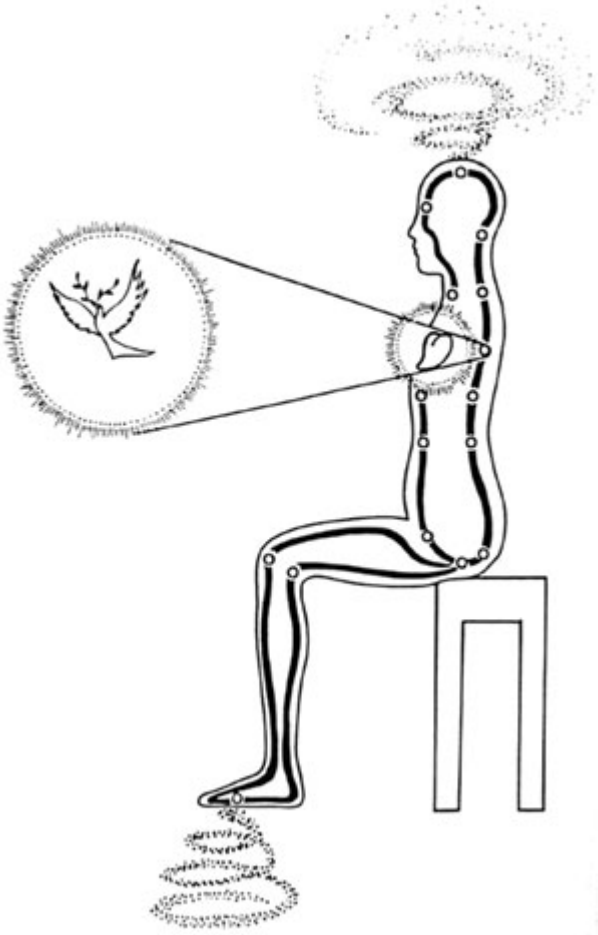

Fig. 14 *Healing with Love from the Heart.*

Inner Alchemy

The Fusions lead to Kan and Li.

Fig. 15 *Inner Alchemy begins and ends with the Inner Smile.*

Iron Shirt Chi Kung

Fig. 16 *The vital Iron Shirt Chi Kung postures and Tan Tien Breath would be empty without the Cosmic Inner Smile.*

Tai Chi Chi Kung

Everyone admires the grace and power of a round of Tai Chi. Integrating the Inner Smile into Tai Chi complements the the inner grace of breath and movement. By smiling into the Tan Tien Chi, the Ying and Yang wholeness of Tai Chi is even more “round”.

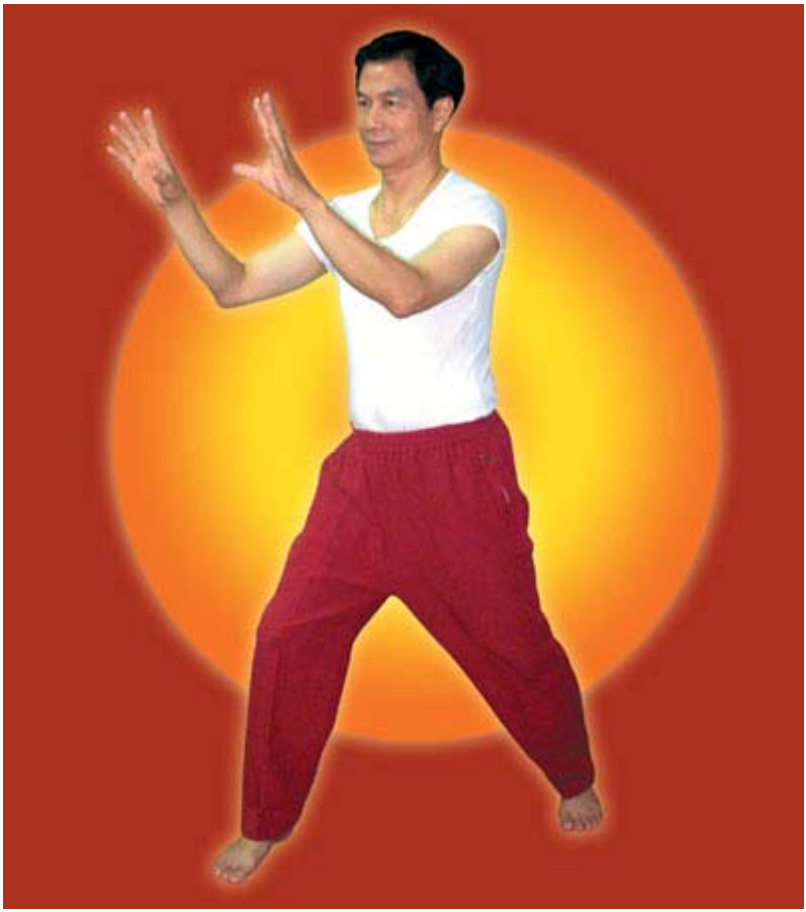

Fig. 17 *The Inner Smile moves the Chi Harmoniously.*

Elixir Chi Kung
Creating the Golden Earth Pill

Fig. 18 *The Alchemy of Creating the Elixir is Enriched with the Cosmic Inner Smile.*

Healing Love

Many practitioners are attracted to the Universal Tao's Healing Love single and dual cultivation. We are sexual beings and must manage sperm and egg energy in a healthy and respectful manner for the growth of our body, mind and spirit.

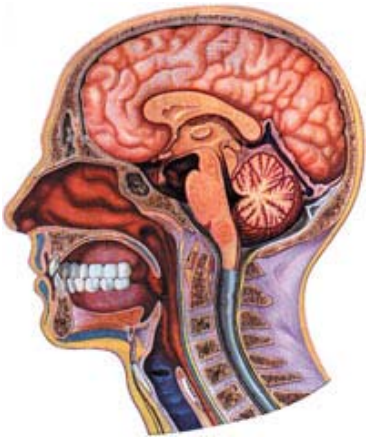

Fig. 19 *The Center of the Brain connects to the Sexual Organs.*

The pituitary, recognized as the “master gland” and the pineal, known as the “spiritual gland” are profoundly and positively influenced by the Inner Smile. They function in concert with the sexual glands during loving sexual arousal. This glandular cooperation blends what are perhaps the strongest human energies: love and orgasm. The Cosmic Inner Smile fortifies this mixture. When the couple makes love they smile at their own organs and at their partner’s organs with sincere gratitude. The sexual energy multiplies this loving appreciation and in this loving cooperation Healing Love is present.

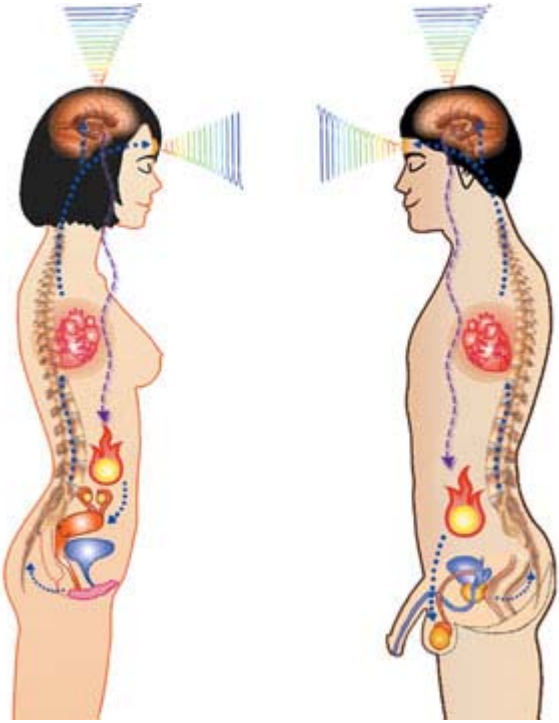

Fig. 20 *Why are this woman and this man “inner smiling”? Because of their loving energy and their orgasmic energy.*

Daily Practice

Practice the Inner Smile when you wake up. It will improve your whole day. If you love your body, you will be more loving to others and more effective in your work. After you have learned the practice, it takes five to ten minutes to smile down your entire body. Try to maintain the sensation of the Inner Smile throughout the day. Keep reminding yourself of the feeling because it is one of the best stress reducers in the world.

Smiling Aura Field: Form of Protection

There are subtle energies or "psychic forces" around us that affect our lives. Although unseen by the majority of people, these forces extend a primary influence on our health and well-being.

Negative psychic energies from others can create stress and cause illness. When a person has strong emotions toward you, the psychological energy associated with those thoughts and feelings can disturb your energies, jeopardizing your health. The "Smiling Aura" is a beautiful emanation of our highest energetic frequencies that protects us from the negative vibrations of others. The Inner Smile Practice enhances this Smiling Aura. By remaining conscious of the smiling energy, especially in the mideyebrow, face, and navel areas, you can intensify the Smiling Aura Field around your body. This will help you to keep out negative vibrations which other people create unknowingly. The Smiling Aura Field can also help you transform your own negative energies into positive life force. For instance, if you feel anger, the smiling energy you maintain gives you the ability to smile into that emotion until it dissipates and transforms into kindness. With practice, you can use this force to transform hatred into love; sadness into courage; and fear into gentleness. After a while, the process becomes automatic.

Fig. 21 *Smiling to the Aura Field.*

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$6.95

Cosmic Inner Smile

Smiling Heals the Body

Mantak Chia

Illustrations by Udon Jandee

Cosmic Inner Smile

The Inner Smile is a powerful internal healing and relaxation meditation. Deep relaxation dissolves physical and mental tensions that can cause energy blockages and unhealthy Chi. The Inner Smile enhances the energy of the organs and glands, our life force in general, and stills and focuses the heart and mind (hsien). It makes us more aware of our body and inner being, because we learn to communicate with our organs, glands, spine and other specific parts of our body, as well as our soul. Taoists discovered that consciousness is rooted not only in the brain, but also in the vital organs and in a more subtle sense, in each of the cells.

Smiling to the organs and thanking them for the work they do will reawaken the intelligence of the body. We are often so out of touch with the body and emotions that we do not notice inner disharmony developing until it finally manifests itself as a serious illness.

Practicing the Inner Smile daily lets us look inside to keep in touch with the state of our inner organs, our Chi, our breath and emotions. We can spot problems at their inception, making it easier to balance the emotions and virtues.

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Healing Hand

Humans can build all kinds of sophisticated instruments because of the magnificence of the hands and the fingers. Another higher function of the hands is the power of healing. Knowing the major points of the hands and fingers will enable you to stimulate and maintain the organs in good function.

Palms

The palms are where all major energies of Chi join. The palm can be the place from which the life-force is sent out to heal others or yourself. The palm also is the place where energy can be received and enter into the bone structure and into the major organs.

Pericardium

The pericardium (P-8) is the main place of energy concentration. You can collect the energy in this point and transmit stronger energy from this point.

Large Intestine

The large intestine (LI-4) is the major point which controls all the pain in the body, especially in the sense organs (eyes, ears, nose) and headaches.

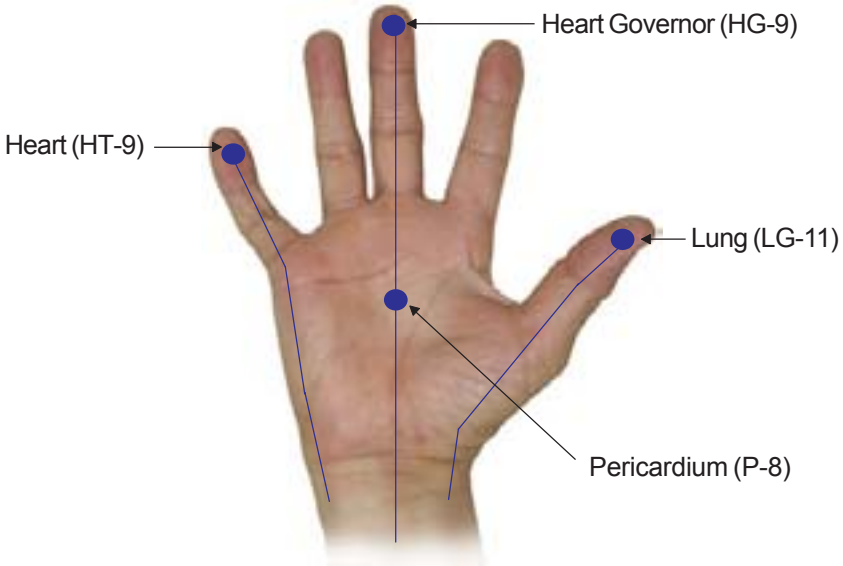

Fig. 1 *Pericardium*

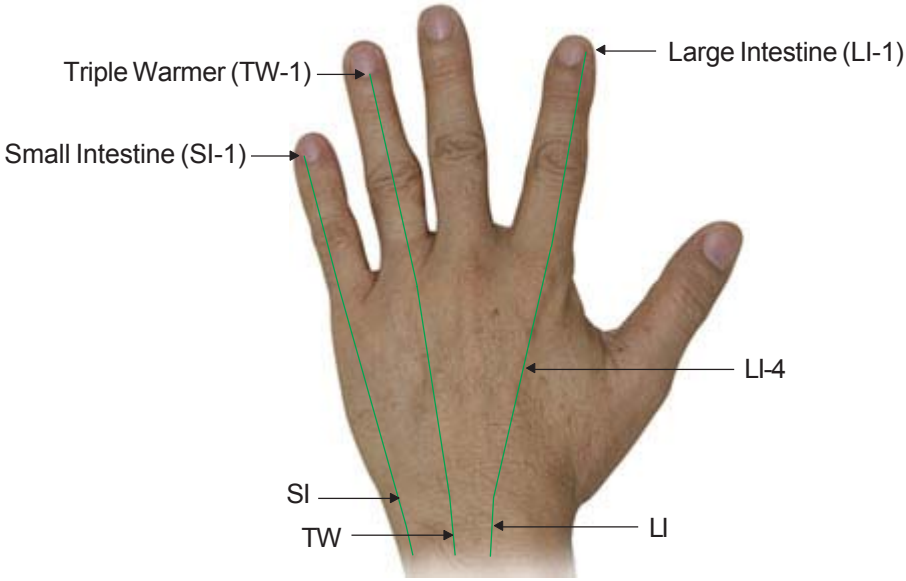

Fig. 2 *Large Intestine*

Major Palm Lines

The three major palm lines are the Life Line, the Line of Intellect and the Line of Emotion.

Fingers have Corresponding Bodily Functions

The fingers are connected to the organs' meridians. The joints of the finger bones are also related to parts of the organs and their corresponding senses and emotions.

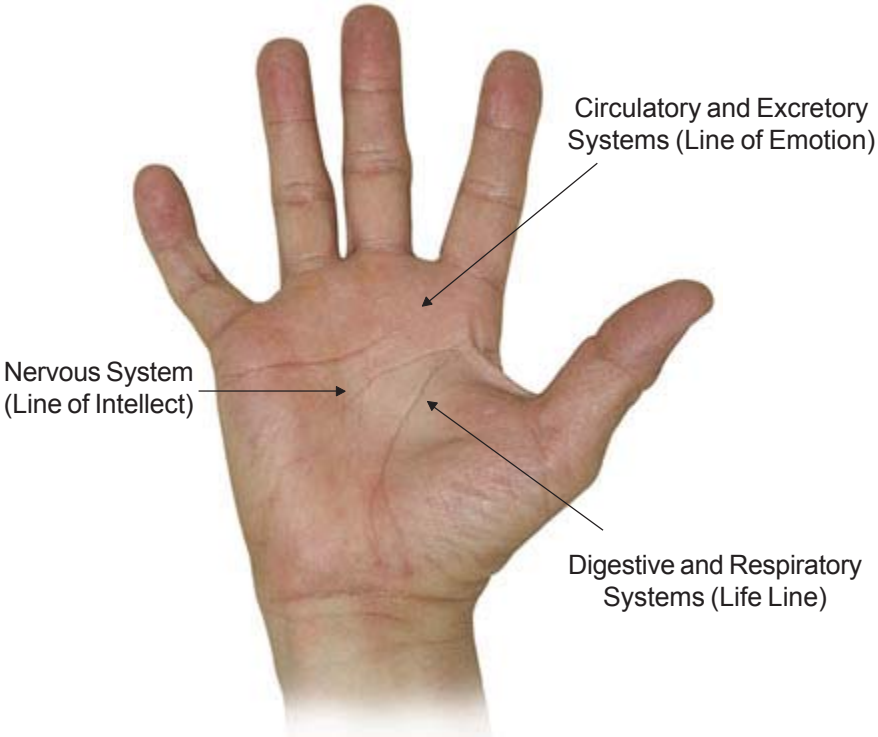

Fig. 3 *Three Major Palm Lines*

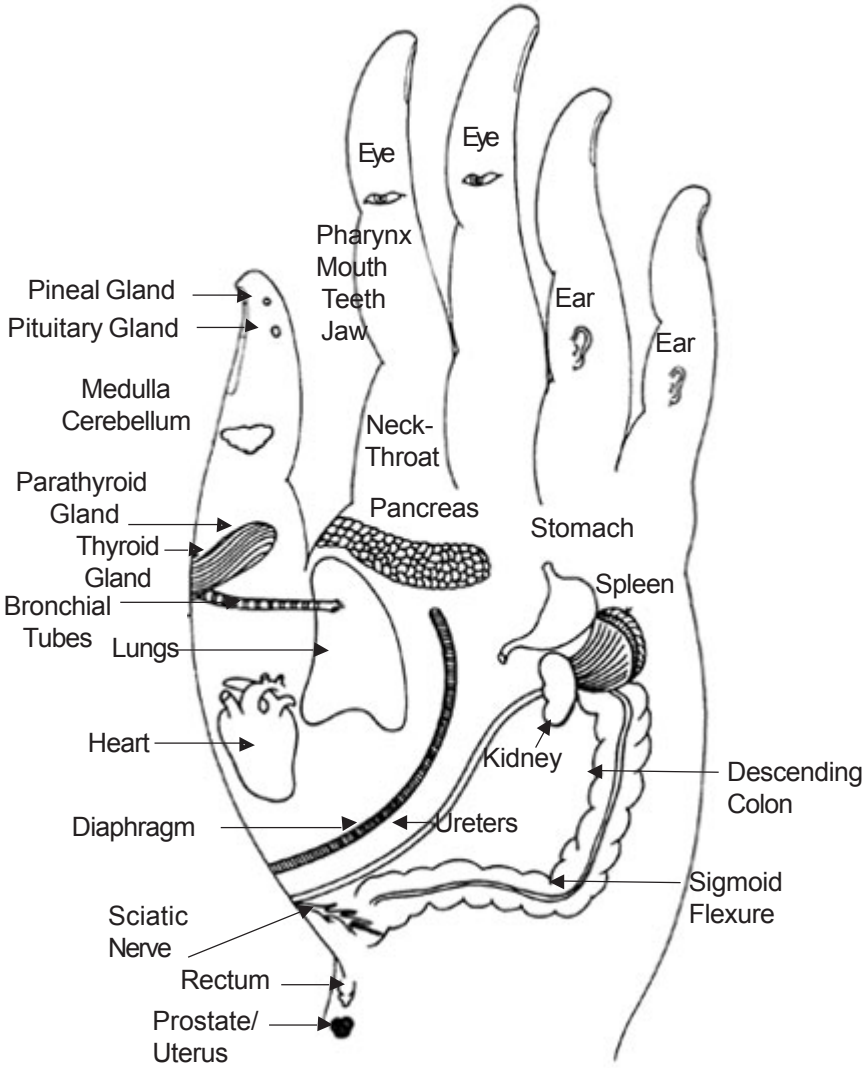

Fig. 4 *Fingers and Their Corresponding Bodily Functions Through the Organs' Meridians*

Massage the Hands

Always start by rubbing your hands until they are warm.

1. Massage the pericardium (P-8). Use the thumb to press the middle of the palm with a circular motion.

Fig. 5 *Massaging the Pericardium with fingers cupped in the palm in a half-fist, the pericardium is the point at the tip of the middle finger.*

2. Massage the hegu (LI-14). Press the thumb around the point in a circular motion, and press more at the index finger bone. Find the pain point and massage it away.

Fig.6 *Massaging LI-14*

3. Massage the major palm lines. Use the thumb to massage along the palm lines. Massage more towards the thumb bone and along that bone. When a lot of emotion is held inside, find the sore point and massage it.

4. Massage the back of the hand. Use the thumb to press along the bones on the back of the hand. When you find a tender spot, take more time to work on it.

5. Massage the fingers. Always rub your hands until warm. Use the right hand's fingers to wrap around the left thumb, and then, one by one, squeeze, hold and release each finger on the left hand three to six times. Start with the left hand and continue to the right hand's fingers, according to the elements of the finger. This will greatly help to control emotions.

Fig. 7 *Massaging the Palm Lines*

Fingers Correspond to Emotions, Elements and Organs

A. Thumb corresponds to the element earth and is associated with the stomach. The corresponding emotion is worry.

B. Index finger corresponds to the element of metal and is associated with the lungs and large intestine. It links with the emotions of sadness, grief and depression.

C. Middle finger corresponds with the element of fire and is associated with the heart, small intestine, circulatory system and the respiratory system. It links with the emotions of impatience and hastiness.

D. Ring finger corresponds to the wood element and is associated with the liver, gall bladder and the nervous system; it corresponds to the emotion of anger.

E. Pinky finger corresponds to the water element; it is associated with the kidneys, and corresponds with the emotion of fear.

Worry

Sadness

Impatience

Anger

Fear

Fig. 8 *Fingers' corresponding emotions, elements and organs*

Head

A. Crown Point

This is located in the center of the crown; in the fontanelle area of an infant's skull there may still be a slight depression. The crown point is the junction of one hundred channels through which the energy of the body passes. Massage this area with both your middle fingers. This will relieve dizziness and headaches, which result from too much energy in the head. It also relieves high blood pressure and stimulates the nervous system.

Fig. 9 *Crown Point is the junction point of one hundred energy channels.*

B. Bring Chi Energy to the Hands and Face

Inhale, contract the sexual organ, buttocks and middle of the anus. Rub the hands, clench the teeth, and put the tongue to the roof of the mouth. When the face, head, and hands are hot, breathe normally and begin to massage.

C. Knock the Head

Hit the head with the knuckles of the hand, knocking all around the head. Knocking the head lightly can help to clear your head, eliminate stubbornness and make your thinking sharper. Many of our students use this knocking of the head to release the pressures that they have from today's life of fast, advanced technology and the feeling of always having to keep up. This is especially true of those graduate students who feel a great deal of pressure and stress in keeping up with their studies. Each year students commit suicide because the pressures and stress accumulate too much in their heads, making them unable to think clearly: they start to feel everything in their society as too much pressure, which leads to worry, fear, sadness, and many, mixed emotions. The simple knocking of the head can release pressure and stress that accumulate there.

Fig. 10 *Knocking the Head*

D. Hold your Breath to Increase Chi Flow

Holding your breath will increase the Chi flow to the face. The head has many channels that join in the skull, especially in the crown point.

E. Scalp

Prepare your hands, head and scalp by warming up. Using both hands like a comb, press hard and move slowly, massage the scalp, going straight back from the hairline to the base of the skull. As you do this, mentally direct your energy from the back of the skull to your feet. Repeat 6-9 times. Massage more in any places in which you feel pain, until the pain goes away.

Fig. 11 *Massaging the Scalp*

F. Crest

Using your thumbs, massage the crest (the edge) at the base of the skull until you feel no pain there. This will help you reduce headaches and eye aches and will increase vision. This place in Tao tradition is called the Pool of Wind which tends to collect the “evil wind”, the major cause of all the pain in the senses.

Fengchi Point (GB-20)

Fig. 12 *Crest - Edge of the Skull*

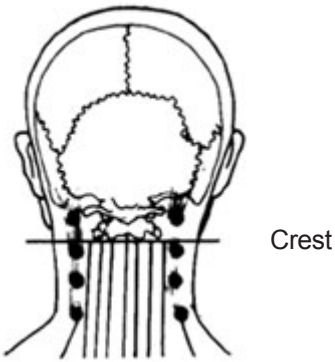

Fig. 13 *Go straight back from the hairline to the base of the skull.*

Face

Natural Beauty

Massaging your face with Chi is a far more effective beauty treatment than the most expensive cream or cosmetic, Your skin will glow brightly and eventually become less wrinkled. There are many meridians passing through or ending at the face. When blocked, they result in reduced flow of Chi energy and circulation. The face is the first impression imprinted in other people's minds. Chi circulation provides it with attractive personal energy.

Fig. 14 *Head and Face*

Fig. 15 *Massage the Whole Face*

Fig. 16 *Massage the Mid Forehead*

Temples

Use your index fingers to massage the temples in a circular motion, first clockwise, then counterclockwise. Massage the forehead and the temples; use the knuckle rub from the middle of the forehead all the way to the temples ten to twenty times. These exercises will reduce headaches in the front and in the temples. Find the painful point and massage it until the pain is gone.

Fig. 17 *Massage the Temples*

Mouth

Depression makes the corners of the mouth drop. Looking cheerful, delightful, more attractive and happy are dependent so much on the eyes and the corners of the mouth. When the muscles of the mouth are loose because of stress, depression, or sadness, the corners of the mouth drop and the energy system is depressed and in low key. No one likes to look at a sad face or a depressed face; it makes other people feel sad and depressed, too.

The flow of energy in the body and the expression of the face are the main attractive powers of a person. Massaging the mouth muscles up will help to lift the corners of the mouth. The Inner Smile and lifting up the corners of the mouth are very important to building up attractive energy.

Beautify the Mouth Massage

Using the thumb and the index finger of the right hand, touch both corners of the mouth and feel the Chi from the thumb and index finger pass to the corners of the mouth. Slowly press and push up about one inch, release and start again at the corners, pressing up ten to twenty times each day.

Cheerful Delight

Mouth Corners Drop

Fig. 18 *Beautifying the Mouth Massage*

Eyes

The eyes are the windows of the spirit. In Taoism we regard the eyes as Yang energy which will guide all Chi flow in the body. The eyes can greatly affect your personality Some people are born with a lot of white in their eyes--three portions of white to one portion of iris—sometimes called “thief eyes” or “danger attack eyes.” Such eyes can result in a suspicious look, portending unpleasant things. Through the exercises, you can gradually correct the white portion of the eyes.

Since the eyes are connected to the entire nervous system, they have a special importance. The eyes reveal the health of your entire body. Through the eyes we can tell which organs are weak and/or toxic. Massaging the eyes will remove stress from the vital organs. Nowadays people use their eyes much more than in the past to read, watch television, and work with computers, electronics and microscopes. This strains them a great deal and makes the openings of the organs loose, so that much of the organ energy is drained out. In Taoism, we regard the eyes as the doorways to the soul as well as the opening of the liver.

A. Bring Chi Energy to the Hands and Eyes

Repeat the procedure for bringing energy to the hands by inhaling; holding the breath; and contracting the sexual organ, buttocks and middle of the anus and both the left and right sides of the anus. Direct the Chi to both eyes. Rub the hands, clench the teeth, place the tongue on the roof of your mouth. Direct the energy to the face and then the hands. When your hands are hot, focus on your eyes until you feel them filled with energy.

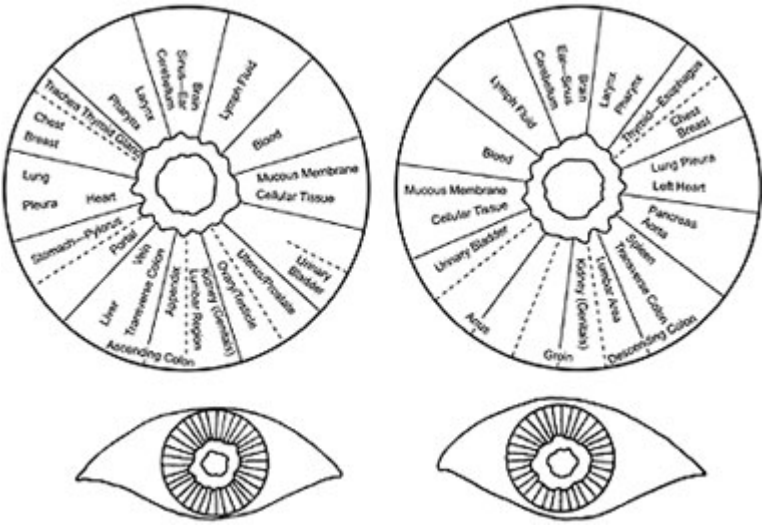

Fig. 19 *Eyes are the Windows of the Spirit*

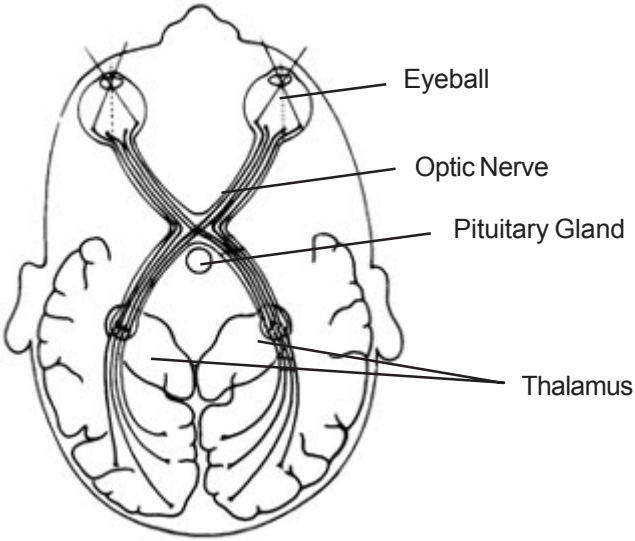

Fig. 20 *Eyes are the Doorways to the Soul*

Fig. 21 *Use the Fingertips to Gently Massage the Eyeballs*

B. For the Eyeballs and Surrounding Area

Close your eyes. Use your fingertips to gently massage your eyeballs through your closed eyelids, six to nine times clockwise, then six to nine times counterclockwise. Then gently massage the area around the lids the same number of times. Be aware of painful spots and massage those places until the pain goes away. Pay special attention to the inner and outer corners of the eyes. These are points of the gall bladder meridian and will relieve eye ailments if massaged.

C. Pull up the Eyelids

Pulling up the eyelids will increase the fluid. Use the thumb and index finger to pinch, pull up and release the eyelids six to nine times.

Fig. 22 *Pull Up the Eyelids*

D. For the Eye Sockets

Bend your index fingers and use the lower section (second phalanx) of each thumb to rub the upper and lower bones of the eye sockets six to nine times.

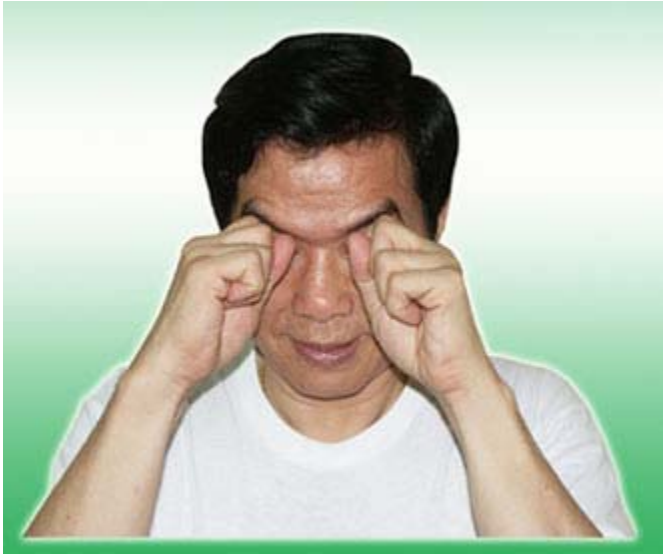

Fig. 23 *Massage the Eye Sockets*

E. For getting a Tear out

Hold an index finger up about eight inches from the eyes, or put a dot on the wall five or six feet away from you. Stare at it intently without blinking your eyes until you feel like a fire is burning in them. The Taoists believe that the toxins will burn out of the body through the eyes. They will begin to tear. Do this to strengthen your eyes. Then, rub your hands until warm; close your eyes and cover your eye sockets with your palms. Feel the Chi from the hands absorbed into the eyes. Rotate your eyes six to nine times, first in a clockwise direction, then counterclockwise.

Fig. 24 *Getting a Tear Out*

Fig. 25 *Absorbing the Chi into the Eyes*

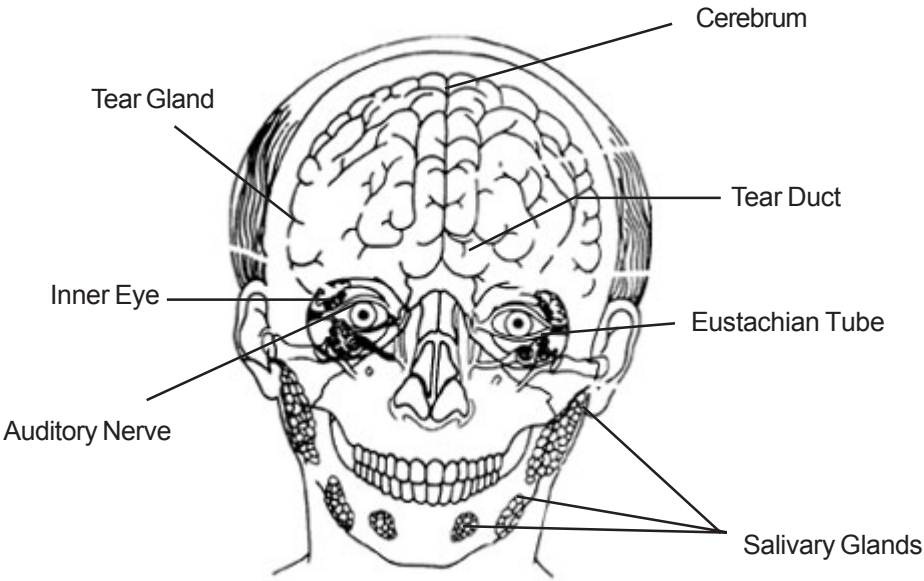

Fig. 26 *Parts of the Eyes Connect with Senses and Brain*

F. Pull in the Eyeballs

The eyes are divided into five parts. Each part is closely connected with the organs and nerves. Become aware of the eyes.

Pulling and pressing the eyeballs will exercise the organs, sense, glands and the brain. This is also the best exercise for the eye muscles. The eyes have many muscles which we do not exercise very much and, thus, they become weak, contributing to poor eyesight.

1. With the eyes still closed and cupped by the palms, inhale, contract the anus and sexual organ, and pull the eyeballs back into the sockets.
2. Contract the middle of the anus and the middles of the eyeballs.
3. Contract the front of the anus and the tops of the eyeballs.
4. Contract the back of the anus and the bottoms of the eyeballs.
5. Contract the right side of the anus and the right sides of the eyeballs.
6. Contract the left side of the anus and the left sides of the eyeballs. This exercise not only strengthens the eyes but also the pituitary and pineal glands and the inner ear including the ear drum and canals. When you pull the eyeballs in and upward and look toward the crown, you are exercising the upper muscles and stimulating the pituitary gland and pineal gland.

When you contract and pull in the middle of your eyeballs, you are exercising the back of the eye muscles and the inner ear.

When pulling in the outer corners of the eyes, you are strengthening the side eye muscles as well as the ear canals end the ear drums.

When pulling in the inner corners of the eyes, you are strengthening the inner side muscles, the tear ducts and the nose.

When pulling in the lower parts of the eyes, you are pressing the lower part of the ear canals and the nervous system.

Pressing into the Inner Ear

Left Eye Pressing into the Ear Canal. Right Eye Pressing into the Eustachian Tube

Pressing into the Pituitary Gland

Right Eye Pressing into the Ear Canal. Left Eye Pressing into the Eustachian Tube

Pressing into the Eustachian Tube

Fig. 27 *Moving the Eyes*

G. Learn to Maintain Eye Contact

Some people in eye to eye contact with other people feel nervous and frightened, and their voices become very low and hard to hear because of weak organs. Some people will look around and not look into your eyes when you talk to them. This can be caused by weakness of the gall bladder and kidneys. To improve this, you can use the Inner Smile, Six Healing Sounds and Tao Rejuvenation, plus the practice of staring.

Look at your face in a mirror for two to five minutes each day for the first week. After ten days you can begin to stare at your eyes and increase your confidence by looking at your irises. Gradually you will lose the fear of looking into other people's eyes.

Nose

The nose has several important functions. When we breathe properly through the nose and not through the mouth, the nose filters out dirt, preventing it from reaching the lungs. It also regulates the temperature of the air: when the air is too cold, the nose will warm it up first. Without this regulating action, extreme temperatures could injure the lungs, make us susceptible to upper respiratory illnesses and subject to getting colds easily. One great advantage about people who practice the Tao System is that they seldom get colds.

The nose has three meridians running through it: the large intestine, the stomach, and the Governor or back Channel. Rubbing the nose strengthens the temperature regulator stimulates the above organs, and increases hormone secretion. In China just a few needles inserted in the nose serve as a general anesthetic for any part of the body to be operated on.

An unhealthy nose affects the personality. A thin, flat and unhealthy looking nose, or a badly shaped nose, can make you less attractive to other people. A strong nose can help you to have good Chi. The nose is the first place into which the breath of life enters.

A weak nose usually will be infected, and a lot of mucous can leak into the sinuses. A weak nose also can affect the voice. A good singer always has a good nose. Rubbing and massaging the nose will increase the Chi and will improve circulation around the nose.

Ears

In China we believe that a person with thick, long ears will have a long, healthy life and that the personality will be more attractive.

The following exercises can prevent hearing loss which occurs gradually as we age. The ears are acupuncture maps of the whole body, containing 120 points. Many acupuncturists now use only the ear points to cure many ailments as well as for weight control.

A. Outer Ear

Repeat the method for bringing energy to the hands, contracting the left and right sides of the anus.

1. Front and back: Make a space between your index and ring fingers and simultaneously rub in front and in back of the ears.

2. Ear shells: Rub the ear shells with all your fingers. This will stimulate the autonomic nervous system and warm up your whole body, especially in the cold weather.

3. Ear lobes: Using your thumb and index finger, pull down on the ear lobes.

Rub in Front and Back of Ears

Rub the Ear Shells

Pull Down on the Ear Lobes

Fig. 28 *Rubbing the Ear*

4. Ear drum exercises: For the outer ear drum, repeat the method for bringing energy to the hands, contracting the left and right sides of the anus. Inhale and then exhale completely. Put your index fingers in your ears; it should feel as if there is a vacuum in the ears. If it does not, then exhale more. Move your index fingers back and forth six to nine times at your own pace until you can feel that the insides of the ears are moving, and pull out the fingers with a quick movement. You should hear a “pop” sound, and you will feel that you can hear better and that your mind is clearer.

Fig. 29 *Outer Ear Drum Exercise*

B. Inner Ear

Repeat the method for bringing energy to the hands, contracting the left and right sides of the anus.

The inside of the inner ear, being inaccessible, is usually not exercised and grows weaker with age. These two exercises use air pressure and vibrations to strengthen the inner ear. The ear canals, the nose canal, and the mouth are connected together, so in this exercise we are using the pressure that builds in the lungs and bringing it back up to the mouth, thus adding pressure to the inner ear drums. This is how to exercise the inner ear drums.

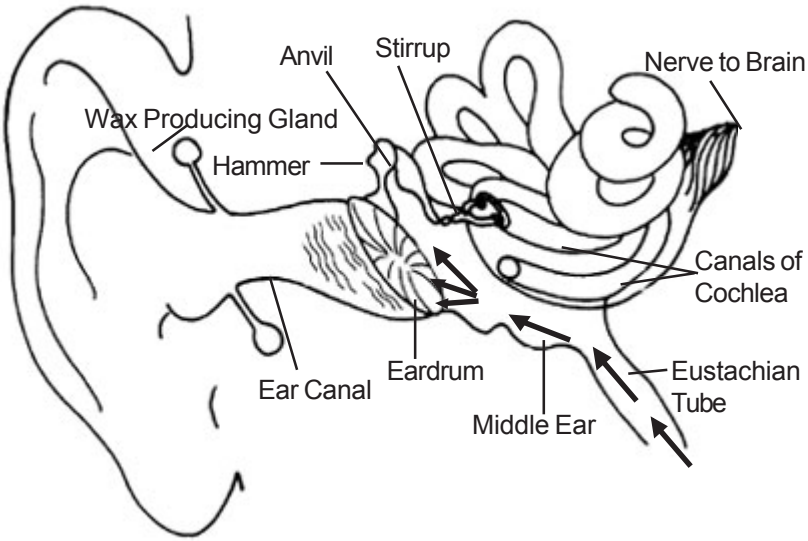

Fig. 30 *Diagram of Inner Ear Drum*

Fig. 31 *Inner Ear Drum Exercise*

Gums, Tongue, Teeth

Healthy teeth require healthy gums as their foundation. These exercises will strengthen both the gums and teeth. Teeth are the excess energy of the bones, and when the teeth get stronger, so do the bones. When the teeth and tongue are strong, your breath improves as well, eliminating bad breath.

We regard saliva as an essential form of energy which can lubricate the organs and digestive system. The tongue is the opening of the heart, and both are made of similar tissue. A healthy and clean tongue will strengthen the organs, especially the heart. You should clean your tongue twice a day with a brush or scrape it with a tongue scraper, and massage your tongue with a tongue depressor or a clean finger. Find the painful spots and massage there until the pain goes away.

A. Bring Chi Energy to the Hands

Repeat the procedure for bringing energy to the hands, contracting the middle of the anus.

B. Gums

Open your mouth and stretch your lips tautly over your teeth. Use three fingertips (index, middle, and ring fingers) to tap the skin around the upper and lower gums. Hit around until you feel warmth in the area.

C. Gums and Tongue

Massage your upper and lower gums with your tongue. Then suck in some saliva, press your tongue tightly against the roof of your mouth, and try to exercise the tongue. When you strengthen your tongue, you are strengthening your heart. Press around. Press the tongue to the roof of your mouth, tighten your neck muscles and swallow the saliva. This lubricates the digestive glands and organs.

Fig. 32 *Hitting the Gums Exercise.Using the Tongue, Massage the Upper and Lower Gums.*

D. Tongue

In a sitting position place the hands on the knees, palms down. Exhale and straighten the arms, spreading the fingers apart and keeping the hands on the knees. Open the mouth as wide as possible and thrust the tongue out and down, focused on the throat. With the tongue out as far possible, gaze at the tip of the nose. The whole body should be tense. Hold the breath for as long as you feel comfortable. Relax with inhalation and regulate the breath. This will help to strengthen the throat, the tongue and the power of speech. These exercises will help to improve foul breath and to clarify speech.

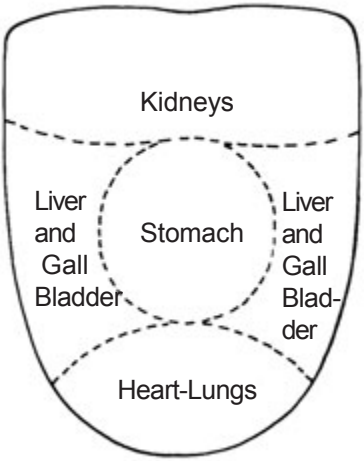

Fig. 33 *Diagram of Tongue Parts and Corresponding Organs*

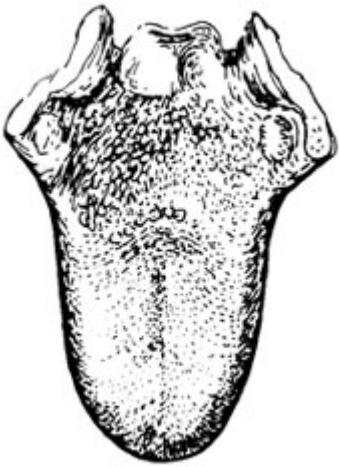

Fig. 34 *Tongue*

Fig. 35 *Press Tongue to the Roof of the Mouth*

Inhale, then exhale as you press your tongue out and down as far as you can. Follow by pulling the tongue in and curling it. Press your tongue to the roof of your mouth as hard as you can, contracting the middle of the anus and the esophagus to help the tongue. With more practice you will know how to use the inside force, the force from the organs, to press your tongue up. Even though the tongue has no bones to exert force, you will still be able to exercise the tongue well.

E. Teeth Clenching

Relax your lips. Click the teeth together lightly and then clench them hard, as you inhale and pull up the middle of the anus. Do this six to nine times. Move your tongue and mouth to create a lot of saliva. The technique of swallowing the saliva is to put the tongue up to the palate and swallow quickly with a hard gulp, sending the saliva down the esophagus to your stomach.

F. Energy to Teeth

Close your mouth and let your teeth touch lightly. Direct the energy to your teeth. Gradually feel the electrical flow of energy there.

Fig. 36 *Click the Teeth Together Lightly*

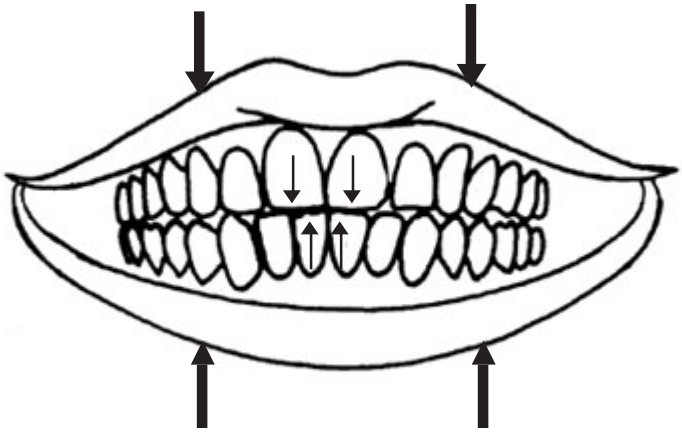

Fig. 37 *Clench the Teeth Together Hard*

Fig. 38 *Throat Glands*

Neck

A. Thyroid and Parathyroid: Site of Courage, the Power of Speech

The neck carries the busiest traffic in the body and is the seat of the thyroid and parathyroid glands. When you massage here, you increase the body's metabolism. Neck tension can also be caused by emotional imbalance. When we are tense and nervous, we are responding to negative emotions, such as anger, fear and sadness. The neck is similar to a traffic bottleneck. All of the signals, as well as the emotions, have to pass through it. When under stress and under emotional strain, the neck starts to accumulate and jam the tension. Unconsciously, the neck muscles tighten, attempting to block out pain. Keeping the neck soft will help Chi flow to the higher center that is located in the brain, keeping the mind and body in harmony together.

Tension in the neck can make you less courageous. When the neck is tense, it will block self expression in the throat. With proper flow of Chi energy, we can express ourselves appropriately at the proper time, place, and in a proper way.

The neck is the passageway of many meridians and is the channel of the Chi energy of the organs. In the middle is the Governor meridian. On the sides are the bladder meridian, the triple warmer meridian and the large intestine meridian. The emotions passing through the meridians of the neck may tense and jam up there.

Emotion:	Organ/Associate Organ:
Anger	Liver/Gall Bladder
Fear	Bladder/Kidneys
Grief	Large Intestine/Lungs
Hastiness	Heart/Small Intestine/Triple Warmer
Worry	Spleen/Stomach/Pancreas

B. Bring Chi Energy to the Hands

Do the procedure for bringing energy to the hands and contract the front of the anus.

C. Whole Neck

Spread your thumbs apart from your other fingers. Alternating hands, rapidly wipe the neck from the chin to the base nine to thirty-six times.

D. Middle Neck

Alternating hands, use the middle three fingers to rapidly wipe down the middle of the neck from the chin to the base nine to thirty-six times. The thyroid and parathyroid glands are in the front section of the neck. Use your thumb and the three other fingers to massage these glands. Find the painful points and massage them until you feel them open. Massaging this area will help to increase metabolism and the power of speaking.

Fig. 39 *Wipe the Neck from the Chin to the Base*

E. Turtle Neck

Sink your chin down, then out and up. Feel your spine press down and then expand. This will help loosen the vertebrae and discs of your neck.

F. Crane Neck

Move your chin forward, circling out, then down, then up, and out again. Feel your spine expand and then contract.

G. Massage the Neck

Massage the points along the back of the neck and on the back along the cervical vertebrae. Start from the shoulders and go up to the base of the skull. Use your fist to hit along the neck. Find any painful spots and any tense spots and massage until they are released. This will greatly help to release the tension of the neck and help to detoxify the toxic accumulations in the neck area, the causes of many headaches.

Fig. 40 *Turtle Neck*

Fig. 41 *Crane Neck*

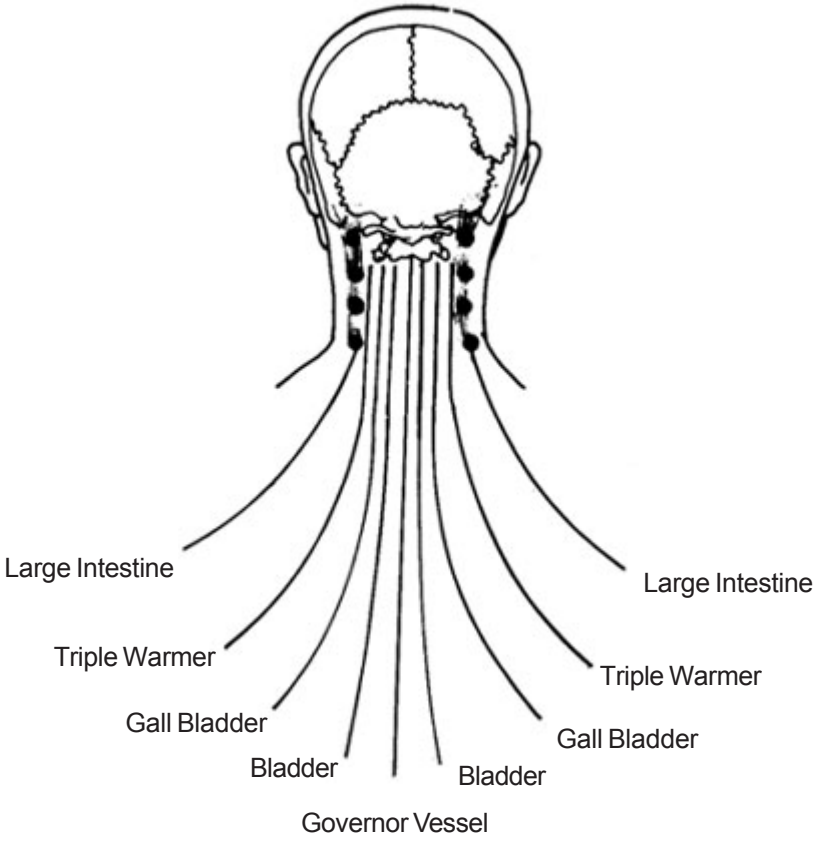

Fig. 42 *Massage the Points Along the Neck*

Shoulders

Many people feel tense and worried, and their shoulders are tight and held up. The way to release the tension is by pulling up your shoulders to press against the neck, tightening the muscles of the neck and shoulders. Hold for a while, exhale deeply, and let them drop down, pulled by gravity like a sack of potatoes. Feel the burden, worry, and stress drop down to the feet and out to the ground. Feel yourself grounded. Do this three to nine times, and the tension and worry will go away.

Relax your shoulders and chest, exhale and release more, until you feel the tenseness gone.

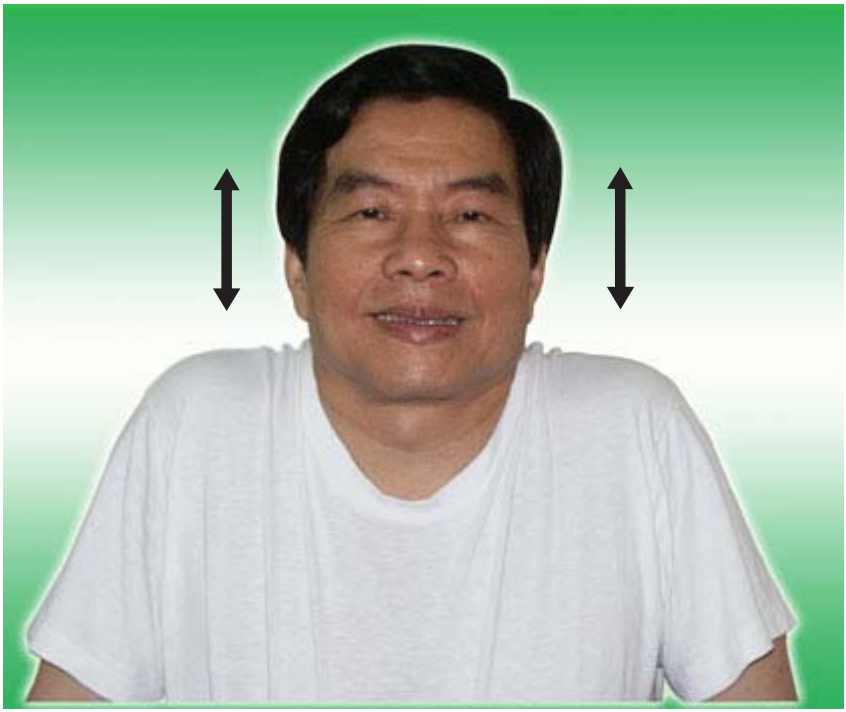

Fig. 43 *Dropping the Shoulders will Help to Release Tension and Worry.*

Detoxifying Organs and Glands

Lightly slapping and tapping over the organs and glands help to shock the toxic sediment and increase the circulation and Chi flow to these areas. Our practitioners claim they are able to heal themselves from many chronic illnesses which are very hard to heal by conventional medicine.

I. Thymus Gland

The thymus gland controls the immune system and is related to longevity. Normally the thymus gland atrophies after childhood. In the higher levels of Taoist practice, the thymus gland can be regrown. This helps maintain health and vitality and supports greater spirituality. Thumbing the thymus gland can help increase the activity and release more hormones.

A. Bring energy to your hands by the usual procedure, contracting the front of the anus and bring the Chi toward the thymus.

B. Make a fist, inhale and thump down the middle of the upper chest from the collar bone to the nipples six to nine times. Do not talk while you are doing this or you might harm yourself.

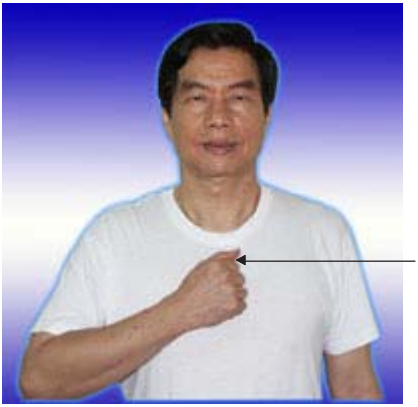

Fig. 44 *Hitting the Thymus Gland*

II. Heart

Lightly slapping an organ stimulates the release of toxins, which allows the organ to rebuild and repair itself. In doing these exercises, be aware that the slapping or tapping should be adjusted by you so as not to use excessive force which may be harmful.

A. Do the energy to hands procedure, contracting the left side of the anus and bringing Chi toward the heart.

B. Slap your heart lightly with your palm six to nine times. Don't speak.

III. Lungs

A. Bring energy to your hands, contracting the right side of the anus and bringing Chi to the lungs.

B. Using your palm, slap up and down your right lung, hitting only as hard as is comfortable. Do not talk. Contract the left side of your anus and slap your left lung. This can help to clean out the mucous and to clean out the lungs.

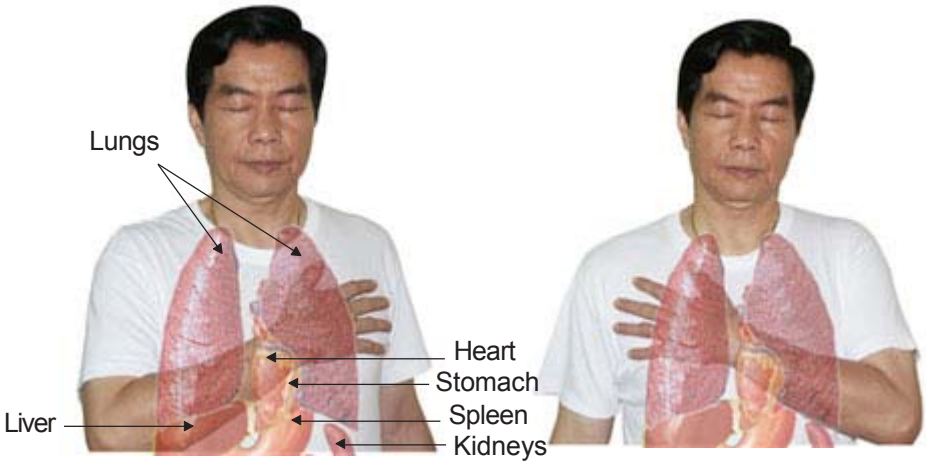

Fig. 45 *Slap at Heart, Lungs and Liver Areas*

IV. Liver

A. Bring energy to the hands, contracting the right side of the anus and bringing Chi to the liver.

B. Using your palm, slap below the rib cage on the right side. Don't speak. This can help to detoxify the liver.

V. Stomach, Spleen, Pancreas

A. Bring energy to your hands, contracting the middle of the anus.

B. Contract the anus at the left side, and slap at the spleen, pancreas and stomach. Place one palm on top of the other and rub below the rib cage, from center to left, then left to center.

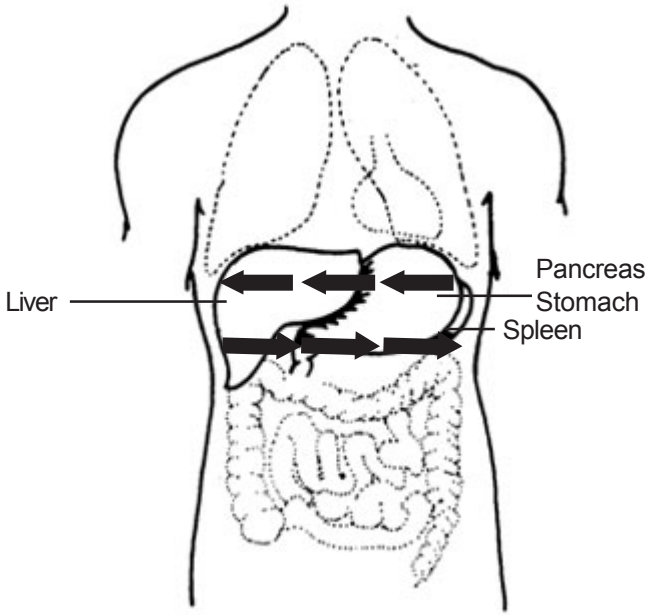

Fig. 46 *Rub the Stomach, Spleen and Pancreas*

Fig. 47 *Rub Back and Forth over the Liver, Stomach and Spleen*

VI. Large and Small Intestines

A.Bring energy to the hands, contracting the entire anus.

B. Small intestine: With palms together, rub a small circle around your navel, first clockwise, then counterclockwise.

The small intestine is one of the longest tubes in the digestive system. A careless diet, too much hot food or dairy products, or too little fibrous food will create mucous that will stick to the walls of the intestine, block the absorption of nutrients and slow down digestion. Once mucous accumulates, it is like a snow ball that will get bigger and bigger, eventually becoming a lump which slows down the traffic of the digestive system.

C. Large intestine: Place one palm on top of the other and rub your abdomen in a large circle. Start on the lower right side and rub up and around in a clockwise direction. This will move the energy in the intestine and relieve constipation. For diarrhea, rub counterclockwise. If you have normal elimination, rub in both directions. These exercises increase the absorption and dissolve the accumulations that stick to the large intestine's wall.

Fig. 48 *Hitting the Sacrum Can Help in Strengthening the Sciatic Nerves*

VII. Kidneys

The kidneys act as helping to filter out waste material from the blood. If there is too much waste in the system, the kidneys cannot filter it all. The waste will tend to collect in the ducts and tubules of the kidneys, impairing their health. By hitting the kidneys' area, we shake out the harmful sediment and help prevent kidney malfunction.

A. Bring energy to the hands, contracting the left and right sides of the anus.

B. Locate the kidneys just above the lowest, or floating, rib in the back on either side of the spine. Make a fist and hit the kidneys with the back of the fist between the wrist and knuckles. Alternate hands and hit only as hard as is comfortable. This will help to shake loose the sediment, crystals, and uric acid that get caught in the kidneys. This will also strengthen the kidneys and relieve back pain.

C. Rub your hands together to warm them. Then rub your palms up and down over the kidneys until they feel warm.

VIII. Sacrum

In the Taoist system the sacrum is regarded as extremely important. It is a pump which helps to bring spinal fluid and energy (Chi) to the brain. It is also the junction where the sexual organs, rectum, and legs meet. Sciatic pain, which shoots down the legs, originates in the sacrum; therefore, strengthening it will release this intense pain.

A. Bring energy to the hands, contracting the back of the anus to the sacrum.

B. Make a fist and use your knuckles alternately to hit both sides of the sacrum. First hit in the area of the eight sacral holes, and then the hiatus, the depression at the bottom of the sacrum.

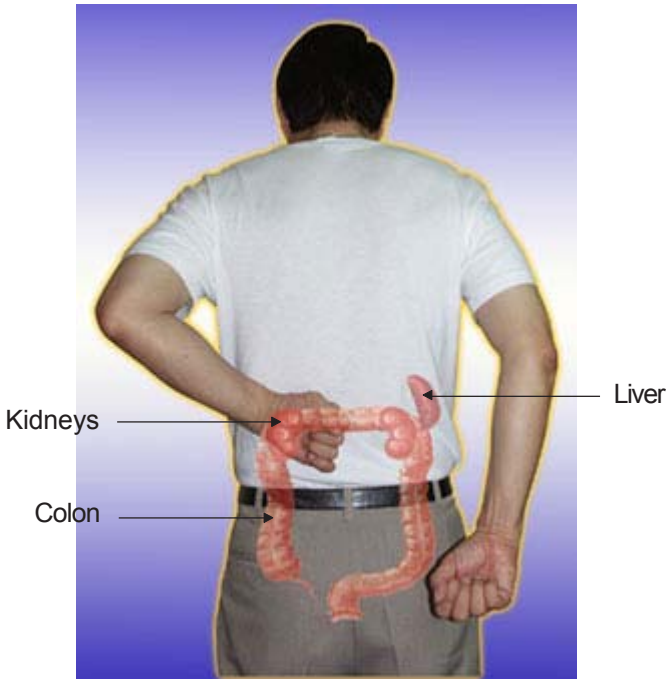

Fig. 49 *Hitting the Kidneys will help to Shake Out Sediment*

Knees and Feet

I. Knees are Toxin Collectors

Toxins tend to collect in the lower limbs because of the slowdown of the circulation due to gravity. The most common places are the back parts of the knees. Slapping at these places will break down the toxins. The body will then eliminate the toxins out of the body by urine, bowel movements and sweat.

A. Bring Chi Energy to the Hands

Bring energy to the hands; do no contractions.

B. Behind the Knees

Prop your leg up on a chair or low table so the knee is straight. Then slap smartly behind the knee nine to eighteen times. Although it hurts, it is extremely beneficial in releasing toxins which accumulate there. This release may be indicated by the appearance of a purple dot. Use discretion as to how hard you slap, since it can be overdone. Repeat this exercise on the other knee.

Fig.50 *Slapping Smartly behind the Knee Helps to Release Toxins*

Fig. 51 *Massaging the Knee Cap*

C. Knee Cap Massage

Massage the knee cap until it is warm, There is very little blood flowing to it and it tends to be quite vulnerable. This practice strengthens it. Massage the other knee cap.

D. Move the Knee Caps

Relax the knee caps, then move them up and down to the left and right and around both clockwise and counterclockwise.

E. Massage the Knees

Falling down is often caused by weak knees. Massaging the knees will improve your stability and flexibility.

II. Feet: Roots of the Body

Strong feet and tendons increase your stability by connecting you to the healing energy of the earth. Feet are the reflexes of the whole body's organs, glands and limbs. (They are like remote controls. Massaging will help to stimulate the organs and glands and increase the circulation.

A. Bring Chi Energy to the Hands

Bring energy to the hands; do no contractions.

B. Massage the Feet

Take off your shoes and stockings and massage the tops and bottoms of each foot with your thumbs and fingers. Be sure to massage the kidney point, the sore spot in the center between the ball of each foot and the adjoining pad. If you are in a hurry, massage the whole of each foot once by rubbing the sole of the foot vigorously and carefully across the top of the other foot, going from the heel to the arch to the toes. The soles of the feet have energy meridians to the entire body. Massage the feet, and when you find painful points massage them until the pain goes away. This will help to clear any blockage of Chi channel flow.

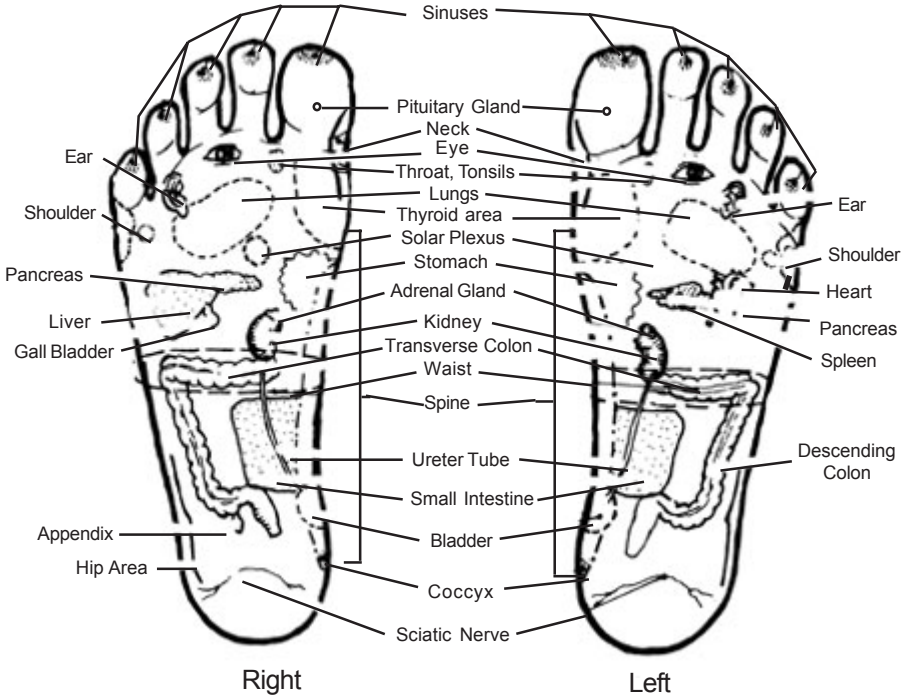

Fig. 52 *Feet are the Reflexes of the Whole Body's Organs, Glands and Limbs*

C. Spread Out the Toes

Spread out and separate all the toes, especially the little toes, and then release. Repeat six to nine times. This is especially good for the tendons of the feet.

Fig. 53 *Separate all the Toes by Spreading them out.*

D. Big and Second Toes

Rub the big toes and second toes together rapidly. This a good exercise to do at odd moments during the day.

E. Rub Feet Together

Keep the feet warm by rubbing them together. This will help to stimulate all the body's organs.

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Mantak Chia

Illustrations by Udon Jandee

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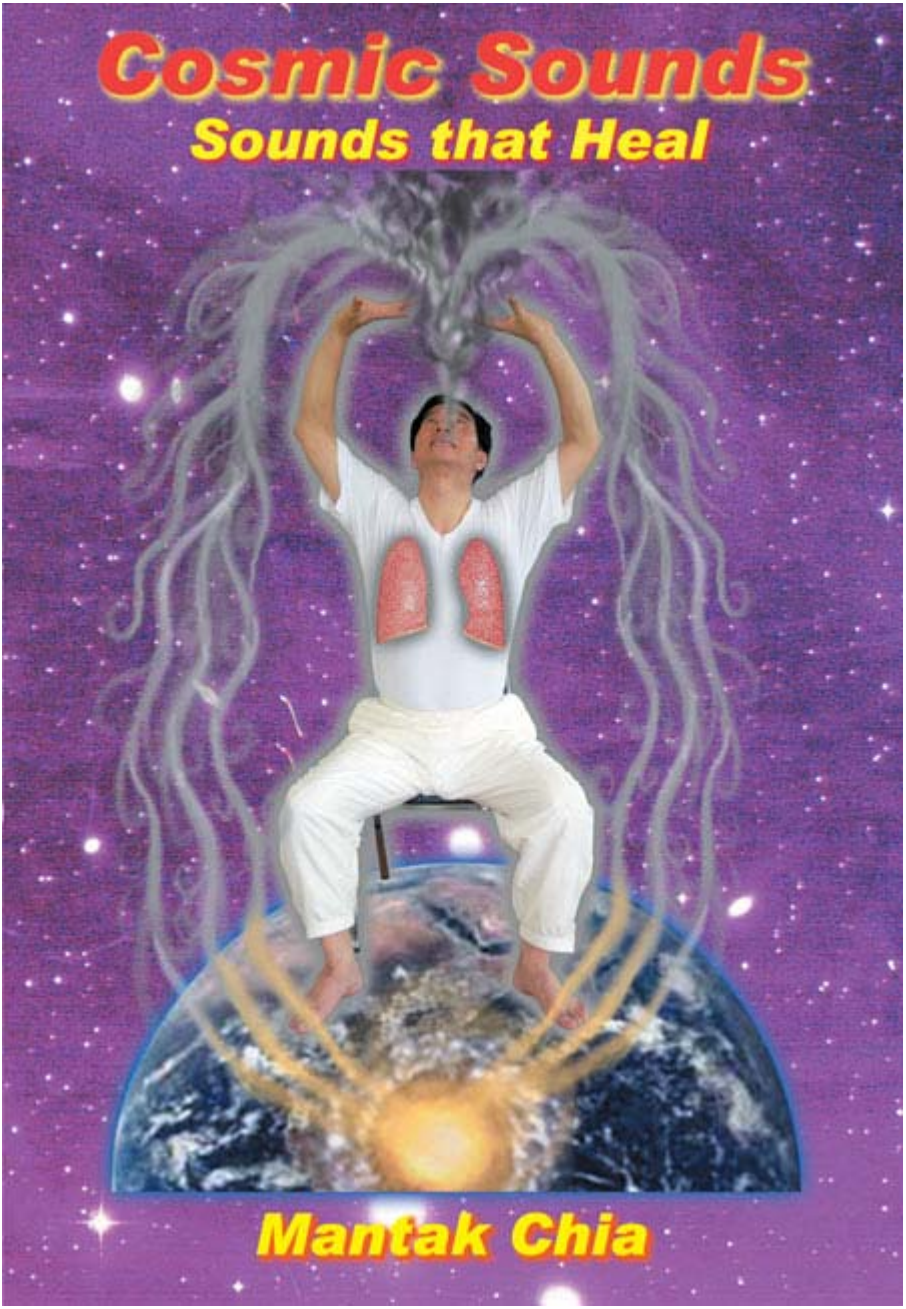
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Sounds that Heal
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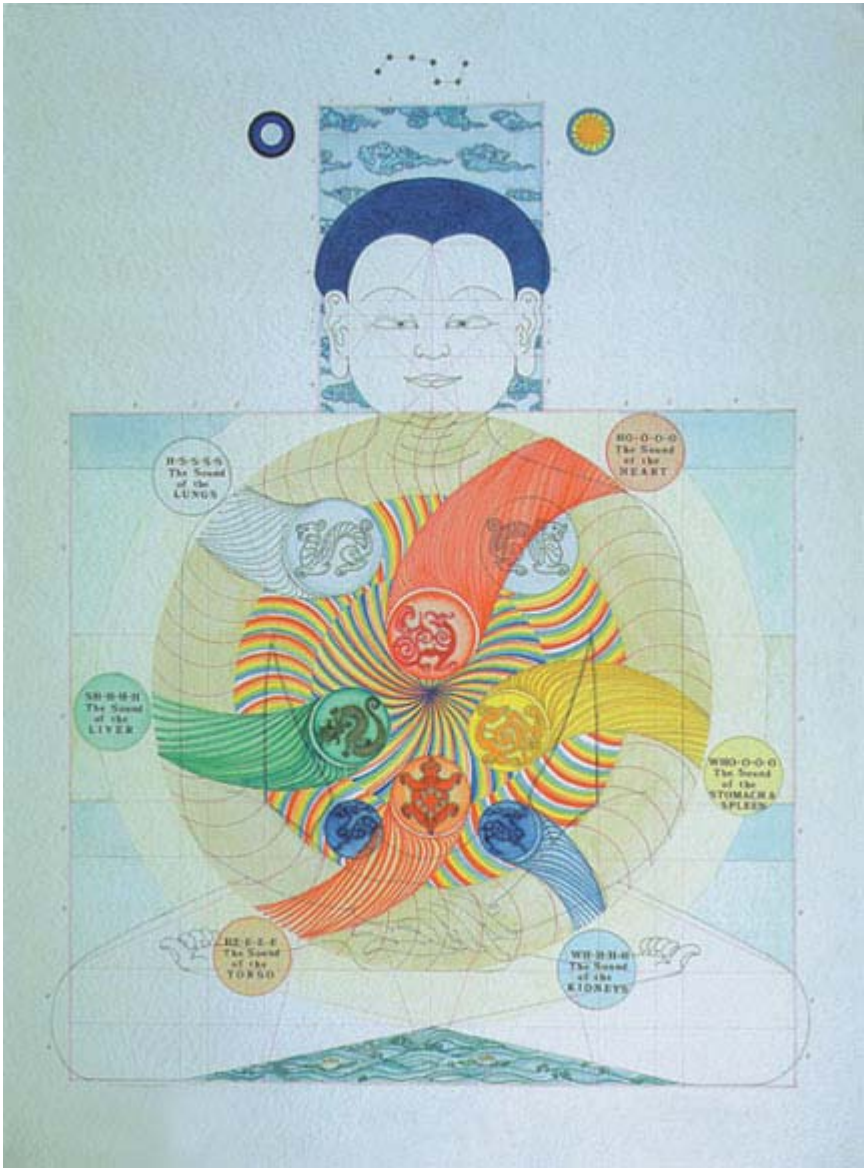

Cosmic Healing Sounds as taught by Mantak Chia
Artist: Juan Li

Cosmic Six Healing Sounds

Theory

Having accessed the knowledge of the universe through internal practices, the Taoist masters discovered that each healthy organ is associated with a particular sound, color, and quality of energy. Emotional problems, pollution, poor food, injuries, and overly strenuous exercise can overheat the internal organs. causing them to weaken. This changes the state of each organ's sound frequency, color, and energetic quality. The Six Healing Sounds practice help to restore, balance, and cleanse the vital organs by correcting these factors. They also stimulate the Chi flow throughout the body to enhance one's overall health and vitality.

The Cosmic Six Healing Sounds help to release any excess heat that may be trapped in the cooling sacs which surround each organ. As you assume the postures and produce the sounds sub-vocally, their vibrations redistribute any excess heat into cooler regions of the body where this can safely be stored or used. Once the organ energies are balanced, you have a good foundation for establishing and nurturing the virtue energies. This will help to maintain the Chi balance throughout the system.

What causes an organ to malfunction? There are many causes. Urban society creates a life full of physical and emotional stresses such as overcrowding, pollution, radiation, junk food, chemical additives, anxiety, loneliness, bad posture, and sudden or overly vigorous exercise. Separately and together, these stresses produce tension and start to block the free passage of enegy flow in the body, thus the organs overheat. In addition, the concrete jungle that we live in lacks the safety valves provided by nature: trees, open spaces, and running water, which give forth a cooling, purifying energy. Continued overheating causes an organ to contract and harden. This impairs its ability to function and results in illness. One of the surgeons working with the Universal Tao Center in New York reports that the hearts of patients who have died of heart attacks look as if they've been cooked! And the ancient Taoists have a saying: "Stress cooks your brain".

Chinese medicine teaches that each organ is surrounded by a sac or membrane, called fascia, which regulates its temperature. Ideally, the membrane releases excess heat out through the skin, where it is exchanged for cool life force enegy from nature. An overload of physical or emotional tension causes the membrane, or fascia, to stick to the organ so that it cannot properly release heat to the skin nor absorb cool energy from the skin.

The skin becomes clogged with toxins and the organ overheats. The Sounds speed up the heat exchange through the digestive system and the mouth. The digestive system is more than 20 feet long and runs from the mouth to the anus as one pipe in the middle of the body in between all the organs. It helps release excess heat from the fascia, cooling and cleansing the organs and skin. When all the sounds and postures and done in the proper order, body heat is evenly distributed by the intestinal tract throughout the whole body, and each of the organs is at its correct temperature.

Daily practice of the Six Healing Sounds wil restore and maintain calmness and good health. Greater sexual pleasure and improved digestion will occur. Minor ailments, such as cold, flu, and sore throats, can be prevented or thrown off easily. Many students of The Universal Tao have overcome their long-standing dependence on sleeping pills, tranquilizers, aspirin, and antacids. Heart attack victims have prevented further attacks. Several psychologists have taught some of their patients to use the Six Healing Sounds to relieve depression, anxiety or anger; and body work oriented healers have used the Six Healing Sounds to help speed up healing, and the healer spends less of his own life force energy.

Each of the six organs in the practice has an associate organ which responds together with it and in the same manner. When an organ is weak or overheated, its paired organ is similarly affected. Likewise, practicing the appropriate healing sound and posture improves the organ and its associate.

***Note**:* Typical side effects of these practices are yawning. burping, or passing wind, all of which are beneficial as indicators of moving energy.

Practice

First Cosmic Healing Sound: Lung Sound

The Lung Sound is a metal sound. It sounds like the vibration of a bell and activates the lung Chi.

Associated Organ: Large Intestine
Element: Metal
Season: Autumn
Color: White
Emotions: Grief and Sadness
Virtues: Courage and Righteousness
Related Senses: Smell (Nose) and Touch (Skin)
Taste: Pungent
Related Parts of the Body: Chest, Inner Arms, Thumbs
Sound: ***Sssssssss*** (Tongue behind Teeth)

Exercise:

1. Sit with your back straight, your hands resting on your lungs, and your eyes closed. Smile down to your lungs. Be aware of the quality of the energy in the lungs. Picture a white light, fresh and pure like the energy of the mountains and hear the metal sound.

2. Take a deep breath, open the eyes and raise your arms out in front of you with the palms facing the lungs. When the hands are at eye level, begin to rotate the palms, bringing them above your head until they face up and are pushing outwards. Point the fingers toward those of the opposite hand. Keep the elbows rounded out to the sides, and do not straighten your arms.

Close the jaws so that the teeth gently meet and part the lips slightly as you slowly exhale through your teeth the sound "***Sssssssss***". In the beginning, you can produce the Lung Sound out loud, but eventually you should practice it sub-vocally.

Fig. 1 *Become aware of the Lungs.*

Feel that the sound starts to move the Chi in the lungs, and that any excess heat and toxins are expelled from the lungs as the sacs surrounding the lungs are compressed.

Fig. 2 *Gather the energy into the Lungs.*

Note: “Sub-vocally” means that you are vocalizing so softly that only you can hear the sound and feel the vibration inside the lungs. You must exhale slowly and fully. Also, the word “sacs” refers to the layers of tissue called fasciae, that surround every organ.

Fig. 3 *Do the Lung Sound.*

3. When you have exhaled completely, rotate the palms and scoop up the white light. Pour this light from the crown down into the lungs. Lower the arms and hold your hands before the lungs and radiate the bright white light, and courage into the lungs.

Fig. 4 *Bring the energy down to the Lungs.*

4. Rest, close your eyes and be aware of your lungs. Smile into them, and imagine that you are still making the Lung Sound. Feel the vibration of the sound moving and cleaning the energy in the lungs. Breathe normally, and see your lungs glowing with a bright white light. This will strengthen your lungs and activate courage in the lungs. With each breath, try to feel that fresh white metal energy is replacing the excess hot, toxic, and depressed energy.

Fig.5 *Cover the Lungs.*

5. Nurture good emotions. This is the most important part of this practice. Take as much time as you need to get in touch with the organs. When you get rid of the excess heat and let the white metal energy expand in the lungs, good emotional qualities will have room to grow. Concentrate on the feelings of righteousness and courage as you transform any sadness or grief. Sit up straight and tall so you can feel courage, and try to maintain the feeling of the Lung Sound for increasingly longer periods after each practice, and in your daily life.

6. Repeat the Lung Sound three to six times. For sadness, depression, colds, flu, toothaches, asthma, emphysema, or depression, you may repeat this exercise 6, 9, 12, or 24 times.

Fig. 6 *Mouth Position for Lung Sound. Close the jaws so that teeth meet. Draw the corners of the mouth back.*

Second Cosmic Healing Sound:Kidney Sound

The Kidney Sound is a water sound and it activates the kidney Chi.

Associated Organ: Bladder
Element: Water
Season: Winter
Color: Dark Blue
Emotion: Fear
Virtue: Gentleness, Calmness and Stillness, Alertness
Parts of the Body: Sides of the Feet, Inner Legs, Chest
Senses: Hearing (Ears), Bones
Taste: Salty
Sound: ***Chooooooooo*** (As when blowing out a candle: lips forming an "0")

Exercise:

1. Sit with your back straight, your hands resting on your kidneys, and your eyes closed. Smile down to your kidneys. Be aware of the quality of the energy in the kidneys. Picture a blue light, the sun shining on the ocean.

2. Take a deep breath, open the eyes and put your legs together, ankles and knees touching. Lean forward and clasp the fingers of both hands together around your knees. Pull your arms straight from the lower back while bending the torso forward (This allows your back to protrude in the area of the kidneys). Simultaneously tilt your head up as you look straight ahead, maintaining the pull on your arms from the lower back. Feel the pull on your spine. Round the lips, and slightly exhale with the sound "***Chooooooo***" as if you were blowing out a candle.

Simultaneously contract your abdomen pulling it in toward your kidneys. At first you can produce the Kidney Sound out loud, but eventually you should practice it sub-vocally. Feel that the sound starts to move the Chi in the kidneys; any excess heat and toxins are expelled from the kidneys as the sacs surrounding the kidneys are compressed.

Fig. 7 *Smile to the Kidneys.*

3. After you have fully exhaled, sit erect, separate the legs and move your arms up to the crown and scoop up the blue light. Pour this light over the body and into the kidneys. Lower your arms and hold the palms on the kidneys. Radiate the blue light, the gentleness, and stillness into the kidneys.

Fig. 8 *Do the Kidney Sound.*

4. Return your hands to your kidneys. Rest, close your eyes, and be aware of your kidneys. Listen to your kidneys. Smile to them, and imagine that you are still making the Kidney Sound. Feel the vibration of the sound is moving and cleaning the energy in the kidneys.

Fig. 9 *Bring the energy down to the Kidneys.*

Breathe normally, and see your kidneys glowing with a cool blue light. This will strengthen your kidneys and activate the gentleness and stillness in the kidneys. With each breath, try to feel that bright blue water energy is replacing the excess hot, toxic, and fear energy.

Fig. 10 *Gather the energy into the Kidneys.*

5. Nurture good emotions. This is the most important part of this practice. Take as much time as you need to get in touch with the kidneys. When you get rid of the excess heat and let the cool blue water energy expand in the kidneys, good emotional qualities will have room to grow.

Concentrate on the feelings of gentleness, stillness, and alertness as you transform any fear. Feel the gentleness relaxing also the lower back. Try to maintain the sensation of this energy for increasingly longer periods after each practice, and in your daily life.

Repeat the steps from three to six times. You may repeat this exercise more times to alleviate fear, fatigue, dizziness, ringing in the ears, or back pain.

Fig. 11 *Round the lips, making the sound one makes when blowing out a candle.*

Third Cosmic Healing Sound: Liver Sound

The Liver Sound is a wood sound and it activates the liver Chi.
Associated Organ: Gall Bladder
Element: Wood
Season: Spring
Color: Green
Emotion: Anger
Virtue: Kindness
Parts of the Body: Inner Legs, Groin, Diaphragm, Ribs
Senses: Sight (Eyes), Tears
Taste: Sour
Sound: ***Shhhhhhh*** (Tongue near Palate)

Exercise:

1. Sit comfortably with your back straight, your hands resting on your liver and your eyes closed. Smile down to your liver until you feel you are in touch with your liver. Be aware of the quality of the energy in the liver. Picture a forest, a big green forest. See the sun shining on the forest creating life force and green light.

2. Take a deep breath, open the eyes and extend your arms out to your sides, palms up. Slowly raise the arms from the sides to the crown, following this action with your eyes. Intertwine the fingers, and rotate your joined hands over to face the ceiling, palms up. Push up and out with the heels of the hands and stretch the arms out from the shoulders; the elbows should be pushing to the back.

Bend slightly to the left, exerting a gentle pull on the liver. Open your eyes wider because they are the openings of the liver. Slowly exhale out the sound "***Shhhhhhh***" loud and eventually sub-vocally. Feel the sound start to move the energy in the liver and that all excess heat and toxins are expelled from the liver as the sac around it is compressed.

Fig. 12 *Smile to the Liver.*

3. After you have fully exhaled, sit erect, separate the hands and scoop up the green light. Pour this light over the body and into the liver. Slowly bring your arms down, palms facing out, and scoop up more green light and hold both hands before your liver. Radiate the green light, the forest energy, and kindness in the liver.

Fig. 13 *Do the Liver Sound.*

4. Return your hands to your liver. Rest. Close your eyes and be aware of your liver. Smile and look in your liver and imagine that you are still making the Liver Sound. Feel the vibration of the sound is moving and cleaning the energy in the liver.

Fig. 14 *Scoop green light as the hands return to the Liver.*

Breathe normally, and see your liver glowing with the green rejuvenating light. This will strengthen your liver and activate kindness in the liver. With each breath, try to feel that bright green wood energy is replacing the excess hot, toxic, anger, aggression and frustration energy.

Fig. 15 *Gather energy into the Liver.*

5. Nurture good emotions. This is the most important part of this practice. Take as much time as you need to get in touch with the liver. When you get rid of the excess heat and let the warm, moist, green wood energy expand in the liver, kindness will have room to grow.

Concentrate on the virtue of kindness and forgiveness as you transform any anger and aggression. Feel warm and energetic, and maintain this feeling for as long as you can after practice.

6. Repeat the steps from three to six times. Practice more to expel anger, to clear red or watery eyes, to remove a sour or bitter taste, and to detoxify the liver.

Fig. 16 *Exhale on the sound "**Shhhhhhh**"*

Fourth Cosmic Healing Sound: Heart Sound

The Heart Sound is the fire sound and activates the heart energy.

Associated Organ: Small Intestine
Element: Fire
Season: Summer
Color: Red
Emotions: Hastiness, Arrogance, Cruelty
Virtues: Joy, Honor, Sincerity
Parts of the Body: Armpits, Inner Arms
Senses: Tongue, Speech
Taste: Bitter
Sound: ***Hawwwwww*** (Mouth wide Open)

Exercise:

1. Sit comfortably with your back straight, your hands resting on your heart, and your eyes closed. Smile down to your heart until you feel you are in touch with your heart. Be aware of the quality of the energy in the heart. Picture a sunset on the ocean, a red light.

2. Take a deep breath, open the eyes and take the same position as for the Liver Sound. Unlike the former exercise, however, you will lean slightly to the right to pull gently against the heart, which is located just left of the center of your chest.

Focus on your heart, and feel the tongue's connection to the open mouth, round the lips, and slowly exhale the sound "***Hawwwwww***" out loud and eventually sub-vocally. Feel the sound start to move the energy in the heart and that excess heat and toxins are expelled from the heart as the sac around it is compressed.

Fig. 17 *Do the Heart Sound.*

3. After you have fully exhaled, sit erect, separate the hands and scoop up the red light. Pour this light over the body and into the heart. Slowly bring your arms down, palms facing out. Scoop up more red light and hold both hands before your heart. Radiate the red light, the love, and inner joy into your heart.

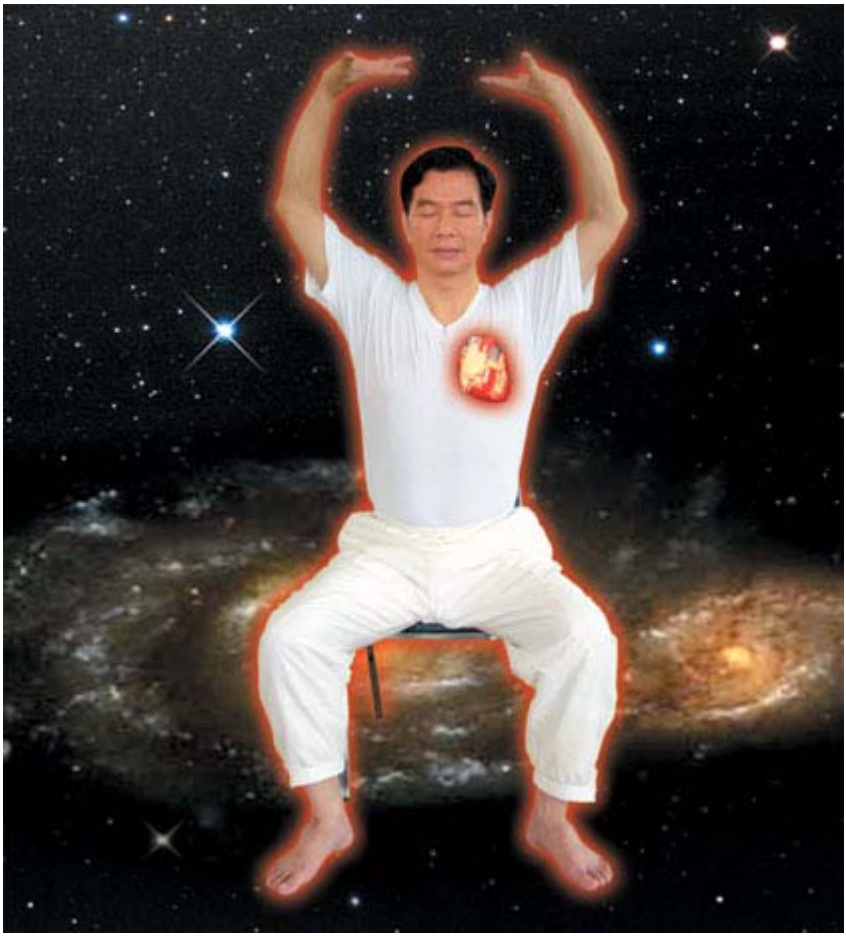

Fig. 18 *Gather energy into the Heart.*

4. Return your hands to your heart. Rest, close your eyes and be aware of your heart. Smile to your heart and imagine that you are still making the Heart Sound. Feel the vibration of the sound is moving and cleaning the energy in the heart. Breathe normally, and see your heart glowing with a red fire light.

Fig. 19 *Smile into the Heart.*

This will strengthen your heart and activate love, inner joy, and sincerity in your heart. With each breath, try to feel that the warm red light is replacing the excess hot, toxic energy and any hastiness, arrogance, and hate in the heart.

Fig. 20 *Turn the senses into the Heart.*

5. Nurture good emotions. This is the most important part of this practice. Take as much time as you need to get in touch with the heart.

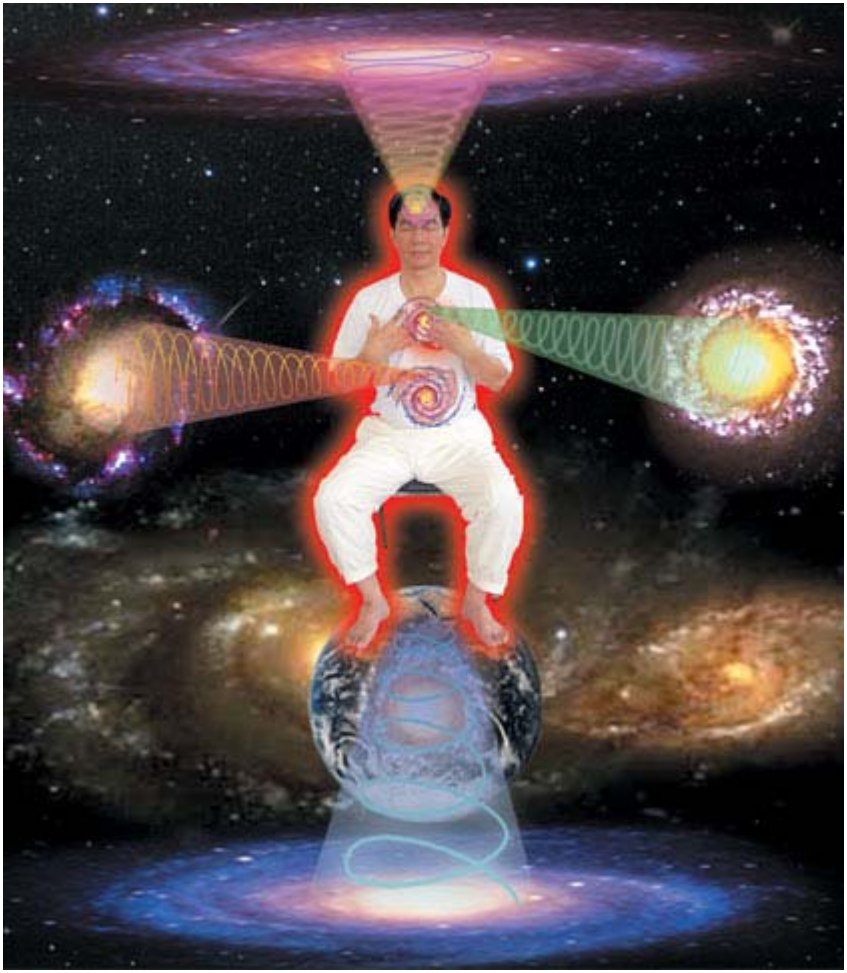

Fig. 21 *Loving energy grows in the Heart.*

Fig. 22 *When the heart is relieved of its daily load and stress, all the organs smile!*

When you gel rid of the excess heat and let the red fire energy expand in the heart, good emotional qualities will have room to grow. Feel love, joy, honor, and respect radiate outwards.

Feel any hatred, arrogance, or impatience transform into loving energy as sincerity, honor, and respect grow in your heart. Try to maintain the feeling of the Heart Sound as long as you can after practice.

6. Repeat the steps from three to six times. Practice more to relieve sore throats, cold sores, swollen gums or tongue, jumpiness, moodiness, and heart disease.

***Fig. 23** "**Hawwwwww**" Sound*

Fifth Cosmic Healing Sound: Spleen Sound

The Spleen Sound is the earth sound, activating the energy of the stomach, the pancreas, and the spleen.

Associated Organs: Pancreas, Stomach
Element: Earth
Season: Indian Summer
Color: Yellow
Emotion: Worry
Virtues: Fairness, Openness
Parts of the Body: Lips, Mouth
Senses: Taste
Taste; Sweet, Neutral
Sound: ***Whoooooo*** (From the Throat, Guttural)

Exercise:

1. Sit comfortably with your back straight, your hands resting on your spleen, and your eyes closed. Smile down to your stomach and spleen until you feel you are in touch with them. Be aware of the quality of the energy in the stomach and the spleen. Picture a yellow light, the golden satiated light of the Indian Summer, a stable light.

2. Take a deep breath, open the eyes, move the arms to the front and place the three middle fingers of both hands just beneath the sternum on the left side of the rib cage.

Look up and gently press your fingers under the rib cage, pushing your stomach or spleen to the back and your middle back out wards you exhale out loud, eventually sub-vocally, the sound "***Whoooooo***" This is more guttural, or "throaty" than the kidney Sound. Unlike blowing out a candle, this sound originates from with in the chest, rather than from the mouth.

Fig. 24 *Smile to the Spleen.*

Feel the Spleen Sound vibrate the vocal cords. Feel the sound start to move the energy in the stomach and the spleen and that all excess heat and toxins are expelled from the stomach and the spleen as the sac around them is compressed.

Fig. 25 *Fingers under the left Rib Cage Preparing to press on Spleen, Pancreas and Stomach.*

3. After you have fully exhaled, move the arms outwards, embracing the earth and scoop up the yellow light. Pour this light into the stomach and spleen. Bring the arms and the hands to the stomach and/or the spleen. Radiate the yellow light, the fairness, openness, and stability into the stomach and the spleen.

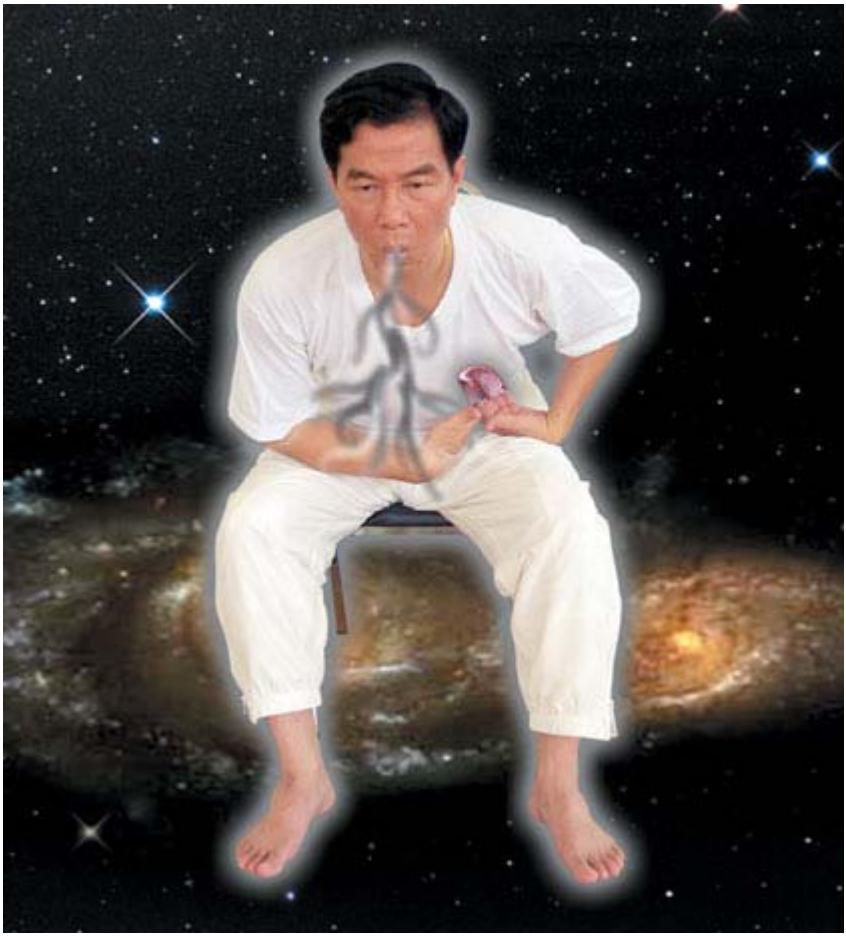

Fig. 26 *Feel the Spleen Sound Vibrate.*

4. Rest, close your eyes and be aware of your stomach and spleen. Smile to them and imagine that you are still making the Spleen Sound. Feel the vibration of the sound is moving and cleaning the energy in the stomach and the spleen.

Fig. 27 *Openesss and Fairness Grow in the Spleen.*

Breathe normally, and see your stomach and spleen glow with a yellow light. This will strengthen these organs and activate openness, fairness, and stability in your stomach and spleen. With each breath, try to feel that the warm yellow light is replacing the excess hot, toxic energy and any worries in these organs.

5. Nurture good emotions. This is the most important part of this practice. Take as much time as you need to get in touch with the stomach and the spleen.

When you get rid of the excess heat and let the yellow earth energy expand in the stomach and the spleen, good emotional qualities will have room to grow. Feel the fairness, openness, balance, and harmony grow in these organs, transforming any worry in them. Try to maintain the feeling of the Spleen Sound as long as you can after practice.

6. Repeat the steps from three to six times. Practice more to eliminate indigestion, nausea, and diarrhea.

Fig. 28 *Exhale on the sound "**Whoooooo**"*

Sixth Cosmic Healing Sound: Triple Warmer

The Triple Warmer refers to the three energy centers of the body: The upper section (brain, heart, and lungs) is hot; the middle section (liver, kidneys, stomach, pancreas, and spleen) is warm; and the lower section (large and small intestines, bladder, and sexual organs) is cool.

The sound "***Heeeeeee***" serves to balance the temperature of the three levels by bringing hot energy down to the lower center and cold energy up to the higher center. Specifically, hot energy from the area of the heart is moved to the colder sexual region, and cold energy from the lower abdomen is moved up to the heart's region.

Exercise:

1.Lie on your back or lean back in the chair. Smile, move your arms up and gather the Chi, and bring your arms and hands to your face. As you make the *"**Heeeeeee**"* sound on exhalation, let the arms slowly move down the body bringing the energy down from the crown to the feet.

2. Inhale fully into all three cavities: chest, solar plexus, and lower abdomen, and then exhale completely. Exhale with the sound "***Heeeeeee***" sub-vocally, first flattening your chest, then your solar plexus, and finally your lower abdomen. Imagine a large, roller pressing out your breath and move the hot energy down as the arms move from your head down to your lower Tan Tien.

3. Rest, and concentrate. When you have fully exhaled, focus on the entire digestive tract.

4. Repeat the steps from three to six times. Practice more to relieve insomnia and stress.

***Note*:** The Triple Warmer can be done lying down to facilitate falling asleep.

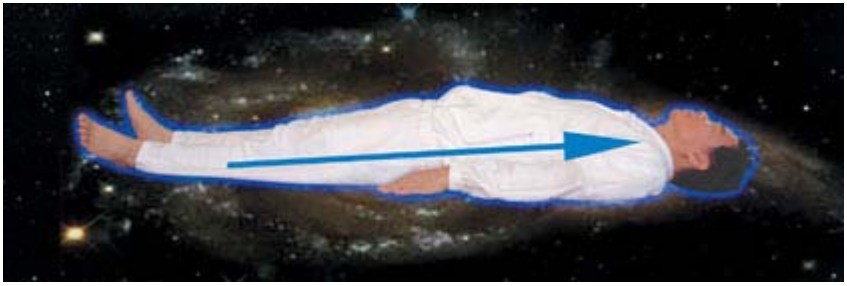

Fig. 29 *Rest by breathing normally and focus on the Triple Warmer Sound.*

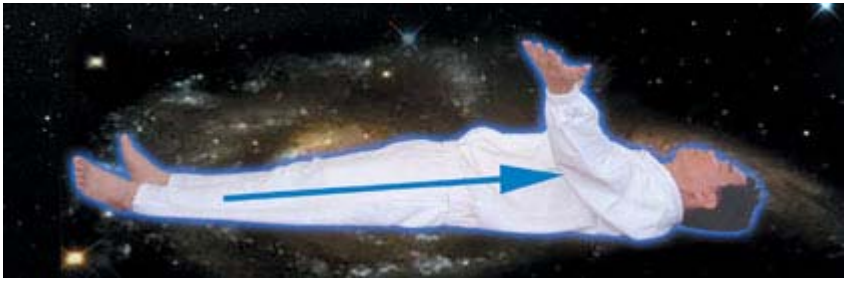

Fig. 30 *Gather the energy from all three Levels.*

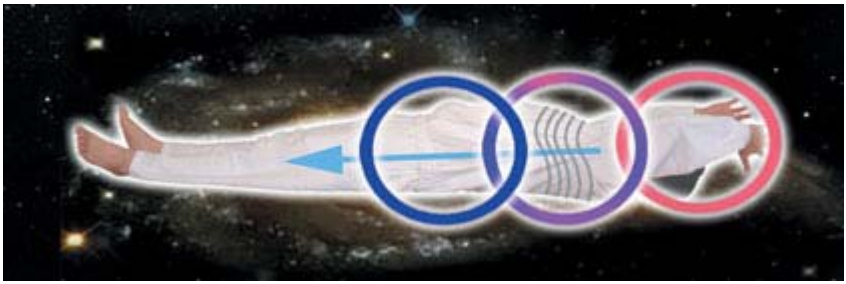

Fig. 31 *Send the energy down the body.*

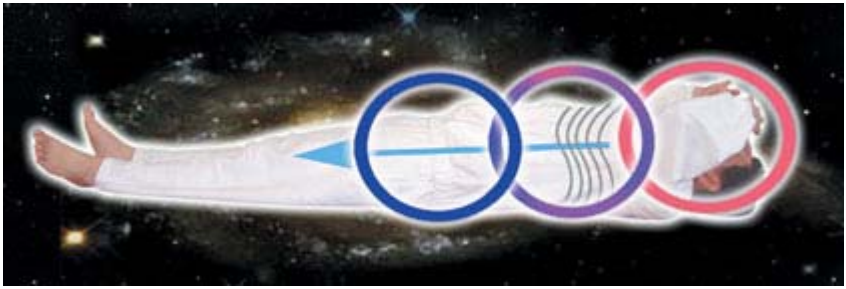

Fig. 32 *Upper Level*

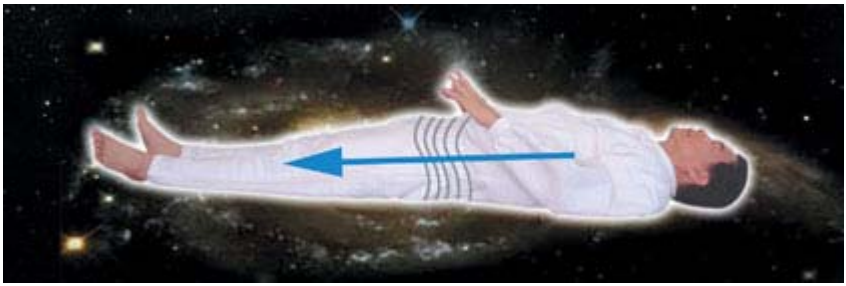

Fig. 33 *Middle Level*

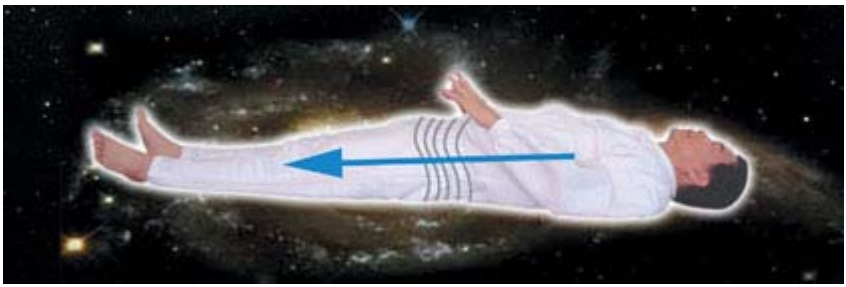

Fig. 34 *Lower Level.*

Fig. 35 *Excess heat flows out of the fingertips and toes into the Earth.*

Fig. 36 *Do the Triple Warner Sound.*

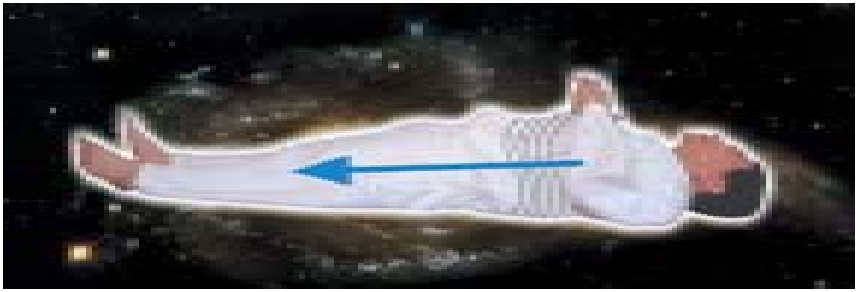

Fig. 37 *All the way down the body with the* ***"Heeeeeee"*** *Sound.*

Fig. 38 *"**Heeeeeee**" Sound*

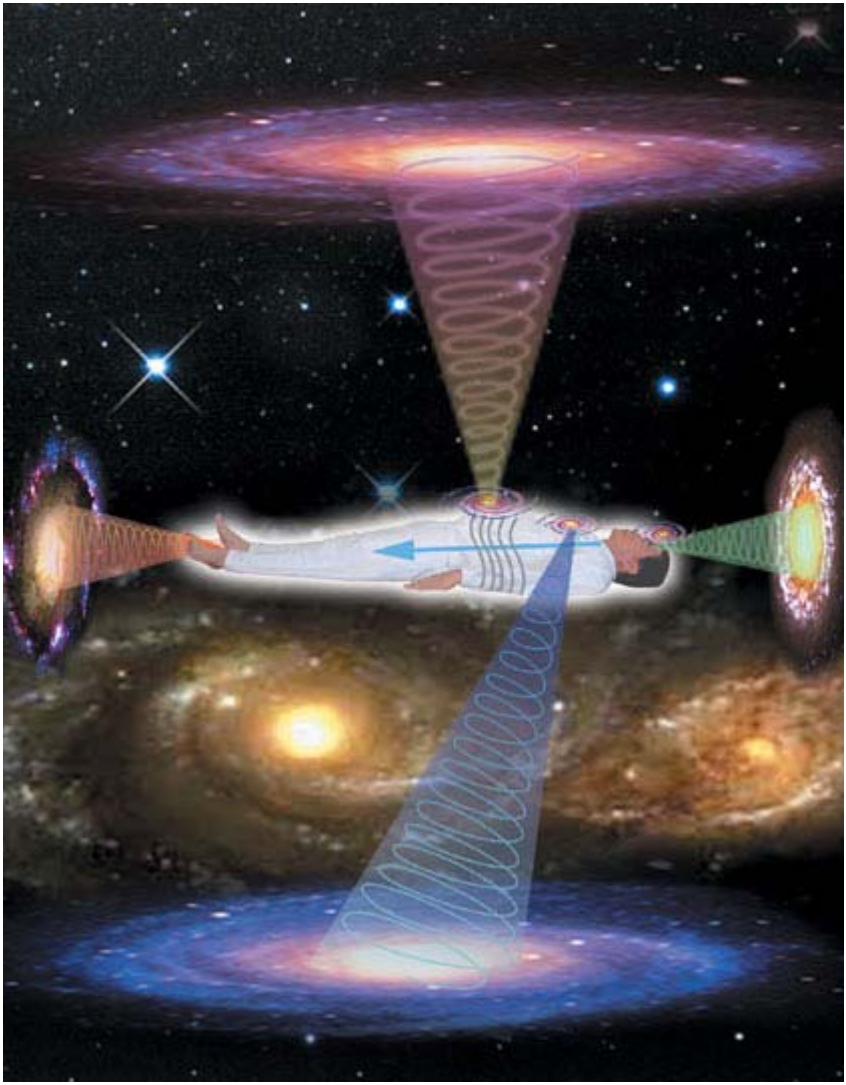

Fig. 39 *Rest and absorb the Cosmic Forces.*

Daily Practice

1. We recommend that you practice the Six Healing Sounds before going to bed at night to relax the body, promote good sleep, and cool down any organs that are overheated. You may also do these sounds to enhance any of the other Taoist exercises whenever you feel like practicing. Do three rounds of each sound to prevent illness and maintain good health. Once learned, the procedures take only ten to fifteen minutes to complete.

2. Clear out any negative emotions, and let positive emotions grow before you go to sleep. You may feel a sense of emptiness as you disengage from your own mental activity to connect with the Universal Consciousness. This will also help you to avoid bad dreams while sleeping, as your body recharges through its connection with the Universal Force. If you have any problems, stress, or illnesses this is the best time to allow the Universal Consciousness to help you find the solution or cure. When you awaken after sleep, smile inwardly, and look for answers within.

3. You can devote extra time to an organ when you feel troubled by it or its associated emotions. You may also emphasize extra practice for an organ during its particular season. For example, in spring you would spend more time on the Liver Sound.

4. The order of the Six Healing Sounds follows the progression of the seasons.

Starting with autumn, practice the Lung Sound, followed by the sounds of the kidneys, liver, heart, and spleen. Finish with the Triple Warmer Sound.

5. When you are feeling tired or depressed at work, practice the Six Healing Sounds. If you do not have time to do them all, just practice the Lung Sound and the Kidney Sound.

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$6.95

Cosmic Sounds

Sounds that Heal

Mantak Chia

Illustrations by Udon Jandee

Cosmic Six Healing Sounds

The Sounds that Heal are the Six Healing Sounds and related postures helping to restore, balance, and cleanse the vital organs. They also stimulate the Chi flow throughout the body to enhance one's overall health and vitality. The Cosmic Six Healing Sounds and their postures help to release any excess heat that may be trapped in the cooling sacs which surround each organ. This booklet will show you how to assume the postures and produce the sounds sub-vocally; their vibrations redistribute any excess heat into cooler regions of the body where it can safely be stored or used. Once the organ energies are balanced, you have a good foundation for establishing and nurturing the virtue energies. This will help to maintain the Chi balance throughout the system.

Practice of the Cosmic Six Healing Sounds will restore and maintain your calmness and good health. Greater sexual pleasure and improved digestion will occur. Minor ailments, such as colds, flu, and sore throats, can be prevented or thrown off easily. Several psychologists have taught some of their patients to use the Cosmic Six Healing Sounds to relieve depression, anxiety or anger; and body work oriented healers have used the Six Healing Sounds to help speed up healing, and the healer spends less life force energy.

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Cosmic Nutrition

Taoist Understanding, Lifestyle & Longevity

Mantak Chia and W. U. Wei

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and
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About the Authors

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Healing Tao System and is the director of the Universal Healing Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Healing Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Westetner Company.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Healing Tao Sys-

tem. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Healing Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,500 instructors and practitioners from all over the world. Universal Healing Tao Centers, Chi Nei Tsang Institutes, Cosmic Healing Forums and Immortal Mountain Sanctuaries have opened in many locations in North America, Europe,South America, Asia, Africa and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Healing Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Healing Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a word processor for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take fifty books to convey the full Universal Healing Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Chi Kung Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Healing Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Center, Internal World Class Weight Lifting Hall and complete Eight Court Recreational Facilities.

In February 2002, the Immortal Tao practices were held at Tao Garden for the first time using the Dark Room technology creating a complete environment for the higher level Taoist practices.

In September 2003 Master Chia opened the Tao Garden Holistic Medical Spa using Western and Eastern Technology with Traditional Thai Massage, India Aveda Therapies and Chinese Chi

Nei Tsang Massage. The Spa is supervised by trained and certificated Medical Doctors, MDs with Holistic Degrees providing Colonic Therapy, Stem Cell Cancer Prevention and Natural Cancer Cure Treatments.

In March 2004 the Complete Holistic Mind, Body and Spirit Training was introduce at Tao Garden.

In July 2009 Master Chia introduced the Five Star Eight Forces Detox Spa with Saunas, Therapy Color Heated Pool, Jacuzzi, and Internal Massage Treatments. This was also introduced with Raw Food and Fasting Program with Organic Juice Bar.

In September 2010 the Universal Healing Tao Instructors celebrated thirty years of Master Chia's teaching with the Tao Congress at Tao Garden having over 200 instructors present for the celebration.

Master Mantak Chia has previously written and published these forty-three Universal Healing Tao books:

Awaken Healing Energy of the Tao 1983 - published by Aurora Press
Taoist Secrets of Love co-authored with Michael Winn 1984 - published by Aurora Press
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
Inner Structure of Tai Chi - co-authored with Juan Li - 1996
Multi-Orgasmic Man - co-authored with Douglas Abrams 1996 - published by Harper Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple - co-authored with Douglas Abrams 2000 - published by Harper Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002

Tan Tien Chi Kung - 2002
Cosmic Fusion - 2002
Karsai Nei Tsang - 2003
Cosmic Orbit - 2003
Lesser Kan & Li - 2004
Cosmic Inner Smile - 2004
Cosmic Healing Sounds - 2004
A Touch of Sex - co-authored with Kris Deva North - 2005
Fusion of the Eight Psychic Channels - 2005
Wisdom Chi Kung - 2005
Multi-Orgasmic Woman - co-authored with Rachel Abrams 2005 - published by Rodale
Tendon Nei Kung - 2006
Living in the Tao - co-authored with W. U. Wei - 2007
Cosmic Vision - co-authored with Robert Lewanski - 2007
Universal World Link - 2008
Simple Chi Kung - co-authored with Lee Holden - 2008
Chi Cards - Book I - co-authored with W. U. Wei - 2008
Emerald River - co-authored with W. U. Wei - 2009
Cosmic Cleansing - co-authored with W. U. Wei - 2009
Emotional Wisdom - co-authored with Dena Saxer - 2010 - published by New World Library
Tai Chi Yang Style - co-authored with Andrew Jan - 2010
Taoist Medicine Wheel - co-authored with Kris Deva-North - 2010
Inner Alchemy from the Stars - co-authored with Christine Harkness-Giles- 2011
Tai Chi Wu Style - co-authored with Andrew Jan - 2011

Many of the books above are available in the following foreign languages editions:
http://www.universal-tao.com/publishers/index.html

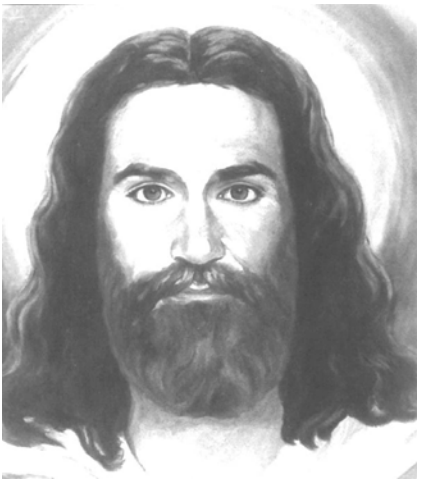

W. U. Wei

Born after World War I, growing up in the Midwest area of the United States, trained in Catholicism; this student of the Tao started studying under Master Mantak Chia in the early 1980s and in the later 1980s became a Senior Instructor of the Universal Healing Tao (specializing on one on one training). In the early 1990s this Senior Instructor moved to Tao Garden, Thailand, and assisted Master Mantak Chia in building Tao Garden Taoist Training Center. For the next six years this student of the Tao travelled to over 30 countries teaching with Master Mantak Chia and serving as Marketing and Construction Coordinator for the Tao Garden. Upon completion of Tao Garden in December 2000 he became Project Manager (Winter) for the all Universal Tao Publications and products (coordinating the completion of an additional 35 titles). With the purchase of a mountain having four waterfalls in Southern Oregon, USA (late 1990s) this practitioner is presently (Summer) completing a Taoist Mountain Sanctuary for Personal Cultivation, Higher Level Practices and Ascension. The co-author of ***"Living in the Tao"***, the 360 Taoist poems from over 1,200 poems ***"Emerald River"*** expressing the feeling, essence and stillness of the Tao; and co-creator of the Universal Tao formula cards, "Chi Cards" (6 sets of over 240 formulas) & book form with Master Mantak Chia under the pen name the "The Professor - Master of Nothingness", the Myth that takes the Mystery out of Mysticism. William U. Wei also known as Wei Tzu is a pen name for this instructor so the instructor can remain anonymous and can continue to become a blade of grass in a field of grass.

Acknowledgments

The Universal Tao Publications staff involved in the preparation and production of ***Cosmic Nutrition - Taoist Understanding, Lifestyle & Longevity*** extend our gratitude to the many generations of Taoist Masters who have passed on their special lineage, in the form of an unbroken oral transmission, over thousands of years. We thank Taoist Master I Yun (Yi Eng) for his openness in transmitting the formulas of Taoist Inner Alchemy.

Thanks to Juan Li for the use of his beautiful and visionary paintings, illustrating Taoist esoteric practices.

We offer our eternal gratitude to our parents and teachers for their many gifts to us. Remembering them brings joy and satisfaction to our continued efforts in presenting the Universal Healing Tao System. For their gifts, we offer our eternal gratitude and love. As always, their contribution has been crucial in presenting the concepts and techniques of the Universal Healing Tao.

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Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Healing Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Healing Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are **not** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Healing Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Introduction

The ancient sages and philosophers have long ago discovered the secret of regeneration. Man searches for outward cures when all the time the riddle of health lies within, by living in harmony with the natural laws of the universe.

From the health teachings passed down to our time has come the momentous discovery that the premature aging process which so quickly mars the human body is not Divinely caused; it is a chronic disease, caused by bad living habits.

Regarding aging as a disease or the breaking of natural health laws which create chronic conditions, it follows that the aging process must be subject to the universal law of cause and effect. To stop the symptoms of aging, which are sickness and decrepitude, remove the causes and the effects cannot come. At the present writing of the ancient secrets as laid down in this book, most, if not all the causes of aging and disease seem to have been clearly worked out. Most importantly of all, every one of these known causes is found to be preventable.

A fact long known to science is that the living tissue cells of our bodies are constantly wearing out and being replaced by new ones. The ancient sages, however, maintained that all human tissue is entirely renewed within seven years. If this is so, it means that every human body is actually a new body every seven years; and moreover, that if our bodies could be protected from the conditions which we know gradually bring about aging, they could live on indefinitely, barring accidents, in changeless youth and strength. By natural analogy it would appear that no human or other body could be expected to live forever, even if all the secrets of life were known to science. All things have a certain time during which they exist on the earth. If a man's time to stay is over, he will have to die. But many die before their time is over, not by a visitation of Providence, but because they are ignorant of the laws controlling their nature.

Life could be indefinitely prolonged if the problem of intestinal auto-intoxication could be solved and the two hundred year man could be as a probable result of the science of the immediate future.

We must all learn from nature, our supreme teacher, and never subject ourselves to any fanatical, rigidly enforced one-sidedness.

Air, sun, water, food, exercise, fasting, sleep and relaxation are all necessary and natural rejuvenating factors, each of equal value, each complimented and completing the others. It is our everyday task and duty to make use of them, at the right time and place, so that our vitality be strengthened, our health promoted, our well-being increased, and our ability to work preserved until the end of our days. If we carry out nature's plan properly, we shall not meet with an early, unnatural end thrust upon us by illness; we shall rather fade away in old age, without pain or torment of death, like a candle extinguishedand find eternal peace.

Medical science as a body, however, is still skeptical about procedures designed to prolong youth or rejuvenate aging. But this need not be taken as discouraging. The history of medicine and science teems with records of organized opposition to new and revolutionary developments. The accepted medical and scientific attitude toward such things has always had and always will have three states: First, it ignores them. Secondly, it becomes sarcastic and irritated about them. Thirdly, it accepts them and forgets that it has not always done so. But this organized resistance to new things works also for the good, in that it warns and protects, so far as it can, the innocent citizen against licensed fraudulent doctors and other advertising quick cure con men. These dishonest quacks should not be mistaken for the honest health practitioner or decent doctor.

Let us be warned by the mistakes of our scientific past and try to be open-minded, but not credulous toward this ancient and up-to-date knowledge of prolonging youth, preventing disease and creating a state of super health; remembering that the present advancement of science admonishes us against defining limits to possible human longevity, and more and more supports the words of an anicent sage written two thousand years ago that man does not die; he kills himself.

Your future health depends upon your daily personal habits of eating, living and thinking today. Reflect upon this ancient wisdom: If you will pay the small price now in learning and disciplining your body, mind and spirit, you will soon come to experience the joy of living in its truest sense.

This comprehensive health program should serve a very useful purpose both in securing better nutrition for those in need of it, and as a practical philosophy for those seeking a better way of living.

This book can be heartily commended for both the old and young, rich and the poor. Ones station in life does not change their biological, emotional, mental and spiritual needs. In fact, success and happiness is almost guaranteed when a wholesome attitude toward health, nutrition and a more natural lifestyle is adopted.

In the following pages you will learn not only the ancient and modern secrets of prolonging youth, preventing disease, building health and superior nutrition, but also the philosophy behind wholesome living. The final section contains invaluable information on attaining inward calm for mental and spiritual happiness and success in life. This philosophy is a practical and positive method toward attaining peace of mind, emotional stability and a vibrant state of health. What you want in life it will seek you, but when it comes, it is up to you to seize it.

Awaiting you is a rare experience. You will find this book like a passport to a wonderful new style and attitude of life. It is strange that science has largely neglected studying those of advanced age. It would seem that if more were known about the habits of those who reach 100, physicians could better advise those of us aspiring to such an age. Common sense dictates that long life must be more than chance and happenstance. There must be a combination of factors which increase man's chances for living to an advanced age, and the sooner this formula becomes common knowledge, the longer many of us can hope to survive. To that extent do diet, exercise, outside interests, and family inheritance contribute to man's length of life. Governments have given many grants for studies on various aspects of health and aging. But to date there has never been a major study to discover what factors may have contributed to longevity of our eldest citizens.

Here in this enlightening, inspiring and informative book you will discover the formulas and secret teachings that have been taught through-out the ages. This book is destined to become a classic in its field. It bridges the gap between Eastern Philosophy and Western Science. For the first time, in one volume, you will be given specific step-by-step instructions of exactly what you can do, with complete confidence, to help yourself and your loved ones to a superior way of living-and build a long, useful, satisfying life of health, success and happiness far into advanced age.

This creative book thus treats ancient health teachings in a new light, and new ideas from a unique but authentic point of view. You

cannot fail to be impressed by the sincerity, the bold directness, and the rare combination of simplicity and mastery of subject that the authors reveal as the result of years of experience, research, observation and practice in the natural health, new age psychology, spiritual and physical culture fields.

Persistent research and study into the vast mysteries of health, from all parts of the world, enables you to master any of your respective afflictions and you can accomplished it with the most gratifying results through correct nutrition. So can you, if you properly apply the physical, mental and spiritual teachings as set forth in this book. You will be introduced to proven principles, the personal application of which can literally transform your life for the better. With these safe teachings you can progress as far as you wish to go in regaining or maintaining superb health, beauty, strength and fitness.

And these Cosmic Nutrition secrets are all so simple and easy to follow. Every day that you apply these health teachings, you will build and improve your well-being. So why not start today, right now, and decide that you too can benefit by all of the wonderful restorative methods these authors reveal and discover for yourself what a dramatic transformation they will bring into your life.

Realize, health is a condition you have to personally earn for yourself. No one can do it for you. You must create your own conditions of health and physical fitness. Instead of merely treating disease, here are confidential disclosures showing you how to build the kind of magnificent health you are entitled to possess. However, in fairness to yourself, decide to apply these life principles faithfully, patiently, persistently and joyously. Stick to these advanced teachings with conviction. Believe and know that all will be well for you over a long and richly rewarding life. Because nothing else can pay you so well.

All the teachings in this tremendous volume have been fully endorsemented and complete approvaled through time tested understandings. And it is a genuine pleasure to unhesitatingly recommend that you adopt these Cosmic Nutrition rejuvenation teachings and make them a vital part of your life.

Decide to wisely join in this great, growing, popular, new, better and more satisfying way of living. Then let others marvel at the results you have achieved. May the Tao be with you and use the three greatest words in the English Language, ***"Do It Now!"***

Chapter 1

Philosophy of Health

Healthy People make Healthy Nations

When you been feeling below par with no energy, vitality, zest for living you wonder why. You are always tired throughout the day and you have to drag your weary, exhausted body out of bed mornings lacking that driving force during the day. You need ten cups of coffee to keep you going from morning until night and you are plagued with constant headaches, colds, aches, pains and sick nauseated feelings. We all have the desire to be healthy. Unfortunately, many people believe that they cannot live a life without disease, thinking a healthy, vibrant life is impossible, and give up in despair.

Approximately 2% of the people think logically for themselves, 8% of the people think when in pain and suffering and 90% would rather die than think. It is generally believed that sound health arises out of thin air, and that practically nothing can be done about it. With this apathetic public attitude toward personal health and physical fitness, is it any wonder why so few individuals radiate good health. There must be a cause for all of this suffering and disease. Observe closely what people are consuming in the name of food.

You will find them consuming tons of white sugar, white flour and it's products, salt, oils, fried foods, canned foods, TV dinners, cakes, pop, candy, alcohol, meat, cigarettes, spices, drugs and chemically treated food in boxes and packages. Nothing more needs to be said.

Cancer and other degenerative diseases are steadily on the rise. Forty years ago one out of 17 died of cancer; in 1980, that ratio narrowed to one out of five. Volumes could be written on the decaying health of civilized nations, but it would only clutter up this book. Our primary purpose is to inspire and encourage people, not to discourage them.

The ancients speak of regeneration (renewing youth) by living in accordance with universal law, the Tao. The wise person of today will also maintain youthful health and prevent disease as taught by these ancient cultures.

Health is your Natural Birthright

The individual who is in excellent health has a smile on his face, while the sick person wears a frown. Good health carries with it poise, power self-confidence, courage and success. Poor health leads to irritability, weakness, lack of confidence, fear and failure.

Good health develops personal attractiveness, for nothing adds so much to the appearance of men or women as a wholesome condition of mind and body. The person who is well can concentrate upon their work and can keep at it day after day with no sense of fatigue, depression, or discouragement. The person in ill health works spasmodically and is unable to bring to their work that energy and enthusiasm that begets success and fortune.

We are Truly a Civilized Nation

Observing the overall health of Americans today, disease is on the increase. Mental and nervous disturbances, heart disease, TB, MS, diabetes, kidney and liver disease, cancer, blood disorders, poor eyesight, etc. are evidenced more than ever before.

The Americans lead the world in science and technology, but our average life-span is only 60 to 70 years, far below that of healthful living people. Sickness and suffering affect almost the entire population of this country. Billions are poured into disease research, new wonder drugs and hospitals yearly. The civilized nations are not becoming healthier, but disease on the increase.

Who are the truly civilized nations of the world? Are they the indus-trialized countries, or the Hunzas of Northern India, the Russian peasants of the Black Sea area, Watusi tribes of Africa, Bulgarian mountain dwellers, and certain American Indian villages right the United States?

These cultures have one thing in common; no disease. Their average life-span is at least 100 years, and many reach the age of 150 and over. Disease is totally unknown to them and they work and enjoy life until the day they die. They enjoy long life in absolute health and happiness; and death is very peaceful and quiet, void of all suffering or disease. These"primitives" are very robust and strong physically, mentally, morally and spiritually. Also non-existent in these cultures, are jails, hospitals, mental institutions, homo-sexuality, divorces and police or military force.

It is a proven fact that excellent physical, mental, emotional and spiritual health create a truly civilized nation. The ancient sages, philosophers and wisemen of antiquity lived to an advanced age, as they taught and practiced the following Universal Secrets and Principles of the Tao.

Physical Health

This requires a natural diet of pure wholesome foods that include a daily balance of proteins, fats, carbohydrates, vitamins, minerals, etc. (Organically grown if possible); sufficient exercise, i.e., jogging, swimming, yoga, weightlifting, chi kung, walking, massage, herbs, tai chi, breathing techniques, cycling, etc.; fresh outside air and sunshine daily; fasting when necessary; adequate sleep (at least eight hours); resting when tired; and drinking pure water (distilled, rain water, or spring water).

Developing good physical health requires several years, depending upon one's present physical condition. The wheels of nature grind ever so slowly, but nevertheless, surely. Time and healthful eating and living habits are the primary requirements in attaining good physical health. Remember: The human body, like all phenomena in nature, possesses the inherent power of self-regeneration when the conditions of healthful existence are adopted.

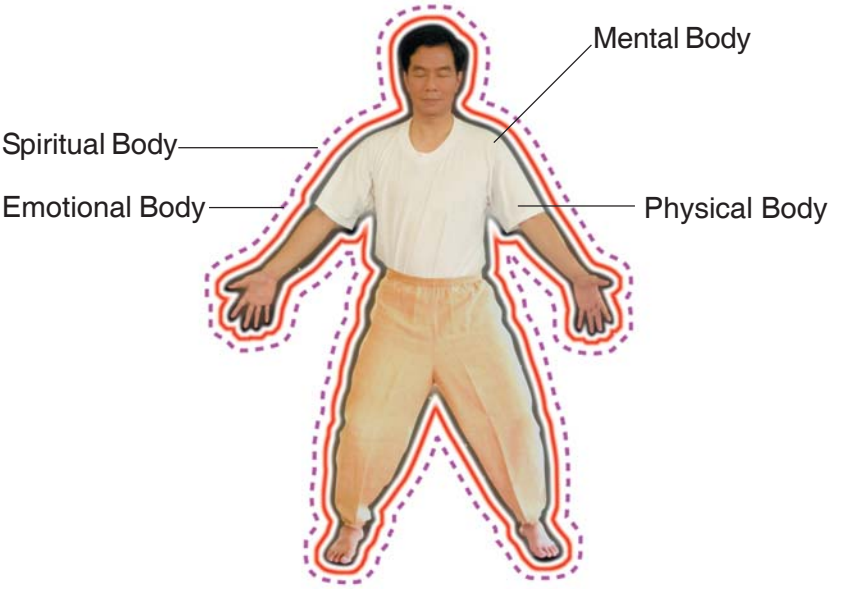

Fig.1.1 Four Body into One

Emotional Health

Emotional turmoil is the result of ill-health and confusion in the mental realm, brought about by overwork, lack of rest and sleep, jealousy, greed, hate, worry, fear, and a life of constant debauchery. People in a state of emotional confusion have little or no control in any department of their lives. They react in a negative way and become emotionally upset when the world around them is not catering to their every whim or desire. Emotional calmness under trying circumstances marks the person of dynamic health and personal magnetism. Good Emotional Health leads to lofty Spiritual Attainment.

Mental Health

Good Physical Health is a foundation for the development of sound Mental Health. The ancients teach us to remain calm and to refrain from hindering or interfering with another's life. Professor Chee Soo, a Chinese Taoist states:

"Do fish In the water complain that It Is cold or dirty? Of course not. Do they complain because the sea becomes rough, or envy or try to exploit each other? No. They live in harmony constantly, never envying or hating anything. Life for them is simply living ..." "The way to the spirit is through constant good thoughts and good deeds, now and every minute of each day, and through this way of life everything becomes an "open door" and the Tao becomes apparent to you In everything you do, and in every thought that passes through your head."

A calm mental attitude is necessary to carry us through the trials of everyday life. Living in harmony with the universal rhythm of life (moderation in every undertaking) produces a healthy mental state.

Spiritual Health

Here we have the culmination and synthesis of the first three characteristics of true health; Physical, Mental and Emotional. Spirituality can be developed only when all conditions, circumstances and difficulties in the game of life have been mastered. When all selfishness, greed, thoughts of hate, fear, anger, worry, anxiety

are vanquished, it can then be said that you are on the road to Spirituality. A Spiritual person expresses total love to all people everywhere, whether they are good or bad, black or white, rich or poor, etc. They are unattached to worldly or material possessions, and are happy with or without these possessions. Happiness to them comes from realizing that "nothing in this world brings happiness except ***Peace of Mind***.

It is our human destiny to live in harmony with the order of the universe and attain good health, otherwise we attract mental and physical suffering and pain. Health cannot be purchased. It cannot be conferred by another. Health, happiness and a successfully abundant life cannot be voted in by a government legislature. Neither king, queen nor congress can guarantee the delivery of health, vitality and happiness to you. You must earn it through your own hour by hour, day by day efforts. Only then will you have learned the joy of living as taught by the ancients.

We urge all those who are interested in living a better life, to always keep an open mind and to constantly study, and to make improvements where necessary. This is the only way possible to arrive at any kind of scientific truth. We can learn something new every day if we have the desire to do so. Let us search together now and hopefully we will meet at the Golden Gates of Truth. Disease is an unnatural state to lone living a natural existence. To those who live unnaturally and surround themselves with artificial circumstances, disease is natural, for cause and effect decrees that normalcy shall generate normalcy and abnormality produce its kind. Hence all disease is seated in some shortcoming that opens the individual to such afflictions.

Four Bodies into One

If you look at a fan you can see its blades, when you start the fan up at the first speed, the blades are moving and you can see the blades. You turn the speed up the blades are moving faster but you can still barely see the blades. Then you turn it up to its highest speed and you cannot see the blades anymore. Are the blades still there? Yes. This is what happens with our first four bodies. They are just really one body with four different frequencies (Physical, Mental, Emotional and Spiritual). If you work on one body (frequency) you work on all of them at the same time.

Fan Still see Blades
Physical Body

Fan moving see blades
Mental Body

Fan moving faster Barely see blades
Emotional Body

Fan moving fastest, cannot see the blades
Spiritual Body

Fig.1.2 Four Frequencies of a Fan are the same as the Four Bodies: Physical Body, Emotional Body, Mental Body,Spiritual Body.

The physical body is the easiest to work with because it is in time and space and we can access it with our five senses which is the Taoist's approach. By working with the physical body through Cosmic Nutrition you are also healing and balancing the mental, emotional and spiritual bodies at the same time. We can also access our other bodies (Aethetric, Astral etc.) through further advance Taoist practices with our sixth and seventh senses (clairvoyance and telepathy) but again we work on all the bodies at the same time when we work on the physical body, because all the bodies are one body.

This is how the Taoist approach healing by first focusing on the physical body because it is the easiest connection.

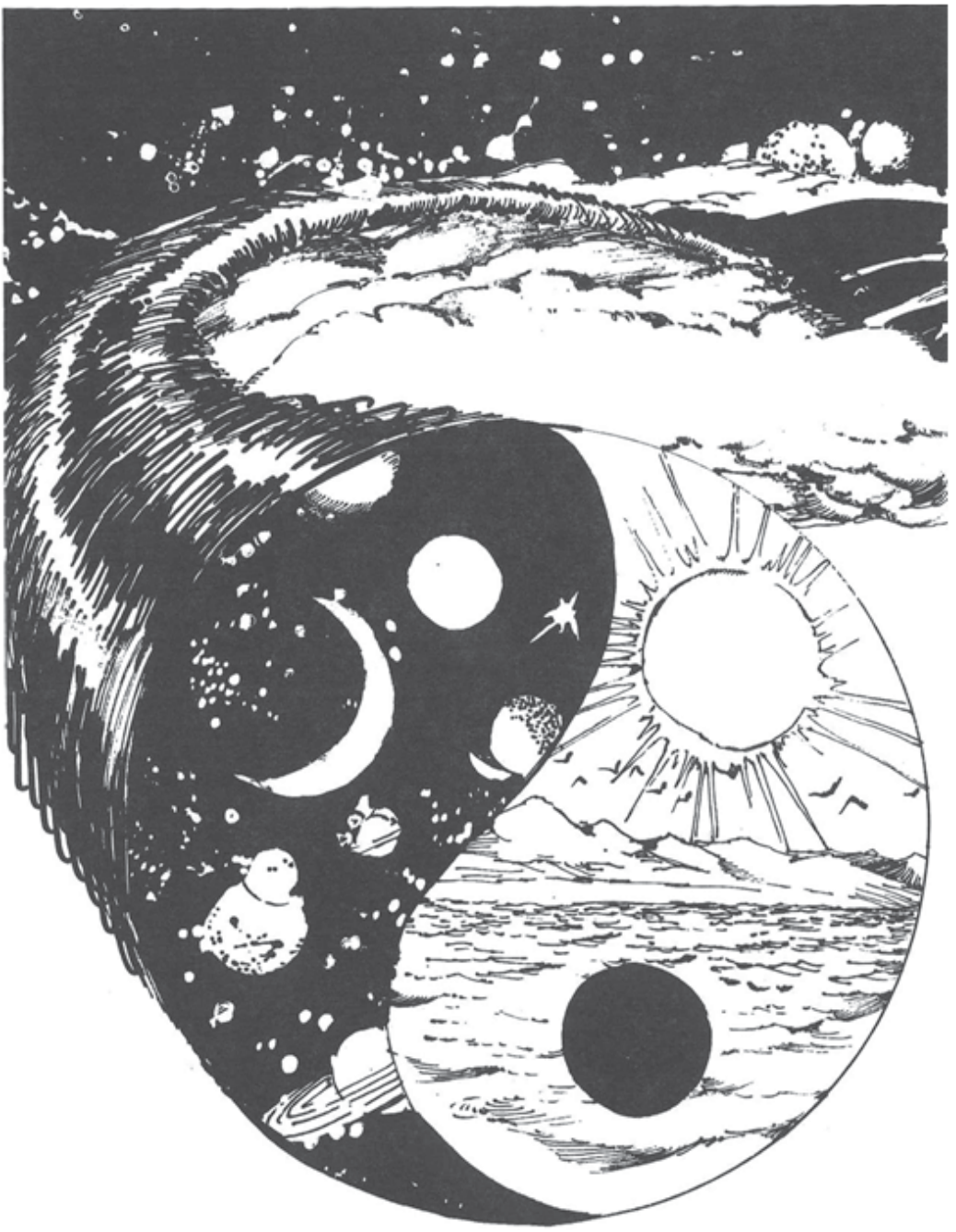

Fig.1.3 Infinity Heavenly Realm - Yin and Yang Physical World

Toxemia, Drug Medication, Cure of Disease and Germ Theory

Oliver Wendell Holmes, M.D., that scholarly gentleman, who was far ahead of the medical world, so aptly voiced his verdict upon his own medical profession when he once stated;

"I firmly believe that, if the whole materia medica could be sunk to the bottom of the sea, it would be all the better for mankind and all the worse for the fishes,"

What is Toxemia? What is Disease? What is Cure? For the answers to these questions we have before us a book written by a medical doctor in 1926, entitled, "Toxemia Explained", skillfully penned by Dr. J. H. Tilden, in which he defines Toxemia and Crisis of Toxemia. In the process of tissue building metabolism there Is cell building anabolism and cell destruction catabolism. The broken down tissue is toxic. In health when nerve energy is normal it is eliminated from the blood as fast as evolved. When nerve energy is dissipated from any cause physical or mental excitement or bad habits the body becomes enervated; when enervated, elimination is checked causing a retention of toxin in the blood or Toxemia. Of the action of drugs we know little; yet we put them into bodies about which we know less, to cure disease of which we know nothing at all.

Action of Disease

Disease in and of itself is a remedial process; a crisis of toxemia"; the end point of years of enervating habitspoor foods, overeating, alcohol, smoking, lack of exercise, stress, little sleep etc. The body continually strives to heal itself, and disease is the process of self-healing. The organism attempts to eliminate or discharge that which is harmful to it; these are the symptoms of disease, which are generally accompanied by our early warning system called pain. If pain is heeded and the proper natural therapy applied, including correct eating and health habits, disease and the symptoms of disease can be overcome.

Chemical drugs merely palliate the symptoms of disease; they impair the body's self-healing process and drive the disease toxins deeper into the organs and tissues. Drugs produce "side effects", which are very often far worse than the original toxic dis-

ease. The side effects of drugs indicate that the body is using its vital energy in an attempt to eliminate the drug poison through the internal organs or other body parts. Medicines only relieve the "temporary" symptoms of disease, pain and distress; they do not overcome disease or improve one's state of health and well-being.

Drugs do not possess the quality or power to act in a living organism; the living organism acts or reacts to any drug or poison in an attempt to expel it before it causes any possible internal damage. The key word here is living. The human body cell is a living intelligence, and as a unit of life it knows when it is being ill-treated or poisoned by dead and inert substances inimical to its existence. Thus, we observe the side effects of drugs when the living, acting body goes into action against them.

Dr. H. M. Shelton, a leading health researcher writes about the action of drugs: When a drug is vomited, this is an action, but it's an action of the living organism and not of the lifeless drug. It Is absurd to write of the physiological actions of poisons: first, because they cannot act; and, second, because their presence always occasions pathological action. These so-called physiological effects of drugs are symptoms of disease. No pharmacologist, no pathologist, no physician will deny this. Dr. Anthony J. Sattilaro, who cured himself of cancer through diet, writes: If we can at least show that people can live better in their lifetimes, rather than suffering all the iatrogenic effects of the standard modalities that we have in Western medicine, I think we will have made a great contribution.

Drugtoxicity

Treating the sick with drugs only adds more to the existing toxemia within the body. It suppresses the healing power of the body. Drugs destroy red blood cells, cause anemia, and create a false illusion of being cured. The drugged patient returns again and again for stronger doses of medication and more experimental treatment. Remember: Health is built through everyday healthy eating and living habits. In addition, health can be restored by applying nature's wholistic therapies, i.e., fasting, herbs, acupuncture, massage, sunshine, oxygen, hydrotherapy, exercise therapy etc.

Drugs Do Not Cure

The following statement is a universal law oi healing: Medicines do not heal or cure the body. The true cure lies in the removal of the causes of disease, and adopting rational and healthful living habits. When this path is followed, the body will then have the energy and power to regenerate, recuperate and heal itself. We then become free from the causes and symptoms of disease.

There are no instant cures for diseased living habits. The process of disease takes many years to develop, as does the return to health. Nature works her wonders ever so slowly. We can dis-cover new wonder-cures everyday, however, we can never escape from the natural law of cause and effect, or whatever we sow, so shall we reap. Disease is created by diseased habits; health is created by natural health habits and principles.

Fig. 1.4. Toxic Phycial, Emotional, Metal & Spiritual Bodies

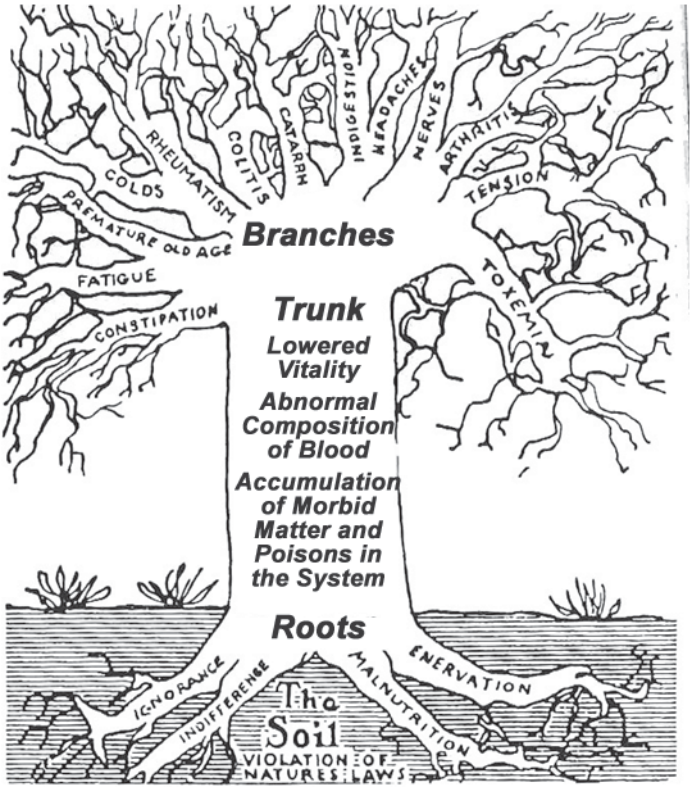

Fig. 1.5. The Root causes of Impaired Health - Tree of Toxemia

Enervation Causes Toxemia

A thousand and one enervating habits of living are the primary causes of toxemia. Without proper and adequate nerve energy, our food is not digested and assimilated properly; cellular elimination and renewal is checked; metabolic wastes are retained in the system, causing toxemia; this leads to a crisis of toxemia, or what is commonly called a disease. Disease is a crisis of elimination by a system overloaded with toxic waste and auto generated poisons. A fast, rest in bed, and the giving-up of enervating habits, mental and physical, will allow nature to eliminate the accumulated toxin; then, if enervating habits are given up, and rational living habits adopted, health will come back to stay.

Acute and Chronic Disease

Acute diseases are short termed. Their symptoms are often violent, but only temporary. Acute symptoms indicate that the body possesses sufficient vital nerve force and energy to eliminate internal toxic conditions, such as colds, flus, mumps, measles, acne etc. On the other hand, chronic diseased conditions are of a more long standing nature, in which pathological degeneration of the cells, tissues and organs has taken place, i.e., cancer.

Suppressing acute symptoms of disease with drugs, if continued for many years, will result in chronic ailments. Acute disease symptoms should be allowed to run their course, without suppressing them with drugs. Acute symptoms turn into chronic pathology by suppressing them. Drugs create chronic disease by suppressing the natural channels of eliminationkidneys, bowels, lungs and skin.

The indiscriminate use of medication when the body is already diseased (toxic) is an unwise gesture. If the organism has the inherent power of self-healing, self-cleansing, and self-regeneration, what then is the purpose of inducing drug medication in an attempt to cure the sick? Answer: There is no return to health with such a practice. It is just a practice and nothing more. Human beings are the willing guineapigs to these drug experimenters. The cures may come and the cures may go, but the curing goes on forever. Also, the billions of dollars involved in the research and the sale of drugs, goes on forever.

This outmoded suppression and treatment does not stop the cause of sickness, cannot prevent further illness and it certainly plays no part in the building and maintenance of healthy cells and tissues. It is not the Creator's intention that man should live by the aid of crutches (drugs and other artificial remedies) or turn this planet into one vast hospital for the sick.

Crisis of Toxemia

Every so-called disease is a Crisis of Toxemia, which means that toxic matter has accumulated in the blood above the point of toleration, and the crisis, the so-called disease call it cold, flu, pneumonia, headache, or typhoid feveris a vicarious elimination. Nature is endeavoring to rid the body of toxin. Any treatment that obstructs this effort of elimination, baffles nature in her efforts at self-curing.

Drugs, feeding, fear, and continuing to work prevent elimination. A cold is driven into chronic catarrh; "flu" may be forced to take on an infected state; pneumonia may end fatally if secretions are checked by drugs; thyphold will be forced into a septic state and greatly prolonged, if the patient is not killed. Drugging pain of any kind checks elimination and prevents the human organism from cleaning house.

Cancer, tuberculosis, Bright's disease, and all chronic diseases were once innocent colds "ameliorated" and which returned and were ameliorated again and again, each time accompanied by a greater constitutional enervation, and a greater constitutional toleration for toxin-poisoning, requiring a greater requisition of mucous membrane through which to eliminate the toxin.

To find the cause of cancer, start with colds and catarrh, and watch the pathology as It travels from irritation, catarrh, inflammation Induration, ulceratlon to cancer.

The proper way to study disease is to study health and every influence favorable or unfavorable to Its continuance. Disease Is perverted health. Any influence that lowers nerve-energy becomes disease-producing. Disease cannot be its own cause, neither can It be Its own cure, and certainly not its own prevention.

The treatment of disease is so simple that It staggers those who believe in drug curing. Heroic treatment is disease-building. Find in what way nerve-energy Is wasted, and stop it stop all nerve leaks. Then returning to normal Is a matter of time, in which nature attends to all repairs herself. And nature resents help medical officlousness.

Body Regenerates Itself

Western medicine too often tends to look at disease in small parts, forgetting that the whole body functions together as an entire unit. Instead of merely treating a particular symptom of disease, we must learn to look for the cause of disease, and eradicate it.

The real error arose when pharmacology and morphology (form and structure of living things) joined together to treat disease. An organ is treated with a drug, or an organ is transplanted. We are only temporarily palliating the symptoms of disease. The body functions as a whole, and will regenerate itself if properly cared for; it

was never meant to be taken apart or artifically poisoned. The organs work in a system within the body to overcome disease, balance itself and regain a state of equilibrium. This is the thrust of holistic medicine. The germ theory of disease will be laughed at during the next century as the crowning piece of folly of the present.

Germ Theory: Myth or Reality

How did the Germ Theory begin? In the mid-seventeenth century, Leeuwenhoek and O. F. Muller studied and reported several forms of bacteria. Around 1830, Ehrenberg separated and grouped microbes into species and genera. Early investigations were badly handicapped by poor microscopes and the lack of understanding and accuracy.

Louis Pasteur became famous as a result of the controversial research he conducted on the germ theory of disease. He is known mostly for the Pasteur treatment of hydrophobia and pasteurization. Pasteur claimed the body was like a barrel of beer, and said, like beer, our bodies were at the mercy, or subject to invasion from germs and bacteria. He pronounced the Germ Theory of Disease, thusly: Each type of germ was responsible for creating its own specific type of disease or sickness. And diseases are due to an outside invasion of specific germ organisms.This theory was merely an announcement or conjecture by Pasteur, but it was, unfortunately, heralded as the final answer and great advancement in science, though the theory had absolutley no foundation in fact. If this theory were true, and proved scientifically, we should all be dead immediately by germ invasion.

Over a century later Dr. Robert O. Young discovered while working with dark field phase-contrast microscope (This high-powered microscope can magnify objects up to 28,000 times, enabling one to clearly view bacterial and fungal forms in exact detail in the blood.) that a dying cell revered back to a living cell when the internal environment of the cell changed from an acid statement to an alkaline state. He was so overwhelmed that he research all the data on the germ theory dating back over a 150 years and discovered that our bloodstream and the inside of your body (cells) have a landscape or terrain and in a disease state the body tissues to become too acidic. This imbalance sets the stage for chaos and disease based on the acid/alkaline balance in the terrain when the body is not getting the raw materials (nutrients) it needs for maintenance and

repair to change the terrain back to normal. He concluded that germs are symptoms that are a result of thriving in an unbalanced terrain. Through Dr. Youngs research he discovered that Antoine Bechamp (1816-1908) a French Professor of Medical Chemistry and Pharmacy described the process of fermentation for what it is: a process of digestion by microscopic beings. He was the first to assert that the blood is not a liquid, but a flowing tissue and brought to the world in 1866 profound revelation that the granules were living ferments. He renamed them microzymas meaning small ferments as an independently living element within all living things, and is both the builder a recycler (Creative Cycle) and destroyer (Controlling Cycle) of organisms.In a state of health, the microzymas act harmoniously and fermentation occurs normally. But in the condition of disease, microzym become disturbed and change their form and function. Their function is a twofold and they are poised to recycle the physical body upon death into the earth (dust to dust). He referred to microzymas as the builders and destroyers of cells. Disease is a condition of our inner terrain and is not caused by attacking entities. This living particle of dust was first discovered by Professor Antoine Bechamp in 1864, and he found it to be physiologically imperishable and autonomously alive, meaning it have the ability to adapt to any circumstance while maintaining its purpose to enhance and organize life whether for the host or for itself. Bechamp stated that the microzyma was thoroughly impressionable and the only living entity capable of receiving and impression. These understandings of Bechamp and Young explaining the microzymas and the balancing of the pH factor (+ Yang & - Yin) confers with the all of the Taoist understandings of the Cosmic Dust Particulars(Star Dust) that give life to all beings and the balance of Yin and Yang in the body for health and well-being. In the morning at sunrise or in the evening at dust you can see them by squinting into the sun as shiny particulars giving life to all of the earth.

Pasteur himself, at a later date, proved the fallacy of the germ theory to his entire satisfaction despite his previously heralded announcement. However, since it departed from his first discovery, that germs cause disease, his new discovery was suppressed.

Pasteur stated that germs and bacteria are not the exact and primary cause of disease. He abandoned his earlier beliefs on the Germ Theory and became convinced that the germ was secondary and the disease came first. He said: The presence in the body

of a pathogenic agent is not neces-sarily synonymous with infectious disease. Pasteur finally opened his eyes to the fundamental fact that germs and bacteria change their forms according to their environment. He realized the truth of these facts in the mid-1880's. However, the stage was set, the propaganda had already began, the lie perpetuated by the regulars, and the error, unfortunately, has continued up to the present day. Thus arose the foundations of the modern germ theory of disease, and in the midst of the wildest conjectures and the worst of logic, a nucleus effect was won, which has since grown and Is growing daily.

Scientific Germ Discoveries

The investigations of Cohn, Pasteur, Koch, Nageli, Kurth and others were totally overlooked: They proved that bacteria are affected by the medium in which they are cultivated. Not only are the forms modified, but also the physiological activity varies in degree and time. There is no question that certain bacteria are associated with specific diseases, but the big question science must face is: Are these germs the accompaniment of the disease or are they the cause of the diseased condition?

The idea that bacteria of a certain specific kind was the accompaniment of the disease was ruled out because it was found that in any particular disease the same type of bacteria was always found So, in order to satisfy a doubting public and furnish an answer to the question, What makes me sick? The medical profession answered germs, of course.

However, in view of the scientific research which has been cast aside by medicine, It is just as reasonable to assume that the maggots and flies found In a manure pile caused the manure pile as it is to assume that the various kinds of germs and bacteria, bacilli, or micro-organisms, by whatever name you may call them, found In a thoroughly filthy body poisoned with (bad) food, drugs, and bad habits, caused the condition of ill health.

Long ago it was demonstrated that the living tissues of a healthy body exert actions which are antagonistic to any of these parasitic invaders; and later bacteriological research shows that the mere admission of a germ or bacteria into an animal does not necessarily cause disease. With the claim by Dr. Rawlins that 2% of the people are diphtheria carriers, in other words, have diphtheria germs in their noses and throats, and yet have no diphtheria, how is the germ theory as the cause of disease correct?

We constantly breathe in some 14,000 germs and bacteria per hour. You cannot keep them out of your body; they are everywhere. Why, then do we not all have some form of disease? Why are some people immune to many diseases, and others susceptible?

It was proven many years ago by Dr. Bosenow of the Mayo Clinic that bacteria change their form according to the medium in which they live. For example, he was able to 'reduce the pheumococcus (germ) to a streptococcus, and a streptococcus back to a staphylococcus,' simply by changing the medium and environment in which they live. This is very important for you to under-stand, for it will liberate you from the fear that germs can cause a disease. People fear from lack of understanding; and when they understand that both health and disease are created by then-own living and eating habits, they will no longer fear the (ubiquitous) ever-present germ.

Fig. 1.6. Learn to Live with Our Germs, they are our Friends

Truth about Germs

It is a scientifically known fact that: 1) Germs take on a form in accordance with their environment; and 2) So long as the internal environment and health of the body remains sound and vigo-rous, it will be completely immune; 3) Germs and bacteria are the lowest form of scavengers and they thrive and multiply in waste matter and filth within the system; 4) Disease germs and bacteria are not capable of affecting healthy living cells and tissues, for they do not have the strength or power to change or alter a higher living life form than themselves, i.e., germs only feed on the lifeless waste of an unhealthy and broken down condition of the body; 5) Bacteria are not the cause of disease, but may be considered as acces-sory factors or tertiary causes, analogous to the common garbage fly or vulture, who feed only when the refuse is placed in the garbage receptacle or an animal dies in the wild.

Germs are Necessary Beneficial to all Life

Microbes are spread throughout nature, are ubiquitous in fact. Human groups swarm with them. They are in the food we eat, the water we drink and the air we breathe. We are reared In an environment laden with them. We cannot escape them. We can destroy them only to a limited extent. We must accept them as one of the joys of life.

From the stand-point of Natural Science, germs cannot be regarded as the cause of disease, for if they were, we should all be victims of one or more germs at all times. Germs are saprophytes; that is, they live off dead inorganic matter. They are omnipresent scavengers in Nature's great laboratory, working over dead organic matter Into forms appropriate to the nourishment of growing vegetation. They are essential nitrifying agents in the soil. Without them, neither plant nor animal could long exist, and the earth would rapidly become encumbered with dead bodies. In the septic tank, sewage is reduced by them until it finally passes out pure water in which fish may live. From both, the esthetic and economic viewpoint, they are benefactors. They are friends of higher life. We live in a balanced and interdependent world, which Is too complex to ever fully understand, but our dependence upon the symbiotic support of germ life is, at least partly, known.

In the body, germs break up and consume dead and dying cells and discharges from the tissues. They perform the same function in the body that is ascribed to them everywhere else in nature. Viewed from this angle, they are purifying and beneficial agents.

Germs are really our best friends. All living matter and human health are totally and com-pletely dependent upon bacterial presence. They are fundamental to the existence of all higher organic life. The atmosphere has 4/5 nitrogen. The soil contains nitrogen fixing bacteria. No plant or animal can use nitrogen directly, with the sole exception of this soil bacteria, which converts nitrogen, with other elements, into nitrates and nitrites and thus develops material for the plant to develop protein. We obtain our nitrogen from the plants, and the plant gets it from the soil with the help of bacteria.

Scientific experiments have shown that when small animals were placed in completely germ free containers, they failed to develop normally; the intestinal tract became abnormal, liver deformed, lungs failed to develop properly and many deformities and ill-health followed. Bacteria is essential for normal development and health, for example, infants at birth are totally sterile, but in 24 hours there are millions of bacteria in the gastro-intestinal tract, which are necessary for the utilization of mother's milk.

Complete and adequate digestion of food is dependent upon a natural abundant supply of intestinal flora, which are referred to as bacterial enzymic activity. They are necessary for the breakdown, assimilation and absorption of all food material. When health Is normal the digestive secretions are sufficient protection against germs and parasites. Germs may cause putrefaction in a meal of lobsters when enervation prevents digestion; but when digestion is normal, the bacillus are utilized as food along with the lobster. Alt of the digestive juices are germicidal, and the normal digestion digests germs as readily as it does apples or bread.

Germs do not cause Disease

If germs are powerless against a healthy body, the logical preventative is the cultivation of health. If the body manufactures its own antiseptics and antitoxins, it should be supplied with the proper elements of sun, air, water, (natural) food, exercise, rest, etc., out of which to build these protective potencies, instead of being subjected to the present mad-house efforts to produce artificial immunity.

Pasteur said: “In a state of health the body is closed against the action of disease germs.” It is a mistake to single out one of the correlated factors that constitute cause and hold it responsible for pathology. Germs alone can no more pro-duce pathology than a seed alone can produce a tree. Just as a seed must have a fertile soil, moisture, air, water, warmth and sunshine, if it is to grow into a tree so the germ, if it is to add its complicating influence to an evolving pathology, must find certain essential conditions existing in the bodies of those it enters, before it can do the slightest harm. Normal nerve energy and pure blood in a word, good health are proof against germs of all kinds.

Impaired health provides the suitable soil in which germs thrive and grow. The soil is more important than the germ. Infection and degeneration can set in only when the soil is badly fertilized by inappropriate nutrition. Germs are imminent coagitators always secondary; a possible reinforcing or contingent cause, but never an exciting or primary cause.

A universal cause comes first; then the ferment, in the form of a germ, gaining access to the weakened tissues, takes on activity and attempts to assist the removal of undesirable material by liquifying it. The morbid material generated by this activity is more a by-product of the disintegrating tissue than a virulent poison resulting from bacterial maliciousness. Germ activity, in this view, is an outside accessory that facilitates the removal of auto-generated filth.” Germs “may complicate when there is a perversion of chemistry. But the germs of the so-called specific ‘diseases’ never take on specificity until the vitality of the different tissues is lowered and nutrition perverted because of dysemla the chemistry of the blood fails to supply the essential elements; then germs, previously innocent, take on virulency in keeping with the general enervation and systemic toxemia of the individual.

Four Postulates

Many years ago, the famous Dr. Koch, a bacteriologist, concluded, that the mere presence of a germ or bacteria in a cell, tissue, or organ is not adequate proof that it causes the disease, and he stated four requirements which must be met before any causal relationship between germs and disease are admitted:

1. Specific bacteria or germs must be found in every case of the disease.
2. Bacterium must never be discovered apart from the disease.
3. It should be possible to isolate the bacteria, culture them in a media and be capable of independent existence.
4. The introduction of a small amount of a pure germ culture should produce signs and symptoms of a specific disease in a healthy organism or body.

The Germ Theory, to be valid, must conform to all four requirements or postulates; all four postulates have been disproved, as demonstrated in the following explanations:

First Postulate: It is a scientifically known fact that specific bacteria are not found in every case of a specific disease. The well known physician, Sir Wm. Osier reported that the diph-theria bacillus is absent in 28 to 40 per cent of cases. According to Green's Medical Diagnosis: "Tubercule bacilli may be present early, more often late, or in rare instances be absent through-out." Koch's first condition is not fulfilled in tuberculosis, diphtheria, typhoid fever, pneu-monia or any other disease, because germs and bacteria are found in human and animal bodies which are healthy and free from the specific dis-ease, or diseases.

Second Postulate: The bacterium are found apart from the disease. It is a medically known fact that bacteria and germs are found in bodies, human and animal, which exhibit no signs and symptoms of any disease; proving beyond any doubt that the lowly innocent germ is not causing a disease. Healthy and disease free people of all ages, upon examination, will be found to harbour bacteria associated with many different diseases, yet, they do not have, have not had, and do not subsequently develop the 'diseases' these germs are supposed to cause. This second postulate holds not one bit of truth, and is rarely conformed to.

Third Postulate: Germs and bacteria are not capable of independent existence as they totally depend on the human or animal organism for their survival. If germs depend on the 'host organism' for survival, they cannot be considered as direct causes of disease, therefore, Koch's third postulate, just as the first two, fail to meet the 'acid test' of the germ theory of disease.

Fourth Postulate: Introducing germ cultures in a healthy body or organism does not produce signs and symptoms of the dis-

ease. The Bio-Chemical Society of Toronto conducted a number of very interesting experiments in which pure cultures of typhoid, diphtheria, pneumonia, tuberculosis and meningitis germs were consumed by the millions in food and drink by a group of volunteers. The results: no ill effects whatsoever. No diseased signs; tuberculosis germs were fed in water, milk, bread, cheese, butter and potatoes, meningitis germs were swabbed into the nostrils, tongues and ton-sils, diphtheria germs were taken in large doses, and the results of these tests showed absolutely no signs of disease. We have shown that fourth postulate that germs cause disease is a complete failure.

Germs vs Disease

If you have a particular disease, what should you do about It? You do not do anything about it. What you do, is you do something about the causes. That's most important. Find the causes of these various problems, and do some-thing about the causes. You do not do someting about the diseases. The disease represents the effort of resistance on the part of your body against the causes. It Is the causes of disease that bring about changes within the body; It is the causes of disease that bring about degeneration; it is the causes of disease that kill you, not the diseases. The disease Is the body's response, or its attempt to combat, overcome and destroy the causes. So, the disease is the process by which the body resists the causes of disease. Disease is the process of resistance, of action, of defense, remedial action, defensive action, or adaptive action.

As a patient's health status changes, bacteria found In the organism also change. Normal flora change into pathogenic as a result of a change of health. For example, a person in a hospital with normal or average bacteria flora in the body, after a cardiac arrest, within a matter of hours, the bacterial flora change and pathogenic bacteria are present. This indicates clearly that the person first develops the disease and then the bacteria change, pro-liferate, contribute perhaps, as secondary factors by elaborating their own toxins which the body has to deal with and in this way are associated with certain diseases, but not as causes.

Germs and bacteria are more In the nature of scaven-gers, more In the nature of organisms which are contributing positively

to the remedial process i.e., by the breakdown of certain decomposed organic products; by the partial digestion of the body's degenerated tissue, because the bacteria themselves elaborate enzymes which digest tissue and the damaged and unhealthy tissue may be broken down by the bacterial enzymes, there-fore, they are acting to some extent as scavengers.

Obviously, we can do nothing about germs in the way of destroying them. If It were possible to destroy them, we would also destroy the rest of organic existence. Consequently, germs are our benefactors, they are neces-sary to life, to normal development; they are intimately associated with certain diseases, acting constructively on our behalf. We should try to understand the inter-relation-ships between micro-organisms and man, and not be forever in fear of them or chasing methods and mechanisms of destroying them. It is, Indeed, difficult to understand why a whole pro-fession has gone insane on the subject of bugs, to the utter neglect of those states of metabolism and nutrition which, when vitiated, constitute the universal cause of all disease.

The medical profession believes that the blood can be immunized. Normal blood does not need it, and the process lowers its resistance; and the victim of low resistance toxemia is further deteriorated by such treatment. An unreasoning way to rid the victim of germs and parasites Is to destroy them with germicides and parasiticides. After killing them off what is to be done about the habitat the patient? The belief that germs can be killed Inside the body is untenable, for any chemical that destroys micro-organisms also destroys the body. Even If medical men are still trying to kill venereal germs with drugs, the fact still remains that they damage their patients more than they do the germs. If I would live my life over again I would devote it to proving that germs seek their natural habitat diseased tissue rather than being the cause of diseased tissue; e.g,, mosquitos seek the stagnant water, but do not cause the pool to become stagnant.

Germ Theory Conclusions

The great fact remains that germs, bacteria and microbes are our best friends instead of our worst enemies. They are necessary in both health and diseased conditions; in health, as friendly bacterial ferments (enzymes) to necessitate the proper digestion

and assimilation of foods; and in diseased conditions, by becoming active and assisting in the removal of undesirable material (dead cells, cellular wastes and filth) by liquifying it. Germ activity, in this view, is an outside accessory that facilitates the removal of autogenerated filth, which, if not released, will cause the dissolution of the body. With the filth go the germs. The search for 'germs' and 'germ killers' has lasted for over 100 years, and in all that time science has never found an anti-biotic, pill, or vaccine that would kill a germ that would not also kill the living body.

It is now known generally that the juices of a healthy body present far greater powers of immunity to all manner of germs than any anti-biotic that can be made. It would be more intelligent, instead of hunting for a magic pill, powder or medicine to kill off 'germs', to study the require-ments and conditions that bring about a state of health. By living in this "Super State of Health", one need not worry about resisting noxious bacteria, for you will once and for all rid your (temple) body of the filthy soil that is required for the life and propagation of 'germ scavengers'. For then, you and germs will be living together on friendly basis.

The entire philosophy of health is expressed in these words, Keep clean internally and externally, and learn to control and stay within the magnetic margins of your vitality and health. These health building suggestions, if followed faithfully, will reward one with superior health, vitality, energy and a zest for living far into advanced age. One will have no fear of germs, for through understanding they will gain knowledge, wisdom and the power to master the drama of life, including the lowly microbe. Neither ought you to attempt to cure the body without the soul; for the reason why the cure of many diseases is unknown to the physicians of Hellas is because they are ignorant of the whole, which ought to be studied also, for the part can never be well unless the whole is well.

American Death Ceremony

The death ceremony started as a crude ritual, back In the days of witchcraft. In recent years it has been developed Into a science. It usually takes from 10 to 15 years, however modern scientific advancements are shortening this period of time. It starts with one simple headache. When the one aspirin will no longer cover up the headache, take two.

After a few months, when two aspirin will no longer cover up the headache, you take one of the stronger compounds. By this time it becomes necessary to take something for the ulcers that have been caused by the aspirin. Now that you are taking two medicines, you have a good start. After a few months these medications will disrupt your liver function. If a good Infection develops, you can take some penicillin. Of course the penicillin will damage your red blood corpuscles and spleen so that you develop anemia. Another medication is then taken to cover up the anemia. By this time all of these medications will put such a strain on your kidneys they should break down. It is now time to take some antibiotics. When these destroy your natural resistance to disease, you can expect a general flare-up of all of your symptoms. The next step is to cover up all of these symptoms with sulfa drugs. When the kidneys finally plug up you can have them drained. Some poisons will build up in your system but you can keep going quite a while this way.

By now the medications will be so confused they will not know what they are supposed to be doing, but it does not really matter. If you have followed every step as directed you can now make an appointment with your undertaker. This game Is played by practically all Americans, except for the few ignorant souls who follow nature. Leave the drugs in the chemist's pot if you cannot heal yourself with nature's food.

Code of Health:

Balancing Yin & Yang Foods - Fasting or Eliminative Diet - Intestinal Cleanse - Sufficient Exercise - Stretching - Plenty of Fresh Air Exhaling Sufficiently - Proper Posture - Adequate Sunshine - Pure Water - Moderation - Correct Reading & Close Work - Self Control - Comfortable Clothing - Sufficient Rest & Sleep - Deep Breathing - Relaxation - Correct Eating - Acid & Alkaline Balance - Chewing Food Well - Personal Cleanliness - Knowing What You Want - Positive Thinking - Confidence - Compassion - Honesty - Eating Foods In Season & your Climate - Temperance in Habits - Eat only When Hungry & Thirsty - Cheerfulness - Thankfulness - Forgiveness & Love - Freedom - Meditation & Prayer

Fig. 1.7. Learn to Work with the Causes of Health

Causes of Disease:

Eating Extreme Yin & Yang Foods - Toxemia (From Enervating Habits) - Constipation Over or Lack of Exercise - Insufficient Stretching - Indoors Too Much - Insufficient Exhaling - Incorrect Posture - Lack of Sunshine or Over Exposure - Impure Water - Overwork - Incorrect Reading & Excessive Close Work - Nervousness - Lack of Self-Control - Restrictive Clothing - Insufficient Rest & Sleep - Working at Night - Tension & Worry - Malnutrition - Out of Acid/Alkaline Balance - Poor Personal Hygiene - Confusion - Fear & Doubt - Eating Foods Out of Season & your Climate - Using Prescription & Recretional Drugs or Alcohol - Overeating & Drinking - Self Righteousness - Discouragement - Self Pity - Fault Finding - Gloominess - Vengence & Hate

These are only a few of the basic causes of health and disease. Open your mind, for we can always learn more about life; ***Know Thyself***; keep the channels of your mind ever open for new causes. Remember: The mind is like a parachute; it functions only when open. Doctors cut, burn, dismember and torture the sick, and then demand of them an undeserved fee for such services.

Fig. 1.8. Learn to Work with the Causes of Disease

Take Charge of your Health

True understanding dispels fear. When we understand health and disease, in its whole form, we can no longer place the blame for our ill-health on the lowly germ or bacteria. We then look within for the answers to build our health force. No sane person wants to be ill; we all desire to be healthy and vibrant. It is tragic to witness loved ones in pain and suffering. Unfortunately, too few people understand or adhere to the natural laws that govern health and life. The ancients referred to sowing and reaping as karma or cause and effect. One may sow (cause) good karma by adhering diligently to the habits that create health. Conversely, one may also sow (cause) illness by ignoring the habits of natural health.

We can be the director of our destiny, captain of our soul and builder of our health if we pursue and practice the upward path as laid down thousands of years ago by the ancient masters. We recognize that the future of medicine is in prevention. Our idea is to give good nutritional and other advice so that people can keep themselves well and alive.

Chapter 2

Yin and Yang Principle

Force of the Universe

In ancient times human beings lived to over the age of a hundred. In our time, we are exhausted at the age of fifty. This is because of changes in circumstances, or is it that mankind is becoming negligent of the laws of nature.

Also in ancient times there were the so-called Spiritual Men: they mastered the Universe and controlled Yin and Yang. They breathed the essence of life (Cosmic Dust Particules), they were independent in preserving their spirit, and their muscles and flesh remained unchanged. Therefore they could enjoy a long life, just as there is no end for Heaven and Earth. All this was the result of their life In accordance with the Tao, the Right Way of Yin and Yang. This coming from profound statements were written some 5,000 years ago in the Huang Ti Nei Ching Su Wen (Yellow Emperor's Classic of Chinese Medicine), an ancient Chinese manuscripts on the subjects of health, healing and medicine.

The Oneness (Wu Chi) split and becomes two. These two are the poles and energies of yin and yang. They emerge continuously from this point within the expanse of infinity as a result of the endless movement within the primal sea. By their combination and interplay, the yin and the yang give rise to all the forms that inhabit the world of the relative universe. Thus, all antagonistic-complementary dualisms of the phenomenal world are but the two faces of the front and the back of one ultimate reality.

The secrets of health, life and longevity have been known and passed down from generation to generation by the ancient sages and wise men throughout history. The universal laws of Yin and Yang were formulated by the masters of the mysterious East. They observed all physical phenomena on earth as being duel in nature; that is, for every force, object or occurrence, there exists its opposite polarity.

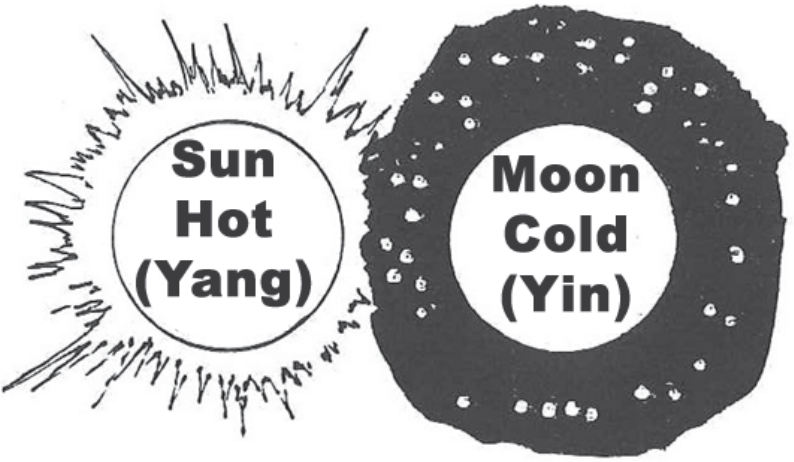

Fig.2.1. Yin and Yang Principle (Cold & Hot)

In the food category, grains, eggs, meat, cooked foods are Yang; and fruits, vegetables, raw foods and juices are Yin. Yin is a centrifugal force in nature (cold, expansive, negative pole, alkaline, etc.). Yang is a centripetal force in nature (hot, contractive, positive pole and acid etc.).

The principles of Yin and Yang is not a fabricated theory or fad dietary practice of recent origin. The conception of Yin and Yang began with the conception of the universe and our physical world. It is the law of polarity or the law of opposites. Nothing exists except in relation to its opposites. To understand electricity, one must learn how to use positive and negative fields.

Yang is positive. Yin is negative. We would not know darkness (Yin) without light (Yang); heat (Yang), without cold (Yin); male (Yang), without female (Yin); hardness (Yang), without softness (Yin); and life (Yang), without death [Yin).

Although the forces of Yin and Yang are dual in nature, they proceed from, and are directed by one unifying force in the universe, known by various names such as God, the Tao, Brahmin, etc. It is a dualistic force emanating from one all-preyading power. There is only one presence and one power; and from that Supreme Power the relative duality of Yin and Yang flow.

The Yin and Yang Principle is relative in this constantly changing world. Nothing forever remains the same. No phenomena is purely Yin or purely Yang. Yin and Yang flow into each other like night and day, or inhaling and exhaling.

Eight Strands of the Brocade

History shows that the Chinese may have been direct descendants from the ancient sunken continents of Lumuria and Atlantis dating back some 12,000 to 25,000 years ago. The Chinese Taoists received the knowledge of the Yin and Yang Principle even before recorded history, stretching far back into antiquity. The Taoists sages teach us that the Principles of Yin and Yang have been passed down by highly spiritual beings called “Sons of Reflected Light” ages ago.

The Sons of Reflected Light brought to China the healing arts, known as the “Eight Strands of the Brocade”, which consisted of eight principals of health as follows:

1. Diagnosis
2. Yin/Yang Diet and Exercise
3. Herbal Therapy
4. Hydrotherapy
5. Acupuncture
6. Acupressure
7. Massage
8. Meditation or the Way of Occulsion

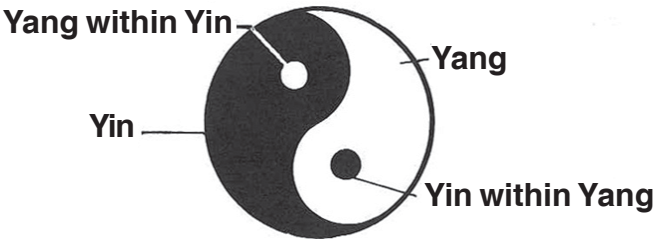

Fig.2.2. Yang within Yin & Yin within Yang

Taoist Principles of Life within Yin and Yang

1. All Phenomena exist within Infinite Space.
2. All Phenomena are Interrelated.
3. All Phenomena are Relative.
4. Everything has Energy or Vibration.
5. Everything is in a Constant State of Change.

Unique Taoist Principles of Yin and Yang

Seven Principles of the Order of the Universe

1. All things are differentiated apparatus of One infinity.
2. Everything changes.
3. All antagonisms are complimentary.
4. There is nothing identical.
5. What has a front has a back.
6. The bigger the front, the bigger the back.
7. What has a beginning has an end.

Twelve Theorems of the Unifying Principle

1. One infinity differentiates itself into Yin and Yang which are the poles that come into operation when the infinite centrifugally arrives at the geometric point of bifurcation.
2. Yin and Yang result continuously from the infinite centrifugality.
3. Yin is centrifugal. Yang is centripetal. Yin and Yang together produce energy and all phenomena.
4. Yin attracts Yang. Yang attracts Yin.
5. Yin repels Yang. Yang repels Yin.
6. The force of attraction and repulsion is proportional to the difference of the Yin and Yang components. Yin and Yang combined in varying proportion produce energy and all phenomena.
7. All phenomena are ephemeral, constantly changing their constitution of Yin and Yang components.
8. Nothing is solely Yin or solely Yang. Everything involves polarity.
9. There is nothing neuter. Either Yin or Yang is in excess in every occurrence.
10. Large Yin attracts small Yang. Large Yang attracts small Yin.
11. At the extremes, Yin produces Yang and Yang produces Yin.
12. All physical forms and objects are Yang at the center and Yin at the surface.

Yin and Yang create Physical Change

Change in the physical realm is inevitable; it manifests itself in a dual nature Yin and Yang which is opposite yet complimentary. Neither one is absolute and the interplay between them is a constant giving and taking, like the ebb and flow of the ocean tides acting and reacting, day flowing into night, summer (Yang) slowly giving way to winter (Yin). Yin and Yang are created by the Universal Force, the Tao, which is without duality. Although Yin and Yang operate apart in outward phenomena, they are one within their natural core.

According to the Nei Ching:

"The Canon of Medicine provides us with many examples of this interchange between Yin and Yang and of the duality preserved within a single thing. The most concrete example of this duality Is man. As a male, man belongs to Yang; as a female, man belongs to Yin. Yet both, male and female, are products of two primary elements, hence both qualities are contained in both sexes. The Principle of Yin and Yang Is the basis of the entire universe. It Is the principle of everything in creation. It brings about the transformation to parenthood; it is the root and source of life and death. Heaven was created by an accumulation of Yang; the Earth was created by an accumulation of Yin. The ways of Yin and Yang are to the left and to the right. Water and fire are the symbols of Yin and Yang. Yin and Yang are the source of power and the beginning of everything in creation (Alpha and Omega). Yang ascends to Heaven; Yin descends to Earth. Hence the universe (Heaven and Earth) represents motion and rest, controlled by the wisdom of nature. Nature grants the power to beget and to grow, to harvest and to store, to finish and to begin anew.

Yin and Yang in Health and Longevity

Nei Ching continues:

"Everything in creation is covered by Heaven and supported by the Earth. When nothing has as yet come forth the Earth is called: the place where Yin dwells. It is also known as the Yin within the Yin. Yang supplies that which is upright, while Yin acts as a ruler of Yang. The affinity of Yin and Yang to each other was held to have a decisive influence upon man's health. Perfect harmony between

the two primogenlal elements meant health; disharmony or undue preponderance of one element brought disease and death. But man is not helpessly exposed to the whims of Yin and Yang. Man had received the doctrine of the Tao as a means of maintaining perfect balance and to secure for himself health and long life."

The Tao as used in this book does not represent the masculine or father image. It refers here to the Supreme Creative Force of the universe. The Tao is also referred to as the one, that creates the Yin and Yang, negative and positive, centrifugal and centripetal, alkaline and acid, electron and proton and the polar opposites which manifest on the physical plane, earth. Yin and Yang is the physical reality of the One Spiritual Force. Male/Yang and female/Yin are also physical opposites of the One Creative Universal Force. The I Ching states:

"The Yang and the Yin of the Universe are called Tao. This knowledge of the Tao and of the workings of Yin and Yang was considered even strong enough to counteract the effect of age".

Thus, we find it said in the Nei Ching: "Those who have the true wisdom remain strong, while those who have no wisdom grow old and feeble. The official view of the Chinese Government regarding Yin and Yang states that it 'contains an original, spontaneously dialectical, and simple materialistic doctrine; it is free of superstition; it approximates scientific formulation; and it represents a progressive way of thinking.

Nature of Yin and Yang

The nature of health and diet is intimately connected and interrelated to the universal laws and operations of Yin and Yang; it is an inescapable principle of life; a duality stemming from infinity itself and manefesting in the physical world of polar opposites.

With this understanding we need to know how can we personally use the laws of Yin and Yang in our daily lives and how can it affect our diet, health and mental make-up. The Ancient Mystery Schools teach what we have not been taught in our modern schools. The following general list of Yin and Yang classifications and attributes will help one to understand what the ancients taught and clarify one's thinking on this most vast subject. Remember: The Yin and Yang Principle is the Law of Opposites in the Physical Realm. Study this chapter and subsequent ones to thoroughly acquaint yourself with the infinite variety and characteristics of Yin and Yang that abound in our midst.

Yin and Yang Characteristics

Yin	*(Its Opposite)*	*Yang*
Alkaline		*Acid*
Centrifugal		*Centripetal*
Negative		*Positive*
Potassium		*Sodium*
Cold		*Hot*
Moon		*Sun*
Water		*Fire*
Dark		*Light*
Night		*Day*
Moist		*Dry*
Fall & Winter		*Spring & Summer*
Female		*Male*
Rest		*Activity*
Vegetable		*Animal*
Expansion		*Contraction*
Outward Tendency		*Inward Tendency*
Narrow		*Wide*
Space		*Time*
Purple		*Red*
Soft		*Hard*
Mental		*Physical*
Periphery		*Center*
Earths Surface		*Earths Center*
Raw Food		*Cooked Food*
West & North		*East & South*
Sour, Sweet, Spicy		*Salty, Bitter*
Tall		*Short*
Slow		*Fast*
Passive		*Active*
Weak		*Strong*
Chronic Disease		*Acute Disease*
Even Numbers		*Odd Numbers*
Parasympathetic Nervous		*Sympathetic Nervous*
Catabolism		*Anabolism*
Fruitarian		*Carnivore*
Electron		*Proton*
Abdomen		*Back*

Yin	*(Its Opposite)*	*Yang*
Yin Organs		*Yang Organs*
Hollow		*Dense*
Absorption		*Blood Filled*
Discharge		*Regulators*
Store Energy		*Transport Energy*
Gall Bladder		*Liver*
Small Intestine		*Heart*
Stomach		*Spleen/Pancreas*
Large Intestine		*Lung*
Bladder		*Kidney*

Yin and Yang in Food & Environment

By studying and understanding the Yin and Yang foods and weather conditions we can know what to eat, how to eat, when to eat and how much to eat at any given time of the day or year.

Hot (Yang) climates produce expanded (Yin) fruits, vegetables, flowers and plants, with the aid of much rain which is Yin and expansive. This climate produces food that is large, watery, sweeter, with an abundance of the potassium element. These are cooling (Yin) foods eaten in Hot (Yang) weather. So, if you are down south or in the tropics, the natural tendency is to consume more of the Yin foods grown in that climate. These foods are also considered base forming or alkaline elements. The blood must maintain a slightly alkaline condition, 7.8 on the pH scale. If the blood becomes positively acid, one would die immediately.

Cold (Yin) climates produces more contracted (Yang) foods such as smaller grains, vegetables and fruits with less liquid within them. Cold climates require more warming foods in the diet, such as cooked grains, soups, bread, and other cooked foods. Foods grown in Northern climates contain an abundance of the sodium element (Yang), which is necessary to keep our body warm and contracted during the cold winter months. Yin juicy fruits and vegetables are also Alkaline. Yang foods, such as grains, eggs and meat are considered Acid forming. The key is to balance the Yin and Yang and the Acid/Alkaline in the diet.

Generally, eat more Yang foods during the Cold (Yin) winter, about 60 to 85 percent Yang and 10 to 30 percent Yin foods and reverse in summer.

In balancing the diet, one must learn to listen to that small inner voice within; or body intelligence, which instinctively instructs us as to the proper choice of foods in the varied environments. If one can tune-in to their true bodily needs, Yin and Yang balance can easily be achieved, resulting in superior health.

Yin is considered anything that grows large and fast in a short period of time. Any substance, for example, drugs, marijuana, medicine, sugar, alcohol are extremely Yin (expansive) and they tend to dissipate and expand the cells and tissues of the body and brain causing light-headedness or a spaced out feeling and lack of judgment.

Since Yin is centrifugal and expanding outward, it requires a great deal of Yang binding and contracting force to equalize the extreme expansion caused by excessive Yin foods and Ying mind-expanding substances.

Salt, time, heat and pressure create Yang conditions in nature and in food preparation. Salt preserves food and in the body it contracts (Yang) the cells and keeps them from expanding. Yang foods counteract Yin (expansion). We all need a balance of both Yin and Yang to maintain a healthy body chemistry.

Sun, heat and activity are Yang. The Moon, cold and rest are Yin. The sun and heat bring on summer outdoor activity. The air is magnetic and charged with Yang elements, which produce Yin summer fruits and vegetables. Cold weather is Yin, passive, tending toward indoor activity; it produces more Yang root, dense vegetables and grains, and smaller Yang fruits or none at all, as in the Arctic.

We are living in a universe of positive (Yang) and negative (Yin) magnetic energy fields, which continually vibrate at tremendous speeds and produce magnetic currents. These magnetic currents register on our brain in a color spectrum visible to the eye. The ultraviolet rays of the spectrum are Yin; and the infrared rays are Yang. From Yin to Yang in this order: violet, indigo, blue, green, yellow, brown, orange, and red.

Eat According to Seasons

The influence of food, climate and environment affects and intimately binds mankind to the inescapable natural laws of Yin and Yang. Cold weather creates an inner biologic need for warmth, fire and Yang foods. Hot or warm weather creates an inner biologic Yin need for Yin foods, which are cooling and refreshing, such as, more water, juicy fruits and vegetables.

An excessive consumption of cook Yang foods eaten in Yang hot weather overheats the body, blood and internal organs, resulting in extra heart beats, a rise in blood pressure, profuse sweating and fatigue. An excessive consumption of raw fruits, juices, liquids or raw vegetables eaten in Yin cold climates will automatically lower ones blood pressure, (due to expansion of vessels) thinning the blood, causing cold hands and feet and weakening the heart and circulatory system.

As the old saying goes, we are what we eat. The changing weather conditions can affect us in a detrimental way if we do not learn how to acclimate ourselves to the changing environment. Just as the weather changes, so must our diet change to meet the demands made upon it. If one lives in hot climates, less Yang foods should be eaten, including a moderate use of raw fruits and vegetables. To balance body chemistry in northern climates, eat more Yang quality grains, beans, seaweed, soups, stews, and less of the Yin fruits and vegetables.

In the food category, eggs, meat protein (lean part), salt and fish are extreme Yang foods; while all grains, legumes, peas, and seaweed are more balanced and healthfully Yang foods. Extreme Yin foods are sugar, alcohol, cow milk, ice cream, tropical fruits, drugs etc. (Refer to Yin and Yang food chart in another chapter). Balanced and healthy Yin foods are; apples, plums, peaches, pumpkin, most vegetables, most seeds and nuts etc.

Yin and Yang Scale

From Yin to Yang in this order:

1. Drugs
2. Sugar
3. Oil
4. Cow Cheese
5. Ice Cream
6. Tropical Fruit
7. Fruit Juice
8. Baker's Yeast
9. Honey
10. *Fruit (In Season)
11. *Water
12. Nuts & Seeds
13. Nutritional Yeast
14. *Sea Vegetables
15. *Land Vegetables
16. *Beans
17. *Grains
18. Chicken
19. Fish
20. Miso
21. Lean Meat
22. Egg
23. Sea Salt

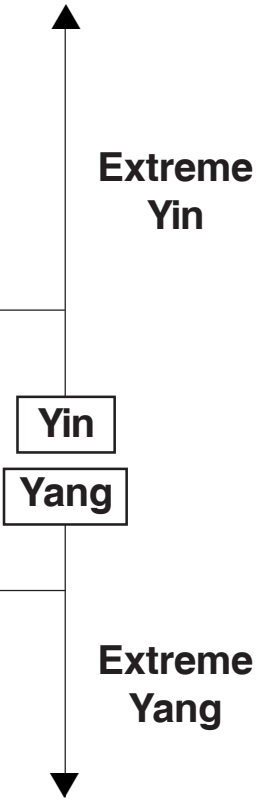

*Staple foods to be used daily in season.

Fig.2.3. Yin and Yang Food Scale

Time, heat and salt will turn Yin vegetables more Yang. Cooked and salted Yang foods become more Yang. Raw eggs are not as Yang as cooked ones. Raw apples are more Yin than cooked ones. Sprouted grains are Yin; cooked and salted grains are more Yang. Dehydration yangizes food. Fats in meat, whole cow cheese, whole milk, cream cheese and ice cream are extremely Yin due to their high fat content. Foods should comprise the main part of ones diet. Consume miso, cold pressed vegetables oils and sea salt during cold weather to maintain internal balance and body warmth.

It takes wisdom and intelligence to understand and apply the universal laws of Yin and Yang. The more it is applied, the more one is guided in life by the Tao. The ultimate key to this unifying principle is very simple. Moderation or adhering to the middle path in life and avoiding extremes in activity will automatically create a Yin and Yang balance, leading to harmony in body, happiness in mind and soul and success in life.

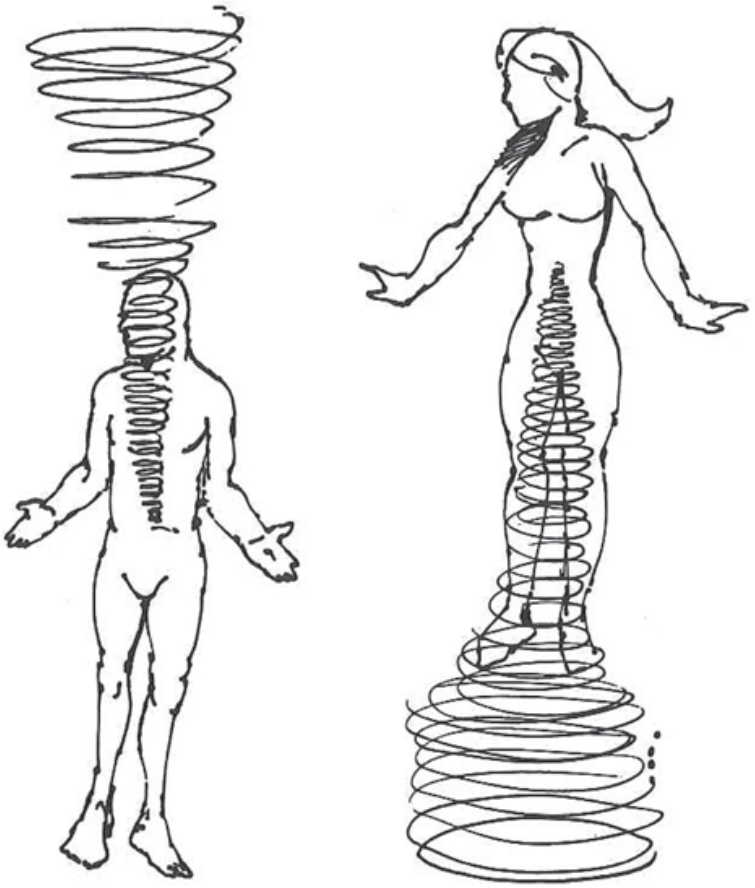

Fig.2.4. Yang Contracting & Force Yin Expending Force

Contracting centripetal force from the upper atmosphere toward the center of the earth produces the Yang-Male organism. Expending centrifugal forces from the center of the earth upwards, produces the Yin-Female organism.

Cosmic Energy Vortex

A clairvoyant's picture of the heart of the universe; the ultimate physical atom seen as a manifestation of pure light force spinning perpetually through itself interacting in the opposites of Yin and Yang.

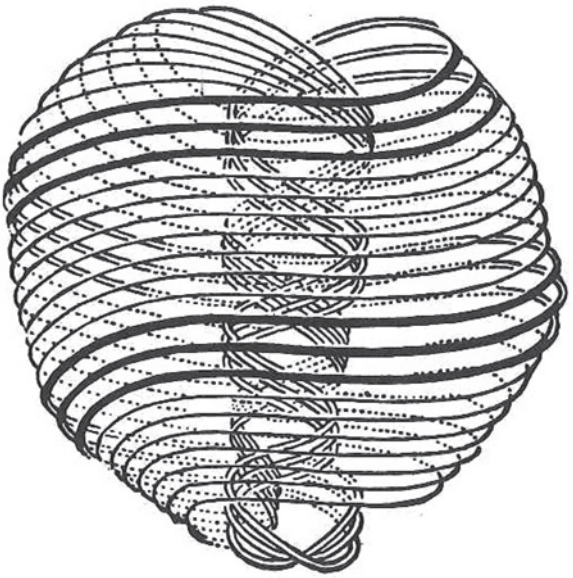

Fig.2.5. Yin & Yang Cosmic Energy Vortex

Yin and Yang

From the interaction of the Subtle Origin in the Mysterious Mother and the balanced energy of Yin and Yang, all phenomena of life came forth. Yang energy is subtle and spiritual. It is positive and has action as its nature. Yin is coarse and physical and is referred to as earth. It is negative and receptiveness is its nature. Both energies are equal and support each other in perfect harmony.

Under the Law of Great Transformation, the energies are constantly changing, never static. Their movement in change is constant. Therefore, the future of a person has several possibilities, but nothing is certain, until the person makes it so.

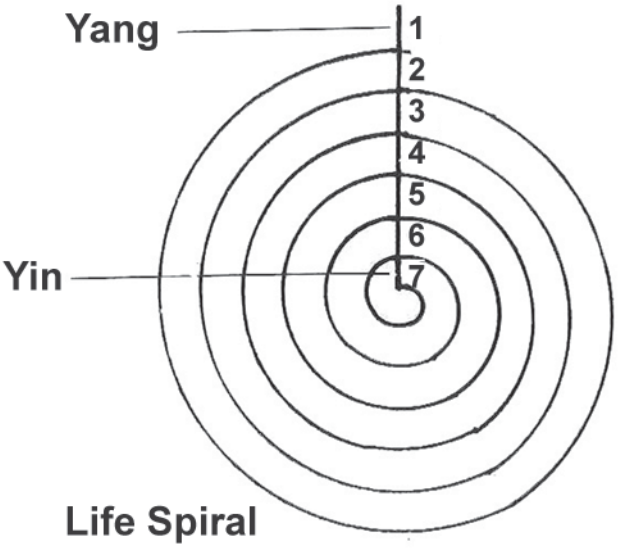

Fig.2.6. Yin & Yang Life's Spiral

Lifes Spiral Unfolds

1. Infinity (Wu Chi), the Tao.
2. Yin and Yang - Relative World begins.
3. Energy, Emotion & Thought - Phenomenal World begins.
4. Fire, Pre-Atom - Material World formed.
5. World of Elements & Minerals is formed.
6. Vegetable Organic World begins.
7. Human Beings and Animal Kingdom begins.

Yin Yang Theory

Taoist Wisdom comes from observation of nature and her laws. By understanding nature's flows we can understand our own internal alchemy and also the dynamics of the universe. The microcosm reflects the macrocosm. The Taoist creation story is that Oneness, or Wu Chi, the source of all, manifests into this life of duality that we observe. Nature is a perfect manifestation of Wu Chi, and so we can learn a lot about life from observing, understanding and living according to nature's laws.

One of the first aspects of nature we can observe is duality: the existence of apparent opposites. For example, we see night and day; we can feel the difference between winter and summer; we experience both light and dark; we can feel warmth and coldness. These apparent opposites are not separate from one another, but are the same energy at different stages of a cycle. Thus we can observe the seasonal cycle taking us from the coldest part of winter through to the warmest part of summer and back again.

The Taoist s called these apparent opposites Yin and Yang. As a way of reminding us how they are not separate entities, but in continuous flow, they created a symbol called the Tai Chi, which shows this flow in its spiralling and dynamic nature. One dot of black appears on the white half and a white dot in the black half. This symbolises how even when we reach extreme Yang, there is Yin within in it, and vice versa.

Fig.2.7. Yin & Yang Opposites of the Universal

Yin

This describes the feminine principle of life and energy in its most contracted form. Winter, night time and dark moon are all examples of energy at its most contracted. In winter we feel to stay in more (we contract socially). At night time we sleep (we contract our activity levels). At dark moon we become introspective (we contract psychologically). When energy contracts it becomes solid: thus all things manifest and solid are described as Yin: the body, the blood, the earth etc.

Yang

This describes the masculine principle of life and energy in its most expanded form. Summer, day time and full moon are all examples of energy at its most expanded. In summer we feel lively and sociable. During the day time we are at our most active. At full moon we feel more inclined to go out and connect with others. When energy expands it becomes more intangible (just as when water is heated it becomes a gas). Thus all things that are less solid are described as Yang: the spirit, the chi, heaven etc.

Yang within Yin

As previously mentioned, the dot of white within the black is there to tell us that extreme Yin contains the seed of Yang, and vice versa. This part of the theory is often hard for people to understand. Once again, looking to Nature can help us to grasp this. In the middle of winter it is hard to see the seed of summer! Yet after mid-winter (Winter Solstice, December 21st) the days begin to get longer each day. This is the seed of summer.

We may describe a big crowd as Yang and a vast empty space in Nature as Yin. The crowd is sociable, the space is unsociable. And yet we can feel extremely lonely in the midst of a crowd. We can feel connected to the entire universe when we are alone in a vast part of Nature. This is another example of Yin within Yang (lonely in a crowd) and Yang within Yin (connected to all in vast space).

Because each opposite contains the seed of the other, when we push to an extreme, we find we suddenly shift to the opposite. Thus if we push something to extreme Yang, it will become Yin, and vice versa.

For example, when we are cold, we contract and become still; we can describe as Yin. In the summer we feel more flexible and active; described as Yang. But in extreme cold we begin to shiver, moving very, very fast extreme Yin has become Yang, in the hottest part of a hot summer we may simply lie motionless under a tree. Yang has turned to Yin.

Another example of the extremes is when we become a workaholic and work excessively hard (Yang), we may suddenly have a breakdown and develop fatigue (Yin). Likewise, people who are forced into a Yin state of not being able to be active, such as being confined into a small space, become very restless (Yang).

Yin and Yang

We can compare opposite pairs as Yin and Yang. However, it is important to remember that these opposites are not separate: they are one entity at different stages of its cycle, or Oneness reflected as two.

Yin	*Yang*
Night	*Day*
Winter	*Summer*
Dark Moon	*Full Moon*
Dark	*Light*
Introvert	*Extrovert*
Intuition	*Analysis*
Rest	*Activity*
Feminine	*Masculine*
Body	*Spirit*
Material	*Immaterial*
Contracted	*Expanded*

There can be a tendency to try to perceive Yin and Yang as being separate when we try to understand oriental theory through the dualistic modern mind: this leads automatically to judgment. We may try to choose between Yin and Yang, almost subconsciously, to decide which one is good and which one is bad. Our cultural bias tends to be towards labeling all Yin aspects as bad and Yang as good. The whole purpose of the Tao path is to transcend dualistic thought and to recognize that all of life is indeed One. Therefore, we need to be careful not to make judgments, but see how apparent opposites are simply different stages of the cycle, or reflections of the whole.

By observing Nature, we can begin to eliminate such judgements. When one has developed a deep relationship with Nature, one cannot choose between winter and summer or between sunset and sunrise. Rather we begin to embrace all and see it as one cycle that has different stages, Nature can teach us how to live in a harmonious way. Nature has no resistances to what is: the tree does not try to hold onto its leaves when autumn comes; the rock does not fight the ocean waves that break against it, but gently wears away. Thus we can learn to accept what is, and yet to walk our path: the path is The Way; it is the Tao.

Chapter 3

Great Physician Within

Fasting is Natural

The phenomenon of fasting is probably the least understood and the most abused health measure that has ever been used in the history of man. Understood and used with the proper knowledge of its processes, it is life saving and health promoting. Misunderstood and abused without thorough knowledge of its principles, it can be disease producing and death dealing.

To set the record straight, fasting or abstinence from food is an intimate part or process of every breathing life form, either plant or animal, (including human) that has ever existed since the beginning of Creation.

Just as we must all rest, mentally and physically from our daily activities, and give our bodies a chance to recharge its batteries through sleep, so must we allow our digestive and eliminative organs a rest (fast) from all food for the purpose of cleansing, purifying and revitalizing worn out cells, tissues, blood and all physiological functions.

There is nothing, mysterious, or occult about fasting. Although fasting has been used in various religious cults throughout history, it has not been generally recognized for its true value in the scientific care of the sick, the maintenance of health and the extension of life.

The word occult means secret. Fasting is an occult mystery only to those who have not taken the time to study it. And it will continue to be a mystery to all those who condemn it without first giving it a thorough investigation and fair trial.

A great sage once said: Condemnation before investigation, is the greatest bar to all knowledge. Let us not condemn the natural process of fasting, for it has been proven through scientific research and testing to be of true value in all states of health and disease. Abstinence is one of the best of all remedies and alone cures with out danger. Instead of using medicines, rather fast a day. Fasting is the royal road to internal purity.

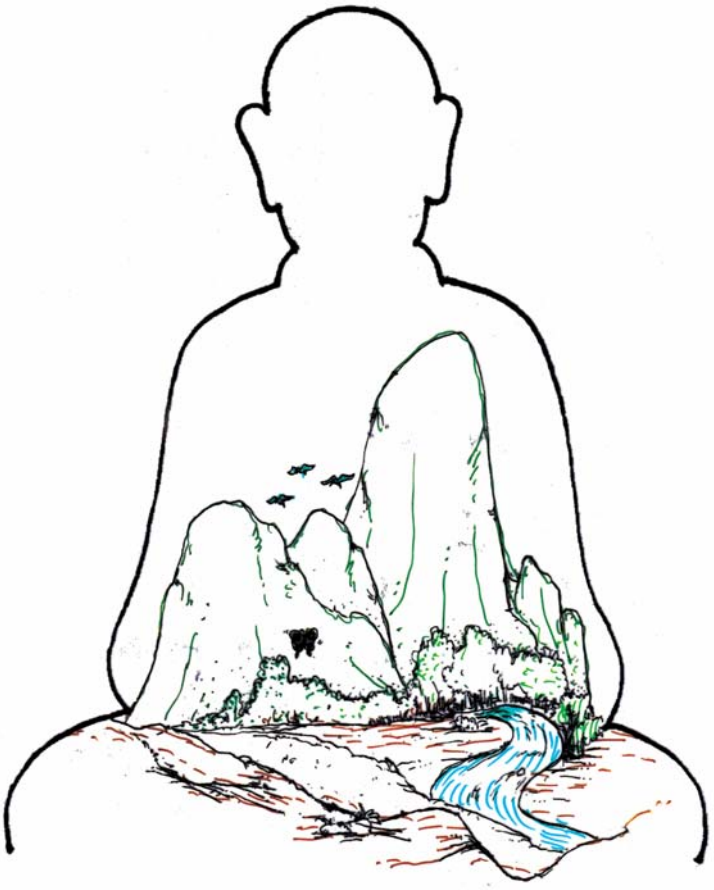

Fig. 3.1. Great Healing Physician Within

Fasting Defined

Fasting is defined as a complete and total abstinence from all food, including juices, for a shorter or longer period of time for any number of purposes, i.e., illness, weight loss, etc.

It can be said that we all fast or abstain from all food during sleep and we customarily break-the-fast with the morning breakfast.

Everyone fasts in rest or sleep whether he knows it or not. Continual eating without periods of fasting would cause internal toxemia or food poisoning. However, nature dearly cares for us by taking away our hunger after a certain amount of food is consumed. It is a built-in safety valve, otherwise we would all die from gluttony.

Any food eaten in excess of bodily needs and natural hunger will cause a toxic overload in the system of undigested waste products (toxemia) within the cells and tissues. This in turn overworks the body's eliminative organs.

We can now detect the first state of the disease process; overworked organs of elimination, followed by toxemia or poisoned blood, and ending with pathology, disease and an early grave.

Fasting allows the eliminative organs to catch up on their work. The body is always striving to maintain a balance, and when it is given a physiologic rest, (fast), it will carry out its prime objective without the aid of drugs, medicines, or any other unnatural cures.

The cure of disease lies in preventing the cause of disease. There is no disease without a cause, and the causes are many, i.e., overeating wrong foods, alcohol, smoking, worry, fear, hate, overwork, lack of exercise, sunshine, rest and sleep.

Fear of Fasting or Starving

Fasting has been feared by many people, due to misinformation and fear tactics by the press, radio, and T.V., including the unwillingness or ignorance of the medical authorities to investigate and reveal the truth of the matter to the people.

The press has run articles telling of plane crash victims and survivors of other natural disasters, in which they survived for many days or weeks without food and medical help. Subsisting almost entirely on water, they come out of it with improved health, and freedom from previous disease conditions. These cases definitely substantiate the claim that the human body is inherently capable of surviving under adverse situations with no ill or adverse effects.

Hospital authorities believe that a patient will starve to death if not fed three square meals a day of the conventional over-cooked fare. Those who are supposed to know about our health and welfare are completely ignorant about the distinction between fasting and starving. Fasting and starvation are two completely different conditions. The first is beneficial and rejuvenating; the latter is destructive and death-dealing. Starvation begins where fasting leaves off.

Fasting is a process whereby the body exists on its stored reserves of fat, protein and minerals, until they are used up or exhausted. Then it is time to break the fast. To go beyond this point is starvation. Fasting does not use up the vital tissues or organs.

Starvation is a state or condition that goes beyond the stored reserves of fasting. It is a pathological skeletal condition which ends in death. Countless people have fasted with or without supervision for a variety of reasons from a few days to many weeks. The results of these fasts have been proven to be of utmost value in achieving superior health. There is no question but that scientific fasting eliminates the bodily poisons, adipose tissue, and breaks down destructive cells. If carried out properly and scientifically, the fast is a means of acquiring complete rejuvenation and vigorous, robust health.

Experimental and Scientific Fasting

It is unfortunate for the American people that the medical society, refuses to acknowledge, recognize, or teach the value of fasting as a natural form of correct care in sickness.

In European countries, fasting, juice diets and other natural therapeutic measures, are used by their best doctors in clinics and sanitariums. One such well-known clinic is the Buchinger Sanitarium in Bad Pyrmont, Germany, where over 70,000 fasts or juice fasts were conducted. In Australia, Dr. Alec Burton has conducted thousands of fasts at his Natural Hygiene resort for many years. In this country, Dr. H. M. Shelton has personally supervised over 30,000 fasts in his 50 years of practice in Texas. In Sweden, in the year of 1954 and again in 1964, Dr. Lennart Edren led a 300 mile walkathon while fasting. A total of 30 people started and finished the walk with no ill effects. All medical tests on the fast-walkers proved to be positive, with no adverse side effects. This experiment clearly proves that man is able to fast even under strenuous physical exertion.

Dr. Shelton writes about some interesting cases of feats of strength while fasting in Volume III of the Hygienic System, Chapter XVI. He states that Bernarn Macfadden, the Father of Physical Culture, held a fasting and strength contest in Madison Square Garden in 1903. After a 7 day fast, J. H. Waltering captured 1st place by winning the 50 yard dash in 6 minutes. A 6 minute mile in 1903 was considered quite fast at that time.

Even more fantastic was Mr. Gilman Low, a weight-lifter from Boston. In 15 seconds he lifted 500 lbs., 20 times, and in 20 seconds 900 lbs. twice. On the 7th day of his fast, he lifted in 19 seconds, 1 ton 22 times. All of this was closely observed by medical

doctors. Mr. Low asserted that after a 15 day fast previously, he could have whipped his weight in wildcats. These feats were accomplished after 7 days without a bit of food.

Does this indicate a state of starvation, weakness or death? No. It simply means that the human body has a tremendous storehouse of reserve food material by which it sustains itself during periods of fasting or food shortage.

Dick Gregory, the famous black comedian, writer, and author of many books, one being on Natural Health and Vegetarian Nutrition, has undergone many fasts while engaged in long distance running (15 miles) non-stop.

We have personally gone on extended water fasts up to 2-4 weeks, and on watery fruit diets for up to 48 days, thus regaining our health and well-being. We do not recommend a fast or fruit diet for this length of time unless under proper supervision, or if you are well-versed in the procedure.

Animals and Fasting

We all can learn a lesson about fasting by observing the habits of wild and domestic animals. Animals will not eat when sick or wounded, but will retreat to a quiet location and rest, drinking only water until well.

It has been observed that some animals will consume a small amount of grass when sick. There is something in the grass and plant life that the animal craves when sick. The green chlorphyll supplies the missing elements or cleansing properties that are needed in sickness.

The household animal will recover of its own accord when left alone. It will let you know when it is ready to eat. It would be well for man to follow the same course of action as do all animals, that is, when sick, diseased or emotionally upset, take a physiological rest; abstain from all food, (fast), rest in bed, keep warm, quiet and drink only pure water as thirst demands until recovered. The humans are the only creature that eats at all hours of the night and day, and continues to do so when sick, diseased and emotionally upset.

They are the only living being that refuses to resort to fasting when sick. In their foolishness they partake of food and imbibes poisonous medications in a futile attempt to restore their sick body to health. Nothing adds to the fires of disease like drug treatment

and forced feeding. This procedure has caused much suffering and agony, sending millions of unwary souls to an early grave.

All living organisms, from the one-celled amoeba to human, the highest form of intelligent life on earth are subject to the same Universal Natural Laws of Life and Existence, namely, the inherent qualities of self-healing, self-regeneration and self-rejuvenation.

It has been noted by research scientists that scores of insects and animals abstain from food from a few days to many months during the winter season. The breeding season of numerous lower animals is a period of fasting and resting. The silver salmon fasts for weeks while swimming hundreds of miles upstream to the spawning ground. The queen ant eats nothing until her eggs are hatched, and then the hatched workers finally bring her food. An incredible period of many weeks pass before she is again ready for food. The common earth worm has been kept alive for well over 15 generations in laboratory experiments because of the periodic fasts they underwent. It behooves every medical scientist and nutritional researcher to investigate the truths nature has to offer, and to use her natural principles for the benefit of all humankind.

Fig. 3.2. Fasting is Internal Resting.

Historical Fasting

Let us again remind our medical bretheren that the father of medicine, Hippocrates, recommended fasting in the care of the sick. He said, if a sick person is fed, one feeds the disease. On the other hand, if the sufferer is witheld from food the disease is fasted out.

All nations of antiquity followed the natural principles and methods of fasting and frugal eating as advocated by their great philosophers and sages: Socrates, Plato, Pliny, Senneca, Pythagores, Moses, Jesus, Budda, Mohammed, Galen, Benjamin Franklin, Thomas Edison, and many, many more.

Jesus reportedly fasted 40 days in the mountains, and thereafter could not be tempted by the devil. Likewise, Gandhi subjected himself to fasting and prayer frequently. Moses followed suit; fasted and prayed, and he decended from the mountains a wiser man.

In early Rome, certain drug doctors were not allowed to dispense their concoctions. The great Paracelsus once said that fasting is the greatest, the physician within, that heals us. Confucius, Buddha, Lao Tzu, Christ, Moses, and others fasted for internal purity and illumination.

By following the advice and example of these great men, you too can become disease free. There is nothing to fear, but fear itself, is an old adage that can be applied to the fear of fasting. Fear not for you will be guided by the Spirit of the Great Ones who have also tread the straight and narrow way.

What to Expect while Fasting

The first two or three days of the fast are the most difficult, especially for sick people. Because the faster has, for the first time in his life missed the accustomed stimulating meal. Like a drug addict, the food addict will go through two or three days of withdrawal symptoms. At this point of the fast, the tongue may become coated white and the breath may smell bad. There may be a foul taste in the mouth, and nausea, accompanied by dizziness upon arising, topped off by an empty feeling in the stomach. After three days these symptoms will usually disappear as the body's reserve forces will draw on themselves for nourishment.

These symptoms may also reappear as the fast progresses, as the elimination process continues. Near the end of the fast these unpleasant effects will subside and a feeling of well-being will take their place. It must be understood that the elimination of toxic material thrown out into the blood stream for expulsion is a necessary cleansing process.

If a crisis overtakes you during a fast, do not panic. Here are some crisis symptoms: feverishness or chills, due to toxic material being thrown into the blood stream for elimination; cramps, retention of urine, diarrhea, headaches, and insomnia are some of the temporary eliminative symptoms one may experience before reaching normal physiological balance and high level health. Fasters require plenty of rest, sleep, fresh air, sunshine and freedom from all stress to facilitate internal healing; this especially holds true for those weakened by a debilitating disease.

Many people prefer to drink warm water during a fast, and to place a ginger compress or hot water bottle on the stomach, intestines or bowels to attract blood to the area for healing.

It is amazing how a person's hunger will vanish after the fifth day of fasting. In fact, the mere mention of food will sometimes cause nausea. As the reserve food supply within the body takes over the job of sustaining the body, other conditions are going on within to maintain a balance, i.e., the pulse rate slows down, the blood pressure decreases, and the stomach secretions are reduce. The eyes become brighter and the hearing becomes more acute. The blood cells increase in number.

As the fast nears completion, the symptoms of elimination will also disappear. The breath smells sweet. The foul taste and nausea are gone. The pulse rate, blood pressure, and temperature return to normal. The stomach secretions and hunger lacking before, now returns in full force. The mouth waters and there is a desire for the simplest of food.

There is a feeling of well-being and a new zest for living. The length of the fast cannot be determined before hand. Each case is unique and every person has different quantities of toxic poisons within them and various degrees of organic constitutional weaknesses. Nature will always indicate how long one should fast. Take it day by day.

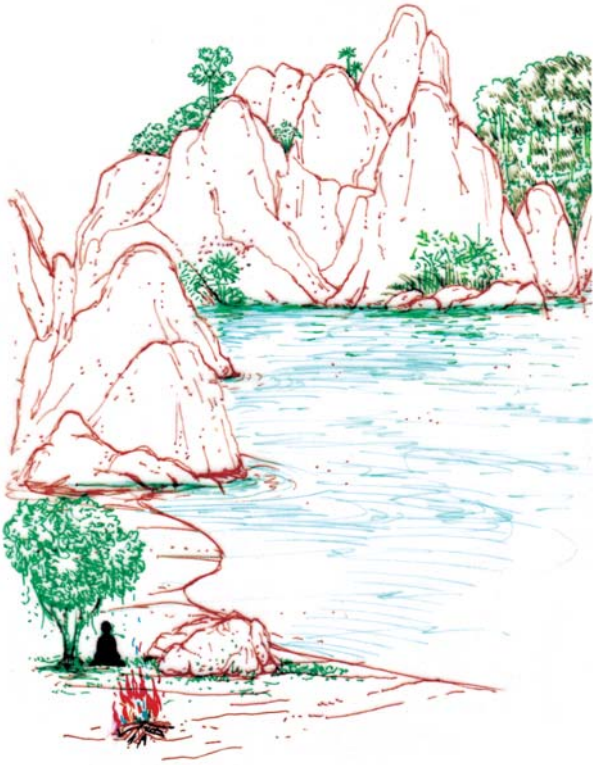

Fig. 3.3. Short and Long Fasts in Nature

Long Fasts

Remember, one fast will never completely cleanse the body. It requires from one to three years of periodic fasting and correct eating to obtain a thorough cleansing and return to vibrant health.

One long fast may produce a clean, pink tongue, but this does not necessarily indicate a totally pure and cleansed body. When the tongue has become pink, it either indicates that the body is pure or that its reserve fuel supplies and vital force has been used up for cleansing during that particular fast.

Many times the faster will run out of energy and vitality well before the tongue clears up and becomes pink. In this case, it is imperative to break the fast and resume the feeding. Nothing is ever gained by trying to break records while fasting, at the expense of the recovery ability of the body. Fasting too much and too often can make a nervous wreck out of the strongest willed person, not to mention a sickly one.

Long fasts must be taken only under proper supervision by one who knows the procedure thoroughly. Remember: The sicker the body, the more crisis reaction it will have. Therefore, the necessity to be supervised by a competent health doctor. Most people can withstand a seven to ten day fast without supervision, provided some studying has been done on the subject. Between each fast maintain a well balanced diet, obtain sufficient exercise, sunshine, fresh air, rest and sleep and emotional poise.

Precautions in Fasting:
Fasting is most beneficial in acute diseases, but not in degenerative conditions. Acute disease is a violent or quick release of toxins in the system; it is a sign that the body has enough reserve vital power to discharge and eliminate the internal poisons and heal the organism. Chronic disease is a condition of long standing (degeneration) leaving an individual with weak vital healing power.

Degenerative diseases, such as cancer, diabetes, rheumatoid arthritis, Parkinsons disease, tuberculosis, heart disease and extreme malnutrition (anorexia nervosa), do not readily respond to long fasts. Other natural health and biological therapies are recommended to regain health and balance body and blood chemistry. Some of these therapies include: herbs, acupuncture, vitamin/mineral food supplements, balanced individual dietary measures, color and music therapy, hydrotherapy, corrective exercise movements, shiatsu massage, sunshine, sufficient rest and sleep, harmonious environment, and positive physical and mental conditions.

Dr. John Tilden, an early 1900's fasting physician, advocated only short fasts from 3 to 10 days for certain chronic diseases, and thereafter fed his patients only one meal per day until they recovered. He never advocated long exhausting fasts to completion, as he believed they were too depleting to the nervous system.

Consult a natural health or biologically oriented doctor in your area for a professional evaluation and consultation of your condition.

Reasons for Fasting

Fasting can be undertaken for many reasons:

1. For Body and Blood Cleansing
2. For Colds or Flu
3. When Mentally and Physically Fatigued
4. For Spiritual Development
5. For Rejuvenating Internal Glands and Hormones
6. For Losing Weight
7. To prevent Acute and Chronic Disease
8. To Feel and Look Better
9. To Eat Less and Save Money
10. To Lower Cholesterol Levels and Blood Pressure
11. To overcome Drugs, Smoking, Alcohol etc.
12. To overcome Stress and Sleep Better
13. To improve Digestion and Bowel Movements
14. To increase Mental and Physical Discipline

Addictions to stimulating foods will cause withdrawal symptoms. Stomach rumblings, headaches, nausea, weakness, fatigue, irritability, coated tongue are definite signs that one needs a fast; and afterwards, a change to a more wholesome, natural, non-stimulating dietary. The most sensible health policy one can follow is to eat only when truly hungry, which is indicated when the mouth waters, and there is a zest and relish for natural unstimulating food. If food is not relished at regular mealtimes, skip the meal and fast until true hunger returns.

Breaking a Fast

Extreme care should be taken in breaking a 5 to 10 day fast. The first day after the fast drink 4 ounces of apple or orange juice and 4 ounces of water, mixed; one glass every two hours. The second day eat fresh fruit according to hunger. The third day continue a well balanced diet. It is best to consume the fruit and vegetables grown in the region and climate where you live, i.e., apples, berries, peaches and cherries and winter vegetables in the northern region and oranges, grapefruits and melons in the southern region.

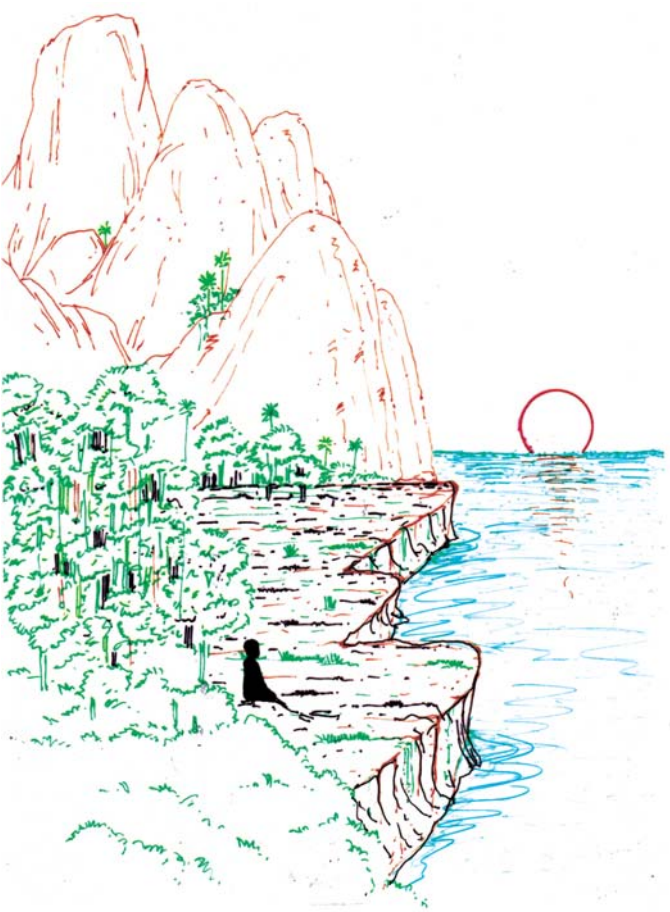

Fig. 3.4. Breaking the Fast

Fasting Recommendations

We do not recommend raw fooders or strict fruitarians to fast for any length of time; what is needed in these cases is a well balanced natural diet. These extreme alkaline diets are already naturally cleansing to the system, but are deficient in many nutrients that are necessary for tissue repair, healing and body-weight maintenance. Any further fasting in these cases will lead to disease and compound the problem.

The ancients teach that it is more beneficial to fast when ill or not hungry; all animals in nature follow this procedure. This is in conformity with the natural flow of life.

Many people attempt to set a scheduled day for fasting; but when their prearranged day arrives, they may find themselves hungry or in no mood to fast. Instead of heeding their inner psychological voice not to fast, they fast anyway. This is not a healthful practice, because the body is not in need or ready for a cleansing at that time; what one requires is wholesome food.

Many health enthusiasts believe the erroneous concept that fasting is a cure all; it is not. Fasting too long and too often, when one is not physiologically ready can lead to nervous exhaustion, anorexia, and may also lead to junk food binging. The former conditions can be fatal.

The best advice is to fast only when necessary, especially when hunger is not present, or when physically or emotionally exhausted. Missing a meal or two occasionally improves digestion, elimination, clears the mind, and increases health and longevity. Fasting in its proper time and need enables one to cleanse, heal and balance the body chemistry in a normal cycle.

Summary of Fasting

To sum up in a condensed version the benefits of fasting, we quote the leading advocate of fasting in America, Dr. H. M. Shelton:

1. Fasting does not cause the stomach to shrink up.
2. Fasting does not cause the walls of the stomach to grow together.
3. Fasting does not cause the digestive fluids of the stomach to turn upon it and digest the stomach.
4. Fasting does not paralyze the bowels.
5. Fasting does not impoverish the blood nor produce anemia.
6. Fasting does not produce acidosis.
7. Fasting does not cause the heart to weaken collapse.
8. Fasting does not produce malnutritional edema.
9. Fasting does not produce tuberculosis nor predispose to its development.
10. Fasting does not reduce resistance to disease.
11. Fasting does not injure the teeth.
12. Fasting does not injure the nervous system.
13. Fasting does not injure any of the vital organs.
14. Fasting does not injure the body's glands.
15. Fasting does not cause abnormal psychism.

On the Positive Side, Fasting does the following:

1. It gives the vital organs a complete rest.
2. It stops the intake of food, which may decompose in the in testines and poison the body.
3. It empties the digestive tract and disposes of putrefactive bacteria.
4. It gives the organs of elimination an opportunity to catch up with their work, and promotes elimination.
5. It reestablishes normal physiological chemistry and normal secretions.
6. It promotes the breaking down and absorption of exudates, deposits, diseased tissues, and abnormal growths.
7. It restores a youthful condition to the cells and tissues, and rejuvenates the body.
8. It permits the conservation and recanalization of energy.
9. It increases the powers of digestion assimilation.
10. It clears and strengthens the mind.
11. It improves function throughout the body.

Rejuvenating Power of Raw Juices

Natural science has rediscovered the regenerating and youthifying properties of raw foods and fasting as passed down throughout the ages from ancient teachings. In the days gone by, man was known to have lived to great ages in perfect health and vitality. Today, the European health clinics are utilizing the principles of this Secret Youth Formula in the form of Therapeutic Juice Fasting, including the use of fresh, raw fruit and vegetable juices, vegetable broths, youth giving herb teas and mineral waters.

Juice Therapy Fasting

In unhealthy, diseased, and acid/Yang conditions raw juice cleansing therapy is a beneficial alternative to the conventional water fast method. Both methods of fasting are useful and will rejuvenate and cleanse the body, however, a juice, vegetable broth and herb program will provide the demineralized and depleted body with the necessary elements as follows:

1. Live raw enzymes, trace mineral elements, vitamins & minerals.
2. Raw juices and broths act as remineralizers. They alkalize, purify and neutralize the acid-toxins and internal waste, as they are poured out into the blood system.

3. The blood-sugar level remains close to normal during a raw juice fast, while building up the alkaline reserves to neutralize the excessive acids in the tissues and blood.
4. The vitamins, minerals and enzymes are extremely necessary factors in supplying the life giving elements for the glands, organs, tissues and blood to increase the recovery ability and healing of the entire body.
5. Juices and liquids do not impair or tax the digestive process and are very effortlessly absorbed quickly into the blood stream, cells and tissues.
6. A juice faster does not experience much weakness or low energy lags during or after the fast, as many times occurs on a strict water fast.
7. The recovery rate after the juice fast, in many cases has been proven to be quicker and more stable. The beneficial results of the fast will be enhanced provided the person adopt a natural food & living lifestyle afterwards, as suggested in this book.
8. Raw fresh fruits and vegetables contain highly nutritive solar-energy electricity and enzymes, that operate to preserve and prolong the life of the living cells.

The morality of clean blood ought to be one of the first lessons taught us by our pastors and teachers. The physical is the substratum of the spiritual; and this fact ought to give to the food we eat, and the air we breathe, a transcendent significance.

Eliminative Diet

The Eliminative Diet consists of consuming only raw fruits, vegetables and juices, excluding proteins, fats and starches, and this list also includes the heavier acid forming fruits and vegetables such as, bananas, dates, dried fruits, potatoes, nuts, avocado, etc. Raw fruits, vegetables and juices are easy to digest and assimilate, thus enabling the remaining body energy to expend itself on self-healing and cleansing. If one consumes starch, fat, or protein foods during this cleansing diet, the healing process will be delayed. Heavier Yang/acid foods are more difficult to digest and take longer to be absorbed into the blood stream, therefore they should be avoided during a cleansing period.

The Eliminative Diet is a superb method of cleansing the body of internal impurities. A few days to a week on juicy fruits and veg-

etables, with sufficient rest, will allow the body to eliminate accumulated waste products, fatty deposits and excess weight. The best time for this type of Yin-Eliminative Diet is during hot summer months. One can expect to lose from 7 to 10 pounds of body weight and fat per week on this diet; it will also normalize blood cholesterol levels and lower high blood pressure.

Fig. 3.5. Cleansing Foods

Eliminative Crisis

Acute and chronic diseases can be attributed to the over-consumption of protein, fat and high-calorie processed starch foods. One should not be too concerned about eating high protein or other acid forming foods; the main concern here is internal cleanliness first, then afterwards a return to a wholesome nutritional program, which includes grains, legumes, vegetables, fruits, seeds and nuts (germinated), sprouts and a moderate amount of low-fat yogurt, buttermilk, cottage cheese (all raw), if you desire it.

During an Eliminative Diet one may experience varying degrees of aches, pains, headaches, diarrhea, dizziness, nausea, etc. Understand: These temporary symptoms are merely a cleansing process which are necessary before a healing can take place within and good health experienced.

These cleansing symptoms indicate that the organism is working to eliminate years of accumulated internal waste products. A crisis resulting from an Eliminative Diet or Fast is a physiologically preventative measure much less painful than the possibility of degenerative or chronic disease years later, i.e., cancer, heart disease, arthritis, etc.

Cleansing Foods

If you are an extremely busy person and do not have the time or inclination to go on a total fast for a few weeks at a Health Spa, then the Eliminative Diet and the Raw Juice Cleansing rejuvenation program is for you. The program consists of consuming only raw fruits and vegetables and their juices, to be eaten at mealtimes or at any other time during the day that you feel hungry. The following Raw Foods are excellent blood cleansers & purifiers.

Grapes	Apples	Cantaloupe
Nectarines	Raspberries	Tomatoes
Watermelon	Blackberries	Huckleberries
Grapefruit	Persimmons	Cucumbers
Cherries	Praches	Honeydew
Papaya	Oranges	Apricots (Fresh)
Pears	Plums	Mulberries
Pineapples	Blueberries	Strawberries

These foods may be used as disinfectors and mucous dissolvers in a salad consisting of tomatoes, cucumbers, green peppers and tender celery.

Onions	Garlic	Leeks
Radishes	Lemon Juice	Cayenne Pepper

The following vegetables are utilized more efficiently to cleanse the cells and tissues, build the blood and purify the internal organs. They must be freshly squeezed in a juice extractor and sipped slowly. Use carrot juice as a base, about five ounces, and add three ounces of any of the vegetables listed here:

Alfalfa	Cabbage	Alfalfa
Dandelion	Lettuce	Potato
String Bean	Squash	Asparagus
Endive	Parsley	Sorrell
Turnip	Swiss Chard	Beet
Cucumber	Kale	Parsnip
Spinach	Watercress	Carrot
Brussell Sprouts	Kelp	Green Pepper
Tomato	Zucchini	Celery

Feel Like a Million

You will be amazed at how much better you will look and feel after a fast or an eliminative diet, maybe even years younger. Without cleansing the body, one cannot possibly attain health. That is how important it is. Never eat when ill, instead rest in bed, drink distilled water when thirsty, have proper ventilation and warmth, and in a few days to a few weeks you will feel like a million.

Fasting and eliminative diets are the greatest means of cleansing the body, says Dr. J. H. Tilden, as it strengthens the nerves, aids digestion and helps to build a powerful organism.

Make up your mind that when your body requires a thorough internal house cleaning, to call on nature's maids in the form of the Water Fast, Raw Juice Cleansing or Eliminative Diet. Remember, your body must be clean before you will experience super health. Do not make a thousand excuses why you cannot begin on a sound health program. Only failures quit. The successful people in life are the ones who follow a truly logical and correct plan of living in harmony with Nature's Laws.

Fig. 3.6. Feel Like a Million in the Tao

Yin and Yang Juices

Yin and Yang refers to the potassium/sodium content of foods and juices. Basically, it involves using the food grown in the climate where you live. For instance, if you live in the North, you will obtain much better results if you consume the fruit and vegetable juices that are grown in that region; apple, pear, plum, berries, cherries, grapes, peaches, melons, carrots, beans (green), squash, celery, green pepper, cucumber, parsley, etc. These foods are grown in cold, (Yin), climates and they are classified as more Yang than tropical foods because of their higher sodium content. Northern (sodium/Yang) foods are more sustaining and warming in cold weather.

Yin, (potassium), foods are grown in hot Southern, (Yang), climates. Southerners can best utilize the foods grown in their region, such as, all citrus fruits, tomato, papaya, persimmons, mangoes, melons, peaches, berries and all vegetables grown in the South. These plant foods are high in potassium (Yin) and very cooling to the system, to withstand the hot weather.

Daily Ration of Juice

Juice is best taken on an empty stomach, or one half hour before a meal. The daily ration of vegetable juice should be from 4 to 6 ounces, unless you are on a juice cleansing program for a specified period of days, in which you can drink a quart or more per day. Any more than four to six ounces of vegetable juice on a daily basis may overwork the liver, causing yellow/orange skin, or what is known as carotene anemia. This is a result of the liver's inability to utilize vitamin A in large amounts. The darker races should observe the whites of the eyes for yellowness.

No more than four to six ounces of fruit juice should be taken daily. An excessive consumption of fruit juice overworks the kidneys and pancreas because of then concentrated sugar content, which depletes the adrenals and waterlogs the kidney/bladder organs. A healthy body produces only a small amount of insulin daily. An excessive intake of sweet juice will make the body produce excessive insulin and lead to hypoglycemia, (low blood sugar).

An excessive consumption of fruits and juices creates high alkalinity (Yin condition) in the system and overworks the adrenal

glands in its effort to maintain the pH balance between 6.5 and 7.0 of the urine. This Yin condition decreases the hydrochloric acid in the stomach, thus lowering protein and calcium absorption. An eliminative diet or fast is not recommended for diabetics, hypoglycemics or other degenerative diseases.

Remember: Consume fruit in season only; but not excessively; more fruit can be eaten in the summer for Yin and Yang balance. Use good judgment in the choice and amount of raw foods at all times. A note to the seriously ill: Please consult a natural health practitioner or a competent doctor who thoroughly understands the process of fasting, natural healing, nutritional therapy and the Yin and Yang principle. A professional of this caliber can determine more accurately, through Oriental Diagnosis, Iridology, etc., what can be accomplished in one's individual case. Disease is nature's effort to get you well. Regain your health by living away disease. Hippocrates claimed that chronic disease came from auto-intoxication, ie., self-poisoning due to constipation. The deposits of accumulated waste in the colon release toxins which inflame the nerves producing rheumatism, neuralgia, melancholia, hysteria, exzema, acne, headaches, and many many other health problems. Hippocrates also taught the way to handle disease.

Overcoming Constipation

Constipation is a worldwide problem. However, it seems to be concentrated in the so called civilized Western nations to a greater extent. Constipation was known back in the time of Hippocrates, where certain days of the month were set aside for taking purgatives, enemas and emetics. It has grown to epidemic proportions especially in stress filled modern society where unnatural living habits are more prevalent, and tons of refined, processed and artificial junk foods and drugs are consumed daily. Constipation precedes most disease conditions. Constipation can be defined as the inability to evacuate the bowels; impacted colon; lack of intestinal strength and paristalsis activity; lack of complete bowel movement; improper stools and infrequent movements. There can also be constipation of the liver, kidneys and bladder because of a clogged condition from overeating.

Yin and Yang Constipation

Atonic constipation is a Yin condition; expanded colon and intestines. The symptoms of this disease are: lack of muscular tone in the colon and abdominal cavity; fallen and pushed out intestines with gas pockets and clogged fecal matter.

Clause: Overeating, excessive fruits, fats, liquids, sugars and other Yin foods to excess; excessive use of cathartics and improper and overuse of enemas.

Constipation is a disease of civilization. Wild men and wild animals do not suffer from this malady, which is perhaps responsible for more human misery and mental and moral disaster than any other single cause.

Spastic constipation is a Yang condition; the colon is constricted or tense and the fecal matter is evacuated in small lumps and stringy.

Cause: Excessive intake of meat, fish, fowl, eggs, white flour products and salt.

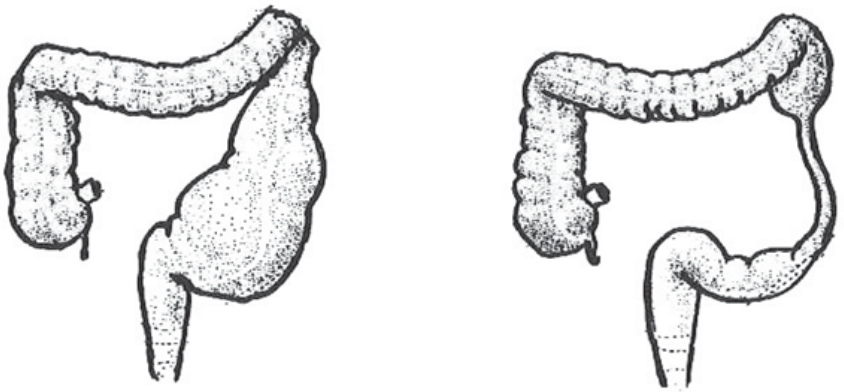

Atonic Constipation Spastic Constipation

Fig. 3.7. Colon in Atonic & Spastic Constipation

Constipation is virtually unknown in undeveloped and agricultural based countries. Compare the healthy normal colon with the abnormal diseased colon, and resolve to eat healthfully and perform internal exercises daily to maintain a normal colon and good health.

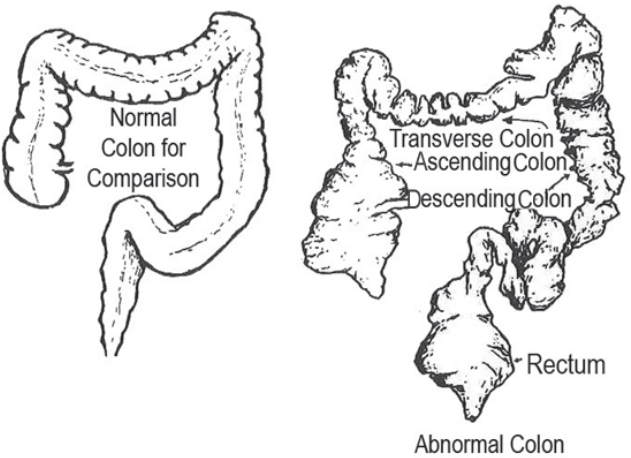

Fig. 3.8. Colon in Atonic & Spastic Constipation

The following are the Most Common causes of Constipation:

1. Constant Overeating and Improper Diet
2. Too many Food Combinations at Meals
3. Improper Mastication
4. Drinking with Meals (Excessively)
5. Eating when not Truly Hungry
6. Ignoring Nature's Call
7. Eating when Emotionally Upset, Angry or Tired
8. Eating too many Constipating Foods
9. Not Eating Enough Fresh Raw Foods
10. Lack of Abdominal Tone and Physical Fitness
11. Excessive Fruits, Liquids and Sugars
12. Excessive Meat, Eggs, White Flour Products and Salt

Causes of Constipation

1. Overeating bloats and overtaxes the digestive system and organs; and along with improper foods, makes the condition worse. An overloaded stomach cannot digest food properly and this mass of fermenting food coats up the walls of the intestines and colon, making it very difficult to evacuate waste matter. Internal secretions also fail to handle the excessive amount of food eaten.
2. Too many food combinations at one meal can easily upset the body and blood chemistry causing indigestion and toxemia. A mono-diet of just one food per meal, i.e., grapes or apples can do wonders in overcoming constipation.

3. Improper mastication overburdens the stomach and digestive organs. Food must be chewed into a semi-liquid state before the digestive system can handle it without trouble. Swallowing foods half chewed places all the work on the stomach and intestines causing blockages in the colon.
4. Excessive drinking with meals dilutes the digestive juices causing indigestion and constipation; it also hampers proper salivation of foods, which impedes digestion. If liquid is taken at a meal, simply sip slowly and mix with the saliva. The Chinese herbalists recommend a small cup of herb tea after meals to help cut any fat (vegetable or animal) eaten during the meal, and to aid digestion.
5. Eating when true hunger is not present is a burden to the stomach, internal secretions and intestines. True hunger is present when the mouth waters for wholesome unprocessed foods. Stomach pangs, pain or rumblings are all signs of indigestion and false appetite cravings. It is best to eat at regular hours, but if not hungry, skip that meal and wait until true hunger returns; or eat a light meal of fruit or vegetable broth.
6. Ignoring Nature's call to evacuate causes an accumulation of fecal matter in the lower bowel, making it insensitive to further movements. This directly leads to colitis, piles, colon prolapsus, auto-intoxication and constipation. No matter what you're doing at the time, always heed the call of nature.
7. Food is very poorly digested and assimilated when eaten in a state of emotional turmoil; the mouth becomes dry, saliva does not flow freely; stomach secretions stop or slow down and there is no real appetite; therefore, no nerve power t digest and utilize food properly, resulting in constipation. It is the same with fatigue; rest when tired. If you cannot sing or laugh before a mea skip it until you can.
8. Eating too many constipating foods, such as, meats, cheeses, nuts, white flour, white sugar, pastries, nut butters, oils, fatty foods, fried foods, too much popcorn and excessive use of lettuce or spinach raw, are direct causes and major constipating factors which leads to disease, if not counter-balanced by high fiber or anti-constipating foods, such as, whole grains, fruits, sprout: vegetables and juices, bens and yogurt.

9. Not eating a sufficient amount of fresh raw foods can cause constricted kidneys and liver and also hardening of fecal matter in the colon and bowels, which is a Yang condition. Lack of raw food deprives one of vitamins, minerals and enzymes necessary to the proper functioning of the digestive and eliminative system.
10. Lack of fitness, especially abdominal tone can cause prolapsus of the internal organs. The diaphragm muscles must be strengthened to build up tone and health in this area. Those who exercise daily (especially the abdominal region) rarely experience constipation. An overall exercise program also stimulates internal secretions, horones and organs.
11. Overeating of fruits, liquids, sugars etc. causes Atonic or Yin constipation.
12. An excessive intake of meat, eggs, white flour and salt causes Spastic or Yang constipation.

Detecting Constipation

Health and disease can be detected by observing the form and color of the feces. The stools should be firm and shaped like a banana or cigar, without odor; odor is a sign of internal stasis or constipation. Light colored feces are caused by an excess of raw fruits and vegetables. The normal feces should be medium brown; if they are dark or black, excessive animal products have been consumed, or there may be internal bleeding. Reddish feces are usually an indication of bleeding hemorrhoids. Greenish stools mean an overconsumption of Yin fruits and sweets. A baby's feces is yellow and soft. The feces should float; if not, excessive Yin foods, fruits, sugars and liquid have been eaten; also eating without thorough mastication and bad food combinations. When eating wholesome foods, thoroughly chewed and digested, the feces will be brown, firm and float on top.

Excessive salt consumption causes intestinal water absorption, which results in small and dry feces. Excessive use of dairy products, fruits, sugar and fats (all Yin), result in shapeless feces or diarrhea. The bowels should move after each meal. If you eat three meals per day, and have only one movement, you are constipated. In this case your body wastes are usually retained for two days or more. If you have small or scanty bowel movements three times per day, you are still constipated.

Foul smelling stools are an unnatural and unhealthy condition, common to meat eaters only. Vegetarian gorillas and apes who are physiologically built like a human, have odorless stools, which are large and mushy. Their intestines and skin are free from parasites. Pin worms and parasites are always a sign of intestinal toxemia and constipation. More than 80 percent of all people have pin worm and many other types of worms. A diet of processed junk foods, meats, fried foods, sugar etc. will surely attract worms in your system.

Meat eaters invariably have bad smelling stool, along with a coated tongue and foul breath. In the case of the dog, tiger and lion and the meat-eater there are always to be found fragments of decaying flesh in the colon; while the colon of vegetarian animals like sheep, cow, deer and the nursing infant or flesh-abstainer, there is no decay or foul odors.

Internal Bath

A high enema of hot water 100°F will soften the deposits of the large intestine or colon and should be taken at least three days in succession to eliminate the hardened waste matter.

Fill your two quart enema bag with 1½ pints of water. Hang the bag 3 feet above the floor so that the pressure goes in slowly, without cramping, and allowing the water to penetrate the deep crevices. Lie on your back; draw knees up and relax the abdomen. Insert the regular 6 inch nozzle at the end of the tube, well-lubricated with vaseline, into the anal opening. Do not hurry the water into the colon; pinch the hose if necessary to avoid stomach cramps; discomfort will pass if done slowly. Now massage the stomach area with your hands for 1 or 2 minutes; next, get into a squatting position and expel the water and fecal matter. Repeat the above process again with warm water. Use cold water for the third enema; this tones-up the entire bowel area. Hold the second enema in for 10 or 15 minutes and pump the stomach in and out several times.

If you are extremely toxic, continue with 3 enemas per day for a three day period. You can never get all the waste out in one enema or in one day. Afterwards, use an enema when you have the flu, colds, sickness, fatigue or toxemia. It will work wonders for your health and well-being. You may also add lemon juice to your enema bag, or garlic and cayenne, to help cleanse the bowels.

Flaxseed Cure for Colon Cleansing

Cook or soak a handful of figs and prunes and blend them thoroughly; make enough to last a few days. Also add enough water to blender to allow for a liquid consistency. To 2 ounces of the fruit, add about 2 or 3 tablespoonsful of cleansed flaxseed, mixing it thoroughly. Eat this mixture after breakfast and before retiring at night. Flaxseed taken in this manner is tasteless and slides down easily. If the constipation is really stubborn, increase the flaxseed to six tablespoonsful per meal. This is necessary to cleanse the walls of the colon.

Flaxseed is not only lubricating, but healing and nourishing as well, as much of the oil is taken by the tissues. The flaxseed treatment to be effective requires that one drink enough water for the seeds to absorb the fluids in the intestines. This swells up and produces a slimy mass that not only cleanses the colon, but will in time restore the elasticity of the intestines with the resultant effect of a complete evacuation or bowel movement after each meal. Try this wonderful treatment and watch your health improve.

Use this treatment only to overcome constipation; never remain on it after the condition is corrected. Maintaining a wholesome diet, plus sufficient and proper internal exercises, will give one healthy and regular bowel movements indefinitely.

Banana Diet for Intestinal Disorders

Bananas are one of the best cures for most intestinal diseases. The gastro-intestinal tract, in terms of our personal health, is the most vital area in the body. Experts in autopsy state they have found that 60 to 80 percent of the colons examined have foreign matter, such as worms, accumulations of old feces-stones, and decaying undigested food residues. The average so-called healthy man of today is carrying continually within him, since childhood, several pounds of never eliminated feces. No wonder constipation is so prevalent today; it is a natural disorder. Poor intestinal health can easily lead to serious metabolic and organic complications.

However, do not lose hope; the mighty banana can rescue you from this internal disorder and restore intestinal fortitude. Fully ripened bananas contain powerful digestive enzymes that help digest other starches and sugars. In all intestinal disorders the body loses the ability to extract any nutriment from all types of carbohydrate foods.

Bananas are an excellent laxative food, which aid the tiny intestinal villi to expel old waste matter; they increase the absorbing surfaces of the entire gastro-intestinal tract. The mashed pulp of fully-ripened (brown speckled) bananas tremendously alters the internal chemistry of the digestive tract, restoring its ability to digest, absorb and totally assimilate complex carbohydrates, and other food elements.

When feeling bloated, no appetite, constipated, fatigued and cranky, try an exclusive banana eliminative diet for a day or two, or up to a week. Mashed ripe bananas are easier to absorb than a whole banana; they also taste like pudding. Mash them into a creamy pulp with a fork. Eat a bowl of this delicious banana pudding at your regular meal times, or when feeling hungry. Mash 3 to 5 bananas per meal, and eat as often as hungry.

For best results, eat no other food during the banana diet, except for pure water. We recommend this for occasional use only as an internal house cleansing. The whipped banana pulp diet feeds and helps to increase billions of friendly intestinal bacteria, or intestinal flora.

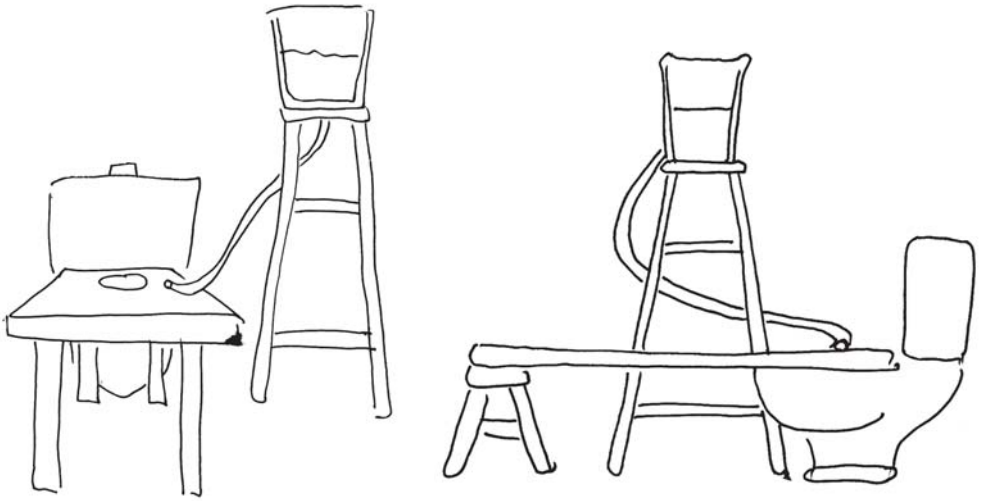

Fig. 3.9. Internal Bath

Other Laxative and Digestive Aid Foods

Apples: contain natural bulk, fruit fiber, iron, malic acid all acting to produce a healthy digestive tract.
Prunes: Rich in iron and potassium. Highly laxative & cleansing.
Pineapple: Contains bromelin, an excellent aid in protein digestion, and enzymic action. Helps to relieve Yang constipation.
Pears: Abundant in malic acid & kidney flushing action; beneficial in overcoming congested kidneys & impacted Yang colon.
Figs: Highly laxative due to its natural fiber, tiny seeds & fruit sugars feeding colon germs. High in iron, minerals & vitamins.
Whole Grains: High in B-complex vitamins, bulk (cellulose) and natural laxative qualities. Use grains in diet for superior health.

Intestinal Cleanse for Internal Health

Practice this Intestinal Program every Mornings:

1. Upon awakening in the morning perform from 10 to 15 sit-ups. Increase the number up to 20 as you become stronger.
2. Next, drink a glass of herb tea.
3. Now do some more abdominal exercises, such as, toe touching, side bends, pulling the stomach in and out. Try to pull the contents of the abdomen upwards, then force it downwards. Wiggle your insides, tossing them from side to side. Strive to control these vital muscles and make them work at will.
4. Continue the exercises until the need for a bowel movement, usually five or ten minutes will be enough.

Constipation is not overcome in a day or two; it takes time for the body to eliminate years of toxic wastes, and rebuild and strengthen itself. Relax and get plenty of rest, exercise, fresh air, sunshine and natural foods. Be persistent in performing the "Intestinal Cleanse" each morning. Within a couple days or weeks on this program you will experience normal and complete morning bowel movements. The key point to remember is to strengthen the entire abdominal cavity, i.e., diaphragm, stomach muscles and the internal organs. When these vital body parts are strengthened, you will vibrate with healthy personal attractiveness.

The Oriental belly dancers have excellent control of their abdominal muscles and diaphragm. Through their action of drawing in large quantities of fresh air and exercising, these girls have mar-

velous complexions, skin tone, sparkling bright eyes and the grace of a fawn. Include some abdominal exercises, hula or belly dancing movements in your morning routine; be imaginative. Never ignore the call of nature for bowel evacuation, whatever you may be doing during the day.

Abdominal Lift

Stand with feet apart, knees slightly bent and lean a little forward from the hips with the back straight. Inhale deeply and then exhale as much air as possible from the lungs. Next, pull in the abdominal muscles with a firm upward movement until a hollow appears under the rib cage. Hold this position for a few seconds; without inhaling, and then relax. Practice this Abdominal Lift on an empty stomach throughout the day, or preferably with the morning Intestinal Cleanse. This super exercise is great for the wasp-like waist appearance. It will provide your internal organs and intestinal canal freedom from unnecessary wastes, and keep the muscles and skin firm and youthful.

If these instructions are carried out regularly, one will receive the marvelous results of superior physical health and well-being. Drugs, laxatives, stomach and bowel remedies, along with their injurious side-effects, can be thrown out with the rest of the garbage!

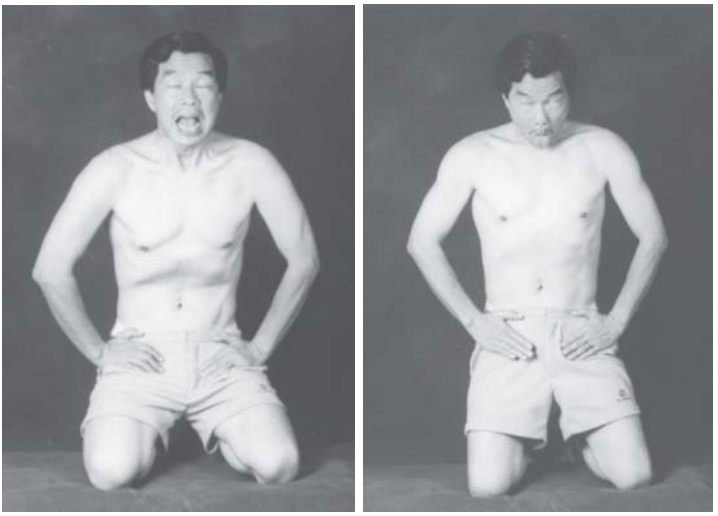

Fig. 3.10. Abdominal Lift - Rolling the Abdominal Ball

Exercises to Overcome Constipation

Exercise #1: Stomach, intestines and chest strengthener. Rock the body to & fro on the abdomen for 30 to 60 seconds as shown. Also tones & trims the waist, hips, legs, arms, shoulders & back.

Exercise #2: Tones & strengthens the abdominal muscles, stomach, lower intestines & reduces the hips. Lie flat on the back, raise legs & sway the legs & hips from side to side. Repeat every day.

Exercise #3: Massages the stomach, intestines and internal organs; trims the waist and strengthen the chest and back. Spread feet 3 or 4 feet apart, knees bent. Inhale while stretching backward with arms overhead; while swinging forward and downward, exhale completely and vigorously. Repeat movement 6 to 8 times per day, especially mornings.

Chapter 4

Signs of Health and Disease

Self-Diagnosis

Many people really do not know what good health really is and what to look for it or what causes it and the lack of it. Many individuals honestly do not take the time and effort necessary to discover who and what they are or study deeply into the Universal Laws of health and life. It is almost a tragedy to hear people boastfully claim that they are in perfect health, when in the fact of visible diagnostic symptoms are the complete opposite.

Peopel do not see their skin pale and anemic. They do not see the body weak and fatigued after the least exertion or the complexion waxy, yellow or pimply. They do not look to see that their eyes are dull and listless or their eyesight failing requiring eyeglasses.They do not understand when their hearing is impaired or that they are plagued with insomnia, worry, hate, fear, nervousness, irritableness, pessimism and anger. These are signs and symptoms of failing health and diagnostic conditions of disease.

Physical diagnosis, according to the ancient Chinese and Japanese physicians is the observation of ones external condition, stemming from internal organic disorders.

We are living in a universe of law: cause and effect; yin and yang; positive and negative; acid and alkaline etc. Disease is an outcome (effect) of our daily eating and living habits (cause); and also our heredity, which is the effect of our ancestor's living and eating habits. We all inherit constitutional weaknesses and strengths from our parents, our habits and nutrition since birth this makes us what we are today.

The causes of illness are many. There are no simple spontaneous causes or quick remedies. The human body is not attacked by disease; disease is the process of degeneration and the symptoms can easily be diagnosed on the face, body, hands, voice and nails etc. before chronic conditions develop. This is the just law of nature and no person can escape its consequences. We can however, live in relative harmony with the Tao or Nature and reap the benefits of good health.

Every body organ affects every other organ, which in turn affects the entire system and manifests itself in observable physical symptoms, which are diagnosable to the trained eye. The physical symptoms can often be diagnosed before a serious disease sets in. It is all in knowing how and what to look for that one can detect a malfunction in the body. This is due to the biological changes the body goes through under various conditions of health, disease and the aging process.

Our external physical conditions, for instance, voice, skin tone, hair, nails and daily vitality depend on the condition of our blood, skeletal, organ and nervous systems, which in turn depend on our total daily eating and living habits.

Four Phases of Oriental Diagnosis

1. ***Bo-Shin:*** The art of observational diagnosis, using the eyes to detect and observe im-balances in the face, hands, nails, posture, skin tone and color, eyes and general habits of living and eating.
2. ***Bun-Shin:*** The art of diagnosing by sounds, such as voice texture, tone, tempo, pitch and breathing.
3. ***Mon-Shin:*** Diagnosing by questioning a person about personal habits, diet, family history, employment problems and psychological tendencies.
4. ***Setsu-Shin:*** The art of touch diagnosis, for instance, acupressure, acupuncture points, pulse diagnosis, skin texture and sense of touch.

This chapter will cover mainly the art of (1) observational diagnosis; and briefly (2) the art of diagnosing by sounds/voice. These can assist one in discovering and overcoming many diagnosable conditions with some conscientious study and research. Diagnosing by questioning and touch require deeper technical research and study by doctors, health practitioners and others involved in clinical patient care.

In diagnosing people of the darker races, the symptoms and colors of health and disease are more detected on the nails, eyes, hair and mouth.

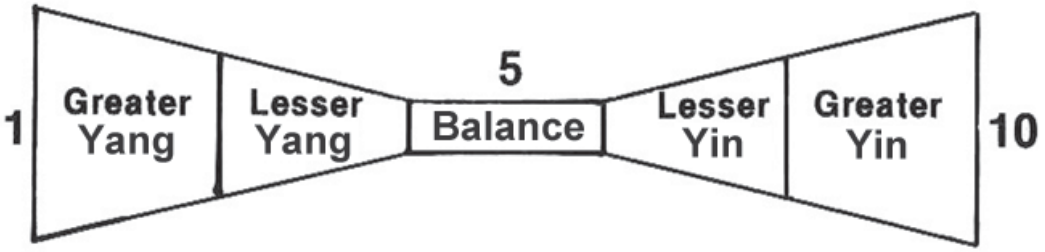

Fig. 4.1. Balance of Yin and Yang

Five Classes of Yin and Yang People

Each individual is born with a certain body type; a Yin or Yang constitution. In diagnosing, there are two factors to consider: inherited constitution, and the present health condition. The Yin and Yang principle is variable, and there are varying degrees of both Yin and Yang people. For example, on a scale from 1 to 10, 1 is Yang and Yin is 10, and 5 is balanced. Body conditions can be diagnosed in a general overall way; to diagnose accurately and precisely, each body organ and body part must be diagnosed separately. No person or phenomena is exclusively Yin or Yang. People are called Yin or Yang because one or the other of these forces dominate in the body; if one is % Yang and % Yin, they are considered Yang; the same with Yin, and vice-versa. We can alter our Yin or Yang condition by the way we eat and live.

There are five classifications of Yin and Yang conditions: Greater Yang and Lesser Yang, Greater Yin and Lesser Yin, and Healthy Balanced Yin and Yang. The balanced person does not exhibit extreme Yin or Yang symptoms. When one shows Greater Yin or Yang signs, they are referred to as Yin or Yang Full; when they show Lesser Yin or Yang signs, we refer to them as Empty Yin or Yang. This tells us how much vitality or energy a person possesses.

A Full or Empty Yang person is much more active; a Full or Empty Yin is less active and energetic. A Yin and Yang Healthy Balanced person is moderate in all activities; neither too slow or fast, but even-tempered in thought and action. This person can eat a wide variety of natural foods in moderation; his digestion, and internal organs function properly; good muscle tone; no constipation; transparent complexion, (glowing); eats seasonally, and never over-eats; performs internal and external exercises moder-

ately daily and weekly; meditates daily; does not crave extreme Yin or Yang junk foods; neither underweight nor overweight; eats more Yang balanced foods in winter, with some Yin, more Yin in hot weather, with Yang foods; his or her attitude is gentle, kind, helpful, giving, loving and inspires those around him. He walks the middle path to truth, enlightenment, good deeds and wisdom ever listening to the Tao within for the secrets of the universe.

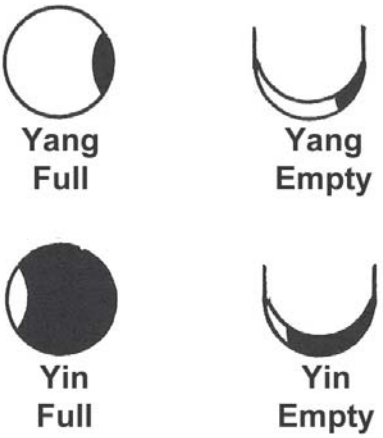

Fig. 4.2. Empty and Full Yin and Yang

Facial Symptoms of Disease

a. ***Cleft Chin:*** Strong Constitution and Amorous
b. ***Vertical Line between Eyebrows:*** Yang Liver
c. ***Horizontal Forehead Lines:*** Denotes Excess Intake of Liquids, Expanded Large Intestine and Kidneys
d. ***Broken and Uneven Forehead Lines:*** Small Intestine Disorders, Yin Condition
e. ***Cheeks Sunken In:*** Malnutrition, Poor Assimilation
f. ***Horizontal Line on Nose Bridge:*** Denotes Yang Liver Condition, Excessive Animal Foods
g. ***Swollen Area Above Upper Lip:*** Shows Expanded (Yin) Condition of Pancreas, Sex Glands, Spleen and Stomach
h. ***Cleft on Nose Lip:*** Heart and Circulatory Disease
i. ***Horizontal Line Above Upper Lip:*** Female Sex Gland and Organ Weakness
j. ***Bags under Eyes:*** Expanded (Yin) Kidneys
k. ***Puffy Half Circles (Bags) an Inch Below Eyes:*** Intestinal Toxemia and Weak Lungs

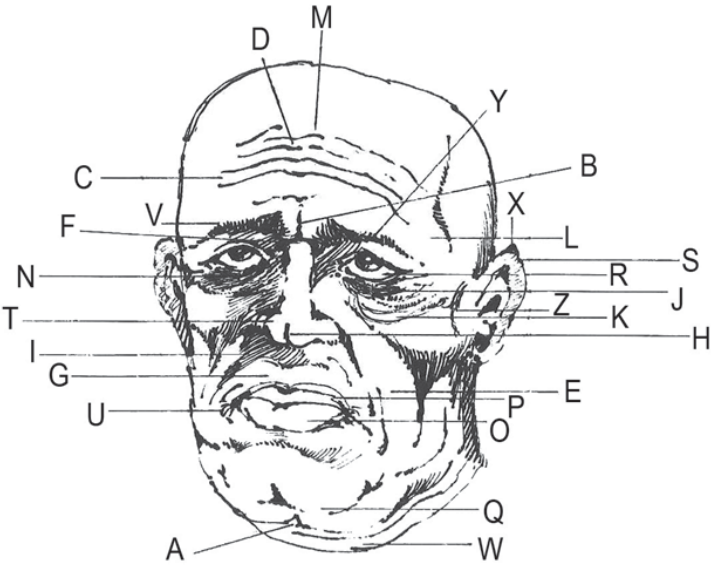

Fig. 4.3. Facial Symptoms of Disease

l. ***Spleen Area:*** Weak Stomach
m. ***Bladder Area:*** Lines indicate a Yin Bladder
n. ***Dark Blue under Eyes:*** Kidney, Bladder & Sexual Disorders
o. ***Swollen/Projecting Lower Lip:*** Intestinal Toxemia/Constipation
p. ***Stomach Area:*** Swollen, Cracked or Inflamed (Redness) indicates Stomach Disorders & Expanded (Yin) Condition.
q. ***Amativeness:*** Strong, Protruding Chin denotes Persistance and Determination, Amorous Nature
r. ***White under Iris:*** Sanpaku (Three-Whites) indicates Extreme Yin Condition in Body
s. ***Kidney Area:*** Ears Red or Swollen Snow Kidney Disorders
t. ***Wide Nostrils:*** Strong Lungs, Vitality
ta. ***Narrow Nostrile:*** Weak Lungs
u. ***Duodenum Area:*** Cracked or Swollen Corners indicates Diseased Duodenum
v. ***Pancreas Area:*** Red, Swollen or Veined denotes Pancreatic Disease
w. ***Double Chin:*** Denotes Excessive Cholesterol in System and Yin Condition
x. ***Pointed Ears:*** Excessive Meat (Yang) Intake & Disordered Eating
y. ***Sparse Eyebrows:*** Degenerative Condition and Weak Vitality
z. ***Hollow on Front of Ear:*** Poor Assimilation and Digestion

Diagnose and Balance Empty/Full and Yin/Yang Constitutions

Diagnosing Yang Full People:

Over-Energetic
Reddish Complexion
Yang Liver and Kidneys
High Blood Pressure
Enjoys Cold Weather
Eats Meat, Dairy, Salt & Eggs
Generally Constipated
Round, Fleshy Face, Wide Jaw
Positive & Aggressive
Works Hard & Heals Quickly
Over-Active Organs
Overweight, Strong Pulse
Heart Disorders
Strong Digestion and Appetite
Energetic and Strong Talk
Likes Drink or Alcohol
Circulatory Diseases
Needs Little Sleep
Fat-Strong Abdomen Muscles

Balancing Yang Full People:

In Extreme Yang Conditions: Induce Diarrhea, Sweating and Vomiting; this Diminishes Excess Energy in the Body. Less Yang People with Constipation: Avoid Vomiting and induce Diarrhea and Sweating.

Dietary Recommendations for Yang Full People:

Eat Less Cooked Food, more Raw Fruit and Vegetables, use much Less Salt, Tamari and Miso. Use thinner Broth Soups. Exercise and Sweat more. Use Watermelons, Grapefruit, Lemons, Celery, Parsley, Cucumber, Sprouts, Radishes, Greens etc.

Avoid: Fats, Cheese, Red Meat, Alcohol, Oils, Fried Foods, Ice Cream, Pastries. Drink more Liquid; Herb Teas. Herbs: Juniper Berries, Dandelion Leaf. Oregon Grape Root, Asparagus, Sage, Chaparral, Gravel Root.

Diagnosing Yang Empty People:

Over-Active, Energetic
Tan to Brown Skin
Kidney and Liver Trouble
Weaker Digestion and Appetite
Yang Constipation
Easily Fatigued,
Needs more Rest & Sleep
Takes Longer to Heal
Flat Abdomen & Firm Muscles
Slim to Underweight
More Athletic Prowess
Nervous Condition
Energetic Talk
Thin, Square or Bony Face
Tight Skin; Penetrating
Contracted Eyes
Positive and Aggressive
Moderate Drinker

Balancing Yang Empty People:

Must be kept Warm. Avoid Noise and Inharmonious Surrounding. Obtain sufficient Sleep and Rest. Dress Warm in Cold Weather. Extreme Yang Empty Conditions should eat more Yin-Quality Food.

Dietary Recommendations for Yang Empty People:

Eat less Salt, Miso, etc. Eat Softer Cooked Foods. Drink Moderate amount of Liquid. Eat Warm Foods. Eat more Cooked Vegetables. Eat Less Protein & Fat. Eat Fruits & Vegetables in Season. Chew Food 30 to 40 times.

Avoid: Fats, Meat, Cheese, Ice Cream, Alcohol, Oils, Ungerminated Seeds & Nuts & Citrus Fruits.

Herbs: Cammomile, Comfrey, Yarrow, Juniper Berry, Parsley Leaf, Dandelion Leaf, Alfalfa, Sage, Yam, Plantain and Chaparrel.

Diagnosing Yin Full People:

Underactive Thyroid
Cold Hands and Feet
Overweight
Poor Memory & Thinking
Weak Heart
Underactive Organs
Does not like Exercise
Overweight, Loose Flesh
Prolapsed Abdomen,
Falling Organs
Low Blood Pressure
Blue or Yellow Color
Yin Liver and Kidneys
Likes Warm Weather
Eats too much Sugar, Fat
Cold Drinks, Pastries
Round Fleshy Face
Bruises Easy
Menstrual Difficulties

Balancing Yin Full People:

Sweat to induce Harmony. Extreme Yin Full People should not Fast at all. Regularly eat Whole Cooked Grains & Vegetables. Needs Daily Exercise and Deep Breathing.

Dietary Recommendations for Yin Full People:

Less Salt, Less Liquid. Less Protein and Fat. Some Fresh Raw Fruits and Vegetables. Eat Slow, Chew Well. Warm Soup Broths. Avoid: Pastries, Ice Cream, Milk, Cheese, Coffee, Sugar Products, Ungerminated Nuts, etc.

Some Citrus is Good. Mushrooms, Potato, Radish, Lettuce. Herbs: Oatstraw, Horsetail, Watercress, Nettle, Marshmallow Root, Licorice, Garlic, Slippery Elm.

Diagnosing Yin Empty People:

Inactive, Low Energy
Can develop T.B.
Hypoglycemia
Poor Memory & Thinking
Cold Hands and Feet
Lack of Exercise
Likes Warm Weather
No Strength, Weak Muscles
Anemic and Pale Complexion
Poor Digestion and Assimilation
Hyperactive Thyroid
Weak Heart and Internal Organs
Yin Liver and Kidneys
Underweight, Thin
Eats too much Yin Food

Balancing Yin Empty People:

Needs to be given much Energy. Must live in Harmonious Surroundings. No Fasting. Keep Body Warm. Start with very light Internal Exercises and work up slowly to more Muscular Movements over several months.

Dietary Recommendations for Yin Empty People:

More Yang Food: Grains, Yang Beverages, Thick Vegetable & Grain Soups. Eat Slow, Chew Well.

Avoid: Yin Foods: Juices, Tropical Fruit, Ice Cream, Dairy Products, Slightly more Salt, Miso, or Tamari. Eat Less Liquid. Eat Less Raw Foods. Herbs: Same as Yin Full. Use Ginseng, Burdock.

Face, Hand and Body Diagnosis

Nose:

Long Thin Nostrils: Indicates weak lung power and less physical stamina. Excessive intake of sugars, fats, dairy and animal foods during the embryonic period. A person with long thin nostrils requires plenty of exercise, deep breathing, and outside fresh air. To help widen the nostrils, pull them apart and outward, this will open up the breathing channels, help sinus problems and increase this person's energy. Practice one minute daily.

Wide Nostrils: Indicates strong lung power and good physical vitality, strength and self-confidence. Wide nostril people make excellent athletes, good orators and are self reliant, and have unlimited energy to achieve success. This is due to their larger lung capacity, and ability to take in large quantities of oxygen, which feeds and sharpens the mind and imparts great energy.

Upturned Nose with Wide Nostrils: A sign of a strong yang constitution and physical aggression. This type of nose imparts one with initiative and a hopeful optimistic attitude. They are cheerful and amiable people with a desire to help others. They are also inquisitive, but they need encouragement to carry out their work.

Long Thin Bony Nose: A Yin Sign, more mentally inclined. The voice of a thin nosed person is generally high pitched. They are curious about life, nature and people; refined in manners. They are sharp and quick to perceive; inquisitive; they like details and sometimes overly analytical and judgmental. To balance this Yin personality, more whole grains and cooked vegetables are required. Deep breathing, outside fresh air, and vigorous exercise will strengthen this type of individual.

Red, Bulbous and Greasy Nose (Veins): Indicates high blood pressure, heart and liver disorders. Excessive alcohol, or sugar, fats and meat are the main cause. A swollen nose is a sign of an enlarged heart.

Cleft on the Tip of the Nose: Indicates heart or circulatory disorders. A dull ache in the nose indicates blood stagnation and heart trouble from eating rancid oils. A soft watery nose shows excessive intake of Yin foods and swollen heart. Sneezing is a discharge of excess Yin in the system, i.e., sugars, liquids, drugs etc.

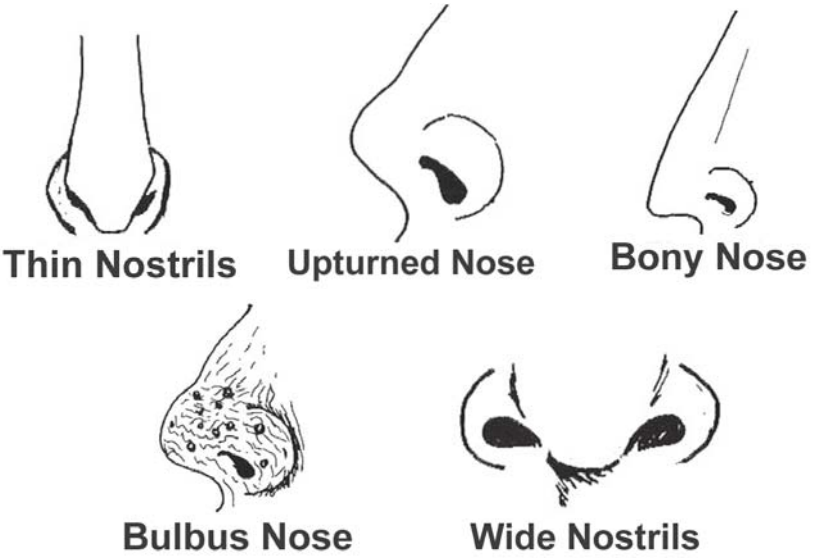

Fig. 4.4. Nose Diagnosis

Face:

Forward Bulging Forehead: Indicates inactive internal secretions and poor body circulation.

Hollow & Sunken Cheeks: Indicates weak lungs and digestive organs; improper nutrition or malnutrition; physical exhaustion and poor endurance. A hollow area in front of the ear opening denotes subnormal secretion of saliva and inefficient food assimilation.

Face Pimples Pimples: Indicates a consumption of extreme Yin foods, i.e., sugars, fats, tropical fruits, juices, pastries, candy, etc., in addition to an intake of extreme Yang foods, i.e., meat, eggs, fish, etc. Yin sweet foods eaten with Yang protein foods results in poor protein assimilation and is eliminated through the skin as eruptions. Intestinal toxemia, poor quality blood and constipation are usually present.

Red & White Spots or Habitual Red Flushed Face: Indicates heart disease, biliousness, fever and inflamations caused by extreme Yang and Yin foods such as animal protein, salt and sugar; disorderly eating. Blood becomes too thick to circulate through the body and results in stagnation and redness.

Orange or Yellow Skin: Shows liver, gall bladder, spleen and pancreas disorders. In vegetarians it indicates an excessive intake of raw vegetables and carrot juice. Sweets are contributing causes.

Green Skin: Indicates liver disease and possible cancer.

Pallor or Pale Face & Cheeks: Indicates weak glands, congested and inactive liver and anemia.

Thin, White Transparent Cheek: Shows weak glands, stomach, lungs and lack of energy. Tendency toward melancholy and introversion caused by poor quality food, weak assimilation, lack of oxygen and proper exercise, yin foods (sugar and sweets). Tendency to consumption and weak intestines.

White Patches: On face or body show liver and kidney disorders caused by excessive dairy foods, fats and sugars.

Veins and Blood Vessels: Showing at temples indicates heart, liver and gall bladder disease.

Cheeks with Veins: Indicates heart & stomach disorders due to gluttony, alcohol & disorderly eating.

Damp, Clammy & Excessive Perspiration: On face indicates extreme Yin and Yang food intake; heart and kidney disease.

Yellow, Waxy or Pasty Face: Shows liver, stomach and gall bladder trouble; dropsical condition of the fluid system caused by excessive fat and animal consumption and sugars.

Warts, Moles and Beauty Marks: Indicates excessive animal protein intake, fats & sugars. Liver & kidney disorders are indicated.
Double Chin: Sign of excessive cholesterol and fatty deposits throughout the system caused by fats, animal foods, salt and sugars; lack of exercise and natural foods.
Well-Developed Chin: Shows a strong heart inheritance, physical strength, and determination to succeed.
Small, Narrow & Receding Chin: Denotes less physical endurance/determination; heart functioning is not as strong as prominent chin caused by poor quality foods during pregnancy, especially calcium deficiency resulting in insufficient jaw formation.

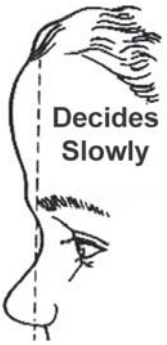

Fig. 4.5. Face - Forward Bulging Forehead

Mouth and Lips:

Normal Nose/Mouth Relationship: Shows normal vertical and horizontal size of mouth. The mouth should be as wide as the outer edges of the nostrils. The mouth and lips are uppermost position of the digestive system, which ends in the anus. Conditions of the mouth and lips indicate deeper internal problems.
Balanced Mouth: Shows that the mother ate a balanced diet during the embryonic period. We inherit the effects of our mother's eating habits.
Pale or Red Lips: Indicates disorders in the stomach and intestines, for instance, compacted colon, constipation, indigestion. Extreme Yin or Yang foods cause internal disease and its symptoms to show up on the mouth and lips. Also show healthy and strong sex glands and hormones with well defined, long vertical crease from the upper lip to the base of the nose; wide horizontal area between the base of the nose and upper lip; and even heart-shaped lips.

Mouth Extended beyond Nostrils: Shows the mouth extending beyond the outer nostrils. It indicates the consumption of extreme Yang and Yin foods during pregnancy and early childhood. Any imbalances in diet cause imbalances in facial features. This condition can be normalized over a period of several years by balancing the diet and avoiding extremes.

Mouth Extended Horizontally and Vertically: Shows weaker internal organs. Generally a Yin or expanded internal condition from generations of Yin foods such as tropical fruits and vegetables, fats, sugar, fried foods, white flour etc. A return to proper eating will eventually contract (Yangize) the internal organs and normalize the exterior features.

Lips Higher Vertically: Indicates a weaker digestive system. Horizontally, the lips are Yang; balanced food was eaten during the mother's pregnancy; but the vertical height shows extreme Yin food during childhood. Also show weak sex glands with a lack of the vertical indentation, short distance between nose-base.

Upper Lip & Thin Pale Lips: Denotes weak internal glands, hormones and sexual powers.

Horizontal Crease Between Upper Lip & Nose-Base: Indicates malfunctioning sex glands.

Large, Loose, open Mouth and Lips: Indicates a Yin expanded stomach and colon; extreme Yin and Yang foods were eaten throughout life. It shows a generally rebellious and uncontrolled nature in mental and physical habits. Can be corrected by natural eating and living habits.

Closed, Evenly Set Mouth & Lips (Heart Shaped Lips): Shows a controlled mental and physical nature. These people direct their lives according to discipline and principle. Their eating habits are more balanced and they avoid extremes in living habits.

Wrinkles above the Lips: Indicate sexual and hormonal malfunctioning; also extreme Yang (dehydration) of body. Excessive intake of salt, spices, protein; insufficient raw foods and liquids.

Cracked Corners of the Mouth: Shows vitamin B-2 deficiency, digestive and stomach disorders caused by extreme Yang & Yin foods, such as animal protein, sugar and fats.

Cleft Pallet: Indicates excessive (Yin) sugars during pregnancy.

Sores on Lips: Indicates intestinal, stomach toxemia and general body congestion.

Tight Constricted Lips: Shows contraction of intestines & vagina.

Small Mouth: Shows much Yang energy & physical & mental vitality. Constant covering of the mouth shows overeating.
Swollen Upper Lip: Denotes stomach disorders; excessive Yin food intake.
Expanded Protruding Lower Lip: Indicates expanded and fallen intestines and constipation. A Yin condition from sugar, fat and excessive liquid intake.
Dry, Thin, Scaly & Mottled Appearance of Lower Lip: Indicates a disorder of the salivary glands.
Thin, Pale & Dry Upper Lip: Indicates weakness of reproductive system. If the upper lip is extremely short (weak spinal column).
Whiteness around Mouth & Pale Lips: Indicates anemia, poor circulation, blood stagnation and lack of expression caused by excessive intake of cheese, ice cream, milk (fats), sugar and high protein (animal).
Pink Lips (Caucasian): Indicates balanced nutrition, good circulation and health.
Darker Races: Observe the condition of the gums; they should be pink (good health). White gums show poor health and anemia.
Dark Lips (Causcasian): Shows liver, kidney and gall bladder trouble. Excessive bright red lips show high blood pressure, acute disease or infection, toxic liver and hemmorrhoids.
Purple Lips: Indicates blood stagnation, diseased heart and circulatory system.
Corners of Mouth Turned Down: Shows intestinal stasis & stomach disorders caused by Dairy foods, fats; cold food and drinks.

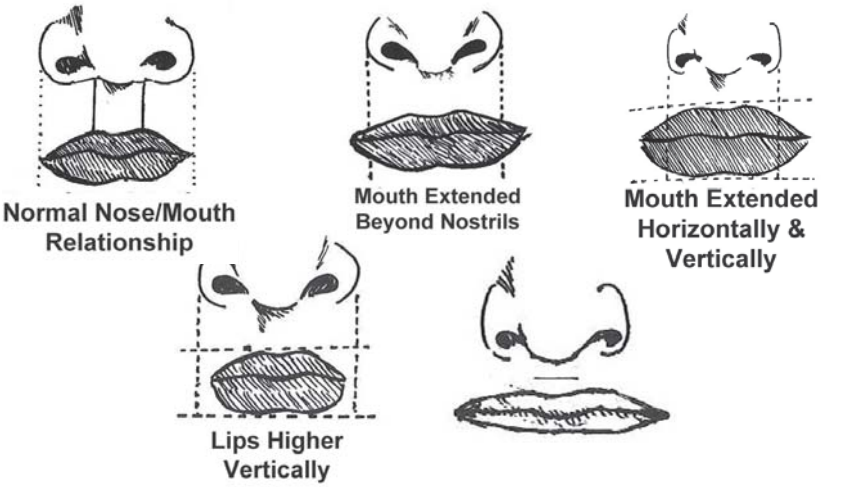

Fig. 4.6. Mouth & Lips Self-Diagnosis

Eyes:

Lower Sanpaku: Shows a condition of the eye known as Sanpaku or three whites eye whites are visible at the bottom and both sides of the iris. The iris is rolled up, leaving the white part of the eyeball exposed. This is a poor health sign. It indicates an extreme Yin or expanded condition of the brain, nerves, organs and body. In lower sanpaku, the higher the iris rises, the more one is beset with tragedy usually self-inflicted misfortune, accidents, problems in relationships with friends or loved ones etc. Sanpaku denotes a disorderly pattern of eating and living. Excessive amounts of fruits (tropical), juices, alcohol, sugars, fats, ice cream, dairy and fats; in addition to overworking, over exercising, malnutrition, lack of sleep and stress conditions will contribute to and cause sanpaku, and its attendent consequences.

Generally, people with this condition are fearful, suspicious and they lack physical and mental stamina. The criminal mind has also been shown to possess sanpaku. Famous people who possessed sanpaku before dying violently or tragically were: Ghandi, Caesar, the Kennedy brothers, Hitler, Martin Luther King, Elvis Presley and Freddie Printz (Chico and the Man). Many fashion models have varying degrees of sanpaku, due to strict crash weight-loss or starvation diets to maintain the modern skinny look.

A person showing signs of sanpaku is very often difficult to relate to and is skeptical of any help or advice. An honest person with upper sanpaku is more likely to be a victim of violence than a perpetrator. A return to whole foods, centered around grains, vegetables, legumes, seeds and seasonal fruit; including proper exercise, sufficient sleep, stress-free work, meditation and harmonious surroundings, can correct and improve ones overall health and center the iris.

Upper Sanpaku: Yang condition, especially of the liver, kidneys, and related internal organs. The iris is rolled-down in this condition and indicates a cruel nature, physical (Yang) aggressiveness, anger and a fighting character. This is usually caused by an intake of extreme Yang foods, such as animal protein. This person is easily provoked into anger or fighting, so be agreeable in his presence. Being vindictive and merciless, they often meet violent deaths.

Excessive Blinking: Body's attempt to expel excess Yin from the system. Babies blink one or two times per minute; their iris covers almost the entire eyewhite. We should blink no more than two to four times per minute the less the better indicating one in sound

health and in control of mind and body. In the animal realm, cats seldom blink; their eyes shine and glow in the dark; they are very independent and in total control of their actions. Humans can accomplish the same; but it may take many years of discipline in diet, health habits, exercise and meditation to attain superior health and control over one's nervous system and bodily functions.

Four White Sided Eye: It is usually accompanied by a bloodshot reddish hue, and is uncontrolled. There is usually a psychological problem or conflict in the person's life, accompanied often by a violent temper, outrage, oversensitiveness and assault. The individual's eating habits range from extreme Yin to Yang; starvation diets to gluttony.

Eyes Turned Inward: Shows a Yang or contracted iris; one that is turned inward toward the nose. It is a Yang condition, resulting in high blood pressure and heart problems. An excessive intake of meat, eggs, salt, eaten during the embryonic period or during early childhood. Balancing the diet can help to correct this condition.

Eyes Turned Outward: Shows a Yin or expanded condition of the eyeball; the liver, stomach and kidneys are also Yin. Cause: Excessive intake of Yin foods, i.e., sugars, sodas, ice cream, fats, tropical fruits, drugs and alcohol. The extreme of this condition may be prone to chronic disease. A Yin and Yang balanced diet can help correct this condition in due time.

Centered Normal Healthy Eyes: The upper and lower eyelids should touch the iris, with very little eye whites showing on the sides of the iris. The eye pupils should function properly in both light and darkness. Healthy eyes do not require glasses or contacts; neither do they squint or function poorly in close and distant vision; the sight is sharp and clear at all times; the eyes sparkle and the eye whites are clear.

Dark Eye Bags: Weak female organs and constricted (Yang) kidneys are indicated by a dark brown (half-circle) coloring under the eyes. Swelling, veined or dark blue under the eyes denotes kidney stones, gall stones, blood stagnation and anemia, caused by extreme Yin and Yang foods. Purple under eyes denotes adrenal exhaustion. Discolored puffy circles one to two inches below the eyes indicates lung disorders. A person with this condition is generally afflicted with diseases such as, lung cancer, tuberculosis, asthma and other respiratory disorders. Cause: tobacco smoke, sugar, high fat dairy products, (cheese, milk, butter) and a host of other extreme Yin and Yang junk foods.

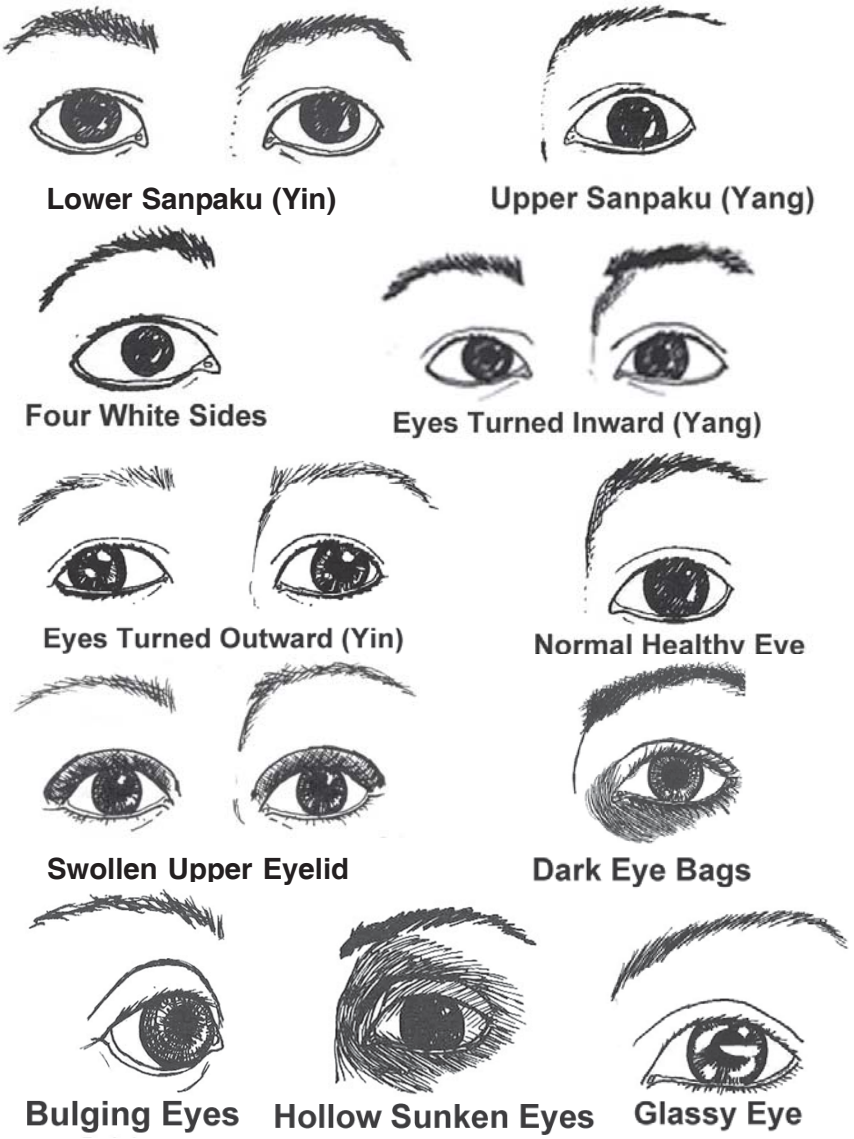

Fig. 4.7. Eye Self-Diagnosis

Swollen Upper Eyelid: Indicates gall bladder stones, heart and sexual manfunctioning. The swelling usually subsides when the stones pass. Cause: Sugar, fats & animal foods eaten to excess. ***Bulging Eyes:*** Indicates lack of iodine in early childhood or embryonic period and thyroid disorder; also a Yin/expanded condition of organs. Excess intake of liquids and sugar.

Wide Staring Eyes: Indicates poor judgment, credulity, or if the expression is anxious, fear and apprehension. Orators & linguists have the full or convex eye. Fullness below the eye verbosity.
Puffiness or Bags under the Eyes: Indicates disease from dissipation; it is not the same as fullness. The eye foretells the truth when all the other features deceive us. When the eye says one thing and the tongue another, the practical man relies on the former.
Dark, Hollow, Sunken Eyes: Indicates extreme emaciation, deficiency of muscular development, nerve and physical exhaustion. Cause: Extremes in diet, starvation, or malnutrition.
Eyes with Light Blue: Indicates internal parasites & kidney trouble.
Scant Lower Eye Lashes: Deficiency in sexual glands & hormones.
Scant Upper Eye Lashes: Denotes (Yang) mental deficiency.
Itchy Eyes: Indicates liver malfunctioning and lung problems.
Hard Yellow Spots in Eye-Whites: Indicates worms in system.
Dry & Inflamed Eyeballs: Indicates an extreme Yang liver disorder and vitamin A deficiency.
Sties Growths on Eyelids: Shows an excessive intake of protein.
Pale, Colorless, White Eyelid (Upper & Lower): Denotes anemia; the eyelids should be pink in good health.
Yellow Eye Whites or Yellow Deposits in Eyes: Indicates excessive cholesterol in the system and liver and gall bladder blockage caused by excessive intake of fats, oils, fried foods, cheese, ice cream, milk, sugar and animal protein.
Entire Eye is Yellow: Jaundice is indicated. A Yin and Yang balanced diet can correct this situation in due time.
Bloodshot Eyes (Habitual): Indicates inflamed condition of the intestines and brain. The liver, gall bladder are affected. Eye strain, poor lighting, constant sun glare and late night reading can also cause bloodshot eyes caused by cheese, sugars, drugs, all fats, alcohol, dairy foods, animal foods etc. leading to chronic disease.
Dull, Lackluster Glassy Eye: The nervous system is under strain and pressure. Poor circulation, extremes in diet, hardened arteries and liver are indicated. A person with glassy eyes requires a complete change in diet and living habits. All drugs, alcohol, cigarettes, marijuana, overwork, excessive sex, stress and tension must be discontinued if a return to good health is desired. Also, meat, animal fats, dairy products, sugars, pastries, oils, etc., are causes of nerve disorders and consequently the dull glassy eyes.

Excessive Large Pupil: In daylight denotes nerve exhaustion and extremes in diet. It is a Yin, expanded condition of the kidneys, stomach, spleen intestines and bladder; adrenal weakness and brain expansion. Excessive intake of raw food (Yin). A balanced grain, vegetable, seeds and legume diet, including seasonal fruit should normalize the eye pupil in due time.

White Ring around the Iris: Indicates excessive intake of table salt, nerve weakness, poor circulation to brain, anemia and possible senility. Disordered eating, living and extremes in diet are contributing factors.

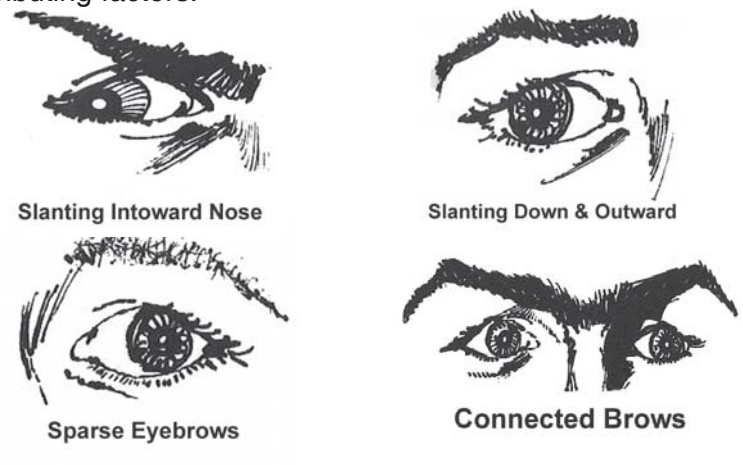

Fig. 4.8. Eyebrow Self-Diagnosis

Eyebrows:

Eyes Slanting Intoward: Indicates Yang and aggressive nature caused by generations of animal food consumption.

Eyes Slanting Down & Outward: Shows a gentler & compassionate nature caused by vegetarian diet.

Sparse Eyebrows: Indicates a weakening health condition. Extremes in diet, such as excessive intake of sugars, liquids, fats, tropical fruits, juices; and animal foods. It shows weak life force, tendency to chronic disease and degeneration.

Connected Brows: Indicates strong life force, vitality, and artistic ability. It also shows generations of fatty animal food & dairy intake. The spleen, liver and pancreas are weakened by these foods.

Thick/Separated Brows: Shows superb health & long life potential.

High-Arched Brows: Denotes a person with a dramatic and creative flair, with the emphasis on active showmanship and leadership. Somewhat eccentric in character and mentality.

Ears:

Large Ears: Indicates strong inherited constitution; strong kidneys and adrenals showing are sign of health and longevity. Generations of basically vegetarian foods.

Thickness & Height in the Outer Upper Ear: Shows excellent blood circulation throughout the body and creative mental capacity; also the ability to accumulate and successfully handle finances and material possessions.

Large & Well Formed Inner Ear Area: Indicates good digestive and assimilation powers.

Fleshy & Thick Inner Ridge: Shows nerve force & inner strength.

Creased Ear Lobe: Shows heart disorders or diabetes.

Large Ear Lobe: Shows a healthy inherited constitution.

Small Ears & Lobes: Shows weak adrenals and small kidneys; generations of meat eating; energy generally low with little interest in mental pursuits. Small eared people should avoid excessive intake of animal protein, as their kidneys are unable to handle it.

Small Ears & Lobes: Shows a weak inherited constitution. Small eared people should emphasize whole grains, vegetables, soaked seeds and nuts, sprouts, fruits in season, with a minimum intake of protein foods. Cooked legumes should be eaten moderately. Sufficient rest, sleep and harmonious surroundings are recommended; exercise moderately, but never to exhaustion.

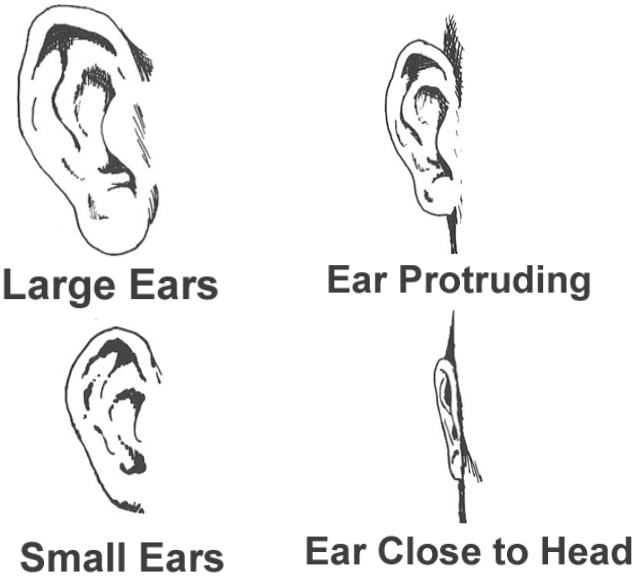

Fig. 4.9. Ear Self-Diagnosis

Ears Protruding: Shows a Yin constitution. Impulsive & emotional activity. Mother ate too much Yin food during pregnancy.
Ears Close to Head: Indicates balance in mind and movement. Mother ate a more balanced Yin and Yang diet during pregnancy.
Ears High on Head: Indicates self-pride, egotistical nature, base instincts and material cravings and desires to excess. Mother ate excessively of animal foods & salt during embryonic period.
Ears Top Level with the Eye Corners: Indicates balanced mental and physical development.
Red Ears: Indicates a toxic, overworked kidney (Yang); excessive salt and protein. Spleen disease is indicated if the outer portion of the ear is red. Avoid extreme Yang foods.
Ear Wax: Sign of excessive intake of fats, oils, animal foods, and fried foods. It will not develop if these foods are not eaten.

Teeth:

Long Front Teeth: Indicates a Yin constitution. Short front teeth and ones that angle inward are Yang and indicate an uncontrolled character. Teeth that angle outward show a passive character.
Pointed Teeth: Excessive meat eating & other Yang foods over generations causes pointed teeth, especially the canines. The canine teeth will diminish in size as less meat is eaten over generations. Natural & orderly eating results in balanced & normal teeth.
Tooth Decay: Result of excessive intake of sugars, fats, animal foods, protein, liquids; and insufficient calcium from natural whole foods, such as grains, seaweeds, legumes, vegetables, seeds & fruits. Animal protein & sugar diminishes calcium absorption from other foods; calcium deficiency is the end result of tooth decay.
Crowding Teeth & Extra Teeth: Caused by extreme Yin & Yang foods during pregnancy.

Pointed Teeth

Fig. 4.10. Teeth Self-Diagnosis

Hands:

Swollen Kunckles & Fingers: Indicates expanded (Yin) kidneys, artheroscerosis and high blood pressure.
Bluish Wrist: Indicates sex gland weakness.
Reddish Palms with White Spots: Shows disorderly eating and poor blood circulation; excessive intake of animal protein and fats.
Bluish Palms: Denotes circulatory and heart trouble.
Dark Red Palm Heel: Indicates bladder & sexual disorders.
Yellow or Orange Palms: Indicates pancreas, spleen and liver disorders. Excessive intake of fats, raw greens or carrot juice are factors to be considered in causing this problem. In good health, the hands should be slightly pink and warm, dry and be firm, but not hard.
Hot, Moist & Red Hands: Indicates Yang congested liver & kidneys.Red hands are caused from excess Yang foods.
Cold, Clammy & Pale Hands: Indicates Yin expanded kidneys, bladder, stomach and intestines; weak nerves and anemia. Pale, cold hands are caused from excess Yin foods.
Flexible Fingers: If the health and blood circulation are normal, the four fingers should bend back 90° to the hand. This indicates a flexible mental and physical character, able to adapt to outward changing conditions; it shows healthy organs and good nerve and blood flow. A less than 90° backward bend indicates calcification or hardening of the bones, nerves, muscles, organs and reproductive system; a stubborn and unchangeable character usually accompanies inflexibility and hardening of the joints and muscles. The cause is from an excessive intake of sugars, salt, fats, oils, cheese and animal protein. Orderly eating can reverse this condition before terminal degeneration has set in. The less angle, more the hardening. Arthritic & painful joints show diseased kidneys.

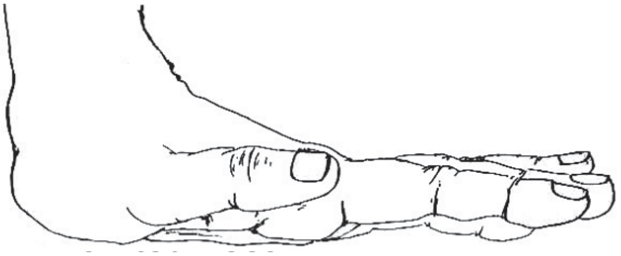

Fig. 4.11. Flexible Wrist

Flexible Wrist: Should also have a 90° angle.
Raised Blood Vessels on the Back of the Hand: Indicates an excessive intake of Yin foods and a Yin kidney.
Trembling Fingers: Indicates weak nerves, nervousness and heart disorders.
Brown Spots on the Back of the Hands, Arms or Body: Denotes liver and gall bladder congestion; excessive intake of animal foods, dairy, fats and sugars.
Webbed Fingers: Indicates over-consumption of Yin foods and liquids during the embryonic period.
Wide Palm with Firm Flesh: Indicates strong inherited constitution with an active, aggressive nature & robust health (Yang).
Narrow Hand & Long Thin Fingers: Indicates sensitiveness, intellectual and artistic personality, and delicate health (Yin).
Round Bulge Appears on the Wrist: When the palm is pressed with the opposite thumb, above the wrist, the body is holding excessive liquids or sugar (Yin condition); the hands are usually moist.

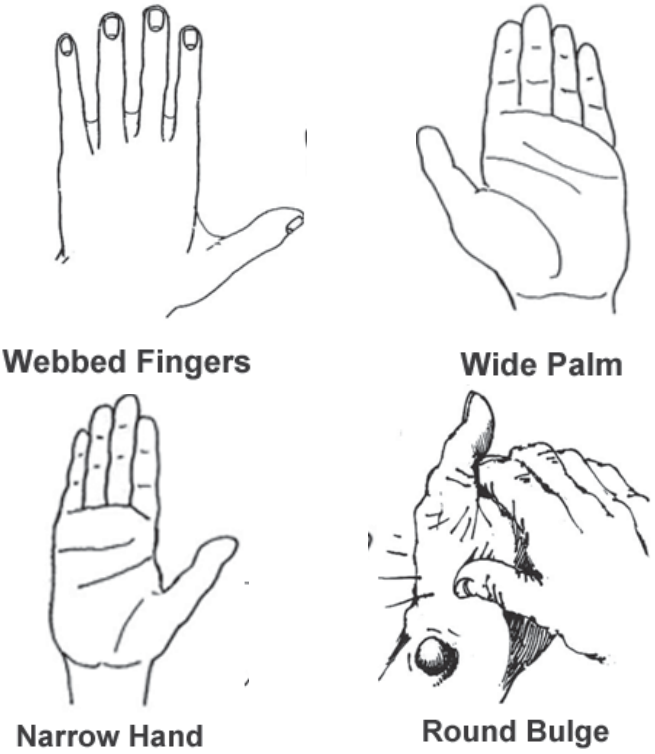

Fig. 4.12. Hand Self-Diagnosis

Fingers and Nails:

The nails are hard or clawlike extensions of the fingers; the fingers, in turn, are extensions of the entire nervous system; the nervous system is intricately connected to the brain, organs and every cell and tissue in the body. In acupuncture, these nerve pathways are known as merridians. If there is a blockage of circulation or stagnation of blood, or an excess of energy in any internal or external area of the body, this deficiency or excess can easily be detected & diagnosed in extremities (hands, nails, fingers & feet).

Visual Diagnosis: One who is trained in visual diagnosis can detect symptoms before they start to appear. One of the methods to do this is to look at the fingernails. For example, if the nail thickens noticeably it is one sign of circulatory weakness, lymph gland malfunction or blood diseases. When a fingernail has a tendency to become yellow, it may be an early sign of liver disease. Diabetes can be recognized by the gradual disappearance of the pink coloration of the nail.

Looking Glass: The fingernails are a looking glass or mirror, reflecting inner physiological conditions. Pink nails indicate good blood circulation to the fingertips showing blood flow through the mirror (nail). Lack of blood flow to the fingertips shows up as clear white nails, and is diagnosed as anemia. One can give an accurate prognoses and avert future health problems by reading and diagnosing the fingers and nails. Proper health measures and corrective eating and living habits can then be recommended to overcome the diagnosed symptoms. The entire hand can show past and more recent conditions of the individual, and it can indicate health or disease tendencies in the future or near future through prognoses.

Inflamed/Reddish Finger: Indicates acute or short term illness.

Hardened, Rigid & Chalky White Nails: Indicates severe and chronic or organic disease.

Wide-Short Fingers & Nails: Indicates a strong Yang constitution; practical, persistent, physically active and aggressive.

Long-Narrow Fingers & Nails: Indicates a Yin constitution; artistic, sensitive, imaginative, delicate;tendency to bronchial disorders.

Extremely Narrow Fingers & Nails: Denotes a delicate inherited constitution and less physical energy.

Finger/Organ Relationsdhip: The fingers are connected via nerves and merridians to body organs. The corresponding reflex finger/organ areas are listed as follows: thumb, lungs; first

phallange, liver/large intestine; second phallange, circulatory system (heart governor) and sex glands; third phallange, kidneys (triple heater); fourth phallange, heart and small intestines.

Lack of Half-Moons: Indicates sodium/potassium imbalance; underactive thyroid gland; weak healing power in system; lack of circulation and low blood pressure. It is usually a Yin condition from an excessive intake of sugars, fats, juices and raw foods. Can also mean possible liver disorder. Indicates little or no physical exercise. It can also be caused by an excess of meat and salt.

Excessive Half-Moons: Half moons more than one quarter of the nail shows an over-active thyroid condition; tendency to excessive physical and mental activity and nervousness. An excessive intake of high potassium (Yin) foods can cause overdevelopment of the half-moons; however, in time the moons may disappear due to the extreme potassium/sodium imbalance and result in disease or poor health. Excessive half-moons can also mean high blood pressure. On the other hand, an excessive intake of sodium (Yang) foods may also cause the half-moons to disappear. Generally a lack of raw fruits and vegetables contribute to a Yang system. Regardless of age, the half-moons should always be present; if not, the important healing and beauty mineral element, potassium, will be missing, resulting in deficiency diseases. Yin, internal conditions change into Yang, and Yang ones change into Yin, (the process of biological transmutation) which is the natural order of Tao.

Healthy Half-Moon: A healthy half-moon should be no more than one-fourth of the nail, indicating potassium/sodium balance; vital healing power in the system; mental and physical energy and a balance between activity and rest. The Taoists teach that the normal sized half-moon indicates freedom from chronic disease and good health. The half-moon should show on all nails.

White Spots on Fingernails: Indicates zinc, pantothenic acid and calcium deficiency; poor protein absorption, pancreatic disorders and insulin deficiency; weak stomach acids and possible worms. Sugars and other excessive Yin foods and substances, such as drugs, chemicals, marijuana and alcohol neutralizes stomach acids causing calcium and mineral deficiencies. This also includes dairy products, honey, tropical fruits, sodas, cakes and candy. Nails take from 6 to 9 months to grow from bottom to top. One can determine, by the location of the white spot, the time of high Yin food intake, diseased organ and sugar in the blood stream. White spots can also mean kidney disease.

Nail Color:

Pale & Chalky Nails: Indicates poor circulation, nerve exhaustion and possible stroke; anemia and poor iron and protein assimilation. Cause: Extreme Yin and Yang foods.

Green Nails: Denotes improper copper disposal and congenital liver ailment.

Bluish Nails: Indicates lack of oxygen and circulation to heart and heart disorder.

Tiny Red Dots under the Nails: Shows possible pin worms.

Transverse White Lines across Nails: Denotes fever, heart and kidney disease and malnutrition.

Biting Nails: Denotes intestinal and stomach problems and possible parasites in the body.

Red or Purple Hemorrhages under the Nails: Indicates an inflamed heart lining.

Soft Nails: Denotes calcium, vitamin, mineral and protein deficiency from an excess of sugars, dairy, fats and animal foods in the diet, weak will power and general fatigue.

Excessively Hard & Brittle Nails: Denotes anemia and hormonal imbalance.

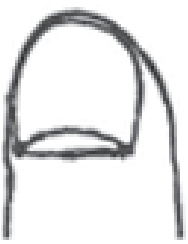

Wide, Short Fingers

Long Narrow Fingers

Lack of Half-Moons

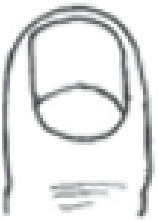

Excessive Half-Moons

Healthy Half-Moon

White Spots

Fig. 4.13. Nail Self-Diagnosis

Excessive Shiny Nails: Shows an overactive thyroid gland.
Excessive Red, Dark Blue or Purple Nails, Fingers & Swollen Hands: Shows heart and circulatory problems.
Triangle Shaped Nail: Indicates a weak inherited constitution and a ten-dency to nerve diseases, such as paralysis or palsy. This individual should watch his or her health, taking care to eat wholesome foods and obtaining proper sleep and exercise.
Short, Shrunk & Whithered Nail: Denotes a hypertensive nervous system and extreme malnutrition or malabsorption of food; extremes in diet during pregnancy or through early childhood; chronic disorders and critical & fault finding character.
Convex or Hour-Glass Nail: Denotes lung ailments, scrofula, dyspepsia and a possible Yang liver; excessive mucous and possible tendency to tuberculosis. A Yin lung condition from excessive intake of Yin foods.
Concave or Spoon-Shaped Nail: Shows tendency to infections, chronic anemia, possible hook worms, hyperthroidism and malnutrition; extremes in diet.

Triangle Shaped Nail Short Nail Hour-Glass Nail Spoon-Shaped Nail

Vertical Ridges Horizontal Ridges Round Bulging Nail

Fig. 4.14. Nail Color Self-Diagnosis

Anemia Test: One way of detecting anemia is by pressing any fingernail with the thumb; the nail will turn white from the thumb pressure; if after releasing the thumb pressure, the whiteness remains longer than a second, anemia is indicated. A pink color should show up immediately after releasing thumb pressure, indicating good blood circulation and absence of anemia.
Vertical Ridges: Denotes intestinal, liver & kidney disorders; circulation & skin impairment; poor protein & calcium absorption.
Ridges with Convex & White Chalky Nails: Denotes advanced chronic disease, such as stroke, cancer & hardened arteries.
Cracked & Split Nails: Calcium deficiency & weak sex glands.
Deep Horizontal Ridges: Indicates severe calcium and protein deficiency; acute illness; nerve exhaustion; anemia and psoriasis; extreme dietary eating patterns and changes in environment. For example, moving from north to south frequently and changing from Yang to Yin diets, or hinging on junk foods to Yang foods to fruitarian and raw foods/fasting and repeating the cycle over and over.
Round Bulging Nail: Denotes lung disorders; possible liver trouble and hardened arteries; this is a Yang sign.
Thick Raised Cuticle: Denotes an excessive intake of animal protein; extreme dietary changes, kidney and liver disorders.
Red or Bleeding Cuticle: Extreme condition of the above problems caused by excess Yin food intake.
Flat Nails: Indicates a weak lymphatic system, proneness to mumps, tonsils, appendicites, including other acute disorders. This is a Yin condition.
Square Nails: Indicates kidney disorders; excessive intake of animal protein or malabsorption of food.

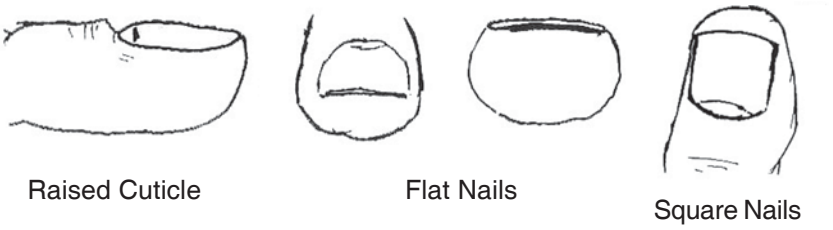

Fig. 4.15. Nail Shape Self-Diagnosis

Feet:

Foot: Indicators of health or disease throughout the body. Certain symptoms in the feet signal trouble in the reflex body organs.
Athletes Foot: Sign of kidney problems caused from excessive animal protein intake.
Fallen Arches (Yin Condition): Indicates weak nerves.
Foul Smelling Feet: Sign of excess animal protein intake, liver & kidney disease.
Hard Callouses on Feet or Hands: Denotes excessive dairy products and animal protein in the diet.
Cracked Nails: Shows liver, kidney, spleen and pancreatic disease; excessive Yin and Yang foods.
Toes: Each Toes is connected to a body organ via Nerve Pathways (Merridians) as follows: Big Toe, Liver; 2nd Toe, Stomach; 3rd Toe, Bladder; 4th Toe, Gall Bladder; 5th Toe, Kidneys. Each toe can be massaged or pressed for one or two minutes to help improve the corresponding organ.
Hard, Whitered-Inflexible Toes/Nails: Denotes organic disorders.
Pain or Swelling in a Toe or the Feet: Indicates a disorder in the corresponding organ.

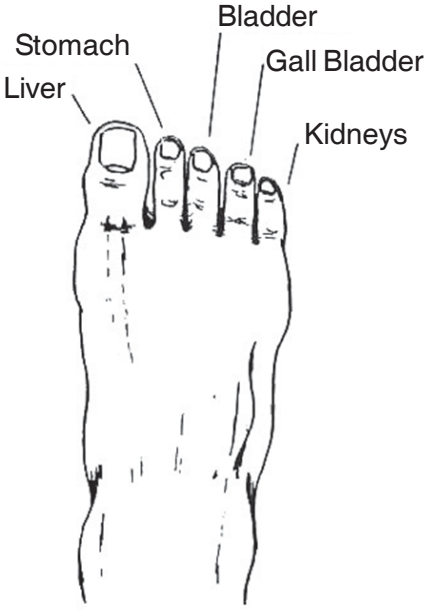

Fig. 4.16. Feet Self-Diagnosis with Five Vital Organs

Hair:

Premature Grey or White Hair: Sign of an excessive intake of Yang animal protein and Yin sweet foods. This indicates a liver, gall bladder and kidney malfunction. White haired people are generally more set in their ways, and it is hard for them to change and be more flexible.

Much Body Hair: Denotes a Yang inherited constitution and excessive animal protein consumption over generations.

Split Hair Ends: Indicates malfunctioning sex glands and hormones in both male and female. Excessive sugars, fats, and animal protein are the main cause of split ends. Poor hair circulation, overeating and lack of exercise are other contributing factors.

Dry Hair: Indicates liver, gall bladder, spleen and pancreatic disorders caused by fats, sugars, animal protein.

Oily Hair: Caused by excessive fats and oils in the diet.

Dandruff: Caused by excessive animal protein, fats, oils and sugars and kidney malfunction.

Hair Loss: Indicates internal organic disorders, especially from excessive animal protein, fats and sugars.

Hair Loss Front of Head: Caused by excessive Yin liquids, sugars, fruits, alcohol which lowers kidney & bladder functioning.

Hair Loss Top of Head: Indicates excessive animal protein. The lungs and large intestines are adversely affected.

Hair Loss Back of Head: Denotes excessive intake of chemicals, drugs, marijuana & medicine affecting liver & gall bladder.

Hair Loss Temples: Indicates excessive intake of drugs and sugar foods. The lungs and large intestines are affected.

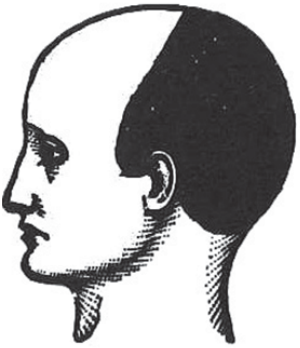

Front Head Hair Loss

Top and Side Hair Loss

Fig. 4.17. Hair Self-Diagnosis

Tongue:

The tongue is an extension of the gastrointestinal track, which terminates in the anal canal. Any problems or disease symptoms on the tongue indicate disorders in the stomach, intestines and colon. Diseases can be diagnosed from the condition of the tongue. Any disorder in the *Middle of Tongue (Stomach); Sides of Tongue (Liver); Root of Tongue (Kidneys) & Tip of Tongue (Heart)*.

White/Yellow Color & Dry Coated Tongue: Indicates stomach fermentation, intestinal toxemia, liver and gall bladder disorders caused by excessive intake of dairy foods, fats, animal foods and overeating. A short water fast is indicated in this condition.

Green Tongue Color: Shows liver and kidney disorders.

Blue Tongue Color: Shows kidney and bladder trouble; disorderly eating. A balanced natural diet will balance the organs.

Violet Tongue Color: Shows liver & heart disease (Alcoholics).

Grey or Black Tongue Color: Indicates kidney and heart disease; black at the tongue base shows possible cancer.

Purple Tongue Color: Denotes sex and bladder disease.

Crease down the Middle of Tongue: Denotes intestinal disorders & vitamin B complex deficiency and extremes in diet.

Trembling Tongue: Shows a nerve condition & brain weakness.

Sties or Growths on Tongue: Indicates excessive intake of animal protein, kidney disease & a Yang heart. Also intestinal toxemia and constipation are generally indicated. Avoid over-eating, especially extreme Yang foods, meat, eggs, fish & salt & extreme Yin foods, i.e., ice cream, white sugar, pastries, alcohol & all fats.

Soft, Loose Tongue: Shows an expanded gastrointestinal system; excessive Yin foods.

Hard, Tense Tongue: Denotes excessive mucous in the system; animal foods, dairy, sugars and disorderly eating are indicated.

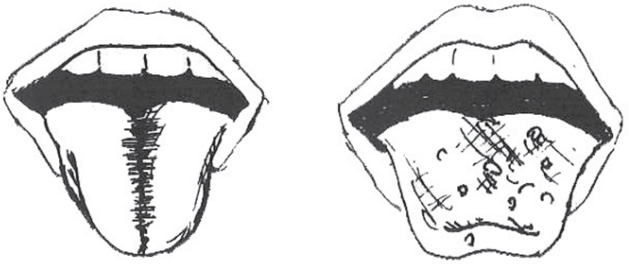

Line on Tongue Sties on Tongue

Fig. 4.17. Tongue Self-Diagnosis

Voice:

Many diseases can be diagnosed from the sound and texture of the voice. The sound of the voice corresponds to inner physiological conditions. A crackling, hoarse voice always denotes degenerative disease of the sexual glands & hormones.

Voice Sounds: Designated into Yin and Yang as follows:

Yang	***Yin***
Strong Voice	Weak Voice
Low Pitch	High Pitch
Fast Speech	Slow Speech
Loudness	Softness
Dry Sound	Wet Sound
Tenseness	Looseness
Distinct Sound	Unclear Sound

Watery, Loose Voice, with Slow Speech: Indicates an excessive intake of (Yin) liquids, fruits and sugars. The result is kidney expansion, weakness and mucous.

Unclear & Weak Voice (Yin): Denotes lack of inner energy & vibrant health. For example, if one's health is poor, with low energy, the body lacks the force or vitality to express itself in a clear vibrant tone. Very sick people always speak quietly in a trembling tone.

Tense, Dry, Fast or High Pitched Voice: Indicates intestinal congestion, sexual degeneration, constipation; bladder, high blood pressure and circulatory trouble. Cause: Excessive intake of Yang foods, such as meat, eggs and salt contract the sex glands, kidney and liver, causing the person to shout or talk in a loud voice.

Fast Speech: Denotes an overactive heart; a Yang condition.

Stuttering: Indicates extremes in diet (heart & nervous conditions).

Voice Resonates: From various sections of the body; congestion and mucous can be detected according to location in the body. One can help to heal a congested section by making the sound of the designated vowel or letter for a minute or two, and focus the concentration on the area to be healed. For example, if one has sinus congestion, place the tongue on the upper palate and hum the sound "N" several minutes a day.

Magnetic Voice: A healthy voice is enjoyable to hear. It is neither too high or too low, but resonates and vibrates in a clear musical tone; this is the magnetic voice; it soothes and heals those who hear it. Consuming the balanced Yin and Yang foods and correcting the living habits will eventually improve ones voice.

Vibrant, Pleasant Voice: One must speak with an open throat and from deep down in the lower diaphragm-abdominal region.
Voice Exercise: Take a deep breath; open the mouth wide, and make the sound "AH" from the lower abdomen for five seconds, then stop. Inhale again and repeat for ten seconds and stop; continue in this manner up to 20, 30, 40 or 50 seconds, or as long as comfortable. Always start at the zero second mark and work up with five second intervals, i.e., 0-5, 0-5-10, 0-5-10-15 and so on. After a few weeks practice, of a minute or two per day, one can be up to 30 or 40 seconds non-stop, and the throat will then be opened and relaxed; the voice will be more vibrant and pleasant. If one reaches the sixty or seventy second mark while humming "AH" non-stop, they are on the way to developing a pure magnetic voice, one that others will gladly listen to. One may also practice this humming tone with the other body sounds M, N,, E, O, U.
Excessive & Confused Talking or Slow Talking: Indicates extremes in diet and excessive or disorderly eating. If one is not understood, it is because he does not understand himself due to inner physiological and psychological confusion and dietary imbalances. A healthy person speaks little, says much.
Strong, Clear Voice: Indicates healthy kidneys, liver, stomach, lungs, and strong sex power.
Weak, Trembling Voice: Denotes kidney & sex gland disorders.

Urine:

Dark Yellow or Brownish Color Urine with a pH under 6.5: Denotes a sluggish Yang liver and bile backed up in the blood caused by excessive intake of animal protein, fats, chemicals and sugar. The kidneys are constricted (Yang).
Light Colored or Clear Urine with a pH over 7.5: Denotes an expanded (Yin) kidney and liver caused by excessive intake of Yin foods; sugars, juices, alcohol, tropical fruits, liquids and raw foods.
Excessive Urination: Denotes expanded (Yin) kidneys caused from an excessive intake of Yin foods. Excessive urination with an excessive appetite, a glazed and furrowed tongue, diarrhea and loss of sexual and mental powers indicates a diabetic condition caused by diet too high in fats, sugars, animal protein, empty calories; excessive intake of Yin and Yang (extreme) foods.
Healthy Urine: Should be straw colored or the color of light beer, which will be 7.0 or balanced on the pH scale. This denotes a balanced Yin and Yang and Acid and Alkaline diet.

General Body Symptoms

Belching, heart burn, nausea, loss of appetite and dyspepsia are caused by an overloaded stomach, excessive fats, protein, oils and sugars in the diet. Toxemia and fermentation result from overeating, disorderly eating and various other enervating living habits. Constipation is usually present.

A swollen abdomen, itching about the anus and genitals and an offensive bad breath indicates pin worms or tape worms in the stomach or intestines, constipation and general body toxemia. Disorderly eating, overeating and extremes in diet are general causes of this condition. A pain in the lower back, in many cases, can be attributed to Yang (overworked) kidneys; the kidneys are located just above the right and left hip bone in the lower back region. An excessive intake of animal protein contracts (Yang) the kidneys and causes pain in the lower back.

An unlively, slow and mincing walk, when habitual, indicates premature nerve degeneration or senility. This can happen at any age, depending on the individual's living and eating habits. One can be young, active and full of vitality at 80, or burned out and aged at 30 or 40; it all depends on the health habits and attitude of the individual. Constant colds, flu or sinus trouble is a definite indication of an excessive intake of fatty foods, cheeses, oils, fruits, liquids, sugars and animal protein. Excessive fruit eating can also lower stomach acids, depress kidney and lung activity and result in chronic mucous. Nuts, cheese, milk and fruits can cause colds and mucous just as fast as regular junk food.

Vibrant Health and Human Beauty

The idea of beauty of person is synonymous with that of health and a perfect organization. What an inspiration it is to see a truly robust and healthy man or women. A radiantly healthy man is always handsome; an energetic healthy woman is always beautiful.

They possess a magnetic charm that draws attention and compels admiration wherever they go. Beauty is but the reflection of wholeness, of health. Partial beauty, fading beauty, decaying beauty these are but expressions of partial, fading or decaying health.

An abundantly healthy individual is in perfect symmetry and proportion of body. The complexion glows and is free from blemishes, with the red blood shining through at the cheeks, fingers and toes. The hair sheens, is strong and full of life. The eyes are clear and sparkling, lips are rosy in color, the teeth pearly white, sound and even. An unmistakable look of confidence, courage, alertness, love and joy radiate upon the countenance. If you love beauty in body, mind and spirit, and desire it for yourself and for your offspring, there is only one way to attain it, and that way is to live in harmony with the laws of life.

If you possess most of these positive vibrant health qualities, you are living in accordance with natural law; if not, start on a rejuvenation health program today.

1. A healthy, normal appetite for natural wholesome foods.
2. Sound undisturbed sleep, and a zest for living upon rising mornings; free from fatigue.
3. Calm nerves, clear thinking and a steady magnetic gaze.
4. A clear, strong and musical voice in both sexes.
5. Hair that is strong, lustrous, plentiful and sheening; no dandruff or dryness.
6. A clear complexion, bright and glowing.
7. A firm, powerful and flexible grip.
8. A clear alert mind, with a good memory; no absent-mindedness or forget fulness.
9. Constructive and happy thoughts about yourself & others.
10. The attitude is confident, loving, cheerful & positive; a realist.
11. Perfect eyesight without glasses; eyes clear and sparkling; hearing perfect.
12. The tongue is pink & uncoated; the breath is sweet and clean.
13. No dark circles or puffiness under eyes.
14. A good sense of humor about yourself and others; a calm, peaceful nature.
15. A proper upright-posture & carriage; neither bent or inflexible.
16. Body weight proportionate to height and bone structure; neither thin or fat, but firm.
17. Body joints flexible & free from stiffness & calcium deposits.
18. You are taking total responsibility for all your actions, and circumstances.

19. Teeth are even and shiny white; gums do not bleed; no cavities and strong bite.
20. Muscles are firm, strong and smooth; an energetic springing step; athletic ability.
21. Internal organs and glands in their proper place and functioning healthfully.
22. No sensations of pain, pressure, swellings, soreness, tiredness, stress or indigestion.
23. Neither cold hands or feet; body temperature & blood pressure normal; pulse not too high or low but even & steady.
24. A grateful and thankful feeling for being alive, and appreciation for the things you now have.
25. You are orderly and precise in thought and action; neither hasty or plodding.
26. You are an independent thinker, free from dogmas, prejudices, and false notions.
27. You do follow organizations, groups, teachers or cults without question, failing to reason and thin about the truth of life by your own intelligence and creativity.
28. Your goal in life is to help other people; you are not self-centered and egocentric.
29. You do have plans and goals in life based on your own creativity and individuality.
30. You do know who you are, where you are going, and what is the purpose of your life.

Price of Health

Perfect Health is your natural right. The glossy hair, bright eyes, clear skin, active brain, steady nerves and happy disposition, together with the strength, vigor and unlimited energy of a truly healthy human being are all yours if you want them enough to pay the price. But these things cannot be purchased with money. They are not for sale in any store and cannot be found in boxes or bottles. They can be maintained or regained only one way and that is by carefully obeying the laws of nature every day. Health and beauty are born companions.

Yin and Yang of Health

In Taoist healing we are always looking at the balance between Yin and Yang as a measure of health. They say that when Yin and Yang finally separate, we have death. The Yin body returns to the Earth and the Yang spirit ascends to Heaven. Thus the work of a Taoist healer is to maintain a balance between Yin and Yang in order to preserve life. Healing is about becoming whole. In order to feel balanced and health, we have to have a flow between our Yin aspects and our Yang aspects.

Yin: Ability to stay calm; rejuvenation; detoxification; sleep.
Yang: Ability to take action; exercise; movement; zest for life.

If these are out of balance, then health problems may follow physical, mental or emotional. We can see this immediately by observing the extreme cases:

If one is excessively Yin without enough Yang, for example sitting at home on the couch all day watching TV, no exercise, no working soon enough one may suffer from overweight, fatigue and depression.

If one is excessively Yang without enough Yin, for example working long hours, spending time off working out fanatically in a gym, always rushing about and never resting sooner or later one may suffer from panic attacks, hyperactivity, sleeping problems and heart problems.

We must remember that Yin and Yang are not separate opposites: this is an over simplification of the Yin & Yang theory. Rather it is about flow. There is no problem to be busy, as long as one takes time to unwind and relax later. Likewise, there is no problem completely relaxing and being still, as long as one takes time to exercise and move later on.

Thus Yin and Yang do not have to be in balance at any one moment. But they must flow in a smooth and regular cycle for health to ensue. Just as night and day do not have to co-exist, they each have their time and flow one into the other in a smooth cycle.

In terms of health, there are some signs of imbalance that we are overly Yin (or do not have enough Yang), and others that we are overly Yang (or do not have enough Yin). Some imbalances are a result of our constitutional traits and others are due more to our lifestyle factors.

Here are some examples of symptoms that may indicate that we are becoming either overly Yin or overly Yang:

Overly Yin	***Overly Yang***
Excessively Cold	Excessively Hot
Deficient Chi	Excess Chi
Fatigued	Hyper
Weak	Rigid
Excess Fluids	Dryness in the Body
Low Blood Pressure	High Blood Pressure
Slow Respiratory Rate	Fast Respiratory Rate

Health is about harmony: smooth flow and overall balance. If we experience one of these symptoms (such as feeling cold) it is not necessarily a problem unless it is consistent and unbalanced. The more we connect to nature, the more we can see how we flow harmoniously with nature's cycles, For example, human beings naturally operate well when they are awake and active during the daytime and rest and sleep during the night. We are more comfortable if we stay in more during the winter months and spend more time in the outdoors during summer.

Thus, if you are very active during the day, this does not mean you have an overly Yang problem. But if it persists and you are unable to sleep well at night, then this indicates an imbalance, if you are cold during the winter, no problem, But if you continue to feel cold even in the summer months, there may be a deeper problem. Likewise, when we force our bodies out of harmony with nature for extended periods, we usually fall ill. A prime example is that of the night-shift worker. Even though a person may be sleeping a full 8 hours every day, if they always work at night then they are acting against the natural flow, it is not uncommon for night shift workers to begin to experience imbalances.

Yin & Yang theory gives us a model to understand health and illness that is dynamic. Many models of health make the mistake of using a static model: assuming that there is a point of good health to attain. For those seeking a static goal of health, this is very hard, indeed impossible. Our bodies are constantly changing and evolving, responding to the world around us. For example, our bodies tend to put on a little extra weight during colder months and become lighter in the summer. Thus if we are trying to stick to a single static weight, we are fighting against nature. The Oriental therapies give us a more fluid model, and yet a model with very clear ways of understanding our health and illness.

Yin and Yang of Illness

We can also view different illness in terms of Yin and Yang, though it must be remembered that this is only an approximation and does not apply to every case, in ancient times when Oriental Therapy was used, the names of diseases were often not known. A Chinese doctor would simply look at the symptoms and examine the person's energy to decide how to treat them. However, we can see that there are often similar patterns in particular diseases, and thus we can make an estimation of Yin & Yang imbalances. Always look at the individual's expression of the illness and their unique symptoms (such as heat, cold, weakness etc) before deciding.

Overly Yin	***Overly Yang***
Headaches (Front of Head)	Headaches (Back of Head)
Diabetes II	Syndrome X
Colitis	Duodenal Ulcers
Asthma	Gout
Hypothyroid	Hyperthyroid
Meningitis	Appendicitis

Excess and Deficiency

From the surface we may identify things as being overly Yin, Yang or balanced. However, in Chinese Medicinal Theory it was know that there are different underlying situations that can create each surface appearance.

An overly Yin situation may be caused by two possibilities:

1. Excess Yin
2. Deficient Yang

In other words, it may be that the person has built up an excess of Yin energies, habits or foods, or it may be that they do not have enough Yang qualities to balance their Yin. We can understand this by making simple charts to demonstrate. Balanced Yin and Yang would look like this:

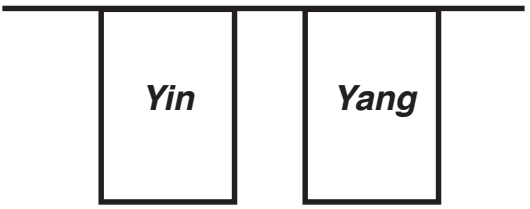

Fig. 4.18. Balanced Yin & Yang

Yin may become excessive. This may be our constitutional tendency, or it may be of our behavior. For example, if we take too many cold watery foods and drinks which are Yin. It could be that we are in a very cold damp environment, and thus develop an excessively Yin situation. Therefore, there are a number of ways that we can develop too much Yin, which can be illustrated as so:

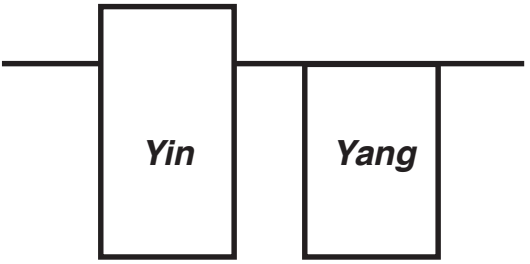

Fig. 4.19. Unbalanced Yin & Yang

The other scenario which looks externally the same is deficient Yang. This may be our constitution, or may develop out of our behaviors. For example, we may lose Yang when we avoid stimulating activities and sports. If we are lazy and sedentary, we may become deficient in Yang, or if we do not spend enough time with other people we can develop a deficiency. Deficient Yang may be illustrated as so:

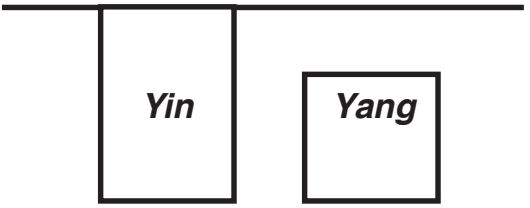

Fig. 4.20. Unbalanced Yin & DeficientYang

Thus Excess Yin and Deficient Yang look externally the same, but under the surface there is a slightly different cause. Excess is always the result of too much of something (e.g. too many iced drinks) and deficiency a result of a lack (e.g. not enough exercise).

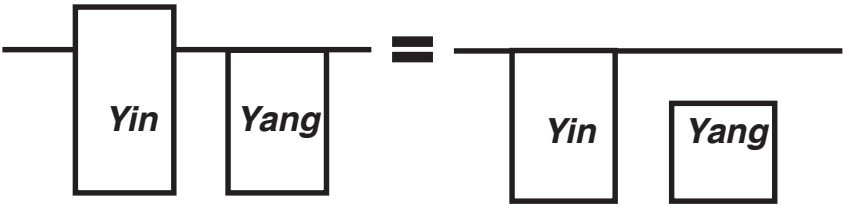

Fig. 4.21. Excess Yin & DeficientYang

The same can be found when we examine and overly Yang situation. This has two possibilities:

1. Excess Yang
2. Deficient Yin

It may be that the person has built up an excess of Yang energies, habits or foods, or it may be that they do not have enough Yin qualities to balance their Yang. An excess Yang situation may be constitutional, or it may be the result of too many Yang foods, exercises and habits. For example, if we eat too many rich and spicy foods then we can develop Excess Yang. It can be illustrated as so:

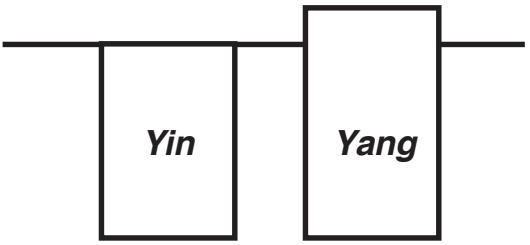

Fig. 4.22. Deficient Yin & Excess Yang

Deficient Yin maybe a constitution or we may develop it from not nourishing our Yin qualities. For example, if we do not take enough rest, do not take enough time alone and do not surrender into relaxing pasttimes we may develop a lack of Yin. This can be Illustrated as so:

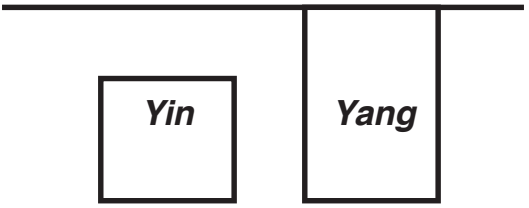

Fig. 4.23. Lack of Yin & Excess Yang

Thus we can see that from the surface level, Excess Yang and Deficient Yin look the same, though they have different underlying patterns.

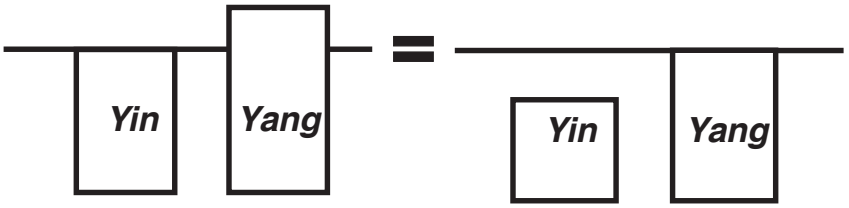

Fig. 4.24. Excess Yang & Deficient Yin

Therefore, in Oriental Theory, we distinguish between different underlying patterns so that we can understand the situation even deeper and know how to respond to it in an appropriate way.

Yin and Yang Types

Thus we can find two main different types: the Yin and the Yang. But when we look deeper we find four different subgroups. The following table shows the four different groups identified in Yin & Yang diagnostics:

	Overly Yang	***Overly Yin***
Yin Imbalances	Deficient Yin	Excess Yin
Yang Imbalances	Excess Yang	Deficient Yang

The external appearances are two groups: Overly Yang and Overly Yin. The internal imbalances may take four different forms, depending on whether it is a predominantly Yin imbalance or a predominantly Yang imbalance. Understanding our health problems from this perspective can help us to gain deeper insight into the nature of our issue, and of how to remedy it.

Theory in Practice

These theories are used directly in the practical application of Oriental Therapies. To a certain extent we can treat simply Overly Yin and Overly Yang situations the same, However, this deeper insight can give us even more understanding of the current imbalance and thus show us how we can treat the situation even more effectively. Oriental Therapy has many applications. Acupuncture, Chinese Herbs, Massage, Medical Qigong and Shiatsu are all based on the same theories.

However, the focus of this book will be on Nutritional Therapy. This can be used alone or combined with other treatments. Ancient Taoist theory is the foundation for two popular nutritional systems: Macrobiotics and Five Element Nutrition. Macrobiotics is concerned with the balance and harmony between Yin and Yang; whereas Five Element Nutrition looks with more details into the health of each organ system. Macrobiotics has been highly developed in Japanese culture, whereas Five Element Nutrition is more widespread in China. Both can be used alone or the systems can be integrated.

Chapter 5

Increase your Life Force

How to eat, when to eat, what to eat and where to eat are some of the basic questions people ask when starting a program of natural eating. We all should eat to live, not live to eat. An old Chinese proverb says: When feasts are spread the doctor rolls his pills. In fifty dishes lie a hundred ills. Most people today live to eat and they end up with enormous medical bills for all of their ills.

The three vital functions of food are to rebuild the living tissues; to supply energy; and to preserve a proper medium in which the biochemical processes of the body can take place.

We might add that the food must be in an assimilable form and that the combinations of food must be correct in order to insure perfect digestion. Otherwise, fermentation and gas will result from faulty combining. Here then are the rules of how to eat.

Twelve Keys to Good Health

1. Eat only when hungry stop before full.
2. Proper Acid and Alkaline and Yin and Yang balance.
3. Chew your food well mix thoroughly with saliva.
4. Refrain from eating when emotionally upset or physically exhausted.
5. Eat food at room temperature.
6. Use fresh natural organic raw and cooked foods daily.
7. Fasting or Eliminative Diet when necessary.
8. Combine food properly.
9. Refrain from close eye or brain work before, during, or after meals.
10. Consume your last meal at least three to four hours before bedtime.
11. Keep cheerful and calm at meals.
12. Follow the Law of Moderation (rhythm). Never overeat.

Eat Only When Hungry

Do not eat unless you have absolute hunger. True hunger is a mouth and throat sensation. The mouth waters when true hunger is present. True hunger is not stomach pangs or that empty feeling at the pit of the stomach. These symptoms are a form of addiction to highly seasoned and stimulating foods, such as meat products, coffee, salt, spices, and alcohol. When these foods are eaten they create withdrawal symptoms and the body again craves them with a burning desire. True hunger leaves the body in a relaxed state with no morbid cravings for junk foods. Eat only to satisfy hunger, no more. Hunger is the true spice of eating.

A completely full furnace smokes and will not readily burn. The stomach acts in the same manner; when completely full, it will not digest the excess load of food, but instead will ferment and putrify, poisoning the body and causing toxemia. A furnace not quite full will burn beautifully. The stomach, not quite full, will also burn (digest) beautifully. Overeating causes malnutrition. Surveys taken on individuals living past the age of 100, never fail to show that they are always moderate eaters. The glutton will never reach the age of 100. If you are not hungry at meal time or in the morning, skip that meal and you will enjoy your next meal. Eating three full meals a day, in most cases, overworks the digestion and internal organs. Listen to that small inner voice within you. It will tell you what to eat, how much to eat and when to eat; and you will seldom go wrong. Never eat between meals. Eat a meal, then do not eat again until you experience true hunger. Your stomach will thank you. To lengthen your life, lesson your meals. Who is strong? The ones that can conquer their bad habits.

Proper Acid/Alkaline & Yin/Yang Balance

Alkaline quality foods are classified as all watery type fruits, vegetables and their juices. To achieve Yin and Yang balance, simply consume the foods grown near or in the climate in which you live and in season. Use more cooked grains, legumes, vegetable stews and soups in the winter, and eat more raw food during the summer months.

Alkaline Foods (General Percentages)

Summer	60% to 70%
Winter	25% to 35%
Fall	50% to 60%
Spring	50% to 60%

The Yin and Yang Balance is a different ratio and will be discussed in another Chapter. The foods falling into the Acid quality are all proteins, starches, fats and sugars, i.e., all nuts, seeds, cheeses, bread, potatoes, rice, oils, dried and sweet fruit, like dates, raisins, figs, bananas, etc.

Acid Foods (General Yearly Percentage)

Summer	30% to 40%
Winter	65% to 75%
Fall	40% to 50%
Spring	40% to 50%

Listen to your inner bodily needs; you may require more or less of the Acid foods at different times. All heavy type foods are acid forming and they show up acid on the pH urine scale. Also, eat sparingly of fats and sugary type foods, i.e., honey, dried fruits.

The human body requires just the right amount of proteins, starches, sugars, fats, minerals, vitamins and liquids. An excess or deficiency of any one food element, over a period of time, can cause acute, chronic or deficiency diseases, i.e., diabetes, cancer, obesity, high and low blood pressure, emaciation, hypoglycemia, schizophrenia etc. A balanced and moderate amount of all food elements, coupled with physical fitness, is the master key to good health, nutrition and longevity.

For example, too much protein damages the kidneys, ages the cells and tissues, pollutes the blood stream with uric acid and toxins. A deficiency of protein atrophys the kidneys, causes anemia, falling hair, emaciation, fatigue and mental depression.

An excess of starch injures the liver, causes nerve depletion, constipation, skin eruptions and mental fatigue. A deficiency of starch causes cold hands and feet, weight loss, a nervous and irritable condition, loss of energy and lack of body heat during cold weather.

All sugars eaten to excess impair the pancreas, kidneys and causes poor eyesight, falling hair, tooth decay, impotence, schizophrenia, paranoia and premature aging.

An excess of fat overworks the gall bladder and liver, and together with refined sugar raises the blood cholesterol. Fat is difficult to digest if eaten in excess of the bodily needs, and causes anemia, skin problems and obesity. A deficiency or an excess causes nerve disorders, falling hair, poor eyesight, lack of body heat and general fatigue.

Vitamins and minerals are essential in preventing various deficiencies and diseases. Lack of adequate vitamins and minerals has caused such deficiency as: beriberi, pellagra, rickets, scurvy and others. Severe mineral and vitamin depletion can be fatal An excess of minerals and vitamins can cause disease. Likewise, an excess of vitamin and mineral supplements in megadoes can be dangerous. Consult a competent health doctor of nutrition to advise you on their use.

Learn to listen to your inner bodily cravings for the proper amount of proteins, starches, sugars, fats, vitamins, and minerals; this will lead you to health and longevity.

Masticate & Salivate your Food

Indigestion is a universal malady. One of the main causes of stomach ailments is bolting food in a hurry. Nothing ages one faster than this pernicious habit. The stomach has no teeth to break up large particles of food. Nature has endowed man with a set of teeth to break down food into fine, almost liquid particles, so that the digestive enzymes and juices may easily mix with it. Sufficient mastication and salivation of all food, including liquids, insures healthy and thorough digestion and assimilation. Mastication allows us to enjoy and taste our food to the highest degree. Eating should be a pleasurable experience. Swallowing and hurried eating never allows one to really enjoy their meals. Adequate chewing enables one to eat less and to digest, assimilate and utilize their food better. Chew your food to a liquid then drink it, your stomach has no teeth; and also, chew your liquids.

Never Eat When Upset

Animals will not eat if wounded, sick, excited, frightened or maddened. Working under mental or physical strain will retard or suspend digestion. Never eat during a fever, as it will only feed the fires. Eating food when upset or under physical strain will cause

faulty digestion and the result is toxemia. Eating under these adverse conditions slows down and impedes the peristaltic action of the stomach and its juices. The rule is then, when sick or in distress, stop eating until normal hunger returns. Rest, and a short fast will be the only remedies.

Eat Food at Room Temperature

Cold and hot food suspend digestion for some time. A great amount of body energy is wasted by this ill-habit. It is best to allow food and drink to reach room temperature before consuming it. In China one of the causes for failing to achieve longevity is considered to be the use of ice in food and drink.

Cooked & Raw Foods Daily

Eat according to season, climate and weather variations. Eat some cooked and raw food daily. Consuming only 100% cooked or 100% raw food exclusively is not conducive to vibrant health.

Consume more cooked grains, legumes and vegetables during the winter; and more raw foods during the summer.

Fasting or Eliminative Diet

A fast or an eliminative diet, when necessary is an excellent way to cleanse the body. Fast 3 to 5 days on distilled water with plenty of rest and fresh air, followed by a day of fruit. The eliminative diet of three days on watery fruits or vegetables or juices will bring superb health results. Refer to chapter on fasting and eliminative diet for more details. A temperate diet arms the body against all external accidents, so that they are not so easily hurt by the heat, cold or labor.

Combine Food Properly

The body and blood chemistry can easily be upset by continually consuming improper and incompatible food combinations, i.e., raw fruit with starch foods and fruit with animal protein are the most inharmonious combinations. See chapter on food combining.

Avoid Close Work during Meals

This is so important that it will add many years to your life. Oxygen is necessary to properly digest and assimilate the food eaten. Performing close work or reading or staying indoors after eating will hinder digestion and result in poor eyesight and other ills, because close work diverts the blood out of the stomach and into the head and brain area, causing a lack of blood for proper food digestion. After meals, go out into the open air and look into the distance. This will relax the entire nervous system resulting in improved digestion, assimilation and better health. Never lie down after eating, because the digestive juices do not flow freely in this position, and results in fermentation and gas. Too many people, including Health Culturists, are wearing glasses and weakening their eyes, because of the practice of not resting the brain and not getting fresh air after eating.

Eat your Last Meal 4 Hours before Bedtime

The body has the least amount of energy and vitality at night, which prevents the proper digestion and assimilation of foods eaten at a late hour. Good sound sleep is necessary for the repair of the cells, tissues and organs of the body. Eating a heavy meal at night before going to bed prevents the body from repairing and replenishing itself from the daily activities.

By evening, the body's energy has been mostly expended. Because of this low energy flow, the food consumed in the evening hours should be relatively light and easy to digest. After sunset, the ionic charge of the atmosphere drops, and the later one eats, the more likely the food is to be improperly digested. The last meal of the day should be taken on or before sunset. If you are hungry later in the evening, eat an apple or pear, or a few grapes and berries. Heavy food eaten before bedtime causes muscle twitching and cramps. Yellow and bilious skin can be attributed to this practice, as well as anemia and poor circulation.

This faulty habit weakens the vital organs and uses up a large amount of energy, causing a lack of good sound sleep. The best time to eat the heavier foods is earlier in the day, when the body has the vital energy to digest and assimilate the food properly. The average person does just the opposite; they eat a big meal just before bed time. No wonder there are so few magnetically healthy

people around today. An abundance of energy can be yours when you learn to obey nature's laws.

Be Cheerful and Calm at Mealtime

Anger, hate, anxiety and worry stop digestion. At meal time keep calm and think about the lovely and beautiful things in life. Above all, enjoy your meal, and do not become a hypochondriac over your health or natural eating, learn the rules, practice them always, make them your habit, and then take up a worthwhile hobby or profession with the zest for living and doing.

These little secrets of correct eating may not seem like a big deal, and you may want to neglect them, but we can assure you they are very important for the maintenance and preservation of your health and happiness.

Moderation is the Key to Health and Long Life

Moderation is the natural law of temperance, not only in eating and drinking, but in sleeping, working, exercising, studying, meditation and all other activities. Overdoing anything in life tends to weaken ones vitality and physical powers. Excessive sleeping can make one sluggish, lazy and dull; the proper amount of sleep revitalizes and rejuvenates the body for daily activity. Excessive exercise, work or mental activity can lead to nerve and adrenal exhaustion, and the consequent loss of personal magnetism, vitality and health. If one lives within these magnetic margins (moderation) they can build a reserve energy supply to cope with any stress or heavy physical or mental emergency situation.

Moderation in all of the healthy activities and functions of life is the key to attaining vitality and good health. The ancients teach us that one cannot be moderate and attain good health and spiritual development by even the smallest use of drugs, alcohol, dope, sugar foods, smoking, lying, cheating, hate, anger, or swearing etc. Any amount of these negative habits in ones life are harmful to the spirutual and physical body and cause untold misery and suffering. They are contrary to the Tao and the order of the universe.

Sleep, activity and proper eating habits are the three most essential functions of life. When any one of these essentials are out of balance in some degree, one must suffer the consequences.

We learn through experience, and if we have suffered enough and learned our lessons well, we may alleviate our sickness and self-induced misery. Natural law will not be violated with impunity; the rich and poor are equal in respect to the Yin and Yang laws that govern physical life.

Remember these Suggestions on Moderation:

Eat only when hungry and stop before full.
Drink pure liquids when thirsty.
Rest or sleep when fatigued or exhausted.
Exercise daily, with moderation.
Cultivate cleanliness of body and mind.
Study and read when alert and willing.
Maintain a poised, confident, cheerful and thankful attitude.

Happiness and Laughter are Medicines

Chinese Taoist physicians say that the liver churns and exercises when we laugh. The liver circulation is quickened, the respirations are deeper and more profound, and we feel warmer all over. Mirth promotes digestion, while gloom and depression of spirits will produce dyspepsia and indigestion. He or she who is habitually joyful, calm and happy will generally possess good health. A philosopher once said that he would always trust one who whistled while working.

It is impossible to reach old age with a bad stomach. There is a great deal of truth in the statement that a good stomach is not affected by aggravations, sadness, or insults. All these emotions affect primarily the stomach. Of all man's functions that affect the body and soul together, laughter is the healthiest. Laughter aids digestion, circulation, sweating, and has a refreshing effect on the strength of all organs.

Cheerfullness and gladness are not only of value in preserving health, but they are of equal service as a remedy in disease. No one should visit a hospital who is gloomy or despondent; the patient will pick up the vibrations and feel more depressed and ill.

A calm, happy, and positive attitude lifts the soul and body, and inspires all who come in view of such a person. The longest lived and healthiest people throughout the world are always happy and full of inspiration and good cheer. Health is the most precious jewel and greatest possession upon earth.

Health Wisdom of Benjamin Franklin

To lengthen your life, lessen your meals. I saw few die of hunger; of eating, 100,000. Eat to live, and not live to eat. A full belly makes a dull brain. Hold your council before dinner; the full belly hates thinking as well as acting. He that never eats too much, will never be lazy. Eat few suppers, and you will need few medicines. Many dishes, many diseases; many medicines, few cures. Hunger is the best pickle. To live long it is necessary to live slowly. Wish not so much to live long, as to live well. Keep out of the sight of feasts of banquets as much as possible. If a man casually exceeds (overeats), let him fast the next meal, and all may be well again. A temperate diet frees from diseases and illnesses. Early to bed and early to rise, makes a man healthy, wealthy and wise. A sober diet makes a man vigorous; it preserves the memory and helps the understanding; it makes the body a fit tabernacle of the Lord to dwell in. Drink does not drown care, but waters it, and makes it grow faster. He is the best physician that knows the worthlessness of most medicines. Health is not lost by accident, not can it be repurchased at the drug store. It is lost by physiological errors, and can be regained only by erroring no more. Disease is nature's protest against a gross violation of her laws. The reward for service is more service.

Food Combining made Easy

You are what you eat is an old health saying that is only partly true. More importantly, you are what you digest, assimilate, absorb and utilize. Our total health depends, not only on what we eat, but how efficient our digestive and assimilative powers are. Understanding proper food combining can make a tremendous difference in our over-all health and well-being. It can even extend our lives far beyond the average, and slow down the aging process.

Most people consume food indiscriminately, that is, without regard to what happens to the incompatible food mixtures when they reach the stomach, i.e., gas, flatulence and indigestion. It is not necessary to get bogged down in strict unbending food combining rules in order to achieve good health. One need only apply a few important combining principles, as outlined here, to obtain excellent health benefits.

Eight Food Combining Principles

Most Important Food Combining Principles:

1. Salads should not be eaten before protein or starch (beans, grains), always with or after these foods. Food is digested much easier when eating from Yang foods to Yin ones. Protein and Yang foods require plenty of stomach hydrochloric acid for proper digestion. If one eats Yin salads, fruits or other light carbohydrate foods first, for which hydrochloric acid is not needed, and protein/ Yang foods are eaten last, the Yin foods will interfere with protein/ Yang food digestion because of diminished hydrochloric acid in the stomach. Therefore, when eating a grain/bean dish, cheese, yogurt etc., eat them before or with the vegetable salad, never after. One can alleviate much gas and indigestion by eating in this manner. The body secretes enzymes and hormones at all times on a healthy and well balanced diet: there is no need to eat salads first in the meal to supply any missing enzymes to digest protein or Yang foods.

2. Many foods, such as grains and beans contain both protein and starch, which are the principal foods of people worldwide. Eaten in moderation, protein and starch foods are not incompatible, as some erroneously believe. Complex carbohydrate foods, in fact, have a sparing effect on protein foods, thus saving the protein for its hormone and tissue building work. Complex carbohydrates, like grains, beans and root vegetables are energy and heat producers. If an insufficient amount of these are eaten with a protein, the protein is then used as a secondary source of energy and heat which requires extensive energy conversion and deprives protein of its main function hormone and tissue repair. Generations of healthy people have eaten protein and starch foods at the same meal. Nature produces a variety of protein and starch mixed foods, such as wheat, peas, beans, corn, buckwheat, potatoes, seeds, nuts, rye and all other grains.

3. Acid and sub-acid fruits combine fairwith pure protein foods, such as yogurt, cottage cheese, buttermilk, raw milk, eggs, etc. Milk always curdles as soon as it is mixed with the gastric juice, and this is a help rather than a hindrance to digestion, as it would leave the stomach too quickly if it remained in the fluid state. Fruit acids are mild compared to gastric secretions, therefore, they will not interfere with the digestion of a pure protein food eaten in moderation. This mixture can be eaten more in hot weather or tropical climates.

4. This is the most important food combining principle to follow! The worse combination of all is mixing acid or sub-acid fruits with starch foods, such as beans, bread, grains. The acids in the fruit impede starch digestion considerably, causing fermentation and gas. It is best to eat fruit alone. Stewed or baked fruit with a starch meal, however, will not cause any problems. Cooking fruits diminish their acids, and can be eaten occasionally with grains or other starch foods.

5. Avoid protein and sweet fruit or any other sweets, such as honey, sugar, corn syrup etc. Sweets inhibit stomach secretions (hydrochloric acid), and result in poor protein assimilation and digestion, along with fermentation and gas. Sweet fruits, such as melons, bananas and dates should be eaten on an empty stomach. You may eat fruit or melons in the morning, at least one-half hour before a protein or Yang food meal. Fruit for breakfast gives the stomach natural bulk and acts as an intestinal cleaner and eliminator.

6. Foods rich in fat, especially high fat cheeses, meats, nuts, milk, oils, butter, etc., inhibits the flow of gastric secretions, slows down digestion and delays the emptying of the stomach by several hours. If an excess of fatty foods are eaten at one meal, there will be digestive problems.

7. Avoid sulphur foods, such as onions, garlic, leeks, etc. at the same meals with sweet foods, such as fruits or honey. Stomach pains, gas, fermentation and indigestion can easily result from this poor combination.

8. The three most important points to remember are to: a) never overeat at mealtimes; b) eat only when truly hungry; and c) limit the combination and variety of foods at a meal 3 or 4 items per meal are sufficient for health and nourishment. Generally, the more foods that are mixed at one meal, the more digestive trouble one will have. Keep your meals simple, but delicious and nutritious. Eat to live, and not live to eat. With many dishes, comes many diseases.

Help for Weak Digestive Systems

Those with very weak digestive systems will benefit greatly by eating only 1 or 2 foods at a meal, thus lessening the burden on the entire digestive process. If you are sick, eat only one meal per day until your digestion is back to normal; it usually takes about

one week to get back your normal digestion. The one meal per day plan can include cooked grains and vegetables in winter and a sub-acid fruit with the seed/nut milk or fruit alone; or cultured raw dairy products alone.

Food Combining Groups

Try to follow these simple food combining principles as much as possible but do not become a fanatic over the subject of food combining and nutrition. When visiting friends, relatives or restaurants, do not become a food combining crank by lecturing others on dietetics. Do not give advice unless asked, and then give just a little. Listen more and talk less no one likes a know-it-all. Extend the freedom onto others to do as they wish. Living by example is a far better teacher than excessive talking or preaching. Be careful of giving advice wise people do not need it, and fools will not heed it anyway.

The following is a list of food classifications and food combining groups, to be used at your own discretion, according to your individual needs and requirements. The food we eat is as important as the most potent medicine, even more so. For what we eat becomes part of us, part of our blood, our heart, our brain.

Million Dollar Minerals

Are you timid and shy? Do you constantly worry and show fear? Are you easily discouraged? Do you bite your nails? Are you anemic, weak, underweight or overweight? Are you a negative thinker? Is your memory poor? Why are some people serene, dynamic and vital? What makes certain women kissable at any age? Why is fear unknown to others? Why can some people sell snowballs in Alaska while others cannot sell water in a desert? Why can some men and women entice the fortunes of life to themselves? What is it? What is the secret of Super Health, Youth and Vitality?

The answer to these often asked questions lies in the powerful mineral elements that compose your body. You will learn all about these miraculous vital mineral elements how to use them harness them direct them and transform your life with their life giving power. These body elements must be raised through plant life, not given in drugs, to become yours. Most of us who study, work and read, are hungry for those tiny units of power the sixteen mineral elements.

Group A: Proteins

Nuts & Seeds
Dairy
Beans & Peas
All Meat
Eggs

Group B: Starches

All Grains	Carrots	Parsnips
Potatoes	Legumes	Bananas
Cauliflower	Chestnuts	Rutabaga
Pumpkin	All nuts	Bread
Turnips	Beets	

Group C: Fats

All Oils	Avocado
Butter	Olives
Cream	Nuts
Milk	Cheese
Margarine	Fat Meats

Group D: Acid Fruits

Orange	Lemon
Pomegrante	Grapefruit
Lime	Sour Apple
Pineapple	Strawberry
Sour	Plum
Tomato	Sour
Grape	Tangerines

Group E: Sub-Acid Fruits

Pear	Papaya	Figs
Apple	Huckleberry	Plum
Peaches	Grape	Apricot
Blackberry	Guava	Mango
Raspberry	Quince	
Nectarine	Blueberry	

Group F: Sweet Fruits

Fresh Raw	***Dried Fruit***	
Bananas	Peach	Figs
Cantaloupe	Plum	Dates
Watermelon	Apricot	Raisins
Crenshaw	Pear	Prunes
All Melons	Apple	
Persimmons	Pineapple	

Group G: Non-Starchy Vegetables

Alfalfa	Sweet Pepper	Broccoli	Escarole
Garlic	Asparagus	Fresh Peas	Spinach
Chard	Zucchini	String Beans	Mushrooms
Okra	Squash	Radish	Lettuce
Chicory	Bamboo Shoots	Kale	Parsley
Celery	Eggplant	Cucumbers	Watercress
Sorrell	Cabbage	Brussel Sprouts	Sprouts
Leeks	Artichoke	Water Chestnut	Onions

How to Combine the Groups:

Group A and Group G: Good
Group A and Group D: Fair
Group B and Group C: Fair
Group A and Group F: Poor
Group D and Group E: Good
Group B and Group D: Poor
Group B and Group F: Poor
Group A and Group C: Fair
Group B and Group G: Good
Group A and Group E: Fair
Group C and Group G: Good
Group D and Group F: Poor
Group E and Group F: Good
Group B and Group E: Poor
Group A and Group B: Fair

Fig. 5.1. Food Combining Groups made Easy.

Glamorous Minerals

Charm your world with sulphur and iodine. Master your world with calcium and fluorin. Laugh with your world with silicon and potassium. Prosper in your world with manganese, iodine, calcium and phosphorus. Entertain and fascinate your world with sodium, magnesium, Iodine and chlorine. Love your world with iron, copper, phosphorous and potassium. Be self-confident in your world with all the powerful minerals which regulate our social, mental, health, business and esthetic life.

Many business executives have conquered their nerves and fatigue as well as other serious deficiencies by using all twelve of the body minerals. Some perpetually tired people may be hungry for only iodine, sulphur, phosphorus and manganese, to reenforce their vital system. Arthritic sufferers are hungry for sodium, chlorin, iodine and sulphur. Diabetics need sodium. Fearful, timid people need calcium, fluorin, iodine and oxygen, attracted to the body by the use of potassium. Those low in muscular power need Vitamin C with potassium, sodium and chlorin. Sad, melancholy and easily infected types need silicon, fluorin and iodine. Only a little lack brings disastrous consequences.

Through very small amounts of these precious elements are contained in the normal body, they have tremendously important work to do. The mineral elements work hand in hand with the glandular system. Nature placed these elements in the soil and not upon the drug shelf. More powerful than drugs in lasting nourishment, they provide the spark of life, the immunity against disease, the enthusiasm of youth, the endurance of health, the enchantment of well-being and calmness. To neglect them in our diet is to turn our face from bountiful supply in nature.

Only a tiny amount of copper, yet that mineral is like an electric dynamo charging complexion, hair, blood stream, and even the intestinal tract with an essence which enables other minerals to give forth their benefits. Copper, manganese and iron are an unbreakable corporation in the financial affairs of body chemistry. They are needed by tired mental workers, who are low in drive, energy and easily fatigued.

Phosphorus, calcium, silicon, and fluorin hunger are found in tuberculosis. Fluorin starvation means erratic characteristics, infections, premature aging and greying. Potassium hunger is found in those with no come back, no resilience of muscle, and those

who suffer with intestinal atony. Sodium, chlorin and potassium assist assimilation and elimination. Sulphur, queen of enthusiasm, beauty and golden nerves, yet taken without balance, a Vesuvius of drying, scorching irritation. Magnesium and silicon, diplomats of optimism and poise, who never let one down. Iodine, the confidence artist, the clever, original life enjoyment chemical which turns back the clock toward youthful appearance and ambitions. You may combine iodine with any of the other minerals which you lack because it accelerates assimilation.

Power of Minerals

Minerals are found in small quantities within the body, about five percent, but they are vitally important to your health and well-being. They have very individual and distinct physiological functions to perform. They are necessary to the life process of plant, animal and man. These precious little minerals preserve our life, repair our tissues and bony structures. They impart firmness, form and grace to our body. Without them, our glands would stop functioning, because the glands maintain metabolism, secretions, digestion, mental activity and all physiological functions. The body fails to rebuild, repair and regenerate without an adequate supply of these dynamic little wonder-workers.

They give us vital electricity and magnetic power, ceaselessly working to recharge physical and mental batteries; and they carry the life sustaining oxygen to all parts of the body. They provide the spark of life and immunity against disease and poor health.

They are powerful neutralizers of toxins and wastes, purifying the blood and casting out of the system, uric acid and other poisons. They are the natural healers and give the body vital resistance and immunity against so-called germs of disease.

Raw fruit and vegetable juices contain the organic minerals the body can use. The cholrophyll found in the green coloring matter of plants, made into juice, is a superior storehouse of these vital mineral elements. They aid the body in producing and sustaining the supply of internal hormones, enzymes and secretions to keep you youthful and zestfully alive. They are necessary for the proper digestion and assimilation of proteins, starches and fats.

Our bodies are composed of these ***16 Mineral Elements***, primarily, plus over ***30 Other Trace Minerals:***

Iron	Sulphur	Chlorine	Oxygen
Silicon	Fluorine	Iodine	Carbon
Calcium	Sodium	Manganese	Nitrogen
Phosphorus	Magnesium	Potassium	Hydrogen

Our cells are constantly being used up and repaired daily, and this repair comes from within. Minerals and vitamins require daily replenishment. They supply the body through the bloodstream, therefore, the blood must contain and deliver all sixteen mineral elements that the body vitally needs and is composed of. Without all of the 16 elements, the body fails to function properly, hence sickness and poor health will follow. There are also over 30 trace mineral elements needed in small quantities by the body.

Wholesome, organic and natural foods adequately supply the body with minerals. However, if mostly unnatural and devitalized foods are eaten, only a small fraction of the requirements are supplied, resulting in severe mineral starvation and depletion, leading to ill-health, depression, fatigue and the common low-energy symptoms.

Minerals and Richest Food Sources

Iron (Blood Builder Mineral): It is an oxygen carrier in the blood and is found in the hemoglobin of the red blood corpuscles. Anemia cannot be present when the blood has a good supply of Iron flowing through it. Iron in the blood allows you to utilize the oxygen out of the air. The thyroid is considered the oxygen gland and iron helps the thyroid gland, along with the oxygen, to eliminate the cellular wastes, use them up, and make our foods in the body ready for blood assimilation. Iron imparts strength, vitality, courage, warmth, creativity and mental power. It gives you ambition to succeed and to be a live go-getter.

Inorganic Iron, as found in drugs, irritate the kidneys and cannot be assimilated by the body. Organic Iron, as found in natural foods, builds rich red blood. Anemic, pale, thin, depressed and sick people need large quantities of Iron from quality organic products. The lack of Iron brings on sleeplessness, irritability, neurasthenia, starvation, disease and unhappiness. If you want success, happiness and love to be a part of your life, use organic iron-rich foods.

Food Sources: Spinach, sorrel, lettuce, cherries, grapes, raw egg yolks, sunflower seeds, strawberries, asparagus, cucumbers, rye, goat cheese, blackberries, blueberries, apricots, lentils, currants, pomegranates, prunes, carrots, walnuts, figs, apples, wheat, pumpkins, tomatoes, radishes, cabbage, onions & chard.

Silicon (Optimism Mineral): It makes you happy, joyful and zippy. It builds the bones, hair, teeth, eyes, nails, eyesight and improves the complexion and is needed in the structural system, membranes and arterial walls. It brings beauty and firmness to the cells and tissues. Silicon is a good antiseptic, alkaline in composition. It is a great body toner and builds up body resistance. People plagued with sexual weakness, tumors, bad circulation, liver problems and constipation are in need of Silicon. Skins of fruits and vegetables and the outer coats of whole grain cereals are high in Silicon.

Food Sources: Whole wheat, seeds, oats, barley, figs, strawberries, apples, grapes, cherries, peaches, carrots, greens, walnuts, almonds, rye, onions, spinach, egg yolk, asparagus and lettuce.

Calcium (Will Power Mineral): It gives strength and durability and maintains the bone structure. It builds teeth, nails and steadies the nerves. It adds strength and firmness to the arteries and pulse. Calcium imparts endurance, will power, good memory, strong bones and teeth. It heals wounds and neutralizes toxic acids in the system. It is needed for concentration and strengthens the heart and courage. Calcium is destroyed in the body by white flour products, white sugar, candy, etc. It extends life and prolongs youth. Pregnant women need Calcium to produce healthy children and to maintain health. The infant will draw the Calcium from the mother's bones if she has a lack of it in her diet. Lack of Calcium brings on rotten teeth, rickets, anemia, weak & soft bones & diseased bodies. Calcium requires Vitamin D for proper assimilation.

Food Sources: Goat milk, egg yolk, Canadian wheat, kale, swiss cheese, buttermilk, green vegetables and juices, garlic, oats, lemons, oranges, berries, cabbage, dates, prunes, apricots, sesame and sunflower seeds and cauliflower.

Phosphorus (Brain and Nerve Building Mineral): Stimulates powerful mental thought and brain activity. It helps promote digestion, and better metabolism of carbohydrates and fats. Phosphorus works along with calcium as a bone builder, assisted by Vitamin D. The diet should consist of 2.5 calcium to 1 phosphorus to maintain a healthy ratio within the body. People eat too much phosphorus and consequently need to increase their intake of calcium.

Lack of this magic mineral will make you look old, but it maintains your youth if eaten daily. Lack of phosphorus can cause nerve and brain disorders, fatigue, weakness and poor elimination.

Food Sources: Almonds, rye, egg yolk, wheat bran, rice bran, goat cheese, turnips, soy beans, oats, barley, seeds, nuts, peas, beans, lentils, buckwheat, asparagus, yellow corn, parsnips, whey, cauliflower and kale.

Sulphur (Sex Appeal Mineral): It cleans, tones and purifies the system, feeds the nerves and gives life and beauty and an abundant growth of hair. Sulphur is associated with insulin, the hormone secreted by the pancreatic gland to properly digest carbohydrates. It throws out body impurities and promotes bile secretions, enabling the liver to utilize all food minerals. It promotes better bowel action and helps manufacture hormones for the generative system. It increases feelings and emotions. Lack of Sulphur produces dull brains, poor blood, lustreless hair, impotence, nervousness.

Food Sources: Cabbage, onions, garlic, radishes, raw egg yolk, asparagus, almonds, chestnuts, cauliflower, kale, brussel sprouts, pecans, mustard greens, broccoli, leeks, horseradish, string beans, endive, thyme and figs.

Sodium (Youth Mineral): It cleanses and sweetens the body. It builds the glands, ligaments and blood. Sodium neutralizes acidosis, helps digestion, overcomes fermentation. Prevents hardening of the arteries and joints. High strung people need this mineral in abundance. It improves good nature in the personality. Lack of Sodium results in catarrh and congestion and slows the mental processes. Depressed, discontented and downhearted people are usually deficient in it. Increase your Sodium intake and watch yourself become optimistic and contented.

Food Sources: Celery, carrots, asparagus, seeds, beets, pumpkin, squash, apples, cherries, egg yolk, berries, turnips, spinach, rice, goat cheese, black figs, string beans, oats, dandelions, whey, radish and goat milk.

Magnesium (Nerve Relaxer Mineral): This wonderful mineral calms and steadies the nerves, relieves mental fatigue. It helps keep the brain and emotions cool and calm. It relaxes the nerves and has a laxative effect. It is a sleep enhancer; calms irritatility and hot tempers. It helps overcome constipation and toxemia. Magnesium has recently been found to activate about 30 enzymes within the body and helps to metabolize protein, starch and fat. It

also promotes vitamin and hormone activity. Lack of Magnesium leads to hysteria, nerve disorders, insanity, constipation and fainting spells. It protects against strontium 90 fallout in the air. City tap water (high in fluorides) will immobilize the usable magnesium in the body. Drink pure distilled water and be safe.

Food Sources: Nuts, seeds, whole grain foods, greens, peas, beans, almonds, apples, brown rice, goat milk, raw egg yolk, whole barley, black figs, walnuts, apricots, wheat, dandelion, garbanzo peas, pomegranates and corn.

Chlorine (Body Cleanser Mineral): It purifies, cleanses and cleans out body waste. It disinfects, freshens and sweetens the entire system; promotes joint agility and flexibility; cuts down fat and auto-intoxication. Lack of Chlorine may cause mucus, fear, anemia, depression, kidney problems, indigestion and no ambition to succeed.

Food Sources: Beets, red cabbage, cucumbers, spinach, radishes, sea salt, goat cheese and milk, carrots, egg yolk, lettuce, olives and pears.

Iodine (Thyroid Regulator Mineral): It normalizes the metabolism and protects the brain and nervous system from body toxins. It is a natural germicide, protecting, balancing and immunizing the internal system. Iodine nor-malizes the body weight through the function of the thyroid gland. The thyroid produces a horhome called thyroxin containing 65% iodine. Thyroxin controls the glandular secretions and the heat and energy production in the body. It helps digestion and assimilation. It slows aging and prolongs life. Iodine detoxifies the cells and tissues. Iodine regulates the cellular structures and the heart and circulatory system. It prevents goiter, loss of hair, brain fatigue, shyness, glandular problems, excitability and irregular pulse rate.

Food Sources: Sea kelp, dulse, irish moss, pineapple, brown rice, garlic, apples, raw egg yolk, strawberries, potato skin, watercress, sea foods, carrots, onions, tomatoes and artichokes.

Manganese (Nerve Controller Mineral): A thought coordinator, it increases mental and nerve force, quick recuperation and improves memory. It feeds the brain and nerves; and increases resistance to disease. It is the mineral controlling the emotions and affections, giving social poise, confidence and steady nerves. It also imparts to the body elasticity and fast recuperative ability. Lack of Manganese causes confusion and scatter-brained activity in work, studies and love. It can lead to nerve disorders if deficient too long.

Food Sources: Almonds, walnuts, endive, wintergreen, raw egg yolk, prunes, peppermint tea, parsley, pignolia nuts, rye meal, sun dried fruits and greens.

Potassium (Strengthen Mineral): It nourishes, gives health, strength and quick recuperative powers. It puts fire and zip into the body. It reduces pain and regulates the brain and body. It promotes elastic and supple muscles, and creates grace, beauty and good disposition. It helps to prevent constipation. It activates the liver and is alkaline to the body. It aids the tissues and internal secretions. Stress depletes the potassium in the body and this leads to an acid condition. People on the go need potassium. It helps to control temper. Get your share of this magic mineral daily.

Food Sources: Potato skin, almonds, parsley, watercress, carrots, berries, cherries, figs, grapes, lemons, olives, alfalfa, cucumber, dandelion, sage, dill, lettuce, peaches, oranges & tropical fruits.

Fluorine (Beautifier & Youth Mineral): It protects against sickness; knits bones, aids teeth enamel and strengthens tendons. As the youth element, it gives you strong mental powers and keeps you elastic. It works with calcium to build strong tooth enamel, bone structure, hair and elastic tissues. Fluorine is the rejuvenation mineral and helps to keep you young. It improves the eyes, hair and nails. The lack of fluorine causes premature old age, fear, hair loss, brain and body fatigue, tuberculosis, paralysis and a run down condition.

Food Sources: Raw goat milk/cheece, spinach, cress, garlic, oats, greens, beets, wheat, brussel sprouts, cabbage and cauliflower.

Oxygen (Life-Giving Mineral): Oxygen is primarily found in the air. Mountain and ocean air is the purest type available. City air is polluted and its oxygen is full of chemicals. Pure oxygen gives us brain and body stimulation. Oxygen comprises over half the body weight. Normal breathing is not enough. We must get out into the fresh air, exercise and expand our chest to its fullest capacity with the life-giving oxygen. Fresh oxygen helps to digest our food. It purifies and blood stream and cleans out the lungs. It is necessary for the metabolism and all processes of the body. Oxygen makes us happy, bouyant and fresh. Lack of it causes depression, anemia, low energy and a hopeless outlook on life.

Food Sources: Pure water, all fresh fruits, vegetables, juices, and pure outside air.

Carbon (Body Heater Mineral): One fifth of the body is composed of carbon. Only so much carbon is needed by the body. Too much can break down the liver and cause disease. Carbon is the fuel and heater to the body. Carbon is mostly found in fats, and they yield 4040 calories per pound, while carbohydrates furnish only 1820 calories per pound. Fats are composed of about 76 percent carbon, 12 percent hydrogen and 12 percent oxygen. After digestion, fats are absorbed and then oxidized to produce energy, carbon dioxide, and water. Eaten to excess, fats may be stored as body fat or converted into carbohydrate and stored as glycogen. Lack of carbon may cause coldness, forgetfulness, laziness, fear, brain deficiency and over all lack of energy. White flour products, white sugar, lard, fatty animal foods and fried foods are dangerous to life and health.
Food Sources: Rice bran, oats, corn, millet, cheese, butter, egg yolk, goat milk, avocado, pure vegetable oils, nuts, rye, wheat bran, barley, pecans, brazil nuts, walnuts, peanuts and coconuts.
Nitrogen (Muscle Builder Mineral): Nitrogen is mainly found in the form of protein, which is composed of carbon, oxygen, hydrogen, sulphur and nitrogen. Nitrogen furnishes building material to keep the cells and tissues together. In the construction of the protein molecules of plants, nitrogen is absorbed from the soil in soluble forms, as compounds of nitrates and ammonium salts, which are converted first into amino acids and then into protein. The body takes up this protein and converts it into amino acids for the promotion of growth, life, health and vitality. This is known as the Nitrogen Cycle, and all plant and animal life are dependent upon it for existence. The atmosphere is ¾ Nitrogen, with oxygen, carbon and hydrogen composing the rest of the ether. We could not breathe or live on 100% pure oxygen without the other three elements. Nitrogen keeps the oxygen from burning up in the body.
Food Sources: Nuts, seeds, legumes, milk, eggs, whole grains, cheese and all other foods high in protein.
Hydrogen (Cooling Mineral): Hydrogen maintains body coolness and body temperature. It is the youth mineral that helps to overcome inflammation and pain. It also flushes the inner organs of toxins and waste matter. It is involved in the nitrogen cycle of plants and animals. It is located in the atmosphere and fresh foods.
Food Sources: Fresh fruits and vegetables, lettuce, tomatoes, celery, juices, cucumber, water & all foods with a liquid content.

Trace Minerals: Copper, zinc, cobalt, selenium and the over 28 other trace minerals are found in very small quantities in the body. However, they are vitally important, and as necessary to your health and well-being as the other 16 Magic Minerals. These trace elements are found in all plant life.
Zinc: It is found in the hair, nails, bones, liver, skin, glands, kidneys and the prostrate gland. It increases blood production in weak areas. Wounds heal faster with zinc, and it can act as an antidote to certain poisons. Zinc deficiencies cause diabetes, retardation, schizophrenia, fatigue, infection, and poor skin. If you have white spots on your fingernails, you have a zinc deficiency.
Food Sources: Apricots, nutritional yeast, nuts, pumpkin and sunflower seeds, wheatgerm, egg yolk, soy beans, spinach and mushrooms.
Copper: It assists in forming rich red blood cells. It prevents anemia, builds the bones and circulator system. It heals the body, improves the hair and skin. Lack of Copper causes weakness, skin trouble, poor respiration, baldness and fatigue.
Food Sources: Nuts, raisins, molasses, soybeans, legumes, apricots, dark fruits and juices.
Cobalt: It is needed in small amounts only. It assists the absorption of B-12 in the body. It is contained in a variety of natural foods listed under the other minerals.
Selenium: Small amounts are needed. In functions similar to vitamin E in the system. It is located in small traces in sea water. It is contained in all natural foods.

Your food shall be your medicine, and your medicine shall be your food. Eat sparingly and defy the physician. The human is the most helpless creature on the face of the earth. When they come into existence they have to be taught everything which become their habits. But this is our salvation. If man is a creature of habits why not be a slave to good habits? We can reeducate ourselves and take control of our own destiny. Love does not dominate; it cultivates.

Natural Foods contain all the vitamins that have been discovered and will be discovered. Scurvy, pellagra, beriberi, and most all diseases are the result, partially at least, of vitamin deficiencies. Cheat the body of vitamin-rich food and you are on a disease-producing diet. Quality foods count, not quantity.

Vitamins for Vitality

Vitamins were discovered by Dr. Casmir Funk about 62 years ago. The word vitamin comes from the Latin word vita, which means life, and amins, meaning amino acids, which form the life substances of protoplasm or organic compounds, of which the growth and life of plants and animals depend. They are composed mainly of carbon, hydrogen, oxygen and nitrogen.

Actually, vitamins provide no heat, energy, or material for tissue building, however, they are vitally important for proper growth and good health. The minerals are the nutritional elements necessary for building and repairing cells and tissues. Vitamins are those atomically small sparks of food energy elements that carry on the process of metabolism; the activation, assimilation and utilization of minerals, fats, carbohydrates, trace elements and other nutritional factors in our food.

Vitamins keep the fires of life aglow. They secretly control the internal chemical process; converting food into blood, tissue and dynamic energy. The body needs vitamins from outside sources and they must be eaten daily, for it cannot store them.

Through the process of photosynthesis, (air, light and water), nature manufactures the organic vitamins, mineral salts, and enzymes through plant life; fruits, vegetables, seeds, nuts and sea vegetation. All earthly life forms are created and sustained by this process. Plant life is the number one source of nutriment for all beings and creatures on this planet.

Natural Vitamins are Superior

Nature makes no artificial substitutes for vitamins and minerals. No other substances can take their place in human and animal chemistry. We need them in abundance daily, in whole food form and in natural food supplement form to assure adequate and complete nutrition. The difference between synthetic and natural vitamins may be the difference between disease and health. Synthetic vitamins and minerals are inorganic chemical substances and cannot be utilized by the cells and tissues of the body. The chemist will never produce a single blade of grass, yet the body can assimilate and utilize that blade of grass, while rejecting the chemist's synthetic formula.

Scurvy, pellagra, beri-beri, rickets and similar diseases are caused by a vitamin starved body. When the body is lacking the

essential vital nutrients, it will develop disease. Healthy bodies are built by quality foods, not quantity. Natural foods and natural food supplements will meet those needs to the fullest. Super Health will result with the intelligent use of them.

Major Vitamins and their Food Sources

Vitamin A *(Fat Soluble)*

It is destroyed by high heat in the presence of oxygen. It is stored in the fatty tissues for future use. Stress and strain will quickly use up Vitamin A. It builds resistance to colds, lung and sinus trouble. It is necessary for visual purple production and night vision. Increases growth and increases blood quality with the help of B complex, Vitamin C, D, E, F, Calcium, Phosphorus and Zinc. It helps conditions of acne, colds, allergies, eczema, diabetes, stress, and arthritis. Lack of this vitamin may cause night blindness, poor eyesight, rough skin, infections, dry hair and fatigue.
Food Sources: Alfalfa, green vegetables, carrots, tomatoes, apricots, cherries, egg yolk, papaya. RDA: 5,000 to 25,000 International Units daily. A glass of fresh carrot juice contains 9,000 to 12,000 units.

Vitamin B Complex *(Water Soluble)*

The B Complex family consists of the following B Vitamins: B1 (Thiamine), B2 (Riboflavin), B6 (Pyridoxine), B12 (Cobalamin), Biotine, Choline, Folic Acid, Inositol, Niacin (Niacinamide), Pantothenic Acid, Para-Aminobenzoic Acid and Pangamic Acid. The first three of these vitamins are the most important. They are stored in limited quantities in the body. They are active in enzyme production. They improve the digestive tract, skin, nerves, eyes and liver. They improve the absorption of food, and calm the nervous system. B Vitamins help metabolize fats, starches and proteins; reduce blood cholesterol; increase appetite; increase cell life; build rich red blood; prevent gray hair; promote sex hormone production; controls weight; maintains the sodium-potassium balance of the body and nerves; aids circulation of blood and lymph; improves friendly bacteria activity in digestive tract; helps depression, insomnia and fatigue; overcomes anemia, skin disorders, acne, dizziness, irritability, learning disabilities, weakness and hair loss and can help heart disease, gland and nerve disorders.

Food Sources: Nutritional Yeast, wheat germ, whole grains, egg yolks, brown rice, sunflower, pumpkin and sesame seeds, mushrooms, brown rice polishings, beans, buckwheat, lentils, peas, spinach, walnuts, goat milk, asparagus, tomatoes, green juices, berries, rye, wheat, almonds. These foods eaten in moderate daily quantities will supply all the B Complex required.

Vitamin C *(Water Soluble)*

This vitamin is destroyed by high heat, antibiotics, aspirin, tobacco, fever, stress, cortisone and other drugs. Essential for tissue respiration, improves appetite, builds capillary walls and connective tissue; gums, heart, skin, teeth and bones. Good for colds, shock and infection and tooth decay. Vitamin C works best with all vitamins and minerals, calcium, magnesium and bioflavo-noids. It improves anemia, bleeding gums, cavities, poor digestion and tissue damage.

Food Sources: Citrus fruits, all berries, green peppers, strawberries, tomatoes, currants, cress, cabbage, apples, green vegetable juices, papaya, melons, lettuce, peas and pineapple. It is not stored in the body and must be supplied daily. Fruits and vegetables eaten in season and grown locally will meet your daily vitamin C requirements. Rosehip powder can be used to supplement your diet with extra C.

Vitamin D *(Fat Soluble)*

Heat or oxidation does not affect this Vitamin. A limited amount of Vitamin D is stored in the body. The greatest source is from the sun; exposing the skin to the sunlight. The ultra-violet rays change the ergosterol in the skin into small amounts of Vitamin D. It helps the absorption of calcium and phosphorus. It is a good bone builder. It controls mineral metabolism. It favors good posture, bone growth and tooth development, fatigue, caries, nerve disorder, infections, poor skin tone, rickets and constipation.

Food Sources: Fruit and vegetables grown in the sunshine and their juices, butter, chlorophyl, goat milk and plenty of solar light. Crude mineral oil destroys Vitamin D in the body. Daily amount should be from 500 to 1,000 IU.

Vitamin E *(Tocopherol - Fat Soluble)*

It is not affected by heat or oxidation. The body stores a limited supply of Vitamin E. An adequate supply increases fertility, healthy skin and reduces abnormal hair growth on women. It is good for lactation, menstrual disorders, miscarriage and reproduction. Deficiencies of Vitamin E can cause sterility, loss of vitality and virility, lack of courage, pessimism and impaired mentality. It improves blood vessel and heart function. It builds the nerves and promotes the pituitary gland into activity. It helps to retard aging, controls blood cholesterol, tones muscles and nerves, keeps the blood from clotting, protects the lungs from pollution, increases male and female fertility and potency, and strengthens blood vessels, arteries and veins.

Food Sources: All whole grain foods, green vegetables, wheat germ, olive oil, corn, most fruits, cottage cheese, goat milk, soybeans, tomatoes, egg yolks and oats. Vitamin E is destroyed by birth control pills, tap water, crude mineral oil and hard fat. Vitamin E oil can be used topically for burns, wounds, warts and scars with good results.

Vitamin F *(Unsaturated Fatty Acids - Fat Soluble)*

Excessive heat destroys Vitamin F. Radiation and x-rays harm this vitamin in the body. It prevents stiff joints and hardened arteries. It controls blood cholesterol, improves blood pressure and glandular activity. It helps functioning of adrenal and thyroid glands. It calms the nerves and beautifies the skin. Lack of Vitamin F causes acne, gall stones, diarrhea, allergies, poor nails and hair, underweight and varicose veins. It makes for stunted growth, poor sexual development and loss of appetite.

Food Sources: Nutritional yeast, spinach, fruits, all seeds and nuts, egg yolks, wheat germ, olive oil, sunflower oil; whole grains, orange juice and root vegetables. Adequate supply from above foods should be eaten in moderation.

Vitamin K *(Menadione - Fat Soluble)*

X-rays, radiation, drugs, hard oils and fats destroy this vitamin. It improves the blood clotting system, and can be used for hemorrhages, menstrual problems and bruising. Lack of Vitamin K causes nosebleeds, diarrhea, tendency to hemorrhage and possible miscarriages.

Food Sources: Blackstrap molasses, yogurt, safflower oil, green juices and vegetables, oats, tomatoes, green peas, carrots, cauliflower and spinach. One to two milligrams per day are enough.

Vitamin P *(Biof Lavonoids - Water Soluble)*

It is part of Vitamin C. It builds and maintains the blood, connective tissues, skin, gums, bones, teeth and capillary walls. Good for coldsores, colds and the flu.
Food Sources: Cherries, apricots, grapes, grapefruit, lemons, plums and the inner skins of most fruits. Same daily allowances as Vitamin C.

Vitamins and Mineral Food Supplements

1. ***Alfalfa Liquid, Powder or Tablets:*** Two teaspoonfuls or 3 to 5 tablets daily.
2. ***Nutritional Yeast:*** B-Complex and protein source. Two to four tablespoons daily.
3. ***Wheat Germ Oil or Flakes:*** Vitamin E, protein, B-complex, minerals. Must be fresh. Two to 4 tablespoons daily of flakes.
4. ***Sea Kelp or Dulse:*** High in iodine, trace minerals. Use in salads, cooking, eat 3 to 5 tablets, or 1 teaspoon daily.
5. ***Pure Rosehip Powder:*** High in vitamin C, bioflavonoids and enzymes. One teaspoon.
6. ***Pure Cold Pressed Vegetable Oils:*** High in unsaturated fatty acids. Use sesame, sunflower or safflower oils. No more than one tablespoon in summer and two in winter.
7. ***Rice Polishings:*** High in B-Complex vitamins and minerals. Two teaspoons daily.
8. ***Fresh Squeezed Vegetable Juices:*** Vitamins, minerals and enzymes. 4 to 8 ounces in summer - less in winter.
9. ***Spirulina Plankton:*** High in vitamins, minerals, enzymes and protein. Protects against radioactive agents. Two to four tablets, or two teaspoons daily.
10. ***Powdered Carrot Calcium (Dr. Bronner):*** High in Calcium and minerals. One teaspoon daily.

Vitamins seem to offer the kick to the minerals that enter our bodies. They are little invisible helpers ready to right every wrong that may come about in the complicated processes of building and maintaining a perfect body.

Power of Enzymes

All growing and living things, including the foods we eat, contain enzymes. Where we find minerals, vitamins, protein etc., we also find enzymes. Enzymes are tiny almost invisible ferments, which cannot even be seen by the strongest microscopes. They help us digest our food and keep the fires of metabolism alive in our system. Enzymes are contained in proteins and some vitamins. Enzymes require a protein carrier to charge us with health and vitality. In fact, if we eat raw food exclusively, i.e., raw fruits and vegetables, our enzyme activity will decrease. The body needs a certain amount of all natural elements to function properly and increase the enzymes in our system. When enzyme activity slows down, we age and slowly die. If enzyme activity is increased in the system, our health and longevity improves. Enzyme levels are generally low in cases of chronic disease.

Foods that lower enzyme activity: Fats, ungerminated seeds and nuts, nut butters, excess oils, alcohol, eggs, sugar, white flour and excess fruits. Overeating, which causes constipation and obesity also reduces internal enzymes. Foods and habits that increase enzyme activity: germinated or sprouted seeds, nuts and grains; fermented seeds, miso, tofu, tempeh, tamari, cultured products these foods contain aspergillus plant enzymes, the highest source of enzymes as yet discovered. Fasting when not hungry and obtaining sufficient exercise, sunshine and fresh air aid our enzyme production.

The body produces only two Enzymes Amylase and Protease, which digest carbohydrates and proteins. Without sufficient enzymes vitamins, minerals and hormones cannot carry on their activity. Biochemist and enzyme researcher, Dr. Edward Howell states: Enzymes are substances which make life possible. They are needed for every chemical reaction that occurs in our body. Enzymes may be the key factor in preventing chronic disease and extending the human lifespan. A balanced natural food diet with healthful living habits produces the ultimate results in superior health and longevity.

It is the opinion of those who best understand the physical system, that if the physical laws were strictly observed from generation to generation, there would be an end to the frightful diseases that cut life short, and make life a torment or a trial. The more you know the less you know but the more you become.

Perhaps the most predominant food fallacy is the high protein intake usually recommended. Protein in excess of our needs is not utilized by the body.

Protein Requirements

Where do you get your protein if you do not eat meat? How many times have vegetarians been asked this question throughout the history of nutrition? Why not ask how a cow produces milk and attains great size on vegetable matter; or where an elephant, gorilla and rhinoceros obtain their protein. Better yet, ask the vegetarian centenarians, worldwide, where their sources of protein come from.

There are people living in the mountains of Russia, Turkey, India, Northern Hunza, Iran and Poland who live over 100 years in good health. Their main diet consists of whole unprocessed grains, i.e., rye, wheat, oats, millet, buckwheat and rice; seeds, nuts, locally grown fruits, vegetables and raw cultured milk products. Their diet is basically high in natural complex carbohydrates and never high in protein. Their approximate protein intake ranges from 25 to 40 grams daily. People who subsist on these natural whole foods contract *no* disease of any kind. These centenarians work all day long in the fields and never experience fatigue as we know it. They are not protein deficient. Westerners are just protein hypochrondriacs. They know nothing of high protein or other fad diets. They exist healthfully and happily, and they are not skinny or fat, but firm, muscled, robust, and energetic. Did you ever see a fat native Chinese or Japanese who subsisted on their typical traditional diet who use meat mainly as a condoment in soups and vegetable stir fries. We have personally observed these tireless people subsist on a bowl of rice, beans and vegetables daily. Young Oriental women who did not look a day over 18 or 20, we discovered, were 35 and 40 years old, with youthful smooth skin and sparkling eyes to match. These people know nothing about protein. They simply radiate beauty and tranquility. They possess well-formed physiques, and maintain the same body weight throughout a long healthy life.

These are empirical (derived from observation without reliance on theory) facts, not based on personal opinions. These dietary patterns have been tried and tested for centuries. One only has to observe how the longed-lived people live and eat, and gently follow in their footsteps.

The nutritional skeptics of the West should take an example from these wise and healthy old people. Their diets, habits and cultures have been around long before America was discovered; and long before books and magazines were published on health and nutrition. We must remember that super markets, processed foods, drug companies, protein and other trendy diets are all modern inventions, not more than 60 to 80 years old; mere seconds in the history of the world.

Protein and Amino Acid Metabolism

Proteins, like carbohydrates and fats, are composed of carbon, hydrogen and oxygen, with the addition of nitrogen, sulphur and phosphorus. Plants can synthesize protein elements from the nitrates, ammonia in the soil and decomposing vegetable matter, along with water and carbon dioxide from the air. Therefore, humans are dependent upon plants for nitrogen-rich foods.

There are eight essential and fourteen non-essential amino acids necessary for growth. The essential ones are: isoleucine, leucine, lysine, methionine, phenylalanine, tryptophane, threonine, and valine. All 22 amino acids are necessary for health, however, the eight essential ones must be supplied in the diet daily. The fourteen other amino acids are alanine, arginine, aspartic acid, cystine, glutamic acid, glycine, histidine, hydro-xyglutamic acid, hydroxylsine, hydroxproline, norleucine, proline, serine, & tyrosine.

A good quality complete protein supplies all the essential eight amino acids for normal growth and health. Incomplete proteins are the ones that lack one or more of the eight essential amino acids, and can neither support normal growth or good health. Over fifty percent of our body is composed of protein including skeletal muscles, intestines, skin, ligaments, cartilage, eye, hair, nerve fibers, bones and blood. Protein is necessary for blood clotting; and produces hormones and all enzymes. Lack of sufficient protein can cause anemia, skin disorders, constipation and even death.

Protein is converted into amino acidswhich are the basic buildingblocks of our body. Protein is used to build the various body structures, for example, muscle protein is called myosin; connective tissue uses collagen protein; and hair is made up of keratin protein. An excess as well as a deficiency of protein can cause health problems. The residue of excess protein is converted into fat and carbohydrate which is highly toxic and disease producing.

To understand this it might be well to know something of the structure of an amino acid. As the name implies, the backbone of every amino acid is an amino (nitrogen) group, NH^2, and an acid(carboxyl) group, COOH, held together by a single carbon atom, To the carbon atom is also attached a chain of organic compounds (usually denoted as R) which give each amino acid its special characteristic. These individualizing chains are made up of carbon, nitrogen, hydrogen, oxygen and sometimes sulphur.

Hence the base of every amino acid looks like this:

$$NH^2 \qquad \begin{matrix} H \\ C \\ R \end{matrix} \qquad COOH$$

Now, whenever the body cannot use an amino acid, the liver breaks it down into its various parts and uses the oxygen, hydrogen, and carbon atoms to form glucose or saturated fat. The rest, meaning the amino groups and sulphur groups it discards as ammonia and sulphuric acid. Get enough of those two elements in your system and you will be set up for all kinds of health disasters.

The ammonia (NH^3) is usualy taken care of by uniting with carbon dioxide which forms urea, a less nitrogenous substance which can be easily eliminated from the kidneys. An excess of ammonia can be converted into uric acid, however, which has the tendency to accumulate in the system and cause trouble. And sometimes the ammonia just remains as free NH^3. When there is a sufficient supply of minerals in the body, the acids, including sulphuric acid, combine with them and are eliminated as salts. Without enough minerals present, they get stuck in the body and clog up the functions of the cells. It is very important, therefore, to make sure that one's protein intake meets the body's needs, but no more. An excess of protein can create an excess of fat, raise the cholesterol level in the process, and fill the body with troublesome toxins.

Proteins are not Fuel Foods

Most recent research, worldwide, both scientific and empirical, shows more and more convincingly that our past beliefs in regard to high requirement of protein are outdated and incorrect, and that the actual daily need for protein in human nutrition Is far below that which has long been considered necessary.

The metabolism of proteins consumed In excess of the actual need leaves toxic residues of metabolic wastes in tissues, causes autotoxemia, over-acidity and nutritional deficiencies, accumulation of uric acid and purines in the tissues, intestinal putrefaction, can contribute to the development of our most common diseases such as arthritis, kidney damage, pyorrhea, schizophrenia, osteoporosis, atherosclerosis, heart disease, and cancer.

Proteins are among the most complex organic compounds found in nature. Proteins are used in the body for repair and replacement of worn out cells and tissues, but are not equally useful as fuel foods.

Carbohydrates and starchs are the primary fuel and energy supplying foods. Your need for protein can be drastically reduced by including in your diet complex carbohydrates such as, whole grains, legumes, peas, whole grain breads, whole grain noodles etc. These foods also contain an adequate supply of protein in the right proportion, especially when legumes and grains are combined at a meal.

Worldwide Protein Research

American health is declining. As a nation Americans are 21st in life expectancy, and 18th in infant mortality. They lead the world in cancer, heart disease, kidney disease, diabetes, osteoporosis, arthritis and hypoglycemia. Every cell in our body is built of protein, but that is not all we are built of. We are also 70% or more water with small amounts of minerals, vitamins etc. Proteins are needed for cell building and repair, enzyme and hormone synthesis, mineral metabolism. We need protein. But how much is too much?

Early European investigators advocated from 100 to 150 grams of proteins as a daily requirement. These erroneous figures were based on observation of what people were actually eating. Meat consumption was very high during the time of these investigations and it is easy to see how these scientists arrived at their conclusions. In the early nineteenth century conducted scientific tests on students and discovered that they could remain in nitrogen balance on less than a third of the amount of protein previously recommended and considered necessary. In fact, we have been made to believe that the more protein we consume, the better. We just could not get too much of it. Yet, the most recent worldwide research shows that the actual daily need of protein in human nutrition is far below that which has long been considered necessary.

Pritikin Diet Program

The internationally renown Pritikin Nutrition Program recommends that we ingest no more than 15 or 16% of our total calories in protein. Anything over that amount and you go into negative mineral balance. Pritikin states: "For example, if you drank a quart and a half of milk per day, more calcium would be expelled through your urine than you take in. High protein diets change the body's metabolism so that it must draw calcium from the bones to neutralize the acid conditions set up by amino acids and high protein, producing increased calcium and mineral excretion through the urine. Vegetarians always ask about getting enough protein. But I do not know any nutrition expert that can plan a diet of natural foods resulting in a protein deficiency, so long as you are not deficient in calories. You need only 6% of total calories in protein to maintain a positive nitrogen balance and it is practically impossible to get below 9% in ordinary diets. African Bantu women take in only 350 mg. of calcium per day. They bear nine children during their lifetime and breast feed them for two years. They never have a calcium deficiency, seldom break a bone, rarely lose a tooth. Their children grow up nice and strong. How can they do that on 350 mg. of calcium a day, When the American recommendation is 1200 mg. They are on a low protein diet that does not kick the calcium out of the body. In our country, those who can afford it are eating 20% of total calories in protein, which guaranties negative mineral balance, not only of calcium, but of magnesium, zinc and iron. It is all directly correlated to the amount of protein you eat".

If you maintain your calories with whole grains, legumes, seeds, vegetables, fruits etc., you will obtain sufficient protein to keep you healthy. We are in total agreement with the food intake percentages of the Pritikin Diet: Fat intake is 5-10%, protein 10-15%, and complex carbohydrates, primarily unrefined.

Dr. Paavo Airola on Protein

Dr. Airola reports of a recent American research effort performed under the direction of Dr. Lennart Krook, showing that overeating meat leads to serious mineral imbalance, especially with respect to calcium and phosphorus. Dr. Airola goes on to report of another recent study conducted at the U. S. Army Medical Research and Nutrition Laboratory in Denver, Colorado, demonstrating that a high

meat intake results in significant vitamin B6 losses. He adds that a high protein diet also causes severe deficiencies in magnesium, calcium, and niacin. Dr. Airola reports further of research conducted in Germany by Dr. Ph. Schwarz, of Frankfort University, and of those performed by the famous Swiss biochemist, Dr. Ralph Bircher, showing that the aging process is initiated by amyloid, a by-product of protein metabolism, which collects in connective tissues causing cellular and tissue degeneration. This process carried on throughout an entire organism seems to be the leading cause of premature aging.

Those peoples of the world who show the highest average life expectancy (Hunzas, Bulgarians Russians, Yucatan Indians, etc.) have traditionally subsisted on low protein diets, whereas those people who show the lowest life expectancy in the world of between 30 and 40 years (Eskimos, Lapplanders, etc.) have consumed large animal high protein diets.

Dr. Hindhede, in Protein and Nutrition; “a rich protein diet is a cause of various ailments, that luxurious habits especially overindulgence in meat, can give rise to various stomach, kidney and arthritical complaints, is reported by manifold experience. The office of the liver is to render harmless, by conversion Into urea, the ammonium, compounds which arise from the decomposition of animal protein in the intestines, and suggests that the ogran performs the same service in regard to various other waste products of metabolism. It is easy to conceive that the liver is to a certain degree composed of these poisonous products, but there are limits to the functional ability of the organ to render these poisons harmless, which may possibly explain some to the maladies from which those who indulge largely in meat suffer.”

Protein and Calcium Metabolism

A series of studies with young adults of both sexes show clearly that as protein intake is increased retention of bone calcium decreases. Researchers at the University of Wisconsin found that when the protein intake of young men was raised to 140 grams per day, the subjects proceeded to lose bone calcium at a rate which, if continued, would have left them no bones at all by their early 50’s. Not one subject failed to experience rapid bone deterioration, even though they took liberal amounts of calcium and their phosphorus intakes were kept artificially low. Studies with young

women show that they too respond to high protein intake with marked bone erosion. It requires even lower protien intakes to effect the losses in women but this can be explained by their smaller body sizes. Young men had strong bone retention with protein intakes in the range of 50 grams per day. Unfortunately, young American adults are taking on the average as much as 100 grams of protein per day, suggests that our young may be experiencing rapid bone deterioration.

A build-up in blood urea Is associated with kidney failure and doctors in Italy, Hungary, Canada, Russia, and more recently in the U.S., report success in treating kidney patients with low protein diets. A Quebec physician, Dr. M. G. Bergerson, states that a low protein diet can be highly beneficial for kidney patients, even when they have reached the some stage. An Italian rsearcher reports patients with chronic kidney insufficiency can be rendered symptom free for years on a diet containing 20 grams of protein per day. A Russian group reports prolonged use of diets containing 18-24 grams of protein per day has netted good results with patients suffering from kidney insufficiency. The Russians have made extensive use of a potato diet for kidney patients and American researchers found plant proteins were far more effective than animal proteins in keeping blood urea levels down.

Russian Research on Protein

Dr. Uri Nikolayev is probably the most successful psychiatrist in history; the mentor of Moscow's prestigious Psychiatric Institute has cured thousands of desperately ill schizophrenics. What his technique does is rid the body of protein derivatives and other chemical abnormalities that Psychiatry Digest cites as the apparent cause of all forms of schizophrenia. His technique is of course, fasting. Fasting, it should be noted, Is the ultimate in low protien diets, low calorie diets, even protein-free low calorie diets, sharply curtail the excretion of protein wastes, only a fast can in the short run, at least, purge the body of the excesses of a lifetime. Dr. Nikolayev's treatment of fasting has received wide acclaim which it richly deserves. What has escaped attention is the second phase of his treatment, that is the treatment that follows a successful fast. For only with the adaption of a low-protein vegetarian diet are the results lasting, a return to a meat-based diet is a return to emotional stress.

Excess Protein causes Cancer

High protein intake is strongly linked to cancer. A Cornell researcher places the blame on ammonia. Ammonia, and possible other protein wastes, may indeed play roles in cancer, but protein partners cancer in a number of ways. High protein intake incites a cancer-like frenzy of activity at the cellular level. It weakens the body's capacity to resist cancer by weakening the liver, it stimulates the production of hormones involved in widespread hormone-dependent cancers, and it promotes the kind of growth on which cancer thrives.

High protein intake causes sharp increases in the rates of breakdown of existing protein and of synthesis of new protein at the cellular level. In the presence of adequate caloric intake the synthesis of new protein tends to exceed the breakdown of existing protein. The resulting protein build-up causes the cells to grow and divide. Rapid cell growth and rapid cell division are hallmarks of cancer. Tumors are the result of a concentration of frenzied protein synthesis and cell division at the site.

The rapid cell division that accompanies elevated protein intake begins as a general body phenomenon rather than being concentrated in on small region as It would with cancer. And finally, women should find this fact most convincing: High protein intake leads to increase production of estrogens (female sex hormones) in women; increased estrogen output tends to promote various female cancers.

Protein Reducing Diets

Most so-called reducing diets are harmful, and although damaged health. High protein diets and low or no carbohydrate diets are especially harmful. Severe restriction of carbohydrates with no restriction of fats and proteins may take weight off effectively, but can have the disastrous effect of causing irreparable damage to brain, nerve system and heart. A high protein diet, always popular with reducers, will admittedly help to reduce, but always with severe health damage as the result. Over indulgence in proteins is one of the prime causes of such dreaded diseases as arthritis, osteoporosis, heart disease and cancer.

Scientific Consensus

Perhaps the following fact will convince you more than anything else. The Food and Nutrition Board of the National Academy of Science, in collaboration with the World Health Organization, publishes every four years the Table of Recommended Daily Allowances of various nutrients. In the last two decades, they have lowered the daily recommendation for protein from 120 grams to only 46 grams. This was prompted by world-wide scientific consensus and a growing concern that an excess of protein in the diet, just like an excess of anything else, can be extremely harmful and can contribute to the development of biochemical and metabolic imbalances and diseases.

Protein Requirements and Sources

The protein requirements for each individual are totally different. Each person is unique in his nutritional needs, requiring certain foods for his own metabolism, glands and body structure. Hard and fast nutritional rules cannot be applied generally. Everyone must take a close look at themselves, and determine through self-diagnosis, habits and heredity, exactly what they require to improve their own health. No book can do this for you; a book can only be a guidepost to teach us universal principles, so that we may apply them to our own individual needs.

Generally, the protein intake for growing children is higher than for an elderly person. Pregnant women and nursing mothers may need a little extra supply of protein to provide nourishment for two organisms. The supply should only meet the demands of the body, and no more. Weight lifters and bodybuilders need more grams of good quality protein to make good the breakdown and loss of their cells and tissues.

You, as a unique organism, must determine what your protein requirements are on a day to day basis. Some days your inner voice or body intelligence will require that you consume additional amounts of natural protein, other days you will not feel the need for half that much protein. Stress conditions, exercise, hot and cold weather, sleep and rest, unforseen environmental factors, and human physical and physhological variables all play an extremely important role in your daily protein requirements.

Grams of Protein in Various Foods

Seeds and Nuts		Grams
Filberts	½ cup	6
Almonds, Raw	½ cup	13
Brazil Nuts	½ cup	10
Cashews, Unsalted	½ cup	12
Pecans	½ cup	5
Sesame Seeds	½ cup	9
Sunflower Seeds	½ cup	12
Walnuts	½ cup	7
Pumpkin Seeds	½ cup	14
Grains, Fruits and Vegetables		
Barley, Whole	½ cup	13
Buckwheat, Whole	¾ cup	12
Lima Beans, Cooked	1 cup	16
Kidney Beans	1 cup	15
Broccoli, Steamed	1 cup	6
Cauliflower	1 cup	3
Corn, Steamed	1 ear	3
Kale	1 cup	4
Lentils	1 cup	15
Peas, Steamed	1 cup	5
Peas, Split	½ cup	8
Potatoes, Baked	1 med	2
Squash, Winter	1 cup	4
Avocado	½	2
Apricots, Soaked	½ cup	4
Blackberries	1 cup	2
Dates, Soaked	1 cup	4
Prunes, Soaked	1 cup	3
Raisins, Soaked	½ cup	2
Wheat Bread	1 sl.	2
Corn Bread	1 sl.	3
Soy Flour, Powder	1 cup	39
Oatmeal	1 cup	5
Rice, Brown	1 cup	15
Rice Polish	½ cup	6
Wheat Germ	1 cup	17
Bean Soups	1 cup	8
Creamed Veg. Soups	1 cup	7
Nutritional Yeast	¼ cup	13
Nutritional Yeast	1 T	6
Soy Powder, Concentrate	1 T	12

	*Dairy-Animal	
Raw Goat Milk	1 cup	8
Buttermilk	1 cup	9
Yogurt (Low Fat)	1 cup	8
Skim Milk	1 cup	8
Cottage Cheese	1 cup	35
Swiss Cheese	1 oz.	7
Egg	1	6
Skim Milk Cheese	1 oz.	8
Flesh	4 oz.	20

*Use these foods sparingly. Listed for clarity and information.

It should also be understood that under stress conditions and anemic conditions the body needs extra amounts of the entire B-Complex vitamines, and the best source of B-12, B-6, etc. is whole unprocessed grains: rice, rye, buckwheat, millet, wheat germ, and brewers yeast. For a calm disposition and steady nerves, grains, fruits, vegetables, seeds and nuts will provide the essential nutrients to overcome stress.

The most reliable indicator of protein need is our present overall health. Are we full of pep and energy? How about our skin, nails, hair and eyes? Is the skin smooth and clear? Are the nails without ridges, pink and smooth, with small half-moons at the base and are they free of white spots? Does the hair sheen and bounce with vitality? Do your eyes sparkle? Are they clear, without redness or yellowness? Is there dark circles under them? These are all self-diagnosing indicators of health and vitality of our organs. Also, is your digestion good? Are you always uncomfortable, bloated or experience gas after meals? Are you constipated? Is your elimination poor? Ask questions and experiment on yourself. No authority can decide for you what you need on any given day or hour. One must ultimately depend upon his own body wisdom to determine his or her own nutritional needs.

Muscleman advocates Low Protein

Vegetarian world champion bodybuilder, Bill Pearl (Mr. America, Mr. Universe), states quite emphatically that a growing bodybuilder simply does not need 300-400 grams of protein to reach his potential. Mr. Pearl believes that one can build health, strength and muscles on 50 to 70 grams of protein per day on a well balanced

vegetarian diet. Beef is actually fairly low in protein, because once you remove all the fiber, water and uric acid from the prime steak, very little protein remains. Pearl has been a vegetarian since 1971 and has been pumping iron for 50 years. He is now near 80 years old and weighs well over 200 pounds of solid muscle with Herculean strength to match. He further says that there is absolutely no question that it Is possible to build a high-class physique and be a vegetarian at the same time. Vegetarian eating has had numerous positive effects on his body. His cholesterol gradually dropped down to a normal level of 198, and the blood pressure lowered. His pulse rate and other physiological processes are much better, and overall he is in better shape than he was 15 years ago.

One of the most dramatic changes has been in his uric acid levels. His uric acid is now down to zero, but before it was so sky high that every joint in his body ached. His uric acid was once so high that he could hardly move my hands. He actually thought he was getting arthritis. Now his energy levels are incredible, and he feels like a million dollars all of the time. His 33rd year of training starts in August (1979), and he definitely feel as good today as he did 30 years ago. There is nobody in his club, or anyone he have ever trained with, that he could not stay up with in a hard workout. His energy is greater that ever, and they do not need to knock off 15 cows a year to keep him fed.

The biggest change has been in his attitude toward himself and my fellow man. Perhaps this sounds crazy, but he is not as aggressive as he was in the past. There have been times in his life that he has wanted to go out and fight some guy for saying something to me. Or he would scream and holler, and really make an ass of himself. Now he catches himself smiling and trying to work out a problem. Vegetarianism has definitely had a mellowing effect on me. Once you are eating as a vegetarian, you cannot be swayed away from it by anyone, regardless of what he says. If a person offered him $50,000 to eat a steak, he would tell him to stick it in his pocket. What is the sense of making a commitment if you are not committed? He is a firm believer in sticking to convictions.

Mayo Clinic Report

According to Nutritionist, Dr. R. A. Nelson, of the Mayo Medical School: Animals fed high protein diets have increased urea production. Kidney hypertrophy occurs in animals on long term protein diets; more strikingly, if one kidney is removed, the degree of hypertrophy of the remaining kidney is directly related to the amount of protein ingested. High protein diets increase albumin and casts in animal urine. Rabbits on high protein diets develop nephritis, as do rats if the diet is continued long enough. Trout fed a low protein diet live twice as long as trout given a high protein diet.

Protein vs Complex Carbohydrates

An article appearing in Iron Man Magazine, Sept., 1978, entitled "Carbohydrates-No Villain", written by Vince Gironda, body building champion, exercise and nutrition researcher, states: "I advocate a relatively low protein intake, about 45 grams per day. Too much protein creates a negative nitrogen balance which in turn leads to gout, sluggishness, and liver and kidney problems. The body cannot digest more than 20 grams per meal, and anything beyond that leads to problems. At least one meal per day should be carbohydrates in the form of vegetables or grains, thereby giving the body a protein break. Futhermore, it has been demonstrated repeatedly that protein combustion is not higher during heavy exercise than under resting conditions, while on the other hand the body uses carbohydrates stored first before it turns to other sources. Even after depleting the carbohydrate deposits, continued exercise does not hike protein needs significantly. According to my research, athletes performing strenuous, endurance tasks such as bodybuilding, and burning up 9,000 calories per day, show no noticeable increase in protein needs. If this all is not enough to turn your heads, Dr. Per-Olaf Astrand, a famous exercise physiologist in Sweden, performed a study which concluded that endurance tends to decrease as protein intake is elevated. He discovered that a high protein diet lowered endurance as well as reduced buildups in muscle carbohydrate, more than high carbohydrate diet. Experiments by Christensen and Hansen found that in heavy work such as powerllfting or bodybuilding, the major participant towards endurance was, once again, carbohydrates. Also, the subjects were able to perform three times longer on a carbohydrate diet than a protein or fat diet.

Probably the most asked question now is, if body building essentially is the tearing down and building up again of muscle tissue, then is not increased protein necessary for that process? The answer is no. A high protein intake even after a sustained injury, does not prevent a transient rise in nitrogen losses. Dr. Doris Callaway and a team of researchers found that animals fed three times as much protein as normal recovered no better than those on normal amount of protein. Now let us get one thing straight before we go any further. There is a quality difference between carbohydrates. Do not go out and load yourself up with candy and that type of junk carbohydrates. Carbohydrate loading with sugar is a mistake. Carbohydrates replace glycogen which the body stores and uses for energy. Sugar in any form leaches the stored glycogen from the liver and produces nervousness, irritability, fears, doubts, and various psychic changes in the personality. The major sources of carbohydrates should be from, as stated earlier, grains, and vegetables.

The protein contained in seeds and nuts, (soaked over night or germinated) all grains, all legumes, vegetables, sprouts, fruits; supplemented with nutritional yeast, soybean, tofu, soy powder, miso, and sea weed products are biologically superior, and pound for pound much cheaper than meat, eggs or dairy.

Vegetable Protein Superior

The animal cannot exist without the vegetal. The human body cannot digest inorganic substances or manufacture them from proteins, carbohydrates, vitamins or minerals, etc. The synthesizing and vitalizing of inorganic elements is a vegetal function. This process is called autotrophism. Only the vegetable kingdom can perform this phenomenon. Vegetables absorb inorganic elements and convert them into organic foods, which are very complicated in their composition and construction. This is a veritable miracle produced by the interworking of the forces of nature. Biologically speaking, we are children of the vegetal mother, and spring from the vegetal. Without vegetable life, no animal on the earth would survive. We depend upon vegetal products. Our hemoglobin is derived from chlorophyl. All vegetal foods are virgin materials for the purpose of maintaining or constructing our body. Neither meat nor animal products are pure virgin material for us. We must eat vegetables and their direct products. This is the biological principle and fundamental law: vegetables are the superior food.

Important Protein Points

1. Always go outside after eating, especially protein meals. Outdoor oxygen is absolutely necessary for normal protein assimilation and utilization.
2. Eat your protein meals earlier in the day if possible, but never over an hour after sunset. Daytime is for assimilation and digestion of foods. Night hours are for sleep & recuperation.
3. It is best to consume no more than 20 grams of protein at one meal. The body cannot utilize more than this at one time.
4. As a general percentage, the body requires from 30 to 60 grams of protein daily, depending on age, sex, activity, stress, sleep, weather, food quality and environment.
5. Eat the protein foods that your body can tolerate and easily digest and utilize. Consume only what agrees with your constitution and body intelligence. Meat, dairy and eggs are not absolutely necessary for protein requirements and health.
6. Legumes can be combined with grains and seeds to form complete and adequate proteins.
7. Junk food cravings are directly linked to protein deficiencies, incomplete dietary protein or poor protein utilization.
8. Germinated or soaked (overnight) seeds and nuts liquified in a blender will increase their quality and net protein utilization. Raw dried seeds and nuts, unsoaked or ungerminated are inferior foods and do not contain complete proteins.
9. An excess of protein in the diet, especially animal meat protein, including fish and poultry, leaves poisonous residues and uric acid in the system causing Yang disease symtoms, such as constricted (Yang) kidneys, high blood pressure, liver congestion, constipation, cancer etc.
10. The long lived people in many sections of the world (Russia, Hunzas, Bulgarians) consume a moderate amount of protein daily, and they remain in vibrant health and vitality past the 100 year mark. They are able to healthfully sustain themselves on a low protein diet because of their superior, pure organically grown food, pure fresh unpolluted air, clean fresh water, no stress and their joyous attitude. Their meat intake is almost nothing, and they consume mostly raw dairy products (fresh), grains, seeds, nuts, fruits and vegetables.

11. Americans consume more meat and other proteins than any other nation on earth, and they suffer from the most degenerative diseases known to humankind.
12. An excess or lack of protein in the diet can be a quick way to lose beauty, health and strength; you can develop unsightly facial wrinkles, hair loss, poor sight and hearing, underweight or overweight, premature aging, low blood sugar and many other disease symptoms. Listen to your inner body (voice) or intelligence for the proper amount you require daily. Only you can be the final judge.

Carbohydrates and Sugars

Carbohydrates are composed of carbon, hydrogen and oxygen. They are fuel, heat and energy producing foods. The main sources of carbohydrates are all grains, fruits, vegetbles, seeds, nuts, legumes, potatoes etc.

Starch foods begin digestion in the alkaline saliva of the mouth and are completed in the small intestine. For this reason, starches should be thoroughly masticated and insalivated in the mouth before swallowing. Starches are converted into dextrines and sugars, then into dextrose and glucose before entering the blood stream, where they are readily utilized and produce animal heat.

Cooked starch is acted upon by saliva and pancreatic juice very quickly; raw starch is not. Raw starch granules are surrounded by an envelope of cellulose, which the saliva penetrates very slowly; the same for pancreatic juice. The digestibility of starch (grains, legumes, potatoes etc.) depends upon the cooking. Improperly cooked or imperfectly chewed starch food pass mostly undigested into the feces. This is also true to poorly baked bread.

Glycogen like starch is insoluble. Hence, it is stored in the liver until needed for use; it is also stored in the muscles. Every cell in the body contains a small amount of glycogen. When fuel is needed, the glycogen is again transformed into sugar, dextrose, which nourishes the body. The body maintains its heat by the burning of glycogen. Muscular work is supported by the energy set free by the burning of glycogen just as the work of a steam engine is performed through the energy obtained from coal. When glycogen becomes exhausted, the bodily forces fail. The heart consumes glycogen with every beat. Without glycogen the heart could not beat and no muscle in the body could contract. The body contains

about four percent glycogen. The greatest source of glycogen is found in natural foodstuffs, i,e., grains, vegetables, fruits, seeds, nuts, legumes etc.

When no starches or carbohydrates are eaten, the body makes glycogen by splitting the protein molecule. By this means, about half the weight of protein may be converted into glycogen. The other half of the protein is converted first into ammonia then into urea. The fuel value of protein is then only half its face value, and the body is taxed in the disposal of the large amount of poisonous waste. Consequently, protein is a very poor fuel food. In other words, carbohydrates are protein sparing, instead of the body converting protein into glucose for energy, it provides the heat, energy and fuel so that protein may be used for tissue building. Proteins are utilized more fully for tissue repair if some form of natural carbohydrate food is consumed at the same meal.

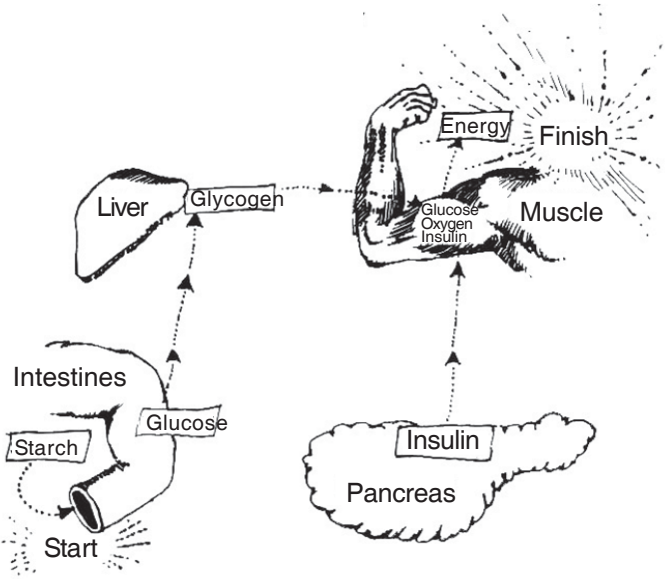

Fig. 5.1. Where our Energy Comes From.

Start with the intestines on the lower left hand corner. Here the starch, after being swallowed, is converted into glucose in the intestines, absorbed and carried by the blood stream to the liver, where it is converted into glycogen. When a muscle contracts it needs fuel so the glycogen is carried by a blood vessel from the liver to the muscle, converted again into glucose, mixed with oxygen from the lungs, and fired by insulin from the pancreas, producing energy.

Tea and coffee, both of which contain considerable amounts of tannic acid, prevents the action of saliva upon starch foods. Tea and coffee drinkers experience much gastric acidity and poor digestion and health.

Fruit Sugars

Natural fruit sugars are digested and absorbed into the blood stream within 30 to 60 minutes. The natural sugars contained in all fruits, dried fruits, honey, maple syrup etc., contain fructose, grape sugar, and levelose. Honey contains equal amounts of dextrose and levulose. Milk sugar contains lactose. Refined white sugar, commercial sugars, brown sugar, saccharine, (made from coal tar products), chemically treated sweets, ice cream, candy, cakes, pies and sodas are all devoid of vitamin and mineral elements, and create calcium loss, and cause conditions from anemia to schizophrenia. If you value you health, avoid these junk food refined sugars.

Natural sugars from fruit eaten in season (moderately) will satisfy your sweet tooth, and give the body wholesome minerals, vitamins and natural fiber/bulk for intestinal health. Eat more raw fruit in summer and sparingly in winter. Fruit is Yin and is high in potassium, needed for hot weather. The body does not require much Yin food in cold weather; but rather it needs more Yang foods, such as grains, legumes, miso, soups, steamed vegetables. Yin foods help to cool the body during hot weather. Yang foods warm the body during cold winter weather. We must learn how to change our diet according to seasonal changes. This is living in harmony with heaven and earth and gives us increased health and freedom.

Fats

Fats are called hydrocarbons because they produce oil when heated. Fats are used in the body as heat, energy and fuel. They are found in butter, cream, olive oil, seeds, nuts, avocado, cheese, milk, egg yolks and all oils. Fats are digested slowly, and remain in the liver and stomach longer, delaying hunger for quite some time. Fats differ from other foods in that they are stored in the body in almost unlimited amounts. Fat is somewhat of a reserve fuel that the body draws upon when the sugar stores are greatly reduced. A

normal amount of fat is stored in the body to maintain body heat, protect and lubricate internal vital organs, and give a graceful contour and shape to muscles and skin. An over consumption of fatty foods will congest the liver and weaken the digestive organs. Fats are needed more in cold weather than hot to keep the body warm.

Cholesterol is a chemical component of oils and fats. The body forms fat from starch and sugar foods. If no natural fats are included in the diet, the body will produce fats from starch and sugar foods. It is best to take fat in small quantities giving the body a chance to manufacture its own fat. If a person's diet is aduquate in B vitamins, fresh fruits, grains, vegetables, seeds, nuts and soya products, he can produce all the lecithin and anti-cholesterol agents his body needs.

An excessive consumption of eggs, meat, cheese etc., can contribute to a rise in body cholesterol. Other cholesterol forming foods are: hydrogenated oils, margerine, butter and white flour, white sugar and salt. A small amount of natural fats eaten daily will maintain the body in good health and vitality. Remember, the body will produce its own fat if the diet is deficient in it.

Percentages of some fatty foods: Butter is nearly 90 to 100% fat. Nuts contain a large amount of fat 40% to 70%. Cream is from 25% to 40% fat. Avocados contain from 25% to 40% fat; the same as the ripe olive. The soy bean contains about 20% to 30% fat. Meat contains 40% to 50% fat. Regular cheese contains from 60% to 80% fat, except skim milk cheese. Eggs are 10% to 20% fat. Ice cream is very high in fat, from 70% to 90%, plus high in sugar. Vegetable oil is 80% to 90% fat. Natural foods, such as avocados, nuts and soybeans, because of their high fat content, should not be used excessively; they are not staple foods and should be eaten very sparingly.

The greatest cause of cholesterol build-up is a combination of two things: First, fatty foods, sugar foods, white flour, salt etc. Second, a lack of daily exercise and lack of fresh outdoor oxygen, and stressful conditions. To help overcome this, consume a low fat, low protein, and high natural carbohydrate diet, including: whole grains, low fat dairy, legumes, peas, seeds, fruits, vegetables, and obtain sufficient daily exercise, fresh air, sunshine and sleep. Avoid stress. Eventually, this diet will balance the internal organs and stabilize the mind and emotions. The body weight will also normalize itself, along with blood pressure, pulse rate and cholesterol levels. Exercise helps keep the blood stream flowing freely and the arteries free of cholesterol deposits.

Free Fats are Harmful

All extracted or refined oils, whether animal or vegetable are referred to as free fats or triglycerides; all of the bulk, fiber, vitamins, enzymes and minerals are removed from the food, and we no longer have a water soluble food. Even pure vegetable or nut oils are harmful, if taken to excess, especially if eaten in hot weather. A small amount, (one teaspoon per day) may be used in cold weather for body warmth. The body can obtain its fatty acids from whole foods such as, legumes, grains, and germinated seeds and nuts. The human system cannot properly handle extracted or fractionated free fatty oils in any form. These include: butter, cream, sour cream, peanut butter, nut butters, egg yolks, mayonnaise, margarine, lard, seed/nut oils, and vegetable oils. Pure vegetable oils are the least harmful, but should also be used sparingly.

Polyunsaturated fats can cause disease as well as saturated ones. Polyunsaturates do lower serum cholesterol levels in the blood; however, the cholesterol moves out of the blood and into the cells and tussues. These free fats then clog and block the oxygen carrying red blood cell from entering the tissues. Oxygen is thus reduced to the brain and body cells, which cause many internal disorders. All fats animal or vegetable if eaten beyond the needs of the body, can cause the following diseases; gallstones, diabetes, tumors, skin diseases, liver disorders, obesity, colitis, cancer, heart disease, lung disorders etc.

Human requirements for fatty foods are very low. We do not need an extra abundance of free fats in our diet; this only leads to ill health. Obtain your fats from whole foods in their natural state, and watch your health improve tremendously. When you realize that each body cell is a small battery, needing constant recharging through the food you eat, you will really begin to think about diet.

Fig. 5.2. Life starts with nature and blooms with Life.

Whole Food Supplements

Why cannot we obtain good nutrition from wholesome food in its natural state? We agree that under idea conditions, food supplements would not be needed. But what is considered ideal conditions? They are: 1.) All foods grown in rich, natural, organically fertilized soils year around. 2.) These organically grown foods should be available and raised in your locality. 3.) Living in a totally stress free, natural and unpolluted environment. Are you living in this naturally perfect environment? Are you obtaining all your food from such organically rich soil? Are you eating the organic food grown in your locality, not shipped from across the country? Are you living and working outdoors daily under natural lights, and without stress conditions? Do you spend hours each day in the outdoor atmosphere? Do you obtain suffcient exercise?

The majority of individuals cannot answer yes to most of the above questions: They can tremendously benefit from the daily use of natural whole food supplements and organic food concentrates, which furnish the missing organic minerals, vitamins and trace elements required by every cell of the body.

If one constantly craves junk foods, a dietary deficiency may be present and one may be severely in need of a balanced dietary program, plus whole food supplements. These nutrition rich food concentrates can help one to overcome the junk food syndrome and protect against any possible deficiencies from the use of commercially grown mineral poor foods.

Our first obligation to ourselves and our families should be to obtain the highest quality food grown locally, prepared in a nutritionally healthful manner and also, if conditions permit, to grow as many organic foods as possible in our own backyard garden. If we all had our own gardens on well mineralized fertile soil, vitamins might not be needed. If we ate foods that were not overprocessed and overmilled, the capsule might never have been invented. If we ate for nourishment rather than for palatability and if sixty times as much mineral values were not taken each year from the soil as are restored to it in fertilizer, and if in some households up to 77% of the mineral values were not lost or destroyed by heat and oxidation, we would not require the use of food supplements.

There are those who would have the Western public believe that present day foods are adequate in their vitamin and mineral content and that vitamin deficiency diseases and subclinical defi-

ciencies are too rare to be a threat to public health. The majority of Americans are poorly nourished and consume nutritionally poor food. Hereditary factors also play an important part in your over-all health and nutritional needs. If your parents were in poor health and consumed mineral deficient foods, you may require more food supplements than a person who had parents with strong and healthy constitutions and ate mineral rich and nutritionally superior organic foods. One must judge their own nutritional needs and eat the whole foods and food supplements that fulfill the requirements of their totally individual body.

Food supplements should not be taken with the erroneous idea that they will give one Super Health while living on a diet of conventional calamity foods. They will, however, add some improvement to the conventional Western diet. It is true that food supplements would not be necessary if our food crops and top soil were rich in organic mineral elements, and all of our foods were grown on chemically free soils: unfortunately, these quality foods are a rarity, and as a result, most persons consume mineral deficient foods, causing malnutrition.

The following food supplements are some of the best known health aides to insure us of obtaining complete nutrition for superior health. Use them daily.

Alfalfa (Liquid, Tablets or Powder)

This amazing plant travels 24 feet into the soil and picks up the trace minerals that the average person is so lacking in. Alfalfa contains 8 essential enzymes, which help in the buildup of the internal bodily enzymes. Alfalfa closely approximates the blood hemoglobin, and is one of the most highly potent vitamin and mineral foods. It is rich in protein and contains every essential amino acid.

Many diseases are caused not only from excesses, but also from deficiencies of the necessary trace elements to maintain the body in proper chemical balance. If the body is not in balance, it can lead to a host of diseases from colds to cancer. Alfalfa grown on organic soil and made into liquid, tablet, powder or tea can be used with great benefit by all persons, healthy or sick.

The ancients knew its value, yet men forgot the ancient learning. For centuries sick farmers watched their cattle grow sleek and robust on alfalfa without the glimmer of an idea that this remarkable plant might help them. Even today, when food scientists

cite the countless cases of benefits achieved by the use of alfalfa, the uninformed raise skeptical eyebrows. It may be a generation before most of our physicians and the general public wake up and grasp the truth about the place of alfalfa in human nutrition.

The same opinion was voiced by C. H. Burgess of the Michigan State Agricultural College, who said: "Rich in medicinal properties beneficial to the human race, the real value of alfalfa is but little known." But, with the passing years, the evidence that alfalfa has more total food minerals and trace elements than any other known plant that grows on land is beyond dispute. The famed farmer-writer, Louis Bromfield spoke of alfalfa's unique ability to tap the deep mineral richness of soil and to bring that richness upward to the sunlight and the air. The alfalfa root will reach down, in some instances, as much as 125 feet in order to do so.

Alfalfa is an excellent food; it improves digestion and a lagging appetite, as it is filled with several digestive enzymes:

Lipase Fat splitting enzyme.
Amylase acts upon starches.
Coagulase coagulates milk and clots the blood.
Emulsin acts upon sugar.
Invertase converts cane sugar into dextrose.
Peroxidase has an oxidizing effect on the blood.
Pectinase forms a vegetable jelly from a pectin substance.
Protase digests protein.

Alfalfa contains Vitamin U, an element that is an aid for peptic ulcers. It is a good diuretic and excellent regulator of the bowels. It has sufficient Vitamin D and phosphorus to build strong bones and teeth. Alfalfa has Vitamin K, flavones, growth and anti-stiffness factors. This remarkable product helps to prevent fatigue, and provides a perfect calcium-phosphorus ratio (2:1). The pure vegetarian or vegan, who uses no dairy products will be happy to know that alfalfa has .3 meg of Vitamin B-12 per 100 grams, and contains all essential amino acids.

Kelp and Seaweed

Kelp is a great source of iodine. Our soils are almost totally lacking in this very essential element. This is why certain sections of the country are known as goiter belts. Iodine is necessary for the proper functioning of the thyroid gland, which effects body growth, metabolism and over all health.

Hiziki and nori are also good seaweed products to include in salads, soups, or grain and bean dishes. Kelp and dulce are sea plants high in iron and copper, even more so than a pound of spinach or 7½ pounds of tomatoes. It contains more phosphorus than 1½ lbs. of carrots and more iodine in kelp than in oysters.

Scientific tests have shown that seaweed contains over thirty vital mineral elements and life sustaining organic substances that are absolutely necessary for a high state of health. The body loses these essential minerals daily, and they must be replaced by organic mineral-rich foods such as found in seaweed products. Here are a few of the major minerals and trace elements found in kelp:

Nitrogen helps to build and repair the body.
Iodine prevention against goiters.
Iron Blood Builder.
Copper together with iron builds the blood and helps the body to absorb oxygen.
Silicon helps to give beautiful sheen to the hair, nails and skin; prevents wrinkles and sagging skin.
Sodium helps to digest food, purifies the blood and prevents acidosis.
Sulphur builds the body cells.
Manganese builds the reproductive organs and is necessary for bone formation. It is a protective agent, especially for the heart, blood vessels, brain, and urinary passages.
Zinc helps prevent diabetes and prostate problems.

Kelp, dulce or other seaweed foods can be purchased in dried, powdered or liquid form. You can eat them whole, chew the kelp tablets, add the liquid to soups or sprinkle the powder over your favorite vegetable salads and grain meals. Kelp is a Yang food and can be consumed year around. Be sure to include kelp in your daily diet for better health and long life.

Nutritional Yeast

Brewer's Yeast from beer breweries is a thing of the past. Yeast, as a supplement many years ago, was available only as a by-product of the beer vat. Today, it is no longer associated with the brewing industry, although many people still call it Brewer's Yeast. The correct name now is primary grown nutritional yeast.

A recent science writer once called the tiny yeast cell a terrific chemical factory for the manufacture of all the vitamins of the B complex. The yeast cell is a terrifically small unit of living matter, and similar to the cells of the human body. Many health authorities state that yeast contains more nutritional power than any other single food factor known to man. Yeast, as a food is grown without soil, takes up very little space in its growing process. Nutritional yeast has a very pleasant taste and is higher in nutritional value than the old time Brewer's Yeast.

The ancient Egyptians are said to have used yeast; and it has been used for baking, brewing and other uses throughout history. "Yeast is the smallest of all cultivated plants about l/4000th of an inch in diameter or about the size of a human blood corpuscle, as written in "The Complete Book of Food and Nutrition," edited by J. I. Rodale. Rodale continues:

The yeast plant stores enormous quantities of vitamins for its own use. These are then utilized as a food supplement by human beings, after the yeast plant is dried. Brewer's Yeast contains all the elements of the Vitamin B complex. It is also a rich source of complete protein. Brewer's Yeast contains 16 of the 20 amino acids forms of protein that are essential for the proper functioning of our bodies for longevity, for resistance to disease, for rebuilding tissues.

Nutritional yeast is reported to contain anti-aging and youth sustaining elements called nucleic acids RNA and DNA. Laboratory tests have shown that RNA and DNA protect mice and rats against lethal radiation doses. Yeast also contains the amino acids lysine and tryptophan, which may be missing from certain cereal and grain foods. Due to Its high natural B-Complex factors and minerals, it helps to build strong nerves and calmness under stress and other living conditions. A lack of the essential B Vitamins results in nerve disorders, irritability, depression, fatigue, skin problems, muscular weakness and underweight conditions. Nutritional yeast can put an end to the junkyism syndrome once and for all. It is rich in

essential super food factors necessary for complete nutrition. It is one of nature's most complete and perfect foods. Yeast cakes used for baking bread should not be eaten raw, as they rob the body of B Vitamins.

Yeast is a miniature sprout of high nutritional value, and is dried in such a manner as to preserve its wealth of nutrients. Nutritional yeast can be used in soups, salads and other dishes to improve the nutritional value of foods. Yeast is also available in various concentrated forms in powder, flakes or tablets. Some people prefer to take yeast mixed in a glass of their favorite juice on an empty stomach, assuring quicker assimilation and no digestive interference with other foods. If yeast causes you gas, when eaten with other foods, try this method.

Miso

Miso is a dark paste made from fermented soybeans and other grains. The three types of miso are: Rome, made from soybeans and rice; Mugi, made of barley and soybeans and Hacho made soybeans only. Miso is aged from 3 to 18 months in wooden barrels, depending on the type. Hacho miso should be used more in winter due to its Yang quality. Mugi or Kome miso can be used moderately in the summer. Miso is a healthful salt substitute, which can be used in soups, bean and grain dishes, casseroles and wherever a salty flavor is required in cooking. Miso is one of the best sources of iron and vitamin B-12. Due to its fermented quality, miso builds up the intestinal flora & helps to overcome anemia.

Miso broth aids digestion and food absorption; it helps to alkalize the system, and balances the metabolism. It can be sipped slowly on cold winter days to keep one warm and cozy on the inside. Miso is also a protein source.

Soya Sauce

Soya sauce is a close kin to miso also fermented and made from soybeans with the addition of sea salt, wheat and water. It contains easily absorbed proteins, vitamins and minerals. Soya sauce can be used in soups, vegetable and grain dishes.

Tofu

Tofu is a soybean product with a consistency of farmer's or pot cheese. It is a very delicious, nutritious protein packed food. It can be used in soups, salads, sandwich spreads, grain, bean and vegetable stews. It contains vitamin B-12 and builds friendly intestinal bacteria, due to its fermented quality. Tofu is a highly concentrated food, containing all of the amino acids necessary for healthy growth.

Beet Juice *(Tablets or Powder)*

Beets are a powerful blood builder, with a high and easily assimilable iron content. It is used in diabetic disorders. Beets contain several digestive enzymes. Beets should be used only in small amounts because they may overwork the liver if over eaten.

Garlic

Garlic has been used successfully for high blood pressure, intestinal problems, colds, flus and lung disorders. Chinese herbalists caution against the use of garlic and sweets at the same time, as this mixture can cause nausea and indigestion. Garlic should not be used excessively every day, as the body will begin to emit a garlic odor in public, and one may chase away more than colds.

Garlic is also a powerful internal germicide and bactericide, keeping the system free from pathogenic or cancer causing agents. Garlic is used by all of the long lived people throughout the world.

Balanced Mineral Salt

This is a seasoning vegetable powder to be used in place of the salt shaker. It contains minerals and trace elements in balanced pro-portion, such as powdered soy beans, anise seed, calcium-magnesium phosophate, dulce, parsley, lecithin, vitamin C, rosehips, thyme and other dried vegetable ingredients. It can be used on all main dishesgrains, beans, vegetable stews, soups etc. It is very delicious and nutritious.

Calcium *(Carrot-Poxtoer)*

Calcium is one of the most important, but difficult to obtain foods in the dietary. This calcium supplement is made from pure fresh raw carrot juice, from high mineralized soil grown carrots dehydrated into a pure powdered concentrate and easily assimilable. Calcium is missing from almost all processed, canned and packaged super market foods. Calcium builds strong teeth, bones, hair, connective tissue and organic structures. One level teaspoonful of carrot-calcium supplies 1000 mgs. of pure calcium. The body requires from 800 - 1000 mgs. of this important element each day.

Umeboshi *(Salted)* Plum

Umeboshi Plums are pickled in salt for about two years, by an acid bacterial method. They have been used for centuries in Japan as a mainstay in cooking. They are used in main dishes, dressings and take the place of vinegar. They help to alkalize the system. Umeboshi Plums are used as remedies for stomach trouble, headaches and internal acidity; it aids the digestion and assimilation of food. It also helps in cases of dysentery and fatigue. They are especially delicious with rice and other grains.

Spirulina Plankton

Spirulina Plankton is a microalgae, like hijiki, nori and wakame. It grows in lakes and salt water, however, the best spirulina is said to come from fresh water ponds. The Aztecs ate spirulina over 400 years ago. They ate it with corn and millet. Spirulina is mass produced in two locations; from Lake Texcoco in Mexico and from Thailand. The nutrients in Spirulina are up to 95 percent digestible. Spirulina is twenty times as high in protein as soybeans, forty times as much as corn, 400 times as much as beef. Spirulina is low in the amino acid methionine, therefore, one should eat other grains, beans and seeds at the same meal or during the day to make up the loss. One tablespoon of spirulina contains:

6 to 7 Grams of Protein
35% of the RDA for Vitamin B1 - 25% of B2 - 6% of B3
90% of Carotene (Provitamin A)
10 % of Vitamin E
29% of Iron
(Small %) Trace Vitamins, Minerals and Enzymes

Spirulina Plankton is the most basic food in the whole food chain. It is a simple hydrocarbon made directly from photosynthesisthe interaction of sunlight and water. It is the most concentrated form of any known organic food; a complete protein containing 18 of the 22 known amino acids (the building blocks for living cells), including the eight essential amino acids. It contains the highest natural known source of Vitamin B-12, as well as many other vitamins, and all the cell salts and enzymes essential for body metabolism.

This new food from sunlight provides 4 times the protein power of beef 250% more Vitamin B-12 than liver 26 times the calcium of milk. Spirulina has incredibly long strings of amino acids of several kinds. The proteins of spirulina are 80-85% assimilated compared to 20% for beef protein. Spirulina is 65-71% protein; beef is about 18%. Spirulina contains the biologically active sugar rhamnose. The research on this effect was pioneered by Dr. Christopher Hills during his over 25 years of research into microalgae. Spirulina can be purchased in tablet, powder or liquid form. There is a new pasta on the market made with spirulina pastalina, a combination of wheat, soybeans and spirulina. It is delicious and highly nutritious. Spirulina is also helpful in removing radioactive agents and other pollutive metals from the body.

Herbs *(Elixirs of Life)*

"And God said, Behold, I have given you every herb yielding seed, which is upon the face of all the earthy and every tree, in which is the fruit of a tree yielding seed; to you it shall be for meat." (Bible, Genesis-Chapter 1, Verses 29-31). Herbs are the true life-givers and healers of nature. Their use has become a lost art, but fortunately, they are gaining in popularity and usage by intelligent and advanced thinking physicians today. Herbs have been used since the beginning of time. The ancient Egyptians, Greeks, Lemurians and Chinese studied herbs systematically, and they respected the powerful rejuvenating qualities of nature's healing plants.

Hippocrates, probably the first herbal physician to make an art of nature's medicines, lived some 2,500 years ago. He is known as the Father of Medicine. Hippocrates believed in the powers of the human body to heal itself. And he used the constructive properties of herbs to facilitate the healing. He said: "The body has within itself the power to heal."

About 1,500 A.D. Hohemhein began using inorganic chemicals to treat disease. He and the medical men that followed him believed that the body could be healed and purified chemically. They burned the books of Hippocrates and Galen, in public, for they wanted no competition from the natural methods of healing. Medical men wanted full power over the lives of sick people, to administer chemicals in place of herbs. Hohemhein was the first practitioner to give mercury as a medicine.

The true successors and pupils of Galen and Hippocrates are the herbal doctors of Great Britain. Hohemhien's successors are today's modern medical profession. The early Native Americans were well-versed in the use of herbs and plants. They were seldom sick, always full of vitality, stamina, endurance and fighting force. Our first colonists learned many things from the Native Americans; the use of herbs in the treatment of disease and maintaining vigorous health.

Fig. 5.3. Red Emperor, Shen-Neng, Patron Saint of Chinese Herbalism

Biblical Records

Moses taught the Israelites to subsist on natural simple foods and to use the herbs of the field for disease. The Good Book also instructs us to eat the fruit of the trees as nourishment and the leaves or herbs of nature for medicine. Paul recommended the consumption of herbs for fatigue and sickness.

The best Biblical argument for the use of natural foods and herbs is found in Gen. 1:29, which states: "And God said, Behold, I have given you every herb bearing seed, which is upon the face of all the earth, and every tree in which is the fruit of a tree yielding seed; to you it shall be for meat". Leave your drugs in the chemises pot if you cannot heal the patient with food. He who for an ordinary cause resigns the fate of his patient to mercury (chemicals) is a vile enemy to the sick.

Herbs for Life, Health and Vitality

Hippocrates relied on the course of nature to restore health. He taught Moderation in all things. He had a working knowledge of over 400 various herbs. He was a true physician. Inter-estingly, the word physician is derived from physics, a Greek work for nature. So, Hippocrates was a doctor of nature. Nature has provided man with herbs in all parts of the world. Herbs are natural remedies; modern medicines are alkaloid chemicals taken from a plant and do not contain the health-building and restoring properties as herb teas used from the original plant. Medicines only relieve symptoms temporarily, while herbs and natural foods are more beneficial in the long run to restore and maintain health indefinitely. Given the proper care and nourishment, our bodies will remain free from disease.

Dr. Otto Mausert states that: "Chemistry of today has accomplished wonderful results in many ways, but all the laboratories in the world will never be able to supplant the remarkably fine process which takes place in the living cell. They will never successfully imitate the wonderful methods that Nature uses in performing its work in the plant, as well as in the human body."

The great American inventor, Thomas A. Edison, once wrote: "Until man duplicates a blade of grass, Nature can laugh at his so-called scientific knowledge."

Drugs vs. Plant Herbs

Herb teas assist nature in purifying the body, while chemical medicines squelch the symptoms and drive the disease deeper into the body, latrogenic diseases (drug induced) side-effects are far more harmful than the original sickness. This is the result of direct drug interference of the body's own natural healing powers.

Modern medical drugs are powerful-reacting chemical agents; most of them are Yin-expanding in action, while a few are Yang-contractive in quality. The Yin drugs spaces out or expands the brain and body cells, causing one to lose sight of reality, i.e., grogginess, loss of will and unclear thinking and perception. Hospitals and clinics are full of pickled brains and bodies. The list of drug induced diseases is growing every year. The AMA admits there is always a great risk in drugging a person. Chloromycetin, for example, is toxic to the blood producing system. About 20% of the drugs in vogue 20 years ago are now listed as harmful, yet many were considered wonder-drug discoveries.

Why is the average person very careful about the new car he buys? It must be perfect in every respect. The owner has it checked every few months to insure that it runs like new. He would not think of putting sand or water in the gas tank; No! The best grade of gas and oil must go into that car, and it must have the best possible main-tenance and care available at all costs. And the auto-mechanic must fix it right, or the owner does not pay him. Yet, the average person blindly accepts, without a word of objection, a dose of some medicine, tablet or drug, without thinking of what it might do to his or her body. Or more harmful serums and vaccines are injected into the bloodstream without a whimper or question as to what the substance is, or what value or harm it will do.

In his new book, "Herb Growing for Health," Dr. Donald Law writes: "The whole theory of botanic medicine is based upon the logical and simple practice of building up the human body to strengthen all the natural eliminating and healing processes. . ." "Botanic medicine does not seek to cure you by "killing off germs", it strengthens your natural func-tions of phagocyte production, (the little cells that eat up alien organisms invading your body); it strenghtens your liver and kidneys to do their clearing out functions better, and It makes defecation and perspiration function effeciently so as to expel the toxic matter you have acquired."

Another intelligent author, Dr. Otto Mausert, writing in his book, ''Herbs for Health,'' states: "Herbs contain the vital elements, vitamins and organic minerals that are deficient or lacking in the diseased body. They contain them in such a finely distributed and prepared state that they may be readily assimilated by the system and conveyed to the blood. Herbs also promote the elimination of waste matter and poisons from the system by simple, natural means. When correctly used, they support nature in the fight against disease."

In the future, science promises to those races who will take advantage of the newer knowledge of nutrition, a larger stature, greater vigor, increased longevity and a higher level of cultural attainment. Those who travel go nowhere until they journey within. They who see are blind and see not, until they look within. They who seek the Tao, find not, until they know the Tao is within. Credo of a Taoist: Feel like a boy, act like a gentleman, speak like a saint, and work like a horse, because the journey is within.

Health Aide Guide:

Foods to Avoid	**Replacements**
Tea, Coffee, Alcohol, Sodas, Tap Water	*Herbal Teas*
Chocolate, Candy, Artificial Sweets	*Dried or Fresh Fruit, Honey*
Gelatin	*Agar*
Canned Bouillon, Meat Broths	*Vegetable Broth, Miso*
Cold Drinks, Sodas, Sugared Beverages	*Fresh Fruit & Vegetable Juice*
Tap Water	*Spring, Distilled or Pure Water*
Devitalized Commercial Sugared Cereals	*Whole Grain Cereals*
White Commercial Crackers & Snacks	*Rye Krisp, Corn & Wheat Chips*
White Bread	*100% Whole Wheat, Rye Breads*
Lard, Margarine, Butter	*Sesame, Tahini Sauce, Seed Butters*
White Vinegar, Wine Vinegar	*Lemon Juice, Apple Cider Vinegar*
Commercial Vegetable Oils	*Cold Pressed Olive & Sunflower Oils*
White Rice, White Flour Noodles	*Whole Brown Rice, Noodles & Pasta*
Cow Milk Cheeses & Other Dairy Foods	*Tofu, Soy Milk, Seed & Nut Milks*
Salted, Roasted Seeds & Nuts	*Raw Soaked Seeds & Nuts*
White Flour Pastries	*Whole Grain Baked Pastries*
Meat, Fish, Fowl, Eggs	*Seeds, Grains, Legumes, Nuts*
Common Salt, Pepper, Condiments	*Kelp, Dulce, Thyme, Parsley, Ginger*
Spices, Mustard, etc.	*Vegetable Seasoning, Tamari, Sea Salt*
Baking Powder	*Nutritional Yeast, Wheat Germ*
Pasteurized Cow's Milk & Cheeses	*Raw Cow's Milk, Yogurt & Goat Milk*
Food Thickening Agents (Eggs, Gelatin)	*Arrowroot, Agar, Seaweed*

Chapter 6

Transformations of the Five Elements and Yin/Yang Within

From the eternal Tao or creative force of the universe evolves Yin and Yang. The cycles of Yin and Yang produce the five elements of earth, which in turn produce all other physical phenomena: Wood, Fire, Earth, Metal (Air), and Water. The universe is the macrocosm of which humans are the microcosm and subject to the interplay of these five ancient forces. The five elements/transformations operate according to natural rhythms, i.e., seasonal changes, the moon's influence on agriculture and oceans, astrological changes, daily, monthly and yearly nutritional variations and variable psychological patterns.

The Theory of the Five Elements/Transformations is attributed to the Nei Ching, The Yellow Emperor's Classic of Internal Medicine, which dates back to the Chinese physician Chang Chuug-Ching in the second century A.D. Subsequent Chinese philosophers and physicians have since contributed material to the Nei Ching, which now contains twenty-four books.

Other groups of five elements include: The five Yin body organs, the five Yang organs, the five sense organs, the five tastes, the five planets, the five grains, the five directions, the five emotions etc.

Five Elements in Life

All biological forms are made up of these five elements, for life is a dynamic interplay of both heaven and earth Yin and Yang respectively. We may live a healthy and harmonious life by applying these universal principles to our everyday needs whether it be to overcome a disease, to use observational diagnostic procedures, to plant crops and to measure our everyday nutritional requirements.

Huang-Ti, the Yellow Emperor, is respectfully known as the father of Chinese Medicine. He is the author of the Huang-Ti-Nei-Ching Yellow Emperor's Classic of Internal Medicine written about 6,000 years ago.

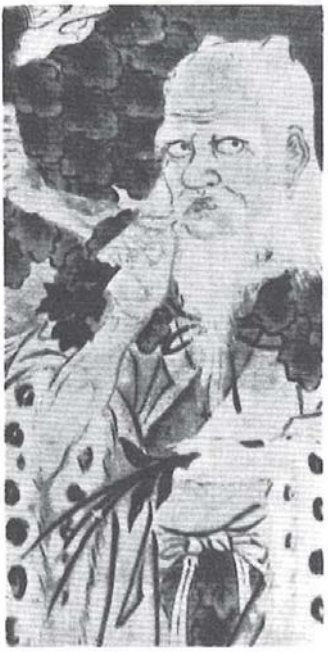

Fig. 6.1. Huang-Ti, the Yellow Emperor

The Five Elements are not only expressed as physical reality fire, earth, metal (air), water and wood but are more intimately associated with the energy they express in their formation. These energy transformations are used in oriental diagnosis, massage, acupuncture, shiatsu, exercise therapy and dietary considerations.

Each of the Five Elements give birth to a corresponding food flavor; Wood creates the sour, Fire creates bitter, Earth creates sweet, Metal creates a hot (pungent) taste and Water creates a salty flavor. Each organ corresponds to one of the five different flavors and the body requires each of these flavors in a moderate amount daily. An excessive intake of one flavor will harm the associated organ and its corresponding one, i.e., an excessive intake of the sweet flavor injures the stomach/pancreas, the associated organs, and also harms the corresponding organ the Kidneys. The key is to balance the five flavors according to seasonal changes and inner biological needs on a day to day basis. If one consumes an excessive amount of salty foods, one will automatically desire or crave sweet foods to create a balance in the taste, which corresponds to an inner (organ) physiological need.

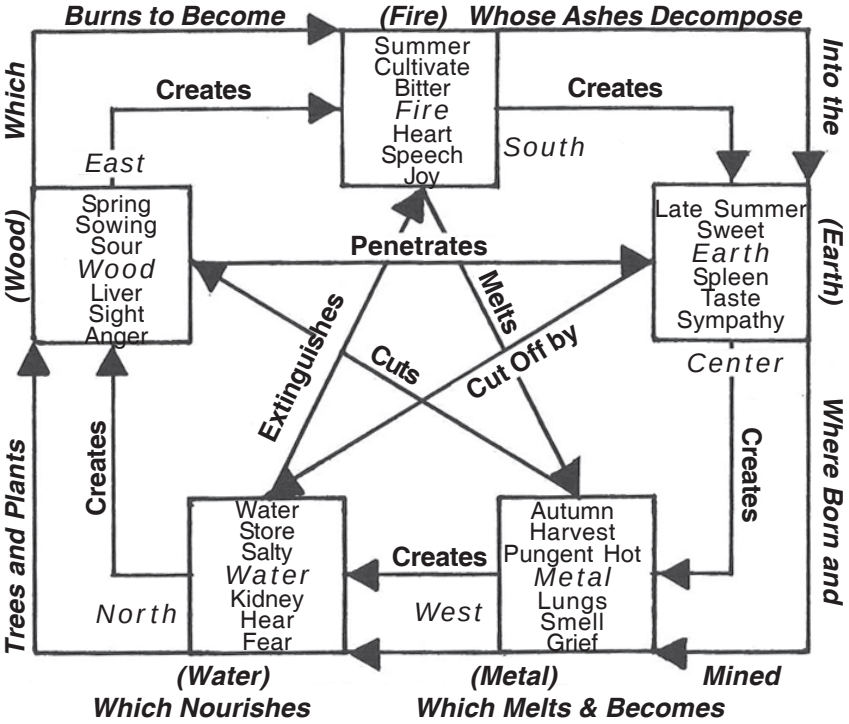

Fig. 6.2. Five Element Relationships

The Nei Ching explains the five elements in various relationships as follows:

Five Fluid Secretions as connected with the Viscera:

Perspiration is connected with the Heart.
Mucus is connected with the Lungs.
Tears are connected with the Liver.
Saliva is connected with the Spleen.
Spittle is connected with the Kidneys.

Five Climates as they affect the Viscera:

Heat injures the Heart.
Cold/Dry injures the Lungs.
Wind injures the Liver.
Humidity injures the Spleen.
Dryness/Cold injures the Kidneys.

Controls exerted by the Viscera:

Heart controls the ***Pulse***.
Lungs control the ***Skin***.
Liver controls the ***Muscles***.
Spleen controls the ***Flesh***.
Kidneys control the ***Bones***.

Effect of the Flavors upon the body:

Excess of ***Salty*** flavor hardens the Pulse.
Excess of ***Bitter*** flavor withers the Skin.
Excess of ***Pungent*** flavor knots the Muscles.
Excess of ***Sour*** flavor toughens the Flesh.
Excess of ***Sweet*** flavor causes aches in the Bones.

Five Spiritual Resources as Controlled by the Viscera:

Liver controls the ***Soul***.
Heart controls the ***Spirit***.
Spleen controls the ***Ideas***.
Lungs control the ***Animal Spirit***.
Kidneys controls the ***Will Power***.

Effects of the Five Flavors:

Pungent flavor has a dispersing effect required in ***Fall***.
Sour flavor has a gathering effect required in ***Spring***.
Sweet flavor has a retarding effect required at ***All Times***.
Bitter flavor has a strengthening effect, required in ***Summer***.
Salty flavor has a softening effect, required in ***Winter***.

Injuries caused by Season's Climate following Next Season:

Injuries caused by the ***Cold of Winter*** cause a recurrence of the ***Illness in Spring***.
Injuries caused by the ***Wind of Spring*** make people unable to ***Retain Food in Summer***.
Injuries caused by the ***Heat of Summer*** cause intermittent ***Fever in Fall***.
Injuries caused by ***Humidity of Fall*** cause ***Cough in Winter.***

Five Organs and Body Relationships:

Heart is connected with the ***Pulse*** and rules over the kidneys.
Lungs are connected with the ***Skin*** and rule over the heart.
Liver is connected with the ***Muscles*** and rules over the lungs.
Spleen is connected with the ***Flesh*** and rules over the lungs.
Kidneys are connected with the ***Bones*** and rule over the spleen.

Five Nourishing Organ and Body Relationships:

The liver nourishes the muscles; the muscles strengthen the heart; the liver governs the eyes.

The heart nourishes the blood and the blood strengthens the stomach; the heart rules over the tongue.

The stomach nourishes the flesh; the flesh strengthens the lungs; the stomach rules over the mouth.

The lungs nourish the skin and the hair; the skin and the hair strengthen the kidneys; the lungs govern the nose.

The kidneys nourish the bones and the marrow; the bones and the marrow strengthen the liver; the kidneys rule over the ears.

Five Moods in Relation to the Organs and Daily Time Cycles:

People troubled with liver disorders appear mentally alert during the morning hours, are active and bright toward sundown and of quiet mind at midnight.

People troubled with heart disorders are mentally alert at noontime, active and bright at midnight & quiet in the early morning.

People troubled with spleen disorders are mentally alert just after sundown active and bright at sunrise, and are quiet during the afternoon.

People troubled with lung/respiratory disorders are mentally alert just before sundown active and bright at noon, and are quiet at midnight.

People troubled with kidney disorders are mentally alert at midnight, active and bright during the last days of the four seasons, and are most quiet before sundown.

Five Element Creation Cycle:

Wood burns to create ***Fire***.
Fire leaves behind ashes and compose into ***Earth***.
Earth which are created and mined and become ***Metal***.
Metal which if heated and melted become molten like ***Water***.
Water produces & nourishes trees, plants & ***Wood***.

Five Element Destruction Cycle *(Subjugation)*:

Wood is cut and felled by ***Metal***.
Fire is extinguished by ***Water***.
Earth is penetrated by ***Wood***.
Metal is dissolved or melted by ***Fire***.
Water is halted, absorbed and obstructed by ***Earth***.

Five Emotional to Oragn Relationships:

Anger is injurious to Liver, but ***Grief*** counteracts Anger.
Extra Joy is injurious to Heart, but ***Fear*** counteracts Joy.
Extra Sympathy is injurious to Stomach, but ***Anger*** counteracts Sympathy.
Extreme Grief is injurious to Lungs, but ***Joy*** counteracts grief.
Extreme Fear is injurious to Kidneys, but ***Sympathy*** overcome fear.

Five Food Tastes and their Corresponding Organs:

Excessive Salt injures the heart, and the pulse hardens, tears make their appearance and the complexion changes.

Excessive Bitter injures the lungs, and the skin becomes withered and the body hair falls out.

Excessive Pungent food injures the liver, and the muscles become knotty and the finger and toe nails wither and decay.

Excessive Sour food injures the spleen and stomach, and the flesh hardens and wrinkles and the skin becomes slack.

Excessive Sweet food injures the kidneys, and the bones ache and the hair on the head fall out.

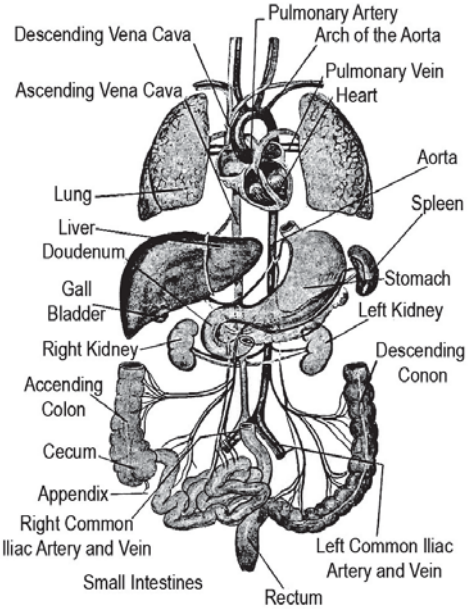

Fig. 6.3. This diagram shows the general position of the 5 major organs of the trunk, in relation to each other. The method by which veins and arteries maintain circulation of the blood is shown also.

	Metal	***Water***	***Wood***	***Fire***	***Earth***
Tissues:	*Skin*	*Bones*	*Nerves*	*Blood*	*Muscles*
Bodies:	*Emotional*	*Dream*	*Mental*	*Spiritual*	*hysical*
Mental:	*Sensitivity*	*Creativity*	*Thinking*	*Intuition*	*ontaneity*
	Non-Judgmental	*Concept*	*Planning*	*Communication*	*Judgment*
	Discrimination	*Will Power*	*Strategy*	*Consciousness*	*Cleverness*
Function:	*Detoxification*	*Creation*	*Elimination*	*Circulation*	*Digestion*
Kingdom:	*Jester*	*Queen*	*General*	*King*	*Prime Minster*

Solar Calendar (Western) 13 Weeks-Lunar Calendar (Chinese) 13 Months or 13 Cycles:
Sunday-Sun; Monday-Moon; Tuesday-Fire; Wednesday-Water; Thursday-Wood; Friday-Metal; Saturday- Earth.

Controlling Cycle (Ko Cycle):
Fire Forges Metal - Metal Cuts Wood - Wood Roots Earth - Earth Dams Water - Water Puts Out Fire
Wood Covers Earth - Fire Melts Metal - Earth Contain Water - Metal Cuts Wood - Water Puts Out Fire.

Emotions: Anger Injures Liver - Sadness Controls Anger - Excess Joy Hurts Heart - Fear Controls Joy - Sadness Affects Lungs - Joy Controls Sadness - Fear Injures Kidneys - Thinking Controls Fear.

Way of Yin and Yang

Nei Ching says:
The sages did not overexert their bodies at physical labour and they did not overexert their minds by strenuous meditation. They were not concerned about anything, they regarded inner happiness and peace as fundamental, and contentment as highest acheivement. Their bodies could never be harmed and their mental faculties never be dissipated. Thus, they could reach the age of one hundred years or more.

Those who rebel against the basic rules of the universe sever their own roots and ruin their true selves. Yin and Yang, the two principles in nature, and the four seasons are the beginning and the end of everything and they are also the cause of life and death. Those who disobey the laws of the universe will give rise to calamities and visitations, while those who follow the laws of the universe remain free from dangerous illness, for they are the ones who have obtained the Tao, the Right Way.

Tao was practiced by the sages and admired by the ignorant people. Obedience to the laws of Yin and Yang means life; disobedience means death. The obedient ones will rule while the rebels will be in disorder and confusion. Anything contrary to harmony (with nature) is disobedience and means rebellion to nature.

Hence, the sages did not treat those who were already ill; they instructed those who were not yet ill. They did not want to rule those who were already rebellious; they guided those who were not yet rebellious. This is the meaning of the entire preceding discussion. To administer medicines to diseases which have already developed is comparable to the behavior of those persons who begin to dig a well after they have become thirsty, and of those who begin to cast weapons after they have already engaged in battle.

No matter whether people are rebellious or obedient, there is method and regularity in the workings of the four seasons and Yin and Yang. Everything is subject to their invariable rules and regulations, which govern the relationship between external and internal influences.

Wisdom increases Longevity

Nei Ching continues:

Those who have the true wisdon remain strong while those who have no knowledge and wisdom grow old and feeble. Therefore the people should share this wisdom and their names will become famous. Those who are wise inquire and search together, while those who are ignorant and stupid inquire and search apart from each other. Those who are stupid and ignorant do not exert themselves enough in the search for the Right Way, while those who are wise search beyond the natural limits.

Those who search beyond the natural limits will retain good hearing and clear vision, their bodies will remain light and strong, and although they grow old in what the mind can conceive and years they will remain able bodied and flourishing; and those who are able bodied can govern to great advantage. In their pleasures and joys they (sages) were dignified and tranquil. They followed their own desires and they never directed their will and ambition toward the protection of a purpose that was empty of meaning. Thus their allotted span of life was without limit, like Heaven and Earth.

Yang, the lucid element, ascends to heaven. Yin, the turbid element, returns to earth hence the universe (Heaven and Earth) represents motion and rest, controlled by the wisdom of nature (the Tao). Nature grants the power to beget and to grow, to harvest and to store, to finish and to begin anew. The Humankind of Virtues matched heaven when they cultivated their minds; they resembled the earth when they provided sufficient nourishment; and they were by the side of the people in the care of the five viscera.

The heavenly climate circulates within the lungs; the climate of the earth circulates within the throat; the wind circulates within the liver, thunder penetrates the heart; the air of a ravine penetrates the stomach; and the rain penetrates the kidneys. The six arteries generate streams; the bowels and the stomach generate the oceans; the nine orifices generate flowing water; and heaven and earth generate Yin and Yang (the two opposing principles).

The laws of nature are just, but terrible. There is no weak mercy in them. Cause and consequence are inseparable and inevitable. The elements have no forbearance. The fire burns, the water drowns, the air consumes, the earth buries. And perhaps it would be well for any race if the punishment of crimes against the laws of humans were as inevitable as the punishment of crimes against the laws of nature, were humankind as unerring in thier judgements as nature.

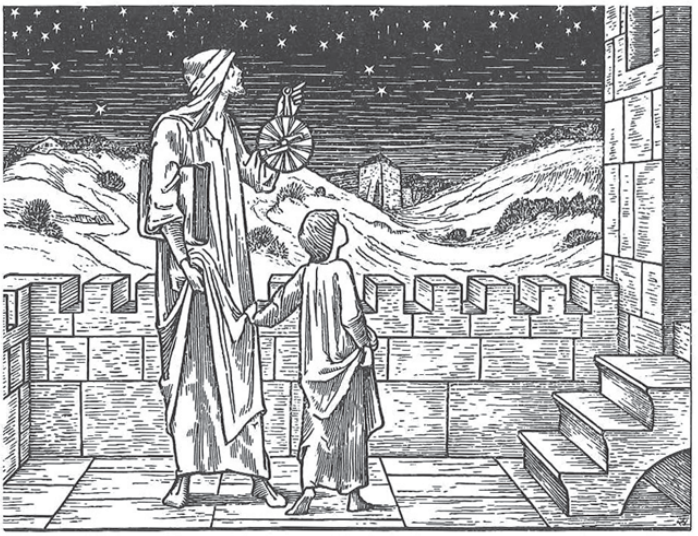

Fig. 6.4. What the mind can conceive and believe, the mind can achieve is inherited in the wisdom of the Tao.

Transformations of the Five Elements

	More Yang	Less Yang	Center Yin/Yang	Less Yin	More Yin
Five Elements:	Wood	Fire	Earth	Air	Water
Yang Organs:	Liver	Heart	Spleen/Pancreas	Lungs	Kidneys
Yin Organs:	Gall Bladder	S.Intestines	Stomach	L.Intestine	Bladder
Inner Anatomy:	Muscles	Blood Vessels	Flesh	Skin	Bones
Outer Anatomy:	Nails	Complexion	Breast/Lips	Hair/ Breath	Head Hair
Sense Organ:	Eyes	Tongue	Mouth	Nose	Ears
5 Senses:	Sight	Speech	Taste	Smell	Hearing
Body Fluids:	Tears	Sweat	Saliva	Mucous	Urine
Direction:	East	South	Center/Earth	West	North
Climate:	Windy	Hot	Humid	Dry	Cold
Seasons:	Spring	Summer	Late Summer	Autumn	Winter
5 Sounds:	Shouting	Laughing	Singing	Weeping	Groaning
5 Emotions:	Anger	Joy	Worry	Depression	Fear
Body Changes:	Control	Anxious	Sobbing/Belch	Coughing	Trembling
Creation:	Inspiration	Aspiration	Intellect	Dominance	Will
5 Functions:	Color	Odor	Taste	Voice	Fluid
Skin Color:	Blue/Grey	Red	Yellow/ Milky	Pale	Black/Dark
Daily Periods:	Morning	Noon	Afternoon	Evening	Night
Weather:	Crisp/Dry	Fog/Mist	Mellow	Snow	Ice/Frost
Planet:	Jupiter	Mars	Earth/ Saturn	Venus	Mercury
Monthly Cycle:	(+)Half-Moon	Full Moon	Hidden Moon	(-)Half-Moon	New Moon
Number:	8	7	5	9	6
Color:	Green	Red	Yellow	White	Black
Controler:	Spiritual	Soul	Mind	Ambition	Body Strength
Energy:	Upward	Active	Downward	Solidified	Floating
Examples:	Gas	Plasma	Condensation	Solid	Liquid
	Tree	Heat	Soil	Metal	Water
5 Tastes:	Sour	Bitter	Sweet	Pungent	Salty
Grains:	Wheat	Red Millet	Yellow Millet	Rice	Legumes
Fruits:	Apple/Plum	Berries	Dates/Olives	Melon	Citrus
Vegetables:	Leeks	Shallots	Mallow	Onions	Greens
Foods to Avoid:	Rancid, Oily	Burnt	Fragrant	Rotten	Putrid
Disease Areas:	Nerves	Viscera	Tongue	Upper Back	Cavities
Modalities:	Prayer	Healthy Habits	Herbals	Acupuncture	Heat Therapy

Fig. 6.5. Classification of the Five Elements and Transformations

Liver & Gall Bladder Conditions

General Toxicity Signs of Malfunctioning Yin or Yang Liver and Gall Bladder

Blockage of the Tear Ducts or Excessive Tears	Shouting and Anger
Soft Ridged Nails	Weak Knees and Muscles
Poor Vision and Light Sensitivity	Fuzzy Thinking
Bloodshot Eyes	Liver Pain (Under Right Rib Cage)

Symptoms of Yang (Contracted) Liver and Gall Bladder

Dizziness	Incomnia
Headaches	Nosebleed
Red Eyes	Cataracts
Aversion to Heat	Irritability
Impaired Hearing	Farsightedness

Symptoms of Yin (Expanded) Liver and Gall Bladder

Nausea
Poor appetite
Depression
Apprehension
Nearsightedness

Foods Discharge Toxins from Liver and Gall Bladder

Radishes
Potatoes
Lettuce
Mushrooms

Eaten Moderately Sour Foods Strengthen Liver and Gall Bladder

Grains	*Fruits*	*Vegetables*	
Wheat	Plums	Beets	Cabbage
Rye	Berries	Artichoke	Watercress
	Cherries	Celery	Burdock
	Apples	Leeks	Parsley

Liver and Gall Bladder are Weakened by an Excess of:

Fats, Butter, Dairy	Sweets	All Rancid Fats & Oils	Alcohol
Eggs and Vinegar	Outdoor Wind	All Drugs	Cold Drinks/Foods
Nuts & Nut Butters	Overeating	All Chemicals	

These Herbs in Small Amounts Discharge Toxins from Liver/Gall Bladder

Burdock	Golden Seal
Dandelion	Raspberry Leaf
Holy thistle	

These Yin Herbs Balance Yang Symptoms of Liver/Gall Bladder

Sage	Wild Yam
Chaparral	Oregon Grape
Echinacea Root	

Yin Herbs Balance Yang Symptoms of Liver/Gall Bladder

Watercress	Nettle	Licorice
Garlic	Slippery Elm	Marshmallow

Mental Healthy Signs of Liver/Gall Bladder

Good Decisions and Ability to Make Plans
Confidence to achieve Success
Agreeable Personality and Disposition

1. *Excessive sour food injures the spleen and stomach, toughens and wrinkles the flesh, and the skin and lips become slack, and is balanced by a moderate amount of pungent food.*
2. *Excessive and/or lack of sour food injures the Liver and Gall Bladder.*
3. *Eat more steamed food during Spring to Strengthen Liver & Gall Bladder.*
4. *Anger is injurious to the Liver and Gall Bladder.*
5. *Excessive Running or Walking injures the Liver and Gall Bladder.*
6. *Excessive blowing wind injures the Liver and Gall Bladder.*
7. *A malfunctioning Liver and Gall Bladder causes Anger and Irritability.*
8. *A healthy Liver and Gall Bladder instills Peacefulness and Calmness.*

Fig. 6.6. Balancing Body Organs: Liver & Gall Bladder Conditions

Heart & Small Intestines Conditions

General Toxicity Signs of Malfunctioning Yin or Yang Heart & Small Intestines

Swollen Nose and Hands
Cleft in Nose
Excessive Joy
Excessive Sweating or not at all
Excessive Laughing
Emotional Ups and Downs

Symptoms of Yang (Contracted) Heart and Small Intestines

Chest Constriction
Excess Perspiration
Dizziness
Stroke
Dry Palate
Back Pain
Laughing Fits
Little Talk

Symptoms of Yin (Expanded) Heart and Small Intestines

Shortness of Breath
Rambling Talk
Sorrowful and Listless
Sciatic and Lumbar Pains
Facial Pallor

Foods Discharge Toxins from Heart and Small Intestines

White Beans
Vegetables Oils
Seaweed
Beans

Eaten Moderately Sour Foods Strengthen Heart and Small Intestines

Grains	*Fruits*	*Vegetables*	
Red Millet	Apricots	White Beans	Pumpkin
Corn	Strawberries	Oils	Chickpea
Nuts	Cherries	Seaweed	Scallion
Almonds		Garlic	Burdock
		All Greens	

Heart and Small Intestines are Weakened by an Excess of:

Overdressing (Hot Clothing)
Burnt Food
Hot Drinks and Food
Excess Salt & Spice

These Herbs in Small Amounts Discharge Toxins from Heart/Small Intestines

Mint
Cayenne
Motherwort
Bayberry

These Yin Herbs Balance Yang Symptoms of Heart/Small Intestines

Black Cohosh
Caraway Seed

Yin Herbs Balance Yang Symptoms of Heart/Small Intestines

Borage
Gensing
Hawthorne Berry
Comfrey Root

Mental Healthy Signs of Heart/Small Intestines

Honesty and Integrity
Optimistic Personality
Poised in Mind and Body
Extends Love to Humanity and own Family

1. *Excessive Bitter Food injures the lungs, whithers the skin, body hair falls out, stomach becomes congested, and is balanced by a moderate amount of Salty food.*
2. *Excessive and/or lack of Bitter foods injure the Heart and Small Intestines.*
3. *Eat more Raw food during Summer to Strengthen Heart & Small Intestines.*
4. *Excessive Joy and Excitement are injurious to the Heart & Small Intestines.*
5. *Excessive eye focusing, reading and close work weaken Heart & Eyesight.*
6. *Excessive Heat injures the Heart and Small intestines.*
7. *A malfunctioning Heart and Small Intestine causes Hysteria.*
8. *A healthy Heart and Small Intestine instills Happiness.*

Fig. 6.7. Balancing Body Organs: Heart & Small Intestines Conditions

Stomach, Spleen & Pancreas Conditions

General Toxicity Signs of Malfunctioning Yin or Yang Stomach, Spleen & Pancreas

Ulcers	Vomiting	Fatigue	Obsession
Drolling	Heavy Limbs	Abdominal Pains	Overweight
Lack of Taste	Low Energy	Mental Depression	Intestinal Problems
Excess or Diminished Salavia		A Sing-Song Voice	Excessive Worry

Symptoms of Yang (Contracted) Stomach, Spleen and Pancreas

Watery Stools	Constipation
Light Headedness	Quarrelsome Moods
Flatulent Stomach	Sweet/Greasy Mouth Taste

Symptoms of Yin (Expanded) Stomach, Spleen and Pancreas

Indigestion	Diarrhea
Heaviness	Gastric Cramps
Emaciation	Nausea

Foods Discharge Toxins from Stomach, Spleen and Pancreas

Dark Greens
Herb Spices

Eaten Moderately Sour Foods Strengthen Stomach, Spleen and Pancreas

Grains	*Fruits*	*Vegetables*	
Yellow Millet	Dates	Squash	Dark Greens
	Olives	Parsnips	

Stomach, Spleen and Pancreas are Weakened by an Excess of:

Hot Food	Excessive Sweets	Lack of Mastication
Damp Clothing	Eating too Fast-Overeating	Damp Ground

These Herbs in Small Amounts Discharge Toxins from Stomach, Spleen/Pancreas

Ginger	Gential	Vervain
Golden Seal	Juniperberry	

These Yin Herbs Balance Yang Symptoms of Stomach, Spleen/Pancreas

Lobelia	Basil
Fennel	Catnip

Yin Herbs Balance Yang Symptoms of Stomach, Spleen/Pancreas

Ginseng	Fennel
Orange Peel	Licorice

Mental Healthy Signs of Stomach, Spleen/Pancreas

Constructive Thinking and Action
Calm Disposition and Satisfaction
Sound Ideas and an Excellent Memory
Sympathetic Nature and a Balanced Critical Faculty

1. *Excessive sweet food injures the kidneys, causes hair loss, aching bones, and is balanced by a moderate amount of Sour food.*
2. *Excessive and/or lack of sweet food injures the Stomach, Spleen/Pancreas.*
3. *Eat more Stewed food during late summer to strengthen the Stomach, Spleen and Pancreas.*
4. *Extreme Sympathy, Moodiness and Worry is injurious to the Stomach, Spleen and Pancreas.*
5. *Prolonged Sitting weakens the Stomach, Spleen/Pancreas.*
6. *Excessive humidity (moisture) injures the Stomach, Spleen/Pancreas.*
7. *A malfunctioning Stomach, Spleen/Pancreas causes suspicion & mistrust.*
8. *A healthy Stomach, Spleen and Pancreas instills Trust.*

Fig. 6.8. Balancing Body Organs: Stomach, Spleen & Pancreas Conditions

Lungs & Large Intestines Conditions

General Toxicity Signs of Malfunctioning Yin or Yang Lungs & Large Intestines

Whimpering and Sorrow
Hemorrhoids
Sinus and Mucous Problems
Chest Congestion
Anguish and Helplessness
Bowel Difficulties

Symptoms of Yang (Contracted) Lungs and Large Intestines

Rapid and Deep Breath
Carcked Lips
Non-Productive Cough
Dry Rough Skin
Chest Pain

Symptoms of Yin (Expanded) Lungs and Large Intestines

Shallow Respiration
Shortness of Breath
Cold Hands and Feet
Never Thirsty
Drowsiness
Emaciation
Cramps
Loose Stools

Foods Discharge Toxins from Lungs Large Intestines

Green Peas
Cider Vinegar
Lemon
Tomato
Radish

Eaten Moderately Sour Foods Strengthen Lungs and Large Intestines

Grains	*Fruits*	*Vegetables*	
Rice	Peaches	Onion	Radish
Oats	Lemon	Comfrey	Cider Vinegar
Barley	Melons	Garlic	Hot Pepper
	Tomato	Green Pea	

Lungs and Large Intestines are Weakened by an Excess of:

Excess Fats
Excess Dairy
All Cold Foods
Under-Dressing in Cold Weather
All Cold Drinks
Excess Oils

These Herbs in Small Amounts Discharge Toxins from Lungs/Large Intestines

Horehound
Golden Seal
Wild Cherry Bark
Slippery Elm
Elecampagne

These Yin Herbs Balance Yang Symptoms of Lungs/Large Intestines

Pleurisy Root
Coltsfoot
Myrrh
Eucalyptus
Lobelia
Mullein
Garlic
Ginger

Yin Herbs Balance Yang Symptoms of Lungs/Large Intestines

Comfrey
Yarrow
Ohsa Root
Cayenne

Mental Healthy Signs of Lungs/Large Intestines

Physical Strength and Endurance
Good Mind and Body Rhythm
Harmonious Personality and Intuition
Buoyant Health and Vitality

1. *Excessive Pungent foods injure the liver, knot the muscles, slow the pulse and injure the spirit, and are balanced by a moderate amount of Bitter food.*
2. *Excessive and/or lack of Pungent food injures the Lungs/Large Intestines.*
3. *Eat more Baked foods during the Fall season to Strengthen the Lungs And Large Intestines.*
4. *Extreme Grief is injurious to the Lungs and Large Intestines.*
5. *Excessive lying down or sleeping weakens the Lungs/Large Intestines.*
6. *Excessive Dryness (Extreme Low Humidity) injures Lungs/Large Intestines.*
7. *Malfunctioning Lungs and Large Intestines causes Depression.*
8. *Healthy Lungs and Large Intestines instill Positiveness and Confidence.*

Fig. 6.9. Balancing Body Organs: Lungs & Large Intestines Conditions

Kidneys & Bladder Conditions

General Toxicity Signs of Malfunctioning Yin or Yang Kidneys & Bladder

Frequent Urination	Scant Urination	Poor Hearing	Moaning Sound
Hair Loss	Dandruff	Weak Ankles	Sex Problems
Arthritis	Painful Joints	Backache	General Fatigue

Symptoms of Yang (Contracted) Kidneys & Bladder

Dry Mouth	Nymphomania
Excess Mucous	Painful Swelling
Fevers	Cold Diseases
Restlessness	Perspiration after Eating

Symptoms of Yin (Expanded) Kidneys & Bladder

Soft Speech	Fatigue
Poor Memory	Weak Joints
Impotence	Chills/Coldness
Headaches	Swollen Legs
Ulcers	Indecisiveness

Foods Discharge Toxins from Kidneys & Bladder

Aduki Beans
Black Beans
Cider Vinegar
Oils (Vegetable)
Cirtus Fruit

Eaten Moderately Sour Foods Strengthen Kidneys & Bladder

Grains	*Fruits*	*Vegetables*	
Buckwheat	Grapes	Green Vegetables	Beans
	Grapefruit	Aduki Beans	Parsley
	Oranges	Black Beans	Seaweed
		Cauliflower	Cabbage
		Sea Salt	Miso

Kidneys & Bladder are Weakened by an Excess of:

Scalding Hot Food	Scalding Hot Drinks	Excess Protein and Vinegar
Excess Sweets/Liquid	Drugs/Chemicals Alcohol	Hot Clothing (Over-Dressing)

These Herbs in Small Amounts Discharge Toxins from Kidneys & Bladder

Raspberry Leaf	Cleavers	Nettles
Plantain Leaf	Saw Palmetto	Berries

These Yin Herbs Balance Yang Symptoms of Kidneys & Bladder

Juniper Berry	Gravel Root
Parsley Leaf	Myrrh
Asparagus Root	Dandelion

Yin Herbs Balance Yang Symptoms of Kidneys & Bladder

Oat Straw	Horsetail
Marshmallow Root	

Mental Healthy Signs of Kidneys & Bladder

Excellent Concentration
Clear Beautiful Voice
Tenacious Will Power
Strong Sex Glands and Personal Magnetism

1. *Excessive Salty food injures the heart, causes high blood pressure, hardened pulse, and weak bones and is balanced by a moderate amount of Sweet food.*
2. *Excessive and/or lack of Salty food injures the Kidneys and Bladder.*
3. *Eat more Sauted Food during Winter to Strengthen the Kidneys/Bladder.*
4. *Extreme Fear and Moaning is injurious to the Kidneys and Bladder,*
5. *Prolonged Standing is harmful to the Kidneys and Bladder.*
6. *Excessive Cold Temperature injures the Kidneys and Bladder.*
7. *Malfunctioning Kidneys and Bladder cause Fear and Depression.*
8. *Healthy Kidneys and Bladder instill Courage and Fortitude.*

Fig. 6.10. Balancing Body Organs: Kidneys & Bladder Conditions

Using Herbs according to Five Elements

1. Use only the specific herb designated for a particular symptom or condition as explained in the Five Elements. Herbs should not be used indiscriminately without regard for their Yin or Yang qualities as is commonly practiced by most American herbalists. The Chinese Yin/Yang herbal system is far more accurate and scientific in their diagnosis, treatment and use of herbs.
2. Herbal teas are best utilized and assimilated on an empty stomach, in the morning, or before a meal. However, a small amount of tea may be used after a meal to help to assimilate fat eaten in the meal and aid digestion; no more than 2 to 4 ounces may be taken after meals, sipped slowly.
3. Herbal teas should be limited to one or two cups per day. An excess of an herb tea can cause a reverse condition or symptom in the body. The Chinese herbalists teach that what an herb can cure, it can cause the very same condition or problem, if it is taken in excess or the cause of the disorder is not stopped. For example, if one attempts to correct or balance Yang (contracted) constipation with a Yin herb, such as senna leaf tea, without removing the initial cause (overeating, white flour, salt, meat, dairy products etc.), the tea will help for a few days or weeks, temporarily, and the constipation will still remain a problem. If larger doses of senna leaf tea are taken to correct constipation, it will help for only short period of time, however, it will compound the problem by further weakening the intestines. The continuous use of laxatives, such as Senna leaf, in large doses, poisons and irritates the system. The body cures or heals itself; herbs are used only for remedial measures and to balance the organs and blood, provided the causes of the disorder are discontinued, and proper health and living habits are adopted. Herbs do not cure, they balance.

Another example: If one suffers from frequent or excessive urination, a Yin (expanded Kidney/Bladder) condition caused by an excessive consumption of liquids, fruits, juices, tropical fruits, melons, sugar etc. one or two cups per day of corn silk tea will help to constrict and strengthen the kidneys and bladder, and eventually correct the Yin condition, provided the above mentioned causes of the disorder are removed. Many herbalists today, recommend drinking large quantities of water, and using Yin herbs, i.e., parsley and Yin foods, i.e., cucumber and watermelon for kidney and bladder problems, without regard to whether the disorder is a Yin or Yang condition. If (Yin) parsley and Yin foods are used

for Yin (expanded) kidneys and bladder, it will further weaken and expand them. Most herbs and herb teas should be used only to balance diseased conditions or symptoms. Discontinue their use after the health problem is overcome. Some herbs, such as alfalfa, dandelion, bancha, cinnamon, chicory, grain beverages, etc., can be consumed in small amounts (1 or 2 cups) daily for better health and enjoyment. Moderation in foods as well as herbs is the key to superior health.

4. Herbal teas should be used for short periods of time only (2 to 4 months); discontinue their use, or change to different herbs for your condition. Herbs are strong agents, and should not be used for too long a time, as the body will not respond or heal as quickly if used continually.

5. Yin herbal teas are used for Yang conditions and ailments, i.e., heavy meat, egg and salt consumers. Yang herbal teas are used for Yin condition, such as those who have been on a strict (Yin) raw food or fruitarian diet, or those eating excessively of fats and sugars, such as ice cream, cheese, sweets, donuts, soft drinks, etc.

6. Body Organs for the correct herbs used in balancing Yin or Yang diseased symptoms and for discharging toxins from the system. Use one or two herbs from the discharge toxins category; and one or two herbs from either the Yin or Yang category necessary for your specific symptoms or condition.

7. For specific disease conditions, herbs always remedy, correct and balance the system with optimum results when the cause or causes of disease (improper food, overeating, poor health habits, etc.) are eliminated and rational, healthful living and eating habits are adopted.

There is a delicious herb tea recipe is called Dr. Chang's Long Life Tea. It contains the following ingredients: Peppermint, Honeysuckle, Licorice, Ginseng, Cinnamon, Poria & Chrysanthemum.

Dr. Chang is trained in both Chinese and Western medicine, herbology, and acupuncture. He says this about herbs: "Herbs, like the regular foods, work by adjusting the flow of vital energy in the entire body of the human being. This is accomplished by increasing the energy where it is too low and lessening the energy where it is too high. When herbs are assimilated by the body their vitality is absorbed too. The herb's vitality passes through the pathways of energy (meridians) to reach the internal organs and to

support and adjust them to their optimal functioning. The most useful purpose of herbs is the prevention of illness, rejuvenation and longevity. Everyone, whether sick or healthy, can benefit from herbs. A complete diet should include both regular foods and herbs. No one can obtain perfect health unless he has a complete diet program. Anyone who stops learning is older whether this happens at 20 or 80. Anyone who keeps on learning not only remains young but becomes constantly more valuable, regardless of physical capacity.

Diet and Longevity Secrets

The food question is infinitely the most important problem of the present day, and if properly dealt with must result in the disappearance of the vast bulk of disease, misery and death. Dr. Harvey W. Wiley, who was responsible for our pure food laws, joins Sir Arburhnot Lane, in saying that: "I believe I would not be far out of the way if I should say diet may be said to be a factor in every disease to which man is heir."

Natural Science teaches us that we must eat for replenishment, drink for replenishment and breathe for replenishment. Nutritional replenishment means that we must put back into our body and blood what has been used up in the process of living. The ultimate purpose of blood circulation is to feed the hungry cells of your body, and this is accomplished by vitalizing and building a rich red blood stream through a balanced program of natural foods. This is the great Law of Life.

Hidden Hunger

Inadequate and incomplete nutrition along with poor food assimilation and lack of intestinal and muscular tone are some of the major initial causes why many individuals experience hidden hunger pangs or abnormal cravings, which compels them to constantly consume junk food. A well-balanced nutrition, exercise, fitness, and antistress program can help alleviate the problem in a short time. Natural whole food supplies in easily available form valuable elements that the human body is composed of, namely: vitamins, minerals, trace elements, enzymes, proteins, carbohydrates and fatty acids. The presence of these life sustaining components in their proper balance determines our state of health, vitality, and

length of life. When any one of these natural elements become depleted or reduced below the body's requirements, that instant, health and vitality begin to diminish, and will continue to do so until disease appears. If the body's requirements are adequately met in every department, health will be the natural outcome.

Nutritional Power

Health minded individuals are becoming more concerned with nutrition power. Through the power of nutrition, the food we consume daily, we become physically and mentally what we are now and in the future. Food can build us into dynamos of health, strength and power or break us down into sick, weak and powerless individuals. The quality and not the quantity of foods is the determining factor in our overall health and well-being.

If civilized peoples do not use natural foods, if their food is changed from the condition in which nature supplies it, we have located at least one civilized habit that must tend towards body degeneration, organic strain and illness. Every human being knows that a building cannot be any more perfect than the materials used in its construction. Foods, just as they come from nature's hand, are capable of building perfect human bodies.

Confusion about Nutrition and Health

What is a proper diet of man? Is there one good diet that is good for everyone, everywhere, and will end all argument on what one should eat? One authority says to eat only fruits, nuts and vegetables; another says, eat only rice and no fruits. Still another advocates eating only fruit. One recommends a high protein diet, low fat diet. Some say to eat everything, because man is an omnivore. There are diets from each nation around the world, and we can take our pick. One author is against eating breakfast, another says to eat a big breakfast. One says to fast one day a week and another advises to fast 40 days at a time.

Here are a few national diets advocated by various authorities in the West:

Low Cholesterol	High Fiber Diet	Policeman's Diet
Weight Watcher's Diet	Air Force Diet	Mucousless Diet
Orange Diet	Grapefruit Diet	Grape Diet
High Carbo Diet	Low Carbo Diet	High Protein Diet
Low Protein Diet	Save Your Life Diet	Working Man's Diet
Drinking Man's Diet	Rockerfeller Diet	Mayo Diet
Eat All You Want Diet	No-Risk Diet	Diet Revolution
Inches-Off Diet	Milk Diet	Bran Diet
Fruitarian Diet	Breatharian Diet	Rice Diet

Some of these diets can be used for a limited period of time without harm in certain conditions, for instance, weight loss, lowering cholesterol, or for cleansing purposes, such as recommended in this book. However, there are no health or longevity advantages of living on any exclusive or extreme dietary fad or program beyond a few days or weeks. Superior health can only result from a balanced dietary program and proper living habits.

Is the meat diet the answer? What about the all fruit diet? And the grain only diet? Should I use food supplements? One groups says that honey, onions, garlic and grains are taboo. We have personally experimented with many of these diets, including the rice diet, high protein diet, fruitarian diet, vegetable, the cooked diet, the raw diet, the juice diet, the water diet, and yes, even the breatharian diet of only pure air. What is humans most optimum diet? What diet plan will impart superior nutrition and good health? As can be seen by the above diet statements and lists, confusion and contradiction is rampant in the health and nutrition field.

One thing is certain: Positive results in health and nutrition are of prime importance; not theory or speculation that look impressive on paper, but fail to produce healthy specimens in real life. In order to arrive at a logical and truthful conclusion, we must seek all the facts clinical and empirical that produce actual physical results, and not mere opinions and theories that do not produce positive, healthful results.

We must all learn to remain open minded in all of our research and study, investigating all sides of the issue before reaching answers or conclusions. The mind is like a parachute; it only functions when open. No one religion or philosophy has all the answers, but we can learn from them all. Unfortunately, all too often,

we allow our own subjective ego's to obstruct our thinking and reasoning processes. Being human, we tend to hold on to our pet theories and opinions on health, diet and life, not opening our minds to a higher truth or superior method. When individual consciousness learns how to flow with the universal consciousness or natural law, one may easily discern the proper and true nature of health and life.

The ancient sage Buddha, during his earlier life, attempted to subsist on almost nothing, while fasting and praying in the mountains. One day he became enlightened, fled the mountains, and proclaimed to the masses, that fleeing society and depriving oneself of food and other necessities was not the answer to reach heaven or God. He revealed the answer to health, happiness and long life with one word: Moderation. Moderation in all the good and beneficial things of life. Moderation in diet, exercise, working, playing, sleeping, etc., is the answer to living a well-balanced and healthy life. Always keep this important point in mind when studying and practicing health and nutrition. To preserve health is a moral and religious duty, for health is the basis of all social virtues. We can no longer be useful when not well.

Fig. 6.11. Bodhidharma, the Ting Yun-peng, who came from India to China preaching a kind of Buddhism which ultimately evolved into Ch'an or Zen Buddhism. Courtesy of Field Museum of Natural History, Chicago.

We are What We Eat

Improper or one sided nutriton can cause serious metabolic and chemical disorders that can take years to correct. For example, a heavy meat and protein diet is the cause of many diseases such as, kidney (contracted), arthritis, gout, premature aging and cancer tumors. Meat protein is extremely high in phosphorus, which can cause high calcium loss and bone cancer; it is deficient in almost all vitamins, minerals, enzymes and base elements. Meat can impart strength and power (Yang) for a short time, but it is not conducive to a healthy long life. Exclusive meat diets are extremely Yang and acid, resulting in very aggressive, hot-tempered, over-sexed and dictatorial characters. Grains, legumes, vegetables, seeds and fruit are superior sources of protein and biologically and more healthfully superior to meat protein. The exclusive cooked grain, legume and vegetable diet lacks the elements of raw food and potassium the beauty mineral. This diet usually leads to extreme underweight conditions or emaciation. Mentally, this diet produces Yang temperaments and organic contraction; fevers; sometimes uncompromising and arrogant. This diet lacks in sufficient raw fruits and vegetables, especially during summer weather; too much cooked food in hot weather; may lack sufficient protein and alkaline vitamins and minerals.

The Fruitarian Diet (watery fruit) is extremism on the alkaline side (yin) and will result in low blood pressure, poor circulation, cold feet and hands, anemia and nervousness. This last symptom is caused by a lack of sufficient proteins and grains which builds powerful nerve force in the body. Blood is not built by fruit alone, but by a combination of alkaline and acid food together. Mentally, the alkaline fruitarians tend to be over-critical. They whine and complain continually, feeling that no one is as moral or as perfect as themselves. They withdraw from society thinking that everyone else is headed for destruction.

The authors writing on fruitarianism, juicearianism, breatharianism and mucuslessarianism have not been able to live up to their own teachings. They live on the diet for a time, but nature always pulls them back to eat the heavier type of acid foods, i.e., protein, and carbohydrates. The reasoning is, that on some future day, when they have cleaned out every speck of mucus from the body, they will be ready to live on air. If Breatharianism were possible, it could be done only through divine intervention

(grace) through Taoist practices, and not by consciously going to the extreme in any phase of life and living. There is an underlying truth to the vast sub-ject of health, diet and nutrition that must be considered before advocating a specific nutrition plan for anyone. Natural Law settles and answers the question as to what each of us shall eat in the following section. There is a natural affinity between natural foods and the human body. They share the earth as source, and the body so fed holds energies to be found in no other way. We call it health.

Locally Grown Foods for Optimum Health

Nature decides what foods we are to eat; and that decision is made according to the zone or region in which we live. In the cold frigid regions of the far north, fuel foods are required. Fruits, seeds and grains are very scarce in that region. The cold (Yin) temperatures require heavier and more Yang/Acid foods, such as cooked grains, legumes, miso, soups, stews etc. Generally, those living in a cold climate may consume a higher percentage of natural cooked starches and proteins and a small or moderate amount of raw foods and natural fats. On the other hand, as we travel south to the tropics, we need less fuel foods and more fresh fruits, vegetables and nuts. A high meat and fat diet, eaten in the south, would result in rapid decay and death. Hot weather is Yang and requires some summer grains and raw fruits and vegetables. A Yin fruit and vegetable diet in Alaska would cause a rapid loss of weight, extreme coldness to the bones and ultimate sickness.

The temperate zone produces a person with a well balanced spiritual, mental and physical nature. Here is where we find the greatest inventors and scientific advancement. Nature provides the greatest variety of foods in this region. While the south grows mostly Yin foods and citrus fruits, the temperate zone produces fruits and vegetables tending toward the Yang elements, for example, apples, peaches, beets and cherries. These Yang foods are higher in sodium, which is necessary for the temperate region. Tropical foods predominate in the element potassium, which is required to cool the body in the hot Yang climate.

There is little use in theorizing on the question of what we should eat. Nature simplifies the matter. For optimum health, consume foods grown within a 300 mile radius of where you live. Avoid foods shipped in from across the country or other countries. The red

pepper, (cayenne), which grows so profusely in southern latitudes, is strongly magnetic (Yin), and the lemons, limes, oranges and tropical fruits abound in citric acid, which are assimilated and utilized easily by southern inhabitants. In the temperate region, the woods are overflowing with luscious ripe red berries, seeds and nuts, cucumbers, and nature has produced just the right kind of food that the humans and animals inhabiting that region require. Refer to the chapter on Yin & Yang balance for proper selection of foods.

Those living in a temperate climate, with a change of seasons winter, spring, summer and fall and the weather changing from hot to cold throughout the year, the diet must be adjusted to meet the environmental conditions to maintain nutritional balance and optimum health.

For instance, during the northern winters of the temperate zone, you will require more Yang and heavier foods such as, grains, wheat and rye bread, beans, peas, steamed vegetables and apples. Temperate summers require more cooling foods as found in this zone such as, cherries, peaches, plums, grapes, berries, melons, etc. The spring and fall diets will vary between the winter and summer ones. This is where one must become the final judge in the choice of foods they eat. Listen to the inner voice or feelings as to what the body requires of certain foods on any given day. Age, physical activity and stress conditions must also be considered as variables in an optimum selection of natural foods.

An occasional orange, pineapple juice or other tropical fruit eaten in the northern zones will do you no harm. Be moderate and use supreme judgment. Do not become a food fanatic or diet crank. Acid and Yang meat eaters can benefit more by eating some vegetable and fruit foods to balance their Yang characters. Vegetarians, who are mostly Yin and alkaline, would do better to eat more of the Yang natural foods, such as seeds, peas, grains, beans, miso, cooked vegetables, etc.

Longevity Secrets of Centenarians

The longest lived and healthiest people in the world live chiefly on the natural whole foods grown in their own region and climate. For example, the Bulgarian diet consists largely of whole rye and barley bread, sunflower seeds, vegetable soups; fermented foods

such as, yogurt, sauerkraut, sourdough bread, soured milk, etc. They seldom eat meat. They consume goat or sheep milk and fresh raw honey. Bulgarians are mostly lacto-vegetarians. The Bulgarians boast of about 1,500 centenarians per million population, as contrasted to 100 or less persons over the century mark per million in the United States.

The Himalayan Hunzas consume a similar diet, with the addition of apricots, millet, buckwheat, mulberries, buttermilk, soups, fruits and vegetables. They work outside most of the day, getting sufficient exercise and oxygen to digest their food properly. They drink the highly mineralized water coming down from the majestic glaciers. They maintain a positive, happy attitude and youthful condition well into advanced age. Many Hunzas reach the age of one hundred years and beyond. The long lived Mexicans on the other hand, utilize the foods grown near them, such as: papayas, pineapple, corn, cornbread, beans, limes, lemons, oranges, red peppers, bananas, avocados, various vegetables and many herbs including damiana and sarsparilla. The Russians, living to a healthy advanced age, consume an abundance of garlic, onions, honey, pollen, buckwheat, sunflower seeds and oil, fermented lactic acid foods such as soured milks, sauerkraut, sourdough bread and pickles. Their foods are unprocessed. They eat very little meat and live an outdoor life.

Live to be a Hundred

1. Pure, whole, organic, natural foods.
2. Natural foods grown on rich humus black soil.
3. Clabbered goat milk products, fruits, vegetables, seeds, nuts and grains and very little or no meat.
4. Eating when hungry and only when hungry.
5. Eat and live in moderation.
6. Daily exercise outdoors; walking, running, gardening.
7. Centenarians always maintain a positive mental attitude.
8. A strong belief in a Supreme Guiding Force. They pray often, fast occasionally, live without fear and are serene and loving.
9. Most of these vibrant oldsters have developed and maintained perfect bodily postures, which is necessary for good circulation, nerve flow and superb health.
10. They live in an almost perfect environment with an altitude of about 4,000 feet, perfect for the heart, metabolism and thyroid. Sunshine and rain are abundant throughout the year

and food grows continuously. The atmosphere is brisk, bracing, energizing and pure. Never too cold or hot, but just right.

11. These healthy long lived people make their work their play and their play their work. They enjoy what they do and they love what they do.
12. They are never in a hurry or under stress, which is the greatest killer and life shortener of modern human.
13. Many of them avoid meat completely, do not smoke or drink alcohol.
14. They live by the cycles of the earth; early to bed when the sky darkens and up with the sun at the crack of dawn.
15. Most of them were married one or more times and have grandchildren and great grandchildren and enjoy being around young people.
16. Living at a 4,000 foot altitude, they have less gravitational pull on their bodies by climbing steep mountains. This insures good body circulation from the leg muscles to all parts of the body and brain.
17. They obtain an abundance of ultra-violet light from the sun daily. This light controls calcium, which are found in the long bones of the body that produce rich red new blood cells.
18. They drink the pure mountain glacier water and consume a variety of herb teas, such as, ginseng, peppermint, alfalfa, etc., and they drink only when thirsty.
19. The greatest secret of the centenarians is that they live a well-balanced life, mentally, physically, emotionally and spiritually.

Fig. 6.12.We squander health in search of wealth, we scheme and toil and save; then squander wealth in search of health. And all we get is a grave. We live and boast of what we own we die and only get a stone.

Vegetarianism vs Carnivorism

You may be surprised to learn that about one-half of the world's population is either totally Vegetarian or leaning in that direction. There are approximately eleven million Vegetarians in America today, and that number is growing fast. Many social and economic factors indicate that vegetable plant foods will account for as much as 90% of the United States food budget within ten years.

The current methods of food production, especially in the United States, is most uneconomical and wasteful. For example, eighteen million tons of vegetable protein are lost in feeding them to animals for the production of meat protein. If this vegetable plant food was fed directly to humans, it would meet 90% of the world's protein deficiency.

Nearly one-half of the United States harvested land is planted with crops to feed animals. The United States Department of Agriculture states that the billion people in developed countries use almost as much plant food as feed to produce animal protein as the two billion people in other countries use directly as food. Among other things, the meat industry may soon be using sterilized chicken manure as animal feed for the commercial market. In feeding vegetable foods to animals for meat, a 90% to 95% waste factor is involved. The cultivation of grains, vegetables, nuts and fruits can support a population eight times or more than that provided by the present wasteful system of feeding this food to animals first, then eating the animal.

We must not only provide superior nutrition for the people, but most importantly, save the land from exhaustion. Our cosmic spaceship (earth) is burning and smouldering with chemicals, inorganic fertilizers, fallout, industrial wastes and destructive poisons too numerous to mention. It is time for everyone to take some positive action and to demand that peace be given to our fields not only to save humans from malnutrition and disease, but consider a diet for the earth itself. Our world leaders are leading us like sheep, into mass suicide from the lack of true wisdom and deep insight. We must think of the generations and civilizations to come.

The Vegetarian philosophy is appealing to a growing number of people of all ages who desire a peaceful world now and for generations to come all over the globe. Youth is disillusioned with society. They have witnessed only war, insecurity, economic strife,

chaos and corruption in all levels of government. Many of our young people are seeking only good and constructive change. The non-violent plan of eating, if embraced by mankind, would lead to world peace, as there would be no more killing; but it must start with each person. The whole Vegetarian Ideal will not only improve the individual, (the microcosm) but humanity as a total unit, (the macrocosm) and the entire environment.

Scientific and Anatomical Basis of Vegetarianism

All modern physiologists admit that flesh is not an essential part of the dietary of human beings. A well-selected vegetable diet is capable of producing the highest physical development. Prof. E. V. McCollum of John Hopkins University contributed his opinion of diet in the early nineteen hundreds, thusly: “I have not the slightest hesitation in saying that a vegetarian diet, is the most satisfactory type of diet that humans can take.”

Nothing is more easily demonstrated than animal meat being positively injurious in the highest degree, and that many of the diseases of our civilization are derived exclusively from its use. We will dispose of the meat question with the following incontrovertible scientific facts, which should be sufficient evidence that the practice is an acquired habit and wholly unnatural.

First: It is a universal fact that all animals that are naturally carnivorous are more active at night than in the daytime, and are of a nature which makes them positive at night and negative during the day. Man is more active in the daytime than at night by nature, and if he is carnivorous he furnishes an exception to the universal rule. Persons who consume large quantities of meat are rendered sleepy and dull during the day and are sleepless and nervous at night. Heavy meat eating usually accompanies the drinking of alcohol, along with spicy, fattening and other devitalized foods during a period of time in which the body requires sleep and recuperation from the daily activities.

Second: All animals that are naturally carnivorous perspire through the tongue and not through the skin. All naturally vegetarian animals perspire through the skin, as man does. Meat eaters have a feverish and disagreeable condition of the tongue, causing an unnatural thirst, which vegetarians do not experience.

Third: Man's anatomical structure is not adapted to a meat diet. His teeth are not adapted to tearing flesh and he has no claws to kill and rend his prey. His tooth structure is designed for biting and chewing grains, legumes, fruits, vegetables, seeds, nuts and other natural foods, as opposed to the carnivore who kills the animal and eats mostly inner organs, blood, guts, bones and lastly flesh.
Fourth: The perspiration and other forms of excreta thrown off from the bodies of meat eaters is exceedingly offensive, while that from vegetarian eaters is agreeable and less in quantity. Flies and mosquitos torment meat eaters, while vegetarians are comparatively immune. Vegetarians are seldom constipated, while meat eaters are almost universally so. Man secretes alkaline saliva, the carnivore secrets acid saliva.
Fifth: The carnivore stomach is small and round, as opposed to an oblong stomach of man, which has convolutions needed for the breakdown of fruits, grains and sweet tender vegetable foods. Man has an alimentary canal twelve times the length of his body. The carnivore canal is only three times the length of his body. The carnivore colon is smooth and short, which is necessary for the quick evacation of the putrefying flesh fare. The colon of man is long and convoluted for a more thorough digestion of the food from the plant kingdom.
Sixth: The consumption of meat renders the individual more ferocious and disagreeable in manner, less considerate of others, and more inclined to acts of brutality and selfishness, than to acts of kindness. In many cases, it produces the effect of continued irritation, nervousness, and sometimes results directly in insanity.
Seventh: When man attempts to comsume meat he literally poisons himself. Flesh foods begin to putrefy about one-fourth of the way down the intestinal canal, causing uric acid poisoning, ptomaines, chemicals, deadly hormones and the waste products from the animal's metabolism at the time of slaughter. Meat products in the human system over-stimulate the heart, causing it to beat up to 50% higher than average, which leads to high blood pressure.
Eighth: Man takes his liquid through sucking. All carnivores lap liquids with their tongue. Carnivores have large livers to handle the heavy meat consumption. Man's liver is small and not developed to handle a flesh diet. Flesh eating animals secrete ten times the hydrochloric acid into their stomachs, as do the vegetarian eaters. They require it for the breakdown of meat, bone, organs, sinews,

feathers etc. Carnivorous animals eat mostly the inner organs of their prey in a raw state. The vultures, hyenias and other scavengers feast only on the left over muscle meat, after the tiger or lion has finished feasting on the best inner parts. Man falls into the scavenger category by consuming not raw muscle flesh, but aged, bacteria ridden and cooked flesh. Muscle meat is highly deficient in vitamins and minerals, and contains an excessive amount of phosphorus, which if eaten to excess throws off the calcium balance within the body. This phosphorus robs the bones and teeth of its valuable calcium and sets up uric acid crystals throughout the body joints, causing stiffness, pain and disease.

Ninth: Repeated experiments have proven that vegetarians excel over meat eaters in all tests of endurance and strength in both physical and mental labor and live longer lives. You do not need meat for heavy work. Prof. Voit of Munich discovered that, "heat and energy are almost exclusively created by carbohydrates." Always keep in mind, however, that we must obtain a daily balance of natural proteins, carbohydrates, fats, vitamins and liquids. The gorilla, elephant, oxen, horse are tremendously strong, with great endurance, subsisting solely on vegetarian fare.

Tenth: Fruits, vegetables, grains and seeds repair and replenish the cells and tissues, whereas meat overstimulates and tears them down. Flesh food often causes a ravenous appetite, which nothing but more flesh can satisfy. Meat, being an extreme Yang substance, causes an internal craving for extreme Yin substances, i.e., sugar, alcohol, drugs, sodas etc. Extremes in diet cause extreme conditions or chronic diseases, i.e., leukemia, cancer etc.

Eleventh: Meat contains a high proportion of cholesterol (an important causative factor in thrombosis, high blood pressure etc.) with no lecithin (nature's antidote) to balance it. (All vegetable proteins, on the other hand, contain lecithin to naturally counterbalance it).

Meat is an Unnatural Substitute Food

When thinking about vegetarianism especially the total kindmost people quite naturally ask what they can use in place of the various animal-source foods. It should be clearly understood that every one of these animal-source foods is already a substitute food: a perversion of the natural diet that is Ideally suited for the normal human body.

Vegans do, of course, advocate human milk given by a healthy mother direct to her own baby, as the ideal food in early infancy. Cow-milk formula is today finally being widely recognized as an inferior substitute for this. In cases where a mother has been unable to nurse her baby for whatever reason, or to supplement the mother's milk, various nuts, seed, and soya-based milks have been used with success. If we, as adults, bear in mind that milk, eggs, and meat are all in fact mere substitutes for our natural vegan foods, we will not be so concerned with searching for substitutes for substitutes items that look, smell, or taste like the barnyard/slaughterhouse products we are so used to.

There are, of course, many vegetable-source replacements for the various animal products. But these are more in the nature of a dietary crutch to help one through the transition period, rather than a nutritional necessity. We should really learn what our natural foods are, and go on to build our diet up from these. So you want to be a vegetarian? We will help you all we can. But in the final analysis, we can only help you to help yourself. We are not just interested in getting someone off the animal flesh and substituting some over-cooked canned soyabeans. Are you still stuffing up on the junky white flour products? Sugar? White rice, Soda pop and stimulating cola drinks? Coffee? Do you smoke? Drink? Why do you?

But you are convinced. Now you want to know how to go about eating both ethically and healthfully. Generally, the first thing to go is meat. Makes no difference whether it is from a steer or a sheep; that of a pig may be worse for you; that of a chicken or fish is not so harmful from a cholesterol standpoint but Is likely to be worse in the matter of pollution. Ethically speaking, all are slaughter products, though you would have to kill many little fish or birds to equal the amount of meat taken from one larger animal. In any event, out goes the flesh: all of it. Calcium, protein, vitamins, minerals? Well, where do you suppose those animals got theirs? How is it that man uses the great big strong vegetarian animals around the world, for beasts of burden, for meat and milk, yet he thinks he must eat these things from them to obtain protein or some other nutriment? "Consider Mr. Elephant, with huge tusks and teeth and bones: whence come his calcium? Or the ox or the bullock, or the camel: where do they get their protein, with which to build their powerful muscles? How is the horse able to be strong and energetic? They are all total vegetarians. The vegetable kingdom Is, in point of fact,

the only natural first hand source of all the protein on this planet. Not one animal creates protein but by eating proteinous foods; none can synthesize calcium or other elements within the body; every one depends on the vegetable kingdom for the raw materials to restructure into its own particular type of make-up. No two types of animals have the same general protein type. But all vegetarian creatures can obtain their essential ammo acids (the building blocks of all proteins) from the vegetable proteins that are so abundantly and widely distributed in the world of plants.

Even the fang-and-claw predators, such as the dog and cat families, must obtain their protein from plants ultimately, though they take it second hand by eating vegetarian animals; but they pay a price in parasitic diseases and other problems associated with flesh-eating, even as humans do it they become dietary copycats and try to eat like a tiger or jackal. Truly man is the king of beasts, for his brutality exceeds them. Leonardo da Vinci stated, "We live by the death of others. We are burial places. I have since an early age abjured the use of meat, and the time will come when men will look upon the murder of animals as they now look upon the murder of men."

Fig. 6.13. When feasts are spread the doctor rolls his pills.
In fifty dishes lie a hundred ills.

Meat Eating may be Hazardous to your Sex

The addition of chemicals and hormones to meat are causing sex gland problems. Experiments by Dr. F. Pottenger Jr. of Monrovia, California, have proven that the physical make up of men and women is changing. Men are looking and acting like women, and women are looking and acting like men. Hair is growing in abundance on the arms and legs of women. Men are becoming more feminine and weak physically, mentally and emotionally.

Another experiment was conducted in which a few chosen men and women were lined up facing a wall. Next, a number of doctors were invited to distinguish between the male and female from behind. These doctors had a great deal of trouble distinguishing the difference in gender. The men in this experiment had narrow shoulders and wide hips, which is a female characteristic, while the females had wide shoulders and narrow hips, which is a male characteristic. Have you ever seen synthetic female hormones at work? Did you know that a cow given a shot of DES (there are eight other lesser-known brand names) will abort her calf? A rancher years ago, found that he could chemically castrate young bulls with this small dosage. Any knowledgeable veterinarian will tell you that if a rooster is given DES daily eventually he will cease to crow and will begin to cluck like a hen when his tolerance level for female hormones has been breached. This last experiment could be viewed as unisex in the poultry yard as the rooster has been affected both mentally and physically. Roosters and, unfortunately, DES are both easily obtained. The French tests found that rats fed meat coming from steers fattened with the aid of DES were radically affected sexually impotence and sex reverses among male rats and cancer of the breasts and other female organs was produced in the female rats.

The Canadians banned DES as a result of the French tests, but no such luck for us. Is it simply because this nightmare was invented here that we must be the last to awaken from it? Why, after 20 years of flagrant use of synthetic female hormones in the cattle feeding industry do we find the chemical companies frantically pushing the new synthetic masculine hormones? Are the chemical companies (aided by an eye-closed attitude from the FDA) trying to cover up a tragic 20 year experiment with female hormones by forcing the American public to undergo mass hormonal therapy with the new masculine hormones? If so, how will

the new experiment turn out? Why cannot we merely shut off all of these hormones rather than face the long ghastly transition which seems to be in store for us? The excessive consumption of hormon eladen meat products, in addition to a large intake of white sugar products, is one of the main causes of reversed sex roles today. This is certainly something each individual must seriously think about; and evaluate the effect of their dietary life styles and the socioeconomic impact it entails.

Choosing Your Own Diet

The question of whether to eat flesh products or not is strictly an individual matter. It depends on how far one desires to progress on the path to health and well-being. It has been scientifically proven that an excessive consumption of meat can easily lead to arthritis, gout, stomach, colon and bone cancer. We contend that overeating of any food item, either natural or unnatural, can cause a host of physical and mental diseasesfrom colds to cancer.

Certainly, we are not claiming that if one consumes a very moderate and limited amount of meat per week or day, that they will immediately drop dead from doing so. Almost everyone has eaten their share of meat before becoming a vegetarian; and they could not be coerced into giving up meat against their will. Each individual must accomplish this transition when they are physically and mentally ready.

We have researched and observed individuals and cultures worldwide and have discovered many healthy 100 year old plus people in both meat-eating and vegetarian categories. In both cases moderation in diet and personal habits seemed to be the key to their perspective longevity. In presenting this material to the public we are not attempting to be moralistic or dogmatic. Our main purpose here is to present the facts and scientific data as it is revealed to us. We do not personally partake of meat products through our own choosing for the following reasons: health, economics, spiritual, moral, ethical, ecological, aesthetic, scientific and humanitarian. Likewise, this decision should be based upon one's own deep study, contemplation and overall commitment to higher ideals; physically, mentally and spiritually. The reader must make that choice for himself or herself, and be given the freedom and love to do so.

Alternative Vegetarian Protein Foods

The following vegetarian foods are all high in protein, Vitamin B-12, iron, phosphorus etc. They are more nutritionally balanced than meat products, and are a safe, wholesome and healthful alternative to flesh.

Grains	Raw Goat Milk	Peas	Soy milk
Yogurt	Nutritional Yeast	Miso	Buttermilk
Legumes	Seeds (Soaked)	Nuts (Soaked)	Tofu

Many delicious recipes can be made with these foods without worrying about protein deficiencies or meat hormones. Eggs should be used sparingly, or rarely if at all. Use fertile eggs if you must have them.

Vital Statistics on why the Vegetarian Diet is Superior

1. Vegetarian food can feed the world ten times over and be better fed.
2. It is free from all hormones, antibiotics, drugs, chemicals and cancer causing agents.
3. It is free from trichina worms, parasites, food poisoning bacteria and uric acid.
4. It is high in vitamins, minerals, enzymes and other fresh raw food factors.
5. It supplies adequate proteins with complete amino acids for growth and health.
6. It maintains the arteries, internal organs, heart and body in a youthful condition.
7. It does not require the killing of animals for food and is free from animal diseases.
8. It makes one more kind, peaceful, gentle and loving to both animals and humans.
9. It is more economical individually and on a worldwide basis.
10. It gives one more endurance, strength, health and longevity.

Famous Vegetarian Personalities

As you can see from the list below, the vegetarian philosophy and way of life is not a passing fad. Vegetarianism is normal. Meat-eating is abnormal. This was the verdict of these scholarly people. The following is a partial list of the great men and women of history who because of their reverence for life avoided the eating of meat in their diet:

George Bernard Shaw	Lucius Seneca	Count Tolstoy Plato
Mahatma Gandhi	Socrates	Albert Schweitzer
Nietzsche	Leonardo da Vinci	Aristotle
Albert Einstein	Prince Paul	Troubetskoy
Maurice Materlinck	Charles Darwin	Henry David Thoreau
Sir Isaac Newton	Percy Shelley	Horace Greeley
St. Francis of Assisi	William Blake	Ben Franklin
Edward Fitzgerald	Richard Wagner	Bram well Booth
Francois Voltaire	Edward Carpenter	Arthur Shopenhauer
Paganini	Jesus Christ	Krishna
Buddha	Mohammed	Emerson
Pythagoras	Origen	Diogenes
Cicero	Herodotus	Porphyry
Plutarch	Ovid	H. G. Wells
John Wesley	Scott Nearing	Dr. Ann Besant
Lord Montgomery	Lord Dowding	Lady Dowding
Louisa May Alcott	Vinoba Bhave	Sir Stafford Cripps

Nerve Force Principle

Are you nervous, irritable and fidgety? Do you easily lose your temper? Do you entertain thoughts of fear and suspicion? How often do you take headache relieving drugs and medicines? Do you suffer from nervous butterflies, and do you constantly pity yourself? Are you sleeping soundly? Did you know that these lowly moods are the results of a depleted, destroyed and malnourished nervous system? These damaged and half-starved nerves impair digestion, cause headaches, mental anguish, heart disease, impotance, mental illness, nerve disorders and bring on a host of other physical ills. Poor nerve health and constant nerve leakage can destroy friendships and put an end to your lovelife and marriage. No matter how wealthy, influential or successful you are, if your nerves are jangled, starved and weak, you cannot be happy in life.

Nerve Force Principle will help create and build a healthy, strong and powerful nervous system; nerves of steel responding to your every command. Our super fast style of living, constantly rushing and on the go from morning until night, tends to drain and weaken nerve force and nerve energy faster than it can be recharged and energized. Nerve Force can be drained away quickly by these following nerve habits:

1. ***Immoderation:*** Overworking, over eating & over doing anything.
2. ***Poor Posture:*** Slouched sitting posture & bent standing posture.
3. ***Malnutrition:*** These foods are irritants to the nerves: coffee, alcohol, drugs, dope, salt, smoking, white flour foods, white sugar and sugared foods.
4. ***Lack of Proper Exercise:*** No daily exercise program and not getting enough pure outdoor oxygen after meals and throughout the day, results in sluggish nerve flow and poor nerve nourishment due to lack of adequate circulation of the blood to all body parts.
5. ***Insufficient Rest & Sleep:*** Lack of sufficient rest and sleep can result in rapid nerve loss and nervous disorders. No known remedy can rejuvenate a sleep and rest starved body. Proper sleep and rest is one of the quickest ways to restore lost nerve power.
6. ***Lack of Mental Poise:*** This is the result of immoderation, poor nutrition, lack of exercise, rest, and sleep. Emotionally unpoised people have the least nerve power and lead miserable and unhappy lives.

Every act of living uses up or drains away a certain amount of Nerve Force daily. The more Nerve Force we can accumulate within the system, the healthier, stronger, and younger we will remain. People who are constantly ill possess very low nerve force, and they deplete it faster than it can be replenished. To attain Five Level Nerve Health, we must conserve our energy and learn how to accumulate, recharge and rebuild our internal batteries to acquire powerful nerve force vitality.

Take care of your health; you have not right to neglect it, and thus become a burden to yourself, and perhaps to others. Let your food be simple; never eat too much; take exercise enough; be systematic in all things; if unwell, starve yourself until you are well again, and you may throw care to the winds, and physic to the dogs.

Health Rating System

Level One

Degenerative Disease: Cancer, rheumatoid arthritis, parkinson's disease, heart disorders, tuberculosis, multiple sclerosis, musular dystrophy, diabetes, colitis, blood disorders, nephritis, extreme fatigue etc. The individuals in this category have lost their health and vitality, and have very low nerve force energy. They suffer from every known degenerative disease.

The age of a person does not determine a health rating, for an individual can be anywhere from 1 to 90 or more years old. The health rating of a person depends on his daily health habits; if the habits are poor, he will climb no higher than the first level. One can be old at the age of 20, or young and healthy at the age of 100. Time or calendar years is not a prime factor in developing degenerative disease or Super Health. The fact is, that you can develop a a Super Health rating at any age if you persistently follow the teachings in this book.

Many young children born today of unhealthy, alcoholic, drug addicted and junk food eating parents are coming into this world with First Level health or degenerative diseases. Many are lucky to have average health, and very few children or adults are fortunate to be blessed with good health. The Frist Level person, however, can build his health to the Three or Four Level category, but they will have to follow the Five Level Formula very strictly.

Level Two

Poor Health: Asthma, eczema, psoriasis, sciatica, back problems and nerve disorders, hypoglycemia, mental problems, sexual impotence, frigidity, chronic fatigue, chronic visual and hearing problems etc. Second Level people generally have poor health, are constantly fatigued and lack energy. They suffer with chronic conditions such as, kidney, liver and organic problems that have not yet reached the degenerative state. The majority of this group are past the age of fifty, however, an increasing number of younger people have been developing these same chronic disease symptoms and therefore, fall into the Level Two category of poor health. Hospitals report that there are more cases of heart disease below the age of ten than above. This proves the fact that diseases are the result of habits and not chronological age. A poor constitution

and poor health are either inherited from the parents or conditioned by poor eating and living habits early in life. They can, however be improved by following these formulas.

Level Three

Average Health: Poor eyesight and hearing; colds, flu, hay fever and sinus problems. Colds, flu, etc. are vital signs of internal elimination, which indicates that the body still has sufficient nerve force power to eliminate toxins and prevent degenerative conditions, such as arthritis, heart trouble, cancer etc. Suppressing acute (colds etc.) will eventually lead to chronic disease. This is the category of Average Health into which most Americans fall. Their nerve force energy runs from high to low on any given day. Many children are born today in the Third Level Health category, while many years ago they were born with Fifth Level Super Health because of better food and healthier environmental conditions.

Level Four

Good Health: People possess a great deal of energy and good health. They retire evenings only slightly fatigued and arise the following morning full of energy and nerve force, ready for a full day of activity and excitement. Fourth Level individuals possess normal sight, hearing, digestion, elimination and good organic health. Many people over the age of 20 do not possess a Level Four Rating. Their health begins to decline from age 20 to 30. Those possessing the Level Four Rating, over the age of 20, 30 or more are either living and eating properly, or were born of extremely healthy parents into a Fifth Level Health category.

Level Five

Super Health: It is the ultimate reward of those possessing a Fifth Level Rating. The individuals in this elite classification enjoy an abundance of vitality, nerve force and human energy mentally, physically, emotionally and spiritually and they know not what it is to be fatigued or worn out. This Super Health Level people are endowed with the following qualities: hair sheens, eyes sparkle, skin glows, teeth are glossy white, muscles are firm, the posture is perfect and they radiate a wealth of energy, confidence and happiness.

Level Five people retire evenings with a reserve of energy, and arise at the crack of dawn with a zest for living, ready to conquer the world. Their health is far above the norm, suffering neither digestive problems or organic disease, with excellent sight, hearing, sexual magnetism and clear voice. They are self-motivators, and great leaders in their perspective fields; setting high standards for the world to follow. To possess the Level Five Nerve Force Health Rating is a grand accomplishment in itself; and it is a very worthwhile goal for all to follow, for it would be the closest reality in developing Super Bionic men and women, endowed with superior spiritual, mental, emotional and physical health. This is indeed the goal of creation, for we are all born in the likeness and image of the Supreme Creator. It has been said that man was given the power to move mountains and to create miracles. That power is within you, controlled by the Tao within, to be used by you for good and constructive purposes. Like an old shoe that is worn down and needs new leather, so our brain and nerves need living natural food to restore their power.

Six Formulas to increase your Nerve Force

1. Moderation in all the Good Things of Life
2. Super Nutrition
3. Correct and Proper Posture
4. Adequate Daily Exercise
5. Sufficient Rest and Sleep
6. Mental and Emotional Poise

Moderation:

Moderation basically consists of this one key point: Expend no more energy beyond what has been accumulated each day. For example, by not going to extremes we will automatically maintain our reserve energy supply and enjoy excellent health. Overstepping our energy bounds can easily lead to nerve leaks, and consequent failing health. It is similar to saving money; if the bank account is overdrawn, there will be no funds in reserve to live on. Likewise with energy; the more energy one conserves, the more they will accumulate in the body, to be utilized for reserve and emergency purposes.

Powerful Nerve Force can never be built by going to extremes or immoderation in eating, working, studying, exercising, sleeping, reading, sexual indulgence, etc. Super Health will be an impossibility if one continually depletes, drains & destroys their nerve force.

Level One people possess very little Nerve Force, and if they are injured or wounded, they heal very slowly or not at all. Level Four or Five individuals possess an abundance of recuperative power and they heal very quickly. As you accumulate and hoard your energy. Nerve Force will eventually increase until the goal of Super Health is reached.

On the pathway to Super Health, one must learn how to regulate and conserve their own energy supply. You may accomplish this by adhering closely to the Law of Rhythm. The Law of Rhythm teaches one how to balance his life and practice moderation in all things. For example, when you've had enough to eat, your body rhythm alerts you by taking away hunger until more food is required; if we do not sleep or rest when tired or exhausted, we have ignored our body rhythm, and we may collapse from nerve exhaustion. Moderation is the key that unlocks the door to greater Nerve Force.

Super Nutrition:

To build powerful nerve force we need an abundance of essential nutrients in the form of vitamins, minerals, proteins, carbohydrates, trace minerals, enzymes and fats. However, the nerves must not only be fed, they must first be cleansed. A detoxification diet of three to five days or a short fast of a few days will help tremendously in cleansing the cells and tissues of the body for a more perfect and smooth nerve flow. Be sure to follow the cleansing period by eating highly nourishing foods. The following food minerals will rebuild, feed and protect the nerves. They are absolutely necessary in your quest for Super Health.

Calcium	Phosphorus	Manganese
Magnesium iron	Iodine	Sodium
Chlorine		

It must be understood that to build powerful nerve force, one needs not only an abundance of minerals, vitamins and enzymes, but also adequate supply of complete protein and a sufficient amount of carbohydrates and fats.

Correct Posture:

Correct posture is a vitally important factor in restoring our Nerve Force vigor. A slumped back and shoulder position, while sitting or standing is a sure way of cutting off nerve supply from the spinal cord to the entire body.

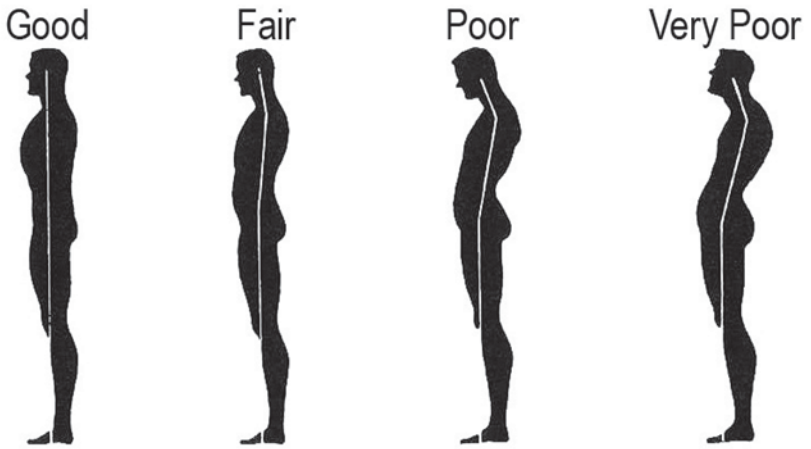

Fig. 6.14. Correct Posture

A bent over, stooped position broadcasts to the world that life is too difficult to cope with; it is the appearance of a coward and makes one actually feel like one. You will never see or hear stooped over individuals singing happy days are here again, because it is contrary to their nature. Improper posture develops spinal curves, the adam's apple; it weakens the internal organs and forces out the pelvic joints, which is a major cause of prolapsed fallen organs. Poor posture can lead to headaches, backaches, tiredness and fatigue. Incorrect posture hinders good breathing, affects the digestion and is a prime cause of constipation.

The road to a perfect posture lies in the daily practice of sitting and standing as upright as we possibly can. Always sit with hips and back well against the back of a chair. While writing in a sitting position, bend from the hips, but do not round the back while doing so; this maintains the lumbar and sacral vertebrae in perfect alignment. Here is an excellent exercise to assist in developing a straight standing posture:

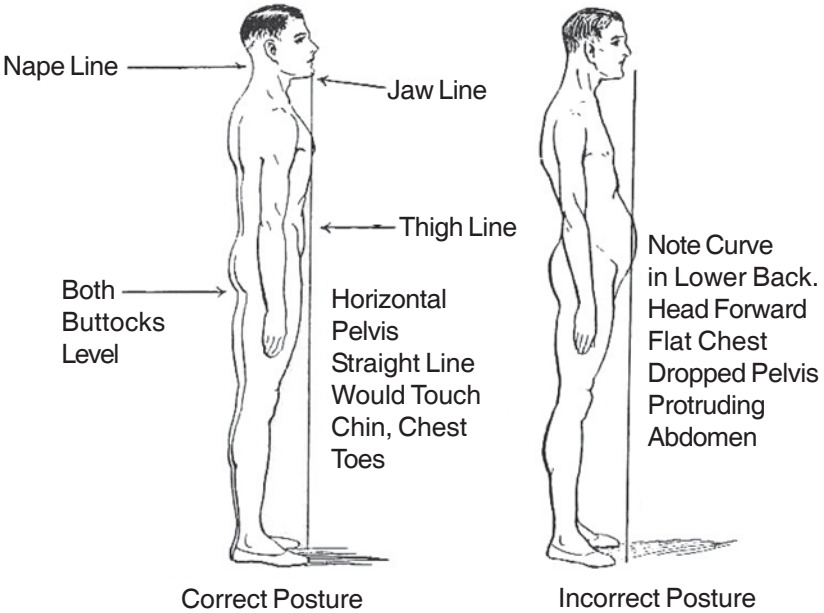

Fig. 6.15. Correct Posture & Incorrect Posture

Lower Back Wall Exercise

Stand against a straight wall with the heels about two inches away from the base of the wall with the buttocks, shoulders and lower back all touching the wall. You should not be able to place a hand between the lower back and the wall. The idea of the exercise is to maintain an upright posture without the lower back curving inward and away from the wall. Move the lower hips inward and flatten them against the wall; this will remove the lower back curve and you should not be able to place your hand between it and the wall. It is this pocket between the wall and the lower back, that must be removed, that will ensure a straight posture.

Strive to relax in this exercise and remain free from strain and tension. The lower back should be flat and in line with the hips, and it should not curve inward in a sway back position. Practice this exercise for a few minutes two or three times a day and strive to maintain this correct posture daily. A perfect posture will allow the internal organs to remain in their proper place. Good posture enables the organs to function normally and the muscles to become firm and strong; you will be able to completely relax and become less fatigued while working. Here is another posture exercise that will help you to gain a perfect upright carriage.

Delsarte Hook

Imagine a fully expanded and suspended ballon. Think of the lungs as a large balloon and the chest as a collapsible aerodome, with the ribs as the rafters. The rafters must be lifted up completely away from the balloon. This is done by standing erect, then placing an imaginary hook where your breast bone is, and a pulley in the ceiling above you; then imagine yourself pulling the rope through the pulley, lifting up that portion of the anatomy (rib cage), which will leave the arms in a loose swing, shoulders relaxed back and down. The entire body will fall in proper alignment. In this correct posture you will be able to breathe easily and naturally. Always remember to keep the shoulders back and down and the chest out. Stand with the knees locked (abdomen and back flat). This is the correct standing posture. If you suffer from back problems consult a chiropractor and he will instruct you on the proper care and exercise of your spine and back.

A proper and correct posture will instill in you an attitude of courage and confidence that will be noticeable by all those around you. Proper posture insures excellent circulation throughout the body, which means greater nerve force, more energy and a higher health rating. An abundance of proper exercise tends towards the building up of an erect, well-propotioned body. The head, chest and shoulders should be held up. A flabby, clumsy, stooped body and a protruding abdomen detract greatly from the beauty and efficiency of the body.

Daily Exercise:

Proper daily exercise is as necessary to life as is food and nutrition. Exercise tones up the internal and external organs and muscles; it helps to circulate the nutrients to the nerves, muscles and vital organs. Exercises that leave one breathless are a great tonic to the body, inspiring us with courage, strength and confidence; it imparts a fresh feeling of energy and nerve power to every cell in our body. There is nothing like daily exercise to lift our spirits and set us on the path to Super Health. An adequate amount of daily exercise together with proper rest and sleep is vitally important in building powerful nerve force and energy. The best type of exercises are those that reach all the joints, spinal area and muscles of the body. The cells and tissues automatically go through a system of contraction and relaxing. When they contract they squeeze out their waste matter; when they relax they absorb their nutrients.

The Standing Spinal Twist and Stretch Stand with both feet on the floor, raise arms over head, lock fingers together, turn palms out, keep knees stiff and stretch forward as far as possible. After bending forward, return back to the erect position with the hands above the head; now bend backwards slowly and feel the muscles relaxing. Repeat the two movements five or six times. Next, with hands interlocked, stretch in a circular motion, bending in every direction from the hips; forward, backward and rotate all the vertebrae in their entire range of motion. Rotate six times each way. These exercises can be performed any time during the day when you need a quick energy boost, or if feeling sluggish.

Fig. 6.16. Standing Spinal Twist and Stretch Stand

Exercise #1: For waist reduction, stomach, liver and kidney stimulation. Swing the body in a complete circle 3 to 5 times in each direction. Inhale in upright position, and exhale slowly and com-pletely while making a wide circle as shown.

The cervical vertebrae is an area of much congestion and interference with blood flow and nerve energy to the eyes, ears and nasal cavities. This exercise will help to remove some of that congestion. Stretch head backward and forward as far as possible. Next, stretch it from side to side, attempting to lay it on each shoulder; then turn head from one side to the other, looking over each shoulder; next rotate the head in a circular motion, clockwise and counterwise six times. Stretch the muscles, then relax them. Repeat each exercise at least six times.

These joint type of exercises should be performed with other body parts as well; for example, one can twist, stretch, flex and rotate the shoulders, wrists, ankles, hips, knees, fingers, arms, etc. We can stimulate nerve and blood circulation to our face by squeezing, stretching and making face contortions; this will keep the face looking young and firm. The hands, feet and toes may be squeezed, rotated and stretched for better circulation. Stretching before arising in the morning is an excellent method of awakening our vital Nerve Force for the day ahead. All of these various circulation exercises are beneficial to all the organs, cells, blood and nerves of the body, building powerful nerve health.

Conserve Nerve Force Energy

Nerve energy and personal magnetism is conserved and accumulated within the body by the practice of controlling body movements and mo-tions. Constant fidgeting, excessive and nervous hand and leg motions while sitting, temper tantrums, constant talking and chattering and irritability must be controlled before we can attain the Level Five Rating.

All of these useless motions cause a serious, leakage of nerve energy away from the body. If this nerve energy were not squandered away in wasted motions and other immoderate habits, we could easily acquire a high degree of personal magnetism and health. It must be understood that our body may accumulate a certain amount of nerve energy daily and if we waste or deplete more than we receive, poor health will result. However, if we cease to squander our nerve energy away with useless and harmful motions, actions and immoderate habits, we will develop health, strength, energy and powerful nerve force.

While walking, relax and make all your movements smooth and easy; refrain from jerky motions and use only the muscles required for the task. It is best to sit down with both feet on the floor and in correct posture, relaxing without unnecessary motions. During the day, when time permits, lie down and relax in a dead still position for a few moments; it may be the refreshing lift you need. Here is an excellent nerve exercise that can help you gain self control and personal magnetism.

Dead Still Paper Exercise:

Take a standing position. Grasp a sheet of typing paper by the lower right hand corner between the thumb and first two fingers; hold it in front of your chest with the elbow away from the body. Next, locate a tiny spot or small point somewhere on a wall and hold the paper so that the upper opposite edge of the paper is in exact line with your eye and the spot on the wall. Control it in this position for fifteen seconds without any kind of shaking.

At first, the paper may uncontrollabley shake; but keep practicing it in spare moments and you will finally succeed in not moving in the slightest degree during the fifteen seconds. While performing this exercise do not cease breathing or eye blinking; just relax and be calm! This Dead Still Paper Exercise helps to control and stop nerve energy leakage and enables one to gain control of their body and mind. It forces the body and mind to concentrate and be still, while conserving and accumulating a supply of nerve force. It may take a few weeks to master this technique, but even-tually nervousness will vanish and relaxation and control follow. You will gain personal magnetism that will be noticed. If we constantly strived to be self-controlled, our vital nerve force energy and health can improve by leaps and bounds.

Sufficient Rest and Sleep:

Sleep and rest are vitally necessary to restore powerful nerve force in the body. It is during sleep that the body repairs itself; resting during the day recuperates the nerve energy lost during the daily activity. For sound sleep, your room should be well ventilated for the complete circulation of air. Fresh night vitalizes the body during sleep and prevents carbon monoxide poisoning from your own exhalation. However, the room temperature should be neither hot or cold.

For proper spinal nerve flow, the bed should be firm and not soft. Old worn out soft mattresses create spinal curvatures and impinge the nerves. Most people require from six to nine hours of sound sleep for the maintenance of health and repair of cells, tissues and nerves. Lack of sufficient rest and sleep is a prime cause of a drawn out haggard look, wrinkles, loss of vitality, poor memory, grouchiness and loss of beauty. Some people try to get by on only a few hours of sleep a night; others in their mad rush for wealth, fame and power, neglect proper rest and sleep. Nervous exhaustion is usually their reward.

It is generally believed that there is little harm in lying down or sleeping after meals, but this idea is entirely false. When you lie down or sleep after eating, the gastric juices do not flow readily. The main objective of sleep is to repair and replenish the nerves and tissues, but if we consume food directly before retiring at night, the body spends its energy on digestion instead of repair. The result will be a lack of vitality, health and strength. Because of poor elimination and repair, it can result in anemia. It is best to eat no later than three or four hours before going to sleep. If hungry at bedtime, a piece of fruit before retiring will do no harm as it is very quickly digested.

No-Exercise Super Beauty Treatment:

This Super Exercise is so simple that you expend absolutely no energy in performing it; all you do is lie down in bed and sleep! Sounds too easy does not it? Here is what you do before retiring to bed: Raise the foot end of your bed about two inches off the floor with a wooden block. Leave the bed in this raised position from now on. What does this simple exercise accomplish? It reverses the downward pull of gravity on facial muscles, skin and internal organs. When the lower part of the body is raised a few incher higher than the upper body while lying down, the blood stream gently courses down to the head stimulating the ductless glands to pour out their rejuvenating and beautifying juices to all parts of the face and body. This head lower sleeping position gives the vital organs an opportunity to fall back into their proper position, allowing them to function at peak effeciency to keep you young and vigorous.

The great eagle who lives to the age of two hundred and fifty years old usually flies with its head lower than its heart. In fact, all

animals, to a certain degree, maintain their head lower than the heart. The ancient wise men knew the secrets of youth and longevity; they practiced yoga exercises daily, and obtained proper nutrition, rest, sleep etc. They slept with the foot end of their bed raised a few inches. After a few days you will become accustomed to this head lower position and begin to see and feel the results in better muscle tone, brighter complexion, smoother internal functions and firmer facial skin. Try this no-exercise health and beauty treatment and see and feel the results for yourself.

Rest and Sleep:

When fatigued and sleepy stop all activity, i.e., reading, watching television, etc. Retire to bed. Relax your muscles starting from the toes and loosening all body parts up to your head, feeling each body part relaxing in turn as you free it from tension. Think of your body as an extremely heavy weight sinking deeper and deeper into the mattress while relinquishing from your mind all thoughts of worry, anxiety and tension. Now fill your mind with beautiful and serene thoughts of love, happiness and peace. Spend a few minutes mentally forgiving everyone, and send these love, happiness and peace thoughts to the far corners of the world. By mentally blessing and forgiving the world, you send out healing energy which re-turns its blessings in health, success and sound sleep. Also, mentally picture yourself attaining your heart's desires and success. These few sleeping secrets will help to give you a peaceful night's rest. The next morning you will feel fit and ready to face the world with courage, confidence and love.

Mental and Emotional Poise:

The wisdom of the ancient sages passed down through the centuries have taught humans that mental poise or peace of mind is one of the greatest assests a person may possess. Freedom from worry is a vitally important factor in cleansing the mind and attaining Mental Poise. Why are people troubled with worry, anxiety and tension? Are your prolems so important that you worry yourself sick over them? Do you worry about a certain problem and then discover that the problem was hardly a problem at all? It was just our own lower mind entertaining thoughts of fear, failure and trouble. The sages tell us not to worry about the future; not to overly concern ourselves about employment, marriage, possessions, or

losses. Do not trouble yourself about the future, but live the best you can in the present; this will insure our future success and happiness while giving us mental and emotional poise in life. Why does worry halt success and happiness? Worrying about the future or over trivial matters prevents us from accomplishing our best in the present; it stops us from doing the things we could and should do but fail to do, because of our incessant worry about the things we cannot do.

Dwelling on future desires will not bring happiness, but only anxiety and mental torment. Many people constantly dwell on some future desire, thinking that when they achieve their desires and goals, happiness will be guaranteed. This is generally not the case. For example, many people believe that they would be happy and contented as a president or executive of an organization. How many of these executives do you know are happy with their tremendous responsibilities? Happiness is a result of the right attitude of mind. If we have a negative attitude toward our present life and activities we will be unhappy; if we have a positive attitude toward life we will remain enthusiastic and enjoy our successes and achievements.

When we let go of the idea that we must have something to be happy, we automatically let go of envy, jealousy, revenge, hate, pride and in its place will appear true happiness and mental poise. We then become Master of our emotions. Perfect Mental Poise will open the inner door to our higher mind. This greater power will guide you to peace, health, harmony, happiness, success, a good marriage and true friends. The Supreme Architect knows your every need. To have faith is the highest high you may ever achieve. A mind brimming with faith and love is a tonic to the nerves and entire system. Perfect Mental Poise will regenerate your body which is a major step toward Super Health.

These Six Super Health Steps can lead you to happiness and success far beyond your highest expectations. As you gain in Super-Health and Nerve Force, you will become poised, emotionally balanced and in complete control of your life. You will have developed complete mastery in the drama and circumstances of your earthly existence.

Yin and Yang of Nutrition

It has long been understood that there is a link between the food that we eat and our health. The ancient Taoists developed a sophisticated understanding of health and wellness, including the use of herbs and food for rebalancing health.

These days we have a far more complex situation. This is due to several factors:

1. We have developed extremely sophisticated methods for the manufacture of food. There are huge numbers of highly processed and refined foods available to us that the ancient Taoists would never have dreamed of.
2. We travel more than our early ancestors. We expose ourselves to a wider variety of climates, seasons & food types.
3. Our farming systems have developed a huge range of chemicals, factory farming and modified food types that also affect our nutrition.
4. Our bodies are exposed to high levels of chemicals, pollutants, Pharmaceuticals and stress that our early ancestors would have had no experience of.

Thus we have to make adaptations in order to apply ancient principles to our modern situation. In the struggle to find the nutrition solution, the health world is not overwhelmed with theories and suggested diets. One year we are told to eat only raw food; the next year the high-protein diet is in. How on earth do we know which one to follow to restore our health to balance? What we need to look for is flexible Nutritional therapies that respond to each individual's needs.

Extremism versus Balance

In the modern world we have a habit of extremism. We are always trying to find the simple answer to solve all of our problems. The early Taoist models of thought show us that life does not operate in this way. Rather than trying to attain a single goal, life can be seen as a flow of energy. It is up to us to find harmony and balance within that flow.

For example, in modern thinking we may be tempted to try to aim to reach a perfect goal: perfect weight, perfect health, ideal levels of energy. However, if we stop and observe Nature we see that this is not reality, in reality, we flow between being tired to

sleeping to wakefulness to high energy every day cycle. We are in constant flux. The result of trying to force our bodies towards an unnatural goal is that we push ourselves farther away from balance and harmony, A lot of modern illnesses that we see are a result of this disharmony.

Thus to improve our health, we need to start listening to our bodies, seeing where the imbalances lie and finding the ways to restore our own bodies into balance. Rather than just applying the same dietary therapy to all people, we need to find ways of observing and measuring Yin and Yang imbalances and then use dietary therapy to restore health. A lot of the current nutritional theories are based upon a movement in a single direction towards one extreme. For example:

Alkaline Theory: suggests that we all need to eat more alkaline-forming foods.
Raw Food Theory: suggests that we all need to eat only raw uncooked foods.
High Protein Diet: suggests that we all need to eat a high-protein, low-carb diet.
Vegetarianism: suggests that we all need to eliminate animal products from the diet.

These examples all work extremely well for some people, and books will be full of personal case histories to support the theory. The problem is, there is also a portion of the population for whom the diet does not work at all, and may even cause further illness. For example, cold and thin people may become very weak from the raw food diet; others will put on weight from eating a high protein diet. Oriental Nutritional Theory emphasizes the importance of choosing the right treatment for the right person. A complex system of diagnostics was developed, and is still in use today by many practitioners of Chinese Medicine.

One of the gifts of modern medicine has been its sophisticated diagnostic procedures. Therefore, we can use either system to enable us to choose the correct dietary therapy for each individual. Either way, we must choose a treatment based upon each unique person. To choose a diet without first diagnosing the person would be like taking a medicine without seeing what the illness was.

Food Energetics

The ancient systems of nutritional healing regarded different foods as having different energetic qualities. They did not have access to reductionist science, and thus did not know about micro-nutrients (minerals, vitamins etc). However, they did observe the different qualities of foods and the effects that they have on the people eating them.

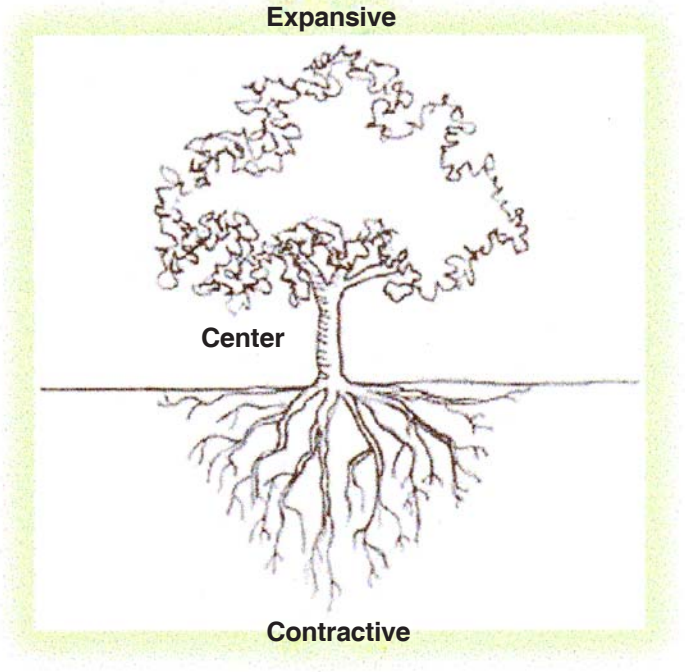

Fig. 6.5. Energetics of a Tree

Just as Yin and Yang can be observed in a person's energy, it can also be seen in a food, In food energetics, some foods are considered balancing: they do not have an extreme effect on energy, but maintain the center. Other foods have an expanding quality: they expand our Chi and make us feel lighter. Other foods have a contracting quality: they contract out Chi, making us feel more grounded. We can understand these qualities better by considering a tree. A tree has a stable centre: its trunk, it also has branches that reach upwards to Heaven and expand their energy out. In addition there are roots that sink deep into the Earth and contract the energy down.

We can use this model and apply it to different foods to understand their energetic qualities. If we look at food groups we find that the most expansive are the simple carbohydrates, which release their sugars very fast and thus rapidly lift our energy. Complex carbohydrates also give us energy, but released more slowly. Thus they are expansive, but less so. Fats and Proteins have a contractive effect. They build our body cells and have a grounding effect. Physiologically these food groups slow down the release of sugars in the diet, and thus help to regulate our blood-sugar levels. The denser the food, the more contractive it is. Thus meat is more contractive than beans and tofu.

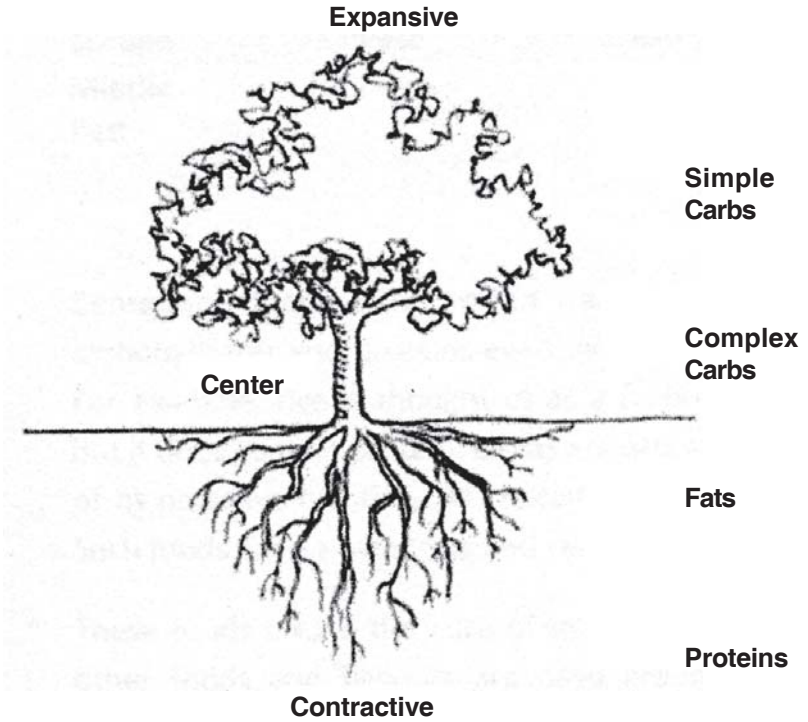

Fig. 6.6. Tree Energetics of Simple Carbs Complex Carbs Fats Proteins

Some food are centering.those are the foods that are neither too sugary/refined nor too dense a protein/fat. These usually form the center of most ancient time-tested diets. Most diets from around the world will have both a protein and carbohydrate as the center. Commonly this will be a whole grain plus a bean.

Here are some examples:

County	***Protein***		***Carbohydrate***
India	Dahl	+	Rice
Mexico	Beans	+	Corn
Japan	Tofu	+	Rice
United Kingdom	Dairy	+	Potato
Europe	Cheese	+	Bread (wheat)
Middle East	Hummus	+	Bread

Centering foods are often a mixture of carbohydrates and proteins even within each food. For example, rice is thought of as a carbohydrate, but it does contain protein. Beans are often thought of as proteins, but they do contain carbohydrates. Such foods have a balancing and centering effect.

These foods create the core of the diet, and then other foods and flavours are used around these staples. Core foods help to maintain our sense of center. This is a very important principle in Taoism and Oriental Therapy.

Center

Our center is about staying balanced, if we only have extremes in our life, then we become pushed and pulled about by circumstances. For example, if we eat only expansive foods we may feel high, but ungrounded. The opposite is if we eat an excess of contractive foods then we may feel grounded, but depressed and heavy.

If we choose one extreme, we will soon crave the other. Thus we become a victim to our own feelings and cravings. We are constantly swinging from one extreme to the other, the energetic equivalent of manic-depressive. This is reflected in the habits of yo-yo dieting and detox-retox in which people swing from a diet or detox program into their old bad habits as a response.

In Oriental Therapy we seek to build a strong center. In Taoist Chi Kung (energy exercises) we put awareness to the Tan Tien area below the navel. This is the place where we try to store our Chi and build awareness. When we have more awareness in the center, then we are not so affected by outer circumstances. This gives us a gentle strength and stability. Building a strong center is an important aim. However, we also need to address any imbalances that occur and restore them, especially when we first start our practice.

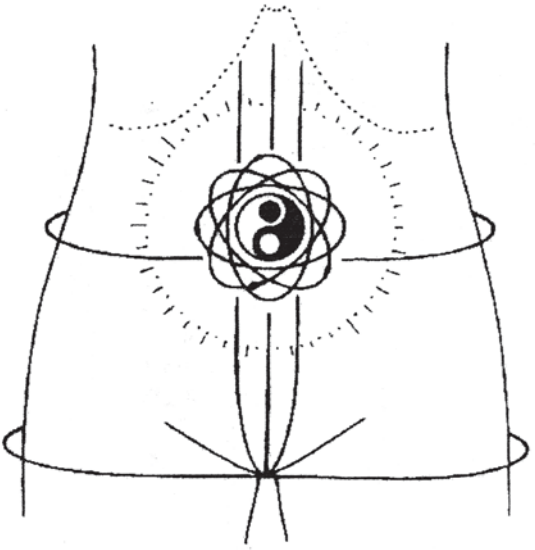

Fig. 6.7. Center Force

Another time we may encounter strong imbalances is when we experience great change in our life, such as moving to a new country, travelling, changes in life circumstances and so on. The stronger our center is, the easier we will make such transitions. But we may also need to attend to adjusting our balance.

Balancing Yin and Yang

We have seen earlier how we can develop an overly Yin or Yang situation of imbalance. A simple way to apply Oriental Dietary therapy is to eat a little more of the foods that will rebalance us, until we feel harmonized again.

Overly Yin = Too Lethargic, Fatigued, Cold, Slow Pulse etc.

Overly Yang = Too Stressed, Busy, Hot, Fast Pulse etc.

Those who are too Yin can assist their body with the addition of a few more contractive foods. These will build strength and stamina. Thus a few more protein-rich foods and healthy fats (cold-pressed oils, nuts, seeds etc) can be added to the diet.

Those who are too Yang can assist their body by eating a few more expansive foods. Eating more vegetables will have a cooling and cleansing effect on the body, clearing excess heat. Whole grains will assist in the body's energy management.

If one becomes rebalanced from the diet, it may be wise to eat a more centering diet. We all have constitutional tendencies that mean that we will always benefit from eating more proteins or more carbohydrates (depending on our tendencies). Try to listen to your body as you adapt your diet to hear how it responds to different foods.

Situation	***Signs***	***Foods to Eat***
Overly Yin:	Cold, Weak, Tired, Too Moist	More Proteins/Fasts
Overly Yang:	Hot, Stressed, Hyper, Too Dry, Sleepless	More Carbs

This is about rebalancing: we do not want to move to another extreme. Therefore, just try gently altering your diet, rather than making sudden and dramatic changes. The body likes smoothness rather than suddenness.

Weight Problems

Weight problems are an increasing concern is modern healthcare. In 2005, the World Health Organization (WHO) estimated that 400 million adults were obese. In 1998 the US spent $78.5 billion on medical costs attributable to obesity. It appears that our modern consumerist society has a cost.

In Oriental Nutrition, not all overweight problems are seen as the same; and thus they are treated differently. Once again, we can use the Yin/Yang model to gain a clearer insight into differences. The overly Yang type of obesity is the result of a pattern of excess. Excess food, excess alcohol, rich and fatty foods all lead to an overweight pattern that is overly Yang. It can be identified by having characteristics such as: The body fat is solid and turgid; when pressed it has little give and feels full. There may be signs of heat. The person may be loud and impatient, or show other Yang characteristics.

On the other hand, the overly Yin type of obesity is the result of a pattern of deficiency. Deficiency of quality foods and nutrients, lack of exercise, yo-yo If these symptoms exist, then it can be wise to pay attention to the water content or moistness of the food that we eat. We can tell a lot about the moistening effects of a food juts by common sense and observation. If a food looks and tastes dry, then it usually is! if it appears moist, then it is.

Therefore foods that will dry up an overly Yin and excessively moist situation include lightly-cooked grains, foods without sauces, fish and meat. Foods that can moisturize an overly Yang and excessively dry situation include soups, sauces, fruits and water-rich vegetables.

Moistening	***Drying***
Soups, Sauces, Salads, Fruits	Dry Grains, Meat, Fish, Root Vegetables

Those who are excessively dry may choose to make a special moistening drink. Soaked psyllium husk or fiaxseeds (linseeds) soaked in water over night make a very moistening drink, or make a smoothie from yoghurt with seeds and fruit added.

Those with moistness and water retention may benefit from the addition of some diuretic herbal teas, such as roselle and nettle tea.

Flavors

In Oriental Therapy, different flavors have different energetic effects on the body. The sweet flavor has the most uplifting effect, whereas the salty flavor has a grounding effect. Blander-flavored foods have a more neutral effect.

Grounding	***Drying***
Salty	Sweet

Therefore, someone who has an overly Yin imbalance may want to reduce their intake of sweet foods. Someone with an overly Yang imbalance may want to reduce salty foods. The other flavors, bitter, sour and pungent, have varying effects on the body and are used to make fine tuned adjustments.

Colors

Color is energy; different colors are different wavelengths of energies. Thus the colors of our foods have an energetic effect on our being when we consume them. Brighter and lighter colors have an uplifting energetic effect. Darker and duller colors have a grounding effect. Therefore someone with an overly Yin imbalance may choose darker foods, such as meat, fish and beans. Someone with an overly Yang dieting and other inconsistent eating patterns all contribute to an overly Yin pattern, It may be accompanied by too much water in the body (water is Yin), leading to fluid retention and dampness, it can be identified by certain characteristics, including: The body fat is soft, flaccid and flabby; when pressed it gives way and feels empty. There may be signs of coldness. The person may be withdrawn and depressed, or shows other Yin characteristics.

Treatment

The overly Yang weight problem requires a treatment protocol that reduces excess Yang, and adds a little Yin. For example:

Fasting works well with this type of pattern as it quickly removes excess Yang.
The person can eat more cleansing and light foods: raw food, steamed vegetables, fruit and juices.
Protein and fat should be avoided.
Toxins must be eliminated: caffeine, tobacco, alcohol and drugs must be cut out, at least for the cleansing period.
Peace, quiet and tranquility need to be sought: this person will benefit enormously from walking alone in nature and taking up meditation. It is hard for them to lose weight without some level of relaxation.
Yang sports could be reduced, such as gym workouts. Yin exercise should be chosen such as yoga and Chi Kung.

Treatment for an overly Yin weight problem will be entirely different, as the whole situation is different. They need to make sure they are reducing excess Yin and adding a little Yang.

For example:

Sugars and fast-releasing carbohydrates should be eliminated, including fruit juices.
Fasting is unlikely to help with the weight problem, though it may reduce toxins and water. This type has to be careful because if they go without food this enhances the yo-yo dieting phenomenon, and their body's metabolism becomes even weaker.
Eating regularly is more important for these types. This helps to balance the blood sugar levels.
Increasing the levels of quality proteins and healthy fats can also help this type to lose weight. This means lean meats/fish and cold-pressed oils such as olive and flaxseed oil.
This person needs to add a little Yang exercise, such as running, dancing, jumping on a bouncer etc.
A little green tea can assist in stimulation of stagnant Chi and assist with weight loss.

These types are not gender dependent. However, a larger proportion of men will suffer from the overly Yang type of weight problem, whereas women are more prone to overly Yin weight problems. If you are trying to deal with a weight problem, try to assess where you are imbalanced in your life (e.g. not enough exercise, too much alcohol consumption) and seek balance.

Underweight

Being underweight is also an issue for some people. Even though our beauty magazines often exalt extreme thinness, it is often a sign of weakness and deficiency, and an underweight situation may not support vibrant health. Once again, we can distinguish between the overly Yang and Overly Yin underweight problems.

An overly Yang underweight problem would be a person who is overly active, nervous and jittery. They may be always moving or fidgeting and find it difficult to rest or be still. In order to gain weight, this type of person will need to eat more complex carbohydrates. They also have to rest and learn some form of relaxation. Deep breathing can be tremendously helpful. They need to avoid stimulants such as caffeine at all costs.

The overly Yin underweight situation is one in which a person is thin, quiet and fragile. They are likely to get cold to the core and feel as if they have weak bones. They may find it very difficult to socialize and to express themselves. To begin to gain weight and restore health, this person may need to eat quality proteins and fats (such as olive oil and flaxseed oil). It is important in the type of person that they eat very nourishing and high-quality foods, with an emphasis on warm and cooked foods.

It always takes longer to restore a deficiency pattern. An overly Yin underweight person is very deficient. Therefore, they will need to take a lot of time and dedication to rebalance their health.

Chapter 7

Effects of Yin/Yang with Acid/Alkaline

Acid and Alkaline pH

The principle of Yin and Yang is the basis of the entire universe. It is the principle of everything in creation. It brings about the transformation to parenthood, it is the root and source of life and death especially with acid and alkaline balance.

In order to grasp the significance of acid and alkaline, one must first understand the meaning of pH. pH is a measure of hydrogen ion concentration in blood, urine and liquids, and is used as as symbol to indicate acidity and alkalinity. A pH of 7 is considered neutral, the measure of pure water. pH 7 is .0000001 gram atom of hydrogen ion per litre. The acid end of the pH scale is from 1 to 7, and 7 to 14 is the alkaline end.

Normal healthy skin can have a pH reading of from 4.5 to 6, or acid. Blood pH is slightly alkaline, from 7.3 to 7.8 on the scale and strives to maintain that reading at all times. Urine should range from 6.5 to 7.0 on the over-all average to insure good health. Urine measurements can fluctuate depending on the type of foods eaten beforehand. However, the urine should be slightly acid or neutral. Saliva is slightly alkaline. The stomach must maintain between 4.0 to 5.0 acidity to digest and breakdown protein foods. If the stomach loses its acidity somewhat, and tends towards neutrality or alkalinity, protein and calcium digestion, assimilation and absorption are lowered or decreased, resulting in indigestion and poor health. Mouth saliva, in good health, should be 7.1 pH.

It is not necessary to continually check your urine pH. It is more important to heed your inner voice or feelings as to what natural foods your body requires at any given time. Balance will be maintained by applying the universal yin/yang and acid/alkaline principles; the body will balance itself, and the urine analysis will be normal. Your health will improve tremendously by eating mainly locally grown natural foods in season. The Acid/Alkaline balance affects every phase of life; from diet, to thought, to weather, to sleep, and physical activity. Everything we do in life either creates acidity or alkalinity. To attain good health it is necessary to thoroughly understand the causes of acidity and alkalinity and apply this knowledge to our life.

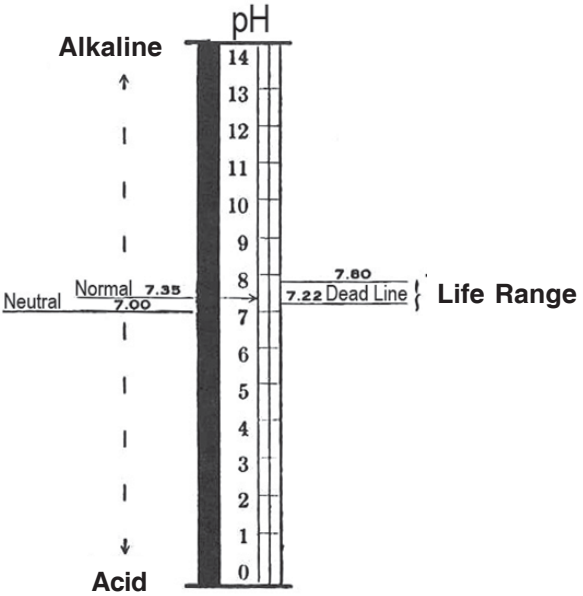

Fig. 7.1. Alkalinity of the Blood

Acid-Alkaline Balance

As the Alkalinity Scale shows, the normal condition of the blood must be maintained slightly alkaline, between 7.22 to 7.35. Neutral blood would result in immediate death. A slightly alkaline blood and lymph is a requirement for health and long life. An acid condition of the body and its organs does not mean that the blood has become acid. Acidosis is not acid blood. If the blood were actually acid the body would immediately die from positive acidosis. Cells cannot live in an acid medium.

The body always maintains an alkaline reserve in order to neutralize acid elements. These alkaline reserves are called buffer salts, which are sodium, potassium, calcium and magnesium. These buffer salts maintain a balance between the alkalinity and acidity of the blood, which is normally 80% alkali and 20% acid. An excess of either acid or alkaline in the body is quickly neutralized by the buffer salts. An exclusive acid forming hi-protein or junk food diet, plus a lack of fresh fruit and vegetables will cause a deficiency of these salts, causing a drain on the alkaline reserves and irritation in the cells and tissues of the body, resulting in disease.

Overeating of alkaline foods will also cause a drain on the buffer salts in the cells to neutralize the over-alkalinity. The body expends much energy in overcoming or neutralizing either an over-alkaline or over-acid dietary. The key is to consume both acid-forming and alkaline-forming foods in balance daily, adjusted to seasonal weather conditions. The solvent watery type foods are (alkaline). The heavier type foods are (acid). These are alkaline foods: all watery type fruits, juices, and vegetables (non-starchy). The acid type foods are: all proteins, starches, seeds, nuts, cheeses, fats.

Acid/Alkaline Body Fluids

Body Fluid	***pH of Fluid***
Gastric Juice	1.2 - 3.0
Vaginal Fluid	3.5 - 4.5
Urine	4.6 - 8.0
Saliva	6.35 - 6.85
Blood	7.35 - 7.45
Semen	7.2 - 7.6
Cerebrospinal Fluid	7.4
Pancreatic Juice	7.1 - 8.2
Bile	7.6 - 8.6

Yin/Yang vs Acid/Alkaline Foods

Yin and Yang is generally believed to be the same as Acid and Alkaline; in actual application it is not. From a broad universal perspective, Yin is Alkaline and Yang is Acid; from the food standpoint, acid-forming elements are made up of sulphur, phosphorus and chlorine; alkaline-forming elements are made up of sodium, potassium, calcium, magnesium and iron. The Yin and Yang scale is more variable than the Acid-Alkaline scale, i.e., potassium and sodium are alkaline forming elements, yet potassium is Yin and sodium is Yang. For example, meat, grains, nuts and sugars are all considered acid-forming, yet meat and grains fall into the Yang Acid category, while nuts and sugar are classified as Yin/Acid. Simply stated; Yin and Yang is on a deeper, more universal scale than Acid and Alkaline.

Yin foods are also high in fat, such as nuts, dairy foods and avocados. Yin/Acid forming foods, like milk, sugar, nuts are high in phosphorus and sulphur, but are low in sodium. Yang/Acid forming foods, for example, rice, rye, eggs, fish are all high in phosphorus, sulphur and sodium.

Yin/Alkaline forming foods, for example, oranges, pineapples, tomatoes, are high in potassium, calcium and iron, but are low in phosphorus and sulphur. Yang/Alkaline forming foods in the form of cherries, berries, garlic, burdock root, ginseng, are high in sodium, but low in phosphorus and sulphur. Acid and alkaline are subject more exclusively to chemistry and food. Yin and Yang encompass all phenomena physical (food, biochemistry, etc.), mental, emotional and spiritual.

Acid Forming Elements	***Alkaline Forming Elements***
Sulphur	Sodium
Phosphorus	Potassium
Chlorine	Calcium
Magnesium	Iron

Acid/Alkaline is also on a sliding relative scale, i.e.,meat is highly acid, but it contains some alkaline elements, while apples are mostly alkaline, but contain a small amount of acid elements. Meat is on the Yang end of the scale, and fruit is on the Yin side.

Pure sugar and fats are always Yin. Pure starch and protein are always Yang. Pure sugar, fat starch, and protein are always Acid. Dairy fat is Yin and Acid. Watery fruits and vegetables are always Yin and Alkaline. Raw unsalted seeds and nuts are always Yin and Acid. Cooked grains, beans, eggs, meat, fish and chicken are always Yang and Acid. Yin foods cause expansion of the organs. Yang foods cause contraction of the organs. Consume only the proper quantity of protein, starches, fats and natural sugars that the body requires daily; realize that an excess or a deficiency of these foods can cause disease. Consume mostly whole grains, seeds, and beans from the Yang protein & starch category.

Seasonal Eating Percentages

Season	**Alkaline Foods**	**Acid Foods**
Summer	65%	35%
Fall	50%	50%
Winter	25%	75%
Spring	50%	50%
Very Hot	80%	20%
Very Cold	20%	80%

Note: These are only general percentages. Learn to listen to your inner physiological needs; eventually you will know the right amount, or whether you are eating too much or too little of the Acid or Alkaline foods. Study and learn how to balance foods.

Alkaline Foods Above 7.5PH +

Alkaline Forming Elements: *Sodium, Potassium, Calcium, Magnesium, Iron*

Yang Fruit	***Yang Vegetables***
Apple, Apricot, Berries,Cherry, Grape, Melons, Nectarine, Peach, Pear, Pomegranate	Burdock, Garlic, Dandelion, Ginseng, Onion, Leek, Radish, Watercress, Parsley, Endive,Alfalfa/Kelp-Dulse

Yang Foods: High in Sodium, Low in Potassium.
Yang/Alkaline Foods: High in Sodium, Low in Phorphorus and Sulphur

Yang Fruit	***Yang Vegetables***
Citrus Fruit, Guava, Mango, Papaya, Persimmon, Pineapple,Tomato, Plum	Celery, Cucumber, Cabbage, Sprouts, Sweet Pepper, Green Vegetables Spinach, Asparagus, Lettuce

Yin Foods: High in Potassium; Low in Sodium.
Yin/Alkaline Foods: High in Potassium, Calcium; Low in Phosphorus/Sulphur

Acid Foods Below 7.0 PH +

Acid Forming Elements: *Sulphur, Phosphorus and Chlorine*

Yin Protein	***Yin Fat***	***Yin Starch***
Avocado	Dairy Cow (N)	Banana (Unripe), Carob,
Dairy Cow (N)	Butter (N)	Potato (N), Prunes,
Nuts	Fatty Meat*	Dates, Raisins (N)
Seeds	Avocado, Nuts	Figs, Honey

Regular cheese, milk, nuts and avocado contain both fats and proteins.

Yin Foods: High in Potassium; Low in Sodium.
Yin/Acid Foods: High in Phosphorus and Sulphur; Low in Sodium.

Yang Protein	***Yang Starch***
Tofu and Miso	Carrot (N)
Goat Cheese (N)	Beet (N)
Beans	Beet (N)
Corn Goat Milk (N)	Rice
Olives	Barley
Rye	Oats
Nutritional Yeast	Millet
Buckwheat	Pumpkin (N)
Eggs*, Fish*,	Wheat
Fowl*, Meat*	Peas

Yang Foods: High in Sodium; low in potassium.
Yang/Acid Foods: High in sodium, phosphorus and sulphur.
(N) Neutral or 7.0 PH
* If you can stop these foods, do so.
+ PH taken from urine analysis.

Fig. 7.2. Food Chart Classification with Yin/Yang Designation

Eat Foods in Season

In arranging daily menus seasonal weather changes must be taken into account, especially if one lives in the northern or seasonal climates. Why is this so important? Because, as we men-tioned, cold weather is alkaline upon the body fluids, therefore, the body requires more acid foods to balance itself correctly.

During cold winter months consume more protein, natural starches and fats, and less alkaline foods to maintain internal balance. Use more raw food in summer and more cooked food in winter. Fall and Spring require generally 50% alkaline foods and 50% acid foods. In tropical zones or during summer in the north, 65% alkaline foods can be consumed, while acid food requirements can be lowered to 35%. If the temperature soars over 90 degrees use more seasonal fruits and vegetables, and less grains, beans and cooked food. By eating in this manner heat and cold will be more comfortable, mentally and physically. Hot weather reacts acid upon the body fluids. Vacationers in Mexico and other tropical zones generally blame their diarrhea and stomach upsets on the water. Eating rich, spicy acid foods, cold drinks and ice cream, creates extreme acidosis, digestive disorders and loose bowels.

Consuming excessive alkaline foods in cold weather will cause over-alkalinity within the body; (cold hands and feet, low blood pressure, diarrhea etc.). Excessive acid foods in hot weather will cause over acidity. Living and eating according to the universal principles of Yin and Yang, and Acid and Alkaline should be an enjoyable pleasure and experience for your creative imagination. It is a living, dynamic philosophy a guide, lighting our way to superior health and a well-balanced life style. These life principles should never become a strict, inflexible and austere ideology ruining all joy, happiness and pleasure in life.

Meat eaters and exclusive grain and cooked food eaters have an acid/yang urine pH from 5.0 to 6.0, indicating that the internal organs are working hard to maintain slight alkalinity in the blood. To overcome low pH in the system, consume a little more raw food, (fruits and vegetables in season). Many raw fooders, fruitarians and vegetarians usually have a high (7.3 to 8.0) urine pH, which is considered alkaline and yin. This can result in poor protein/calcium absorption and indigestion. High alkalinity in the stomach reduces its hydrochloric acid content causing the above

problems. Balance must be maintained with additional cooked grains, legumes and vegetables. Purchase Nitrazine pH paper to check your urine and saliva readings occasionally.

Above 7.50 PH is an alkaline condition, which is taken from urine analysis. Below 6.5 are in an over-acid condition from urine analysis. Both of these conditions overtax the body causing it to become tired and weak. The body organs are always working to maintain the blood slightly alkaline, 7.22 to 7.35. Over acidity and over alkalinity will eventually break down the organs (disease) because of the immense strain upon them to maintain the blood in proper balance.

Yin/Yang and Acid/Alkaline Conditions

The type of food we eat places us in a definite category. These different categories are as follows: Yin/Alkaline, Yang/Acid, Yin/Acid, Acid/Alkaline balance in a Yin condition, Yin/Yang balance in an Acid condition, and lastly, Acid/Alkaline and Yin/Yang balance. Let us take a look at these different groups.

Yin/Alkaline Condition Above 7.5pH

A Yin-Alkaline condition of mind and body is caused by eating an excess of Yin/Alkaline foods, such as citrus fruits, tropical fruits, grapes, green vegetables, sprouts, onions, tomatoes and any other food that gives a pH reading of the urine more than 7.5. In the non-food category, all drugs, marijuana, alcohol, and soft drinks are Yin (expansive). If one consumes excessive amounts of Alkaline/Yin foods and not enough Acid/Yang foods, the urine pH will rise above 7.5 to 8.0 or more (Urine Scale Test). In this condition the system is deficient in protein, fats, sulfur, chlorine, grains and legumes.

Yin/Alkaline diets are excessively high in potassium. Potassium is an expansive (Yin) or centrifugal element. It expands cells, tissues and organs. If indulged in to excess, this diet can cause kidney expansion and weakness, resulting in over-urination and loss of sex and glandular hormones (testosterone). The kidneys are directly tied in with the entire glandular and reproductive systems. Weak kidneys and adrenals can diminish or stop the sex drive. In this condition the urine turns light in color, like water, with a 7.5 to 8.0 pH reading. The kidneys lose their contractile or yang power and become loose, unable to synthesize protein and filter out waste products.

Excessive consumption of raw vegetables, especially lettuce, carrots and carrot juice will cause liver congestion and yellow/orange or muddy colored skin, (caucasions only) so prevalent in many raw fooders or vegetarians. The liver eliminates bile through the bile ducts, through the intestines and out with the stools. If the liver is sluggish, from improper foods or constipation, the bile will stagnate and flow into the blood, into the system and out to the skin as a carrot complexion.

An overworked or diseased liver has long ago been associated with a mental condition called melancholia. Melan refers to the skin, and dark bile reaches the skin from biliousness, and causes mental depression & melancholy, or a negative mental condition.

As a result of a Yin/Alkaline condition a person tends to suffer with low blood pressure, (expanded arteries and blood vessels) poor circulation, cold hands and feet, anemia, low blood sugar, diarrhea, asthma, impotence, Yin arthritis, mental and physical laziness, nervousness, schizophrenia, poor memory and loss of concentration.

Mentally, this condition causes fear, worry, anxiety, self-pity, irritability, criticalness and self-righteousness. Yin/Alkaline people are sus-picious, with their nerves on edge, and are therefore easily intimidated on the defensive, mentally and verbally. They attempt to make others perfect, instead of extending freedom to all. Usually unhappy themselves, they force their ideas or advice on others. Remember: These are extreme nutritionally affected psychological behavior patterns. There are variations of this type.

Yin/Alkaline people lose the ability to center (contract-Yang) their mind to a specific goal. With brain cells Yin and expanded, (confused thinking) they are unable to go within (one pointedness) to find peace and contentment.

Dietary Recommendations: A Yin/Alkaline diet is deficient in sulphur, phosphorus, cholrine acid forming minerals; beans, protein, B-complex, whole grains, sea vegetables etc. This deficiency many times leads to cravings and binging on Yang/Acid forming junk food, such as pizza, flesh foods, restaurant food etc. Or due to lack of B-vitamins and protein, (which maintain normal blood sugar levels) an excess of ice cream, cheese and other sugared foods are eaten. Diet lacks grains, beans, miso, cooked vegetables, sea vegetables; too much raw food in winter; not enough grains, beans etc. Diet lacks the pungent and salty taste according to the Five Elements.

Yang/Acid Condition Below 6.5pH

A Yang/Acid condition of mind and body is caused by consuming an excess of Yang/Acid foods such as: all meats, eggs, salt, fish, grains, nuts, fats, cheese, etc., and all other foods that gives one a urine pH reading of 6.5 or less.

Yang/Acid diets are excessively high in sodium. Sodium is a contractive (Yang) element. It contracts or restricts organs, tissues and cells. This type of diet causes kidney contraction or restric-tion, resulting in scanty urination, dark yellow or brownish and foamy urine.

Healthy urine is straw colored or of a light beer consistency. Dark urine indicates over-worked kidneys. The kidneys eventually shut down operation and the end result is Bright's disease. Diseased kidneys are unable to synthesize protein and fail to filter out normal body wastes and environmental toxins.

A Yang toxic liver backs up bile into the blood, making it dark or black, causing biliousness, mental depression and melancholia.

A person in a Yang/Acid condition exhibits aggressive energy-force. They have high blood pressure, ulcers, heart disorders, kidney disease, gout, bone disease, cancer etc. In physical diagnosis, their face and ears are reddish, veins in nose and cheeks, yellow eye whites, hot moist hands and feet, excessive sweating, farsightedness etc. This is an extreme Yang/Acid condition.

If the urine pH drops to 5.5 and below, the kidneys, liver, bladder, lungs, skin and other organs must operate under a heavy load to attempt to expel the excess acid toxins from the system, and to preserve and maintain the blood in its normal 7.5 pH a slightly alkaline condition. When the internal organs malfunction from overwork (overeating, toxins) disease is inevitable; if the blood pH falls to positive acidity, even slightly, death is certain.

The Yang/Acid person exhibits the following physical and mental traits: excessive sexual desire (irritated sex glands), menstrual disorders, hot temper, impatience, arrogance, possessiveness, dominance, hold grudges, exclusiveness, demand immediate attention, and in the extreme, dictatorial.

Mentally, these people are self-centered, egotistical and overbearing in manner and attitude. Unlike the Yin spaced out person, the Yang person is more centered in his concentration and mental activity. Their brain cells are more con-tracted (Yang and centered thinking) to a specific goal. They are not generally fearful or worrisome, like their Yin counterpart.

Dietary Recommendations: This diet is deficient in alkaline minerals: potassium, calcium, magnesium and iron. Also lacks raw foods, fruits, vegetables, seeds, grains, legumes, sea vegetables etc. Yang/Acid people crave many foods and substances, such as beer, wine, alcohol, coffee, mari-juana, tropical foods, potatoes, juices and all sugared foods all Yin and Alkaline, except for potatoes and sugar, which are Yin and Acid. This diet lacks seasonal fruit and vegetables eaten daily in moderation; too much meat, cooked foods and fats, especially in summer. According to the Five Element Taste Theory, this diet is too high in the salty, pungent and sweet taste, and sometimes deficient in the bitter and sour taste. Bitter: almonds, raw vegetables. Sour: apples, plums, yogurt, etc.

Yin/Acid Condition Below 6.5pH

A Yin/Acid condition is caused by consuming chiefly Yin (expansive) and Acid forming foods. For example, milk, cheese and ice cream are Yin because of their high fat (expansive) content, and Acid due to their Acid forming qualities, lowering body and urine pH below 6.5. All sugared foods, such as pies, cakes, donuts, soft drinks, candy etc., are Yin/Acid due to their high sugar and white flour content. All sugar is Yin (expansive), and all white flour products are Acid forming.

People falling in this category usually consume an excessive amount of devitalized junk food. Their urine pH is well below 6.5, and the blood and body is generally deficient in vitamins, minerals, trace elements, enzymes and quality protein. Yin/Acid individuals suffer from every known disease: Arthritis, diabetes, hypoglycemia, gout, obesity, kidney and liver disorders, lung and blood diseases, skin and sexual diseases, fatigue and all types of cancer.

Mentally, this condition produces weak willed individuals, lack of concentration and drive, low self-esteem; usually followers, allowing others to use them; do not think clearly for themselves; do not stand up for their personal rights; allowing others to think for them; duped by commercials and slick advertising, believing without questioning, what product to purchase or what alleged pain killers to use.

Acid/Alkaline in Yin Condition Neutral 7.0 pH

A Yin condition while maintaining an Acid/ Alkaline balance results from consuming an excess of Yin foods in both the Acid/ Alkaline categories, while at the same time eating the correct balance of Acid and Alkaline.

For example, this individual generally eats a large amount of tropical fruit: tomatoes, sprouts, cucumbers, raw greens, fruit and vegetable juices, which are all Yin and Alkaline; all high fat cheeses, milk, avocados, seeds, nuts, oils high in fat (Yin) and Acid forming; bananas, dates, figs, raisins, all dried fruit high in sugar (Yin) and Acid forming; and potatoes, yams, eggplant (Yin) and also Acid forming.

These people generally suffer with cold hands and feet, falling hair, skin disorders, colds, flus, fatigue, nervousness, low blood sugar (hypoglycemia), sexual impotence or frigidity.

Mentally, they tend to be docile, fearful, lack success drive, and express little faith; usually peaceful, but lazy. Recommendations: Diet too high in Potassium (Yin) element; deficient in Sodium (Yang) element; excessive tropical fruits and juices. Balancing the diet: Consume fruit in season and climate only more raw fruit and vegetables in summer, less in winter. Use more cooked grains, legumes, miso, sea vegetables and soups. Lacks sour, salty and pungent taste.

Yin/Yang in Acid Urine pH 6.5 or Below

An Acid condition while in Yin/Yang balance is caused by eating an excess of acid foods, while eating the right balance of Yin and Yang foods. This person generally eats a large amount of the following foods: All grains (rice, wheat, oats, etc., millet, beans, fish, cooked vegetables and soups, burdock, ginseng and beans; little or no raw food).

These people generally suffer physically with lung problems, occasional fevers, yang liver congestion, anemia and some skin disorders; usually underweight and at the extreme, emaciated. Body becomes too Acid. Mentally, they are sometimes arrogant, generally desire leadership and are too demanding. Recommendations: This diet is usually deficient in alkaline elements, such as potassium, iron and calcium. This deficiency sometimes leads to a craving for beer, coffee etc. If the diet is too strict, there may be occasional hinging on extreme Yin/Alkaline fruits, ice cream or other

sweet foods or juices. This diet lacks seasonal fruit eaten daily in moderation; too little raw food, especially in summer. According to the Five Element Theory, this dietary condition lacks two of the five tastes sweet and sour. All five tastes must be balanced daily more or less according to the seasons, climate and region where one resides.

Yin/Yang-Acid/Alkaline Neutral Urine 7.0 pH

To acquire Yin/Yang and Acid-Alkaline balance, one should eat a sufficient amount of Acid and Alkaline foods, while balancing the Yin and Yang factors. In order to attain the correct balance, eat mostly the foods grown in your own climate.

In the south, some Yin fruits and vegetables can be eaten daily in moderation, balanced equally with natural Yang grains, legumes, sea vegetables, soups, land vegetables, etc. One who wishes to achieve balance in the North should not use tropical food to any great extent. In the main, their diet should consist of: grains, soups, legumes, seeds and nuts soaked or germinated, apples, pears, berries, burdock, low fat raw milk dairy (sparingly), miso, sea vegetables etc. Consume foods locally grown. Those who constantly have a neutral 6.5 to 7.2 pH urine reading are in Acid/Alkaline balance. A Yin/Yang balance is achieved by adhering closely to the above Yin and Yang balancing diet. This Yin/Yang diet will automatically place one in the proper Acid/Alkaline balance.

The healthiest and longest lived people throughout the world in Tibet, Russian mountains, China, Northern India, Iran, Turkey, etc. do not consume extreme Yin or Yang diets: neither all raw foods or all cooked foods. They eat a variety of natural foods (grains, legumes, vegetables, fruits, seeds, nuts, fermented and cultured dairy products, and meat very sparingly or not at all) grown in their own climate and environment eaten in season.

Those who attain this proper balance, obtain sufficient exercise and sleep, and live in accordance with the natural laws of life will achieve super health physically, mentally, emotionally and spiritually. These are the true compassionate teachers and leaders of the world; their judgment is always sound and useful.

True Teacher - The Tao

Humankind has always longed for a leader/teacher to ease his suffering. But what they really needs is enlightenment from within themselves. A healthy man or woman wants no followers and would never follow another person blindly. They are the true individualists, not carbon copies of another's mind. The true teachers of the world inspire others to great heights. Students learn to think for themselves under a true leader and teacher, and are taught to be responsible for their own actions. They inspire and always extend others the freedom to live their own life without interference. They are positive, happy, magnetic, calm, patient, understanding, loving, kind, and full of pep and energy, with a clear, sharp mind.

Balancing Body, Mind & Blood Chemistry

According to ancient Chinese Taoist health teachings written in "The Yellow Emperor's Classic of Internal Medicine" as the Five Elements and Transformation principle, there is no one perfect or ideal food to subsist on fruits and vegetables alone are too Yin/Alkaline; grains, beans and meat alone are too Yang/Acid. Extreme diets whether Yin or Yang are unbalanced diets, creating imbalances in mind and body chemistry.

A Yin/Alkaline diet can be used effectively as an eliminative or cleansing for a short period of time when necessary. All cleansing diets, fasting, juice diets, sprout/raw food diets can help tremendously to eliminate internal (Yang/Acid) toxins, poisons, overcome Yang constipation, Yang liver disorders, Yang kidney trouble etc., and balance body chemistry. They should be undertaken for this purpose only, and not as a regular dietary program.

The same dietary principal holds true for one who has become too Yin and Alkaline, from eating excessively of fruit, juices, sprouts, vegetables, liquids and all raw foods. One can create a balance in the system by discontinuing all raw foods for a few days or weeks, and consuming exclusively only grain-based products, legumes, cooked vegetables, miso, soups, sea vegetables, etc. These are natural Yang/Acid foods, which will help to bring an extreme Yin/Alkaline system back to balance. After internal balance has been achieved, one can then end this exclusive Yang/Acid diet and return to a properly balanced diet as stated in this chapter and in the following Food Chart.

Extreme Yin Foods:

High Sugar & Fat, White Sugar & Ice Cream, Fructose & Glucose, Margarine & Lard, Dope & Chemicals, Pop & Cold Drinks, Grapes, Cakes, Pies & Jams, Coffee & Alcohol, Baking Yeast & Spices, Chocolate & Candy

Natural Yin/Acid Foods:

Honey & Maple Syrup, Carob & Molasses, Dried Seeds & Nuts, Dried Fruit, Oils & Butter, Avocado & Mushrooms, Potatoes & Nut Butters, Milk & Cheese, Over-Eating

Yin/Alkaline Foods:

Tomatoes & Oranges, Grapefruit & Pineapple, Fresh Figs & Dates, All Juices, Tropical Fruits, Melons & Bananas, Eggplant

Balanced Food Category:

Yin/Alkaline Foods:

Fruits: Apples, Pears, Plums, All Berries, Cherries, Apricots, Pomegranate, Blueberry, Strawberry, Blackberry, Grapes.

Vegetables: Cabbage, Romain lettuce, Green pepper, Sprouts, Alfalfa, Squash, Carrot, Garlic, Onion, Celery, Leeks, Radishes, Sea Vegetables, Broccoli, Dandelion, Kale, Bib Lettuce,Artichokes, Brussels Sprouts, Cauliflower Okra, Swiss Chard, Cucumber, Endive Parsley, Endive Parsley, Mustard Greens, Watercress, Sorrel, Beet Tops, Turnip Greens, Turnip, Spinach, Tomatoes.

Yang/Acid Foods:

Seed/Nuts Soaked: Pumpkin, Sunflower, Sesame, Almonds, Walnuts, Pecans, Brazil.

Grains: Rice, Rye, Wheat, Corn, Buckwheat, Oats, Millet, Barley.

Beans & Peas: Lima, Pinto, Kidney, Aduki, Butter, Black & Tofu.

Dairy: Low Fat Yogurt, Buttermilk, Skim & Goat Milk (Sparingly).

Food Supplements:

Yin/Alkaline: Chlorophyll Liquid, Alfalfa Tablets, Spirulina, Garlic Pills.

Yang/Alkaline: Kelp, Dulse

Yin/Acid: Nutritional Yeast (Eat 90% or More of the Foods in this Balanced Food Section for Optimum Health)

Extreme Yang Foods (High Starch and Protein):

Yang/Acid: Meat, Fish, Fowl, Eggs, White Flour, Brunt Food, Skim Milk Cheese, High Salt Cheese and Cigarettes.

Yang/Alkaline*: Salt, Ginseng, Burdock, Miso and Tamari.

(*Note: Consume Yang/Alkaline foods in cold weather; and very sparingly in warm or hot climates).

Fig. 7.3. Yin/Yang and Acid/Alkaline Food Classification

Effects of Various Diets on Mind and Body

Grains, Legumes, Vegetables, Fruits, Sea Greens, Seeds, Nuts (Soaked) (More Raw Food in Hot Weather-More Cooked Food in Cold Weather): More healthful; physically and mentally balanced temperament. Generally free from illness and disease. Intuition, creativity nature well balanced and more developed.

Grains, Beans, Cooked Vegetables: Tendency to underweight or emaciation. This diet lacks raw food and sufficient potassium; may also lack protein and alkaline vitamins and minerals. Insufficient raw foods during hot weather may cause fevers, Yang temperaments and contracted organs; anemia present; arrogance.

Exclusive Raw Fruit, Vegetable, Juice and Nut Diet: Tendency toward possessiveness, nerve disorders, over sensitive, sentimental and emotional; critical temperament. Disease symptoms: Expanded (Yin) kidneys, intestines, bladder and colon; excessive urination, lung and respiratory weakness; weak digestion and sexual organs, glands and hormones.

Alcohol, Spices, Stimulants and Drugs: Emotional instability and insecurity; heart and blood pressure weakness; expanded kidneys and skin diseases. Disorders in the sex glands and hormones; excessive sexual desire; falling hair on front and sides of head. Poor creativity and confusion in the mental realm.

Meat, Fish, Salt and Eggs: Tendency to be more aggressive, stubborn and determined. More practical, mechanical and materially minded. Fast and sharp thinking mind and senses. Disease symptoms: Constricted (Yang) heart, high blood pressure, circulatory problems, Yang kidneys, liver and gastrointestinal tract (pain in these areas). Constricted constipation, cancerous growths and tumors; farsightedness; loss of hair on top and back of head.

Sugar Products, Honey, Dried Fruits, All Sweets: Mental instability and delusion, schizoid tendencies, nervous disposition, overweight, hypoglycemia, diabetes, skin disorders; expanded (Yin) digestive systems and disorders; weak kidneys and bladder; sexual weakness; liver and pancreatic disorders.

Dairy Foods (Cheese, Milk, Ice Cream): More docile, mentally dull and unresponsive; painful joints and lower back area. Disease symptoms: mucus condition, colds, flu, lung disorders, skin diseases, cysts, tumors, heart and circulation problems; liver, gallbladder, and spleen congestion and sexual difficulties; prone to cancer and growths. Anemia and fatigue are generally present.

A true, lasting and stable physical and mental healing, however must take place after the cleansing period on a well-balanced Yin/Yang and Acid/Alkaline diet. A well balanced diet is a definite requirement afterwards in order to strengthen and build cellular structures, increase normal hormone production, impart muscle tone, form and reconstruct blood and hemoglobin.

Exclusive fruitarian, juicearian or sproutarian diets, beyond a certain point of cleansing, generally fail to produce healthy results in balancing the body physically, chemically and mentally. Blood, bone and muscle are built by 16 mineral elements, several vitamin elements, plus the proper amount of protein, natural complex carbohydrates and fats. A balanced body chemistry is a prerequisite or necessary factor for internal healing and health maintenance.

Extreme Diets cause Imbalances

Raw fooders too often over-cleanse the body to a deficiency point, which leads directly to serious health disorders and emaciation. For example, an emaciated, bony physique is not Nature's plan for vibrant manhood and womanhood. Disorders of this type are contrary to natural law. Powerful magnetic nerve force and energy cannot be built on a diet of fruits, sprouts or cleansing diets alone. One has only to observe an emaciated, bony dog, cat or horse and see that it is not pleasant to look at; its grace, beauty and normal form is gone. The same principle holds true for men and women; they should possess a well proportioned physique, according to their height and bone structure with firm, well-formed and elastic muscles, which look pleasing to the eye.

An extreme raw food diet will create a hinging syndrome, which pulls one to consume large quantities of straight junk food or Yang or Acid victuals, such as grains, bread, potatoes, nuts, health food cakes and pies etc. In balance, these Yang/Acid foods are beneficial in moderation; however, the raw fooders believe that these natural Yang/Acid foods are poisons or mucous forming in the body, and therefore avoid them like the plague. They are constantly pulled towards these heavier Yang foods like a magnet to a bar of steel. Their conscious lower mind or will tells them to eat more and more Yin foods, while the subconscious mind constantly seeks equilibrium, and creates an insatiable craving to overeat Yang/Acid foods. Humans are an intimate part of nature's finer forces; it is the natural law or urge within humans that strives for eternal balance within the body; and it will not be denied by a scheming conscious lower mind.

This same principle of binging can be applied to any strict dieting program: for example, a strict grain and bean diet, which is too Yang and Acid will create an internal subconscious and physical craving (physiological need) or binging syndrome in which one consumes large quantities of Yin foods fruit, juices, vegetables, or Yin junk food, such as beer, coffee, ice cream or sweets.

Extreme Yin or Yang diets are much too rigid and create imbalances in body chemistry. Each causes its own kind of physical and mental disharmony. A person on a strict Yin diet almost always binges on Yang foods. A Yang (diet) person binges on Yin food. According to the cycles of Yin and Yang; Yin, in the extreme turns to Yang, and Yang in the extreme turns or transforms into Yin. If one denies Yin, they will crave Yin; if one denies Yang, they will crave Yang. We are pulled toward what we need, if we deny it in our diet or elsewhere. Raw fooders (Yin) become underweight or emaciated (contraction, Yang). Cooked grain, bean or meat eaters (Yang) are also (Yang, contracted).

A healthy and nutritionally balanced person has no need to fly from one extreme to another; they eat only according to their inner physiological needs and requirements, and select foods from a wide variety of nature's bounty. When out of physical and dietetic balance or half-starved, the lower conscious mind sends a message to the subconscious mind for a more adequate and balanced diet. Always remember: The inner physiological voice or subconscious mind can never be denied without ill-effects. The lower mind or will can make or break you; it can be used to help you develop superior health or turn you into a dietetic cripple, mental and physical wreck or health hypochrondriac. The choice is yours.

The body cell is bi-polar; it's nucleus is positive (Yang); the cytoplasm is negative (Yin). The cytoplasm is alkaline, which is surrounded by the nucleus, acid. For a proper balance the cells need an 80/20 ratio, that is, 80% alkaline and 20% acid. This is of vital importance and is essential for that spark of animation or electric potential between the nucleus and cytoplasm. If an excess of acid foods are eaten, the alkalinity of the cell is reduced. If an excess of alkaline foods are eaten the acidity (nucleus) of the cell is reduced. An excess or deficiency of either acid or alkaline elements in the diet will result in a loss of that vital spark which is so necessary to maintain vibrant health.

Although one can Imitate the diet by observing the techniques of others, this is not enough. There are many people who, even after several years of observing what they consider to be the (ultimate) diet, are still unable to make themselves healthy and happy. Because they have not yet understood the principle behind the diet, without comprehension of which the technique is dangerous. For example, if a person living in a hot climate were to maintain a diet consisting of about 75% grains, 15% cooked vegetables, 5% beans, seaweeds and pressed salad, that person would eventually become very sick (too yang). But such a diet would be a good approximation for the average person living in a cold climate (depending on such variables as age, activity, previous eating habits, and other variables). In short, the clearer one's understanding of the Unique Principle, the better able one is to follow the (correct) diet successfully.

The two most fundamental ways to establish health, freedom and happiness in our life are One: (Yin) by improvement of our thinking ability toward the highest judgment (awareness of Absolute Truth), and Two: (Yang) by dietary discipline in accord with the Unique Principle (Yin and Yang). But actually, these two ways are one, for without using our judgment, how can we eat correctly? And without eating correctly, how can we become aware of Truth? A clear mind cannot exist in a disturbed body.

Sodium and Potassium Balance

The Yin/Yang balance is achieved by regulating the Potassium and Sodium intake. Generally, the ratio is *2* ½ Potassium to 1 Sodium in the human organism. The formed elements of blood contain twenty times as much Potassium as Sodium. This is the main reason why strict grain eaters become underweight, lose muscle form and tone; they lack sufficient potassium, which fills out the muscle tissue and imparts beauty. A 7 to 1 Potassium to Sodium ratio, as advocated by some is much too low for health maintenance. A healthy person does not deny the body what it requires.

To achieve a proper Yin/Yang and Acid/Alkaline balance, it is best to consume food grown in one's own local environment, which includes a daily quota of raw fruits and vegatables, cooked grains, legumes etc. Then, listen to the inner physiological voice, whether to eat Yin or Yang. Our inner body intelligence knows what kind and how much food we require to maintain nutritional balance.

You are What You Eat

You are what you eat is an old axion as true today as it ever was. Food does make or break one's mind, health or character. If one is skeptical of this statement, they are urged to experiment on themselves by eating certain Yin or Yang foods exclusively for several weeks or months, and observe the change or reversal in their temperament, character, and overall health and well-being. Only then will they personally know that we are exactly what we eat, digest, assimilate, absorb, and nothing can change that fact. We can control our health and life by becoming master of our habits. It is an extraordinary blindness to live without investigating what we are. A sound brain is not found in an unsound body; nor do we find a sound body nourished by an impure blood stream.

Balancing the Life Cycle Triangle

Everything in life affects the Yin/Yang and Acid/Alkaline balance. Activity, such as exercise, work, study, etc., creates acidity (Yang), while rest, sleep, creates alkalinity (Yin) within the body. Cold weather is Yin/Alkaline upon the body, while hot weather is Yang/Acid upon the body. Anger, hate and jealousy create Yang and Acidity; peace, love, harmony in thoughts and actions and enthusiasm create a natural body balance. Positive thoughts are Yang; negative thoughts are Yin.

Exercise creates acidity within the body. Vigorous exercise, where there is a breakdown of muscular tissue, as in barbell training, distance running, swimming, etc., will cause much lactic acid to be generated in the system. In this case, the athlete will require more calories from complex carbohydrates (grains, legumes) to replace the broken down tissues. However, Yin/Alkaline foods must also be consumed to balance the acidity of the exercise and to replace and renew electrolytes within the cells and tissues. This is not to say that one must overeat; on the contrary, the demands made upon the athlete's body will automatically require that he eat enough to sustain his endurance, stamina, strength and health. A non-exerciser cannot possibly utilize his food as efficietly as an exerciser, due to slower blood circulation, poor stomach tone and weak assimilation of food.

Only you can judge how much activity or rest you require, and also how to balance your diet properly. You must listen to your inner conscience (voice) to know when, what and how much to eat, sleep, work, exercise, etc. Be moderate in all your activities.

The Life Cycle Triangle is the Law of Rhythm in dynamic action. By understanding the universal law of rhythm, one may achieve superior health and harmony.

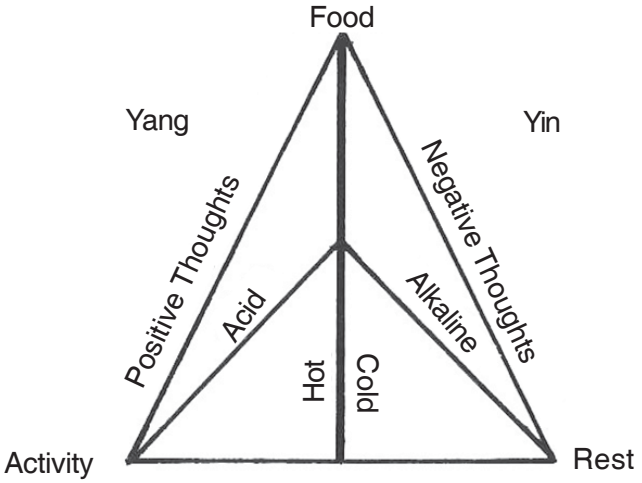

Fig. 7.4. Life Cycle Triangle

Feminine and Masculine

Yin and Yang can also be viewed in terms of our feminine and masculine qualities. It is a common misconception that only women should have feminine qualities and only men should possess masculine qualities. Yin/Yang theory is a theory of relativities, not absolutes. All of us are whole as we are, and thus we have our Yin aspects and our Yang aspects. These aspects include the following:

Feminine	***Masculine***
Intuition	Logic
Receptive	Creative
Passive	Active
Internal	External
Subconscious	Personality

We all possess all abilities and are complete in our self. However, when we are with another person, we may be relatively feminine (Yin) or masculine (Yang) compared to them (regardless of gender). Often (but not always) a woman is relatively Yin compared to a man, but she still possess Yang qualities within herself.

These individual differences are what give us our individuality and do not need to be fixed or changed. It is only when the harmony within our self becomes unbalanced that we may need to take remedial action. For example, a person with a lot of feminine qualities may be always cooler than their more masculine and partner who has a warmer body temperature. This does not need to be viewed as a problem as it is simply individual differences.

However, if a person suddenly feels that they are much colder than they used to be, and begins to suffer discomfort from it, then there may have been a change in their own internal balance that needs to be addressed.

In terms of remedial action, we can see that proteins and fats enhance our masculine or Yang qualities; whereas carbohydrates enhance our feminine or Yin qualities. We often think of meat as being a masculine food, and we think of sweet foods as being a favourite of women. If the Yin/Yang imbalance starts to cause health and wellbeing imbalances, then we may need to use the opposite food to bring ourselves back into balance. Five Element Dietary Therapy is a delicate art of listening to the body & responding accordingly.

Yin and Yang Dietary Guidelines

The balance between Carbohydrates and Proteins/ Fats is the most broad way to balance Yin and Yang. However, there are many different aspects of diet that can assist in this, including:

Cooking Methods
Thermal Properties of Foods
Water Content of Foods
Flavors
Colors
Parts of Plants Eaten

In Five Element Dietary Therapy, these factors all have a subtle influence on the energetics of our food. Paying attention to them can enhance the effectiveness of our dietary therapy.

Cooking Methods:
Raw foods and lightly-cooked foods have a more cleansing and cooling effect on the body. Thus they can be used to treat an overly Yang situation, especially where there is heat and toxicity. The longer a food is cooked, the more warming and nourishing it becomes. Therefore, these cooking methods can be used to treat an overly Yin situation, especially where there is coldness and weakness.

Nourishing	***Cleansing***
Grilled	Raw
Baked	Steamed
Pressure Cooked	Stir-Fried

Thermal Properties of Foods:
The ancient Taoists discovered that each food has its own thermal property, regardless of its actual temperature. These can be chosen specifically to regulate internal temperature imbalances. Some examples include:

Warming	***Cooling***
Ginger, oats, chestnut, sesame seeds, sweet potato, garlic, kale, date, cinnamon.	Lettuce, cucumber, celery, cabbage, tofu, wheat, yoghurt, peppermint.

This can be taken as additional information and used if there is a specific temperature imbalance.

Water Content of Foods:
One of the features of overly Yin is to have an excess of water, such as fluid retention, dampness and phlegm. A feature of the overly Yang situation is to be too dry, such as dry skin, dry hair, dry nails and dry lungs imbalance may choose lighter foods such as fruits and salad vegetables.

Parts of Plants Eaten:
Yin and Yang are relative terms, and thus they can be applied to any whole unit. Therefore, we can find Yin and Yang aspects within one vegetable. Some parts of the plant will have a more expansive effect, others more contractive, and some centering.

Just as we saw with the tree example, the roots of a vegetable will have a more grounding and contracting effect. The shoots and stalks have a more neutral effect. Leaves and flowers have the most expansive and uplifting effect.

Expansive

Centering

Contractive

Fig. 7.5. Parts of Plant Eaten

Eating all parts of a vegetable will have a balanced and whole effect, or we can choose specific parts for their specific qualities.

Yin/Yang Guidelines:

Therefore there are many different aspects of the food we eat that we can attend to when we are trying to regain balance. The relative amounts of carbohydrates versus proteins and fats is the most powerful factor, but the others can be used to rebalance on a more subtle level.

To Treat Overly Yin		***To Treat Overly Yang***	
Quality	***Effect***	***Quality***	***Effect***
Protein/Fats	Slow-Release Energy	Carbohydrates	Fast-Release Energy
Long Cooking	Nourish	Light Cooking	Cleanse
Warming	Warms	Cooling	Cools
Low Water-Content	Dries	High Water-Conten	Moistens
Salty	Grounding	Sweet	Uplifting
Dark colour	Grounding	Light colour	Uplifting
Roots	Grounding	Leaves	Uplifting

No Extremes

Five Element Therapy always warns us about the dangers of extremes, if we choose an extreme diet we will always pull ourselves off-center, and building a strong center is so important for health and happiness. One of the rules of Yin/Yang theory is that an extreme will always turn into its opposite. Remember the example of the workaholic who suddenly collapses with exhaustion? This rule applies also to dietary therapy.

Thus the overly Yin person may benefit from the addition of a few extra proteins and quality fats. However, if they were to embrace a diet exclusively of these foods, they may in fact end up feeling too heavy and even more lethargic! Sometimes excessive consumption of meat is not calming and grounding, but actually creates aggression. This is an example of an extreme having the reverse effect.

Similarly the overly Yang person will benefit from a few more carbs in the diet. For example, a few salads and steamed veggies will cool and calm them immensely. However, if they were to go overboard on fruit juices and sweet foods their blood sugar would rise up excessively, causing too extreme an energy rise. It is thought wiser to take one's time and add a few foods into the diet for rebalancing. Once again the golden rule of the center appears: if we are eating some centering foods, plus the rebalancing items, then we will have a more successful result in the long-term.

We have become a very mind-dominated society in the modern world. This can lead to the situation in which we try to rule the body with the mind. However, a healthy relationship in one in which listening and acting are equal therefore we must listen to the body and then act. This will improve the relationship between mind and body. Controlling the body with the mind can lead to the development of an eating disorder and can bring us a long way from feeling whole.

Taoist practices always aim to harmonize the different aspects of the self, indeed, this is another way to balance Yin and Yang: the body is Yin relative to the mind (yin= material, Yang = immaterial), and so to harmonize the two is healing in itself.

Eating Habits versus Making Changes

Our eating behaviors are directly correlated with our psychological patterns. Eating is tremendously tied in with our emotional being; it is far more than meeting our physiological requirements. Humans are the only animal that has taken the act of eating beyond the practical level. Therefore, to look only at the micronutrients in our food is to overlook a major aspect.

Think about the emotional aspect of eating: we celebrate occasions with elaborate feasts, when we fall in love we exchange gifts of food (chocolates especially!) and we take our beloved out for dinner. As well as expressing joy with food, we can then use food to try to recreate that sense of happiness when are no longer feeling it; hence the concept of comfort eating (one extreme being bulimia nervosa). Think of the woman who has just ended her relationship munching her way through a big box of cookies.

Other people are used to receiving attention through pain, it is not uncommon for victims of abuse to develop eating behaviours through which they punish themselves with food. They may try to starve themselves (anorexia nervosa) or to eat very plain foods or extremely strict diets. This is a way of reinforcing the belief that they are guilty and must be punished.

This emotional link with food operates on even a more subtle level, and we receive comfort or pain on a highly subconscious level all of the time. It is easy for us to develop eating patterns and habits that reinforce our psychological blocks, and this will create cravings for foods that do not serve us.

Intuition vs. Addiction:

We often talk about the body's wisdom and natural intuitive ability. We may assume that our body's desires are always for what will heal us or for what we need. How do we know whether we are craving a food that we are addicted to, or that our body is asking for what it needs? We can see how cravings arise when we look at the more addictive foods. If we have been drinking coffee for many years then our body adapts its energy system, as it expects a cup of coffee every morning. This leads to a craving for coffee, which will maintain our current equilibrium, though it will not bring us into vibrant health. This is a craving for what our body expects rather than a desire for what our body needs.

When we develop an eating habit, for any food, then we may crave it as our body's way of maintaining routine. The further a food is from the center the more addictive it can become. Centering foods are the least addictive.

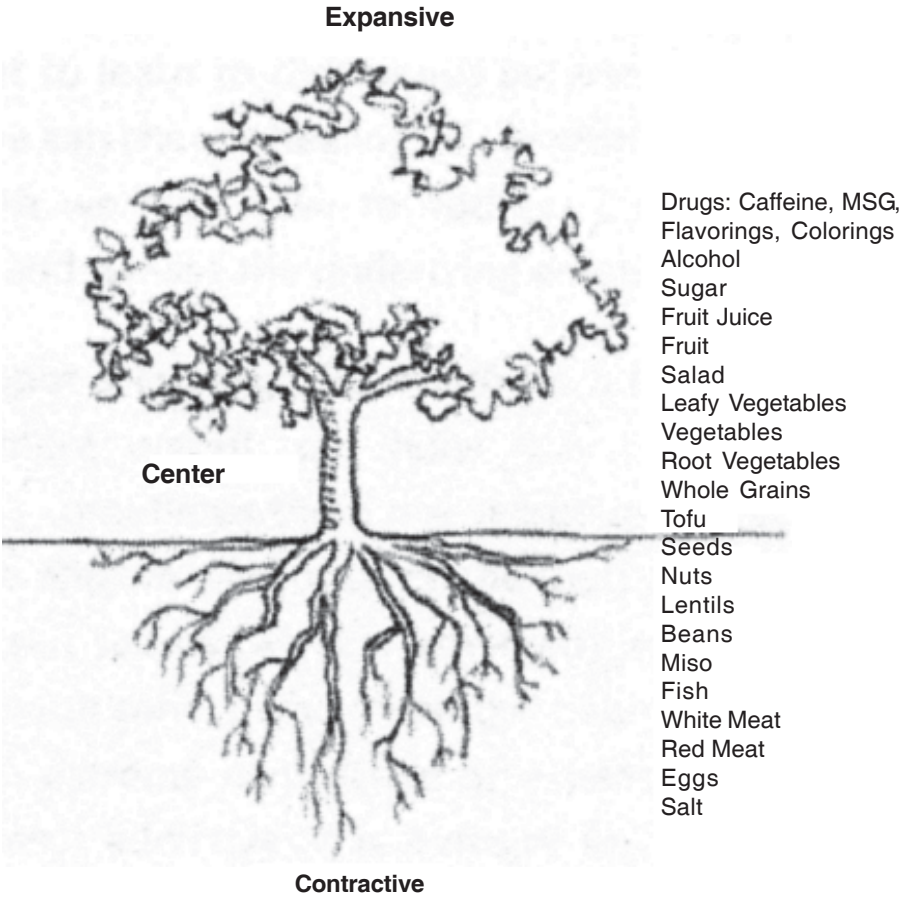

Fig. 7.6. Intuition vs. Addiction

Most addictive foods: drug-foods, including 1MSG and caffeine, alcohol, sugar. The more refined a food is, the more expansive and thus addictive. At the other end of the spectrum we have the most contractive foods, especially salt, but also an excess of meat and eggs. Dairy products may become addictive as they have the effect of protecting us from difficult emotions. More extreme foods are more addictive.

Balancing foods include vegetables, salads, whole grains, tofu, seeds, nuts and lentils. It is unlikely that we will develop an addiction for these foods, unless they have been refined or have additives. Therefore we have to be on alert for what is a true instinctive desire and what is a habitual craving, it is important to learn to distinguish between the two so that we can choose healing. If we wish to restore our health we may have to address our habitual patterns and release the underlying emotions.

How to Spot a Craving: The desire for a food tends to feel more urgent; our body may feel mildly panicky; sometimes there is a secretive aspect to the desire and we will consume the food where no one else can see us (we feel ashamed); or we may hang out with others who share our habit to justify ourselves; extreme contractive or expansive foods are the most addictive; it is a desire for the same substance over and over; we may want more and more an insatiable desire.

How to Know an Intuition: The desire Is deep, but not urgent; our body feels calm and relaxed; our desires change as they are responses to the changing environment; once we have taken the food, we are satisfied and the desire is gone.

There is no right or wrong in this, We all have a choice at every moment. If you feel ok in your current situation, then do not try to make changes. If you are motivated to make a shift, then change your diet and make space for transformation. Do not change your diet for no reason. Rather, learn to listen to your body and act (or not) accordingly.

Clearing Habits: Fasting and cleansing are great ways to clean the slate and start again. For example, just following a simple diet of organic centering foods, with no salt, sugar, caffeine or additives, can helps us to clear attachment to old patterns. Such procedures must be accompanied by consciousness: it is important to take time to look at what is going on so that we can really make the shift at a deeper level. Often when we remove our comfort foods, emotions will arise that we had been suppressing. This needs to be met with awareness, so that we can find ways to meet the underlying pain and thus heal it. It can be a wise idea to go to a Fasting Center, where you will receive guidance throughout your cleanse and emotional support will be offered. Meditation is a great accompaniment to any cleanse or fast, as it helps us to bring consciousness to our process.

Healthy Habit Formation: If you have a strong mind, be wary not to let your mind overtake your healing process. It may be that we feel great when we fist make a dietary change; for example, we add more protein to a protein-deficient diet. At first we feel fantastic at this change. But then the mind takes over, adding protein to every meal, if we do not listen to the body, then we may not hear a signal that our diet has been rebalanced and it is time to move back to a more balanced diet. In this way, what started as a healthy change soon becomes yet another mind-controlled habit. When the mind takes over our eating habits, it is possible to develop an obsessive disorder, it is even possible to become so obsessed with eating what the mind considers health foods that a disorder called Orthorexia Nervosa can develop.

In Five Element Dietary Therapy, the focus is only to correct an imbalance if one exists. Once everything is back into balance, the person is encouraged to eat a wide variety of foods and a balanced diet. Obsession with food is considered an imbalance of the Earth Element (of the Taoist Five Element Theory) and is a sign that the person has a weak center. It can be the result of consuming too many extreme foods and of partaking of too many extreme activities.

Maintaining Balance

There is a difference between using dietary therapy to correct an imbalance, and eating to maintain health. Often when people fist become interested in nutrition, it is because a health problem has motivated them to make change. However, once that problem has been healed, we then need to switch our diet towards one that simply maintains our good health.

Maintenance Diets need to have Several Qualities:

1. They must be stable, and not extreme, so that they are easy to follow continuously.
2. There is evidence that they have been in use for long periods of time.
3. They promote wellbeing and health.
4. They promote longevity.

Thus to find an ideal maintenance diet, it can be helpful to look into different cultured to find diets that have been in use for a long time and in which the members of that population enjoy good health and longevity.

It is important not to mistake rebalancing diets for maintenance diets. Rebalancing diets will involve going to the opposite extreme for a period until we come back to balance. However, once balance is achieved, it is important to switch to a maintenance diet, else we will swing the other way. For example, many people suffering from the results of an excessive lifestyle: too much fat, sugar, toxins and stress, will benefit from a cleansing diet such as raw food. However, after a period, one should return to a more balancing diet else eventually the body will weaken.

Different cultures can be observed to have very high levels of longevity and wellbeing. For example, the island of Okinawa in Japan is known for the outstanding longevity of its inhabitants. This population has been studied extensively to gain better understanding of their dietary habits. The average citizen of Okinawa will consume a diet made up of the following:

At least seven servings of vegetables daily, and an equal number of grains (in the form of noodles, bread, and ricemany of them whole grains).
Two to four servings of fruit.
Green tea (full of anti-oxidants).
Tofu and other forms of soy; various types of seaweed (soya and seaweed balance each other in terms of iodine)
Sweet potatoes, bean sprouts, onions, and green peppers are prominent in the diet.
Vegetables, grains, and fruits make up 72% of the diet by weight.
Soy and seaweed provide another 14%.
Meat, poultry, and eggs account for just 3% of the diet
Fish about 11%; fish rich in omega 3 is taken (about three times a week).
There is an emphasis on green vegetables rich in calcium.
Okinawans, like other Japanese, don't eat much dairy (calcium comes from the dark leafy greens).
Okinawans do drink alcohol, but women usually stick to one drink a day, while men average twice that. Moderation is key.

In terms of vegetables, there is a special emphasis on sweet potatoes, which play a central role in the diet. This food has a very different effect on health than the normal potato. For example, a baked potato releases blood sugar very fast, whereas a sweet potato Is slow-releasing. In Five Element Therapy, the sweet potato is known to improve digestive ability by enhancing the spleen-pancreas.

The diet of the Okinawans is in fact what Five Element Therapy would call a centering diet. It minimizes extreme foods and focuses on those that have a centering quality. According to Five Element Therapy, such a diet puts least stress on the body (extremes cause most stress) and help to maintain wellbeing.

Building a Strong Center

In Five Element Therapy, the strength of the center can be seen by the power of our digestive ability. The ideal situation is one in which we can eat anything without a problem. This is called having a good digestive fire; though even this does not want to be excessively strong. Digestive fire is a concept in many Asian nutritional systems; in Ayurveda it is called “agni”. In Five Element Nutrition they take the model of having a small fire burning in the belly. The stomach is like a cooking pot, and when we ingest food it enters the cooking pot and is broken down by the fire.

If our fire is not strong enough, we will struggle to digest the food that we eat. We may feel tired after eating, have constipation or lose stools, or even undigested matter in the stools. Feeling that we cannot absorb the food that we eat is frustrating to those who are trying hard to improve their health. There are several steps we can take to enhance our digestive ability, including:

1. ***Chew.*** This is the most simple and efficient way to boost digestive fire.
2. Taking root vegetables can be very helpful to nourish the digestive fire: pumpkin, sweet potatoes and carrots.
3. Adding a few digestive spices, such as cinnamon, cloves, nutmeg & garlic can assist. Avoid these if there are heat signs.
4. Avoid foods that are cold, sweet or mucus forming, as these will diminish the fire! Ice cream is a prime example, but also iced drinks, refined sweets and dairy.
5. Eat a good breakfast: this is the time that the Earth Element, which rules the digestion, is active. Therefore, a wholesome breakfast that is not too sweet can help our digestive ability.

Try not to get too scattered during the day: taking on too many tasks, seeing too many different people, being too long on the internet or having different communication sources all going off at once these will all scatter your Chi and diminish your center. The more we can build a sense of center, the better our digestion will become.

Chapter 8

Diet Fads, Junkfoodism to Extreme Yin and Yang

Confusion Reigns Supreme

Webster defines a fad as a pet idea, a passing fad or fashion. There are literally dozens of dietary fads in vogue today. It is the thing to do. Each fad has it's own set of prejudices, rules and regulations. Many people often experiment on themselves, changing from one dietary program to another without learning sound and scientific nutritional and health principles. In most cases, the fad diet does not meet their own individual and physiological requirements.

Confusion reigns supreme and many people give up in disgust and return to the realm of junk food. Thus ignorance, prejudices, fashion, gullibility due to fear tactics or false hope, and a relaxing sense of security which comes from allowing someone else to think for us, are all forces which make people susceptible to dietary fads. Some food fads are harmless, while others can be very dangerous to the body. An occasional exclusive fruit or eliminative cleansing diet when the physiological need arises is definitely bene-ficial and health building; but carried to extremes it can lead to malnourishment and ill-health. The same with an all grain diet; it is very cleansing and healthful for a specific period of days, but carried on exclusively or permanently, it can be damaging.

An exclusive fruit diet, vegetable diet or grain diet are referred to as mono-diets. Each diet itself is based on simplicity, which makes digestion much easier, to allow for healing, cleansing, rebalancing the internal organs, and rejuvenating the blood and lymph system. Thus, a mono-diet improves one's physical and physiological health. Complete rest, mental poise, sunshine, exercise, pleasant and healthful environmental conditions are all key factors along with a simple nourishing diet that produce favorable results in any dietary system or health program. Generally, if one's diet is well balanced in all food elements and if one exudes energy, glowing health, and vitality constantly, that person is cultivating good eating and living habits. This person is not a food faddist. He or she is balanced mentally, physically, spiritually and emotionally.

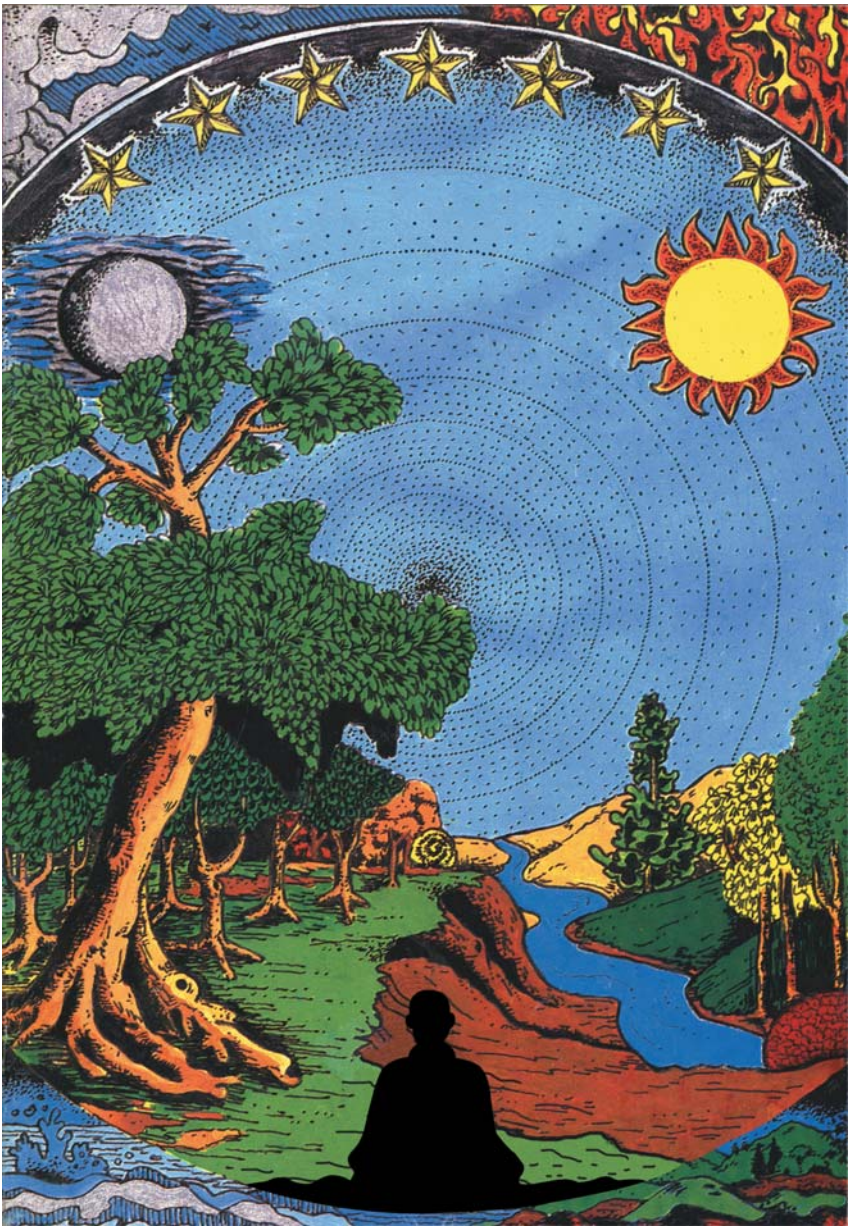

Fig. 8.1. Whatever you do, or dream you can do, begin it.
Boldness has genius, power and magic in it.
We can live in the Tao by just deciding to do it.

The fact that a cult or organization has a large following, or that its followers experience certain benefits, are not conclusive proof for or against the philosophy it teaches. People can be helped temporarily by almost any change in diet away from the conventional meat and potato, coffee and donut mode of existence. Dietary and reducing fads are more fashionable than sensible. Propaganda is the tool used to rake in enormous financial profits. People are commercially exploited by fast and slick salesmen who prey on the credulous and fearful public.

Many strict dieters limit themselves unnecessarily in their choice of foods, in the false belief that these foods are fattening, mucous forming or acid producing. Some people cannot tolerate fruit due to gas; others shun grains and beans; some are strict food combiners; and some cannot tolerate nuts or dairy products. These notions are generally not based on a solid foundation of facts. Such people make themselves miserable by attempting to live by a set strict standard of rules and regulations; of do nots and cannots. So, for the bewildered dieter, what is left to eat?

The longest lived and healthiest people throughout the world do not follow any dietary fads; they are usually much too busy working outdoors planting, gathering food, climbing mountains and working the fields. They achieve good health by living close to Mother Earth, making work their exercise and remaining physically fit well over the century mark: sunshine, fresh air and outdoor activity are part of their daily living habits. People who are bored with life nothing constructive to accomplish lacking exercise and physical fitness and seeking excitement and stimulation in artificial things, are the ones who run, like bees to a hive, to the first dietary fad that sounds plausible to them. If results are not forthcoming, they look to other dietary cults for further relief or guidance to their health phobias.

Raw Foods vs Cooked Foods

Most fruits and some vegetables should be eaten raw. Grains can be sprouted, cooked or made into bread and casseroles. Root vegetables, squashes, beans and peas are more easily digested and assimilated when well cooked, steamed or baked. The body requires some raw fruits and vegetables daily; they furnish vitamins, minerals, enzymes, especially vitamin C which is lost in cooking. There is no absolute necessity for anyone to consume all foods in the raw state.

In fact, there is no proof whatsoever of strict raw fooders living any longer, or being any healthier than a person on a well balanced moderate natural and mixed food diet. Many raw fooders have digestive problems because of sensitive and expanded (Yin) intestines and kidneys. Protein deficiencies are also common. A good natural food mixed diet, including raw and cooked foods, is better for most people.

Food Crank

We are living in an age of the food crank. Many theories are expounded concerning the natural food of humans, and how to prepare food. The theories and speculations are abundant. Listed below are just a few now in vogue. Cooking is evil and against nature, only raw foods should be eaten. Eat lots of meat, humans are carnivores. Eat only cooked grains and vegetables, raw food is for apes. Eat only raw fruits and nuts, humans are like apes. Drink only fruit juices, humans are fruitarians and was not originally meant to eat solid food. The body requires no protein, eat only sprouts and fruit. The high-protein diet is necessary for health and strength. Live on air alone, human are breatharians and should fast as much as possible, drinking only water. And on and on. If all of them are right, we should all, right now, stop eating and never leave our homes from all this confusion. However, all is not lost; there is bright hope for survival in this nutritional/dietary jungle; a healthy, vibrant life can be achieved by thinking, studying, contemplating and applying the secrets of the ancients as set forth in this book.

Overcoming the Junk Food Syndrome

Because of nationwide publicity, in recent years, on the subjects of natural living, health foods and vegetarianism, the public has become more consciously aware of their health and well being; taking positive responsibility for their actions. The term Junk Food Junkie was coined during the surge of health awareness in the 1960s, and refers to those people who take little or no responsibility for their own health usually consuming a great deal of processed, chemicalized, unhealthy junk food. This group generally refers to a health food conscious individual as a health food nut.

However, many health food nuts, if not balancing their diet carefully, can be easily caught in the Junk Food Syndrome. There is a

difference between a Junk Food Junkie, and one who is caught in the Junk Food Syndrome. The former consumes junk food at almost every meal; the latter eats healthy food most of the time, but all too often finds himself caught in the vicious circle of junk food eating the Junk Food Syndrome.

We will address those health fooders who would like to put an end, once and for all to their hinging, or Junk Food Syndrome. Fasting or cleansing programs: Many people fast or attempt a raw food cleansing diet indiscriminately, or when their body does not require one. They have usually been on a general health food diet for several years or have undergone several detoxification programs with some degree of success. However, this person may believe that a fast or raw food diet of long duration will cleanse the body permanently. They have experienced the Junk Food Syndrome for many years and believe that fasting or raw foods only will cure their cravings for junk food. All too often, this group will be found junking-up or pigging-out on their favorite morsel of junk food soon after a fast or raw food trip. (Pizza, ice cream etc.). Fasting is extremely alkaline on the body cells and fluids, which are necessary to cleanse and purify a toxic and diseased organism. A very sick and diseased conventional calamity food eater will benefit greatly by a long fast or an extended juice diet. Why? Because they are so acid, Yang and full of mucus, toxins and wastes, that fasting or raw juices will counteract, neutralize and allow the body to eliminate these diseased conditions toxemia. They need a fast to balance out their alkaline reserves and Yin/Yang polarities.

However, most vegetarians and health culturists do not need a fast, as they are quite alkaline, Yin and flushed out from all the alkaline and Yin foods they have been eating. What they need is proper and complete nutrition to put an end to the Junkyism Syndrome. An occasional short fast, fruit or juice diet for a few days should not cause any problems, provided a sound nutritional program is followed afterwards. Eating too much fruit or juices, especially in cold weather, (Yin) will cause a swing in body polarity to eating heavier and more Yang and Acid forming foods such as, starches of all kinds and heavy protein foods to excess.

The key to good health is to balance these two factors according to the weather, environment and physical requirements on any given day or hour. You must listen to your inner voice and body intelligence for its daily food needs.

Causes of Junkfoodism

Junkfoodism in health food (conscious) people, can better be defined as a syndrome or symptom brought on by poor dietary habits, bad digestion, poor assimilation and absorption and malnourishment. Although health fooders consume much more natural, pure and healthful foods than the conventional eater, they do, more often than they would like to admit, garbage-up or eat calamity junk foods such as, ding-dongs, cakes, pies, soft drinks, cookies, moon pies, candy, pizzas, twinkies, ice cream, fast food hamburgers and on and on. The reader can easily add to this list.

What causes Junkfoodism and the Junk Food Symdrome? How may one overcome the insidious and incessant cravings for junk food? Are you beginning to wonder if it is possible for anyone to live on a natural food diet without experiencing those hidden hunger pangs and the Junk Food Symdrome? Is there something wrong with you, or does everyone experience these health food growing pains?

We have all experienced the Junkyism Syndrome in our own personal way. Each of you can relate a case history of your trials and experiments on various diets and junk food trips. However, there is only one basic cause or reason for Junkyism, and it is this: The body is crying out for vital nourishment in every cell and tissue of its being. If your body could talk it would tell you that it needs an adequate supply of top quality protein, natural vitamins, minerals, trace elements, carbohydrates, fats and enzymes; to be eaten in such a manner that it can easily assimilate, absorb, digest and utilize the vital essences of those foods.

The diet and health suggestions as outlined in this book can help one overcome the Junk Food Syndrome and guide them to mastery of their eating habits. Junkfoodism can be overcome, and eventually one may look upon it as an experience or growing pains in their quest for super health. There are certain practices, misapplications, lack of thorough understanding of health principles and poor living habits that cause abnormal food cravings and malnourishment, that turn a person into a junkfooder or health hypochondriac. An excessive daily consumption of raw foods, raw greens, dried, unsoaked nuts and seeds, dried fruits, lack of oxygen after meals, lack of exercise, too much fruit or juices, fasting when not required, lack of sufficient sleep and lack of proper nourishing foods and food supplements are some of the reasons why health food people turn into junk food junkies.

Flowing with the Tao and Yin/Yang Forces

As we give up our junk food habits, such as coffee, alcohol, sugar, ice cream, milk, meat, pastries, etc., we begin to crave and desire these products as they are being eliminated from our system. An outright denial of these cravings can be disastrous to both mind and body. But the reason we desire these foods is because they cause an addiction and when they are eliminated too fast we experience withdrawal symptoms, the same as a drug addict. However, this is only temporary, until elimination of internal toxins is complete, and the body becomes balanced.

When we totally deny our addictions to junk food, with the attitude or affirmation of never eating them again for the rest of our lives, we become obsessed with denying that which our body craves for. If the mind denies junk food strongly enough, it will run to what it dwells upon, and cause one to junk up hi large quantities. A good method to overcome junk food addiction is to say to yourself, I will avoid junk food for as long as I can, then when I desire some junk food, I will eat it in small quantities only. This will satisfy the addiction or withdrawal symptoms, and your mind and body will be more at peace. As your body continues to cleanse and eliminate poisons slowly, over a period of weeks or months the junk food that once tempted you, will no longer do so. Your cravings will vanish like magic, and you will become the master instead of the slave of your dietary habits.

The reason this method works is because we are not negating or feeling guilty about eating a small amount of junk food occasionally. When we affirm to our mind that we may eat anything at any time, the struggle between our mind and body ceases. This no deny method removes the tension and stress which accompanies the attempt to live up to our perfect dietetic expectations or ideals. Tell yourself that you cannot have something, and you will want it even more. An extreme Yang action will change into an extreme Yin reaction.

When the mind/will/ego are used (in a Yang way) to overcome, control or deny physical or physiological cravings and addictions (Yin) which are still present in the system extreme junk food binging is generally the result. If the Yang mind strongly denies an inner craving, the craving usually wins out. If Yang will not bend, it will break. Yin and Yang must be balanced within the body for optimum health. This is the unique principle of physical life.

Deny something, and you will be pulled toward it. Place a wet paint sign next to a freshly painted fence, and people will touch it to see for themselves if it is wet or dry. Vow to become a celibate, and your sexual cravings will overwhelm you, unless your whole being body, mind and soul has overcome the desire without struggle. Denying or struggling against something takes us away from the flow of life from harmony with the Tao. Tell a child a fire will burn and hurt him, and in spite of the warning, he will play with fire and get burned. Deny him the real experience and he will be attracted to it unconsciously.

Eat too Yang, and you will crave extreme Yin, and vice-versa. The mind and body operates in unison; an unbalanced body creates an unbalanced mind, and an unbalanced mind further imbalances the body. The mind creates the body. A sound mind in a sound body is what we should strive to attain. In this physical three-dimensional world all is duality and change. Nothing here remains forever the same. All phenomena are constantly spiraling onward and upward evolving into higher and greater things. Change *is* the illusion of the physical world; the spiritual worlds never change they are absolute and non-dual; it is where the dual physical world is born. The One (Wu Chi) becomes the two (Yin and Yang), the two becomes the three (Trinity) and the three becomes 10,000 things.

Flexibility is the Key to Yin and Yang Balance

Second generation teachers like Michio Kushi, Michael Abehsera, and Herman Aihara modified these (Ohsawa's) practices and recommended a somewhat wider application of grains and vegetables. Michio Kushi's standard diet of fifty percent cereal grains, twenty-five percent cooked vegetables, and twenty-five percent supplementary foods such as miso-soup, beans, seaweeds, fruit, is an example. While this diet is generally sound for the temperate zones, it can still create complications if its practitioners do not understand how to apply the unifying principle of yin and yang. A principle without a practice is useless; a practice without a principle is dangerous. I have seen too many people become too yang that is, contracted, rigid in their thinking, subject to a variety of symptoms associated with over-stimulation of the parasympathetic nervous system, etc. Aside from the discomfort of being too yang, such people suffer an inability to discharge old,

poor-quality, stored yin such as cholesterol, crystals, stones, and cysts. The simple fact of the matter Is that the heart must expand as well as contract, we must breathe In as well as out, and so on. Yin Is necessary to life. In fact, as a general rule we need at least seven or eight times as much yin as yang In our diet, and the ratio can go much higher if, for example, we are very active (yang) in hot weather (yang). However, if we become too yang the body will necessarily retain its stored animal fats and yin toxins, particularly if we consume too much salt and other minerals such as those contained in seaweed. The farther we move toward yang and away from balance, the more desperately will the body hold on to yin.

The frequent practice of macrobiotics is to deny cravings until they build up to a point of IrreslstabIlity, at which time many people binge wildly, eating pints of ice cream, sugar-rich foods, meat, or even on occasion turning to drugs such as marijuana, LSD, or cocaine. The law of front and back Is undeniable. Balance will be made sooner or later. We must learn to change and be flexible in our diet and health program. What worked for you in the past may not work for you now. You are a different person every second, every minute, every hour, every month and year. Without constant change, growth and flexibility, we would die of stagnation. Accepting change and flexibility in this physical Yin and Yang world spirals us onward in our quest for perfection, toward the Universal Force.

Overcoming the Junk Food Syndrome

1. Consume a well balanced diet consisting of whole grains, beans, peas, sea vegetables, seeds, nuts, fruits and vegetables, miso, tofu.
2. All seeds and nuts should be soaked and germinated overnight for proper assimilation and protein absorption. These can be blended into a seed or nut shake the next day. Eat germinated seeds and nuts more in hot weather and sparingly in winter. Seeds/nuts can be roasted in winter.
3. Use whole food supplements daily: nutritional yeast, alfalfa seeds (powder or tablets), carrot calcium, kelp, dulce, nori etc., raw vegetable juice (more in summer), fresh raw wheat germ, miso, soybean powder, etc.
4. Beverages: cereal grain coffee, dandelion, bancha twig tea, Mu tea, jasmine tea, alfalfa tea.

5. Consume vegetable stock soups highly nourishing.
6. Eat more cooked grains, beans, vegetables and soups in winter according to inner bodily requirements; more raw food, in season, in summer. Use the various methods of cooking: sauteing, boiling, steaming and baking.
7. Consume some raw food daily, more in summer; less in winter. Best fruits: apples, peaches, all berries, cherries, pomegranates, apricots. Best vegetables raw: celery, green peppers, sprouts, cucumbers.
8. Avoid tropical foods as much as possible, unless living in the tropics, including, tomatoes, oranges, avocado, eggplant, potatoes, yams, pineapple, etc.
9. Avoid all animal fats, eggs, high fat dairy, fried foods in grease, meat, soft drinks, sugars, white flour, white vinegar, hot spices, MSG, saccharine, coffee, commercial tea. Sweeteners such as: honey, maple syrup, barley malt, rice bran syrup can be used sparingly. Avoid canned, packaged and most restaurant foods.
10. Go outside after meals for proper digestion & assimilation. Oxygen is necessary for proper metabolism & absorption.
11. Daily Exercise: yoga, running, swimming, cycling, body building, breathing/stretching exercises & Chi Kung exercises.
12. These natural low fat dairy products can be used occasionally: Yogurt, buttermilk, cottage cheese (raw milk). Tofu can be used to supplement dairy products. Yang people should not use eggs and all others should use them sparingly.

The foods listed here, plus the health suggestions will nourish and vitalize your body. They will halt all cravings for junk food. A poorly nourished body is in a half-starved condition and needs many vital food elements: a half-starved body will cause deficiency diseases and result in the ubiquitous Junk Food Syndrome. May you eat in peace. We are creatures of habit. We succeed or we fail as we acquire good habits or bad ones; and we acquire good habits as easily as bad ones. Most people do not believe this. Only those who find out succeed in life.

Fig. 8.2. If you smile, it smiles with you in return. If you frown, you will be frowned at. If you sing, you will be invited in joyous company. If you love the world you will be surrounded by loving friends, and nature will pour the treasures of the Tao.

Extreme Yin and Yang Foods and Poisons

Did you know that the average American diet is costing this nation over 30 billion dollars yearly in doctor bills? Americans are consuming 102 lbs. of refined white sugar, 53 lbs. of processed oils and fats, 100 lbs. of white flour, 7 lbs. of white rice, many gallons of alcohol & thousands of cigarettes per person annually.

Disease is on the rise. Hospitals are filled to capacity. Jails and mental institutions are over crowded. One of the main causes of these confusing problems can be attributed to very poor living and eating habits over decades, such as the consumption of processed and demineralized foods and poisonous substances (drugs, marijuana, coffee, sugar, alcohol).

List of Extreme Yin and Yang Foods and Poisons:

1. Meat, Fish and Fowl
2. Pasteurized Milk and its Products
3. White Flour and its Products
4. White Sugar and its Derivatives
5. Vegetable Oils, Animal Fat and Derivatives
6. Tobacco, Alcohol, Vinegar, Tea, Coffee, Sodas, & Cocoa
7. Processed Peanut Butter, Nut Butters, Ungerminated Seeds and Nuts, and Dried Fruit
8. Salt and Condiments
9. Marijuana
10. Commerical Eggs

Meat, Fish and Fowl (Extreme Yang Food):

Flesh foods affect the body. Meat contains urea (uric acid or the urine of the animal), creatinine, creatine and phenolic acids. They may contains synthetic female sex growth hormones (des); other chemicals pcb, mga, antibiotics, drugs, nitrates, nitrates and red dye coloring to preserve and make the otherwise cadaver grey flesh more pleasing to the eye at the bucher's counter. These are all cancer causing agents. It is loaded with trichina worms, parasites and putrefactive bacteria. Pork contains 31,080, 000,000 putrefactive bacteria per ounce; steak and beef, 24,500,000,000; hamburger, 21,000, 000,000; sausage; 20,000,000,000 per ounce. Excessive flesh eating produces toxic metabolic wastes in the system causing toxemia, malnutrition, high-acidity, purine bodies, intestinal putrefaction, and contributes to the diseases of meat-eaters, such as cancer, kidney and liver disorders, arthritis, hard-

ened arteries, mental disorders, bone and blood diseases and many others. Meat eaters generally age faster, have less endurance, develop more diseases, and have a lower life expectancy than vegetarians. The flesh of an animal is not food; it is the result of food plant life. All animal and human life is dependent upon the plant kingdom for its sustenance. Meat eating animals are not the strongest and longest lived animals in nature the elephant, rhino and gorilla (vegetarians) are the true kings of the jungle. Several years ago the government placed a ban on the use of growth hormone drug (des) fed to cattle to stimulate weight and growth. Some cattle owners have been taken to court for continuing to use the hormones. The cattle were losing too much weight and this became unprofitable to cattle owners. Growth drugs have been used for over 20 years as a cattle feed additive or injection to increase growth quickly, without using extra feed. There is a close link between these growth drugs to human cancer and other diseases. Over 300 cattlemen throughout the United States are still using growth hormones in their livestock. If they get caught and convicted, they could get a 3 year sentence and a $10,000 fine. The ban on growth hormones and the penalty if caught using them seem to have no effect on the law breakers. Profit is clearly more important than health or honesty. This is just another very good example and reason for you to consider alternative sources of nutriment, relatively free of hormones and poisonous substances, such as found in plant food.

Pasteurized Milk & Products (Extreme Yin or Yang/Acid Food): Drinking milk may be hazardous to your health. This statement appeared in the National Enquirer a few years ago, along with an excellent article explaining the menace of pasteurized milk. Some milk supplies have been found contaminated with penicillin and chloramphenicol, two antibiotics, which are supposed to be forbid-den by law. Among the ailments attributed to milk are: Pesticide poisoning, adverse drug reactions, drug resistance, salmonella, and staphylococcus poisoning, anemia, hypercalcemia (excess calcium in the blood), diarrhea, asthma and liver damage, plus insecticides, lethal drugs and radioactive material. If you are eating pasteurized cheeses, ice cream, sour cream, powdered milk, cottage cheese, cream cheese and anything made from the pasteurized milk, you are getting a dose of the above poisons.

Think about that the next time you go shopping in your local market Dr. Pottenger conducted another experiment on cats. He fed them pasteurized milk and in three generations they displayed homosexual tendencies and were unable to produce offspring. They developed brittle bones and lung diseases. Pasteurized milk and its products lack the necessary enzymes, vitamins and minerals so necessary to maintain health. Milk drinkers are always full of mucous, coughs, headaches, colds and flus. Pasteurization is for the purpose of keeping bad milk in a saleable condition and for no other purpose. Pasteurized cow milk products are primary factors in causing body cramps, allergies, arthritis, fatigue, indigestion, gas and diarrhea due to fat and lactose intolerance. Lower back pains can also be attributed to milk consumption. Most humans do not produce enough of the enzyme lactase, after the weaning period, which digests the milk-sugar, lactose which causes trouble. Cheeses and cow milk are extremely high in lactose and fat, both extreme yin elements and contributing factors in heart disease, high cholesterol, diabetes, colds, skin diseases and cancer. Cheese is so concentrated that it takes 5 quarts of milk to make one pound of cheese. There is more fat in regular cheese than in most meats. Scientists have discovered that pasteurized cow milk products remain unmetabolized in many adults because it lowers hydrochloric acid in the stomach, which is required for protein and mineral assimilation. Milk the intestines to generate excessive amounts of lubricating substance called mucous, to help keep foods moving through the system. This material has the ability to harden and forms a coating on the inner lining of the intestines that makes it almost impossible for nutrients to pass through into the blood stream, which of course means poor absorption. Poor absorption leads to chronic fatigue. An excessive build up of mucous travels up to the lungs, bronchial tubes, nasal cavity and head causing colds, flu, headaches, pneumonia and asthma. Cow's milk contains hormones which are secreted by the cow for the purpose of stimulating growth in a calf, to move its weight from about 80 pounds at birth to 1,000 pounds two years later you probably weighed about 7 pounds at birth and it took you a full 21 years to reach your present weight. Milk is an excellent source of calcium but many people just don't seem to be able to metabolize It properly. It may be because the pasteurization of milk destroys enzymes in milk, or the heat of pasteurization distorts the calcium. No one really knows, but laboratory animals raised on pas-

teurized milk exhibited all the symptoms of arthritis. Anyone who depends upon milk for his calcium is making a mistake. Low calcium intake can cause muscle cramps. Non-dairy sources of good quality calcium can be found in sesame seeds, cabbage, okra, parsley, watercress, wheat, kale, cauliflower, lemons, straw-berries and collards. Pasteurization totally changes protein molecules in milk making it difficult to digest and assimilate. The body cannot utilize 42% of the protein contained in pasteurized milk according to Dr. S. C. Deal in his book "New Life Through Nutrition," 1974). High fat dairy foods, i.e., butter, processed cheeses, sour cream, cream cheese, and regular raw and pasteurized cheeses (cheddar, muenster, edam) are all extremely Yin, and should be eaten very sparingly. Low fat yogurt, buttermilk, and skim milk are more Yin and Yang balanced, and can be consumed in moderation. Low fat skim milk cheese, swiss cheese, low fat cottage cheese, and highly salted cheeses are extremely Yang due to their fat-free concentrated protein and high salt (Yang) content, and should be eaten very sparingly. Goat milk, goat cheese or feta cheese are Yang.

White Flour and Products (Yang/Acid Poison):
White flour and its derivatives affect the body. White flour products, such as white bread, noodles, pizza, etc., are considered Yang and are the main cause of Yang of constrictive constipation. The stools are dry, small and hard and bowel elimination is difficult. It contains a calcium sulfate, a chemical name for Plaster of Paris it will plaster-up, clog and close-up the eliminative channels of the body if continually indulged in. Intestinal statis or constipation causes anemia and pasty complexion, which can be attributed to white flour products. It is totally lacking in the entire vitamin B-complex family. It also depletes these vitamins from the body if eaten exclusively. It contains zero roughage or bulk, which is necessary for healthy digestion and proper intestinal and bowel action. They add empty calories and unhealthy weight to the body. White flour products maintain long shelf life, due to their lack of whole food value. Whole grain flour products cannot keep long because of their freshness and high nutrition. Bugs and insects will not eat white flour due to its lack of nutritional qualities. The wheat bran and wheat germ are fed to livestock for health and prize-winning reasons, while the farmers poison themselves unwittingly. These show animals are healthier than most humans.

The bread millers remove all of the vitamins, minerals, protein, bulk elements out of the wheat and enrich it with a tiny amount of synthetic vitamins and minerals, which cannot be absorbed by the body. This goes for all supermarket products, such as macaroni, gravies, spaghetti, etc. Twenty-six natural elements are removed from the flour, and a fraction of a penny's worth of inorganic vitamin/mineral elements are added back. White rice has the bran removed, which contains the valuable B-complex vitamins. It is constipating and does not promote health. It contains some or all of the following inorganic chemicals and unwholesome substances: plaster of Paris, polysorbate 60, calcium bromate, azodicarbonamide, sodium stearoyl-2-lactylate, amomonium phosphate, carrageenin, propylene glycol, diacetyl tartaric acid, monoglycerides and diglycerides and synthetic vitamins. Propyleneglycol is used in antifreeze; carragennin is a possible cancer causing agent; be suspicious of the other chemicals also.

All soft, fluffy supermarket bread is puffed with air in big vats, to blow it up for shelf life. If bread can be squeezed like an accordian it is not fit for human consumption. Supermarket cereals are made from white flour, with added, salt, sugar, BHA, BHT, artificial additives, pyridoxine hydrochloride, colorings, cotton seed oil, hydrogenated oils and preservatives. Cheap cereals contain as much as 70% to 85% refined sugar and white flour starch. Cheap hydrogenated coconut oils and salt come next as chief ingredients in cereals; artificial colorings are also high on the list. Cereal was named after the Roman goddess of grains, Ceres. The real cereals are whole grains: rye, rice, wheat, corn, barley, buckwheat, oats, millet etc. Whole grains are not fattening; legumes are not fattening; fruit, vegetables and low fat dairy are not fattening. Whole fiber foods cause one to eat less and to move the stomach and bowel contents along, thus aiding weight loss. White flour is devoid of nourishing elements, fiber bulk which will make you fat. You can make your own whole grain flour products and avoid obesity, disease and a thin wallet. White flour products do not fill you up, therefore you can keep on eating them, while chalking up the calories and fat. Over $2 billion dollars are poured, yearly, into advertising white flour products by large companies. Avoid all products containing white flour, sugar, additives etc. Use only 100% whole grain products. Avoid canned, bottled or frozen food and drinks (the sugared or salted variety), such as salad dressings, ketchup, tomato and other sauces, crackers, chips etc.

Consume foods made from whole grains, fresh vegetables, fruits, seeds, nuts, rice, melons, pure unsweetened fruit or vegetable juice, popcorn, grain cookies, honey oatmeal cookies. Make your own pasta and noodles with a pasta machine. Make your own tofu or yogurt salad dressing. In the long run, whole foods natural cooking can save you loads of money, prevent disease, increase your health force and most importantly, save your life.

White Sugar and Derivatives (Yin/Acid Poison):
Sugar, its derivatives and other unnatural sweeteners and food additives affect the body. It is an extreme-Yin substance, and psychologically and physically addicting. It contains zero minerals, vitamins, enzymes, protein, natural fiber, trace minerals and other food value. It contains empty calories, and can make one obese and lethargic. It uses up insulin and causes diabetes, obesity, heart disease, poor eyesight, skin diseases, bad memory, cancer, kidney and liver disorders. It places a drain on the alkaline buffer salts and causes calcium to be depleted from bones, teeth, hair, nails, eyes, causing tooth decay, soft nails, blindness, bone disease and hair loss. It robs the body of iron, the major blood-building mineral. Sugar is a main ingredient in most processed foods: ice cream, 30%-50%; white bread, 10%; commercial cereals, 40%-50%; peanut butter, mayonnaise, salad dressing, ketchup, 20%-30%, non-dairy coffee creamer, 30%-40%; imitation fruit juice, 98%; gelatin desserts, 85%; cigarettes, 50%; cigars, 20%;, pipe tobacco, 40%, canned fruits, 20%-35%; candy, 30%-50%; baby food and infant formulas, 20%-30%; spaghetti sauce, 10-20%; colas and soft drink sodas, 40-60%; hot dogs, 10%; cookies, cakes, pies, donuts, etc., 30%-50%. Sugar in any form is harmful. Read labels. Any of the following is just another name for sugar: sucrose, fructose, glucose, maltose, lactose, galactose, cane syrup, corn syrup, corn sugar, invert sugar, dextrose, saccharin (coal tar product), cyclamates etc. Most fast-foods contain high percentages of both sugar (Yin) and salt (Yang). Sugar is sold to the tune of 32 billion pounds and $6.4 billion per year. Dental bills cost Americans $6 billion a year. Isolated societies and rural cultures worldwide, who do not consume sugar and its derivatives are free from tooth decay. Excess sugar in the blood can result in brain damage, schizophrenic tendencies, depression and extreme mood changes. Sugar consumption is now up to approximately 200 pounds per person per year.

The death rate from diabetes has also increased 52% in 70 years. As sugar intake increases, degenerative diseases also increase. Refined sugar, fats and empty calorie carbohydrates exhaust the pancreas, which results in diabetes. Diabetes, hypoglycemia, skin diseases etc., are all unknown in societies who do not consume sugar and refined foods. Diabetes and hypoglycemia can be controlled and prevented on a sugar-free and junk food-free diet. The diet must contain whole grains, legumes, vegetables, fruits, seeds, nuts, low-fat dairy. Brown sugar is white sugar colored with molasses, and it reacts exactly the same in the body. Honey, rice bran syrup, molasses, barley malt syrup, dried powdered dates, carob powder, malt powder, etc., are all natural sweeteners and substitutes for all forms of white sugar and its derivatives. However, these substitutes should be used very sparingly and in small quantities in cooking or flavoring food. All sweet foods and substances are extremely Yin (expansive to mind and body) and can cause disease if used indiscriminately). Intestinal mucous is usually simply an extension of mucous of the stomach, and is always aggravated and instigated by the use of white sugar and other similar irritants. Chronic diarrhea is often the result of the free use of sugar in its various forms, causing intestinal (Yin) expansion and loose stools. Dilation or distention of the stomach, with enormous quantities of gas and fermentation can be attributed to sweets and sugar. Gastric ulcers can be caused and greatly aggravated by sugar products. The stomach requires a good calcium supply to function properly; sugar causes rapid calcium loss. Gout, chronic rheumatism, nervous headache, neurasthenia, eczema, apoplexy, leukemia, ms, tb, md, and other chronic diseases require entire abstinence from white sugar and its derivatives, if there is any chance or hope of a healthy recovery. White sugar is not digested in the mouth or stomach, but only in the small intestine, where it comes in contact with the intestinal juice. Several hours pass after eating a meal before the intestinal fluid is able to digest white sugar and prepare it for absorption. This is not true, however, of fruit or other natural sugars. It is evident that cane sugar is a crude vegetable product not well adapted to human nutrition. Stomach acidity, catarrh, indigestion, gas, ulcers and hyperacidity in many cases are due to this cause. The extensive use of candies, preserves, sodas, sweets of various kinds, as well as the free use of white sugar, corn syrup, etc., with cereals, pancakes, in coffee, tea, and in other ways, may be directly held

responsible as the one cause of indigestion and chronic disease which prevails throughout the civilized world. Millions of men, women and children are suffering from disordered conditions of the body due to the excessive use of white sugar without being aware of the real cause of their distresses. Not a few intelligent, observing people have discovered that sugar is productive of sour stomach and various other gastric disturbances. It is evident, then, that white sugar and its derivatives are totally devoid of properties which are found in wholesome natural foodstuffs. No healthy human being can suffer physical ills from consuming whole grains, legumes, fruit, seeds, yogurt or vegetables because these foods are natural to the human digestive process. Up to 90 percent of our supermarket food is loaded with chemicals, dyes, sugars, salt, colorings, additives, and preservatives. Their sole purpose is to give taste, prevent spoilage and impart bright colors for eye appeal and saleability. Most packaged supermarket goods fall into the category of yin substances (expansive qualities) which tend to produce specific and systemic biochemical and hormonal imbalances. Sugar and salt are sold to the tune of 15 million pounds each per year; corn syrup, 6V& billion pounds; sodium bicarbonate, 60 million pounds; monosodium glutamate, 30 million pounds and monosodium diglycerides, 90 million pounds. There is now about 2000 different chemicals used in foods for various reasons. It is amazing that the human being can survive at all.

They strongly urge and recommend that people drastically reduce their salt intake for young and old alike. Americans, they say, should eat less meat, whole milk products and eggs which are rich in cholesterol. The study states that people get 24% of their daily calories from refined sugar and 40% from fats. This is extremely high and the committee recommends that people eat less of these high calorie foods and more of the complex carbohydrates, that are the natural ingredients of fruits, vegetables and whole grains. In fact, as much as 45% of what people eat should be starch, and the fats they eat should be primarily unsatured (of vegetable origin), the study says. Although the report urges people to substitute more fish and poultry for meat, we recommend that seeds, nuts, raw goat milk products, soya protein, grains, beans and nutritional yeast can completely take the place of all meat; including fish and poultry.

With the adoption of proper nutrition and eating habits, the study estimates that most major diseases could be reduced up to 50%, including overweight problems. Our research reveals that the healthy, vibrant and disease-free centenarians from around the world prove that disease can be nonexistent.

Vegetable Oils, Animal Fat & Derivatives (Extreme Yin/Acid): Vegetable oils, animal fats and their derivatives affect the body. Fats are used as fuel in the body. The amount of fat required daily is quite small. The body's preference is to store up fat for use in emer-gency. It is deposited under the skin between the layers of muscles and serves as a padding around the internal vital organs; it is used to nourish the nerves also. Fats are converted into soap in the intestines by the action of the digestive fluids. Soap is soluble in water and in this form the fat is absorbed after the soap is de-composed and the original fat is reconstructed. Kidney and gall stones are nothing more than hard round soap balls, developed in the system from an excessive consumption of fatty foods and oils. The less oils and fats in your diet, the healthier you will be there is no secret about this. Bottled oils Even vegetable oils will cause liver and bladder trouble if eaten to excess. Why is this so? Be-cause all oils, from either vegetable or animal sources, are super concentrated food derivatives of which the human body was never designed to handle. For example, several pounds of nuts are re-quired to manufacture one small bottle of nut oil it is the same with all other oils the whole food factor has been removed from the original product, (fractionated) and we are left with a highly con-centrated food substance, which the human chemistry system and internal organs are burdened beyond their capacity to deal with. Result: malnutrition, indigestion, chronic fatigue, liver and bladder disease, anemia, falling hair, malabsorption of food, poor eyesight, and ultimately, cancer. The body was designed to handle foods in their whole form, with oils intact, such as found in all seeds, nuts, legumes, beans, grains, olives, cultured dairy products etc. In this manner, we can be assured of obtaining the whole food factor in the right combination and proper proportion. Remember: no more than one to two tablespoons of free oils or other fats daily. One famous health writer and researcher has discovered that any consumption of free-fats as found in vegetable oils or other animal fats, which have been fractionated and placed in bottles, is delete-rious to one's health. So again, heed the warning: The less free-

oils in your diet, the healthier and longer you will live. Animals in nature do not consume such things it is common sense that we should follow that line of logic also. Cold pressed vegetable oils should be used mostly in cold weather (winter), and very sparingly in summer. The body requires a very small percentage of fats in the daily diet these can be acquired mostly from whole natural foods, without injuring one's health. Most Americans consume from 50% to 60% fat daily, which is why we have the highest death rate from heart disease in the world. With the excessive consumption of animal protein, sugar, salt and fat, it is easy to see why the United States is one of the most chronically diseased countries on earth. Most people consume over 2000 calories in fat per day. Overconsuming fatty foods and oils does not give the body an opportunity to manufacture its own fat as is the case when only small quantities are eaten. The human body is an amazing work of art, and it can do many things on its own if we feed and take care of it properly.

One ounce of fat contains 240 calories more calories than the same amount of carbohydrates or protein. The excessive use of oils or fats creates chronic digestive disorders, takes several hours to digest, and leads to a multitude of illnesses. Left to its own, the body will form its required fat from natural complex carbohydrate foods, i.e., whole grains, legumes, seeds, nuts, fruits, and vegetables. The fat formed in this way is different from other fats because it contains the special characteristics of human fat, which was specifically designed by nature for the human body. Expensive margarines are an extremely Yin and inferior product. Margarines made from soybean or other oils are all hydrogenated and artificially flavored and colored. For example, soybean oil is heated to high temperatures, and hydrogen gas is bubbled through it, which causes the liquid oil/fat to become solid and made into bars of commercial brightly packed margarine. This hydrogenation process does two things to the unsaturated oil: 1) it makes it hard; 2} it changes polyunsaturated fats into saturated fats, which are more chloresterol forming than butter or eggs. Avoid all margarines, including corn, safflower, soybean and any other ones made from cheap oils. Use yogurt, tofu, natural cooking herbs, miso, etc., to make your own fresh toppings and salad dressings. They are all fast, easy to make, inexpensive, and will save you doctor bills.

Metallic nickel is also used in the process of turning unsaturated liquid vegetable oils into a hard stick of phoney imitation butter. Free nickel in the system can cause ill-health. Imitation margarines will raise your cholesterol, not lower it it will clog-up your organs and arteries, not clear them out. Coconut oil, animal fats, lard and butter are all highly saturated fats 100% fat. Coconut oil is the most saturated of all fats butter, lard, and animal fat comes next. Coconut oil is added to almost all processed foods, including imitation baby milk it is also used to make soap. Cottonseed oil is another highly processed, non-nutritive product used in many commercial foods, including potato chips, candy, pastries, ice cream, etc. This harmful oil has been reported to lower the sperm count in the testicles of male animals. In simple terms: cottonseed oil will lower your sex drive, reproductive powers and cause impotence. Palm oil is usually found in the same products as cottonseed oil. Read labels, even the ones in health food stores, and avoid these disease producing poisons.

The best polyunsaturated vegetable oils, if one must use them are: cold-pressed virgin safflower oil, dark sesame oil and olive oil. Safflower oil contains the highest amount of linoleic acid (75%) which is the most polyunsaturated oil of all. The lower the linoleic acid content, the more saturated a fat or oil is. Deep fried foods in oils, especially rancid, cheap commercial oils can cause severe organic health disorders. Vegetables sauteed in a small amount of pure dark sesame oil or safflower oil is permissible during the cold winter months. Use less oil in summer.

Tobacco/Alcohol/Vinegar, Tea/Coffee/Sodas (Yin/Acid Poisons): These poisons affect the body. Tobacco dulls the finer senses and severely weakens the pineal and pituitary glands, the very receptors of higher values and intuition. There are 19 poisons in cigarettes, i.e., nicotine, arsenic, methene, etc. Smokers are known to take on Buerger's disease which lowers skin temperature and causes gangrene. Smoking pregnant women can easily pass on the habit to their offspring. In many cases, the children of smoking mothers are sick from birth. Smoking is a contributing factor in all cases of heart disease and circulatory disorders. It lowers the red blood count and causes anemia. Heavy smokers do not generally have a taste for natural foods everything they eat is heavily sugared, salted or spiced, which further imbalances the system. Stomach ulcers are greater in smokers than non-smokers.

Smokers generally appear 10 to 15 years older than their actual age. The heavy tar substances in cigars or cigarettes adhere to the lung walls, coating them thick and black, and obstructing the oxygen and blood exchange within the lungs. It cripples the brain cells, causing them to harden, thicken and finally lose their finer nerve tissue. Brain cells do not regenerate or grow back when destroyed through smoking or other nerve poisons.

Normal Brain Cell **Tobacco-Crippled Brain Cell**

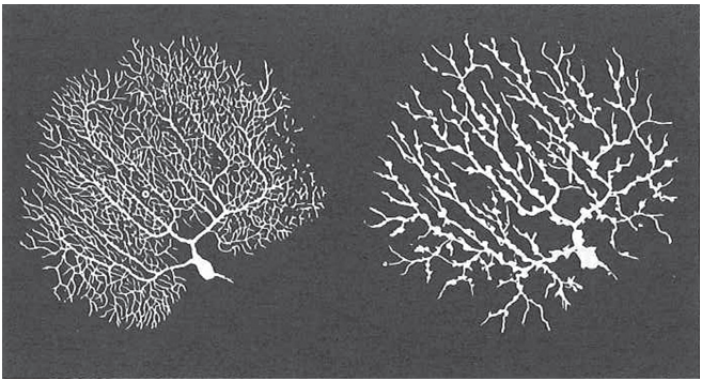

Fig. 8.3. Tobacco affects the Brain.

The nausea and sickness following the first attempt to use tobacco is definite evidence of the poisonous character of this drug. Vertigo, pallor, high pulse rate, pounding heart beat, breathing difficulty, vomiting, and in extreme cases unconsciousness are produced by a very small quantity of tobacco smoke in persons not accustomed to its use. Almost no one dies of nicotine poisoning when first smoking, because the human system possesses great powers of accommodation to circumstances. In this way tne worst poisons may by degrees be tolerated until enormous doses can be taken without immediate fatal results. However, the system is still slowly poisoned, and remains in a lowered state of health, until the smoker suffers and dies 10 to 20 years or more before his natural life span. A single cigar or several cigarettes will, in thirty minutes, produce a rise of blood-pressure amounting to twenty points. One pound of tobacco contains 350 grains of nicotine. One-thirtieth of a grain causes toxic symptoms in man. One drop kills a dog. Nine-tenths of a grain will kill a man. One pound of tobacco, then, contains more than enough to kill three hundred people.

When smoking is stopped, it takes about a month to get the nicotine out of the body. It takes several months to a few years to completely clean out the lungs and internal systems, provided a wholesome dietary and exercise program is adopted.

Alcohol and Vinegar:

These products are proroplasmic poisons. Vinegar is extremely acid and harmful to the stomach, kidneys and liver. They destroy red blood cells and lessen the functioning power of the brain. Alcohol over stimulates the brain and body, leaving the drinker fatigued and washed out after its effects have worn off. It eats away the stomach lining, leading to ulcers and cancer. It expands the liver and kidneys, causing chronic disease symptoms. Alcohol is a narcotic, which impairs one's intelligence, weakens the memory, judgment and the reasoning faculty. It lessens endurance and the power to resist disease. Healthy blood corpuscles help to prevent disease; a pint of alcohol puts 20% of our blood cells out of commission. The craving for alcohol, in many cases, can be traced to poor nutritional habits and deficiencies, lack of exercise and fresh air and stress. Alcohol is extremely Yin, and heavy drinkers generally crave much meat (Yang). Any extreme always creates a craving for its opposite. A healthy, well functioning liver will feel the effect of even one drink. Heavy drinkers do not feel the effects after a few drinks because their liver has become diseased and unable to react to any further poisoning. It produces a profuse flow of mucous in the stomach, the purpose of which is to protect the mucous membrane from the irritating effects of the alcohol. It hinders the formation and accumulation of glycogen in the liver, thus lessening resistance to infection. Alcohol diminishes muscular vigor, nerve sensibility, vital endurance, and has a retarding effect upon digestion. It causes depression and mental degeneracy. It hinders the formation and the action of the gastric ferments, in as little as one part to 250 of water, ½ of 1 %.

Alcohol always diminishes, never increases the energy of the heart, and is detrimental rather than beneficial in cases of shock, collapse, fainting, etc. It increases the liability to infectious disease, and prevents the development of immunity. It diminishes the alkalinity of the blood, and so diminishes vital resistance and increases susceptibility to disease.

Tea, Coffee, Sodas and Cocoa:
Coffee and commercial tea are artificial mild narcotic stimulants, and are definitely addicting and habit forming when continually used. They are extremely Yin and Acid-forming in the body, containing poisonous substances that narcotize the brain, nerves and blood. They excite the nervous system temporarily, followed by physical and mental let-down, fatigue and depression. Strong cravings for these substances are definite indications that they contain mild narcotic poison-stimulants, which create a dependency-addiction syndrome, and withdrawal symptoms when they are abruptly taken away from the user. They cause transitory stimulation, followed by marked increase of fatigue. Commercial tea contains tannic acid; it inter-feres with gastric juice in the stomach. All of these Yin poisons expand and weaken the kidneys, bladder, liver and intestines, etc., causing their acids to flow into the blood, poisoning the system. Many tea and coffee drinkers develop discoloration of their teeth and skin. Coffee contains pyramidine, a smoke poison produced by the roasting process. Caffein's effects on the nerves cause wakefulness, nervousness, excitability, insomnia and muscle twitching. It raises the blood pressure. Eight ounces of coffee contains 85 to 90 mg. of caffeine; colas about 75 mg. of caffeine.

Colas and soft drinks contain 7 to 8 teaspoons of white sugar per bottle (about an ounce). Other orange or lemon flavored imitation drinks contain brominated vegetable oil, corn and cottonseed oil, and the poisonous chemical bromine. All colas and soft drinks eat away at the vital organs, including the reproductive glands. Colas were also known to contain small amounts of cocaine. Cocoa contains a mild narcotic called theobromin, equal chemically and pharmacologically to caffein in tea and coffee and its effects on the body are the same. It should not be difficult in the light of these facts, for any intelligent person to reach the conclusion that these poisonous stimulants do not build health or instill vitality within the body they only waste vital energy, exhaust the body's reserve force, and lower immunity and resistance to disease. Rest and sleep are the only natural and healthful remedies for fatigue. Addiction to these dele-terious substances confuses and dulls the body's natural signals for rest and sleep, thereby re-sulting in nerve exhaustion, nervous disorders and mental confusion. If you value your personal well-being, and are interested in building your vital health force, avoid these artificial stimulant/ poisons like you would arsenic capsules.

Processed Nut Butter & Ungerminated Seeds/Nuts (Extreme Yin/Acid Food):

Nut butters and dried seeds and nuts affect the body. Commercial peanut butter contains, salt, sugar, cheap hydrogenated oils, about 80% fat, and nickel which can cause lung infections. All nut butters and nuts are extreme Yin due to their high fat content. These products should be used sparingly. Excessive fats expand the liver and decrease normal bile functioning. A diseased liver causes poor eyesight, jaundiced eyes, dandruff and falling hair, skin diseases and other maladies. Unsoaked or ungerminated seeds and nuts are only about 10 to 20 percent digestible and assimilable, due to the fact that their life force is lying dormant the life force becomes active only when moisture (liquid) is added to them. They then become active and start growing or germinating: only then will they become almost 100% digestible and assimilable in the human system. Dried seeds and nuts can cause severe digestive disorders. The following seeds and nuts can be soaked overnight in water: sunflower seeds, pumpkin seeds, sesame seeds, pumpkin, almonds, walnuts, pecans, etc. After soaking, they can be placed in a blender with some added apple or pineapple juice and you can enjoy a zesty seed or nut milk. Soaked cashews also make a delicious cashew milk, creamy and good tasting. Soaking and blending seeds and nuts makes their protein value more easily digestible. Two to three ounces of a single seed or nut, or in any combination will add variety to the seed milk. You may also soak a couple dried figs or apricots with the seeds, and blend them together; add one-half teaspoon of licorice powder to moving blender for pleasant taste. Use this seed/nut blended mixture more during hot weather, two or three times per week.

Dried Fruit:

These include dried apricots, raisins, apples, pineapples, figs, peaches etc. All dried fruit should be soaked at least 10 to 12 hours before eating. It takes about 9 or 10 hours to properly digest dried fruit. They will cause intestinal gas before being acted upon by the digestive juices. The natural fruit liquid has been removed from dried fruit, which turns them into a very concentrated sugar. They almost always cause skin eruptions when eaten dried, or if eaten excessively, soaked. You may eat them mostly during cold weather when fresh fruit is not available, and very sparingly no more than 1 or 2 apricots or figs, or a teaspoon of raisins per day maximum.

Being difficult to digest and assimilate in dried form, they pass out of the body before being properly and adequately absorbed. All dried fruit is extremely Yin and Acid, and is the cause of much distress and ill-health among dieters today, who use them excessively. Dried fruit should not be used as staples in the diet, but only occasionally, and mostly in cold weather as a supplement to the diet. Dried fruit may also be boiled in water for a few minutes, and let stand overnight. Soaked dried fruit can be used in bread and other baked dishes.

Soaking dried fruit and seed and nut germination has been one of the most important health secrets that we have investigated and researched in the health field. When on a vegetarian or health diet, do not become a health-nut and attempt to live on dried nuts and fruit, as some have attempted to do with disastrous results in poor health. The practice of seed and nut germination has been a regular practice of the ancient Yogis, Chinese Taoists, and other long lived people throughout the world for centuries. Make it your practice too, and experience the vibrant health force that you are capable of attaining.

Salt and Condiments (Yang/Alkaline, Poison in Extreme):
Salt and condiments affect the body. Salt is composed of the caustic alkali, sodium, and a poisonous gas, chlorine. Common table salt is an inorganic compound which cannot be assimilated by the system. It has no nutritional value because it cannot be dissolved and utilized by the cells and tissues. We need about 200 milligrams per day for optimum health from sea salt or kelp. The average person who eats processed commercial food, consumes more than 2000 milligrams of cheap salt. Excessive consumption of salt will cause high blood pressure, hypertension, kidney disease (Yang) hardened arteries, eye disorders, unbalanced chemistry etc. It also depletes calcium from bones and teeth, and irritates the mucous lining of the stomach and intestinal tract; it affects the nervous system causing nerve disorders and irritability. Today, our lands are demineralized and chemically fertilized, plus the top soil is very poor due to bad agriculture methods, thus washing away of the more soluble sodium salts, leaving it high in potassium. The result of this sodium loss led to the use of a deadly substitute sodium chloride, or common table salt. Biologists have shown that a half ounce of salt absorbs and holds four pounds of water in the body, thus leading to edema and obesity. It draws the vital flu-

ids from cells, tissues, glands and organs causing them to atrophy or dry up. It degenerates the lymphatic and endocrine systems. The thymus is known to be very sensitive to salt rapid aging accompanies the deterioration of the thymus gland.

In China, salt in a saturated solution has been used as a means of suicide. Poor capillary circulation, hot or cold hands and feet, anemia, dizziness, headaches, nose bleeds and sexual hyperesthesia are all symptoms of excessive salt in the system. The only salt that the body can actually use is the organic salts formed from air, water, soil, and solar energy into plant life. From the plant, man can digest, assimilate and fully utilize the organic salts. Inorganic table salt destroys the electrochemical balance between the natural combination of organic salts in the body the sixteen mineral elements. We require more than just one mineral salt we need all of them in the right combinations potassium, silicon, calcium, iron, lime, chlorine, etc. Common salt is not an organic salt, and therefore, causes an imbalance of the sodium/potassium elements that make up cell life. Sodium is found in the fluids of the body, and potassium exists mainly within the cell. Salt, including all restaurant and most processed foods, smothers or crowds potassium out of the cell, where it rightly belongs, and the inorganic table salt overloads the cell, causing local irritation, Yang inflammations, hypertension etc. African natives do not use salt, and the Eskimos, not only do not use salt, but abhor its taste. Animals will eat salt only when there is no fresh green grass and herbs to eat. They shun the salt-lick during summer months. Salt eating is a habit, just like tobacco, alcohol, coffee or drugs. It hinders the digestion of albumen, by interfering with the secretion of gastric juice. Gout is aggravated by the use of salt, and attacks of gouty pain subside when salt is stopped. Eczema, skin diseases and dropsy, along with swellings, are directly attributed to salt eating.

Overeating has become a universal habit. The use of salt and salted foods, plus the use of other table condiments, such as monosodium glutamate (MSG) and black pepper, are largely responsible for the desire to overeat, especially of devitalized foods. Salt deadens the sensitive tastebuds on the tongue. Regular salt eaters generally have no desire to eat fresh raw foods because they have lost the finer sensitive nerves of taste on the tongue. The more salt one eats, the more he will crave junk food, and the less he will desire fresh wholesome poison-free food.

Salt removes water from blood and lymph which is needed for its excretion by the kidneys. This causes abnormal thirst, only satisfied by copious drinking of water, alcohol, sodas etc. Heavy salt eaters are generally also heavy meat eaters and drinkers. This person requires plenty of liquids to quench his thirst and to dilute the poisonous salt. In the long run, the internal organs become diseased and malfunction at an early age. Salt is also used in meat products to preserve and mask the taste and appearance of the dead, decaying and decomposing flesh. Ancient civilizations used salt to preserve and embalm the mummified bodies of their dead royalty. It is ironic, and rather sad that today, we are preserving and mummifying living bodies in early preparation for burial.

Here is a list of foods that are commonly eaten by millions of people, containing large quantities of salt and other unmentionables: All cheeses, except the low-sodium variety; commercial bread; processed boxed cereals; ketchup, sauces, and spreads; frozen dinners; salad dressings; cottage cheese; margarine and butter, except unsalted butter; cakes, cookies, pies, candy; dried soups in envelopes, canned soups, vegetable, beans etc.; The list goes on and on. Read labels and buy only salt free food.

Commercial salt contains the following chemicals: silicon dioxide (common sand), aluminum calcium silicate, tricalcium silicate, sodium calcium aluminosilicate, sodium aluminosilicate, calcium silicate, magnesium silicate, yellow prussiate of soda and sodium ferrocyanide. Do you agree that commercial salt should be labeled with skull and cross bones.

For your improved health use the following salt substitutes: Powdered kelp, Dr. Bronner's Balanced-Mineral Salt, Vegetable (dried powder) seasonings, miso (from soybean), soy sauce (from health store), sea salt etc. Awareness is the key; be aware of what you buy from food stores. Read labels. Ask questions. Think. Think. Think. It requires little effort to cease the consumption of junk food when a sound nutritional program is adopted. Cravings for unwholesome foods and poisons are always a sign of malnutrition, poor eating habits, bad digestion and assimilation which are the effects of lack of knowledge and misapplication of universal and natural health laws.

Marijuana (Extreme Yin Poison-20 times more Yin than Sugar): You can only shake your head in wonder every time an educated person says marijuana is harmless, or repeats the comment that there is no scientific evidence that marijuana is dangerous. In the 13th century All al-Hariri reported the dangers of marijuana smoking. Warnings kept cropping up over the next 600 years and in 1893 the Indian Hemp Drugs Commission urged great caution. In 1924, the League of Nations unanimously classed marijuana as a dangerous drug. And it remained a dangerous drug until the early 1960's when 'due to a lack of solid evidence' researchers decided that marijuana was harmless. The evidence was there, it was just being ignored. A few tried to get their anti-marijuana views before the public and were hooted down. Others conducted research and published the results in obscure medical journals rather than face the public ridicule that an anti-marijuana stance brought. Finally, in 1974, the Senate Judiciary Committee conducted hearings on the marijuana epidemic and anti-marijuana research was made public. The collective testimony of 20 of the world's leading medical researchers unquestionably revealed that:

1. THC (intoxicating chemical in marijuana) tends to accumulate in the brain, glands, and fatty tissues.
2. Marijuana causes massive damage to entire cellular process.
3. Smoking marijuana causes irreversible brain damage.
4. There is danger of genetic damage from marijuana use.
5. Chronic smoking (three joints or pipeful per week) produces lung damage in six months that would take 20 years of heavy smoking of normal cigarettes to equal.
6. Marijuana and tobacco smoke are far more damaging to lung tissue than either by itself.
7. Prolonged use results in emotional problems.

These opinions were not the result of a single, isolated study as the nation's media reported and implied. Instead they were compiled after the study of many, many research projects. Nor were the studies conducted by unknowns trying to make a name for themselves. Dr. Julius Axelrod, a Nobel prize winner for his study of drugs and the brain said, marijuana causes an irreversible damage to the brain. Dr. Phillip Ze in ben berg, senior research psychiatrist at New York State Psychiatric Institute, said, chronic marijuana smoking causes bronchitis, diminished lung capacity and changes in lung tissue. He went on to say that it was very much more dangerous than first expected.

Dr. Harvey Powelson, a research psychiatrist at the University of California, Berkeley, was highly praised for his pro-marijuana stand in 1964. He was attacked in the press and in person when he changed his views. Opposition to the decriminalization of marijuana laws was unanimous. The committee was opposed and the witnesses were opposed. Facts supported their decision and logic refuted every pro-marijuana argument. The main reason was the conclusion that marijuana can cause death. This view may *be* shocking but scientific evidence proves that the dangers of death are great because marijuana increases:

1. The heart beat and blood pressure, enhancing the danger of a stroke.
2. Blood pressure and fainting, which could come while working or driving a car there is no advance warning,
3. The potency of barbituates, thus a non-lethal dose could be turned Into a lethal dose without the know-ledge of the barbituate user.

Those are the hard facts. Medical evidence also revealed dangers of chromosome damage, sexual impotence, and emotional changes, all of which the marijuana user may not be aware of until it is too late. Dr. Powelson's views changed as his psychiatric study deepened. He found that marijuana disrupts the thinking process and that memory and time become distorted. Brain damage to chronic users is permanent said Dr. Powelson. He said that three years of chronic smoking left one with a brain damage equal to 10 years of heavy drinking.

The effect of cannabis (marijuana): It is subtle and insidious, but harmful reactions in the heart and circula-tory system are suspected, and there are indications of adverse reaction in the body's anti-infection chemistry, said Dr. Henry Brill, regional director of the New York State Department of Mental Hygiene. While no one suggested that all marijuana users will move on to heroin, it was brought out, and unchallenged by the pro-marijuana groups, that 'the greater use of pot, the greater use of other drugs and that marijuana is the universal threshold drug through which young people make their entry Into the drug culture. But the biggest reason for opposing marijuana, both the use and sale, was brough out by Dr. Hardirt B. Jones, perhaps the world's most respected authority on drugs and drug abuse. Dr. Jones is professor of medical physics, professor of physiology, and assistant director of the

Donner Labora-tory at the University of California at Berekeley. He has taught drug abuse courses and interviewed over 1,600 drug users. Jones' findings, after many years of research, show that marijuana use kills cells in the area of the brain necessary for the awareness of pleasure the very part of the brain that allows the full awareness of the joys of being alive. There is perhaps no greater hell, said Dr. Jones, even with pain, than not to be able to feel alive. Those who are not able to feel alive will ever seek pain to get relief from their remorse. And that is the hell that is projected for those who use cannabis. The medical evidence filled 400 pages in the record of the hearings. This summarizes only a tiny bit. Marijuana also decreases the sperm count and volume in males, from ages 18 to 28; blood plasma is reduced 50% below normal.

Commerical Eggs:

Eggs may be used by those on transition diets stemming from the use of flesh foods, or by extrememly rundown and protein deficient individuals. Eggs contain complete proteins of high biological value, but the white of an egg, when taken to excess, is capable of producing intestinal putrefaction to a great degree. Non-fertile, unhygenic commercial eggs, increase stomach putrefaction to an ever greater degree. Many people are very sensitive to egg albumen and suffer symptoms of toxic poisoning, causing nausea, vomiting and diarrhea. The free use of eggs, especially of the white of egg, is found to be injurious in many cases of Bright's disease. Eggs encourage the growth in the colon of germs of putrefaction, which have been proved to be the cause of membranous colitis and of appendicitis. The regular and excessive intake of eggs, overworks the liver, causes gas, constipation and an over supply of albuminous matter in the body.

It can be seen then, that eggs, as a class of food, cannot be recommended without qualification. Infants, young children and invalids should use them very sparingly, or not at all. This class of people can better utilize raw goat milk products, as it contains high quality proteins with less danger of toxic residues. Cooked eggs are harder to digest than raw ones. Raw eggs are practically liquid. All foods must be turned to liquid before the body can digest it. The longer an egg is cooked the more difficult it will be to assimilate. Cook eggs as little as possible, never allowing the white to set. Coddled, soft boiled or poached eggs are the easiest to digest.

One egg contains 6 grams of protein, which is utilized about 94% by the body. Egg yolks are rich in all the elements necessary for complete nutrition, including iron, minerals, Vitamin B Complex and fats. Powdered egg shells are very high in calcium. Eggs are one of the few foods high in Vitamin D and A. The best eggs from the health standpoint are the ones bought locally from a farmer who allows a rooster to roam freely in the chicken coop, which produces fertile eggs. The chickens should also be allowed the freedom to soak up the outdoor fresh air and sunshine and be fed pure whole grains and food substances. Eggs being an extreme Yang food, should not be eaten in warm weather; they can be digested and utilized easier in cold (Yin) weather. People with Yang livers, kidneys, heart, colon and intestines should avoid the Yangizing affect of eggs. Meat, fish and eggs are not absolutely necessary to reach and maintain the highest level of optimum health, nutrition and longevity. If at first you succeed try to hide your astonishment.

Fig. 8.4. You have neither friends or enemies, only teachers. Learn from the Tao and you will have Internal Peace.

Chapter 9

Tao Garden's Healing Meals

As knowledge with regard to the effects of food upon humans increases, it is more than conceivable that the races that first avail themselves of the new values of nutrition may decrease the handicaps of disease, lengthen their lives, and so become the leaders of the future. Regimen is better than physic. Everyone should be his own physician. We ought to assist, and not to force nature. Eat with moderation what agrees with your constitution. Nothing is good for the body but what we can digest. What medicine can procure digestion? Exercise. What will recruit strength? Sleep. What will alleviate incurable evils? Patience.

The consensus of worldwide research and observation idicates that the ideal diet for mankind should consist of foods that are high in natural carbohydrates and low in animal protein, especially meat. This diet consists of the following foods and nutritional elements: Seeds, nuts and grains, which contain high quality B-Complex vitamin factors, Vitamin E, natural fatty acids, lecithin, phosphorus, iron, magnesium, zinc, proteins, fat lowering and energy building elements; fresh fruits and vegetables, especially berries, sub-acid and sweet fruit, fresh squeezed vegetable and fruit juices. These foods contain a super abundance of essential organic vitalizing vitamins, minerals, trace minerals, enzymes, alkaline cleansing, purifying and blood enriching elements.

This Ultimate Super Diet may be supplemented with yogurt, buttermilk, whey, nutritional yeast, kefir, sea kelp, alfalfa liquid, brown rice polishings and soybean powder with enzymes. These are natural protective foods. Use moderately.

Golden Nuggets of Nutrition

Seeds	***Nuts***	***Grains***	***Legumes***
Sunflower	Almonds	Buckwheat	Peanuts
Sesame	Walnuts	Rice, Corn	Soybeans, Peas
Pumpkin	Pecans	Millet, Oats	Aduki, Carbanzo
Alfalfa	Fillberts	Wheat	Black Beans
Chia	Cashew	Barley	Lima Beans
Flaxseed	Pine Nuts	Rye	Pinto Beans

Fig. 9.1. It is better to light one candle (Light of the Sun), than to curse the darkness. There is not enough darkness in the world to put out the light of one candle; nor is there enough ignorance or wrongdoing on earth to submerge what is corrected (The Way of the Tao).

Grains are Nourishing and Strengthening

All grains can be sprouted or used in making bread. Cooked grains are best in cold weather. In combination with legumes and vegetables, grains form nutritionally complete proteins. Grains are high in sodium, a Yang element. Grains are also high in phosphorus, an important mineral for proper brain functioning. Natural whole grains are excellent sources of B vitamins and contain six of eight

essential amino acids. The other two amino acids can be supplied by adding seeds, nuts, vegetables or legumes to grain meals.

Grains are heat producers and impart sustaining energy. For example, two slices of whole grain bread well-chewed, will impart more energy and working power to the body than two pounds of steak. The European centenarians are known to work all day in the fields on a bowl of vegetable soup, raw fruit and a few slices of dark whole grain bread. The hard working, enduring Chinese consume whole rice and seaweeds as their energy and strength sustaining foods. The Turkish people are extremely hardy and robust and eat grains, sesame seeds, dates, and raw camel or goat milk. The strong Russians use buckwheat and millet. The Mexicans use corn and beans. The Bulgarians are a lactovegetarian culture. They are a very hard working and strong people. The Bulgarian diet consists of whole grains, mainly barley, sunflower seeds, honey, sauerkraut, fresh fruits and vegetables.

Buckwheat is the most Yang grain, high in vitamin E and protein. Rice is more balanced and easy to digest. Rye and wheat are good muscle builders and give great endurance to the body. Barley is also very easy to digest. It can be mixed with vegetables, used for bread making and excellent for soups. Oats, flaked or rolled are good in cereals, soups and cookies. They are high in fat and aid people with slow working thyroid glands. Corn is an excellent summer food; corn meal and flour make delicious corn bread. Corn builds the blood and imparts high energy; it is high in calcium and natural complex carbohydrates. Millet is a yang grain, but not as acid forming as other grains. Its nut-like flavor makes a delicious and nutritious meal on cold winter days.

Grains are high in natural carbohydrates and should be used mostly during the cold winter months for heat and body energy. They should be used in smaller quantities in warm weather. Warm weather is Yang, and the body needs more fresh fruits and vegetables to maintain its fluids in proper Yin/Yang balance.

Whole Grains

Rice:

There are two types of brown rice long grain and short grain. Long grain rice is a summer food; short grain rice is more Yang and imparts more heat energy for the cold weather. Brown rice is an easily digestible starch, good for weak constitutions and for build-

ing overall good health. Rice, and all other grains should be chewed very well, from 30 to 50 times each mouthful; this will insure perfect digestion and assimilation. Rice can correct conditions of diarrhea and constipation, due to its balanced qualities. A regular diet of rice can lower blood pressure and help arteriosclerosis. Due to its high B-complex, rice calms the nerves and brain; it helps to overcome allergies. Brown rice contains phytin acid, which eliminates toxins and poisons from the body.

Oats:

Oats are valuable in cases of underactive thyroid and overweight conditions. Oat meal or steel cut oats are best eaten in the winter and late fall. It has been used with success to combat sterility and sexual impotence. Oats are high in silicon, a mineral element which gives one a healthy complexion, shiny hair, strong nails and sparkling eyes. Diabetics can become stronger and healthier with the regular use of oats in the diet. Oats help to eliminate stored protein and toxic wastes from the body. Oats are excellent in cooking breads, cookies and soups. Lungs and large intestines are most benefited by oats and rice.

Millet:

Millet is rich in phosphorus, magnesium, iron, silicon, fluorine, manganese, vitamin A and B-complex. Yellow millet aids digestive problems and can help repair the gastro-intestinal system. With its high B-complex, magnesium and manganese, it is excellent for all nervous conditions and mental fatigue. Millet has been used to help prevent miscarriages and correct deficiencies in pregnant women. Yellow millet should be used mostly in the fall, or Indian Summer. Red Millet is more Yin, and is a summer grain. Millet is the most alkaline of all grains, therefore it aids conditions of toxemia and acidosis. It is a good source of protein. The spleen is the organ most benefited by millet, as is the stomach.

Rye:

Rye helps improve the circulation and clean the blood vessels, therefore helping artereosclerosis. Rye helps strengthen and tones muscles and imparts high energy and endurance. It is very low in gluten. Rye is a spring food. Rye strengthens and purifies the liver and gall bladder. Rye is a hardy grain used by many European cultures. Rye is used to make bread, or as a cooked cereal.

Buckwheat:

Buckwheat has the highest amount of protein of all grains. It is also rich in minerals and vita-mins. In analysis, buckwheat contains 12% to 16% protein. The amino acid lysine is very high in buckwheat, therefore it has the same high biological value and nutritive quality as the protein found in animal food. The darker the buckwheat, the more protein it contains. Buckwheat contains a large amount of manganese, a mineral generally deficient in many people. Manganese strengthens the nerves, muscles and helps build good posture and courage to carry on the responsibilities of life. The manganese in buckwheat is necessary for muscle control, growth, metabolism and the reproductive system. Buckwheat is rich in rutin, one of the bioflavonoids, which is vital in reducing capillary fragility and maintaining sound blood vessels. Buckwheat helps to overcome environmental radiation poisoning and fallout. Its magnesium helps to calm, relax, cleanse and balance the nutrients in the blood.

Buckwheat is rich in Vitamin C. It should be used mostly in winter, as it imparts high energy and heat. The kidneys and bladder are most benefited by buckwheat. The very hardy Russians and other European countries thrive on this most versatile grain. It can be used in noodles, cereals, casseroles, loafs, and takes the place of meat products. Buckwheat is also a good blood builder and helps to overcome anemia.

Corn:

Corn is very rich in calcium, Vitamins B, C, A and F. It is a summer grain. Corn aids conditions of underweight and overactive thyroid; it slows down the metabolism. It is beneficial for the heart and small intestines. Corn builds strong bones, teeth and muscles. Our ancestors thrived and survived on corn. The early Native Americans and Mayans cultivated corn for centuries. They built great civilizations, and their people were robust and long lived. Corn can be eaten on the cob, made into corn bread and soups. It is the most Yin grain and should be used mostly in summer. It imparts good vitality, aids digestion, and builds rich red blood. Corn is the sweetest of all grains, and is converted into sugar within the system very quickly, giving quick energy and endurance. Corn oil contains vitamins F and E. Corn meal is highly nourishing and contains vitamin A.

Barley:

Barley is a fall food. It is beneficial for the lungs and large intestines. Barley is very easy to digest and is good for those with weak digestive systems. It can be used in soups and bread; it is used in making barley miso, which is not as Yang as soybean miso. Barley is used by many cultures around the world. It imparts much heat and energy and gives one strength and endurance. Valuable in conditions of underweight, stomach ulcers, diarrhea. Contains vitamins B-l and B-2. Also as poultice for skin diseases and burns.

Wheat:

Wheat contains the highest vitamin and mineral content of all grains. The bran in wheat imparts good digestion and elimination. The germ in wheat contains a rich source of vitamin E, which builds a strong reproductive system, improves endurance and aids the heart function. Wheat is beneficial to the liver and gall bladder.

The gluten in wheat will not cause allergies if the liver, kidneys, and eliminative channels are kept clean and free of toxic wastes. Many times allergies are caused, not by wheat alone, but by a system filled with milk, cheese, fats and sugars. The gluten may react allergically in a body that is weakened by high fat and sugar foods. Experiment on yourself; discontinue all fatty, oily and sugared products, including dried fruit and tropical fruit for several weeks. Then eat whole wheat for a few days, and observe the reaction in your body. Poorly masticated wheat can cause indigestion, mucous, allergies and poor health. Chew and salivate all grains very well, and watch your health improve, and allergies vanish like magic.

Wheat is used in bread making, cereals, sprouting, noodles, pancakes, bulghur and couscous. Wheat is high in protein and gluten. Wheat has been used by all great civilizations and cultures throughout history. Allergies are unknown in wheat eating cultures where there is no milk, sugar and fatty food.

Beans and Legumes

Legumes take in the whole bean family, including peanuts, peas, split peas and lentils. Legumes consist of both protein and starch they are considered complex carbohydrates and are rich in vitamins and minerals, especially the B-complex vitamins. All legumes should be eaten moderately more in winter than summer.

Aduki Beans: Used successfully in kidney disorders, and is a good bean for general use. When cooking all beans, use about 3 cups of water to one cup of beans.
Black Beans: Aid kidney functioning and sexual disorders, such as menstrual difficulties, frigidity, barrenness, low sex drive. Black bean juice the liquid left over after cooking the beans, (use 1 or 2 extra cups of water when making any bean juice) can be used for throat disorders, such as laryngitis and hoarseness. Black turtle beans are excellent in soups and combined with rice or buckwheat.
String Beans: More like vegetables, and contain more protein than vegetables. They should be eaten in warm summer months, in season when available. They are good for constipation, rheumatism, acidosis, bladder and kidney disorders. They are low in protein and rich in vitamin A, B-1, C and B-2.
Soybeans: Not generally recommended to be eaten regularly, as they contain difficult to assimilate substances that adversely affect the thyroid gland. Tofu, a soybean cheese can be used occasionally. Miso and tamari sauce are made from soybeans and can be used more often during winter months for body warmth. These products are high in vitamin B-12 and iron. They also help the body fight off the harmful effects of environmental radiation and fallout. They are beneficial to the thyroid gland. Soybean products are also high in protein.
Green Peas: Good for the stomach and lungs. They contain many valuable vitamins and minerals. Green peas are highly nourishing and strengthening. They aid conditions of anemia, emaciation and low blood pressure. Contain vitamins A, B-1, B-2, B-6 and nicotinic acid. Good with most grain dishes and salads. Yellow split peas are excellent for all digestive disorders, and are very easy to assimilate. They can be used at all times of the year for warmth and energy. Lentils contain similar properties of split peas and cook the same way. They are all good sources of protein. Dried peas can be cooked without soaking overnight, in 60 to 90 minutes on the stove. Pressure cooking takes about 30 minutes.
White Beans: Aid in discharging excess toxicity from the heart. They are a good all around bean to eat with grains and vegetables.
Garbanzo Beans: They are also called Chickpeas. Good source of protein. Used in many cultures around the world, including Greece, the Near East and in most American restaurant salad bars. Chickpeas can be eaten in soups, salads, loafs, sauces and dressings. They have a rich flavorful taste and are highly nourishing.

Pinto Beans: Contain the highest RNA and DNA factors of almost all foods, except sardines. They have been used in the south and Mexico for many years, and are usually combined with corn bread and other corn recipes. Pinto beans are also high in protein, vitamins and minerals.

Kidney Beans: Shaped like the human kidney and are said to strengthen the kidneys. They are rich in protein, and are very warming and nourishing to the body. They can be used in salads, casseroles and other grain dishes.

Lima and Butter Beans: Good sources of iron and are easily digested and assimilated. Good for anemic people and weak digestive systems. These beans are very strengthening and building and can help to overcome emaciation and malnutrition. They contain vitamins B-6, B-1 and B-2. Good protein source. Good in casseroles, grain and cooked vegetable dishes. Lima beans aid the discharge of toxins from the liver, and build strength in that organ.

Germinated Seed and Nuts

The king of all nuts is the almond. The sunflower and sesame seeds are the queens of all seeds. Germinated seeds and nuts are alive with life; they have the power to grow and to create new life. They can create a new rebirth in your own body if used regularly. The world renowned health authority and longevity researcher, Seeds have been found in Tutankaman's tomb three thousand years old they have been put in the soil and have grown. Sunflower seeds have been found in the old missions that are two hundred years old and, when planted, have grown. The seed is the element that contains the birth of a tree, the birth of a plant, the birth of vegetables. In the seed of the tree we have the pattern for the bark, the sap, the flowers, the fruit everything that had to be put into that seed to begin with. All the life giving elements are contained in seeds, carefully locked in. They are there for our good. Seeds contain nearly every single food element that has been discovered, and doubtless all the additional factors not yet identified. No other one food is so rich in nutrients, the seed containing as it does, the life forces needed to build the new generation. Seeds have highly potent therapeutic values. They are prime sources of most of the nutrients and one of the most potent sources of unsaturated fatty acids needed to maintain youthful and elastic arterial conditions.

Seeds and nuts are high in calcium, Vitamin E, phosphorus, niacin, lecithin, fatty acids, iron, natural oils and a good high quality protein. Pumpkin seeds contain zinc, a hard to get mineral necessary for proper prostate functioning. Seeds are rich in Vitamin A, B-Complex and magnesium. Germinated seed and nut milks are an excellent substitute for regular milk, and contain complete proteins of a superior biological value, capable of sustaining life in perfect health indefinitely.

Miracle of Seed and Nut Germination

Seeds and nuts are essential nutrients for the body. Mention seeds or nuts to someone and this is what you hear. They make me constipated. They cause skin problems. They are indigestible. Yes, when seeds and nuts are eaten in the conventional way they can cause these problems.

Seeds and nuts are loaded with vitamins, minerals, fats and proteins of a high biological value. But if they are eaten after a heavy meal, snacked on between meals, poorly chewed, ungerminated, salted, oiled and preserved with chemicals, they can cause much harm to the liver and intestines. Seeds and nuts are very concentrated, so they must be eaten in small quantities.

Since seeds and nuts are quite difficult to digest for most people, passing through the body unassimilated, it is important that they be soaked or germinated, at least overnight in water or juice. The longer you sprout a seed or nut, the more alkaline it becomes, and the less acid reacting qualities it will have. So, we recommend soaking the seeds or nuts overnight to maintain the protein elements that are needed for the daily acid/alkaline balance. Three to seven day old sprouts are excellent alkaline foods, but they should be balanced with 1 day old seeds or nuts, soaked.

Soaking seed and nuts, and the sprouting process make them very easy to digest and assimilate. This method also converts them into complete protein, allowing the body to utilize up to 100% nutrition as a result. Unsoaked or ungerminated seeds and nuts contain only 20 to 30% nutrition: the rest being waste products, causing indigestion and cravings for junk food. Humans cannot derive complete nutrition from dried fruits and dried seeds and nuts. Undigested protein from these foods creates toxemia, which can cause the following conditions in time: falling hair, poor eyesight, anemia, diabetes and weakness.

Dried fruits, nuts and seeds, unless soaked overnight, are extremely constipating and toxic. They can become as disease producing as devitalized foods, due to their indigestibility and poor assimilation. Dried apricots, figs, dates and raisins should be soaked in water or juice from 4 to 8 hours. Use dried fruits in moderation and mostly during the winter months. The Taoist of China and India, who maintain vibrant health and youth far into advanced ages, from 120 to 200 years old or more, advocate and practice the eating of soaked and germinated seeds, grains and some nuts.

Germinating Seeds and Nuts

If we could pick nuts and seeds right from the tree and eat them on the spot, there would be no need to soak them because the necessary moisture and life force would still be intact. In the dried state the life force is lying dormant, therefore, these foods require soaking to wake up the Life Force within them. This is the same principle used in sprouting wheat grass, lentils, mung beans or alfalfa seeds. The life force within the seed or nut is tremenously increased.

Since we are living in an unnatural society and environment, we have to resort to these methods, which are in no way contrary to Natural Law. In fact, it is natural to germinate all seeds and nuts. Also as these foods were already tampered with through the process of early picking and storing; we are merely replacing the natural moisture that was taken out. Another important benefit from soaking seeds and nuts, is that their protein quality is enhanced, along with a higher quality natural taste. We are simply bringing out their finer qualities, and not detracting one iota from the health value. The same method is true of soaked, dried fruits. Their vitamin, mineral and iron content, and assimilability greatly increases. For more variety, use different seeds or nuts. Try sunflower, pumpkin and sesame seeds, almonds, filberts, pine nuts, walnuts and pecans. Make sure that you hull these seeds and nuts before soaking them. The seeds need only be soaked overnight. The heavier nuts can be soaked up to 24 hours for better assimilation and nutrition. If you are planning to sprout seeds and nuts for a longer time, use a sprouting dish, or a jar with a screen on the lid. Wash them with water 2 or 3 times a day; let the water drain over the sink, and in 3 to 6 days you will have some nutritious and delicious

green sprouts. The last day of sprouting, place the sprouts on the window ledge and the sprouts will turn green. You can sprout anything that will grow from a seed. Sprouts and all seeds and nuts contain Vitamin E. They also build up the glandular system of the body.

The maximum benefit is received from dried fruits if they are soaked first, as unsoaked dried fruits almost always cause gas before the digestive juices can get to them. The normal digestive process for dried fruits lasts about ten hours, and before the unsoaked dried fruits are adequately soaked up by the digestive juices, the body is ready to expel them. Thus, we do not get the good out of them unless they have been pre-soaked. There is an art to soaking the dried fruits properly. Wash, add cold water to cover, and bring slowly to a boil. Remove from heat and allow them to stand all night. The boiled wated kills all insects and parasities that might otherwise cause trouble. Remember to start with cold water, so that the increasing heat will penetrate into the inside of the fruit. They also may be soaked overnight and liquified with juice in a blender.

Enzyme Inhibitors in Unsoaked Seeds/Nuts

According to Dr. Edward Howell, research biochemist in the field of nutrition and enzymes states that any ungerminated raw seeds or nuts contain enzyme inhibitors. These inhibitors are necessary for the protection of the seed, to keep it from germinating prematurely and die. Raw seeds and nuts actually neutralize some of the enzymes our body produces. In fact, Howell states, eating foods with enzyme inhibitors causes a swelling of the pancreas. Raw peanuts and egg whites contain the most enzyme inhibitors. Most fruits and vegetables do not contain enzyme inhibitors; they are rich sources of living enzymes.

Sprouting and germinating seeds and nuts destroys the enzyme inhibitors and also increases the enzyme content from a factor of 3 to 6. Peanut butter and other nut butters, because of their lack of enzymes and high fat content, are very indigestible and should not be eaten often; use sparingly. The same goes for all seeds and nuts, unsoaked or unsprouted.

Germinated and Blended Seed/Nut Milk

When soaking seeds and nuts overnight they become much easier to digest and assimilate in combination with sub-acid fruits. No more than 2 or 3 ounces should be eaten. Soak seeds or nuts overnight in fruit juice or water, and the next morning or afternoon make a blended nut milk. Add berries and juice along with 1 teaspoon of vegetarian protein powder; blend together and you will have a meal of total and complete nutrition. After a few weeks on these super nutritious foods, your complexion will glow and your blood count will rise. As health culturists, let us look the part, so that we may be an inspiration to everyone we meet. Remember, the proof is in the doing.

Sprouts: Wonder Food

Sprouts are truly a miracle food. They are an excellent source of vitamin A, B-Complex, C, D, E, G, K, and U. Dr. Pauline Berry Mack, at the University of Pennsylvania, found that soybean sprouts of 72 hours contain more Vitamin C than 6 glasses of orange juice. Sprouts also contain all eight of the amino acids which make up protein. It only takes about a tablespoon of alfalfa seeds and two to three times that much to plant 25-30 square inches. Soak the seeds overnight in a warm dark place in about three times as much water as you have seeds. The water should be warm (70-80 degrees) and free of chlorine and flourine, which can sterilize the tender embryo.

Pour the water off and rinse them well to prevent mold. This water is excellent for juices and stock. Place seeds in a warm, moist, dark container. Flush every 4 to 6 hours with water to clean them and assure adequate growth. Be certain the seeds drain well because they will sour and rot if you do not. In 3 to 6 days, depending on the temperature (80 to 90 is best) and seed variety, your seeds will have doubled or tripled and be ready for consumption. Sprouts reach their highest vitamin peak 60 to 80 hours after germinating.

If you expose your sprouts to indirect sunlight during the final several hours of growth, they will develop chlorophyll. The chlorophyll molecule is very similar to the hemoglobin, the only difference being that chlorophyll has magnesium at the center, while hemoglobin has iron, and consequently, acts as a blood booster.

Probably the simplest container is the mason jar, substituting a wire mesh for the lid. A large bowl makes an excellent container for the jar since it should be at a 45 degree angle to assure proper drainage.

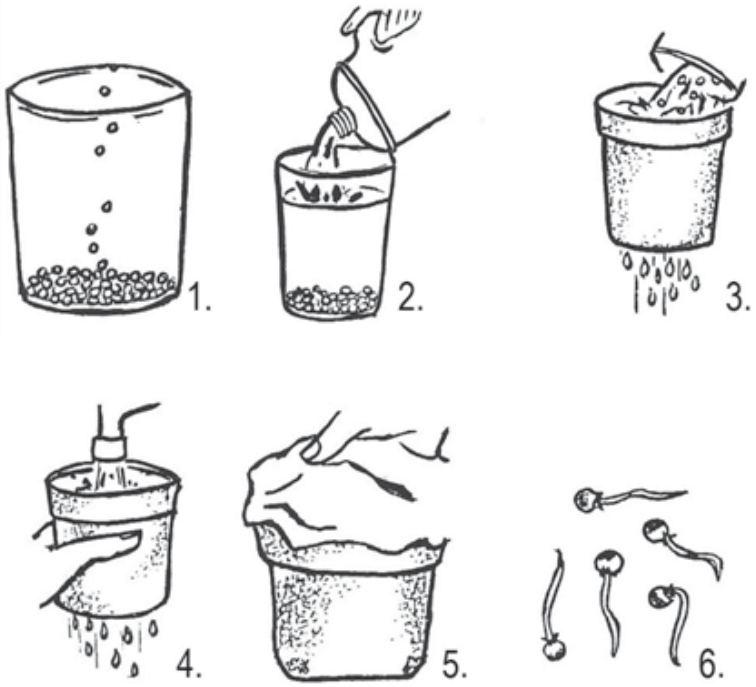

Fig. 9.2. Sprout Seeds

1. Individual portion, put a ¼ inch layer of seeds in a water glass.
2. Fill glass about ¾ full of distilled water. (Do not use tap water). Let this soaking take at least six hours, or if done just before going to bed, let stand overnight.
3. Pour contents of glass into a small flower pot that has small holes on the bottom. If it is a pot with one large hole, put cheese cloth or wire mesh over the hole.
4. Bring flower pot under water faucet and allow water to thoroughly rinse over seeds.
5. Cover seeds with wet cheesecloth, or turkish toweling. Repeat rinsing of seeds three times a day (as in No. 4), replacing moist cloth over seeds.
6. Sprouts should look like this on the third day ready to eat.

Fruits for Beauty, Health and Longevity

The bioelectric forces of the earth in its mysterious way, combined with the biomagnetic forces of the sun and atmosphere, produce fresh, ripe blood building fruit. Fresh wholesome fruit, taken in season, and in moderation, release upon the forces of the body vital alkaline vitamins and mineralsthe living building blocks so necessary for healthful robust living.

The living fruit, kissed by the basking rays of the energizing solar sun, absorbing draughts of magnetized air, attracting to itself all the vital elements necessary for its perfection, is a cosmic miraclean electrochemical laboratory of Nature (the Tao). Scientists can remove all the chemicals of an apple out of a chemist's dish, but he cannot construct an apple. They may probe and analyze all the elements of a cherry, but they is dumbfounded to know what makes them red. They may take apart and attempt to reconstruct a plum, and they will find that the plum will help support life, but the broken down chemicals do not. Fruit contains essential bioelectric principles Yin and alkaline elements which, when eaten in additon to a well-rounded, balanced diet, will give the electric spark of life and vital health force.

Who has not had his mouth water on seeing a luscious peach, cherry or melon before him when hungry. The sight, aroma and taste of fruit, bring on an abundant secretion of digestive juices; they are very digestible on an empty stomach. A total fruit or eliminative diet can be used as a remedy to balance Yang kidneys, liver, colon and intestines, for a short period of time. Otherwise, use fruit in season and grown locally. Eat more fresh raw fruit in hot summer months when they are abundant; less in cold weather when they are not in season and less abundant. Apples or pears can be baked or steamed in the winter for warmth and variety.

Berries	***Melons***	***Seasonal Fruits***	***Tropical Fruits***
Blueberries	Watermelon	Cherries	Oranges
Blackberries	Cantaloupe	Grapes	Grapefruit
Strawberries	Honeydew	Apples, Figs	Tangerine
Raspberries	Casaba	Pears, Raisins	Pineapple
Huckleberries	Persian	Peaches	Mango
Gooseberries	Cranshaw	Apricots	Papaya
Elderberries		Plums	Lemons
Loganberries		Nectarines	Limes, Avocado
Boysenberries		Persimmons	Banana, Dates

Fig. 9.3. Seasonal Fruits

Fresh berries head the list as being the best of all blood builders, containing a rich source of iron and vitamin B-12. Ripe fruit, in moderation, does not cause acid or toxic conditions in the body, nor do they cause diabetes or other diseases when used judiciously. Sub-acid or acid fruits may aggravate a system that is already highly toxic or acidic: they will stir-up the internal acids and cause pain or discomfort. Acid and Yang conditions can benefit from the use of non-acid fruit, such as all melons, and neutral vegetables and their juices.

In healthy people, fruits are alkaline in reaction in both urine and ash lung tests. Fruits are easy to assimilate, and if eaten moderately, do not overwork the pancreas, as does pastries, fats and sugar products. However, be advised that an excess of fruit will over-alkalize the body and blood, and cause Yin diseases, such as, hypoglycemia and diarrhea. Melons are a rich source of minerals and vitamins, however, they should be eaten only in small quantities, especially if one has expanded (Yin) kidneys.

The longest lived and healthiest people on earth consume some fruit everyday rounding out their daily diet with grains, seeds, nuts, vegetables and some raw milk yogurt or buttermilk. Chlorophyll is not only found in the green element of vegetables, but also in all fruits kissed by the sun. Fruit is also more likely to be free from strontium 90 radiation fallout than other food grown close to the ground. Fruits are manufactured from cosmic sun rays, the oxygen absorbed through the leaves, and the water filtered by the roots in the soil. A large fruit orchard will produce over 100 times more pounds of fruit than meat in the same acreage.

Fruits are very abundant in organic vitamins, mineral salts, purified distilled water, and refreshing and healthful. They are high in natural sugars and fruit acids. Most fresh fruits contain about 90% water, 10% carbohydrates and not more than 1 ½ % protein. Fruits are cooling and refreshing to the body because of their high water and organic acid content. All ripe fruits are alkaline reacting within the system. These alkalies neutralize the acid poisons, uric acid and acidosis, usually coming from a high protein meat diet. Overeating of fruit, especially the citrus variety will saturate the body with citric acid, which can cause serious calcium loss, mineral depletion and an unbalanced blood chemistry resulting in Yin arthritis, stiff joints, tooth decay, nervousness, nerve diseases and toxic acidity.

All fresh berries and especially strawberries, excel almost all other foods in easy to assimilate iron and organic bases to neutralize acid wates. Fruits contain citric acid, malic acid and tartaric acid. Citric acid is found in all citrus fruits and in other fruits such as, cherries, currants, berries, pomegranates and tomatoes. Malic acid is found mostly in pears, plums, apples, pineapples and cherries. Grapes contain tartaric acid. Oxalic acid is found in small amounts in most fruits, but cranberries, spinach and most greens are high in it.

Fig. 9.4. Seasonal Melons

Sweet fruits are especially valuable for their delightful sugars, so easily digested (sometimes almost predigested), which sustain the body with so little energy expenditure for digestion.

Fruits can help you overcome Yang constipation, especially cherries, grapes, prunes, figs, berries and lemons. The acids of fruits increase the secretions of the intestines, move the bowels and increase their peristaltic action. Fruit meets the bodily need for natural bulk and intestinal health.

Most fruits contain phosphates and alkalies, together with acids, which increase the solubility of the blood, causing it to flow through the system more readily. Since fruits are Yin, overeating them can easily cause Yin constipation (expanded colon and intestines). In this condition, eat less fruit, and increase consumption of cooked grains, vegetables, miso and tamari, for a natural balance and healthy colon.

A balanced diet, including fruit, purifies the blood, that even the cravings for alcoholic drinks have been known to disappear. When the blood is purified and its pure nutrient stream bathes the cells and tissues, it will remove wastes, impurities and dead cells, and leave behind strong healthy tissues. In time, the alcoholic will be completely purified and cleansed, and in his right mind. Alcohol will then be repugnant after the cleansing period.

Eat Fruit Alone

Fruits should be eaten on an empty stomach, and not as a dessert, after the appetite is satisfied and the digestion is already sufficiently taxed. Fruit taken in the morning, before the fast of the night has been broken, is very refreshing, and in addition to its nutritive qualities, serves as a stimulus to the digestive organs. Berries, cherries, melons, tropical fruits, apples or pears are all excellent at this time. Eat ½ hour before protein or starch meals.

Fruit to be most valuable as an article of diet, should be ripe, sound, fresh, and in every way of superb quality, and be eaten raw or baked. If you live in the sub-tropics, you can pick and enjoy fruit directly from the trees almost all year long. Northerners will find apples, pears, peaches and plums most enjoyable during the summer and winter months.

Many people believe that fruit does not agree with them. In such cases, the trouble may be traced to the abuse and misuse of the fruit, or because of digestive weakness due to wrong eating habits previously. Fruits combined properly will not cause problems. Fruits eaten with starch or other junk foods will cause fermentation. Fruits eaten moderately and by themselves are easily digested.

Fig. 9.5. Seasonal Vegetables

Vegetables: Rich in Chlorphyll

Vegetables, especially the non-starchy greens, contain the greatest amount of blood building chlorophyll. Chlorophyll, as found in fruits and greens, is necessary for the health and well-being of all living creatures on this planet. The strongest and longest lived animals in the world are vegetarians and consume rich green chlorophyll in the form of plant food, which is adapted to their complex digestive system.

Chlorophyll is composed of a combination of tiny molecules of a substance called pyrrole. These pyrroles are the building blocks of the animal blood pigment, hematin or hemoglobin. The pyrroles in plant chlorophyll are tied together by an atom of magnesium, whereas in human blood, the mineral bond of these pyrroles is iron. The human system requires green chlorophyll for proper blood formation, which builds healthy cells and tissues. The color green, according to the ancient art of color therapy is a healing agent and bone mender. Green vegetables are excellent sources of Vitamins A, B-l, B-2, C, K and Vitamin E as well as an abundance of organic mineral salts, alkaline elements, trace minerals and enzymes. Vegetables rank high as health builders, and are superior blood and bowel regulators.

The best raw vegetables for salad making are: alfalfa and mung sprouts, cucumbers, green and sweet red peppers, onions, radishes, celery, romaine, bib and Boston lettuce. Coarse, tough vegetables should not be used instead use the tender juicy variety. Root vegetables, cabbage, beans, peas, squash should all be cooked for proper assimilation. Hardly a person exists that can properly digest and assimilate these foods without the aid of fire to soften the cellulose and tough fibers, a substance that is indigestible for humans, and which is not acted upon by the digestive fluids, unless it is softened by heat.

All raw vegetable greens can be easily utilized and assimilated by the system when they are juiced and consumed immediately. The rich green chlorophyll in vegetable juices is easily absorbed into the system within a matter of minutes. Use juices moderately at all times. Use small raw salads in warm weather, and cooked vegetables in cold weather. A word of caution: Consuming large salads daily will overwork the liver and stomach causing digestive disorders. Too much raw vegetables cause expansion (Yin) conditions within the body. Man does not possess several stomachs as a cow does, to assimilate and digest hugh amounts of raw vegetables. About 20% to 30% of the daily diet should consist of raw and cooked vegetables.

Besides drinking vegetable juices, you can make delicious vegetable broth soups, steam a variety of starchy and mildly starchy vegetables such as potatoes, pumpkin, beets, carrots, broccoli, celery and cabbage, or cook grains such as brown rice, buckwheat, millet or oats. Steam and cook your vegetables and grains in a stainless steel pressure cooker, steamer, or waterless cooker over a very low flame. This will insure that the goodness and freshness of the cooked food remains intact when you serve it at the table.

Cultured Dairy Products

The long lived Russians, Europeans and Bulgarians, believe strongly in the use of cultured dairy foods. Scientists have found that cultured dairy products help to increase the beneficial and friendly bacterial flora in the intestines, maintaining its cleanliness and health. Soured acidophilus milk rejuvenates the intestinal tract, improves digestive problems and relieves constipation.

Those who want to use dairy food, without the harmful effects of high fat milk and cheese, can consume the following low fat dairy products in moderation: buttermilk, low fat yogurt, cottage cheese and skim milk. These products are not extreme Yin or Yang, but are more neutral except for low fat cottage cheese which is more Yang. Cultured dairy food should be used very sparingly in cold weather, and moderately in warm weather. Yogurt began its rise to fame many years ago in the European countries, and suddenly it has become a super food of the world. Yogurt contains high quality and easily digestible proteins, vitamins, minerals, enzymes, including Vitamin D and B-12. Because it flourishes with friendly bacteria it is almost a predigested food, quickly absorbed and assimilated into the blood stream. The sparing use of low fat dairy products can add variety and nourishment to your natural food diet. However, that milk was originally intended for infants only. Use wise judgment in the dietary use of this food.

The kind of food you eat is even more important to your existence than the kind of air you breathe. More good healthor ill healthcan be traced directly to food than to any other of the outside factors surrounding your existence.

Fig. 9.6. Seasonal Foods

General Dietary Principles

The daily menu plans should be flexible and adaptable to meet individual needs and requirements. It is very difficult to set down a specific dietary eating program for all persons under varying conditions on a daily basis. Each person must use supreme judgment in choosing foods, recipes and menus to fit their own personal and environmental needs. One has to devise their own pattern of how to eat, when to eat, where to eat and what to eat. For example, people working physically hard outdoors all day long may require a more substantial breakfast to meet their energy demands. People not working as hard will require less food and calories.

The main point to remember is to eat only when hungry in the morning and/or throughout the day. Keep in mind, however, that the body is not fully awake and ready to absorb and assimilate a heavy meal soon after waking. The ancient Taoist recommend that we may eat more food at breakfast in cold winter weather and less food in the evening during warm summer months. Many people consume far too much food and exercise very little, whereas, if they would exercise moderately everyday, they would utilize their food more efficiently and not require as much volume. Or, many people consume too much fruit and not enough vegetables, or too much meat and dairy, and not enough of grains and legumes.

The key to good health is to balance our eating habits with our daily work, exercise and living habits, and thus maintain the body in a constant youthful condition. We learn a thing by constantly doing itif we constantly cultivate healthy habits, we will reap or create healthy bodies and freedom form disease. The ultimate choice is yours; you can be master of your destiny if you truly understand that your health can be no better than what you eat, assimilate, absorb and digestand the effort, discipline and value you place on internal and external physical fitness.

By daily cultivating these dietary and health principles for the rest of your long life, you will not worry about vitamin or mineral deficiencies, malnourishment, calories or ill-health. The suggested menus should not be a strict cut and dried calculation. Use them as approximations of what to eat according to climate, locality and daily body requirements. Study the diets of various countries around the world. Many nationality dishes are vegetarian or can be easily converted. Many nations with a history of longevity and good health have a national staple based on legume and grain combinations which are easily included in a vegetarian or transition diet.

Food Cooking

To cook or not to cook, that is the question that has been hotly debated by healthfooders for many years. It is true that some articles of food can be eaten without preparation or cooking with full benefits of health and nourishment, i.e., most fruits and some vegetables, such as cucumbers, all germinated seeds and nuts, green peppers, celery and other tender juicy greens. Much of the food consumed by the long lived people of the earth has been raw, i.e., yogurt, seeds, grapes, pears, berries and celery. However, during cold winter months these robust people consume cooked grains, vegetables, legumes and soups. Since cold weather is extremely Yin upon the body, properly cooked natural foods are a physiological necessity to keep the body warm and in Yin and Yang balance. We need more Yang cooked food in winter, and much less in summer; eat more raw food in summer. This is the law of nature. If we try to deny our physiological requirements, i.e., consuming raw food exclusively or cooked food only, the body will not function efficiently and in good health.

It has been argued that all wild animals take their food raw. This is true. However, they have a digestive system adapted to digest tough raw vegetables. Their system consists of several stomachs, larger livers and kidneys, very powerful enzymic and digestive secretions and acids. Fire is one of the five elements of nature. Fire is what separates humans from beast. Without fire, civilizations would not advance; we would still be like the animals in a wild or primitive stateno advancement, no civilization, no evolution, no great intelligence, no art, no culture, no mental and spiritual upward movement. Humankind was given the knowledge of the use of fire to advance themselves; to populate the globe, including the cold northern regions. To accomplish this task, heat and fire was a necessity to keep warm, survive and grow; heat energizes food. A total raw food diet would not meet this requirement. Constant change and advancement is the law of the universe. Without change, there is decay. Without change, there is no advancement. When we learn to flow with the change, we can become healthy, and advance successfully. The human system cannot possibly assimilate and digest raw legumes, grains and root vegetables the starch molecule must be broken down or dextrinized by the use of fire to absorb the food value. Raw starch is indigestible. Sprouted grains and seeds are also Yin and can be used in salads, along with cooked legumes and grains.

Fruits can be eaten raw in season, and can be absorbed and digested easily, however, they cannot sustain the body in superior health exclusively. It is true that cooking has been abused in modern times, but this does not mean that proper cooking is bad; it is good. Because water drowns people is no reason to stop drinking it; because fire can burn and destroy life and property is no reason to not use it to heat the house or cook the food. In general, foods that are palatable raw, should be eaten in that form. Other foods not suitable to the human stomach raw, are better cooked, in which state they are more readily acted upon by the digestive juices of the stomach.

Fig. 9.7. Code of Eating Natural Foods

Vital Keys to increase your Life Force

1. Refrain from overeating at any one meal. Leave the table one-half to three-quarters full. This will allow proper assimilation and digestion. Overeating overworks the liver, kidneys and internal secretions and can take 30 to 40 years off of your life and cause many illnesses.
2. Always go outside after a meal. Because the body requires plenty of oxygen to properly oxidize and assimilate food, especially protein or starch foods. Take a slow outdoor walk for one-half to one hour after meals and gaze into the distance; this relaxes the digestive and nervous systems, allowing smooth and easy digestion.
3. Never eat according to the clock. Eat only when there is a very strong desire for wholesome foods. Hunger is a watery

mouth and throat sensation. Nausea, headaches, addictive cravings, or stomach pangs are a sign of stomach trouble. When not hungry, fast until it returns in full force.

4. Always chew or masticate your food to a liquid state before swallowing it. The stomach has no teeth. The more you chew, the better your digestion will be. Starch foods, i.e.,grains, legumes, root vegetables especially require ptyalin, an internal chemical secretion in saliva which starts the process of digestion of starches. If you have trouble chewing food, eat a bite of celery with every bite of starch; you will chew longer.
5. Do not eat when in pain, worry, emotional upset or when sick; food cannot digest in these states.
6. It is best to eat the evening meal no later than sundown, when the earth's energy and magnetic forces are still present. Allow 3 to 4 hours from the evening meal to bedtime.
7. Keep meals simple for easiest digestion and most efficient utilization of nutrients.
8. Use only soaked or germinated seeds and nuts. Roasted seeds and nuts are more Yang and can be used more in winter. Roasting lessens the fat content.
9. Always soak dried fruits over night. Use more in winter.
10. Use kelp, powdered vegetables seasonings, miso, tamari on foods for taste.
11. Use pure vegetable oil in cooking or salads; no more than 3 teaspoons/day. Make dressings with yogurt or seed sauces.
12. Eat foods mostly grown in the region you live; eat seasonally, i.e., foods grown in your area at each season. Eat more raw food in summer; more cooked food in winter.
13. Use mostly neutral herb teas for daily consumption: Mu tea, bancha, jasmine and dandelion are good.
14. If possible, eat food organically grown without pesticides.
15. Plan meals not only for nutritional content, but also aesthetic interest. Blend and harmonize colors, textures and flavors.
16. Cut vegetables in small pieces; they will cook quicker.
17. In food combining use nuts and seeds or milk products with acid or sub-acid fruit or non-starchy vegetables; use grains and vegetables together; do not use fruits and starches together and do not use sweet fruits and protein together. Sweet fruits are best eaten alone.
18. Be cheerfulness at mealtimes to aid digestion.

By making these General Dietary Principles a daily habit, you can attain excellent health and long life. However, everyone is different, and they must vary these dietary suggestion to fit their own individuality. Changes can also be made for people on special diets or severe digestive disorders, such as blending salads or pureed fruits and nut and seed milks. Weak digestive systems need much help, and they can greatly benefit from the use of blenders, juicers, mixers etc.these are life saving dietary measures to be used when necessary.

Fig. 9.7. Five Element Food Tastes in the Creation Cycle at Tao Garden

Five Elements and Food

Balancing the Five Elements can become extremely complex. However, there is a lot you can do with careful choice of food to rebalance your own organs and health. Firstly, we look at the different internal and external climates and foods to help them:

Condition:	***Symptoms***	***Foods***
Too Windy:	Moving Pains, Wind, Spasms, Dizziness, Spring Season	Oats & Pine Nuts; Chamomile Tea, Ginger and Fennel. Fresh Greens and Salads bring a Spring Cleanse.
Too Hot:	Feeling Hot, Flushed Skin, Summer Season	Raw Foods, Fruit, Cooling Herbs (Mint). Light Eating.
Too Dry:	Dry Skin, Thirst, Constipation, Autumn Season	Soya Products, Nuts, Seeds, Dairy. Psyllium, Malva Nuts, Flaxseed Tea.
Too Cold:	Feeling Colder than people around you, Winter Season	Soups, Casseroles, Warming Spices, Ginger. Warmth-Building Foods.
Too Damp:	Having too much Mucus or Phlegm, Rainy Season/ Seasonal Changes	Avoid Dairy. Avoid Cold Foods. Mung Beans, Aduki Beans, Garlic and Pumpkin Reduce Damp.

Different flavors are used in Five Element nutrition to balance each element. Different flavors have different energetic effects:

Sweet: This is actually the central flavor of the diet. Thus, the basis of our diet is full sweet foods such as wholegrains, beans and root vegetables. The empty sweet flavour of sugars, honey and fruit should be used more cautiously.

Pungent: This flavor helps expel fluids and pathogens from the body. Thus, it is a flavor we use when we are getting a cold or flu, and also to clear mucus and heat. Warming pungents are ginger, cayenne and pepper. Cooling pungents include peppermint and radish.

Salty: The salty flavor is grounding. It can be used when one feels high or scattered, such as over-excited or having difficulty concentrating. Salty foods include sea salt, miso and seaweed.

Sour: Sour draws energy inwards and so can be used wherever there is abnormal fluid leakage or prolapsed organs. Sour food includes lemons, limes and pickles.

Bitter: This is the most cooling flavor and is excellent when there is body-heat or fever. Many herbs used for fevers are extremely bitter indeed. Bitter foods include endive lettuce, alfalfa, bitter melon and rye.

Tao Garden's Organic Gardens

These principles of Five Element nutrition have been incorporated into Tao Garden's kitchen. We grow as much food as possible on site in our organic gardens. In this way, we can preserve the Chi of the food. Much Chi is lost through storage and transportation of foods over long distances.

Fig. 9.8. Tao Garden's Organic Gardens

In addition, many fruits are picked before they have been ripened by the sun, so that they do not rot before they reach the supermarket shelves. At Tao Garden we allow the fruit to ripen naturally in the sun and it is harvested only when it is ready for eating. Some of the food you will eat at Tao Garden will have been picked only hours previously. This is called living food as its life-force energy is flourishing.

Fig. 9.9. Tao Garden's Kwan Yin Dining Hall

Breakfast

Before Breakfast: Upon arising, drink two ounces of any one of the following juices: apple, grape, cherry fig, prune; mixed with four ounces of pure water. Or, you may drink your favorite herb tea. Follow this with a light internal exercise program, deep breathing and a short morning meditation.

Breakfast: If not truly hungry for a protein or grain breakfast, eat a piece of fruit, such as apples, pears, peaches, berries, grapes. Eat melons alone. Breakfast of Brunch Suggested Choices:

1. Seed or nut milk (germinated/soaked overnight), with berries, apples, peaches etc. Best in summer.
2. Whole grain cereal with slice of rye or wheat wheat bread, and four ounces of cereal grain beverage. Best in cool or moderate weather.
3. Low fat cottage cheese, yogurt, buttermilk, with sub-acid fruit. Best in summer.
4. Oatmeal cooked with a few raisins (soaked overnight), and a slice of corn bread. Best in cool weather.
5. Whole grain granola cereal. Pour warm water over cereal, add ¼ teaspoon licorice powder, lecithin granules, fresh wheat germ flakes; mix contents; cover bowl and let stand 10 minutes. Eat and enjoy. Best in cool to moderate weather.

At Tao Garden we strive to make breakfast the best start to the day. From 7 a.m. to 9 a.m. the stomach is active, and from 9 a.m. to 11 a.m. the Spleen-Pancreas. These are the main organs involved in digestion and in balancing blood sugar. If the wrong food is taken at this time, digestion become sluggish and blood-sugar levels may begin to rise and fall too fast, leading to energy levels crashing.

Breakfast Bad Habits: Minimize hidden sugars: check your cereal, bread and spread ingredient lists. Minimize other sugars: if your blood-sugar levels tend to crash, watch out not to eat too much fruit and fruit juice for breakfast. Minimize heavy oils: cooked foods can be cooked in broth or grilled rather than fried in a lot of oil. If you eat bread, choose an unrefined variety, preferably without yeast.

Breakfast Guidelines: If your digestion is weak, choose warm foods for breakfast. If you are cleansing, choose fruit. Use only sugar-free jams and spreads. Make or buy breads with wholegrain flours. Goat's dairy is easier to digest than cow's dairy. If you choose cow dairy, opt for organic varieties.

Lunch or Dinner Menu

Vegetable salad (raw, best in warm weather), natural complex carbohydrate (grains and legumes) as specified and your favorite health drink.

Salad Suggestions (Raw): Sweet Red Peppers, Green Peppers, Celery, Cucumber, Tomatoes (Sparingly), Onions and Garlic. Romaine, Bib or Boston Lettuce, Alfalfa, Mung or other Sprouts Steamed Beets, Avocado (Sparingly) Wheat Grass.

Complex Carbohydrates:
Grains: Rice, Barley, Buckwheat, Rye, Wheat, Millet, Oats, Corn.
Legumes: Lima, Soybeans, Aduki, Navy, Pinto, Kidney Beans, Split Peas, Lentils, Chick Peas, etc.
Whole Grain Breads: Wheat, Rye, Corn, Bran Muffins, Rye Crisp.
Sandwich Spreads: Tofu, Sesame, Tahini, Humus.
Soups: Vegetable Broth, Miso Soup, Bean Soup, Pea or Lentil Soup, Barley Soup, Mushroom Soup, etc.
Health Beverages: Fresh Raw Vegetable Juice, Grain Beverages, Herbal Teas. Beverages should be salivated thoroughly before swallowing; two to 4 ounces after meals is sufficient. Lunch can be interchanged with dinner meal; be flexible.

Mid-Afternoon Snack (If Hungry Only)

Any health beverage of your choice, fresh carrot or celery juice, or any fruit in season.

Dinner (For Noon or Evening)

Raw vegetable salad (in warm weather), one or two steamed vegetables. Vegetable juice one-half hour before dinner, legume or vegetable soup, grains and beans.

Steamed or Baked Vegetables: Corn, String Beans, Sauerkraut Cauliflower, Asparagus, Beets & Greens, Endive, Zucchini, Squash, Onions, Broccoli, Carrots, Turnips, Peas, Brussels Sprouts, Yam, Artichokes, Kale, Swiss Chard, Summer Squash, Dandelion Greens, Mushrooms (Sparingly), Celery, Okra, Potato (Sparingly).

Protein and Carbohydrate: If you are on a transition diet away from meat products, use only lean meats two or three times per week, such as: white fish, halibut, trout, chicken. Avoid pork, beef or any other high fat meats. Eggs: two to three times per week.
Lacto-Vegetarians: Buttermilk, Goat Milk, Skim Milk, Cheese, (Vegetable Rennet), Yogurt, Kefir, Clabbered Milk, Cottage Cheese.
Use High Fat Dairy Sparingly: Cheddar, Muenster, Edam and Swiss. If you can maintain good health without these foods, do so.
Complete Vegetarians/Vegans (Vegetable Proteins): All Legumes, Beans, Soybeans, Tofu, Miso, Sunflower, Sesame, Pumpkin Seeds, Almonds and other Nuts (Germinated), Wheatgrass, sprouts, Peanuts, Buckwheat, Alfalfa, Spirulina, Seaweed Products.

Legume & Grain Combinations for Complete Proteins Meals

1. Split Pea or Lentil Soup with Whole Grain Bread
2. Beans and Corn Bread
3. Chickpea Felafel with Whole Grain Pita Bread
4. Beans and Rice
5. Whole Grain Spaghetti with Chickpea Balls
6. Pea Soup with Corn Bread
7. Buckwheat and Lima Beans
8. Tempheh (Soy) and Millet
9. Tofu Spread and Rye Bread

Hot Weather Grains: Corn, Red Millet, Long Grain Brown Rice
Cold Weather Grains: Buckwheat, Oatmeal, Short Grain Brown Rice, Barley
Temperate Weather Grains: Wheat, Rye, and Yellow Millet

Cold Weather Menu Samples

Mornings: Cooked Cereals, Cream of Wheat, Rye, Millet, Rice; Oatmeal; 7 Grain Cereal, Whole Wheat or Buckwheat Pancakes/ Waffles; Brown Rice, Bread Ohsawa Loaf, Drop Biscuits, Muffins.

Scrambled Tofu or Tempeh; Tofu Bread Pudding; Marinated Fried Tofu; Baked Stuffed Apple, Baked Potato with Gamasio; Beans.
Mid-Day: Soups, Vegetarian Barley; Miso; Beans; Brown Rice; Leek; Chowder. Sandwiches Spreads: Humus; Tofu; Kidney Bean; Bulghur; Pita Bread Stuffings: Spreads & Sprouts; Cooked Grains with Beans and Veggy Burgers. All leftovers for quick & easy lunch.
Evening: Soups, Vegetables Stir Fried, Sauteed, Steamed, Curried; Arame/Carrot; Sesamed Scallion; Stuffed Squash; Baked Squash; Tempura. Casseroles, Baked Cheese Spaghetti; Chili; Rice Curry; Pasta with Sauce. Soy Dishes, Tofu Quiche; Tofu Lasagne; Stroganoff; Baked Tempeh with Nutritional Yeast; Tofu Enchilladas. Grains & Beans; Nut Loaves; Whole Wheat Pizza.

Warm Weather Menu Samples

Mornings: Fruit or Fresh Fruit Compote; Vegetable Juice; Smoothie; Kelloggs Nutri Grain Cereal; Granola; Seed or Nut Milk (With Fruit, Cereal or Alone); Rice or Bread Pudding; Applesauce.
Mid-Day: Soups, Burgers, Stuffed Tomatoes, Felafel. Salads: Carrot-Raisin; Cucumber Onion; Tabbouli; 3 Bean Dish; Macaroni or Potato; Fresh Fruit Compote; Raw Vegetables with Sprouts. Cold Soups: Gazpacho; Vichyssoise; Fruit Soup.
Evening: Soups, Salads, Grains, Beans and Vegetables. Emphasize Salads and Raw Vegetables.

Fig. 9.8. Recipes for Healing Meals

Cooking Tips

1. Cooking with a loving heart (Cooking Attitudes).
2. Digestion: Fruits 2 hrs; Grains 2-4 hrs; Animal Products 4-8 hrs.
3. Cutting Vegetables determines how they are cooked (Sideways).
4. Combining certain foods while cooking brings out food flavors.
5. Olive oil is too heavy for cooking but is good for salads.
6. Use corn, safflower, or soy oils for cooking; they are lighter.
7. Cooking Heat: Charcoal-Juicy Food; Gas-Neutral; Electric-Dry Food.
8. Cook to the smell for correct timing and adding foods.
9. For steaming food chop food in bigger pieces & thinner in stir fry.

Eating Habit Tips

We all eat too fast. Slowly enjoy your meal. Emotional state is important. Eat with joy and happiness in a good environment. Chew slowly tasting each of the Five Elements activating each organ. Breakfast eat like a King (9:00am-10:00am) (1st meal should be easy to digest); lunch eat like a Prince (1:00pm-2:00pm) (4hrs inbetween each meal); dinner eat like a Pauper (5:00pm-6:00pm). Morning meal should be hot food; body is slow to start; it needs to warm up with grain soup or cereal. Eating fried foods hurts.

Overeating: Eat 1/2 stomach level and double your life. It takes too much energy to digest the food. Eat normally not too much just enough. No liquids with food with exception of thick soups. Drink no iced or cold drinks; drink only herbal tea or hot water. You need warmth to digest the food. Rice (only) soup stops diarrhea. Chinese tea draws out oils, fats and mucus of the body, but it can hurt the heart. Oranges activate lungs.

If your waistband gets tighter with every holiday party, give yourself a ticket for speed eating. It is tempting to blame your aunt's triple chocolate rum balls and that box of sugar cookies in the office coffee room, but a compelling new study suggests that how fast you eat may be as important as what you put on your plate. Researchers already know that speedeaters are twice as likely to be overweight as those who munch in a leisurely fashion. Scarfing down food reduces the release of appetite regulating hormones into your bloodstream. These chemicals normally tell your brain to get your hand off of those sugar cookies. A new Athens University study had volunteers wolfed down two-and-a-half scoops of ice cream in five minutes; on another, they made the treat last for 30

minutes. The scientists measured blood levels of two types of appetite lowering hormones PYY and GLP-1 before and after, and discovered that when people savored their ice cream slowly, the levels of appetite regulating hormones were 25 to 30 percent higher. PYY and GLP-1 are two of more than a dozen hormones responsible for making you feeling full and satisfied. Other mechanisms, such as stretch receptors in the lining of your stomach, play important roles, too.

Fortunately, we know more than ever about how these checks and balances work and how modern food choices and eating habits can short circuit them. There is no better time to help your body's natural appetite control system. Spoil your dinner with a handful of nuts. Begin with a crunch. Your stomach can stretch only so far take advantage. Filling it with raw veggies activates stretch receptors that signal your brain that you are full. Studies have found that people who start meals with a large, low-cal salad eat 12 percent fewer calories during the meal than those who do not.

Dine in the slow lane. Take small bites, chew thoroughly and put utensils down between bites. Fill your senses and notice the colors, aromas, flavors, textures and temperatures of foods before and while you eat them. Fill your tank only to 80 percent. When you eat till you burst, your stomach feels fuller and fuller for nearly an hour afterward. That is a delayed reaction. Harness your meal when you are just 80 percent full. Wait 20 minutes and you will feel fully satisfied. In Japan, they call this trick ham hachi bu and consider it a key to longevity.

Prayer: Chi Charging your Food

By connecting to heaven and earth you will maximise the wholistic healing potential to your physical and subtle bodies. We recommend that you spend a few minutes placing your hands over your food and sending Chi into it connecting with your Ten Tien with the Universal Forces. Sending good Chi into the foods helps your digestion. Always perform this Sacred Chi Food practice before each meal and thanks after. If there is no energy in your Tan Tien, then there will be no energy to work with. Tan Tien and the Universe means connect your center to the infinite source of the universe, the Tao. When you make the connection you access this power. When you are aware of your Chi, you can direct heavenly light straight into your food and energize your body.

Tao Garden's Healing Recipes

The Professor's Ambrosia - Food of the Gods *(Morning Cereal)*

Ingredients:

Rolled Oats, Millet, Rye or Barley.
Raisins, Apricots, Dates or Pineapple.
Almond, Pumpkin or Sunflower Seeds
Cinnamon
Chopped Apples or Pears.

Recipe:

1. Soak 2-3 Dried Fruits and Seeds or Nuts in a pot of water over night.
2. In the morning boil the mixture with two or three pieces of diced Fresh Fruit and a Seasoning.
3. After the mixture has boiled pull off of the fire and let it sit.
4. Boil 3 cups of water to 1 cup of Whole Grain and add Whole Grain after the water boils and let it sit so the Whole Grain can absorb the hot water or for Rolled Grains soak in water.
5. After Whole or Rolled Grain has absorb the water mix the Fruit Compote together with the soaked Grain; and let it sit to marinate for an hour; and serve with honey if needed.

Tao Garden Cashew Nut Butter:

Ingredients:	Cashew Nuts	200G
	Honey	2 Tsp

Recipe:

1. Dry-Fry the cashew nuts in a wok, continuously moving them around to prevent sticking.
2. Blend together in a coffee grinder.
3. Add a little honey and blend in a normal blender.

Tao Garden Sesame Seed Butter:

Ingredients:	White Sesame Seeds	200G
	Sesame Oil	3 Tsp

Recipe:

1. Dry fry the seeds in a wok, moving around to prevent sticking. Watch as they change colour and take on a golden hue. Remove from the heat before they burn.
2. After they have cooled down a little, blend the seeds in a coffee grinder.
3. Add a little sesame oil and blend in a normal blender.

Tao Garden Fruit Compote: *(Builds Digestive Fire)*

Ingredients:

Apple*	1
Orange*	1
Banana*	1
Raisins	½ Cup
Prunes(chopped)	½ Cup
Chinese red date	½ Cup
Cinnamon	1 Tbsp
Water to cover	

*You may use local seasonal fruit to make your compote.

Recipe:

1. Put everything in a sauce pan over medium flame.
2. Stew together for 20 minutes until it all becomes very soft.
3. Serve warm as an accompaniment to another dish.

Tao Garden Vegetable Broth: *(Mineralizing and Alkalizing)*

Ingredients:

Celery/Coriander Roots	50 G
White/Red Radish	300 G
Pumpkin	300 G
Ginger Root	100 G
Green Papaya	500 G
Onion	1
Pandanus Leaf	50 G
Black Pepper (Dried)	30 G
Soy Bean (Rinsed)	50 G
Radish Pickle	30 G
Water	5 Litres

Recipe:

1. Rinse everything well and cut into big pieces (you can leave seeds and peelings on the vegetables). Bring water to a boil on maximum heat. Add all the vegetables, ground black pepper seed, soy bean, and coriander root to the water.
2. When it is boiling again, reduce heat and simmer for three to four hours with a lid on the pot. Skim the froth off the surface of the liquid from time to time using a strainer. Strain off the liquid to use as broth.

Tao Garden Brown Rice Soup: *(Kao Tom Tan Ya Peut)*

Ingredients:

Cooked Brown Rice	1½ Cups
Vegetable Stock	1 Liter
Sunflower Seeds	1 Tbsp
Pumpkin Seeds	1 Tbsp
Roasted White Sesame	1 Tbsp
Minced Spring Onion	1 Tbsp
Minced Coriander	1 Tbsp
Celery (Fine Chopped)	1 Tbsp
Boiled Corn Kernels	½ Cup
Fried Garlic	1 Tbsp
Soya Sauce/Tamari	4 Tbsp

Recipe:

1. Heat the vegetable stock until it comes to a boil. Add the cooked brown rice, reduce the heat & cook for about 20 min.
2. Add the sunflower seeds, pumpkin seeds, sweet corn kernels, and white sesame and stir in well. Season according to taste with the soya sauce. Add the celery, spring onion, coriander and garlic to the soup and turn off the heat.

Tao Garden Goat's Milk Yoghurt: *(Cooling and Probiotic)*

Ingredients: Goat's Milk
Vita-Ferment Yoghurt
(Yoghurt Starter)

Recipe:

1. Bring goat's milk close to boiling point, 85-95 degrees.
2. Let the milk cool down to 42-45 degrees. Mix in 1 pouch of Vita-Ferment yoghurt bacteria until the ferment is dissolved. Pour into a sterilized container.
3. Close lid and place cultured milk into a 42-45 degree warm place for 6-8 hours.
4. During this time don't move or shake the fermented goat milk.
5. After fermentation period place yoghurt in refrigerator for 12 hours.

Tao Garden Broccoli Soup: *(Calming and Moves Stagnant Chi)*

Ingredients:

Vegetable Broth	2½ Cups
Broccoli	3 Cups
Himalayan Rock Salt	1 Tsp
Ground Pepper	½ Tsp
Onion	1
Butter	1 Tbsp

Recipe:

1. Cook the chopped onion in the butter over a high heat.
2. Add the broccoli cut into small pieces.
3. Add the vegetable broth, salt and pepper.
4. Cook until the vegetables are soft.
5. Blend to a smooth consistency.

Tao Garden Tom Yam Soup: *(Stimulates Stagnant Chi)*

Ingredients:

Vegetable Broth	6 Cups
Coriander Root	6 Pieces
Shallots	8 Bulbs
Lemongrass	2 Sticks
Mushrooms (3)	2 Cups
Kaffir Lime Leaf	2 Leaves
Small Red Chili	4
Coriander Leaf	1 Sprig
Soya Sauce	2 Tbsp
Lime Juice	2 Tbsp

Recipe:

1. Put the vegetable broth over a medium flame until it begins to boil.
2. Add the soya sauce and lime juice to taste.
3. Add the coriander root, shallots, lemongrass, kaffir lime and chili. Add the three types of mushrooms.
4. Cook together and serve with a sprig of coriander placed on top.

Tao Garden Pumpkin Soup: *(Builds Digestive Fire)*

Ingredients:

Pumpkin	500 G
Onion	100 G
Butter	2 Tbsp
Vegetable Stock	1½ Liters
Light Soy Sauce	To Taste

Recipe:

1. Clean the pumpkin and chop into pieces.
2. Stir-fry the onion in the butter (those on an oil-free diet can soften the onion by cooking it in a little water).
3. Add the vegetable stock and pumpkin.
4. Boil until the pumpkin is soft. Add soya sauce to taste.
5. Allow to cool slightly and then process in a blender until smooth. Heat until hot and serve.

Tao Garden Green Papaya Salad: *(Anti-Parasite Remedy)*

Ingredients:

Unripe Papaya,	250G
Carrot	30G
Tomato	50G
Garlic	2
Chili	2
Peanuts (Optional)	50G
Lime	2 Tbsp
Soybean Sauce	2 Tbsp
Tamarind Sauce	1 Tbsp
Palm Sugar	½ Tbsp
String Beans	3

Recipe:

1. Peel and shred fresh green papaya. Slice tomatoes thinly.
2. In a clay mortar, pound the fresh chilies (whole), yard-long beans, and garlic. Add string beans, sliced tomato, and roasted peanuts, and pound lightly (do not over-crush).
3. Add soy sauce, tamarind, palm sugar and lime juice.
4. Add these items spoon-by-spoon, and taste as you go. Lightly pound (optional). Add shredded papaya and carrot and pound together until mixed well. Serve on a dish with fresh cabbage and string beans on the side.

Tao Garden Stir-Fried Mixed Vegetables: *(Easily Digestible)*

Ingredients:

Mixed Vegetables	3 Cups
Coconut/Sesame Oil	2 Tbsp
Vegetable Stock	2 Tbsp
Kikkoman Soya Sauce	To Taste
Fresh Cane Juice	To Taste
Garlic (Optional)	½ Tsp
Cashew Nuts	½ Cup

Recipe:

1. Wash and prepare your vegetables. There are many different ways to cut your vegetables, each giving different energetic properties. Cutting vegetables energizes them (as you add some of your Chi as you cut them). Smaller pieces have more energy, making grated vegetables highly energizing. Whole vegetables retain their wholeness and complete energy, and will take longer to cook.
2. Pour a little oil & vegetable broth into a wok over a high heat.
3. When the mixture is hot, add the vegetables and condiments, and stir with a wooden spatula. Keep the vegetables moving so that they do not stick. Cook for a few minutes and serve whilst the vegetables are still warm.

Tao Garden Rice: *(Balancing)*

Ingredients:

Rice* (Rinsed)	1 Cup
Cold Water	2 Cups
Himalayan Rock Salt	¼ Tsp
Mixed Seeds (Optional)	½ Cup

*(Brown, Jasmine, Gac or White)

Recipe:

1. It is preferable to soak the rice (or any grain) in water for 8-12 hours before cooking. This breaks down the enzyme-inhibitors and makes the grain more alkalizing. Place the rice, water and salt into a pan. Cover with a tight-fitting lid and bring to a boil over full heat.
2. Turn heat to low and simmer until the water has been absorbed (roughly 12 minutes for white; 20 minutes for brown)
3. Stir in the mixed seeds if desired and serve hot.

Tao Garden Baked Fish (Turmeric): *(Anti-Inflammatory)*

Ingredients:

Fresh Filleted Fish	1 Medium
Turmeric	1 Tsp
Galangal	1 Tsp
Garlic	1 Clove
Sweet Chili	2
Lemon Grass	1 Tsp
Soya Sauce	1 Tbsp

Recipe:

1. Preheat the oven to 220°F.
2. Blend the turmeric, galangal, garlic, lemongrass and one of the sweet chilies in the soya sauce. Cut three long diagonal lines along the length of the fish, on both sides.
3. Pour all of the sauce over the fish and put into a preheated oven in a baking tray (lined aluminum foil). Bake for one hour.
4. Slice the remaining sweet chili and add over the top of the fish and serve.

Tao Garden Curried Chicken (String Beans): *(Warming)*

Ingredients:

Chicken (Breast, No Skin)	300	G
Curry Paste	1½	Tbsp
Sugar Cane	½	Tbsp
Soya Sauce	½	Tbsp
Chicken Stock Water	½	Cup
String Beans	200	G
Vegetable Oil (Optional)	2	Tbsp
Kaffir Leaves	3	
Red Pepper (Sliced)	1	

Recipe:

1. Heat the oil OR a small amount of the chicken stock (for an oil-free version). Add curry paste, sugar cane, and soy sauce.
2. Heat at low temperature.
3. Add chicken and (the rest of) the stock water.
4. Increase to medium temperature and cook until the water has evaporated. Add string bean, kaffir leaf, and red pepper.
5. Continue to cook until beans begin to get a little soft (not too long). Serve with rice.

Tao Garden Fried Eggelant (Tofu): *(Moves Stagnant Blood)*

Ingredients:

Firm Tofu	250	G
Green Eggplants	2	Large
Miso Paste	2	Tbsp
Unrefined Brown Sugar	½	Tbsp
Freshly Ground Pepper	½	Tsp
Vegetable Stock	3	Tbsp
Chilies (Cut Diagonally)	5	Piece
Fresh Sweet Basil Leaves	10	
Soya Sauce		To Tas
Cooking Oil	1	Tbsp

Recipe:

1. Cut the eggplants into long strips and cover in salt. Leave for 20 minutes and then rinse the salt off.
2. Grill the eggplant (both sides) until it is soft. Set to one side.
3. Cut the tofu into 2.5 cm cubes and steam until cooked. Stir-fry the miso paste in hot oil until fragrant. Add soya sauce, pepper, vegetable stock, steamed tofu and eggplant.
4. Add chilies and basil, stir and serve.

Tao Garden Fried Noodles (Pad Thai): *(Cell Builder)*

Ingredients:

Rice Noodles	50	G
Tofu, Shrimp or Egg	100	G
Garlic (Minced)	1	Tsp
Shallot (Minced)	1	Tbsp
Sesame Oil	3	Tbsp
Tamarind Juice	3	Tbsp
Crushed Peanuts	1	Tbsp
Chinese Green Chives	1	Tbsp
Ground Chili Pepper	½	Tbsp
Chicken/Vegetable Broth	2	Tbsp

Recipe:

1. Soak dry noodles (15 min.). Chop tofu, chives. Rinse the bean sprouts; mince shallots and garlic together.
2. Fry the shallots, garlic, tofu and stir them until they start to brown. Add broth, tamarind juice & chili pepper. Stir. Crack the egg onto the wok & scramble. Fold egg into the noodles.
3. Stir adding bean sprouts, chives a few more times.
4. Pour onto a serving plate and sprinkle with crushed peanuts.

Tao Garden Salad Dressings: (*Moistens and Enhances Flavor)*

Ingredients:

Tamarind Sauce

Tamarind Paste
Coconut Milk
Miso Paste

Ginger Sauce

Minced Ginger
Sesame Oil
Onion
Kikkoman Sauce
Soya Bean Paste

Mango Sauce

Mango (Ripe)
Chili Sauce
Raw Cane Juice/Maple Syrup
Himalayan Rock Salt
Lemon Juice

Passion Fruit Sauce

Passion Fruit Juice (Juice only; not the Seeds)
Chili Sauce
Raw Cane Juice/Maple Syrup
Himalayan Rock Salt
Lemon Juice

Sesame Sauce

Sesame Spread
Water
Himalayan Rock Salt
Lemon Juice

The Professor's Confection Sauce

1 Bunch of Green Onions-Chopped in Food Processor
1 Cup of Water
1 Cup of Tamari
1 Cup of Safflower Oil
3 Tablespoons of Tahini
Juice of 1 Lemon
Few Dashes of Cayenne
2 Tablespoons of Honey
Blend All Ingredients in Food Processor and Chill

Tao Garden Salad Toppings: *(To your Own Taste)*

Ingredients:

Pumpkin Seeds *(Soaked for 4 Hours-Drained)*
Rich in zinc and thus helpful for impotency, prostate swelling, bladder problems, parasites.

Sunflower Seeds*(Soaked for 4 Hours-Drained)*
Chi energy tonic, lubricates intestines and clears constipation.

Garlic
Expels worms and parasites, reduces candida clears colds and other infections, detoxifies body. Use cautiously can cause over heating.

Ginger
Aids digestion by boosting the digestive fire (Kidney Yang) and for any cold condition. Use cautiously can cause over heating.

Turmeric Root
Anti-inflammatory and anti-oxidant qualities, protects liver from toxins, helps break down tumors. Good for gallbladder cleanse.

Dried Seaweed and Sesame
Provides a very mineral-rich alternative to salt. Sesame seeds are extremely rich in calcium providing non-dairy source of minerals. Increases alkalinity of body, assists in elimination of toxins.

Limes/Lemons
Highly alkaline forming once digested for balancing body pH & removing toxins. Good for liver and gallbladder cleansing and move stagnant liver Chi.

Note: Experiment with local nuts, seeds, herbs and roots to add to your salads.

The Professor's Penetrating Split Pea Soup:

Ingredients:

Green/Yellow Split Peas	2	Cups
Water	4	Cups
Onion, Sliced	1	Med.
Carrots, Diced	2	Med.
Celery	2	Stalks
Water	1	Cup
other Vegetables as Desired		

Recipe:

1. Cook peas and onion in 4 cups of water until soft (about 35 minutes). Separately, cook together carrots, celery and other vegetables in 1 cup of water. (20 minutes)
2. Puree peas and combine with cooked vegetables. Serve garnished with chopped parsley.

The Professor's Enervatizing Gazpacho:

Ingredients:

Carrot	1	
Safflower Or Olive Oil	½	Cup
Celery	2	Stalks
Vinegar (Apple Cider)	2	Tbsp
Garlic, Minced	2	Cloves
Whole Cumin	½	Tbsp
Fresh Tomato	2	Cup
Tamari	1	Tbsp
Parsley	2	Springs
Tofu, Cubed	1½	
Pepper, To Taste		

Recipe:

1. At high speed, blend the carrot, celery, garlic, 1 cup tomato and parsley. Pour into bowl. Next, blend lemon juice, oil, vinegar, pepper, cumin, tamari & 1 cup tomato; add to first mixture.
2. Add some sliced zucchini & red pepper, along with the tofu cubes. Refrigerate. Garnish with finely sliced green onions.

The Professor's Vitalizing Humus Spread:

Ingredients:

Raw Chickpeas	1½	Cup
Tahini	1/8	Cup
Garlic, Minced	3	Cloves
Parsley Flakes (½ C Fresh)	3	Tbsp
Salt	1½	Tbsp
Chives Or Basil	2	Tbsp
Tamari	½	Tbsp
Cayenne	1/8	Tbsp
Lemon	2	
Scallions, Minced	¼	Cup

Recipe:

1. Soak chickpeas overnight; boil until soft (45 min.).
2. Cool the beans, then mash to a thick paste.
3. Combine everything and chill.

The Professor's Confection Whole Wheat Pizza:

Ingredients:

Dry Yeast	1	Pkg.
Unbleached Flour	1¼	Cup
Whole Wheat Flour	¾	Cup
Sesame Seeds	¼	Cup
Soy Flour Sift Together	¼	Cup

Recipe:

1. Combine: 1/3 Cup warm water, 2 Tbsp oil, ¼ Cup tofu.
2. Knead; roll out. Add your favorite spaghetti sauce with extra tomato paste to thicken.
3. Garnish with sauteed mushrooms, garlic, onions, peppers, tofu and sun cheese.
4. Bake at 400 ° for 20 minutes.

The Professor's Clarification Lemonade:

Ingredients:

Lemon	1	
Organic Maple Syrup	1	Tbsp
Cayenne	1/8	Tbsp
Pure Water	1	Glass

Recipe:

1. Squeeze Lemon into glass of pure water with Syrup and Cayenne.

The Professor's Liberation Lima Bean Soup:

Ingredients:

Lima Beans	1	Cup
Garlic, Minced	3	Cloves
Scallions, Minced	1	Cup
Pure Water	3	Cups

Recipe:

1. Soak Lima Beans over night and boil with chopped Garlic and Scallions. Let simmer and cool then eat.

The Professor's Perfection Thai Coconut Ice Cream:

Ingredients:

Fresh Coconut Milk	1	Cup
Fresh Coconut Meat	80	G
Sugar Cane	½	Cup
Salt	¼	Tbsp
Pure Water	¼	Cup

Recipe:

1. Mix all Ingredients together and Freeze.

The Professor's Titillation Dip and Hordorves:

Ingredients:

Dip:

Organic Almond Butter	1	Bowl
Lemon (Squeeze)	1	
Dr. Bragg's Amino Acids	¼	Cup

Hordorves:

Dried Smoked Salmon	½	Cup
Pickle Cucumbers	½	Cup
Daicon (Chopped)	½	Cup
Green Onions	½	Cup
Radishes	½	Cup
Boiled Scrimp	½	Cup
Celery	6	Stocks
Carrots	6	Sticks

Recipe:

1. Mix all ingredients for dip and dip with vegetables and fish.

Tao Garden Mung Beans: *(Thua Khiaw Tom Nam Taan)*

Ingredients:

Mung Beans	1	Cup
Unrefined Brown Sugar	¼	Cup
Ginger Root (Chopped)	2	Tbsp
Water	2	Cups

Recipe:

1. Soak the mung beans over night.
2. Add the beans to water and bring to the boil until the beans are soft.
3. Add the sugar and ginger and continue to stir.
4. Serve warm.

Tao Garden Rice Ball in Coconut Milk: *(Bualoi)*

Ingredients:

Glutinous Rice Flour	350	G
Flour	2	Tbsp
Water	100	G
Coconut Cream	300	G
Palm Sugar	300	G
Pumpkin (Pureed)	200	G
Taro (Steamed/Pureed)	200	G
Coconut Milk	750	G
Himalayan Rock Salt	¼	Tsp

Recipe:

1. Mix the rice flour with enough water to make a firm paste.
2. Mix some rice paste with pumpkin puree, and then mix the rest of the rice paste with the taro puree. Knead well and then form pea-sized balls.
3. Bring a large pot of water to a boil, toss in the balls and remove when they float to the surface. Drain.
4. Bring the coconut cream to a boil, add palm sugar and salt.
5. Stir constantly to prevent it from separating.
6. Add the flour balls.
7. When the mixture returns to a boil, remove from heat.
8. Serve as a dessert in small bowls.

Tao Garden's Condiments

Fresh Ground Green/Red Chili (Rice Vinegar): Dissolves mucous, warm stomach, and increase blood flow to the face and brain.
Red Chili Sauce: Helps digestion, restores alkaline condition to blood, prevents & cures cancer, provides boosts immune system.
Dry Papaya Seed: Ground seaweed and sesame seed with a little sea salt Good for the brain. Contains iodine (Thyroid/Metabolism).
White Sesame Seeds: High in Calcium and Fatty acids. Contains very similar amounts of essential amino acids to red meat.
Black Sesame Seeds: Strengthens Kidneys, Liver and Brain food.
Wheat Germ: High Protein, High Fiber and contains Vitamin E.
Dry Banana Powder: Nice energy booster and natural sweetener.
Dry Papaya Powder: Aids body to remove undigested proteins and putrefactive materials.
Stevia Leaf: Sweetener that helps the body regulate blood sugar, correcting both high and low blood sugar. It appears to lower blood pressure, without affecting normal blood pressure. It inhibits growth and reproduction of harmful bacteria and infectious organisms, and those causing gum disease and tooth decay. It can also be used in concentrate to help heal skin problems including acne, seborrhea, dermatitis, psoriasis, burns cuts and eczema without scarring.
Pandanus Leaf: Helps to expel urine, nourishes the heart with a cooling effect. Good remedy for diabetes used with cooking & tea.
Olive Oil: Best used raw or lightly heated assists in gall bladder Cleansing (Lime Juice) and heart disease with essential fatty acids.
Coconut Oil: Enables rapid breakdown in digestion. Helpful in thyroid disorders, candida and digestive disorders because of its stable nature can be used at high temperatures.
Sesame Oil: Stable oil can be cooked at higher temperatures without risk of becoming rancid.
Nut Butters: Freshly and powerfully ground each day.

Tao Garden's Organic Fresh Sprouts

Adzuki: 25% Protein, High in Calcium, Niacin, Iron & Amino Acids.
Alfalfa: 35% Protein, Chlorophyll, Vitamins A, B, C, D, E, F, K, U.
Buckwheat: 12% Protein, High in Lecithin, Rutin and Minerals.
Fenugreek: Blood Liver and Kidney Cleanser. Mucus Remover.
Garbanzo: 20% Protein. High in Iron, Calcium, Vitamins A and B.
Lentil: 25% Protein, Vitamin E, Iron Phosphorus, C & B.
Peas: 22% Protein, Magnesium, Chlorophyll and Amino Acids.
Pumpkin: 30% Protein, High in B Vitamins Phosphorus, Iron, Zinc.

Radish: Contains Vitamin C, Calcium and Potassium.
Sesame: 18% Protein (1125 mg's) Vitamin E, B1, Niacin.
Sunflower: Vitamin B Complex, D, E, and all Minerals & Zinc.

Tao Garden's Organic Herbal/Flower Teas and Juices

Safflower (Stevia Leaf): Cleans the Blood, Dilutes it, and lowers cholesterol and high blood pressure. Makes a dark orange tea.
Lemon Grass (Stevia/Pandanus Leaf): Activate the thymus, improving the immune system, and helps ward off mosquitoes and insects. Mildly Green tea.
Ginger (Stevia/Pandanus Leaf): Warms the stomach (aiding digestion) and helps blood flow.
Lingzhi (Stevia Leaf): Lingzhi is a kind of mushroom, said to strengthen the heart.
Chrysanthemum (Buddha Fruit): Helps the throat, clears mucous, & cools the system.
Bael Fruit: Common Thai Herb, which the locals say improves your sex appeal when consumed after dark.
Green Jasmine: Has some caffeine. They will wake you up a bit. It is best not to drink them in the evening.
Mint Leaf: Served with lime.
Ginkgo Biloba: Improves circulation to the brain.
Mulberry (Stevia/Pandanus Leaf): Harmonizes construction, assisting the Middle Burner.
Roselle: When made into a tea is a cooling blood purifier.
Ginger/Ginseng: Freshly prepared daily. Stimulates, Warms and Energizes for fighting off Colds and Influenza Viruses.
Senna: Mild laxative and cleansing drink with one part Senna with three parts of your favourite Fresh Tea to aid Bowel Contractions.
Japliang: Ancient blend of Chinese herbs to assist in Cooling Body.
Soymilk (Pandanus Leaves): Breaks down of Proteins with no additives becomes a digestive delight, refreshing wholesome drink.
Yogurt: Made from Thai Goat's Milk effective in sweetening the levels of beneficial bacteria within the large intestine.
Green Vegetable Juice: Chinese Cabbage, Scallion, Panadus Leaf, Pennywort, Parsley, Lettuce, Sprouts, Lime & Cane Sugar juice for sweetening with Natural Enzymes, Chlorophyll and Vitamins that alkalinizes blood and cleanse system of putrefactive debris.
Rice Milk: Contains the Building Blocks for DNA production. 4-7 Grains are used to produce this Milk, fresh every evening.
Dragon-Eye (Longan): Thai Traditional Way to Sweeten Food. Contains Fruit Sugar and so Blood Sugar is Balanced.

Fig. 9.9. Happiness is like a butterfly. The more you chase it, the more it eludes you. But if you turn your attention to other things, it comes and softly sits on your shoulders. This is the Way of the Tao.

Solar Light, Fresh Oxygen and Pure Water

Ancient cultures worshipped the sun as a manifestation of the All Powerful Creator. They derived great benefit from its healing power. The Greeks and Romans built solariums where the sick came to fast and bask in the relaxing and healing ultraviolet rays of old sol. Ancient physicians were well versed in the knowledge of solar light therapy, in conjunction with fasting, herbs, natural foods, and physical exercise therapy. Pastries, sugar, white flour, and other junk foods were non-existent, therefore healing and rejuvenation through the use of heliotherapy (sun-therapy), herbs, hydrotherapy (water-therapy), and fasting was rapid and effective.

The bright solar orb (Sun) is the most powerful source of energy and light on this planet. It sustains all vegetation food for man and animal life through the process of photosynthesis. It provides us directly with Vitamin D, but it must shine on our bare skin to receive its benefits. Sunlight directly affects the retina of the eye and the hypothalamus which is a control center in the body. The hypothalamus coordinates the nervous system and the pituitary gland, which is known as the master gland because of its influence on the endocrine system. Hormones from these glands directly influence metabolism, growth, sexual activity, and the overall health and vitality of the body. Poor inside lighting is responsible for many physical and mental defects, from nervous conditions to cancer.

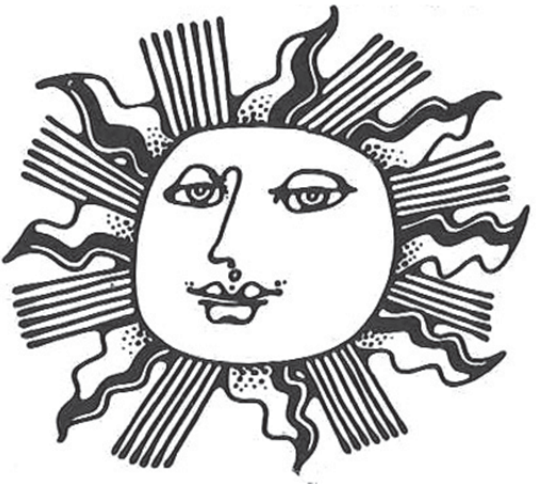

Fig. 9.10. Solar Light

Man needs the full spectrum of the sun, not artificial lights. To stay in good health, we must enjoy the outdoors as much as possible. In the wintertime keep your rooms well ventilated to let in as much light and fresh air as possible. Sunglasses are harmful to the eyes, causing fatigue and tension. Pinhole sunglasses are the best as they admit the entire spectrum of sunlight & reduce glare.

Fresh air and sunshine increase the quality and quantity of the blood by 25% within four hours time. Our blood has more hemoglobin in Summer than Winter. Sunlight makes better use of calcium and phosphorus for bone strength and development. Vitamin D from the Sun helps the body's absorption of carbohydrates and the control of body weight. It acts on the pineal gland and in turn on the sex glands releasing nerve hormones which build up the sex glands.

The rays of the sun help us to utilize our vitamins, minerals and proteins and fats. It helps to overcome insomnia. Sunshine assists in overcoming colds, flus, gland infections, TB, anemia, etc. It distributes calcium in the body and it tones up the muscles. Sunlight helps more ailments than all the drugs in the world.

Blondes require less sun than brunettes. Too much sunlight for the blonde people is very exhausting to their nerves and body. The extra pigment in the brunette gives them more protection from the sunlight. Sun dried fruits and vegetables are excellent sun charged foods loaded with nourishment. The sun vitalizes the waters of the sea and the soil of the earth. The ancient Greeks and Romans and the races ages before them used sunlight for healing the sick and diseased, and for preventing ailments. The powerful rays of the sun help to overcome infections, acting as a disinfectant. Fruit trees take in the most sunlight of all food grown, because it is under the sun's rays throughout the year. Sun and air baths help the body to eliminate its waste material daily. Fresh mountain or ocean air is the best tonic known for poor health.

A few weeks in the mountains or on the ocean beach, with the sun shining on the bare skin, is the best known physical and mental rejuvenator of all. Instead of lying in a head shrinker's office, stretch out your nervewracked body on your favorite beach or mountain resort and let nature restore your health.

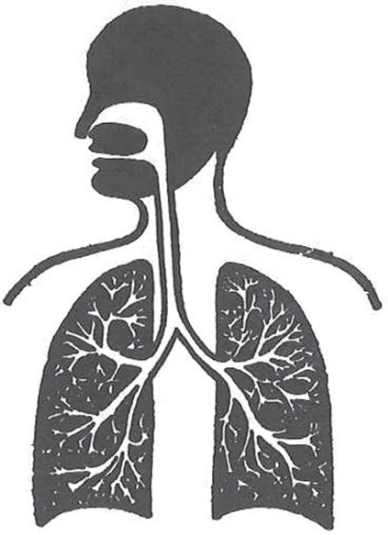

Fig. 9.11. Breathing and good blood circulation are inseparable. Pure blood built from wholesome food, fresh outdoor oxygen, sunshine and physical exercises that enhance free blood and nerve circulation create superior health and freedom from disease and microbes.

Solar Time Clock

It is well known that sunshine and solar energy are necessary for health and life on earth, but it is not generally recognized that there is quite a difference between morning and afternoon sunshine energy. At 4 p.m., on a clear day, one feels the heat of the sun more than at 8 a.m., although the sun is in the same position or height in the sky. The morning sun is tempered by the earth's atmosphere travelling in the opposite direction. Plants utilize morning sunshine better than that of the afternoon.

From dawn to noon the sun and earth forces are in opposition; the sun is radiating towards the West while the earth is revolving towards the East. All life depends on the opposition of these cosmic forces. From dawn until noon the eliminative powers are at their peak; toxins are neutralized or discarded, putrefaction and fermentation is inhibited, and infections are eliminated. During the pre-dawn hours the cosmic energy is at its lowest and more people die at this time than at any other period of the day, especially sick people and hospital patients.

The solar forces in the afternoon operate in the same direction as the rotating earth, East, and have a constructive and recharging influence; the food eaten at this time is thoroughly assimilated and absorbed into every cell of the body for constructive purposes. Therefore, the logical conclusion is that from morning until noon physical and mental activity should be at its height, and the afternoon and evening hours for comparative rest and relaxation. To do otherwise is to work in opposition to the Law of Rhythm and Universal Yin/Yang Balance. Early daylight hours are Yang; full of energy, activities and heat, while early evening hours are Yin, passive, restful, cool and calm. This is the Law of Nature, and is designed for our health and benefit.

Vibratory Light Waves

One of the greatest scientific achievements of this century has been the discovery of the indispensable health benefits that are locked up in sunlight. Although sunlight seems to us to be merely brilliant white light, actually a single beam of sunlight runs the gamut of all colors. If a ray of light is divided by a prism into its different wave lengths, the prism separates what the human eye recognizes as the seven colors of the scale of Light (Red, Orange, Yellow, Green, Blue, Indigo and Violet).

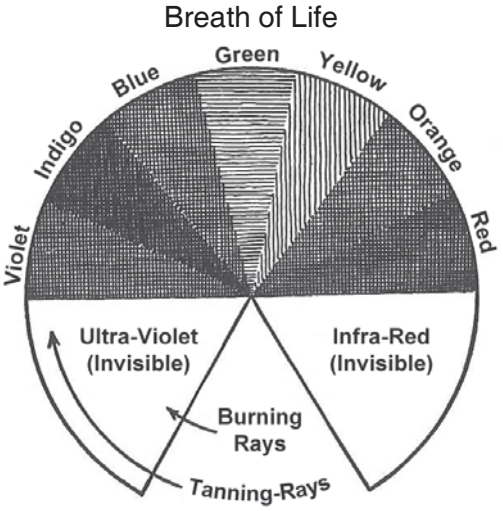

Fig. 9.12. ***Solar Spectrum:*** *7-Color Scale of life and birth. Rays just beyond the violet have the greatest effect in building vitality and health. Rays beyond red are very useful in reducing congested, inflamed tissues.*

Healing Ultra-Violet

When we speak of healing by sunlight, we mean, principally, the healing partly produced by the violet rays of the invisible band of sunlight, together with the ultra-violet rays of invisible light. We are healed, so to speak, by rays of light too short for the human eye to see. Some of the therapeutic properties of sunlight, it is true, are found in the infrared rays. In rheumatism or arthritis, bathing in sunshine has the effect of breaking up the uric/acid crystals into disposable by-products. The uric/acid from the harmful and tissue-stiffening uric/acid crystals is thrown off through the skin and kidneys and some iron, curiously, is released from the crystals for constructive work in the bloodstream.

This property of the infrared rays (invisible long rays of sunlight) in assisting the assimilation of iron by the system, proves to be valuable in certain cases of anemia. The action of the infra-red rays enables the iron (thus released into the bloodstream) to combine with oxygen in the formation of red blood corpuscles.

Sun Bathing

Wait at least two hours after eating your main meal before taking a sun bath. Use pinhole sunglasses to protect the eyes from glare. Winter sun is just as good, or even better than summer sun. Never sunbathe between the hours of 11 a.m. to 2 p.m., especially during the summer months. Nine to 11 a.m. and 2 p.m. to 5 p.m. are the best periods to expose the entire body to the sun. Make every effort to get out into the sun, bathe in it, walk in it, work in it, learn to love it.

Overexposure to the sun where one becomes red or burned causes a negative reaction in the immune system. Gradual and slow tanning in 5 or 10 minute increments benefits and enhances the body's immune system. The healing power of the sun's ultraviolet light is strongest at midday. One can burn very easy on cloudy days due to ultraviolet rays penetrating the clouds, so be cautious.

Scientific Solar Research

Millions of Americans eat diets heavy in refined and animal fatsthese are the diets loaded with fried food, rich pastries and fatty beef. These people should not be getting a lot of sunlight.

Medical science has determined that one of the causative factors of skin, bowel and breast cancer as well as aging of the skin is a high fat diet. The National Cancer Institute has recommended that Americans cut down on total fat in their diets. Experiments have shown that animals fed a high-fat diet and exposed to intense sunlight suffer considerable cancer whereas it is hard to induce cancer in animals getting the same amount of sunlight but eating a low fat diet.

The sunlight acts as an accelerator of cancer, but not as a cause, when there are a lot of fatty substances in the tissues. Wrinkling works the same way. It is the bad diet that has a lot to do with aging of the skin. (Excessive salt is the biggest culprit.) For extra protection, people should eat diets that are rich in vitamin C, E and carotene, a form of vitamin A. These nutrients help prevent harmful chemical reactions in the skin.

In addition, a diet rich in natural complex carbohydrates, grains, legumes, fresh fruits and vegetables, germinated seeds, nuts and sprouts eaten in season, will maintain the body in optimum health and superior protection from cosmic solar rays. When we learn how to live in har-mony with the laws of nature, we are protected and nourished by all of her elements fire, air, water and earth.

Summary Benefits of Sunlight

1. Lowers high blood pressure and cholesterol levels.
2. Strengthens bones, teeth, hair, nails, lessens cavities by increasing absorption of vitamin D and calcium.
3. Decreases susceptibility to bacteria, germs and virus.
4. Improves the immune system by increasing the amount and activity of anti-bodies and white blood cells; these cells manufacture interferon, an internal substance, which aids in healing diseased conditionsinternal and external.
5. Helps to overcome mental and emotional disturbances.
6. Helps to overcome hypoglycemia by lowering blood sugar.
7. Lessens frequency of colds, flus and tuberculosis.
8. Aids in atherosclerosis, angina, cancer and arthritis cases.
9. Decreases the need for insulin in some diabetics, in conjunction with proper exercise, herbs and diets, etc.
10. Improves over-all health, well-being and physical appearance.

Fresh Outdoor Oxygen

Man can live for weeks without food, a few days without water, but only a few minutes without air. Yet modern man stays cooped up in his home or office practically all day with the windows shut. He breathes in impure, stagnant air and wonders why he feels dopey and sluggish all day long. Have you ever noticed stale air in a room with closed windows after one has slept in it? The air is literally charged with autogenerated body poisons! Many heart attacks could be prevented by sleeping in a room with good oxygen ventilation.

Breathing oxygen sustains our life on earth; when oxygen is withdrawn, existence ceases. The most mentally and physically active people are the ones who breathe deeply and use their lungs to the fullest capacity; they are full of energy, vitality, health and youthfulness at any age! The joy of living glows on their face: their cells, tissues and blood is pumped and energized with life giving oxygen. They enjoy life to the utmost, and people are attracted to their magnetic charm and vitality. Diseased, pale-faced, and anemic people are full of uneliminated toxins and poisons in every cell and organ; they do not obtain sufficient vital oxygen to burn up the wastes; they are weak breathers, with poor health force; they are wasting away in their own waste and do not know it; their thinking is poor due to oxygen starvation and poor circulation. The power-charged vital oxygen breather and exerciser functions on 220 volts with energy to spare. Fresh oxygen, sunshine, wholesome food, and exercise are key factors in building super health force.

When the body possesses a high health force rating, four star and above, one is obtaining plenty of oxygen. There is a joy of living; we are happy to be alive; we bounce out of bed mornings with a song in our heart; depression, envy, hate, jealousy, worries, anxieties flee like phantoms in the night; we enjoy our work, and our creativity is enhanced; we are inspired to master life, and accomplish great deeds without struggle. A person who practices scientific breathing does not shun responsibility; they approach it head on with courage, fortitude and determination; they create and invent, but do not follow fleeting fads. The weak shallow breather, on the other hand, is an escapist, turning to drugs, alcohol, morbidness, perversion, fantasy, self-delusion, fads and the make believe tinsel worldmaterial illusion.

Health Benefits of Deep Oxygen Breathing

1. Deep breathing builds a state of high-level health force.
2. Oxygen burns up and eliminates poisons in the lungs and blood stream.
3. Deep breathing builds rich red blood cells.
4. Oxygen breathing helps to overcome the craving of artificial stimulants.
5. The body heals faster when sufficient oxygen is present.
6. It improves the memory and thinking ability and it cleans away the cob webs from the gray matter.
7. It creates healthy circulation to all parts of the body.
8. Helps to overcome anemia and nervous diseases.
9. Deep oxygen breathing improves muscle tone, lung capacity, complexion, flattens the abdomen, reduces wrinkles.
10. Diaphragm deep breathing aids digestion, assimilation and utilization of food.
11. Fresh outdoor oxygen after meals helps us to digest our food efficiently.
12. Deep breathing improves the singing voice and makes the speaking voice beautiful and harmonious.

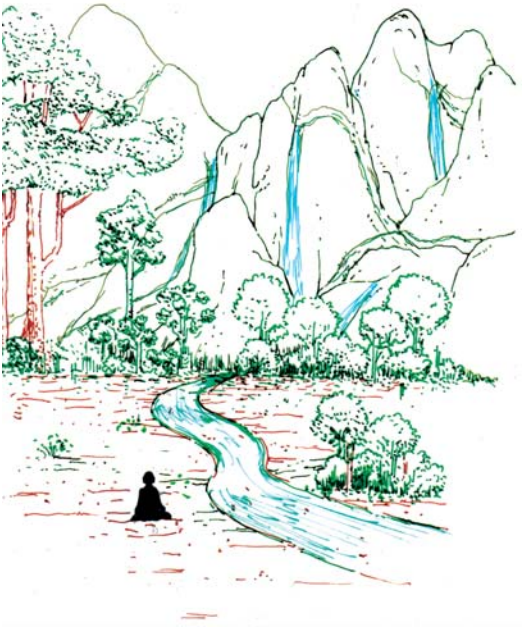

Fig. 9.13. Living and Breathing the Tao

Oxygen: Blood, Flexibility and Longevity

Why is deep oxygen breathing so necessary to health? Because our very life blood depends upon it. Oxygen is a food for the body and it is absolutely vital in purifying the blood. All the blood in the body passes through the lungs every three-quarters of a minute and then purified and enriched by the oxygen we breathe.

While I was in North Africa I was amazed at the beauty, strength and endurance of their native dancers. One of the tricks which cause wonderful beauty of North African girls is the development of their breathing musclethe diaphragm. Through its action in drawing in large quantities of fresh air and throwing out waste material, these girls have a delicious and fascinating complexion and skin, eyes of desire and the grace and suppleness of a fawn. The blood-making spleen sends out that rich material which causes your cheeks to be red and ruddy; the other blood making cells in the marrow of the bones voraciously grab the oxygen the diaphragm draws in. This is the whole secret for all these exercises. They make you breathe right and all the internal organs get the benefit of this right way of breathing.

They do not get this benefit by the ordinary way of breathing, and this is why so many men and women, when they have lived thirty, forty or more years have stiffened intestines, cemented joints, hardening of the liver, inelastic arteries and veins, cold feet and hands, indigestion and nervous dispositionsin fact, why so many indi-viduals commence to deteriorate at a period in life when they should be in the best of physical and mental state.

The human is an oxygen creature and cannot live without air. We should be outdoors for several hours each day, even in cold weather; dress accordingly. A short walk should be taken in the open air after meals. Perfect digestion and assimi-lation requires lots of oxygen. During sleep there should be maximum ventilation, while making sure you are sufficiently warm.

An abundance of fresh oxygen will make a great difference in the way you feel and think. Get your share! Large cities have a great deal of pollution, but outside air is still better than inside air. Go to the country, or near the lake or ocean whenever possible to obtain clean fresh oxygen.

Training yourself to get More Oxygen

People with plenty of oxygen are the happiest, most influential people of all. They make promoters, master salesmen, orators and organizers of note. There is a trick way of causing your lungs to change their position, to enlarge, and to assimilate more oxygen. This is done, in conjunction with proper deep breathing techniques, by the simple trick of flattening the small of the back. After a few attempts you will see that more air is taken into your lungsthat you walk with the stride of youth.

Stand straight up with your back flat against the wall. Leave no room between your back at any part, and the wall. It requires a little practice, but this brings all internal organs into their correct working position. Learning to walk with the back flat is the trick. Stand, walk, he, and sit with the small of the back flat, and the head held erect, and then oxygen will take care of itself in the body. This carriage throws the hips forward and upward and practice gives grace and greater height to the figure.

Water: Liquid of Life

The finest of all water is that found in fresh fruit, vegetables and juices; it is organic water of the highest quality. Pure rain water sent from the heavens is the cleanest liquid substance that nature has to offer. Rain water is naturally distilled by the clouds and gently sent down in little organic droplets for the benefit of mankind. Cloud distilled rain water is vitalized, energized and aerated by the atmosphere on its journey to earth; it is full of life electricity and magnetism.

Rain water may be caught directly from the clouds and stored in a clean, dry and cool place. The easiest way to collect rain is during the whiter when nature pours her white snow flakes to earth in great quantities. The purest rain or snow is found in the country, ocean or mountains where air pollution is at a minimum.

Pure rain or distilled (aerated) water acts as a solvent and dissolves uric acid, old age salts, mineral deposits and toxic wastes within the body that makes one grow older years too soon. Pure vitalized water is a blood-builder because it picks up the internal filth and cleanses the entire system.

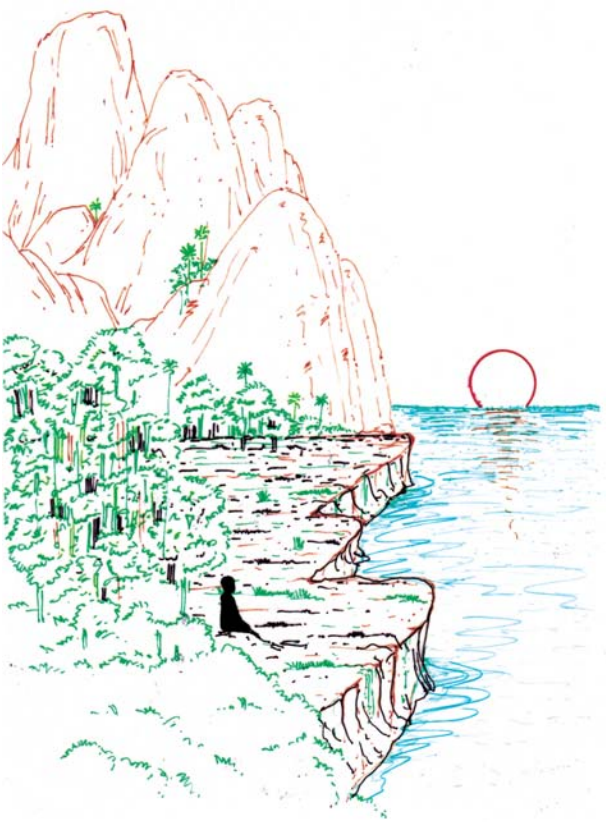

Fig. 9.14. Living in the Tao's Liquid of Light

Distilled and Mineral Water

Factory distilled water is pure lifeless liquid and it lacks the electricity of vitalized rain water. The cosmic rays of the sum and atmosphere are the life-giving principle ingredients that make rain water a superior liquid. However, man-made distilled water may be vitalized and solar-aerated by pouring it from one container to another in the morning sunlight and outdoor atmosphere, thus imparting to it a degree of solar energized electricity. Still waters grown stagnant and lifeless; while moving and churning waters attract to itself more sunlight, oxygen and atmospheric life force. This is the reason that you should aerate your distilled water. You may also store the aerated water in colored glass containers and let it stand in the direct sunlight, covered until ready to use.

The centenarians of high mountain regions utilize pure glacier waters that have been energized by the unpolluted atmosphere; this water is very fast moving and it remains in a constant aerated state for daily use. Mountain or spring water does pick up some inorganic material, but these have always been a part of man's natural environment and are not known to be harmful to the body.

Inorganic mineral water does not cause hard-ened arteries as some people believe. Hardened arteries, and other civilized diseases are the result of a high animal food intake, calamity junk food, stress conditions and lack of pure wholesome natural foods. Cholesterol deposits from wrong foods is the cause of hardened blood vessels and other old age symptoms.

Do not be afraid of a few inorganic mineral sub-stances or a couple of harmless microbes, but on the other hand, be intelligent enough not to use contaminated sewers, stagnant lakes or ponds, or the chemically treated, chlorinated and fluoridated city tap waters. Water which flows in a living stream or which comes to you fresh from the clouds, charged with solar energy and laden with cosmic electricity, is Nature's sweet gift and you cannot improve on it in any way.

Deep mineral waters as a rule are not as good as those which are clear, aerated and fresh. It is a general rule, however, that young and growing persons need to drink water which contains lime, as it builds and hardens the bones and teeth; this is called hard water. It is probable that after a person reaches fifty years of age they will be benefited by drinking soft water, distilled (aerated) or rain water which prevents the rapid solidifying, hardening and aging of the body. Seventy five percent of the human body is composed of water. Water flushes out internal wastes and purifies the cells, tissues and organs.

Drink Only When Thirsty

Liquids should be taken only when thirst is present. Over-consumption of liquids causes polyuria (excessive passage of fluids or frequent urination). It also causes expanded kidneys and intestines, a yin condition. Overconsuming fluids causes the kidneys to excrete urine instead of cleansing the blood and ridding the body of uric acid and metabolic toxins.

Ancient and Modern

There are many modern systems in use, and systems are constantly evolving. Modern research uses experimentations and science as its tools, rather than the observation of Nature, energy and spirit. However, despite such different methodologies, very often the modern systems replicate the findings of the ancient ones.

By understanding the parallels we give ourselves more options, such as new ways of considering old theories. We also open up the opportunity to use modern medical testing procedures to assist us in making accurate diagnosis. We do not need to throw out the old to make way for the new, but can integrate them to bring an even more comprehensive system of Five Element Nutritional Therapy. We will examine several different modern nutritional theories that support the ancient Yin and Yang theory of health.

Metabolic Typing

One sophisticated system of diagnosis and treatment is that of Metabolic Typing. Harold J. Krista and James M. Haig are two of the leading pioneers of this technique. They have proposed a system in which individual differences in metabolism are measured and different dietary therapy is applied to each group.

Tenets of Yin-Yang Metabolics:

1. One man's medicine is another man's poison.
2. Our internal metabolic systems can operate in different ways.
3. Some foods are not healing, no matter what type you are: these are those that are far from being whole: refined and processed foods.
4. When we come more into harmony, we become less of a type and more balanced. Symptoms are reduced, and we become harder to diagnose because there is nothing wrong.

This is a close reflection of the Yin and Yang theory, in which we can look at people along a sliding scale from one extreme to the other. Rather than using the ancient diagnostic techniques. Metabolic Typing uses a series of sophisticated medical tests. These look at various aspects of metabolism.

Just as in Oriental Therapy, there are two main groups that can be distinguished. Another similarity with Oriental Therapy is that these two groups can be further subdivided into an underlying four groups. Balance is also sought as a health ideal in Metabolic Type Five Element Nutrition. To an Five Element Therapy practitioner, balance is the absence of disease plus vibrant health and wellbeing. Kristal and Haig suggest that when such a condition exists, the underlying metabolic state is one in which there is a blood pH of 7.46; slightly alkaline. However, because our metabolic systems operate in different ways, the diet that we have to follow to reach this pH differs from one type to the next. This is because the way that we receive energy from our food can take very different forms.

Metabolic Types

The Metabolic Type method aims to create a slightly alkaline pH (7.46) of the blood for health. This in itself is not a new theory, and there are many advocates of alkalizing. However, what Kristal and Haig discovered is that foods and nutrients that alkalize one group of people actually have the opposite effect on others. They also found that some people have blood that is slightly too acidic, but in others it is too alkaline. It all depends on how people source and metabolize their energy.

Oxidative Types: One group of people, the Oxidative types, gain most of their energy from the metabolism of glucose. There is a system within the body's cells called the Krebs cycle. In this cycle glucose is converted into a useable energy form called ATP. This may be balanced, but in some people this process happens too fast and they process glucose very rapidly. They are called fast-oxidizers, and their blood tends to be too acidic. Others do not process glucose fast enough, and they require more glucose to be fed into the Krebs cycle to produce energy efficiently. These people are called slow-oxidizers and their blood tends to be too alkaline.

Autonomic Types: All humans process energy through the Krebs cycle. However, there are some people who are more affected by the activity of their autonomic nervous system (ANS) than by their oxidative system. This is the part of the nervous system that regulates involuntary metabolic processes.

There are two different divisions of the ANS: the sympathetic and the parasympathetic. The sympathetic nervous system puts us into fight or flight mode, making our body ready to respond hastily to a threat. Some types, called Sympathetic Types, utilize this state as their main form of energy and they have a blood pH that is slightly too acidic. The parasympathetic nervous system puts our body into a state of relaxed and rested. In such a state our body would not be ready to respond to an emergency, but is calm and using very little energy. Some people are governed most by this branch of the ANS, and are called Parasympathetic Types. They have a blood pH that is slightly too alkaline.

Oxidative Systems Two Groups:

Fast-Oxidizers
Slow-Oxidizers

Autonomic Nervous Systems Two Groups:

Sympathetics
Parasympathetics

These are underlying metabolic processes. However, we can also look at health as measured by blood pH.
There are two groups that tend towards having a blood pH that is too acidic:

Fast Oxidisers
Sympathetics

There are two groups that tend towards having a blood pH that is too alkaline:

Slow Oxidizers
Parasympathetics

The aim of Metabolic rebalancing is always the same: to restore blood pH to 7.46. The method however will vary depending on the underlying metabolic system.

Acid and Alkaline Balance

Many nutritionists have realized that blood needs to be slightly alkaline, at 7.46, for health. However, so-called alkalizing diets only seem to work for some people. The Metabolic Type theory states that this is because: The pH effect of a given food is a result of the interaction between the inherent qualities of the food itself and the metabolism of the person eating it. The Oxidative and Autonomic types have different responses to foods, as shown in the table below:

Type	***Food Eaten***	***Response of Blood pH***
Oxidizers	Protein/fat	More acidic
	Carbs	More alkaline
Autonomies	Protein/fat	More alkaline
	Carbs	More acidic

Notice that the two food groups, proteins/fats and carbohydrates are the same two food groups used to rebalance Yin and Yang imbalances in Five Element Dietary Therapy.

Creating Balance

So we can see that the food groups have the same effect on both types of Oxidizer, and the opposite effect on the Autonomic Groups. However, we have also seen that the sub-groups within each type have different pH imbalances: Fast Oxidizers and Sympathetic are too acidic, whereas Slow Oxidizers and Parasympathetics are too alkaline. From this we can work out which food groups will rebalance which types:

- Fast Oxidizers need to become more alkaline, and thus they need to eat more proteins/fats.
- Slow Oxidizers need to become more acidic, and thus they need to eat more carbs.
- Sympathetics need to become more alkaline, and thus they need to eat more protein/fat.
- Parasympathetics need to become more acidic, and thus they need to eat more carbs.

So we can see that both Fast Oxidizers and Sympathetics need more protein/fat; whereas Slow Oxidizers and Parasympathetics need more carbs.

Metabolic Groups

To make this simpler to use, Kristal and Haig grouped together the sub-groups that require the same diet to bring them into re-balance. Thus they placed Fast Oxidizers and Sympathetics into Group I, and Slow Oxidizers and Parasympathetics into Group II.

	Group I	***Group II***
Oxidative Types	Fast Oxidizers	Slow Oxidizers
Autonomic Types	Sympathetics	Parasympathetics

Though the underlying situation is vastly different in each of the four subgroups, the treatment applied is according to the Group. This is similar to Yin and Yang therapy, in which we have two treatment protocols, but four underlying situations.

Dietary Recommendations

The broad outline is that Group I can eat more complex carbohydrates to restore balance. Group II require more quality proteins and fats for their balance.

Complex carbohydrates includes whole grains, vegetables and fruit. However, it does not imply that we should eat the sugars and refined foods that fill our supermarket shelves.

Proteins and Fats includes high quality meats and fish, especially oily fish, Fats must be of high quality, such as fish oils and cold-pressed oils. It does not include poor-quality and rancid oils or deep-fried food.

In addition to these guidelines, there are some specific foods found to have differing effects on blood pH. George Watson, and later Rudolf Wiley, tested many foods and their effects on blood pH. Thus they have created a detailed list of foods for each Group.

Group I Foods *(Slow Oxidizers & Sympathetics)*						
Proteins			***Carbohydrates***			***Fats***
Meat	***Seafood***	***Dairy +***	***Grains***	***Veggies***	***Fruit***	***Oils - Nuts***
Eat Lighter Meats	***Eat White Fish***	***Low Fat Cow/Goat***	***All Whole Grains***	***Emphasize these Foods***	***OK***	***Sparingly***
Buffalo	Catfish	Cheese	Amaranth	Beet	Apples	Almonds
Chicken	Cod	Cottage	Barley	Broccoli	Banana	Cashews
Breast	Flounder	Cheese	Rice	Brussels	Berries	Almond
Ostrich	Haddock	Milk	Buckwheat	Sprouts	Cherries	Butter
Pork	Perch	Yogurt	Com	Cabbage	Citrus	Tahini
Turkey	Scrod	(Plain)	Millet	Chard	Grapes	Olive Oil
Breast	Sole		Quinoa	Cucumber	Melons	
	Trout		Rye	Eggplant	Peaches	***Moderately***
Minimize	Tuna (Lite)	Eggs	Wheat	Garlic	Pineapple	Coconut Oil
Salty Foods	Shrimp		(Very Best)	Kale	Plum	Sesame Oil
Organ Meats	Crab			Greens		Other Nuts
Red Meats	Crayfish		***Minimize***	Lettuce	***Minimize***	Seeds
	Lobster		Oats	Onions	Avocado	
			Beans	Peppers	Artichoke	
			Lentils	Potatoes	Asparagus	***Minimize***
	Minimize			Sprouts	Carrots	Butter
	Oily Fish			Squash	Cauliflower	Fatty Foods
				Tomatoes	Olives	
				Turnip	Peas	
				Yam	Spinach	
				Zucchini		

Eat 3 regular meals per day; eat protein foods at least twice a day; do not eat the same foods every day.

Avoid processed and fast food, and refined or partially hydrogenated vegetable oils; use unrefined oils only.

Eat organic meat, eggs and produce whenever possible; emphasize a variety of vegetables and leafy greens.

Bake, broil, grill, poach or stew animal foods; do not overcook or blacken.

Drink 2 cups of filtered water on arising; drink a total of 6-8 glasses per day.

Minimize alcohol (especially hard liquor) and coffee; completely avoid all sodas (regular or diet).

Avoid all sugar and artificial sweeteners (NutraSweet®, etc.); use stevia, xylitol or lo han instead.

Restrict salt intake; use unrefined sea salts, such as Celtic, Eden, Mediterranean or Real Salt.

Group II Foods ***(Fast Oxidizers & Parasympathetics)***						
Proteins			***Carbohydrates***			***Fats***
Meat	***Seafood***	***Dairy +***	***Grains***	***Veggies***	***Fruit***	***Oils - Nuts***
Eat Darker Meats	***All OK Oily Fish***	***All OK Cow/Goat***	***OK in Moderation***	***Emphasize these Foods***	***OK in Moderation***	***OK***
Beef	Anchovies	Cheese	Amaranth	Artichoke	Apples (Tart)	Butter
Buffalo	Caviar/Roe	Cottage	Barley	Asparagus	Granny	Nut Butters
Lamb	Herring	Cheese	Buckwheat	Avocado	Smith	Tahini
Liver	Mackerel	Cream	Corn	Carrots	Pippins	
Kidneys	Salmon	(Full)	Kamut	Cauliflower	Banana	***Oils:***
Ostrich	Sardines	Milk	Millet	Celery	(Firm)	Coconut
Poultry	Tuna (Dark)	Ricotta	Oats	Green Beans	Blueberries	Olive
(Dark)	Crab	Yogurt	Quinoa	Mushrooms	Pears (Firm)	Sesame
Red Meat	Lobster	(Plain)	Rice (Brown)	Olives		
	Shrimp		Rye	Peas		
Minimize	Oyster	***Misc.***	Spelt	Spinach	***Moderately***	***Nuts/Seeds:***
Broccoli	Shellfish	Eggs		Winter	Apricots	Almonds
Potatoes		Beans	***Minimize***	Squash	Berries	Brazils
Mustard		(Dried)	Wheat & All		Plums	Cashews
Greens		Lentils	By-Products	***Moderately***		Pecans
Soft		Tempeh	White Rice	Chard	***Minimize***	Pumpkin
Squashes		Tofu		Green Salads	Citrus Fruits	Sunflower
Tomatoes				Kale	Grapes	Walnuts
Zucchini					Fruit Juice	
Vinegar						

Chapter 10

Three Treasures of the Tao

Psychological Aspects of Yin and Yang

Just as physical objects, food and climate are classified into Yin and Yang, there are also psychological aspects, mental characteristics, societal conditions and individual tendencies of Yin and Yang. Yin and Yang is the Law of Polarity or the Law of Opposites. Nothing can exist except in relation to its opposite. Without mountains there can be no valleys. Without shadows there can be no perception of light. If masculinity only existed we would have no perception of feminine beauty. There would be no such thing as evil unless we were able to compare it with good. Without wisdom, there can be no ignorance. Without age there can be no such thing as youth.

The enlightened (Yin/Yang balanced) person is a realist. He or she knows how to use Yin and Yang to improve their life. He knows there are basically two types of people in this world; the leaders and the followers. If people refuse to become the leader of their own life and circumstances, they become followers. If they will not become masters of their own life and health, then they become slaves to their uncontrolled desires.

By studying the Yin and Yang principles in all its aspects, you will be able to think and see clearly, thereby developing better judgment and supreme wisdom. Of course, if you do not want to think or see clearly, that is your own funeral. If you let others do your thinking for you, do not feel depressed or offended when their thinking turns out to be for their own advantage and to your disadvantage. The shepherd exists solely to fleece his sheep, and all his loving kindness and solicitude for their welfare is necessary to his fattening them for the slaughter.

Balancing your Yin and Yang Forces

A person who is balanced and controlled in all of their Yin and Yang aspects of egoistic, intellectual, motive, emotive, moral and spiritual can write their way to success and happiness. The Extreme/Deficient/Yin and the Extreme/Excessive/Yang person are not in conscious control of their physical and psychological forces.

They are tossed about by outer circumstances because they have unbalanced their physical and mental Yin and Yang polarities. The Yin and Yang balanced individual consciously maintains and flows harmonously with the natural forces of life as daily situations arise. He is poised in every undertaking, whether it be working in a factory or selling insurance. Nothing disturbs his center of balance or his energy. He does not use the forces of nature or his own power to gain an advantage over another person. He knows that any coersion or force will bring dire consequences upon himself and misery for others. The Extreme/Yang person, on the other hand, consciously uses Yin passive people for his own ends, and he creates a Hell on Earth for himself and others.

By doing this, he sets the wheels of cause and effect in motion and eventually reaps what he sows pain, grief and suffering. Taoist wisdom teaches that: The wise man seeks everything in himself; the ignorant man tries to get everything from somebody else. The essential difference between the Controlled/Balanced/Yin and Yang person and the Extreme/Yin and Yang ones is in the degree of conscious awareness. The former consciously balances his inner mind and soul with his outer physical body, while the later is unbalanced and totally controlled by his desires, habits and physical environment. If we enter into a relationship with a controlled attitude, without attachment or possession, we are considered balanced we must also maintain a kind and loving nature. A person is considered Extreme/Yin in a relationship if he possesses, holds, or becomes emotionally crippled with uncontrolled attachment and desire. In most modern day relationships there is the lover (Yin) and the beloved (Yang). The lover pursues and attempts to possess the beloved, who in many cases is indifferent or unattached to the lover. A true relationship is based on mutual love and respect, where both people have totally balanced natures. Emotionalism is a Yin condition not based on true love. An unbalanced relationship is generally emotional, possessive, which develops into jealousy, self-pity and loss of self-confidence.

Yin Temperament

Need someone or something excessively and you will become Extreme/Yin. Let it affect you mentally, physically, emotionally and spiritually and you will become useless to everyone, including yourself. Excessive and uncontrolled desires are the cause of much

pain and heartbreak. We fail to see life as it is seeing with tunnel vision to escape universal truths and realities of life. To supress a truth is to give it force beyond endurance. It is easier to realize truth than to supress it in the long run. Essentially we live on a material plane, or in a Yin-type world. There is no such thing as a totally Yang person. Since we live in the Yin world of matter, we have a certain amount of Yin within us merely to keep us alive to adapt to the needs of existence. Thus, right from birth we are trained to be Yin, to be materialists enough to support ourselves. We are trained by society to react Yin to outward circumstances. And since Yin is decay and death, we are schooled more in the art of dependence and confusion (Yin), than in the art of healthful living and clear thinking (Yin-Yang Balance) for ourselves.

Yin reacts uncontrollably to outward conditions. Yin needs. Yin is also dominated. That is the whole mystery of it in a nutshell. Yin is dependent. Crave something uncontrollably, and you are its slave. Psychologists say that you are on your way toward becoming an alcoholic as soon as you tell yourself, I need a drink. Alcohol itself is an extremely Yin substance and it tends to expand or Yinnize the body and brain. Respond to something and you are in sympathy with it; you are a part of it. Respond to worry (Yin) and you will have more worries.

Put yourself in the position of craving, lusting and excessively worrying about money, and you will never get enough of it because you are not ruling money, you are letting money rule you. If you are ruled by money, you are Yin. Excessive miserly greed is extreme Yang. Neither condition is healthy. Money in itself is neither Yang nor Yin it is just a manifestation. It is when you let yourself react to it that it becomes Yin. The right attitude about money is to agree to its worth, but do not crave it excessively and let the world see that you do not lust after it and you will get all you need.
It works 100% if you give it a try.

Creditors are Yang. They have control over your money if you allow it. You are Yin and have created a need for something beyond your immediate capacity to buy. Someone once stated that if you want peace of mind, owe no debts. Balancing your Yin and Yang nature in all of its aspects will automatically lead you to peace of mind. The Way of the Tao is this: to take from those who have more than enough and give to those who do not have enough. Man's way is to take from those who do not have enough, to give to those who already have too much.

Yin and Yang manipulate each Other

When you ask for sympathy, you are becoming more Yin; you are putting yourself into the power of another. Like attracts like. Feel sorry for yourself (Yin reaction to circumstances) and the only person who will sympathize with you is somebody else who is feeling sorry for himself (Yin). Do not expect a disappointed lover to sympathize with your money troubles, unless he has lost sums of money in his pursuit of love. Few things are sweeter than money love and money. But fortunate is the healthy lover who has money. This explains why those who have suffered much, understand others who are still suffering. The less someone has, the more (in proportion he is likely to give you. The millionaire who is never known suffering or poverty, wil not understand your need for money. Since we exist within material bodies on a material plane we cannot totally escape its manifestation. We affirm a thing by denying it, just as much as we do by accepting it.

Success comes from creating a need in others. For instance, advertising is the biggest business in the world. It depends on its success by making others need (Yin) things, (a lot of which they do not really need). In a business sense advertising is Yang. People who believe the propaganda are Yin. A person in Yin and Yang Balance always uses good judgment in all of his purchases and never gets duped against his will by false advertising. A salesman can sell things to people that they do not really need. In that case, he is Extreme/Yang and you are Extreme/Yin. Allow financial worries to take you over and you cannot possibly lick them. You have become a slave to the dollar. If you worry about security, you will never attain it. There is no such thing as absolute security in this finite ever changing material world. Nothing ever remains the same.

The only true security in this world is to live in harmony with the Tao or the natural laws of life. Everything in life constantly changes; it is dynamic, not static, and the wise person flows smoothly with these changes.

Overcoming Temptations

Consider the temptations of a mystic, sage, monk or holy man. Since the majority of the human race has been trained to be Yin, and is Yin whole-heartedly, there are very few people who can bring themselves to believe that there is, indeed, enlightened and

self-realized sages, saints and holy men and women now living on this planet. The world has its own vices (Yin enslavements, Yin needs, Yin habits) and is convinced that the holy person must have his own vices also. Maybe he conceals them, they think, but he still has them. So what do they do? They try to tempt him.

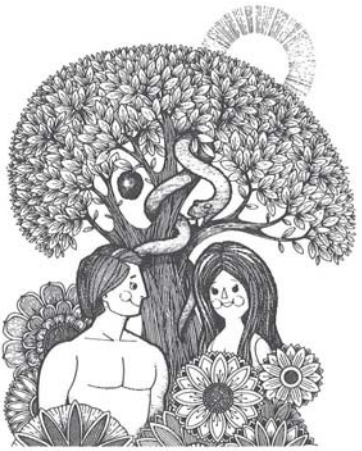

Fig. 10.1. Conserve your powers. Be like the expansive ocean, which quietly absorbs the rivers of the senses. Cravings deplete your inner peace; through them, vital waters are wasted in the barren soil of material things. Wrong desire is the greatest enemy of happiness.

He does not like rich food. Just give me the simple things of life, he informs them. They will tempt him with goodies and try to force him into a craving (Yin) for them. As long as he can honestly reject them, he is safe. No one is forcing the slave to remain the slave. If he's going to retain his vices, if he insists on being dominated by his desires and those of society, there is no hope to help him unless he is willing to be helped. Heaven helps those who help themselves.

Master the Yin and Yang World

If you are a writer, you will have difficulty getting an agent until such time as you no longer need one. An agent will not start handling you for free until you have proved your ability (on your own) to sell scripts. Then he will agree to handle you for a commission, or what he can get out of you and because then he needs (Yin) you.

Take a look at all the slaves of fashion (who try to get you to have your hair clipped off in the latest style) and the slaves of decoration (who try to persuade and seduce you into stocking your house with all sorts of dust-catching objects). It is the women who are independent of fashion who set the fashion and become leaders of fashion. All the latest fashion designers achieved success and reputation by being innovative, creative and unique and not following the trend.

Why do we revere Lincoln, Washington, Einstein, Edison, Shakespeare, etc? Because they dared to be different; to be individualists and being first in their field. They were in complete harmony with their Yin and Yang natures. Set a price on yourself (whether for your services or your integrity) and nobody will want you. Refuse to set a price on yourself and people will swarm on their knees to you because they will know you can be trusted. An Extreme/Yin or Yang person cannot always be trusted. If you are Yin and Yang balanced and demonstrate that you can do without anything, you will have it thrust upon you. Especially demonstrate that you disdain something that the masses lustfully crave, and you will be totally overwhelmed by it, because you will be a challenge to the whole materialistic (Yin) world.

Give someone a gift everyday, and very soon it will lose its meaning. Give it when its least expected and the person will react favorably. Many parents complain, I gave my child everything his little heart desired, and what did I get in return? A child does not necessarily want material things he really wants love, approval and firm, but gentle guidance. Bribe him with gifts and he will despise you forever. Give him love and he will love you forever.

Show a manufacturer that you need his product and he will raise its price. Walk away from his product, be indifferent to it, and he will come running after you. If we continue to allow the oil companies to sell us gas at exorbitant prices, that we need, the price will continue to rise. If everyone in the world stopped using their cars and machines for a week or two, the oil barons would come running after us to buy their oil, dirt cheap. Have you ever found yourself at a table with others who loved to eat rich foods and lived to eat? They will tell you to forget your silly health diet and eat up, you can start back on your diet tomorrow. They are the slave (Yin) to food and want to make sure that you are as much enslaved as they are. Slaves do not want other people to be free. When in Rome, do as the Romans do. If you are surrounded by Yin food

gluttons, they will ostracise and deride you if you do not eat and act like them. Yin people dislike others who think for themselves in a controlled Yin and Yang manner. Since they are not free of their rebellious habits, they despise others who are free. A vain nature invites diverting pleasures and must suffer accordingly. If a person is unstable within, he indulges indiscriminately in the pleasures of the world, and thus they have an influence so powerful that he is swept along by them. In this case, it is no longer a question of danger, of good fortune or misfortune. He has given up direction of his own life; what becomes of him depends on chance.

Attitude changes with your Circumstances

The best method of all is to stop needing so much. Stop letting yourself be dominated by outward circumstances. So you have to live without certain modern conveniences for awhile. You will not die. Our ancestors lived on earth for eons of time and they managed to survive nicely, and to healthy and advanced ages also. A philosopher once said that contentment consists not in great wealth, but in few wants. If you develop a little guts and gumption by being more independent of such things, you can easily master this life in due time. He who knows that enough is enough will always have enough.

Strikes succeed because they are controlled by Extreme/Yang forces (the ability to walk away from something) and the manufacturers have to give in (Yin) to the demands (Extreme/Yang) of labor because they need (Yin) the workers to produce their products. As long as your employer needs you, your job is safe. Demand and complain (Extreme/Yin) that you need a raise, and he will pretend that he did not hear you. Demonstrate to him that you are wanted by another company for a higher salary, and he will probably give in to your demands. It seems a general rule that we always get a thing when we no longer want it, when our attitude is indifferent toward it. It is wise to never take anything for granted, because to take a thing for granted is to rely on it and not on the natural forces within yourself therefore to be subject to its domination. You may ask, Why do millionaires continue to make money, if they are not dominated by money and therefore Extreme/Yin. That question answers itself. Most millionaires manage investments and big business deals not because of lack. They made their money to assert their egos, to prove their ideas to themselves first, and to

others secondly. They do not worry about making big deals or losing a few thousand dollars here and there. It is all a discussion of theory and inventive reasoning, of out smarting the competitor or getting him to react, meaning forcing him into the position of Extreme/Yin. The money is merely incidental. It's the excitement and adventure of pulling a fast one that motivates him, not security.

To receive relief from the wrong way of living, one must follow the way of the Tao, or lose the chance to gain enlightenment.
A long life is only the blink of an eye. If you seek only material things and earthly pleasures, the mirror will reflect your own pale face and the degeneration of your body. Material things may fill the valley, but possessions cannot last and do not help acquire the things which do not come back.

Becoming a Free Individual

The universal laws of life are exact in their operation. As you sow, so shall you reap. For every action, there is an opposite and equal reaction. It is the law of cause and effect on the physical plane. Plant a rose and you will not get rice. Sow Yin, harvest Yin. Sow hate, harvest hate. Sow friendship, harvest friendship. Sow love, harvest love. Like begets like. Sow war, harvest war. Sow politics, and all you get is more politics. A good man (woman) contributes toward a good family, a good family contributes toward a good nation, good nations contribute toward a good world.

We all have a tendency to let ourselves become slaves; the herd instinct. We all want to follow some sort of leader or authority without question, allowing somebody else to do our thinking for us, and take over our personal responsibilities. We want a certain thing because we've acquired the habit (Yin) of it and we lack discipline and courage to break the habit, whatever it is. Buddha knew the secrets of life when he said desire is the source of all pain.

What the world calls repose, the sage does not. His repose derives from his mental attitude. It becomes the mirror of the universe. Nothing disturbs his tranquility. Hence his repose.

A too strong Extreme/Yang attitude is likely to bring an overwhelming Extreme/Yin reaction in others, perhaps even hatred or destruction. Extremes are to be avoided at all times. The key is to balance your Yin and Yang polarities through proper diet, sufficient exercise, attention to the needs of others, kindness, and spiritual development. Extremes in any endeavor only creates pain, suffer-

ing, disease and trouble. The idea is to never need anything so badly that you cannot do without it.

The sage cares not for himself but responds to the needs of others. Be good to people who are good. To those who are not good be also good. Thus goodness is achieved. Be sincere to those who are sincere. To people who are not sincere, be also sincere. Thus all shall be sincere and this is the Way of the Tao.

Harmonize your Life with the Tao

Our goal in life is to develop all of our forces mental, physical and spiritual. This will lead us to a true understanding of creation, peace of mind, the sense of beauty and the appreciation of our real inner self. By blending these forces into one we perfect, harmonize and realize the completion of our being. One quality is almost useless without another. Intelligence can be of no real value unless it has physical strength back of it to carry out its ideas. Moral power can be totally ineffective if it lacks the physical strength to carry out its ideals. Inversely, health alone is valueless unless it is accompanied by mental and spiritual development. A criminal may be intelligent, but he is not well-balanced. He lacks the moral and esthetic sense, and he very often is poor in health. Complete wholeness and harmony are necessary for the perfect life.

It takes wisdom and intelligence to follow the path of Yin and Yang. The more these fundamental laws are followed, the more one will be guided in life by the Supreme Force or Creator. The code to this unifying principle is very simple: Moderation and Balance. Following the middle path of life activity and diet and avoiding extremes will automatically create a Yin and Yang balance, leading to harmony in body, happiness in mind and soul and success in life.

Marriage of Truth & Love (Yin & Yang)

In the Divine Mind, Truth and Love are indissolubly wedded. All human undertakings which count for anything exemplify this union, for it is according to the pattern showed to thee in the mount. The forces of evil try to divorce truth and love in the consciousness of men, and to make them believe that truth can be advanced through war and strife, carried on with motives of anger, hatred, revenge, self-interest, or self-justification.

Ever and anon, problems of importance must be discussed and settled in our families, in our business relations, and in the larger negotiations of politics, law, diplomacy, government and religion. In these discussions, let us defeat the one evil through understanding and bearing in mind that, by no amount of argument, however valid, and by no amount of force of any kind, can we successfully promulgate truth and permanently bring to pass the real issue, unless, during our efforts, we purposely and habitually exercise the spirit of good will, right feeling and right purpose.

In dealing with others, reasoning and goodwill are as the wings of a bird. If a bird tries to fly with only one wing, he whirls round and round, to his own confusion, making no headway; but using both wings, he will make much progress in his flight. Only as the male principle, truth, and the female principle, love, are wedded in our consciousness, can we obey the spiritual command: Be fruitful (of righteous thoughts and deeds), and multiply (them), and replenish the earth (with them), and subdue it. Truth will go no further and no faster than love leads as a companion.

Balancing Yin and Yang Qualities

To balance the elements in one individual, it is well to understand that there is no mental characteristic found in men which is wholly absent from women. There is no mental quality found in women which is not possessed in some measure by men. This is on the human plane. On the spiritual plane there is no sex distinction. Spiritual person possesses both the masculine and feminine qualities in balance.

In music, certain notes, when struck separately, make discord. The same notes, when struck together, make harmony. The same law applied to the characteristics here given will bring about like results. In electrophysics and practice the negative and positive currents produce the circuit. The feminine elements above named and the masculine elements, balancing each other, make for harmony, and complete the circuit of life on the human plane. To bring this balance or harmony about, one must get the idea in mind of the two elements under the heading of feminine and masculine, converging into each other. This attitude must be held, and Its opposite denied, until the fusion is complete in consciousness and demonstrated in life and power.

Yin Feminine Qualities	**Yang Masculine Qualities**

Feeling	is balanced by	Intellect
Love	"	Wisdom
Meekness	"	Self-Value
Caution	"	Courage
Freedom	"	Responsibility
Patience	"	Aggressiveness
Tenderness	"	Stability
Joy	"	Moderation
Faith	"	Understanding
Gentleness	"	Strength
Intuition	"	Logical Reasoning
Generosity	"	Economy
Repose	"	Energy
Zeal	"	Reflection
Ambition	"	Unselfishness
Charity	"	Justice
Candor	"	Tactfulness
Aspiration	"	Judgment
Benevolence	"	Discrimination
Liberty	"	Obedience to Law

Success and health is the perfectly natural culmination of harmonious development. It means a fulfillment of our desires, whether they be in the material or the spiritual world. We know that we cannot fail; if we have completed our development. No earthly force can stop us. If we want health, success and peace, we are certain of achievement, for no one with complete harmony of being can fail It is as impossible to visualize failure as it is to imagine the failure of the sun to appear in the heavens. Let us be thankful and joyful that we have the opportunity to achieve all that we have yearned for during a lifetime. 'A high purpose is magnetic and attracts rich resources.

Fig. 10.2. The Yin and Yang Within.

Majesty of Inward Calmness

Are you discouraged with life? Do you worry over trifles? Are you full of fear and doubt? Do you make mountains out of molehills? Do you get angry over nothing? Are you nervous and irritable? Are you constantly grumbling, criticizing and complaining? Are you envious of the success of others? Are you plagued by the green-eyed monster jealousy? Do you carry grudges, trying to get even with other people? If you are a slave to any of the above habits, you can never have mental peace and Inward Calm. You must realize that confusion in the mental kingdom disorganizes the body and poisons the blood. The person who cultivates Inward Calm will always possess self-control and be moderate in all phases of living. A well-functioning body imparts vibrant health and Inward Calm. Worry, fear, hate and all negative thoughts lead to enervation and finally to disease. Very few individuals in this world possess that great treasure: Peace of Mind. Would you like to be at peace with yourself and the world over-flowing with joy and happiness? Of course you would. To be poised in both mind and body is the greatest thing in the world. You will be looked up to as a leader and teacher.

Cleansing Power of Forgiveness

Spend a few minutes each night in forgiving everyone who might have committed a transgression against you. Let go of your hates, anxieties, problems, then ask God to lead you in your life. You will find a change in your life for the better. Real calmness will set in. Just as it is necessary to cleanse the physical body through fasting to attain a state of good health, so is it necessary to cleanse the heart. Forgiveness is the best means of cleansing the mind. You will never have perfect health or peace of mind while holding a grudge or seeking revenge. Thoughts are things and they will come back to you just as sure as the sun rises in the East. When you forgive, you release a tremendous amount of tension. As you mentally bless and forgive others, yourself included, a heavy weight will be released from your mental shoulders. As you cleanse your mind of hate, vengence, envy, jealousy, peace and love will flow right in. You will experience a peaceful bliss and feel uplifted. Send out thoughts of love to everyone. Do not go to bed any night feeling that you have an enemy in the world. Forgiveness is the great

mental nerve tonic, and is unparalleled in bringing about a state of Inward Calm. No matter how badly anyone has treated you, you must forgive him. If you do not, you are the only one who suffers. This is why the ancient sages and saints have all taught to love one another. Forgiveness cleanses and renews.

Fig. 10.3. Peace and Harmony of the Tao

Peace through Individual Freedom

Each and every day we must extend total freedom to every person in the universe, including our families and close friends. Let them live then own lives. Stop trying to change the world and other people's habits against their will. Let every person make his own decisions, good or bad. No one wants to be fenced in, we all want to be free. The Tao forces no one, for love cannot compel, therefore it is a thing of perfect freedom. Realize that you cannot improve another. He of himself must do the work; all we can do is inspire. This is where the old saying of an example is worth more than a thousand sermons, holds true. The natural way of spreading ideas calls for more than ridding ourselves of name calling, propagandizing, telling others what to think or how to act, and other such actions. It suggests that the soul be cleansed of any such notion, for it is clear that we can no more improve another person than we can alter the heavens above. Quit trying to make carbon copies of others, give them, rather, something to copy.

When you give up the ill-habit of dictating another's life, you open up the channel of love between individuals. Peace will then be yours. You will attract more friends, and your acquaintances and family will find boundless joy and happiness in your presence.

Be Grateful: Live a Life of Cheerfulness

Stop grumbling and complaining. Stop feeling sorry for yourself! Let go of that gloomy attitude. No one likes to be around such a person. Self-pity destroys health and happiness. Instead of complaining about your life and environment, be thankful for what you already possess in life. There are people in far worse circumstances than you! Seek beauty in everyone and everything wherever you may be. The loving, cheerful person beams with vibrant health and happiness. Those who grumble, complain, whine, murmur, criticize and constantly find fault with life, will never have life smile upon them. They are repulsive people and drive from them all the wonderful and beautiful things of life. Conversely, the happy cheerful individual attracts all the grand and lovely things of life. Always remain cheerful. All that we are is the result of what we have thought. It is founded on our thoughts; it is made up of our thoughts. If a man speaks or acts with an evil thought, pain follows him, as a wheel follows the foot of the ox that draws the carriage.

Positive Mental Attitude

Discouragement is a disease. It leads to failure, narcotics, prostitution, gambling and anger; it destroys confidence and faith in oneself. To feel inferior, and to think that you are a nobody, is to be your own worst enemy. Negative thoughts must be overcome if you are seeking a Positive Mental Attitude and an Inward Calm. Keep in mind that you are a child of the Tao. You are the light of the world, a great being. Why not act like one. Perhaps up until now you have failed, or experienced many reverses in your life and you think that you cannot succeed. You can turn things around right now! Failure is no reason to give up. Use failure as a stepping stone to a higher and better achievement. Start again. Never give up. You cannot be defeated unless you allow failure to defeat you. No matter how dark the clouds in your life may be, or how many obstacles may stand in your way, do not give up. Keep on with persistence and determination, and you will succeed beyond your

fondest dreams. Stop making excuses. Quit feeling sorry for yourself! Instead, believe that you can and will be a success. Feel deep down in your heart that you are already a complete success! Believe, know and have faith that your dreams will come true. Cultivate a taste for the beautiful classical music. Visit places of culture and refinement and beauty. Make your life beautiful. Spread hope, kindness and sunshine everywhere. If you are discouraged and depressed, give yourself thoughts of confidence, courage and love. Believe in your heart that these wonderful attributes are yours. Make a list of positive inspiring words or phrases; then read them outloud to yourself, especially when feeling discouraged, distressed or blue. Repeat these words with as much feeling and power as you possibly can. The habit of reading outloud to yourself will give you courage, confidence and faith; it will help you to overcome shyness and timidity.

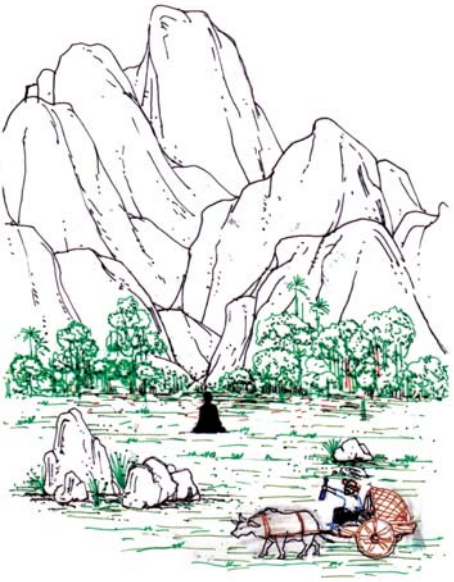

Fig. 10.4. As a wheel follows the foot of the ox that draws the carriage.

Positive, inspiring affirmations implant into your subconscious mind the qualities you require for a successful, harmonious life. Repeat these inspiring affirmations until the subconscious mind picks them up and you actually begin to feel more positive and happy. Then and only then should you discontinue the affirmations for the time being. At first this may take you up to an hour before you feel relaxed and at peace. And afterwards repeat the affirmations

only when the inner need arises. This follows the natural rhythm cycle; there is no need to affirm confidence or peace when you are already in those states of consciousness. When you are already in a positive frame of mind, and you continue to affirm more positive thoughts, it causes mental and physical exhaustion. If we affirm positive (Yang), thoughts and actions in the extreme, it always reverts to the other extreme (Yin) tiredness, depression and unhappihess.

The true positive attitude is to be content and balanced, with calm self-controlled emotions neither extremely happy or sad. When reading these positive affirmations do not become over-emotional or over-joyous to the point of losing self-control. Positive thoughts have ten times the power when we have a controlled mental and emotional poise. Be still for a few minutes each day, and feel the presence of the Tao; this will help you to be in control, physically, mentally, emotionally and spiritually, with very little effort. Here is a list of positive words, character building qualities, and affirmations. Repeat them with deep sincerity from your heart and mentally visualize yourself as you wish to be.

1. I am master of my surroundings nothing disturbs me adversely I am Master of my situations.
2. I am well poised, calm and self-controlled always.
3. I surround myself with an atmosphere of shining success, happiness and love.
4. I have perfect mastery over my temper, emotions & passions.
5. I am pure in thought and deed and no evil shall befall me as the Divine is in my body and watches over me.
6. I ask for strength, guidance and to be surrounded by the white light of Divine protection.
7. With the Creator's help, I am master of my destiny.

We build our future, thought by thought, for good or ill and know it not. Yet so the universe is wrought thought is another name for fate, choose then thy destiny and wait, for love brings love, and hate brings hate.

Words and Qualities that stimulate Positive Thought:
Thankful, Courage, Love, Peace, Strength, Encouragement, Consideration, Tact, Dignity, Politeness, Beauty, Compassion, Joy, Poise, Relax, Cheer, Patience, Honesty, Happiness, Sympathy, Optimistic, Relaxation, Charm, Humility, Health, Virility, Decisiveness, Harmony, Unselfish, Hope, Enthusiasm, Kindness, Tolerance, Forgiveness, Trust, Humor, Understanding, Energy, Gentleness, Bravery, Freedom, Self-Control, Gladness, Dynamic, Power Dependable, Loyalty, Confidence, Mercy, Success, Ease, Sincerity, Alert, Determination, Affection, Faith, Magnetism and Vitality.

These positive traits make it easier on the body to eliminate its toxins, as it relaxes the system, mentally and physically.

Discontinue these Negative Faults and Thoughts:
Hate, Vengence, Fault Finding, Discouragement, Selfishness, Needless Talking, Grumbling, Sorry, Dominating, Gloominess, Anger, Nagging, Inferiority, Self-Pity, Fear, Pessimism, Shouting, Bully, Doubt, Superiority, Grief, Complaining, Jealousy and Greed.

Be courageous. See no evil in another. See only the good and beautiful. Do not even hint at the bad. Charge the atmosphere with sunshine, cheerfulness and loving kindness. You will be rewarded well. Positive traits build the magnetic personality. Negative traits prevent the body from eliminating the toxins properly.

Easy Way to Overcome Worry

Do you constantly worry? Do the smallest problems get you down? Does life seem hopeless? You cannot sleep nights because of your problems, so you worry not only about the problem, but because you cannot sleep. We all know that worry is a great destroyer of health and happiness. But, how many of us can stop worrying about our problems and the problems of the world? If you are a victim of fears and worries, say this to yourself; So what, and your troubles will dwindle in size. Stop tormenting yourself with useless questionings and imaginary doubts. You cannot carry the whole world on your back. Do the best you can with what you have as working tools. Get in harmony with the Laws of life. Love your neighbor and forget about the troubles of the world today. Simply say, So what and fall off to sleep. When morning arrives you will

be refreshed and filled with zest for living. Then, your problems can be easily solved, and the imaginary ones will fade out of existence. Give up self-assertion and relax. Let go! Give up all efforts to be important or superior to your fellowman. You will be more in harmony with life if you do. This is a sign of a magnetic personality. No matter what happens to you in life, always be poised and calm; this is the quality of a great person.

A worrier is not a realist; his perceptions are very narrow; he does not have a universal view of life. He or she is dwelling on their own small individual problems, without seeing the whole picture of existence. Those who think broadly are philosophers; they relinquish their small ego to the larger Spiritual Force (the Tao), who creates and sustains the limitless universe.

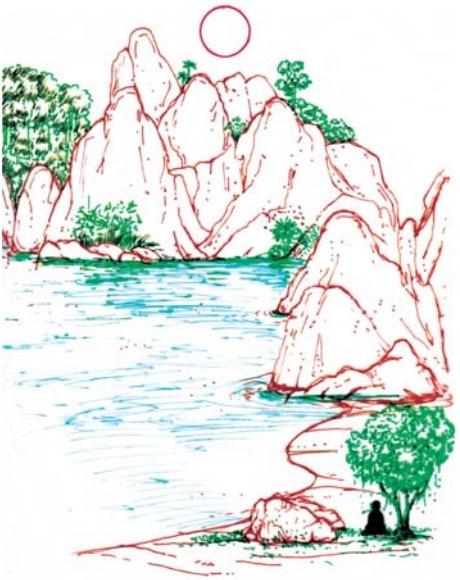

Fig. 10.5. Winds of Freedom in the Tao

Littleness of Humanity

There are many billions of suns in the sky. Each sun is called a star. Each star is the center of a system that contains many worlds known as planets. Each such world contains millions or billions of people. Our sun is a small star. This earth is a small planet. As compared with the million, billions, trillions of others worlds in the sky, this earth is like a grain of sand on an endless shore. How much more tiny are we in comparison. We worry over small trifles, yet the Great Universe operates in perfect order.

Littleness of Time

That greater vision has seen the earth pass from a state of rock to a state of fertile soil as in the twinkling of an eye; yet it revolved on its axis billions of times, and circled the sun a hundred million years; but this vast lapse seemed as nothing. A century is reeled off so quickly that it is too small a trifle to arrest the attention; yet a woman giving birth to a child looks upon the hours of suffering as an age of duration. But millions are born year in and year out, new beings are opening their eyes to the wonders of earth, they grow, they build, they accomplish gigantic tasks, and they pass on.

His coming is so slight an event in the succession of a thousand generations that there is no way of permanently recording his achievements. The remotest event of history is not six thousand years old; and the earth is more than a hundred million years of age. Cities that contain massive structures will some day be rolled under the crust of this earth, and not one trace of them will be found by the peoples who shall come here six thousand years hence. To the greater eye this world is rushing on with whirling speed; weeks, months, and years are too slight to be counted; nothing but aeons are worthy of attention; and yet an aeon witnesses the rise of races the writing of a few thousand years of history, then the wiping of the slate to erase everything. Seventy years on this planet is in fact no more than the span of life of the germ that is born, grown, aged and dead, all in ten minutes.

Unconcer of the Future

One hundred years from now you will be wholly forgotten. Every year many millions like you pass to their sleep in earth. They have been going and coming for aeons. They will keep coming and going for aeons yet. If your greatest achievements were to over-topple the tasks of the past, they and you would disappear and be wholly lost in the melting changes of time and nature. What is the use of worrying when there is nothing at stake for you? You think and fear that this trifle is fearfully and terribly wrong. The spot on your clothing, the loss of a dollar, the breaking of the glass, the ill remark of an acquaintance, this, that, or something else, racks your rnind and depresses your buoyancy. The rich man who loses all his wealth is to be pitied. The calamity that has overtaken you

may be worse. But what does it matter? Humanity are but insects, ants that swarm to and fro about the surface of the world. The span of the longest life is but a second of time on the clock of the universe. In a century it will not matter what you win or tose, what you accomplish or suffer. Look upward and outward; now downward and inward. Then you will worry no more. Toothaches, earthquakes, disasters, holocausts are seemingly great evils, but what difference will it make when the surface of the earth is rolled up as a scroll, and a new aeon shall be under way? His (Chuang Tzu's) view is that the real source of worry and confusion is the apparently real world, with all its pressures and entanglements. The truly wise person, realizing that these may well be an illusion, does not take them too seriously. Thus he is free to achieve harmony with nature however it may be. He does not need to worry about obtaining true knowledge about the state of the world. To nourish the mind there is nothing better than to make the desires few.

Hurry, the Scourge of Humanity

The universe never hurries. Nature plans her activities slowly and patiently, without hurry. Hurry always shows a lack of proper planning and method, confusion and anxiety in the mental realm. Hurried and arrogant ambition can ruin the best of projects. The intelligent person never hurries, but is always thoughtful and calm before undertaking the task at hand. Failures usually run full steam into projects, and soon give up in despair; they lack thought and planning. Hurry creates distress, disease, tension and a multitude of physical and mental ills. A hurried, worried and anxious attitude will never give one good health, long life and peace of mind.

A hurried, diseased person relies on pills and drugs to get him well; but this method never gives one good health. Health improvement and main-tenance requires patience, deep thought, study and proper application over a period of time. The ill demand quick release from suffering, and it never comes, because nature works ever so slowly and surely in returning us to health. The hurried person does not care about his health; does not plan his life according to the laws of health, and therefore does not achieve it.

People hurry for wealth, not caring about their health. They seek to attain some ambition to satisfy their ego at the expense of truth and spiritual attainment. Hurry takes us away from the flow of Tao in our lives; it is the opposite of a calm, dignified and poised attitude. Hurried eating causes indiges-tion; and we hurriedly reach for a bottle of pills to cure us.

All great projects in life are the result of slow growth; patient and careful planning; correct and proper action at the right time. The oak takes years to reach maturity, but it lives for decades; weeds sprout and die quickly. We cannot cause the sun to set or rise ahead of its time; it moves in exact cycles. If we desire success we must accept slow growth, and realize that we will reach our goal in due time, after we have paid our dues in proper study and work and patience. We should do the best we can at the moment, and let the future take care of itself. If we fail, we must not "quit", but keep plodding on until we reach the final pinnacle of success. You cannot fail if you do not give up the ship. Approach the goal slowly, inch by inch, and you will always succeed. Since it is impossible to please men in all things, our only care should be to satisfy our own consciences.

Self-Reliance: Key To Success

One can be very self-confident, and yet lack self-reliance. Self-confidence sees the possibilities and opportunities for a person; self-reliance puts them into action or reality. Every soul must work out their own salvation; financially, emotionally, morally, mentally, socially, physically and spiritually. We are judged according to our own acts and accomplishments. We make or break our own selves; no one is out to get us. We can be our own best friend, or our own worst enemy.

All books, all words, all religious teachings, all health teachings are but guides, tools, and theo-ries. The self-reliant individual functions beyond the letter of the word, and he or she relies on the still small voice within. He listens to the advice and teachings of others, but does not follow others blindly, or worship graven imagesmortals, books, statues, organizations, etc. We must learn to save ourselves from our arrogance and ignorance.

Self-reliance seeks to follow no one; and it does not seek a following. He is friendly, compassionate and kind to all. He does not have an axe to grind. The self-reliant one is beyond argument, anger and self-righteousness; he relies on his inner truth to carry him along through life. If we do not rely on ourselves, we drift through life without direction, waiting for someone else to give us a push.

Fig. 10.6. Self-Reliance in the Tao

Opportunities are Self-Made

Opportunities are there for the asking; we must be ready and prepared for them at the right time, and then take the proper action. We must develop our own talents, and rise to meet the challenge or opportunity that presents itself. No one can give us good health, but ourselves; no one can eat for us, exercise for us, breathe for us, or study for us. The self-reliant ones know that attaining good health requires knowledge, time and personal application; no institution or professional can do it for him.

The weak dependent individual blames others for his failures. He doubts and fears that he will fail, because no one cares about him, and he lacks good judgment. He thinks society is against him, and no one will listen, appreciate or recognize him. He thinks no one has suffered failure and poverty as much as he.

The self-reliant person seeks only to discover and conquer his own shortcomings, failures and weaknesses that keep him from success and happiness. He goes within, to the power source to find reliance to overcome the influences around him. All the greatest men and women in history never had it easy; they all had to overcome obstacles and pitfalls along the way to success. The self-reliant ones realize that there is light at the end of the tunnel; that sunshine always conies out of darkness; that storms are only temporary; that cold winter blasts give way to warm summer sunshine. One's freedom and independence is in proportion to one's self-reliance, and the power to sustain himself from within. He draws from his inner strength to overcome the trials and tribulations of life; he needs no one to hold him up; it is accomplished from within the temple of the inner soul. When storms are brewing, the self-reliant are calm and peaceful, and sail unharmed to the quiet waters beyond the storm. No external advantages can supply the place of self-reliance. The force of one's being, if it has any force, must come from within. No one can safely imitate another; nor by following in the footsteps of another can he ever gain distinction or enjoy prosperity. The spirit of self-help is the root of all genuine growth in the individual; and, exhibited in the lives of many, it constitutes the true source of national vigor and strength. Help from without is often enfeebling in its effects, but help from within invariably invigorates.

Rely on Yourself

Man and woman to be successful in all areas of life must be self-reliant. He does not have to know all things, but he must be self-reliant in his own profession. He is not conceited or aloof; he dares to stand apart from the crowd and think and speak his mind. He or she is an oak, not a weed. He offers others support and inspiration, but does not crave or desire it for himself. He is independent, not dependent.

We are all in life alone, and we must make deci-sions and reach our goals alone. Humanity does not care whether you fail or succeed it pays little heed to the individual. However, it acknowledges and recognizes the self-reliant and successful. If you desire success, strength, ability to perform, do not envy others, or wish you had their abilityemulate the process of success in others, train for it, rely on yourself, and you may develop equal power.

Look upon yourself as a deep well of infinite possibilities and opportunities, and develop and cultivate them to their fullest; dig deep and bring up from within your depths your hidden talents and powers. Surpass yourself, not others. Progressing in an upward spiral brings harmonious growth to mind, body and soul. If we do not grow in wisdom, expand our consciousness, we stagnate, decay and die before our death. Grow from within, outward. Create your own life and circumstances. Do not follow in the foot steps or greatness of another; think for yourself; act for yourself and depend on yourself. Be a strength to others by living the example of self-reliance. As you become stronger, you will be able to help others in their crisis of weakness.

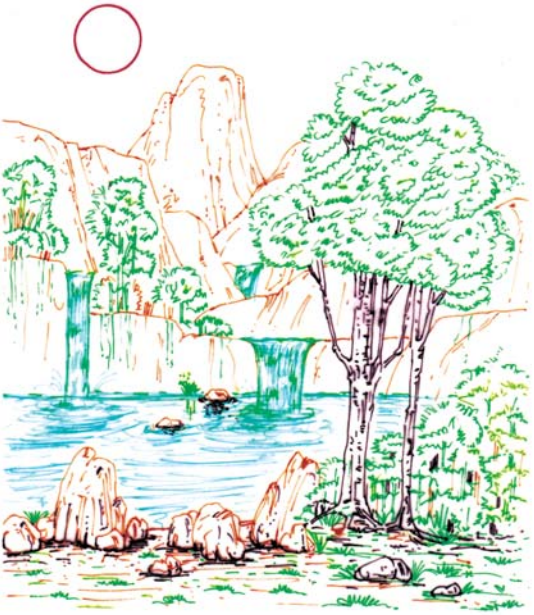

Fig. 10.7. Happiness comes from Within

Happiness comes from Within

Happiness grows from within. It does not come from possessions, people or money. It consists not of getting something, but of being, enjoying the moment; total contentment and peace within the heart, regardless of outward conditions. We create our own happiness and misery. If we attempt to find happiness in material things, disappointment will follow. Happiness is an intangible, spiritual possession.

True happiness of the soul allows us to overcome obstables and trials with a calm joyous heart. Excessive cravings and desires are the root of all unhappiness and discontent. We are satisfied and content when we are thankful and grateful for the things we have. False appetites and illusory desires destroy our poise and inner peace. We may possess a million dollars, yet still be unhappy. Happiness is soul-satisfaction, not the stimulation and satisfaction of the mind and body. Be content with what you have, but always grow and expand your present consciousness.

A happy person does not struggle or worry. He does not seek happiness in pleasures; but seeks to place the happiness of others above his own. True happiness is egoless; it is optismistic, faithful, loving, honest and simple. No one who criticizes, complains or hates can ever attain inner happiness. The cynic looks for the evil in others, because it is in his own heart.

Unselfish Service: Key to Happiness

Unselfishness, service to others, or a high ideal is the key to happiness. Forget yourself and help those around youit is the key to the gates of heaven. Accomplish good because it is the correct thing to do. You do not have to tell anyone of your good deeds; we are judged for our good or bad deeds whether others see us or not. The Creator or Tao of the Universe sees to it that we get back exactly what we give out. If we are discontent, unhappy or dissatisfied, we can blame no one but ourselves. We cannot put happiness into someone else's head; our mate, parents, children cannot infer it upon us. We can cultivate happiness by patience, self-reliance, honesty, good deeds, and unselfishness. When we follow these higher ideals, we do not have to search for happiness at the end of the rainbow; it will be with us forever.

Honesty is the Best Policy

Can I always be depended upon to do what I say I shall do? Honesty and dependability are two of the greatest character traits one could possibly possess. To give your word and not keep it, is to lose self-respect and your influence over others. You will never be truly respected. The person who keeps his word is always admired and respected. When a person is honest and dependable his voice is always full of love and sincerity. He is sympathetic to

all people. Oh, what a tangled web we weave, when at first we practice to deceive. The dishonest person might seem successful at first, but in the long run the honest person will acquire peace, happiness and success. He will then display a clear conscience for all the world to see. Make it your policy to be honest.

Right Action leads to Harmony

A decisive positive attitude leads to health and happiness. A negative confused attitude creates disease and unhappiness. You must choose your own life style. You have been given free choice to chart a destiny during this life. No one else can alter or chart a course for you. No one can live your life for you. There are no magic pills, no potions, no masters, no gurus, no books that can take action for you. Only you can make this decision and take the necessary action that will eventually bring forth the blessings of Health, Happiness and Success to your life. By cleansing your blood and body of impurities, eating wholesome natural foods, purifying your mind and thinking positive optimistic thoughts, you will lose the eight basic fears which plague humanity:

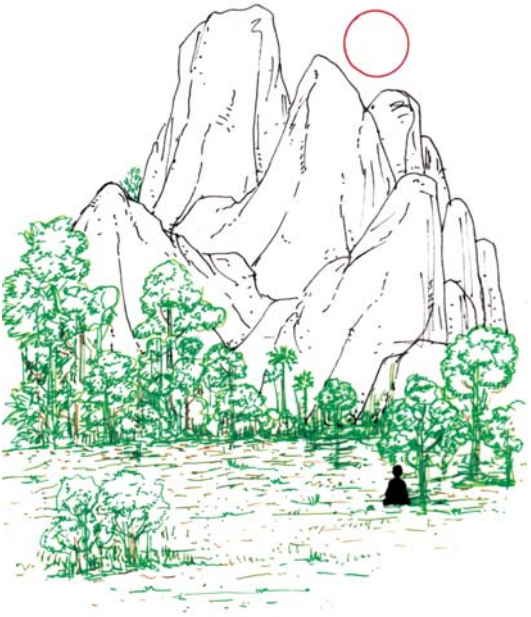

Fig. 10.8. Right Action leads to Harmony in the Tao

It is More Blessed to Give

The average person always thinks in terms of getting or what can I get out of so and so. Try living the opposite way of the world; instead of clinging and holding on to what is yours, learn to give. This will enable you to relax and let go of tensions, thereby letting the universal Divine Supply flow into your life. Too many people believe that getting is what brings happiness; but giving is the true answer that leads to joy, happiness and life without strain. If you hold and cling onto what you have, you will find yourself in difficult situations. You may at times feel that the world is against you; this is the time to stop want-ing your own way and reverse your objective. Go out of your way to help someone in need. Be of service to humanity. Give of yourself for a change. Give your best to the world and the world will give its best back to you. Do a good deed without seeking a reward. Give of yourself unselfishly and you will attain physical, emotional, mental and spiritual happiness.

Taoist Secrets of Personal Magnetism and Peace in Life:

1. Seek beauty in everyone and everything.
2. Love unselfishly.
3. Speak in a positive manner, if not be silent.
4. Maintain calmness and poise at all times.
5. Do unto others as you would have them do unto you.
6. Cultivate a charming, pleasing disposition.
7. Develop a personality that wins, holds and attracts others.
8. Improve your life by learning something new each day.
9. Get interested in people, life or a hobby.
10. Cultivate a pleasing, magnetic voice; cultured and flexible.
11. Always lend a helping hand to those in need.
12. Be clean and neat in your dress and appearance.
13. Always be polite and courteous to everyone.
14. Avoid affectation and veneer. Be your natural self.
15. Be thoughtful and considerate of others.
16. Never gossip, criticize, nag or scold others.
17. Past forgotten, do not worry about the future; live in the now.
18. Praise and flatter others with sincerity and with good taste.
19. Avoid arguments, physical violence and hostility.
20. Assert yourself positively, but graciously.
21. Eliminate self-pity, fear, anxiety, nervousness and doubt.
22. Be dignified and poised, without stiffness.

23. Acquire a flexible, healthy, attractive body.
24. Develop a wholesome, positive, active mind.
25. Be a gentleman or lady at all times.
26. Cultivate mastery over your mind and emotions.
27. Think clearly before you act and speak.
28. Have a daily objective and a goal for life.
29. Improve yourself in small ways waiting for big opportunity.
30. Never let a day go by without doing something constructive.
31. Take prompt right action when the opportunity presents itself.
32. Express yourself in a poised, confident manner.
33. Eat foods that agree with your body and nerves.
34. Maintain order in your home and belongings.
35. Develop self-confidence. Affirm outloud to yourself daily that you are now healthy, happy and successful.
36. Enjoy every task you perform and complete each one before going on to the next one.
37. Practice moderation in all activities. Stop before your limit. All things are accomplished by following the middle path.
38. Forgive everyone who has done wrong to you. Never hold a grudge. If you forgive, you will be forgiven. Release all those who have wronged you, and peace will flow into your life. Love all.
39. Allow others to live their own lives expect nothing from others and you will never be disappointed. Do not try to change people against their will, as you would not like to be changed against your will. Enjoy people for their company and friendship. Avoid fault-finding or critizing, and you will always have dedicated and true friends.
40. Meditate daily until you feel the peace and presence of the Creative Force of the Universe flowing through the Tao.

Golden Stairs in the Tao

A clean life, an open mind, a pure heart, an eager in-tellect, an unveiled spiritual perception, a brotherliness for all, a readiness to give and receive advice and instruction, a courageous endurance of personal injus-tice, a brave declaration of principles, a valiant defense of those who are unjustly attacked, and a constant eye to the ideal of human progression and perfection which the sacred science depictsthese are the golden stairs up the steps of which the learner may climb to the Temple of Divine Wisdom.

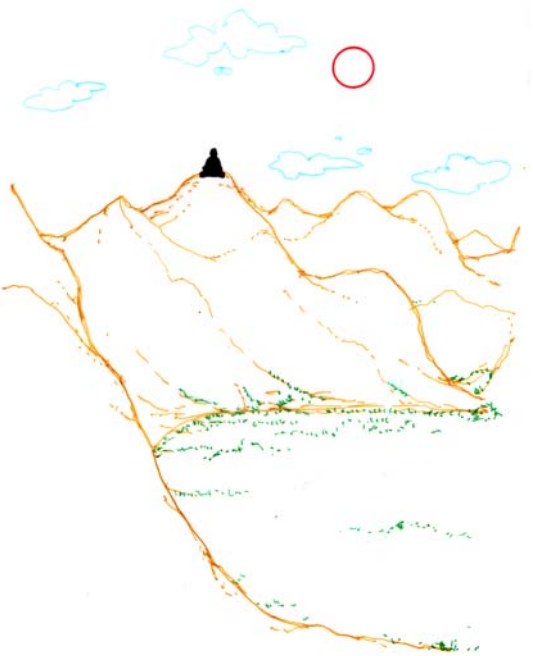

Fig. 10.9. Personal Magnetism in the Tao

Law of Personal Magnetism and Attraction

Magnetism is attraction, repulsion of the opposite. Hypotism is an evil use of the power of influence. As magnetism is not understood it is useless to elaborate on the magnetic laws that govern affinity. Each type of person has his or her own power of attraction and each individual has a magnetism or influence of his own, either pleasing or displeasing, uplifting or depressing. Magnetism used for evil purposes is hypnotic. A rattlesnake or a blood-thirsty tiger is hypnotic. A soulless, heartless, evil and power-hungry person is hypnotic, whereas a saint is magnetic. That special kind of magnetism in a woman or in a man that exalts your power, mind and soul, is to you the right kind of affinity magnetism, but if you feel humble, insignificant, stupid, strange, inferior, mean, nervous, angry, etc., in the presence of a man or woman, he or she is not the one for you. Affinity magnetism and magnetic love exalt, broaden, and enlarge all your powers, otherwise it is not magnetic love, nor affinity magnetism. If you become lustful and familiar in the presence of your chosen one, you are not the one or him or her. That which you then mistake for love is nothing but stormy amatory infatuation very dangerous to your future happiness.

Three Treasures of Tao

Kind Gentle Nature

Being kind, one can be brave; being moderate, one gains ability, not venturing to go ahead, one becomes great. The universe is a great whispering gallery; it whispers back to us the echos of our thoughts and deeds. It is like a mirror; when we frown, it frowns back; when we smile, it smiles back. When we hold negative, cruel or hateful thoughts and wish them upon others they come back to us like a boomerang and deprive us of happiness and a joyful life. This is the universal law of cause and effect; whatever we sow, so shall we reap. Forceful, critical and aggressive people, by their very attitude, create for themselves much trouble, suffering and unhappiness. A gentle natured person is well mannered, tolerant, kind and relaxed a true gentleman or lady. Whatever troubles come to you in life, if you react to them with a kind gentle nature, they will be much easier to master. Calmness is the key to success, happiness and love in life. If we are calm and gentle, we likewise attract to us other people of the same spiritual quality. If our nature is harsh, irritable or unfriendly, we not only repel those around us, but we also cause suffering to ourselves and others.

If we use our clever intellect to outwit or cheat someone, in like proportion we attract to ourselves people of the same cleverness who will try to outwit or cheat us. It is that simple. What we give out comes back to us tenfold, good or bad. If we use physical or mental force to dominate others and get our way, we will meet with a similar force in return. Although, even if we always get our way, we are still the loser, because people are generally repelled by and dis-like forceful and dominant characters. On the other hand, if we are fair, considerate and well mannered, others will likewise be fair, kind and honest with us.

Understand: We are all sons and daughters of the Tao; a king and queen in the physical realm. The ancients teach that we are one with the Tao. A kind gentle nature brings us closer to our Divine Creator. When we see the good in another, they will see the good in you. A kind and gentle nature requires one to be totally relaxed in mind and body. We cannot be kind or gentle when we are tensed or stressed. The key to relaxation is to totally let go of mental and physical problems. Feel your muscles relax; relax your forehead, neck, abdomen, pelvis, legs and feet. Allow yourself a

few minutes a day for meditation to throw your cares to the wind and let the Universal Force, or the Tao guide your life. Dwelling on the past or worrying about the future takes us away from doing our best in the present.

Fig. 10.10. Developing a Kind Gentle Nature in the Tao

Be Still and Listen

Cultivate quiet moments throughout the day; still your thoughts and body movements; feel the presence of the Tao within your consciousness and in the universe. The Tao is everywhere as close as our breath, and to the end of the galaxies.

The human body and mind are finite; a manifestation of the Tao (Infinity). The limited finite conscious mind often attempts to solve the difficult problems of life. If we learn to let go and relax, the Tao will show us the correct answers that we seek. Trust in the Universal Force and It will never fail you. Ask, and you shall receive; seek, and you will find; knock, and the doors (of wisdom) shall be opened onto you. When the lower mind and fleeting passions and desires are transcended, the Tao operates through us for the good of all. When we let go of our problems, then the mind becomes open to the inner voice, or the Tao within, which guides us in the right direction. Be still, and know that I am, applies to stilling the mind and listening for inner guidance. A heavy mind

bogged down with worries, problems, uncontrolled desires and emotions slams the door in the face of the Tao and shuts us off from true guidance answers to our problems. A mind that is light, relaxed and at peace is always open for correct Divine guidance. Such a mind overcomes worries and problems by not thinking about them, or struggling with the lower mind to solve them. We can accomplish much by performing right action at the right time according to our guidance from within.

Struggling, overworking and becoming heavy in mind and body does not create high level health mentally, physically and spiritually. When we learn to relax and be gentle, we create a heaven right here on earth. Thy will be done on earth as it is in heaven. Realize that a dictator creates tension and fear; the gentle, kind person allows life to flow with the Tao, and he/she radiates peace and love wherever they go.

Love vs Power

A wise, loving person in a leadership position commands without exercising any authority or egotistic force. He or she has mastered himself and has harmonized his consciousness with the Creative Force. The Tao is love; this is the ultimate reality in the universe; therefore, the wise person is kind, gentle and tender. He gives love without seeking it in return, because he knows that everyone needs to be understood and loved. The Power of Love overcomes all harshness, fear and weakness. If you would be perfect in knowledge, wisdom and principles, be perfect in Love, compassionate in heart, and calm in mind. Only then will you banish sorrow, suffering and grief.

Men engage in heated controversies, and foolishly imagine they are defending the Truth, when in reality they are merely defending their own petty interest and perishable opinions. The follower of self takes up arms against others. The follower of truth takes up arms against himself. Truth, being unchangeable and eternal, is independent of your opinion and of mine. We may enter into it, or we may stay outside, but both our defense and our attack are superflous, and are hurled back upon ourselves.

Men and women enslaved by self, passionate, proud, and condemnatory, believe their particular creed or religion to be the Truth, and all other religions to be error; and they proselytize with passionate ardor. There is but one religion, the religion of Truth. There

is but one error, the error of self. Truth is not a formal belief; it is an unselfish, holy, and aspiring heart, and he who has Truth is at peace with all, and cherishes all with thoughts of love.

Fig. 10.11. Seek the Truth and the Truth shall make you free - free from suffering, sickness, limitation and distress.

Moderation and a Simple Life

Moderation and simplicity in living has been taught by all of the great sages, saints, mystics and religions throughout history. A moderate simple life is one of balance and equanimity. An immoderate person lives life in extremes over-working, too much talking and useless chatter, excess and/or lack of exercise, reading and studying to the point of mental and physical exhaustion; extremes in dieteating to repletion or fasting excessively, and becoming nutritionally deficient or anorexic.

The little mind clamors after selfish desires and ego aggrandizement. It seeks excitement in sophisticated immoderate pleasures, such as drinking, smoking, mind expanding drugs, laziness etc. The greater mind seeks only to maintain balance and simplicity. Many modern diseases have developed due to our unnatural and immod-erate habits of living, thinking and eating. Extremes in living lead to nerve exhaustion; fatigue and exhaustion cause mental depression, in which we selfishly and constantly dwell upon our problems, making them larger and more complicated than they really are resulting in failure, suffering and unhappiness.

Some millionaires who attain great power and notoriety through long and hard work become weak, ill and exhausted in the prune of their life. They are, in many cases, unable to truly enjoy their wealth and die an untimely death.

Life is Simple

Life and being are simple. The universe is simple. The laws of life are simlple. Man only complicates the original simplicity with his secret vices, lusts, desires, passions and opinions about this or that; he remains ignorant in the university of wisdom, though he attain many college degrees. The simple and moderate life is where true joy resides.

When we learn to listen to our inner voice, and are guided by it in all of our life's activities of eating, sleeping, playing, meditating, exercising, singing and working only then can we become master of this life. By cultivating moderation and simplicity, we will be at one with the Tao, and enjoy a peaceful and happy life without strain. With a tranquil mind I abandon the written and spoken word and find deep contentment in the joy of illumination.

Thankful Humble Attitude

When you do not venture to go ahead, one becomes great. Western religion says, He who exalts himself, shall be humbled. He who humbles himself, shall be exalted. Eastern and Taoist religions over 5,000 years ago said, He who is first is last. He who is last is first. The philosophy is identical. When we strive to be self-assertive and act important, we become exalted and our ego puffs up; this is not humbleness or humility. An overblown ego can be easily deflated or humbled. A humble person does not over or under estimate himself. He does not brag, show-off, complain, criticize or suffer a deflated ego. His attitude is humble and thankful. He or she is free from envy, jealousy, greed, self pity, and self conceit. He does not seek ego gradification, nor does he desire to be the first in the eyes of others, or to exalt his talents to prove himself. If he is wise and talented, people will find out through his every deed, action and word.

If we are unhappy because others possess the wealth we do not have, we are stricken with the problem of envy. If we are to be happy and dispel envy, we should feel joy and goodness for the success of others. This thankful humble attitude places us in har-

mony with life and the Tao. By this attitude, we flow with the grain of life, and not against it; and the good that we send out will come back to us. If we pity ourselves because we do not have the right partner or a true friend, jealousy is the problem. Likewise, be happy when you see a married couple in love; this attitude of mind places us in the right and proper vibration, which will eventually attract our true love to us.

If we continually strive after wealthscheming, toiling and savingdwelling on our own life and problems, we create a self-made prison for ourself. Greed, selfishness, unthankfulness, and pride all lead to a life of loneliness and misery. The selfless humble person who lives a life of giving and sharing, and is kind and encouraging to all, will have peace of mind and a life of happiness.

Dwelling on our past actions and feeling sorry for ourselves because we are not yet successful, happy or healthy, causes us more suffering and trouble. Graditude and thankfulness can lead us out of this self-pitying attitude. Thankfulness and humbleness is true prayer. If we are thankful two percent of the time, we will be happy only two percent of the time. If we are thankful one hundred percent of the time, we will always be happy. The universe pays us back exactly what we give out. In fact, the more we grumble and complain, the tougher and more difficult will our life become. Nations begin to fall when the people constantly complain & criticize.

Be Thankful

Be thankful for the home you live in, the friends you have, the food you eat and all the good things of life. Realize that no matter how much we own, how highly degreed we are, or how much discipline we have applied in our religious beliefs, we are not better or higher in the eyes of the Tao. To think otherwise is to miss the mark. When pride comes, a fall comes. No matter how much intellectual understanding of the Tao we may have, how beautiful a temple we pray in, or what religion we are in, we are all on equal grounds with the person who prays and meditates with sincerity and thankfulness in a humble ghetto shack or a barren desert. The Kingdom of Heaven is within us. We need not go anywhere to pray. Just simply bow our heads and ask the Creative Force for guidance (It speaks to us non-verally - it is a feeling) and with that attitude we can live a heavenly joyous life, even during difficult and troubled times.

Your good is here. Accept it. Your joy is near. Embrace it. Your power is within. Harness it. Your victory is now. Claim it. Your freedom is real. Declare it. Your abundance is overflowing. Share it. Your prosperity is good. Receive it. Your problem is purposeful. Bless it. Your spirit is divine. Free it. Your love is great. Give it. Your faith is mighty. Use it. Your song is beautiful. Sing it.

Fig. 10.12. Lao-Tse, Taoist sage, author of the Tao-Teh-Ching

Know Thyself First

The easiest thing in the world is to give advice; the most difficult is to know thyself. Advice is like salt; it should be given only when asked, and only in small doses. When we attempt to change others against their own will, we stifle the Tao within them. We stop their personal growth and experiences. Realize, that the same Tao that is guiding your life is the same One guiding another's life. Many people have lost touch with their inner voice, or the Tao within, and they consequently live against the grain of their own being, experiencing much suffering as a result.

The enslaved and tyrannical individual, not free himself, attempts to dominate others or force them into his way of living and thanking in order to justify his own enslaving habits. He does not allow the free soul to live out the experiences he really needs in life.

Parents attempt to mold their children into their own image; marriage partners try to make each other perfect; friends tend to criticize each other's faults; congressmen attempt to legislate morality. This cannot be done. These enslaving efforts only stifle and suppress the freedom and Divine power in others.

The ancient sage Lao Tse said that there is nothing worse than the desire to change others against their will. When Confucious came to Lao Tse and announced that the leaders of the world would not listen to him on how to make the world peaceful, even though he gave them the greatest wisdom and advice, Lao Tzu answered, that is good, because your advice would have stirred up more suffering and trouble for the nation. He added that the more laws you make, the further you take the nation's people away from the Tao within. You remove the last speck of individual creativity from their soul. Leave them alone do not interfere with their life force. If you stir muddy water, it becomes muddier. When the water is still, the mud will fall to the bottom the water will clear of itself. Be thankful and humble, and your mind will be clear and sharp. You will then know the joy of creativity, happiness, success and harmony in life. You will attract to you all that is necessary for your health and well being.

Sympathy and Compassion Unlocks Hearts

Sympathy is the key that unlocks the door to every heart. To develope sympathy and compassion for others practice listening sympathically and with attention to others; speak softly this helps the other person to relax and listen; try to understand the ideas and thoughts of others. Never argue, but agree on common ideas; look with understanding eyes; people can see your sympathy in your eyes. We are all alike in that we all want to be loved, appreciated, caressed and understood. With this spiritual attitude self-righteousness cannot be present, because you will become at one or in harmony with those around you.

Without compassion you cannot be happy; give it to others and you will receive it in return. The person of humility does not attempt to reform others or to make them good, but always loves and makes them happy, for in so doing, they become good.

Fig. 10.14. Sympathy and Compassion Unlocks Hearts

Life is a Stage

Life is a stage and we are all acting out a part. The stage is set. You have been given a role to play. It is now your time or cue to go into action and to utilize the parts, props and scenes that the Creator has so generously given you to perform with natural foods, air, water, sunshine, exercise and breathing, and a brain to think with. These are the fundamental Taoist Secrets that no man or woman can ever do without. They are part and parcel of life itself. Our function is to learn how to play our role in life superbly well, and become the star attraction we were all designed to be.

Through the understanding and application of natural law physical, mental and spiritualwe become an acting part of the Creative Force that has brought us to this earth stage. We urge you to seek this path to health, beauty and spiritual evolvement; sincerely believe in it and inspire others to follow your message and example.

We trust that we have shed some light on the subjects of health, happiness, fitness and longevity. May this book wing its way across the earth to those in need of help, inspiration and hope. Our sincere intention is to help others, so that they may help themselves. May you live in love and peace, and may the Tao be with you always. Life is just a manifestation of energy. If you have complete energy, you have a fuller life. If your energy is incomplete, you only enjoy part of life. It does not matter whether you are rich or poor, noble or ignoble. What matters is the good virtue found inside of you, such as honesty, sincerity, patience, and courage. It is particularly important to cultivate these basic virtues with a positive attitude. The more you worry, the more you darken your soul and weaken your power. The virtue of life is by no means external or artifically contrived. It is deeply rooted within your being.

Remember the way you look and feel tommorrow depends on what you do today. We come from nothingness, we belong to nothingness and we are destined for nothingess (the Tao). For things to get better you have to get better. For things to change you have to change. We are all the controller of our own destiny because we are all Divine with our understanding of the Tao and after a combined over hundred years of reseach and experiences on health and longevity we will leave you with one final thought, “It takes a lean horse for a long race” and whatever means you use to become lean will give you your health and longevity. Good luck.

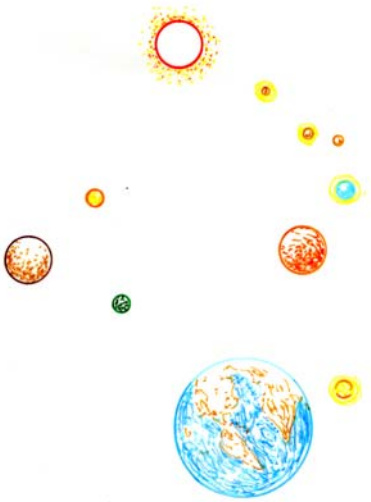

Fig. 10.14. We are destined for nothingess (the Tao).

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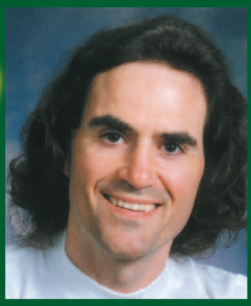

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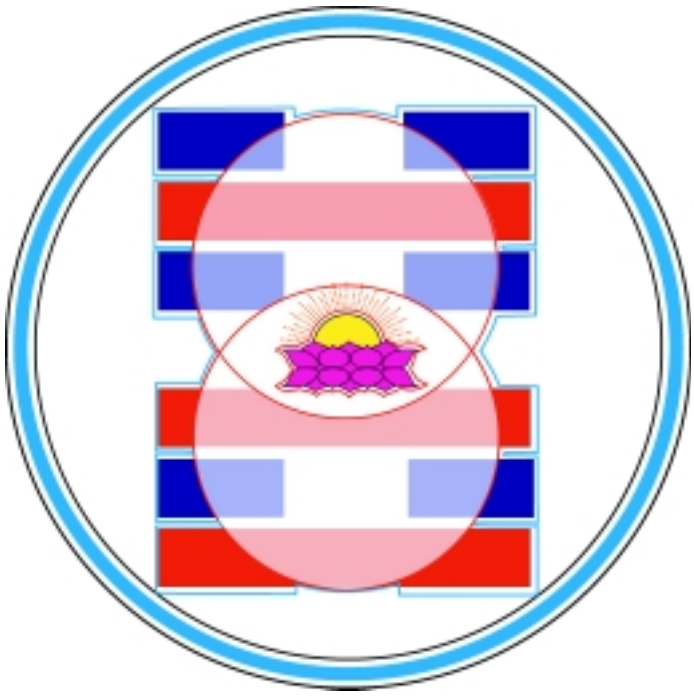

Dark Room Enlightenment

Lesser, Greater, and Greatest Kan & Li

Universal Tao Center, Thailand

18 February 2002

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Dark Room Enlightenment

All spiritual traditions have used Dark Room techniques in the pursuit of enlightenment. In Europe, the dark room often appeared in underground form as a network of tunnels, in Egypt as the Pyramids, in Rome as the catacombs, and by the Essenes, near the Dead Sea in Israel, as caves. In the Taoist tradition caves have been used throughout the ages for higher level practices. In the Tao, the cave, the Immortal Mountain, the Wu San, represents the Perfect Inner Alchemy Chamber. Meditating and fasting in the cave is the final journey of spiritual work. The caves are the Earth Mother and its energy lines. Like the hollowing bones, caves contain the earliest information of life stored inside the Earth. Caves contain the vital essence of the Earth Power. The Tao says: 'When you go into the dark and this becomes total, the darkness soon turns into light.'

In the Dark Room, our mind and soul begin to wander freely in the vast realms of psychic and spiritual experience. When you enter this primordial state or force you are reunited with the true self and divinity within. You literally 'conduct' the universal energy. You may see into the past and future, understand the true meaning of existence, and begin to understand the order of things. You return to the womb, the cocoon of our material structure and Nature's original Dark Room.

Complete darkness profoundly changes the sensory sensibilities of the body/brain. We are deprived of all visual reference. Sounds begin to fall away as we lose contact with the external world and turn the senses inward. The effect of darkness is to shut down major cortical centers in the brain, depressing mental and cognitive functions in the higher brain centers. Emotional and feeling states are enhanced, especially the sense of smell and the finer senses of psychic perception. Dreams become more lucid, and the dream state manifests in our conscious awareness. Eventually, we awaken within ourselves the awareness of the Source, the spirit, the soul. We descend into the void, into the darkness of deep, inner space.

Darkness activates the deepest centers within the brain, the glands of the Crystal Palace, establishing a connection with the Original Source, the Wu Chi (**Fig. 1**). The pineal gland connects us to the Universal Energy. From the hypothalamus gland, we project our soul or spirit upwards, and receive the descending Universal Energy. The pituitary gland receives the Cosmic Force, used to launch the spirit bodies into the earthly or human plane for traveling.

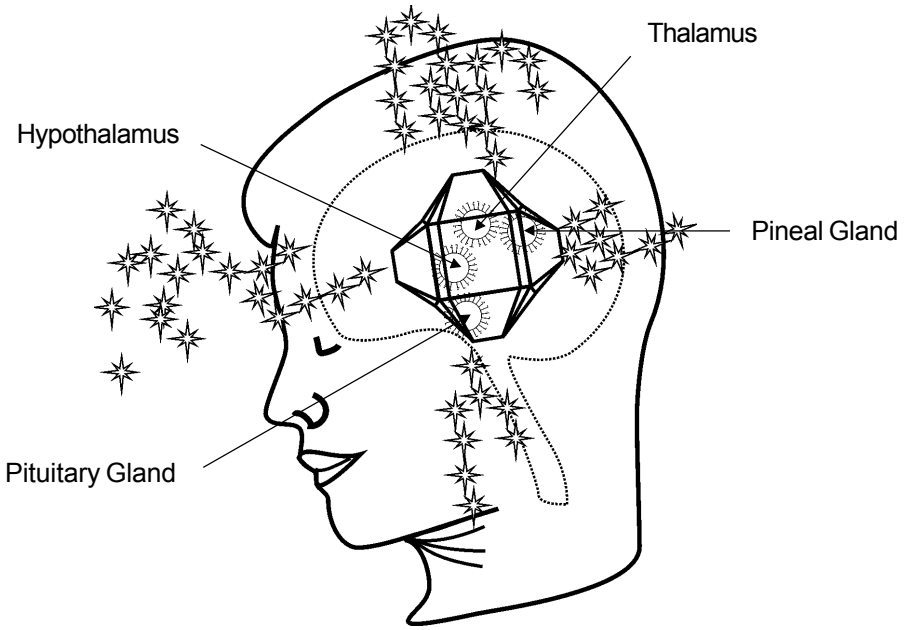

***Fig. 1**.Glands of the Crystal Palace are buried deep within the brain. They include the pineal, hypothalamus, thalamus, and pituitary glands.*

The darkness actualizes successively higher states of divine consciousness, correlating with the synthesis and accumulation of psychedelic chemicals in the brain. Melatonin, a regulatory hormone, quiets the body and mind in preparation for the finer and subtler realities of higher consciousness (Days 1 to 3). Pinoline, affecting the neuro-transmitters of the brain, permits visions and dream-states to emerge in our conscious awareness (Days 3 to 5). Eventually, the brain synthesizes the "spirit molecules" 5-methoxy-dimethyltryptamine (5-MeO-DMT) and dimethyltryptamine (DMT), facilitating the transcendental experiences of universal love and compassion (Days 6 to 12) (**Fig. 2**).

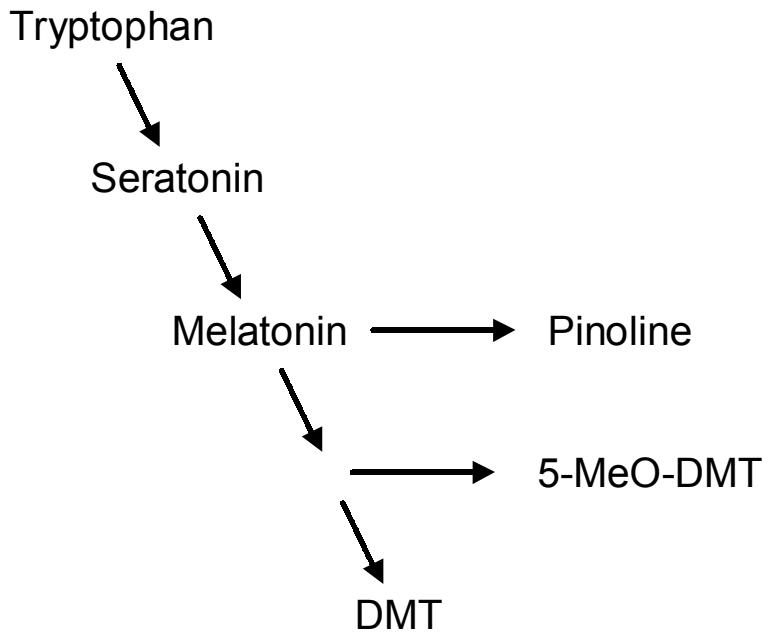

***Fig. 2**. Tryptamine synthesis, simplified: The amino acid tryptophan is the precursor for seratonin, melatonin, pinoline, 5-MeO-DMT, and DMT molecules.*

Universal Tao Dark Room

Starting many years ago, Master Chia went in search of natural caves suitable for meditation in absolute darkness, but none were found. Master Chia and Juan Li spent one day in Wu San, the Taoist Immortal Mountain, the most sacred of the Taoist power centers. The cave was not, however, suitable for dark room retreat. Tourists were ever-present, and the stench of human urine and feces was overpowering. They failed to find the true teaching. Other natural caves were explored, but all suffered some deficiency. The cave environments were dirty and damp, and the air quality poor (dust, fungi, bacteria, insects, snakes …). The caves were dumping grounds, repositories for human waste and garbage. The pristine silence of the darkness was not to be found. Perhaps the perfect cave is still hidden in some deep, high mountain.

Master Chia researched modern Dark Room technologies for many years. A pyramid at Tao Garden, northern Thailand, provided the ground for early experiments in dark room retreat. He made visits to dark room retreats in other countries, to gain insights on the best designs for meditation and for comfort. Eventually, the Universal Tao Dark Room was constructed, based on all available information and latest technologies. The facility is the perfect Inner Alchemy Chamber, conducive to meditation and providing comforts and necessities for up to 60 people. A large central meeting room is surrounded by two tiers of living quarters. The light and sound proof outer sheath is constructed of bricks made from the red earth of Thailand, preserving the earth elements of the original cave. The Mother Earth power is retained in the modern structure.

The Tao Garden Dark Room is enclosed and encased in a light- and sound-proof sheath. The building is constructed of bricks made from the red earth of Thailand, containing all of the properties of natural rock in a cave. The earth was mined and hydraulically pressed into bricks, thus preserving the constituent elements and minerals of the parent materials. The Mother Earth power is retained in the modern structure.

The facility consists of a large, central meeting room for meditation and for dining. Two tiers of bedrooms surround the central area, each with private bath. The entire facility is ventilated with fresh air intakes and air conditioning systems. Food is specially prepared to meet the particular requirements of the body, mind, and spirit in attaining the goals of dark room enlightenment. Fresh juices and soups are served for "breakfast" and a light organic meal are served in the "afternoon". (**See: Dark Room Nutrition**). Participants are trained and prepared for life in the dark (see **See: Dark Room Preparations**).

The Universal Tao Dark Room is currently the largest and most advanced Dark Room meditation facility in the world. Aspiring to the Tao, participants remain in utter and complete darkness for one, two, or three weeks, a perfect laboratory for Inner Alchemy. The spiritual knowledge gained by Taoist masters over the ages merges and blends with the insights of 21st century science and technology.

As Above, So Below

There is one point in the sky around which all other constellations revolve, the North Star point. The North Star is fixed, stationary, motionless. Taoists regard it as the Center, the source of the Universe, the Nothingness, or Wu Chi. The North Star is the Gateway to Heaven. In the Tao, the body is a microcosm of the Universe. "As above, so below." Whatever happens "up there" happens "down here." Hence, the physical body is marked with gridlines of energy and meridians of light around a Center. The Center is called the "Tan Tien", or "field of energy" (**Fig. 3**).

The idea of a Central Axis – the Pole Star in the firmament and a Cauldron in the body – is a central tenet in Taoist philosophy and alchemical practice. To get to the Center of the body, open the Tan Tien; to get to the Center of the Heavens, enter through the North Star. Both are doorways to the heart of the true Tao, the Wu Chi, from which both Heaven and Earth are born. The Inner Alchemy practice of the Universal Tao fuses the body's energies to give birth to a spiritual embryo capable of maturing into a deathless existence and of flight inward, beyond time and space, to the Source.

The Dark Room meditation releases us from the bonds of the Earth. No longer controlled by the rotating power of the Earth, the Sun and the Moon, the organs vibrate in unison with the spiritual stars, the Gates of Heaven. The North Star, unmoving and unwavering in space, is the center, the Wu Chi, emanating violet rays throughout the galaxy, affecting every living cell of nature on our planet. The Big Dipper gathers all the violet light from the universe, and emanates the light as infra-red radiant energy. The emanation of infra-red light of the Big Dipper, combined with the violet rays of the North Star, has a positive, nurturing effect upon the bodies and minds of those who know how to access it. Taoists believe that the Violet Stars, the Big Dipper, and other constellations form the "Gates of Heaven." All living things must pass through these gates to return to their source of origin, the Wu Chi, which is the state of oneness with the Tao.

The dark room environment activates the glouds of the Crystal Palace, actualizing their higher powers and providing a "way back" to the Original Source (**Fig. 1**). When the Crystal Palace is open, it becomes illuminated like millions of shining crystals. It can give and receive light and awaken our inner knowledge and deepest potentials. It receives light and knowledge from the universe and reflects it to the various organs and glands to enhance them.

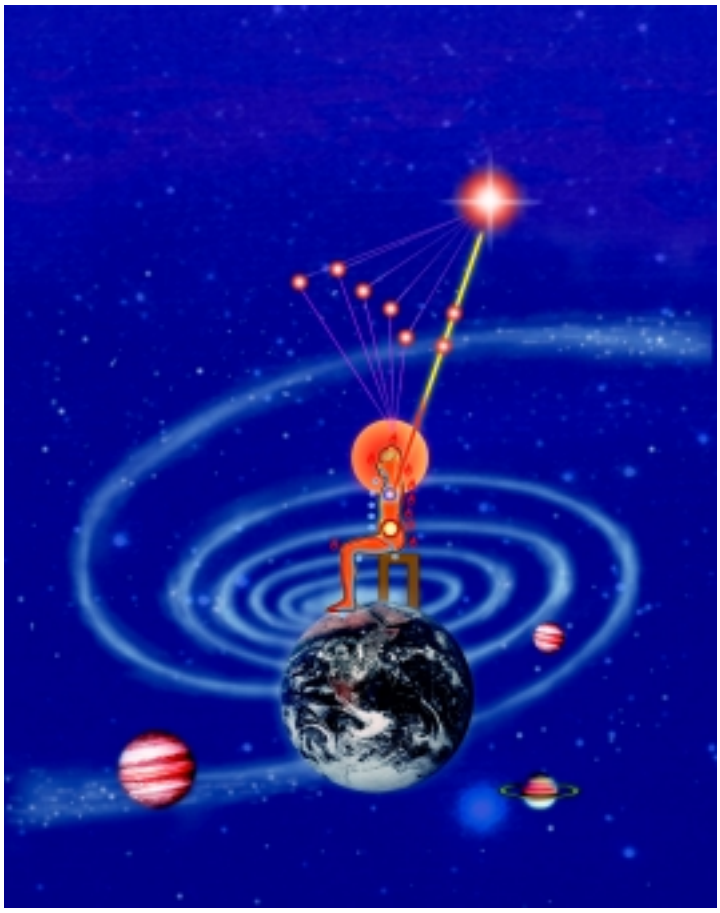

Fig. 3. *Universal connections: We are connected to Mother Earth below, and to the Heavens above. Big Dipper and the North Star are the gateways to immortal life.*

The pineal gland helps us to overcome death by taking in external forces and combining them with sexual energy and the Original Force to form an "Immortal Body." With this body we can leave the physical body before the final transition (death) occurs. By focusing on the tip of the Crystal Palace, the pineal gland, and the back of the crown, we can project ourselves to the North Pole or North Star as we attract its violet emanations (**Fig. 4**).

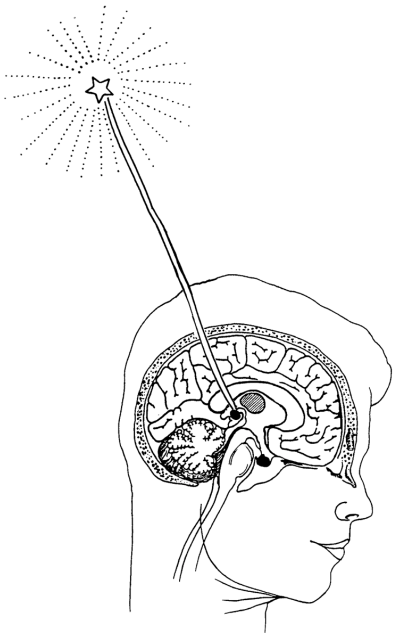

Fig. 4. *Pineal gland has a close connection to the North Star, receiving its violet emanations.*

The pineal, as yang, is balanced by the yin of the hypothalamus gland. Taoists regard this point as the main switch for the Universal Force. When the spirit awakens, it resides in the hypothalamus. When the pineal and hypothalamus are connected, they give out a powerful, balanced force. By focusing on this center and picturing the seven stars of the Big Dipper, you can access the constellation's energy, which emanates from the crown as a ray of red light. (**Fig. 5**).

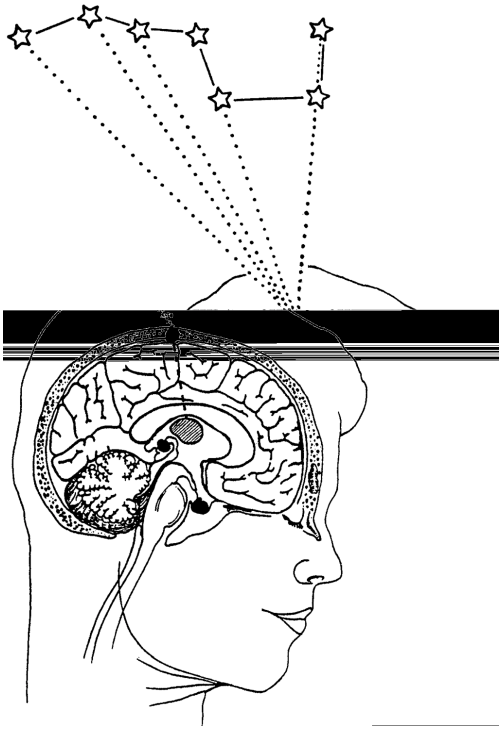

Fig. 5. *Hypothalamus and pineal glands, when connected, allow access to the infra-red emanations of the Big Dipper.*

In the Tao, the sources of longevity and immortality are within the body, not as a physical womb but a spiritual one. Taoists call this spiritual womb the "cauldron". The right method to "cook the cauldron" is not to search outwardly for love from others, but to search within the naked and abandoned self. Self-love, or self-intercourse is the way to give birth to the Immortal Self. The Dark Room manifests the bodily processes of "Healing Love."

The human states of true compassion and sexual arousal create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwined in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love.

When the 'love-vibration' reaches the pineal gland a new hormone is produced, which in turn creates whole body conductivity (**Fig. 6**). Only when you feel the waves of orgasmic vibration and unconditional love for the self and others can the process be activated and the essence of the darkroom is magnified.

The essence of the Dark Room Practice is giving birth to the soul and spirit. The coupling of Yin and Yang energies of the body in the Kan and Li meditations is aimed at overcoming death. It is the method of going back to the state in which we are all orphans, in the very depth of our body/minds.

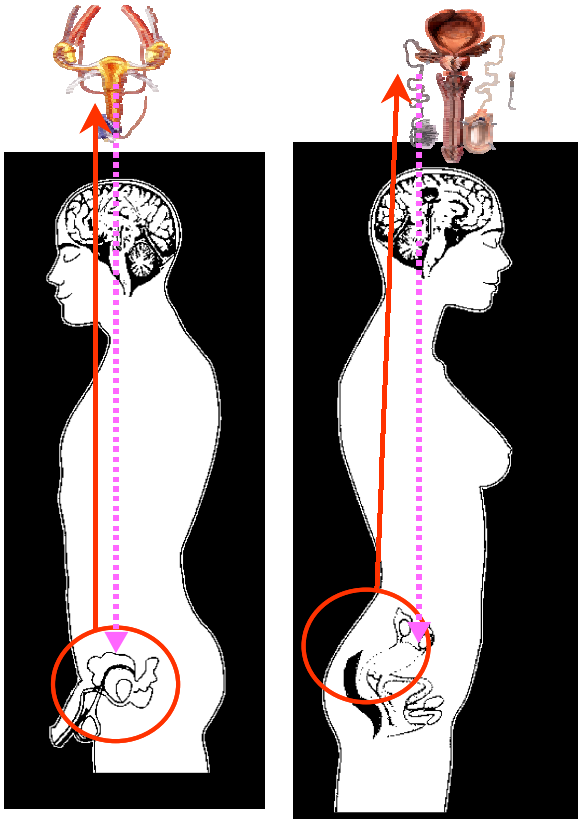

Fig. 6. *Pineal gland connects with the sexual center in the medtation of self-intercourse.*

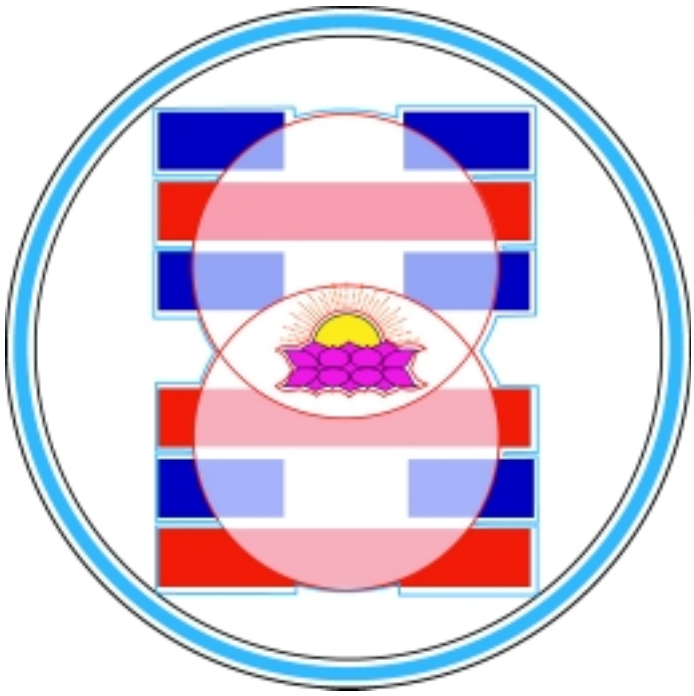

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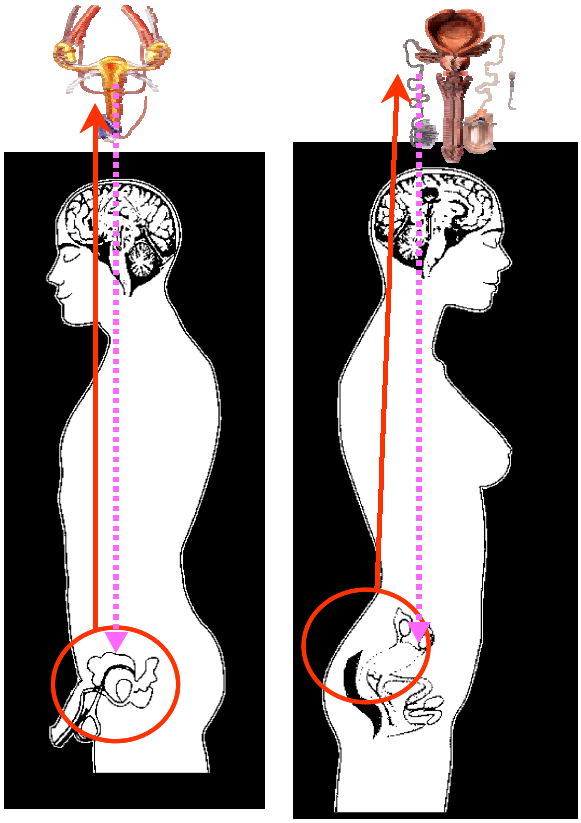

Fig. 6. *Pineal gland connects with the sexual center in the medtation of self-intercourse.*

Consciousness and the Neuro-endocrine System

The dark room environment dramatically alters the chemistry of the brain, manifesting especially in neuro-endocrine systems, which govern consciousness and regulate body functions. An important neurotransmitter involved in waking consciousness (seratonin) converts into a regulatory hormone (melatonin) that shuts down the organ systems, quieting the body in preparation for the finer and subtler realities of higher consciousness. The pineal gland initiates a cascade of inhibitory reactions, permitting visions and dream-states to emerge in our conscious awareness. Eventually, the brain synthesizes the “spirit molecules” 5-methoxy-dimethyltryptamine (5-MeO-DMT) and dimethyltryptamine (DMT), facilitating the transcendental experiences of universal love and compassion.

Autonomic Functions

The body responds automatically and unconsciously to maintain the integrity and vital functions of the organism. The hypothalamus, located deep within the brain, is the major regulatory gland controlling homeostasis, or body maintenance. Factors such as blood pressure, body temperature, fluid and electrolyte balance, and body weight are maintained in dynamic equilibrium, shifting with the needs of the body. To achieve this task, the hypothalamus receives inputs about the state of the body, and initiates compensatory changes if anything drifts out of whack.

The hypothalamus directs body functions though two main pathways. First, the hypothalamus connects to the brainstem, located at the top of the spinal cord, providing a link to the Autonomic Nervous System, the ANS The ANS. has two parts; the sympathetic nervous system activates the “fight or flight” response; the parasympathetic nervous system activates “rest and digest” activities of the body. The brainstem, though the ANS, controls the essential functions of pulse, respiration, body temperature, water balance, swallowing, coughing, as well as our stereotyped reactions and movements.

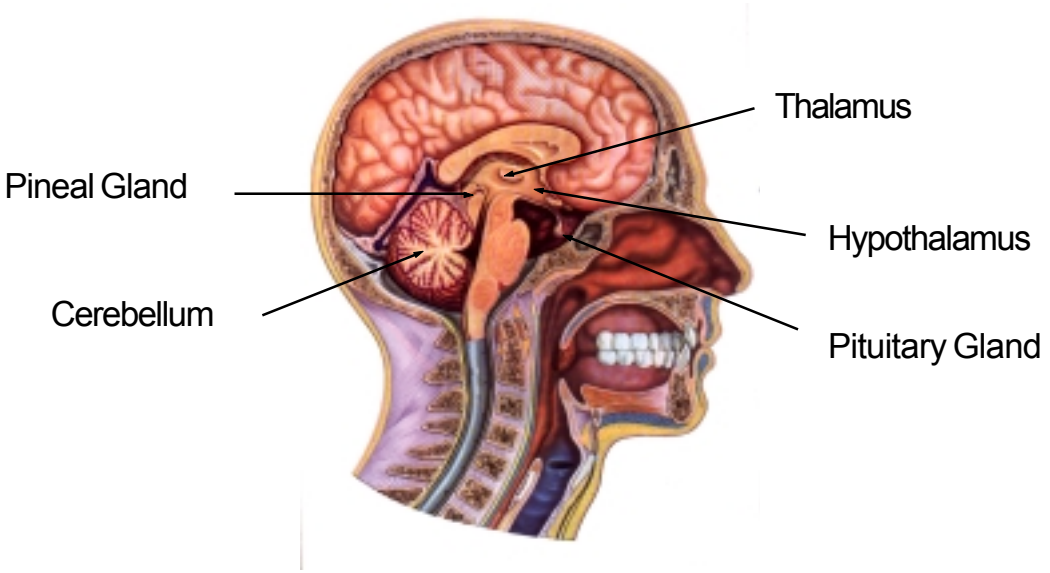

Fig. 7. *Brain Organs*

A second pathway is from the hypothalamus to the pituitary gland, the master endocrine gland in the brain. The pituitary gland secretes hormones, which activate major organ systems in the body, for example the adrenal and sexual centers.

The hypothalamus is of particular importance in the Dark Room because of its affect on circadian (day-night) rhythms in the body. The suprachiasmatic nucleus of the hypothalamus is one of the body's major biological clocks (**Fig. 8**). It not only regulates hormones related to the day/night cycle, but it orchestrates the activities of many other internal clocks. In numerous experiments, it has been shown that when the SCN is not innervated, the human body clocks run free; they set their own time[1].

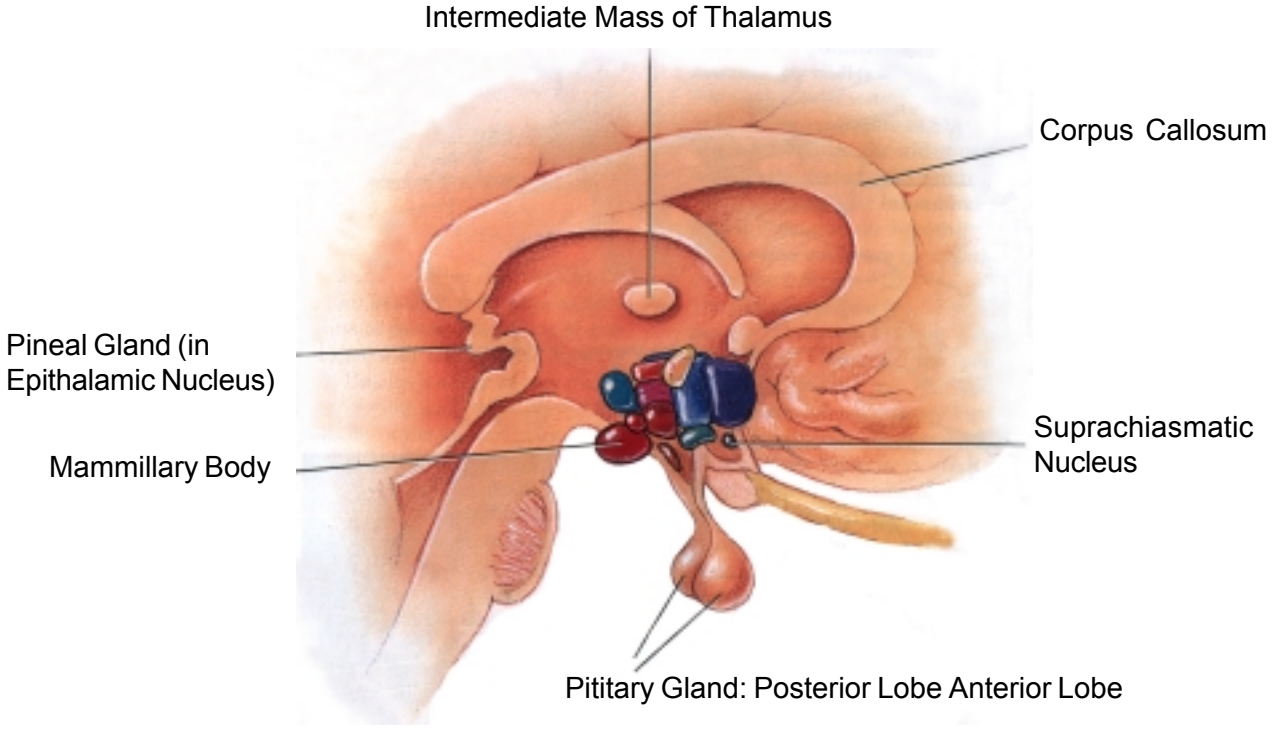

Fig. 8. *Detail of the hypothalamic nuclei. Suprachiasmatic nucleus (SCN) regulates circadian (diurnal) rhythms and activates the pineal gland though sympathetic neurons originating in the brainstem (see Fig. 12)*[2]

Waking Consciousness

An “alarm system” is built into the brainstem, to wake us up and bring us to waking consciousness, called the reticular activating system (RAS) (**Fig. 9**). Sight and hearing are two major pathways of incoming sensory information, providing cues which maintain our state of alertful wakefulness. The optic and auditory nerves stimulate brainstem centers, which, in turn, activate higher cortical centers in the brain though the RAS.

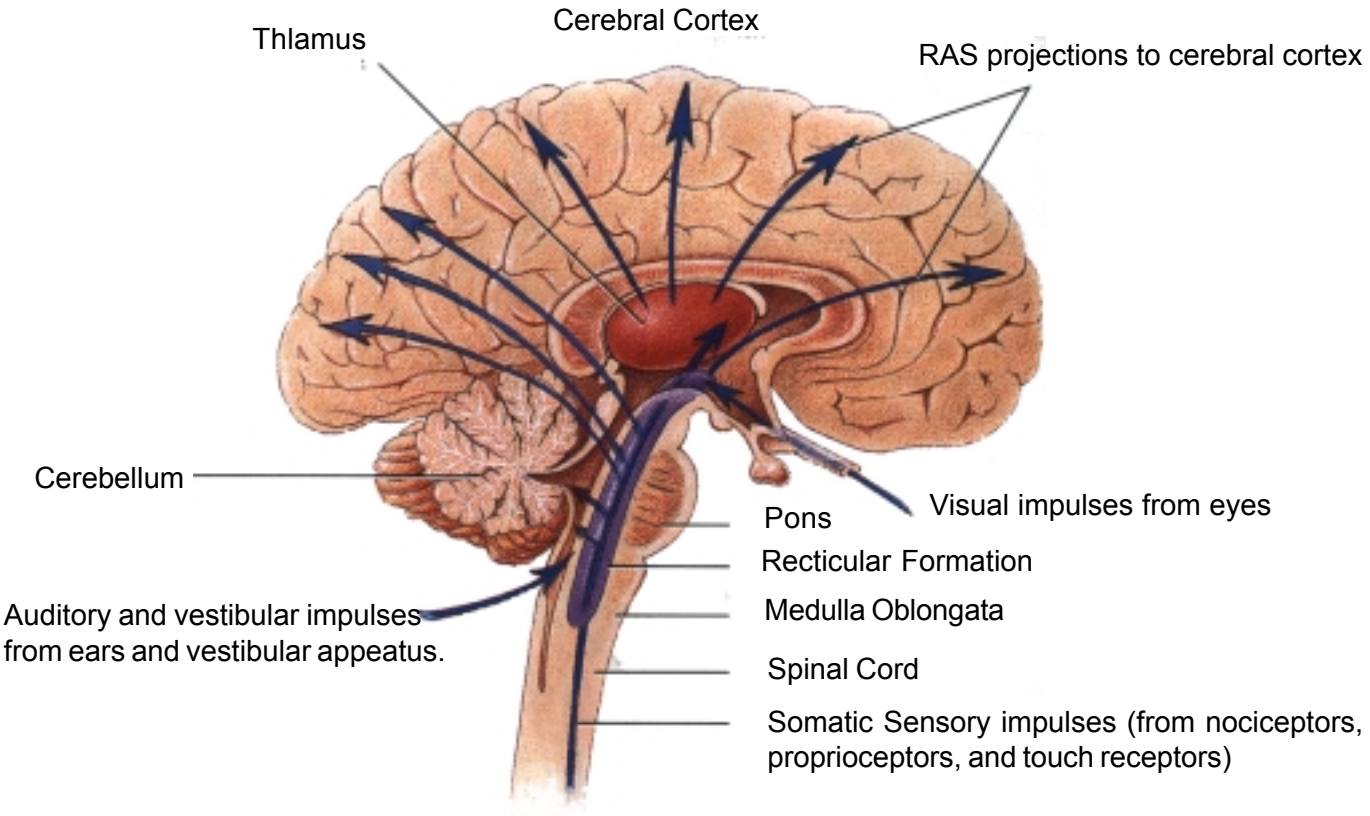

Fig. 9. *Reticular Activating System (RAS): Fibers that project from the reticular formation through the thalamus to the cerebral cortex are responsible for maintaining consciousness, muscle tone, and awakening from sleep, with stimuli from the ears, eyes, and skin, but not the olfactory system, which explains why people die in house fires[3].*

Many of the functions of waking consciousness are maintained by the neurotransmitter seratonin. Seratonin is a chemical messenger, traversing the synapse, or the gap, between two nerve cells (**Fig. 10**). Some of the important nerve pathways assisted by seratonin begin in a region of the brainstem called the raphe nuclei and extend upwards into the cerebrum (**Fig. 11**). Seratonin plays an important role in maintaining cortical arousal, concentration, and suppressing distracting stimuli, as well as a role in sleep.

Seratonin is implicated in a wide variety of psychological phenomena, including depression, anxiety, obesity, and LSD hallucinations. The anti-depressant Prozac, for example, elevates seratonin levels in the synaptic cleft by blocking re-uptake of seratonin into pre-synaptic neurons. (Seratonin levels cannot be raised by ingestion, because the molecule is too polar to pass through the “blood-brain barrier.) As another example, LSD mimics the shape of the seratonin molecule and redirects nerve impulses down unfamiliar and unstructured neural pathways, giving rise to hallucinatory perceptions and experiences. In short, seratonin is the most important neurotransmitter governing states of waking consciousness.

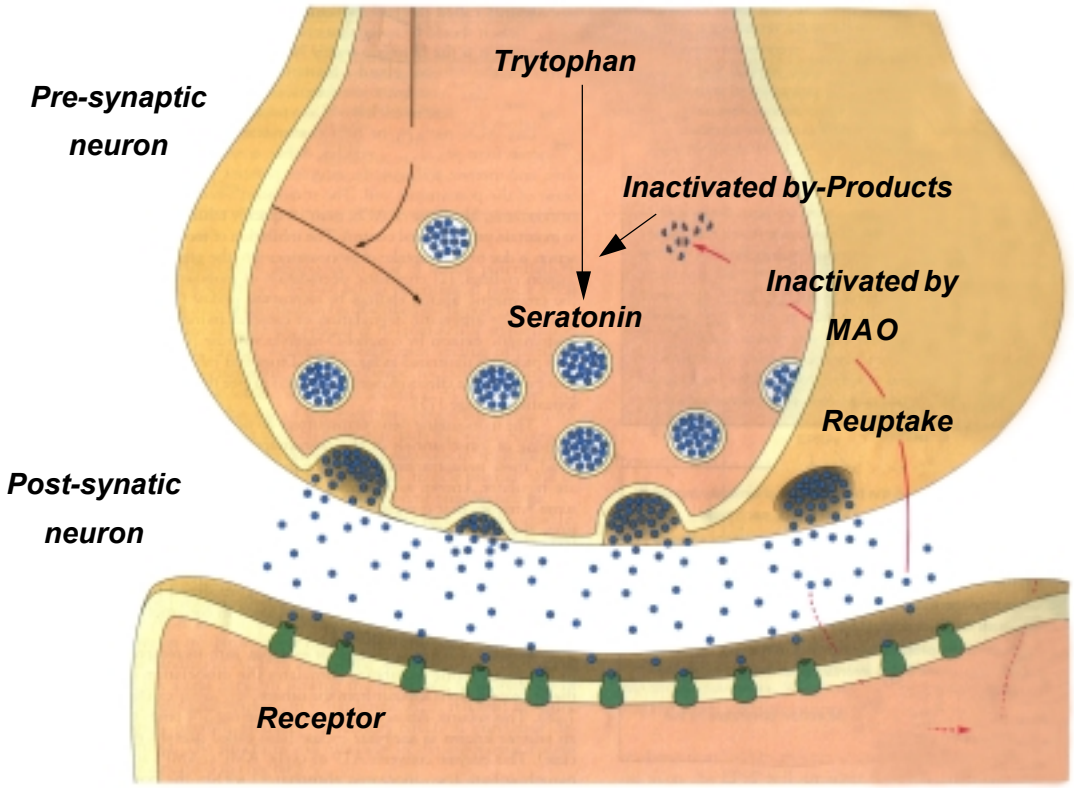

Fig. 10. *Synapse: Neurotransmitter seratonin bridges the gap between nerve cells. After completing its "mission", the seratonin is reabsorbed into the nerve cell and decomposed by MAO into inactive by-products[4].*

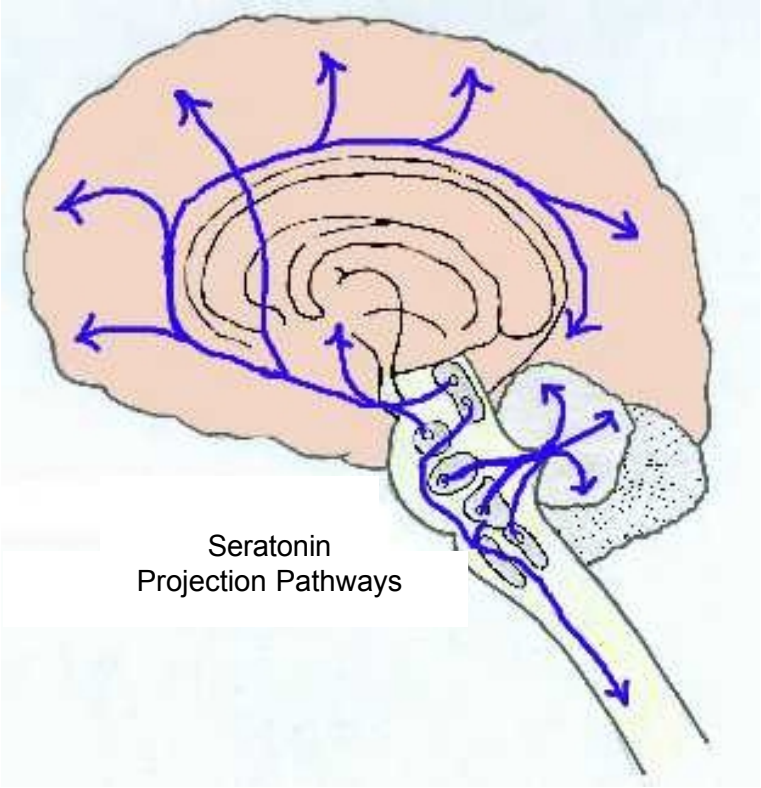

Fig. 11. *Seratonin Pathways. Many of the important nerve pathways assisted by the neurotransmitter seratonin begin in the brainstem and extend upwards into the cerebrum[5] .*

Sleep and Dream

Each night, our waking consciousness is subdued by chemical messengers that inhibit the activities of the brain. Melatonin, the "sleep molecule", is one of these messengers. Melatonin is produced in the pineal gland, in response to the darkness of night, and to the circadian rhythms of light and dark that are programmed into the hypothalamus, an endocrine gland located deep within the brain (**Fig. 12**). Melatonin affects major organ systems, quieting the sympathetic nervous system and allowing daily rejuvenation of mind and body. (also see Appendix: Inner Alchemy, A physical Explanation).

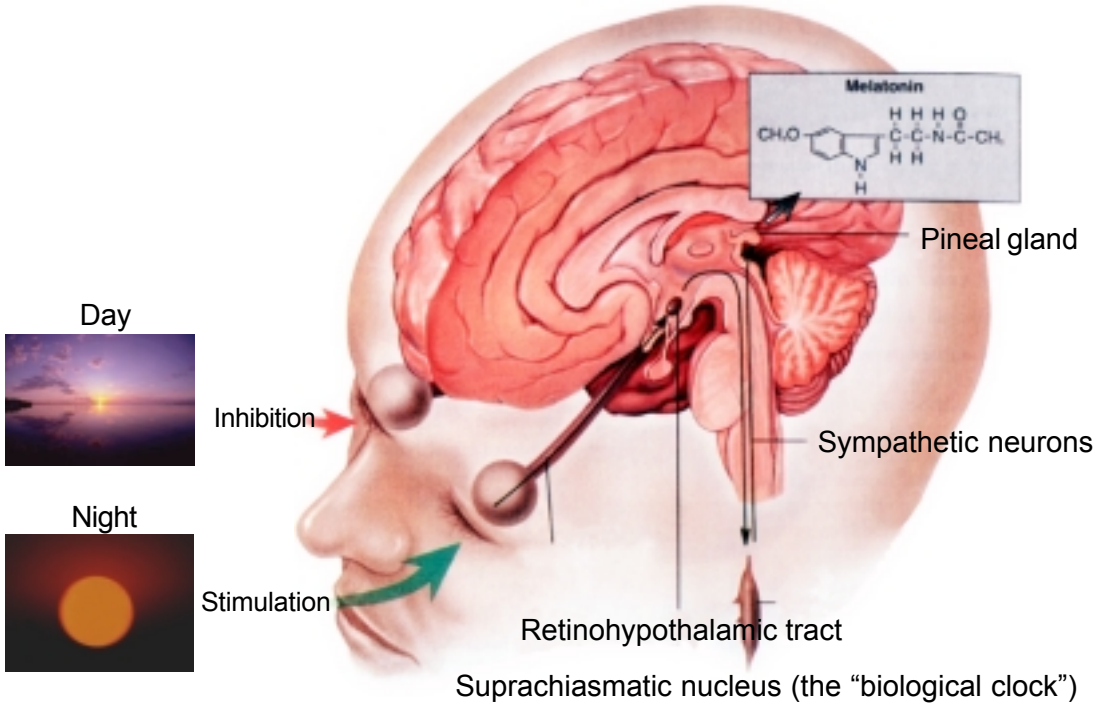

Fig. 12. *Pineal activation: Secretion of melatonin by the pineal gland is stimulated by sympathetic nerve axons originating in the superior cervical ganglion of the brainstem. Activity of these neurons is regulated by the activity of the suprachiasmatic nucleus of the hypothalamus (SCN), which sets a circadian rhythm. This rhythm is entrained to light/dark cycles by neurons in the retina[6].*

The primary function of sleep is to rest and restore not the body, but the mind. Depriving a person of deep, dreamless sleep (delta stage) results in the seepage of hallucinatory phenomena into the waking state. Sleep deprivation causes severe mental disturbance, attention deficits, visual complaints, hallucinations, and time distortion, and, after a number of days a person may go insane.

In the Dark Room, melatonin gradually accumulates in the brain, and we begin to experience the revelations of sleep in our waking consciousness. Sleep and dream states manifest in our awareness, and aspects of our true nature begin to reveal themselves. Sleep consciousness is a profound state of rejuvenation and reconnection to our divine source. It has been said that

> "…the soul temporarily disengages during sleep to 'visit' other dimensions and have experiences, which are remembered during the waking consciousness as dreams. Each and every soul leaves the body as it rests in sleep. The idea that some aspect of the self dissociates during sleep and transits between dimensions (e.g., astral travel) is a common theme in the traditions of many cultures. Sleep is viewed as an opportunity for the mental being to review previous experiences and plan future actions accordingly, hence the retrospective and precognitive function of dreams."

> "During sleep, connection of the physical, mental and spiritual bodies is maintained by a 'silver cord' … similar to the 'thread' or 'cord' of the pineal system. Death involves the severance of this cord whereas sleep may be viewed as merely a temporary 'stretching' of it. The 'projection' of consciousness out of the body during sleep may be related to the … "kundalini" experience and psychic awakening. "[7]

Extended dark room retreats alter sleep cycles somewhat. Initially, people usually sleep more since most people are busy and often sleep-deprived. After two to three days, however, the need for sleep is diminished and a more restful state of being becomes a pervasive aspect of every day. We have observed that when people are quiet and less active during the beginning of a retreat, the elements settle into their own nature more quickly, and a state of alert relaxation arises. After a couple of weeks, one may need only a few hours of sleep each night, and that sleep is often in continuous consciousness.

Descent into Darkness

In the Dark Room, our mind and soul begin to wander freely in the vast realms of psychic and spiritual experience. First, sensory receptors that are controlled by the thalamus gland, with the exception of the olfactory, consciously withdraw (**Fig. 7**). Thus, breathing activity substitutes for the restfulness of visual and auditory function. By keeping the adrenal hormones at their lowest levels the inner peace remains undisturbed. In complete darkness, the visual and auditory abilities become ever more sensitive. The olfactory (smell) and tactile (feeling and touch) organs become the chief senses to supply the little needed energy to the body/mind. Thus the thalamus glands are slowly shut down. The pituitary gland, the master gland for bodily hormones, becomes distilled by the exchange of energy in the body/mind needed for spiritual awakening power.

The hypothalamus gland is in perfect balance and alternates peacefully between wakefulness and sleep. The pineal gland, secreting melatonin to control the subtle bodily rhythms, is sensitized to the vibrations of earth and the scanning light, no longer being driven by the instinctive drive from adrenal power and the waking consciousness of the thalamus glands and the reticular activating system. In this state, wakefulness is a dreaming state and dreaming consciousness is awakening consciousness. They become the functions of spiritual stars and planet earth, rather than the rotating power of the Earth, the Sun and the Moon. This state is the final stage of the returning process on earth.

Limbic System

The primary organ for the emotional activities is coordinated through the function of the amygdala, taken from the Greek word for "almond" because of its fanciful resemblance to almonds. In Taoist tradition, this is the crowning center where both the light and visual frames register, such as the image of sun or of a snake (**Fig. 13**). As the sexual power engages with the light above the brain to form sweet dew, the light in the pituitary becomes gray-white. When it radiates, the two amygdala glands are activated, allowing the Chi to circulate within the temporal lobes on either side of the head, above the ears and around the temples. As the light moves forward, the Third Eye, the essential tool for healing diagnosis, is opened.

The temporal lobes govern all auditory, somatic, and motor sensitivities. The breath coming through the nostrils, as well as the light shining upon the amygdala, charges these sensory activities. The adrenal glands, responsible for releasing norepinephrine and epinephrine, become the seat for true inner stillness (**Fig. 14**). In this state, everything is transformed into the harmless and loving present. By drawing the unconscious light from the adrenal glands, themselves charged by the primordial sexual energy, the mind sees the light and the inner ear hears the cosmic vibration within both the body/mind and the Mother Earth. Mysteriously, the cave of the earth, the cave of the brain (Crystal Palace), and the hollowness within the bones echo with each other, making the cosmic vibration visibly meaningful through the conscious eye.

The meditations of the Inner Smile, Six Healing Sounds, and Fusion Practice are important for quieting and transforming the negative emotions.

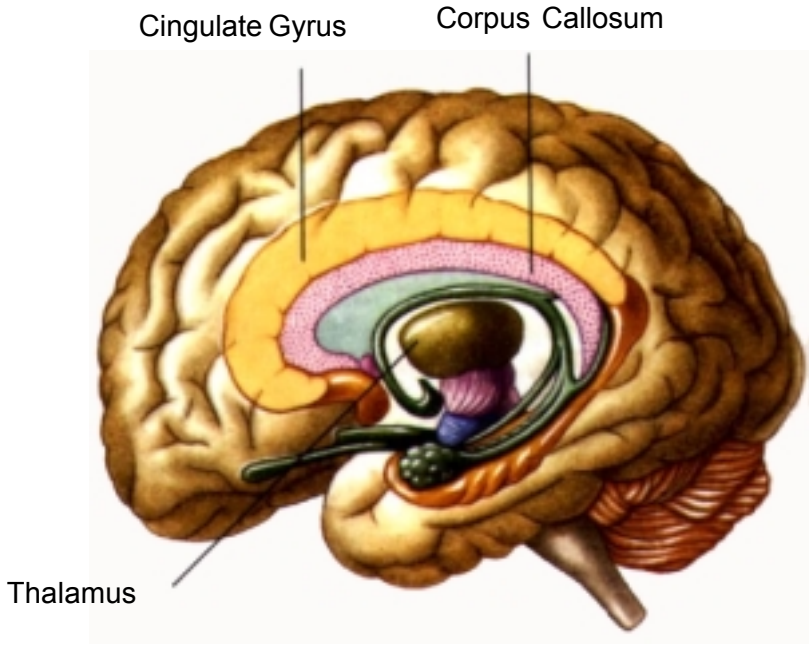

Fig. 13. *Limbic System: The limbic system encircles the top of the brain stem and forms a border (the meaning of "limbic") linking cortical and midbrain areas with lower centers that control automatic, internal body functions.*[8]

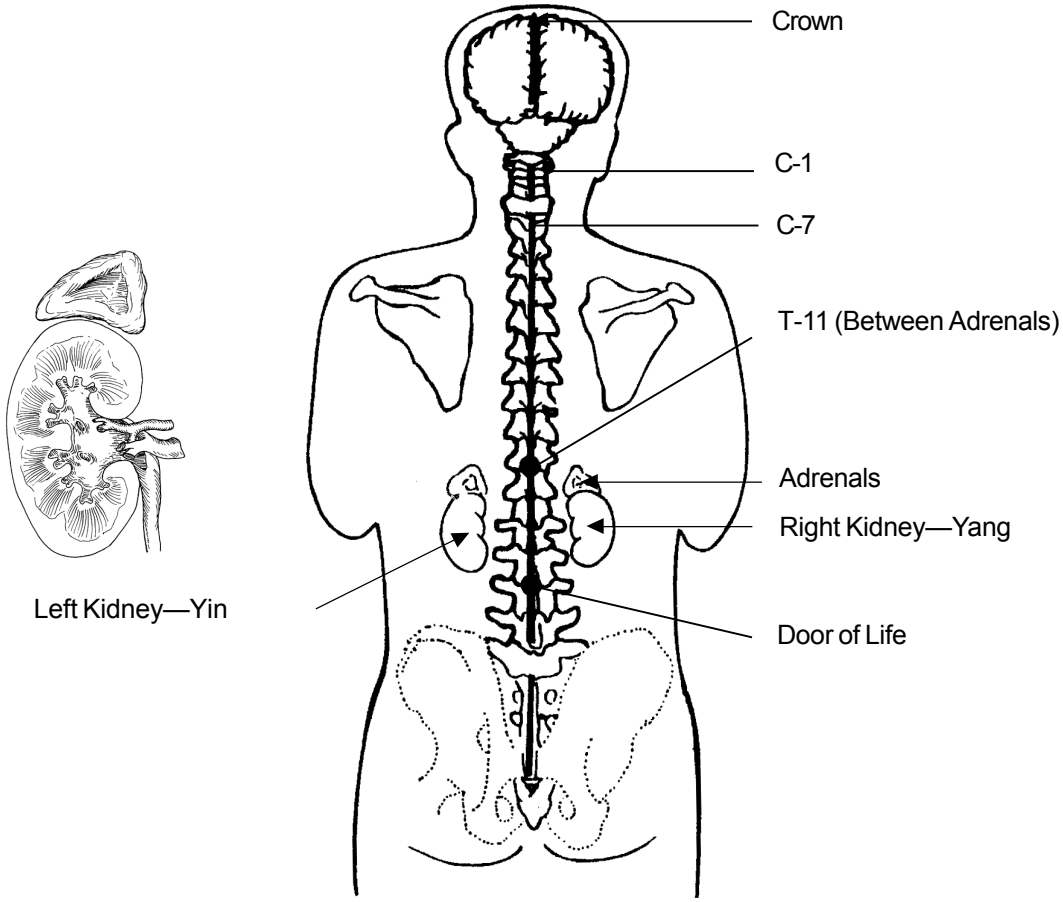

Fig. 14. *Adrenal Glands*

Pineal Gland

The pineal gland is the connection point for the Spirit or Soul. It is the physical center for, and transmitter of, psychic phenomena such as telepathy, clairvoyance in time and space, and the actual influence of thoughts on the physical surroundings[9]. (**Fig. 16**)

"When activated, the pineal gland becomes the line of communication with the higher planes. The crown chakra reaches down until its vortex touches the pineal gland (**Fig. 15**). Prana, or pure energy, is received through this energy center in the head. With practice the vibration level of the astral body is raised, allowing it to separate from the physical. …To activate the 'third eye' and perceive higher dimensions, the pineal gland and the pituitary body must vibrate in unison, which is achieved through meditation and/or relaxation. When a correct relationship is established between personality, operating through the pituitary body, and the soul, operating through the pineal gland, a magnetic field is created. The negative and positive forces interact and become strong enough to create the 'light in the head.' With this 'light in the head' activated, astral projectors can withdraw themselves from the body, carrying the light with them.[10]

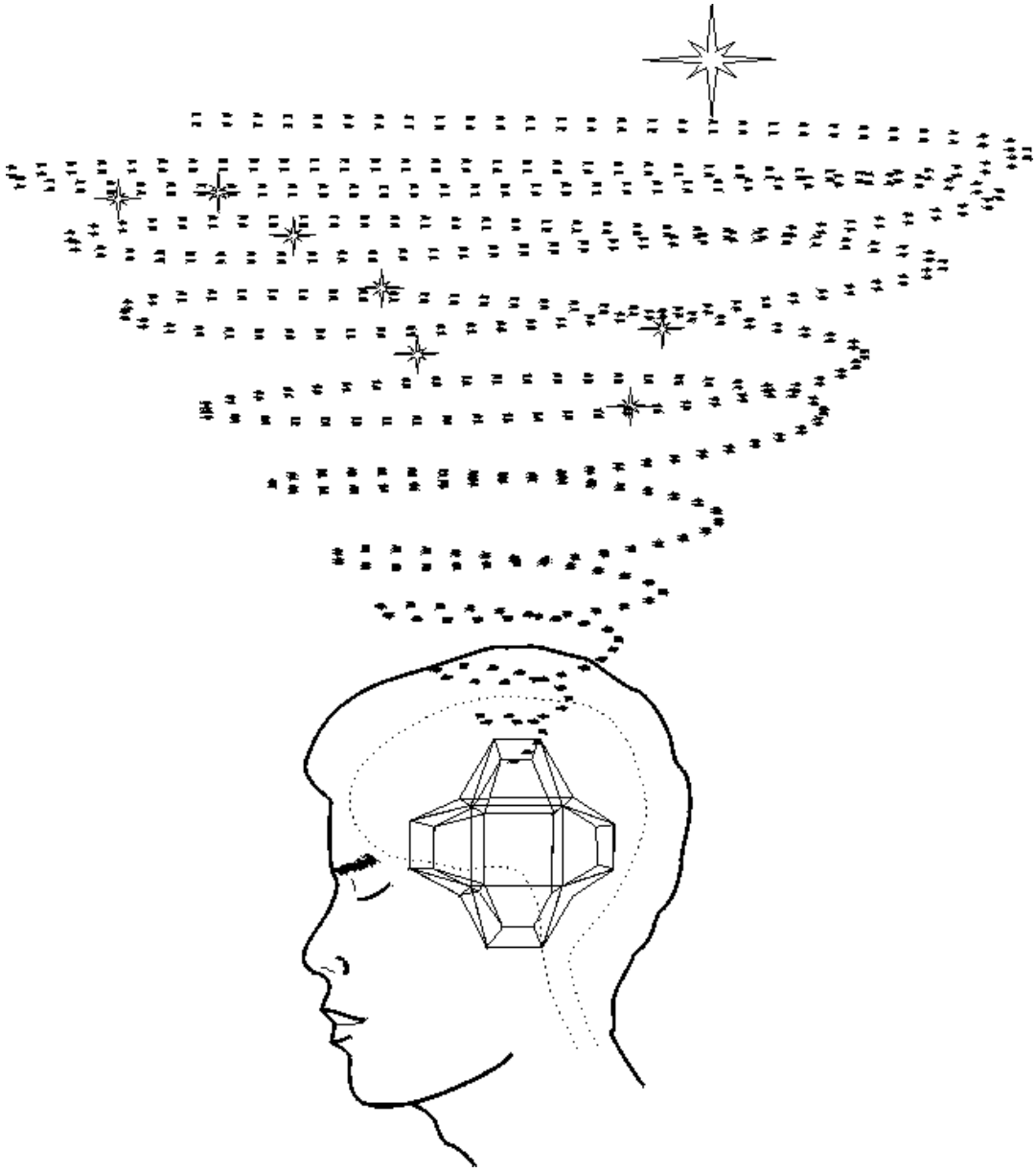

Fig. 15. *Crown Vortex*

Fig. 16. *Third Eye*[11]

"The pineal works primarily by converting the higher dimensional Light, that is constantly streaming into your reality, into usable information for your pituitary. As it gradually activates, the pineal permits the body to move its vibrational patterns into higher and higher levels. This process also allows your Light Body to attach itself even deeper into your physical instrument (**Fig. 17**). Our process is to reset the focus in the pineal. This chemical 'lens' largely disappears as you grow older. The decrease in its efficacy is one of the major reasons for your body aging as quickly as it does. When the pituitary begins to receive the consciousness energy packets from the Well of Dreams through its interaction with the pineal, it secretes enzymes that permit the chemical 'lens' in the pineal to reappear. As this 'lens' strengthens, it allows the RNA/DNA protein strings in your cells to activate your 'third strand'."[12]

Fig. 17. *Heavenly Mirror*

The pineal gland is located in one of the oldest anatomical regions of the brain. If you draw an imaginary line from the center of your forehead, crossed by a line through the head at the ears, you have its general location. The pineal is cone-shaped, about 8 mm (1/3 inch) in diameter, weighing from 50 to 150 mg. The gland is most active during childhood, and begins to regress at about age 7, becoming a calcified tissue strand in the adult (**Fig. 18**).

Fig. 18. *Pineal Gland*[13] *.*

There are numerous anatomical and physiological idiosyncrasies associated with the pineal. It is one of the few solitary organs (most organs in the brain are paired, left and right). While small, the blood flow to the gland is quite large. The pineal has been considered as a homologue of the reptilian 'third eye'. Its photosensitivity derives from neural connections with the retina (**Figs. 12**).

The Taoist practice of Orgasmic Upward Draw is very important to help stimulate the pineal gland. Taoists regard the pineal as the second sexual gland(**Fig. 19**). In the Kan and Li practice, the steaming process helps to clean out all of the organs and reactivate the thymus and pineal glands.

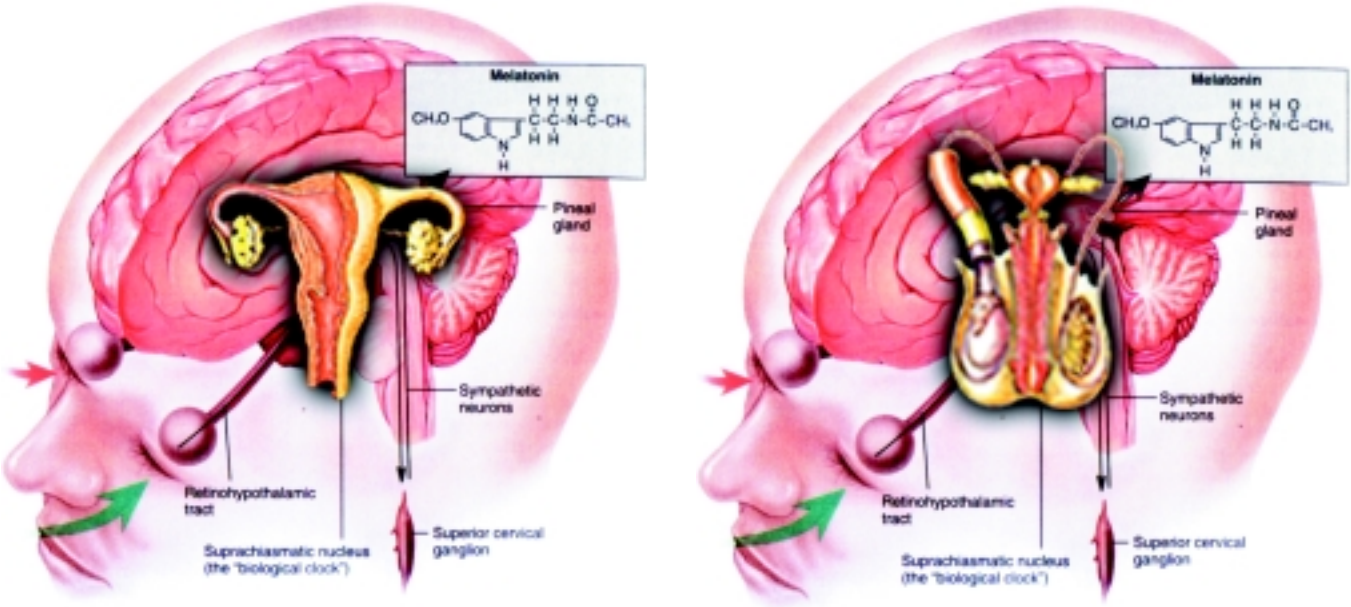

Fig. 19. *Pineal as Second Sexual Center.*

Fall from Grace

Nothing could be more natural than the state of Wu Chi, nothingness, or divine grace. And yet, the realization of Wu Chi is clouded by obscurations and confusions. Consciousness streams into every body, but only a few can see the light. Why is this so?

An essential function of the "upper brain", the Upper Tan Tien, is to manifest the esoteric and divine realizations of consciousness into our humanly bodies. Chi spirals through the Crown and the Third Eye into the pineal and pituitary glands, sustaining existence and nourishing the spirit. Infants and children bask in the glow and the power of the Chi Field streaming into, and interacting with, their bodies. The psyche is vibrant and alive and the energy bodies communicate in non-physical dimensions.

As we grow older, however, the internal realities begin to fade and the external world begins to predominate our existence. By puberty, the pineal gland has ossified into a calcified strand of tissue. Our minds project outwardly, and the demands of existence (work, family, daily living, etc.) preoccupy our awareness. Our emotions (fears, angers, resentments and all kinds of distractions to make ends meet) reflect this outward movement of the psyche.

Fear is the oldest negative emotion. It is felt by all animals, and is even stronger among humans since they have so little power to protect themselves, especially the newborn. The longer history required for organic development makes fear the basis of the entire civilization process: to protect ourselves and achieve our highest potential. Fear is closely connected to the kidney Chi (via the adrenal glands), and when the kidney Chi is diminished, the brain slowly begins to pull back and disengage from the fantastic worlds of the Divine. The upper brain becomes the observing brain, dedicated to the worldly tasks of sending, receiving and processing sensory signals related to daily living.

Inhibiting the Divine

The transition from an internally focused awareness of the Divine, the natural state of infancy, to an externally focused awareness of the adult World, requires significant shifts in the chemistry of the brain. The tissues and molecules which normally manifest the consciousness of Wu Chi must be "turned off" or **inhibited**. Chemically, the inhibitors are enzymes such as MAO (monoamine oxidase) which rapidly convert seratonin into inactive by-products, thus disabling the synthesis of the spirit molecules. The enzyme MAO breaks down seratonin before it can be converted into melatonin, 5-MeO-DMT and DMT (**Fig. 20**).

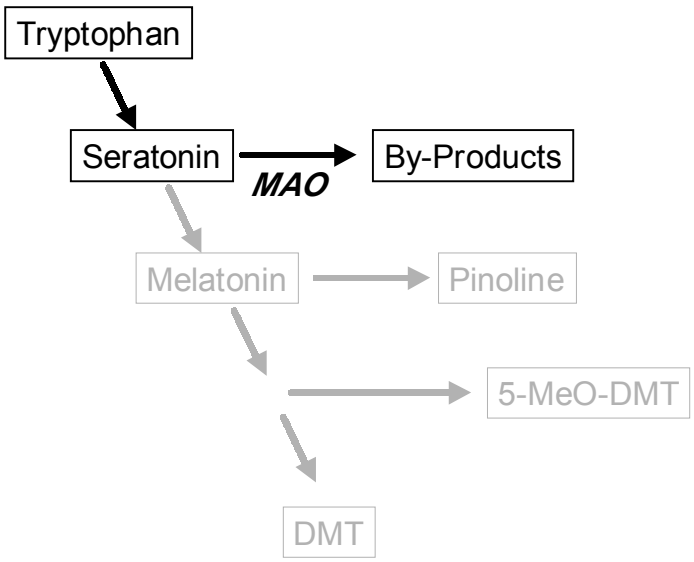

Fig. 20. *Seratonin Deactivaton.*

Our usual perception of the world in waking consciousness is, in fact, a state of waking ignorance. The brain must inhibit our true nature and divine connections to survive in the physical world. In everyday life, we see everything back to front, as it were. We perceive the primary actions of the brain as providing us with sensibility and cognitive awareness. In fact, the brain's mechanism is to filter and shut off the flow of divine consciousness, making possible survival on Earth, but obscuring all transcendental realities. Dark Room meditations remove the obscurations. The inhibitory functions of the brain are lifted, and we revel in the experience of Oneness, Wu Chi, the Original Source.

Reawakening – Spirit Molecules

Waking consciousness satisfies the demands of physical existence, but severs the connection from the Divine. Thus, each night we must disconnect from the outer world and reconnect with our divine source, thereby sustaining life and nourishing the soul. In adult life, the experience of Wu Chi is relegated to the unconscious domains of deep sleep and the supernatural worlds of dream. In Taoist Inner Alchemy, we reawaken the soul to the Immortal Tao, the Wu Chi, the Original Source, and bring back the Divine into our conscious awareness.

Chemically, the reconnection to the Divine occurs by **inhibiting** the enzymatic actions of MAO and INMT, so that seratonin can convert into melatonin and melatonin into the spirit molecules 5-MeO-DMT (5-methoxy-dimethyltryptamine) and DMT (dimethyltryptamine) (**Fig. 21**). The enzymes are inhibited by substances secreted in the pineal gland, such as harmaline and pinoline. The "spirit molecules" allow us to reconnect to divine consciousness. They cause "color imagery, out of body experiences, lucid dreams, visions of beings and/or animals, mystical states, subjective "other realities" and experiences of "being somewhere else." These states are the language of dream.

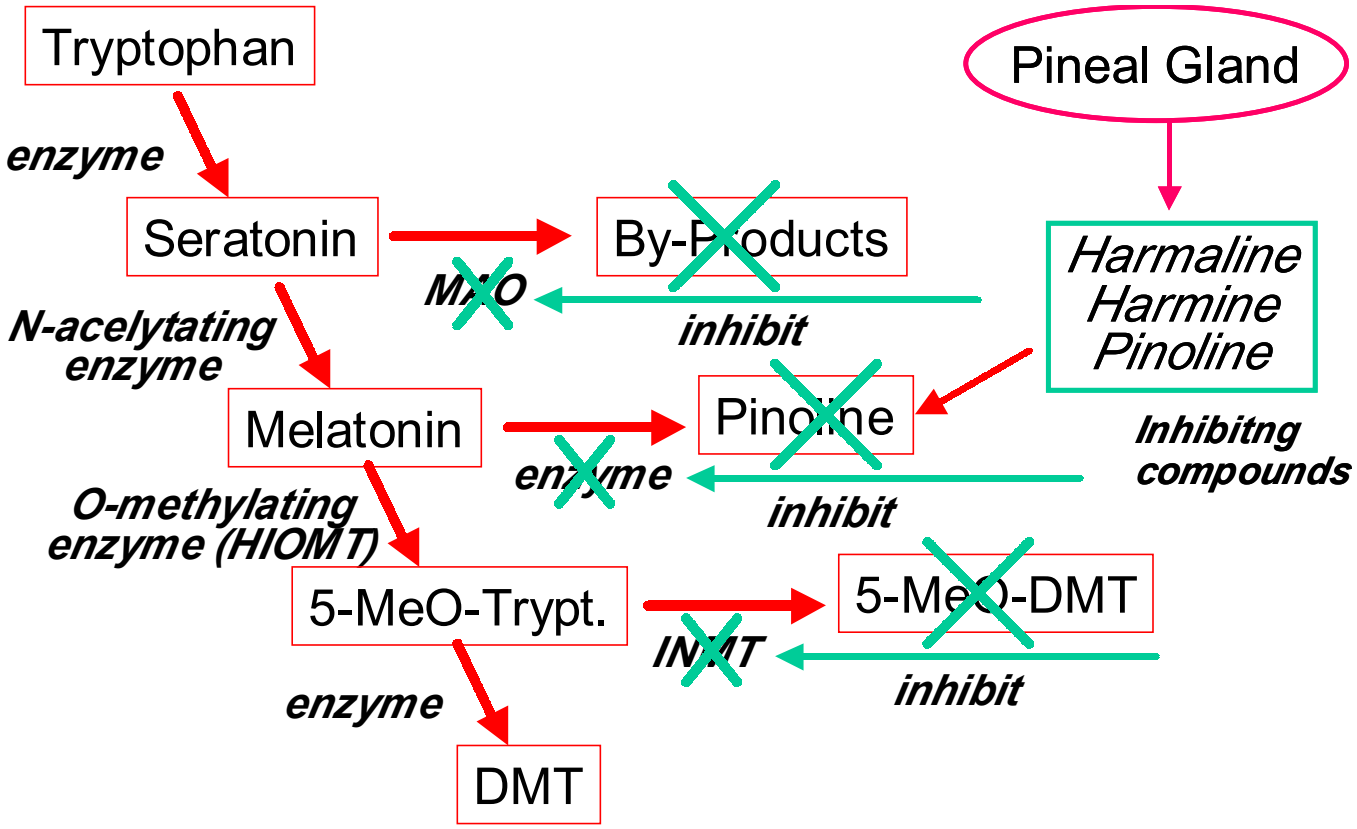

Fig. 21. *Tryptamine Synthesis*[14].

In the Dark Room experience, the "spirit molecules" pinoline, 5-MeO-DMT and DMT alter the receiving qualities of the brain. The brain "tunes in" to invisible worlds and parallel universes, like a television tuning in to different channels. Mystical and near-death, out-of-body experiences reflect dynamic equilibria between "channels" in which we experience the essential energy that courses through the receiver[15].

When you reach the 'DMT state' you begin to function consciously from the various psychic centers or chakras. The bodily processes of 'Healing Love' combine the human states of true compassion and sexual arousal to create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwined in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love.

Immortal Body

Rick Strassman, based on several years of intensive medical research, proposes that the release of DMT from the pineal gland at 49 days after conception marks the entrance of the spirit into the fetus. This 49-day prenatal period corresponds to the first signs of fetal pineal tissue, the differentiation of the gonads into male and female, and the time between the death of an individual and its soul's next rebirth according to the Tibetan Buddhist tradition. He suggests that the individual's life-force enters the body through the pineal gland and leaves it through the pineal gland at death (see "DMT, The Spirit Molecule", by Strassman, and[16]. The infant's brain is flooded with 5-MeO-DMT, secreted from the pineal gland and the brain is 40% more active and open[17].

Chemistry of Consciousness

The chemistry of consciousness is, at first glance, complex. The infant basks in the divine glow of consciousness, manifested in the body/brain by the spirit molecules, 5-MeO-DMT and DMT. However, during development, the brain inhibits the flow of consciousness, utilizing enzymes to deactivate the synthesis of the spirit molecules. Then, to re-realize the divine source, the brain must inhibit the inhibiting enzymes! The chemistry is explained in more detail below.

Seratonin (5-hydroxytryptamine), the neurotransmitter implicated in many of the functions of consciousness, is synthesized in the brain from the amino acid tryptophan, a basic building block of proteins (**Fig. 22**). After fulfilling its role in the synaptic cleft (the space between nerve cells), the seratonin molecule is decomposed into inactive by-products (5-hydroxyindole acetaldehyde) by the enzyme MAO (monoamine oxidase). The seratonin molecule differs from the tryptophan molecule only by the addition of a hydroxyl group (OH) and removal of a carboxyl group (COO).

Melatonin (N-acetylseratonin), the neurohormone implicated in sleep, is synthesized directly from seratonin, by deactivating MAO and inhibiting the destruction of the seratonin molecule (**Fig. 23**). MAO (monoamine oxidase) is deactivated (inhibited) by the beta-carbolene enzymes secreted in the pineal gland: harmine, harmaline, and pinoline. As melatonin levels rise in the brain, the melatonin converts to pinoline (**Fig. 23**). There is some confusion in the literature regarding pinoline synthesis, perhaps because it has multiple synthesis pathways, as well as close affinities to a variety of related compounds (**Fig. 24**).

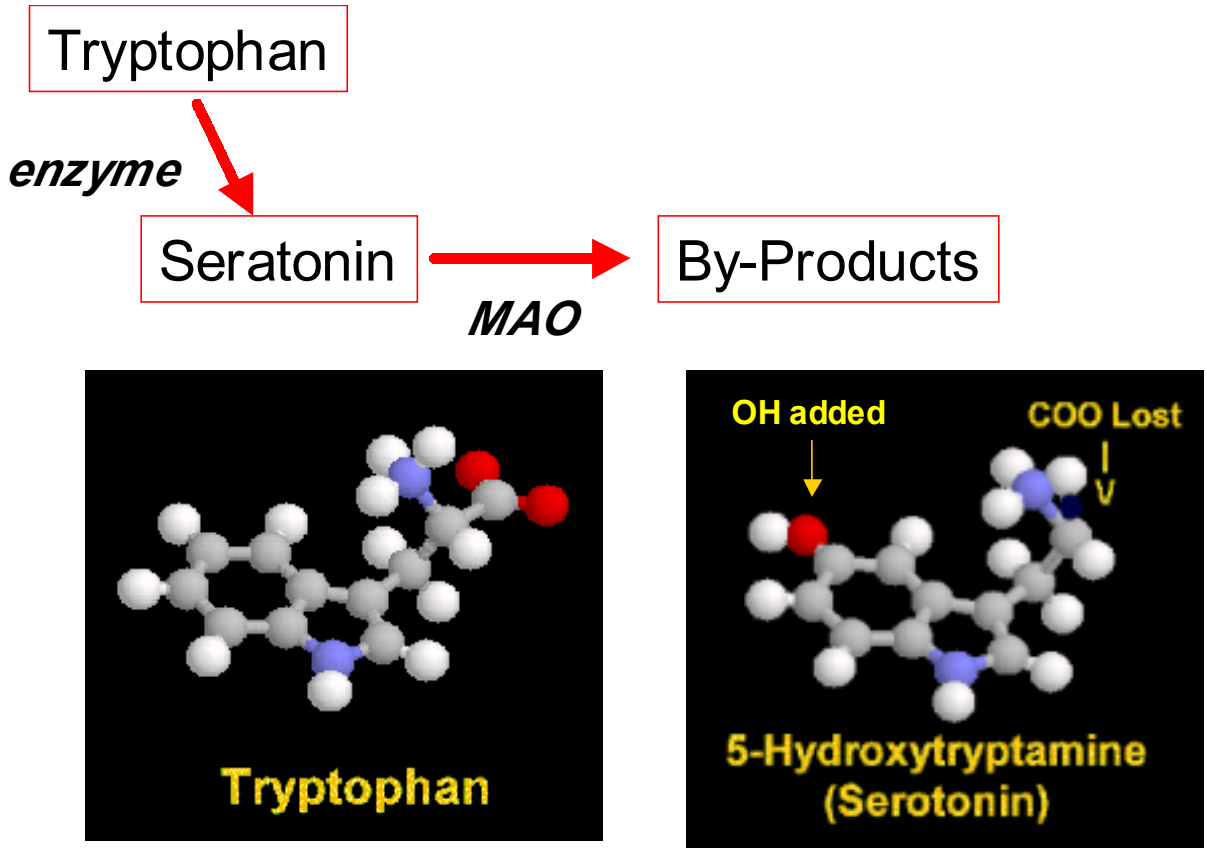

Fig. 22. *Seratonin Synthesis*[18].

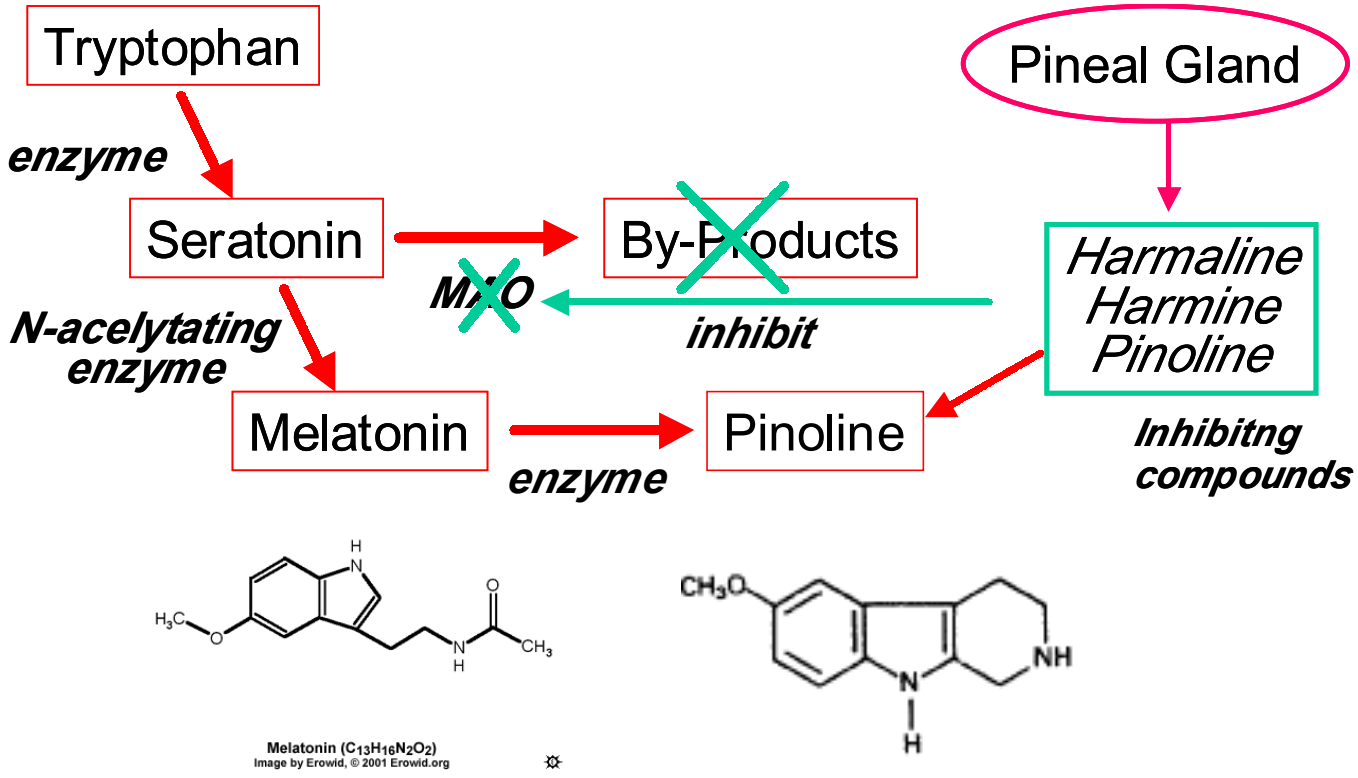

Fig. 23. *Melatonin and Pinoline Synthesis*[19].

indole sub.	aromatic (H_0)	dihydro (H_2)	tetrahydro (H_4)
	with a 1-methyl substituent		
Ar-H	**harman**	harmalan	**tetrahydroharman** (THH)
Ar-6-OH	6-harmol	6-harmalol	**6-tetrahydroharmol**
Ar-6-OMe	6-MeO-harman	**6-MeO-harmalan**	**6-MeO-tetrahydroharman**
Ar-7-OH	harmol	harminol	**tetrahydroharmol**
Ar-7-OMe	**harmine**	**harmaline**	tetrahydroharmine (a)
	with a 1-hydrogen substituent		
Ar-H	βC	DHβC	**THβC (tryptoline)**
Ar-6-OH	6-HO-βC	6-HO-DHβC	**6-HO-THβC**
Ar-6-OMe	6-MeO-βC	6-MeO-DHβC	**6-MeO-THβC (pinoline)**
Ar-7-OH	7-HO-βC	7-HO-DHβC	7-HO-THβC
Ar-7 -OH	7-MeO-βC	7-MeO-DHβC	7-MeO-THβC

Fig. 24. *"Harm'" Compounds. Pinoline also goes by the names 6-Methoxytetrahydro beta carboline, and 6MeOTHBC[20].*

The inhibition of MAO (monoamine oxidase) also allows for the synthesis of the "spirit molecules", 5-MeO-DMT (5-methoxy-dimethyltryptamine) and DMT (dimethyltryptamine) (**Fig. 25**). In a two-step process, 5-MeO-DMT is synthesized from melatonin with the assistance of the O-methylating enzyme HIOMT (hydroxyindole-O-methyltransferase) and the enzyme INMT. Inhibition of INMT results in the formation of DMT.

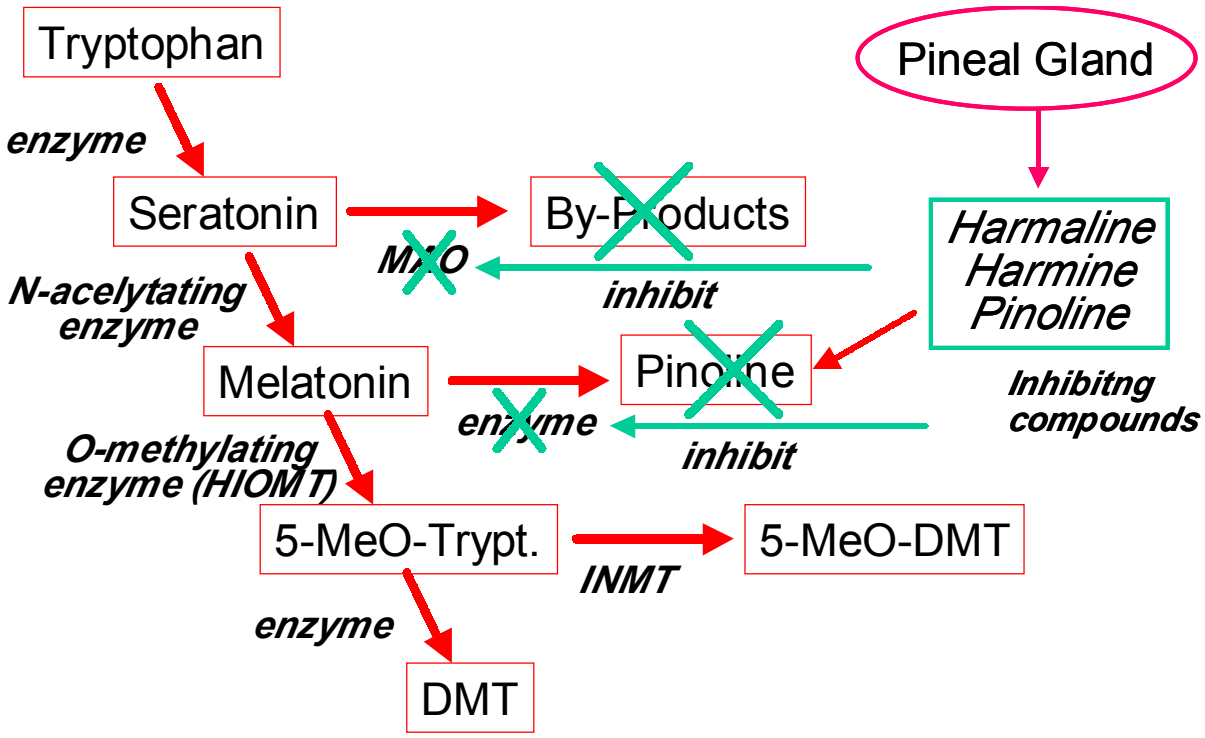

Fig. 25. *5-MeO-DMT Synthesis[21].*

The structures of 5-MeO-DMT and DMT are very similar, differing only by the presence/absence of a CH_3 group (**Fig. 26**).

It should be noted that the tryptamine derivatives are often unstable, volatile substances, and molecules with nearly identical structures may have significantly different functions and effects (**Fig. 27**). DMT, for example, is metabolized by the brain in a matter of 10's of seconds. The tryptamine molecules may rapidly destabilize and transform into sister compounds, and multiple pathways may exist for the formation of a given tryptamine structure. This probably accounts for some of the considerable confusion in the literature regarding the origin of the various "spirit molecules". Pinoline synthesis, as a prime example, has been variously attributed to both melatonin and 5-MeO-DMT parent compounds. The suggestion that pinoline is a pineal secretion ignores the actual molecular pathways that lead to its synthesis.

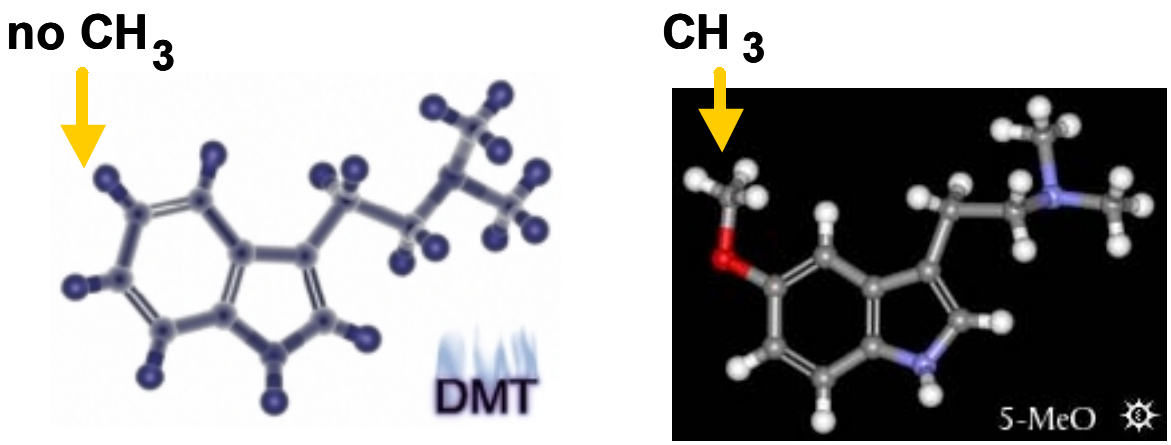

Fig. 26. *Comparison of the DMT and 5-MeO-DMT molecules. They differ by the presence/absence of a CH_3 group*[22].

Orally and Parenterally Active Psychotropic Tryptamine Derivatives http://deoxy.org/trypfaq.htm
Based on McKenna & Towers 1984

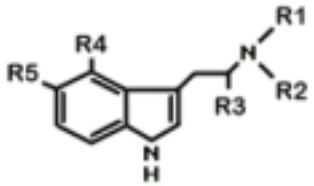

Name of Compound	R1	R2	R3	R4	R5	Dosage (mg)	Route Oral/Par.
tryptamine	H	H	H	H	H	100 *1	par/oral?
DMT (dimethyltryptamine)	CH3	CH3	H	H	H	60	par
5-MeO-DMT	CH3	CH3	H	H	OCH3	6	par
serotonin	H	H	H	H	OH	100 *3	oral
Data compiled from Kantor, et al. 1980; Shulgin 1976, 1982; Shulgin&Carter 1980							

Fig. 27. *Tryptamine Derivatives*[23].

Stages of Dark Room Enlightenment

Benefits of Dark Room Experience

The Dark Room meditations will influence each person uniquely, depending on their maturity and stage of spiritual development. However, most people, even beginners, will receive great benefits, which may include:

1. Relaxation. This is one of the foundations for all other work. During the first days of the retreat, catching up on sleep, allowing the eyes to recuperate from the over-stimulation of our visual world, releasing the grip of mental concerns, plans, and a agendas and simply letting the energies settle creates the best vacation you may ever have.
2. Once relaxed and feeling at home in the dark, the Inner Lights may appear as well as possible images of space teachers, deities, colors, and shapes. Imbalances in one's energies can manifest as dull colors.
3. Over time, as one becomes more open, balanced and awake, images clear as day may appear, not inside the mind's eye but outside in the space of the retreat.
4. Advanced practitioners may experience some of the following: Dreams and sleep become more lucid. A state of continuous consciousness arises in which there is no break in conscious awareness; meditation can continue during sleeping and non-sleeping hours.
5. The Taoist Secret of Love and the Healing Love become very active, so that working with sexual energies and engaging in creative work become easier and more powerful.
6. Dreams will often take the form of teachings or participation in great mythological stories.

The Dark Room enables the body and mind to undergo a series of profound transformations. The 'states of consciousness' appear correlated with the organic synthesis and accumulation of psychedelic chemicals in the brain, especially melatonin (Days 1 to 3), pinoline (Days 3 to 5), 5-MeO-DMT (Days 6 to 8), and DMT (Days 9 to 12). The pharmacology of these states is as follows.

'Melatonin Stage' (Day 1 to 3)

Complete isolation from external light causes the pineal gland to flood the brain with the neurotransmitter melatonin (average 2 to 5 mg/day), manifesting initially as the need for sleep and rest. The eyes recuperate from the over-stimulation of the visual world, releasing the grip of mental concerns, plans agendas, and letting the energies settle. Melatonin is essential for maintaining the hibernation state, which facilitates the emergence of spiritual consciousness. The person retains a child-like biological condition where melatonin is conserved and recycled, not wasted in biological continuation. When this substance works together with the yellow marrow in the bone, the reddish firing reaction will activate a gentle interaction between the sacred water and the light. The sacred waters are the inner fluids that are responsible for producing bone marrow and other bodily fluids. The waters run not only in the in the center of the bones, but also in the spinal connections between the Crown and Perineum Points.

'Pinoline Stage' (Day 3 to 5)

After about three days, when melatonin concentrations reaches sufficient levels (15 to 20 mg) the body then begins to produce the superconductor pinoline, whereby a greater fluidity of thought and healing of the body starts to occur. Pinoline induces cell replication (mitosis) and intercalates with DNA molecules. The 'pinoline stage' is normally activated only in the womb, in lucid dreaming, or in near death experiences. Within this state we can metaprogram the brain to the Unity of Self, heightening awareness of the pathways with which we filter reality. At this stage, the nervous system becomes aware of itself. We become aware of the hologram of the external world that we create constantly in our head[24].

When the pinoline is triggered you activate your clairsentient and clairaudient powers. You may see light and visions, hear music, and gain phenomenal insight. A decoding of the DNA then begins to take place. Cosmic particles are attracted to us and decoded in the form of sound, light, knowledge and realization. The particles, which have the same cell structures as humans (and from which the Tao believes you evolved), are attracted to you magnetically. The body has approximately six trillion cells, which correspond to the universe 'without'. Each of these cells can be seen as a computer with unlimited power and potential. Each cell can become a super conductor, able to receive information from space. You are able to decode this universal information carried from outer space, which may be as old as nothingness itself. When you enter this primordial state or force you are reunited with the true self and divinity within. You literally 'conduct' the universal energy. You may see into the past and future, understand the true meaning of existence, and begin to understand the order of things. You return to the womb, the cocoon of our material structure and Nature's original Dark Room.

'5-MeO-DMT Stage' (Day 6 to 8)

At this stage the pineal gland starts to produce the neuro-hormone 5-MeO-DMT (aka 'akashon'). This psychoactive tryptamine is highly luminescent and also extremely phosphorescent due to the amount of phosphene that it transmits onto the visual cortex. 5-MeO-DMT switches on 40% more of the cerebral cortex and awakens the nervous system to become aware of itself; 'beingness' results. Hence, the possibility of metaprogramming the nervous system's bio-computer - activating healing and conflict message assortment of the nervous system. 5-MeO-DMT is the empathogenic neurotransmitter that expands the emotional body between 'infinity and zero'. It gives rise to telepathy in the emotional and intuitive bodies. It engages the awakening of the 'Flower of Life', the spine, which begins to glow in a state of beingness and peace.

5-Meo-DMT discharges the darkness from the darkroom. A bright light is activated and one experiences a born-again mentality. This Great White Light, the manifestation of the astral body, enables the self to project externally. At this point, some degree of 'N-Methyl-D-Aspartare Inhibition' (NMDA-I) usually occurs. This is a 'soft form' of the slowing of the glutamate input signals into the cells. This makes it easier for the nervous system to cause electrons to stop flowing within the cells, allowing for profound meditative trance states. 5-MeO-DMT intercalates with messenger RNA. One can see in 3 dimensional Holon pictures, as the thoughts behind language.

"Techniques taught in the Dark Room enable one to read and go beyond the matrix, by unifying all directions, and externalize the soul computer so that one can start to interact with ones own genetic code of the Tree of Life. In this intensive process 5-MeO-DMT activates the entire spine, the Tree of Life. The spine is activated and reprogrammed and you can start to process the illusion of the dream from its binary code into the unified translated Self: the Unity Self. Through 14 days of total light isolation your consciousness can be expanded to the wider range of wave emanations and transduce the core hologram of reality that is coherently programming ones nervous system to the Unity Self[25]."

Many exercises will be practiced during this period: compacting Chi, consciousness and awareness into the nervous system, working with the Silent Self and anchoring the Immortal Body.

The 5-MeO-DMT prepares the nervous system, through its empathetic state of being and self awareness of the nervous system, for the DMT or dimethyltryptamine production of the pineal gland, in psychoactive milligram doses.

'DMT Stage' (Day 9 to 12)

When DMT levels reach more than 25 mg, one's experience can become very visual. DMT is the visual third eye neurotransmitter. It enables the energy body and spirit to journey into hyperspace, beyond third dimensional realms of time and space. It is intensely energizing. "After some 10-12 days one starts to see in infra red, and ultra violet, one can actually run across the room and touch a person, by seeing their heat patterns. The Holon Images exteriorize and one is walking in a Virtual Reality, which appears to be the DNA language macro uploaded, and interactive."

When you reach the 'DMT state' you begin to function consciously from the various psychic centers or chakras. The bodily processes of 'Healing Love' are then combined with those of the Dark Room. The human states of true compassion and sexual arousal create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwining in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love. When this 'love-vibration' reaches the pineal gland a new hormone is produced, which in turn creates whole body conductivity. Only when you feel the waves of orgasmic vibration and unconditional love for the self and others can the process be activated and the essence of the darkroom is magnified.

At this stage of the Dark Room Retreat, the required amount of sleep tends to diminish dramatically. Although the day may last 24 hours, 3 hours of sleep can seem like 12. During this period we will engage in further practices; psychic games and interactivity, Taoist Dream Yoga (advanced levels) and Imagination Expansion.

Fusion of Eight Psychic Channels

Opening and Sealing Psychic Channels

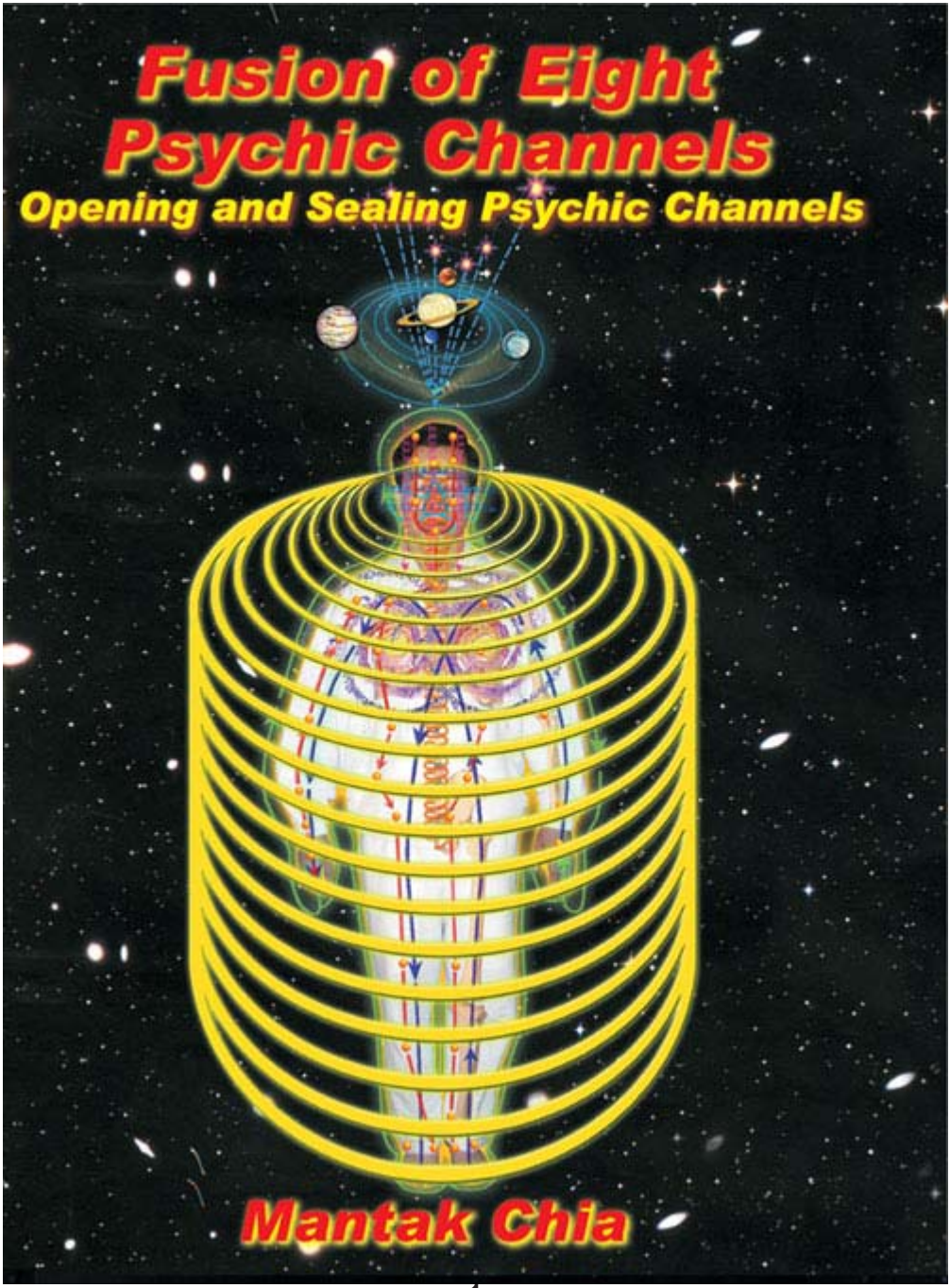

Mantak Chia

Fusion of Eight Psychic Channels

Opening and Sealing Psychic Channels

Mantak Chia

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Introduction to Fusion of Eight Psychic Channels

In Fusion of Eight Psychic Channels

1. You will open and clean the Great Bridge and the Great Regular Channel. Both consist of a Yin and a Yang Channel. All together they form four channels (Yin and Yang Wei and the Yin and Yang Chiao Channels). They are the last Extraordinary acupuncture (psychic) Channels to open. The others are; the Governor (Du Mai) and Functional (Ren Mai) Channel of the Microcosmic Orbit and the Thrusting Channels (count as one Channel, related to the Chong Mai) and the Belt Channel (related to the Dai Mai).

2. You will learn to protect the spine and your energy field, to seal the aura and the senses and to drill your head.

3. You will learn to transform the Microcosmic Orbit, the Thrusting Channels and the Belt Channel in the Energy Body.

Fusion of the Eight Psychic Channels is the last part of the Fusions. It teaches the last techniques and meditation to prepare you for the higher practices. After you master all the Fusion Practices you are ready and prepared to start the Practice of the Immortal Tao.

Practice of Fusion of Eight Psychic Channels

Great Bridge Channel and the Great Regular Channel

1. Theory

The Great Regulator and Great Bridge Channels have no points of their own, but run across specific points of the twelve organ meridians. They connect in this way all these meridians together which enables the energy to flow from one meridian to another, balancing and regulating the energy flow in the meridians. The *Great Bridge*

Channel (Yin and Yang Chiao Mai) serves to connect all the meridians. The *Great Regulator Channel* (Yin and Yang Wei Mai) serves to regulate, coordinate and balance the energy flow between these meridians, also called the body's channels. The routes they follow lie close together.

Although they are separate channels we practice them in Fusion of Eight Psychic Channels as one channel with a Yin and a Yang part. The Yin part connects all the Yin organ-meridians and regulates the flow of energy in these meridians, the Yang part connects all the Yang organ-meridians and regulates the flow of energy in these meridians. The Yin channels run along the inside of the legs and arms and the front of the body. They also regulate the blood. The Yang channels run on the outside of the legs and arms and the back of the body. They control the defensive energy and regulate resistance to external infections. In other words, the Yin Channels protect the body from "attacks" from within and the Yang Channels protect the body from external "attacks".

The most important reason to open the Bridge and Regulator Channel is to promote the unimpeded flow of energy in the body, to heal the body and to prepare the body to receive and to circulate the higher energy forces of the Immortal Practice in your body. All the Eight Psychic Channels act as receivers and distributors to the organs and glands of the *Universal Force*. For this reason, working with the Eight Psychic Channels is considered spiritual work in the Taoist system.

Forming the control base of the Eight Psychic Channels is the *Gate of Death and Life* (also known as the *Gate of Mortality*) at the perineum point. The perineum point serves many purposes. It is considered the sexual energy base. It is also the point to which is joined the Bubbling Spring, the collection point of the Earth energy at the soles of the feet. The Belt Channel passes through the perineum point as it interconnects the other seven channels. The interconnection of the Belt Channel makes it possible to move the energy from one channel to any other channel, while it serves to protect all the body's centers. The crown point at the pineal gland is the other common point of the Eight Psychic Channels.

2. Location of the Points of the Great Bridge and Great Regulator Channels

In this part we give you all the points of these channels with their locations and their meaning as acupuncture point.

A. Locate GB-17 and ST- 4

Part of the Yang Route of the Channel

1. **GB-17 (Gall Bladder Meridian)**
Traditional Name: Cheng Yin = Correct Management
Location: Slightly behind the center of the top of the head, and to the right and left sides.
Uses: To help relieve headaches and toothaches.

2. **GB-16 (Gall Bladder Meridian)**
Traditional Name: Mu Chuang = Eye Window
Location: On top of the head at the central point, and to the right and left sides.
Uses: To help relieve eye problems and facial edema (swelling through water retention).

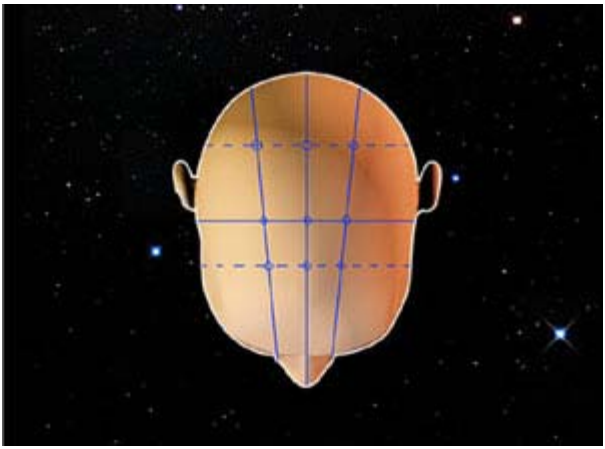

Fig. 1 *Yang Route of the Channel*

3. **GB-15 (Gall Bladder Meridian)**

Traditional Name: Lin Chi = Temporarily Weeping

Location: On top of the head in front of the central point, and to the right and left sides.

Uses: To help relieve stuffed nose, eye problems and strokes.

4. **GB-14 (Gall Bladder Meridian)**

Traditional Name: Yang Pai = White Yang or Pure Yang.

Location: One finger's width above the eyebrow in direct line with the pupil of the eye.

Uses: To help relieve eye problems such as glaucoma, night blindness, forehead pain, facial nerve paralysis, stuffed nose and strokes.

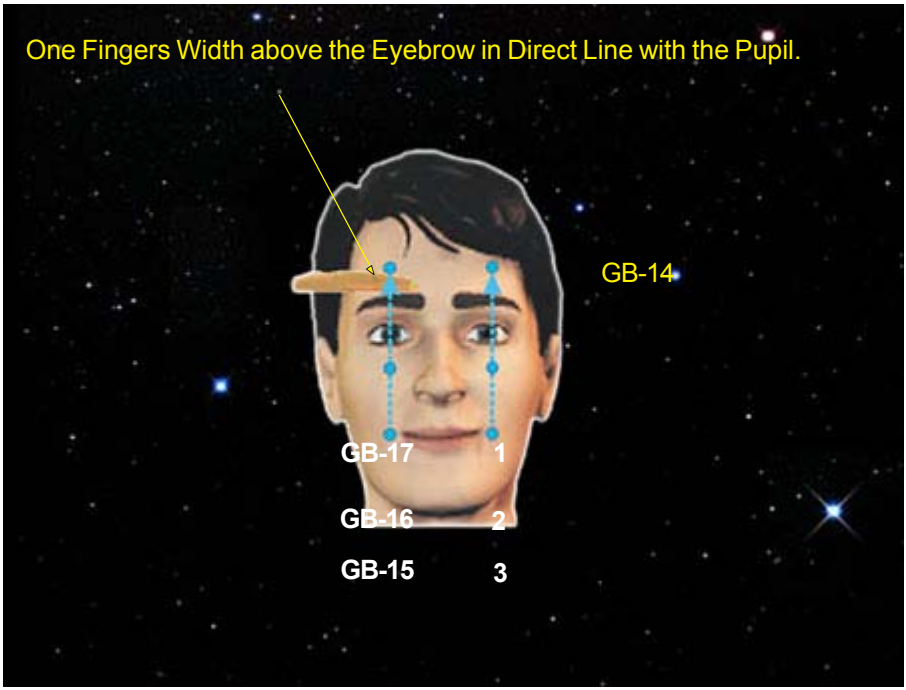

Fig. 2 *GB-14 (Gall Bladder Meridian)*

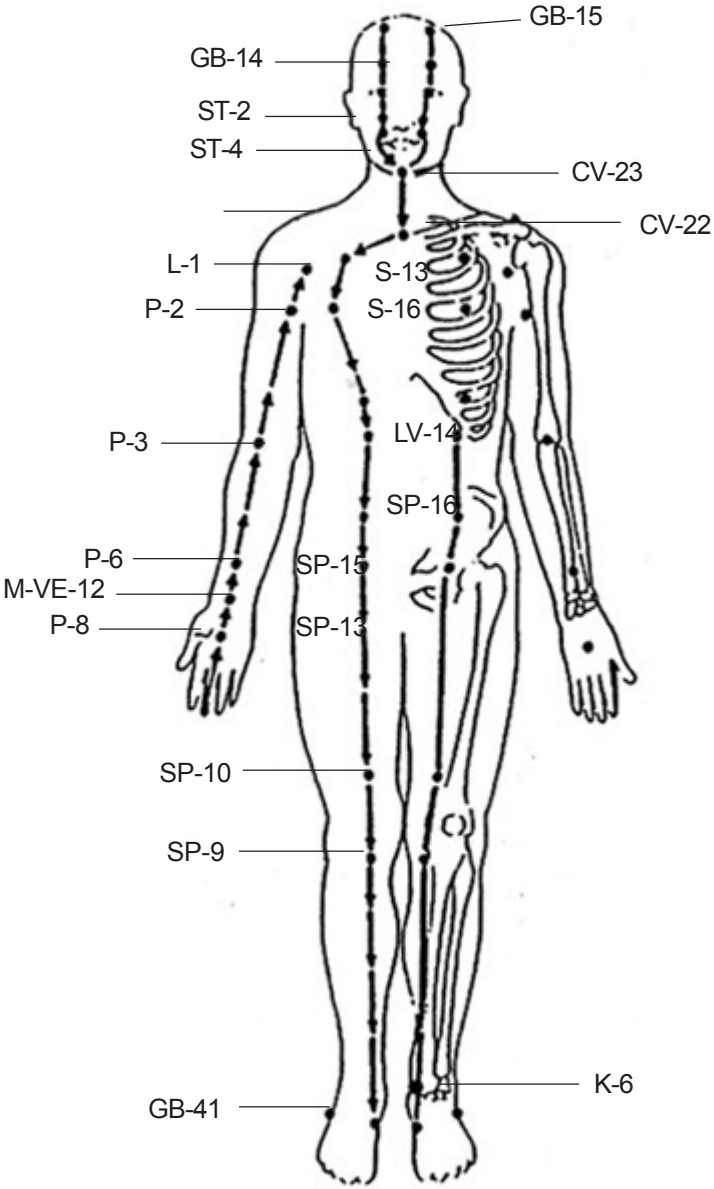

Fig. 3 *Yin Side*

5. **ST-2 (Stomach Meridian)**
Traditional Name: Szu Pai = Four White
Location: Below the eye in direct line with the pupil.
Uses: To help relieve eye disease, toothaches, facial nerve paralysis, nose bleeding, and colds.

6. **ST-4 (Stomach Meridian)**
Traditional Name: Ti Tsang = Ground Storehouse
Location: At the intersection point of a line straight down from the pupil to the base of the cheekbone, and another line along the curve of the cheekbone.
Uses: To help clear nasal passages, colds, toothaches, eye problems, facial paralysis, nose bleeding, and dribbling.

Fig. 4 *ST-4 (Stomach Meridian)*

B. Locate CV-23 and K-1

The Entire Front (Yin) Route of the Channel

1. **CV-23 (Conception Vessel or Functional Channel)**
Traditional Name: Lien Chuan = Corner Spring
Location: Behind the midpoint of the lower edge of the chin bone. Hook the thumb behind the bone, CV-25 and press upward and forward.
Uses: Can help to relieve laryngitis, clears the throat.

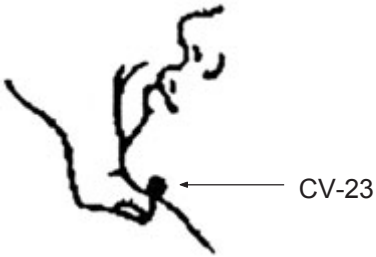

Fig. 5 *CV-23 (Conception Vessel or Functional Channel)*

2. **CV-22 (Conception Vessel or Functional Channel)**

Traditional Name: Tien Tu = Celestial Protrusion

Location: At the top of the breastbone (sternum) in the V-shaped indentation; press downward in a 45-degree angle.

Uses: Can relieve asthma, bronchitis, coughing, sore throat, larynx spasms. Pressing and releasing CV-22 can cause energy to flow more easily through the chest, thereby helping to restore the proper freer breathing.

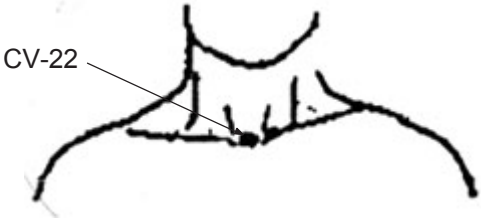

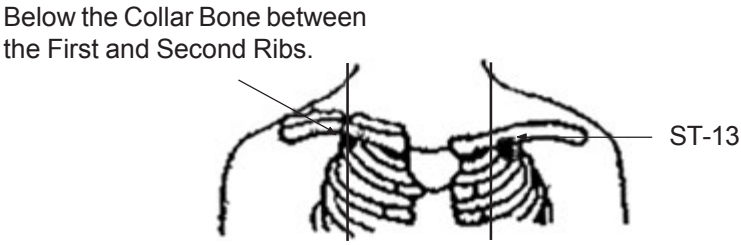

Fig. 6 *CV-22 (Conception Vessel) and ST-13*

3. **ST-13 (Stomach Meridian)**

Traditional Name: Chi-Hu = Door of Chi

Location: Below the midpoint of the collarbone between the first and second ribs. Press straight into the body. The point feels sore or like an electric shock.

Uses: Can relieve asthma, bronchitis, chest and back pain, hiccups. Unrestricted flow through ST-13 allows good energy to flow through the chest.

4. **ST-16 (Stomach Meridian)**

Traditional Name: Yin Chuang = Breast window

Location: Between the third and fourth ribs, one rib directly above the nipples in males, slightly higher in females. When pressed the point feels somewhat sore, especially on females.

Uses: Can relieve coughing, asthma, swelling of the breast, chest and stomach pain, heartburn, short breath, melancholy. Good energy flow clears the whole breast region and promotes optimism.

5. **LV-14 (Liver Meridian)**

Traditional Name: Chi Men = Gate of Hope

Location: At the junction of the ninth rib cartilage to the eighth rib. Follow the bottom edge of the rib cage from the sternum until the first major indentation, then trace a line down from the nipples. The intersection is the LV-14 area. Press slightly up and into the abdomen. The point will feel quite sore when pressed.

Uses: Can relieve difficulty in breathing, chest pain, diarrhea, cholera, menopausal disorders, childbirth pains, abdominal tension. Pressing LV-14 affects the liver, gall bladder, and diaphragm. Used traditionally to relieve side aches from too much running, and to relieve hiccups, belching, and snoring.

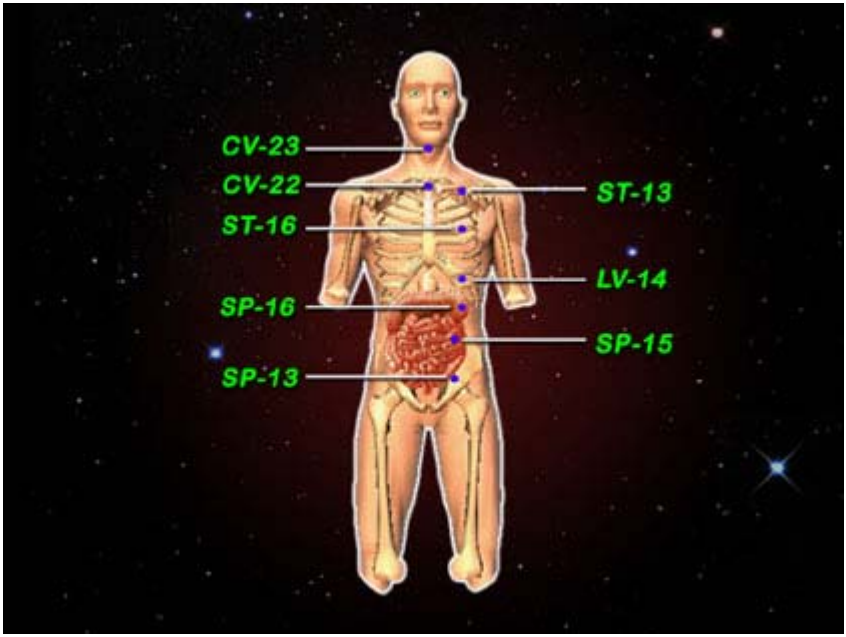

Fig. 7 *LV-14 (Liver Meridian)*

6. **SP-16 (Spleen Meridian)**

Traditional Name: Fu Ai = Abdominal Sorrow

Location: Below the bottom edge of the rib cage in direct line with the nipple. For women, it is in line with ST-13 under the collarbone, and just beneath the rib cage from LV-14 at the edge of the bottom rib. For men, it is in line with ST-13 and ST-16, just beneath the rib cage.

Uses: Can relieve abdominal pain, constipation, dysentery.

7. **SP-15 (Spleen Meridian)**

Traditional Name: Da Heng = Big Horizontal

Location: To the sides of the navel in direct line with the nipple.

Uses: Can relieve nervousness, dysentery, constipation, excessive sweating, diarrhea, abdominal pain, intestinal paralysis.

8. **SP-13 (Spleen Meridian)**

Traditional Name: Fu She = Palace Dwelling

Location: Two fingers' width above the middle of the groin. Hold this point firmly without excessive pressure; it may feel ticklish.

Uses: Can relieve abdominal pain and tension, colic pain, appendicitis, constipation. Good energy flow through SP-13 relaxes the abdominal region, groin, thigh and sexual organs; it relieves menstrual cramps, indigestion, and intestinal weakness.

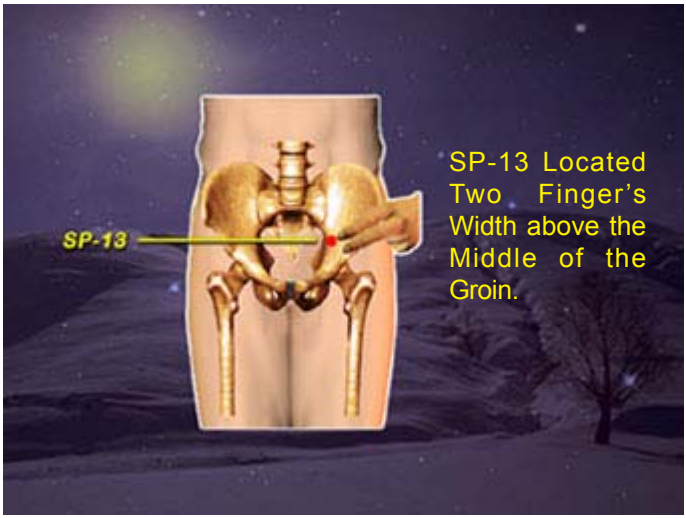

Fig. 8 *SP-13 (Spleen Meridian)*

9. **SP-10 (Spleen Meridian)**

Traditional Name: Hseuh Hai = Sea of Blood

Location: Three fingers' width above the knee on the inside of the thigh. Place the left palm on the kneecap, fingers pointing to the inside of the knee. Press down on the inside with the thumb. The point is sensitive to pressure.

Uses: Can relieve abnormal menstrual flow and cramps, uterine bleeding, rashes, indigestion. Good energy flow through SP-10 promotes smooth functioning of the female organs. This point also releases the flow of energy through the thighs and knees.

10. **SP-9 (Spleen Meridian)**

Traditional Name: Yin Lin Chuan = Dark Tomb Spring

Location: On the inside of the leg below the top of the tibia bone (the large bone of the leg.) The point is very tender.

Uses: Can relieve abdominal pain and distension, excessive menstrual flow, menstrual pain, lower back pain, swelling. Unrestricted energy flow through SP-9 increases the flow of energy through the knees and legs.

Fig. 9 *SP-9 (Spleen Meridian)*

11. **K-6 (Kidney Meridian)**

Traditional Name: Chao Hai = Shining Sea

Location: One finger's width below the inner ankle. The point is sensitive to pressure.

Uses: Can relieve mental disorders, insomnia, tonsillitis, menstrual disorders, epilepsy, sadness. This point helps balance the Yin aspect of the Great Bridge Channel. When good energy flows through K-6, problems in the female sexual organs and the kidneys will be reduced. Also, a deep refreshing sleep is encouraged by pressing this point.

12. **SP-4 (Spleen Meridian)**

Traditional Name: Kung Sun = Grandson

Location: On the bottom of the foot, in a hollow behind the joint of the big toe. The point is sensitive to pressure.

Uses: Can relieve heart pain, stomach pain, epilepsy, vomiting, diarrhea, paralysis of the big toe and foot, cold feet, foot cramps, abdominal tension. This point helps balance the Yin aspect of the Great Regulator Channel. When energy flows well through SP-4, the body energy is balanced.

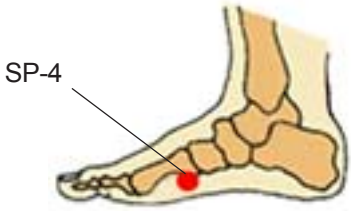

Fig. 10 *SP-4 (Spleen Meridian)*

13. **K-1 (Kidney Meridian)**

Traditional Name: Yong Quan = Bubbling Spring

Location: At the center of the ball of the foot when curling the toes in at the hollow; a sensitive spot.

Uses: Can help to calm the spirit; It opens the senses. Connects the earth energy to the perineum

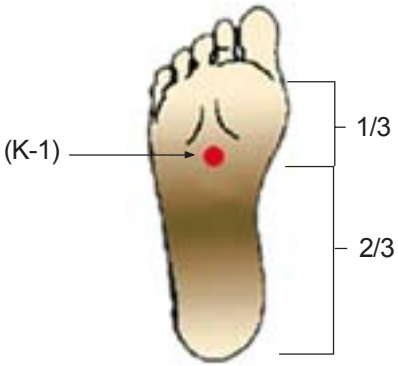

Fig. 11 *K-1 (Kidney Meridian)*

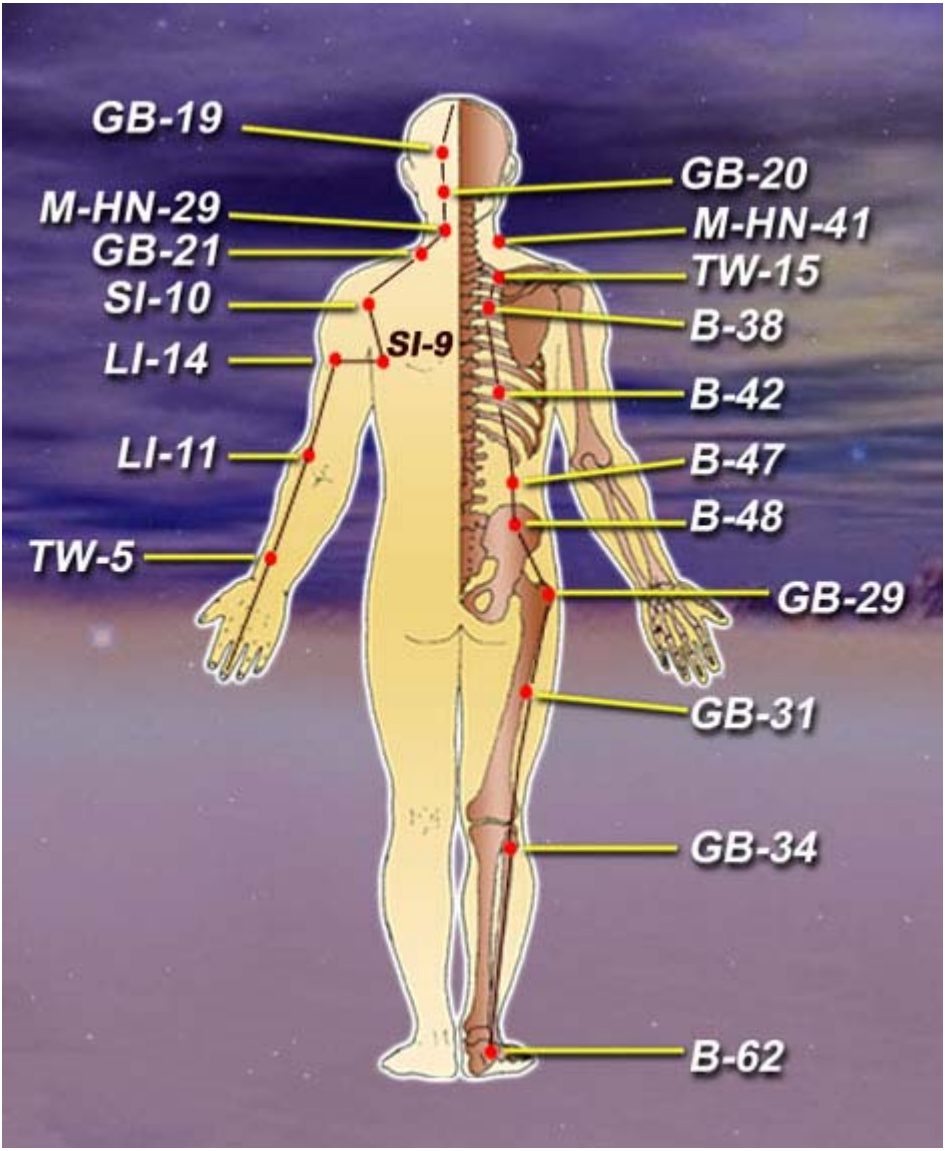

Fig. 12 *Yang Side*

C. Locate GB-41 and SI-9

The Entire Back (Yang) Route of the Channel.

1. **GB-41 (Gall Bladder Meridian)**

Traditional Name: Lin Chi = Attending the Crying Child

Location: Facing the outside of the foot at the joint, in the upper space between the fourth and little toe.

Uses: Can help to relieve arthritis, inflammation of the breast, hearing problems, ringing in the ears, irregular menstruation, insufficient breast milk, headaches, rheumatism, perspiration problems, excessive water retention. This point helps balance the Yang aspects of the Great Regulator Channel and the Belt Channels.

Fig. 13 *GB-41 (Gall Bladder Meridian)*

2. **B-62 (Bladder Meridian)**

Traditional Name: Shenmai

Location: On the outside of the ankle, in the small depression just under and slightly behind the ankle bone. Press straight into the side of the foot.

Uses: Can relieve headache, mental confusion, epilepsy, dizziness, insomnia, backache, aching of the lower extremities.

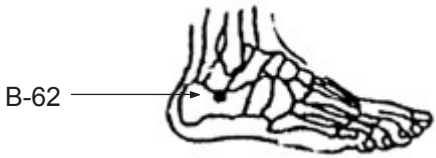

Fig. 14 *B-62 (Bladder Meridian)*

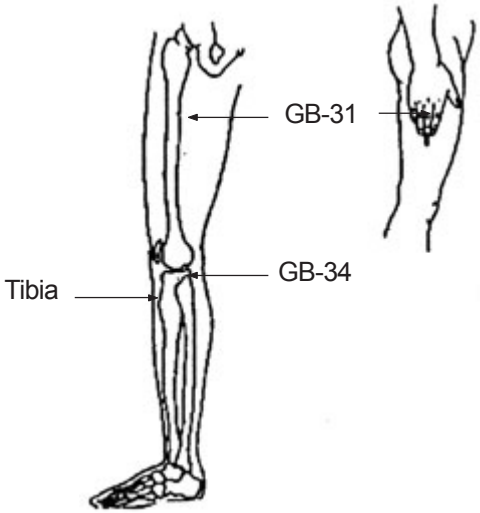

Fig. 15 *GB-31 (Gall Bladder Meridian)*

3. **GB-34 (Gall Bladder Meridian)**

Traditional Name: Yang Ling Chuan = Life Tomb Spring

Location: On the outside of the leg, in a hollow below the top of the fibula (slender, lower leg bone.)

Uses: Can relieve rheumatism in the knees, weakness of the legs, pain or paralysis of the leg, soreness after exercise, headaches, abdominal problems, constipation, lower back tension, and extreme fright.

4. **GB-31 (Gall Bladder Meridian)**

Traditional Name: Feng Shih = Windy City

Location: Standing upright with the hands at the sides, the point is located behind the femur (thigh bone) where the middle finger touches the leg. The point is very sensitive to pressure.

Uses: Can relieve paralysis of the legs, knee joint pain. Energy flowing through GB-31 encourages good energy flow to the knees, legs, hips and back points.

5. GB-29 (Gall Bladder Meridian)

Traditional Name: Chu Liao = Dwelling Bone

Location: At the joint of the top of the femur bone and the hip.

Uses: Can relieve diseases of the hip joint and surroundings, lower leg pain.

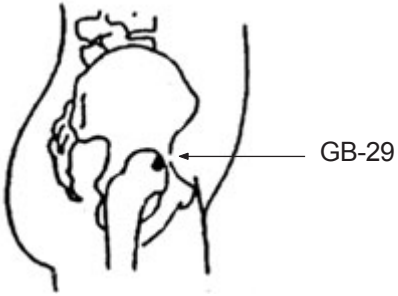

Fig. 16 *GB-29 (Gall Bladder Meridian)*

6. **B-48 (Bladder Meridian)**

Traditional Name: Pai Huang = Round Tissue below the Diaphragm, Uterus, or Placenta

Location: Two fingers' width from the top of the sacrum. The point feels sore.

Uses: Can relieve the pelvic area, abdominal problems, constipation, hemorrhoids, prostate gland and urinary problems.

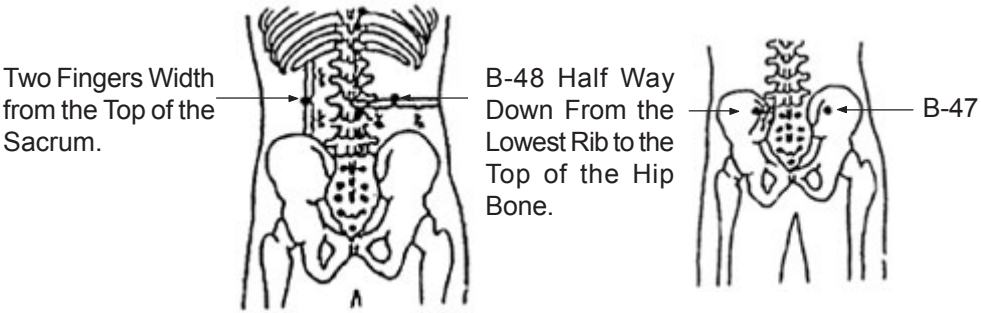

Fig. 17 *B-48 (Bladder Meridian)*

7. **B-47 (Bladder Meridian)**

Traditional Name: Chi Shih = Room of Resolution

Location: On the back, halfway down from the lowest rib to the top of the hip bone, and halfway between the spine and the side of the body.

Uses: Can relieve abdominal problems, appetite balance, genital problems, prostate, urinary, and kidney problems. Good energy flow through B-47 strengthens the lower abdomen and releases energy flow to the lower back.

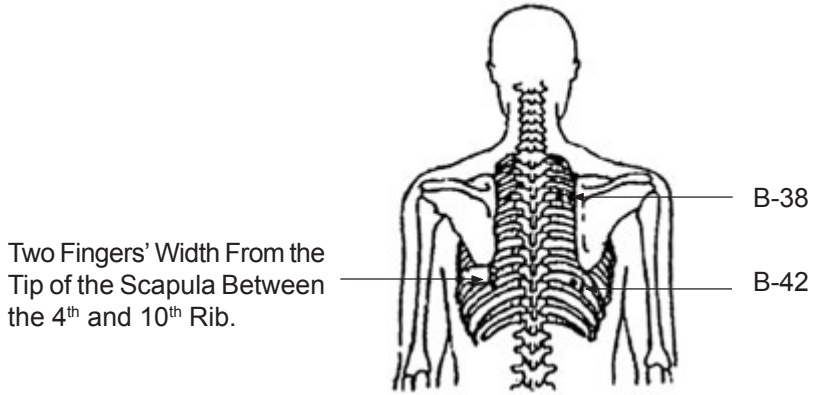

Fig. 18 *B-47 (Bladder Meridian)*

8. **B-42 (Bladder Meridian)**

Traditional Name: Hun Men = Gate of the Soul

Location: On the back, between the ninth and tenth rib, and about two fingers' width below the bottom tip of the scapula.

Uses: Can relieve stomach pain, liver problems, fullness in the chest, poor digestion, fainting. Pressing this point releases the back and affects the diaphragm.

9. **B-38 (Bladder Meridian)**

Traditional Name: Kao Huang = Fat Tissue between Heart and Diaphragm

Location: On the back, between the fourth and fifth rib, between the spine and the left scapula. The point feels like a knot of muscular tension and is sensitive to pressure.

Uses: Can relieve circulation and lung problems, releases the neck, upper back and arms, respiratory difficulties, coughing, hyperactivity, fatigue. Pressing this point strengthens the entire body. This is a very important point and can be used to treat many diseases.

10. **TW-15 (NTB-15) (Triple Warmer (Burner) Meridian)**

Traditional Name: Tian Liao = Heaven's Seam

Location: Above the shoulder blade, toward the side of the neck.

Uses: Can relieve pain in the scapula, back, neck, and the pain of fever.

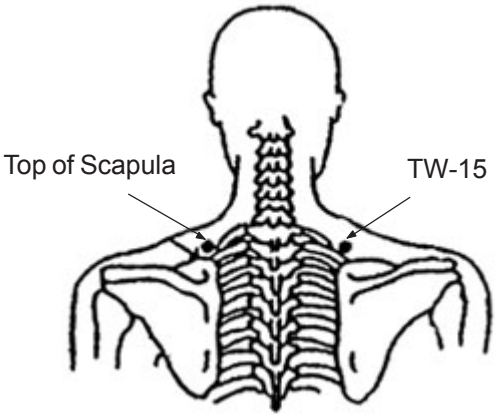

Fig. 19 *TW-15 (NTB-15) (Triple Warmer (Burner) Meridian)*

11. **SI-10 (Small Intestine Meridian)**

Traditional Name: Scapulae's Hollows

Location: On the back, on the scapula directly above the armpit and joint.

Uses: Can relieve chills, fevers, inability to move the arm, soreness of the arm, hypertension, shoulder pain.

12. **SI-9 (Small Intestine Meridian)**

Traditional Name: Jian Zhen = Shoulder Chastity

Location: On the back, just above the armpit.

Uses: Can relieve shoulder problems, paralysis of the upper limbs, excessive perspiration in the armpits, pain in the shoulder blades, toothaches, deafness, swelling of the joints.

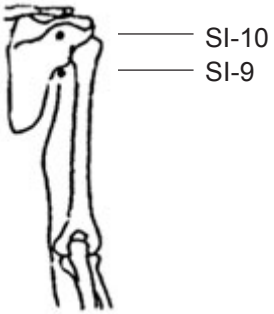

Fig. 20 *SI-9 (Small Intestine Meridian)*

D. Locate LI-14 and TW-5

The Yang Arm Route of the Channel.

1. **LI-14 (Large Intestine Meridian)**

Traditional Name: Binao = Arm and Scapula

Location: On the upper arm, above the midpoint between the shoulder and elbow.

Uses: Can help clear vision, and relieve arm and shoulder, eye problems.

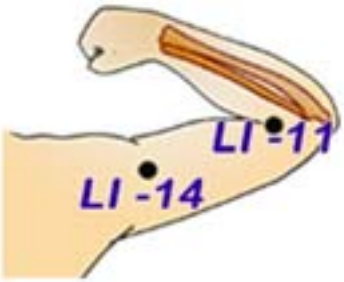

Fig. 21 *LI-14 (Large Intestine Meridian)*

2. **LI-11 (Large Intestine Meridian)**

Traditional Name: Quchi = Crooked Pool

Location: At the front of the arm in the inner crease where the forearm joins the upper arm.

Uses: Can cool heat; can relieve arthritic pain in the arms, paralysis, hypertension, high fever, anemia, allergies, skin problems.

3. **TW-5 (Triple Warmer Meridian)**

Traditional Name: Waijuan = Outer Gate

Location: Two fingers' width above the wrist on the outside of the arm.

Uses: Helps to circulate stagnant Chi; can relieve common colds, high fevers, pneumonia, deafness, insomnia, headache, stiff neck, paralysis.

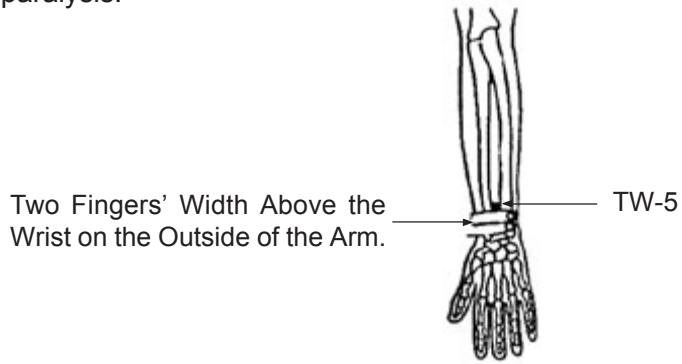

Fig. 22 *TW-5 (Triple Warmer Meridian)*

E. Locate P-8 and L-1

The Yin Arm Route of the Channel.

1. **P-8 (Pericardium Meridian)**

Traditional Name: Laogons = Gakor's Palace

Location: At the center of the palm.

Uses: Can cool the heart and drain heat, relieving heat exhaustion and chest pains.

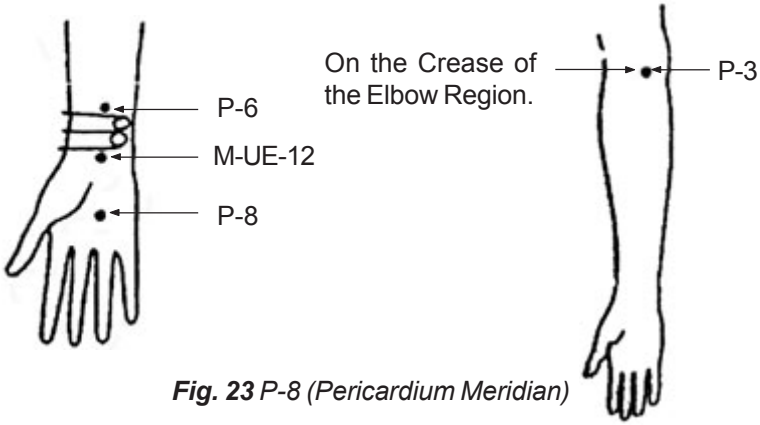

Fig. 23 *P-8 (Pericardium Meridian)*

2. **M-UE-12 (Miscellaneous Point)**
Traditional Name: Nei Yangchi = Inner Yang's Pool
Location: At the center of the inner crease of the wrist.
Uses: Can relieve paralysis, infantile convulsions.

3. **P-6 (Pericardium Meridian)**
Traditional Name: Nei Guan = Inner Gate.
Location: Two fingers' width above the inner wrist.
Uses: Can calm the heart and spirit and regulate Chi; can relieve rheumatic heart disease, vomiting, chest pain, stomach ache.

4. **P-3 (Pericardium Meridian)**
Traditional Name: Quze = Crooked Marsu
Location: On the middle of the crease of the inner elbow.
Uses: Can open heart Chi, and disperse heat; can regulate the intestines, gastrointestinal problems, bronchitis, heat exhaustion.

5. **P-2 (Pericardium Meridian)**
Traditional Name: Tianjuan = Heaven's Spring
Location: Next to the armpit in the front of the arm, within the biceps muscles.
Uses: Can relieve cough, palpitations, chest pain.

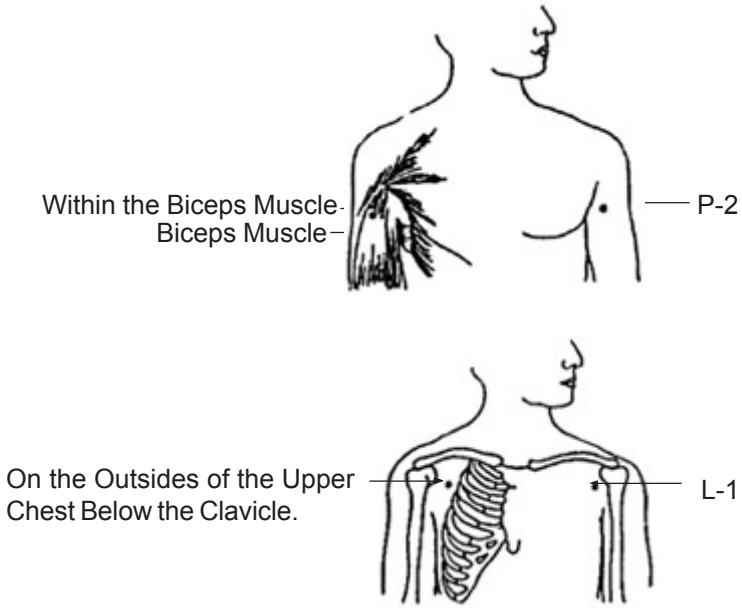

Fig. 24 *P-2 (Pericardium Meridian)*

6. **L-1 (Lung Meridian)**

Traditional Name: Zhong Fu = Central Radiance

Location: On the outside of the upper chest, below the clavicle.

Uses: Can relieve bronchitis, pneumonia, asthma, tuberculosis, coughing, blocked throat, congested nose.

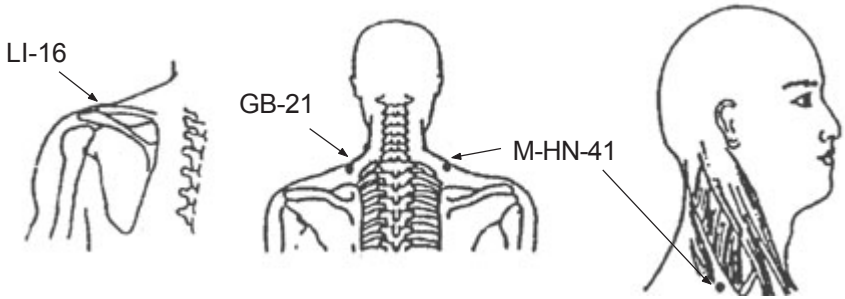

Fig. 25 *L-1 (Lung Meridian)*

F. Locate LI-16 and GB-20

The Last Part of the Yang Back Channel.

1. **LI-16 (Large Intestine Meridian)**
Traditional Name: Fusu = Crest Bare
Location: In a hollow of the shoulder at the end of the clavicle.
Uses: Can relieve shoulder problems, disperse blood congestion, convulsions, neck problems.

2. **GB-21 (Gall Bladder Meridian)**
Traditional Name: Tian Jing = Shoulder Well
Location: On the shoulder, in a hollow of the collarbone near the neck.
Uses: Can relieve uterine bleeding, back pain and shoulder pain.

3. **M-HN-41 (Miscellaneous Point)**
Traditional Name: Jingbi = Neck and Arm
Location: On the side of the neck, above the clavicle.
Uses: Can relieve numbness in the arm; paralysis of upper limbs.

4. **M-HN-29 (Muscle Point)**
Traditional Name: Xinshi = New Recognition
Location: On the back of the neck between the third and fourth cervical vertebrae.
Uses: Can relieve stiff neck, headaches, sore throat.

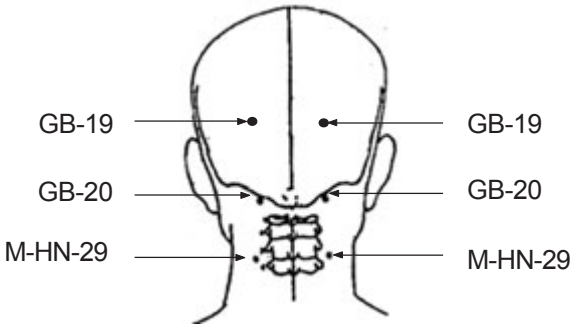

Fig. 26 *M-HN-29 (Muscle Point)*

5. **GB-20 (Gall Bladder Meridian)**

Traditional Name: Fenschi = Pool of Wind

Location: On the back of the neck in the hollow at the base of the

Uses: Can help a hot wind condition; can improve hearing and vision; can relieve the common cold, headache, stiff neck, hypertension, sinusitis, red eyes, deafness, insomnia.

Locate and become familiar with the points and proceed then with the next procedure.

3. Practice of Opening of the Great Bridge and Great Regulator Channels

We will open the channels in two ways:

A. Concentrate on the Flow of (Energy in) the Channel(s)

The most important thing is that you will feel the flow of (energy in) the channels. Therefore just go along the Channels with your hands and mind and be aware of the Channels and the flow of energy.

Start at the top (GB-17) and go over the face and down in a straight line, along the front of the body and the inside of the legs to the K-1 (Bubbling Spring). Then go up, on the outside of the legs, hips and spine to the shoulder and down to the armpits (SI-9). Next go with the right hand over the outside of the left arm and back on the inside of the left arm to LI-16 on the shoulder. We continue with the left hand from SI-9 over the outside of the right arm and back on the inside of the right arm to LI-14 on the shoulder From there we continue with both hand along the neck to GB-20 back to CB-17. Touch lightly each point and use your mind/eyes, when you go down and up along the Channel in this way. You can repeat a few times until you really are aware of the Channel and feel the flow of energy.

B. Open the Channel(s) More Specific by Individually Opening and Connecting each Point along the Channel

a. Open and connect the points GB-17 to ST-4 on both sides of this part of the Channel.

Preparation:

1. Sit or stand up, and smile down.

2. Practice quickly Fusion of the Five Elements, reactivate the pakuas, the facial and universal pakua as well. Spiral the pakuas and draw all the energies also of the organs, the senses and the mind to the big space, the cauldron in your Tan Tien. Balance the emotional energies in the organs as taught in Formula III and let the Compassion Energy grow with the creation cycle of Cosmic Fusion.

Spiral and condense the energies in the cauldron to form a shining pearl.

3. Move the pearl down to the perineum and circulate the energy a few rounds in the Microcosmic. Let the pearl absorb forces of the Earth, the Cosmic Particles and the Universe. Move the pearl down to the perineum again.

4. At the perineum use the pearl to clear the Left, Middle, and Right Thrusting Channel. Move the pearl up and down through all three Thrusting Channels to the crown, in the following way.

- Hold your left arm, with your fingers pointing down to the earth, along your side. Inhale, close your right nostril and pull up your left anus and suck the energy up through the left Thrusting Channel. Exhale and let all the toxic and sick energy flow through the channel down into the earth.

- Close both nostrils, pull up the middle part of the anus and suck the energy up through the middle Thrusting Channel. Exhale, bring your right hand along your side, keep the left nostril closed, and let all the toxic and sick energy flow through the middle Thrusting channel into the earth.

- Keep the left nostril closed, and the right arm hanging down. Inhale, pull up the right side of the anus and suck the energy up

through the right Thrusting Channel. Exhale and let all the toxic and sick energy flow down through this right channel into the earth.

- Repeat the procedure for the middle thrusting channel (when you exhale down, keep your right nostril closed and your left arm hanging down), the left Thrusting Channel, the middle Thrusting Channel (exhale down on the right side), the right Thrusting Channel, the Middle Thrusting Channel (exhale down in the left side) and the left thrusting Channel.

- Rest and feel the three Thrusting Channels and all the organs, they penetrate, open and clean. With your mind/eyes you can still let the energy flow up and down in the three channels. All the routes and clean the Thrusting Channels.

Practice:

1. Then move the pearl through the Left and Right Thrusting Channel to point GB-16 on both side of the Pai Hui, at the top of the head. Use your right and left's hand middle finger to press on the center of the crown through which the Middle Thrusting Channel runs. Now move this fingers to a point about one and a half inches to the left and right of the crown, and press on this point, GB-16. The points GB-16 will feel painful when pressed. Release; press again, then rest. Concentrate on and feel this point.

Note: It is not necessary to find the exact location of each point. The points are quite large. When you use three fingers to cover the point(s), you will find it/them by feeling the spot(s) where the energy is most condensed, recognizable by the strongest pulsation.

2. With the middle fingers of each hand remain on GB-16, place the index fingers about one inch away from the middle fingers on GB-17, and the fourth fingers to a point about one inch away from the middle fingers on GB-15. Press and release all three points a few times simultaneously. All three points will feel painful when pressed. Then continue to use all three fingers to press them lightly until you feel a pulsation at the fingertips.

3. Continue to press the fingers on these points. Then, using the index, middle, and fourth fingers together, gently press on point GB-

14 on both sides, in the middle of the forehead over the left and right eye. When you feel the points, mentally move the energy down from the crown to the forehead. Feel the energy flowing. The energy will flow quite easily through this point, perhaps it will be a little bit painful. Continue to press here until you feel again a pulsation at the fingertips. If you feel tense and worried, GB-14 is usually blocked. Wrinkle the brow as you do when you are tense, and hold GB-14 on both sides to stimulate the energy flow. Stiffness in the neck and face, which is the product of overall tension, can be relieved by restoring proper flow to the area of GB-14. In addition, since this point is strongly related to consciousness, good energy flow through GB-14 will calm the spirit and brighten vision.

4. Move the three fingers of both hands down to press on ST-2 on both sides of the cheekbone in line with the pupil and GB-14. Feel the energy flow in a line from the top of the head down the forehead, through the eyes to the cheekbone points, ST-2. You may feel a pain in the cheekbone area.

5. Move the same fingers to the point at the corners of the mouth, ST-4. Press ST-4 in and slightly upward. This point is also tender upon pressure. You may feel pain from pressing this point manifesting in the teeth. Run the energy again from the crown through the points to the corners of the mouth.

6. Now release both hands from the points they have been pressing. Clasp them together in the holding position of meditation, and mentally run the left route from the top of the head points, GB-17, GB-16, and GB-15, down to ST-4.

7. Rest. Let the energy flow by itself.

b. Open and connect the points ST-4 to SP-4 along the entire front route on both sides.

1. If you start fresh, repeat the steps of A. Otherwise you just proceed to the next points of this route.

2. Keep your fingers on ST-4 in the corners of your mouth and move the energy down to CV-23. Use the left or right thumb to press

CV-23, under the chin. Press upward toward the tongue, and feel the energy flow down to this point. As the energy flows, you may feel a pulse or electricity in the hand.

3. Use the left or right thumb to press down on the top of the sternum toward the chest. Rest, and then use the left index, middle, and fourth fingers to press lightly on the CV-22 point above the sternum. Move the energy to this point, and relax for a while.

As you relax, use the mind to connect these points (CV-23 and CC-22) with the previous points.

4. Move the index, middle, and fourth fingers of each hand from the three points at the top of the head to point ST-13 under the collarbone. Then, move the left and right index, middle, and fourth fingers to just above the nipple at ST-16. Trace the energy flow from the crown down to the forehead, cheekbone, comer of the mouth, CV-23, CV-22 above the sternum, to ST-13 under the collarbone (ST-13), and to ST-16 just above the nipple.

5. Continue to keep the right and left fingers on ST-13. Move the left and right hand down straight in line with the nipple and middle of the collarbone to LV-14 between ribs eight and nine. Feel the energy flow inside your body. Massage, release, and press again until you feel a pulse at this point indicating that the energy has traveled this far. Move the left and right fingers to just beneath the rib cage in line with the nipple to SP-16. Move the energy to the point.

6. Move the left and right fingers to SP-15 at both sides of the navel and to SP-13 at the groin area above the leg bone and in line with the above points. Feel the energy connection and movement.

7. Move the left and right fingers to SP-10 on the inside and just above the knee, Feel the connection. Then, move with the fingers to SP-9 just below the knee, and connect it with the flow of the energy from the above points.

8. Move the left and right fingers to K-6 one finger's width below the inner ankle. Feel the connection. Then, move the left and right hand to SP-4 on the inside of the feet in a hollow just behind the ball of the feet. The energy may pulsate at this point as it connects to the above points.

9. Then move the left and right hand to K-1 (Bubbling Spring) at the center of the ball of the feet.

10. Now, clasp your hands, and put them on your lap in the meditation position. Mentally trace the energy flow from the top of the head to soles of your feet.

11. Slowly open your eyes. You should feel peaceful as the energy connects.

c. Open and connect all the points K-1 to SI-9 along the entire Yang (back) route of the channel.

1. When you start fresh, continue the above procedure all the way down to K-1. If not, just continue.

2. As above, put first the right and left hand on GB-17, GB-16, and GB-15.

Begin to run the route again down to ST-13.

3. Place the three fingers on ST-13 under the collarbone on both sides as before, and continue to hold this point with those fingers as you proceed with the three fingers to press and connect each succeeding point. Run the route in this manner down through ST-16, down the front, left side .of the body to K-1 and GB-41.

4. Continue to follow the route upward in one straight line at the outside of the ankles and legs along B-62, GB-34, GB-31 over the hip GB-29 to B-48 on the back, a little above the top of the sacrum.

5. Then, move the right and left three fingers to the back to the points B-47, B-42, and B-38, all the way up to TW-15 at the top corner of the scapula.

6. Now, move the right and left three fingers to the points SI-10 and SI-9, above and just above the armpits.

7. Now, clasp your hands, and put them on your lap in the medication position. Mentally trace the energy flow from the top of the head to soles of your feet and up to SI-9 just above the armpits.

8. Slowly open your eyes. You should feel peaceful as the energy connects.

d. Open and link together the points LI-14 and TW-5 of the Yang armroute of the left arm.

1. Use the three fingers of your right hand to move down to points LI-14 and LI-11 on the arm, and TW-5, above the outer wrist.
2. Rest, close your eyes and feel the flow of energy.

e. Open and connect the points P-8 - L-1 of the Yin armroute of the left arm.

1. Then move the right three fingers down and over the middle finger to point P-8 on the palm.
2. Next, move the right three fingers up along the inside (Yin) side of the left arm to join the points which are running down the Yang (outer side) of the left arm to the points M-UE-12, P-6, P-3, P-2 and L-1.
3. Rest, close your eyes and feel the flow of energy along the points the Yang and Yin route of your left arm.

f. Repeat step d and e on your right arm to open the points of the Yin and Yang part of the Channels on this arm.

g. Open and connect the points LI-16 to GB-20 on both sides of the last part of the Yang route of the Channel.

a. Move with the fingers of both hands from L-2 to LI-16 on top of the shoulders.

b. Move from there to GB-21, M-HN-41, M-HN-29 to GB-20 at the base of the skull.

c. Put the hands together in the meditation position, mentally move energy through the whole left and right sides of the Great Bridge and Great Regulator Channels. Run both sides of the Channel together by simply using the mind to direct the energy from point to point.

d. Collect the energy at the cauldron, and finish with Chi Massage.

Daily Practice

Quick Morning Checkup of the Eight Psychic Channels

1. Smile down, quickly form the pearl, and bring it down to the perineum. Practice six rounds of the Microcosmic Orbit.

2. Return to the perineum and clear the three Thrusting Channels, including the leg routes with the procedure described in Cosmic Fusion and on page 24 of this handbook.

3. Women, guide the energy into the earth, absorb the energy and spiral it clockwise and then counterclockwise. Start the Belt Channel up to and above the crown. Absorb the heavenly force. Continue spiraling counterclockwise and then reverse the direction and spiral the Belt Channel down to the earth again and back to the feet. Men, guide the energy above the crown. Spiral counterclockwise and absorb the Heavenly force. Spiral then clockwise and circle the Belt Channel down into the earth. Spiral clockwise and absorb the earth force. Reverse the direction and spiral counterclockwise the Belt Channel up to the Crown and then down to the earth again in a clockwise direction, back to the feet.

4. Men and Women split the energy (pearl) at the feet and start the flow of the energy through the Great Bridge and Regulator Channels from the inside of the left and right the foot (SP-4) and run the Channel along the inside of the legs, the groins, the front side of the body up to GB-14. Continue up, over the head, passing GB-15, GB-16, GB-17 down to LI-16. When you go up on the inside of the legs and the front side of the body, you will feel feel the energy flow along the outside of the legs (Most of the Yin and Yang points are located just opposite each other) and the back of the body at the same time. From LI-16 you go to L-1 and then, along the inside of the arms, P8 and from there you go over TW-5 up on the outside of the arms to join again at LI-16. From there you go up to the crown (GB-16) again.

5. Rest. Guide the energy with your mind/eyes through all the eight Channels.

6. Rest and bring the energy and your attention back to the cauldron in your Tan Tien. Gather and blend all the energy. Turn your senses and mind inward. Empty the mind in the Tan Tien and do nothing.

7. Collect the energy and end with a soft Chi Self Massage.

Protection of the Spinal Cord

1. Spinal Cord Microcosmic Orbit: Supplemental Belt Channel

This practice serves to strengthen the spine and protect it, and it is also important in the higher practice to wrap the spine with energy for its maintenance during trips to the midplane.

A. Practice Fusion, and then run the Microcosmic. Bring the pearl into the sacrum, and run it up the inner side of the back of the spinal cord to the brain. Wrap the energy around the frontal lobe and inside the skull. Return it down the inner side of the front of the spinal cord, and wrap it around the whole length of the spine.

B. Bring the pearl down to the coccyx and through it, and then up the outer side of the back of the spinal cord to the outside of the head. Wrap it around the frontal lobe and bring the pearl down along the outer side of the front of the spinal cord and return it to the coccyx.

C. Wrap the pearl around the coccyx. Wrap it around the outside of the spinal cord all the way up to the brain and the frontal lobe of the brain. Wrap the pearl around the skull, and then wrap it down the inside of the spinal cord to the coccyx.

D. Rest and do, with the mind/eye, the Spinal Cord Microcosmic Orbit for a few times.

2. Spinal Cord Cutting from the Throat Center

A. If you start fresh, always start with Fusion of the Five Elements to form the pearl, and circulate it in the Microcosmic Orbit for a few rounds.

B. Stop the pearl at the throat center at the top of the sternum. Inhale, exhale, and project the pearl out from the throat, and around the outside of the head toward the back to cut through C-7. Cut through and cut down through each of the cervical, thoracic, and lumbar vertebrae, down to the sacrum and coccyx.

C. Finish by bringing the pearl back into the throat.

Fig. 27 *Spinal Cord Cutting and from the Throat Center*

3. Protection of the Spine, Organs and Glands Cutting from the Third Eyes

A. Begin at the mideyebrow, and use the pearl to cut either clockwise or counterclockwise through the neck, the thoracic, and lumbar vertebrae. Cut until the whole body has been cut, including all the organs and glands. Return the pearl to the mideyebrow. The spine is now completely wrapped with energy.

B. When finished, bring the energy back down from the mideyebrow to the navel to collect it there.

Butterfly Protection of your Body

Cutting with Energy.

1. Start at ST-16 just above the nipples. (This point is slightly higher on women than on men.)

Fig. 28 *Spiral Energy From ST-16 Just Above the Nipple, Increase the Spirals on the they Encompass the Body.*

2. The pearl spirals in line with the body from ST-16. As it spirals, it cuts through both sides of the body through the rib cage in outward and downward ares (like the wings of a butterfly), and then cuts back in.

3. The spirals grow larger each time to include the whole body and legs. Eventually the spirals come forward out of the body into the aura.

4. Collect the energy at ST-16.

This exercise is often used in the Martial Arts. Because you are spiraling your energy all around you, your opponent can not find where the center of your energy is and can therefore not “attack” you. We use the Butterfly for the same reason in the higher practices to hide our center of energy so “nobody” can attack us. It is a very good psychic protection.

Cutting the Senses

This is a good way to protect and seal our senses.

A. Begin about half an inch in front of the eyes, spiral the pearl in three figure eight motions from the mideyebrow in the following manner.

Fig. 29 *Cutting the Senses*

1. Spiral the pearl down to the bottom of the left eye, circling it up to the top of the left ear. Then, circle it down the back to the bottom of the left ear, and circle up to the left eyebrow.

2. Circle across the mideyebrow, down to the bottom of the right eye, up to the top of the right ear. Circle around the back of the right ear, up to the right eyebrow, and join the first spiral at the mideyebrow.

3. From the mideyebrow spiral down to the left side of the nose, and down to the right corner of the mouth in a half circle. Spiral under the mouth to the left corner of the mouth, and then cut across to the right side of the nose. Return to the mideyebrow.

B. Collect the energy at the mideyebrow when finished.

Drilling the Head with Energy

This exercise is used to drill our head more open in order to receive the higher frequencies. Drilling the head with energy helps also to clear the brain.

1. Drill with the energy by spiraling the pearl into the head horizontally from points on the forehead to the back of the head, starting from the mideyebrow.

2. Later you can drill with energy all over the face, horizontally and vertically, including from the top of the skull to the neck and chin, until you feel your head clear.

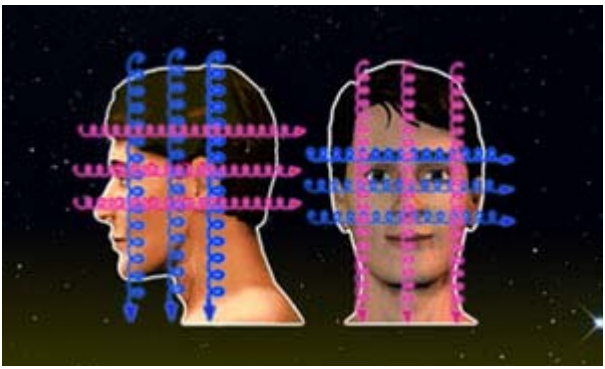

Fig. 30 *Drilling the Head with Energy*

Sealing the Aura

1. This Taoist practice concentrates on containing the aura to preserve energy, and creating a thicker aura to protect the body.

2. Begin at the navel and send a pearl of energy down the front of the leg to the big toe of the right foot. Jump the energy from the big toe of the right foot to the big toe of the left foot.

3. Run a sheet of energy that traces the toes of the left foot and the outside of the left leg. Trace the outer left side of the body to the armpit. Trace the inside of the left arm, thumb and fingers. Trace the outside of the left arm, over the left shoulder, and over the crown.

4. Now trace the outside of the right arm, fingers, and inside of the arm. Trace the right side of the body, down the outside of the leg to the toes. Trace each toe and bring the sheet of energy up the inside of the right leg, around the perineum, to the inner left leg, to the toes, and jump the energy to the right toes again to finish the procedure. Bring the energy up, and collect it. If you wish to continue with this exercise, do not jump the energy back to the right toes.

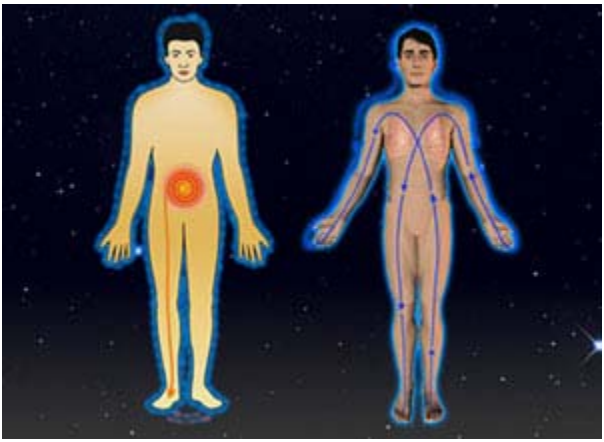

Sealing the Aura: First Part Sealing the Aura: Second Part

Fig. 31 *Sealing the Aura*

5. Trace the front side of the left leg up to the left pelvis. Cross the energy over the solar plexus to the right collarbone, and bring it down the inside of the right arm. Trace the fingers and trace up the outside of the right arm. Wrap the energy over the crown and down the outside of the left arm to the fingers. Trace the inside of the left arm to the left collarbone. Bring the energy down the front side of the body, crossing over the solar plexus again, to the right hip, and then down the front side of the right leg.

6. Bring the energy up the backside of the left leg, and cross over to the T-11 and the right scapula. Trace the inside of the right arm, around the fingers, up the outside of the right arm, over the crown, down the outside of the left arm, up inside of the left arm to the left scapula and across to T-11. Cross over to the right, to the back of the right leg, to end at the toes.

Bring the energy up to the navel, and collect the energy at the cauldron.

7. Rest. Turn your senses and mind inwardly. Empty your mind in the cauldron in your Tan Tien. Feel nice, calm and protected.

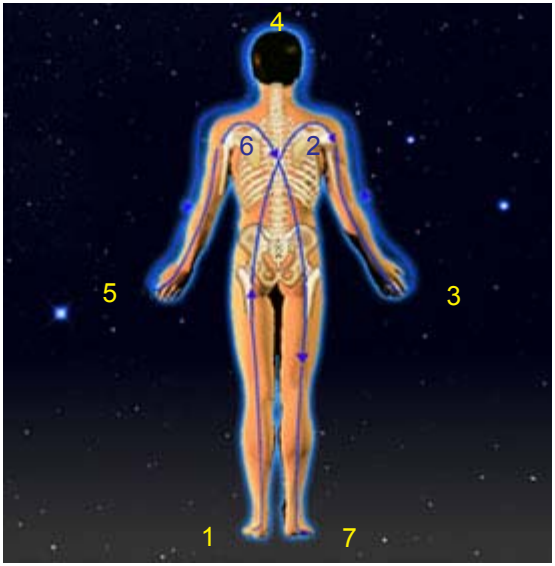

Fig. 32 *Third Part Sealing the Aura.*

Energy Body

Transfer the energy of Microcosmic, Thrusting and Belt Channel from the Physical Body into the Energy Body above. Once you have practiced to this level, you are ready to form the pearl into an energy body.

1. Always do Fusion of the Five Elements to clean out the negative emotions.

2. Condense the pearl and practice the Creation Cycle, Thrusting Channels and Belt Channels.

3. Run the pearl in the Microcosmic, and control its movement with the senses.

4. Move the pearl to the perineum. Inhale in short sips, drawing in ten percent of lungs capacity and pull up the anus. Inhale up to the navel, and inhale up to the heart.

5. Inhale up to the crown. Swallow your saliva (imagine swallowing upward) and exhale forcefully to open the crown and shoot the pearl out.

6. Feel the Universal Force, the forces of the North Star and Big Dipper above your head, and the Cosmic Particle Force in front of you as they shine down to your pearl. Feel your pearl start to absorb this energy, and then feel it expand.

7. Bring your awareness to your feet. Feel the earth energy flow up through your feet, supplying this energy to your body. The pearl continues to expand with all the energy coming to it from outside the physical body.

8. Relax the senses, and form the energy body. Count the years of your age and with each year your energy body is growing. Form the energy body in the way you like.

9. Run the Microcosmic in the physical body. Open the crown, transfer the Microcosmic pathway into the energy body.

10. Form another pearl in the cauldron, and shoot the pearl into the energy body. Circulate the pearl through both Microcosmic Orbits.

11. Move the Thrusting Channels into the energy body.

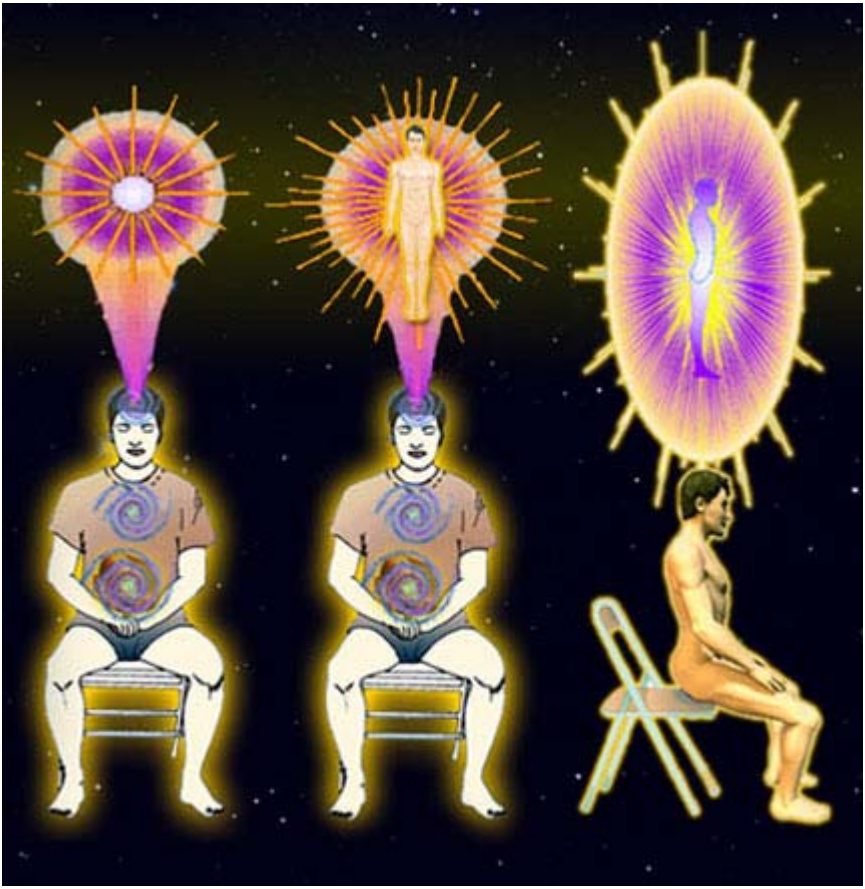

Extend the Microcosmic Orbit.

Extend the Thrusting Channel.

Extend the Belt Routes into the Body Above.

Fig. 33 *Energy Body*

12. Practice all the Belt Channels up through the crown to and around the energy body. Feel the Belt Channel spiral around the physical and the energy body, connecting all the Channels in both bodies and protecting them.

13. Continue to practice until you are in full control of the energy body. Bring your awareness in this body. Just let it very carefully, travel a little bit, still close connected with your physical body (especially with the cauldron in the Tan Tien) and the Earth. Let it collect and absorb the energies of the North Star and Big Dipper, of the planets and the stars.

14. When you are ready, shrink the body to a pearl again. Activate the Cranial Pump. Press your tongue up, clench your teeth, pull back your chin, pull up your anus, and look up to the crown. Feel the beating in your heart and the pulse at your crown.

15. Activate the lead light, and let it shine up from your crown. It may feel like a frequency going out of the crown. Draw the pearl down to the lead light, and land the pearl. Inhale and draw the pearl back into the crown.

16. Move the pearl in the Microcosmic Orbit and nourish the physical body with all the energies the pearl has absorbed. Then bring it down to the navel and to the cauldron at the body's center. Collect, spiral and condense the energy in the cauldron.

17. Sit back. Turn yourself inwardly toward your center. Rest and stay in this energy.

Note: The energy which the pearl/energy body is absorbing, is nourishment for your physical body and especially for your energy and spirit body, which are formed in the practice of the Immortal Tao.

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Fusion of Eight Psychic Channels

Opening and Sealing Psychic Channels

Mantak Chia

Illustrations by Udon Jandee

Fusion of Eight Psychic Channels

Fusion of the Eight Psychic Channels is the last of the three Fusion practices. It teaches you the last techniques and meditation to make you ready and prepared to start the Practice of the Immortal Tao.

In this booklet, you will learn how to open and clean the Great Bridge and Regulator Channels, to protect your spine and energy field, to seal the aura and the senses. You will also learn how to open crown your head. Finally, you will learn to transform the Microcosmic Orbit, the Thrusting Channels and the Belt Channel in the Energy Body.

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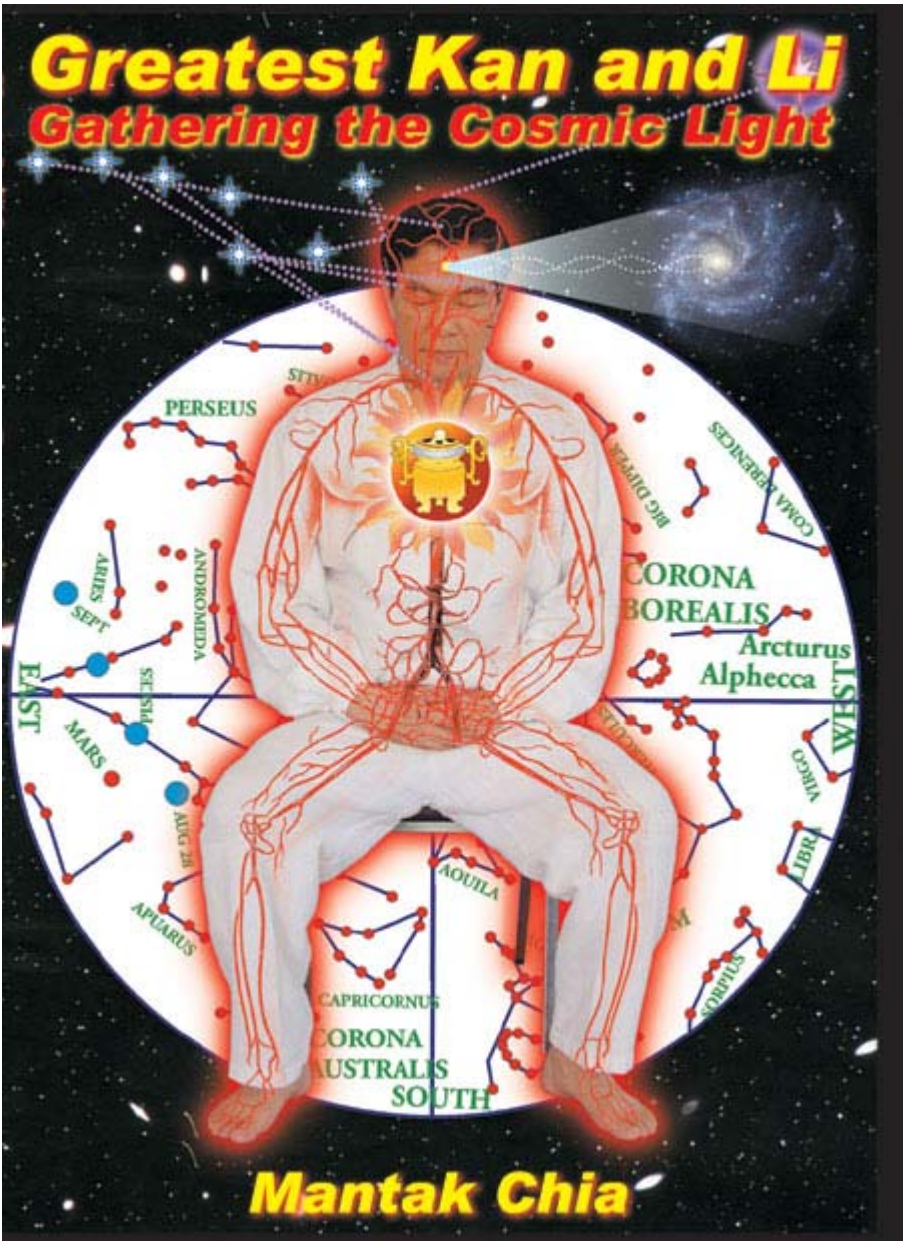
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Mantak Chia

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Introduction

Greatest Kan and Li

Somewhere in the Heavens is the North Star. Looking at the sky at night, one would see it past the top stars of the bowl of the Big Dipper. It lies almost directly above the North Pole, with the Earth angled at 23.5 degrees towards it. To navigators, it appears as a fixed point in the sky, serving as a reliable reference in their travels. It is just one of the myriad stars, rather insignificant and ordinary, but to the Taoists it is the Center, unmoving while all the rest of the constellations revolve around it. It is called by different names—Tian Shu, Tai Yi, the Great One, the Purple Rose, even Zi Gong, the Dwelling Place of the Immortals, because it is believed by the Taoists to be the Gateway to Heaven.

If there is a universe up there, there is one in the body too. To the Chinese, the body is a microcosm of the universe. “As above, so below.” Whatever happens up there happens down here. Hence, the physical body is marked with gridlines of energy and meridians of light around a Center, with different body parts equated with planets and the zodiac. The Center in the body is called Tan Tien, or “field of energy”.

The idea of a Central Axis—the Polestar in the firmament and a Cauldron in the body—is a cardinal tenet in Taoist philosophy and alchemical practice. To get to the Center of the body, open the Tan Tien; to get to the Center of the heavens, enter through the North Star. Both are doorways to the heart of the true Tao, the Wu Chi, from which both Heaven and Earth are born.

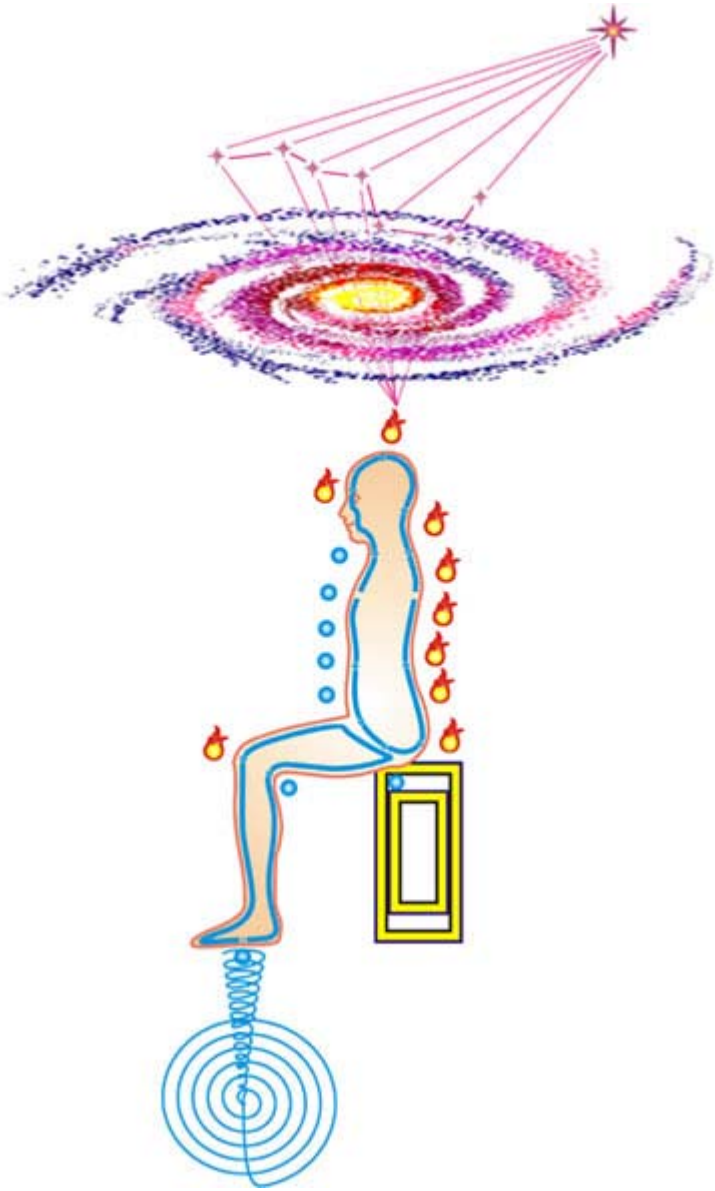

Fig. 1 *Connecting to the Earth and the Polestar by opening the Microcosmic Orbit*

Getting to Heaven and/or achieving immortality without going through countless reincarnations is a vision Taoists cherish. How to get there is a problem they have tried to solve in countless ways through the millennia. One school used external alchemy -- the forging or mixing of metals and elements and herbs to produce some kind of philosopher's stone that transformed mortality into eternal life. Another school relied on internal alchemy --fusion of the body's energies to give birth to a spiritual embryo capable of maturing into a deathless existence and of flight inward, beyond time and space, to the Source.

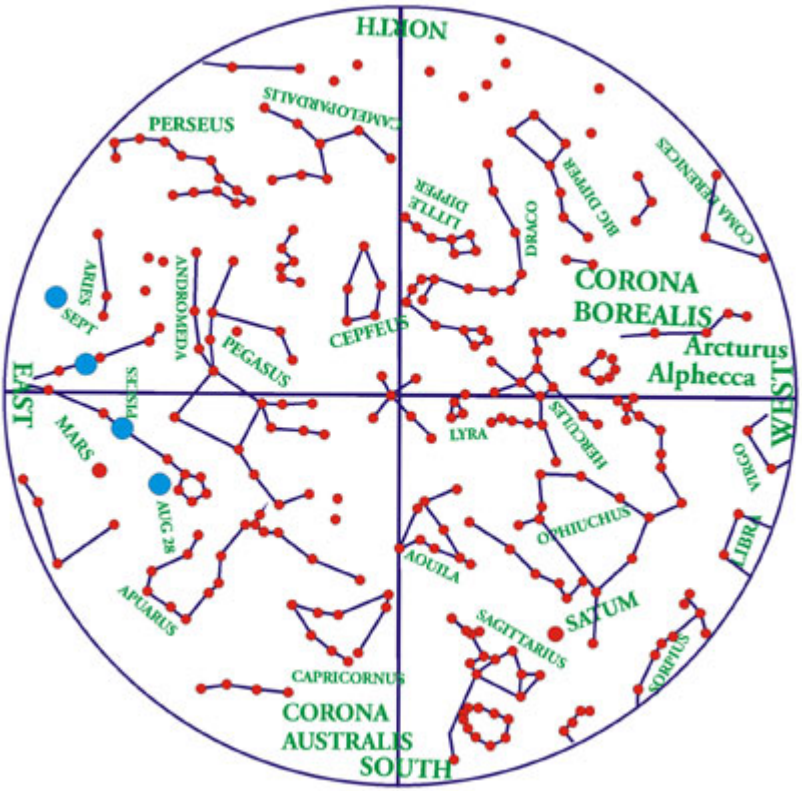

Fig. 2 *Central Axis - the Polestar in the Firmament*

The internal alchemy path relies on a regime of diet, exercise, virtue, and meditation to achieve immortality. To certain practitioners, the goal is possible immortality of the physical body and definitely of the spirit. In short, eternal life here on earth and survival beyond. Others believe that physical immortality is not achievable, so they aim to prolong life to gain time in surviving physical death.

It is not exactly known how the Taoists arrived at the contemplative practices for which they are justly famous, nor how they tracked the energy lines of the body. Whatever means the Taoists used, it is a fact that to them meditation is not just "sitting quietly, doing nothing". It is actively moving the energy through the channels and organs, mixing the energies of the body with the cosmos, giving birth to the Immortal Fetus, and nurturing its growth into the Divine Child within, which matures into a spirit-body that unites one with the Tao.

The Taoist road to that primordial birthplace traverses a difficult and uncertain terrain. It is necessary to prolong life through nutrition, breathing, herbs and exercises to give the adept more time to cultivate the Immortal Pill. Likewise necessary is the rejuvenation of the body through the reversal of the energy flow (as for instance retaining the sexual energy and using it to nourish the organs and endocrine glands), the development of Wu-Wei (non-action) and a serene mind, and a host of other regimens. As important is the calm acceptance of death, for after all, the physical body is only an ephemeral vessel for the earthly transit.

The Taoist adepts do not, of course, end their meditation within the terminus of the physical body, but expand the Immortal Spirit to explore all space both inner and outer. Like the physical self, the Immortal Spirit starts as a fetus, is born and grows slowly into maturity as it is nurtured. Later, it becomes capable of independent existence.

Kan and Li practice points to the Taoist road to spiritual immortality and Taoist internal alchemy. Understandably, there are various versions of how it is done; after all, the Transmissions are shrouded in mysticism and secrecy. Master Mantak Chia is the first Taoist to introduce this spiritual discipline to the Western public.

Through the years, different Universal Tao practitioners have evolved different versions of the formulas. But we all started from the same beginning. Here then, in outline form, is the highest Kan and Li practice as taught by Master Chia of the Universal Tao Center.

Fig. 3 *Necessary is the rejuvenation of the body through the reversal of the energy flow.*

Greatest Kan and Li

Kan and Li literally means Water and Fire. In Taoist alchemy, the meaning of each depends on the level of meditation you are doing. In the formulas, it generally refers to the reversal within the body of hot/fiery and cold/watery energies so that an alchemical transformation can occur.

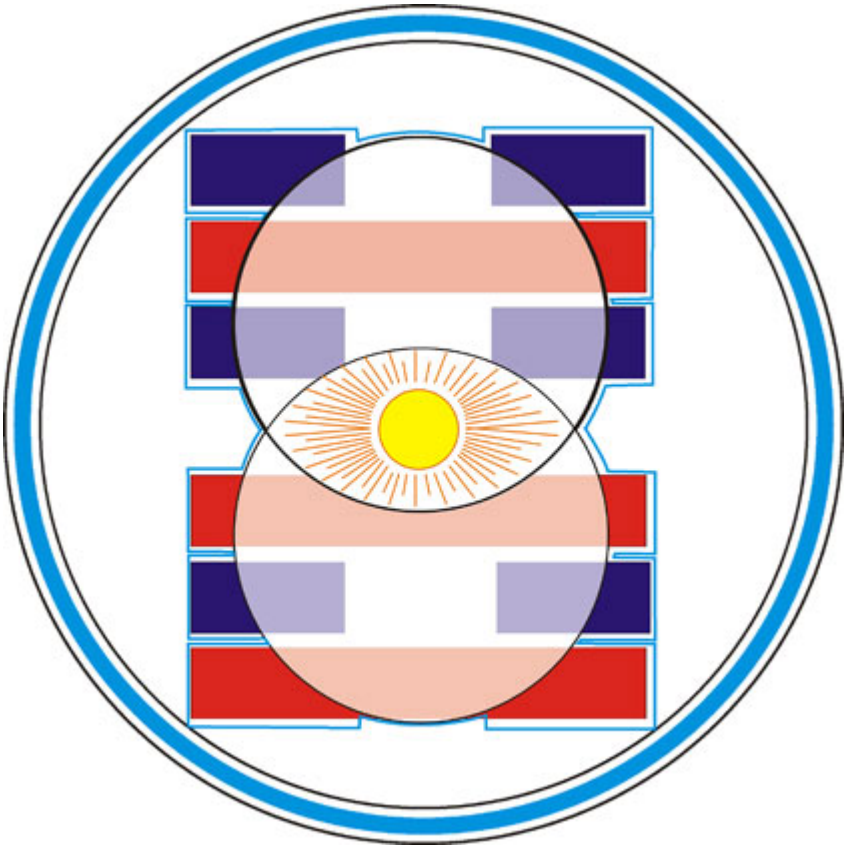

Fig. 4 *Greatest Kan and Li*

Yet Water and Fire are not defined by the physical glands and organs, i.e. kidneys and heart. Nor do they refer to pure Yin and subtle energy.

Water and Fire are the Yin and Yang energies after they have manifested into a particular energy form, and are functioning somewhere between the extreme poles of Earth/matter and Heaven/spirit. We are not tapping into the body as matter, but for the energetic emanations of the physical (Chi, emotions, temper and sexual energy). We reverse and couple Water and Fire in order to dissolve any dualistic energy pattern that limits our spiritual growth.

On our return journey back to the Tao, there are many seemingly fixed patterns of reality that block our progress. As Taoists, we do not struggle or fight with these seemingly impassable obstacles within our body/mind — we simply identify the polarities present, and Dissolve them. This is a necessary step in our return through the 5 Elements and Yin-Yang dialectics to the Uncarved Block, the Undifferentiated Whole, Wu'Chi, the Tao.

Lesser Kan and Li started the reversal of Water and Fire (the Cauldron and Stove) in the lower Tan Tien, between the navel and the Ming-men near the spine. We gathered our Chi to form a special pearl and seeded it with the wood/thunder Chi from the liver, thereby impregnating our soul.

Greater Kan and Li raised the Cauldron to the solar plexus, or Yellow Court. We added more types of Water and Fire energies, both internal and external, to the equation. Our pearl seed was mixed with earth Chi from the spleen, and our spiritual embryo was formed. The steaming process purifies the organs and helps us achieve emptiness; it also softens and clears the Thrusting Channel for our embryo's passage to the Heart.

In Greatest Kan and Li we move the Cauldron up to the heart center, also known as the middle Tan Tien, or Cinnabar Palace. We will again reverse and couple new and more subtle levels of Water and Fire energy. The spiritual embryo is seeded with the third essential alchemical ingredient, Shen, which is our spirit or higher consciousness that resides in the Crystal Palace. If conditions are right, our inner child is born in the heart-womb in a sea of bliss.

Fig. 5 *Greater Kan and Li raised the Cauldron to the solar plexus.*

We also gather the inner light to form the Small Pill or the Great Pill of Immortality, which refer to levels of cosmic consciousness attainable from an expanded heart center as the Holy Spirit descends to impregnate the Cauldron.

We continue to tap into the extra-terrestrial sources of power—the moon, sun, planets, constellations, and especially the Big Dipper and North Star—to fuel our Inner Child's growth towards immortality.

In Greatest Kan and Li, we use Water and Fire to dissolve the ego/mind's arbitrary boundaries between our inner world and outer space. We travel to the farthest reaches of the Universe in order to return to the center of our own Tan Tien.

There are three parts to the practice: A. Basic Formula (Preparation),B. Greatest Kan and Li Proper, and C. Supplementary Practices.

A. Basic Formula (Preparations)

It is often asked, "how do we prepare ourselves for the higher practices?" There is no fixed formula for this, but you are advised to regularly clean your energy field using the basic Fusion meditations. As the energy work becomes very subtle in the Greatest Kan and Li, you must develop and maintain a calm mind and a pure, virtuous energy body in order to receive these subtle cosmic frequencies and perform the exquisite alchemical operations.

If you are living in a stressful urban environment you should practice on a regular basis, if not daily, Fusion of the Five Elements and Cosmic Fusion and if time allows, Fusion of the Eight Psychic Channels. These formulae address the basic transformational and energetic needs of spiritual practice; they clear the channels (Governor, Conception, Belt, Thrusting); and in the Advanced Fusion formulae, allow the practitioner to hook up to the available energies around in the environment.

One problem is time. Not everybody has the convenience of time and leisure. There is that job waiting or that test to be taken. Simply, how do we squeeze one more exotic practice into our already harried lives? Finding time is only a matter of self-discipline and setting priorities in your life. We have to give up a few things—that football game, movie, party, or week-end nap.

Practitioners of the Universal Tao follow a flexible regimen. Along with the Fusions, Iron Shirt and Tai Chi Chi Kung are practiced on a regular basis of at least twice a week. Kan and Li practices, with their dissolving processes, could leave the practitioner spaced-out and ungrounded if he/she does not complement them with rooting. A balanced practice will also nourish both the physical and spiritual, the ascending earth and descending heaven energy and include good nutrition.

Caution: A good rule of thumb—only do what you are comfortable with, never rush into a higher practice unless you are ready. You will know how you feel; if you are not sure, call a person who has practiced at your level. Develop a network of people who are your classmates and share your experiences.

If you have not practiced Lesser or Greater Kan and Li, it is useless to study the Greatest, as each builds on the previous. Spiritual dilettantes will waste their time memorizing this formula—it is an empty husk without the self-discipline of daily meditation. If your Lesser or Greater practice has fallen slack, practice it for a few weeks before proceeding.

Strictly avoid any black magical practices. This means do ***Not*** project any desires for material gain or power over others into your spiritual child. It will corrupt your inner child and derail your spiritual growth into a blind alley. Your inner child is seeking the Tao of Immortality; worldly gain is in the opposite direction.

If you are feeling uncomfortable, consult this manual again or call the Universal Tao Center. Remember that the spirit of Taoism is characterized by joy, humor, compassion, ease, Wu-Wei (loosely translated as patient waiting) and healthy non-attachment. Enjoy your practice, allow for the spontaneous to happen, be patiently aware.

B. Greatest Kan and Li Proper

The essence of Greatest Kan and Li practice is the establishment of the cauldron in the Heart Center and the further refinement of the Soul and Spirit. It is in the Heart Center that most of the Greatest Kan and Li practices take place. The coupling of the energies here, involving macrocosmic-microcosmic energetics, is the central formula. It is therefore important to spend more time on this rather elaborate but enjoyable procedure.

C. Supplemental Practices

These practices are techniques to draw more energy from both outside and within the body, to facilitate the alchemical process. When one becomes familiar with them, they are integrated into the Greatest Kan and Li. They can also be practiced independently as a separate discipline.

All of the above practices will be combined and integrated into one continuous formula for individual and group practice during the week-long retreat.

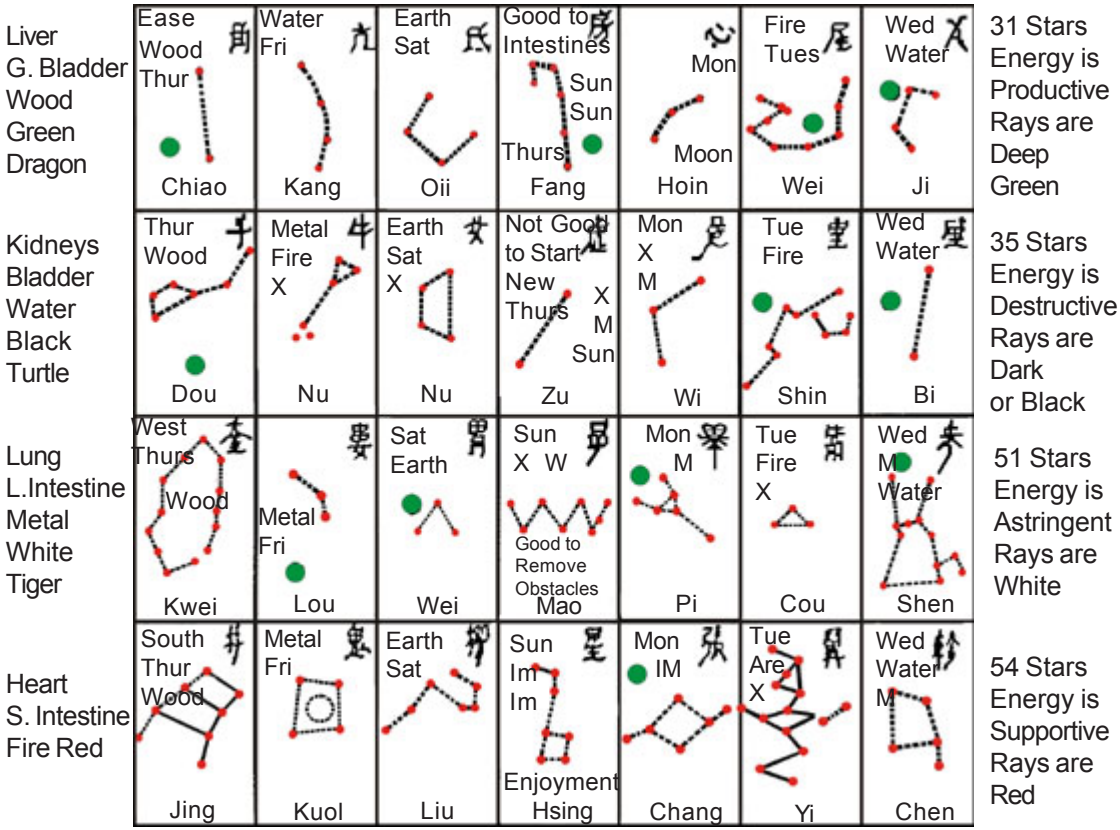

Fig. 6 *Twenty-Eight Constellations*

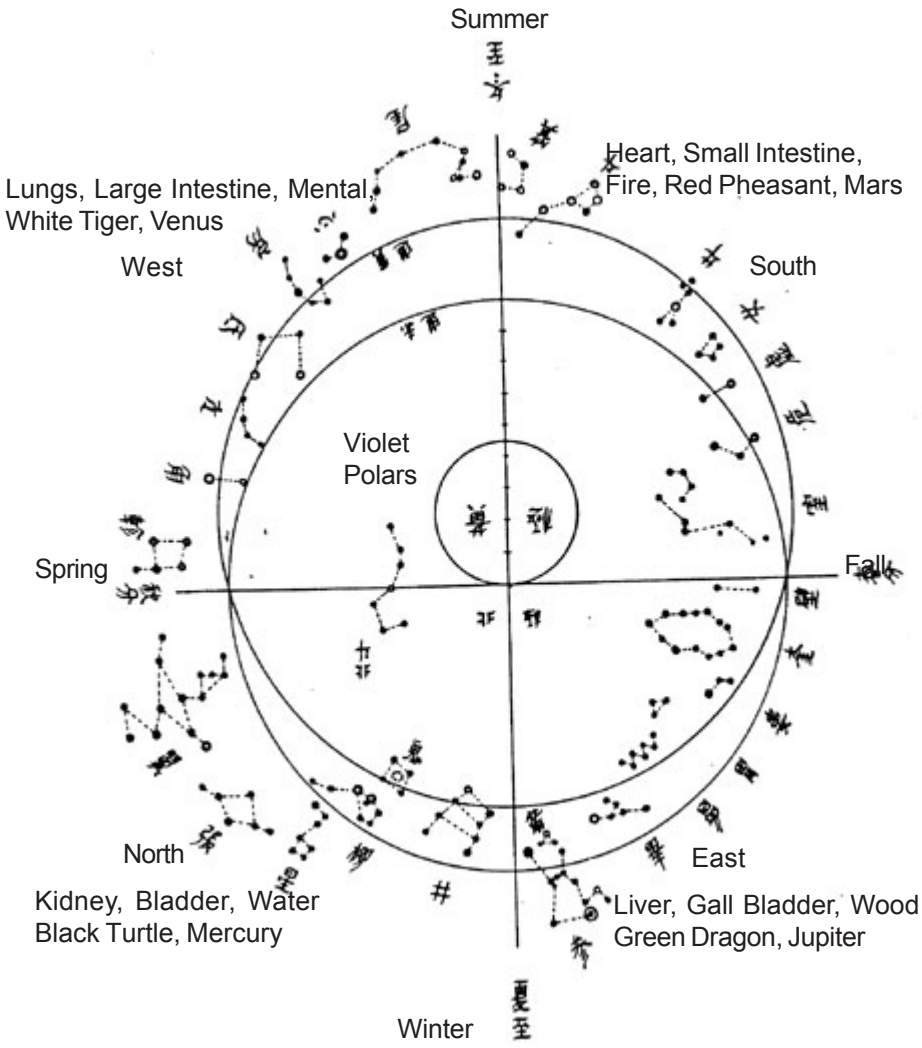

Fig. 7 *North Star - Big Dipper - 28 Constellations*

Outline of Greatest Kan and Li Practice

A. Basic Formulae Simplified

As stated above, it is necessary to keep up one's basic practice, Microcosmic Orbit, Iron Shirt (especially Iron Shirt I), Universal Love and Tai Chi Chi Kung I. It is also necessary to practice the three Fusions before Greatest Kan and Li. A schedule should be followed.

Suggested Practice:

Fusions should be practiced in the morning and Kan and Li in the afternoon or evening. Iron Shirt I and Universal Love (Testicle or Ovarian Breathing, Scrotal and Ovarian Compression and Big Draw), followed by Tai Chi Chi Kung about 2-3 times a week.

In Fusion practice, it is suggested that the practitioner start with Cleansing the Negative Emotions (from Fusion of the Five Elements) and creating a Pearl, Creation Cycle (Meditation on the Virtues from Cosmic Fusion), Clearing the Thrusting Channels and Belt Routes (also from Cosmic Fusion), Microcosmic Orbit Meditation, the Three Planes (Projecting the Pearl through the Perineum/Bubbling Spring to the Earth, through the Third Eye to the Cosmic Plane and through the Crown to the Universal Plane; Projecting the Microcosmic, Thrusting and Belt Routes into the Three Planes, from Fusion of the Five Elements) and then, if time allows, Fusion of the Eight Psychic Channels (Great Bridge and Great Regulator Channels and Cutting techniques). As one gets familiar with the routine, the practice should take about 25 to 45 minutes or it could be stretched to an hour or two hours if one includes the Advance Practices of Fusion of the Five Elements (especially the two formulae—Calling the Earth Force to Empower and Protect and Calling Forth the Planets' and Stars' Forces for Empowerment and Protection).

We cannot, of course, prescribe one regimen for everybody. In time, if you practice consistently, you will find the right combination of formulae and develop a comfortable routine that is suited to your schedule and temper. Whatever your routine, remember to spend time in creating a Pearl to use in cleansing yourself and growing positive virtues.

Many practitioners of the Universal Tao spend more time on Embracing the Tree, Holding the Golden Urn and Golden Turtle/Water Buffalo than on any other postures and find that with this set of three, they attain the rooting that they need for the higher practices. Find out for yourself what postures are ideal for your practice. Avoid packing with physical breath if you are preparing for Greatest Kan and Li. Understand that Chi has different refinements and meanings; at this level you should be drawing the Chi in your body and using mostly your mind to pack the Earth Chi into your organs and fascia.

Here is a brief Preliminary /Preparatory Meditation:

1. Inner Smile (starting with the eyes and covering the head, neck, shoulder, arms, body, hip, legs and feet with Universal Light).
2. Fusion Outline:
   a. Form the 4 Pakua (front, back, right and left).
   b. Collect and balance the Negative energies on all 4 sides. Form the Immortal Pearl.
   c. Creation Cycle (Meditation on the Virtues using a Pearl to travel through the different organs/phases).
   d. Clearing the Channels (Thrusting Routes and Belt Routes).
   e. Microcosmic Orbit (using the Pearl).
   f. Three Planes/Forces (Projecting the Pearl, Pakua, Microcosmic Orbit, Thrusting Routes, Belt Routes, through the Perineum/ Bubbling Spring, Third Eye and Crown).
   g. Closing and Collection of Energy (if further practices are not covered).

B. Greatest Kan and Li Proper

The central focus is the Coupling at the Heart Center. To practice this, however, requires a foundation, part of which we have established in earlier courses.

1. Activating the Cranial and Sacral Pumps
2. Alignment of Three Triangle Forces
3. Coupling in the cauldron.

We will now use these practices on a higher plane. In a way, we have built the structure block by block, starting with the Inner Smile, each piece becoming a new awareness that supports the growth of the next practice level of consciousness.

1. Activating the Cranial and Sacral Pumps

The essentials of this practice have been developed in Iron Shirt and Healing Love. The technique helps to open the Crown by vibrating the bones at the sutures with micro-pressure and to project the Pearl/Soul/Spirit. It has been found that when one holds the breath, the skull vibrates thus loosening the bones, making it possible to open the Crown for the Egress of the Spirit, Basically, the procedure for activating the Cranial and Sacral Pumps (needed in the Alignment of Three Triangle Forces, below) is to:

a. Clench the teeth and look up.

b. Press the tongue to the palate.

c. Bring the chin down and gently push the C-7 back.

d. Sink the sternum and round the scapulas (muscles stay soft).

e. Gently squeeze the buttocks, anus and perineum.

f. Inhale, pull up the genitals. Send the energy up the spine to the Crown, look up, and swallow saliva upward as you feel the earth force come up to you.

g. Spiral feet outwards into the ground.

h. Exhale and completely relax any muscles you have tensed.

Practitioners who have advanced in Iron Shirt I and Healing

Love should have no problem with this sequence. Practice the sequence until you are comfortable with it. Do not overtighten your muscles. You must be able to totally release all body tension so that the Chi can flow easily through the pumps and throughout the body. Work towards activating these pumps through structural alignment and mental focus only.

2. Alignment of the Three Triangle Forces

This technique is basically the same as Activating the Cranial and Sacral Pumps, except for a few differences.

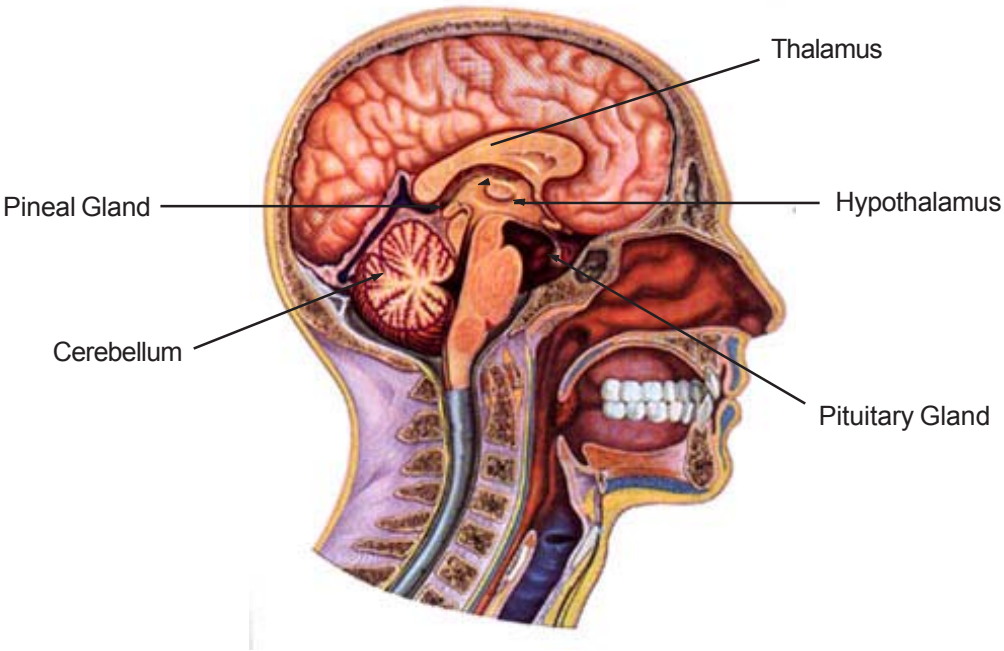

Fig. 8 *Activating the Cranial and Sacral Pumps*

a. The First (Upper or Crystal Room) Triangle -- Pull the jaw/chin back towards the cervical, thus straightening the Jade Pillow. Gently stretch the neck up and open your C-7 to align them to the Crown. This also aligns the Crystal Room (Pituitary Gland, Pineal Gland, Fornix, Mammillary Body) with the Heart (and the Middle Triangle) and the Sacrum/Coccyx (Lower Triangle).

Fig. 9 *Alignment of the Three Triangle Forces.*

b. The Second (Middle) Triangle—Allow the sternum to move down or as the expression says, “Softly sink the chest”. This motion moves the Heart Center and sternum (the solid bone joining the ribs in the chest) back and aligns the Middle Triangle with the Sacrum/Coccyx (Lower Triangle) below and the Crystal Room above.

c.The Third (Lower) Triangle—Arch the sacrum and tilt the coccyx down to align the former to the Upper and Middle triangles and the latter to the Earth.

Practice the Alignment of the Three Triangle Forces separately until you are comfortable with it.

Note that the bones of the Three Triangle Forces (chin, sternum/xiphoid process, and sacrum/coccyx) are themselves triangular in shape. Triangle and pointed bones are able to project and attract energy more efficiently than round or flat bones.

When one aligns the Three Triangle Forces, it is easy to see that they create a kind of arrow, a trajectory upwards to the North Star and downwards to the Earth. Thus the physical body and its varied energies and technology become an efficient machine for attracting different forces, projecting and fusing energies between heaven and earth. The practitioner develops himself/herself into a powerful instrument capable of attuning itself with great precision to its purest source.

3. Coupling at the Cauldron

We established the Cauldron earlier in the Navel, then in the Solar Plexus; now we place it at the Heart Center.

To the Taoists, the heart (usually spelled with a capital H to serve as a metaphor for its functions) is like the mind (usually also caps and lower case); it contains and reflects all the emotions. To empty the heart means to empty it of the negative emotions. To control the heart is to control the emotions themselves.

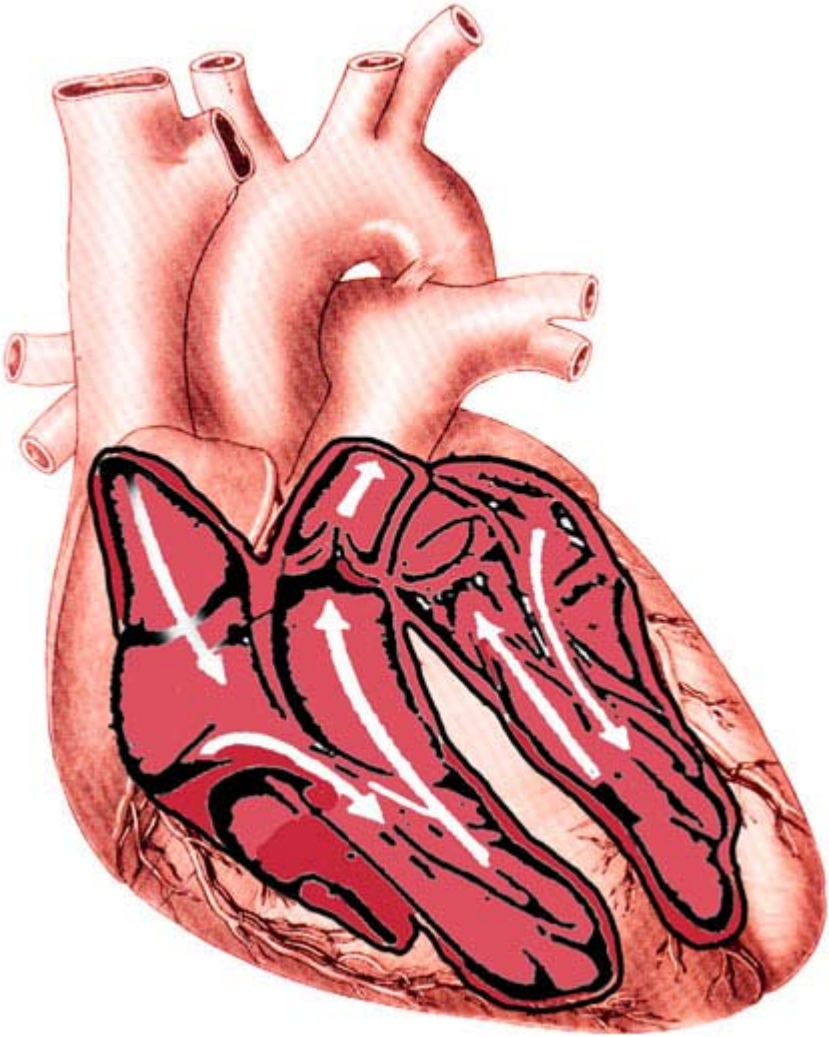

Fig. 10 *Heart controls the following a circulation of blood for distribution of nutrients and oxygen.*

The Heart is a complicated machine. For our purpose, we need to know some of its basic mechanism and functions (in esoteric practice and in eastern and western medicine). It controls the following: (a) circulation of blood for distribution of nutrients and oxygen. The cleansing and oxygenation of blood through the aorta (sun, Yang), vena cava (moon, Yin), and right atrium, right ventricle, left atrium, left ventricle; (b) Yin Regulator channel; (c) Yang Regulator channel; (d) Yang Bridge channel; (e) Yin Regulator channel; (f) Belt Channels (g) Thrusting Channels; (h) Microcosmic (Governor and Conception);(i) 12 Meridians; (j) nerves;(k) bones.

All the electromagnetic currects come into the heart and are sent out ghrough the heart. The electromagnetic current is directly connected with the brain. The fire in the heart and the water in the kidneys balance the heart. Practicing virtue and compassion is the way to control the heart in order to increase the current. Otherwise, the heart overheats and the kidneys become too Yin. The heart and the kidneys are the step-up transformers and batteries of the body. The universe has all sorts of electric-magnetic energies which the heart and the kidneys can absorb. The circulation of the blood utilizes the same type of electric circulation as the heart and kidneys. The heart is the main generator and step-up transformer of the body.

A few facts about the heart: It beats at an average of about 65-75 times per minute, depending on different factors like age, physical activities, sex, body size, health, climate. As large as a fist, it contains four chambers-- the Right Atrium (into which de-oxygenated blood flows from the Superior and Inferior Vena Cava); Right Ventricle (which receives the oxygenated blood from the Left Atrium and pumps it into the Aorta. From there the blood is pumped to the different parts of the body. There is a system of valves and contraction which regulates the flow of blood back to the heart.

Exercise: Sensing the Heart's Polar Energies.

a. Use the mind to follow the Aorta (Yang) and Vena Cava (Yin) as they move the blood, the former away from the heart and the latter towards the heart.

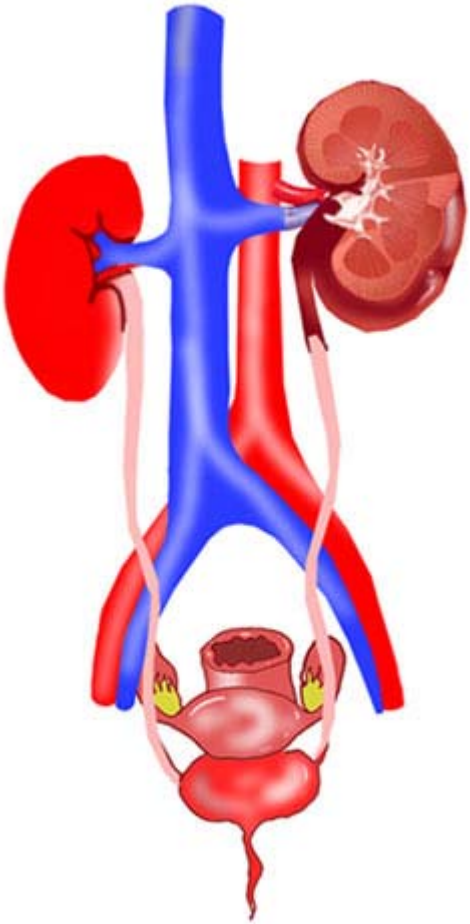

Fig. 11 *Kidneys are the transformers of energy of the lower branches of the Aorta and Vena Cava.*

b. Collect the electricity from both sides of the head, neck, shoulders, upper chest, arms, hands, and collect it in the heart. Feel the recharging of energy.

c. The Kidneys are the transformers of energy of the lower branches of the Aorta and Vena Cava and they act as step-up transformers of energy. Use the mind to direct the circulation of the blood in the lower part of the legs up to the kidneys and feel the two kidneys become electrically charged. Direct the energy back to the heart.

Exercise: Listening to the Moment of Emptiness

a. Follow the flow of blood as it enters the Right Atrium from the Inferior and Superior Vena Cava. The blood is blue as it moves from the extremities towards the Heart.

b. Follow the flow of blood as it enters the Left Atrium from the Pulmonary Vein. The blood is red as it has just been oxygenated by the Lungs.

c. As the blood enters the atria, there is a relaxation. Two valves open and the blood drains into the Left and Right Ventricles.

d. There is a contraction of the Left and Right Ventricles, closing the two valves. The Right Ventricle forces the oxygen-spent blood into the Pulmonary Artery while the Left Ventrical pumps oxygenated blood to the Aorta and on the rest of the body.

e. There is again a moment of emptiness (relaxation) between the heartbeats (contractions). It is this second of emptiness that we should wait for.

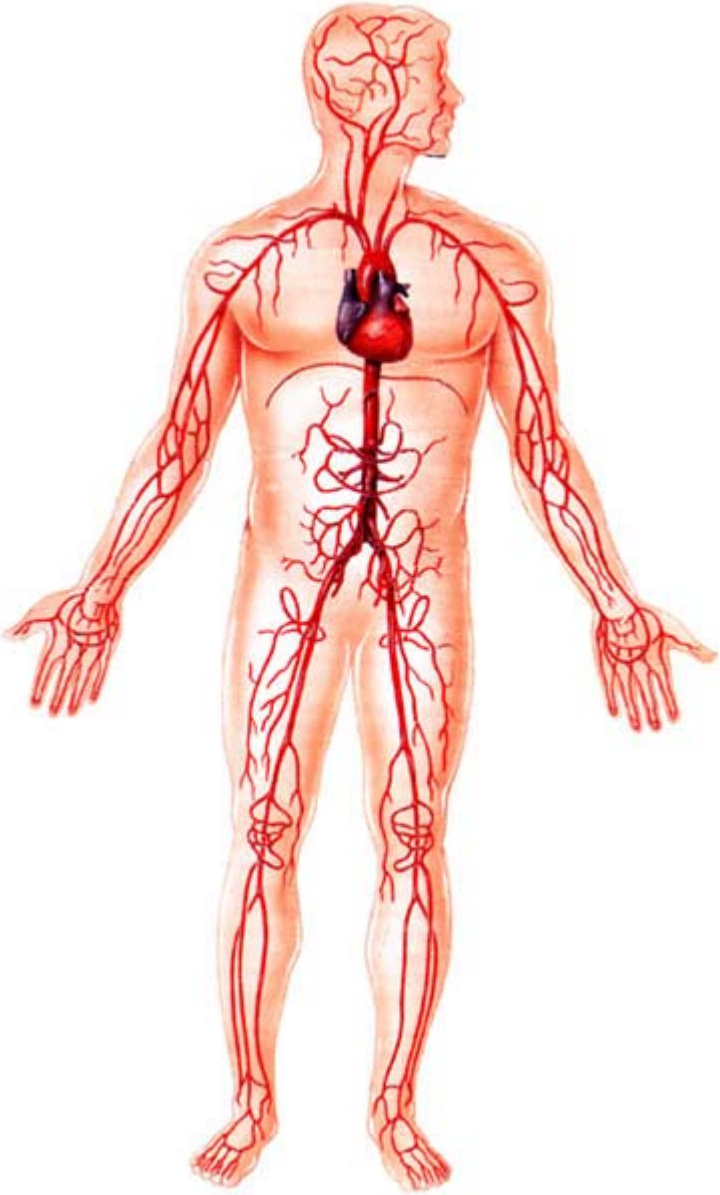

Fig. 12 *Heart and main vessels of the circulatory system.*

Exercise: Activating the spirals of Heaven and Earth

a. Spiral the vortex in a clockwise direction descending from the Crystal Room to the heart; then spiral back up in a counter-clockwise direction.

b. Spiral the vortex in a counter-clockwise direction ascending from the Earth to the Perineum.

4. Coupling in the Cauldron at the Heart

Note that the same Thrusting Channels are used (Left, Right, and Center *or* Front, Back, and Center) as before. Note, however, that:

a. We use not only the Cold/watery energies from the kidneys and the sexual organs and the Hot/Fiery energies from the adrenals, thymus and the heart, but other energies as well. The Human (Third Eye) Force and the Universal (Crown) Force are added at the Crystal Room. The Earth (Perineum/Bubbling Spring) is added to the Cool/Watery energy at the perineum.

b. The warm energies of the hands, arms, shoulders, upper chest, neck and head could be added to the Crystal Room just before it goes down to the Solar Plexus.

c. The Cold/Watery energies of the Earth, legs and hips could be added

d. The Hot/Fiery Energies move from their sources up to the Crystal Room first, via the Left Thrusting Route or Front Thrusting Route; then back down to the Solar Plexus via the Right Thrusting Route or the Back Thrusting Route. You may also simply focus on the place you want to draw the energy to.

e. The Cold/Watery Energies move from their sources down to the Perineum via the Right Thrusting Route or Back Thrusting Route and then up to the Throat Center via the Left or Front Thrusting Route or simply draw the specific Chi to the desired point using your mind.

Exercise: To Mix Hot and Cold Energy

1. Be aware of the different energies of the kidneys (cold/watery) and adrenals (hot/fiery). Take your time in distinguishing the quality of each.

2. Send the Cold/Water Energy of the Kidneys to the Perineum Collection Point, taking along the Cold/Watery Energies of the genitals. Picture the Perineum Collection Point as a blue or dark blue sphere, a Cauldron (or Pot).

3. Combine the Hot/Fire Energy of the adrenals at T-11 on the spine and send it up the Left Thrusting Channel to the Crystal Room. Picture a Stove in the Crystal Room to contain the Hot/Fire Energies collected there.

4. Draw in the Earth Energy through the Feet (Bubbling Spring) and combine with the Cold/Water Energy at the Perineum Collection Point.

5. Build a vortex from the Heart to the Crystal Room.

6. Build up a vortex from the Earth to the Perineum.

7. Move the Hot/Fire Energy in the Stove from the Crystal Room to the Solar Plexus. Simultaneously move the Cold/Water Energy from the Perineum to the Throat Center.

8. (a) Add to the Hot/Fire Energies at the Solar Plexus or Crystal Room the energies felt at the head, neck, shoulders, arms and chest. (b) Add to the Cold/Water Energies at the Perineum the energies felt at the feet, legs, thighs and lower parts of the body.

9 Move the Hot/Fire Energies and the Cold/Water Energies to the Middle Thrusting Channel from the Solar Plexus and the Throat Center respectively.

10. Trace the aorta back to the Heart as you inhale and exhale. Listen to the pulse as you find the times when the Heart empties itself before being filled again. It empties as it pumps blood out. Synchronize the cleansing of the heart, the pulsing of the fire in the Stove and the rising of the steam from the Cauldron to that moment of emptiness.

11. Sink the sternum, round the scapulas, sink the chin, arch the sacrum/coccyx. Move the heart toward the spine. This will assist in the coupling/cupping process.

12. Bring the Fire Energies in the Stove and the Water Energies in the Cauldron towards the Heart Center and couple precisely at that moment of emptiness, that second between heartbeats.

13. Use the rhythm of the breath or the pulse to fan the fire.

14. See the steam rising. Spread it throughout the body, moving to the extreme outer areas and limbs. Steam the Microcosmic Orbit, Thrusting Channels, Belt Routes, Great Bridge and Regulator Channels, the organs and endocrine system, the Crystal Room.

Note: Watch for dripping from the Crystal Room as you steam upward. The drops may come from the Mammillary Body and may taste different, like honey, coconut milk, champagne, something rich and unusual. This is the Fountain of Life. A pool or mirror may form at the Heart, Solar Plexus or Perineum from these drippings. The images reflected there may give you insight into yourself, others, or life itself. Watch for the Crystal Eye in the pool or lake formed by the dripping as the steam condenses.

15. The kidneys as transformers of the heart. Be aware of the kidneys as they are filled and emptied of blood through the Aorta and Vena Cava. Draw the energies of the Earth, feet, legs, thighs and the lower body into the kidneys. Repeat several times. Condense the energies at the kidneys and spiral into the heart. Remember that the Kidneys are the Source of Original Chi (Moving Chi Between the Kidneys, or Pre-Natal Chi) and they transmute Primordial Chi into usable Chi.

Time	Organs	Extremity
3-5 a.m.	Lung	Thumb Forefinger
5-7 a.m.	Colon	Forefinger
7-9 a.m.	Stomach	Middle Toe Second Toe Big Toe
9-11 a.m.	Spleen/Pancreas	Big toe
11-1 p.m.	Heart	Little Finger
1.3 p.m.	Small Intestine	Little Finger
3-5 p.m.	Bladder	Little Toe
5-7 p.m.	Kidney	Little Toe
7-9 p.m.	Diaphragm (Sex/Circulation)	Ring Finger Middle Finger
9-141 p.m.	Umbilicus (Triple-Warmer)	Ring Finger
11-1 a.m.	Gall Bladder	Big Toe Ring Toe
1-3 a.m.	Liver	Big Toe

Fig. 13 *Organ Energy flows into fingers and toes.*

16. Other procedures could be practiced at this point. See Supplemental Practices, below. If no other formula is followed, then proceed to: Slow down the Pulsing. Collect the energies in the Solar Plexus or Navel.

5. Birthing your Inner Child

Watch for a golden or yellow-green or white light from above. It may come in front of you from somewhere. Feel gentle and loving towards it. Bring it with your mind and heart towards the Cauldron and let it seed the Cauldron at the heart. It is the Pill, the Elixir of Immortality, the Holy Spirit and the Divine Child that the ancients talk about and wait for. It is a rare event in the life of the practitioner. Like the appearance of a miracle, the Inner Child or Pill of Immortality should be held with awe and gratitude. It is a gift from the Tao and a sacred responsibility to protect and nurture. Birthing the Immortal Inner Child or gathering the Pill is an advanced stage that may not happen for a long time. Do not be discouraged; be virtuous and continue the coupling and steaming. We are adding it here as a supplement:

Gathering the Small Pill:

The Small Pill, or Lesser Medicine, is another metaphor for the seed-Pearl and Embryo formed in Lesser and Greater Kan and Li, as it first mixes with the Shen/higher mind. The pregnant meditator has begun the labor of giving birth to the inner child.

1. First Light. When you see a light with your eyes closed in meditation, bring it to the Cauldron at the Navel (in Lesser Kan and Li). Pull up the sexual organs. The Light may be dim at first and look like a cloud. It may appear in the middle of the sky or start at the navel and come up to the eyes. Make it grow brighter. Feel the Light inside and outside. Create a Pakua in the navel, crown, Third Eye or anywhere you wish, even in the palms.

2. Condense the Light through the Pakua. The bright light will disappear and will reappear condensed in the Cauldron.

3. Spiral the Light in the Cauldron and condense it into a Pearl. The Pearl is the distillation of the external and internal forces, and becomes a thick energy ball.

4. Move the Pearl down to the Perineum and then to the Door of Life (Ming-Men) and to the Crown. Stop at the Crown for about 5 minutes. Then move the Pearl down to the Solar Plexus and into the Cauldron at the Navel. This gives your mind great calmness and detachment.

Note: The first Pearl produces the Small Medicine. The Taoists believe that this Pearl can heal many deadly diseases because it is the condensation of the life force. It has the power to rebuild the body and destroy foreign antigens.

Gathering the Larger Pill:

This is also called the Great Medicine, or giving birth to the Inner Child. This is a metaphor for the advanced stage of Greatest Kan and Li, when the spiritual fetus is born and begins breathing on its own. This is true internal breathing, and results in the temporary cessation of outer breath and pulse in the meditator. The Universal Life-Force has entered your divine child, giving it the awareness and power of a baby God. (Also called the Red Baby). You may or may not see the visual form of a child within; some adepts see an ancient adult, others feel only divine sound, light, and vibration.

1. With your eyes closed, see a Light inside. When you see the Light outside, mix the two together. The Light will become red. You may hear a sound. Seal all the senses tightly. You should feel something move in the navel area.

2. When a third Light appears outside, bring it down to the Cauldron at the Solar Plexus (in Greater Kan and Li). Seal the senses and the anus until you feel a stirring in the Cauldron, signifying a pregnancy. Collect saliva: it will have a fragrance. Smell the fragrance. Breathing at this point will become slow and even, long and

light, until you seem to stop breathing. The Light will move up from the Cauldron to the nose. Let the energy build into a vortex. Self-intercourse (Bliss) may happen here spontaneously. The pleasure will be greatly multiplied.

3. Move the Pearl through the Microcosmic Orbit 360 times.

4. Guide the Pearl up the Door of Life and rest. Guide the Pearl up to the Crown and down to the Solar Plexus and Cauldron.

5. Seal the Pearl at the Cauldron.

Note: When you put the Light in the Cauldron, do a slow fire (slow breathing, not Breath of Fire) or you can use the mind to slowly fan the fire. When the second light comes, you'll see a brighter Light and you'll see a Dragon (on right) and a Tiger (on the left). You may also hear their voices-high-pitched for the Dragon and low-pitched for the Tiger. The Cauldron will get hotter. The sexual organ will also get hot and muscles will vibrate. The Light will spiral clockwise. When the third Light comes, blend inside and outside and seal the senses. You can swallow saliva until energy stays with you. Remember that the Light does not come to everyone. When the Coupling and Steaming are correct, we attract the Universal Energy and there is a mating. Our inner child is born instantly. If the Universal Energy comes and you are not ready, then you do not get it, and you will have to remain "pregnant" until you are truly ready to receive your spiritual child.

嬰兒現形圖

Fig. 14 Forming the Immortal Fetus

C. Supplemental Practices

Notes on the Constellations and the Stars:

1. The Big Dipper controls one's death and the planet Neptune enforces it.

2. The Southern Constellations control the time of birth and the information is sent to Neptune which enforces it.

3. The Northern Constellations control death.

4. The Western Constellations control the family and intelligence.

5. The Eastern Constellations control the Kitchen God who reports on one's life to the North Star every first and fifteenth days of the month. (That is why many Chinese people eat vegetarian diet on these days.)

The outside energies we tapped into in Lesser and Greater Kan and Li and earlier in Fusion of the Five Elements become increasingly powerful as our capacity to absorb and use these energies becomes more developed. Now, we come to a point where we "plug" into a more powerful resource.

Exercise: The Big Dipper and North Star Connection

In this meditation, we connect the bones of the skull to and draw energy from the 7 Stars of the Big Dipper and the North Star.

The 7 Stars of the Big Dipper, their numbers, elements, planets and days are:

- Alkaid (the first star at the tip of the handle), # 7, Water, Mercury, Wednesday
- Mizar, # 6, Metal, Venus, Friday
- Alioth, # 5, Fire, Mars, Tuesday
- Megrez, (the first star of the cup) # 4, Water, Saturn, Wednesday
- Pheeda, # 3, Earth, Saturn, Saturday
- Merak, # 2, Water, Mercury, Wednesday
- Dubhe (the last star of the cup), # 1, Wood, Jupiter, Thursday

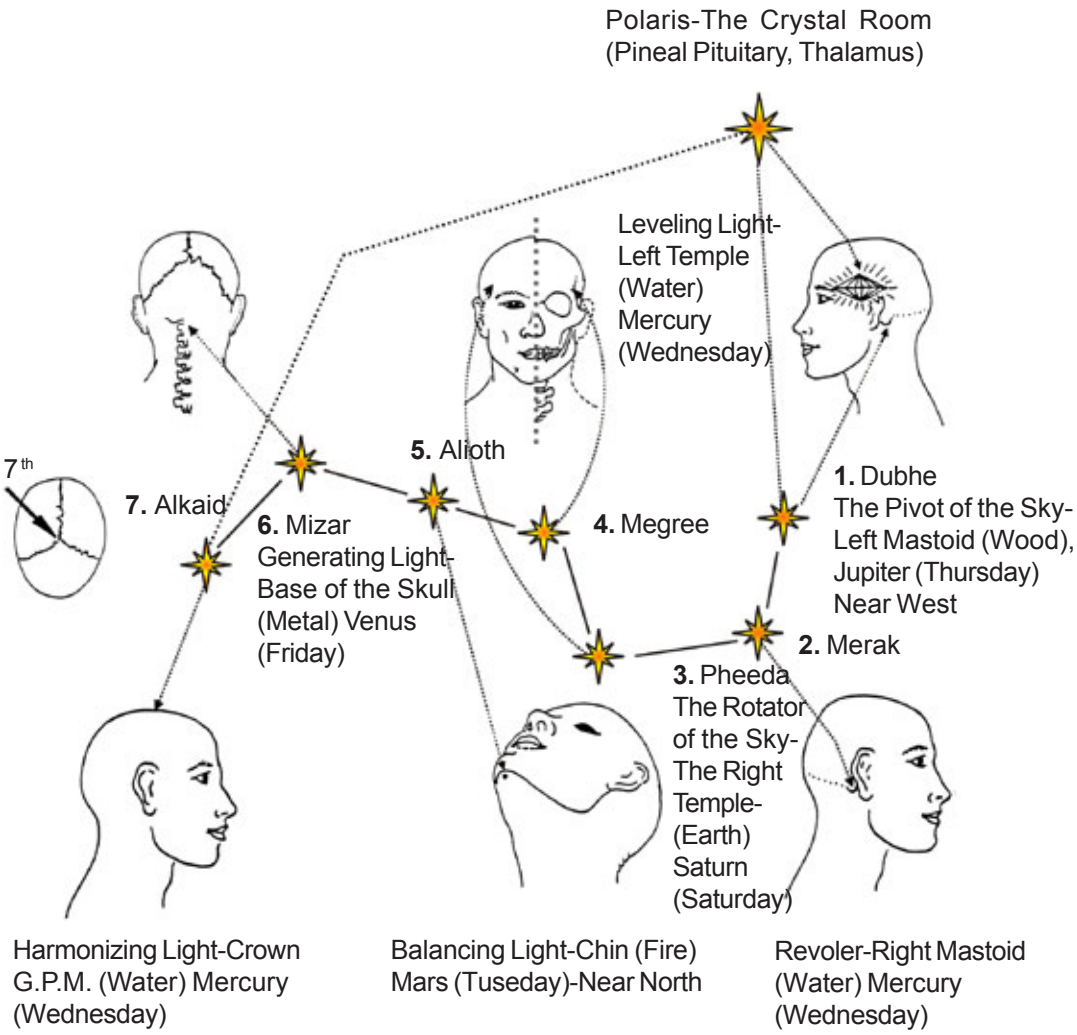

Fig. 15 *Big Dipper and North Star Connection*

Bones and areas of the skull and their corresponding stars:

- Crown—# 7
- Occiput—# 6
- Chin—# 5
- Left Temple and Left Cheekbone—# 4
- Right Temple and Right Cheekbone—# 3
- Right Mastoid Bone—# 2
- Left Mastoid Bone—# 1
- Crystal Room (Pineal, Pituitary, Thalamus)—Polaris (North Star). The thalamus gland connects with the pole star and is considered the pole of the body. The thalamus also connects with all the 28 constellations.

Exercise: Macrocosmic/Constellation Meditation

a. In this meditation, imagine you have a giant body, billions of light years from head to toe. When done properly, you become the Cosmic Being whose crystal palace is the North Star, who has constellations and planets for vital organs; whose heart is the Sun, whose kidneys are the Moon, and whose lower Tan Tien is the planet Earth. This Cosmic Being—the mind of Tao—beams down its exquisite rays to one cell of its being, the human sitting on a chair on planet Earth, meditating up on the stars. This cultivates the cosmic consciousness and opens the three Tan Tiens to receive energy from their heavenly counterpart.

b. Be aware of the North, South, East and West Constellations. Bring down energy from these constellations through the North Star connection. (It serves as the Center for all of these energies as well as its own.)

c. Beam their combined energies through the crown into the heart.

d. Pull up the genitals and the perineum.

e. Be aware of the palms and the soles of the feet as you draw energy up from the earth through the two bottom holes of the sacrum. (The Sacrum has eight holes called the Ba Liao—where Bladder 31, 32, 33, and 34 are located—and are close to the Governor Channel.

f. Align the Three Triangle forces of the body.

g. Beam or Spiral the virtue energy of the organs back to the heart and up to the Crystal Room. Return it to the Heart and to the Crystal Room again. This process, among others, serves to enhance the development of a more advanced Energy Body.

h. Send this Energy Body to the Crown and to the North Star. Picture a tube or a white cord leading up from the Crown to the North Star for this purpose.

i. Keep drawing more virtue energy from the organs into the heart and up to the Crystal Room and back to the heart again.

j. When you are ready, send this virtue energy to the North Star. Spread this positive energy from the North Star to the North, South, East and West constellations. From the Four Constellations, beam this energy to your own planet. (Materials will be distributed so that you can determine which is your planet.)

k. Then beam the energy to yourself, or if in a group, to where you are sitting.

l. Bring more virtue energy from the organs to the heart, to the Crystal Room, and back to the heart a few times. Send it again to the North Star and bring it back to yourself.

When you are ready, send this good energy to the North Star. Spread this good energy from the North Star to the North, South, East and West constellations. rom the Four Constellations, beam this energy to your own planet. (Materials will be distributed so that you can determine which is your planet.)

Then beam the energy to yourself (or, if in a group, to where you are sitting).

Bring more good energy from the organs to the heart, to the Crystal Room, and back to the heart a few times. Send it again to the North Star and bring it back to yourself.

Exercise: Beaming Energy to Yourself

a. Be aware of your palms and feet.

b. Receive energy from the Constellations:

c. Left Palm—Eastern Constellations

d. Right Palm—Western Constellations

e. Left Foot (Bubbling Spring)—Northern Constellations

f. Right Foot (Bubbling Spring)—Southern Constellations

g. Mentally focus on any problem in your life. Be clear about the problem. Send it to the beam. (If in a group, send it into the center of the circle.) The problem can burn up from the intense energy of the practice. Remember to take only the energy you can use and send out any excess that can overheat you.

Note: Collect saliva and swallow it down if you feel that you are overheating. Swallow the saliva down to the throat, heart, solar plexus, navel, sexual center, perineum, sides of both legs, below the knees, small toes, Bubbling Springs, backs of the knees, coccyx, sacrum, Ming-Men, T-11, T-5, T-6, T-7, C-7, outer elbows, middle fingers, palms, inner elbows, Jade Pillow, Crown, Third Eye, tongue, and return to the throat. Repeat this cycle several times to help you cool down.

Exercise: Cleaning Out of the Heart

a. Align all Three Triangle Forces.

b. Beam up the kidney energy to the heart.

c. Beam up all the energy of the different organs (liver/ gall bladder, lungs/large intestine, small intestine, stomach/spleen/pancreas) into the kidneys and then beam it to the heart.

d. Force the heart to clear itself by filling it with so much energy that it will act more powerfully to empty itself and create longer moments of emptiness.

e. When the heart expands to its limit, exhale and spread out all of the energies into the head, hands and body. Rainbow colors should come out of the other organs: receive their respective energies. When the heart is clean, you should feel only joy and happiness--the virtue energy of the heart.

Repeat this procedure of cleansing and emptying several times, up to 9 times.

Fig. 16 *Forming the Cauldron Yang to Yin*

Exercise: Drawing the Power

To help draw the power for:

a. The Crystal Room: Pure Yang energy is on the top. Concentrate on the Thalamus gland and collect the Yang energy and concentrate it at the 10 holes of the crown, connecting them with the 10 meridians of heaven.

b. The Navel and the Heart: Yin and Yang balanced in the middle. Pull in the lower abdominal wall and balance the energy and absorb the spiritual energy of the earth.

c. The Perineum: Yang and Yin at the bottom. Contract the anus and pull toward the coccyx and absorb the spiritual energy of the Earth. This Earth energy will be combined at the heart at the moment of emptiness and stillness. Feel the vibration of the heart.

d. The spine connects the Heart, Pons, Brain and Brain fluid. The heart, tendons, meridians, bones, spinal fluids, coccyx and sacrum are connected to the 12 earth meridians.

***Note*:** The soul body is a Yin energy. The spiritual body is a Yang energy. These energies help to balance the Yin-Yang energy of the body. The soul body (Yin) energy serves as an earth cable and absorbs the Yang energy from the heavenly wire to the soul body and down to the human body. It also absorbs the earth energy to balance the Yang energy absorbed from the spirit body.

The soul body absorbs the earth spirit energy and is sent up to the spirit body to balance and increase the power of absorption of the spirit body to connect earth, man and heaven. The triangle forces combine and align the heavenly, human and earth forces.

1. Spiral the perineum counterclockwise and the crystal room clockwise. Slowly spiral the heart clockwise. Tilt the heart back. Feel the body getting light and the heart like a feather. Contract the solar plexus and abdomen and sink the chest. Feel the three empty spaces enlarge. When practicing with a partner you can create a heart-to-heart connection. When you align all three together the wandering mind in the Crystal Room, the restless emotions of the heart and the sexual desire will eventually come under control.

2. Move the heart center near to the spine, slightly contract the anus, adjust the coccyx and align the pituitary gland. The body will become very light.

3. Move your awareness to the left Bubbling Spring, to the right Bubbling Spring, the left palm and the right palm. Feel the Chi coming out of the T5-T7 region. This will make the hands and legs light.

Note: The three empty spaces serve as a most sophisticated instrument and are similar in construction to a crystal and can send out a powerful electromagnetic beam. When all the energy is concentrated in the heart, you can send a strong beam out of the tip of the sternum to the hand, the head, the leg, or to any organ.

Remember to do bone breathing at the end of Greatest Kan and Li practice. The bones constitute the largest storage of energy in the body. Concentrate especially on drawing energy into the spine. Also do the heart sound several times and you can connect your Ten Heavenly Stems to the Universe and the Twelve Earthly Branches to the Earth as you do the practices.

Year Number	1	9	8	7	6	5	4	3	2
Color	Gray	Purple	Brown	Red	Pink	Yellow	Green	Blue	Black
Planets	Mercury	Mars	Uranus	Pluto	Venus	Earth	Neptune	Jupiter	Saturn
Element	Water	Fire	Earth	Metal	Metal	Earth	Wood	Wood	Earth
Direct	North	South	NE	W	NW	Center	SE	East	SW
Male									
Male Number	1	9	8	7	6	5	4	3	2
Direct	North	South	NE	W	NW	Center	SE	East	SW
Element	Water	Fire	Earth	Metal	Metal	Earth	Wood	Wood	Earth
Female									
Male Number	8	6	7	8	9	1	2	3	4
Element	Earth	Metal	Metal	Earth	Fire	Water	Earth	Wood	Wood
	NE	NW	West	NE	South	North	SW	East	SE
Year	00	01	02	03	04	05	06	07	08
	09	10	11	12	13	14	15	16	17
	18	19	20	21	22	23	24	25	26
	27	28	29	30	31	32	33	34	35
	36	37	38	39	40	41	42	43	44
	45	46	47	48	49	50	51	52	53
	54	55	56	57	58	59	60	61	62
	63	64	65	66	67	68	69	70	71
	72	73	74	75	76	77	78	79	80
	81	82	83	84	85	86	87	88	89

Fig. 17 *Sacred Geometry*

NW	N		NE
	6 Venus Metal Pink	1 Mercury Water Gray	8 Uranus Earth Brown
W	7 Pluto Metal Red	5 Earth Yellow	3 Jupiter Wood Blue
	2 Saturn Earth Black	9 Mars Fire Purple	4 Neptune Wood Green
SW	S		SE

Fig. 18 *Magic Square*

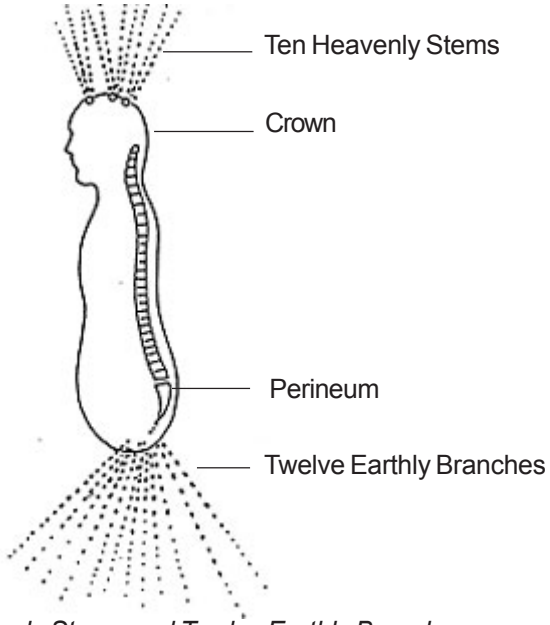

Fig. 19 *Ten Heavenly Stems and Twelve Earthly Branches*

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$6.95

Greatest Kan and Li
Gathering the Cosmic Light

Mantak Chia

Illustrations by Udon Jandee

Greatest Kan and Li

This booklet contains instructions for the final of the Kan and Li meditation series, the Greatest Kan and Li. The essence of the Greatest Kan and Li practice is the establishment of the cauldron at the Heart Center, also known as the Middle Tan Tien or Cinnabar Palace, and the further refinement of the soul and spirit. It is at the Heart Center that most of the Greatest Kan and Li practices take place. The coupling of the energies here, involving macrocosmic-microcosmic energetics, is the central formula.

The Kan and Li practices point to the Taoist road to spiritual immortality and Taoist internal alchemy. The immortal fetus is produced, nurtured and finally matures into a spirit body which unites one with the Tao. Master Mantak Chia is the first Taoist to introduce this spiritual discipline to the Western public.

As well as the instructions for the Greatest Kan and Li practices, the student is given instructions on the basic formulae to practice in preparation for the higher practices, The practitioner then learns the foundation procedures leading to coupling at the Heart Center; the activation of the Cranial and Sacral Pumps and the Alignment of the Three Triangle Forces. Coupling then leads to the birth of the Inner Child or Pill of Immortality. Other practices described in this booklet help you to draw energy from the Cosmos, enabling you to "plug in" to a resource of limitless power.

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Chi Nei Tsang I

Internal Organs Chi Massage

Mantak Chia

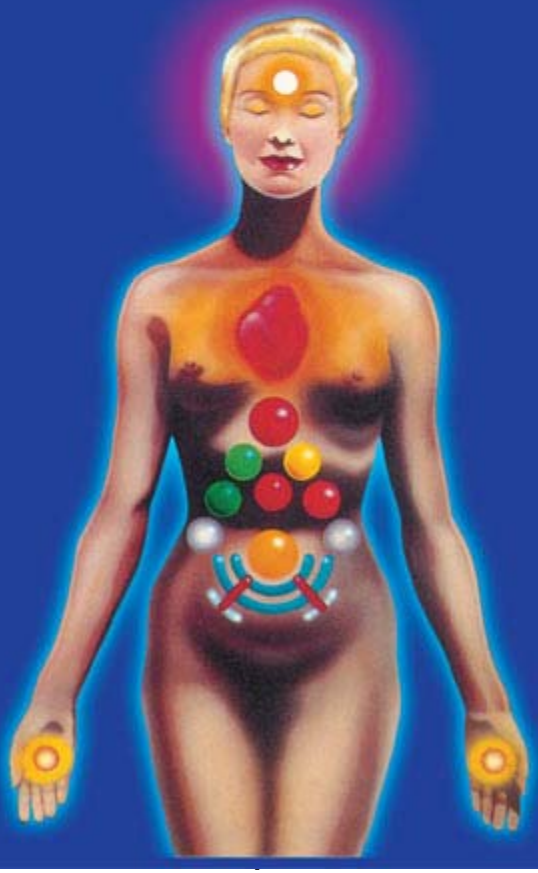

Chi Nei Tsang I

Internal Organ Chi Massage

Mantak Chia

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Performing the Healing Hands Meditation

The more you are aware of your sources of energy, the more that energy will come to you from those sources. According to the wisdom of the ancient Taoists, the energy that you receive from meditating is superior to the energy that you obtain from food.

The Healing Hands Meditation will help to grow and strengthen the energy in your hands and fingers. Your hands will develop sensitivity and you will be able to feel the energy in your own and your student's organs and abdomen. You will find this to be very useful.

Meditating to Expand the Aura

a. Practice the Inner Smile down to the organs and glands.

b. Bring the energy to your Navel Center and practice the Fusion Meditations.

(1) Form the four pakuas and the collection points.

(2) Clean out negative emotions by transforming them into positive, healing forces.

(3) Form their energies into a pearl.

c. Circulate the energy in the Microcosmic Orbit faster and faster until it expands outward from your body.

d. Feel the energy expanding outward from your navel as you visualize the sun shining in that area. Feel the energy filling your aura with a warm, pleasant sensation.

e. Be aware of the North Star and Big Dipper above you and absorb their respective violet and red lights, the golden light of the Cosmic Particles and the blue force of the Earth into the navel.

f. When you feel your aura has expanded, maintain a distance of at least two square feet away from other people. If their auras are stronger than yours at this time, your aura may be squeezed and you will experience discomfort. After you have felt the outer forces strongly, proceed with the following meditation.

Channeling the Force through the Palms

a. Hold both of your hands in front of your eyes and gaze at both palms.

b. Focus on the middle of your palms by using the corners of both eyes to gaze at the palms' centers. The corners of the eyes have special cells that can see in very dim light. Using your eyes to focus this way will help you develop the ability to see auras and movements in the dark. Using the combined power of the mind and the eyes, you can cause the aura of each palm to grow and expand. The Chi can feel like it is contracting and absorbing, and the sensation can be of drawing the forces into the palms, or an expansion of the palms. You might see a ball of Chi or a ball of color between the palms through the corners of your eyes.

c. Be aware of the fingers. Feel your fingertips pulsing. Use your mind and eyes to absorb the Cosmic Chi into the right palm. Send the Chi from the right palm and fingers across to the left palm and fingers. Repeat nine times.

d. Next move the fingers of both hands until they nearly touch each other: thumb to thumb, index finger to index finger, etc. You can feel sensations like electric sparks traveling across from one fingertip to the other. Some can feel pain, swelling, or simply expansion in their fingertips.

e. Gradually spread the hands apart, but not so far that you permit the Chi connection to diminish or break. If this happens, stop moving them and project more energy with the mind to re-establish the connection. Spread the hands from nine to eighteen times.

This practice will increase your sensitivity to energy and your healing ability. Transforming the Universal and Cosmic Particle Forces for immediate use will prevent drainage of your life-force. The energy can feel warm and pleasant.

Growing the Right Fingers' Auras

When your palms feel full of Chi, start to grow more Chi in the right hands' fingers.

a. With both hands' fingertips still raised in front of your eyes, begin by gazing at the right hand's fingers.

b. Use the corners of both eyes to gaze at the tips of the fingers. Focus on the tip of the index finger. Using the energy of your eyes, cause the aura of the index fingertip to grow and expand. Feel that fingertip pulsing. Make the energy cool and pleasant.

c. Next grow the middle finger, thumb, fourth finger, and pinky finger auras.

d. Choose your main healing finger(s) by observing and feeling which finger most noticeably permit(s) the energy to be absorbed in and passed out. Choose by comparing the length of the aura of each finger by the intensity of a tingling sensation or by any method that feels comfortable to you. Don't neglect the finger(s) that you do not select. Continue to practice with them as well.

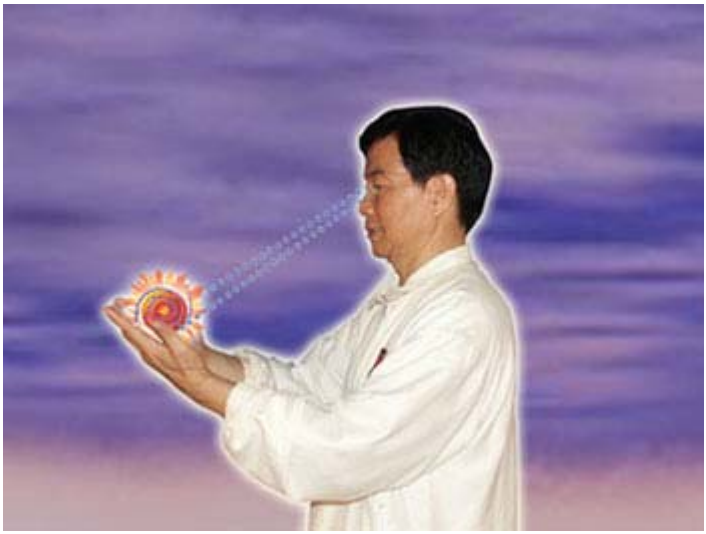

Fig. 1 *Focus on the right hand's index finger and let the Aura grow.*

Growing the Left Fingers' Auras

a. Inhale energy into the left hand and fingers.

b. Grow the thumb aura beginning with the tip.

c. Next, grow and absorb the auras of the index, middle, fourth, and little fingers. Receive and feel the Universal and Cosmic Particle Energies.

Fig. 2 *Grow the aura of the left thumb.*

Fig. 3 *Grow and expand the auras of the left hand's index, middle, ring, and little fingers.*

d. Select the finger on the left hand with the strongest energy. Press that fingertip with the tip of the thumb, forming a circle. Keep the other fingers straight. Rest the left hand on your lap. This circle is the best way to receive Universe and Cosmic Particle Energies.

e. Curl the pinky and fourth fingers of the right hand and press them with the tip of the thumb, again forming a circle. Keep the index and middle fingers straight.

Fig. 4 *Choose which finger in the left hand has the strongest energy. Join the thumb with the strong finger, and place the left hand on the lap. Curve and join the right hand's little finger and ring finger with the thumb. Keep the other fingers straight.*

f. Form these circles and use your mind and eyes to absorb the external Cosmic Particle Force through the fingers of the left hand. Send it up through the left hand, outside the left arm and the left shoulder, to the back side of the left ear, and across the crown. Blend this energy with the Universal Force entering through the crown. Then send their combined energy down to the right ear, the right shoulder, the outside right of the right arm, and the right hand to its index and middle fingers. Send it out through these fingers and receive it again through the extended fingers of the left hand. Continue this practice for nine, eighteen, or 36 cycles.

Fig. 5 *Absorb the Human Plane (Cosmic Particle) Energy through the left fingers and circulate it blend it with the Universal Force at the crown. Then circulate the energies down the right arm, out thought the index and the middle fingers, and back to the left fingers.*

Open the Wind Gates

It is important to master and clear out the winds at beginning of every session. This will help to activate the abdominal energy and loosen the tightness and tension in that area. Some persons will have abdomens that are too painful to bear the pressure of this procedure. In such cases, first do gentle skin detoxification.

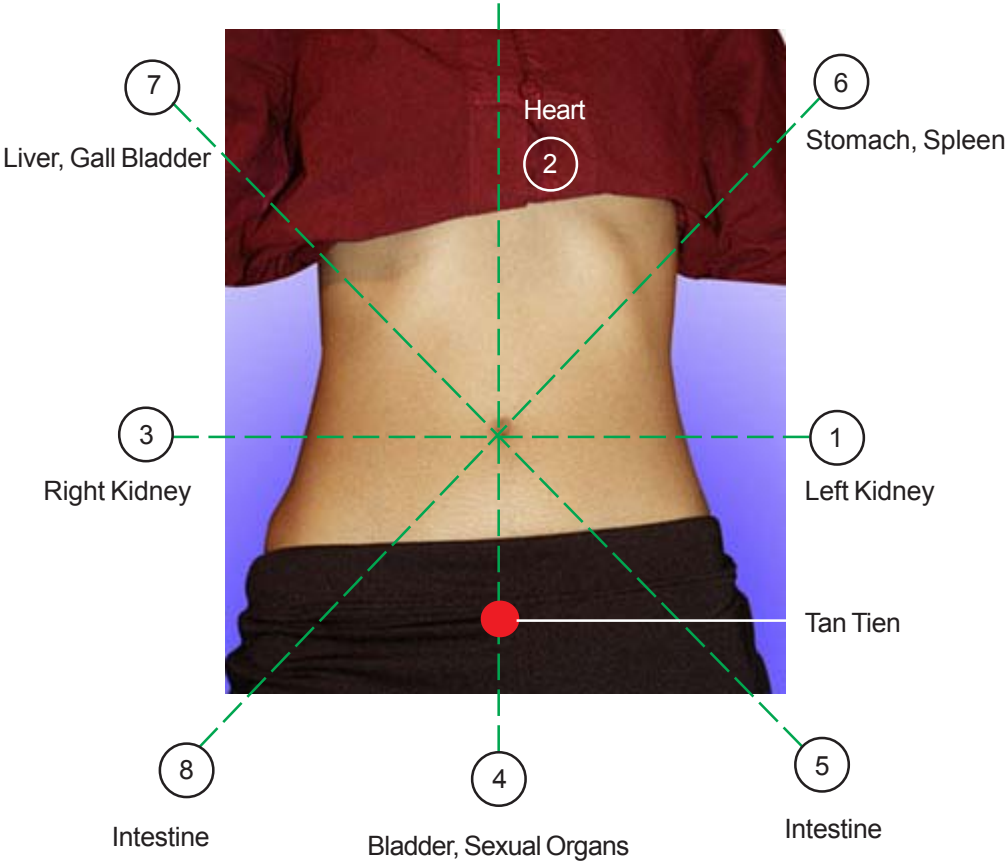

Fig. 6 *Pressure Points Around the Navel. Number sone to eight list the sequence to follow and indicate the organs you will affect.*

Wind Gate Chart

a. Open the winds gates in the order listed. Visualize the Tai Chi symbol as the navel.

b. Follow the navel center guides 1-8 and use the thumb or elbow to press at the point indicated. For example, after you do the groin gates and the Gate to the Sea of Winds (Tan Tien), go to point I and notice that on Monday the pulse is held for eight beats of the pulse. If it were Tuesday, you would hold the pulse for seventeen counts, on Wednesday nineteen counts, on Thursday 21 counts, and so on, through the end of the week.

c. Then go to point 2. The point in that area would be held for seventeen counts Monday, nineteen counts Tuesday, and so on.

d. You will travel all round the navel opening the gates. After each point pause to let the effect take place and the energy settle. The daily number guide is traditional in the Taoist numerology practice for opening the Wind Gates.

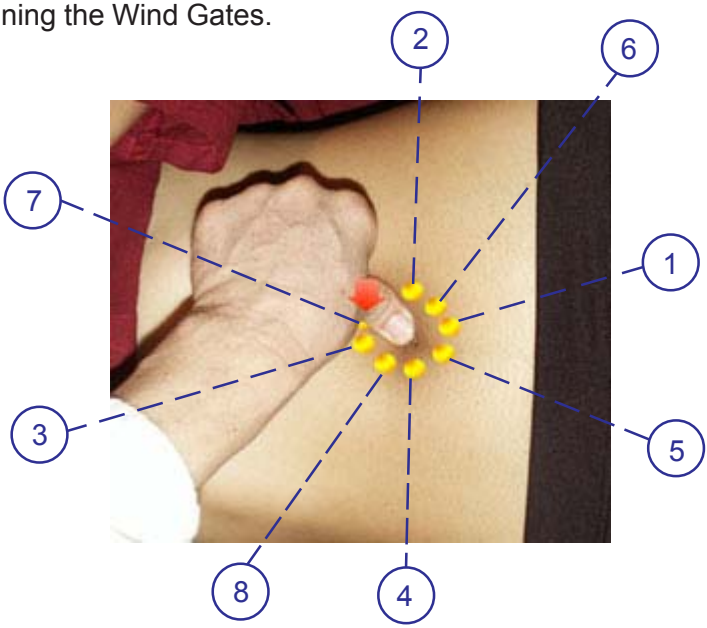

Fig. 7 *Wind Gate points are on the sides of the navel and not in the navel.*

Flushing the Blood at the Groin

a. Stand or kneel beside the student (unless the person is very large, in which case it is best to kneel between his or her legs.) Press the edge of each palm into the femoral artery pulse at the crease of each leg in the groin area.

b. One pulse will probably feel stronger than the other. In that case, press down on the pulse that is strongest. This will help bring more blood and Chi to the weaker pulse. You should feel them equalize.

c. Hold the pulse for 36 or 72 counts to stimulate the circulation in the lower abdomen and legs and break up obstructions. Some winds will exit through the legs. This procedure will open the passageways.

Note: Do not practice this technique on someone in danger of, or afflicted with, thrombosis or a severe case of varicose veins.

a b

Fig. 8 *a. Pressure Points for Opening the Groin*
b. Opening the Wind Gates of the Groin

Opening the Gate to the Sea of Winds

You may remain between the student's legs, or move to the side of the body

a. Locate the Tan Tien pulse (the Gate to the Sea of Winds) in a depression approximately one and a half inches below the navel at six o'clock.

b. Press down until you feel the pulse. Usually a thumb is used; if you are working on someone who is very fat or very muscular, you may to use your elbow to find a pulse. Whether you use your finger or elbow, be gentle and don't slip. Sometimes you cannot find a pulse; in that case, all you can do is slowly count out the number for that day (one thousand, two thousand, three thousand, and so on.)

c. Fig. out the number of pulse counts you will hold for that day. Consult the chart under "Tan Tien." On a Monday you would hold for fifteen counts, Tuesday eight counts, Wednesday seventeen counts, and so on.

d. Release the pressure after the required number of counts has expired. The student should feel energy flowing down to the lower part of the body.

e. To gain experience you should do all the points or gates on yourself as well.

Fig. 9 *Opening the Gate to the Sea of Winds*

Opening the Wind Gate to the Left Kidney - the Western Gate

a. Check point 1 on the chart to note the daily count.

b. Press the point just to the left of the navel at three o'clock until you feel the pulse.

c. Hold for the count.

d. Just before you release, direct the energy to the left kidney by using your mind and intention. The student may feel warmth and comfort spread to that area.

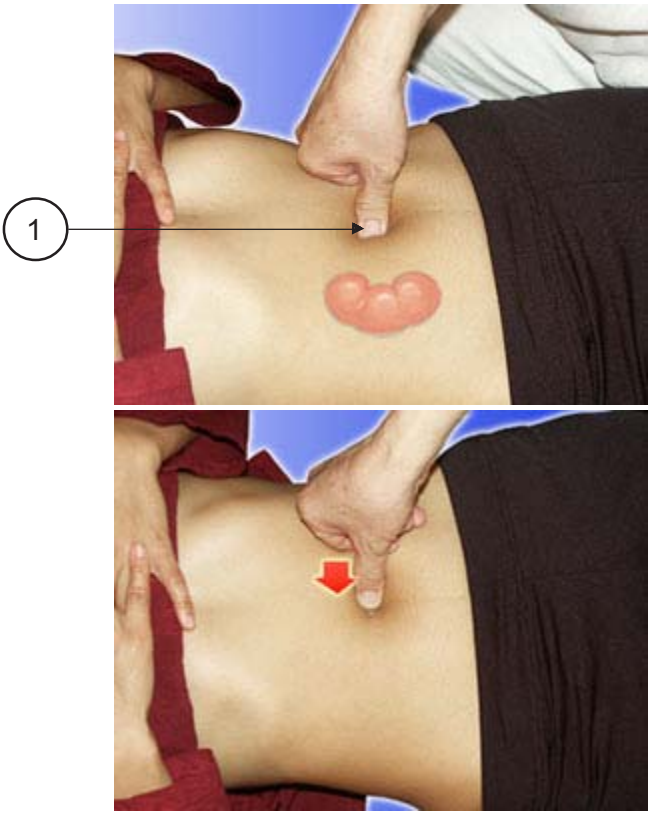

Fig. 10 *Opening the Gate to the Left Kidney*

Opening the Wind Gate to the Heart - the Southern Gate

a. Check the chart for point 2 and note the daily count.
b. Press the point above the navel at twelve o'clock.
c. Hold the count with moderate pressure.
d. Before you release, direct the energy toward the sternum. The student may feel warmth and comfort spread to the chest and heart area.

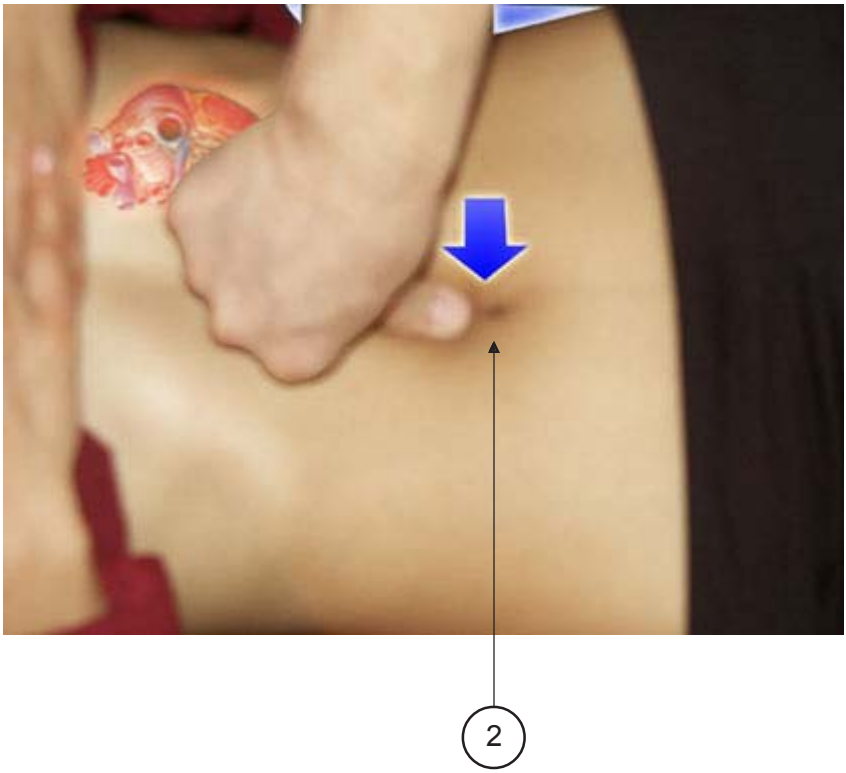

Fig. 11 *Opening the Gate to the Heart*

Opening the Wind Gate to the Right Kidney - the Eastern Gate

a. Get the daily pulse count from the chart for point 3 and press at nine o'clock.

b. Send the energy to the right kidney just before releasing.

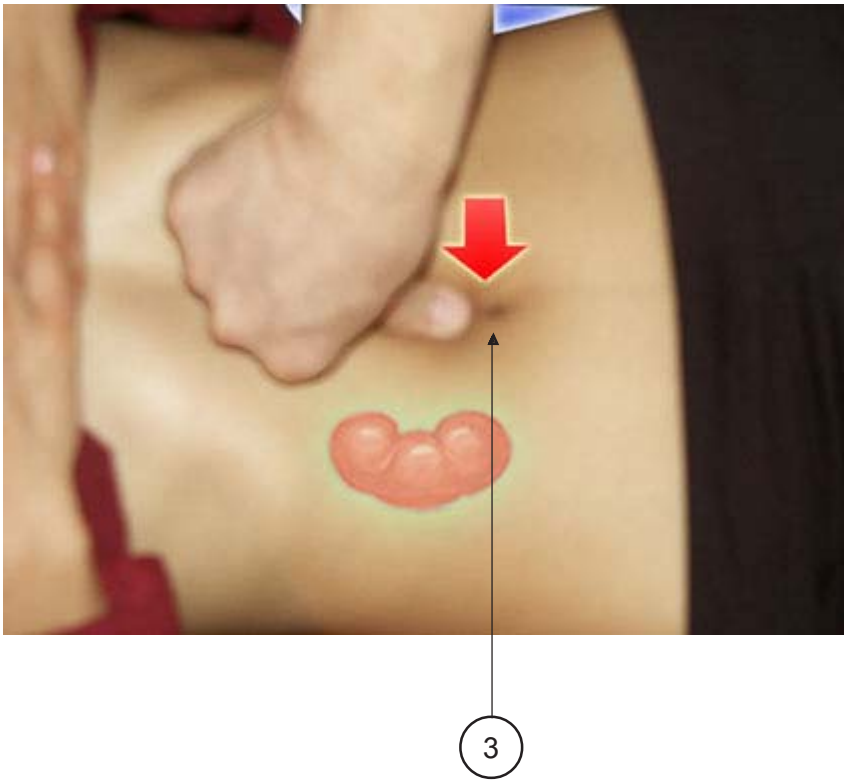

Fig. 12 *Opening the Gate to the Right Kidney*

Shape of the Navel

The Taoists learned by observing the most obvious things. They learned that it is possible to know a great deal about the condition of the abdominal area and organs just from examining the shape of the navel.

1. Examination of the Navel

Always note the shape and position of the navel before beginning a session. The navel is similar to a funnel, and it divides into three parts: the rim, the sidewall, and the bottom. The navel should be round, centered, and symmetrical. It should be firm and springy, not hard and tight, or soft and weak. The sidewalls should be symmetrical. The floor or bottom should be in the center of a circular rim.

The rim can be misshapen and off-center. The sidewall, and sometimes the rim, can be puffy, curved, high angled, or pulled in one or more directions.

The floor of the navel can be puffy and congested, or it may be very deep. It may be twisted or pulled, and may or may not include the sidewall and rim. The navel may be pulled in one or more directions. It may be vertical, horizontal, diagonal, teardropped, collapsed, blown out, or turned clockwise or counterclockwise.

With some practice, you will find that by reading the three parts of the navel, you can determine which way or ways it is being pulled. Distortion of the navel indicates the direction and location of tight, congested areas and blockages. Sometimes this will show which organs or systems are involved and at what depth.

2. Different Navel Pulls and their Effects

Imagine a pie six inches in diameter placed on the navel. Now divide that pie into eight sections. Note where the navel is pushing or pulling according to the eight directions. Notice if the navel is pulling in one or more directions simultaneously. When you learn which organs

are in each pie piece and can associate them with the distortion of the navel, you will have a very good means of determining what imbalances are present in the body.

The pulling may only affect the superficial tissues or a specific organ or system. Usually the pulling affects the body's center, both superficial and deep, and involves more than one organ or system. Remember that any pulling distorts the body's center and the first system to be influenced is the Navel Center Chi system. When the Chi system is off-center, the physical body is also off-center, creating an imbalance in the emotions, systems, and organs.

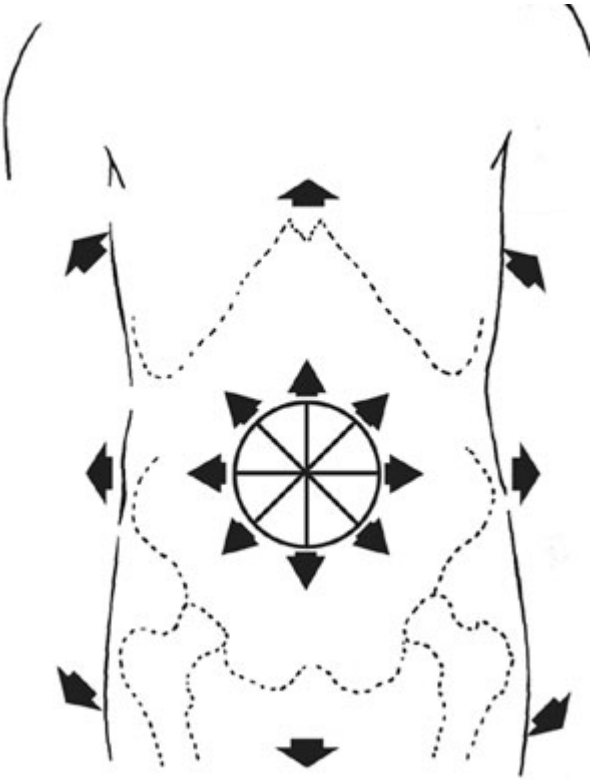

Fig. 13 *Chart for Reading Navel Pulls*

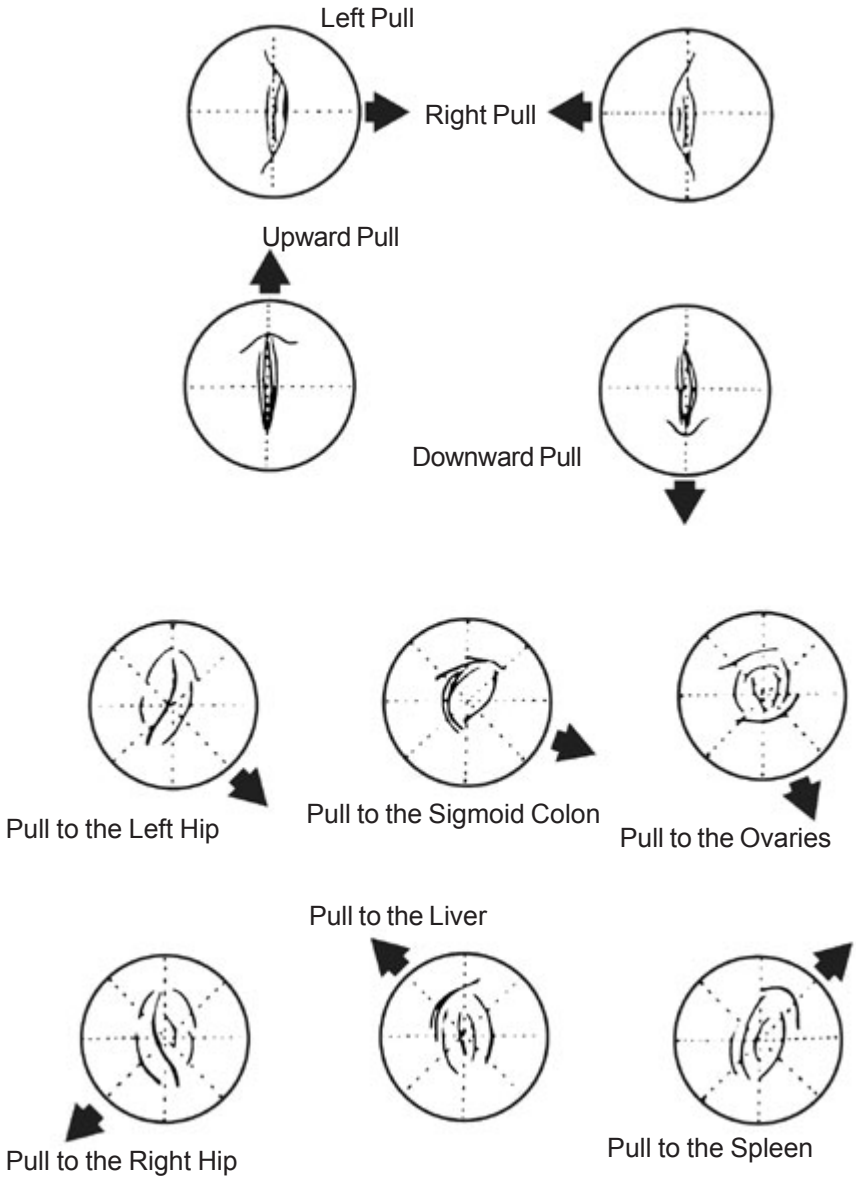

Fig. 14 *Navel Pulls*

Skin Detoxification

In CNT we treat the skin of the abdomen, starting at the navel. This is where the umbilicus of the fetus received nutrition and eliminated toxicity. As the original center of the body, the navel is still connected with all the organs. Whatever toxins the organs cannot process, they store in the navel for later detoxification.

By massaging the skin lightly and stimulating its surface, you can draw the pressure and toxicity from deep within all parts of the body to the surface. It is easier to reach the toxins on the skin to break them down. The longer you work on the skin, the easier it will be to work deeper later. The skin is a storage space for whatever extra toxicity the organs have. When you release the toxins stored in the skin, you create an open area on the skin. The organs can now release more toxins to the new storage space just made available. Instead of clearing, sometimes the skin may swell. This is because more toxins have been released from the organs to the skin. Once cleared, the skin will recover its balance.

The toxins, tightness, and tension in the abdomen also block the flow of energy from the vital Navel Center or Tan Tien. When you clear the area, the pre-natal Chi can begin to flow through the body more forcefully.

Warning and Caution: If there are any warts or moles very close to the rim of the navel, do not work on the student. This suggests that there is a serious viral problem and a doctor should be consulted. You can, however, teach the student to work on himself or herself.

1. Spiraling Technique

The Spiraling Technique is the main technique for skin detoxification. Gently use both hands on the abdomen to loosen the tissues. Begin by massaging with the thumbs, finger, or fingers together in small, tight, clockwise circular motions around the navel. The sequence for each point is to press in, spiral, and loosen the skin. Continue to

create tight, clockwise circles outward from the previous points you have worked on. This will create a large spiral, extending from the navel to the outer edges of the abdomen. Although this procedure mainly influences the small intestine, the clockwise direction also follows the path and motion of the large intestine, the body's "great eliminator." With this movement toxins are encouraged to pass from the body. This technique is especially powerful for breaking up a constipated large intestine.

Conversely, if your student has diarrhea problems, you should teach him or her how to spiral in a counterclockwise direction. This will encourage the watery waste to slow its exit, until it has formed into normal stool consistency.

If your student's abdomen is tense, nervous, hot, hard, and too Yang, this means there is excessive energy and you should drain some off. Spiral counterclockwise to withdraw the energy. Use your concentration. Ask the energy to leave. Direct it into the Microcosmic Orbit, where it can be circulated and stored safely in the Navel Center. You can also direct it to go into the Navel Center.

If the abdomen is cold, soft, weak, sick, and too Yin, this means that there is deficient energy. Spiral clockwise to add energy. Concentrate to direct some of your energy to pass from your fingertips into the student's abdomen, to help warm the area. .

When you finish the finger spiraling technique, apply the following hand techniques. You will become very familiar with these techniques, for they are used repeatedly in CNT.

2. Scooping Technique

With your fingers together, press inwardly and scoop in, or press downward and scoop out. There are many variations to the direction and use of this technique.

a. Use Two Thumbs

b. Use Four Fingers

c. Use a Single Finger

Fig. 15 *Spiraling Technique: Use the (a) thumbs, (b) fingers, or (c) finger to press in, spiral, and loosen the toxins locked in the skin.*

3. Rocking Technique

Use all the fingers to hold the abdominal muscles while rocking forward and back. Spread your fingers to cover the ascending and descending colon, or change the width and cover the small intestines.

4. Kneading Technique

Use all the fingers of both hands to scoop the intestine into the navel and central area. Follow by pressing with the heels of the palms into the navel and the central area as though you were kneading a loaf of bread.

5. Shaking Technique

Use either the index or middle finger to press on the knot or problem area. Move the finger quickly up and down or from side to side. Use two or three fingers to cover a larger area.

6. Patting Technique

Pat around the navel and the entire abdominal area with the fingers and with a soft, open palm. (Patting is generally used to finish a CNT session.)

7. Elbow Press

Remember, if you are working on someone who is very large or very muscular, sometimes the only way you can have an effect is to use you elbow. Press straight down or spiral with your elbow.

Small Intestine

The small intestine is the digestive tract between the stomach and the cecum. It is in charge of absorption and digestion. The small intestine divides into the duodenum, jejunum, and ileum. The small intestine is about twenty feet long and fills up the central space of the abdomen. Its main role is the absorption of food. It allows the digested food to go through its lining to the liver via the portal vein system, where the food is further processed before reaching the rest of the body.

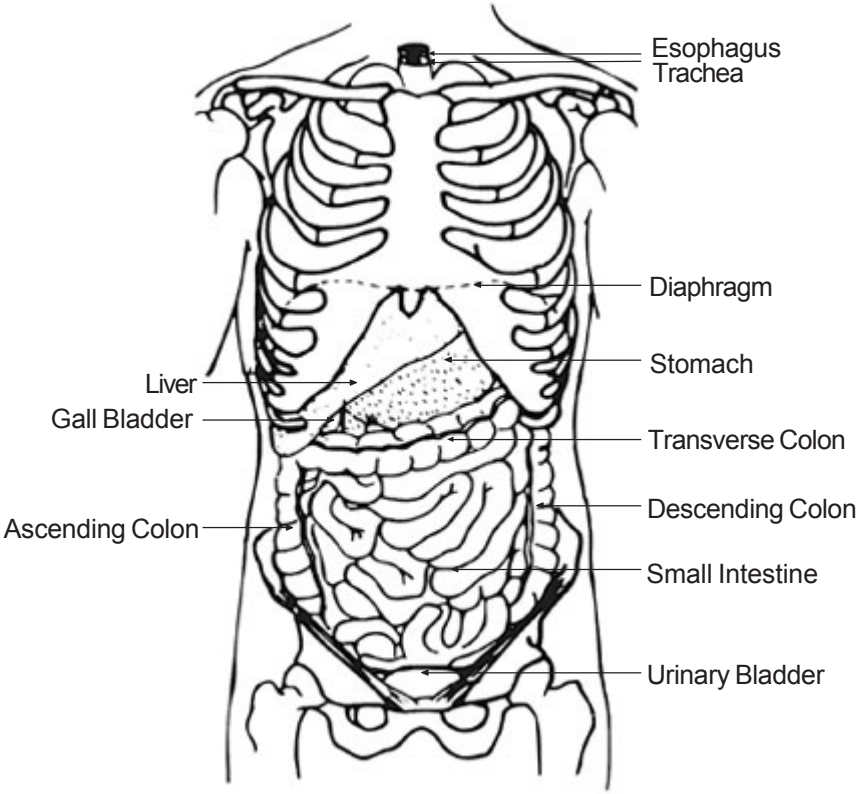

Fig. 16 *Small Intestine and Neighbors*

1. Abdominal Brain

The small intestine is in charge of digesting emotions as well as food. Different contractions of this intestine correspond to undigested emotions. In Chinese medicine it is called the abdominal brain. All negative emotions are expressed in the small intestine by contraction and circumvolutions. Anger contracts the right side of the intestine near the liver. Worry affects the upper left side near the spleen. Impatience and anxiety affect the top. Sadness affects both lower lateral sides. Fear affects the deeper and lower abdominal areas.

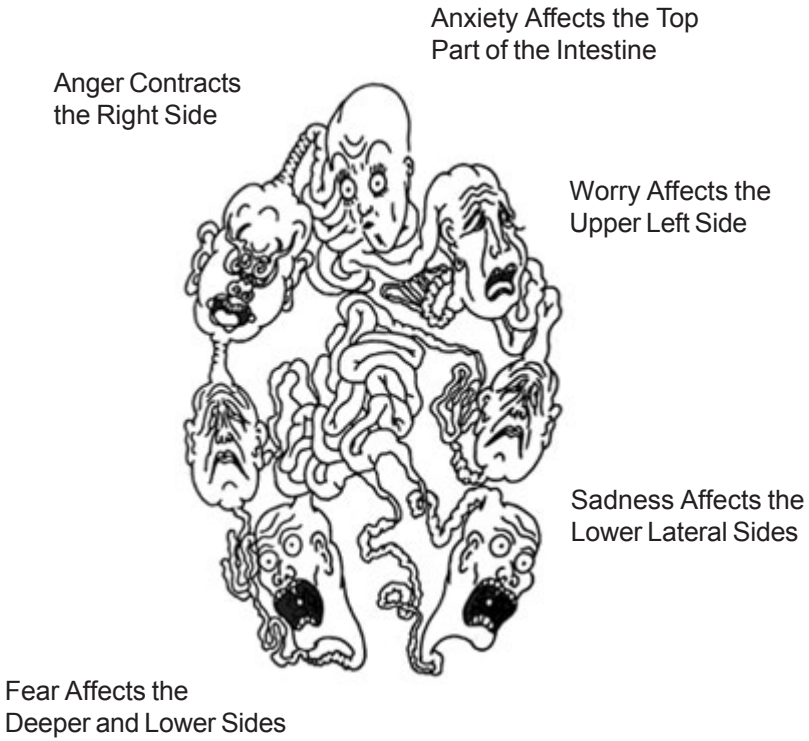

Fig. 17 *Effect of Negative Emotions on the Small Intestine*

2. Toxins in the Small Intestine

Toxins travelling inside the intestines are still outside the body, since they do not penetrate the membranes of the digestive system. They are on their way to being eliminated. These are toxins that have not been digested or broken down by the stomach and its digestive juices into particles small enough to go through the digestive membrane and into the blood system. When the intestines become too crowded with toxins the speed of digestion will slow down and the absorption function of the small intestine will be impaired. The intestine will become congested ant cannot perform all its physiological functions. Though you may eat well, you may be undernourished.

3. Healthy Small Intestine

A healthy small intestine can be covered with one spread hand When touched, it should feel even and soft. It should move easily, painlessly, and give way to the fingers without creating any muscle reflex reaction. It will move back to its normal position after releasing the pressure. A light small intestine will be firm when touched and will often allow you to feel the pulse of the aorta very strongly. A loose and weak small intestine will be unevenly shaped and filled with bubbles gas and fluid. Often some parts are too tight and others too loose.

Fig. 18 *A healthy small intestine can be covered with a spread hand and should feel soft and even.*

4. Small Intestine Techniques

Working on the small intestine is of primary importance to the practice of CNT. Any congestion, toxification, or stagnation, including trapped emotions, will inhibit the Navel Center from supplying the rest of the body. These are not only techniques; they involve using your personality and spirit. When you push in to massage and spiral your student's stomach, you may feel your stomach being massaged and spiraled as well. You attach the spirit of your intestine to his or her intestine and connect your healing energy as well. It will take some time before you can do this well, but start trying immediately. The small intestine work is very much like playing and should be approached with a bubbling kind of joy. If you are tight, it is transmitted to the student. Therefore, you have to be very grounded, safe, comfortable, relaxed, and spontaneous.

a. If the student's abdomen is very hard and so painful that you can hardly touch it, you will have to be softer and more patient. Your fingers can only skim over and lightly touch them with a feathery pressure. You can lay the whole surface of the palm or the heel of the palm on the skin and gently spiral it. After some time it will start to soften. The harder the abdomen, the softer your finger should be. If you want to go in deeply, your fingers must also be soft.

b. Practice deep skin detoxification and use the Wave Technique.

c. When doing the Wave Technique, your fingers may feel one area of the intestines is tighter than another, or you may feel knots. This could be chronic contraction of the involuntary muscles within the tissues of the intestine, a diverticulum (a pouch or sac), or a hernia. As long as it is not a painful spot, massaging this area will progressively alleviate the problem.

d. The small intestine has a serpentine or S-shaped design, with one curve of it lying on top of the other. When you detoxify the intestine, use the basic spiraling techniques of the fingers, but try to feel and follow its sinuous design. When your fingers come to a "switchback," shake it until it feels loose. This will help to move the food (chyme) and activate the intestine.

e. Work with short, bubbling bursts, back and forth, counterclockwise and clockwise half spirals. You can use a left-right-left-right, one, two, three, four motion or longer sets. Always end by pulling the fingers and energy toward the cecum, which is where the contents of the small intestine flow into the large intestine.

f. Keep working until you have stimulated the entire small intestine.

g. Cover the small intestine with your hands and have the student breathe into your hands. Both of you do the Inner Smile. Breathe with the student. Fill yourself with light and exhale through your hand into the student as he or she inhales. Teach the student deep abdominal breathing.

h. A good time to work on your own small intestine (and all other areas) is when sitting on the toilet. You can bend over, lean into your finger, and probe deeply.

Work in clockwise and counterclockwise half spirals.
Always end by pulling the energy toward the cecum.

Fig. 19 *Working on the Small Intestine*

Open the Large Intestine

Many of the problems with the large intestine occur at the cecum/ ileocecal valve or at the sigmoid colon. Your palpation of these areas should indicate the problem. If the problem is in the sigmoid area, don't start there but work around it. Never work directly on a painful area (in the large intestine or anywhere else); prepare a place for the pain and congestion to go. To release the congestion in the large intestine, start at the left side of the rib cage at the splenic bend. This will release congestion there and make room for more congestion coming from the problem area.

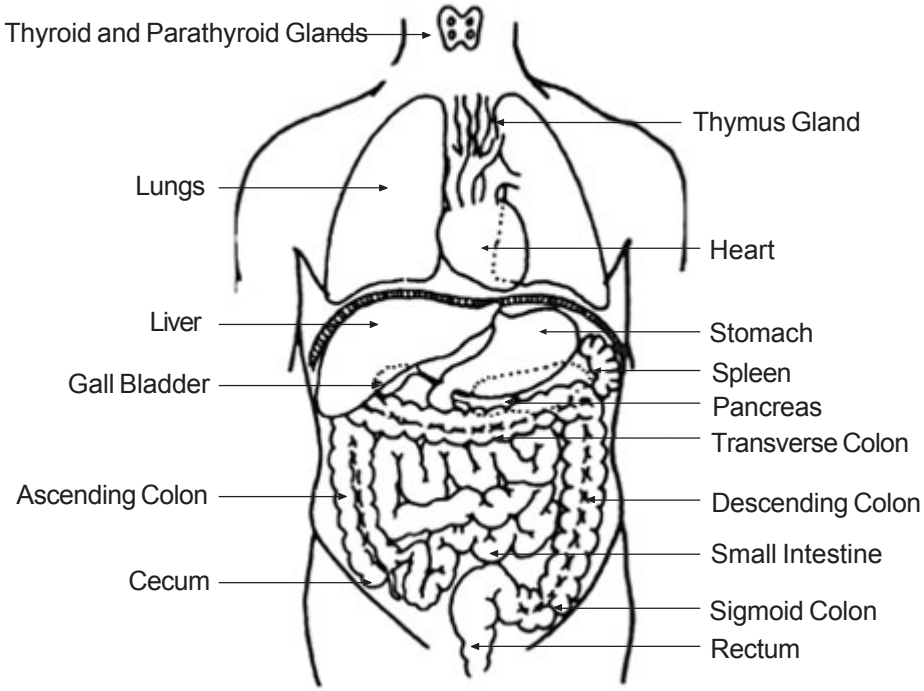

Fig. 20 *Large Intestine and the Viscera*

Relaxing the Diaphragm

The diaphragm is a breathing muscle attached to the lower portion of the rib cage and anchored to the spine in the lumbar region. It is shaped like a dome and projects up against the heart and lungs. Upon inhalation it pushes down against the abdomen, creates a vacuum in the chest, and allows air and Chi to fill the lungs. If the diaphragm becomes tense or stiff, which it often does when one feels inhibited, it interferes with the ability of the lungs to breathe fully and deeply.

The lungs are called the Sea of Chi. Chi in the lungs drawn from the air mixes with Chi derived from food (by the stomach and spleen). Together they form the blood and nutritious Chi which service all the functions of the body. A deep breath also draws Chi to the lower organs, to the kidneys and bladder, and especially to the large intestine. The large intestine gets energized this way. If it does not have energy, it will not be able to do its elimination work.

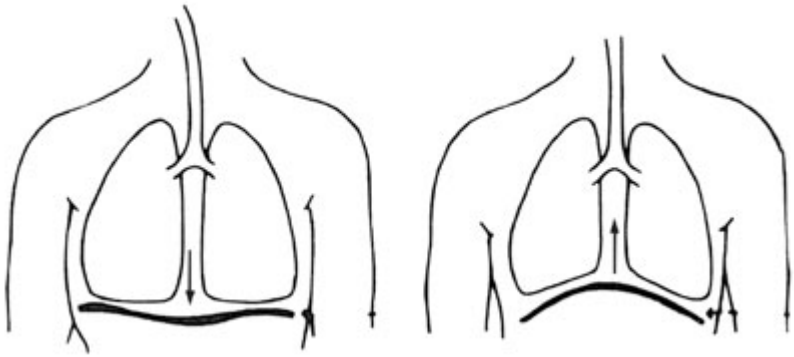

During inhalation, the diaphragm goes down. When exhaling, the diaphragm goes up.

Fig. 21 *Front View of the Diaphragm*

1. Abdominal Breathing Exercise

a. To practice abdominal breathing, keep the chest very relaxed. This may be difficult at first, but it is important.

Begin by breathing in and drawing the air into the abdomen. It may help you to imagine that you are first breathing into the coccyx, then the sacrum, and then up each vertebrae of the spinal column.

b. Make the chest hollow and drop the diaphragm down. You will feel pressure inside the abdomen which will begin to protrude on all sides in a rounded shape. Do not expand the stomach only. With the diaphragm lowered and the abdomen filled with air, the space containing the abdominal organs is minimized, and the organs massage themselves.

c. Expel the breath by drawing the abdomen up, squeezing in on all sides of the abdomen, and forcing the breath out of the nose.

2. Technique for Releasing the Diaphragm: Creating a Space

a. As in every CNT session, start massaging around the navel to loosen the tightness. This will prepare a place for the breathing when the abdomen does start to expand. Sometimes you will encounter an abdomen that is contracted and full of toxins and tension. Your student will hardly let you touch the abdomen; it hurts too much. Imagine what his or her breathing pattern is like. There is no way they can do deep abdominal breathing, even if they knew how. It's too painful. This is common. If you meet a student with an abdomen in this condition, you can be sure that you will need to do diaphragm work. This is a worst-case scenario. Even when you work on diaphragms paired with healthier abdomens nearly every one will need some work.

b. When the large intestine is full or constipated, it will push up into the diaphragm, lungs, and heart. Release the intestine, starting from the lower left side of the rib cage, along the descending colon, near the splenic bend. Then start working across the transverse

colon, under the right side of the rib cage, loosening the area. Be conscious that you want to work back toward the beginning of the large intestine, which is at the ileocecal valve.

c. Place one hand on the left side of the rib cage, while the other penetrates under the ribs to lift them while breathing in.

d. The hand on top of the rib cage will be pushing down while the student is exhaling. The range of motion of the ribs will be increased, because you will be progressively releasing the tensions in the inter costal muscles. If the tension is severe, you may have to use the technique for loosening the rib cage described for asthma treatment .

f. Work on the right side.

g. Start at the lower left rib cage and work your way to the lower right rib cage. Use your fingers to press down all along the edge of the rib cage.

Fig. 22 *Releasing the Diaphragm Using Both Hands*

Hand Techniques for the Lungs

a. Working with the Left Lung First

Always start by removing any congestion in the splenic bend under the left rib cage. Use the Figure Five Technique outlined in Chapter Five.

b. Lung Detoxification

Reach progressively under the left rib cage to stimulate the lung area. Then hold the left LU-1 or LU-2 on the Lungs' Channel below the clavicle. Press in firmly and stimulate it with your fingertips. Have the student breathe the Lungs' Sound (***Sssssssss***) into your finger a few times, until you feel the lungs' energy activate on the meridian. When it is activated, you can feel a pulsing in LU-1.

Fig. 23 *Lung Detoxification—Exhalation Phase*

c. Exhalation Phase

(1) Place one hand on the upper rib cage and the other hand on the lower rib cage. When working on a woman, place one hand above and the other hand below the breast.

(2) The student inhales using deep abdominal breathing. When the lungs are full, rock the rib cage. Upon exhalation push the rib cage toward the opposite side.

(3) Upon completion, hold and press momentarily. Then follow the inhalation with a gentle, but firm pressure of the hands. Return to the starting position and begin again to rock and shake.

(4) Repeat for three to five breaths. Note that you may also rock the rib cage on the complete exhalation as well.

d. Inhalation Phase

(1) Begin this phase with the same hand position. This time start in the full exhalation position. Rock the exhaled rib cage and ask the student to do deep inhalations.

(2) While the student is inhaling, hold the pressure on the rib cage and ask him or her to breathe into your hands.

(3 When the student reaches full inhalation, keep rocking and maintaining pressure. Follow the exhalation to the starting point of inhalation, repeat for three to five breaths.

(4) On the last inhalation, ask the student to inhale deeply and quickly. When the student reaches full inhalation, remove the pressure, but not the contact of the hands from the chest. Allow the chest and lungs to overfill with air.

(5) Use this technique for the right lung as well.

Liver Hand Techniques

Liver work starts with making space by releasing the congestion of the large intestine. The large intestine, which runs over the liver at the liver bend, needs to be clear, or you will not be able to work on the liver without pain. Clear the large intestine from the ileocecal valve to the sigmoid colon. This is important for clearing the flow of the liver meridian that runs right through the ileocecal valve around the testicles and the ovaries. This is the only way to affect the part of this channel that runs deep and is not accessible to acupuncture needles.

a. Make small, circular motions with your fingertips on the liver, searching for the hardened spots. These hard places are areas where there are accumulations of toxins. As these toxins leave, the liver has more room and energy, allowing it to function more efficiently, and the health improves.

b. When you find a place that is unyielding, spend more time there, working until it becomes softer. Remember not to release too many toxins at once. Ask for feedback from the student. Talk, and watch the eyes for signs of pain. If the student falls asleep, listen for groans and moans.

c. To work on and drain the lower part of the liver, switch from using the fingertips to using both thumbs together or side by side. Place them underneath the lower right side of your student's rib cage. Let your fingers rest gently on top of the ribs.

d. Press in and rock up with both thumbs under the right rib cage reaching into the liver. Scoop in and down with both thumbs releasing the lower edge of the liver and creating a pumping action as you work. Move along the lower border of the rib cage. Proceed slowly and be gentle. Make small circles in a spiral motion, working upward toward the common bile duct. Move slowly, but go deep enough to meet the liver tissue. Loosen any knots or tightness. Have your student do the Liver's Healing Sound (***Shhhhhhhh***) and breath directly into the tension. Remember to be gentle.

You will be working further up the liver, underneath the rib cage. Whenever you can, change the angle of your thumbs so that you can contact more of the liver tissue. Again, be cautious and go slowly. You can go over the area several times, adding more pressure and going deeper each time. Work until you reach the gall bladder.

e. To work the upper part of the liver, start with your hands positioned to the right of the xiphoid process.

f. Use one hand on top of the other for guidance and support.

g. Use the fingertips to move underneath the rib cage, sweeping toward the gall bladder. Working this area will activate the heart. The upper lobe is just beneath the heart and right on the heart reflex point. When the liver overheats, it will heat up the heart. Make sure you do not stimulate too much heat in this area.

h. Have the student do the Liver's Healing Sound through the whole process, but when you work near the heart reflex, practice the Heart's Sound (***Hawwwwww***). This will counteract the tendency to overheat this area.

i. When finished ask the student to push your fingers out with his or her liver and Chi.

Liver Pumping Technique

The liver is like a sponge, since all of its cells either filter or store. When you use the pumping technique, you work its sponginess and help the liver in its work. The Liver Pumping Technique is as follows:

a. The right hand is stationary. It is positioned with the right thumb under the lower portion of the rib cage and the index finger pointing toward the sternum.

b. The left hand is placed on top of the right ribs over the liver and does the pumping action. This is a gentle downward motion toward the navel or the left hip.

c. Pump several times, coordinating with the exhaling breath. This technique is very relaxing. Remember to follow the rhythm of your student, rocking your body to create the movement.

d. Keep your body and hands relaxed throughout.

Pancreas Massage Technique

a. Place the fleshy, knife edge of the palm on the head of the pancreas at the centerline, and press deeply into it. Apply as much pressure as the student can take. If possible, apply extra weight with the other hand resting on the working hand. If you are working on a sugar addict or alcoholic, the area will be very painful. Remember the rule is to be gentle and to go slowly. The harder the pancreas is, the softer the massage should be.

b. Apply a rolling pressure with the edge of the palm and fingers. (Caution: Pump toward the body's midline so that stones or crystals do not enter the spleen.) As you get to the narrow end of the pancreas near the lower left rib cage (where the mass of the pancreas decreases), the pressure you are exerting will decrease as the tips of your fingers tail off.

c. Together you should do the Spleen's Sound (***Whoooooo***) during the massage.

d. When working on yourself, use the basic two-handed spiraling technique. If you are sitting and leaning into your fingers, you can apply pressure.

Fig. 24 *Working on your own Pancreas and Stomach*

Fig. 25 *Spleen Detoxification—Spiraling with the Thumb*

Hand Techniques for the Spleen

a. First remove any congestion in the large intestine at the splenic bend.

b. Use your thumbs or fingers to spiral in the spleen area. The spleen is deep so add weight by pressing down on the thumb or fingers using the other hand.

c. As you reach the level of the spleen under the left rib cage, you should not encounter any hardness because the spleen is soft tissue. It is unlikely that you will be able to feel it. However, you should take time to work at length on it to improve its natural function and increase its pumping action. Massaging the spleen will help it to pump blood in and out and thus increase its cleansing effect on the blood. The massage will also increase the energy level in the spleen/pancreas meridian system and spread its benefits to the entire lymphatic system.

d. Have the student push away your fingers with his or her spleen and Chi.

e. Use the Baking Technique with one hand on top of the spleen and the other beneath it (on the back).

Hand Techniques for the Heart

Massage the heart area with one hand while pressing Heart-7 on the wrist with the other hand. This will sedate and slow down the heart.

Hand Techniques for the Heart Controller

Massage the heart controller area with one hand while pressing Heart Controller-6 with the other hand. This will relax the diaphragm and stimulate the appetite.

Hand Techniques for the Triple Warmer

Massage the Triple Warmer area with one hand while pressing the Triple Warmer-5 with the other hand to calm the nerves.

Triple Warmer-5 Point

Triple Warmer-5 Point (On Both Arms)

Fig. 26 *Hand Technique for the Triple Warmer*

Kidneys Hand Techniques

a. To work on the right kidney have the student lay on the back and then twist the pelvic area over to the right so that the right hip is pointing straight up and the right knee is drawn toward the chest. Place a cushion behind the right knee to support it and keep it in position, or kneel behind the student and use your knee to support the raised hip. Ask the student to relax the shoulders.

b. Look at the area where the kidney should be. Look for an indentation or slight depression on the skin surface.

c. Use both hands and eight fingers to go into this area. You won't use all eight fingers to massage the kidney. Usually you will use just your two middle fingers with the others for support.

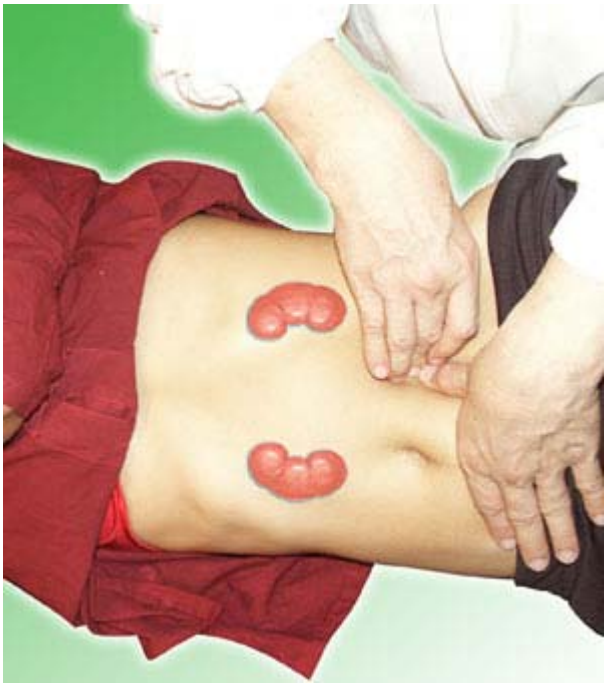

Fig. 27 *Working from the Side to Gain Better Access to the Kidneys*

d. Every kidney is different. If the kidney is normal and is not situated too low, you will only be able to feel the bottom of it. If it is in good shape, it might have the texture of a marshmallow or be just a little firmer. Inhale air to make your cheeks round and puffy. Feel the surface of your skin to feel what a healthy kidney feels like. It feels soft and gentle, but with a slight surface tension.

e. Use your student's assistance in finding the kidney. The student can guide you to the kidney and you may hear such comments as, "'That just feels like your finger nail," or, "That feels like your just pushing against my skin." When you hear, "I feel something in my back," or "You are touching it now," you can start massaging in small spirals.

f. An unhealthy kidney will feel uneven with alternating soft and hard spots. At times it is painful, and you may not be able to work on it for long. Sometimes you can't reach the kidneys because the tissue surrounding it has become very hard. In that case, gently massage this area until the congestion dissolves and you can reach the kidneys. Assign homework.

g. When you begin to use a spiraling massage with your fingers, have the student continuously use the Kidneys' Sound every time he or she exhales. Massage very gently.

h. On the average you can spend one or two minutes on each kidney, but do not spend more than five minutes maximum.

i. The question of how long this procedure should take permits us to introduce an advanced healing technique developed by a woman who is very talented CNT practitioner. You may attempt it when your energy is highly developed, and you are sure of your ability to recover and protect yourself. In a meditative state, she works organ to organ by uniting the energy field of her organ to that of her student. By doing this she knows when her fingers have reached the kidneys because she feels "something very respectful and valuable." If she finds a sick kidney, then her kidney also feels sick; if the kidney she is working on hurts, then hers hurts. When she begins to spiral her fingers, she can feel fingers spiraling in her kidney. She is constantly sending good kidney energy from her kidney to that of her student while constantly doing the Kidneys' sound with

her student. She determines when she will stop the massage and the healing process by evaluating the feeling in her kidney. When her kidney feels well again, then she knows she has helped her student to restore her own kidney to full functioning and a healthier state. The practitioner approaches each of the organs in this manner.

j. The release technique is very important. When you have finished the massage, have the student push your fingers out of her kidney with her energy and Chi.

k. After you have finished the massage, blow warm air into the Kidney. This is an early shamanistic Taoist practice adopted by Chinese healers when they started applying burning moxa on a cold area that needed heat.

Lymphatic System

1. Feeling a Lymph Node

Since maintaining the activity of the body's immune system, much of which concerns lymphocyte production and distribution, is central to the practice of Chi Nei Tsang, acquaint yourself with the lymphatic system. Note where the many lymph nodes are and where the main ducts are commonly found.

To acquaint yourself with the feel of a lymph node, you can find one under the armpit or, since the armpit can be a very delicate area; it may be easier to find a superficial node in the groin area.

a. Locate the large nerve under the artery; it will feel like a nylon cord soaked in oil. Be gentle.

b. Next find the vein; it will feel hollow, like a water hose. You can feel the blood flowing through the vein, though there is no pulse, and the pressure is lower than in the artery.

c. Behind the vein is the artery. Here you can feel the definite pulsations of the blood.

d. Finally locate a lymph node along the artery. Practice until you can find and distinguish all four things, but take care not to massage a swollen lymph node in the armpit. (The abdomen is the only area in which swollen lymph nodes can be massaged.)

2. Concentration of Lymph Nodes in the Abdomen

The largest lymph nodes are near the navel. These become very clogged because the blood has picked up toxins from the body. When a lot of toxins accumulate in this area, cells can become so toxic that they begin to die. The first step in healing is to detoxify the body.

The nodes in the abdomen are positioned in two layers. The shallow group is just below the fatty layer under the skin and the other major concentration is very deep, around the kidneys and just above the backbone. There is a tendency for more lymph nodes to be concentrated and congested in the lower abdomen than in the upper abdomen.

3. Lymph Drainage

The lymph drainage system covers the whole body. The lymph from the abdomen, lower body, and legs drains into the cisterna chyli (in the lower abdomen in front of the first two lumbar vertebrae) and from there into the thoracic duct. There it is joined by the lymph from the left side of the head, neck, and chest. The right lymphatic duct drains lymph from the upper right side of the body and from the right side of the head and neck.

Eventually, the thoracic duct empties all of its lymph into the left subclavian vein and the right lymphatic duct empties all of its lymph into the right subclavian vein. Together they drain the lymph into the heart and into the blood, and the cycle repeats itself.

4. Detoxifying the Lymphatic System

As you massage the abdomen, the lymph glands will automatically be stimulated by the motion given to the tissues. This stimulation is increased by working directly and gently on the lymph nodes.

Lightly stimulating the lymph in the abdomen will help to decongest the lymph nodes in this area. The abdominal lymph nodes and system are important because of their close connection with the intestines and digestive system and the detoxification system of the liver. Generally, eating loads everyone up with lymphatic waste (animal proteins, fats, milk). Bad eating habits damage the intestines and then the whole system. The remedy is a good diet and Chi Nei Tsang lymph massage.

Once you begin the process of draining the lymph, the body continues the process. It is not always necessary to continue working on a particular lymph node until it is completely clear. You may observe, in a following session, how that node has continued to soften, and how the entire lymph flow has irnproved. It is beneficial to point this out to your student, emphasizing the remarkable healing properties of the body and noting that the body likes a little encouragement.

a. Hand Techniques to Release Toxins from the Deep Abdominal Lymph

(1) Detoxification of the lymph toxins in the abdominal area begins by massaging the navel, first clockwise, and then counterclockwise.

(2) Do the Wave Technique until you can clear and reach deep into the abdomen. Feel for lymph nodes along the midline. They are smaller than knots or tangles. If you can feel them, then they are congested. Massage them lightly with your fingertips.

(3) Continue searching for nodes in this area especially around the aorta and vena cava close to the spine. Massage any that you find.

b. Working on the Rest of the Body's Lymph

(1) Begin by place your hands flat on the navel. Ask him/her to breathe against them while you press down. When the student exhales press down a little more, thereby activating the lymph flow into the thoracic duct.

(2) Clear the superficial lymph system in the skin by stroking the ribs. Move your hands to the lower ribs at the level of the liver. Place your thumbs underneath, pushing up from the sides in a forward motion toward the centerline. Stroke (do not rub) the skin very gently. Gradually move your way up toward the sternum.

(3) Go to the spaces between the ribs on the left side of the sternum. Place the fingertips of all eight Fingers into the spaces and, with a circular and downward pressing motion, push the lymph into the body toward the thoracic duct. Work the lower ribs first and gradually move up to upper ribs just below the collarbone. Repeat on the right side.

(4) Drain the areas above the collarbone and again direct the lymph down into the body. Place your middle and index fingers above each side of the collarbone into the hollow spaces and make a circular motion into the body, thereby draining the lymph into the vena cava.

(5) Stand at the head of your student, and turn the head to the left.

When you turn the head, cradle it in your left hand and support it so that the student relaxes. Lay the head down just before you move the lymph down from the right collarbone. It is very important to use a light, feathery touch in this area since it is very delicate. Use the fingers to drain lymph vessels from below the jaw and ear, down the side of the neck.

Drain it into the space above the right collarbone. (Do not work on anyone with a thyroid problem since this procedure can be very uncomfortable for this person.)

(6) When the lymph nodes under the armpit and around the neck are enlarged and painful, do not massage them. Wait until the pain is gone. These lymph nodes are close to the heart drainage area. Massaging them could push the infection into the bloodstream, thereby spreading it throughout the body.

The lymph nodes in the abdomen are large and numerous. Since they are far from the heart drainage area, the lymph system has a chance to deal with them. Massaging the lymph nodes in the abdomen can help improve the overall immune system.

(7) Next, turn the head to the right, cradle the head, and repeat the massage on the left side.

You can work both sides simultaneously by placing one hand on each side of the neck (with the fingertips on the back of the neck).

Make a circular motion downward, without rubbing the skin. If your hands are small, you might have to place them a little lower and do the movement a second time to work the whole neck.

(8) Using your flattened hand press the lymph nodes in the left armpit downward into the body. Repeat for the right side.

(9) Press the groin nodes towards the lower abdomen collect point near lumbar-2, also with your flattened hands or fingers.

(10) You may end by placing the students' hands over the navel and allowing rest. Thank the lymph nodes for letting you work on and disturb them.

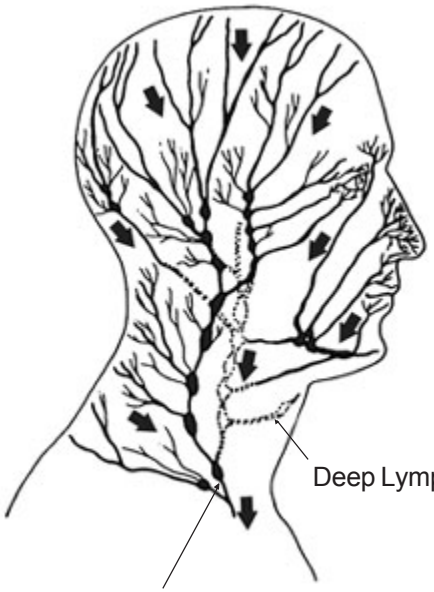

Fig. 28 *Superficial and Deep Lymphatic Drainage of the Head and Neck and Direction of the Flow*

Psoas Muscles

1. Releasing Sciatic Pains by Working on the Psoas Muscles and the Lumbar Sacral Plexus

Work on the iliopsoas muscles and the sciatic nerves goes together because they can influence one another. The accumulation of toxins and tensions in the abdomen presses against the nerves, muscles, and tendons that are coming out from the spine. This impairs communication between nerves. Tension in the muscles goes on unnoticed and the muscles don't receive the message to relax. To restore the nerves to their function of controlling the muscles, the pressure has to be relieved.

Major psoas muscles originate along the twelfth thoracic to the fifth lumbar vertebrae bones, descend through the pelvic region, and attach to the top part of the femur (thigh) bone. They form part of the posterior wall of the abdomen and help support the organs in the abdomen. They are also the flexors of the thigh. On some the psoas muscles do not descend to the thighbone, but anchor to the lower brim of the pelvis.

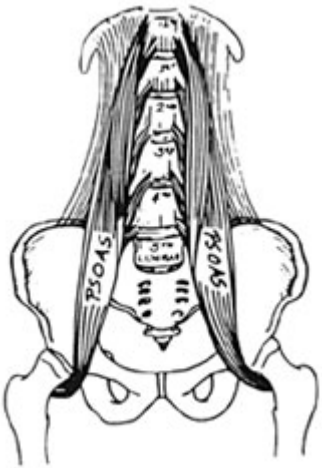

Fig. 29 *Psoas Muscles*

2. Techniques for Releasing the Psoas Muscles

a. While the student is lying down, look at the legs and feet. One leg may be shorter than the other. This indicates tension in the psoas muscle on the short side. One foot may be naturally turned out while the other is pointing straight up. The tense leg and foot indicates tension in the psoas muscle and sciatic nerves on that side.

b. Work in the lower abdomen and pelvic area and loosen any knots or tangles.

c. Press all your fingers into the area of the psoas. The psoas is very deep, and you will need the student's help to find it. Help the student to raise the knee closest to you and pull it toward the chest. Have him or her take over and rotate it, moving it back and forth while you search for the psoas. The psoas muscle is engaged by this movement of the knee and leg. You can feet it moving. This is a simple way to find it, since it is so deep. When you feel it moving, lock in on it with all your fingers lined up in a row along its length.

d. Press down and hold your fingers still. Shake your body sideways, right and left. Be vigorous; keep the fingers on the muscle so that they can massage it. If you are working on yourself, elevate and rest your feet on armchair and use however many fingers you are comfortable with. Use a standard spiraling motion up and down its length.

Fig. 30 *Place all the fingers on the psoas muscle.*

Releasing Sciatic Nerve in the Buttocks and Legs

a. With the student on his back, lift the leg closest to you toward the chest and rotate it in the hip socket. This will help set the bones in the pelvic region in their right place. You can also lift both legs at the same time. Keep the knees together and gently rotate both hips in their sockets.

b. Place the student on his or his left side. Feel for an indentation or “hole” between the gluteus medium and gluteus maximum to find the piriformis muscle. Massage and release the contracted piriformis muscle, which is close to the sciatic nerve running through the buttocks. Press straight down with the thumb or elbow. Often this area is very painful if there is a problem. If there is no pain there is no problem. It is important to spend some time working here While it is painful, the massage has a “sweet ache” to it; it hurts but the student starts to feel that he or she is going to get better. Do not forget to use your concentration to send healing energy into this area.

c. Massage down the middle line of the back of the thigh to loosen the muscle there.

d. The next position is behind the knee at the popliteal tendons. Work on both sides of the knee, since the Sciatic nerve branches into two divisions here. Massage with the thumbs on the left and right side and use your fingers to pull the tendons apart. This will stretch the tendons and muscles and release the pressure on the nerves.

e. The third position is under the inner ankle, under the bone. It is very close to Kidney-3. Massage and press it with your finger (s) or thumb.

f. End the procedure by lifting the lower leg and tapping the heel with your fist.

g. Repeat the procedure on the right side.

Fig. 31 *Stretch the tendons at the back of the knee apart so that you can reach the nerves.*

Fig. 32 *massage the nerve area below the ankle bone.*

Massaging the Uterus

(1) Place eight fingers to one side of the uterus and the thumbs together on the opposite side. Keep the edges of both hands together and aligned. Apply a deep, probing, kneading motion with this combination. Massage any tangles or twists you find and hold the uterus with both hands for a while in the center.

(2) There are often knots and tangles in the uterus and along the branches of the uterine tubes leading to it. Trapped or excessive heat often causes this. Release the heat using the techniques for removing winds.

(3) Tightness in the muscles and fasciae holding the uterus in position can also cause this problem. This congestion may cause the uterus to be slightly tilted. Use detoxification massage techniques to clear the congestion. Then cup the hands between the ovaries, gently push in, and massage the area above the cervix, removing any congestion. If during ovulation and menstruation the energy flow through this area is disturbed, pain and cramps can occur. This practice also seems to have the very beneficial effect of helping to balance the hormones.

(4) Another technique is to do gentle circular massage on the fallopian tubes.

Fig. 33 *Locating the Uterus and Ovaries*

Ovarian Massage Technique

a. Have the student pull her knees up. Search for the ovaries.

b. Use the fingers and heel of the hand in a rocking motion. If working from the right side, the heel of your hand massages the right ovary. As your hand slowly sinks in, the fingers massage the left ovary. You can add your other hand for extra weight, although one hand is heavy by itself. Do this for five minutes (or longer) and many of the conditions listed above will correct themselves. Push and pump. Do a soft rock and roll. Send them energy, talk them back to health. This is very comfortable to the student, and she will feel serene and trusting.

c. This technique works better if is it is done by another person. It is much faster than working on just one side at a time. Nevertheless, you should teach your students to work on themselves at home to maintain the work you have done. If the student doesn't do homework, the ovaries will revert to their old position after a few days. They are used to being in the same place and would like to go back. Its like an old habit. Make them feel comfortable in their new situation.

Fig. 34 *Ovarian Self-Massage*

Prostate

Blockages near the prostate gland can cause impotence. When these blockages are removed, virility may return. Toxins in that gland are usually another cause of this problem.

The prostate is right above the perineum, between the anus and the testicles, just under the skin. Massage this area as well as the testicles.

More about Headaches

Headaches are a pain. Any pain has to be taken as a warning signal that something is wrong. If you take a pain killer, you are only suppressing the signal (symptoms) and are ignoring the cause of the pain. Your body is alerting you; do not ignore it. In CNT pain is a guide to the source of the problem. Respect this pain and rest. You can save the body's energy which it can then use to strengthen the organs. Of course, people do not want to hear this; they want to keep working or playing, so they take pain killers in the belief they have no time for preventive measures.

Often, the pain is expressing itself along a specific channel when it involves a specific organ. Most channels run through the head. If the head pain is localized, study a chart of the head channels. Then you can figure out the organ that is involved with the problem. The most common causes are heat in the liver, blockage in the gall bladder, and constipation.

Tension and stress are also causes. Fear gets trapped in the kidneys and weakens them and the adrenal glands. This can create tension which causes heat in the heart. The heat rises up and creates tension and pressure in the head.

You can alleviate this pressure as follows:

1. Detoxify the skin.
2. Release the large intestine.
3. Detoxify the liver, gall bladder, and kidneys.
4. Work on the adrenal glands.

Balancing the Pulses

If you find a knot blocking the aortic pulse in the solar plexus, you may assume that the other pulses are out of synchronization. The idea is compare the aortic pulse with the pulses at different places in the body. Using it as a gauge is wise because it reflects the pulse of the heart and the center of the body. Compare the speed and intensity of the pulses with each other and with the aorta. They should be nearly the same, but can be slightly different. If they are different, check the abdominal area for blockages and begin to remove them with small circular motions using both hands. You can adjust the pulses by applying pressure on the aorta with one hand while keeping contact with the unsynchronized pulse using the other hand.

Balancing the pulses and clearing abdominal blockages may take more than one session to accomplish. You may find it easy to balance and clear them in one session, only to find that the student has incurred the problem again between sessions. Give your students homework!

Remember, releasing knots and tangles in the abdominal area has a general effect on the body. Your efforts to undo these tissues induces pressure on the aorta and vena cava simultaneously. Thus, it is easy to affect many systems and organs, either directly or indirectly. For example, if you are working on the stomach at a moderate to deep level and pressure, you are also affecting the aorta, pancreas, transverse colon, and psoas muscle since these organs are aligned in layers next to each other from front to back.

1. Hand Techniques—Practicing on Yourself

a. Check the navel area. Press into it in all directions and observe the sensations. Use your thumb to move your intestines and work your way in. Sometimes you can feel your aortic pulse deep within your abdomen. If it is off-center, try to center it using the navel massage centering technique. It is possible to align everything when you are quiet. Sometimes it may take repeated corrections before

you can center your pulse. Once you feel a satisfactory aorta pulse, follow the techniques listed below and compare, contrast, and balance it with the other pulses in the body.

b. Compare it with the wrist and other pulses. Keep the left hand on the master pulse by the navel and feel the left radial wrist pulse with the fingers of the right hand. Hold the pulse until it synchronizes and beats at the same time as the aortic master pulse. Switch hands and feel the other wrist.

Fig. 35 *Searching for Your Own Aortic Pulse*

2. Hand Techniques—Working on Another to Balance the Aorta with Other Pulses

First work on the pulses on the left side of the body, and then the right side.

a. Work from the left side of the student's body. First, locate the aortic pulse and maintain your hold on the aorta with your left hand. Then place one or two fingers of the right hand on the left carotid, feel the pulse, and gently hold until the aorta pulse and carotid are synchronized.

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Rooting Cosmic Internal Energy

Mantak Chia

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The meditations, practices and techniques described herein are *not* intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Introduction

What is Iron Shirt Chi Kung?

Iron Shirt Chi Kung is the martial arts aspect of the Universal Tao System which develops internal power and a well-conditioned body through simple techniques that build and store Chi (life-force energy). The Iron Shirt training first of all develops a body relaxed and open, strong and healthy, and structurally aligned with the forces of heaven and earth. The Iron Shirt techniques help us to become rooted to the earth, thereby keeping the body centered and balanced. Iron Shirt offers a means of perfecting our inner selves, allowing us to reach higher spiritual levels.

Chi Kung is a form of internal aerobics that involves mind and Chi power and breathing exercises.

The term Chi Kung means: “the skilled use of energy”. It teaches us how to detoxify and clean out the body in order to stimulate the flow of energy and all fluids through the body. It also teaches us how to draw in the energy from outside, to pack and condense it and to circulate it in and around the human body as a protection.

Chi Kung can also be translated as “practicing with the breath”, and includes any exercise that uses breathing to energize the body. Breathing, which is the act of gathering the energy from the environment, is one of our most important bodily functions. The physical breath activates the Chi, also known as subtle breath, which generates increased physical and psychic strength (see the booklet *Tan Tien Chi Kung*).

In Iron Shirt Chi Kung we use the breath to pack the organs, glands, muscles and bones with so much Chi that they will stay healthy and strong and resist aging and disease. This will release long held tension as well.

All the Chi Kung movements and breathing exercises should be done mindfully in order to reach the deeper emotional layers of your body. These emotional layers can cause tension and blockages in the physical body. If you are not aware of this, the breathing exercises and movements of the Iron Shirt will intensity the blockages as well as the emotions themselves.

The real point of Iron Shirt Chi Kung is to prepare the body to receive higher spiritual energies.

The Core Iron Shirt Chi Kung training consists of:

- Packing breathing process.
- Iron Shirt postures.

Main goals are to develop:

- Centering and Rooting power.
- Structural alignment with the earth and also with the heavenly force.
- Internal power.
- The ultimate goal is to prepare the body for the higher spiritual energies.

As stated in Chapter 78 of the Tao Te Ching

When people are born, they are soft and gentle.
When they die, they are stiff and callous.
When myriad things, grasses and trees, are born, they are soft and tender.
When they die, they are withered.
So stiffness and callousness are the company of death.
Softness and suppleness are the company of life.
The powerful army will not win.
A stiff tree will break.
So stiffness and power stay below.
Softness and suppleness stay above.

Iron Shirt Breathing

Breathing, which is the act of gathering energy from the environment, is one of the most important bodily functions. It is used in Iron Shirt to strengthen the internal organs and glands by increasing the Chi energy pressure (pounds per square inch) around them and in the Tan Tien and the spine.

Iron Shirt breathing techniques provide a longer, deeper, more relaxing breath cycle and sufficient oxygen to cleanse the body of waste materials, sediment, and toxins that have accumulated in the organs. The increase in circulation also provides enhanced nourishment for the organs. The circulatory, lymphatic, nervous, and endocrine gland systems are all activated, and blood, spinal fluid, and hormones flow more easily to reduce the work of the heart. Sexual (creative) energy, another source of life-force, is also used in this process to enhance the body and produce spiritual energy.

Packing Breathing

Packing Breathing is the most important breathing technique in the Iron Shirt practice. It is used in all the related Iron Shirt postures. “Packing” condenses energy into each individual body section to increase the Chi/air pressure, especially in the abdomen, the glands, the organs, and the fasciae around the organs. Chi pressure will help the organs to hold their shape and lift the organs to their own positions so that energy can flow easily. Thus, the Chi pressure serves as an energy charger for the organs and the fasciae. After you practice for a period of time, you will feel a permanent flow, vibration and a suction of the Chi inside the Tan Tien, your lower abdomen.

Tan Tien Chi Kung teaches the packing process in the abdomen (Tan Tien) in a more elaborate way. (see the *Tan Tien Chi Kung* booklet).

The principle of Packing Breathing is to compress the abdomen from three directions: above (from the lowered diaphragm), below (from the upward pull of the perineum/sexual organs, also the uterus and the prostate gland) and in front (from the abdominal wall). It reduces the space in the abdomen and packs and condenses the Chi there. The packing process should be done carefully and without strain. Always breathe through the nose from the lower abdomen and exhale slowly (in some exercises through the mouth) in all the Universal Tao breathing techniques. Be sure to keep the diaphragm down, to sink the rib cage and the sternum and to relax the chest during the Packing Breathing. Keep your heart soft and gentle. Feel the Yin in the Yang fire of the heart. And keep the tongue against the palate during the packing process.

In Packing Breathing we use small sips of air (a small part: 10% of the whole breath) which is like sucking up the breath from the lower abdomen. We sometimes refer to it as “part of the breath” or “inhale more” or as “a little bit” and when you are trained you can also use a breath we call “inhale without inhaling”.

You can increase the suction in your abdomen as follows: Inhale, exhale, flatten down the stomach, hold the breath, and very lightly pull up the anus and the sexual organs (especially the uterus and the prostate gland) a few times, until you feel a suction. The uterus and prostate gland will work like little pumps.

Practice

We start the “Packing” with the Energizer Breathing. It is always good to relax yourself first with calm, deep, and smooth abdominal breathing and to activate the Tan Tien Chi.

1. Start with bellows breathing. Inhale slowly but forcefully. Keep the chest relaxed and feel the area of the lower abdomen below the navel and in the perineum bulge. Exhale forcefully, flatten the stomach and feel the pull of the pelvic and urogenital diaphragm and the sexual organs. Regulate this breathing to a steady, strong pace 18 to 36 times.

2. Exhale very slowly down to the navel and flatten the stomach towards the spine. Exhale once more and lower the diaphragm; exhale once more and pull up the sexual organs and the anus. Hold for a while and feel a suction in the abdomen. In the next stage, we continue with reverse breathing.

3. Packing Breathing/building Chi pressure.

- Inhale part of the breath down to the navel, suck in the abdomen and put pressure on the navel. Relax the chest and the belly and keep diaphragm down.

- Inhale more; enhance the suction, relax and pull the left and right anus up to the left and right kidney, put pressure on the kidneys and wrap them with Chi. Feel the kidneys and the Door of Life expanding. Hold the breath.

- Inhale without inhaling and feel the suction in the abdomen sticking in the sexual organs and the anus. Relax and press the Chi down into the lower abdomen. Hold the breath.

- Inhale and suck in more, relax and press the Chi down to the perineum. Feel pressure in the perineum and the whole lower part of the abdomen.

- Continue inhaling without inhaling while enhancing the suction in the Tan Tien, sucking in the sexual organs and anus even more and sealing them.

- Hold this as long as you can. If possible, inhale more, and exhale then very slowly and smoothly. Keep the pressure. Relax and let/feel the Chi flow into the organs and fasciae, inflating them with Chi. Feel a suction in the Tan Tien and feel the Tan Tien Chi breathing and vibrating.

With this breathing method, the organs become packed, compressed and strongly massaged.

Normalize your breathing by doing abdominal/Energizing Breathing, circulate the Microcosmic Orbit for a few rounds and brush down the excessive energy from the chest. Walk around and shake out the arms and the legs.

Always remember: Do not use force. Relax the chest, and let the rib cage, the chest, the sternum and the diaphragm sink down.

With Packing Breathing you should remain soft inside. If you feel uncomfortable and can no longer hold the breath, exhale a little bit in between, but maintain the pressure.

Do no more than three cycles of Packing Breathing a day in the beginning.

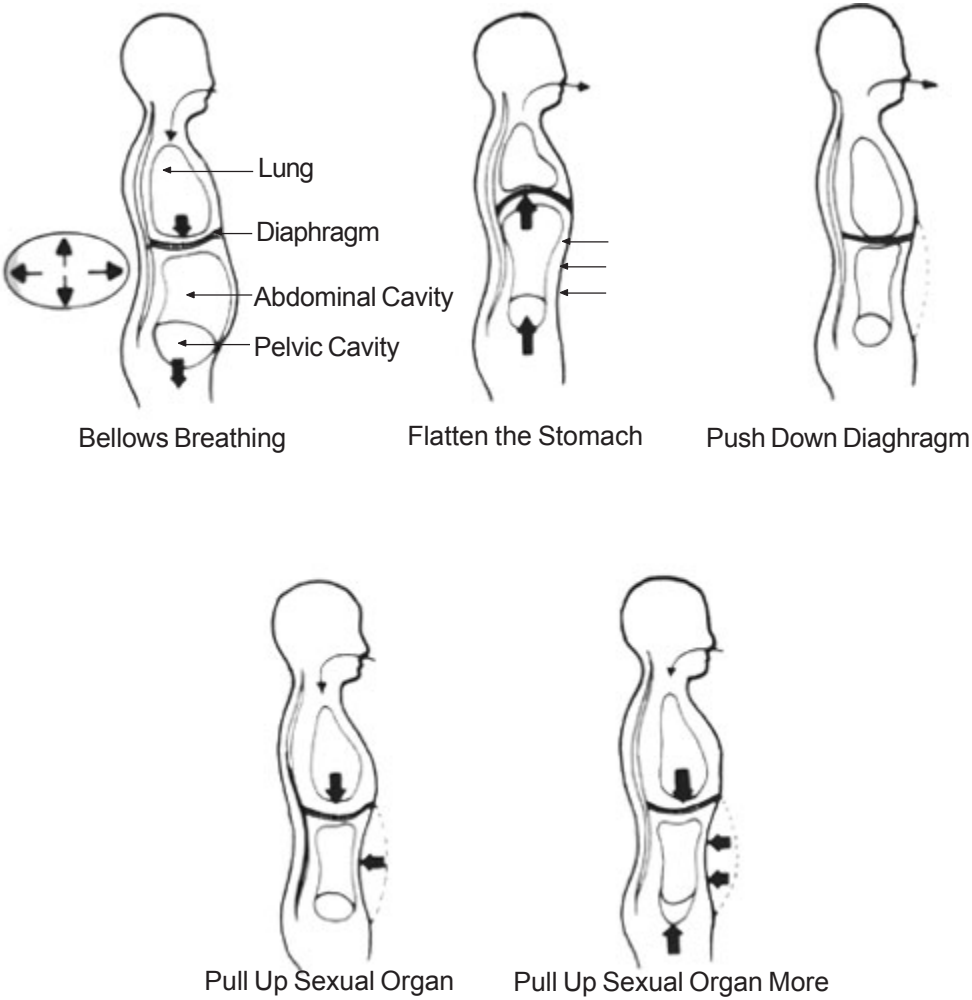

Fig. 1 *Packing Process Breathing*

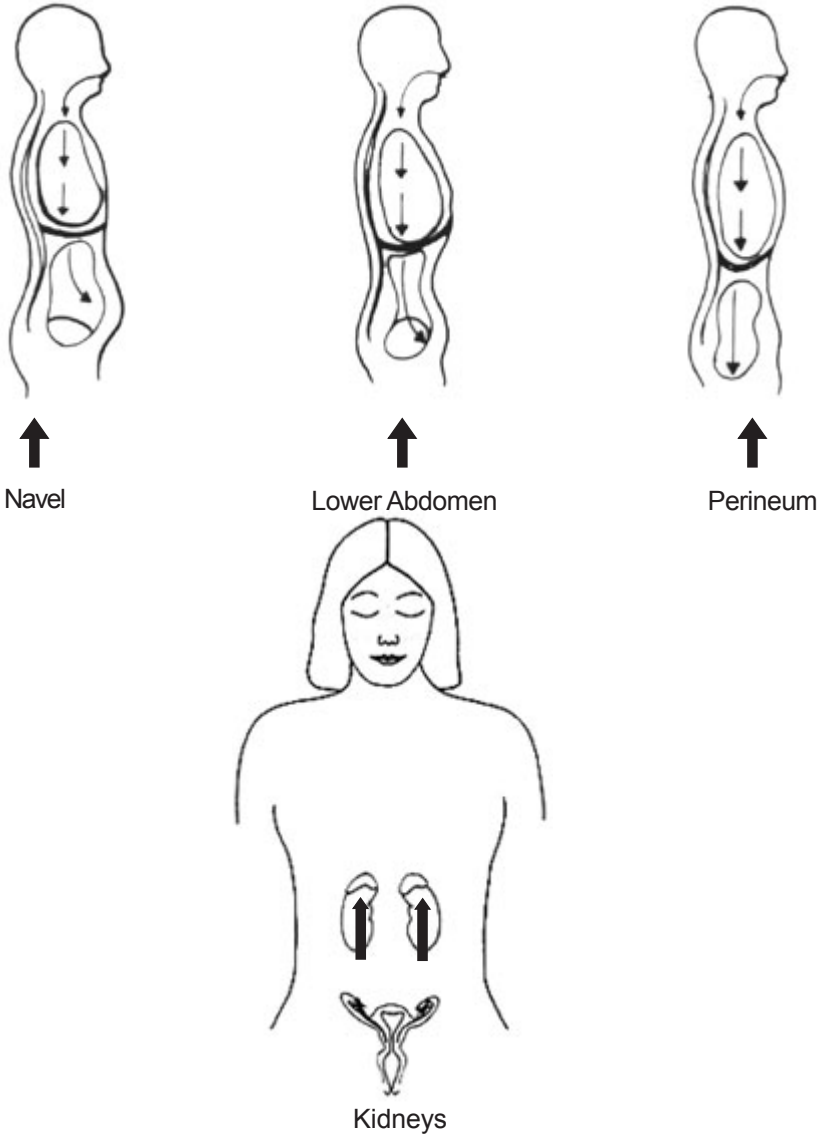

Fig. 2 *Packing Process Breathing*

Precautions

The following is a warning to all practitioners, especially those with high blood pressure, emotional instability, heart or chest pain, or any acute illness.

1. If you have high blood pressure, check with a doctor before attempting to practice Iron Shirt. Do not do the exercises and breathing techniques strenuously.

2. Women should not do Iron Shirt breathing during menstruation, but may practice the structure, standing meditations, and Bone Breathing. If pregnant, do not practice Iron Shirt Packing Breathing; use only Energizer Breathing and standing meditation.

3. Be sure that the diaphragm is lowered while practicing these exercises to avoid accumulating energy in the heart and to facilitate the flow of the Microcosmic Orbit. Do not pack the chest as this can cause energy to congest there, which can affect the heart. Again, you should always relax the chest.

4. Always breathe into the lower abdomen and perineum to avoid trapping negative energies in other parts of the body, especially in the brain, the heart, or the liver.

5. After practicing the postures, be sure to place the tongue on the roof of the mouth to connect the Microcosmic channels so that all energy from the head can be drawn down through the Functional Channel to the navel for storage. Do not leave energy in the head or upper body.

Iron Shirt Postures

The Iron Shirt Chi Kung consists of five standing postures. There are many standing Chi Kung postures. Master Chia has taken the essence of all these postures and distilled them into five postures. Every posture teaches:

a. To align one's muscular skeletal structure with the gravity of the earth and with the forces of heaven. Each posture presents a slightly different energetic variation and teaches a new alignment skill.

b. The packing breathing in different postures to increase the Chi pressure, especially in the abdomen, organs, glands and spine and to improve the rooting.

c. How to test the structure and the rooting in the different positions. The Embrace the Tree position is the most important position, because it teaches the basic alignment of every standing position and of Tai Chi Chi Kung.

Horse Stance and Embracing the Tree

1. Position

A. Stand Shoulder Width and the Feet Parallel

B. Distribute the Weight of the Body Evenly over all the Nine Points of the Feet

"Claw" the ground by gripping the earth with the toes, particularly the big toes. The human body is like a tree. The roots are in the feet, the legs and torso are the trunk and the arms are the branches. The inner foundation of Iron Shirt is the life force, the outer foundation the feet. The feet support the whole body's weight, and at the same time they connect with the earth force. Feel the Tan Tien Chi pushing down.

You must feel that the weight of the body is evenly distributed over all nine points of the feet. Check and feel which parts are too tense or have too much pressure on them. This can cause the body to misalign and the spine to tilt to one side.

C. Relax the Soles of the Feet and Turn the Big Toes Slightly Inwards and Root the Feet

The second toes should point straight ahead, while the outside of the feet stay parallel. This will help to open or keep the sacrum open by rounding the pelvis. Feel that the rounding of the pelvis corresponds with the circle around the toes/feet.

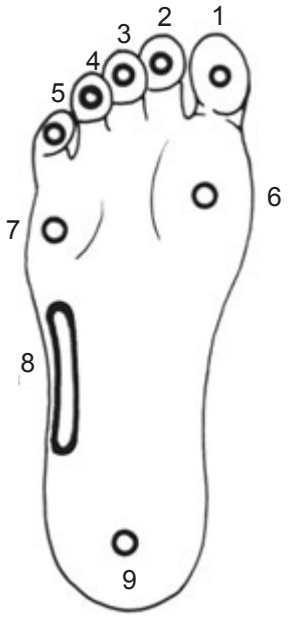

Fig. 3 *Nine Rooting Points of the Foot.*

When the soles are open and relaxed, you can feel the soles "sucking" and having a connection with the ground. Turning the feet inward will help to make the connection between the tendons of the big toes and thumbs and of the small toes and the pinky fingers, thereby increasing your rooting power. Note that if, at this point, the toes and the balls of the feet were raised, you would have no rooting.

D. Align the Ankle and the Knee Joints

Let all the points of the feet especially the big toes, press firmly with the same weight into the ground and twist the ankle joint very slightly outward. If one can properly press the soles of the feet in the earth and gently twist the ankle joints, this will help transfer the weight into the ground. When one part of the foot raises or collapses, this is a clear sign that the ankle joint is not aligned.

Fig. 4 *Rooting to Mother Earth's Energy*

Next, keep the ankle joints locked and the feet pressed firmly into the earth and lightly twist the femurs with a slight twist at the knees. This will align the ankle and knee joints. In this critical joint alignment, the "saddle" of the tibia (shinbone) is situated over the talus (ankle bone) which stabilizes everything above. In this way, all the internal pressure of the synovial fluid is kept constant and the ball and the socket of the joints will remain aligned.

The spiraling action that begins with the ankle joints now connects with the knee joints, the next vital element in transferring the earth force from the ground to the hips. If you twist the knees prop-

erly, all the tendons are rotationally wrapped around the bones, creating a strong spring force. In this position, the earth, ankles, knees and hips are in one line of power. Instead of the knees supporting the full weight of the body, the weight is transferred from the ankles through the heels and the soles of the feet to the ground. With all this twisting, It is important to reemphasize the lightness and gentleness of this posture. Listen and smile to your body. If you feel joint pain, stop.

E. Open the Kua. Align the Hip Joints and the Sacrum and Sink from the Kua

a. The position of the hip joints and the sacrum is very important for the structural alignment of the body. When your ankles, knees and hips are aligned, your sacrum and hip joints will be open and the tendons in the groin area firm and relaxed. This allows the transfer of force from the legs to the spine.

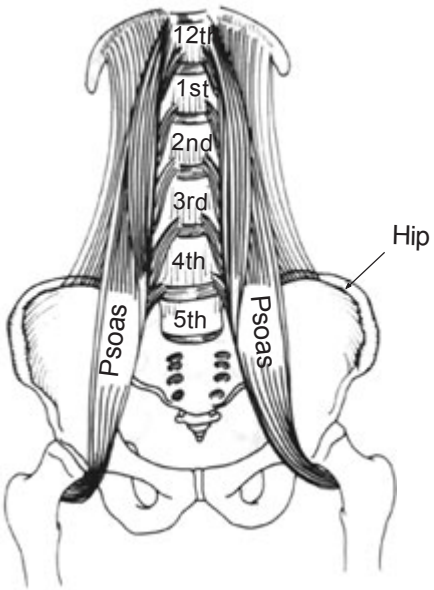

Fig. 5 *Kua Anatomy*

b. You sink from the kua and not from the knees!

The sacral alignment determines whether your structure is strong or weak. You sink in the kua by relaxing the lower back and slightly dropping the pelvis and the sacrum as if you were tucking the tail-bone between your legs and sitting down on a chair. If you have your hands in the inguinal crease, you will feel it deepen. If you feel the feet, especially the heels and the big toes, pressed firmly into the ground, you will have also aligned the sacrum with the legs. You will feel one line of power from the feet, the groin, the sacrum, and up to the spine.

Perineum power, the sacral and cranial pumps and the Tan Tien will also help you to open and align the hip joints and the sacrum. When activated, they help to tuck in the coccyx, tilt the sacrum, and expand the sacrum and the lower back.

c. Opening the kua is also very much related to the psoas muscles. Successfully opening the kua very much depends on relaxing the psoas muscles. Iron Shirt Chi Kung, Tai Chi Chi Kung. and the Tao Yin are internal exercise systems that attempt to lengthen and free up the functioning of these muscles.

In Iron Shirt, awareness of the psoas muscles is vitally important. Because the psoas muscles connect the lower vertebrae to the lower kua, they are the major keys in linking the power of the legs to the spinal column.

The psoas muscles are also closely connected to latissimus dorsi muscles which extend from the upper spine to the humerus and the shoulder bones. Therefore, the psoas muscles are an important bridge between the lower and the upper body. If the psoas muscles are relaxed and supple, the power of the legs can flow unimpeded, like a wave from the legs, up the spine, and to the head.

F. Activate the Chi Belt

You can activate the Chi Belt in the following way:

a. Activate the Tan Tien Chi and let it expand to the kidneys, and the Door of Life, and T-11.

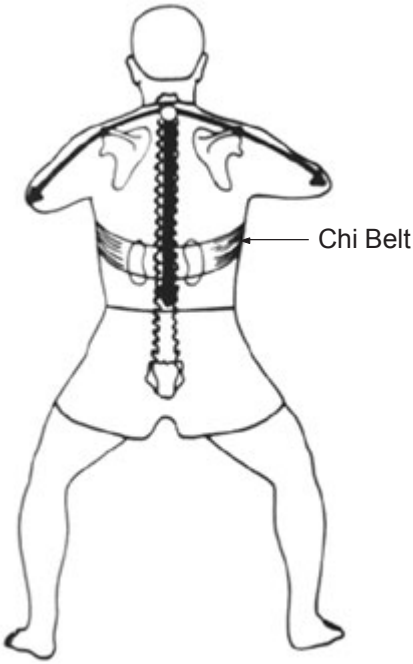

Fig. 6 *Developing the Chi Belt*

b. Hold the Chi Pressure in the Tan Tien. Inhale, pull up the left side of the anus and let the energy of the left kidney expand out to the left side of the waist and from there to the navel in front. Inhale more, pull up the right side of the anus and let the energy of the right kidney expand to the right side of the waist and from there to the navel. Join both sides together at the navel. Hold the breath and exhale slowly, expanding the Chi Belt around the waist.

The Chi Belt acts as a major bridge linking the tower part of the trunk to the upper part. If the Chi Belt is not properly developed, the feet, legs, and hips will have no connection to the upper body.

The psoas muscles are also closely connected to the diaphragm. If the psoas muscles are supple, you can breathe more deeply and easily and can fully use the power of the diaphragm and breath to help link the lower and upper body together in the Chi Belt.

G. Aligning and Elongating the Spine

To elongate and align the spine, you have to open the spinal joints and expand the Chi pressure in the whole spine. You can start the practice by activating the Chi pressure in the Lower Tan Tien, as described above and in the *Tan Tien Chi Kung* booklet. Then inhale, exhale, press the diaphragm down and pull up the anus toward the coccyx. Use the sacral pump and guide the energy up the spine, pushing the energy into the spaces between the discs which separate the vertebrae. This will elongate the spine. You can also use meditation to develop the Chi that will open the spine. Feel a string through the center of the spine is pulling you up from the crown. Imagine that the string is connected with a star above your head. Feel this string lifts the body and elongates the spine. The sacrum is pulling down and the crown is pulling up. Keep the chest and ribs relaxed (The arm position will vary according to the exercise being practiced in this posture). Keep the back straight and the neck pushed back at C-7 and the base of the skull. The head should feel as if that string extending from the crown is lifting it. You may practice against a wall.

The spinal cord is formed from 24 vertebral bones plus the sacrum and the coccyx. It connects the head, arms, and legs. For the Chi to pass back and forth between the head and the limbs, it must go through the spinal column. The alignment of the spine is thus an essential part of Iron Shirt, Tai Chi, and meditation.

The spine, when properly aligned, is full of power and can greatly amplify the force from the legs (earth) and from the arms (cosmic and universal force) to the feet. By slightly pulling up the sexual organs and the anus, tilting the sacrum and rounding T-11 and T-5 one draws the spine like a bow to shoot an arrow.

H. Aligning the Arms with the Scapulae and the Spine

The arms are connected to the trunk via the clavicles in the front and the scapulae in the back.

Be aware of the different points:

- Keep the arms at shoulder level and round the scapulae as if holding a big ball or hugging a tree. Your fingers should be slightly separated by holding the fingertips of each hand one to two inches from each other.

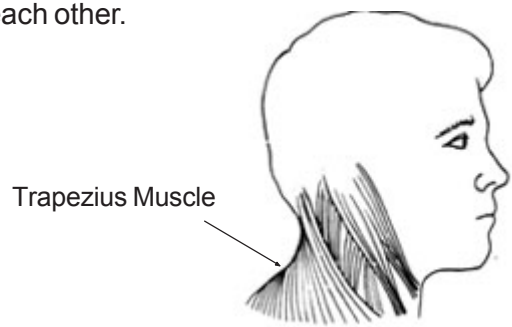

Fig. 32 *Trapezius Muscle*

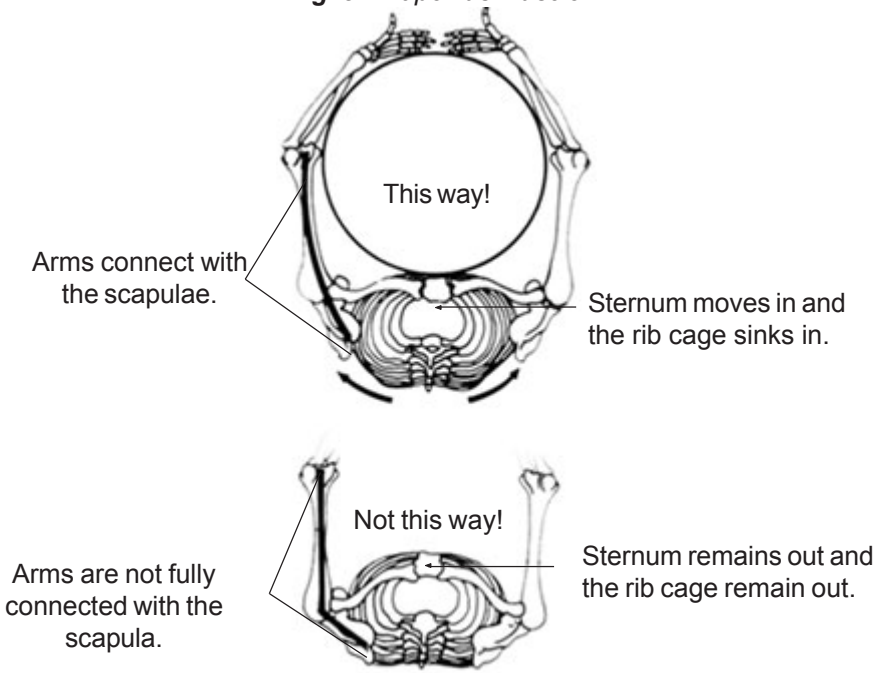

Fig. 7 *Connect the Ams with the Scapulae Properly.*

-Sink the shoulders and open the shoulder joints. Relax the trapezium (which connects the back of the neck with the back of the shoulders) and the neck muscles.

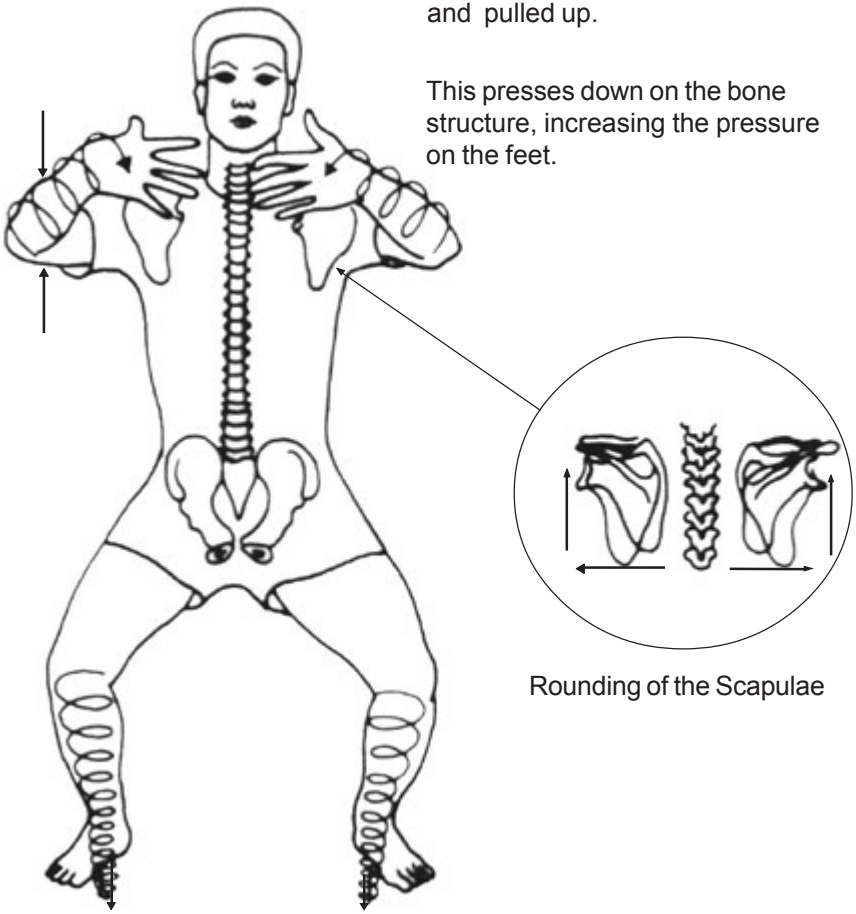

Fig. 8 *Press down on the bone structure.*

- Let the elbows sink down and turn them inwards. Feel the force of the sinking elbows push down the entire skeletal structure. If the elbows are up, you will disconnect yourself from the power of the tendons.

- Push C-7 out and be sure to move the sternum in and sink the rib cage down (Keep the lower part of the rib cage in and when you sink the rib cage down, T-11 will protrude outward, connecting with the sacrum and the hips and all the way down the legs to the heels).

Fig. 9 *Tendons of the big toes join with the tendons of the thumbs.*

- Turn the thumbs upward to make the tendon connection with the big toes, thus, the two muscle-tendon meridians join together; the front structure of the bones, tendons, fasciae and muscles tighten together as one.

- Attach the hands and fingers to the scapulae and cranial bones by pulling the thumbs' tendons away from the body and the pinky fingers' tendons toward you. Feel a spiraling action when you pull the scapulae to the sides.

-In practicing this. you will feel a stretch of force like a bow from C-7 to the thumb, and a stretch of the neck joints, which will align the neck and the crown. If you sink your elbows down and press them inward, you will feel more stretching of the bow. This will connect the fingertips and the arms with the scapulae and with the back between the scapulae (T-5 - T-6).

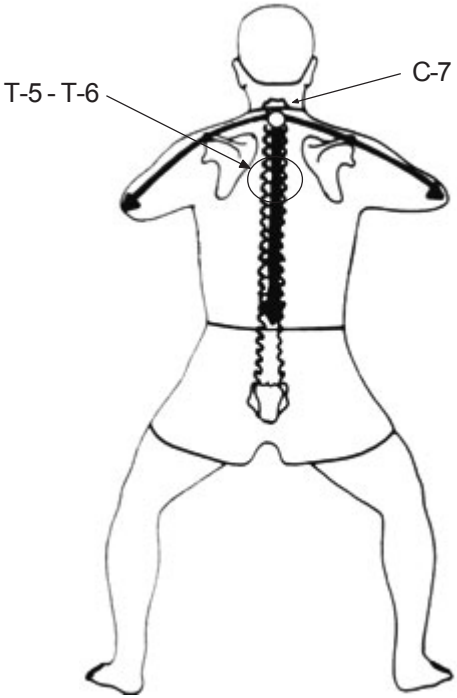

Fig. 10 *Connect the Scapulae with the Spine*

By stretching the scapulae and spine tendons and connecting them, the shoulder joints open more, and the shoulders and the scapulae are rounded. You can now sink the chest and push it back toward T-5 - T-6 which is pushed outward.

-It is very important to keep the chest relaxed, and the center of gravity low and practice abdominal breathing. If one is a chronic shallow chest breather with lots of accumulated tension in the chest muscles, there will be very little flexibility in the chest and sternum. If one attempts to sink the chest in such a situation, the shoulders usually compensate by moving upward.

The initial preparations, the Iron Shirt Packing Breath, and the Inner Smile meditation, and other meditations will relax the chest and diaphragm and restore a smooth breathing pattern.

I. Connecting the Whole Body in One Structural Alignment

Connect the upper body from C-7 and T-5/6 down through the Chi Belt (T-11), the sacrum, and the hip joints, down through the knee and ankle joints and the feet into the earth. Feel the connection with the ground.

All points should form one straight line. Feel a star pulling you up and a star pulling you down. Feel the energy in the Tan Tien and the spine. Stay very relaxed for a while in this position. Feel the whole body connected and aligned. Feel rooted and centered and the Tan Tien Chi moving you frontwards and backwards. Let the eyes look at your fingertips and your ears listen inside your body to the Tan Tien. Feel calm and peaceful.

Test and strengthen this structure by asking a partner to push gently against you while you are in this position.

The Embrace the Tree posture is the basic standing position of the Universal Tao practices. Just standing for a while enhances the power of the muscles, bones, and tendons.

You can start by standing 5 minutes in this position and increase this up to half an hour. Just stand and relax, feel the Tan Tien as an ocean and waves are moving you back and forth. If you like, you can also do the meditation in this standing position.

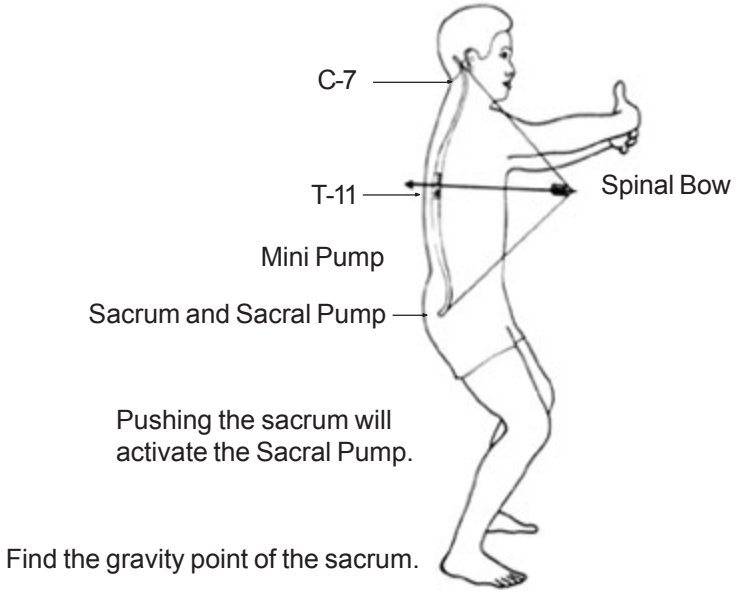

Fig. 11 *Connect hands, scapulae and spine to sacrum.*

2. Packing Breathing

Packing Breathing, applied along the different points of the abdomen and up the spine, releases long-accumulated tension and strengthens the muscles, tendons, tissues, bones, and bone marrow by subjecting them to gradually increasing pressure. The releasing of this tension often gives us a general sense of well-being and self-confidence along with better posture.

In the Embrace Tree position, we do the Packing Breathing in three stages. If, after each stage, you do not continue with the next step, it is very important to collect the energy in the navel.

To do so, stand straight and place both palms over the navel (women, put the left palm over the navel and cover it with the right palm; men, do the same in reverse. Don't follow this rule too strictly).

If you feel uncomfortable, exhale a little bit in between but maintain the pressure.

Remember always keep the diaphragm down!

Before you start to do the Packing Breathing, concentrate on the abdomen for a while. Feel the pulsation and vibration of the Tan Tien Chi inside you and the fire of the Tan Tien and the kidneys/Door of Life. Feel the skin and bones breathing. If you have time, you can start with the Bone Breathing. Always stay as relaxed as possible. Smile and be gentle.

A. Stage One: Connecting with the Earth Force from the Tan Tien to the Soles

1. Stand in the Embrace the Tree position, as described above.

2. Begin energizer breathing. Practice breathing this way from the lower abdomen 9 to 18 times. When you do this breathing, emphasize inhalation by rounding the abdomen, and emphasize exhalation by flattening the abdomen on all sides, pulling the breath to the center. Feel the sexual organs move up and down with the breath.

3. Exhale, and flatten the stomach. Exhale again and push the diaphragm down. Exhale more and feel the pelvic and urogenital diaphragms and the sexual organs pull up.

4. Begin the packing breathing. (Always keep the diaphragm down!) Use perineum power. Remember that the muscles of the arms have a close relationship with all the organs and glands. (Keep the tongue against the palate).

Inhale, suck in the stomach and pull up the perineum and the anus. Hold the breath, inhale more, pull the sexual organs up, and press down on the navel area. Inhale more as if you are breathing (inhaling) without breathing (inhaling). Pull up both sides of the anus to the kidneys and suck the energy to the kidneys. Wrap the Chi in and around the kidneys and feel the kidneys expanding outwards. Relax and hold the breath. Inhale without inhaling, pull up the perineum and the front part of the anus even more and feel a suction in the middle abdomen as you push the Chi down from the diaphragm. Feel the abdomen expanding. Spiral the energy at the navel.

Relax the abdomen, inhale more, continue to pull up the perineum and push the Chi down into the middle abdomen. Hold this pressure for a while. Inhale without inhaling, feel a suction at the perineum, and press the Chi down through the lower abdomen to the pelvic area and the perineum. Hold the breath and the Chi pressure and pull up more at the perineum and the anus.

5. Be aware of the soles and the earth force. Feel the connection to the perineum.

Exhale very slowly, controlling the breath with the mouth. As you exhale, direct the Chi down the legs to approximately six inches beneath the earth. Feel the palms and soles breathing and drawing energy in as you practice abdominal and simple bone breathing to regulate the breath. Feel the energy circulating in the Microcosmic Orbit.

B. Stage Two: From the Soles to the Perineum; Absorbing the Earth's Force

1. Start with the energizer breathing and proceed with steps 2 - 4 from stage one.

2. Inhale, contract the perineum without force, keep the tongue gainst the palate and use the power of the mind and suction in the abdomen to draw the earth energy up.

Press the soles of the feet into the earth. Claw the toes as though you were clenching the earth and spiral with the eyes and the mind. Spiral the energy around the Bubbling Spring (K-1). Hold the breath.

3. Inhale more, and suck the earth energy through the legs to the knees and all the way up to the perineum. Spiral the energy around the perineum. Feel the perineum bulge.

4. Exhale very slowly, hold the Chi (pressure) in the perineum and Tan Tien.

Regulate the breath with energizer breathing and simple bone breathing,

Be aware of the soles, the perineum and the palms breathing together. Feel the earth energy as a nice, cool, blue (or yellow) force, kind and gentle. Relax. Practice the Inner Smile and collect loving energy from all the organs. Feel the energy flow in the Microcosmic Orbit.

C. Stage Three: Pumping the Energy up through the Spine to the Brain

Spiral the energy at each station nine times clockwise and nine times counterclockwise.

1. Start with energizer breathing.

2. If you start fresh, develop Chi pressure in the Tan Tien by following steps 2-4 from stage one.

3. Loosen the abdominal muscles without exhaling, increase the pull at the perineum and push the energy to the perineum.

4. Inhale without inhaling, pull up the front and back part of the anus, suck in the coccyx and tilt the sacrum back. Hold the breath and push the energy into the coccyx to the sacrum. Feel the sacrum expanding. Hold the breath and spiral around the sacrum.

5. Inhale without inhaling, pull up the left and right sides of the anus toward the kidneys and suck the energy up to the kidneys, the Door of Life, and T-11. Feel the lower back, the kidneys and the Chi Belt expanding. Hold the breath and spiral around T-11.

6. Inhale without inhaling, pull up the middle and back part of the anus and use the power of the sacral pump to suck and guide the energy to C-7. Sink the chest and push the sternum and the chin to the back. This will straighten the curve at the neck and lock the neck. Feel the whole spine expanding with Chi. Hold the breath and spiral around C-7.

7. Continue to pull up the middle and back part of the anus; inhale without inhaling and suck and guide the energy to the Jade Pillow. Clench the teeth, keep the chin in and squeeze the skull and temple bones to activate the cranial pump. Hold the breath and spiral at the Jade Pillow.

8. Continue to pull up the middle and back part of the anus, feel the suction in the abdomen. Inhale without inhaling and suck and guide the energy up to the crown and into the brain. Exhale very slowly and let the energy flow into the brain, energizing the brain.

9. Be aware of the crown, the North Star and Big Dipper emanating violet and red light. Inhale, and use the eyes to spiral and blend these energies. Exhale slowly out of the crown and the soles.

10. Concentrate on the mideyebrow until you feel the Chi building up there. Regulate the breath with energizer breathing.

11, Exhale and guide the energy down through the centers of the throat, heart, solar plexus to the navel. Spiral the energy at each center.

12. Feel the sensation of the flow of Chi through the Microcosmic Orbit. Regulate the breath with an even abdominal breathing. Feel the Chi in the Tan Tien and the spine breathing/vibrating. Turn your senses inward and empty the mind in the Tan Tien. Feel nice and calm inside. Also feel the skin and bones, the soles, the palms, the perineum, the mideyebrow and the crown breathing. Just stand for a while like a wave is moving you back and forth.

13. Rest. Put the feet together and place both hands on the navel. Gather and condense the energy in the Tan Tien.

14. Walk around and brush the energy down, if necessary, and shake your legs and arms loose.

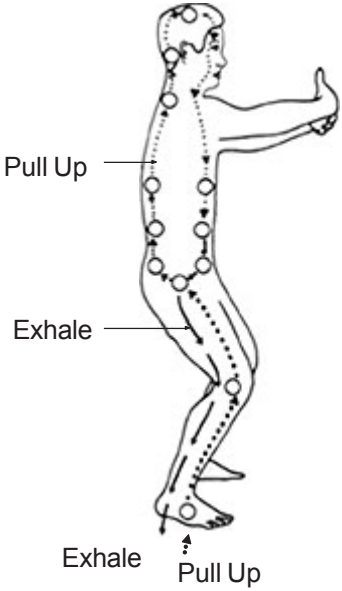

Stand still. Relax the whole body and direct the Chi flow.

Fig. 12 *Smile! Settle into the Tree Position.*

3. Testing and Rooting

The principle of rooting is to become like a stick, which is most powerful when positioned sticking out of the ground at a 45-degree angle. The stick is not what is powerful; it is the earth behind it which has the power. Naturally, the stick has to be strong to pass the force. The foot, the leg, the knee can all be adjusted to be like a stick protruding from the earth at a 45-degree angle. If your body is aligned with the ground in such a manner, a force coming against your body will pass right through your bone structure, through the soles of your feet, and into the earth. When a person pushes you, he passes the force to you. Therefore, if you are properly rooted, you can receive the powerful healing energy created by the blending of your energy, your partner's energy, and raw earth energy. No matter where the force is coining from, you can redirect it down to the earth rather than let it break your alignment.

The first principle of testing the structure and the rooting is being as relaxed as possible!

Next, when you are pushed, be aware of perineum power, the diaphragm, Chi pressure in the Tan Tien, and the Chi Belt. Let the eyes look at your fingertips and listen inside your body, in the Tan Tien. Feel calm, centered, and rooted, aligned with the forces.

A. Left and Right Side Rooting Practice

Assume the posture. Let your partner push you horizontally from the side, with one hand on your hip and the other on your shoulder. Keep your structural alignment, with the knees spiraled out and the scapulae rounded in order to redirect the force down the structure to the earth.

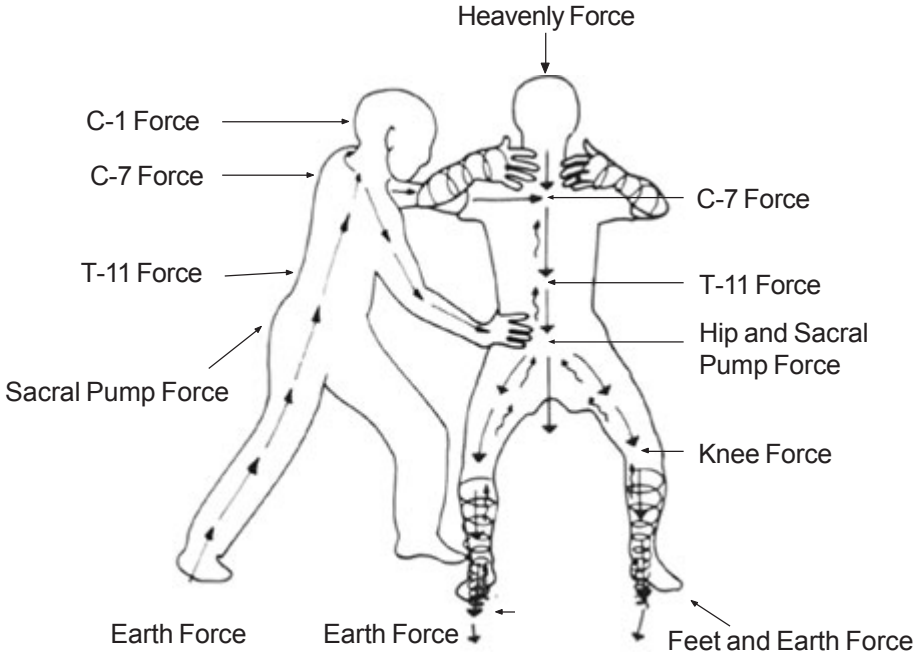

Fig. 13 *Partner's force is transferred down to the ground though the bone structure by the left and right side rooting practice.*

B. Front Rooting

Let your partner push you horizontally from the front. The push should be on the wrists, not the back of the hands, to avoid injury. Keep the elbows down and inwards, and the arms relaxed. Let the force pass through the shoulders, scapulae, spine, sacrum, hips and legs as one line. Do not lean toward your partner when he pushes you. Trust your structure and feel the whole body join into one piece. Feel the bones absorbing the force like sponges and passing it along the bone structure to the ground.

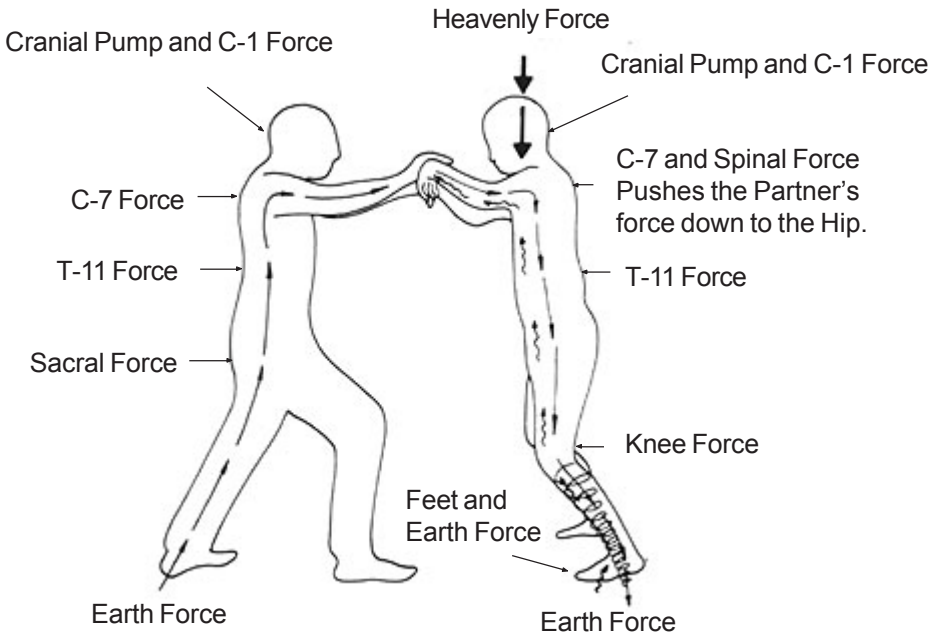

Fig. 14 *Front Pushing and Transferring the Force to the Ground.*

C. Back Pushing

Back pushing strengthens the whole spinal cord. Let your partner push you gently on your sacrum, Ming Men, T-11, C-7, and Jade Pillow. Push back (expand) at this point with the power generated from the Tan Tien Chi and the perineum and your structural alignment.

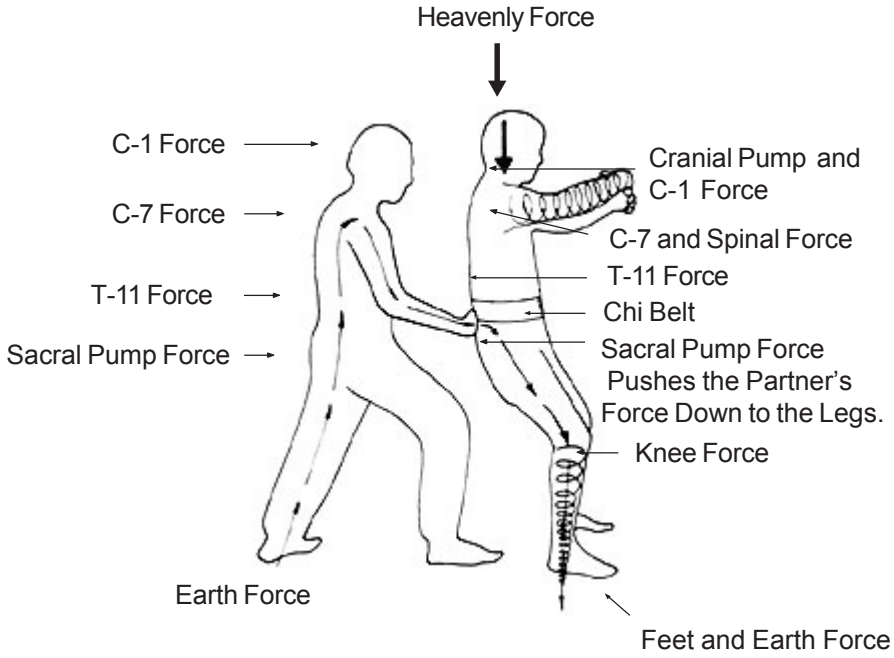

Fig. 15 *Partner's force is transferred down to the ground though the bone structure by the force of the sacral pump.*

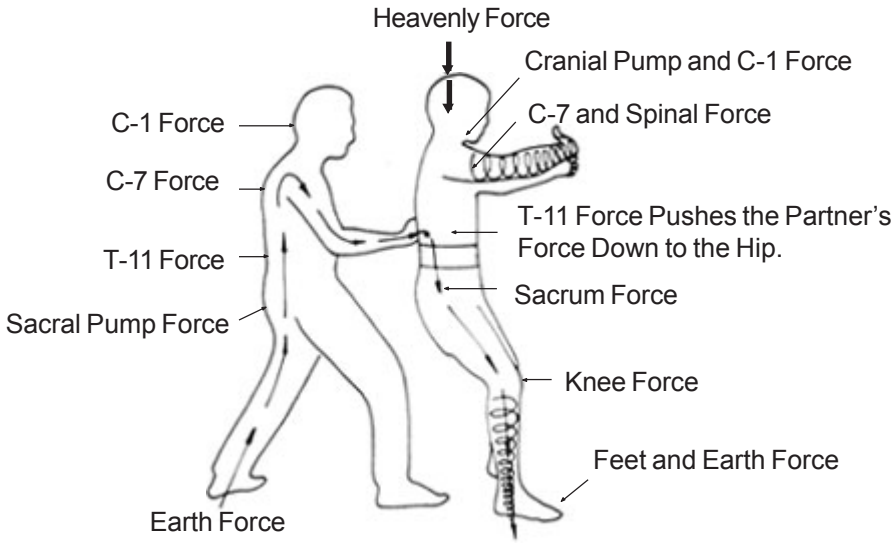

Fig. 16 *Partner's force is transferred down to the ground through the bone structure by the force of T-11.*

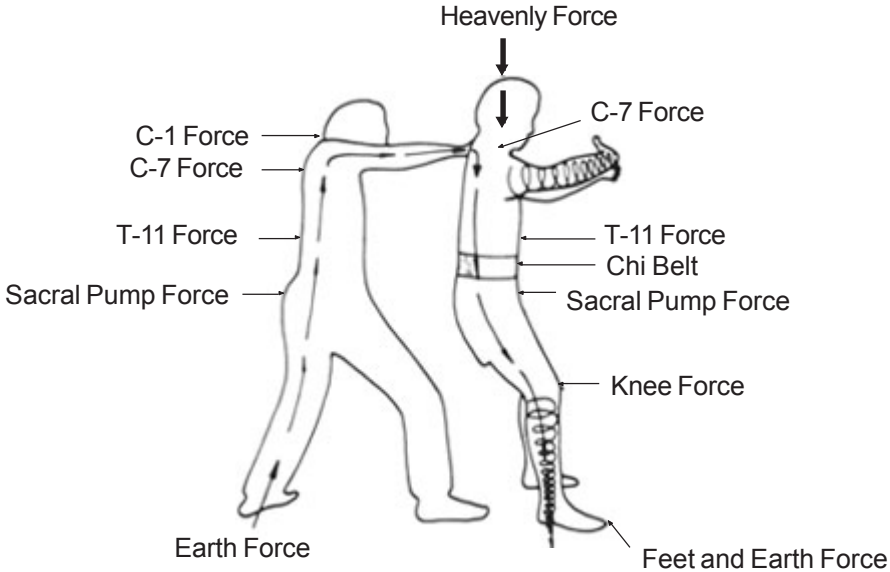

Fig. 17 *Partner's force is transferred down to the ground though the bone structure by the force of C-7.*

Fig. 18 *Partner's force is transferred down to the ground through the bone structure by the force of C-1 and the base of the skull.*

Holding the Golden Urn

1. Positions

A. Yang Position

This position helps to absorb the earth's force.

-Assume the Embrace the Tree position.

Lock the position of the elbows. Turn the palms down, lock the wrists and stretch them outward by stretching the pinky fingers, in a 45-degree angle to the forearms.

Feel the connection between the pinky fingers and the little toes, activating the muscle-tendon meridian that extends from the pinky fingers up the arms, up the sides of the face and around the ears, then down through the scapulae, into the sacrum, and down the outer sides of the legs to the little toes.

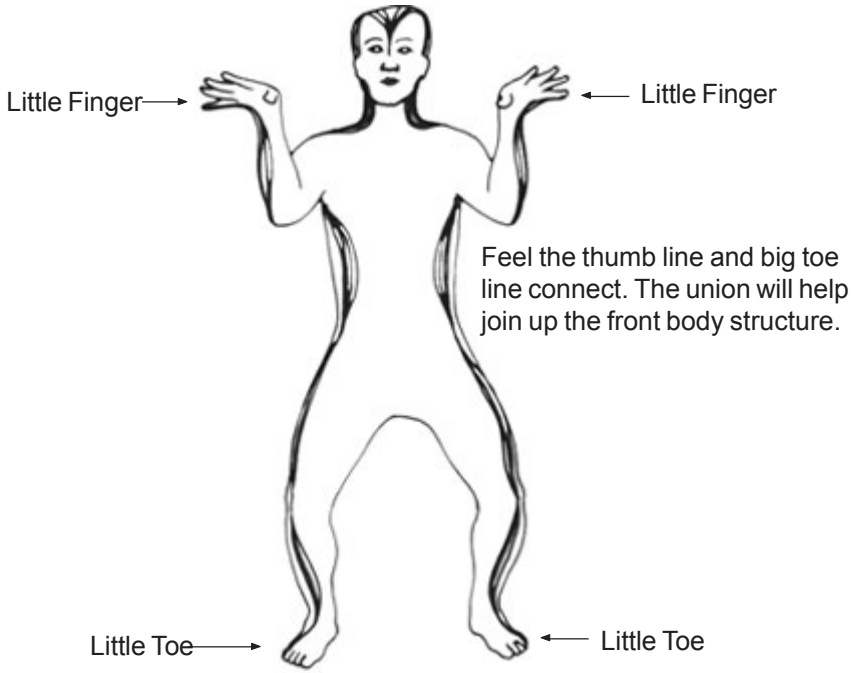

Fig. 19 *Holding the Golden Urn-Yang Position.*

B. Yin Position

The Yin force of the palms helps to absorb the Heavenly force. Hold the same position and turn the hands up. Lock the elbows and the wrists and stretch the hands 90-degrees outward with the stretch of the thumbs, moving inward. Feel the stretch of the wrist tendons by locking the elbows and the wrists by turning the hands. The stretch of the thumb activates the muscle-tendon meridian that extends from the thumbs, up through the insides of the arms, to the sides of the sternum, reaching down to the navel. From here it spreads out to the insides of both thighs to access the lower legs and to the big toes. Both tendons have strong rooting power.

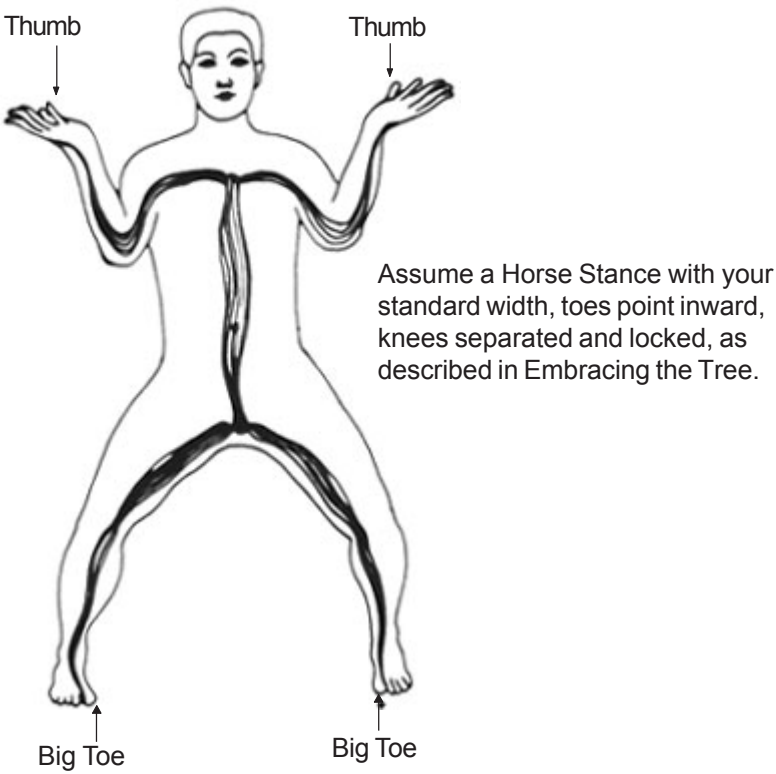

Fig. 20 *Holding the Golden Urn-Yin Position.*

2. Packing Breathing

A. Yang Position

1. Assume the posture.
2. Start with Energizer Breathing.
3. Exhale, flatten the stomach. Exhale more and press down the diaphragm, exhale more and pull up the perineum, anus, and sexual organs.
4. Inhale, draw more Chi into the abdomen and pack the Chi into the kidneys. Hold the breath and keep this energy in the kidney area for a while.
5. Release the abdominal muscles; inhale without inhaling, and pack the middle abdomen. Hold the breath, suck up the perineum and the anus and condense the Chi.

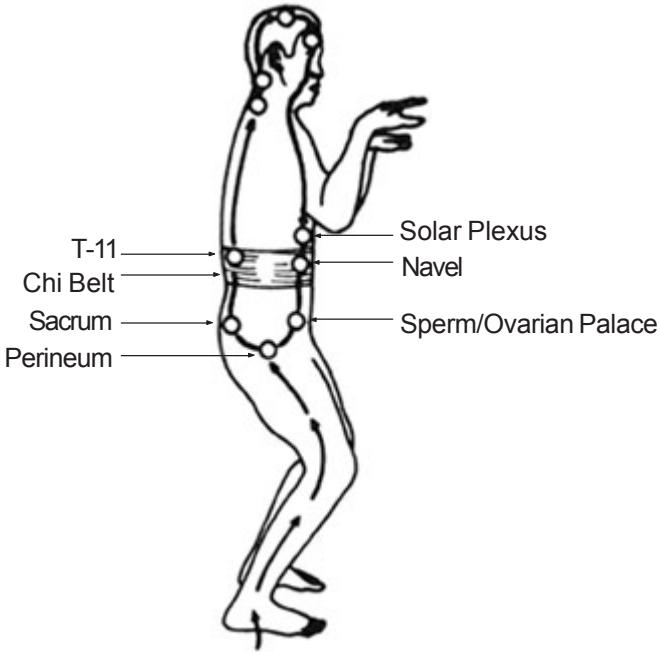

Fig. 21 *Flow of energy during holding the Golden Urn*

6. Inhale again, suck up the anus and perineum even more and push the Chi down to the perineum.

7. Be aware of the soles and the earth energy as you pull up the perineum to attract the earth force. Use your mind and eyes to spiral and draw the force up through the soles, spiraling around the legs to the perineum.

8. Inhale, suck up the perineum once more, maintain the pressure and the suction in the lower abdomen. Keep pushing the energy down until you feel it move through the lower trunk toward the sacrum. Inhale more, pull up the middle and back part of the anus, tilt the sacrum and push and pack the energy into the sacrum.

9. Inhale without inhaling, pull up the left and right side, and the back part of the anus. Expand the left and the right kidneys, sucking the energy up to the kidneys, the Door of Life, and T-11. Feel the Chi Belt expanding.

10. Inhale without inhaling, pull up the middle and back parts of the anus, relax and sink the chest. Push the chin back, slightly tense the neck muscles and suck the energy up to C-7 as you inflate the neck with Chi.

11. Inhale without inhaling, continue to pull up the middle and back parts of the anus and guide the energy to the Jade Pillow. Squeeze the skull and temple bones to activate the cranial pump.

12. Inhale once more. Pull up the middle and back parts of the anus and suck up the energy all the way to the crown and into the brain. Exhale slowly and let the energy flow into the brain, energizing the gray matter.

13. Be aware of the North Star and the Big Dipper. Feel the violet and red light shining upon the crown. Inhale and draw the light into the crown, using your mind and eyes to spiral the energy.

B. Yin Position

1. Exhale slowly, turning the palms up with the wrists locked. Energize the thumbs, and bring the energy down through the tongue to the navel. Use the mind and the eyes to spiral at the navel.

2. Put the feet together and place the hands on the navel. Gather and condense the energy in the Tan Tien. Relax.

3. Testing Structure and Rooting

Side push. The pushing method is as follows: The pushing partner uses the web between his/her thumb and index finger to press against your wrist while pushing against your hip with the palm of the other hand. Start with the left side and continue with the right side. You should push in a horizontal direction.

A. Side Push, Yang Position

Assume the Yang position and pack Chi into the abdomen, the spinal cord, and the neck, Feel the strength of the spine, like a bow. Brace your tendon lines by stretching your pinky fingers out very forcefully. Have your partner test your structure by gradually pressing horizontally against the wrist and the hip of either side.

B. Side Push, Yin Position

Stay in the same position, turn your hands over, maintain the Chi pressure and connect the force to the ground through your bone structure. Brace the tendon lines by stretching the thumbs inward very strongly. The whole front line, starting from the thumb and continuing to the hand, arms, head is aligned.

Have your partner test your structure and rooting in the same way as in the Yang position.

C. Back and Front Pushing

Back pushing strengthens the whole spine, the pinky fingers, the little toes and the back fasciae. Be sure to press the big and little toes down, and feel the force you are exerting upon the little toes and the pinky fingers. Let your partner push you from the back while you assume the stance.

Front pushing will increase the thumb and tendon power. Maintain the stance and let your partner push you against your chest or the front of the shoulders.

By using the tendons, you need less effort to maintain a good structure.

Fig. 22 *Side Pushing*

Fig. 23 *Back Pushing*

Fig. 24 *Front Pushing will increase the thumb and tendon power.*

Golden Turtle (Yang Position)/ Water Buffalo (Yin Position)

Precaution: People with high blood pressure should consult a doctor before attempting this posture. Women who are menstruating or pregnant should not practice this exercise.

The Turtle energizes the toes and all the tendons of the toes and the fasciae of the thighs and legs and strengthens the back fasciae, spinal cord, sacrum, kidneys, adrenal glands, neck and head. This position is also called the “turtle back”.

1. Positions

A. Golden Turtle Immersing in Water, Yang Position

- Stand in the same position as in Embrace the Tree. The feet are a little wider apart. In this position, the alignment of the ankles, knees, hip joints, and sacrum is very important in order to let the weight of the body go down to the hips, to the knees, to the feet, and

finally to the ground, which make it easy to hold the posture. Tighten the fists and fold the forearms against the upper arms.

- Bend down from the kua, push both hips to the side in order to open the sacrum and straighten the back. The back should make one horizontal line to the floor, from the coccyx to the head.

- Keep the arms in the folded position resting in front of the chest. Keep the armpits open and the scapulae rounded. The back should feel like a turtle's back.

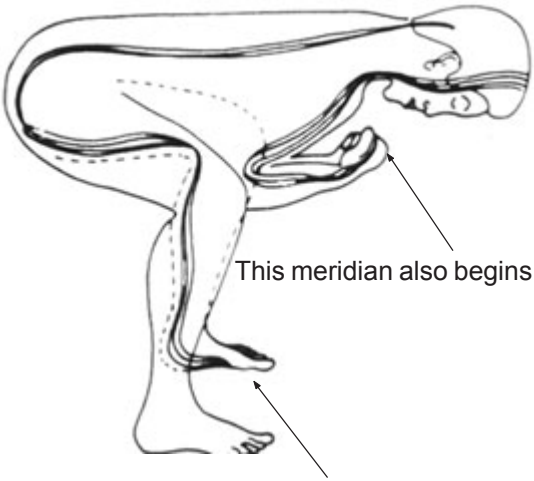

Fig. 25 *Muscle-Tendon Meridian in the Turtle Position.*

B. Water Buffalo Emerging From the Water, Yin Position

Look slightly up by moving the neck up, thereby relieving the tension, and tilt your head and eyes upwards without straining them. Sink the sacrum and extend the arms down in front of you with the backs of the hands facing forward and the fingertips touching the perineum and the anus or touching the ground. Keep the groin open.

Open Groin Breathing Process

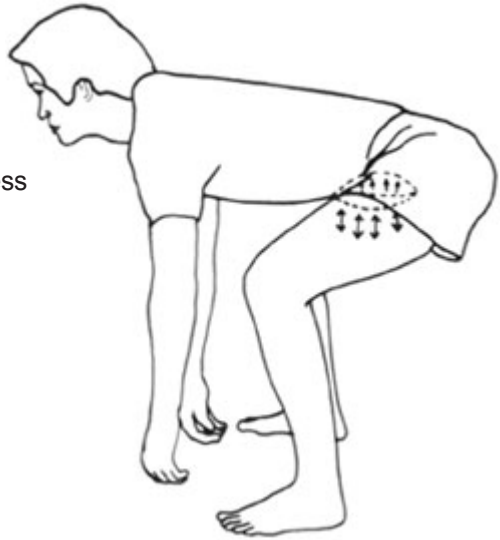

Fig. 26 *Buffalo—Left Side View*

2. Packing Breathing

A. Golden Turtle Immersing in Water-Yang Position

1. Assume the Horse stance.
2. Practice Energizer Breathing.
3. Exhale, flatten the stomach, exhale more and press down the diaphragm, exhale more and pull up the anus and the sexual organs.
4. Inhale, tighten the fists, fold the forearms against the upper arms, round the back and sink the chest. Bend forward from the kua with the back straight to maintain the energetic structure through the spine and the neck. Open the sacrum by pushing the hips, knees, and ankles in one line outwards so the weight of the body can sink down from the hips to the knees, the feet and the ground. Tuck the chin and set the neck firmly in position. Press the elbows against the inside of the knees.

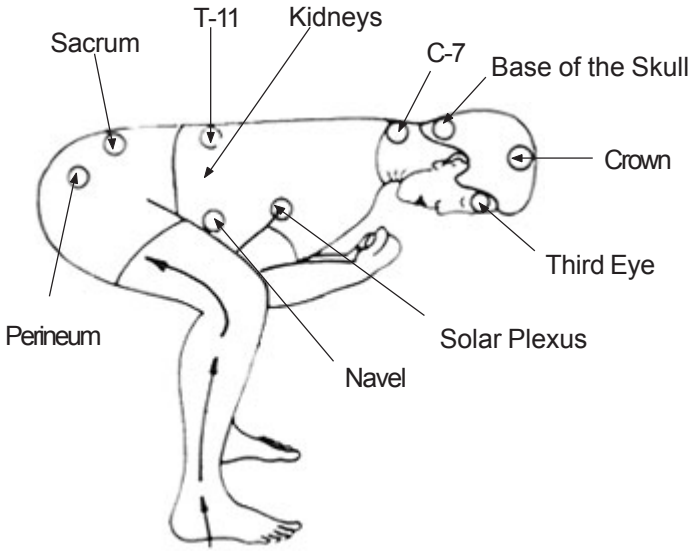

Fig. 27 *Packing the energy during the Golden Turtle.*

5. Inhale part of the breath, pull up the perineum and pack the energy into the navel area. Hold the breath.

6. Inhale without inhaling, suck in the perineum and press the energy down in the lower abdomen. Hold the breath.

7. Inhale without inhaling, feel a suction in the abdomen sucking up the sexual organs and the anus and press the energy to the perineum. Suck up the earth energy from the perineum.

8. Inhale, pull up the middle and back parts of the anus and suck the energy to the sacrum. Tilt the sacrum and feel the sacral pump activated. Hold the breath.

9. Feel the suction in the abdomen. Pull up the perineum and the left and right sides, and back part of the anus, bringing the energy all the way lo the kidneys. Feel the kidneys, the Door of Life, T-11, and the Chi Belt expanding.

10. Inhale and suck the energy up to C-7. Tighten and elongate the neck. Tighten the skull and cranial bones and clench the teeth.

11. Inhale again and suck the energy up to the crown and into the brain.

B. Water Buffalo Emerging from Water-Yin Position

1. When you have packed the energy into the head, exhale and look slightly up by moving the neck up thereby relieving the tension from the back of the neck. Extend the arms down in front of you with the backs of the hands facing outward and the fingertips touching the perineum and the anus, or touching the ground.

Keep the groin open and practice the open groin breathing process. Relax, keeping the tongue against the palate. Inhale less and exhale more, breathing right into the groin, energizing the sexual organs and the urogenital and pelvic diaphragm. The blood and Chi flow in the lower areas of the body.

When your breath has normalized, close your eyes and slowly come up to a standing position.

Collect the energy at the navel and in the Tan Tien. Practice bone breathing and let the Chi flow in the Microcosmic Orbit.

Walk around, brush the energy down and shake out the arms and the legs.

3. Testing Structure and Rooting

A. Turtle Position/Side Rooting Practice

- In this position, hold the elbows in tightly, press them against both thighs so that you can feel the energy concentrated in the groin area. The spine should be horizontal to the ground.

- Pack Chi from the abdomen along the whole back. Have your partner stand on your left side with one hand on your shoulder and the other hand on your hip.

- When your partner is pushing you, pull up the sexual organs, perineum, and anus, then open the sacrum and the hip joints (by pushing the hips outward to both sides) and align them with the knees and ankles in order to transfer the force to the ground.

Become one with the earth, and expand both kidneys and the Chi Belt.

The bone structure should be like a sponge absorbing the force and transferring it to the ground. Once you become adept in this practice and you feel your body's structure as one piece. you can

relax the muscles more and you will find no need for packing breathing. If you simply concentrate on the Chi flow and relax, the force will pass through the bone structure.

- Change sides and let your partner push you gradually. The purpose is not to push you over, but to let you feel where the force comes from so that you can redirect the force to the earth. And when the push is gradual, it is possible for you to realign or to relax that part to let the force pass through. Once you know how to redirect the force from any part of your body, you will start to learn how to reabsorb the force from the earth.

You can use this energy for self-healing or to counteract your partner's pushes.

- The Turtle Position strengthens the whole spine. You will feel that, as your partner pushes from the left, the force goes from the left shoulder, past the scapula to the spine, to the right scapula, down the spine to the hip. to the right thigh, the right leg, and foot and down to the ground. At the same time, feel the soles breathing and "claw" down with the toes into the ground.

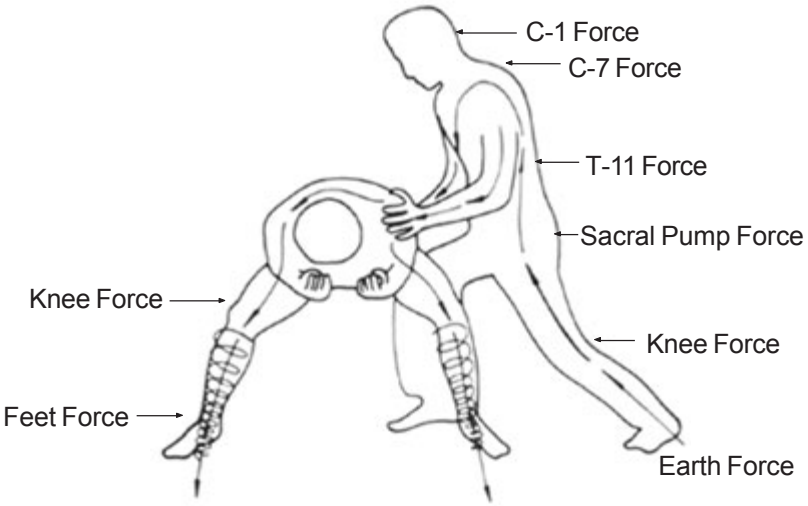

Earth Force is transferred down to the ground.

Fig. 28 *Rooting practice during the Golden Turtle—Left side position.*

B. Buffalo Position/Front Rooting Practice

Your partner should place one hand on each shoulder and gradually push you in order to strengthen the frontal aspect of this posture. To maintain this difficult posture you must keep the perineum and anus contracted, the kidneys expanded, and gradually feel the connection of the shoulders to the scapulae and the spine to the sacrum and the hips. Keep the neck locked and elongated. Front rooting requires more practice. The soles/heels and feet are very important in the front rooting. With practice, you can maintain the feet's firm contact with the earth.

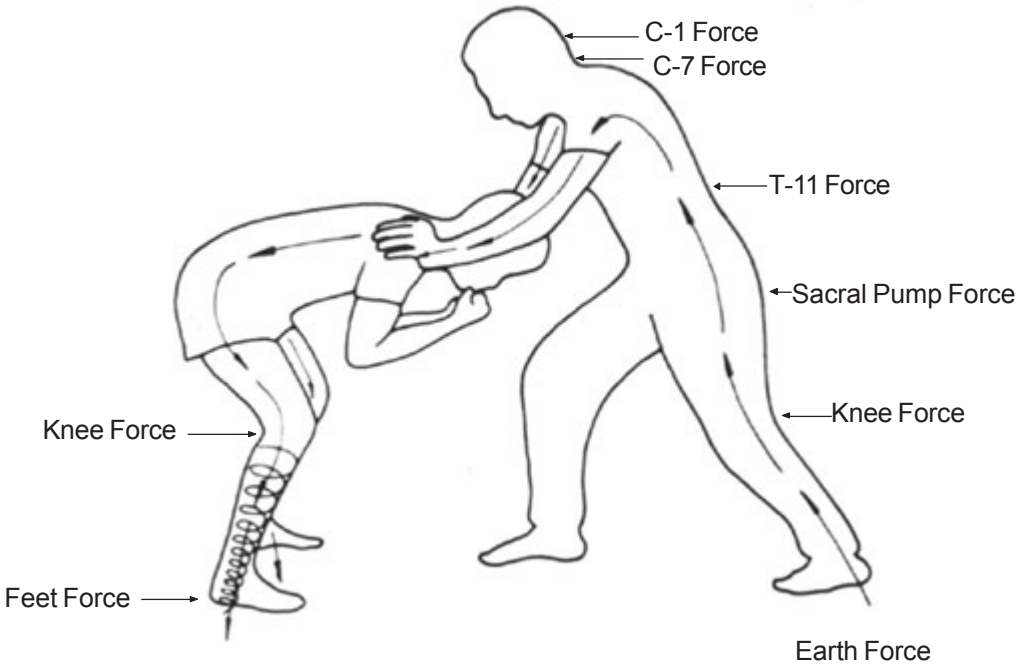

Fig. 29 *Turtle/Buffalo—Front Rooting Practice*

Golden Phoenix Washes Its Feathers

The Phoenix Position strengthens both sides of the ribs, from the armpits down to the sides of the hips and enhances the Chi pressure of all the major organs.

The Phoenix also strengthens the fingers, toes, tendons and the tongue (which is one of the main tendons of the body). The pinky fingers are small, but can activate many tendons, especially along the sides of the body.

Position/Packing Breathing

1. Assume the Horse Stance and practice energizer breathing. Exhale. Pull up the perineum and feel the Chi pressure in the Tan Tien.

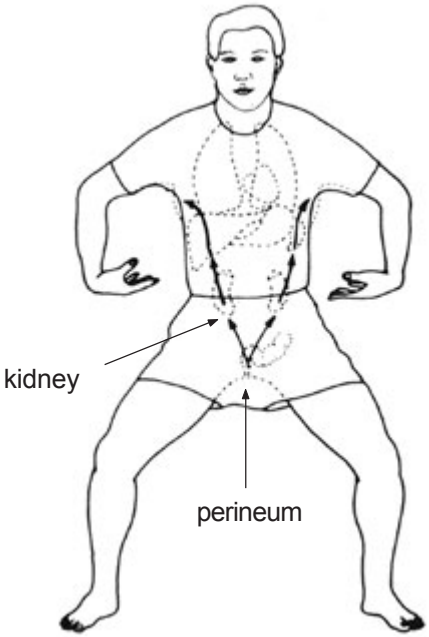

Fig. 30 *Phoenix Exercise*

Palms continue to face up

Side View

Rotate the hands medially

Push from the C-7 by sinking down the sternum and pressing towards the back.

Fig. 31 *Phoenix Exercise*

2. Put your arms in front of your body with the backs of the hands facing each other. Inhale, swing the arms to the sides of the body near the kidneys, the palms face up and are turned in toward the body with the pinky fingers pointed up. Feel the pull of the tendons.

3. Inhale more. Pull up the middle part, and the left and right sides of the anus, press the diaphragm down and feel the kidneys expanding with energy.

4. Inhale more, and raise the hands along the sides. Continue to pull up the middle part, and the left and right part of the anus and suck the Chi into the lungs and spleen. Pack and wrap them with energy.

5. Inhale once more, raising the hands higher. Continue to pull up the middle part, and left and right part of the anus and suck the Chi into the lungs and the heart. Pack and wrap them with Chi. Feel the rib cage bulge.

6. When you have brought your hands as close as possible to the armpits, continue to maintain the contraction in the perineum and anus, and rotate the hands medially until the palms face outwards. Keeping the wrists flexed, push from the sternum to C-7, and extend your arms at shoulder level. Exhale, and as you push the hands out. begin the Lungs' Healing Sound of "***Sssssssss***"

7. Inhale, and tighten the perineum and anus. Gather the fingers to the thumbs, and press them together into a small point by exerting force on the pinky fingers (which should be in the middle with all the fingers pressed against them). We call these finger positions "beaks." Inhale, bend the elbows, and bring the beaks in toward the shoulders. Repeat, raising the beaks a little higher.

8. Exhale with the Kidney's Healing Sound "***Shoooooo***", releasing the perineum, anus, and the beaks as you lower the arms while straightening and locking the elbows and knees.

9. After this sound, when the hands are down with the wrists flexed, turn the hands out to the sides of the thighs, and spread the fingers and toes as much as possible. Turn the eyes to look up at the bridge of the nose as you push up the tongue and pull up the anus and sexual organs and make the sound "***Hawwwwww***".

Push the fully extended arms.

Arms fully extended

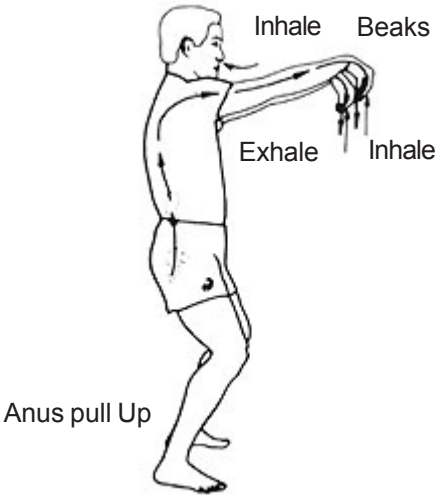

Gather the fingers and form “beaks”

Pulling the “Beaks”

Fig. 32 *Phoenix Exercise*

Pulling the “Beaks”

Exhale, Release the “Beaks”. Press your arms against the front of your body.

Arms Pressed Down

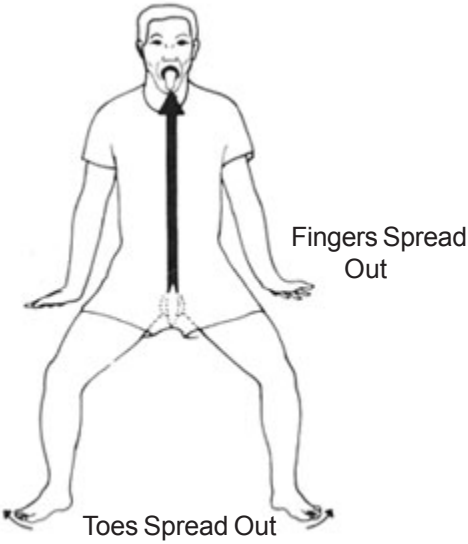

Sexual organs are connected to the tongue.

Fig. 33 *Phoenix Exercise*

10. You can just do one sound and go on to the next step of your practice, or you can do all of the sounds. Replace the Healing Sounds of the lungs and kidneys, first with the sounds of the liver ("***Shhhhhhh***") and heart ("***Hawwwwww***"), and then with the sounds of the spleen ("***Whoooooo***") and Triple Warmer ("***Heeeeeee***").

11. After the last Healing Sound, repeat step 9.

12. Collect the energy at the navel.

Iron Bridge

1. Position

A. Yang Position

One muscle-tendon meridian begins at the second, third, and fourth toes of both feet, running up to the ankle where it splits into two main branches. One branch travels up the middle of the lower leg, crossing at the knee to the outer thigh, then returning in toward the pubic bone. It travels up through the abdomen, through the collar bone to the side of the neck and the jaw where it splits in two, one section veering around the corner of the mouth, and the other running along the jaw line to the temple. The other main branch of this meridian runs laterally to the first, but continues up to the hip joint, over the upper pelvis, and up to the lower ribs of the spine.

1. Stand with the feet at a knee-to-toe length apart.

2. Place the hands al the sides of the body. Touch both thumbs and index fingers together, forming a circle. The other three fingers of each hand should remain straight and touch one other.

3. Begin with abdominal breathing: exhale and flatten the stomach. Inhale to full capacity, and bring the hands up and to the back. Bend the elbows back and place the palms up. Fingers should be about two inches apart and remain close to the scapulae. This will open the sternum, activate the thymus, the thyroid, and parathyroid, and stretch the chest and the side fasciae.

Arch the upper and middle back, but not from the lower spine and the hips. This will stretch the front fasciae. You can release any accumulated tension in the chest and the abdomen in this way. To

protect the lower spine, arching the back strongly from the upper spine is necessary while firmly tightening the thighs and buttocks.

This will squeeze the sacrum down, lessening the compression in the lower back. The knees should be firmly locked and straight.

Caution: Keep your chin on your chest. Keep the spine and neck straight to avoid blocking the circulation to the brain.

4. Look to the ceiling and lock and pull the neck fasciae. From there you will feel a stretch in the chest that will arch the upper spine more, and in the abdomen all the way to the groin area.

5. Squeeze the thumbs and index fingers together and tighten the muscles of the arms and shoulders. This will stabilize your position.

6. Hold the breath and maintain this position for 30 to 60 seconds.

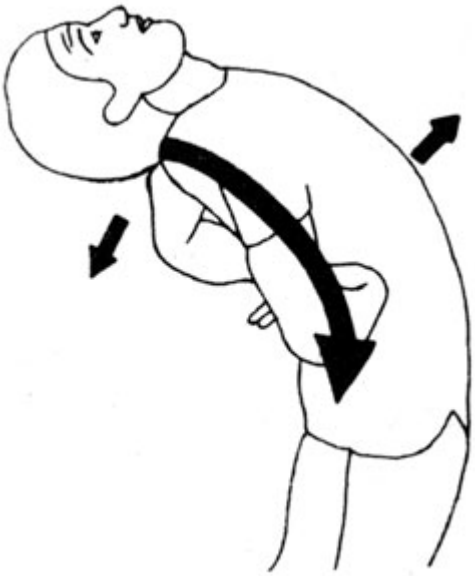

Arch the upper and middle back and be sure to tuck the chin to protect the cervical spine (neck).

Fig. 34 *Iron Bridge-Yin Position.*

B. Yin Position

1. Exhale. Straighten up and bring the arms to the front, maintaining the hand position, and slowly bend forward from the hip joints. The head should be down and the hands just above or touching the ground. Do not force yourself.

2. Adjust the tendons. At first, do not bend too low. For additional comfort, you can bend the knees slightly.

3. Feel the Chi flow down to the head and back and down the tongue and through each finger. If you can touch the ground, you will feel the energetic connection. Breathe normally.

4. Come up very slowly from this position. You may feel dizzy at first. Stand still for a while, and feel the energy flow in the Microcosmic Orbit. Collect the energy in the navel. Walk around, or lie down on your back and massage your belly from right to left to assist your Chi circulation.

Iron Bridge-Yang Position

Stretching the hamstring

Fig. 35 *Iron Bridge Stretch*

2. Testing Structure and Rooting

A. Yang Position

Assume the posture. Let your partner push you very gently. Remember that the main arch is in the upper back. **Be very careful in this Iron Bridge Rooting Practice. Your partner has to be aware that it is dangerous when you arch too much backward to push. The back and spinal cord are vulnerable to injury in this position. Be careful to apply a gentle pressure to avoid hurting the spinal cord or falling down.**

Your partner puts one hand on your back near T5/6 and one hand on your chest. Your partner slowly and gentle presses up from the back and down from the chest till you find your alignment of the upper spine with the heels of your feet.

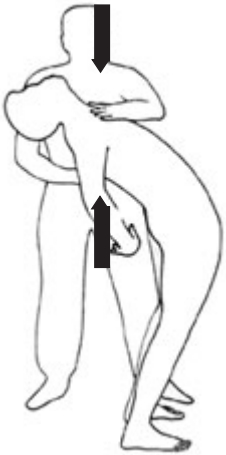

Fig. 36 *Iron Bridge Rooting "Yang Position Rooting"*

B. Yin Position

While you are bent forward, your partner presses his/her hands on your shoulders. You push up the lower spine. Your partner can use his entire body to press down. In this position you are exerting more force on the lower back. This will strengthen the lower spine, especially the lumbar region.

Fig. 37 *Iron Bridge Rooting "Yin Position Rooting"*

Yin Stage of the Practice

After all these exercises brush the energy down, shake out your arms and legs and walk around.

Take your stance again or sit down and put both palms on the navel area.

Turn yourself inward and observe the flow of energy in your body. Smile to your whole body, especially to the organs, glands, spine, brain and bones. Feel the healthy vibration of the Chi in all these different parts of your body. Feel you are aligned and firmly rooted in the earth.

Bring you attention back to the Tan Tien. Empty your mind in the Tan Tien. Feel Chi pressure in the Tan Tien. Keep the lower gates closed and feel a little suction in the lower abdomen. Fix your mindeye and other senses in the Tan Tien. Feel the waves of this ocean of Chi moving you gently back and forth. Feel very calm and peaceful inside in this way for a while, breathing with a long, soft breath. For a while, just sit still like this and do nothing. It can happen that at one moment the physical breath stops and the Tan Tien (Chi) will function as a lung. We call this inner or embryonic breathing (Tai Hsi) and it can only happen when your whole being is calm and quiet and full of Chi at the same time.

Supplement

After practicing Iron Shirt, before the Yin stage of the practice, you can do some exercises to make your energy connection with the forces stronger.

You can practice the “Opening of the Three Tan Tiens to the Six Directions” or part of this practice after the Iron Shirt training or one of the three following exercises:

Cosmic Energy Mideyebrow Connection

1. Stand in Embracing the Tree and face the sun or moon. If you are facing the sun, this exercise should only be performed at sunrise or sunset, when the light of the sun is softer and will not damage the eyes. Close and rest your eyes whenever the light feels too intense.

2. Slowly raise the palms out in front of the body with elbows slightly bent outward. Bring the arms up to just above the level of the mideyebrow and make a triangle between the index fingers and thumbs of both hands, with either the sun or the moon centered within the triangle.

3. Hold this position and draw the Yang (sun) or Yin (moon) energy in through the mideyebrow.

4. Gather some saliva in the mouth, and mix this energy drawn in with the saliva to collect a ball of Chi energy in the mouth. This increases the amount of saliva produced.

5. Slightly extend the neck. Swallow the saliva with a strong gulp and mentally direct it to the navel. Feel the navel warm up with the arrival of this new energy.

6. Repeat these steps 9 to 36 times, and then close by slowly lowering the arms to the navel. Place the left hand over the right, and collect energy by spiraling at the navel as described earlier.

Washing the Body with Heavenly and Earth Energy

1. Stand in the Embracing the Tree position. The feet should be shoulder-and-a-half width apart, with the nine points of the feet pressed firmly against the ground. The knees are bent and torqued slightly outward with a corresponding torque in the ankles and hips. This acts to screw the body into the ground and to initiate the earth connection. Straighten the spine by slightly tucking in the sacrum (this increases the connection to the earth) and by tucking in the chin to connect with the heavenly energy.

2. Reach down and forward, keeping the palms cupped upward, and slowly scoop up the earth energy (use your imagination at first until you are sensitized) though the body. Simultaneously, feel a cool blue water-like healing sensation rising through the body at the level of the hands as you raise them until they are fully extended above the head.

3. Turn the palms of the hands up and connect with the heavenly energy.

4. Slowly lower the arms to the sides. Simultaneously, feel the heavenly energy descend through the body at the level of the hands. The heavenly energy may feel like a hot white firey expansive sensation that washes down through the body until it reaches the ground, at which point the hands will have returned to their original position.

5. Repeat this exercise 9 to 36 times until you feel fully saturated with both types of energy.

Navel/Palm Connection

1. Place both hands approximately two inches out from the navel.

2. Slowly inhale, allowing the abdomen to fill completely with air. As this is happening, tug a “string” of energy lightly away from the navel using the centers of the palms.

3. Then, slowly exhale and feed the “string” back into the navel.

4. Repeat this 9 times and then collect energy at the navel.

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Iron Shirt Chi Kung I

Rooting Cosmic Internal Energy

Mantak Chia

Illustrations by Udon Jandee

Iron Shirt Chi Kung I

Iron Shirt Chi Kung is part of the Universal Tao System's basic practices. The Iron Shirt techniques are learned and then the improved body (healthy Chi posture and healthy Chi breath) utilizes the results of the Inner Smile and Six Healing Sounds. This powerful Inner Structure is the ideal environment for the healing elements of the Microcosmic Orbit. Many students claim that Iron Shirt Chi Kung postures, movements and breathing have helped alleviate or directly cure pre-existing maladies and complaints.

Here are some of the detailed fundamentals that you'll discover described step-by-step within this essential booklet: Rooting, Centering, Inner Structure, Packing Breathing, and Chi Belt.

There's more! These basic Iron Shirt Chi Kung postures and movements are explained in detail: The Horse Stance, Embracing the Tree, Holding the Golden Urn, Golden Turtle and Water Buffalo, Golden Phoenix Washes its Feathers and Iron Bridge.

Have fun working with a partner to improve your earth connection and to boost your Chi generation and flow. Your practice can be helped tremendously with these Structure Testing and Rooting Pushing exercises performed with a friend. Smile, center yourself in the Tan Tien, root to Mother Earth and enjoy the myriad benefits of Iron Shirt Chi Kung!

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I have come upon Master Chia's Taoist practice in my old age and find it the most satisfying and enriching practice of all those I have encountered in a long life of seeking and practicing.

Felix Morrow, Senior Publisher

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and “still the mind.” While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi’s patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun’s system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty-five books to convey the full Universal Tao System. In June, 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December, 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices were held at Tao Garden for the first time using the Darkness technology creating a complete environment for the higher level Taoist practices.

Master Mantak Chia has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002
Tan Tien Chi Kung - 2002

Many of the books above are available in the following foreign languages:

Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

Acknowledgments

I thank foremost those Taoist Masters who were kind enough to share their knowledge with me, never imagining it would eventually be taught to Westerners. I acknowledge special thanks to Roberta Prada and Roderick Kettlewell for encouraging the production of this book, for their input on the original manuscript, and for their editing regarding technical procedures.

I thank the many contributors essential to the book's final form: the artist, Juan Li, for many hours spent drawing, making illustrations of the body's internal functions and for the artwork on the cover of the book; Terry Goss for his chapter on Breath Alignment which helps tremendously in the practice of Iron Shirt; Larry Short for sharing some of the Tibetan Nui Kung Exercises; Michael Brosnahan for helping to clarify the technical points of structure; Dr. Michael Posner for sharing his view of Chiropractic and Iron Shirt; Gunther Weil, Ph.D., Rylin Malone, and many of my students for their feedback; Jo Ann Cutreria, our secretary, for making so many contacts and working endlessly; Daniel Bobek for long hours at the computer; John-Robert Zielinski for setting up the new computer system and for his interview of Michael Winn; Valerie Meszaros for editing the book, organizing, typing, and revising it on the computer, and proofreading; Helen Stites for proofreading; Adam Sacks, our computer consultant, who assisted in solving computer problems as they arose during the final stages of production; Michael Winn for general editing, and Cathy Umphress for design and paste ups. Special thanks are extended to David Miller for overseeing design and production and to Felix Morrow for his valuable advice and help in editing and producing this book and for agreeing to be the publisher of Universal Tao Publications.

Without my son, Max, the book would have been academic; for his gifts, my gratitude and love.

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

How to use this Book

In the last pages of this book the reader will find descriptions of the courses and workshops offered by our Universal Tao Centers. This material is also in effect, a comprehensive description of the whole Taoist System. All of my books together will be a composite of this Taoist world view. Each of my books is thus an exposition of one important part of this system. Each sets forth a method of healing and life-enhancement which can be studied and practiced by itself, if the reader so chooses. However, each of these methods implies the others and is best practiced in combination with the others.

The foundation of all practices in the Taoist System, the Microcosmic Orbit Meditation, is the way to circulate Chi energy throughout the body and is described in my book, *Awaken Healing Energy Through the Tao*. This practice is followed by the meditations of the Inner Smile and the Six Healing Sounds, set forth in my book, *Taoist Ways to Transform Stress into Vitality*. All three meditations are emphasized throughout the Taoist System.

The practices of Iron Shirt Chi Kung are very powerful and therefore very effective. To insure that you carry them out properly, prepare yourself first by learning the Microcosmic Orbit Meditation, the Inner Smile and the Six Healing Sounds. These will enable you to identify and eliminate energy blockages that may occur in your Iron Shirt practice during the learning stages.

Second, learn information contained in the chapter in this book on body alignment.

Third, understand the rooting principles.

Fourth, learn the preliminary exercises until you are proficient at them and comfortable with them. This will give you the conditioning you need to proceed comfortably to the postures.

You can use the complete description of each posture during your learning. The shorter description of each posture is meant as a guide during your practice.

Lastly, we offer to you a suggested practice timetable, although it is not necessary for you to follow it exactly. Use it merely as a guideline for adjusting your own schedule. As you read the information provided in this book and become aware of concepts not contained in Western thought, you will deepen your understanding of the relevancy of these practices to your physical, emotional and spiritual advancement.

Mantak Chia

Chapter 1
General Introduction

A. Universal Tao System and Iron Shirt Chi Kung

In addition to the more popularly known martial arts disciplines of Kung Fu and Tai Chi the Universal Tao System includes health practices, healing arts, the development of a state of mindfulness, and the management of vital energy (Chi). The martial arts aspect of this training, the practice of Iron Shirt, develops a highly refined moral and spiritual awareness.

The goal of the Universal Tao System is to keep our physical bodies in good condition in the physical plane in order to build and store more Chi energy for further use in the higher level of the spiritual plane. (Fig. 1.1)

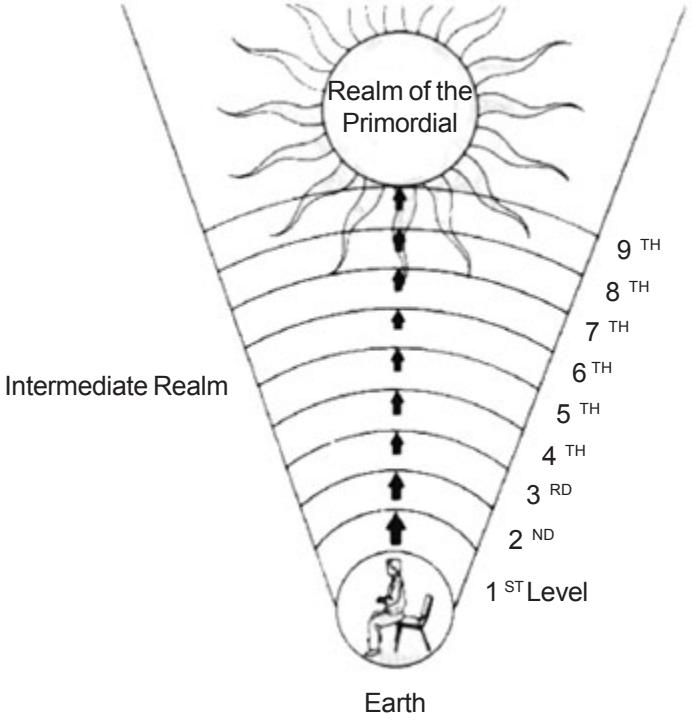

Fig. 1.1 *Realm of the Primordial Tao*

In the spiritual plane, the aim is to develop the immortal fetus. The immortal fetus is developed in two stages. The first stage is concerned with overcoming reincarnation. The next stage develops and educates the immortal fetus to become a full-grown immortal spirit.

Iron Shirt is one of the most important exercises of the physical plane because through its practice one learns rootedness to Mother Earth energy, a phenomenon intrinsic to the spiritual plane. (Fig. 1.2)

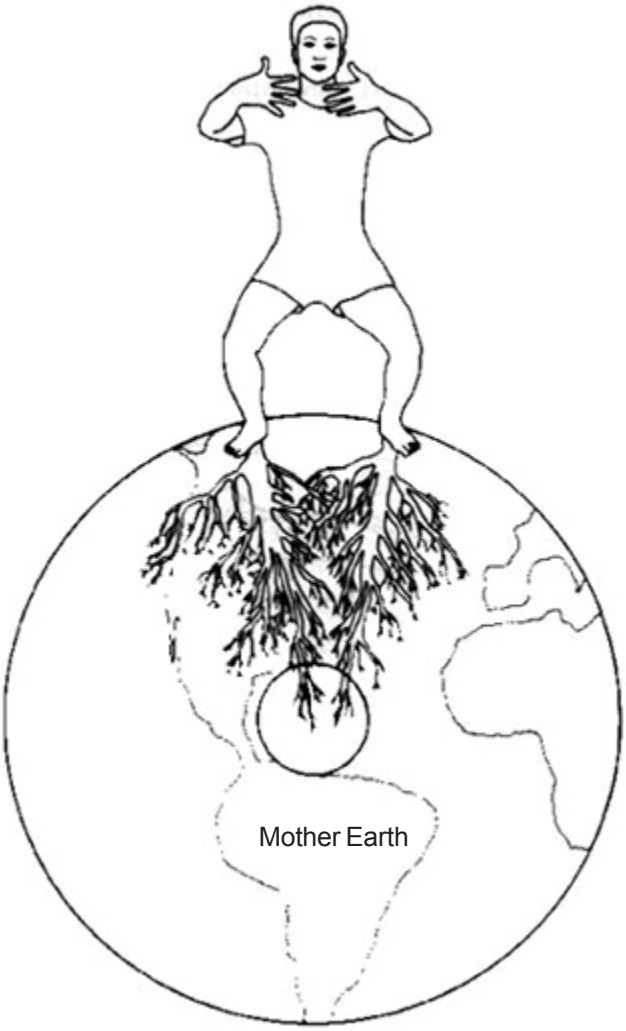

Fig. 1.2 *Rootedness to Mother Earth Energy*

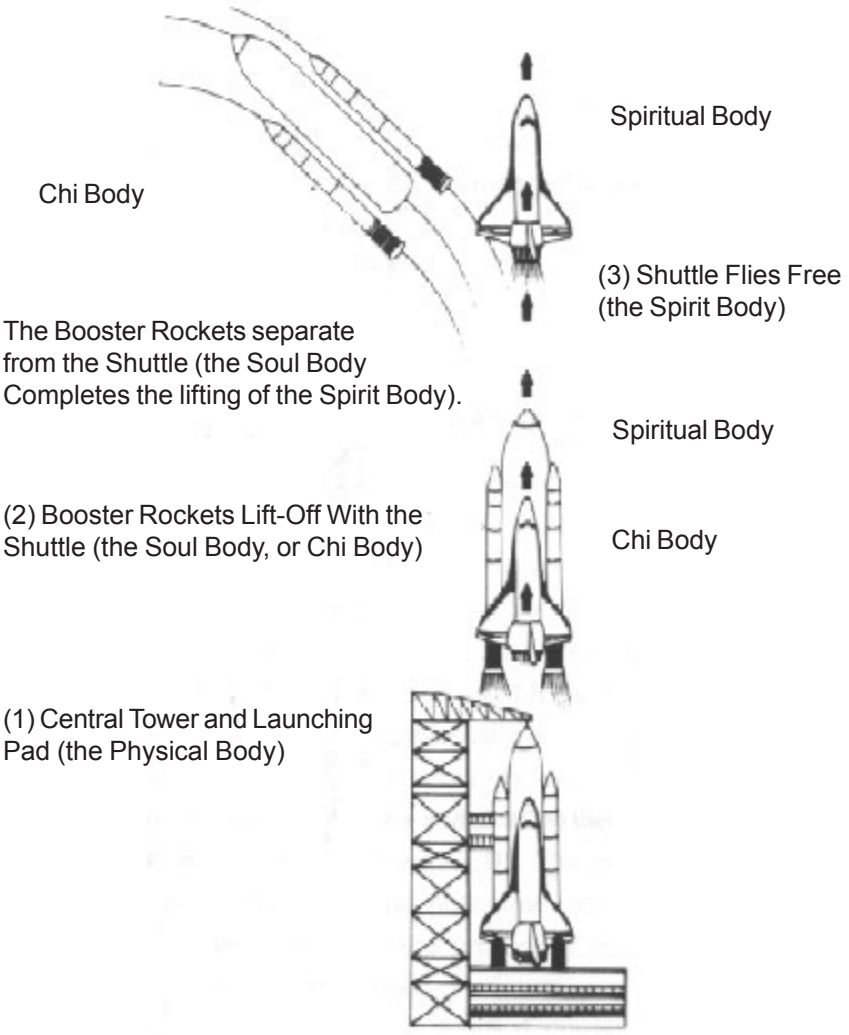

Fig. 1.3 *Launching of the Spiritual Body*

One may compare the foundation, or rootedness, of the physical body to an Earth Control Tower, vital to the travel of a space shuttle in space. (Fig. 1.3) To boost the space shuttle, the spirit, into space the Earth Control Tower requires a booster rocket, the soul or energy body, which is guided by an inner compass and computer, the pineal gland. The Earth Control Tower, in the form of our physical body developed during the practice of Iron Shirt, becomes a storage place for fuel: Chi (our life-force energy) and our creative or sexual,

energy. Here our fuel awaits transformation into another kind of energy: spiritual energy. As we learn how to develop an immortal spirit compass and computer by opening the pineal gland which will guide us back to Earth to complete the unfinished job of development here, we must maintain our foundation, or rootedness, to the Earth. (Fig. 1.4) Thus we are able to return to Earth, refuel and resume our space travel to our destination until, eventually, we are able to discard the earthly base entirely.

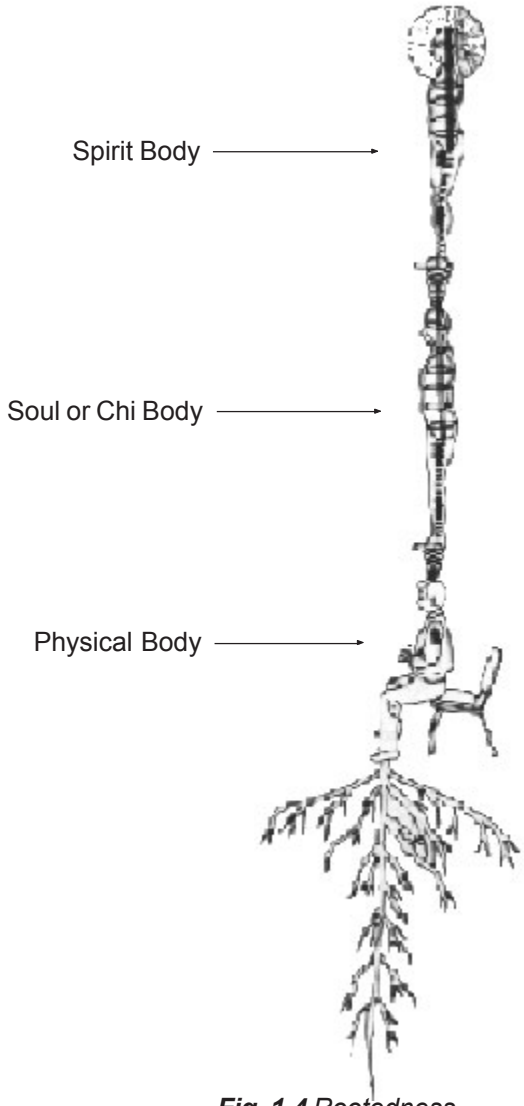

Fig. 1.4 *Rootedness*

1. Iron Shirt Chi Kung—Ancient Kung Fu Practice

a. Bolin Period (the Time of Kung Fu Fighters)

Kung Fu was used in China long before the advent of firearms. During the Bolin Period, approximately 1000 B.C., training in the various spiritual/martial arts was very intense. It is said that at the time one tenth of the population of China was involved in some sort of Kung Fu.

In ancient Kung Fu practice, training began in very early youth. One first worked to develop internal power (inner strength through organ exercise), a venture that could take as long as ten years. Thereafter, one might have to throw a straight punch 1,000 times a day for a period lasting from three to five years. One might be instructed to strike the top of a water well with the flat of his palm 1,000 times a day for five to ten years, or “until the water leapt out of the well”.

Iron Shirt Chi Kung, a method of Kung Fu, was learned as a protective training, providing internal power by the practice of simple external techniques. The practitioner was guarded against the effects of blows to his vital organs and glands, the primary sources for the production of life-force energy (Chi). The word Chi means air. Kung means discipline: one who puts time into practice. Therefore, Chi Kung means “to practice the process of breathing to increase Chi pressure (life-force pressure)”.

A thousand times a day internal power was cultivated until it could be felt flowing out of the hands. With weights tied to the legs, the practitioner ran and jumped in prescribed ways for over three hours a day until, eventually, he could jump easily to great heights and, at the same time, further develop his internal power. Only after these exercises were mastered were actual fighting techniques taught.

The importance of the development of internal power in martial arts training may be compared to the effect of being struck by a steel rod as opposed to one that is made of soft plastic. The Chi Kung practitioner of old practiced one punch for years until he could feel the power go out of the lower part of his hand, while the rest of his body seemed as though made of steel. There were many other benefits as well, e.g., internal power improved general health and is claimed to have maintained youthfulness.

b. Iron Shirt helps to Perfect Mental Faculties

Chi Kung also helped to perfect mental faculties, enabling the practitioner to have knowledge of many things. One reads that during the Bolin period, there were eight “immortals” who spent most of their lives in such practice and developed extraordinary abilities. They could predict the future and see into the past. They are said to have been capable of space travel and of clairvoyance and clairaudience. It is also said that during that period, many people had at least some such powers, a result of widespread Kung Fu practice. Some sources attempt to explain this by claiming there must have been a general universal reservoir of power, far greater than is now available, from which the more capable practitioners could draw.

c. Age of Gunpowder

After the invention of gunpowder and the subsequent elaboration of firearms, men no longer felt the need to spend a decade or more of their lives learning skills that no longer seemed practical. A man could now defend himself, or cause great damage at a great distance from his objective, with weapons. (Fig. 1.5) Contact fighting became a thing of the past, and much of the associated knowledge that was useful to man was lost with it.

Fig. 1.5 *Age of Gunpowder*

Today, however with the recent revolt against the depersonalizing and unhealthy effects of a technology of monstrous proportions, there has been a revival of interest in the simpler ways of life. Thus, Kung Fu is again in the limelight. Kung Fu has been called a way of perfecting the inner self.

2. Creating Chi (Life-Force) Pressure

Chi Kung may be thought of as internal aerobics. Chi, as an aerobic energy involving air, steam, and pressure, presses out and circulates to protect the human body. One can compare the internal pressure created by Chi to the force of air in a tire which is sufficient to keep the tire inflated and maintain a cushion between the car and the road. (Fig. 1.6)

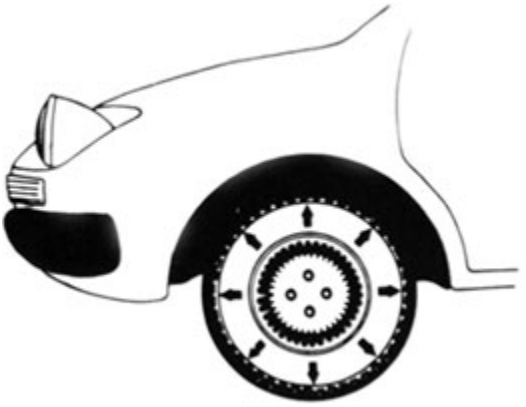

Fig. 1.6 *An inflated tire provides cushioning.*

a. Breath of Life—Chi Pressure

Breathing is the most important part of our lives. We can go without food for months, or without water for days, but we can go without air for only a few minutes.

In practicing Iron Shirt, we use our breath to maximum advantage. We can actually increase our vital energy, strengthen our organs, and promote self-healing by increasing the Chi pressure (pounds per square inch) in the organs and cavity of the body. The circulatory system, the lymphatic system, the nervous system, and the endocrine glands will be activated, and blood, spinal fluid and hormones will flow more easily so that the heart will not have to work hard.

b. Origin of Iron Shirt Breathing

Taoists believe that while we are in the womb, we use Iron Shirt Packing Breathing. Before birth, the infant does not use the lungs and nose to breathe. The Chi (life-force) enters through the umbilical cord to the navel (Fig. 1.7), down to the perineum, up the sacrum to the spinal cord to the head, forehead, and down the front from the tongue (Taoists believe the fetus always holds the tongue on the palate) to the throat, heart, abdomen and navel centers in the abdominal area where the Chi pressure can be used. You will recognize this as the path of the Microcosmic Orbit (described more fully in Chapter 2).

At birth, we begin to use lung breathing and generate our own energy rather than use the internal source of energy. To begin with, the lungs are not strong. The abdomen, closer to our original source of energy in the navel, has more Chi pressure. It assists the lungs in breathing by pulling down on the diaphragm so that the lower portion of the lungs fills with air; initiating inhalation. In this way, the lungs use less energy, but take in more life-force (oxygen). As children, we still use abdominal Chi pressure energy.

Fig. 1.7 *In an unborn infant, the Chi (life-force) enters through the umbilical cord to the navel.*

One can see the effects of reduced Chi pressure with age. In older people the prenatal life-force (Chi) is drained out from the navel and kidney areas. Gradually Chi pressure is lost, creating an energy imbalance: when the pressure is low, the fluid flow in the entire system slows down. As a result, at the times when our energy becomes too hot, it will move up and congest the chest and head. Cold energy will move down through the sexual organs and leak out. Gradually, we lose Chi pressure. We begin to lose the habit of abdominal breathing. The lungs are left alone to do chest breathing.

This is inefficient. It requires greater energy to expand the rib cage, which action fills only the upper third of the lungs. Scientists have affirmed that we use only one-third of our vital capacity (lung capacity) for breathing. This method of breathing actually expends more energy than it creates. Yielding to the external pressure, we collapse inside. With abdominal breathing we can expand the amount of pressure exerted on the organs and voluntarily compress them so that they will strengthen upon release.

B. Why put on your Iron Shirt?

1. Internal Management

Many of the physical changes associated with Kung Fu come through management of the internal organs and endocrine glands.

In Kung Fu, a person's life-force is said to depend primarily upon the endocrine glands, or sexual hormones. It is very likely that this was deduced from the following observations.

Consider what happens when someone is deprived of a fully functional endocrine system. A male is radically altered when his testes, part of the endocrine system in males, are eliminated, and more so when this is done before puberty. Such characteristics as weak musculature and feminine fat distribution develop. Depending upon the time in life in which he was so mutilated, he might also lack such secondary male characteristics as a deep voice, facial hair and sexual drive. Male and female castrates have been well documented to have shortened life spans.

With Iron Shirt Chi Kung, one is able to increase the flow of hormones produced by the endocrine glands, building up the immune system and giving a general sense of well-being. The sexual (creative) energy produced as a result is another source of Chi energy which may later be transformed into spiritual energy.

Integral to Iron Shirt are the organs' exercises which clean and strengthen the organs. Strong, detoxified organs are important to modern life. Iron Shirt practice will strengthen; help to clean out the toxins, waste materials and sediment in the organs; and convert the fat stored in layers or sheaths of connective tissue (fasciae) in the body into Chi energy. The Chi is subsequently stored in the fasciae layers where it works like a cushion to protect the organs. As previously mentioned, this process may be compared to a tire which, when inflated with air, can sustain tremendous weight. Chi which has been stored in such a way then becomes available for transformation to a higher quality energy that can nourish the soul and spirit.

In the practice of Iron Shirt, we put more emphasis on the fasciae connective tissues, organs, tendons, bones and bone marrow and less emphasis on muscle development.

a. Chi, the Fasciae, Organs and Bones

The body may be conceived as consisting of three layers: (a) the innermost which is made up of the internal organs that produce Chi; (b) a layer consisting of fasciae, bones and tendons; and (c) the muscles, which constitute the bulk of the body. Chi, after being developed in the internal organs, is then distributed throughout the fasciae. It is with the fasciae that Iron Shirt I is primarily concerned.

(1) Fasciae

Each organ has a fascia layer covering it. (Fig. 1.8) In the heart this layer is called the pericardium; in the lung it is called the pleura. The fasciae which cover the stomach, liver and kidneys have protective, connective, regenerative and nourishing properties. They act as energizing chambers for the organs.

In Heller work and Rolfing massaging techniques, the fasciae are dealt with from the outside in. The art of Rolfing involves the freeing of areas of fasciae that have become stuck together through trauma, infection or chronic muscular tensions. Iron Shirt works from the inner layer of fascia out. (Fig. 1.9) The intent is to allow for a free flowing energy in the body and to enable psychological insight into events long harbored in restricted musculature.

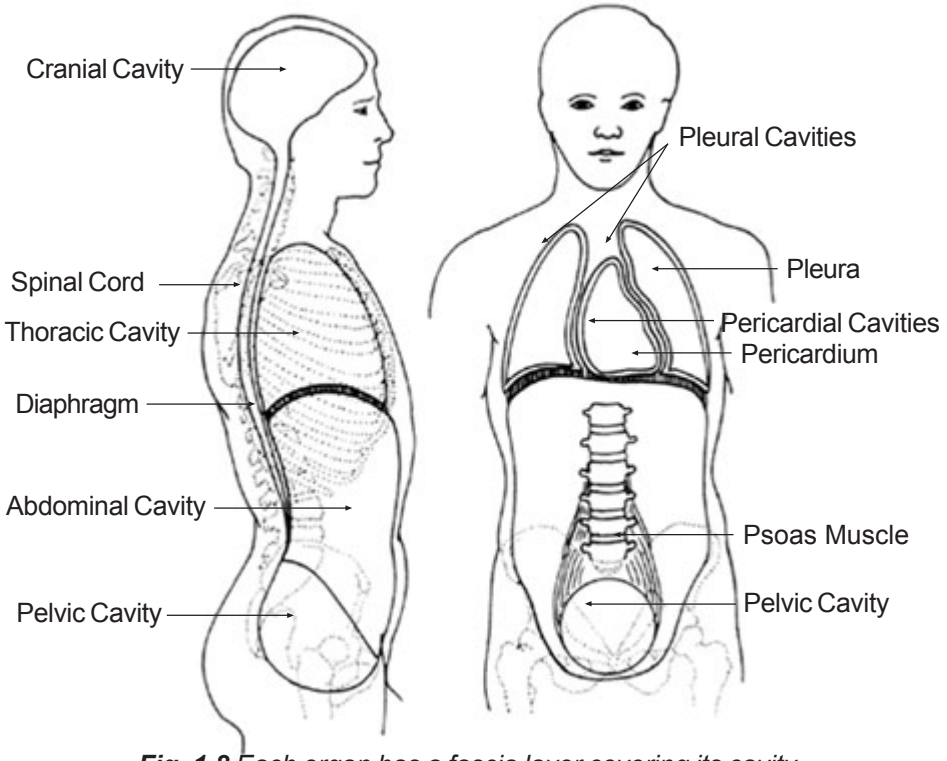

Fig. 1.8 *Each organ has a fascia layer covering its cavity.*

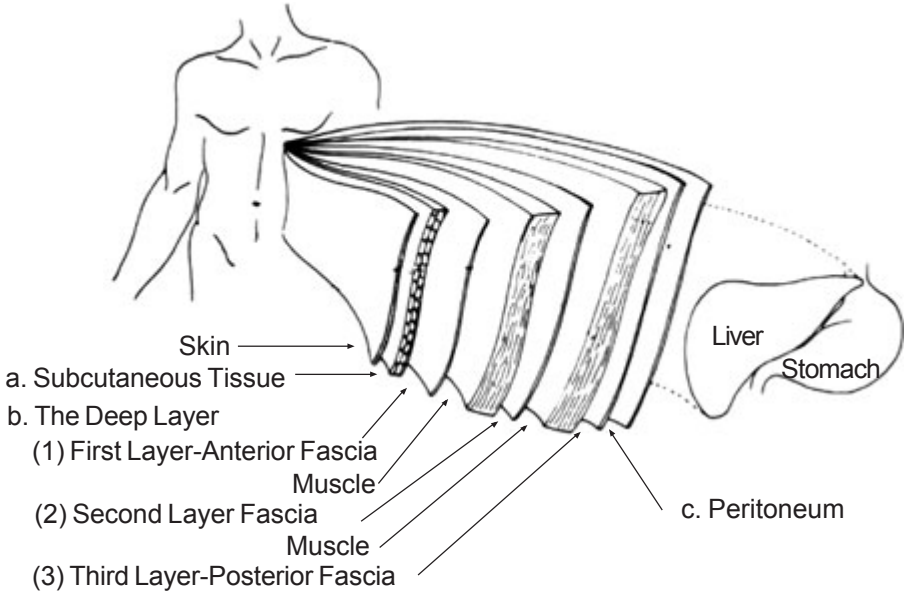

Fig. 1.9 *Fasciae Layers*

The fasciae are extremely important in the practice of Iron Shirt because, as the most pervasive tissues in the body, they are believed to be the means whereby Chi is distributed along acupuncture routes. Research has shown that the least resistance to the flow of bioelectric energy in the body occurs between the fascial sheaths, and that when these routes have been charted, they have been found to correspond to the classical acupuncture channels.

(2) Iron Shirt Strengthens and Protects the Organs

When we pack and wrap the organs with Chi pressure, we start to strengthen the organs. The fasciae layers covering the organs, when filled with Chi pressure, will act as energizers to the organs. Extra Chi pressure will escape to the abdominal fascia layer fill the abdominal cavity with Chi pressure, act as a protector to the organs and permit the Chi to flow more easily. When the abdominal cavity fills with Chi pressure, the Chi pressure will start to fill in the deep fasciae and, finally, fill in the outer layer, acting as a triple layer or cushion of Chi pressure to pack and protect all of the organs, muscles and vital glands.

To better understand how Chi, the fasciae and the organs relate to one another, picture an egg residing inside a balloon filled with air residing inside another air-filled balloon, both of which reside inside one more air-filled balloon. (Fig. 1.10) An egg is normally quite vulnerable, but inside a blown-up balloon, it is cushioned against blows. Inside a triple layer of balloons, we see that the egg has even greater protection. You can throw and kick these three layers of balloons and the egg will remain unharmed. Chi and the fasciae act in the same way to protect the fragile organs. The fasciae are elastic and protective like balloons, and the Chi, expanding as the air expands within the balloons, creates pressure (Fig. 1.11)

When Chi pressure is reduced by sickness or a weakened state the organs become cramped because they yield and become compressed by pressures external to them.

Most people, when hit in the abdomen will fall down, or if they are so unlucky as to have the vital organs hit, are seriously injured in the vital organs. When the vital organs are injured, life can be endangered. With this practice of building layers of protection, you will greatly reduce the risk of unexpected injury and in many instances might help to save your life.

From the fasciae, Iron Shirt extends to involve the bones and tendons and, finally the muscles.

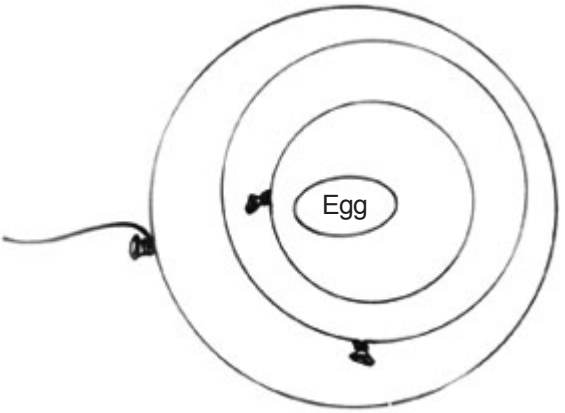

Fig. 1.10 *Balloons containing an Egg*

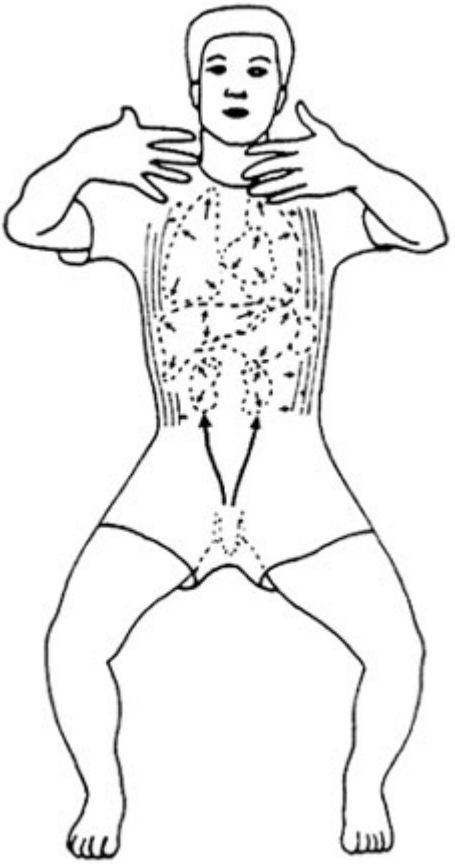

Fig. 1.11 *Pack the Chi into the organs and fasciae layers to protect the organs.*

(3) Burn Out Fat and Store Chi in the Organs

Food (nutrition) that is taken into the body but is not required by the body is turned into fat and stored in the outer layers of fasciae. This fat will greatly reduce the flow of Chi. The Iron Shirt Packing Process will help to pack and squeeze the fat, transforming it into energy to be stored in the fascial covers of the organs for use whenever needed. When Chi pressure occupies the fascial layers, the fat cannot be stored there. Therefore, the body becomes trained to convert fat into Chi energy for storage in the fascial layers.

(4) Structure of the Bones

When the fasciae are filled with Chi, the tendons are strengthened and the bones hold together as one structural piece. When the fasciae are weak, the muscles are weakened and the bone structure will not hold together. Similarly, when the muscles are weak, both the fasciae and the tendons are weak. When muscles are not used, they diminish in size and strength as do the fasciae which contain them and the tendons upon which they pull when activated.

There is a constant turnover of most of the cells of the body and replacements are governed by ongoing needs. It has been demonstrated that during prolonged periods of weightlessness in outer space, the constitution of bones is not as dense as it is on the surface of the Earth where the greater stresses of gravity signal heavier bone growth. When we are young, our bones are filled with marrow. (Fig. 1.12) When we become adults, the bones gradually hollow out, filling with fat and producing less blood cells, until they become brittle and susceptible to fracture. Iron Shirt Chi Kung is primarily designed to gradually reabsorb the Chi life-force back into the bones, which can be transformed into bone marrow to strengthen the bone structure.

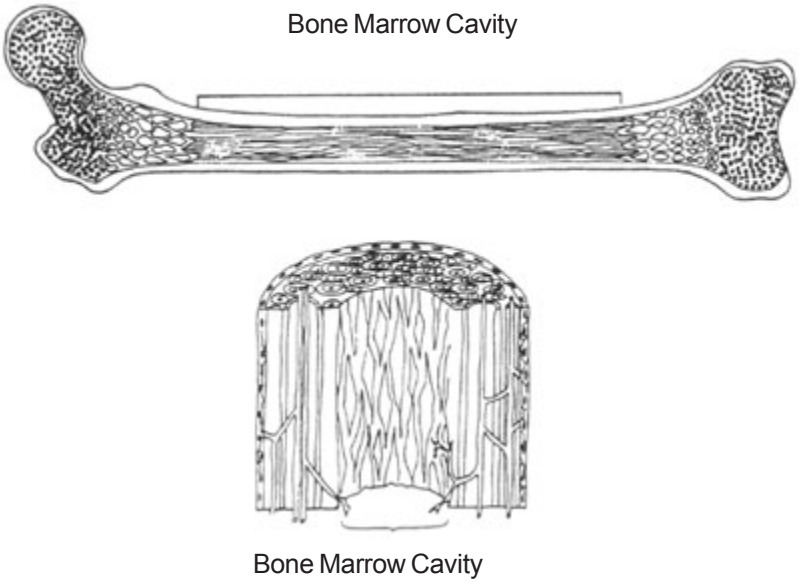

Fig. 1.12 *When we are young, our bones are filled with red marrow.*

b. Chi Pressure and Meditationi increase Circulation while Reducing the Heart's Work

As mentioned, we must learn again to use the abdomen to aid in breathing and to help increase the circulation. The abdominal area accounts for two-thirds of the blood supply that flows through the liver, kidneys, stomach and spleen. When one knows how to pack and release, the abdomen will act like the most efficient heart you could ever have. In Iron Shirt Chi Kung Packing Process Breathing, by limiting the space of the abdomen and increasing the pounds of pressure per square inch, all the organs in the abdominal area will be packed in a very small space. This will expel all the toxins and sediment which have accumulated in these organs. The diaphragm will pull down to create a vacuum in the lower part of the lungs, filling the lower lobes first, and extending to the whole lungs. This gives a longer deeper breath which will furnish sufficient time and quantity of oxygen to cleanse the body of waste materials, sediment and toxins.

Our systems rely entirely upon Chi pressure to move the fluids. Increased pressure in the abdominal cavity will help to increase

the Chi pressure in order to move Chi, blood and lymph fluids. (Fig. 1.13) When the new blood is released, oxygen and nutrition will enter into the organs. With this practice, you will gradually increase the flow of the circulatory and lymph systems and, in return, will greatly reduce the work of the heart. As you gradually increase your vital capacity by learning how to pack air into the organs, thereby creating the cushion, or Chi pressure, to protect and strengthen them, the heart will have to work with progressively less effort and circulation will increase. The vital energy thus conserved can be used to enrich our spiritual and creative lives.

Our goal, then, is to increase the organ and abdominal pressure so that the Chi presses outward on the fasciae layers from inside. To do this, you will learn Packing Process Breathing to increase the pressure of Chi in the organs and abdomen. When this pressure is released, the fasciae expand, as do the organs.

Chi circulation meditation affords a means of generating and directing far more Chi than would ordinarily be available without causing pressure on the heart. Meditation increases circulation and the production of lymphocytes without affecting blood pressure the way running and western aerobic exercises do. Once you have practiced Chi circulation meditation by learning the Microcosmic Orbit, you will understand that the energy made use of in Iron Shirt travels very much along the same route of the Microcosmic Orbit, but is found to be expressed differently in each of the channels. As the Chi flows more freely throughout the entire body the experience takes on new dimensions.

c. Preventing Energy Leakage

The Taoists believe that Chi can be transformed into anything in our body. Certainly the energy we channel in the body has a generative effect. Therefore, an important function of Iron Shirt is to learn how to create space in the body to store Chi energy and how to prevent energy leakage. Energy is dispersed and scattered in the average person, escaping out daily through various openings in the body. Iron Shirt teaches the practitioner how to seal these openings. A process is then learned to direct this conserved energy to the navel region, there to be packed and condensed into an energy ball (Fig. 1.14) which can be directed to any part of the body or in later practice, to build an energy body to boost the spirit to a higher plane.

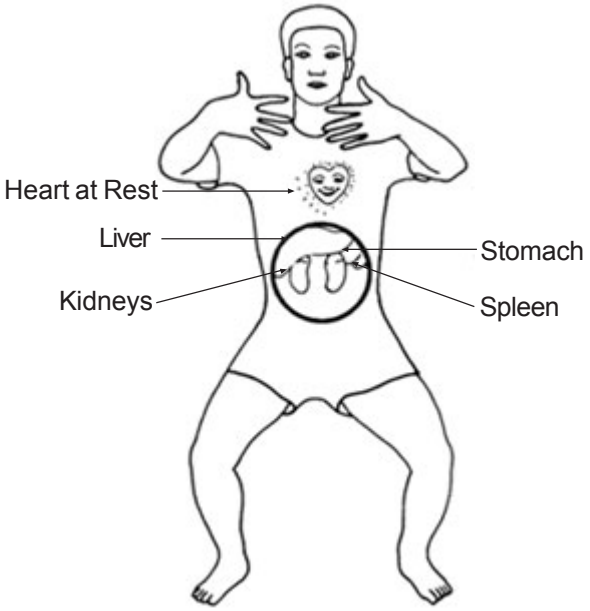

Fig. 1.13 *Compressing the organs, thereby creating a pressure in the abdomen, can cause the abdomen to pump like a heart, moving fluids through the system.*

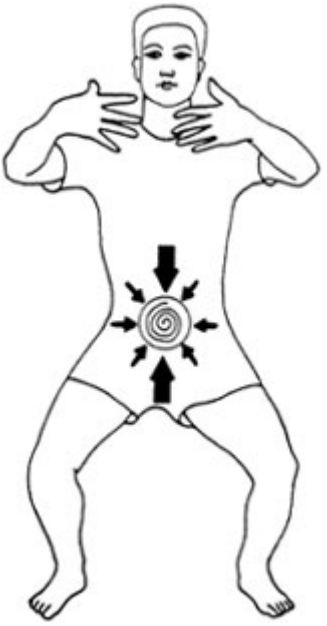

Fig. 1.14 *Concentrating Energy into an Energy Ball.*

2. Iron Shirt prolongs Life

Long life and happiness have been pursued by people for centuries, and the search still continues. However, even with the added impetus of all that modern science and technology can offer, little, if any real progress has been made that is in the common domain. It is currently believed by many here in the West that daily physical exercise helps to stave off aging. However, statistically, athletes do not live longer nor seem to be appreciably healthier for their efforts. In fact, as the effects of aging impede them more and more, many of them become subject to depression. They are no longer able to compete successfully. In order to do more strenuous exercises, parts of the body must be changed. Also, there seems to be some basis for thinking that certain situations, such as the stress of competitive athletics or the use of drugs, may contribute to premature aging (discounting injuries that are sustained in more violent pursuits). A Taoist might comment that this is so because in accenting the physical, the spiritual was neglected, as well as the mind, the nervous system and the internal vital circuits.

Man's life span has been prolonged by science and technology. However, more often than not, the added life span can be of a low enough quality not to seem to be of great benefit.

The old Taoist sages say that in ancient times, men lived from 500 to 1,000 years. Modern society emphasizes material aspects of life whereas the ancient Taoists sought a balance of the material with the spiritual. The Taoist and Yogic approaches describe an "inner world" which man can develop and cultivate that is reflected in his "outer world". There is an old Taoist saying, "Living one hundred years is common. Life is in my hands, not in the hands of a Universal Being." It might be that this positive statement is derived from a genuine knowledge of how to prolong life in such a way that it is also vital and satisfying.

The Taoist System is very precise in the matter of building Chi, guiding it and finally developing skills to make the best use of it. To attempt to hasten the process by skipping steps is to end with nothing or to create complications such as irregular heartbeat, chest congestion, headache, pain in the heart, chest or back, which result from not knowing how to guide the energy.

3. Summary of the Benefits of Iron Shirt Chi Kung Training

In summary, Iron Shirt Chi Kung I training is divided into three levels: physical, emotional and spiritual.

a. On the physical level, one learns how to (1) align structurally to strengthen and alter a weak structure into a strong structure so that Chi can flow easily throughout the body and provide room for organs to grow within the body's structure; (2) develop a Chi Belt, the major connection of the upper and lower energy channels, without which proper structural alignment and Chi energy will be lost; (3) detoxify and exercise the organs and glands in order to charge and pack the Chi in them, to serve as cushioning to surround and protect them, and to fill the cavity of the body with Chi pressure; (4) increase Chi storage between the fasciae sheets; open the fasciae to serve as Chi storage areas of the body replacing fat previously stored there; understand the function of the fasciae layers as cushions around the body which protect the vital organs; (5) root down to the earth, sink down and become one with the earth, to be able to pass the outside force down to earth through the structure without obstruction, and to pump the earth force up into the structure and counteract outside forces with the assistance of the earth; (6) generate an easily flowing Chi through the meridians of the body and transform Chi to a higher "octane" to serve as the nourishment of the soul and spirit body.

b. On the emotional level, or soul level, one learns how to (1) condense the Chi into a controllable mass of energy, transforming and moving the Chi by changing negative energy into positive energy; (2) condense life-force Chi into a ball. This is one of the most important functions of the Iron Shirt Chi Kung practice since it enables one to control his Chi so that the Chi will not scatter around the body and leak out of the system. Condensed Chi will stay together and have more condensed power to be used as a person desires. When you are well trained in condensing the Chi energy into a ball, by physically moving the abdomen up and down, or left and right, you will be able to move the ball. In later practice, you will be able to use your mind to move the ball and direct it through channels in your body, always returning it to the navel. In the higher level, the condensed Chi becomes a light ball, like a glowing pearl, which develops into the energy body, serving as a booster rocket to boost the spirit or space body into orbit.

c. On the spiritual level, Iron Shirt Chi Kung condenses, strengthens and creates more Chi, thereby laying the groundwork for a spiritual foundation (rootedness) which serves the later part of the system. Previously referred to as an Earth Control Tower this foundation will direct the spirit in its journey through space where preparations are made for life after death.

C. Iron Shirt Chi Kung Exercises

The Iron Shirt exercises introduced here are primarily concerned with the fasciae and bone structure as well as with some tendons.

These eight exercises (namely, Embracing the Tree, the Yin and Yang Positions of Holding the Golden Urn, the Golden Turtle Immersing in Water (Yang Position), the Water Buffalo Emerging From the Water (Yin Position), The Golden Phoenix Washes Its Feathers, the Iron Bridge and the Iron Bar), condensed from forty-nine postures, are very precise in developing the most vital energy routes. There are many exercises known that will serve this purpose; however, by doing the eight exercises and the structural alignment exercises described in this book, you will derive as much benefit as you would from a much wider selection of positions and movements. These exercises develop Chi flow and strengthen fasciae, tendons, bones and muscles. In the tradition of Taoist Esoteric Yoga, it is said that (a) Chi moves the blood (and the heart works less); (b) blood moves muscles; (c) muscles move tendons, and (d) tendons move the bones to which they are attached.

Iron Shirt strengthens muscles, tendons and bones by subjecting them directly and gradually to increasing stress. It is a well rounded approach which offers, as an additional benefit, a means of releasing long held areas of tension. This often reflects in a general sense of well-being, of self-assurance and ease, along with better posture.

Many of my students report that Iron Shirt has enabled them to achieve a deep sense of feeling grounded and centered. Others suddenly discover that their hands and feet are no longer cold.

There is another advantage to Iron Shirt. The pneumatic effect joins what would otherwise be separate members of your body into one continuous unit. This produces a tremendous increase in mechanical advantage that increases geometrically as this work progresses.

The Universal Tao System offers many types of practices, many of which can be practiced individually. However, it is most beneficial to the practitioner to realize that all are interrelated and practicing them together will bring the best results. If one attempts to practice Tai Chi Chuan, for example, before having first cultivated internal energy through Iron Shirt, it might be compared to entering high school without having learned the alphabet.

Iron Shirt Chi Kung is the foundation of Tai Chi which uses structural alignment as a basis for exercise. Many people have the wrong idea about Tai Chi. When the energy is felt in the Tai Chi movements, the practitioner wants to move the energy. However, the moving form of Tai Chi occupies the mind with many things other than moving the energy. The more the practitioner moves his form, the busier his mind, making him less aware of the subtle energy that can be felt within himself. In other words, the simpler one keeps the activity of the mind, the better one can feel his inner workings. Iron Shirt uses the mind to guide the Chi flow in a static position. If you train in the methods of Iron Shirt first, you learn well how to move the Chi. Then when you practice Tai Chi, it is easier to move the Chi while practicing the moving forms. In the Universal Tao System, we require students to learn the Microcosmic Orbit, Iron Shirt Chi Kung, and then Tai Chi. Therefore, the structural rooting and energy discharge and control that is learned in Iron Shirt can be transferred into the Tai Chi form. It should also be noted that to practice Tai Chi Chuan properly, it is necessary that your meditation practice take you at least to the levels in the Universal Tao System of Fusion of the Five Elements or to Lesser Enlightenment Kan and Li.

Since the basic approaches of the Microcosmic Orbit, Iron Shirt Chi Kung, Seminal or Ovarian Kung Fu, and Tai Chi Chi Kung deal with some aspect of coaxing energy out of the deepest and outermost reaches of the body, it is wise for the practitioner who is interested in developing fully his physical, emotional and spiritual potential to consider the Universal Tao System in its entirety.

D. Three Levels of Iron Shirt

This first Iron Shirt book is concerned with the first level of Iron Shirt, Iron Shirt Chi Kung I, in which, through internal organs exercises, the fasciae (the connecting tissue which cover the organs and glands) are energized.

The second book, Iron Shirt Chi Kung II, deals with tendon exercises, known since olden times as 'Changing the Tendons'. This practice utilizes the mind and heart to direct, stretch and grow the tendons.

Iron Shirt Chi Kung III, the third book in this series, works on bone structure and increases the bone marrow. This procedure, known by the ancient Taoists as "Cleansing the Marrow", is used to clear out fat stored in the hollow bone and absorb the creative power (sexual energy) into the bone to rebuild the bone marrow. Bones are the major blood builders, including the white blood cells necessary to the body's defense mechanisms.

Chapter 2
Initial Preparations

A. Iron Shirt Breathing and Relaxation

You must not use force in any of these procedures. These exercises depend very much upon mind control and relaxation. In doing the chin press, which is accomplished by pressing the chin down to the chest and pushing out C-7, the chest must remain relaxed if you are not to develop chest pain and congestion and if you are to avoid difficulty in breathing. Practice the relaxation of the Inner Smile and run your Microcosmic Orbit (described briefly in this Chapter and more fully in the book, *Awaken Healing Energy Through the Tao*). If you find yourself shaking and jerking about, just simply let it all happen. It is a refreshing experience.

In a standing or walking position, you can stroke your chest with your palms from top to bottom from nine to eighteen times to relieve any congestion that might have accumulated there. Burp, if the need arises. If you begin to salivate copiously, tighten your neck muscles, press your chin to your chest, 'smile down" through all of your organs and then put your tongue to your palate and, using force, swallow saliva so that you feel as though you have indeed swallowed all the way down to your navel. Concentrate there until you can feel your navel grow warm.

Practice the Iron Shirt Chi Kung breathing twice per day only during your first week of practice and three times per day in the following week. By the second to fourth week, you can increase six to nine times and increase the length of time in Packing Breathing.

1. Abdominal and Reverse Breathing (Energizer Breathing)

Those who have not been trained in Chi Kung, Yoga or any other breathing exercise will be tense and will use very shallow, short breaths, uilizing only one-third of the lungs. This causes lose of Chi pressure in the abdominal cavity. With practice, proper breathing is accomplished.

Iron Shirt breathing combines various types of breathing. First, abdominal breathing is practiced to energize and loosen the fascial

layers of the body. When the breath is harmonized, Chi is sent down to the navel. At this time, reverse breathing is initiated. Abdominal and reverse breathing are the two basic ways of breath training. Practiced together they are known as Energizer breathing, but have also been called “Breath of Fire” or “Bellows Breathing”.

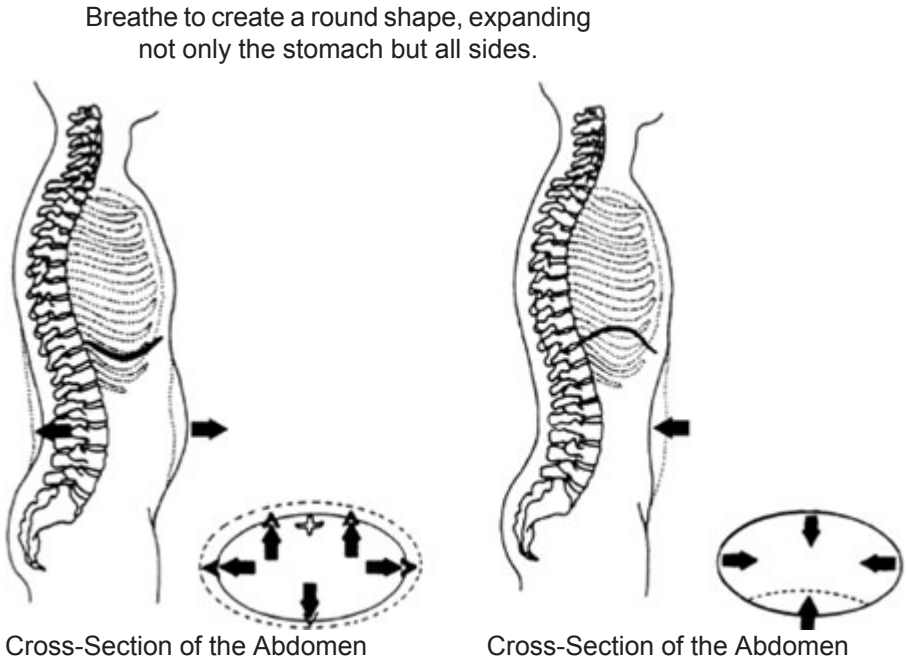

Fig. 2.1 *(a) Abdominal Breathing* *(b) Reverse Breathing*

Abdominal and reverse breathing are caused by the up and down movement of the thoracic diaphragm. (Fig. 2.1 (a) and (b)) During abdominal breathing, the diaphragm lowers and forces the vital organs, especially the adrenal glands, to compress downward, allowing the lower lobes of the lungs to fill with air, and forcing the abdomen to protrude. The chest and the sternum sink, which presses and activates the thymus gland. Upon exhalation, the stomach returns to a flatter shape and the other vital organs return to their original size and shape. In reverse breathing, on inhalation

we flatten the stomach, push the organs and diaphragm up, and allow air to fill the whole lungs. As your practice develops, you will be able to maintain a lowered diaphragm during reverse breathing, thereby lowering and compressing the organs. Upon exhaling, we fill the abdomen out. The motions thus created massage the vital organs to a certain extent. It is to reverse breathing that "Packing" Breathing is added.

a. Practice Abdominal Breathing (Fig. 2.1 (a))

(1) To practice abdominal breathing, keep the chest very relaxed. This may be difficult at first, but it is important. Begin by breathing in, drawing the air into the abdomen.

(2) Make the chest hollow and drop the diaphragm down. (Fig. 2.2(a)) Pressure is felt inside the abdomen which will begin to protrude on all sides in a rounded shape. Do not expand the stomach only. With the diaphragm lowered and the abdomen filled with air the inches of spacing containing the abdominal organs are minimized. (Fig. 2.2(b))

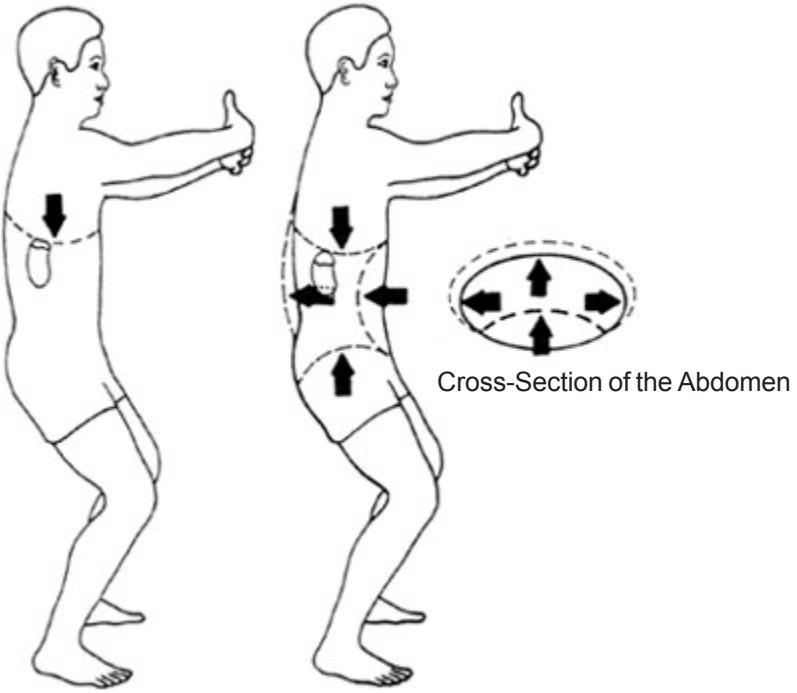

Fig. 2.2 (a) Diaphragm pressing down on the Adrenals and Kidneys.

(3) Hold your breath for a moment and exhale, flatten the stomach to the spine and feel the perineum (the region between the genital organs and the rectum) flood with the pressure. Pull the sexual organs up. The chest and the sternum sink, pressing and activating the thymus gland. (Fig. 2.3) Do not use force. It is enough to feel a slight pull and flattening of the chest.

(4) Inhale and relax, maintaining a dropped diaphragm, and feel the air expand on all sides of the abdomen (not only the front) like a round ball. Exhale and feel the pull of the sexual organs.

(5) With each inhalation and exhalation counting as one set, practice each set nine, eighteen, and then 36 times. Abdominal breathing, as the initiation of what is called “Energizer Breathing”, is used throughout all the exercises as a pre-exercise to Packing Process Breathing. It is also used after packing process breathing to regulate the breath.

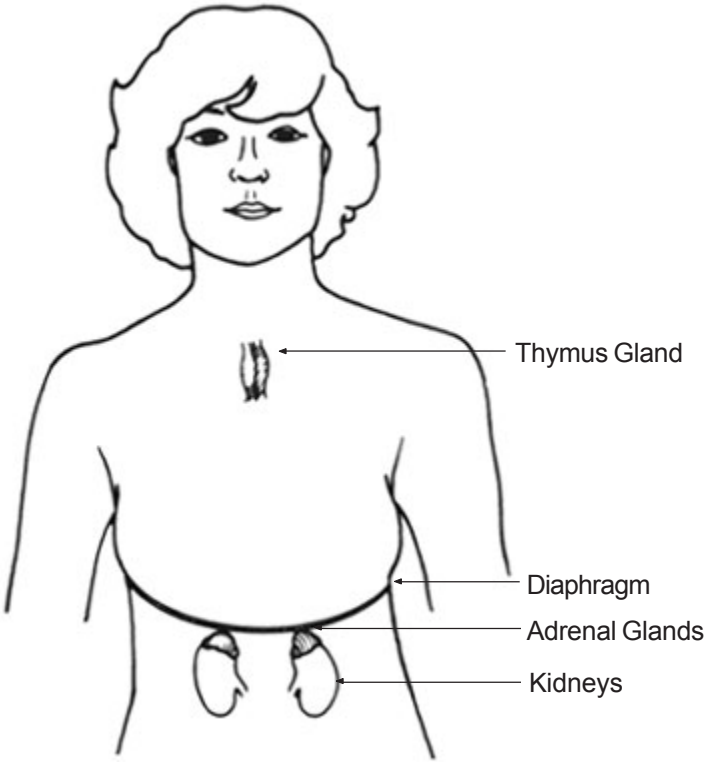

Fig. 2.3 *When the diaphragm presses down on the adrenal glands, the sternum sinks. This activates the thymus gland.*

(6) If you find that your diaphragm becomes tight and pushed up into the rib cage, rub the diaphragm with both hands using the fingers to gently work the diaphragm so that it will drop down out of the rib area into a relaxed position. (Fig. 2.4) Tightness in the abdominal area is one of the main causes of breathing problems. Abdominal massage will help to relieve the tightness of the diaphragm. Use your fingers to lightly massage the abdomen in the navel area until you feel the tightness ease. This will greatly improve your deep breathing.

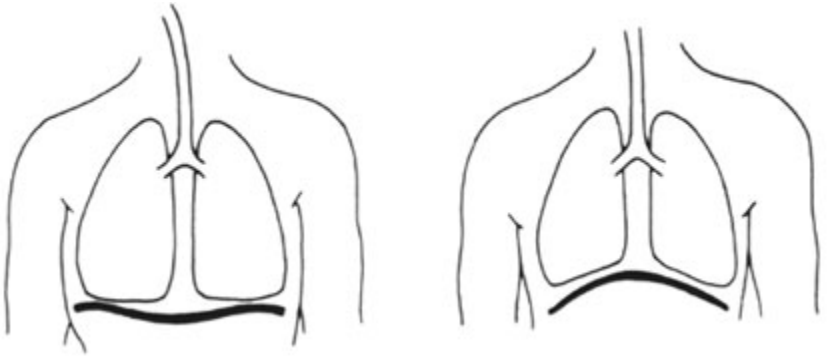

Diaphragm down,
lung capacity increases.

Diaphragm up,
lung capacity decreases.

Fig. 2.4 *Front View of the Diaphragm*

b. Practice Reverse Breathing (Fig. 2.1 (b))

Tight muscles in the chest can be a problem, and so it is important to relax. It is not the muscles but this relaxation which holds the Chi packed inside. Moreover using and training the mind to direct and condense the Chi are the ultimate goals of Iron Shirt training.

As you begin to inhale for reverse breathing, the organs and diaphragm are pushed up as the air fills the entire lungs. As your practice develops, you will be able to control the diaphragm and organs, maintaining them in a lowered position.

Reverse breathing, as the preparation for Packing Process Breathing, also takes place in the lower abdomen and should be practiced in conjunction with abdominal breathing. Draw air into the abdomen while contracting the muscles in front of the abdomen.

Begin with abdominal breathing, and follow with reverse breathing.

(1) Practice abdominal breathing six times. Upon the last exhalation, flatten the stomach. Maintain the flattened stomach and begin reverse breathing upon inhalation. Feel the abdomen flatten even more, as if it were approaching the spine and feel the perineum flood with a pressure. Pull the sexual organs up and, at the same time, try to lower the diaphragm so that you are pushing down on the organs. Try not to let the diaphragm push up. Lowering the diaphragm is the hardest part of reverse breathing. It is very important now to practice the relaxing technique of smiling to the diaphragm and the abdomen.

(2) Exhale, releasing the pressure in the perineum and in the sexual organs. Exhale through the lower abdomen, allowing the pressure to protrude from the lower abdomen to all sides and not only the stomach. Relax, letting the fasciae expand while releasing and relaxing the chest totally. Smile down. Relax.

(3) Counting each inhalation and exhalation together as one, practice reverse breathing six, nine, and then eighteen times. Practice until you are able to control the diaphragm with your mind, commanding it to lower down or rise up.

2. Pelvic and Urogenital Diaphragms

The body also contains a pelvic diaphragm and a urogenital diaphragm which are exceedingly important in transmitting energy in Iron Shirt. (Fig. 2.5) The pelvic diaphragm is a muscular wall that extends across the lower part of the torso, suspended concavely downward from the level of the symphysis pubis (the joint of the pubic bones) in front and the sacrum (the back of the pelvis) in back. There are several organs that penetrate this muscular partition that lies between the pelvic cavity and the perineum. These are the urethra, the vagina and the rectum, and they are supported by the pelvic diaphragm. In fact, the pelvic diaphragm is the floor of the pelvic cavity which contains the large intestine, small intestine, bladder, kidneys, liver spleen, and pancreas. It is the pelvic diaphragm that lifts up and maintains the shapes of the vital organs.

Below the pelvic diaphragm and above the perineum is another muscular diaphragm called the urogenital diaphragm. (Fig. 2.6) This is penetrated by the urethra, while its underside is the attachment site of the root of the penis or vagina. The pudendal

nerve connects the muscles of the urogenital diaphragm, the penis or vagina and the anus. There is a membranous superficial fascia that attaches to the back of this lowermost diaphragm that comes forward to engulf the scrotum or vagina (which also contains muscle) and joins with the abdominal wall. The importance of these anatomical structures will become apparent as you progress in your work in Taoist Yoga, especially in Iron Shirt I, II and III and in Taoist Secrets of Love (Seminal and Ovarian Kung Fu). These two diaphragms serve to assist the flow of pressure to the vital organs and glands, and help tremendously to increase Chi pressure in the organs and the abdomen. Knowing how to utilize and control these diaphragms will improve your capabilities in all levels of the Universal Tao practice.

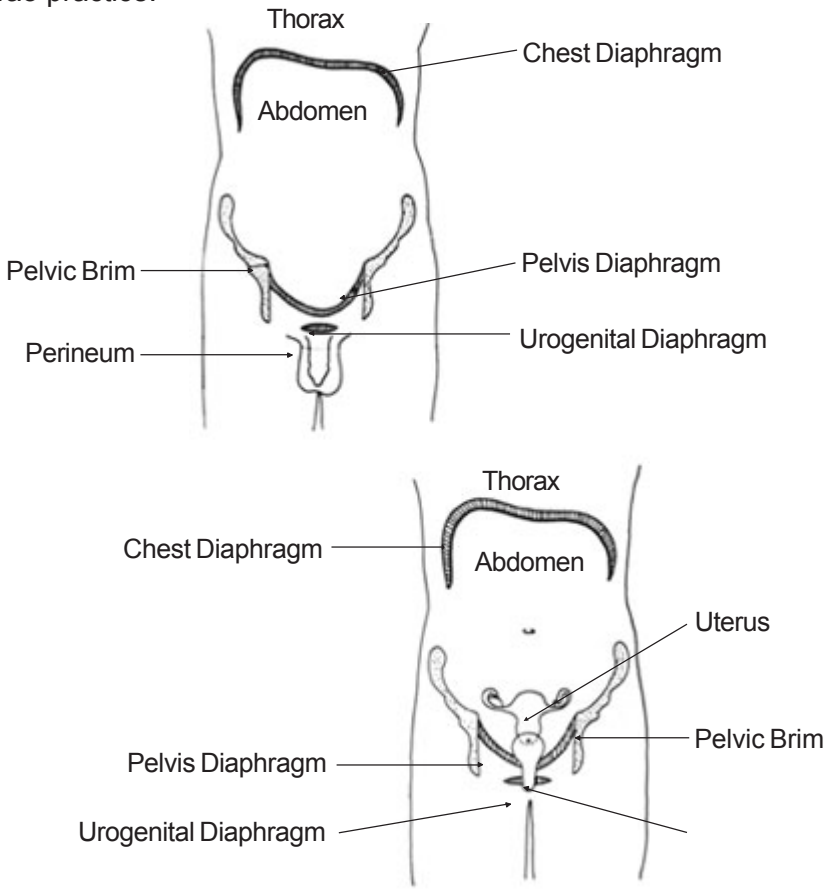

Fig. 2.5 *Pelvic and urogenital diaphragms are the major lower seals which prevent vital energy from leaking out the lower openings.*

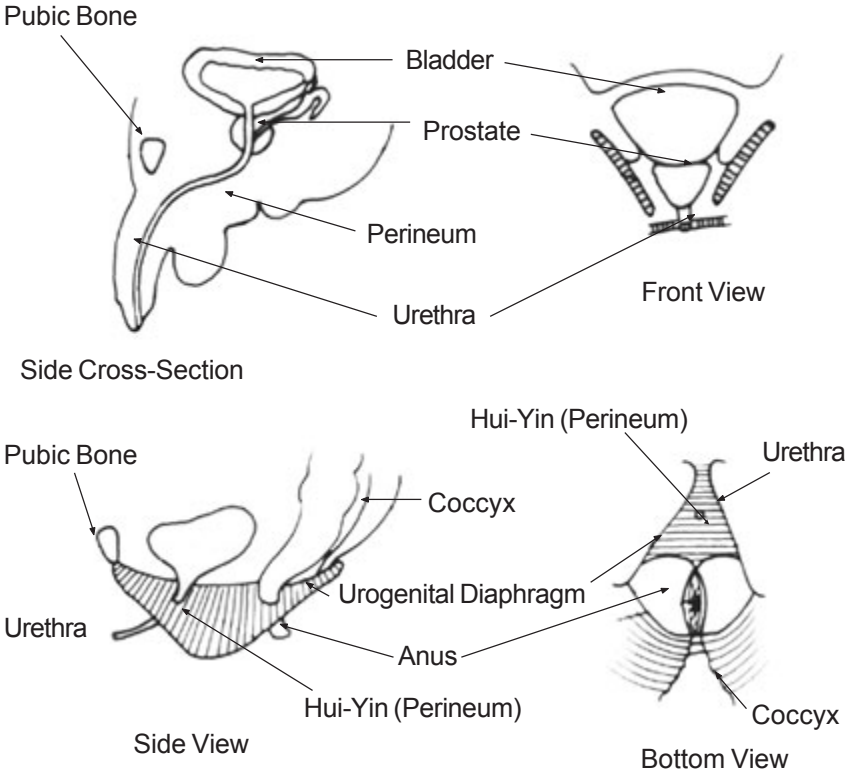

Fig. 2.6 *A closer view of the urogenital diaphragm in the male*

3. Iron Shirt Packing Process Breathing (Chi Pressure)

Packing Process Breathing is the most important breathing technique to master in the practice of Iron Shirt. It is used in all of the Iron Shirt postures and practicing it well will be a great aid in benefitting from the postures.

The Packing Process creates air pressure in a small space so that the body can have more pounds of pressure per square inch (psi). The importance of not only expanding the abdomen out in the front but allowing it to protrude on all sides has been stressed in the description of abdominal and reverse breathing. The same is true of Packing Breathing. The expansion of the front, back and sides occurs proportionately until the abdominal area becomes round like a ball. (Fig. 2.7) Watch a child breathe and you will notice

that his/her abdomen is round. In Chapter 1, we compared this phenomena to a tire which inflates to a certain number of pounds of air pressure (psi) in order to lift and support a car By utilizing this process, the human body can store air pressure (energy) in various parts of the body. When the pressure (Chi) drops, all the organs will drop and stack on each other dropping down and giving a greater burden to the pelvic and urogenital diaphragms. Chi pressure will help the organs hold their shape and uplift the organs into their own positions so that energy can flow easily. Thus, the Chi pressure serves as an energy charger of the organs.

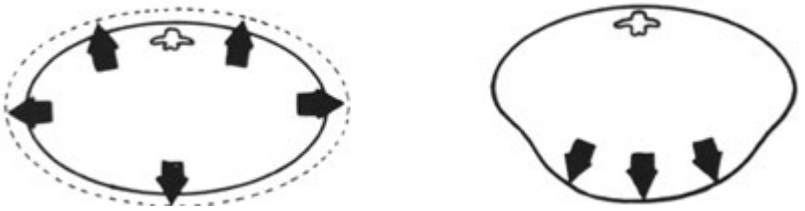

Fig. 2.7 *Abdomen during Packing Process Breathing become rounded like a ball.*

The Taoists believe that the body has many openings: one front door the sexual organ; one back door the anus; and the seven openings of its windows, two eyes, two ears, two nostrils, and one mouth. It is through these openings that energy can enter or leak from the body. In the practice of Iron Shirt, we learn to seal our bodies to prevent energy leakage and the loss of Chi pressure, enabling us to pack, condense and store energy in our bodies and organs. Pulling up the pelvic and urogenital diaphragms helps to seal the sexual organ and anus doors. Turning the attention of your senses down to the navel area will also help to seal the energy.

a. Preparation Using Abdominal and Reverse Breathing (Energizer Breathing)

Sit at the front edge of your chair (the best position for practicing the Microcosmic Orbit also). Place your tongue at the roof of your mouth to seal the leakage of tongue and heart energy. Listen inwardly to your kidneys and breathe inwardly to the lungs. Look inwardly to the liver, and all of the other organs as well, to seal the senses from the inside.

(1) Start with the first stage of Energizer Breathing; that is, abdominal breathing. (Fig. 2.8(a)) Inhale slowly but strongly. Keep the chest relaxed and feel the area of the lower abdomen below the navel and perineum bulge. (Remember abdominal and reverse breathing originates from the lower abdomen, approximately one and one-half inches below the navel.) Then, forcefully, exhale. Notice that when you exhale, the belly flattens toward the spine. (Fig. 2.8(b)) Feel the sexual organs pull up. The perineal bulge diminishes. Learn to keep the stomach flat after exhaling. Inhale slowly again and allow the perineum to bulge as you do so. Repeat in multiples of eighteen to 36. The purpose is to energize the Chi and is also called “Fanning the Fire”.

(2) When you are ready and feel that you have sunk the Chi downwards towards the navel, exhale so that the abdomen flattens towards the spine. The chest and sternum sink down, pressing and activating the thymus gland. Exhale once more and lower the diaphragm down. (Fig. 2.8(c)) Hold for a while and then, using reverse abdominal breathing, inhale ten percent of your full capacity to the navel (ten percent means a short, little breath) while keeping the belly fiat (Fig. 2.8(d)), then relax the chest and belly. Try to keep the diaphragm low.

b. Building Chi Pressure

(3) Inhale about ten percent while contracting the pelvic and urogenital diaphragms. (Fig. 2.8 (e)) Pull up the sexual organs and tighten the anus to seal in your energy. Compress the abdominal organs in three directions: above from the lowered daphragm, below from the sexual organs, and in front from the abdominal wall. The ribs and spine hold from behind. (Fig. 2.2(b)) Inhale ten percent. Contract the left side of the anus, thereby bringing the Chi to the left kidney. Pack and wrap the energy around the left kidney and the adrenal glands. At the same time, pull in more of the left stomach towards the spine. Pull up the right anus and bring the Chi to the right kidney. At the same time, pull more on the right side of the abdomen wall, flattening it towards the spine. Pack and wrap the energy around the right and left kidneys. (Fig. 2.8(f)) Hold this position for as long as you can.

Remember if the diaphragm becomes tight and pushed up, rub it with both hands to gently work the diaphragm so that it will drop down into a relaxed position. (Fig. 2.4)

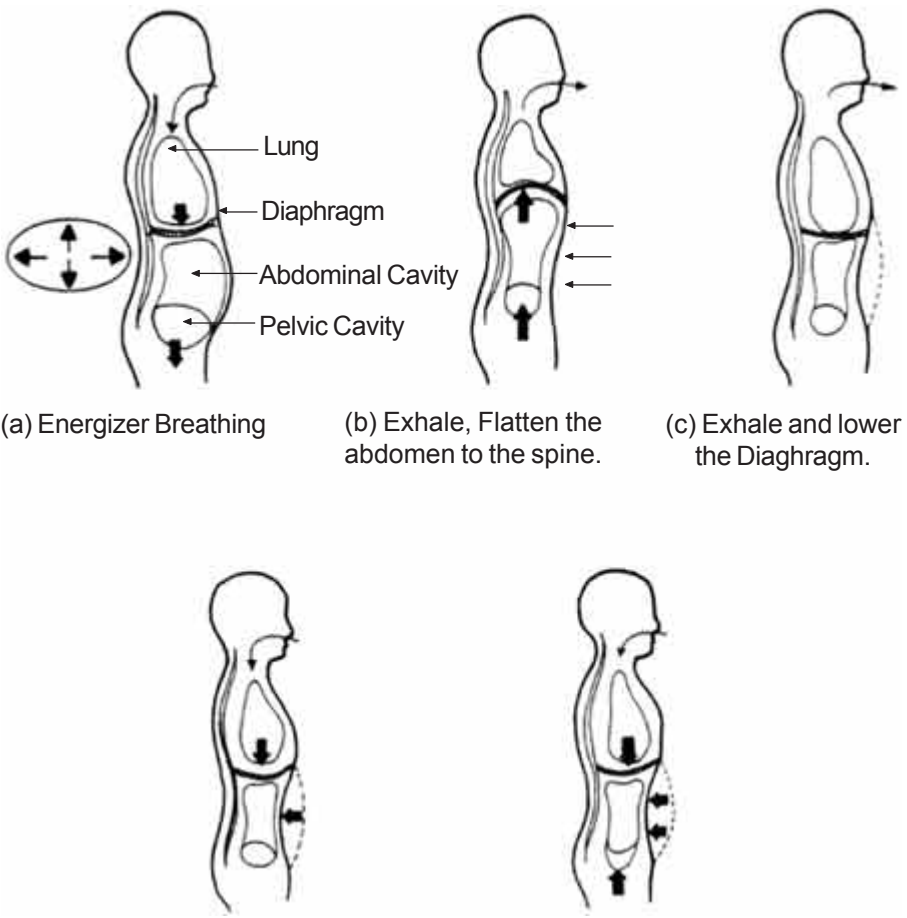

(a) Energizer Breathing

(b) Exhale, Flatten the abdomen to the spine.

(c) Exhale and lower the Diaghragm.

(d) Inhale ten percent, keeping the belly flat.

(e) Inhale ten percent, contracting the Pelvic and Urogenital Diaphragms.

Fig. 2.8 *Packing Process Breathing*

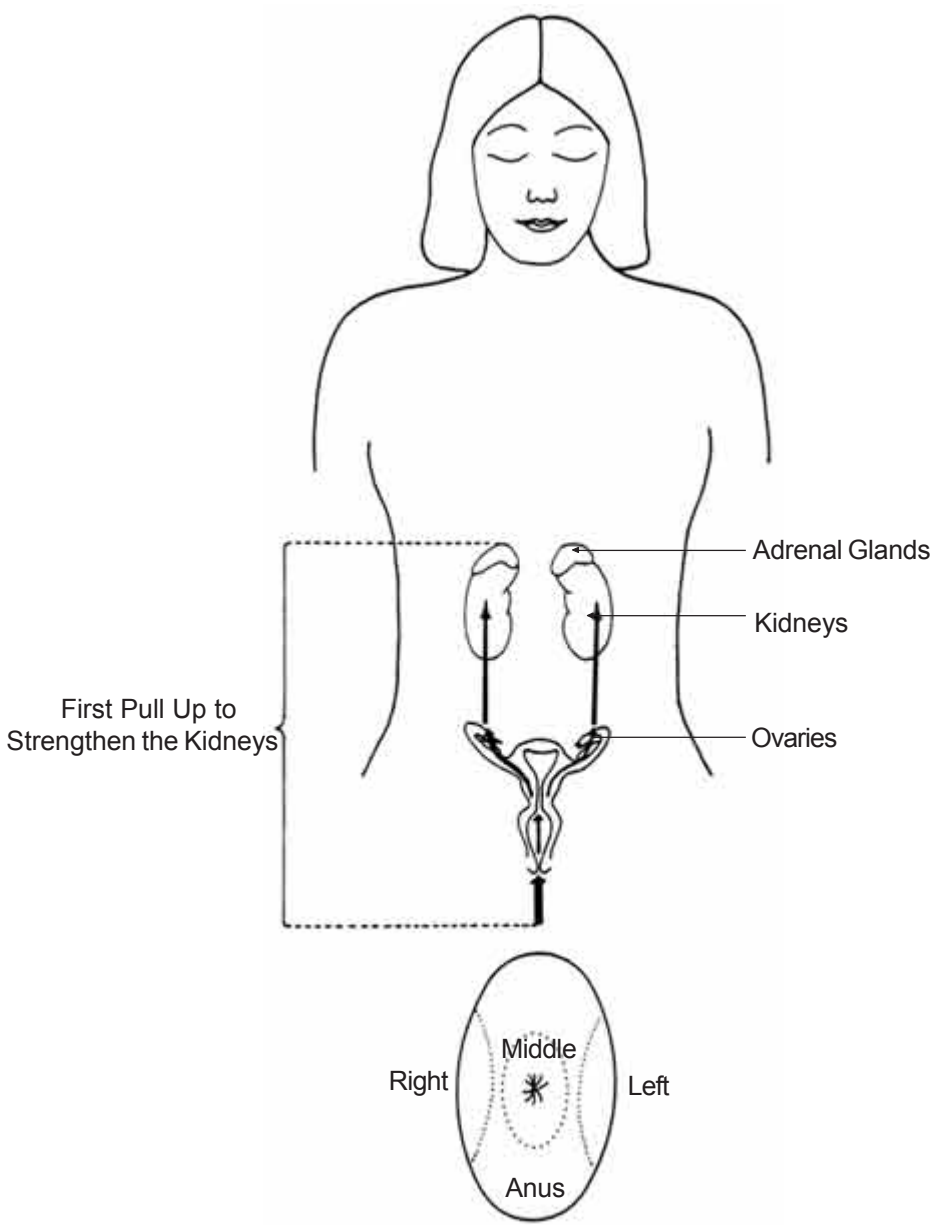

(f) Inhale ten percent. Contract the left and right anus. Bring Chi to the left and right kidneys. Pack and wrap the kidneys.

Fig. 2.8 *Packing Process Breathing*

(4) When you can no longer hold your breath, inhale ten percent more air on top of the air that you already have inhaled. Contract the perineum more tightly especially the sex organs. You can jerk a little, in order to pack the energy in the lower abdomen. Seal and limit the energy to a small area. You must maintain a relaxed chest and sink the sternum so that the diaphragm will stay soft and lowered. The stomach is flat and held in. Feel the pressure extend to the area of the sperm palace/ovary palace. (Fig. 2.8(g)) Pull the sex organs and the anus up again and seal them so that no energy can leak out.

(5) Inhale ten percent more air. (You can exhale a little in order to inhale more air). Contract the pelvic area and lower part of the abdomen, and hold this position for as long as possible. (Fig. 2.8(h))

(6) Inhale ten percent more. Repeat. Feel the pressure build in the perineum. (Fig. 2.8(i))

(7) By this time, it may seem that you cannot accommodate any more air, but if you exhale a little bit, bend forward slowly and direct your attention to the kidneys, feeling them expand on both sides and backwards, relaxing and trusting that the air will have room there, you will be able to inhale the last ten percent of your full capacity to that area in the back. (Fig. 2.8(j)) Hold as long as possible. This will help to open the sides and back.

(8) Exhale. Sit up straight.

(9) Normalize breathing by using abdominal breathing.

When you exhale and relax at the end of such a session, you will immediately experience heat or feel the energy run all around the body. Put the tongue to the palate. At this point you should meditate and circulate the Microcosmic Orbit for a few rounds. Collect the energy in the navel when you have finished. (Fig. 2.8(k))

Using this breathing method, the organs are packed, compressed and strongly massaged. When you inhale, blood and energy (Chi) will rush in with great force to clear the organs out, making them progressively stronger and healthier.

If you feel energy stuck in the heart area, use both hands to brush the chest in a downward motion. In addition, you may want to do the Healing Sound for the heart (see the method described in the book, *Taoist Ways to Transform Stress into Vitality*) and walk around, shaking out the arms and legs.

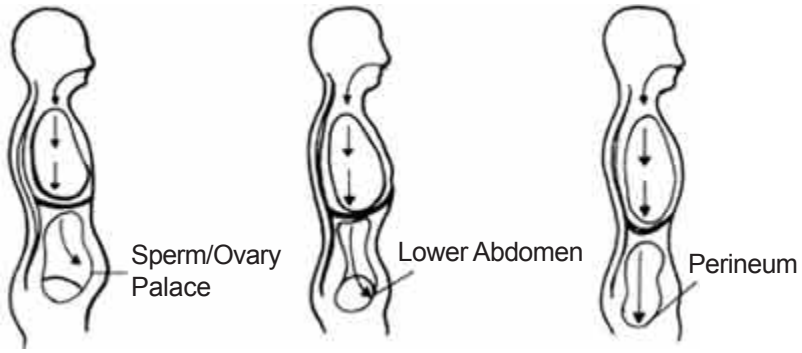

(g) Inhale ten percent down to the lower abdomen.

(h) Inhale ten percent down to the pelvic area and lower abdomen.

(i) Inhale ten percent down to the perineum.

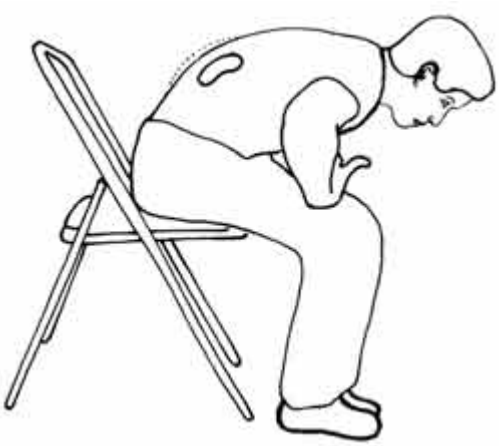

(j) Bend forward to accommodate more air.

(k) Collect the energy at the navel.

Fig. 2.8 *Packing Process Breathing*

4. Points To Remember in Practicing the Breathing Exercises

a. Always remember: ***Do not use force***. Relax the chest so that the chest, sternum and diaphragm can sink down.

b. When packing, stay soft inside, not tense, at least for a good deal of the time. Soft energy is said to be unlimited.

c. Do no more than three cycles of packing per day for the first week. Gradually increase to six, nine and eighteen cycles per day. This exercise is much more strenuous than you might imagine. Energy, wrapped around the organs and pushed into the fasciae by opposing pressure, eventually increases the amount of energy stored in the fasciae and organs, protecting you against blows or unexpected injuries.

5. Preliminary Exercises

Here are some exercises which will be very helpful to you in the practice of Iron Shirt Chi Kung. All exercises should be performed as often as the body finds necessary in multiples of three.

a. Check the Diaphragm

The following is a procedure to check that the diaphragm is lowered. First, press deeply on the stomach with the fingers of one hand directly below the sternum. You will feel a sharp pain that will tell you that you have pressed on the stomach. Next, inhale, allowing the abdomen to balloon out. Touch the diaphragm under the rib cage near the sternum, above the stomach. You will feel a pain which is quite different from stomach pains. Make sure you are relaxed so that the diaphragm lowers. This is the most important part of Iron Shirt practice. Keep the diaphragm lowered at all times while using the packing process. This will prevent the Chi from congesting the lungs and heart and allow it to continue its course downward to the navel.

b. Massage the Diaphragm

Many people have a very tight, stiff diaphragm which sticks to the rib cage. To release the diaphragm, you can massage above the rib cage: (a) massage along the rib cage from top to bottom; (b)

use the index, third and fourth fingers to push downward from the rib cage, and feel the stretch of the diaphragm. (Fig. 2.9) When the diaphragm is stretched, you will feel breathing to be easier and deeper. This can easily be accomplished in the morning when you rise.

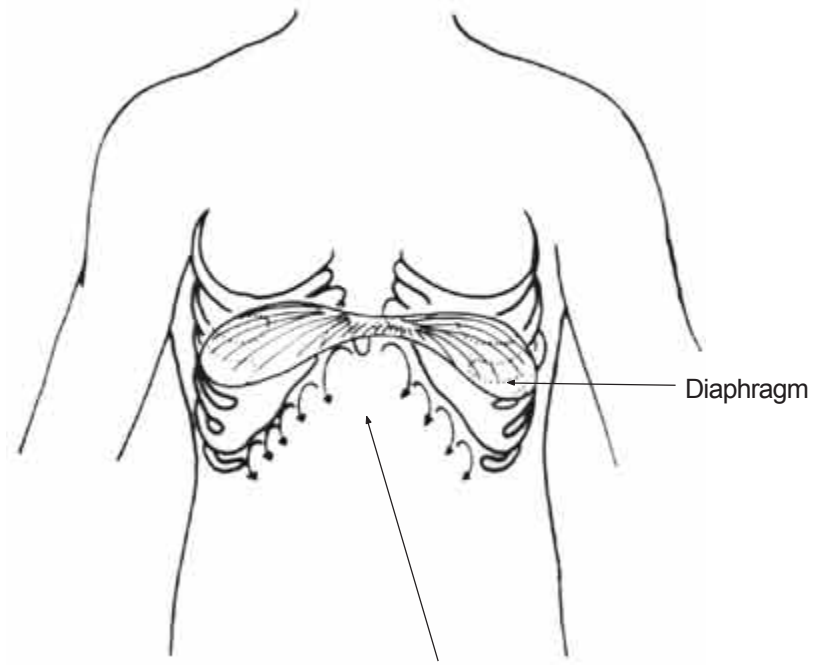

Press in and down all along the edge of the rib cage.

Fig.2.9 *Releasing Tension in the Diaphragm*

c. Abdominal Breathing in a Lying Position

Your greatest reservoir of Chi is in the area of the navel. Concentrating on this area can increase Chi pressure and stimulate its flow. Your Chi always travels to where your attention and activity is centered. When you breathe high in the chest, your Chi goes there and, because Chi cannot be stored there, you will begin to feel distress. Abdominal breathing will avoid this problem.

This exercise will help you accomplish abdominal breathing in a lying position easily.

Lie flat on your back with the legs flat on the floor or with the feet on the floor and the knees raised just enough to allow the lower back to flatten against the floor. Place one hand on the sternum and the other hand on the lower abdomen. When you inhale, allow

the belly to swell enough to raise the hand that you have resting on it, while the chest remains comparatively still. Do this to the count of nine, and then put the arms at the sides. Exhale. Breathe in for nine more such cycles. Breathe abdominally without using the hands. Then place the hands on the chest and lower the abdomen again and repeat the exercise. Be alert to this breathing process and not to how you feel. Put the hands at the sides of the body again, and realize what you have learned.

Repeat this exercise lying on one side and then the other. To give you stability in this position, bend the knees in front of you so that if someone were to look at you from above, you would look as if you were seated in a chair. When breathing, gradually feel the air expand from the lower lungs to the middle, the left, the right side and up, until the chest feels like a cylinder.

d. Abdominal Breathing on a Slant Board

This exercise will greatly increase the pressure and strength of the abdomen and strengthen the diaphragm.

Lie on a slant board with the head towards the floor while doing this same exercise. Using a weight on the lower abdomen while lying flat, breathe in so that the weight is raised as the diaphragm lowers. Exhale. The diaphragm goes back to its normal position and allows the belly to flatten and lower the weight. Practice this daily, increasing the weight once a week and you will soon acquire a great control in directing Chi to the lower abdomen while strengthening the abdominal muscles. By putting the board higher up on the wall, you can increase the demands made on the abdomen and diaphragm. This approach allows you to discover various ways of adapting to a new position and gain greater control. Always repeat in multiples of three to 36 times.

When you are proficient at abdominal breathing, you may go on to the next exercise.

e. Strengthening through Counter Pressure

For this exercise you will need a partner who will exert pressure on specific points of your body using a fist. Your partner should coordinate with you to determine the correct amount of pressure required for you to respond.

(1) Have your partner hold a fist against your solar plexus. (Fig. 2.10) Inhale, directing your attention and your diaphragm to the

point of contact, and produce a counter pressure. Practice this six times only, resting after each time, and you will see how quickly you have learned to respond.

(2) Your partner should hold a fist against your navel area. (Fig. 2.11) Inhale, direct your attention and your diaphragm to the point of contact, and produce a counter pressure. Practice at this spot six times, resting after each time.

(3) Now, have your partner hold a fist against the lower abdominal area. Inhale and direct your attention and your diaphragm to this area, producing a counter pressure. Practice this exercise six times also, again resting after each time.

(4) Finally, ask your partner to hold a fist against each side separately, a little towards the back in the kidneys' areas (vulnerable areas which are easily hurt by a blow). (Fig. 2.12) Inhale, direct your attention to the spot and produce a counter pressure. Do this six times, remembering to rest after each time. This exercise will begin to strengthen the kidneys' areas.

(5) Change places with your partner and repeat (1) through (4). The effects of this simple exercise are widespread. It is invigorating, will mobilize an otherwise lax abdomen and can help you complete the Microcosmic Orbit quickly. If you cannot do it with a partner use a wooden dowel affixed to a flat board. The dowel should be about one and one-half inches in diameter. Simply place the fiat surface against a wall and lean against the dowel so that it presses against those places described above.

f. Abdominal Breathing in a Standing Position

Standing positions are mostly used in the Iron Shirt practice. It is harder to accomplish abdominal breathing in a standing position, thus you need to be more relaxed.

As your abdominal breathing in a lying position improves, you will more easily control it in a standing position. While standing, the fasciae have tension to hold the muscles and the organs. This exercise is to strenghthen the abdominal fasciae. This is a means of acquainting you with the way the mind and body work together and of learning how to bring energy to a fascial area. Stand with the feet a shoulders' width apart. Relax the entire body and make sure the diaphragm is lowered. Take a deep abdominal breath, swelling out the belly. Hold it as long as you can comfortably. Exhale. When you feel the need, inhale. Repeat this cycle in multiples of three.

Fig. 2.10 *Your partner with his fist againt your solar plexus.*

Fig 2.11 *Your partner with his fist againt your navel.*

Fig. 2.12 *Your partner pressing with his fist against your side, towards the back, in the kidney area.*

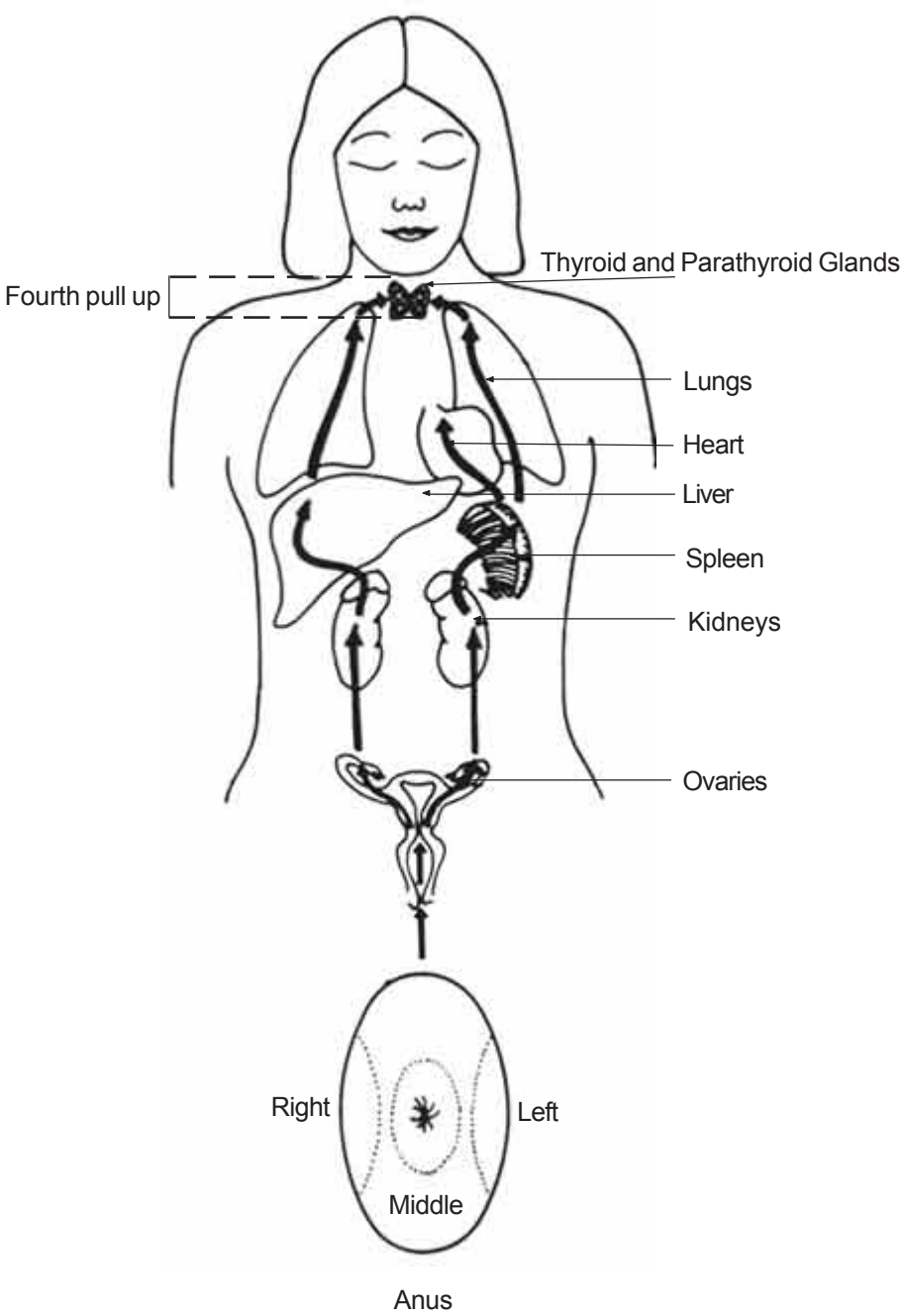

Fig. 2.13 *Train the mind to direct Chi to the organs and glands.*

g. Getting Energy to Abdomen by training the Mind to direct it.

After you have learned Iron Shirt Breathing, you can practice sending energy to the abdomen. With this exercise, you will gradually train your mind to direct and increase the Chi pressure at will to the upper middle and lower abdominal areas, or to the left or right kidneys, packing, wrapping and energizing them, to the adrenal glands, the liver, the spleen, the pancreas, the lungs, the heart, the thymus gland, or the thyroid and parathyroid glands. (Fig. 2.13) (In the advanced level, you will learn to direct Chi to other parts of the body as well.)

h. Practice: Development of Iron Shirt Protection

Make your left hand into a fist, with the inside edge of the fist facing inward as if it were holding a knife, and hold it over the abdominal area. Inhale. Imagine that Chi is filling the lower abdomen and that the edge of the fist is exerting 100 pounds of pressure against the abdomen. (Fig. 2.14) Resist. Now relax. Inhale. Do not force the energy in any way. When you feel comfortable with this pressure, gradually increase it so that the body will be able to handle it. This prepares you so that if you were hit without any warning anywhere on the body, you could send Chi to those points to cushion the body and vital organs from harm.

Most people cannot take a punch to the stomach, which is located at the level of the solar plexus. With this training, you would be able to do just that. However in the Taoist practice we do not encourage people to show off by taking a punch.

You must make sure you are relaxed throughout this exercise. begin by “filling the abdomen with air”. You can achieve this by concentrating on the area around and below the navel. The area from the navel to the sternum is divided into four parts. (Fig. 2.15) Wherever you direct your attention, Chi appears and protects the area like an inflated rubber tire. Use no force at any time in this practice. Simply breathe into the area you want to cushion, and concentrate on it while gradually pushing your palm into it. Do this systematically so that you cover all the body surfaces that you can reach.

Once you develop energy in the region between the sternum and the navel sufficient to protect you against unexpected injury, the rest of the abdomen is more easily protected. The counterpressure that is created drives Chi into the fasciae. When the deep fasciae fill with Chi pressure, the Chi pressure will spread out to the second layer of the fasciae. (For more detailed information regarding fasciae, see Chapter 4.) Soon, as you increase pressure in the abdomen, you will be able to move the Chi pressure around the abdominal area. Practice this constantly in conjunction with all of the Iron Shirt exercises.

Once you have become proficient with the hand, you can use a short stick. Press the stick in the abdominal area and push in as you bring the Chi pressure to the area to counteract the stick.

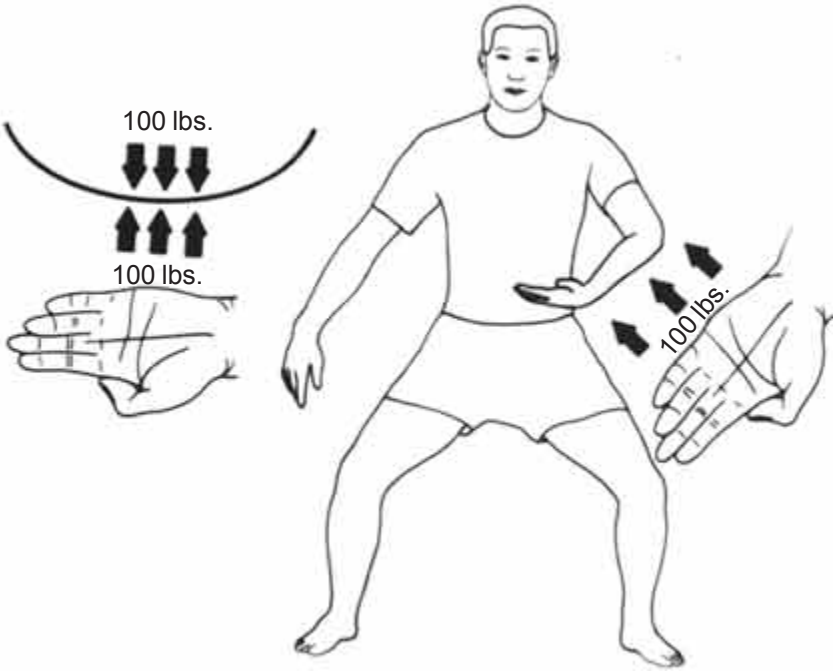

Fig. 2.14 *Imagine exerting 100 pounds of pressure against the abdomen.*

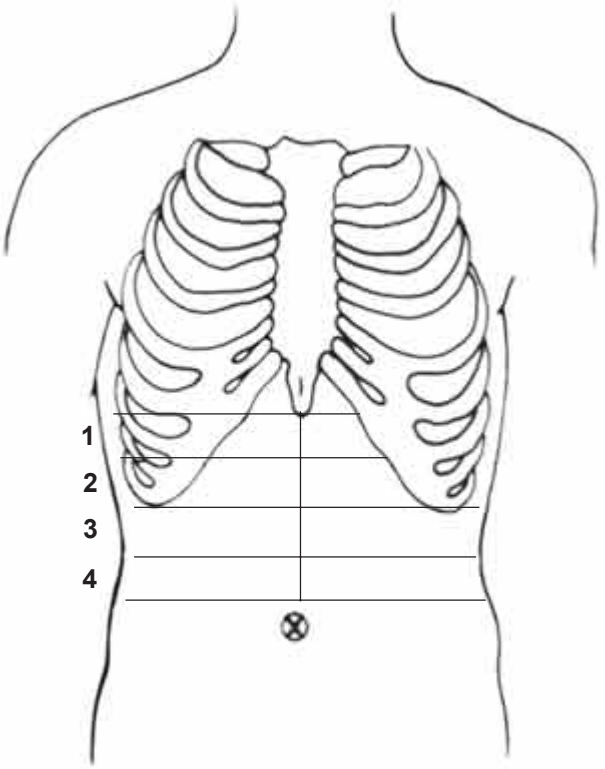

Fig. 2.15 *Four Divisions of the Abdomen below the Sternum.*

B. Summary of Iron Shirt Breathing

The breathing processes explained in this Chapter may seem to be numerous but, in fact, all relate and lead to Iron Shirt breathing.

1. Exercises to Improve Abdominal Breathing

a. Abdominal Breathing in a Lying Position

(1) Lie supine, legs flexed or extended, hands on belly. Inhale nine counts. Raise hands. Exhale. Repeat nine times with your hands at your sides.

(2) Lie supine, legs flexed or extended, hands on chest and lower abdomen. Inhale nine counts, allowing the belly to rise. Exhale. Repeat nine times with your hands at your sides.

(3) Repeat (1) and (2) on each side with knees flexed.

b. Abdominal Breathing on a Slant Board

(1) On a slant board, using a weight on the belly, inhale, raising the weight. Hold. Exhale.

(2) Lower the weight. Repeat, adding to the weight on a weekly basis. Repeat in multiples of three, nine, eighteen and 36.

c. Strengthening Through Counter Pressure

Use mind and body to direct pressure from within against an outside force, concentrating Chi in a particular area of fascia.

d. Abdominal Breathing in a Standing Position

(1) Stand with feet a shoulders' width apart. Inhale and hold as long as comfortable. Exhale. Repeat in multiples of three.

2. Iron Shirt Chi Kung Packing Process Breathing

a. Abdominal Breathing

Begin with abdominal breathing, expanding the lower abdomen.

b. Lower the Diaphragm

Lower the diaphragm upon inhalation while keeping the chest relaxed. Exhale, flattening the stomach, and feel the pull of the pelvic and urogenital diaphragms and sexual organs.

c. Reverse Abdominal Breathing

When you have brought the energy down to the navel, begin reverse breathing with an exhalation, flattening down the stomach. When inhaling, relax the chest and maintain a flattened stomach.

d. Slightly Contract the Pelvic and Urogenital Diaphragm

Contract the pelvic and urogenital diaphragm and, at the same time, slightly pull up the anus, and pull up the testicles or contract the vagina.

e. Packing Process Breathing

Begin Packing Process Breathing with an inhalation. Using the packing process, seal and limit the energy to a small area. The diaphragm is lowered. The stomach is flattened and held in. Pull up the sexual organs and anus and seal them so that no energy can leak out of these three areas.

f. Pack the Organs with Chi

The energy goes back, filling out and packing the kidneys' areas.

g. Exhale and Relax

Exhale and let the Chi out. Relax.

C. Cranial, Respiratory and Sacral Pump Functions

Contained and protected within your spinal column and skull is the very "heart" of your nervous system. Cushioning it is the cerebrospinal fluid, cerebro for the head and spinal for the vertebrae. This fluid, as described by the Taoists in ancient times, is circulated by two pumps. One is in the sacrum and is known as the sacral pump. The other is in the region of your upper neck and head and is known as the cranial pump. Many people who have been able to feel these pumps working have reported feeling a "big bubble" of energy travel up their spine during Packing Breathing.

1. Sacral Pump

The sacrum consists of five pieces of bone when we are young; when we grow up these five bones fuse into one piece. Taoists regard the sacrum as a pump which will help to hold the sexual energy coming from the sperm/ovaries and perineum and transform the energy, at the same time giving it an upward thrust. It is similar to a way station, refining the sperm/ovaries' energy as it circulates in the body. In the Iron Shirt practice we tilt the sacrum to the back, or against a wall, exerting force to straighten the sacrum. This helps to activate the sacral pump to pump the spinal cord fluid up.

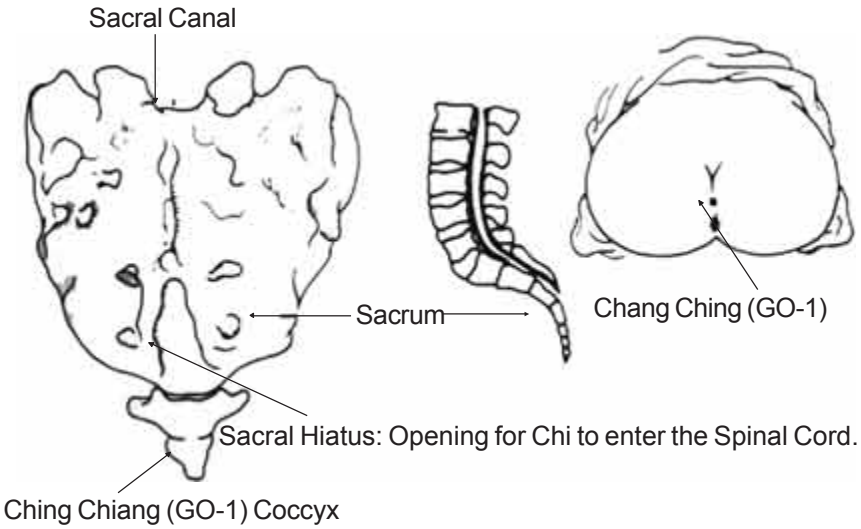

Fig. 2.16 *Sacral Pump*

2. Cranial Pump

The cranium of the skull has long been regarded by Taoists as a major pump for the circulation of energy from the lower centers to the higher centers. Medical research has recently confirmed that minute movements of the joints of the eight cranial bones occur during breathing. (Fig. 2.17) Cranial movement is responsible for the production and function of the cerebrospinal fluid surrounding the brain and spinal cord, which fluid is necessary for normal brain, nerve and energy patterns in the entire body.

Improper cranial respiratory function develops for many reasons. It may have been present from birth. At this time the skull is soft and moveable and the trip down the birth canal could jam a baby's skull, or it may be the result of a difficult birth in which forceps were used. It may also occur later in life. A bump on the head coming from a certain direction while the person is breathing in the specific manner that allows the bone to move can cause improper cranial respiratory function. Auto accidents causing whiplash very often are the cause of cranial faults. Since cranial faults affect the flow of the fluid and the brain, nerve and energy patterns of the entire body, symptoms can develop anyplace. Strengthening the cranial joints can increase energy and alleviate symptoms, such as headaches, sinus problems, visual disturbances and neck problems.

In Taoism, cultivation of the movement of the pelvis, perineum, urogenital diaphragm, anus, and the sacrum and cranial pumps is very important in helping to move the life-force and sexual energy up to the higher center. The Iron Shirt Chi Kung Packing Process activates these pumps using various methods, e.g. mind control, muscle action, clenching of the teeth and tightening of the neck, and pressing the tongue to the palate. All of these methods will help to activate the eight pieces of cranial bone.

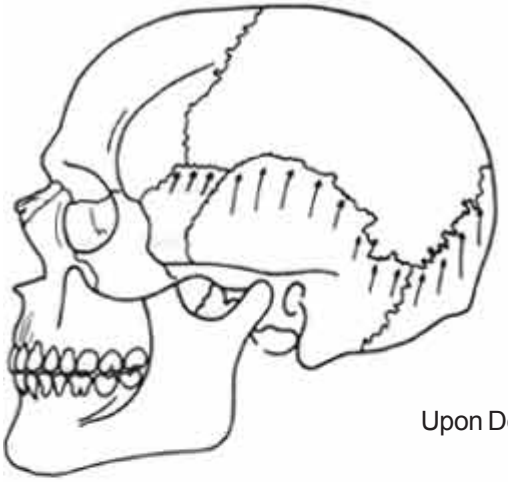

Upon Deep Inhalation

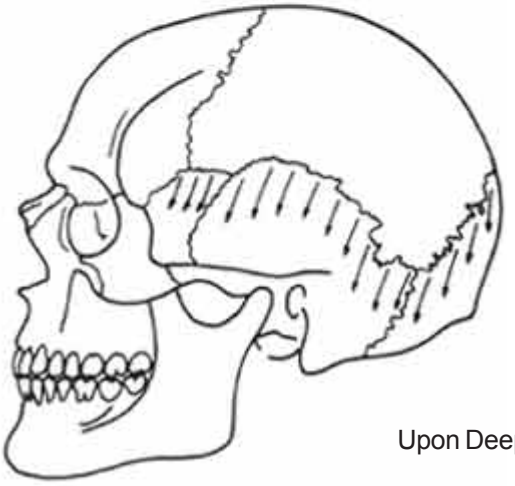

Upon Deep Exhalation

Fig. 2.17 *Micromovement of Cranial Bones*

D. Microcosmic Orbit Meditation

1. Circulate your Chi in the Microcosmic Orbit

In the preceding breathing exercises, you have been asked at certain points to circulate the Microcosmic Orbit. Your life-force energy thus must be circulated through specific pathways in the body efficiently and safely to be used for healing and growth. The Microcosmic Orbit circulation uses the power of the mind to help activate the sacral and cranial pumps into pumping the life-force energy throughout the body.

It is much easier to cultivate your energy if you first understand the major paths of energy circulation in the body. The nervous system in humans is very complex and is capable of directing energy wherever it is needed. The ancient Taoist Masters discovered that there are many channels of energy flow. However, two energy channels carry an especially strong current.

One channel is called the "Functional" or "Yin" Channel. It begins at the perineum, the point located at the base of the trunk, midway between the testicles/vagina and the anus. It goes up the front of the body past the sex organ, stomach, organs, heart, and throat and ends at the tip of the tongue. The second channel, called the "Governor" or "Yang" channel, also starts at the perineum but goes up the back of the body. It flows from the perineum upwards into the tailbone and the sacral pump and then up through the spine into the brain and the cranial pump, finally flowing back down to the roof of the mouth.

The tongue is like a switch that connects these two currents—when it is touched to the roof of the mouth just behind the front teeth, the energy can flow in a circle up the spine and back down the front. The two channels form a single circuit that energy loops around. This vital current of energy circulates past the major organs and nervous systems of the body in a loop, giving cells the juice created from organ energy and smiling energy that is necessary to grow heal, and function, and spreading vitality throughout the body. This circulating energy is the Microcosmic Orbit, and forms the basis of acupuncture. Western medical research has already acknowledged acupuncture as being clinically effective, although scientists admit they cannot explain why the system works. The Taoists, on the other hand, have been studying the subtle energy points in the body for thousands of years and have verified in detail the importance of each channel.

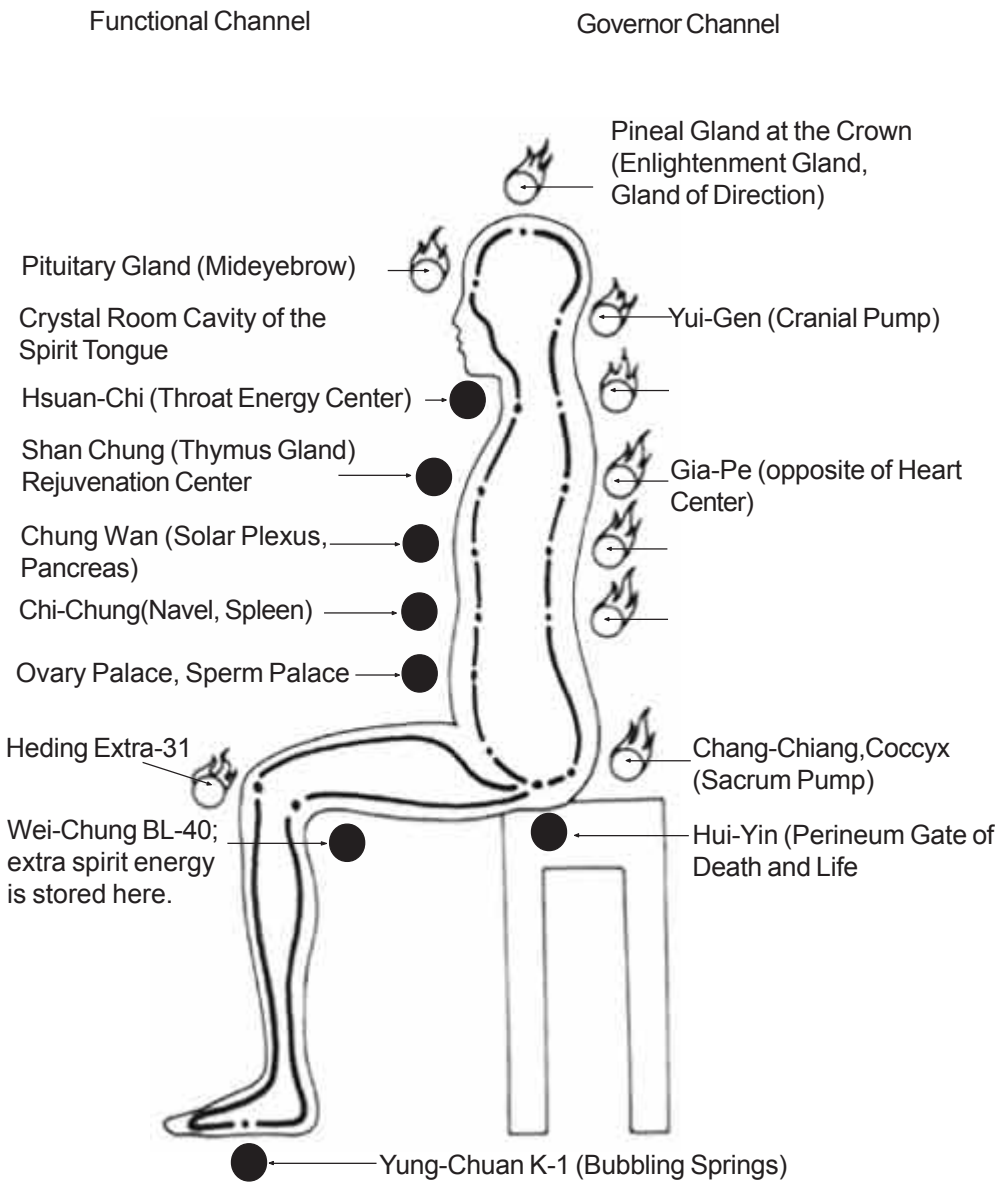

Fig. 2.18 *Learn to circulate your Chi in the Microcosmic Orbit. Tongue touches the roof of the palate to complete the circuit of the Governor and Functional Channels.*

2. Importance of the Microcosmic Orbit

By opening up this Microcosmic Orbit and keeping it clear of physical or mental blockages, it is possible to pump the life-force energy up the spine. If this channel is blocked by tension, then learning to circulate the Microcosmic Orbit is an important step to opening up the blocks in the body to circulate and revitalize all parts of the mind and body. Otherwise, when intense pressure builds in the head, taking such forms as headaches, hallucinations, and insomnia, much of the life-force energy escapes through the eyes, ears, nose and mouth and is lost. This is like trying to heat a room while all the windows are open.

The way to open the Microcosmic Orbit is by sitting in meditation for a few minutes each morning as you practice the Inner Smile. An essential Taoist technique, described in detail in *Taoist Ways to Transform Stress into Vitality*, the Inner Smile is a means of connecting visual relaxation and the ability to concentrate. Allow your energy to complete the loop by letting your mind flow along with it. Start in the eyes, and mentally circulate with the energy as it goes down the front through your tongue, throat, chest and navel and then up the tailbone and spine to the head.

At first it may feel as though nothing is happening, but eventually the current will begin to feel warm in some places as it loops around. The key is simply to relax and try to bring your mind directly into the part of the loop being focused on. This is different from visualizing an image inside your head of what that part of the body looks like or is feeling. Do not use your mind as if it were a television picture. Experience the actual Chi flow. Relax and let your mind flow with the Chi in the physical body along a natural circuit to any desired point, e.g. the navel, perineum, etc.

Study of the Microcosmic Orbit is recommended to all students who truly seek to master the techniques of Iron Shirt. Progress to the higher levels of transforming Chi and our creative energy to spiritual energy, without first learning the Microcosmic Orbit, is very difficult. Some people may already be “open” in these channels or relaxed when they are close to nature. The benefits of the Microcosmic Orbit extend beyond facilitating the flow of life-force energy and include prevention of aging and the healing of many illnesses, ranging from high blood pressure, insomnia and headaches to arthritis.

E. Perineum Power

In Iron Shirt practice, we will utilize “Perineum Power” to direct Chi to the areas, organs and glands that you wish to energize in order to pack and increase the Chi in that region. “Perineum Power” will be used in all Iron Shirt positions.

1. Anus is connected to Organ Energy.

The perineum (Hui-yin) region includes the anus and sexual organs. The various sections of the anus region are closely linked with the organs’ Chi. The Chinese term Hui-yin (perineum) means the collection point of all the Yin energy, or the lowest abdominal energy collection point. It is also known as the Gate of Death and Life. This point lies between the two main gates. One, called the front gate, is the sexual organ which is the big life-force opening. Here the life-force energy can easily leak out and deplete the organ’s function. The second gate, or back gate, is the anus. This gate can also easily lose life-force when not sealed or closed tightly through muscular toning. In the Tao practices, especially in the Tao Secrets of Love and Iron Shirt, the perineum’s power to tighten, close and draw the life-force back up the spine is an important practice. Otherwise, our life-force and sexual energy can become a ‘’river of no return.’’

2. Anus Region is divided into Five Parts.

The anus is divided into five regions: (a) middle. (b) front, (c) back, (d) left, and (e) right. (Fig. 2.19)

a. Middle Part

The middle of the anus Chi is connected with the organs as follows: the vagina-uterus, the aorta and vena cava, stomach, heart, thyroid and parathyroids, pituitary gland, pineal and top of the head. (Fig. 2.20)

b. Front Part

The front of the anus Chi is connected with the following organs: the prostate gland, bladder, small intestine, stomach, thymus gland, and front part of the brain. (Fig. 2.21 (a) and (b))

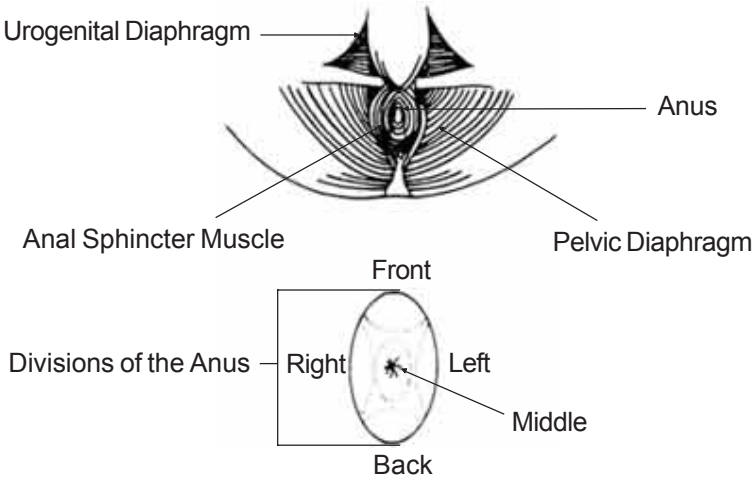

Fig. 2.19 *The anus is dividded into five regions*

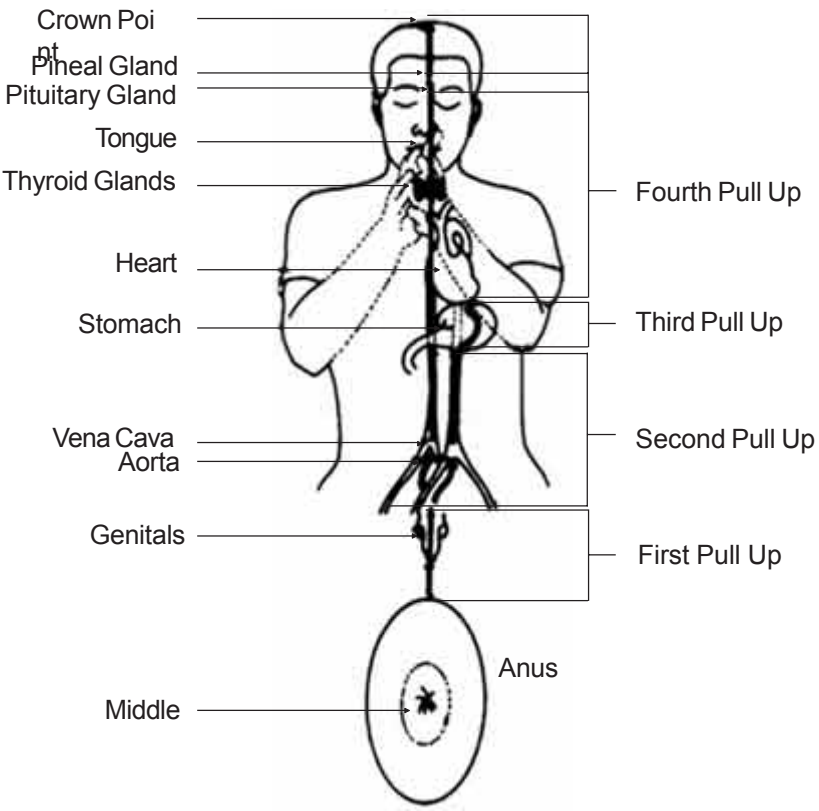

Fig. 2.20 *Middle Part*

(a) Front Part in the Male

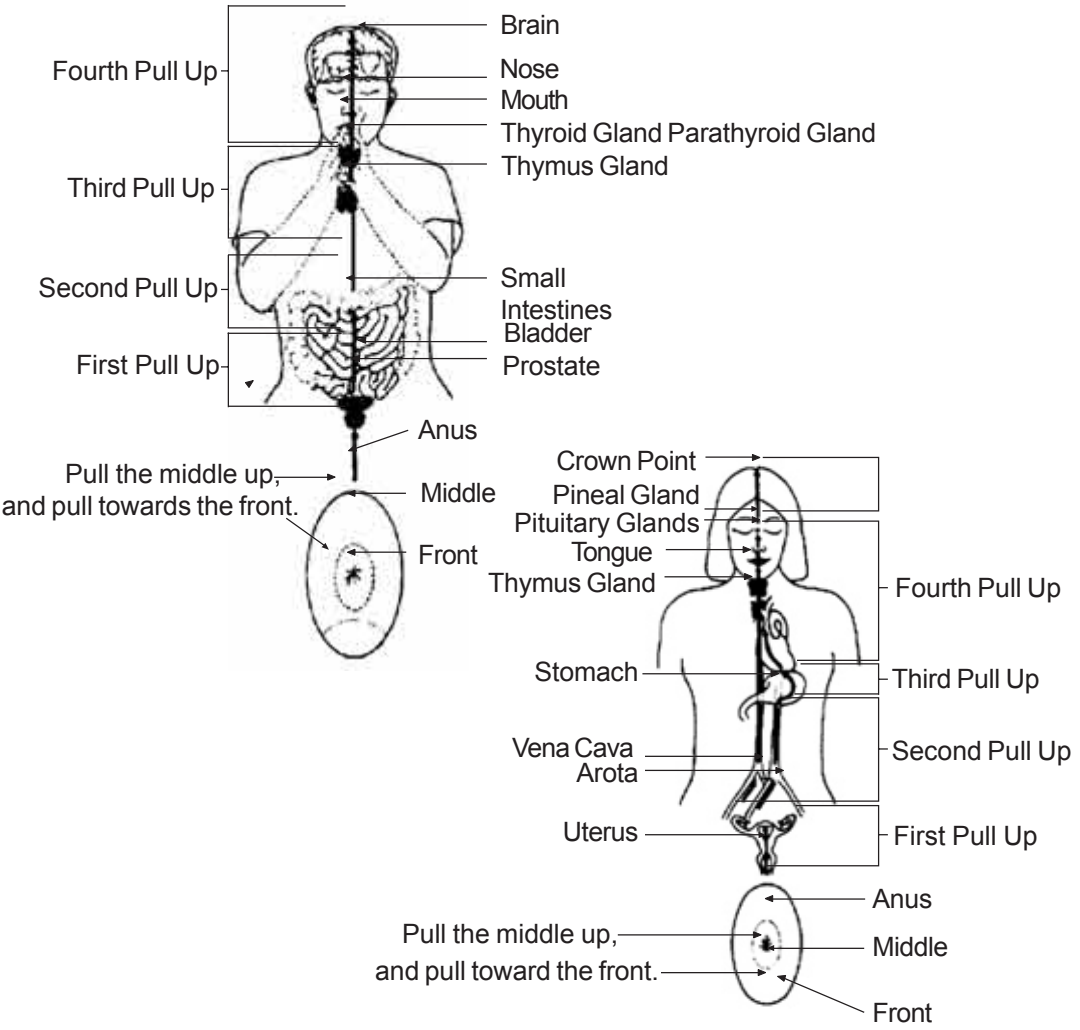

(b) Front Part in the Female

Fig. 2.21 *Front Part*

c. Back Part

The back part of the anus Chi is connected with the organ energies of the sacrum, lower lumbars, twelve thoracic vertebrae, seven cervical vertebrae, and small brain (cerebellum). (Fig. 2.22)

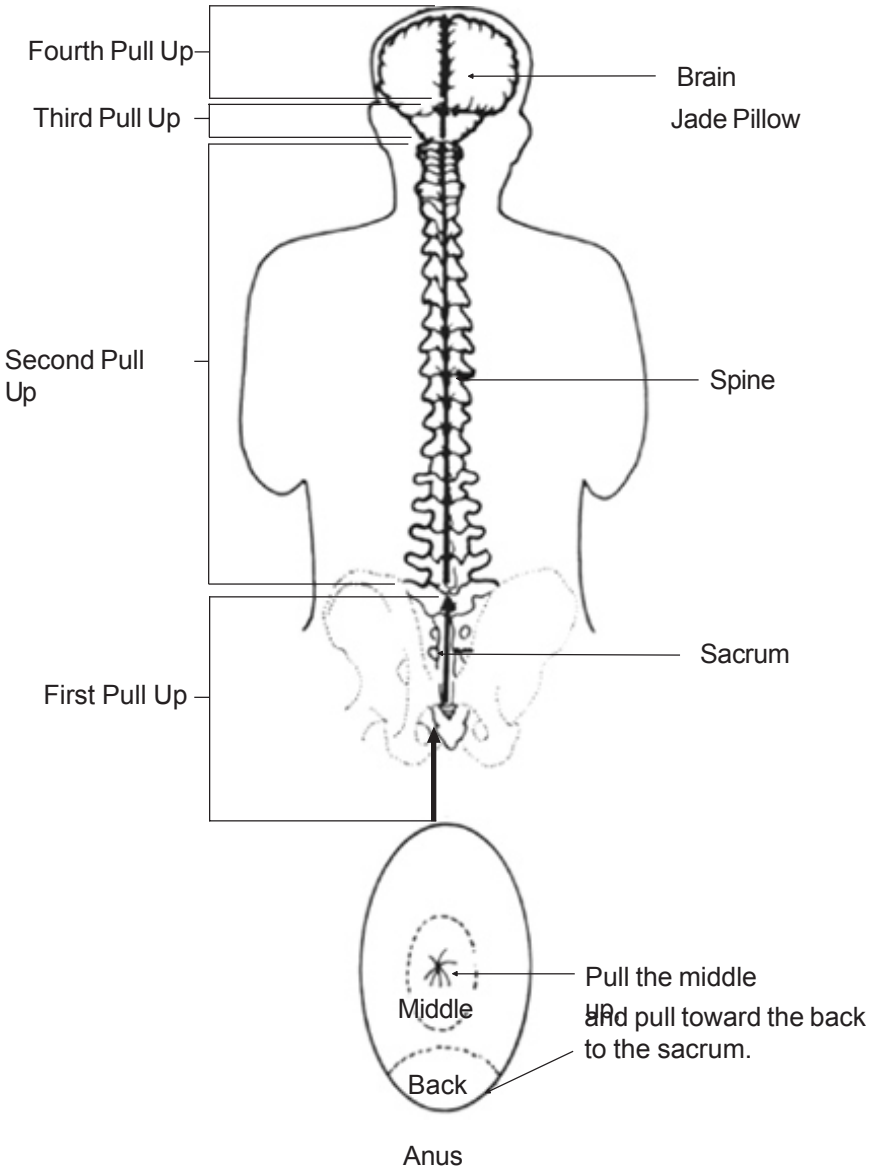

Fig. 2.22 *Back Part*

d. Left Part

The left part of the anus Chi is connected with the organ energies of the left ovary, the large intestine, left kidney, left adrenal gland, spleen, left lung and left hemisphere of the brain. (Fig. 2.23 (a) and (b))

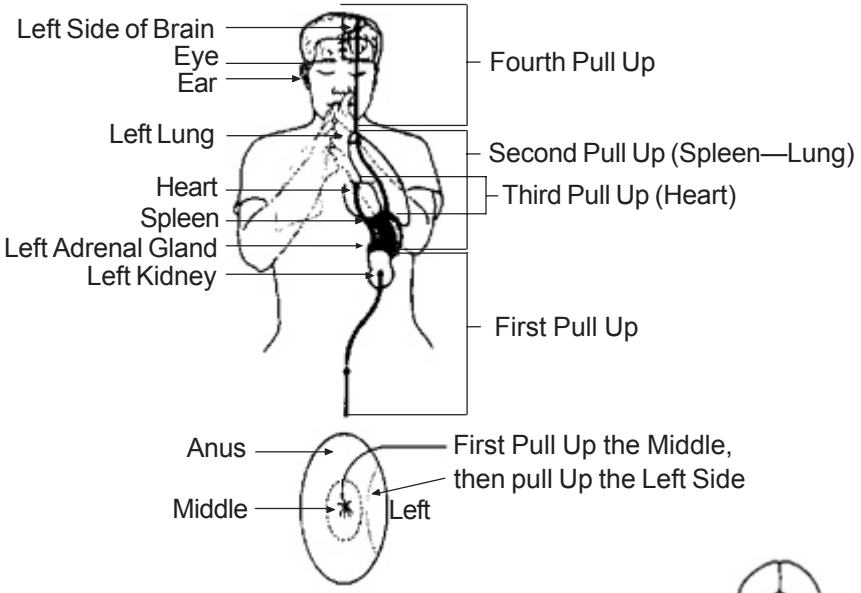

(a) Left Part in the Male

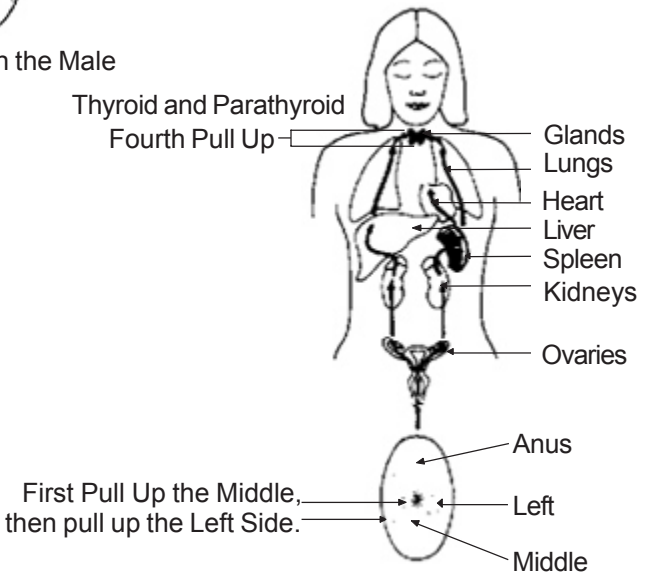

(b) Left Part in the Female

Fig. 2.23 *Left Part*

c. Right Part

The right part of the anus Chi is connected with the organ energies as follows: the right ovary, the large intestine, right kidney, adrenal gland, liver, gall bladder, right lung and right hemisphere of the brain. (Fig. 2.24 (a) and (b))

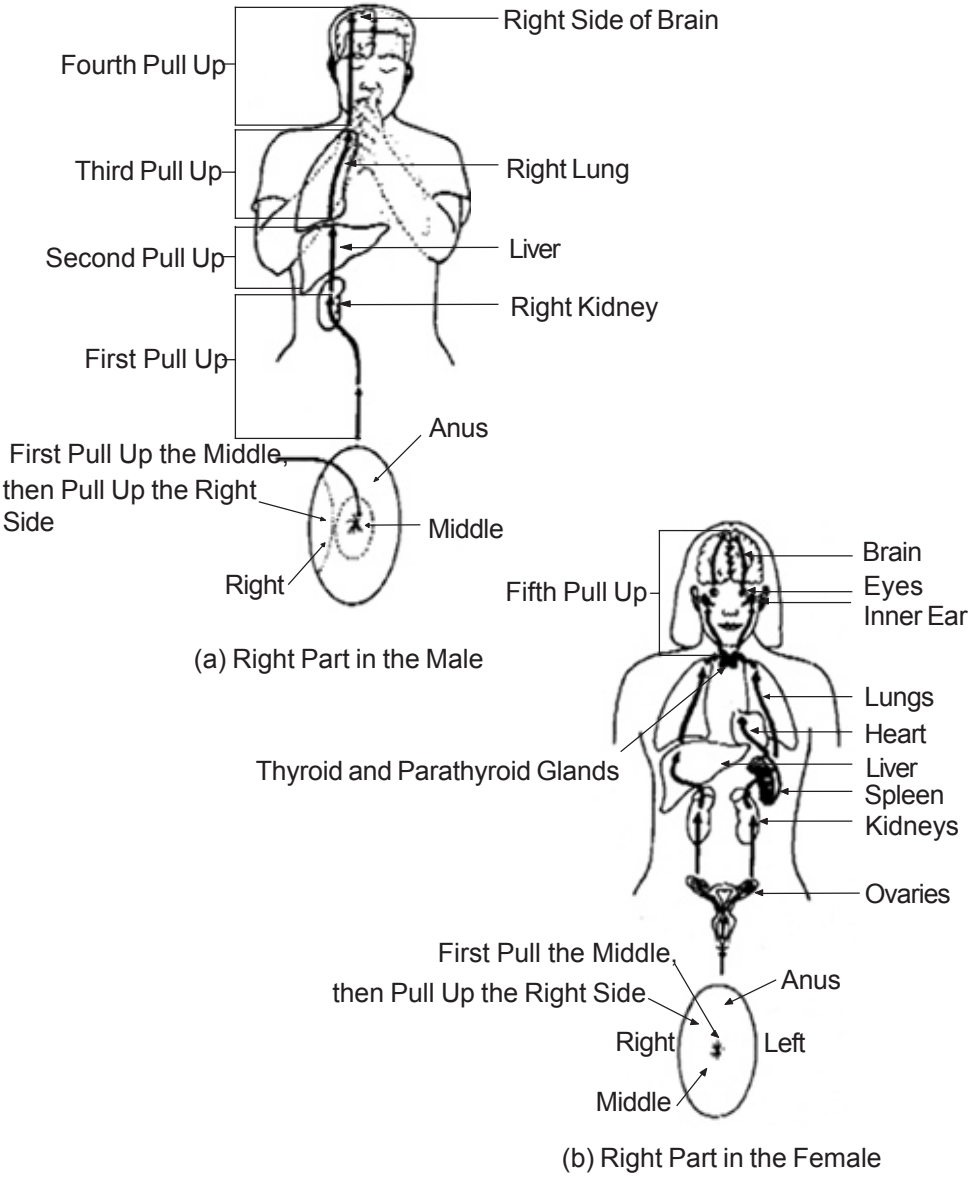

Fig. 2.24 *Right Part*

By contracting the anus in different parts you can bring more Chi to the organs and glands, and the effects of the massage will increase. (Fig. 2.25)

Fig. 2.25 *Wrap the organs, encircling them with Chi energy.*

F. Precautions

The following is a warning to practitioners with high blood pressure, emotional instability, heart or chest pain, or any acute illness.

1. If you have high blood pressure, check with a doctor before attempting the practice of Iron Shirt. Do not do the exercises and breathing techniques strenuously.
2. Women should not do Iron Shirt breathing during a menstrual cycle, but may practice the structure, standing Chi meditation and Bone Breathing. If pregnant, do not practice Iron Shirt Packing Breathing; use only energizer breathing and standing Chi meditation.
3. Be sure that the diaphragm is lowered while practicing these exercises to avoid accumulating energy in the heart and to facilitate the flow of the Microcosmic Orbit.
4. After practicing the postures, while bringing the energy down, be sure to place the tongue on the roof of the mouth to collect all energy from the head (the Governor Channel). Take the energy down from the head, slow it down in the solar plexus, and then store it in the navel.

Chapter 3
Practice of Postures

There is an integral relationship between strong, unblocked Chi flow and good structural alignment. Proper practice of Iron Shirt, as well as all other Taoist exercises, will lead to a dramatic improvement in structural health, as well as increased Chi flow. A refined understanding of the structural interrelationships of the body is inherent in Iron Shirt.

Because of poor postural habits, many people have developed serious structural distortions and have no natural sense of the body in appropriate alignment. If these distortions are carried over into Iron Shirt practice, much effectiveness is lost and bad habits perpetuated. In effect, one is practicing the very problems that need to be corrected.

I. Iron Shirt Horse Stance using a Wall

The following exercise demonstrates how to use a wall to align yourself perfectly in the Iron Shirt Horse Stance used in Embracing the Tree, Holding the Golden Urn and the Phoenix postures. These postures will be described fully in this chapter.

This wall position is a variation of the Structural Training Position against a Wall which is described in Chapter 4. As your practice continues, you will develop the feeling of proper alignment and will be able to follow the same principles without a wall. Whenever you practice your alignment against the wall, when you feel you can hold the position, step away from it and apply the same principles. After you have learned to adopt the correct stance without the wall, occasionally practice against it again to check yourself. Once you are skilled, occasional use of the wall will allow you greatly to increase your spinal lengthening when you practice.

Use this wall position to practice alignment by itself as well as with the breathing used in Embracing the Tree and the other excersises in which packing is done. Practicing the full exercise with Packing Breathing while against the wall will help to insure that you can maintain the alignment while in the much more dynamic state of packing and energy circulation.

At first, applying some of these details may seem difficult or unclear. However as your body opens up, you will gradually be able to apply each detail easily and naturally. Since these principles represent application of the basic design characterisics of your body structure, you will feel more and more as you practice that your body will naturally fit into these" grooves".

A. Sequence of Practice in Using a Wall to Develop the Iron Shirt Horse Stance

1. Distance Between Feet

Stand with the left foot a few inches away from the wall. The foot should be straight along the second toe, or just slightly turned out at the heel. To measure the proper distance between the feet, touch the knee of the right leg to the heel of the left foot. Place the ball of the right big toe in line with the ball of the left big toe so that both are the same distance away from the wall. Now, as you stand up, rotate the right foot around the ball of the big toe. Both heels will then be the same distance from the wall, and the feet will be the correct distance apart.

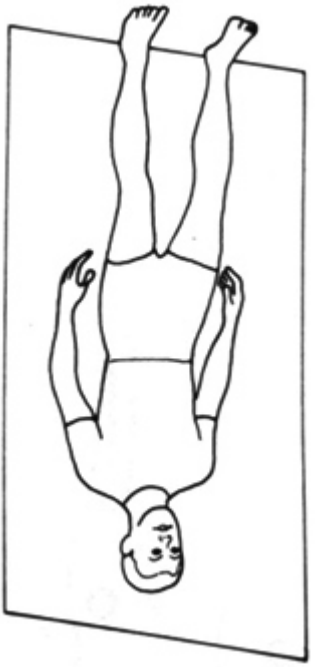

Fig. 3.1 *Horse Stance Using a Wall*

2. Foot Alignment

First, feel that you firmly contact the ground with the balls of the big toes. Then, spread the toes by widening the feet across the balls. Now equalize the weight over the whole foot by equalizing the weight on the following three points: the ball of the large toe, the ball of the last two toes, and the middle of the heel. (Fig. 3.2) The toes should remain relaxed and not be grasping the floor. Remember that the feet are the foundation of your stance. As these details become natural, your practice will be much stronger, and you will experience greater body-mind integration. Proper foot alignment is the basis of understanding.

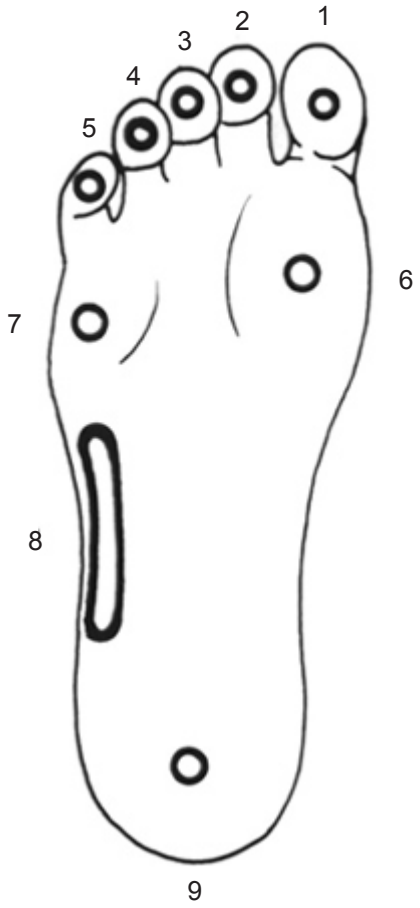

Fig. 3.2 *Nine Points of the Foot*

3. Distance from the Wall

The feet should be the right distance from the wall so that with the spine flattened to the wall, you do not feel like you are leaning back. If the wall were suddenly removed, you would not need to adjust yourself to keep from falling back.

4. Rooting with the Feet

When practicing those parts of Embracing the Tree and Rooting that call for strongly grasping the ground with the toes, feel that this clawing begins at the balls of the feet, not at the toes themselves. Accentuate this grasping at the big toe in particular and there will be much stronger rooting because the foot is used in a more complete and integrated fashion.

5. Knees

Bend the knees so that the kneecaps are directly over the toes. Bend the knees no farther than the ends of the big toes. The knees can be bent less than this, but eventually should be bent this far to insure maximum development of strength.

6. Pelvis

First, allow the lower spine to flatten firmly against the wall for as long as this can be done without discomfort. Then, place your hands on the tops of the thighs at the crease where the thighs connect to the pelvis. With the lower spine flattened to the wall, you will feel that the tendon in the front of the thigh and slightly to the inside is very tight. Now rotate the pelvis slightly so that the lower spine comes away from the wall. You will feel this tendon relax. You should barely be able to place a flat hand between your lower spine and the wall. This will also increase the crease at the junction of the thigh and pelvis. Continue to feel that the sacrum is stretching the spine down.

7. Pelvic Tilt

As your practice of Iron Shirt continues and your attention is focused to the sacral area, the pelvic tilt is used. This is accomplished by strongly pushing against the wall at the sacral area while maintaining the other structural details. As you strongly push back to the wall,

your spine will arch slightly more, and you will feel the muscles around the sacrum become very firm. As this happens, it is very important to feel that you are also stretching the sacrum further down the wall. (Fig. 3.3) If you are doing this properly you will feel a strong force around the sacrum with only a small added arch in the lower spine.

8. Middle Back

To insure that this pelvic aligning does not arch the middle spine, maintain the pelvic tilt position, and push back gently but firmly the back lower ribs, simultaneously lifting them slightly higher up the wall. During this procedure you will feel the middle and lower back lengthen. (Fig. 3.3) This is the work of the psoas muscles.

9. Head/Neck/UpperBack

Remain in the pelvic tilt position and bring as much of the upper spine as fiat to the wall as possible without strain. Maintain the head as if it is being gently pushed back from the upper lip and simultaneously lifted by its crown. (Fig. 3.3) Again, for many people the head held in this way will not touch the wall. This is usually because of excessive curvature of the upper spine, which can be eliminated by practice of the Iron Bridge, the Backbend and Door Hanging. (The Iron Bridge is described subsequently in this chapter; see Chapter 4 for descriptions of the Backbend and Door Hanging.)

10. T-11 Thrust

When Chi energy is brought to the adrenal energy center (the T-11 point, located at the top of the kidneys at the point of the adrenal gland, or at the bottom edge of the rib cage at the spine) and packed in the kidney area, it is necessary to lean forward and thrust the T-11 area back. To feel this on the wall, simply keep the T-11 area firmly pressed against the wall and round the rest of the spine above this point away from the wall, while maintaining the other alignment principles. By practicing against the wall in this way, it is possible to feel this thrust very strongly, as when practicing with a partner pushing at that point.

Fig. 3.3 *Pelvic Tilt*

11. Shoulders

Place the arms in any one of the arm positions as described in the first four Iron Shirt exercises in this chapter . Then move the shoulder blades firmly back to the wall so that the whole area of each shoulder blade is in firm contact with the wall. Now round the shoulders for ward, feeling the shoulder blades move away from the wall, until just the spine and, if possible, the area between the inner edges of the shoulder blades remain on the wall.

12. Head/Neck (C-7, the Base of the Neck, and C-1, the Base of the Skull)

After rounding the shoulders forward, push back gently, but firmly at C-7, the bone at the base of the neck, and at C-l, the bone at the base of the skull. The chin will tuck in as you do this. When bringing the Chi to these two points, you will drop the chin, bringing it closer to the chest. Even when pushing strongly neither point will touch the wall. Until that point in the exercise is reached, however, push back less strongly (particularly at C-7) to insure that alignment with the upper spine and neck remains correct. (Fig. 3.4) If done properly, pushing back at C-7 after rounding the shoulders forward will increase the rounding of the shoulders, and you will feel that the shoulders have become “locked” in place.

13. “Locking” the Structure

Lock the knees and do not move them. As you concentrate on the knees, they will feel as though they are simultaneously being pushed in and out. Then push the knees outward. You will feel a spiraling effect from the knees to the ground as if your legs were screws being screwed down into the earth. In Embracing the Tree, similarly lock the arms, but do not move them. Feel that the elbows are simultaneously being pushed in and pulled out as if the arms were screws being moved by the spiraling action of the forearm. You can also feel this locking action of the elbows and the knees if you imagine that you are straightening the joint, but without actually doing so. Locking these joints greatly improves strength, stability and Chi flow. Practice the Wall Stance and the Embracing the Tree posture for a while, until you can feel you are able to hold the position.

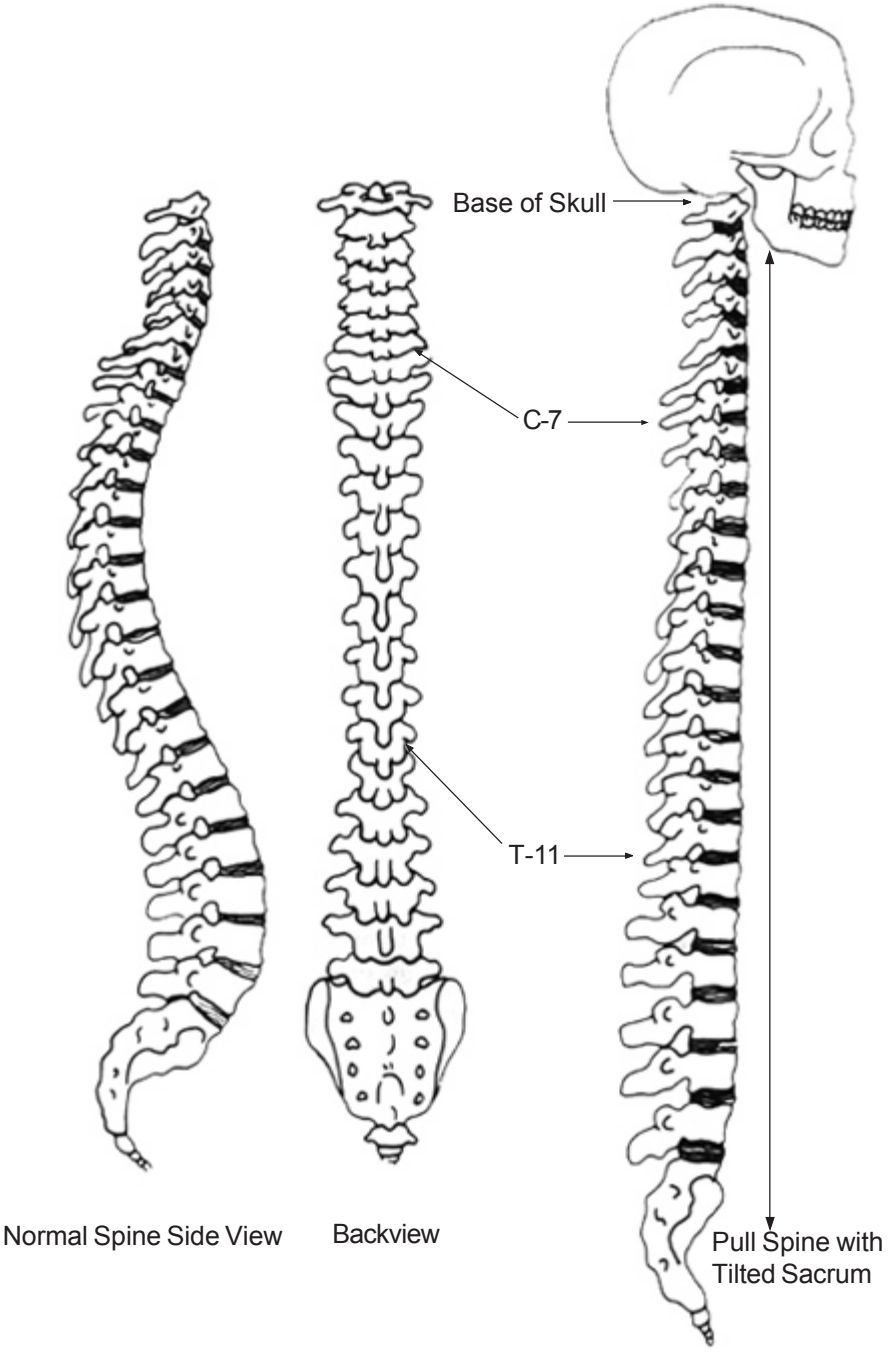

Fig. 3.4 *Spinal Alignement*

B. Summary of Practice for Using a Wall to Develop Iron Shirt Horse Stance Basic Alignment

1. Feet: Measure the proper distance of the feet from each other and from the wall. Align each foot.

2. Lower Back: Lean against the wall with the lower spine flat, if possible.

3. Head/Neck/Upper Back: Bring as much of the upper spine as possible flat to the wall, with the head held as if it is pushed back from the upper lip and lifted by its crown. The back of the head may or may not touch the wall.

4. Pelvis: Rotate the pelvis back until the thigh tendon is more relaxed. Feel that the sacrum is pulling the spine down.

5. Middle Back: Bring the lower ribs firmly to the back wall, then stretch them up slightly higher on the wall.

6. Arms/Shoulders: Position the arms for one of the first four Iron Shirt exercises. Flatten the shoulder blades to the wall. Round the shoulders forward, feeling the shoulder blades move away from the wall until only the spine and, if possible, the area between the inner edges of the shoulder blades remains on the wall. Lock the elbows and knees.

7. Chest: Check that the chest muscles are relaxed. The chest will be somewhat depressed.

8. Head/Neck: Gently, but firmly, push back at C-7 and at the base of the skull. Extend up from the crown of the head. The back of the head does not touch the wall.

Special Alignment During the Exercises:

9. Rooting with the Feet: “Claw” with the feet by grasping with the balls of the feet first, particularly the balls of the big toes. The toes will then follow in grasping the ground.

10. Pelvic Tilt: Rotate the pelvis back farther as you strongly extend the sacrum down the wall. Feel the muscles around the sacrum firmly push against the wall.

11. T-11 Thrust: Push the T-11 area firmly to the wall as you bring the rest of the upper spine away from the wall,

II. Starting Position for all Exercises: Embracing the Tree

We will describe the positions of Embracing the Tree very carefully in a detailed, step-by-step explanation in Part A below. In Part B, we will give a sequence of practice, which will give you a complete sequential picture to follow without distraction. Practice as you read Part A first. Then, join all the steps together by following Part B. Part C is a summary of the sequence of practice. Utilize the Horse Stance with the assistance of the wall to improve your structure.

A. Embracing the Tree (Explanation of Procedure)

Embracing the Tree is the Master Stance practice. This practice joins many body structures and tendons (Chi channels) together into one system. In the beginning it seems difficult, quite like putting a puzzle together. However if you begin this practice by taking one step at a time, practicing each one until you can master it, then moving on to the next step, you will find this practice much easier to do. Once you have mastered the Horse Stance on the wall, you will find it much easier to practice Embracing the Tree.

1. Correct Stance

The correct distance between the feet in all Iron Shirt stances is the length of the lower leg from knee to toes. (Fig. 3.5(a)) Beginners may wish to place feet slightly farther apart, but the standard position yields the quickest results. (Fig. 3.5(b),(c) and (d))

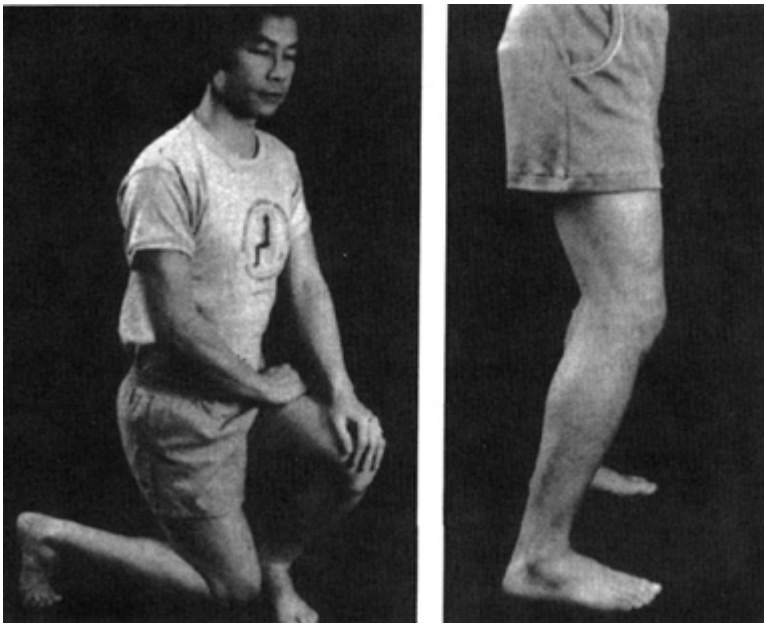

(a) Finding the Standard Position of the Feet. (b) Rooting the Feet

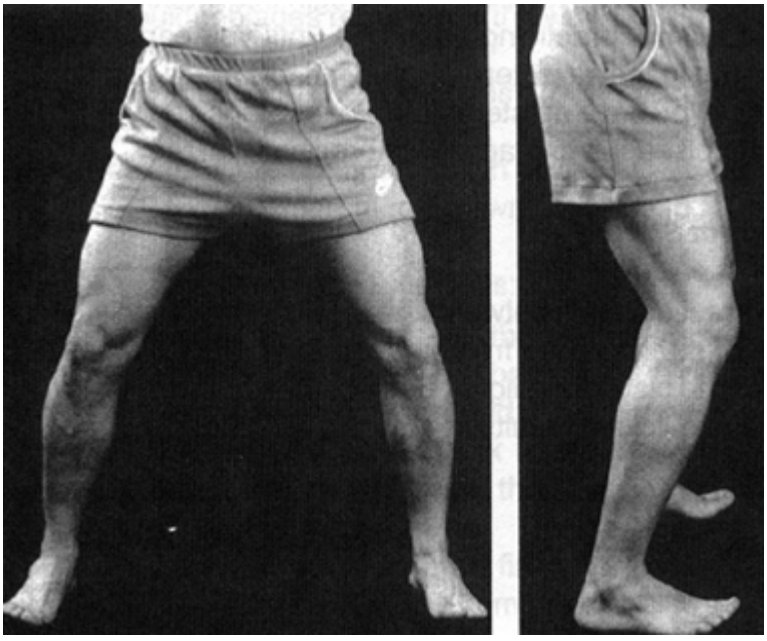

(c) Incorrect Rooting—Front View (d) Incorrect Rooting—Side View

Fig. 3.5 *Embracing the Tree–Rooting*

Fig. 3.6 *Feeling rooted to the Earth.*

2. Rooting of the Feet

As previously discussed, rooting is a very important practice in the Tao System which begins with the physical practice and builds into the higher or spiritual, practice. Like the foundation of a building, the Rooting Practice makes a strong foundation upon which to build, making the structure last longer.

To root is to surrender yourself to the pull of gravity while maintaining a structural skeletal alignment which supports the body in an upright posture.

In beginning the physical part of rooting, the soles of the feet (K-1) are the places where Mother Earth's healing energy enters. When the soles are open, you can feel the soles ''sucking'' and having a connection with the ground. This healing energy passes into the body through the soles and will nourish the organs and the glands.

Like the roots of a tree, the feet support the entire structure. (Fig.3.6) It is important to distribute your weight solidly and evenly on the whole foot. We divide the foot into nine parts, or nine bases: (I)big toe, (2)second toe, (3)third toe, (4)fourth toe, (5)small toe, (6)big ball, (7)small ball, (8)outer edge, and (9)heel. (Fig.3.7)

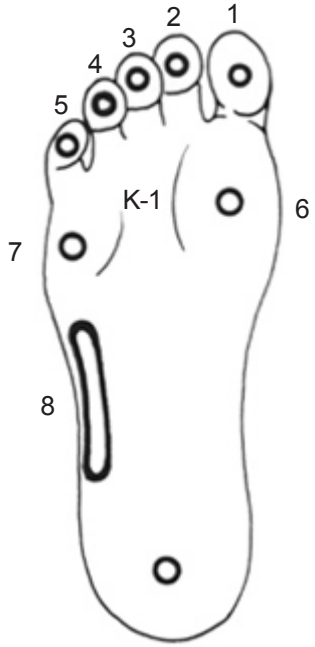

Fig. 3.7 *K-1 and the Nine Points of the Foot*

You must feel that the nine parts are evenly contacting the ground. Feel and check which parts are too tense or have too much pressure on them. This can cause the body to misalign and the spine to tilt to one side. Over a long period of time, improper alignment can cause spinal cord or disc problems.

The big toe joins with the tendons of the thumb (Fig. 3.8). and the little toe joins with the tendons of the pinky finger (Fig. 3.9); thus, all the tendons of the body are connected, increasing your rooting power. Slightly moving the feet inward, thereby pointing the toes in, will help to make the connection of the big toes and the thumb. In this posture, imagine you have roots extending down into the ground.

Fig. 3.8 *Tendons of little toes join with the tendons of little finger.*

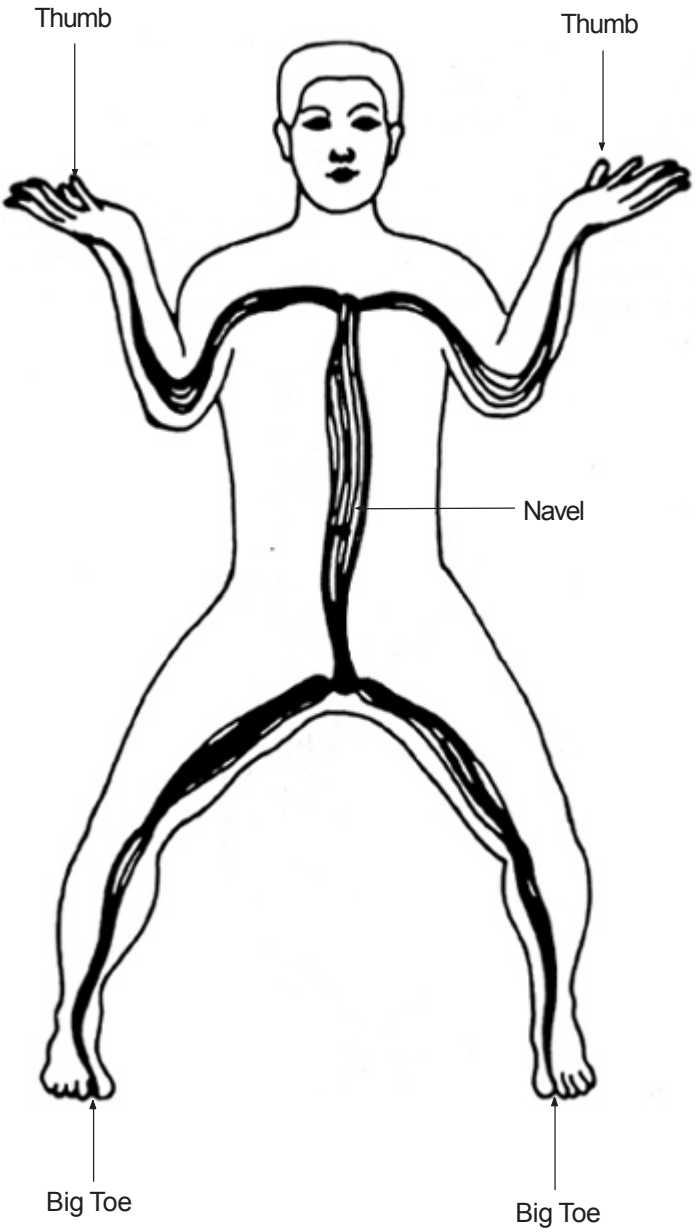

Fig. 3.9 *Tendons of the big toes join with the tendons of the thumbs.*

Note that if, at this point, the toes and ball of the foot were raised, the practitioner could easily be pushed over.

In the spiritual level of rooting, it is important to know that as there is a Mother Earth, there is a Father Heaven. Many people in the spiritual practice always want to raise themselves to a higher level to be filled with spiritual energy. If you want to go higher, you must take care that the foundation, the rooting, is good. This connection of heaven and earth is most important in the Tao practice. In the higher practice, the ground energy from Mother Earth is equally important to the spiritual energy from Father Heaven.

To assist you at this point with an overall view of the Embracing the Tree posture, see Fig. 3.10(a) through (g).

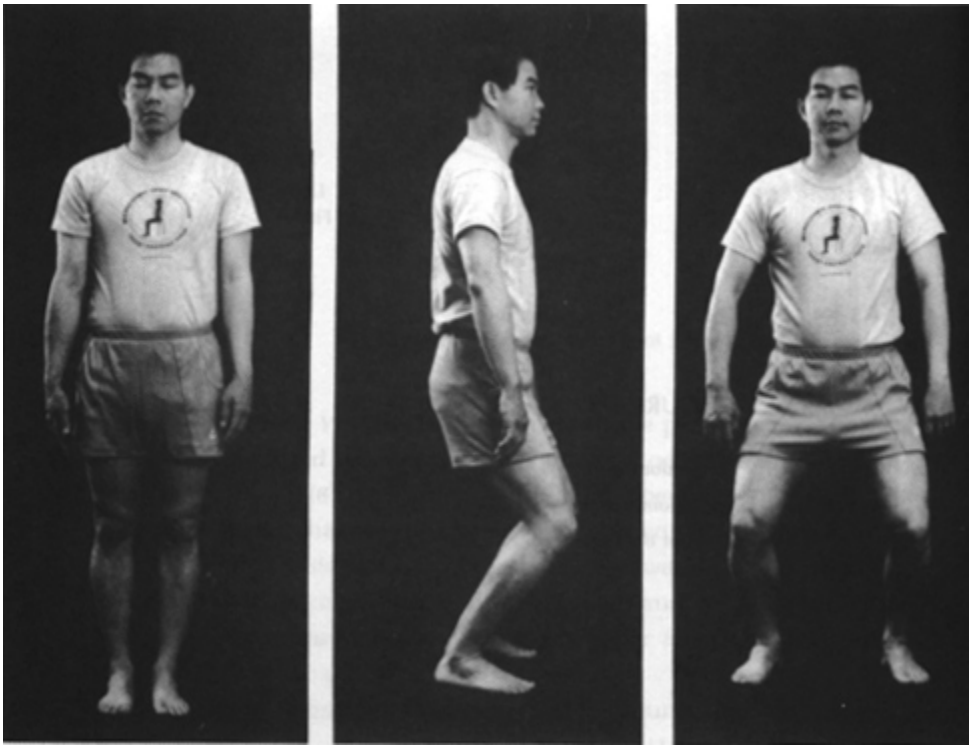

Fig. 3.10 *Embracing the Tree Posture*

(d) Full Embracing the Tree Posture—Front View

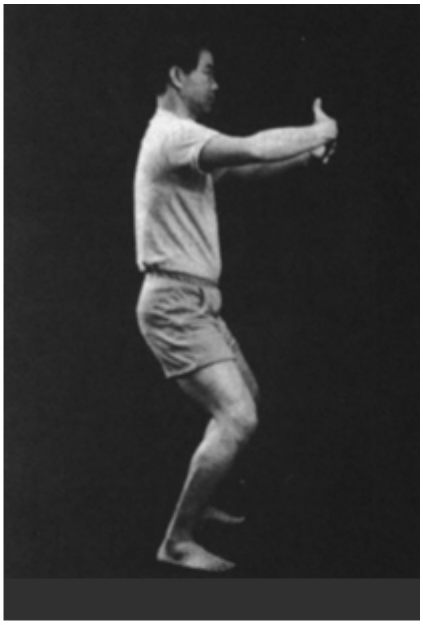

(e) Full Embracing the Tree Posture —Side View

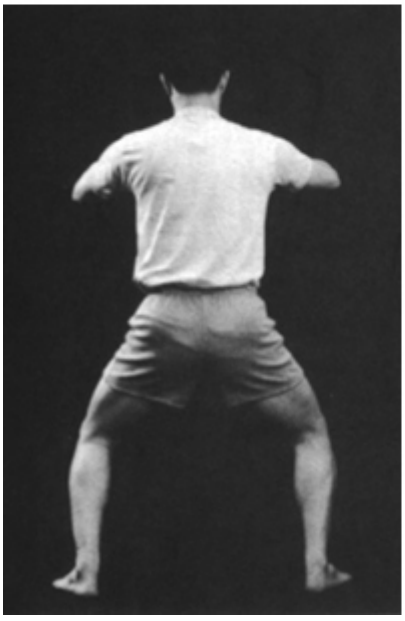

(f) Full Embracing the Tree Posture—Back View

(g) Rounding of the Scapula

3. Elongation of the Spine (Fig. 3.11(a), (b) and (c))

When you feel the Chi and fullness down below the navel, slowly sink down into the knees and feel the sacrum pulling the spine down and the head stretching upward as if pulled by a string. Keep the spine erect. Feel the spine suspended upward and the sacrum downward in order to help elongate the spine and keep the discs released. Gradually you will become taller. This elongation gives more room for expansion of the nervous system and for spinal fluid and Chi to travel freely. Look straight ahead, and step to the side with the left foot to the standard position.

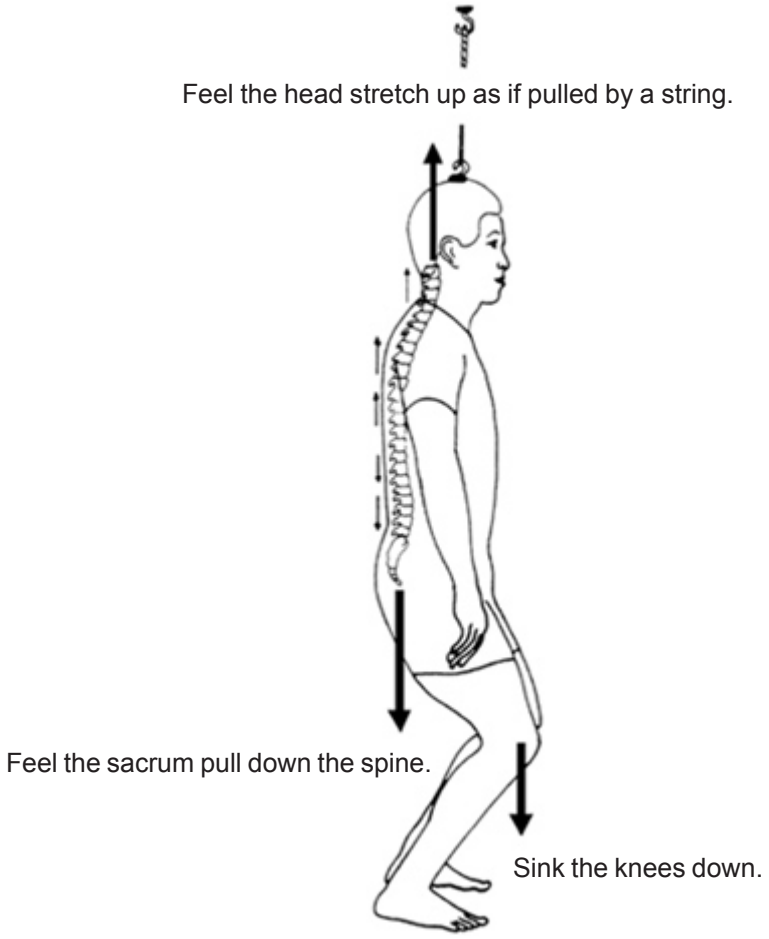

(a) Elongation of the Spine

Fig.3.11

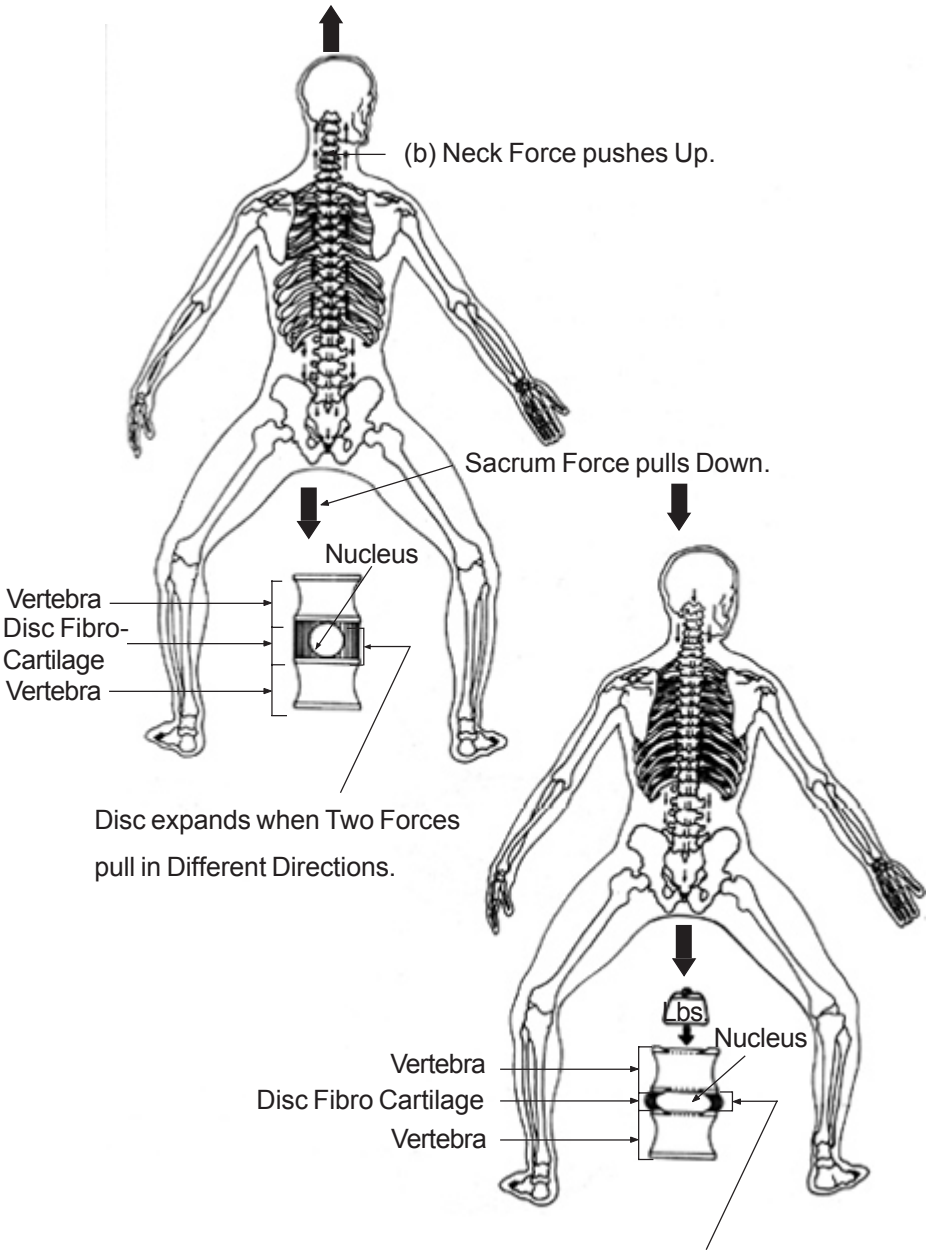

(c) Disc is Compressed Because of Stress and the Weight of the Body pressing into the Spinal Cord.

4. Three Chi Circles

a. Connect the arm with the scapula-the First Circle (Fig. 3.12)

Raise your arms in a circle as if holding a large ball or a tree lightly between the hands and chest. This forms the first circle. Your fingers should be gently separated by holding the fingertips of each hand one to two inches apart from each other. The neck (C-7) is the main juncture where energy and the powerful tendons of the body meet. Gradually you will feel the Chi spread from the C-7 to the outside of the arm, to the middle finger to the palm and feel the Chi jump from the right middle finger to the left middle finger and from the right thumb to the left thumb.

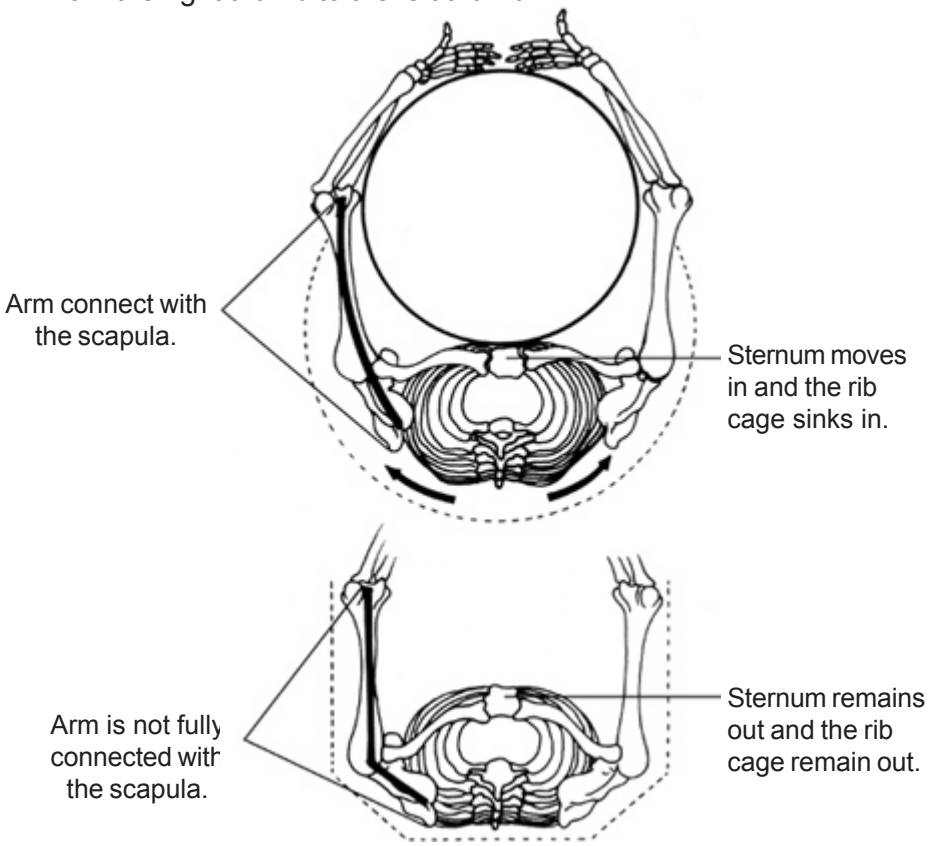

Incorrect Rounding of the Scapulae

Fig. 3.12 *First Circle: Connect the Ams with the Scapulae*

Elbows sink down, turning inward, and should feel as if they are maintaining their position by resisting the downward pull. Imagine that someone is pushing you on the outside of your elbows and you, in turn, are pushing outward to maintain the position. Feel the spiral in your forearm as if it were a screw turning clockwise. This will connect the wrist, elbow and arm together. Relax the shoulders. Drop the neck muscles down. The trapezius muscles, connecting the back of the neck with the back of the shoulders, have to be relaxed so that the connection can be transformed down. (Fig. 3.13).

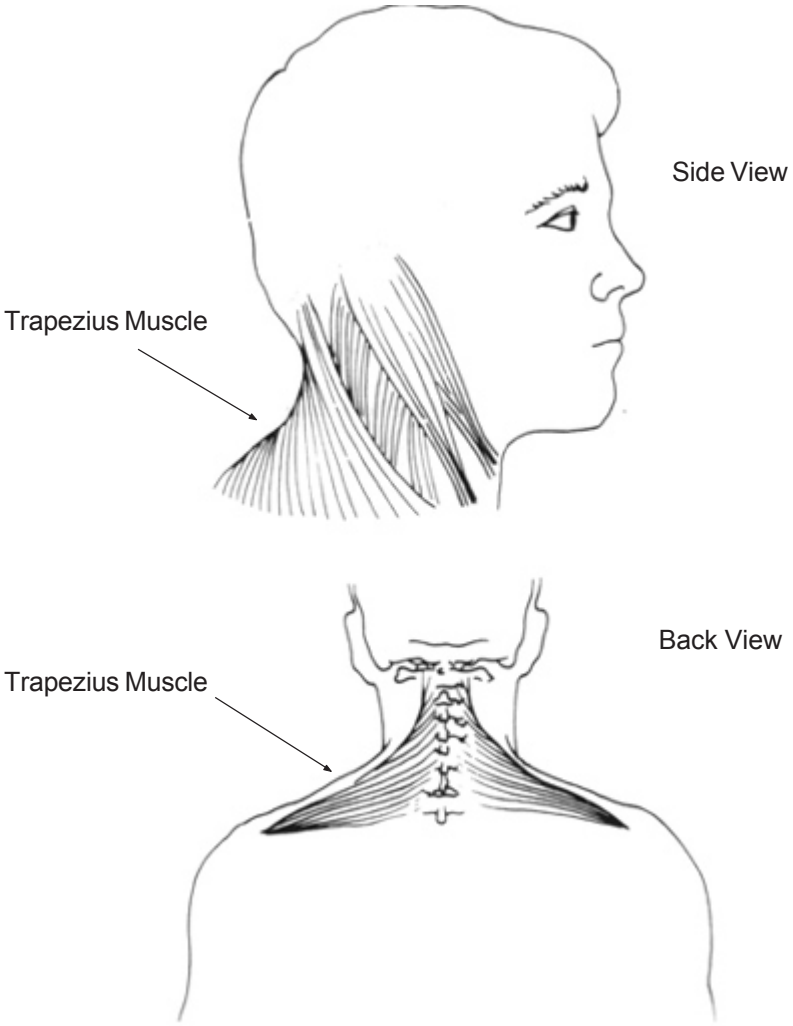

Fig. 3.13 *Trapezius Muscle*

Bring your concentration down the spine, pressing down on your skeletal structure to the sacrum, to the knees, and finally down to the feet and the earth. You are pressing down on the skeletal structure for the body's support, rather than the muscles. The pressure gradually travels down the spine to the sacrum and hips, tightening the legs and feet. Eventually you will feel your bone structure connected down to the ground, rooted as if you had grown into the ground and were all one piece with the earth. (Fig. 3.14)

Stand erect, feet close together and feel the weight distributed evenly on the feet. Relax the neck, the shoulders and the chest. Gradually bring your attention to the navel and send the Chi energy to the navel until you feel a warm fullness there.

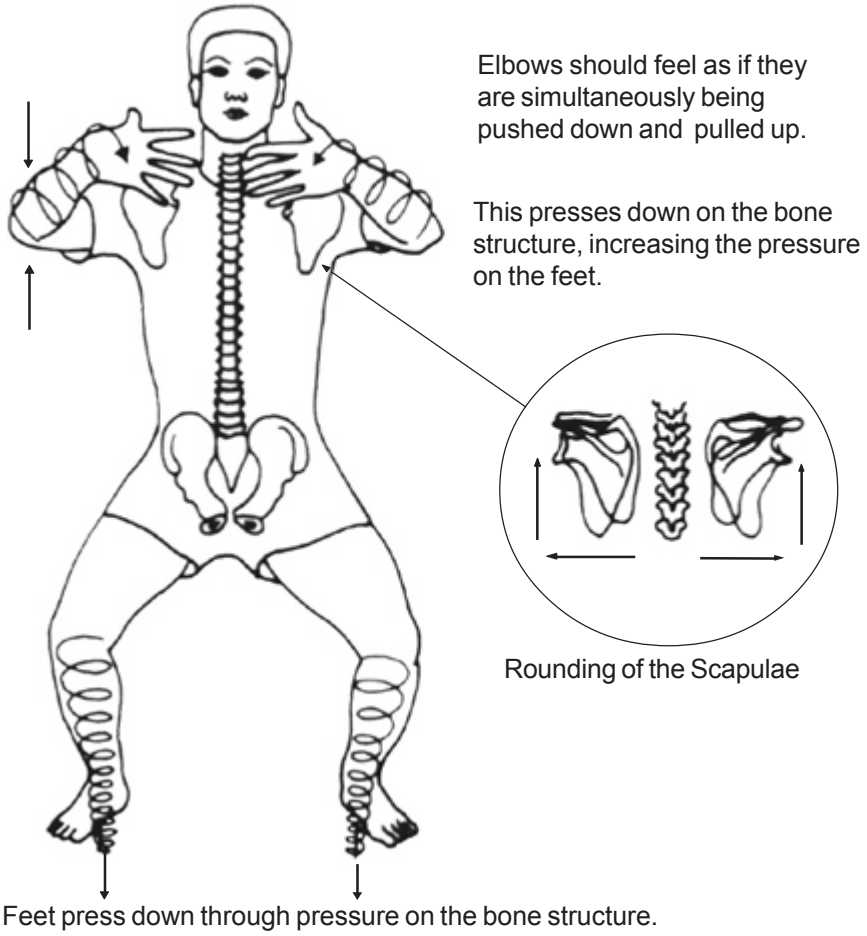

Fig. 3.14 *Press down on the bone structure.*

b. Connect the scapulae with the spine—the Second Circle (Fig. 3.15 (a), (b) and (c))

Thumbs point up so that the energy will flow between the two thumbs and the energy will connect with the big toes; thus, the two muscle-tendon meridians join together, and the front structure of bones, tendons, fasciae and muscles tighten the structure together as one. (Fig. 3.15 (a))

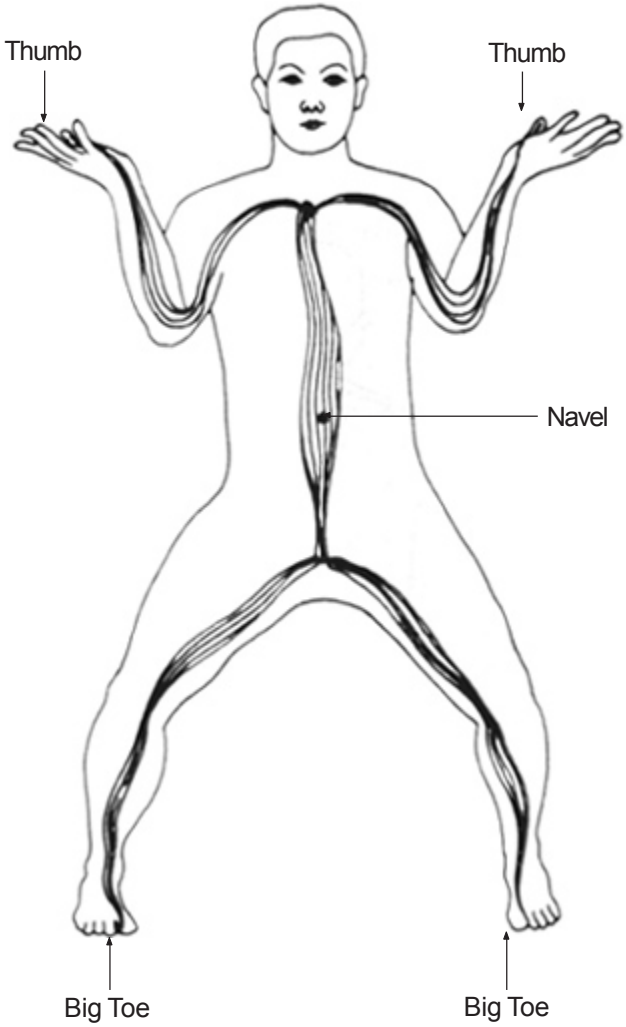

(a) The tendons of the big toes' lines connect with the tendon of the tumbs.

(b) Spiral the energy though the arms and out of the fingers.

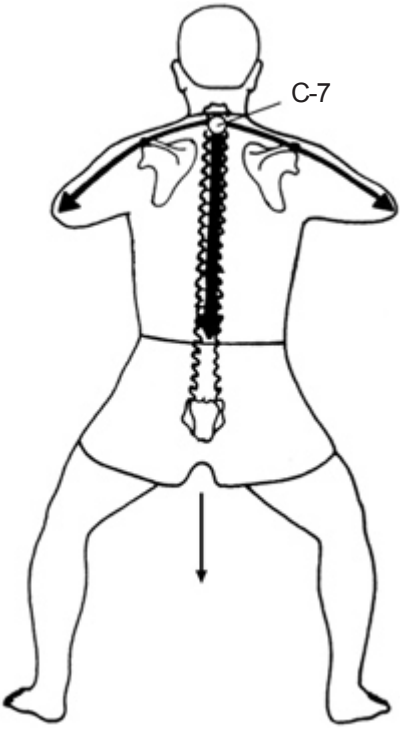

(c) Stretch like a bow from C-7 to the thumbs, thereby connecting the hands, C-7, scapulae and spine

Fig. 3.15 *Second Circle: Connect the Scapulae with the Spine*

Attach the hands and fingers to the scapulae, or shoulder blades, and cranial bone by pulling the thumb tendons away from the body and the pinky fingers' tendons towards you. Feel a spiraling action turning in a clockwise circle as you pull the scapulae to the side. (Fig. 3.15(b)) As in using the wall, feel as though the inner edges of the shoulder blades remain on the wall with the shoulder blades sticking to the back of the rib cage. This will allow the transference of force from the shoulder blades to the rib cage, which in turn will transfer to the C-7, or energy junction point, to the spine, the sacrum, the knees and down to the feet. In this way the force can also be transferred from the earth to the feet, to the knees, to the hips, to the sacrum, to the spine, to the shoulder blades and, finally, to the hands. Since the shoulder blades, while near the spine, are not connected to it, there can be no force transferred from one to the other unless you practice the proper stretching.

In practicing this posture, you will feel a stretch of force form like a bow from C-7 to the thumb. When your elbows sink and press inward, you will feel more of the stretching of the bow. By stretching the scapulae and spine tendons and connecting them together (Fig. 3.15 (c)), the back becomes rounded and the chest sinks. Feel the hollowness of the chest. The sternum then sinks down to press the thymus gland, the major gland of rejuvenation and the immune system. (Fig. 3.16) Keeping this gland active will increase Chi flow.

These events will help to activate the cranial pump. (Fig. 3.17) Rest and feel the head start to pulsate. Joining the powerful muscle-tendon meridian down to the navel will connect the Chi energy in the front line and join the bone structure of the rib cage together (Fig. 3.15(a)) In doing so you are helping to sink the energy down. This forms the Second Circle.

Embracing the Tree will strengthen the thumb and toe muscles and tendons along this meridian. The thumb and toes have the principal rooting power.

By strengthening these muscles tendon meridians which join at the navel, all the muscles, tendons, bones and fasciae (connective tissues) will become tied together greatly improving the bone structure and holding a good posture.

Bad posture is caused by weak tendons, muscles and fasciae, which cause bones to fall easily out of alignment.

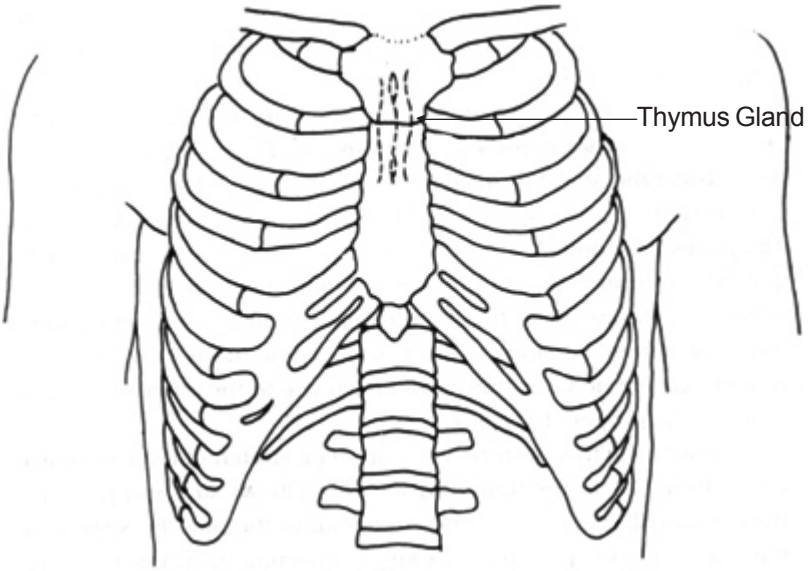

Fig. 3.16 *Thymus Gland is the major gland of rejuvenation and the immune system.*

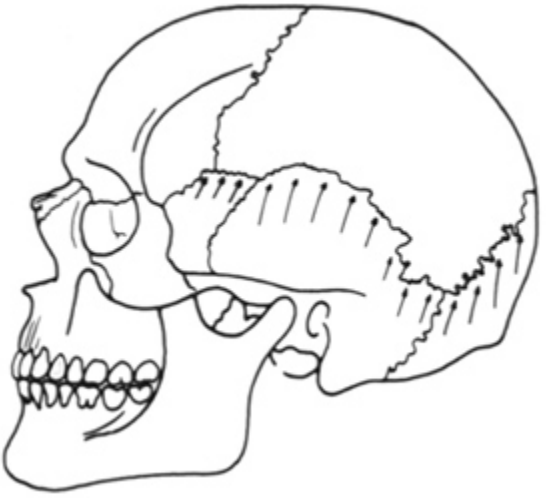

Cranial Pump becomes activated during the Second Circle when, upon deep inhalation, there is a micromovement of the Cranial Bones.

Fig. 3.17 *Cranial Pump*

c. Connect the hand, scapulae and spine to the sacrum—the Third Circle (Fig. 3.18)

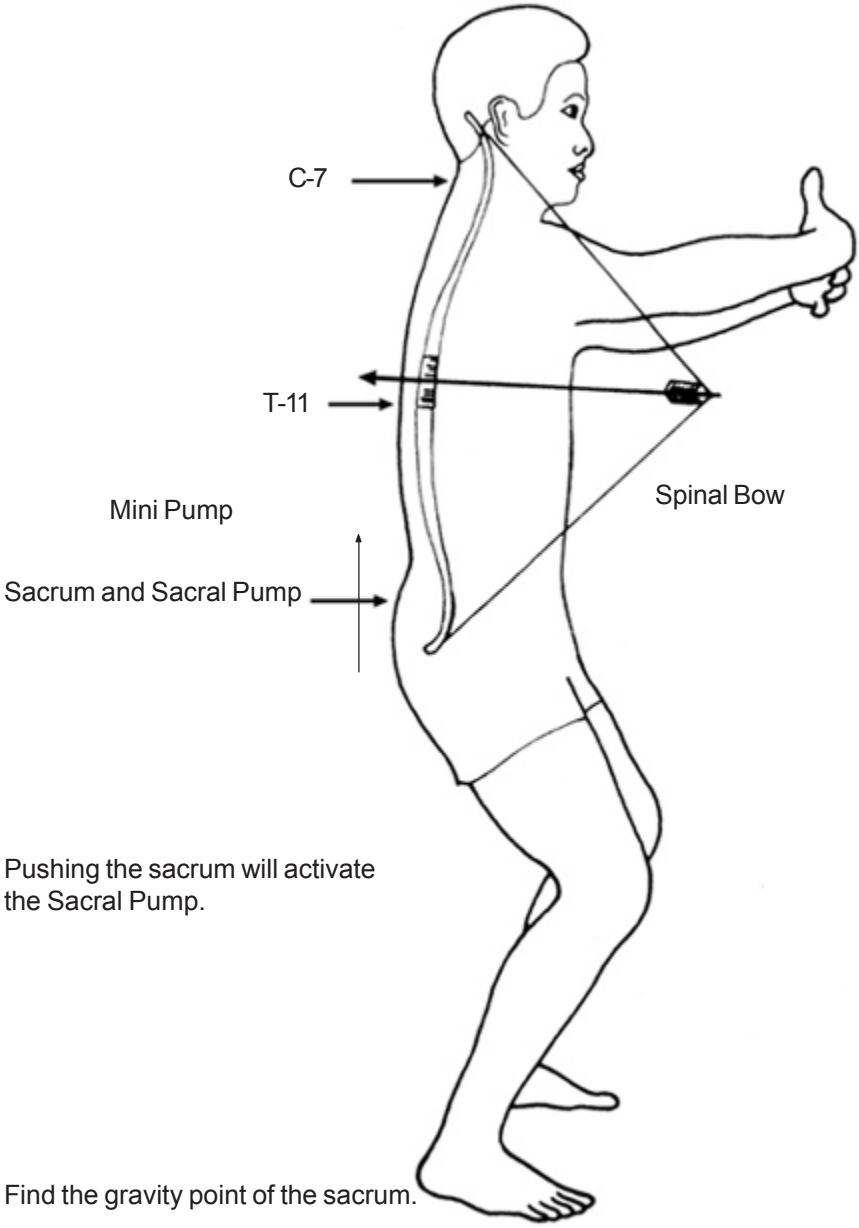

Fig. 3.18 *Third Circle: Connect hands, scapulae and spine to sacrum.*

This connection is made by pushing out the curve of the C-7 from the sternum, the natural curve of the spine, and locking the hips. This will stretch the spine like a flexed bow that will link the spine, C-7, scapulae, shoulders, arms, elbows, and hands together. Push the sacrum out as if you were pushing against the wall; the hips remain the same. The hip bones and sacrum can be separated individually. Once you can separate out and move the sacrum straight, you can activitate the sacral pump which is very important to help circulate the Chi. (Fig. 3.19) You will feel the connection of the spine, the scapulae and the sacrum. Find and adjust the gravity point of the sacrum in between the feet.

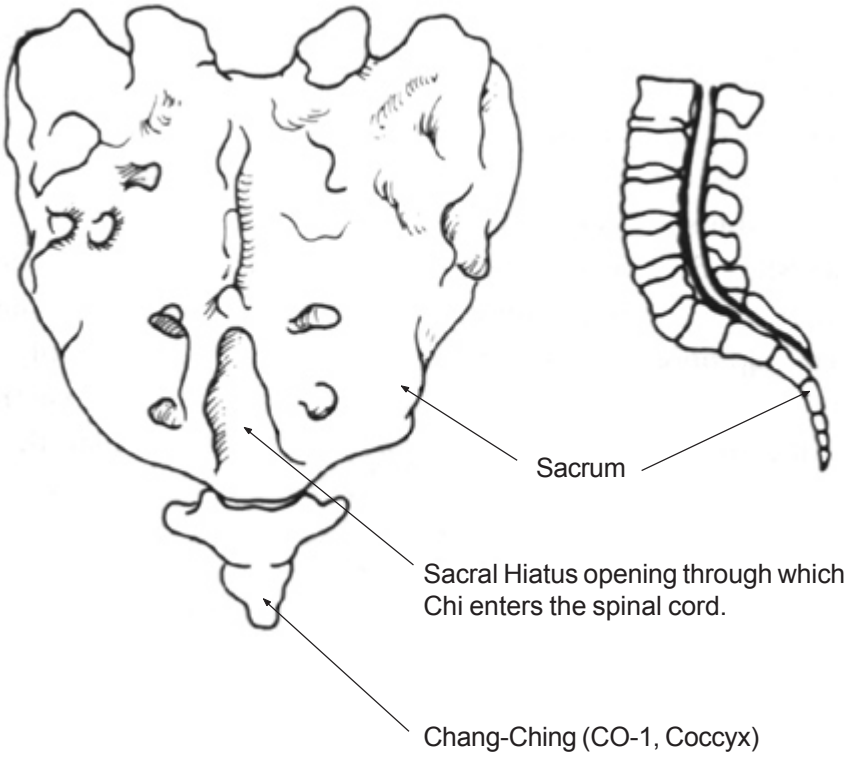

Fig. 3.19 *Sacral Pump*

The greatest kinetic energy and power in the human body is generated through the hip joints, around which are attached the largest muscles (the psoas muscles). (Fig. 3.20) However if you cannot open the pelvis and differentiate both sides (pelvic differentiation), the power of the hip joints is limited to only two directions. The simple fact of standing on one leg without leaning to one side would require an internal sense of the angle of the pelvis, and the arrangement of the spine. To feel “empty” on one side can only happen when you feel grounded, supported and aligned on the other (emptiness and fullness: Yin-Yang).

Round the pelvic area like an arched bow. By turning the big toes in slightly, the second toes point straight ahead so that your feet are positioned as though standing on the circumference of a circle, making yet another circle. This will gradually open the groin area and allow the Chi pressure to fill the area as if a ball were in this area.

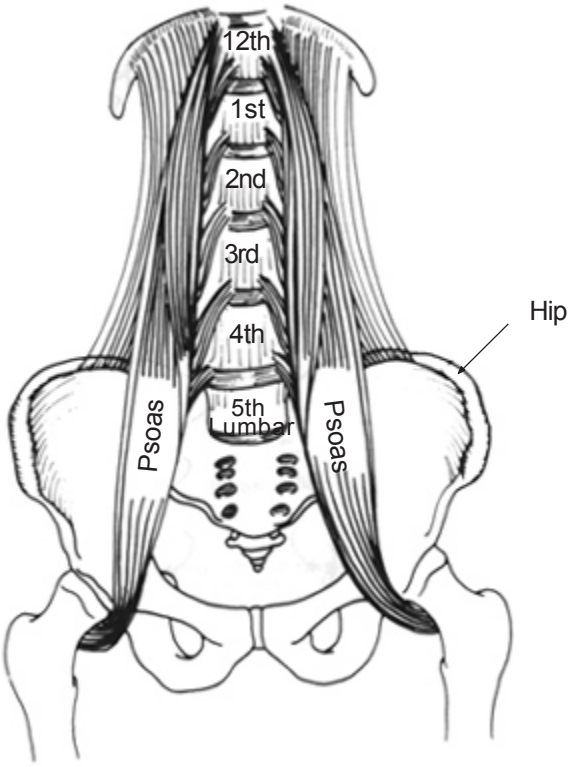

Fig. 3.20 *Opening the Pelvic Area*

The hip joints are synergistically dependent upon two further joint alignments: the knees and ankles.

The knees, ankles and feet are the next connection to the earth. Embracing the Tree requires a precise alignment of the knee and ankle joints. The critical joint alignment is in the 'saddle' of the tibia (shin bone) over the talus (ankle bone), which stabilizes everything above. Sink, down and open the knees a little bit, turning the knees outward slightly as if you were in a saddle. Feel a spiraling downward movement as if your legs were screws, screwing down into the ground, created by pressing firmly on the feet, and then feel the whole body force transfer to the ankles, the feet, and to the ground. (Fig. 3.21) Feel your bone structure. The knees should feel as if they are simultaneously being pushed in and out. Lock the knee caps.

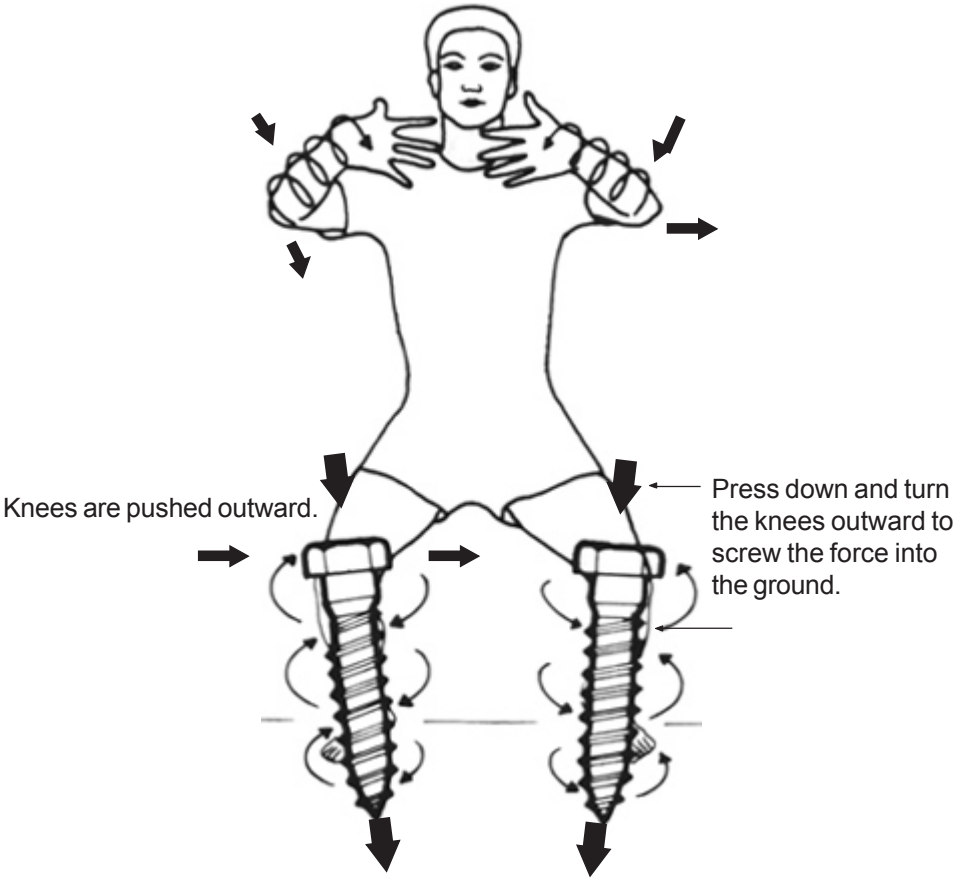

Fig. 3.21 *Screw the force into the ground.*

If the alignment is oblique, forces through the feet are not spread evenly.

The knee joints should not be positioned over the big toes as this may cause some to experience knee pain, making them unable to continue. If you have trouble with your knees while in the Horse Stance, you must judge just how much you can do. In your own best interest, you may have to forego some of the positions. Note, however that the cause of pain is not necessarily found in the physical location in which the pain is felt.

Fold the tongue back to the soft palate in the area of the Heavenly Pool. (Fig. 3.22(a)) If this is difficult, simply touch the tip of the tongue to the gum line behind the front upper teeth. (Fig. 3.22(b)) Now you should feel the whole body structure connect into one piece from the feet, ankles, knees, hips, sacrum, spinal cord, scapulae, arms, elbows and hands.

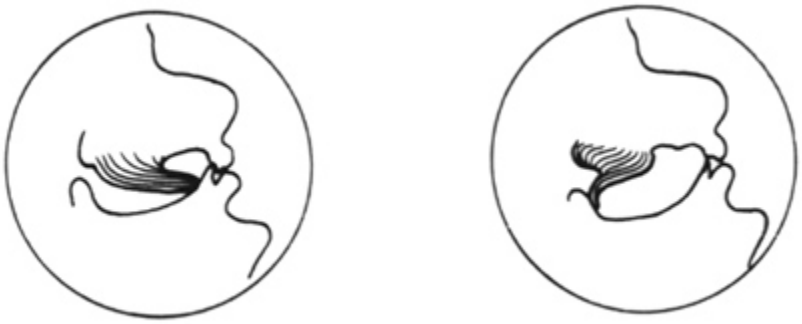

(a) Heavenly Pool (b) Tongue touches behind the teeth

Fig. 3.22 *Tongue Positions*

5. Eyes Can Help to Direct Chi

The Taoists regard the eyes as the windows of the soul and a most powerful tool in directing and absorbing Chi into the body.

Direct the eyes to look at the fingertips of both hands. Hold the eyes steady to direct the Chi flow. Keep them wide open while looking at the fingertips to help connect the Chi between the fingers while seeing the tip of your nose with some part of your vision. Allow the ears to listen inside the body to the navel. (Fig. 3.23) This will make you feel very centered, peaceful and calm.

During inhalation, create a ball by expanding the abdomen on all sides. Exhale and feel the ball roll up your chest.

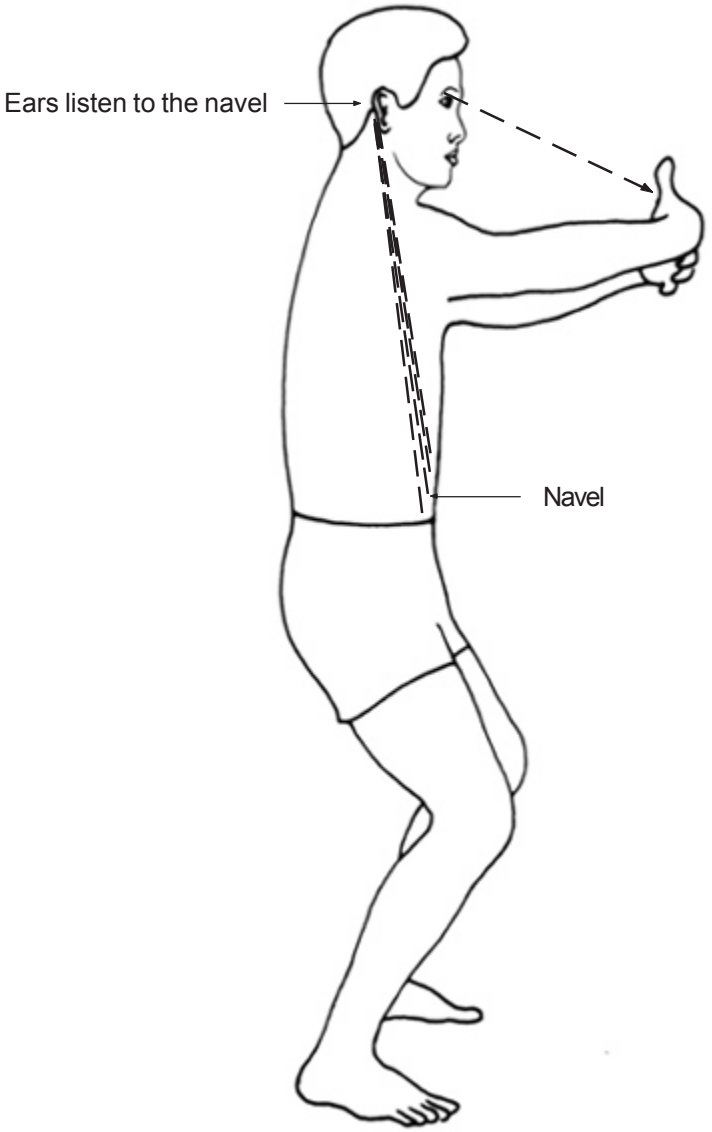

Fig. 2.23 *Inhalation*

6. Begin with Energizer Breathing (Abdominal and Reverse Breathing)

Concentrate on the area just one and one-half inches inside and below the navel until you feel some Chi activity there. At that point, begin breathing, preferably the Energizer Breathing. As described in Chapter 2, this is accomplished by first inhaling into the lower abdomen (the region below the navel). Feel the abdominal wall pull the lower lobes of the lungs down and the air move in. Feel the lower abdomen and perineum bulge on all sides like a ball, then forcibly expel the air through your nostrils. With this expulsion of air, feel as if a ball were rolling up your chest. (Fig. 3.24) Sink the sternum and press into the thymus gland. At the same time, pull up the sex organs and the anus. When exhaling, the abdomen is flat to the spine. Release. One such inhalation and exhalation constitutes a round.

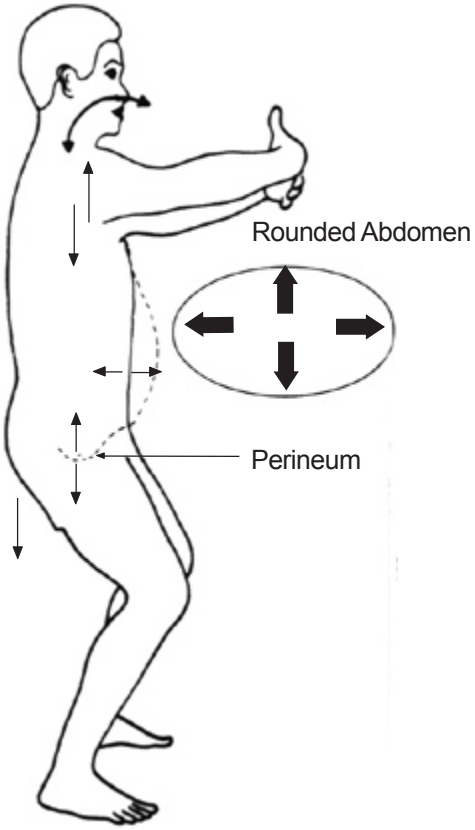

Fig. 3.24 *Energizer Breathing*

7. First Stage

a. Do nine to eighteen rounds of Energizer Breathing. Remember the breath should be generated from the lower abdomen, one and one-half inches below the navel. You can put your hand at the lower abdominal area to make sure the breathing is generating from there.

b. Exhale your last inhalation and be aware of how you flatten the abdomen, pulling in and up behind the front lower ribs to do this. This will increase and strengthen the psoas muscle. Exhale once more and relax the diaphragm downwards. Gradually you will feel the diaphragm press against the adrenal gland. (Fig. 3.25) Do not tighten the abdomen. Contract the perineum and start to do the Iron Shirt Packing Process.

Diaphragm presses down on the adrenals and kidneys.

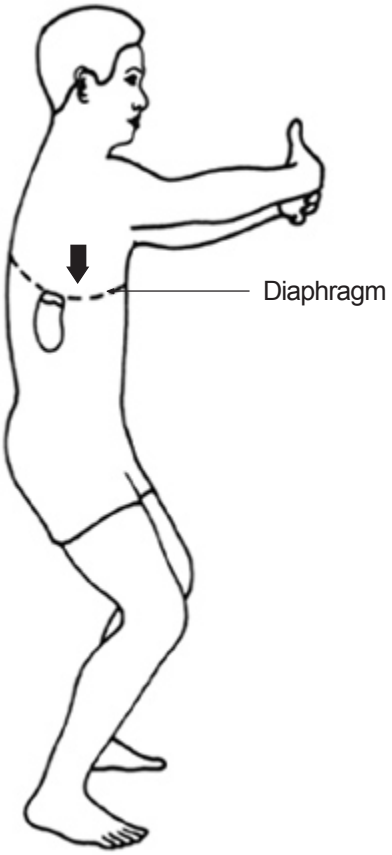

Fig. 3.25 *Relax the diaphragm downwards.*

c. Perineum power: Inhale ten percent of your capacity with short, quick breaths generating from the navel by using the navel to pull the air in and pull up the sexual organs. (Men pull up the testicles and the penis; women pull up the uterus and squeeze the vagina tight.) Keep the abdominals in the position they assumed when you exhaled and feel pressure build in the upper abdomen. (Fig. 3.26)

Diaphragm, abdominal wall and perineum press into the abdomen.

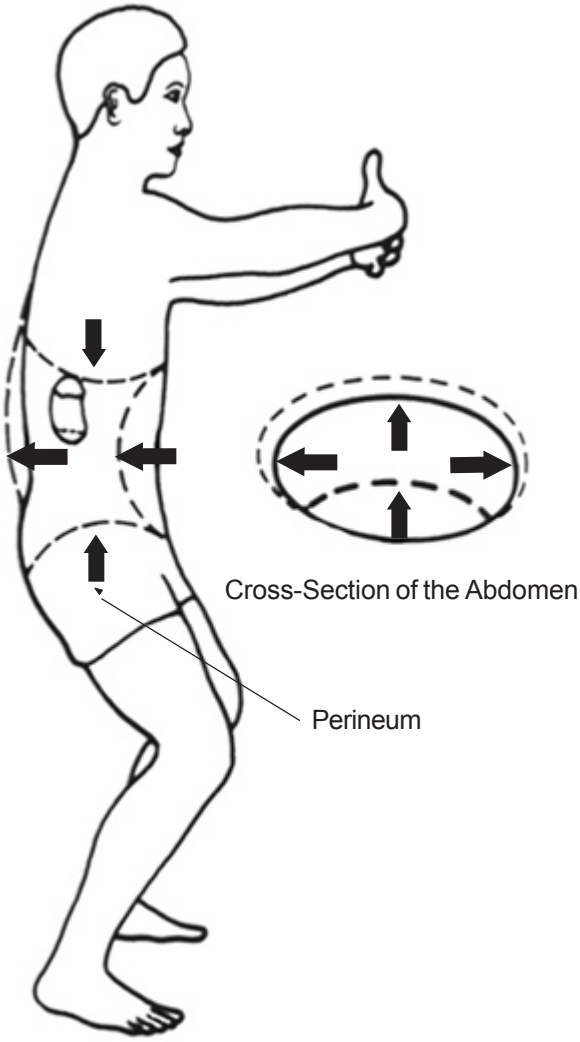

Fig. 3.26 *Perineum Power*

d. Inhale another ten percent and pull up the left side of the anus. Bring the Chi to the left kidney and wrap and pack the kidney and adrenal glands with Chi. (Fig. 3.27) In the beginning you might not feel it, but when you practice for a while, you will feel something under the back rib cage bulge out. The sensation is very unusual. Inhale again to the right side of the anus and pull the Chi to wrap around the right kidney. The kidneys are the first organs to be exercised. Remember the first point of each kidney, K-1, is on the sole of each foot; these points are the major points of rooting. When the kidneys are strong, the bones will be strong because the kidneys control the bones and the Chi in the bones. When you can master the kidneys' Packing Process, that is, wrapping and packing the Chi around the kidneys, you can easily move to wrapping and packing the ovaries, prostate gland, adrenal glands, liver, spleen, lungs, heart, and thymus gland. (Fig. 3.28)

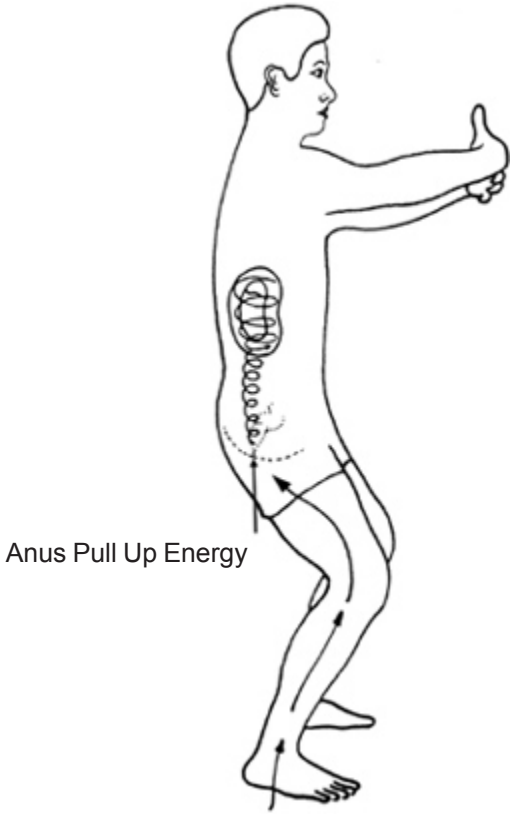

Fig. 3.27 *Wrap the energy around the kidneys.*

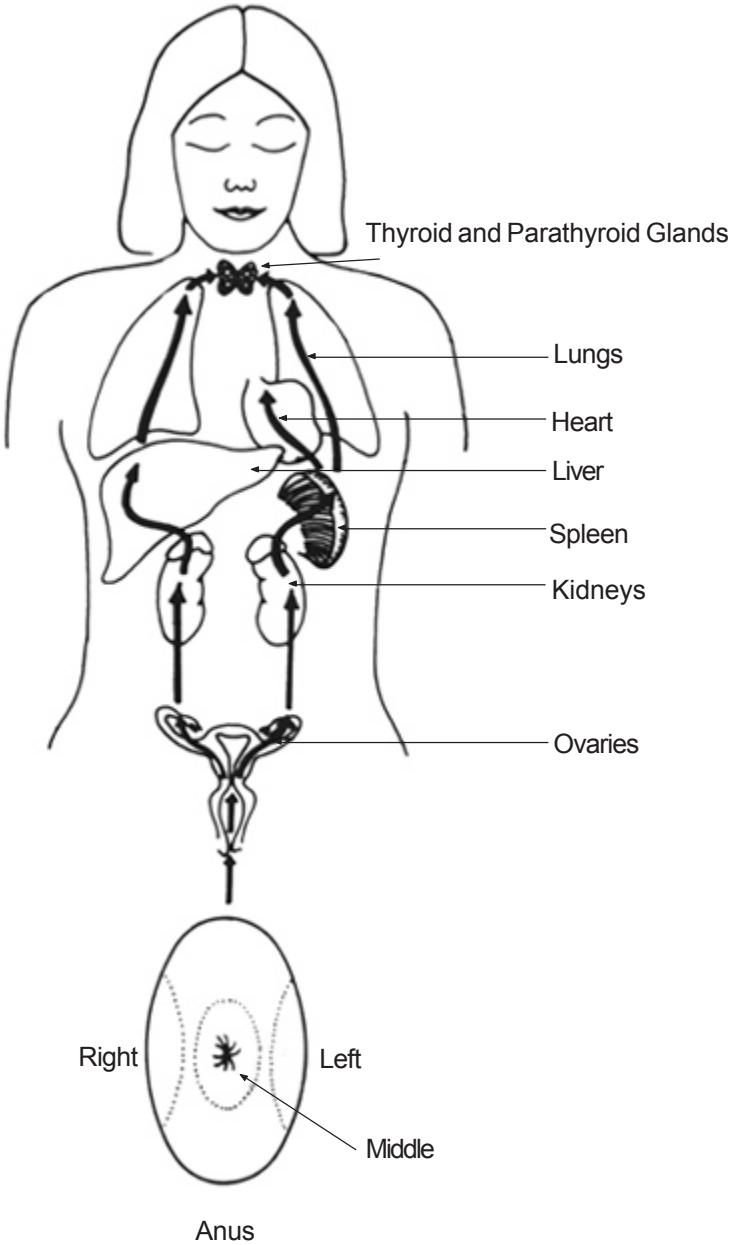

Once you have mastered the Kidney Packing Process, you can proceed easily to wrap and pack the other organs.

Fig. 3.28 *Kidney Packing Process*

e. Concentrate on the navel and circle the Chi in that area nine times in a clockwise direction in an area three inches in diameter, and nine times in a counterclockwise direction, thereby condensing the Chi into a ball. (Fig. 3.29) Use your mind and eye movements to help create the circular direction by moving the eyes in a round circle. (Fig. 3.30) First move the eyes clockwise beginning with the eyes looking downward, moving up to the right comer, to the top, to the left comer and down again nine times; then, circulate the Chi counterclockwise by moving the eyes from the bottom to the left, to the top, down to the right, and to the bottom nine times.

You should begin at your navel and circle inwards using a three inch diameter, while thinking that the Chi in the body is being drawn to that place by that activity and that it is being packed into the smaller and smaller area of an energy ball, to be finally contained in the navel. Slowly do nine rounds. Concentrate and collect your energy when you feel Chi has been generated. The Chi will condense into a small, dense unit.

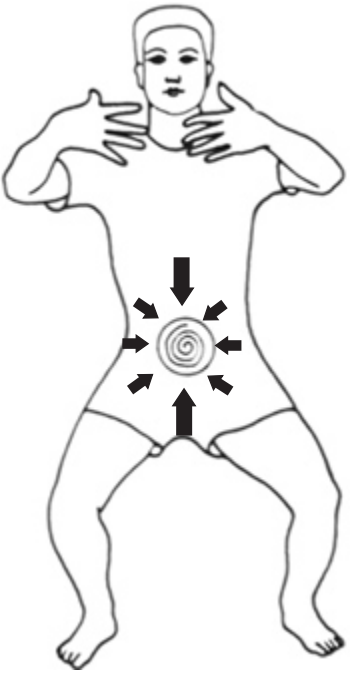

Circle the Chi and concentrate the energy into an energy ball.

Fig. 3.29 *Creating an Energy Ball*

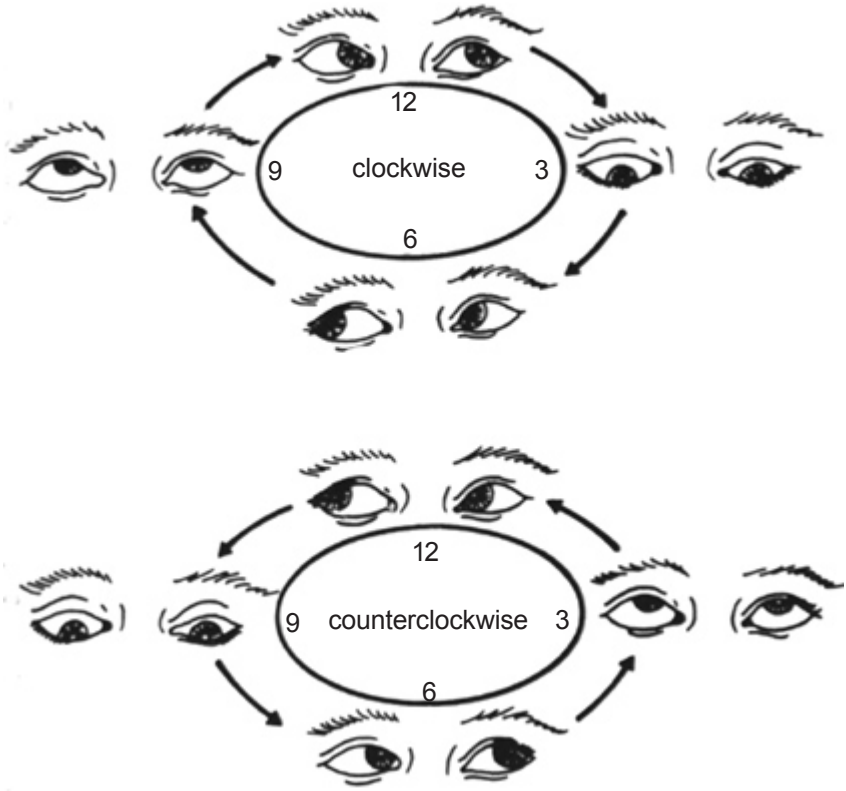

Use the mind and eyes to help circle the Chi energy ball nine times clockwise...and nine times counterclockwise.

Fig. 3.30 *Circulate the Energy Ball.*

There are nine points in which the Chi is to be circulated and condensed. (Fig. 3.64) In later practice, you will condense, store and bring up the Chi from these power stations. These Chi power stations are tremendously useful in the Kung Fu energy and spiritual practice.

It is most important to keep the diaphram down. Remember to check it by touching the sternum and the stomach. You can feel the diaphram coming down when it is distinguishable from the stomach.

f. Inhale another ten percent. If you feel that you cannot inhale more, you can exhale very little and inhale again. Make the abdomen flatter and draw Chi into the lower abdominal area. The area below

the navel seems to be filled, but keep the upper abdomen flat in order to minimize the space so that the Chi pressure can be increased. As mentioned previously, this sensation is caused by the action of the diaphragm pressing down against the organs contained in the abdomen. The pressure between the outer wall of muscle of the abdomen, which is kept flat, and that of the diaphragm pushing down from above serves to compress the abdominal organs. When you pull up the pelvic and urogenital diaphrams and pull up the sex organs and anus, more energy will pack in the lower abdominal area. There is where the Chi is condensed into an energy ball. This energy ball will expel wastes and rinse out the toxins from the system, aiding in the circulation of blood and lymph through the area and driving excess Chi into storage between the fascial layers. (Fig. 3.31) Remember the Chi will occupy this space, prohibiting fat from being stored there.

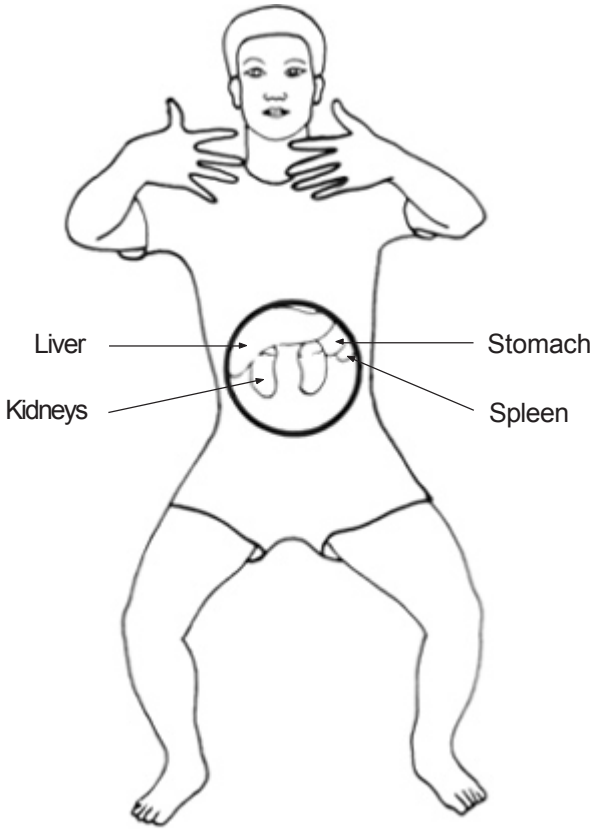

Packing and condensing the organs will help to expel toxins and wastes from the body.

Fig. 3.31 *Pack and condense the organs.*

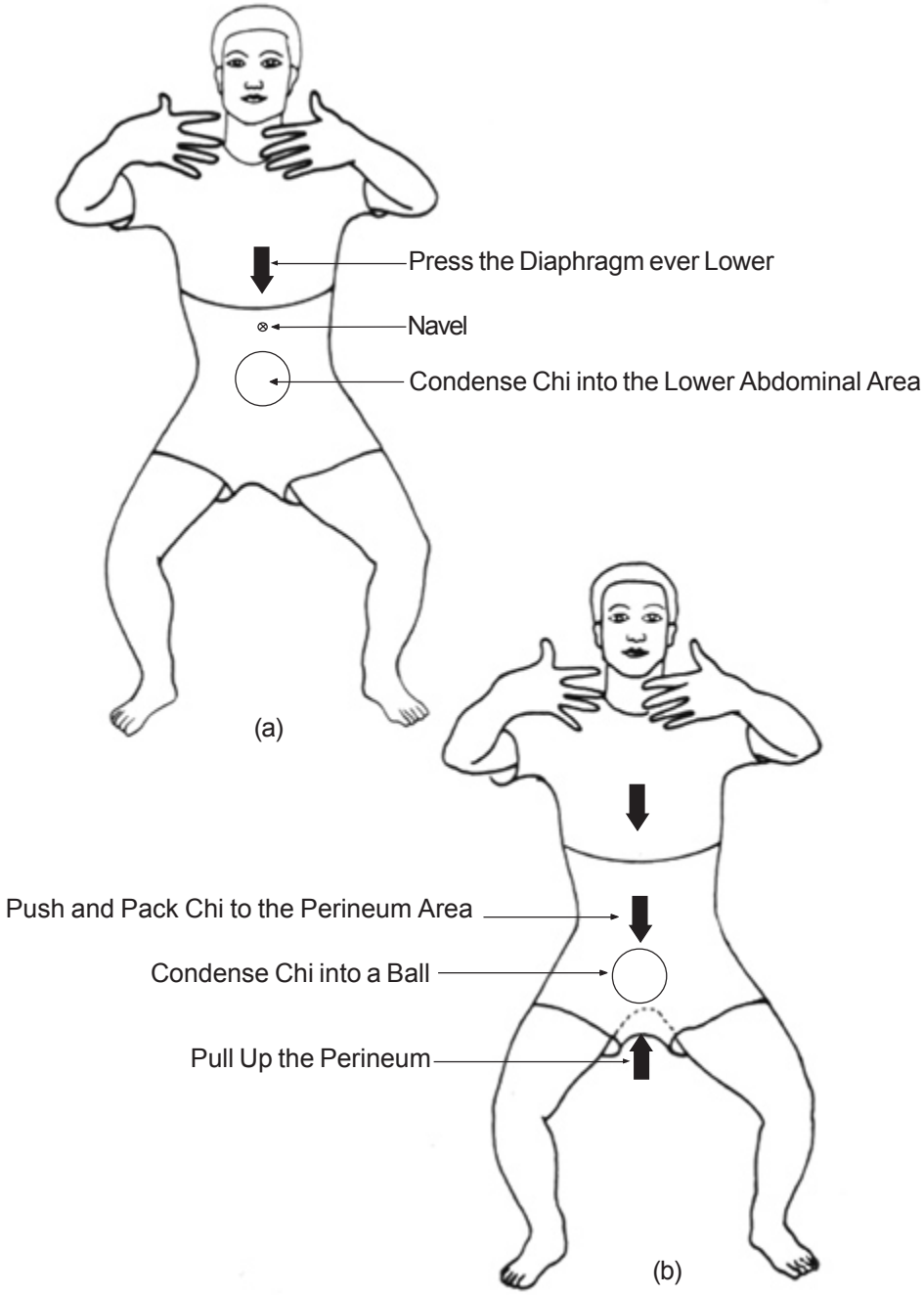

Fig. 3.32 *Condensing Chi*

g. Inhaling ten percent more of your total capacity presses the diaphragm even lower so that now you become more aware of the contents of the lower abdominal area. (Fig. 3.32(a)) Women should be aware of the area in which the ovaries rest. Hold your breath until the need arises to inhale.

It is at this point that you can work on your feet and coccyx, which are most important as energy sources. Those who have already completed the Microcosmic Orbit should make rapid progress here.

h. Inhale ten percent more of your capacity. Concentration should now be on the sexual organs.

With more practice your mind can direct the Chi more easily, giving you greater control over the Chi energy. Condense the Chi into a compact ball. Hold this energy in the lower abdominal area where you can increase it by using your mind and the Packing Process.

i. Inhale ten percent more of your capacity to the Hui Yin (perineum) to activate Perineum Power. Pull up the perineum, push and pack the Chi down to the perineum area and condense it into a ball. (Fig. 3.32(b)) Concentrate on the perineum again. With more practice you will gradually feel the perineum bulge downward. You should be able to feel a big channel running from the navel to the abdomen to the perineum connecting with Chi. Hold the breath as long as you feel comfortable.

j. Now exhale and relax the whole body, sending energy down the back of the legs into the ground. (Fig. 3.33) Regulate your breathing with energizer breathing. Inhale more; exhale less. When you exhale, pull up the perineum (include the sex organs and anus). Be aware of the middle of the palms of the hands and the middle of the soles of the feet. Use the mind to feel the palms and soles “breathing”. Coordinate your breath with the palms and soles, breathing simultaneously. With the Packing Process Breathing, the palms and soles will open easily. Gradually, you will feel as though the soles and palms seem to breathe. (Fig. 3.34) The left eye looks at the left palm, the right eye looks at the right palm. In the forehead, above and between the eyebrows, resides what the Taoists regard as another eye called the “Heavenly Eye”. Feel the Chi from the palms flow to the forehead while the “Heavenly Eye” sends Chi to the palms.

Now exhale and relax the whole body, bringing the Chi down the backs of the legs to the soles of the feet and hold your attention there. Concentrate on the soles until you feel the energy going down into the ground. Gradually, increase the energy down to the ground and feel as though you are growing roots like the roots of a tree inch-by-inch downward, at first six inches, then one foot, and so on. Feel the flow of Chi from the navel to the perineum, to the backs of the knees, to the soles of the feet and down into the ground. Become one line of energy flow.

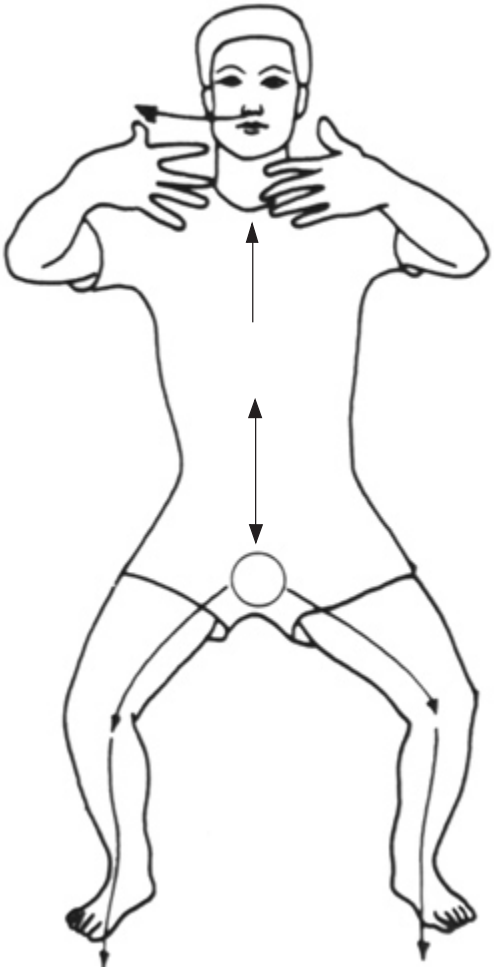

Exhale and let the energy flow down though the legs and into the earth.

Fig. 3.33 *Send the energy into the earth.*

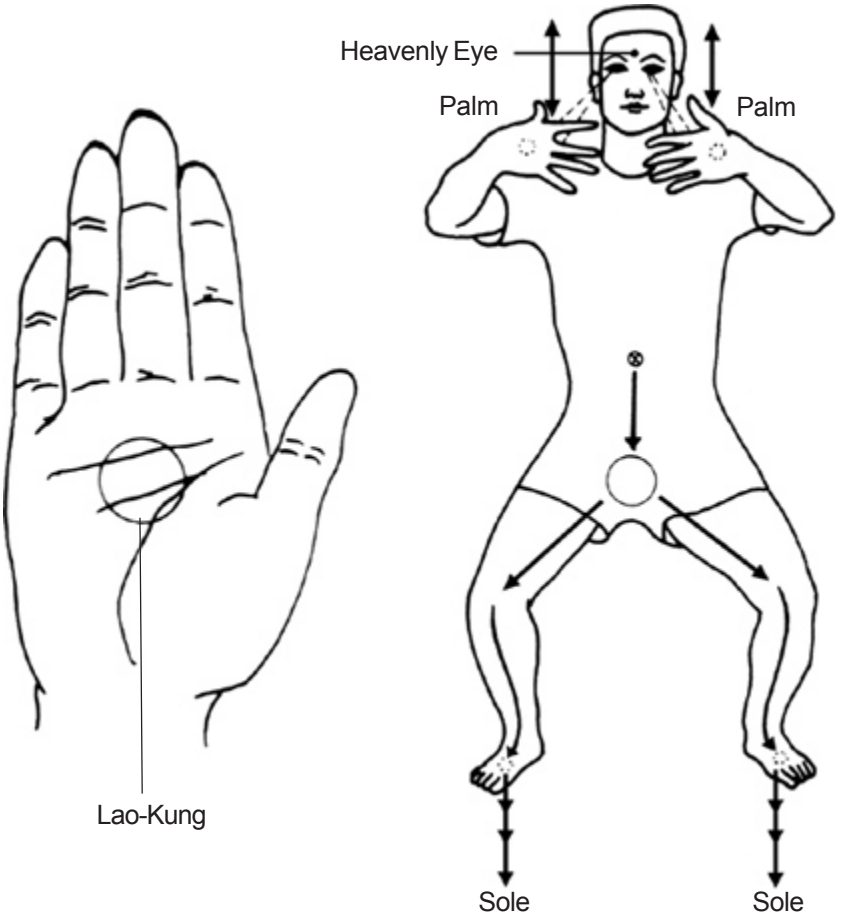

Fig. 3.34 *Feel the palms and soles breathing.*

k. When you can feel that you are rooting into the earth, you are hooking up to Mother Earth's inexhaustible sources of energy (Fig. 3.35) Become aware of the "loving, healing energy" emanating from Mother Earth, which enters through the soles and rises up the front of the legs six inches at first, then two feet, then three feet or more. Continue in this way until your whole body is full of this "loving, healing energy". Hold and pack the Chi in the perineum until you feel the urge to breathe. Exhale and do the Energizing Breathing to regulate your breath.

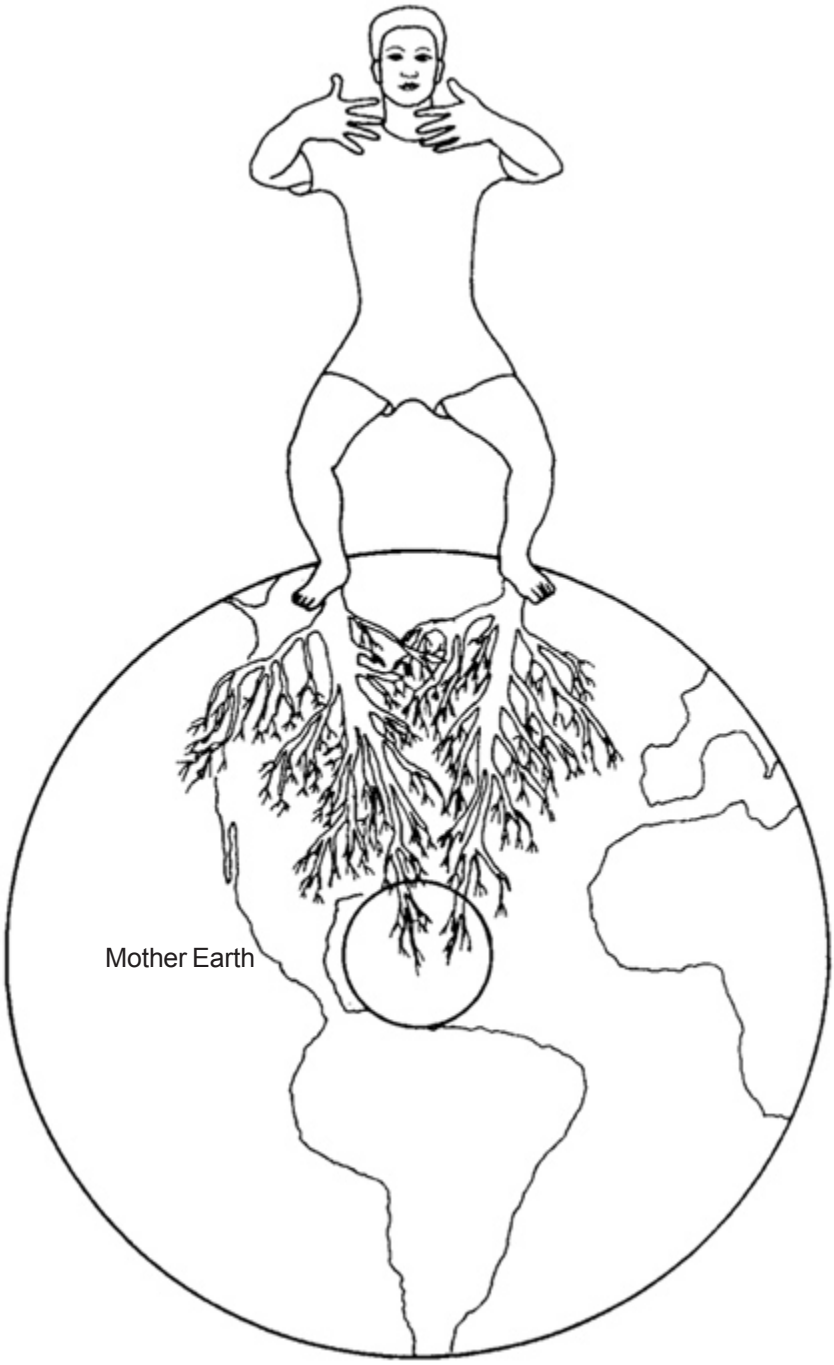

Fig. 3.35 *Hooking up to Mother Earth's inexhaustible sources of energy.*

At the end of each stage, once you have finished packing the Chi, standing or holding yourself still and relaxing the muscles of the whole body are very important. You should hold this position for as long as you can or have time to hold it, gradually increasing the time, if possible. Using the Iron Shirt Chi Kung Packing Breathing has created a tremendous Chi pressure and you can now use your mind to condense and direct the flow. (Fig. 3.36) At this point, you will fully feel the energy flow in the Microcosmic Orbit. Use your mind to direct the energy up and down, flowing from finger to finger, down the legs and back up.

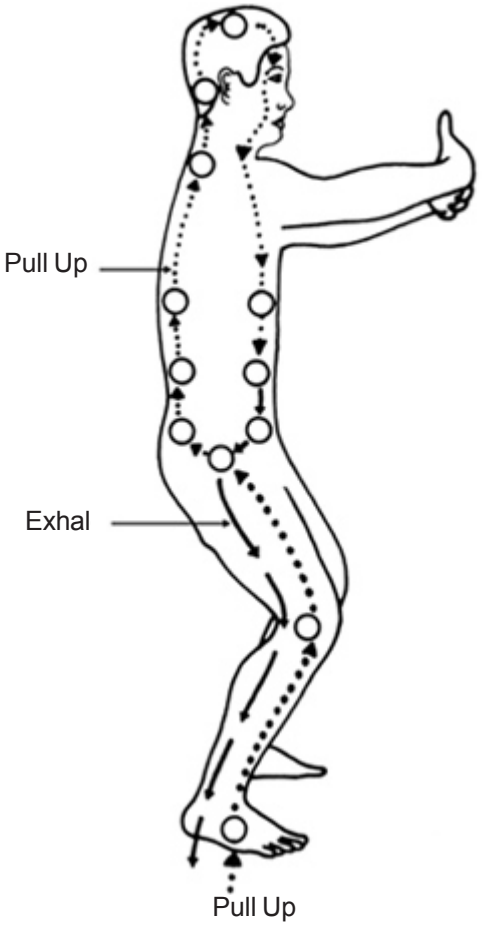

Stand still. Relax the whole body and direct the Chi flow.

Fig. 3.36 *Direct the Chi flow.*

In the beginning it seems that you are very tense and nervous when you practice Iron Shirt, the way you felt when first learning to ride a bicycle. However once you are trained and know how to move and pack the energy, you use more structure and mind control with confidence and less muscle.

Each time you finish a stage and are not proceeding to the next stage, you must collect the Chi in the navel. Stand up straight, touch the tongue to the palate, and put the palms over the navel. Men put the right palm over the navel, covering it with the left palm. Women put the left palm over the navel, covering it with the right palm. (Fig. 3.37) Concentrate on the navel for a while, feeling the energy that is generated by the Chi Kung. As you are standing, practice the Bone Breathing Process described below.

Practice the first stage for a week or two, until you can master moving the Chi from the navel to K-1 at the soles of the feet and master palm and sole breathing, and then proceed on.

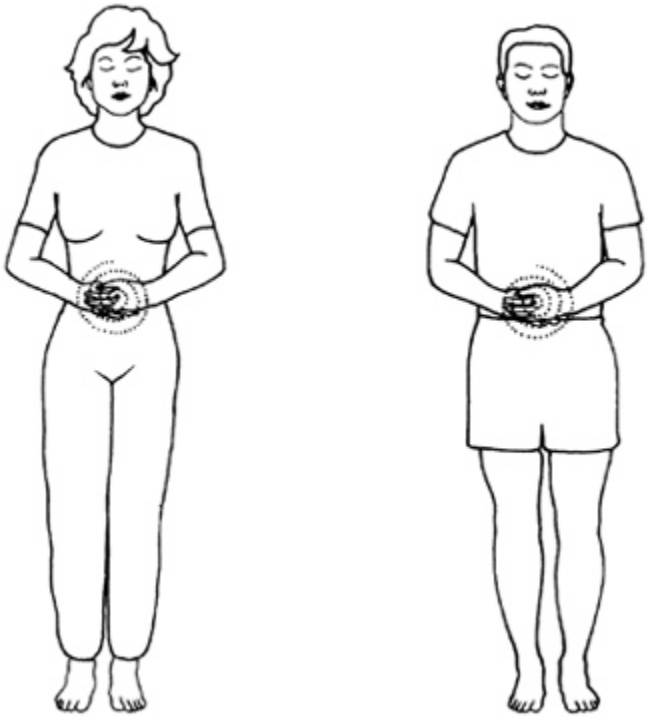

Woman places the right palm over the left. Man place the left palm over the right.

Fig. 3.37 *Place the palm over the navel and collect the Chi.*

8. Second Stage

Begin with the First Stage and continue as follows:

a. Press the soles of the feet to the floor so that they seem to adhere to it by suction. The toes are part of a tendon line and, as such, are part of an energy flow line. To take advantage of this fact, press and clamp all of the toes firmly to the floor but do not allow them to bulge up. When concentrating on the soles, you may find that they grow warm or feel cool. Inhale ten percent and coordinate with the breath, sucking the earth energy into your soles. Inhale ten percent using the Packing Process breathing technique described in the First Stage. (Fig. 3.38) Pull the energy up to the sexual organs and the urogenital diaphragm, the pelvic diaphragm, the left and right anus, the kidneys (Fig. 3.39) and the lower diaphragm. Feel as though you are sucking the earth. Feel the earth energy begin to enter the soles and move up the leg bones to the knees. The earth energy can feel cool or sometimes tingling. Some people feel warm.

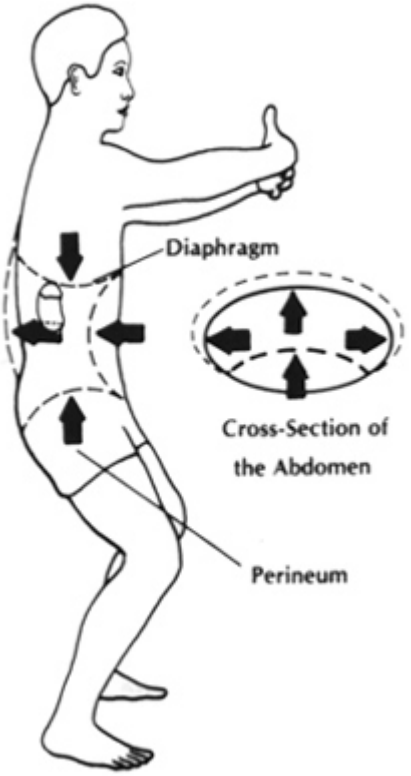

Fig. 3.38 *Pull and lower the entire diaphragm.*

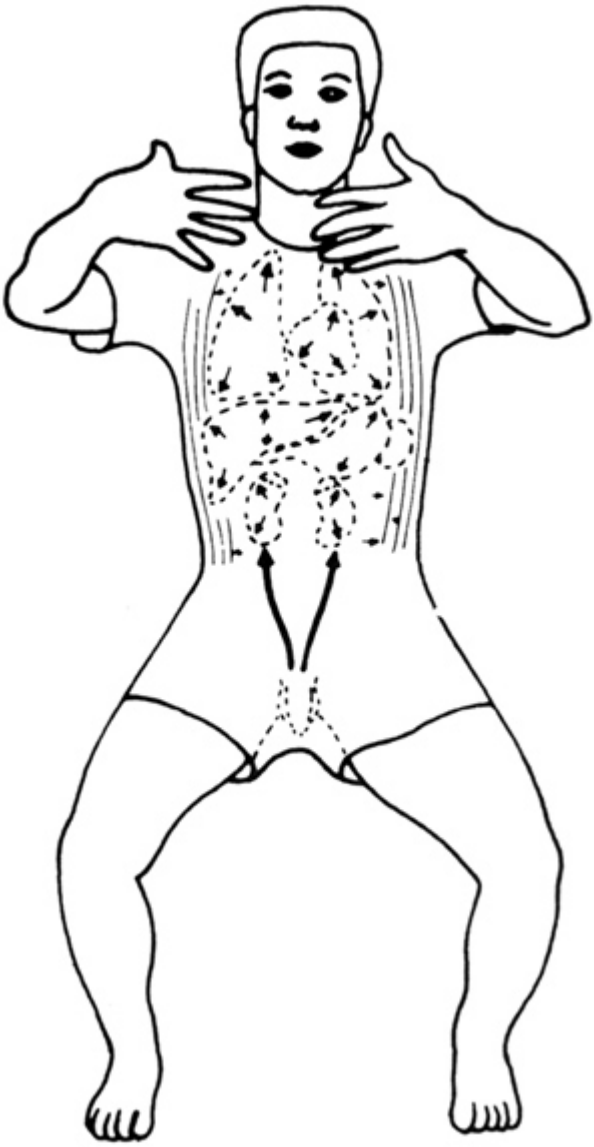

Fig.3.39 *Pull the energy up from the anus to the kidneys.*

b. Using your K-1 center in the soles of the feet as a hub, circle nine times clockwise out from the middle to a distance of three inches, and then nine times counterclockwise back to K-1. (Fig. 3.40) Again, use the mind, coordinating with eye movements, to help circulate the energy.

Inhale ten percent and press the soles of the feet firmly into the Earth.
Claw the toes and circulate the energy nine times.

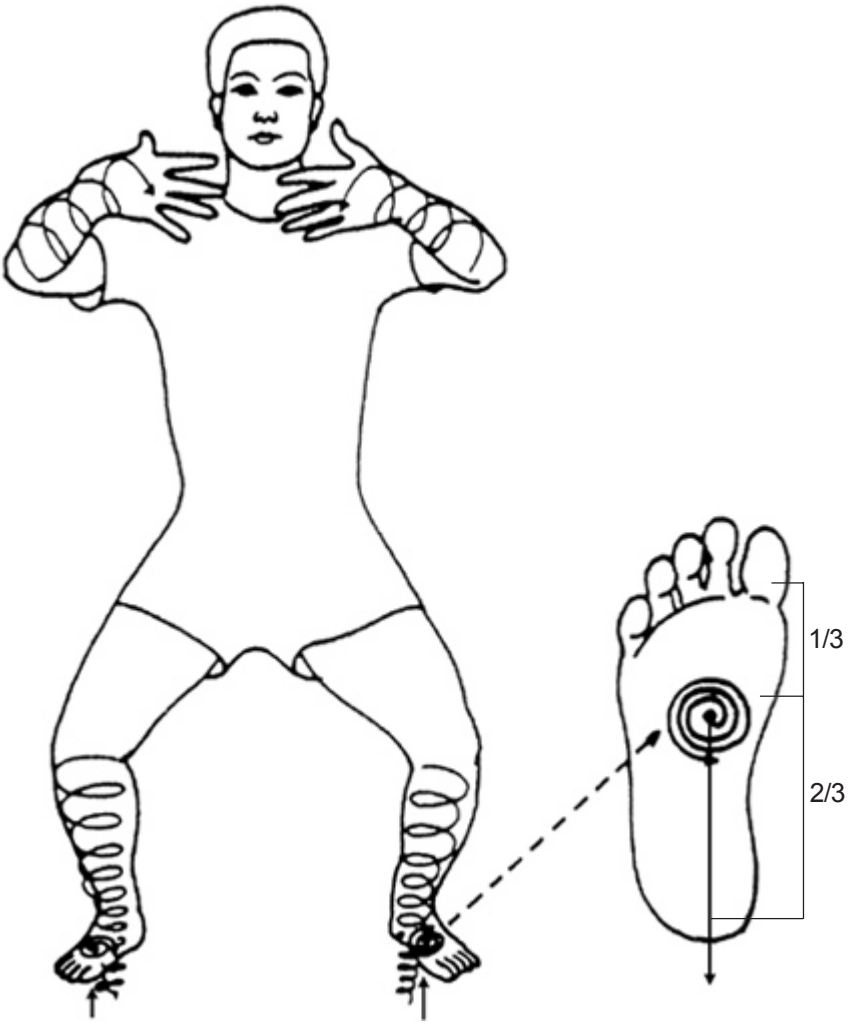

Fig. 3.40 *Use the K-1 center in the soles of the feet as a hub.*

c. Inhale and bring the energy up out of the big toes to the knees. Lock the knee cap and tighten the legs by turning the knees outward with the feet firm. (Fig. 3.41(a)) Feel the legs like screws being screwed into the ground. (Fig. 3.41(b)) Imagine someone pushing the knees in while you try to push outward. Slightly pull the knees outward and feel the outside force push in. This action will join the sacrum with the knees, and the knees with the ankles and the feet. This also activates and aligns all the lower part tendons together Remember that the feet point in and the knees push slightly outward. Concentrate on them until you feel energy collect there. Do not circulate the energy at this point.

When you feel the urge to breathe you can exhale a little bit. Exhaling and inhaling are very personalized; therefore, each person must adjust to his or her own needs.

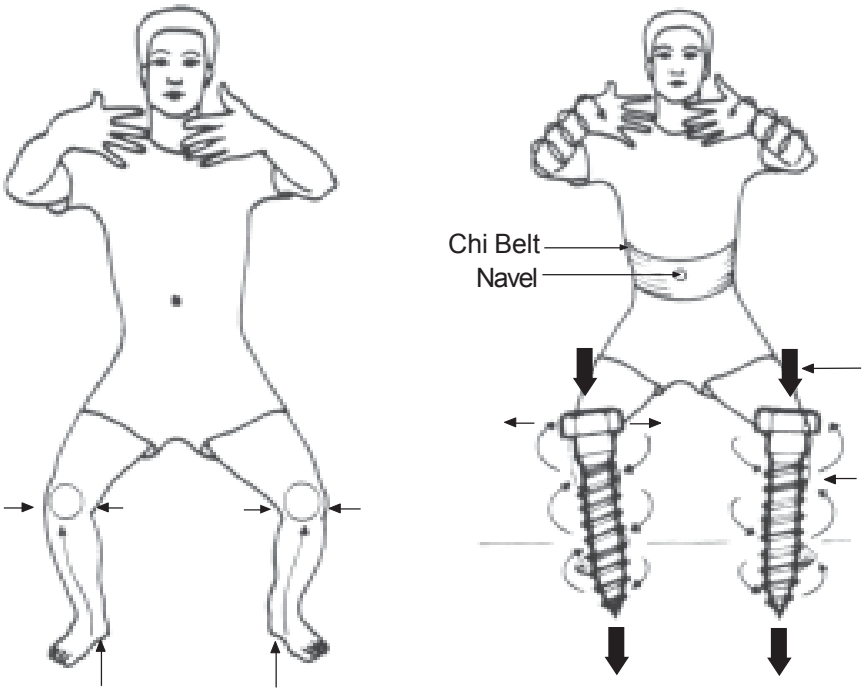

(a) Inhale twenty percent and bring the energy up to the knees. Lock the knees.

(b) Press down and turn the knees outward to screw the force into the ground.

Fig.3.41 *Screw the force into the ground.*

d. (1) Inhale ten percent, coordinating the breath with pulling in the sexual organs and anus, thereby bringing the energy up your knees to the buttocks and then to the perineum (Hui Yin). At the same time, feel the energy as it is drawn from the earth enter the soles of the feet and rise to the knees and perineum. Inhale and pack more in the perineum. Use your eyes to help circulate the Chi energy nine times clockwise and nine times counterclockwise in a three inch diameter at the perineum. (Fig. 3.42)

Increasingly send energy down to the Hui Yin from the navel and continue to feel it come up out of the legs. In time, it may seem as though there is a flow as of water entering the Hui Yin from above and from below moving up and down as though through a pipe. It might also become evident why the K-1 points in the soles of the feet are referred to as the “Bubbling Springs”.

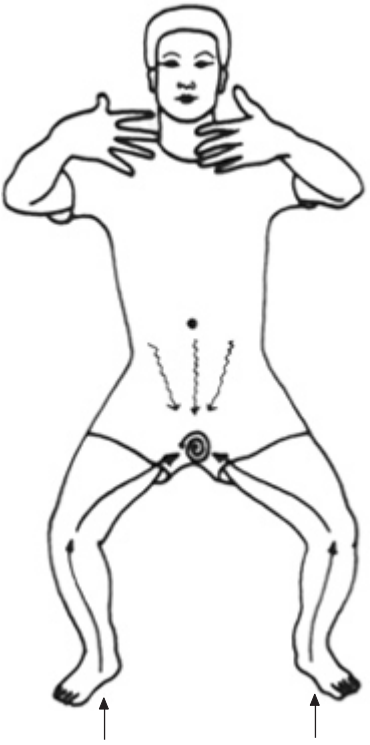

Pull the sexual organs and anus in. Inhale ten percent up to the perineum. Circulate the energy nine times clockwise and nine time counterwise.

Fig. 3.42 *Draw the energy from the earth and pack and circulate it in the perineum.*

(2) Exhale and normalize the breath by Energizing Breathing. (Fig. 3.43) Relax and collect “loving energy” from all of the organs. To create the loving energy you can start your smile in the eyes. Bring that smile down the face, slightly lifting the corner of the mouth, and keep on smiling inwardly to the organs: the heart, lungs, liver, pancreas, spleen, kidneys and sexual organs. (Fig. 3.44)

Remember standing or holding yourself still at this point and relaxing the muscles of the whole body are very important. Feel the energy flow in the Microcosmic Orbit. (Fig. 3.45) Remember also that after each stage, if you are not proceeding to the next stage, you must collect the Chi in the navel. Stand up straight, touch the tongue to the palate, and put the palms over the navel. Men put the right palm over the navel, covering it with the left palm. Women put the left palm over the navel, covering it with the right palm. (Fig. 3.46) Concentrate on the navel for a while, feeling the energy that is generated by the Chi Kung. As you are standing, practice the Bone Breathing Process described below, which has just been described above as the First and Second Stages then proceed to the next stage.

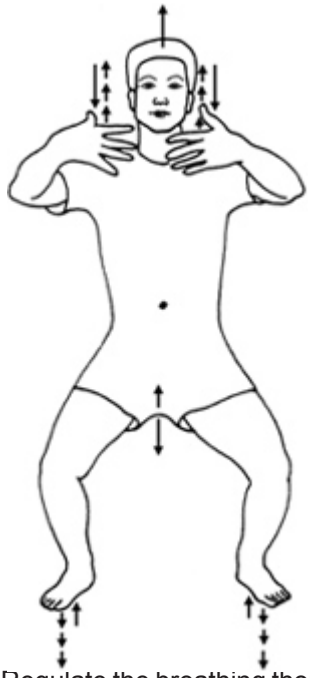

Exhale and Inhale. Regulate the breathing though the palms and soles.

Fig. 3.43 *Energizer Breathing*

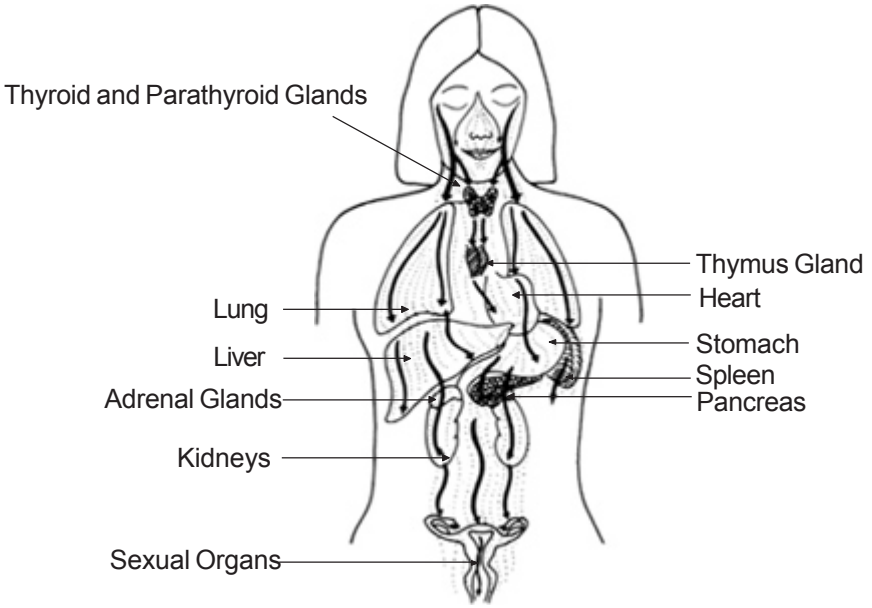

Fig. 3.44 *Smile down to the organs.*

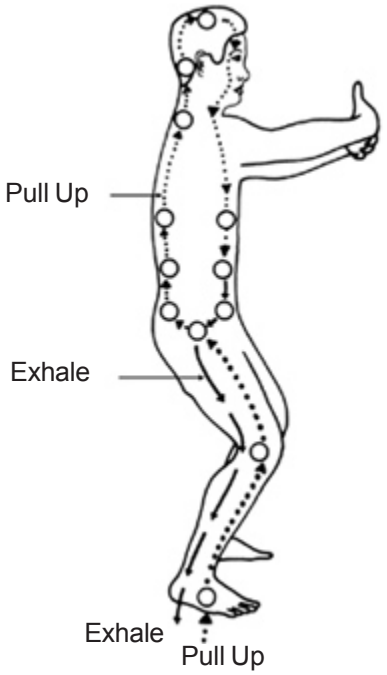

Fig. 3.45 *Stand still in Embracing the Tree position and feel the energy flow in the Microcosmic Orbit.*

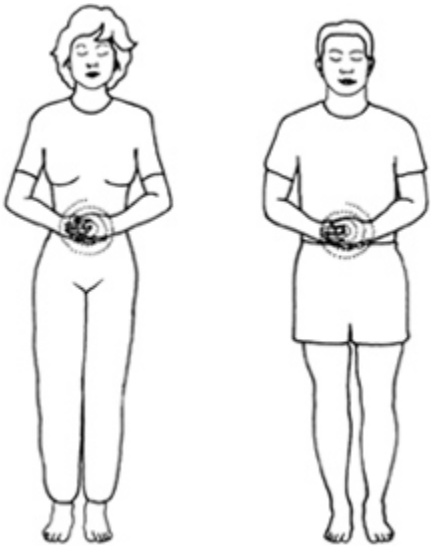

Woman places the right palm over the left.

Man places the left palm over the right.

Fig. 3.46 *Place the palms over the navel to collect the energy.*

9. Third Stage

Begin by repeating the First and Second Stages, then proceed as follows:

a. After you have normalized the breath, exhale and flatten the stomach. Inhale ten percent using the Packing Process Breathing as described in the First Stage. Inhale up the front and middle of the anus, and at the same time, pull up the back part of the anus so that you can direct the Chi into the sacrum, (Fig. 3.47 (a) and (b)) Put pressure on the sacrum by pressing tightly to the ground and tilting the sacrum back without moving the hips. This will activate the sacral pump. (Fig. 3.48) You can practice this by putting your back to the wall and pressing the sacrum to touch the wall, as described in Section I of this Chapter. Do this gradually and do not force it. In gradually developing the psoas muscle, as well as the hip and sacrum tendons and muscles, you will be able to move the sacrum separately. (Fig. 3.49) By this movement, you are activating the sacral pump to help increase the spinal fluid and to open the sacrum for the Chi to enter This will greatly increase the circulation of spinal fluid. When you can master this, you will no longer need the wall. Use wall alignment in practicing Embracing the Tree.

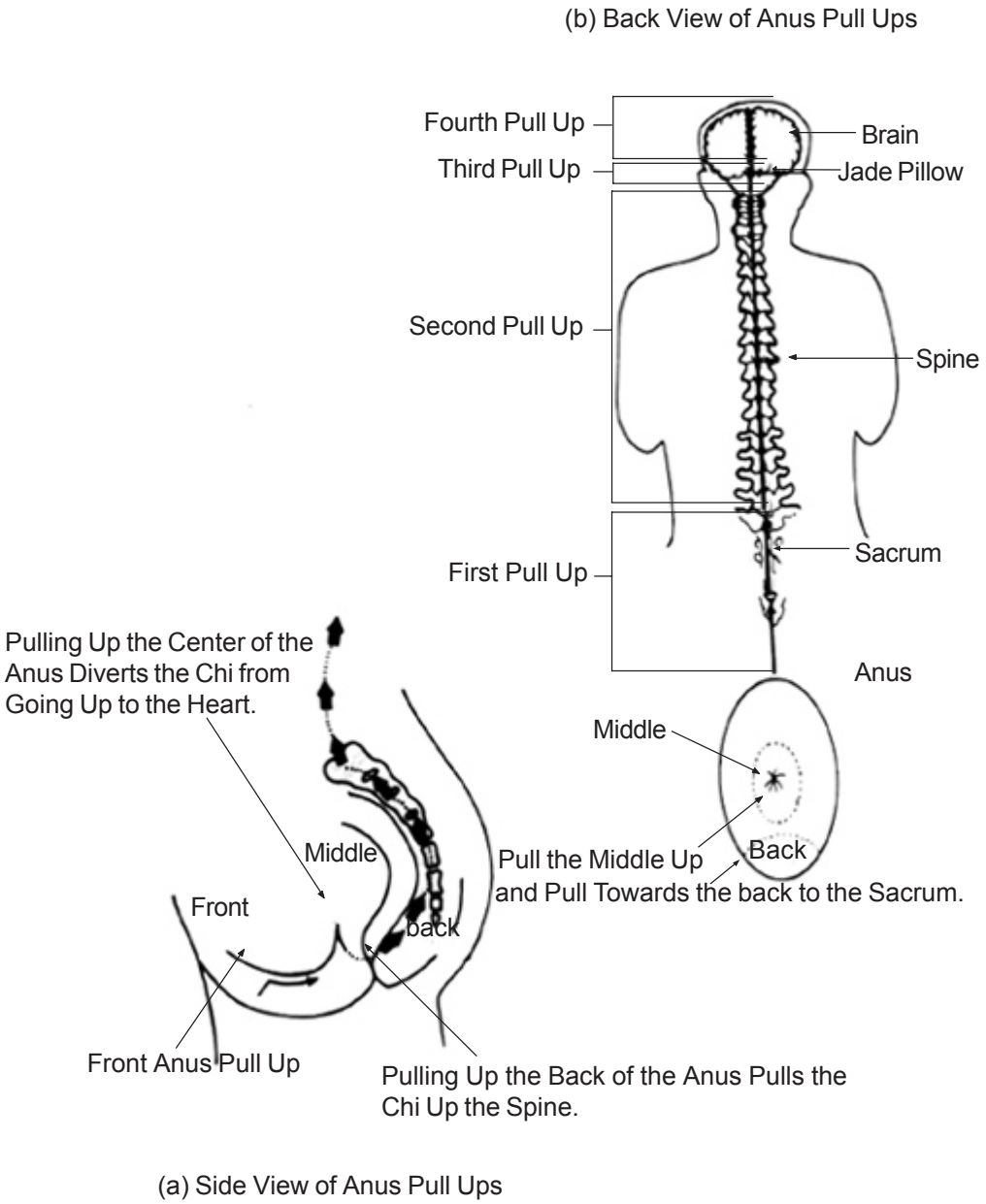

Fig. 3.47 *Direct the Chi into the sacrum.*

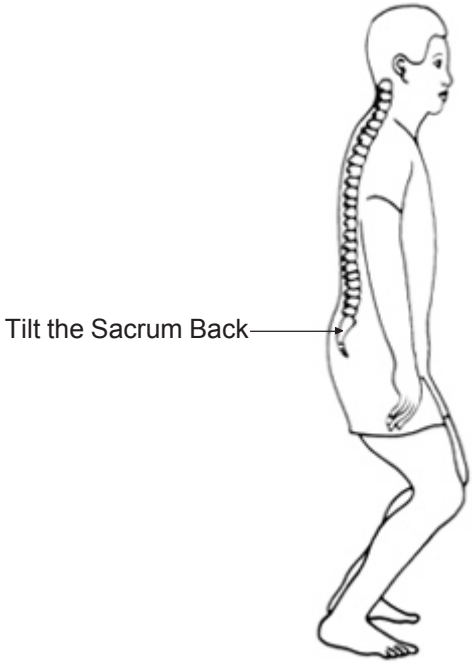

Fig. 3.48 *Activate the sacral pump.*

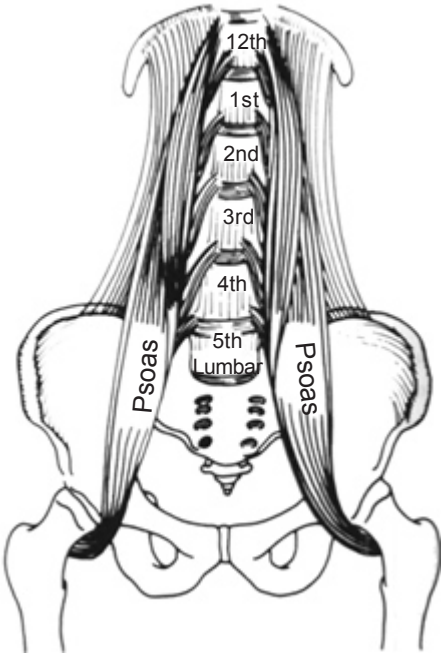

Fig. 3.49 *Sacral tilt will help develop the psoas muscle.*

b. (1) Bring more energy (kidneys' energy) up from K-1 on the soles of the feet to the coccyx and to the sacrum. Inhale, pulling up the left and right anus and the back part of the anus. Pull up toward the coccyx and up to the sacrum, packing Chi to the kidneys. (Fig. 3.50(a)) Feel the back area surrounding the kidneys bulge out. Concentrating here, tilt the sacrum and circle the energy out at the sacrum from that point first nine times clockwise to a distance of three inches, and then nine times counterclockwise back to the sacrum, using the eyes to help direct the circulation. (Fig. 3.50(b)) Feel the collection of the Chi there.

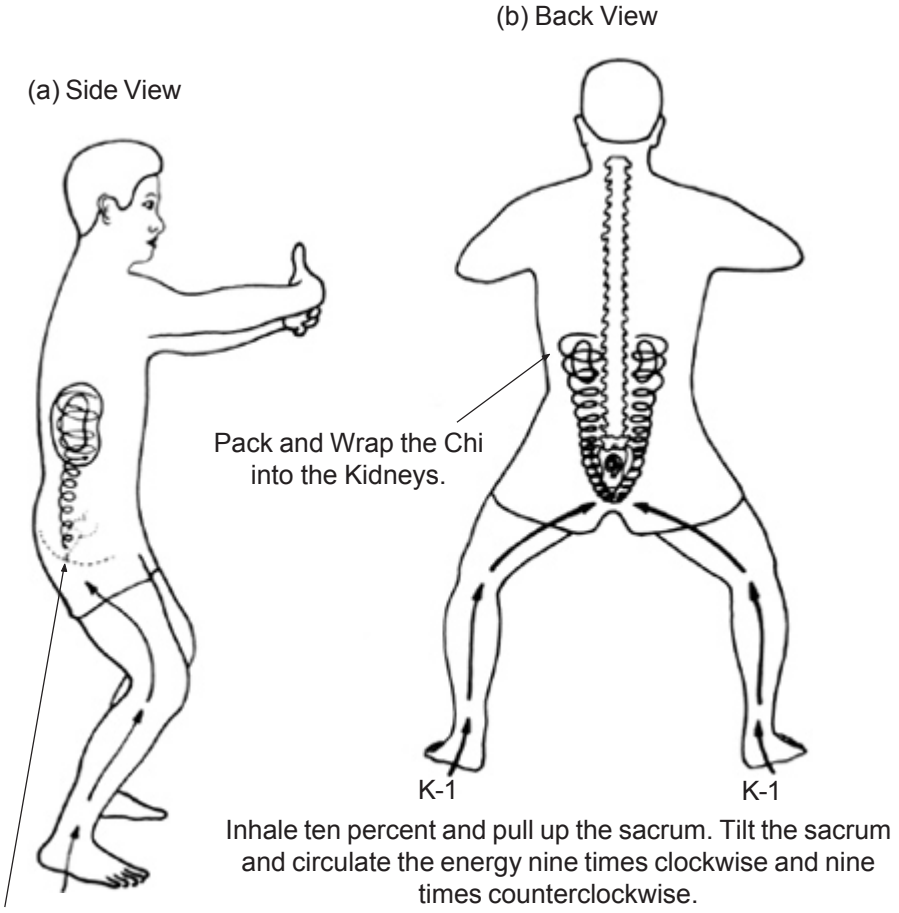

Use the Anus to Pull Up the Energy into the Kidneys.

Fig. 3.50 *Pack and wrap the Chi into the kidneys.*

The Chi feeling is reported differently, even by the same practitioner at different times. There can be a range of feelings such as hot or cold, or pricklings, vibrations, numbness or a combination of all of these and other sensations. The effect is identifiable as something which is not ordinarily experienced. There might be pain or extremes of sensation. This part of the practice should take one or two weeks.

I feel that it is necessary to stress that in this system you must realize that what you experience is very real. There are no visualizations or acts of the imagination here. You actually feel energy accumulate and then go from place to place because it really does. In some people it takes off on its own and goes through the very same routes and stopping off places that would have later been prescribed. If this happens to you, it is extremely convincing and is thereafter self-evident that there really is Chi and that all one needs to do is follow.

(2) When you feel Chi in the sacrum, inhale ten percent and pull the Chi up to T-11, tilting the T-11 (the adrenal glands, Chi-Chung, CO-6) back. (Fig. 3.51(a)) This will push the lower back and straighten the curve. Again, use the wall as a guide. Do not force your spine, but gently ease it until you feel the spine becoming straight. This will open the Door of Life Center (Lumbar 2 and Lumbar 3) opposite the navel. The pumping action will increase as the spine straightens, pulling like a pipe or bow and the Chi will flow easily as if through a straight pipe. With the lower back pushed and the curve straightened, you will be stretching the psoas muscle very strongly. This will help to strengthen the lower back tremendously Connect the sacrum and the C-7 into one pipe or a bow. Bring the Chi to T-11, concentrating at this center, and circle the Chi outward clockwise to a distance of three inches. Do this nine times and then circle back nine times down to that center in a counterclockwise direction, finally concentrating it there. (Fig. 3.51(b)) It can take you from less than a week to more than three weeks to develop to the point where the sacrum and the T-11 fuse into one channel.

It is important to remember that each time you start to inhale and pack, you must start at the navel, gather the Chi, and bring the energy gathered there to the Hui Yin. Then, push the energy to the ground. Bring it up from the soles to the Hui Yin, and mix it with the energy already brought down from the navel before going on to the coccyx, T-11 and up. As you continue to practice in this way, the whole procedure will take less and less time until it finally becomes simply moments.

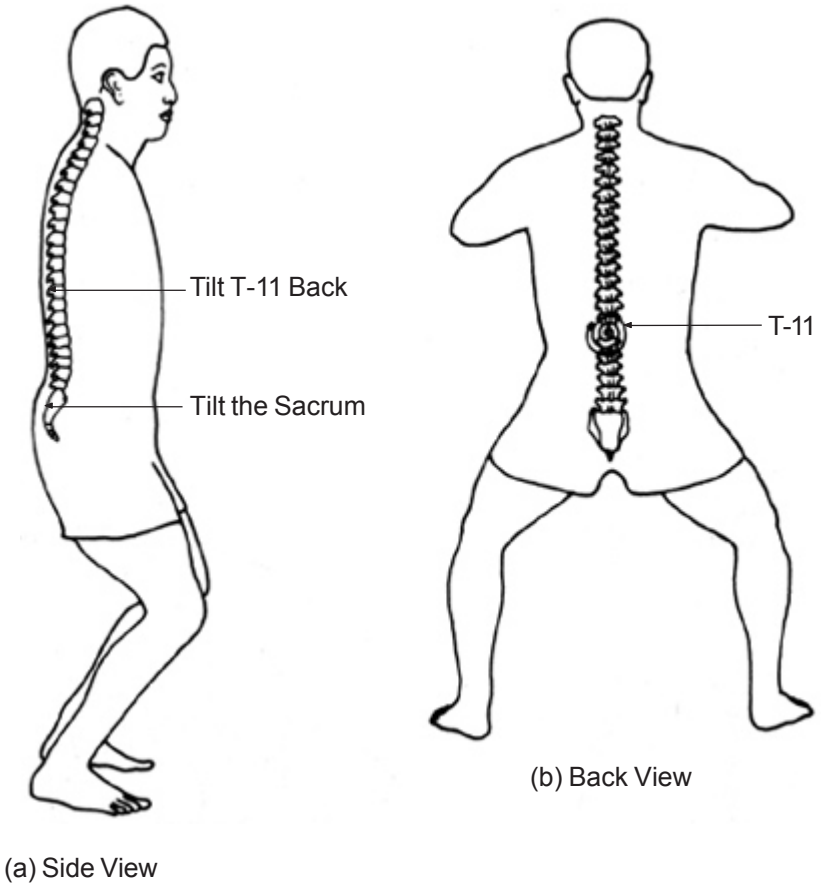

Inhale ten percent up to T-11. Tilt T-11 back and circulate the energy nine times clockwise and nine times counterclockwise.

Fig. 3.51 *Tilt T-11*

c. Inhale and pull the Chi from the T-11 up to C-7. (Fig. 3.52) Push from the sternum to tilt the C-7 back. Tuck in the chin, clench the teeth (Fig. 3.53(a)), squeeze the temples (Fig. 3.53(b)) and the occipital bone, and press the tongue firmly to the roof of the mouth. (Fig. 3.53(c)) This will create a tension similar to the tension of the arched bow discussed previously which is ready to release an arrow. (Fig. 3.54(a)) The whole neck will be connected to the spine and sacrum, and to the legs and heels. (Fig. 3.54(b)) As the energy moves up from the sacrum to C-7, the major push of internal force occurs. (C-7, T-11 and the sacrum are known as the “stations of

internal force".) Once you can develop and feel the force in the C-7, you will be able to exert the force. This entire process is called self-adjustment of the cranial pump and will activate the cranial pump. (Fig. 3.55) The action of the cranial pump will greatly increase, thereby increasing brain power as well. Circle nine times clockwise and nine times counterclockwise at C-7. Feel the Chi energy join the scapulae, the arms, and the hands and fingers together. You will feel the Chi start to flow from the thumb and fingers of one hand to the thumb and fingers of the other hand, like a jumper cable. Use the eyes to look at the thumbs and direct the Chi to that point.

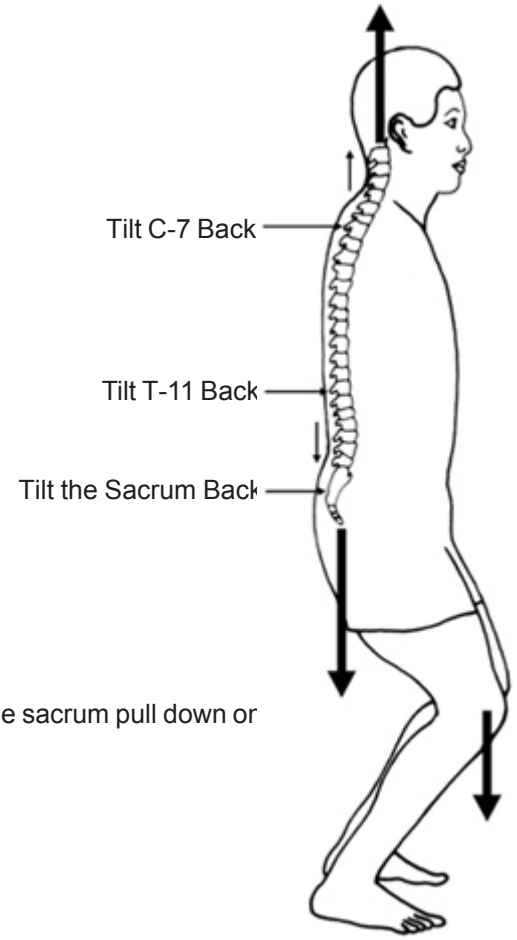

Fig. 3.52 *Pull the Chi from T-11 up to C-7.*

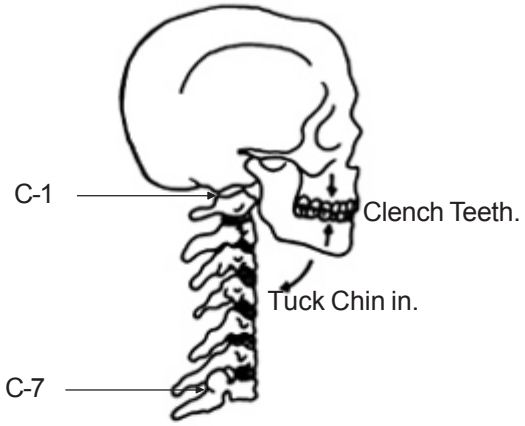

(a) Clench the teeth. Sink the chin in.

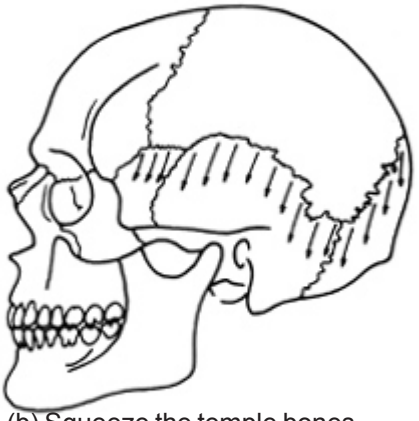

(b) Squeeze the temple bones.

(c) Press the tongue firmly to the roof of the mouth.

Fig. 3.53 *Locking the Head*

(a) Creat a tension similar to a fully arched bow.

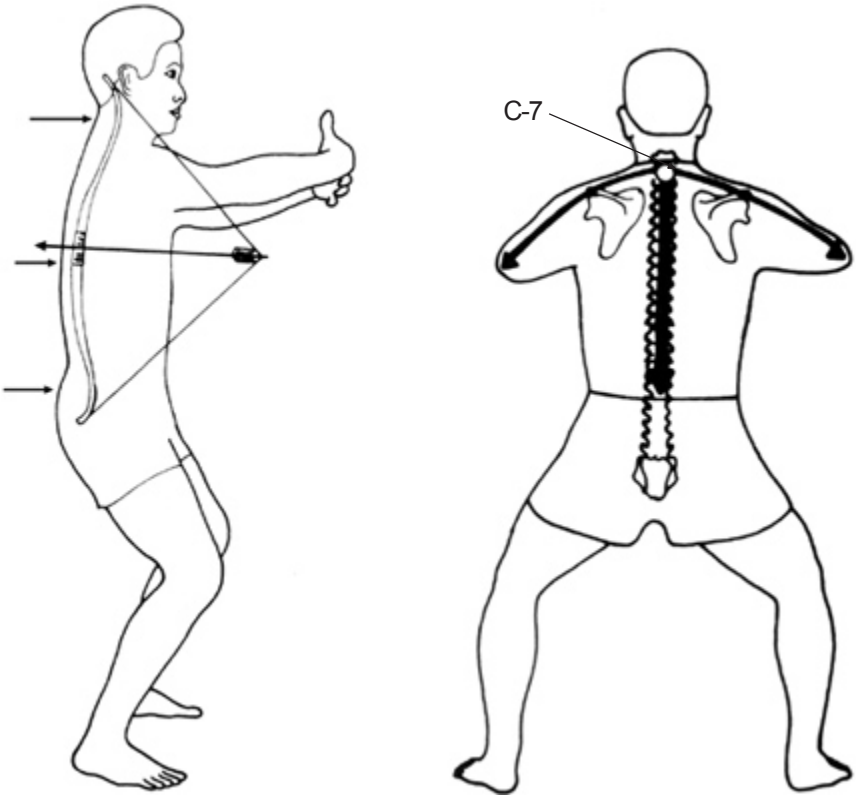

(b) As you push from the sternum to C-7, the spine and shouders will connect.

Fig. 3.54 *Spine Alignment*

d. If you are out of breath or cannot go on, exhale a little bit and then inhale again. If you cannot do this, you can simply exhale and bring the Chi up to the crown, omitting the Yu Chen (Jade Pillow, BL-9 or Base of the Skull). If you can continue, bring the Chi up to the Yu-Chen and circle it nine times both clockwise and counterclockwise as you did at the points previously described, until you feel that Chi has developed there. (Fig. 3.55)

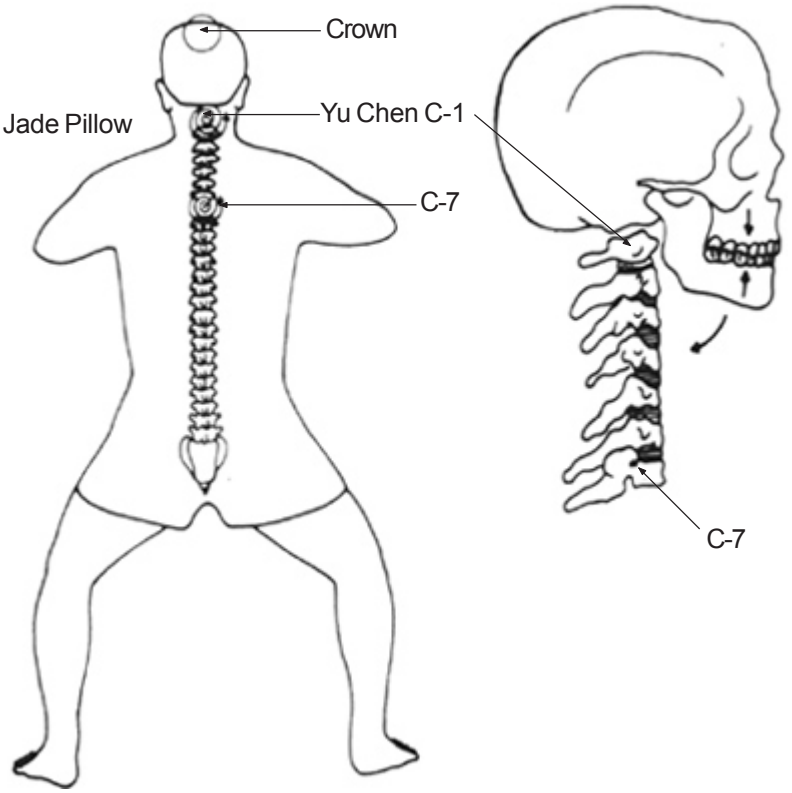

Inhale ten percent up to C-7. Tilt the neck back and circulate the energy nine times clockwise (to the left) and nine times counterclockwise(to the right.) Inhale again and bring the energy up to C-1 at the base of the skull. Circulate nine times counterclockwise. Inhale and bring the energy to the crown.

Fig. 3.55 *Self-Adjustment of the Cranial Pump*

e. Inhale and pull the Chi up to the crown (Fig. 3.55), the seat of the pineal gland located at the top of the head, by looking up with your eyes. (Fig. 3.56(a)) Concentrate on the Pai Hui at the crown and circle it again nine times clockwise and nine times counterclockwise, using your mind and your eyes, until energy is experienced there. (Fig. 3-56(b)) Feel the energy flow from the sacrum to the Door of Life, to T-11, to C-7, to the occipital bone, and to the crown as they become fused into one channel and linked together. If you are out of breath, you can pull up and exhale. Normalize your breathing.

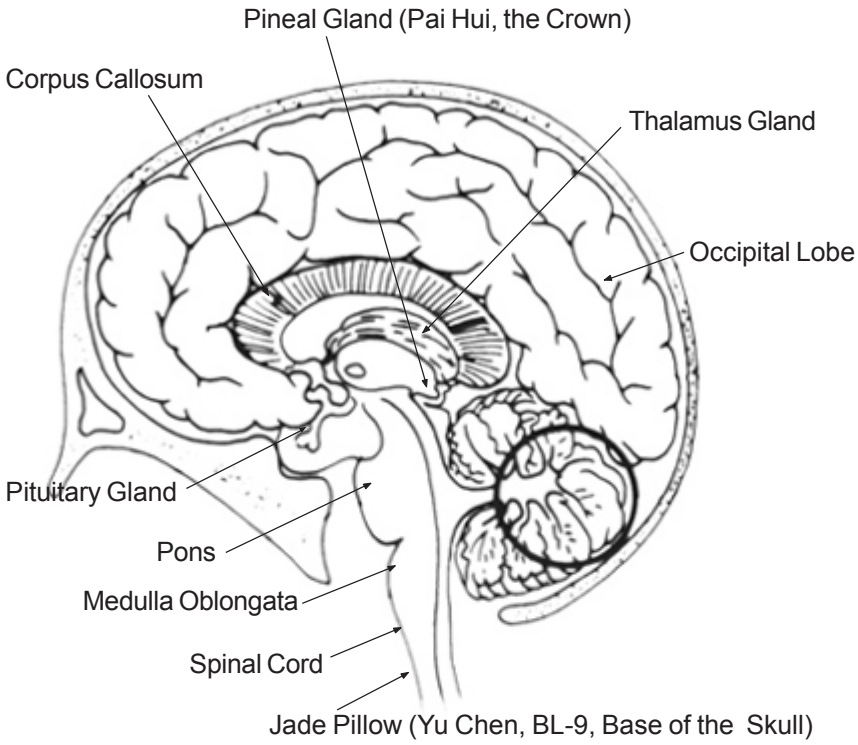

(a) Location of the Pineal Gland

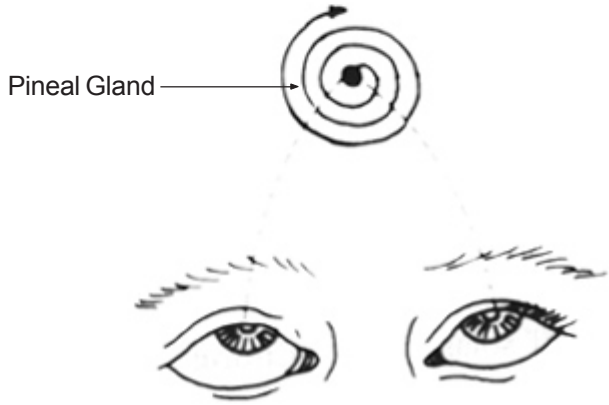

(b) Look up to the pineal gland and circle the enerrgy nine times clockwise.

Fig. 3.56 *Circle the energy in the pineal gland.*

f. Make sure that the tongue is up on the roof of the mouth. (Fig. 3.57(a)) Bring the energy down to the mid-eye, concentrating there for a while while practicing normalized breathing, until you feel the energy build up. (Fig. 3.57(b)) Then bring the energy down to the palate where the tongue will serve as a switch joining the Governor Channel to the Functional Channel. Bring the Chi down to the throat, heart center and solar plexus (Chung Wan, CO-12), circling it nine times in both directions, until you feel energy enlivened there again. (Fig. 3.57(c)) Use the eyes to help in this circulation.

Mid-Eye, Third Eye, Pituitary Gland

(a) Tongue is on the roof of the month.

(b) Bring the energy down to the third eye.

(c) Bring the energy down to the solar plexus.

Fig. 3.57 *Functional Channel*

g. Finally bring the energy to the navel. (Fig. 3.58(a)) Concentrate there until you feel Chi freely go down to it. Listen and look inside. Feel the sensation of the flow of Chi in one circulating motion from the navel to the perineum, to the soles, up to the knees, to the perineum again, and up to the sacrum, to the spine, to the crown and down to the third eye, to the throat, to the heart and to the navel. (Fig. 3.58(b)) When you feel the circle is moving well, simply let it flow by itself. Feel the navel warm and fill with Chi.

(a) Bring the energy down to the navel.

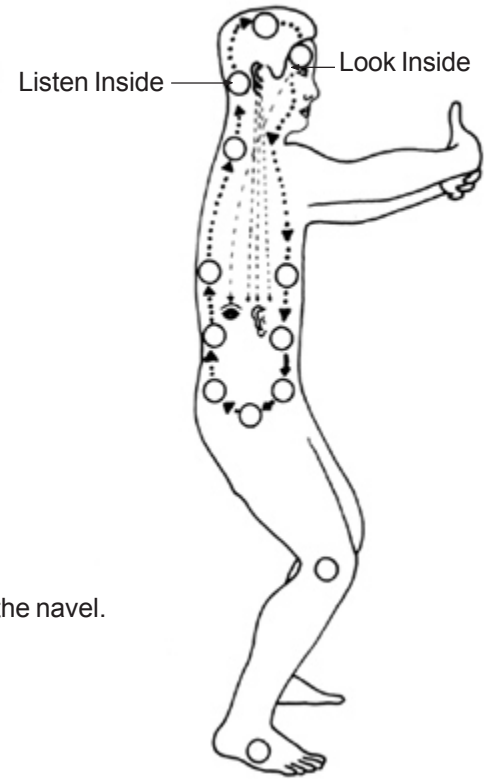

(b) Feel the sensation of the flow of Chi.

Fig. 3.58 *Microcosmic Orbit*

Remember as you complete the final stage to stand still and relax all of the body's muscles, holding this position for as long as possible. Simply standing and experiencing this powerful energy flow for ten to fifteen minutes will shorten the time necessary to master the Iron Shirt techniques by as much as one to three hours. You have created a tremendous Chi pressure and your mind will condense and direct the flow. Feel the energy flow in the Microcosmic Orbit.

Stand up straight, continue to touch the tongue to the palate, and put the palms over the navel. Men put the right palm over the navel, covering it with the left palm. Women put the left palm over the navel, covering it with the right palm. (Fig. 3.59) Concentrate on the navel for a while, feeling the energy that is generated by the Chi Kung. As you are standing, practice the Bone Breathing Process described below.

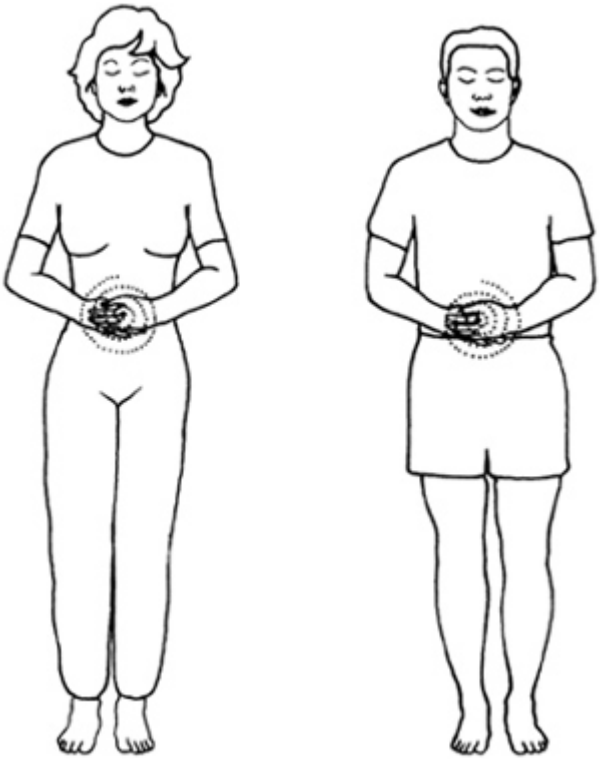

Woman places the right palm over the left. Man places the left palm over the right.

Fig.3.59 *Stand up straight and put the palms over the navel.*

10. Bone Breathing Process

a. The Bone Breathing Process is practiced immediately after you finish the First Stage, the Second Stage and finally, after the Third, and final, Stage of this exercise, to bring the energy down to the navel. At this time, your body is still filled with energy. To practice the Bone Breathing Process you can use Embracing the Tree or any position that you are in at the time.

Bone Breathing or bone compression is the method of "Cleansing the Marrow", or cleaning out fat in the bone marrow so that you can direct and absorb the creative (sexual) energy into the bone to help regrow the bone marrow. (Fig. 3.60) During this process, we take advantage of the Chi generated in Iron Shirt I by absorbing Chi into the bones, thereby greatly increasing the circulation of Chi. With increased circulation, the Chi is permitted to flow freely into the bones and the blood, carrying necessary nutrients and oxygen, and is permitted to circulate freely throughout the body. Tension in the muscles surrounding the bones is lessened. The bones become strong and healthy because the marrow as the major product of red and white blood cells, now has room to grow.

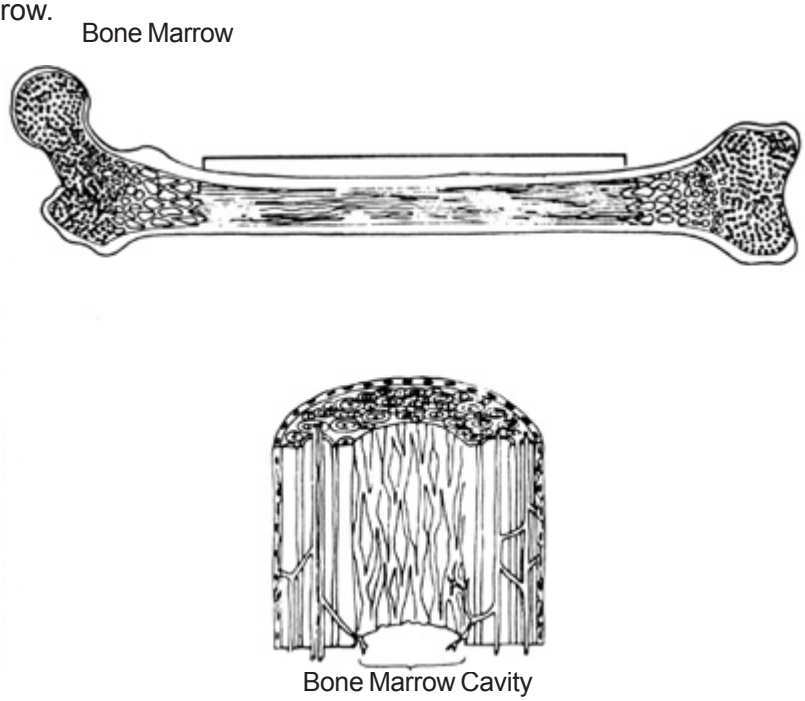

Fig. 3.60 *Bone Marrow*

This process takes time to practice. It is most important that you relax and are not tense when you practice Bone Breathing.

Bone Breathing is a two stage process:

1) Inhale and exhale as though through the fingers and toes: In the first stage of the Bone Breathing Process, by using the powers of the mind and the eyes, outside energy is breathed in through the fingertips and toes, gradually up to the hands and arms to the skull, and then down the spinal column and legs. (Fig. 3.61) A sensation is felt as you breathe into each area. Some people report a numbness, others a fullness, still others a tingling, or "something different" in their bones. Many people claim to feel more in their legs. When you inhale through the fingers, the feeling is cool. When you exhale, the feeling is warm. Feel inside the bones. No matter what you feel, Bone Breathing is practiced to cleanse the fat stored in the bone marrow to make room for positive energy such as creative energy (sexual power), which will allow the bones to store, rebuild and grow the marrow.

(2) Inhale and exhale the same way through the toes: In the second stage, inhale through the toes and then, by degrees, inhale up to and into the thigh bones. After inhaling, hold your breath, but not so long that you experience discomfort. Then, exhale down and out through the toes. In the next progression, inhale up through the legs and into the hips, then exhale down and out through the legs. When you have accomplished this, breathe in through the legs to the sacrum. Here, you may feel energy surge up through the back and throughout the entire nervous system. Breathe up the back; the breath will be quite long at this point.

Finally, while you breathe through the legs and up the back, also breathe in through the fingers, up into the arms and shoulders, through C-7 and into the head.

Keep in mind that energy is absorbed and ejected more effectively at appointed places such as the toes, fingertips, elbows, knees, sacrum, C-7, Door of Life, shoulders, or tip of the nose. (Fig. 3.62)

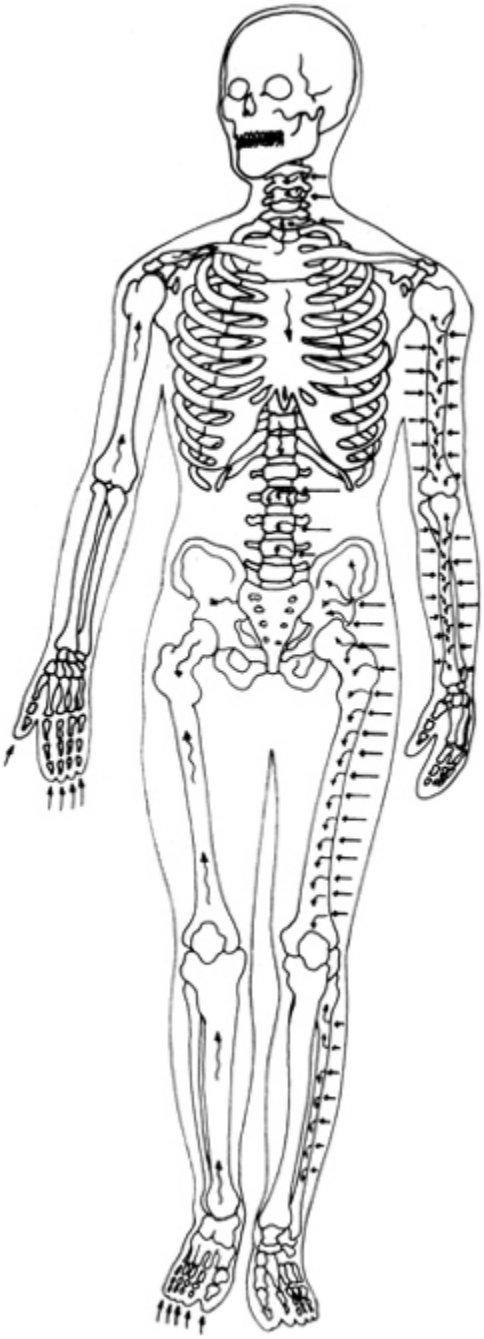

Fig.3.61 *Use the mind and eyes to breathe Chi though the fingertips and toes, up the arms and legs, and up the spinal column to the skull.*

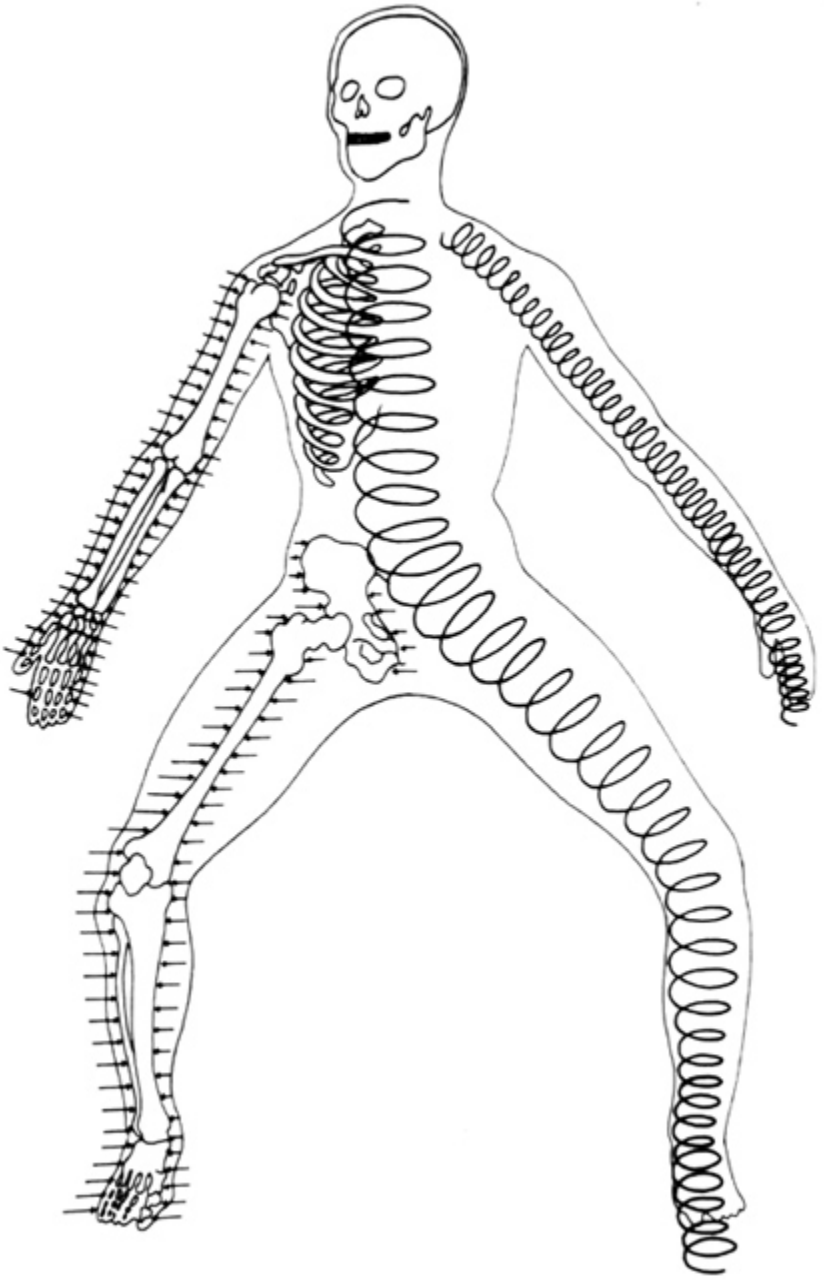

Fig.3.62 *In advanced techiques, you will learn to breath through the skin to push the Chi into the bones and wrap the Chi around the bones.*

11. Power Exercise

This exercise is another means of increasing the flow of Chi to the bones, squeezing out the toxins, sediment and waste materials, as well as the negative emotions that have become stored in the muscles. Muscles and the Emotions Stored within Them

In this stressful life, pollution and chemicals accumulate in the system, depositing in our organs. In the Tao System we believe that all negative and positive emotions are also stored in the organs. When the organs are filled with toxins, sediment, waste materials and too many negative emotions, these substances will back up into the muscle which handles the overflow of each organ, similar to a backup tank. If we do not squeeze the muscles by increasing the flow of Chi, thereby eliminating the undesirable elements and emotions which have been stored there, the muscles will be very tense and clamp onto the bones. As a result, the person will constantly have the feeling of stress.

Once the negative emotions are cleaned out, the positive emotions have more room to grow. Positive emotions make the muscles relaxed and loose. The explanation below gives details of muscles and the emotions that become stored there. This information is contributed by Larry Short, the founder of the Institute for Total Person Facilitation (T.P.F).

Muscles and Their Associated Negative/Positive Emotions

Hands
– Fear of losing grip
+ Belonging, reaching out

Forearms
Brachioradialis and forearm extensors/flexors
Correspond to Stomach—appropriate meridians
– Rejection
– Fear of attack
+ Acceptance
+ Recognizing the way to proceed

Scapulae
Correspond to Triple Heater
– Fear of taking risks; not willing

Upper arms
Correspond to Stomach and Spleen

Biceps and Triceps, Deltoids
Correspond to Lungs
– I can't do it
– Weakness, fear of lack of capacity
– Sorrow, loss
+ I can do it
+ Strength
+ Responsibility

–Fear Gluteus (Muscles of Buttocks)
– Disloyalty, lack of commitment

to take risks
– Cowardly
+ Vitality, radiant power, life-force, responsive action
+ Brave
SCM, Scaleanus, and Neck Muscles
Correspond to Stomach
Upper Trapezius Muscles
Correspond to Kidneys
– Guilt
– Fear turtle hiding
+ Responsive
+ Expressive
+ Taking risks
Feet
Correspond to Spine
– Insecurity
+ Taking a stand, projects, leaving your mark in the world
Lower legs, Calves
Correspond to Adrenals and Triple Heater
Gastrocnemias
Soleus
– Hesitation, fear of going forward, waiting
+ Setting the stage, preparing
Upper legs, quadriceps
Correspond to Small Intestines
distraction
– Lack of support
Hips, Psoas/Iliacus
Correspond to Kidneys
Jaw Masseter, Pterygoids
Correspond to Stomach
– Frustration
+ Knowing what you want and need
Occiput
Corresponds to Back of skull

+ Loyalty, commitment, letting go
Sacrum, Piriformis
Correspond to Circulation/sex
– Insecurity
+ Security,rootedness,rounded, stable
Lumbar spine, Sacrospinalis
Correspond to Bladder
– Fear of being taken advantage of and/or of being cheated
+ Ability, bravery, courage, ability to take charge of situation
Thoracic spine and rib cage, Spine
Correspond to Bladder
– Fear, cowardice, running away
+ Ability to perform
Ribs
Correspond to Lungs
– Sorrow and grief
+ Vitality, surrender, openness
Cervical spine
Corresponds to Neck extensors
– Inappropriateness, tiredness
+ Clarity
Skull
Corresponds to Breathing
Head
Corresponds to Temple
– Dullness, confusion,

+ Environmental awareness, being present, being here and now
+ Inspiration
– Dullness, worry
Sternum, Pectoralis muscles
Correspond to Liver
– Anger resentment
– Anger resentment

The Power Exercise, also known as Dynamic Tension, will greatly tone up the body muscles by simply a few minutes practice each day instead of an hour of workouts. (Fig. 3.63) In this exercise you evenly work out every muscle and will not overtire them. Studies have been made showing that the proper tension of these muscles for a few minutes each day will indicate that these exercises develop good muscle tone.

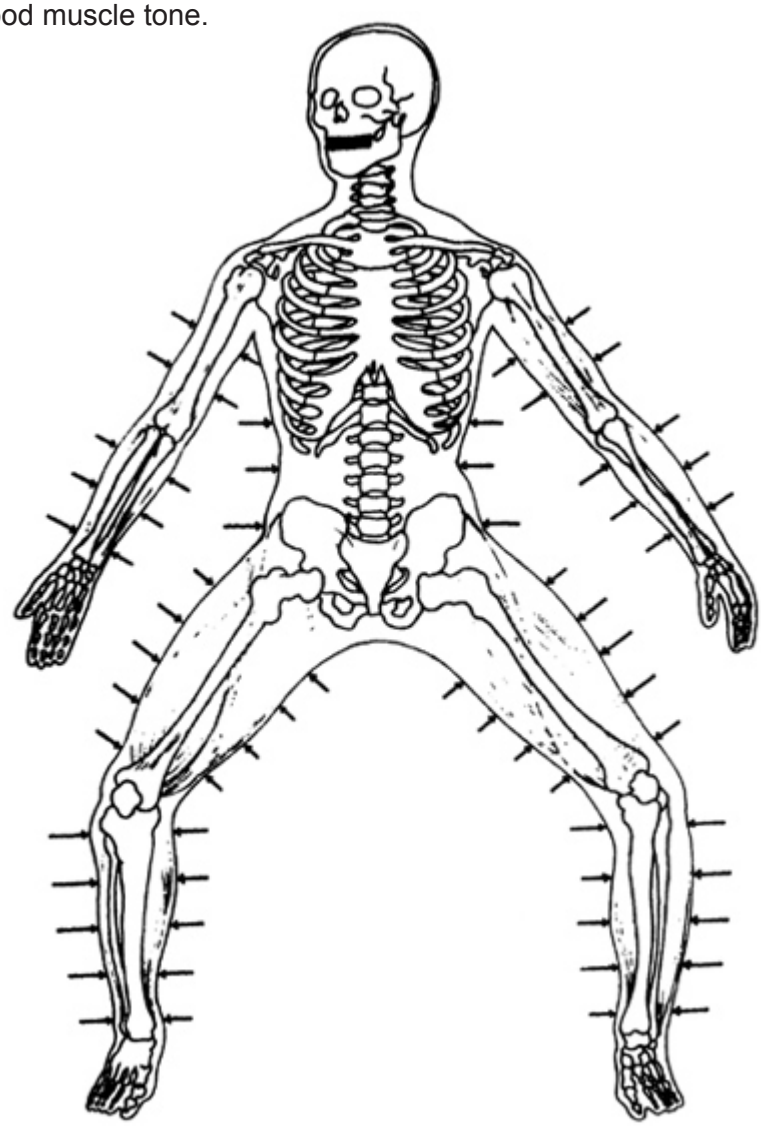

Fig. 3.63 *Dynamic tension tones up the muscles, permitting compression of muscles and bones.*

If you tire in the standing position, rest and walk for a while and then resume the same position practiced in Embracing the Tree, or you can simply continue from the Bone Breathing Process.

(1) Relax the hand muscles. Then, use the mind to tighten the hand muscles and squeeze the muscles to the bones of the radius and ulna (the bones of the forearm) tightly. Hold the muscles firmly to the bones for 30 to 60 seconds. Exhale strongly through the mouth, then totally relax the muscles and the shoulders. Feel the rush of Chi as the toxic tensions and negative emotions, such as fear of attack, leave the muscles. Feel the positive emotions, such as recognizing the way to proceed, letting the life-force enter into the muscles.

(2) Relax the arm muscles. Inhale and spread the arm muscles into the humerus (the bone of the upper arm). Tighten the muscles all around the arm. Hold them tightly for 30 to 60 seconds. Exhale and release them. Let go of the fear that you cannot do it. Let go of weakness. Release the feelings of sorrow and loss. Let positive emotions enter into these muscles. Feel that you can do it. Feel that you are strong, and that you have capacity and can take on responsibility.

(3) Relax the legs. Inhale and squeeze the muscles around the fibula and tibia (the bones of the lower leg) tightly to the bones. Hold them tightly for 30 to 60 seconds and exhale. Relax the muscles, letting go of the toxins and accumulated negative emotions such as hesitation and procrastination. Allow the positive emotions to enter such as preparedness or readiness to grow. Be totally aware of the Chi that is generated.

(4) Relax the thighs. Inhale and squeeze the muscles around the femur (the bone of the upper leg) tightly to the bones and hold for 30 to 60 seconds. Exhale and relax the muscles away from the bones. Release the feeling of lack of support; let the feeling of support grow. Be aware of the Chi flowing between the bone and muscle.

(5) Relax the neck. Inhale and squeeze the neck, the head muscles and the cervical (the neck) muscles tightly holding the squeeze for 30 to 60 seconds. Relax and let go of guilt and fear Feel the positive growth of expressiveness, responsiveness and taking risks.

(6) Relax the back, especially the spinal cord, and the chest. Inhale and tightly squeeze the muscles around the spinal cord from the thoracic vertebrae, down to the lumbar vertebrae to the sacrum

as well as the rib cage of the chest. Hold for 30 to 60 seconds. Release the entire spinal cord and the rib cage. Relax and let go of the fear of being taken advantage of or being cheated. Eliminate cowardice and the desire to run away. Release sorrow, grief and tiredness. Grow the positive feelings of bravery, openness and the ability to take charge and to perform.

(7) After you have practiced well for one to two weeks, you can do exercises (1) through (6) all at once by starting from the hands to the legs, to the neck and head, to the spinal cord and rib cage. Hold the squeeze for 30 to 60 seconds and release totally. Feel the muscles and bones separate from each other.

(8) When you finish the exercise, stand up straight and put the palm on the navel. Men should put the right hand on the navel, covered with the left palm. Women should place the left hand on the navel with the right palm over it. Stand still for a while and feel how the Chi flows. Then, concentrate on collecting the energy into the navel. In the beginning, you can use the hand to assist in the collection of energy.

(a) Men, starting at the navel, should spiral the energy out in a clockwise direction, making 36 revolutions, being careful not to go above the diaphram or below the pubic bone. Circling out beyond the pubic bone allows the energy to leak out. Once you have completed the clockwise revolutions, spiral inwards in the opposite direction 24 times, ending and collecting the energy at the navel.

(b) Women should do the same thing, but begin by spiraling the energy out from the navel in a counterclockwise direction, and spiraling back to the navel in a clockwise direction.

Spend one to two weeks on this practice. Review the Microcosmic Orbit Meditation for circulation of the Chi in Chapter 2 of this book.

When you become proficient at using the mind in this practice, you need only use the mind to circulate the Chi.

When you are finished, walk. If you feel the chest tighten or any congestion, use the palms and gently brush down the chest to bring the Chi down.

(c) Once you have completed the circuit, you will need less time to practice it in preparation for this Embracing The Tree stance. Thereafter raise the energy up to your head to the Pai Hui (Crown). Once the energy arrives there, you should feel as though something were pushing up through the crown of the head. Always end by returning the energy to the navel.

B. Embracing the Tree Stance (Practical Procedure)

1. Exercise

When you have practiced well and understand each part of the previous exercises, you can proceed with the next practice as described below.

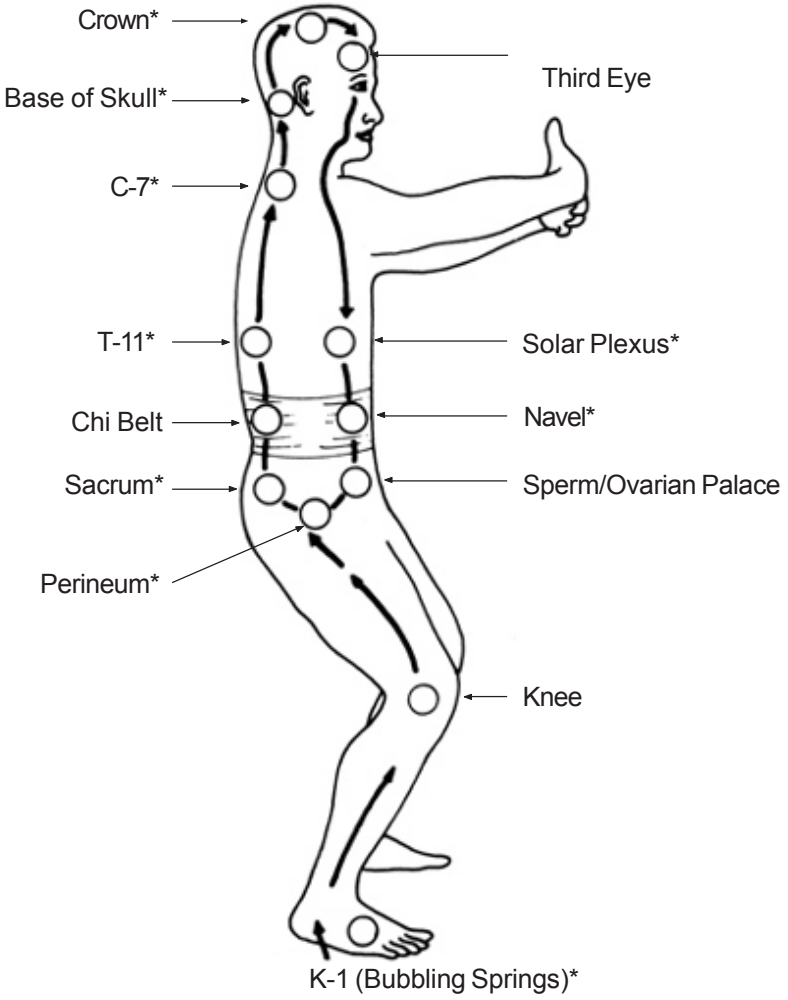

Fig. 3.64 *Embracing the Tree*

a. Assume a Horse Stance. Sink down onto the hips, keeping the back straight and holding the legs apart in the standard length of the lower legs. Turn the toes inward so that the feet are positioned as though on the circumference of a circle. The knees are well bent and the groin area is relaxed and open.

b. Extend the arms out in front of you at shoulder height as though you were encircling the trunk of a tree. The palms face you. The fingers are gently separated with the thumbs pointing up and the fingertips are held apart a distance of about the width of the face. Feel as though you were lightly holding a ball between your hands.

c. Place the tongue on the palate. Breathe in and out deeply nine to eighteen times so that each time that you exhale, the abdomen contracts and the thoracic diaphragm goes up into the chest, compressing the lungs and pulling the sexual organs up. When you inhale, the thoracic diaphragm goes down to compress the abdomen so that you can feel the perineum bulge outward.

d. After you have exhaled for the ninth, eighteenth or 36th time, inhale ten percent of your total capacity to the level of the navel, while keeping the abdomen flat. Pull up the sexual organs, or close the vagina tight, and pull the anus closed. Inhale again and pull up the left and right anus, bringing Chi to the kidneys. Wrap and pack the Chi in the kidneys, then circle the energy in the navel nine times clockwise and nine times counterclockwise to collect the energy there, pausing until you feel the need to breath again.

e. Inhale ten percent of your capacity down to three inches below the navel or, for women, the Ovary Palace. Pack the Chi in this region. Inhale down to the lower abdominal area or for men, the Sperm Palace and hold it again until you feel the need to breathe. Inhale ten percent more of your capacity down to the perineum and hold it as long as you comfortably can. You can keep on inhaling and packing in as long as you feel comfortable. Sometimes you can exhale a little bit so that you can inhale more. In the beginning, start by inhaling less air in a short period of time. When you are well-trained, you can hold more air for a longer time.

f. Exhale and send energy down the backs of the legs into the ground. The feet will fill with the energy and you should feel the palms and soles “breathing”. Breathe through the palms and soles. Regulate your breath.

g. Apply pressure, especially with the big toes. Feel that you are “sucking” energy up out of the earth through the “Bubbling Springs”

in the soles of the feet (K-1 point). “Claw” the floor with the feet. Inhale and draw the energy out of the ground. Collect energy there by circling the sole (K-1) with energy nine times clockwise and nine times counterclockwise. Contract the muscles of the anus and groin and pull up the testicles or vagina and anus. Bring the energy up the front of the legs to the knees, hold the Chi at the knees and lock the knees by turning them slightly outward. Bring the energy to the buttocks by curving in the upper thigh and then bring the energy into the perineum. Hold the Chi here and circle it nine times clockwise and nine times counterclockwise. Exhale and regulate the breath by Energizer Breathing nine to eighteen times and continue to feel the palms and soles breathe.

h. Inhale ten percent, pulling up the left and right anus and packing the back area and kidneys.

i. Contract the back part of the anus to bring Chi up to the sacrum. Pull up the testicles or vagina. Put pressure on the sacrum and tuck it back, but do not tilt the hips. This pushes the lower back (lumbar vertebrae) out and straightens curves in the spine. Inhale ten percent of your capacity and pack Chi into the sacrum. Collect the energy there by mentally circling it nine times clockwise and nine times counterclockwise. Continue to contract the anus.

j. Inhale ten percent of your capacity again. Pull the Chi up to T-11 and tilt the back to a straight position. Collect the energy there by circling nine times clockwise and counterclockwise within a three inch area.

k. Inhale ten percent of your capacity and pack more at the whole back. Continue to tighten the anus and groin, pull up the testicles or squeeze the vagina, tighten the neck, sink the sternum, and push from the sternum to tilt C-7 back.

l. Tuck the chin in to lock the neck, keeping the chest relaxed. With this action, the energy moves from the sacrum to C-7. Pack the Chi at C-7 by circling the energy nine times clockwise and nine times counterclockwise. This will activate the cranial pump located at the base of the skull (the Jade Pillow C-1) which works in tandem with the sacral pump to move cerebrospinal fluid up the back. The sacral and cranial pumps activate the cerebrospinal fluid in the spine and brain.

m. With your neck still tight, inhale, packing energy up to your Jade Pillow. Collect it, circling nine times clockwise and nine times counterclockwise.

n. Inhale ten percent and pull up to the crown of the head. Stop, turn both eyes up, and look inward to the area of the pineal gland, circling nine times clockwise and nine times counterclockwise, until you are out of breath. Exhale slowly. Relax the neck, anus, groin and urogenital diaphragm. Keep the tongue at the palate.

o. Regulate the breath by Energizer Breathing, but exhale more and inhale less. Concentrate on the third eye. Guide the energy down from the tongue past the throat, heart center and down to the solar plexus. Collect the Chi in the solar plexus, circling nine times clockwise and nine times counterclockwise.

p. With the toes extended, open the knees slightly so that you can feel the force in the ankle joints. This will enable you to grasp the ground with the feet, and feel the soles press down to the ground. Force the energy to flow down inside, putting the dynamic tension on the small and big balls of the feet and to the outer edges, like axles running from the outside of the ankles to the big toes. Make sure you do not lift any of the feet's nine points of contact off the ground.

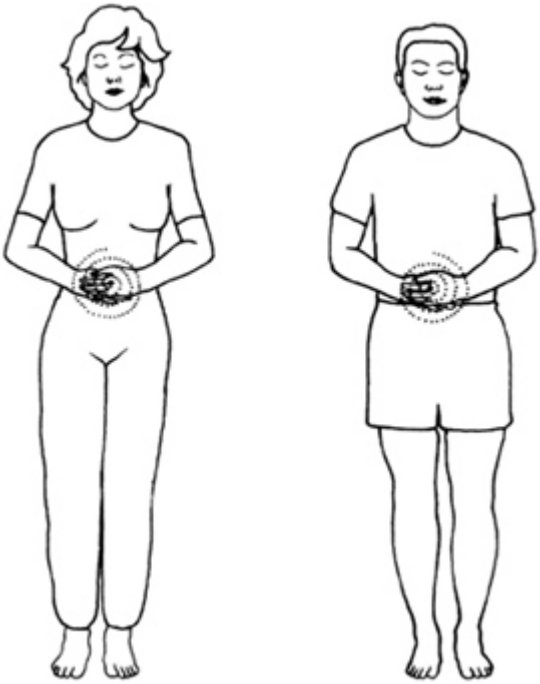

Woman places the right palm over the left. Man places the left palm over the right.

Fig. 3.65 *Place the palms over the navel to collect the energy.*

q. Stand still, maintaining the position. Feel the energy travel out of the ground, up the legs and into the spinal cord, through C-7 at the base of the neck out into the arms, up to the pineal and pituitary glands, and then down the front of the body to the navel. Feel heat in the navel and continue circulating the energy for as long as you wish.

r. Practice the Bone Breathing Process.

s. Practice the Power Exercise.

t. Stand erect, keep the tongue at the palate, and collect energy in the navel. (Fig. 3.65)

u. Walk slowly and breathe normally. Stroke the chest downward with the palms of the hands to prevent or counteract any congestion that might develop there and walk about to distribute Chi and give the stressed muscles a chance to recuperate. (Fig. 3.66)

Keep the abdomen soft. Remember that softness makes energy: it is said that soft makes strong. To achieve this, keep the muscles in a soft tension.

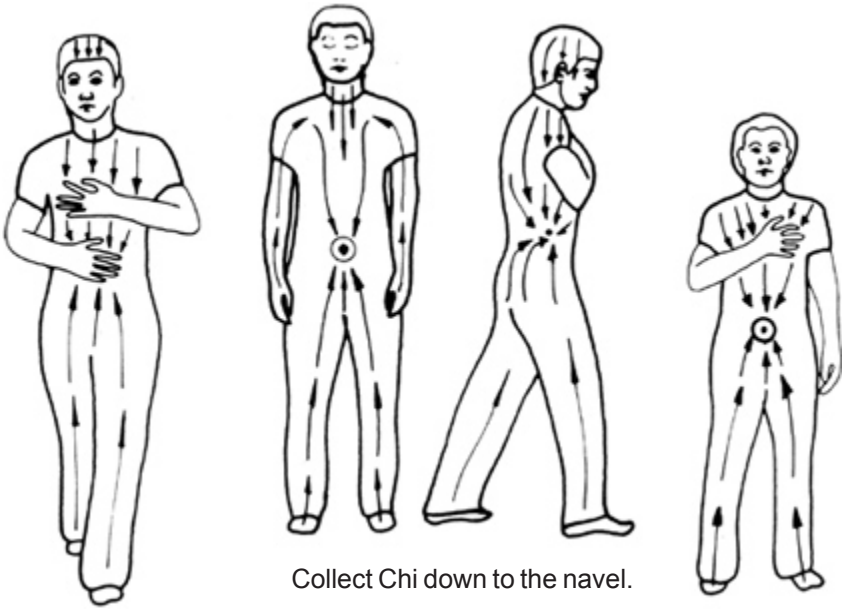

Fig. 3.66 *Brushing Chi down.*

In time, you should be able to do Embracing the Tree in two breaths: one down the front and one up the back. With practice, if you are relaxed, you can do the whole process in just one breath. The stance strengthens the muscle-tendon lines (meridians) that travel through the thumbs and big toes.

You may have already discovered that all Iron Shirt work exercises the body and instills confidence.

C. Summary of Embracing the Tree

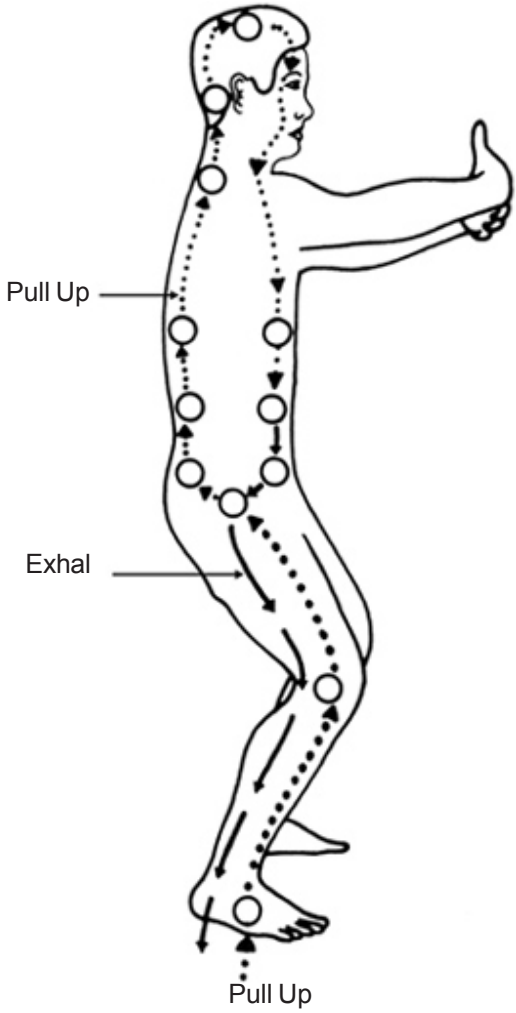

Fig. 3.67 *Circulating the energy during Embracing the Tree.*

1. Stand with the feet a knee-to-toe length apart; press the sacrum down; round the scapulae; relax the chest; hold the head erect; position the arms as if they were encircling a tree; hold the thumbs up; relax the fingers, barely permitting them to touch.

2. Practice lower abdominal breathing nine to eighteen times. When you do abdominal breathing, emphasize inhalation by rounding the abdomen and exhalation by flattening the abdomen on all sides. Feel the sexual organs move up and down with the breath.

3. Exhale; flatten the stomach; lower the diaphragm.

4. Inhale, tightening the perineum and anus by pulling up the middle anus, then the left and right sides of the anus. Feel the Chi energy go up to both kidneys and pack into them. Pull up the sexual organs. (Remember that the anal muscle has a close relationship with all organs and glands.) Pack into the navel without expanding the abdomen. Keep the chest relaxed and the abdomen soft, and spiral first nine times clockwise, then nine times counterclockwise, making a circle of about one and one-half inches in radius.

5. Breathe into the middle abdomen, without spiraling, and pack.

6. Breathe into the lower abdomen, without spiraling.

7. Breathe into the perineum and feel it bulge out.

8. Exhale through the legs and feet down to about six inches into the ground. Feel the palms and soles breathing and use the lower abdominal breathing.

9. Inhale, tighten the perineum, and press the soles of the feet into the ground. Claw the toes and spiral at the kidney points (K-1) on the soles, nine times clockwise and nine times counterclockwise, both spirals moving simultaneously in the same direction.

10. Inhale, bringing energy to the knees. Lock the knees, without spiraling.

11. Inhale up to the perineum, and spiral nine times clockwise and nine times counterclockwise. Feel the bulge.

12. Exhale. Regulate the breath, and be aware of the soles and palms breathing.

13. Inhale up to the sacrum, tilt the sacrum back, packing it, and spiral nine times clockwise and nine times counterclockwise. This will strengthen and activate the sacral pump.

14. Inhale to T-11, inflating the kidney area, and press out on the lower back to straighten the curve there, spiraling nine times clockwise and nine times counterclockwise.

15. Inhale to C-7, straightening the curve at the neck, and lock the neck. Spiral nine times clockwise and nine times counterclockwise.

16. Inhale to the Jade Pillow, clench the teeth tight, and squeeze the skull and the temple bones to strengthen and activate the cranial pump. Spiral nine times clockwise and nine times counterclockwise.

17. Inhale to the crown (pineal gland) and spiral nine times clockwise and nine times counterclockwise. If you cannot go all the way up on one breath, you can pass over the Jade Pillow or take an extra breath where needed until your capacity increases.

18. Exhale with the tongue up to the palate. Regulate the breath.

19. Concentrate on the third eye, until you feel the Chi build up there. Bring the energy down to the solar plexus and spiral nine times clockwise and nine times counterclockwise. Bring the Chi down to the navel. Stand still and maintain this position.

20. Stand up and bring the energy into the navel, putting your hands over the navel and bringing the feet together. Relax. Collect the energy in the navel area. When you feel calm, walk around and brush the energy down, if necessary.

21. Practice the Bone Breathing Process.

22. Practice the Power Exercise.

III. Rooting, Collecting Chi Energy, Illustrations of Postures

A. Rooting Practice

The Rooting Practice is very important in the Universal Tao System. Rooting can be compared to the foundation of a building. The stronger the foundation, the higher the building may be built, and the more difficult it is to topple.

After mastering the Rooting Practice you will feel, as you walk around, stand, or sit in your daily life, that you are more in touch with the earth. (Fig. 3.68) You will feel more stable and practical minded, not “spacey”. Many Universal Tao students, after practicing Iron Shirt Rooting for a while, find that they have good balance and greatly improve the quality of their physical activities, such as running, skiing, tennis and Yoga.

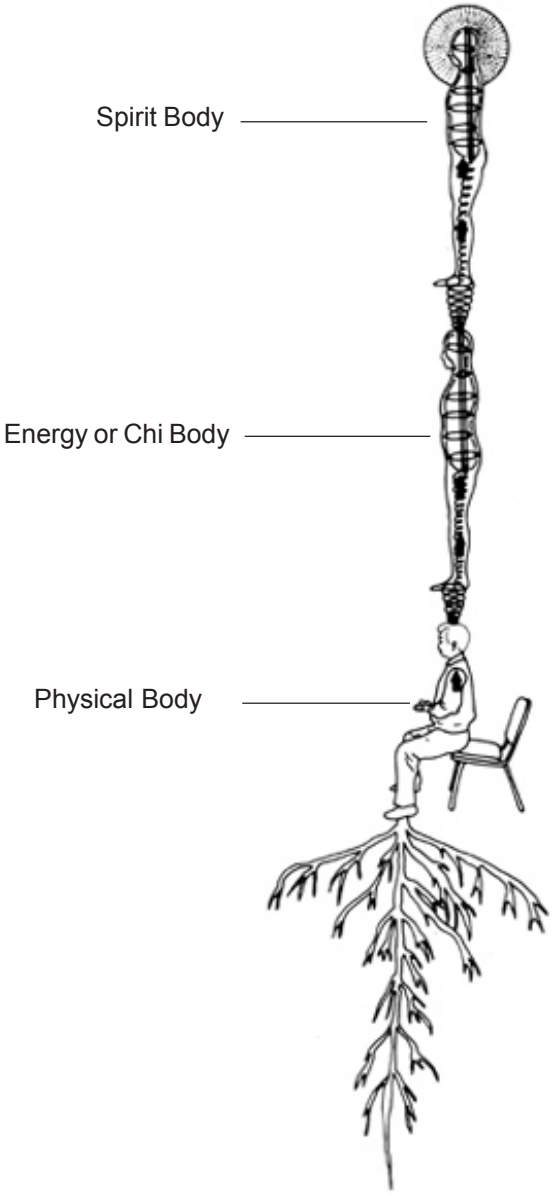

Rootedness serves the soul the soul (Chi Body) and spirit the way a control tower serves a space rocket. The more you can root to Mother Earth, the more balanced the energy will be.

Fig. 3.68 *Rootedness to Mother Earth*

Taoist Practitioners are very concerned with rootedness. The more he or she can root to Mother Earth, the more balanced the energy will be. Such a balance of energy increases healing energy. In advanced practice, rooting is required to perform the practice of the Thrusting Channels and Belt Channels. Tai Chi, the Healing Hand and the higher spiritual practices draw upon the earth energy, as well as heavenly energy, to transform life-force energy into spiritual energy in order to give birth to the soul and spirit. It is the earth energy which helps the soul and spirit grow. Astral traveling requires rooting, and this earthly rootedness serves the soul and spirit the way a control tower serves a space rocket. Those who try to bring Chi up to the head, or receive heavenly energy without grounding in the earth, become “spacey” instead of “in tune” with their experience.

Always balance out by using both sides of the body during practice.

Developing the Rooting Practice requires two people: one to push and the other to stand. This exercise will greatly improve your stance. Many people will find that one side is weaker than the other or the upper part, such as the neck, is weaker than the lower part. Practice on the strong side first and then the weak side so that you will have a reference for improving the weak side.

Gradually you will grow stronger and it will require less effort to maintain your structured position because you will have built extra muscles and strengthened the tendons, tendon attachment sites and fasciae as one structure. When you “root” properly, it feels as if you are sucking the ground, or have grown a deep root into the earth. This is because the whole structure, as a unit, is pressing into the ground. You can feel the entire bone structure sink down to the ground.

With practice you will be able to bring energy along the prescribed course more quickly and easily To test your rootedness, find a partner who can push you while you hold the structure.

1. Stance

The purpose of the Iron Shirt Rooting Principle is to line up the bone structure with the joints to feel the whole body become one piece. Once you become proficient in the practice, you will position yourself in the proper structure quite easily. Stand in the Iron Shirt Horse Stance. Sometimes you can stand with the feet at a slightly

wider position. However if the feet are too wide apart, you have to use muscle strength to hold the whole body together. When the force comes, the muscle will hold the force and knock the alignment off. If the position of the feet is too narrow you will be using the tendons' force to help hold the structure together, affecting alignment as well.

When your partner pushes you with force, your neck must be relaxed so that the force will not go into the neck, causing pain there. Your structure, inner organs, and tendons, muscles and fasciae must work as a whole to hold the position. This will gradually increase your inner strength.

2. Chi Belt

Packing Chi into the organs is very important in the practice of rooting. It is particularly important to pack Chi in the kidneys and to join the kidneys and K-1 (Bubbling Springs) into one line. The navel and the two kidneys must join together feeling like a large belt, belted across your waist. (Fig. 3.69(a)) The joining of the navel, the sides of the waist, the two kidneys and T-11 with Chi energy is basic to the rooting principle and is called the "Chi Belt".

Without the Chi Belt, the major connection of the upper and lower energy joints, the structure and Chi will be lost. To develop the Chi Belt, first pack Chi in the kidneys and the navel, expanding first from the left kidney out to the left waist, then towards the front to the navel. Expand, pack and wrap the right kidney to the right waist, and then forward to the navel. This joins both sides together at the navel. As the Chi Belt expands, it connects to the T-11 and the Door of Life. The navel now feels like a full blown tire encased within a big belt. Once you experience a Chi Belt in the rooting practice, you will be able to attain rootedness quickly and will not need to use your muscles to join your structure together Therefore, mastering the Chi Belt will help you to be very relaxed in your practice.

3. Principle of Rooting

a. Assume Embracing the Tree.

b. Sink the energy down to the lower navel area.

c. Sink down as comfortably as you can, and open the groin by slightly separating the knees.

d. The toes turn slightly inward. When the knee caps are locked (meaning that the knee joints are held tightly), the knees will lock in the ankle joints like the position assumed when you are sitting astride a saddle. Sink into the knees. You can feel the connection between the knees and the ankle joints and the connection down to the feet. Feel your whole body weight drop down to the ground. The force passes through the bone structure. (Fig. 3.69(b)) Feel the bones like sponges that absorb the force and direct into the ground.

e. The hands are at shoulder level, the elbows sink. Feel the force of the sinking elbows pressing into the bone structure. If the elbows are up, you will disconnect from the tendon power.

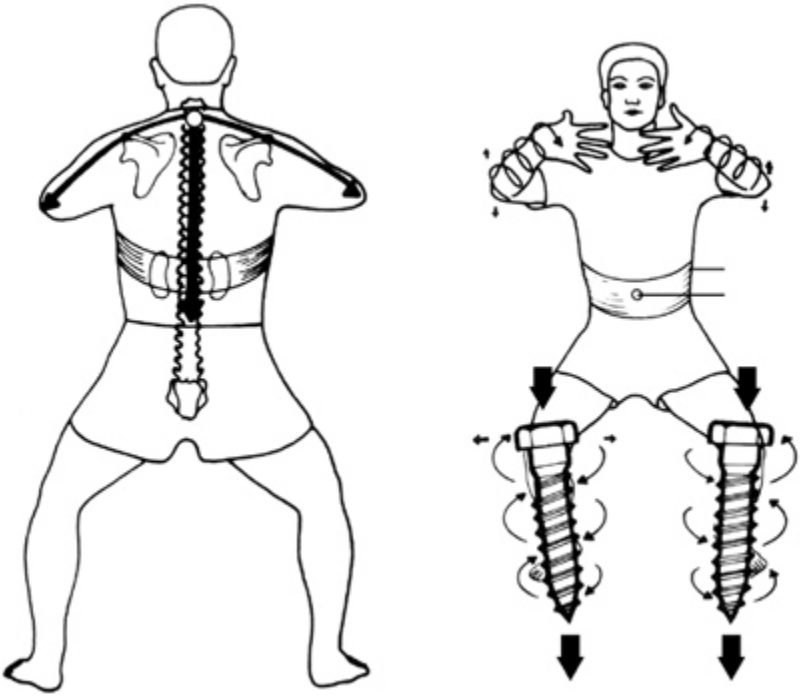

(a) Chi Belt joins the whole body structure together.

(b) Press down and turn the knee outwards to screw the force into the ground.

Fig. 3.69 *Principle of Rooting*

f. Line up the shoulders, joining the scapulae with the spine by rounding the scapulae and sinking the chest. Connect through the hip joints down to the knee and ankle joints.

Line up the shoulder joints by pushing the thumbs out and the pinky fingers in, feeling the tendons pull. The wrist joints are connected to the shoulders. Relax the neck, especially the trapezius muscle, so that the connection does not go up to the head which will bring force to the neck. Otherwise, when your partner pushes you, you will feel like you were hit by a two-by-four and it will knock you over. When you relax the neck and join the shoulders with the spine, the force travels down the spine and down to the ground.

To connect the shoulder joints with the spine, you need to round the scapulae and sink the chest so that the force can be transferred from the shoulders to the scapulae. Then, push the neck straight and the T-11 out. Keep the sacrum straight without moving the hips, until you feel the spine as a flexed bow full of strength. All becomes one line. When the groin area is open, the hip joints will join with the knees, the feet, and all will join down with the ground. Feel the Chi Belt, belting the waist and joining the entire structure together.

4. Practice of Rooting

Having a partner push against you can increase your rooting power and thus strengthen the fasciae and spinal cord, increasing the function of the sacrum and cranial pump.

Assume the position for Embracing The Tree, and pack with air as described. Your partner should then push (not hit) his fist against your sacrum, T-11, C-7, and the base of the skull, respectively. It is important that these four centers become strengthened and linked together into one line. If they are not linked, they become many unconnected lines, and the partner's force will not travel down to the ground properly.

The spinal cord is the house of the nervous system which joins all the other parts of the body. The spine consists of many bones which are put together and held by muscles, tendons and fasciae. Most of the exercises are not to strengthen the spine solely, however Iron Shirt Chi Kung is designed to strengthen the entire bone structure, especially the spine. Many people have weak spines which cause bad posture, breathing problems and weak organs.

Weak organs are the original cause of a weak spine. Poor posture becomes a vicious cycle: organs are kept weak because Chi cannot circulate throughout the various body systems. Iron Shirt (1) protects organs which generate vital Chi; (2) recharges them with packing; (3) circulates Chi up the spine and strengthens the nervous system; and (4) creates the storage space for the Chi energy by burning out fat.

5. Strengthening the Sacral Pump (Fig. 3.70)

The sacrum is the very important pump that moves Chi into the spine. Assume the Embracing the Tree stance. Be aware of your sacrum, pack with Chi, develop a Chi Belt, and have your partner put his fist right on the sacrum. Slowly tilt the sacrum to the back, pushing against your partner's hand, with very little movement from the hip. Have your partner push you as much as you can withstand, without being pushed over and gradually increase the push until you grow more powerful in the sacrum area. Hold this position for one to two minutes. Breathe normally.

Be aware of the force of your partner being transferred from your sacrum to the legs, to the feet and to the toes. You can exert force from the toes back up the feet to the heels, to the legs and to the sacrum.

When your partner releases you, rest for a while and feel that the sacrum is open and feel how the Chi flows up the spine.

When you are advanced in the practice, you can be very relaxed. There is no need to pack. Simply feel the force pass from the sacrum to the ground, and feel the ground force come up to resist the force through use of the bones. Do not lean towards your partner.

6. Strengthening T-11

T-11, or the eleventh thoracic vertebra (the point of the adrenal gland and the kidneys), is regarded by the Taoist as a pump which aids in moving the energy to the upper body. Assume the position for Embracing the Tree, and pack with Chi as described. Your partner then pushes his fist against T-11 as you press back with that area of the spine. The work is done by the spine, not by the whole body. (Fig. 3.71) Do not lean towards your partner.

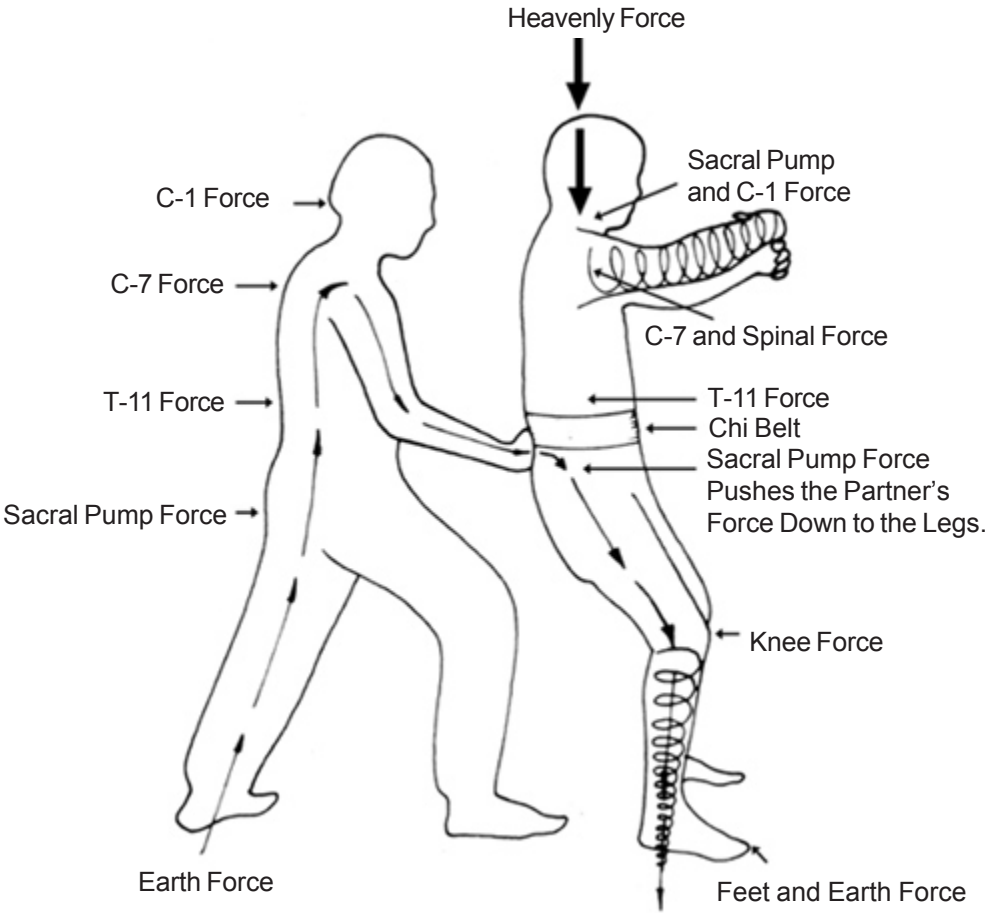

Fig. 3.70 *Partner's force is transferred down to the ground though the bone structure by the force of the sacral pump.*

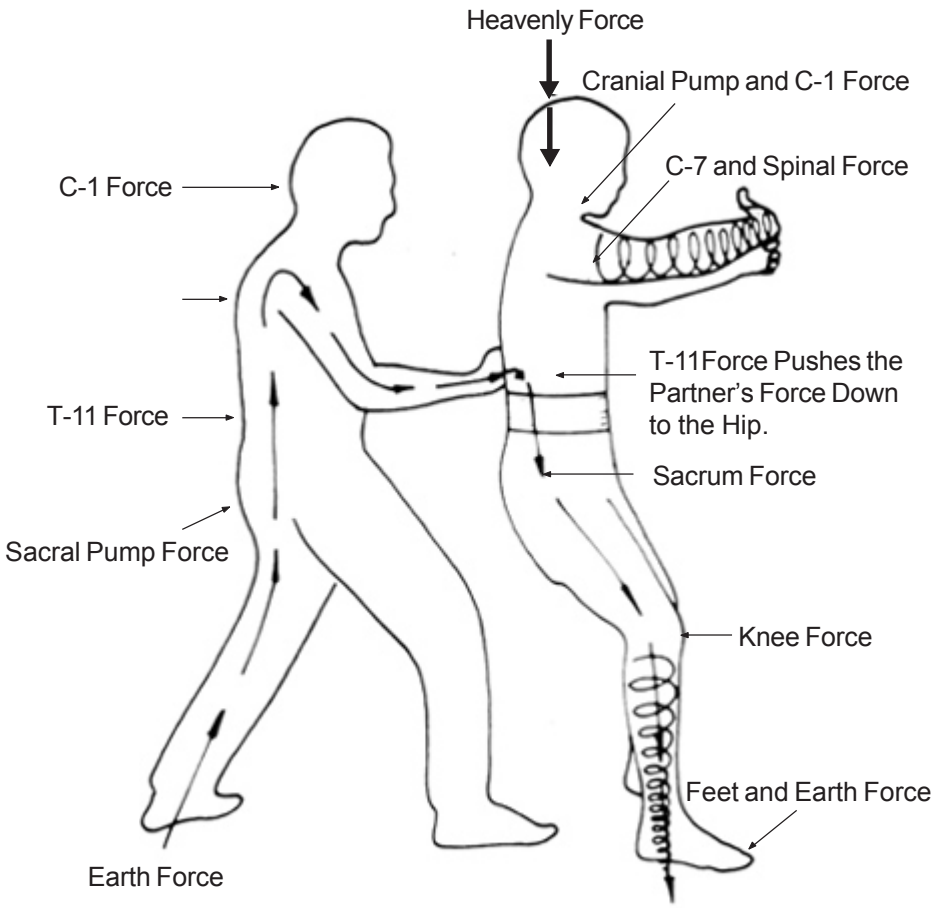

Fig. 3.71 *Partner's force is transferred down to the ground through the bone structure by the force of T-11.*

7. Strengthening C-7

C-7, or the seventh cervical vertebra, is considered the point at which all the tendons of the body join together. By strengthening this part, the tendons, the fasciae and the neck will be strengthened. The C-7 also is the junction point of hand and spinal cord power.

Assume the position for Embracing the Tree and pack with Chi pressure as described. Your partner then pushes his palm (not his fist) against C-7 as you press back with C-7. Hold this position for as long as you can. (Fig. 3.72) Your partner should coordinate with you when you are ready to release.

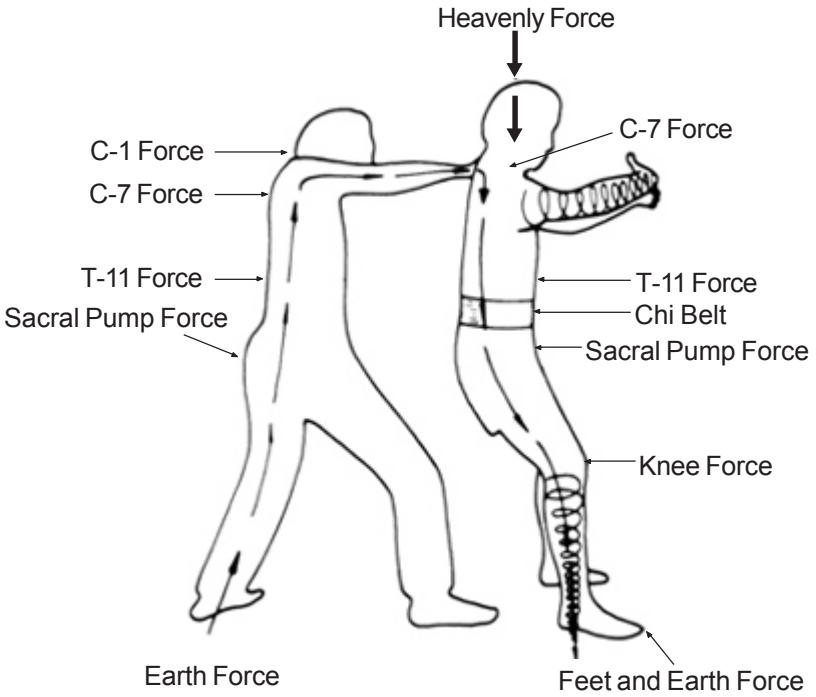

Fig. 3.72 *Partner's force is transferred down to the ground though the bone structure by the force of C-7.*

8. Strengthening the Cranial Pump

The cranial pump has long been regarded by Taoists as a major pump for the circulation of energy throughout the body. It has been previously mentioned that minute movements at the joints of the eight cranial bones occur during breathing. Cranial movement stimulates the production and function of the cerebrospinal fluid surrounding the brain and spinal cord. The cerebrospinal fluid is necessary for normal nerve and energy patterns in the entire body. Strengthening the cranial pump can increase energy and alleviate symptoms such as headaches, sinus problems, visual disturbances and neck problems.

Assume the position for Embracing the Tree and pack with Chi pressure. Clench the teeth, tighten the neck and contract the cranium by squeezing the muscles around the skull and pressing the tongue tightly to the roof of the mouth to activate the cranial bones. Push back as your partner pushes his palm against C-1 at the base of the skull. (Your partner should use his palm, not his fist.) (Fig. 3.73)

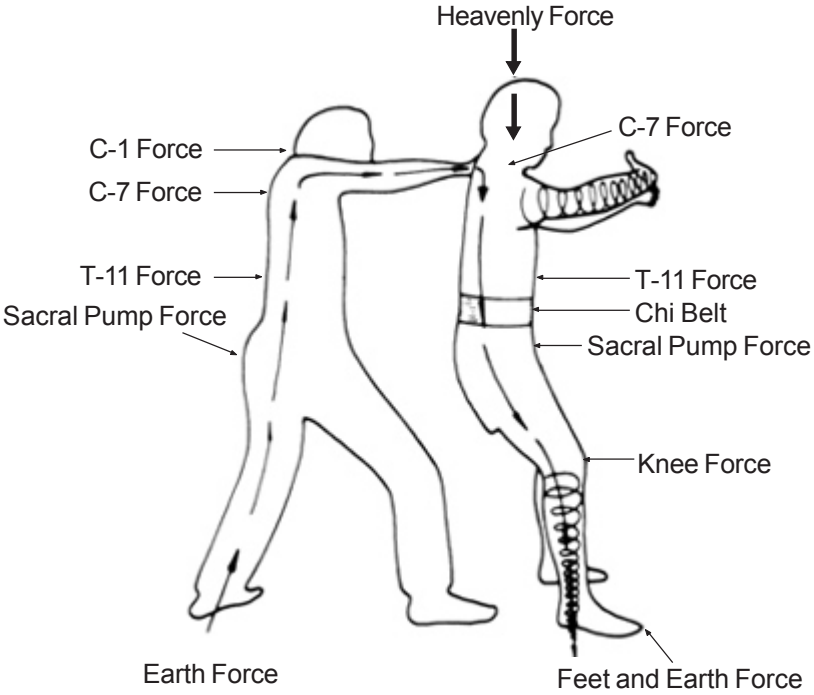

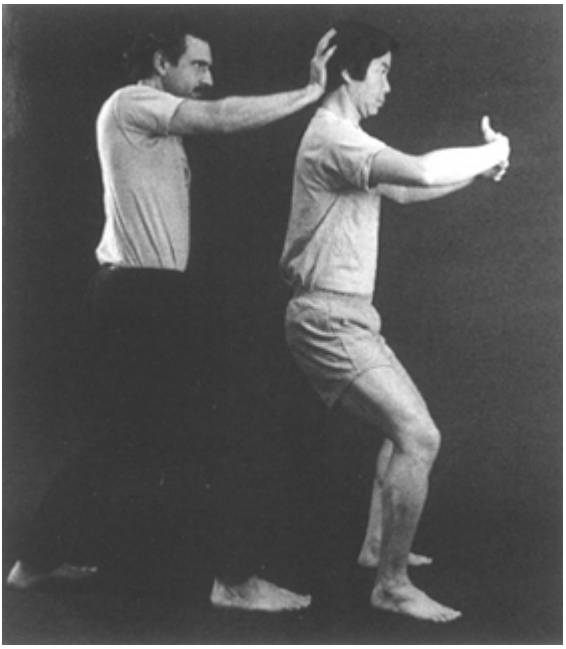

Fig. 3.73 *Partner's force is transferred down to the ground though the bone structure by the force of C-1.*

9. Building Up Rootedness

a. Left and Right Side Rooting Practice

Assume the stance for Embracing the Tree and pack with Chi energy as described. Your partner stands to one side of you, placing one hand on your shoulder and the other on your hip. Your partner pushes you lightly, gradually increasing to full force. If you are well-rooted, the force of the push will flow right through your bone structure, down to the feet and into the earth. (Fig. 3.74) If you have learned to direct and absorb energy through the bone structure and into the soles of the feet, you will be able to receive the powerful healing energy created by the blending of your energy, your partner's energy and raw earth energy. Your practice should have acquainted you with the flow of energy that goes down through the feet into the earth and then back out of the earth, up through the feet into you, while at the same time you are using the rest of the foot to "claw" against the floor.

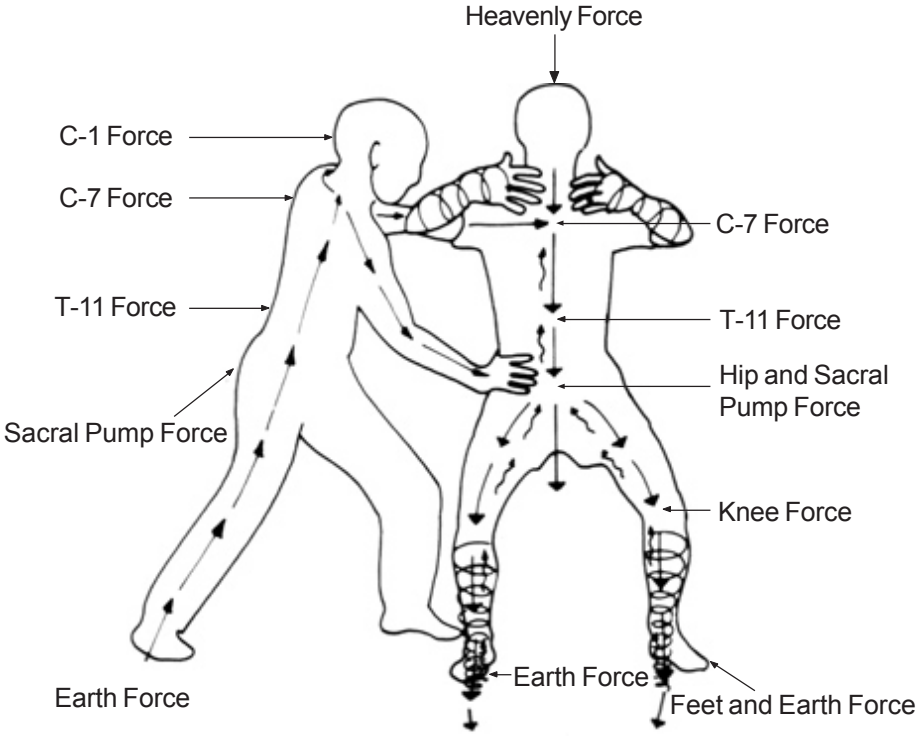

Fig. 3.74 *Partner's force is transferred down to the ground though the bone structure by the left and right side rooting practice.*

Have your partner push on the left side first, and then the right. Do the Energizer Breathing and resume the stance again. Have your partner push the right side. In the beginning, you will be tight and tense. You will need to use Packing Process Breathing, holding the breath to hold your structure together. As your practice improves and you are able to control and pack the energy, it will not be necessary to hold the breath since you will be able to maintain the structure and rooting in a relaxed manner without packing and without tensing the muscles at all. If the shoulder and spine are not joined together you will fall. (Fig. 3.75)

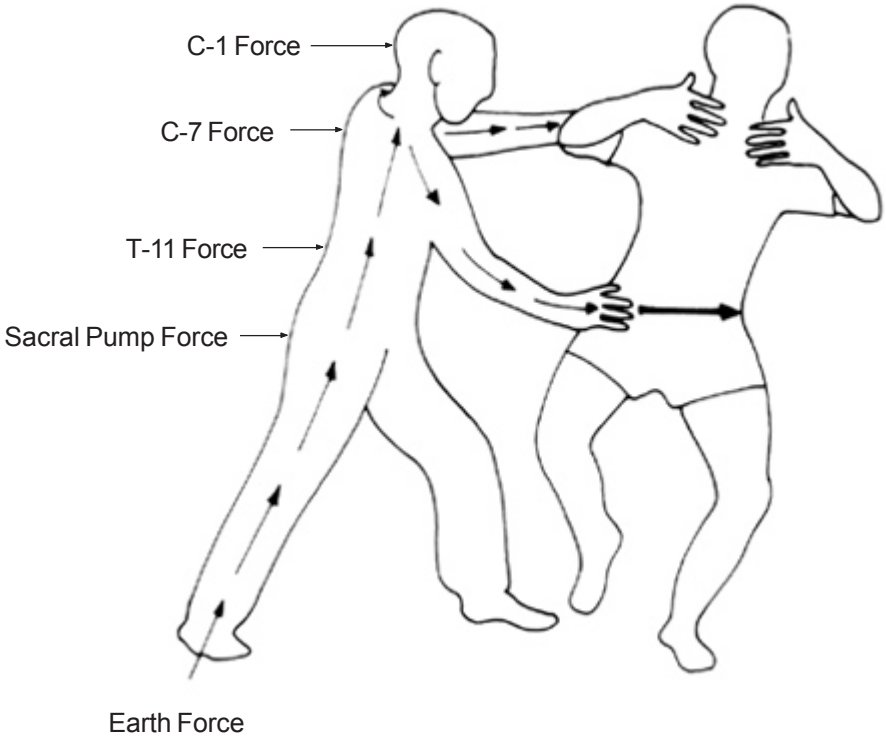

Fig. 3.75 *If the force is not grounded, the force does not pass though the structure and the body falls.*

b. Front Rooting

Front rooting is primarily training the front structure to root more solidly to the ground, especially the hands, the ribs, the front of the legs, and the soles and toes. Many people will find it hard to do any rooting to the ground at all. You must feel the force of your partner pass to the shoulder, to the scapula, to the spine, to the sacrum, to the hip and to the leg as one line.

Assume the Embracing the Tree stance. Your partner pushes you on both wrists with both of his palms. (Fig. 3.76) Front rooting is very hard and takes a lot of practice. In the beginning it is difficult, so apply only a small force and gradually increase. This will open the leg channels and hand channels and join them together. C-7 and the spinal cord play a very important role in the front rooting practice.

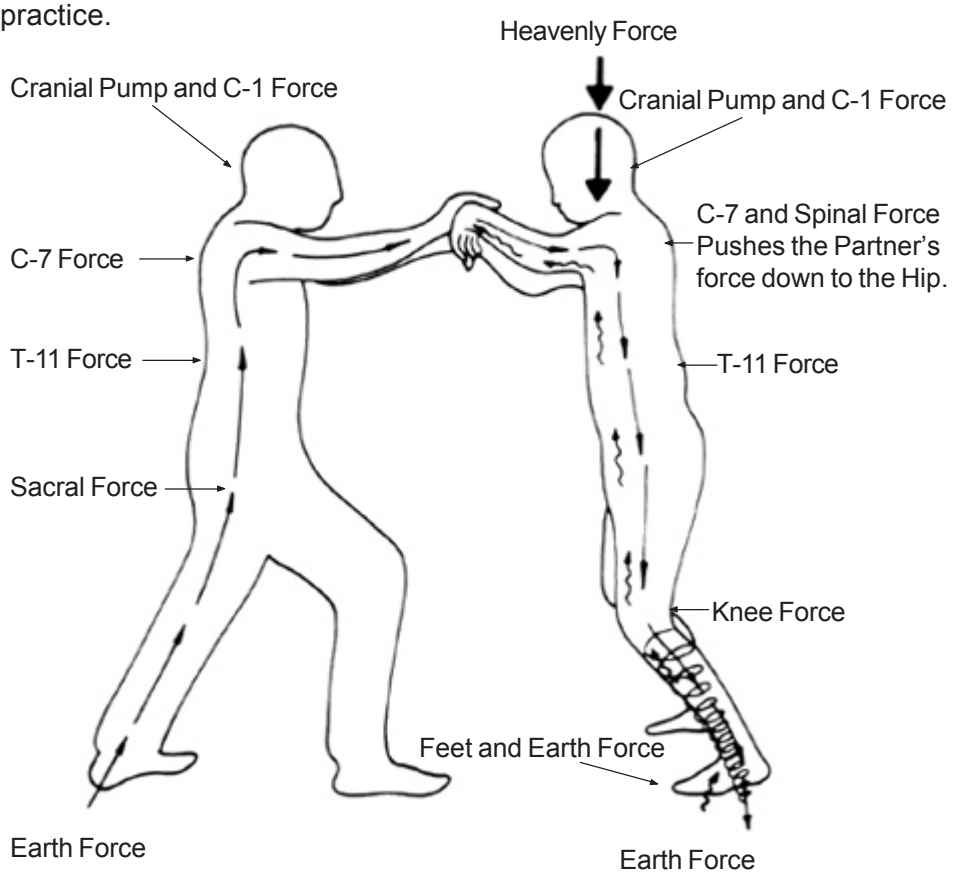

Fig. 3.76 *Front Pushing and transferring the force to the ground.*

c. One Legged Stance Rooting

Stand on one leg and circle out the opposite arm. Sink the chest. Feel how the arms and legs are in one line, connecting together. Sink so that the structure is joined. When your partner pushes, you can guide your partner's force down to the ground. (Fig. 3.77)

d. Force Transfer

The arm, the scapula, the spine, and the leg become one line, similar to a stick sticking into the ground. (Fig. 3.78) If you try to push on the end that is sticking into the ground, all the force is transferred to the ground. If the fasciae and tendons are not as strong as possible, the whole structure will break when pushed.

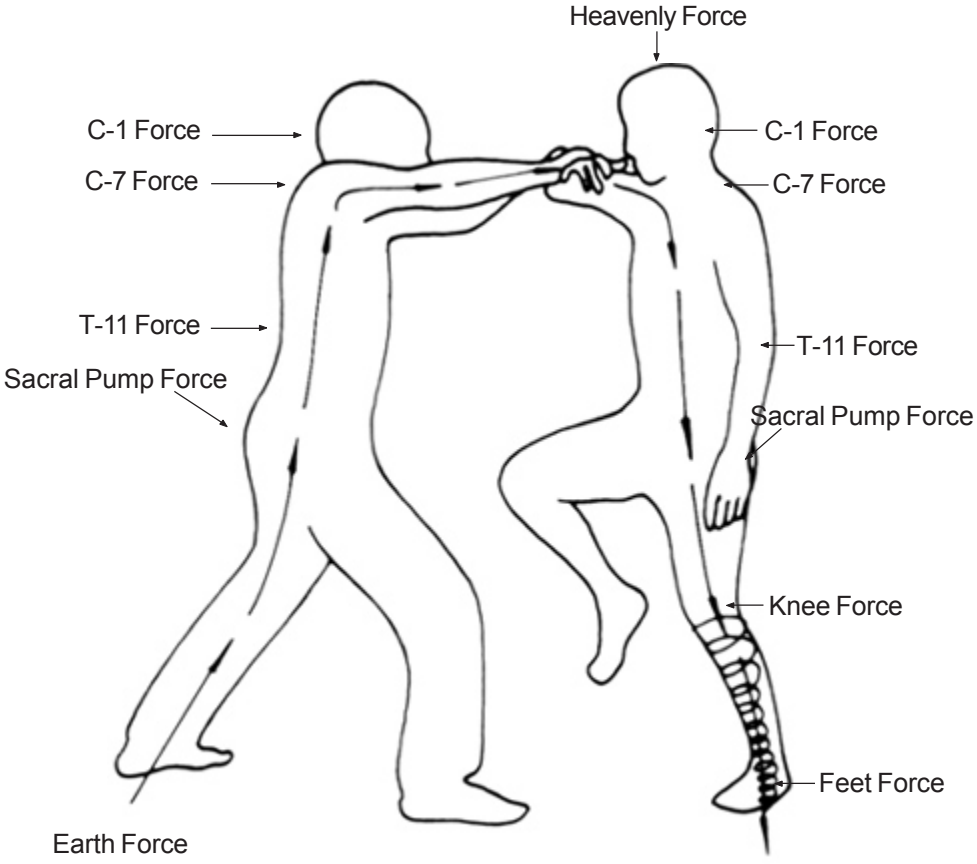

Fig. 3.77 *One legged stance and transferring the force to the ground.*

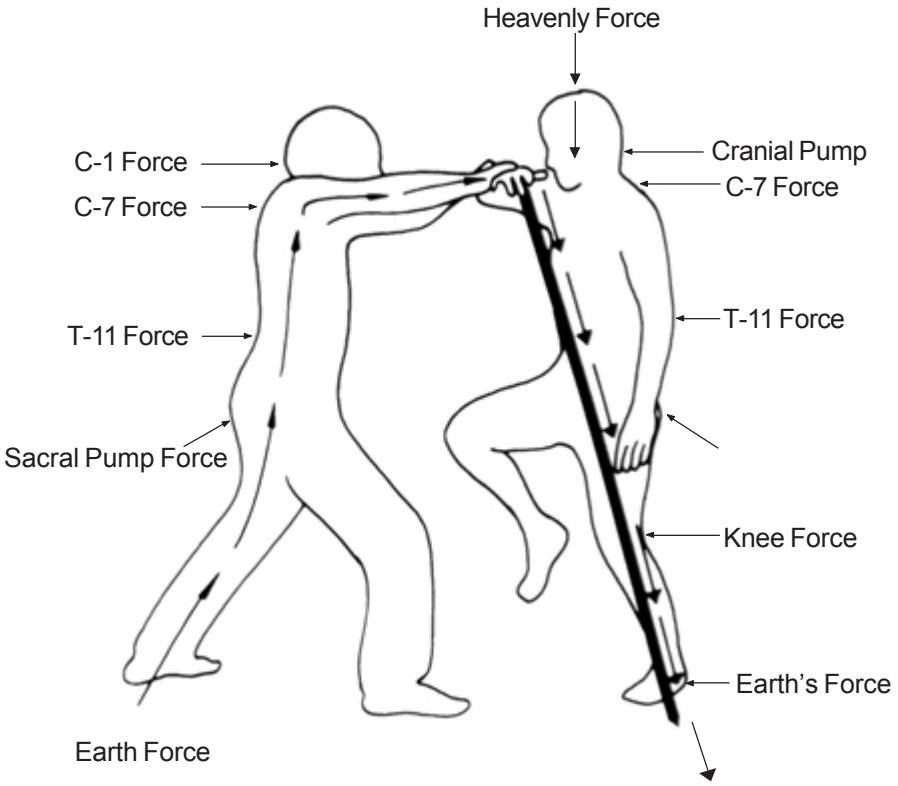

Fig. 3.78 *Force transfers though the bone structure as it would through a stick sticking ino the ground.*

e. Rooting against People—Force Transferred by bone structure to the ground.

When your partner pushes you, do not lean towards him. Trust your structure and feel the whole body join into one piece. Feel the bones like sponges absorbing the force and passing it along the bone structure to the ground. When you feel the force, open the knee a little and feel the knees connected to the earth. Feel the energy pass to the ground.

When someone pushes you, he passes the force to you. The tendency as your partner pushes you is to counter the force by pushing the elbows out. This action moves you out of alignment. Therefore, when you feel the energy come at you from the side of your body, keep the elbow down and redirect the force back to the scapula and to the spine. The force, then, will not push you out of alignment.

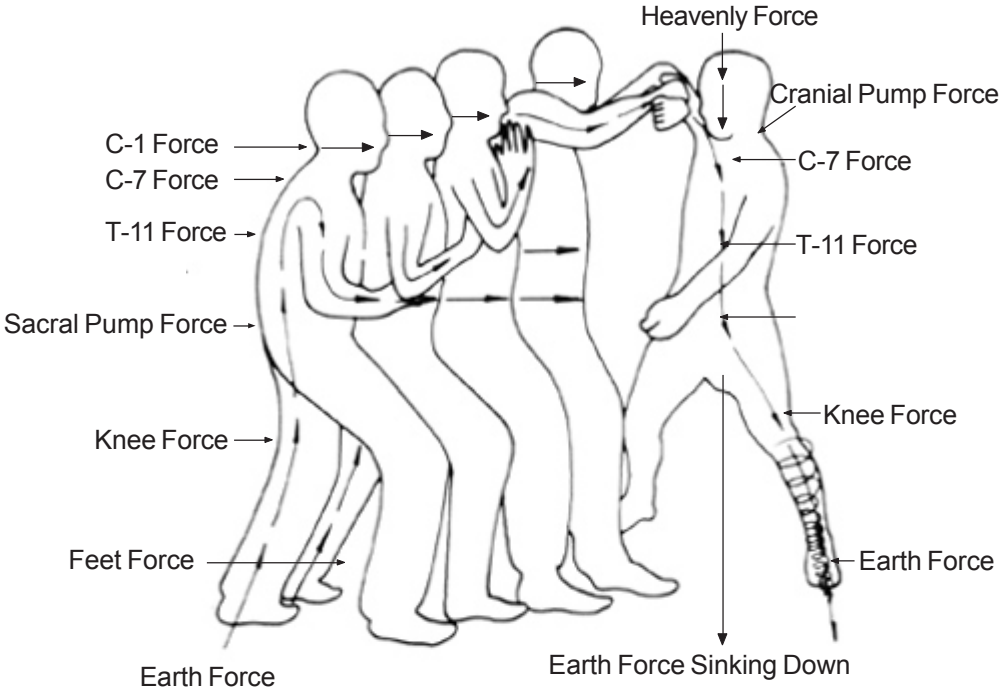

Fig. 3.79 *Partner's force are transferred down to the ground though the bone structure because the body is properly aligned with the ground.*

When you are good at aligning all of the joints together, no matter where the force directed at you comes from, you will be able to redirect it down to the earth, rather than let it break your alignment.

The principle of rooting is to become like a stick. The stick is most powerful when positioned at a 45 degree angle. When you push the end of the stick from a right angle, the force will go into the earth. If your body alignment is joined with the earth, when the force comes, it will go right through you and into the earth. The stick is not what is powerful; it is the earth behind it which has the power. Naturally, the stick has to be strong to pass the force. (Fig. 3.79) The foot, the leg, the knee can all be adjusted to be like a 45 degree angle stick protruding from the earth. No matter what position you are in, you must always bear in mind that your body must be aligned with the ground, so that the force will not stay in the joints but can pass through the bone to the ground. (Fig. 3.80)

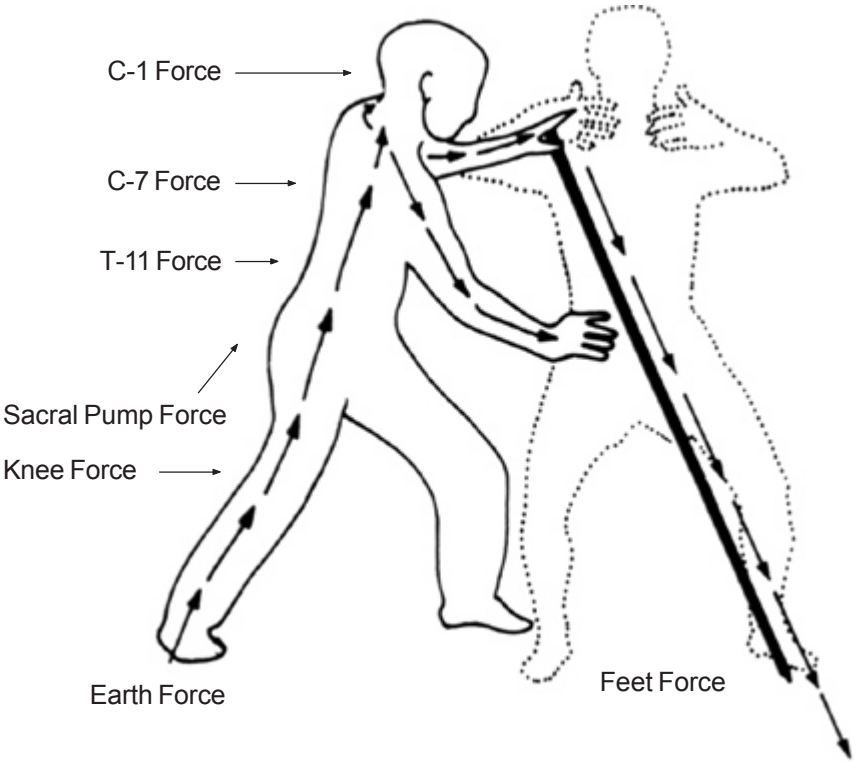

Fig. 3.80 *If the force is transferred down to the ground though the bone structure, it is as if the partner is pushing a stick into the ground.*

B. Collecting Chi Energy after Practice

1. Preventing Side Effects

After each practice, stand silently erect for a few moments. Concentrate your attention on the navel, collecting the Chi there. As the Chi sinks down, stroke the chest from top to bottom with the palms of the hands. This prevents congestion of the chest and heart, as well as other side effects, such as heartburn, headache and eye pain. Move your hands to release the congestion and walk around until you feel the energy settle down.

After practicing Iron Shirt, take time to do the Microcosmic Orbit Meditation, also called the "Awaken Healing Energy" meditation, as described in Chapter 2. During your Iron Shirt Practice, you generate tremendous energy which tends to flow up and become trapped in the brain and the chest, especially in the heart. With practice, you will be able to direct the energy down to the navel from all sides and collect it there. (Fig. 3.81) As your practice of Iron Shirt progresses, you will open up the navel area more for the storage of energy to be utilized in the higher spiritual practice.

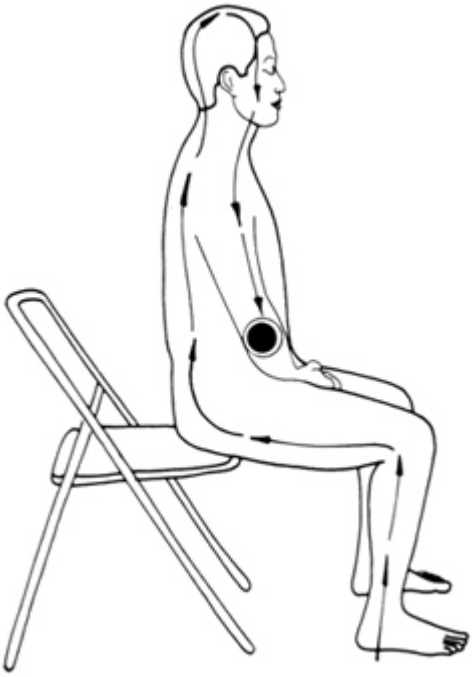

Fig. 3.81 *Collect the energy at the navel.*

2. Sitting and Standing Positions for Collecting Energy

When you have finished the Iron Shirt Practice, you should sit down to collect the energy that you have built up.

Sit on the edge of a chair using your sitting bones to find that delicate point of balance which will help hold you erect. (Fig. 3.82 (a)). Men should sit far enough forward to allow the scrotum to hang freely. Women should also sit forward and should keep genitalia covered to avoid energy loss. The back must be comfortably erect, the head bowed slightly forward.

Stand straight, touch the tongue to the palate, and put the palm on the navel. (Fig. 3.82 (b)) Smile down to the organs and bring the energy to them. Let the energy circulate in a circle, starting from the navel down to the perineum and up the sacrum, to the spine, to the top of the crown and down the third eye to the tongue, to the heart, to the solar plexus, and to the navel. Do this several times and collect Chi in the navel by circulating it 36 times outward and 24 times inward to the navel.

(a) Sitting Position

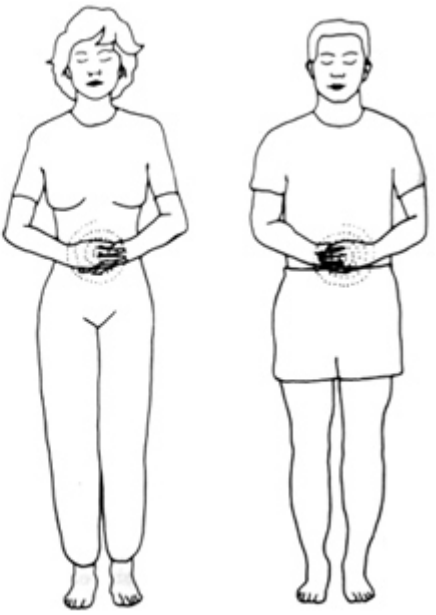

(b) Standing Position

Fig. 3.82 *Sitting and Standing Position for collecting energy in the navel.*

C. Illustrations of Postures

1. Holding the Golden Urn

Designed to strengthen the pinky and thumb fingers, Holding the Golden Urn joins the pinky fingers to a line which runs up and around the ears (at which location is housed one of the two major cranial bones), down the sides and to the small toes (Fig. 3.83(a)), and strengthens the thumb line by joining it to the cranial bone, to the chest, to the navel and down to the big toes. (Fig. 3.83(b)). These two lines are very important in holding the muscle tendons and bone structures together. When connected, these two tendons issue force on the sides and the front. Holding the Golden Urn is divided into two positions: the Yang Position and the Yin Position.

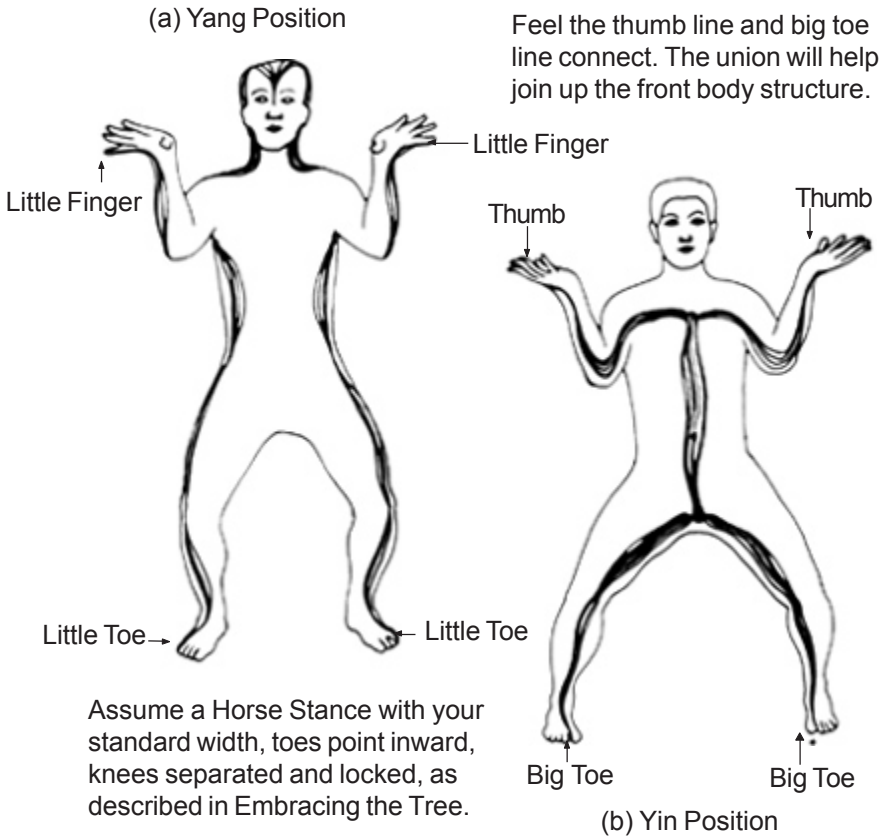

Fig. 3.83 *Holding the Golden Urn*

a. Yang Position

Assume a Horse Stance with your standard width, toes point inward, knees separate and locked as mentioned above in Embracing the Tree. (Fig. 3.84)

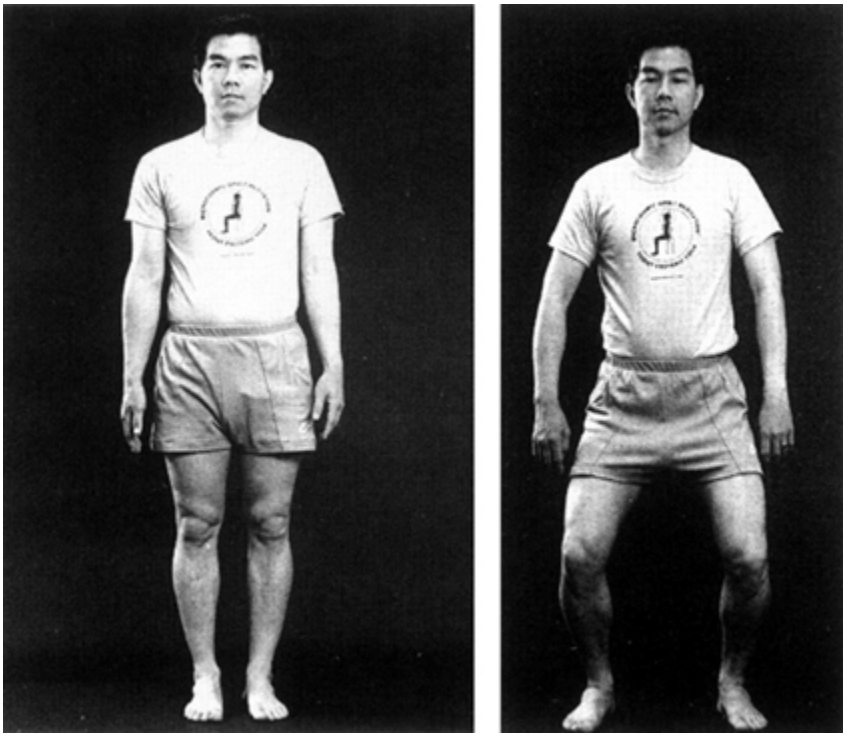

Fig. 3.84 *Holding the Golden Urn—Yang Position*

Bend your arms (as shown in the Fig.) so that your elbows, at a shoulders' width apart, drop and are forward vertically, causing your upper arms to be about 45 degrees away from your back and your forearms about 30 degrees out to your sides (not directly in front of your upper arms), with the wrists at 90 degree angles. For both hand positions of the Golden Urn, round the shoulders forward, then feel as if you are pressing up strongly, but without actually moving the arms. The chest sinks down slightly in response to the scapulae pulling around. In the Yang position, your hands are spread, palms down, with a pull exerted on the tendons of your fifth fingers (pinkies), so that the backs of your hands make a flat surface

upon which you could support a large “Golden Urn”. (Fig. 3.85(a)) (The spread fingers with the outward pull felt in the pinkies produce a bracing action that enables you to sustain considerable weight.) The tendon lines that are used here connect the small toes and small fingers, putting more force and energy in the small fingers and small toes. Small fingers are weak and seem useless but, when strenghtened, will give power to the whole structure. (Fig. 3.85 (b)) The diagram shows the meridians of the fifth finger tendons joining the fifth toe tendons. This tightens and strengthens the entire outer structure.

(a)

(b)

Feet the little finger line and little toe line connect.
Union will tighten up and strengthen the outer structure.

Fig. 3.85 *Holding the Golden Urn—Yang Position, Side View*

b. Practice

In the Golden Urn we use one breath, but many inhalations. This means continue to inhale until you are out of breath, then exhale. This is regarded as one breath.

Your tongue should be at your palate throughout to keep the energy flowing safely.

(1) Start with Energizer Breathing, nine to eighteen times. (Fig. 3.86) Exhale and flatten the stomach. Inhale and pull up the left and right side of the anus. Bring the Chi to pack, circle and wrap around the kidneys.

(2) Inhale and pack the Chi in the lower abdominal area, contracting the anus, and pull up more on the urogenital diaphragm. Feel energy draw up from the soles of the feet to the sacrum.

(3) Inhale, packing to the sexual organs. Tilt the sacrum back to create a suction and pull the back part of the anus toward the sacrum.

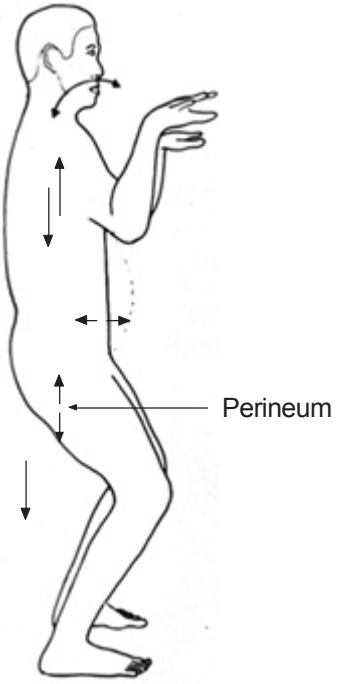

Fig. 3.86 *Holding the Golden Urn with energizer breathing.*

(4) Inhale and pack the Chi at the sacrum. Tilt the sacrum back.

(5) Inhale and pack up to T-11, tilting or pushing the T-11 to the back (or use a wall as a guide and push the T-11 to the wall) until you feel like a flexed bow. The power of the bow is felt as the T-11, in being pushed back, creates a tension in joining together with the C-7. Inflate the back with Chi pressure, contract the anus and pull up the urogenital diaphragm. Feel the energy rise from the soles K-1 to the T-11. Feel a big band or Chi Belt stretching from the T-11 to the Door of Life and then towards navel and lower abdomen.

(6) Inhale, contracting the anus more and lifting the genitals, drawing more energy up from the feet and packing it into the kidneys and C-7. (Fig. 3.87) Tilt the C-7 to the back (use the wall as a guide and push the C-7 to the wall) until you feel the C-7's strong connection to the T-11 and sacrum. Feel the full strength of the flexed bow as the Chi inflates the entire neck. Hold for a while.

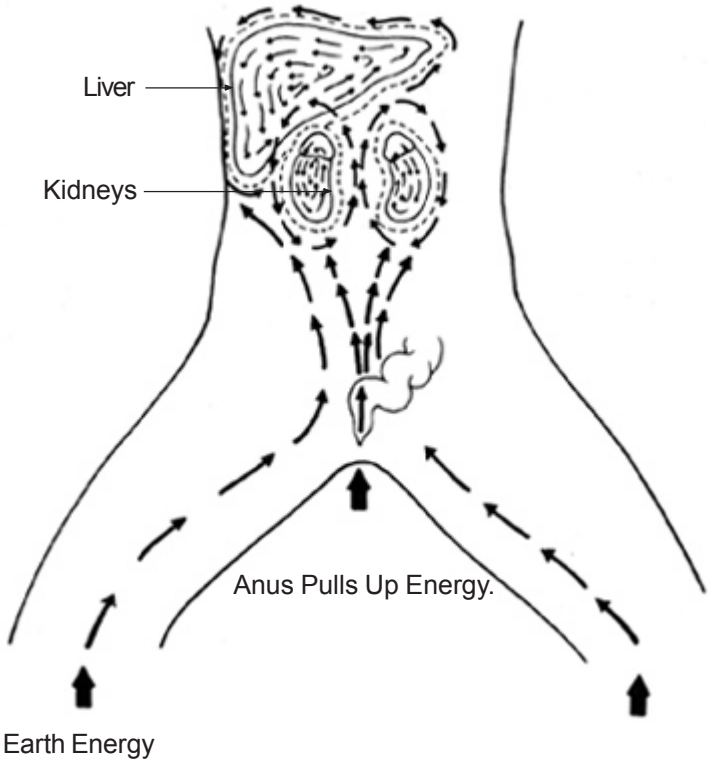

Fig. 3.87 *Draw the energy through the feet up to pack and wrap the kidneys.*

(7) Inhale and pull up more, tighten the neck and squeeze the cranial bones. Clench the teeth and press the tongue up to the roof of the mouth. Inhale. Pull the energy up to the base of the skull and squeeze more in the cranial bones. Tilt the neck to the back (use a wall as a guide by pushing the neck toward the wall). Feel the neck and the base of the skull have a strong connection with C-7, T-11, the sacrum, the knees, and the feet, and feel them become one flexed bow of strength. Inhale more and tighten, bringing energy up to the crown. (Fig. 3.88) Stop for a while, and exhale. Relax. Follow with the Yin Position.

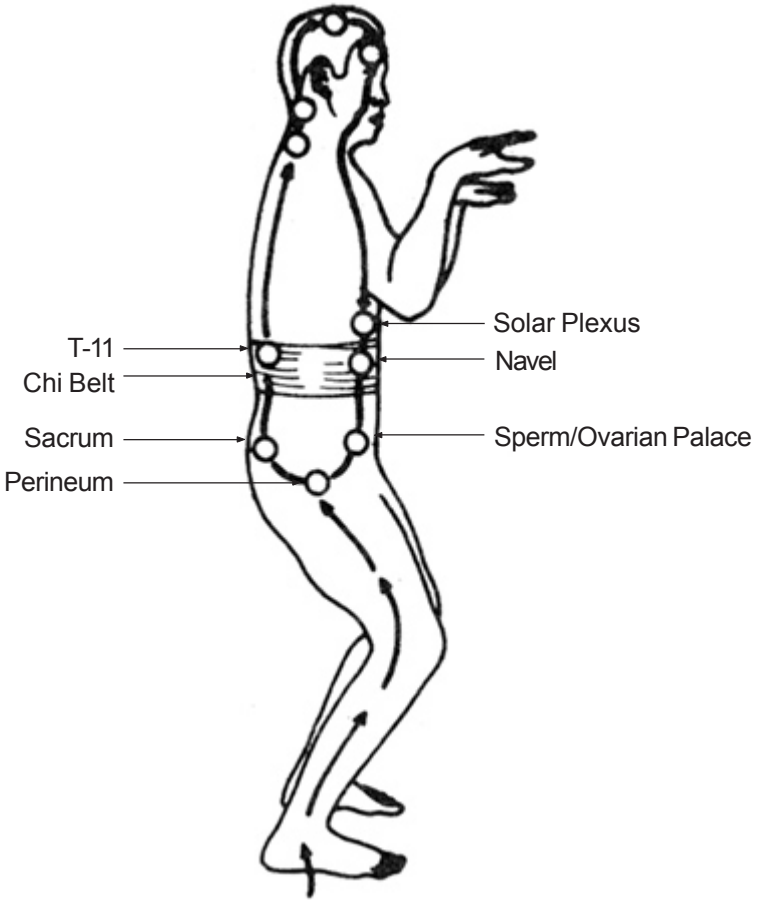

Fig. 3.88 *Flow of energy during Holding the Golden Urn*

c. Yin Position

(1) Turn the hands over palms up, and rotate the hands outward so that the thumbs now pull back and out to the ears with the wrists at 90 degree angles. Feel the stretch of the wrist tendons by locking the elbows and the wrists when turning the hands. The elbows sink in. The scapulae are rounded. When you stretch the thumbs, you are stretching the tendons. This is the Yin position. (Fig. 3.89(a) and (b)).

(2) Breathe normally. You should feel the energy rush up and over the head, into your arms and down the front of the body to the navel. Concentrate on the solar plexus. Make sure the energy is flowing down from the tongue to the solar plexus and navel along the Microcosmic Orbit. Considering an inhalation and an exhalation as one cycle, do nine cycles. Exhale more and inhale less. This is called Yin breathing. It will help to bring the energy down the front more easily.

Fig. 3.89 *(a) Holding the Golden Urn—Yin Position, Front View*

(b) *Thumb and Big Toe Lines*

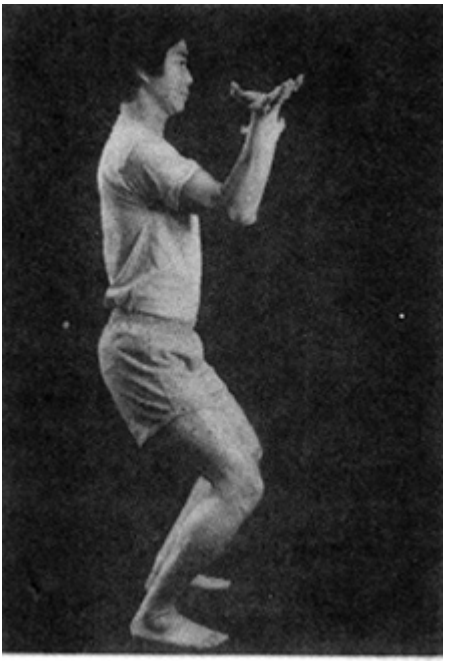

Fig. 3.90 *Holding the Golden Urn—Yin Position, Side View*

(3) Yin Position—side view (Fig. 3.90): When the thumb and toe lines are linked together they will connect all the muscles, tendons, bones, and the spinal cord to operate as a single structure. This will help the rooting power in the front energy line.

In the Yin position, the flow runs from the thumbs to the upper arms, and the big toes connect with the knees, navel and thumbs. The thumbs connect with the lungs and with tendons that run down the torso and the front of the legs to the big toes.

d. Holding the Golden Urn-Rooting Practice

Using his thumb and index finger your partner will press against your wrist and place another hand on your hip. Start with the left side, then do the right side.

e. Rootedness

(1) Yang Position Rooting: Assume the Yang position and pack in energy to the abdomen, the spinal cord, and up to the neck. Feel the strength of the spine, as a flexed bow. Now brace your tendon lines by extending your pinky fingers out very strongly. Have your partner attempt to push you out of the stance by gradually pressing against the wrist and the hip. (Fig. 3.91(a))

(a) Side Pushing

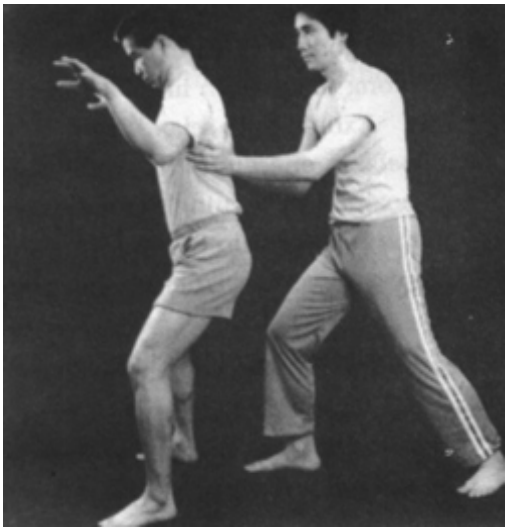

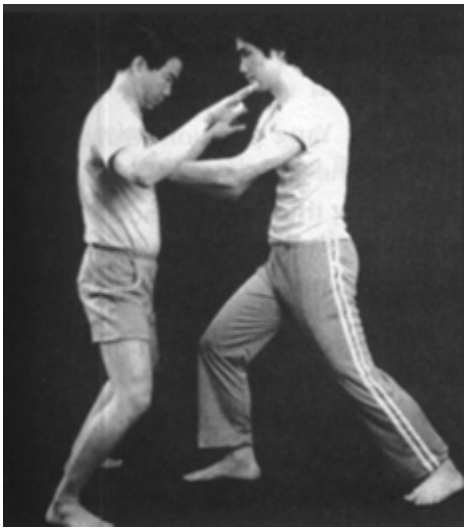

(c) Front Pushing will increase the thumb and tendon power

Fig. 3.91 *Front, Back and Side Pushing*

(2) Yin Position Rooting: With your bodies connected in Yang Position Rooting, turn your hands over and you can transform the force to the ground through the bone structure. The thumbs link with the big toes. You must feel the thumb gaining force. The whole front line, starting from the thumb and continuing to the arm, hand, front of the head, ear, arm pit, front of the hip, and the leg to the big toe, is connected and pitted against your partner's force. Have your partner attempt to push you out of the stance by gradually pressing against the wrist and the hip.

f. Back and Front Pushing

Back pushing strengthens the whole spinal cord, the pinky fingers and small toes, and the back fasciae. Return to the Yang position. Be sure to press the big and small toes down, and feel that you are exerting force on the small toes and on the small fingers. Have your partner push from the back while you assume the stance. (Fig. 3.91(b)) retain the stance and have your partner push your chest. (Fig. 3.91(c))

When the tendons are used properly, less effort is needed to maintain good structure. In the Yang position, notice the feeling of support along the tendon lines.

Exhale and relax. Begin by assuming the Yang position. Quickly pack in energy to the whole back and to the neck. Move into the Yin position by turning the hands over and pulling the thumbs back. Feel the relationship between the thumbs and big toes. Keep this awareness as your partner pushes you in the Yin position.

2. Summary of Holding the Golden Urn

a. Yang Position

(1) Stand with feet a knee-to-toe length apart; sink the elbows; hold the hands open at shoulder level with the palms down; lock the wrists; hold the hands at a 45 degree angle to the forearms; stretch out the pinky fingers so that you feel the energy in the small fingers; and feel the connection between the small fingers and the small toes. (The muscle-tendon meridian from the pinky fingers goes up the arms, up the side of the face and around the ears, down the outside of the arms, through the scapulae, down into the sacrum, and down the outside of the legs to the small toes.)

(2) Breathe below the navel (lower abdominal breathing).

(3) Exhale, pull up on the genitals, the perineum and the anus,

locking the knees and feet.

(4) Inhale and pack in the navel.

(5) Inhale and pack the middle abdomen.

(6) Inhale and pack the lower abdomen.

(7) Inhale, tilt the sacrum, and pack the sacrum.

(8) Inhale and pack T-11 and the kidneys' areas.

(9) Inhale, lock the neck, bring the energy up to C-7, and inflate the neck.

(10) Inhale to the Jade Pillow, squeeze the skull and the temple bones.

(11) Inhale to the crown.

a. Yin Position

(1) Exhale, turning the hands with the wrists locked, energize the thumbs, and bring the energy down. (The route from the thumbs goes down the inside of the arms to the collar bones, to the sides of the sternum, down to the navel and spreads out to both legs, down the inside of the thighs to the lower legs and to the big toes.)

(2) Place the hands over the navel, bring the feet together and relax.

(3) Practice the Bone Breathing Process.

3. Golden Turtle and the Water Buffalo

People with high blood pressure should consult a doctor before attempting this posture.

This posture energizes the toes and all the tendons of the toes and the fasciae of the thigh and the legs and strengthens the back fasciae, spinal cord, sacrum, kidneys, adrenal glands, neck and the head.

This position is called the ''turtle back''. The back will be energized like a blown-up balloon.

The workout given by this pose is equivalent to a headstand, but rather than blood flowing to the head, Chi is directed to the head, making it easier to direct and circulate the increased blood flow downwards.

Due to weakness in the thighs or tight hip joints, you may feel excessive strain when you first begin to practice the Turtle/Buffalo positions, even if you are not sinking very deeply into the position. If this is the case, practice with a chair or table in front of you on which to rest the arms. This support will enable you to gradually work into the position without straining yourself. (Fig. 3.92)

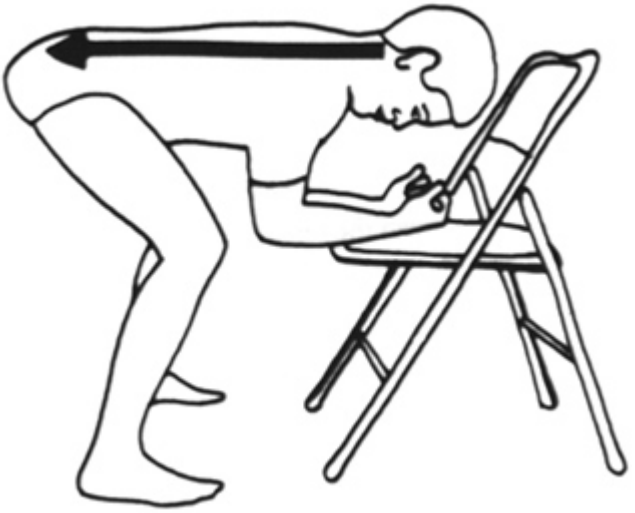

Note that the back is straight and parallel to the floor.

Fig. 3.92 *Turtle/Buffalo Position—Side View*

It is very important to keep the back straight and parallel to the floor. It may be difficult to feel when this is happening at first. Practice occasionally in front of a mirror to help develop the inner feeling of this occurrence.

a. The Golden Turtle Immersing in Water-Yang Position

(1) Place the legs in the standard stance.

(2) Begin Energizer Breathing. Breathe in and out nine to eighteen times, inhaling more, exhaling less. When exhaling, keep the abdomen flattened to the spine.

(3) Inhale. Tighten the fists, fold the forearms against the upper arms, round the back, and sink the chest. Exhale and bend forward with the back straight so that the line made from the coccyx to the top of the head is horizontal to the floor. (Fig. 3.93)

(4) Keep the forearms folded onto the upper arms, resting in front of the chest. (Fig. 3.94) Keep the armpits open to make a space big enough to accommodate an object about the size of a pigeon egg. Round the scapulae. The back feels like a turtle and is energized with Chi.

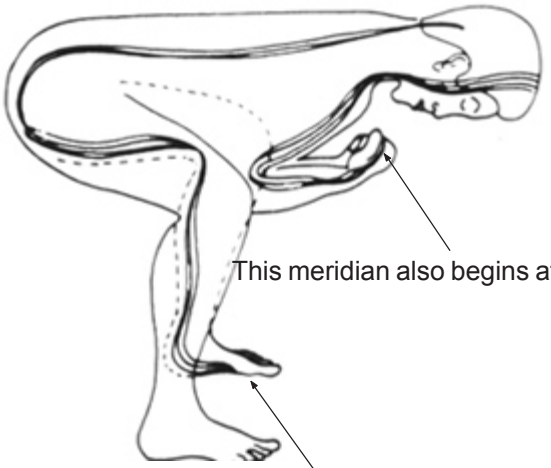

This meridian also begins at the tip of the index finger.

This meridian begins at the little toe and runs beneath the foot ascending though the inner side of the leg to the genital region.

Fig. 3.93 *Muscle-Tendon Meridian in the Turtle Position*

Fig. 3.94 *Position of Forearms during the Golden Turtle*

(5) Lock the sacrum and open the knees so that you can feel the weight of the body sink down to the hips, to the knees, to the feet and, finally to the ground. The spine should be horizontal to the ground. Pull the energy into the groin area where the sexual energy is. Tuck in the chin and set the neck firmly in position. Press the elbows against the inside of the knees. With the elbows, press out against the knees, while the knees press in, equalizing the force. Neither should press harder than the other.

(6) Inhale ten percent and pack the energy in the abdominal region (navel). Hold until you are out of breath.

(7) Inhale and pack down to the lower abdomen.

(8) Inhale, pack at the perineum and pull on the sexual organs more tightly. Pull the Mother Earth energy up to the perineum.

(9) Inhale, pack at the sacrum and tilt the sacrum. Pull up the sex organs more firmly.

(10) Inhale, pack at T-11, the kidneys and adrenal gland areas. Tilt the T-11. Feel the entire spine as a fully flexed bow . Inflate the lower back with Chi pressure and energize the kidneys.

(11) Inhale, pack at C-7. Tighten the neck and the cranial bones. Clench your teeth.

(12) Inhale up to the crown. (Fig. 3.95)

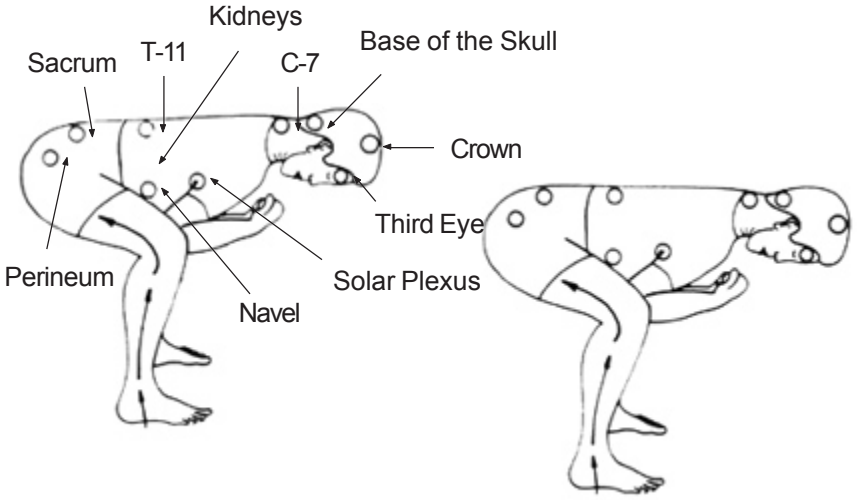

Fig. 3.95 *Packing the energy during the Golden Turtle.*

See Fig. 3.96 (a) through (k) for additional exercises utilizing Golden Turtle Position.

(a) From the basic stance, with the outside edges of the feet parallel, squat down, placing the elbows between the knees with the palms together. Keep the back as parallel to the floor as possible and your eyes looking up. Press out with the elbows resisted by the knees. Press and resist for two seconds, then release and relax.

(b) Hook both elbows around the outside of the legs with the forearms behind the knees (Front view).

(c) Side View

(d) Clasp the forearm or elbow with the opposite hand. Bring the head and tail down and toward each other as if looking at your tail. This is very important for protecting your back. Let the shoulder blades be your uppermost point.

(e) Pull up strongly, forcing the T-11 and mid-back upward against the resistance of the thighs, head and sacrum. Pull and resist for only two seconds and relax.

Fig. 3.96 *Following are additional exercises in the Turtle Position.*

For maximum results, they should be practiced in the sequence given, repeating the entire sequence three times.

(f) Unlock the arms and bring them to the sides with the forearms rotated so that the palms face the floor. Pull the shoulder blades together.

(g) Bring the elbows and head up.

(h) Press the elbows up hard, lifting the head and looking forward while pressing the sternum forward. Hold two seconds and relax (Side View).

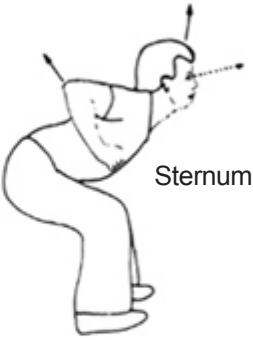

(i) Front View

(k) Keep looking at the floor while you pull your ear and tail to the side opposite the knee you are holding, resisting with the knee. After two seconds, place the hand on the floor, wag the tail to relax, and then repeat the exerciseon the opposite side.Again, wag the tail to relax the spine. During the exercise, the whole column from head to tail should form a curve like the letter “C” parallel to the floor and you should feel a stretching on the sides of the spine and the neck.

(j) Lock the arms around one knee, clasping the elbows around one knee while looking at the floor.

b. Water Buffalo-Yin Position

(1) When you have packed the energy to the head, exhale and look slightly up by moving the neck up, thereby relieving the tension of the lock in the neck. Extend the arms down in front of you with the backs of the hands facing frontwards and the fingertips touching the perineum and the anus or touching the ground. Keep the groin (genital area) open. (Fig. 3.97)

(2) Practice the open groin breathing process. (Fig. 3.98) Relax, keeping the tongue up. Inhale less, exhale more, breathing right into the groin area. In this position, the groin is open and you can breathe down to the lower part of the body which greatly energizes the sexual organs and increases circulation tremendously. Breathe easily and feel the energy descend to the navel and perineum, activating and strengthening the circulation of the lower abdomen. The urogential and pelvic diaphragms, which hold the sexual organs, bladder, and large and small intestines in place, become activated as well.

When your breath has normalized, close your eyes. Slowly bring yourself to a standing position. Remember when you get up, do so very slowly to avoid dizziness. Stand erect. Work up some saliva and, tightening the neck, swallow down to the navel with a guttural sound. Feel the saliva shoot down to the navel and burn with Chi power. Normalize breathing and place the hands over the navel. Collect Chi in the navel.

Practice Bone Breathing to absorb Chi into the bones. Meditate standing for a while. If you wish, work on circulating the Chi in the Microcosmic Orbit. Then walk around, shaking out the legs and brushing down the chest.

c. Turtle Position—Rooting Practice

In the Turtle Position, the elbows are held in tightly pressed against both thighs so that you can feel the energy concentrated in the groin area. The spine is horizontal to the ground. (Fig. 3.99) Pack Chi along the whole back. Have your partner stand on the left side with his one hand on your shoulder and his other hand on your hip. (Fig. 3.100) When your partner pushes you, lock the sacrum. Open the knees slightly and adjust the feet to align the force of your partner down to the ground. Become one with the earth. Gradually push and increase to whatever pressure you can take. The bone structure is like a sponge absorbing the force and transferring it to the ground.

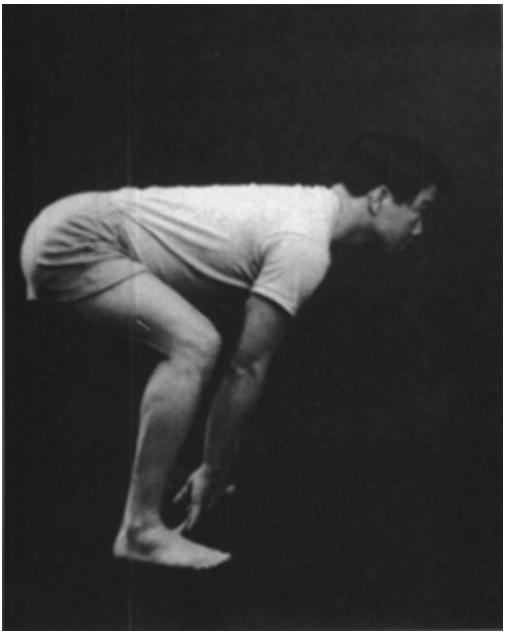

Fig. 3.98 *Buffalo—Right Side View*

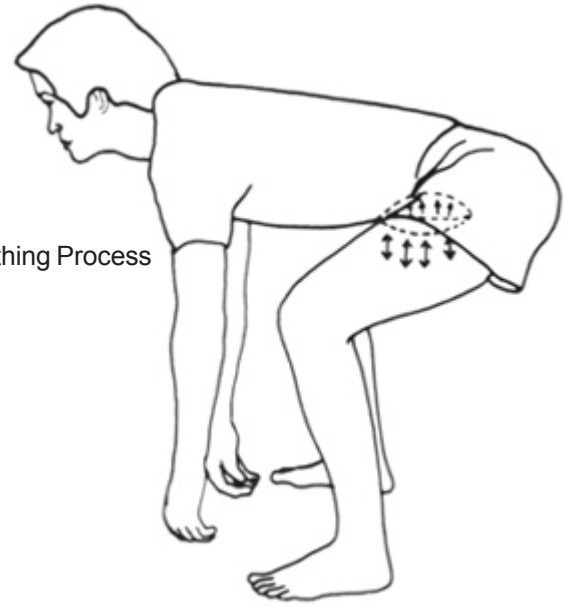

Fig. 3.98 *Buffalo—Left Side View*

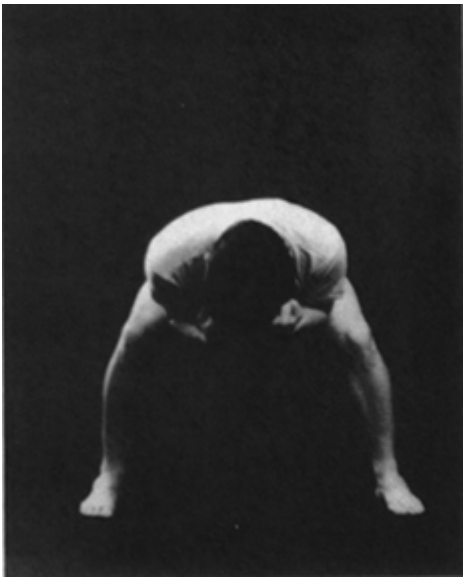

Fig. 3.99 *Turtle—Front View*

Your partner should not continue to push when you are out of breath and about to rest. Once you become adept in this practice and you feel your body's structure as one piece, you will feel the muscles relax and find no need for Packing Breathing. If you simply concentrate on the Chi flow and relax, the force will pass through the bone structure.

Change sides and let your partner push you gradually. (Fig. 3.101) The purpose is not to push you over, but to let you feel where the force comes from so that you can redirect the force to the earth. When the force is started gradually you are able to feel where the force is going, permitting you to re-align or relax that part to let the force pass through.

Always balance out both sides by having your partner push on both the left and right sides. Remember one side is generally stronger than the other.

Once you can successfully redirect the force from any part of your body, you will start to know how to reabsorb the force from the earth. The force that your partner pushes you with, when directed to the earth, can be reabsorbed back from the earth and becomes more powerful than before. This energy can be used for self-healing, or to counteract your partner's pushes. In the higher level, you can pass that force to your partner to heal him or her as well.

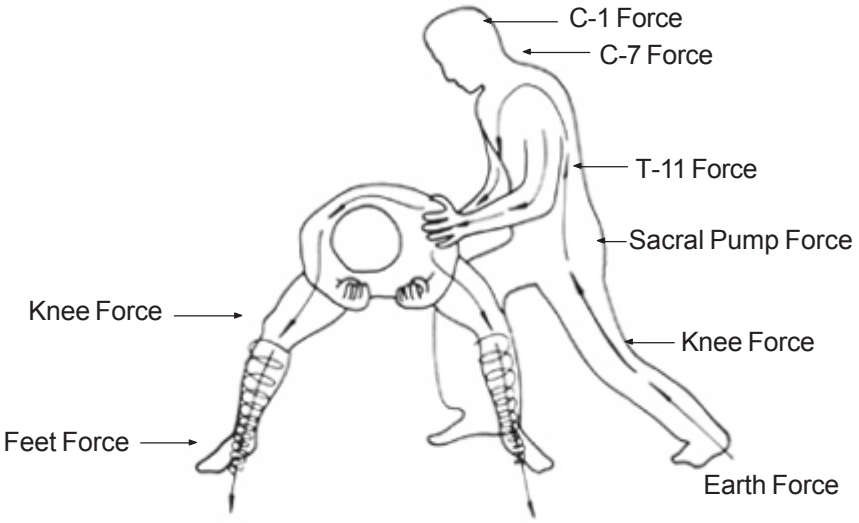

Earth Force is transferred down to the ground.

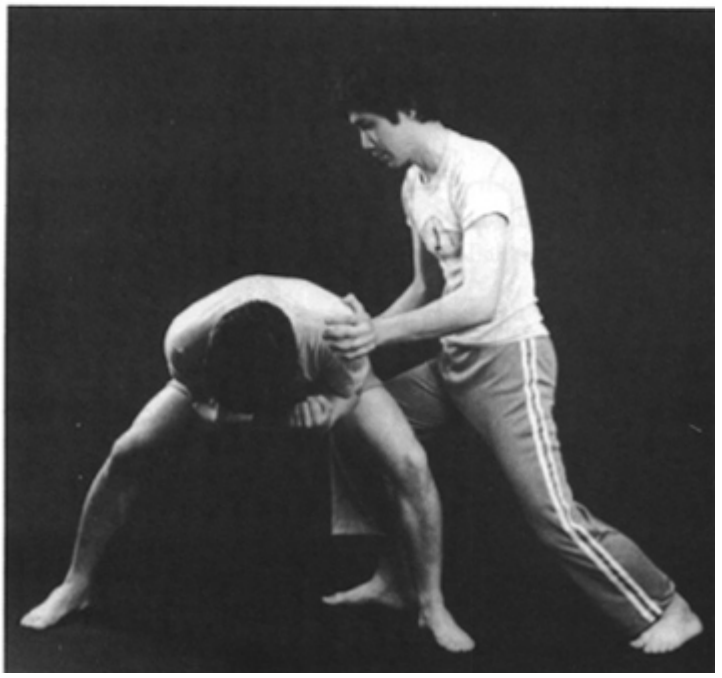

Fig. 3.100 *Rooting practice during the Golden Turtle—Left side position.*

Fig. 3.101 *Golden Turtle—Right Side Position*

After each pushing, go back to the Buffalo Position. The chin is up, the shoulders relax, the hands drop down to near the groin area, or touch the sexual organs to strengthen the pelvic and urogenital diaphram energy. Breathe deeply to the groin area to strengthen the sexual/creative energy.

The Turtle Position strengthens the whole back and spine. When your partner pushes from the left, you feel the force go from the left shoulder pass the scapula to the spine, to the right scapula, down the spine to the hip, to the right thigh, the right leg and foot and down to the ground. At the same time, feel the sole breathing and "claw" down with the toes into the ground.

If the pressure is too much, the left foot will uproot. Push down the left foot by exerting more pressure on the hip down to the thigh and the leg.

Partners should be roughly equal in size, stature and strength for pushing.

d. Turtle/Buffalo-Front Rooting Practice

Your partner should place one hand on each shoulder and gradually push you in order to strengthen the frontal aspect of this posture. (Fig. 3.102) To maintain this difficult position, you must gradually feel the connection of the shoulders to the scapulae and the spine to the sacrum and the hips. Front rooting requires more practice. The soles and feet are very important to front rooting. With practice, you can maintain the feet's firm contact with the ground.

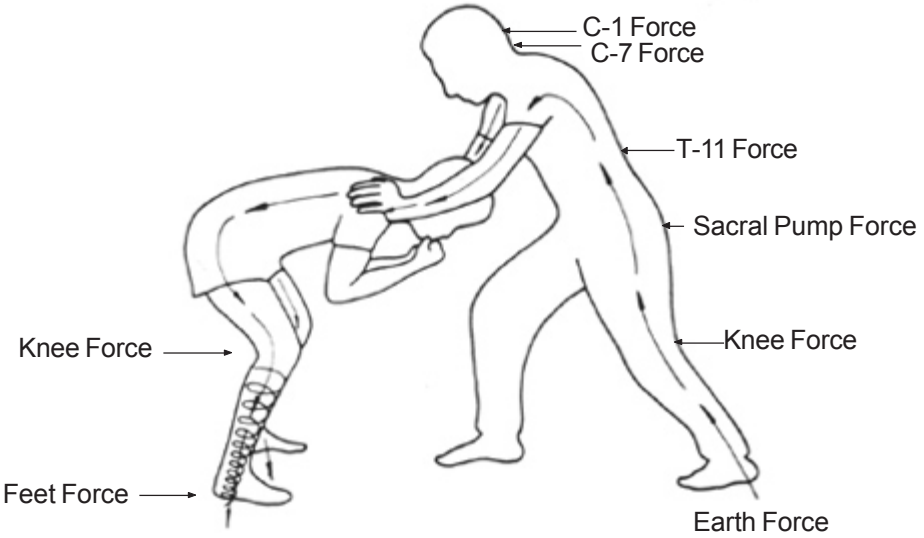

Force transferred though the bone structure into the ground.

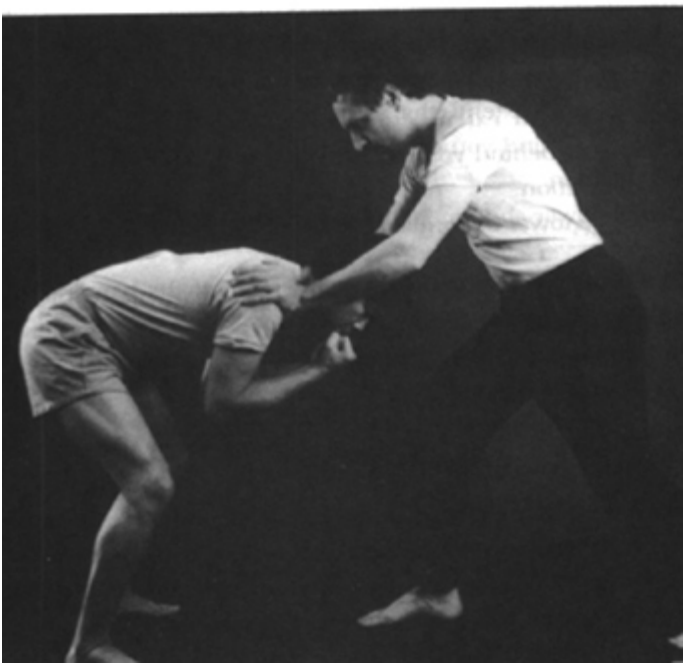

Fig. 3.102 *Turtle/Buffalo— Rooting Practice*

4. Summaries of the Golden Turtle and the Water Buffalo

a. The Golden Turtle Immersing in Water (Yang Position)

(1) Place the tongue on the roof of the mouth.

(2) Practice lower abdominal breathing in a standing position.

(3) Bend forward with the back straight, bend the arms in close to the body, maintain the continuing line of the spine through the neck. and clench the fists.

(4) Inhale and pack to the navel.

(5) Inhale and pack to the middle abdomen.

(6) Inhale and pack to the lower abdomen.

(7) Inhale and pack to the perineum.

(8) Inhale and pack to the sacrum.

(9) Inhale and pack to the T-11.

(10) Inhale and pack to the C-7.

(11) Inhale and pack to the Jade Pillow.

(12) Inhale and pack to the crown of the head.

(13) Inhale and pack more along the back.

b. Water Buffalo Emerging from The Water (Yin Position)

(1) Exhale and regulate your breathing.

(2) Head and eyes should be looking up, but not straining. Keep the back level and extend the arms with the hands towards the ground slightly behind you or touching the groin area. Maintain the same back position.

(3) Practice lower abdominal breathing while focusing on the genital area.

(4) Close the eyes and gradually stand up. Put the hands on the navel area and collect the energy.

(5) Practice the Bone Breathing Process.

(6) Muscle Power Exercise.

5. Golden Phoenix Washes Its Feathers

The Phoenix Position strengthens both sides of the ribs, from the armpits down to the sides of the hips and packs Chi pressure into all the major organs. On the left side, pack, wrap and squeeze the Chi to the left kidney, spleen, left lung, and heart; on the right side, you are strengthening the right kidney, liver and right lung, (Fig. 3.103)

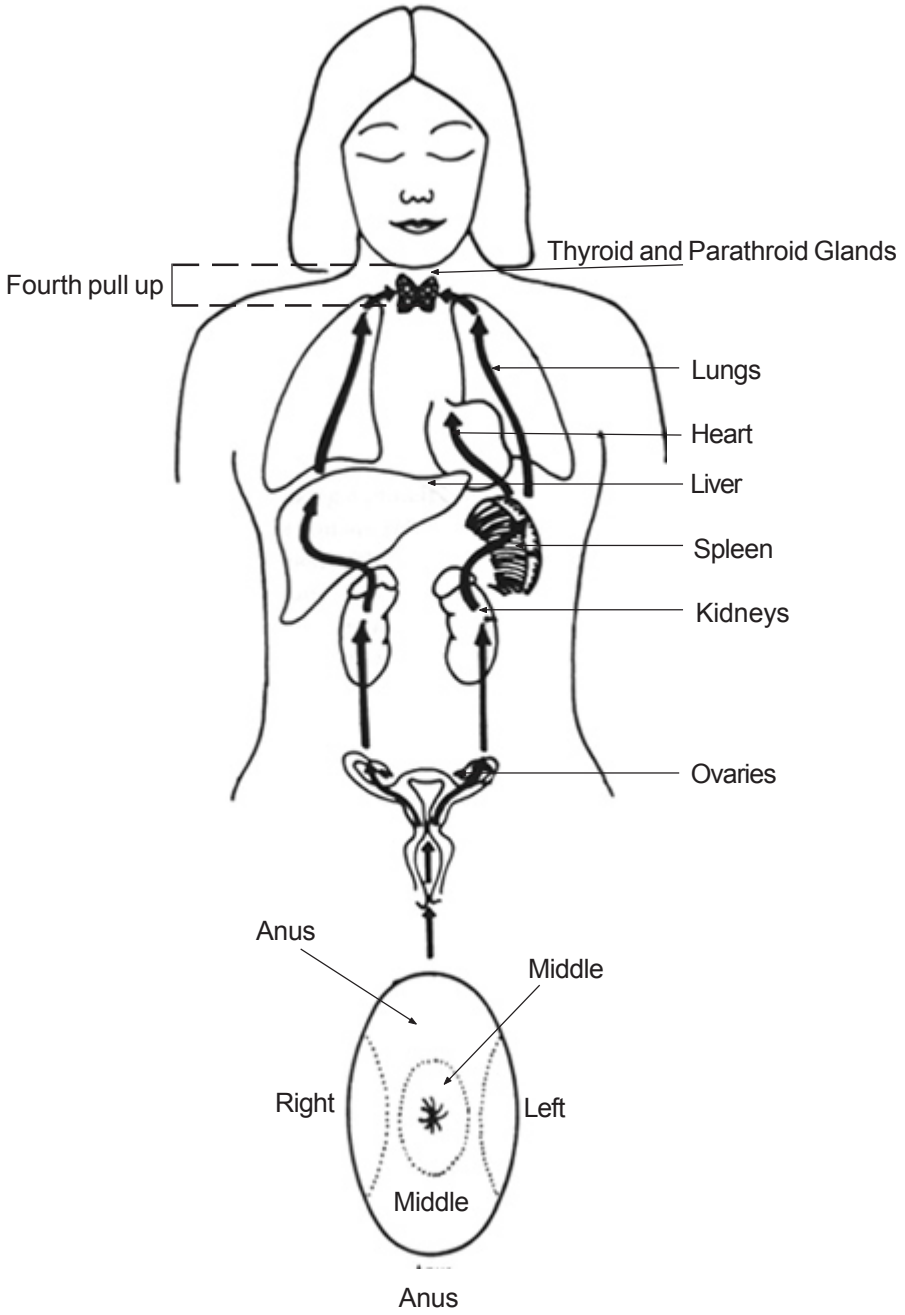

Fig. 3.103 *Wrap and squeeze Chi into all of the major organs.*

The Phoenix Exercise also exercises the fingers, toes, tendons and the tongue (which is one of the main tendons of the body.) You will also exercise the tendons of the whole body. The pinky fingers are small, but can activate many tendons, especially along the sides of the body.

a. Practice

(1) Assume the Iron Shirt Horse Stance. (Fig. 3.104(a)) Place your arms at your sides. Practice the Energizer Breathing to fan up the energy.

(2) Sweep the arms out to both sides and turn them over so that the wrists are straight. (Fig. 3.104 (b)) The palms begin to face up and are turned in towards the body as though you were gathering something up under the armpits. The pinky fingers are pointed up toward the ceiling. (Fig. 3.104 (c)) Feel the pull of the tendons all the way up the arms to the ears, circling the ears, and down the sides of the body to the small toes. The scapulae are rounded. The neck muscles and the trapezius muscles are relaxed so that the hands and the arms are connected. The elbows are bent out to the side.

(3) Inhale while you pull up the left and right sides of the anus and bring the sexual energy from the testicles/ovaries to the kidneys. Pack in energy to the kidneys and to the level of the adrenals which are located at the top of the kidneys on about the same level as the solar plexus. Bring the palms up along the sides of the body feeling the tension and the pull of the tendons on the insides of the arms up to the elbows, the pinkies and the thumbs.

(4) Inhale higher toward the armpits, pulling the sexual energy from the testicles/ovaries to the kidneys and up to the spleen on the left side and the liver on the right side. Hold and pack the Chi in the organs and then wrap the Chi around them. The palms still face up and the pinky fingers' tendons stretch toward the ceiling. Inhale and get closer to the armpits, pulling the sexual energy up to the heart, and to the lungs. Fill the lungs with Chi.

(5) Feel the whole rib cage and the armpits bulge up, filled with Chi. (Fig. 3.104(d))

(6) When you get as close to the armpits as you can (Fig. 3.104(e) and (f)), exhale while maintaining the contraction in the anus and the pull on the genitals. Rotate the hands medially. Face palms out (Fig. 3.104(g)), pulling from the scapulae which are connected to the earth. The forearms are straight; the elbows are

back; the wrists are locked; the knees are open. Push from the sternum to C-7 in order to feel the force come from the earth up into the heels, the sacrum, the spinal cord, the scapulae and the hands. (Fig. 3.104(h)) As you push, extend your arms and exhale using the First Healing Sound, the Lung Sound "***Sssssssss***". (A complete explanation of the Six Healing Sounds is provided in the book *Taoist Ways to Transform Stress into Vitality*.) From the palms of the hands to the heels of the feet you will feel like one piece. This is what is meant by "structure".

(7) When the arms are fully extended (Fig. 3.104(i) and (j)), inhale and contract the middle of the anus and pull up the sexual organs. Feel the pull at the tip of the fingers of both hands. Gather the fingers to the thumbs and press them together in a small point by exerting more force on the pinky fingers (which should be in the middle with all the fingers pressed against it), and more force on the tips of all the fingers. (These finger positions are called "beaks"). (Fig. 3.104(k)) Feel the pulling force in the anus and in the tips of the fingers combine into a single force.

(8) Inhale, pull the "beaks" inward from the elbows and contract the middle part of the anus. (Fig. 3-104(l)) Feel the force of the anus and the sexual organ pull the "beaks" in.

(9) Inhale again, pulling the "beaks" closer to the body, further tightening the anus and genital area. (Fig. 3.104(m)) While inhaling, pull the elbows and the wrists near the chest with the "beaks" pointed out.

(10) Exhale as you open the "beaks", extend the arms in front of you and then spread the fingers wide apart. (Fig. 3-104(n)) Exhale, using the Second Healing Sound, the Kidney Sound "W0000000", and lower your arms in front of you, the heels of the hands leading the way with the action originating from the shoulders. (Fig. 3-104(o)) When the arms have reached the sides of the hips, lock the elbows, keep the fingers spread apart and rotate the hands laterally out to each side. Flex the finger tendons out, especially the pinky fingers and the thumbs. Spread the toes out, especially the small toes. At the same time, extend the tongue out as far as you can to the chin. (Fig. 3.104(p)) Direct your eyes to look at your nose. Feel the tongue and the sexual organs pull up as one line out to the tongue. Finally, turn the big toes and the heels inward, and then make the feet move towards one another by taking "steps" leading with the big toes and alternating with the heels until the feet come in together. This will exercise the feet tendons.

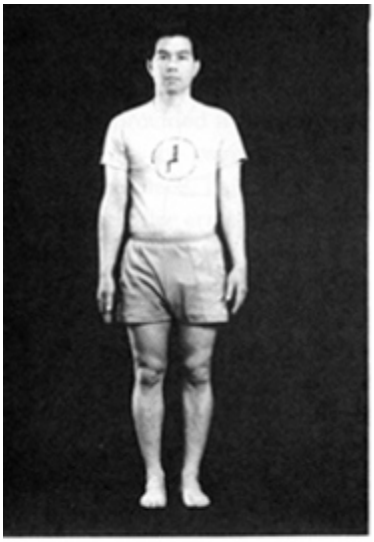

(a) Assume the Iron Shirt Horse Stance. Place your arms at your sides. Practice the energizer breathing to fan up the energy.

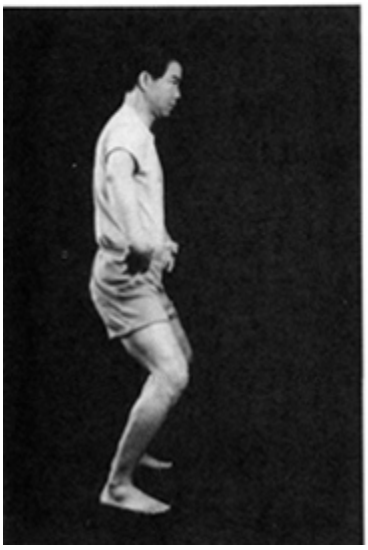

(c) Palms face up and are turned in toward the body with the pinky fingers point up.

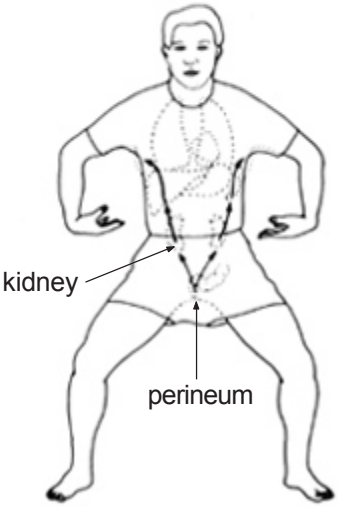

(d) Pack the energy in to the testicle /ovaries, into the kidneys, then into the spleen on the left side and the liver on the right side. As you continue to pack and pull the energy up to the heart and to the lungs, you will feel the rib cage bulge up.

Fig. 3.104-A *Phoenix Exercise*

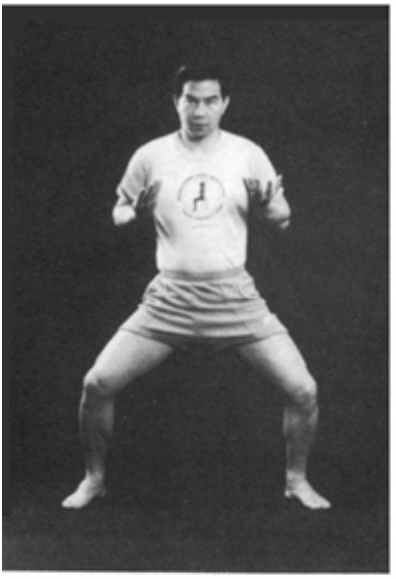

(e) Palms continue to face up.

(f) Side View

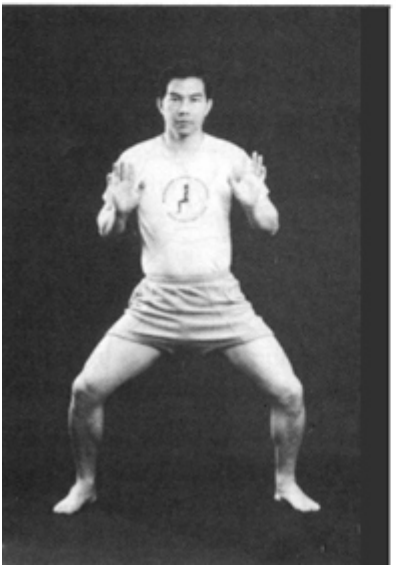

(g) Rotate the hand medially.

(h) Push from the C-7 by sinking down the sternum and pressing towards the back.

Fig. 3.104-B *Phoenix Exercise*

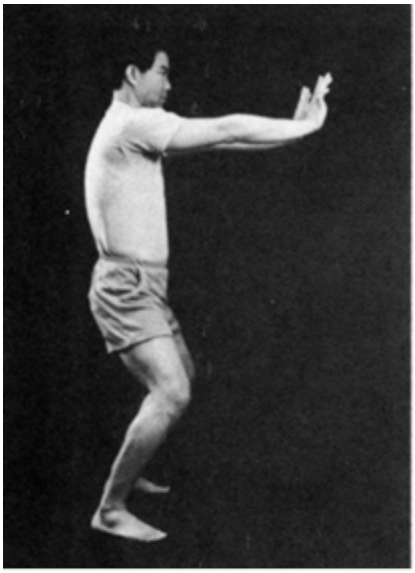

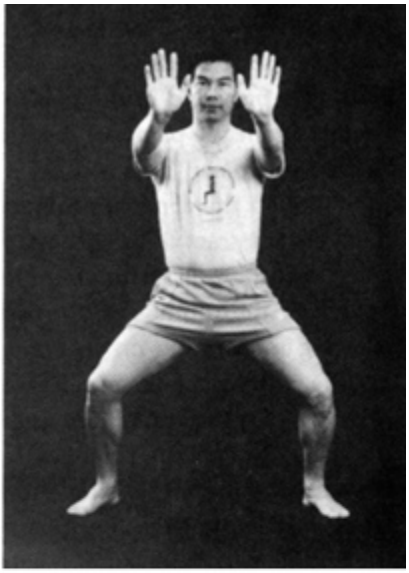

(i) Push the fully extended arms. (Side View) (j) Front view of arms fully extended

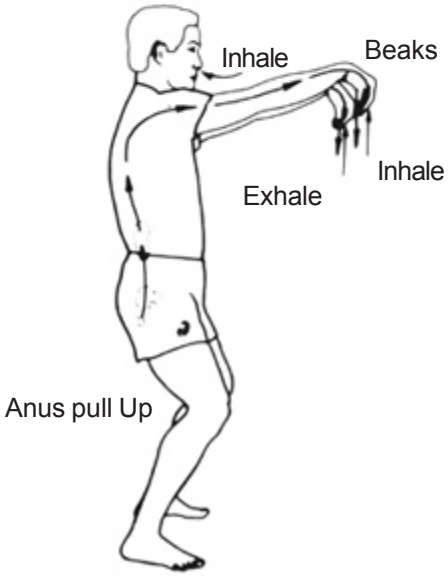

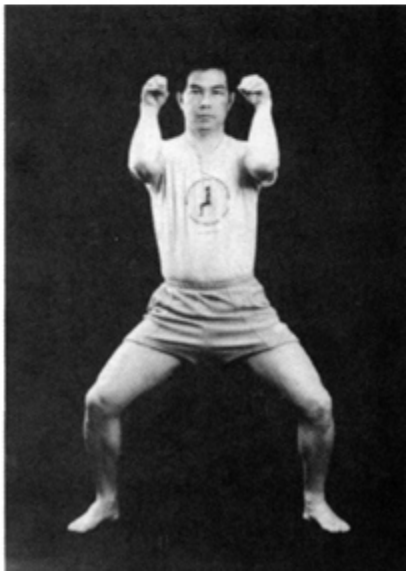

(k) Gather the fingers and form “beaks”. (l) Front View of pulling the “Beaks”

Fig. 3.104-C *Phoenix Exercise*

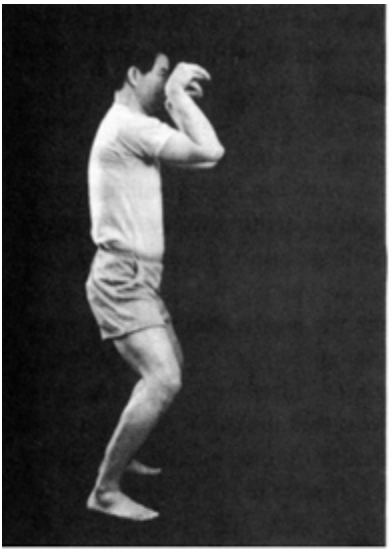

(m) Side view of Pulling the “Beaks”

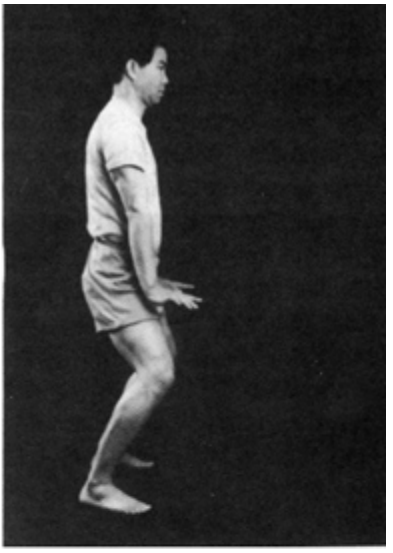

(n) Exhale, Release the “Beaks”. Press your arms against the front of your body.

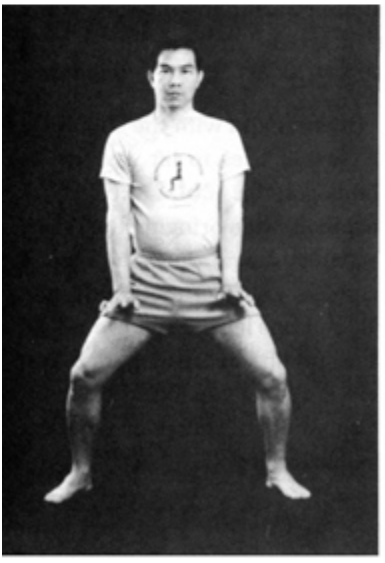

(o) Front View of the Arms Pressed Down

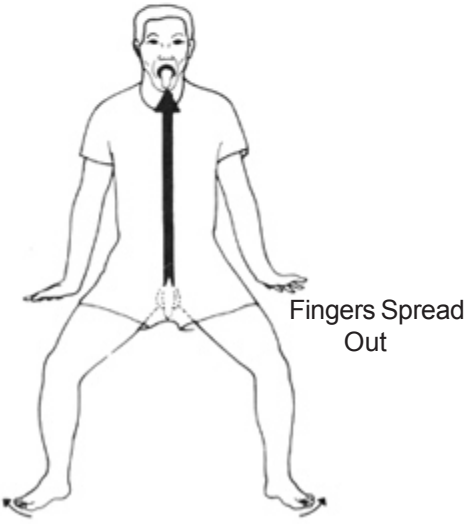

(p) Sexual organs are connected to the tongue.

Fig. 3.104-D *Phoenix Exercise*

Repeat steps (6) through (10). This time, however replace the Lung Sound in Step (6) as you push your palms out straight in front of you with the Third Healing Sound, the Liver Sound "***Shhhhhhh***". Replace the Kidney Sound in Step (10) as you are lowering your arms in front of you, with the Fourth Healing Sound, the Heart Sound "***Hawwwwww***". Repeat steps six through ten one more time. Replace the Lung and Liver Sounds in Step (6) with the Fifth Healing Sound, the Spleen Sound "***Whoooooo***". Replace the Kidney and Heart Sounds in Step (10) with the Sixth Healing Sound, the Triple Warmer Sound "***Heeeeeee***".

You should feel connected through the legs, spinal tendons, scapulae and arms.

(11) Spread the fingers apart and extend the arms. (Spreading the fingers enlists the use of tendon power.) Feel the force come out from the scapulae. Relax. Feel the Chi spread out to all the tendons of the hands, legs, and tongue. The tongue connects to the tendons.

b. Rooting Practice of the Golden Phoenix:

Feel the Force Transfer from the Hand to the Ground

Practice the Phoenix Exercise and extend the arms out. Lock the elbows. Lock the wrists. Round the scapulae. Pull up the middle anus and the genital area. Open the knees. Feel that the palms and feet are connected to the ground. Have your partner use his palms to hit your palms. If you are well connected and are relaxing the muscles of the neck, you will feel the force travel to the ground.

c. The Lift Up Connected Practice

This exercise requires a locked wrist and hand with the shoulders and scapulae connected while your partner tries to lift you up. Be cautious because you can be hurt in this practice.

Lower the arms, shoulders and scapulae while bringing the hands to the sides of the thighs. Place the palms down, draw the elbows back, lock the wrists, round the scapulae, and feel the connection with the spinal cord. Have your partner put one leg between your legs, his palms turned in against your palms and lift you up. (Fig. 3.105) Find a partner who is your height. Make sure that you lock the elbows, the wrists and the scapulae; otherwise you can hurt your wrists or scapulae, and your partner will be unable to lift you.

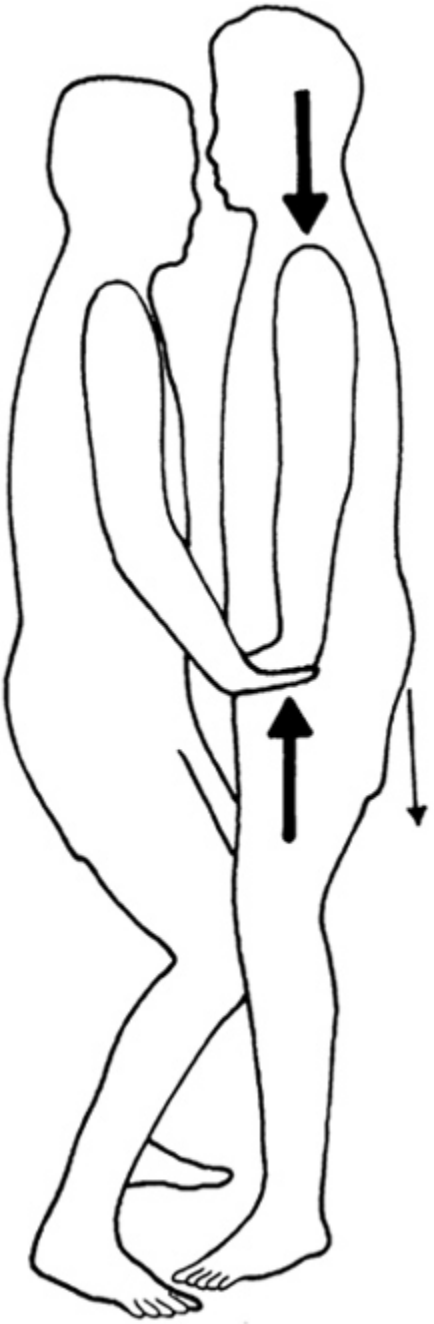

Fig. 3.105 *Lift Up Practice*

b. “Beaks” Rooting Practice

Extend the arms and form “beaks”, connecting the arms with the scapulae, the spine, the legs and the feet. Have your partner push the wrists, and feel the force transfer to the ground. (Fig. 3.106)

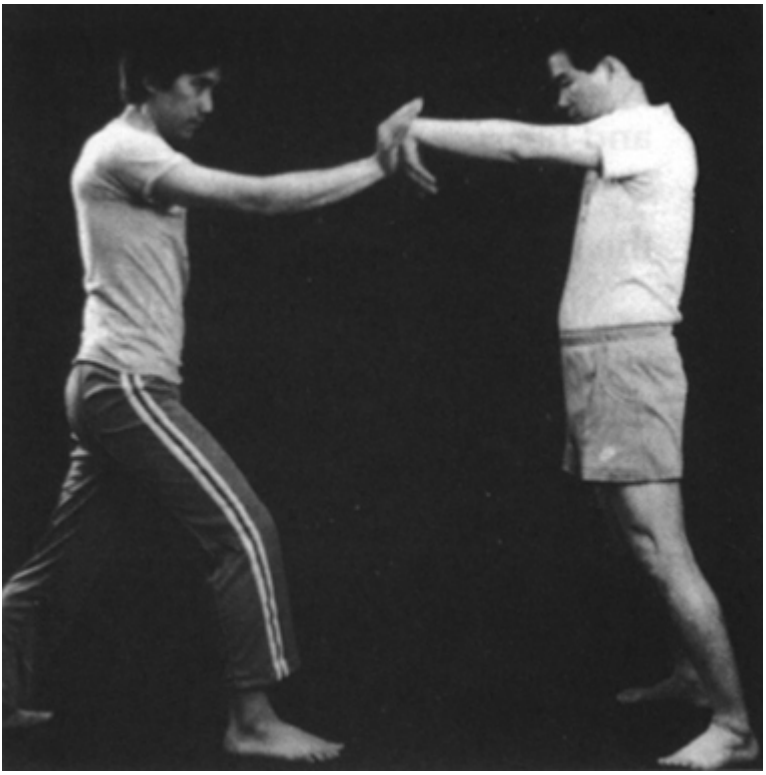

Fig. 3.106 *“Beaks” Rooting practice*

6. Summary of the Golden Phoenix Washes Its Feathers

a. Practice lower abdominal breathing in a standing position.

b. Place your arms in front of your body with the backs of the hands facing each other. Inhale and allow the arms to sweep out to your sides, pointing the fingers towards the ribs, and pull up the perineum and anus. Pack into the fasciae on the sides of the ribs and pack into the kidneys. Inhale, raising the hands up along the sides. Pack and wrap the Chi into the liver and spleen. Inhale once more raising the hands higher and pack and wrap the Chi into the lungs and heart.

c. Exhale, keeping the perineum and anus closed while pushing the hands out at shoulder level. Keep the wrists flexed.

d. Inhale and tighten at the perineum and anus. Form 'beaks' with your fingers and bring them in toward the shoulders. Repeat twice more, raising the "beaks' a little higher each time.

e. Exhale, releasing the perineum and anus and lowering the arms while simultaneously straightening and locking the elbows and knees. When the hands are down with the wrists flexed, turn the hands out to the sides of the thighs and spread the fingers and toes out as much as possible. Thrust the tongue and pull up the anus and sexual organs.

f. Collect the Chi energy at the navel.

g. Practice the Bone Breathing Process.

7. Iron Bridge

The Iron Bridge is designed to strengthen the front and back fasciae. By stretching the fasciae from the pelvis to the neck and both sides of the rib cage in this exercise, you will greatly increase the flow of Chi between the fasciae and will tone up the front and back muscles considerably.

Arching the spine backwards greatly strengthens the lower spine, especially the lumbar region. By stretching the upper back and spine opposite to the normal direction of its curve, the backbend will help to lessen the often excessive forward curvature of the upper back, limber the shoulder joints, and open the chest. The point to remember is that the bend is from the upper back and not from the hip.

a. Iron Bridge Standing Position - Yang Position

This position will create a tremendous amount of Chi energy which will rise up the spine to the head.

(1) Stand, keeping the knees straight and the feet one foot apart. It is best for beginners if the feet are placed so that they point straight ahead along the second toes. If the toes turn out, there may be unnecessary compression in the lower spine, even if the knees are locked and the thighs and buttocks tightened. The thumbs and index fingers are touching each other and the remaining three fingers are held together. Keep the hands straight, low and slightly in front of the body.

(2) Begin abdominal breathing; exhale and flatten the abdomen. Inhale to full capacity. Bring the hands up and to the back, bend the elbows back, and place the palms up. (Fig.s 3.107(a) and (b)) Fingers should be about two inches apart and will rise close to the scapulae. This will open the sternum, activate the thymus, stretch the thyroid, the parathyroid, the chest and the side fasciae.

(3) Any accumulated tension in the chest and abdomen can be released. Hips stay over the feet. It is most important to arch the upper and middle back and not the hip. This will stretch the front fasciae. Excessive arching of the hip and lower spine can damage the discs between the vertebrae and pinch the nerves because of the excessive weight. Also, if the arching in the Iron Bridge is mostly from the lower spine, there will be much less stretching of the fasciae in the front of the torso. To keep the lower spine protected, it is necessary to arch the back strongly from the upper spine while firmly tightening the thighs and buttocks. By strongly tightening the thighs and buttocks, you can feel that you are squeezing the sacrum down, thus lessening the compression in the lower spine. The knees should be firmly locked and straight. This will allow the thighs and buttocks to be very firmly tightened.

(4) Clench the teeth. As you arch back, begin with the head. Rotate the head back from the upper neck, until you feel the front fasciae of the neck stretching. Do not let the head drop back as this is very bad for the neck vertebrae. If done properly, you will still feel that the neck is elongating upwards, even while it is rotated back. If there is any discomfort whatsoever; you are either practicing incorrectly or trying to stretch back too far.

Look back, locking and pulling the neck fasciae. (Fig. 3.107(c)) As soon as the front of the neck has stretched properly, you will feel an automatic lifting at the chest which, as it stretches up, will then automatically stretch the abdomen. As the abdomen stretches, push the pelvis forward, keeping the thighs and buttocks very tight. As you stretch the chest, feel that the breastbone is being pulled forward and up. In this way, the upper back will be arching, rather than only the lower spine. (Fig. 107(d))

If done properly, you will feel the fasciae being stretched from the groin up to the chest and the neck, pulling tight as a drum without having to arch very far back.(Fig. 3.107(e) If you are arching very far back, then you are inevitably overarching the lower spine. (Fig. 3.107(f))

(a) Standing Position

(b) Back View of the Standing Position

Fig. 3.107-A *Iron Bridge*

(d) Arch the upper and middle back.

(c) Look back and pull the neck fasciae.

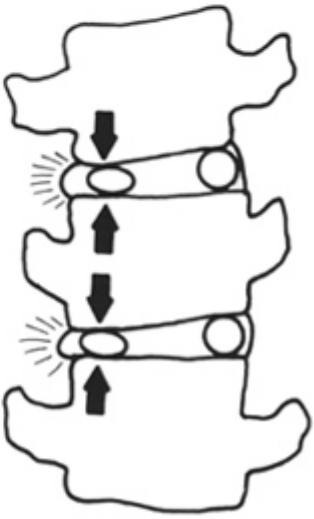

(e) Stretch is felt beginning at the second, third and fourth toes up the back to the spine, and up the front until it ends at the sides of the nose.

(f) Excessive arching of the hip and lower spine can damage the discs.

Fig. 3.107-B *Iron Bridge*

If your upper spine is not very flexible, or has a large forward curvature, then you may look as if you are hardly arched back at all when you first practice, though you will still be able to feel a stretch across the front torso. Remember that no matter how flexible you are, you will not arch very far back if you are practicing properly. It is a good idea to practice this upper body stretch while sitting until you can do it well before practicing in a standing position.

Remember also that if you bend too much initially, you may fall back. In the beginning, have a partner look after you when you bend back to steady you, if necessary.

(5) Squeeze the thumb and index fingers together and tighten the muscles of the arms and shoulders. This will stabilize your position.

(6) Hold your breath and maintain this position for 30 to 60 seconds.

b. Iron Bridge Resting Position - Yin Position

(1) Exhale. Straighten up and bring the arms to the front, maintaining the hand position, and slowly bend forward from the hip joint. The head is down and the hands are above or touching the ground. (Fig. 3.108(a)) Do not force yourself.

(2) Adjust the tendons. In the beginning, do not bend too low and, for additional comfort, you can slightly bend the knees. This is particularly important if you are practicing rooting in this position. If the knees are locked back, there will be strain in the knees. If you want to stretch farther forward, do not increase the forward curvature of the upper spine to do it. Stretch forward by letting the hamstring muscles at the backs of the thighs lengthen. (Fig. 3.108(b)) If you are stretching forward vigorously, or are not very limber, bend the knees much more while stretching so that you can lay the whole abdomen firmly on the thighs. Then, test your flexibility by slightly straightening the knees, while keeping the abdomen on the thighs. Practicing in this way will guarantee that you are only stretching the lower spine and hamstrings, and not arching the upper spine.

Feel the Chi flow down to the head and back and down the tongue. The three fingers of each hand are nearly touching each other and you can feel the Chi flow from the right hand's middle finger to the left hand's middle finger up the left arm to the spine, to the head and down to the navel. Stay relaxed until you feel the energy flow without obstruction. Some people may feel a certain

vibration which gradually spreads throughout the body. Allow the vibration to occur for a while. Slowly stand up to avoid dizziness.

Maintain this position only for as long as you feel comfortable. It is quite strenuous and should be approached with moderation.

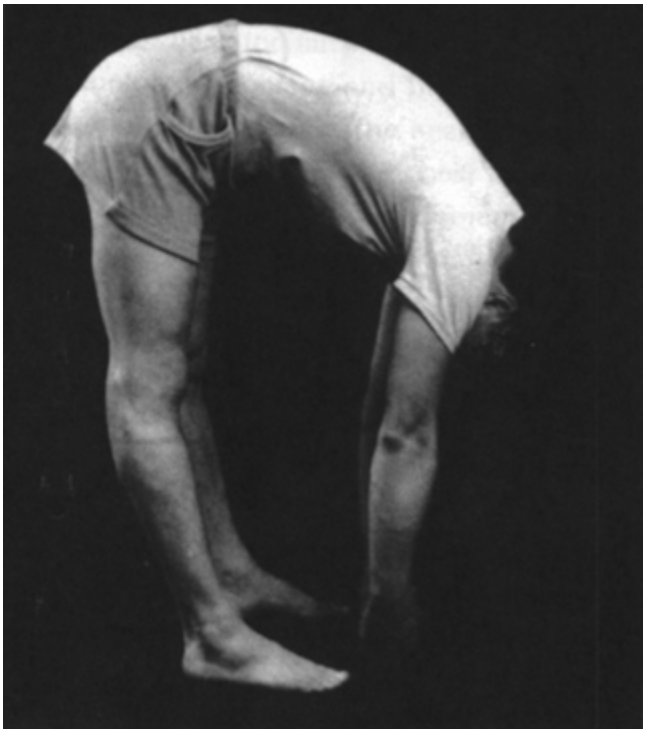

(a) Resting Position of the Iron Bridge

(b) Stretching the hamstring

Fig. 3.108 *Iron Bridge Stretch*

8. Summary of the Iron Bridge

a. Standing Iron Bridge—Yang Position

(1) Assume the Horse Stance.

(2) Place hands at the sides of the body. Touch both thumbs and index fingers together, forming a circle. The other three fingers of each hand remain straight and touch one other.

(3) Breathe abdominally, inhale and look up at the ceiling. Arch back from the lower back, keeping the legs straight and the hips aligned over the legs to maintain balance.

b. Standing Iron Bridge - Yin Position

(4) When you feel you have had enough. exhale and bring the body slowly to a standing position.

(5) Bend the knees slightly in the beginning. Lower the head, and bend forward from the shoulders and chest, rounding the back.

(6) Relax the arms and allow them to dangle in front of you, maintaining the finger position with the fingers facing each other. Feel the Chi flow through each finger. If you can touch the ground, you can feel a certain connection of the Chi energy. Breathe normally.

(7) Come up very slowly from this position. You may feel dizzy at first. Stand still for a while, collect the energy, practice Bone Breathing and the muscle Power Exercise. Walk around, or lie down on your back and massage your belly from right to left to get your Chi circulating.

Additional Exercises: To strengthen the upper abdominals, do sit-ups with bent knees. The lower abdominals are strengthened by doing sit-ups with your legs extended straight out in front of you, although it is recommended that this, as all exercises, not be excessively practiced.

c. Standing Iron Bridge - Rooting Practice

Assume the posture. Have your partner push very gently. Remember that the main arch is in the upper back. Be very careful in this Iron Bridge Rooting Practice. Your partner has to be aware that it is dangerous when you arch backwards. The back and spinal cord are vulnerable to injury in this position. Be careful to apply pressure gently to avoid hurting the spinal cord or falling down.

(l) Yin Position Rooting Practice

While you are in the backbend position, your partner should put one hand on your back and one hand on your chest. (Fig. 3.109(a)) As your partner slowly presses down, observe that you can take the force only for a few seconds. Bend forward to rest for a while and then practice rooting in the forward position.

(2) Yang Position Rooting Practice

While you are bent forward, your partner should press his/her hands on your shoulders. (Fig. 3.109(b)) You push up from the lower spine. He/she can use his/her entire body to press down. In this position you are exerting more force on the lower back. This will strengthen the lower spine, especially the lumbar region.

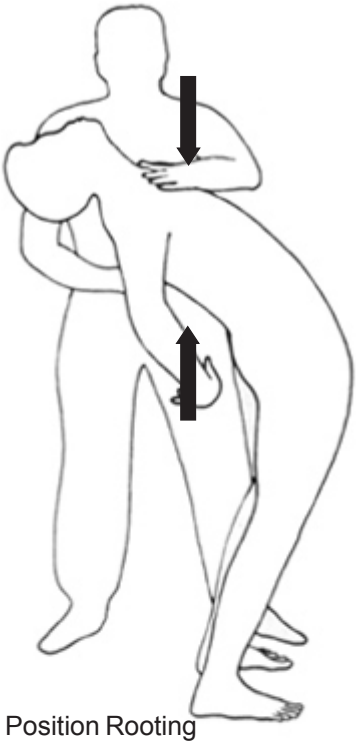

(a) Yin Position Rooting

(b) Yang Position Rooting

Fig. 3.109 *Iron Bridge Rooting*

9. Iron Bar

The Iron Bar practice greatly strengthens the front and back fasciae and thus makes the spinal cord very strong. The spinal column consists of 24 vertebrae held together by tendons, fasciae and muscles. Normally we do very little to exercise the vital spinal column. The Iron Bar exercise automatically adjusts all of the spinal column, strengthening it segment by segment.

a. Iron Bar Practice

(1) Place two chairs facing each other. Have your partner hold the chair at your head to keep it steady. If you do not have a partner put one of the chairs against the wall.

(2) Put both hands palms down behind you on the floor and push your self up on the chair. Put the feet and ankles on one chair the head and shoulders on the other. Fold the hands across the belly. Straighten out the body especially the lower back. With the toes pointed down and outward, you can feel a pull on the fasciae and tendons. (Fig. 3.110(a)) Make sure the lumbar region is straight, not bent. This will help to strengthen the front and back fasciae.

(3) If you initially feel that the Iron Bar is too difficult to do properly and comfortably, bring your arms back over your head onto the chair that your head is on. This makes it much easier to maintain a straight spine and is considerably less strenuous. As you feel stronger gradually increase the amount of force with which you are pushing down the arms into the chair. When you can practice without pushing the arms down at all behind you, you are ready to move gradually to the final position with the hands resting over the navel.

(4) Place both hands on the stomach and breathe normally to the abdomen. (Fig. 3.110(b)) When you begin to feel uncomfortable, using the hands to steady and hold the chair that the head and shoulders are on, lower the buttocks and feet to the floor. Sit up and place the tongue on the roof of the mouth and let the energy flow in the Microcosmic Orbit. (Fig. 3.110(c)) Do not stand up right away as you may feel dizzy.

(5) After you have practiced for two to four weeks, you can start, very carefully, to move the chairs further apart so that only the neck and head are on the end of the other chair (Fig. 3.110(d)) Do not rest the head only as this can hurt your neck.

This is a very strenuous exercise for the back. Do not attempt

to move the chairs further apart unless you feel very strong. You can step up training by supporting a weight on the abdomen. Again, work gradually. Eventually you will be able to support 30 pounds or more of weight. (Fig. 3.110(e))

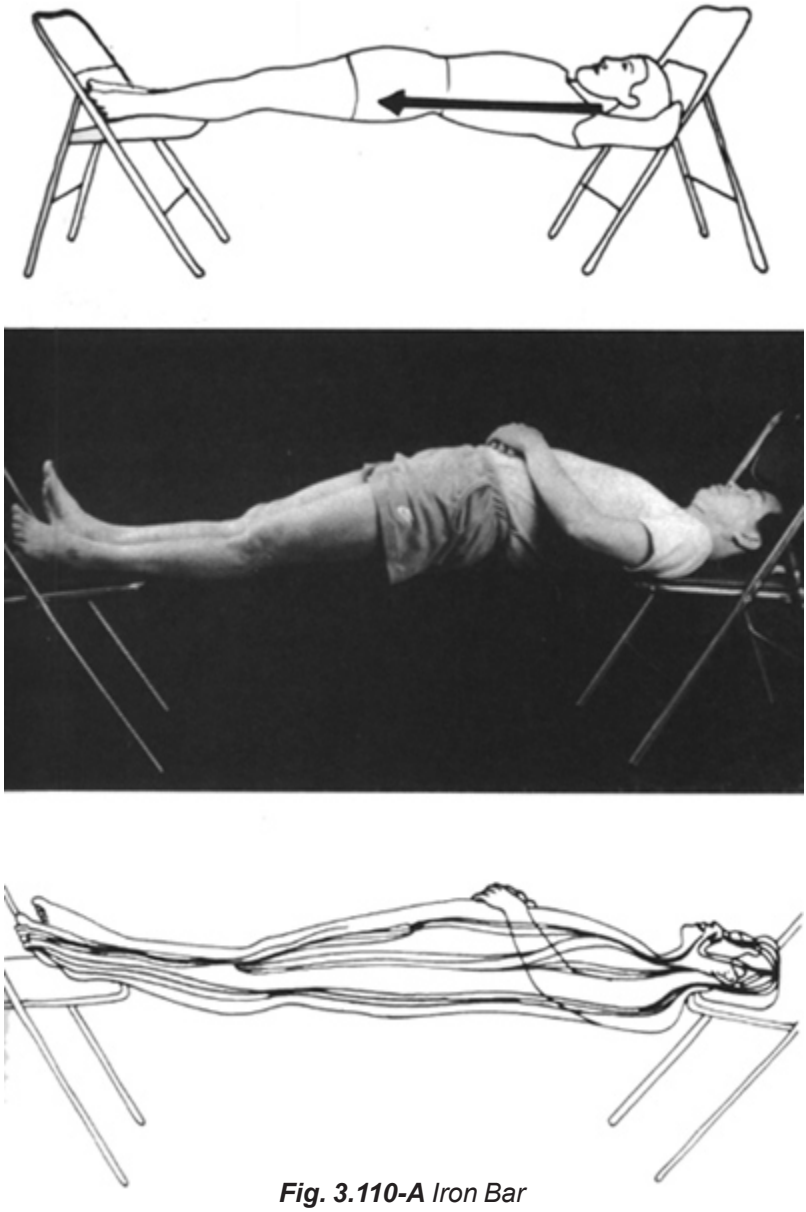

Fig. 3.110-A *Iron Bar*

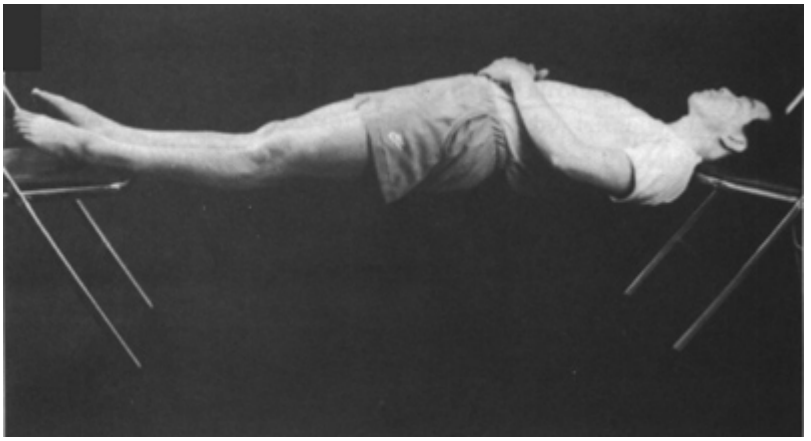

(d) Once you are well-trained, you can move the chairs further apart so that only the neck, head and heels are resting on the chairs.

(e) In the advanced practice of the Iron Bar, you can add weight and still maintain the position.

Fig. 3.110-B *Iron Bar*

b. Iron Bar Rooting

Have your partner place one hand under your back for support in case you should begin to fall. With the other hand, your partner presses down on your abdomen slowly and gently increasing pressure gradually.

This exercise strengthens the lower back in the lumbar region and the psoas muscle.

10.Summary of the Iron Bar

a. Put two chairs across from one another at a distance that will allow you to:

(1) Place the feet and lower legs on one chair with the toes pointed down and outward, away from you, to develop the most balanced alignment of force in the legs, particularly in the calves.

(2) Place both palms down on the floor behind you and the head and shoulders on the other chair.

(3) Maintain a straight back. To avoid stress in the lower spine while practicing, consciously tighten the buttocks and feel the sacrum squeeze down. This will lengthen the lower spine.

(4) Breathe normally from the abdomen.

(5) When you are ready, come down to the ground slowly.

(6) Stand up and collect the energy at the navel.

(7) Practice the Bone Breathing Process.

Chapter 4
Breath Alignment*

A. Structural Alignment and Taoist Yoga

Radiant health and efficient, powerful movement patterns are attained only when the body structure conforms more closely to its inherent structural pattern. This ideal pattern is the blueprint for the "stacking'' of body segments in space. The function of this more appropriate structural relationship is the unhindered flow of energy breathing, alertness and movement.

The development and use of an aligned structure is basic to Iron Shirt practice. However for many students it will be difficult to apply principles of alignment in their practice without first approaching structural development in its own right. That is the purpose of this chapter. The structural exercises that follow lead to actual structural reformation so that "posturing" oneself according to desirable structural principles becomes easier and more natural. For most of us, without structural change "good" posture will remain alien to our being. Without intentional practice of "good' posture, particularly in the beginning, structural reintegration cannot proceed smoothly.

The anatomical relationships of the entire body are created in these structural exercises, whether moving or stationary. In structural development, it is important to conceptually understand what appropriate alignment means. Application of correct structural patterns during your practice of Iron Shirt movements will reveal their meaning and greatly speed up the process of body development. Remember that these relationships of one body part to another represent an ideal pattern. The more you practice these exercises and apply their principles in daily life, the more closely your own structure will approach the ideal in an increasingly effortless way. There should never be a sense of strain or unpleasantness in trying to "fit" the structural ideal. For most people, simply a month of practice and application will lead to a profound improvement in structural health.

In the beginning of your application of these principles to daily life, there will inevitably be occasional feelings of unnaturalness. This will occur as you choose new patterns of body use which are opposed to previous distorted patterns that have become habitual. This sense of "posturing" in an artificial way will rapidly decrease with time, if you are practicing diligently. You will then experience ease and naturalness in body usage that allows you to respond in any direction with an appropriate amount of force. The principle of automatically applying appropriate force is at the heart of martial arts. In order for this full movement potential to be possible, the body must spontaneously return to its "center" of relaxed alignment after movement. This is the relaxed "idling" position that is most unblocked and energetically economical, and out of which movement flows.

Inanimate objects are completely dominated by the pull of gravity. Plants maintain their uprightness by the rigidity of their cell walls. Animals automatically resist the pull of gravity by normally remaining on a large base created by four legs, or two legs and a strong tail. The upright human being, on the other hand, is a unique expression of evolving self-awareness. The full and intentional expression of standing upright further develops the human spirit. Likewise, the more developed human spirit naturally manifests a greater upright stance. All esoteric traditions that work with energy understand the signifiance of this fully developed upright human form. This is particularly true of the Taoist tradition.

B. Applying Structural Alignment Principles to Iron Shirt Chi Kung Practice

Diligent practice of Iron Shirt Chi Kung will lead to an increased flexibility and range of motion of the spine and other joints. As the body becomes more open, it is important to understand and apply the principles of healthy structural alignment in daily life. Since many of us have come from a background of structural randomness and distortion, it is necessary to learn what to do with our various body segments as our body becomes open and capable of new, more appropriate alignment. In effect, we must learn how best to "wear the body".

The very center of our physical structure is the spine and its foundation, the pelvis. Encased within the spine and cranium is the Central Nervous System, center of our conscious life. Thus, structural health of the spine is the foundation for the structural and energetic health of the rest of the body. For this reason, the basic structural exercises taught in this section focus strongly on the spine. Regular practice of these exercises will help heal any existing structural problems and tremendously enhance your Iron Shirt practice.

The structural exercises that follow: Structural Training Position Against Wall, Spinal Elongation Breathing, Door Hanging, Shoulder Widening and Backbend, develop a straighter, more elongated spine and joint spaces that are not cramped. The spine will retain its three normal curves, but these curves will not be as excessive as they are in nearly everyone. Attention to details will guarantee that your practice is safe, effective and progressive. Also, additional exercises (the Warrior Poses) that complement the practice of Iron Shirt Chi Kung by eliminating structural blocks in the hips and back, and by strengthening the lower body are described.

By applying the structural principles during your Iron Shirt practice, as well as in your daily life, you will feel the primary forces that are always acting on your structure. These two basic forces are (1) a strong downward rooting force connecting you to the earth; and, at the same time, (2) a strong upward elongating force lengthening your spine which connects you to the heavens. To attain balance and integration, both of these forces must be developed.

1. Relaxation

a. Lower Abdomen

At the level of the navel center and the Door of Life (located behind the navel), rooting and elongating forces originate and mingle. For this to happen fully, the lower abdomen must always remain relaxed. The lower abdomen should remain soft, except when you are making a full exhalation, such as when you are very active, or practicing abdominal breathing. The rest of the time (which is most of the time), practice releasing any tension in the lower abdomen until this becomes automatic. Your breathing, digestion and elimination will improve, and the rest of your body will relax more fully.

The two central points of the body that reflect and determine your tension level in daily life are your face and lower abdomen. During your daily activities, practice smiling with the eyes and face, and keep your lower abdomen relaxed. Remember always to relax as much as possible, no matter what you are doing. You will feel much happier, your organs will work better and your energy will flow more easily.

b. Inner Smile

While practicing these structural alignment exercises, also practice the Inner Smile. If you can maintain the Inner Smile while practicing vigorous exercises like Iron Shirt and the Warrior Poses, you will be able easily to maintain it during times of emotional challenge as well. Remember that the face is not only the primary expresser of body language, but also returns to your system the very emotions it expresses outwardly.

Intentionally develop the various details of facial alignment that accompany soft, relaxed, smiling eyes whenever you exercise, and you will gain much more energy and emotional balance from your practice.

When you practice the Inner Smile, let all of the facial muscles relax. This relaxation can be seen and felt particularly around the eyes and mouth. Feel the eyelids subtly close slightly as the area around the eyes relaxes, and the space between the eyebrows widens. Let the eyes be gently receptive to incoming visual stimuli. Feel that sights and sounds flow into their respective organs, rather than being grasped for outwardly. Allow the nostrils and sinuses to subtly widen, creating more space for the breath to enter the body. Let the outer corners of the mouth lift very gently, with the tongue up to the palate, the lips slightly touching, and the jaws just separated or barely touching. This will produce a smile like that of the Mona Lisa or Buddha. This lifting of the corners of the mouth must be effortless, and the outer result of an inner smile. (Fig. 4.1(a))

If you can relax deeply enough, all of these details will take place spontaneously because they are natural aspects of healthy facial alignment in a happy, centered person. Practicing them intentionally will quickly condition them into your basic neuromuscular patterns. Practice the Inner Smile in this way with your eyes opened as well as closed. This will enable you to apply it at all times. A smile in the eyes and the subtle lift at the outer corners of the mouth are the

most important details. Whenever you do this, it will be easy to have access to feelings of inner happiness, serenity and compassion.

Feeling the Inner Smile and relaxed facial alignment during Iron Shirt will insure that the mind remains more centered and calm, and that you are continuous and fluid in your movement. As a result, you can experience and develop the flow of Chi. (Fig. 4.1(b))

(a) Mouth corners are up.

(b) Mouth corners are down, causing the organs to fall and the Chi energy to diminsh.

Fig. 4.1 *Inner Smile*

c. Tight Jaw Muscles

Chronically tight jaw muscles are very common. They often distort the entire facial structure. Clenched or tightened jaws become that way for various reasons. Strong emotions that are held back from expression may produce this. On the other hand, the universal distortion of a collapsed neck in which the chin moves forward out of alignment will often cause compensations in the jaw pattern. Whatever the cause, tight jaw muscles need to be loosened up so that you can fully practice the Inner Smile and relax completely throughout the body.

Since it is difficult to relax the jaw muscles simply through intention, a cork can be useful. (Fig. 4.2) This is a very beneficial

exercise for people who have a lot of jaw tension, although practically anyone can benefit from trying it. Buy a simple cork stopper in a grocery or hardware store. Cut it if necessary to fit between the front teeth, thus keeping the mouth wide open. Make the width of the cork such that it is still possible to open the mouth a little farther so that holding the cork does not result in strain. Simply place the cork in the mouth for about ten minutes every day for several weeks. As the jaw muscles stretch open, use a longer cork until you can easily use a normal sized one. This can be done while reading, driving, showering, or watching TV. Do not do this if it produces pain, if your jaws make audible sounds when they open and close, or if you have a history of jaw dislocation or other problems.

Fig. 4.2 *Practice to Stretch Tight Jaw Muscles.*

2. Structural Training Position Against Wall

Using a wall for feedback, you will be able to feel when you have a structurally aligned, elongating spine. This exercise is dependent only upon a wall or door to lean against, so it can be done anywhere as a postural recharging exercise. For those with back problems, particularly lower back pain and sciatica, it is a powerful method for decompressing the vertebrae and lessening the discomfort.

a. Lower Body

Lean against a wall with the heels approximately one to one and a half feet from the wall. Bend the knees and tuck the pelvis under so that the lower spine becomes flattened to the wall without discomfort. Work gradually to this position if there is discomfort initially The calves will be perpendicular to the ground or slightly angled back toward the wall. You should feel that you are comfortably leaning against the wall.

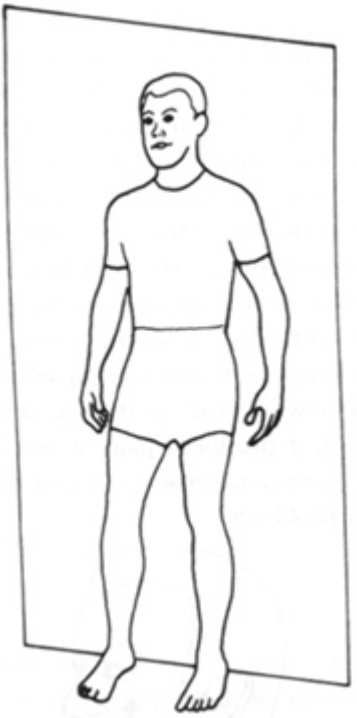

Fig. 4.3 *Structural Training Position Against Wall*

b. Feet

Press the balls of the big toes firmly to the floor, then widen the feet across the balls. This will spread the toes. Now, equalize the weight on three points of each foot: the ball of the big toe, the last two toes and the middle of the heel. The toes should remain relaxed without grasping the floor with the second toes pointing straight ahead. Keep the feet aligned in this way, even if you feel pigeon-toed. Apply this same foot alignment when standing, walking or exercising.

c. Head/Neck/Upper Back

Bring as much of the upper back as flat to the wall as possible without strain, by beginning with the sacrum against the wall while holding the remainder of the spine rounded forward away from it. Now roll the spine vertebra by vertebra against the wall until you reach your limit of flexibility. Hold the head as if it is gently pushed back from the upper lip and lifted (or suspended) from its crown. Do not overdo this by tucking the chin. For many persons, the back of the head will not touch the wall. (Fig. 4.4)

Fig. 4.4 *Do not lift the upper lip excessively.*

d. Shoulders

Tuck the shoulders down away from the ears and widen them out to the sides. (Fig. 4.5) (See the Shoulder Widening Exercise in this Chapter.)

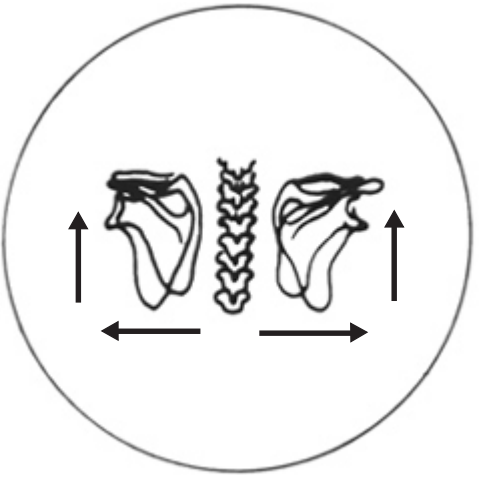

Fig. 4.5 *Widen the shoulders*

e. Arms/Shoulders

There are several possible arm positions:

(1) Simply let the arms hang relaxed at the sides with the palms facing into the torso. This is the most natural position and is appropriate if you are practicing around other people, at work for example, and do not want to look like you are doing an “exercise”.

(2) Starting from position (1) bring the elbows back to barely touch the wall, without bringing the forearms to the wall or the shoulders back. This position helps to properly align the shoulders. As the elbows are brought back, the shoulders will naturally roll back slightly, without being pulled back excessively.

(3) Roll the left shoulder blade away from the wall until only the inner edge of the left shoulder blade is touching the wall. Now roll the rest of the left shoulder blade back to touch the wall. Repeat on the right side, then bring the arms to position (1) or (2). This position strongly stretches the shoulders out to either side, and thus widens the upper back and chest simultaneously. This stretch is good preparation for the Iron Shirt exercises which require scapulae power.

Do not attempt positions (2) or (3) unless they can be done without strain.

f. Stretching the Lower Spine

For additional stretch in the lower back, bend the knees and sink down lower on the wall. Then, keeping the sacrum in firm contact with the wall, slowly straighten the knees back to the original position. For even more stretch, place the hands around the hips and push down while you straighten back to the original position. This will strongly lengthen the lower spine. Do not attempt this until the lower back can be brought to the wall without discomfort. This is most effective when practiced against a wall that is not completely smooth. This extra stretch is particularly valuable for anyone with lower back pain or sciatica.

g. Spinal Elongation Breathing

Simply standing in the Structural Training Position Against Wall will help to decompress and straighten the spine. It is not necessary to do special breathing in order to derive benefit from this position. The goal is not to have a straight spine, but a straightening spine. The wall gives you feedback when your spine is in a more straightened alignment.

In a structurally balanced body, breathing causes a natural elongation of the spine. This occurs to the greatest degree when the chest is filled during inhalation. The lifting and widening of the ribs causes the vertebrae to separate from each other and the spine to lengthen. Practice of deep chest breathing in this position and in Door Hanging leads to a conditioning of this natural breathing/ alignment relationship. (Fig. 4.6) Once you have developed this spinal elongation, it will occur even in the more relaxed, daily-life breathing that is primarily abdominal. This opening and closing of the spine with breathing is an integral part of the normal body mechanism that pumps blood, Chi and cerebrospinal fluid around the central nervous system.

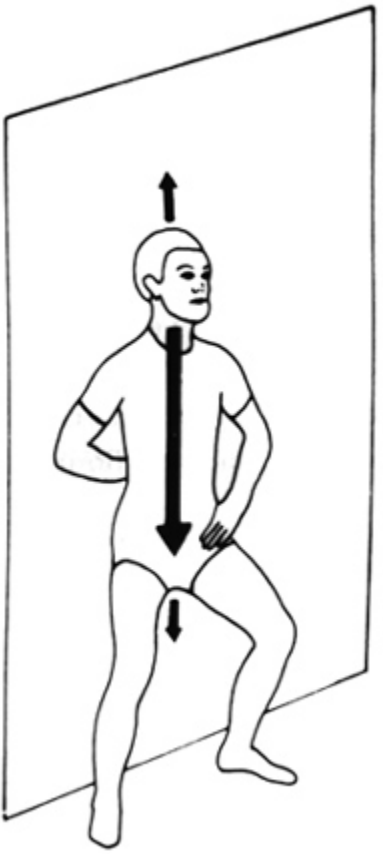

Fig. 4.6 *Stretching the Spine and Spinal Elongation Breathing.*

3. How to Practice Spinal Elongation Breathing

a. Inhalation

To enhance the effects of the Structural Training Position Against Wall and the use of the breath, first fully exhale. Then, inhale slowly and deeply through the nose, directing the breath up into the chest. The abdomen should remain in and not protrude. As you do this, visualize and feel the spine lengthen. This will happen automatically if you stay relaxed. Do not try too hard. Once you feel spinal elongation, you can refine this sense further by feeling a wave of elongation starting at the base of the spine, traveling upwards as you inhale.

b. Exhalation

As you exhale, continue to feel yourself lengthening upwards, rather than collapsing back completely. You will feel the structural muscles around the spine "take over". The lengthening upwards that occurs with exhalation is more subtle than that which occurs with inhalation, and is really a wave of support that prevents excessive collapse. This wave of support begins at the head, and travels downwards as you exhale.

c. Abdominal Tightening

Because of structural blockage in the chest, it may be necessary at first to tighten the abdominal muscles in order to direct the breath up into the chest. Do this if necessary. Otherwise the abdomen will protrude as you inhale with very little chest expansion. Over time, gradually use less and less force to hold the abdomen in while inhaling, until you can breathe into the chest without either intentional abdominal contraction or unintentional abdominal protrusion.

d. Daily Life Breathing

Breathing into the chest in this way is meant as an exercise to release structural blockage in the chest and lengthen the spine fully.

After you have finished practicing, forget about your breathing and let it flow naturally. Natural breathing begins in the abdomen and only expands the chest when you are very active and, thus, breathing very fully. Do not maintain this type of full chest breathing constantly in daily life or you may cause energy to congest in the chest and head.

4. Head/Neck Alignment as the Basis for Spinal Elongation and Upright Structure

Spinal Elongation breathing cannot lengthen the spine unless the head is held as if it is pushed back from the upper lip and lifted from its crown without strain. (Fig. 4.7) If the chin moves slightly forward and up, the neck collapses and the entire upper body will be collapsed and distorted. Then the spine will curve excessively and no type of deep, free breathing is possible. Even the wind pipe itself becomes constricted. This is the condition of most people's necks. For this reason, it is rare to find people in our culture who do not have chronic misalignment of the neck vertebrae.

Push back from the upper lip and lift the head as if from its crown.

Feel the head stretch up as if pulled by a string.

Feel the sacrum pull down the spine.

Sink the knees down.

(a) Elongation of the Spine.

Fig. 4.7 *Proper alignment of the head and neck is the basis for effective spinal elongation and upright structure.*

The feeling that the head is suspended from its crown and gently pushed back from the upper lip without strain should be applied at all times. It is the foundation for an erect upper body and free breathing. Appropriate alignment of the head and neck insures a healthy communication between the body and head. Thus, awareness spreads more fully to the whole body. In a higher meditation formula of the Universal Tao System called Lesser Enlightenment of the Kan and Li, one learns to observe oneself with the Inner Eye. In the body structure, conscious alignment of the head and neck without strain is the foundation for a greater awareness that results from self-observation and self-awareness. In the practice of Hatha Yoga, elongation of the back of the neck that results from head/neck alignment is called “the root of watchfulness,” or “the root of mindfulness”.

Even after balanced structural alignment becomes easy and natural, a very subtle intention to maintain head/neck alignment may be necessary. This slight lifting and moving back of the head is the single most important factor in erecting the entire body. The actual elongation and shifting back of the head is often only a very small change. Without it, however the chest, upper back and entire spine cannot come into alignment. This importance is due to the fact that the neck and head are the upper end of the column that we wish to lift. The importance of this one factor of neck and head alignment cannot be overstressed. Whole body integration is not possible without it.

It is useful to be familiar with the feeling of neck collapse that afflicts nearly everyone. After aligning the body, let the chin move forward and up, and thus out of alignment. Notice how the back of the neck shortens, the throat closes, the sternum sinks, the chest closes, the upper back arches excessively, the shoulders roll forward, breathing is restricted, and spinal elongation becomes impossible. Then practice a Spinal Elongation breath as the head is once again placed appropriately and feel the sense of full openness that accompanies it throughout the body.

Greater self-awareness, full uprightness of the trunk, and unstrained alignment of the head and neck are integrally related. The interplay of these three factors is particularly evident in Iron Shirt. The intention required to maintain head/neck alignment and the other aspects of fully aligned structure is an expression of the autonomous will of a self-aware being. Likewise, relaxed practice of fully aligning oneself develops this autonomous will in a beneficial way.

5. Door Hanging

Developing a straighter more elongated spine is the purpose of both the Door Hanging Position and the Structural Training Position Against Wall. In Door Hanging, however the arms are held over the head, which puts a traction on the spine and greatly increases spinal lengthening. (Fig. 4.8) Daily practice of Door Hanging for even a few weeks will lead to better posture, a more flexible spine, reduction of chronic back stress and a heightened awareness of natural structural alignment. Door Hanging will also help you to be aware of and control your psoas muscles, which are very important in many Universal Tao practices.

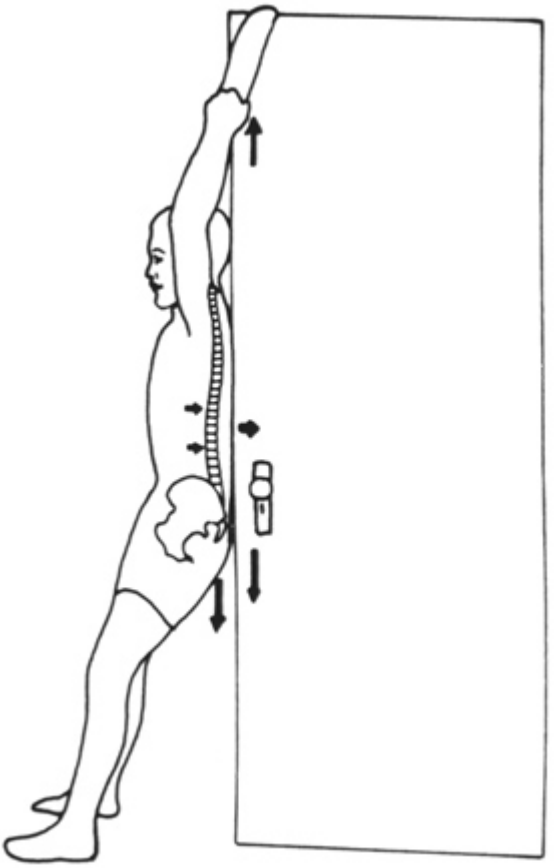

Fig. 4.8 *Door Hanging*

a. Basic Position

Roll up a towel and place it over the top of a door. Lean against the narrow edge of the door bringing the spine as flat to the edge as possible without discomfort. Follow all position details for Structural Training Position Against Wall, except those for the arms.

b. Lower Ribs/Middle Back

Maintain your attention at the lower ribs, and the middle and lower spine. Bring the arms overhead without letting the spine come away from the edge of the door. Feel that you are tucking the lower ribs in as the arms are brought overhead.

c. Hands/Arms/Shoulders

Grasp the towel fairly high, but with the elbows at least a little bent. Continue strongly to pull the shoulders down, and widen them to the sides. Do not hang from the towel. All of the body weight is still on the legs.

d. Shoulder Strain

If the shoulders are strained in this position, hold the towel lower to decrease the shoulder stretch. If necessary the elbows may be only shoulder height or even lower. If a towel is not long enough for this, use a thick rope. Gradually you will be able to hold the towel higher as your shoulder joints become more flexible. The first position of backbend exercise will help limber your shoulder joints.

e. Breathing/Full Spinal Elongation

While maintaining this position, practice breathing up into the chest, as in Spinal Elongation breathing or the Structural Training Position Against Wall exercises described above. Along with the traction of the arms overhead, filling the chest during inhalation will result in tremendous spinal elongation. It will not take much practice to feel your spine start to lengthen. As you feel this start to happen, after every five breaths or so, bring the pelvis and the lower and middle spine a few inches away from the door edge. This allows the lengthened upper spine to lengthen further down the door. Again bring the spine and pelvis back to the door edge and continue practicing.

f. Time

If possible, practice from one to three minutes or longer. Do not continue if discomfort begins. Straining will not open your spine up faster; it will add more tightness. Regular practice and respecting your own limits will inevitably lead to very rapid spinal elongation and realignment.

g. Leaving the Position

To leave the Door Hanging position, walk the feet back toward the door and come straight up. Do not come up by pushing the pelvis away from the door first.

h. Full Hanging

If you are completely comfortable with steps a through g, you can end by letting your full weight hang from the towel. Gradually bend the knees and slide down the door edge until the arms are straight and holding you up entirely. All other details of practice are the same. Hold this for as long as comfortable, which may only be a few seconds, then come up. Be sure to continue stabilizing the shoulders by feeling them pull down and widen to the sides. Practice of Full Hanging is very strengthening and produces tremendous spinal extension, but must not be attempted if it causes strain.

6. Psoas Muscles

a. Feeling and Using the Psoas Muscles

Once you feel comfortable with the details of Door Hanging, consciously relax the abdominal wall while you practice. As you soften the abdominal muscles, relax and straighten the spine against the door edge. You will be able to feel a sensation of ‘pulling in and up’ deep inside behind the front lower ribs. This is the left and right psoas muscles working. (Fig. 4.9)

Feel this same sensation of pulling in and up deep inside behind the front lower ribs when you walk and sit. This will keep your lower spine lengthened and comfortable without needing to “suck in your gut”. Pulling in the abdomen to flatten the belly or straighten the lower spine will hamper your energy flow and organ function. However, working the psoas properly will not only align the lower spine, but will also flatten the belly without tightening it.

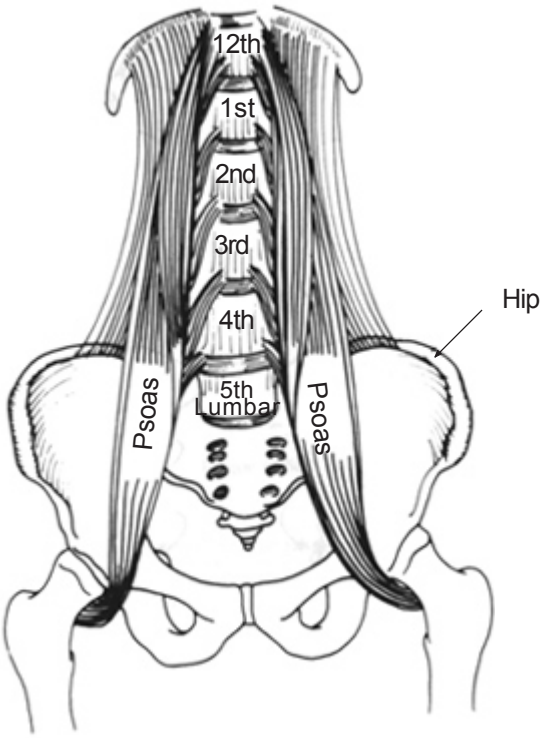

Fig. 4.9 *Psoas Muscles*

When you carry the head as if gently pushed back from the upper lip and suspended from its crown, the tendency is to let the lower ribs push forward. To prevent this, feel that you are keeping the lower ribs tucked back slightly. Remember to keep the lower ribs tucked back from inside, not from tightening the abdomen. This will put you in touch with the psoas alignment. You are not actually sinking the lower ribs back, for this would cause you to slouch. You are instead keeping them in a straight line with the abdomen below and the chest above. Feeling the tucking sensation will stabilize the mid-torso, and allow the whole spine to lengthen equally. The feeling, once it is developed, is that there is a subtle pulling back and up deep inside at the lower rib area. Experience this first in Door Hanging, then apply it at all times. Like all structural improvement, intention is required initially. Gradually it will become automatic.

Door Hanging is the key to developing this psoas feeling. If the spine remains on the door and the abdomen is soft, then you need

only relax and gradually sense what is already happening inside. It also helps to have a good mental picture of the anatomy involved. Once you have developed this psoas feeling, you will find how important it is in all of the Universal Tao practices. During your practice of Iron Shirt, when you are using reverse breathing to pack the abdomen, slightly increase the psoas work of pulling in and up behind the front lower ribs. This will allow you to pack even more fully, but without tightening the abdominal wall to do it. Gradually, you will be able to pack very powerfully with very little abdominal tension at all. When you thrust back at T-11 to pack the lower back, apply the psoas work very strongly and you will be able to focus your force to the T-11 area much more directly.

b. Psoas Muscles and the Six Healing Sounds

The relationship between the psoas alignment and the lower area can be felt very well when practicing the Six Healing Sounds. (For detailed information on the Six Healing Sounds, see the book, *Taoist Ways to Transform Stress into Vitality*.) Remember to keep the lower rib area back using the psoas muscles, not by tightening the abdomen. For the Lung, Liver and Heart Sounds, be sure to keep the lower ribs held in. Then, while exhaling and making the unvoiced sound, you can put pressure within each organ more effectively. While exhaling continuously increase the pressure to the particular organ area. At this point you will feel that you are “wringing out” the stale energy from each organ with this pressure.

Using the correct psoas alignment as you inhale will allow you to direct the fresh energy from your breath directly into the organ are more easily. When doing the Liver Sound, tilt to the right and slightly forward. Do this tilting from the lower rib area. This will increase the pressure you can apply to the liver. For the Heart Sound, tilt to the left and slightly forward, and stretch the heart meridian by stretching the little finger. For the Lung Sound, stretch the lung meridian by stretching the thumb.

For the Kidney and Spleen Sounds, the lower ribs should sink back so that you can apply pressure in each organ. When the lower ribs sink back, you are really accentuating the psoas stretch. Using the psoas muscles corectly will improve your practice of the Six Healing Sounds. By simply practicing the Six Healing Sounds you will become aware of the psoas alignment, particularly when the arms are overhead.

7. Standing Pelvic Alignment

Balanced alignment of the psoas muscles is also essential for correct leg movement and pelvic alignment. However the feet are placed, be sure that the pelvis is not tilted back or pushed to one side. The knees should remain at least slightly bent, and the arches of the feet lifted by distributing the weight equally on the three corners of each foot.

If the pelvis is askew or the knees locked back, there is stress in the lower back and knees and integration between the lower and upper halves of the body becomes impossible. For most people, maintaining structural alignment in the lower body while “”standing around” requires more intention than aligning the upper body, though it is also dependent on upper body alignment. This is due to weakness in the legs and buttocks. Maintaining an aligned stance during daily life will do a great deal to strengthen the lower body, improve energetic flow and heal lower back problems.

8. Sitting Posture

When you sit erectly for meditation, be sure that the “sitting bones” of the pelvis are directed straight down into the chair seat. Tucking the chin slightly will align your spine and give a gentle pull to the spinal cord. Then energy will flow more easily into the back portion of the Microcosmic Orbit. If you find that placing your hands in your lap causes your shoulders to roll forward or your upper back to become uncomfortable, place your hands on a thin cushion or folded blanket in your lap to alleviate this. When your Chi flow is strong, this will no longer be a problem. (Fig. 4.10)

Fig. 4.10 *Practice the Microcosmic Orbit while in the sitting position.*

9.Shoulder Widening Exercise

The Shoulder Widening Exercise develops natural alignment of the shoulders by widening the shoulder blades out to the sides, rather than rolling them forward or pulling them back. In all body segments, healthy alignment leads to an increase of space. If the shoulders are pulled back, then the width of the upper back is decreased and the upper spine is compressed. If the shoulders are rolled forward, the chest collapses and its width is decreased. However, if the shoulders are dropped down and widened out to the sides, then there is an equal opening of space across both the front and back of the upper torso.

In several of the Iron Shirt exercises, flexibility and control are developed by widening the shoulder blades out to the sides. One feels the chest sink in, but not collapse, and the shoulders drop down. This movement makes the necessary connection to the rib cage, which will permit the Chi energy to flow, thus giving the practitioner scapulae power. Remember to let the shoulders return to a natural “idling” position of dropped and widened out to the sides after your Iron Shirt practice. Do not permit them to roll forward at all so that there will be no significant loss of potential scapulae power.

a. Position for Practice

You can practice while sitting, standing, or in the Structural Alignment Position Against Wall. Be sure that the spine is erect. Aligned placement of the shoulders must begin with an erect neck head and an erect upper back/chest.

b. Hands/Arms/Applying Force

Hold each wrist with the opposite hand. Keep the arm down low near the torso rather than lifted. Gently, but firmly, pull the elbows out to the sides without letting go of the hands. Be sure the shoulders are kept consciously dropped. Let the force at the elbows be reflected up to the shoulder joints which will increase the sense of widening at the shoulders. This is a subtle feeling, but can very definitely be felt. (Fig. 4.11)

Fig. 4.11 *Shoulder Widening Exercise*

c. Releasing the Force

Slowly release the pulling out of the elbows and the active drop ping and widening of the shoulders. Maintain the same dropped and widened position of the shoulders which are now in a relaxed state with the arms hanging loosely at your sides.

d. Rolled-Forward Shoulders

If your shoulders are usually rolled forward, you will also need to roll them back simultaneously while performing this exercise. Be sure not to roll them back so far that the shoulder blades begin to move toward each other.

e. Practicing without Holding the Wrists

While practicing this exercise, feel which muscles are doing the work of active shoulder alignment. Muscles in both the chest and back will be working. Then, after mastering (a) through (d) above, begin to practice actively aligning the shoulders while the arms remain at your sides. You will be able to align the entire upper body easily and quickly whenever you wish. Be sure to maintain the dropping and widening of the shoulders, even when you raise the arms above shoulder height. This stabilizes the shoulders and makes arm movement steadier and more grounded while lessening the build-up of tension in the shoulders and neck.

10. Backbend

The Backbend stretches the upper back and spine opposite to the normal direction of its curve. This helps lessen the often excessive forward curve of the upper back, limbers the shoulder joints, and opens the chest.

The Backbend is the most important stretch for a healthy upper spine and freer breathing pattern. The Backbend is also very good preparation for the Iron Bridge.

a. Back Position

Roll up a blanket tightly and place it on the floor. Lie over the blanket so that it is just below the top at the shoulders. Lengthen the spine by tucking the pelvis forward to straighten the lower spine, and tuck the chin in to lengthen the back of the neck. If there is any discomfort in the back, the blanket is too high. (Fig. 4.12)

Fig. 4.12 *Position of Back During Backbend*

b. Neck Support

If there is any discomfort in the neck after tucking in the chin and elongating the back of the neck; it is essential to place the head on another blanket or cushion. This extra neck support should be lower than the one under your back, but high enough to eliminate any neck strain and allow you to feel that the back of the neck is lengthening.

As you practice over time and gradually increase the height of the rolled-up blanket, it may be necessary to use a neck support, even though one was not needed when you used a lower rolled-up blanket. This is particularly true in the first position when the blanket is just below the top of the shoulders.

c. Arms

Slowly bring the arms back to rest on the floor above the head with the elbows well bent. Only do this if it can be done without strain. If bringing the arms back causes discomfort, they can remain at the sides, or be brought back only so far as produces stretch without strain. If brought back only part way, the arms can either be held there or placed on a cushion, piece of furniture or other prop. As the shoulder joints become more limber, the arms can be brought lower. As the arms are brought back, be sure to continue keeping the shoulder blades dropped and widened.

d. Breathing

While relaxing in this Backbend posture, breathe deeply and slowly, directing the breath to fill the chest rather than expand the abdomen. This greatly increases the stretch of the spine and chest. If necessary, hold the abdomen in while inhaling so that chest expansion can occur. It may seem very difficult initially to breathe up into the chest while practicing the Backbend, but practice will be rewarded by a great deal of structural opening in the chest and upper back.

e. Several Positions for Blanket

In order to limber the whole upper spine and shoulder joints practice the Backbend in each of the following positions. Do not practice with the blanket below the sternum.

First position: The blanket is just under the tops of the shoulders. Second position: The blanket is under the middle of the chest. Third position: The blanket is under the bottom of the sternum.

f. Time/Resting between Positions

Remain in each position for several minutes or more if you are comfortable. Most people find the Backbend very pleasant from the beginning: similar to getting a back massage. If the Backbend is initially a difficult stretch for you, leave the position and rest before continuing to the next position. Once the Backbend is easy and pleasant, you can shift from first to second to third positions on the blanket without coming up first.

g. Leaving the Position

To get up after the Backbend, use your hand to lift your head to a chin-on-chest position, then roll off the blanket to one side before sitting up. This will prevent strain on the neck or back.

h. Forward Bend

Ideally, bend over forward and relax after the Backbend and upon completion of the Iron Bridge. The knees should be at least slightly bent. If the knees are locked back, they will be strained. If you want to stretch farther forward do not increase the forward curvature of the upper spine in doing so. Stretch forward by letting the hamstring

muscles at the backs of the thighs lengthen. If you are stretching forward vigorously, or are not very limber, bend the knees much more while stretching so that you can lay the whole abdomen firmly on the thighs. Then, test your flexibility by slightly straightening the knees while keeping the abdomen on the thighs. Practicing in this way will guarantee that you are only stretching the lower spine and hamstrings, and not arching the upper spine.

i. Increasing the Height of the Blanket

As the upper back becomes more limber, continue to increase the height of the rolled-up blanket (s) in order to feel a strong stretch but no discomfort.

11. Warrior Poses 1 and 2

Practice of both Warrior Poses leads to great flexibility and strength in the buttocks and legs. As the strength and flexibility develop, there is structural opening and realigning in the hip/thigh /lower back area that is essential in Iron Shirt. The awareness created in the Warrior Poses develops the ability strongly to use the lower body in movement or in standing, without compressing the lower spine or neck.

a. Warrior Pose 1 (Fig. 4.13(a) and (b))

(1) Feet

Stand with the left foot straight ahead and the right foot turned in 45 degrees. A line through the middle of the left heel should intersect the middle of the arch of the right foot. Throughout the exercise, keep equal weight on the three points of each foot. The distance between the two feet should be as wide as possible without losing the indicated alignment for the lower back and back leg.

(2) Pelvis/Lower Back

Start with both legs straight at the knees. Strongly turn the pelvis under, so that the lower back is straight. This will require strong buttocks work. It is absolutely essential that the lower back remains in this straightened position throughout the exercise. If the feet are too far apart, this will be impossible.

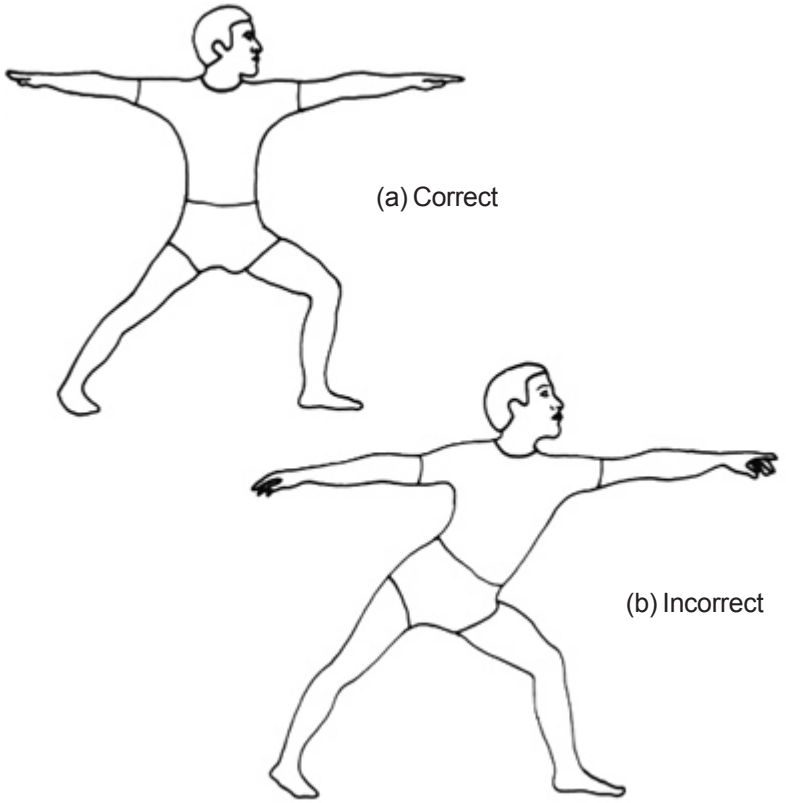

Fig. 4.13 *Warrior Pose One*

(3) Spinal Extension

After flattening the lower spine, extend upward through the whole spine. Hold the head as if it is gently pushed back from the upper lip and lifted from its crown. Be sure that the front lower ribs remain in. Do not permit the lower rib area to push forward. This is particularly true in these Warrior Poses, and more so in Warrior Pose 2 than in Warrior Pose 1. Maintain a full extension of the spine throughout the exercise.

(4) Moving Into the Full Pose

Now exhale and bend the left (front) leg, until the left knee is directly over the left ankle, keeping the right (back) leg as straight as possible. Do not let the left knee move to the right as it comes forward. This would prevent the groin from opening. The knee must remain exactly over the ankle.

(5) Distance Between Feet

If the feet are too far apart you will not he able to bend the left knee all the way over the left ankle without arching the lower spine and/or bending the back leg a lot at the knee.

(6) Back Leg

It is all right to let the back leg bend a little to keep the lower spine straight. As you are holding the position, gradually straighten the back leg more at the knee until you reach your limit. Do not straighten it to the point where your lower spine begins to arch.

(7) Time Breathing/Leaving the pose

Maintain this position for one to two minutes, breathing slowly and deeply up into the chest to elongate the spine. Breathe continuously without any pause. Come out of the position while exhaling by first straightening the front leg. Then, turning, both feet parallel to each other, place them together. Repeat for an equal time on the opposite side. (Simply reverse left and right when following the instructions).

b. Warrior Pose 2 (Fig. 4.14(a) and (b))

(1) Feet

Stand with both feet facing straight ahead, the right foot several feet behind the left foot and several inches to the right. Lift the heel of the right foot off the floor. Throughout the exercise, keep equal weight on the three points of the left (front) foot and equal weight across the balls of the right (back) foot. The distance between the two feet should be as wide as possible without losing the indicated alignment for the lower back and back leg.

(2) Pelvis/Lower Back

Turn the pelvis so that the pelvis and whole torso is square with the front thigh, The navel will then be pointing exactly in the direction of the front foot. Begin with both knees straight. Strongly turn the pelvis under, so that the lower back is straight. It is absolutely essential that the lower back remains unarched throughout the exercise. If the feet are too far apart, this will be impossible.

Instructions (3) through (7) for Warrior Pose 2 are identical to Warrior Pose 1.

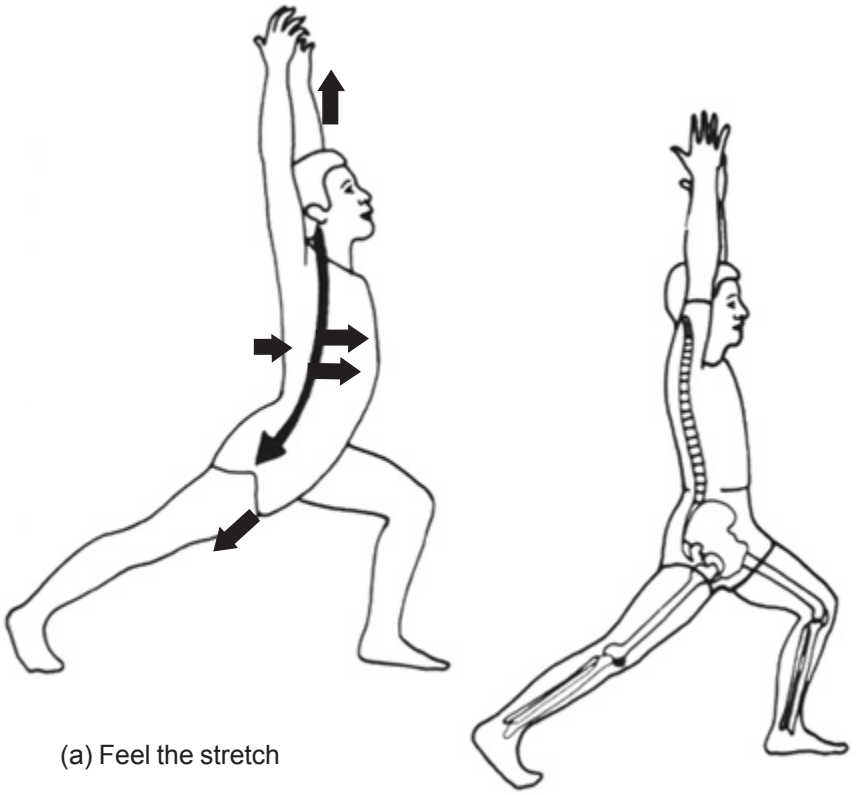

(a) Feel the stretch

(b) Skeletal Position

Fig. 4.14 *Warrior Pose Two*

(8) Arms Position When Warrior Pose 2 Is Developed

When your practice has become familiar and strong, add the following arms position. Extend both arms straight up, while keeping the shoulder blades dropped and widened. The palms face each other. Pay particular attention not to let the lower rib area extend forward as the arms are extended upward.

(9) Arms Position

Because this is a very strengthening exercise, it requires strong concentration and strong (but not stressful) exertion to maintain the straight lower spine and straightening back leg. When first learning either Warrior Pose, it is usually best to use the arms to aid pelvic alignment. One hand pushes the sacrum down and forward from the back, while the other hand pushes in and slightly up at the lower ribs from the front. (Fig. 4.15) This helps greatly in keeping the spine straight, and you can keep all of your concentration on the lower body exertion.

Fig. 4.15 *Arm Position for Beginners*

(10) Further Details of Practice

If practiced two or three times per week, strength will develop rapidly and flexibility slowly, but surely. As flexibility increases, the feet can he held farther apart from each other until finally the front thigh will be parallel to the floor while the other details of the form are maintained. This final position requires tremendous flexibility and strength. Most people will not achieve this for a long time. Just remember that an arched lower back or well-bent back knee means the feet are too far apart. It is a good idea to check your lower back in a mirror when first learning. You may be quite suprised how close the feet have to be to practice properly.

(11) Arms Position when Warrior Pose One is developed.

When your practice has become familiar and strong, add the following arms position. Extend both arms strongly at shoulder height directly to the front and back. Let the eyes gaze at the tip of the second finger of the forward arm. Keep the shoulders pulled down, rather than hunched. Extend from the fingertips through each joint to the shoulder blades.

Chapter 5
Body Construction - Iron Shirt

This chapter is concerned with the construction of fasciae and their structural interrelationship with bones, muscles, and tendons. Further, instruction on the muscle tendon meridians (or acupuncture routes) of the body increases an awareness of the body's construction, which awareness is vital to the work at hand: the creation and storage of Chi energy and its circulation throughout the body. Dr. Michael Posner, a practicing Chiropractor, provides an introduction to this chapter by discussing the major keys to good health through an understanding of body structure. Learn as much as you can about the way that you are constructed because it will speed your progress. Knowing what makes you tick and how you are put together is very important in putting you in contact with yourself through Iron Shirt Chi Kung.

I. Iron Shirt and Chiropractic
by Dr. Michael Posner

In all health professions nowadays, one thing that is commonly considered detrimental to our health is the phenomenon of stress. Various methodologies and theories have emerged that aim to help minimize the amount of stress one has to cope with. I wish to discuss the unavoidable stress of gravity on a body's structure when in an upright position, some health implications, and how, through proper alignment of bone structure, we can efficiently minimize stress and increase good health.

As gravitational forces act upon our bodies when we are upright, various groups of musculature work so that we can stay erect. To resist gravity, these muscles must exert a certain amount of energy. These anti-gravity muscles help to stabilize the bone structure in such a way that movement is possible in an upright position. The success that a person has in meeting the constant stress of gravity may have a subtle set profound influence on his or her quality of health, performance and emotional states.

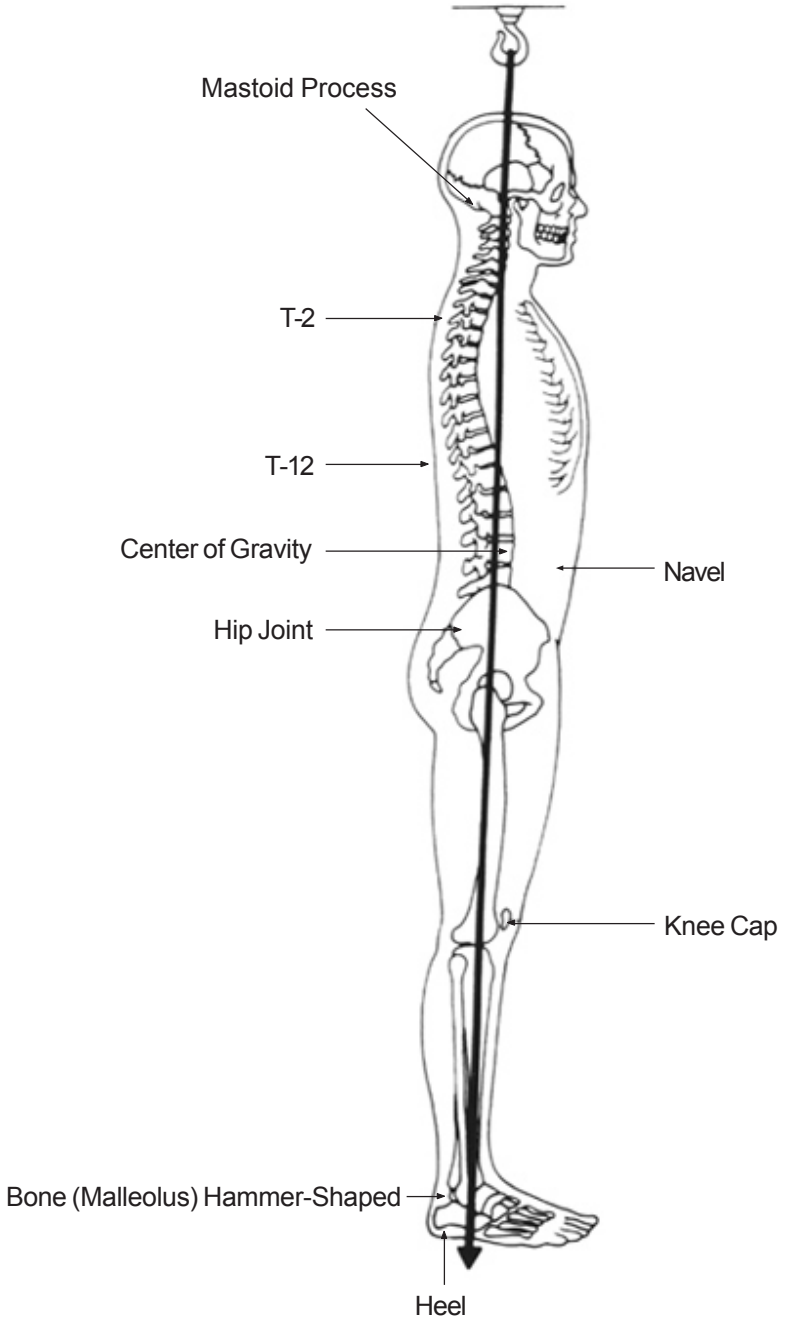

Fig. 5.1 *Line of Gravity in a Body's Structure*

At this point, it is necessary to understand some basic concepts such as “line of gravity” and “center of gravity” as they relate to our bodies’ structures. The line of gravity, viewed laterally (Fig.5.1), anteriorly and posteriorly, falls from above downward through the earlobe, slightly behind the mastoral process (or the attachment of muscles behind the ear of the temporal bone, the bone located at the side of the head which contains the organ of hearing), through the odontoral process (a toothlike projection from the body of the axis or second vertebra of the neck upon which the first cervical vertebra rotates), through the middle of the shoulder joint, touches the midpoint of the frontal borders of T-2 and T-12, then falls just slightly outside to the sacrum, slightly behind the axis, or support, of the hip joint, slightly behind to the patella (or kneecap), crosses in front to the middle malleolus (the hammer-shaped bone on each side of the ankle) and through the outer bone of the ankle to fall between the heel and metatarsal heads. When viewed from the back, the· line of gravity passes through the occipital bone (or the lower back part of the skull), C-7 and L-5, the coccyx (or lower end of the spine) and pubic cartilage (or supporting tissue of the pubic bones) and bisects the knees and ankles.

As gravity acts on all parts of the body, one’s entire weight can be considered as concentrated at a point where the gravitational pull on one side of the body is equal to the pull on the other side. This point is the body’s center of gravity. Generally speaking, the center of gravity is located in a region directly in front of, and about one and a half inches above and below the level of the navel. Its location varies according to body type, age, sex, attitude, breathing patterns, stress level, or abnormal neuromusculoskeletal disorders.

The most economical use of energy in the standing position occurs when the vertical line of gravity falls through a column of supporting bone in alignment. If weight bearing bony segments are aligned so that the gravity line passes directly through the center of each joint, the least stress is placed upon the adjacent ligaments, tendons and muscles. When this alignment is achieved, the antigravity muscles which expend much energy to resist the downward pull of gravity need not work as hard. The bones now take on a more active role in supporting our bodies in an upright posture, allowing the muscles to relax and rest, thus conserving energy and diminishing stress and tensions developed from unbalanced bone and muscle patterns.

Health potentials can be realized only when balance of structure exists so that both nerve energy and Chi flow freely.

There are many negative health effects produced when these antigravity muscles are working either too much or too little. Muscles function to move bones and, if muscles are either very tense or too flaccid, unilaterally or bilaterally they will create a derangement in our bone structure. When a person feels knots or spasms in their muscles, this means that the muscle has gone into a state where it has a sustained contraction. A contraction means that the muscle fibers have shortened. As this occurs, bones can be pulled out of their proper alignment. When spinal vertebrae are involved in this structural imbalance nerve roots can be irritated, thus interfering with the function of the nervous system. When the nervous system is interfered with, a multitude of health problems can arise since the nervous system is the means by which all body functions are regulated and monitored.

Health potentials are enhanced when proper communication between the brain and all body parts is maximized. Since this is the function of the nervous system, the structural integrity of our musculoskeletal system is of prime importance. Structure is said to determine function.

The chiropractic profession deals with problems of health and disease from a structural point of view, with special consideration given to structural intergrity, spinal mechanics and neurological relation.

Thus far, it has been shown how gravity interrelates with our musculoskeletal systems, and how this stress on our structure could affect our health in general. Of course, other factors such as emotions, toxins and trauma affect one's structure as well. Muscles store and harbor tension and stress from various sources, but the point is that structural imbalance is the end result and, in turn, our functionability is diminished, as well as our health.

From this standpoint, logically speaking, one must seriously consider how to go about producing optimum structural integrity in a balanced way. To do this, it is necessary to understand the value in learning about alignment; learn the principles from a competent source; recognize one's own problems in this area; and then apply the knowledge to oneself.

As a chiropractor, I am concerned with correcting each patient's structure to allow the body's optimum function to be restored. But

I can only do so much for a person and, in reality, one's health is one's own responsibility. Therefore the necessity for everyone to learn about structure for themselves, and to recognize what is right or wrong is essential for good health. I believe that some of the major keys to good health are proper bone alignment, muscle balance (symmetry), flexibility of joints and fasciae, proper breathing, relaxation and proper body utilization. Finally, of extreme importance, is to learn to conserve, build and store energy that is usually wasted when structural imbalance exists.

Exercise is an indispensible means to attain the above keys to health. The kind of exercise, therefore, must not be unilateral, as most sports are and not tension producing (i.e., not in excess). Well-toned muscles and fasciae are desirable, but not too much or not too little. Balance is, therefore, the key when choosing an exercise system. The exercise system should be one that develops body symmetrically, reduces stress, teaches proper alignment and one that shows how to store, increase and conserve vital energy.

I am a chiropractor who sees health to a great extent dependent on symmetry or balance of body structure and so became interested in the Chinese art of Iron Shirt Chi Kung. Iron Shirt emphasizes the importance of maintaining a bone posture in such a way that the gravitational forces acting to push us down to earth can be transmitted through the bones into the earth rather than wasting energy resisting with the muscles or putting undue stress on the joints. The Iron Shirt postures align the vertebrae in such a manner as to permit the line of gravity to pass through the center of the vertebrae. Now the force is not being resisted, but rather transmitted. The muscles, ligaments and tendons can relax instead of working to resist. Integration of all structural tissues for optimum functions is created by the Iron Shirt postures. Relaxation, proper breathing, symmetrical muscle development, tendon and ligament strengthening; as well as strengthening the bones, result from Iron Shirt practice.

Another very important concept is to learn to experience and recreate one's proper center of gravity. I say ''proper'' because generally one's center of gravity changes from the navel area up into the chest or higher as one confronts life situations and stresses. This interferes with normal breathing patterns which should be originating from the abdomen as well as the chest. One simply has to compare a child's breathing to the breathing of most adults,

and it will become evident that adults mainly breathe from their chests with very little abdominal or diaphragmatic action. It is very important that we utilize our diaphragm when breathing since the diaphragm descends upon and massages our internal visceral organs. This action enhances circulation and blood flow as well as increased oxygen to all of our vital organs.

The increased energy, structural integrity and phenomenal health benefits gained from Iron shirt practice, in my opinion, are outstanding. I feel that its practice can develop future health potential in a wholistic way: physically, mentally, emotionally and spiritually. When one aligns oneself with Iron Shirt practice, he also aligns himself with the harmony of the universe.

II. Construction of Fasciae, the Relationship of Fasciae to Bones, Muscles and Tendons, and Acupuncture Routes, or Muscle Tendon Meridians

A. Fasciae: Protectors of your Vital Organs

After an ovum is fertilized it differentiates into three main systems, the ectoderm, endoderm and mesoderm. Fasciae are derived from the mesenchyme, which is a subdivision of the mesoderm.

Nuclei in the mesenchymal substance give rise to bones, ligaments, muscles and tendons. Then a more structureless system of casings, sheaths and tissue takes shape around the various centers which have been developed.

The fascia is a sheath and its function is that of support, protection, mechanical advantage, some degree of contractility and lengthening, and energizing the organs and muscles to let Chi energy flow through easily. The fascia is a type of connective tissue which is avascular (or without blood vessels), translucent and tough. It is intimately involved with muscles, encasing them and enhancing their duties by various means, which include separating them into distinct bundles, providing bonds of especially tough fibers to offer support for purposes of leverage, and allowing for lubrication by means of fluids released from the tissues of an organ or part so that these enclosed muscle groups can slide over each other.

Fasciae are present throughout the body, separating, connecting, wrapping and supporting various parts of it, and finally on a superficial level, encasing the whole body in a shimmering sheath just beneath the level of the skin.

These superficial fasciae are very resilient, due to the fact that the fibers run in a criss-cross pattern. Damage by trauma alters them, making them denser and shorter, a characteristic of scar tissue.

Since this network is present throughout the body, it might explain the mechanism of trigger points, whereby the malfunction of internal organs is evidenced as pain in small areas often quite remote from the organ involved.

This might also explain another mechanism, the one found in reflexology. Certain areas of the feet might at varying times be painful, coinciding with organs in the body.

There is another little-recognized function of fasciae: that of providing muscle tone. In fact, low blood pressure is associated with a hypotonus condition of fasciae and hypertension with a hypertoned fasciae. (This means that a condition of the fasciae exists in which a high or low pressure causes too much or a limited diffusion of solutions throughout the fasciae.) There are several types of fasciae, all built of collagen. The most widely distributed is the loose connective tissue, which is the most flexible and most elastic of all, its fibers going in all directions. It consists of protein imbedded in a liquid ground substance and is very important to water metabolism and to other fluid exchanges. Tough, fibrous tissue can be found in areas where more tensile strength is required. Here the tissue is tough and unyielding, resulting from the parallel arrangement of bundles of fibers which are also found in tendons and ligaments. Huge fascial sheets found in the body are comprised of such tissue. All variations in fasciae, however, stem from the mesoderm.

The fasciae, though avascular themselves, furnish support for blood vessels, nerve fibers and vessels of the lymphatic system and contain the nerves which convey fluid into the veins and sensory receptors which are responsive to internal stimuli from the muscles, joints and tendons. The fasciae are also responsible for maintaining the relative positions of the various organs and muscles in the body.

1. Fasciae Exist in Three Layers (Fig.5.2)

a. The Superficial or Subcutaneous Layer: The superficial layer (the layer beneath the skin) is composed of two subdivisions: (1) a layer which can contain a tremendous amount of fat in those who are overweight; and (2) the more internal area of the subcutaneous fasciae. This is the most elastic of the various fasciae, since it has to accommodate varying amounts of fat storage, swelling when there is inflammation and muscular activity and distension when the muscles are worked. In this layer we are able to store Chi energy. As this layer of the body fills up with Chi, it is unavailable for storage of fat by the body. By practicing Iron Shirt packing, you can burn out the fat already existing in this layer.

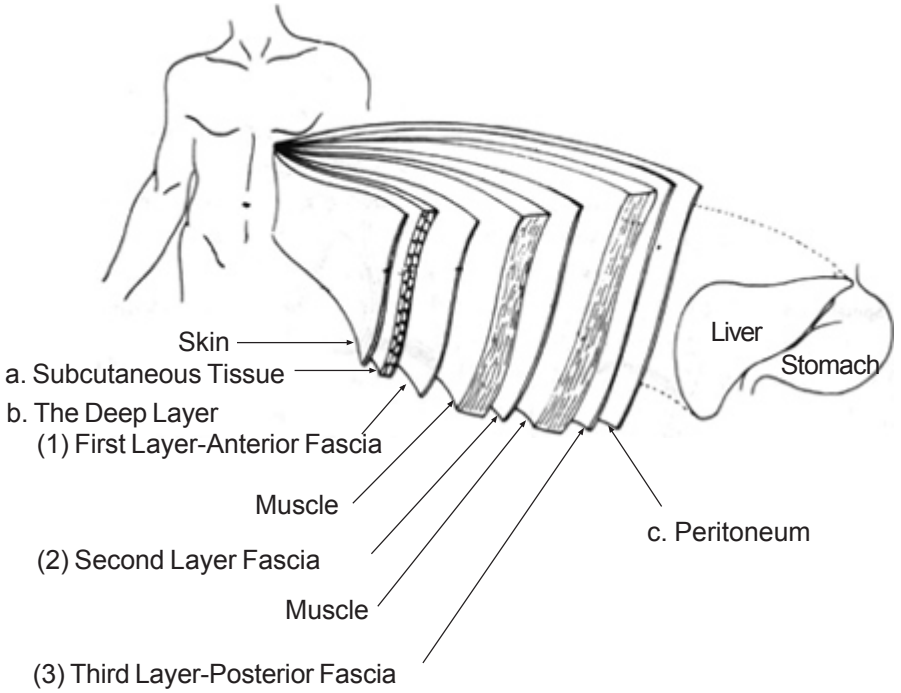

Fig. 5.2 *Fasciae exist in Three Layers.*

b. The Deep Layer: The deep fasciae, which are denser and have a smooth surface, allow for a reduction in friction as one surface slides over another. The deep fasciae produce bundles of fibers in parallel arrangement, giving great tensile strength. This sort of tissue is formed around the ankles, knees, wrists and elbows where it acts as an anchor against which muscles can pull. Fasciae also act in the capacity of a nutritional storehouse, as a source of insulation and support by means of fatty content, and as a barrier to impede the entrance of foreign organisms and objects.

The deep fasciae keep muscles in their distinct shapes and positions. These fasciae, which are the densest and have the greatest tensile strength, are made up of three types. The first and outermost is the external surrounding layer. These cover large muscle groups. The intermediate membranes separate individual muscles and, finally, the internal surrounding layer covers the external surfaces of the body cavities.

c. The Subserous Layer or Peritoneum: Internal to the intermediate membrane lie the subserous fasciae, or fascial layer beneath the membranes of the body which line all of the large cavities of the body. There are two types: (1) the parietal (or cavity wall) fasciae which cover the inner surfaces of the body cavities such as the thorax or abdomen; and (2) the visceral (or internal organ) fasciae which cover the organs in those cavities such as the lungs or liver. Again the main functions are protective and supportive, as well as a means of lubrication. During irritation these serousal surfaces sometimes adhere to one another, causing great pain.

2. Iron Shirt is Concerned with the Fasciae of the Whole Body

Iron Shirt is concerned with the fasciae of the entire body; that is to say it primarily involves the subcutaneous layer (beneath the skin) which covers the whole body. Iron Shirt is specifically concerned with the fasciae in the lumbar region, which are thicker and more fatty than ordinarily encountered. These two divisions of fasciae are joined by spindle connections, which are columnar shaped fibers between which the fat is deposited.

The lumbar fasciae are composed of three layers. The most super ficial one extends out from the middle, from the spines of the lumbar verterbrae (situated near the lower rib and hip bone) and

the spine of the sacrum (the bone formed by the union of five vertebrae between the lumbar and caudal, or tail) region, constituting the back part of the pelvis and sacrospinalis ligament (a muscle which extends vertically along the length of the vertebrae in that area) and also out to the sides to the intermediate layer. The intermediate layer extends from the middle of the area of the lumbar and out to the sides, where it joins with the superficial layer. These two layers envelop the muscles which hold a person erect.

The fasciae also extend upward to the lower portion of the twelfth rib and, at its lower extremity are attached to the iliac crest (the large upper part of the pelvis) and the iliolumbar ligament, both in the small intestine area. The deepest layer envelops the quadratus lumbarum (a muscle which extends out from the area of the lumbar to join the other two layers at the sides, as previously described.) The three layers together comprise what is technically known as the “Origin of the Transverse Abdominis Aponeurosis”.

The deep fasciae of the upper back are made up primarily of thoracic fasciae, which are thin coverings of the extensor muscles of the thoracic spine (vertebrae between the neck and abdomen, enclosed by ribs). Its lower border joins with the most superficial part of the tri-layer of the deep lumbar fasciae, while its upper portion combines with the cervical and trapezius fasciae. Attaching along a mid-line composed of the spines of the thoracic vertebrae, the deep fasciae of the upper back extend out to the sides following the rib angles and the fasciae of the muscles between the ribs.

The deep fasciae that enclose the rhomboids (two muscles that attach to each shoulder blade) and muscles of the posterior (or back) are considered to be separate from the thoracic fasciae, though there is no actual separation between the two.

Out to either side the axillary fasciae (covering the armpit) are to be found, serving as a protective layer over the axillae which are practically devoid of muscular tissue. They also partially enclose the back and side muscles, blend in with the thoracic fasciae, and are connected to the fasciae beneath the spine. In turn, the deltoid fasciae (covering the triangular muscle of the shoulder and upper arm), at about the level of the fourth thoracic vertebra and the mid-scapular (mid-shoulder blade) line, connects with the fasciae beneath the spine and is anchored to the spine and acromion process (the shoulder blades’ projections which form the points of each shoulder).

All of the various layers just mentioned combine to form the continous fascial network of the back.

The deltoid fasciae extend out from the spine at the scapulae to the clavicle (or collar bone). There they merge with the pectoral fasciae (covering the breast). The deltoid fasciae also extend laterally from the shoulder into the arm where they become known as the brachial fasciae. These brachial fasciae join with the pectoral and axillary fasciae and are attached to the epicondyles of the humeri (covering the large rounded prominences associated with the shoulder joints) on the upper end of each humerus (bone of the upper arm) as well as the olecranon of each ulna (or the curved part of the ulna bone at the point of the elbow). (The ulna bone is one of two bones in the forearm and is on the same side as the pinky finger. The other forearm bone is called the radius.) The brachial fasciae are thin where they cover the biceps and thicker over the triceps.

The interbrachial fasciae join as one with the brachial fasciae and extend from the epicondyles of the humeri to the remotest ends of the radius and ulna bones.

The pectoral fasciae are thin sheaths connected to the clavicle and sternum (or breastbone) and extend to the deltoid, brachial and axillary fasciae and also the outer surrounding layer of the abdominal fascia. They also attach to the diaphragm. Beneath the pectoral fasciae lie the pectoralis major muscles. Beneath those are fascial sheaths called the clavipectoral fasciae that enclose the pectoralis minor muscles. This is found between the pectoralis minor and the thoracic body wall.

These fasciae, attached to the clavicle and enveloping the artery running beneath the clavicle, extend to the first rib, the coracoid process of the scapula (the bone that unites with the scapula to form the cavity through which the arteries of the scapula and temporal bones run) and the axillary fasciae.

The ribs comprise the foundation of the thoracic body wall and are covered exteriorally by the external intercostal fasciae (or fasciae between the ribs). This sheath, extending in the direction of the head, joins the scalene fasciae (the fasciae covering the deep muscles attached to the cervical vertebrae and first and second ribs, acting to flex or bend the neck). Extending downwards towards the lower abdomen, this sheath joins with the fasciae that separate the external and internal oblique muscles of the abdomen.

The interior surfaces of the ribs are covered by the endothoracic fasciae (surrounding the muscles within the thorax). These extend toward the head, blending with the prevertebral fasciae (covering the vetebrae which are at the beginning or top of the spinal column), while in their extension to the lower abdomen they connect to the internal surrounding layer of the abdominal wall. The subcutaneous fasciae of the abdomen are soft and pliable, increasing in tensile strength as they extend out to the sides. The highly elastic deeper portion of the subcutaneous fasciae are attached to the linea alba and the inguinal (or groin) ligament. (Alba is a white substance carried by the central nervous system.) The outer investing layers of the deep abdominal fasciae unite with the fasciae of the back and the breast. In their extension downward they connect with the fasciae lata (the external fasciae of the thighs), symphysis pubis (the junction of the two bones which join with a third to form the arch on either side of the pelvis), and the aponeurosis (the white fibrous tissue which forms the attachment of the external abdominal oblique muscles).

The surrounding internal layer unites with the deepest portion of the thoraco-lumbar fasciae, the pelvic fasciae and the fasciae of the diaphragm and are commonly referred to as the transversalis fasciae. These cover the external surface of the abdominal cavity wall, the lumbar vertebra bodies and the psoas major muscle.

The various fascial layers which have been described are integral to the cultivation of Iron Shirt as the fasciae into which we pack Chi. As previously described, this Chi will then form a protective cushion in the body which is also a storage place from which Chi can be retrieved when required.

B. Cleansing the Marrow/Changing the Tendons

1. "Cleansing the Bone Marrow"

The process of transforming sexual energy for storage in the brain and bone marrow, cleansing the internal organs, and restoring the organs to proper function is known as "Cleansing the Bone Marrow"

By circulating Chi in the Microcosmic Orbit and cleansing the "inner marrow" (which, as described in Chapter 1, increases the quantity of blood cells, a vital source of life-force), your system is cleansed of pollution. With the routes cleared, Chi flows freely to

where it is needed and then it is said that the whole body is filled with Chi. When a person ages, the bone marrow begins to dry out and produces fewer blood cells. At that time, the body fills the empty space within the bones with fat. In order to fill the empty bones with renewed energy to revitalize the marrow to a youthful condition, we need to transfer sexual energy which can be stored in the bones while simultaneously burning out fat.

Cleansing the bone marrow, maintaining healthy organs and changing the tendons lead to a strengthening of the muscles, tendons and ligaments, a condition described as one in which the inside of the body is clean and the outside is strong. All three levels of Iron Shirt practice are involved with strengthening and rebuilding the fasciae, tendons and bone marrow.

2. "Changing the Tendons"

Using various methods, Chi can be gathered from internal organs and led out to the fasciae surrounding them whenever necessary. When sufficient Chi has been accumulated, it is guided out along the fasciae between muscle groups and finally to the tendons which themselves are included in fascial sheaths until the entire body is filled with energy.

Tendons connect muscles to bones, are stronger than muscles and last longer. Fewer cells and smaller blood supplies are required to maintain and develop the tendons. Iron Shirt is designed to strengthen and develop the tendons so that movement no longer depends strongly upon the muscles.

In Taoism your health is said to be impaired if your tendons are crooked, loose or weak. Diseased and crooked tendons will cause you to be thin and if the tendons are no longer resilient, this causes you to be easily fatigued as well. The fasciae can become restricted due to injury, resulting in scar tissue which is tougher and tends to contract and pull upon the surrounding tissues and tendons, impeding blood flow and interfering with the passage of Chi. Emotions can also be traumatic and can chronically alter your way of seeing the world and, thereby, the way in which you present yourself to the world. This is evident in many ways, most obviously by the way in which you hold yourself physically.

Fasciae and bone tendons take a longer time to grow and, when injured, take a much longer time to heal. When, however, the

tendons are strong, relaxed, and long and full of strength, they are also full of large quantities of Chi and have ready access to more of it when needed. Once developed, they will be much stronger, last longer and work harder. They will use very little nutrients and will require very little maintenance.

Some therapists have worked on loosening what has become overly restricting fascial tissue, thus often liberating emotions and memories that had created a constant drain on a person's energy reserves. Sometimes the person experiences a new lease on life by being able to function with a range of freedom of motion that he might otherwise never have known.

As previously mentioned, "Changing the Tendons" and "Cleansing the Bone Marrow" will be dealt with further in Iron Shirt II and Iron Shirt III, respectively.

C. Harmony of Fasciae, Tendons and Chi

A Taoist would describe the body as internally consisting of the vital internal organs and the Chi energy which services them. Externally the body is comprised of bones, tendons, muscles and the fasciae which contain them. If you recall, bones are moved by the action of muscle contractions which pull on the tendons that are attached to the bones. Blood is said to move muscles and Chi to move blood. Thus, the Taoist Master strives to create and protect the Chi and the blood. This Chi, as an electromagnetic energy is unseen, while the muscles, tendons, bones and fasciae are quite visible. Practice consists of working both the visible and the invisible as an expression of the harmony of Yin and Yang.

To stress only internal or external development will result in disharmony and dysfunction. The organs and muscles must be vitalized by Chi, but the circulation of the Chi is augmented by having a healthy body. Strengthening muscles without cultivating Chi creates a similar imbalance which will not lead to true health or strength.

"Changing the Tendons" works with the muscles, tendons, bones and fasciae, developing both the visible (muscles, tendons, bones and fasciae) and the invisible (the flow of Chi).

The practice of loosening the tendons is comparatively easy, whereas that of utilizing the fasciae is considered to be more difficult. Iron Shirt Chi Kung is said to be the most difficult discipline

of all and yet its practice, in which you learn to increase and store more Chi, truly begins with the Microcosmic Orbit. Once you have collected
Chi,you you can direct it as it is needed to the fasciae of any point in the body.

By a process in which you collect, conserve and reserve the energy of the vital organs (kidneys, brain, heart, liver, lungs, spleen and genitals), the polluted energy descends and exits as the clean, vital energy rises up to replace it. As you relax and collect more and more Chi, it is directed towards the tendons and fasciae until the entire body is filled with Chi energy.

The Chi flows into the fasciae, expanding and strengthening the tendons.

Again, balance or harmony is necessary. If you practice so that your fasciae are vitalized with Chi and your tendons are neglected, the fasciae will have nothing to depend on, since it is by way of the tendons that the muscles attach to the bones. On the other hand, if you work on the tendons and not the fasciae, the fasciae will not fill out and serve well as a coordinator of the muscle groups which they cover. If you exercise the tendons and the fasciae without Chi Kung to activate an energy flow, the tendons and fasciae will not ‘’raise up’’ separately and will not be able to work freely. If you practice Chi Kung and not the tendon or fascia exercises, the Chi will not be able to travel freely throughout the body and will be impeded in gaining access to all of the meridians. At the same time, the tendons will be weak through disuse and the fasciae will be tight and restricting.

In this chapter, an overall picture is presented describing how the muscles, fasciae and bones function together. Muscles cover other muscles and bones and contain the various cavities which hold your vital organs. The tendons and fasciae are joined together and the tendons connect muscles to bones. The fasciae cover muscle groups, affording them the ability to do more work than they would were they not so bound together, and add to the resilience and general tone of the muscles as well. Since these bundles of muscles wrapped in fasciae lie outside of bones, they protect them; and since they make up the walls of the thoracic and abdominal cavities, they protect everything within them. The most important uses of the Iron Shirt Chi Kung are to fill the cavities of the body with Chi and to build up more Chi pressure in the vital organs, protecting and enabling them to deliver instant energy. (Fig. 5.3)

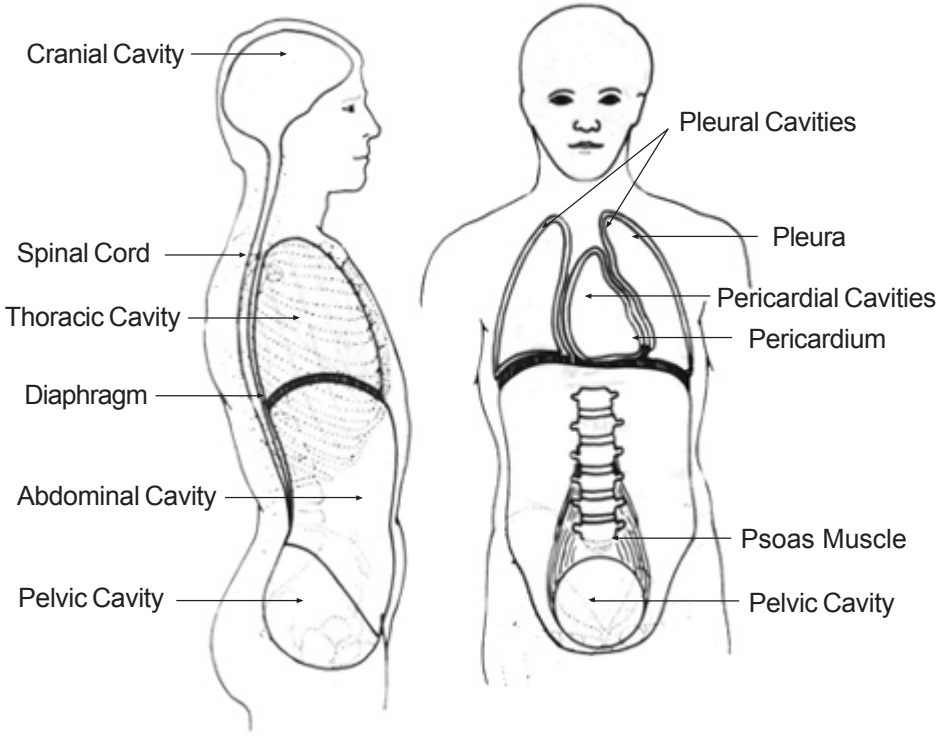

Fig. 5.3 *One of the most important reasons for practicing Iron Shirt is to fill the cavities of the body with Chi.*

D. Muscle-Tendon Meridians

There are 12 muscle-tendon meridians in the body. These exist along the surfaces of the muscles and tendons, running from joint to joint. Unlike the other meridians, these do not connect with any internal organs. They seem to be primarily involved in the gross utilization of energy with which the musculature is associated. Here, however, there is far greater efficiency (that is, minimized effort with increased energy output) than is ordinarily presumed to be normal.

Muscle-tendon meridians originate in the extremities, meet at major joints and end at points ranging throughout the torso and head. Knowing the tendon routes well and energizing them will greatly increase the muscle-tendon-fascia tone and improve the range of movement, or radius.

1. Lung Muscle-Tendon Meridian (Fig.5.4)

This meridian has its origin at the end of the thumb. Looking at a person standing and facing you with his arms at the sides of his body and the palms facing forward, the meridian would be seen as a line that extends up along the outer side of the bones of the thumb to the outer side of the wrist. It then ascends up the outerside of the forearm to the crook of the arm and, rising up the biceps, crosses over to and enters the chest, coming out again at the sterno-clavicular joint, From there it extends across the collar bone to the front deltoid, while another branch extends downward into the chest sending still other branches down to the diaphragm.

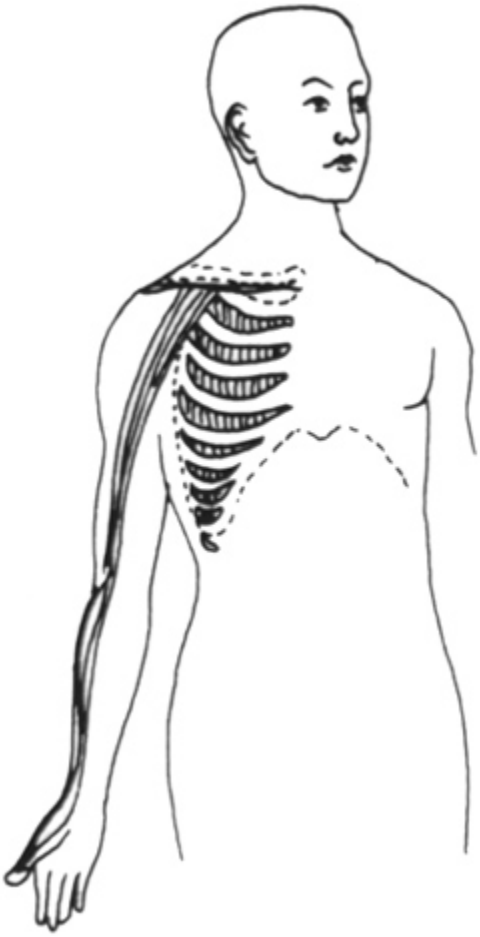

Fig. 5.4 *Lung Muscle-Tendon Meridian*

2. Large Intestine Muscle-Tendon Meridian (Fig.5.5)

Again, picture a person who is standing and facing you. Now his arms are at his sides with the palms facing inward to the torso. Beginning at the end of the index finger this meridian travels up along what is then the outerside of the forearm to the outer portion of the crook in the arm. There it continues to ascend along the outer side of the upper arm to the side deltoid and then splits into two branches. One goes back over the trapezius muscle, descending down between the spinal column and scapula and extending up along the backbone to about midway of the length of the neck. The other travels across the lower surface of the trapezius and then to the sternocleidomastoid muscle on its way to the face, where it splits again at the jaw line. One short branch runs to the corner of the nose, the other travels up along the side of the face, passing through the side of the forehead on its way over the top of the head and down a similar route to the opposite jaw where it finally anchors.

Fig. 5.5 *Large Intestine Muscle-Tendon Meridian*

3. Stomach Muscle-Tendon Meridian (Fig.5.6)

This meridian is somewhat more elaborate, starting at the third toe and sometimes the second and fourth, too. The meridian runs up the lower surface of the foot to about the level of the ankle. From there it splits into two branches. One goes up the middle of the lower leg to the outerside of the knee. The other, running laterally to the first, continues to the hip joint and then up over the ilial crest (upper part of the pelvis) to continue on around to the back where it crosses the lower ribs and joins with an extension of the meridian that runs along the backbone from the sacrum to about the level of the collar bone. Returning to the more medially located branch, we see that it continues up to the top of the thigh and veers in towards the pubic bone. There it enters the abdomen and emerges again above the cavity of the collar bone. Next, it travels up the side of the neck and jaw, where it splits in two. One branch veers forward towards the corner of the mouth, ascending up along the side of the nose to the corner of the eye. The other goes up along the jaw line to a point in front of the ear at the temple.

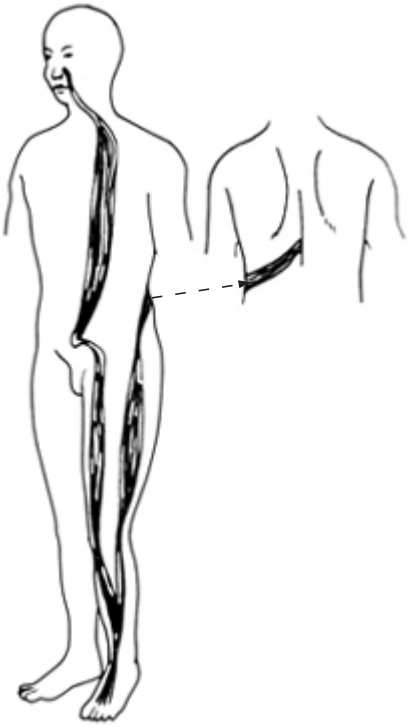

Fig. 5.6 *Stomach Muscle-Tendon Meridian*

4. Spleen Muscle-Tendon Meridian (Fig.5.7)

With the figure standing and facing you, this meridian is seen as originating at the middle and end of the big toe. It then runs along the middle of the foot and ascends to the internal malleolus (hammershaped bone on each side of the ankle). From there it continues upward along the middle of the shin, passing the middle of the knee. Then it travels upward, beginning at the middle of the thigh and sweeping across it to end at a point on the groin. It then turns in toward the pubic bone and rises straight up to the navel. Veering off laterally, it crosses the abdomen, ending at a point just below the nipple, where it then enters into the chest. Another branch runs through a point located at the pubic bone to the coccygeal region where it ascends the mid-line of the backbone to about the level of the tops of the scapulae.

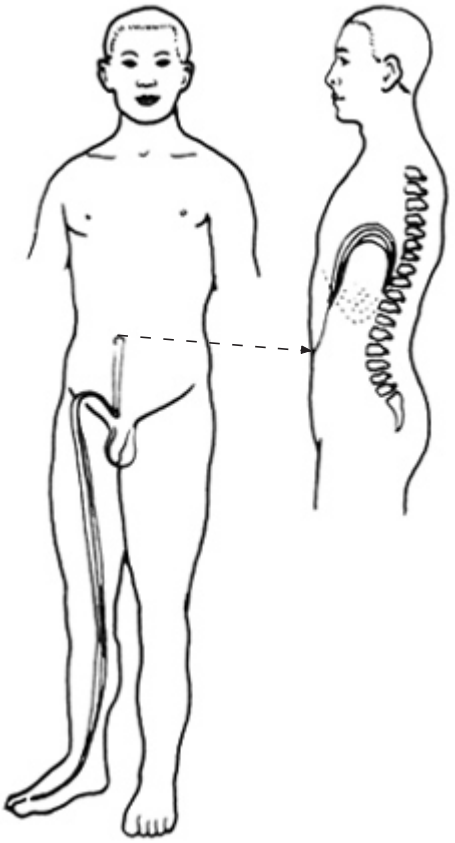

Fig. 5.7 *Spleen Muscle-Tendon Meridian*

5. Heart Muscle-Tendon Meridian (Fig.5.8)

With the person standing with his arms at the sides of his body and the palms facing forward, this meridian begins at the lateral tip of the pinky finger. From there, it ascends to the middle of the wrist, continuing upward along the middle of the forearm to the crook of the arm. Traveling upward and medially, it runs to the armpit and then crosses the pectoral muscle at about the level of the nipple, joins at the mediastinum (the partition between the two pleural sacs of the chest, extending from the sternum to the thoracic vertebrae and downward to the diaphragm) and runs straight down to the navel.

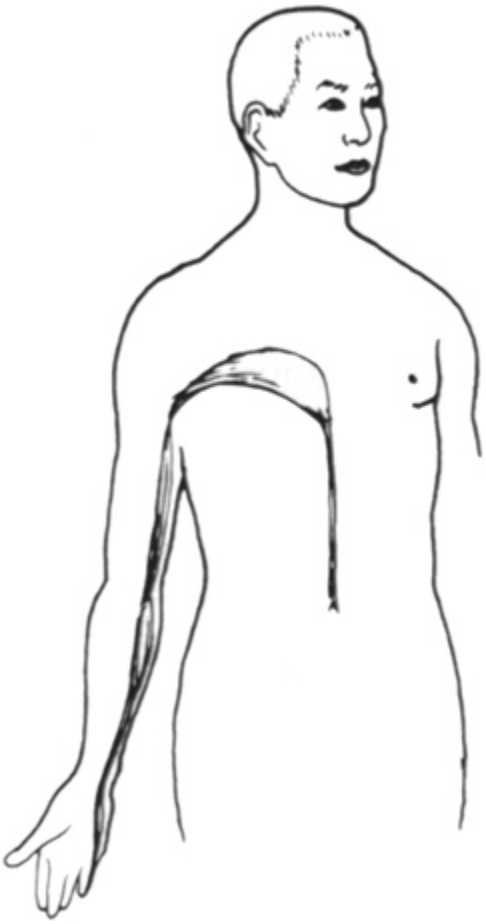

Fig. 5.8 *Heart Muscle-Tendon Meridian*

6. Small Intestine Muscle-Tendon Meridian (Fig.5.9)

With the person standing and facing away from you with his arms at the sides of his body and the palms facing forward, this meridian begins at the tip of the little finger. Ascending up along the back of that finger to a point on the wrist just above it, it continues up along the middle of the forearm, joining its upper arm extension in the middle of the elbow. Proceeding up the middle of the upper arm, it unites with its neck and ear extension behind the armpit. Ascending and descending, tracing out a pattern like a Z on its side, it continues up and over the trapezius, crossing the neck and connecting at the mastoid process with a small branch entering the ear. Another branch loops up and over the ear and then dips down to end at a point on the jaw below that is slightly behind the level of the outer corner of the eye. It then ascends, passing very close to the outer corner of the eye as it travels to the forehead, uniting with the muscle-tendon meridian extension of the mastoid process at the temple.

Still another branch issues out of the point at the mastoid process, ascending the previously described branch that crosses the forehead on its way to the temple.

Fig. 5.9 *Small Intestine Muscle-Tendon Meridian*

7. Bladder Muscle-Tendon Meridian (Fig.5.10)

Looking at a standing figure faced away from you, the bladder meridian begins in the small toe. Running along the outer side of the foot, it rises and joins with the external malleolus.

It then ascends to and joins the lateral corner of the popliteal fossa (or cavity behind the knee), while a branch extends downward from the external malleolus to join at the heel. Then it runs up along the calf and joins at the back of the knee. From there, it ascends to the middle of the buttocks, while at the same time extending downward along the middle of the calf to the heel. From the buttocks it ascends along the mid-line of the backbone to the nape of the neck, continuing upward to join with the occiput (the lower back part of the skull). It then continues upward across the crown of the head to unite with a point at the side of the nose near the inner corner of the eye. A branch arches along the line of the eyebrow and swoops down to the cheekbone. Then, continuing downward it extends to the lower jaw, the throat and onto the chest, passing under the armpit to angle up to and join with the line that ascends the backbone. A small branch extends up out of this extension to the backbone, rising at an angle out of the region of the scapula to unite in the shoulder. There is also a branch that extends out of the nape of the neck to unite with the root of the tongue. Finally, a short branch extends from the line coming up and out from under the armpit to join at the mastoid process.

8. Kidney Muscle-Tendon Meridian (Fig.5.11)

Looking at the back of a standing figure with the left heel lifted, the meridian is seen to start under his little toe. From there it travels along the spleen meridian and curves up at the arch of the foot, passing the underside of the ankle and uniting with the calf extension of the muscle-tendon meridian at the Achilles tendon. Continuing to ascend the middle of the calf, it unites again at the middle of the popliteal fossa (cavity behind the knee) joining with the bladder meridian.

Viewing the same standing figure from the front, the kidney meridian is seen to continue up along the inner side of the thigh along with the spleen muscle meridian. It unites at the pubic bone, continuing a short way up to the navel. From the pubic bone it goes through to the coccyx, where it ascends the backbone to connect with the occiput and join with the bladder meridian.

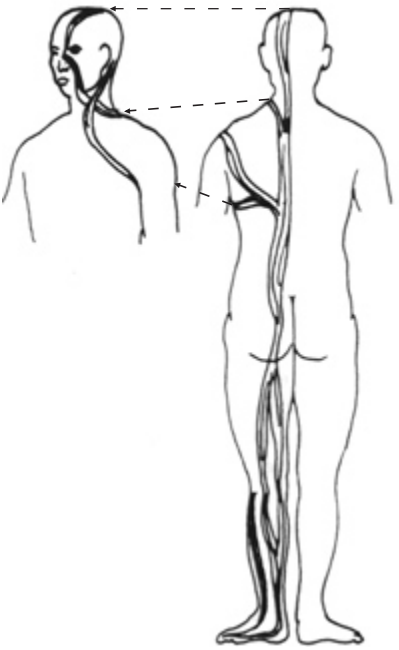

Fig. 5.10 *Bladder Muscle-Tendon Meridian*

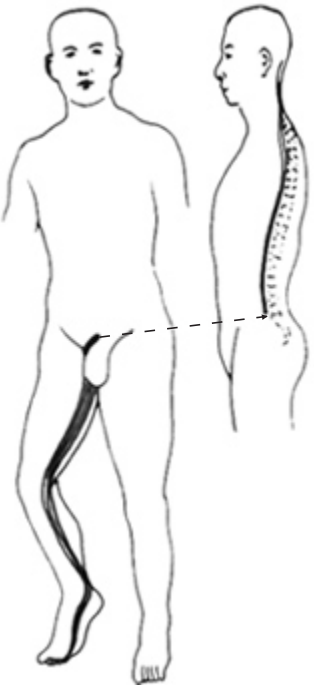

Fig. 5.11 *Kidney Muscle-Tendon Meridian*

9. Pericardium Muscle-Tendon Meridian (Fig.5.12)

Facing a standing figure with his arms at his sides and the palms of the hands facing forward, the meridian begins at the middle fingers. It then rises up the mid-line of the forearm and upper arm, passing through the middle of the palm, the crook of the arm, the point of attachment of the front deltoid and then into the armpit. From there it spreads out into the chest both ventrally and dorsally.

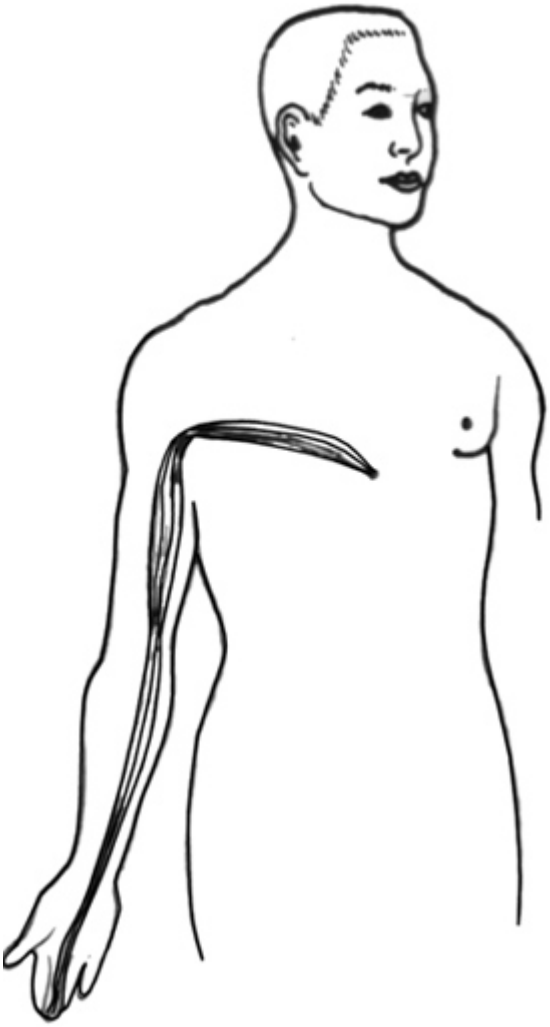

Fig. 5.12 *Pericardium Muscle-Tendon Meridian*

10. Triple Warmer Muscle-Tendon Meridian (Fig.5.13)

Observing a standing figure from the rear with his arms at his sides and the palms of the hands facing forward, the meridian is seen to begin at the end of the fourth finger. It rises to a point directly above it at the wrist and goes up the forearm to the elbow. Then, it travels up the middle of the upper arm, over the trapezius to the neck, where it joins the small intestine meridian. One branch goes to the jaw and connects with the root of the tongue, while the extension of the main meridian rises past the teeth to the ear. There it shifts forward to the outer corner of the eye and continues up past the temple to the upper part of the hairline.

Fig. 5.13 *Triple Warmer Muscle-Tendon Meridian*

11. Gall Bladder Muscle-Tendon Meridian (Fig.5.14)

Here, when we view the figure from the side, we find that the meridian begins at the outer side of the end of the fourth toe. From there it angles up along the lower leg, sending out a branch to the outer side of the knee. Continuing up the thigh, it disperses another branch at S-32 and, continuing upward, sends out yet another branch that runs to the anus. It then ascends along the side of the body and rises in front of the shoulder, uniting with the muscle-tendon meridian extension that leads to the breast at the supraclavicular fossa. A slightly divergent point just below this bulges forward, where it links with the breast. The main meridian continues upward, rising up behind the ear to the crown of the head. It also descends in front of the ear to the side of the jaw from where it ascends again to the corner of the nose, while another branch travels up to the outside corner of the eye.

Fig. 5.14 *Gall Bladder Muscle-Tendon Meridian*

12. Liver Muscle-Tendon Meridian (Fig.5.15)

Here we view the standing figure facing us. The meridian starts at the big toe and connects in front of the internal malleolus. It then rises up the lower leg along the tibia (the inner and larger of the two bones of the lower leg) and joins on the inner side of the knee. Finally it sweeps up the thigh and unites at the pubic bone, thereby connecting with all the other muscle meridians.

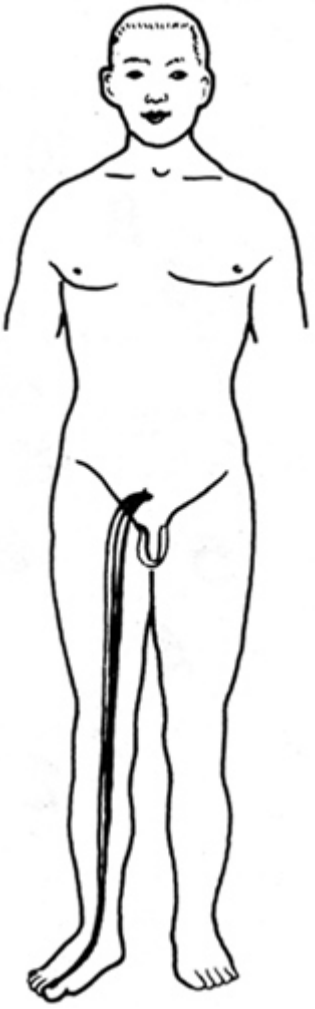

Fig. 5.15 *Liver Muscle-Tendon Meridian*

If you want to strengthen a particular muscle-tendon meridian, you can practice by using a Chi timetable. For example, if you want to strengthen the liver muscle-tendon meridian, it is best to practice at 1:30-3:30 a.m.

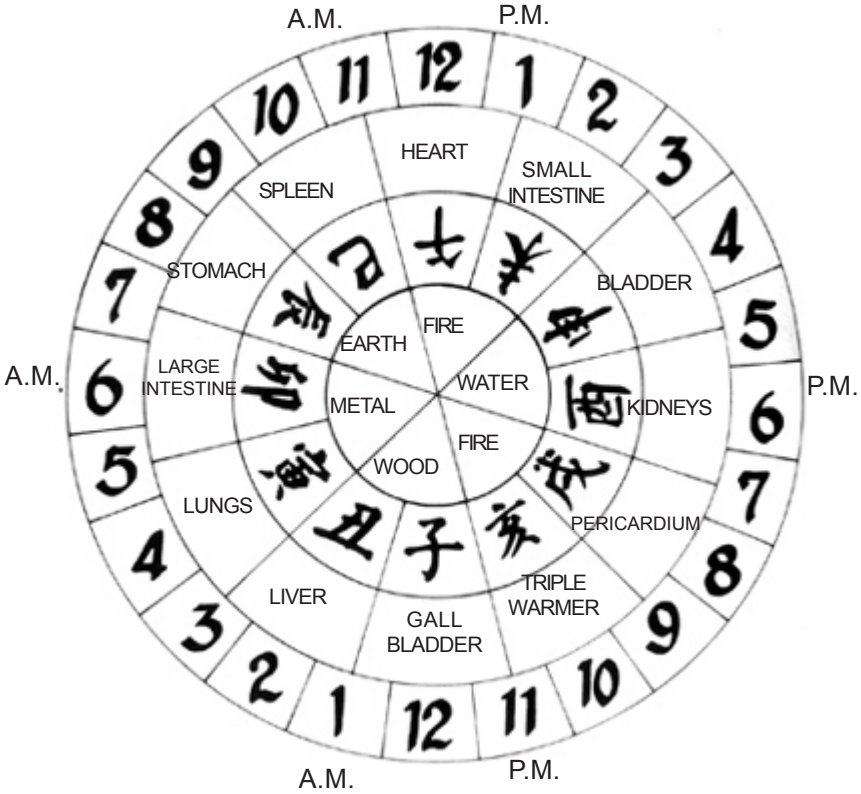

Fig. 5.16 *Timetable of Chi Flow to the Organs*

Chapter 6
Developing a Daily Routine

If you practice the Six Healing Sounds (as described in *Taoist Ways to Transform Stress into Vitality*) just before going to bed, you will sleep more soundly and awaken earlier and more refreshed. Upon awakening, do not suddenly jump out of bed. Allow your engine (your body) to warm up a little first. Switching into high gear as soon as you get up can be disruptive and damaging to your entire system. If you are in the habit of bouncing out of bed in the morning as soon as you awaken, even though you may experience vitality lie in bed awhile instead and practice the Inner Smile, allowing the energy to flow into your Microcosmic Orbit, and you will be amazed at how much your health and overall progress will improve. Continue with Chi Self Massage (as described in *Chi Self-Massage: The Taoist Way of Rejuvenation*). If you are pressed for time, practice Chi Self-Massage while sitting on the toilet seat. It is not necessary to set aside time to do these practices since you can combine them with other activities. After diligently spending time in the Universal Tao System, you will easily be able to realize differences in your general well-being.

You should drink some water when you get up, but not to excess. Drink as much as you feel is comfortable. Imbibing too much water can make you feel nauseated and even damage your kidneys. For drinking purposes it is wise to use a water filter or distill your water. Water and air are your two most important ingredients to good health and steady progress in this system. If you are worried about losing trace minerals through distillation, use tap water to cook with. Then you will have your minerals, too. Make sure that the tap water is filtered, at least through a simple mesh. Make sure that the air that you breathe is filtered as well whenever possible. The “Bionaire” air filter is a good choice because, in addition to filtering the air, it has an ion emitter.

Practice the Iron Shirt exercises you have learned in this book, and in a short time you will find that it all fits together quite easily and becomes as ordinary and yet as necessary, as brushing your

teeth. You will, in other words, begin another good habit. To develop the daily practice of Iron Shirt, it will serve you well to realize that you do not need to do all of the exercises or breath alignment every day. On those days that you practice, it is best to do so early in the morning when you arise. Design a schedule that works for you. You might be able to devote no more than five or ten minutes to an activity, but do it. Rising twenty minutes or a half hour earlier in the morning will improve your whole life. In fact, in a short time you will discover that you need less sleep and have more strength and energy. At the same time, you will find that your activities, both before and after practice, will become more efficient and, therefore, you will derive more benefit, even though you spend what might seem like only a little time in actual practice.

You can create a schedule to fit your time allowance. A recommended schedule to follow might be:

Monday: Embracing the Tree for approximately six to seven minutes, followed by Holding the Golden Urn and the Horse Stance Using a Wall.

Tuesday: Embracing the Tree, the Turtle and Buffalo and the Horse Stance Using a Wall.

Wednesday: Embracing the Tree, the Turtle and Buffalo, plus the Phoenix and Door Hanging.

Thursday: Embracing the Tree, the Phoenix, the Iron Bridge, and the Backbend.

Friday: Embracing the Tree, the Iron Bridge, the Iron Bar and the Warrior Poses.

Saturday and Sunday: Embracing the Tree, or rest for both days before beginning the cycle again. You may also decide to start the schedule over on Saturday. It is important to remember to start gradually, practicing only fifteen or twenty minutes to a half hour per day.

Iron Shirt can be practiced at any time. Once you master using the mind to bring Chi to the various parts of the organs, you will find it very useful and you will be able to use the Chi energy anytime that you want or need it.

If, for example, you are riding in a car, on a train, or in a plane and you feel back pain, you can bring the energy to the back by pulling up the anus and bringing the energy to the kidneys, or simply by contracting the back muscles. Squeeze and release, squeeze and release and you will find that the pain or stiffness will go away.

You will feel energized immediately. In this way you can help the organs that need to be exercised.

Squeeze in some practice whenever you find some time during the day. It does not have to be any particular time and/or place. When you are standing on line, for example, with time on your hands, you can practice the elongation of the spine by pressing the legs down with the sensation of screwing them into the ground. Pull your head up at the same time and push the spine down. Once you master the practice, you can use it in any way that you want.

Do not practice too close to bedtime or you will not be able to sleep. If you feel any discomfort during your practice, consult any Universal Tao Certified Instructor. If the problem still exists, consult a qualified physician. Remember that exercise is a tool. To misuse such a tool can be harmful. Iron Shirt Chi Kung is not meant to be harmful and will not be if used in the proper way. The exercises have been clearly outlined, as well as the side effects and how to prevent them. If the instructions are followed properly there will be no problems. People have been practicing this system for many thousands of years successfully.

Chapter 7
Iron Shirt Chi Kung Experience

A. Testimonials from Advanced Iron Shirt Students

Gunther Weil, Doctor of Psychology

I have been a student of spiritual practice for many years. I was involved for a very long time with the Gurdjieff work as a practitioner. In 1978 my teacher died and I decided to step out of that teaching which, by then, I'd been involved in for some fourteen years. I began studying Taoist work, particularly Tai Chi and then Chi Kung, studying the latter with Don Ahn. In September of 1980, I met Master Chia and learned to practice the Microcosmic Orbit, Seminal Kung Fu, Tai Chi Chi Kung and now Iron Shirt. The approach taken in teaching Iron Shirt is extremely precise and has provided what was lacking in my previous experience of Chi Kung. Although my health had improved enormously in my earlier experiences, and I had a great deal of energy I had reached the point of feeling stuck and blocked. I hadn't made any progress in a year. I feel that the Iron Shirt teaching has been very helpful in getting me going again.

Roberta Prada, Opera Singer

As a classically trained singer, I find the Iron Shirt practices, in combination with the Microcosmic Orbit meditation and the Six Healing Sounds, to be of great benefit to my technique. Specifically, my goals for my singing include a free and easy vocal mechanism and an ability to feel grounded and centered while performing. Since beginning the Taoist practices, I have achieved the relaxation of my jaw, the lowering of my breathing, and the ability to search out areas of tension in my body, so that I can release them and allow the free flow of energy throughout my body. The more tissues resonate freely along the paths of vocal production, the more beautiful and

powerful the sound becomes, and the production of that sound becomes more precise and effortless. This is true for me. It would be difficult to attribute these results to Iron Shirt alone, since I continually study with a voice teacher as well, and perform regularly. However I am certain that the degree of body alignment, delicate coordination, physical and mental power and the ability to still myself, have enhanced my ability to achieve the goals I have set for myself in my art with greater naturalness, precision, clarity and beauty of sound. Ideally I would like to see courses in these arts form part of the studies offered in conservatories and professional schools as part of the body movement/breathing curriculum. Tai Chi is already taught in these settings in England. Once the exercises are learned, they can be used in free moments anywhere: on tour, in a dressing room, in small spaces, without equipment, and without a teacher. They are practical and of lasting value.

I would heartily recommend the Microcosmic Orbit Meditation, Iron Shirt and Tai Chi to singers, actors, conductors, instrumentalists and dancers as a valuable adjunct to their studies.

B. Interview of Iron Shirt Practitioner Michael Winn, conducted by John Zielinsky, Instructor

John: Can you tell me when you first started Iron Shirt?

Michael: I first studied Iron Shirt a little over two years ago. Before that, I was doing Kundalini Yoga which involves a lot of breathing and intense energy. I found Iron Shirt to be even more intense because the air was packed inside, held and circulated internally whereas with the other practices, I breathed in and out and slowly moved the energy around using various sounds. In the beginning I found that I had too much energy in my head for doing Iron Shirt, partly as a result of my other practices. When I started to do Iron Shirt, my face would get very red. As I got better at it, doing it every day, I started to get the energy more rooted, or grounded. I discovered that when a practice is done properly, you are mixing energy from the air with what is in the body, holding it inside where it is somewhat warm, and mixing this with the energy from the ground which is cool. It took me a while to really get the energy down out of my head, and relax before I could begin to practice and

feel like I was drawing in some full energy, mixing it and circulating it around.

John: How long after practicing Iron Shirt I did you begin practicing Iron Shirt II and Iron Shirt III? Also, how long do you practice? How frequently every day during all that time, and how much do you now practice?

Michael: I practice every day, almost without fail. I studied the Iron Shirt II a few months later and Iron Shirt III a year or so after that. I continued doing the Iron Shirt I, even when I did the Iron Shirt II or III. I did not continue with the Iron Shirt II practice because I found that the Iron Shirt I and the Iron Shirt III were sufficient. Iron Shirt III, of course, added another level to my practice. A lot of people do not practice Iron Shirt I long enough to get to the other levels. In fact, what I found out in going through the stages of Iron Shirt I is that it is related to all of the other meditation practices, but as your energy gets more refined and you start to pack the energy in your body more, you feel a different quality to the energy as it circulates around. When I really had it right, I could feel a kind of cool radiant heat emanating out of my body. It was not an electric energy. It was mixed with the Yin energy and properly refined. It left my body feeling that it was together really flowing, giving me a nice energy throughout the day.

The other sensation started happening after a year and a half as I was beginning to take longer before doing Iron Shirt I, before packing, to stand and relax more down to the earth. This allowed me to take more cool energy in. I would begin spontaneously to do the full Microcosmic Orbit, down to the leg roots into the ground, bringing the energy back up the front of my legs to the perineum, back to the spine, around the top of my head and rooting to the ground again. As I looked back into the ground, I would then do the Microcosmic Orbit a full body length into the ground below me. In other words, I was pretending that I was buried underground and my head was right at the surface of the earth. I would circulate the energy through myself standing under the ground. I found a very rooted, cool energy and could visualize myself and my energy in the ground below. I pulled the energy back into my body before I even began to pack. I found myself already getting rooted, just with my mind.

Also, at one point, spontaneously, I started seeing a variety of crystals at various points within my body, and in the body in the ground that I was circulating the energy through. This would add

another quality to Iron Shirt: refining energy. My practice then continued at a much higher level of energy.

What I finally realized is that when you do the Iron Shirt and you are circulating the energy around in the Microcosmic Orbit, you are also pulling in the earth energy and circulating it around in your body before sending it back down. This is what rooting is about.

John: The variation underground, was that yours or from Master Chia?

Michael: Actually, I asked him about it and he said you could do that when you work from a very high level, and even visualize yourself five body lengths down. I started off visualizing myself all the way down to the center of the earth and pulling earth energy out from there. Then I asked him about it. He said try something closer in the beginning. I found that this position at the center of the earth also worked, but Master Chia warned me that the center of the earth is very molten and I might pull out some very hot energy. It has the same effect though.

I have really begun to notice in whatever I do that there is Chi in my bones. When I am doing Tai Chi, I begin to feel my skeleton with a dense, glowing energy in it. This is what lets me know that the energy is not just in my body anymore, or just in my head. When you swing your arm, the feeling is that the flesh and the blood are really light and not quite there, but in the center you can feel steel, an energy that is packed in. I think you get the same sensation from Tai Chi or anything else, but doing the Iron Shirt III speeds the process up a hundred times faster. I think the main things to caution against are not to get too much hot energy into your head or into your heart. When you hold the energy in for a long time and circulate it around, it can strain your heart. The important thing, then, is to start gradually and bring your body up so that it can handle the energy until you can move it around comfortably.

John: Do you relax after you exercise and walk?

Michael: Yes. This is very important. Some days Iron Shirt I is so intense that I do not do anything else. The energy that I have pulled in and circulated through my body is enough for me to digest and work with. I do not do any other practice, not Tai Chi, not anything, because my body has been fed, even stuffed. In fact, I have to sit down and digest the meal.

John: Have you noticed any specific health benefits related to the Iron Shirt practice?

Michael: Yes. In my other practice with Kundalini Yoga, the energy would be very high, but it would leak out of my body. I noticed in the winter that I would be cold. I was becoming very Yin. It was a very Yang practice, but it used up the energy in my body. I notice now with Iron Shirt that my body is much warmer in the winter. I can withstand the weather, the elements. I was already becoming very healthy as far as not getting very much illness or sickness from Kundalini Yoga, but I feel that this has further increased my abilities to fight off flus or colds, or any similar illness. At one time, four or five family members were visiting me and they all came down with the flu and were out for a week. I felt it try to come into my body for a day or so, and I felt very weak. I was able to push it out. I think that packing the Chi inside your body leaves no room for the bacteria, viruses, etc., once the Chi has been built up to a certain level.

John: One other question about your practices: When you practiced Iron Shirt, did you have someone do the pushing to develop the rooting?

Michael: I was living alone and often did not have anyone with me, which is unfortunate. Periodically I would go over to the center and get pushed again and found that I was breaking at the waist, for example, because I did not have my posture quite right. There are small corrections you really need to make. They probably slowed down my progress in getting it right. I was still studying the energy and still packing it in, but there is no benefit to doing so if you do not do it perfectly. So I would say that it is good to get pushed.

John: Michael, I know you lead a busy life and you have a lot of mental activity; do you find that Iron Shirt III helps you to cope with stress from day to day life? Does it help you on a mental level as well as a physical?

Michael: Yes. Sometimes when I am writing, I will work for fifteen or sixteen hours a day. When I feel that I have used up my Chi, my energy, and my brain is not functioning enough, I will do some Iron Shirt to get the energy going again. At times, I do not want to sleep, I want to keep going and keep pushing myself, but I do not think this is the right way to live. It is smarter to live simply. However sometimes you find yourself in the situation of a deadline and, yes, it definitely helps to relieve the stress.

John: Do you have any general comments about your Iron Shirt?

Michael: I have seen other kinds of Chi Kung, and they involve

movement and inhaling and exhaling with those movements, and I think those other Chi Kung are valid and powerful. However, I think that ultimately, this is a higher Chi Kung because it is more internal. In other words, it does not rely on continual breathing, or continued movement of any sort. You do breathe in in the beginning, but as you move along to higher levels of the Iron Shirt Chi Kung, you do not even have to bring in your breath, but can just draw in the energy with your mind, pack it and circulate it around. Movement with your mind emphasizes the internal aspects of the energy; it is also more integrating. That can be a problem in the beginning for a novice whose mind is not integrating with his Chi, and he cannot move his Chi around with his mind. He needs to use more breathing and more movement. I think that if a person sticks with it, it will come in time.

C. Personal Experiences of Students

- No matter what sort of physical activity I indulge in since I've begun studying here, I feel heat in my arms, legs and back. I'm sure that something has opened up for me.
- I cook for a living and I get cut and nicked a lot at work. I've noticed since coming here that I heal a lot quicker. There's something else. I feel I can store a lot of energy in my back now.
- Iron Shirt makes me feel as though I've discovered myself. I've meditated and used energy in other systems, but they've been nothing like what I've experienced here.
- What I enjoyed the most was the harmony that I found among Iron Shirt Chi Kung that "builds the fire", the meditations to open the channels to enable the "fire" to be transported more fully through the body, and Tai Chi as the means to send the Chi through the channels. It all came together very clearly for me here. My concern has been to preserve the "life-force" in the face of the many influences that attack it in daily life, and how to develop a means of harmonizing and choosing the most life-giving elements that are available. This information has laid out a method that I can easily follow to attain this goal.
- I found Iron Shirt II to be most gratifying. After finishing an Iron Shirt II class, I'd experience a "click" in my hips. This

had never happened before. As the week progressed the "clicks" came on sooner and stayed longer. Then, suddenly, three days ago, I discovered that I had new hips and there was an incredible feeling of space throughout my lower abdomen. When I practiced Tai Chi I felt a definite connection between my feet and hips and scapulae. This was something I had heard about and could not enjoy first hand. Now I feel connected all over.

- I first learned about Chi Kung when I was a small boy, reading Kung Fu stories, and I continued to think that it was just story stuff until I came here and found that it is true. Along about April, after practicing Chi Kung for just a couple of months, I had to go to the hospital with a terrible pain at the back near the kidney. At the hospital I was given a morphine shot and I found that my experience with that shot was very similar to the experience I had forcing Chi into my head. So I tried using Iron Shirt to suppress the pain. I didn't have any luck at first, but after a couple of days I was actually able to create the pain-suppressing effects of morphine.
- I have practiced Yoga, Judo and Tai Chi extensively. When I came across Master Chia's book, I sensed that it was just what I'd wanted. I'd had terrible migraines for years. I'm all right now. Before that alt the energy had been stuck in my head. I could feel it there, and I could feel it come down when I completed the Orbit. In fact all I had to do to complete the Orbit was bring it down, because I'd actually spent years in my other practices bringing energy up to my head. Now, after three months of practicing Master Chia's Taoist system, I have enormous energy.
- At first Iron Shirt seemed to be too different from the gentleness of the Tai Chi I'd learned. But I learned to recognize the need for the balance that it produces. I feel that I've been learning to use my body and I see how it is now very different. Soon I will be able to do these exercises on my own, anywhere I need to.
- I feel that I have much more energy now. I can hold my breath twice as long as when I first began to practice. I definitely feel more rooted. I feel energy racing through me.
- I could really feel energy coming up out of the ground doing the Iron Shirt exercises, and I know what it is to be rooted

now. Sometimes my legs shake when the energy comes up through them. There's something else, too. My back seems more like one unit. I can inhale more air and I feel stronger all over.

- I've been practicing meditation for about ten years, primarily a type of Kundalini Yoga meditation practice. It did stress circulation of the energy, but it was only up and down the spine rather than using the front channel. I came across Master Chia's book about six weeks ago and started to practice according to what I read there. I happened to go on a meditation retreat for a month where I was able to practice quite a bit and experience an opening of the Microcosmic Orbit, a deepening of my meditation and a release of blockages that I had been aware of for a number of years. My experience with the Chi Kung thus far has been of an increase in energy flow and a further unblocking of the leg channels.
- I've been studying meditation and martial arts for about nine years and I've always had a complete separation between the two: one being physical and one being spiritual. When I came here, the two were linked together. I'd read about it but had never experienced it, that is, until now. When I lived in San Francisco I thought I had Chi Kung down pat by doing tension exercises, but now as I practice Iron Shirt, I realize that I was going down the wrong road. I was trying to use the mind and to strengthen the muscles, instead of working from the inside structure out.
- For the past 25 years or so I've been involved in martial arts: Karate, Kung Fu and Tai Chi. Through these practices I had experienced various energy centers. I had not been aware of a circuit that had to be completed until I saw it depicted on the cover of Master Chia's book, *Awaken Healing Energy Through the Tao*. I was especially drawn to it because I saw that along that route were some of the centers I had already experienced. When I read the book, I discovered that it answered questions for me that I'd not yet been able to put into words. I began to realize that I must learn to turn my senses inward and to reflect. I recognized that introspection is something we are not ordinarily taught. As I read, I came to believe that this might

be what I had been looking for: a method to follow that would allow me to know more about myself.

- I approached the Microcosmic Orbit and Iron Shirt because I was searching for something to cure a serious problem that was unsuccessfully treated previously. I had a four-by-six centimeter duodenal penetrating ulcer. (It's been documented.) And for those who don't know about such things, that's a big ulcer. I also had two crushed discs commonly called kissing vertebrae, from two separate accidents. In addition, I had a genetic curvature of the upper portion of my spine for which I'd had chiropractic adjustments over a period of two years. When I came to inquire about your courses, my digestive system had wound down to a standstill, I had lost about thirty pounds, and my gastroenterologist had told me that I must undergo surgery. In less than four months of practicing Iron Shirt, I actually have scar tissue where the ulcer had existed. I no longer have to take medication, and now I have no back pain, after having experienced it constantly for three years prior to starting this practice. During this period I did nothing but what I've learned here: Iron Shirt each morning, and the Microcosmic Orbit during the day. I have gained twenty-five pounds, and I really do feel that Iron Shirt supplied the real healing power.
- I was introduced to Master Chia through a friend who said that he knew that Master Chia could help me get rid of bad headaches. I had seen Chinese, French and American doctors and none of them could do anything to help me with a problem that had made me miserable for almost fifteen years. After three days with Master Chia, I completed the Orbit and gradually I found my headaches were subsiding.
- I studied some Tai Kwan Do and I'm presently studying Praying Mantis Kung Fu. I became interested in the internal Kung Fu through a friend of mine. As soon as he told me about it, I was interested. I went to learn Tai Chi at the time and learned very fierce breathing exercises. It did seem to get energy going but after practicing it I didn't feel as energetic as I do here. The surprising thing about Master Chia's system is that it's so simple to do, and yet, it's so

effective in doing what it's supposed to do. I feel it inside my navel as opposed to feeling it in my stomach or my elbow or different parts of my body. I also find that it helps my martial art practice.

- I have been practicing some martial arts from time to time, especially Hsing Yi, and have sought out internal practices. Your system is by far the best that I have found and I want lo thank you for it. In fact, it intergrates Kundalini Yoga and some Western practices, integrating the uses of the centers and the meridians. It is excellent and I want to continue with it.
- I've practiced martial arts, meditation and a number of spiritual disciplines for around eight or nine years and, last spring, I took Master Chia's Microcosmic Orbit workshop. I had the personal experience of feeling the Chi travel through the basic meridians and a number of acupuncture points. I was surprised because before, they were just points in books to me. I thought maybe you could influence that energy with needles, but I never believed you could feel it. I look forward to practicing more and more Iron Shirt and deepening the sensation of the energy and the experience.
- Before coming here I had experienced energy in my body but I didn't know what to do with it; it seemed very scattered. Through the structure that Master Chia offers, I now have a means of control that I never had before. My background is in martial arts and in meditation for about the past five years. Iron Shirt is something I've never seen offered anywhere else, and I feel it's invaluable to anyone who is doing any martial arts, especially a dynamic type, which can easily throw your body out of alignment or else lead to damaged organs. It's become apparent that if I know how to use this type of energy that I get in Iron Shirt, I feel my risks of sustaining damages are greatly lessened.
- I still have a long way to go to develop any rooting power, but I do feel stronger especially in my back.
- You brought up something a little while ago about people having more difficulty in dealing with pleasure than with pain. Well, I'd been meditating twice a day during my vacation and got so high that I just couldn't stand it. My whole body was like golden light. I had to back away from the practice.

I just wasn't ready for it. This stuff is really authentic. I am very convinced. There's another thing I'd like to say about this practice. I am an acupuncturist and have no trouble getting patients these days. I never even have to think about soliciting clients. They just show up. My work is more effective, efficient and clear.

- I find myself growing, now that I have discovered this teaching, and I've discovered my body, I've already helped my body immensely. I want to learn everything that I can that relates to these methods, now. The effects are too convincing. It's like coming across the answers to everything.
- I came from another system that I felt was very good, in fact, perfect. So I really wasn't looking for anything else, except that I was curious to know about this other system.I found theUniversal Tao exciting and very different. As I went into it and felt so much energy running around in my channels, I began to miss some of those simpler powerful ethics of my earlier meditations. It took me a while of practicing the Taoist meditations on a daily basis to understand that in the Taoist approach, I was making use of sources of energy that I had, in my earlier system, not tapped. While previously I had been achieving one sort of intensity of energy I find that through Tai Chi and Iron Shirt, I can hold that energy in my body rather that just having a temporary experience that might come on from a lot of chanting or breathing exercises.

$15.95

Iron Shirt Chi Kung I

Once a Martial Art, now the Practice that strengthens the Internal Organs, Roots Oneself Solidly, and unifies Physical, Mental and Spiritual Health.

Mantak Chia

Profusely Illustrated by Juan Li

In the days before gunpowder, Iron Shirt Chi Kung was one of the principal martial arts, which built powerful bodies able to withstand hand-to-hand combat. Even then, however, martial use was only one aspect of Iron Shirt and today its other aspects remain vitally significant for anyone seeking better health, a sane mind and spiritual growth. "Iron Shirt" refers to the fact that its unique system of breathing exercises, which permanently pack concentrated air into the fasciae (connective tissues) surrounding the vital organs, make them well nigh impervious to injuries from accidents or blows. We also learn how to root ourselves in the earth's power and thus to direct the earth's gravitational and healing power through our bone structure. Iron Shirt's strengthening of the organs is of special interest to athletes and performers, for it teaches them how to increase the performance of the organs during sports, speech, singing, dancing and playing music. For the Taoist masters, all this in turn lays the groundwork for higher, spiritual work. Every step of the way is made clear in the numerous line illustrations of Juan Li.

Master Mantak Chia, born in Thailand, comes from the ancient lineage of Taoist Masters, extirpated in communist China and now existing in dwindling numbers among the Overseas Chinese. He also has a Western education in anatomy and physiology. Now in Thailand, he has developed a clear and practical way of teaching this ancient wisdom, much of it hitherto kept secret. He is also the author of *Awakening Healing Energy*, *Taoist Secrets of Love*, *Taoist Ways to Transform Stress into Vitality*, and *Chi Self-Massage*.

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Bone Marrow Nei Kung

Bone Marrow Nei Kung teaches how to cleanse and grow the bone marrow, regenerate sexual hormones and store sexual energy in the fascia, tendon, and bone marrow.

The bone marrow is responsible for the production of red and white blood cells, so any work which helps in the production, circulation and overall health of the blood also assures one of having more Chi. The red blood cells are a truly vital source of energy because the medium in which the body is able to make use of oxygen and to get rid of the carbon dioxide.

In Taoist yoga it is believed that the sexual organs are joined with all the other organs of the body. In addition, the tendons, muscles, and glands all join together at the sex glands. So any exercise which revitalizes and strengthens the sex organs will also have a positive effect on all the Internal organs, tendons, muscles, and glands.

In Bone Marrow Nei Kung one works at revitalizing and strengthening the organs through vaginal and testicle weight lifting. For example, if a five pound weight pulls down the testicles, then there is an equal five pounds force pulling up within the body; otherwise, the testicle would drop to the floor with the weight. What pulls up with equal force to the weight is a combination of connective tissue (fascia), urogenital and pelvic diaphragm force, as well as muscle, tendon, and internal organ force.

As the sexual organs develop the ability to lift comfortably five pounds of weight or more, all the genital areas are strengthened resulting in greater control of sexual energy. Moreover, the techniques of the "Big Draw" (males) and the "Orgasmic Upward Draw" (females) learned in the *Taoists Secrets of Love* Practice are greatly enhanced by *Bone Marrow Nei Kung* practice. Genital weight lifting also stimulates the sex hormones and endocrine glands. The sort of hormone stimulation brought about by Bone Marrow Nei Kung is extremely invigorating, leading the development of the "Steel Body"; a body able to withstand injuries without internal damage.

The process through which sperm or ovarian energy is made to lodge in the bones and marrow is through the practice of " beating" the body with a rod made of metal wires. Beating produces a vibration which penetrates deeply into the core of the organs shaking loose deposits of toxins, stimulating circulation and setting off a process of restructuring and repair which, after prolonged practice, results in the development of muscles and organs which are thoroughly cleansed of impurities.

The work with Bone Marrow Nei Kung is not simply limited to restoring mental health and preventing injury—it prepares the stage for the higher techniques of the intermediate level of the Universal Tao Practice when the practitioner, using the physical body a solid foundation, begins to work on developing the Spirit Body for the experience of ultimate transcendence.

Bone Breathing

Bone Breathing or Bone Compression is the method for "Cleaning the Marrow", or cleansing out fat in the bone marrow so that more sexual energy (Jing) can be absorbed into the bones to help regrow the marrow.

During Bone Breathing we take advantage of the Chi generated in Iron Shirt I by absorbing Chi into the bones, thereby greatly extending the circulation of Chi for the meridians and the organs. As the Chi permeates and penetrates the bones, nutrients and oxygen come to enrich the bone marrow. Tension in the muscles surrounding the bones is lessened allowing continuous flow and movement of the whole body—an important factor for people who depend on physical activity as a way of living. As a result of increased Chi circulation in the marrow, the bones become strong and healthy because the marrow, as the main producer of red and white blood cells, now has more room to grow.

Strong bones play a significant role in preventing many of the problems relating with aging: decalcification resulting in fragile bones; poor posture which generates feelings of depression and loneliness; frequent infections due to a weakened immune system; and restricted physical activity due to arthritis and calcified joints.

The key ingredient in practicing Bone Breathing is relaxation. It is most important that one not be tense in the practice. Bone Breathing is a two stage process:

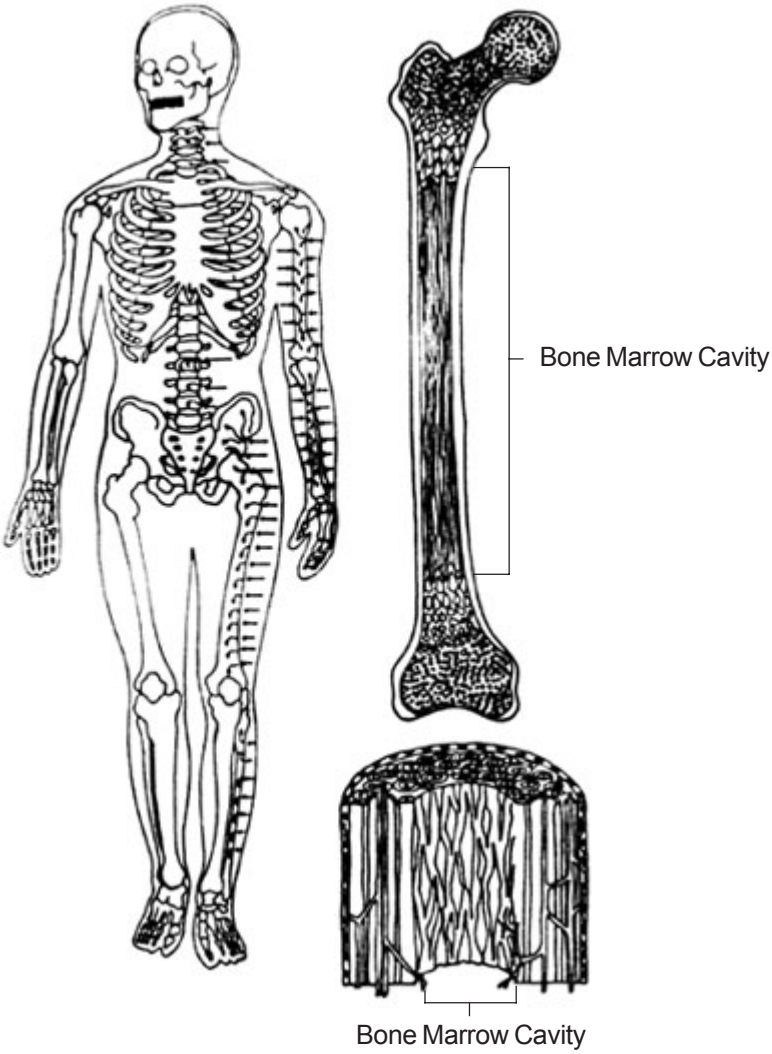

Fig. 1 *Bone Marrow*

First Stage

Inhale and Exhale through the Fingers

- At first one can use the mind and the eyes to visualize the respiration process through the fingers.
- Gradually feel the breath moving up the hands, arms to the skull, and then down the spinal column and legs.
- Notice the sensation as the breath moves through these areas.
- During inhalation, the breath feels cool and in exhalation it feels warm.
- Feel the inside of the bones and allow the breath to penetrate the bones by relaxing the muscles and tendons.

Fig. 2 *Bone Breathing*

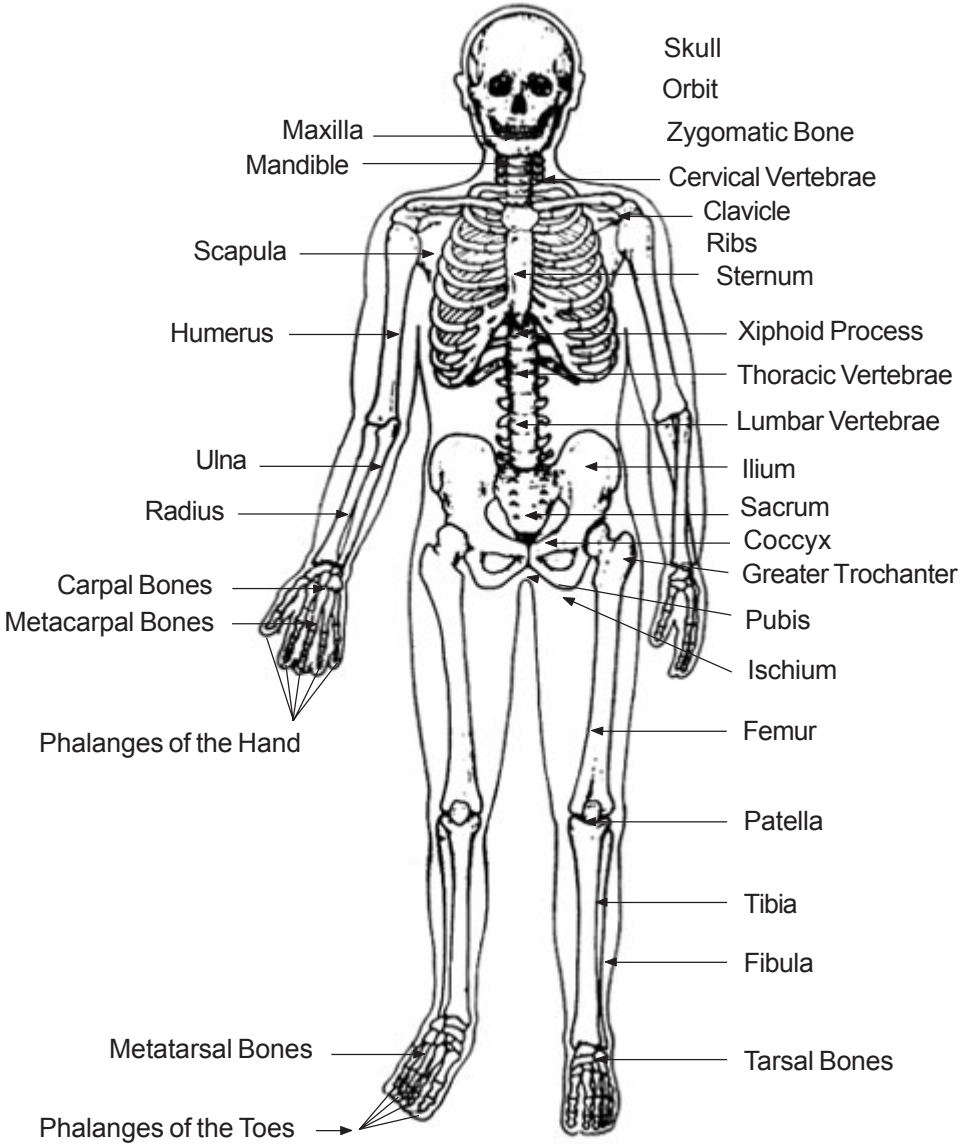

Fig. 3 *Skeleton*

Second Stage

Inhale and Exhale through the Toes

- By degrees inhale up through the legs into the thigh bones.
- After inhaling, hold the breath, but not so long as to experience discomfort.
- Then exhale down and out through the toes.
- In the next breath inhale all the way up to the hips and then exhale through the toes.
- Next breathe up to the Sacrum. At this point energy may rise up through the back and reach the head, overflowing into the entire nervous system.
- Finally, breathe up the legs and back, combining it with the fingers breath coming up the arms and shoulders, through C-7 into the head.
- Keep in mind that energy is inhaled and exhaled most effectively through the toes, fingertips, elbows, knees, sacrum, C-7, Door of Life, Shoulders, and the tip of the nose.

Applications for Chi Weight Lifting

Strengthening the Fasciae Network

An upward counterforce is created by the internal organs and glands to resist the weight placed upon the genitals. This force is strengthened by the Chi released from the sexual center as the internal system engages the fasciae to pull up against the weight. The fasciae, therefore, contribute greatly to the distribution of energy. They also serve as the connection between the genitalia and the pelvic and urogenital diaphragms. When this connection is loose, the Chi

Muscle and the diaphragms allow the organs to drop their weight onto the perineum, thereby reducing the Chi pressure. When the connection is kept strong, the organs and glands are held in place and the Chi pressure is maintained.

Chi Weight Lifting for Powerful Urogenital and Pelvic Diaphragms

The human body has many diaphragms holding the internal organs and glands in place, such as the thoracic, pelvic, and urogenital diaphragms. During Chi Weight Lifting these contribute greatly to the upward counterforce deployed against the downward pull of the weights anchored to the genitals. (Fig. 4) The pelvic and urogenital diaphragms, considered the floor of the organs, and the Chi Muscle, are all strengthened by this practice which helps to prevent any loss of energy through them. Their increased strength also helps to alleviate the protruding abdomen caused by organs stacking up on the pelvic area.

Chi Weight Lifting is credited with many other benefits related to the improved functioning of the diaphragms, such as the lifting of dropped kidneys. Furthermore, the practice helps to seal the openings of the anus and sex organ to prevent the leakage of Chi. Taoists believe that this helps to redirect the spirit away from these openings as one prepares to finally leave the body. The upward flow of energy that is developed through Taoist practices will point toward the crown as the proper exit for the spirit to use at the end of life.

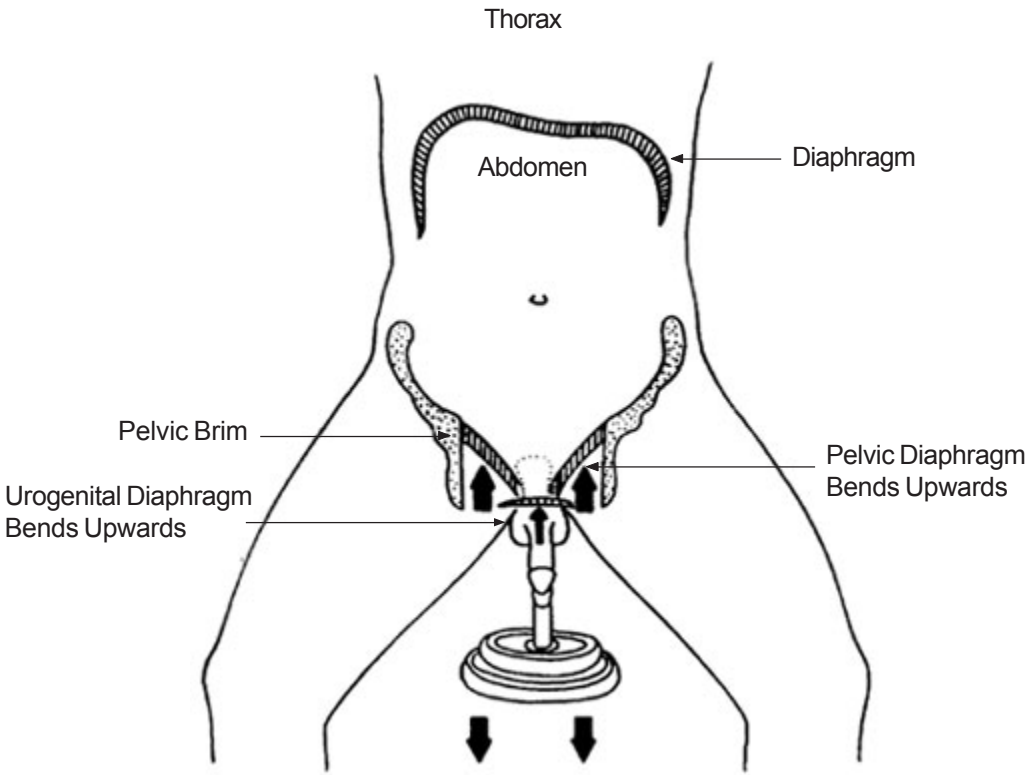

Fig. 4 *Pelvic and urogenital diaphragms provide counterforce to the weights.*

Sexual Hormones Delay the Aging Process

The release of sexual hormones stimulates the pituitary gland to prevent the production of an aging hormone. It has been proposed that one function of this gland may be to measure the growth of mutated reproductive cells. Scientific studies have found some evidence that the aging hormone is released when these mutations are allowed to increase beyond a certain level. Theoretically their growth should be impeded by a healthy reserve of sexual hormones. Otherwise, upon sensing the reduced presence of Ching Chi within the body, the pituitary gland can cause a premature death by producing the aging hormone. It is therefore wise to maintain sexual energy and hormones through the Taoist practices.

Sexual Hormone Stimulation of the Brain

The right side of the brain is also influenced by the sexual hormones to promote the healing and rejuvenation of the body. Since Ching Chi revitalizes the internal system and regrows the bone marrow, hormonal stimulation of the brain greatly enhances these processes. This effect also serves Taoist spiritual work because practitioners find it to be an invigorating experience on all levels. The health of the body and the mind directly affects the spirit.

Equipment and External Preparations

Cloth for the Massage and Lifting the Weight

Men and women use a silk cloth for the Sexual Energy Massage techniques to increase the flow of Chi and blood in their sexual centers. Silk works well because it develops considerable static energy when rubbed. This is important for the stimulation of Chi in the sexual organs, perineum and sacrum. Women also use the cloth to massage their breasts. Men use the cloth after the massage techniques to lift the weight from a special holding apparatus.

Men: Two sizes of cloth can be used to lift the weight, depending on the method chosen for practice. The smaller cloth, which is used for lifting the weight from a table or chair, should measure approximately three and one-half by eight inches. If you choose to lift the weight from the floor, the length of the cloth can very according to the length of your legs. When the cloth has been cut to size, you can sew the edges to prevent unraveling and to avoid abrasions of the skin.

Equipment for Men

Men require a special device by which the weight can be held to the cloth. (Fig. 5) Cut a ten inch length of galvanized pipe for an apparatus to be used from the floor. Cut an eight inch length for an apparatus to be used from a chair. (Either size is adaptable to either method if necessary.) Drill a one-quarter inch hole through the pipe one-half inch from either end.

Secure a piece of chain two links long to the pipe with a one quarter inch bolt inserted through the hole and fastened by a nut and washer at its end. At the end of the chain, a heavy ring one and a half inches in diameter is attached. Several types of clamps may be used on the opposite end of the pipe to hold the weights. After the silk cloth has been tied gently, but firmly, around the groin, it can then be attached to the ring in order to lift the entire weight-holding apparatus.

Some men can begin Chi Weight Lifting with a two and one-half pound weight; however it is safer to start with the apparatus alone, or with one or two weight clamps attached to it. (These are used in standard barbell sets.) If you use two weight clamps, their weight should equal one pound, plus the weight of the apparatus itself. Some stores that carry sporting equipment sell one and a half pound weights. Add on more weight gradually, but only as much as you feel comfortable with. Do not advance to higher weights unless you can lift the current weight easily for one minute.

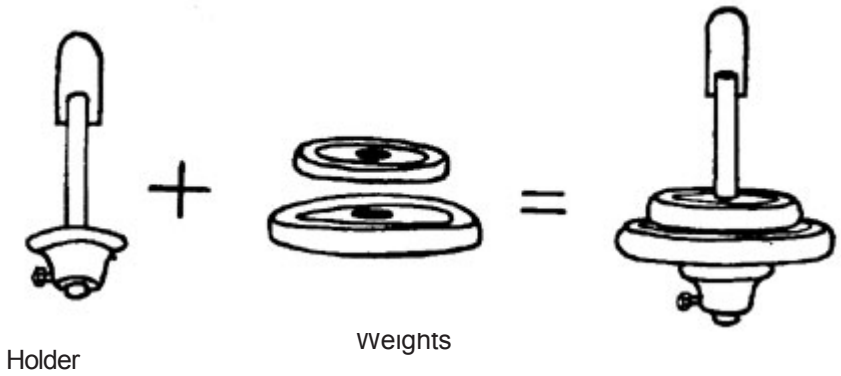

Fig. 5 *Chi Weight Lifting Equipment*

Genital Massage and Preparatory Exercises for Men

Massage Techniques

Cloth Massage and Sexual Energy Massage Practices: These stimulate internal energies and prepare the genitals for the role at hand. (Fig. 6) First, the silk cloth is applied to the sexual center, perineum, and sacrum to activate the Chi. Men should feel the testicles fill with energy as they become firm. Women should feel the breasts enlarge slightly as the vagina becomes moist with secretions. The Sexual Energy Massage techniques should then be used to condition the genitals for Chi Weight Lifting. After the weights are removed, the massage techniques must be repeated to restore the circulation of blood and Chi to the sexual center.

***Men**:* Although not all six techniques are required, the Sexual Energy Massage must be emphasized by men after the weights have been removed to ensure that the genital area will be clear of any blood coagulation which can lead to blood clots.

Fig. 6 *Cloth Massage*

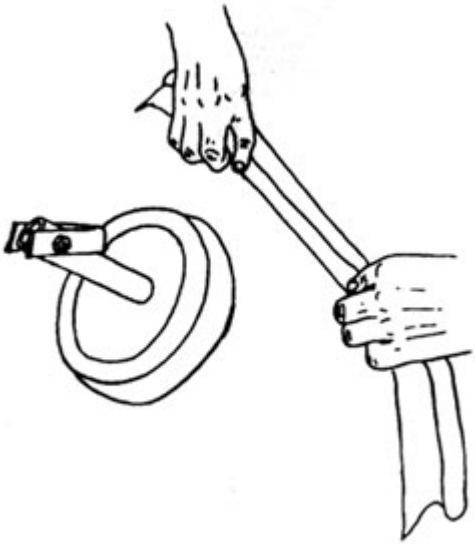

Fig. 7 *Folding the Cloth*

Outline of Pre-Chi Weight Lifting Exercises

Both men and women should specifically review the Power Lock which is used before the Sexual Energy Massage and again immediately after the weights have been removed. The Kidney and Chi Pressure exercises are included herein.

Men:

(a) Increasing Chi Pressure Exercise
(b) Increasing Kidney Pressure
(c) Power Lock-two or three times up to the Crown
(d) Cloth Massage
(e) Finger Massage of the Testicles
(f) Palm Massage of the Testicles
(g) Ducts Elongation Rubbing
(h) Stretching the Ducts Gently with Massage
(i) Stretching the Scrotum and Penis Tendons
(j) Tapping the Testicles

Chi Weight Lifting

Warning: Do not attempt Chi Weight Lifting without studying the precautions in Section F.

Students are expected to receive instruction before attempting Chi Weight Lifting; however, the following detailed synopsis will clarify this practice for novices. Students are not expected to remember every detail. In advanced practice, the steps which follow are combined into a very brief exercise. Although the summary is concise enough to be used as a practice guide for trained practitioners, all practitioners are advised to first read the details.

Attaching the Weight—Men

a. Position of the Weights

Chi Weight Lifting can be initiated from either a kneeling or standing position. (Fig. 10) If you cannot kneel, set the weight on a chair in front of you. It may be necessary to relieve the pressure of the weights quickly at times, particularly if they are too heavy and the knot beneath the testicles is tight. For this reason, keep the weight close to a place where it can be quickly removed. Consider tying one end of the cloth to the ring while leaving the other end in a loop--folded beneath the knot--so that the knot will undo itself if that end is pulled.

b. Standard Method of Tying the Cloth

Warning: Do not tie the cloth around the testicles alone.

(1) Fold the cloth lengthwise several times to a width of about one inch. (Fig. 7) This creates a thick padding.

(2) Hold the cloth beneath the perineum, and bring it up behind the testicles. Be sure that the edge of the cloth is folded away from the skin so that if does not cut into the groin.

(3) Wrap both ends of the cloth upward around the penis and testicles, and secure the cloth at the surface of the penis base by tying a knot.

Note: If you prefer, you can place the cloth on top of the penis and tie the knot beneath the testicles. In either case, the knot must eventually be positioned at the perineum. (Fig. 10a)

(4) Move the knot behind the testicles and beneath the perineum. The ends of cloth should hang to the floor. Before tightening the knot, you can use one end to create a loop between the knot and the groin so that the cloth and apparatus can be quickly removed.

(5) Contract the muscles of the undertrunk and tighten the knot. The penis and testicles should bulge slightly from the pressure to insure against slippage. Do not cut off the circulation to the testicles.

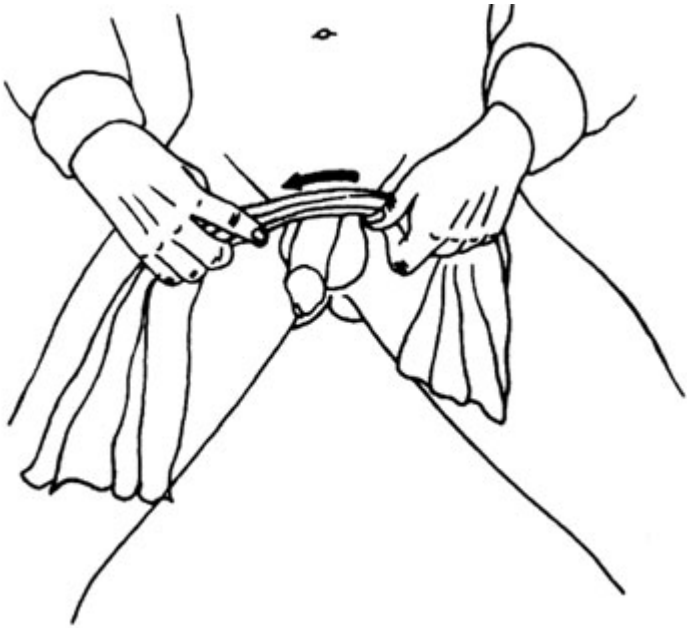

Fig. 8 *Tying the Silk Cloth around the Genitals.*

(6) Tie one end of the cloth to the weight that you have placed on the floor, or on a chair. (Fig. 10 and 11) If the weight is on the floor, tie the cloth to it from a kneeling position.

(7) To remove the weight at the end of practice, kneel in front of the chair--or near the floor--and untie the cloth attached to the holding apparatus, then remove the cloth from the groin.

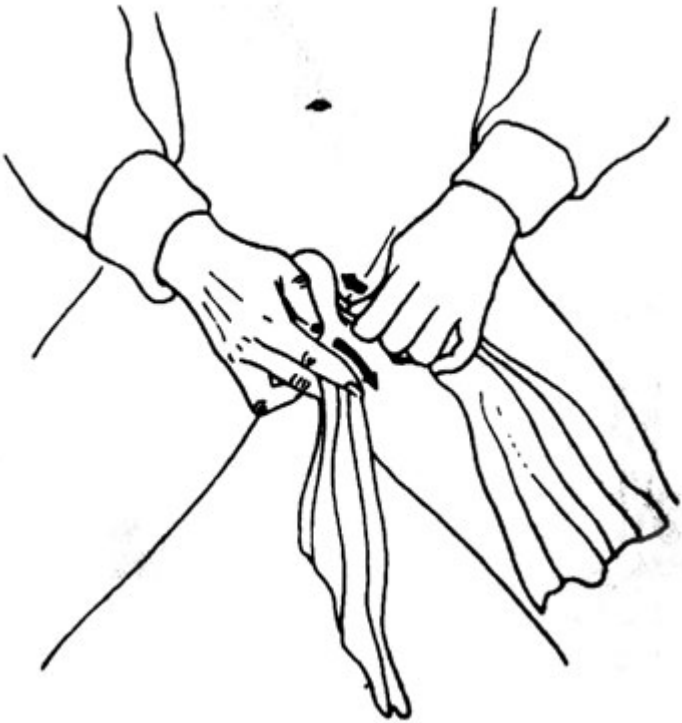

Fig. 9 *Tying the Silk Cloth.*

(a)

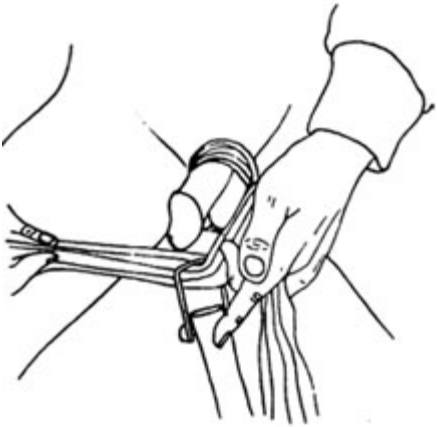

(b)

Fig. 10 *Chi Weight Lifting can be initated from either a kneeling or a standing position.*

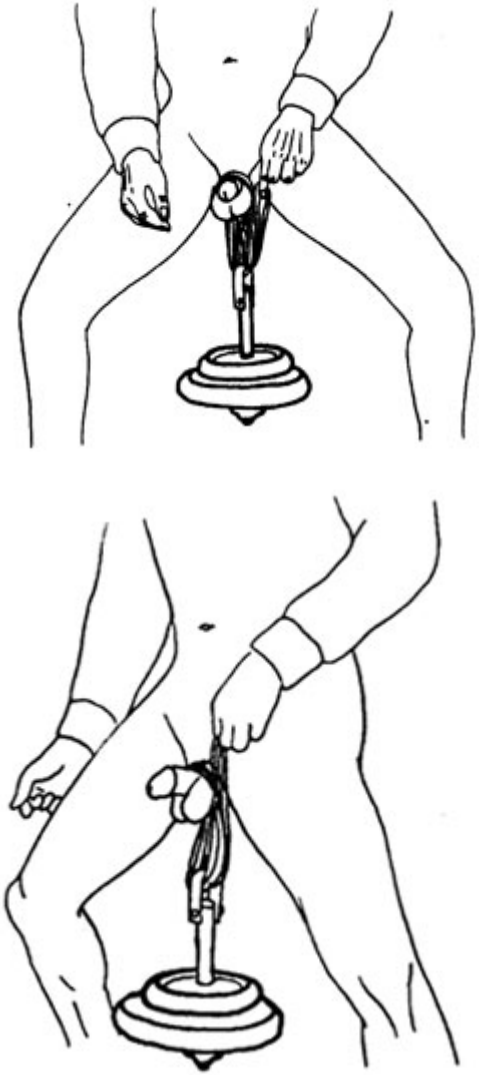

Fig. 11 *Chi Weight Lifting a standing position.*

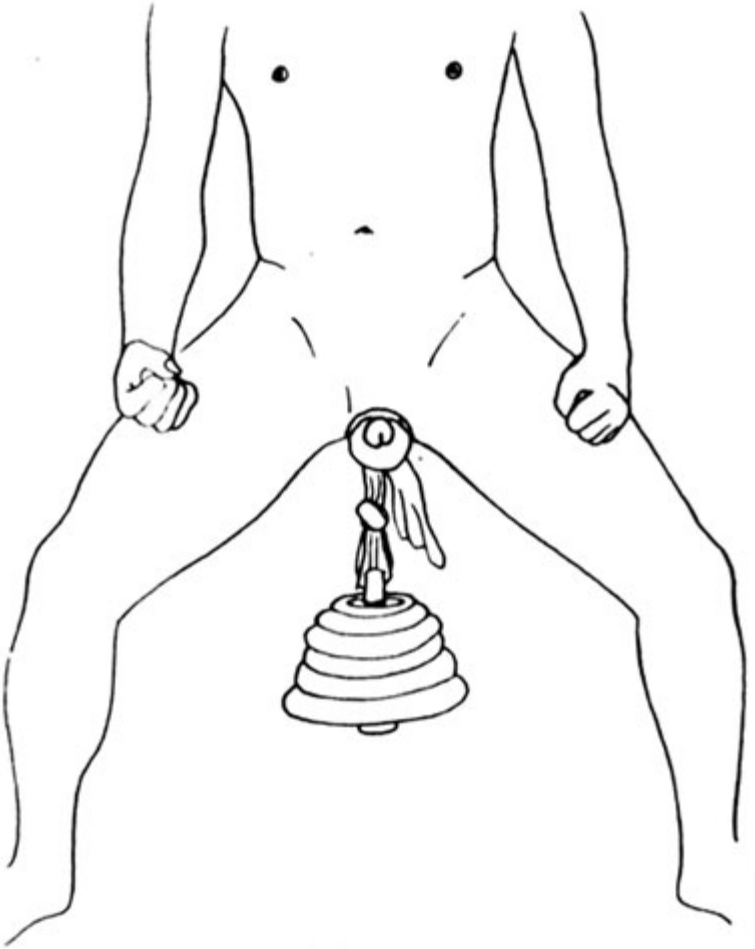

Fig. 12 *In the beginning stages of Chi Weight Lifting it is the kidneys that provide the internal counterforce.*

Vaginal Weight Lifting

The only difference between the Egg Exercise and Vaginal Weight Lifting procedure is the addition of a weight to the specially drilled egg after its insertion. In weight lifting we use wooden eggs. Usually an egg is chosen of approximately one inch diameter with holes drilled through which a string can be threaded for attachment to a weight. Use a sturdy string that can sustain at least ten to twenty pound weight. You can buy a half-pound plate that has a hole through which the string can be tied, or use a small cotton or plastic bag into which a weight can be placed and the bag easily attached to the egg's string and hung. The heavier the weights, the more counter pressure must be exerted by the vagina, the cervix, the ovaries, the diaphragm, the organs and glands. This extended effort will result in increased Chi pressure and hormone production. Make sure you can handle the weight well before adding more to it.

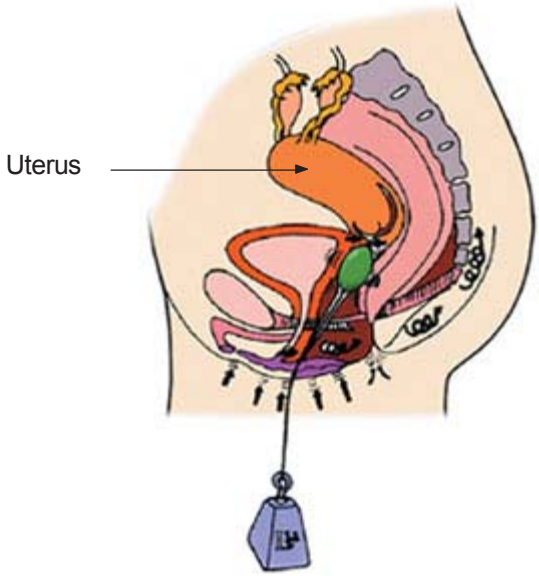

Fig. 13 *Vaginal Weight Lifting*

The exact sequence of steps is then followed as described in the Egg Exercise. This time, however, do not move the egg up and down. Hold it by tightening and squeezing the external and middle sections of the vaginal canal around the egg and pulling the egg up. Do not release it.

Practical Exercise Step-by-Step

(a) Insert the Egg While Holding the String and Weight

Place a chair in front of you and then place the weight on the chair. If you are not already prepared, start with the breast massage, followed by massaging the mons, the perineum, and the coccyx. When you feel the Chi is ready, insert the jade egg with the string attached into the vagina, always attempting to increase the force of section used to draw it in. Use the other hand to hold the string with the weight.

(b) Assume the Horse Stance

Align your body in the basic Horse Stance.

(c) Grip the Egg Using the Muscles of the Vaginal Canal and Release the String and Weight.

Inhale, closing the external and internal vagina tightly. At the same time contract the uterus near the cervix so that the vaginal canal has been closed on both ends. Inhale, squeeze the egg tightly, and pull it up until you feel you have gripped the egg firmly, then slowly release the string with the weight attached. Do not remove your hand in case you did not grip the egg firmly enough. If the egg with the weight attached falls out, it might hurt you.

(d) Use the Cervix to Pull the Weight up

Hold your breath and contract harder. Inhale and start to pull from the cervix and feel the force of the cervix helping to pull up the weight. When your feel you are holding the egg with the weight securely, start to rock the pelvis, thus rocking the weight, 30 to 60 times. This will generate a tremendous energy. When you feel the energy build up, inhale slowly and deeply down to the ovaries, gathering your sexual energy, and carry it through the uterus and down to the clitoris. Hold it there.

(e) Employ all the Muscles of the Vaginal Canal

Contract and hold the lower, then the middle and upper vaginal muscles, so that the egg pushes deeply up into the vaginal canal and the weight will not pull the egg out.

(f) Bring the Energy into the Head

Now draw all the energy you have just gathered up the spine and into the head, as you continue to hold the egg deeply inside of you.

(g) Continue Pulling the Energy into the Brain

Still holding the same breath, continue gathering and pulling the sexual energy up into the head, where the brain can now be bathed in this wondrous nourishment.

(h) Hold the Energy in the Brain

Hold this energy in your brain, initially for 30 to 45 seconds, and gradually increase this time period.

(i) Bring the Energy to the Navel

Finally, stick the tongue up to the palate, exhale, bring the energy down, and collect it in the navel point.

(j) Rest the Weight on the Chair and Expel the Egg

Grip the string on the weight and place the weight on the chair. Remove the egg, utilizing the contractile strength of the vaginal muscles to expel it.

(k) The Ovaries Pull and Lift the Egg and Weight Upwards

When you feel you can pull from the cervix well, begin to use the force of the ovaries. You will try only the left side first, then the right ovary, and finally both sides together. When you feel you can once again secure the egg in the vaginal canal, use your mind and start to contract the left ovary, wrap the Chi around that ovary, and then pull from the left ovary toward the cervix and the vaginal canal, pulling the egg and attached weight upwards. Do the same on the right side, and then both sides together.

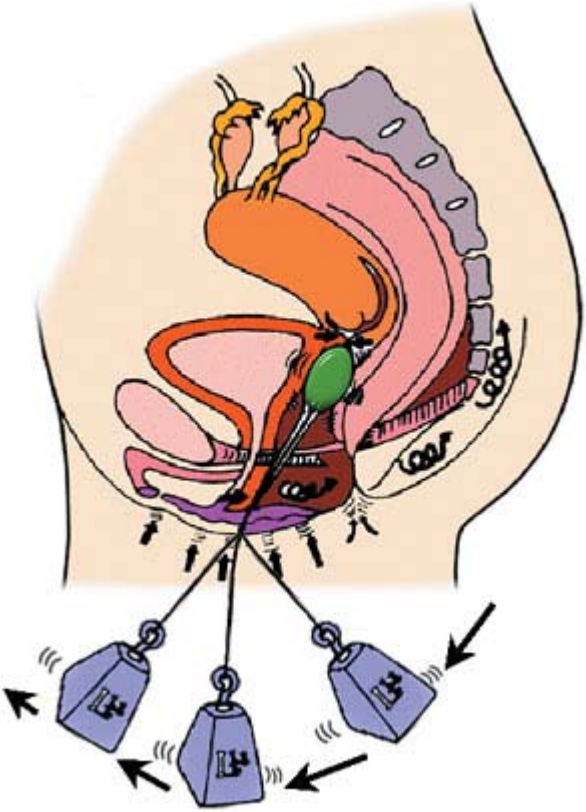

Fig. 14 *Swinging the Weight Back and Forth.*

(I) Using Organs and Glands to Pull Up the Weight

Continue to use first the left. The right and then both sides of the organs and glands to pull the weight upwards, returning after each one to the ovaries to begin the exercise again. Practice in the following order: kidneys and adrenal glands, spleen and liver, lungs, heart (with caution), thymus gland, and then pulling all the way to the brain with the pituitary and pineal glands.

(m) Secure the Egg in the Vaginal Canal

Press your tongue firmly to the palate with the tip of the tongue touching the lower jaw behind the teeth and the flat part of the tongue touching the middle of the palate. Turn your eyes up toward the middle of the brain, and squeeze the head muscles toward the brain's middle area. Contract the lungs, heart, and thymus gland, and press upwards to the middle section of the brain. The pituitary gland, together with all of the other glands and organs pull up the spleen, liver, kidneys, bladder, ovaries, cervix, vaginal canal, egg and weight. Repeat the practice, now focusing on the pineal gland.

When finished with all of these steps, make sure that you circulate the energy for a few rounds in the Microcosmic Orbit, finally collecting it in the navel. Since all the steps of this exercise are very important and extremely powerful, you must use caution. Gradually you will feel all the organs and glands contributing to the internal force that will pull the weight.

Cleanse the Egg Thoroughly

Since the mucous secretions on the egg are an ideal medium for bacterial growth, be sure to cleanse the egg thoroughly after each use.

Massage Yourself

Massage the Hui Yin point in the perineum. Massage the mons and the coccyx. This massaging after each exercise is very important. It will help you clear the remaining energy so that the body can absorb it easily.

Channel the Energy in the Microcosmic Orbit

Gently tap the lower abdomen with your palm to remove the excess energy from the ovaries, vagina and clitoris. Sit down quietly and channel the excess energy in the Microcosmic Orbit, so that all your organs will benefit.

Hitting

General Instructions

- Can be done every day to stimulate the organs and channels.
- Be careful not to hit too hard.

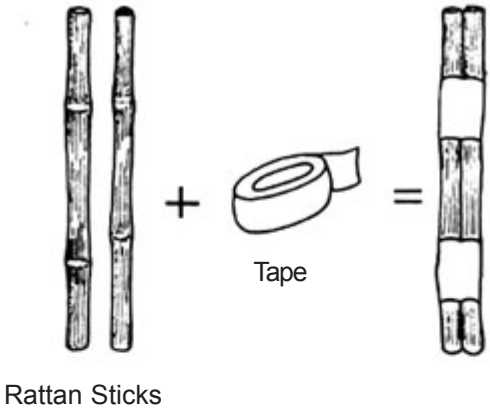

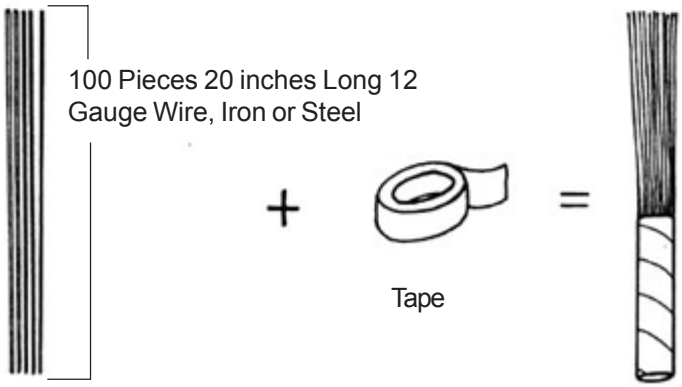

Fig. 15 *Construction of Rattan and Wire Hitters.*

Awakening and Detoxifying the Lower Abdomen and Joints

- Begin with the following warm up exercise to unlock energy in the major joints and lower abdomen.

A. Lower Abdomen

- Inhale; pack energy in the lower abdomen about 3 inches below the navel just above the pubic bone.
- Hit 3 times on this point; feel the energy awakening.
- Exhale and rest; inhale and repeat procedure.

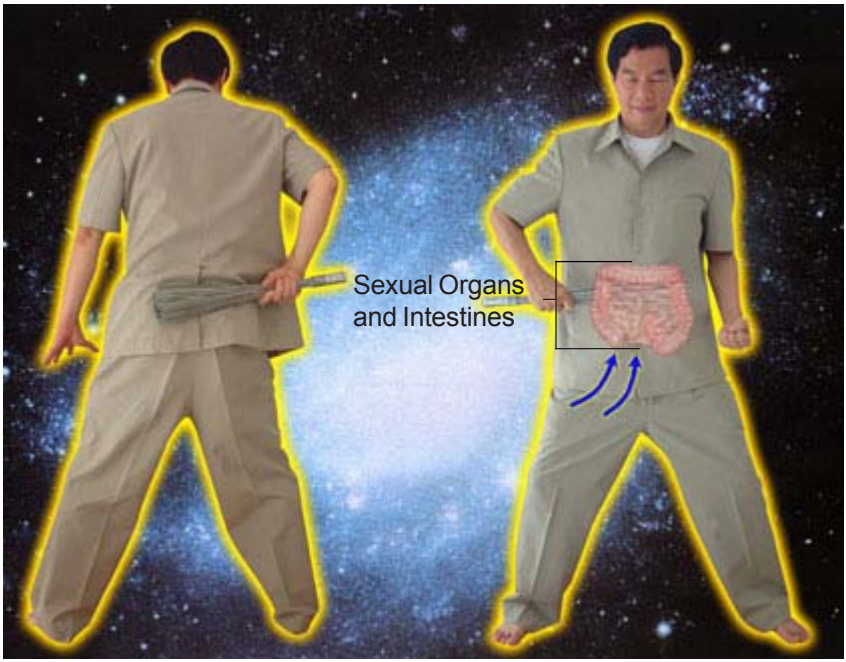

Fig. 16 *Hitting the Door of Life and Lower Abdomen.*

B. Door of Life

- Inhale; pack energy at the Door of Life (Point opposite the navel) and hit 3 times.
- Exhale and repeat.

C. Knees

- Inhale; pack energy in the left leg and hit 3 times on the joint at the back of the knee.
- Exhale and repeat.

D. Inside of Elbows

- Inhale; pack energy in the arms and hit 3 times on the inside of the joint of the left arm.
- Exhale and repeat.
- Do right arm joint.

Detoxifying and Strengthening the Organs

A. Stomach/Prostate/Ovaries

- Inhale, pull up genitals and urogenital diaphragm.
- Begin hitting on the navel and hit down to just above the pubic bone and then up again to just below the sternum.
- Rest and feel the energy flow.

B. Abdominal Organs

- Inhale, pull up genitals and urogenital diaphragm.
- Hit about 1 ½ inches to the left side of the navel.
- Hit down to the pubic bone in a parallel line to step A, and up again to the left side of the rib cage.
- Exhale and move about 3 inches from the navel.
- Inhale, pull up and hit down in a parallel line to the hip and up to below the rib cage.
-Repeat the procedure on the right side of the navel.

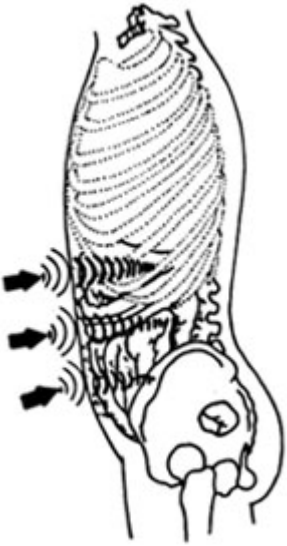

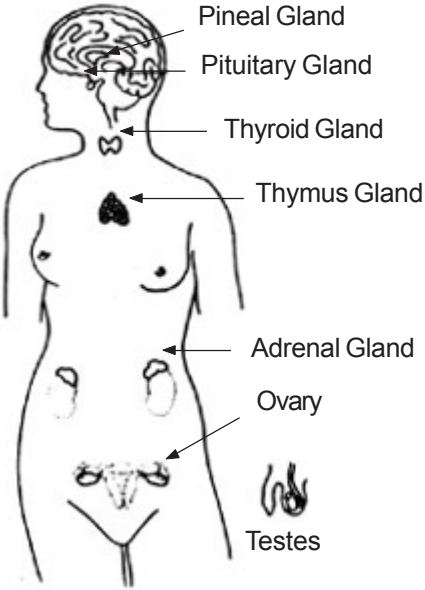

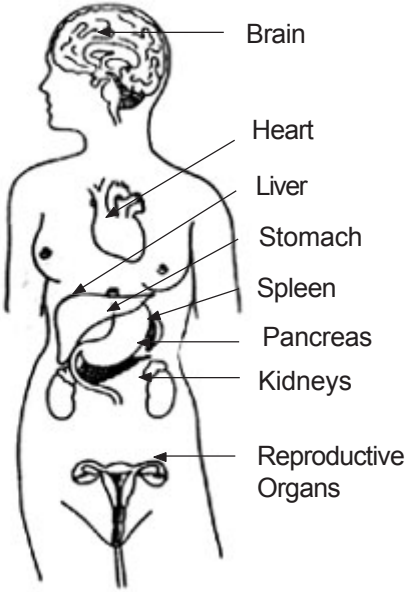

Endocrine Glands

Fig. 17 *Detoxifying and Strengthening the Organs.*

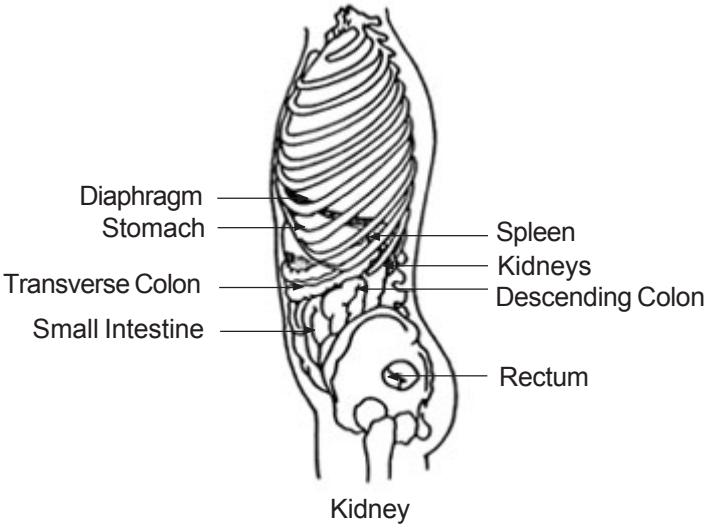

Fig. 18 *Hitting Abdominal Organs.*

12 Channels in the Hand

A. Inside Elbow/Middle Finger

- Begin at the inside of the left elbow, hit 3 times and hit down the inner side of the forearm to the wrist toward the middle finger and then up the shoulder.

B. Inside Elbow/Thumb

- Begin just to the left of center of left elbow, hit 3 times and hit down forearm to wrist toward the thumb. Then hit up to the shoulder.

C. Inside Elbow/Small Finger

- Begin just to the right of center of left elbow, hit 3 times and hit down toward the small finger and up again to the shoulder.

Fig. 19 *Hitting to Stimulate the 12 Channels in the Hands.*

D. Outside Elbow/Middle Finger
- As above, but starting just below the left elbow.

E. Outside Elbow/Thumb
- As above, but start just below the left elbow.

F. Outside Elbow/Small Finger
- As above, but start just to the right of the left elbow.

G. Repeat as above on the Right Arm beginning with the Middle Line of the Right Elbow.

12 Channels in the Legs

A. Back Side of Left Leg
- Hit 3 times on the middle of the back left leg joint. Hit down to the ankle and up to the buttocks.

B. Back Side of Leg/Great Toe
- Hit 3 times on the back of the left leg joint to the right of center.
- Hit down to the ankle and up to the buttocks.

C. Back Side of Leg/Small Toe
- As above, but begin just to the right of center of the back of the joint.

D. Front Side of Leg/Middle Toe
- As above, but begin hitting just below the center of the knee cap, Hit down to the ankle and up to the groin.

E. Front Side of Leg/Great Toe
- As above; begin hitting to the right of front center.

F. Front Side of Leg/Small Toe
- As above; begin hitting to the left of front center.

G. Move to the Right Leg and Cover the Channels as above.

Fig. 20 *Heel Line-Hitting the Big Toe Line of the Leg.*

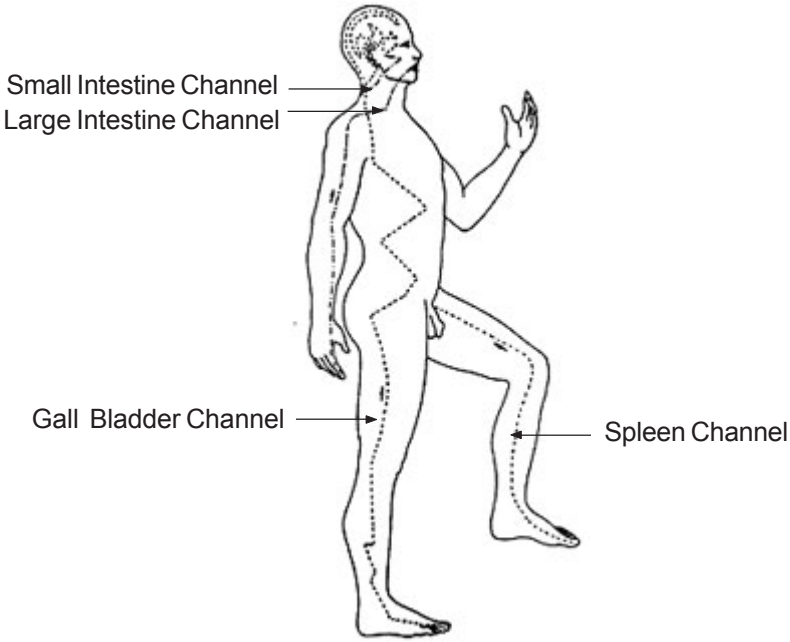

Fig. 21 *The 12 Channels in the Leg.*

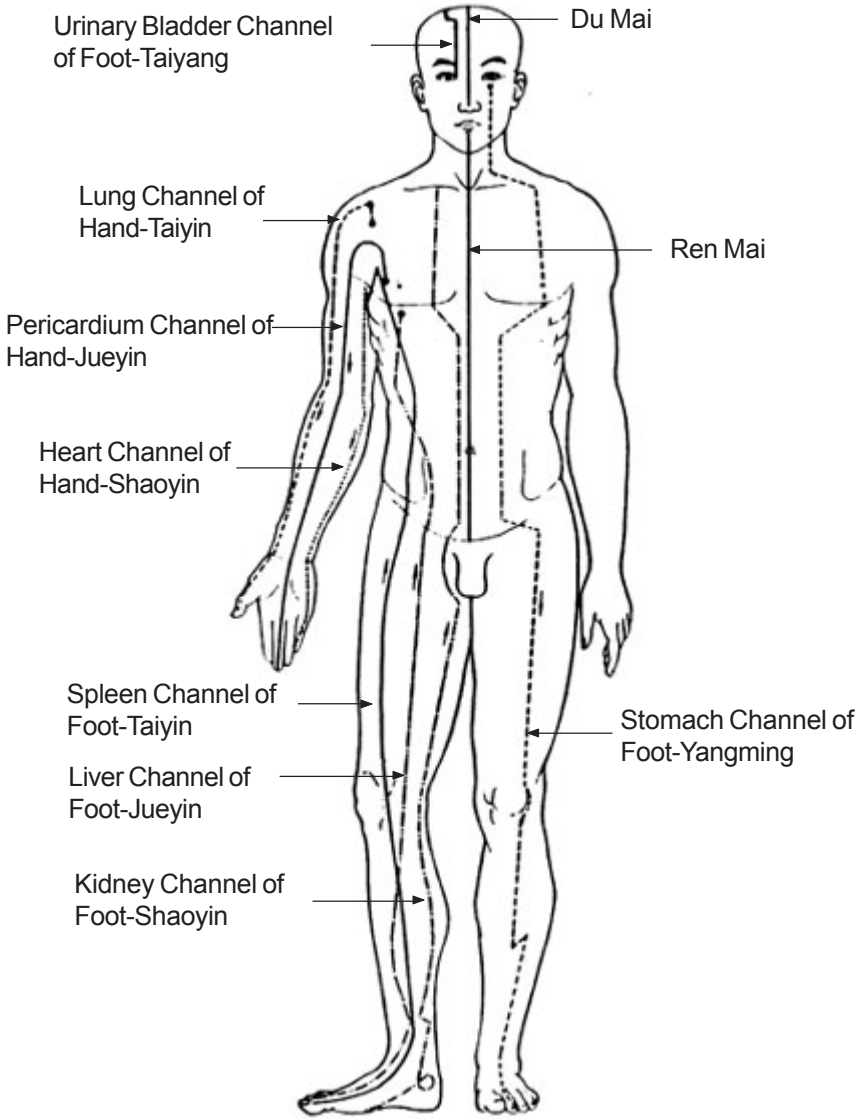

Fig. 22 *Distribution of Fourteen Channels (Anterior View)*

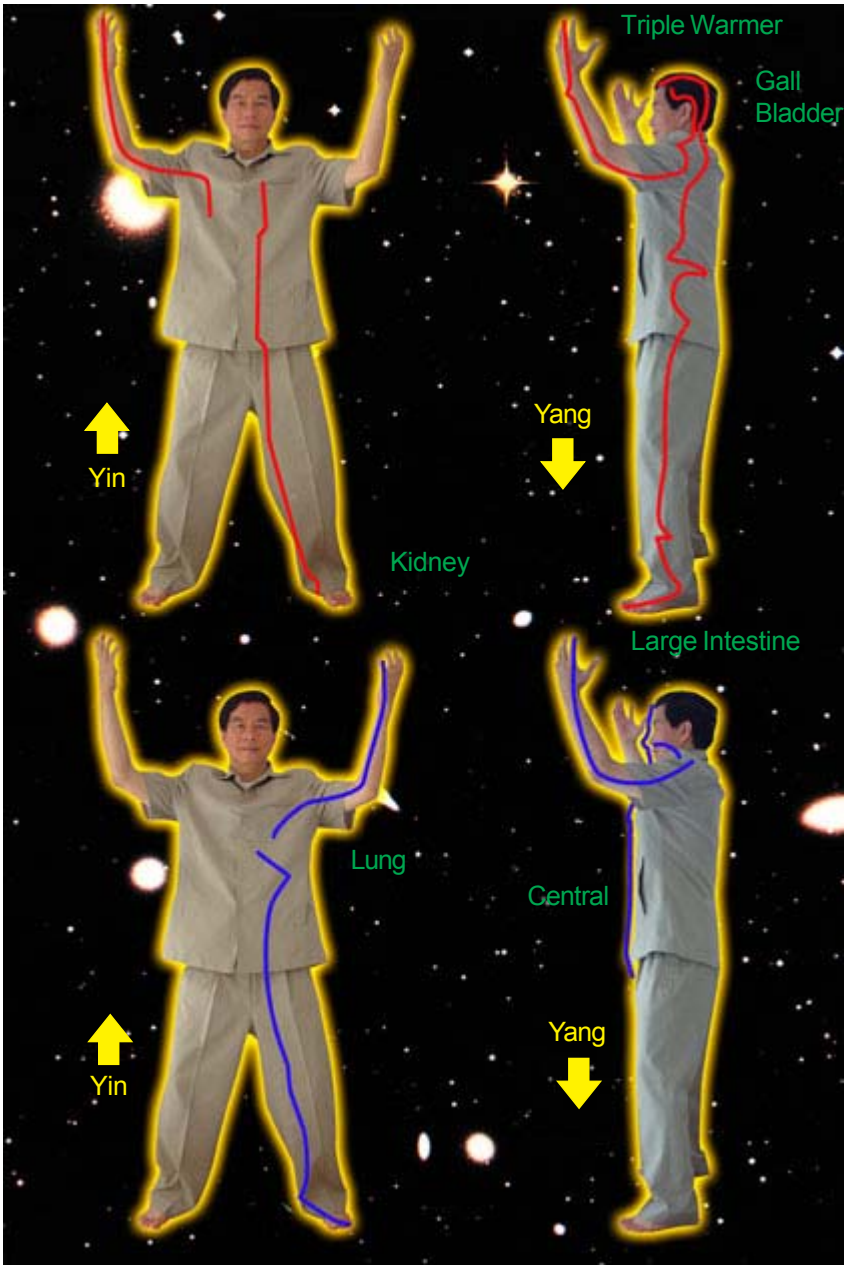

Fig. 23 *Gall Bladder, Lung, Kidney and Large Intestine Meridian*

Fig. 24 *Small Intestine,Stomach, Heart and Spleen Meridian*

Back

A. Left of Spine 1 ½ Inches

- Hit at the left of the Door of Life, and hit up parallel to the spine up to the neck and down again to the buttocks and sacrum.
- Be very careful over the kidney and be sure to round the scapula.

B. Left of Spine 3 Inches

- Begin at the Door of Life and hit up to the rib cage and down to the buttocks.

C. Right of Spine 1 ½ Inches

- As above.

D. Right of Spine 3 Inches

- As above.

Fig. 25 *Hitting Left and Right of Spine*

Fig. 26 *Hitting the Ribs*

Ribs and Chest

- The chest is hit in horizontal lines, extending out from the sternum and beginning at the bottom rib.
- Each of the hitting lines is about 1 ½ inches apart.
- There are 6 such lines on the left and right rib cage.
- Do not hit on the center of the chest over the sternum.
- Be extremely gentle over the heart and lungs.
- Begin at the bottom of the left rib cage and hit just to the left of center and hit around to the side parallel to the belt route.
- Move 1 ½ inches up and hit parallel to the above line.
- Finish the last 4 lines on the left rib cage and then hit the 6 lines on the right rib cage.

Fig. 27 *Hitting the Chest*

Fig. 28 *Hitting the ribs from the sternum outward horizontally*

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$6.95

Bone Marrow Nei Kung
Iron Shirt Chi Kung III

Mantak Chia

Illustrations by Udon Jandee

Bone Marrow Nei Kung

In this booklet you will find all the information needed to begin the Bone Marrow Nei Kung Practices. Bone Marrow Nei Kung is a system of health developed by the ancient Taoist Masters for the cultivation of internal power. They discovered that, through the process of absorbing energy into the bones, bone marrow can be revitalized to replenish the blood and nourish the life-force within. Many healers have sought these methods, which are known to make the body impervious to illness and disease. In ancient times, the "Steel Body" attained through this practice was a coveted asset in the fields of Chinese medicine and martial arts.

Today the copious health benefits of this art are sought after by health enthusiasts from all walks of life. The Taoist methods of "regrowing" the bone marrow are crucial to the rejuvenation of the body, which in turn rejuvenates the mind and the spirit. These secrets have never before been revealed, but now their disclosure is necessary to instill the sensibilities of the masters into an energy-deficient society. In this booklet, Master Mantak Chia divulges the step-by-step practices of his predecessors in a useful and informative work, written for the health and spiritual well-being of today's world.

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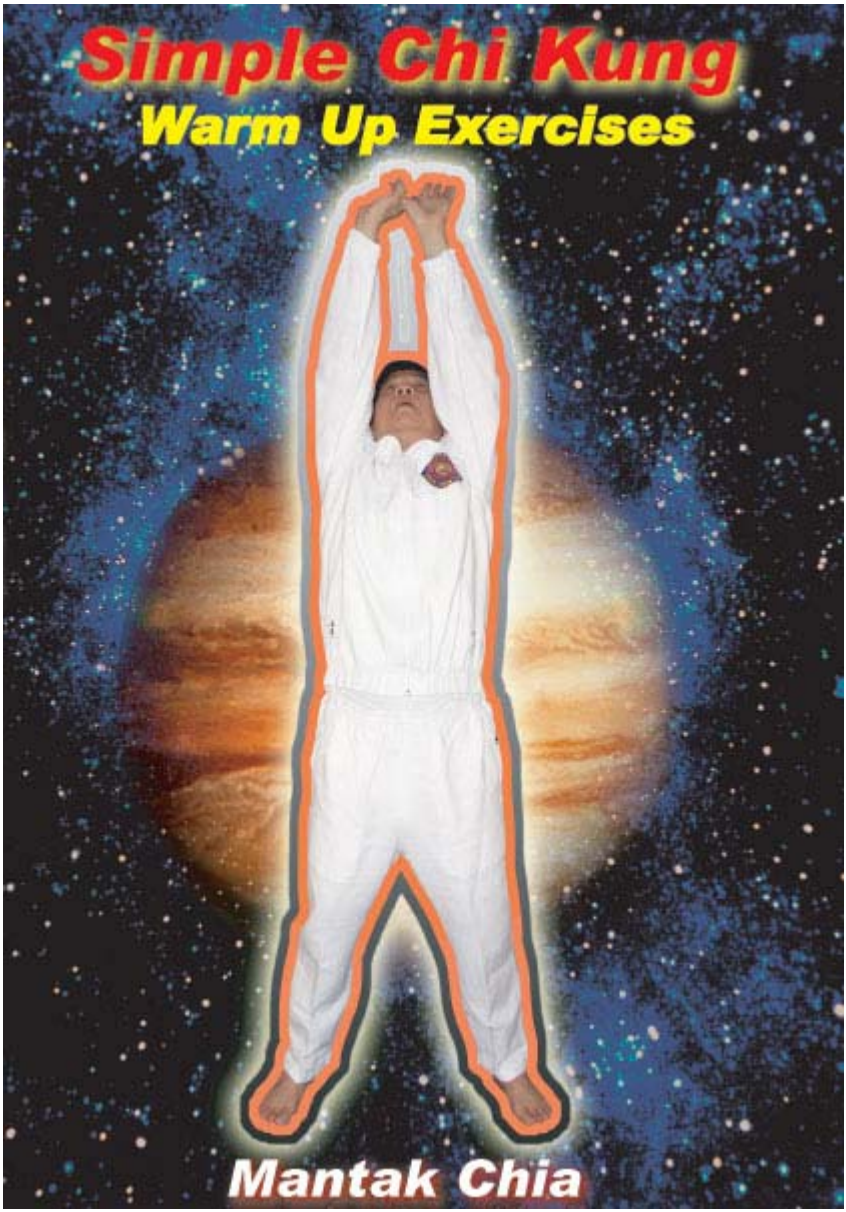
Simple Chi Kung
Warm Up Exercises
Mantak Chia

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Mantak Chia

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Simple Chi Kung

Whether one is student or an expert, practice is essential. A practice session can be fruitless, however, if the body is not properly prepared to handle the energy it is about to absorb. This is the main reason for these additional Iron Shirt training exercises. The term "warm-up" means to begin the Chi and blood flow and invigorate their circulation throughout the body. Warm-up exercises are particularly important for areas of the body that are rarely stretched, such as the spine and the sacrum. Even a person who does weight training and aerobics is still not properly prepared for the conduction of large amounts of energy. Without an adequate warm-up before exercise, the muscles may also be stiff and tight and lack sufficient blood supply to meet the sudden demands placed on them by strenuous activity. This is one major cause of athletic injury.

They are also easy to perform. Listen to the messages from your body as you do the various exercises. Pain is the body's warning signal that you may be overdoing it. The goal is not to overstretch or to develop large muscles, but to loosen the joints and relax the muscles so that the Chi and blood can flow without obstruction. Don't force yourself beyond your limits: less is better, especially at the beginning. If you feel any joint pain or discomfort while doing any of the exercises, back off until you feel comfortable. If you still feel strain or pain, discontinue the exercise all together.

Be especially respectful of any injuries, chronic problems, or physical limitations you may have. If you are kind and gentle to your body, it will start to trust you and relax by itself. You will find yourself starting to loosen on a deeper level without having to force the issue. In this way, you will develop naturally, gradually, and safely. In Iron Shirt Chi Kung, you learn to reorganize the structure of your body in the way you are standing, sitting or moving. In particular, you discover how to use the power of the Lower Tan Tien, the perineum and the spine to stand in a strong, stable, integrated way.You will see that many warm-up movements focus on training the waist for this reason.

Bouncing

Bouncing the body can be compared to a brief ride on the subway. For those of you who commute, this can be practiced on the way to work as well.

1. Just relax the body while concentrating on opening the joints, and bounce on the floor without any tension.

2. Let the vibration in the heels work its way up through the entire skeletal system: from the legs to the spine to the neck to the skull. Shoulders and arms should vibrate as they hang loosely by the sides of the body. To enhance this, you can hum a vowel to hear the vibration make the voice tremble as well.

3. Rest and feel the Chi entering the joints.

Fig. 1 *Shake all the joints loose and feel them open.*

Foot and Hand Kicking

Draw out your leg and opposite arm and kick out letting go of any tension, pain and stress (30 to 60 times); then do the opposite leg and arm.

Fig. 2 *Foot and Hand Kicking*

Knee Rotations

Standing with feet together, hands on your knees, knees flexed, rotate both knees together, exercising your ankles and knees with clockwise/counterclockwise rotations.

1. Place the feet together. Bend the knees and place the palms lightly on the kneecaps.
2. Slowly and gently rotate the knees to the left.
3. Rotate the knees to the back.
4. Rotate the knees to the right.
5. Repeat steps 2 and 4 eight more times.
6. Now reverse direction and repeat nine times.

Fig. 3 *Knee Rotations*

Hip Rotations

1. Stand with the feet parallel and slightly wider than shoulder width apart. Place the hands on the sides of the waist. As you perform the hip rotations, keep the head above the feet. Move slowly and easily, breathing deeply and continuously.
2. Bring the hip and forward.
3. Move the hips in a large clockwise circle..
4. Now move the hips in a circle to the back.
5. Move the hips counterclockwise.
6. Repeat steps 2-5 eight more times.
7. Reverse the direction and repeal steps 2-5 nine times.

Fig. 4 *Hip Rotations*

Sacrum Rotates Back and Forth

Rotating the sacrum is an excellent exercise to open the lower back and activate the spinal cord. Place one hand over the sacrum and the other over the pubic bone. Rotate the sacrum in a circle, 36 times in each direction. This movement activates the sacral pump.

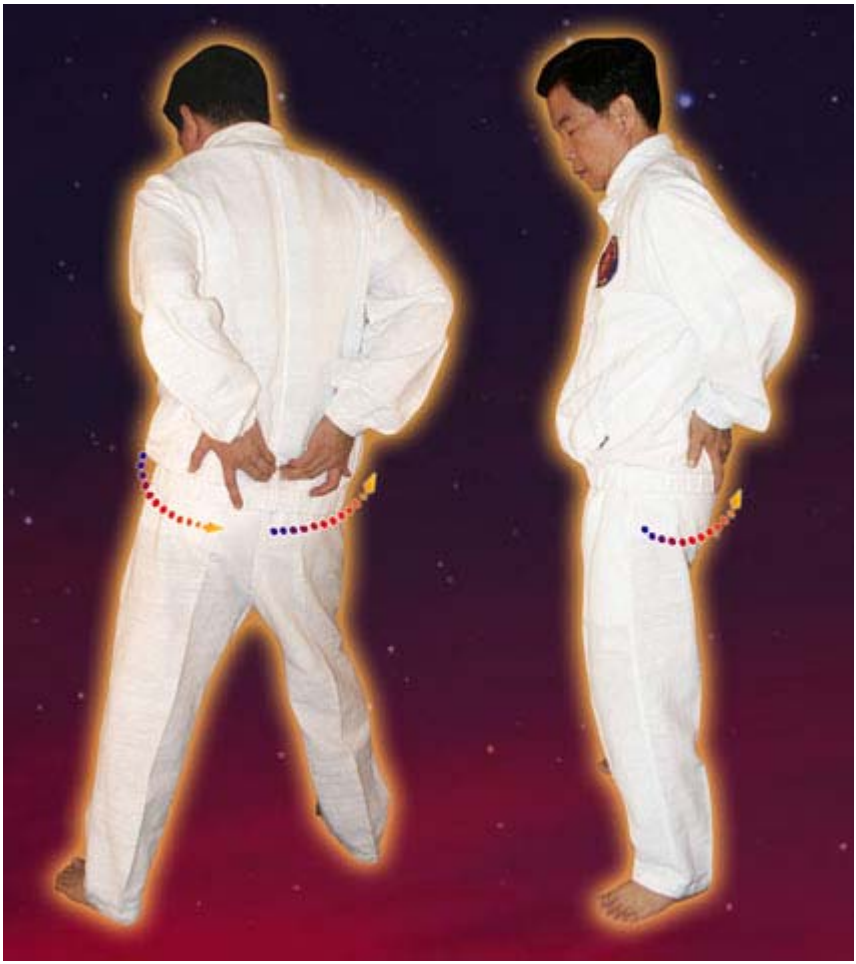

Fig. 5 *Sacrum Rotates Back and Forth*

Standing Crane and Turtle

Stand with feet apart and draw your head out in front of you with your chin extended out and your palms on your knees.

Draw your chin into your body moving your spine. Do Crane Exercise nine to eighteen times and reverse curving your lower back nine to eighteen times with the Turtle Exercise.

Fig. 6 *Standing Crane and Turtle*

Standing Crane

Fig. 7 *Standing Crane*

Spinal Cord Breathing

Inhale and expand the chest, arms bent at the elbows and extended to the sides of the body. Exhale, tuck the tailbone under and round the back forward, bringing the elbows toward one another in front of the chest. Inhale, expand the chest, tuck the chin in toward the throat, push the chin back, raise the crown and bring the arms out to the sides. Repeat this back and forth movement 36 times. This movement activates the cranial and sacral pumps, and loosens all the joints in the spine.

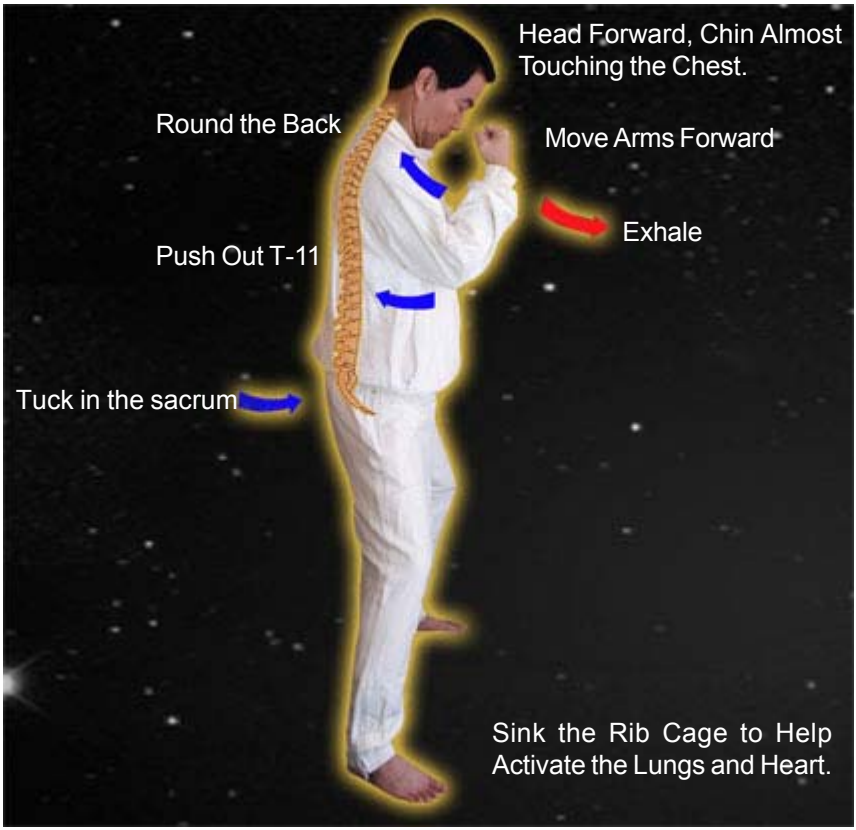

Fig. 8 *Spinal Cord Breathing*

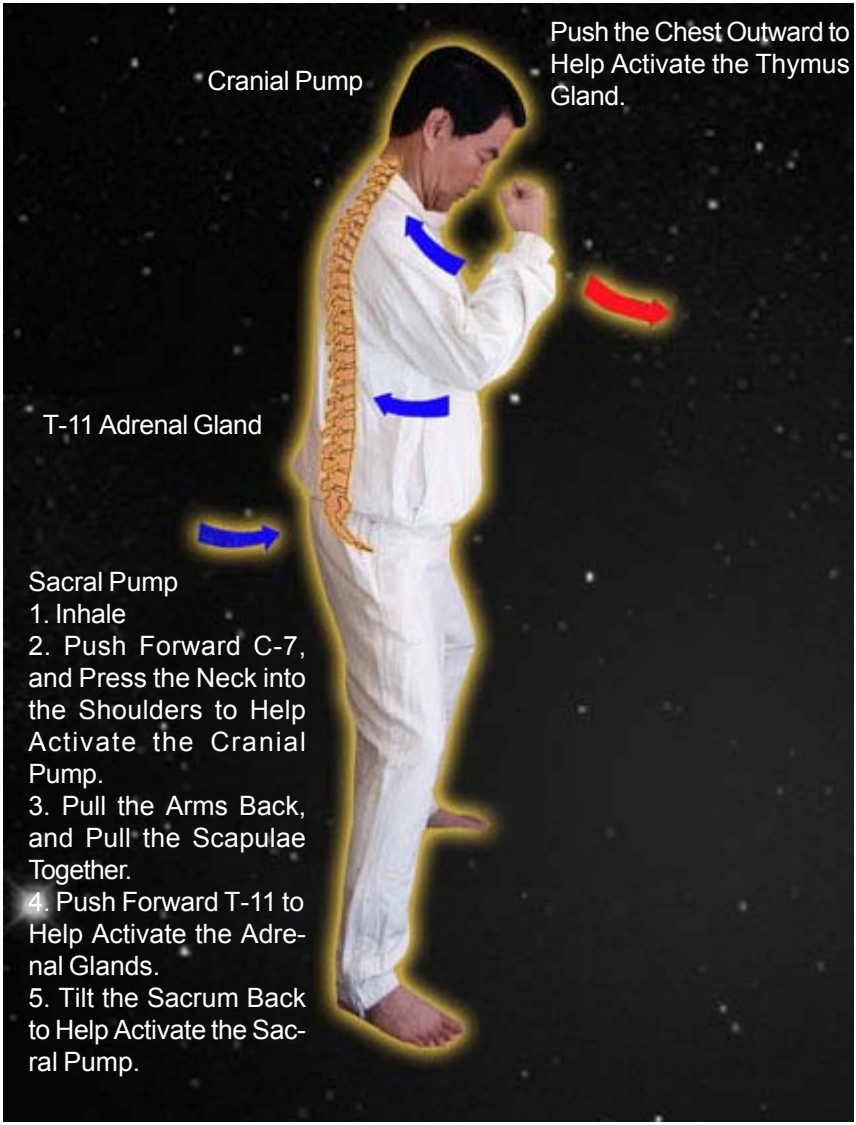

Fig. 9 *Spinal Cord Breathing*

Empty Force in Lower, Middle, Upper Parts of the Body

Breathe in the three abdominal areas (Lower, Middle and Upper) and exhale deeply out with mouth open. Breathe in deeply and exhale, sticking the tongue out and curling it under with the movement of the lower abdominal area emptying any further air out of the body. (Optional: Men: Pull your genitals down at the same time as you breathe and Women: Use a string and jade egg).

Do the same procedure for the Middle and Upper abdominal areas, then move the tongue and abdomen in a circular motion and reverse continually emptying the body out of any air.

Fig. 10 *Empty Force in Lower, Middle, Upper Parts of the Body*

Empty Force Practice

Fig. 11 *Empty Force Practice pulling the Genitals down*

Upper Stretching and Twisting to Four Sides

Raise hands above head and stretch as far as you can reach, moving up on your toes. Grab your elbows, moving down on your feet and lean to each side several times. Then turn your spine to the right and then to the left.

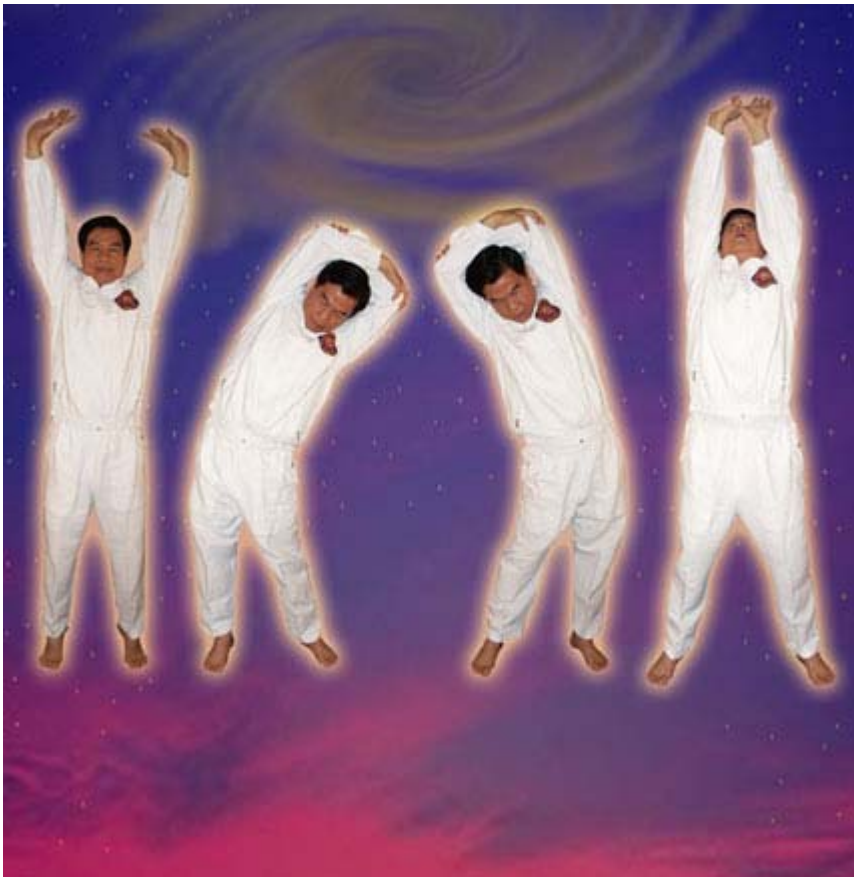

Fig. 12 *Upper Stretching and Twisting to Four Sides*

Windmill Exercise: Opening the Spinal Joints

Do each phase of this practice very slowly and mindfully.

A. Outer Front Extension

1-3. Begin in the same stance as for Waist Loosening. Bring both hands together and hook the two thumbs together. Keeping the hands close to the torso, inhale and raise the arms until they are extended straight above the head, with the fingers pointing upward. Gently stretch up in this position, extending the spine slightly backwards. You can even say ***"Ahhhhhh"*** as you would when you stretch first thing in the morning.

4-5. Begin to exhale slowly and bend forward, reaching as far out in front as you can, keeping the head between the arms. Try to feel each joint of the spine releasing one by one in a wavelike motion. Bend first from the lumbar vertebrae, then from the thoracic vertebrae, and finally from the cervical vertebrae. At this point you should be completely bent over.

6-9. Slowly straighten your back, once again feel each joint of the spine become open, from the sacrum, lumbar, thoracic and cervical vertebrae. Allow arms and head to hang heavily until you are back in the starting position. Repeat three to five times. Finish with the arms over the head as at the end of Step one.

B. *Inner Front Extension*

1-3. Now do the same movements, but in reverse. Point the fingertips downward and slowly lower the arms, keeping the hands close to the torso. When the arms are completely lowered, begin to bend forward. Release the head, cervical vertebrae, thoracic vertebrae, and lumbar vertebrae, until you are bent all the way forward as at the end of Step two of the Outer Front Extension. Feel each joint become open.

4-5. Keeping the head between the arms, start to straighten back up. The arms should extend in front as you slowly move back to an erect position. When you finish straightening up, the arms should be straight up above the head. Repeat three to five times.

C. *Left Outer Extension (Left Side Bending)*

1. Keep your head between your arms in the overhead position, and lean to the left. You should feel a gentle stretch on the left side of the waist. Continue stretching down and to the side until you are bend all the way down to the side.
2. Then circle back up on the right side until you are once again standing straight with the arms overhead. Repeat three to five times.

D. Right Outer Extension (Right Side Bending)

Repeat the side-bending movements as in the left Outer Extension, but to the right. Do three to five times.

E. Conclusion

To finish, unhook the thumbs and let the arms slowly float back down to the sides.

Fig. 13 *Windmill Exercise*

Fig. 14 *Windmill Exercise*

Look from Side to Side from the Neck

1. Neck tilt: Let the head drop gently on one side, then the other back and forth. Let gravity do the work. Try to feel how much it weighs. Keep both shoulders dropped, relaxed and motionless.

2. Side to side rotation: Look over the shoulders one after the other, looking further and further back as you warm up.

Let your eyes direct the movement and let your neck follow so it is always in extension, never in contraction.

3. Up and down: Look up right over the head, then down in between your feet alternately.

4. Rotations: Follow a circle around your face clockwise several time, then counterclockwise. Again keep your eyes open and directing the movement. The neck is only following.

For all the exercises make sure you keep the rest of the body joints loose and breathe calmly from your abdomen.

Fig. 15 *Look from Side to Side from the Neck*

Shoulder Rotation with Eyes

1. Lateral movement: Spot an object in each extreme angle of your peripheral vision and move from one to the other alternately without turning your neck.

2. Up and down: Spot an object over your head, another one by your feet and go from one to the other without tilting your head.

3. Upper right corner of the right eye to the left corner of the left eye.

4. Upper left corner of the left eye to the right corner of the right eye.

5. Rotations: Follow a circle around the eyes very slowly and catch yourself when your eye balls want to skip an angle and go back and forth there until you have a smooth movement.

N.B.: Make sure you are breathing steadily from your abdomen and your neck is unlocked.

Fig. 16 *Shoulder Rotation with Eyes*

Shoulders

1. Shoulder Rotations: Stand with feet a shoulder or hip width apart in a relaxed manner.
   a. Bring the shoulders all the way up to the ears
   b. Then as far back as possible (Trying to touch the shoulder blades together)
   c. Then let them drop.

Repeat several times.

2. Shoulder rotations + Front Arms Stretch
   Stand with feet a shoulder or hip width apart in a relaxed manner, arms extended forward.
   a. Bring the shoulders all the way up to the ears
   b. Then as far back as possible (Trying to touch the shoulder blades together)
   c. Then let them drop
   d. Stretch all the way from the tip of the fingers to the spine as if you were pulled forward by the fingers.

Repeat several times.

3. Shoulder Rotations + Arms Stretch over the Head: Stand with feet a shoulder or hip width apart in a relaxed manner, arms extended over the head.
   a. Bring the shoulders all the way up to the ears
   b. Then as far back as possible (Trying to touch the shoulder blades together)
   c. Then let them drop
   d. Stretch all the way from the tip of the fingers to the spine as if you were pulled by the fingers from the ceiling.

Repeat several times.

4. Shoulder Rotations + Lateral Aarms Stretch
   Stand with the feet a shoulder or hip width apart in a relaxed manner, arms stretched out laterally.
   a. Bring the shoulders all the way up to the ears
   b. Then as far back as possible (Trying to touch the shoulder blades together)
   c. Then let them drop
   d. Stretch all the way from the tip of the fingers to the spine as if you wanted to touch the walls in both directions at the same time.

Repeat several times.

The stretch happens from the tip of the fingers and involves all tendons, ligaments and faciae from the tip of the fingers to the spine. This is excellent for prevention and correction of carpal tunnel syndrome and tennis elbow.

Fig. 17 *Shoulders*

Forearm and Palms Slapping the Organs

Twist the spine left to right, letting go of the arms with palms slapping the organs (Lungs, Heart, Kidneys, Spleen, Pancreas, Lower Bladder) as you turn the spine several times.

Fig. 18 *Forearm and Palms Slapping the Organs*

Hand and Wrist

Wrists:

One arm and hand active, the other arm and hand passive. The passive side receives the treatment/exercise, the other side (active side) gives the stretch. Stretch is given upon exhalation.

1. Simple flexion:
   a. The active hand lifts up the passive wrist at sternum level and flexes the wrist by pushing the hand toward the inside of the arm.
   b. Repeat several times.
   c. Switch sides.
2. Internal rotation with flexion and abduction of the wrist:
   a. Passive hand facing your face; the active hand wraps around the back of the passive hand, thumb between the little finger and the ring finger, with middle finger and ring finger wrapping around the wrist of the passive hand.
   b. Rotation of the passive wrist is given by pushing the thumb of the active hand between the little finger and the ring finger of the passive hand while the middle and ring fingers of the active hand pull the passive wrist in the opposite direction.
   c. Repeat several times.
   d. Switch sides.
3. External rotation with flexion and adduction of the wrist:
   a. Arms outstretched palms facing each other.
   b. Passive hands turns outwardly, active hands spoons the passive hand, slightly clenches the fingers together holding the weight of the passive hand and arm.
   c. Passive side decontracts and lets drop the whole weight of the elbow and shoulder.
   d. Active hand flexes and stretches the passive wrist by bring ing it closer to the sternum.
   e. Repeat several times.
   f. Switch sides.

4. External rotation with abduction and extension of the wrist:
   a. Passive hand extended, with arm outstretched, palm facing forward, thumb down.
   b. Active hand takes all the fingers of the passive hand in a palm to palm position giving an upward rotation, hyper extending the wrist while you let drop the whole weight of your arm and shoulder.
   c. Then lift up all the weight of your wrist, elbow and shoulder in a stretching movement toward the ceiling. Stretch should be felt all the way from the fingers to the neck.
   d. Repeat several times.
   e. Switch sides.
5. Hyper extension of the wrist:
   a. Passive hand palm up.
   b. Active hand takes the fingers of the passive hand and hyper extends the fingers, hand, wrist and arm in one motion down toward the leg.
   c. Repeat several times.
   d. Switch sides.

Fig. 19 *Hand and Wrist*

Fig. 20 *Elbow Twist*

Opening the Door of Life

1. Begin in the same stance as the Waist Loosening. Twist to the left as in the Waist loosening exercise, initiating the movement from the hips. Let the right arm swing across the front of the torso, raising it up to head height with the palm facing away from you. At the same time, let the left arm swing around the back and place the back of the left hand over the Door of Life point (the point on the spine opposite the navel).

2. When you reach your full extension, relax, and then extend again by loosening the lower back. Feel the gentle stretch and increased extension coming all the way from the Door of Life area, not from the shoulders. Extend in this way two or three times.

3. Twist to the right and repeat the steps as above on the right side. Repeat nine times to each side.

Fig. 21 *Door of Life*

Fig. 22 *Opening the Door of Life*

Elephant Swings his Trunk

Let go of your arms and move your hips back and forth throwing your arms out and loosening your shoulders and neck.

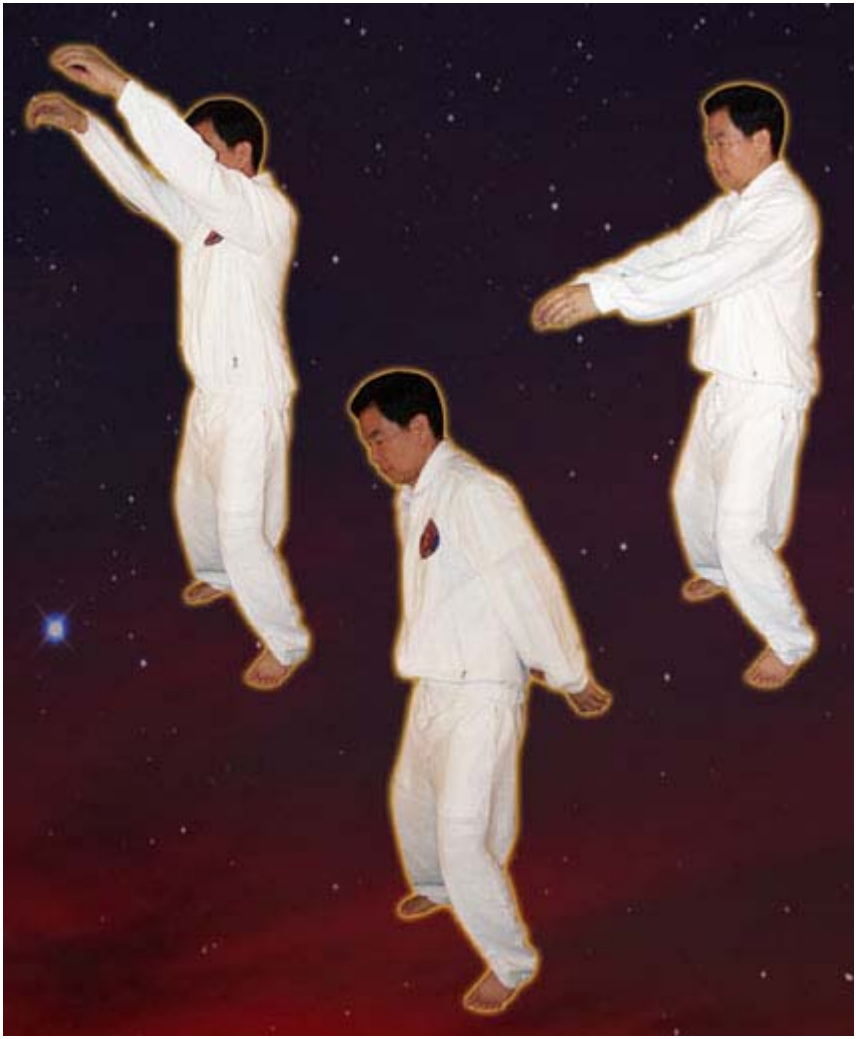

Fig. 23 *Elephant Swings his Trunk*

Squatting to Open Sacrum

A good exercise for developing the squatting position is to stand with your feet shoulder width (when you improve your squatting ability, place both feet together) close to a wall, facing the wall and then to squat straight down from the kua (like you are sitting down, not bending the knees too much). The wall will prevent you from leaning forward when you squat. Some people tend to bend the head forward first, and also to bend the back and lean forward. Using a wall will make you see whether you are bending too much. Breathe in the Lower Tan Tien. Keep the chest relaxed and feel a force pulling you down and a force pulling you up, when you squat down to the Earth.

To squat down you can also use the help of a partner or the edge of a table. Be sure that you go straight down and bend from the kua. When you work with a partner, stand shoulder width facing each other, arms stretched, and firmly grasp each other's wrists. From this position, squat straight down together from the kua while supporting one another. Sink as deep as you both can without leaning forward.

Start by standing in front of the wall 18 cm or more away. Eventually you can move closer to the wall. Place both hands on the sides, the tips of the fingers touch the thigh bones.

Slowly drop down from the groin, like you are sitting down; drop till you can't go any further, and lightly bend the knees. If you bend too much your knees will hit the wall.

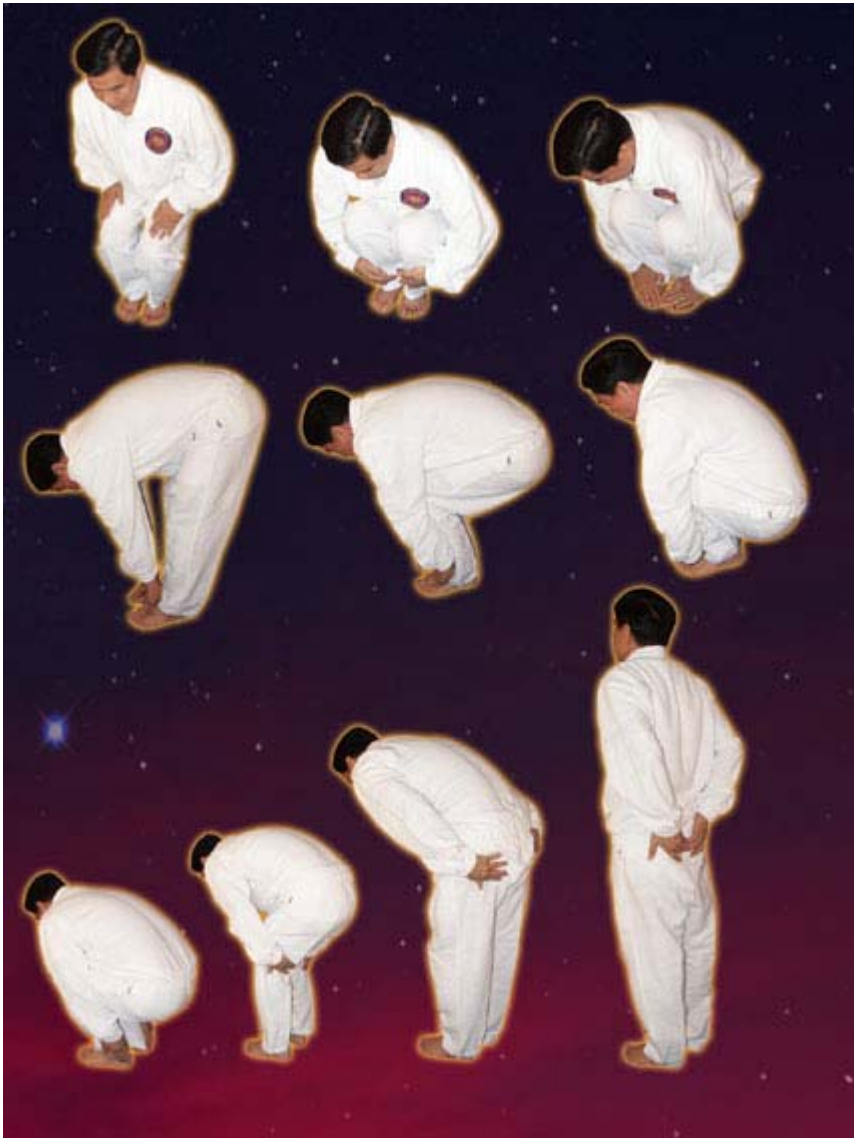

Fig. 24 *Squatting to Open Sacrum*

Clench and Tap Teeth

Clench and tap your teeth several times from the front, right and left sides.

Fig. 25 *Clench and Tap Teeth*

Bone Breathing

1. Bone Breathing Process

The Bone Breathing Process uses the mind and the eyes to absorb the Cosmic Force into the bones. The mind and the eyes are also used immediately after each exercise (in any posture) to bring the energy down to the navel.

Bone Breathing is the method of drawing external energy through the skin into the bones to clean out fat in the bone marrow(“Cleansing the Marrow”). This process helps to regenerate the bone marrow, thereby rejuvenating the production of blood and Chi. It is vital to the practice of Iron Shirt Chi Kung III, but is also used in Iron Shirt I to increase blood and energy circulation. Chi can then flow freely into the bones and blood, carrying nutrients and oxygen to areas in need. Tension in the muscles surrounding the bones is lessened and the bones become strong.

Bone Breathing is a three-stage process of inhaling and exhaling as through the fingers and toes:

a. Use the powers of the mind and eyes to breathe in outside energy through the fingertips, gradually up to the hands and arms to the skull, and then down the spinal column. A sensation is felt as you breathe into each area.

b. Inhale and exhale the same way through the toes and then, by degrees, inhale up to and into the thigh bones, legs, and hips (also in a step-by-step progression). Then inhale up your legs to the sacrum where the energy will enter your spinal column, surging up throughout the nervous system.

c. Finally, breathe into both the arms and legs simultaneously, through C-7, and up into the head. Remember that you absorb and eject energy more effectively at specific points, many of which protrude from the body; toes, fingertips, elbows, knees, sacrum. Door of Life. C-7, shoulders, and nose.

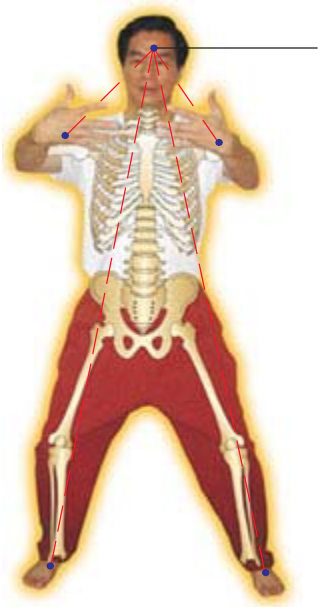

Fig. 25 *Bone Breathing*

2. *Bone Compression*

This exercise is another mean of increasing the flow of Chi to the muscles and the bones, squeezing out toxins, sediment, waste material, and negative emotions that have become stored in the muscles. Once these negative qualities are cleaned out, positive ones have room to grow. Positive emotions relax the muscles and the entire body.

We also know the Bone Compression as the “Power Exercise” or the “Dynamic Tension” which serves to greatly tone up the muscles and strengthening the bone and bone marrow. It is accomplished by tightening and squeezing the muscles to the bones as you inhale, then releasing and totally relaxing chose muscles as you exhale strongly.

Practice in the following progression: (a) hands, forearms, upper arms; (b) legs, lower legs, thighs; (c) neck and head, (d) back (spinal cord) and chest (rib cage). Peel the muscles and bones separate from each other as you relax.

Complete the exercise by standing up straight with the palms on the navel. (Men, left palm over right; women, right palm over left). Stand for a while, and feel the Chi flow in your Microcosmic Orbit. Then concentrate on collecting the energy in the navel. Men should spiral the energy outwards in a clockwise direction 36 times, being careful not to go above the diaphragm or below the pubic bone, then inwards 24 times, and collect the energy at the navel. Women should spiral in a counterclockwise direction 36 times, reversing when spiraling inwards for 24 times. When you are finished, relax, and use the palms to gently brush any remaining energy down from the chest.

Tips of the fingers have a lot of Chi.

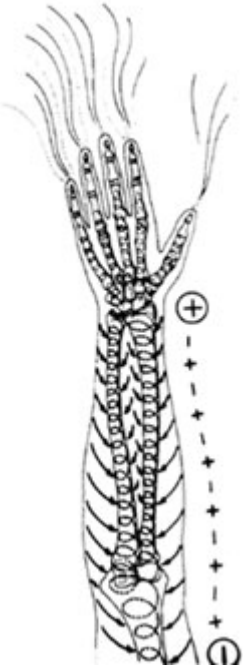

Fig. 26 *Touching Navel and Sexual Center.*

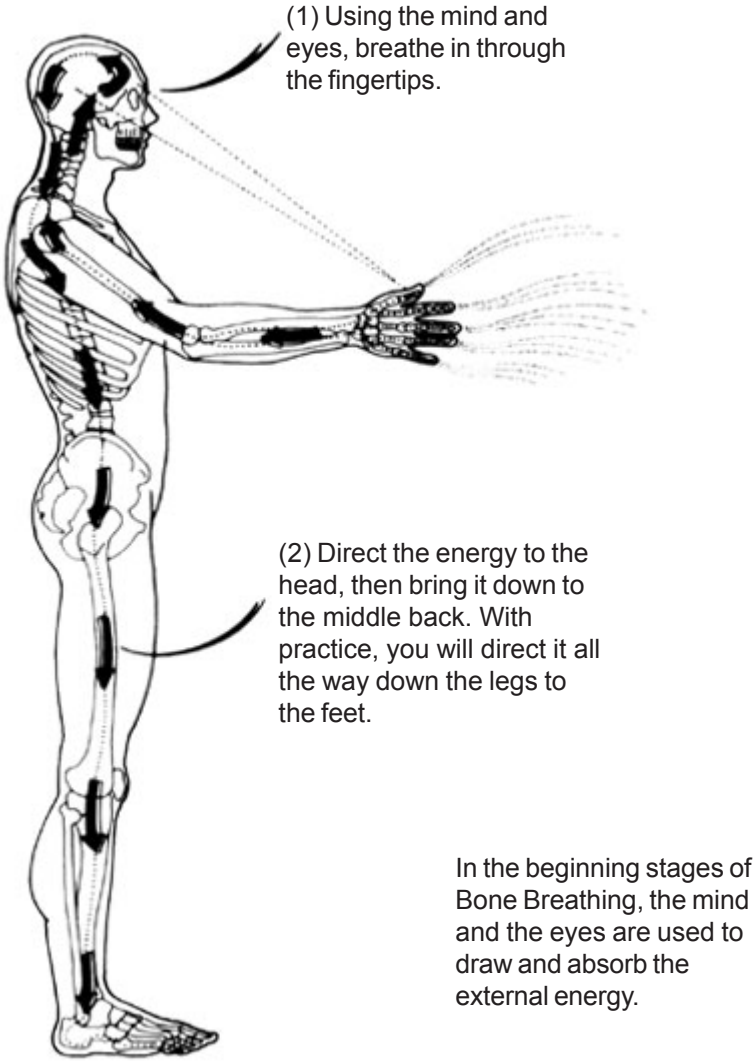

Fig. 27 *Stage One: Respiration through the Fingers*

Precautions

The following is a warning to all practitioners, especially those with high blood pressure, emotional instability, heart or chest pain, or any acute illness.

1. If you have high blood pressure, check with a doctor before attempting to practice Iron Shirt. Do not do the exercises and breathing techniques strenuously.

2. Women should not do Iron Shirt breathing during menstruation, but may practice the structure, standing meditations, and Bone Breathing. If pregnant, do not practice Iron Shirt Packing Breathing; use only Energizer Breathing and standing meditation.

3. Be sure that the diaphragm is lowered while practicing these exercises to avoid accumulating energy in the heart and to facilitate the flow of the Microcosmic Orbit. Do not pack the chest as this can cause energy to congest there, which can affect the heart. Again, you should always relax the chest.

4. Always breathe into the lower abdomen and perineum to avoid trapping negative energies in other parts of the body. especially in the brain, the heart, or the liver.

5. After practicing the postures, be sure to place the tongue on the roof of the mouth to connect the Microcosmic channels so that all energy from the head can be drawn down through the Functional Channel to the navel for storage. Do not leave energy in the head or upper body.

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Simple Chi Kung

Warm Up Exercises

Mantak Chia

Simple Chi Kung

In this booklet you will learn a series of simple exercises which can be used as warm ups for higher Chi Kung practices. When the practitioner does these exercises, the body is prepared to handle the energy it is about to absorb and the circulation of Chi and blood throughout the body is facilitated.

The exercises are easy to perform and are designed to loosen the joints and relax the muscles to improve the flow of Chi and blood. Every part of the body is given attention, and the exercises start with generalized "bouncing" to shake the joints loose and open them.

The joints of the knees, hips and spine are worked, and these exercises are followed by breathing routines, then stretching, twisting and rotation exercises working on the tendons and ligaments in different parts of the body.

Specific techniques for opening the Door of Life point and the Sacrum are illustrated in a clear step-by-step manner, and the booklet ends with an explanation of Bone Breathing and Bone compression.

Practice of these warm up exercises will result in a deeper level of loosening in the body and an increased awareness of the body's structure. The practitioner can then progress to practice of Iron Shirt Chi Kung with confidence.

Universal Tao Publications

Tan Tien Chi Kung

Empty Force, Perineum Power and the Second Brain

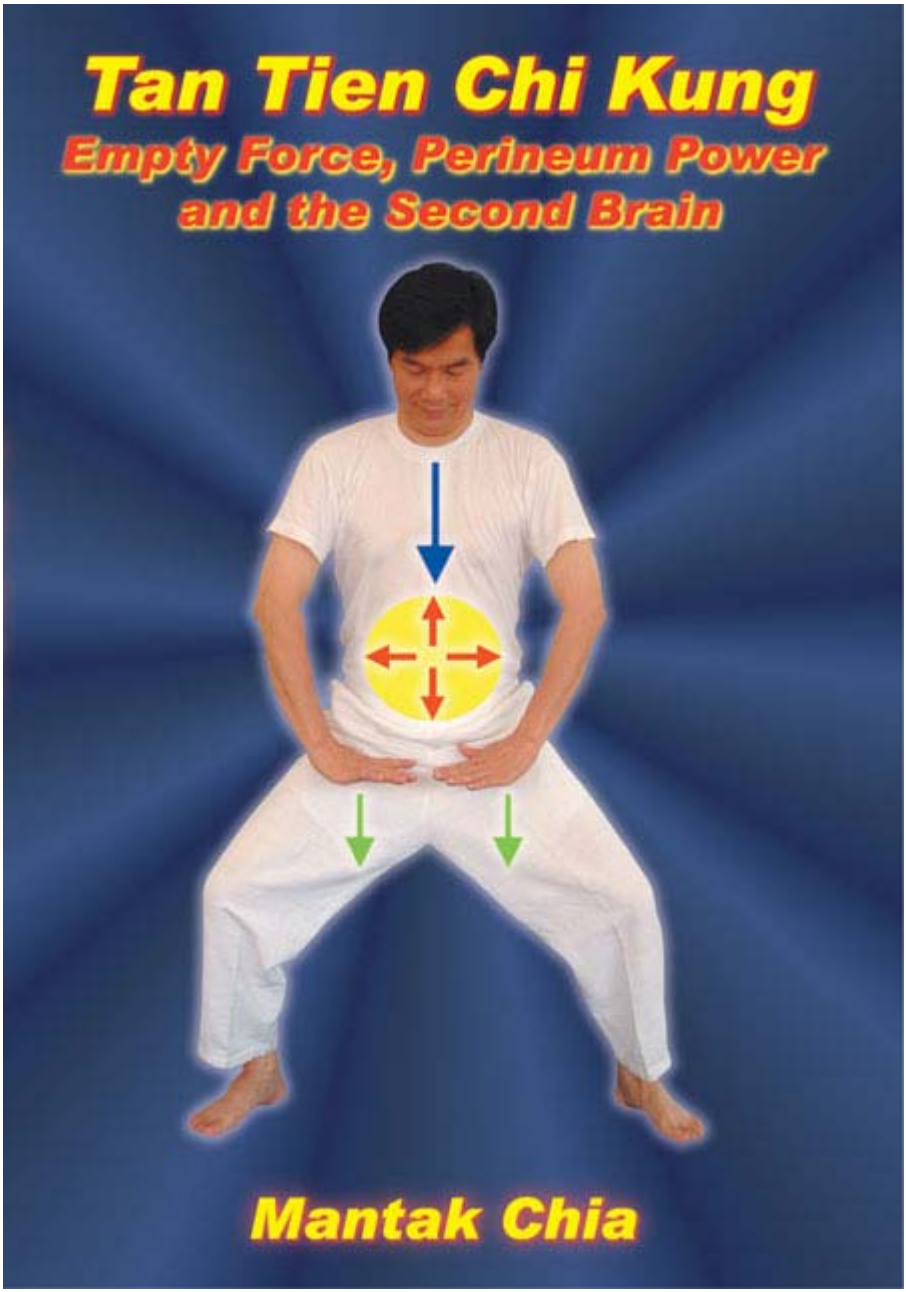

Mantak Chia

Tan Tien Chi Kung

Empty Force, Perineum Power and the Second Brain

Mantak Chia

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Introduction

Tan Tien Chi Kung is one of the Taoist Chi Kung practices used to develop Tan Tien and Perineum power.

We need Chi and Chi pressure in the Tan Tien as a foundation for most of our Universal Tao practices, especially for Iron Shirt and Tai Chi Chi Kung, and meditation.

The Lower Tan Tien is the main energy reservoir in the body. It is the place where we store the energy we generate, gather and absorb in Chi Kung and meditation. If the energy is stored in the Tan Tien it can be accessed later, if not the Chi dissipates and cannot be used. The Tan Tien is therefore also called the Ocean of Chi. According to the Chinese medical theory, once the ocean is full it overflows into the eight extraordinary meridians. Once these are full the Chi flows into the twelve ordinary meridians, each of which is associated with a particular organ. The Tan Tien is therefore the foundation of the entire energetic system of the body.

Fig. 1 *Expanding the Chi Ball.*

We usually refer to the lower abdominal area as the Tan Tien, but we actually have three Tan Tiens: the Lower Tan Tien, the Middle Tan Tien (heart) and Upper Tan Tien (behind the mideyebrow point; the brain). You can read more about the Tan Tien in the booklet, “Opening the three Tan Tiens to the Six Directions”. All three Tan Tiens are used in Taoist inner alchemy. Because of their capacity to deal with a large amount of Chi, the Tan Tiens are used as a “laboratory” for Inner Alchemical work. Translated from the Chinese, the word Tan means elixir (literally cinnabar, a mineral used in the Outer Alchemy as a basis for the elixir of immortality, since it was considered to have the perfect balance of Yin and Yang). Tien means field or place. It is the place where all the energies of our body, the earth, the Universe and nature come together to form the pearl, the elixir of immortality, the nourishment for our soul and spirit.

The Lower Tan Tien (hereafter referred to as “the Tan Tien”) is located in the abdomen approximately three finger-widths below the navel near the center of the body. The precise location varies from person to person and depends on the body type. In the Tan Tien we store our Original Chi. Original Chi is the Chi derived from the egg and sperm of our parents, from which our entire organism arises.

In Iron Shirt Chi Kung practice we learn to stand effortlessly and relaxed in the “Embrace the Tree” position through our internal body structure and alignment, our rooting, a powerful pelvic floor and the centering in the Tan Tien. In Tai Chi Chi Kung we learn to move this “tree”, circulate the energy and strengthen our internal power. All movements in Tai Chi originate from the Tan Tien. This important region is responsible for control and balance, two key ingredients in proper Tai Chi execution. Additionally, the Chi generated through the Iron Shirt and Tai Chi practice is stored in the Tan Tien.

For the development of the internal and rooting power and the centering of the body and the mind, it is necessary that enough energy is stored in the Tan Tien (so that the Tan Tien is filled with Chi pressure) and that our mind is strong and focused in the Tan Tien. This will also makes us more focused, stable and balanced in daily life. It enhances our personal power.

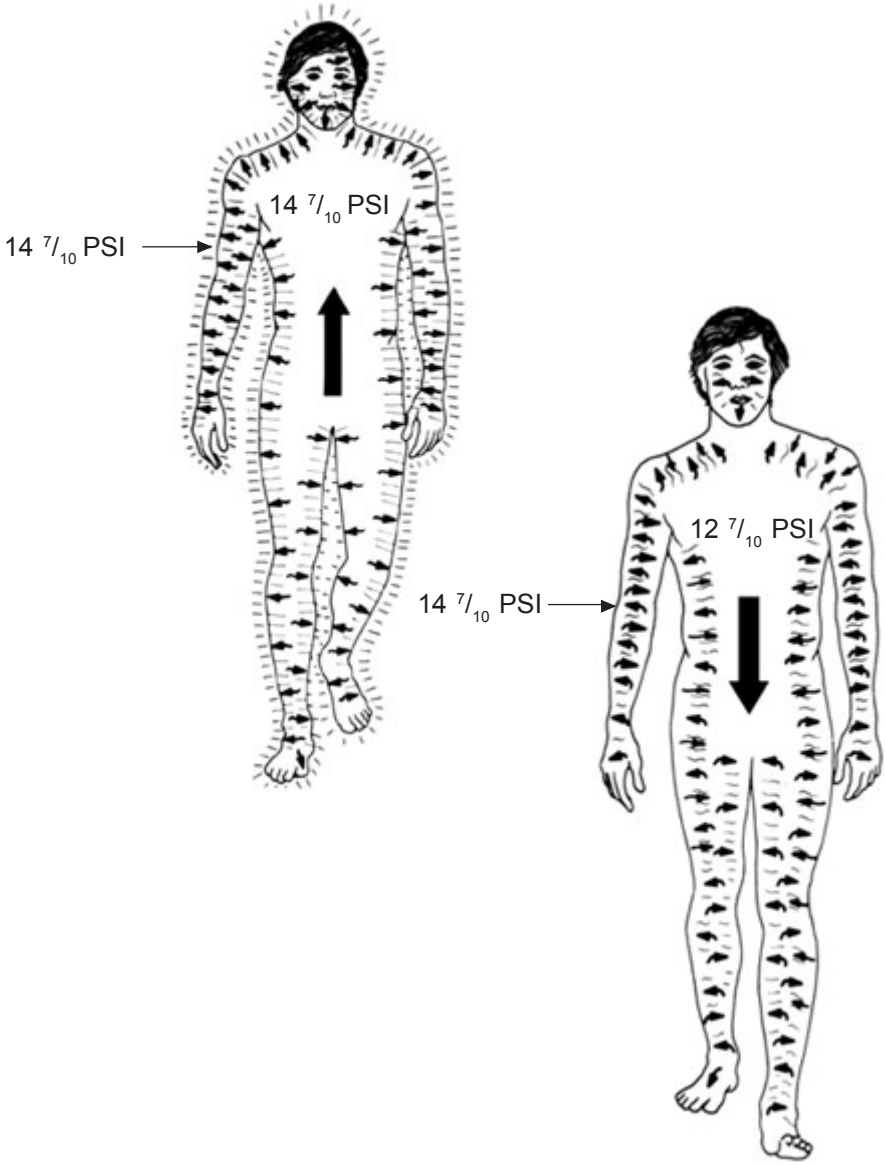

Fig. 2 *A healthy body has an internal pressure of fourteen and seven tenths pounds of pressure per square inch (PSI) Any reduction of this pressure increases the chances of illness and overall weakness.*

While the Tan Tien is both the source and container of Chi power, the mind acts like a general that issues orders to the Tan Tien for directing power. Through this we can draw energy quickly and effectively from this area and direct it to another area. This is especially important in Tai Chi and Healing Love practices.

We have a constant air pressure in our body. We call this Chi pressure. In Tan Tien Chi Kung we learn to develop this Chi pressure in the Tan Tien and to strengthen our organs and fasciae. Our system relies entirely upon Chi pressure to move the body fluid. We can actually increase our vital energy, strengthen our organs, and promote self-healing by increasing the Chi pressure in our organs and body cavity. The circulatory system, the lymphatic system, the nervous system, and the endocrine glands will all be activated, and blood, spinal fluid and hormones will flow more easily so that the heart will not have to work as hard. Increasing pressure in the abdominal cavity will help increase the Chi pressure used to move the Chi, blood and lymph fluid.

One of our goals is to increase Chi pressure in order to increase organ and abdominal pressures so that the Chi presses outward on the fasciae layers from the inside. We pack the Chi in the Tan Tien and, after it is released, the fasciae expand as do the organs.

When people are sick, the Chi pressure inside decreases and falls below the Chi pressure from outside, which is about 14.7 PSI. So these people cannot tolerate the exterior pressure so well. They will become irritated very quickly, tired from people around them, etc. Life becomes a burden. A lack of Chi pressure also slows down all circulation (Chi, blood, lymph and spinal fluid). It is a downward spiraling movement of the whole life force.

Developing Chi pressure is one of the best practices we can use to reverse the downward spiraling movement into an upward spiraling movement in the quantity and quality of our life force. In other words, the increase of the Chi pressure in our Tan Tien through the Tan Tien Chi Kung will enhance our healing, martial arts (Iron Shirt and Tai Chi), meditation abilities, and the art of daily living and will also nourish our Original Force. It is the Chi pressure in the Tan Tien that roots our body and mind.

It is our electric wire in the earth, our ground wire. When the Chi pressure is low, we will have no rooting. The energy and the mind will be fuzzy, drifting and will quickly rise upward and dissipate, and cause overheating, headache, pain in the heart and a distracted mind.

If you want to become a big strong tree, you need deep roots, which also means a high Chi pressure in the Tan Tien. This is one of the reasons why the Tan Tien Chi Kung is the foundation for Iron Shirt and Tai Chi Chi Kung and it is also important for our meditation practice.

In the long run we will regain our inner peace and stillness through this inner power in the Tan Tien. This will restore our connection with our Origin, the mind of the Tao.

Fig. 3 *All forms of energy work require that we remain solidly connected to the ground.*

Practice

The practice is divided into two parts. In part one, we will learn to increase the Chi pressure in the Tan Tien, in the organs, especially the kidneys, in the fasciae, in the lumbar area and the Door of Life. This is accomplished through a combination of breathing, contraction (pulling upward) of certain parts of the perineum (anus) toward specific areas of the abdomen and pressing down the abdominal diaphragm. The exercises also nourish our Original Force.

The warm-ups open the kua/sacrum and the hip joints and strengthen the anus (perineum)

In part two, we will learn eleven animal postures. In fact, they have the same results as the exercises from part one. They are, however more powerful and will significantly enhance the Chi pressure/inner power in the Tan Tien, the strength of the perineum and the rooting power. They are actually a very good preparation for Tai Chi.

Warm-up Exercises

We start the practice of Tan Tien Chi Kung with some warm-up exercises: the opening of the sacrum/kua and the strengthening of the anus (in fact the whole perineum, including the sexual organs).

An open sacrum and a strong anus are the necessary conditions for the development of Chi pressure in the Tan Tien (Tan Tien power). These are the requirements for the correct execution of the exercises of Tan Tien Chi Kung.

1. Opening the Sacrum

The sacrum, the groin area, the hip joints and the iliopsoas all form the kua. When the kua is closed, the flow of Chi, blood, lymph fluid down and up the legs is blocked as are the nerves to the legs. In order to enable the sacrum to move freely, the sacrum should be separate from the hip bones. When the sacrum and the pelvis are open, there is space for the energy and we can push this energy far down in the Lower Tan Tien.

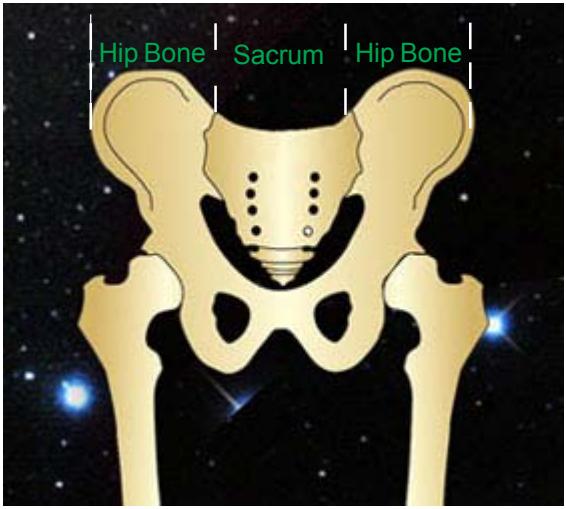

Fig. 4 *Sacrum*

1. Rub the sacrum warm. Stand shoulder width, feet parallel, ankles and knees slightly spiraled outward and locked together like one piece. The arms are round and the palms are facing the earth. Picture your Lower Tan Tien as an ocean. The waves are moving you back and forth. Sink down in the groin/kua. Inhale, turn the palms and raise them upward, pull the perineum slightly up, the sacrum is closed. Exhale, turn the palms, with the thumbs inward, down and push them firmly toward the earth. This will create a tension in the tendons. At the same time contract the anus and push the heels which are firmly rooted, outward and turn the upper thigh inward. This will help to open the sacrum. Keep the knees and ankles aligned and connected with the earth. When you open the sacrum this way, it feels like you are pushing the hips to the side. Actually, you are also pushing the sacrum to the back, tucking the coccyx in and opening the pelvis.

Activating the hips and the sacrum pump activates the cranial pump, stimulating the flow of cerebrospinal fluid through the spine to the brain. This will nourish the brain and enhance the clarity of our thinking and the activities of the central nervous system.

Fig. 5 *Sink down in the kua, round the arms and push down into the earth.*

2. Squatting will also help to open the kua, especially the sacrum and the hip joints. Squatting is a powerful and effective way to open the kua and the sacrum. For many people in the world it is still common to sit, talk, eat, empty the bowels, meditate and relax and restore the energy flow in the squatting position.

The squatting position also provides a deep massage and enhances the Chi and blood flow to all organs in the Lower Tan Tien, including the small and large intestines and the fasciae. It releases gases and is very helpful in relieving constipation.

A good exercise for developing the squatting position is to stand with your feet shoulder width (when you improve your squatting ability, place both feet together) close to and facing the wall and then to squat straight down from the kua. The wall will prevent you from leaning forward when you squat. Breathe in the Lower Tan Tien, keep the chest relaxed and feel a force pulling you down and a force pulling you up, as you squat down to the Earth.

To squat you can also use the help of a partner or the edge of a table. Be sure that you go straight down and bend from the kua.

When you work with a partner, stand shoulder width facing each other, arms outstretched, and place the hands on each other's shoulders. From this position, squat straight down together from the kua while supporting one another. Sink as deep as you both can without leaning forward.

3. Other exercises for loosening the sacrum:

- Put your hands on your sacrum and pubic bone and rotate the sacrum in both directions.

- Hold your hands again on the sacrum and move the sacrum back and forth, back and forth.

Fig. 6 *Squat*

2. Anus/Perineum

The Taoists divide the anus into five parts: the front which is connected to the Hui Yin (the perineum point and the sexual organs); the back of the anus, which is connected to the coccyx and the sacrum; the middle; the left, which is connected to the left side of the body, especially the left kidney; and the right side, which is connected with the right side of the body, especially the right kidney. In Tan Tien Chi Kung we strengthen all these parts (perineum power) by contracting them (pulling up). When your pelvic area is strong, no energy will leak out of these gates, and you can enhance the Chi pressure in your Tan Tien. With a weak perineum and anus, this is not possible.

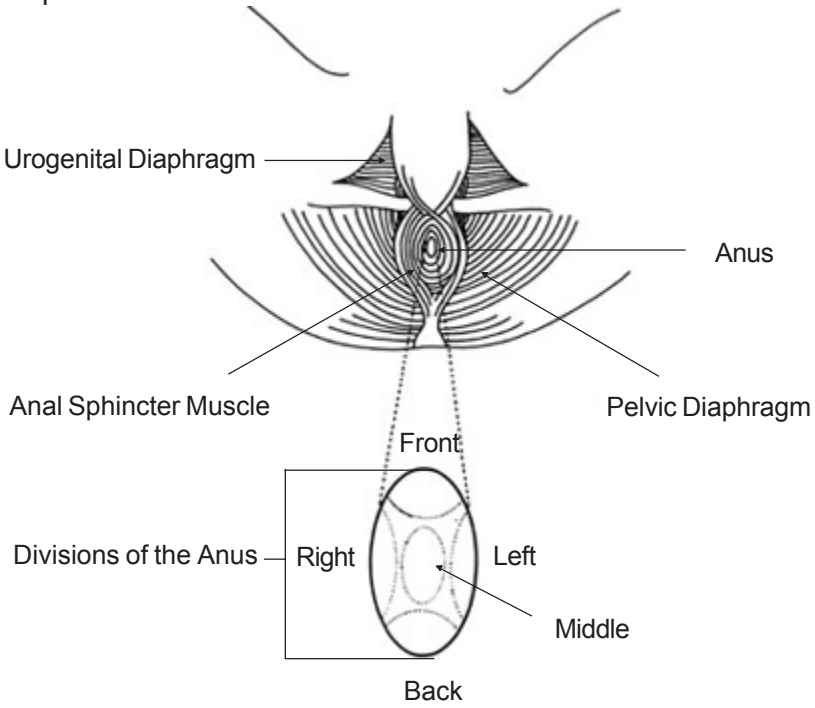

Fig. 7 *Anus is divided into five regions.*

There are good Taoist exercises to strengthen the anus and the different parts of the anus (perineum/pelvic floor) and to learn to contract them (by pulling up) without tightening the muscles too much. To make them really strong, which means giving the muscles a strong tone, you must do these exercises many times a day. The pleasant thing about them is that you can do these exercises everywhere: good times and places to practice are while waiting at the post office, the bus station, the shop, or when you watch a movie or TV, or work on the computer. When you are creative, you will find many occasions during the day to practice these exercises.

The best way to do these exercises is in the standing position. However, you also can practice them sitting or laying on the ground, in bed or even in the bathtub.

We give you the exercises in the standing position;

1. Stand shoulder width with the feet parallel and all the nine points firmly rooted in the earth. Just be aware of the front part of the anus and the sexual organs, especially the testicles, the vagina and the uterus. Inhale half the breath, flatten down the stomach, hold the breath, inhale without inhaling, inhale more and contract the **front** part of the anus and the sexual organs. Keep your tongue against the palate. Exhale very slowly and pull up even stronger. This will be easier and more effective when you exhale with the kidney sound. When you do this well the coccyx will turn in and the sacrum will push out, rounding the lower back, because the sacrum and the sexual organs are connected.

2. Stand in the same position, be aware of the middle part of the anus, and for men also the prostate gland. Inhale half the breath, flatten down the stomach, hold the breath, inhale without inhaling, inhale more and contract the **middle** part of the anus. Hold the breath and exhale very slowly, pulling up the middle part of the anus even more. You can also exhale with the kidney sound now, if you wish.

3. Stand in the same position; be aware of the **left and right** sides of the anus. Inhale, flatten down the stomach, hold the breath, inhale without inhaling, inhale more and contract the left and the

right sides of the anus toward the kidneys. Hold the breath and exhale slowly, if you wish, with the kidney sound, pulling up the left and right side of the anus even more. Feel the kidneys and the whole part of the back expand, including the Door of Life.

4. Stand in the same position; be aware of the **back** of the anus. Inhale half the breath, flatten down the stomach, hold the breath, inhale without inhaling, inhale more and contract the back part of the anus. Hold the breath and exhale very slowly, with the kidney sound if you wish, contracting the back part of the anus even more. You will feel that the lower back is pushed further outward and has more power.

When you inhale and contract the different parts of the anus, at the same time you can always contract your eyes, suck in your mouth, widen your nostrils like a rabbit and push the tongue against the palate. All the round muscles around the orifices of the body and the diaphragm are working together.

3. Releasing Tension in the Diaphragm

Many people have a stiff diaphragm which sticks to the rib cage. In order to be able to develop the Chi pressure, we should have a diaphragm that is loose and that can easily move up and down. To release the tension in the diaphragm, you can massage the diaphragm:

a. You can massage under, and along the rib cage from top to bottom and, or

b. You put the left hand's middle fingers with the palm facing upward, under the rib cage. Place your right hand on the lower part of the right rib cage and push the rib cage downward with your right hand. Repeat for the left side.

This massage will loosen and stretch the diaphragm and will facilitate and deepen the breath. You will be able to keep and push the diaphragm down on the exhalation, which is necessary for the development of the Chi pressure in the Tan Tien.

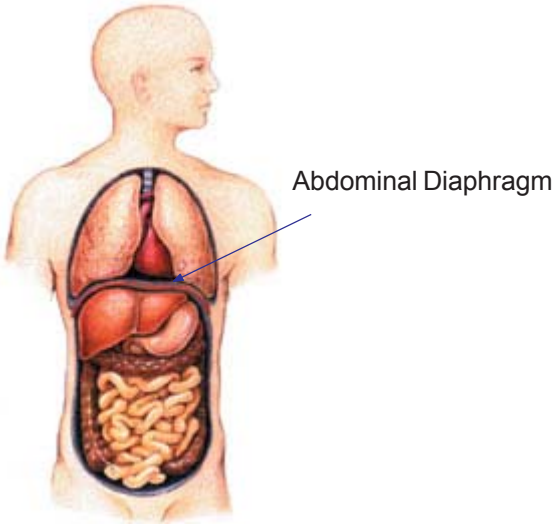

Fig. 8 *Release Tension in the Diaphragm*

Development of Chi Pressure in the Tan Tien Through Tan Tien Breathing

To feel Chi within you is not easy. When people laugh in the Lower Tan Tien, the Tan Tien Chi starts to develop. You can picture the Tan Tien as a balloon that you can fill with air, creating air pressure in the balloon. The main thing you have to do to fill this balloon is to blow air in it little by little. Blow and hold, blow and hold. With the Tan Tien it is the same. You inhale, blow in the air, hold the breath (air) and exhale very slowly. In this way you can maintain the pressure.

You can verify this with a partner exercise. Take a partner and gently put your fist on his or her Tan Tien (belly) just below the navel.

a. Let him inhale in the abdomen and feel the pressure of the breath (Chi) pushing his abdomen against your fist. Let him then exhale quickly and you will feel that the air (Chi) pressure is gone and that you are pushing into an empty Tan Tien.

b. Let him inhale in the same way and exhale this time very slowly through the mouth. You will feel that the pressure is still there. Just as with the balloon, when you pull up the perineum and push down the diaphragm, the air (Chi) pressure in the Tan Tan will be more condensed and stronger.

As you continue to push, you will feel that the energy remains there and is moving. Let your partner now laugh in the Tan Tien while you are still pushing, and you will feel the Chi pressure becoming stronger and the Chi moving and vibrating. You can change places and let your partner work on you.

1. Breathing exercises to develop Chi Pressure in all Seven Areas and in the Whole Tan Tien

We distinguish seven important areas in the Lower Tan Tien where we would like to develop the Chi pressure:

1. Area below the navel (Chi Hai)
2. Both sides of the front part of the Tan Tien
3. Bladder Area
4. Area near the Solar Plexus
5. Both Sides of the body
6. Both Kidneys
7. Door of Life.

Areas 1 - 4 belong to the front part of the Tan Tien, and 6 and 7 to the back part of the Tan Tien.

Just as with the balloon, you can press some areas of the balloon/Tan Tien to increase the pressure in other parts of the balloon/Tan Tien. The two main areas you always press are the perineum and the diaphragm. This will reduce the space in the Tan Tien and condense the Chi (ball) in the Tan Tien. When you pull to the right, the left, the back or the front, the Chi ball (pressure) will move from one side to the other.

A. Lower Tan Tien: Ocean of Chi or Chi Hai

Put your hands on the Chi Hai in the lower abdomen very gently and very softly. Smile and do a few abdominal breaths. Inhale half the breath, hold the breath, inhale more and pull up the front part of the anus (and the sexual organs) and push at the same time into your lower abdomen; the breath pushes your hands out. Feel a suction. Slowly exhale (hold the Chi pressure in the Chi Hai) and push the Chi down to the lower abdomen part of the Tan Tien. Regulate the breath and maintain equal force between the downward pressure of the Chi and the upward force from the anus (perineum). Always keep the diaphragm down and the chest relaxed. You can make a high pitched sound when you inhale (dragon sound), suck up with the sound and a low pitched (tiger sound) sound when you exhale and push the energy down. Laugh softly inside and feel the vibration in the Chi Hai.

Fig. 9 *Put your hands on the Chi Hai in the lower abdomen.*

Repeat several times. Feel the pressure becoming stronger with every breath. Especially when you exhale consciously, you hold the Chi. When you inhale and exhale with an absent mind, you lose the Chi. Then it will be true what the Taoists say, that with every breath taken, life is one breath shorter.

B. Both Sides of the Front Part of the Tan Tien

Put your hands gently on both sides of the front part of the Tan Tien. Smile and inhale half the breath. Hold the breath, inhale more and pull up the anus and the left and right sides of the anus and push these points of the Tan Tien outward against your hands. Exhale slowly and press the Chi down to the right and left parts of the front Tan Tien maintaining equal force. Do this several times until you feel a strong Chi pressure. Laugh softly inside and feel a vibration in both sides of the Tan Tien.

Fig. 10 *Smile and inhale half the breath.*

C. Bladder

Put your hands gently on your bladder. Smile and inhale half the breath. Hold the breath, inhale more and pull up the anus and the front part of the anus and push the bladder outward against both hands. Exhale slowly and consciously and push the Chi down in the bladder. Maintain equal force. Repeat several times until you feel a strong pressure in the bladder region. Laugh softly inside and feel a vibration in the bladder. You can do this exercise when you are urinating to greatly reduce the loss of energy during urination.

Fig. 11 *Put your hands gently on your bladder.*

D. Upper Abdomen near the Solar Plexus

Put your hands gently on the upper part of your abdomen. Smile and inhale half the breath. Hold the breath, inhale more and pull up the anus and the front part of the anus. Press the upper part of your abdomen out against your hand (with the high pitched dragon sound). Exhale slowly and consciously (with the low pitched tiger sound) and push the Chi in your upper abdomen. Maintain equal force. Repeat several times until you feel a strong Chi pressure in this area. Laugh inside and feel a vibration in the Upper Tan Tien.

Fig. 12 *Laugh and Smile in Solar Plexus.*

E. Both Sides of the Body

Place your hands gently on both sides of your body. Smile and inhale half the breath. Hold the breath, inhale more and pull up the anus and left and right sides of the anus and push both sides out against your hands. Feel both sides expanding. Exhale slowly and consciously and push the Chi down to the left and right sides. Maintain equal force. Feel both sides of the Tan Tien expanding. Repeat several times until you feel a strong Chi pressure in both sides. Laugh inside and feel both sides of the Tan Tien vibrating.

Fig. 13 *Feel both sides of the Tan Tien expanding.*

F. Kidneys

Place your hands gently on your kidneys. Smile in the kidneys and inhale half the breath. Hold the breath, inhale more and pull up the anus and the left and right sides of the anus and push the kidneys out against your hands. Feel the kidneys expanding, and the whole lumbar area opening. Inhale more, expand, hold the breath once more and exhale slowly down in the kidneys. Feel the whole kidney area expanding when you exhale and push the energy down. Repeat several times until you feel a strong Chi pressure in both kidneys and a Chi belt around your waist. This exercise will also strengthen the kidneys and increase your Original Force. Smile in the kidneys and feel them vibrating.

Fig. 14 *Feel the kidneys expanding, and the whole lumbar area opening.*

G. Door of Life

Place both hands gently, one over the other, on the Door of Life (about L2/L3 level). Cover the Door of Life. Smile and inhale half the breath. Hold the breath and pull up the anus and the back part of the anus and push the Door of Life out against your hands. Feel the Door of Life expanding and becoming more open. Inhale more, hold the breath, pull up more and expand, inhale more, hold and expand. Exhale slowly and consciously and press the Chi down to the Door of Life. Maintain equal force. Repeat several times until you feel a strong pressure in the Door of Life and you feel it open and breathing. Be aware of the soles of your feet, the coccyx and the sacrum. Inhale and pull up the anus and the back part of the anus, feel the pulsation in the Door of Life sucking up the energy of the Earth and moving it upward through the spine to the brain. Exhale, put both feet together, scoop up the energy and bring it down. Touch the navel and focus on the Door of Life. Repeat several times.

Rest, cover the navel, smile and feel your whole abdomen full of Chi, open and breathing/pulsating.

Fig. 15 *Focus on the Door of Life.*

H. Tan Tien Breathing

Breathe slowly and smoothly in the Tan Tien until you feel nice and calm. Then combine all the seven breathing exercises together. Smile and gently place both hands on the Lower Tan Tien. Inhale part of the breath. Hold the breath, inhale more and pull up the anus and the front part of the anus and push against the fingers. Exhale slowly and push the energy down, expanding the lower abdomen. Hold the pressure.

Place your hands on both sides of the front Tan Tien. Inhale again part of the breath. Hold the breath, inhale more and pull up the anus and the left and right side of the anus. Push against the fingers. Exhale slowly and push the energy to the left and right side of the front Tan Tien. Feel these parts expanding and hold this pressure. Place your hands on the bladder. Inhale part of the breath. Hold the breath. Inhale more and pull up the anus and the front part of the anus, pushing out the bladder. Exhale slowly and push the energy down in the bladder.

Feel the bladder expanding and hold the pressure. Place your hands on both sides of the body. Inhale part of the breath. Hold the breath and pull up the anus and the left and right sides of the anus. Push both sides of the body out against the hands. Exhale slowly and push the energy down to both sides of the Tan Tien. Feel the sides expanding and hold this pressure.

Place your hands on the kidneys. Inhale part of the breath. Hold the breath, inhale more and pull up the anus and the left and right sides of the anus toward the kidneys. Push the kidneys outward. Exhale slowly and push the Chi down into the kidneys. Feel the kidneys expanding. Hold the pressure.

Place both hands on the Door of Life. Inhale part of the breath. Hold the breath, inhale more and pull up the anus and the back part of the anus. Exhale slowly and push the energy down into the Door of Life. Feel the Door of Life expanding, pushing the lumbar area slightly to the back. Feel the energy rising up the spine to the brain. Your whole Tan Tien is now like a balloon with a very high Chi pressure inside, expanding to all sides.

Hold both hands on the Tan Tien and laugh gently inside it. Feel the vibration and pulsation of the Chi. Turn your senses inward to the Tan Tien. Empty the mind in the Tan Tien. Just rest for a while. Feel nice, calm, relaxed and energetic.

Fig. 16 *Laugh gently in the Tan Tien.*

2. Exercises to Bring More Chi Pressure and Energy Vibration in the Tan Tien

1. You can just repeat the exercises. The only difference is that this time you use your fingers to give counter pressure against the pressure of the Chi from inside.

For example: Put your fingers on the Chi Hai in the lower abdomen. Smile and do a few abdominal breaths. Inhale half of the breath, hold the breath, inhale more and pull up the front part of the anus and push at the same time against the lower part of the Tan Tien, against the pressure from your fingers. Feel a suction. Slowly exhale (hold the Chi pressure in), increase the pressure of your fingers and push the Chi down in the lower abdomen against your fingers. You will notice that with the counteracting force of the fingers the Chi pressure becomes stronger. Do this a few times. The last time you hold the breath after the exhalation and tap both fists on the Chi Hai until you feel a vibration in this area.

Do this for all the other six areas of the Tan Tien (tapping on the bladder is especially good for women). You then combine them, enhancing in this way the Chi pressure and vibration in the whole Tan Tien. Repeal this until you feel a very deep vibration of the Chi inside the Tan Tien and in your original force.

Have a partner gently push you with his fist in your Tan Tien, so that you have to hold and apply counter pressure. This will help you to develop a stronger Chi pressure and vibration in the Tan Tien.

2. Repeat each exercise again and continue to use the fingers as a counteracting force. At the end of each exercise, inhale and expand for instance the lower abdomen and exhale quickly with the deep tiger sound “haaa”, pushing the energy down and out against your fingers. The sound is made through a quick expansion, for instance from the lower abdomen. The exhalation, the expansion and the sound should be completely synchronized.

Repeat with the whole Tan Tien.

Rest with the palms facing downward. Feel the Tan Tien Chi breathing and pulsating. Inhale and pull up the front, back, left and right parts of the anus together with a light contraction of the eyes and mouth and feel the suction in the Tan Tien, the palms, the soles of the feet, the perineum, the sacrum, the mideyebrow point, the crown. Exhale and condense the energy in the Tan Tien.

Repeat several times.

Fig. 17 *Use counter pressures of hands and breath to increase Chi pressure.*

Animal Exercises

After each animal exercise: Inhale, put the feet together, scoop up the energy from the universe, palms facing up. Turn the palms downward and pour the energy down over the body, back into the navel, back into the Tan Tien. Focus on the Door of Life. Gently, move the hands from the navel (Lower Tan Tien) to the thighs. Feel the fingers and Chi penetrate the thighbones as Chi is absorbed into the bone marrow. Move the hands down the thighbones. Feel the fingers penetrate the bones, glide past the knees, and across the shinbones. As you glide the hands down, sink the hips and bring the tailbone down to the heels in a squatting position.

Fig. 18 *Scoop up energy and pour it onto and into the crown.*

Feel yourself sinking down through the Earth and into the infinite space beyond the Earth. Picture the galaxy and feel the spiraling of the force.

Fig. 19 *Lift the Tailbone first.*

With your hands resting on your feet, lift the tailbone until the legs are straight. Feel the Chi drawn from outer space and the earth spiraling into your body.

Squat down again and gather more Earth energy and more Universal energy. Do this 3 to 9 times.

With your hands resting on your feet, lift the tailbone until the legs are straight. Feel the Chi drawn from outer space and the earth. spiraling into your body.

Stand up slowly, gliding the hands over the back of the legs. Feel the fingers touch the bones and the bone marrow and glide up to the coccyx; hold them there for a while. Feel the Chi rising to the spine and the brain. Move the fingers to the sacrum. Feel the Chi pour into the sacrum and the sexual center.

Bring the hands up to the Door of Life and concentrate on the navel.

Feel the Chi energize the kidneys and the Door of Life. Slowly bring the hands to the navel. Smile and collect the energy in the Tan Tien.

Notes: In all the animal exercises the diaphragm is down, the chest relaxed and the anus pulled up. Repeat all the animal exercises several times.

Start the exercises with some Tan Tien breathing, expanding the front, back and sides of the Tan Tien with every breath. Stay relaxed and keep your mind focused.

When doing the animals breathe in with the high pitched, wheezing dragon sound and breathe out with the low pitched, growling tiger sound.

1. Rabbit (Front Tan Tien)

This exercise develops the Chi pressure in the front part of the Tan Tien, navel and pelvic area.

Stand shoulder width, with the feet parallel. Inhale, pull up the anus and the front part of the anus, expand the lower abdomen (with the high pitched dragon sound) and feel the suction in the abdomen, while raising the arms slightly above the head. The wrists should be bent down and the fingers facing the earth.

Exhale quickly and pull up the anus and the front part of the anus even more and, like a rabbit, widen your nostrils. At the same time, sink down a little in the kua, press the palms down and push the energy in the front part of the Tan Tien and the pelvic area. It is very important that you synchronize these three movements. When you do this you will feel the Chi pressure increasing in this part of the Tan Tien and in the palms of your hands. Because there will be a lot of Chi generated in the lower abdomen, the kua and the hip joints will open more.

Fig. 20 *Rabbit sinks into the kua.*

2. Crane (Both Sides of the Tan Tien)

This exercise develops the Chi pressure in both sides of the Tan Tien.

Stand shoulder width, with the feet parallel. Inhale, pull up the anus and the left and right sides of the anus, expand the left and right sides of the Tan Tien and feel the suction in this part of the Tan Tien. Raise the arms. The fingers should form beaks. Move the arms to the sides of the body at shoulder level. Exhale quickly and pull up the anus (the left and right sides of the anus even more). At the same time, press your palms down to hip level and press the Chi to the left and right sides of the Tan Tien. Feel them expanding and feel the Chi pressure growing in this part and in the palms of your hands. Repeat several times.

Fig. 21 *Crane makes beaks.*

Fig. 22 *Crane expands left and right sides of Tan Tien.*

3. Bear (Back Part of the Tan Tien and the Whole Back/Spine)

This animal position corresponds to the back part of the Tan Tien, especially to the sacrum and the whole back: a bear back! We already did part of these exercises in the beginning to open the sacrum and the kua.

Stand shoulder width, feet parallel with the palms facing up. Inhale. Pull up the anus and the back part of the anus, expand the sacrum and the lower back and feel a suction. Feel this suction raises the palms. Now, on exhaling, you must quickly do several things at once. Just as in all the animal exercises, you have to exhale quickly and pull up the anus and the back part of the anus even more. At the same time, you must turn the palms downward and push them down together with the energy and open the sacrum as described in the warm-up exercises, while rounding the shoulders and sinking the chest. You will feel the whole back expanding.

Fig. 23 *Bear expands the sacrum.*

4. Swallow (Left and Right Tan Tien)

Stand in the Embrace the Tree position. Inhale, pull up the anus and the left and right sides of the anus and let the Lower Tan Tien Chi move you to the left. Your left foot turns 90° and your right foot 45° to the left. Exhale, pull up the anus and the left side of the anus more and press the Chi down in the left Tan Tien, in the left leg, pushing you down into the earth. Feel a force coming up from the earth and a force pushing you down. Inhale again; pull up the anus and the right side of the anus and let the Lower Tan Tien Chi move you to the right. The right foot turns to the front and then 90° to the right, the left foot also turns to the front and then 45° to the right. Exhale quickly, pull up the anus and the right side of the anus more and press the Chi down in the right Tan Tien, in the right leg, pushing you into the earth. Feel again a force coming up from the earth and a force pushing you down.

This exercise is very important for your Tai Chi, especially for the Tan Tien form.

Fig. 24 *Swallow moves the tree.*

5. Dragon (Left, Right and Middle Tan Tien)

Stand shoulder width, with the feet parallel and the fists at hip level. Inhale, pull up the anus and the left side of the anus and expand the left side of the Tan Tien. Feel a suction. Exhale quickly, pull up the left side of the anus more and, at the same time, press the energy in the left Tan Tien and the right fist to the left leg. Feel the left side of the Tan Tien expanding. Repeat this for the right and the Middle Tan Tien. For the Middle Tan Tien, you push both fists down and pull up the middle part of the anus. This exercise is also very good for your Tai Chi.

Fig. 25 *Dragon makes suction.*

6. Eagle (Lower Tan Tien)

Stand shoulder width, feet parallel and hold the arms with the elbows bent. Pull up the anus and feel the force in the Tan Tien activated by the force of the fingers and a slight contraction of the eyes. At the same you will feel that the force in the fingers is activated through the force in the Tan Tien. Just stand for a while and feel the forces moving you, enhancing the power in the Tan Tien and in your fingers.

Fig. 26 *Eagle activates Lower Tan Tien Chi.*

7. Monkey (Lower and Upper Tan Tien)

Stand shoulder width, with your feet parallel and your fists in front of the kua. Inhale, pull up the anus and the middle part of the anus and expand the lower Tan Tien, fists pushing down. Then with a swing coming from the force in the Tan Tien and a contraction of the anus, move your arms up quickly, palms facing downward and let the Chi rise to the Upper Tan Tien. Exhale, pull up the anus more and push the energy down in the Lower Tan Tien. At the same time press the hands down to the earth in a squatting position and then scoop up the earth energy.

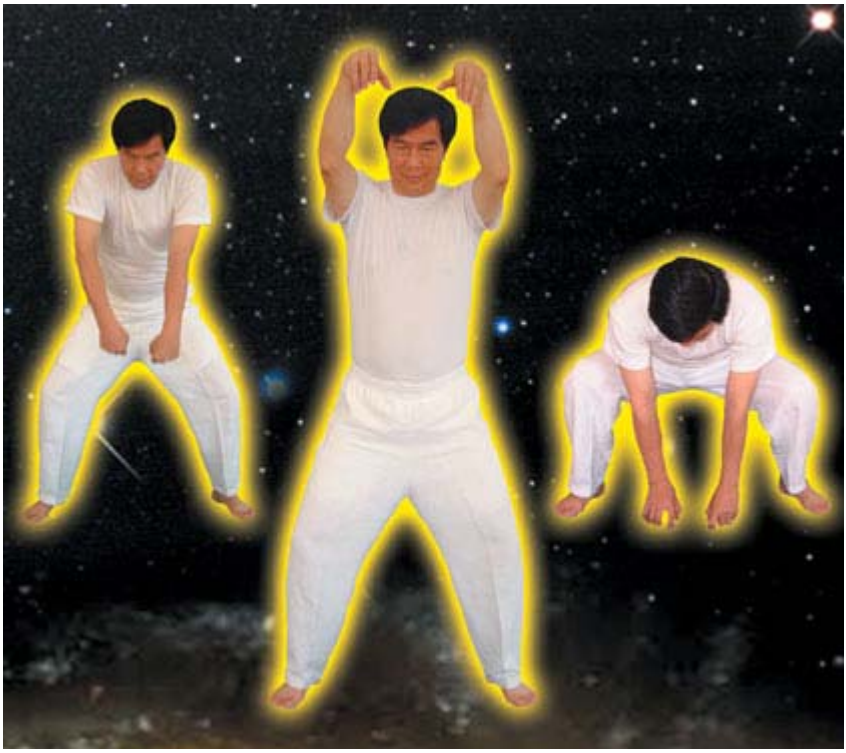

Fig. 27 *Monkey pushes down to Earth.*

Come back to the starting position. Inhale again, pull up the anus and the middle part of the anus, and swing the arms high up in front of you.

When you exhale quickly, pull up the anus more and push down the Chi ball in your Lower Tan Tien with some force and then let your whole weight freely come down with the kua until you are in the squatting position. Let your hands swing backward like open cups beneath the perineum. Inhale, gradually raise up from the knees to the hips and, with your palms, scoop up the earth energy. Gather the energy at the navel. In this exercise, the upper part of your body is loose while the lower part is heavy.

Fig. 28 *Monkey scoops up Earth energy.*

8. Elephant (Left and Right Kua and Lower Tan Tien)

Stand with your feet parallel and shoulder width. Inhale, pull up the anus and the left side of the anus and swing your arms, like the trunk of an elephant, upward to the front and to the left as you turn your waist to the left. Hold the breath, expand the left Tan Tien and swing the trunk and the waist to the middle again. Exhale, pull up the middle side of the anus and at the same time press the energy and swing the trunk down until you are in a squatting position. End the swing of the trunk between your legs. Inhale, pull up the anus and the right side of the anus, swing the trunk upward to the front and to the right as you swing your waist to the right. Hold the breath, expand the right part of the Tan Tien and swing the trunk and the waist to the front again. Exhale, pull up the middle side of the anus and at the same time press the energy and the trunk down until you are in a squatting position. End the swing of the trunk between the legs. The swing of the trunk should be light and smooth.

Fig. 29 *Elephant swings his Trunk.*

Fig. 30 *Elephant gathers Chi.*

9. Rhinoceros (Left and Right Tan Tien)

Stand shoulder width, with your left foot in front and your right foot at a 45° angle behind you. Stretch your left arm straight in front of you, the palm facing downward. Hold the back of your right hand in front of your forehead. Inhale, pull up the anus and the left side of the anus, sink a little bit in the kua and move the waist with the Tan Tien to the left. Your hips and navel should stay pointed straight in front of you. The arms and the upper body move with the Tan Tien to the left. Exhale, pull up the left side of the anus more and, at the same time, press the Chi down in the left Tan Tien, pressing the left leg into the ground.

Repeat to the right side, the right leg in front and the left foot at 45° turned outward behind you. Stretch the right arm straight in front of you and hold the back of the left hand in front of your forehead. Inhale, pull up the anus and the right side of the anus. Sink a little bit in the kua and turn the waist with the Tan Tien to the right. The navel and hips should not move. Exhale, pull up the right side of the anus more and, at the same time, press the Chi down in the right Tan Tien, pressing your right leg in the ground.

Fig. 31 *Rhinoceros presses and condenses Chi into Left and Right Tan Tiens.*

10. Horse (Upper Tan Tien and Solar Plexus)

Use an expanding sound from the upper Tan Tien/solar plexus. Stand shoulder width, with the feet parallel and the fingertips on the Tan Tien. Inhale, pull up the anus and the front side the anus and expand the upper Tan Tien against your fingertips. The fingertips will provide some counter pressure. Exhale quickly, pull up the front side of the anus more, swing the arms and press them down with the Chi. Sink a little in the kua and at the same time feel the upper part of the Tan Tien expand with the horse sound ("ho"), it is an echoing sound coming from the solar plexus.

Fig. 32 *Horse makes "Ho" Chi in Solar Plexus.*

11. Bull (Back Tan Tien)

Stand shoulder width, with the feet parallel. Put your left leg to the front and turn your right foot 45° outward. Your arms are in front of you, palms facing outward. Inhale, pull up the anus and the back side of the anus; sink to the back and at the same time turn the palms and scoop up the Chi on the left and right side when you sink to the back. The Tan Tien Chi is pushing you to the back and down into the right leg. Spiral the hands with the spiral of the tendon under the armpits until the palms are facing you. Then exhale, pull up the front side of the anus, spiral the hands more until the palms are facing outward and, at the same time, let the Tan Tien Chi push you to the front and down into the left leg. Feel the energy rising from the earth. Pull up the front and back side of the anus, round the sacrum/ lower back (with your chest in, scapulae round and chin pushed back and up). Feel the energy rising in the spine and push the energy out to the fingertips. Repeat with the right leg in front and the left leg back.

Fig. 33 *Bull strengthens the Back Tan Tien.*

This is a very important exercise for Tai Chi. From this exercise you will learn to sink back in the kua, move from the Tan Tien with the Tan Tien force and direct the force through the spine to the fingertips and from the fingertips back into the earth.

Finishing Tan Tien Chi Kung

After you have finished Tan Tien Chi Kung, sit and relax. Put both palms on your Tan Tien. Smile and feel the Chi vibrating in the Tan Tien and in all the organs, glands and fasciae. Then inhale, move your arms above your head, exhale with the Heart or Triple Warmer Sound and with the palms move all the excess heat (and sick energy) down out of the body, into the earth. Repeat a few times. Let go and empty yourself. Inhale again, raise your arms slowly upwards and scoop up the Universal energy, the violet and ultra red light, into a huge Chi ball. Turn your palms toward your crown and pour the energy over you. Be aware of the soles of your feet and slowly move the energy with the palms down into your body, energizing the body, including your brain, organs, glands, spine. Repeat a few times. Rest. Turn your mind and senses inwards. Empty your mind in the Tan Tien. Feel nice, calm and energetic.

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Tan Tien Chi Kung

Empty Force, Perineum Power and the Second Brain

Mantak Chia

Illustrations by Udon Jandee

Tan Tien Chi Kung

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TAOIST SECRETS OF LOVE

CULTIVATING MALE SEXUAL ENERGY

MANTAK CHIA

MICHAEL WINN

ISBN: 0-943358-19-1

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Without my wife Maneewan the book would have been academic. For her gifts, my gratitude and love.

A WORD OF CAUTION

Any man suffering from venereal disease or any local illness of his sexual organs or prostate gland should consult a medical doctor and a qualified instructor of Taoist Esoteric Yoga before practicing the methods taught here.

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ABOUT THE AUTHOR — Mantak Chia

The author of this book, Mantak Chia, was born in Thailand on April 4,1944. When he was six or seven years of age he learned to "sit and still the mind" from Buddhist monks while on a summer vacation. This is not to say that he was passive and quiet as a child. In fact, he excelled in track and field events during his grammar school days in Hong Kong. It was during that time that he learned the traditional Thai Boxing and met Master Lu, who taught him Tai Chi Chuan. Shortly thereafter, Master Lu introduced him to Aikido, Yoga and more Tai Chi. His knowledge of esoteric practice did not begin, however, until he was eighteen and he had returned to Thailand. It was at that time that a senior classmate, Cheng Sue Sue, a student of Yi-Eng, taught him the level of Tao Esoteric practice up to the Reunion of Man and Heaven.

When he was in his twenties, Master Chia studied with Master Meugi in Singapore, who taught him Kundalini Yoga and the Buddhist Palm. With the Buddhist Palm, he was soon able to eliminate blockages of flow of life-force in his internal organs and to drive cold, wet or sick energy out of patients who came to see his Master, thereby restoring them to health. The young Mantak Chia felt, however, that Kundalini Yoga produced too much heat and could be dangerous and so he later combined it with elements of Taoist practice, which had cooling effects.

Later, in his twenties, he met and studied with Master Pan Yu, who had created a synthesis out of Taoist, Buddhist and Ch'an teaching, and Master Cheng Yao-Lung, who had also created a new system by combining Thai Boxing and Kung Fu. From Master Cheng Yao-Lung, he learned the Shao-Lin secret method of internal power as well as the Iron Shirt method called "Cleansing the Marrow and Renewal of the Tendon". From Master Pan Yu, he learned a variation of Kundalini and the "steel body", a technique that is said to keep the body from decay. Master Pan Yu still lives and practices in Hong Kong, where he treats patients by transmitting his life-force to them. To better understand the mechanism behind the healing energy, Chia also studied Western medical science and anatomy for two years.

Yet, with all of these achievements, Master Chia was the manager of the Gestetner Company in Thailand, was in charge of sales of offset machines and was well acquainted with the working of the company's copying and printing machines. He may well be the

only Taoist master in the world with a computer in his living room. He is also married and has a son. His wife Maneewan works as a medical technician. He is, in short, living proof that his practice is very much down-to-earth, striving to enhance everyday life and not requiring retreat from society to a hermit's life.

The main thrust of Chia's intention is to strip away the mysticism, the mumbo-jumbo, the powers vested in the Guru, the reliance on things-other-worldly or magical. He seeks to present, instead, a fully predictable working model that might be considered as a scientific means of dealing with energy systems. In time, he hopes this will lead to technological developments that might serve to simplify or speed the means whereby such progress might be made. It is with such hopes that he beckons members of the medical community to investigate what he has to offer. There are already physicians and lawyers and computer programmers, who have experienced, first hand, the benefits that Master Chia's methods provide. It is up to them and others in the scientific community to join Master Chia in his lifetime task of bridging the gap between reason and spirit, mind and body, science and religion.

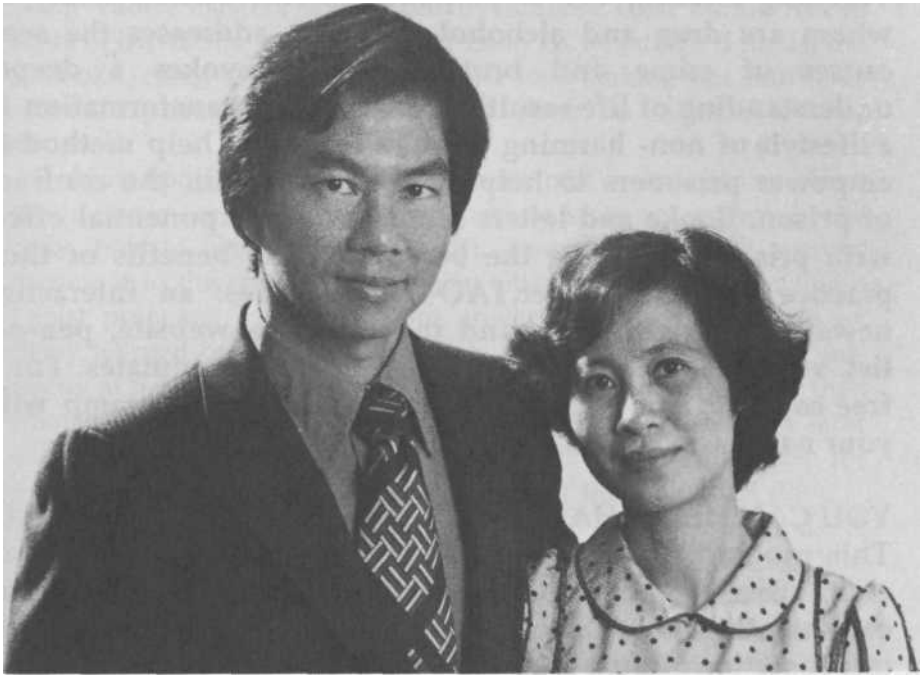

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INTRODUCTION

Taoist "Dual Cultivation" and the Quest for Sexual Love

by Michael Winn

"What a pity! A mountain peak as tiny as one square inch has been the source of great inspiration and misery for centuries."

—*Anonymous Chinese Poet on man's obsession with woman's sex.*

Thousands of books have been written attempting to help men and women resolve the problems arising from the endless search for sexually fulfilling love. What could possibly be written that is new?

Taoist Secrets of Love is not just another flowery philosophical treatise on the ecstasies of oriental love. Rather it is a pragmatic handbook that distills the secret teachings on sex of four different living Taoist masters sought out by Mantak Chia during fifteen years of travel and study in the Far East. As he put it, "I read a ton of books telling me how great esoteric love-making was, but none of them explained precisely how it was done. So I decided to write it myself."

Most books on Taoist sex fail to instruct on how to transform sperm energy once it is held in, where to store sex energy in the body, how to best exchange it with a woman, and give cursory treatment to the retention of semen. Chia synthesized the ancient Taoist practices into simple but powerful methods that can be easily learned by western men. This first volume is directed primarily at men, simply because most men are sexually weaker than women and lose more energy through sex than women. A later volume will describe the esoteric Taoist sexual practices for women, which includes voluntary arrest of the menstrual flow.

The sexual imbalance between men and women is obvious. A woman can sexually receive her man for as long as she pleases, and thus the Taoists say her yin essence is nearly inexhaustible. A man's love making is limited to the amount of energy he has to keep his erection. His yang essence is more easily tired. A woman is sexually stronger than a man because biologically she needs to

be. Her reproductive organs must bear the strain of physically producing children and nurturing them. The effects on men of this primal biological inequality are profound, setting off a chain reaction that can permeate male thinking and feeling on all levels, from marriage to work to cultural roles we choose to play and to the spiritual models we choose for our inner growth.

At heart most men are as terrified of women's infinite sexual capacity as they are fascinated by it. The general effect on men is to make them feel sexually insecure and causes them to attempt to compensate with some other strength. Sexual insecurity may be the primary reason men have sought physical, political, financial, intellectual, and religious advantage over woman. Correcting this sexual imbalance could have significant side benefits in establishing a more harmonious society, although the primary goal of the Taoist teaching on cultivation of sexual energy was personal health and spiritual fulfillment.

The quest for sexually fulfilled love has taken on the dimensions of a religion amongst those who are too liberal or too scientific to believe in any traditional version of God. The power behind this belief in romantic love, in an ultimate commitment to one person, is the power of sexual experience. If offers something tangible to be shared, a sacrament that is personal and present.

The decline of religion in the west may have begun when the experience of sex became more powerful than the spiritual experience offered by religion in prayer or in fellowship. The current revival of religion in the west ironically may be due in part, to a sexual exhaustion following on the heels of the sexual revolution. Sex became a drug, an opiate for the discontent. Total sexual freedom did not supply the stability people needed most. Today, people are turning back to either marriage or religion to seek their sense of an absolute.

The Taoists offer neither religion nor marriage as the solution to stability, unless it be the marriage of subtle energies they identify as yin and yang. They simply encourage each individual to cultivate his natural inner life-force, or chi. It is in this context the ancient Chinese developed highly refined methods of increasing sexual vitality for the single and the married man. There are two main ways that these energy cultivation methods can be used and this book will accordingly attract two distinct kinds of students.

The first student seeks worldly happiness in the form of physical, emotional, and mental satisfaction. This includes any layman interested in strengthening his personal love relationship, in al-

leviating sexual frustration, in relieving boredom with sex, in curing impotency, wet dreams and premature ejaculation and in general increasing his longevity and good health. If he is disciplined and does the practices taught in this book, he can attain all of these benefits.

The other student considers himself on a spiritual path and wants to somehow integrate his sexual desires with his meditative practice or spiritual beliefs. The students already drawn to study the Taoists secrets of cultivating sexual energy with Master Chia have come from an amazingly broad range of spiritual disciplines, including every type of yoga: Kundalini, Hatha, Kriya, Tantric, Siddha and martial artists as well as T.M., Zen, Buddhist, Sufi, Hindu, and Christian adherents. The suggestion is that many Americans, however satisfied they are with their basic spiritual beliefs, feel the need to better integrate their sexuality with their spiritual growth.

The Taoist practice of chi cultivation focuses on integrating the divine or subtle energies into the human body, with the goal of achieving a dynamic balance of opposing energies called yin and yang. The Tao is the indescribable sum and absolute source of these energies, which manifest in ever changing form. The Taoists, being practical, proposed that a man can begin with the most accessible energy at hand, namely the sexual attraction between men and women, and use that as a springboard to more subtle realms.

Taoist Esoteric Yoga is neither a religion, nor a path to salvation. Its vision reaches very far, teaching that enlightenment and physical immortality are only stages in a process of coming to wholeness as a human. It also remains very near and practical. The raw materials required for this evolution can be found at any given moment within the life of an ordinary human being.

The Taoist teaching of physical immortality doesn't suggest men no longer die. It means that before they die they have the opportunity to cultivate a "solid" or substantial spiritual body, also known as the Immortal Body, the Solar Body, the Crystal Body, and other names. In the west the closest parallel to a Taoist Immortal is probably an angel. This is different from schools that teach how to become a holy man by dissolving the individual ego into the bliss of cosmic oneness. The Taoists insist each adept preserve his individual nature within a body (physical or spiritual) so he can oversee the growth of his soul until final union with "wu chi," the nothingness from which the oneness of the Tao emerges. This "staying in your own body" precludes the adept from totally

surrendering to any guru or divine being or religious authority. No one else can do your spiritual work for you.

Chia sees his role as simply that of a teacher who helps his students empower themselves through cultivation of their chi energy. He passes chi (or "shakti") to his students only so they will have a better sense of what to cultivate and refuses any dependent emotional relationships. He describes himself as the lead driver in a caravan of cars. "I can give each student a road map, a set of tools and instructions on how to fix his car. We start out together, and help and love each other as much as possible along the way. But ultimately everyone has to make it on his own. Some will break down, get lost, or choose a different route. Some may find a better road than the one I plotted. As a teacher, there's no kindness I can offer beyond the map and tools and precise instructions for driving safely."

The Taoist premise is that few men ever penetrate the secret of fully tapping the sexual power that is sleeping deep within their own body. It is revolutionary for the average man to think he can enjoy a deep and radiant pleasure in sex that penetrates permanently to the core of his being, an experience far superior to ordinary genital orgasm. The kind of prolonged "total body and soul orgasm" cultivated by Taoists is normally thought to be the exceptional gift of passionate and sensitive women. It has even become the greatest myth of western culture—the woman as passionate object of romantic love, the one who brings love to its real tenderness. The Taoists taught that men can participate equally in love through a truly exquisite balancing of sexual energies that is as tangible as any physical sensation of genital orgasms.

How is it possible for a man to so radically transform his sexual experience and through it his whole experience of life? Paradoxically, this "higher orgasm" can be discovered only when the "normal" or genital orgasm which so preoccupies America's sexologists is de-emphasized. The beginning three basic stages of Taoist "dual cultivation" of sexual energy for couples are:

1) The male learns to hold the penis erect for as long as desired and does not ejaculate any sperm.

2) Man and woman re-direct sexual energy through specific bodily channels into higher regions of the heart, brain and glands.

3) Man exchanges his super charged energy with the complementary energy of woman.

For the man, it is opening his feelings and subtle energy channels to the woman's essence and absorbing it during sex that is the key.

If you are without a lover, the Taoists offer a modification of this practice known as "single cultivation." This teaches a single man how to put his sex energy to work creatively in daily life or simply to enjoy life in good health without the plague of sexual frustration. The goal of the Taoist masters was not to create a new myth of a super macho orgasm which everyone would struggle to achieve and thus create competition. Rather it was to teach men and women practical ways of using natural energies to go more deeply into life's greatest gift, the freedom to love.

So what does all this cultivation of sexual energy have to do with love, of either the personal romantic type or the compassionate religious variety? The Taoists teach it is the responsibility of man and woman to balance the powers of Heaven and Earth harmoniously within themselves and that harmony in other spheres of life will follow thereafter. On the esoteric level, all acts of human love are the spontaneous transformation of our seed essence. Our seed essence, the seed of our very soul, is physically stored in the body as sperm or ovarian energy. When we love someone, we not only help them, but we also transform some of our own essence to a higher level of energy. Thus the Taoists see sexuality as a primary source of power behind love on the human level. Anyone following "the path of the heart"—the spontaneous and continuous loving of all that one meets—will find their way much strengthened by the Taoist insights into using the power of sexuality to that end.

At the same time it is the larger unseen cosmic harmony of the Tao that is always present that allows the experience of personal love to occur. Thus the Taoist term "harmony" is probably the closest equivalent for the western concept of "love" or compassion, on both the personal and universal levels. The Taoist goal is not to fulfill the human ego with its insatiable desires. It is to quiet the ego and calm the mind so that the subtle energies in the body can be first observed and then cultivated to a high level of awareness. Then the mind can see its true role in the larger order of things and work harmoniously to keep the forces in balance. Personal love relationships can be one valuable stage in this process, a microcosm of the larger subtle energy fields of the universe.

Western sexologists will undoubtedly dismiss these methods as having no statistical or verifiable scientific basis and accuse them of using vague terms such as "energy." It may be shunned by Western religions who are against sexual pleasure as well as by Eastern ascetic schools who believe spiritual enlightenment can be

found only by austerities that include sexual abstinence. The fact is that the early Taoists were scientists who based their practices on precise observation of human biology and psychology. They were neither hedonists nor ascetics, but sought a middle path to create the highest spiritual harmony possible between man and woman in accordance with natural laws of the universe. The deeply philosophical poetry of the Taoists, from the I Ching to Lao-Tse's "Tao Te Ching" to the "Secret of the Golden Flower," all testify to the sublime heights of their vision.

The fact these Taoist practices have survived by secret oral transmission for several thousand years is the strongest testimony that they work. The interviews I have conducted with dozens of modern western couples using these Taoist sexual practices, confirmed they still work for an ordinary cross section of urban men, young, old, white, black, Chinese, married and unmarried. Students of yoga, martial arts, and meditation have found it especially easy to learn the technique of seminal retention. Many people were already aware of the importance of sexual energy in their spiritual path, but simply lacked the method of expressing it directly in love making.

The Taoist methods may appear to be similar to the tantric sexual techniques becoming popularized in the west. The principle of balancing male and female and using the body as the crucible for transformation are essentially the same. As Nik Doulgas and Penny Slinger suggest in their authoritative "Sexual Secrets" (Inner Traditions N.Y. 1980) Indian tantra may have originated with ancient Taoists in China and then re-entered China hundreds of years later with the effect of re-vitalizing Taoist sexual practices.

For westerners today the foremost practical difference is that esoteric Taoism never assumed the cloak of secret rituals and invocation of religious deities that can make tantra seem strange and ill-fitting when transplanted to this culture. Sex was used more openly in China as a medicinal form of healing and natural path to spiritual balance without the same religious overtones. I strongly recommend that you obtain Sexual Secrets as a companion volume to this book, as it contains fresh translations of the classical Taoist treatises on sex and has dozens of superb illustrations of Taoist love-making positions not offered in this book.

It must be stressed that Master Chia does not teach his Taoist methods of transforming sexual energy as separate from his practice of meditation, Tai Chi Chuan, Iron Shirt Chi Kung and other Taoist arts. Sexual balance is a very important foundation for

building a healthy physical and emotional life, but the Taoist goal is ultimately to gather the primal energies driving all our desires, emotions, and thoughts and cultivate them back into their original state of pure spirit.

The Taoist Masters of ancient China were no fools. They knew love between man and woman is a mystery which cannot be taught. Sex may be only the hand maiden of higher love, but our sexual limitations often confront us with the feeling that our relationships with our lovers or that our life in general is incomplete. The techniques taught in this book are not mechanical substitutes for love. The Taoist secrets of love are meant to be mastered and then discarded when the transformation of sexual energy is experienced as a natural creative power of man, as easy as walking, talking or thinking. Then the pleasure of sex can be ecstatic beyond orgasm and love tender beyond belief.

Michael Winn
June 1984

Michael Winn is general editor of the Taoist Esoteric Yoga Encyclopedia and an instructor at the Healing Tao Center in New York. Born in San Francisco in 1951 and educated at Dartmouth College, he has travelled to over sixty countries as a journalist, photographer, expedition guide and observer of global culture. He has practiced various kinds of meditation, Kundalini yoga, Chi Kung and Tai Chi forms over the last fifteen years. He tested the methods taught in this book during an extended period of celibacy and later with a lover. Only after finding the methods effective, in both situations did Winn agree to this collaboration. The principle ideas belong solely to Mantak Chia as transmitted to him by his Taoist teachers.

CHINESE SEXUAL KUNG-FU: Will It Work in the West?

by Gunther Weil, Ph.D.

America's fascination with sex in the 1980's is matched only by its massive confusion of attitudes towards it. We need the pleasure of sex but can't decide how to deal with the emotional pain and complexity that often accompanies it. We have all felt guilty, conflicted or alienated by our sexual involvements and commitments at one time or another. From where does sex draw such enormous power to influence our lives?

No doubt, there is a biological imperative at work—the species' need to reproduce and continue itself. Less clear but equally powerful is the way sexual feelings become ensnared in the complex web of our culture. Eventually the culture-wide sex habits become a powerful set of unconscious influences. Most of us have been carrying the excess baggage of the sexual mores of our age for so long that we've forgotten how heavy the load is.

The cultural legacies of the Judeo-Christian ethic were the axis around which the sexual experiments of the 1960's revolved. The neurotic and barren life-styles of this ethic in previous generations were among the major causes of the sexual revolution of the 1960's. Alienated by sexual hypocrisy and the obvious destructive effects of sexual repression, people began searching for new and more honest ways of expressing their desires. Over the last twenty years we have seen the sexual revolution come full circle. What was previously illicit and forbidden became commonplace and banal. Some seek a solution to this current dilemma by returning to the old morality. Some seek refuge in celibacy. And some of us are still searching___

The far reaching implications of the sexual revolution of the 1960's, including the various liberation movements that have accompanied it, are now being re-examined in the wake of widespread conflict and unhappiness between men and women. The recent quest for a "new frontier" for the sexuality of the 1980's, a trend that is beginning to appear in the popular media, is essentially a reaction to the unhappy results of the new morality experiments of the last two decades. We thought we knew what we wanted, but when we got it we realized something else was missing. Individu-

ally and culturally we are again examining the meaning of our sexuality and the deeper purposes served by our loving relationships.

Many new ideas are now emerging from the New Age consciousness movement which address this need. Witness, for example, the concept of "High Monogamy" which emphasizes the challenge and excitement of conscious, through-time, relationships that transcend romantic egotism. The much publicized revival of popular interest in Indian and Tibetan sexual tantra is another example. Others are re-examining the merits of celibacy. The sexual paradigm is shifting again, part of the polar shift of the American morality play. As this play continues we are further mystified by the Moral Majority seeking to revive the old repressions and neurotic patterns which drove us to seek relief in the first place.

Many of us are struggling to understand the meaning of the conflict between the old and new sexual morality. Can we avoid the pitfalls of both repressive and "liberated" sexual morality which are by now all too familiar? Where do we turn for guidance in seeking our own truly individual answers?

Unfortunately, our views about human sexuality are constantly shaped by the fads and fashions of science and popular culture. We are influenced as much by these trends—from Dr. Spock to the Herpes scare—as we are by the actual biochemical processes of our bodies and minds. We often "know" more about who and what we are from what we read or see on television than from a deeply lived experience of ourselves. It is obvious that we lack a clear and impartial vision of our own social conditioning. Our self-knowledge is usually derived from the world of well known experts, books, films, TV, magazines, rather than from a patient understanding of our deepest gut feelings or intuitions.

The power of these cultural influences can be understood by carefully noting the cyclical and often contradictory scientific and psychological theories about sexuality found in the popular media. We can easily conclude that consistent valid and practical guidelines for the physical, psychological, and spiritual health of men women are few and far between. This conclusion applies to most of our difficult social and interpersonal problems, but is especially true in the sexual arena. The fact is that we really don't know much from our scientific or popular media sources about the function of sex beyond the obvious reproductive and "pleasure principle" arguments that have influenced all of our thinkers from Freud up to the more recent sociobiologists.

Unfortunately, our lives are powerfully affected by this loss of personal sexual self-knowledge. As a society we have chosen to ignore what the great spiritual traditions once understood about sexual energy and its role in personal transformation and spiritual evolution. What knowledge we once had has been fragmented or distorted by the institutionalized Judeo-Christian religions and remade to serve the lesser gods of social, political and personal control. Our Western institutional religious tradition has essentially repressed and distorted the sexual instinct and thereby created a variety of personal and social pathologies. In so doing, it has also effectively removed sexuality from its spiritual foundations.

In this respect, Western psychoanalysis correctly perceived the role of repressed sexuality in individual neurosis. Whatever limitations the psychoanalytic view may have as a full representation of human potential, this much can be granted to Freud's insights. Wilhelm Reich and Carl Jung understood quite well the enormous power of liberated sex energy and its connection to a larger universe of spiritual meaning. Jung rightly protested Freud's emphasis on disease as a model for health as well as the narrowness of his understanding of the range and purpose of the unconscious. He correctly emphasized instead the creative and transcendental function of sexual energy within a spiritually attuned and evolving individual.

But all of these psychologists and their legacies have missed the point in one way or another. It is true that the sexual instinct can both liberate and enslave, but in order to be truly liberating, the sexual instinct must be channeled in the direction of another purpose. Only in conjunction with the drive for spiritual transformation can sex become truly liberating.

Because of his lack of knowledge of the great spiritual traditions, Freud was completely unable to see this point. Wilhelm Reich, whose work has influenced so much of the Human Potential Movement's body centered therapies, was bold enough to bring Freud's insights to their logical conclusion. Reich clearly recognized that the ultimate result of repression was individual dis-ease and political fascism.

But in his zeal to emphasize the destructive effects of sexual repression, he also ignored the spiritually transforming functions of sex energy. Carl Jung had just the opposite problem. He clearly emphasized a spiritual and transcendental perspective on the sexual instinct, but he left out the central role of the physical body in this development. This omission made it next to impossible to

apply Jung's elaborate intellectual models to daily problems of sexuality.

So we search in vain within Western psychology to find the practical disciplines and principles we need in order to reconcile the conflicts which face us in the sexual realm. This is a simple and ordinary dilemma. But when we want to harmonize our sexual and love relationships with our spiritual goals, our situation seems especially poignant. Time and time again the sexual function proves to be a disruptive influence, generating conflict and division in our lives. It should not be too surprising therefore that celibacy has become an appealing alternative to so many who wish to follow a spiritual path while remaining worldly men and women.

These facts become even more obvious when we observe the behavior of the gurus, swamis and other teachers in "New Age" spiritual circles. The numerous examples of apparently celibate spiritual teachers born and raised in the puritanical context of traditional oriental cultures and suddenly set loose in the American "new morality" is simultaneously sad and funny. We frequently hear of this guru or that master who has fallen into the temptation of sexual relations which their disciples. Scandals have now become almost commonplace in the ashram and dojo. One does not need to become cynical about this in order to recognize that the sexual instinct is bound to find its expression in rather prosaic and predictable ways no matter what the official spiritual dogma may condone or prohibit. This has been true one way or another throughout the history of the institutionalized Judeo-Christian churches, as well as in the New Age spiritual scene, embracing as it does so much of the Buddhist and Hindu life-styles. In regard to sex, institutional religion, old or new, has little to offer us.

Turning to examples of the teachers of sexual tantra, the gap between theory and practical knowledge becomes rather obvious. We hear of the marvelous and ecstatic rewards of tantric inspired relationships. Our New Age spiritual bookshelves and periodicals lend themselves increasingly to the interest and fascination with esoteric sexual practices.

But what is the real purpose of esoteric sexuality and where can one find real knowledge and practical instruction in these publications? How is it possible for someone to actually apply these rituals in a form that is applicable to ordinary life and relationships? And how much do we really understand of the actual esoteric teachings when they are removed from the larger religious and ritualistic context of the Hindu and Buddhist traditions?

In order to answer these questions we need to accurately understand esoteric sexuality as the study and control of sex energy within ourselves having little or no connection with outer rituals of culture. Beyond this, we need practical methods that can be understood by the Western mind and applied in contemporary life.

One way to discover these methods is to identify the essential, fife-affirming aspects of sexuality found in mankind's cultural and spiritual traditions and determine which work today. We must carefully separate what we need to guide ourselves in the sexual realm without getting bogged down in outmoded ways of thinking and living.

The tradition of Taoism, the core of Chinese culture, presents an interesting and practical perspective on this question. The ancient Chinese masters observed that the sexual function is closely related to physical and mental health and is also the basis for the cultivation of higher spiritual faculties. The position that effective conservation of the life force energy and its gradual transformation into a kind of spiritual/material substance is both the birthright and responsibility of mankind. When practiced within the monastic tradition of religious Taoism, the conservation and cultivation of sex energy was largely a matter of celibacy.

But in its wisdom the Taoist tradition also provided another or practical way: The path of Sexual Kung Fu (sometimes called "Seminal and Ovarian Kung Fu"). This practice indicated a way by which a married monk or ordinary man and women could cultivate the Tao ("The Way") while remaining in worldly life. Because of its eminently practical orientation in matters of health and living, the Taoist tradition addressed sexual relationships in a straightforward and realistic manner.

The Taoist Sexual Kung Fu was and is today a method of increasing longevity and health, harmonizing the relationship between the sexes, and a means of spiritual transformation.

Aside from some historical distortions in which the basic egalitarian nature of the practice were subverted by emperors and aristocrats in the direction of a kind of male exploitation of the female, the basic premise of the method of Sexual Kung Fu is that of spiritual development and the harmony of the male and female energies.

Accustomed as we are in our Western traditions to consider the field of sexology from within the limits of our religious, scientific and cultural conditioning, it is difficult for us to grasp the

essential meaning of the metaphor of Sexual Kung Fu. We have a vague understanding of some kind of relationship to the martial arts, but beyond this, the concept of a sexual kung-fu seems comical if not downright ridiculous.

In fact, the literal meaning of "Kung-Fu" is method, practice or discipline. The concept of sexual Kung-Fu implies a specific method or practical discipline of having sex without ejaculation. At the same time the Taoist tradition recognizes a certain form of conflict between the sexes: a form that is universally represented by the lawful opposition and dynamic interplay of the forces of Yin and Yang. This lawful opposition plays itself out on the "battlefield" of sexual relations and is expressed as the playful conflict between sexual adversaries. A conflict, by the way, in which man is weaker than his "strong enemy," and where the Kung-Fu of ejaculation control is developed as a way of remedying this imbalance of sexual force.

In the western world we also have a related notion of a battle between the sexes. But we easily make a major error by assuming that this expression connotes the same meaning as the Taoist metaphor in anything other than the most superficial sense of conflict. Our Western concept of the battle between the sexes conveys the morbidity and frustration of the ponderously serious sexual dramas which dominate so much of our current thinking about relationships. It has little to do with the playful and transformative aspects of sex as they are understood in the Taoist tradition.

Only when we move our thinking to the level of "sexual energy" is it possible for us to begin to see how the sexual function can be properly understood and correctly employed in the service of sexual harmony and health. According to the Taoist view, man is constitutionally inferior to woman with respect to his sexual capacities.

His energies are easily spent and with the advancement of years his energetic capacity becomes severely diminished. It is this factor that is a major cause of conflict between men and women and it is this factor that is the basic underlying issue of so much of the current sexual counseling and sex therapy.

From our contemporary perspective the idea of a sexual Kung-Fu seems odd and maybe even a little revolutionary. But with the growing interactions of oriental and Western culture and medicine, and the resultant impact on Western sexology, the principles and methods of Seminal and Ovarian Kung-Fu could gradually become accepted.

Considering the fact that Western sexological research is quite young, we might anticipate the kind of confusion that one finds in a teenager exploring his/her sexuality. By contrast, the Taoist tradition is over eight thousand years old and has reached a full maturity in both theory and method. In fact, both traditions are dealing with the control of the same powerful impulse. Whether or not the Taoist Sexual King-Fu can work in Western society will be determined in part by its translation of it into Western forms of scientific understanding and psychology. Its acceptance may hinge equally on the willingness of Westerners to adapt themselves to the wisdom of the Taoist masters.

The ancient Taoist masters would enjoy this play of opposing forces as the inevitable working of the Tao. A young Taoist master has taken the bold step of revealing the secret methodology to the west; it is up to the reader to test its truth.

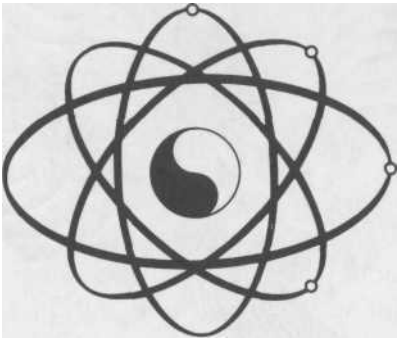

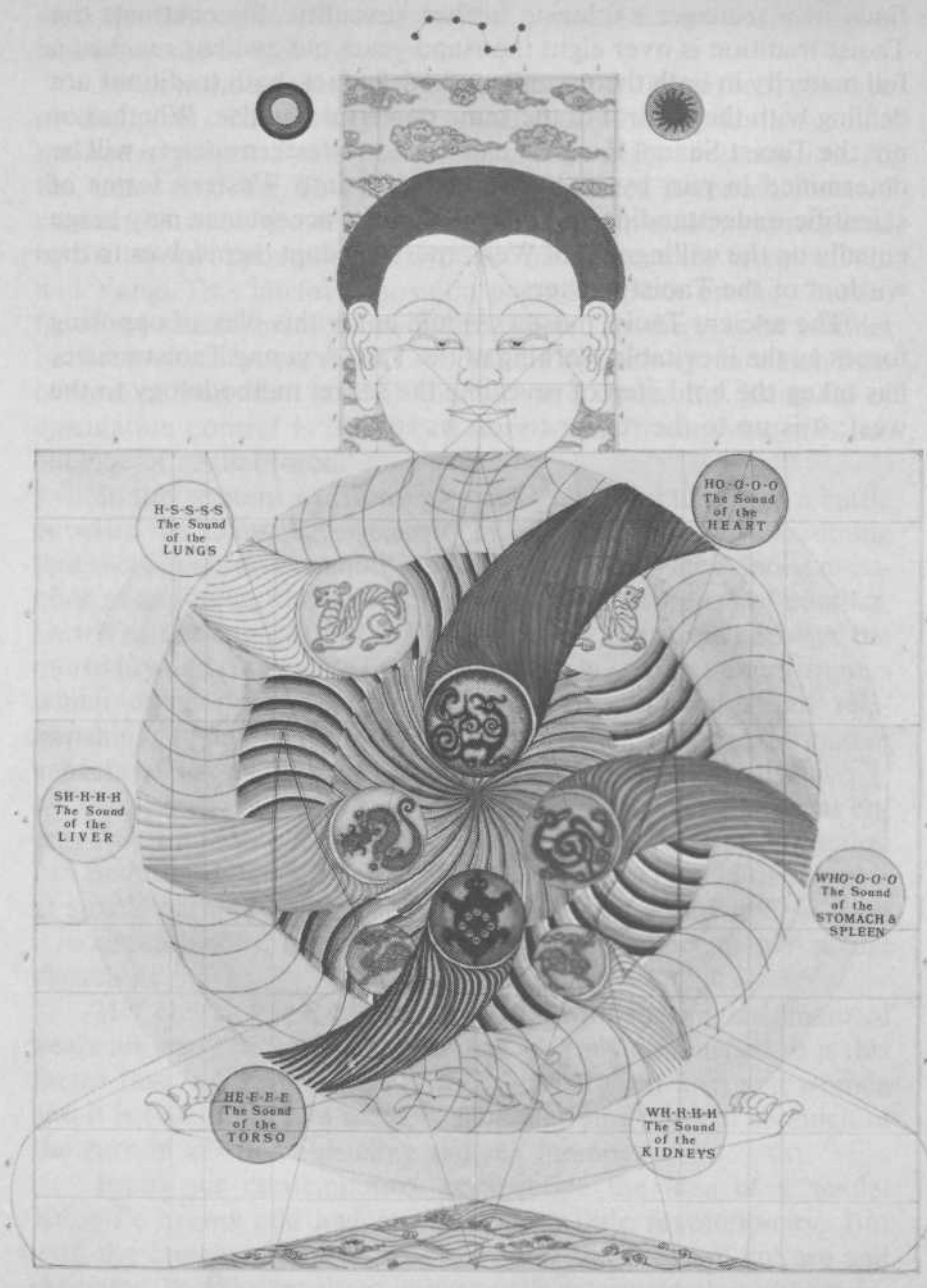

The Six Healing Sounds
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SUMMARY OF THE PRINCIPLES OF TAOIST CULTIVATION OF SEXUAL ENERGY

1. The universe is filled with different kinds of dynamic energy, or "chi." The Tao, or "way," for each man is to creatively transform his energy over a course of a lifetime back to its original state of harmonious balance. Sexual essence, or "ching," is a powerful, vital energy that is generated continuously within the human body. Sexual drive propels the course of man's evolution biologically by transmitting the genetic lineage. Emotionally it harmonizes the love between man and woman, and spiritually provides a tangible link between the "ordinary" creative powers of man and the eternal creative process of the cosmos. Refining one's awareness of sexual energy—with or without a partner—is one of the simplist ways of humans to return to pure consciousness and experience the deepest rhythms of life. (Chapters 1 and 2.)

2. Sperm is the storehouse of male sexual energy. A single ejaculation has 200 to 500 million sperm cells, each a potential human being. There are enough spermotozoa lost in a single orgasm to populate the entire United States if each cell was to fertilize an egg. The manufacture of a sperm fluid capable of such psychic super potency consumes up to a third of a man's daily energy output and is especially taxing on the male glandular/immunological system. (Chapters 3 and 4).

3. Conservation of sexual energy is the first principle of cultivation. Ejaculation of the male seed for purposes other than having children is a wasteful loss of an extremely precious treasure. The energy loss over long periods of time weakens the physical health of the male, can lead to unconscious emotional anger towards women and gradually robs the male higher mind/spirit of it's power to rejuvenate itself. For this reason many traditional spiritual orders in the world require male celibacy. Taoists accept sexual love as natural and healthy, but know the momentary pleasure of genital orgasm with ejaculation is superficial compared to the profound ecstasy possible when love is enjoyed without the loss of the powerful male seed. It's every man's birthright to have full control over his bodily functions and prevent this loss. The secret Taoist methods of sealing the penis in order to conserve "ching" are given in Chapters 5 thru 8.

4. Transformation of sex energy is the second principle of cultivation. During sexual arousal, the "ching" or sexual essence stored in the testicles expands rapidly and causes some energy to

naturally rise to higher centers in the heart, brain, glands, and nervous system. This upward movement is cut short by ejaculation outward, so most men never become aware of the full power of their sexuality. The Taoist method perfects this upward transformation of sex energy by opening subtle channels from the genitals up the spine to the head and back down the spine to the navel. The expanding sexual energy is chanelled into this "microcosmic orbit" so it flows past all the major vital organs and harmonizes the etheric energy complexes in the body, called "Tan Tiens" by the Taoists (or "chakras" by the Hindus). (Chapters 7 and 8)

5. Balancing the polarity of female-male (yin-yang) forces is the third principle of Taoist cultivation. Once the sex energy has been conserved and transformed up, a single man can use meditation to balance the male and female poles which exist inside every male body. In the practice of "dual" cultivation, a couple balances this field of energy between them by sharing and circulating their subtle energies. The relationship becomes a springboard to transform the sexual attraction into personal love and then into spiritual awareness and service. The power struggle between the sexes gradually diminishes and balancing their differences over work, family, love, and the purpose of existence leads them into deeper harmony. Balancing this core sexual polarity in a couple is true depth psychology, as it nourishes man and woman at their innermost root. Chapter 9 details the "valley orgasm" method of exchanging the yin and yang energy during intercourse. A higher level of this practice involves exchanging energy without sex, or having orgasm within oneself, and must be learned from a master. (Chapter 18)

6. Don't over-emphasize physical sex in your daily practice, as it is easy to get stuck on pleasure without experiencing higher subtle energies. Proper sexual refinement is only one small part of the vast and all-encompassing Tao. If the mixture of your chi (general vital energy), ching (sex essence) and shien (spirit) is imbalanced, it will be difficult to unite yourself and feel whole and peaceful. Cultivating sex energy is important in nourishing your spirit, but without proper diet, exercise, meditation, virtuous moral behavior and love, true cultivation is impossible. Likewise, don't ignore sex and focus excessively on the higher spiritual centers; the roof will easily fall without a strong foundation below. Tao is the wholeness of Heaven and Earth, true harmony for man is the middle way between them, found in the balanced integration of their subtle energies.

7. Avoid sex without love. It creates imbalances in your physical, mental and spiritual bodies and will slow your real growth. The Taoist techniques are meant to be practical, not mechanical. A woman seeks tenderness of feeling in her lovers and will resent a man who is overly compulsive or preoccupied with his mechanical mastery of esoteric love methods. Dual cultivation is impossible without the full participation of the woman, who must transform up her yin essence stored in her ovaries. Regard the woman you love as more than a powerful generator of yin energy; she is foremost a human being worthy of your full love and respect.

8. You do not need a wife or girlfriend to cultivate your sexual energy. In the beginning it is easier to practice controlling your ejaculation alone, without the distracting excitement and heat of a woman. At any stage it is essential to tell your lover exactly what you're doing and ask her cooperation. The same principles of Taoist cultivation apply to women, with sexual essence drawn from the ovaries and this "ching" transformed upward into higher mind and heart. Many women already have an intuitive feel for the process. The receptive nature of women allows them to quickly learn the Tao of love, especially if the man has mastered the process in his own body.

9. Any male in reasonably good health can master the Taoist methods of cultivating sexual energy taught in this book. If you feel impotent or ejaculate prematurely, the rejuvenation exercises in Chapter 15 should be studied before attempting the Big Draw method taught in Chapter 7. The principles of cultivation are simple, but require steady attention. Its like cultivating a garden—hoe a little everyday, and nature will do the rest. One day you will have luscious blossoms and fruits. An impatient mind kills progress. Do not feel guilty or angry when you spill your seed; it may take years to fully master the Tao of love. The key is to relax, enjoy yourself and keep practicing.

PART I

THE FUNDAMENTAL PREMISE:
Sex Energy Can Be Transformed into Spirit

CHAPTER I

MALE SEX ENERGY IS STORED IN ITS SEED

"There is no medicine, or food, and no spiritual salvation that can prolong a man's life if he fails to understand or practice the harmony of sexual energy."
—*P'eng Tsu, physician to the Emperor*

For more than 8,000 years of Chinese history, the "Sexual Kung Fu Method" of retaining the seminal fluid during the act of love remained a deep secret. At first it was practiced exclusively by the Emperor and his innermost circle, who learned it from the Taoist sages that advised the court. These wise men claimed in earlier times it was a natural gift of all mankind. The Emperor needed the method to prevent impotence and illness; improperly educated monarchs were exhausted at an early age by the sexual demands of their wives and concubines. In aristocratic families it passed from father to chosen son alone, excluding wives, daughters and other family members.

Sexual Kung Fu is an internal practice that permits men to retain certain bodily secretions which are a source of incomparable energy when stored and recirculated to higher vital centers. One prevents loss of this biochemical energy by not ejaculating. Stopping ejaculation is not to be confused with stopping orgasm. The

Sexual Kung Fu Method provides an altogether unique and superior type of orgasm repeated over lengthy periods of love making. Its secret is simply, there is no loss of seminal fluid during orgasm.

By practicing control of certain muscles, tendons, and fascia of the lower trunk and by allowing the genital pressure to spread over the entire body, the seminal fluid is withheld. At the same time one thrills to pleasures of infinite variety. Indeed, the joys of this kind of love must be considered quite different from ordinary physical pleasure; the intensity is so great that it often leads to a spiritual awakening.

A man who masters this method will find his sexuality so enhanced that he will feel a revolution has occurred in his life. The pair of lovers becomes a dynamo, generating great quantities of electromagnetic energy. With this method one can make love more often than before, with tremendous benefits to one's health. Sexual Kung Fu stimulates production of precious hormonal secretions instead of depleting them, as is ordinarily the case with ejaculation.

Every vital function is invigorated because one no longer discharges life energy through the genitals. Real sexual fulfillment lies not in feeling the life going out of you, but in increasing awareness of the vital current that flows through the loins. The body is further replenished by a method of "steaming" the vital energy up from the sexual centers to the brain and higher organs such as the heart and crown of head. The life-enhancing energy process is completed by exchanging energy with one's lover during a relaxed meditation following the creation of this supercharged sexual energy.

This powerful release and sharing of life's vital force is the fundamental bond in human love. To awaken this dynamic energy is also to experience the force behind man's biological and spiritual evolution, also known as the Rising Kundalini.

EXTRAORDINARY POWER OF THE SEXUAL ELIXIR

Wise men of the Orient have from time immemorial sought means of preventing discharge of the seminal fluid. Without exception they have realized the tremendous implications of the sexual act: when performed with love and discipline, it may awaken dormant powers in the mind and body. The nervous and endocrine systems are particularly open to improvement. The act of love has long

been recognized as healing, but the Taoist masters sought to go beyond this and find the principles of physical immortality within it. Many schools arose proposing various ways of tapping the secret elixir of sexuality.

Those who fully understand conventional ejaculatory sex, know it grossly exploits every gland and organ. With ejaculation, the internal pressure of life is expelled from the body, leaving behind in some sex-obsessed men only enough life force to fold the newspaper, squeeze food through the bowels and make for the psychiatrists's couch.

The sages considered one drop of semen equal in vital power to one hundred drops of blood. The Hindu holy men refer repeatedly to Amrita, the elixir of life, a rejuvenation substance that may be produced during prolonged sexual activity without ejaculation. The production of this elixir, which westerners might call a higher hormonal secretion, requires a sexual technique that prevents ejaculation and thereby allows the body to enter higher and higher states of energy.

Extraordinary powers, including healing and clairvoyant perception, may evolve when one retains the semen and drives its power back up into the body. Many gifted minds have held that if one could retain these fluids for one's entire life, the body would not decay after death. The Saints—Christian, Buddhist, Moslem, or Taoist—all used the power dwelling in the vital seed to perform "miracles."

DIAGRAM 1

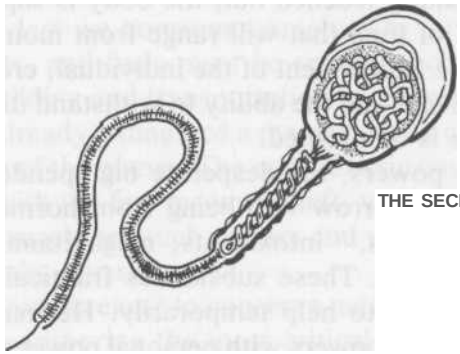

THE SECRET OF SECRETS

Many esoteric sects have urged the eating of the seminal fluid to increase sexual ability and bodily fitness. This practice is at least as rational as buying vitamins. Scientific analysis has found it to

contain a treasure house of vitamins, minerals, trace elements, hormones, proteins, ions, enzymes, and other vital nutritional substances.

But there is an additional property in the sperm seed which present-day science cannot analyze and is far more important than any vitamin. This may be called the Life-Force. Though it registers on no scientific instruments, it is far from imaginary since it separates the living from the dead. Ginseng root is an example of another natural substance which shows no special properties under chemical analysis, yet its life restoring powers are now widely acknowledged. Love making is a powerful healing tonic because it involves sharing the human life force, which is far more potent than any herb or medicine.

Chinese aristocrats and adepts seeking the deepest level of fulfillment have long had the capacity to return the energy of the seminal fluid to the brain and vital bodily centers. But ordinary people in our society have, until now, had no technique for recycling this great life power to the body. Most men have found the sexual lure irresistibly attractive and have happily lost their seed when succumbing to it, unaware of the consequences to their health or that there was even an alternative available to them.

With frequent ejaculation of sperm vitality ultimately plummets. The big spender loses stamina, his vision begins to weaken, hair tumbles from his skull: he grows old before his time. At first he will not feel drained, but after years of abuse his capacities will begin to drop alarmingly. When the hormonal secretions of the sexual glands are regularly leached out, the body is sapped at its root. Within a period of time that will range from months to decades depending on the endowment of the individual, creative and sexual abilities are halved, and the ability to withstand disease and the frailties of old age is diminished.

To regain failing powers, the desperate big spender of vital seed sometimes tries to borrow well-being from hormone injections, "uppers," "downers," intoxicants, megavitamins, hallucinogens, and aphrodisiacs. These substances frantically stuffed into the body may appear to help temporarily. He may seek to regain his dwindling sexual powers with personal power purchased with money or political influence. If he is on a spiritual path, or is surrounded by a loving community of family and friends, this feeling of a failing life power will be slowed. But so long as the pro-

digious energy waste continues, decline is inevitable. The organs of digestion will be unable to assimilate sufficient nutritional energies to replace those irrecoverable life energies lost by ejaculation.

The Taoist method of cultivating sexual energy recirculates to the body the hormones, proteins, vitamins, enzymes, minerals and electrical energies of the semen. When they are conserved and transformed, one enjoys a marvelous sexual life, improved health, deep inner balance, and rising spiritual consciousness.

The Taoist method of love actually stimulates the production of hormonal substances of unusually high quality. One can learn to focus energy on the endocrine glands during the act of love. When the glands are bathed in energy, the quantity of their secretions increases; more importantly, their quality improves. At higher stages in the practice the hormones develop extraordinary properties.

The Sexual Kung Fu method allows one to generate and conserve more nervous and hormonal energy than are necessary for ordinary functioning. This excess vitality may be channeled to strengthen the body and to raise mental and spiritual abilities. When lovers are in close embrace subtle Yin and Yang energies are concentrated into vortexes from the sexual region to the head and eventually remain in the head at all times.

WHY HAS THE SPIRITUAL POWER OF SEX BEEN KEPT A SECRET?

Our race has finally grown aware of the need to conserve natural resources, lest we consume ourselves to total ruin. Fresh water, soil, forests, and fuels must be spared, food produced more efficiently, building and transportation accomplished with less waste. We have already exhausted a major portion of the readily recoverable riches of the planet. The cost of basic commodities skyrockets because, with the few resources left, we continue to over produce inefficient machines such as cars and unproductive military armaments—tanks, missiles, etc.

Everyone is eager to conserve natural resources, but few even dream of conserving the most critical resource of all: one's own vital energies. The careful harboring of the energy stored within man's seed is a truly rational energy program. Yet this aspect of conservation is entirely overlooked by politicians and health experts.

One reason for this neglect is simply general ignorance of the ancient and highly secret methods used in the past. Taoist Masters gained knowledge of these methods through unknown millenia of relentless searching for the secret principles animating matter. These methods are the fruit of many generations of inspired meditation by sages coupled with my close observations on modern life. This book fashions into a unified whole my personal experience of the teachings.

The Taoist masters felt bound to reveal their potent secrets to only the most select disciples, those who had proven their devotion to the Master's ideals by years of arduous self-sacrifice and service. Why did the Masters feel so strongly compelled to hide their tremendous knowledge from the public?

The reason for this secrecy is not easily comprehended by the western public today. The mass media have fostered a state of mind in which anyone's life is everyone's business: the most intimate details of private sex life are the most greedily lapped up. Advertisers assure their clients today "Nothing sells unless it is sexy." This mentality has made sex, in America, into a disposable commodity, making it harder in our private lives to experience sex as an intimate pleasure that can be cultivated over time to ever deepening levels. Today sex is often consumed and thrown away as soon as the lover becomes old or an inconvenience. Even the women in the harem of Chinese Emperors and aristocrats fared better, being assured of material comfort for life in exchange for their sexual favors. The court society favored the position of men, but at least the female sexual energy was respected for its healing benefits and honored as being necessary for the spiritual development of the male.

A classic Taoist story tells of a woman who learned the process of sexual transformation and exchanged her yin energy with her lover's yang energy and thereby achieved Immortality. She thus became the guide to ancient emperors on the subject of love. There is a recorded historical instance of a palace maid in 690 A.D. becoming the Empress on the death of the Emperor. Empress Wu, respected for her mastery of the art of love, ruled wisely for several decades until her death.

The ancient Taoist masters were not superstitious. They were natural scientists who laid the foundation for amazing technological advances in medicine, chemistry, biology, navigation, and

many other fields that would not be discovered by western scientists until 2000 years later. Nor did they crave exclusive possession of their potent knowledge. They had their reasons for secrecy, and their reasons were well-founded at the time. They were custodians of the doctrine taught to them by their masters, and feared the misuse of the great force unlocked by the secret principles. Perhaps, they felt an obligation to protect the public from its tendency to distort the purest teaching to suit its own base instincts. In rural China, which was much less populous then, someone with such esoteric knowledge could easily become a chieftain or a king. A warrior could use his power to defeat his opponents.

The Taoist Masters thus thought it dangerous to spread their teachings too widely, and passed them on to only a few chosen disciples before departing their earthly life. To guarantee that the formulae not be used for selfish purposes, these Masters often transmitted to each disciple only a part of the doctrine. Thus, only if the disciples banded together and shared their learning could the supreme potencies be unleashed. If anyone selfishly withheld his learning, they would never receive the whole doctrine. In the course of many generations, fragments of the innermost secrets came to be regarded as the whole. My attempt is to reunite many disparate parts into an organic whole which I believe similar to the most ancient and complete teachings.

WHY REVEAL THE SECRET NOW?

Why violate the traditional Chinese teaching method and expose to the general public these powerful principles? The simple reason is that the historic moment is already late. The human condition is too desperate to deprive our species of a potentially great infusion of vital energy. If the human race is not quickly infused with a new life energy to render it more harmonious than it has been for most of the last 2,000 years, we are all, earthly Masters and mortals, threatened with an untenably harsh existence, if not extinction.

There are so many wizards of the computer, stock market, test tube, and spectator sport, but so few of the art of life. Our race spends its brief span fiddling with statistics, black boxes, noxious chemicals, and above all, with meaningless words. A majority of Americans daily pass more than six hours in a mesmerized trance induced by a colored shadow dancing in a box of glass. These

machines have inadvertently become instruments of our own destruction; a tv programmed mind is not a free mind. Too few devote even one second to entering deeply the great current of life hidden within ourselves. Yet all the technological energy is eagerly sought is an apish imitation of the electrifying ecstasies found hidden within the body and mind.

There are positive signs; in Taoist thinking, any excess eventually leads to its opposite. Despite the current mediocrity of most popular culture, there are tremendous forces driving the race into expanded consciousness. It is clear that the reason for the chaotic state of planetary affairs is the revolutionary advance in human consciousness. In simplest terms, hydrogen bombs hover above us only because we are clever enough to conjure them up. Hatred contains the seeds of love. We have created a crisis in order to force a solution demanding that we restore our balance with one another and nature.

Among the most important implications of this soaring up of consciousness is that the ordinary man will be admitted to secrets of life and mind that were formerly reserved for the chosen few. The French scientist Schwaller de Lubicz elucidated this idea: "It is certain that such a revolution in thought . . . is not the result of whim. It is in fact a question of cosmic influence to which the earth, along with everything in it, is subjected. A phase in the gestation of the planetary particle of our solar system is completed . . . A new period must begin, and this is heralded by seismic movement, climatic changes, and finally, above all, by the spirit that animates man." Not only do troubles press consciousness to evolve, but changing consciousness bursts the constraints of existing order.

I hope that the Taoist practices of cultivating male energy presented here will attain higher perfection when subject to the shock of opposing ideas, scientific study and personal experiment, and the whole race's inventive genius. Today in China, it is formally prohibited to keep secret beneficial practices: one must reveal all knowledge that may improve the general welfare. Henceforth, closely-guarded preparations of medicinal herbs, roots, mineral waters, barks, muds, flowers, gems, venoms, as well as yogic and meditation practices will reach perfection more quickly by serving all.

So the revelation of the Taoist secrets of sex is a contribution

to human culture that may take time to manifest its real influence. Where a few great minds once acted, the full race of human genius must now struggle to save our world from the dangers of its own excess.

CHAPTER 2

WHAT IS "CHI" ENERGY?

"Essence, chi, and spirit are the three jewels of life!'
—*Book of Changes and The Unchanging Truth,*
Master Ni Hua Ching

Taoist cultivation of sexual energy cannot be understood until the Chinese concept of "chi" is clear. Chi, also known as prana, the warm current, Kundalini power, or the electro-magnetic life force, is very difficult to describe because this life energy is invisible and cannot be seen. However, we can feel it. "Chi" is simply the Chinese word for "breath." On the physical level it is the raw air we breathe in and out, revitalizing us and keeping us alive. Our life hangs by this thin thread of breath every second of our lives, and that thread is seemingly empty air.

We transform that raw air by mixing it with other nutrients and refining it into a different kind of energy, one that takes a solid form. It becomes our blood, flesh and bones, but never loses an inner rhythm of pulsation that flows through each cell. Our vital organs—heart, liver, kidney, and glands—in turn refine this energy and send chi power to the higher functions of our brain, thus creating our thoughts, dreams, and emotions. From this emerges the human will to live and die, the power to love and ponder this breathing planet suspended in the vacuum of space. As this "chi"

follows a self-perpetuating cycle, its rhythm becomes so natural we hardly ever notice it. When was the last time you marvelled at the simple fact you are breathing and your heart is beating?

The ancient Taoist masters spent a lot of time observing the flow of this "chi", which they recognized as the breath of the universe that moves through everything. Chi is the glue between our body, mind, and spirit, the link between our perception of the inner and outer worlds. Living close to nature with few of the distractions of modern civilization, the Taoists were able to map in fine detail the workings of the chi energy both within the human body and in the world at large. Later Taoists made numerous distinctions between the different kinds of "chi" that operate, so that today in China the working heirs to their knowledge—the acupuncturists and herbologists—refer to as many as 32 different functions of chi in the human body.

The Chinese never bother trying to analyze exactly what this "chi" is. Whether it is matter or energy or a process of changing between the two is irrelevant. All that matters is how the chi functions, in short, what it does. When you want light in your room you turn on the lamp, the electricity flows and radiates light. You don't analyze it, you simply flip the switch. When an acupuncturist inserts a needle into a point on a liver meridian, he switches on the liver "chi" so it flows more powerfully.

DIAGRAM 2

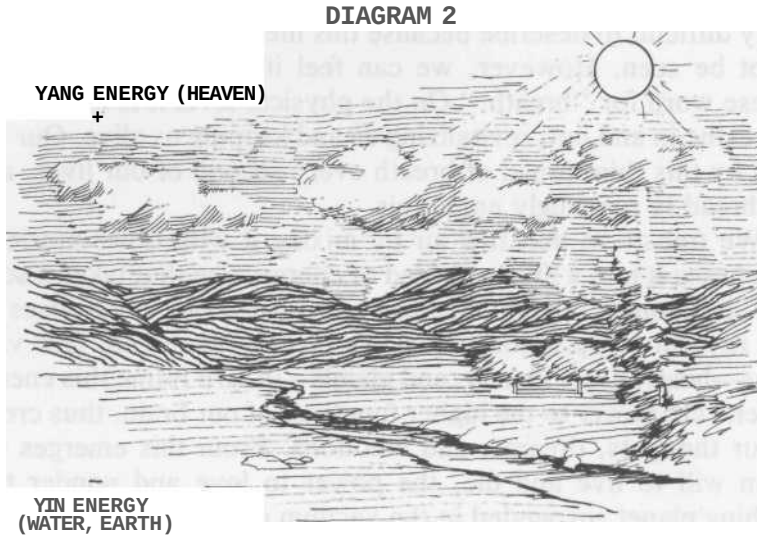

CHI: ELECTRICITY OF THE HUMAN BODY

Modern scientists are beginning to describe the world in much the same fashion that the ancient Taoists described it—as an interplay of positively (yang) and negatively (yin) charged "chi" energies. Here is a recent description of electricity in Time-Life's science magazine:

> "Electricity is almost certainly the most elusive of everyday things: It lives in the walls of our houses, and regulates the lives of our cells. It bolts from the sky as lightning, and sparks from your finger if you touch a metal doorknob after shuffling across the rug. It shapes the structure of matter—making plastic pliable, oil slick, and glue sticky. It runs electric trains and human brains . . . Light is electromagnetic radiation—and that includes everything from visible light to x-rays, microwaves, and radio waves. The magnetism in iron magnets is caused by the spinning of countless electrons twirling in unison, just as the magnetic field of the earth is most probably created by the swirling of electric currents in its molten metal core.
>
> "Your entire body is a giant electric machine: body chemistry (like all chemistry) is based on electrical bonds. It even runs on electricity. The energy you need to see these words comes from the egg you ate for breakfast; the egg got its energy from the corn consumed by the hen; the corn extracted that energy directly from the electromagnetic light of the sun through photosynthesis.
>
> "When you think about it, the universe is positively (and negatively) electrifying. But because of the usually perfect balance between positive and negative forces, most of the electrical power around you is neutralized—and therefore unnervingly invisible, at least in the normal sense . . . Essentially, everything around us is electrically charged empty space."
> K. C. COLE,
> *Discover Magazine,* Feb. 1984

What is curious is that even in China today, ordinary people take for granted that the universe is made up of these charged energies. If asked, they would say a garlic has a very hot (chi) energy. It warms the body: therefore the essence of garlic "chi" is hot, or yang. In the early centuries of China, chi was expressed in written Chinese as a blank in the top portion of the Chinese pictogram and as fire in the lower part. This was done so that no "fire"—no single creative energy might be conceived of as defining chi.

Chi pre-existed before everything in the physical world as original chi, or pure energy. This neatly avoided disagreements about the metaphysical nature of original chi (eg. is God good or evil?) and focused attention on its functional manifestation in the ordinary world, as hot yang chi in fresh garlic or weak yin chi in a diseased liver. As a result, Taoist philosophy tends to be very pragmatic and grounded in observation of the natural organic world. Taoist cultivation of chi energy may extend into what may at first glance appear to be impossibly subtle spiritual realms, but it always begins with down-to-earth and in-the-body practices.

DIAGRAM 3

THE ANCIENT CHINESE CHARACTER FOR CHI ENERGY

derived from the root of fire above
and emptiness below to denote its original purity.

HOW DOES "CHING", OR "SEXUAL ESSENCE" FUNCTION IN HUMANS?

For the Taoists, sexual energy is called "ching," or "essence." It can also be understood as a kind of "human electricity" because like "chi" it is an invisible energy that flows through the body. However in its raw physical form, it is stored in men in their sperm and women in their ovaries. Thus it is a kind of chi energy that has

been transformed by bodily process into a more potent form. It is raw matter distilled into a powerful essence that has the ability to recreate the entire human organism. For men, their sperm power is the essence of their "yang" or male energy.

When you feel sexually aroused, this is your "ching" essence expanding at a phenomenally powerful rate. Your whole being is suddenly charged with new energy, your body fired with passion and your heart transfixed with desire. It's like turning on the light switch. Your entire world of touch and feeling is dramatically changed from night to day within seconds. This happens in men when they feel attracted to a woman because their hundreds of millions of sperm cells begin vibrating and generating a larger field of sexual electro-magnetic energy. It also occurs spontaneously in the springtime. When trees are bursting with sap, man's ching is attuned to the cycles of nature and expands as well. What is the relationship of this sexual "ching" essence and the other types of chi energies that form your life force?

MAJOR PHASES OF CHI ENERGY

The following lists in simplified form some of the major phases of "chi" in humans and their relationship to "ching" essence as well as "shien," or spirit, the highest stage of refinement. These three: chi, ching and shien, are known as the "three treasures" because their proper cultivation leads one to enlightenment.

1. Prenatal Energy: Combines "chi" and "ching" inherited from mother and father, expressed in the gene code and visible as the innate vitality that people have.

2. Breath Energy: Body absorbs cosmic energy from the inhalation and exhalation of air. Those who breathe properly—relaxed, deep breaths to the abdomen—will receive more energy.

3. Food Energy: The purity of chi received from food will depend on quality of diet and ability of body to digest and assimilate nutrients.

4. Meridian Energy: Comes from different types of body cells that produce the energy. It courses through the acupuncture channels linking all the vital organs and glands.

5. Pulsation Energy: The deep rhythm of your body, felt especially in veins and arteries, also seen in biorhythm energy flue-

tuations that harmonize our emotional, mental and physical bodies.

6. Sperm (Ovarian) Energy: "Ching" is the sexual essence that exists from birth but grows more powerful when fed by other types of chi (food, breath, etc.) Sex essence is the source of all energy available for creative and thinking processes (shien).

7. Spirit Energy: "Shien" is the light behind our personality, the ability to discriminate, human self-awareness. At its purest level, it is our very being.

8. Wu **Chi:** The emptiness, or void from which all chi energies originate and must return. (Original Chi)

DIAGRAM 4

THE CYCLE OF SUBTLE ENERGY

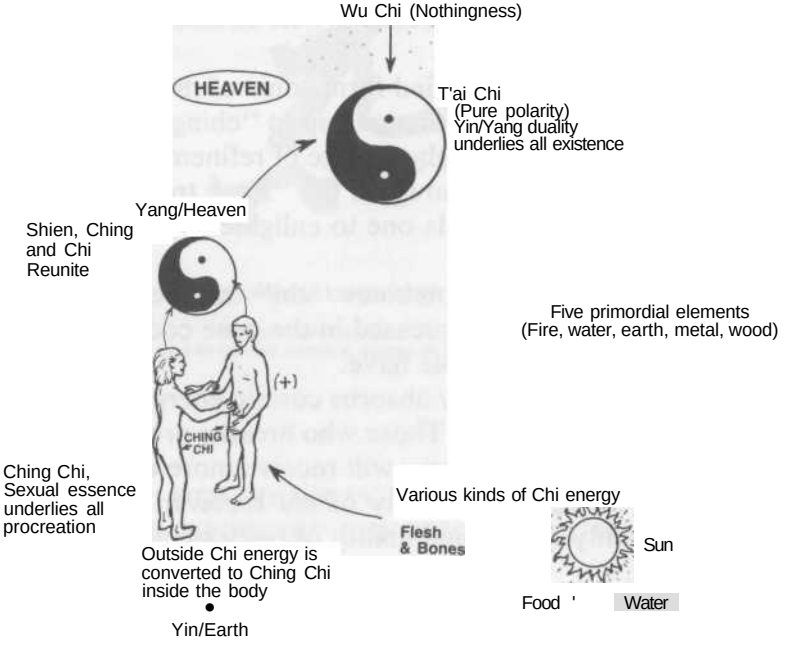

The goal of Taoists is to cultivate the life energy to the highest level possible, bringing good health and deep fulfillment of the human aspiration for wholeness. The early sages observed the natural process of the raw chi of the universal elements—sun and earth, food and air—being transformed into ching, or sex energy, and in the male stored as sperm. The next step is far more subtle and difficult to observe. The sperm energy is mixed with the chi of the human vital organs and refined into shien, or spirit. In short, sex energy offers a link between our biological and metaphysical identities, between the animal and the divine. Sexual ability gives man the divine power to re-create himself, but it also binds him to his animal body and that of his lover.*

The Taoists believe that you can use any substance or force that exists in the universe to feed the process of cultivating your spirit, and thereby free yourself of the limitations of your animal body. Everything has energy in it, and human consciousness can absorb that energy if it so desires. But some substances are easier for the human body to change into a useable form than others. For example, you can absorb the energy from eating a good hot meal more easily then you can from sitting on the beach under the sun. The solar energy is too raw and too powerful to be easily "digested" by the body. Sunlight will burn you severely if you try to absorb too much. But your body can easily assimilate a plate of food and function for a long time on the calories and nutrients digested.

DIFFERENCE BETWEEN HUNGER AND SEXUAL DESIRE

What is the difference between food and sex as energies that our bodies crave to be fed? Many people confuse the hunger for food and sex as being similar biological desires that are both necessary for survival. Clearly they are connected, as many people feeling sexual frustration turn to food for gratification. An imbalance in

*If you are interested in a fuller elucidation of the working of chi energy in the spiritual realms, read two books by Taoist Master Ni, Hua Ching: "Tao: The Subtle Universal Law" and "The Taoist Inner View of the Universe and the Immortal Realm" (College of Tao, 117 Stonehaven Way, Los Angeles, CA 90049). There are many volumes in Chinese on this subject, but I feel these are the best translations and commentary on the Taoist canon available in English. Ni's translation of the I Ching is preferred over those of western scholars, who don't understand fully the esoteric aspects of these classic texts. His translation is titled "The Book of Changes and The Unchanging Truth."

ching (sex) energy ranks as a major cause of obesity—when you are sexually frustrated, food is the easiest substitute.

The major difference between food (chi energy) and sex (ching essence) is that sex energy, because it has already been refined and produced inside the body, is much easier to "digest" or "absorb" than a raw substance like food. Food must be broken down and connected before it supplies any useful energy. Sexual essence is already in a state of readiness that is linked within milliseconds to our hormonal and nervous system. The image of sex or the mere thought of it can instantly enter our brain and alter our entire psychological state as well as our bodily feeling.

Thus sexual energy potentially has a far higher value than food as a kind of "nourishment" needed for human emotional maturation and spiritual growth. That is why sex was also considered a department of Chinese medicine and treated so matter-of-factly. A Taoist doctor might prescribe a two week round of love making in certain positions to heal your illness. Human love, expressed through the function of sexuality, was seen as the most potent medicine you could take. It was a kind of "human herb" that could cure most ailments as it restored the flow of chi which governs our organ vitality and general immunological system.

People become obsessed by their relationships as the exchange of sexual energy that occurs is the most important source of sustenance in their lives after food. Relationships invariably get complicated because although your friends and lovers are visible and tangible beings, the sexual energy you are constantly exchanging and transforming into emotion and spirit with them is invisible. It can be known only through your feelings and intuition.

A relationship fails when the spirit of it is not properly cultivated, and you force yourself to "eat" negative, or poisonous, sexual energies without transforming them into positive or neutral energies. When the imbalance in energy becomes strong enough, divorce occurs unless the couple finds another way to correct it. Reading pornographic magazines or masturbation are other examples of negative cultivation of your ching, because they stimulate the "yang" essence in your sperm without balancing it with a real woman's "yin" sexual energy.

The major difference between ching, or sex essence, and food and sunlight energy is that your ching chi is physically manufactured and stored inside your body. This precious substance—

sperm, with its extraordinary power to mate with a female egg and create another life—is manufactured and stored in your testicles for safekeeping. The point is that you are free to tap into your supply of sex energy at anytime by drawing the sperm power from the testicles.

DIAGRAM 5

The modern character for fire can be interpreted as: the primordial element of fire, physical fire, or psychic heat burning beneath the Taoist cauldron.

If you run out of sperm your body automatically makes more. This allows you to be physically ready for your lover at all times. Even if you are alone, without a lover, and never intend to procreate, your body produces the sperm and transforms it into creative sexual energy. So you can always transform this stored sex energy into spirit, your pure awareness, and express it through creative personality at will. So in fact "ching" is internal energy that nourishes us night and day without ceasing. The process of refinement is partly automatic, and partly voluntary. We can either help or hinder the process of transforming our sex energy into creativity depending on how aware we are of our internal process. Yet, like breathing, we draw on this source of energy constantly without being aware of it.

Freud stumbled partially upon this truth many millennia after the Taoist masters had clearly mapped out the role of sex in shaping our destiny. Freud didn't realize that the mental neuroses he discovered could be healed by cultivating the sexual and other Chi energies within the body. When these energies are re-balanced through proper love-making and meditation, the mind is re-patterned and freed of old traumas and habits. Taoist cultivation of one's sexual energy is an extremely powerful tool for self therapy. So powerful, in fact, that it should be used only by those who have achieved a certain degree of integration in the body, mind, and

spirit. Severly imbalanced individuals may release more energy than they can safely deal with, and should see a psychiatrist before attempting to learn the Taoist methods.

DIAGRAM 6

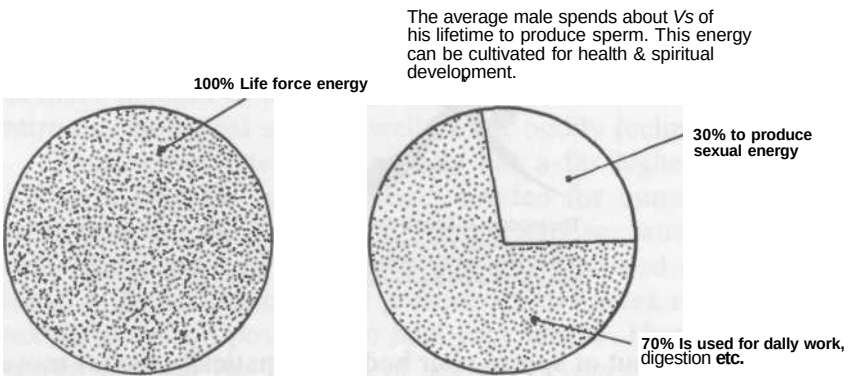

This unique human freedom of utilizing our sexual energy so flexibly does not come without it's price. The price is that we spend an estimated 25% to 40% of our chi energy taken in through food, air, and sunlight just to manufacture this sperm energy and maintain sexual readiness. Why does the body spend so much of its valuable resources to produce billions of sperm cells and regulate them with an accompanying hormonal system? Simply to produce a few children over the course of a lifetime? Nature is not that extravagant. The enormous investment of our bodies in producing this sperm energy is to speed our overall evolution. The more successful man is in transforming his stored energy into higher creative and spiritual energy, the more rapid his evolution. This path of Taoist cultivation of chi energy is simply an attempt to most efficiently utilize the natural gifts every man is born with to evolve the maximum possible in a single lifetime.

CHAPTER 3

THE BIOLOGY OF ESOTERIC SEX

Ordinarily discharge of the seminal fluid completes the act of love. As soon as the fluid is spent, the body strains to replace it. The faster sperm is used, the more the body is forced to produce. Quite obviously, production of this nutritionally rich and psychically superpotent substance requires an enormous amount of raw materials. The reproductive glands receive these raw materials from the blood stream. In its turn, the blood withdraws the precious elements from every part of the body, liver, kidney, spleen, etc., including the brain.

Every organ pays heavy tribute to the glands that produce the sexual seed. Because a single drop of semen houses such prodigious life energies, frequent loss of fluid depletes the body systems of their most precious nutrients and speeds the inevitable physical decline into old age. Retaining the seed within the body is the first step to reversing this cycle in which the male pays an unnecessarily stiff price for sexual satisfaction.

THE VOLUME OF SPERM FLUID LOST IN A LIFETIME

One may conservatively estimate the average American male ejaculates 5,000 times in his lifetime, equal roughly to 4 gallons of fluid. The Kinsey Report provided the following details on the American male's normal frequency of ejaculation:

AGE	AVERAGE EJACULATION PER WEEK
Puberty-15	3.17
16-20	3.3
21-25	4.14
26-30	3.51
31-35	2.9
36-40	2.42
41-45	1.95
46-50	1.8
51-55	1.54
56-60	1.09

More recent studies suggest that it is likely that the vital seed is more frequently lost now than in the time of Kinsey's study because the overall level of sexual stimulation and activity is presently higher. The effects of the sexual revolution, availability of contraceptives, attitudes toward sex in television, film and magazines has been particularly strong in encouraging premarital sex among youth.

But to avoid any statistical inflation, let us use the estimate of 5,000 ejaculations per lifetime made by Kinsey in the 50's. To calculate the flood of fluid normally lost: 5,000 (ejaculations) x 3 cc (fluid) = 15,000 cc.

This is 15 liters or roughly 4 gallons of fluid. The semen spent in an average ejaculation has a volume of 2 to 5 cubic centimeters. These drops contain 200,000,000 to 500,000,000 individual sperm cells.

YOUR BODY HAS ATOMIC ENERGY IN IT!

This is an astonishing statistic: a single male ejaculation scatters two to five hundred million sperm cells. Cast upon two hundred and fifty million female eggs, a single ejaculation could conceivably generate the present population of the United States. Multiplying this figure by 5,000 ejaculations per lifetime yields a numerical indication of the seminal power.

The normal male ejaculates enough semen to generate one

trillion human lives. Within a single man's loins sits the capacity to sire more than two hundred times the present population of four billion on the planet! In a very real sense every man can create a stockpile of sex energy literally more potent than the atomic bomb. If this immense reservoir of psychic energy were to be redirected towards love and spiritual harmony, the possibilities for a peaceful existence seem unlimited.

Some Western scientists may scoff at the idea that semen is an immensely powerful substance. Yet no one can deny the prodigious life-potential in the seed of a single man. By gathering this life-generating force within oneself, one collects tremendous energy.

The effects of conserving this energy would differ with every individual. No man or race produces the same type of energy. Each creates according to its own genius. One group develops enormous physical force, another massive resistance to disease, another clairvoyant powers, still another great longevity. But all men have the inherent ability to substantially increase their active lifespan by creatively adapting to their environment.

Scientists have tried to improve upon Darwin's thesis by focusing on specific genetic impulses behind behavior that lead to increased survival of an individual's gene pool. This correctly gives a lot of evolutionary power to our sexual impulses, but ignores the process whereby this sex energy is transformed into higher creative impulses of the mind and spirit. The evolved man directs his animal body and instincts with his mind and spirit. The scientists maintain the reverse is true. They are right, but only to the extent that man's evolution back to his original self is incomplete.

Man is still bullied about by his biological urges. When man is complete, and has truly integrated his still clumsy body with his mind and spirit, his total freedom of spiritual being is beyond the control of biological instinct. This does not violate the physical laws of the universe; it simply postulates that we are beings with the inherent power to cultivate our energy to a level of power where it allows us to direct our bodies freely. It is not mind over matter, as that implies a battle. It is more mind inside matter. The revelations of mind have allowed us to create nuclear bombs and send man to the moon, so why not use mind to direct its own body which is immediately at hand?

Scientifically minded readers may refuse to accept this. No

proof is possible except in the experience given by daily cultivation of one's chi. Many scientists may have thought it impossible to have an orgasm without ejaculation, yet I and hundreds of my students know it is only a matter of education, of training the mind to control the chi in the domain of its body.

While science may analyze the chemical constituents of seminal fluid, it cannot account for the human seed's life-genius. This is beyond instrumental measure. How can one measure a human life? Only a scientific philistine would try to reduce man to a mechanical theory.

These and other scientific explanations pale before the power of the seed's ability to make 4 billion unique human beings with creative intelligence. Theoretical physics now acknowledges it is impossible to scientifically analyze the ecstatic fact of creation. Quantum physicists have accepted the likelihood that there is no smallest particle, no physical building block upon which the cosmos is built. There are only the multi-universes of space and time linked together by infinite fields of energy. These are currently described as gravitational, weak and strong forces, and electromagnetism. Taoists view any attempt to describe the totality of nature, the Tao, as futile. They found it far more useful to find ways of experiencing deeper harmony with it.

Sexual energy is a field generated within the body and linked to the larger cosmic fields in ways that no scientist can presently understand. But there is no reason to wait 500 years for science to come up with explanations of sexuality, as every man can experiment with his own sexual energy field and draw his own conclusions today. The Taoist masters were ancient scientists with a genius for self-observation and were dedicated to furthering human evolution. Each generation tested the practices taught to them by their masters and tried to improve on it. The methods of chi cultivation may have evolved over the millennia, but the principle has remained the same: The ching or sperm power is a super potent force readily available to men, awaiting only their harvest. Sexual essence is a building block for expanding our personal universe, the foundation for human love and evolution.

BIOLOGICAL IMPORTANCE OF SEX HORMONES TO HEALTH

Modern science has given us the opportunity to study the function of sperm in the body in amazing detail. Each of the sperm cells contains 23 chromosomes, prostaglandins, ions, enzymes, trace elements and other essential parts of human life. Only the elements of the egg and the nurturing environment of the mother are needed to form a living human being of infinite potential.

The seminal vesicles, two little sacks collecting sperm at the base of the bladder, are tied to the vas deferens. They produce a yellow fluid that mixes with the sperm and thickens the seminal fluid. This secretion contains the sugar, fructose, which nourishes sperm cells.

The prostate gland also contributes to the reproductive secretion. It surrounds the urethra (the main duct or tube running the length of the penis) beneath the bladder. In ejaculation the prostate jets forth a thin clear fluid which helps to propel the sperm. Cowper's glands along the urethra supply a few drops of alkaline secretion, which serves to neutralize acid remaining from urination.

DIAGRAM 7

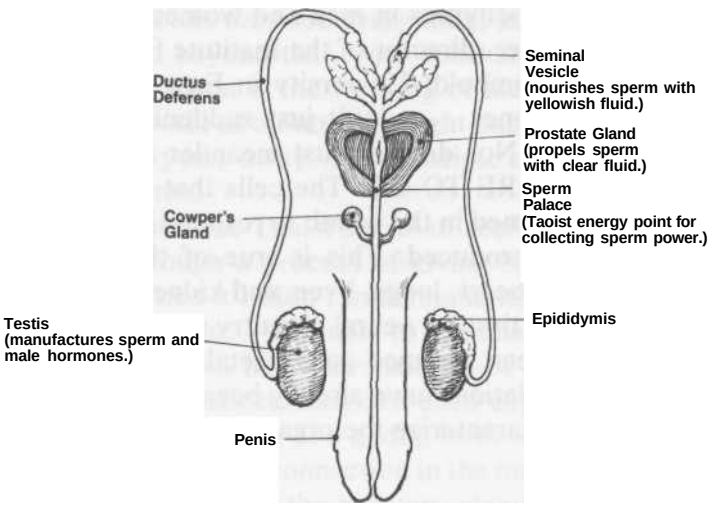

Dr. Beyoihn, a noted endocrinologist, stressed the importance of the hormonal function of semen production: "Sexual hormones are important to our harmonious development. When men abuse the reproductive function, the secretions of the sexual glands are lost. . . resulting in mental and physical weakness, inability to concentrate, and a less tenacious memory."*

Love-making is an internal exercise which helps restore imbalances in bodily chemistry. A moderate amount of sex tends to repair hormonal disturbances, to reduce cholesterol and blood pressure levels. Sexual activity alters the body chemically. The reason this happens is because each gland in the body affects all the others. Thus when sex hormones are stimulated, it stimulates the hormones secreted by the other major glands—adrenal, thymus, thyroid, pituitary, and pineal. The illusion when you are young is that you can stimulate your glands indefinitely, without paying a price for it. Sex seems like a bottomless well of bliss. It is, if you take the trouble to recirculate the sexual hormones within the body instead of repeatedly ejaculating them.

These sex hormones do more than just make you feel good. They literally invade every sphere of your activity and form your personal identity. Recent scientific studies have shown that sex hormones influence the brain's cellular organization. If you are male, then your brain has male stamped on each cell. This is what produces different proclivities in men and women.

Dr. Gunter Dorner, director of the Institute for Experimental Endocronology at Humboldt University in East Germany points out: "The sex hormones . . . don't just suddenly appear out of nowhere at puberty. Nor do they just meander about the body. THEY KNOW WHERE TO GO. The cells that are their targets have already been primed in the womb to respond to the hormones that are now being produced. This is true of the body, of the reproductive organs, heart, lungs, liver, and kidneys. But it is also true of the brain. The tissues, neural circuitry and chemistry of the brain have already been stamped during fetal life by the sex hormones. And the foundations have already been laid for the range of behaviors that will characterize the organism as male or female in adult life."*

*E. Flatto, *Warning: Sex May Be Hazardous To Your Health* (Arco Publishers 1973).
**Science Digest*, September 1983, p. 87.

These hormonal differences obviously determine many of the qualities in men and women the Chinese have called yin and yang. The Taoist goal of total integration of sexual impulse with the mind begins to make sense even to a western intellectual when the connection between sexual activity, hormonal balance, physical health, and personality are examined together. The evidence for health being powerfully affected by hormonal balance has been well substantiated, and is even now a major topic for cancer researchers in their efforts to understand how the mind and emotions control our immune system. The Taoists would say it is unnecessarily complicated to track each individual microscopic hormone receptor and enzyme in the gene code to fight the hundreds of different types of cancers and diseases that result when our immune system fails.

The Taoists contend the critical factor is simply balance—that when male and female chi energies are balanced in the body, each cell will have the energy to function perfectly, and hormones do their job in making the body machinery run smoothly. This balance of male and female hormones produces a happy personality who lives harmoniously with the world. The specific Taoist practice of sexual energy conservation and transformation is one of many designed to insure that the internal equilibrium of the human energy system is so powerful that no outside force can destroy its inner balance. The Taoists thus see everything, hormones, sex, personality, health, and beyond that, your spiritual destiny, linked inextricably together. That is the working of the Tao, which links the finite ordinary world of a Saturday night date to the explosion of a super nova light years away. The principle of the fusion of energy in both is the same.

In olden times the Taoist secret of secrets was the method of being reborn through a process of giving birth to your new self. When I first learned it I didn't understand it, but later, in studying the endocrine system, I was able to see analogies. I realized that both men and women have the makings of male and female hormones and that, in effect, they are each capable of having intercourse within themselves, and giving birth to a new self.

The most important connection in the male hormone system is between the testicles and the pituitary gland located between the eyebrows, behind the forehead. These glands work together in the transformation of sexual energy, a fact that you will experience

DIAGRAM 8

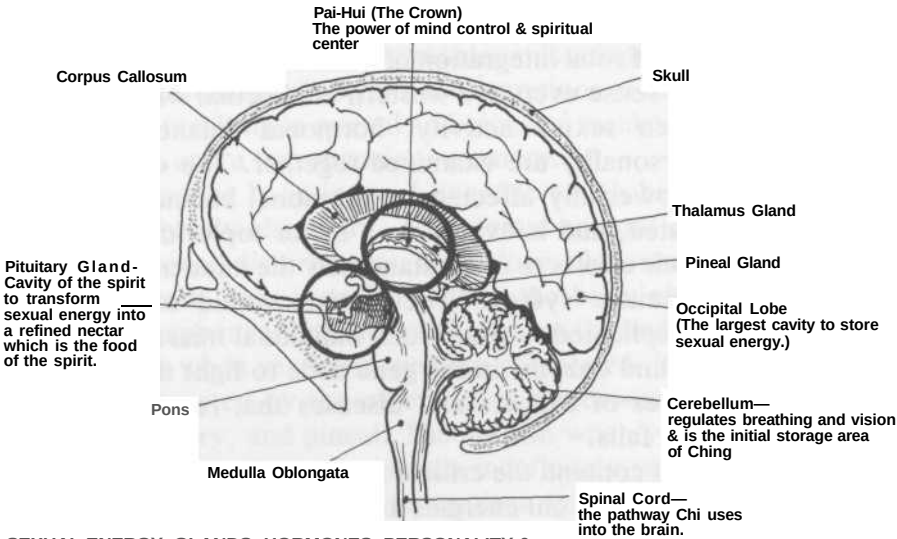

SEXUAL ENERGY, GLANDS, HORMONES, PERSONALITY & DESTINY ARE ALL LINKED TOGETHER IN THE BRAIN.

when you begin cultivating your sexual energy up. Your testicles and your pituitary gland will begin to pulsate together when the ching is cultivated properly, and is a sign that your glandular system is working harmoniously all the time, not just during sex. The pituitary gland in turn regulates the activity of the other glands. When they are in perfect harmony they secrete an exceptionally fine nectar—a superfine hormonal substance undiscovered by scientists—which floods the nerve centers of the brain and helps create the feeling of bliss described by so many mystics. This is only one phase of spiritual development, but one that is powerfully affected by the balance of sexual energy in the body.

Sexual activity is equally powerful in the more ordinary spheres of health. Sex offers all of the health benefits of physical exercise. Sex reduces the tendency to compulsive eating while burning calories, and thus helps remedy obesity. Sex strains the heart less than driving a car in city traffic, or watching a good football game. Moreover, the heart rate quickly diminishes after sexual action. (For someone on the verge of a heart attack, passionate sex may be sufficient to trigger it. Passive sex is recommended in this case.)

Loving is thus a great natural antidote to stress. Emotional stress especially causes untold harm, as it is a continuous injury to

every cell. Life in our urban society subjects us to increasing doses of this potent poison.

Stress directly causes cardiovascular degeneration, such as arteriosclerosis and hypertension. Love restores impaired body chemistry by activating the hormonal centers to defend the physical body and by harmonizing our mental and spiritual faculties.

With frequent ejaculation, the benefits of sex begin to decline, and vitality ultimately plummets. The sexual big spender loses stamina. His vision begins to weaken, hair tumbles from his skull. He grows old before his time. The physical damage caused by expelling the sexual essence from the body is greatly alleviated only in couples or individuals who create and sustain a powerful emotional and spiritual love.

Over years of marriage, couples who consistently find a deeper harmony naturally conserve some of their sexual essence. Insurance studies bear this out: married couples live longer than single people. Two can often share the stress of life better than one alone. A better balance of yin and yang is achieved. The very act of love spontaneously transmutes lower vital chi and ching into higher mind. The Taoist methods of cultivating sexual energy are powerful aids to those following this "path of the heart", but take the path a step further by maximizing the benefits of sex for health and personal growth.

In Chicago a group of elderly people urge couples to practice sex in a ritualistic fashion to preserve vitality. The group, called "Sexy Senior Citizens," is the unconscious heir of many comparable societies flourishing in the Orient for millennia which taught Taoist methods of chi cultivation.

With aging all bodily systems become less efficient. Among these is the hormonal system, which regulates important electromagnetic reactions. If hormonal secretion declines from optimal levels, the body must necessarily weaken.

The relations between the hormones, sexuality and aging have not been fully elucidated. However, many researchers in the vanguard of medical science feel that the hormones regulating growth and sexual development play a critical role in aging. These are produced in the pituitary, thyroid and gonads.

The testes have a double function: besides being the factory for the sperm, they produce male hormones, among which is testosterone. The Sertoli cells in the testes produce another hormone,

inhibin. When not ejaculated, these hormones go into the blood stream and are carried to every part of the body.

DIAGRAM 9

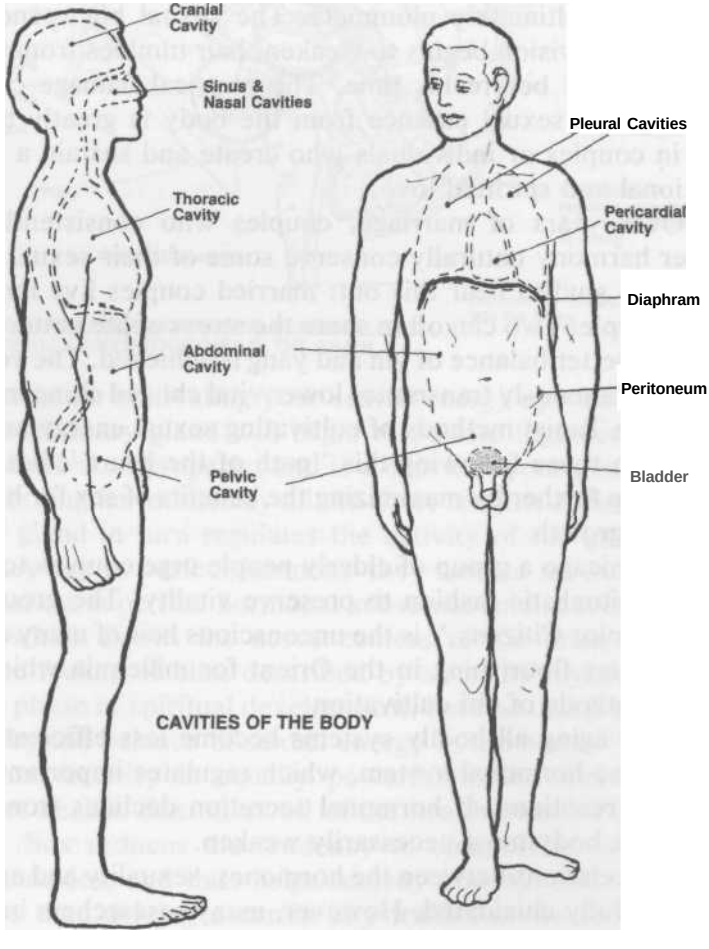

Sexual Kung Fu fills the cranial cavity with Chi. This overflows & begins filling other body cavities with life-force, retarding the aging process & strengthening the body's immunity to disease.

Much evidence points to the link between harmonious sexual activity and the retardation of aging. Loving sex stimulates high-quality hormonal secretion. The presence of these hormones in the blood appears to slow the aging process. With Taoist cultivation one produces unusually potent hormones because one focuses energy directly on the endocrine glands, stimulating them to much greater levels of activity. Because the hormonal energy is constantly circulated within the body instead of being ejaculated, a successful student of Taoist loving finds himself with ever-increasing amounts of energy as he grows older.

This increased circulation of sexual energy also redistributes the chi within the body's storage system. As we grow older and our life force is depleted, our body cavities increase in size and are gradually filled with fat or various kinds of pollution that speed the aging process and lower the quality of our final years. The Taoist method draws sexual energy up from the testicles and fills the spinal and cranial cavities with ching. When full, this overflows and begins to fill the chest and abdominal cavities with rejuvenating life force.

These reservoirs of chi within the body supply the raw material used to make the body virtually impervious to disease in the method known as "inner alchemy" to the ancient Taoists. This process of refining the "Elixir of Immortality" or the "Pill of Immortality" may be described in biological terms as storing the body's life-force and then returning it to its source. The chi is moved from these reservoirs within the body cavities into the deepest centers of the brain and bones. The secret of packing chi into the bone marrow is well known to highly achieved masters of Tai Chi Chuan and other internal martial artists. They know that muscle power cannot survive the aging process, but that bones survive for thousands of years. This practice which I will describe in an upcoming book on Iron Shirt Chi Kung, is dependent on retention of sperm power.

Recent scientific studies show the importance of bone marrow to the production of disease fighting white blood cells. These scientists will eventually catch up with the ancient Taoist masters and figure out the full connection between healthy sex, hormones and bone marrow and the prevention of aging and disease.

DEATH AND SEX IN THE NATURAL WORLD

"... When the living organism, whether vegetable or animal, achieves its aim, which is a new seed, its organism deteriorates."
—*Schwaller de Lubicz, The Temple in Man*

Nature perpetuates its species through sex. In the male seed she concentrates the parent's essential elements. The theme of parental sacrifice for the offspring is repeated in all life forms, from amoeba to walrus, praying mantis to orchid.

One may readily glimpse the death in generation by considering the Emperor Moth's brief span. This large moth travels many leagues across the countryside in quest of his female: "The famous principle of the struggle for life is here the struggle to give life, the struggle to die. Although they can live three days in quest of the female, they perish as soon as the fertilization is complete."*

Plants, too, are subject to these laws. After a plant goes to seed or bears fruit, it dies or enters a period of dormancy. Gardeners know that a plant prevented from going to seed outlives its more precocious brothers. Most fruit-bearing trees do not produce fruit until they are five or ten years old. During this period they devote their entire biological force to the growth and strengthening of tissue.

Later in their life, plants split their vital force between reproduction and tissue maintenance. When they grow old they need all of their remaining energies for survival: they withdraw power from the sexual sphere and bear no more.

Some male insects may increase their lifespan several fold simply by not spending their seed. One may object that an insect's sex life has no relevance to ours. Yet the insects excel brilliantly in sexual invention and effectiveness. They comprise more than half of the total animal weight on earth. They far surpass human erotic variety. The insects make D.A.F. de Sade, Saint Anthony, and David Bowie look like a troop of boyscouts discovering sex for the first time.

Insects work the web of material life with particular intensity. Their power to impose their definition of life is manifest in their

*Carlos Suares, *The Cipher of Genesis* (Shambhala 1978).

numbers, gigantic age and breadth of habitat, garb and custom. Marxist-Socialist deification of the State but weakly mimicks their pitiless genius for collective organization. Rather than staggering them, nuclear war will offer a rare occasion to spin new organs to create an abundancy of new life forms.

In all forms of life the reproductive act exhausts essential energies. The offspring consume bodily stores of nutrition to get a grip on their new life. Vital organs suffer the most depletion because they contain the densest concentration of nutrients. Among humans, the female sacrifice of her bodily energy is unavoidable in the passage to birth. The male, likewise, must surrender the potency of his seed at least once to fertilize the female ovum.

Nature warrants the sacrifice worthwhile, for it fulfills her goal of multiplying life. She intends the old to make way for the new. But amongst all material creatures, only man has the force of will to oppose Mother Nature. "Not distance, not the difficulty of the journey, not the danger of approach foils instinct (in the animal kingdom). In man, who sometimes has the force to escape the sexual commandments, disobedience may have fortunate results.

Chastity in a human being can function like a transformer, changing unused sexual energy into intellectual or social energy. Among animals, this transformation of physiological values is impossible."*

It is the very possibility of transforming our instinctual and essentially animal sexual energies into something higher that makes us human, and potentially divine. The failure to direct our sexual energy upward is a failure to fulfill our deepest human potential. That is why unconscious sex with ejaculation of the male seed is a kind of mini-death seen so often in the plant and animal kingdoms. Two hundred to five hundred million sperm die upon a single ejaculation. The expenditure of subtle energy is even much greater than these huge numbers suggest.

If this spent seed leads to any kind of rebirth in the man, or in the woman, receiving new life, this loss or death is in harmony with nature. But without transforming these mini-deaths into a sharing, a love, a child, or a higher awareness of some sort, this act of sex becomes a mere killing of the potential life energy stored in the seed. Perhaps that's the connection between sex and violence.

*Suares, *op. cit.*

Those radically opposed to abortion and contraception might as well begin their campaign against men who kill their potential life-force by ejaculating needlessly.

Although the Taoists have no concept of sin, they might say that man has fallen to his current weakened psychic state in large part because he has squandered his sexual energies over the last several millennia. The Chinese legends speak of a golden age when all men lived in harmony with nature and transmuted their seed up as naturally as you or I breathe. Whether or not this is literally true is irrelevant—the kernel of truth in the story is that man is capable of a much higher existence than what he now accepts. The story bears a striking resemblance to the Biblical story of Adam and Eve's fall from grace after tasting the forbidden fruits of sexual love. In this sense, the end of the Taoist cultivation is to regain the lost paradise which still exists within every man and woman, their original nature.

The major function of sex in nature is to create new life and to perpetuate the species. Yet in our time humanity has been fruitful and multiplied itself to the brink of overpopulation and its attendant ecological horrors. The abuse of sexual power through indiscriminate procreation has brought humanity to a global crisis. It has accelerated the danger of a war which might result in the extinction of the species.

Apart from certain insects and higher apes, animals engage in sexual intercourse for reproductive purposes only. The female receives the male only at definite mating periods, that overall compromise a small part of the animal's lifespan. It is clear that sexuality plays a different role for humans than it does for animals, and it is critical that men and women become educated as to the possibility sex can play in their own evolution and thus affect the balance of nature as well.

CHAPTER 4

THE SEXUAL ECONOMY

"Man cannot be without woman and woman cannot be without man. If you think intercourse is an isolated or separate act, longevity is threatened and every illness arises."
—from the Recipe for Making Priceless Gold
Sun S'su-Mo, physician who lived 101 years

Every man is born with a certain amount of priceless vital chi energy. Some begin with more than others, but for the sake of simplicity let us assume an average man is born with a sum of vitality likened at $1,000,000. Over one's life span this million dollar's worth of life force is spent. Some spend wisely and live heartily into the 80's and 90's. When you are young you spend it faster because it seems like such a huge amount it could never run out.

Most people in our consumer society spend more money than they earn. They borrow themselves deep in the hole, assuming they will earn enough to pay it back later. If they fail, they face bankruptcy or a corrective period of lean living. Through poor habits the same thing happens with life energy, only the penalty is loss of appetite for life, sickness, and death.

Let us say that someone earns an additional 100 units of life force daily through breathing, eating and resting. Yet he may spend 125 units of life through poor diet, smoking, gluttony, overwork, anxiety, constitutional weakness, drug abuse and frequent loss of the vital sex fluid. To spend the extra 25 units he must continuously borrow vitality from the brain and organs. This theft of vital energy from one's own million dollar reserves gradually induces mental and physical sickness and premature aging.

Conserving sexual energy is a practical way to earn 125 units and spend 100 units or less. It's an investment in one's physical, mental, and spiritual growth. The imbalance of one's personal economy can be corrected by reducing the disastrously wasteful expenditure of ejaculation. A "profit" of 25 units of vitality is then made by transforming the conserved sexual fluid into higher mental or spiritual energy. Eliminating other bad habits will reduce the loss and increase the profit, but no other single factor in life is so potent as sexual energy.

If you work hard all day, you've already used up much energy. If you then have a few drinks, eat a heavy dinner and later have sex in which you ejaculate the vital sperm fluid, you are overspending your life's provision prematurely. Some people would call it a day well spent, as they cannot envision anything better in life to spend their energy on. If you continue to overtax your resources, you may wake one morning fatigued with life, sick with arthritis or cancer, or maybe you won't wake up at all. You will have prematurely exhausted your vital capital and may have to die at an age that you feel is somehow "unfair" or possibly worse,

suffer through your final years in life with your creative powers and physical faculties greatly diminished.

I am a Taoist living in the twentieth century near New York City and lead an extremely busy life. I have a wife and an overly energetic young child. I own a computer, drive a car in city traffic, deal with teaching hundreds of students, and maintain a heavy travel schedule flying around the U.S.I know it is possible to lead a rich and rewarding life without exhausting oneself, and have seen my students do the same. The more you cultivate your chi energy with daily practice, the easier it becomes to replace energy spent and still end up ahead.

Of course, if you choose a simpler lifestyle you can progress much more quickly. That's why many Taoists choose to live up in the peaceful mountains. But you can live by the same Taoist principles anywhere. The universe is bountiful if you know how to live with it. Sexual energy is one of the most abundant gifts given to us by nature, yet most people casually toss it away without realizing the full value of its treasure.

As Americans become more aware of the importance of personal health they are seeking to change their lifestyles. Many people are now realizing that they have been living destructively. Fortunately, they have grown conscious before it is too late. Whether they are jogging or taking a dance class, they wish to begin a life-energy conservation program. First they must pay the interest on the vital sums they have overspent from their mind and body. After a while they may repay both interest and principal as they begin to produce and conserve more energy. At that point they can take the path of cultivating their chi energy into its original spirit.

Have realistic expectations. You may have spent more vitality than you had to spare. Concentration and patience are necessary to recover it. You can spend $100,000 in an hour, but you may need one year to earn it back. Serious physical and mental trauma, heavy use of drugs, and frequent ejaculation all involve grossly excessive spending. Many young people seem to have unlimited energy. But these youths are toying with the sources of life as if on a wild spending spree.

Many older people apparently in good health are, in fact, tottering on the brink of serious breakdown. Only the strength of habitual self-will allows them to continue to function. When they have a check-up—often prompted by unconscious awareness of

their condition—the doctor may order an immediate halt to strenuous exertion. Often these people collapse in the first days of their enforced rest because the flimsy strand of willpower which kept them going has been cut. Friends will say, "I can't believe it. Yesterday he seemed strong as an ox." If you learn to balance your account in the sexual economy, you will be taking the most prudent steps possible to avoid such a scenario in your own life.

THE YOUTHFUL FURY OF SEXUAL FRUSTRATION

One of my main concerns is the frustration of youth in our society. Upon the quality of their thoughts and acts civilization will endure or crumble. Most male youths are more interested in sex than almost any other subject. This is natural, as their bodies are working overtime to produce billions of sperm cells. Women cannot imagine what an intense experience this is, as their energy cycle is more evenly distributed over the fluctuation of a monthly menstrual cycle.

This build-up of male energy is a natural manifestation of universal Yang energy. The development of traditional romantic love at this stage is natural. If this expanding Yang energy finds a receptive female to nourish it the love between them can mature and spiritual evolution gradually awaken. The problem of obsessive sex arises from a material society that stresses the value of physical sex so highly that people remain immature all their lives seeking to sustain a lusty image of sex that exhausts them and ultimately blocks their evolution by stimulating them to rapid loss of their seed.

The harder youths try to grab pleasure, the more surely it eludes them. In their frustration, many seek pleasure with increasing fury, a quest for identity that leads to frequent masturbation and promiscuity. The more often they spill out their vital seed, the more empty they gradually become despite the temporary feeling of gratification as the life force passes out their loins. Unrestrained sexual frenzy can destroy a young man's fragile identity and melt him into the mob mind cultivated by sex-for-profit industry and sexually exploitive media shows. Higher vital energy which should nourish the young person's true center serves instead to grease the empty fantasy of his bed of lust. Afterward he is left with nothing. This spells spiritual disaster if the excesses are not corrected in

time. This type of young man may have difficulty in his relationship with women and ultimately this leaves a vacuum in his understanding of himself and the female pole of his own male energy.

For this same reason adolescents tend to fanaticism, political, religious, or otherwise. Mao's Red Guard is but one youth group that has propagated its reigning tyrant's brand of fascism. The proliferation of various cults in the U.S. is strong evidence that the young are not able to fill the void in their lives with the physical pleasures that have become standard. If the fragile link with his newly forming adult identity is frayed or broken by lack of love or social nurturance, a youth has only the group psyche to animate his life. The group mind provides the fullness their hollowness craves. As Nature abhors a vacuum, their own emptiness despises itself.

These remarks apply to adults in our sex obsessed society as well; many are desperately questioning for an identity that is their own by natural right, if only they knew how to claim it. The proper understanding of the function of sexual love in their personal evolution would go far to correct these excesses. Education about methods of chi cultivation of all types, but especially of the sexual energy is the most direct solution. Teenagers will never give up their sexual desire, but it is not far-fetched that many of them would be interested in improving it if they knew how.

SEX AND THE SUPER ATHLETE

There is a widespread belief among many professional sports coaches that an athlete who makes love the night before a big game loses his competitive edge. This is a controversial topic and a survey of existing opinion on the subject is inconclusive. Clive Davis, editor of the Journal Of Sex Research, looked into the effects of having sex before competition and concluded "You can always find anecdotal reports to support any position you want to take, but certainly you couldn't support either side medically."

Top-ranked prize-fighters are the most vociferous in contending that they cannot violate natural laws without paying a stiff price. Ken Norton publicly stated that he gave up sex for eight weeks before his first fight with Ali and abstained for a similar length of time in subsequent Ali fights. "A couple of times in my first 10 or 11 fights, when I didn't abstain from sex, I think it hurt me." Norton said that he believed that "9 out of 10" fighters give

up sex while training for a bout. Joe Frazier, who also fought Ali, felt very strongly about the damaging effects of ejaculatory sex: "If you mess around before a fight you don't have any reserve energy left."

It is rumored that the great Muhammed Ali observed strictest sexual continence for as long as one year before his bouts. He didn't publicize this because he keeps his training methods secret.

The Taoist approach to sexuality resolves the dilemma facing a male athlete who is forced to choose between losing his competitive edge or his woman. An athlete can have the best of both worlds by learning the secrets of conserving and transforming sexual energy. There is a substantial increase in available energy reserve after Taoist lovemaking, as the male has not only conserved his own super potent seed power but also absorbed a high dose of equally potent yin/earth power from his lover. Any athlete who can master the urge to ejaculate his life-force will have taken a step in the life-long process of mastering himself and his chosen sport. He can awaken from a night of ecstatic lovemaking feeling light hearted and energetic, with his batteries fully charged. This is quite different from the pleasant exhaustion that often follows ejaculatory sex.

Some male athletes claim that ejaculatory sex the night before is beneficial to their sport. The reason for this is usually simple—the athlete has too much nervous energy and lovemaking relaxes him. His excess energy impedes his performing ability, and ejaculation relieves that tension. This improves his coordination and attention in the field the next day and thus helps him to win. This is entirely in line with the Taoist idea of the function of lovemaking to harmonize the mind, body, and spirit. Huge quantities of raw chi energy in the physical body are useless until they are harmoniously integrated with the mind and spirit.

University of New Mexico Professor Mark Anshel did extensive research on sex and the athlete. He found that many coaches were intentionally creating sexual frustration with the hope that their athletes would redirect their drives against an opponent. "All people don't react to frustration the same way," Anehel points out. "By preventing sexual activity, these coaches (or the athlete himself; Guillermo Vilas, the Argentine tennis pro, once admitted staying celibate for a year to improve his game) may actually bring about negative personality manifestations such as anger or feelings of isolation."

The Taoists have used sex since ancient times to heal physical, emotional, and mental imbalances, a practice very much in line with helping athletes maintain maximum fitness. The Taoists were martial artists as well, and knew the secret of defeating an opponent was a combination of physical discipline and maintaining a superior degree of self-awareness. For this reason they cultivated their chi energy and guarded against the loss of their seed to women. This Taoist practice of "Sexual Kung Fu" is kept a closely guarded secret amongst martial artists lest their opponents learn it and grow stronger. The modern athlete can enjoy the same benefits today as the Taoist fighters, swordsmen, and Tai chi chuan players have for hundreds of years—the full freedom to love without losing the competitive edge.

SEX, COMMITMENT, AND MARRIAGE

This subject of marriage is too vast to be generalized by any fixed rules. Marriage may suit some men and not others. One man may marry and be happy for a lifetime and his brother find it torture. In the Tao, nothing is ever forced; alignment with the natural is sought, and from this comes lasting balance of yin and yang.

The Taoist sages would never say that a celibate man is higher or more pure than a married man. Both men have equal opportunity to adapt their daily practice of cultivating their chi energy to their life situation, and thus, to achieve union with the Tao. If all spiritually inclined men were to remain celibate, society might suffer from the lower quality of parental guidance offered to children, and result in disharmony in the world.

Practically speaking, a marriage, especially with children, consumes an enormous amount of time and energy and should not be entered into lightly or for the wrong reasons. The wrong reasons include marrying because of outside cultural pressure or to satisfy someone else's desire, such as parents.

The decision should come freely from within you or else later you will have trouble accepting the responsibilities which arise from your choice. Many men marry because they are emotionally insecure and hope a woman will offer that security. This emotional insecurity can often be traced to insecurity in the male sexual role. So, if you have not yet married, I suggest you master the sexual energy cultivation methods in this book before making that deci-

sion, and if possible learn the Fusion of Five Elements meditation for balancing emotional energy (see Chapter 18 for a description).

Even this is no miraculuous overnight cure for emotional insecurity. If you spent decades feeling and acting insecure, it will take a while to change. Cultivate and balance your internal energy constantly, and you will be surprised at how your emotions will lose their power over you, and be replaced by a continuous feeling of inner connectedness. You won't need to seek your emotional understanding from a woman, which is a dependancy trap many men fall into. When you understand the source of your emotions in the movement of the chi energy in your body, you will be in a position to maintain inner balance and help your lover to achieve the same.

Once you are free of sexual and emotional compulsiveness you will find yourself a very changed man in your relations with women. Ideally, you would get to know a woman for several years before having children with her. This allows you both to learn the subtle energy rhythms of the relationship before your attention is focused on child-raising. If, by then, you have practiced dual cultivation to a high level, the deep bond will go far in getting you through the inevitable difficulties that lie ahead.

For many American men, sexuality actually remains on an infantile level. It is often no more than an extension of feeding. It is an attempt to take in love from outside themselves and childishly demand the certainty of continual gratification. This leads necessarily to the jealous dependency that plays havoc with so many relationships. People spend years watching to see if they are loved: in this way they annihilate even the possibility of what they seek. This type of destructive sexuality is a constant looking outside oneself for assurances. This insecurity can generate negative emotions we are often unconscious of, such as jealousy and guilt, as well as acts that consciously violate our own integrity, such as adultery. One ceases to live in the present moment, creation stops, and life becomes slavish rehearsals of lust broken by long periods of boredom.

It's easy to observe that after a time the life of many couples seems weary, stale, flat and unprofitable. One reason for this is because when they embrace intending to make love, the man ejaculates and thus excretes his deep vitality and depletes his yang charge. Nature is abundant and forgiving, but after years of ejaculation the difference shows up as weakened sexual desire.

Unless the couple has spontaneously found the will to transform their life energy into a higher love—a process of spiritual attunement that balances the daily losses of vital energy—the relationship is in danger of becoming a ghost of its former passionate self.

Energy that could become genuinely joyous is spasmodically thrown out of the body by ejaculation. This loss occurs every time you ejaculate. Eventually a man can develop feelings of indifference or hate for his sexual partner because he subconsciously realizes that when he touches her, he loses those higher energies that could make him a truly happy man. This produces a deep crisis, because during the years of love-making and sharing their lives, a powerful emotional bond has developed. A lot of his sexual energy has gone into making that bond and he can't understand how the bond could exist and yet he feels bored, resentful, and fatigued.

This flattening of sexual desire between regular partners is due largely to depletion of polarity or sexual-electrical tension. You can increase the attraction by charging the positive and negative poles of the male-female battery. Some couples achieve this temporarily by taking seperate vacations or sleeping in separate beds, or they find other ways to naturally keep the balance of energy through outside friendships and activities. With polarity restored the current of life flows between the lovers ever more swiftly and powerfully. Dual cultivation allows a couple to remain together and keep this polarity of their relationship fully charged.

Dual cultivation is designed to promote the happiness of couples, to teach the partners to discover inexhaustable pleasures in each other. There is no inherent reason for love to grow old. The practice of conserving and exchanging sexual energy without loss of the seed will help remove a major cause of promiscuity: incomplete satisfaction with one's lover.

It can also alleviate a common problem in marriage: not enough energy to work things out. With the stress of both parents working and modern fathers trying to share in the child-raising tasks, many couples simply burn out. They never have enough time to make love; if one is aroused the other is exhausted or asleep. Using the Taoist Secrets of Love, both husband and wife will find sex rejuvenating and an endlessly fascinating journey into the subtle realms of chi exchange. They can return to the routine of daily drudgery with renewed vigor and light heart; when your chi is

full and running in all your meridians, the most ordinary things become interesting again. Your chi is the glue between your body, mind, and spirit; until it is completely integrated you will feel incomplete.

The Tao teaches there is infinite pleasure and limitless potential within every human being. The addiction to sex as emotional food can gradually be changed from within the male body through chi cultivation. One grows to appreciate this fact with the retention of the seminal fluid and its transformation into the higher center of the heart. One experiences the fullness of life long after the lovemaking has ceased, and a delicacy that more easily moves beyond temporary sensory stimulation, to a continuous connection of feelings with the lover.

The man who diligently studies the Tao learns that the source of all emotions as well as the source of a woman's allure is also within himself. However, when difficulties arise, the first question to arise is always, "What does my commitment to her mean?" This self-questioning can raise its head at any stage of spiritual accomplishment or emotional maturity in your marriage.

The highest commitment a Taoist can make is to the marriage of yin and yang in the universe. In fact yin and yang are always married, as they are just two poles of the same subtle energy field. Thus, the real commitment a Taoist makes is to consciously realize their union in his life and thus empower himself (single cultivation) and his lover (dual cultivation) with his awareness. When the level of chi and ching chi cultivation reaches a very high level and is integrated with shien, or spirit, the awareness extends to an even wider field and might be likened to the Christian universal love or Buddhist sense of compassion for all sentient beings.

The difference is that a Taoist cultivates this universal sense within his body, so it remains as a tangible experience of his subtle chi energy field. This insures it does not become a conceptual or theological idea of love into which a man is trying to fit his behavior. This is an impossibility, as no whole human being with an integrated body, mind, and spirit can fit into the shoes of an abstract idea, even a noble one like love.

The Taoists in China traditionally cultivated themselves in pairs or small groups, whether it be two friends, a master and student, a man and woman, or a small community of adepts. There were many different approaches used by these different groups;

some were strictly celibate, others quite openly favored dual cultivation between man and woman. Because of the strong emphasis on sexuality in America, and the freedom from social restraints, I'm certain that the method of dual cultivation will become a major path for growth among couples. Americans are raised with the idea that they can do anything they want to do, and don't like being told by priests or gurus that their love of sex is dirty, sinful, or blocking their path to enlightenment. So, let them enjoy sex and take the best from it. It's all part of the Tao, and their marriages will be all the better for it as long as the sexual energy is properly used.

Some men and women will choose to love outside of marriage, and if they cultivate a harmonious balance of yin and yang their union is as holy as one with an official state seal stamped on it. A word about the virtue of a lengthy committment. It normally takes decades to fully cultivate one's chi energy to the highest level of shien. It will likely take years to appreciate the subtle energies your woman is capable of creating and making available for your own cultivation. It is said it takes seven years to know the rhythms of a woman's body, seven years to learn her mind, and seven years to understand her spirit. Don't be a promiscuous fool who is never patient enough to learn the true depth of the Tao.

THE MORAL EFFECT OF SEMEN LOSS

There is a distinct tendency for strengths and weaknesses to propagate themselves. The weak grow weaker, the strong strive to increase in strength still more. Taoist Cultivation helps curb self-destructive tendencies which are worsened by weakness itself. The Taoist treasures the energy stored in his vital fluid. The vital power within him slowly begins to resist abuse of any sort to both his body and character.

The loss caused by ejaculation is not limited to the physical sphere. Mental and emotional functions are profoundly influenced. Hormonal fitness directly effects personality and capacity for creative thought. The mind suffers from the loss of testosterone, the hormone secreted in the testes and spent in ejaculation.

Chinese medicine long ago observed that vicious crimes are often committed soon after seminal loss. Courage is usually at low ebb after ejaculation. One scares easily and reacts violently. This is

one reason murder and mutilation often follow rape.

Thus there is what may properly be called a moral effect of cultivating one's sexual essence or ching chi. The yang fire within the seed burns up internal poisons at the same time it generates an essential life-supporting substance. One who retains his seed increasingly respects every form of life.

Everyone has experienced discomfort when watching someone abuse their child in public, or felt the stare of a starving bum. The anger or despair of others actually spills over to us and influences us whether we like it or not. In like manner, each of our thoughts and acts beams to the far reaches of creation.

The man who cultivates his subtle energy eventually experiences in his body the fact that all living beings are part of one life. He and his lover flow into each other. He knows that across the web of consciousness one living thing constantly nourishes another. In becoming highly aware of the interconnection between all creatures, he strengthens his tendency to be unselfish. He may suddenly find himself asking: why pour negative thoughts into the single stream from which we all must drink? In this sense all loving energy is cosmic, or divine energy. When two people love each other consciously their energies are intentionally consecrated to the good of humanity. This kind of love offering develops a special egolessness in the lovers and will inspire others whom they meet.

While this approach to loving is not limited to the esoteric Taoist cultivation, the use of its methods of transforming sex energy vastly increases the amplitude of loving power which is emanated. In the Taoist view, man cannot direct the heavens, but if he behaves in harmony with the laws of heaven and earth he can guide the larger course of events by becoming harmonious within himself. Thus, Taoist philosophy does not preach any specific moral guidelines. It simply posits that morality is innate within man; if he cultivates his subtle energy and experiences his true self, he will act in a moral fashion among men.

THE CONTROVERSY: IS SEX GOOD FOR YOUR HEALTH?

Man appears to be the only higher creature naturally endowed with the power and inclination to perform sexually regardless of the possibilities of spreading his own kind. There is no falling off of

sexual appetite in the pregnant female or her mate. The human begins sexual activity soon after reaching puberty. Most people spend a lifetime performing and dreaming of sexual intercourse for the sake of pleasure and emotional fulfillment. It seems clear that sexuality serves a higher function in humans, but doctors, scientists, psychologists, priests and artists cannot even begin to agree on what this higher function is and how or if it should be regulated to improve human well-being.

Western scientific texts are curiously contradictory about the healthfulness of sexual intercourse. Many sex manuals today praise the restorative qualities of extensive sexual activity. Others, equally authoritative and based on psychiatric studies, caution against sexual overindulgence. Which school of thought is correct? When does too much sex become unhealthy?

To complicate matters still more, there are similar inconsistencies among Oriental sages. One renowned Indian holy man counsels the male to see every woman as a sack of shit and piss in order to resist the temptation of losing the precious male seed to her.

Yet the Lord Buddha himself is held to have said: "Women are the Gods, women are life . . . Be ever among women in thought."

The Taoist teaching of sexual yoga reconciles these viewpoints because it accepts the middle way, recognizing the truth in both extremes. Their solution is of utmost simplicity: joyous and loving sexual intercourse without the loss of the male seed is healthful in the highest degree.

Much depends, of course, on the path you are taking through life. At a certain time in your life celibacy may be best for restoring your health or for achieving rapid spiritual progress. Celibacy can be an extremely powerful means of conserving all your vital energies freeing you to work with greater intensity in cultivating yourself. But most Westerners are focused on finding the right mate, and working out their sexual and emotional desires with a partner.

The Taoist principles of energy cultivation work equally with both cases, the single or the dual cultivation. For a Taoist, all paths must ultimately move beyond a focus on sex energy and towards attunement to all the subtle energies of the Tao.

But no one can take more than one step at a time. If part of your mind is fixed on sex, you must live out that impulse, study it,

and know its source before you can transcend it. Taoists are always flexible; your energy can be cultivated no matter what your situation in life is. But the basic principles remain the same. Sexual activity without love and with frequent loss of fluid is physically and mentally destructive to any path. Engaging in sexual love with a partner—but without any esoteric practice to cultivate the chi—is an incomplete path to transforming oneself.

Love will spontaneously transform any couple to a higher level of awareness, but at the same time the repeated loss of seed will hasten their physical decline and slow their progress. It's like climbing a mountain slope with loose rock scree—you take three steps up and slide back down one. This pace may lead to emotional and mental happiness found at the top of the first ridge. But it may deprive you—for the lack of time and energy—from seeing the valleys, mountains, rivers and ocean beyond. This is the fullness of the Tao, the attaining of a lasting experience of your higher spiritual self.

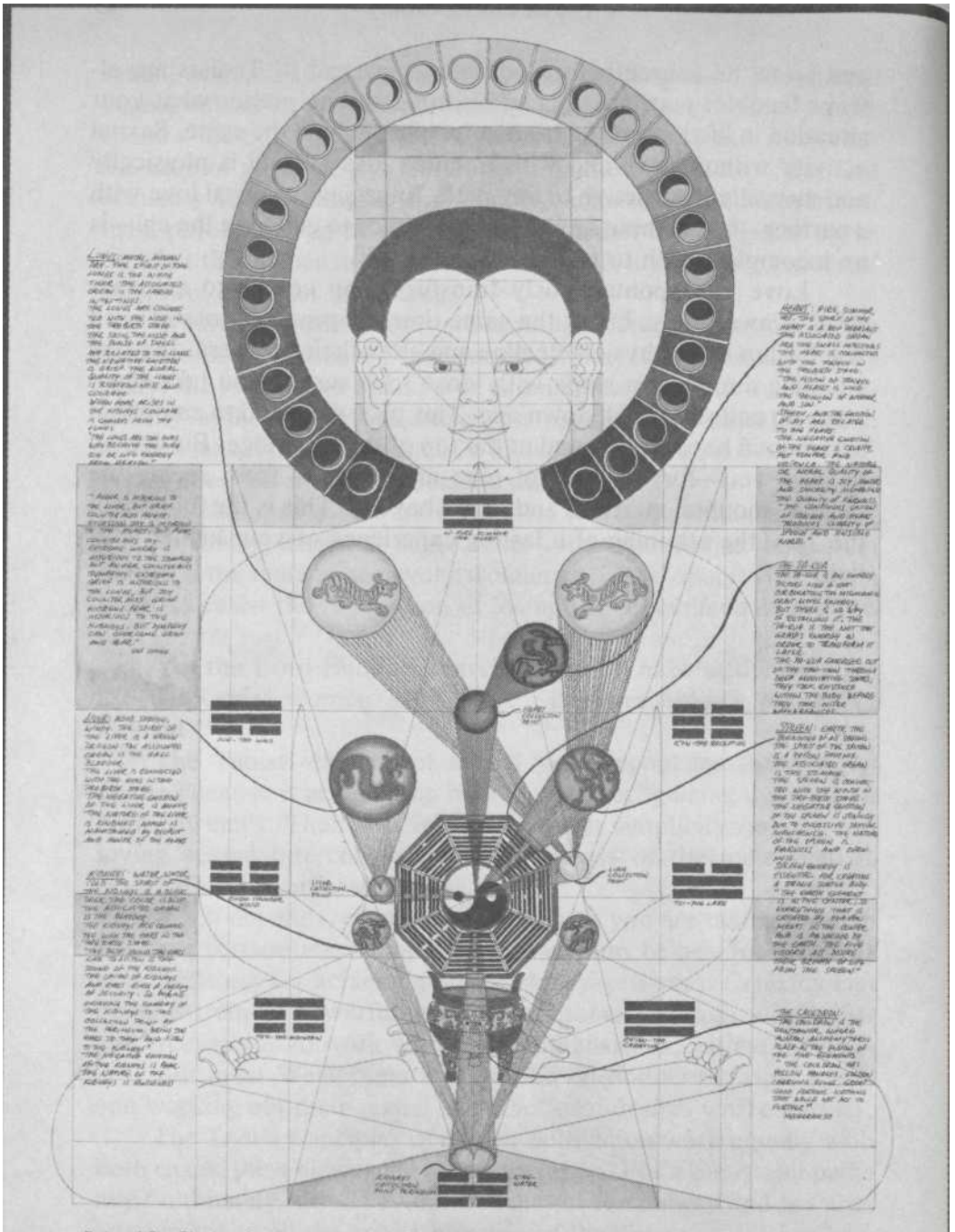

Fusion of Five Elements I
Cleansing, Clearing and Harmonizing
of the Organs and the Emotions
as taught by Master Mantak Chia

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CHAPTER 5

SEX IN THE ESOTERIC TRADITIONS OF THE WORLD

". . . It is impossible for us to learn elsewhere what we are incapable of learning within our own bodies."
—*Schwaller de Lubicz, The Temple In Man*

Religions have nearly always tried to control the sexual habits of their followers. Their success seems to swing in cycles of the public submitting and rebelling, but I would guess that ultimately they have failed because for most people the experience of sex is more powerful than their experience of religion. As a biological impulse, sexual drive so completely permeates our actions and desires that it is not easily harnessed by any system of belief, however dogmatic. Hence the adage that prostitution is the world's oldest profession.

In my travels I have noticed that prostitution seems to flourish side by side with the most fanatic religious communities. Sex is like an inflatable ball floating on the surface of a pool—the deeper you push it down into the water, the more strongly it presses back up. If you lose control of the ball for even a split second, it will shoot up into the air out of control.

The attempt by religions to publicly dictate sexual morality is actually a vestige of an earlier, less material era when spiritual experience was more intense than the fleshly pleasures of sex. The

founders of the earliest religions—then known as Mystery Schools or Fertility Cults—understood the role of sexuality in spiritual development, which is why their practices and rites held such powerful experiences for converts. Many modern spiritual leaders, whether Catholic, Jewish or Hindu etc., have forgotten the link in their religious rites connecting sexual power and spirituality. Circumcision rites, Spring fertility festivals *(e.g.* Easter), and communion ceremonies are all remnants of a time when the esoteric and hidden meaning of sexuality was understood and incorporated into religion.

The task for twentieth century man is to peel off the layers of his outer or "exoteric" religious beliefs and free his mind to experience the ecstatic core of his existence in his body. Then the outer ritual and the beliefs of the old religions will either fall way, or take on a new and profound meaning. By accepting sex as sacred, the role of religion will be revitalized in society and made more meaningful in ordinary personal relationships.

Taoism is different from the major religions in that it is a spiritual philosophy and not an organized religion with a body of believers obeying a holy scripture. Faith in God (or the Tao) is not enough for the Taoist; devotion to higher harmony must be accompanied with the self-knowledge that comes from cultivating one's own energy. In a sense, a Taoist must "grow" his soul in order to fully gain knowledge of it. Every human has the same seed within, but unless it is properly nourished, its bearer will never see its fruit. The divine world within man is patterned after the natural world—as a child will never know its full self until adulthood, so must a man cultivate to maturity his subtle spiritual energy if he wishes to enjoy and participate in the fullness of the Tao.

There were some folk cults with Taoist priests that rose up to compete with the arrival of Buddhism in China, but I am concerned here only with the original esoteric teachings of the Taoist masters. These Taoists are famous for permitting the use of sex on their spiritual paths. There were many Taoist sects which sprung up on the five holy mountains of China, and each emphasized different aspects of chi cultivation in their spiritual development. A few sects taught the path of "single cultivation", which utilizes the Taoist principle of mating male and female subtle energies withn one body, but strictly forbids physical sexual intercourse as either unnecessary or too risky.

The practice of "dual cultivation" was widely accepted by most Taoists for both its hygienic and spiritual virtues. Even in these schools the danger of becoming deeply attached to one's lover was acknowledged as a possible stumbling block for those seriously aspiring to become immortals and enjoy full union with the Tao. This sexual attachment was never viewed as sinful, and no sense of guilt was encouraged as in the Christian tradition. Becoming sexually attached to one's partner simply means that the aspiring yogi might experience only the union of a man and woman in this lifetime instead of the greater union of Heaven and Earth. This is no condemnation of the couple, as such a union might be a high accomplishment for them.

The Christian religions have a strong tradition of a sacred marriage, but church politics—mostly male priests afraid or jealous of women's earthy, "dark," yin power—led the Christian world into periods of woman-hating witch hunts that alternated with

woman-worshipping cults of the Virgin Mary. China, whose culture was molded by a blend of Taoism and Confucianism, was spared this vicious cycle. The yin energy of the universe—personified by woman—was always viewed as necessary to its functioning and to the well-being of man.

Even when the original Taoist teachings on the perfect balance between yin and yang fell into periods of decline after the Manchu reign in the Eighth Century A.D., women were not subjected to the same abuse seen in some other cultures. Chinese society became increasingly paternalistic and women were viewed as a kind of male property, but at least the general cultural sentiment favored treating this female "property" with respect. Many of the Taoist sexual manuals which survive today come from this period, and are somewhat lopsided in advising the aristocrats who read them on how to get healing yin energy from the woman.

These manuals totally ignore how men can help to heal women with their powerful yang energy. They do correctly advise men to conserve their seed while suggesting that a man make love to as many as eleven concubines a night. The manuals are really medical textbooks, with a very cut-and-dried clinical approach to sex that treats it solely as a means to harmonizing one's health. Although these manuals fail to stress the higher path or teach meditative practces for exchanging energy with the women they do reflect the basic esoteric Taoist teachings that sex, when properly practiced can be incorporated into daily life with tremendous benefits to health.

The Taoists may have one of the oldest esoteric traditions of cultivating sexual energy in the world, but they certainly were not alone. The idea for transforming sexual energy for spiritual purposes is well known in all the esoteric traditions of the world, both Eastern and Western, although generally it has been guarded as a great secret. Whether in Egypt, India, Tibet or Europe, the information that was revealed to the public was usually kept to a vague or abstract theoretical/theological level. A practical method to hold and transform the sex energy in the body was never taught to the public.

The best place to begin a brief historical survey of this field is with Theophrastus Bombastus Paracelsus, the famous 16th century physician and alchemist extraordinaire. Paracelsus' credentials as a medical scientist are impeccable; more than 400 years ago he

discovered the mercury cure for syphilis. Yet, he came to the same conclusion as the Taoist masters of what was known as sexual alchemy—the seemingly magical but entirely natural transformation of the sexual seed.

Paracelsus experienced the seminal fire with as much reality as an ordinary person feels when his hand is burned in a hot oven. Regarding the constituent elements of the substance, he wrote: "All the organs of the human system, and all their powers and activities, contribute alike to the formation of semen . . . The semen is, so to say, the essence of the human body, containing all the organs of the latter in an ideal form." This position is strikingly similar to the Taoist description of "ching chi," or sexual essence. Taoist cultivation also emphasizes balancing the subtle energies of each organ, which one then fuses into a single higher spirit.

Paracelsus distinguishes between the sperm fluid and the "aura seminalis", which is the light or energy of the sperm. Scientists today might call the "aura" the biophysical energy of the seminal fluid. Paracelsus claimed energy could be distilled from the physical fluid: "This emanation or separation takes place by a kind of digestion, and by means of an interior heat, which during the time of virility may be produced in man by the proximity of woman, by his thoughts of her, or by his contact with her, in the same manner a piece of wood exposed to the concentrated rays of the sun may be made to burn."

This statement rudely translated into modern language means that contact with an attractive woman may stimulate the production of high quality biophysical energy. Taoist alchemists realized a thousand years before Paracelsus practical ways to retain these valuable energies in order to profit from them.

If we turn from the Renaissance alchemist to the great British authority on Indian Tantric practice, Sir John Woodruffe, we find the same principles. In his classic work, *The Serpent Power,* Sir John speaks plainly to those who know how to hear: " . . . the force of the latter (sexual centers), if directed upwards, extraordinarily heightens all mental and physical functioning." He notes that mind, breath and sexual function are interconnected. The spiritual aim of the yogi is to "carry his seed high." This seed releases pranic energies, also known as the Kundalini power, rising up the spine to higher chakras or centers of spiritual function.

Another great modern spiritual authority, attuned to the

power within semen was Gurdjieff. According to this master, certain peoples understood that ". . . by means of the substances 'Exhioehary' or sperm formed in them, it was possible to perfect oneself." He adds that " . . . this self-perfection could probably be actualized by itself, by abstaining from the ejection from oneself in the customary manner of these substances formed in them called sperm."

Gurdjieff maintains that this self-perfection usually cannot be attained simply by retaining the semen, but requires a technique to release the energies of the seed. He is in perfect agreement with Paracelsus and the Taoists on this point.

Without exception authorities on the occult know of the seminal power, and that this substance must be stored and transformed to accomplish higher deveopment. The distinguished magician, Kenneth Grant, writes: "Thus the function of the semen—in the Tantras—is to build up the body of light, the astral body, the inner body of man. As the vital fluid accumulates in the testicles it is consumed by the heat of the Fire Snake, and the subtle fumes or 'perfumes' of this molten semen go to strengthen the inner body."

Most authorities agree on the necessity of collecting seminal fluid and transmuting it by application of inner heat. In the Chinese practice we refer to this as "cooking" the seminal fluid to obtain its "steam." The first step to release this tremendous vitality is conservation of the semen in the act of love.

The modern American spiritual master, Da Free John, also stresses the necessity of conserving the seminal force: "We must find a way of enjoying sexual intimacy whereby Life is not lost, we do not discharge Life in order to achieve pleasure, and we love one another, completely happy and free in our life together."

The "loss of Life" Da Free John refers to is ejaculation. He considers proper use of the sexual force—without ejaculation and with truly loving feeling between partners—as a key to human evolution. He stresses the importance of love in aiding the spontaneous transmutation of the seed to its higher centers of divinity. In this he is in complete accord with other spiritual authorities. Alchemists, yogis, magicians, and mystics agree unanimously on this fundamental point.

Another perspective on the vital seed is found in the works of an eminent Kabbalist and poet, Carlos Suares. The esoteric Kabbalist tradition originated in ancient Egypt. He emphasizes that

development of the will to retain the seed is identical with development of one's true self: "... man, endowed with his self (which, though static by nature, shelters living seed) must struggle against and overcome the centrifugal sexual movement which tends to lead him into the abyss of the female. . . . Instead of being carried away, his mind rules."

Suares here alludes to the degenerative role played by woman in unconsciously luring the seed out of man. She profits very slightly from his great loss, since she usually doesn't have the yogic skills to absorb it. Woman is a bottomless pit for the man who incessantly gives his seed to her, although she can attempt to compensate this loss with her nearly inexhaustable female energy and love.

This chapter could be expanded to include the entirety of initiatory writing. There are many works by Masters who have felt the powers of semen transmuted by vital heat. When Moses is wandering in the desert for forty years, he speaks in the Bible of experiencing "a serpent fire." Since the Bible also declares Moses was "trained by the Egyptians in all their mysteries," it seems likely that this fire refers to the transmutation upward of his psychic energies. Bodily experience of the subtle realm is the final criterion in these matters.

THE DIFFERENCE BETWEEN TAOISM AND TANTRA

The principles of Tantra from India and Tibet have received wide attention in the west in recent years, especially by seekers interested in integrating their sexual impulses into their spiritual growth. The principles behind Tantra are nearly identical to that of Taoism. Both seek to reconcile the opposing dualities of life as symbolized by male and female and both accept any moment or experience in life as a starting point for spiritual growth and as an end point for insight into truth.

Keith Dowman, a western scholar and practitioner of Tibetan Tantric Buddhism put it succinctly: "Strip the (tantrie) yoga of its arcane terminology and there is a simple meditation technique: stimulate the desire and then use it as the object of meditation and it becomes awareness—a field of Emptiness and pure Pleasure." A Taoist would agree, only he might phrase it differently: "Within every moment there is only the Emptiness of yin receiving the

Fullness of yang." This is the eternal marriage of man and woman, of spirit and matter, of Heaven and Earth.

The Taoist path and Tan trie path differ mainly in their language and in the practical yogic methods taught to achieve the same union of mind, body, and spirit. Both fully accept the mastery of one's sexuality as not only a legitimate but necessary means to attain the highest enlightenment possible in the body. Dowman describes the importance of semen in the inner tantric path:

> "Refined semen in the heart center permeates the body as awareness. Loss of semen, by any means, causes life-span to be shortened and causes a pallid complextion. In Anuyoga (fulfillment yoga, or Kundalini yoga) loss of semen is equated with killing of the Buddha. . . . After initiation, intensity of desire is essential to force the bodicitta (seed essence) up the medial nerve (of the spine); not only is desire vitiated by orgasm, but the will to enlightenment itself is temporarily lost."*

This accords perfectly with the Taoists view of retaining semen and transferring it upward, only the Taoists do not personify the subtle energies with a pantheon of divine beings. So I would say that the Tantra is for someone who is fascinated by or is attracted to the religious archetypes of the Tantrics—the gods and goddesses, the Bodisattvas and demons—and their elaborate secret rituals, initiations and invocations using mantra. If you have the patience to follow the rigorous path set out by a lama or guru who understands the true esoteric practice and is not merely a faith worshipper, you should eventually be successful with it.

I myself was raised near a Buddhist temple in Thailand and hung out with monks from an early age. I later decided the external rituals were not so effective as the internal methods of cultivating I learned from my Taoist teachers. These rituals are a blend of the esoteric and local culture. Many westerners may not respond deeply to the archaic imagery of the religious deities or will be confused by the different states of mind to be invoked, as the traditional descriptions of these states of mind do not translate easily from Sanskrit or Tibetan into English.

Certainly the acceptance of Taoism here in the west has been slowed by the difficulty of translating Taoist philosophy from Chi-

*"Sky Dancer: The Secret Life And Songs Of The Lady Yeshe Tsogyel" (Routledge and Kegan, Paul 1984).

nese into English. But the archetypal images of the Taoists—principally images from nature, but including the yin and yang symbol—became globally accepted archetypes long before myself and others began teaching out the esoteric practices. The Chinese form a quarter of the world's population, and our civilization has been around for the last 5000 years, so our basic teaching models are already well known throughout the world.

Perhaps most important is the fact that the esoteric yogic practices of the Taoists were not buried in the rituals or lost on the changing doctrines of religion. They were kept secret and passed on orally for many thousands of years, and when they were finally written down beginning in the second century A.D. they were disguised with arcane poetry to prevent the uninitiated or unvirtuous from learning the meditative practices. But much of this esoteric knowledge was preserved and further developed by Taoist acupuncturists and herbologists, which helped to keep the mystical teachings practical and grounded in using the chi energy to heal bodily functions. Another example of this is the Taoist art of Tai Chi Chuan, a wonderfully multifaceted form that is simultaneously a means of self-defense, a playful dance, a metaphysical meditation on yin and yang, a physically healing exercise, and a ritual invocation of the cardinal energies that can be experienced by anyone watching a master perform.

The actual Taoist practices themselves are as simple to understand as the sun and the moon, because the ancient Taoists used the natural elements of the universe as their teacher. They watched the way plants and animals lived and died, how the weather effected their own metabolism, and how their subtle energies varied with the seasons, the earth's tilt toward the sun and stars, and the phases of the moon. Before language was even invented the sages observed the balance of forces in nature and then found that same harmony within themselves. Life is simple and natural if you keep it that way. No extraneous cultural images or religious concepts are needed to decorate the original and natural vision of the Tao as harmonious nature.

Anybody familiar with the qualities of water, fire, metal, earth, and wood—the primal elements—and has lived through the four seasons of the year—spring, summer, fall, and winter—is a candidate for beginning the Taoist practices. For example, to balance the sexual relationship you basically need to know that

woman is water and has the power to regulate man, who is fire. On a deeper level you would discover that man has both fire and water in his body and can achieve a perfect internal balance by harmonizing his fire (thinking mind) with his own water (sperm fluid, or sexual "waters").

These symbols of fire and water, often expressed as yin and yang are simple to identify with and work with once you are given the specific details of what to do—how to hold your seed in, how to move your energy in psychic channels, and exchange it with the woman, etc. Of course, the experience of more subtle levels of chi energy takes time and cultivation of physical and mental purity. Thats why practice of tai chi, chi kung, meditation, and virtuous living enhance the speed with you gain clarity, and thus compliment the sexual practices.

KAREZZA AND COITUS RESERVATUS

There are other methods of sexual intercourse which should not be confused with the Taoist practice. Most widely known is the simple act of coitus reservatus, which is making love without orgasm. While this conserves the valuable male seed, it does not teach how to circulate the sexual energy upward or store it in the body's higher centers so it can be exchanged with the woman or put to other creative use. Coitus reservatus can also create severe pressure on the prostate gland and lead to its eventual malfunction since the orgasmic tension in the prostate is never released inwardly (as in Taoist sex) or outwardly through ejaculation. I specifically recommend that you avoid coitus reservatus for this reason—too much heat builds up in the genital area without any means to cool it.

Karezza is a love-making technique said to have originated in Persia. It involves long periods of passive sexual intercourse—lying still for half an hour or more while waiting for the male and female energies to build up. The Taoist method differs in that it encourages as much loving physical movement that the couple can handle without genital orgasm. This dynamic aspect of sex is normally important to westerners raised on a romantic role model of passionate love. To a Taoist, movement is life, whether in the physical body or in the subtle energy, and should be thoroughly enjoyed for the good health it brings. Karezza also fails to provide

a method for transforming the sexual energy upward into a transcendent internal orgasm, and is satisfied with simply increasing and prolonging physical pleasure. It was originally intended to help any royal male survive a long night of love-making with his harem. Later it was popularized in America in the Utopian Oneida colony in 1866 as a form of mandatory birth control. Certainly it is an improvement over hasty ejaculatory sex, but ultimately lacks true depth.

PART II

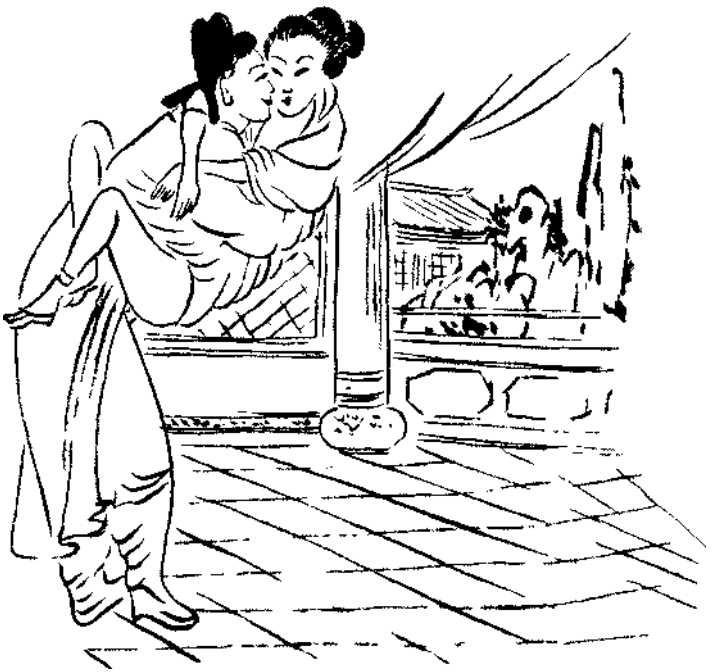

TAOIST PRACTICES FOR MASTERING SEXUAL LOVE

CHAPTER 6

THE DANCE OF THE TESTES: EXERCISES FOR PELVIC STRENGTH

"If a man has intercourse once without spilling his seed, his vital essence is strengthened. If he does this twice, his hearing and vision are made clear. If three times, all his physical illness will disappear. The fourth time he will begin to feel inner peace. The fifth time his blood will circulate powerfully. The sixth time his genitals will gain new prowess. By the seventh his thighs and buttocks will become firm. The eighth time his entire body will radiate good health. The ninth time his lifespan will be increased."
—*from the Canon of Taoist Wisdom collected by Emperor Tang*

All of us are familiar with the shoot-out scene in which someone in danger pulls a gun which doesn't fire. If it's a good guy, he usually finds some heroic way out of his predicament. But when the "weapon" is the male penis, a "misfire"—a failure to erect—is a fiasco for the simple reason that no heroic alternative is easily found. Repeated and chronic misfire is impotence, the incarnation of male misery and the ruin of many relationships. In this chapter we study two excellent pelvic diaphragm exercises that build your urogenital and anus ring muscles and thus greatly strengthens your control of your erection and reduce the likelihood of misfire. Careful practice of these exercises will also prepare you for learning to retain the vital seed during intercourse.

America is presently exercise-crazy. Yet, except for sexual activity, few exercises strengthen the crucial pelvic muscles. There exist pelvic exercises which greatly strengthen the reproductive organs and the complex network of tendons surrounding them. Strength in this department is of inestimable importance—it is the root of man's health. Leading into the pelvis are a vast number of nerve endings, and channels for your veins and arteries. Here terminate tissues communicating with every square inch of the body. All of the major acupuncture meridians carrying chi between the vital organs pass by this area. If it is blocked or weak, energy will dissipate and the organs and brain will suffer. This is what happens to most men in old age—their rectal and pelvic muscles become loose and their vital chi energy slowly drains out, leaving them weak and feeble.

It is important to remember that the foundation of penis strength is seminal retention. Without this nothing permanent may be accomplished, even with exercise. Spending the semen brings about premature impotence and decay. No one, no matter how strong or brutish, can ejaculate often without ultimately paying a stiff price. These exercises massage and stimulate the pelvic region. Life energy is driven down into the testes, filling them with extraordinary vitality. These exercises, combined with the "Big Draw" method of semen retention in Chapter Seven, will allow you to create a permanent store of sexual essence in your body. Only then can you begin to refine it into a higher state and combine it with your chi and spirit to regain wholeness.

THE PELVIC AND UROGENITAL DIAPHRAGMS

The body possesses not one but several diaphragms. Everyone is familiar with the thoracic diaphragm in the chest that causes it to expand on inhalation. Lesser known is the pelvic diaphragm and the urogenital diaphragm which separates the pelvis from the perineum. To practice Sexual Kung Fu properly you must use not only the chest diaphragm but also the pelvic one. Real deep breathing issues from this lower diaphragm. They are exceedingly important in transmitting energy during love-making in the Taoist practice of dual cultivation.

The pelvic diaphragm is a muscular wall that extends across the lower part of the torso. It is suspended concavely downward

from the level of the symphysis pubis in front and the sacrum in back. There are several organs that penetrate this muscular partition that lies between the pelvic cavity and the perineum. These organs are the urethra, the vagina and the rectum and they are supported by the pelvic diaphragm and allow you greater control over them. In fact, the pelvic diaphragm is the floor of the pelvic cavity which contains large intestine, small intestine, bladder, and kidney. It lifts up and helps shape these vital organs.

DIAGRAM 10

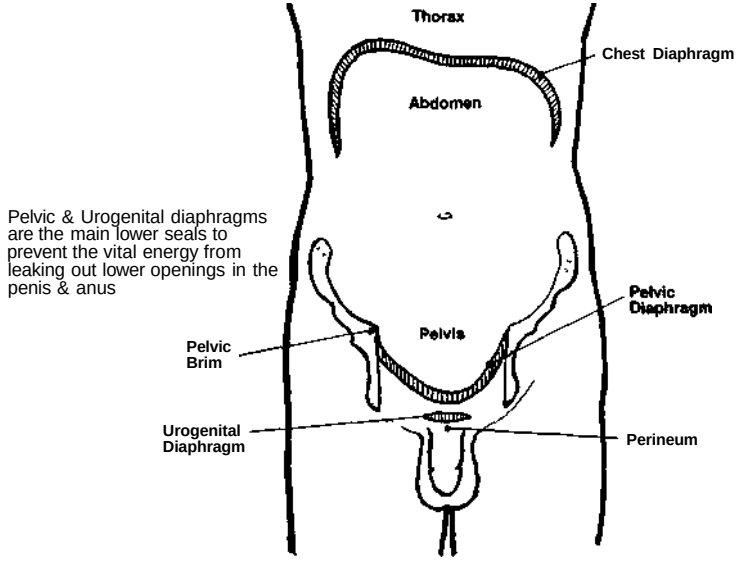

But in the perineum, which is a point midway between the anus and genitals below the pelvic diaphragm, is another muscular diaphragm called the urogenital diaphragm. This is penetrated by the urethra, and to its underside is attached the root of the penis. The pudendal nerve in the penis controls the muscles of the urogenital diaphragm, which in turn holds up the prostate gland, seminal vas deferens, cowper's gland, penis and the anus. Part of this lower-most diaphragm comes forward to engulf the scrotum (which also contains muscle) and the penis and then joins to the abdominal wall.

DIAGRAM 11

PELVIC & UROGENITAL DIAPHRAGM

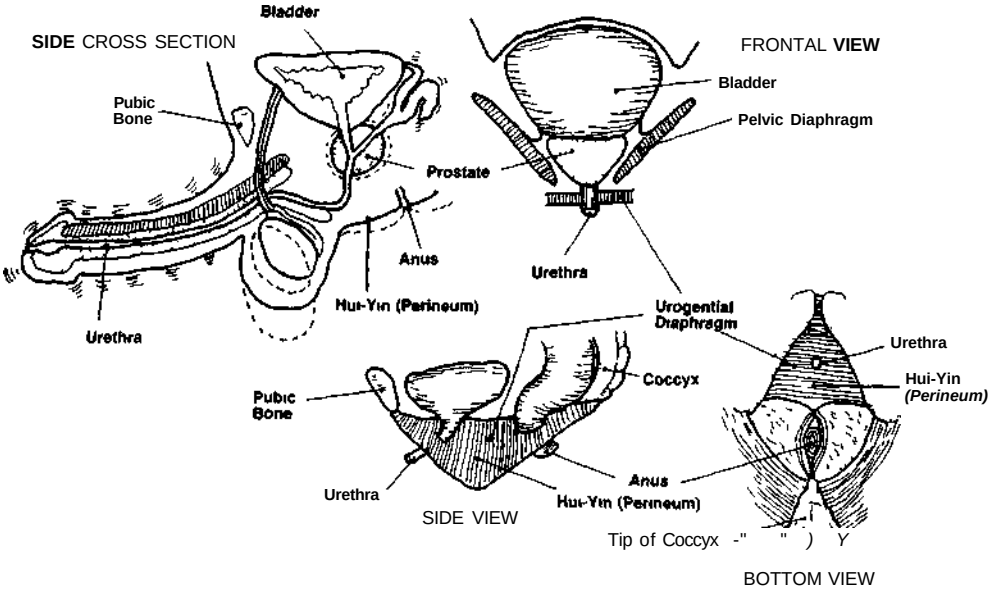

These two diaphragms are the lower seals to hold the life force—the chi energies—from escaping out through the lower openings in the body. When tightly sealed they will increase the chi pressure in the abdomen. When chi pressure strengthens, it will invigorate the vital organs and move the chi and blood flow better. The importance of these anatomical structures will become apparent as you study the larger system of Taoist Yoga. The Iron Shirt Chi Kung exercises also help develop power and strength in these areas, and are a perfect complement to anyone seeking a daily regimen that will aid the practice of Sexual Kung Fu. (See Chapter 18 for a course description)

THE SCROTUM PUMPS COLD SPERM ENERGY UPWARD

Taoists regard the scrotum as the lowest diaphragm, one that functions like a pump. The scrotum is tight during youth and after a refreshing sleep. It is loose in old age or after fatigue. Strong flow of life energy tightens the skin. Scrotal breathing floods the region with energy, and the scrotum begins to tighten almost immediately.

The scrotum is the factory that produces the sexual energy, sperm, and male hormones. So there is a tremendous store of "yin" chi (cold life force energy) in this area. All sexual energy, whether male or female, is "yin" in its latent or resting state. Sexual fluids belong to the water element in the Chinese system of classifying the qualities of different types of chi. Water-rivers, lakes, and oceans are yin. However, yin energy can rapidly change its nature and become more "yang", or hot, when sexually aroused. This can only happen if the sperm is already manufactured while the testicles are still cool. In fact, western scientists have determined the male sperm count goes up dramatically when the testicles are put on ice and several companies are already selling special devices like a "freeze-pak" jock strap to aid infertile men. The cold quality of sperm energy means it must be circulated upward to harmonize with the hot mental energy in the head and the chest area and vice versa.

The testicles are constantly involved in producing sperm, hormones and, though it might presently be debated, or even denied by scientists, in creating ching chi, the life-force essence. The ancient Taoists, who had extraordinarily astute powers of empirical observation, noted that the energy of the sperm cells are of prime importance in that all of the vital organs must contribute some of their own reserves to create and maintain the potency of the sperm. Amongst those organs is the brain. The vernacular expression, "I screwed my brains out last night," suggests a common wisdom that bears out this connection between the balls and the brain.

The records amongst the Taoists on the subject of sex were surprisingly consistent over long stretches of time, which in China meant not hundreds but thousands of years. This is significant because many groups didn't even know of each others abilities or whereabouts or even existence, because these esoteric practices were very hidden. Their records point out that when the energy in the testicles is cold or mostly yin, that this is a sign of strong and youthful sperm energy. This experience of cold gives way to what has been described as a mildly warm quality when the sperm is moved into the body from its exterior scrotal sac and stored in the epidedymis and vas deferens.

The (cold) yin sperm ching chi is more dense than the hot (yang) ching or sexual energy. Most people experience their sexual energy only when aroused and the ching chi is hot, although cer-

tainly it is always present. This means the cold energy, since it is thicker and slower to move, needs all the help it can get on its path up to the higher center. If you can open the Microcosmic Orbit first it will make it much easier. This channel, which loops up the spine to the head and down the front to the navel, genitals and perineum, is recognized by acupuncturists as the main energy channel in the body linking the various organs, glands, and brain.

DIAGRAM 12

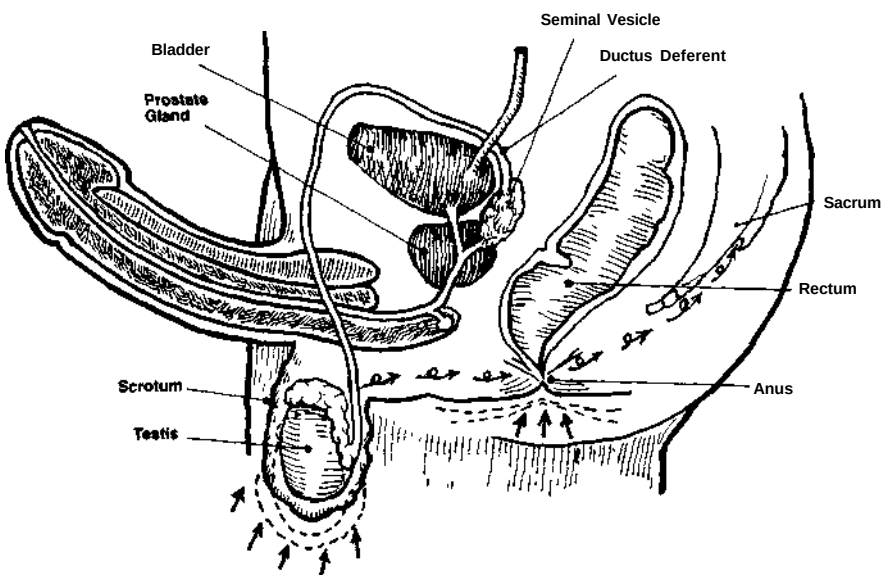

The testicle breathing exercise that follows will also help you to open these channels and complete the microcosmic orbit, a process more fully described in Chapter Seven.

In the "testicle breathing" exercise you use your mind to draw the "cold" (yin), youthful sperm energy up the spine to your head. You draw not the sperm itself, but the energy generated by the sperm. At first it's slow going, but the energy is easy to deal with since it's still cool. Later just a thought will send a refreshingly delightful cool wave of energy up your back to your head.

The second exercise, "scrotal compression," trains you to build up "warm" ching energy in the scrotal sac and move this energy safely upward. The third exercise, the "Power Lock," shows you how to deal with the ching when it is sexually aroused and very "hot." It is like a wild mare, and the most difficult to control. It is recommended you practice this alone (using self-arousal) before attempting to tame your sex energy at its most explosive, during love-making with a woman.

SACRAL PUMP AND CRANIAL PUMP

Contained and protected within your spinal column and head is the very heart of your nervous system. Cushioning it is the cerebrospinal fluid, cerebro for head and spinal for the vertebrae. This fluid, as it turns out, is circulated by two pumps. One is in the sacrum, and is known as the sacral pump. The other is in the region of your upper neck and head, the cranial pump. Many people who got these pumps working have reported feeling a "big bubble" of energy travel up their spine during testicle breathing.

DIAGRAM 13

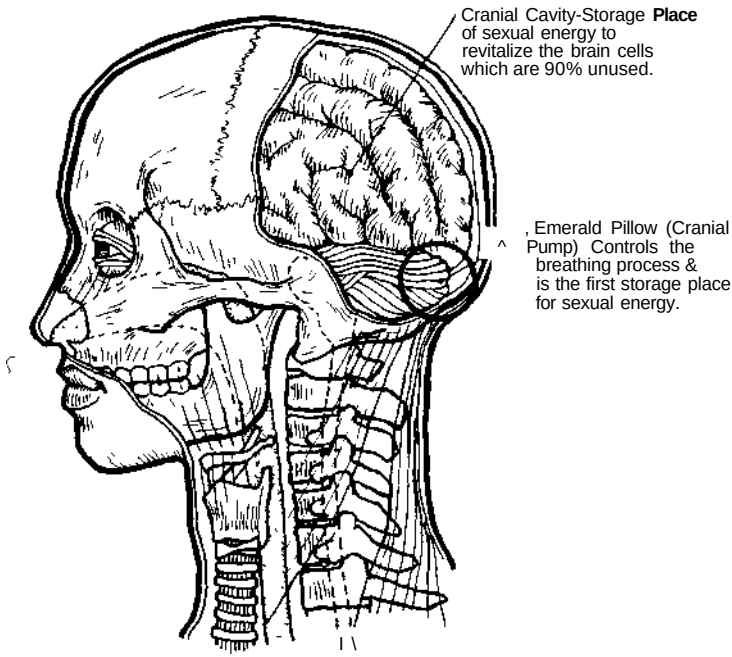

Taoists regard the sacrum as a pump which will help to hold the sexual energy coming from the scrotum and transform the energy at the same time it gives it a push upward. It's like a way station that refines the ching chi as circulates in the body. If the opening of sacrum, the Hiatus, is blocked, the life force cannot enter and flow back to the higher center.

The cranium of the skull has long been regarded by Taoists as a major pump for the circulation of energy from the lower to the higher centers. Medical research has recently confirmed that minute movements at the joints of the eight cranial bones occurs during breathing. Cranial movement is responsible for the production and function of the cerebrospinal fluid surrounding the brain and spinal cord and this is necessary for normal nerve and energy patterns in the entire body. Strengthening the cranial joints can increase energy and alleviate symptoms, such as headaches, sinus problems, visual disturbances and neck problems. In Taoist cultivation the pelvis, scrotum urogenital diaphragm, sacrum and cranial pump are very important to help move the sexual energy up to the higher center.

THREE POSTURES OF TESTICLE BREATHING: SITTING, STANDING, LYING

Sitting: I generally recommend sitting on a chair. I prefer this position for its simplicity and comfort. Sitting lends ease to a practice that favors relaxation and good concentration.

Sit on the edge of a chair with the buttocks and legs supporting your weight. The scrotum hangs free in the air. This point is important because the testes must be freely suspended in order for you to push a maximum of air energy down into them. Raise the tongue to the roof of the mouth as this is essential in circulating the chi, completing the loop between the front and back channels of the microcosmic orbit.

The feet are firmly planted on the floor with hands resting palm down on the knees. The back should be quite straight at the waist but slightly round at the shoulders and neck. This very minor forward curvature of the upper back tends to relax the chest and helps the power flow through the neck, chest, and abdomen. Keep the chin slightly tucked in. Military posture, with shoulders thrown back and head held high, tends to lodge power in the upper body

and prevent its circulating back down to lower centers.

A variant of the sitting position is to sit cross-legged, either in lotus position or American Indian style. We appreciate the esoteric virtues of the lotus position, but Chinese practice attributes to the lotus serious disadvantages. Some Buddhist monks have been crippled by lengthy meditation in lotus position. Also, turning the soles of the feet away from the ground prevents one from directly drawing in through the feet the earth's yin power. The human body is designed to absorb earth energy through the kidney (K-l point) and other meridians in the feet and filter it before passing it up to the coccyx and brain. Some people can develop problems if they absorb too much "raw" earth chi directly into their sacrum, as occurs in lotus position. Eventually they become allergic to this undigested energy and go crazy.

Nevertheless, the lotus may be used by those accustomed and devoted to it so long as they are comfortable and can apply their whole attention to the exercise. Few cross-legged positions afford such freedom of scrotal movement as sitting on the edge of a chair. If you sit cross-legged, you should wear very loose pants and remove your underpants to prevent resistance to full inflation of the scrotum.

Standing: Another good position is standing. The above instructions on raising tongue tip to palate and maintaining correct posture apply equally to this position. Standing is particularly favorable for scrotal breathing because the testes hang quite freely. Standing up straight in a relaxed manner encourages good posture. The hands are at the sides and the feet at shoulder width. Discipline yourself to relax if you get too tense, or the chi power may stick in the heart region and make you irritable.

Lying: Never lie flat on the back when performing these exercises. In this position the chest sits higher than the abdomen and receives too much energy. Nor should you lie on the left side. Both incorrect positions unduly stress the heart.

The proper lying position is on the right side. A pillow placed beneath the head should raise it about 3" to 4", so that the head sits squarely on the shoulders. The four fingers of the right hand area are placed immediately in front of the right ear, while the thumb sits behind the ear and folds it slightly forward to keep it open.

The ear must stay open to permit air flow through the eustachian tube. The left hand rests on the outer left thigh. The right leg is straight; the left leg, which rests on the right one, is slightly bent. This position allows the scrotum to hang free of the thighs.

DIAGRAM 14

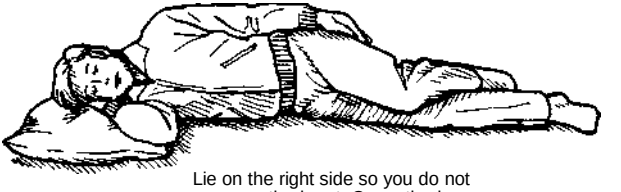

Lie on the right side so you do not press on the heart Curve the legs so the testicles hang freely

You may have noticed that lions often sleep in a similar posture. The animals are informed by wise instinct. The position frees the spinal column of the oppression of gravity and allows it to assume its natural curvature. Lying on the right side relieves the spine from stress.

TESTICLE BREATHING: STEP BY STEP

1. Sit erect on the edge of your chair with your feet flat on the floor about shoulder width apart. Wear loose pants or wear nothing from your waist down, so it can literally all hang out.* Do not practice naked in a cold room, or you will lose a lot of chi. With the air circulating around your bottom you'll naturally become more aware of your "privates." Allow your attention to center around your scrotum between the two testicles and you might be surprised to discover that it really is cold, or yin, down there. Make sure you feel very relaxed. If you are tense, do some stretching exercises or take a walk first to disperse tension.

2. Inhale slowly and pull the testicles up. Hold for awhile, then exhale slowly and lower the testicles. As you inhale, think of the breath going down into the testes and filling them up. At the same time raise the testes with the breath. Gently continue inhaling and

*If a woman performs any of the exercises in this book, substituting her ovaries as the source of energy, she should keep her panties on to prevent any chi from draining out.

exhaling with the testicles until you feel a lot of cold energy in the scrotum. You may do this in a round of 9, then rest and practice again 3-6 sets.

Draw the life-giving air to the very root of the body. Breathe out the accumulated wastes as the testes sink downwards. Generate a strong flow of energy to swiftly circulate the pelvic blood. Use the mind alone to cause the movement of the testes up and down—don't flex your penis or anus muscles.

After exercising for a week or two, you may observe the actual rise and fall of the testes during practice. This movement confirms that you are breathing properly. At a more proficient level, the lower abdomen will appear to move less: nearly all visible action will be in the scrotal sac itself. The dancing movements of the testes may be noted in the mirror and have a rather humorous aspect.

Unless specifically indicated otherwise, all breathing is to be done through the nose. Nasal breathing affords better control of the air inhaled. It filters and warms the air and supplies life force of well-balanced quality.

The whole body must relax. Allow all tension to flow out of you as if you were in meditation. Use the mind alone to raise and lower them. With practice you will learn to identify the cold ching chi stored in the scrotum area.

DIAGRAM 15

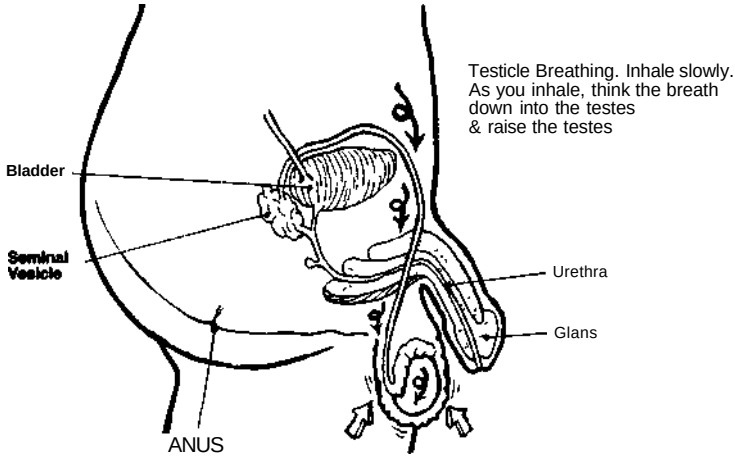

3. Guide that "cold" feeling from your scrotum to your perineum by inhaling and pulling up slightly on your testicles. At the same time feel it coolly flow the few inches to the perineum, an action induced by putting your mind at the perineum and holding it there. Inhale and exhale several times at the testes to build up more energy. The retention of the ching chi at the perineum is very important, for if you release your attention the cold energy will drop down to the scrotum or leak out. It is just like you are using a straw to draw up the fluid. When you are out of breath and pause for a while you need to keep the attention by holding your finger over the straw. If you release it it will drop down and you'll have to start again. Do this for several days or until you get it.

4. Begin to draw the sex energy from the testes up the back channel, as if sipping on a straw. Always start with testicle breathing, inhaling and exhaling till you feel the ching energy is ready. Inhale, draw the "cold" from your testicles to the perineum and then draw it up to your coccyx, the very bottom end of your spine. There's an area a little up from the tip of your spine, mostly bone, that's called the hiatus opening of the sacrum.

When you pull the cool ching up to the perineum and then to the sacrum, slightly arch your lower back outward, as if you were standing with your back against a wall and flattening it against it. Tilt the sacrum downward and hold it down in order to help activate the pump action, which will be further accentuated if you gently tighten the back of your neck and skull bones. Hold the energy at the sacrum for a while, then exhale but hold your attention at the sacrum.

Then let your sacrum and neck relax back to their normal positions, this will help to activate the two pumps, sacrum and cranial pump. At the same time do the testicle breathing. Bring the energy up to the sacrum again, hold it there till you can feel the sacrum open and the energy gradually move up. You can actually feel the cold energy move up a little at a time. If you're having trouble feeling this, try rocking your sacrum back and forth and then hold still and observe the effect of this pumping.

There's an indentation in the sacrum bone and that's where you draw your testes' "cold" energy. This particular area is usually a little difficult to work because sperm energy is denser than chi and has to be pumped up. So that's where that pump comes in.

Some people experience pain, or tingling or pins and needles when the "cold" enters the hiatus, so don't be upset if it happens to you. You can help get through the coccyx if you're having trouble by gently massaging the area with a silk cloth from time to time.

5. If you've managed to go up through your coccyx, spend the next week drawing the cold to T-11 in your mid-back (the 11th thoracic vertebra). Do it in the same manner, with an inhale-exhale at the testes and sucking it up your spinal "straw" to the perineum, sacrum, T-11 (opposite your solar plexus, at the last "floating" rib). Pull up and retain at T-11 till it feels full and continues to open and move up by itself. Again, because sperm energy is denser than chi, you have to accomodate to it by flexing that part of your back in and out to straighten it. That loosens it for freer passage of the "cold" energy.

At the T-11 adrenal glands energy center, sitting atop your kidneys. In Taoist practice we regard this as a mini pump, where your arch will create a vacuum to push up the energy higher.

6. Your next stopping place is at your jade pillow. This is at the back of your head, between C-l and the base of the skull. Do it in the same manner as discribed by inhale-exhale at the testicle and keep on pumping up the energy up to perineum sacrum, T-11 and the base of skull. In this area is a place to store the energy for further use.

7. Your next stopping point is Pai Hui, at the crown of your head. Do it in the same manner only this time fill the straw to the top. Tilt the sacrum to the back in order to straighten the curve out a little bit to help activate the pump action. This gets the lower pumping going. At the same time you tuck in your chin a little and squeeze the back of your skull, it will activate the upper cranial pump. Keep on pulling up to the point dead center on top of the head.

8. When the energy finally goes up into your head, men will have the very distinct feeling that it's spinning and usually in a clockwise direction, as you look up. If you're alert you can count 36 revolutions. It should feel good and refreshing; the extra energy should help your creative power and improve your memory. You can think more clearly, and are at the beginning stage of controlling

your sexual urges or frustrations. This sperm energy is later converted into chi, the original life force, in the spiritual levels of Taoist yoga. When people get older they've used up so much of their chi that the brain energy and spinal fluid gradually drain out and dry up, leaving a cavity. The testicle breathing transports the sexual energy to fill the cavity and vitalize the brain. Taoists regard the sexual energy as very close to the brain energy.

9. Finally you can bring the sexual energy from the testes up to the head in one sweet draw up the straw, a single clean inhale. In the beginning you can just go from station to station, till you feel the back channel (governor channel) is more open. Eventually you will be able to put your mind in the testicles and the crown of the head and just mentally move the sexual energy from the testicles up all the way to the brain.

10. Take your time to really feel the "cold" when you practice. Don't rush it, and always keep those pumps going as you breath in and out. Use more mind than physical pull when you do all this. Let the "cold" feeling be your guide. Work at it too hard and you'll heat up the "cold" ching. You won't be able to safely store this hot energy in your brain.

DIAGRAM 16

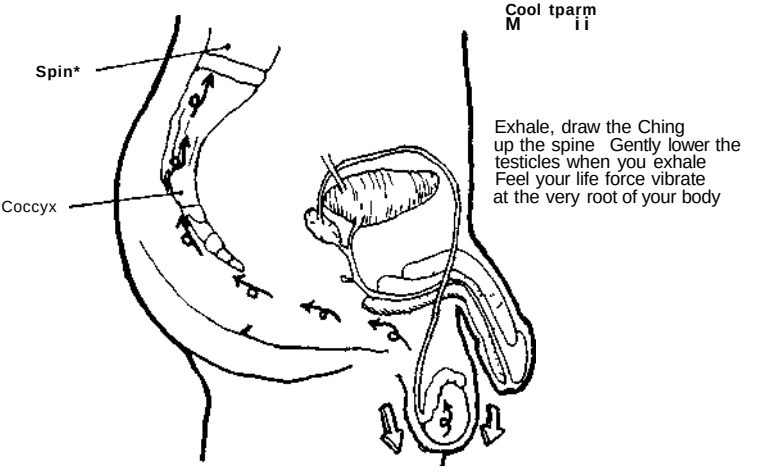

THE GOLDEN NECTAR

When your head is filled with sperm energy the excess ching may spontaneously combust with the chi in your higher centers and spill over into the Microcosmic Orbit and flow down through your palate and down the tongue. This will taste different to different people. It's generally called the Golden Nectar but it can taste like champagne, honey, coconut juice, or fragrance of all kinds of things, or it can simply feel like a warm tingling sensation on your tongue.

This exercise, the "Dance of the Testes", may be performed anywhere: in the subway or car, at your desk or television, in bed, etc. The main consideration is that the back be properly straight, chest relaxed, and scrotum hanging freely.

It is highly desirable to use the testicle breathing to tone the pelvic diaphragm. The whole lower abdomen is deeply massaged each time the pelvic diaphragm flexes. Life force flows into the region through periodic waves of breath which stimulate the glands and vital organs.

COMPRESSING THE AIR INTO THE SCROTUM INCREASES SEXUAL POWER

Many benefits of the Testicle Breathing are magnified when performed in conjunction with the Scrotal Compression exercise. This exercise reduces the incidence of nocturnal emission and premature ejaculation. It lessens the chance of hernia. It helps you calm down when sexually over-excited by teaching you to consciously direct energy into and out of the pelvic region. It builds your sexual power dynamically by using the vital chi taken from air and packing its charge into your ching chi.

Of the three suggested positions, sitting or standing are preferable. Inhale a fairly large amount of air into the throat and swallow the air. Swallowing drives the air down to the solar plexus. From this center it will be driven down to the testes. This is accomplished by contracting the abdominal muscles downward in a slow wave.

From the solar plexus the air is rolled down into the pelvic region. From there it is compressed into the testes. When the air is driven into the testes you experience a flush of heat. The testes

seem to expand, and after a short time the power driven into them flows up the spine to the head, which also becomes very warm.

SCROTAL COMPRESSION EXERCISE: STEP BY STEP

1. Sit on the edge of your chair with your feet flat on the floor about a shoulder apart. Wear loose pants or wear nothing from your waist down, so your testicles literally hang out.

2. Inhale through the nostrils into the throat. From there swallow the air down to the solar plexus, midway between your heart and your navel. Imagine the air as a ball.

3. First the ball sits behind the solar plexus. From this point roll it down to the navel. Then into the pelvis and scrotum.

4. Forcibly compress the air into the scrotum for as long as you can do so. The minimum period for each compression should be 30 to 40 seconds. Slowly work up to at least one minute. Every single scrotal compression shoots tremendous energy into the testes. With compression of an entire minute the exercise takes full effect. The anal sphincter and perineum muscle must be squeezed tight during this exercise to prevent leakage of energy.

5. When you have finished the compression, exhale and relax completely. If saliva accumulates in the mouth during compression, swallow it before exhaling.

6. After complete exhalation take a number of quick, short breaths to recover your wind. Dart the air in and out of the nostrils to quickly regain capacity for another compression. Remember to breath through the nose, and do not inhale unduly large quantities of air. This is called "Bellows Breathing", because you must pump your lower abdomen in and out quickly in order to do it.

This exercise quickly charges the whole body. If you feel ill or out of sorts, several scrotal compressions will restore you to good form. Perform the exercises in the following sequence: First do one scrotal compression. Then rotate the waist with the arms at shoulder level. Rest for a moment and repeat the exercise. Remember to keep the tongue up to the palate when compressing the air. Perform 5 contractions.

When you have grown stronger, you may do five compressions in succession and then rest with waist rotation. Then begin a second series of five compressions. Keep the breathing between compression short and shallow to not lodge power high in the body.

DIAGRAM 17

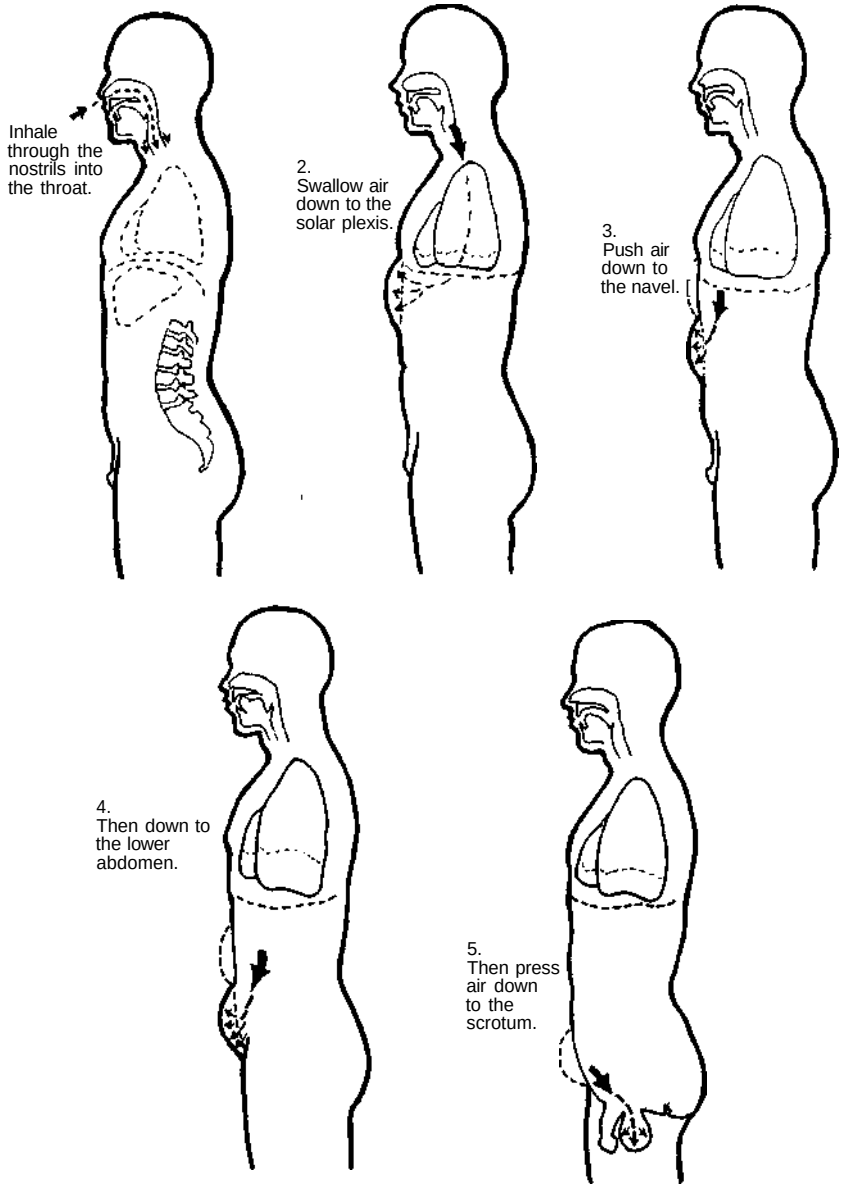

Practice testicle breathing and scrotal compression twice a day for about fifteen minutes in the morning and fifteen minutes in the evening. This method alone yields real benefits. In addition to those benefits already mentioned, it also helps cure impotence or deficient virility. Insomnia and nervousness often radically improve with these breathing techniques. General lack of energy and associated symptoms may also be relieved with regular practice.

If you have retained your sexual fluid for four weeks or more, the exercise should start to take effect within three days after beginning practice. The testes feel warm, tend to "jump", and may itch somewhat. These indicate that the testes are receiving unusually high amounts of vital force. The tissues are already regenerating. These signs occur only if the exercise is done properly. A month or two of exercise will produce substantial increase in strength and well-being.

VENTING EXERCISE FOR HIGH BLOOD PRESSURE

After practicing scrotal compression for 2 to 6 weeks, some students with high blood pressure notice a large flow of chi energy to the head. They feel tension in the head because the blood has followed the upward flow of the vital power. This is not unlike a mild symptom of the "Kundalini Syndrome", in which freed energy races about the body out of control.

If you suffer from high blood pressure and haven't practiced meditation to open the microcosmic orbit (described in chapter 8) which distributes the energy evenly through the circuits of the body, you can meditate on two points to vent excess pressure. These are the Ming-Men, on the spine directly opposite the navel (between T-12 and T-13) and the Yuang Ch'uan (K-l point), on the balls of your feet.

To locate the Ming-Men place a string around the waist like a belt. Make it perfectly horizontal and place it across the navel. The Ming-Men lies where the string meets the spine. If you have a big hanging belly, measure from where your navel was before it fell. When you bend over backwards from the waist, the point feels like a hole in the spine.

The other point, the Yuang Ch'uan, lies on the foot. When clenching the toes, it is the deepest central point on the ball of the foot.

Once you've found the point on both feet, tape onto them spiny little balls such as a prickly chestnut or plain tree seed pod. Place both hands at the back and press firmly on the spiny ball while concentrating on the M4ng-Men point. This draws the chi and blood there.

After you feel the power flow to the Ming-Men, direct it down the spine and legs to the Yuang Ch'uan. Press down on the ball so that you feel the spines very distinctly. In severe cases it may take a month or two to get the power into the Ming-Men and bring it down to the Yuang-Ch'uan.

If blood flows too strongly to the head during or after scrotal compression, vent the power. Imbalanced force will flow out of the body through these two points. After practicing the scrotal exercises, many students open the microcosmic orbit so that their energy flows in a continuous circuit. This alone has often cured high blood pressure.

DIAGRAM 18

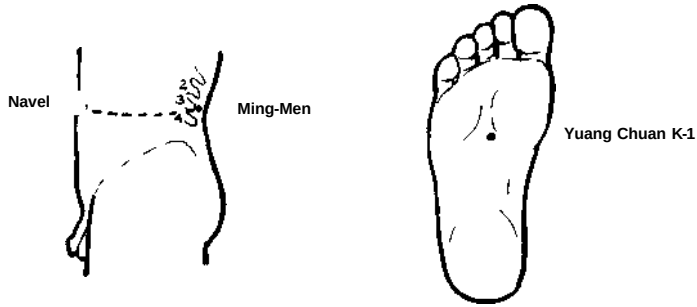

THE POWER LOCK EXERCISE FOR SEALING THE SEMINAL FLUID

When you are well trained in this exercise you can use a variant of it during sexual intercourse, known as the Big Draw. The power locking method is done without a partner as a daily practice exercise. The method is the best for building power in the perineum to seal the seminal fluid. The sexual energy that we deal with here is different from the testicle breathing and scrotal compression and it's important to learn the subtle difference.

In the testicle breathing you move the cold sexual energy, the ching chi that lies in the scrotum in its yin state after production by the testicles, up to the head and then down into the body. With the scrotal compression exercise you force the chi energy that is produced in the organs—heart, lungs, spleen, etc.—down to mix with the cold ching chi resting in the sexual organs. Then you move the resulting warm energy upwards and circulate it.

In the Power Lock Exercise we arouse the sexual organ, turning the cold energy that lies in the seminal vascular duct into hot sexual energy. This heat is generated by the movement of millions of sperm cells. This yang energy is more explosive, harder to control, and always seeking the most direct path out to a cooler (yin) environment. In most men the path of least resistance is out the penis. In a Taoist master the easiest channel is up into the higher centers of the body. But it takes a lot of practice to control the anus muscle and the involuntary muscle around the seminal vascular duct to reverse the flow towards the penis and to help push up the sexual energy into the spine and upper body.

There are 4 levels of Power Lock practice:

1. Beginner: use muscles of the fist, jaw, neck, feet, perineum, buttocks, and abdomen to divert sexual tension and block the urge to ejaculate, and push upward the hot ching chi which created the aroused state.

2. Intermediate stage: less muscle use of the fist, jaw, feet, and increased reliance on the pelvic diaphragm, and sphincter, sacral, and cranial pump to help move up the sexual energy.

3. Advanced stage: less muscle in the perineum and more use of sacral and cranial pumps. Greater power of mind to move the ching to the crown center. By concentrating power at the upper part of the crown you draw the energy from the lower center to the higher center.

4. Most advanced stage: pure mind control only, no need to use the muscle, just use the mind power to command the penis, and command the ching energy to move up and down, to be erect or flaccid, as you will.

DIAGRAM 19

POWER LOCK EXERCISE

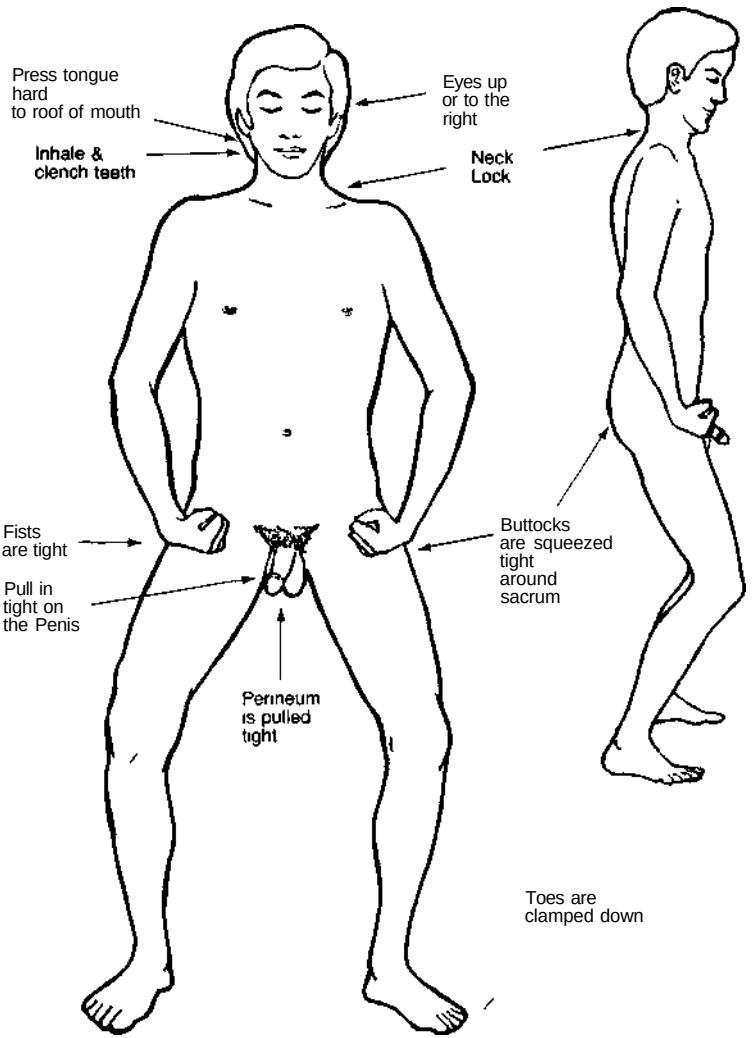

Ching Chi is stopped from escaping out the penis & its energy is pulled up to the crown until the penis erection subsides

In this exercise, you need to arouse the penis about 90% of the way to orgasmic ejaculation. Do not go beyond the point of no return, or you will have no sperm chi to practice with for awhile. As you master the Power Lock you may fine tune how close you come to ejaculation and stop at 98% or 99%. Rub the glans of the penis until it is erect. When you have a feeling that orgasm is imminent, stop and do the Power Locking method 3 to 9 times or until the erection subsides. This counts as one exercise. Repeat this procedure—stimulate penis to erection and then do the locking until it subsides—as many as 3-9-18-36 times at a sitting.

Practice makes perfect. Once you gain control of your sexual organs totally in this practice, you will naturally have full control in sexual intercourse. I recommend practicing up to 10,000 times in order to gain advanced control, although some will naturally master it much more quickly if they have trained their mind through yoga, meditation, or other disciplines. If you are not involved in a program of daily physical discipline, I suggest you at least do some warmup exercises and stretching before practicing the Power Lock. This will tone up the energy in your organs and make it easier to feel your internal chi energies and thus hasten your command of your sexual energy.

POWER LOCK EXERCISE: STEP BY STEP

1. Sitting position is the same as in Testicle Breathing—feet flat on the floor, wear loose pants or naked from the waist down. Stimulate your penis to erection. Center your attention on your sexual organs and the expanding energy in the penis and scrotum.

2. Inhale deeply through your nose when near orgasm. Simultaneously clench both fists, claw your feet down, make them feel like vacuum pumps sucking at the floor. At the same time clench your jaw, tighten the cranial pump at the back of your neck and press your tongue firmly to the roof of your mouth. Inhale once more and draw up the entire genital-anus region, concentrating on the Hui-Yin (perineum), urogenital diaphragm, and especially the penis. Pull the energy from the penis to the perineum by squeezing as tightly as possible. Holding your breath, slowly count to 9 with all muscles fully flexed. When you are out of breath, exhale and release all muscles in the body. You may feel energy rush up and down, especially in the sexual region.

After exercising for a week or two, you may actually begin to feel the muscle contraction pull your penis up and in. The anus will feel like it's closed super-tight. Unless indicated otherwise, all breathing is to be done through the nose. Nasal breathing affords better control of the air inhaled. It filters and warms the air and supplies life-force of well balanced quality. The whole body must relax on the exhale. Allow all tension to flow out of you as if you were in meditation.

Inhale, clench, and pull up repeatedly on your sexual region, holding the energy at the perineum. The retention at the perineum is very important. If you release your attention the hot energy will drop down to the sexual organs or leak out to the penis. If you release the energy it will drop down and you'll have to start again. Do this for at least one week.

3. Start with arousing the penis. Clench fists, feet, neck, and jaw, on the inhale. Draw up the entire genital organs, diaphragm, anus, and especially the penis, pull the hot energy up the perineum and continue to draw it up to your coccyx. A little up from the bottom tip of your spine. Feel it enter the hiatus opening in the sacrum.

Activate your sacral pump by arching your lower back outward in order to straighten the spine. This makes it easier for the chi to rise. Hold the energy at the sacrum section, keep on inhaling and pulling, inhaling and pulling in the sexual energy from the sexual organs until you can feel the erection calm down. Sometimes it may need 3-9 inhalations with increasingly hard contraction. Squeezing the buttocks more tightly may help you force the ching into the sacrum. When you're out of breath, exhale. Then relax and let your sacrum and neck go back to their normal positions, this will help activate the two pumps.

If you practiced the Testicle Breathing (or already opened your microcosmic orbit), when you do the Power Lock it will be much easier to get the hot sexual ching to enter the sacrum. Otherwise this area is usually a little difficult to work through because sperm chi energy is denser than other types of chi and has to be pumped up. That's where the sacral pump comes in. Some people experience pain, tingling, or "pins and needles" pain. When the hot sexual energy enters the hiatus, don't be upset if it happens to you. You can help the ching get past the coccyx if you're having trouble with it by gently massaging the area with a silk cloth from time to time.

4. If you to go up to through your sacrum, spend the next week drawing the energy to T-ll on the spine, opposite your solar plexus. Repeat the same procedure—arousing, clenching , and inhaling. Pump up the energy up to the perineum, sacrum, then to the T-ll, where you should retain it until it feels full of energy. It's really open when you feel the ching itself. Again, because sperm energy is denser than chi, you have to accommodate to it by bowing your spine outward to straighten it to increase the pumping action and allow for a freer passage of ching chi upward.

DIAGRAM 20

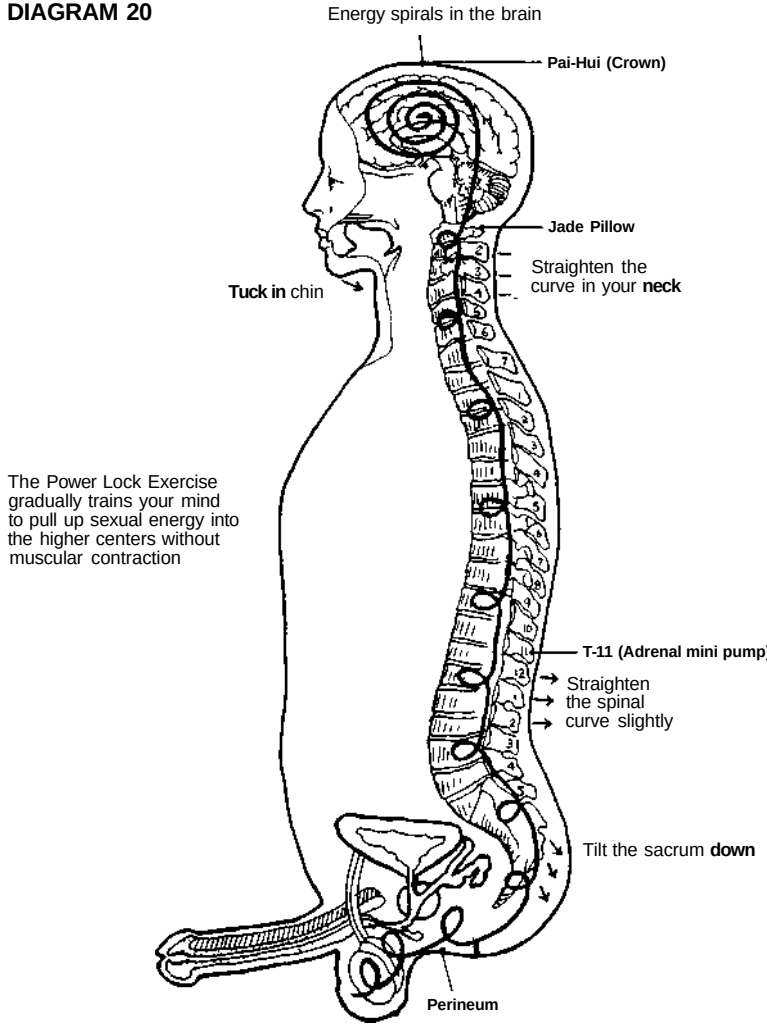

5. Your next stopping place is at your jade pillow. This is at the back of your head, between C-l and the base of the skull. Do it in the same manner as described—keep drawing up the energy up to the perineum, sacrum, T-ll, and the base of the skull. The cranial pump may fill with energy and pound furiously when the energy first moves through.

6. The next stopping point for the energy is the Pai Hui, at the crown of your head. Repeat the same process of arousing and deflating your erection by drawing the energy up. Make sure you tuck in your chin slightly and squeeze in the skull to further activate the upper cranial pump and keep the upper spine straight. Keep on pulling the energy to the top of your head until you get the erection to subside.

When the energy finally goes up into your head, you'll have the very distinct feeling of warmth and tingling sensations from the energy. The usual immediate response is that it feels good and amazingly refreshing. Some people claim they can think more clearly and are more creative; it's possible they are at a stage where they can easily convert the ching chi into expanded consciousness automatically. This sperm energy is later converted into the original chi, the pure life-force, in the spiritual levels of Taoist Yoga. When we get older we have used up so much of our brain energy that the fluids gradually begin to dry up, and leave a cavity in our head. The Power Lock helps to transport the sexual energy to fill the cavity; instead of storing it in the scrotum it is stored in the higher regions of the body/mind that can take immediate benefit from it. Taoists regard the sexual energy as a creative energy that can be transformed to any part of our vital organs, glands, or brain.

Practice the Power Lock until you can pull up the sexual energy from the penis to the head in one pipe. In the beginning you can just go from one station to another. Later the back channel (governor channel) will feel more open. Eventually you will be able to put your mind in the testicles and at the crown of the head and just bring the sexual energy from the testicles all the way up to the brain. Take time to really feel the sexual energy when you practice. Don't rush it, and always keep those pumps going after the exercise as you breath in and out. Gradually use more mind than physical pull when you do all this. Let the energy feeling be your guide.

7. When you feel the energy has filled the brain, concentrate on the mid-eyebrow and bring it down through the nose and the palate and

down from the tongue to the throat center, heart center, solar plexus, and then down into the navel. This circulation is aided by the internal pressures created during the Power Lock. You press the lower trunk energy into and up the spine. At the same time, you press the energy in the upper body downward and hold the contraction as long as you can. When you exhale completely relax the whole body. The natural direction of the chi is to continue in a circle up the back of your body and down the front to the navel.

Continue cycling the sexual energy in this way until your erection subsides. In the beginning, and especially if your very aroused sexually, it may take 3 to 9 such cycles to accomplish. But after you've practiced for awhile, one such round is enough.

8. Perform 36 complete contractions in the morning and at night. Once you've got the hang of it, for the normal man 36 repetitions, morning and night, should not be unduly strenuous. If you are very aroused you will do fewer repetitions as each erection will take longer to subside. With such intensity of training, you will easily develop the muscle tone needed for effective seminal retention within a month or two. How quickly you progress is not important; what is essential is that you progress steadily. Rock bottom minimum should be one round per day just to keep the habit. If you happen to see a pretty woman or photograph that arouses you during the day, you can instantly perform the Power Lock and draw the energy up. Make sure your boss is not watching as he may think you're having a seizure.

The preferred times for these exercises are from eleven P.M. until one A.M. or 11 A.M. until one P.M. During these periods the tide of Yin Energy changes to Yang, and vice versa. The sun begins to rise around midnight and starts to set around noon. At these times the power flows very well. If you cannot practice during these hours, don't be discouraged: you will definitely advance so long as you exercise daily.

9. A final refinement to remember is that the lower contraction is not centered in the stomach or abdominal region. We concentrate on the front of the under trunk—the penis, perineum, and urogenital diaphragm. Our goal is to so train these muscles that they immovably dam up the seminal river. Then we will reverse the river's flow and flood the body with restorative energy.

Directing power from the upper and lower trunk toward the center of the body pours energy into the navel region. Since the

seminal fluid (like the blood) tends to follow the chi energy, the navel, in effect, grips the seminal fluid and pulls it up into the body through the spine. So contract the urogenital diaphragm as if you were holding in a bladderful of urine. Lock the passage so tightly that no internal urge can burst through the sealing rings of muscle.

SAFETY POINTS FOR TESTICLE BREATHING, SCROTAL COMPRESSION, AND POWER LOCK

1. Never lie flat on the back during these exercises. The power may stick in the chest, causing considerable irritability and undue pressure on the heart.

2. Never lie on the left side when practicing. This also stresses the heart and overfills it with energy.

3. Never place any objects under your side while in the lying position. This will bend the channel of energy and may cause back pain.

If any of the problems mentioned in points 1 to 3 arise, release the energy safely by using the "Venting Exercise". Any pains or discomfort should disappear within one week of beginning to vent.

4. Practice on an empty stomach whenever possible. In any event, always wait one hour after eating.

5. Wear clothes or wrap yourself in a light blanket during this practice. You will perspire if the exercises are done properly and will suffer a chill if not covered. After practice change your clothes so that you are removed from the moisture of the fabric. There should be a gentle flow of clean air in the room. Avoid any drafts or wind. Wind tends to blow the chi power away. It might cause your energy to get cold easily.

6. Sweat should accumulate on the brow after five scrotal compressions. As you advance, beads of sweat should stand on your brow after three compressions. Rub this sweat into the skin: it has desirable properties which should be returned to the body.

7. Don't breathe through the mouth during these exercises. It is

easier to control the flow of air when breathing through the nose. Inhalation through the nose charges the air with energy and invigorates the brain.

8. Do not be concerned if you feel little effect during the first days of practice. Students need varying amounts of time before heat flows from the testicles.

9. You must develop intense concentration. Keep the mind from wandering. Allow thoughts and images to leave without following them. Empty the vessel-of-the-mind of thoughts: powerful energy will stream into the void. Your power of concentration will develop greatly if you persist in this discipline. Learn the Microcosmic Orbit Meditation and do it immediately after practicing the Power Lock.

10. During practice close the eyes and follow the energy's path. The mind should not stray to thoughts or fantasies but strictly track the course of the power. This may sound very difficult. You will be amazed at how quickly you can become sensitive to your own energy. When you experience these energies within yourself, you will know exactly what we mean. Since the energy flows along natural courses, it guides your mind even as your mind guides the power.

11. Those who suffer from constipation should practice in the morning, the regular hour of bowel movement. These exercises will help greatly to remedy the problem.

12. For the method to be effective, you must not ejaculate for 30 days. After ejaculatory orgasm, the body must begin anew to accumulate enough chi pressure in the testes. If you have not learned to hold in the seed during intercourse, refrain from sex during this 30 day period. In this manner you will experience the full power of the method.

Of course, I am not opposed to your desire to have sex. I merely inform you that your progress will be retarded if you ejaculate. Begin learning now to sacrifice ejaculatory pleasure for greater pleasures to come. When you have accomplished these scrotal exercises with proficiency, you may more quickly master

retention of the vital seed during love making. This is the main teaching of Sexual Kung Fu.

CLEANSING SIDE EFFECTS

1. It has been my experience that many students of this method soon begin to move their bowels with unaccustomed ease.

2. If you are infected with venereal disease, thoroughly cure yourself before engaging in this exercise. Otherwise the pain will be quite severe when you draw so much blood and power to the pubic region.

3. Some will pass an unusual amount of gas for a time and move the bowels two or three times per day. In this way the body uses its new resources to thoroughly cleanse and purify itself by completely natural means. The unusual number of evacuations and the gas cease within one or two months.

4. This purgative detoxification is followed by regular bowel movements and a deep sense of bodily purity and strength. The saliva becomes lighter and sweeter. Improvement in bowel function arises from the increased flow of vital energy into the entrails. This energizes the involuntary muscles and allows them to function with ease. There may also be a noticeable increase in burping, which is a healthy exhalation of impurities and noxious gas within the body. Burping also lessens after a time with the body much refreshed.

5. The Power Lock is excellent for curing hemorrhoids. Hemorrhoids are caused by sedentary life styles, accumulated heavy toxins, gravitational pooling of blood, stressful bowel movements, and depressed levels of chi energy in the Hui-Yin. In already existing hemorrhoids, the Power Lock may cause increased bleeding for two to four weeks. If the bleeding is not excessive, perform the exercise at *Vi* strength. You will gradually be cured. The exercise remedies specific causes of hemorrhoids. It evacuates stagnant blood from the anal blood vessels. While performing the Power Lock as a cure for hemorrhoids, you may use medication to speed the healing process. Horsetail Grass, Equisetum Narvensis, is an excellent remedy used as a tea and in Sitz baths. People who have serious hemorrhoid problems should consult your doctor first.

SUMMARY OF TESTICLE BREATHING

1. Choose your preferred position. Standing is well-suited to this form. Relax the whole body and concentrate on the testes.

2. Think the testes to rise in the scrotum as you inhale. Let them sink slowly as you exhale. Practice 36 to 108 breaths.

3. Relax: do not use muscular force. Keep the tongue on the palate, and feel the cool yin energy of the sexual fluids rise up your spine.

SUMMARY OF SCROTAL COMPRESSION

1. Choose your preferred position.

2. Breathe in very slowly through the nose, concentrating on the throat. Compress the air in the throat until you can inhale no further.

3. Swallow strongly to the solar plexus and hold the air there as if it were a ball.

4. Press the ball of air down to the navel region.

5. From the navel press the ball of air down to the pelvic region.

6. Press the ball strongly and continuously into the scrotum until you can hold your breath no longer. At the end of your breath capacity swallow the saliva strongly.

7. Rest by taking quick, shallow breaths through the nose.

8. Relax by rotating the waist several times.

9. Start with 5 repetitions and increase slowly to 36 at a sitting.

10. Keep the tongue up to the palate.

POWER LOCK IS THE BASIS FOR ALCHEMICAL SEX

Though they may appear elementary, the exercises in this chapter are highly refined techniques for increasing vital power. They represent the essential Taoist breathing technique. They are like sharp swords which must be used with care to perform their functions without harming oneself. If you follow my instructions closely, you will not suffer any distressing side-effects. Study the methods with seriousness, assimilate every line of the text. Persist until you have succeeded.

These methods are received from many Taoist masters. The breathing exercises in this chapter, for example, synthesize the teaching of four Masters. Each believed his Method the supreme secret and had notable results with his breathing technique alone.

Nothing will come of nothing. You must spend time in practice to reap the benefits. An ounce of practice is worth a ton of theory. Modern life affords little time for anything but getting and spending. You must be willing to surrender a part of time to speedily advance. The practice must become part of your daily routine. You will make some progress if you do the exercise more often than not. But if you practice as regularly as jumping from bed in the morning, progress will be swift, and chi will begin to build in your upper body which you should collect at your navel.

To make full use of the ching gathered at the navel requires study of the Taoist methods of meditation. Slightly below the navel is the lower "tan tien" center, the lower field of energy in the body within which the Taoists store chi before refining it back upward. The chi moves in circles between the lower, middle, and upper tan tiens, and each time it spirals past it is refined into higher quality of chi. The process of refinement and balancing of the energy is taught in the Microcosmic Orbit, the Fusion of Five Elements, and the Lesser Enlightenment of Kan and Li courses.

It's not unlike taking crude honey mixed with wax and dirt and dead bees and methodically refining it into the sweetest of nectars. The Taoists treat sperm like raw honey. The Power Lock is the step of preventing the raw honey from leaking out of an old bucket and storing it an a new and well-sealed jar. This jar was placed at the level of the navel about two-thirds the way back towards the spine, and was called by the ancient masters the "cauldron". In this cauldron they mixed and cooked the different

chi energies of the body in a process they called "alchemy"—the precursor of modern chemistry.

The secret alchemical agent they used was nothing more than ordinary sexual "essence", your ching. But without it, none of the higher levels of alchemical meditation work. So these simple Sexual Kung Fu exercises—Testicle Breathing, Scrotal Compression, and Power Lock—may seem simple and too rudimentary to effect spiritual development, but their proper mastery is essential before you can move on to loving a woman with full command of your sexual and spiritual powers. Your sexual essence is an elixir of life and the fountain of your youth, and is worth training vigorously to safeguard.

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*If a woman performs any of the exercises in this book, substituting her ovaries as the source of energy, she should keep her panties on to prevent any chi from draining out.

CHAPTER 7

POLARITY IS THE KEY TO TRANSFORMING SEX ENERGY

"Sexual interaction is comparable to water and fire. Water and fire can kill man or help him, depending on how they are used.
—*Pao, the plain master*

To be a Taoist is to experience life as a harmonious flow of life energy. In the traditional Taoist terms, this flow in humans is from "chi", to "ching", to "shien"—from breath to sex essence to spirit. It flows both visibly and invisibly, in a never ending cycle, as it circulates within you, between you and the world, and between Heaven and Earth with man in the middle. It is the blood that flows between heart and kidney, the love (and hate) that passes between man and woman, the storms and sunshine that circulates between sky and earth.

Many people drown in this flow of life; they are simply overwhelmed by it. Some can't "get" enough flow and feel cheated or bitter. Others drift aimlessly without purpose, alienated and unaware there is a flow. Regardless of your attitude toward life, nearly everyone seeks at some point, to anchor themselves in a love relationship. Such is the power of the flow of ching chi, of sexual essence between man and woman. This much is obvious. What is also obvious but is almost always overlooked is the polarity between male and female, and the subtle flow between their two magnetic poles.

This polar exchange is overlooked because the flow is invisible to the physical eye, and because its workings are often too subtle for the uncultivated mind to perceive. That is why Taoists study the workings of chi, ching chi, and shien. These energies, also called the three treasures of life, are the subtle language of life, and to speak in them properly takes years of practice and refinement. At first approach it may seem like learning a foreign language. But after a few lessons you quickly realize you were born speaking this language and merely forgot the subtle grammar of chi energy while being intensively schooled by parents and teachers in more mental subjects.

This flow of energy between opposite poles of male and female is the key to harmonizing the flow of energy in one's life. It is the simplest and most basic secret, not only of the Taoist masters but of every esoteric tradition. It is the key to mastering the Taoist secrets of love. It's simple because its based on the natural law of the universe—that positive and negative forces attract and bond with each other. Its as true for a simple pair of magnets locking together as it is of the protons and electrons locked into the dance of subatomic particles that form the atom. The Taoists called this polarity yin and yang, terms that have become popular today in the field of holistic health, but are not well understood in terms of their functioning in sexuality.

One way the Taoists describe it is with the simple metaphor of cooking. Yang is fire and yin is water. Man is the fire, and woman is the water. When man makes love with a woman, he cooks the woman's water (in her womb) with his fire (penis). The woman is almost always sexually stronger, for her water puts out the male fire; his erection loses its flame. Yin, the soft and yielding, always conquers yang, the hard. In the same way water (rivers are yin, or female) triumphs over solid rock. Thus a stream slowly wears away a giant mountain and carves the Grand Canyon a mile deep.

YIN AND YANG: BATTLE OF THE SEXES

This battle between yin and yang is seemingly endless, just like the never ending battle between the sexes. In fact, the Taoist sages also used the metaphor of combat to elucidate the act of sexual love. For some men love is a passionate struggle for domination and surrender; to the Taoists it was more a lawful play of opposites. Ideally you enter the battle of the sexes with a spirit of gamesmanship. You approach not with the intention of defeating your lover, but in the hope of matching her grace and receptive energy with the exact complementary male skill and force.

Unfortunately, few men today seem to proceed with such tact in love-making; as a result, most are beaten soundly within minutes by the woman. This failure is due to tactical ignorance of both the male sex organs and the nature of sexual energy. Misunderstanding of love's strategic laws is so widespread that a myth has developed that the average man cannot fully satisfy a passionate woman.

In fact, the average man can unfailingly satisfy his mate when

he learns to discipline his forces. Untutored man's nature is to attack: he possesses the offensive weapon. Woman's is to defend: she protects without exhausting herself. When man assaults furiously and discharges the sperm, he crumbles. Yet the woman may remain most eager to continue, even if she kindly denies it and thus "spares" her opponent.

To pursue the martial metaphor of the Chinese. . . . The woman's shield and short sword is her vagina and clitoris. Man is armed with a long spear alone, his penis. If man attacks too violently with his love weapon, woman easily fends off his thrusts and does him in when he exhausts his seed. But if man remains beyond woman's striking range, she drops the shield from fatigue. The contest will be over before man has lost his vehicle of higher vitality.

The point is this: Man must stop throwing away his sexual energies. When he stops the sperm loss, woman is no longer in a position of superiority. She meets her match and no longer suffers disappointment. Man doesn't exhaust himself and retreat in humiliation, yet feels he has met a good match. Woman reaches the limits of her erotic capacities and is ready to make real peace with her opponent.

The sages thus advise you to use your tactical weapons first. Hold the strategic one in reserve. In other words, use the finger, tongue and other parts of the body before using the penis. Through tender and skillful use of your other limbs in foreplay, you may bring your partner to a state of very high receptivity as the first step in gaining equality with a superior opponent.

Her breasts will rise, respiration and glandular secretion will increase. You should wait till fluid rolls to the vaginal lips before using your chief arm. Give your lover time to fully enter the condition of love before you enter her.

The battle between man and woman is over when both recognize that neither can "win" by either dominating or submitting. At that moment, both become free to surrender to each other and exchange their deepest love—their vulnerabilities have been matched and their fear of losing is neutralized.

HIGHER ORGASM IS A DELICATE BALANCE OF POLAR ENERGIES

But how to reach that point of tenderness, where both lovers joyously yield and receive life from one another? It sounds great on paper, but what happens to tense energies left over from a tough day at work and an argument with your wife about whether she should go back to work? How do you keep daily politics out of the bedroom? This chapter will offer some practical ways to approach love-making with the goal of balancing the flow of yin and yang power. But first understand the principle of polarity is dominant in this sexual practice.

The single most important point to remember about polarity is that yin and yang energies are not separate energies: they are one and the same energy, but with two different charges. They never exist apart from one another, but are always in fluid motion, like a pendulum swinging back and forth, passing from hot to cold, and gradually moving to stillness at the perfect moderate temperature. Another metaphor is to see man and women as two sides of the same coin. During love, the coin spins rapidly, fusing the two sides into one.

That is how man and woman can become "one": they simply realize the flow of sexual energy between them is continuous and belongs to them both. Each lover is at opposite ends of the polar flow. When the exchange of ching chi reaches a certain intensity and balance the solid bodies of the two lovers begin pulsating as if charged with electricity. The feeling of having solid flesh disappears. You are suddenly a pillar of vibrating energy held in exquisite balance by your lover's field of energy. This is a total orgasm of body and soul. The battling ego shrinks to its true size, a tiny grain of sand, and reluctantly begins humming in chorus with the ocean of the subtle universe that rhythmically washes over it.

Many men may have a glimpse of this, but few are able to sustain the experience because they discharge the energy from their half of the polar field by ejaculating. This is not true orgasm; it is merely releasing the discomfort, the exquisite "itch" of too much excited energy that has nowhere to move but out.

A true orgasm occurs when both man and woman continue to pulsate together. Their sexual energy completes a full circuit between their two magnetic poles, charging each of them more fully

than before. This circle is the Tao, the black and white teardrop symbols of yin and yang flowing into each other in perfect circular harmony.

The flow of sex energy alone cannot complete this circle; love must be present. The mind must participate in sex with a totally attentive feeling. This circle of energy cannot connect if a man only joins his penis with a woman's vagina without loving her with his heart. That is like holding the ends of two horse shoe magnets close and then only touching one arm from each magnet. The other arm also wants to connect, to seal the magnetic attraction. Only when both positive and negative poles of both the man and the woman are locked in place can the energy flow with any power and stable balance. That is why sex alone, without love makes you unhappy—you're only connecting one half of yourself to the woman, and your lower half at that. The flow of chi in the Tao's circle is broken, and without that total flow between yin and yang no amount of sex will satisfy your deeper desire for wholeness.

The ejaculatory orgasm to which most men are so deeply attached restricts their life force to the genitals. During sex the penis literally bursts with life, as it is too small to contain the expanding sexual force. The penis was not designed to hold your life-force anymore than it was designed to be your brain and central nervous system. The real function of your penis is to conduct life into and out of the body. The sex organs are only doors through which life enters and issues forth.

When the upper poles of men and women are connected—at the heart and mouth—as well as the genitals, then the magnet can become an electro-magnetic dynamo. Then the chi can nourish the ching chi in the lower half of the body, and combine together to be transformed into spirit in the upper half. If both man and woman cultivate their chi upward, and refine it to a high level through meditation and love, they can develop a polarity which creates a super magnet and conducts even higher spiritual energies through their human form. Such experiences break through the bounds of individual pleasure and sensation, and go beyond the satisfaction of their personal egos to attain an entirely different state of being.

Perhaps you know a couple who is radiantly happy and deeply loving and do not practice any esoteric method of love-making and who you assume ejaculate and have orgasm to their heart's content. You are right to ask—why bother learning these seemingly

DIAGRAM 21

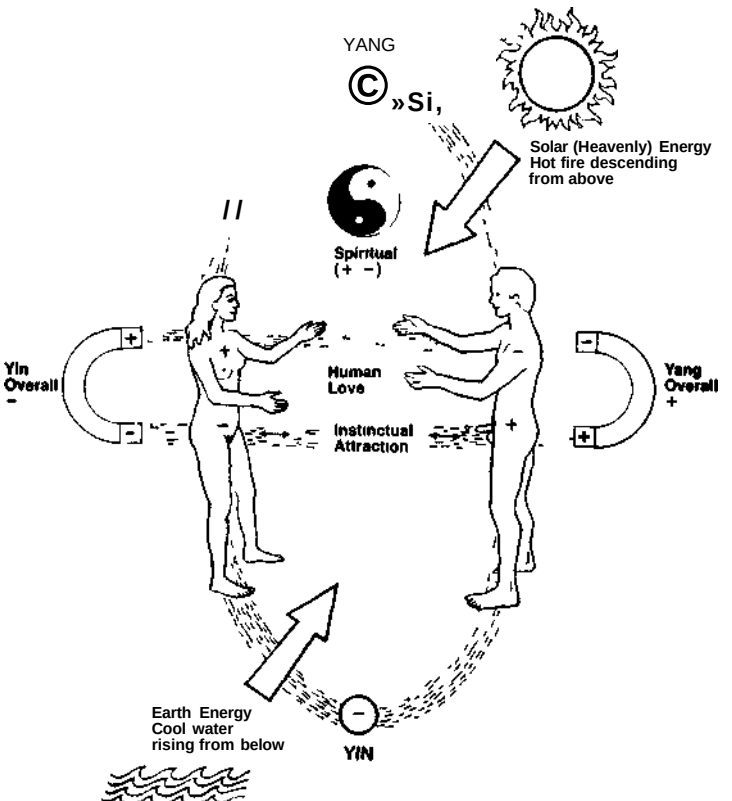

The key to higher orgasm is the balancing of subtle polar energies on the physical, emotional mental & spiritual levels Yin & Yang are always a single energy with opposite charges at each pole

complicated and time-consuming Taoists exercises and methods of sex energy transformation? Why not just love your woman the way you know now, and let nature take its own course? Why meddle with the one pleasure that above all others should be free of schooling?

The simplest answer is that Taoists are trying to help nature take its course within humans, not to alter its basic processes. The radiant and loving couple you know could be doubly radiant and live 10 or 20 years longer in good health to enjoy their love if they conserved their ching chi and practiced the transformation of the sex energy. Perhaps their radiant happiness is more dependant on

external circumstances than you are aware—a good job, preoccupation with children, etc. Will they appear so radiant in old age? Is it progressing to more subtle levels? The Taoist love techniques serve to speed up, intensify and stabilize your natural evolution. There is no limit to the scale of good health and profoundity of love possible. At the higher levels there are always new spiritual challenges to be met. The balance of polarity moves beyond the poles of man and woman and you become aware of the play of opposites between Heaven and Earth.

The Taoists know this high level of harmony is a tangible experience that can be permanently known to man, they call it Immortality. They prepare for it by conserving their sex energy and harmonising their spirit with their lover. In this way love-making becomes, in western terms, a way to draw nearer to God. It can become the worship of divinity in the temple of your lover's body and soul.

PREPARE THE YIN ESSENCE WITH GENTLENESS

As the man, it is your responsibility to see that your lover's organs are literally first warmed. This is the Taoist way of harmonizing the yin essence, of increasing her receptive power to love-making. Her vital organs—kidney, liver, heart, lungs, spleen/pancreas—actually produce and refine the chi needed for love-making. If her inner organs are weak or feeling sick, the music of your love-making will be discordant or heavy no matter how good you are feeling. To hear the music of the celestial spheres you must learn to orchestrate her feelings and sensations with your own. Generally, it takes longer for her organs to warm up and get into fine tune than it does a man.

To return to the simple Chinese metaphor, think of woman as water and man as fire. A man can light his fire quickly but if he burns up his wood too soon the pot of water won't have time to boil. The water will warm more slowly than the fire. So the man should conserve his firewood while slowly warming up the woman's water. Observe the basic rule of cooking: don't put your carrots and peas (your penis and testicles) in the pot before the water is already about to boil. A lot of men don't know this, since they have little experience in cooking. If you toss the carrot and peas in a pot while the water is cold, the carrots absorb cooking

heat and it takes the pot of water much longer to heat. The carrots also don't cook as well this way, and may turn out soggy and not as tasty.

So its best to wait until the water in the woman's womb is about to boil before beginning intercourse. The traditional Taoist texts mention nine things to look for in a woman as a sign she is truly ready for the man: A woman's energy goes through nine stages as her organs begin to warm and release their harmonious chi. It was described by the Mysterious Lady, a sex consultant to the Yellow Emperor of China nearly two thousand years ago:

1. Her chi is in her lungs when she begins to breathe rapidly.
2. The energy has moved to her heart when she kisses the man.
3. She hugs the man: chi is in the spleen.
4. Her vagina grows moist: chi is in the kidneys and genitals.
5. She moves her pelvis and bites gently: chi has penetrated the bones.
6. Her legs grab tight around the man: chi is in the muscles.
7. She caresses the penis: chi is in the blood.
8. She kisses with deep passion: chi has arrived in her skin and flesh.
9. She surrenders herself and moans in ecstasy: chi has entered the liver and released her spirit. She is truly ready to receive the man and exchange her yin essence with his yang essence.

The purpose of waiting until the woman is fully ready will become clear when you practice the semen retention technique taught in the next chapter. The man and woman begin to "steam up" the sexual essence, the ching chi, but if the pot is not properly prepared and the temperature is wrong, it will be difficult to successfully transform the sex essence into spirit. If the man lets his fire go out (by ejaculating his seminal fluids) before the woman is ready to begin the steaming process, then it will be impossible to refine the male and female essence together into a single nectar.

THE ART OF PASSION: TIMING AND FREQUENCY

The number of times of intercourse bears little relation to the satisfaction and happiness of lovers. A woman may be very well pleased with one round or totally uninspired with fifteen. The point

is to love her with irresistible tenderness from the start.

Try to enter neither too early nor too late. If you are too early, you may tire before she has reached the peak of her desire. If you are too late, you will miss the heights of her pleasure. Enter at the proper moment and satisfy her the first time.

Just as you should not eat until you're stuffed, so you should not make love until you're exhausted. You should slightly desire food after a meal, and you should still desire your lover after you've lain with her. A Taoist master of love strives for harmony by curbing excessive greed. Sometimes less is more. Don't satiate your sexual desire, or it will turn into distaste. Extreme yang (expansion) gives birth to yin (retreat). Unless your lover is very highly-sexed, once a day seven days per week will be too much for her if you are a Seminal Kung Fu Man. If she doesn't consciously inhibit her orgasm, her appetite for daily loving will decline. The macho myth of "giving it to her umpteen times" is an attempt to cover futility in a haze of supposedly impressive numbers. There are very few partners who will not be richly pleased by one beautiful act of intercourse. Many will experience several orgasms in one long loving.

SEX POSITION AFFECTS THE FLOW OF ENERGY

I say little about sexual position because there are many other works available on this subject. The most thorough text with lavish illustrations is Sexual Secrets by Nik Douglas and Penny Slinger (Inner Traditions, New York). This text shows over 30 classic Taoist positions for making love and also includes the special postures for healing various illnesses. The essential key to choice of posture is governed by the hidden laws of energy flow. Remember these two points and you can create any energy you desire:

1. To relax and harmonize, place like to like: belly to belly, hand to hand, mouth to mouth, open eyes to open eyes, etc.

2. To stimulate and excite, place together unlikes: mouth to genitals, genitals to anus, open eyes to closed eyes, etc. The art of love is to interweave stimulating and harmonizing positions into a sublime dance.

THE COLD WATER SKINNY DIP FOR PREMATURE EJACULATION

Once you have fully aroused the woman, you will be ready to enter her. You will be quite hard and prepared to leap in. Should you enter her with your penis at maximum size? Maybe. If you are an accomplished Taoist lover, you may enter when you please. You will have developed a degree of self-mastery that gives you perfect freedom in love. But if you are just beginning to control your passions, you may prefer to cool down somewhat.

One extraordinary procedure for those who are too quick on the trigger requires a bowl of cold water. The technique is simply to dip you penis into the cold water until erection has diminished about 50%. This should take only a few moments. Then count slowly to 30, thinking of nothing but counting itself. During this time continue to caress the woman.

After your brief swim you may please her greatly by stirring the penis around the outside of the vagina. While whirling, you may again count to 30. Slowly breath deeply while stirring. Your partner's entire body will ache to receive you. When you finally introduce yourself, she feels as if the world flowed into her.

Unlike the stereotypical macho brute, you have not coughed forth your vitality shortly after entry. When others are dead, you are just being born inside of her. Your partner has already been mounting for quite some time. You are beginning to climb. The goal is not to climb just one peak together, but an entire series of mountains, each higher and with a more spectacular view than the previous peak. An ambitious journey requires some disciplined training—but it will be fun to train with your lover in bed.

THE CENTURY COUNT: BUILD YOUR STAYING POWER

This useful mind control technique is a breath exercise. Slowly count from one to one hundred. Let no extraneous thought enter your mind. Coordinate deep, harmonious breathing into your lower abdomen with the counting. Count a complete inhalation and exhalation as one.

This is not nearly so easy as it may sound. Most people have difficulty counting from one to ten without wandering. When the

mind strays, begin the count over till reaching 100 with no random thought.

This method of calming the agitated spirit will greatly help you develop the self-control to pull back from ejaculation. If you've not practised relaxing, you will have difficulty resisting the urge to release the seed.

Practice the 100 breaths twice daily. After a period of serious practice you should be able to clear the mind and calm most violent agitation with few breaths from the depths of the pelvic diaphragm.

The Cold Water Skinny Dip may be used by those readers who have difficulty exercising any degree of self-control at all. It is a simple mechanical technique to help you begin to exercise self-restraint.

The Century Count will help you actually learn to command the penis to cool off when too hot. To retain the semen you must be able to withdraw excess heat from the genital region at will. With regular practice you will prevent ejaculation far more easily than seemed possible but a short time before. It is an important step toward the higher forms of esoteric love. Esoteric knowledge alone is useless or worse, for it may engender a complacency that precludes doubt, or experimentation with real people and events. Knowledge with living application through practice is the goal of this work. The Taoist approach is fundamentally practical.

Most books claiming to improve the art of loving literally bury the reader under a bewildering variety of second-rate methods. It is better to learn a few excellent methods in greater detail. I am familiar with many other techniques, but my experience has shown a student fails in this practice if his mind is overloaded with information. A boxer who knows 20 different punches usually falls before one who knows two or three punches that he has honed to perfection. First master the fundamental principles, by "getting" the energy inside your body using these techniques, then improvise as you will in bed.

The finger, tongue, penis each has its own unique character. The penis may give supreme union, but it is dangerous for the beginner to overuse. Until you've gained a degree of self-control, reserve it for strategic interludes. When woman is well-prepared, a mere touch of the penis is more satisfying than many passionate strokes of intercourse without proper foreplay.

Ripeness is all. There is more taste and nourishment in one

ripe apple than in ten green ones. Only the woman ripened for reception of the penis can adore your male yang essence with her every cell.

THE FOUR ATTAINMENTS OF THE JADE STALK

In order to harmonize fully with a woman who is going through the nine stages of arousal, the man will naturally pass different phases of arousal before entering her. The Yellow Emperor is said to have asked: "If I wish to make love but fail to gain erection, is it wise to force intercourse?"

The Mysterious Lady replied, "No, it is not wise. The Jade Stalk (penis) should first pass the Four Attainments before intercourse will be proper." Naturally the Emperor asked, "What are the Four Attainments?"

"If the Jade Stalk is not able to erect", she replied, "the yin and yang energy is not in harmony. Firmness is the first attainment. If the Jade Stalk erects, but is not swollen, the chi is insufficient in the blood. Swelling is the second attainment. If the man's Jade Stalk is swollen, but not hard, his chi has not penetrated to his bones. Hardness is the third attainment. Finally, if the Jade Stalk is hard but not hot, the vital energy has not reached the man's spirit. Heat is the fourth attainment.

It is far more important to have a small but hard penis than it is for a man to have a large but semi-soft penis. That is why no man has any true biological advantage over another in sex. Anyone can cultivate his internal energy to a high level of intensity regardless of the outer appearance of his body. Other practices like Iron Shirt Chi Kung, Tai Chi Chi Kung, and meditation all help develop a high level of chi cultivation where energy can be passed or exchanged with a woman without using a penis as the channel of transmission. A light touch of your hand, a glance, or a thought will suffice to send the energy. But even this would not make the penis obsolete, as there are always more refined levels of love-making to be enjoyed.

You can observe your own penis to know the level of your arousal. What if you have not reached the highest level of having a rock hard penis radiating tremendous heat, but the woman is ready to receive you? I suggest you enter her and pass the other attainments of the Jade Stalk while making love. You can do this

safely—without ejaculating—while inside her by using the Power Locking or Big Draw. However, it is very tempting to release your seed when your penis reaches this degree of arousal, so in the beginning you may need to lock your seed in before reaching the fourth attainment.

THE NINE SHALLOW/ONE DEEP THRUSTING METHOD

There are a great number of thrusting methods. The Kama Sutra alone offers many different ones. We suggest a powerful method, which we consider among the "cream of the crop." Our method is based on the number, NINE, a figure of great importance in Taoist practice considered a powerful yang energy.

The essence of this thrusting technique is to go nine shallow and one deep. The one deep thrust, besides varying sensory stimulation, forces the air out of the vagina. This allows you to create a vacuum inside her with the nine shallow thrusts which follow. You never withdraw completely: this would break the vacuum seal. Rather, you hover at those outermost inches of the vagina which are covered with a dense net of nerves.

The nine shallow, one deep rhythm delights your partner. The vacuum has tremendous effect: she feels empty then full, empty then full. This pause pleases because you constantly refresh her senses with change. When we eat our fill, we want no more. But one delicious taste (the deep thrust) increases desire. We satisfy then stimulate desire. We create desire than renew satisfaction.

The other reason that shallow thrusts satisfy is that the woman's most sensitive area is about one inch inside her vagina on the upper wall. This point connects a vast network of nerves in the sexual organs with the rest of her body. This is known as the G-spot, after Graffenberg, the scientist who discovered it, and is also the site from which females ejaculate a fluid when highly aroused. The Taoists consider this fluid also to be highly charged with her essence that is absorbed directly into the head of the penis glans.

Continue going nine shallow, one deep until accomplishing nine full sets. The number of short thrusts thus totals 81, another potent number. At first you may go 3, then 6 cycles before building up to the 9. This potency will be increased if you swallow her saliva every time you pause for a deep thrust. This fluid is highly charged with her yin essence and will balance your expanding yang energy.

DIAGRAM 22

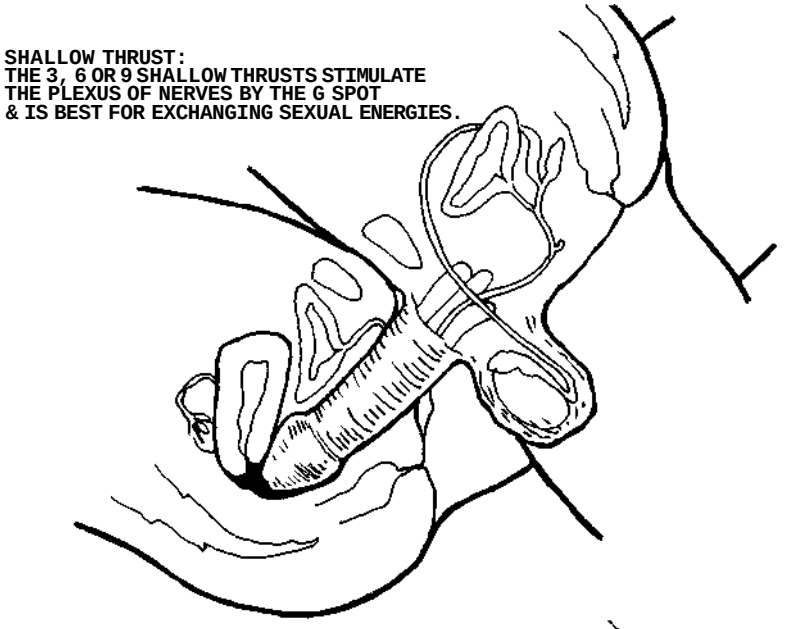

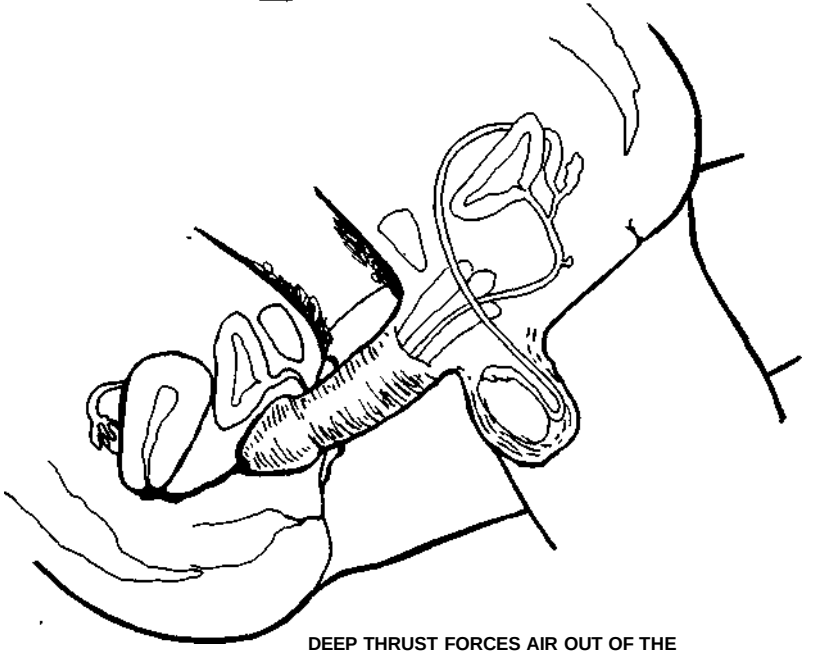

DEEP THRUST FORCES AIR OUT OF THE VAGINA TO CREATE A VACUUM DURING THE SHALLOW THRUSTS THAT FOLLOW. THIS VACUUM HAS STIMULATING EFFECT ON A WOMAN.

On reaching this goal, you may rest or use the more sophisticated techniques found in Chapter 8, The Secret of Semen Retention.

Once you have relaxed and removed surplus electricity from the testes, recommence active thrusting. You are in an extremely pleasurable state, calm yet able to keep the seminal fluid and erectile power through another series of thrusts. Then rest again.

You may prefer to thrust in slowly and to depart more quickly. This way is well adapted to woman's deep-seated nature. Enter slowly because she grows aroused more slowly than man. Untaught man is quick to begin and quick to finish.*

Since she must make life, she naturally begins and ends over a greater period of time. Man must consciously accommodate himself to woman's primoridial rhythm. With reverence light the sacred candles in her thighs.

If she is taken too abruptly, the flush of pleasure has insufficient time to spread over her entire nervous system, Sensation remains fixed in the genitals. Think of it this way: when you pinch yourself for a second or two, only the spot actually between your fingers feels the sensation. But if you hold on for a long time, the sensation spreads over a wider area, eventually flowing to remote limbs. As with pain, so with pleasure.

Therefore, thrust slowly: each thrust is itself an act of love. Woman wakes according to her own mysterious cycles. To defy the laws of creation is to suffer sure disappointment.

You may prefer to thrust out somewhat more quickly. You have already stimulated her: she needs some particularly poignant sensation to fling her toward greater heights. Extra thrill may be provided by quicker retreat after slow penetration. Do not thrust all of the way out: pull back to a 1" or 2" depth. This movement away from the woman flicks your up-bowed penis into strong contact with the woman's clitoris. This is a seat of her erotic sensitivity. Suffuse her with pleasure, then sting with a hot surge.

*She needs less instruction than you: Man is God's secret, Power is man's secret, Sex is woman's secret.

CHAPTER 8

THE SECRETS OF SEMEN RETENTION

"Reject all reasoning about sex; practice special exercises. To be able to make love and not emit is the secret of returning the semen. Increasing and aiding the semen is the way of the life-force."
—*Plain Woman's advice to the Yellow Emperor 2nd century B.C.*

In the centuries past, the Emperor of China invariably called in the court sages, usually Taoist, to get advice on his sex life. Before accepting the advice of any sage, so the story goes, the Emperor required any prospective master to prove his sexual control. He did this by offering the would-be advisor a full glass of wine and demanding the sage insert his penis into it. If he was truly a master, he could absorb the wine into his penis, and then release it back into the wine glass. This was taken as absolute proof that the sage could also absorb a woman's sexual fluids, her yin essence, and therefore knew the secrets of Immortality.

This practice of absorbing fluid into the penis is quite real, and can still be seen on the streets of India today. One enterprising yogi in Bombay sucks up oil into his penis in private and then publicly lights it on fire as he urinates it out, claiming it is divine fire. Amusing, but not very inspiring as a model for the transformation of sex energy. This yogic suction technique is one that many people confuse with the true practice of semen retention.

Drawing any fluid into the urethra of the penis is accomplished by creating a vacuum in the bladder through certain physical exercises. It is a dangerous practice because it is easy for the male prostate or bladder to become infected by the inhaled fluid, especially female sexual fluids drawn during love-making from the highly bacterial culture of the vagina. Some yogis have become ill from this practice, and thus all methods of semen retention have gained a reputation in some circles as being unhealthy and leading to impotence and prostate problems.

I warn my students never to suck in a woman's fluids. The Taoist method of semen retention I teach is directed towards a single goal—the transformation of sex energy, or ching, into higher levels in the body, mind, and spirit. The sperm seed is held only so its essence is not lost outside the body. The method is useless unless the ching is withdrawn from the seed and pulled up and circulated throughout the body. There is no need to draw in a woman's sexual fluids inside your body; the head of the penis glans is specially designed to absorb the woman's powerful essence directly through the skin.

But by far the most powerful exchange with this Taoist method occurs on a level of subtle energy. That is why I teach all my students to circulate their chi in the microcosmic orbit as the prerequisite to understanding the cultivation of ching from the raw physical level of sperm to the refined subtle energy of a shien, or spiritual being. When they have opened their microcosmic orbit, it is already a minor enlightenment. The mind has begun to realize it has control over its own subtle energy. Ultimately you learn that all mind is the movement of subtle energy.

LEARN TO CIRCULATE YOUR "CHI" IN THE MICROCOSMIC ORBIT

The methods of chi cultivation explained in detail in this book—from Testicle Breathing to the Big Draw method to the valley orgasm—all involve drawing sexual energy stored in the testicles up the spinal column and into the brain. When full, this energy will come down the front into the throat, heart, and navel. The brain and pituitary gland will aid in distributing this powerful energy to wherever it is needed, whether for fighting off illness, answering a child's question, painting, or making love. This is a unique at-

tribute of sexual ching over other types of chi with special functions, such as liver chi. Sex energy is extraordinarily versatile, and can be transformed into many different functions. This is one reason it is so nourishing to our spiritual being. It can easily digest it, almost as if it were baby food.

It is much easier to cultivate your energy if you first understand the major paths of energy circulation in the body. The nervous system in humans is very complex and is capable of directing energy wherever it is needed. But the ancient Taoist masters discovered there are two energy channels that carry an especially strong current.

One channel is called the "Functional," or "Yin" Channel. It begins at the base of the trunk midway between the testicles and the anus at a point called the perineum. It goes up the front of the body past the penis, stomach organs, heart, and throat up and ends at the tip of the tongue. The second channel, called the "Governor," or "yang" channel, starts in the same place. It flows from the perineum upwards into the tailbone and then up through the spine into the brain and back down to the roof of the mouth.

The tongue is like a switch that connects these two currents—when it is touched to the roof of the mouth just behind the front teeth, the energy can flow in a circle up the spine and back down the front. The two channels form a single circuit that the energy loops around. This vital current circulates past the major organs and nervous systems of the body, giving cells the juice they need to grow, heal, and function. This circulating energy, known as the microcosmic orbit, forms the basis of acupuncture, Western medical research has already acknowledged acupuncture as being clinically effective, although scientists admit they cannot fully explain why the system works. The Taoist, on the other hand, have been studying the subtle energy points in the body for thousands of years and have verified in detail the importance of each channel.

It is this loop of energy about the body which also carries the sexual current from the testicles and spreads the vitality to other parts of the body. This has a profound effect on ycur health, as it triggers the glands to release the sex stimulating hormones that regulate body chemistry and ultimately affect your ability to do any thing. It has an especially strong influence on the quality of your love-making, as on the biological level sex is largely a question of hormonal balance.

DIAGRAM 23

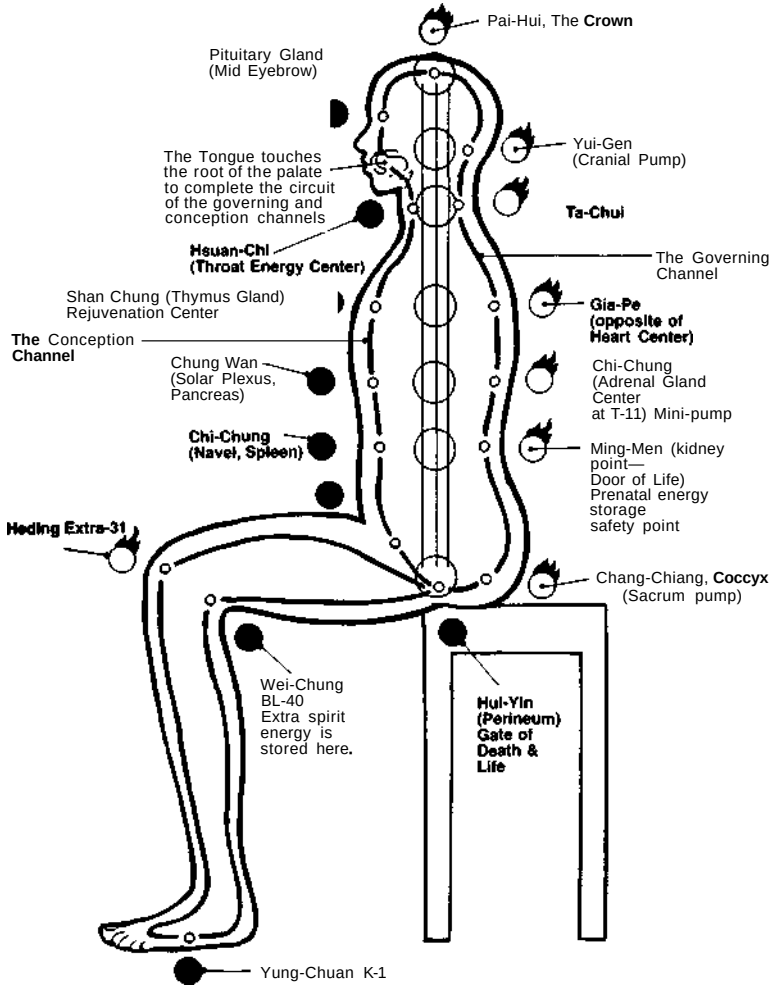

Learn to circulate your Chi in the Microcosmic Orbit to assist mastery of semen retention & transformation of sexual energy.

The sexual energy that moves in the microcosmic is a primordial energy. Human life begins with the piercing of an egg by a sperm cell. This is the original act of Kung Fu in the battle of yin and yang. Sexual Kung Fu is the recreation of that act within the male body. Only instead of forming a foetus from a fertilized egg growing inside the woman's womb, the sperm energy penetrates to higher energy centers inside the male body and gives birth to man on a spiritual level. It is drawn upward by the microcosmic channel where it literally gives a man a rebirth, a "new life"—the confidence of controlling a powerful flow of creative energy and the satisfaction of a deep sense of harmony. Whenever you are "in love" with a woman or with life at large, energy is flowing into your microcosmic orbit. It is the feeling of intense connectedness, of being centered in the warm flowing current of life.

THE IMPORTANCE OF THE MICROCOSMIC ORBIT

By opening this microcosmic channel up and keeping it clear of physical or mental blockages it is possible to pump greater amount of sexual energy up the spine. If this channel is blocked by tension, then during the sexual excitement of love-making the hot sperm energy will seek the quickest alternate escape route and go out the penis. The sexual power is then lost until the body goes through the long and physically taxing process of manufacturing more sperm. Some of man's power of magnetic sexual attraction is temporarily lost by this discharge of sperm. There are some methods of kundalini and tantric yoga that devise a very powerful flow of energy up the spine to the head, using mantra, breathing techniques, yogic postures and locks to channel the sperm power upwards. Leaving to circulate the microcosmic orbit is an important step to sealing this energy within the body so it will circulate and revitalize all parts of the mind and body. Otherwise when intense pressure builds in the head much of it escapes out the eyes, ears, nose and mouth and is lost. This is like trying to heat a room with your body heat while all the windows open—you're going to have a very high fuel bill. You'll spend a lot of sperm energy that isn't recoverable for immediate practical use, such as sharing it with your lover.

The easiest way to open the microcosmic energy channel is by simply sitting in meditation a few minutes each morning and relaxing. Allow your energy to automatically complete the loop by let-

ting your mind flow along with it. Start in the eyes, and mentally circulate with the energy as it goes down the front through your tongue, throat, chest and navel and then up the tailbone and spine to the head.

At first it will feel like nothing is happening, but eventually the current will begin to feel warm in some places as it loops around. The key is just to relax and try to bring your mind directly into the part of the loop being focused on. This is different from visualizing an image inside your head of what that part of the body looks like or is feeling. Do not use your mind as if it were a T.V. picture. Experience the actual chi flow. Relax and let your mind flow with the chi in the physical body along a natural circuit to any desired point e.g. your navel, perineum, etc.

Those interested in fully mastering this method of relaxation and opening the microcosmic orbit can refer to my first book "AWAKEN HEALING ENERGY THROUGH THE TAO." The best lover is a fully relaxed man who understands what is going on inside him. The man who masters this easy flow of energy inside the body's microcosmic orbit will find tapping into his sexual powers a simple and natural step.

Experience has shown that the Sexual Kung Fu practices taught in this chapter were quickly and effortlessly mastered by students who first studied the microcosmic orbit and opened its two channels of energy flow. So study of the microcosmic orbit is highly recommended to all students of Sexual Kung Fu who seek to truly master the techniques taught here. Progress to the higher levels of transforming sexual energy without first learning the microcosmic is very difficult. Many people may already be "open" in these channels and simply need to be told where the energy flows in order to do it. Others get it simply by being very relaxed and living close to nature. The benefits of the microcosmic orbit extend beyond facilitating the flow of sexual energy, and include prevention of aging and the healing of many illnesses ranging from high blood pressure, insomnia and headaches to arthritis.

Mastering the microcosmic current also prepares the serious student for utilizing other energy-conserving techniques that complement Sexual Kung Fu such as "Iron Shirt Chi Kung I, II, III," a method of packing and storing chi energy into vital organs. Another powerful technique is Tai Chi Chi Kung, a condensed form of Tai Chi Chuan that circulates chi energy between body, mind, and

spirit and strengthens muscles, tendons and bones. (Both of these techniques will be available in publication at a later date.)

Let's move into the first technique of semen retention during love-making. Even if you don't sit daily and circulate the microcosmic current, just being aware that it exists in your body and functions automatically during these practices should help you more quickly master the methods of Taoist loving. You may even learn it through your love-making; all it takes is attention. The less "automatic" and the more conscious you become of the functioning of subtle chi energy in your body, mind, and spirit, the greater your freedom to creatively love and be yourself.

DIAGRAM 24

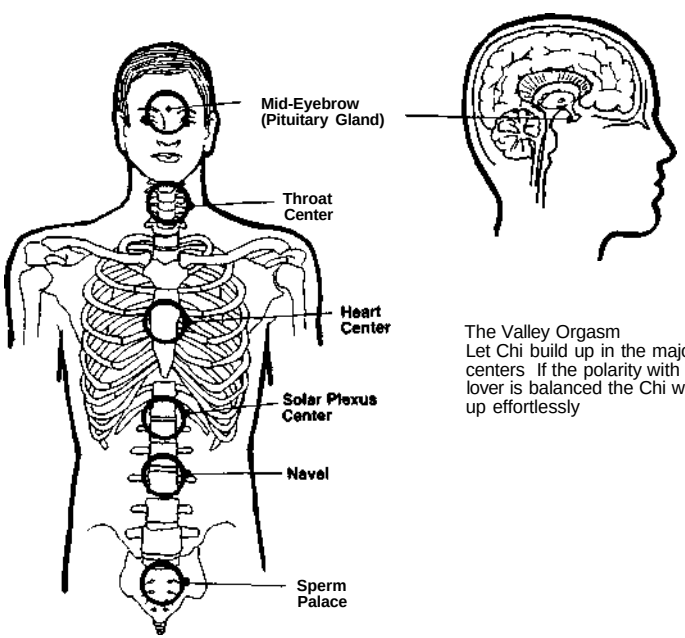

The Valley Orgasm
Let Chi build up in the major energy centers If the polarity with your lover is balanced the Chi will rise up effortlessly

EXTERNAL LOCKING: THE THREE FINGERS METHOD

Three Fingers Method of seminal retention has been practiced in China for more than five thousand years. It is so easy and simple that anyone can learn it quickly and with considerable effectiveness. The method seals in the vital fluid from the outside with fingertip pressure. It requires slightly more coordination than stepping on a garden hose to stop the flow of water.

The Three Fingers Method involves essentially this: Several seconds before the moment of ejaculation, press the mid-point between the anus and the scrotum with the three longest fingers of the right hand. This seals in the fluids and much energy.

THE PRACTICE:

1. Locate The Point: Apply the pressure at the mid-point between the anus and scrotum. This point, which lies at the very bottom of the trunk, is a "door" through which energy enters and leaves the body.

2. Apply pressure: Apply pressure neither too hard or too light. The proper amount of force must be found with experience. Generally speaking, the stronger the finger tips, the less pressure needs to be applied to halt the fluid.

DIAGRAM 25

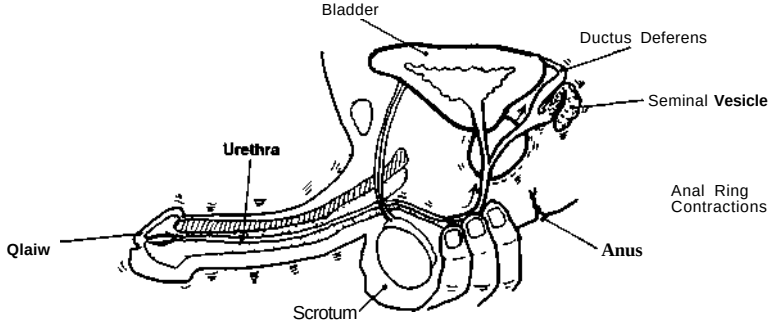

External Locking Method
Several seconds before the moment of ejaculation press the mid-point between the anus and scroturr with the three longest fingers of the right hand

3. Use Three Fingers: The passage through which the semen travels tends to slide away from one's fingers. Two fingers cannot hold the tube and block it at the same time. We use the second and fourth fingers to press both sides of the urethra and anchor it in place. Then the middle finger presses directly on the urethra itself, which doesn't slip away because it is pinned on both sides by the other two fingers. The fingers should be curved slightly. The middle finger is a little more bowed than the other two in order to provide a solid, even wall through which the fluid cannot pass.

4. Timing: As soon as you feel the inevitability of ejaculation, apply the fingers for External Locking. If you wait too long, no force can stop the flow. When you know that ejaculation is imminent, apply the fingers. The locking should be applied before, during and after the contractions. Lock until you are certain that the pumping has ceased completely.

The net result of locking in the semen is that much fluid flows back to the reservoirs from which it came. There is no harm whatever done to the bodily organs, for the tissues in this region are highly elastic and accept the fluid which returns when you reverse the flow.

It might seem that the seminal reservoir cannot hold fluid beyond a maximum level. This would be true if the male reproductive system were a simple hose and tank. This it is not. When the fluid reaches a high level, several things happen.

First, production of sperm automatically declines. This saves the energy and materials needed to produce the nutritionally-rich sperm. Second, there is a natural tendency for the body to reabsorb these fluids spontaneously. Third, the Taoists have perfected a system for "steaming" the seminal power up to the higher vital centers, thereby reducing pressure in the lower sperm ducts and prostate gland. This involves transmuting the liquid sperm to a higher energy state. It is somewhat like boiled water becoming a gas, a property which allows moisture to travel upward to the sky while still retaining the essence of water. The liquid ching is likewise transmuted into a different and more mobile energy form that retains the creative essence of ching.

Remember that the force of the seed is more than mere chemical analysis can explain. Any scientist can stew together the ingredients of the sperm. But inspiring them with the power to re-

produce life is a much more difficult task. It is the life in the seed which we seek to conserve and transform.

The main use of this method is for beginning and intermediate practitioners of Sexual Kung Fu who have not yet mastered the Big Draw method of retaining semen yet want to continue love making without losing their seed. In short, it is an external crutch that should be thrown away when you have thoroughly learned the more internal practices. You may experience a little discomfort after the first few times after you try this method. This is normal and no more cause for alarm than stiffness in long-unused muscles after a good workout.

TIMING AND SAFETY POINTS

1. Don't overdo it at first. For the first few weeks, use this powerful practice no more than once every two or three days. The elderly and sick should use the method not more than twice per week at the beginning of practice.

2. After using the method, the vital heat may so increase that you will feel quite thirsty. Simply drink more water.

3. After practicing External Locking for one to three months, and in some cases sooner, the sexual drive will be appreciably heightened. Erections will be more frequent. Increase your sexual activities at a moderate pace. Don't abuse your newfound power.

4. The practice requires strong fingertip pressure. If you are too weak to do it do several fingertip pushups every day. Use five, then four, then three fingers and increase the number of pushups as your strength develops.

5. Since a small amount of seed will remain in the urethra, some semen may leak out when erection is lost. Thus, to use this practice for birth control, you must withdraw from the vagina before erection falls. For contraceptive purposes urinate before entering the woman for a second act of intercourse. To be 100% safe use this method in conjunction with a spermicidal foam or other contraceptive of your choice.

6. At first you may experience light fatigue after sexual activity. However, the body's vital reserves will rapidly increase so that all fatigue will disappear despite a minor loss of power.

7. Some vital energy is lost in this method. Loss is avoided with the more perfect Internal Locking Method described later in this chapter. The energy loss of External Locking is usually 40 to 60% of the power of the seed. Nevertheless, this is greatly preferable to indiscriminate ejaculation of the fluid. The External Locking very appreciably improves strength and virility. It is an excellent beginner's method and prelude to the Internal Locking.

MASSAGE THE PERINEUM AFTERWARDS

After using the External Locking, you must massage two key acupuncture points of the body. The first of these points is called the Hui-Yin or perineum. It is the midpoint between the anus and scrotum. You pressed this point to lock in the seed. The other point is the Chang-Chiang, midway between the coccyx and the anus.

DIAGRAM 26

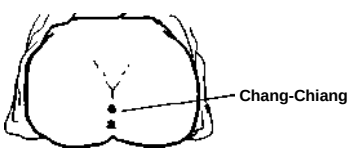

The Chang-Chiang point lies between the coccyx tip & the anus.

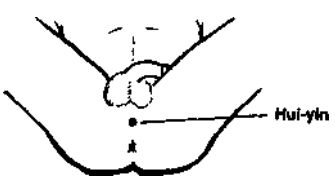

The perineum lies midway between the anus & the scrotum.

Gently massage the perineum & coccyx areas to facilitate reabsorption of the seminal fluid & to prevent congestion of energy in the prostate gland.

Hui-Yin: This is the starting point of the energy path running up the front of the trunk. It is the bottom of the trunk. The Hui-Yin links the highest point, the "Crown" of the head of Pai-Hui, with the lowest point on the sole of the foot, the Yung Ch'uan.

From the Pai-Hui (the crown of the head) the power of the heavens is drawn into the body. From the Yung-Ch'uan (sole of the foot) the power of the earth is absorbed into the body's web of etheric energy. The Hui-Yin (perineum) is thus the central point between the crown and the sole. It is a crucial midway juncture of energy transmission.

Through the Hui-Yin (perineum) the Yin energy, the energy of the earth, enters the trunk. The energy of the testes also enters and leaves the body through this door. In other words, when the door of the Hui-Yin is closed, it retains the life energy. But when ejaculation opens the Hui-Yin, vital power can spill out with dire consequences. Slowly flowing blood settles and stagnates in the Hui-Yin. When the blood lingers there due to weak flow of the chi and gravitational influence, many health problems arise. Hemorrhoids may develop. The veins bloat with blood when chi constantly leaks out through the lower body energy door.

Chang-Chiang: The point lies between the coccyx tip and the anus. Through this point the power flows up to the head. From the head energy will radiate forth to the entire body.

At the Chang-Chiang many major nerves terminate. It is never the beginning of the second main route of electrical energy in the body known as the Governor Meridian. This route runs from the Chang-Chiang to the Pai-Hui to the palate of the mouth roof.

Massage the Hui-Yin and Chang-Chiang vigorously with 27 to 81 circular rotations on the point with two thicknesses of folded silk cloth. Massage with the middle three fingers. The use of silk cloth helps prevent irritation in these sensitive areas. It also increases the flow of power by generating electricity.

The massage helps release muscular tension and facilitates reabsorption of the seminal fluid. It is essential in preventing any prostrate problems. Most importantly, it stimulates the power flow up to the Pai-Hui Crown of the head.

BE AWARE OF THE MAGNITUDE OF POWER GENERATED

The power which you have begun to generate with retention of the

seed is enormous. It has the force to crack massive bone. For this reason the sutures atop the skull of advanced adepts often loosen. The power can drill through the plates of the skull, increasing cranial capacity and opening direct access to higher energies.

The practices advocated herein may allow one to regain part of the prodigious learning and regenerative powers of the child. The only humans with loose skull sutures are the evolved adept and the infant. The meditational practices taught in the books and courses at the Taoist Esoteric Yoga Centers allow one to replicate another aspect of the child's life processes. They allow one to direct energy along the passages of electrical respiration used by the foetus in the womb. The foetus uses energy far more efficiently than the human being at any other stage in his/her existence.

The vastness of this accomplishment in the womb makes other works of human creation seem comparatively insignificant. The meditational process acts to renew the fountains of creative energy that flowed when we were in metamorphosis from a single microscopic dot to a quadrillion-celled human being.

After one to three months of practice the beginner at seminal retention may experience a certain feeling of pressure in the head. For some this feeling will be very unpleasant; for others, it will be not only tolerable but rather pleasurable. This feeling of pressure is the vital power rising to the top of the head with unaccustomed intensity. It is a sign of progress: the body has far exceeded its usual capacity of life force.

Those born for the practice of esoteric loving enjoy this life intensity. This feeling is an early sign of the development of a super-chemistry of the body. It has been popularized by Hindu-based yoga teachings in the west as the Kundalini force. With this chemistry energy normally lost is retained and transformed into higher states of health and consciousness. A gradual heightening of this vital force poses no danger to your health. However, if the power surges too strongly or grows very uncomfortable, it may be released or vented to other parts of the body. Physical labor, massaging the feet, and a heavy grain or meat diet will also help to ground this energy.

If you don't wish to perform the venting exercise (see chapter six) or to advance further on this path at this time you may simply ejaculate once or twice to release the excess power. Then once again carefully harbor the seed for superior health and pleasure

until the pressure builds to too great a point. Again, you ejaculate if you wish. Even this practice of ejaculating once or twice every one to three months will result in a substantial economizing of energies lost in the ordinary way of life. You can enjoy tremendous advantages if you hold on to the seed regularly in this way without advancing to higher levels in the practice.

ROTATE SEX ENERGY TO THE HEAD AFTERWARDS

Rotation of the sexual energy upward is a most important practice after External Locking. The three finger method keeps much of the power from escaping but it does not, by itself, drive the energy upward. Thus a special technique has been evolved for this important removal of the power.

This method removes sex power from the lower centers to the reservoirs of power in the head. When the head is charged to capacity with energy, high quality energy overflows to the entire frame. The method is similar to Testicle Breathing (chapter 5), with the difference that there is a reservoir of ching chi amassed during love-making and held inside the lower trunk of the body. Because the energy is already removed from the testicles and is warmed (but in the process of cooling) after love-making, this rotation of energy to the head is far more potent than Testicle Breathing.

Basic Technique: After intercourse using the External Locking, wash and massage the Hui-Yin and Chang-Chiang points with a silken cloth, or your fingers if none is available. Then assume a lying position on the right side. Draw power from the penis, testes and Hui-Yin up to the head. The tongue must be pressed against the palate, as in all exercises where the energy is circulated.

Draw up the power from sexual organs as in the testicle breathing. Don't use too much force as you inhale the air. Upon exhalation, fix the power at the highest point to which it has flowed. Do not let the power fall from its highest point when you exhale. Then draw up the power anew from the three lower centers on the next inhalation.

To understand this process, you need only think of filling a very long straw with water. The bottom of the straw is at your penis/testicle and the top of the straw is the crown of your head. The straw is too long to fill with one breath, so you must inhale and then stop the end while exhaling. Otherwise, the fluid will run out,

and you will have to start all over again. Fix the power at the level to which it has been drawn, then exhale; then inhale the fluid still higher. You will feel a cool energy (or warm if still sexually aroused) leave your groin and pass up your spine.

Keep driving the power higher and higher up the spine into the skull and Pai-Hui. It may take one or two months for the power to pass the coccyx, but once it passes this difficult bridgehead, it will leap up to the middle of the back. Then it will jump to the nape of the neck and from there up to the Pai-Hui.

After some weeks or months of practice (depending on the individual's body and frequency of practice) the head reservoir will fill and the power will run down the front of the body with relative ease. It travels through the point between the brows, then down through the roof of the mouth to the tongue tip. It continues through the throat, chest, and navel. Collect the energy at your navel, when the chi is full in the navel (cauldron) it will overflow to the sex center and rejuvenate the sex organs, and complete the circuit at the Hui-Yin.

This technique will not be realized overnight. While you feel the lukewarm (the retained sperm) in the lower body within days or weeks, it may take a few months to bring it completely up the back and into the head. Don't be discouraged: if you persist the power will definitely flow. You will open a critically important route for the passage of vitality to all parts of the body.

When you have completed this circuit, you will feel a flow of cool energy, the Yin Energy, circulating the entire length of the route. This is a very important accomplishment and marks the completion of a cardinal step in your increasing power and health.

SUMMARY OF THE EXTERNAL LOCKING METHOD

A. During love-making

1. When you feel ejaculation is imminent, use the three fingers to stop the flow of the seminal fluid.

B. After love-making

1. Wash and gently massage the Hui-Yin (perineum) and Chang-Chiang (coccyx) with a folded silk cloth.

2. Lying on the right side, draw the power up to the head from the penis, testes and Hui-Yin. When full let it flow down to the palate,

throat, heart center, solar plexus and collect the energy in the navel. Finally recirculate the sexual energy back to strengthen the sexual organs.

INTERNAL LOCKING: DRAW NECTAR UP TO THE GOLDEN FLOWER

More than any other part of the book this method requires close study. It explains in detail the essential practice of semen retention, transformation, and exchange of male and female energies. You will do well at first to adhere closely to the technique as I describe it. When you attain a fundamental mastery, you may experiment and make suitable changes. You will find certain techniques consistently effective. Everybody is different, so use what works best. Remember that seminal retention is a means to an end and not itself the ultimate goal. We save seed to gather energy so that we may more deeply delight in love and life.

True esoteric methods are not complicated. If only a genius can do it, it is probably no great practice. The simplicity of esoteric love is itself the real secret. I explain everything in fine detail so there will be no lingering questions or risk of misguiding you. But once you get it, its simple. For brevity's sake I will refer to the practice of "Draw Nectar Up to the Golden Flower" as simply "The Big Draw." This is the abbreviated term my English speaking students use in place of the more ancient Chinese name, and describes the process most succinctly.

For the sake of clarity I have broken down the Big Draw method into its component parts. When practiced properly it is a single action performed by your unified body, mind, and soul. If you feel these three aspects of your person are not well integrated, work on mastering the Big Draw on the physical level and meditate everyday on the microcosmic orbit to aid in evenly distributing your energy. You may go through a rough period if you have a lot of blocks or impurities that your newly heightened chi is attempting to clean out. With continued practice you will feel the chi of your physical body become more integrated with the subtle sexual essence and spirit of your person. You will know this by the way your life begins to flow more smoothly and lovingly.

THE SECRET STEPS TO BLOCK EJACULATION IN THE BIG DRAW

To resist the urge to ejaculate you must block the nerve impulse that causes ejaculation. The basic technique for interrupting the impulse is strong, rapid clenching of the under trunk muscles, teeth and fists. You do this nerve-blocking after you have finished the first round of thrusting.

Step 1: Stop Thrusting, Squeeze Tightly and Retreat.

As a thrusting technique for the beginner I suggested three slow, shallow thrusts followed by one deep thrust to the bottom of the vagina. The most sensitive part of the vagina lies at the outermost two inches. This region is thickly covered with nerves and corresponds to the first two inches of a man's penis. Deeper inside, the web of nerves grows less dense.

DIAGRAM 27

THE BIG DRAW

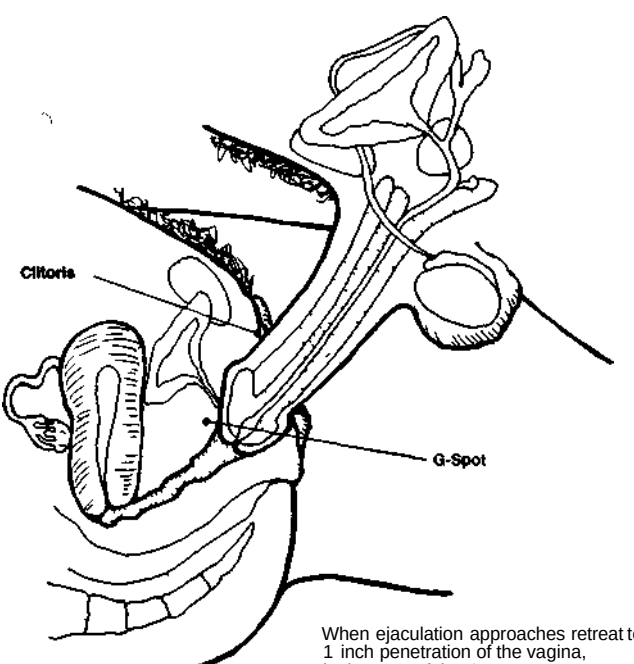

When ejaculation approaches retreat to 1 inch penetration of the vagina, in the area of the G-spot

As you dive deeper she grows tighter. Consequently, seminal retention becomes more difficult. In terms of our "battle of the sexes" metaphor, plunging deeply too often is like repeatedly entering too far into enemy territory. There the encircling enemy overcomes you. Retreat from deep penetration is treacherous. To do it successfully requires great discipline and little movement.

With practice you build up first to six shallow, and later nine shallow, alternated with one deep thrust. If you are a novice at seminal retention, or if you encounter a new or exciting partner, you may find it difficult to go 81 shallow (and 9 deep) strokes before resting.

When you first sense ejaculation approaching, no matter what the number of strokes, stop thrusting and tightly close the urogenital diaphragm. When you stop thrusting do not pull out altogether. Retreat to about one inch of penetration in the vagina. Remain there until you've regained control. Thrusting itself generates a great deal of electricity. Still more electromagnetic energy is produced during the sex act because the hundreds of millions of sperm swim more quickly than usual. As energy accumulates in the genital system, local nerves shoot stimulation up the spinal column to the brain, which gives the order to fire. In this sense even genital orgasm really occurs in your mind. You are just training your mind to have a higher, more mentally and spiritually integrated orgasm.

If your partner tries to wrap her body around you and pull you in deeply, retreat to the point where she can no longer follow you. When she lowers her arched back, follow her down, staying near the mouth of her vagina. Teach the woman to rest when you need to recover your composure: never forget that she is your supreme ally when you gain her loving cooperation.

Step 2: Do 9 Rapid Hard Contractions While Holding The Breath.

After inhaling through the nose, quickly perform 9 very hard contractions of the entire undertrunk musculature, teeth and fists. This is a variation of the form you have been practicing as the Power Lock exercise in 36 repetitions. In that exercise you did one long muscle contraction for each deep breath. For the Big Draw you do 9 rapid muscular contractions for each breath. These contractions are very hard and absorb so much power that little energy remains in the nerves to trigger ejaculation. Do up to six sets of 9 contractions, until the urge to ejaculate leaves you.

With this method your excited sex energy tends to leave the nerves and lodge in the contracting muscles. The breath taken after 9 contractions must be drawn in quickly so that the nerve impulse is cut as frequently as possible. Repeating the 9 contractions 6 times should definitely reduce the urge to ejaculate. You may do less than the 6 sets of 9 contractions if fewer sets allow you to regain self-control. Because you are lying in the arms of a woman with your penis inside her vagina, your seed will be far more volatile, like a young bucking bronco with a spur under its saddle. The added nine contractions of the Big Draw are necessary at first to rein the seed under your control. In time you are able to remove the irritating bucking caused by the spur and enjoy a smooth and powerful ride.

Your genital glands expand in preparation for shooting forth the fluid. The Big Draw contractions reduce their size, literally squeezing the energy out of them and lessening sexual-electrical tension. The shorter the time interval between contractions, the greater the power of the muscles to grip the seed. If much time elapses between clenchings, the muscles get poor traction. Inhalation also must be too swift to allow energy to slip back into the genital region. Holding the breath through all 9 contractions weakens the nerve impulse to ejaculate.

Your goal is to change the direction of the seminal fluid. Physically speaking, the speed of your sperm energy must be accelerated up the spine. Acceleration takes place only at the moment of muscle contraction itself and not while holding onto the contraction. Thus, it takes many separate contractions to drive the fluid deep into the body and defeat the urge to spend your seed.

Step 3: Clench Buttocks Tightly.

Tightly clench your buttocks. The importance of this cannot be overemphasized. The driving power of the largest muscle in the body must be turned to advantage. Bring the two cheeks together with such force that you actually lift up the whole body.

Maintaining good tone of the buttocks is crucially important for overall health. When this muscle is flaccid, power continuously drains out of the body. When it is firm one of the two main lower body energy leaks is plugged. The other lower body energy leak is through the penis in ejaculation.

One can tolerate pain more easily when clenching the muscles

very tightly. Just as the nervous impulse called "pain" is weakened by hard muscular contraction, so is the nervous impulse to ejaculate weakened. In both cases the muscles absorb energy: this interferes with the nervous message. Contraction of certain key muscle groups withdraws energy from the genital area. Clenching the buttocks is especially helpful in breaking the nerve circuit between the brain and genitals at the base of the spine. Squeeze the buttocks until they are rock hard; the message to ejaculate is in effect intercepted and never delivered.

Step 4: Clench Teeth Tightly.

Clench your teeth and push your tongue hard to the roof of your mouth. Clenching the teeth tightly interrupts nervous flow at the head and neck. It also helps tighten the buttocks. These two muscle contractions must be simultaneous, so that they reinforce each other and secure complete locking. As you clench, press the semen deeper and deeper into the body. Greatest retraction of fluid occurs toward the end of the count: during the 7th, 8th and 9th clenchings you drive the fluid most deeply inward. Be irresistibly determined to force back the fluid. The contractions from 1 to 9 should grow harder and stronger.

As you prolong the act of intercourse, your pleasure will grow more intense. When you reach a high level of pleasure, you should keep the urogenital diaphragm constantly closed. This helps prevent the sperm from sneaking halfway out the door. Stop the fluid behind the dam. When it has spilled over, attempts to stop it or to harness its power are futile. You must stop the ejaculation before the sperm has begun to move within the body.

Step 5: Pull The Wave Of Energy From Genitals to Head

The Big Draw may be conceived as an internal wave beginning with contraction at the penis tip, moving through the perineum and buttocks up the spine to the head. In this way the energy, traveling along the crest of voluntary muscular contraction, will be forced up to the crown.

If you have difficulty drawing power to the head, you may draw it first to the navel. After it accumulates there for a while, again direct the power down to the hui-yin and up the spine to the head. It should help it flow more easily, particularly if you have carefully harbored the seed.

DIAGRAM 28

THE BIG DRAW

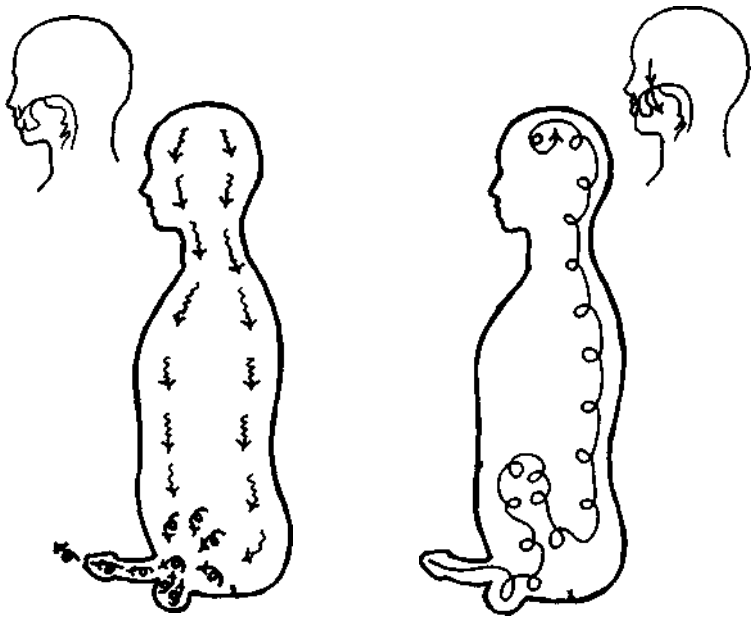

Inhale & pull orgasmic energy to the head If you have difficulty drawing power to the head, first draw it to the navel, accumulate it there & direct the power down to the Hui-Yin & up the spine to the head

Exhale & release yang energy and all tension by relaxing the head, throat, chest, adbomen & pelvis Let the relaxation spread from the top to the bottom of the body in a wave Allow the energy to flow into your partner

Relaxation after the Big Draw dilates the contracted blood vessels in the penis. It is actually at this point, where no effort at all is exerted, that you absorb the greatest amount of yin energy. During the Big Draw the woman's power enters the man's lower body. During relaxation the power shoots up to the higher centers. This effect is particularly noticeable when you have practiced the Power Lock Exercise.

At first the repeated exertion of the Big Draw may seem very difficult, and ruinous to love-making, but with practice it will become easier to perform. Hold back the mutinous seed that would crash through the lower body door and disperse your powers. Your will power to control semen loss will grow stronger each time you use it. The stronger your will power to prevent loss of your sexual

essence grows the greater your will power becomes in all of your life. In work, play, family relationships, your will to love and spiritually grow unfolds with a renewed vigor that daily will surprise you.

Step 6: If Erection Is Lost, Begin Thrusting and Use Gentle Sucking.

After the first round of thrusting and Hard Contractions, you may occasionally contract the penis head inside the woman while you are thrusting. The penis head is like a baby gently sucking milk at his mother's breast. You begin to lightly draw the Yin in this manner. The Big Draw has greater effect when the penis is already filled with Yin energy from Gentle Sucking.

Keep clear in your mind the difference between the Gentle Sucking and the Big Draw. Gentle Sucking accompanies regular thrusting. Only the penis head, testes and uro-genital diaphragm are contracted: the rest of the muscles remain relaxed and do not draw in power. In this technique we do not drive the energy far. We prevent our own energy from inching forward and leaping out into the woman. We also fill the penis itself with energy which we will transfer to the head with the Big Draw.

BIG DRAW FOR WOMEN

The woman should also perform the Big Draw, using the vagina to suck in the Yang power from the man's penis. The detailed explanation for women will be found in the next book, Ovarian Kung Fu. Until the detailed explanation appears, she may simply adapt the principles of Seminal Kung Fu and perform the Big Draw on her ovaries. Women often have a good intuitive understanding of the process; hence their sexual superiority. But higher levels of love always exist. I strongly suggest that women train to suppress her genital orgasm. This will appreciably reduce her loss of energy in the act of love. She too can gradually achieve a "higher" orgasm as a "mysterious portal" to the Tao. Man and woman can attain the Tao together by this way of "dual cultivation."

THE BIG DRAW AND MASTURBATION

The Big Draw method works well for single men who either cannot find a woman partner or who have chosen to remain celibate. Men with lovers may also choose in the beginning to train themselves alone. In fact, I recommend this for most men, as it is much easier to block the urge to ejaculate when you are not being stimulated by the heat and touch of a woman. The Big Draw for single men is performed exactly the same way as described for couples, only instead of thrusting into a woman's vagina the single man stimulates his penis glans by caressing and massaging it.

This is different from masturbation which ends in ejaculation. You must break the urge to ejaculate before the semen escapes, using the rapid hard contractions and clenching of the Big Draw. This may be done in any position—standing, sitting, or lying—but standing may be preferable at first as it firmly roots your feet on the ground and connects you with its cooling yin energy.

A good reason for practicing the Big Draw alone is that you can clearly observe if you have mastered the first level of the method, physical control over ejaculation.

When you arouse your penis, massage it until you sense the first glimmering of the urge to ejaculate, and then do the Big Draw before the sperm begins to move. You should do the contractions and raw repeatedly until you see your penis become flaccid. The stiffness of your penis becomes the barometer of your ability to do the Big Draw. The more quickly you can soften the erection, the closer you are to mastering the method. Eventually you will be able to command it down with your mind by merely drawing the energy out of your penis and bringing it to your head without any muscular clenching.

This method can be extremely useful to any man who feels sexually frustrated. You simply make love internally, between the yin and yang poles within your body, imagining you are pulling the ching chi up to make love to your highest center, the crown. However, if you lose your seed while masturbating it will go for nothing, and thus masturbation is far worse than losing your seed to a woman, who at least gains from it and gives her sweet yin essence in exchange. Even if you retain your seed, masturbation offers only a very dry, yang energy that can be very fiery and intense but imbalanced, unless you know the higher level meditation to de-

velop the male yin energy pole. That is why masturbation should be used for training purposes only; it is not advisable to develop a strong attachment to it that might prevent you from maturing. This training stage for some men might last as long as a year or two. It will depend on how frequently you practice the Big Draw and other pelvic exercises and on the availability of a suitable partner.

MORNING ERECTION HAS POTENT CHI

The other occasion in which all men can use the Big draw alone is at night or in the early morning in bed when they wake up with a powerful erection. This is very powerful and pure ching chi produced after your body and mind have been charged with sleep. Some Taoists think this is the most potent chi available to a man. It is undiluted by any psychic toxins from another, and your own mind is so relaxed and free of outside tension that it can absorb the energy more easily than at other times.

You can do the Big Draw lying in bed on your right side until the erection disappears. It may take more contractions because of the amount of sexual energy pooled in the sperm palace. If this produces too much energy in the head, be sure to bring it down to your navel by focusing your mind there and spiralling it a small circle 3" in diameter. Do this first clockwise (imagine a clock at your navel facing outward) and then counter-clockwise. This will balance and center the excess energy. If this is insufficient, do the venting exercise as well.

INTENSE ENERGY IN THE HEAD MUST BE VENTED

During the Hard Contractions power is drawn in forced up from the lower trunk. Power is simultaneously forced down from the head. Thus tremendous pressure builds in the mid-trunk. This high pressure energy must be vented: it cannot go out the penis or anus for you have locked these shut.

It shoots up to the ear and eye and escapes slightly from these apertures. As the power passes through these organs it invigorates them. If the eyes are kept open at this point and moved somewhat in their sockets, more restorative energy will flow to them

The power which you have begun to generate with retention of the seed is enormous. It has the force to crack massive bone.

For this reason the sutures atop the skull of advanced adepts often loosen. The power can drill through the plates of the skull, increasing cranial capacity and oepning direct access to higher energies.

The practices advocated herein may allow one to regain part of the prodigious learning and regenerative powers of the child. The only humans with loose skull sutures are the evolved adept and the infant.

After one to three months of practice the beginner at seminal retention may experience a certain feeling of pressure in the head. For some this feeling will be very unpleasant; for others, it will be not only tolerable but rather pleasurable. This feeling of pressure is the vital power rising to the top of the head with unaccustomed intensity. It is a sign of progress: the body has far exceeded its usual capacity of life force.

Those born for the practice of esoteric loving will enjoy this life intensity. This feeling is an early sign of the development of a super-chemistry of the body. With this chemistry energy normally lost is retained and transformed into higher states of health and consciousness. Such heightening of vital force poses no danger to your health. However, if the power grows very uncomfortable, it may be released, vented to other parts of the body, used to impower meditation or spent creatively in other areas of your life and work.

AUTOMATIC MIND CONTROL OF EJACULATION

According to Taoist tradition, in the beginning of mankind our ancestors had the ability to control sex instinctively. They could control emotions, ejaculation, and sex as they wished. But gradually our ancestors were drained off of this ability. Through oversex, overpleasure, overdrinking, and over thinking by overspending themselves, they gradually lost this ability. This ability can be restored to the mind by training it to automatically stop the leakage of sexual energy. The key is repeated practice of the big draw until you do it instinctively. Then the nectar of your sexual essence will flow continuously up to the crown of your head, the golden flower. In Automatic mind control the pineal gland is the most important key to link the sex organ to the brain.

The greatest goal for this locking is that after 6 to 21 months, or 10,000 Big Draws, you will be able to use the mind alone to draw

it up anytime or anywhere, whether standing, sitting or talking. If you can draw up and shut the leaking door continuously for a week, that means you are beginning to assume control. At that point, put your concentration on the crown (pineal gland) and try to just think the power up without using any big force, and eventually the door will close automatically and for as along as you want. When you put your mind at the crown, its pulls the power up to the head.

Some people may pull too often, or do it the wrong way thus feeling the power stuck in the heart. To release it drink honey in tea or use the hand to brush it down the front of the body towards the navel where it is safer to store. If energy remains stuck in the heart, just do normal breathing and use the mind to cure. Start circulating your chi from the perineum. Breathe in and think from the Hui-Yin (the Gate of Death and Life) up to the top of the head (pineal) and down to the third eye (Yin-Tang) between the eyebrows. Stop for awhile. Then breathe down and when it passes through the heart, try to think of it as flowing down like a waterfall and entering the navel 9 to 36 times will gradually take the power stuck in the heart out.

You will eventually reach the state where you can control your sexual urge anytime you want. Even at night when erect, you can just pull the power up and the erection will drop and the mind and the sex organs will be at one. You can control sex like a voluntary muscle of the arm. The understanding it takes to reach this stage depends on the person. Some get it quicker and some more slowly. Practice is the key. After trying for a while you will eventually have more confidence and can command the sex organs or command the door of immortals (Gate of Death and Life) to open and close at will.

Points to remember:

1. After you've really succeeded in using the mind to control the urge of ejaculation, the second or third day you may feel some pain in Hui-Yin or penis. This is a normal thing to happen. The mind orders the muscles to contract and push the fluid back which uses a lot of muscle power to hold that flow. Naturally, you will have the soreness of muscles in that area. Just rub the Hui-Yin in that area and try to relax the muscle. After a few more times you will not feel anything any more.

2. Some people, if they have been collecting a lot of power this way, might feel very hot and some might have an irritating feeling to vomit or headache because the sexual energy is stuck in the head of chest and the power is too great. This is a mild case of the "Kundalini syndrome". The method mentioned of eating honey or brushing the chest alone cannot solve the problem. You may have to use running to burn the energy away, or other extensive exercises. The energy should be disposed of in a non degenerative way. Completing the Microcosmic Orbit is the most important safety valve to help distribute the sexual energy evenly.

3. In the final stages of automatic mind control of sexual energy, there is no need to clench the teeth, anus and buttocks. The whole body stays relaxed and you contract not the buttocks but the front urogenital diaphragm and the perineum only.

4. To more easily achieve the goal of automatic internal locking, bear in mind you can do internal locking any time you want, driving the car, sitting down, coffee or doing work. Practice contracting the urogenital diaphragm, the contraction in front, not the buttocks. Do this until you can fully control an erection or an urge to ejaculate with a flicker of your mind.

PART III

TRANSFORMING SEXUAL ENERGY INTO SPIRITUAL LOVE

CHAPTER 9

THE YIN AND YANG EXCHANGE: CULTIVATING THE VALLEY ORGASM

"Yang can function only with the cooperation of **Yin, Yin can grow** only in the presence of Yang"
—*Yellow Emperor's Female Consultant on Sex.*

Our universe changes perpetually because of the eternal flow of yin and yang energies. The very essence of yin-yang exchange is the cyclical alternation of day and night. Due to this alternating energy flow, this respiration of the heavens, living things can grow. Were there only day and no night, all would be burnt; or if there were only night and no day, nothing would have strength to grow. As living things, humans are also subject to the law of yin and yang exchange.

The human being can live happily only if he/she is in harmony with the principles of life. If one violates the law of the yin and yang interchange, by forbidding the sexual communion of yin and yang energy, energy will not flow in the body. The life force will slowly stagnate and leach out. Life will become a long slide into depression interspersed by spasms of enslavement to the passions.

If you have learned to block the urge to ejaculate, or even decided that you have the will to learn the Tao of love, you are on the threshold of a new experience. That experience will alter your perceptions of your own body and mind. It will change the way you

see your lover, and change your understanding of sex and love.

Drawing Nectar up to the Golden Flower is incomplete without the Exchange of Yin and Yang energy. The Golden Flower is the light at the crown of the head. The Big Draw conserves your nectar, the sexual essence. It is exchanging your ching with your lover that transforms it, and in the process gives you an experience of sex which is deeply shared as love. Your orgasm will be totally unlike that known to simple ejaculators. As you make love over periods of time, the pleasure spreads over and fills the entire body. This orgasm of the whole body is unknown to quick-ejaculating males whose thrill is confined primarily to the genital area. Most important you will gain a new sense of inner equilibrium that will be stored in your body long after your pleasure has become a flitting memory.

This method prolongs penetration to one-half hour, one hour, two hours, or more. You can enjoy this form of sexual love indefinitely without paying for your pleasure with your life force. The difference is in the type of orgasm. The ordinary one may be called the Peak Orgasm: one fleeting moment of intense, even excruciating pleasure, then nothing.

Taoists advocate the Valley Orgasm: continual rolling expansion of the orgasm throughout the whole body. The Valley Orgasm provides more gradual, but ultimately greatly heightened ecstasy. Carlos Suares used an image similar to the Taoist Valley Orgasm to distinguish true loving in sex from ejaculation: "Erotically, the man is more like a valley watered by innumerable streams than like a deep gorge where an overwhelming torrent rushes along."

During the Valley Orgasm, lovers can relax and have all the time in the world to share their tenderness. There is no frenzied explosion, only wave after wave of higher subtle energies bathing the entwined man and woman. The Valley Orgasm is not a technique, but rather a certain kind of experience that the lovers allow to happen to themselves. But it can be encouraged by following this time-tested process:

1. Timing: after thrusting, relax and exchange energy.

Following the Hard Contractions of the Big Draw return to thrusting. After another round of 81 shallow (and 9 deep) thrusts, you may again be drawing near ejaculation. Meanwhile, the woman has been highly stimulated by your passion. She, too, may be approaching orgasm.

When she becomes very excited, the vaginal lubricant flows

DIAGRAM 29

ORDINARY ORGASM

Bang! . **Peak Orgasm**

What **Happened** Here?

Genital orgasm with ejaculation is intense but cuts short love-making.

VALLEY ORGASM

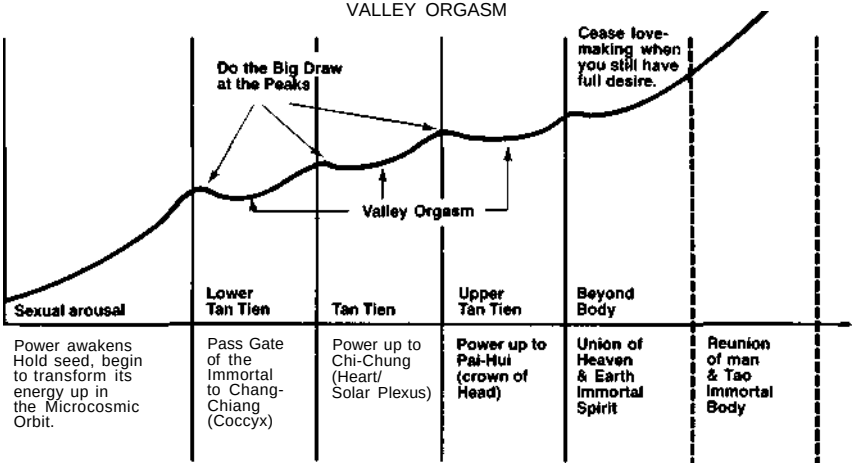

Valley Orgasms are spontaneous openings for lovers, to higher levels of Taoist Chi cultivation.

more freely. In this fluid there are large amounts of Yin energy. Following the second series of thrusts you need to perform the Big Draw a second time to prevent ejaculation. Or if the woman is about to have an orgasm, cease rubbing while she performs the Big Draw. In either case, the momentum of your sexual energies should be established and moving up toward your higher centers.

At this point cease thrusting and begin to exchange the restorative energies with her. You will gently release the hot, male Yang energy into her. She will release the cool, female Yin into you. Remember you cannot take in her power without giving freely of your own. The exchange heals both. Man needs the soft recep-

tive energies a woman produces to achieve perfect balance. And woman needs the expanding male energies to attain her own higher harmony. This is the underlying reason for the attraction of the sejes to begin with.

2. Position: When you cease from active thrusting and begin your embrace in any pleasing position. If the man is heavy, the woman should usually be on top. If the woman is stronger than the man, she should usually be on the bottom so that he can draw the power more easily. If the woman is weaker she may be on top where she can draw more readily. In any case, make sure it is a position you can rest in for a long while. You should keep two extra pillows handy for this purpose.

3. Coordinate Breathing With Your Lover.

"Chi" means "breath" in Chinese. Life is breath. All living activity has the quality of inhalation, exhalation, or some combination of the two. This is why Chinese philosophy classifies everything as Yin (exhalation) or Yang (inhalation) to a greater or lesser degree. The act of love is essentially an act of respiration. You breathe your ching into your lover's body and soul. You inhale this life energy by drawing it up to the head and exhale it into your partner.

So after you have stopped thrusting and embraced your lover, coordinate the breathing. Each partner places his ear near the lover's nose with chest to chest. In this position you can easily feel the other's breathing. In the act of love the breath cycles stimulate and harmonize all processes of life. Physically breathing together unifies the two partners and focuses the rhythm of all of their energies so that together they may contact the source of their life current. You should become so sensitive to the presence of her breath that you feel yourself inside her breath as deeply and strongly as if you were pushing your penis into the bottom of her vagina.

4. Inhale Power Up Spine To The Head, Exhale Out The Penis.

After you breathe together for a time, gradually draw the power up to the crown of the head. On the inhale the man thinks the yin power from the vagina into the penis and the woman thinks the yang power from the penis into the vagina. Both draw it back to the Hui-Yin, (the perineum) the Chang-Chiang (the coccyx) and up the back in steps to the Pai-Hui (crown). From there it goes

through the tongue which is, during the whole exercise, raised to the top of the mouth.

The goal is not to use muscular force to help (as in the Big Draw), but simply to use the power of thought to direct the sexual energy. Think it up. This instruction may sound baffling on first reading, but those who have begun to do sexual kung fu will start to feel the power and will understand intuitively what I mean. The power will rise to the head eventually as your mind learns how to direct its own chi energy connecting the mind and body.

In the beginning, you can accelerate the exchange of yin/yang power with a long, deep muscular contraction. When the vaginal fluid seethes inside the woman, inhale slowly and deeply through the nostrils. While you inhale contract the penis, Hui-Yin, anus, buttocks, jaws and fists, in that order. As you tighten this contraction, think the power into the penis, past the Hui-Yin, into the Chang-Chiang and up the spine into the crown of the head. When you have finished the inhalation, hold the breath and contraction for as long as you can. Keep drawing the power up to the head until you can hold the breath no longer.

DIAGRAM 30

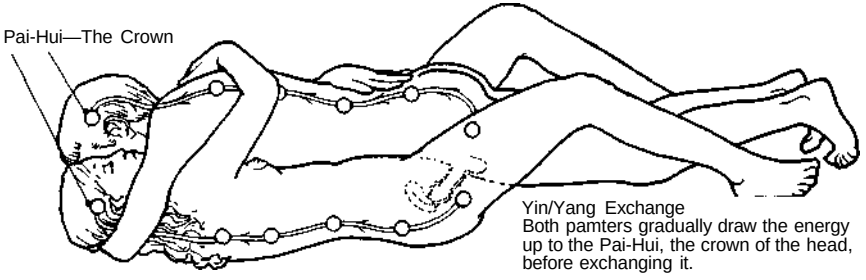

When you release the breath, consciously give your excess Yang energy and heat to the woman. To successfully bestow the power upon her, you must exhale deeply. Release all tension by relaxing the head, throat, chest, abdomen and pelvis. Let the relaxation spread from the top to the bottom of the body in a wave. When the gentle wave reaches the pelvic region, send the Yang warmth energy not seed!—into the woman through the penis. The contraction and relaxation should be done gently, creating a feeling of pulsation travelling between your body and hers.

Lovingly offer her your essential energy. This surrender shall carry with it all emotions of love and devotion. This is not mean sentimentality. It will inspire her to surrender her nourishing yin essence and to totally embrace the yang within yin. This is the nature of her fulfillment. If you attempt to withhold your energy, she will sense-consciously or unconsciously—your sense ofseparateness, your stubborn ego, which is in one sense nothing more than energy stuck in one place (usually the head in the male). So allow her to absorb the Yang energy she needs while you surrender the excess which might have forced you to ejaculate. As the urge to ejaculate fades with relaxation, the Yin energy will flood your entire body while the Yang floods into her.

If you are just beginning to practice, you may be so overwhelmed by the sensations of sexual love that it will seem impossible to distinguish her yin energy from your yang. Everything may seem hot and explosive and a single energy. As you build up your nervous system to handle higher charges of energy without ejaculating, the exchange of yin and yang energy will gradually come into awareness. If you build energy at successive points in the body, greater powers of exchange will open to you and your lover. You can start by drawing the power to the Hui-Yin and meditating there.

If the man has more power than the woman he may help the woman to open her centers by sending his power to her unopened centers: both concentrate their attention on these points. Chi will flow wherever the mind is focused. After the power flows into the Hui-Yin (perineum) send it back up to the Chang-Chiang (coccyx). While meditating there, you will feel a little pain and tickling on the scrotum as the center opens. Then to the Ming-Men, door of life in the back opposite the navel, Til the adrenal glands. When you feel the power's warmth there send it up to the Gia-Pe point between the shoulder blades.

After it flows there it will feel very warm and will spread to the lung. Next direct it to the "emerald pillow" Yui-Gen, at the top vertebrae on the back of your head. There will be a feeling of heaviness when the center opens. From there bring it up to the crown of the head, on a line drawn between the ear and the nose. The head may feel very heavy or as if there were something drilling up from inside the head. Then transfer it to the point between the mid eyebrows.

Remember that you can't open all of the points in one sexual embrace. To open one point may take many exchanges of yin and yang. If you ejaculate, the power is very hard to exchange, for man loses much power and there remains little to be transferred up. When the energy is full in the upper region then it will come down from the tongue. Bring it down to the navel, and collect it in the navel.

5. The Plateau Phase: Circulate Your Microcosmic Into Your Lover's Orbit

Depending on the level of vital energy and the spiritual development of the individual lovers, a couple over time will experience new "openings" that occur during their love-making. This means you will suddenly find you have made a quantum leap in your feelings and awareness. This usually happens during the plateau phase of the yin/yang exchange. The period of love-making when you are not thrusting passionately is referred to as the "plateau" phase. The "peaks" are the moments prior to the orgasm averted by doing the Big Draw. The "plateau" is the physically passive exchange of energy that occurs between the peaks.

DIAGRAM 31

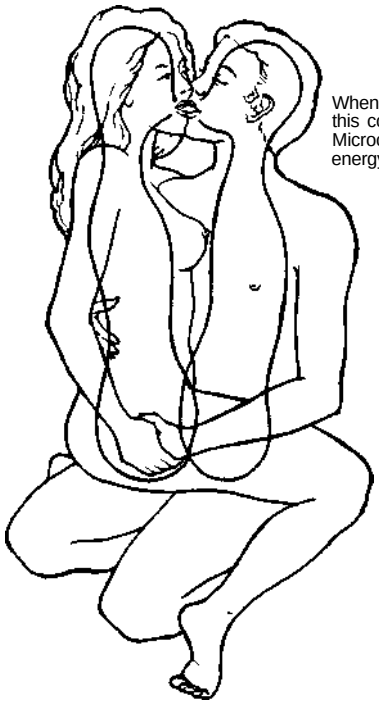

When the tongues touch this complees the Microcosmic Orbit of energy in both partners

The subtle energies within your resting bodies are not passive at all, but are moving dynamically between partners, building to a new level of sexual-electromagnetic tension. It is an internal wave of energy building up, an ocean wave that gathers momentum and crashes, only to be replaced by the next wave. After the sexual energy has been raised to a high intensity by thrusting and drawn up the spine on the route of the "Microcosmic Orbit" with the Big Draw, the yin/yang exchange can begin to happen in many different ways.

In the beginning the energy exchange between lovers may seem to be chaotic and happening between any two points of bodily contact. As you grow more accustomed to the energy gained by stopping your ejaculation you will begin to discriminate the clearly defined channels of the microcosmic orbit rising up the spine and descending down the front of the body. During the plateau phase of love making you may feel a warm flowing current passing between her vagina and your penis and between your lips/breasts.

These are the two individual microcosmic orbits joined into one larger flow circling your two bodies. This will greatly enhance the balance of energy in both lovers and deepen the bond of loving in their life. The chi flow is increased in amplitude: you may even feel like a warm electric current is passing between you. This effect often occurs quickly in lovers in good health practicing the Big Draw ranging from only a few love making sessions to several weeks or months.

The two microcosmic circuits, that of the man and the woman, can be joined in a number of different ways. The most common is the intersection of their two circular orbits at the mouths and genitals of the two lovers forming a figure eight. The figure eight can cross as the Microcosmic energy drawn up by the man up his spine is passed into the woman through his tongue, which acts like a kind of electrical switch. The male energy then enters her Microcosmic orbit and goes down her front (functional) channel and down through her vagina, into the penis and back up his spine. The woman circulates her orbit in a parallel fashion, up her back channel and down his front channel before it re-enters her body at the vagina and goes back to her perineum and spine. This is the simplest way to consciously direct this level of exchange of yin and yang energy.

Each couple can play with different figure eight patterns of

exchange. At first you may verbally tell your lover what you're concentrating on. Later, as you become more sensitive to your own and your lovers energy, the chi exchange itself will become a silent language, punctuated by the pleasure of sending a tingling warm current into your lover. The figure eight may cross at your mouths only, or at your genitals only if you are not kissing but still lie within her. It may snake around your governor channels—up your spine and down hers, or vice versa.

At this level many couples experience spontaneous openings of some of the 8 special psychic channels taught as the "Fusion of the Five Elements" meditation in the Taoist yoga system, (see chap. 18) These channels include the positive and negative arm and leg routes, the belt routes spiralling around the body, and the thrusting route up the center of the body. Don't be alarmed if your energy goes wild and begins moving in ways to which you are not accustomed. Many lovers experience a column of energy rising on a line midway between their bodies; if it happens to you, just relax and enjoy the play of the subtle energies. Some couples report the chi shooting up to the top of their heads and showering down in a fountain of nectar. Others feel like they are wrapped in a cocoon with their lover, with lines of invisible energy being spun around them.

When you've opened all your psychic channels and you know what is possible in terms of energy exchanges, you will then be free to choose the path of expressing your love at will. It is interesting that lovers who know nothing of these esoteric methods sometimes have similar experiences during sex. They can't do it at will but they do know it first hand from spontaneous opening of subtle energy channels. The Taoist secrets of love are designed to focus your awareness on the infinite possibilities that lie within you. This concentrated awareness is what spontaneously sparks these experiences of divine energy exchange. In this sense love is universally the path to greatest freedom—the more you share with your lover, the more choices open to you.

6. Cultivate A "Valley Orgasm" In The Three Tan Tiens.

When both lovers have shared their chi in the Microcosmic Orbit or other psychic channels, their energy is both intensified and balanced. This sets the stage for a true fusion of their being in the valley orgasm.

The "valley orgasm" is an even higher experience of yin/yang

exchange that goes beyond the Microcosmic. It may occur spontaneously in any couple dedicated to expanding their love and spiritual awareness. No technique can guarantee it will happen, but the methods taught here vastly increase the probability of a couple enjoying regular valley orgasms during lovemaking. It is a state of prolonged orgasm that generally occurs during the plateau phase when the yin and yan^ energies come into an exquisitely delicate balance. It is a fusion of opposites, a meltdown. However, do not be disappointed if you learn to block ejaculation and master the Big Draw but do not have a valley orgasm. That happens frequently and should be expected, especially in a stressful urban setting where there are so many distracting forces working against the sustained balance of subtle energies.

DIAGRAM 32

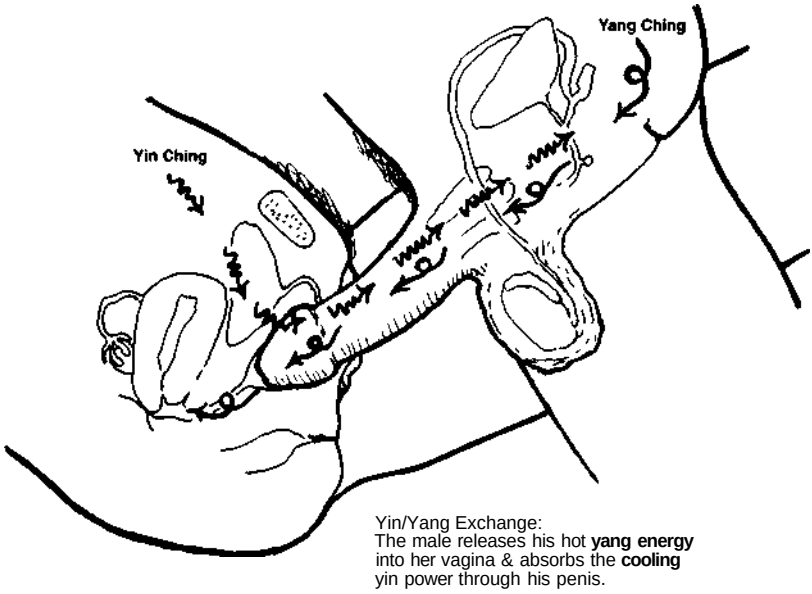

Yin/Yang Exchange:
The male releases his hot **yang energy** into her vagina & absorbs the **cooling** yin power through his penis.

The lovers simultaneously experience an "opening" of an energy center during a valley orgasm. This releases a tremendous energy that is truly thrilling as it radiates out to fill every cell of your body and joins it together with your lover. The Hindus call these centers "chakras". The Taoists refer to them as lower, middle and upper Tan Tien, and locate them in the abdomen, heart, and head.

In truth, the entire body is one Tan Tien, or field of energy, but in practice it is easier to learn with smaller vortexes of energy until you can handle the greater power. The sequence of opening them is generally starting with the lower and moving up. If higher centers open before the lower ones the energy may be unstable and short lived. In that case the lovers should direct their higher energy into the lower centers to create a more grounded polarity. Filling the lower body with higher energies will lend greater fullness to the feeling of intimacy and create a greater foundation for future exploration of the spiritual world of the two lovers.

The opening of these energy centers is the actual process of transforming your sex essence into spirit. The valley orgasm actually is a fusion of ching, chi, and shien in the two lovers. All three are normally present in everyone, but in a divided and weakened state. The two lovers can supply energies missing in their partner and bring out recessive energies with the simple presence of the opposite subtle polar energy. When you open a new energy center your mind makes a leap in awareness by fusing these three in a spontaneous alchemical process. Your own spirit is purified and is one step closer to becoming centered in your body.

It's important to know that these centers cannot be "forced" open, any more than a child can suddenly be forced to grow up. There are natural stages. That is why you must relax to entice the Tan Tiens to open; then you will experience a valley orgasm as a spontaneous gift, a sparkling jewel bestowed upon you by the Tao. It has been described as a state of profound clarity and serenity, but even these phrases are insufficient to convey its deep beauty and truth.

The more deeply you learn to relax during the yin/yang exchange, the more deeply you can surrender yourself to your lover, the more likely you are to reach the balance of polar forces needed to open each center. This process happens in a split second but can take months or years of subtle fine tuning of energy between lovers. That is why a committment is usually needed to get to the higher levels of dual cultivation—it requires a great deal of time to understand the play of subtle forces and to refine your more gross physical and emotional energies.

Your nervous system must also be strong enough to handle the increased flow of chi experienced during a valley orgasm. That is one of the reasons I teach strengthening exercises like the Power

Lock in chapter 6. Any Tai Chi, Yoga, Chi Kung or other purifying meditative work is invaluable in this respect as it speeds up and clarifies the process. Sensitive couples that want to have valley orgasms without any formal physical discipline could use the sexual cultivation practices taught in this book if their health is good and they do the Microcosmic and fusion meditations.

DIAGRAM 33

The Valley Orgasm can happen when both lovers have harmonized their will power and their breathing during the yin/yang exchange. The energy is flowing between the man and woman and they collectively focus their attention on each center. It helps to mentally spiral the energy in a three inch diameter circle (male clockwise, female counter clockwise) at a point about three inches inside the body near its center. You should experiment with the location of the point you focus on, as some people find the energy is more powerful a little closer to the spine.

The chi energy likes to move in a spiralling motion, so by mentally spiralling at key points you may trigger the release of a far more powerful vortex of energy, the valley orgasm. This spiralling movement of the chi itself is caused by the interaction of male and female energies. This can be seen geometrically in the symbol of the female—the circle, and that of the male—a straight line with an arrowhead. The fusion of these two signs is a spiral which is a circular energy containing a linear energy moving towards the center of the circle. When a man and a woman make love the same thing happens—the yang chi enters the circle of the yin chi. The chi fuses, the circle of energy expands, and spirals upward through both their bodies.

The energy will naturally travel in this sequence, spiralling through:

1. The navel center, or lower Tan Tien is the joining of the many routes of the body. When the navel is opened, all routes in the body will be joined. You will regain something of the terrifying vitality of the new-born baby, for its energy has been fed to it by the mother through the navel,

2. Move the power to the solar plexus, which controls the digestive system, stomach, spleen and liver. This will greatly strengthen your health and will. At the solar plexus center the power is much stronger and purer and widespread. But you must open the navel first for the power to flow up.

3. Move the power into the heart center, which is so important to strengthen the heart and lungs and to amplify your power of love and sympathy. This is the center of the middle Tan Tien, and extends into the areas immediately above and below it,

4. Next move it up to the throat. The throat energy center is the thyroid gland and is the door of the energy between man and Heaven. As it controls speech, it is also known as the creative center.

5. From the throat send the power to the Yin-Tang (or third eye) between the brows which controls the nervous system and soul. Its development calms one and lessens the influence of stress and fear. The head is the upper "field of energy" or tan tien.

6. Finally direct the power to the Pai-Hui, the crown, the center of spiritual knowledge and the doorway to higher spiritual evolution.

VALLEY ORGASM SUMMARY

1. First make love actively, using 3 or 6 shallow strokes for each deep one, or 9 shallow and 1 deep.

2. Stop thrusting when you feel near orgasm. Use the Big Draw to bring power up to the Pai-Hui.

3. Embrace and synchronize the breathing. Get in a comfortable position with no undue stress on the limbs.

4. Open the Microcosmic Orbit by directing your chi around the circuit with the power of thought.

5. Exchange power by circulating your energy in and around your entwined bodies using meditation. Focus your attention on the polar balance of energy in your lower Tan Tien. When the power builds move it upward in a wave towards your middle and upper tan tien.

6. When your energy has been transformed up, or you feel the loss of 50% of your erection, start to thrust again if you wish and build up more energy, keeping the urogenital diaphragm closed, and stopping before ejaculation.

7. Exchange power several times. Each time try to bring the energy up to increasingly higher centers, meditating on each Tan Tien for as long as you feel comfortable.

8. Women should also perform the Big Draw during the act of love. It will help her to tighten the vagina, stimulate hormonal production, and it offers the same benefits of longevity and spiritual development, just as the man's practice does. Remember the Big Draw is a muscular and mental practice; whereas the exchanging practice is a mental and spiritual operation. The higher energy in women is different from men. This study merits a complete work of its own which is projected for a later volume.

In the true Taoist dual cultivation both man and woman are regenerated in the practice, and neither is harmed. It is highly important the practice is not used for selfish interests. I recommend that neither partner have genital orgasm in the higher stages of the practice, although it may not be as great a loss for a woman and might even stimulate her to higher levels sometimes. When one partner approaches too near the orgasmic abyss, the overheating partner must signal the other to stop motion. Either may lessen the urge of orgasm by immediately doing the Big Draw to vent the power away from the genitals.

In the Taoist practice of "single cultivation", a man alone can also induce a kind of inner valley orgasm by learning to balance the exchange of yin/yang energies between his different Tan Tiens. There is a method of "self-intercourse" induced by reversing the polarity between certain organs which is quite wonderful. This is meditation experienced as lovemaking and is a higher practice that ultimately the individual lovers in a couple should learn to master. This is part of the "Lesser Enlightenment of Kan and Li" described in chapter 19.

THE BIG DRAW AS A CONTRACEPTIVE METHOD

Taoist cultivation of sexual energy can aid you in creating the healthiest and most organic contraceptive ever devised. I personally did not ejaculate for ten years using this method, and never had any unwanted pregnancy. When my wife and I decided to have a child, I ejaculated twice. The first ejaculation was solo, to clear any weakened sperm cells out of my body, cells that were weakened because I had drawn their chi up to my higher centers during meditation. Then my body responded by vigorously producing new sperm cells to replace those lost in the first ejaculation, and I focused my intention and energy on making them as powerful and healthy as possible.

I ejaculated only once in my wife in order to get her pregnant. Of course, we were careful to choose the beginning of her ovulation, so my sperm had several days to swim around chasing after her egg. Our child, Max, is the result, and as any of my students can testify he is a living dynamo. I believe we gave him the best start in life possible by guarding my seed and cultivating it to maximum health by cultivating the health of my body, which produced the seed.

However, there is a warning in all this. Because your seed becomes stronger as a result of these practices, it is much easier to impregnate a woman should you slip and lose it. Even though you are one hundred percent confident of your mastery of your seed I would recommend using a backup artificial contraceptive. Don't meddle with the body; avoid vasectomy or sterilization. Condoms prevent absorption of female yin fluids and may slow or weaken your sensitivity to the passage of chi energy through the penis.

To be safe, use a backup contraceptive even if you can prevent

orgasmic ejaculation of your seed. You can still leak some of the clear "water" or semen which lubricates the passageway for the sperm out of the penis during the plateau phase of exchanging energy. This watery seminal fluid may carry a few invisible sperm eager to meet some lonely egg. This is also a caution against sleeping with women whom you do not love—an unwanted child will cost everyone far more dearly than the momentary sexual pleasure is worth. Remember that you are not only cultivating your sexual energy, you are cultivating the Tao in everything you do and think. Try to do it wisely—avoid big problems by taking the correct small measures.

A WOMAN'S VIEW OF DUAL CULTIVATION

Michael Winn conducted this interview with a 35 year old dancer, teacher, psychotherapist, housewife, and mother of one child.

MW: Did you find it difficult to learn the female half of dual cultivation, Ovarian Kung Fu?

Student: I've been practicing it for about 2 years. The concept was simple, the physical part was fairly simple, but it has taken me time to find my own needs and balances in sex. It was more difficult to help my partner to not have orgasms than to turn my own orgasm back. The question of whether or not to have an orgasm, whether or not it gives me energy or depletes me of energy seems to change. It depends on a couple of things. It depends on the type of orgasm, the type of energy between myself and my partner and where my energy is during that sexual encounter during that day or time or emotion.

MW: So, if your energy is at a low place, does your orgasm take you to a high place? Or if you're at a high place, does the orgasm drain you?

Student: I think if I'm in a low place, stirring up the sexual energy will increase my energy. But going all the way and having an ordinary orgasm will deplete me. If my energy is high, stirring up the sexual energy will make it higher and clearer and having an orgasm won't deplete me. It sometimes can give me more energy. When my partner gets more energy from my orgasm he's learned how to transfer it back to me so I don't lose energy from an orgasm, unless I'm depleted to start with. Then I tend to want to really conserve and do the Big Draw.

MW: Do you think this has radically changed sex for you?

Student: Definitely. Without a doubt. It's very special. I would say the ability to tune in to each other is really heightened. The harmony is far beyond what sex I had before. It's turned the sexual act into a really high art form of communication. Sex was great for me before, but this is much deeper. It has to do with the ability to communicate physically and psychically which I have gotten to at other times in my life, but this is a consistent path of getting there.

MW: So, let's break this down, is it just more physically intense?

Student: It's more intense, it's warmer, it's longer. And I

think longer is a big part of it. I can have a whole body orgasm, and sexual excitement all over my body. I had that before a few times, but it happens much more often now. I can sustain the orgasm a long time. They last longer, a couple of minutes sometimes. Before it was only a few seconds. I'm really tuned into different types of orgasms now which I hadn't been before.

MW: What are the different types of orgasms?

Student: Each one is different. There are real gentle, mellow ones, there are intense ones, there are really driving forceful ones. They can happen in different parts and happen in the brain. It can happen in the genitals. I have used it for healing and it works. A couple of times I had an orgasm I've directed it to the weak organ to be healed, but I find it more useful to hold back on the orgasm and send the energy there. I have found one trick that really seems to intensify and lengthen an orgasm and that's to go into it about *Vi* way and then begin to hold back on it.

MW: So when you are already into an orgasm you can do the ovarian kung fu.

Student: Yes. It's as if you would withdraw from it but since you are already into it, it continues it and lengthens it and makes it last for a real long time. What it does is instead of turning off the orgasm if I'm already into it, it makes it last for a real long time. I send the energy up my spine. I'm not actually doing the Big Draw clenching contractions. I'm just tightening the vagina muscles and tilting the pelvis back. It's a slight arching of the spine out so the back is rounded.

MW: And that prolongs your orgasm.

Student: Yes, tremendously.

MW: Is it because the spine is aligned that the energy can travel up easily?

Student: Probably. I'm not sure how it's pulling energy up, I found out about it trying to keep an orgasm from happening in my partner. When I start to have an orgasm it will trigger him to orgasm and I don't want that to happen. So if I start to have an orgasm and I feel his orgasm coming on, I'll pull back. I pull his penis out of my vagina and start to send my energy up. And what I found often happens is that just prolongs the orgasm in me.

MW: So you'll have an orgasm withdrawn from him; you'll have the orgasm more privately.

Student: Yes, I'm trying not to pull him into it. At other times

we stay together if he's feeling totally in control, and that's wonderful.

MW: What's the response amongst other women doing Ovarian Kung Fu?

Student: Generally it's good, they like doing it. Most women I talk to tend to think they had it all together before.

MW: I've heard that a lot also. Is that a common reaction?

Student: To tell you the truth, there are only a few women that I think who have really been practicing with partners. Some of the women are doing the exercises, but I know only one other woman who has been doing it with a partner. It's pretty much my own isolated experience, there just aren't enough women doing it.

MW: Have you ever felt, in terms of the quality of your sex, the quality of the energy, a high vibrational level?

Student: Yes. Sometimes I have a sense that I'm under water after an orgasm is over. I see things differently, and there is a buzzing in my ear. I've also had this happen after an intense meditation.

MW: How has Ovarian Kung Fu practice affected your daily life?

Student: It's made me more sensitive to my partner and more sensitive to my own energy. There is a deeper level of tenderness and I think from this there is the impetus to conserve one's energy. To hold and cultivate it is precious. I think when you do that you create a certain type of presence in the world, and other people respond to you in a like manner.

MW: In terms of your energy and sharing it with your lover, what's the difference between energy and love? Is just having more energy in physical intensity the same as having more love?

Student: It's not just physical; it feels psychic. You're creating a loving relationship. The sex is a vehicle in creating harmony. The Taoist methods put more power into your emotions, into everything. There have been times in the middle of love making that we've both just cried, it is so powerful. That quality of tenderness, that connection. So it's definitely more than physical.

MW: On any level, do you feel you can distinguish between yin and yang energies?

Student: I don't think of it as yin and yang, but I do feel his heat going up my spine, and it transforms me. I feel more like a woman. But I couldn't define it as feelings. I would just define it

more as a special energy. It's like fanning the fire inside yourself and then allowing yourself to melt into it.

MW: So what's the difference between this chi exchange and love?

Student: It's one way of exchanging love. It's one way of sharing energy. It creates more polarity. I feel fed, it's like a food. I get yang energy, and hot yang energy allows me to then create more yin. I become more balanced. I'd felt it before but I couldn't always get to it. And it wasn't as intense.

MW: Has this increased your appetite for making love?

Student: Yes. It's increased my appetite but I'm okay without it. I feel so satisfied so that it's not an absolute requirement. And also the Ovarian Kung Fu allows me to transform my sexual energy up so I don't get crazy if I'm horny and he's not. But when the opportunity is there I like to take advantage of it.

MW: Did you ever feel that your partner was more concerned with conserving his energy than in actually making love? Did you ever feel it got in the way of love making?

Student: No, never. It has only enhanced it. Sometimes it is frustrating when it doesn't work. But I look forward to getting better and better at it.

CHAPTER 10

THE SEVEN SPIRITUAL STAGES OF CULTIVATING SEXUAL ENERGY

In the practice of exchanging sexual power with one's partner or absorbing one's own seminal power there are many ways of proceeding. Each individual must develop himself using his current stage of evolution as the starting point. There are higher, more purely spiritual levels of transforming human consciousness than the beginning techniques of sexual cultivation taught in this book. But it is impossible to fully comprehend them and attain lasting benfit from them until a man is able to exert positive control over his sexual drive.

Many yogis, gurus and masters from the East have arrived in America thinking themselves fully enlightened, but soon discovered they had not achieved control over their sexuality. They had merely repressed their sexual desires while developing their higher spiritual centers. Some may have been genuinely accomplished but were trapped by their religious or cultural taboos against sex. This imbalance is made possible by the strong local taboos against free sex in the orient.

The Eastern culture is still tightly controlled by religious or family pressures that greatly reduce the temptation to have extramarital sex. The penalty for being discovered is too great and would ruin the "career" of an aspiring yogi or other spiritual teacher who is assumed to have transcended the sexual urge. In the climate of unbridled sexual freedom that exists in America, their

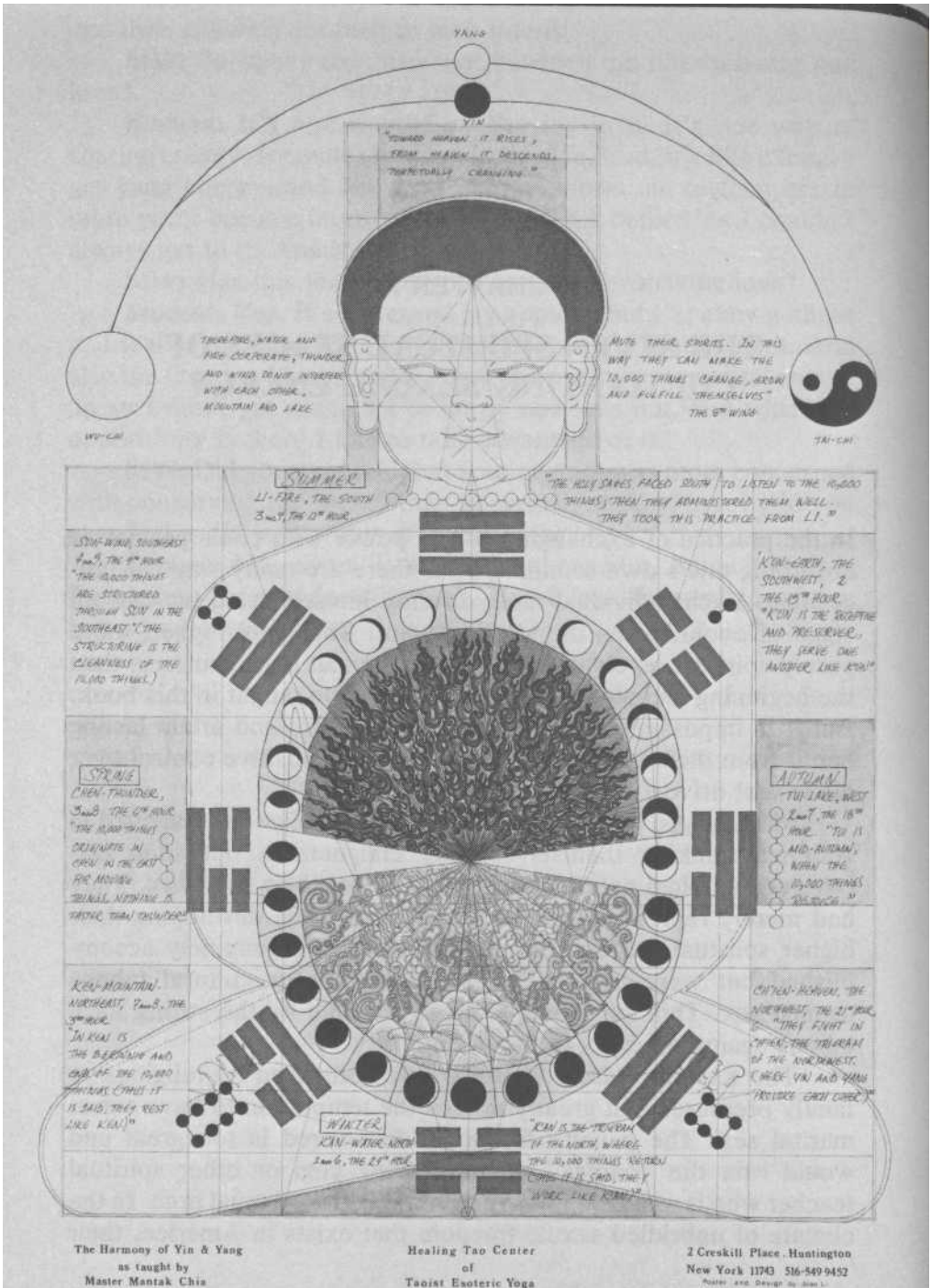
YANG
YIN
"TOWARD HEAVEN IT RISES, FROM HEAVEN IT DESCENDS, TORTUOUSLY CRAWLING."
THEREFORE, WATER AND FIRE CORPORATE; THUNDER AND WIND DO NOT INTERFERE WITH EACH OTHER, MOUNTAIN AND LAKE
MUTE THEIR STORIES. IN THIS WAY THEY CAN MAKE THE 10,000 THINGS CHANGE, GROW AND FULFILL THEMSELVES" THE 8TH WING
WU-CHI
TAI-CHI
SUMMER
LI-FIRE, THE SOUTH
3 and 9, THE 12TH HOUR
"THE HOLY SAGES FACED SOUTH TO LISTEN TO THE 10,000 THINGS; THEN THEY ADMINISTERED THEM WELL. THEY TOOK THIS PRACTICE FROM LI."
SUN-WIND, SOUTHEAST
4 and 9, THE 1ST HOUR
"THE 10,000 THINGS ARE STRUCTURED THROUGH SUN IN THE SOUTHEAST." (THE STRUCTURING IS THE CLEANLINESS OF THE 10,000 THINGS.)
K'UN-EARTH, THE SOUTHWEST, 2 THE 13TH HOUR.
"K'UN IS THE RECEPTIVE AND PRESERVER. THEY SERVE ONE ANOTHER LIKE K'UN"
SPRING
CHEN-THUNDER, 3 and 8, THE 6TH HOUR
"THE 10,000 THINGS ORIGINATE IN CHEN IN THE EAST. FOR MOVING THINGS, NOTHING IS FASTER THAN THUNDER"
AUTUMN
TUI-LAKE, WEST
2 and 7, THE 18TH HOUR. "TUI IS MID-AUTUMN, WHEN THE 10,000 THINGS REJOICE."
KEN-MOUNTAIN-NORTHEAST, 7 and 8, THE 3RD HOUR.
"IN KEN IS THE BEGINNING AND END OF THE 10,000 THINGS. (THUS IT IS SAID, THEY REST LIKE KEN)"
CH'IEN-HEAVEN, THE NORTHWEST, THE 21ST HOUR.
"THEY FIGHT IN CH'IEN, THE TRIGRAM OF THE NORTHWEST. (WHEN YIN AND YANG PRODUCE EACH OTHER)"
WINTER
KAN-WATER, NORTH
1 and 6, THE 24TH HOUR
"KAN IS THE TRIGRAM OF THE NORTH, WHERE THE 10,000 THINGS RETURN. THUS IT IS SAID, THEY WORK LIKE KAN."
The Harmony of Yin & Yang
as taught by
Master Mantak Chia
Healing Tao Center
of
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2 Creskill Place . Huntington
New York 11743 516-549-9452
Poster and Design by Jian L.
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sexual urges re-emerged forcefully and became stumbling blocks in their spiritual development. Many slept with their followers, who later became disillusioned with their guru as he proved himself too human and attached to sex for the pleasure of it.

Some spiritual leaders are very critical of "lower" attempts to transform sexual energy using physical techniques as described in the beginning methods of Taoist dual cultivation of chi energy. They ignore that man is human and will make mistakes even while pursuing a spiritual path. Because sex and eating habits are deeply engraved in the nature of a man, you can't change these habits overnight. But if a man gradually changes inside, his habitual way of thinking and behaving will alter to conform to his innermost spiritual nature. This is the essence of the process of chi cultivation. The likeness is to a young tree beside an old tree: the first may bend easily but the old will not be bent so suddenly. Sexual essence, or ching chi, is our own internal fountain of youth, the sap flowing in the young tree. When you conserve and circulate it, it has a rejuvenating effect. Your mind, body, and spirit become more supple and pliant, then spiritual development can happen gracefully without great struggle. When the sap has run dry and you are crooked and arthritic, the path is painful and difficult.

IS DUAL CULTIVATION A LEFT HAND PATH?

Certain people involved in spiritual practices will recoil from Taoist cultivation of sexual energy and accuse its practitioners of using the "Left-Hand Path." By Left-Hand they mean that it involves the use of man and woman meditating together while sexually coupled. For this reason the practice appears to them suspect, tainted, or somehow less pure than a meditative practice or prayer which does not consciously involve sexual energy. In the Right-Hand path one takes a vow of celibacy.

Sex is not by itself spiritually undesirable. Without it no holy man would ever be born. The purity of the practitioner's intent in dual cultivation is critically important, as it is in every spiritual practice. If the intent is to control another person, then the practice can become "black". The crucial distinction is whether there is an attempt to interfere with the will of another, for his/her "good" or ill. Any manipulation or interference charged with subtle energy is a form of black magic, unless the other person freely asks for help or love and willingly expresses the desire to receive it.

Otherwise, there's nothing to fear from sex—it's part of you, you're born and die with it, it gives warmth and power to human love and is charged with the same polar forces as the rest of the universe. In fact this path of cultivation is called "White Magic" by some Taoists, as it teaches people how to reach a pure polarity by balancing their yin and yang. Even my master's name, "White Cloud", taken from this sacred mountain in China where he lived reflects this teaching. There are other powerful paths that focus more strongly on the yang or yin energy, but I find them more risky. Some people criticize the use of sex as a "red" yoga, but they are confusing this color with the fire energy of passion. In dual cultivation you mix equally the white and the red, his seed and her blood, mind and passion, the primal man and woman, the yang and the yin. From that you alchemically distill a neutral essence, a precious elixir that is without color, with the power to transform your soul into an immortal spirit and body. This elixir is made of refined chi and ching and spirit and takes years to prepare properly.

No saint or guru or king is born without reproductive organs. So everyone born man has to go through the male stage of sexual development. How fast and what kind of method he uses to pass through it differs, but he will experience sexual arousement, erection and ejaculation. If he can pass this worldly stage quickly, perhaps he can become a monk, a saint, Master or Guru. Or perhaps he will choose to remain an "ordinary" person in the world.

Many of the high Taoist masters keep a low profile and do their work silently. If you met them you would not think them extraordinary unless you were aware enough to sense the serenity about them. Their energy is like a gentle breeze waving across the room, touching everyone in a special way. In Taoist cultivation the man and woman meditate together. They use the natural human sexual urge as a bridge to higher consciousness. Taoism provides techniques to help a man to master his sexual impulse, so that he is free to choose the way of life he prefers. The alternate is to be a slave to animal instincts or sexual frustration. No matter how deeply these may be buried, they will find a way to surface if left unattended.

LEFT HAND PATH

Even among the Taoists who were ambivalent about the practice of dual cultivation and maintained strict celibacy, it was not because women or sex energy were considered dirty, impure, or evil. The yin essence of a woman was always acknowledged in China for its power and harmonizing influence. The doubts about the practice of exchanging energy during sex mostly centered on whether the adept—male or female—practicing the technique would continue to progress beyond the sensual and emotional pleasures of sex to achieve the highest spiritual awareness.

There is real danger of confusing your emotional attachment to your lover with attunement to the higher subtle union of yin and yang. I would say it is a phase that for most men cannot be avoided, but that in time and with continued cultivation of your energy through meditation, Tai Chi, and related practices you will naturally pass beyond it. This does not mean living without emotions; it means keeping them in balance and using the emotions that do arise to lend positive power to your chi cultivation process. It is more dangerous to force yourself into celibacy before you are really ready for it, as you will never know if you have really mastered your sexual desires and emotions or just avoided or otherwise suppressed them.

Celibacy can also be very distracting if you enter into it prematurely. You can easily build up more sexual power than you are able to balance in your meditation. You may have the inner will to resist sexual involvement with women, but if your soul keeps wandering back to them in dreams or thoughts you will lose energy and it will divide your attention. For this reason men need women; whatever the difficulty in coming into balance with them, their very presence affords a certain primal peace of mind.

In this sense, dual cultivation is the safest path, as it leaves no stone unturned. You have someone to accompany you on this long journey through life, and that makes it fun if you enjoy your path you stay on it more surely than someone who forces himself into an austere program of self denial. A woman's heart filled with yin essence is beautiful, accept it. You can both use the relationship as a microcosm of the universe. It will act as a mirror and reflect back to you a certain spiritual truth. This feedback from a partner is valuable and is one of the reasons the Taoists often worked in

pairs, and not just lovers. There is valuable support and feedback in every relationship.

In Right Hand Cultivation, you use your own mind and body as a microcosm of the universe. Celibacy makes your life simpler, less messy, and the borders of one's individual conciousness are more sharply defined. This saves energy and can make for rapid progress in meditation. But it can also lead to a certain sterility, if you're not careful, the illusion of perfection in an inner world that negates the reality of the material world.

It's like being inside a crystal ball and looking out at the world but not actually experiencing the world and coming into harmony with it. You may find yourself avoiding your real life obligations, or falsely believing that you are separate from the world by virtue of your spiritual energy attainment. If you believe this you may have fallen into the common trap of putting too much energy in your head, and broken true contact with your body, and the five primal elements.

There is nothing to fear in the world if you keep your integrity, your balance of body, mind, and spirit. In the case of dual cultivation, you needn't be afraid of a woman. Her yin energy may seem different or discomforting at times, but the challenge a man takes on is to absorb that energy and use it to increase himself and balance her by increasing her yang. Spiritual men who are afraid of women, who avoid them for fear they will get attached or contaminated, are trying to protect a self-contained male spiritual ego. Many are afraid they will not be able to match the woman's power over them. This is blocking the flow of the Tao. It's as irrational as being afraid of water. You could drown in water if you fell off a boat in the middle of the ocean. But you wouldn't refuse to drink water because of it. It's a question of balance, of harmony between the five subtle elements. You can control this balance more easily once you've learned to control your seed. Then if you add her water essence and your seed energy to the soil everyday, a healthy garden will bloom that you can both share.

CULTIVATING THE RIGHT HAND PATH

One method of the Right Hand path that students of the Tao may wish to try is the following. After retiring to bed early, awaken in the early hours of the morning, somewhere between midnight and

6:30 AM. Often an erection spontaneously occurs at this time; if not, one can easily be induced. When erection is attained, assume to the proper lying position.

Perform the Big Draw 9, 18 or 36 times depending how soon erection drops down. Each time shift the power up to the head. When the head fills, the power is allowed to descend to the heart, solar plexus, and navel respectively. Then it will proceed down to the Hui-Yin and rise back up to the head, completing a full circuit. This meditating form is very strengthening and may be engaged in every night if the student so desires, with increasingly beneficial effects.

I have found this exercise to relieve many difficulties men may experience with the prostate gland. It involves a literal pulling away of any undue tension tending to swell and irritate the gland. It also serves to open the routes of electrical energy in the body which will increase your permeability to your partner's energy, as well as to all other sources of life.

Some Masters regard the powers that are connected with sexual intercourse as dirty or unrighteous power, somehow not pure. If you are concerned by this, you should know the hour of 12 P.M. is considered the purest one, for yang changes to yin at this moment. But remember, the power gained is like the money that people earn. Some people earn it in the high and easy position, some earn it from hard physical work like sanitation men, truck drivers, window cleaners. The money they earn is the same. Can you judge which one is the righteous man? It's not the money you earn that counts; it's how you spend it. The Taoist spends his energy cultivating himself and others to the highest level possible, using his left hand, right hand, and no-hands.

NO HAND PATH OF THE TAO

In my meditation classes I go beyond, into things that cannot be taught in a book. I expand on the Taoist approach to increasing man's freedom absolutely. This is the Taoist teaching of the three levels of enlightenment, and beyond that, Immortality. We Taoists have many secret ways of reaching our pure being. In Iron Shirt Chi Kung, I teach a technique for weightlifting on the male reproductive organ which literally pumps great quantities of the sperm power up into the head and body. In China or India, you

might wait a lifetime at the feet of a master before he taught you this secret. I have no secrets, only the desire to teach others what I have learned. The problem is to find students with the patience and self-discipline to practice it.

Remember that the seminal power we use in Sexual Kung Fu is more than the nutritional value of the substance, however high that be. Here we are tapping into a nearly infinite source of electo-magnetic energy from the sperm. They are moving constantly and creating, by elementary principles of electro-magnetics, human electricity. We have stopped the disastrous waste of energy from frequent ejaculation, and have begun to elevate it's power more completely to the heart and head.

DIAGRAM 34

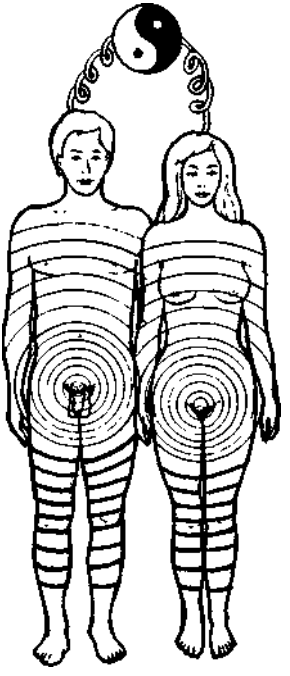

The No Hand Path of Tao
Yin & Yang energies are balanced.

In the Iron Shirt Chi Kung practice, we increase the stability of our life energy by rooting it more firmly in the earth and packing the chi energy into the fascia, bones and hollow cavities of our

body. In the Taoist Esoteric Yoga technique of "Lesser Enlightenment", or Kan and Li, I teach the esoteric formulae for increasing the yin and yang powers within the body and "steaming" the stored chi and ching up into the heart and head in a more refined form. In the "Greater Enlightenment" you learn to absorb yin and yang energy from sources outside your body—the earth, sun, and moon—and "steam" those up in an alchemical process of refining. But unless you can first master your own creative sexual energy, you shouldn't even dream of mastering the subtle realms rest of the universe. You will spend your life chasing illusory powers or a false sense of oneness that will wither away in old age or on your death bed, when you realize you can't carry your dreams with you into afterlife.

According to Taoist tradition the basic process of transformation in stages of bodily energy is this: the sperm energy is channeled into the warm current or Microcosmic Orbit. The warm current is transmuted into mental power and this power or "soul" is finally transmuted into the highest manifestation, which is pure spirit. When this spirit is embodied in an Immortal Body, it gains freedom to work in different spiritual planes at will. This is a step beyond the awareness of cosmic oneness.

The man who practices Taoist cultivation inevitably becomes more aware that all living things are one. He knows that power flows into him from others and back to them again. Whenever there is life the power flows. He understands this truth by experiencing it in his body. After these experiences selfish motives gradually dissolve. To take from another is to take from oneself, for one is the other. To dirty another's stream is to dirty ones own: there is one stream in all creation, and that is the stream of life.

So I offer the reader a sequence of methods to choose from so that you may spontaneously advance without any strain or forcing on your part. It is advisable to proceed from one step to the other; most spiritual people began with lower forms and gradually stepped up.

It is wrong to think the use of human sexual energy on the physical plane is from an impure left-hand path, because it is the path everyone must travel. If you start with the left hand, you will eventually progress to the right hand, and ultimately attain the no hand path. But you can't get to the highest attainment without first ascending the lower ladder step by step, with both hands firmly

grasping the rungs. As you climb, the right hand and the left hand alternate in stabilizing your balance. You don't let go until you have reached the top of whatever the ladder is leaning against. Then you can stand on firm ground and kick the ladder away and stand with "no-hands"—empty hands free to do whatever you choose next, be it to climb another ladder or stay where you are.

Those who are not really involved in a daily Taoist practice such as Sexual Kung Fu may criticize the use of sexual energy to evolve. But if they studied and came to know the complete system, they would understand there is no left-hand and no right-hand path, only yin and yang mixed harmoniously in an infinite multitude of forms.

Everything leads to it's opposite: sex leads to no-sex; oneness leads to twoness (twoness of yin and yang) twoness leads to threeness and everythingness leads to nothingness (Wu Chi). This is true cultivation of the Tao—the No-Hand Path. With No Hands life becomes effortless.

There is a stage in Tai Chi Chuan sometimes referred to as "wonderful hands". A beginner learning Tai Chi may use 90% yang energy to move his body. An intermediate student may use 60% yang and 40% yin. A master of Wonderful Hand Tai Chi uses 50% yin and 50% yang. A Taoist master creates this same balance at every moment in his life. This is the No Hand Path of the Tao. It is wonderful because it is so graceful and effortless, the way the whole human being should live.

THE SEVEN SPIRITUAL STAGES OF TAOIST SEXUAL ENERGY CULTIVATION

First Stage: PHYSICAL CONTROL OF SEED LOSS. This control is exerted within the "human plane" of consciousness, as are the first five stages of Taoist Cultivation. The finger is used to stop the flow of semen during love making or masturbation. This slows the loss of vital fluids and helps to redistribute it to the needy parts of the body. Using the finger may block ejaculation of the seed but it will not redirect the ching chi upwards. You will have a normal orgasm and lose 60 to 70 percent of the seminal power (electromagnetic power produced from the motion of the 200-500 million sperm), but keep most of the seed in the body. The seed will gradually decay and the hormones will be absorbed back into the body.

But the body will conserve some energy by producing less sperm. It cuts back production automatically when it senses that it is already contained inside. After practicing this "external locking" method the penis will drop down and you may feel quite tired. After a certain time it will improve body health, strength, and result in a deep increase in sexual life. It will also build up power, but this takes a longer time because most of the yang power is lost during the ejaculation.

Second Stage: PHYSICAL AND MENTAL CONTROL OF SEXUAL ORGASM. This stage uses a combination of external finger pressure and the internal locking method of "Drawing the Nectar Up to the Golden Flower", or the Big Draw.

Before ejaculation, you use your finger to press on the Hui Yin and at the same time use the Big Draw to draw some energy up, before it can leak out the penis. In this way you lose less than in the first stage, but the penis will drop down and you will still have a normal orgasm centered in the genitals.

The opening of the Microcosmic Orbit is the key to allowing the flow of energy to move upward instead of being forced to move out the penis. Once you can get the energy into the coccyx it will begin flowing easily up the spine for most people. When you can feel the pressure of the chi in your head you must begin circulating it down to the navel.

Third Stage: MIND CONTROL OF SEXUAL DESIRE AND ORGASM. After more practice with the Big Draw, you will eventually control ejaculation with your mind only. You will be able to do the Big Draw without physical force and will gain the ability to play with your orgasm. This will occasionally result in releasing sperm, but gradually you will develop the power to stop physical ejaculation and enjoy the experience of a different but more highly pleasurable kind of orgasm, the "valley" orgasm.

If you can stop before going too far by ejaculating, you can draw and exchange the power from the woman. In that way you lose one but gain one. You lose mainly yang energy and receive the thing you need, yin energy. It's almost a barter; you have too much yang and woman has too much yin, so you exchange energies, each one receiving the proportion of what he or she needs. This method involves a higher consciousness, higher self-control and getting away from erotic thinking and imagining the act of love. Think of the energy you have given to your lover as a conscious sacrifice made at the altar of higher consciousness.

This third stage is higher than the second stage, for your mind has entered into a new relationship with the ching chi. Your mind has begun to integrate your sex essence with your general chi energy into a single unified being. There is a big difference in the experience of people who have practiced using only the mind and those who use the finger and Big Draw combination. It is far superior to simple coitus interruptus. Big Draw shifts the excess power in the reproductive region upward to the higher centers of the body which can store the power for greater uses. Your sexual essence becomes food to nourish your higher spirit.

In this stage, if people use the Big Draw, they can increase the power they have each time. When they use this method in making love they will not feel tired. They can have as much sex as they want although they frequently have it less often because the quality is so deeply satisfying they feel stronger and are able to control themselves and overcome other worldly desires that have a controlling influence on their lives.

However, at this level you should be aware you are drawing this extra energy from another imperfect human being. For this reason, you must be able to overcome the failings of this person within yourself. In this third stage, both partners must be very understanding and be highly involved in this practice. If one partner is not involved, it is very hard to work together exchanging the power. If your partner has troubles, or is upset, you can absorb this psychic distress into yourself. If the method will not work, sometimes it is because one partner is having personal trouble. That is the very first thing to check out, and correct with meditation or other therapy. Otherwise you will absorb these troubles into your system, where they will act as psychic toxins.

The method might seem to be unfair if your partner is very sad but you are cheerful and energetic. She will receive life-force happiness and energy from you, but you will absorb her sadness and her burdens into yourself. Only if you are highly committed can you purify her and help her tremendously by guiding her onto a higher path that will free her from her inner toils. For this reason you must be very selective of your partner, for you will be literally drinking of the life essence of the person. A vulgar, vain or jealous person is what you will tend to become if your partner has these qualities in abundance—or at least, you will have to use your greater power of love and benediction to consume these lower impulses.

Fourth Stage: EXCHANGE ENERGY WITHOUT HAVING SEXUAL INTERCOURSE. For the male this practice is easier with a youthful female partner who has not borne children and still has great vitality, or with any woman who has cultivated her chi to powerful levels through meditation. It is a method of self-healing that can be used by young people, but is more likely to be employed by older people who have less interest in an active sex life yet seek the rejuvenating powers of sexual energy. The most famous practitioner of this level is undoubtedly Mahatma Gandhi, who insisted his 18 year-old niece sleep chastely beside him at night. The spiritual fires burning brightly within Gandhi needed the nourishing and cooling balance of a female's ching, yet cultural and religious standards forbade sexual contact as a Hindu holy man.

During the Middle Ages the knights sworn to the code of chivalry were under similar pressure to sublimate their sexual drive into a kind of sublime spiritual romance. A chaste kiss from a damsel or a nonsexual embrace with loving eye contact were idealized in legends such as the Holy Grail myth (a clear symbol of the quest for pure female energy within each male knight) and in the songs of troubadors.

Today the practice is useful in situations where two friends wish to deepen their spiritual contact or heal each other, but because of marriage ties or other competing relationships do not want the disharmony that might arise from a sexual affair. Taoist philosophy has high respect for the stability of harmonious relationships, but it also recognizes the need for the spiritual freedom to balance and nourish one's personal elements. This method allows a greater range of freedom in relationships beyond the limiting categories of lover/not-lover, and encourages the blossoming of spiritual friendships in which the exchange of sexually polarized energy is acknowledged gracefully and without shame. It is a delicate and wonderful way for two people to cultivate their energy together. Married couples may find it another way to deepen the sharing of their love.

This level can only be practiced by a man who has already mastered the first three stages and has attained a certain level of spiritual self knowledge. He has learned that what he's seeking is not to be found in the external woman, in her sensuality. His chi is moving not outward to his senses but inward to his center. He seeks the inner woman within himself and finds it easier to tap his

own yin power when stimulated by the presence of strong female energy.

Method: Lie or sit facing your partner. Having physical contact is optional—such as holding hands or embracing—but you should feel aroused by the presence of your partner. Focus your attention on the subtle energy field of your partner; you must "feel" his/her aura. In the beginning absorb his/her energy into your lower Tan-Tien. Draw the power to your head, gradually opening the passage to allow greater flow of energy. At higher levels of this practice energy can be absorbed directly into the heart or into the head, but it must be well distributed to avoid imbalances from developing. If you do this every day you will get tremendous power; much of which comes from your own body, a yin power of the seminal fluid which is much purer than the first and second steps. By cultivating this new sensitivity within yourself you can greatly hasten your own and your partner's growth.

Fifth Stage: BEYOND SEX. This is a stage that highly disciplined Taoist Yogis aspire to. You are still on the human plane, but your energy is much higher than the level your energy attains when you sleep at night, which is already quite pure. This stage involves no sexual stimulation at all. In Taoism, this method is known as the "Life Hour" meditation or the "hour of tsu", as it is employed between 11 PM and 1 AM. The Tao masters have learned that the power that you absorb from your own body can stay in your body forever. The power which is absorbed from another person will not stay as long or become readily a part of your own. It's just like blood transfers, in which the cells will stay for 24 days and then die off. The goal of esoteric sex is to learn the secret power of balancing subtle yin and yang energies. But sex is man's habit. You have to move up and gradually change your routine. You would not expect to change a lion from eating meat to eating grass over night. When you get higher and higher in the practice you will change your habits easily without anyone forcing you or telling you what to do.

It is common after sleeping to awaken and feel an erection. This is because sleep has filled the body with sexual essence and chi life force. Your penis is erect with power. At this time it is very important to draw the power up so you can enjoy its intense and pure strength. If you don't draw it up it will go out. Many people are tempted to have sex or to masturbate and they lose much

power by doing so. This stage is higher than the first four stages, for without a human partner, there is a total absence of erotic thinking and hence closer proximity to the original emptiness of the Tao. The penis is erected by virtue of its own power. In Taoism this technique is considered highly secret.

Sixth Stage: TRANSFORMING SPIRITUAL ENERGIES BEYOND THE MIND/BODY. This stage is for people who have a higher spiritual education in advanced yoga, meditation or Taoist Chi Cultivation. Many who approach this level believe they are following a righteous or saintly path by detaching themselves from worldly things. This often results in aspiring yogis trying to keep down sexual feelings. But in fact all must deal with sexual desire before mastering this stage.

This high spiritual stage solves the human need for sexuality, the quest for primordial creative energy, by teaching the human to absorb energy directly from the universal, all-pervading life force. You must first spend years gradually absorbing power on the human plane until the energy of your mind, body, and spirit—chi, ching, and shien—are full to the point of overflowing (stages 1-5). Then you can work on larger fields of yin and yang energies beyond your body, and project your chi where it does the most good.

Many people try to skip impatiently up to the divine aspects of their nature without fully understanding the human and animal components. As one spiritual sage put it, "It is easy to know God, but hard to be a human being." This is why Taoists cultivate themselves from the foundation, and emphasize rooting in the earth as a prerequisite to invoking power from the Heaven.

The power of sexual energy is insignificant compared to the totality of cosmic energy, the Tao. But for humans sex is extraordinarily powerful and a bridge to the vast powers of the universe and the spiritual realms of the consciousness. Failure to cultivate this energy properly is one of the most common obstacles among men to sustaining consciousness in the sixth stage. Many men obtain a temporary glimpse into this realm through meditation or vision, but few can sustain living in it.

The vital chi energy which formerly was used to create generative (sperm) power, is now diverted in the body and channelled directly to higher centers of energy. The Taoists refer to the stages of this process as Lesser Enlightenment. When perfected, the body becomes permeable to heavenly energies directly without any in-

termediary stage whatsoever and ceases producing sperm cells.

On this higher plane, the Pai-Hui (crown) and Yin-Tang (third eye) are the two points which can absorb the universal power and Yung-Ch'uen (ball of foot) the point that can absorb the power from the earth. In this state you can practice with morning and noonday sun, and with the moon. You absorb the earth power by the Yung Ch'uen through the feet and get heavenly power and sun energy by the Pai-hui. This offers the pure super conscious power from the universe, balanced with the moon energy entering through the Yin-Tang, or third eye.

Using the Greater Enlightenment formula the universal energy is transformed and mixed with your own energy so it can become useful on the human plane. This universal energy is so raw that our body needs to transform it and adapt it to our bodily needs. When you get to this stage, you gradually do away with human power resources. This is the stage at which some Taoists cease eating food and become breatharians; they retire to the purity of secluded mountains and dine on the subtle energies of nature. My master reached this stage but was forced to leave his mountain retreat because of Japanese bombings in **WWII.**

Seventh Stage: UNION OF MAN AND TAO. This stage is what the Taoists call Immortality. I can't yet describe it from personal experience, but it is well documented in the thousand volume Taoist canon, including the names of many individuals who reached this state. You can believe it or not, or dismiss immortality as metaphor for some kind of cosmic awareness. But the Taoist teachings are clear this is meant literally and not symbolically. The highest creation for man is to create oneself consciously. Union with the Tao suggests the total act of self-creation from the original chi or the Wu chi. See chapter 19 for a fuller description of the seven higher meditation formulas of the Tao that lead to this state of divintiy.

All seven steps will gradually guide you up to higher spiritual attainment, but it is up to you to choose how far you wish to pursue your own evolution. I cannot recommend any one step for you to go on as being better than another. No one can tell you how to live your life. Many people historically use the first and second steps to live beyond a hundred years. Tradition holds others have used the third and fourth steps to live a happy energetic life for several hundred years in some cases.

The second, third or fourth steps might be better for you when young and you desire several partners. Then when you are more mature you may want only one wife. The young often desire a very beautiful wife, but after you are married for years, beauty is not the main quality in a wife. A plain girl with lovely character may be the best for achieving spiritual serenity. It depends on your spiritual will and her level of cultivation and maturity.

Likewise the seven steps. I don't know what step you will pursue. I only offer some guidelines. Some men may not be ready for many more lifetimes to change stages. After you read this book you may abandon the Sexual Kung Fu practice altogether and go on happily ejaculating like Niagara Falls.

But if you want to get involved in cultivating your energy you will spontaneously evolve and move toward higher spiritual levels. Your goal will be realized most quickly if you apply yourself with singleminded devotion to your spiritual evolution. Eventually it will become effortless as you stop struggling against your nature, which is the same in essence as the Tao. Your awareness of the universal subtle energies will grow naturally and you will move up by yourself, not according to any religion or philosophy, but from an inner guidance.

The great Chinese physician Sun S'su-mo, (581 to 682 A.D.) famous for inventing the small pox innoculation and who lived to be 101 years, astutely noted the problem of progress in his Recipe for Making Priceless Gold:

"In youth, man does not understand the Tao.

At middle age he hears much about the Tao but does not practice what he hears.

When he is old he sees the truth of Tao, but is too weak to act on it."

CHAPTER 11

ORGASM AND WU WEI

by Michael Winn

"Man is aroused by the chi of woman, and his Jade Stalk is called to action. Woman is aroused by the chi of man, causing the waters within her Secret Gate to flow. These movements are the natural outcome of the universal yin and yang. They cannot be duplicated by human will alone."
—*Taoist Canon*

There is some historical debate about whether the female has an infinite amount of yin essence and thus is capable of endless multiple orgasms. This is the point of view of the Taoist medical texts from the 8th century, which suggest that men should stimulate women to have as many orgasms as possible, thus releasing the maximum yin essence.

Women's energy is lunar, following a monthly cycle. She loses her energy each month through menstruation. But she is also renewed by the earth energy every month, which does give her tremendous orgasmic potential. But multiple orgasms can be very draining, depending on the type of orgasm and the woman's level of energy. Because a woman's sex organs are inside her body it is far easier for her to transmute the orgasmic energy up to higher centers than it is for a man. That is why many uncultivated women are more spiritual than similarly unaware men. These men instinctively toss their seed outward and lose its spiritual benefit.

But when a man begins to cultivate his seed, he can do it day and night if he has the discipline. His body will speed up production of its seed. This permits a man to cultivate his chi more rapidly than the woman, who is bound to a slower monthly cycle. This is why many of the gurus and masters are male. The other reason is that women by nature are yin, and thus closer to Emptiness. They simply don't feel as strong a compulsion to pursue such a yang, expansive goal of teaching outwardly. Women have a different journey.

But this is also the very heart of man's fascination with woman and with her orgasm, which is a kind of inward teaching for the male adept subtle enough to learn from her. The female orgasm is an inward explosion—or implosion—of her yin essence. In the valley orgasm man can experience this imploding yin energy in his different Tan Tiens as a fusion, a kind of meltdown. Yin represents earth energy, or physical matter. What happens during her orgasm is that the very structure of her body is vibrating and imploding, and by harmonising your energy with hers you are opened up to a new and polar opposite experience of your body. The woman's wisdom is that if you go deep into the earth, your body, it will lift you into heaven. It's an initiation into an inner mystery of being that women are empowered to give men, but can't bestow without an infusion of male energy as a catalyst.

Lovers who have no esoteric model to guide their path sometimes gain glimpses of this meltdown state when they languish in a kind of sweet trance after love-making and their energies fuse in a spontaneous valley orgasm. Their bodies may feel transparent, or they may feel like they are floating; sounds arrive with a tinkling crystal clarity, and colors in the room seem brighter, as if freshly washed. This is an altered state of consciousness in which they are perceiving with purity and directness the primal unity of the natural world.

The goal of Taoist cultivation is to sustain and intensify that state, in which the separateness we ordinarily feel is dissolved and integrated into a higher reality. A higher orgasm of our mind and body magically moves us closer to the original chi which exists everywhere. The pure fusion of the yin and yang subtle energies in the microcosm of our body reminds us that the same is happening in the macrocosm—that the sun and the moon and earth and the Milky Way literally make love with one another. The planets at-

tract each other with vast electro-magnetic and gravitational fields. The stars and quasars shoot out hot yang streams of light and radiation to be received by the cold yin vacuum of empty space. We witness this cosmic love-making from afar, reflected in the eerie light that reaches us on earth by way of the moon or shooting stars that streak across the sky. Perhaps all this light energy ends up being sucked back into the womb of the universe, the black holes, beyond which is true nothingness, what the Taoists call "Wu Chi."

In a parallel sense the male's seed is his solar or nuclear energy. He cultivates or stockpiles it so it can be exploded in a controlled manner in his tan tiens. It is then emitted out into his personal space as radiant heat. A woman can absorb it and give it back in material form as a cooling mystic heat which heals. The Taoists call the balance of mind within which this alchemical process of transformation effortlessly occurs "Wu Wei". This is translated as "non-action", and sometimes taken to mean that the Taoists are passive mystical observers of nature who never get involved for fear of upsetting the delicate balance of yin/yang. What it really implies is a neutrality, or state of receptivity, so that anything can spontaneously happen. It's a passive state in the sense that the entire universe is pure potential, but it is active in that it exists in total harmony with the universe that is dynamically manifesting itself every moment. You are eternally free to act or not-act, depending on what the situation demands.

On a practical level, women might be seen as living closer to the state of "Wu Wei" than men, for it is their nature as yin to empty themselves and receive the universe to realize fullness. This yin essence is what makes a woman's energy so spontaneous and attractive to a man. The less effort she makes, the more natural and easy and accessible she appears to a man. A woman can just lie there and get pregnant; she makes the very act of creation seem simple. Men, on the other hand, are yang, with an expanding energy that seems to imply great effort to sustain itself. How can men effortlessly get bigger or stronger or create anything without work and more work?

Perhaps men can find an answer in their experience of the valley orgasm. This orgasm of the total mind, body, and spirit is entered into effortlessly. When you are in the valley, strolling through the lovely scenery that includes only you, your lover, and

the subtle cosmos, you remember how easy and natural this higher harmony is, that you've been there before, but forgot it while you were busy struggling out in the world to earn money, raise a family, etc. You don't have to work to create this sense of loving peace. To the contrary, this state of "Wu Wei" is achieved not by exerting yourself, but by lying in relaxed intercourse with your lover and simply being with her. Wu Wei is nothing more than being balanced in the field of pure subtle energies generated by your bodies and by the pre-existing fields of yin/yang energy in the universe. Your love-making is practice for staying in that relaxed state, so eventually you'll be able to constantly feel that deep serenity within yourself after you return to the world of chores.

I have found the spontaneous effortlessness of the valley orgasm reaches to the very heart of the Taoist teachings. Some men may get trapped by their fascination with the techniques of chi cultivation—by the mechanics of the Big Draw method. They may get a lot of chi from it, but if they are trying too hard they may never experience the valley orgasm or the wu wei process, which is a delicate balance of non-striving yin energy and very directed yang energy. When the two are balanced in a valley orgasm you experience the full paradox of standing still (yin) and moving at the same time (yang).

That is why the great Taoist poets write of the paradoxical nature of the Tao. Wu Wei is doing nothing, but everything happens. My first experience of the valley orgasm took me and my lover by surprise, probably because we expected the Taoist esoteric methods of love making to be like the deep solo meditative experiences both of us had experienced for a number of years before we became lovers. During the valley orgasm I felt like I was in two places at once. My body was imploding and fusing inwardly, while my awareness was expanding outwards into larger energy fields and subtle realms of being impossible to describe.

I found it amazing the way my body seemed to take its cues from my lover's body. My entire body started to vibrate rapidly at the same speed as hers and stayed attuned for some minutes. Despite the orgasmic intensity, my body temperature was neither hot nor cold, but even and pleasant. It was very different from my previous meditative practice which stimulated the kundalini energy to rise in a column of hot electric yang energy and led to explosive opening of my crown or third eye centers. It would sometimes put

me into a trance where I forgot I even had a body. My conscious mind would shut down while my body raced to absorb the high dose of subtle yang energy.

The point I'm trying to make in describing such a subtle and subjective personal experience is that Taoist cultivation teaches balanced meditation in all the body's tan tiens (or chakras). This is considered the most stable marriage of yin and yang—the cooler grounding lower centers receiving the heat from the expanding higher centers, the classical mixture of fire and water. This is the middle path of the Tao—staying grounded in your body while on a lifetime journey though the subtle energy realms.

The spiritual direction of Taoist dual cultivation is not Sudden Enlightenment, or astral travel, dissolution in bliss, or fantastic visions. These might occur as temporary side effects of the practice. But the main intention of the Taoists aspiring to immortality was simply to maintain a dynamic balance of energy during the 10,000 ordinary moments of the day. The Taoists are suspicious of any transcendental path that claims to be very high and very quick or that leaves the human body uncared for in the rush to become divine. Their wisdom is that what counts is an evolution that lasts, and that such growth usually comes slowly and steadily. The 10,000 daily moments when stretched over 25 years adds up to a 125 million moments, so you have plenty of opportunities to practice cultivating the your chi over a lifetime. Fortunately, these millions of moments occur one by one, making the task simpler, and a bit less imposing.

Many people in the west want 60-second Enlightenment, and they may well get what they project—Enlightenment that lasts 60 seconds. The Taoist process may seem slow to some with its insistence on circulating higher energies into the lower centers. It seems much easier to open a third eye and go to the spiritual worlds directly, without bothering with a clumsy and heavy physical body. This is the value of the Taoist practice of dual cultivation of sexual energy. It leads to the acceptance of the ordinary moment, of human desire, of the never ending sexual impulse, as a valuable in-the-body way of understanding the Tao.

This emphasis on the ordinary in daily life being an essential part of the wholeness of the Tao is why the ancient sages did not live for peak spiritual experiences, or seek an explosive peak orgasm in sex. This seeking after bliss is like trying to be all yang. It

is an extreme state. The valley orgasm is not just a code name for bliss. It balances the yin energy of our earthly body (and the Karma, or suffering, it creates) and the bliss of transcending it with heavenly yang energy. When this bodily suffering and heavenly bliss are balanced, they cancel each other out. Emptiness is the result. This is true serenity, remaining empty even as you acknowledge both poles of experience as possibilities. Neither pole controls you, so you are truly free to choose. The desires for bodily pleasure and spiritual transcendence are born and destroyed every moment. You remain both empty and full, and life becomes a tai chi dance. When you experience this, you have tasted enlightenment. When you can stay that way, you are immortal.

PRESERVING POLARITY: WHAT DOES IT MEAN TO BE YANG?

By Michael Winn

"A Sage will practice the Tao. A fool will only admire it."
Ancient Taoist proverb.

I interviewed several dozen of Master Chia's students in the course of writing this book with him, and was deeply struck by the differences in attitude to sexual cultivation between men and women. In couples that were practicing the methods taught here, the men were more fascinated by the energy generated or the states of mind that might be reached. The women were more concerned to know that their man loved them; whether or not he succeeded at his spiritual technique was secondary.

Some women were worried initially that all the time their man spent doing Taoist exercises and meditations meant less time for his relationship with her. A few complained that a sense of technique invaded their love-making. Most admitted that this negative aspect seemed to disappear as the Taoist semen retention methods began to work. The love-making grew longer, and the added time allowed for more tenderness to develop in the relationship.

Other men began doing the Taoist practices and encountered resistence from their lover over the holding back of ejaculation. Their women felt that when the man ejaculated, it was a more total

surrender of himself to her and thus more loving. These women were also concerned that by missing his ejaculation the woman might somehow be at fault for not bringing him to full conventional orgasm. Most of this resistance is due to lack of spiritual education, or may be an unconscious attempt to maintain sexual power over a man. As one woman explained it to me, "some women get a feeling that they can possess their man only when he has surrendered by ejaculating. She isn't consciously aware of the energy equation, but it may be the way she alleviates her insecurity about his love for her."

In this kind of relationship the man's ejaculation has become a kind of football on the sexual playing field. The pattern is one wheje after the man surrenders his seed, he unconsciously holds back from her in other ways to conserve his energy and identity. She unconsciously senses this, and thinking she is strengthening their relationship encourages him to ejaculate. When he learns the Taoist method of retaining his seed and moving the energy up within himself, she resists because she is losing the tangible symbol of his surrender to her, his semen. Her motives are loving on one level, but unfortunately they are possessive.

The only remedy for this situation is for the man to share his experience of increased energy and love with her. Taoist lovemaking is impossible to master if the relationship is poisoned by jealousy and possessiveness over the exchange of lower sexual energy. The essence of the process of esoteric love is to transform the energy up to the heart and spiritual centers before exchanging it with your lover. This highlights the importance of the man returning to the woman the energy he has received from her during sex. If he tries to keep it for his own personal ends or projects it out his third eye into some fantastic vision, he disperses the chi and breaks the cycle of exchange with her. This is why the Taoists believe it is better to repay the immediate source of your energy—your lover—as she can use the higher transformed energy you give her to balance herself and you.

The energy of the two partners in the relationship begins to move in an upward spiral, and becomes more exquisitely refined with each spiral. It eventually expands to embrace friends and family members in the dynamic. This spiral relationship is actually expressed in the Taoist symbol of yin/yang circling endlessly around in a circle. The male energy is directed, like an arrow

moving in a straight line. The female energy is rounded and embracing, like an empty circle. When they intersect, the circle embraces the straight line and bends it in a spiral. Taoist love-making is a spiritual ecology system for recycling lower energies into higher ones, with Enlightenment and Immortality being phases of the spiralling process when the energies get very pure.

However, most of us, myself included, are still very mortal and struggling with our ego. Once I leave the small and private world of sexual intimacy or meditation, my public ego adamantly refuses to adopt a stance of spontaneous non-action, of Wu Wei, and keeps insisting I plan ahead for my own self-interest. To ameliorate this selfish tendency, I try to focus on serving the ever-changing balance of subtle energy around me instead of my ego. My ego is very good at lying to itself and is always getting me into trouble with its own projections, rationalizations, and hidden agendas. Seeing things in terms of their energy encourages a certain neutrality—I stop struggling to get money or position and look at what kind of energy the things I want really represent.

While it is easy to misinterpret the quality of chi I feel in myself or sense in a person or situation, I feel that ultimately the energy doesn't lie because it is the very glue connecting me with other beings, both human and spiritual. In this sense Taoist chi cultivation is a method of refining one's power of intuition, of knowing beyond one's rational mind. Most western men find it easy to accept this in theory. But the balancing of yin and yang energy can seem very abstract and impractical. I read Taoist poetry and the / *Ching* for years and liked it, but never got a deep "gut" feeling of what was really happening with yin and yang.

Only when I began doing Taoist yoga and practicing testicle breathing, the big draw, the microcosmic and fusion meditations did I experience in my body the distinct subtle energies of hot and cold, and the energies in the five major organs, heart, kidney, etc. I had to get trained by Master Chia on what to look for. When I saw it right inside my body I felt ecstatic, like Christopher Columbus confirming the world was not flat. There was a cool, yin energy inside me, a new dimension of my being to explore. I set sail on the Taoist path with the faith that the world was round and I would return to my starting point a bit wiser. I find that spirit has enlivened my love-making as well. Dual cultivation has become an adventurous journey into a new part of myself and my lover.

Yin and yang are not just concepts. They represent real qualities of chi energy that can be stored in your body and used in your ordinary life. A purely intellectual approach to Taoism is one of the toughest obstacles a highly educated western student has to overcome. Westerners consider the intellect to be the mind, while Taoists see intellect as just one tool of the whole mind-body-spirit. When Taoists cultivate their chi and refine the union of body, mind, and spirit with their spiritual exercises and alchemical meditations, they are training the mind to live in a world filled with dynamic fields of energy.

This means to be a Taoist you stop living in a disembodied world of words and concepts constructed by your intellect. You doq't stop thinking, but you may need to learn how to think-feel with your whole being. To do this you will develop faculties you forgot you had and which are right now sitting dormant in the 90% unused portion of your brain and body capacity. That is why sex is so healthy for western men; it is the only time many of them escape from the conceptual prisons of their intellect and ego, and gain an experience of being wholly in the body.

If you are just beginning to cultivate your chi, don't worry if you have trouble distinguishing between yin and yang energy. Just do your exercises and meditations daily. When you begin to sense any vibration, warmth, tingling, or altered sense perceptions it is a sign your body is waking up to its subtle energy. In time you will realize this play of ying/yang energy is not an abstract metaphysical game, but your personal destiny. By knowing it you can slowly come to grips with the source of the subtle forces working through your psyche. These are the polarized energies that find their way into your hormones, your health, your behavior, your male personality, your perceptions of who you are and what the world is all about.

Some men get the confused idea that becoming spiritual means dropping their assertive masculine qualities and becoming passive, meditative, wearing soft flowing clothes, and acting motherly and nurturing after the yin female model. According to Taoist teachings, this is a mistake; if a man becomes too yin he is in danger of losing his polar attractiveness to women and the very qualities that satisfy them both sexually and spiritually.

Instead of becoming spiritual, you may become a sissy—soft, yielding, and spineless. Balancing the yin/yang polarity within your

psyche does not mean you should weaken your yang energy and shed your masculine qualities. The goal of Taoist cultivation is not androgeny, to make life colorless and sexless. It's not to prove that there is really no difference between men and women, since both are "one", in a bland soup called the Tao.

The difference between the polarity of masculine and feminine is what creates energy. The dynamic tension between yin and yang is what gives life to a relationship between a man and a woman. Every man and woman has both yang and yin poles within themselves, and will express a wide mixture of masculine and feminine qualities in their personality. But a man's primary subtle energy charge will be yang, and it is only in relation to this that he inwardly cultivates the yin pole of his yang energy. This may outwardly change the quality of his masculine energy, softening his rough edges or leading him to direct his male energy for more wholesome and loving purposes. But he will and should remain male in his orientation with the outer world, because that is his true nature. Women love strong men; the point of cultivating your chi is to become more sensitive and feeling within that strength. Likewise, you must help your lover to develop her strengths as well.

On the psychological level, I will risk the generalization that one of the major difficulties men have in practicing dual cultivation, is in harmonizing their ego with the woman's emotional sensitivities. The lesson both need to learn, is that people are not either their ego or their emotions, but that these are manifestations of deeper subtle energies within the self. Many couples with problems expend much time, money and energy frantically pruning the dying leaves of their relationship with the aid of marriage counselors and psychiatrists. This is working from the outside in. On one level this is very helpful, as talking about something can open the door to self-improvement.

But the Taoist approach is to nourish the roots of the tree, so that the sap can run strong and feed the entire trunk, branches, and wilting leaves from within. This works from the inside out. The process is more invisible, but it is more lasting. The sap in a human tree is chi energy, and if you want to nourish your woman you must not let your ego block the process of sharing energy. The woman is a mirror to a man. The subtle law of universal energy is that you get back what you project out. If you send her an abundance of love and energy, she will respond and return it to you. The proof of

whether a couple practicing dual cultivation has transformed their ego and emotional imbalances will be known internally to each, but also reflected in the tenderness and harmony that develops in their daily living.

A good rule to follow in Taoist dual cultivation, is to make love with your chi energy, not your ego. Sexual energy will begin to cause a degeneration in couples when it is used to feed male egotism or female emotional domination. This is the danger of using sex for spiritual growth when you don't really have your personal life together. The only protection is to give as much love and respect to your lover as you humanly can. A woman needs a certain emotional stability before she can balance higher subtle energies. Likewise, a man's ego will block him from receiving higher energies or experiencing the valley orgasm. If you can selflessly send your supportive masculine love to a woman, the energy will empower her to return it to you ten times over. This is the yin/yang dynamic. It's a single energy that constantly flows wherever your intention sends it. It then returns to its source, just as you spiritually are returning to your source.

I have begun to notice the subtle domino effect between sexual love and my destiny in the world. When I reach the point of Wu Wei, of spontaneous non-action during sex, it creates a serenity in me that softens the demands of my ego in the outside world. Somehow, the struggle of life gets easier, I find myself resolving problems with less effort.

Life is like one of those puzzle-box eggs: when you open it there is another egg, and inside that another, and so on. Sexual love is one of the eggs halfway to the empty egg at the center of the puzzle. When you make love and transform your selfish ego, raw vital chi energies and raw sex drive into something more refined and radiant, this middle egg shines through to the other eggs in the puzzle, lighting up both the innermost spiritual egg as well as the worldly outer shell.

The idea of Wu Wei and committment to a lover is very confusing. The practice of spontaneous neutrality would seem to encourage the very opposite of long term commitment to another person. Indeed, there are Taoist sex manuals on the market which encourage readers to love as many people as possible to satisfy our spontaneous impulses. I feel this is an irresponsible and misleading oversimplification of the esoteric Taoist teachings on sex. Dual

cultivation is directed at experiencing and balancing our inner subtle energy fields, not at acting out with our bodies the same basic sexual impulse again and again. Promiscuity is not the effortless grace of the Tao, but a superficial use of spiritual philosophy to justify dilettantish tendencies and erotic fantasies. The excuse of needing many partners often masks a fear of deeper intimacy with oneself and one's lover. Spiritually, it can block the alchemical union of ching, chi, and shien. The process of transformation requires a certain stability of the lower physical forces that are upset by wild, erratic, or excessive sexual behavior.

While the Taoist philosophy on sex requires a totally non-possessive attitude toward the energies being exchanged, it does not imply acting irresponsibly towards other people. The neutral mind of Wu Wei implies a balanced wisdom in spontaneously choosing the middle course at every moment. This would apply to questions of committment in a relationship as well. The perfect middle choice would naturally balance the virtue of stability in a relationship with the need for freedom to nourish one's subtle energy. These are difficult questions, but there is no ancient Taoist sage who can answer them for you. You and your lover must cultivate your own energy and become subtle beings wise enough to know the truth of your own modern situation. In short, you must become the sage, moment by moment, over the course of your lifetime.

CHAPTER 12

COMMONLY ASKED QUESTIONS ABOUT SEMEN RETENTION

1. I've had a vasectomy. Will that affect my ability to do the Big Draw?

Chia: The effects of vasectomy upon one's sexual life and general health warrant consideration. It is well-recognized that there prevails among vasectomized men a normal level of physical and mental health. Most individuals surveyed after vasectomy have considered their health good to excellent. Many wives thought their husbands' distinctly more virile.

Improved sexual performance may be readily accounted for: sperm is no longer discharged and its energies are no longer wasted. The body reabsorbs active principles of the sperm cells via the blood stream. However, those secretions not formed in the testes are ejaculated.

These benefits and far greater ones are enjoyed by Taoist lovers. They retain not only the sperm but the entire volume of seminal fluid, each part of which bursts with enzymes, vitamins, proteins, trace elements, and electrical energies. Yet this is not the most important advantage.

Secretion of the vasectomized male's testes lessens over a period of time. The volume of hormones available for reabsorption gradually declines. While the vasectomized man never more loses sperm, he ordinarily does not stimulate hormonal production.

The Big Draw Method increases hormonal secretion. First, one focuses energy on the genitals to directly stimulate them. Second, the transformation of sex energy to a higher level produces higher quality hormones.

Fortunately, a vasectomized man may use the Big Draw to "steam" the seminal energies up to the head and vital organs. Moreover, with this method every man, vasectomized or not, may exchange fortifying energies with his love partner.

2. I thought yin energy is supposed to be cool, and yang warm. Why does a woman feel so warm when you have sex with her?

Chia: Relative to the male, however, the woman remains more yin in her basic polarity. Some men may have very yin, female-like qualities that they have cultivated and some women may be very aggressive and yang in their personality. Such a couple would exchange their excess energy to achieve balance. But this doesn't change the polarity at its most primordial, pure level.

In this practice you will eventually get to the point where you experience the woman's energy as cool. This happens normally in the resting stage, during the yin/yang exchange. You will feel a cool fluid running up the spine to the top of your head. It will move up the spine in stages, as if climbing a ladder. When you learn to surrender your fiery hot yang male energy you will feel this cool, soothing yin female within you. At the higher level of practice you can get this effect by simple meditating alone on the yin pole of your yang energy.

3. How long do the Taoists take to make love? It sounds like a very long affair.

Chia: Intercourse lasts as long as both lovers desire and should depend on the quality of the energy being exchanged. Don't force extra orgasms, or if you haven't mastered the method, extra ejaculations. Once you begin feeling deep satisfaction, you won't feel the need to have sex as frequently so when you do have it don't rush. Sometimes perfect polarity can be achieved quickly, but usually when you make love the Taoist way, it is no casual affair. From the beginning foreplay to the final quiet embrace may involve two hours or all day. The Taoist classics suggest one thousand loving strokes to satisfy a woman. You may rest several times and renew more active loving. Allow an appropriate length of time without distraction. Take the phone off the hook, and get rid of the kids!

4.1 believe that if you ejaculate, the woman can gain a lot of yang energy directly from the sperm. What's the difference between giving it to her this way versus giving her yang energy and yin/yang exchange?

Chia: So long as you keep the male fluid, you may give her energy and quickly recharge yourself. If you give her the fluid, you lose the means of re-charging for a long time. Give her much energy, but don't give away the whole battery. Unless she is an advanced yogini who has developed the meditative ability to really draw the full power of sperm into herself, she can't use it and you will lose the power to give more. Even an advanced yogini will be limited in the amount she can absorb from physical sperm. Ultimately, she is much better off if her yogi conserves and transmutes his seed. Give her baskets of peaches: don't uproot the tree and send her shaggy roots.

5. When I do the yin/yang exchange, I sometimes feel a mini-orgasm in my genitals. How do I know if I am losing fluid?

Chia: During exhalation and relaxation, the penis will often "jump" as though you were ejaculating. In fact, no seminal fluid pours from the body. The prostate gland and seminal vesicles can also "pop" periodically, yielding great pleasure. The Taoist Method provides this orgasmic pleasure yet keeps the fluid inside the body.

Make sure at first there is no loss of fluid in the popping. When you keep every drop, the method is properly performed. If there should occasionally be some loss, immediately use the Hard Contractions and the Three Finger External Locking together to prevent further waste of seed. You must also distinguish between losing "milk" and "water". Milk is thick and whitish sperm fluid and is the secret elixir Taoists seek to conserve. Water is clear and thin runny seminal fluid that the prostate produces to help deliver the sperm. It is possible to leak some water without ejaculating any milk. If you are at this level you shouldn't rely solely on the method as a means of birth-control, as it only takes one sperm cell in the watery semen fluid to impregnate a woman.

6. I'm just beginning to learn the Big Draw. Will it harm my effort if I fail and ejaculate?

Chia: Don't make it an issue of your failing or not. Nobody expects you to hit a home run the first time you swing a bat. You hit some singles, then a double, eventually you run to third base.

When you've got full control you can hit a home run almost at will. The main thing in learning something new is to keep a positive attitude.

When you begin to practice seminal conservation, try to ejaculate no more than once per week. As you improve keep the loss down to once or twice per month. Continuing to progress, you will lose less and less fluid. Don't worry about losing the seed, simply learn to harbor it for increasing periods of time. Taoists accept what is natural, they never force any sudden change on their body. If you lose your seed, enjoy it and send it lovingly to your partner who will absorb at least a part of its yang essence into her body. Likewise, never force yourself to ejaculate to please yourself or your lover. This is a gradual process: you will spend the rest of your life increasing in knowledge and perfecting the Tao of love.

7. What is the relationship between the strength of the buttock and pelvic muscles and sex? I thought having sex strengthened them, since you get a lot of exercise in your lower body.

Chia: A moderate amount of sex is healthy for your body in many ways; your glands are exercised, especially the prostate, and more chi runs through your meridians. But a lot of these benefits leak out the anus and buttocks because so many men with office jobs develop a fat ass. You wouldn't believe how much chi just trickles out of the body through the buttocks. Ejaculation is opening the flood gates to energy loss, and it has an after effect on your buttocks.

Frequent sex with ejaculation disrupts your health by spasmodically coughing forth vitality. After a period of long abuse, it weakens the tissues so that they are unable to inhale life properly. Frequent ejaculation breaks down the tone of the lower body, inducing chronic flaccidity and steady trickling out of power. I teach pelvic strengthening exercises to improve lower body tone. By maintaining this tone, you constantly save energy that frequent ejaculators lose.

8.1 feel less sexual desire after doing the Big Draw every day for several weeks. What's happening to my sexual energy?

Chia: For the first several weeks of Big Draw practice, you may experience slight lessening of sexual appetite. This is more likely to occur if you are in a weakened condition. This indicates that you are successfully transferring power upward from the genital area to the higher centers. Don't be alarmed! This is a sign that

you are progressing well. You are conserving energy as never before and beginning to change it to a higher form.

After no more than several weeks the power will complete the microcosmic circuit and return much increased to the sexual centers. The power will recirculate to the genital region, which will then be permanently fortified. Once you have completed the circuit, the power will flow throughout your entire body every time you make love and revitalize you further. Then your appetite for sex may well increase. Its different for each man and his lover.

9. Aren't you being a bit fanatic in trying to save every drop of sperm? There's so much of it. I thought Taoism was a "middle" path that advocated no extremes.

Cfaia: Semen retention is simple and natural once you've unlearned your old habit. Taoists claim that it was once the middle way, a natural function that all humans could do naturally, and that our current sex habits are a product of degeneration. That's why we've got 4 billion people on earth and all the problems of over population and pollution of a once pure earth. If people felt more fullfillment within, they would create fewer demands without. Not to worry. Nature—the Tao—always finds the proper way to balance itself.

The conventional idea of male orgasm as a few instants of (literally) blinding pleasure is an extreme one. After ejaculation the man is finished unless he digs deep into himself for more energy only to rush forth again before falling off into a pleasant emptiness. To spend the vital seed wastefully is to excrete life. Frequent ejaculation is an infantile attempt to solve our lonely separation from bliss. It is a rejection of the inborn joy that we may all know.

Of course, people can and do love deeply without retaining their seed during sex. But these people are unconsciously transmuting their seed power into love the rest of the time—this is where love obtains its power of spontaneity. But they may miss a deeper joy. Until you learn this deeper joy I must strongly recommend you not be fanatic about losing a few drops of sperm—nature is abundant and forgiving and its best to change gradually. Then the change will be more permanent.

But at the same time you won't be motivated to change your sex habits unless you remember that ejaculation isolates. It cuts you off and enslaves you in small steps to a lower state of energy. Ejaculation is one of many subtle forms of suicide, including drugs,

over-eating, over-everything. Your real task is not to prevent ejaculation: it is to establish direct contact between your physical nervous system and the subtle sources of life. To do so you must conserve the vehicle through which your chi life energy flows.

10. Most modern sex manuals claim it's healthy to fantasize about your erotic desires. What do the Taoists say?

Chia: Many sexologists are not aware of the higher possibilities of their mind and don't understand the process of transforming energy into spirit, ching into shien. Above all, Taoists are training the mind. It is very important to keep the mind free of distracting images. Fantasizing about sex ultimately strangles the mind. It breaks the flow of life and provokes orgasm.

Open your mind to the power of life: this will dissolve fantasies. When you empty the mind of thoughts, cosmic energies stream into the void. This is the first principle of meditation. The act of love becomes a meditation on the great life force. Of course, it takes time to cultivate this level of crystal clarity in your mind, so don't worry about your habit of fantasizing. Simply begin by not encouraging it, by catching yourself when you drift off, and return to the present.

The presence of your lover should arouse you. If her company doesn't stimulate you, if you have to turn to erotic fantasizing, wait for another occasion or partner. Obsessive erotic thinking inevitably leads to loss of the life force. Fantasizing causes energy to seep out even where there is no ejaculation, as well as preventing life from flowing in spontaneously. The same is true of electric vibrators or other stimulators. They feel good, but they mechanize your sexual response. You can grow dependant on your machine. If you want to be more human and ultimately find deeper pleasure, follow your natural impulses only, not the ones contrived by your culturally conditioned mind.

11. Will this practice of holding my sperm inside eventually lead to my losing my appetite for the physical passion of sex?

Chia: As you advance in the practice you lessen your need for physical movement. Physical movement is but the shadow of movement of the energy body. Contact with your lover's subtle chi is incomparably more thrilling than the hooked-fish leaps that are often mistaken for the heights of love. Your definition of sex will be radically changed by mastery of these practices that will find you concerned with the quality of your subtle energy relationship with your lover.

12. What's the difference between the physical pleasure of sex and the pleasure of feeling love?

Chia: Your pleasure is limited only by your level of consciousness. The difference between whole body orgasm and ejaculatory orgasm is the difference between human and animal love. The animal frantically ejects his energies. The higher man responsibly conserves vital energy and changes it to love. The truly free and wise man ever restores himself and his partner. This supreme art is his duty, privilege and joy. The purest pleasure is far beyond any sensory feeling perceived through our emotions or intellect. When you cultivate your original spirit, your delicate sense of subtle energy flows as well as your physical sensations are a quantum leap beyond what most people accept as pleasure.

The quality of your feeling determines the quality of energy you generate and absorb. If your desires are selfishly erotic, the energy may temporarily heighten your animal vitality but will not rise and open the higher genius of your heart, mind, and spirit.

These principles apply universally, but the act of love is particularly momentous for a human being. It involves one's entire destiny. The energy of every act and thought is preserved: one who thinks egotistically will find nothing but egotism from others. Another finds love everywhere because he unfailingly brings it within. When you raise your sexual seed-essence to a high level of spiritual intention, it becomes a light-essence, or light seed that illuminates your path through life and beyond. This is the Taoist enlightenment taught in the higher levels of meditation.

13. If the goal is to build up one's sexual energy, what's the harm of sleeping with a lot of different women (or men) to increase your ching chi?

Chia: The goal is not to build up one's sexual energy—it is to transform raw sexual energy into a refined subtle energy. Sex is only one means of doing that. Promiscuity can easily lower your energy if you choose partners with moral or physical weakness.

If you lie with degenerates, it may hurt you, in that you can temporarily acquire your partner's vileness. By exchanging subtle energy, you actually absorb the other's substance. You become the other person and assume new karmic burdens. This is why old couples resemble each other so closely: they have exchanged so much energy that they are made of the same life-stuff. This practice accelerates this union, but elevates it to a higher level of spiritual experience.

So the best advice I can give is to never compromise your integrity of body, mind and spirit. In choosing a lover you are choosing your destiny, so make sure you love the woman with whom you have sex. Then you will be in harmony with what flows from the exchange and your actions will be proper.

If you think you can love two women at once, be ready to spend double the chi to transform and balance their energy. I doubt if many men can really do that and feel deep serenity. For the sake of simplicity, limit yourself to one woman at a time. It takes a lot of time and energy to cultivate the subtle energies to a deep level.

It is impossible to define love precisely. You have to consult your inner voice. But cultivating your chi energy sensitizes you to your conscience. What was a distant whisper before may become a very loud voice. For your own sake, do not abandon your integrity for the sake of physical pleasure or the pretense that you are doing deep spiritual exercises. If you sleep with one whom you don't love, your subtle energies will not be in balance and psychic warfare can begin. This will take its toll no matter how far apart you are physically until you sever or heal the psychic connection. It's better to be honest in the beginning.

For the same reason make love only when you feel true tenderness within yourself. Your power to love will thus grow stronger. Selfish or manipulative use of sex even with someone with whom you are in love can cause great disharmony. If you feel unable to use your sexual power lovingly, then do not use it at all! Sex is a gleaming, sharp, two-edged sword, a healing tool that can quickly become a weapon. If used for base purposes, it cuts you mercilessly. If you haven't found a partner with whom you can be truly gentle, then simply touch no one. Go back to building your internal energy and when it gets high you will either attract a quality lover or learn a deeper level within yourself.

14. Isn't the Big Draw a form of sexual vampirism, teaching men how to suck women's juices, etc?

Chia: This view is incorrect for several reasons. First of all there is necessarily an exchange of energy between partners, all lovers exchange energy; the Big Draw just dramatically adds to its magnitude. You cannot inhale the yin from your partner without surrendering to her an equal measure of yang. This is simply a law of etheric energy.

Generosity is its own reward: the more you give, the more

you will receive. If you selfishly refuse to surrender the yang to your partner, you can absorb little energy from her. Thus, attempts at selfish use of the Big Draw will lead to failure. Their only effect of trying would be to deeply imbalance oneself mentally and spiritually. Likewise, generous and compassionate use of the method guarantees the fullest flow of invigorating energy from your partner.

This "Fail-Safe" aspect of the method not only prevents serious abuse of one's partner, but the natural law of the Tao will ultimately mete out an equal punishment to one who tries to take advantage of his lover. Taoists agree with the Bible here: "As ye give, so shall ye receive."

Secondly, when you draw up power you inhale mainly the energy of your own sexual centers. During the act of love the hundreds of millions of sperm cells swim about frantically in their desire to get out of you and into the egg. Their motion creates a high electromagnetic charge in the semen. In this way your lover stimulates you to produce and concentrate your own energy, which you move to higher centers with the big Draw.

Finally, a major part of the energy you draw from the lover would leave her body at any event as a result of sexual stimulation. If you did not absorb it, the power would dissipate into the atmosphere. By suppressing your ejaculation and your partner's orgasm, both lovers lose much less energy than they would in conventional sex. By following the Big Draw Method both effectively absorb some of the energy the other releases instead of letting it blow away.

15. After practicing dual cultivation for a while, how do you feel when you ejaculate again?

Chia: When you begin to meditate and cultivate your sexual energy and engage in various Taoist exercises, you notice immediately what happens when you ejaculate. There's an immediate feedback in what happens to your energy level. You feel emptied, weakened, sometimes enough to temporarily depress you. The same feeling prior to doing Taoist practices you might have called "pleasant fatigue"; now the loss begins to feel painful on a psychic level, as you are accustomed to living at a higher standard of chi energy. In actual sex, in ejaculation the energy loss is very apparent and very obvious.

16. How are the eyes used in Sexual Kung Fu practice?

Chia: The eyes are very important. Later on, if you just use the eyes and a little breathing you can do the whole Big Draw. You should keep your eyes closed during sex to maximize your internal energy; if you are looking around, the mind will be distracted and chi will escape as the eyes are the most yang organ in the body. Learn to see inside your body and that of your lovers. The eyes reflect your intention psychologically so you can literally direct everything with your eyes. Correct practice of Taoist cultivation will help you develop powerful eyes. The opposite is true as well; improper sex can destroy the sparkle in your eyes. If you're observant, without knowing anything about oriental medicine, you can actually "see" people who have depleted themselves sexually. You see it in the face, the sallowness of the eyes and skin, and lackluster quality in the hair.

17. How will ill health, tension, stress and other adverse psychological states affect Taoist sex?

Chia: A good sex life is closely related to your physical health and mental condition. If you are tense it is difficult to use mind control and the big draw methods. Your ability to use these methods in actual sex is more limited when you are tense, and it's not much fun having uptight sex anyway. Microcosmic meditation and Tai Chi Chi Kung will greatly help you to calm down. If you're not feeling well or if your general level of chi is low, your sex should be passive with your partner moving on top, giving you the healing energy. What happens in your sexual encounters is like a microcosm of daily life that is magnified tremendously.

Your psychological state is very important. Feeling loving, feeling relaxed, feeling calm and not having a lot of negative emotions is essential. If you're very angry or sad or fearful it's very difficult to engage joyfully in sex and to use this kind of practice. It may throw you or your partner off emotionally, as your aura is very open during sex and you absorb negativity easily. Better to sit down together and use the Fusion of Five Elements meditation to calm the mind. Even after years of having practiced the Big Draw, if you are not in a good psychological state you might have to exert considerable effort to hold your seed. On the other hand, when you feel calm and good psychologically you can carry the whole thing off with no effort.

18. What is the difference between mechanically blocking ejaculation through celibacy and the Taoist cultivation method?

Chia: You can mechanically block ejaculation using your mind only by refusing to have sex or masturbate. But this is using willpower against the body impulse; Taoists cultivate the bodily impulses, they put the chi energy to work elsewhere. If you are celibate and can naturally transform your sex energy and you can keep your body fully integrated with your mind, you should be shiny and radiant. But not many men are so naturally enlightened.

There's some negative evidence on health and celibacy based on data that has been collected about priests, using sheer willpower to mechanically prevent sex. This can create long term problems of the prostate, causing failure and inflammation of that organ and very often considerable pain and debility. One study did medical autopsies on over a thousand Catholic priests and found one third died of prostate complications or prostate cancer. The suggestion is that their celibacy was bad for their health. In their case apparently it was true, I've heard of celibate yogis who have similar problems with their prostate.

The problem arises, I believe, because they did not know how to cultivate their sex energy properly. Their energy channels aren't open between their lower and upper body and so their sex energy is blocked and congests the blood and hormones in the genitals and the prostate. To prevent prostate problems, a celibate should squeeze his perineum tightly and relax it several dozen times a day. This will exercise the prostate somewhat, although not as well as the Big Draw, which also circulates chi energy through it. If you try to cure a weak prostate by having more sex it can work, as orgasm exercises your prostate, but you risk losing a lot of sperm energy unless you know the Taoist method. Other men weaken their prostate from excess ejaculation and depletion of their sexual energy. For them celibacy is a cure.

Stopping ejaculation with an internal (big draw) practice may look similar to mechanically stopping sex through celibacy, but the difference is great. The Big Draw consciously transforms your energy up using internal skill, celibacy leaves it to chance or willpower. I've done this practice many years and never had any problems at all. Sometimes, when there's some congestion, just a little massage clears it up. That's why in terms of hygiene, you cannot separate this practice from the larger context of meditation and the energy work in the Taoist system not to speak of other considerations that have to do with ethical, psychological and spiritual aspects.

19. Could you summarize the advantage of the Taoist total body orgasm over a loving normal sex orgasm with ejaculation?

Chia: A total orgasm of the body and mind might be described as a showering of nectar from the head, running down your insides like a springtime shower. It is unmistakable. It is a wave of subtle chi energy that breaks up muscle armoring, releases nerve and lymphatic tension, and opens up hidden powers of feeling. You feel like a new born baby, only instead of experiencing your rebirth as a baby does—as unconscious bliss—you are very adult and conscious. The weight of the world is there, but suddenly it becomes lighter than a feather.

This feeling of lightness hanpens because the heavy fluid of your sperm-seed has successfully been transmuted into a light-seed which nourishes your higher consciousness. You feel happy deep inside because you know you have found the path home. You are not weighted by yourself or your lover. This is different from a genital orgasm, which is usually followed by either a heavy sleep as the body attempts to recover energy lost or by a still anxious mind that asks: "What next?" With genital orgasm the body is relaxed, but the mind and spirit are not; they are still hungry for nourishment of subtle energy because the polarity between lovers is not complete.

20. Could you explain in detail what happens when you reach the point of no return during an orgasm?

Chia: The curve of sexual arousal in both men and women but especially for men (because women have a greater capacity to maintain a plateau) is to have a gradual (or rapid) arousal, a short plateau and then a rapid and sudden fall off and that's it . . . The Big Bang Theory. Taoist cultivation teaches you to use the Steady State theory, which is continuous expansion and contraction of yin and yang during a series of "valley" orgasms. The Big Bang theory, currently in vogue as the cosmological theory of the Universe, has as its roots the sexual desires of the western male scientist.

Now, the plateau can be likened to a "primal zone", that is an experience of primal time and space. Minutes may seem like hours; however you choose to define it. It is what psychologists call an altered state of consciousness. Women seem more capable than men of extending this plateau. Beyond that there is a critical point of no return and then the "fall off." The plateau can last anywhere

from a few seconds to several minutes to a half hour or longer and is characterized by quieting, relaxation and a diminishing erection in the male. In practice, after this period of quiet the couple resumes mutual stimulation, building up the energy, building the chi through thrusting and various other means of arousal. And again a plateau may be reached and maintained a while.

It takes practice to keep from "stepping off the edge" but the rewards are great. It's like climbing a pyramid—the top of each step is safe and flat, but going up over the edge to the next step is a little dizzying. In this step procedure you build a potential to respond to your lover that's enormous and so the probability of losing control increases as you progress to higher steps. It's as though you were building more and more pressure, but it's a pleasurable pressure, because the energy of each plateau is greater than the last. In fact, the plateaus get longer as the energy builds. When sufficient energy has developed and you are at a plateau, the chi energy begins to run through the chi channels in the body and so what had begun as a genital response now becomes a bodily one. If the whole body energy of the male is balanced with that of the female, the energy penetrates the subtle bodies on mental and spiritual levels as well, aligning your total polarity and opening your awareness of both knowledge and bliss. The nature of the Tao reveals itself to be both awesome and ordinary.

The "primal zone" on the plateau is a very precarious place and it is here that the skill of Taoist dual cultivation can really be said to be exercised. The sensitivity and ability to keep from going on to the "point of no return" is a function of your experience, your intention and your overall state of relaxation and health and your relationship to your partner. Now a woman can trigger a man's ejaculation quite easily thru her own orgasm or by stimulating him by contracting vaginal muscles. So this technique does not require a mutual orgasm and especially in the learning phase, the man must be permitted time to gain some stability at the plateau. It's interesting that many women feel that unless a man has an ejaculation he's not satisfied. This is where sexual politics comes in with all the attitudes and expectations which color responses tremendously. Both men and women have to gradually de-condition themselves of their old concepts. This will happen naturally as a couple cultivates their energy together.

21. Does homosexuality or group sex block spiritual development?

Chia: The Taoists are too wise to condemn anything outright, as everything leads back to the Tao. So the question really is how can it be against nature, or the Tao, if the Tao created it? Homosexuality is not against the Tao, but it is also not the highest experience of the Tao possible. It's impossible to experience the full balance of male-female polarity with homosexual love. The subtle energies are lacking and you can't create something if the raw materials are absent. The highest harmony of yin and yang cannot be achieved. It depends on how far on the spiritual path you wish to proceed. If you go deep enough into meditation you may cultivate your opposite polar energy within. But then your homosexual love life might disrupt that balance, so you would constantly be correcting it.

The problem is greater for two men than for two women, because their double yang energy is too expansive and more easily leads to conflict. A double yin energy can be harmonious, as yin is yielding, but neither woman will experience deepest fulfillment. Both cases can lead to subtle organ imbalances that require attention if best health is to be maintained.

The situation for male homosexuals can be somewhat ameliorated if the men seek alternate sources of yin energy. They could eat more yin food, spend more time with female friends and work in the garden cultivating earth chi. You can also absorb energy directly from the earth by lying face down on the ground and meditating, drawing it into your penis and hands. This might help if it were done before or after sex. If you wish to practice semen retention and find yourself in rapidly changing male homosexual relationships, I advise you to become celibate for a period and attempt to gain stability through intensive single cultivation using the Big Draw and Meditation.

In group sex it is even more difficult to harmonize the subtle energies. I recommend you avoid it as it is rarely motivated by love. The only exception might be two women with one man, as the double yin can harmonize his yang if they are also in harmony. For most people this is unlikely to be stable, which is necessary for real cultivation to occur. If you feel attracted to several people the best thing you can do for them is to inspire them to cultivate themselves using Tai Chi, meditation, yoga, or the methods described in this

book. Teach by example; you don't have to physically love everyone you feel attracted to. You will never go deep in yourself if you scatter your energy widely.

22. What causes the penis to go flaccid, if you began with a stiff erection but didn't ejaculate?

Chia: It may be that your mind has left the act of love, and is distracted elsewhere. The chi moves with the mind, it is guided by it. If your mind is concentrating on a higher exchange of energy with your lover and you've lost your erection, it may be a sign that physical love is no longer needed and you should relax and enjoy the communion. You should keep your flaccid penis within her or touching her if possible, as the chi can still flow through it. But please, for yourt)wn sanity, don't try to force a new erection.

23. If I master the Big Draw and am celibate, but still have wet dreams, what should **I** do?

Chia: If you really master the Big Draw this should not happen at all, but this might happen to someone who retains the sex energy but hasn't transformed all of it up to a higher center. The sex energy remaining in the lower part might be causing trouble. The Taoist method of Microcosmic Orbit Meditation, Fusion of Five Elements, and Kan and Li contain the formulas for transforming the energy up. If that doesn't work and the wet dreams persist, listen to your body's message and find a lover.

24. Is it o.k. to make specific wishes or project a thought at the moment of orgasm?

Chia: I strongly recommend you avoid projecting your ego at the moment of orgasm or at any time during love-making. This is a magical practice that can have very unexpected effects, sometimes dangerous to your spiritual growth. Evil astral entities can attach themselves if you are not well balanced. Some men have sex with "phantom" lovers in their dream state that are real entities. You might also get what you asked for—and much more that you failed to specify and that you find extremely undesirable. You will also lose energy by sending it all outside. I know one woman who did this "magical child" projection for ten years. It made her pale and sickly. It is best to give the energy back to your lover, as that is where it came from. In this way you pay the universe immediately for its blessing. If you increase your lover's energy instead of some ego desire, she will be transformed to a higher level and be in a position to return even higher blessings to you or others in the

universe. Spiritual progress comes from achieving balance of yin/yang, from being both spontaneously present and neutral, not from fulfilling some mental projection. Taoists refine their chi in their body. We don't send out our dirty laundry and hope it comes back washed—we clean it ourselves. So keep your attention on balancing your chi where you are; that is your entire obligation to the universe.

CHAPTER 13

STUDENT EXPERIENCES OF TAOIST SEXUAL CULTIVATION

This interview was conducted by Michael Winn with a 46 year old psychologist and student of Master Chia who has raised several children.

M.W.: Was it easy to learn the Sexual Kung Fu?

Student: I've been practicing Seminal Kung Fu for a year and a half now. I found it easy to learn when I practiced alone but difficult to implement during sex because of an unconscious resistance from making love for so many years in a different way.

It got easier as I grew more aware that normal sex fatigued me. But it is not possible to divorce this practice from the other practices that I've studied, such as the Microcosmic and fusion meditation formulas, Iron Shirt Chi Kung, and Tai Chi. They increased my sensitivity to energy, particularly the Iron Shirt Chi Kung.

M.W.: How has it affected your daily relationship?

Student: It has produced a very strong bonding. Many times the expression takes the form of energy that flows between us. Sometimes it's translated into telepathic or clairvoyant experiences. That happens in many relationships when partners are together over a long period of time. What's unusual in my relationship is that it's happened very, very quickly. My Taoist practice accelerated the process.

M.W.: Has it been so satisfying to you that you've wanted to have sex less often?

Student: No. The reverse. I want sex more frequently, three or four times a week, depending on the occasion or the situation. Sometimes a number of times during the day. And quite frequently during the week.

When sex does become tiring is when I fail to do the practice and I lose my energy by ejaculation. And I still find that after a year and a half, almost 2 years, of doing this practice that it happens periodically that I lose the will to implement it, I find it quite interesting as a psychologist to see the old conditioning which still remains in myself is not yet totally overcome. That I just want to go for the orgasm. That's something I'm still struggling with. I have control of it now but I have to be pretty watchful.

M.W.: It's like looking at an aspect of your former self.

Student: I owe it much to social and cultural conditioning. This type of sexual activity is absolutely counter to the drive of western sexuality as we understand it.

M.W.: Can you describe any extraordinary experiences?

Student: A number of them. They were characterized by intense energy flow between us after a period of intercourse and repeated control of ejaculation. There were many occasions where the energy would build up and there was an arching between our mouth and genital, like electricity leaping across a gap. Or it would zoom through our Microcosmic Orbits, back and forth between us. At other times it was like a cocoon of energy that just wraps us both, radiating inside and outside our bodies.

M.W.: Is the cocooning valuable to the relationship or is it just for its pleasure?

Student: It is pleasurable but it also has a tremendous compelling emotional quality. It's an extraordinary communication between partners that generates beyond the sex experience to the relationship itself. We feel the energy flow, frequently outside of sex itself. When we meditate together, there is an arching through the head, especially when we do the Fusion formula. Another experience I've had during sex is I felt the thrusting routes connecting. It felt like there was a ladder between the bodies. It formed a fountain at the top and ran down into the bodies and around the bodies so that the thrusting routes were merged at the center point and developed a magnetic field. It was very powerful.

M.W.: Did you ever feel any distinct hot and cold energies?

Student: Yes, that's quite common, just at the point of

ejaculation control. At that point there is a lot of my heat energy going through the penis. Just then I've often felt a chill go right up my back. At one point I looked at the window, I thought there was a draft at my back, it was so distinct. I've often experienced my partners body feeling cool and moist, while my energy is very hot and dry.

M.W.: Is this a practice that you would, as a psychologist, recommend to someone who is emotionally disturbed or is trying to work out their relationship?

Student: No, not at all. The energy swings would be very destabilizing.

M.W.: So it's really only for people who already have a fairly solid relationship? »

Student: I think so. It's also very important that people practice this meditation together, the Microcosmic Orbit. It should not be divorced from the system.

M.W.: You said it brought so much more to your relationship and so many relationships flounder on sexual compatibility. Wouldn't this help cure that or have a therapeutic value?

Student: It could in certain ways, in that it cures premature ejaculation. I think the real benefit is to see the spiritual context but teaching it as a therapeutic method should be an interesting experiment.

M.W.: Do you think Western sexologists, like Kinsey and Masters whould be interested in this?

Student: They might if it were in a context where they could understand it. Masters and Johnson and other sexologists work with ejaculatory control, so in that sense this method is not dissimilar. Putting pressure on the seminal duct, manually, is very similar to Masters and Johnson method. But beyond that they are still in kindergarden when it comes to understanding the role of sex in the human energy system, or how to use your mind to control energy balance and sex drive.

M.W.: A lot of men your age go through a mid-life crisis which is partly seen in sexual terms. How does the practice relate to that?

Student: I had my mid-life crisis these last few years. A lot had to do with a career change and decisions about what kind of work I wanted to do. So this Taoist work has helped me decide on what I want, how I use my energy and how I use my energy in sex and

what my purpose is. So, yes, the Taoist practices and Seminal & Ovarian Kung Fu have helped to clarify the picture, because a lot of the mid-life crisis is about your spiritual direction in life.

The following excerpts were tape recorded following a Sexual Kung Fu workshop in Denver, a discussion between Master Chia and his students.

Student: I've been around the esoteric world for about twelve years now and I've heard about chakras and energy flows and what the properties are and how to understand it. Sexual energy, I think is a very potent force in life and controls many people's minds. So to put this in order, to put it in a proper perspective is very important and I'm happy to have found someone to teach me to do it.

Chia: There's an order in going to school. You wouldn't attempt to take a Master's when you haven't finished grade school. In the same way you shouldn't attempt Tai Chi Chuan, which is comparable to taking a Master's until you've developed a good foundation in your esoteric practice, at the very least, the Microcosmic Orbit. The style of Tai Chi Chuan is not so important as developing an internal flow of energy.

Student #2: I found that doing the testicle breathing really gives you a lift, it keeps you awake and refreshes you. I used to use No Doze to stay awake when driving long distances. Now I use testicle breathing instead, and it really works.

Student #3: 1 really appreciate the details that you offer in the Taoist Sexual Kung Fu. I'd practiced a Buddhist Tantric method that made use of the Microcosmic Orbit, the tongue and the anal sphincter muscle, actually the perineal area. My experience with the Taoist method was different. Immediately upon drawing in my penis and testicles as you suggested, I pulled up through the perineum and the energy shot to the top of my head.

Chia: Can you describe this Buddhist Tantric Method?

Student: Yes, I'd hold my breath, push my tongue up and look into my head. So you bring the tongue up, the breath up, the eyes up and then squeeze the perineum, but the details were lacking, as I said, as soon as I pulled in my penis and testicles, it made a tremendous difference. I thought the power that I derived here was at least twenty times what I'd experienced in that Tibetan approach. During the last workshop with you I actually felt the tendons around my penis and the testicle cords pull up. When the perineum was closed, the rush of energy was overwhelming.

Occasionally, in the Kundalini approach, a practitioner will spontaneously draw in air thru his urethura into his bladder. That can be painful, and even troublesome later when a pressure bubble forms in the bladder, in the practice of drawing water up into the bladder, where the same sphincter is used, that air bubble can interfere and again cause pain.

Chia: I must point out an important difference between the methods that you've described and the one you've just learned here. In that approach the perineum is left open during the big draw. When you close it off first and then pull up (or draw), air doesn't get into the bladder. In the practice of drawing water into the bladder you must be sure to have expelled everything out of it first. Otherwise you,can have pain. That is why I do not teach it. Besides, it's not really necessary. Here you close off before the "draw" to prevent air or water from getting in. When you get to Lesser Enlightenment, Greater Enlightenment and Greatest Enlightenment, you'll also find that when you mix the higher cosmic energy you have to close off so that no air gets in when you "draw". In fact, a spontaneous "draw" occurs by then, which means that you should have mastered closing off first to avoid the trouble of pulling in air.

Student: In that Tibetan Tantric teaching we were told that the Buddha could pull his penis in, but it was never presented as a technique. Here, it's as though the whole thing is brought together, on both physical and spiritual levels. By the way, the packing of chi in the body, done in Iron Shirt, reminds me very much of Tumo Yoga or the Inner fire, because a very important part of that is "packing". There again I appreciate the way you've described exactly what to do inside your body. The Tibetan teacher would demonstrate and the way that many of us imitated him we might have been doing a comical dance.

Student #4: In the male, in the normal course of ejaculation, there is a strong charge in the perineum that switches the parasympathetic stimulation to a sympathetic one, which quickly leads to exhaustion. By contrast, the female remains in a parasympathetic state of arousal throughout. After the ejaculation reflex takes place there is a sympathetic nervous system stimulation in the male. This is evident in the flush and the dryness in the mouth that is experienced. Each time ejaculation takes place it leads to an outright catabolic state. Instead of building there is a tearing down.

Chia: And that leads to anger or in extreme cases even crime.

Student #5: This Taoist method is very, very, good. It's my second time taking this class. The first time I didn't practice on any regular basis. About three weeks ago, I found the Big Draw without even looking for it. I found energy coming from the perineum. I then concentrated on bringing it into the coccyx while making love and my whole body filled with an enormous bubble of energy. The next day I repeated the "Big Draw" with great success. One thing I would caution everybody—I forgot to bring my energy down. About a week or so later, I became very, very angry and flew off the hook very fast, and I realized in today's session that you really have to concentrate on bringing it down. I was just letting the energy shoot up. I forgot to go through the practice and bring it on down. So I caution you. It's very important to bring it down. It's a terrific practice and it really gives you enormous energy, and a great vitality. It's fabulous.

The following statements were taken from interviews with students of Taoist Esoteric Yoga who studied the methods taught in this book.

EXPERIENCE OF A LAWYER, AGE 29

I'm a lawyer, age 29, from New York. Taoist cultivation of sexual energy has brought a revolutionary change in my life. This is not because I was a failure as a lover. As an adolescent, of course, I had periods of insecurity about my virility and occasional impotence due to fear of particularly powerful women. But after leaving adolescence my self-confidence gradually improved and I learned each year how to please women more and more.

As I learned something of the arts of love, I realized that there could never be lasting satisfaction unless I learned to retain the seminal fluid and avoid the breakdown at the end of normal love. This point was the flaw in an otherwise marvelous experience. I could often have sex for a long time without ejaculating, but it was a hit or miss affair. I didn't know how to transfer the energy away from the genital region at will, nor to swiftly calm myself if I was in an overexcited state.

I sensed that sex-love relationships were so perishable because men and women didn't know how to nourish the life flame

between them. I realize that even when I had been a superb lover, at the end of the act I always felt insufficient. Ejaculation forced me to stop making love whether or not desire continued.

When I first began to practice with Master Chia, I immediately recognized the immense value of his teaching. This was surely to be the most important thing I had learned to this point in my life. At first, it was not very pleasant to do the muscular contractions and I was a little embarrassed. But since I made love to one partner who cared very much for me, my embarrassment quickly faded. She really wanted to help me accomplish my goal. This is so important.

I cannot urge too strongly other students of Taoist cultivation to stick to one loving partner. There is so much more to know in one good soul than in 50 good bodies. The adventure and variety of experience that comes from diving into the soul of another person is incomparably superior. After all, the body, like all material things, exists on one plane. The depths of the human soul, however offer multiple worlds to explore, the one more fascinating than the next. The analogy in the physical world is that playboy never really moves from that hick town called the body; whereas, the faithful lover may travel vast continents of hidden worlds within.

When I began to practice Sexual Kung Fu it was somewhat awkward at first. I had to concentrate on these seemingly unnatural movements and this deprived me of the small degree of freedom I had already attained in my ordinary, good old, down home loving. But I persisted and everything quickly became much easier. I found I could soon abandon the Hard Contractions, which most seemed to disrupt the smooth harmony of the act. I did this when I had learned to calm down to a certain degree. After that I had to use the Big Draw for several months to keep calm enough to hold the seed. However the Big Draw didn't disturb me or my partner's delight. Over the course of months, I have attained to virtually effortless control of the seminal fluid.

Just after entering I still must sometimes consciously cool off due to the initial stimulation. After that I have no difficulty holding the seed with the sheer strength of my thought. I rythmically inhale the power and exhale it to my partner. I am always sure to give her more than I take. There are certain times when it is more desirable to maximize the exchange, others when I prefer to lessen it. These things must be learned for oneself and are intensely personal.

The zone between high excitement and ejaculation has grown continually greater. When I got very excited before it was very unpredictable when I would come. Sometimes I could go on for a long time, sometimes I would lose control just as I reached a state of high excitement. Now there is a much larger space between excitement and ejaculation. The plateau has grown wider and I can stroll around there joyfully without danger of falling into the pit.

After about *VA* years, I can see that there are no limits to this practice. It has grown more and more pleasurable, and has deeply changed my relations with women.

I attribute much of the historic repression of woman to man's fear of woman's sexual potency. There is no way he can match her unless he learns to control his seed. My sex drive has always been tremendous and women have come back to me for more, but ejaculation always flawed love fatally in the end. Even if the woman didn't realize it and thought she was getting the greatest possible time, I knew that something crucial was lacking. A valid method of seminal retention is the only way to overcome that hidden fear of women. And as long as man continues to fear his mate, nothing of lasting beauty may be accomplished. The loss of fear of woman is a magnificent new freedom. Even when I don't make love, the power of the fluid pervades and fills my life.

EXPERIENCE OF A BUSINESSMAN, AGE 45 YEARS OLD

I'm a 45 year old businessman from Connecticut. About one year ago I had a chance to study Seminal Kung Fu with Master Chia. Originally, I took the class out of curiosity. Seminal Kung Fu, to my surprise, has turned out to be the most valuable technique I ever learned. The method is simple yet so powerful.

During my ten years of marriage I always failed to reach orgasm at the right time. I usually came too early and too fast for my wife to have full pleasure. This problem didn't destroy my marriage, however it troubled both me and my wife.

Seminal Kung Fu changed the whole experience of love-making. With the controllable orgasm, sex has become much more enjoyable for us. The method began to be effective from the first lesson. A year of practice has made me more skillful. Now I am enjoying a much happier life with a sweet wife, two lovely children, and good health.

We are living in a highly tense society. We are heavily loaded with work, worries, endless desire, and abuses like smoking, drinking and promiscuity. It is difficult for an average middle-aged man to survive in his sex life without trouble. That is why impotence is a common word today.

I sincerely wish that every man on this earth has the opportunity to experience sex as it's really meant to be.

EXPERIENCE OF A TEACHER, AGE 37

I'm a 37 year old teacher from San Francisco. I'm Chinese but have been in America for 10 years. At the age of 15 I had my first ejaculation. I was intensely curious about it and began to read much on the subject including esoteric books that a friend of mine had. I later talked to yogis and monks from a temple near my house who might know what it meant apart from its reproductive function. I began to appreciate the value of the semen and the importance of its retention. But I couldn't help ejaculating often and masturbated once or twice a week.

When I was 18 I went to a Chinese medical doctor who told me I had kidney trouble. He said this caused my frequent ejaculation. He prescribed a very expensive course of medication and said that if I didn't follow his prescription I would be impotent by middle-age. Being unable to pay even one-quarter of his fee, I began to despair.

I experimented with many methods over a long period of time. None of these methods were really effective. Some times I abandoned even attempting to control the outflow of my semen.

Then I was taught the External Locking Method. The first time I used it I had a little pain in the perineum. My teacher said that this was from never using these muscles and organs in this way before. He assured me that there was no danger to my body. After this first time I used External Locking 300 to 400 times without any discomfort or problem.

When I learned the Taoist internal method, I realized they had a very deep understanding of human sexual power. The importance of opening the energy route in the back to bring power up to the head cannot be overemphasized. When I opened this route, I could store much more power, for the head can hold more than the lower back. I gradually produced more and more power for the well-being of myself and my wife.

During my first three years of marriage I have used Sexual Kung Fu as an effective means of birth control. When I wanted to have a child, I needed to ejaculate only three times before my wife conceived our beautiful son.

I know that I could have never achieved my present happiness and success without Sexual Kung Fu. My health is wonderful, and I am told that I look much younger than my age. In fact, I've noticed that after a good night of love-making, my partner and I actually look several years younger the next morning. My wife says the power I give her when we make love is the world's best beauty aid.

EXPERIENCE OF AN ELECTRICIAN, AGE 27

I am 27 years old and work as an electrician in an electronics firm in Long Island.

When I was 20 years of age I had to work to help support my family and put myself through school. It wasn't long before I became physically run down and it was during that time that I experienced wet dreams, sometimes as often as three or four times a week. These made me feel weak and ashamed and somehow guilty. As time went on things seemed to get worse.

If I looked at pictures of naked women or went to porno shows I would get so sexually aroused that If I just touched my penis I would ejaculate. If I went on a date and if the girl and I petted a little and she rubbed against me I would ejaculate. It made me so embarrassed that after a while I dreaded going on dates.

By the time I met Master Chia, about two years ago, my emotional and physical health were pretty far gone. When I described the situation to him, he advised me to open the Governor route so that I could practice Seminal Kung Fu which directly related to my problem. He advised me to do the exercise thirty-six times in the morning and the same number of times at night. Instead, I did it 100 times in the morning and 100 times at night. In one week, the wet dreams stopped and after two weeks had passed I still didn't have any.

I practiced every opportunity I had. Some days I did the exercise as much as 400 times. I found it invigorating. If I grew tired or sleepy while driving, I would pull over to the side of the road and practice a while and in no time I was wide awake and full

of energy. In fact, whenever I found myself with nothing to do I would practice. Waiting in line in a supermarket or when alone and not having anything to do, I might practice the "Big Draw" and "Scrotal Compression".

When I get up in the morning I rub my penis and then again when I go for a b.m. When I have an erection I draw the energy up using the "Big Draw" exercise. As soon as the power rises up to my head the erection subsides. Six months after I began this practice, i ceased being troubled by wet dreams. When I do dream of a girl, which has happened many times, I have an erection, but instead of ejaculating, the energy is drawn up to my head, at which time I wake up with a sense of a cool, fragrant nectar, beyond description. This nectar of heaven, as I've heard it called, tastes like nothing I've ever tasted before.

After practicing the "Big Drawing" for a year, my memory has improved, the wet dreams have stopped, my health has improved and I'm not afraid to date anymore. It wasn't easy. There were many setbacks along the way but practice makes perfect. After doing the "Big Draw" exercise many thousands of times, a feeling now develops which is so pleasurable that I am sure that nothing can be compared to it. The sexual pleasure that I had experienced earlier, prior to and during the ejaculation were nothing by comparison. What I experience now can only be called spiritual. I feel as though it penetrates my very soul. The Seminal Kung Fu pleasure transcends all that we know of in our everyday world.

EXPERIENCE OF DRY CLEANER, AGE 67

I am 67. **I** am still working at a dry cleaner upstate. I first noticed my sex life falling off when I was 39.1 was no longer easily aroused and when I finally was, I had trouble maintaining a firm erection. I began to read anything I could lay my hands on relating to the subject. Nothing seemed to really work, so I devised my own way. Upon reaching the point of ejaculation I just held it back. That didn't work too well either because after a time I simply had a wet dream. Yet, I continued the practice thinking it could help. By the time I was 50 my sexual activity had diminished considerably. At 60, it had dropped off to just 4 or 5 times a year.

I met Master Chia when I was 64. I listened to him give a talk

on "Seminal Kung Fu" but really couldn't believe him. After all, by that time, I'd been practicing it, I thought for almost 30 years. But he said something that caught my attention. He said that one had to complete the Microcosmic route after which the Ching power would more effectively be utilized. I recall that he compared the Microcosmic Orbit to a highway and explained that unless you had such a highway, it would be very difficult to transport goods from one place to another. It took me four months to open the route after which Master Chia taught me "Seminal Kung Fu" and the "Big Draw."

In the beginning, I practiced 36 times a day whenever I could, or just a few times if I was too tired. He taught me a number of techniques during that time. I was told to rub my penis until it became erect, expose myself to the sun and absorb power from the earth. After six months I found myself frequently awakening in the morning with a very firm erection—a most impressive sign of improvement.

However, when I had a wet dream for the first time in ten years I quickly called Master Chia to thank him. Six more months more went by with no success. I told him the way I felt—that I had no faith in the method. He introduced me to other students who were practicing Sexual King Fu.

Talking to them and hearing of their success first hand I grew very confident that I could succeed too. Though I practiced for two years I had difficulty succeeding in deriving much pleasure because of my age. In fact I succeeded only three times, however I did develop much control. Master Chia said that I am only 40% effective because I am now 67. He promised me, though, that if I continued to practice, I would still be able to have intercourse in my eighties and will be able to produce sperm to maintain my health and vigor.

After three years of practice I suddenly realized that I am fortunate in not having any prostate gland trouble—an affliction that troubles men between the ages of 60 and 70. I think that Master Chia's suggestion that I rub the area around my prostate, the Hui yin and the area around that, has been of most help in the matter. Before I started this practice I had to urinate three or four times a night, the frequency of which is just half that now.

EXPERIENCE OF A COOK, AGE 30

I am 30 years old and work as a cook. My main problems are that I ejaculate too quickly and have occasional wet dreams. I read extensively on the subject and talked and meditated to no avail. Then a friend introduced me to Master Chia saying that he had found him to be very good. Even after I'd practiced Seminal Kung Fu for six months, however, I still had trouble with control, because as Master Chia said, I am not married. Going to prostitutes as I do I cannot practice the method. They want to have me ejaculate as quickly as possible so that they can go on to their other clients. Master Chia advised me that I find just one girl, who will work with me and he assured me that with practice I would succeed. He urged me to practice the "Big Draw" and to rub my penis more, thinking that that could also help. I really have a problem, though, because I don't think I can stick with one girl, let alone get married. I have improved, though. I'm nowhere near as bad as I used to be. At one time I'd ejaculate within a couple of seconds after entering a girl's vagina. Now I can go as long as a minute and a half.

EXPERIENCE OF GARMENT FACTORY OWNER, AGE 38

I am 38 years old and own a garment factory. I'm young, I'm prosperous and I am proud of my sexual prowess. I've never had any problems getting girls nor have I had any trouble after we get together.

For years I studied and practiced all kinds of variations of sex a man and a woman can enjoy together. Then I heard that a Master Chia was teaching Seminal Kung Fu and Taoist Yoga and I was so intrigued that I went to see him.

I've been going to see him for around three and a half years. At this point, I am convinced that Seminal Kung Fu is the heart of Taoist Yoga. Now that I have practiced these methods I can satisfy my wife much more fully than I had when I was younger. Besides, my own pleasure has been greatly heightened.

There is no comparison between what I call worldly pleasure and my new found beyond-worldly-pleasure. In the normal, everyday sort of ejaculation my pleasure is quickly over with. Not so in Seminal Kung Fu. The pleasure generated here stays with me throughout the day. There seems to be no final peak to this plea-

sure, either. Each time I seem to go to newer, more delightful levels of loving my wife, which cannot be described. This practice offers the added bonus of affording extra energy, so I am just never tired. Now I can have as much sex as I want and I can control it rather than have it control me. What more can a man ask for?

EXPERIENCE OF AN EXECUTIVE, AGE 38

I am a 38 year old executive for a well known company in New Jersey. When I was 25 years old I was taught a method of sexual control by a Master who forbade me to teach it to anyone else. After about a year I could indulge in sexual intercourse for more than an hour without ejaculating. I've been in this country for about 10 years and I am still not married. I was thankful for having learned such self control because it has enabled me to have continuing relationships with women who enjoy my company.

I heard about Master Chia three years ago and went to see what he could teach me. In three months I opened my Microcosmic Orbit. Then, he taught me Seminal Kung Fu. I was just curious to know whether there was any difference in approach in his method and was willing to pay to find out. I discovered that Master Chia taught a much more detailed and higher level of practice and presented a much more complete program for overall development.

My previous Master had never taught me anything about opening the Microcosmic Orbit nor had he told me what to do with excess power. Master Chia has even taught me how to transmute Ching Ch'i, during sexual intercourse, into power that can be sent up to the head. I feel confident now that I am learning a more complete system. Furthermore, I feel better and stronger and enjoy more feelings of pleasure than ever before. It is most important to transmute the sperm energy into a type that can be used throughout the system. Simply retaining it is no use and doesn't even really manage to keep you from losing fluids.

It is like building a dam. After a while the water just runs over the top. But when I transmute power and send it to my head, I feel my energy routes getting joined and cleared. Otherwise energy builds in areas like the head. Having nowhere else to go, it might cause damage. Right now I'm working on opening the 32 routes that must be opened. This should allow me to accommodate much more power, as there is much more room for it to occupy. So

what's the end? Immortality seems like a long way off, but it beats the hell out of my job. I think I'm going to go for it.

CHAPTER 14

PRACTICAL GUIDELINES TO KEEPING SEX RADIANT AND HEALTHY

"The Way of the Tao is to unify the spirit. Do this by gathering your vital energy, calming your mind, and harmonizing your will. The body should be regulated neither too hot nor too cold, neither hungry nor overfed. In this way sex is always leisurely and relaxed."
—*Plain Woman's advice to the Yellow Emperor*

Over the centuries the Taoists observed there were many different ways to maximize the power of love-making and minimize the harmful loss of the sexual energies being exchanged and transformed. For example, assume you had mastered the "Big Draw" so you had perfect control over your orgasm. Suppose you then ate a big meal before making passionate love with your partner for several hours. Afterwards, you took a shower right away and then lay about naked under a cool summer breeze coming through the window.

You very likely neutralized the energizing effects of the sex, °r worse, harmed your health by ignoring that the flow of energy before and after love-making is as important as the flow of chi felt during sex.

Mastering semen retention is an essential step in transforming your sexual energy, but it is worthless if that energy generated is

not harmonized with the rest of your life. The big dinner ties up your digestive energy and the shower and breeze disperse the chi so carefully conserved during sex. Taoists are concerned with keeping the overall flow of life energy in balance and this demands growing awareness of the subtle events that control your life. Here are some observations culled from Taoist teachings on keeping sex radiant and healthy.

1. GET TUNED WITH YOUR PARTNER'S ENERGY 48 HOURS IN ADVANCE

Sex really begins 48 hours in advance of the act, as the energies you accumulate then will express themselves when you go deep into sex. So the day before, during and even after sex you should try to calm down any feeling of agitation or anger, as this, more than almost anything else, will block the balanced flow of energy with your partner and within yourself. A woman's yin nature gives her sensitive antennae to hidden under-currents. So if you are clear, it will help her be clear and relaxed when you begin to make love. If you start on the plane of serenity, sex will more easily take you to a higher level of ecstasy. Be sensitive, stay with your partner; the effort is to move to a deeper state of being together, not just share a momentary climax. Let the sex become part of the larger meditation that is your life.

2. FOREPLAY BEGINS WITH A RELAXED ATMOSPHERE

Remember a woman's erogenous zones are different and often broader, than a man's. Caress her by creating an intimate "home" or bedroom conducive to love-making. Foreplay begins before you even touch a woman's body; dim lighting or candles, soft pillows and loose, natural clothes, sweet smells, music and gentle talk will appeal to her sexual energy and expand her openness to your own.

3. DON'T MAKE LOVE AFTER A BIG MEAL

This common mistake can ruin either your digestion or your love-making. Sex and eating are two separate functions that work best when there is no competition for body energy. Sex on a full belly reduces semen production, causes indigestion and harms the

spleen. Wait until your food is fully digested, and the quality of your love making will be much higher. After sex is over, it may be nourishing to eat some warm sweet foods. Herbal tea can be especially tonifying and help a man regain his energy. Avoid cold drinks, ice cream, or ice cubes afterwards—your body has to heat them up which burns off your subtle sexual energy.

4. AVOID INTERCOURSE IN ANY EXTREME STATE

If you are too tired, angry, hungry, afraid, sad, weak, or angry don't have sex. The energy required to make love may throw your health further off balance, and accelerate the development of a minor illness into a major one. A cold acquired from a partner can develop into a flu. If you feel sexual frustration and are literally "bursting" with extreme yang sex energy, engage in sex but with restraint. Don't exhaust the yang energy so that you flip into the opposite "yin" state of exhaustion. This is like a thirsty man dying from gorging on water suddenly found.

You may feel passion and should fully enjoy the body sensations and feelings stimulated by sex, but try not to get lost in their extremes, or the pleasure may turn to pain. When the atmosphere is one of relaxed enjoyment both lovers will find it easier to open to the higher energies within themselves. If one lover moves to an extreme state of arousal, the other may feel left out or unbalanced.

5. DON'T MAKE LOVE WHEN DRUNK ON ALCOHOL

It's hard to control your semen flow much less your chi flow when you're drunk. The feeling of warmth you feel on alcohol is temporary, caused by your blood capillaries opening and releasing your inner energy. Strong physical exertion while drunk may damage your lungs through loss of breath control. One or two drinks may help some people relax without causing loss of control; if you must drink alcohol learn your own limits and stay within them. When your own energy becomes more intensely satisfying than that offered by alcohol, your need for it will drop away naturally, without struggle.

6. URINATE 20 MINUTES BEFORE YOU HAVE INTERCOURSE

Making love on a full bladder puts stress on your kidneys and thus makes it difficult to feel relaxed during sex. The only time it's advisable to urinate after intercourse is if the woman has her period. The urine will prevent her blood from drying inside the urethra of your penis and blocking it which can be very painful.

You should wait a short while after urinating before having intercourse to give your bladder (or intestines if you defecated) and other vital organs time to return to balance. A short rest lying down should quickly restore them. Otherwise your love making may suffer from irregular rhythm and contribute to the development of ulcer tensions.

7. SEX DURING EXTREME WEATHER CONDITIONS CAN BE UNHEALTHY

Severe cold or heat, rain and dampness, fog and great winds, thunder and lightning all have an input on the function of your vital organs and electro-magnetic field balance. These can lead to imbalances between love partners and even illness if one is already in a weakened state. Weather is a very powerful force and should be respected. This is especially true if you are attempting to conceive a child, where it is important to create a balanced "home" (parents energy field) for his/her spirit.

8. AVOID HARD PHYSICAL WORK BEFORE AND AFTER SEX

If you engage in vigorous activity for the couple of hours before and after intercourse it may temporarily deplete the organs and muscles being exercised. This may interfere with the transformation of sexual energy into your higher centers, since the energy will be needed for physical recovery. When you are sweating or feel physically exhausted your life-force can easily leak out of the body. Sex is a proper cure to this condition only if the love making is totally passive and restful.

9. DON'T RELY ON ARTIFICIAL SEXUAL AIDS

Vibrators and dildoes can be of a great help to someone who suffering from a sexual dysfunction (can't erect or have orgasm). But for most men it is better to "sharpen your own weapon" and strengthen your sex organs through exercise, diet, and sexual kung-fu than to rely on artificial aids. The goal is to have love making become an internal process between the energy poles of man and woman, so the sooner you can leave behind external aids the better.

10. DON'T BATHE/SHOWER IMMEDIATELY AFTER SEX

Water is a strong conductor of electricity and that includes human electricity as well. If you bathe immediately after love making it will draw off some of the charge built up. Wait until your body/ mind has had time to relax and absorb the sexual energy of your lover before showering. Yoga tradition extols the virtue of water in cleansing negative particles and energy from the body, but this should be done daily or in any case before sex. The skin will smell and feel fresher if it is not washed excessively with soaps that remove natural oils. Experiment by washing only the armpits and groin with soap and scrubbing the rest of the skin with a sponge only. This will make it soft and natural.

11. DON'T THRUST TOO POWERFULLY INTO THE WOMAN

The woman's vagina may grow numb if you pound her continuously with your pelvic bone and penis and lead to exhaustion or negative association of pain with sex. Firm but gentle thrusts will provide the most lasting enjoyment. In the beginning it will also make it easier to hold your seed; as you master the process of sexual transformation, you can play with more passionate variations.

12. YOUR SEXUAL POWER IS GREATEST IN THE SPRINGTIME

Your body has four seasons, just like nature. Don't force yourself to relate with the same intensity. It's not natural and will ultimately

wear you down. April and May are the best months for sex, as the sperm is in an expanding state. The same amount of sperm is far more dormant in winter, when your energy naturally contracts to survive the cold. If you must ejaculate spring is the best time, with summer and fall next as your surplus declines toward winter.

13. IF YOU ARE ILL MAKE LOVE PASSIVELY

Sex can be very healing for a man in a weakened state, but only if the man assumes a passive role with the woman moving on top. This will allow you to absorb her healing yin energy without losing more of your already depleted yang energy. If you are strong and lover is weak, you can help heal her by assuming the active role. If you feel ill from too much sex, passive love-making without movement can work as a cure. Symptoms will include pain in penis, damp scrotum and low energy.

14. STOP MAKING LOVE IF IT HAS BECOME A ROUTINE CHORE

Sex becomes mechanical for men when they forget or ignore the proper preparation of women for love-making. Warm the woman with proper foreplay and with warmth of feeling. If you take her body or the sex act for granted the woman will not be properly readied to exchange her love energy through her breasts and lips. If the only contact is genital penis and vagina the energy will not flow to her higher heart and centers into the man. So a man defeats the very goal of what he is seeking if he uses her for a kind of masturbation. He cuts off the return flow of his own sexual energy by engaging in mechanical sex. Better to stop sleeping with your lover than to have "dead" sex—at least then the polarity between you may build up and reawaken you to the attraction that still exists.

If you feel sex is becoming boring, cut back on the frequency of your intercourse. Treat love-making like it was a feast and do it only when you are both feeling extremely healthy and passionate. Stop using sex as an escape from boredom or anger or as a means of masking your hidden fear that the love between you is dead. Quality of love-not quantity of sex is the important thing.

15. DON'T RELY ON SEXUAL FANTASY TO GET AROUSED

The danger of reliance on sexual fantasy is that sex will become limited to a mind trip. The yin and yang energies moving through man and woman are real, not a fantasy. If you limit sex to an idealized image taken from Playboy or invented by your imagination you will find it difficult to experience in your body the profound flow of your deeper energies. If sex becomes a mental play, it can block the deepest play of your being because it is not centered in the body in the present moment but in projecting ahead into the future. How can you love a woman in your arms if you are busy holding another one in your dreams? Both lovers are cheated by this.

The common tendency of the male is to project ahead in time a plan of action. This imagination is a strength when it leads to positive accomplishment. A joint projection of spiritual will shared by lovers can certainly lead to deeper fulfillment.

But sexual fantasy becomes a negative projection, an escape from the present, this is impossible for any real woman to fulfill. Worse, it reduces real women to the level of fantasy objects. It can be an excuse to leave the real woman in your life to go off and pursue an imaginary one. The classical Taoist texts speak of "ghosts" that visit men in their dreams and make intensely passionate love to them. These men are never happy, with their life, constantly seeking their intensity in dreaming, and never awaken to the possibility they could have a more satisfying love with a real woman, with a flesh and blood body and soul if only they spent their energy cultivating that possibility.

But how does one escape the powerful lure of sexual fantasy? By cultivating the flow of one's own energy through healthy physical exercises such as sports, yoga, martial arts, and the Microcosmic Orbit meditation. The Big Draw is also effective if done whenever you catch yourself falling into fantasy. If you transform your energy up to the crown of your head each time you get an erection or feel a sexual fantasy coming on, you will eventually master that tendency in yourself.

Another way of mastering sexual fantasy is to live it out if the opportunity presents itself-engage in your idea of wildly erotic behavior or pursue women you know at heart are not for you—but observe yourself carefully and ask what the real satisfaction gained

is. This is often enough to diffuse the charge built up around the fantasy as the real life experience of your fantasy can rarely match the perfect fantasy of your dreams. The Taoists would say that you cannot make "this world" more perfect. Only that simple awareness of the forces in your life will lead to a profound experience that the world is perfectly made.

16. KEEP SEVERAL PILLOWS HANDY

Because the Taoist love methods can be lengthy, it's important to use pillows to avoid crushing your partner during the long periods of resting and exchanging energy. A man's leg can be heavy over a woman, and will cut off blood circulation. At least two pillows are needed if you are lying side by side.

CHAPTER 15

EXERCISES TO INCREASE MALE POTENCY

In this chapter for increasing male capability potency, there are many exercises. Each one works on a particular aspect of the male sexual organs and energy. Choose one you like or one that is suited to your particular specific health needs. Once sexual vitality is restored the main exercises to use are taught in chapter six, the Testicle Breathing and PowerLock, combined with solar energy absorbtion and massage of the penis, prostate, and anus.

HOW TO CURE IMPOTENCY

For those who are impotent, the most important means of curing impotency is stopping sex for a while. It's like a man who has no money saved and starts saving; when he has saved a few dollars he spends it all again. Likewise when you want to regain potency, most important is to stop having sex until the body is repaired. No hormones or medicines or drug stimulation will help. It's like bankruptcy, you borrow and borrow until you cannot borrow anymore. No one will lend you any money. You keep on drawing from your life reserve energy.

Save your seed, do exercises, and try to eat right by stopping all bad habits like smoking, alcohol and sex movies—which will stimulate you to lose much power just by thinking of it. For those times you engage in sex prepare yourself with the technique known

as "Sharpening the Weapon". This will help you to retain your potency as well as develop your ability to prevent premature ejaculation.

This first method is practiced while the man is immersed in a hot bath. While in the tub, and the water is still hot, rub the penis as if to masturbate. When it is fully erect, at optimal size, and maximally stimulated, grab the testicles with your hands and forcefully grab, squeeze, pull, and hold the testicles. Perform this an uncountable number of times (at least 100-200 times). At first rub the penis slowly, but persistently. This method gradually builds up a man's sex power.

The idea here is that by practicing this exercise under water in a tub, the water pressure is increased by grabbing, pulling, and squeezing the testicles. This stimulates hormone secretions and sperm production. Over a period of time, sexual potency is increased dramatically. During the exercise, the man should refrain from ejaculation at all costs because he will be defeating his purpose.

HOW TO AVOID WET DREAMS

Wet dreams have different causes: one is from daily stimulation along sexual avenues and the other is because of the over richness of food and eating too late at night. Another cause may be that the blanket is too warm or the underwear is too tight. Another cause is drinking too much water, causing the bladder to press into the prostate gland and thus producing wet dreams.

In the normal adult having a wet dream once a month is considered normal. But some lose the seed 4 or 8 times per month because they are too weak or have too much sex or you masturbate too much. So when sperm is too full and stimulated, you will have ejaculation. Sickness such as infection of the uterus or prostate or venereal disease damages the genital parts and may cause you to ejaculate very easily.

Even worse is to have wet dreams with still greater frequency, as much as every night. Some even have them during day time naps. Their face is very pale, their eyes are dull, their body is clumsy, they have a loss of memory and they are always in a physical low. After practicing this method for a few weeks their power begins to return.

First try to stop the leak. Because the weaker the body is the more the sperm will leak. The main thing is to close or seal the leaking penis. This practice is called "Seal the Leaking Door". If you diligently practice this method you can stop the leak in one week. The method we teach here has been used by people who have had serious problems with wet dreams with good results.

There are two positions. One is lying flat on your back, thinking and concentrating on bringing warmth to the hiu-yin and testes. Do this for about ten minutes. After doing that for ten minutes, do the Big Drawing, clenching the teeth and fists, putting your tongue up to your palate and drawing in by tightening the feet and buttocks. Start to pull in from the Hui-Yin, testes and penis, holding your breath while doing this. Hold this for one to two minutes and gradually increase to five minutes.

Do thirty-six repetitions five times a day: 180 times altogether. Or use a sitting position with back erect and meditate to the Hui-Yin region for ten to fifteen minutes and gradually tighten the teeth, hands, feet and buttocks. Do the big Draw also for 36 repetitions, 5 times per day for at least 2 weeks to one month.

The second position is to lie flat on the bed and rub your hands until they are hot. Use the right hand under the head and the left hand under the testes. . . . .pulling the penis up, use the palm to press the whole testes and start to draw in thinking the power transferred from the back to the head and from the left hand to the right hand. Tighten your feet, clench your teeth and do the big drawing 24 repetitions for 5 times a day.

A third method is to sit down on the floor, back straight, and put the left foot over the right foot. Rub the whole foot, especially on the yung ch'uen for 36 times. Change legs and repeat, bringing the power down to the feet and later back up to the head.

The most effective method is the first, especially for those people who have been meditating and can gradually transfer the power to the head. This technique is also the most powerful one for those with no training in meditation. It will take a bit more practice but will produce good results. The second is only for those with no training in meditation and can't control the mind very well. The third method is good for any condition or time, as rubbing the feet is very good for the entire health.

I mention again that these methods have been kept extremely secret. Many books talk about this but never reveal the secret.

Though the method is simple, the effectiveness is real because it has already helped so many people.

WARMING THE STOVE

The next method of increasing male sexual potency is a variation of the Male Deer Exercise, called Stoking the Golden Stove. To perform this exercise stand in a slight horse posture, or sit on the edge of a chair so the scrotum overhangs the edge of the chair. Optionally it may be performed lying down on the right side with the right leg extended straight and left beg bent at the knee leaving the testicles hanging freely. The left arm may be resting on a cushion, and the right hand supports the head with the thumb and fingers surrounding the ear.

DIAGRAM 35

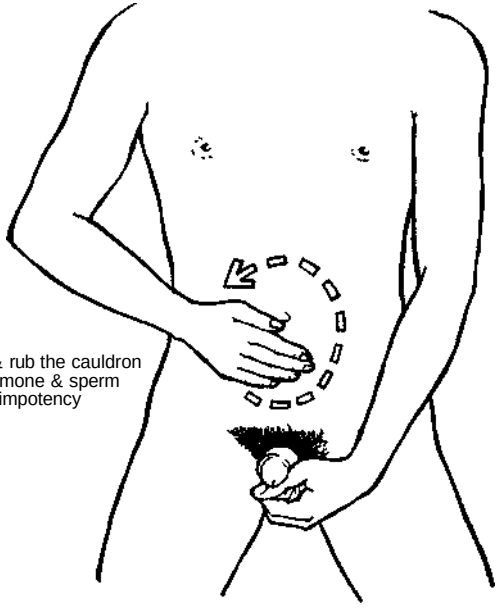

Hold the scrotum & rub the cauldron
This stimulates hormone & sperm
production to heal impotency

To perform the exercise, rub the palms of the hands together until they are hot. With one hand, cup the scrotum, with the other hand, rub the lower abdomen (Tan Tien) back and forth for at least 100-300 times*As you rubbing the lower fanteu inhale and contract the anus, perineum, and buttock muscles. Hold the breath and contractions for as long as you can. Try to conduct the energy generated up the spine to the brain, then down the front of the body to tte navel again. After a time you can switch hands and use the other hand to perform the rubbing. If you have been lying down doing the exercise switch to the other side.

MASSAGE THE FIELD OF PILLS (LOWER TAN TIEN)

This exercise is a variation of Warming the Stove and is simply called massaging the Field of Pills. To perform it the man briskly rubs his palms together until hot, with one hand pressing firmly against the base of the thigh at groin level and with the other hand pressing hard against the Tan Tien. The man begins to rub with the hand pressing the root of the thigh from the right thigh to the root of the left thigh, then massage the Tan Tien area. The hands should not touch or press against the genitals. Rub each area a total of 36 times in the above sequence. When you rub the Tan Tien area, the force of the massage stould make the penis lift up and move. This shows that energy is reaching the penis and scrotal area. This technique will cure impotence and increase the man's energy. Also, this will indirectly stimulate the prostate gland and increase semen production.

HARMONIZING THE TENDONS, MARROW, AND BONES

To perform this exercise, sit with your feet outstretched in front of you on a mat or bed, etc., with your hands relaxed on your knees. While inhaling, bring your arms up to your sides and with your hands, make fists with your palm facing up, elbows bent at your sides. Suck up your genital organs, anus and squeeze buttocks tight. Press your legs straight out with toes bending back toward you. At the same time, press your arms up. Rotating the wrists so the palms remain facing up and turn your eyes to glare at the backs of your hands. Inhale air into your Tan Tien. Hold this posture for as long as comfortable, focusing the energy 1-2" below the navel.

Exhale and as you exhale, bend from your hips, foward to touch your toes (or knees if you can't touch your toes). Inhale, and come back to a sitting posture, and relax. Take a breath and repeat. Start with ten repetitions and increase to 36 times or 100 times. You may perform this exercise in the morning upon rising and in the evening before retiring.

SECRET TAOIST METHOD OF URINATING

Another technique that strengthens the kidneys is to pass urine while standing on the tip of the toes. In order to increase one's sexual potential, it is very important to strengthen one's kidneys. The practice of this exercise helps cure impotence and helps prevent premature ejaculation because it strengthens the kidneys when practiced over a period of time. It is very simple and consists of passing urine while standing on the tips of the toes and at the same time keeping the back and waist straight. Clench the teeth, lock the buttock, and keep pressure in the abdominal and forcibly discharge urine while exhaling slowly. This process increases and tones kidney energy.

Impotence and weak sexual capability is usually associated with other symptoms of weak kidney energy including fatigue, laziness, and a lack of will-power to carry out ones aims. You can easily test your sexual strength by observing the strength of the discharge of your urine. How forceful is it? If it is forceful, then the sexual power is good. If it is weak with no force and dribbling at the end, then the sexual strength is weak.

Another simple method for strengthening the kidneys and thus increasing sexual potential is to sit on a backless chair or stool or on the floor. Sit with your knees bent and your hands placed on your knees. Rock backward to a 45 degree angle, then back to beginning position. Do this as many times as you can and repeat this exercise at least ten times a day. This exercise places a great deal of stress on your abdominal musculature, thus increasing abdominal strength. A strong abdomen is another indication of strong sexual potential.

SIX EXERCISES FOR THE KIDNEYS AND BACK

The following is a listing of a set of exercises that work both the abdominal ^nuscles, the waist musculature and the lower back. A strong lower back and abdomen are indicative of a strong sexual potential, thus helping to prevent premature ejaculation, lumbago, lower back pain and urogenital problems of all kinds. These exercises and the movements work to strengthen the kidney energy as well.

Exercise One:

Lie with back on the floor or mat with both legs held up, outstretched at a 80-90 degree angle. Begin to slowly lower legs to the left until they reach an angle of 45 degrees. Then bring them back to the beginning position. Then slowly lower them to the right side until they reach a 45 degree angle and bring the legs back to the beginning position. You may perform this exercise at least 10-12 times at each sitting.

Exercise **Two:**

Lie with your back to the floor on a mat. Raise both legs so they form a 45 degree angle with the ground. Then cross each leg over the other three to four times. Repeat this exercise ten to twelve times.

Exercise Three:

Lie with your back on the floor or on a mat. Hold your hands on your waist and lift up the upper half of your body until it forms a forty-five degree angle with the floor. Hold as long as you can, then lower your body to the floor. Repeat the exercise 10-12 times or more, if desired.

Exercise Four:

Lying on your stomach on a mat, with both arms bent at the elbows and hands held out next to your ears, lift the upper half of your body off the floor. Hold this position for as long as you can, then lower your body slowly to the floor. Repeat the exercise 10 times.

Exercise Five:

Lying on your stomach on the floor on a mat, grasp both hands behind your back at the level of the small of the back. Lift the upper half, and the lower half of your body simultaneously off the ground so that just your abdomen touches the ground. Hold for as long as possible. Lower both halves of your body to the floor and repeat ten times eac.

Exercise Six:

Lying on the back, alternately lift the legs one at a time and hold it in the lifted position for as long as you can. Do ten sets of the exercise.

The above set of exercises should be performed on a daily basis and in the early A.M. is best.

The following is an exercise taken from the Pa Tuan Chin (Chinese Health Exercises), and is very good for the kidneys. Stand with feet shoulder width apart, hands at your sides, with tongue touching the palate. Inhale, bend from the waist, and exhale as you go down, touching the floor with your palms if you can. Inhale while straightening up. At the same time as you straighten up bring your hands out-stretched over your head and stand up on your toes as you reach maximum outstretched reach. Exhale, as you come down off your toes and at the same time place your fists on your kidneys, on the back under the rib cage, relax on both sides,and then inhale as you press your fists into your kidneys while leaning as far back as you can. Exhale as you come back to the starting position and repeat 10 times.

HOW TO ENLARGE AND ELONGATE YOUR PENIS

Inhale the air through the nose into the throat from there swallow and press it down to the stomach. Do not keep it in the chest. Then the air, which you may experience as energy, is imagined as a ball, and is rolled down the front of the body beneath the abdominal muscles. When the air reaches the lower-most part of the abdomen, press it into the penis itself. This exercise for enlarging the penis differs from scrotal compression, because in the latter the air is pressed into the scrotum.

As you direct the air to the penis take the 3 middle fingers of the left hand and press them to the Hui-Yin midpoint between the anus and the scrotum. This pressure prevents the air power from flowing back into the body. The power lodges in the penis itself.

Resume normal breathing while keeping the left fingers on the Hui Yin midpoint. At the same time begin to directly exercise the penis. Pull it forward and backward, stretching it out in a smooth rhythmical movement for 36 times. Next use your thumb to rub the glans of the penis. This should erect the penis. If there is no erection, continue pull and rub the glans until the penis stands.

The right hand then circles the penis firmly at its base and, while holding firmly, slides forward about an inch. In this way the air energy is locked into the body of the penis itself and driven toward the*tip of the head. Feel the pressure pushing forward toward the head and maintain it but don't force it too hard.

Then the penis is pulled out to the right and rotated with a stirring action thirty six times clockwise and counterclockwise. Then it is pulled out to the left and rotated another thirty six times clockwise and counterclockwise. Simultaneously maintain the outward pressure locks in the air.

This exercise massages the entire urogenital system including the penis, the prostate gland, and the veins, arteries, and surrounding nerves; the bladder and even the kidney are beneficially stimulated. The energy of many bodily organs flows into the penis, and the tone and function of all are enhanced.

In the final penile manipulation, gently beat the inner right thigh with the erect penis 36 times, while simultaneously you are maintaining the air-lock pull. Then beat the inner left thigh 36 times.

Upon completion of these calisthenics soak the penis in warm water for one minute. This will help it absorb the warm yang energy and to expand. This completes massage of the organ and should produce growth of a healthy inch during the first month or two of practice. Depending on individual bodily structure, further gains may be realized.

HOW TO DECREASE PENIS SENSITIVITY

Techniques for reducing penis sensitivity have been sought for millenia as a way of preventing premature ejaculation. I prefer Seminal Kung Fu methods to those surveyed here, yet I do not discourage anyone from trying others, so long as proper precautions are observed. (Also see chapters on sharpening Your Weapon and Salvation for Impotence.)

Some have worn coarse material inside their underpants. The cloth rubs the penis and nervous sensitivity may gradually subside. Many have counseled thrusting every day into sand or bags of rice. However, sand may get inside of you and cause irritation and infection. Rice may actually cut and abraid the member.

These methods may provide a little extra stimulation, but they

are primitive, painful and dangerous. They miss the point: the naked penis is perfect when used with understanding of its laws, rigorous training and the invincible force of Love.

STRENGTHEN YOUR ERECTION

This method helps a man to obtain a stronger, healthier, more energetic erection. Place the thumb on the top of the penis at the root, and the index finger at the bottom of the penis at the root. Inhale, hold your breath, then squeeze and grip the shaft in a wave toward the penis tip. The thumb, index finger, pinky finger push so that the blood is forced to the penis head. Hold this grip for as long as you can hold your breath. Do nine repetitions. This forces the blood into the penis and it can't get back out again. As you hold your breath, count to nine and with each count, squeeze more toward the head of the penis. This technique strengthens the penis and reflexively strengthens the entire body.

REFLEXOLOGY MASSAGE OF THE PENIS

A healthful reflexology massage can be performed on the penis, just as a similar massage can be performed on the hands, feet, and ears. This results from the fact that on some areas of the body there are reflexive zones that refer to other areas of the body and the internal organs. Just as the entire pattern of internal organs is found on the soles of the feet, so is the pattern for the internal organs found on the shaft and head of the penis.

This massage is both pleasurable and very beneficial to health. This can be clearly seen when the penis is rubbed and feeling how quickly pleasurable sensations emanate to other areas of the body. There are two parts to this massage, (a) First spot massage with the thumb and fingers starting at the base, and massaging along the entire shaft of the penis in both directions with a circular motion on the top sides, under side, to the tip of penis, and back toward the base.

(b) "Rubbing the Turtle Head"—To massage the head of the penis, grip the head of penis with index and third fingers. Massage the tip with the thumb in a circular motion while gently pressing in on the head. This reflects to the prostate gland and massages this gland which is very beneficial. Repeat this massage 100-300 times

in both directions. This builds up and energizes the prostate gland.

Exercise Note: Don't ejaculate. If you feel yourself getting too excited, perform the Big Draw technique or slow down for a few moments.

This massage builds sexual potential by building up the prostate gland. This is a prostate gland cancer preventative exercise, which may be performed 100's of times daily.

DIAGRAM 36

PENIS REFLEXOLOGY

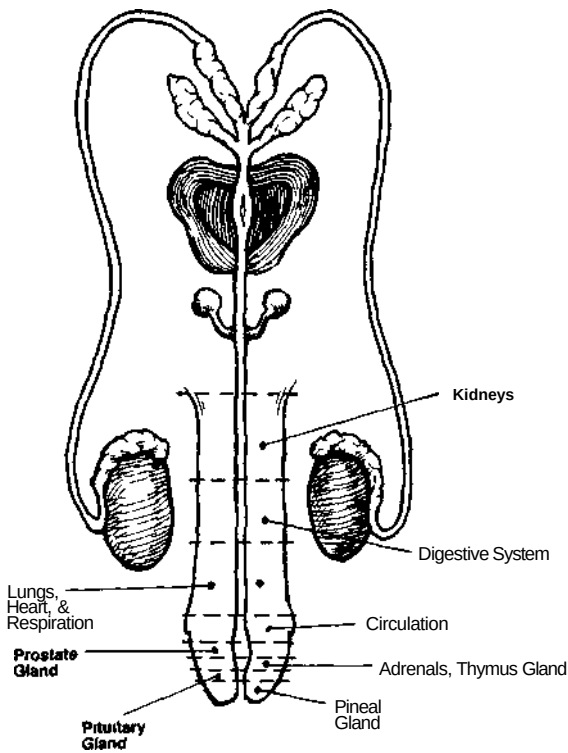

Different zones of the penis connect with the vital organs

THE INDIAN ROPE BURN MASSAGE

In this massage, rub the palms of the hands together until they are hot. Hold up the penis with one hand and with the other hand grip the penile base firmly with thumb and index finger. Perform the Indian Rope burn technique back and forth 9 to 36 times. This stimulates the kidneys. Performing this same technique on the middle of the shaft stimulates the digestive system. Massaging under the penile head stimulates the heart, lungs, and respiratory system.

With one hand hold the penis up, while with the other hand perform the Rope Burn technique.

FOUR WAYS TO INCREASE SPERM COUNT

1. Testicles Grip and Squeeze Massage: This exercise stimulates sperm and hormone production and builds up sexual potential in the man. To perform, rub hands until hot. With one hand hold penis up and with the other hand grip the testicles and gently squeeze them. Gradually squeeze them harder with definite short and pronounced grips while gently tugging on testicles. Perform a minimum of 100 grips before switching hands and repeating from the other side.

2. The Testicle Rattle: Like the above exercise, this stimulates sperm and hormone production for the man. Rub the hands together till they are hot and with one hand, hold penis up. With your other hand cup testicles starting the testicles shaking gently and gradually increasing the intensity of shaking. Shake testicles for at least three to five minutes. Switch hands and repeat.

3. Testicle Tapping: Again rub hands until they are hot. With one hand hold penis up and with the other hand, gently tap and pat testicles, gradually increasing intensity and strength of pats. (Don't do it too hard). Perform for at least 3-5 minutes and then switch hands and perform from the other side. Also, pat at the root of the testicles at the base, on the perineum.

4. Testicle Spot Press Massage: Rub hands until hot. With one hand hold penis and with the other hand massage testicles with the thumb, in a circular manner in both directions for at least 3-5 minutes, (at least 100-300 times). Switch hands and repeat in both directions 100-300 times. Or, you can support the testicles with the fingers and thumb and massage in a circular manner with the heel of the hand.

All of these exercises increase sexual potential and hormone production, stimulate the ching energy and prostate gland, and build power to the penis and lower energy centers. After you perform these exercises you must perform Seminal Kung Fu to transmit this sex energy to the higher centers. If you should happen to waste the energy by ejaculation, you are definitely defeating your purpose.

MASSAGING THE PROSTATE GLAND

Besides massaging the "Turtle Head," you can also massage the prostate directly. This is done by placing a finger in the anus. This is done using your index finger, a glove, and a little saliva, vaseline, or massage oil for lubrication. Gently thrust and massage on the prostate gland. You can also thrust in and out, varying the rate to get maximum stimulation, at the anal sphincter. Or, vibrate the sphincter, this will also stimulate the large number of local nerves and the prostate gland. You can also press the Hui-Yin point in the perineum. Rubbing this point back and forth hundreds of times will also stimulate the prostate gland.

Spot pressing points around the anus will also stimulate the prostate gland. First wash the anus very clean with mild soap and water when you shower or bathe. Press and rub around the sphincter. This will stimulate the prostate gland and all of the higher endocrine glands, including the pituitary and pineal glands. This is the best way to preserve, harmonize, and increase blood circulation.

ANAL PUMP SQUEEZE EXERCISE

Inhale through the nose and hold your breath while you pump and pull up the anal sphincter, the muscle around the anus. That is, you squeeze the anus like you're holding in a bowel movement. This stimulates the prostate gland. The method is easy and effective and can be done anytime, anywhere. It is important to contract the anal sphincter with maximum grip to get the most out of this exercise. Exhale slowly and relax. This is a simple way to relieve stress and tension at the same time build up sex potential and energize the body.

Eventually you will feel a warm sensation in your lower groin

and anal area. This feeling may spread to the back and up over the head, eventually returning to the solar plexus and navel area. By constantly gripping your anal muscles, you can energize the prostate gland and cowper gland and circulate the blood, strengthen your penis, and gain control over ejaculation. After a period of practice, you can test your rectum strength by trying to suck up water while squatting in a tub of luke warm water via the anus grip exercise. (Make sure the water is clean).

They say the last act before a man dies is to take a bowel movement, and that a flaccid rectal sphincter is indicative of poor health. By doing this technique, the sphincter will never become flaccid. Maintaining a strong healthy prostate gland is one of the secrets for leading a long healthful life.

So squeeze and rub yourself for good health and happiness!

TONGUE KUNG FU

The first major strategic tool in love-making is the tongue. Learn to maneuver this erotic arm par excellence. It has miraculous powers of sensual stimulation and can, by itself, wage brilliant love campaigns. Use of this arm may be mastered through practice of Tongue Kung Fu.

The tongue combines more virtues for the bedroom than any other organ. It is warm and moist. Its file-like roughness wears down resistance. Besides these perfect attributes for erotic arousal, it changes size and shape. It flicks about with quickness, strength and infinite variety of movement.

The "Illusion of Descartes" proves the tongue's magnificent sensitivity. This philosopher observed that a pinhead-sized cavity seems as large as a matchhead to the tongue: such is the organ's unique capacity to magnify tactile impressions. More importantly, the tongue is the major means of directing your chi into your lover prior to intercourse. This is because the tongue is the main switch for the chi flowing in your microcosmic orbit. Whenever you kiss deeply or lick her, your life energy flows into her, and hers into you. A power tongue is like a magic wand, sprinkling bliss wherever it touches, making the spark that connects two life forces.

The essential Tongue Kung Fu exercises follow:

A. Serpent Tongue: Thread an orange with string and secure one end of the string with a 1" section of toothpick. Hang the

orange at mouth level. Then lash out at the orange precisely in the manner of a viper. Shoot the tongue straight out of the mouth, making it ver,y firm and sharp-pointed. Fire it directly forward and with practice increase speed. This serpent-movement is useful in stimulating breasts, genitals, and ears. Ears are especially sensitive, as each ear has dozens of acupuncture points that connect to the whole body when activated by chi flowing through the tongue.

B. Hook Tongue: Using the hanging orange, stick out the tongue as far downwards toward your chin as possible. Stick the tip forward. Then try to hook the orange as you lick up its side. This action is especially exciting to the genitals; if you touch her g-spot, it may cause her to release her "elixir of moon," the female ejaculate considered by Taoists to contain a super powerful yin essence.

C. Slap Tongue: With the hanging orange stick the tongue quite far out while drawing it to the extreme left. Then quickly swing it to the right, forcefully slapping the orange with the rigid tongue side. Then start with the tongue at the extreme right and slap at the orange with a quick movement to the left. Slap the orange around with increasing power and speed. Teach this to your lover, she can use it to arouse your "Jade Stalk" (ancient Chinese term for "penis"). It will increase your own oral dexterity and nimbleness much to her delight.

After some practice you should be able to dribble the orange. Catch it on tongue tip, side and surface, balance it with flashing movements. Use the orange for the first month; then move up to grapefruit for the second. In the third month graduate to a hanging glass jar filled with little steel balls or with nails, beginning with ballast of *¥1* lb. and progressing to 1 lb. As you improve larger jars may be used.

Wash citrus fruits before and after each workout. Keep them in a plastic bag in the refrigerator. In this way the fruits may be used for a few weeks of practice, and you will avoid infection. It is of the highest importance to keep your mouth clean and free of offensive odor. Casanova himself commented on the discouraging effect of bad breath. In fact tongue Kung Fu will stimulate the production of fresh, clean saliva, which you should swallow in a single gulp to your navel. Taoists consider saliva to be a very potent elixir that can be used to intensify and center one's chi. If you have an ongoing problem with plaque coating your tongue, eat

less meat and more vegetables and use a tongue scraper to clean it daily.

The graduate school of tongue exercises involves the use of a plastic ruler, which you alternately lift up and depress with the broad base of the tongue. These Power Lifts strengthen the tongue muscles and complement the darting practice. You may use any flexible material such as wood, metal or bamboo for the ruler. Use only smooth rulers, since any wound in the tongue is slow to heal. It sits in a medium full of microbes. If your tongue should happen to suffer a cut for any reason, you may find it helpful to rinse the mouth with boiled salt water thrice daily.

Once you have practiced the secret tongue gymnastics, you are ready to approach the fortunate partner of your choice. Find the spots of her greatest sensitivity and lavish your skill upon them. Often you may find those points by watching where the woman directs her hand or eye.

When you've found the places where she wants you, enjoy playing with your full complement of tongue techniques. What pleases best in one place may not be what she craves in another. Watch for her responses; she will tell you with unmistakeable eloquence when you hit the mark.

D. For tumescent nipples you may unfold the Drill Tongue. In this esoteric practice the tip of the tongue drives the projecting nipple back into the breast where it is whirled around in a little circle, creating a thrilling spiral of energy.

If you perform Tongue Kung Fu in the vagina, moisten the right thumb and index finger. Put the thumb inside the vagina and the wet index finger over the anus opening. Seal the anus to prevent loss of your partner's energy. When your partner kisses your genitals, have her seal your anus with a moistened middle finger while she stimulates your scrotal region with the other fingers.

I must emphasize the importance of being with partner who observes reasonable standards of hygiene. The genitals and anus are warm and moist, ideal conditions for bacterial growth. Wash and keep them clean especially when you have sex. Odor can spoil or lessen the enjoyment of sex.

Like the tongue, the index finger is also a very powerful stimulator. You may have it lightly explore the vagina and gently massage the clitoris. Keep your finger nails clean, especially the index finger. Trim the nail quite short and file it to a smooth surface

which will not scratch sensitive tissues. The utmost gentleness must be used in these attentions. Pain may upset your mate and bring her pleasure to a screaming halt.

The gentle of the index finger can easily stimulate the gland (critoris) and the G spot which lie behind the pelvic bone, one inch behind the gland (cretoris).

DIAGRAM 37

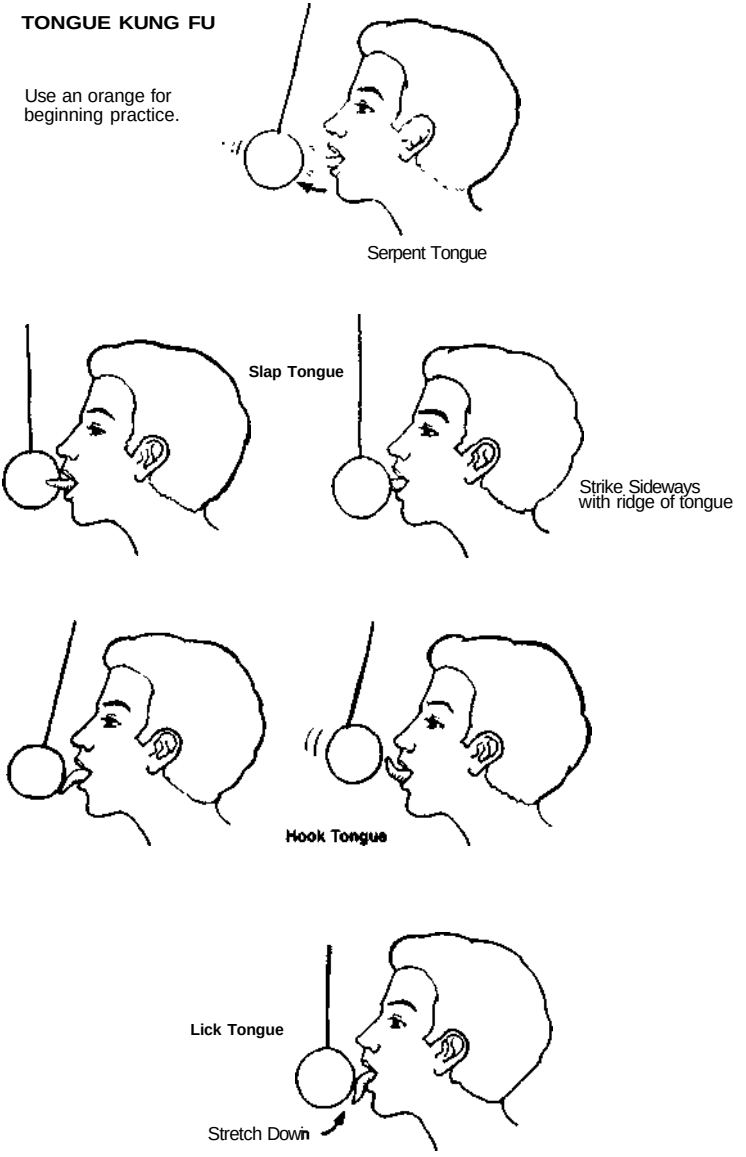

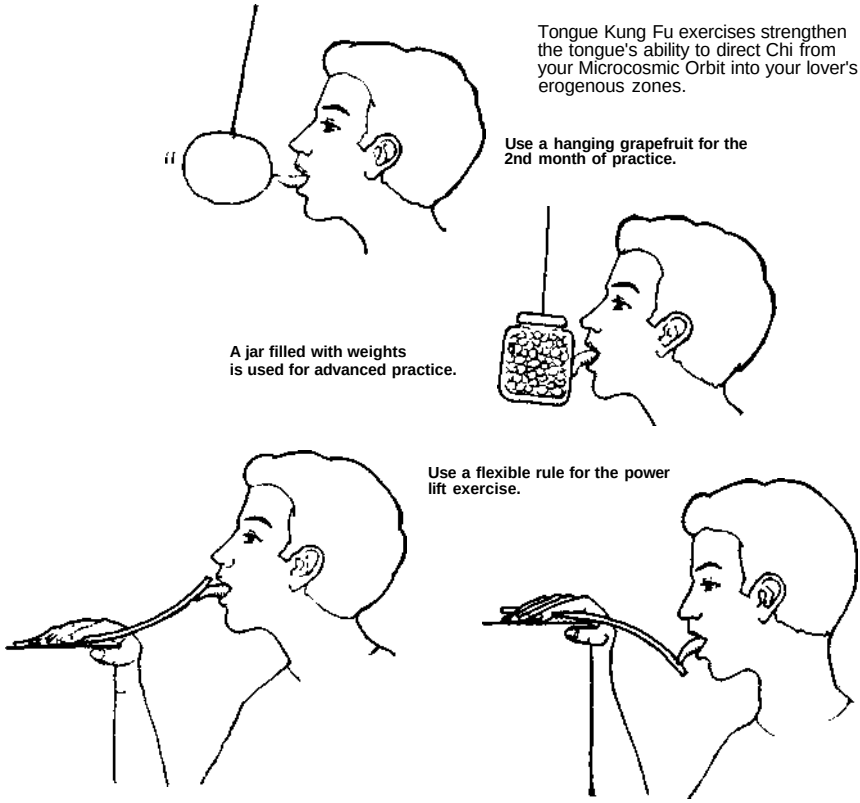

HOT AND COLD BATHS FOR SEXUAL HEALTH

These ancient time tested methods that have come down to us help build the body's resistance to disease.

(a) Cold Water Sitz Baths

This technique is extremely good to alkalize the blood of the genital groin area. This increases blood flow to the genital area, stimulating the prostate and production of sperm for the man (and stimulating the hormones in a woman), thus increasing sexual potential. The procedure is quite simple. Just squat or sit in a tub of cold water so that your genitals, anus, and coccyx are submerged in the water. Minimum time for this is ten to twenty minutes. Start with cool water and gradually accustom yourself to colder temperatures.

(b) Alternating Hot and Cold Water Baths, Showers or Sitz Baths

This also is an ancient technique in which one alternately plunges into first hot, then cold water. This method increases blood circulation, tonefies the body, increases resistance to disease, and stimulates hormone production, thus increasing sexual potential. One must stay for a minimum of three minutes in either hot or cold baths before one alternates to the other temperature extreme. And, one must alternate at least six times to be effective. Try for 12 times is best, with at least three minutes in each one. If you don't have time, during your morning shower begin it hot—while soaping—and finish with a cold rinse.

One may also instead of plunging into the bath, gradually enter first with your toes, then legs, body, back, shoulders, abdomen, and lastly the head. This way the body gradually acclimates itself to the temperature change. Those suffering from high blood pressure, heart disease, kidney disease, etc., can also enjoy alternating hot and cold baths, but be careful and go slowly.

(c) Exposing the Skin to the Air (Air Bath)

This is very healthy for the body, aerating the skin. It gets rid of musty odors, builds the body's resistance to disease, and helps blood circulation. It keeps the male genitals cooler than the rest of his body temperature thus increasing his sexual potential. The thought of running naked on a beach or in a mountain field has much appeal. One gets exposed and absorbs much needed negative ions. The weather should be moderate to warm, the temperature typical of late spring through early fall. This can also be done sitting inside your house naked with the windows open. Do not use this practice as a way to exciting your sexual fantasies as it will waste the chi. Think about how healthy you feel.

HARMONIOUS ENERGY FOR THE HOMOSEXUAL

In Chinese practice Heaven is Yang or male and Earth is Yin or female. When both lovers are of the same sex, there are two poles of Yang (homosexuals) or Yin (lesbians). There is an inherent imbalance in this type of relationship which favors instability and violence, and blocks progress to higher levels of balancing sexual energy.

To attain a more harmonious balance it is essential for those that love their own sex to find a source of the opposite type of energy; otherwise, they will receive too much imbalanced force.

Fortunately, there are sources of female energy which the male may absorb to his great benefit. Likewise there are available means whereby the lesbian may obtain additional yang energy. This is because man and woman are not the only sources of yin and yang but small reservoirs of these energies which stream through creation.

The key is in the very first line of this chapter: heaven is male and earth is female. Thus the man who needs yin energy but prefers not to receive it from its human container will absorb it from the earth; and woman will draw in the male potency from its source, the heavens.

For the man to draw in the yin energy, he lies belly down, embracing the earth. One leg is straight and one bent at the knee. He will pull in the energy from the earth. He must try to have no sexual thoughts. The genitals should not touch the ground, but hang a little above it. Relax and gather your concentration by breathing deeply in and out through the nose. Think the power

DIAGRAM 38

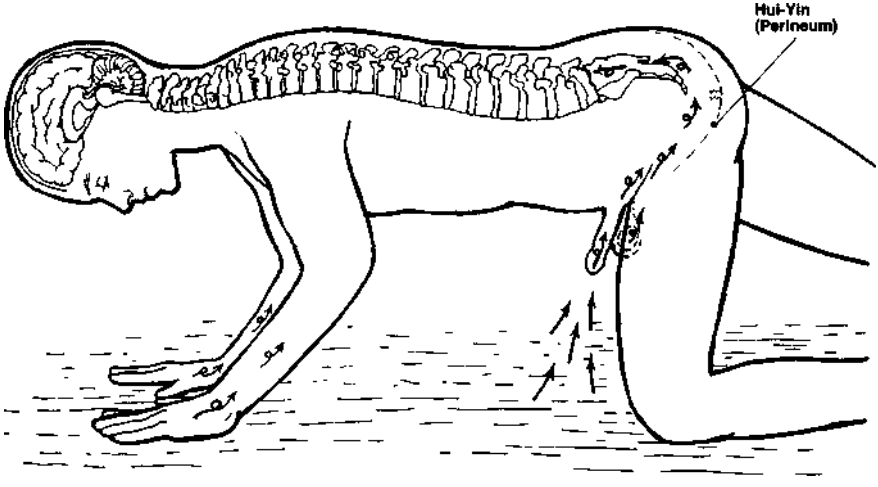

The earth, yin energy can be gathered using this palms down position. Think the earth energy up into the penis, up past Hui-Yin into the spine up the back to the head.

from the earth slowly into the penis. This basic practice applies to man: think the power up through your breathing.

As you inhale, draw the power up as if you were absorbing up fluid in a Straw: the fluid is the power and the straw is the penis. From the penis draw it past the hui yin, chang-chiang, and up the back to the head. Store the yin power in the head. In due course it will overflow the crown and move down the front of the body and return to the hui yin. When this point is reached, you may bring it up the front of the body to the navel and work the centers navel, solar plexus and heart, respectively, in the manner described in the Yin-Yang Exchange. Put away all obsessive erotic thoughts or it will cause the power to drain out.

HOW TO ABSORB SEXUAL ENERGY FROM THE SUN

Throughout the civilized world there is an increasing enthusiasm for nudism and nude sunbathing. Our body can in fact absorb energy from nature. Some parts are more absorptive of the life energy than other parts. The lower part of the body, penis and testes especially, can absorb more power than other lower parts (perineum and Hui Yin).

During the course of civilization, man has hidden the reproductive organs as secret things. So we have what is commonly called "underpants" and "panties" to protect from the outer world. That is the part that can absorb much natural energy to strengthen the body or greatly increase force and endurance in sex life. The more we keep it hidden from nature the weaker the parts will be. It will effect your entire body deleteriously.

This method of absorbing the solar power into the penis is regarded as top secret and rarely revealed.

Practice: Morning sun from 7 to 11 is much preferred or 3 to 6 in the afternoon. If the sun is not too strong we can gradually absorb its power into the glans (head) of the penis much easier.

To expose to the sun, hold stem of the penis with one hand and use it to rub the glans until penis is erect. Put it down facing towards the sun and imagine the power coming into the glans, absorbing it, so that it fills the organ with warm power. It will fill the entire organ with energy if your thought is properly concentrated. When your penis softens, do the whole procedure again. Do this exercise three to four times.

Pull the testes up and expose them to the sun. Use your right hand to rub the Hui-Yin and imagine the power being absorbed through the Hui-Yin to the whole genital region, and especially the testes. Rub the testes with both hands gently for a few minutes. Rub the stem of the penis (which is beneath all the glands) and the prostate gland by using one hand to hold the testes up and the other to rub gently. Start with 5 to 10 minutes and increase gradually up to, at most, one hour. This may require months to attain.

The lower part of the body is rarely exposed to sun. Moderate exposure to the sun, in this way, is a preventative measure against skin disease in this part of the body as well as a strengthening measure. This sensitive part will feel much stronger and less sensitive, thus reducing the difficulty of withholding or retaining the seminal fluid.

DIAGRAM 39

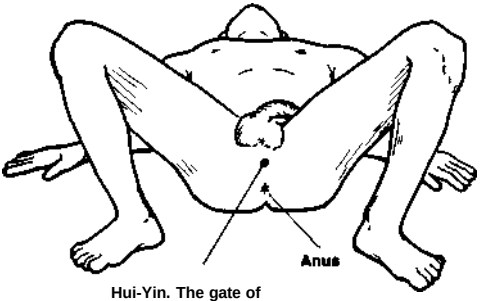

When rubbing the glans, start with light rubbing and don't heat too much. When rubbing the Hui-Yin begin gently and gradually; take care not to injure yourself. Injuries to the reproductive organs are the hardest to cure.

Be sure to be in a covered place and don't show other people, so that you don't get in trouble. Some people might find these meditations and hygienic practices provocative. These exercises will greatly help reduce premature ejaculation, impotence, and nocturnal emissions.

The second position I recommend is the "head stand", "shoulder stand", or lying on the back with hands under back of

DIAGRAM 40

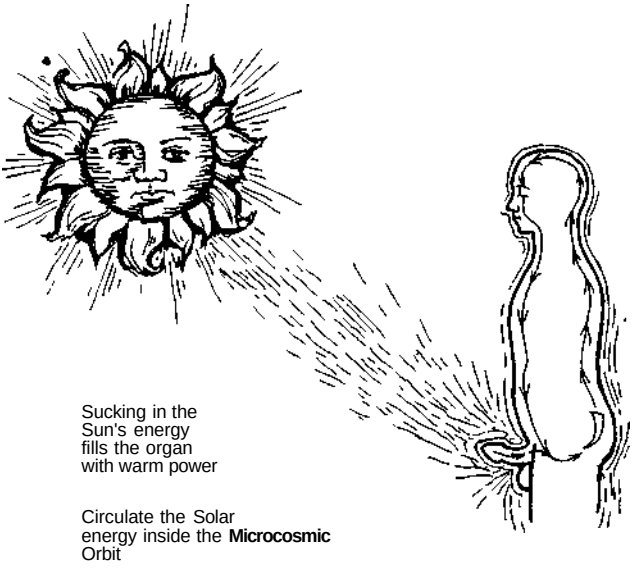

lower thighs to hold the anus, Hui-Yin, scrotum, and penis up to the sun. People never expose these parts to the sun though they are highly permeable to energy and readily draw it into the body.

Male and female reproductive organs are never exposed to solar energy. Yet the organs are very powerful. They can expel energy or absorb it in from the universe, but because man ignores this method by wearing clothing that close this way of absorbing power from the universe. The best position is the head stand, with the two legs facing down. Absorb with your mind the solar power through the anus and penis in from both directions to the prostate and then forward into the scrotum. Keep the scrotum warm and try not to expose too much at first; start with 1 or 2 minutes. Do not absorb excess heat, because the scrotum can't be too hot or the sperm cells will die, and that defeats our purpose.

CHAPTER 16

ACUPUNCTURE, MOXIBUSTION AND HERBS CAN HEAL WEAKENED SEXUAL ENERGY

ACUPUNCTURE-MOXIBUSTION METHOD TO HEAL IMPOTENCE

Moxibustion is a very old Chinese tradition more than 5,000 years old. It is a way of increasing the chi energy to stimulate the glands, organs, nerves, and circulation of blood using heat applied to acupuncture points. Moxa or moxa-rolls can be bought from a Chinese store selling acupuncture equipment. You can also use a cigar or a cigarette, but the moxi-roll is better, although both will give you a lot of smoke in the house. You can also use a fish tank heater attached to a long glass tube.

The best way to overcome impotence is to generally keep oneself healthy and to protect oneself from excessive sexual stimulation, which will only fan the flames of your feeling of impotence. You should abstain from sex for a period, make sure you sleep and eat well until your health and sexual potency recovers. If you modify your life-style to allow a renewal of your life energy, moxibustion and acupuncture can be used to quicken the recovery of your potency by aiding the flow of chi energy to your hormonal system and reproductive organs.

You can treat yourself at most points, but should probably obtain a good book on acupuncture or moxibustion to aid you with

the location of the points described here. DO NOT moxa any points on the body at random, as some are forbidden to moxa heat as dangerous. Without further instruction, you should moxa only the points I describe here.

It is best to use garlic and onion with mox. Garlic is the best, which you should slice or chop and put in a piece of cheese cloth. You then put it on the acupuncture point to be treated and apply the heat of mox or the roll or the cigar or heater to the garlic. Don't overwarm it, as you can hurt yourself. Garlic is a very strong stimulus. If kept on the place too long it will "burn" the skin, and you may suffer from superficial heat burns as well. So, be careful. If allergic to garlic you can use the onion. If allergic also to onion, you may use heat alone, which is still effective.

DIAGRAM 41

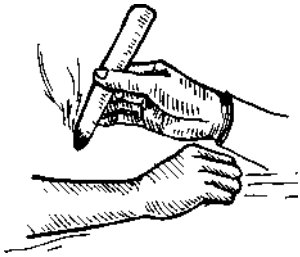

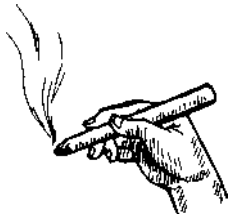

Roll the moxa in tissue paper into a cylindar & ignite Hold the ignited moxa 1/2' above the acupuncture point.

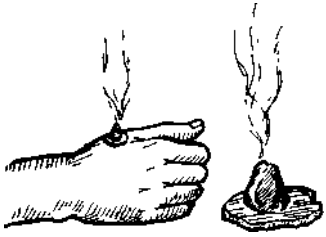

Ignite a small pile of moxa on a slice of ginger Place the ginger & burning moxa over the acupuncture point

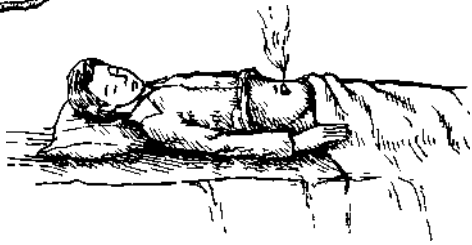

Moxa each point for 3 to 4 minutes, but hold the heat roll at the point for a few seconds only, moving it up and down all the time, pressing deeply unless discomfort sets in. Do not exceed this time of 3 to 4 minutes. When doing moxa try to keep the room warm. Be careful of a cold room, especially when you are nude, as you will lose a lot of chi. If you are using the cigar, moxi rolls, or cigarette, afterwards the room will be smoky for awhile. So you must have very good ventilation to exhaust the smoke out.

Do this moxa treatment every day for ten days and then stop for 3 days. Then start another 10 day period of application. Don't drink wine or take a bath for two hours after mox treatment. During mox treatment stop having sex until you recover. If the condition is serious, stop sex for 1 to 3 months. After a thorough rest you will recover your strength and potency. If you discipline yourself to follow the cycle of 10 day treatments and 3 to 4 day rest, most men will recover their potency unless suffering an anatomical defect (which is extremely rare).

1. URINARY BLADDER MERIDIAN-KAN-SHU BL-18 THE MAIN LIVER POINT

Start at back, the urinary bladder meridian, called the Foot Tai-Yang. The first point is the Kan Shu BL-18. Kan-Shu is one and one-half tsun beside the lower end of the spinous process of T9. One and one-half tsun (1 tsun is a thumb-width) is the width of your index and middle finger. This is considered the main liver point. The liver stores the body's energy. With too much intercourse or stress, the body must draw its supplies from the liver and deplete it. For this reason this treatment is helpful in hepatitis. The spinous process is the outer tip of the vertebra as you move outward from the center line of the spinal cord.

2. PI-SHU BL-20 MAIN POINT OF SPLEEN

Second point is the Pi-Shu BL-20, which is one and one-half tsun beside the lower end of the spinous process of Til. This is the main point for the spleen. It also helps backaches and indigestion.

3. SHEN-SHU BL-23 PALACE OF SPERM/TZU-LIAO BL 32

Third point is the Shen-Shu BL-23. (Palace of Sperm). One and one-half tsun beside the lower end of the spinous process of L2. Used for kidney, this helps fight infections, lower back pain and sexual problems. Shen-shu means "palace of sperm". Do on both sides of the spine for all points.

Finally come down to Tzu-Liao, BL-32 on the 2nd posterior sacral foramen and midway between the lower part of the posterior superior iliac spine and the median line. It's easy to find; start with the sacrum, the large piece of bone above the coccyx. Put your thumb on the point BL-27, which is the last point between the spinal vertebrae on the sacrum. Put your little finger on your coccyx, and spread the fingers out, and your index finger falls on the Tzu-Liao. Your thumb should be just at the upper rim of the sacrum and the fingers evenly spread out.

Another way is to find the point where the sacrum meets the spinal column. Place the thumb at this junction and then spread the fingers. This may be easier. Surrounding the outline of the hand are eight holes of the sacrum. Shang Liao upper hole is on BL-31. The most important point is the Tzu-Liao BL-32 on the second hole, then Chung-Liao BL-33 on the middle hole and Hsia-Liao BL-34 on the lower hole.

There are more points than those mentioned here. Not all of the points need moxa every day. Do your back if you have someone to help you. You can do it once every two or three days on the back, combining and alternating with points on your back and front.

4. GOVERNOR MERIDIAN-CHANG-CHIANG GO-1 FUNCTIONAL MERIDIAN CHI HAI CO-6 THE OCEAN OF ENERGY

Another point is on the governor meridian, the chang-chiang, GO-1 at the lower end of the coccyx between the tip of the coccyx and the anus. It's also good for lower backache. Another point is on the Functional Meridian. The point is Chi-Hai CO-6, one and one-half tsun below the umbilicus, known as the ocean of the chi energy- This also helps disorders of the bowel. Next go to Kuan Yuan

CO-4, three tsun below the umbilicus. All points on the functional (conception) meridian on your back help increase energy in the abdominal organs, including the small intestine, large intestine, bladder, and prostate gland. By stimulating all these organs you greatly help to reduce your impotency.

DIAGRAM 42

THE **MAIN** MOXIBUSTION POINTS TO RESTORE MALE POTENCY.

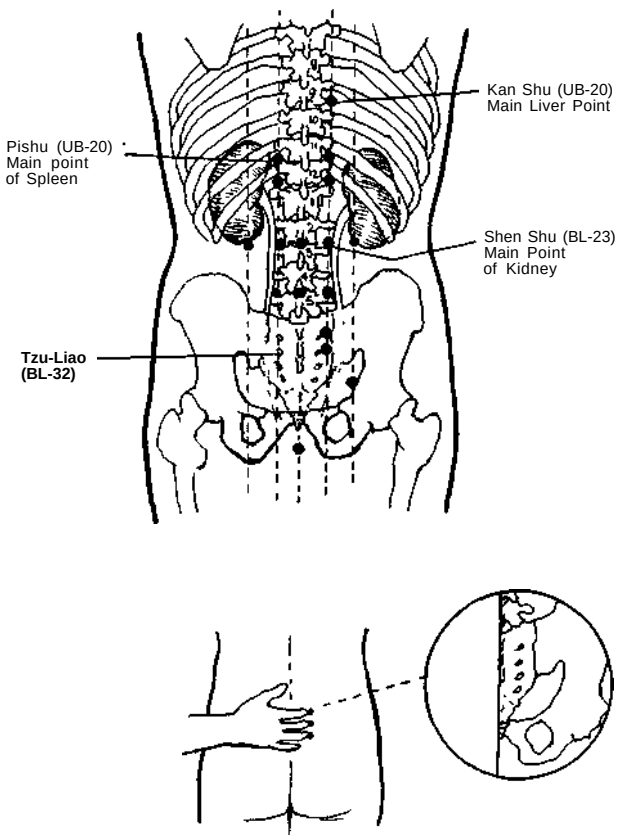

With the thumb on the sacro-iliac to the left side, spread out the three fingers evenly on the right side. They will touch S1, S2 & S3.

THE SPECIAL POINTS FOR IMPOTENCE:
1. HEAD OF THE PENIS, GLANS PENIS, ROOT OF PENIS, HUI-YIN

All back and front points on the governor and functional meridians stimulate the organs. The points listed here are the special points for impotence. First point is the head of the penis, or the glans penis. Best way to use is slice the garlic (don't chop it and don't use garlic if you are allergic to it) and punch a hole in it with a needle. For the first few times put on a silk cloth to prevent burning the penis glans and then use the heater. Second point is the 2 points at the under root of penis. Third point is hui-yin, the perineum located between the anus and the penis, which is included in the special points.

DIAGRAM 43

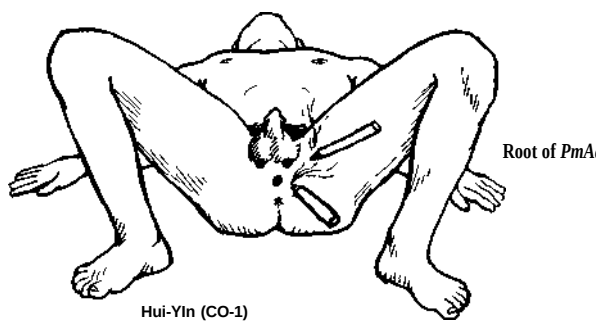

2. FU-LIU KM (MASSAGE ONLY)

On the leg, point Fu-Liu KI-7 is two tsun above the posterior media malleolus on the inner ankle bone.

DIAGRAM 44

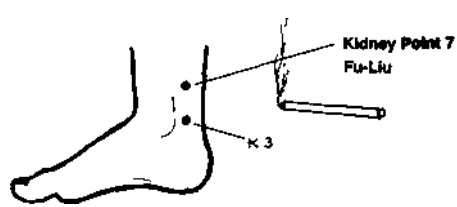

3. LAO-KUNG (MASSAGE ONLY)

The point mentioned here cannot use moxa, but responds to massage and rubbing. On the hand, the Lao-Kung is between the middle and fourth fingers when the hand is closed so that all fingers run along the line in the hand. Rub this point every day.

DIAGRAM 45

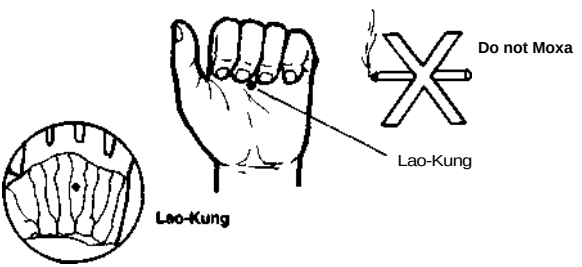

4. YUNG-CHUAN KIDNEY POINT (MASSAGE ONLY)

Another point is on the Kidney meridian, called the Foot Shao-Yin. The point is the Yung-Chuan. KI-1 point is on the inside of the ball of the foot (where your weight falls directly) on a line below the second toe, counting your big toe as the first. Never moxi this point. Only rub with a finger or rub the bottom of your feet together every day. This will help to stimulate the kidney energy, the most important in regulating sexual activity.

DIAGRAM 46

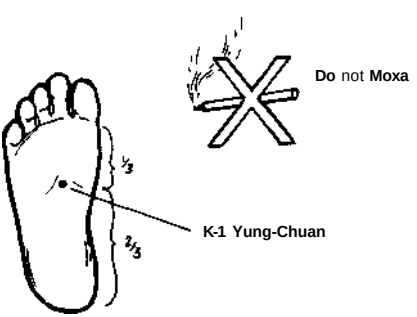

I have used moxa treatment for many years and helped many patients and students with the problem of impotence, and most recover in a very short time. Some have very serious nocturnal emissions (wet dreams). Some have emissions every two or three nights or sometimes in the daytime. They lose too much seed essence, or ching, and so lose the ability to have sex. They usually feel weak, and their face is pale. Using the moxa method combined with the power lock exercise (described in chapter 6) is the most effective, and the students who do both recover the most quickly, you should clench 108 times each morning and evening until your erection returns.

Many people get desperate and try to cure impotence with other methods. They try to stimulate themselves with even more sex, with hormones, Spanish fly, etc., but these only drain off their energy more quickly. The best way I can advise to cure impotence is to use Taoist methods of cultivation. I'm not telling you to have sex as much as you want but to have sex as a meaningful and delightful act in your life.

Any compulsive sex is meaningless and dangerous to your health. It's better to complete one very successful sexual act than 10 or 100 of unprepared, unpracticed sex. If you regard every act of sexual intercourse as a special or sacred occasion, take a bath, put perfume on, brush teeth, wash penis and anus, wash hair, ears, change bed cover, clean up the room, have some flowers, etc., it will help you reduce your compulsiveness.

If you have a gun you can't go out and begin shooting any person you see on the street. You'll get yourself in big trouble. Sex is the same; it's a powerful tool that becomes a dangerous weapon when fired indiscriminately. If you practice the Taoist method, your sexual organ will become strong but you need not give it to every woman you see. Use it meaningfully. A tool like a gun can help protect life or it can kill you and others. Using these things one must be very careful. If you know that excess ejaculatory sex can harm you and that cultivation of harmonious sexual energy with love makes life meaningful, you can cure yourself of impotence and return to full sexual fulfillment.

RESTORE SEXUAL VITALITY THROUGH DIET

Food is alive, and each kind of food contains its own energy vibra-

tions that when eaten forms part of the overall vibration of your body. The process of food selection, therefore, becomes a process of selecting vibrations for ourselves that not only are in harmony with the universe but that will bring us into harmony with a love partner.

Factors involved in food classification include size, shape, color, taste, nutritional level, and animal or vegetable origin. Everybody's balance of chi energy and bodily health is different, so everyone needs to choose the foods most balancing for their specific state of health. Thus the Taoists avoid prescribing any one dietary regimen such as macrobiotics, vegetarianism, fruitarianism, etc. although these diets may well be suited to particular individuals or good at certain times of the year. The topic of diet is a large one that I intend to cover in another book. Here is a superficial outline that will give you a sense of the possibilities of balancing yin and yang energies in your body using food.

Very Yin: (Drugs) Sugar, Alcohol, Fruit. Yin: Beans, Veggies, grains, fish. Yang: Poultry, Meat, Eggs, salt. Very Yang: garlic, ginger, red pepper.

EATING FOODS IN EXCESS

If men eat very yin foods in excess after a while sexual activity will diminish. When their yang energy is exhausted it will peeter out all together. Yin foods include foods that grow below ground level: roots, fibers, and bulbs.

Men eating very yang foods to excess may cultivate a strong, even violent sexual appetite characterized by egotism, insensitivity, and its short duration. Eat from both extremes and your sexual activity and desire will fluctuate, sometimes on and sometimes off.

SEX AND SEASONS OF THE DIET

According to the Taoist Lui Ching "In Spring a man can allow himself to emit semen once every three days, in Summer and Autumn twice a month and during the Wintertime he should save his semen and not ejaculate at all. The loss of yang energy caused by one emission in Winter is considered a hundred times worse than one emission in Spring.

In accordance with nature Winter was believed to be the season of storage and accumulation of energy. For a man this means he should conserve his semen and increase his "hot" energy by eating hot and warming and fortifying foods during winter, and cooler foods in the summer.

SEPARATE STEPS TO TAKE FOR MEN AND WOMEN TO ACHIEVE YIN/YANG BALANCE

Women:	Men:
Less salt	Slightly more salt
More vegetables	More grains
Shorter cooking time	Longer cooking time
More green, leafy veggies	More Root veggies
Little or no fish	Very moderate to low fish
Little or no animal food	Very moderate to low animal food

Too much yang food makes a woman hard and insensitive (foods such as meats, eggs, and dairy foods).

Too much yin food can make a man soft and incapable of having an erection.

FOOD FOR SEXUAL ORGANS

During sexual intercourse a great deal of "hot chi" is released, and anything that supplements this hot chi is considered a great help. This means that foods that are extremely cold should be avoided because they bring down the chi quotient of the body. On the other hand, foods that are cold but stimulate the Kidneys can be eaten since the Kidney is in charge of the sexual apparatus and is thus stimulated. Examples of extremely cold foods to be avoided are: coconut milk, mentholated wines, chrysanthemum tea, and ice water.

Foods that provide nourishment to the entire organism are adviseable after sexual activity, for example, muscle and organ meats, ginger, red dates, sharks fin, swallow nest, and sea cucumber. These are examples of tonic foods, in that they build the energy of the body.

CHAPTER 17

BIOLOGICAL FACTS EVERY MAN SHOULD KNOW ABOUT FEMALE SEXUALITY

Few things confuse men more than women's bodies and their monthly cycles. Women's bodies are different from men and this alters their psychological and spiritual path of development. Many spiritual groups don't discuss the female body because it carries such a loaded charge of sexual energy they don't like dealing with it. But men need to understand woman and her biology if he is to move beyond the level of emotional struggle and come into complete harmony with her yin essence. As Taoist sex brings a man into the most intimate contact he'll ever have with a woman's body, I am including some brief but important pieces of information about their sexual organs and reproductive cycle. This will be vastly expanded in volume two of this series, "Taoist Secrets Of Love: Cultivating Female Sexual Energy," also known as Ovarian Kung Fu.

The best education you can get is from loving a woman and observing how her particular subtle energies change with the moon and seasons of nature. If a man cultivates his yang energy he can have a powerful effect in strengthening his lover's body and stabilizing her energy cycles. When the subtle energies of yin and yang have proper intercourse, the hormones and vital organs function at a more refined level and produce radiant good health.

THE UTERUS

The uterus, a muscular organ smaller than a woman's fist, is suspended in the pelvis by large ligaments which attach to the pelvic bones. It is like an upside-down pear. The lower part, the cervix, (like the stem end) is the only part that is visible in the vagina, and is at the end of the vaginal canal. It is pink, round, and has an opening in the middle (called the cervical os) which leads through the cervix (about *W2"* long) and into the uterus. The fallopian tubes extend out at the right and left side of the uterus and form an umbrella over the ovaries. The ovaries are white, about the size and shape of an unshelled almond.

OVULATION

Around the middle of a woman's cycle (the timing can be extremely variable) an egg breaks out of one of the ovaries. Some women experience a brief twinge at ovulation, some women have severe pain that can last up to a day or two. Most women are not aware of any changes at all during this process.

Although the egg only lives for 12 to 24 hours, a woman's fertile period can be as long as five days. How is this possible?

DIAGRAM 47

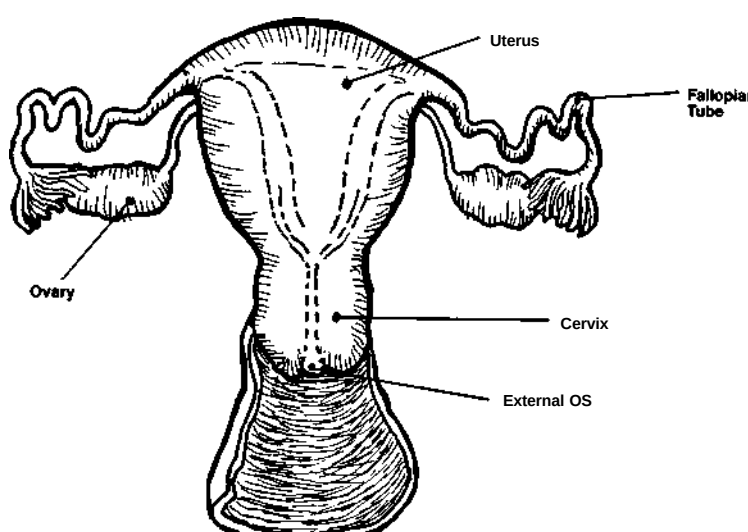

FERTILE MUCUS

Before ovulation, the glands lining the cervical canal start producing a slippery, stretchy clear or translucent mucus which flows down the cervical canal and into the vagina. There may be enough for a woman to be well aware of it, or she may just notice a slickness around the opening to her vagina. The molecular structure of this mucus is like tunnels and ladders, giving sperm direction and support in their journey toward the cervical canal.

Ten minutes after ejaculation into the vagina, some sperm can be found in the fallopian tubes. Sperm also find their way into the crypts lining the cervical canal where they are nourished by the mucus and time-released out over a period of three to five days. So, if a woman and a man have intercourse on Saturday night and she has fertile mucus but doesn't ovulate till Tuesday, she could get pregnant some time on Wednesday.

NONFERTILE MUCUS

During the rest of her cycle, a woman may notice periods of relative wetness and dryness. The cervical mucus produced during the nonfertile times varies in quantity and is usually white and sticky. The molecular structure of this mucus is like a mesh or grid, preventing most sperm from entering the cervix. Observation of the mucus cycle aids many women in determining their fertile times.

MENSTRUATION

About two weeks after ovulation, if a woman has not gotten pregnant, the lining of the uterus, which has been building up to make a nest for a developing embryo, sloughs off and another period begins.

The menstrual cycle is measured as the time between one period and the next, counting the first day of bleeding as Day 1. Most women menstruate about once a month, although few women have periods exactly every 28 days, which is denoted as the "norm" or "ideal." Regular cycles can vary as much as from three to seven weeks. Some women who have only two to three periods a year are often unaware of any cycle.

PERIODS

For many women, their periods are a sign of the health functioning of their body, occurring more or less "on time," lasting three to five days, and requiring a certain amount of paraphernalia and attention to hygiene. For sexually active heterosexual women their period is the sign that they are not pregnant. From the Taoist viewpoint, the loss of blood is a loss of valuable energy that can be minimized or altogether stopped if the woman has finished bearing children. The Taoist method is reversible should the woman change her mind.

The typical period often starts out "light," that is with a small amount of pink-tinged mucus or a few drops of blood, increasing to a bright red full flow on the second day and perhaps going on for a couple of days, then diminishing to brownish "spotting" as it tapers off. Some women bleed a lot; for some, their periods start and end dramatically, like turning on and off of a faucet; some have very little bleeding. Some women's blood is dark and can have clots varying from specks to the size of a dime; some women's periods have a lot of mucus. The blood as it comes out of the cervical canal has virtually no odor or taste. These characteristics change with exposure to air and the passage of time as cells break down.

Many women commonly experience some discomfort during their periods: swollen, sore breasts, fluid retention, pimples, headaches, low back pain, diarrhea or constipation. Some women with chronic herpes are likely to have an outbreak around the time of their period, indicating some of the "stress" imposed on the body by her period. The uterus, which is a muscular organ, can contract, which sometimes feels like a cramp does in any muscle of the body, or may be described as pressure, ache, or a bearing down feeling. A few women are absolutely incapacitated by their periods, e.g., with severe pain or vomiting. Virtually no research has been done to understand such recurrent misery and Western allopathic doctors only offer these women strong and possibly dangerous medications to relieve the symptoms.

Women are intimately familiar with their own cycles but rarely exchange these details with friends or relatives. Most American women are deeply ashamed of their menstrual blood, feel humiliated and embarassed if they stain their clothes, and are very

self-conscious about bulges of sanitary pads, odors, and the discreet disposal of bloody pads or tampons.

EMOTIONAL CHANGES

Some women experience mood changes around the time of their periods, but studies have not been able to document any patterns in large numbers of women.

Most women can identify a part of their cycle when they feel "horny" and indeed every portion of the menstrual cycle, including the period itself, has been claimed by some women as being the time when she feels her sexual desire most strongly.

WOMEN'S SEXUAL ANATOMY

So, let's take a look at women's genitals. Starting at the front and top is the Mount of Venus (mon veneris, or mons, for short). The amount, texture and distribution of pubic hair can vary from a few straight hairs to a bushy growth going up the abdomen or down the thighs. The mons is a cushion of fat protecting the pubic bone underneath (which is joined together by cartilage that softens during pregnancy so that the bones can separate if necessary during childbirth). The mons divides and separates into the large outer lips (labia majora).

INNER LIPS

Inside the outer lips are the inner lips (labia minora)—very different in color and texture, they are related to the mucous surfaces, like the lips of the mouth. In the unaroused state they vary in color from pink to dusky to dark maroon/purple. Sometimes the inner lips are long and can be seen protruding from the outer lips. During sexual arousal the small lips, which are well-supplied with blood vessels, get engorged and swell to two or three times their resting size! As the point of no return approaches orgasm they can go through a color change sometimes turning to crimson or dark wine. (Masters & Johnson)

Follow the small lips to the top where they join together to form the hood that protects the glans of the clitoris. Usually the glans, in the unerect state, is nestled under the hood. You can see it

by pulling back on the hood. The glans of the clitoris is loaded with nerves, and for most women the glans is the most acutely sensitive spot in their sexual anatomy. Some women find it is so sensitive that direct stimulation can be irritating.

THE SHAFT OF THE CLITORIS

The shaft of the clitoris can be felt like a strong rubber band under the surface between the glans and mons. As sexual excitement mounts, the shaft thickens and shortens and the glans, shaft and supporting structures erect. As with men, there is often a dramatic change in size and shape.

THE GLANS

Travelling down from the glans is the opening to the urethra. Below this is the opening to the vagina. A woman's urethra is about *IVi"* long from the outside to where it opens into the bladder. Surrounding the urethra is a plexus of blood vessels. Since these blood vessels had no name in medical books, a group of women named it the urethral sponge (A New View of a Woman's Body). During sexual excitement the blood vessels engorge and a bulge can be felt through the vaginal wall. This bulge has been named the G spot (after Grafenberg, one of the first sexologists). It can be explored by feeling around the front and upper part of the vagina. (It has also been said that the G spot is located *Vi* inch deeper than a woman's longest finger).

THE POSITION OF THE G SPOT

Making love in a face-to-face position, the G spot can be difficult to reach directly (with the exception of those men whose penises, when erect, press right up against their bellies). Shallow thrusting gets closest to the G spot and can cause that stimulation of the suggestive and tantalizing kind.

However, a change in position may be necessary if a woman wants her G spot stimulated more directly. Fingers are often most effective and direct. A woman stimulating herself might choose to squat or lie with her legs up in order to reach it better. Her partner might find it easier to reach if she is lying on her stomach; during

coitus, if the woman is on top she can position herself more precisely.

Some women, when holding their man tight, enjoy the sensation of an erect penis rubbing on their lower abdomen, right above the pubic bone, stimulating the G spot from the other side.

When the G spot is massaged, often a woman's first impression is that she has to urinate. However, sexologists assure women that if the pressure is continued there will be a transition to sexual arousal. The sexual response to G spot stimulation may also have to be learned by some women and it can take several sessions for it to feel good. (Perry and Whipple)

Some women find that stimulation of the G spot can trigger their orgasm, while many women enjoy G spot stimulation as part of the whole panoply of sexual stimulation.

With or without G spot stimulation, there are women who ejaculate when they orgasm. This ejaculate, which can be quite copious, is much like seminal fluid. It is not urine. However, many women who experienced ejaculation report they were dismayed, felt sure they had urinated, and they learned to withhold this reaction. Now that the word is out about women's ejaculations there will probably be much relief and relaxation and increased enjoyment by the women who have this particular capacity. No research has yet uncovered where this fluid is made or stored.

THE WALLS OF THE VAGINA

Inside the vagina, the walls rest against each other, creating a potential space. The walls of the vagina are pink and have many folds, accounting for its tremendous elasticity. During sexual arousal lubricative fluid oozes out of the walls in a kind of sweating action.

Across from the urethral sponge there is an area of blood vessels protecting the anus called perineal sponge. This can be felt through the lower back part of the vagina. During the plateau phase the perineal sponge thickens, further narrowing the entrance to the vagina.

THE CERVIX

At the end of the vaginal canal is the cervix, the neck of the uterus. Most sexologists agree that women have little sensation beyond the first (outer) third of the vagina. However, many women strongly disagree saying that they experience terrific pleasure with deep thrusts at the back of the vagina in the area of the cervix and many women feel pleasurable contractions of the uterus during orgasm.

The perineum is the skin from the vaginal opening to the anus. The anus is a sexual orifice for some women, and quite taboo sexually for others. Those women who enjoy anal sex usually prefer lots of lubrication such as, K-Y or spermicidal jelly, to reduce irritation and discomfort to these delicate mucous surfaces. Also, for hygiene, men are discouraged from putting their finger or penis in the vagina directly from the anus.

LOVE MUSCLE

Below the surface level of the visible genitalia is the figure-eight pubococcygeal (P-C) or "love" muscle. The P-C muscle encircles the urethra, vagina and anus. A well-exercised P-C muscle is considered by some sexologists to be the key to healthy sexual functioning for both men and women. Poor muscle tone leads to sexual difficulties as well as other physiological problems, such as difficulty in childbirth and urinary incontinence. In fact, the first person to understand the importance of good P-C tone taught exercises to women in preparation for childbirth. His name, Kegel, is still associated with these exercises.

Men and women can test their P-C muscle by starting and stopping a stream of urine and then starting it again. This ability is due solely to P-C muscle tone. Many women have found on their own the pleasure they can get for themselves and give to their men by squeezing this muscle. It is in the vagina, and many women have become quite dextrous at this.

SEXUAL RESPONSE CYCLE

Women's sexual response was described by Masters and Johnson as being in four phases: excitement, plateau, orgasm, and resolu-

tion. These phases are marked by physiological changes in the sexual organs: beginning engorgement in the excitement phase with sweating of lubricant in the vagina; pulling up of the broad ligament which supports the uterus, which in turn enlarges the back of the vagina in the plateau phase: a myriad of changes during orgasm, including for some women changes in skin color on the back and chest, tingling, or contractions in the hands and feet; and gradual return to resting state in resolution. What is truly notable is that women are described as having a long arousal period. Yet, in Shere Hite's research, most women describe themselves as reaching orgasm very quickly once they start masturbating. Whether it is women's capability to extend sexual pleasure or the ineptitude of their lovers coupled with her reticence to instruct her lover (Shere Hite's Report on Male Sexuality) is not clear, but is an important question.

DIAGRAM 48

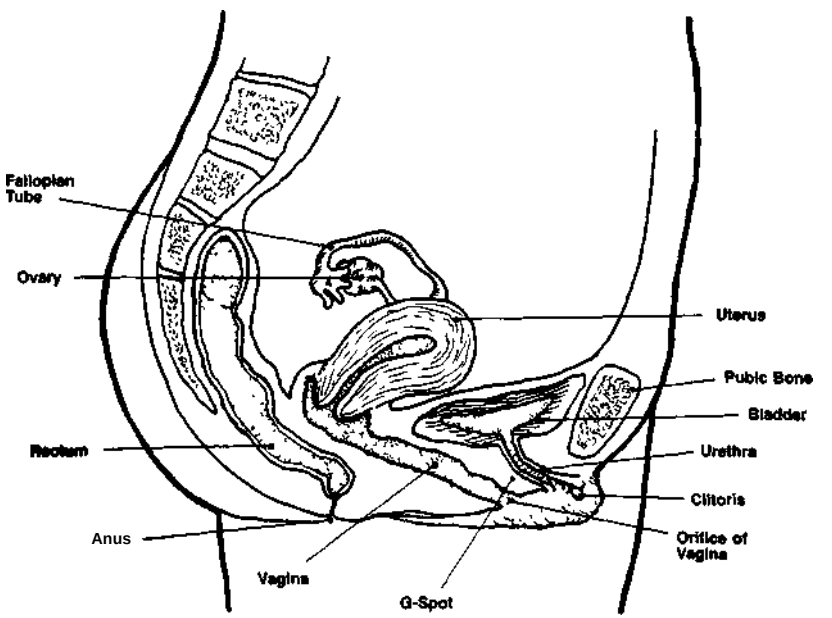

The most sensitive part of the vagina is the outermost 2 inches

CHAPTER 18

SUMMARY OF THE SEVEN STAGES OF TAOIST ESOTERIC YOGA

SMALL HEAVENLY CYCLE (MICROCOSMIC ORBIT)

The introduction to the seven higher formulas of Taoist practice is the Opening of the Microcosmic Orbit, or the rebirth process of return to the mother's womb. This route is composed of the Functional and Governor Channels, which must be purified and linked to form a free-flowing circuit.

The life of a human being begins with the piercing of an egg by a sperm cell. From this original act of Kung Fu, an enormously complex human being develops, which is capable of real genius. The fetus develops around that point, which is called the navel. It is from this point that nutrients are absorbed and wastes expelled from the developing creature. Therefore, in the Warm Current Practice the navel is a point of overriding importance. While in the womb the human being doesn't breathe air (the lungs do not function at all). Energy and oxygen are passed to the fetus through the umbilical cord. When the energy flows into the fetus' body, it enters at that point at which the navel will later be after the umbilical cord is severed. Then it proceeds downwards to the bottom of the trunk, flows all the way up the spine to the crown of the head and from there, flows down the middle of the face continuing on to the navel, again to complete the circuit.

The fetus, it is said, automatically touches its tongue to its palate. This serves to link the two energy channels and allows the power to flow. The crown of the baby's head is open and moves up and down. This is due to the waxing and waning of the flow of power through this particular part of the body.

Thus, the tongue is the terminus of the Functional Channel. This energy pathway begins at the bottom of the trunk at the point midway between the anus and the testes, called, the "Hui-Yin". From there it flows up the front of the body through the Kuan-Yuan and the Chi-Hai and then through the Chi-Chung (the navel). Then it passes through the Chung-wan (solar plexus) and proceeds to the Shan-chung (the heart center). Thereafter, it passes through the Hsuan-chi (throat) center and up to the tongue terminus. When connected with the Governor Channel the energy path reverses direction and flows down from the tongue, navel, to the Hui-Yin.

The Governor (or control) Channel also starts at the Hui-Yin. From this point it moves up the posterior of the body. In doing so it passes through the Chang-chiang (the base of the spine) and goes up to the Ming-men (L2 and L3) or Door of Life where it continues up to the Chi-chung (Til) between the adrenal glands and then proceeds upwards to the Yu-chen or the Emerald Pillow of the medulla. From there it rises to the crown of the head or Pai-hui (the crown) and then goes to the Shen-ting and down to the Yin-T'ang between the eyebrows. Here it passes to the San Ken (the tip of the nose) and finally travels down to the palate, which is the terminus of the Governor Channel.

DIAGRAM 49

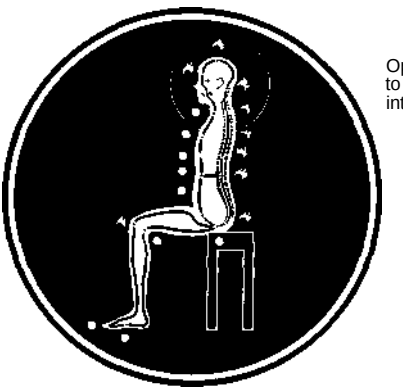

Open the Microcosmic Orbit to aid your practice of interal locking.

THE TONGUE IS A SWITCH OF THE CIRCUIT

The circuit may be closed when the tongue end of the Functional Channel is raised to contact the palate terminus of the Governor. Thus, during practice, we must keep the tongue in contact with the palate. Placing the tongue against the palate has a calming effect for those who practice the Warm Current Method. It also generates saliva, which is regarded as the water of life in Taoist practice. Saliva is said to be the chief lubricant of all bodily functioning. In the Taoist view the soft palate is regarded as a direct link to the pituitary gland.

As a man grows older he suffers increasingly from an imbalance of Yin (female) and Yang (male) energies in the body. As these disharmonies multiply, the bodily organs begin to suffer from the receipt of too much or too little energy. How different is the vital power of the infant! He grows nearly an ounce a day. This represents an astounding accomplishment in the assimilation of energy by the material body. The baby's body can do this heroic job of cell building because its routes of energy are thoroughly open and the flow of power is, consequently, very strong.

The Governor Channel controls the Yang organs of the body. These are the lungs, spleen, heart, kidneys, circulation-sex, and liver. The Functional Channel controls the Yin organs, which are the colon, stomach, small intestine, bladder, triple warmer, and gall bladder. The tissues are Yang in tendency and the blood is Yin.

THE SEVEN FORMULAS OF THE SEVEN BOOKS OF THE TAO*

THE FIRST FORMULA: FUSION OF THE FIVE ELEMENTS

This formula literally combines the separate energies of the five principal elements into one harmonious whole. The meditation has a particularly powerful filtering and purifying effect upon the human nervous system.

The Earth is the Mother of all the elements. All life springs from her generative womb. This reunites the other four elements of Chinese cosmogeny with the mothering Earth. Thus, metal, wood,

*The Taoist Masters traditionally referred to each level of esoteric practice as a "book" with a formula even though, until now, they have never been written but passed down only by word of mouth)

water and fire are drawn back into the earth and are simmered gently at this point. Each element is purified but is not so hotly fused that it loses its integrity and dissolves into ashes.

This formula is regarded as a highly secret method of Taoist meditation. In Chinese Philosophy each element corresponds to a particular organ. The Earth corresponds to the spleen, metal to the lungs, water to the kidneys, wood to the liver, and fire to the heart. The five elements interact with each other in three distinct ways: producing, overcoming, and threatening. The producing or creating cycle runs thusly: wood burns to make fire, the ashes decompose and seep into the earth, where are born and mined metals, which when melted become water (liquid), which nourishes trees and plants. The overcoming or destruction cycle runs thusly: wood is cut down by metal, fire is extinguished by water, earth is penetrated by wood, metal is melted by fire, and water is interrupted and cut off by earth.

The life cycle also has its relative elements thus: birth corresponds to wood, growth to fire, maturity to earth, harvest to metal and storage to water. In climatic types, wind corresponds to wood, heat to fire, dampness to earth, dryness to metal, and cold to water. Their corresponding emotions (sympathy, sadness, joy, anger, fear) blend one harmonious whole, raising the morale and encouraging kindness, gentleness, rightousness, respectfulness and humor. The formula of the five elements combined into one involves the mixing of the Yin and Yang to attain a higher state of bodily harmony and beauty. The ancient alchemical formula SOLVE ET COAGULA corresponds to the second stage in the meditational forms.

SECOND FORMULA: LESSER ENLIGHTENMENT OF KAN AND LI (YIN AND YANG MIXED)

This formula is called Siaow K'an Li in Chinese and involves a literal steaming of the sperm (Ching) into life force energy (Chi). One might otherwise say that this begins the transfer of the power of the sexual hormones into the whole body and brain. The crucial secret of this formula is to reverse the usual sites of Yin and Yang power, thereby provoking liberation of the sperm's energy.

The first and second books are the preparation of the paths for the greater energy flow of the sperm so that the body will be able to

handle the great influx of energy (power which might correspond to the awakening of the Kundalini). This formula includes the cultivation of the root (the Hui-Yin) and the heart chakras and the transformation of the sperm energy to sperm power at the navel. This inversion places the heat of the bodily fire beneath the coolness of the bodily water. Unless this inversion takes place, the fire simply moves up and burns the body out. The water (the sperm and seminal fluid) has the tendency to flow downward and out. When it dries out that is the end. This formula reverses the normal, energy-wasting relations by the highly advanced method of placing the water in a closed vessel (cauldron) in the body and then cooking the sperm with the fire beneath. If the water (sperm power) is not sealed, it will flow directly into the fire and extinguish it or itself be consumed. This formula preserves the integrity of both elements, thus allowing the steaming to go on for great periods of time. The essential formula is to never let the fire rise without having water to heat above it and to never allow the water to spill into the fire. Thus is produced a warm, moist steam containing tremendous energy and health benefits.

The Second formula consists of:

(a) Mixing of the water (Yin) and fire (Yang) (or male and female) to give birth
(b) Transforming the sperm power (generative force) into vital energy (Chi), gathering and purifying the Microcosmic outer alchemical agent
(c) Opening the twelve major channels
(d) Beginning of the half immortal (joining and sublimation of the body & soul)
(e) Circulate the power in the solar orbit (cosmic orbit)
(f) Turn back the flow of generative force to fortify the body and the brain and restore it to its original condition before puberty
(g) Gradually reduce food intake and depend on inner self, sun, moon and water, a beginning of the cosmic energy, (beginning of the Half Immortal)

THE THIRD FORMULA: GREATER ENLIGHTENMENT OF THE KAN AND LI (GREATER YIN AND YANG MIXED I)

This formula comprises the Taoist Dah Kan Li (Ta K'an Li) practice. It uses the same energy relations of Yin and Yang inversion but increases to an extraordinary degree the amount of energy that may be drawn up into the body. At this stage, the mixing, transforming and harmonizing of the energy in the Solar Plexus (it might correspond to the Manipura Chakra) takes place. The increasing amplitude of power is due to the fact that the third formula draws Yin and Yang energy from within the body, whereas, the third formula draws the power directly from Heaven (above) and Earth (ground wire-Yang and Yin, respectively) and adds the elemental powers to those of one's own body. In fact, power can be drawn from any energy source, such as the moon, wood, earth, light, etc.

The Third Formula consists of:

a. Moving the stove and changing the Cauldron.
b. Greater Water and Fire mixed (male & female intercourse).
c. Greater transformation of sperm power into the higher level.
d. Gathering the outer and inner alchemical agents to restore the generative force and invigorate the brain.
e. Cultivating the body and soul.
f. Beginning the refining of the sperm power (generative force, vital force, Ching Chi).
g. Absorbing Mother Earth (Yin) power and Father Heaven (Yang) power. Mixing with sperm power (body) and soul.
h. Raising the soul.
i. Retaining the positive generative force (seminal) force and keeping it from draining away.
j. Gradually do away with food and depend on self sufficiency and Universal energy. (Breatharian)

THE FOURTH FORMULA: GREATEST ENLIGHTENMENT OF THE KAN AND LI (T'AI K'AN LI) GREATEST YIN AND YANG MIXED II

This formula is Yin and Yang power mixed at a higher bodily center. This is to reverse the aging process, to re-establish the thymus glands to increase natural immunity. This means that the radiation of healing energy stems from a more powerful point in the body and provides vast benefits to the physical and etheric organism.

The Fourth Formula consists of:

a. Moving the stove and changing the Cauldron to the higher center.
b. Absorbing the Solar and Lunar power.
c. Greatest mixing, transforming, steaming and purification of sperm power (Generative Force), soul, Mother Earth, Father Heaven, Solar and Lunar Power for gathering the Microcosmic inner alchemical agent.
d. Mixing the Visual power with the Vital power.
e. Mixing (sublimating) the body, soul and spirit.

This might correspond to the heart Chakra (Anahata).

THE FIFTH FORMULA: SEALING OF THE FIVE SENSE ORGANS

This very high formula effects a literal transmutation of the warm current or Chi into mental energy or energy of the soul. To do this we must seal the five senses, for each one is an open gate of energy loss. In other words, power flows out from each of the sense organs unless there is an esoteric sealing of these doors of energy movement. They must release energy only when specifically called upon to convey information. This might correspond to the Brow (Ajna) and Throat Chakra (Vissuddha).

Abuse of the senses leads to far more energy loss and degradation than people ordinarily realize. Examples of misuse of the senses are as follows: if you look too much, the seminal fluid is harmed; listen too much and the mind is harmed; speak too much and the salivary glands are harmed; cry too much and the blood is harmed; have sexual intercourse too often and the marrow is harmed, etc.

Each of the elements has its corresponding sense through which its elemental force may be gathered or spent. The eye corresponds to fire; the tongue to water; the left ear to metal; the right ear to wood; the nose to earth.

The Fifth formula consists of:

(a) Sealing the five thieves: ears, eyes, nose, tongue and body
(b) Controlling the heart, and seven emotions (pleasure, anger, sorrow, joy, love, hate, and desire)
(c) Unite, transmutes the inner alchemical agent into life preserving true vitality
(d) Purifying the spirit
(e) Raising and educating the spirit, stopping the spirit from wandering outside in quest of sense data
(f) Do away with decayed food, depending on the un-decayed food, the universal energy is the True Breatharian.

THE SIXTH FORMULA: CONGRESS OF HEAVEN AND EARTH IMMORTALITY

The sixth formula is difficult to describe in words. It involves the incarnation of a male and a female entity within the body of the adept (this might correspond to the Crown Chakra, Sahasrara). These two entities have sexual intercourse within the body. It involves the mixing of the Yin and Yang powers on and about the crown of the head and being totally open to receive energy from above and regrowth of the pineal gland to its fullest use. When the pineal gland is at its fullest, it will serve as a compass to tell us in which direction our aspirations can be found. Taoist Esotericism is a method of mastering the spirit, as described in Taoist Yoga. Without the body, the Tao cannot be attained, but with the body, truth can never be realized. The practitioner of Taoism should preserve his physical body with the same care as he would a precious diamond because it can be used as a medium to achieve immortality. If, however, you do not abandon it when you reach your destination you will not realize the truth.

The Sixth formula consists of:

(a) Mingling (uniting) the body, soul, spirit and the universe (Cosmic Orbit)

(b) Full development of the positive to eradicate **the** negative completely
(c) Spirit returned to nothingness

THE SEVENTH FORMULA: REUNION OF MAN AND HEAVEN
TRUE IMMORTAL MAN

We compare the body to a ship and the soul to the engine and propeller of a ship. This ship carries a very precious and very large diamond, which it is assigned to transport to a very distant shore. If your ship is damaged (a sick and ill body), no matter how good the engine is, you are not going to get very far and may even sink. Thus we advise against spiritual training unless all of the channels in the body have been properly opened and have been made ready to receive the 10,000 or 100,000 volts of super power, which will pour down into them. The Taoist approach, which has been passed down to us for over 5,000 years, consists of many thousands of methods. The formulae and practices we describe in these books is based on such secret knowledge and the author's own experience in over twenty years of study and of successfully teaching thousands of students.

The main goal of Taoists:

1. This level—overcoming reincarnation, or enlightment.
2. Higher level—the Immortal spirit.
3. Highest level—the Immortal spirit in an immortal body. This body functions like a mobile home to the spirit and soul as it moves through the subtle planes, and allows greater power of manifestation.

TAOIST ESOTERIC YOGA COURSE OFFERINGS

There are now Taoist Esoteric Yoga Centers throughout the U.S. offering personal instruction in the complete Taoist Body/ Mind/Spirit system. Opening the **Microcosmic Orbit** is the prerequisite for all other courses. If you are having difficulty mastering the methods taught in this book, it will help to study the Microcosmic with a teacher and follow that with a class (usually a weekend) in the **Taoist Secrets of Love/Cultivating Male** and **Female Sexual Energy.** This will answer personal questions and allow discussion of many related topics that could not be included in this book. The Microcosmic course includes the Inner Smile meditation, the Six Healing Sounds, and the Taoist Rejuvenation exercises.

Complementary to the cultivation of sexual energy are the course offerings in **Iron Shirt Chi Kung.** This teaches how to pack energy in various organs and cavities of the body and strengthen the connective tissue which gives our body its integrity. These powerful exercises can be performed in a few minutes and will greatly increase your "rooting" power in the earth. It is an invaluable aid to anyone who meditates and tends to get "spacey," for martial artists, or anyone seeking to increase their immunity against disease. The higher level Iron Shirt classes strengthen the tendons and bone marrow, increase sperm count, allow your internal organs to gain super strength leading to the development of what Taoists call the "steel body" impervious to attack or illness.

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AWAKEN HEALING ENERGY
THE HEALING TAO

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AWAKEN HEALING ENERGY THROUGH THE TAO

The Taoist Secret Of Circulating Internal Power

Mantak Chia

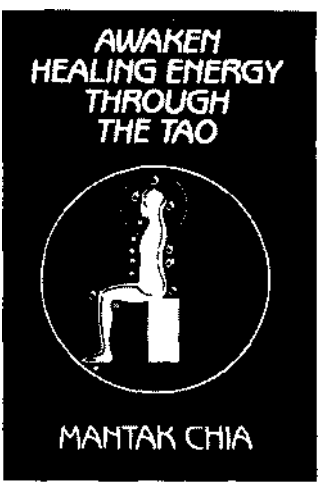

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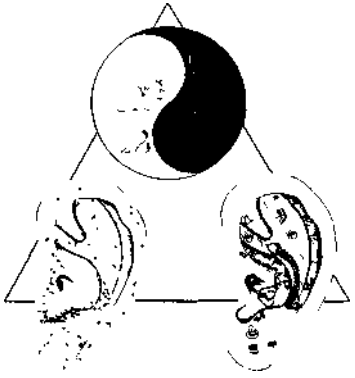

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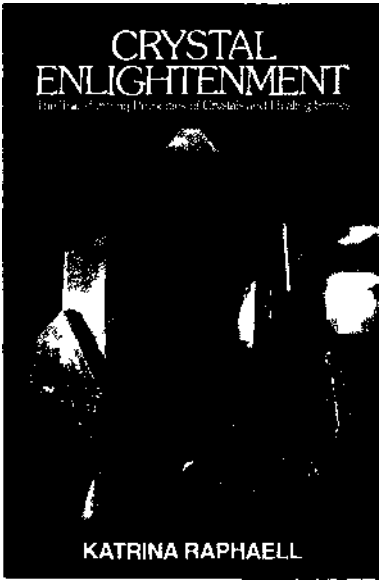

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Taoist Ways to Transform Stress into Vitality

Inner Smile • Six Healing Sounds

Mantak Chia

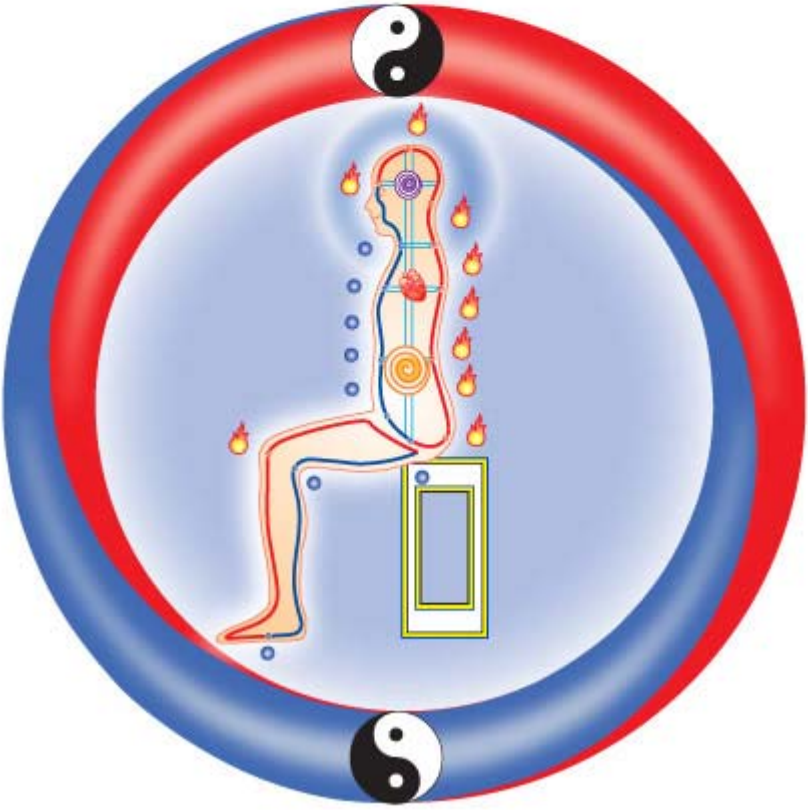

Taoist Ways to Transform Stress into Vitality

Inner Smile • Six Healing Sounds

Mantak Chia

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I have come upon Master Chia's Taoist practice in my old age and find it the most satisfying and enriching practice of all those I have encountered in a long life of seeking and practicing.

Felix Morrow, Senior Publisher

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty-five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi Gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices were held at Tao Garden for the first time using the Darkness technology creating a complete environment for the higher level Taoist practices.

He has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper/Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper/Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002
Tan Tien Chi Kung - 2002

Many of the books above are available in the following foreign languages:
Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

Acknowledgments

I thank foremost those Taoist Masters who were kind enough to share their knowledge with me, never imagining it would eventually be taught to Westerners. I acknowledge special thanks to Dena Saxer for seeing the need for this book to be published and for her encouragement and hard work on the initial manuscript.

I thank the many contributors essential to the book's final form: Dena Saxer, for writing a portion of this book, especially the basic step-by-step instructions, and for choosing the title; the artist, Juan Li, for spending many hours drawing and making illustrations of the body's internal functions; Günter Weil, Rylin Malone, and many of my students for their feedback; Jo Ann Cutreria, our secretary, for making so many contacts and working endlessly; Daniel Bobek for long hours at the computer; John-Robert Zielinski for helping with the new computer system and for rearranging the files and programs to speed up the new, process; Helen Stites for editing the book and entering it into the new computer; Adam Sacks, our computer consultant, who assisted in solving computer problems as they arose during the final stages of production; Valerie Meszaros for refining the text and typesetting the book on the new computer; and Cathy Umphress for design and paste ups. Special thanks are extended to Michael Winn for general editing into a form consistent with the Universal Tao Book; to Felix Morrow for his valuable advice in producing the book; and to David Miller for design and overseeing production.

Words of Caution

The practices described in this book have been used successfully for hundreds of years by Taoists trained by personal instruction. Readers **should not undertake the practice** without personal training by the Universal Tao since certain of these practices, if improperly done, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone does so entirely at his or her own risk.

The practices described herein are ***not*** intended to be used as a substitute for professional medical care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

Chapter 1
What is Universal Tao?

I. System

The Universal Tao is a self-help system for curing and preventing illness and stress, and for enhancing all aspects of life. Its key concept is increasing vital energy, or Chi, through easy techniques and physical exercises. This life force energy is then circulated through the acupuncture meridians of the body and channeled into health, vitality, balanced emotions, and creative and spiritual expression.

A practical system accessible to everybody, The Universal Tao is a modern expression of centuries-old Taoist practices. Many of these techniques were formerly known only to an elite group of Taoist Masters and hand-picked students. I have formulated these powerful practices into a comprehensive system which I began teaching to the public at large in my native Thailand in 1973. In 1978 I brought this system to the Western world. I then opened The Universal Tao Center in New York and began teaching the practices there. Today we teach our system in various places throughout the United States and Europe. Though spiritual in its foundation, The Universal Tao is not a religion. It is compatible with all religions, as well as with agnosticism and atheism. There are no rituals to perform and no gurus to surrender to. The Master and the Teacher are highly respected, but are not deified.

This book covers the beginning practices of Level I of the System:

1. Inner Smile
2. Six Healing Sounds

The entire system has three levels:

1. Level I concentrates on Universal energy, strengthening and calming the body;
2. Level II concentrates on changing negative emotions into strong, positive energy; and
3. Level III concentrates on creative and spiritual practices.

All levels include both mental (meditative) practices and physical disciplines, such as Tai Chi, Papua, and Iron Shirt Chi Kung. The foundation course called the Microcosmic Orbit is covered in my first book, *Awaken Healing Energy through the Tao*, but is also surveyed in this book as part of a Daily Practice. For a description of other courses and for the addresses and phone numbers of the Universal Tao centers, see the end of this book.

II. Taoism and Some Basic Concepts in Chinese Healing

Taoism is the 5000-8000 year old foundation of Chinese philosophy and medicine. It is also the mother of Acupuncture and the inspiration for modern body-oriented therapies, such as Acupressure, Rolfing and Feldenkrais. The Tao has been described as “natural law” or “natural order”, “the constantly changing cycle of the seasons”, “an art”, “a method”, “a power”, and “a path of direction”.

In the Taoist view, harmony and balance are essential for health. The body is seen as a whole; therefore, stress or injury to one organ, gland or system weakens the entire body. The body is also self-regulating and will naturally move toward balance if allowed to.

Illness is caused by a blockage of energy. Too much or too little energy in one part of the body results in disease to that part and stresses the entire body. The Universal Tao teaches us how to correct this imbalance by awakening the Chi, or vital energy, and circulating it to the needed areas.

The Taoist system links each organ to one of the five elements in nature: metal, water, wood, fire, or earth. It also connects them to a season of the year, a color, and a quality in nature (e.g., wet, dry, windy, etc.). This relationship often describes the characteristics of that organ. For example, the heart is linked to summer, fire and red; a healthy heart is associated with excitement and warmth. The season of an organ is the one in which the organ is dominant or working the hardest.

Body, mind, and spirit are totally integrated in the Taoist view. Therefore, Chinese medicine finds that negative emotions, such as anger, fear or cruelty, and excessive amounts of positive emotions, such as too much joy or excitement, can injure the organs and associated organs and cause disease. Both the Inner Smile and the Six Healing Sounds (covered in this book) help to balance the emotions as well as to improve health.

III. Illness starts as a Problem with One's Energy Level

World of Stress

A problem may exist for many years before it physically manifests itself as a disease. It may appear as a blockage or decreasing of the Chi energy level leading to a Chi imbalance in particular parts or organs of the body. If we become aware of the Chi imbalance when it first occurs, we have a long grace period in which to correct it.

Many people don't regard bad temper or negative emotions as sickness. In Taoism we regard these as the beginning of the imbalance of the Chi energy in the system, just like bad breath or body odor can be the beginning signs of weakness or illness of the liver, kidneys or stomach.

Stubbornness can be caused by an imbalance of the heart energy. Malodorous sweat can be due to a dysfunction of the kidneys, which have lost the filtering function to eliminate excess water contained in the body fluids. Cowardice and fear can be due to an imbalance of the lung or kidney energy. Back pain can be caused by an imbalance of the kidneys and bladder, and many other bad behaviors and physical ailments can be traced to an imbalance of the Chi energy in different parts of the body.

As we live our lives now, our attachment to the material world grows, and we become more and more drawn to material things, like various drugs, entertainment, services and unnatural foods. The more we feel that we need to have this and buy that, the more worry and mixed emotions we feel. We can get rid of all of these feelings by getting rid of our emotional attachment to these materials.

Conserving, increasing and transforming the Chi energy should be the first or primary preventive method practiced. When a person has a heart attack, he might use this method to prevent a second. When a bad kidney or bad back develops, the use of this method prevents it from getting worse. The primary preventive practices are started at the Chi level. In the Taoist system we map out all the organ energy meridians, which have a network extending from the organs throughout the body. When blocked or decreased the organs are the parts which will get less life force and will trap in the bad Chi (i.e., the Chi we know as sick energy in the organs or

the meridians.) If we are not in touch with our inner selves, it is very hard to notice much change internally. By knowing how to conserve, transform and increase the Chi, we have more Chi to open the blockage, increase the body's defensive powers and prevent illness. We can live the happy, healthy life we want to live and maintain our health as we age; we can live life not going from one illness to another, but instead have lifelong vitality and a will (desire) to live.

The Taoist system is geared to help you live a healthy life, free from illness, with vitality to help other fellow human beings. Many of my students had given up coffee, drinks, drugs, and certain kinds of "necessary" entertainment quite easily when they started to work on themselves to satisfy their organs and senses and thereby strengthen them.

I have one student who, at one time, had many factory workers and, therefore, had power over many people. However, he was deeply in debt because he couldn't give up endlessly buying things. Finally, he came to me and talked to me about his problem. I explained to him that stress and emotional energy created blockages due to energy imbalances in his organs. If he could strengthen his organs and senses and increase the circulation in his body, he would see the world from a different angle. After he completed the Microcosmic Orbit Meditation and practiced the Six Healing Sounds, Inner Smile and Tao Rejuvenation, he came to me and said, "Master Chia, I'm going on a long vacation". I asked, "What happened? " He replied that he had sold his factory, paid all of his debts and had a few thousand dollars left. "I want to rest, practice more of what you teach and come back and start all over again", he said. There was a tremendous change in his face.

IV. Best Investment is your own Health

Many people put all their life force into earning money, until their vitalities are depleted and illnesses set in. They have to spend more and more of their money on hospitals, surgery, medicine, and, finally, spend most of their time in bed.

Many people say, "I don't have time to practice. My day is filled with appointments and work, meetings, study and children." If you can improve your mind, body, and spiritual level of energy, your

mind will be clearer; you will be more physically fit; your work will usually take less time to accomplish; and your emotions will be calmer.

Many of my students have the same problem: it is hard to find time to practice the Microcosmic Orbit Meditation, Six Healing Sounds, Inner Smile, Tao Rejuvenation, Tai Chi Chi Kung, Iron Shirt and Fusion of the Five Elements. It takes time to learn in the beginning, but after you learn it, it becomes a part of your life. For example, you can do the Inner Smile while waiting in line. We spend a lot of time each day just waiting, and you can turn that time into practice time.

Many of our students study this system for a while and actually sleep less and eat less, so they end up having more time to do the practice. My knowledge and experience tell me that if people can put a 30-60 minute daily investment into their health each day, they will get 1-4 hours back and will be able to achieve more in less time. As a result, they will have more time to do more things.

V. Taoism in the Home

The Taoists do not regard differing characteristics or personal qualities of the husband and wife as the main sources of unhappiness in the family. The natural thing is for opposites to attract each other. The most important thing is to understand each other, look at each other's strong points, and help to overcome each other's weak points.

In order to understand the other person, you have to understand yourself first. The best way to understand yourself is to get in touch with your own organs through the inner system and senses. You can then strengthen the organs in order to transform negative energy and cultivate positive emotions and values.

Negative emotions are the main causes of energy imbalances in the body. The existence of negative energy in one family member will create negative emotions in other family members and disturb the energy balance in the entire family.

VI. Sexual Imbalances can be modified with Practice

Another factor in the breakdown of the family is an imbalance in the sex life of the married couple. Healthy vitality is a major source of sexual energy. The organs and glands are the main source of sexual energy, and therefore, healthy organs and glands will increase the happiness of a couple's sex life. A stressful life, pollution, and the vast regulations that govern life in our society rob people of their organ and sexual energies. They are left depressed, with their vitality and sexual energy depleted. This leads to psychological and marital problems. These problems can cause muscular weaknesses, such as impotence (inadequate erection) in men and lack of muscle tone in the sexual organs of women. For a couple, the question is how to increase and transform their sexual energies and therefore correct the physiological problems of the sexual organs. In this book we deal directly with strengthening the internal organs and senses.

VII. Peacefulness of Chi Energy

The balance of peaceful Chi energy in a person is very important because it can help to balance the Chi of another person who is close. Anything that is overly extreme will cause an imbalance of Chi energy and will destroy peacefulness. There are five types of peace necessary in a family:

Peace of mind,
Peace of the heart,
Peace of the body,
Peace of the organs, and
Peace of the senses.

Taoism says that too much noise will hurt the ears and their associated organs, including the kidneys and the bladder causing fear and disturbing the peace. Too much drinking or eating will hurt the spleen and indirectly, hurt the liver, which will result in anger and bad temper and will disturb the peace of the family. Too much looking at television or movies will hurt the eyes, which will hurt the liver and the gall bladder and cause a loss of energy, weakening the vitality of the entire body. Overexercising or overworking will hurt the tendons. Too much worry will hurt the nervous system.

Weakness of the organs or senses and nerves can cause certain types of unpleasant personal characteristics and bad habits which, in the long run, cause problems for the entire family. By understanding the sources of the problems and using the Inner Smile, Six Healing Sounds and the Tao Rejuvenation exercises and meditations together, the Chi energy imbalance and organ weakness can be treated. It is important to understand the problems and to use the Taoist practices to help family members get over them, in order to avoid larger disturbances. By practicing together, the energies of the family members are exchanged and balanced together as a family unit. When one of the family comes down with a sickness due to stress or negative emotional energy, other members of the family can help to balance that energy before further problems develop.

Chapter 2
Inner Smile

I. Benefits

A. Low Grade Energy vs. High Grade Energy

In Taoism we regard the negative emotions as low grade energy. Many people operate their lives in anger, sadness, depression, fear, worry, and other kinds of negative energy. These types of energy are bound to cause chronic disease and steal our major life force. The Inner Smile is the true smile for all parts of the body, including all the organs, glands, and muscles, as well as the nervous system. It will produce a high grade of energy that can heal and eventually be transformed into an even higher grade of energy. (Fig.2.1).

A genuine smile transmits loving energy, which has the power to warm and heal. Just recall a time when you were upset or physically ill and someone, perhaps a stranger, gave you a big smile—suddenly you felt better. Norman Cousins, former editor of The *Saturday Review*, writes in *Anatomy of an Illness* that he cured himself of a rare connective tissue disease by watching old Marx Brothers moves. One of my students cured herself of cancer of the breast by continually practicing the Inner Smile to the part that was sick.

In ancient China, the Taoist Masters recognized the power of smiling energy. They practiced an Inner Smile to themselves, which moved Chi energy and produced a high grade of Chi, and achieved health, happiness and longevity. Smiling to oneself is like basking in love, and love can repair and rejuvenate.

The Inner Smile directs smiling energy into our organs and glands, which are so vital to life. Ironically, although we often pay a great deal of attention to our outer appearance very few of us are aware of what the inner organs and glands look like, where they're located, or what their functions are. Worse yet, we are insensitive to the subtle warnings they send us when we mistreat them with poor diets and unhealthy life styles. We are like a boss who never pays any attention to his employees and is startled when things go wrong. If we're acquainted with our organs and glands, appreciate what they do, and learn to hear their messages, they will reward us with relaxation and vitality.

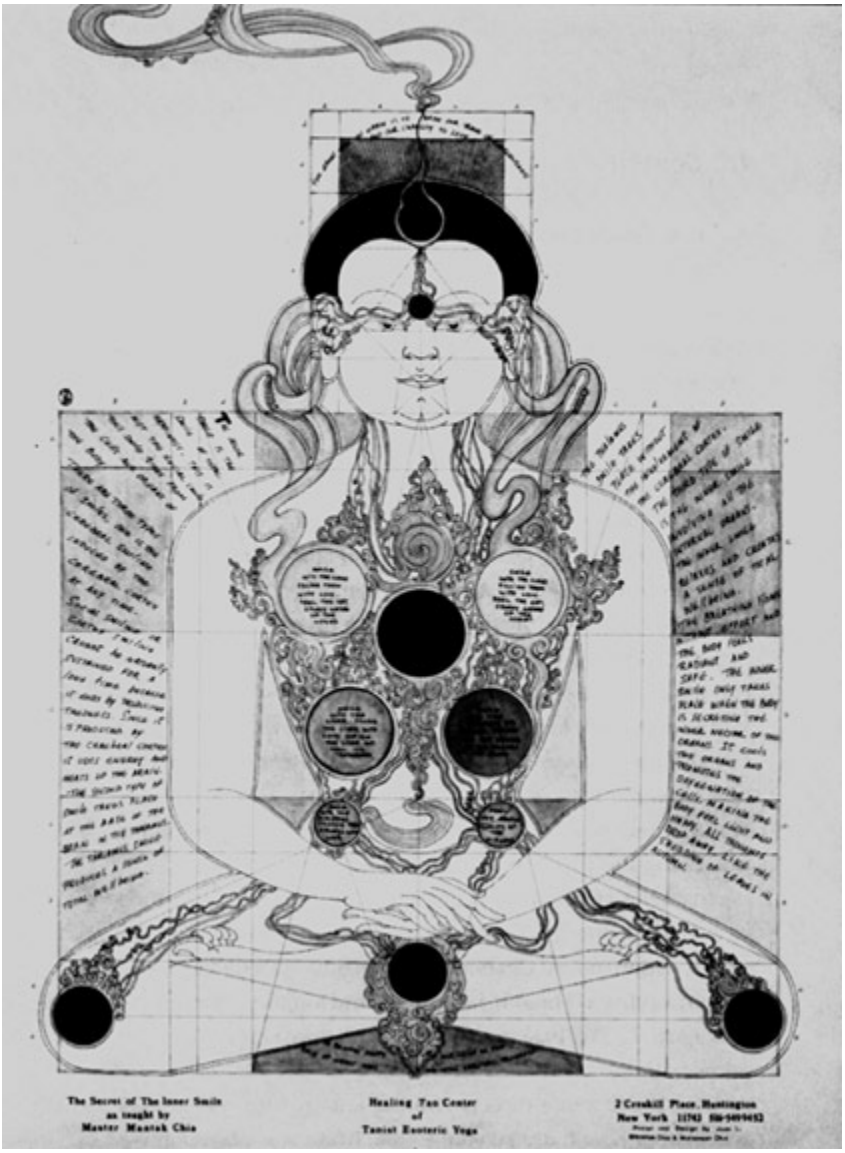

Fig. 2.1 *The Inner Smile will help you have more Chi energy and produces a high grade of Chi.*

B. Honey-like Secretion or Poisonous Secretion

The Inner Smile is most effective in counteracting the stresses of life. In our current society, we spend millions of dollars just to find a way to release stress. Often, these remedies provide only partial and temporary relief.

The Inner Smile has a close relationship with the thymus gland and will increase the activity of that gland. In the Taoist system, the thymus gland is the seat of greater enlightenment, the seat of love and the seat of the life force Chi energy. When we are under emotional stress, the thymus gland is the first to be affected. In the book *Your Body Doesn't Lie* by John Diamond, M.D., Dr. Diamond presents a study that shows that the thymus has a role as the master controller that directs the life-giving and healing energies of the body. The theory of cancer formulated by Sir MacFarlane Burnet, the Australian Nobel Prize winner, suggests that increasing the thymus gland's activity will result in a greater ability to ward off cancer. One type of cells produced by the thymus is T-cells. The function of the T-cells is to recognize abnormal cells and to destroy them. Of the billions of cells produced in the body each day, some will be abnormal. If Ihe T-cells are not activated by the thymus hormone, the abnormal cells will continue to proliferate and develop into clinical cancer. Hence, the thymus gland plays a critical role in the prevention of cancer throughout adult life.

In Applied Kinesiology, there is a way to test the strength or weakness of the thymus gland in which the Inner Smile will make an important difference. Have your partner try this test: Touch the thymus, located at the point where the second rib joins the breastbone below the throat. First have your partner not smile, but let the facial muscles drop and the corners of the mouth turn down. Have him keep one hand extended out to the side, while you press the hand down. Then, try it with your partner smiling and see the difference. This demonstrates that when you smile, you activate the thymus gland. (Fig. 2.2 and 2.3).

Taoist sages say that when you smile, your organs release a honey-like secretion which nourishes the whole body. When you are angry, fearful or under stress, they produce a poisonous secretion which blocks up the energy channels, settling in the organs and causing loss of appetite, indigestion, increased blood pressure, faster heart beat, insomnia and negative emotions.

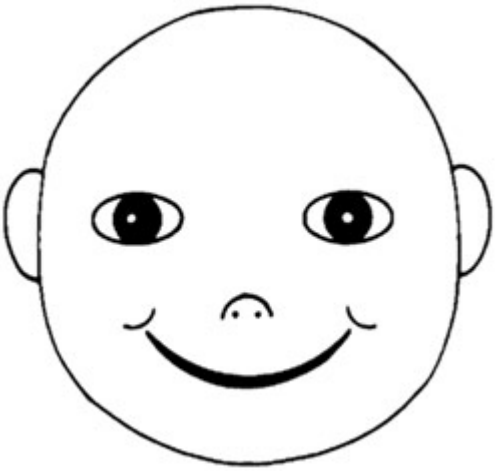

Fig. 2.2 *The expression in this picture will increase energy.*

Fig. 2.3 *The expression in this picture can affect your level of energy.*

Smiling into your organs also causes them to expand, become softer and moister and, therefore, more efficient. As a result, the liver, for example, has more room to store nutrients and detoxify harmful substances.

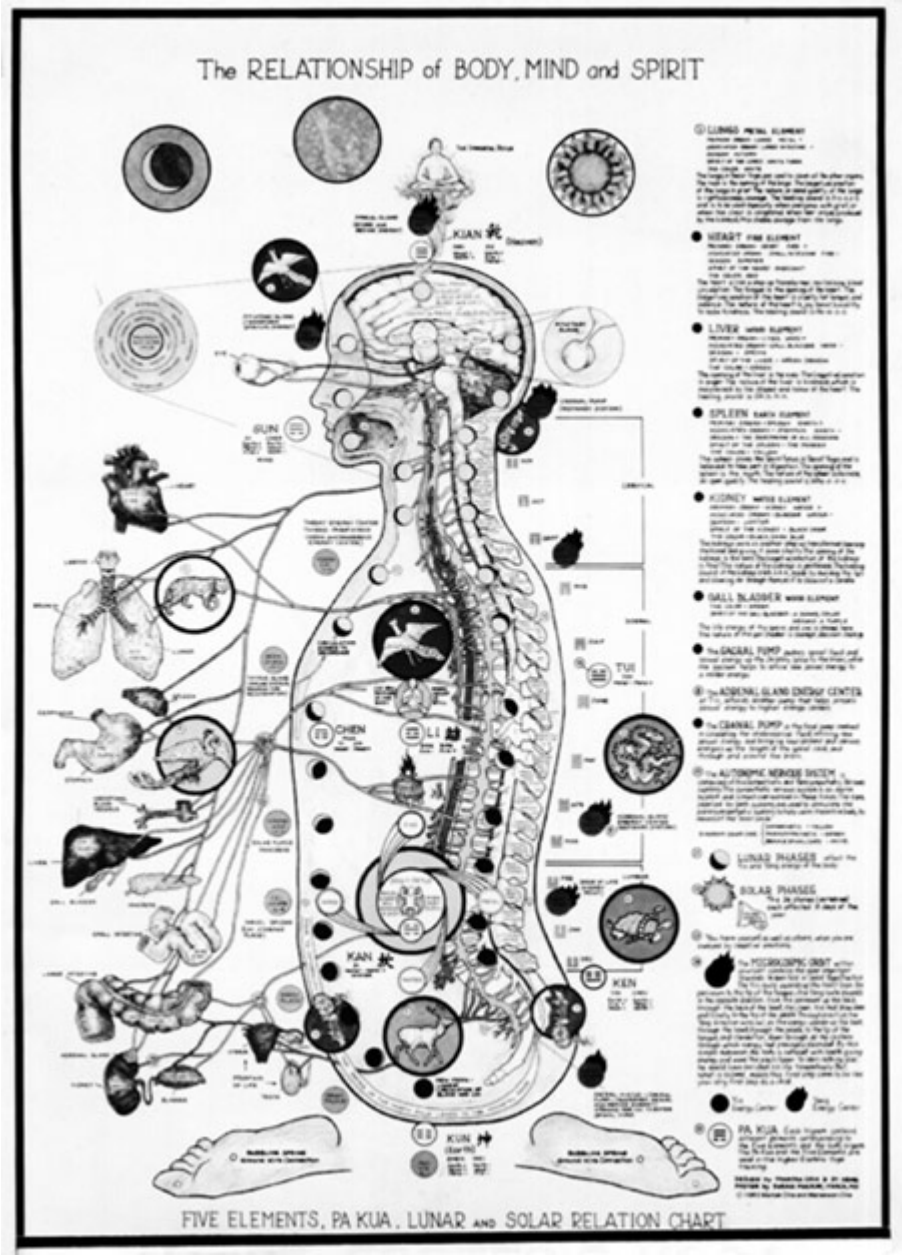

Fig. 2.4 *Eyes linked to autonomic nervous system can affect your level of energy.*

The practice of the Inner Smile begins in the eyes. They are linked to the autonomic nervous system, which regulates the action of the organs and glands. The eyes are the first to receive emotional signals and cause the organs and glands to accelerate at times of stress or danger (the “fight or flight” reaction) and to slow down when a crisis has passed. Ideally, the eyes maintain a calm and
balanced level of response. Therefore, by simply relaxing your eyes, you can relax your whole body and thus free your energy for the activity at hand. (Fig. 2.4).

C. Learning through the Inner Smile

When you are stressed, overly emotional or operating your life in anger or fear, your organs become obstructed and your performance levels are lowered. A lot of energy is eaten up, and you become dull, lacking alertness and playfulness. You are hindered in learning or developing new ideas, and if you try to force yourself to learn, the subject matter often will not remain in your mind and you will not be able to integrate it into yourself. In the Tao system, we believe that our organs, senses and parts of our bodies are involved in learning.

When you smile to your organs, senses and glands, you make a connection and have good communication with them.

When you are stressed or fearful, all the organs and senses are closed. For example, when you do not like someone, your body does not want to accept the person and, thus, is not able to accept that person’s teaching and ideas.

1. Main Sources of Auditory Energy

The main sources of auditory energy are the kidneys and their associated organ the bladder. For example, when the kidneys are functioning well you will be more alert and, thus, able to learn. The kidneys are connected to the openings of the ears. The auditory sense—hearing—is very important in learning. When the kidneys are strong, you will increase your auditory sharpness, which will enhance your learning.

The bladder helps in eliminating toxic fluids, which makes the blood cleaner and the fluids able to flow more freely. If the bladder is impaired, then the kidney functions will be affected.

2. Main Sources of the Power of Speech

The main sources of speech power are the heart and its associated organ, the small intestine. The heart provides the spirit for learning and is the seat of joy. Without eagerness or a spirit to learn, learning will be difficult. The secret of learning is joyfulness, fun and delight. When these are present your whole body will accept what you learn into itself. The heart is also the seat of respect and honesty. When you have respect, the heart is open. The tongue connects to the heart, and when that connection is open, you can start to accept and program your mind in bits and pieces, assimilating into order what you have learned.

The small intestine helps you assimilate. When the small intestine has a problem, the heart functions are affected. Many times, in order to learn new things, we need time to assimilate them into our systems.

3. Main Sources of Visual Energy

The main sources of visual energy are the liver and its associated organ, the gall bladder. When the liver is in good working order, you will be able to be more assertive, be able to make more decisions, and be able to integrate the things you learn. The opening for the liver is the eyes. When the liver is weak or sick, or you are under stress or are angry, you won't be able to make decisions and your vision will be impaired, making it difficult to program into your mind what you see and to integrate what you learn.

A healthy gall bladder helps you make decisions more easily, too.

4. Main Sources of Gestational Energy

The main sources of gestational energy are the spleen and stomach. The spleen gives the good sense of inclusiveness. It is the opening for the mouth and is involved with the sense of taste and in digesting what you learn.

The stomach is associated with the spleen. When the stomach is in good condition, you will be more receptive to new thoughts, ideas, and ways. Once you have accepted them as your own, you will be more willing to learn new things and more economic ways.

5. Main Sources of Olfactory and Kinesthetic Energies

The main sources of olfactory and kinesthetic energies are the lungs and the large intestine. The lungs are associated with good impulses, and their openings are the nose and skin. They are involved with kinesthetic feeling, the senses of the skin and the sense of touch and feeling, thereby increasing awareness of your surroundings and, so, tremendously increasing your ability to learn.

The large intestine is involved in elimination and release and makes you more open, physically and mentally. When you are constipated, you are more closed, not open to new ideas and not willing to change. Even though only a small step might be required to change, some students will not let go of old ways or ideas to succeed. The large intestine is the associate organ of the lungs and helps strengthen the lungs' functions.

6. Adrenal Glands' Energy gives you Enthusiasm to Learn

The adrenal gland gives you vitality and the hot energy, or Yang energy, of the kidney. It also energizes you and makes, you enthusiastic to learn. Without vitality you will feel lazy, sleepy and not eager to learn.

7. Thyroid and Parathyroid Glands help Power of Expression

The thyroid and parathyroid glands will help you increase your ability to express your opinions and your experiences so that all the senses can be involved in learning.

8. Thymus Gland helps Immune System

The thymus gland is the seat of energy, and it helps us in strengthening our immune systems. It creates energy in the form of enthusiasm and in this way gives you strength and energy to learn.

9. Sexual Organs' Energy increases Creative Power

The sexual organs are the seat of energy for creative power. When you have low sexual energy, you will be less creative and will be stuck in old, inefficient ways. When you know how to smile and increase your sexual energy, you will increase your power to solve problems in daily life.

10. Spine is Center of Communication

The spine is the center of control and the center of communication. Know how to smile down into your spine and relax it, and you will increase your communication powers; you will know how to communicate what you have learned through your spine into your organs and to accept new and more efficient ways into your system. The spine is also known as the controller of the networks.

11. Guidelines for Super-Learning

a. Smile throughout learning. Smile to the parts or organs that are resistant to new ideas. For example, if the heart is unwilling to be accepting and open, smile to it to release the joys and fun of learning. If the liver has too much anger, which shuts off vision, smile to it until it is open.

b. Let your hands, legs, head, chest, eyes, nose, mouth, ears, tongue, anus, etc. all be involved in learning by acting out. For example, if you are learning a new computer, let yourself act or imagine that you are a computer. Get inside and understand it; use your hands, eyes, ears, etc. and let them all be in contact with what you want to learn.

c. Smile to the senses and let them all open and feel light and happy to learn. Let them all be involved in learning. Start from vision; go through the auditory, olfactory, kinesthetic and gustatory senses. Imagine or involve what you are going to learn with your visual sense of what it looks like, with your auditory sense of how it will sound, with your olfactory sense of how it will smell, with your kinesthetic sense of how it will feel, and with your gustatory sense of how it will taste.

d. Use metaphors of your daily life that you know or use the most. For example, if you are a gardener or like flowers, you can connect the thing you know into gardening or flowers. Or if you are an animal lover, transform the things you learn into animals and the characteristics that are like the animals' characteristics.

e. Involve your total self in learning. Check out your whole system—your senses, your organs, your arms, your hands, etc. They are willing to learn and recognize what they don't want to learn. Smile to them; tell them you love them and want them to get involved.

D. Personal Power through the Inner Smile

1. The smile is the most powerful energy of personal power. The true inner smile from your organs will make all the organs contribute their own power to generate and streamline out to your senses, especially the eyes. The eyes connect to all the organs and senses. Once you know how, you can get power to all the organs.

Imagine we have 63 trillion cells. Each cell gives out a very small amount of energy. Multiplied by 63 trillion cells, the energy is tremendous. When you are relaxed and calm and you smile, you can maintain energy at its peak performance and always be ready to take action. The level of energy is always the main clue.

2. When your level of energy increases, you will have more energy to increase your skills, you will have more flexibility of action, and you will know better what you want and how to get it—i.e. specificity.

3. Smile to the sexual organs. The higher the level of sexual energy that you have, the more personal power you will have. When sexual power decreases, personal power decreases, too. Practice how to conserve and increase sexual energy by recycling it. Foods or drugs that claim to increase sexual power are not going to last long, if at all, and cannot increase energy or be effective in the long run. Knowing how to cultivate sexual energy is one of the main sources of power.

II. Preparation for the Inner Smile

A. Wait at least an hour after eating to begin the practice.

B. Choose a quiet spot. It might help in the beginning to disconnect the phone. Later on, you will be able to practice almost anywhere with any noise, but for now you need to eliminate distractions in order to develop your inner focus.

C. Dress warmly· enough so as not to be chilled. Wear loose fitting clothes and loosen your belt. Remove your glasses and watch.

D. Sit comfortably on your “sitting bones” at the edge of a chair. The genitals should be unsupported because they are an important energy center. This means if you are a man, the scrotal sac hangs free of the edge of the chair. If you are a woman practicing nude, you should cover your genitals with cloth to ensure no energy loss through them.

Incorrect Sitting Position

Correct Sitting Position

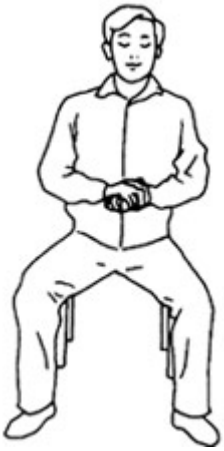

The back should be straight.
Fig. 2.5 *Sitting Posture*

E. The legs should be a hips' width apart and the feet should be solidly on the floor.

F. Sit comfortably erect with your shoulders relaxed and your chin slightly in.

G. Place your hands comfortably on your lap, the right palm on top of the left. You may find it easier for the back and shoulders to raise the level of your hands by placing a pillow under them. (Fig. 2.6)

Fig. 2.6 *Close the circuits in the hands, with the left hand on the bottom and the right hand on the top.*

H. Breathe normally. Close your eyes. While concentrating, the breath should be soft, long and smooth. After a while you can forget about your breath. Attention to breath will only distract the mind, which must focus on drawing energy to the desired points, There are thousands of esoteric breathing methods; you might spend your whole life mastering them and acquire no lasting energy.

I. Position of the tongue: The tongue is the bridge between the two channels. Its function is to govern and connect the energies of the thymus gland and pituitary gland, and it can balance the left and right brain energies. There are three positions for the tongue. For the beginning, place the tongue where it is most comfortable. If it is uncomfortable to place the tongue on the palate, place it near the teeth. (Fig. 2.7).

Fig. 2.7 *Tongue Position*

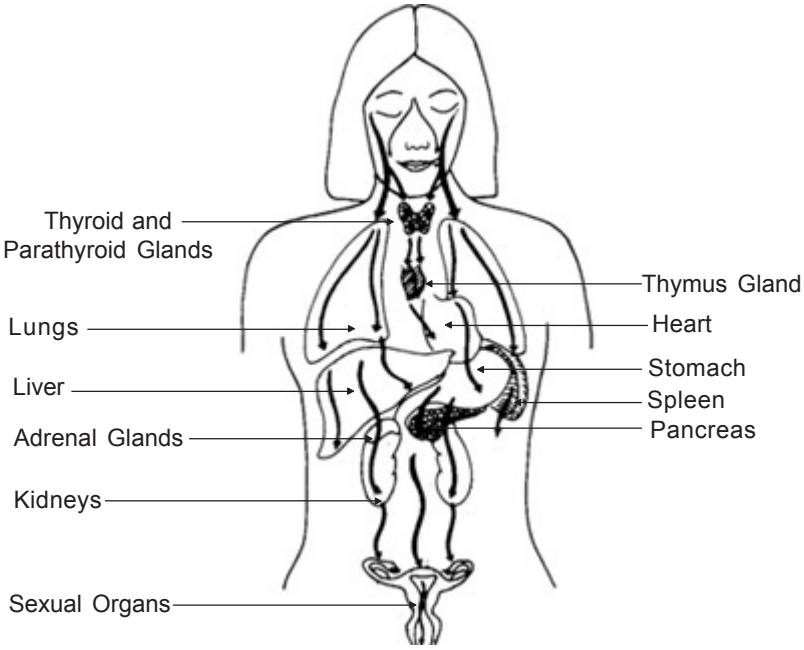

Fig. 2.8 *Front Line Smile: Major Vital Organs*

III. Practice

A. Smiling Down to the Organs—the Front Line

1. Relax your forehead. You can imagine meeting someone you love or seeing a beautiful sight. Feel that smiling energy in your eyes.

2. Then allow that smiling energy to flow to the midpoint between your eyebrows. Let it flow into the nose, then the cheeks. Feel it relaxing the facial skin, then going deep inside the face muscles; feel it warming your whole face. Let it flow into the mouth, and slightly lift up the corners of the mouth. Let it flow into the tongue. Float the tip of the tongue. Put your tongue up to the roof of the mouth and leave it there for the rest of the practice; this connects the two major channels of energy, the Governor and the Functional. Bring the smiling energy to the jaw. Feel the jaw releasing the tension that is commonly held there.

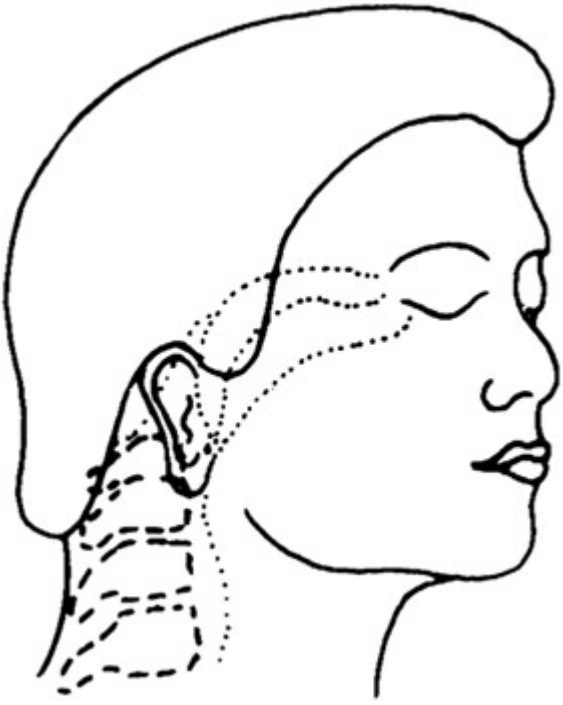

Fig. 2.9 *The neck is a major thoroughfare for most of the body's systems.*

3. Smile into your neck and throat, also common areas of tension. Although the neck is narrow, it is a major thoroughfare for most of the systems of the body. Air, food, blood, hormones, and signals from the nervous system all travel up und down the neck. (Fig. 2.9). When we are stressed, the systems are overworked; the neck is jammed with activity, and we get a stiff neck. Be like the Taoist Masters and think of your neck as a turtle's neck—let it sink down into its shell and let it rest from the burden of holding up your heavy head (Fig. 2.10). Smile into your neck and feel the energy opening your throat and melting away the tension.

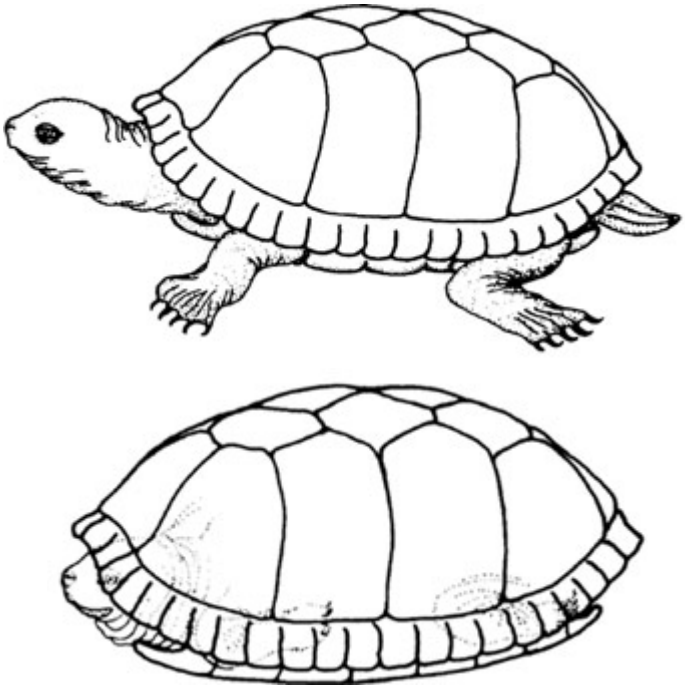

Fig. 2.10 *Think of your neck as a turtle's neck.*

4. Smile into the front part of your neck where the thyroid and parathyroid glands are. This is the seat of your power to speak and when it is stuck, Chi cannot flow. When it is tense and held back, you cannot express yourself. You will be frightened in front of a crowd, cowardly, and communications will break down. Smile down to the thyroid gland and feel the throat open, like a flower blossom. (Fig. 2.11)

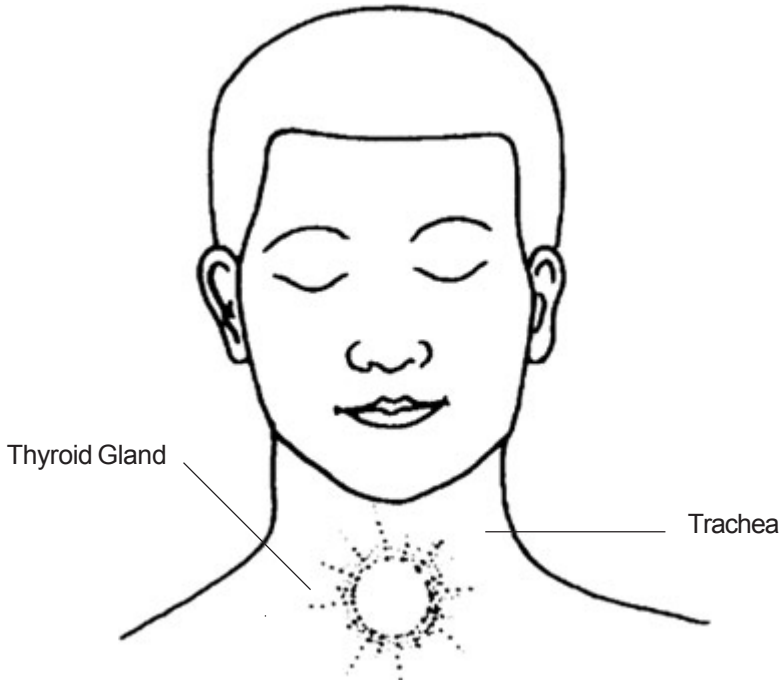

Fig. 2.11 *The throat is the seat of your power to speak.*

5. Let the energy of the smile flow down to the thymus gland, the seat of love, the seat of fire, the seat of Chi, and the seat of healing energy. Smile down into it, feel it start to soften and moisten. Feel it grow bigger, like a bulb, and gradually blossom. Feel the fragrance of warm energy and healing Chi flow out and down to the heart. (Fig. 2.12)

6. Let the smiling energy flow into your heart, which is the size of a fist and is located a little to the left of the center of the chest. The heart is the seat of love, the seat of compassion, the seat of honest respect and the seat of joy. Feel the heart, like a bulb, gradually blossom and send the fragrant warmth of Chi love, joy and compassion radiating throughout all the organs from the pumping of the heart. Let the smile energy fill your heart with joy. Thank your heart for its constant and essential work in pumping blood at the right pressure to circulate throughout your body. Feel it open and relax as it works more easily. (Fig. 2.13)

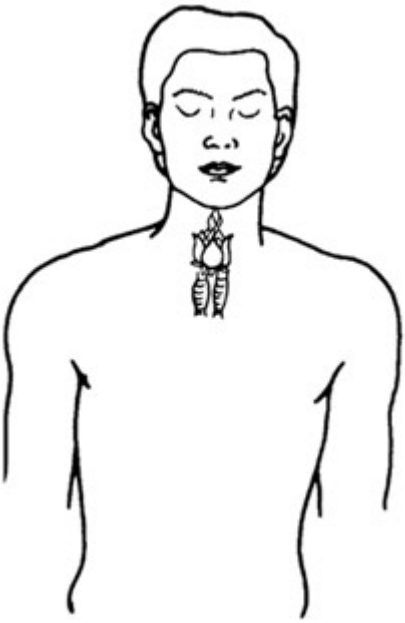

Fig. 2.12 *Feel the thymus gland gradually blossom.*

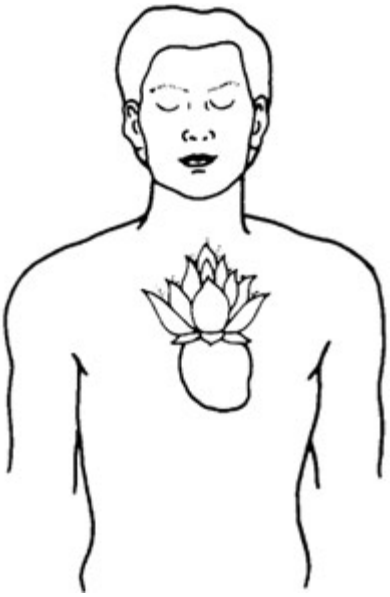

Fig. 2.13 *The heart is the seat of joy;*
feel it gradually open like a bulb.

7. Bring the smile and joyful energy from the heart to the lungs. Smile into every cell of your lungs. Thank your lungs for their wonderful work in supplying oxygen to the body and releasing carbon dioxide. Feel them soften and become spongier, moister. Feel them tingling with energy.

Smile into the lungs deep inside and smile your sadness and depression away. Fill the lungs with the fragrance of righteousness that is induced by the love, compassion and joy from the heart. Let the smile energy of joy, love and righteousness flow down to the liver.

8. Smile into your liver, the large organ located mainly on the right side at the bottom of the rib cage. Thank it for its marvelously complex part in digestion—processing, storing and releasing nutrients—and its work in detoxifying harmful substances. Feel it soften and grow moister.

Smile again and get deep into the liver. See any anger and hot temper lying in the liver. Smile them away and let the joyfulness, loveliness, righteousness and warm Chi induce the nature of the liver—kindness—to flow until it is full and overflows out to the kidneys and adrenal glands.

9. Bring the smiling energy into your kidneys, just inside the lower part of your rib cage in the back on either side of the spine. Thank them for their work in filtering the blood, excreting waste products and maintaining water balance. Feel them grow cooler, fresher, and cleaner. Smile into your adrenals, on top of your kidney's these produce adrenalin for "fight or flight" situations and several other hormones. Your adrenals may thank you by giving you a little extra shot of energy.

Smile again and get deep into the kidneys. See and feel if there is any fear lying inside the kidneys. Smile with the warmth of joy, love, and kindness, and melt your fears away. Let the nature of the kidneys—gentleness—come out and fill them until they overflow to the pancreas and spleen.

10. Smile into your pancreas and spleen. First smile into your pancreas, which is located at the center and to the left at and above waist level. Thank it for producing insulin to regulate your blood sugar level and enzymes for digestion. Then smile to the spleen,

which is at the bottom and left side of the rib cage. Thank it for producing antibodies against certain diseases. Feel it grow softer and fuller.

Smile again into the spleen and pancreas; feel and see deep inside if there is any worry hidden; let the warmth of joy, love, righteousness, kindness, and gentleness melt your worries away. Smile into the virtue of the spleen—fairness—bring it out and let it grow downward to the bladder and sexual region.

11. Bring the smiling energy down to the genital area in the lower abdomen. For women this is called the "ovarian palace" and is located about three inches below the navel midway between the ovaries. Smile into the ovaries, the uterus and the vagina.

For men this is called the "sperm palace" and is located one and a half inches above the base of the penis in the area of the prostate gland and seminal vesicles. Smile down to the prostate gland and the testicles. Thank them for making hormones and giving you sexual energy.

Let love, joy, kindness and gentleness flow into the genital organs so you can have power to overcome and eliminate uncontrollable sexual desires. You are the one who controls your sex drive; it does not control you. Thank your genitals for their work in making you the sex that you are. Sexual energy is the basic energy of life.

12. Return to your eyes again. Quickly smile down into all the organs in the Front Line, checking each one for any remaining tension. Smile into the tension until it is released.

B. Smiling Down the Digestive System—the Middle Line

1. Become aware once more of the smiling energy in your eyes. Let it flow down to your mouth. Become aware of your tongue, and make some saliva by working your mouth and swishing your tongue around. Put the tip of your tongue to the roof of the mouth, tighten the neck muscles, and swallow the saliva hard and quickly, making a gulping sound as you do. With your Inner Smile, follow the saliva down the esophagus to the stomach, located at the bottom and below the left side of the rib cage. Thank it for its important work in liquefying and digesting your food. Feel it grow calm and comfortable. Sometimes we abuse our stomachs with improper food. Make a promise to your stomach that you will give it good food to digest.

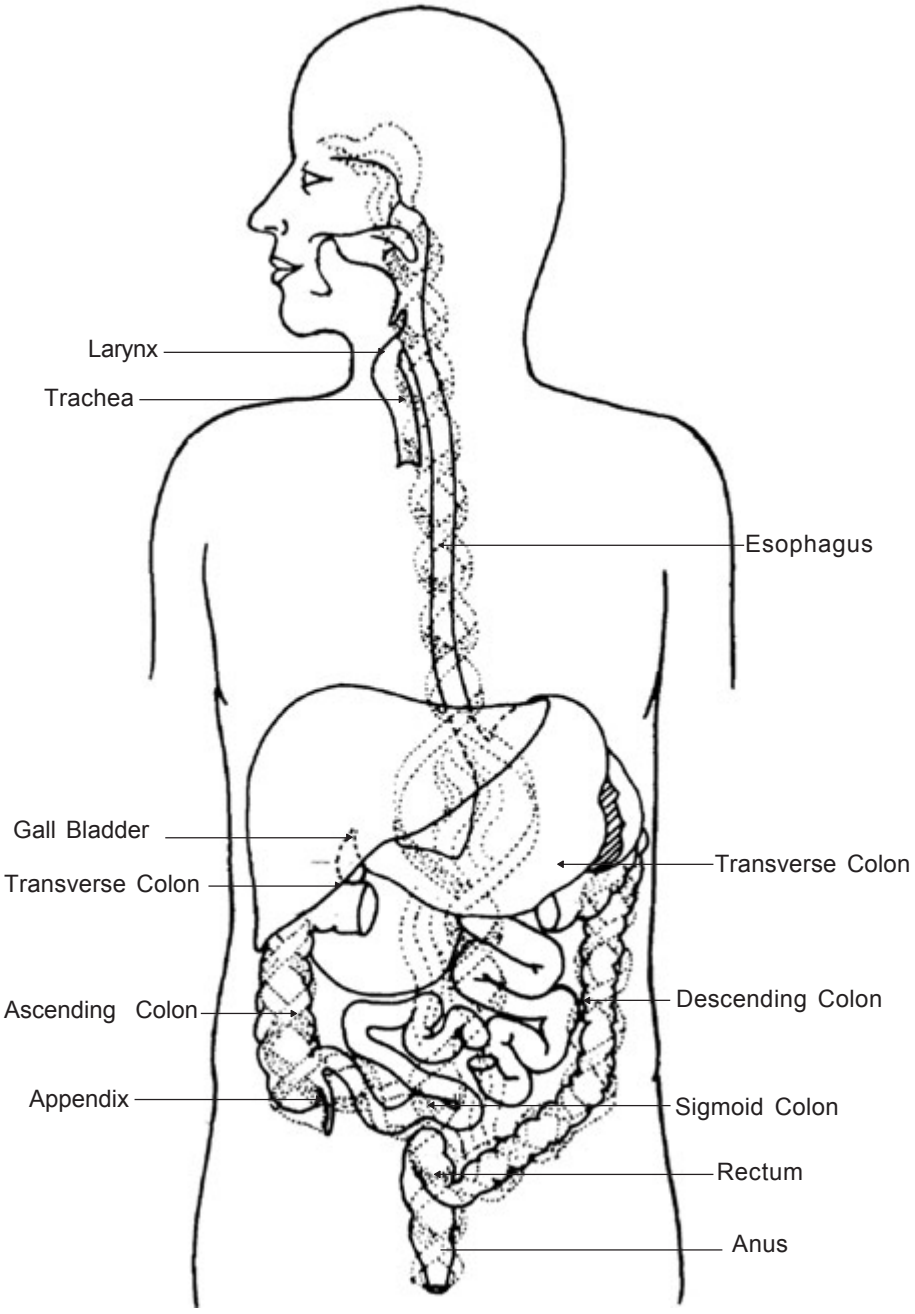

Fig. 2.14 *Smile down to the digestive system.*

2. Smile into the small intestine: the duodenum, the jejunum, and the ileum, in the middle of the abdomen. It is about seven meters long in an adult. Thank it for absorbing food nutrients to keep you vital and healthy.

3. Smile into the large intestine: the ascending colon, starting at the right side of the hipbone and passing upward to the undersurface of the right lobe of the liver; the transverse colon, which passes downward from the right liver region across the abdomen to the left beneath the lower end of the spleen; the descending colon, which passes downward through the left side of the lumbar region; and the sigmoid colon, which normally lies within the pelvis, the rectum and the anus. The large intestine is about 1.5 meters long. Thank it for eliminating wastes and for making you feel clean, fresh and open. Smile to it and feel it be warm, nice, clean, comfortable and calm.

4. Return to your eyes. Quickly smile down the Middle Line, checking for tension. Smile into the tension until it melts away.

C. Smiling Down the Spine-the Back Line (Fig. 2.18)

1. Bring your attention back to your eyes again.

2. Smile inward with both eyes; collect the power of the smile in the third eye (mideyebrow). With your inner eyesight direct your smile about three to four inches inside into the pituitary gland, and feel the gland blossom. Direct the smile with the eyes into the third ventricle (third room, the power room of the nervous system, highly magnified). Feel the room expand and grow with bright, golden light, shining throughout the brain. Smile into the thalamus, from where the truth and power of the smile will generate. Smile into the pineal gland and feel this tiny gland gradually swell and grow like a bulb. Move your smile's eyesight, like a bright, shining light, up to the left side of the brain. Move the inner smiling eyesight back and forth in the left brain and across to the right brain and cerebellum. This will balance the left and right brain and strengthen the nerves. (Fig. 2.15, 2.16, and 2.17)

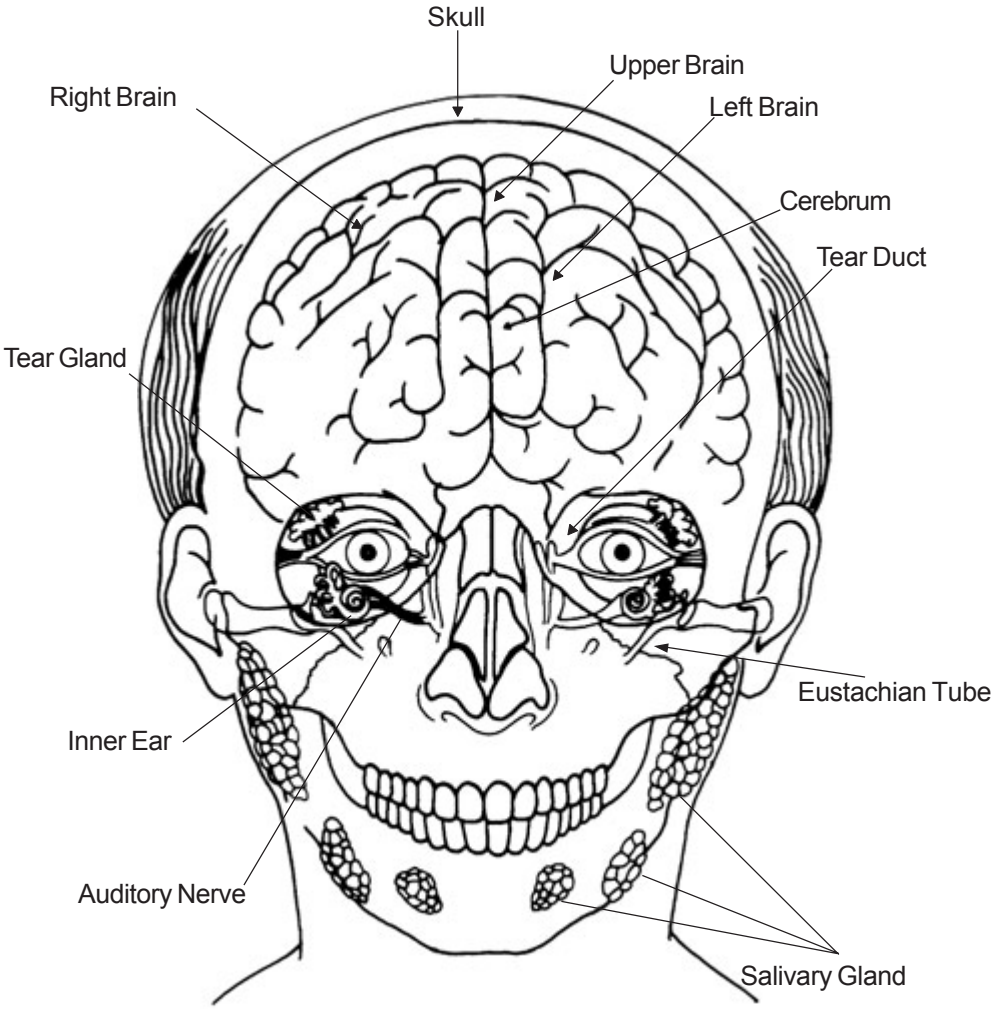

Fig. 2.15 *Parts of the Brain and Head*

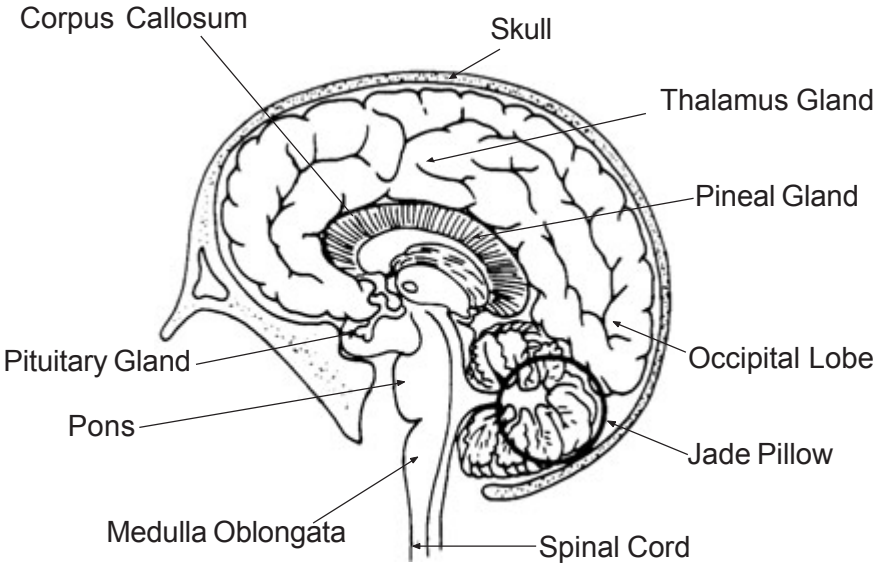

Fig. 2.16 *Side View of Mid-Brain Cross Section*

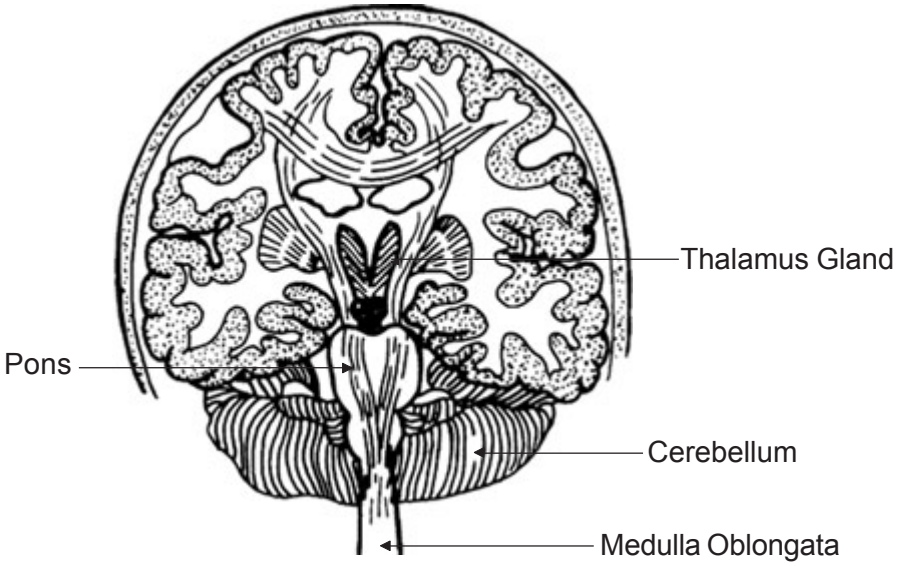

Fig. 2.17 *Frontal View of Mid-Brain Cross Section*

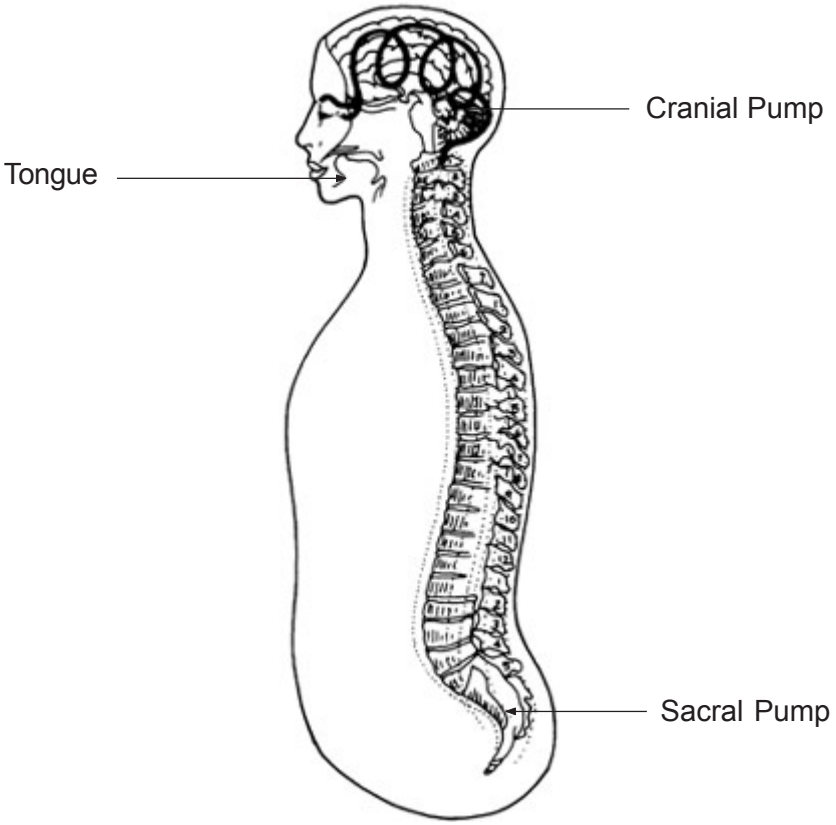

Fig. 2.18 *Side View of Mid-Brain Cross Section*

3. Move the inner smiling eyesight down to the midbrain. Feel it expand and soften and go down to the pons and oblongata (see illustrations) and to the spinal cord, starting from the cervical vetebra at the base of the skull. Move the inner smiling eyesight, bringing this loving energy down inside each vertebra and the disc below it. Count out each vertebra and disc as you smile down them: seven cervical (neck) vertebrae, twelve thoracic (chest), five lumbar (lower back), the triangular bone called the sacrum, and the coccyx (tail bone). Feel the spinal cord and the back becoming loose and comfortable. Feel the discs softening. Feel your spine expanding and elongating, making you taller.

4. Return to your eyes and quickly smile down the entire Back Line. Your whole body should feel relaxed, The Back Line exercise increases the flow of the spinal fluid and sedates the nervous system. Smiling into a disc keeps it from hardening and becoming deformed so it cannot properly absorb the force and weight of the body. Back pain can be prevented or relieved by smiling into the spine.

D. Smiling Down the Entire Length of your Body

Start at the eyes again. Direct your Inner Smile's eyesight. Quickly smile down the Front Line. Follow the smiling down the Middle Line and then the Back Line. When you are more experienced, smile down all three lines simultaneously, being aware of the organs and the spine.

Now, feel the energy descend down the entire length of your body, like a waterfall—a waterfall of smiles, joy and love. Feel your whole body being loved and appreciated. How marvelous it is!

E. Collecting the Smiling Energy at the Navel

1. It's very important to end by storing the smiling energy in the navel. Most ill effects of meditation are caused by excess energy in the head or heart. The navel area can safely handle the increased energy generated by the Inner Smile. (Fig. 2.19 and 2.20)

2. To collect the smile's energy, concentrate in your navel area, which is about one and a half inches inside your body. Then mentally move that energy in an outward spiral around your navel 36 times; don't go above the diaphragm or below the pubic bone. Women,
start the spiral counterclockwise. Men, start the spiral clockwise. Next, reverse the direction of the spiral and bring it back into the navel, circling it 24 times. Use your finger as a guide the first few times. The energy is now safely stored in your navel, available to you whenever you need it and for whatever part of your body needs it. You have now completed the Inner Smile.

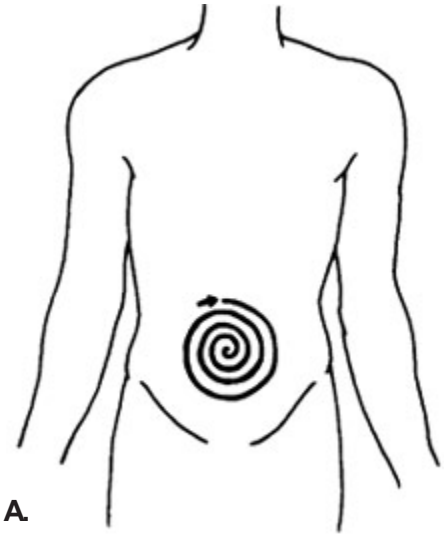

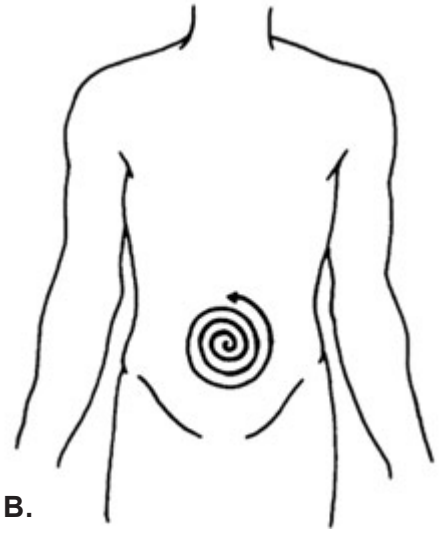

A. Collect the energy in the navel, circling it 36 times clockwise and
B. 24 times counterclockwise.

Fig. 2.19 *Collecting smiling energy at the navel for men.*

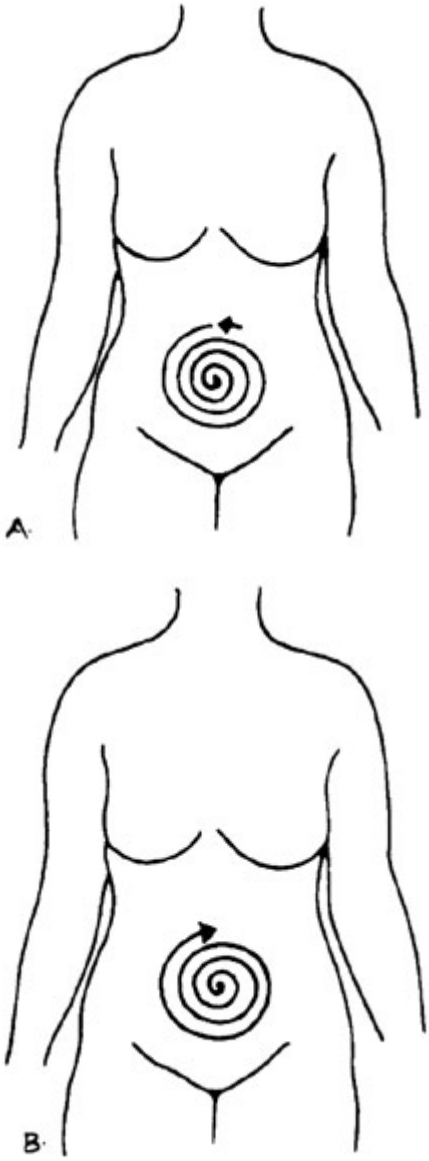

A. Collect the energy in the navel, circling it 36 times counterclockwise and B. 24 times clockwise.

Fig. 2.20 *Collecting smiling energy in the navel for women.*

F. Daily Use

Try to practice the Inner Smile every day as soon as you wake up. It will improve your whole day. If you love your own body, you will be more loving to others and more effective in your work. Once you have learned it and practiced it regularly you can, if you are short of time, do it more rapidly, in a few minutes.

G. Smile the Negative Emotions Away

Practice it also at times of stress, anger, fear, or depression. Smile down into the part that feels tension and strain, and gradually see the negative energy transform into positive vital life force energy. These draining, negative emotions will be turned into positive energy and vitality. Smile the emotions away. The smile's energy can change emotional energy into vital energy—provided you smile enough into the emotions—such as anger, stress, fear, and impatience.

H. Smile Pain and Sickness Away

If you feel pain and uneasiness in any part of your body, or feel sick in any part of the organs, keep on smiling to these parts; spend more time smiling to these parts, talk to them, get feedback from them, until you feel them get softer or more open or their color changes from dark to bright.

Chapter 3
Microcosmic Orbit Meditation

I. Circulate your Chi in the Microcosmic Orbit

The Inner Smile, the Six Healing Sounds and Tao Rejuvenation will gradually increase your life force energy by transforming stress into vitality. To use this energy efficiently and safely for further healing and growth, it must be circulated through specific pathways in your body.

It is much easier to cultivate your energy if you first understand the major paths of energy circulation in the body. The nervous system in humans is very complex and is capable of directing energy wherever it is needed. The ancient Taoist Masters discovered there are two energy channels that carry an especially strong current.

One channel is called the “Functional” or “Yin” Channel. It begins at the base of the trunk, midway between a man’s testicles or a woman’s vagina and the anus at a point called the perineum. It goes up the front of the body past the sex organ, stomach, organs, heart and throat and ends at the tip of the tongue. The second channel, called the “Governor” or “Yang” channel, starts in the same place but goes up the back of the body. It flows from the perineum upwards into the tailbone and then up through the spine into the brain and back down to the roof of the mouth.

The tongue is like a switch that connects these two currents—when it is touched to the roof of the mouth just behind the front teeth, the energy can flow in a circle up the spine and back down the front. The two channels form a single circuit that the energy loops around. This vital current circulates past the major organs and nervous systems of the body, giving cells the juice they need to grow, heal, and function. This circulating energy, known as the Microcosmic Orbit, forms the basis of acupuncture. Western medical research has already acknowledged acupuncture as being clinically effective, although scientists admit they cannot explain

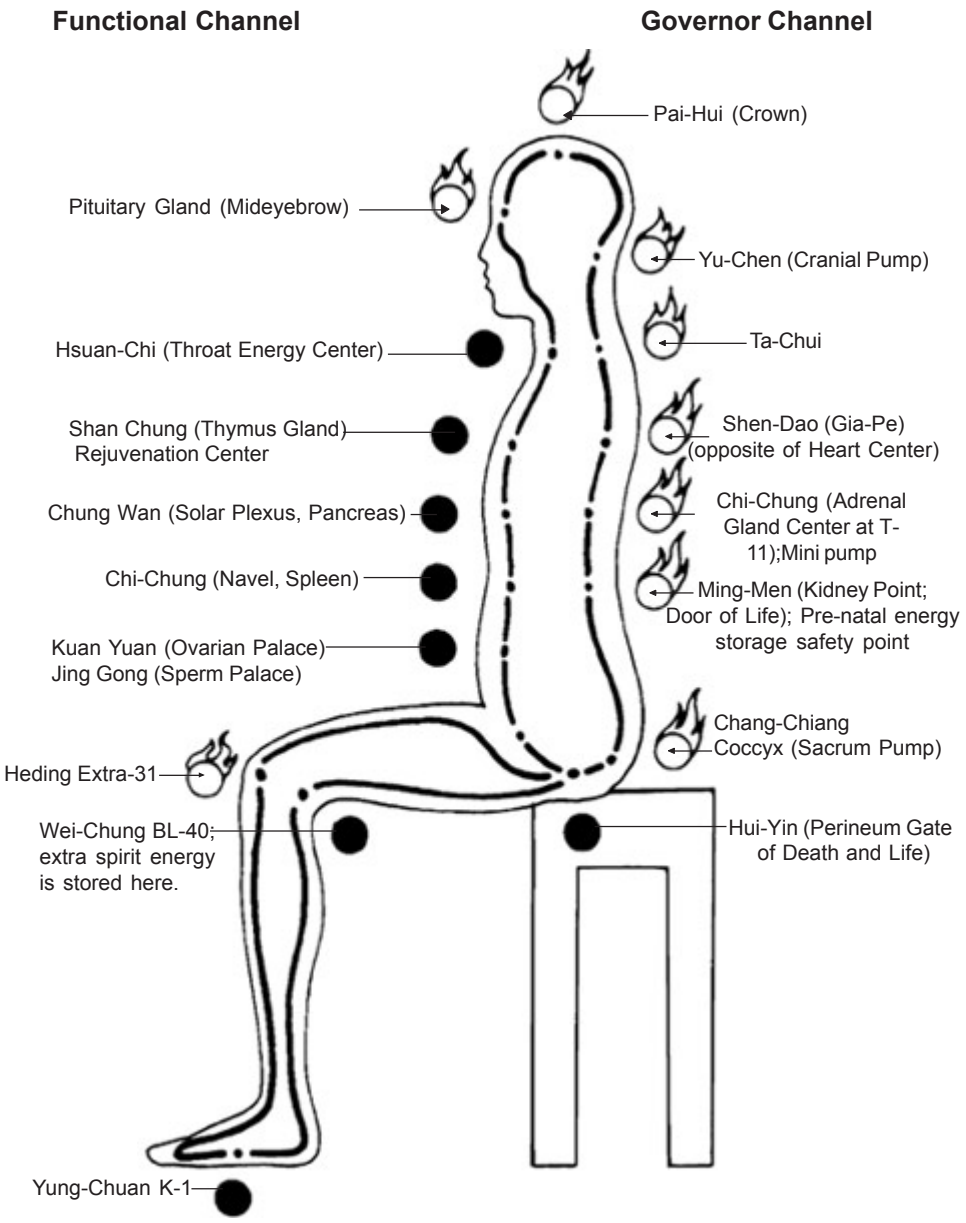

Fig. 3.1 *Learn to circulate your Chi in the Microcosmic Orbit to assist in counteracting stress. The tongue touches the roof of the palate to complete the circuit of the Governor and Functional Channels.*

why the system works. The Taoists, on the other hand, have been studying the subtle energy points in the body for thousands of years and have verified in detail the importance of each channel. (Fig. 3.1)

It is this loop of energy about the body which also carries the organ energy and smiling energy and spreads vitality to other parts of the body.

II. Importance of the Microcosmic Orbit

By opening up this microcosmic channel and keeping it clear of physical or mental blockages, it is possible to pump the life force energy up the spine. If this channel is blocked by tension, then learning to circulate the Microcosmic Orbit is an important step to opening up the blockages in the body to circulate and revitalize all parts of the mind and body. Otherwise, when intense pressure builds in the head, much of it escapes out the eyes, ears, nose and mouth and is lost. This is like trying to heat a room while all the windows are open—you're going to have a very high fuel bill.

The way to open the microcosmic energy channel is by sitting in meditation for a few minutes each morning after you do the smile. Allow your energy to complete the loop by letting your mind flow along with it. Start in the eyes, and mentally circulate with the energy as it goes down the front through your tongue, throat, chest and navel and then up the tailbone and spine to the head.

At first it will feel like nothing is happening, but eventually the current will begin to feel warm in some places as it loops around. The key is simply to relax and try to bring your mind directly into the part of the loop being focused on. This is different from visualizing an image inside your head of what that part of the body looks like or is feeling. Do not use your mind as if it were a television picture. Experience the actual Chi flow. Relax and let your mind flow with the Chi in the physical body along a natural circuit to any desired point, e.g. your navel, perineum, etc.

Study of the Microcosmic Orbit is highly recommended to all students who want to better master the transforming of stress and who seek to truly master the techniques taught here. Progress to the higher levels of transforming emotional energy, without first learn-

ing the Microcosmic Orbit, is very difficult. Some people may already be “open” in these channels or relaxed when they are close to nature. The benefits of the Microcosmic Orbit extend beyond facilitating the flow of life force energy and include prevention of aging and the healing of many illnesses, ranging from high blood pressure, insomnia and headaches to arthritis.

Chapter 4
Six Healing Sounds

I. Benefits and Theory

Thousands of years ago the Taoist Masters discovered in their meditations the six sounds which were the correct frequencies to keep the organs in optimal condition by preventing and alleviating illness. They discovered that a healthy organ vibrates at a particular frequency. To accompany the Six Healing Sounds, six accompanying postures were developed to activate the acupuncture meridians, or energy channels, of the organs. (Fig. 4.1)

A. Overheating of the Organs

What causes an organ to malfunction? There are many causes. Urban society creates a life full of physical and emotional stresses such as overcrowding, pollution, radiation, junk food, chemical additives, anxiety, loneliness, bad posture, and sudden or overly vigorous exercise. Separately and together, these stresses produce tension and start to block the free passage of energy flow in the body and, thus the organs overheat. In addition, the concrete jungle that we live in lacks the safety valves provided by nature: trees, open spaces, and running water, which give forth a cooling, purifying energy. Continued overheating causes an organ to contract and harden. This impairs its ability to function and results in illness. One of the surgeons working with The Universal Tao Center in New York reports that the hearts of patients who have died of heart attacks look as if they've been cooked! And the ancient Taoists have a saying: "Stress cooks your brain". (Fig. 4.2 and 4.3)

B. Cooling System of the Organs

Chinese medicine teaches that each organ is surrounded by a sac or membrane, called fascia, which regulates its temperature. Ideally, the membrane releases excess heat out through the skin, where it is exchanged for cool life force energy from nature. An overload of physical or emotional tension causes the membrane, or fascia, to stick to the organ so that it cannot properly release heat to the skin nor absorb cool energy from the skin.

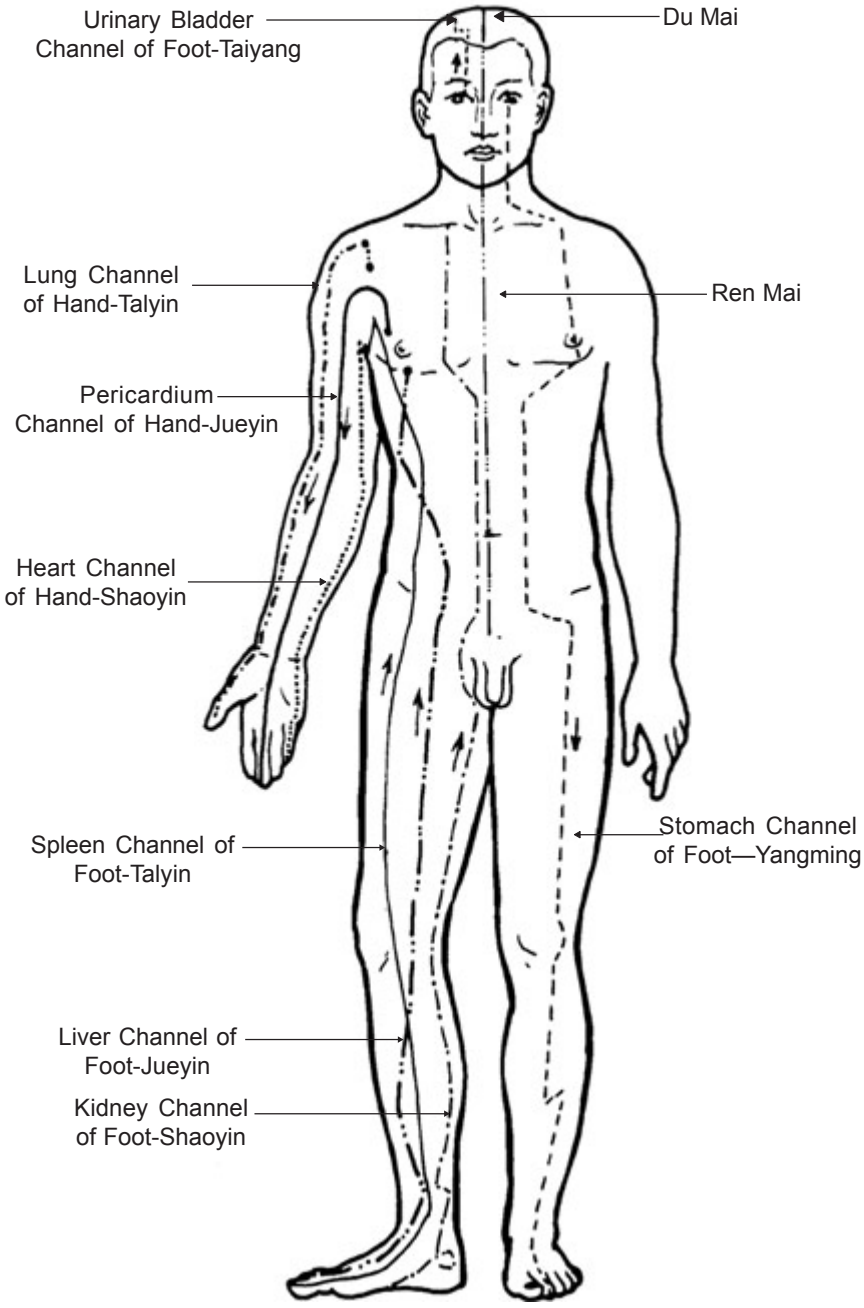

Fig. 4.1 *Distribution of Fourteen Channels—Anterior View*

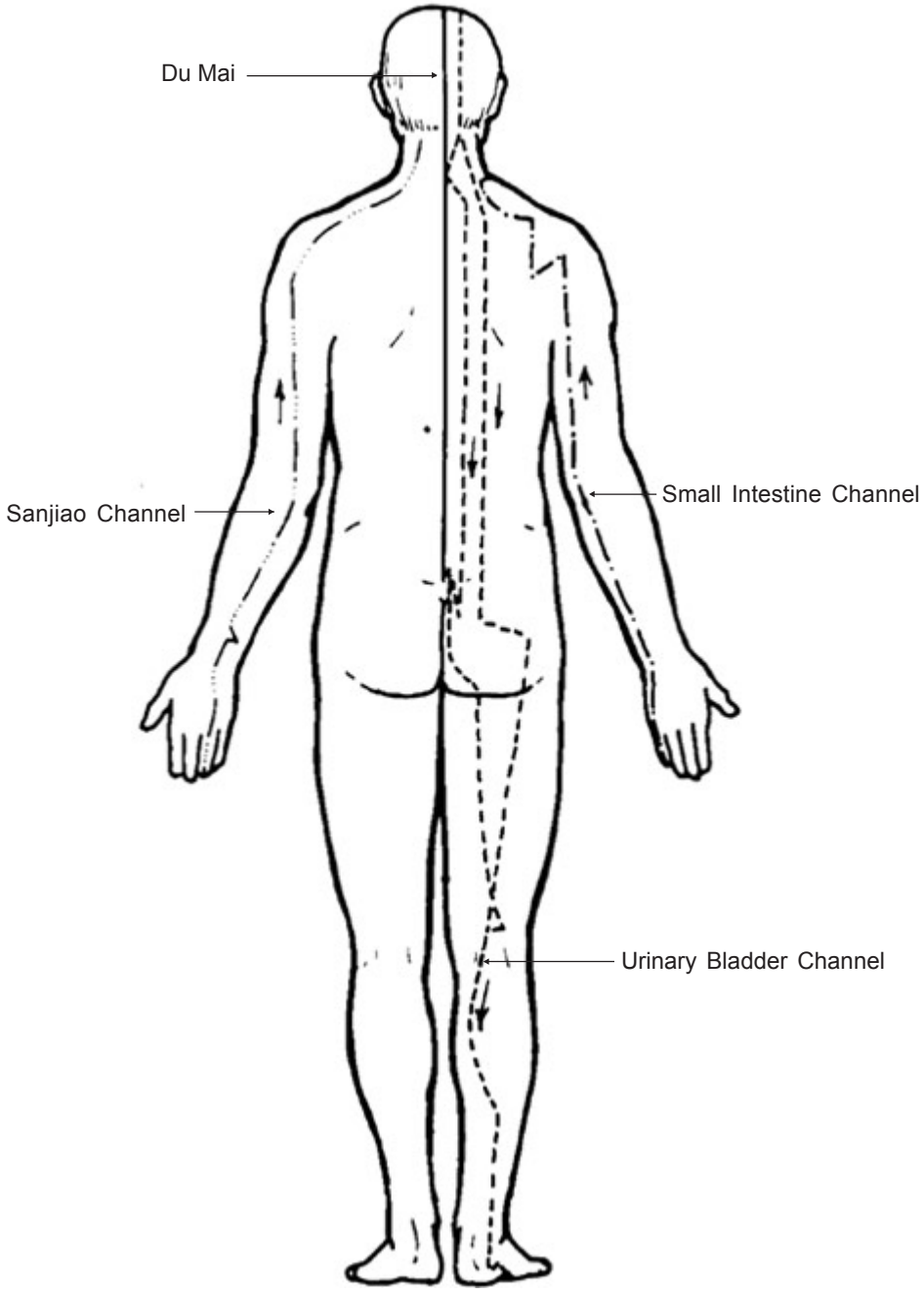

Exterior View

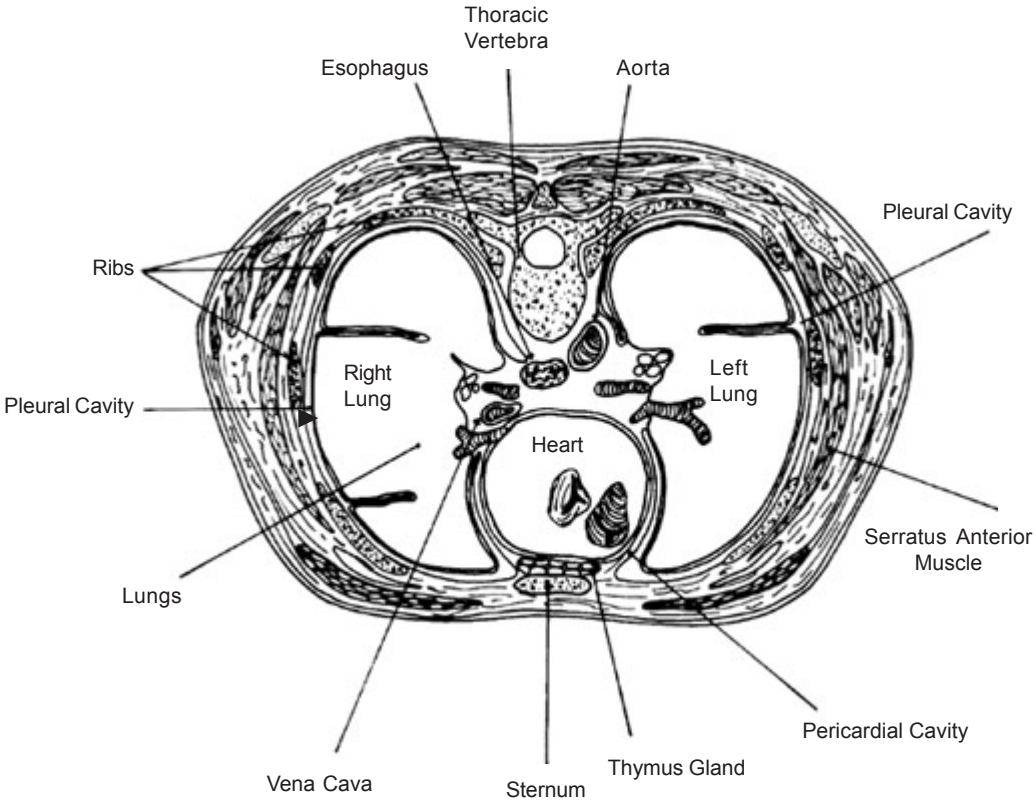

Fig. 4.2 *Cross Section of the Thorax*

The skin becomes clogged with toxins and the organ overheats. The Six Healing Sounds speed up the heat exchange through the digestive system and the mouth. The digestive system is more than 20 feet long and runs from the mouth to the anus as one pipe in the middle of the body in between all the organs. It helps release excess heat from the fascia, cooling and cleansing the organs and skin.

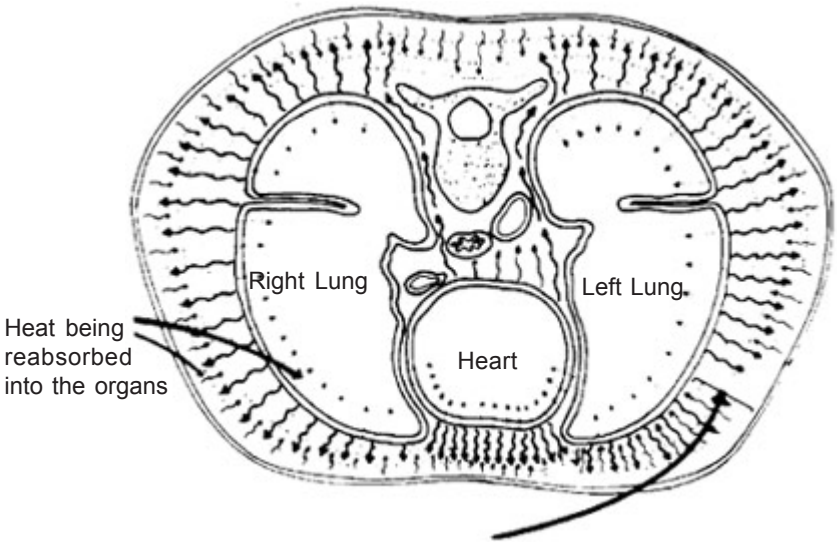

Toxic deposits on tissues and muscles block the free passage of heat generated by the organs. The heat is reflected back into the organs, causing pressure, overheating and eventual malfunction of the organs.

Fig. 4.3 *Overheating of the Organs*

When all the sounds and postures are done in the proper order, body heat is evenly distributed by the intestinal tract throughout the whole body, and each of the organs is at its correct temperature. (Fig. 4.4)

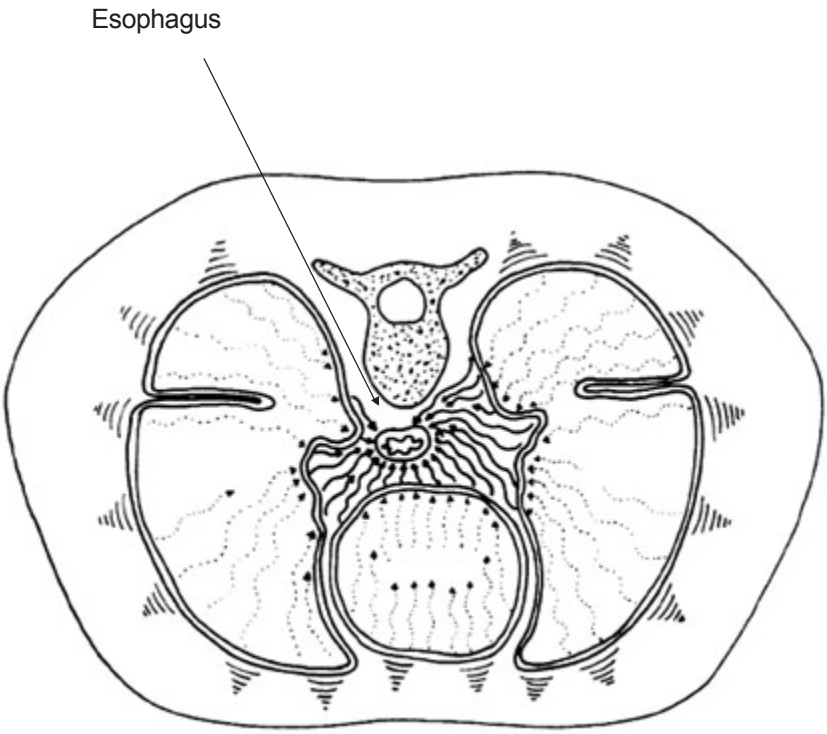

As the sound is made, the heat given off by the organs is transferred out of the body through the esophagus.

Fig. 4.4 *Cooling System of the Organs*

C. Sounds that Heal and Prevent

Daily practice of the Six Healing Sounds will restore and maintain calmness and good health. Greater sexual pleasure and improved digestion will occur. Minor ailments, such as colds, flu, and sore throats, can be prevented or thrown off easily. Many students of The Universal Tao have overcome their long-standing dependence on sleeping pills, tranquilizers, aspirin, and antacids. Heart attack victims have prevented further attacks. Several psychologists have taught some of their patients to use the Six Healing Sounds to relieve depression, anxiety or anger; and body work oriented healers have used the Six Healing Sounds to help speed up healing, and the healer spends less of his own life force energy.

Each of the five organs in the practice has an associate organ which responds together with it and in the same manner. When an organ is weak or overheated, its paired organ is similarly affected. Likewise, practicing the appropriate healing sound and posture improves the organ and its associate.

D. Sensations of the Resting Period

The sensations experienced during the “rest period” of the practice vary from individual to individual. You may feel coolness, tingling, vibration, or lightness or expansion in a particular organ, or your head, hands or legs. Or you may feel nothing specific, just a general feeling of relaxation. You may begin to sense the changes as your organs become softer, moister, spongier and more open.

E. Best Negative Emotion Control

The Six Healing Sounds are the fastest way to calm down the organs. The “concrete jungle” life that we live tends to trap the pollution and excess heat that surround us in our environment. All kinds of waves stimulate our bodies and organs to hyperactivity. Likewise, the circulation of the life force energy is obstructed, and the energy cannot flow efficiently or easily. When negative energy cannot be expelled from the body, it is circulated and trapped in the organs and in the membrane covering of the organs. The organs themselves begin to overheat, creating more negative emotional energy and added stress.

However, by simply pronouncing the organ sounds, one can release and exchange the gas trapped in the organs. Just as the Taoist Masters of olden times discovered certain sounds that had a close relationship with the organs and which would cool down the organs to their normal temperatures, so can we deliver fresh energy into the organ to release or transform our negative emotions into a more positive or life-giving energy.

F. Getting Rid of Bad Breath

Mouth odor is a most common problem. Many people are not aware of how greatly it affects them personally. People who come in contact with someone with bad breath feel uncomfortable and unpleasant. When you know your breath is bad and you cannot get rid of the persistent odor, you gradually lose confidence in yourself in social gatherings. One of the reasons for bad breath is tooth decay, which can be corrected by a dentist. The other major cause of bad breath is disease of the internal organs. The internal organs, when not healthy, will cause bad breath. A sickly liver, for example, will cause bad breath which smells like decaying meat. The kidneys, when not in a healthy state, will cause breath to smell like fermented urine. A weak or sickly stomach is the main cause of bad breath. When the stomach and the intestines reduce their healthy digestive activities, a great accumulation of partially undigested food remains in their walls, leading to bad breath. The Six Healing Sounds help to detoxify the body, strengthen the organs and release the trapped gases which cause bad breath.

G. Help Get Rid of Body Odor

Strong body odors also make people disliked, especially in the summer. Body odor can be caused by long term work under stress, which makes the organs more nervous and can cause organ pain, especially stomach pain. Stomach pain obstructs the digestive system and the Chi circulatory system. The odor that is secreted when perspiring, especially the odor secreted by the armpits (which tap the body's energy flow), becomes very strong. The Six Healing Sounds, especially the Lung Sound, can help to exchange the energy and make energy circulate. To do the Lung Sound you have to raise the hands above the head and expose the arm pits. This will help to increase circulating and exchanging the energy in the armpits so that the organs are more open and cleaner.

The Kidney Sound will also help eliminate bad perspiration. People who perspire easily with little movement or when nervous do so because they have weak kidneys. Their kidneys cannot filter the uric acid out of the body and into the blood stream. When the kidneys are weakened or sick, this filtering system breaks down and an excess build-up of uric acid occurs in the kidneys and throughout the body. This causes a foul smell in an individual's perspiration. When the excess water in the body cannot escape via the kidneys, the body becomes stressed and fear occurs easily, reflecting in foul smelling perspiration. Uttering the Kidney Sound and massaging the kidney area in the back by lightly tapping the kidneys can help to shake the stuck uric acid particles loose from the kidney filters. Massaging the feet at the kidney point, especially at the bubbling spring point on the soles of the feet, will also help greatly.

H. Yawning, Burping and Passing Gas

Yawning, burping or passing gas are common reactions during or shortly after doing the Six Healing Sounds. These aren't socially approved responses in North America, but they are actually beneficial. They're part of the process of releasing trapped bad breath, gas and hot energy from the digestive system. As you inhale, you take cool fresh life force energy into the esophagus and breathe into the organs. Exhaling and pronouncing the correct sound creates an exchange of energy, bringing the good energy to the organ and forcing out the waste energy. The world now spends billions of dollars on antacids and soft drinks to release trapped gas. The Six Healing Sounds do the same thing more efficiently and without expense.

I. Best Detoxification is through your own Life Force Energy

Detoxification through the Six Healing Sounds is by far one of the best ways to clean out the organs, because it employs fresh energy to clean them. People spend a lot of money for herbs and drugs in order to cleanse and detoxify the organs. A lot of times substances will enter and remain there, causing more toxicity. Some people will experience moving of gas, or loose or very bad smelling bowel movements; these also are indications of ongoing detoxification.

J. Tears and Saliva

Similar to yawning and burping, practice of the Six Healing Sounds may develop another sign of detoxification: tearing. Tearing helps prevent eye disease and cleanses the organs. Usually cleaning out will also be followed by a spring of saliva from the salivary glands of the mouth, which you will feel to be fresh and fragrant. When you have a lot of saliva, swallow down by pressing your tongue to the roof of your mouth, locking your neck and swallowing.

K. Sounds can increase the Range of Movement

Trapped bad energy in the organs can make the organs tense and painful to contract, thus slowing down many physical activities. However, the Six Healing Sounds release the trapped energy in the organs. In a study by Dr. G. Goodheart, the originator of a practice called Applied Kinesiology, he discovered that each large muscle was related to a body organ. A weakness in a muscle usually meant there was a problem in the Chi energy level of a corresponding organ. In the Taoist system, all organs are associated with movement and the extremities. If there is an obstruction of energy in an organ, trapped bad energy or negative emotions, movement of the muscles paired with that organ will be tense, painful and limited. The muscles are like the back-up tank of the organs. So the range of movement throughout the body will be greatly obstructed and limited when the organs are obstructed with tension or under stress. We find that many of our students improve their range of movement when the tensions are released from within their internal organs after practicing the Six Healing Sounds.

The chart below shows the details of the organs, muscles and emotions associated with them. (Fig. 4.5)

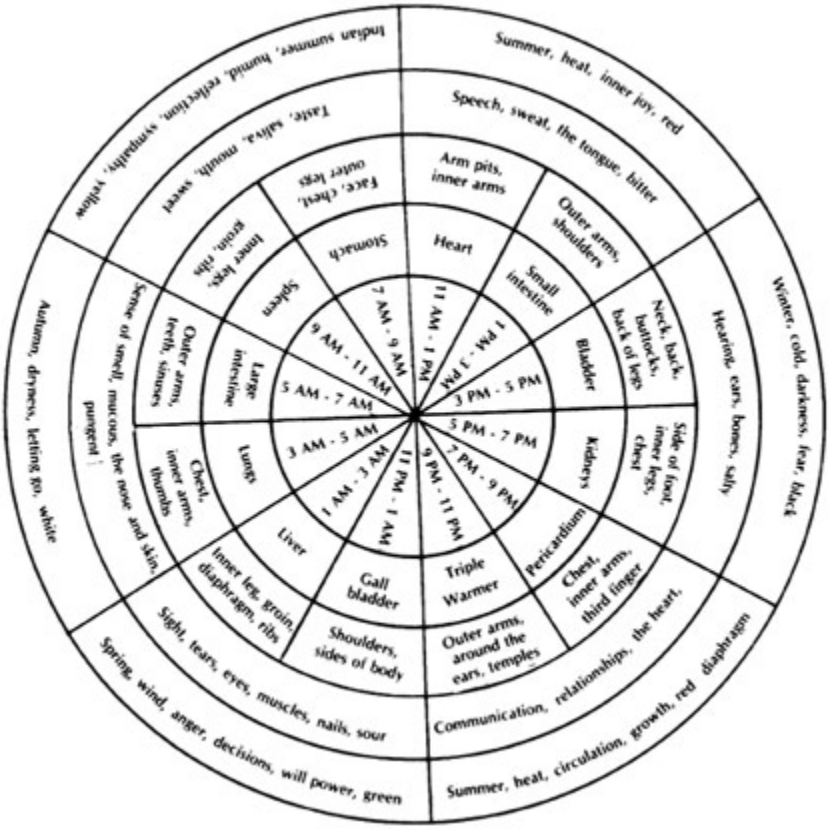

Fig. 4.5 *Body Clock Chart*

II. Preparation for the Six Healing Sounds

A. For maximum benefit, be precise in assuming the position and making the sound for each organ.

B. During all of the exhalation positions, you will be looking up at the ceiling with your head tilted back. This creates a straight path from the open mouth, through the esophagus, down to the organs, and permits a more efficient exchange of energy.

C. The sounds are done sub-vocally—that is, the lips, teeth and tongue produce the sound, but it is heard only internally; this intensifies its power. All sounds are made slowly and evenly.

D. Be sure to follow the order of the exercises as given. This enhances the even distribution of heat in the body. The order follows the natural order of the seasons, from autumn through Indian Summer.

E. Wait at least an hour after eating to begin the practice. However, if you have gas, nausea or stomach cramps you may do just the Spleen Sound right after eating.

F. Choose a quiet spot and take the phone off the hook. Until you've developed a strong inner focus, you need to eliminate distractions.

G. Dress warmly enough not to be chilled. Wear loose fitting clothes and loosen your belt. Remove your glasses and watch.

III. Position and Practice

A. Sit on your sitting bones at the edge of a chair. The genitals should be unsupported; they're an important energy center. (Fig. 4.6)

B. The legs should be a hip's width apart, and the feet should be solidly on the floor.

C. The back is straight, shoulders relaxed; sink the chest.

D. Keep the eyes open.

E. Rest the hands on the thighs, palms up. You are now ready to begin the exercises.

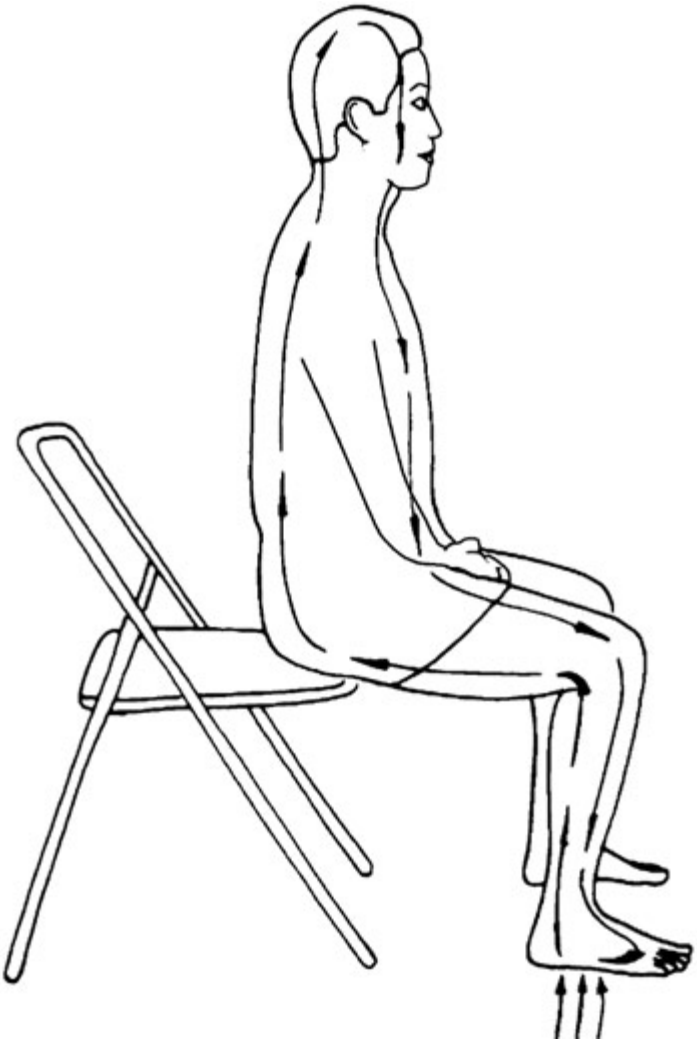

Fig. 4.6 *Sit on your sitting bones at the edge of a chair.*

IV. Lung Exercise: First Healing Sound

A. Characteristics
Lungs
Associated organ: large intestine
Element: metal
Season: autumn - dryness
Negative emotions: sadness, grief, sorrow

Positive emotions: righteousness, surrender, letting go, emptiness, courage

Sound: ***Sssssssss***
Parts of the body: chest, inner arms, thumbs
Senses: nose - smell, mucous, skin
Taste: pungent
Color: white

The lungs are dominant in autumn. Their element is metal and their associated color is white. The negative emotions are grief and sadness. The positive emotions are courage and righteousness.

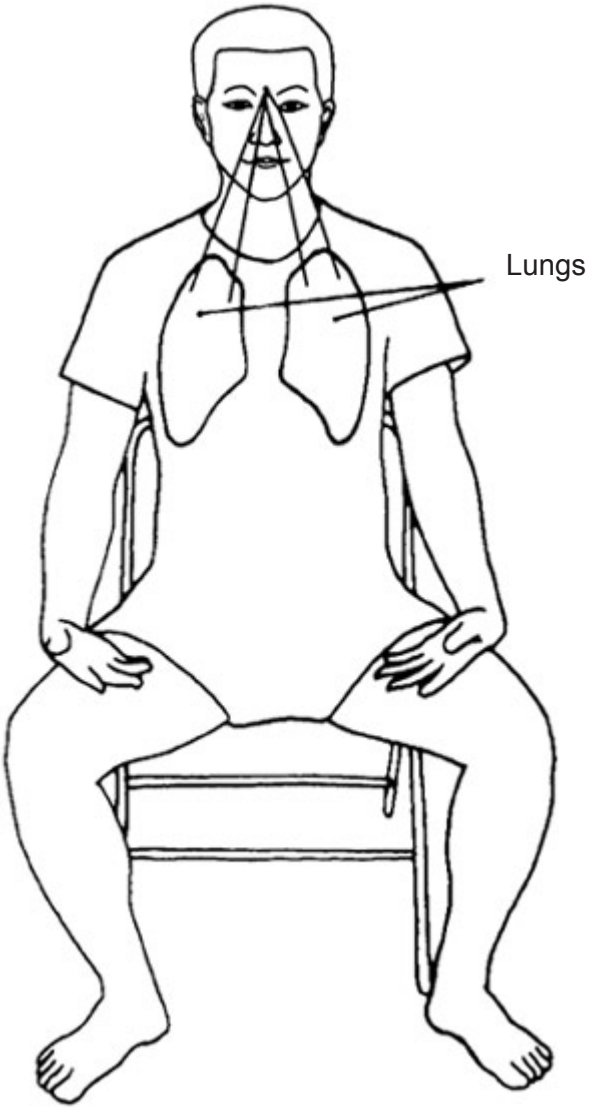

Fig. 4.7 *Become aware of your lungs.*

Fig. 4.8 *Rotate your palms and...*

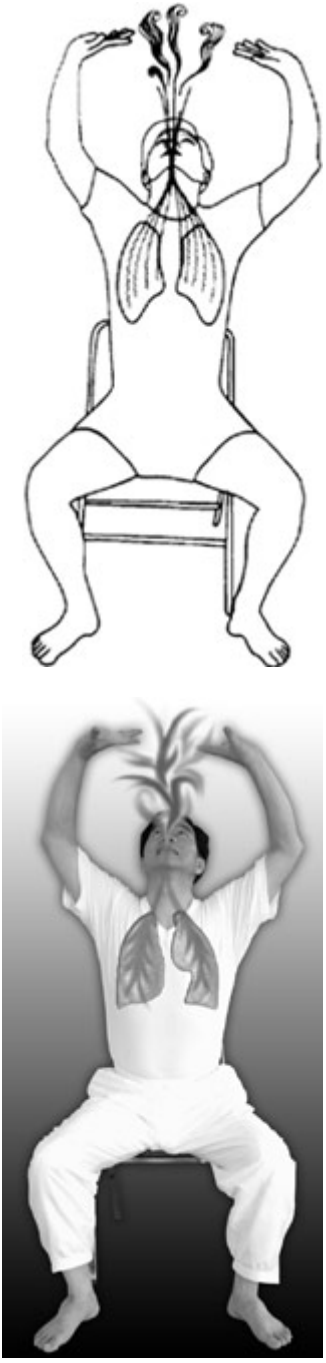

Fig. 4.9 *....bring them up above your head.*

B. Position and Practice

1. Become aware of your lungs. (Fig. 4.7)

2. Take a deep breath and, letting your eyes follow, raise the arms up in front of you. When the hands are at eye level, begin to rotate the palms and bring them up above the head. Keep the elbows rounded. You should feel a stretch that extends from the heels of the palms, along the forearms, over the elbows, along the upper arms and into the shoulders. The lungs and chest will feel open and breathing will be easier. (Fig. 4.8 and 4.9) Close the jaws so that the teeth meet gently, and part the lips slightly. Draw the corners of the mouth back, exhale, and allow your breath to escape through the spaces between the teeth, making the sound "***Sssssssss***", sub-vocally, slowly and evenly in one breath. (Fig. 4.10)

4. As you do this, picture and feel the pleura (the sac that covers the lungs) as being fully compressed, ejecting the "excess heat", sick energy, sadness, sorrow and grief. (Fig. 4.11).

5. When you have exhaled completely (without straining), rotate the palms down, close the eyes, and breathe in to the lungs to strengthen them. If you are color oriented, you can imagine a pure white light and quality of righteousness entering into your whole lungs. Float the arms down by gently lowering the shoulders. Slowly lower them to your lap so that they rest there, palms up. Feel the energy exchange in the hands and palms.

6. Close the eyes, breathe normally, smile down to the lungs, be aware of the lungs, and imagine that you are still making the sound. Pay attention to any sensations you may feel. Try to feel the exchange of cool, fresh energy replacing hot waste energy. (Fig. 4.12)

7. When your breathing calms down, repeat the sequence 3 to 6 times.

8. For colds, flu, mucous, toothaches, smoking, asthma, emphysema, or depression, or if you want to increase the range of movement of the chest and the inner arm, or for detoxifying the lungs, you can repeat the sound 9, 12, 18, 24, or 36 times.

9. The Lung Sound can help to eliminate nervousness when in front of a crowd. You can do the Lung Sound sub-vocally without the hand movements several times when you feel nervous in front of a crowd. This will help you to calm down. The Heart Sound and the Inner Smile will help also if the Lung Sound is not enough to calm you down.

Fig. 4.10 *Mouth Posittion for Lung Sound*
Close jaws so that the teeth meet. Draw the corners of the mouth back.

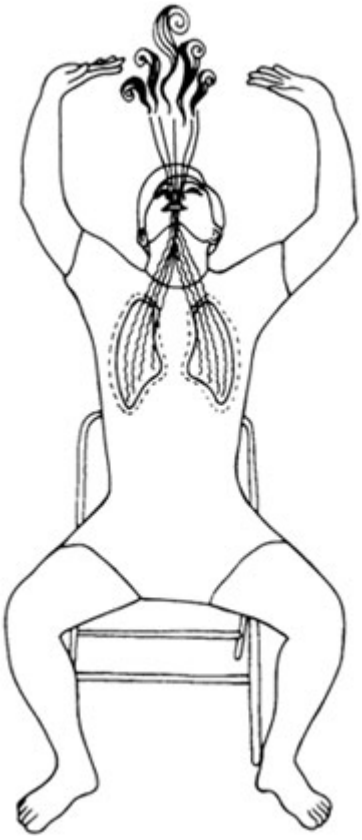

Fig. 4.11 *Picture and feel the sacs being fully compressed.*

Fig. 4.12 *Close the eyes; breathe normally; smile down to the lungs.*

V. Kidney Exercise: Second Healing Sound

A. Characteristics

Kidneys
Associated organ: bladder
Element: water
Season: winter
Negative emotion: fear
Positive emotions: gentleness, alertness, stillness
Sound: ***Chooooo***
Parts of the body: side of foot, inner leg, chest
Senses: hearing, ears, bones
Taste: salty
Color: black or dark blue

Winter is the season of the kidneys. Their element is water and their color is black or dark blue. The negative emotion is fear and the positive emotion is gentleness.

B. Position and Practice

1. Become aware of the kidneys. (Fig. 4.13).

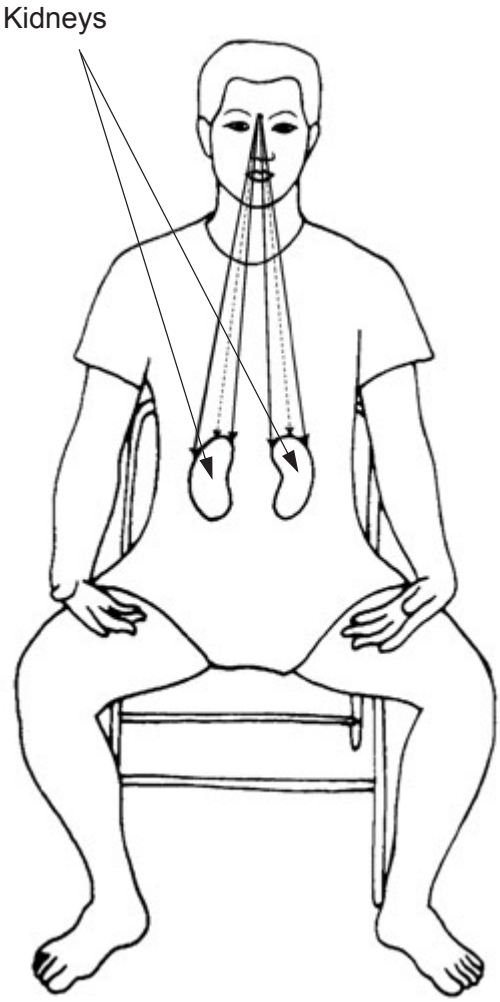

Fig 4.13 *Become aware of your kidneys.*

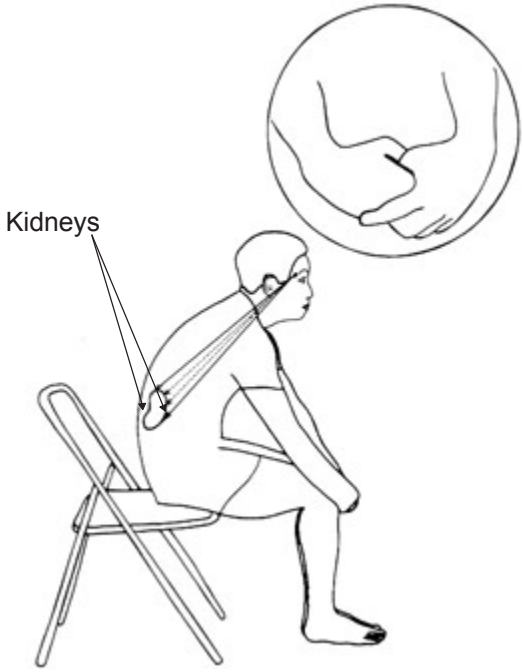

Fig. 4.14 and 4.15 *Hook the hands around the knees.*

2. Place the legs together, ankles and knees touching. Take a deep breath as you bend forward, and clasp one hand in the other; hook the hands around the knees and pull back on the arms. With the arms straight, feel the pull at the back where the kidneys are; look up, and tilt the head back without straining.(Fig. 4.14 and 4.15)

Fig. 4.16 and 4.17 *Round the lips, making the sound one makes when blowing out a candle.*

3. Round the lips and silently make the sound one makes in blowing out a candle. At the same time, press the middle abdomen, between the sternum and navel, toward the spine Imagine the excess heat, the wet, sick energy, and fear being squeezed out from the membrane around the kidneys. (Fig. 4.16, 4.17 and 4.18)

4. When you have exhaled completely, sit up and slowly breathe into the kidneys, imagining a bright blue energy as the quality of gentleness enters the kidneys. Separate the legs to a hip's width and rest the hands, palms up, on the thighs.

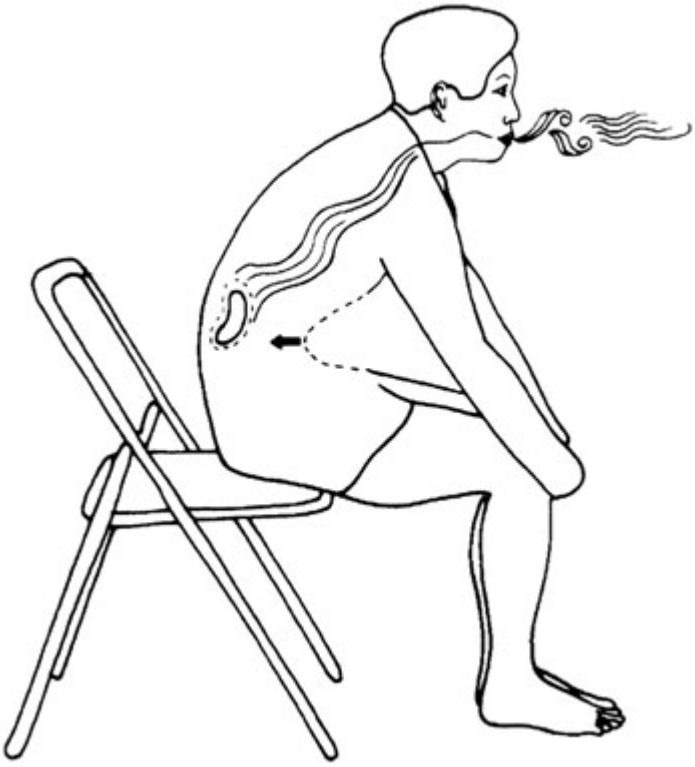

Fig. 4.18 *Press the middle abdomen toward the kidneys.*

5. Close the eyes and breathe normally. Smile to the kidneys, as you imagine that you are still making the sound. Pay attention to sensations. Be aware of the exchange of energy around the kidneys, and hands, head and legs. (Fig. 4.19)

6. When your breathing calms down, repeat 3 to 6 times.

7. For back pain, fatigue, dizziness, ringing in the ears, or detoxifying the kidneys, repeat 9 to 36 times.

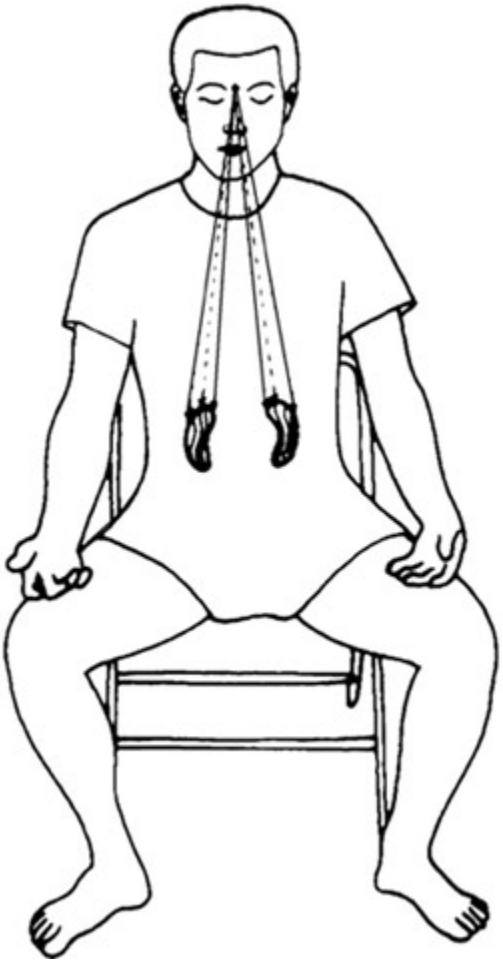

Fig. 4.19 *Close your eyes and smile down to the kidneys.*

VI. Liver Exercise: Third Healing Sound

A. Characteristics

Liver
Associated organ: gall bladder
Element: wood
Season: spring
Negative emotions: anger, aggression
Positive emotions: kindness, self-expansion, identity
Sound: ***Shhhhhh***
Parts of the body: inner legs, groin, diaphragm, ribs
Senses: sight, tears, eyes
Taste: sour
Color: green

The liver is dominant in spring. Wood is its element and green is its color. The negative emotion is anger. The positive emotion is kindness. The liver is especially important.

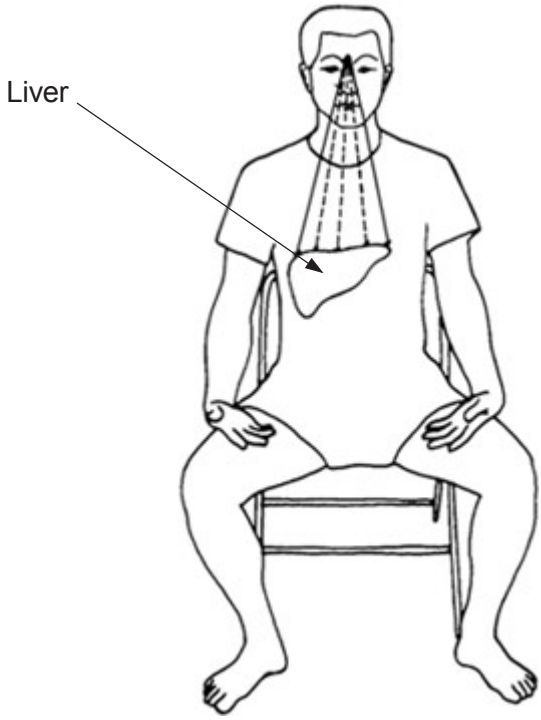

Fig. 4.20 *Become aware of the liver.*

B. Position and Practice

1. Become aware of the liver, and feel the connection between the eyes and the liver. (Fig. 4.20)

2. Place your arms at your sides, palms out. Take a deep breath as you slowly swing the arms up and over the head. Follow with the eyes. (Fig. 4.21)

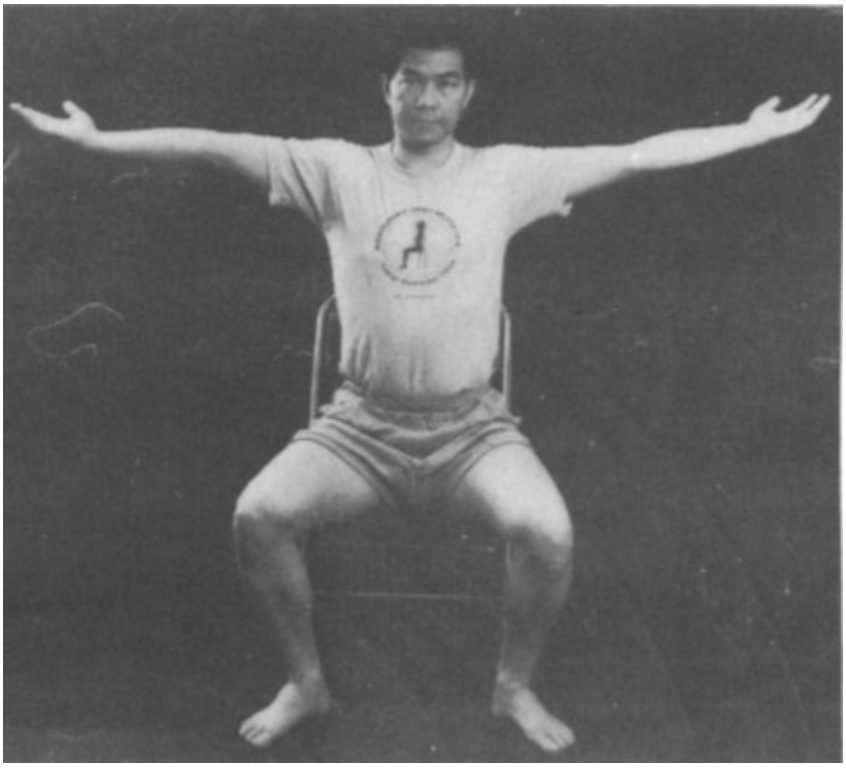

Fig. 4.21 *Slowly swing the arms up and over the head.*

3. Interlace the fingers and rotate the palms (Fig. 4.22) to face the ceiling. Push out at the heels of the palms (Fig4.23) and feel the stretch through the arms and into the shoulders. Bend slightly to the left, exerting a gentle pull on the liver. (Fig. 4.24)

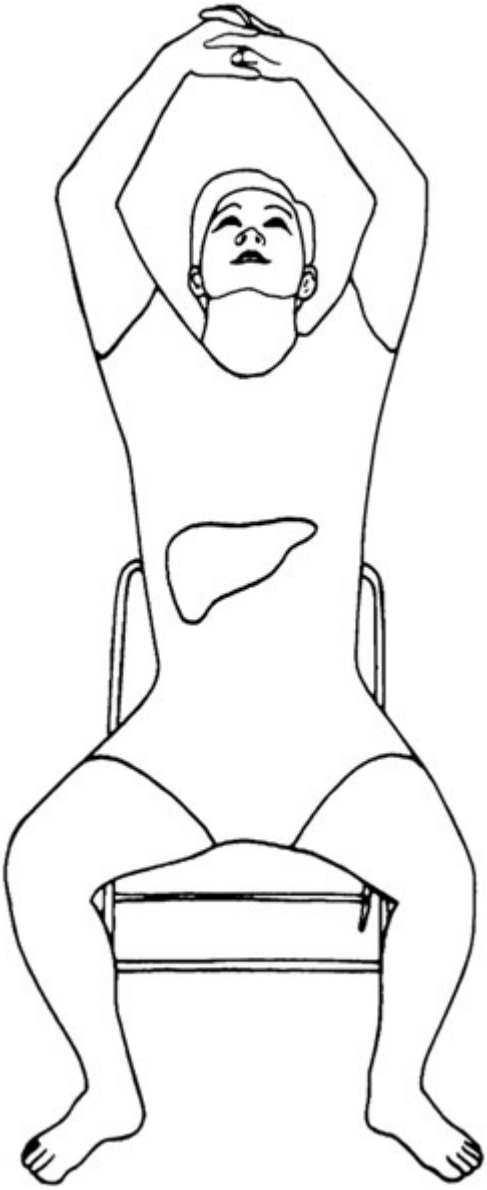

Fig. 4.22 *Interlace the fingers and rotate the palms.*

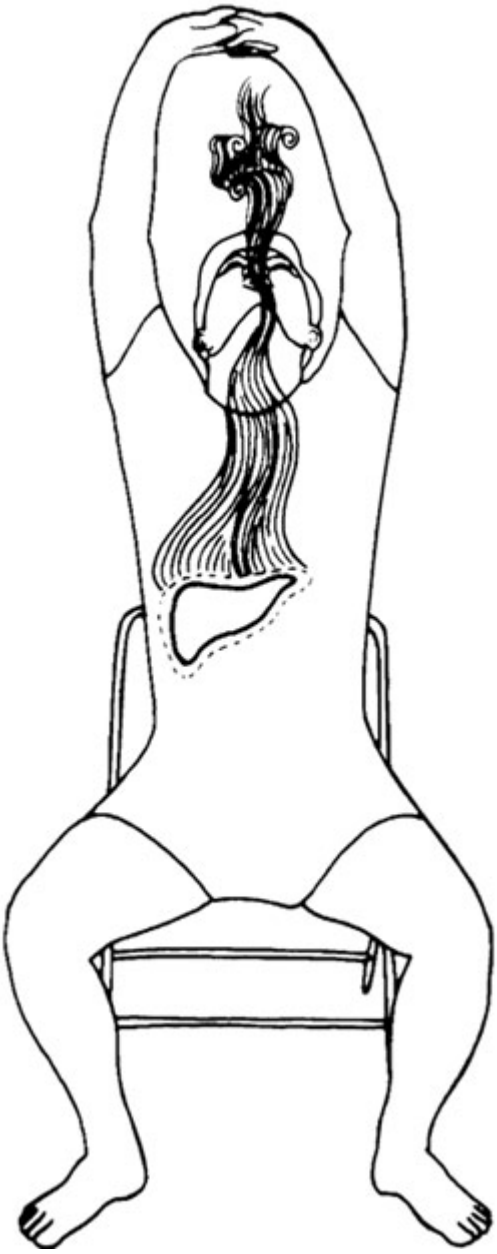

Fig. 4.23 *Push out at the heels of the palms.*

Fig. 4.24 *Push more with the right arm.*

4. Exhale on the sound, "***Shhhhhhh***" (Fig. 4.25), sub-vocally. Again, envision and feel that a sac encloses the liver and is compressing and expelling the excess heat and anger. (Fig. 4.26)

5. When you have exhaled completely, unlock the fingers, and pressing out with the heels of the palms (Fig. 4.27), breathe into the liver slowly; imagine a bright green color quality of kindness entering the liver. Gently bring the arms back to the side by lowering the shoulders. Place your hands on your lap, palms up, and rest.

6. Close the eyes, breathe normally, smile down to the liver and imagine you're still making the sound. Be aware of sensations. Sense the energy exchange. (Fig. 4.28)

7. Do this 3 to 6 times. For anger, red and watery eyes, or a sour or bitter taste, and for detoxifying the liver, repeat 9 to 36 times.

A Taoist axiom about controlling anger says: If you've done the Liver Sound 30 times and you are still angry at someone, you have the right to slap that person.

Fig. 4.25 *Exhale on the sound "**Shhhhhhh**".*

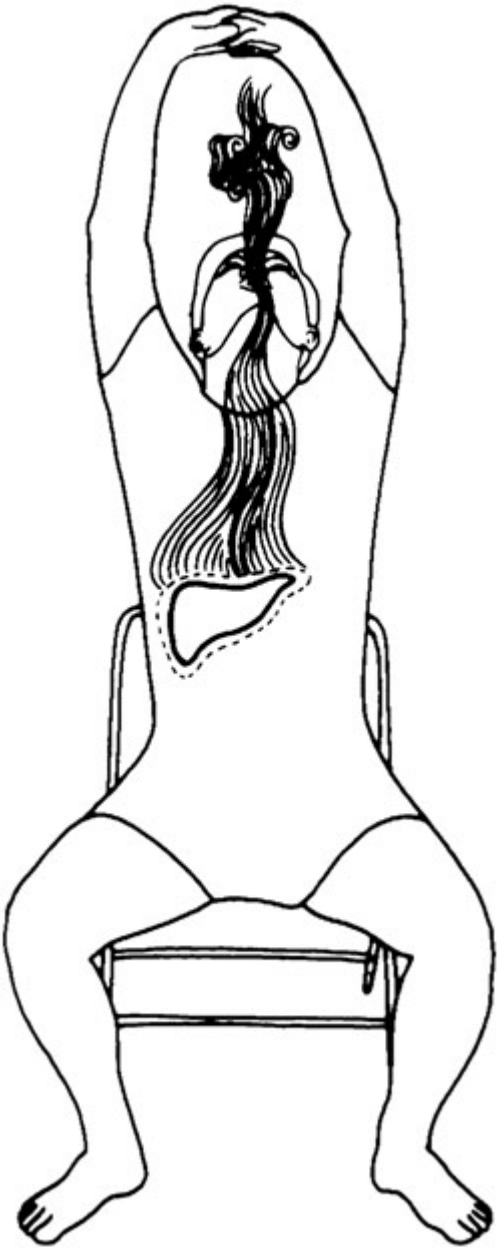

Fig. 4.26 *Feel that a sac encloses the liver and is compressing.*

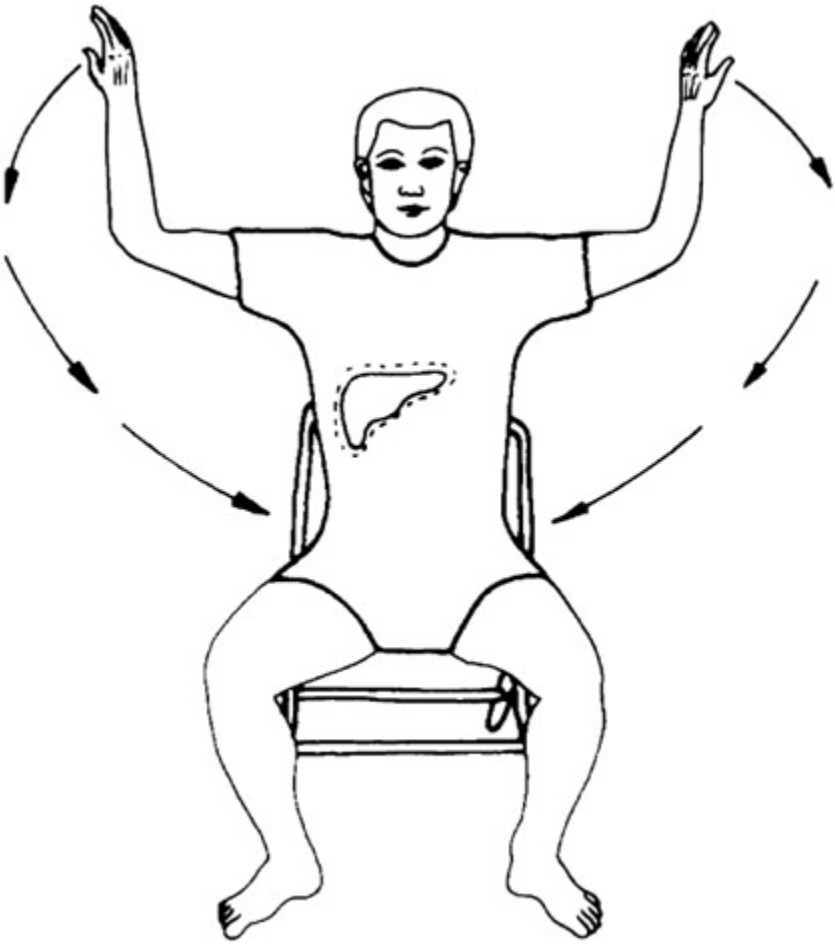

Fig. 4.27 *Press out with the heels of the palms.*

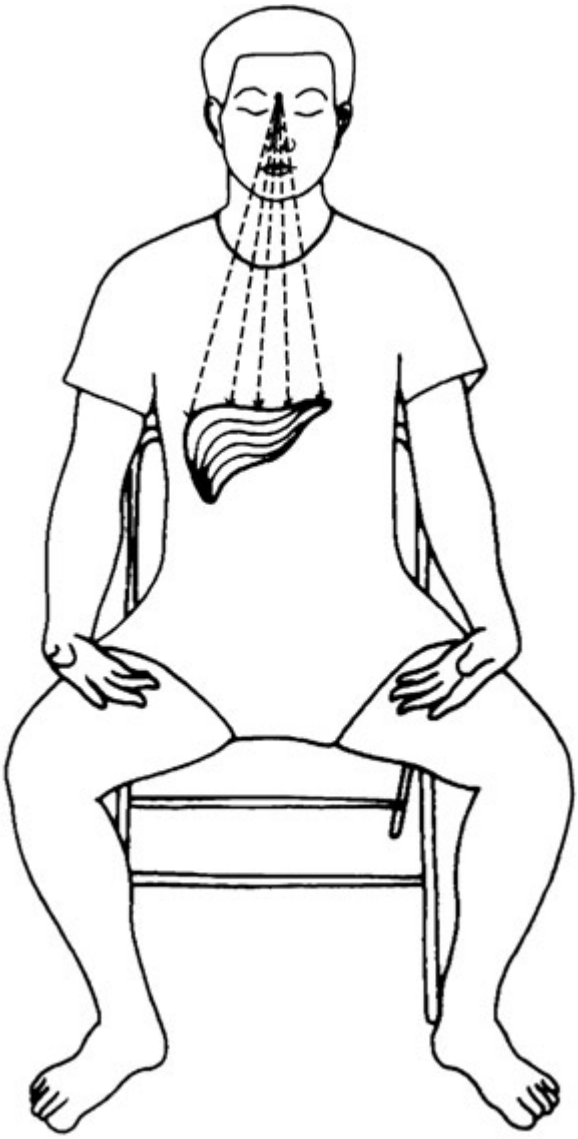

Fig. 4.28 *Close your eyes and smile down to the liver.*

VII. Heart Exercise: Fourth Healing Sound

A. Characteristics

Heart
Associated organ: small intestine
Element: fire
Season: summer
Negative emotions: impatience, arrogance, hastiness, cruelty, violence
Positive emotions: joy, honor, sincerity, creativity, enthusiasm, spirit, radiance, light
Sound: ***Hawwwwww***
Part of the body: armpits, inner arms
Senses: tongue, speech
Taste: bitter
Color: red

The heart is constantly working, beating at the rate of approximately 72 times a minute, 4,320 times an hour, 102,680 times each day. This naturally produces heat, which is dissipated by the heart's sac, the pericardium. In the Taoist view, the pericardium is important enough to be considered a separate organ.

B. Position and Practice

1. Become aware of the heart and feel the tongue connected with the heart. (Fig. 4.29).
2. Take a deep breath and assume the same position as for the Liver Sound (Fig. 4.30), but lean slightly to the right (Fig. 4.31).
3. Open the mouth somewhat (Fig. 4.32), round the lips and exhale on the sound "***Hawwwwwww***" (Fig. 4.33,4.34 and 4.35), sub-vocally, as you picture the pericardium releasing heat, impatience, arrogance and hastiness.
4. For the rest cycle, repeat the procedure for the Liver Sound, but focus attention on your heart (Fig. 4.36) and imagine a bright red color and the qualities of joy, honor, sincerity and creativity entering the heart.
5. Do 3 to 6 times. For a sore throat, cold sores, swollen gums or tongue, heart disease, heart pains, jumpiness, moodiness, and for detoxifying the heart, repeat 9 to 36 times.

Fig. 4.29 *Become aware of the heart.*

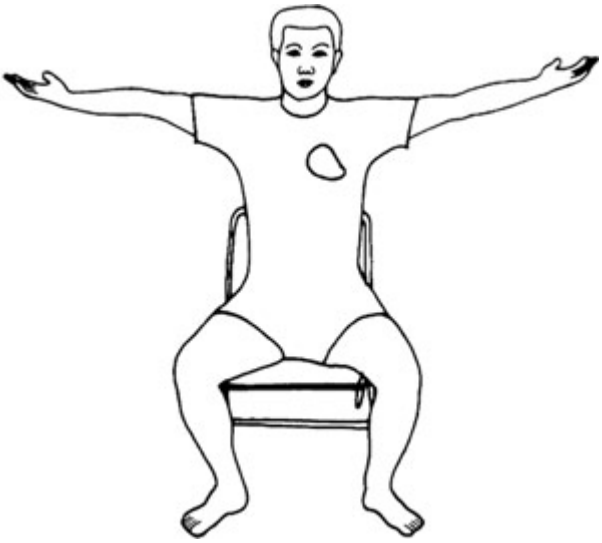

Fig. 4.30 *Assume the same position as for the Liver Sound.*

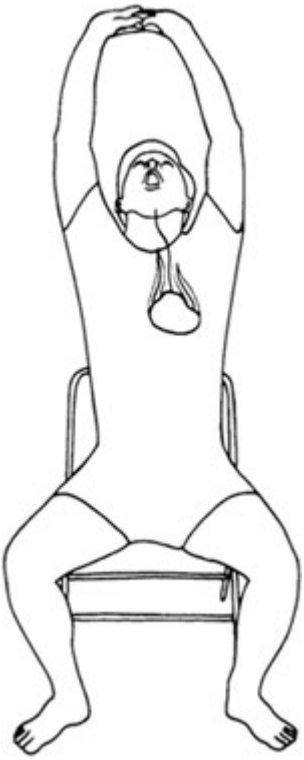

Fig. 4.31 *Push more with the left arm.*

Fig. 4.32 *Open mouth, rounded lips.*

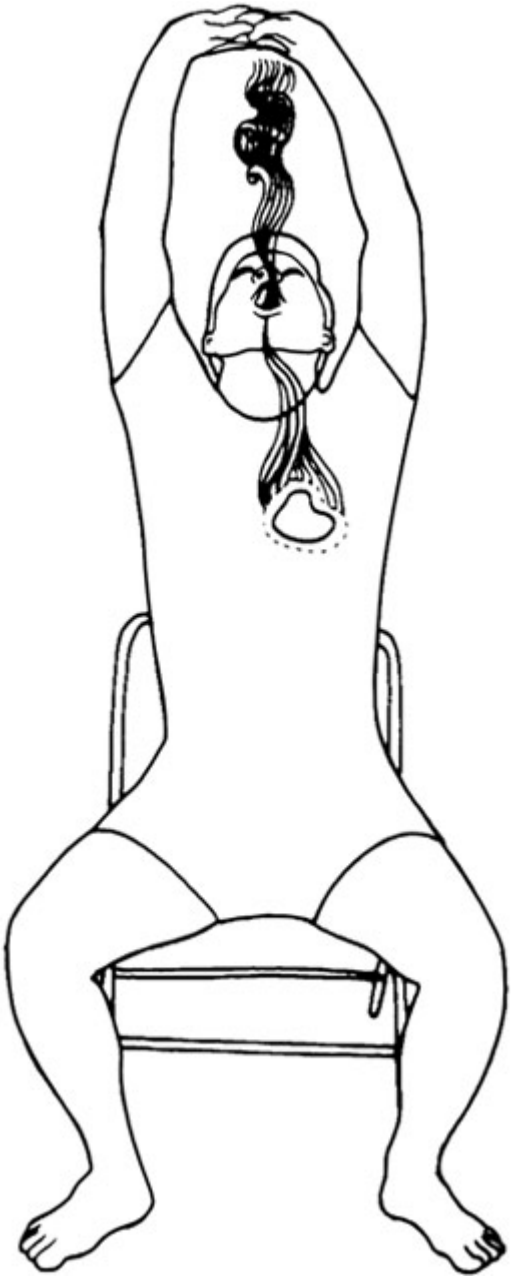

Fig. 4.33 Hawwwwww *Sound*

Fig. 4.34 *Breathe out Dark, Murky Energy.*

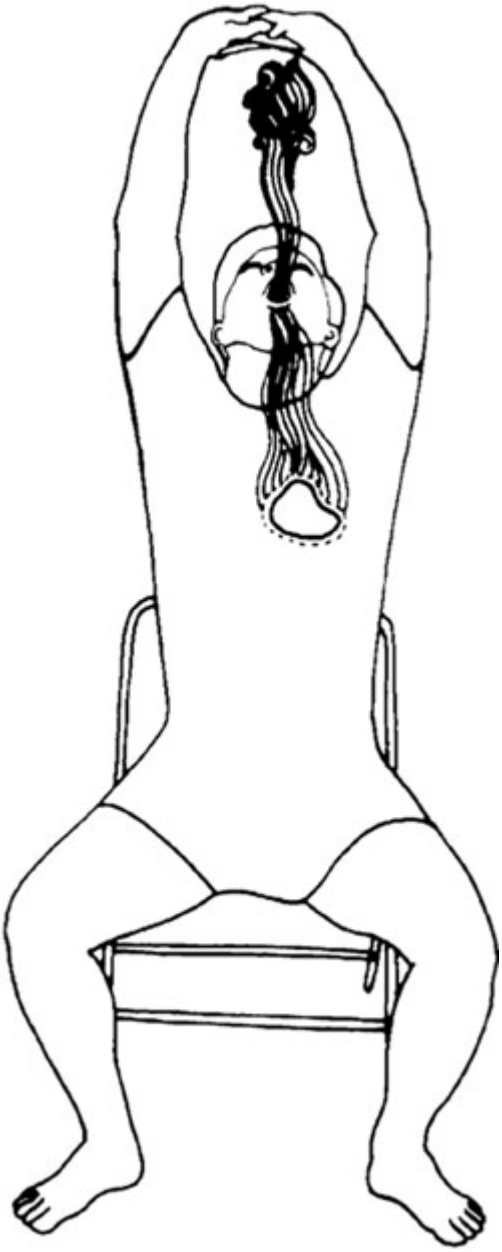

Fig. 4.35 *Open your mouth somewhat, round your lips and exhale on the sound "**Haaaaaw**".*

Fig. 4.36 *Close your eyes and smile down to the heart.*

VIII. Spleen Exercise: Fifth Healing Sound

A. Characteristics

Associated Organs: pancreas, stomach
Element: earth
Season: Indian summer
Negative Emotions: worry, sympathy, pity
Positive Emotions; fairness, compassion, centering, music Making
Sound: ***Whooooo***
Taste: neutral
Color: yellow

B. Position and Practice

1. Become aware of the spleen; feel the mouth and the spleen connect. (Fig. 4.37)

2. Take a deep breath as you place your hands (Fig. 4.38) with the index fingers resting at the bottom and slightly to the left of the sternum. (Fig. 4.39). Press in with the fingers as you push out with the middle back. (Fig. 4.40)

3. Exhale on the sound "***Whoooooo***" (Fig. 4.41), made sub-vocally and felt in the vocal chords (Fig. 4.42). Expel the excess heat, wetness and dampness, and worry, sympathy and pity.

4. Breathe into the spleen, pancreas, and stomach (Fig. 4.43), or imagine a bright yellow light, and the qualities of fairness, compassion, centering, and music making entering them.

5. Lower the hands slowly to your lap, palms up.

6. Close the eyes, breathe normally and imagine you are still making the sound. Be aware of sensations and the exchange of energy. (Fig. 4.44)

7. Repeat 3 to 6 times.

8. Repeat 9 to 36 times for indigestion, nausea and diarrhea, and for detoxifying the spleen. This sound, done in conjunction with the others, is more effective and healthier than using antacids. It is the only sound that can be done immediately after eating.

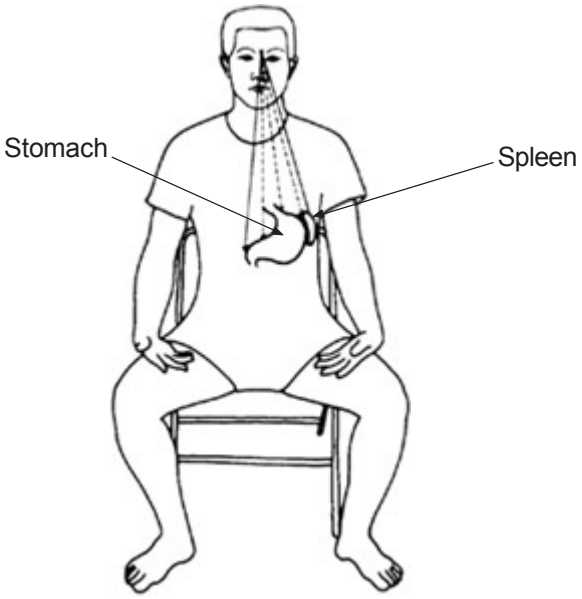

Fig. 4.37 *Become aware of the spleen.*

Fig. 4.38 *Take a deep breath.*

Fig. 4.39 *Place your hands with the index fingers resting at the bottom and slightly to the left of the sternum.*

Fig. 4.40 *Feel the sound in the vocal chords.*

Fig. 4.41 *Exhale on the sound "**Whoooooo**".*

Fig. 4.42 *Feel the sound in the vocal chords.*

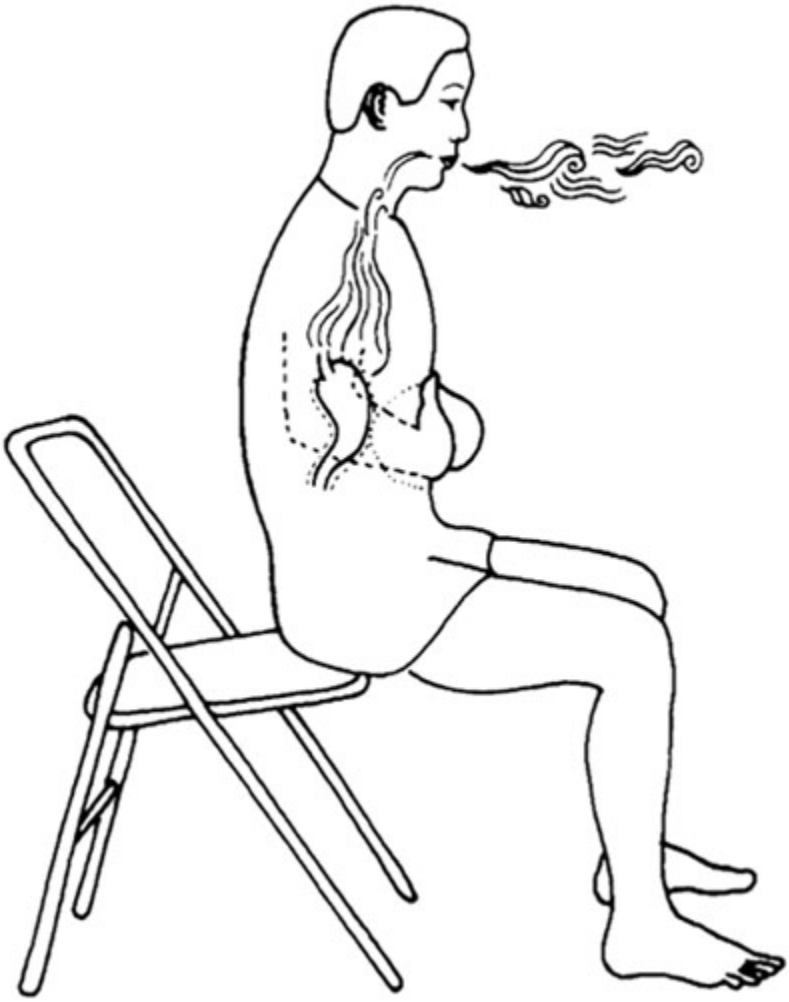

Fig. 4.43 *Breathe into the spleen, pancreas and stomach.*

Fig. 4.44 *Close your eyes and smile down to the spleen, pancreas and stomach.*

IX. Triple Warmer Exercise : Sixth Healing Sound

A. Characteristics

The Triple Warmer refers to the three energy centers of the body. The upper level, which consists of the brain, heart, and lungs, is hot. The middle section consisting of the liver, kidneys, stomach, pancreas, and spleen, is warm. The lower level containing the large and small intestines, the bladder, and the sexual organs, is cool.The Triple Warmer Sound balances the temperature of the three levels by bringing hot energy down to the lower center and cold energy up to the upper center, through the digestive tract. This induces a deep, relaxing sleep. A number of students have been able to break a long-standing dependence on sleeping pills by practicing this sound. It's also very effective for relieving stress.

There is no season, color, or emotion associated with the Triple Warmer.

Fig. 4.45 *Lie on your back; close the eyes; take a deep breath.*

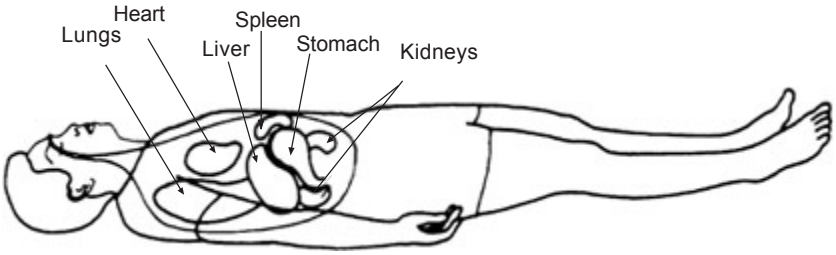

Fig. 4.46 *Organs' Diagram*

Fig. 4.47 Heeeee *Sound*

Fig. 4.48 *Breathe in Upper Body.*

Fig. 4.49 *Breathe in Middle Body.*

Fig. 4.50 *Breathe in Lower Body.*

B. Position and Practice

1. Lie down on your back. Elevate the knees with a pillow if you feel any pain in the small of the back or lumbar area.

2. Close the eyes and take a deep breath, expanding the stomach and chest without strain. (Fig. 4.45 and 4.46)

3. Exhale on the sound "***Heeeeeee***" (Fig. 4.47), made subvocally, as you picture and feel a large roller pressing out your breath, beginning at the top of the chest and ending at the lower abdomen. Imagine the chest and abdomen are as flat as a sheet of paper, and feel light, bright, and empty. (Figs. 4.48, 4.49, 4.50, 4.51 and 4.52) Rest by breathing normally. (Fig. 4.52)

4. Repeat 3 to 6 times, or more, if you are still wide awake. The Triple Warmer Sound also can be used to relax, without falling asleep, by lying on your side or sitting in a chair. (Fig. 4.53)

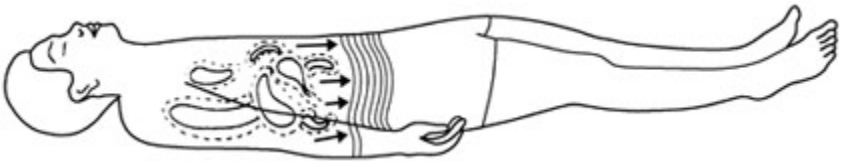

Fig. 4.51 *Breathe in everything.*

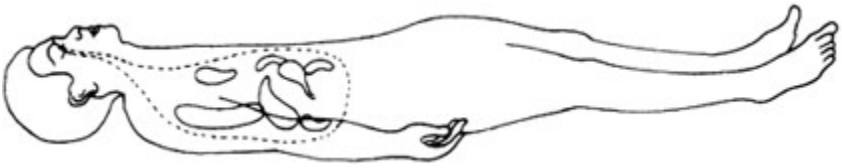

Fig. 4.52 *Rest by breathing normally.*

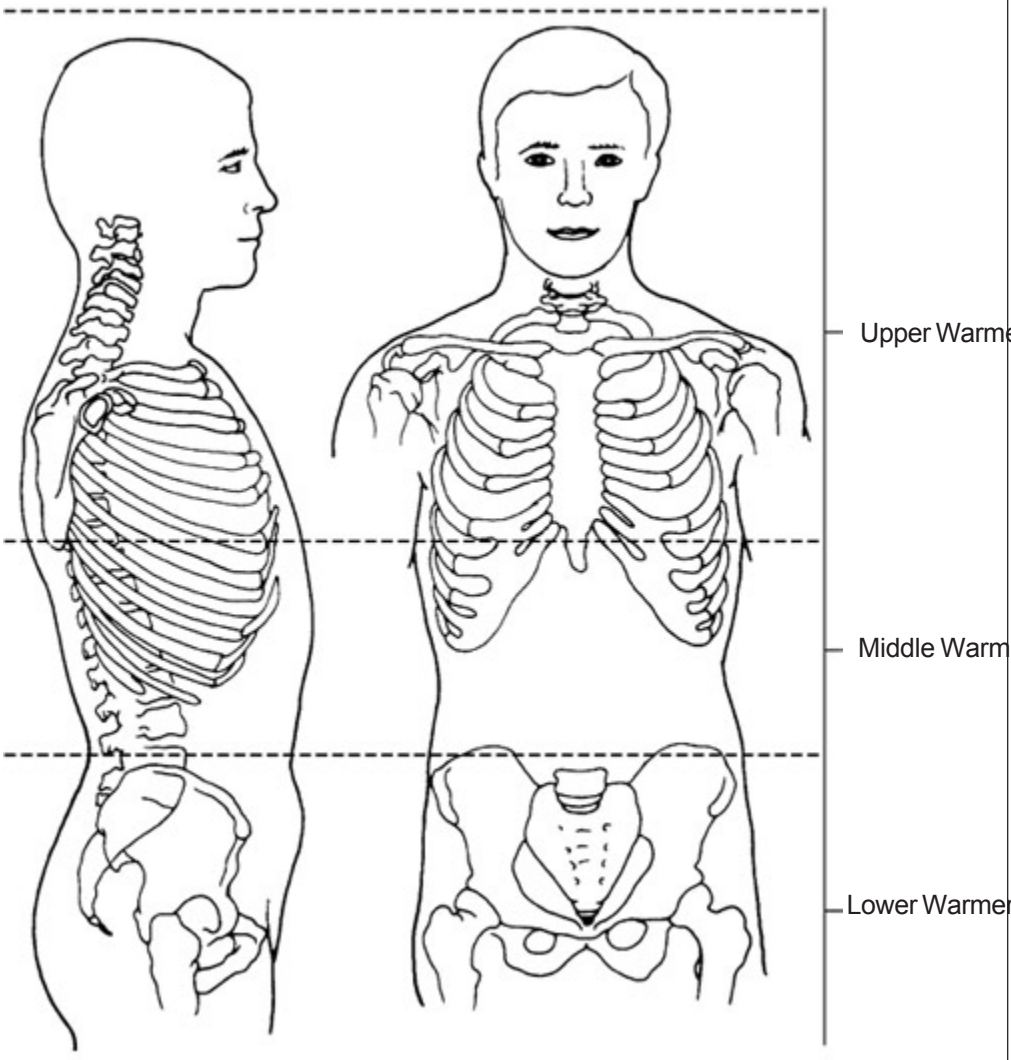

Fig. 4.53 *Triple Warmer*

X. Daily Use

A. Try to Practice the Six Healing Sounds Daily

Any time of the day is fine. It is especially effective at bedtime because it induces a deep, relaxing sleep. Once you have learned the procedure, it takes only 10-15 minutes.

B. Release the Heat after Vigorous Exercise

Do the Six Healing Sounds right after vigorous exercise, such as aerobics, jogging, martial arts, or after any type of yoga or meditation that creates a lot of heat in the upper warmer (the brain or the heart). This prevents the dangerous overheating of the organs that can otherwise occur. Do not take a cold shower right after vigorous exercise; it's too much of a shock to the organs.

C. Do the Sounds in Proper Sequence

1. Always do them in the proper sequence: Lung Sound (autumn), Kidney Sound (winter), Liver Sound (spring), Heart Sound (summer), Spleen Sound (Indian summer), Triple Warmer Sound.

2. If a particular organ or its accompanying symptom is bothering you, increase the number of times you do that individual sound without going through the whole sequence.

D. Season, Organ, and Sound

An organ works harder, and thus creates more heat, during the season in which it is dominant. Therefore, increase the number of times you do its exercise. For example, in spring do the Liver Sound 6 to 9 times while doing the other sounds 3 to 6 times.

If you are very pressed for time or very fatigued, only do the lung and kidney exercises.

E. Get in Touch During the Resting Period

The resting period in between each sound is very important. It is the time that you are becoming in touch with, and more aware of, the organs. Often times when you rest and smile into the organ, you can feel the exchange of the Chi energy in the organ, the hands and the legs. The head also feels the energy flow. Take as much time as you desire during the rest periods.

Chapter 5
Taoist Daily Life Wisdom

I. Smile away the Stress

Remember always to smile sincerely with your eyes and to fill your heart with love. This acts as a preventive medicine. When you are sad, angry, crying, depressed or nervous, your organs secrete poisons; but when you are happy and smile, they produce a honey-like, health giving secretion instead.

It is common knowledge that life today is very hectic. Ending the workday with a headache has become a way of life for many. With pressures building seemingly all around you and within you, "something has to be done." Oddly, the thing to do is not to do anything. When a trying situation arises no matter what it might be, you have to learn not to be drawn in by it. The way to be able to do that is to smile. In that simple act the world is made over, and what would otherwise have been troublesome never seems to arise.

At first it may prove to be very difficult to comprehend the results of the Inner Smile, let alone to make it into a new experience but, with sufficient practice, you can make it an integral part of your life.

Wherever you are—standing, walking or sitting—remember to smile, and relax, to fill your heart with love and to let the loving feeling spread through out your whole body. It is so very simple and yet so very effective Just cultivate a peaceful, loving heart; smile easily and your troubles will melt away.

II. Speak with Thought

Speak less; choose carefully what you say and when and how you say it. Speaking appropriately can be a blessing to all, and speaking less conserves Chi.

III. Worry Less—Take Action More

Think less about the future and the past, because those are the things that worry builds on, and worry produces stress.

Try instead to concentrate whenever you can—remember that concentration happens and is not something that you make happen-and cultivate attitudes of helping and of forgiveness in your daily life.

IV. Cultivating Mental Power

Taoist methods involve the cultivation of generative and mental power. The word for mind also means heart in many oriental languages, just as in Chinese. When you develop to the stage of no longer being concerned with personal ambition, when you are able to forget yourself and cultivate your heart, you have at hand the means of being free from illness.

When you are ill and meditate, do not think that you are doing it to escape from your illness. Instead, simply concentrate on a prescribed point or method and everything else will drop away.

V. Control your Sex Life—Do not let it control you

Curb your sexual activity. Too frequent ejaculation will greatly reduce your store of Chi and your ability to concentrate.

The mind is troubled by what is fed to it through the eyes, ears, mouth, nose and mind—i.e., the senses. When we are young and are exposed to sexually stimulating reading matter, we are not equipped to deal properly with it in a way which would conserve our energy. Therefore, it is advised that you concentrate on your daily practice and avoid "distractions".

VI. Respect your Head—Warm your feet

Regard your head with the greatest respect. Think of it as a temple of God and of the mind. See it as the temple of the soul and the main control of all the vital organs. There is a rule of thumb to abide by which is “Cool head, warm feet”. This will insure you against collecting too much power in your head, thereby possibly causing you discomfort and possibly illness. When power goes to the head, high blood pressure can develop. Directing the power down to the feet can relieve the pressure, and keeping the feet warm can guard you against heart attack. So rub your feet and keep them warm. When you finish, you must always store the energy in the navel and keep it warm.

VII. Keep your Neck Warm

The neck has many important blood vessels and nerves and connects to that very important part of you, the head. So treat it well, too; keep it warm and loose by pervading it with a smile.

Try not to use your senses too much. Don’t look at or listen to anything for too long at a time. Whenever the senses are used excessively, sickness can result.

Overindulge yourself with too much food and drink, and you will cause yourself ill health.

To prolong your life and avoid illness, practice swallowing your saliva many times a day.

Do not expose yourself to the wind after bathing or perspiring.

Replace the unpurified Chi of your body with pure original Chi, by practicing the Microcosmic Orbit and by opening all of the 32 routes.

Please the divinities within, and you may in time progress toward immortality.

VIII. Wisdom in Eating

Do not overeat until you are too full and then lie down or sit for a long time, as such practice will surely shorten your life.

Eat short of satiation, and then take a leisurely stroll; and do not eat at all at night before retiring.

Eat small amounts of food and eat more frequently. In this way you will be assured of proper digestion and of not overtaxing your five organs.

When eating, eat hot foods first, then warm; and if there is no cold food, drink some cold water. Always, before eating, inhale slightly and swallow some air.

Eat more pungent food in the spring, more sour food in the summer, more bitter food in autumn, and less salty food in winter, but do not be excessive in doing this.

In general, cooked food is better than uncooked, and eating a little is better than eating a lot.

If you have eaten too much, be careful not to drink too much water and not to gulp it down suddenly.

Indigestion follows when you eat to satiation after having been hungry for a long time.

Do not eat raw fruit on an empty stomach, because it heats above the diaphragm.

Too many raw vegetables can upset one's healthy color.

IX. Do not do these to Excess

Walking too long harms the tendons; sitting too long harms the flesh; standing too long harms the bones; lying down too long harms vital energy; and gazing too long harms the blood.

Anger, grief, pity and melancholy are harmful, as is too much joy or pleasure. Suffering is harmful; abstinence from sexual activity is harmful; to be anxious is harmful. In short, to neglect moderation is harmful.

X. Joy increases the Chi

With great joy, the vital Chi soars.

Great sadness causes the flow of Chi to stop.

You can exhaust your vital energy by too frequent sexual activity.

To swallow saliva is to increase its essence. When it is not swallowed it loses strength.

When you are ill, do not lie with your head to the north.

Right after awakening from sleeping, talking too much robs you of vital energy.

XI. Seasonal Health Care

During winter, see to it that your feet are warm and allow your head to be cool. In the spring and autumn permit both your head and feet to be cool.

When ill and perspiring, do not drink cold water, as this will damage your heart and stomach.

When lying down in spring and summer have your head face east, whereas in autumn and winter it should face west. To be free of sickness, a Master squats to urinate before eating and stands to urinate after eating.

When sleeping, bend the knees and lie on your side. This increases your vital energy.

In summer and autumn go to sleep early and arise early; in winter retire early and arise late; and in spring go to sleep while there is daylight and arise early.

At dawn, midday, during the afternoon, at twilight and at midnight, clean your teeth and rinse your mouth seven times this will lengthen your life and strengthen your bones, teeth, muscles, nails and hair.

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Taoist Ways to Transform Stress into Vitality

Inner Smile • Six Healing Sounds

Mantak Chia

Profusely Illustrated by Juan Li

Western medical doctors have only recently discovered the disastrous effects on health of stressful living and their ways of coping with it are still in their infancy. They know nothing of the ancient, successful tradition of the Tao and its long record of transforming stress into vitality and power.

Here, in this book, the Taoist way is set forth and illustrated. The meditation technique of the Inner Smile teaches you how to get in touch with your inner organs, feel love for them and smile to them, so that stress and negative emotions are transformed into creativity, learning, healing and peak performance energy.

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Master Mantak Chia, born in Thailand, comes from the ancient lineage of Taoist Masters, extirpated in China and now existing in dwindling numbers among the Overseas Chinese. He also has a Western education in anatomy and physiology. Now living in Northern Thailand, he has developed a clear and practical way of teaching this ancient wisdom, much of it hitherto kept secret. He is also the author of *Awakening Healing Energy* and *Taoist Secrets of Love*.

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Wisdom Chi Kung

Opening the Brain to Wisdom

Mantak Chia

Edited by:

Lee Holden

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Wisdom Chi Kung Theory

Western science has discovered that when people are heavy thinkers, when they worry a lot, are full of anger, jealousy, hatred or other negative emotions, their brain activity can consume 80 percent of all their total body energy. The brain is a heavy user of energy and when it begins to use it's energy, it doesn't stop if it is not told to. The rest of the body has only 20 percent of it's energy to use for all other intricate functions needed for daily activity. You can imagine why at the end of the day, most people go home and 'vege out' in front of the television. There is no energy in the body left to do anything.

One of the things that many religions have tried to do through meditation is to discover how to stop people from thinking. How do you stop the monkey mind from spinning constantly? All this activity does not stop at the end of the day but continues on during dreaming. In this chapter, we will introduce you to the monkey mind concept, how to recognize it when it begins, and how to respond correctly to it's perpetual activity.

Basis of Theory

So, the whole secret of the practice is; just smile down, relax, picture the eyes like a 'sun shining on the water,' suddenly you will start to feel something like a steam starting to rise up from your sacrum. You will feel this energy move up and begin to charge the brain. Now, if you expand the mind out and connect with the Universe, bring the energy back and store it in the organs, when that energy is transformed and charged back up to the brain, that will bring the brain functioning to a new level. This energy has been transformed and digested so that the brain can use it effectivley. This is very different then storing Universal energy it in the brain itself. The process of storing undigested universal energy in the

brain can actually have something like an allergic reaction which can cause an ‘ energy indigestion’. The brain can have a very strong reaction to this unprocessed energy.

In the Taoist practices we are always concerned about the lower Tan Tien. The energy there is the basis of all the higher practices. Wherever your mind goes, the Chi will go, that is where the fire will be burning. So you must always keep your mind on the lower Tan Tien, or else this fire will burn out. When the fire burns out, the body will loose an emense amount of life force. The mind then needs to be turned in, and then it can expand out. We will further expand on this topic in later chapters.

Fig. 1 *Smile down and Fill the Tan Tien with Chi.*

Introduction of Monkey Mind

In the West they believe that the brain, the vital organs, the sexual organs and energy are all separate. The sexual function is seen by religions as sinful, but it is obvious that it is not possible to suppress the natural instinct to have sex. The problem is that sex has become a very basic drain on everyone because it is approached in the wrong way. So how does one manage this energy and maintain it? The sexual energy and the brain energy are the same energy and their communication with each other is vital for their healthy functioning. The problem is that our mind is patterned to function continuosly with out recieving messages of impulses from the rest of the body. Our mind will voulentarily spin with no direction, for the purpose of maintaining itself. With no structure, or discipline, this monkey mind will run loose and rampid. In the upcoming chapters, we will describe in detail, how to begin to manage this monkey mind, and connect it down to our sexual organs, turning this generated energy into fuel for the body.

Fig. 2 *Connect the mind*

Inner Smile

The most essential point is to connect all the organs and the brain. So you say, how am I going to make this connection? And I say it is nothing more than a “Smile”. Nothing more. It took me thirty years to understand this. Even then, afterl we did all the testing was when it all became clear.

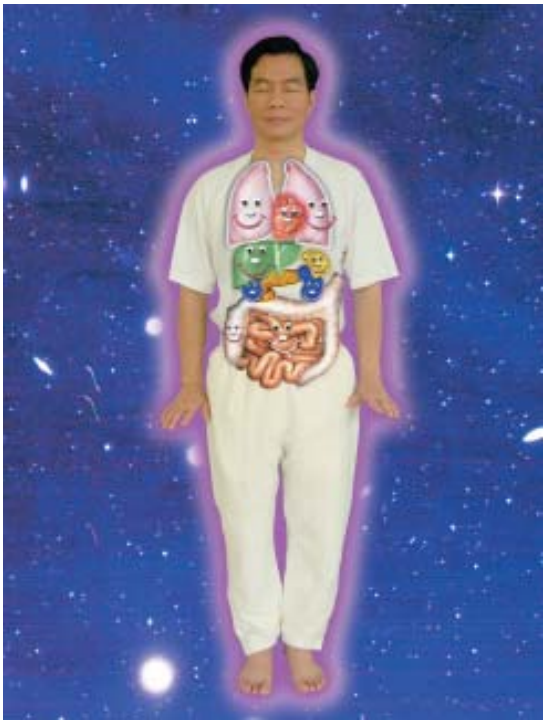

Fig. 3 *Inner Smile into Organs*

The whole goal is to increase the capacity of the brain to hold energy because the brain is really not very capable of ‘holding energy’ The brain can easily overheat actually “cooking” the brain. When the brain gets too cooked, there can be detrimental experiences, like psychological damage. Many people have experienced too much heat in the brain and end up in the hospital beacuse their heightened

experiences have brought too much undigested brain food, turning it into sickness rather than nutrition.Smiling into the organs will allow us to filter energy, giving just enough to charge the brain and revitalize the organs.

Fig. 4 *Connect the brain and the organs.*

Second Brain

In 1996 New York Times published the article, “Complex and Hidden Brain in the Gut makes Stomachaches and Butterflies” the entire article is dedicated to explaining to the public on how “the gut has a mind of it’s own, known as the enteric nervous systemlocated in sheaths of tissue lining the esophagus, stomach, small intestine and colon.” Because of it’s direct relevance to the information in this book, much of this section will be quoted from this article. The

authors explain that the gut brain," is a network of neurons, neurotransmitters and proteins that zap messages between neurons, support cells like those found in the brain and a complex circuitry enables it to act independently send and receive impulses." record experiences and respond to emotions. Nearly every substance that helps run and control the brain has turned up in the gut.

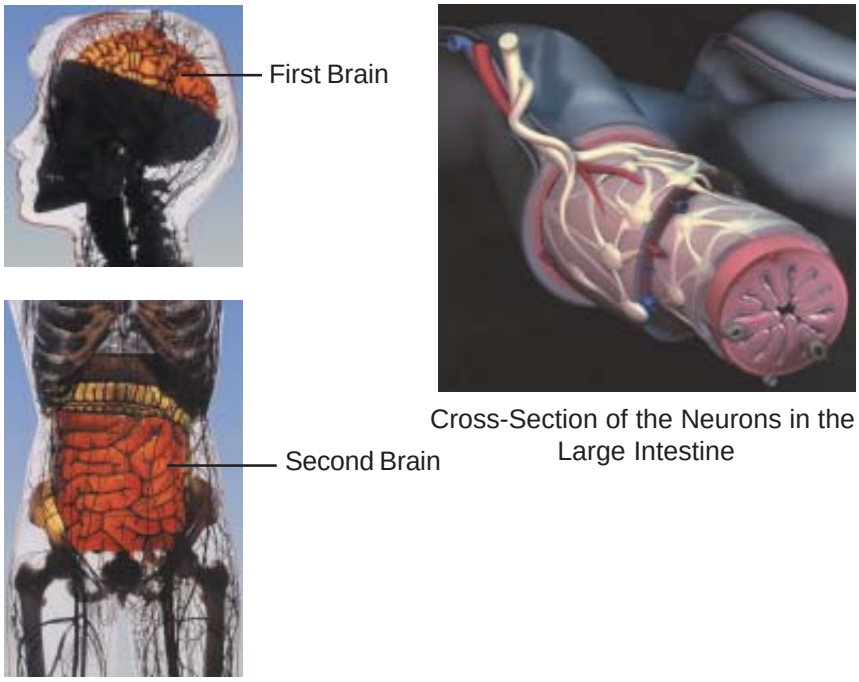

Fig. 5 *Energic nervous system feeds the second brain*

"Since offspring need to eat and digest food at birth, nature seems to have preserved the enteric nervous system as an independent circuit only loosely connected to the central nervous system. A clump of tissue called the neural crest forms early in embryogenesis; one section turns into the central nervous system, another piece migrates to become the enteric nervous system. Only later are the two nervous systems connected via a cable called the vagus nerve."

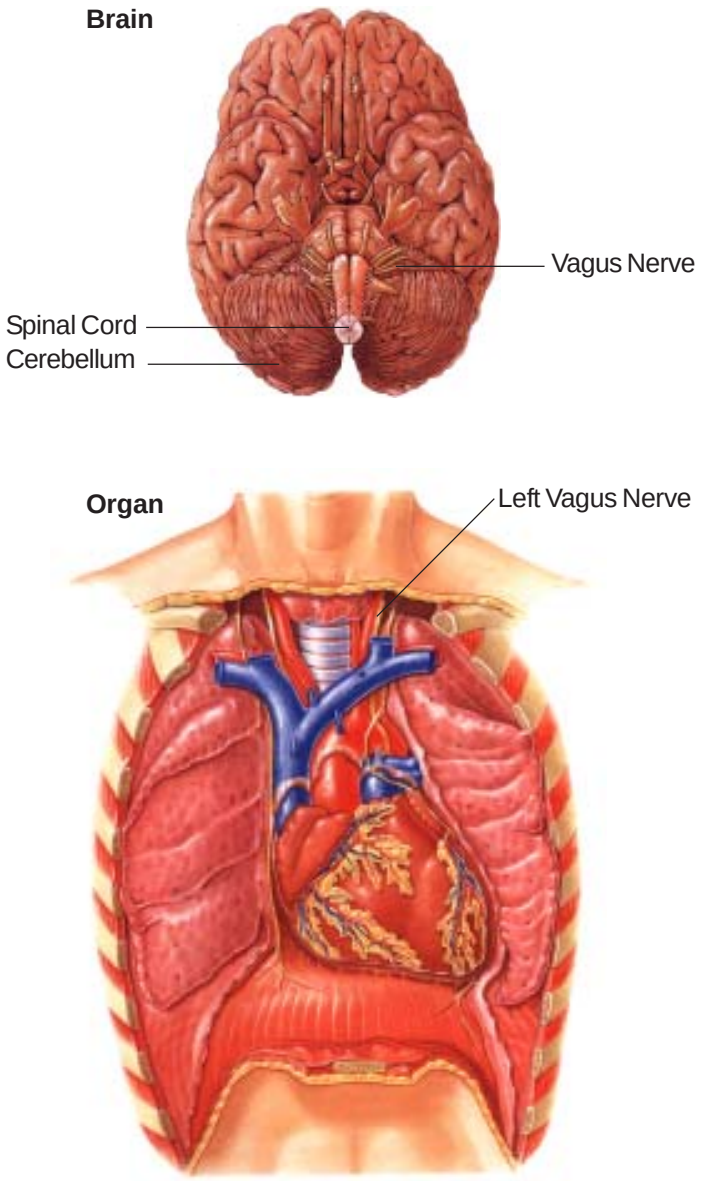

Fig. 6 *Energic and Central Nervous System connected by Vagus Nerve*

"The gut contains 100 million neurons – more than the spinal cord has. Yet the vagus nerve only sends a couple of thousand nerve fibers to the gut. The brain sends signals to the gut by talking to a small number of "command neurons," which in turn send signals to gut interneurons that carry messages up and down the pipe. Both kinds of neurons are spread throughout two layers of gut tissue called the myenteric plexus and the submuscosal plexus."

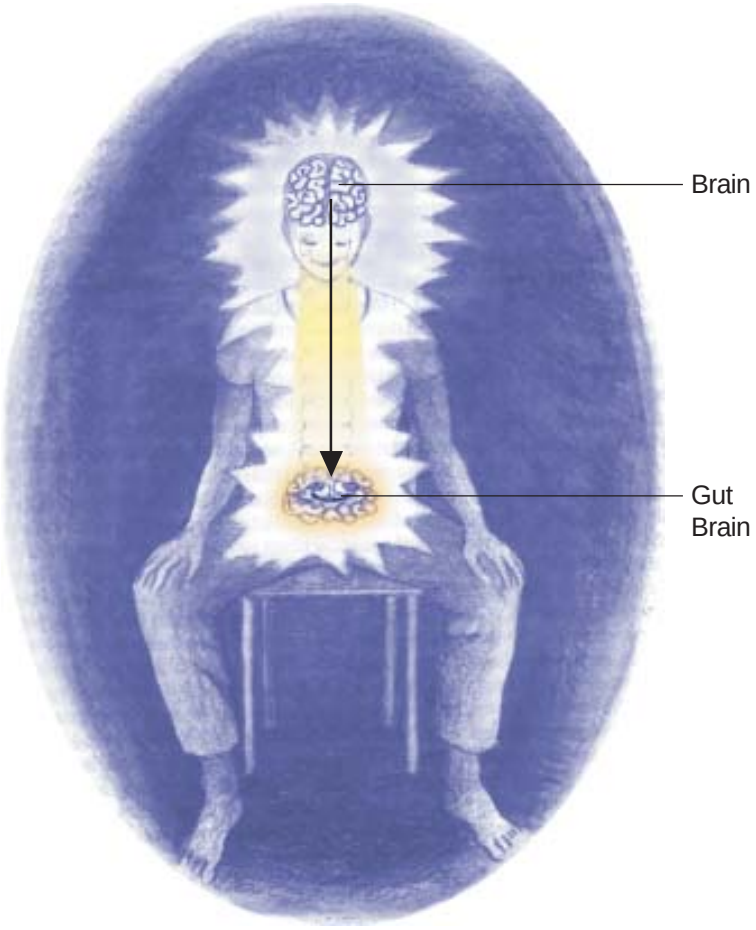

Fig. 7 *Vagus Nerve send corresponding messages to gut brain.*

"The gut's brain and the head's brain act the same way when they are deprived of input from the outside world. During sleep, the head's brain produces 90- minute cycles of slow wave sleep punctuated by periods of rapid eye movement sleep in which dreams occur. During the night, when it has no food, the gut's brain produces 90-minute cycles of slow wave muscle contractions punctuated by short bursts of rapid muscle movements. Such cross talk also explains many drug interactions; psychic drugs that affect the brain are very likely to have an effect on the gut as well." The gut can think.

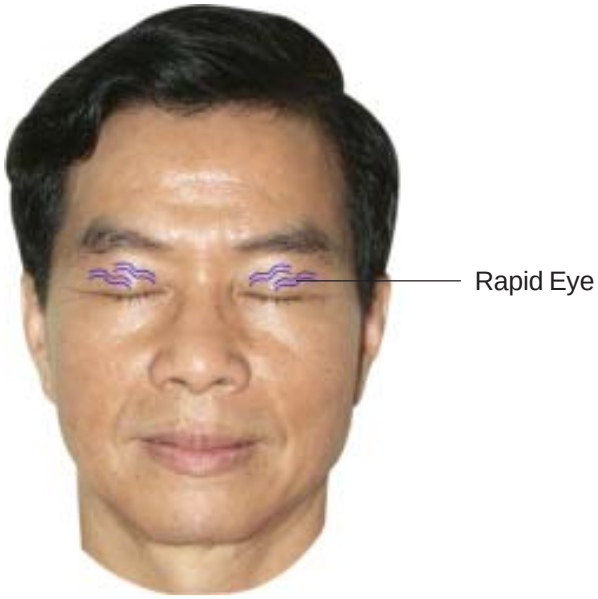

Fig. 8 *Rapid Eye Movement during Sleep*

For centuries, Taoists have been working with this complex and hidden brain in the gut. They have realized and worked with the specific alchemy of the body and used it's simplicity for healing purposes.

For example, water and it's properties can be reflected to the cycles of human life. The human body is about 90% water. Starting

with ice, ice changes to water, and then water changes to steam or gas. This transformation is going on every day. The sun shining on the water. Without the sun shining on the water, very quickly everything that we know of on the world would vanish. Without the steam, there would be no rain. We've had the same water going around in this recycled manner for 100 million years. The ancient Taoists said that the secret of immortality is to transform all liquids into life force.

Ice *Water* *Steam*

Fig. 9 *Transformation Cycle: Ice, Water and Steam*

Reconnect to yourself

Taoism believes that the mind, body and spirit must work together.

1. Sexual organs: The Taoists discovered that although the sexual organs are responsible for *generating* life force energy, they cannot store the energy efficiently. Once a certain amount of energy has been generated, some energy has to be dumped out.
2. The brain can access and generate the higher forces, but it is not easy to store this energy in the brain. We need to train the brain to increase its ability and its capacity to store energy. The brain energy, when increased to a certain level can enable more synapses to grow, and can help convert protein into material the brain cells can use. Taoists believe that with training and practice, one can learn to grow more brain and nerve cells, as well as increase the number of synapses or connections between the nerve cells in the central nervous system.

3. The organs of the body can also generate energy, but much less than the sexual organs and the brain. They do however have a much greater capacity to store and transform energy.
4. The three Tan Tien also can store energy as well as transform and supply it to the brain, spinal cord, sexual organs, and other organs.

The aim of Taoist basic training is to integrate the brain, sexual organs and internal organs into one system. If the brain generates an excess of energy, this energy can be stored in the organs. Excess sexual energy can also be stored in the organs and three Tan Tiens. If the brain generates a surplus of the higher force energy and we are unable to store this energy, we end up having to throw it away. It is like preparing food for one hundred people, and only one person eating. The rest is wasted. When too much sexual energy is produced and there is no practice in how to store it, it will be wasted.

Wisdom Chi Kung Practice

Preliminary Practices Breath Activation

Here we have the bulk of the practice, with an introductory breathing activation, the Wisdom Chi Kung and finally a practice which will tie the two together. The first part of the practice is standing up, “spinal cord breathing.” Spinal cord breathing is about activating the “three pumps.” The first pump is the sacral or sacrum pump. Separating the sacrum movement from the hip movement is important because they are very different movements.

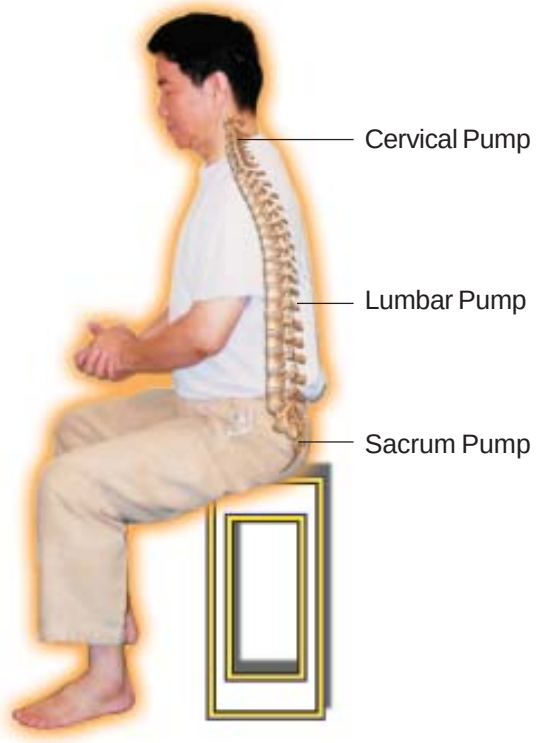

Fig. 10 *Activatng three pumps in the body.*

The sacrum needs to pump the fluid to flow up the spinal cord and to the brain. When you are sitting all the time, you are sitting on the sacrum, on your pump, the fluid does not flow. To activate this pump begins the perenial and sacral flow of energy, sustaining this flow throughout the body, regulating the distribution of energy to all the different points along the meridians.

In order to activate this you must inahle and expand the chest, arms bent at the elbows and extended to the sides of the body. Exhale, tuck the tailbone under you and round the back, bringing the elbows toward one another in the front of the chest. Smile, Inhale, expand the chest, tuck the chin in toward the throat, push the chin back and raise the crown, bring the arms out toward the sides.

Repeat this movment 36 times. This movement activates the crainial and sacral pumps, and loosens all the joints in the spine. When you get old, the brain is no longer fed by this fluid and large parts of its capacity are lost. That's why many older people begin to shrink, their bones actually start to shrival, and condense. There is no fluid for elasticity of the muscles or bones, creating a loss of mass of these parts.The brain "dries out" and often this is the reason for decreased mental capacity.

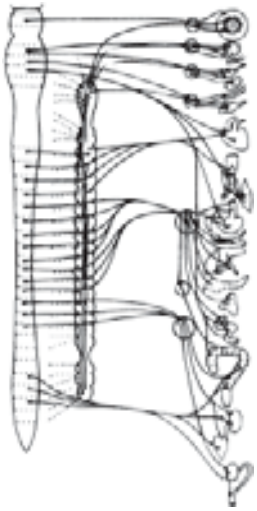

Fig. 11 *Activate sacral pump with spinal cord breathing.*

Because the human being stands erect, it takes a powerful pump to pump the fluid all the way up to the brain. The pump has to work against the force of gravity to push the fluid all the way up to the brain. So the sitting position, especially sitting on the sacrum makes this very difficult.

Study the diagram carefully and make sure you understand the exact movement. Look into a mirror to see that you are doing the movement correctly

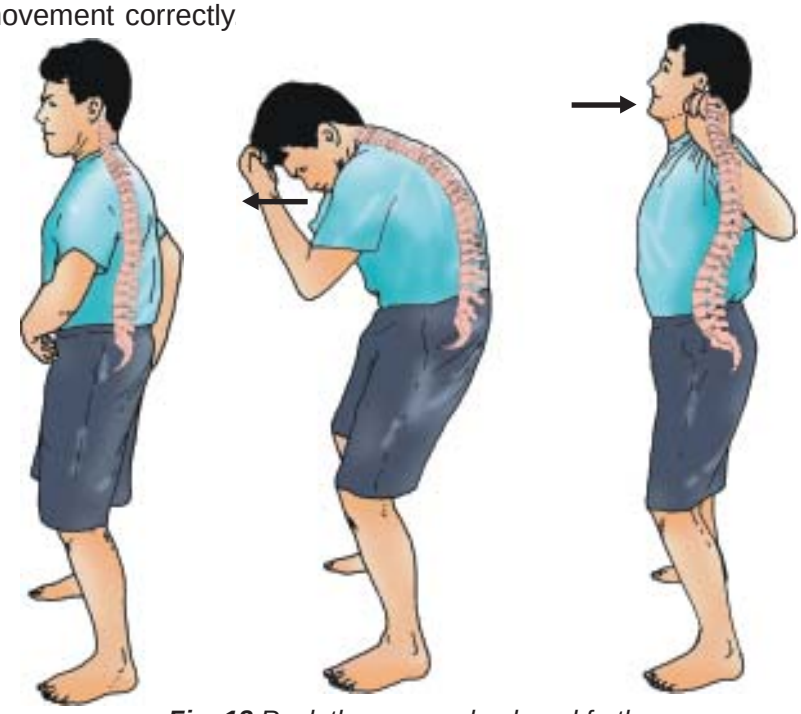

Fig. 12 *Rock the sacrum back and forth*

We really only see this movement in the pop stars in our society. That is how they make millions of dollars. When people see the rock singers moving like this, they feel sexually aroused, they feel so excited and free in the body that they begin to circulate this sexual energy. The sacrum bone is considered the secret bone or sacred bone.

Centuries ago, this movement for 'ordinary' people was forbidden to see. The young virgin girls were taught by priests to dance for God, calling it a sacred dance, in which only the priests themselves could watch. Not surprised are you?

In these ceremonies, when the sound of a drum is made, the heart activates, the sexual energy rises up but often jams in the brain. When the energy does not move people go crazy or become obsessed because this energy is constantly creating pressure on the brain. Much sexual frustration happens with this jamming also because of the fantasy and dreaming created in the brain, and this energy not being expelled through the body.

So we need to move the sacrum back and forth like this.

When you move like this you activate the sacrum pump and pump the fluid up the spinal cord.

Fig. 13 *Fluid pumping up the Spine by rocking the sacrum.*

The next pump is the Door of Life, above the sacrum, including the lumbar spine. When you start to rock the sacrum and the Door of Life Center, both move and the fluid starts to circulate. When the fluid circulates to these areas, the posture becomes more erect, your stance will improve and height will increase. By rocking and walking, these pumps will activate, and the oxygen from your breath will induce appropriate movement of the blood in this area.

Fig. 14 *Activate the Door of Life*

The next pump we call the cranial pump. The first opening part of the movement is to lower the chin down and pull the chin back so the sacrum pump also moves as well. This opens up the neck, crainal sutures, muscles, parathyroid and thyroid glands and opens up the lungs for increased oxygen. Rock the neck back and forth 36 times, including the breath, inhale and exhale each time.

Fig. 15 *Activate the Cranial Pump*

Because the neck and cranium are so intrinsically connected, by activating one, you automatically activate the other. The cranial-sacral movement has been studied for a long time now, and there are even specific forms of bodywork and healing methods that focus only on this flow between the two pumps. This flow is actually fluid called dural matter, encased in a sac, that lubricates the cranium, the entire spine and vertebre, and around the sacrum and pelvis.

It's like having a pully at the head and sacrum, with a rope connecting the two. When one side of the rope is pulled, the other is activated, but pulled in the opposite direction. By feeling the pulls of this movement, one can increase the healthy flow of the dural matter and improve the alignment of the corresponding bones and muscles. Many times as children, we fall on the tailbone, this impact creates movement of the sacrum, often inhibiting the connection to the crainal. This then affects the way the cranium and sacrum connect with each other, and it takes much awareness and attention to appropriatly make this connection again.

When this connection happens and all three pumps are activated, there is a natural flow of the energy through these pumps to activate Chi and enliven the body.

Fig. 16 *Combination of all three pumps Activated.*

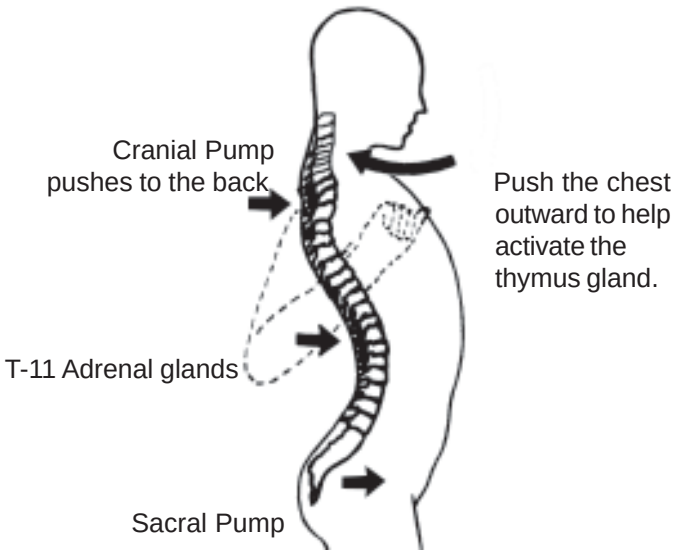

Fig. 17 *The sacrum tucks, the door of life pushes to the front, the sternum also pushes to the front, and the cranial pushes to the back.*

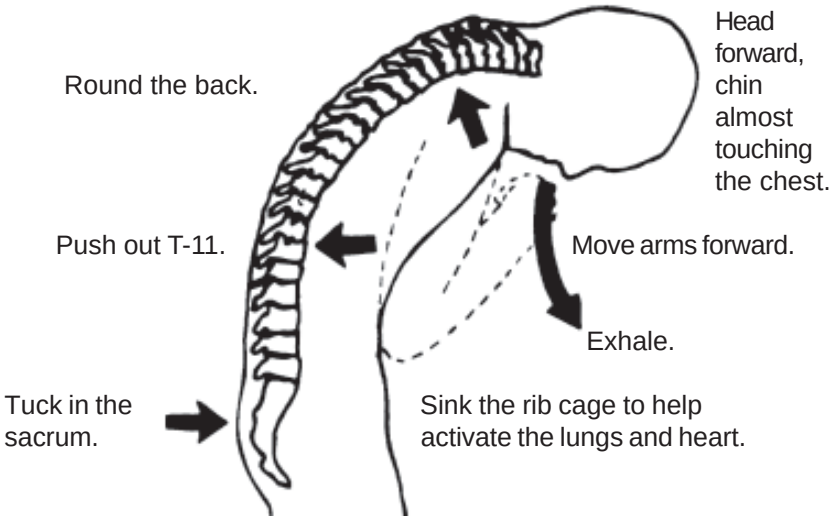

Fig. 18 *The sacral tilts, the door of life pushes to the back, the sternum tucks in and the chin tucks as the cranial opens.*

Breath and Laughter

During the course of my study, in sitting with different masters, every one has given me at least one breathing technique. Then after many years, practicing all these different techniques I came to realize something. The Tao texts always talks about a 'drum' beating in the Tan Tien, like a vibration there. I realized we naturally have a very effective and powerful breathing technique. This comes from when we laugh. When this is a real, deep, honest laugh, that is the abdominal laugh.

You will see that when you learn how to laugh, the diaphram activates up and down and this causes a pumping. Taoism refers to this as the second heart. It has the same kind of pumping action as the heart. When people are sitting, and sitting for a long time, thinking and thinking, nearly two thirds of the blood is stagnant in the organs. It does not move at all. This is a major cause of all sickness. The other being when the heart is pumping but the blood is stagnant and it does not move. So when you learn how to laugh, and the vibration in the Tan Tien is very strong, just like a heartbeat, this pump helps to move the blood, moving the Chi. With this, the heart can pump so much more easily. So if you can activate the vibration in the Tan Tien, Taoism says it is like a second heart. Many good things are associated with this second heart.

Fig. 19 *Activate the Second Heart by abdominal laughing*

So we are going to learn this laughing three different ways.

One way laughing loud, so when you laugh loud, you feel the vibrations.

The second way like you are in church and suddenly something is very funny but you cannot laugh loudly and you feel a higher vibration in the throat.

The third way you laugh is with the cranial, something right in front of you is so funny you have a feeling very big in side of you.

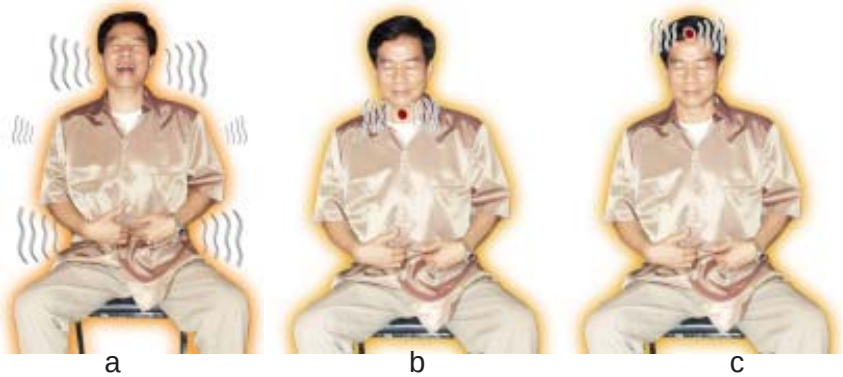

a b c

Fig. 20 *a. Laugh out loud b. Laugh a little c. Laugh with the cranium*

Feel it like a drum beating and vibrating deep inside you.

When you learn to laugh deep inside, feel that the laughter is vibrating tremendously inside you. When you do this, the blood, the Chi, the energy is all moving. So the stagnant Chi is gone, and the most important part, the heart, can work less.

Fig. 21 *First Fire activated: the Tan Tien Fire.*

Fig. 22 *Feel the Vibration of love filling your spine.*

Introduction to Three Fires

With the natural connection of the laughter activating the second heart, and establishing the vibration in the Tan Tien, we start smiling down to introduce the activation of the three fires: Inhale the smiling energy and exhale it down to the Tan Tien.

1) Feel the smiling energy in front of you.
2) Lift up the corners of the mouth, and empty your mind.
3) Keep on smiling, empty your mind down to the Tan Tien.
4) Fix a point in the abdominal area, and just keep smiling down.
5) When you get to a certain level the Tan Tien starts to get warm. Once you get it warm, the fire the first fire has started, the fire burning under the sea.

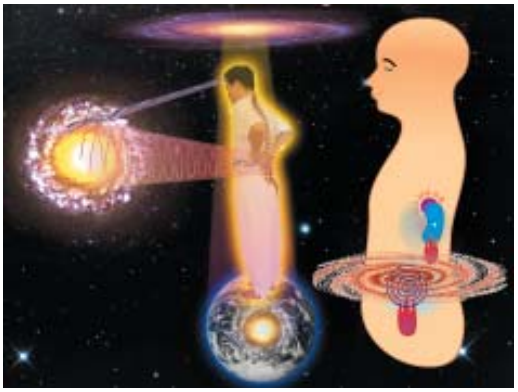

Fig. 23 *Second Fire activated: Kidney Fire (Door of Life)*

You can touch the naval, focus on this area, the door of life, and feel the door of life warm, there is a fire burning here.

This is the kidney fire activating, the kidney fire is so important because it is the original force. We are born with this force and are continuously using it throughout our lifetime. The Taoists believe that when this force is drained out, your life force is finished. This force is actually involved with the sexual energy. Everyday this fire is burning, and when it goes out, you die.

After that you move the hands, and keep smiling down, feel the heart fire activate, the loving energy, the compassion energy, and when you feel the heart fire burning, make it soft, very very soft.

Fig. 24 *Third Fire activated: Heart Fire*

Keep emptying the mind down, emptying the mind down, the energy activates

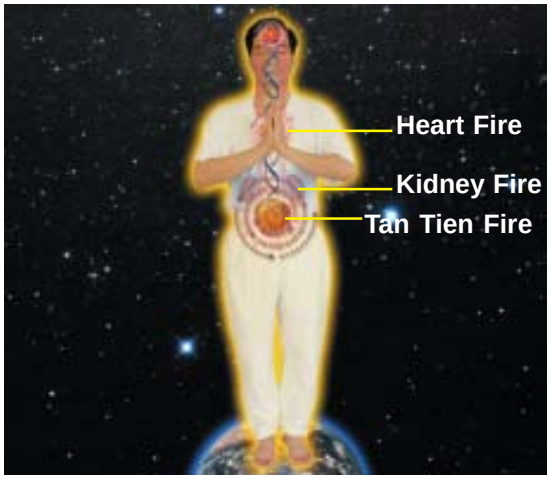

Fig. 25 *Activation of Three Fires: Tan Tien, Kidney, Heart*

You will begin to feel that something actually begins to charge up to the brain. In the beginning you might feel something like a numbness in the brain. And then the energy begins to rebuild, begins to repair, starts to develop new brain power.

Fig. 26 *Brain Activation as a result of the Fire Activation.*

Fig. 27 *Taoist Practices Charge the Entire Being with Energy.*

In all the medatative practices in the world, the first step is to get the energy flowing. Wether it's chanting, praying, singing, mantras, focus on a statue or whatever, there is always instruction like this. They all have a starting pattern to focus and move the energy.

But the goal is energy. So in Taoism, we do not have all these other patterns in front, we go directly into the real practices and techniques to induce the spiritual flow. There has to be an understanding and explanation of how to get this moving, so this next section is dedicated to doing just this.

Now that you are aware of your breath and the essential focuses of the practice, we can now begin the heart of the Wisdom Chi Kung Practice.

Wisdom Chi Kung Practice

Continue to bring your focus and Awareness to the Tan Tien and the acivated fires in the body. This will allow you to increase your energy more and more. The continued focus is the key to this practice.

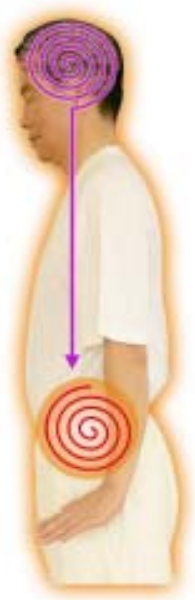

Fig. 28 *Smile down & empty the mind to the Tan Tein, Abdominal brain*

Fig. 29 *Wisdom arises from the awareness and senses of appropriateness created when the head brain and the abdominal brain connect. Fill the Tan tien with Chi.*

Fig. 30 *Tan Tien Fire: Activate the Tan Tien Fire to transform the Chi.*

Fig. 31 *True Fire: a. Fire under the Sea*
b. Activate the Kidney Fire c. Always retain awareness at the Tan Tien

Fig. 32 *Imperial Fire: Activate the Heart Fire*
Keep the Heart Soft. Feel Love, Joy and Happiness.

Energy transfomed into the organs can charge back up to the brain when the mind is empty.

Fig. 33 *Smile to the Kidneys. Continue to empty the mind to the Tan Tien and the Kidneys.*

Fig. 34 *When the Kidneys are filled, transformed Chi will arise up and fill the back part of the brain. Keep 95% of the attention at the Tan Tien.*

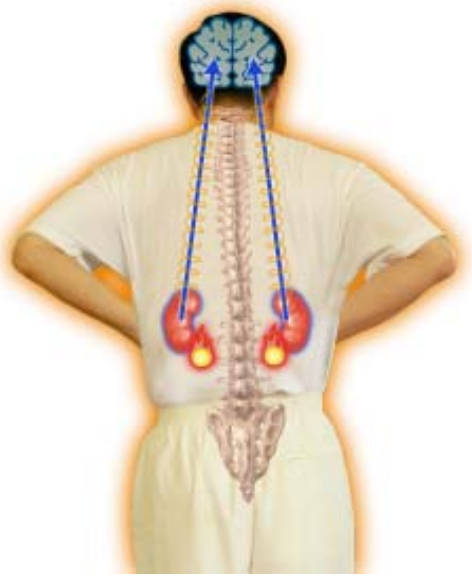

Fig. 35 *Left & Right sides of the back of brain both fillwith Kidney Chi.*

Fig. 36 *Smile, relax, empty the mind down to bladder & sexual organs.*

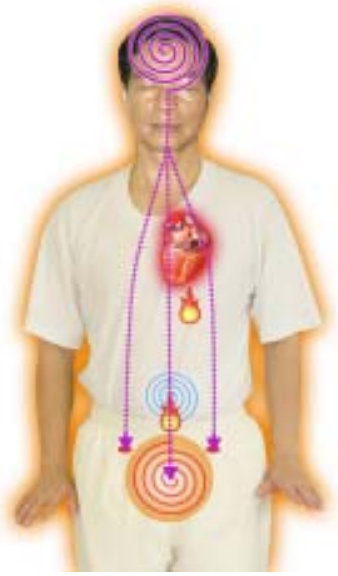

Fig. 37 *The bladder and sexual organs can store and transform Chi.*

Fig. 38 *The transformed Chi will rise up to fill the center of the brain.*

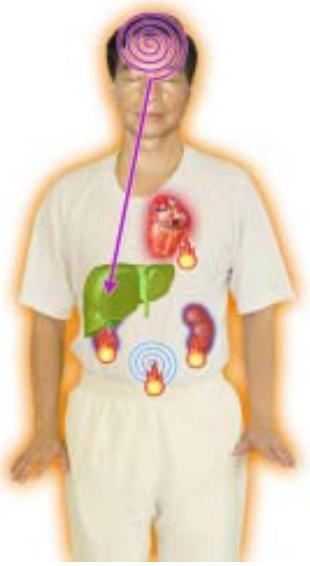

Fig. 39 *Smile. relaxand empty the mind down to the liver and gall bladder. Let them transform with Chi.*

Fig. 40 *Chi transformed in liver will rise up to fill center of right brain.*

When we empty our mind into our organs, we will have extra energy to repair and heal the body.

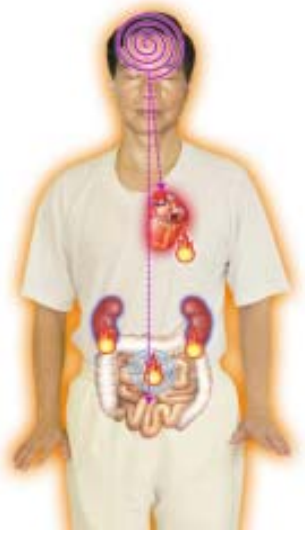

Fig. 41 *Smile, relax, empty the mind into the heart and small intestine.*

Fig. 42 *The heart and small intestine can store and transform Chi.*

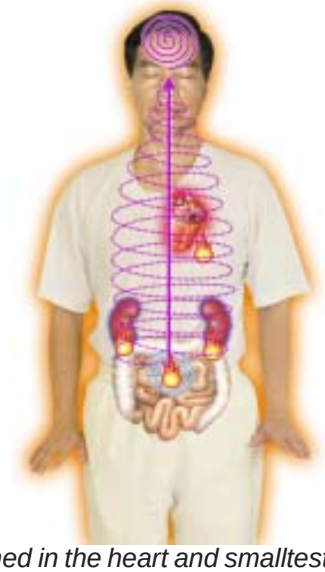

Fig. 43 *Chi transformed in the heart and smalltestine will charge up and fill the front part of the center of the brain.*

Fig. 44 *Smile, relax, empty the mind down to the Stomach, Spleen and Pancrease. 95% of the attention on the Tan Tien.*

Use the Inner Smile to charge the energy back up to the brain to repair, increase memory and to expand the capacity of the brain.

Fig. 45 *Chi transformed in the Stomach, Spleen and Pancrease will charge the left Brain with Energy.*

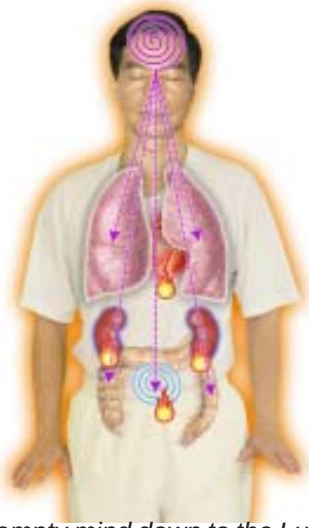

Fig. 46 *Relax, smile, empty mind down to the Lungs & Large Intestine.*

Fig. 47 *Transformed Chi from the Lungs and Large Intestine rises up to fill the front part of the left and right Brain.*

Fig. 48 *Continue to empty the mind down to the Tan Tien and Organs.*

Fig. 49 *When the mind is empty. transformed energy from the Organs can charge the Brain with Chi.*

Fig. 50 *Once the mind has become empty, then it can be filled with transformed Energy.*

Combine Chi and intention with the universal energy and it will be returned to you, multiplied many times, to fill you with enhanced Life Force.

Fig. 51 *With the brain filled with Chi, be aware of a star or light above you. Always maintain awareness of the Tan Tien.*

Fig. 52 *Be aware of the universe, the stars, and the galaxies in it. Smile and empty the mind to the universe. Relax and let go and be compleatly empty.*

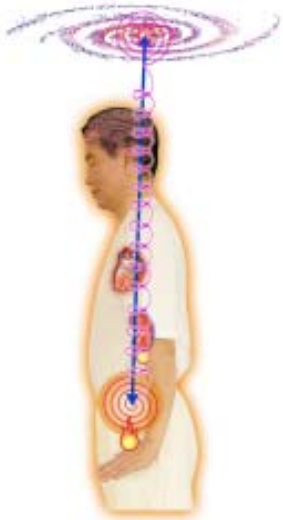

Fig. 53 *Touch and be aware of the universe, the stars and galaxies in it. Continue to be aware of the Tan Tien so you do not lose yourself.*

Fig. 54 *Open yourself to contain the universe. Combine the universal energy with the transformed Chi at the Tan Tien. This is the secret of all the great masters.*

Fig. 55 *Combine your Chi and good intention with the high universal energy and let this multiply while retaining a majority of your awareness at the Tan Tien.*

Fig. 56 *The energy will be returned to you multiplied many times to fill the brain and the whole body.*

Fig. 57 *Hold the enhanced Chi in the brain for as long as it is comfortable. As your practice deepens, you will be able to hold it longer.*

Fig. 58 *Empty the mind down to the Tan Tien once again. Feel this enhanced energy fill the Tan Tien with a higher frequency of Chi which will be refined and enhanced and available to fill the brain again.*

Fig. 59 *Once the brain has been filled again, empty the mind again to the universe. Once it is empty, the mind can be filled with a higher force which will open the capacity for increased understanding and wisdom.*

Integration

Allow yourself a moment to feel the practice. Notice any differences in your, body, mind, heart, from when you began the practice, and now. It may be subtle to begin with, but just notice and bring your attention to what has altared. As you consistantly expand the pratice the sublties will increase and your awareness of the Chi that is flowing through your body will enhance dramatliclly.

As you 'check in' with yourself at this moment, reflect on any other thought processes that occured during your practice. Notice the activity of the "Monkey mind" and quietly thank and tell that part of your consiouness that it is no longer needed during this time of meditation. Be gentle with yourself, and allow yourself ample time to familiarize and grasp the Wisdom Chi Kung practice as "every Oak starts as a seed."

Combination of Practices

Now that you have been introduced to the system, it is important to make a connection with the different aspects of these practices, to combine and integrate, for a more compleate understanding.

In practice a, we felt the breath increase by internally activating the three pumps, the three fires and finally feeling the sensations and affects of laughter in the body.

So again, put your hands on the naval. Everyone knows laughing lightens the spirit, but do we always have to have a reason to laugh? You still can laugh without a reason, it is actually very important. Hearing yourself laugh will also make you laugh more. Especially when your by yourself! Sometimes I think how hilarious it is that I am alone and laughing at nothing. But I am actually laughing at myself laughing at nothing, and that's quite funny. So I end up laughing even more!

So let's try laughing with no reason. If you are feeling too serious or too emotional, loud laughing on tape actually makes you laugh.

Fig. 60 *Feel the laughing, giggling, smiling energy deep inside.*

Again, experience the sensations of laughter in your entire being. Laugh loud, then softer, and finally give yourself a little giggle as if you just remebered one fo the most embarassing times of your life.

Put your hands down over the naval,

Now very subtley, feel the smiling energy around you.

Keep a slight smile on your face

Inhale, exhale, feel the breath sinking down.

Smiling, relaxing, breathing and sinking down to the Tan Tien

Keep reminding yourself, empty the mind down, fill the Tan Tien with Chi.

If the mind is wondering around, fix the mind on the lower Tan Tien, breathing the mind down, continuing to smile.

Fig. 61 *Bring the wondering mind back with the breath & into the Tan Tien.*

One hand touch the naval invite your awareness to feel the all three fires activated Door of Life, Imperial fire and Tan Tien.

Keep smiling down to the Tan Tien, the eyes like the sun shining on the water.

Now move the hands down and cover the pelvic area and smile down to the sexual organ picture the sexual organ, exhale, relax, empty the mind down down to the lower abdominal, feel the sun shining on the water.

Fig. 62 *Sun shining on water: onto Three Fires and Sexual organs*

Now move the hands to the naval, and just start spiraling don't worry about the direction down and begin to feel the energy being stored in the naval area. Feel the naval begin to grow warmed energy when you feel the energy begin to charge up to the brain.

Fig. 63 *Feel the relaxed, charged energy fill the brain with Chi.*

The next thing you are going to get is a lot of saliva, very sweet saliva or nectar coming down. We can swallow this nectar down to the Tan Tien. This is a special form of nourishment from the brain.

Fig. 64 *Swallow nectar from the brain (sweet saliva) into Tan Tien*

Rest and feel the naval and lower Tan Tien increase the warmth. Feel the nourishment of the smile and lughter, the relaxing breath, and the rejuvination of Chi vibrate your being.

Fig. 65 *Rest and be rejuvinated.*

Integrating Wisdom Chi Kung; Ending the Meditations

This very basic practice is the most important thing you can do in your life. Even when you learn the Universal Tao practice to the highest level, this is the most important foundation. Every time you must do this same practice; Empty the mind, stop the brain, fill the Tan Tien With Chi. Simple and effective, this practice is the most crucial.

Ending the meditations is perhaps the most important time of the meditations. This is the time when the body has to compleatly relax and assimilate everything that has occured before and during the practice. This is the time when the body, mind and spirit begin to intergrate, fuse together, and unify the external with the internal. This is the goal of the practice. This is why we do the practice, to be finished with it. When we are finished, we live our life and the practice becomes a part of who we are. What we live for, what we learn and teach, how we talk and breathe. How we relate to others and how we interrelate with ourself.

Take time at this time to feel yourself, notice any changes, or anything that has not changed. Just to notice, and be gentle with yourself at this crucial stage of integration. When at this stage, our inner being begins to strengthen, and the spirt becomes stronger with awareness.

Awareness of our being allows our counsiouness to expand, we become wiser. This is Wisdom Chi Kung. Empty the mind, raising the Chi. The more we can do this, the more our wisdom increases to higher capacities. Generate energy, and at the same time be empty, this is Wisdom Chi Kung.

Master School

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The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this booklet. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

Master Mantak Chia is the creator of Universal Tao System, Healing Tao, Tao Yoga and is the director of the Universal Tao Master School at Tao Garden Wellness Retreat in the beautiful northern countryside of Chiangmai, Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Wisdom Chi Kung

Lower the mind, fill the Tan Tien with Chi. This practice teaches the art of meditation and physical rejuvenation. Opening the brain to be filled with the knowledge of the Universe, by increasing our own mental capacity. Wisdom Chi Kung is a simple and highly effective method which prepares the mind for higher levels of Universal Tao knowledge.

A New Approach to Healing

In combination with Universal Tao healing systems such as the Inner Smile, Laughing Chi Kung and Chi Nei Tsang, Wisdom Chi Kung prepares the practitioner for increased understanding of how to heal the body with an empty mind. Techniques taught in this booklet are for increasing Mental Alertness, Memory, Clarity and to have the ability the maintain this for a lifetime

Meditation that will connect with the Universe

Unlike other meditations Wisdom Chi Kung in this booklet teaches to connect with the universal energies, expand our awareness out, but charge the body with this energy, not to loose sight of the physical realm. It is essential to maintain a healthy connection with our bodies, and Wisom Chi Kung is one way of doing this.

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Sexual Secrets
Every Couple Should Know

THE MULTI-ORGASMIC COUPLE

How Couples Can Dramatically Enhance Their Pleasure, Intimacy, and Health

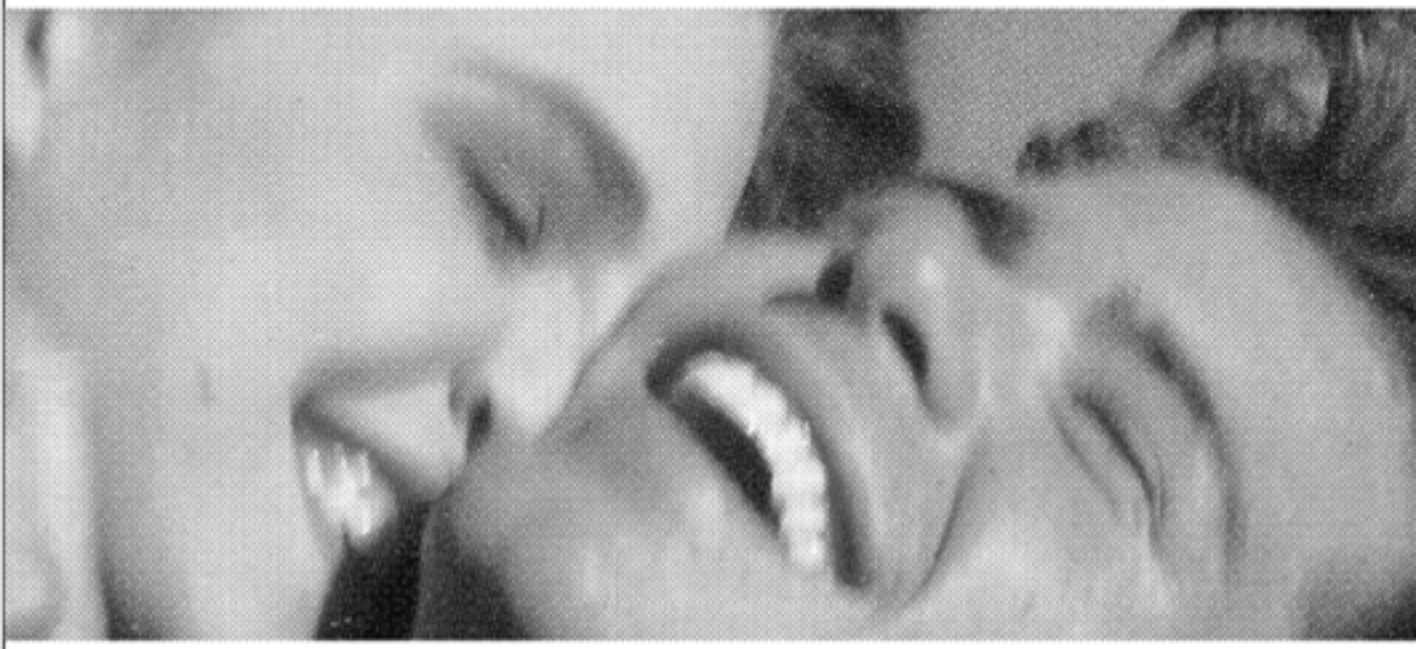

Mantak Chia and Maneewan Chia
Douglas Abrams and Rachel Carlton Abrams, M.D.

THE MULTI-ORGASMIC COUPLE

Sexual Secrets Every Couple Should Know

Mantak Chia,
Maneewan Chia,
Douglas Abrams,
and Rachel Carlton Abrams, M.D.

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WARNING: *These are powerful practices*. The techniques given in this book can profoundly improve your health as well as your sexuality. However, we do not give any diagnoses or suggestions for medication. If you have a medical condition, a medical doctor should be consulted. People who have high blood pressure, heart disease, or a generally weak condition should proceed slowly in the practice. If you have questions about or difficulty with the practice, you should contact a Universal Tao instructor in your area (see Resources: Universal Tao Books and Instructors).

Practice makes pleasure. Because this book is based on a three-thousand-year tradition of actual sexual experience, the authors are well aware of the effort that is involved—pleasurable as it may be—in changing your sex life. Learning sexual secrets is one thing, but using them is quite another. The techniques in this book have been tested and refined by countless lovers over thousands of years in the laboratory of real life. We have tried to present them in as clear and simple a way as possible, but the only way to benefit from them is to really use them.

This position, which the missionaries made famous, is extremely good for harmonizing, since similar body parts are touching

Many men find that this is the easiest position in which to have multiple orgasms. In this position, the man can relax his pelvic muscles and pay close attention to his arousal rate

PREFACE

It may help to know a little about the authors to better understand the book and the many benefits of multi-orgasmic lovemaking. Let us begin by explaining how we came to write this book with Mantak and Maneewan Chia, since we never set out to write a sex book.

We stumbled across Taoist sexuality while Rachel was entering medical school and Doug was studying and working ten-hour days. We were amazed not only at the far more pleasurable and profound lovemaking we experienced but also at the increased energy we had for our work and our lives as a whole.

Taoist sexuality, also called the "Arts of the Bedchamber," is a three-thousand-year-old tradition that has long known about male multiple orgasms and many other secrets of sexual satisfaction. It was developed to help couples experience more pleasurable and more healing lovemaking. With all the shame and misinformation that most of us grow up with about our sexuality, the Taoist Arts of the Bedchamber were a revelation.

Taoist sexuality, also called the "Arts of the Bedchamber," is a three-thousand-year-old tradition that has long known about male multiple orgasms and many other secrets of sexual satisfaction.

We shared the existing books on Taoist sexuality with our friends, who said the practice sounded wonderful but they didn't know how or where to begin. Unfortunately, there was no simple step-by-step book that showed ordinary men and women like us how to become multi-orgasmic and how to experience the physically healing, emotionally intimate, and spiritually profound aspects of lovemaking. Finally, after many requests from friends, we agreed to try and write such a book.

After extensive reading and research, it was clear that Mantak and Maneewan Chia were the most authentic and practical teachers of this tradition. Mantak Chia had studied for many years with Taoist masters, learning the sexual wisdom that he distilled into a unique system he called "Healing Love." Its benefits are greater healing and love as well as greater pleasuring and passion. He has taught thousands of people around the world, has trained hundreds of teachers, and is respected as the world's leading teacher of Taoist sexuality, as well as powerful Taoist practices such as tai chi, chi kung, and others.

The Taoists masters, we quickly learned, were themselves physicians who studied sexual response with precision and insight. We were interested in

concrete benefits that people could experience in their own bedroom, as were they. We wanted to join the Taoist understanding and techniques, which have been refined over several thousand years, with the latest in scientific research.

We decided to write a book primarily for men, which was eventually called *The Multi-Orgasmic Man,* because much of the power of Healing Love depends on the man's ability to cultivate his sexuality and ideally to become multi-orgasmic. The book struck a chord and has been read by hundreds of thousands of readers around the world in more than ten languages.

While we were discussing the first book with readers around the country, we were continually asked when we would write a book for couples that would help women as well as men to incorporate Healing Love into their lives. Finally, several years and countless drafts later, we offer *The Multi-Orgasmic Couple.* We hope we have done justice to this rich tradition, presenting modern readers with the sexual wisdom we so desperately need in these days of carnal confusion.

This book has benefited from the expertise, wisdom, and skill of many people, who we would like to thank and acknowledge: the Universal Tao instructors who teach these practices around the world and who contributed to this book, including Michael Winn, Marcia Kerwit, and B. J. Santerre; the Eastern and Western sexologists whose research made this book possible, including Felice Dunas, Beverly Whipple, and Theresa Crenshaw; the extraordinary publishing team at HarperSanFrancisco, including John Loudon, Terri Leonard, Lisa Zuniga, Priscilla Stuckey, Karen Stough, Joseph Rutt, Joan Olson, Steve Kennedy, Kris Ashley, Calla Devlin, Margery Buchanan, Laura Beers, Jim Warner, Kathi Goldmark, Sam Barry, and Steve Hanselman; the readers, friends, and advisors who improved the manuscript, including Megory Anderson and Heather Kuiper; and our agent, Heide Lange, who has all three qualities—expertise, wisdom, and skill—in equal and extraordinary measure.

Finally, we would like to thank the readers, both men and women, of *The Multi-Orgasmic Man,* who have told us how the Arts of the Bedchamber have transformed their sexuality. We hope you and your partner (or future partner) find the joy and satisfaction that we have in this extremely powerful and profound practice of Healing Love.

Douglas Carlton Abrams
Rachel Carlton Abrams
Santa Cruz, California
April 17, 2000

Shocking as it is for most people to hear, both women *and men* can have multiple orgasms. In this book, both you and your partner will learn how to experience multiple whole-body orgasms. However, this is just the beginning of the sexual knowledge that we present. When you and your partner are both multi-orgasmic, you will each experience far greater individual pleasure. You will also be able to harmonize your sexual needs and to reach ever more fulfilling levels of intimacy and ecstasy together.

Multiple Orgasms for *All* Men

Male multiple orgasms have been confirmed by Alfred Kinsey and other sex researchers since the 1940s.

Few people know that men can have multiple orgasms. While this fact has been known for several thousand years in the East and has been confirmed in the West by Alfred Kinsey and other sex researchers since the 1940s,[1] it still remains a surprise to most men and women.

In our earlier book, *The Multi-Orgasmic Man*, we reviewed the most recent scientific evidence and presented ancient techniques for helping men become multi-orgasmic. We tried to give men a manual for a healthier and more satisfying experience of male sexuality. In this new book, we have tried to give couples a guidebook, or what the Taoists called "a pillow book," to deepen both partners' ability to experience pleasure, health, and intimacy.

Multiple Orgasms for *All* Women

While the fact that women can have multiple orgasms is well known, more than 50 percent of women have never had multiple orgasms or are not regularly multiply orgasmic. In this book, we will show all women how they can become consistently multi-orgasmic, and for those who are already multi-orgasmic we will show them how to expand and intensify their orgasms.

Harmonizing Sexual Desire

Lovemaking in which both partners are multi-orgasmic allows couples to reach many peaks of orgasmic pleasure together. Equally important, it allows

Multi-orgasmic lovemaking allows men and women to harmonize their often different sexual rhythms and desires.

men and women to harmonize their often different sexual rhythms and desires so that they can have a deeply satisfying and profoundly intimate love life.

But sensual pleasure, as exquisite and enjoyable as it can be, is only the beginning.

Physical Health, Emotional Intimacy, and Spiritual Growth

This book draws on thousands of years of sexual knowledge to show couples how sexual energy can be used to cultivate all other aspects of their relationship, including their physical health, emotional intimacy, and even spiritual growth. In the modern world, we have torn ourselves apart: we have separated our genitals from the rest of our body and our body from our spirit. In this book we show couples how to put the pieces together again for a level of health, intimacy, and spiritual union that many may never have known was possible.

The Loss of Sexual Wisdom

We live in a time of great sexual freedom but also great sexual confusion.

In the modern world, we have lost most of our sexual wisdom. We live in a time of great sexual freedom but also great sexual confusion. Sexuality is everywhere used to titillate us, but there remains an enormous amount of shame. Many readers may feel embarrassed about simply picking up a book on sexuality (*multiple orgasms*, no less!) in the bookstore. This is understandable since most of our churches, synagogues, mosques, and temples view sex through a narrow lens of fear and moralism. Most of us are left feeling profoundly anxious if not downright ashamed of our sexual needs and desires.

Even people with "healthy" attitudes toward sex still find it difficult to talk with their partner about what they want sexually. We may have little problem telling our partner where to rub our shoulders, but most of us are much more reticent to tell our partner where to rub our "privates." A major part of overcoming the shame that restricts our sexuality is learning that it is natural and discovering a more holistic and healthier view of human sexuality.

Discovering Sexual Wisdom

In this book, we present the sexual wisdom of the Taoist (pronounced DOW-*ist*) tradition. Originally, the Taoists were a group of seekers in ancient China (around 500 B.C.E.) who were devoted to understanding health and spirituality. In this book, we will call the Taoist sexual tradition "Healing Love" since lovemaking was seen as a powerful way to heal ourselves and each other. It was also called "Sexual Kung Fu." *Kung Fu* simply means "practice," so *Sexual Kung Fu* simply means "sexual practice." (Rest assured, you will *not* be breaking any bricks with your forehead or karate-chopping each other in bed.)

Sex Is About Health

For the Taoists, sex is about health, not morality.

The Taoists were doctors and were concerned with the body's overall well-being as much as with its sexual pleasure. For the Taoist then and now, sex is about health, not morality.

The Taoists deeply investigated the healing power of lovemaking. In addition to giving their patients pills, Taoist doctors would often prescribe making love in various positions to help cure different illnesses.

Taoist sexuality—or, as we will call it in this book, Healing Love—began as an important branch of Chinese medicine, and an active sex life was understood to be an essential part of health and longevity. In studies of older adults, modern medicine has recently confirmed that sex is in fact vital for our long-term health.

Among the early Taoists, sex was a serious science to be studied and understood like any other branch of medicine. In this way, the Taoists were like proto-sexologists, early Masters and Johnsons, you might say. Just as we study nutrition to prepare healthy food and study cooking to prepare delicious food, one was expected to study sexuality to make it both healthful and more enjoyable.

Sexual Harmony and Love for a Lifetime

The Taoists saw sexual harmony as essential for marital satisfaction. Indeed, this was one of the prime motivations in the development of the bedroom arts. They knew, like any modern-day couples' therapist, if there are problems in the bedroom the whole relationship suffers. Sexual harmony, however, is not always easy to achieve. Partners often have very different sexual needs. While

not all women or all men are identical, it was understood that women's sexual arousal and sexual response often differ dramatically from men's.

The Taoists referred to these differences as the result of male and female sexual energy (which they called *yang* and *yin*). We will explain to couples how these energies influence our sexuality and how to use this understanding to satisfy both partners' needs.

It is worth mentioning that while the Taoists were primarily concerned with harmonizing male and female sexuality, the practices are equally valuable for gay and lesbian couples. For the Taoists, all people have masculine (yang) and feminine (yin) energy, and they knew it is essential for couples—straight, gay, or lesbian—to harmonize the differences that exist between the partners. In addition, the practices for pleasure, healing, emotional intimacy, and spiritual relationship are equally powerful and important for gay and lesbian couples.

A New Sexual Evolution

While many of the Taoist practices for sexual fulfillment and physical health are now over two thousand years old, they remain extremely effective today. Over the past twenty years, since these long-secret Arts of the Bedchamber have started to be introduced to modern couples, there has been a quiet but profound sexual evolution in bedrooms and in relationships around the world. We hope the sexual arts and sexual science that we present in this book will help your relationship as they have helped the thousands of others who have practiced them.

Before you and your partner can explore the heights of Healing Love, it is important for each partner to cultivate his or her own sexual potential. In Part 1, "Solo: Multiplying and Expanding Your Orgasms," we first discuss how both men and women can become multi-orgasmic. Then, in chapter 3, we discuss how couples can expand their sexual energy to experience whole-body orgasms. The ability to circulate energy in your body will be important for the practices introduced in Part 2, "Duo: Sharing Passion, Healing, and Intimacy with Your Partner.

CHAPTER 7

Sexing the Spirit

In this chapter you will discover:

- The Importance of Your Sexuality for Your Spiritual Growth and Spiritual Life
- Energizing Morning Prayer Lovemaking
- Soul-Mating and Soul Orgasms
- How to Make Your Sexual Energy Most Powerful and Nourishing
- How to Transform Sexual Energy into Spiritual Energy
- Cultivating the Highest Form of Life Energy
- The Profound Connection Between Your Relationship and the World

Sexuality and spirituality are inextricably linked for Taoists.

Sexuality and spirituality are inextricably linked for Taoists. For this reason sexuality is seen as an essential part of the spiritual path. In the West, we have torn ourselves in two: a fleshy, sinful body and an immaterial, saintly soul. For the Taoists this separation is artificial. Indeed, Taoist sexuality allows us to experience an embodied, palpable spirituality. The soul itself is said to reside at the navel in the abdomen, and it is believed that high levels of orgasmic energy allow the soul to emerge. You probably didn't hear *that* in Sunday school.

For Taoists, sexual energy is sacred. Whenever we are aroused, whenever we are having sex, we are in communion with the divine, or universal, energy. But most people do not know how to use this energy to cultivate their spiritual life.

Sadly, most of the world's religious systems regard sex as negative or even evil and therefore try to suppress it. Even when they do not suppress it, religious traditions generally consider sex as a distraction or a hindrance along the spiritual path. Most people have been taught that they have to deny their sexuality to grow spiritually. According to the Tao, this is misguided. Sexual energy makes up approximately a quarter of our total life force. People who deny sexual energy lose access to this vital source of energy and vitality for their life *and* their spiritual growth.

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Morning Prayer

The Taoists developed a simple way to cultivate this vital life energy each morning, and they saw it as so essential to their spiritual as well as their physical well-being that they called it "Morning Prayer."

We tend to think of sex as a nighttime activity and relegate our love life to the moments before we go to bed. The Taoists knew this is often not an ideal time for lovemaking because we are often exhausted from the day and our bodies long for sleep as much as for sex. While Healing Love at night before bed can be very energizing and allow us to sleep more soundly and wake more refreshed, the Taoists thought that morning lovemaking is equally if not more important for starting the day off right.

Even brief lovemaking in the morning was considered to be extremely energizing because it allows us to greet the day and its inevitable frustrations with a lighthearted and joyous spirit. Try it, and you will find that it is better than caffeine. But remember, it is essential that the man avoid ejaculating, or he will lose much of his energy.

Exercise 25

MORNING PRAYER

1. Make love however you find arousing and satisfying.
2. As you approach orgasm or after you have had one or more orgasms, circulate the energy throughout your body with the Orgasmic Upward Draw.
3. Circulate the energy down to your navel with the Inner Smile.
4. Continue lovemaking and circulating the energy until you are sexually satisfied and physically energized.

When you are not able to practice Morning Prayer, you can always begin your day by circulating your own energy through the Inner Smile and the Orgasmic Upward Draw. Eventually you will be able to feel an energizing, even orgasmic, wave of energy anytime and anywhere. Now *that* could really improve your commute. Once you have learned to circulate energy in your own body, you are ready for soul-mating.

Union: Soul-Mating and Soul Orgasms

In Exercise 19: The Orgasmic Upward Draw During Lovemaking, in chapter 5, you learned to circulate energy in your own body during lovemaking. In Soul-Mating you actually exchange energy with your partner. This experience is profoundly intimate and can lead to a feeling of union and oneness that is difficult to describe and profound to experience.

When both partners experience the intense energy exchange of Soul-Mating, they are able to feel orgasmic pleasure for many hours and to feel deeply connected to their partner even when they are apart. This is what the Taoists call a Soul Orgasm.

Couples are able to feel orgasmic pleasure for many hours and to feel deeply connected to their partners even when they are apart.

Because Healing Love teaches couples to circulate energy to each other beyond simple physical touch, they are able to feel this electrical connection even when they are not touching or are not together. When both partners are feeling highly orgasmic, their souls begin to emerge and can join together above their heads. Once joined beyond their physical bodies, they are able to maintain this union long after lovemaking.

Finding the Way

Helpful Hints for Soul-Mating

- FACE-TO-FACE: For this exercise, as in the Orgasmic Upward Draw During Lovemaking, it is best to be in a face-to-face position with most of your bodies in contact. If the woman is much lighter she should be on top; otherwise, it doesn't matter which partner is on top. The sitting position is one of the best for exchanging sexual energy.

- SEND HEALING LOVE WITH YOUR EYES: It is very helpful when you are exchanging energy to look into each other's eyes. Through your eyes, you can send each other healing and loving energy. Remember to keep your genitals connected and hearts open at all times.

- TOUCHING TONGUES TO CLOSE THE CIRCUIT: When you touch tongues, you will be closing the circuit between your bodies.

- DRAWING YOUR SOULS OUT: You want to make sure that you have enough sexual energy to circulate and exchange. Wait until both of you are highly aroused but before the man is on the verge of ejaculating. If either or both of you are multi-orgasmic, you can enjoy several orgasms before soul-mating.

Soul-mating allows couples to give and receive sexual energy.

Exercise 26

SOUL-MATING

EXCHANGING SEXUAL ENERGY AND HAVING SOUL ORGASMS

1. STOP: When the two of you are highly aroused, draw back slightly so that the tip of the man's penis remains inside the entrance to the woman's vagina. This will allow both partners to cool down.
2. EXHALE AND THEN CONTRACT: Each partner should exhale and then contract your PC muscle. Make sure that the woman's contraction does not push the man over the edge. Often it is helpful for the man to contract first and for the woman to follow.
3. PUMP: Pump the energy back to the sacrum and up the spine to the crown of the head by contracting your PC muscle and anus.
4. SMILE: Rest and smile to the sexual organ, and let the energy continue rising up to your head.
5. SPIRAL: Spiral the energy in your head by rolling your eyes from side to side.
6. THRUST: Continue to make love, stopping to circulate the energy.
7. EXCHANGE: When you are ready to exchange energy, the woman should send her partner cool yin energy from her vagina and absorb hot yang energy from his penis. At the same time, the man should send his partner his hot yang energy from his penis and absorb his partner's cool yin energy from her vagina.
8. CIRCULATE: Draw your partner's energy back to your spine and up to the crown of your head (contracting your PC muscle if necessary).
9. TOUCH TONGUES: Let the energy descend down the front of your head to your tongue. Touch your tongues together, which will close the circuit and allow the energy to be exchanged through your mouths as well as through your genitals.
10. LOVE: Bring the energy down to your heart, and exchange the healing love energy directly through your chests.
11. STORE: Smile as you focus on your navel and bring the energy down to your abdomen.
12. JOIN: Instead of leaving it in your navel as you did in the Orgasmic Upward Draw, you will keep the energy circulating around your Microcosmic Orbit and exchange it with your partner three, six, or nine times. Finally, imagine this refined, orgasmic, sexual-spiritual energy joining above your head with the energy of your partner. You can picture the image of your partner and you in sexual union above your head. This will allow your soul to unite with your partner's.

Universal Love

The Healing Love practice allows people to circulate their sexual energy and learn to multiply and expand their orgasms and their energy. In the previous chapters, you have learned how pleasurable, how healing, and how emotionally intimate this can be. You have learned how to generate sexual energy and how to transform it into physically and emotionally healing energy.

You may never have thought (or been taught) that so much joy and such profound power lay waiting in your sexual organs. Still, for the Taoists there was more. This sexual energy that you have learned to cultivate can be transformed into spiritual energy that allows you to transform yourself and your relationship—not only with your partner but also with the world.

The passion and compassion that you develop with your partner through Healing Love can profoundly affect your relationship to your partner and to others in your life. According to the Taoists, this love and ecstasy that we feel in our most intimate relationship is simply a taste of the Universal Love and the blissful oneness with the Original Force of the Universe that we can experience as we grow spiritually.

Unlike many spiritual traditions, the Tao does not valorize the spiritual benefits of Healing Love over the sexual, healing, or emotional benefits. Indeed, they are all simultaneous and complementary. We have organized the book with the spiritual practice at the end because in our bodies there is a continuum of energy from the most palpable, which is sexual energy (*ching chi*), to the most subtle, which is spiritual energy (*shen*).

There is also a natural progression from our sexual life to our emotional life to our spiritual life. If we are not able to cultivate our sexual life or our emotional life before we embark on a spiritual path, we will find that our spiritual progress is often undermined by our suppressed sexual desires and emotional needs. This is the unfortunate reason that so many spiritual leaders are found to have secret sexual lives that they have forbidden for their followers. They have not yet learned to integrate their sexual and emotional lives. The Tao sees that all of us are human, even our leaders, and that we cannot escape from the fact that we are embodied creatures with physical as well as spiritual needs.

If we are not able to cultivate our sexual life or our emotional life before we embark on a spiritual path, we will find that our spiritual progress is often undermined by our suppressed sexual desires and emotional needs.

Transforming Sexual Energy into Spiritual Energy

Sexual energy can be turned into spiritual energy by circulating the energy through your body along the Microcosmic Orbit that you learned about in chapter 3 and that you used to cultivate your sexual energy in prior chapters. Taoists said that circulating sexual energy through the body nine times (their sacred number) transforms it into spiritual energy. In addition, this refines the energy and makes it easier for your body to store and assimilate.

When sexual energy and loving energy are combined, the energy becomes stable and nourishing.

Equally important to creating spiritual energy is love. Remember, for Taoists, love is much more than an ephemeral feeling or mental construct. It is a bodily energy that is centered at the heart. When sexual energy (from your genitals) and loving and compassionate energy (from your heart) are combined, the energy becomes stable and nourishing. This energy will allow you, your relationship to your partner, and your relationship to the world to deepen and grow spiritually.

Compassion and the Virtues of Our Spiritual Life

The quality of our energy (chi) is just as important as the quantity. While the practices in this book will allow you to expand the energy in your life manifold, it is essential that this energy be positive rather than negative. The way to expand our positive energy is through cultivating our emotional and spiritual qualities, or what the Taoists called the Virtues. We discussed this briefly in the last chapter, on cultivating the positive emotions in our romantic relationship. In this section, we will expand on this discussion and explain the importance of cultivating these positive qualities in our life and relationships overall.

The Taoists believed that we are all born with the virtues of love, gentleness, kindness, respect, honesty, fairness, justice, and righteousness. These are actually the positive qualities of our emotions, and, characteristically for the embodied perspective of the Taoists, these qualities are all connected with the bodily organs. When we are expressing these virtues our life force energy (chi) flows smoothly and efficiently. If we neglect to cultivate these virtues, however, we run the risk of channeling our additional sexual energy directly into our negative emotions, exacerbating any negative or neurotic tendency we may have. (Keep in mind that we usually exude the emotional energies that are most prevalent within us.)

While we are born virtuous, emotions such as fear, anger, cruelty, impatience, worry, sadness, and grief are inevitable as we grow up. These emo-

tions, if left to fester, can damage our health and weaken our immune system. Modern medicine now acknowledges that the presence of negative emotions like anger and fear can wear down the body's immune system before any clinical evidence of disease appears. These emotions can also pollute our individual relationships and our overall relationship with the world.

Some spiritual traditions urge us to get rid of these negative emotions and negative energy. Just as the Taoist practice does not suppress sexuality and sexual energy, it does not try to suppress these negative emotions and this negative energy. Negative emotions are a natural and inevitable part of being human, like day and night, hot and cold, or black and white. We can no more escape this emotional garbage than we can escape creating actual garbage. For Taoists, it is all energy. Their solution was to recycle these negative emotions and this negative energy into positive emotions and positive or virtuous energy. There is valuable energy in our negative emotions, just as there is great energy in our recycled garbage. For Taoists, nothing is wasted.

By transforming hate into love, sadness and depression into courage, worry into openness, fear into gentleness, and anger into kindness, we literally detoxify our body, our emotions, and our spirit.

In the last chapter, you learned how to recycle and cultivate your negative emotions and negative energy into positive emotions and positive energy. By transforming hate into love, sadness and depression into courage, worry into openness, fear into gentleness, and anger into kindness, we literally detoxify our body, our emotions, and our spirit.

Cultivating Compassion

For the Taoists, compassion is the highest expression of human emotion and virtuous energy. Compassion is not a single virtue but the culmination of all virtues, expressed at any given moment as a blend of fairness, kindness, gentleness, honesty, respect, courage, and love. When a person is compassionate he or she has the power to express any or all of these virtues at the appropriate moment.

It should be pointed out that compassion is often misunderstood to be based on sympathy. According to the Tao, sympathy is a weakness individuals show when they are easily affected by the emotions of others. Compassion is more closely related to empathy, which is a superior state that can acknowledge the emotional outpourings of others without being thrown off balance by them. The difference between empathy and compassion, however, is that compassion is not seen as an emotion or a feeling but as a higher state of consciousness that naturally radiates the best human qualities. In short, the Taoists regarded compassion as the finest form of life energy.

Before we can truly open our heart and the rest of ourselves to our partner and to others in our life, we must make sure that we transform the negative emotions that we carry and cultivate compassion for ourselves, our partner, and others in our life. As you cultivate self-love and love for your partner, you can also take this love into the rest of your life. With compassion, one can love unconditionally and thereby accept the world on its own terms without suffering.

With compassion, one can love unconditionally and thereby accept the world on its own terms without suffering.

As you do "The Compassion Cycle" exercise below, remember to relax and breathe. Relaxing and breathing deeply will allow your body to open and make it easier for you to circulate and join the energies in your body. (For the location of your organs, see illustration on p. 162.)

Exercise 27

THE COMPASSION CYCLE

1. YOUR HEART: Start by focusing on your heart. Smile to your heart, and let it feel soft and loving. With your mind, spiral this energy of love in your heart.
2. YOUR KIDNEYS: Now move your awareness to your kidneys (on your back opposite your navel on both sides of the spine). Smile to them, and let a feeling of gentleness rise up to your heart. Spiral this energy in your heart so that it blends with the energy of love already there.
3. YOUR LIVER: Now move your awareness to your liver (on your right-hand side under your rib cage). Smile to it, and let the feeling of kindness rise up to your heart. Spiral this energy in your heart so that it blends with the rest of the energy there.
4. YOUR HEART AGAIN: Now become aware of your heart again. Smile to it, and this time feel love, joy, and happiness. Spiral this energy in your heart so that it blends with the rest of the energy there.
5. YOUR SPLEEN: Now move your awareness to your spleen (on your left-hand side under your rib cage). Smile to it and let the feeling of openness and fairness rise up to your heart. Spiral this energy in your heart so that it blends with the rest of the energy.
6. YOUR LUNGS: Finally, move your awareness to your lungs. Smile to them, and let the feelings of courage and righteousness flow to your heart. Spiral this energy in your heart so that it blends with the rest of the energy and together becomes compassion energy.

Revealing Ourselves

For the Taoists, the microcosm (our body, our relationship) is inextricably linked to the macrocosm (the planet, the rest of humanity). As we heal and transform ourselves and our most intimate relationship, we heal and transform all our relationships and the world as a whole.

In *The Multi-Orgasmic Man*, we explained that the more pleasure we give, the more pleasure we receive. The more we heal, the more we are healed. In *The Multi-Orgasmic Couple*, we have tried to show that the more we open ourselves up physically, emotionally, and spiritually to our partner, the more pleasurable and profound our lovemaking and our relationship will be. The more we reveal ourselves, the more joy and love we can share with each other and with the world.

The more we open ourselves up physically, emotionally, and spiritually to our partner, the more pleasurable and profound our lovemaking and our relationship will be. The more we reveal ourselves, the more joy and love we can share with each other and with the world.

Multiple orgasms are part of an unfolding process of "becoming one" with each other and with the world. According to the Tao and even according to modern physics, the world is continually pulsating. When we orgasm, we harmonize not only with our partner but also with the world and its pulsations. It is for this reason that sexuality is seen as so vital to our physical, emotional, *and* spiritual health. The more we open ourselves and become one with our partner, the more we open ourselves and become one with the world. In the next chapter, we will discuss how to maintain this pleasure and love, this joy and harmony, for a lifetime in our most intimate relationship.

NOTES

INTRODUCTION

1. Alfred Kinsey was the first to report that men could experience multiple orgasms. For more on Kinsey's pioneering research see chapter 1 below or see his classic work: Alfred C. Kinsey, Wardell B. Pomeroy, and Clyde E. Martin, *Sexual Behavior in the Human Male* (Philadelphia: W. B. Saunders, 1948), pp. 158–59. William Hartman and Marilyn Fithian were the first to document male multiple orgasms in the laboratory. See Hartman and Fithian's *Any Man Can: The Multiple Orgasmic Technique for Every Loving Man* (New York: St. Martin's Press, 1984) or our *The Multi-Orgasmic Man* (San Francisco: HarperSanFrancisco, 1996) for more detail on male multiple orgasms.

CHAPTER ONE

1. According to the thirteenth edition of *Smith's General Urology*, orgasm includes "involuntary rhythmic contractions of the anal sphincter, hyperventilation [increased breathing rate], tachycardia [increased heart rate], and elevation of blood pressure." See *Smith's General Urology*, 13th ed., ed. Emil A. Tanagho and Jack W. McAninch (Norwalk, CT: Appleton and Lange, 1992), p. 710.
2. Alfred C. Kinsey, Wardell B. Pomeroy, and Clyde E. Martin, *Sexual Behavior in the Human Male* (Philadelphia: W. B. Saunders, 1948), pp. 158–59.
3. Kinsey et al., *Human Male*, pp. 158–59.
4. Herant A. Katchadourian, *Fundamentals of Human Sexuality*, 4th ed. (New York: Holt, Rinehart and Winston, 1985), p. 292.
5. William Hartman and Marilyn Fithian, *Any Man Can: The Multiple Orgasmic Technique for Every Loving Man* (New York: St. Martin's Press, 1984), p. 157; Marion Dunn and Jan Trost, "Male Multiple Orgasms: A Descriptive Study," *Archives of Sexual Behavior* 18, no. 5 (1989): 382.
6. Female ejaculation has been demonstrated in the laboratory over the past twenty years, since the publication of the landmark book that popularized its existence: *The G Spot and Other Recent Discoveries About Human Sexuality*, by Alice Kahn Ladas, Beverly Whipple, and John D. Perry (New York: Dell, 1983). The Taoists have long described a woman having three waters (the first water is lubrication, the second water is orgasm, and the third water is ejaculation). Generally ejaculation is experienced as a copious amount of fluid, although some woman do actually experience a spray of liquid.

CHAPTER TWO

1. P. Blumstein and P. Schwartz (1983), quoted in Julia R. Heiman, Ph.D., and Joseph LoPiccolo, Ph.D., *Becoming Orgasmic: A Sexual and Personal Growth Program for Women* (New York: Simon & Schuster, 1992), pp. 223–25.
2. The G spot is named after Dr. Ernst Gräfenberg, the first modern physician to describe it.
3. Some sex researchers compare the G spot to the male prostate gland, since they derive from the same embryonic tissue and both are made up of glands and ducts, swell when they are stimulated, and produce secretions. While female ejaculation is rare, the release of fluid from the urethra with orgasm is a natural part of some women's sexual response.

4. Beverly Whipple, William E. Hartman, and Marilyn A. Fithian, "Orgasm," in *Human Sexuality: An Encyclopedia*, ed. Vern L. Bullough and Bonnie Bullough (New York: Garland Publishing, 1994), p. 432.

5. William Masters and Virginia Johnson, *Human Sexual Response* (Boston: Little, Brown, 1966).

6. Beverly Whipple, Gina Ogden, and Barry R. Komisaruk, "Physiological correlates of imagery induced orgasms in women," *Archives of Sexual Behavior,* 21, no. 2 (1992): 121–133.

7. Having a glass of wine, a beer, or one drink a day has some health benefits and is unlikely to be harmful unless there is some history of alcohol abuse in yourself or your family. However, alcohol can impair sexual response, and we would not suggest using it routinely to get you in the mood.

8. Beverly Whipple, quoted in Anne Vachone, "Multiple Orgasms: Why One Orgasm is Never Enough: Cosmo's Guide to Making Orgasms Happen and Happen and Happen," *Cosmopolitan*, July 1998, p. 156.

9. Arnold Kegel was the physician who first recommended these exercises, in 1948, to strengthen the vaginal muscles and as a treatment for incontinence.

10. Carol Anderson Darling, Jay Kenneth Davidson Sr., and Donna A. Jennings, "The Female Sexual Response Revisited: Understanding the Multi-Orgasmic Experience in Women," *Archives of Sexual Behavior* 20, no. 6 (1991): 529.

11. Julia Heiman and Joseph LoPiccolo, *Becoming Orgasmic: A Sexual and Personal Growth Program for Women*, rev. ed. (New York: Prentice-Hall, 1988), p. 27.

12. Darling et al., "Female Sexual Response Revisited," p. 529.

13. Quoted in Susan Bakos, "Just When You Thought You Knew All There Was to Know About Orgasm," *Cosmopolitan*, August 1996, p. 148.

14. Alan P. Brauer and Donna J. Brauer, *The ESO Ecstasy Program: Better, Safer Sexual Intimacy and Extended Orgasmic Response* (New York: Warner Books, 1990), pp. 103–9.

15. Brauer and Brauer, *ESO Ecstasy Program,* p. 70.

16. Joy Davidson, "You Always Have Orgasms . . . Then Suddenly You Don't," *Cosmopolitan*, December 1996, 90.

17. Some IUDs release progesterone into the uterus and may have some small effect on sex drive. IUDs are available without hormonal components.

18. The IUD, though it does not increase the risk of sexually transmitted diseases, can cause a much more severe infection if you do contract one. An infection of the uterus and fallopian tubes (pelvic inflammatory disease) can cause scarring, which may compromise future fertility.

19. Linda DeVillers, as quoted in "Sexual Satisfaction Guaranteed," *Redbook*, November 1996, p. 74.

CHAPTER THREE

1. Felice Dunas, *Passion Play* (New York: Riverhead Books), p. 53.

CHAPTER FOUR

1. See Theresa Crenshaw's excellent book, *The Alchemy of Love and Lust: How Our Sex Hormones Influence Our Relationships* (New York: Simon & Schuster, 1997).

2. Crenshaw, *Alchemy of Love and Lust,* p. 96.

3. Crenshaw, *Alchemy of Love and Lust,* p. 122.

4. Robert T. Michael, John H. Gagnon, Edward O. Laumann, and Gina Kolata, *Sex in America* (Boston: Little, Brown, 1994), pp. 158–65.

5. P. Blumstein and P. Schwartz, quoted in *Becoming Orgasmic: A Sexual and Personal Growth Program for Women*, by Julia R. Heiman, Ph.D., and Joseph LoPiccolo, Ph.D. (New York: Simon & Schuster, 1992), pp. 223–25.

CHAPTER FIVE

1. Susan Crain Bakos, "Just When You Thought You Knew All There Was to Know About Orgasm," *Cosmopolitan*, August 1996, p. 148.

2. While it was not clear from the study whether the men were ejaculating each time, we assume they probably were. This study suggests that ejaculatory sex is still better than no sex. From a Taoist perspective, the sex would have been even healthier and more healing had they minimized ejaculation. *British Medical Journal*, December 20, 1997, vol. 315, no. 7123, p. 1641; "Sex and Death: Are They Related? Findings from the Caerphilly Cohort Study." George Davey Smith; Stephen Frankel; John Yarnell.

3. Theresa L. Crenshaw, M.D., *The Alchemy of Love and Lust: How Our Sex Hormones Influence Our Relationships* (New York: Simon & Schuster, 1997), pp. 4–5.

4. Daniel P. Reid, *The Tao of Health, Sex, and Longevity: A Modern Practical Guide to the Ancient Way* (New York: Simon & Schuster, 1989), p. 290.

CHAPTER SIX

1. Theresa L. Crenshaw, M.D., *The Alchemy of Love and Lust: How Our Sex Hormones Influence Our Relationships* (New York: Simon & Schuster, 1997), p. 95.

CHAPTER EIGHT

1. *Consumer Reports* survey, reported in Herant A. Katchadourian, *Fundamentals of Human Sexuality*, 4th ed. (New York: Holt, Rinehart and Winston, 1985), p. 385.

2. For a full description of our different sexual stages and the latest hormonal research, we strongly recommend the excellent work of Theresa Crenshaw, particularly "Sexual Stages," in *Alchemy of Love and Lust*, pp. 18–52.

3. Reported in the *Los Angeles Times*, June 4, 1995.

4. As we have said previously, testosterone is primarily responsible for active female libido, but supplemental estrogen plays an important role in augmenting sexual interest and improving orgasmic ability.

5. Increased desire in 90 percent of women, sensitivity in 50 percent of women, orgasm frequency in 30 percent of women, and orgasm intensity in 40 percent of women. See Maida Taylor, M.D., M.P.H., "Sex, Drugs, and Growing Old: Sexual Dysfunction in Perimenopause, Menopause, and Post-Menopause: Physiology, Psychology, and Pharmacology" (paper presented at Current Issues in Women's Health Conference, Sacramento, CA, 1999).

6. Recent studies call into question the benefits of hormone replacement therapy for reducing heart disease, particularly in the first two years of therapy. Because the field of hormone replacement therapy is rapidly evolving, we suggest that you consult your physician for the most current information.

7. Unfortunately, oral testosterone decreases your good cholesterol (HDL) and increases your bad cholesterol (LDL). In addition, there are no long-term studies that show that it improves sex drive after more than three months. There is also some question about its effect on breast cancer. Topical forms of testosterone, which do not affect cholesterol

levels, will soon become available. If you are interested in testosterone replacement therapy, please discuss the current available options with your physician.

8. Phytoestrogens and natural progesterones do not increase bone density and are not as effective as hormone replacement therapy in relieving menopausal symptoms.

9. Marion Dunn and Jan Trost, "Male Multiple Orgasms: A Descriptive Study," *Archives of Sexual Behavior* 18, no. 5 (1989): 385.

10. Masters and Johnson, *Human Sexual Inadequacy*, quoted in Jolan Chang, *The Tao of Love and Sex: The Ancient Chinese Way of Ecstasy* (New York: Dutton, 1977), p. 21.

11. Crenshaw, *Alchemy of Love and Lust*, p. 282.

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Sexual Secrets
Every Man Should Know

THE MULTI-ORGASMIC MAN

How Any Man Can
Experience Multiple Orgasms
and Dramatically Enhance
His Sexual Relationship

Mantak Chia & Douglas Abrams

THE MULTI-ORGASMIC MAN

Sexual Secrets Every Man Should Know

Mantak Chia and

Douglas Abrams Arava

An e-book excerpt from
perfectbound

The Sexual Secrets

In this book you will learn to

Have multiple orgasms without losing your erection

Experience longer, more intense whole-body orgasms

Use your sexual energy to improve your overall health

Increase your sexual energy and vitality

Recognize the signs of your partner's desire

Help your partner to become multi-orgasmic

Master thrusting techniques that will completely satisfy your partner

Use sexuality to deepen your spirituality

Make all sex safer

End premature ejaculation

Overcome impotence

Increase the size and strength of your penis

Raise your sperm count

Prevent and help prostate problems

Increase your sexual strength in middle and older age

Maintain the passion in your relationship as you age together

For our sons, Max and Jesse

The Sexual Secrets

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Spontaneous Energy Movements
The Art and Science of Using Condoms
What If . . .

WARNING *This is not just another sex book.* There is so much talk about sex today, and yet still so much misunderstanding, that it is difficult to know what is of any value or use. You have no doubt seen advertisements from sexperts that promise to teach you how to become the world's greatest lover, have daylong orgasms, and reach sexual ecstasy—all without doing anything. Because this book is based on a three-thousand-year tradition of actual sexual experience, the authors are well aware of the effort that is involved—pleasurable as it may be—in changing your sex life. Learning sexual secrets is one thing, but using them is quite another. The techniques in this book have been tested and refined by countless lovers over thousands of years in the laboratory of real life. We have tried to present them in as clear and simple a way as possible, but the only way to benefit from them is to really use them.

These are powerful practices. The techniques given in this book can profoundly improve your health as well as your sexuality. However, we do not give any diagnoses or suggestions for medication. People who have high blood pressure, heart disease, or a generally weak condition should proceed slowly in the practice. If you have a medical condition, a medical doctor should be consulted. If you have questions about or difficulty with the practice, you should contact a Healing Tao instructor in your area (see the appendix: "Healing Tao Books and Instructors").

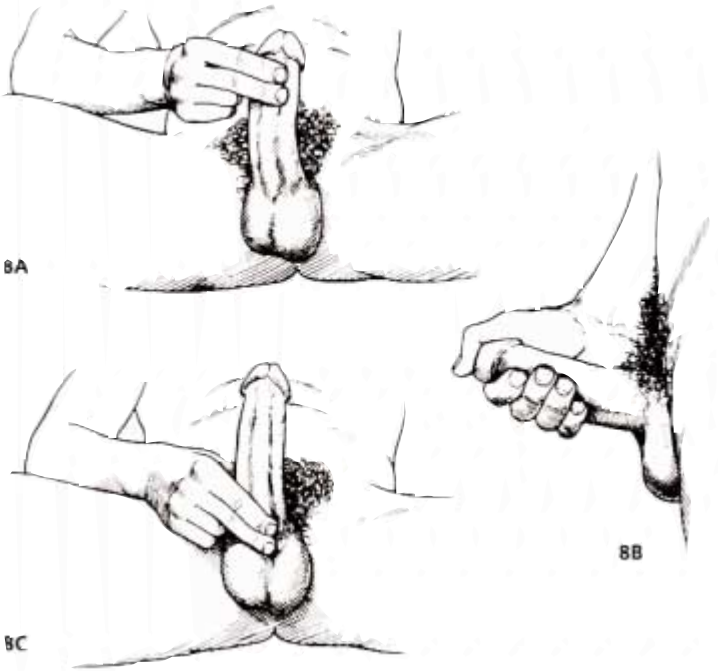

FIGURE 8. DELAYING EJACULATION WITH THE SQUEEZING METHOD

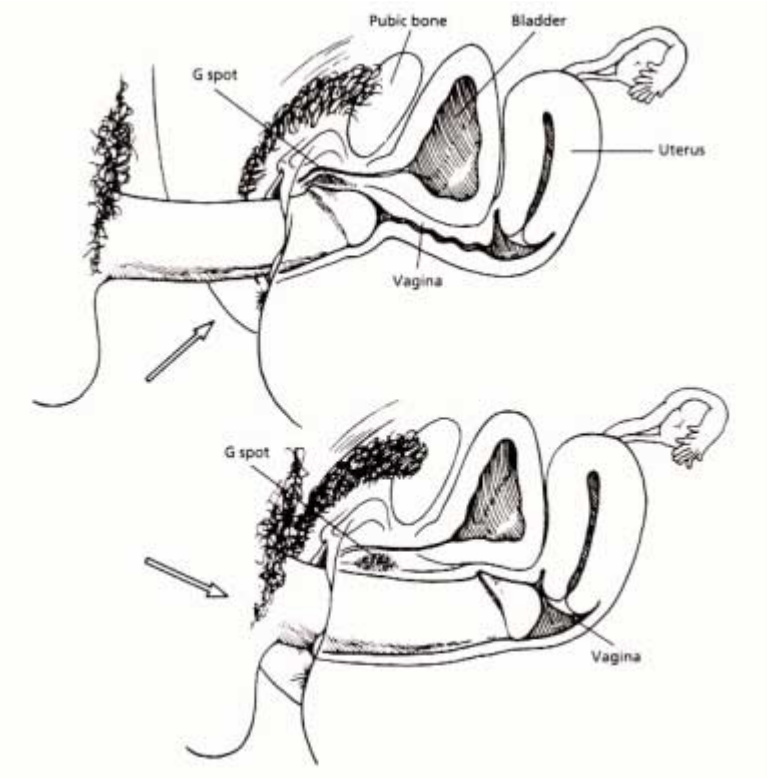

FIGURE 20. SHALLOW AND DEEP THRUSTS

Over three thousand years ago, the Chinese recognized that men can achieve multiple orgasms by delaying and even withholding ejaculation. This is possible because orgasm and ejaculation are two distinct physical processes, though they have long been equated in the West. Although clearly less precise than today's sex researchers, the ancient Chinese recorded their findings in detail for future generations of sexual and spiritual seekers.[1]

In the West, it was not until the 1940s that pioneering sex researcher Alfred Kinsey reported similar discoveries.[2] Yet even several decades later, after his claims have been proved repeatedly in the laboratory, most men remain unaware of their multi-orgasmic potential. Without this knowledge and without a clear technique, men are unable to feel the difference between the crescendo of orgasm and the crash of ejaculation.

Male sexuality in the West remains incorrectly focused on the inevitably disappointing goal of ejaculation ("getting off") instead of the orgasmic process of lovemaking. *The Multi-Orgasmic Man* shows men how to separate orgasm and ejaculation in their own bodies, allowing them to transform the momentary release of ejaculation into countless peaks of whole-body orgasms. In the words of one multi-orgasmic man, "In the normal, everyday sort of ejaculation my pleasure is quickly over with. Not so in multiple orgasms. The pleasure generated here stays with me throughout the day. There seems to be no final peak to this pleasure, either. This practice offers the added bonus of affording extra energy so I am just never tired. Now I can have as much sex as I want and I can control it rather than have it control me. What more can a man ask for?"

The Multi-Orgasmic Man also shows men how to satisfy the multi-orgasmic potential of their partners. One multi-orgasmic man who had been practicing the techniques in this book for three months explained his experience: "Basically, I have slept with three women since starting to practice these techniques, and *all three* have told me that I was their best, literally said it to me while we were in bed: 'This is the best I have ever had.' "

Women who read *The Multi-Orgasmic Man* will learn secrets about male sexuality that few women, and even few men, know. Couples who read it together will find levels of sexual ecstasy and satisfaction that they may never have imagined were

possible. As one partner of a multi-orgasmic man put it, "Our lovemaking has always been good, but now it is so much richer and more balanced with both of us experiencing many waves of orgasm. Multi-orgasms, though, are just the beginning of the profound changes that this practice has made in our relationship. Our love is much deeper and more intimate now."

The fact that men can have multiple orgasms is so surprising to most of us that we may find it hard to believe. It is worth remembering that only in the last forty years have female multiple orgasms been recognized and accepted as "normal." Even more surprising is the number of women who have become multi-orgasmic—once they were told it was possible. Since the fifties, when Kinsey was studying female sexuality, the number of women who experience multiple orgasms has tripled, from 14 percent to over 50 percent![3] In the l980s, sexologists William Hartman and Marilyn Fithian found that 12 percent of the men they studied were multi-orgasmic. As men recognize that they also have this potential and learn some simple techniques, more and more of them will discover that they too can experience multiple orgasms.

In this book we draw on both ancient Taoist (pronounced *DOWist*) practices and the most recent scientific knowledge to show you how to separate orgasm from ejaculation, how to experience multiple orgasms, and how to improve your overall health. The Taoists were originally a group of seekers in ancient China (around 500 B.C.E.) who were extremely interested in health and spirituality. Although many of the sexual techniques they developed are now more than two thousand years old, they are as effective today as they were then. Since the techniques in this book were introduced to the West fifteen years ago, there has been a quiet sexual revolution going on among ordinary men who have tried these techniques and proved that they work. However, we believe that the only real proof is in your own body. We hope you will accept or reject the information given here based on your own experience.

Multiple orgasms are not just for adolescent boys, unusually lucky older men, or religious adepts. A software salesman in his thirties who calls himself a "cynical, uptight New Yorker" sat down one evening with the exercises in this book and had six orgasms: "The orgasms got more powerful one after the other. It was like nothing I had ever experienced. But the most amazing thing is that I had been working too much and was getting sick.

The next morning I woke up healthy and with more energy than I can remember." According to Taoist sexuality, experiencing multiple orgasms without ejaculating can also help men achieve their body's optimum health and even, believe it or not, live longer.

Taoist sexuality, also called Sexual Kung Fu, began as a branch of Chinese medicine. (*Kung fu* literally means "practice," so *Sexual Kung Fu* simply means "sexual practice.") The ancient Taoists were themselves doctors and were concerned as much with the body's physical well-being as with its sexual satisfaction. Sexual Kung Fu helps men increase their vitality and longevity by allowing them to avoid the fatigue and depletion that follow ejaculation—to stop them from, literally, going to seed.

In chapter 1, we describe the Eastern and Western evidence for male multiple orgasms. We also discuss recent scientific research that seems to confirm the ancient Taoist understanding about the importance of orgasming without ejaculating. In reporting on these surprising studies, the *New York Times* concluded, "Creating sperm is far more difficult than scientists had imagined, demanding a diversion of resources that might otherwise go into assuring a male's long-term health."[4]

Theory without practice, however, is worthless. So in chapters 2 and 3 we give you the "solo practice" that you can use to develop your multi-orgasmic ability—whether you have a partner or not. Many men begin experiencing multiple orgasms within a week or two, and most are able to master the technique within three to six months.

Chapters 4 and 5 teach you the "duo practice" that you will use to share Sexual Kung Fu with a partner and to pleasure her in ways she probably never imagined were possible.

Although women will benefit from reading the entire book, chapter 6 is written especially for them and explains what they will need to know to help their partners—and themselves—reach their multi-orgasmic potential.

Chapter 7 is written for gay men and describes the specific practices they need to learn for a satisfying and healthy multi-orgasmic sex life.

Chapter 8 addresses the concerns of men who are experiencing difficulties with their sexuality, such as premature ejaculation, impotence, and infertility. Taoist sexuality offers completely different ways to think about and overcome these problems.

Finally, chapter 9 offers advice on how men and their partners can have a lifetime of ecstatic sexual intimacy. It begins with a section for middle-aged and older men, who often experience a decline in their sexual appetite and potency. We present research on multi-orgasmic men that contradicts the widely held belief that male sexuality peaks in the teens and declines slowly thereafter. The Taoists have always known that if a man understands the true nature of his sexuality, it will only improve as he matures. This chapter also includes a section on how we can help our sons begin a life of healthy and satisfying sexuality. If only *our* fathers had known!

China produced the world's first, most comprehensive, and most detailed sex manuals. In *The Multi-Orgasmic Man* we continue this long tradition by providing men and their partners with a practical, straightforward guide to transforming their sexuality. Although in Taoism sexuality and spirituality are not separated, we realize that some readers will be interested exclusively in practical sexual advice and that others will want to learn more about the sacred dimension of their sexuality. Starting with basic techniques that all readers will need in order to become multi-orgasmic, we gradually add more subtle techniques for readers who are interested in using their sexuality as a path to improving their health and deepening their spirituality.

It is worth mentioning that this is not a book about Taoism, either as a philosophy or as a religion. (One of the authors of this book, Mantak Chia, has already written over ten books that explain in great detail the practical teachings of this ancient tradition, from which he has developed a comprehensive health system called the Healing Tao.) In *The Multi-Orgasmic Man,* we offer practical Taoist techniques that have been confirmed by scientific study to readers who are looking not for a new religious system but for a deeper experience of their own sexuality.

It is also our hope that this book will spark further scientific research to confirm or revise the theory and practice offered here. We believe that the time for secrecy and cultural chauvinism has passed. East and West can share their knowledge for the benefit of all modern lovers who seek sexual fulfillment in this age of carnal confusion.

CHAPTER THREE

Becoming a Multi-Orgasmic Man

Now that you have a better understanding of your sexuality and its true potential, it is time to become multi-orgasmic. This ability requires developing both your sexual strength and your sexual sensitivity. As mentioned in the introduction, most men who practice the exercises in this chapter will begin to experience multiple orgasms within a week or two and will master the technique within three to six months. Some with strong sexual energy and sexual sensitivity may experience them the first time they try, while others with weaker energy or less sensitivity may take longer than six months to become regularly multi-orgasmic. It also depends on your dedication to the practice. We give you these time frames as an estimate, but the most important thing is not to get discouraged. If you persevere, you will get it.

Breathing Basics

Strange as it may seem, learning to control your ejaculation and to become multiply orgasmic begins with strengthening and deepening your breathing. As is true in all martial arts and meditative practices, your breath is the gate through which you can gain control of your body. Breathing

is both involuntary *and* voluntary. In other words, we breathe regularly without thinking about it, but we can also choose to change the rhythm or depth of our breathing. This use of the mind to cultivate the body is the very basis of Sexual Kung Fu.

Your breathing is also related to your heart rate. If you are breathing quickly and shallowly, as after running, your heart rate increases. If you are breathing slowly and deeply, your heart rate decreases. As we learned earlier, increased heart rate is part of orgasm and breathing quickly is one sign of orgasm's approach. So the first step in controlling your arousal rate, and therefore your ejaculation, is deep and slow breathing.

BELLY BREATHING

Most of us breathe very shallowly, generally into our chest and shoulders, which allows only a small amount of oxygen to be absorbed by our lungs. Belly breathing—breathing deeply into the bottom of our lungs—is the way a newborn child breathes. If you watch a sleeping newborn, you will see the child's entire belly rise and fall with each breath. Belly breathing allows us to replace stagnant air at the bottom of our lungs with fresh, oxygen-filled air. This is the healthiest way to breathe, but we lose this natural ability as stress and anxiety cause us to cut our breathing short. This anxious breathing is confined to our upper chest. When we are happy and laughing, we are able once again to breathe into our belly. In this exercise, you will learn to belly breathe as you did when you were young.

FINDING THE WAY

Inhale Through Your Nose

When practicing any of the exercises in this book, always inhale through your nose, which filters and warms the air. When you inhale through your mouth, you breathe unfiltered, unwarmed air, which is harder for your body to assimilate.

Learning to Control Ejaculation

Now that you have started learning how to control your breath and your sex muscles, you are ready to learn some specific techniques for controlling ejaculation when you are highly aroused. The more you practice the exercises you've learned so far, the easier it will be to practice the ones given later in this chapter and stop yourself from going past the "point of no return."

STOPPING

First, and most important, you need to stay aware of your arousal rate and *stop a few strokes* (or thrusts, if you're with your partner) before you think you will ejaculate. Many sexologists call this *the stop/start technique,* but it is just common sense. Better to stop too soon than too late. In the beginning, you will probably need to stop stimulating yourself for ten or twenty seconds to allow the urge to ejaculate to subside.

BREATHING

The deep breathing we described earlier is extremely important in controlling your arousal rate and in delaying ejaculation when you are highly aroused. One technique that has proved especially effective is to breathe in deeply and hold your breath for several moments until the urge to ejaculate subsides. Some multi-orgasmic men, however, breathe rapidly to delay ejaculation. (This quick, shallow breathing is called *the breath of fire* in the yoga tradition.) Deep, slow breathing helps control your sexual energy, whereas shallow, rapid breathing helps disperse the energy. You can experiment and see what works for you.

CONTRACTING THE PC MUSCLE

As already mentioned, the PC muscle surrounds the prostate, through which your semen must pass during the expulsion phase of orgasm. By learning to squeeze your prostate during contractile-phase orgasm (when it is contracting involuntarily), you can help yourself avoid moving from contraction to expulsion. (Between contraction and expulsion lies the infamous "point of no return.") One multi-orgasmic man described his experience: "I hold back the ejaculation simply by contracting the PC muscle at precisely the right time. It took quite some time to master this process, but the results are definitely worth the effort."

SQUEEZING THE PENIS

Many sexologists recommend squeezing the penis, a technique that was originally developed for men who ejaculate "prematurely." It is simple. Just place the first two fingers of either hand on the underside of your penis, place your thumb on the top, and squeeze (see figure 8a). Some men also find that gripping their penis like the handlebar of a bicycle and pressing down on the tip or underside with their thumb helps them reduce their arousal (see figure 8b). Although these techniques can be effective in solo practice, they are awkward when having intercourse because you must withdraw. To prepare for this situation, you can try using your mind to help squeeze the tip of your penis. Eventually, you will be able to squeeze the tip of your penis with just your mind and will avoid the clumsiness of having to use your hands. Another good technique is squeezing at the base of your penis (remembering to also squeeze with your mind). This will help you control your arousal and will also expand and strengthen your erections (see figure 8c).

FIGURE 9. SCROTAL TUG

PRESSING THE MILLION-DOLLAR POINT

One of the oldest Taoist techniques is pressing the Million-Dollar Point while contracting your PC muscle. This helps delay ejaculation both by focusing your attention and by interrupting the ejaculatory reflex. It is simple and effective. First locate your Million-Dollar Point, which is just in front of your anus (see figure 2). There should be an indentation when you push at the correct spot. You will need to push your finger in up to your first joint. One multi-orgasmic man described his experience: "Pressing on the Million-Dollar Point for a while decreases my erection slightly and the danger of ejaculating greatly." You will also be able to use this technique during intercourse without withdrawing.

SCROTAL TUGGING

Since your testicles have to pull up close to the body in order to propel the semen out of the testes, pulling them away from your body can delay ejaculation. Circle the top of your sac with your thumb and forefinger (see figure 9). Pull down firmly.

DRAWING AWAY SEXUAL ENERGY

More than any mechanical technique, the secret to stopping yourself from ejaculating is learning to pump your sexual energy away from your genitals and up through your spine to the rest of your body. If the sexual energy continues to build up in your groin, it will eventually be too great to control and will shoot out in the most direct way it can—through your penis. However, if you draw this energy away, it will be much easier to stop yourself from ejaculating. As we discussed in the previous chapter, this is also the secret to learning how to have whole-body orgasms. In the next section we will give step-by-step instructions to show you how to circulate your sexual energy through your body. In the meantime, simply imagine drawing your sexual energy out of your penis, past your perineum, and up your spine. Contracting your perineum will help pump the energy up and will prepare you for the Big Draw exercise we describe later in this chapter.

EXERCISE 6

SEPARATING ORGASM FROM EJACULATION

1. Start by lubricating your penis, as you did in the Self-Pleasuring exercise.
2. Before focusing on your genitals, remember to touch and massage the rest of your body, especially your belly, thighs, and nipples.
3. Self-pleasure however you like, remembering to stimulate your entire penis, your scrotum, and your perineum.
4. Pay close attention to your arousal rate. Once again, try to notice your increasing levels of arousal: notice the tingling at the root of your penis, notice the stages of erection, notice your breathing change and your heartbeat rise.
5. As you feel yourself getting close to the point of no return, stop, breathe, and lightly contract your PC muscle around your prostate. In addition, you also can delay your ejaculation by pressing on the Million-Dollar Point, by using the scrotal tug, by pressing on the tip of your penis, or simply by using your mind to squeeze the tip of your penis. You can experiment and see which of these techniques works best for you. Most important of all, however, is paying close attention to your arousal and stopping in time—at least a few strokes before the point of no return.
6. If you feel that your sexual energy is getting too wild and difficult to control, try to draw this energy up your spine with your mind, and squeeze and release your PC muscle several times. If you are still feeling too hot and out of control, stop for ten or twenty seconds and focus on deep breathing.
7. Try to notice the contraction of your PC muscle and anus that occurs at contractile-phase orgasm.
8. After you have peaked several times without ejaculating, stop. You will feel peaceful and/or energized afterward. Try to notice your sexual energy circulating in your body, which you will feel as a tingling, itching, or prickling.

In exercise 6, you will use these techniques to help cool you down as you start to get highly aroused. Again, you will try to experience the pleasurable involuntary pumping of the prostate and anus (contractile-phase orgasms) without ejaculating. One multi-orgasmic man described how he is able to orgasm without ejaculating: "I do a number of things. [1] Variation seems to help, not doing the same over and over again—varying the depth of the thrust when I am making love, or using different strokes when it's just me and my hand. [2] Slowing down when I feel close to the edge. [3] Deep-breathing exercises. And [4] moving the accumulated *chi* up my spine and through the Microcosmic Orbit."

Whatever techniques you use to heat yourself up and cool yourself down, *the most important parts of the practice are breathing, squeezing your* PC *muscle, and learning to relax into a none-jaculatory orgasm.*

CHAPTER FIVE

Becoming a Multi-Orgasmic Couple

Controlling your ejaculation while self-pleasuring is one thing, but controlling it during the throes of lovemaking is quite another. The control you developed in chapter 3 over your breathing, your concentration, your PC muscles, and, most important, your sexual energy will help you immeasurably in becoming multi-orgasmic with your partner, but you also need to know the duo practice for lovemaking.

Pleasuring Your Partner

Unlike men's arousal, women's has no precipice. True, many women will have orgasms that they find so fully satisfying (and climactic) that they do not need to continue making love. And as we discussed earlier, some women even ejaculate. But since women do not have to worry about losing an erection or spilling their seed, they can generally surrender themselves to pleasure in a way that men cannot. Nevertheless, women do not fall into bliss without effort. Reaching orgasm, multiple orgasms, and expanded orgasms requires knowledge, skill, and effort of women just as it does of men. Here's how you can help.

In Sexual Kung Fu all aspects of touch are seen as part of the union between man and woman. Touching hands or lips is as much a part of harmonizing with one another as is intercourse. As with self-pleasuring, you probably have your own way of pleasuring your

partner, and though most women have the same general erogenous zones, each woman, of course, has different sensitivities at different times. Try out these Taoist techniques, but let your partner's preferences be your guide.

"The essence of foreplay is slowness," states the *Discourse on the Highest Tao Under Heaven*. "If one proceeds slowly and patiently, the woman will be exceedingly joyful. She will adore you like a brother and love you like a parent. One who has mastered this Tao deserves to be called a heavenly gentleman." Because anticipation and growing intensity are important in bringing your partner's desire to a boil, you should begin with passionate kissing. Begin at her extremities rather than her genitals. Caress, massage, and kiss her hands and wrists as well as her feet and ankles. Move up her arms and legs to her abdomen. Stimulating points along the meridians of her body (energy channels) will help increase her sexual excitement: there are many points along or near her spine (the Back Channel), such as the small of her back, her neck, and her ears. The underside of the arms and the inside of the thighs are also very sensitive on most women. By *caress,* we mean that your touch should generally be featherweight, although it can be heavier when you are stimulating larger muscles such as her buttocks.

HER BREASTS

As we mentioned earlier, when you approach her breasts, spiral around them in ever narrower circles until you slowly reach her nipples. Most men go for the nipples too soon. (Old breast-feeding instincts, perhaps.) Circling them slowly will draw her sexual energy to her nipples. Also, remember to rub your thumbs and forefingers together to generate more *chi.* Finally, touch her nipples lightly, and try rolling them between your thumbs and index fingers. (You can touch both breasts or just focus on one at a time.) Some women enjoy harder squeezing and fondling, but let your partner's responses guide you. As we already mentioned, your tongue is highly charged with *chi,* and using it to lick, spiral around, and suck on her nipple is often an excellent way to arouse her. If her nipples become engorged and erect, you are doing something right.

HER GENITALS

In approaching your partner's genitals, it is best to stimulate her inner thighs, mons, and vaginal lips before approaching the clitoris. Imagine that you are moving through concentric circles of increasing pleasure and intensity. When you finally approach

her clitoris, her sexual energy and excitement will be enormous.

Each woman likes to have her clitoris touched differently, and you need to become the expert in her particular pleasure. Even more important than where to touch is how to touch. Using your finger, stroke or spiral evenly—not too fast, not too slow. Avoid big movements: the clitoris's sensitivity is far more concentrated than that of the penis, and you are better off with more focused, subtler movements than with the kind of vigorous stimulation that most men enjoy.

As for where to touch, you are best off starting with the less sensitive parts of this very sensitive sex organ. Try stroking the base and sides of the clitoris. Then try stroking the hood and rolling the clitoris between your thumb and index finger—gently! Remember to touch the hood first, before touching the extremely sensitive glans. Experiment with different strokes and varying degrees of pressure. If your partner likes it, she will push her genitals slightly toward you for more stimulation. Moans, sighs, pants, jerking muscles, curling toes, and sweat, as well as smiles and other facial expressions, are all good signs. If your touch is too heavy or uncomfortable, she will pull her pelvis slightly away. Lighten up or try another stroke.

TONGUE KUNG FU

Although effective, fingers are not ideal, because they are not nearly as sensitive as your partner's clitoris. The hardness of the bones in your fingers and the sharpness of your nails can be painful. (Always make sure your nails are short and smooth.) For this reason, your tongue is much better suited to the task.

There have been many jokes about oral sex and its attendant smells and tastes. There are men who grimace at the thought and men who smile with fond memories. One multi-orgasmic man described his conversion to an oral-sex fan: "In the past, I definitely didn't like to use my tongue because it felt like I wasn't getting anything out of it. I was kind of selfish, really—I was a getter. And now my partner will be having these incredible orgasms because of what I am doing with my tongue, and it feels great to watch. I even start tingling in my body. It's true what the Tao says about when you are in tune. I get by giving. This is something a lot of guys miss. I know I did for a long time." Whatever your personal feelings are about oral sex, you should know that it is probably the fastest way to get a woman's vaginal juices flowing in preparation for lovemaking. As we discussed earlier, it is also the easiest, and for some women the only, way in which they have an orgasm.

If you are not a cunnilingus fan, you do not have to dive in head-first. If you use your tongue on your partner's clitoris, your nose and face will be nearest her mons and lower abdomen. If it is the odor that you object to, you and she can try bathing together or using scented oils. (We should mention that many men are turned on by, or over time come to be turned on by, the smell of their partner's vagina.) Best, of course, is not to focus initially or exclusively on her clitoris: use your tongue to touch her inner lips, the sensitive spot at the base of her vagina, and her perineum as well.

It is also important not to get overly fixated on her genitals to the exclusion of the rest of her body. Some women feel disconnected during oral sex, and this feeling can be lessened by using your hands to continue caressing her legs, belly, breasts, hands, and face. Many women find that having their nipples stimulated during oral sex can heighten their pleasure immensely. Other women find that this distracts them from the intensity of clitoral stimulation. As for clitoral techniques, you probably will want to try a combination of brushing with your lips, flicking with your tongue, and sucking with your mouth. Alternating between using your tongue and gently sucking her clitoris into your mouth can be extremely pleasurable. Again, be careful of too much pressure. Light, consistent, and rhythmic pressure is generally best.

Many men mistakenly think that oral sex involves inserting their tongue into their partner's vagina. This is not generally the case, since the tongue is usually too short and too soft to stimulate a woman's vagina successfully, although Taoists do recommend a technique for stimulating the G spot by hooking your tongue and pulling back. It's worth a try—especially if you have a strong tongue! (You actually can strengthen your tongue by sticking it out and then pulling it in like a snake as fast as you can for a minute or two. Practice as often as you can.)

ENTERING HER

Generally, your fingers are more effective than your tongue for stimulating the inside of your partner's vagina. You can use one finger (or, if she's very aroused, two fingers) to enter her. Circle around the wall of her vagina to find where she is most sensitive. Don't forget to try the G spot about an inch or two behind her clitoris. You may also wish to thrust your fingers in and out (slowly at first), simulating the action of your penis.

At this point, your partner's desire is probably close to boiling and she is eager for you to enter her. But do not enter her quite yet. Hold your penis in your hand as if you were about to

guide it into her vagina. But before entering, rub the head of your penis against her clitoris. This will help bring her passion to a rapid boil. Then enter her gradually, first about an inch, then two, and then pull back a little so that your penis is just inside the entrance to her vagina. This slow, lingering approach will help you control your own desire and will allow you to begin a thrusting pattern, which will bring both of you to the peak of pleasure many times.

If she is multi-orgasmic, you may want to help bring her to orgasm before you enter her, or you may want to wait until you have entered her. If she has already orgasmed at least once, she may be more patient with your need to stop momentarily during lovemaking as you approach the point of no return. Also, when you are making love her orgasms actually will help you control your ejaculation. As the Taoists understand it, water (vaginal fluid) cools down fire. As you gain greater mastery over your urge to ejaculate, this will be less of a concern because you will be able to use your breath and your mind more effectively to control this urge and will need to interrupt the rhythm of lovemaking less often.

CHARGING HER EROTIC CIRCUITS

While pleasuring your partner, you should try to avoid sexual scripts or patterns of lovemaking that can become routine. The sequence for pleasuring your partner described in the previous section is not the only one. It generally follows the pattern of arousal for most women, but not necessarily all women and certainly not at all times. During a "quickie," for example, you might want to jump right to oral sex. Mix and match. See what your partner wants and what the mood of the moment is. Although techniques can help you satisfy your partner, it is worth bearing in mind Herant Katchadourian's advice in his *Fundamentals of Human Sexuality:* "A simplistic search for bodily levers and push-buttons leads to mechanical sex since the energy that charges the erotic circuits is emotion." Knowledge of your partner's body is essential, but there is no substitute for sincere affection.

Thrusting Techniques

Most porn movies portray men thrusting in and out, sawing away until they ejaculate. It is no surprise that this is therefore what most men think they should do. In fact, this thrusting rhythm is a recipe

for fast ejaculation and little satisfaction for either the man or the woman. The Taoists recognized that proper thrusting was essential for coital pleasure, ejaculatory control, and sexual health. Yet even more important than any particular technique is making sure your partner is already highly aroused. Thrusting in too soon (before she is highly lubricated) should be avoided at all costs. Even if she is eager for you to enter her, a slow hand and pelvis will raise her anticipation and help you control your ejaculation.

FINDING YOUR RHYTHM

The Taoists developed numerous different thrusting patterns, most of which involved varying between shallow thrusts and deep thrusts (see figure 20). All of these patterns encouraged the man to thrust shallowly a number of times before thrusting deeply, the most common involving *nine shallow and one deep*. (As you learn to control your ejaculation, you can lessen the ratio to six or even three shallow to one deep.)

Alternating between shallow and deep thrusts will not only help you last longer; it will also thrill your partner. The deep thrust pushes all of the air out of her vagina, creating a vacuum, which the shallow thrusts intensify. You want to avoid withdrawing completely, which breaks the seal of the vacuum; instead, pull back so that you are about an inch or so inside her. One multi-orgasmic man described his experience: "When I read about this Taoist thrusting technique I really didn't believe it would work, but women just go crazy: they *love* the shallow and deep. They orgasm a lot quicker and can have two or three before I get to one. In the past, I couldn't last long enough to get a woman to that point."

More important than any particular number of shallow and deep thrusts is practicing a basic rhythm that you can maintain and that both you and your partner can enjoy for prolonged periods of time. Don't allow your thrusting to become mechanical by getting lost in counting off numbers.

DEEP THRUSTS

When most men thrust deeply, they pull back all the way, which rubs the head of their penis—their most sensitive spot—against the full length of their partner's vagina. If you have difficulty getting or maintaining an erection, this in-out deep thrust is especially valuable (see the Soft Entry exercise in chapter 8). However, as you can imagine, this thrust is also highly arousing and ordinarily leads to quick ejaculation.

For this reason, the Taoist masters developed the up-down deep thrust. This thrust uses the base of your penis, which is your least sensitive spot, to stimulate your partner's clitoris, which is her most sensitive spot (see figure 21). The benefits for postponing ejaculation are obvious. Instead of pulling back, you can stay deep inside your partner and thrust up and down repeatedly. This is especially important when she is in the midst of orgasming and wants you deep inside her but you are close to the edge.

Keep in mind that women's clitorises differ in their proximity to the vagina, which may be one reason that some women are more easily orgasmic during intercourse than others. You will be able to stimulate some women clitorally just by using the up-down deep thrust, while others will need the help of your fingers. Either way, this thrust will help you immeasurably during the most intense throes of lovemaking.

INTRODUCTION

1. After reading these accounts, Herant Katchadourian, M.D., author of the standard textbook *Fundamentals of Human Sexuality,* concluded: "The ancient Chinese clearly understood the distinction between ejaculatory and nonejaculatory orgasm. Those who mastered the art of achieving the latter obviated the refractory period [in other words, didn't lose their erection], which made it possible for them to engage in prolonged coitus with multiple nonejaculatory orgasms" (p. 292).

2. In conducting his famous studies of male sexuality, Kinsey discovered that "orgasm may occur without the emission of semen. . . . These males experience real orgasm which they have no difficulty in recognizing, even if it is without ejaculation." See Kinsey et al., *Sexual Behavior in the Human Male,* pp. 158–59.

3. Hartman and Fithian, *Any Man Can,* p. 157.

4. Natalie Angier, *New York Times,* Dec. 3, 1992, front page.

CHAPTER ONE
1. Arousal Chart for Multi-Orgasmic Man

CHAPTER TWO
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3. The Microcosmic Orbit
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19. Discrete and Continuous Female Multiple Orgasms

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15. Testicle Massage
16. Enlarging Your Penis
17. Helping Your Prostate
18. Touch Meditation
19. Strengthening Your Anus

PARTNER EXERCISES

1. Stopping the Stream
2. PC Pull-Ups
3. Strengthening Your Entire Vagina
4. Deepening Your Orgasms
5. The Big Draw for Women

HEALING TAO BOOKS AND INSTRUCTORS

The sexual practices described in this book are part of a complete system of physical, emotional, and spiritual development called the Healing Tao, which is based on the practical teachings of the Taoist tradition. Following is a list of other Healing Tao books written by Mantak Chia.

HEALING TAO BOOKS

Awaken Healing Energy Through the Tao

Awaken Healing Light of the Tao (with Maneewan Chia)

Bone Marrow Nei Kung: Iron Shirt Chi Kung III (with Maneewan Chia)

Chi Nei Tsang: Internal Organ Chi Massage (with Maneewan Chia)

Chi Self-Massage: The Taoist Way of Rejuvenation

Fusion of the Five Elements I (with Maneewan Chia)

Healing Love Through the Tao: Cultivating Female Sexual Energy (with Maneewan Chia)

The Inner Structure of Tai Chi: Tai Chi Kung I (with Juan Li)

Iron Shirt Chi Kung I: Internal Organs Exercise

Taoists Secrets of Love: Cultivating Male Sexual Energy (with Michael Winn)

Taoist Ways to Transform Stress into Vitality

To order Healing Tao books, audiocassettes, or videotapes, write, call, or fax the Healing Tao Center, 1205 O'Neill Highway, Dunmore, PA 18512 (tel. 717-348-4310; fax 717-348-4313).

HEALING TAO INSTRUCTORS

There are over three hundred Healing Tao instructors throughout the world who teach classes and workshops in various practices, from Sexual Kung Fu to Tai-chi and *chi-kung.* For more information about instructors and workshops in your area, contact the Healing Tao Center, 1205 O'Neill Highway, Dunmore, PA 18512 (tel. 717-348-4310; fax 717-348-4313), or the International Healing Tao Center, 274 Moo 7, Laung Nua, Doi Saket, Chiang Mai 50220, Thailand (tel. 66-53-495-596; fax 66-53-495-852).

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About the Author

Mantak Chia, educated in anatomy and physiology, is the leading teacher of Taoist sexuality in the West. **Douglas Abrams** is a writer and editor and longtime student of Taoist sexuality.

Reader comments for *The Multi-Orgasmic Man:*

"**No man should have sex until he reads this book!!!** This book absolutely changed my life. The info that I applied in this book was surprisingly easy to learn and use. I believe that if you want to be good at something you have to study it and this was a great place to start concerning my sexuality. My only regret is that I wasn't exposed to this book a long time ago!"

—A reader from Rolla, Missouri

"**If you don't buy this book you're making a mistake.** This is undoubtedly one of the most surprising things I have ever learned. This really works. Males can have multiple orgasms. This is one book that I will be glad I have read for the rest of my life (not to mention the appreciation my girlfriend has for this book). If you do not buy this book, you are making a mistake. The techniques laid out in this book are something every man should know!"

—A reader from San Diego, California

"**The technique works!** This is the first book like this I have ever read—and it may be the last. Although I am generally skeptical of this sort of "self-help" book, this one is everything it claims to be. I am absolutely amazed that a technique such as the one this book describes could be so easily workable. To say the least, my wife has enjoyed the book every bit as much as I have, and she hasn't even read it yet!"

—A reader from Salt Lake City, Utah

"**A must-read for men (and women) of all ages.** I read this book before encouraging my husband to read it. The chapter for women is an added blessing. I plan on allowing my teenage son to read it, possibly for the benefit of my someday future daughter-in-law."

—A reader from Massachusetts

"**You'll be begging for more.** This book expands the realm

of possibility.… Run, don't walk … buy this book for yourself and then make your significant other read it as well."

—A reader from San Francisco, CA

"**Wow! Easy to read and master techniques for accomplishing every man's (and woman's) dream.** A must have for all men. I intend on making sure my sons each have it. My second day practicing I had any number of orgasms…to tell the truth I stopped counting."

—A reader from Utah Valley

"**A must read.** On the second day I had 8 orgasms, and have been a believer since!"

—A reader from Oklahoma

"**The authors have changed sexuality from a source of anxiety, frustration, and mystification to a wonderfully satisfying experience of growth and passion.** After reading this book, one realizes that our society's view of sex has little resemblance to what can be achieved between two people through the gentle control enabled by these techniques. To be in deep throes two and a half hours later is something men deserve to know about. It's almost too good to be true. I'm a love machine."

—A reader from Maine

"**This book is absolutely PRICELESS!!!** This book finally allowed me to release all my sexual performance anxiety, allowing me to enjoy making love instead of worrying about it. It will change your life.... It's as simple as that."

—A reader from USA

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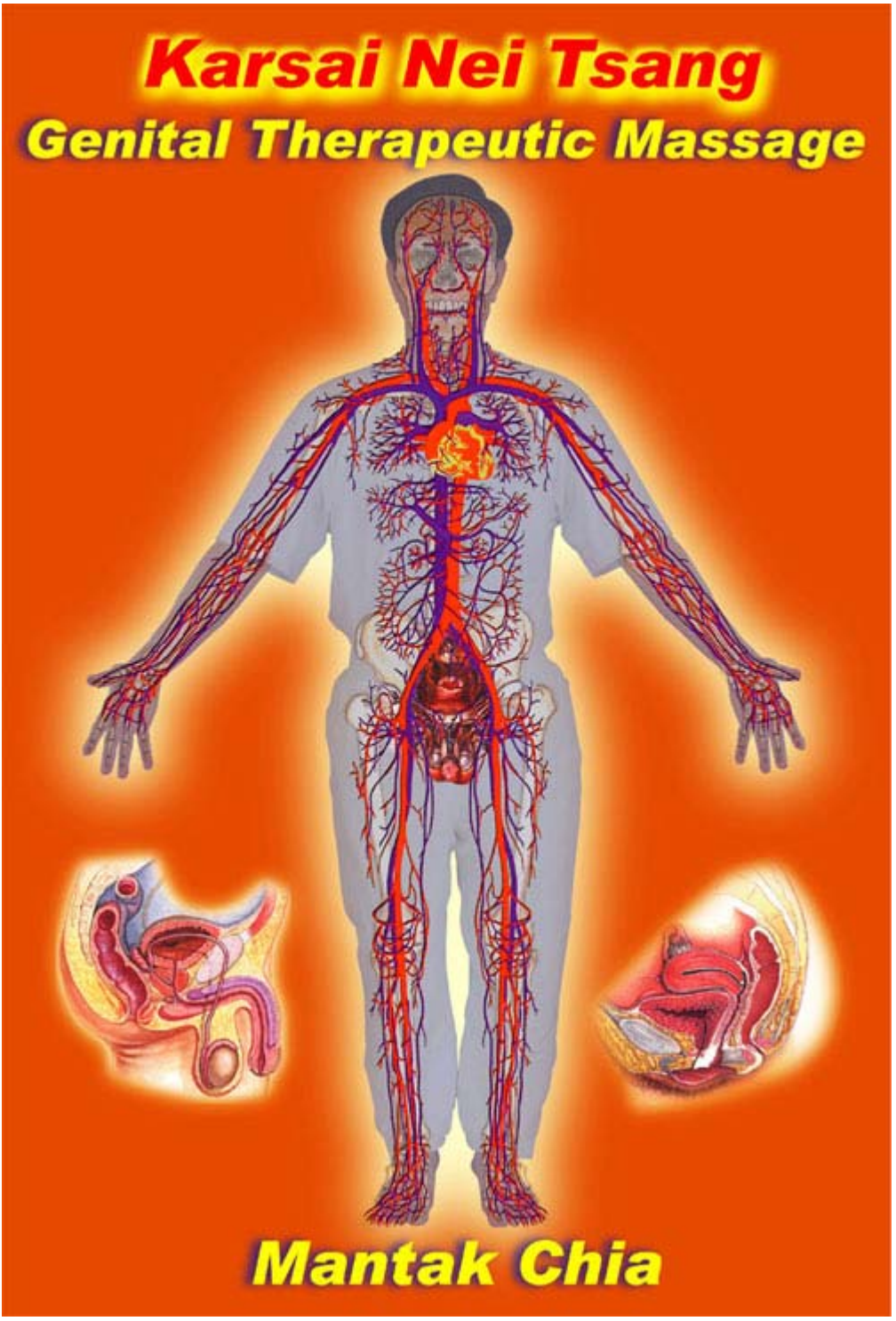

Mantak Chia

Karsai Nei Tsang

Genital Therapeutic Cleansing Massage

Mantak Chia

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 2,000 instructors and practitioners from all over the world. Living Tao Centers, Chi Nei Tsang Institutes, Cosmic Healing Forums & Immortal Tao Mountain Sancutaries have opened in many locations in North America, South America, Europe, Asia, Africa and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden and the Universal Tao Training Center fifteen miles outside of Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a word processor for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirt-five books to convey the full Universal Tao System. In June, 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December, 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete eight Court Recreational Facilities.

In February, 2002, the Immortal Tao practices were held at Tao Garden for the first time using Darkness Technology, creating a complete environment for the higher level Taoist practices.

Master Mantak Chia has previously written and published these twenty-four Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002
Tan Tien Chi Kung - 2002
Cosmic Fusion - 2002
Karsai Nei Tsang - 2003

Many of the books above are available in the following foreign languages:

Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

Acknowledgements

The Universal Tao Publications staff involved in the preparation and production of ***Karsai Nei Tsang: Genital Therapeutic Cleansing Massage*** extend our gratitude to the many generations of Taoist masters who have passed on their special lineage as an unbroken oral transmission over thousands of years. We wish to thank the thousands of unknown men and women of the Chinese healing arts who developed many of the techniques and concepts presented in this book.

Mui Yimwattana

We also wish to thank the Chi Nei Tsang teacher Dr. Mui Yimwattana, and Taoist Master Yi Eng, both of whom worked so patiently to teach their students.

Bunjong Pun (Ni)

A unique genital health massage service is now available at Tao Garden Health Resort. A Thai Massage masseuse with twenty-six years of professional experience does this special masage. In addition to being highly skilled and effective in all of the forms of Thai Massage that one is likely to encounter, our new staff professional, 'Ni', has acquired this secret specialist training that most of us have never come across before. Her professionalism, knowledge and sensitivity in this delicate area of the sexual organs and glands massage has gained immediate trust and respect from all of us here who have been privileged to benefit from her massage. Not to be confused--this is not a 'sexual' massage--it is for the sexual organs, glands, associated parts and areas.

We offer our eternal gratitude to our parents and teachers for their many gifts to us. Remembering them brings joy and satisfaction to our continued efforts in presenting the Universal Tao System. As always, their contribution has been crucial in presenting the concepts and techniques of the Universal Tao.

Buathon Thienarrom

Buathon Thienarrom was formerly the Medical Manager and Chi Nei Tsang Practitioner at the exclusive Chiva-Som International Health Resort in Hua Hin, the Royal seaside resort south of Thailand. She hopes to be able to pass on her knowledge of healing to those who are interested in the approach to Holistic Health. Due to her comprehensive background knowledge in Nursing, Psychology and Health Sociology, she has been able to easily grasp the fine balance between traditional/alternative medicine and modern medicine. She fully understands the connection of harmony between body and mind in order to achieve spiritual development, which are the keys to personal fulfillment. She has undergone extensive training in alternative/holistic medicine. She has appeared in the BBC program on Holistic Health, Discovery Channel (Asia) on Alternative Therapies, and various other interviews on television, radio and the press. She has also given many lectures on Holistic Health topics at various leading universities throughout Thailand. She has practiced her healing tehniques in Hong Kong, Singapore and the United Kingdom.

We wish to thank the thousands of unknown men and women of the Chinese healing arts who developed many of the methods and ideas presented in this book. We express special thanks to Saumya Comer for her writing and editorial contributions. We appreciate her research and great labor. We express deep appreciation to Udon for his illustrations, book layout and beautiful cover. We thank Wilbert Wils, and Jean Chilton for their assistance in preparing, editing, and proofreading the manuscript. We wish to thank Jettaya Phaobtong and Buathon Thienarrom for their editorial contributions in the revised edition of this book.

A special thank you goes to our ***Thai Production Team*** for their cover illustration and book design and layout: Raruen Keawpadung, Computer Graphics; Saysunee Yongyod, Photographer; Udon Jandee, Illustrator; and Saniem Chaisarn, Production Designer.

Saumya Comer has been a student, teacher and practitioner of the healing arts since 1984. She began her studies in the field of Somatics, learning how to bring people to deeper connection with their bodies through bodywork and sensory/movement awareness. She now combines different forms of bodywork such as Chi Nei Tsang, Craniosacral Therapy and Visceral Manipulation to assist her students in releasing their limiting physical, emotional and spiritual blockages. Saumya is an instructor of the Universal Tao System and uses the powerful self-healing techniques of Chi Kung to teach her students self-care. She lives mostly on the west coast of the United States and teaches Chi Kung internationally. She travels to Thailand twice a year to teach and assist in the Universal Tao trainings at Tao Garden.

Saumya Comer,
Editor

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists and Thailand trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

Introduction

Blockages and Karsai happen in all parts of the body. Karsai means the sedimentation in the veins. These blockages come from the aging process, emotional and physical traumas, toxins, heavy metals, the air-pollution that we breathe, poor nutrition, from the pesticides put into our food, polluted water and too much stress. These may cause speed up at the blockages. There are many different types of blockages. There are blockages in our circulatory systems that affect blood and lymphatic flow, blockages that cause our organs to function poorly; especially the kidney, bladder, spleen, pancreas, lung, prostate gland,testicles, uterus and vagina, energy blockages, blockages in our tendons plus fascia and muscles, to name just a few.

Karsai Nei Tsang focuses on the blockages in the genital area, especially the blockages that take the form of sedimentation in the veins. In order to have healthy, functioning genitals we need a rich supply of blood flow. When this blood flow becomes blocked with crystal like sedimentation and fatty deposits, the human sexual arousal response is greatly affected. With a poor blood flow to the genital area men will experience difficulty in getting and maintaining a good erection. Because a woman's arousal also depends on a healthy blood flow, she will have difficulty with getting the proper swelling of her labia and clitoris and producing the sexual fluids. Karsai Nei Tsang releases the blockages and sedimentation that cause poor blood flow so that men and women can regain healthy sexual function.

Another important benefit of Karsai Nei Tsang is an improved hormonal balance. When the circulatory flow in the genital area increases, hormones are more easily released. A healthy balance of hormones stimulates the sexual and brain functioning. When we have healthy hormonal function we are given some protection against many of the age related problems such as memory loss, back pain, poor circulation, problems associated with menopause, and sexual libido.

Karsai Nei Tsang is especially important for men and women over the age of forty and for anyone who feels blocked sexually. The age of approximately forty is when the blockages and sedimentations become manifest.

Our sexual organs play a major role in our physical, emotional and spiritual health. Because every part of the body is connected, tensions in one area have an affect on the rest of the body. This is also true for the genitals. When the genitals suffer from blockages, the jing chi (sexual chi) is not free to circulate through the body. The body is then deprived of this powerful healing energy. We need arousing, orgasmic energy for the healthy functioning of our beings.

We have neglected our sexual organs for far too long, our genitals need attention and expert care just like the rest of our bodies. Karsai Nei Tsang provides this care. The Karsai Nei Tsang practitioner uses a sensitive touch with deep, direct pressure and small circular massage movements to dissolve the sedimentation in the circulatory system, release the toxicity in the organs, and assist the student in letting go of any past emotional blockages held in this area.

Karsai Nei Tsang addresses the common problems associated with our sexual organs; impotency, frequent and difficult urination, painful menstruation, painful intercourse and low sexual libido. It is also quite effective in alleviating lower back pain, improving the body's alignment, strengthening the pelvic floor muscles and increasing general vitality.

Chapter I
Preparation for Karsai Nei Tsang

Preparation for the Practitioner

As a Chi Nei Tsang practitioner, it is important for you to maintain a clear, healthy body with abundant Chi flow and healthy boundaries. Because of the sensitive nature of genital massage this is especially true for the Karsai Nei Tsang practitioner. It is a prerequisite for you as a Karsai Nei Tsang practitioner to have worked out any issues of past sexual trauma and to have gained enough experience in the Universal Tao Healing Love and Basic practices so that you have good management of your sexual energies. As a practitioner you represent yourself as a standard of physical, emotional and spiritual health. It is your responsibility to stay clear and centered in your own energies. Any exchanging of your sexual energies with your student is just a distraction from the healing purposes of Karsai Nei Tsang and it invites negative influences for both you and your student. Unclear boundaries create an opening for the repressed negative energies of your student to enter into your body or vice versa; your unprocessed negative energies to enter into your student. This is obviously not the purpose of any Chi Nei Tsang session and can adversely affect your abilities as a healer in the future. The simplest way is to stay present in your integrity and you will be rewarded ten fold. Following are 12 steps for becoming an effective healer.

1. Establishing a Strong Connection with your Sources of Energy

First it is necessary to establish a connection with your sources of energy and connect with the energies emanating from heaven and earth. This ability is very beneficial for self-healing and is essential for healing others. If you do not connect to some source of external energy when healing others, you will draw upon your own personal reservoirs. Our personal Chi is limited by nature, and can easily become depleted if we give it away too freely.

Refer to Mantak Chia's book*, Awaken Healing Light of the Tao* for a description of this practice. Stay connected with these energies while you are giving treatments. You will discover that you have ample energy of the correct quality and quantity to help your student.

2. Preparing Yourself Physically

When creating the strong, healthy body necessary to practice Karsai Nei Tsang, bear in mind that energy flows to wherever it is needed. If your energy is lower than your student, his energy will flow to you and you will become weaker. In emphasizing physical preparation, it is important to know that tendons, muscles, fasciae, channel systems, and bones draw in power that can be channeled to another. Following is a list of physical practices that are important for you to do.

Fig. 1.1 *Preparing Yourself Physically*

A. Iron Shirt Chi Kung

The Iron Shirt Chi Kung exercises allow you to draw energy from the Earth, Cosmos, and Universe to strengthen the tendons and clean out and energize the fasciae. This provides protection and opens the channels so that they can receive more energy.

B. Tai Chi Chi Kung

By practicing Tai Chi you can learn to move the body in one unit using Chi instead of muscle power. You can build inner strength by circulating energy through the channels, muscles, tendons, bones, and fasciae. This ability is very important in Karsai Nei Tsang for protection and for storing and channeling energy. The Universal Tao's Tai Chi Chi Kung, which can be learned very quickly, is a short but powerful way of achieving such results.

C. Bone Marrow Breathing

The Universal Tao has published a book on the subject of bone marrow breathing entitled *Bone Marrow Nei Kung*. By studying and practicing bone marrow breathing, you can cleanse and grow bone marrow, refresh the blood, and develop enormous power. You can develop the ability to channel energy through breathing while using less muscular force and passing on more energy.

D. Diet

Whether or not you are familiar with cooking using the Five Phases of Energy theory, you may find it very interesting because it is so full of novelty and surprise. Culinary artists who incorporate the Five Phases of Energy (Five Element) theory in their cooking skills using the produce and foods of their countries or regions are quickly creating new and exciting trends in cooking.

The Five Element theory of cooking that pervades much of the world of Chinese cuisine is served in many wonderful restaurants. In fact, its cooking rules are a part of every Asian culture. Asian cooks balance their food in five ways, separating food according to five tastes, five colors, hot, cold, and PH balance. Then the foods are combined and beautifully prepared.

The stomach, spleen, and saliva sort out the food and distribute it to the organs according to taste and color. Each color and taste feeds energy to its own particular organ group. Each organ will only accept that energy designed for it by nature.

3. Practicing Meditation Daily

To maintain your energy, meditate every day by connecting with the outer forces and burn out any of your sick and undesirable energies. The Six Healing Sounds Meditation, Microcosmic Orbit Meditation and the Fusion Meditations are especially effective for these purposes. Refer to Master Chia's *Awaken Healing Light of the Tao* and Fusion of Five Elements books for instructions of these meditations.

The Healing Hands Meditation, when practiced every day, increases the ability of your hands to channel the Universal, Human Plane (Cosmic Particle), and Earth Energies. You will be able to

feel the energy emerging from your palms and fingers as you touch the student. Refer to Mantak Chia's *Chi Nei Tsang I* for this meditation.

4. Recognizing that Healing is a Gift of Nature

Everyone in good health can heal. The healing ability means having a powerful life-force with good intention. A powerful life-force means having a higher vibration. Usually, it takes one year for a person to absorb enough Universal Energy to be effective. That is the time it takes for the Earth to revolve around the Sun. (Fig. 1.2) With the practice of the Cosmic Particle Chi Circulation and the Embracing the Tree exercises, you can quicken the process of energy absorption and transformation without overheating your system or creating a problem of cosmic energy indigestion. The energy is then immediately useful.

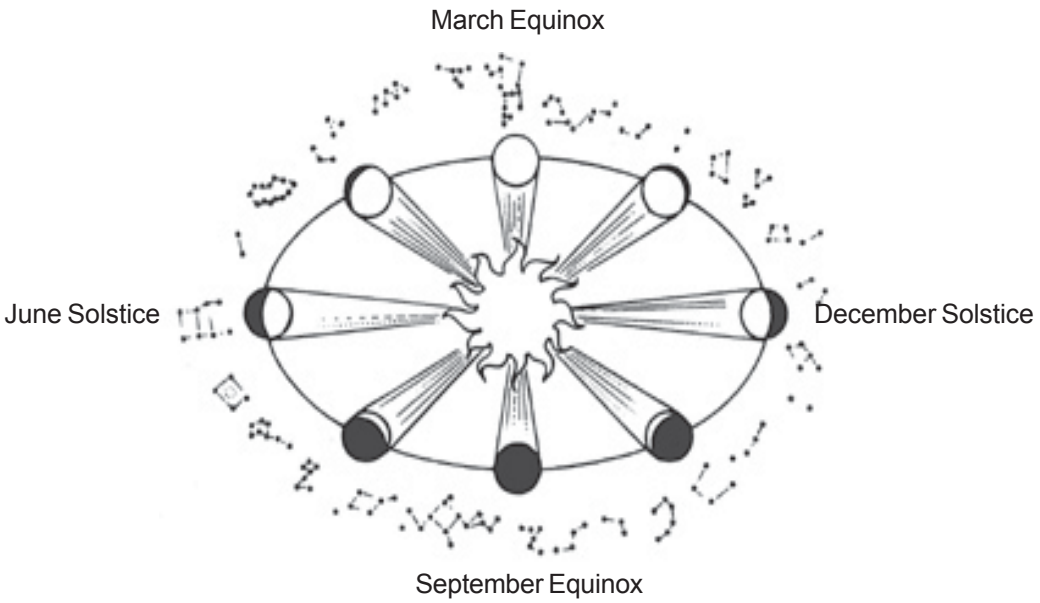

Fig. 1.2 *Ordinarily, it takes one year for a person to absorb enough Universal Energy to be an effective healer. Meditation can quicken the absorption process.*

5. Becoming a Channel for Powerful Forces

The more channels you open, the better off you are. Therefore, to receive energy, it is important to open at least the two major channels (Functional and Governor) of the Microcosmic Orbit. It is better still to add the Thrusting and Belt Channels. By doing so you will know first hand the way your energy flows. Then you can direct and draw in healthy energy, and use it to burn sick energy out of your system. By first opening the energy channels within yourself, you become more efficient as a healer and can avoid succumbing to the illnesses that you are removing from another.

The quickest way to open your Microcosmic Orbit is to take a weekend workshop with a certified Universal Tao Instructor. You may also teach yourself by using the *Awakening the Healing Light* book or video. To open the Thrusting and Belt Channels, you could study with us, a certified instructor, or teach yourself by using the *Fusion of the Five Elements* book and Fusion I, II, and III videos. Audio tapes are also available.

6. Preventing the Depletion of your Energy

It is important to channel the energies of the Universal, Human Plane Cosmic Particle, and Earth Forces rather than using your personal storehouse of energy. When practitioners rely on their own energies they soon become depleted and then it is very easy for disease to take hold.

As you try to help a person and your life-force energy flows into him or her, be sure your energy is healthy. Otherwise any sick energy you send will create the same sickness in that person.

The reverse also holds true. As you send energy into a person, his or her energy passes to you. This means that this person's problems become your problems. There is no such thing as becoming involved with the healing without also becoming involved with the problem. This is how many people in the healing arts get sick. Their energy systems are not efficient enough to counteract the effects of the sick energy to which they have exposed themselves.

Young and healthy people who enter these professions can get by with no apparent ill effects because they have "energy to burn". However, they are depleting their energies and the sick energies

they take on eventually do affect them. This is why it is important to think that you are not simply healing them, but you are a teacher and an adviser. Developing and maintaining an open channel to the Universal, Human Plane, and Earth Energies will help you avoid picking up sick energy and help you burn out the sick energy when it enters you.

7. Healing from your Heart

Chi Nei Tsang is full of brilliant and wonderful techniques that have the potential to significantly alter the basic way we care for ourselves and for each other. Even though the techniques are powerful and can relieve both chronic and acute illnesses, they will not work effectively unless they are activated and animated by a love and compassion that is given sincerely and abundantly from your heart. Your fingers and hands can become healing hands only when you are full of good intentions.

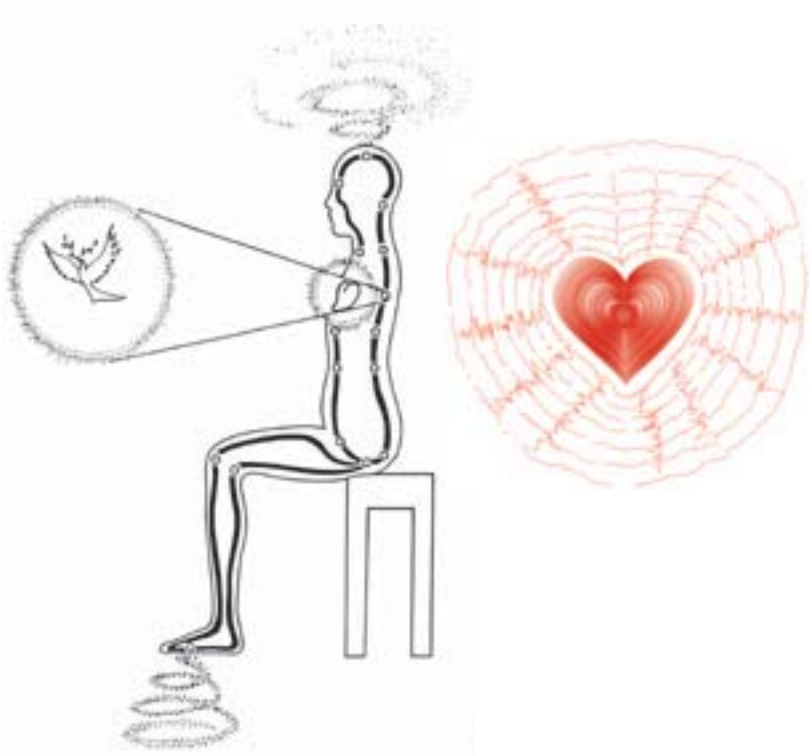

Fig. 1.3 *Healing with Love from the Heart.*

When you touch others, touch them with all the love, care, and compassion that you can find within yourself. Connect yourself with the forces of the Universe, the Cosmic Particle or Human Plane, and the Earth and become a physical channel for these forces. Apply your hands with the tenderness of a mother touching her child. If your touch is from your center to theirs, they will open like the petals of a flower in the morning sun. Every life and body has a self-healing mechanism that you can help to awaken. Once the center at the navel is activated and freed and the organs are detoxified, the process of healing can be completed by your students through their own discipline.

8. Educating your Students to Heal Themselves

A universal law states that energy cannot be destroyed; it can only be transformed. As you engage in healing your student, Chi Nei Tsang I, II and III techniques will help you locate the problem and boost the level of energy. You will help your student to transform their toxic, blocked energy. As a healer it is you that starts the fire, but it is the student's responsibility to maintain it and not let it die out. The main role of the Chi Nei Tsang practitioner is educator not healer. The philosophy and purpose of Chi Nei Tsang is to teach people how to heal themselves by providing insights into their own immense, internal healing powers. If you teach the student the Inner Smile, the Six Healing Sounds, and the Microcosmic Orbit, along with the CNT self massage, you will help them transform their sick, negative energies into good life-force energy. Chi Nei Tsang practitioners, therefore, never refer to their students as "patients" or "clients". A student who has awakened his or her own healing energy can continue the process by practicing at home and teaching family and friends. One must always remember that the most important healing energy comes from within oneself.

9. Clearing your Energy after each Session

When helping someone it is possible to accumulate sick energy on the surface of the skin of the hands and arms. Do not allow it to go beyond the shoulders and enter the body. If you practice daily, your mind's power can hold back the encroachment of the sick energy.

There are many different theories on how to get rid of this unwanted energy. Some people advocate washing the hands. If you do this, make sure that you use cold, running water, or you can drive the energy into your body further.

One method is to place your hands on a surface conductive to Earth Energy and connected to a ground (e.g., a water pipe). Iron will do, as will a brick or cement wall that has a footing. It will pass the sick energy down to the earth. The earth can help neutralize sick energy.

With some sick energy this grounding method is not effective or powerful enough. Therefore, our advice is that you meditate as well so that you are sure to be clean.

10. Restoring the Force after Each Session

It is important that after each practice session you sit and meditate. Be sure that you are free of sick energy before ending your meditation. You may feel coldness in the hands and itchy skin, let it go down to the ground and bury them them under the ground.
Meditate until you feel warmth in your navel area and your hands; it will burn out the sick energy. Use the Fusion I practice to get more energy into the navel and transform the sickness into positive life-force.

11. Know Thyself

A healer is knowledgeable and, above all, careful with his or her treatment of life-force energy. Only then can the healing experience be gratifying both for the teacher and the student.

Upon arising in the morning, spend a few moments checking your energy level. If your energy level is not good, take time to raise its level. Put your fingers touch the navel and keep on smile to the navel and feel it warm and the chi started flow up to the head andstarted flow down to the tongue and circulate it around the whole body.

Never overdo anything. If your energy is low, or if you do not feel well, do not attempt to give a session to anyone. The meditations mentioned or described above and below are very important to help you raise your energy to a higher level. The Microcosmic Orbit and Fusion exercises are very powerful means of checking and replenishing your energy level. Fusion II is very useful for warding

off most illness effects by using the Thrusting Channels and especially, the Belt Channel.

At all times it is wise to take precautions and to know what you are doing. Advice and warnings about healing energy and sick energy are consistently given throughout the Chi Nei Tsang books. It is extremely important that you follow instructions on how to care for yourself carefully.

12. Using the Earth and Trees for Healing

Spending time with nature is an excellent way to purge any toxicity and replenish your energy. Trees and other plants are very good at taking the sick energy into the Earth. Houseplants, however, do not receive the direct energy of the Sun, nor are they directly connected with the Earth. They can only absorb limited quantities of sick energy.

The sick energy of other people can seep into your inner organs and accumulate there. It is a very dense, coarse energy and can feel both cold and biting. This is, by far, the worst way to experience sick energy. A tree can handle this energy by sending it into the healing Earth.

Fig. 1.4 *Passing Sick Energy to a Large Tree*

A detailed section on training, protection and self-care for the practitioner is found in the first Chi Nei Tsang book. It covers the Healing Hands Meditation and the Microcosmic Orbit, Inner Smile, Six Healing Sounds and Fusion Practices in order to prevent depletion of energy, and to be able to give, take and transform energy. There are many Universal Tao practices that can be a great complement to your practice of KNT. For example, practicing Iron Shirt Chi Kung and Tai Chi Chi Kung can help you to relax and work with your whole body as a unit in a harmonious way. Cosmic Healing is also an effective protection against absorbing negative Chi because it focuses on using external energies for healing and not your own energy.

Preparation for the Student

Before you work with your student, hold an interview with him /her in order to review the level of care that is required for a successful outcome. It is important that students take responsibility for helping themselves, so they need to prepare their bodies before you start working with them and then continue the self-care throughout the treatment.

If people are not willing to take care of themselves, all the effort and energy expense is on your part, and you will be pouring your energy into a bottomless pit. If this is the case, you need to be very open, gentle and honest and tell them you cannot work with them unless they are willing to work on themselves as well.

Before the session, it is important for your students **to detoxify and clean the colon**. You can give or send them a printed sheet explaining the procedure. Students should also become aware of their breathing patterns and focus on breathing properly. The following is an overview of what students need to focus on before the session.

1. Detoxification

When the body is full of toxins it is impossible for the organs to function properly. By releasing toxicity and tension, more free flowing energy is available to balance and heal the organs.

In order to prepare their body for the treatment, two or three days prior to the session students should drink plenty of water and

follow a special diet, eating only the following:

1. Brown rice (to carry out poisons from the blood).
2. Congee (thin rice soup) made with six parts filtered water to one part organic rice,
3. Vegetable soup. It may be seasoned with a bit of organic chicken, but the chicken should not be eaten.
4. Juice from green vegetables and leaves (i.e. spinach), which are naturally rich in chlorophyll.
5. Fresh, natural fruit and vegetable juice.

2. Cleaning the Colon

When the colon is clogged, the body becomes more acid and reabsorbs toxins intended to be eliminated. After one day of stagnation, the large intestines send the toxins back for storage, causing discomfort and pain.

For CNT treatment to be successful the colon must be clean, otherwise you simply massage past stool in the large and small intestines. Some people can carry many pounds of impacted fecal matter and many unfriendly bacteria in the colon. A great deal of sick energy can accumulate in old, putrefied stool. My teacher would never do Chi Nei Tsang on someone whose colon was not clean.

Colonics can be very helpful in moving out old mucus, gas and hard impacted fecal matter, and they also help restore proper peristaltic action of the intestines. Parasites can be eliminated with colonic irrigation and the use of fresh raw organic garlic cloves ground and filtered into the water (cooking garlic even slightly eliminates its detoxifying and antiparasitic properties).

To support the colonic cleansing it is good to massage the sigmoid colon in the lower left quadrant, then the descending colon, the two upper flexures in the corners under the spleen and liver, the transverse colon and finally the ascending colon and ileocecal valve. (For a more detailed explanation, refer to the CNT I book.)

To release and facilitate the movement of waste through the intestines while doing a colonic treatment it is good to take a teaspoon of psyllium seed husks and a tablespoon of bentonite mixed in a glass of room temperature water (8 ounces), and then drink another glass of water.

It is good to cleanse the colon two or three times per year and

after periods of travel or dietary excess. In addition to many well-trained, competent colon therapists, home colonic units with slant boards are now available. At Tao Garden, our training center in Chiang Mai, Thailand, where there is plenty of fresh air, filtered water and sunshine, there is a special seven-day cleansing program.

3. Importance of Breathing Properly

The way we breathe is the way we feel. It reflects on the way we stand and move and how we perceive ourselves in the world. Most people have a habit of not breathing deeply, fully inhaling and exhaling, especially during periods of stress.

By blocking our breath, we block our access to feelings. We protect ourselves from experiencing certain feelings, and these become trapped energy in the organs generating imbalances and wind problems. Getting sick is the way our body draws our attention to the blocked and neglected organs. As we breathe into them, we release the winds and emotions that are trapped inside.

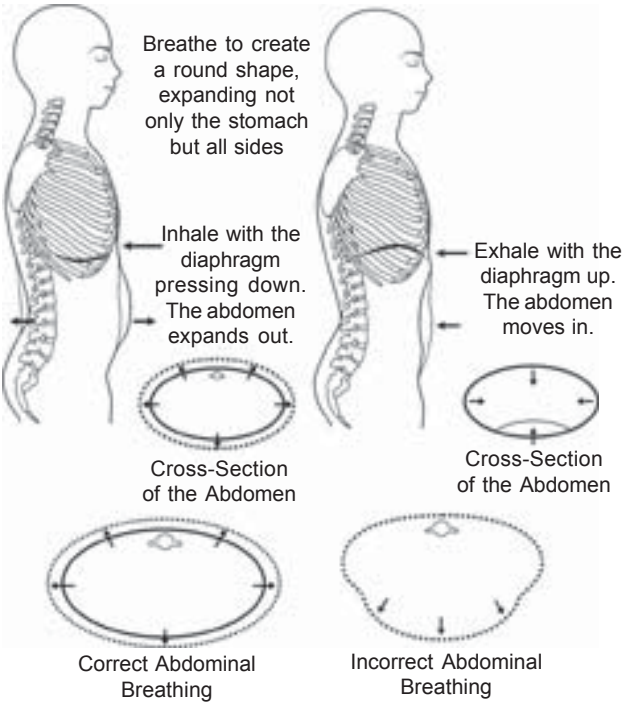

Fig. 1.5 *Abdominal Breathing*

Breathing appropriately means using the diaphragm. Relax the chest and breathe in deeply drawing the air into the abdomen, feeling it expand in all directions (front, back and sides) and expel the breath by drawing the abdomen up, squeezing in on all sides of the abdomen and breathing out through the nose. (Fig. 1.5) In cases of hernia, asthma, heart attack and strokes, proper breathing allows the wind to move out.

The Tao Yin exercises from the Universal Tao series (now available in book and video) are very helpful to teach students to breathe deeply into the lower abdomen and progressively feel the breath expand upwards, filling the entire lungs as the diaphragm moves down.

Deep Belly Laughing

Deep belly laughing is the best form of breath work. Laughing from the abdomen 4-5 times per day stimulates the intestines to move waste out and promotes the circulation of blood and lymphatic, eliminating energy stagnation. Also, as we move from the sympathetic to parasympathetic system with laughter, the blood becomes more alkaline.

Laughter stimulates a healing set of brain chemicals, and fosters self-loving, joyous feelings. Dr. Bernie Siegel's approach to self-healing through laughter shows that people have healed themselves from serious illnesses with laughing therapy.

Fig. 1.6 *Laughing Practice*

In a harmonious way, Cosmic Healing is also an effective deterrent to absorbing negative Chi because it focuses on using external energies for healing and not your own energy.

Contraindications for Treatment

Before treatment it is important to interview your student carefully so that you can ascertain whether or not a Karsai Nei Tsang treatment is appropriate. Karsai Nei Tsang is contraindicated for women who use an intrauterine device for birth control (IUD) and for pregnant women. It is also contraindicated for anyone with venereal disease. People with high blood pressure, heart disease, cancer or generally weak constitutions need to first consult with a physician and then proceed cautiously.

Chapter II
Refining your Chi Nei Tsang Skills

Karsai Nei Tsang is an advanced practice and it requires a high degree of sensitivity on the part of the practitioner. It is an absolute requirement for practitioners to have practiced Chi Nei Tsang I and II for a number of years before studying and applying the techniques of Karsai Nei Tsang.

What exactly are the gifts of an effective healer? On the following pages you will be introduced to the individual elements that when synthesized and integrated make a great healer.

Inner Cultivation

There is a wise saying that states: we can only help others to heal themselves to the extent that we have healed ourselves. This is the primary reason why developing your own personal spiritual and healing practice is so important.

Create an Open Hearted Healing Space

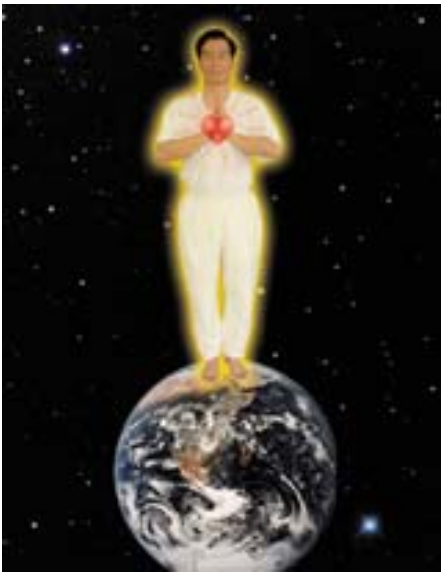

Fig. 2.1 *Opening your Heart*

It is important to let go of your personal agenda for all healing sessions. Ground yourself to the earth forces and open your heart to the unconditional love of the universe. Realize that you are not the healer but a facilitator for healing. Let yourself be guided by the healing process. Sometimes healers just work from a routine. It is important to have the sensitivity to know where you need to focus more and when to introduce new elements. For example, when you find an area of the body that is highly sensitive and tight, do you automatically just press in or do you ask the area what it needs in order to release? Perhaps this area needs a softer approach and to be contacted in just a certain way. Do you dialogue with your student to see what emotion might be hiding out in this area? Do you wait and give room for your student to tune in and feel their feelings? Move through each session with these questions and let yourself be guided by the needs of the moment. The healing process may shape your sessions in ways your monkey mind would not have thought of. Trust this guidance and you will be surprised by the wisdom of the healing process.

Connect to the Forces of Heaven and Earth

As a preparation for every session it is of primary importance to connect to the external Chi emanating from heaven and earth. This ability is very beneficial for self-healing and is essential for healing others. If you do not connect to some source of external energy when healing others, you will draw upon your own personal reservoirs. Our personal Chi is limited by nature, and can easily become depleted if we give it away too freely.

Mastering your Awareness of Chi

Understanding the nature of Chi and being able to distinguish its positive and negative qualities is of the utmost importance. Without a clear working knowledge of Chi, the practitioners of Chi Nei Tsang have no means of protecting their own bodies and energies from the negative influences of others. They also may find themselves giving away more energy than they can spare. Becoming a master in detecting the subtleties of chi will greatly enhance the effectiveness of your sessions.

A. In the Universal Tao system, the first goal is to learn to **conserve our Chi**. When a battery is totally drained it is harder to charge; money makes money, Chi makes Chi. Conservation of Chi will help gain more Chi. To have more Chi we first need to maintain control of the gates through which energy normally leaks out and unwittingly drains our life force.

We leak energy:
- through our reproductive system
- through negative emotions
- through constantly turning our senses outward

Without knowing how to conserve the Chi that we already have, what is the point of acquiring more?

B. We learn to **balance our Chi**; that is, we seek to keep a smooth and balanced flow of energy moving throughout the whole body. If our energy is imbalanced, we may have too much energy in some places and not enough in others; we may also be too yang or too yin. We may have excess or deficient heat, cold, damp or dryness. This imbalanced energy tends to make us go to extremes.

C. We learn to **transform our Chi** into more beneficial energies. For example, through the Taoist Sexual Chi Kung practices taught in the Universal Tao (the course known as Healing Love through the Tao), we can transform sexual energy back into basic life force Chi. Through other practices (such as the Inner Smile, the Six Healing Sounds, and Fusion of the Five Elements) we learn to transform negative emotional Chi into positive virtuous Chi. Thus Chi is not only the foundation of our health; it is also the basis of spiritual development in the Tao.

D. Once we have accomplished the three previous phases of mastering Chi, we then learn to **cultivate Chi**. Chi pervades all of heaven, earth and nature. In the Universal Tao workshops students learn time tested ways to tap into these unlimited and transpersonal reservoirs of Chi and greatly expand the amount of available energy. It is very important to master first the stages of conservation, balance and transformation before emphasizing the cultivation of Chi. Otherwise we may waste the energy we bring in, or we may inadvertently amplify the imbalanced or negative energies that we have not yet learned to bring under control.

E. Finally, we can learn to extend our mind to tap into the vast Chi

of nature, cosmic particles and the universe. We learn to heal our body, mind and spirit and to heal other people. The Cosmic Healing Chi Kung practice of the Universal Tao sensitizes your hands to the feeling and movement of Chi. It uses the mind-eye power to absorb cosmic Chi into the palm and crown and to send it out through the hands and beyond.

Develop Sensitivity in your Hands

Practice the art of seeing with your hands. Learning to feel specific blockages will come with time and experience. Practice your sensitivity by observing changes in temperature, density, lack of movement, too little or too much chi, or perhaps you will see colors and images as you work. Sometimes it is easier to feel a restriction or a blockage of chi by taking your hands 5-6 centimeters off the body and scanning for energy changes. Remember to empty your mind down to your lower Tan Tien and sense with your abdominal brain. The mind brain is not the best tool for feeling the subtleness of chi blockages.

Sensing Sedimentation,Knots and Tangles

Sedimentation

These are toxin settlements under the skin. When you lightly touch you will feel sand like deposits there. Gradually use the fingers and circulate over the area slowly dissolving the toxin settlements. When you get to a deeper level, you might have the same sensation in particular organs which have sedimentation and blockages. With a one finger technique you can slowly dissolve the settlements.

Knots

As knots and tensions in the body grow, they build up pressure against the nerves coming out of the spine. Nerves do not tense up: muscles tense up. The nerves just transmit information. When one is subjected to stress, whether through anger, illness, or fear, the sympathetic nervous system is stimulated, causing contraction in the muscular system. As a result, the muscles, nerves, lymphatic system, and blood vessels contract into knots. Sometimes

the knots can feel like small plums. It is important to move past the surface tension to dissolve the “seed” knot inside. These knots pull on other areas of the body, causing contraction and pain. (Fig. 2.2)

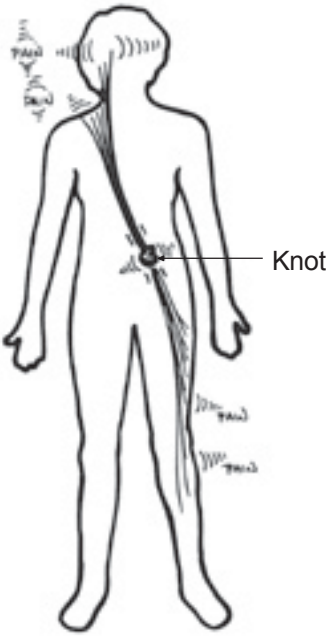

Fig. 2.2 *A knot in the abdomen can cause pain in distant areas of the body by pulling and creating tension.*

Dissolving Knots

If an area is especially knotted and tight, do not first work directly on the knot. Instead, find an area that is loose and relaxed and work there. Extend the relaxed area to surround the area of the knots with relaxed tissues. By the time you get to the knot, the area won’t be as painful for the contracted area will have relaxed.

(1) Ask your student to tell you where there is any discomfort. Observe the face of the student since it will reveal the painful or uncomfortable condition.

(2) Press down gently on the knot and spiral. You may start by using the palm, then the heel of the palm, then three fingers, then two fingers, then one finger. This is not a rule, however. You can start with two fingers and go to one finger. You will discover a personal technique after having worked on several people.

(3) The process of clearing knots can continue after the session has finished. Finish by teaching the student how to do their homework.

Tangles

Tangles occur more deeply than knots. Tangles may consist of nerves, blood and lymphatic vessels and tendons that are twisted together. (Fig. 2.3) They may have lymphatic nodes and fatty tissue inside them. Tangles, in part, may be composed of small layers of connective tissue that are growing all over the organs, holding them in place. This tissue should be supple, and the organs should be able to float and move. When the connective tissues get tangled and become rigid, they hold the organs very tight.

The less movement in the tissues, the tighter they will be held. The important work here is to make the connective tissues stronger by stretching them and moving them around.

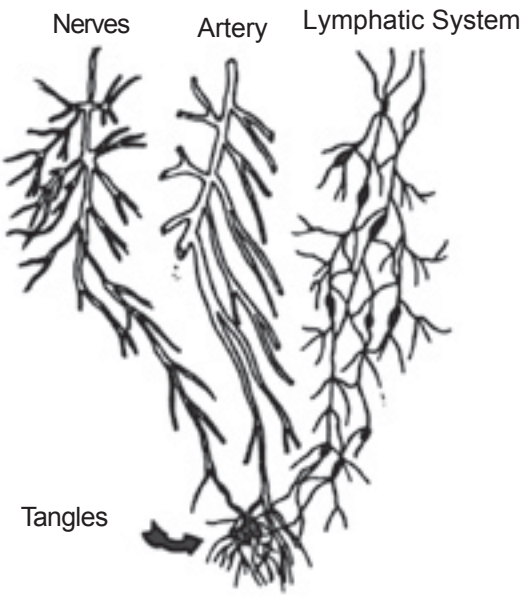

Fig. 2.3 *Tangle of Nerve, Arteries, and the Lymphatic System*

Dissolving Tangles

a. Loosen the whole abdomen. Practice skin detoxification. Relax any knots.
b. Work at the edge of the tangle. The tangles can feel like a big ball of yarn with a head and a tail. Work on the edges of it until you feel it start to unravel.
c. When it starts to unravel, work toward the center and untangle it.
d. Be very patient. It could take weeks to attain successful results. Assign homework, and advise the student not to drink coffee. Coffee tightens the abdomen.

Differentiating Knots and Tangles

Knots are usually surface blockages that can appear as thickened or lumpy areas. They entangle with the superficial fasciae, lymphatic system, small nerves, and capillary beds. Tangles occur more deeply than knots and involve the larger structures of nerves, lymphatic system, tendons, muscles, arteries, veins, fasciae, and the organ systems and their energies. A light touch when doing KNT will keep you in contact with the knots, while a heavier touch will keep you in contact with the tangles. With a little practice you can feel the size and texture of the tissues on both levels.

Untangling Nerves

Freeing a tangle of nerves allows the blood and Chi to flow freely. (Fig. 2.4) Numbness occurs where there is a tangle of nerves that does not permit the blood to flow. Feel for such a tangle and first work the tangled nerve upward away from the navel. If the condition does not change, work in the opposite direction. (Fig. 2.5)

When you listen and become sensitive to the tissues of your student's body you will receive information on how best to release the blockage. Following are different massage techniques for releasing the knots, tangles, calcifications and sediments in the tissues of the body.

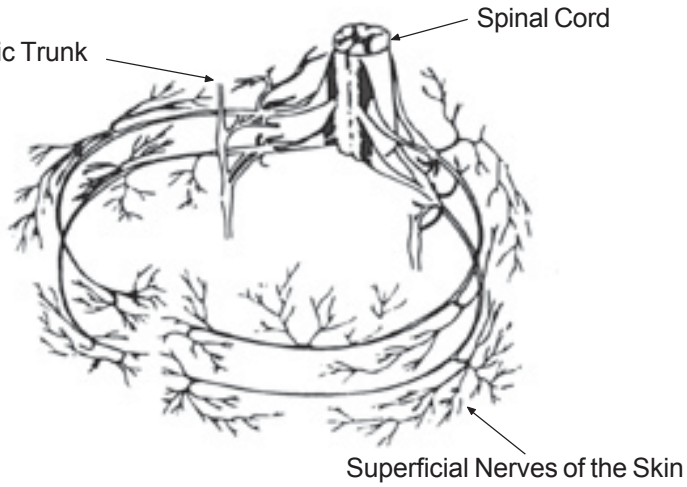

Normal Ramification of Nerves from the Spinal Cord.

Abdomen Ramification of Nerves from the Spinal Cord.

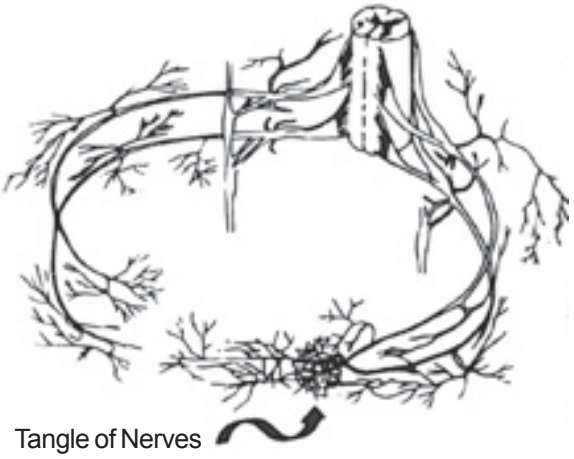

Fig. 2.4 *Nerves can get tangled.*

First work the knot upward, away from the navel.

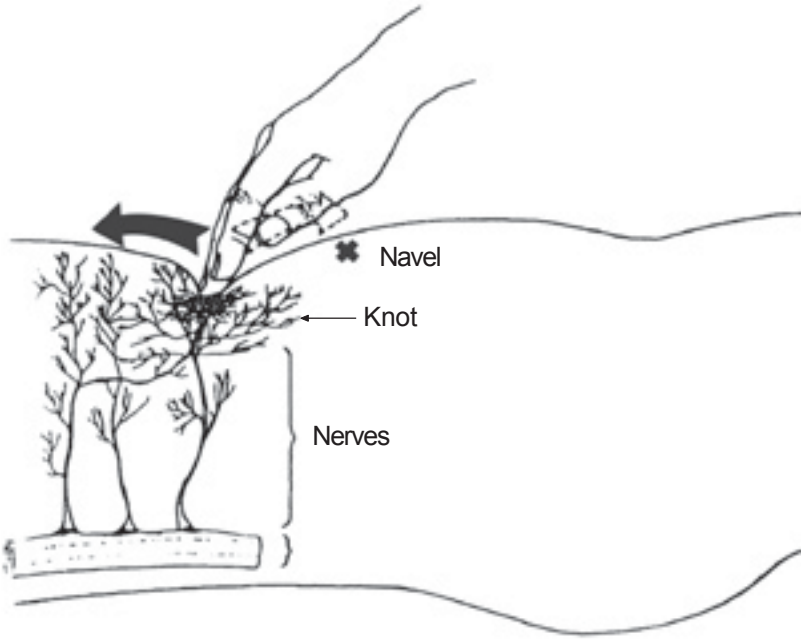

If the condition of the knot does not change, work downward toward the navel.

Fig. 2.5 *Working on Knots*

1. Spiraling Technique

The Spiraling Technique is the main technique for releasing the blockages. Gently use both hands on the abdomen to loosen the tissues. Begin by massaging with the thumbs, finger, or fingers together in small, tight, clockwise circular motions. (Figs. 2.6-2.7) The sequence for each point is to press in, spiral, and loosen the skin. Continue to create tight, clockwise circles outward from the previous points you have worked on.

If your student's abdomen is tense, nervous, hot, hard, and too Yang, this means there is excessive energy and you should drain some off. Spiral counterclockwise to withdraw the energy. Use your concentration. Ask the energy to leave. Direct it into the Microcosmic Orbit, where it can be circulated and stored safely in the Navel Center. You can also direct it to go into the Navel Center.

If the abdomen is cold, soft, weak, sick, and too Yin, this means that there is deficient energy. Spiral clockwise to add energy. Concentrate to direct some of your energy to pass from your fingertips into the student's abdomen, to help warm the area.

When you finish the finger spiraling technique, apply the following hand techniques. You will become very familiar with these techniques, for they are used repeatedly.

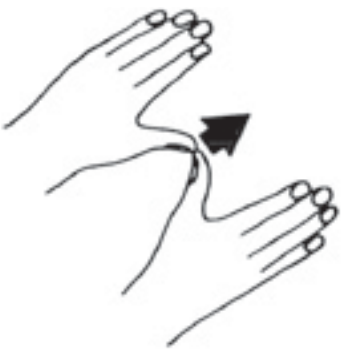

b. Use Four Fingers

c. Use a Single Finger

Fig. 2.6 *Spiraling Technique: Use the (a) thumbs, (b) fingers, or (c) one finger to press in, spiral, and loosen the toxins locked in the skin.*

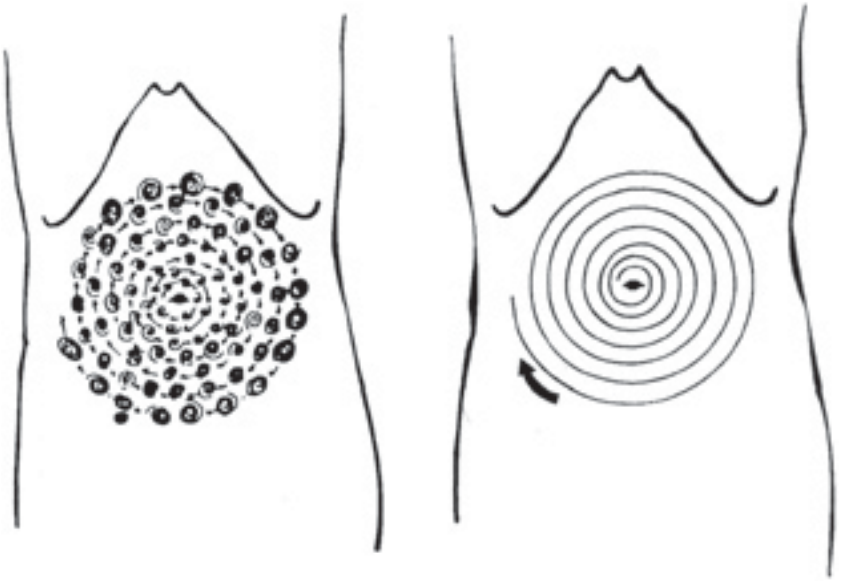

Fig. 2.7 *Create tight spirals. Move in clockwise circles beginning at the navel; gradually spiral out toward the perimeter of the abdomen.*

2. Scooping Technique

With your fingers together, press inwardly and scoop in, or press downward and scoop out. There are many variations to the direction and use of this technique. (Figs. 2.8, 2.9, and 2.10)

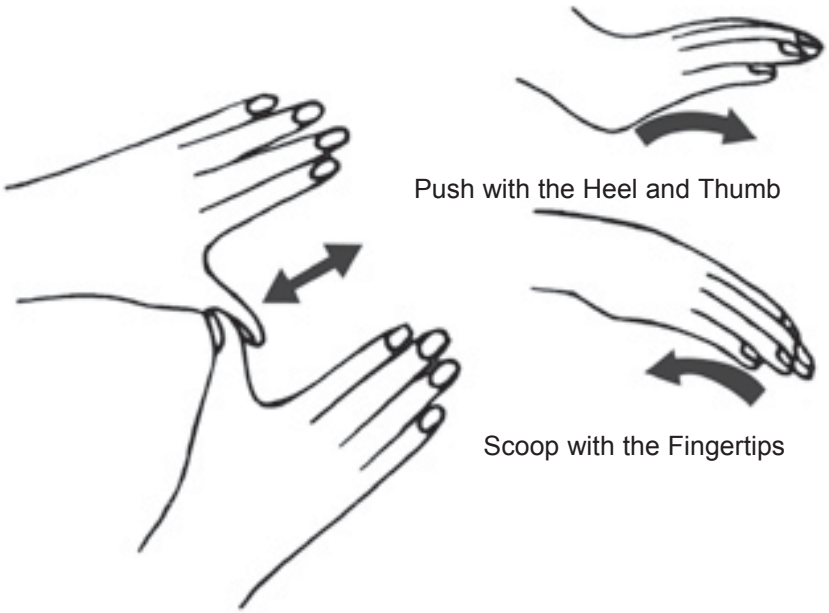

Fig. 2.8 *Pushing with the Palm-Heels and Scooping with the fingertips*

Fig. 2.9 *Scooping with Two Hands*

Fig. 2.10 *Scooping with One Hand*

3. Rocking Technique

Use all the fingers to hold the area of blockage while rocking forward and back. (Fig 2.11)

Fig. 2.11 *Rocking*

4. Kneading Technique

Use all the fingers of both hands to scoop up the area of restriction. Follow by pressing with the heels of the palms into the area as though you were kneading a loaf of bread. (Fig. 2.12)

Fig. 2.12 *Kneading*

5. Shaking Technique

Use either the index or middle finger to press on the knot or problem area. Move the finger quickly up and down or from side to side. Use two or three fingers to cover a larger area. (Fig. 2.13)

Fig. 2.13 *Shaking*

6. Patting Technique

Pat around the navel and the entire abdominal area with the fingers and with a soft, open palm. (Fig. 2.14) (Patting is generally used to finish a CNT session.)

Fig. 2.14 *Patting*

7. Elbow Press

Remember, if you are working on someone who is very large or very muscular, sometimes the only way you can have an effect is to use you elbow. Press straight down or spiral in gently with your elbow.

Fig. 2.15 *Elbow Press*

Root to the Earth while you work

An important part of not draining your energy reserves is to stay aware of your body mechanics while working on your student. Be familiar with the practice of Iron Shirt and while you are working place your body in a modified Iron Shirt position that is suitable for the movements that you are making. This is very important for maintaining the health of your joints. It is especially important to pull back your Ming Men point while you work because this gives you added protection from picking up the negative energies of your student. There is a high degree of burn out with all kinds of body workers because they use their muscles rather than the power from their tendons and bones. If you use good body mechanics and combine this with connecting to the earth and universal forces you will be able to perform massage for a very long time.

Have a working Knowledge of Anatomy

It is necessary to have a working knowledge of the internal organs and their functions: the lymphatic, circulatory, and nervous systems, the energy channels, the muscles and fasciae (connective tissues), and the interrelationships among all of these facets of the body.

Be familiar with the body's energy channels

Become familiar with the energy meridian lines of the body, the acupuncture points and the special Chi Nei Tsang treatment points covered in *Chi Nei Tsang I*. Knowing your energy anatomy will enable you to have a global awareness of your student's whole physical and energy bodies.

Understand the Relations of Emotions with the Internal Organs

We store our unresolved emotions in our bodies. When we have feelings and just let them go there is no trace left in the body. But when we hold onto our feelings they become emotions and there becomes a habitual physical contraction that is stored in the body. When this blockage is released in the body there can be a return of the original emotions. As a practitioner it is important to be aware that your student might need help in processing these emotions so they can let them go. Giving them this chance will help them to open up and release both physically and emotionally.

Understand the Inseparable Relationship between Sexual Energy and the Human Experience

With Karsai Nei Tsang you are working with the genital area. This is an area where a particularly high number of emotions are stored. These emotions can come from potty training, shame about the genitals (pudenda, the Latin word for genitals also means shame), pain from traumatic sexual experiences and the disconnection from the genital area that is so prevalent in many cultures. As a practitioner when you touch this area be aware of these connections. In addition to stored emotions, any touch in this area is very intimate and makes us very vulnerable. Keep all these considerations in mind and approach Karsai massage with extra sensitivity.

Chapter III
Opening the Abdomen and the Sexual Palace

Genital massage is practiced with a mixture of sesame oil, Citronella oil and coconut oil. It is important for the practitioner to wear latex gloves as a precaution against sexual transmitted disease.

The beginning sequence of techniques for Karsai Nei Tsang is the same as it is in a Chi Nei Tsang session. It is important to open the gates and clear out the winds in the abdomen at the beginning of every session. This will release the tension blockages and sedimentation in the organ veins on the abdomen area so when the genital area is worked on the circulation of the genitals may freely flow. It is extremely important that these preliminary techniques be successfully applied before proceeding further.

Techniques 1 through 3 are performed with the practitioner sitting or standing to the side of the student. The student is lying in a supine position.

Technique 1
Opening the Abdomen

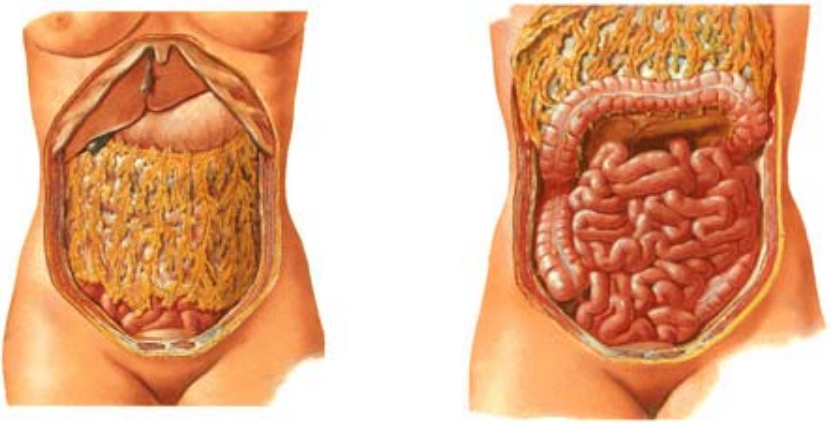

Fig. 3.1 *Become familiar with the anatomy of the abdominal area.*

A. With your fingers together and using the full palm of your hand, scoop first with one hand following the perimeter of the abdomen. Follow with your other hand moving from the lower right abdominal quadrant to the upper right quadrant, over to the upper left quadrant and down to the lower left quadrant. As you move your hands over the large intestine feel for any blockages and chi stagnation. With your yi (mind, eye and heart power), Tan Tien and universe connection focus on releasing the stagnations and restoring a healthy flow of chi. (Fig. 3.2-3.3)

Fig. 3.2 *Making Circular Massage Movements*

Fig. 3.3 *Opening the Abdomen, and feel with hand for settlement in the abdominal.*

B. Stand to the right side of your student and directly face the abdomen. Reach across to the left side and use your finger pads of both hands to pull up on the descending colon. With the palms of your hands push in on the ascending colon and massage it towards the midline of the abdomen. Repeat this movement making a rhythmical motion, pulling the left side of the abdomen toward you as you then push the right side of the abdomen away from you. Work with this motion on the full length of the abdomen. (Fig. 3.4)

Fig. 3.4 *Kneading the Abdomen from Side to Side*

Technique 2
Releasing Specific Blockages

Use both thumbs, press down to the area that you feel by hand in hand stimulation. The sedimenation will feel like sand or small petals. The hand stimulation will make them dissolve. Then place one hand over your other hand with your fingers together and slowly press your hands in to the depth of the restriction. Hold your pressure directly on the restriction until you feel a softening and a return of chi flow. You may also move your fingers in small circles directly into the restriction, slowly breaking up any stagnation. (Fig. 3.5)

Fig. 3.5 *Releasing Specific Blockages*

Technique 3
Opening the Wind Gates

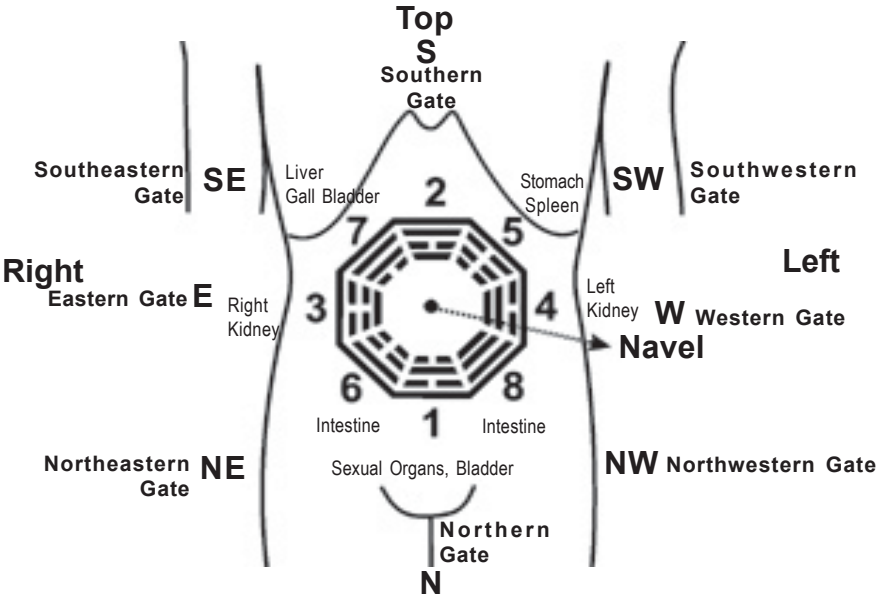

Fig. 3.6 *Sequence for releasing the blockage and sedimentation on the Pakua*

Place your left hand over your right hand and place your right fingers directly below the navel. Press in with your finger pads to the level of tension and then pull slightly away from the navel. Hold this pressure until you feel a softening of the tissues under your fingers. Continue to work around the navel, working in the order of the Pakua symbol. This will discharge the tension from the abdomen, release tight nerves and reestablish the healthy circulation of blood and lymphatic flow. (Fig. 3.6-3.7)

For more information on opening the gates around the navel refer to the Chi Nei Tsang I and II books.

Fig. 3.7 *Opening the Wind Gates*

Techniques 4 through 8 are performed with the student lying supine on the massage table and the practitioner sitting cross legged on the table at the base of the student's pelvis. The student rests her legs over the practitioner's bent knees.

Technique 4
Releasing the Aorta and Interior Vena Cava

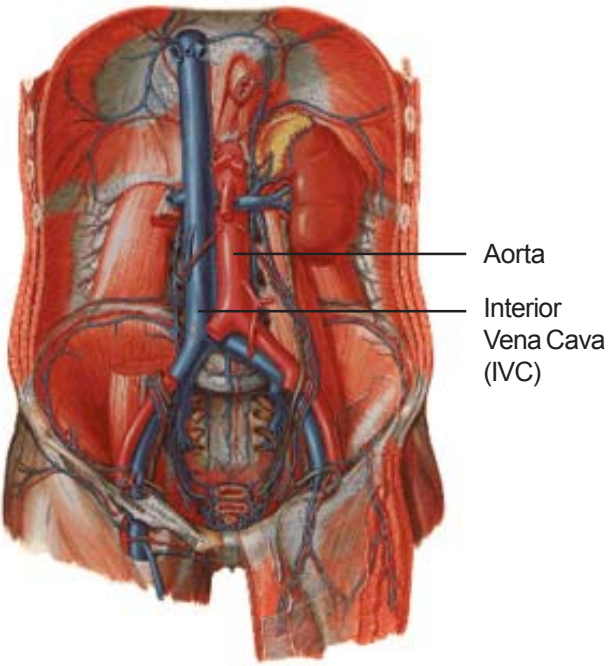

Fig. 3.8 *Aorta and Interior Vena Cava*

Place one hand over the other hand with your fingers together and press under the navel and find the aorta which is pulsing and interior vena cava with your hands flat and at a slight angle. Press in and then slightly down with sensitive firmness. Feel any blockages and tangles in the aorta and vena cava and slowly use force to lightly press to break the sedimentation. When you feel a block-

age, hold the pressure longer or make small circles with your finger pads over the restriction. When you feel the tissues releasing, move your hands a few centimeters down towards the pubic area and repeat following the aorta and interior vena cava. Continue pressing and releasing until you reach the pubic bone. (Fig. 3.8-3.9) and start again from the solar plexus down to the navel.

Fig. 3.8 *Pressing out the Restrictions in the Aorta and Inferior Vena Cava.*

Technique 5
Releasing the Energy Meridians Lines

Fig. 3.9 *Energy Meridians Lines: Karsai I and II*

A. Energy Meridians Lines Karsai I and II

– Karsai I starts at the navel. It extends from the navel and runs down to the urethra. Karsai II starts from the navel and extends down to the anus. These two energy meridians lines are important meridians for energizing and improving the circulation of the genitals. They are also indicated for treating frequent urination, female infertility, irregular menstruation and uterine bleeding. (Fig. 3.9)

Treatment for Karsai I and II - Place your right hand over your left hand with your fingers together and press your hands below the navel. Push in and slightly pull down toward the pubic bone. Hold the pressure until you feel a release such as a softening, a return of energy, a warming sensation, etc. Repeat, each time moving your hands down a few centimeters until you have worked your way down to the pubic bone. (Fig. 3.10)

Fig. 3.10 *Releasing the Energy Meridians Lines: Karsai I and II*

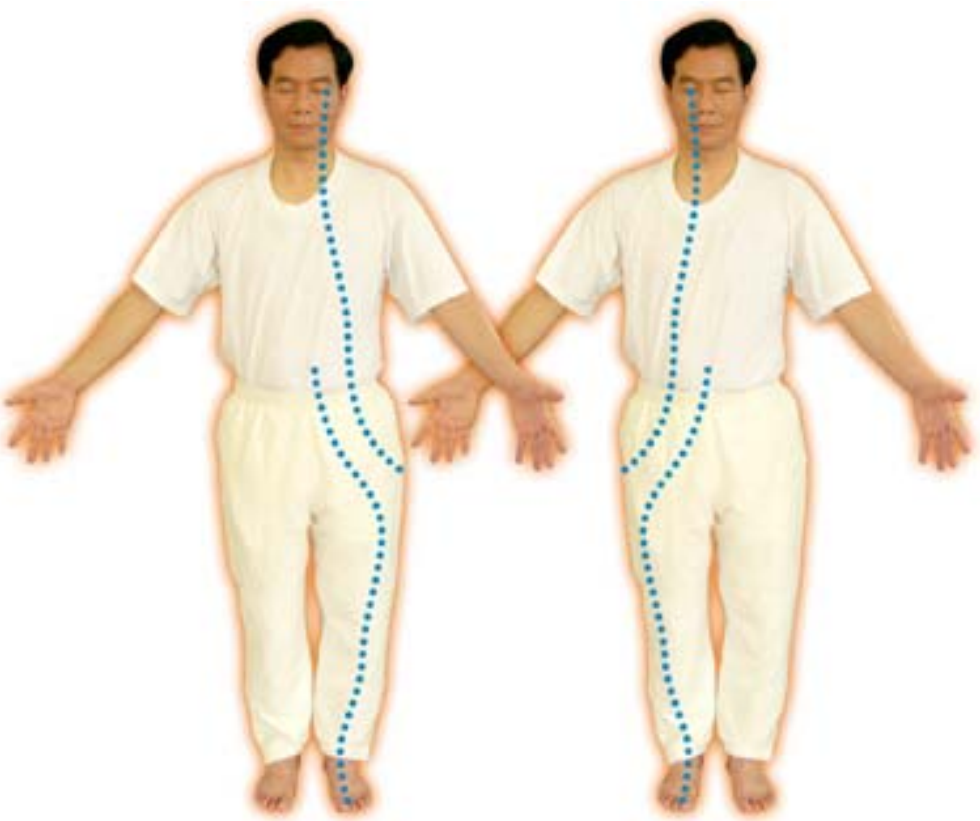

Fig. 3.11 *Energy Meridians Lines: Karsai III and IV*

B. Energy Meridians Lines Karsai III and IV - These are identical meridians, one for each side of the body. They start on the insides of the feet, run up the insides of the legs, cross the midline of the inguinal ligaments and then cross the lower abdomen on a diagonal line, ending at the navel. Releasing these meridians is also very effective for energizing and improving the circulation of the genitals. Treating these energy meridians lines is indicated for diseases of the Urogenital system. (Fig. 3.11)

Treatment for Karsai III and IV - Place your left hand over your right hand with your fingers together and press your hands below the navel. Push in and slightly pull down at a 45 degree angle toward the midline of the inguinal ligament. Hold the pressure until you feel a release. Repeat, each time moving your hands down a few centimeters until you have worked your way down to the inguinal ligament. (Fig. 3.12)

Fig. 3.12 *Releasing the Energy Meridians Lines: Karsai III and IV*

Technique 6
Releasing the Psoas Muscles

It is important to work on the psoas because of its close relationship to the kidneys, sexual energy, solar plexus, nerves and many blood vessel in this area. When the psoas is held in contraction this disrupts the free flow of sexual energy. (Fig. 3.13)

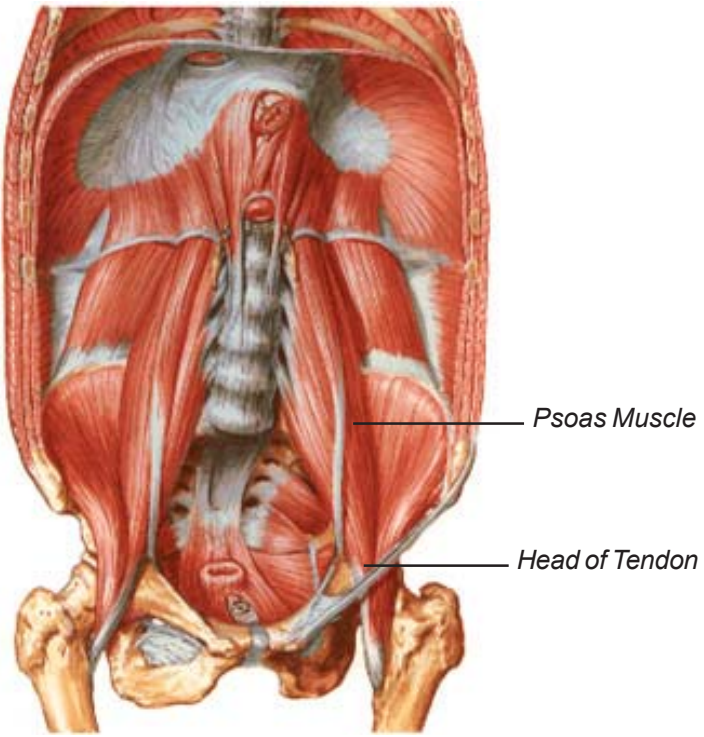

Fig. 3.13 *Become familiar with the Psoas Muscles.*

With your fingers together and using the pads of your fingers press deeply into the area of the psoas. If you are unsure whether you are on the psoas you can help your student to raise the same sided knee and bring it to his or her chest. Ask her/him to rotate the leg and move it back and forth as you search for the psoas. The psoas muscle is engaged by this movement of the knee and leg and this movement will help you to find it. When you feel the psoas contract, press your finger pads down to the depth of the psoas and line your fingers up on the length of the psoas. Continue pressing

down and feel for any excessive contractions. You may also feel a spiraling contraction of the psoas. When there has been excessive fear, the psoas often responds by contracting with a spiraling force. Maintain your deep pressure and slowly move the pads of your fingers in a lateral direction, unwinding the spiraling force and tension of the psoas. Continue with this pressure and lateral movement, slowly working the full length of the psoas. (Fig. 3.14)

Fig. 3.14 *Releasing the Psoas Muscles*

Technique 7
Massaging around the Iliac Crest

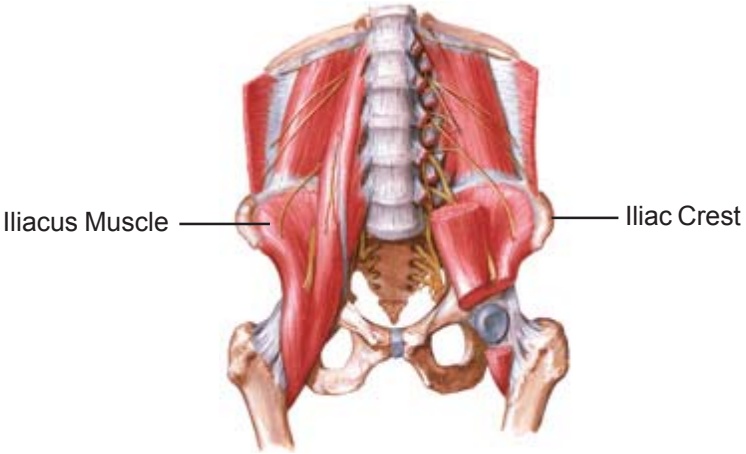

Fig. 3.15 *Iliac Crest and Iliacus Muscles*

The iliacus muscle joins the psoas muscle in the lateral wall of the pelvis to insert onto the lesser trochanter of the femur. The iliopsoas is the most powerful flexor of the leg at the hip joint and when this muscle is held in flexion it disrupts the circulation and flow of energy in the genital area. (Fig. 3.15)

Press with your right thumb into the inside curve of the anterior, superior iliac spine (the pelvic crest). Place the rest of your right hand around the back side of the pelvis for stabilization. Move your right thumb into the inside curve and follow the edge of the ileum massaging the ligaments attached to the iliacus and the iliacus muscle. Feel for a softening and an increase of space in this area. (Fig. 3.16)

Fig. 3.16 *Massaging the Iliacus Muscle and Iliac crest*

Technique 8
Balancing and Smoothing out the Tissues

This is an important movement to make after working specifically on the knots, tangles, sedimentation and deep congestion. After you finish working an area in detail use your palms and fingers to gently smooth out the skin and tissues. Make sweeping motions moving your hands up the midline and back down the outside edges of the lower abdomen. Then you can reverse and move your hands up the outsides and back down the midline to the pubic bone. It is good to be creative and let yourself get a sense of what the tissues need to integrate the deeper work. With these integrating movements you are letting your student's body, mind, emotions, and spirit feel reassured and safe. This will assist them in releasing the blockages. (Fig. 3.17)

Fig. 3.17 *Balancing and Smoothing out the Tissues*

Technique 9
Massaging the Sexual Palace

Place your two hands side by side with your fingers together. Press into the lower abdomen above pubic bone, and make small circular movements, moving with the pads of your fingers up, around and down. Work from the right side over to the left side, from the area under the small intestines all the way down to the pubic bone. Feel for any congestion and knots. When you feel a restriction you can pause and press with more intention, circle more directly into the restriction. You can ask your student to breathe into the restriction and upon exhalation assist you with the release. When the superficial layer is released and the healthy flow of chi has returned, you can repeat this sequence, gently moving your fingers deeper. In this deeper layer you can access the tangles of the nerves and the deeper circulatory flow. As you move deeper, slow your movements down, the deeper you work the slower your movements need to go. (Fig. 3.18)

Fig. 3.18 *Massaging the Sexual Palace*

Technique 10
Releasing the Inguinal Ligament

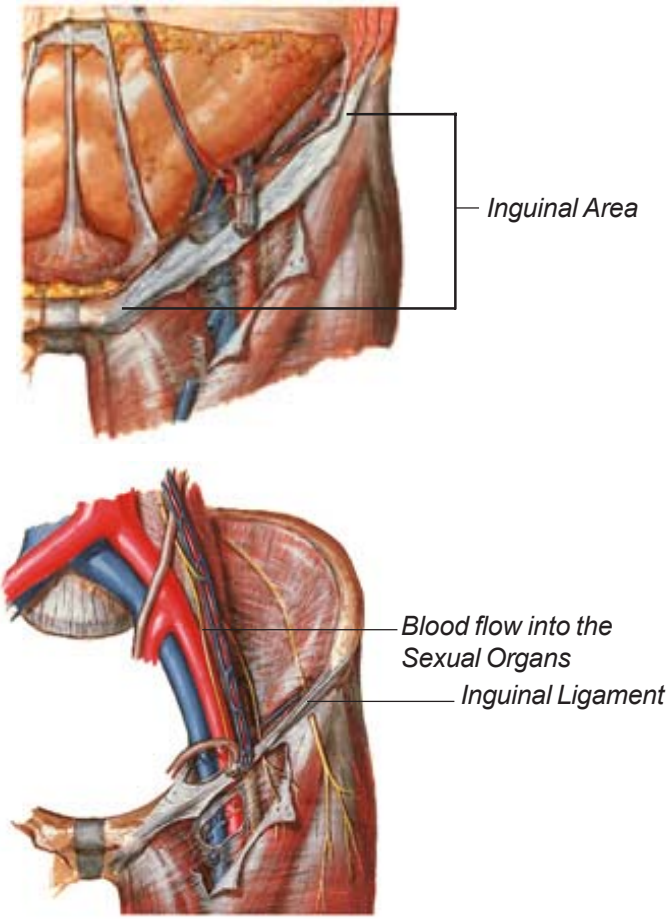

Fig. 3.19 *Inguinal Ligament*

The circulation system of the genitals is greatly affected when the inguinal ligaments are overly contracted. When the inguinal ligaments are shortened from poor alignment or other causes the fascial tissue will also tighten and shorten. This will then affect the blood flow and lymphatic flow in the genitals. (Fig. 3.19)

Using the pads of your fingers or the outside of your thumb, press into the base of the inguinal ligament where it attaches at the pubic bone. Slowly move your hand up, feeling the ligament lengthen under your touch until you reach its attachment at the crest of the pelvis. Repeat this movement a few times until you feel the ligament soften and relax. (Fig. 3.20)

Fig. 3.20 *Releasing the Inguinal Ligament*

Technique 11
Lymphatic Drainage over the Inguinal Ligament

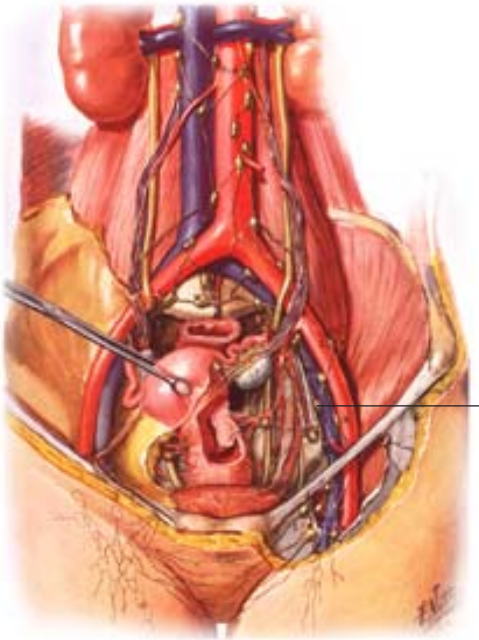

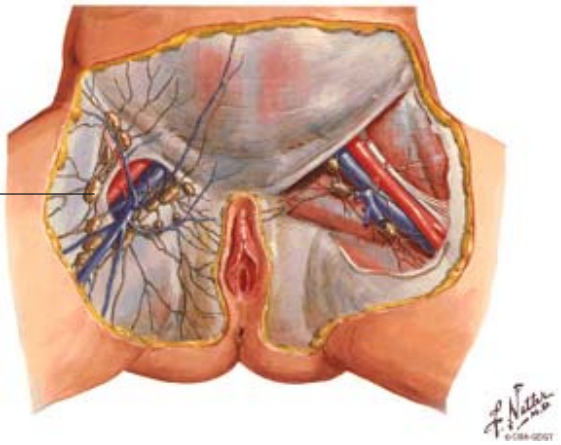

Fig. 3.21 *Lymphatic Ducts and Vessels of the Lower Abdomen and Inguinal Canal*

Place the flat of your fingers over the inguinal ligaments, working both sides at the same time. Make gentle pushing movements towards the navel. Feel the lymphatic ducts releasing and the lymphatic fluid flush to the deeper nodes. Repeat several times on both sides. (Fig. 3.22)

Fig. 3.22 *Releasing the Lymphatic Flow*

Chapter IV
Female Karsai Nei Tsang

Genital massage is especially helpful for most women. There are many internal physiological changes that start to take place in women at about middle age. These many changes create extra winds in the body and the potential increases for these winds to become trapped. Any past traumas from childbirth, physical injury, issues around sexuality, sexual abuse, etc, increase the likelihood of problems developing in this area. Also, with age, plaque can build up in the veins of the lower abdominal and genital areas and this exacerbates the problem of chi flow in the genitals even further. These massage techniques are a safe and effective way for women to address the health of their genitals. Female genital massage helps to keep the blood and lymphatic circulating freely, the genital organs aligned and healthy, the hormones balanced and the sexual energy flowing. It can help with problems such as menstrual cramps, PMS, frigidity and infertility.

It is important to keep this area open to permit the sexual energy to flow.

Sexual or reproductive energy is one of the primary energies. Any stagnation of energy in this area will have a corresponding emotional blockage. It is of ultimate importance to work in this area with sensitivity and take the amount of time necessary to help your student process her emotions. Always refer on to a psychotherapist if you feel your student needs professional help beyond your capabilities.

***Note:* Do not work on women when menstruating, women using an IUD, pregnant women or women with venereal disease or cancer.**

Technique 1
Releasing the Uterus

The uterus is connected within the body by ligaments that frequently tighten through internal congestion and require adjusting. The broad ligaments connect the uterus to the lateral walls of the internal pelvis. The round ligaments are thin cords that connect from the uterus, through the inguinal canal and finally merge with the labia majora. The uterosacral ligaments connect the uterus to the rectum and sacrum. When these ligaments become tight they pull the uterus out of alignment and the arterial, venous and lymphatic circulation of the pelvis and lower extremities will be adversely affected. The small intestines, large intestines, bladder and kidneys are closely associated with the uterus. It is important to regard the body as a whole functioning unit and remember that it is impossible to treat one part of the body in isolation. Always be careful to release the abdominal restrictions before working on the ovaries and uterus.

The uterus is shaped like an inverted pear and is located between the bladder and rectum. The uterus has three sections; the dome shaped portion is the fundus, the central portion is the body and the narrow part opening to the vagina is the cervix. The uterus has two fallopian tubes that connect to the ovaries; these tubes pass the ova to the uterus. These tubes often get twisted or tied together. (Fig. 4.1-4.2)

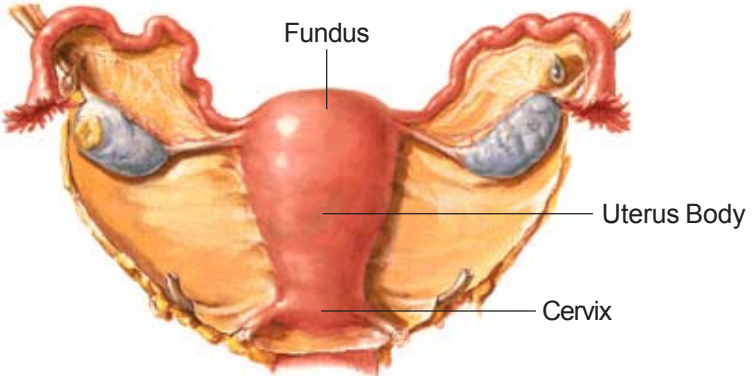

Fig. 4.1 *Become familiar with the shape and position of the uterus.*

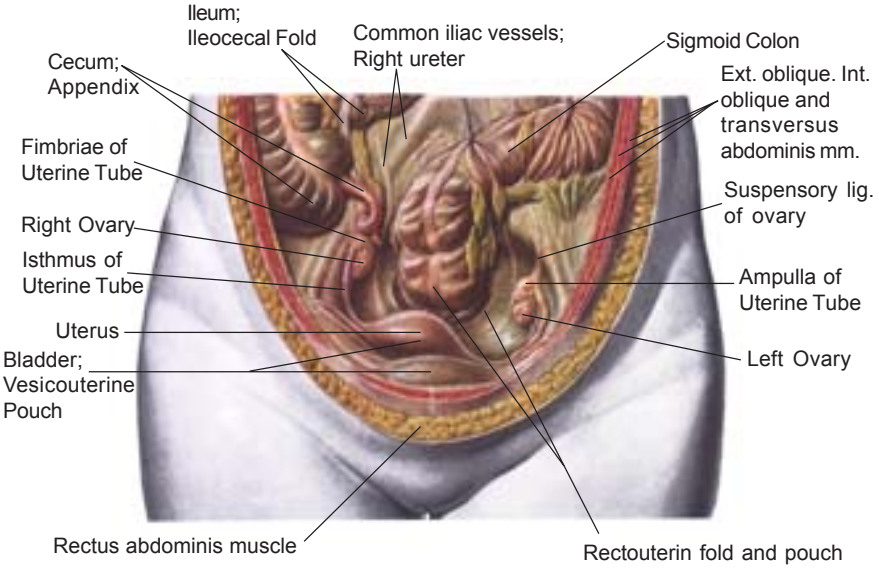

Fig. 4.2 *Be familiar with the Anatomy of the Lower Abdomen.*

You can locate the uterus by asking your student to place her thumbs together at the navel and form a triangle with her fingers together. The index fingers will lie at the location of the uterus.

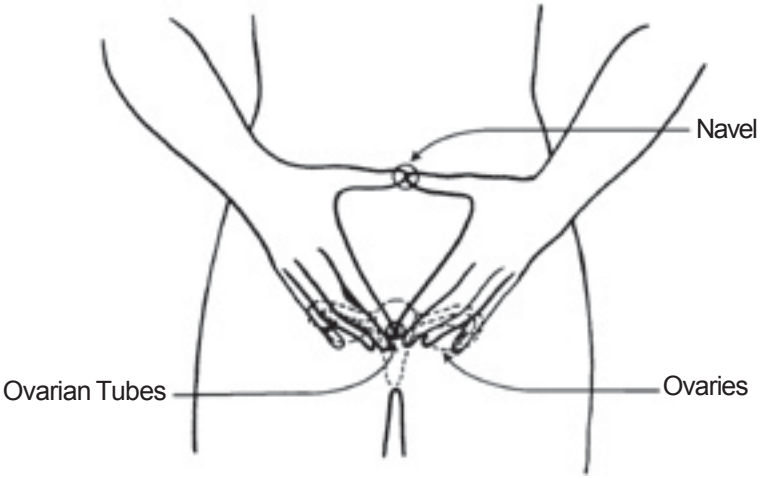

Fig. 4.3 *Locating the Uterus*

This technique is performed with the practitioner standing to the side of the student.

Place your eight fingers to one side of the uterus and your thumbs together on the opposite side. Press in with the flat of your fingers and pull the uterus toward your thumbs. Now press in your thumbs and push towards your fingers. Continue with this motion, kneading the uterus between your fingers and thumbs. Massage any tangles or twists and hold the uterus for a while in the center with both of your hands. Repeat on the other side. (Fig. 4.4)

Fig. 4.4 *Releasing the Uterus*

Techniques 2 through 6 are performed with the student lying supine on the massage table and the practitioner sitting cross legged on the table at the base of the student's pelvis. The student rests her legs over the practitioner's bent knees.

Technique 2
Releasing the Fallopian Tubes

Fig. 4.5 *Be aware of the shape and position of the Fallopian Tubes.*

With your fingers together apply gentle circular massage over the fallopian tubes. Start at the uterus and work you way over to the ovary. Notice if you feel any crimping or twisting in the tube. The fallopian tube and veins can become twisted. Slowly massage out the twists, knots and tangles. Repeat on the other side.

Fig. 4.6 *Releasing the Fallopian Tubes*

Technique 3
Releasing the Ovaries

The ovaries are paired glands, one on either side of the uterus, and are approximately the size and shape of an almond. (Fig. 4.7) They can usually be located by asking your student to place her thumbs in her navel and her fingers together forming a triangle. (Fig. 4.8) The ovaries are usually in the area where the tips of the little fingers lie, yet it is important to remember that every woman's anatomy is different. It is common for a woman's ovaries to gradually descend as she ages so it is good to suggest to your students to practice the Healing Love exercises from Master Chia's book, *Cultivating Female Sexuality.* These exercises tone the tendons, ligaments and muscles of the genital area and are very helpful for keeping the sexual organs healthy and in proper alignment. (Fig. 4.7)

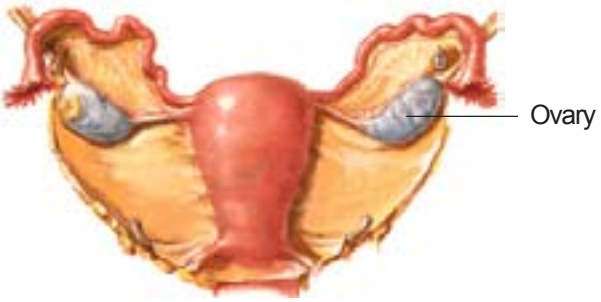

Fig. 4.7 *Be aware of the Shape and Position of the Ovaries.*

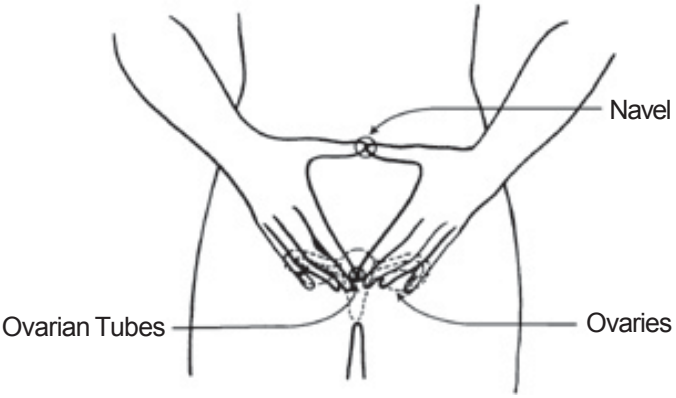

Fig. 4.8 *Locating the Ovaries*

Always make sure that any congestion in the cecum and sigmoid colon is released before you work on the ovaries. It is important to first clear the space around the ovaries so you can easily reach them. Very often this is all that must be done to relieve the congestion or pain in the ovaries.

It is essential to be very sensitive when working on the ovaries. The ovaries are as sensitive for the female as the testicles are for the male, so massage them with great care. Healthy ovaries feel soft, like jelly.

Touch the ovaries and feel the energy flow. If the egg is just beginning to move the area will be warm. If ovulation is near they will be hot and after the cycle they will be cool.

Feel whether the ovaries are in their proper alignment. The two ovaries should be approximately even in height. If they are uneven in height, the high ovary will often drain down to the lower ovary. The higher ovary can then become weak, dry and tight. This can cause cramps during menstruation and make pregnancy difficult. The ovum may not leave or cause pain when it does leave. Also check to feel if one ovary is closer to the skin surface then the other.

Bring your awareness to the arteries and veins around the ovaries. It is possible that they have become tangled or knotted together with the ovaries. Patiently work out the tangles and knots with the massage.

These techniques can also be effective for removing ovarian cysts. Massage improves the circulation by breaking down the congested matter. If the hardness does not release, you should advise the student to have a medical check-up. If there is a medical problem, work only with the authorization of the doctor.

The following techniques will help to release the congestion in the ovaries and gradually return them to their proper position. Moving the ovaries to their correct position may be a slow process. It is best to do a little at a time and repeat the techniques over time.

Bring your fingers together and press into the ovary with your fingers flat and relaxed. Feel for any tightness in the connecting ligaments and congestion within the ovary. Make small circular movements and free the ligament connections to the ovary. Massage directly into the ovary and feel for the return of chi flow. Releasing congestion in the surrounding area can help the ovaries return to their proper place. Repeat on the other side. (Fig. 4.9)

Fig. 4.9 *Releasing the Ovaries*

Technique 4
Releasing the Urogenital Diaphragm

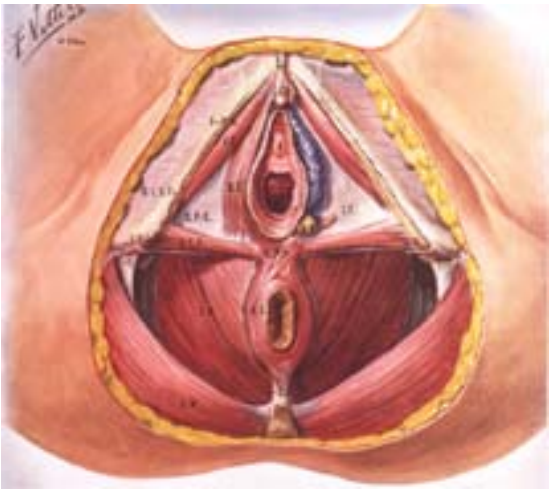

Fig. 4.10 *Urogenital Diaphragm*

This technique releases the blockages in the small muscles, ligaments, arteries, veins and nerves of the urogenital diaphragm. As you move your thumb along the outside of the labia majora you will be affecting the ischiocavernosus muscle, the broad ligament of the uterus, the edge of the bulbocaernosus muscle, and the perineal muscles. You will also be affecting the rich supply of arteries, nerves, fasciae and lymphatic vessels. (Fig. 4.10)

Bring your right hand over to the right labia majora and use the flat of your fingers to pull the labia over to the right side. With your left hand stabilizing the genitals to the left, use your right thumb to massage up the outside of the labium, along the ischiocavernosus muscle. When you feel knots, tangles or congestion, press in and pull the tissues to the crease of the leg. Repeat many times, until you feel the area soften and the chi flow return. Sometimes it is possible to feel a spiraling of the muscle or a tangling of the veins and nerves. Work slowly and carefully to bring space back to the different structures. Repeat many times, until you feel the area soften and the chi flow return. Repeat for the other side. (Fig. 4.11-4.12)

Fig. 4.11 *Releasing the Urogenital Diaphragm*

Fig. 4.12 *Releasing the Urogenital Diaphragm*

Technique 5
Releasing the Circulation of the Clitoris

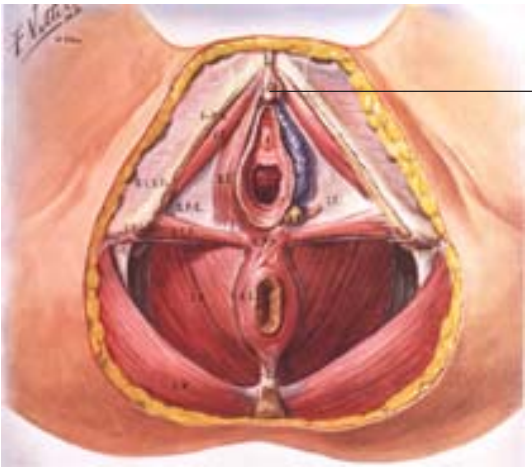

Fig. 4.13 *Be familiar with the Location of the Clitoris.*

With your thumbs on either side of the clitoris press into the outsides of the clitoris and the inside surfaces of the labia majora. You are pressing into the upper end of the ischiocavernosus muscle and the veins and nerves that feed the clitoris. Feel for any spiraling in the muscle and tendon or tangling in the arteries and nerves. Press until you feel a positive response. It may take many massages to fully release the blockages in this area. (Fig. 4.14)

Fig. 4.14 *Releasing the Circulation of the Clitoris*

Technique 6
Releasing the Inner Thigh

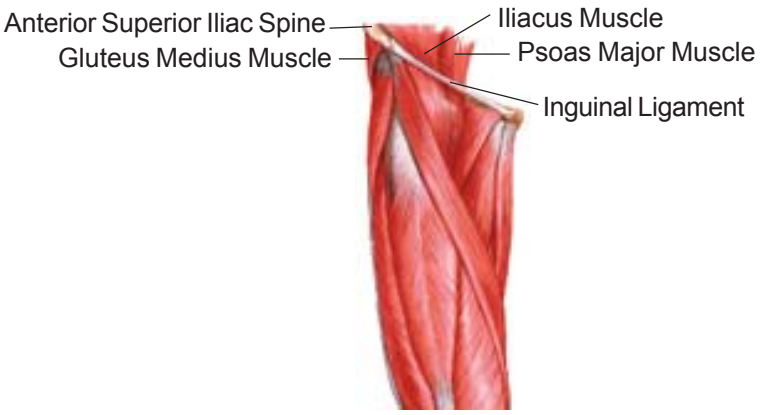

Fig. 4.15 *Muscles and Tendons of the Inner Thigh*

Move a little away from your student and rotate her right leg exteriorly so that the inside of the right leg is exposed. In this position the gracilis and adductor muscles will contract and bulge out a bit. Place your right hand over the genitals and stabilize them to the right. Press in with your left thumb underneath the bulging muscles and to the outside of the labia majora and massage with a long stroke down the inside of the leg. Any tension in the genital area will also express itself down the inside of the legs. Repeat these movements until you feel a softening in the muscles and the leg release. Repeat on the other side. (Fig. 4.16)

Fig. 4.16 *Using Long Strokes for the Inner Thigh*

Technique 7
Lifting the Uterus

Fig. 4.17 *Be familiar with the Position of the Uterus.*

It is common for the uterus to drop down toward the pelvic floor with age and trauma. This is an effective technique for stretching the ligaments of the uterus and positively affecting its alignment. The student bend her knee up. The practitioner stands to the side of the student and facing her pelvis, shapes the hands like the bottom of a bowl and scoops up the underside of the uterus. Lift the uterus gently but firmly upwards toward the solar plexus. You will be more effective if you feel the path of movement as the ligaments will stretch with the least resistance. The movement of the uterus upwards is never perfectly linear. After repeating these movements a few times smooth out the tissues in the abdomen as in technique 9. (Fig. 4.18-4.19)

Fig. 4.18 *Pressing on the Uterus*

Fig. 4.19 *Lifting the Uterus*

Technique 8
Lifting the Ovaries

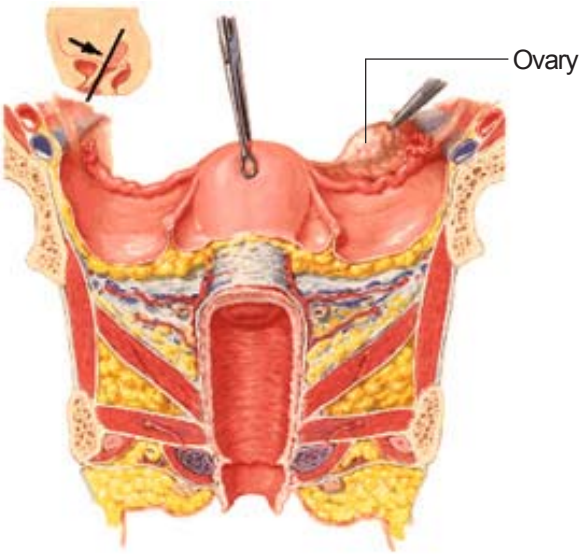

Fig. 4.20 *Become familiar with the Position of the Ovaries.*

Standing to the side of your student, reach across to the opposite side and scoop into the inside rim of the pelvis with the flat surface of your eight fingers. Gently lift the ovary and move it in the superior and medial position stretching it away from the pelvis. Be sensitive to the direction the tissues move and follow the path of least resistance. Move to the opposite side and repeat for the other ovary. (Fig. 4.21)

Fig. 4.21 *Lifting the Ovaries*

Technique 9

Spreading the Energy

Sit between your student's lower legs, stretch out your right or left leg and press the sole of your foot into her pelvic floor. Hold the pressure for two to three minutes. Ask your student to be aware of where she feels the chi flowing through her body; she might be more aware of the flow moving upwards or more aware of the flow downwards to her legs. This is a nice technique to finish with after the specific work on the genitals. (Fig. 4.22)

Fig. 4.22 *Spreading the Energy*

The following techniques are performed with the student prone on all fours, resting her weight on her knees and her elbows. The practitioner is sitting on the table facing her pelvis.

Technique 9
Massaging the Buttocks and Sacrum

At this point in the massage there has been much release of energy in the genitals and pelvic floor. It is important to clear the pathway for this energy to rise into the sacrum and continue along the microcosmic orbit. (Fig.4.23) This technique focuses on releasing the intricate pathway of nerves along the sacrum and buttocks as well as releasing the tension in the buttocks muscles so the sexual energy (jing chi) can move upwards and be transformed into healing energy. (see *Healing Love* book)

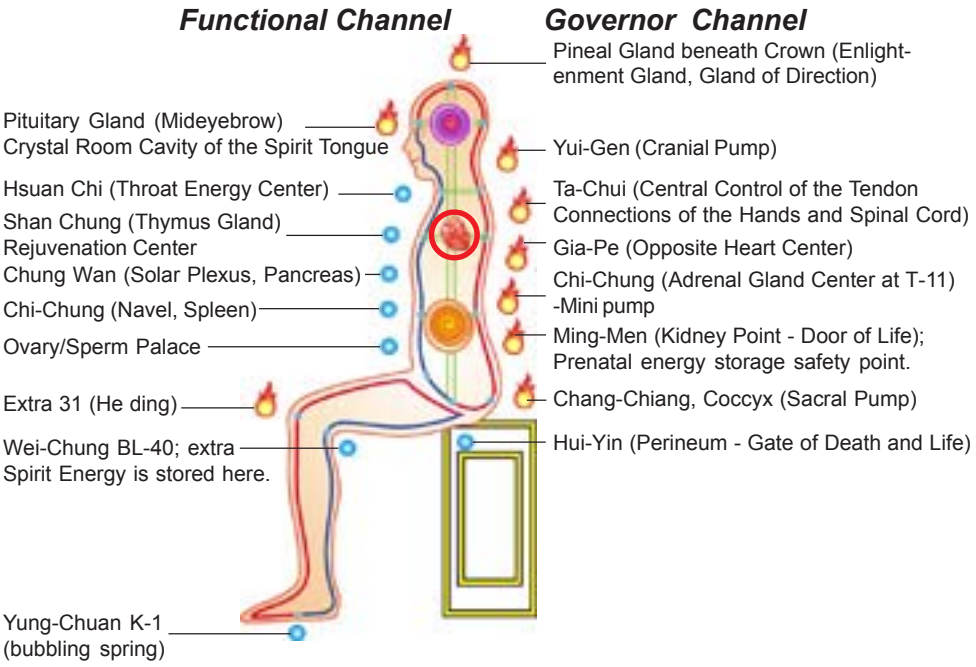

Fig. 4.23 *Microcosmic Orbit*

Using the full palms and fingers of your hands, start at the level of the ischial tuberosity and move your thumbs upwards along the edges of the sacrum with your fingers out to the sides of the buttocks. Bring your fingers and thumbs together as you reach the top of the pelvic crest and then sweep your hands down along the outsides of the pelvis. Repeat this movement a few times and feel for any restrictions. Pause when you feel a blockage and press in. If the restriction feels like it needs movement in order to release, make small circular movements. (Fig. 4.24)

Fig. 4.24 *Massaging the Buttocks and Sacrum*

Technique 11
Releasing and Balancing the Area of the Perineum

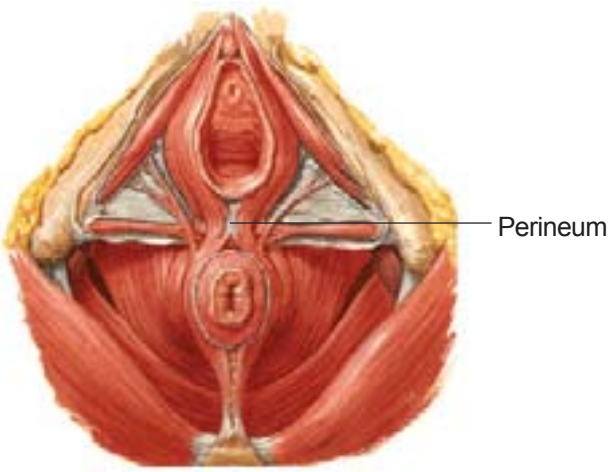

Fig. 4.25 *Pelvic Floor*

It is important for an individual's health to have good tonus in the muscles of the perineum / pelvic floor. When these muscles, the levator ani, coccygeus and transverse perineus are weak, the abdominal organs lose their support and an individual is drained of chi. Because of our sedentary lifestyles, it is a common occurrence for the muscles of the pelvic floor to be weak and inadequate. Releasing the tendons, ligaments, nerves and circulatory system of the pelvic floor will greatly improve the natural tonus of the muscles. It is very helpful if you advise your student to continue with pelvic floor muscle and tendon strengthening exercises. Please refer to Master Chia's *Healing Love* book for these exercises.

A. Between the Anus and Coccyx

With your left thumb press into the left side of the anococcygeal ligament, in the area between the coccyx and anus. Stabilize the right crest of the pelvis with your right hand so that the pressure you exert with your left thumb will not shift the position of the pelvis. Next, move your thumb directly under the coccyx and above the anus, and press into the anococcygeal ligament. Notice if there is any twisting or stagnation in the ligament. Now move your right thumb just to the right of the ligament and press in. Press these points until you feel a return of chi flow. And repeat on the other side. (Fig. 4.26)

Fig. 4.26 *Releasing between the Anus and Coccyx*

B. Anus

Place your left thumb near the left side of the anus and the rest of your hand around the left buttock. Stabilize the pelvis by placing your right hand on the right pelvic crest. Press in with your thumb and pull slightly to the left. Feel this space open and relax. Repeat for the other side. (Fig. 4.27)

Fig. 4.27 *Releasing the Anus*

C. Ischial Tuberosity

Working both sides together, press your thumbs below and a little to the medial surface of the ischial tuberosity. Feel for any congestion, knots or tangles in the veins and nerves. Making small circle movements into the restriction will help the area release. (Fig. 4.28)

Fig. 4.28 *Releasing the Tuberosities*

Technique 12
Releasing the Sciatic Nerve

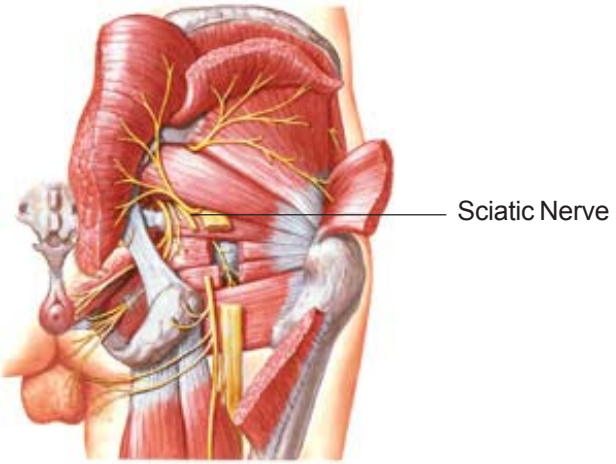

Fig. 4.29 *Be familiar with the Path of the Sciatic Nerve.*

Press your thumbs into the pathway of the sciatic nerve. (Fig. 4.30) Feel for any knots and tangles and make small circular movements to release the restrictions.

Fig. 4.30 *Releasing the Sciatic Nerve*

The following technique is performed with the student prone and the practitioner kneeling on the table facing the student's pelvis.

Technique 13
Forearm Press – Anus to Sacrum

Lean over the student's buttocks and place your forearm, ulna side down, along the midline from the anus to the sacrum. Rest your bodyweight down for two to three minutes and feel the energy flow up the spine. (Fig. 4.31)

Fig. 4.31 *Releasing the Anus to the Sacrum*

The following techniques are performed with the student crouching on all fours and the practitioner standing to the side.

Technique 14
Releasing the Circulation of the Pelvic Floor

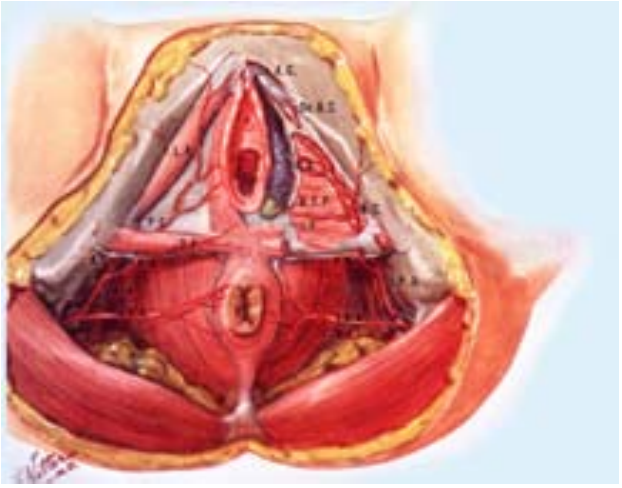

Fig. 4.32 *Be familiar with the Pathways of Blood Flow.*

By working from the posterior direction it is possible to release the circulatory system of the pelvic floor. This technique affects the perineal vein, pudendal vein, hemorrhoidal vein, urethral vein and the vein of the clitoris.

Place your right middle finger to the outside of the right labia majora and move the flat of your finger forward, massaging along the crease of the leg and labia. Repeat this motion a few times and repeat on the opposite side. (Fig. 4.33)

Fig. 4.33 *Improving the Blood Flow*

Technique 15
Massaging the Lateral Edges of the Abdomen from Underneath

Stand to the right side of your student with your right side touching the massage table. With your right fingers flat, make a scooping motion into the medial surface of the pelvic crest and massage down to the pubic bone. Repeat this sweeping motion a few times and then move over to the opposite side and repeat on the other side. (Fig. 4.34)

Fig. 4.34 *Massaging the Abdomen from Below*

Technique 16
Lifting the Ovaries and Uterus from Underneath

Kneeling to the right side of your student, scoop the right ovary up with your right hand and gently pull upwards. Make this same scooping motion to lift the uterus, feeling the uterus drop into your hand as it becomes free from any posterior restrictions. Move to the other side and repeat for the left ovary. If the uterus feels more restricted on the left side, repeat the movement for the uterus while standing on the left side. (Fig. 4.35)

Fig. 4.35 *Lifting the Ovaries and Uterus*

The herbal massage is performed with the student supine and the practitioner standing to her side.

Herbal Packs – The herbal packs are important for soothing and cleansing the tissues after the massage. They will stimulate the blood and lymphatic flow to speed up the detoxification process after the genital massage.

These herbal packs are made from a special blend of Thai herbs. They are applied at a fairly warm temperature, to the tolerance of the student. They are shaped like a ball with extra material at one end so it is easy to hold them when they are hot.

Technique 17
Herbal Packs over the Abdomen

Press the herbal ball into the upper abdomen and make a fairly rapid circular motion over the skin. Use the whole ball, the bottom and all the sides to rotate the herbal ball over the skin. Work your way down to the pubic bone, being careful to reach to the sides of the abdomen. Spend extra time with the herbal ball in the lower abdomen where so much of the massage took place. (Fig. 4.36-4.37)

Fig. 4.36 *Roll the Herbal Ball over the Abdomen.*

Fig. 4.37 *Rolling the Herbal Ball over the Abdomen.*

Technique 18
Herbal Packs pressed into the Genitals.

Ask your student if the herbal ball is too hot before you press directly into the genitals. Press and hold. Hold for 15 seconds or so and then finish the massage by moving the herbal ball up and down from the anterior to posterior pelvic floor and back. Feel the energy move up through the central channel to the pineal gland. (Fig. 4.38)

Fig. 4.38 *Roll the Herbal Ball over the Genitals.*

Chapter V
Male Karsai Nei Tsang

As people age, the lower abdominal area often becomes quite congested. This expresses itself in the presence of toxins in the organs and blockage in the circulatory system. This buildup of toxicity and sedimentation in the veins and lymphatic vessels creates many problems for the genital area.

As the circulation slows down this inhibits the healthy exchange of nutrients and the cleansing of the toxins. When the circulatory system is congested male potency can be affected. The circulatory structures that are most affected are the inferior vena cava, and more specifically, the internal and external spermatic vessels, pudendal veins, perineal veins, urethral veins, deferential veins, testicular veins and the pampiniform plexus and the group of arteries flowing to the testicles. There are numerous lymphatic nodes in this region that need to stay open and flowing with lymphatic fluid. When the lymphatic system clots, the body's defense system is inefficient. The primary lymph vessels in the genital area include the superficial and deep inguinal nodes, external iliac nodes, cloquet's nodes, and the rich network of lymphatics in the prostate and testicles.

This increased toxicity and pressure also weighs heavily on the nerves. With any added pressure, pulling from knots and tangles from other nearby structures, excess heat, dampness, or cold winds, the nerves lose their ability to effectively communicate with the genitals. The nerve impulses will then travel very weakly and slowly and the genitals will lose their ability to respond in a healthy manner.

Technique 1
Releasing the Blood Supply to the Testicles and Penis

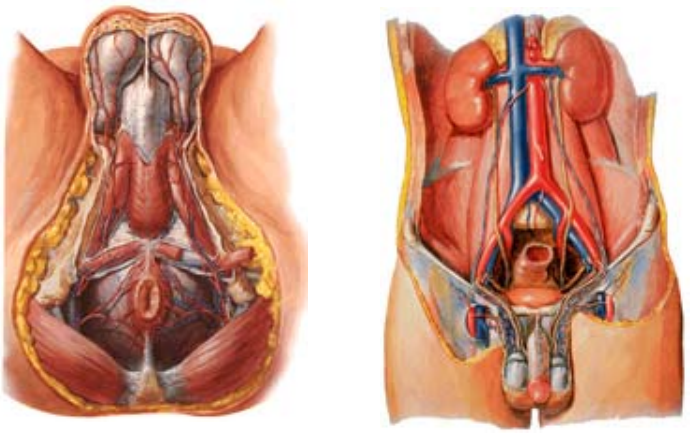

Fig. 5.1 *Be familiar with the anatomy of the male genital area.*

With your left hand lift the testicles and penis and stabilize them up and over to the left side. Place your right thumb on the lower right edge of the scrotal sac. Move your thumb upwards, following the edge of the scrotal sac and the crease of the leg. As you work, observe any deposits you feel in the veins. Pause when you feel a deposit and work this area with a small circular movement pressing into the restriction. Smooth out the area with long, lighter strokes before you move on to the next technique. (Fig. 5.2)

Fig. 5.2 *Releasing the Blood Supply*

Technique 2
Energizing the Prostate through the Perineum and Supine Position

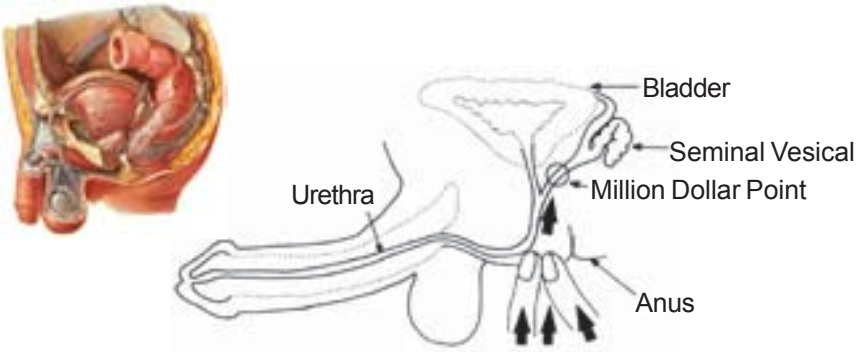

Fig. 5.3 *Be familiar with the Anatomy of the Perineum.*

With your left hand lift the testicles and penis upwards and stabilize them away from the perineum. With the pad of your right middle finger push directly into the million dollar point until you feel the base of the prostate. Hold this pressure until you feel the prostate vitalized with chi. (Fig. 5.4)

Fig. 5.4 *Energizing the Prostate through the Perineum*

Technique 3
Releasing the Sedimentation in the Scrotal Sac

Fig. 5.5 *Become familiar with the anatomy of the testicles.*

This is an explanation of the testicle massage but it is highly advised that no one practice this technique without taking the Chi Nei Tsang course in Genital Massage. This following massage technique requires finely skilled hands because it is extremely easy to hurt your student and cause swelling of the testicles. This technique is only used on the superior boundary or the testicles. ***Do Not*** work on the sides of the testicles or the inferior border of the testicles. This can cause serious problems. The practitioner will sit in between the student's legs.

Place your eight fingers under the testicles and let the weight of the testicles rest into your hands. Place your left thumb between the two testicles, stabilizing the left testicle by pressing your left thumb down to meet your left fingers. Press down with your right thumb into the superior boundary of the right testicle holding the underside of the right testicle firm with your right fingers. Now start to search for sedimentations in the veins with your right thumb and fingers. You will feel the sediment as sand.You are looking for the veins that are just above the testicle. Press into the sediment and make small circular movements and focus on breaking up the sediment. Feel the sediment dissolve between your fingers and thumb. Continue searching for sediments in this area and patiently work them one by one. Now repeat this procedure for the left testicle. (Fig. 5.6)

Fig. 5.6 *Releasing the Sedimentation in the Scrotal Sac*

Technique 4
Smoothing out the Veins in the Upper Scrotal Sac

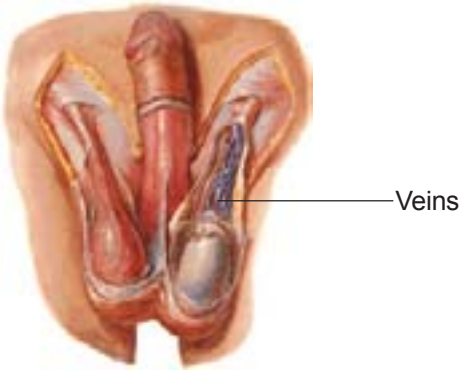

Fig. 5.7 *Be familiar with the Veins in the Scrotal Sac.*

Place your fingers under the scrotal sac supporting the testicles and place your thumbs on top of the scrotal sac and superior to the testicles. Gently move your thumbs along the veins in the scrotal sac to the base of the penis. Repeat this movement a few times balancing and smoothing out the chi flow. (Fig. 5.8)

Fig. 5.8 *Smoothing out the Arteries*

Technique 5
Stimulating the Circulation through the Scrotal Sac

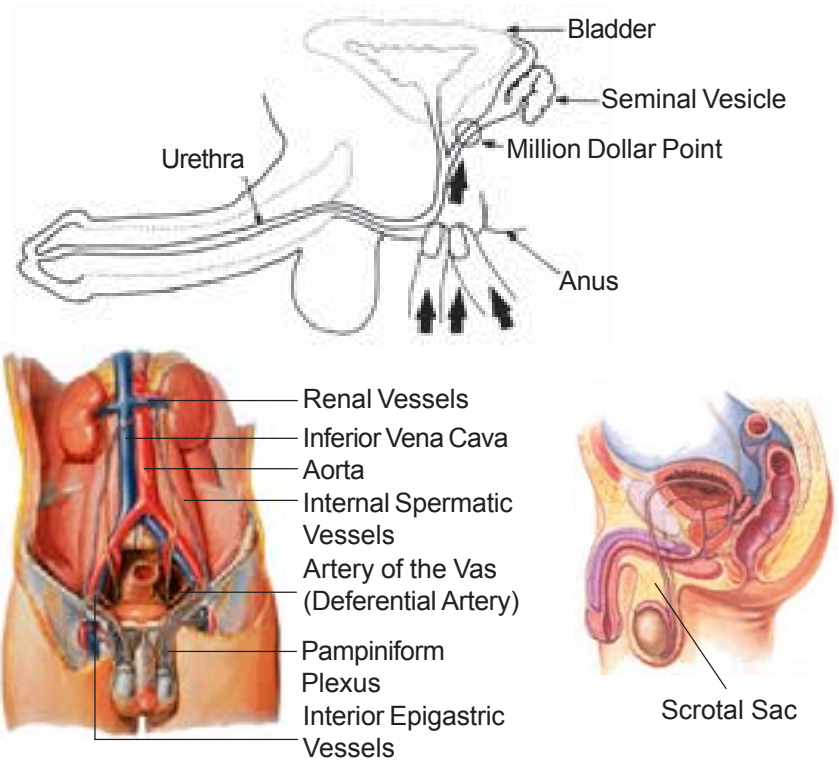

Fig. 5.9 *Be familiar with the veins and lymphatic nodes that supply the sexual organs.*

This is another effective technique for stimulating the blood and lymphatic flow in the genital area. By working through the scrotal sac you can directly affect the lymphatic nodes, deferential veins, dorsal veins of the penis and the pampiniform plexus.

Move your middle finger through the top of the scrotal sac and to the side and base of the penis. You will feel that your finger is on top of the pubic bone. Sweep your finger from side to side, stimulating the circulation of the testicles and penis. If you find a restriction, pause and press into the restriction while you make small circular movements. (Fig. 5.10)

Fig. 5.10 *Stimulating the Circulation through the Scrotal Sac*

Technique 6
Testicle Rub

Fig. 5.11 *Outer and Inner Anatomy of the Testicles*

The purpose of this technique is to stimulate the circulation on the sides and lower edges of the testicles. It is important to be gentle yet firm with the testicles. Avoid all quick and sharp movements. Do not overly squeeze the testicles nor push in too hard.

With a firm yet sensitive touch wrap your left thumb and forefinger around the base of the scrotal sac and slightly rotate the testicles clockwise to the right. This will place the testicles in a small space at the bottom of the scrotal sac under a bit of tension. With the palm of your right hand rub in a circular motion, somewhat vigorously, all around the sides and base of the testicles. Repeat this movement, now using your right thumb and forefinger to encircle the base of the testicles and rotate the testicles counterclockwise to the left. Now use your left palm to massage. (Figs. 5.12-5.13)

Fig. 5.12 *Rubbing the Testicles*

Fig. 5.13 *Rubbing the Testicles*

Technique 7
Releasing the Inner Thigh

Fig. 5.14 *Muscles and Tendons of the Inner Thigh*

Move a little away from your student and rotate his right leg exteriorly so that the inside of the right leg is exposed. In this position the gracilis and adductor muscles will contract and bulge out a bit. Place your right hand over the genitals and stabilize them to the right. Press in with your left thumb underneath the bulging muscles and to the outside and massage with a long stroke down the inside of the leg. Any tension in the genital area will also express itself down the inside of the legs. Repeat these movements until you feel a softening in the muscles and the leg release. (Fig. 5.15)

Fig. 5.15 *Using Long Strokes for the Inner Thigh*

The following techniques are performed with the student prone on all fours, resting his weight on his knees and his elbows. The practitioner is sitting on the table facing his pelvis.

Technique 8
Massaging the Buttocks and Sacrum

At this point in the massage there has been much release of energy in the genitals and pelvic floor. It is important to clear the pathway for this energy to rise into the sacrum and continue along the microcosmic orbit. This technique focuses on releasing the intricate pathway of nerves along the sacrum and buttocks as well as releasing the tension in the buttocks muscles so the sexual energy (jing chi) can move upwards and be transformed into healing energy. (see *Healing Love* book)

Using the full palms and fingers of your hands, start at the level of the ischial tuberosities and move your thumbs upwards along the edges of the sacrum with your fingers out to the sides of the buttocks. Bring your fingers and thumbs together as you reach the top of the pelvic crest and then sweep your hands down along the outsides of the pelvis. Repeat this movement a few times and feel for any restrictions. When you feel a blockage pause and press in. If the restriction feels like it needs movement in order to release, make small circular movements. (Figs. 5.16-5.17)

Fig. 5.16 *Massaging the Buttocks and Sacrum*

Fig. 5.17 *Massaging the Buttocks and Sacrum*

Technique 9
Releasing and Balancing the Area of the Perineum

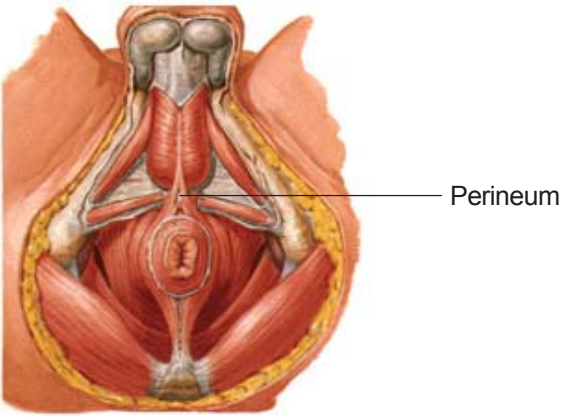

Fig. 5.18 *Pelvic Floor*

It is important for an individual's health to have good tonus in the muscles of the perineum and pelvic floor. These muscles are the levator ani, coccygeus and transverse perineus muscles. When they are weakened, the abdominal organs lose their support and an individual is drained of Chi. Because of our sedentary lifestyles, it is a common occurrence for the muscles of the pelvic floor to be weak and inadequate. Releasing the tendons, ligaments, nerves and circulatory system of the pelvic floor will greatly improve the natural tonus of the muscles. It is very helpful if you advise your student to continue with pelvic floor muscle and tendon strengthening exercises. Please refer to Master Chia's Healing Love books for these exercises.

A. Between the Anus and Coccyx

With your left thumb, press into the left side of the anococcygeal ligament, in the area between the coccyx and anus. Stabilize the right crest of the pelvis with your right hand so that the pressure you exert with your left thumb will not shift the position of the pelvis. Next, move your thumb directly under the coccyx and above the anus, and press into the anococcygeal ligament. Notice if there is any twisting or stagnation in the ligament. Now move your right thumb just to the right of the ligament and press in. Press these points until you feel a return of chi flow. (Fig. 5.19)

Fig. 5.19 *Releasing between the Anus and Coccyx*

B. Anus

Place your left thumb near the left side of the anus and the rest of your hand around the left buttock. Stabilize the pelvis by placing your right hand on the right pelvic crest. Press in with your thumb and pull slightly to the left. Feel this space open and relax. Repeat for the other side. (Fig. 5.20)

Fig. 5.20 *Releasing the Anus*

C. Ischial Tuberosity

Working both sides together, press your thumbs below and a little to the medial surface of the ischial tuberosities. Feel for any congestion, knots or tangles in the veins and nerves. Making small circle movements into the restriction will help the area release. (Fig. 5.21)

Fig. 5.21 *Releasing the Tuberosities*

Technique 10
Releasing the Sciatic Nerve

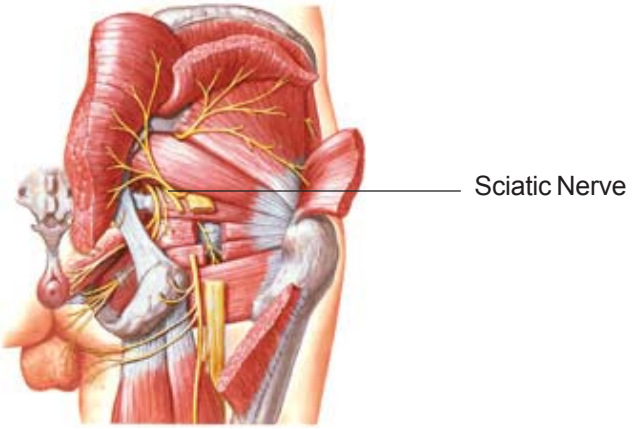

Fig. 5.22 *Be aware of the sciatic nerve path.*

Press your thumbs into the pathway of the sciatic nerve. Feel for any knots and tangles and make small circular movements to release the restrictions. (Fig. 5.23)

Fig. 5.23 *Releasing the Sciatic Nerve*

The following technique is performed with the student prone and the practitioner kneeling on the table facing the student's pelvis.

Technique 11
Forearm Press – Anus to Sacrum

Lean over the student's buttocks and place your forearm, ulna side down, along the midline from the anus to the sacrum. Rest your bodyweight down for two to three minutes and feel the energy flow up the spine. (Fig. 5.24)

Fig. 5.24 *Releasing the Anus to the Sacrum*

The following techniques are performed with the student crouching on all fours and the practitioner standing to the side.

Technique 12
Energizing the Prostate through the Perineum on all Fours

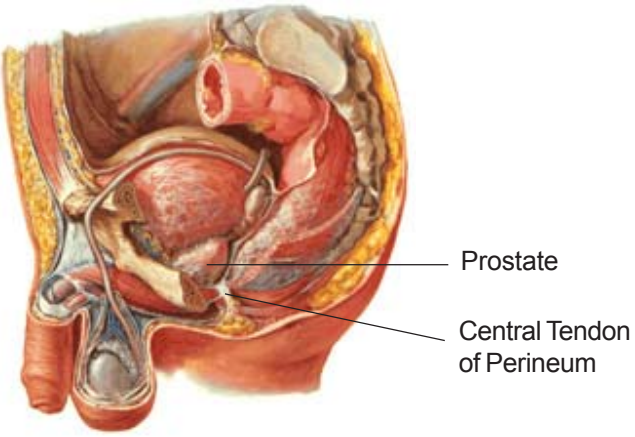

Fig. 5.25 *Be familiar with the position of the prostate.*

Stabilize the sacrum with your left hand and press your middle right finger directly into the million dollar point. The million dollar point is just in front of the anus and behind the perineum. Press in firmly until you feel you are in contact with the prostate. You can also press in with your thumb if this is easier for you. Press in and feel for any congestion. Release your pressure when you feel the prostate release and flow with energy. (Fig. 5.26)

Fig. 5.26 *Energizing the Prostate*

Technique 13
Releasing the Circulation of the Pelvic Floor

Fig. 5.27 *Be familiar with the pathways of blood flow.*

By working from the posterior direction it is possible to release the circulatory system of the pelvic floor. This technique affects the perineal vein, pudendal vein, hemorrhoidal vein, urethral vein and the vein of the penis. (Fig. 5.28)

Fig. 5.28 *Improving the Blood Flow*

Stabilize the sacrum with your left hand and bring the fingers of your right hand underneath the anus to the left side of the scrotal sac. Slide your fingers down the left side of the scrotal sac and forward along the crease of the leg and testicles. Repeat this motion a few times and repeat on the opposite side.

Repeat Technique 8 - Repeat technique 8 to smooth out and integrate the releases. Feel the energy move upwards along the spinal column.

Technique 14
Massaging the Lateral Edges of the Abdomen from Underneath

Stand to the right side of your student with your right side touching the massage table. Place your right hand over the lumbar vertebra while the finger pads of your left hand scoop under the lower ribs and massage down the ascending colon and down to the pubic bone. Repeat this sweeping motion a few times and then move over to the opposite side and repeat for the descending colon, across to sigmoid colon. (Fig. 5.29)

Fig. 5.29 *Massaging the Abdomen from Below*

Technique 15
Massaging the Inguinal Ligament from Underneath

Stand to the right of your student and face their right leg. Place your left hand around the outside of the thigh and with the finger pads of your right hand massage down the length of the inguinal ligament. Repeat this movement a few times and then treat the other side.

Fig. 5.30 *Massaging the Inguinal Ligament*

Herbal Packs – The herbal packs are important for soothing and cleansing the tissues after the massage. They will stimulate the blood and lymphatic flow to speed up the detoxification process after the genital massage.

These herbal packs are made from a special blend of Thai herbs. They are applied at a fairly warm temperature, to the tolerance of the student. They are shaped like a ball with extra material at one end so it is easy to hold them when they are hot.

Technique 16
Herbal Packs over the Abdomen

Press the herbal ball into the upper abdomen and make a fairly rapid circular motion over the skin. Use the whole ball, the bottom and all the sides to rotate the herbal ball over the skin. Work your way down to the pubic bone being careful to reach to the sides of the abdomen. Spend extra time with the herbal ball in the lower abdomen where so much of the massage took place.

Fig. 5.31 *Roll the herbal ball over the abdomen.*

Technique 17
Herbal Packs over the Genitals

Move the penis away from the testicles and then press the herbal ball on the top side of the testicles. Ask your student if the herbal ball is too hot before you press directly on the testicles. Hold for 15 seconds or so and then move the herbal ball to each side of the testicles. Press and hold. Finish the massage by moving the herbal ball to the base of the testicles and feel the energy move up through the central channel to the pineal gland. (Fig. 5.32)

Fig. 5.32 *Roll the herbal ball over the genitals.*

Interviews

By Dennis Huntington

New Life: Rebecca (Retired Business Woman, 55)
Rebecca had suffered chronic vaginal pain as well as psychological confusion and emotional anguish towards her doctors, gynecologists and psychologists for twenty years since her operation after giving birth to her child. Those 'professionals' offered her superficial remedies and considered her continued complaints as being psychosomatic—without ever diagnosing the problem or giving her any relief for her painful physical condition. Yet after four sessions of Karsai Nei Tsang the results seemed like a miracle cure: the pain was gone! She feels that she has been given a new life. The following is her story.

Rebecca: Twenty years ago a few days after the birth of my son I had a very hard operation and they did something wrong. Nobody knows exactly, and later my doctor, my gynecologist, tried to find out what happened on that night in the hospital, but we never—we never—got the papers! Ever since then there has been something very wrong.

"I worked on this problem for many years with gynecologists, psychologists and with special gymnastics, called 'Hanken Gymnastic' in Germany. This gymnastics is especially good for exercises after birth, and for the vagina while breathe in and relaxing, and breathe out and relax. After the operation I felt weak for months. I could sit only in a special round cushion with a hole in the middle. One sits over the hole, so as to not have contact with the vagina. For months I couldn't sit on any normal chair. They hurt me in a way I really don't know and nothing seemed to help me.

I tried to tell my story to Khun Ni, (Khun Ni is the Karsai Nei Tsang therapist at the Universal Tao center, Tao Garden, in Thailand). She put her hands on me and said, "Oo-oo-h-h-h, pain, pain." And I said, "Yes, a lot of pain." Then I allowed her to go deeper. She did not go into my vagina but she did work around the area, where the blood circulation is and all the points that connect. I think that she found a lot of blockages. She worked there for some time. It hurt, and it brought up all those pictures from the operation and all that stuff from twenty years before. It was good for me that it

was a woman because all the doctors for the operation and all the people in the hospital were men, except the midwife—but she was not really a nice person, I must say. She upset me in many ways. I felt like I could trust Khun Ni, so after this one session I agreed that I would have three more sessions of this special massage.

"The second massage was really hard. For the first session I had all my clothes on and for the second session I was naked. Really, I was surprised how painful the massage was. It was really painful; she really went into the pain and released the blockages. In the beginning when she was touching around my vagina, she explained to me that something was crossed. I think it was little veins or little muscles; I don't know. She showed me like this: fingers crossing. Then she worked on that area, and it was painful, of course. After the third massage, she said, 'OK now.'"

Interviewer: *"Ah-h-h, so she got them untangled."*

Rebecca: "Yes and the miracle was that when I had sex with my boyfriend afterwards there was no pain. Before the Karsai massage I always had a lot of pain with love making. It was always a little bit strange for me, and now I have this feeling that something is released. I will see in the future what will happen. I am very, very impressed, and I think, 'Thank heaven that she does this work and she knows it so well.' When I looked at her, she was always sitting with closed eyes, and she was really so in her work! I really have a lot of respect for it. I trust her totally, and this is a most important point. I was breathing, she was pressing. It was like giving birth, but in a good way. I felt safe; I felt really protected by her. "For me, it was what I was waiting for, for twenty years, to release pain that had become part of me for such a long time. This session was very special for me.

"The third session was easier; she didn't go back to those points. But then the last one was painful again because she went up to the joints on the hip and the muscles higher in the tummy. I still felt a little pain, until yesterday. Today I'm completely free after all this treatment. I feel very good with it. She said that I might have to come back in six months, a year or two to do it again. But, between now and then, I will see how it goes and how I feel—especially, if I am together with a man and have sex because that was always something painful for me. I'll really think about coming back for this reason, and to continue to feel good."

Interviewer: *"That's a really meaningful story."*

Rebecca: "Yeah, it has a lot of meaning for me, and I'm happy that I had the courage to do it—because I was really afraid to go back again after the first session. But, I knew how I always felt very sad and that in the recent years if I just talked to somebody about it, I was crying. All the tears were coming out because it touched me so deeply, and it was so painful. I think it's important because I'm very happy with the result. This was the main point for me in deciding to give you this interview—to help some other people who might go through the same hell I went in. Yeah, it's great. It's great to be back in life again."

Geoffrey (Retired Business Consultant, Body Worker,60)
I was surprised to notice that Karsai Nei Tsang is much broader than massage of the testes. It's a massage of the entire sexual area, the lower belly and the anal region. It works on the sedimentation deposits in the blood vessels there which inhibit good circulation. I have never found anybody who worked on that. I must say, it's a reasonably painful massage that she gives, but it is absolutely unique. I find her very sensitive and completely in tune with the body, and very effective for what she does. I feel that she really addresses the essential points.

This massage is a natural way of addressing any problems in the genital area. So far, I am quite happy with these treatments. It helps with the strength of erection and I feel more alive in that area.

Nerve Compression: Alexis (Nurse, 39)
Alexis is a Universal Tao instructor, and she also has considerable experience as a yoga instructor. She had a beautiful nine-month old daughter at the time of the massage. She sent the following interview response by email after returning home.

Alexis: "During my pregnancy, I developed Meralgia Paraesthetica in my left thigh. This condition is a symptom complex that includes numbness, paresthesia and pain in the antero-lateral thigh. The cause can be an entrapment neuropathy or a neuron of the lateral femoral cutaneous nerve.

"In my case it was the weight of my pregnancy that was causing the compression of the nerve. My condition continued even after delivery. I saw a neurosurgeon, and the treatment plan was wait

and see, rather than surgery.

"Nine months later I was still experiencing numbness, reduced sensation and occasional pain over the entire left lateral aspect of the thigh, right down to the knee. At this time I was fortunate to be in Tao Garden. I booked to see Ms. Ni. During my first treatment, I felt my sensations returning to my thigh, and by the end of the treatment I had 80% normal sensations to my thigh.

"Needless to say I was extremely impressed and incredibly grateful to Ms. Ni. She is very capable and knew exactly where to work to release the nerve compression. I find her to be a highly competent practitioner."

Painful Intercourse: Marsha
(Massage Therapist, 35)

Marsha is a Universal Tao instructor and an experienced Chi Nei Tsang Massage practitioner with a classical massage background.

Marsha: "One of the things that I learned from receiving this massage is that there is more than one way to lift the uterus. Women have been studying how to do this; there are a couple of techniques out there. When a woman's uterus drops down, it puts pressure on her cervix which can cause painful intercourse. For example, women continue to collect negative energy by having sex and there is a build-up of negativity if you continue to have sex when it hurts. So, the most effective remedy is to lift the uterus so that the cervix is not so close to the vaginal canal. When the woman's cervix is low the man's penis will bump against the cervix during sex. This is very painful at the time, and afterwards you are sore for twenty-four hours. The resulting inflammation is just not good for you.

I find this massage different than the other uterus lifting techniques because rather than just lifting the uterus by digging under the pubic bone and lifting up, the practitioner may find where a tendon is knotted and too short so it is pulling the uterus down. There may be tendons connected to the pelvic bones that are constricted and pulling the uterus and the bladder down. So instead of just pulling up from the pubic bone, now we can untie the knots, tangles and twists in the ligaments that connect the hips and free the uterus itself. So, instead of just pulling the uterus up, the tendons and ligaments were released that were responsible for pulling the uterus down. This is huge, really huge!

"The other thing is that for women who have negative energy collected in their sexual organ region, we now have a respectful, gentle massage that works. We have a massage that works to free up this stuck chi that may have accumulated from any kind of negative sexual activity or any negative sexual thought. So, when you release a tendon, you release the negativity inside the tendon, we know this from Chi Nei Tsang I and II. Master Chia says that this is the missing piece and I agree! This is where sediment, both energetic and physical, settles. So for woman the release is both physical and emotional.

Interviewer: *"Did you have new experiences in the massage?"*

Marsha: "Yes. For me, I have many years of doing personal body-work—bodywork on myself—and also studying the Tao. So I knew what to expect, and a lot of the work had been done. But not all of it, and I could not seem to free up the area between the upper thigh and the top of the pubic bone. I could have worked it on my own—what I was lacking was an education. For example, and this is so important, in classic massage school they teach a technique called 'cross fiber.' So, instead of going along the length of the tendon, you find a knot and you go across the knot. Instead of going parallel to the fibers of the tendon you go perpendicular. In Karsai Nei Tsang, you massage along the line of the tendon very gently, repeatedly, and using intention. That's how you untie this very delicate tissue. This is very different from deep tissue massage.

"So, in my first appointment, I did feel some emotions, because someone was touching around my genital area. There's a certain amount of trust that a person must have, and if you don't have it, well, you could have some issues come up just from that. Then as things released over the course of the next twenty-four hours after my first session I experienced a lot physical toxins releasing, and I had pain physically. This was OK with me.

"When I came back two days later, Khun Ni said, "You are not ready yet. You are still swollen, and have inflammation and it looks like we broke up adhesions." And, I am sure I did because my tangled-up tendons had been there since I rode horses when I was eleven/twelve years old. I know that this kind of massage can bring about much emotional release but I didn't get the tears that some of my other woman friends experienced. I know that some women

had very big releases. I think this was only because I had known for eight years that this was the worst area of icky stuff in my body. For me, it was very joyful because I finally found somebody sensitive enough and knowledgeable enough. These are two very important things in order to work the area effectively and efficiently.

"I think I had three treatments, and I now know what to do for myself—because I have to leave Khun Ni. So, I feel that she was repetitive enough so that I got it. Maybe not everything, but I have enough to get in there and start—with my new information—to start straightening my tendons. As a matter of fact, before she worked on me, I didn't understand that I needed to straighten my tendons. My groin had been just a rock—and I didn't know what to do with it. Now I have techniques to stretch and lengthen and pull and untie the knots. For me, the experience was life changing because, maybe in the next few months, I can no longer say that my groin is the most congested part of my body.

"One of the important points for me is the combination of sensitivity and knowledge. What this massage brings to us is new knowledge. We already have lots of techniques for lymphatic, for tendon and for muscle massage. This is a very clear, concise massage technique that does not veer off of its formula."

Interviewer: *"it is important when you are moving sediment or other energetic blockages from the area that it has to have a place to go. So, as a component of the massage, she prepares the other areas so that when she activates the movement, then it has a place to go."*

Marsha: "Yes. When I went for my last massage, she knew she needed to move a lot of stuff out. She took almost thirty minutes and opened up the lymphatics around the belly. You're right, she prepared my body. That's where the knowledge comes in. It is important to know about the body. You have to know there's a cluster of lymph nodes in the belly. Otherwise, you move stuff out and maybe the knees get stuck or something. Ha-ha-ha.

"Oh, yes, after my third massage, over the course of about five days, I went back to my room and lay down on my belly. I felt energy in the form of a tingle rise up from my groin and start to move up toward my head. The energy made it to my shoulders and there it dissipated a bit. Another experience I had after the massage was

how much sexual energy it gave me! I had so much heat, and that heat lasted probably half a day. I had a build-up of energy that must have been stuck in the tendons, ligaments and skin. I had stored this heat, inappropriate heat, and I was sweating. This was one of the first things I experienced. Then, as I got healthier and the energy released, it felt light and bubbly and tingly."

Interviewer: *"Oh, how nice—champagne massage!*

Marsha: "It was nice. I think that for a woman to release this beautiful energy is so important. It feels like things start to flow. I would think this would benefit our skin, our hair, our mind, and our organs. This is what makes a woman really powerful, to be able to tap into this energy."

Mary (Mother, 33)

Mary was participating in Dr. Roy Martina's "Inner Power Zone" retreat in the summer at Tao Garden when she heard about the genital health massage.

Mary: "I thought it was done in a very skillful and sensitive way, which made it possible for me to really breathe into the areas and loosen up. For example, the pelvic floor—I really felt that she was able to loosen up the whole pelvic floor area. She works from all angles, and it's quite intimate, but she does it in a very professional way so it doesn't feel that she's intruding. I also liked very much that she worked all around. She works the front. She works the bottom. She works the back. She integrates this with working on the abdomen on the intestines, on the organs, on the inguinal area—on the ovaries, uterus, rectum. She works on the anus—around the anus almost, on the outside on the left and right and the side of the anus also—which was a new experience for me, but it felt really very good afterwards. Yeah, I really felt that there was an increase in circulation. I felt really that the breath and chi was filling-up the base, all the circuits or something. It was really a very good feeling after the sessions.

"It really felt like she released quite a few blockages: both in the abdomen and on the sacrum, and definitely on the pelvic floor—on the sides of the genitals, that group of muscles that constitutes the whole bottom of the torso and prevents the organs from falling down. It released tension for sure, also very good work in the inguinal

area. I felt energy released. For sure, I felt the chi flow really much better into this area after the massage.

"I think a very important point is that it's called a genital massage, and it sounds very intimate, but it's really not very intimate. It's really very professional—it releases a very important area that you normally don't get worked on if you go to a massage therapist. I think this is very important. There is nothing sexual about it. It's really professional bodywork."

Anya (Scientist, 41)

Anya was a participant in the Universal Tao summer retreat. She had suffered from tension and pain in her legs, hips, lower back, shoulders and neck for many years. She had been wearing a platform shoe for twenty years to compensate for one leg being shorter than the other.

Anya: "I went to Khun Ni to have the genital massage, and then during the very first session she told me that my leg should be treated first before she would be able to do the genital massage because there was just so much tension in the leg, and it was affecting the genital area. There wasn't really a problem in the genital area; it was just affected by the leg."

Interviewer: *"Many people have discovered through their experience with this massage that other areas are affected, and other areas affect the genital area. … This seems to be the case with you.*

Anya: This was something I already knew: One leg was shorter than the other. So, she treated me for the difference in the length of the two legs. That was quite amazing because she put a lot of force into this—because it involved big muscles and big joints. I already had pain in my right hip for eight years. When I was jogging or doing sports I often got injured in my knee or ankle, and it had to do with the difference in the length of the legs. In two sessions, with her experience she adjusted the length in my legs. I don't know how she did it, but she did it. She made the legs the same length. In one or two sessions I was standing evenly on both legs. It was amazing. I threw away two pairs of shoes because one shoe had higher soles to make up for the difference in length. I bought myself new shoes in Chiang Mai. It was nice."

Interviewer: *"And now you feel very comfortable with both legs equal?"*

Anya: "Yes. Yes, it's really like a miracle. I always had these very tight muscles on the inside of the thigh. There was so much tension; you could feel them like little knots in different places along the muscle tissue. It's great to have the feeling that there is less tension in the muscles."

Interviewer: *"So the whole leg has had a readjustment, a realignment or something, so that the muscles now are flexible."*

Anya: "Yes, it was the tension of the muscles that made the hips rest at a different level. Now she has released the tension, It's not like the two legs are the same at this moment, but I'm making progress, and she gave me some exercises to take home. So, I have to take care not to get too much tension again."

Interviewer: *"Are you finished with your sessions now?"*

Anya: "Tomorrow is the last one because I am leaving to go home after that. She's treating my shoulder now—the same problems, the same tension, and same uh-h …"

Interviewer: *"Well, if you are out of balance in the lower body that would affect something in the upper body maybe, too."*

Anya: "Sure."

Interviewer: *"So, did that seem to have any effect in genital the area that you started with?*

Anya: "I did not experience that there was less tension in the genital area, but I asked her if this would be the point, and she said it would be. It would just go away as a result of removing the cause of it. Yes, she said there would be less tension in the genital area—but I have to experience that." It is not that I feel tension in this area but at this time I do not feel the difference. I think I need to take time and become more sensitive. It is a big gift for me to feel more balanced in my hips and then I will see what happens.

Michael (Businessman, 55)
Michael was visiting Tao Garden with the group for the Inner Power Zone retreat.

Michael: "I had the first Genital Health Massage of my life yesterday. I was a little afraid of it because my scrotum is a little bit tense. But she did it very nicely, though I felt a little bit of pain up through my kidneys. But after awhile, after massaging it three times, it was gone. So afterwards, I feel pretty good. But during the dancing at night, I couldn't do that because I felt a pain again in my sensitive area. Then after one hour, it was gone. Well, now, it's relaxed and feels open. I did like the treatment from the woman, especially. She's very easy to read: She's open, she's friendly, and she's kind. So it was a beautiful experience."

Interviewer: *"I get from what you said that she relieved some tension from your scrotum and testicles. Also, from the effect that you had later on, it sounds like she removed some blockage. Do you think so?"*

Michael: "I don't know. I'm not an expert, but it feels like so. It feels like it's open. Yeah, it's accessible also. Something flows, and now that pain is completely gone. "

Interviewer: *"So, are you looking forward to your second session?"*

Michael: "Ha-ha-ha. Well, I am still a little bit afraid. Especially when she touches the way, the channel, which leads from the scrotum to the kidneys—you feel the pain. Yeah, that's a little bit frightening, but, well, you get used to it."

Interviewer: *"I think it's a good sign, actually, because it opens up the energy flow of the connection to my kidneys. Maybe the pain is a little discomforting if there is a little pain involved, but it's helping—in my experience, if it is not there, I've got a problem. So probably that's a good sign, more than not."*

Michael: "It was a wonderful experiment for myself. I wanted to experience that, and it went well."

Interviewer: *"Do you feel that you would feel more comfortable in performing self-massage?"*

Michael: "I did it this morning, a little bit, but that area is always so tense that I don't dare to touch it. So, I did it a little bit in the morning, and it went well. And if it is going to happen in my home country, I will certainly come. If she comes, I will certainly make an appointment."

Pieter (Dance Teacher, 42)
Pieter is a forty-four year old dance teacher in a dance academy. He teaches improvisation, choreography and dance analysis. He came to Tao Garden for Dr. Martina's two-week "Inner Power Zone" retreat.

Interviewer: *"You have had three Karsai Nei Tsang massages already, are there any particular results that you find to be of value?"*

Pieter: "I think one of the main results is that the energy in the abdominal area is much better. It's much lighter, and it's much better connected so that I feel the chi more easily. I also feel a difference in my thinking and I feel more playful than before. These are things that I can tell now are already changed.

"Also, I feel that a lot of weight from heavy emotions that were stored in the abdomen have released. I had a lot of gas there, and there is hardly any left. Also the volume of the belly area has diminished by more than one-third.

Interviewer: *"Due to the excess, trapped gas, do you think?"*

Pieter: "Yes, gas and a lot of emotions were stuck there. Khun Ni said that I should express my emotions quickly: say what I have to say instead of keeping them inside. She is so right about this. She can feel so much through her hands; it's really amazing that she can pinpoint this. That's very nice. I also had a problem with my testicles; one of my testicles had a line of tension to one of my kidneys. One testicle was a little bit smaller and lower than the other that's what my girlfriend told me, because she was there when Khun Ni worked on it. After working on the testicles, they became the same size and adjusted to the same level, instead of

the one hanging lower. She put the alignment back together. She could feel very clearly that there was a knot in the groin area that blocked the connection between the testicle and the kidney. So she worked there, and she opened it. That was very nice because I had a lot of problems a year ago with my groin. And I feel now that it's more flexible."

Interviewer: *"So, she massaged that area to release the tension that was blocking the energy flow to the kidneys."*

Pieter: "Yes.

Interviewer: *"Can you feel the open flow between the testicles and the kidney area now?"*

Pieter: "Yes, I do. I think it would be much better if I had more massages. It's a pity that there is not enough time. I think she could do more good work. I have had all of my three sessions now, but she is so overbooked that I can't get in anymore."

Interviewer: *"Yes, she's been really busy."*

Interviewer: *"Well, so, she balanced the height of the testicles. Were there any other things that you noticed? Was there any accumulation of sedimentation that she helped to breakdown and move?*

Pieter: "Yes. She did a strange thing yesterday with my leg and with the knots in the groin. Now it's more flexible. It was stiff and frozen. She just felt it and with one little massage manipulation and it was done! So amazing. She also worked on my legs yesterday, and she opened my legs and my ankles much more. It's very good and my neck is better also. She did several things to open it up again. So it has all been very good.

Interviewer: *"So she released the blockages to the sexual energy flow in your body so that it goes up to your brain. And by opening these areas in your wrists and ankles, it has helped the circulation of energy through the whole body."*

Pieter: "This is where I feel a difference in how she's working with other massages. They do their job, and it's very good. Other massages open up surface things, but Krasai Nei Tsang goes amazingly deep into the body and in the organs. It's more of a mind-body connection, instead of only the body. So, on this level it's amazing what she's doing. And what she feels and what she sees in the body! So I think she's a gift from the Center!"

Interviewer: *"Is there anything else you would like to say that I haven't asked you about?"*

Pieter: "I think it would be good for everybody to receive this type of massage Yes, it may be a little bit strange when you see the title, Genital Massage, you think, 'Whoa, what's happening there?' But I think, there's a taboo in the world that the lower part shouldn't be touched by somebody else in the form of massage. If Tao Garden had not suggested it to me, I probably would not have received this massage. It's amazing! Again, thank you."

Anke (Teacher, 55)
Anke came to Tao Garden for Dr. Martina's Inner Power Zone summer retreat. She heard about the massage after previous treatments had failed to work.

Anke: "I have had three sessions, and tomorrow I will have the fourth one. There are three big releases that I have received from this massage. I have had a blockage for five years in the area of my stomach. The acupuncturist didn't help; my physician was not able to help either. Then Khun Ni began to massage it, and she said there were three knots very close to each other from the stomach down. She began to work on them and after the third session it's much better, so much relief. This is the biggest change. I feel very comfortable now in my lower belly. Before I had constant pain, a kind of nagging pain that was always there and now this is gone. So, after five years, it's really like Wow-w-w, my complete body—this part is again mine. This is such a gift.

The other two little things were that I had little knots on the side of my belly. She detected them by just holding her hands on them. She said, 'Hum, what's this here?, and then she started massaging the knots. I had massaged them many times already, but they always jumped away. After two minutes they were gone. It was

like, 'OK, this is nothing; it's just how you touch it and how you massage it, and they were gone.' Then I started getting a breast pain. I thought this might be from the exercises we had been doing and I thought I might have over stretched a muscle. When I told her, she said, 'Oh it's related to the part in your stomach, in a line down to your lower belly.' There were two little knots. She massaged them, and let me feel how I could massage them, and now after three days they are gone.

"Tomorrow I have one more session because I have a lot of gas packed in my stomach and down through my intestines. I am really pleased about the results up to now, especially because of those five years that I was in so much pain."

Interviewer: *"And was that pain something that she discovered in connection with its effect in the genital area?"*

Anke: "Yes. I had an irritation on my vagina and it was swollen a little. I had had it for three months, and she said, 'Uh-uh-uh, I know, what it is.' She massaged it, and it also went away. During that week it became better and better. It was related to the channels not being open, and the pressure being stuck so that all the other organs had less space.

Interviewer: *"So, from there, she cleared the line from the lower abdomen up towards the navel area?"*

Anke: "Yes, or downwards, because she started from the navel area and she worked downwards. I could feel it as a heat being released. I was really embarrassed because I had a lot of burping. She was massaging, and I was constantly doing this. That gave me a lot of release. And that's basically it."

Interviewer: *"And you feel a lot better as a result of it, obviously."*

Anke: "Yes, absolutely. I feel much more now that everything in my belly is again for me! So, I think, 'Hey, this is the way it's supposed to feel."

Interviewer: *"Wow, I'm really happy to hear that."*

Anke: "Yes, I'm really glad that you gave us the talk on Monday and said, 'You you might want to try this.' Otherwise, we never would have done this. So, thank you for that."

Elizabeth (Bodyworker and Universal Tao Instructor, late 40's)

Interviewer: *"Can you please share with us any particular experiences you had with the Karsai Nei Tsang massage"*

Elizabeth: "Yes, I have been experiencing some pain in my right ovary and the right side of my sacrum. I was able to manage the pain with Chi Kung and Tao Yoga but I was not able to rid myself from the pain completely. After two or three sessions of Karsai Nei Tsang the pain went away and has not come back. Another wonderful benefit I have received from this work is a deeper sense of stillness. A few years ago I was involved in a frightening auto accident. Ever since then I have felt more alert and not able to go as deep into my meditations.

During my first session, Khun Ni immediately felt this deep spiral twist in my left psoas muscle. With her sensitive hands she released the spiral twist and very quickly I started to rest deeper. And so, as you know, the psoas, the kidneys, the fear, and the sexual organs are all so connected. She really helped me and I feel very grateful. Next she worked down the inside of my legs. Afterwards, when I got off the table I could feel my whole relationship to the earth dramatically changed. I've gone through so many different trainings, and I always think, 'Wow, this is what it feels like to be grounded.' But there is always more. And now with Khun Ni's work I feel like, 'Ah-h-h, now I feel the earth, even more!' Very nice!"

Interviewer: *"This relationship between the genitals and other parts of the body is something that is obvious once we have the experience, and everyone I have interviewed seems to have recognized it in one way or another. Generally, they say: 'Yes, we have some manifestation of some symptom that we experience in the genital area, but it is connected to other parts of the body—either going down into the legs or up into the organs. So, she works on the surrounding area and clears something there so that the energy*

that's blocked in the sexual area will have a place to go and can be moved out through healthy channels.'

Elizabeth: Yes, I feel this also. When we stop to think about it, it makes no sense whatsoever that bodywork focuses on all parts of the body except on the genital area. If we really believe that the whole body is connected then we need to address the whole body. My awareness in my sexual organs has heightened because of this massage, now I feel much more integrated, from my head down to my toes. This is really so exciting.

Interviewer: *"How do you feel this massage has affected your Tao practices?*

Elizabeth: Well, in addition to the rooting to the earth I have felt an increase in my sexual energy. Lovemaking has always been enjoyable for me but now I feel really so alive. My Healing Love practice has become even more pleasurable and beneficial, now the sexual energies are more easily channeled because the congestion is released. I plan to continue with Karsai Nei Tsang self massage and always make this a part of my self care. I look forward to training in Karsai so I can help others like I have been so generously helped.

Louis (Production Manager and Universal Tao Instructor, early 50's)

Louis is a Universal Tao senior instructor and has been teaching chi weight lifting (for genital organs) for fifteen years. He has been especially diligent in maintaining regular practice, including thorough testicle massage, for the past two years to ensure his longevity. He is also a certified teacher for Chi Nei Tsang organs massage. He had no problems or concerns regarding the condition of his sexual anatomy. In fact, he felt that this part of his body was in the best condition ever. However, he took three sessions of testicle and prostate gland massage for the sake of the experience. Not only did the results take his personal practice to another level, but the massage also opened up other chronic problem areas, such as the sacral and lower back, where he had sustained earlier injuries.

Louis: "This whole experience has been a boost to my personal practice, and it has helped me to focus even deeper in the area that I've been concentrating on, especially in the last two years. She's been able to massage me in a way that is different from the way that I have been doing. It has helped to open up the whole flow of the creative life force, sexual energy, a lot deeper than it was before. Now it is even more dramatic. I can imagine that people who have never worked on this area, and all of a sudden get this exposure will get even more of a dramatic response than I had!

"I think the Genital Health Massage is a little bit more unique and specialized than the other kinds of massage. You really have to be trained and have certain sensitivity because that's the most sensitive part of your body. It's a very important ingredient for the higher level practices because you need these blockages and sediments released in order to do the full internal alchemy transformation. So it is actually a very key component for the whole process of the immortal practices—which takes it to another level of understanding that is very beneficial for those people who are seeking that type of self-realization. So, for my own personal practices and my own personal journey, this is a very key component to my own evolution.

"Overall it's an unusual experience, and you touch a lot of areas that you don't normally get involved with on that certain level. You're dealing with root problems, balancing and correcting them at the root level, and literally your genitals are the roots of your whole energetic body. I think it's a very critical and very important part of our internal practices."

Kees (elected city official and bodyworker, early 50's)
Kees is a Universal Tao instructor and spends a few months every year at the Tao Garden in Thailand. He has been able to profit from many Karsai Nei Tsang sessions and so his story comes from much experience.

Interviewer: *"How many sessions have you had of the genital massage?"*

Kees: "Yes, I believe approximately forty."

Interviewer: *"Wow!"*

Kees: "Yes. I'm quite experienced now."

Interviewer: *"Could you please tell us what has been meaningful about your experience. Did you have any problems that were resolved by the massage?*

Kees: "Well, what happened is that I realized a time ago that I had many blockages in my genital area that were covered up and very old. Khun Ni was able to touch these areas where there was hidden pain and open them up.

Interviewer: *"So, she would open up these areas that had been hiding from you."*

Kees: "Yes, working on them and letting me feel the old pain. One of the most special things that she did was just this; I was able to let the pain come, and go one step further and go into the pain. This is something we can decide for ourselves. 'OK, let the pain come.' Then, it's not so much the pain that is coming, but it's a whole new area that is coming. I realized it was very old for me. So, she's opening up very old things. I don't know if she knows, but that's what she did."

Interviewer: *"What was the result of these areas opening up?*

Kees: "I walk differently. I feel differently. I feel more connected."

Interviewer: *"So by 'opening up,' you mean that there are things that you have been blocking either emotionally or physically."*

Kees: "I mean emotionally."

Interviewer: *"Was there a physical pain associated afterwards? One of the purposes of this technique is to clear up physical sedimentation that accumulates in the area.*

Kees: "Yes, I'm quite sure that has happened as well. After about session twenty-five I became really quite sick. It felt very much like my body detoxifying with diarrhea and fever.

Interviewer: *"So you were clearing out some toxins and blockages from your body. The sickness was a manifestation of a cleansing process, a clearing out …"*

Kees: "Of course, for sure. I'm sure about that.

Interviewer: *"Has there been any specific difference? It is common for older men to have blockages that affect the prostate gland and other areas of the sexual organs so that they lose some of their urine flow or erection.*

Kees: "I have the impression that my urine flow is stronger. My prostate area used to be very bound up—covered, like an iron shield around it—and it's much more open now. It can move more freely." Another important part for me has been the work she has been doing on my veins. I have certain problems with my veins in my genital area, and she's correcting them, quite well. She is also working on the blockages in my blood flow.

Interviewer: *"You say that feel emotionally more open. That's an interesting thing because it's something you don't see or feel physically so much. How do you feel as a result of having cleared away your emotional blockages?*

Kees: "I have had many massages and bodywork sessions in my life but never have I had my genital area worked on. It is especially in this area that we cover up with many experiences from the past. Now it feels as if my genitals and the surrounding area are much more a part of my whole body now. This is a wonderful feeling."

Interviewer: *"In regards to the whole body energetically, did you have a feeling that this massage opened up chi flow in other parts of the body?*

Kees: "Yes, I feel a lot stronger. People tell me that I look much, much different; so, it's not only me that notices this.

Interviewer: *"So you have an overall tonic or toning effect because of the opening up of what was blocked in your genitals. Do you feel generally more open all over your body?"*

Kees: "Yes, and for me, the most important part is that I have the feeling that my body is now integrated. I no longer feel like separate parts with other parts missing. I feel all of a whole and this is a very good feeling.

Interviewer: *"OK. Well, any concluding comments you'd like to make?"*

Kees: "She's great—she's been great!"

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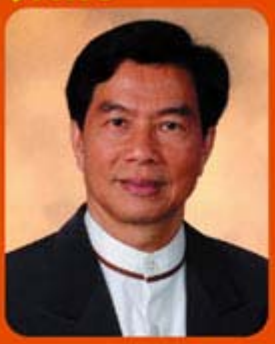

Karsai Nei Tsang

Genital Therapeutic Cleansing Massage

Mantak Chia

Illustrations by Udon Jandee

New Development in Chi Nei Tsang

Universal Tao System is pleased to announce a new development in the organ massage practice of Chi Nei Tsang. Karsai Nei Tsang, also known as Genital Health Massage, has been developed specifically for improving the health of the genitals and the genital area. This special massage is now available for individual appointments at the Tao Garden Spa.

Genital Health and Cleansing

Our sexual organs play a major role in our physical and emotional health. Because every part of the body is connected, tensions in one area have an affect on the rest of the body. This is also true for the genitals. When the genitals suffer from blockages, the Jing Chi (Sexual Chi) is not free to circulate through the body. The body is then deprived of this powerful healing energy.

Benefits of Karsai Nei Tsang

We have neglected our sexual organs for far too long, our genitals need attention and expert care just like the rest of our organs. Karsai Nei Tsang provides this care. The Karsai Nei Tsang practitioner uses deep, direct pressure with small circular massage movements to break up and dissolve the sedimentation in the circulatory system, release the toxicity and remove the physical and emotional blockages in the pelvic area. Genital Health Massage addresses the common problems associated with our sexual organs; impotency, frequent and difficult urination, painful menstruation, painful intercourse and low sexual libido. It is also effective in alleviating back pain, improving the body's alignment, strengthening the pelvic floor muscles and increasing general vitality.

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Universal Tao Publications

The Proof Is in Your Pants

You may already have experienced multiple orgasms. Surprising as this may sound, many men are multi-orgasmic before they enter adolescence and begin to ejaculate. Kinsey's research suggested that more than half of all preadolescent boys were able to reach a second orgasm within a short period of time and nearly a third were able to achieve five or more orgasms one after the other. This led Kinsey to argue that "climax is clearly possible without ejaculation."

But multiple orgasms are not just limited to prepubescent boys. Kinsey continues: "There are older males, even in their thirties and older, who are able to equal this performance." In *Fundamentals of Human Sexuality,* Dr. Herant Katchadourian adds: "Some men are able to inhibit the emission of semen while they experience the orgasmic contractions: in other words they have nonejaculatory orgasms. Such orgasms do not seem to be followed by a refractory period [loss of erection], thereby allowing these men to have consecutive or multiple orgasms like women.

Why do most men lose their ability to be multi-orgasmic. It is possible that for many men the experience of ejaculating, when it happens, is so overwhelming that it eclipses the experience of orgasm and causes men to lose the ability to distinguish between the two. One multi-orgasmic man described the first time he ejaculated: "I still remember it clearly. There I was orgasming as usual, but this time a white liquid came spurting out. I thought I was dying. I swore to God that I would never masturbate again – which of course lasted about a day." Since orgasm and ejaculation generally occur within seconds of one another, it is easy to confuse them.' To become multi-orgasmic, you must learn (or possibly relearn) the ability to separate the different sensations of arousal and to revel in orgasm without cresting over into ejaculation. Understanding how orgasm and ejaculation are different will help you distinguish the two in your own body.

Brain Waves and Reflexes

Orgasm is one of the most intense and satisfying human experiences, and if you have ever had an orgasm – and almost all men have – you will not need to have it defined. All orgasms, however, are not created equal. Orgasm is slightly different for each person and even different for the same person at different times. Nonetheless, men's orgasms share certain characteristics, including rhythmic body movements, increased heart rate, muscle tension, and then a sudden release of tension, including pelvic contractions. They feel good, too. After noting that "orgasm is the least understood of the sexual processes," the thirteenth edition of *Smith's General Urology* explains that orgasm includes "involuntary rhythmic contractions of the anal sphincter, hyperventilation [increased breathing rate], tachycardia [increased heart rate], and elevation of blood pressure."

These definitions include changes that occur throughout your entire body. However, for a long time orgasm was seen – and for many men is still seen – as strictly a genital affair. In the West, William Reich, in his controversial book *The Function of Orgasm,* was the first to argue that orgasm involved the whole body and not just the genitals. In the East, the Taoists have long known that orgasm could be a whole-body experience and developed techniques for expanding orgasmic pleasure.

Many sex researchers are now arguing that orgasm really has more to do with our brain than our brawn. Brain-wave research is beginning to reveal that orgasm may occur primarily in the brain. That you can have an orgasm in your sleep – without any bodily touch – seems to confirm this theory. Further support comes from neurologist Robert J. Heath of Tulane University, who discovered that when certain parts of the brain are stimulated with electrodes they produce sexual pleasure identical to that produced by physical stimulation. Many sex therapists are fond of saying that sex takes place in the brain. There is some truth to this statement – especially when it comes to orgasm.

Unlike orgasm, which is a peak emotional and physical experience, ejaculation is simply a reflex that occurs at the base of the spine and results in the ejection of semen. Michael Winn, senior Healing Tao instructor and coauthor of *Taoist Secrets of Lowe: Cultivating Male Sexual Energy,* explains: "A lot of men are freaked out by the very idea of nonejaculatory orgasm because they've been having ejaculatory sex for such a long time, often decades. So the first thing to do is demystify ejaculation, which is just an involuntary muscle spasm."

With practice, you can learn to experience the peak feeling of orgasm without triggering the reflex of ejaculation. In the next two chapters we will explain, step-by-step, exactly how to separate orgasm from ejaculation and how to expand your orgasms throughout your body. But first let's look at the evidence that men, like women, can have multiple orgasms.

Prove It

Probably the most extensive laboratory investigation of male multiple orgasms was made by sex researchers William Hartman and Marilyn Fithian. They tested thirty-three men who claimed to be multi-orgasmic – that is, to be able to have two or more orgasms without losing their erection.

While these men had sex with their partners in the laboratory, Hartman and Fithian monitored their heart rates, which the researchers had chosen as the clearest method of identifying orgasms. At rest, the average heart rate is around 70 beats per minute; during orgasm it almost doubles, rising to about 120. After orgasm, the heart returns to its resting rate (see figure 1). They also measured pelvic contractions (most obvious in the involuntary squeezing of the anus), which coincided with the peaking of heart rate at orgasm. What they found was pretty surprising: the arousal charts for these men were identical to those of multi-orgasmic women.

Male and female sexuality may be more similar than is usually thought. Developmentally, this similarity makes sense, since male and female genitals come from the same fetal tissue. In their famous book *The G Spot and Other Recent Discoveries About Human Sexuality,* Alice Ladas, Beverly Whipple, and John Perry argued that male and female sexuality were almost identical. In addition to their much-reported discovery of the female "G spot" (which we will discuss more in chapter 4), they also suggested that men can experience multiple orgasms just like women.

During Hartman and Fithian's research, the average number of orgasms a multi-orgasmic man had was four. Some men had the minimum of two, and one had as many as sixteen! In a study by clarion Dunn and Jan Trost, most men reported having from two to nine orgasms per session.

It is important to mention here that Taoist sexuality is not about numbers and keeping score, it is about satisfaction and cultivation. You can feel satisfied with one orgasm, with three orgasms, or with sixteen orgasms. You cultivate your sexuality as you deepen your an awareness of your body's pleasure and increase your ability for intimacy with your partner. Each person and each sexual experience will be different, and the "right" number of orgasms will depend on your and your partner's desires at the time. When you become multi-orgasmic, you will never have to worry about how long you can last or how many orgasms your partner has, because you will both be able to have all the orgasms you could ever want.

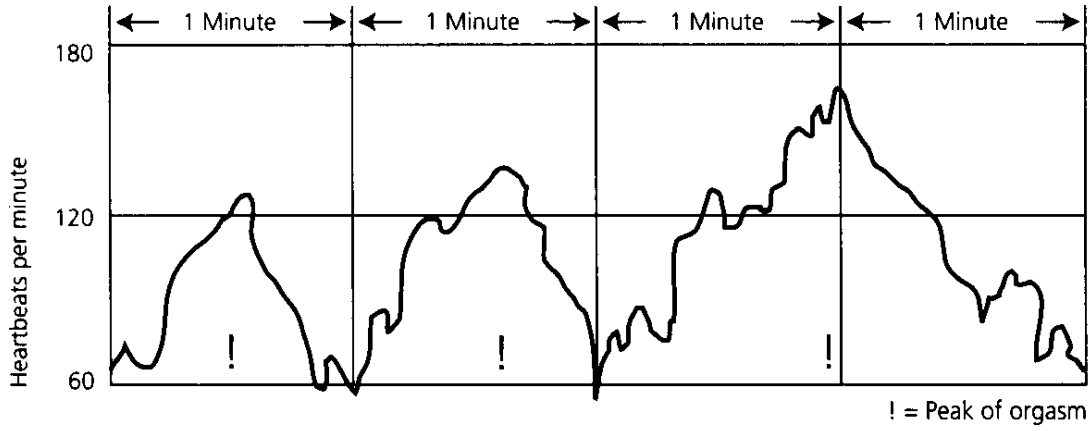

Figure 1 - AROUSAL CHART FOR MULTI-ORGASMIC MAN

The Little Death

As doctors, the Taoist masters were interested in sexuality as part of a larger concern for the health of the entire body. They practiced Sexual Kung Fu because they discovered that ejaculation drains a man's energy. You have probably also noticed this loss of energy and general feeling of fatigue after ejaculating. Even though you would like to be attentive to your partner's sexual and emotional needs, all your body wants to do is sleep. As one multi-orgasmic man put it, "Once I ejaculate, the pillow looks better than my girlfriend does."

The image of the unsatisfied woman whose lover ejaculates, grunts, and collapses on top of her is so common that it has become a cultural joke, but the exhaustion that men feel after ejaculating is as old as the first coital groan. Peng-Tze, a sex adviser to the famed Yellow Emperor, reported almost five thousand years ago: "After ejaculating, a man is tired, his ears buzz, his eyes are heavy, and he longs for sleep. He is thirsty and his limbs feel weak and stiff. In ejaculating he enjoys a brief moment of sensation but then suffers long hours of exhaustion."

Western folk wisdom agrees with the Taoists regarding the importance of conserving sexual energy. Athletes have long known the weakness and lethargy that follow ejaculation, abstaining from sex the night before the "big game." Artists have also felt the lingering effects on their work. Jazz musician Miles Davis explained in a *Playboy* magazine interview:

> Davis: You can't come, then fight or play. You can't do it. When I get ready to come, I come. But I do not come and play.
>
> *Playboy:* Explain that in layman's terms.
>
> Davis: Ask Muhammad Ali. If he comes, he can't fight two minutes. Shit, he couldn't even whip me.
>
> *Playboy:* Would you fight Muhammad Ali under those conditions, to prove your point.
>
> Davis: You're goddamn right I'd fight him. But he's got to promise to fuck first. If he ain't going to fuck, I ain't going to fight. You give up all your energy when you come. I mean, *you give up all of it!* So, if you're going to fuck before a gig, how are you going to give something when it's time to hit?

Miles wasn't exactly a romantic, but he didn't mince words, either. As one of the world's greatest trumpet players, he knew how ejaculating decreased his stamina and depleted his art. Unfortunately, like most men, he didn't know that he could have had sex all he wanted, even have orgasmed, before any gig – as long as he didn't ejaculate. It might have even improved his "hitting."

Although the effects of ejaculating may be more obvious to professional musicians and prizefighters, all men eventually experience the same depletion from coming – which might more appropriately be called *going.* According to one multi-orgasmic man, "I really notice it in the morning if I ejaculate. I get up dragging my feet and I am tired by noon. When I have multiple orgasms without ejaculating, I wake up refreshed and I need less sleep." Another man who was recovering from a chronic illness explained: "My sexual desire has always been strong, so I ejaculated often, once or twice a day. And with every ejaculation my health got worse and worse because I was losing a lot of energy." Many men, especially young men, may not notice this feeling of depletion at first unless they ejaculate when they are sick or working hard.

In the West, we assume that ejaculation is an inevitable culmination of male arousal and the end of lovemaking. In China, however, doctors long ago saw what the French call *le petit mort* – "the little death" of ejaculation – as an avoidable betrayal of male pleasure and a dangerous depletion of male vitality.

DON JUANS, MONKS, AND MULTI-ORGASMIC WORMS

In a front-page story on December 3, 1992, the *New York Times* reported startling scientific research that seems to confirm the ancient Taoist insight about the toll that sperm production takes on a man's body. "These results are the last thing I had expected when I started doing the experiment," said Wayne Van Voorhies of the University of Arizona. "They were so startling that I did the work over four times to make sure I got it right. They basically say a lot of our preconceived notions [about male sexuality] just do not hold."

Dr. Van Voorhies was studying simple but revealing worms called nematodes. What, you may ask, do worms have to do with your sexuality'. Well, these nematodes are not just your everyday, garden-variety worms. "The genes and biochemical processes nematodes use," explains Dr. Philip Anderson of the University of Wisconsin, "are the same as those that humans and other mammals use." In scientific studies, nematodes are frequently used in place of human subjects.

Dr. Van Voorhies tested three kinds of male worms. The first group of worms was allowed to mate at will, which required frequent sperm production. On average, these Don Juan worms lived only 8.1 days. (Nematodes, in general, don't live very long.) The second group of worms was not allowed to mate at all. These, shall we say, *monastic* worms lived an average of 11.1 days. But even more startling, the third group, the *multi-orgasmic* worms that did not constantly have to produce sperm but were allowed to mate at will, lived close to 14 days – *over 50 percent longer* than the worms that needed to continually produce sperm!

The *Times* concluded: "The new work suggests that ceaseless sperm production takes its toll on a male, perhaps requiring the use of complex enzymes or biochemical processes that have harmful metabolic byproducts." The *Times* goes so far as to suggest that "the difference in life span between men and women just may be linked to sperm production. Women on average live about six years longer than men." There are other theories to explain the disparity in life expectancy between men and women, including differences in lifestyle and in hormones. Whether or not the production of sperm actually shortens your life, it certainly saps your strength.

Over two thousand years ago – long before experiments on nematodes – the Taoists described the importance of not ejaculating in the *Discourse on the Highest Tao Under Heaven:* "If a man has intercourse without spilling his seed, his vital essence is strengthened. If he does this twice, his hearing and vision are made clear. If three times, all his physical illness will disappear. The fourth time he will begin to feel inner peace. The fifth time his blood will circulate powerfully. The sixth time his genitals will gain new prowess. By the seventh his thighs and buttocks will become firm. The eighth time his body will radiate good health. The ninth time his life span will be increased." Ancient texts exaggerate to make their point, and it is unlikely that the above benefits occur in this exact order or at the exact specified time. However, it is clear that Taoists have long known the importance of conserving semen.

PROGENY AND PLEASURE

Looking at the simple arithmetic of sperm production helps explain the reason that ejaculation can be so taxing on your body. An average ejaculation contains 50 to 250 million sperm cells. (Theoretically speaking, if each sperm fertilized an egg, one to five ejaculations could repopulate the United States!) Every single one of those sperm cells is capable of creating half of an entire new human being. Any factory that produces 50 to 250 million products needs raw material, and in this case the raw material is you. Although your body produces a large amount of sperm each day, the value of this sperm should not be underrated. If your body does not need to replenish this sperm, according to the Tao, it is able to use this energy to strengthen your body and your mind. In the Taoist practice, this energy is used to improve your health, creativity, and spiritual growth.

Every time you ejaculate, your body assumes that it is getting ready to create a new life. According to the Tao, all of the organs and glands in your body give their best energy, what is called *orgasmic energy.* In many species, once this energy has been given, once the seed has been lost, the body of the animal starts to deteriorate. Salmon, for example, die soon after they spawn. Anyone who has spent time gardening knows that plants die or become dormant once they give their seed. Plants that are kept from going to seed live longer than those that are not. Though, luckily for us, we do not die after ejaculating, Taoists know that we are part of nature and that we must understand nature's laws.

According to *Sexual Behavior in the Human Male* (popularly known as the Kinsey Report), an average man ejaculates about five thousand times during his lifetime; some men ejaculate many, many more times. During the course of an average man's sex life (and this includes time spent locked in the bathroom), a man ejaculates 1 trillion sperm. Assuming that some of this ejaculation happens with a partner, the chances of his passing on his genetic code are pretty good. Most of the time, however, when we make love – not for progeny, but for pleasure – there is no need to spill our seed and deplete our bodies. So, if you make love only when you want to conceive a child, you will not need to practice Sexual Kung Fu. If, however, you want to have a multi-orgasmic and healthy sex life, read on.

Know Thyself

Exploring your body and understanding your arousal rate are essential to becoming multi-orgasmic. The best lovers are aware of both their own and their partner's desires. In the chapter "Know Your Partner", we discuss how to satisfy your partner's desires, but first you must learn how to satisfy your own. In this chapter, we begin by briefly describing the basic facts about your sexual anatomy, your energy, your arousal, your ejaculation, and your orgasms. Then we offer some ideas for exploring your full potential for pleasure.

Your Body

PENIS

When most men think about their sexuality, they think about their penis. This is a logical place to start, since it is the most obvious part of our sexual anatomy. Strangely, there is still a lot of mystery and misinformation about this seemingly simple organ. To begin with, there are no bones or muscles, you cannot enlarge it like your biceps – sorry. However, two or three inches of the penis is rooted inside the body in the pubococcygeus (pronounced *PEW-bo-cox-uh-GEE-us*) muscle – often just called the PC muscle – and it is possible, as we explain in the next chapter, to strengthen this muscle for stronger erections, stronger orgasms, and better ejaculatory control.

Since many men are concerned with the size of their penis and some are now even having penis-enlargement operations, we should take a moment to discuss the subject. Throughout human history, men have made many attempts to expand their so-called manhood – even the Taoists had their method, which we describe in chapter 8. But the truth is that the size of your erection is much less important than its strength and what you do with it. If you practice Sexual Kung Fu, you will have ample confirmation that your are "man enough" for any woman. If you are still concerned about the size of your penis, take a moment before running out to a plastic surgeon and read the section in chapter 8 called "Please Sir, May I Have Some More: Enlarging Your Penis."

TESTICLES

Most men know that their sperm is produced in their testicles and may also know that normal body temperature is too hot for sperm production. (This is why tight underwear that keeps your testicles close to your body can lower your sperm count.) Your testicles, however, are pulled into the body as they prepare to ejaculate. Pulling the testicles down away from the body, which we describe below, is one age-old technique for postponing ejaculation.

The vas deferens is a firm tube that extends from the testes to the prostate gland (see figure 2). Sperm move through this tube to the upper end, where they mix with secretions from the seminal vesicles and the prostate just before ejaculation. The secretions from the prostate constitute about one-third of your ejaculate and are responsible for its whitish color. The sperm are only a small part of the ejaculate, which is why a man who has had a vasectomy ejaculates about the same amount of fluid as he did before the operation.

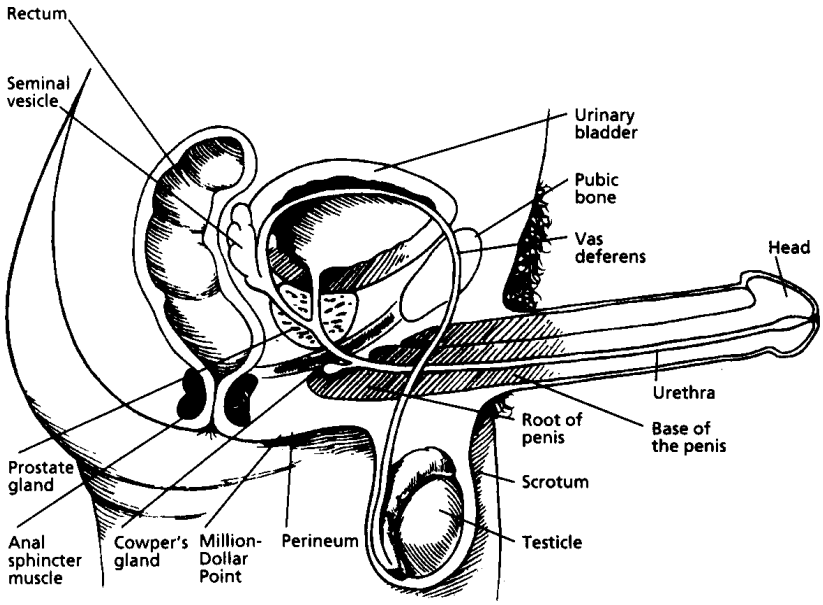

Figure 2 - MAN'S SEXUAL ANATOMY

PROSTATE

The prostate is a gland that lies at the center of your pelvis, just behind the pubic bone, and just above the perineum (pronounced *pear-ah-NEE-um).* Most men have heard about the prostate only in connection with the dreaded and widespread prostate cancer, which occurs in approximately one in eleven American men. A healthy prostate is important for avoiding prostate cancer and for your long-term sexual well-being. You can help keep your prostate healthy and possibly reduce your risk of prostate cancer by doing the pelvic Sexual Kung Fu exercises suggested here and by massaging your prostate regularly. If you have prostate trouble or want to avoid having prostate trouble in the future, see the section called "My What? Preventing and Helping Prostate Problems".

The prostate, like the G spot for women, is often highly sensitive to sexual stimulation. It has in fact been called "the male G spot." The authors of *The G Spot* concluded; "In men there is an orgasm triggered by the penis and one by the prostate." Men report that prostate orgasms are quite different from penile orgasms, emotionally as well physically. The authors of *The G Spot* suggest that this is equivalent to the difference women experience between clitoral and vaginal orgasms.

Like a woman's G spot, the prostate becomes increasingly sensitive to erotic stimulation as the man becomes aroused and approaches orgasm. This is why a prostate checkup at the doctor is quite different from prostate stimulation in bed with your lover. (You and your partner should remember that the body becomes engorged from front to back, so partners should wait until a man is highly aroused before attempting prostate stimulation.)

You can stimulate your prostate externally through your perineum at your Million-Dollar Point (more about this spot later in the chapter) or more directly through your anus. It is not always easy to reach by yourself if you are not very limber. Generally, the best position is lying on your back, either with your knees bent and your feet on the bed, or with your knees against your chest. In this position, you can insert a (well-lubricated) finger, curl it forward, and touch your prostate. You should feel something the size of a walnut an inch or two inside on the anterior (front) wall of your rectum. Gently rub the prostate back and forth. You can also thrust in and out at different speeds, which will also stimulate the highly sensitive nerves around your anus. If your partner is willing, she can do the same, but from a slightly easier angle. (Make sure your or your partner's nails are short.) If either you or your partner is not interested in venturing inside your anus, you can stimulate the anal sphincter and/or the perineum, which will also stimulate the prostate.

When prostate stimulation brings you to ejaculation, the fluid generally comes flowing out instead of spurting out. Keep in mind that this stimulation is very deep and very intense; as a result, it is even more difficult to control your arousal rate with prostate stimulation than it is with genital stimulation. So go slowly, and try not to push yourself over the edge.

PERINEUM

The perineum is an essential sexual landmark and was called 'he Gate of Life and Death" by the Taoists. Its role in preventing ejaculation was a closely guarded secret. On the perineum just in front of the anus is the Million-Dollar Point, named to suggest its value to Sexual Kung Fu (see figure 2). This spot was originally called the Million-Gold-Piece Point (they didn't have dollars back in ancient China), because that is supposedly what it cost you to have a Taoist master teach you its exact location. (The ancient Taoist masters were holy men, but they also had to make a living.) In the next chapter, we discuss the role of the Million-Dollar Point in helping you control your ejaculation.

SEX MUSCLES

The pubococcygeus, or PC muscle, is a group of important pelvic muscles that run from your pubic bone ("pubo") in the front to your tailbone or coccyx ("coccygeus") in the back. These muscles form the basis of your sexual health and are essential for your becoming multi-orgasmic. In the following chapter we will describe exercises to strengthen these muscles.

If you have ever been forced to stay in bed for an extended period of time or to wear a cast, you know how your muscles atrophy and become weak when they are not used. This is equally true of your sex muscles. The penis actually withdraws into the body if it is not used regularly, as many older men who are not sexually active have witnessed. The Taoists knew that it is as important to exercise your sexual organs as any other part of your body.

ANUS

Its proximity to the prostate and its own high concentration of sensitive nerve endings make the anus a highly erogenous zone, as many men – both gay and straight – have discovered. Many people worry about the anus being "dirty" and consider it "unnatural" to stimulate the anus sexually. You should make sure that your anus is clean before you touch it and that you wash anything (such as a finger) that you use for anal stimulation before using it for vaginal stimulation to avoid spreading bacteria. Yet it is difficult to explain why the anus would be so sexually sensitive if stimulating it were "unnatural." Many heterosexual men also worry that they are gay or "will become gay" if they enjoy having their anuses

stimulated, put there is no evidence to suggest a relationship between anal sensitivity and homosexuality. Homosexuality is a sexual orientation, not simply a sexual practice. Many gay men enjoy having their anuses stimulated, but many straight men do as well.

NIPPLES

Many men are surprised to find that their nipples are sensitive. Other men may require some regular stimulation to awaken their nerve endings. Nipple stimulation is one of the underrated and under-explored pleasures of male sexuality.

Your Energy

Understanding how the energy in your body works will allow you to expand genital orgasms into whole-body orgasms and to use your sexual energy to improve your creativity and health. As we mentioned in the introduction, Sexual Kung Fu developed as a branch of Chinese medicine. One of the world's oldest and most effective healing systems, Chinese medicine is responsible for the discovery of such successfully proven therapies as acupuncture and acupressure. According to Chinese medicine, in addition to the physical structures of your body, you also have physical energy that is constantly circulating through every cell of your body.

THE BODY ELECTRIC

As Western chemistry has become more refined, it is now able to demonstrate that our bodies are indeed filled with energy and electric charges. In the February 1984 issue of *Discover* magazine, K. C. Cole explained the comparison: "Electricity is almost certainly the most elusive of everyday things: It lives in the walls of our houses, and regulates the lives of our cells.... It runs electric trains and human brains.... Your entire body is a giant electric machine: body chemistry (like all chemistry) is based on electrical bonds."

Chinese medicine is based on a person's ability to maintain the proper circulation of this bioelectric energy through the body. If you have ever had acupuncture, you have experienced the circulation of this bioelectric energy, which the Chinese call *chi* (pronounced *CHEE),* in your own body. However, if you have not had this opportunity, there is a simple experiment you can do to feel your body's *chi.* Rub your hands together for ten seconds and then hold the palms about an inch apart. If you concentrate, you should be able to feel a flow of energy passing between them.

The idea of *chi* is not unique to China. Dr. John Mann and Larry Short, authors of *The Body of Light,* count forty-nine cultures around the world that have a word for *chi;* the words vary from *prana* in Sanskrit to *neyayoneyah* in Lakota Sioux to *num,* which means "boiling point," in the language of the kalahari !Kung. The West is perhaps unique in its lack of an equivalent term. In the West, we speak about feeling *energized* or having *low energy,* but with a few notable exceptions, we tend to ignore this important part of our physical body.

The concept of *chi* is gaining increasing acceptance in the medical establishment. A major transition occurred when President Richard Nixon reestablished diplomatic relations with China in 1972. In Beijing, Chinese doctors performed emergency surgery on *New York Times* correspondent James Reston, using only acupuncture for anesthesia. Since then many delegations of Western physicians to China have witnessed similar events.

Chi is just beginning to be understood in the terminology of Western science. Currently, several Western physicians are exploring the phenomenon, such as Robert Becker, a Syracuse University orthopedist and author of *The Body Electric,* who is trying to explain *chi* in relation to his work in bioelectricity and healing. It was Dr. Becker's research into electricity and its role in regenerating bones that led to the current method of using low-level electrical currents to stimulate the mending of fractures.

YOUR MICROCOSMIC ORBIT

You have bioelectric energy in every cell of your body. This energy also travels along certain well-defined circuits, called *meridians,* which acupuncture utilizes to regulate the amount of *chi* in any particular part of your body. The main circuit in the body is called the Microcosmic Orbit (see figure 3) and is made up of two channels, the Back Channel and the Front Channel (in Chinese medicine traditionally called the Governor Channel and the Functional Channel, respectively).

These channels are part of our earliest development. In utero, our body first resembles a flat disk. As the embryo develops, the disk folds over, leaving two seams, one along the midline of the back of our body and one along the front. The back seam can be seen in our spine, but the front line is more subtle. We rarely notice the front seam unless it does not close completely, as is the case with a child who is born with a harelip.

One multi-orgasmic man explained his understanding of the Microcosmic Orbit: "I think of the Microcosmic Orbit as a channel or meridian or route that has been discovered and tested over thousands of years to transform the raw biological energy used to create children into a lighter and more refined energy that can be used to improve one's health and one's lovemaking."

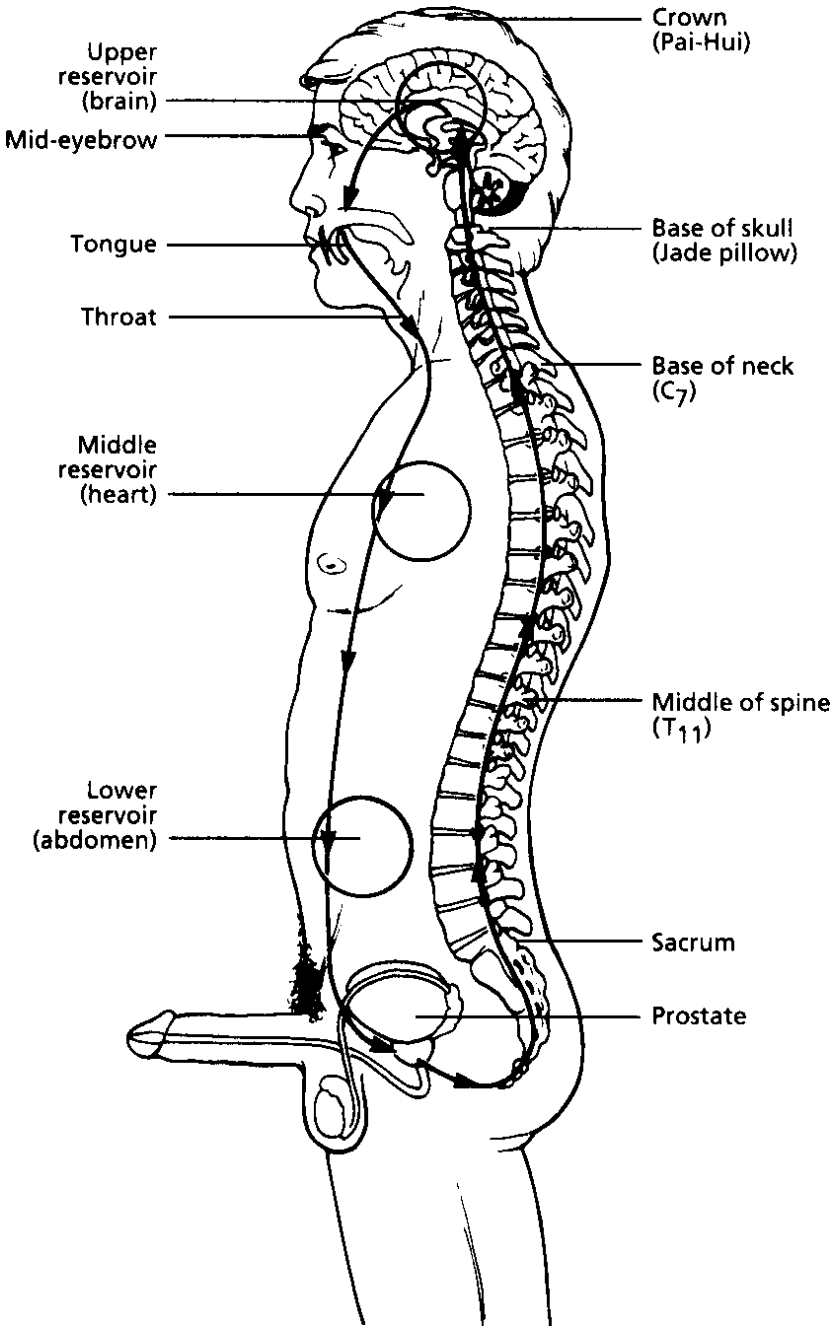

Figure 3 - THE MICROCOSMIC ORBIT

THE BACK CHANNEL

The Back Channel begins at the perineum and runs along the back of the body from the tip of the tailbone, up the spine and neck, to the crown of the head, and finally down the forehead to where it ends between the bottom of the nose and the upper lip, where there is an indentation.

THE FRONT CHANNEL

The Front Channel runs from the tip of your tongue to your throat and along the midline of your body down to your pubis and perineum. Touching your tongue to your palate closes the Microcosmic Orbit. The Front Channel is sometimes translated from the Chinese as the Conception Channel, and if you look very closely at the belly of a woman who is pregnant, you will generally see a dark line (which doctors call the *linea nigra)* that extends along part of this channel.

WHAT DOES ENERGY FEEL LIKE WHEN IT IS MOVING IN YOUR BODY?

The fact is that you already have energy, or *chi,* moving through every part of your body. Without it, you would not be alive. Generally we just are not aware of this current of energy moving through our bodies. When we first become aware of *chi,* we may experience many different sensations. Some of the most common that people report are warmth, tingling, prickling (like the feeling of static electricity), pulsating, humming, bubbling, and buzzing. Some people feel it move slowly, while others feel a fast "rush." Though some people feel it move in a straight line along the Microcosmic Orbit, most people feel it more at some points along the orbit than at others.

HOW DOES *CHI* MOVE?

There is a Taoist saying: "The mind moves and the *chi* follows." Wherever you focus your attention, the *chi* tends to gather and increase. As biofeedback experiments have now confirmed, focusing your attention on an area of the body can cause increased activity in the nerves and muscles in that area. The stronger the focus, the greater the movement of the *chi. Keep in mind that you are not pushing or pulling the* chi, *you are simply shifting your focus to another point.* Understanding this is crucial to developing an effective practice. However, you will not just be moving your attention over your skin, you will be experiencing a palpable flow of warm, tingling energy.

SEXUAL ENERGY

Sexual energy, or *ching-chi* (pronounced *JING-CHEE)* in Chinese, is one of the most obvious and powerful types of bioelectric energy. What we in the West call getting aroused, or getting horny, the Taoists thought of as the generating of sexual energy. Sexual Kung Fu practices are based on cultivating this sexual energy and using it to increase your overall energy and health. You must learn to draw your sexual energy out of your genitals and to circulate it through the rest of your body to truly master the Taoist techniques for experiencing multiple and whole-body orgasms and for improving your health.

As we mentioned in the previous chapter, according to the Taoists all the parts of your body (including the brain, glands, organs, and senses) give their best energy during orgasm to create a new life. This is the power that goes into creating a child, but when procreation is not the goal, the Taoists believe, it is best to conserve this energy and channel it throughout your body for pleasure and health. *Since we are conceived through orgasm and orgasmic energy permeates every cell of our body, to stay healthy and active we need to feel this rejuvenating, orgasmic energy regularly – ideally, every day.*

Once you develop the ability to circulate sexual energy through amour body, you will be able to feel this sensation throughout your body anywhere and at any time. Senior Healing Tao instructor Michael Winn explains: "Sexual energy is available to men twenty-four hours a day, but most men starve themselves because they believe they can satisfy themselves sexually only during a few minutes of intercourse. The most liberating thing for men is to discover that they have total access to and control over their sexual energy at any time." You may be wondering whether all of this sexual energy will result in your feeling constantly aroused and in need of having sex, "an itch that needs to be scratched." On the contrary, men (and women) have sexual urges that need to be acted on or channeled in some way. In the West, we have tried to suppress or sublimate these desires, but according to the Tao this leads to physical and psychological imbalances.

When you practice self-cultivation, this feeling of arousal will result not in uncontrollable sexual urges but in an energetic, calm sense of well-being. One multi-orgasmic man explains the difference: "Before I started practicing Sexual Kung Fu, if I had not ejaculated in a while, my sexual urge would get stronger and stronger. I would look at pornography, look for one-night stands, or go to prostitutes. After ejaculating, this urge would disappear almost instantly and I couldn't understand why I had spent so much time and money trying to satisfy it. I would tell myself that I wouldn't do it next time, but I knew that after a while the sexual urge would return and I would do it all over again. When I finally started practicing Sexual Kung Fu, my sexual energy was still strong, but balanced. It was the first time in my life I was happy to be a man sexually, because I finally had control over my sexual energy."

As you practice, you may have more sexual energy than you are used to, and you will need to learn to channel this excess energy. As one multi-orgasmic man explained, "When I started the practice, all of my relationships became sexualized. I needed to learn to circulate and balance the energy." If this happens to you, the Cool Draw exercise described in the following chapter will help you transform this sexual energy into more neutral and less volatile physical energy, referred to earlier as *chi.* You can also take up Tai-chi or chi-kung (pronounced *CHEE-GUNG)* or other practices to help you ground and channel this additional energy. Exercise in general will help you to manage this additional energy.

Your Arousal

According to Taoism, we need to feel aroused, to feel the life-giving force of sexual energy, every day, because when we feel aroused, our bodies produce more sexual hormones, which in Taoism were considered the fountain of youth. (This need for arousal is why sex sells: we are drawn to images that stimulate this sexual energy and these sexual hormones.) When you learn how to circulate your sexual energy, you can feel this rejuvenating polymer at any time.

BECOMING AWARE OF YOUR AROUSAL

To learn to become multi-orgasmic, you will need to become increasingly aware of the speed at which you get aroused. This sounds pretty straightforward, but most men pay little attention to their arousal rate. Often men go from erection to ejaculation like race cars, without taking the time to notice, let alone enjoy, the sights along the way.

When you start to get sexually aroused, your penis increases in length and width as its spongy tissue fills with blood. As you become erect, valves close down in the veins, stopping the blood from returning to the body. Erection occurs spontaneously in newborn boys and in most men at least several times each night while dreaming.

Almost all men at some time in their lives experience the awkward situation in which they are unable to get an erection with a partner. The occasional inability to gain an erection may be caused by what psychologist Bernie Zilbergeld calls the "wisdom of the penis," telling you that there is something that needs to be addressed in your relationship, or it may simply be a sign that you are distracted by work or other pressures.

If a man repeatedly does not get an erection, he is called *impotent,* a word that also carries the suggestion of being weak and powerless. In Sexual Kung Fu, there is no such thing as "impotence," and by using the solo exercises to strengthen your erections and the Soft Entry technique in lovemaking, you should never have to worry about it again. If you are unable to get an erection when you want or if you want to know what to do when the situation arises (or doesn't), see "Snake Charming: Overcoming Impotence" in chapter 8.

THE STAGES OF ERECTION

Most men believe they are either horny or they're not, that they either have an erection or they don't. When we are young, we get directions so often and so quickly that it is hard to distinguish levels of arousal. The Taoists, however, noticed that there are actually four stages of erection – four *attainments,* as they called them.

The first is *firmness* (also referred to as *lengthening).*
The second is *swelling.*
The third is *hardness.*
The fourth is *heat.*

Your erection is not then just a static appendage, but undergoes a process that reflects your level of arousal. Western physicians have recently confirmed these four stages of erection, although describing them in somewhat more technical terms.

Healing Tao instructor Walter Beckley described the four stages like this: "In the first stage, your penis starts to *move and become erect.* In the second stage, it's *firm, but not bard* – not really hard enough to penetrate (unless you use the Soft Entry technique). In the third stage, it is *erect and hard.* In the fourth stage, it is *stiff and really hot.* This last stage is also when your testicles draw into your body. It is much easier to avoid ejaculating when you can remain in the erect and hard third stage. Pulling the sexual energy up helps keep the penis from getting to the final, stiff and hot stage. Relaxing is also essential, as is trying to be aware of when you move into that anxious, explosive fourth stage when ejaculation is imminent.

THE SECRET OF MALE SEXUALITY

As we mature as lovers, we are able to gain some control of our arousal in an attempt to please our partners. Generally called our *staying power,* this ability is often achieved by learning to distract ourselves from our arousal (thinking about baseball statistics, for example) rather than by learning to sensitize ourselves to it. True ejaculatory control comes from knowing your individual arousal rate, not ignoring it. As you learn to feel your rising pleasure more, it will become easier for you to take the multi-orgasmic path.

BUT ISN'T SEX SUPPOSED TO BE ABOUT RELAXING AND LETTING GO? To experience sexual pleasure, men must certainly relax and let go, but if we relax and let go too much, we ejaculate and then most, if not all, of the pleasure is gone. Knowing when to let go of our sexuality and when to control it is the essence of Sexual Kung Fu, and the secret to male sexuality.

Your Ejaculation

The ejection of semen from your body actually occurs in two parts. In the *contractile* (sometimes called "emission") phase, the prostate contracts and empties semen into the urethra. In the *expulsion* phase, the semen is propelled down the urethra and out the penis. When you become multi-orgasmic you will experience the pleasurable pelvic contractions – what we will call *contractile-phase* orgasm, which is felt as a popping or fluttering sensation in your prostate – without actually ejaculating. Though some men have multiple *ejaculations* during one love-making session (this is easiest for teenage boys), it should be clear by now that this is quite different from multiple – nonejaculatory – orgasms.

As you are becoming highly aroused, a few drops of clear fluid may trickle out of your penis. This preseminal fluid comes from the prostate and other glands, such as the Cowper's glands, which produce an alkaline fluid used to lubricate the urethra and pave the way for the sperm. The Taoists called this liquid *water,* which they distinguished from *milk,* or semen. This fluid is perfectly natural and signals the approach of contractile-phase orgasm. It may, however, have a number of sperm in it. This is the "pre-ejaculate" that they warn you about in sex-education classes, so you will need to make sure that you continue to use birth control even if you don't ejaculate. However, if you have nonejaculatory orgasms, the chances of you and your partner having an unplanned pregnancy are much lower.

WHERE DOES THE SEMEN GO WHEN I DON'T EJACULATE? The semen is broken down and reabsorbed by the body, just as the sperm are reabsorbed in a man who has had a vasectomy. However, the effects of the Taoist techniques on the body are very different from those of a vasectomy. With a vasectomy, the vas deferens is cut just above the testicles and the sperm have nowhere to go. They are eventually reabsorbed, but many men complain about feeling congestion in the testicles and pelvis. If you have had a vasectomy, it is additionally important for you to practice the Testicle Massage exercise (see chapter 8) and to circulate your sexual energy. Both of these techniques help the body absorb the sperm and reduce any feeling of fullness or congestion. The involuntary contractions of the contractile-phase orgasms that you will learn to experience without ejaculation also massage the prostate, which helps to relieve congestion and keep the prostate healthy.

CAN NOT EJACULATING HURT ME? The Taoists have been practicing the techniques given in this book for thousands of years without negative side effects, and in fact with great improvement to their health and longevity. From their study of multi-orgasmic men in the West, Dunn and Trost concur: "None of our subjects has yet developed erectile or ejaculatory difficulties. Our older multiple orgasmic men maintain firm erections after one or more orgasms. In our clinical experience we have not seen men who become sexually dysfunctional following experimentation with multiple orgasms."

FINDING THE WAY

Where Did It Go?

I didn't ejaculate, but I lost my erection. What happened? There is one other thing that can happen to your semen besides its being ejaculated or reabsorbed by your body. Occasionally, as you are practicing the Taoist techniques, you may experience an orgasm without ejaculating but lose your erection. If this is not simply due to a decrease in your arousal, you probably have experienced a *retrograde,* or backward, ejaculation. When this occurs, the semen goes into your bladder and passes harmlessly out of your body the next time you urinate. Since you lose your erection and eventually your sperm (when you urinate), you have not done the practice correctly, but you should also know that you have not done yourself any harm. Hartman and Fithian explain: "What's important to know is that there is no apparent harm to the body when a retrograde ejaculation takes place. All that happens is that if the ejaculation is complete the penis becomes flaccid, as it usually does after ordinary ejaculations." If you lose your erection and are curious, you can urinate into a cup. If it's clouds; you had a retrograde ejaculation. You may not want to do this urine test except when you are practicing by yourself, since it might seem a bit clinical during a candlelit night of lovemaking.

Your Orgasm

The male orgasm lies on the precipice of ejaculation. If you rush forward to experience it, you will fall over the edge and down into the ravine of postejaculatory stupor. Though many men continue to feel pleasure after they have ejaculated, most find themselves at the bottom of their arousal slope, having to climb slowly back up. The five to ten strong ejaculatory contractions are quite pleasurable; otherwise, most men would not see them as the goal of their desire. Ejaculatory orgasm may seem like a thrilling ride, but after you experience the prolonged and ecstatic sexual aerobatics of multiple orgasms, this ejaculatory descent will seem pretty tame and, by comparison, pretty disappointing. "After I have a 'squirt' orgasm," as one multi-orgasmic man described ejaculation, "I feel like I've been on a six-second roller coaster – after standing in line for two hours!"

HOW CAN I EXPERIENCE MULTIPLE ORGASMS? As with any orgasm you have had, you begin by getting sexually aroused, whether from a thought, the sight of your lover, your lover's voice, or your lover's touch. (In the case of adolescent boys, the blowing of the wind can suffice.) This arousal generally leads to an erection, and with increasing stimulation you pass through an excitement phase until you reach your *contractile phase.* The contractile phase is a crucial fork in the road, one direction leading to ejaculation and the other to multiple orgasms (see figure 4).

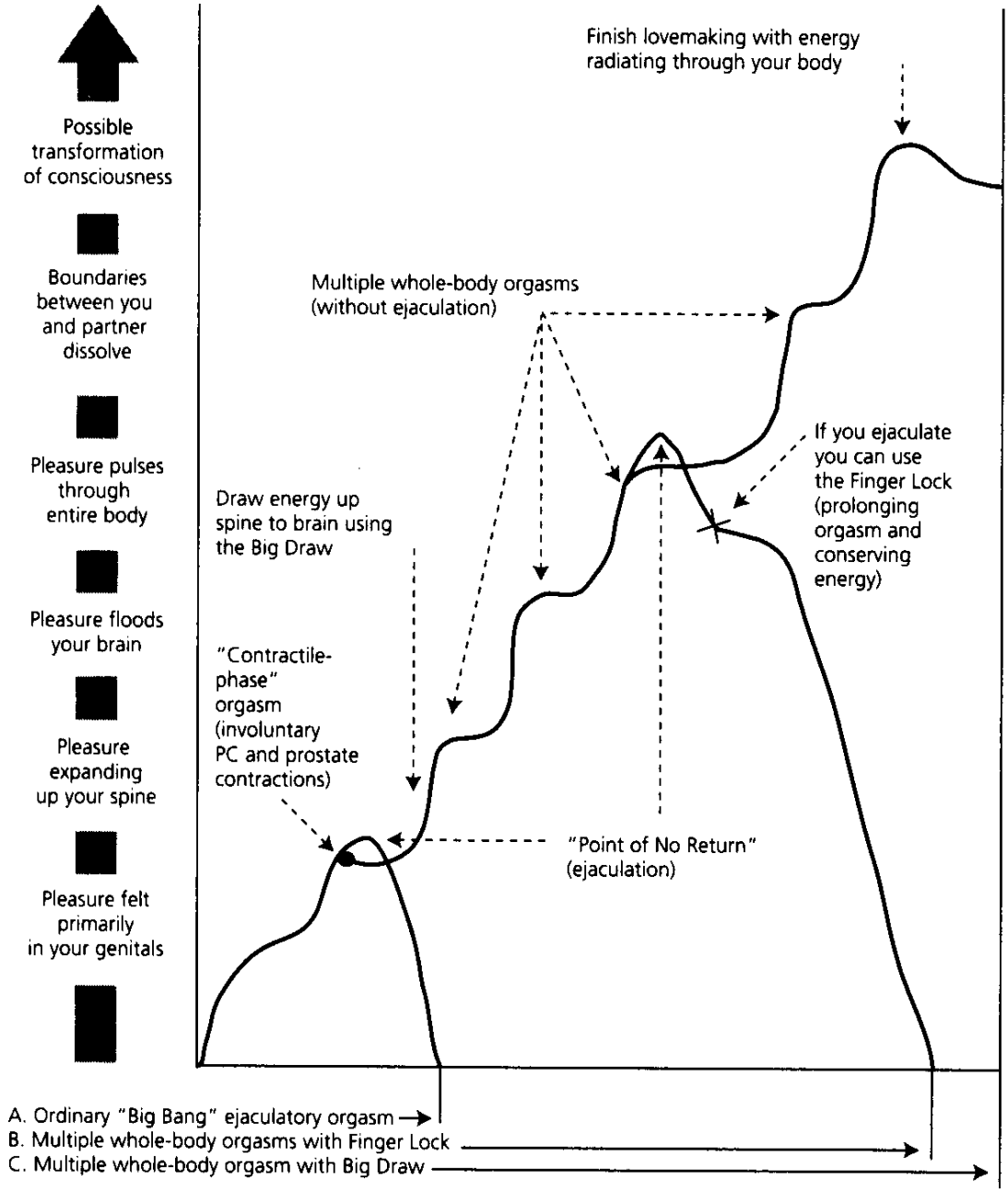

Figure 4 - YOUR ORGASMIC POTENTIAL

Instead of the ordinary "Big Bang" ejaculatory orgasm (A), with Sexual Kung Fu you can draw your sexual energy up during your contractile phase (before ejaculation) and have multiple whole-body orgasms. If you ejaculate, you can use the Finger Lock, which will prolong your orgasm and conserve energy (B). If you avoid ejaculation, you can use the Big Draw to finish lovemaking with energy radiating through your body (C).

During the contractile phase, you will feel a series of prostate contractions lasting three to five seconds. These pleasurable pelvic orgasms are what we have been calling *contractile-phase orgasms.* Though the intensity of these orgasms varies and they can often be as intense as regular ejaculatory orgasms, at first they may be quite mild. Now is the moment of truth. Instead of continuing to the point of no return, past which you must ejaculate, you will stop or otherwise decrease your stimulation momentarily – long enough for you to gain control of your arousal rate.

You can also squeeze your PC muscle around your fluttering prostate, which will help you maintain some control over these spasms. Drawing the energy away from your genitals and up your spine as we describe in the next chapter will help relieve the pressure and the urge to ejaculate. Your level of excitement will decrease slightly in preparation for another genital orgasm. With multiple orgasms, your arousal is like a wave that rises to a peak and then, instead of cresting over and crashing, is swept up by a larger wave and on to an even higher peak.

One important point: if you strive for contractile-phase orgasms, there is a good chance you will crest over into ejaculation. Most men find that they must stop their arousal just before reaching contractile-phase orgasm and let themselves relax into it. Many multi-orgasmic men describe themselves as mentally falling *backward* into nonejaculatory orgasms instead of falling *forward* into ejaculation. The idea is to stay as close as possible to the point of ejaculatory inevitability – reveling in the contractile-phase orgasm – without cresting over into ejaculation. You will feel the pleasure and release of the prostate contractions, the PC contractions, and the anal-sphincter contractions.

How close together you experience these multiple contractile-phase orgasms depends on you. You will experience waves of satisfying pleasure, which, if your partner is multi-orgasmic, will help you harmonize your sexual desire. You will not have to worry about giving your partner "her orgasm(s)" and then getting "your orgasm." Rather, you both have the potential for multiple peaks of orgasmic pleasure.

FINDING THE WAY

Oops!

If you are having difficulty separating your orgasm from your ejaculation, you can begin drawing the sexual energy up your spine before you orgasm. According to the Tao, the real key to whole-body pleasure and healing is the circulation of this sexual energy through the Microcosmic Orbit. Once you start drawing sexual energy up, you may discover that you have "orgasmic" feelings in your brain or in other parts of your body or in your entire body.

Voluntarily squeezing your PC muscle around your prostate will also help you develop sensitivity in your pelvis and control the contractile-phase orgasms that cause your prostate to contract in pleasurable involuntary spasms.

When you do crest over into ejaculation, which you will do many times while you are learning – and even occasionally afterward – don't get frustrated or disappointed. Enjoy the pleasurable contractions of your penis that accompany ejaculation and realize that there is always another opportunity to experience more peaks later. Remember, the practice takes time and intimacy, with yourself and with your partner.

WHAT IS THE DIFFERENCE BETWEEN MULTIPLE ORGASMS AND *WHOLE-BODY* MULTIPLE ORGASMS? Each genital orgasm helps release the tension that results from the built-up sexual energy and the increased flow of blood into your pelvis. Several pelvic – non-ejaculatory – orgasms are extremely satisfying (and energizing), but as you develop your orgasmic capacity, you will no doubt want to expand these pelvic orgasms throughout the rest of your body, which is the real secret of the Tao.

Whole-body multiple orgasms also begin with the contractile-phase release of pelvic orgasms, but instead of keeping the sexual energy (and the pleasure) in your pelvis, you draw your sexual energy up your spine, into your brain, and throughout your entire body, as we will show you step by step in the next chapter.

Most men do not even realize they can reach these sexual peaks. Not only do they experience only one orgasm (which, for them, is the same as ejaculation), but they experience this orgasm almost exclusively in their genitals. In *Everything You Always Wanted to Know About Sex (But Were Afraid to Ask),* Dr. David Reuben describes orgasm as it is typically understood by Western sexologists; "For orgasm to occur, the full force of the body's entire nervous system must be concentrated on the sexual organs. Successful orgasm requires that every microvolt of electrical energy be mobilized and directed toward the penis and clitoris-vagina." Reuben, however, goes no further than a discussion of what the Taoists knew was just the first level of orgasm, or *genital orgasm.*

As represented in the illustration of your orgasmic potential (see figure 4), you can learn not only to experience multiple orgasms, but also to expand your orgasms from your genitals to your brain to your entire body. In the words of one multi-orgasmic man, "A whole-body orgasm is unbelievable. Once you experience it you never go back to a genital orgasm."

WHAT EXACTLY DO WHOLE-BODY ORGASMS FEEL LIKE? Everyone experiences this orgasmic high slightly differently, which makes it difficult to describe in general terms. The experience is often so intense that people resort to mystical language (using phrases like "oneness with the universe") that is difficult to understand if you have not experienced what is being described. However, people frequently have more concrete sensations such as warmth, tingling, vibrating, or pulsating throughout their body. The best way to know what you might feel is through the descriptions of men who have had whole-body multiple orgasms.

One multi-orgasmic man described his first experience of a whole-body orgasm: "We were making love and I thought I was going to come and I started doing my deep breathing, and as I was doing my deep breathing my head started to kind of electrify – to tingle. Like little sparks going on inside, tingly little things that went up the back of my neck a little bit. It started rushing back and forth in my head. And I almost thought I was going to get dizzy – it was so *good*. And I thought, 'If this goes any further, I might just lift off!' It lasted for – it's hard to know what time is like in bed – but at least a minute. It was a *long* orgasm. Just tingling, tingling, tingling. It would go away and then come back. Sly body was ringing like a bell."

Another man described his first experience of a multiple orgasm like this: "It was not localized in my genitals. My whole body started vibrating. And I thought, 'Well, I don't know what is going on here.' And so at first I was a little alarmed, but it felt good, so I just relaxed and let it happen."

Another multi-orgasmic man described his experience this way: "My growing sexual arousal is less active, less hot, less wild than an ejaculatory orgasm. It is more balanced and controlled. As the pleasure and pressure build up, they can flow into the Microcosmic Orbit and through my whole body. The goal is not to shoot the sperm, but to feel this vibrating energy throughout my whole body, to activate love and tenderness, and to expand my spirit. The whole body is much more relaxed, especially at the moment of orgasm."

Finally, one multi-orgasmic man compared the experience to an ejaculatory orgasm like this: "The feeling of the whole-body orgasm is more subtle, complete, satisfying. The whole process is not a feeling of a short explosion but of a longer and slower implosion. I don't feel empty afterward, which is easy to understand because with an explosion something leaves your body, but with an implosion you still have it in you. There remains a deep satisfaction on the physical, emotional, and spiritual levels, which stays sometimes for hours, sometimes for days."

In the West, we have limited our definition of an orgasm to pulsations that take place in our pelvis (prostate) and genitals (penis), but the ancient Taoists understood that an orgasm is any pulsation (contraction and expansion) and can take place in any part of your body. Michael Winn explains: "You can have an orgasmic pulsation in the whole body or in any part of the body. One of your organs can have an orgasm. Your brain can have an orgasm. You wouldn't know you are having an orgasm in your penis or in your prostate unless your brain was having an orgasm, too."

DISCRETE AND CONTINUOUS MULTIPLE ORGASMS

It is important to point out that whole-body orgasms are so intense that it is often hard to know where one ends and another begins. The waves of pleasure that you experience make any attempt to keep score" truly irrelevant. Hartman and Fithian's laboratory research (see chapter 1) suggests that men (and women) can in fact have both *discrete* (separate) multiple orgasms and *continuous* multiple orgasms.

With discrete multiple orgasms, you have a peak orgasmic experience and then the orgasm subsides, but it is then followed by another discrete orgasm. With continuous multiple orgasms, you have a peak orgasmic experience that may grow more or less intense, but you never leave the orgasmic state entirely. Hartman and Fithian recorded these two different types of orgasms by looking at heart rate, which in discrete multiple orgasms would return to its baseline figure (around seventy beats per minute) between orgasms. In continuous multiple orgasms the heart rate reached a number of peaks without returning to the baseline in between (see figure 19, page 98). Finally, these discrete and continuous orgasms can combine to make countless combinations of pleasurable peaks. The possibilities are really endless. It's a far cry from the six-second orgasm most men have learned to settle for as the "normal" male orgasm.

SEX AND SPIRITUALITY

If you are practicing the duo practice (that is, with a partner), you may also feel your sexual energy circulate through her and her sexual energy circulate through you. Eventually you may feel as if the physical boundaries between the two of you dissolve. Many men have experienced this oneness with a partner, or even a feeling of oneness with the universe, during extraordinarily intimate lovemaking. With Sexual Kung Fu, you will learn how to return to this place regularly with your partner and even by yourself. This kind of sexual union with another person and between yourself and the universe can actually result in a transformation of consciousness. It is for this reason that sexuality in the East has often been seen as part of the spiritual path, and not as something opposed to it. (We discuss the connection between sexuality and spirituality more in chapter 5, in the section called "Sexing the Spirit.")

Becoming a Multi-Orgasmic Man

Now that you have a better understanding of your sexuality and its true potential, it is time to become multi-orgasmic. This ability requires developing both your sexual strength and your sexual sensitivity. Most men who practice these exercises will begin to experience multiple orgasms within a week or two and will master the technique within three to six months. Some with strong sexual energy and sexual sensitivity may experience them the first time they try, while others with weaker energy or less sensitivity may take longer than six months to become regularly multi-orgasmic. It also depends on your dedication to the practice. We give you these time frames as an estimate, but the most important thing is not to get discouraged. If you persevere, you will get it.

Breathing Basics

Strange as it may seem, learning to control your ejaculation and to become multiply orgasmic begins with strengthening and deepening your breathing. As is true in all martial arts and meditative practices your breath is the gate through which you can gain control of your body. Breathing is both involuntary and voluntary. In other words, we breathe regularly without thinking about it, but we can also choose to change the rhythm or depth of our breathing. This use of the mind to cultivate the body is the very basis of Sexual Kung Fu.

Your breathing is also related to your heart rate. If you are breathing quickly and shallow, as after running, your heart rate increases. If you are breathing slowly and deeply, your heart rate decreases. Increased heart rate is part of orgasm and breathing quickly is one sign of orgasm's approach. So the first step in controlling your arousal rate and therefore your ejaculation, is deep and slow breathing.

BELLY BREATHING

Most of us breathe very shallowly, generally into our chest and shoulders, which allows only a small amount of oxygen to be absorbed by our lungs. Belly breathing, breathing deeply into the bottom of our lungs is the way a newborn child breathes. If you watch a sleeping newborn, you will see the child's entire belly rise and fall with each breath. Belly breathing allows us to replace stagnant air at the bottom of our lungs with fresh, oxygen-filled air. This is the healthiest way to breathe, but we lose this natural ability as stress and anxiety cause us to cut our breathing short. This anxious breathing is confined to our upper chest. When we are happy and laughing, we are able once again to breathe *into our belly*. In this exercise, you will learn to belly breathe as you did when you were young.

FINDING THE WAY

Inhale Through Your Nose

When practicing any of these exercises, always inhale through your nose, which filters and warms the air. When you inhale through your mouth, you breathe unfiltered unwarmed air, which is harder for your body to assimilate.

EXERCISE 1

BELLY BREATHING

1. Sit on a chair with your back straight and your feet touching the floor about shoulder width apart.
2. Place your hands over your navel and relax your shoulders.
3. Inhale through your nose and feel your lower abdomen expand at the navel area (below and around it) so that it bulges outward. Your diaphragm will also descend (see figure 5).
4. Keeping your chest relaxed, exhale with some force to pull the lower abdomen back in, as if you were pulling your navel back toward your spine. Also feel your penis and testicles pull up.
5. Repeat steps 3 and 4 eighteen to thirty-six times.

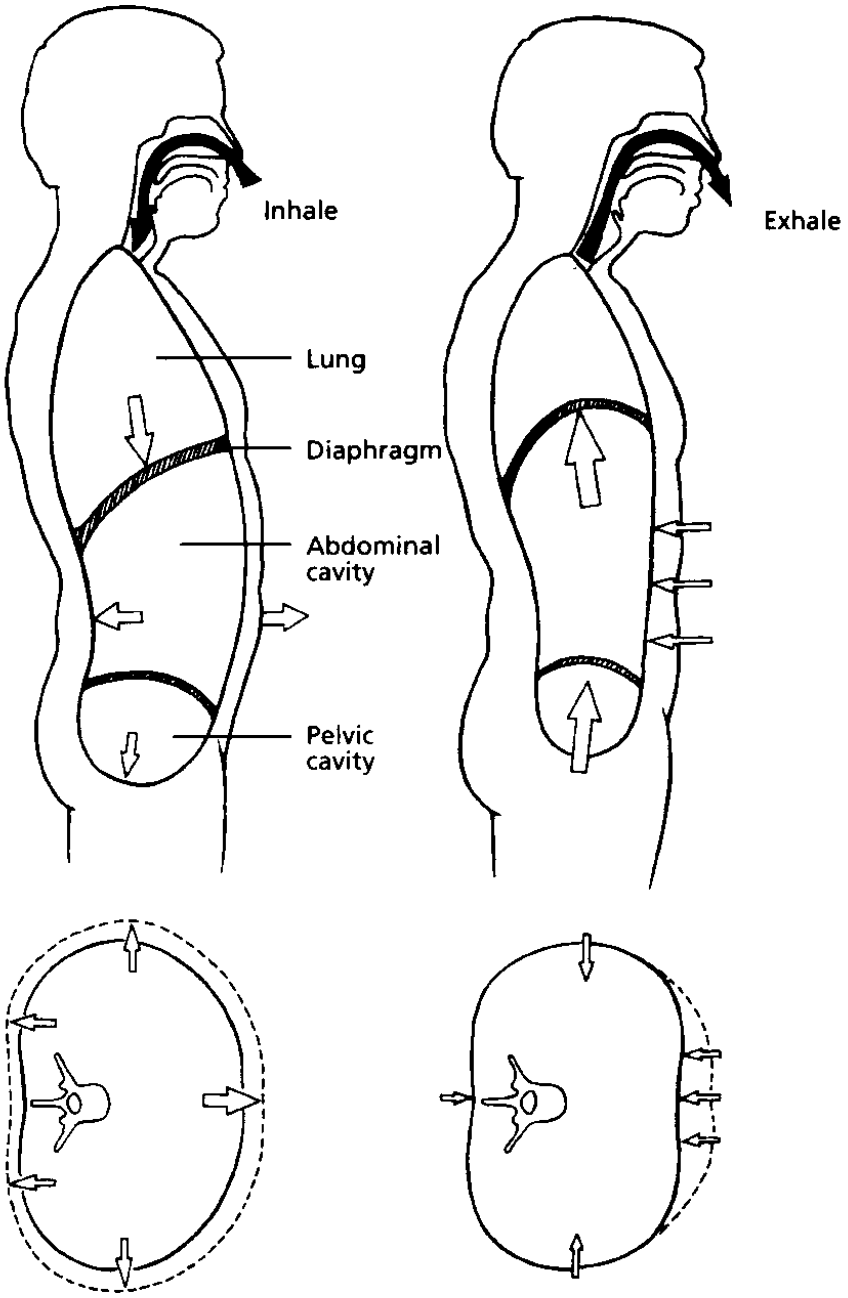

Figure 5 - BELLY BREATHING

A few minutes of belly breathing each day will teach your body to breathe deeply on its own, even when you are asleep. When you are in the heat of passion, this ability to control your breathing will be essential to stopping yourself from ejaculating and to expanding the feeling of orgasm throughout your whole body.

Once you learn not to ejaculate, it is very important to do this deep-breathing exercise or eventually just to breathe deeply on your own. It will help circulate your sexual energy through your body and absorb it into your organs. Belly breathing also massages the organs and prostate and can relieve the full feeling many men experience when they first stop ejaculating.

Although it is not as important to exhale through your nose as it is to inhale, it is still preferable. Some people, however, find it easier to exhale through their mouth when breathing deeply. See what works best for you.

FINDING THE WAY

Belly Laughing

If you are having a hard time with belly breathing, as many Westerners do, you can practice belly *laughing* instead. A belly laugh is the kind of laugh that makes your whole abdomen shake. It is not the fake salesman's laugh; it is the genuine laugh you have with your close friends. It is the kind of laugh that can make your stomach ache, since most of us do not use these muscles very often.

To belly laugh, sit in a chair with your back straight and your feet on the floor about shoulder width apart. Place your hands over your belly and start to laugh (from your belly). Feel your stomach vibrate. This belly laughing will help relax your diaphragm and let you breathe from your belly. It also will help you generate a lot of energy, which you will later learn to circulate through your body for better orgasms and better health.

EXERCISE 2

CENTURY COUNT

1. Slowly inhale (expanding your belly) and exhale (flattening your belly). Count each complete inhalation and exhalation as one breath.
2. Continue breathing from the belly and counting from one to one hundred, thinking only about your breathing.
3. If you notice that your mind has strayed, start again.
4. Practice this exercise twice a day until you can count to one hundred with ease.

Increasing Your Concentration

This exercise builds on the belly breathing you just learned and will help you improve your concentration. In this exercise you count one hundred breaths without letting your mind wander. (A complete inhalation and exhalation is one breath.) This is very simple, but not easy. Most people have difficulty counting to ten, let alone one hundred, without letting their mind wander. One multi-orgasmic man explained his practice: "I go the gym and I'll sit in the sauna and count my breath in and out as one, in and out as two, all the way to one hundred. Sometimes I'll be breathing and counting and suddenly around fifty or sixty I realize I'm thinking about stocks or something and I can't remember what number I'm at, so I go back to one and I just start counting again until I get to one hundred."

Strengthening Your Sex Muscles

Now it is time to develop your sexual strength. The pubococcygeus muscle, or PC muscle is the muscular sling that stretches from the pubic bone in the front to the tailbone in the back (see figure 6). Most men feel their PC muscle at their perineum, just behind their testicles and in front of their anus. This is the muscle you use to stop yourself from urinating when you can't find a toilet. The PC muscle is also responsible for the rhythmic contractions in your pelvis and anus during orgasm. In *The G Spot*, Ladas, Whipple, and Perry describe the importance of the PC muscle: "If men increase the strength of their pubococcygeus muscle, they too can learn to become multiply orgasmic and separate between orgasm and ejaculation." Your orgasm builds from your prostate, so learning how to squeeze on the prostate with your pelvic muscles is essential. In addition to having more and better orgasms, you will by this squeezing prevent hardening and swelling of the prostate and help avoid or heal prostate problems.

The PC muscle (which surrounds the prostate gland) serves as a valve around the genitals that you will learn to open and close. You can feel this muscle working when you are trying to push out those last few drops urine. Women feel it most when they are trying to push out a baby. Women who have developed strong PC muscles can hold a man's penis in their vagina more tightly, increasing sensation for both partners.

The PC muscle is also what allows animals to way their tails. Strangely, the word *penis* literally means "tail" in Latin. So what you are going to do with these exercises is learn to "wag your tail" to strengthen your erections, intensify your orgasms, and separate your orgasms from ejaculation.

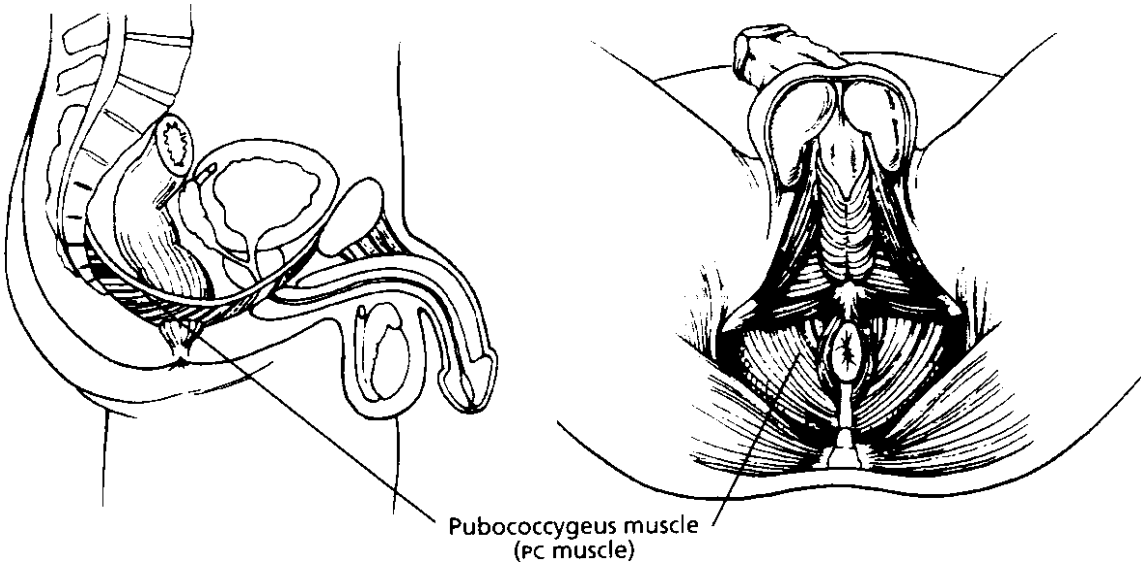

Figure 6 - THE PC MUSCLE

EXERCISE 3

STOPPING THE STREAM

1. When you are about to urinate, stand on your toes and the balls of your feet. If necessary, you can use the wall for support.
2. Inhale deeply.
3. Exhale slowly, forcefully push out the urine while pulling up on your perineum and clenching your teeth.
4. Inhale and contract your PC muscle to stop the flow or urine midstream.
5. Exhale and start urinating again.
6. Repeat steps 4 and 5 three to six times or until you have finished urinating.

Stopping the Stream

The easist way to find your PC muscle is to stop the flow of urine by clamping down the muscles in your pelvis that next time you are going to the bathroom. Stopping yourself from peeing was one of the first acts of control you learned to have over your body. Using your ability to control your urine flow can now help you control your ejaculation, because the urinary duct, the ejaculatory duct, and the seminal-vesicle duct all pass through the prostate. (This is why when a man's prostate is enlarged, he has problems urinating and ejaculating.)

FINDING THE WAY

Emptying Your Bladder

Because the bladder and the prostate are so close, you should also urinate before self-pleasuring or lovemaking whenever your bladder feels full. A full bladder will make you feel like you need to ejaculate and can actually make it more difficult for you to stop yourself from ejaculating.

If you have a strong PC muscle, you should be able to stop the flow or urine midstream and then start it again. If this is difficult for you, your PC muscle is weak. Stopping the flow of urine may sting at first. This is perfectly normal and should stop within a few weeks, unless for some reason you have an infection, in which case you should wait until you have seen a doctor and cleared it up before continuing with the practice. If your muscle becomes sore, you just need practice. Pulling up on your perineum as you push out the urine will help you urinate with more force and will help strengthen your kidneys, prostate gland, and bladder in addition to your PC muscle.

Although standing on your toes and clenching your teeth will help intensify your practice, *the most important part of the practice is simply to stop and start urinating as many times as you can*. Once multi-orgasmic man described his "peeing practice" this way: "Whenever I go to the bathroom now, I tray to stop and go at least three times. And if I am in a fun mood and I am not in a rush, I will try to just stop, go, stop, go, sometimes maybe five or six or seven times."

PC PULL-UPS

The importance of the PC muscle was discovered in the West during the 1940s by Arnold Kegel, a gynecologist. He developed the famous Kegel (pronounced *KAY-gul*) exercises, which help many pregnant women control their bladders and which can ease childbirth. Women found that these exercises could also increase their sexual desire, intensify their orgasms, and help them become multi-orgasmic. Strengthening this muscle is equally important for a man's pelvic health and sexual pleasure.

There are many different exercises for strengthening your PC muscle that have been taught in the West, most of them adaptations of Kegel's original technique. All of them teach you to contract and relax the muscle, although the number of repetitions and the amount of time suggested for holding the contractions vary. The following exercise is based on the Taoist awareness that the circular muscles of the body (including the muscles around the eyes, mouth, perineum, and anus) are connected. By squeezing the muscles around your eyes and mouth, you can increase the force of your PC Pull-Ups. It is easiest to begin practicing this exercise while sitting, but later on you can do this exercise while standing or lying down.

EXERCISE 4

PC PULL-UPS

1. Inhale and concentrate on your prostate, perineum, and anus.
2. As you exhale, contract your PC muscle around your prostate and around your anus while at the same time contracting the muscles around your eyes and mouth.
3. Inhale and relax, releasing your PC, eye, and mouth muscles.
4. Repeat steps 2 and 3, contracting your muscles as you exhale and releasing them as you inhale, nine to thirty-six times.

Although contracting your eyes and your lips will help you squeeze your PC muscle around your prostate and anus, *the most important part of the practice is simply contracting and releasing your PC muscle as often as you can*, which you can do practically anywhere - while driving, while watching TV, while sending a fax, while in a boring meeting. You can see how many contractions you can do during a red light, or you can hold a single contraction until the light turns green.

Try to do the exercise at least two or three times a day, although you can do it as many times as you like. Your muscles may get sore, just as they do after doing regular pull-ups. Don't push yourself too far; increase the number and frequency gradually. Consistency is more important the quantity. One way to help develop a daily routine is to connect your practice to daily events, like getting up in the morning, taking a shower, or lying in bed at night.

According to the authors of *The G Spot*, a man with a healthy PC muscle should be able to raise and lower a towel on his erect penis by contracting this muscle. (In the more advanced Taoist practice, you can even learn to use weights to strengthen your pelvic muscles.) For now, you may want to try raising and lowering a towel, but you probably should avoid having an audience. As the authors of *The G Spot* correctly point out, "'performance anxiety' is the archenemy of male erection."

Self-Pleasuring and Self-Cultivation

Next, you need to cultivate your sexual sensitivity. The easiest way to develop this awareness is through self-pleasuring. Unfortunately, most of us in the West did not grow up with an understanding of sex and sexual energy as natural and essential parts of our overall health. From the first time you started touching your "privates," your parents may have subtly, or not so subtly, told you to keep your hands out of your pants. Though this probably did not stop you from

locking yourself in your bedroom or in the bathroom, you probably have some guilt and embarrassment about masturbating. You are not alone.

Christianity's ambivalence toward sex, especially sex that is not procreative, still influences Western society and sexual mores. For example, in 1994 Dr. Joycelyn Elders, the U.S. surgeon general, was forced to resign for stating publicly that masturbation "is a part of human sexuality." Therefore, it is worth mentioning that Christianity's prohibition of masturbation, which at one time was called *onanism*, is based on a misreading of the biblical story of Onan. Onan was punished for refusing to impregnate the wife of his dead brother, as was the custom at the time. His "sin" had nothing to do with masturbation.

PLAYING WITH YOURSELF

Taoist sexuality was developed as a branch of medicine, not morality. It therefore does not prohibit any form of human sexual activity but simply tries to teach people how to stay healthy while engaging in it. The Taoist masters saw masturbation, which they called *solo cultivation* or *genital exercise*, as an essential way of developing ejaculatory control and of learning to circulate sexual energy to revitalize the body. (Remember, solo cultivation, which we will refer to as both *self-cultivation* and *self-pleasuring*, does not include ejaculation.)

According to the Tao, play is one of the best ways to learn, and "playing with ourselves" is an excellent way to strengthen our genitals and our sexual energy. Many people worry about masturbating "too much," but the Taoists knew that there is no such thing, as long as one learns to control ejaculation. Too much ejaculation is the problem: it drains men of their strength, but this can happen with intercourse as well as self-pleasuring.

According to Kinsey and more recent surveys, almost all boys and most men masturbate. Prohibiting or discouraging a natural part of child sexuality turns boys into sexual thieves, forcing them to steal their pleasure. It is quite possible that most men ejaculate so quickly because they grew up trying to "get off" before they "got caught." Dr. Wardell Pomeroy, in his book *Boys and Sex*, explains that since almost all boys masturbate, they should learn to do so slowly and for extended periods of time so that they will be able to make love longer when they eventually become sexually active.

The Taoists would add that boys should learn to pleasure themselves without ejaculating. Young boys or teenagers who ejaculate too much can find that their energy and motivation for other activities decreases significantly. When one of the authors was growing up in Thailand, he sat next to a boy in school who had repeated the fourth grade four times. The boy masturbated each day in class four or five times and ejaculated into a bottle. Obviously, his was an extreme case, but according to Taoism, his failure in school was quite understandable. He was literally draining himself and his brain. The expression "screwing your brains out" is an accurate description of the stupor that occurs after repeated ejaculation.

Many men (and women) who are married or in relationships continue to pleasure themselves. In 1972, the American Medical Association advised physicians in a book entitled *Human Sexuality*, "Masturbation is practiced by men and women of all ages, often as a supplement to marital coitus, and women tend to masturbate more as they grow older." (Estimates suggest that about 70 percent of married men and married women pleasure themselves.) Self-pleasuring does not take the place of sex with a partner, but it can serve as a valuable complement. A recent national sex study sponsored by the University of Chicago found that people who are having sex regularly with a partner actually pleasure themselves *more* than people who are not.

Pleasuring yourself can help relieve built-up tension when you need a sexual release more than intimacy. It also can help when your partnet is tired, distracted, or does not have the same sexual appetite. If for whatever reason you feel that you just can't pleasure yourself, you can learn to become multi-orgasmic with your partner instead. It may take a little longer, that's all. You can do the exercises you have already learned: Belly Breathing, Century Count, Stopping the Stream, and PC Pull-Ups.

Pleasureing ourselves is not something we are taught to do. Considering the outcry that occurred when Surgeon General Elders suggested that masturbation "perhaps should be taught," it is unlikely that it will be introduced into the curriculum anytime soon. Most of us learn how to masturbate in a hurry, by ourselves, or with orther, equally inexperienced boys. None of these circumstances are conducive to developing real sensitivity or much skill, so we offer a few pointers.

EXPERIENCE YOUR OWN PLEASURE. If you choose to use pornography or erotica to get aroused, try, once you are aroused, to shift your focus to the sensations in your body. Pornography, though it can increase your sexual energy, is also distracting and can make it difficult for you to focus on your own sensations as you approach orgasm. Many men learn to self-pleasure with pornography, and although this is not the place to discuss the pros and cons of the First Amendment or the sex industry, it is important to recognize that pornography succeeds when it takes you away from yourself. In this practice you need to go inward and experience your own pleasure, not someone else's idea of pleasure.

STIMULATE YOUR ENTIRE PENIS. It is important to try to stimulate your entire penis. Most men focus primarily on the head of their penis, which is the most erogenous part. However, according to Chinese medicine, the different parts of the penis correspond to different parts of the body (see figure 7). To avoid overstimulating one part of your body, try to rub your entire penis, the shaft as well as the head.

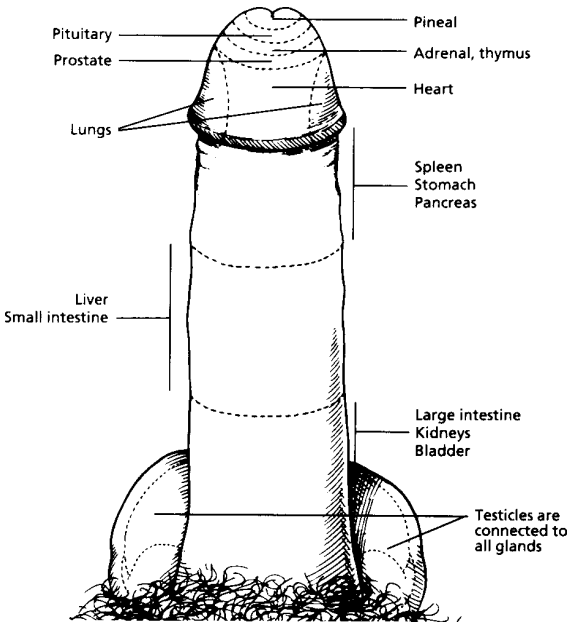

Figure 7 - PENIS REFLEXOLOGY

TOUCH YOUR BALLS. If touching your scrotum is not part of your regular routine, you may want to try it. The testicles can be especially sensitive to light touch, although many men also enjoy pulling on their scrotum. Rubbing your testicles actually increases production of testosterone, which adds to your potency both by raising your sperm count and by improving your overall health. In the next section we describe the Scrotal Tug, which can help delay ejaculation, but for now you should learn to touch your scrotum just for pleasure.

EXPLORE THE MILLION-DOLLAR POINT. As you masturbate, you should explore your perineum and the Million-Dollar Point (just in front of your anus). Pushing on this spot when you are about to ejaculate can help stop the ejaculatory reflex, but again, for now you are just exploring it for its pleasure. Pushing on this spot can squeeze more blood into your penis, which will make it throb pleasurably. Strong rhythmic pressure here also imitates the prostate contractions that accompany contractile-phase orgasm.

The Million-Dollar Point is best stimulated after you have an erection and are highly aroused, since once again the body gets aroused and swells from front to back. If you do not feel any sensation or it feels uncomfortable, stop until you are more fully aroused. If you don't warm to this point as a place of sexual stimulation, you can return to focusing on your penis and scrotum.

TAKE TIME. It is important to take as much time as you have to enjoy and learn to prolong ejaculation. "In our work with over a thousand cases," Hartman and Fithian report, "we've found that if a man can learn to go for fifteen to twenty minutes during masturbation or pleasuring, he can go as long as he wants to during intercourse. That period (fifteen to twenty minutes) seems to be critical. Once you've passed it, you have control. It's that simple."

This may seem like a long time, and it is, especially if you have been used to two- or three-minute masturbatory quickies. One multi-orgasmic man explained the difference: "When I used to play with myself, I would jack off in three to five minutes just to release tension or because I was bored or whatever. Self-cultivation is different. I try to play with myself as long as I can and not come. After a while, I could play with myself for twenty minutes." Once you become multi-orgasmic, you will be able to peak many times (without ejaculating) during these twenty or so minutes and you will be able to circulate rejuvenating, healing energy through your body. As another multi-orgasmic man described self-cultivation, "It's somewhere between masturbation and meditation."

The last thing we want to do is make pleasuring yourself mechanical or turn it into a burden, and as with lovemaking there is no one right amount of time or number of orgasms. Both depend on the situation, your free time, and your level of arousal. If you start to feel bored, ask yourself what is causing the boredom. Are you falling back into old patterns? Is you touch becoming mechanical? Are you focusing too much on your genitals? Are you distracted?

Sensitizing our bodies and pampering ourselves is not something we generally consider very manly, but pleasure is just as manly as pain and a lot more fun. It will help your practice to begin by taking a hot bath (maybe with a little soothing sesame or olive oil) and even massaging your body. Lowering the lights and lighting a candle can help you focus. You can also sit in front of a mirror (with or without a candle) and notice what your body looks like. Try to find its sensuality.

Touch and feel your hands and arms, your feet (if you can reach them), calves, and thighs. Touch your chest and even your nipples. When you pleasure yourself, try massaging your thighs and stomach before you zero in on your genitals.

CULTIVATE LOVE. While most men do self pleasure (feeling guilty or not), few are really able to do it lovingly, to cultivate love—make love to themselves—while they are doing it. Cultivating self-love is essential to being a loving partner. Sexual energy simply magnifies the energy in your body, positive and negative. If you are feeling love, love will be increased by your sexual desire. If it's hate you're feeling, then hate will be increased. It is essential that you understand the way sexual energy amplifies your emotions for both your solo and your duo practice. Cultivating your sexual energy into loving-kindness will also help you not to ejaculate, it is much more difficult to maintain control when you are feeling anger or impatience.

In Taoist sexuality you cannot separate your genitals from your heart because the sexual energy circulates throughout your entire body. As one multi-orgasmic man explained, "I used to actually want to keep sex and emotions separate, but as I practiced Taoist sexuality, my genitals became more connected to my heart and I discovered real, profound love for my partner and even other people."

The Taoists have a simple exercise for connecting your heart and your genitals (love and sex). Try it if you find that your are feeling irritable, frustrated, or distracted when you start being sexual with yourself or your partner; put your right hand on your groin and your left hand on your heart, connecting sexual energy with love. If you often feel anger, hatred, or other negative emotions, you must transform these feelings before cultivating your sexual energy. The Inner Smile and the Sex Healing Sounds—techniques described in Mantak Chia's *Taoist Ways to Transform Stress into Vitality* can help, as can psychological counseling.

Self-love, which is quite different from egotism or narcissism, is the basis for any solo or duo practice. In *The G Spot*, the authors caution that they have not written a book about love. Our book is also not about love; it is primarily about sex. But the Taoists knew that if you are to stay healthy you can never really separate the two.

Now try a self-pleasuring exercise that will help you expand your sensual focus and extend pleasure to your entire body. In the next section, you will learn more demanding exercises for controlling your arousal and becoming multi-orgasmic. But they are based on your being highly aware of your pleasure, so we begin here is self-pleasuring.

If you are able to experience the involuntary PC contractions that occur at contractile-phase orgasm without ejaculating, you have already taken the right road to becoming a multi-orgasmic man. If you actually have two of these mini-orgasms, you already are! These will not be earth-shattering orgasms at first, but eventually they will spread throughout your body. For now just enjoy the shivering feeling of these mini-orgasms. One multi-orgasmic man described his experience: "Just as I am about to reach the point of ejaculation, I stop and relax and breathe. It's almost as if I asm letting myself go or fall back into a non-ejaculatory orgasm. Sometimes it feels like a pleasurable twitch in my prostate. Other times I can feel it throughout my whole genitals and it's as intense—more intense than an ejaculatory orgasm. My wife often can't tell whether I have ejaculated or not until I tell her."

If you have not yet started to feel the contractile-phase orgasm, and if the pressure in your pelvis feels uncomfortable, you can try the Pelvic Massage exercise described later or you can just ejaculate. Drawing the sexual energy away from your pelvis and massaging your pelvis will help decrease the pressure that all men feel when they begin. Also, if you crest over accidentally, don't give yourself a hard time. You are just beginning to learn the practice and to gain control of your arousal rate.

EXERCISE 5

SELF-PLEASURING

1. Start by lubricating your penis. Lubricant will increase your sensations. Oil is generally better than lotion, which dries up more quickly.

2. Pleasure yourself however you like, remembering to massage and stimulate your entire penis, your scrotum, and your perineum, including the Million-Dollar Point.

3. Try to notice your increasing levels of arousal: notice the tingling at the root of your penis, notice the stages of erection, notice your heartbeat rise.

4. When you are getting near ejaculation, stop and rest. Try to notice the contraction of your PC muscle and anus that occurs at contractile-phase orgasm, although don't be surprised if it takes some time to experience this without ejaculating. You can also try to squeeze your PC muscle around your prostate if the prostate starts contracting and you are afraid you might fall over the edge.

5. After you regain control, you can start again as many times as you like and continue for as long as you like.

Learning to Control Ejaculation

Now that you have started learning how to control your breath and your sex muscles, you are ready to learn some specific techniques for controlling ejaculation when you are highly aroused. The more you practice the exercises you've learned so far, the easier it will be to practice the ones given later and stop yourself from going pas the "point of no return."

STOPPING

First, and most important, you need to stay aware of your arousal rate and *stop a few strokes* (or thrusts, if you're with your partner) before you think you will ejaculate. Many sexologists call this *the stop/start technique,* but it is just common sense. Better to stop too soon than too late. In the beginning, you will probably need to stop stimulating yourself for ten or twenty seconds to allow the urge to ejaculate to subside.

BREATHING

The deep breathing we described earlier is extremely important in controlling your arousal rate and in delaying ejaculation when you are highly aroused. One technique that has proved especially effective is to breathe in deeply and hold your breath for several moments until the urge to ejaculate subsides. Some multi-orgasmic men, however, breathe rapidly to delay ejaculation. (This quick, shallow breathing is call *the breath of fire* in the yoga tradition.) Deep, slow breathing helps control your sexual energy, whereas shallow, rapid breathing helps disperse the energy. You can experiment and see what works for you.

CONTRACTING THE PC MUSCLE

As already mentioned, the PC muscle surrounds the prostate, through which your semen must pass during the expulsion phase of orgasm. By learning to squeeze your prostate during contractile-phase orgasm (when it is contracting involuntarily), you can help yourself avoid moving from contraction to expulsion. (Between contraction and expulsion lies the infamous "point of no return.") One multi-orgasmic man described his experience: "I hold back the ejaculation simply by contracting the PC muscle at precisely the right time. It took quite some time to master this process, but the results are definitely worth the effort."

SQUEEZING THE PENIS

Many sexologists recommend squeezing the penis, a technique that was originally developed for men who ejaculate "prematurely."

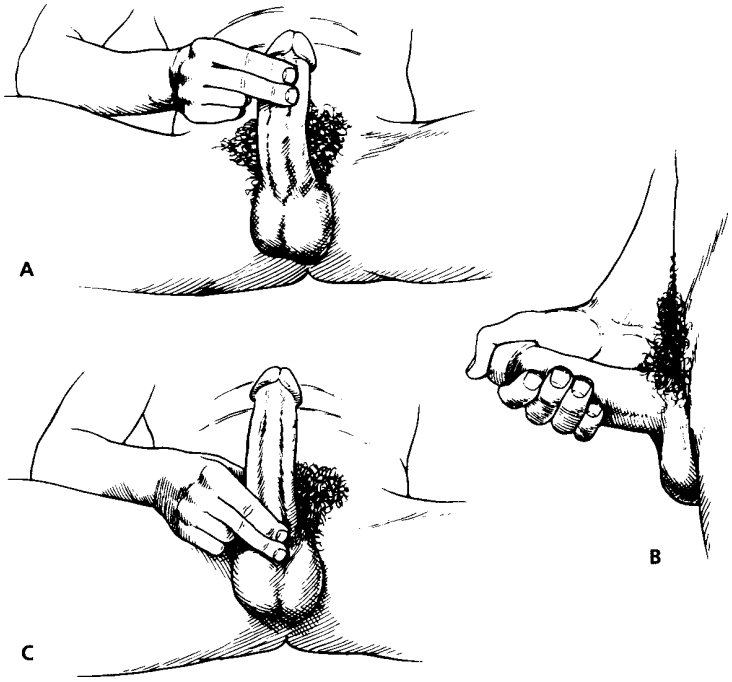

Figure 8 - DELAYING EJACULATION WITH THE SQUEEZING METHOD

It is simple. Just place the first two fingers of either hand on the underside of your penis, place your thumb on the top, and squeeze (see figure 8a). Some men also find that gripping their penis like the handlebar of a bicycle and pressing down on the tip or underside with their thumb helps them reduce their arousal (see figure 8b). Although these techniques can be effective in solo practice, they are awkward when having intercourse because your must withdraw. To prepare for this situation, you can try using your mind to help squeeze the tip of your penis. Eventually, you will be able to squeeze the tip of your penis with just your mind and will avoid the clumsiness of having to use your hands. Another good technique is squeezing at the base of your penis (remembering to also squeeze with your mind). This will help you control your arousal and will also expand and strengthen your erections (see figure 8c).

PRESSING THE MILLION-DOLLAR POINT

One of the oldest Taoist techniques is pressing the Million-Dollar Point while contracting your PC muscle. This helps delay ejaculation both by focusing your attention and by interrupting the ejaculatory reflex. It is simple and effective. First locate your Million-Dollar Point, which is just in front of your anus. There should be an indentation when you push at the correct spot. You will need to push your finger in up to your first joint. One multi-orgasmic man described his experience: "Pressing on the Million-Dollar Point for a while decreases my erection slightly and the danger of ejaculating greatly." You will also be able to use this technique during intercourse without withdrawing.

SCROTAL TUGGING

Since your testicles have to pull up close to the body in order to propel the semen out of the testes, pulling them away from your body can delay ejaculation. Circle the top of your sac with your thumb and forefinger (see figure 9). Pull down firmly.

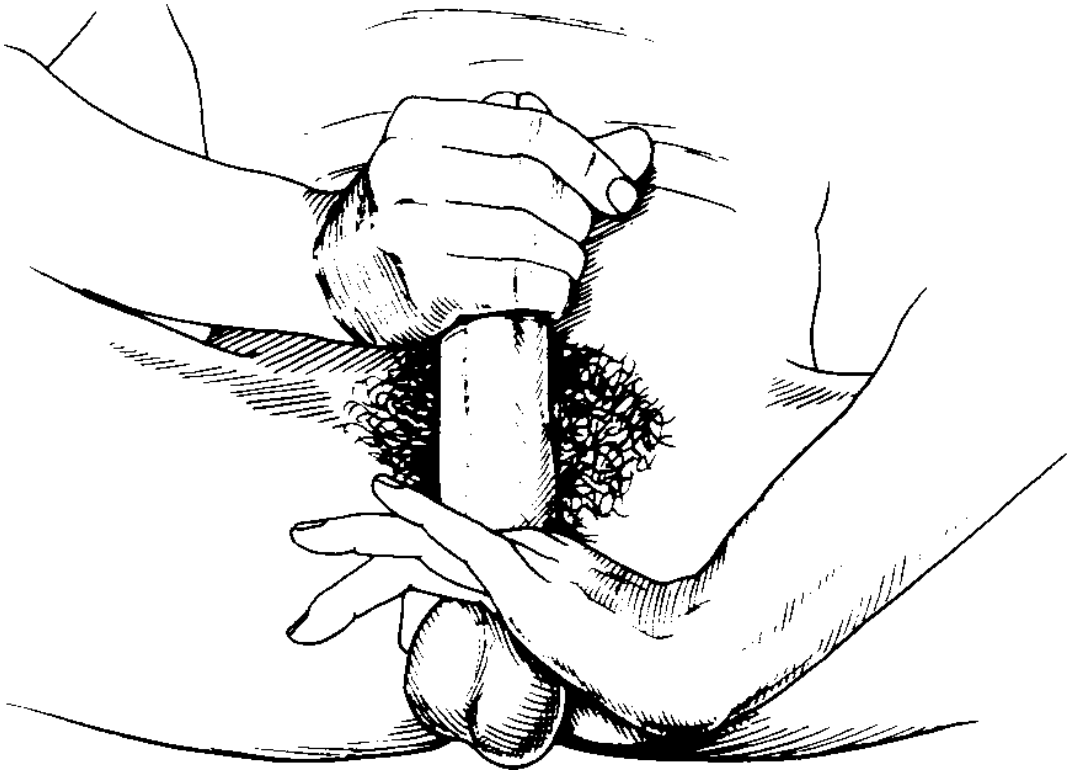

Figure 9 - SCROTAL TUG

DRAWING AWAY SEXUAL ENERGY

More than any mechanical technique, the secret to stopping yourself from ejaculating is learning to pump your sexual energy away from your genitals and up through your spine to the rest of your body. If the sexual energy continues to build up in your groin, it will eventually be too great to control and will shoot out in the most direct way it can, through your penis. However, if you draw this energy away, it will be much easier to stop yourself from ejaculating. This is also the secret to learning how be have whole-body orgasms. In the next section we will give step-by-step instructions to show you how to circulate your sexual energy through your body. In the meantime, simply imagine drawing your sexual

energy out of your penis, past your perineum, and up your spine. Contracting your perineum will help pump the energy up and will prepare you for the Big Draw exercise we describe later.

EXERCISE 6

SEPARATING ORGASM FROM EJACULATION

1. Start by lubricating your penis, as you did in the Self-Pleasuring exercise.
2. Before focusing on your genitals, remember to touch and massage the rest of your body, especially your belly, thighs, and nipples.
3. Self-pleasure however you like, remembering to stimulate your entire penis, your scrotum, and your perineum.
4. Pay close attention to your arousal rate. Once again, try to notice your increasing levels of arousal; notice the tingling at the root of your penis, notice the stages of erection, notice your breathing change and your heartbeat rise.
5. As you feel yourself getting close to the point of no return, stop, breathe, and lightly contract your PC muscle around your prostate. In addition, you also can delay your ejaculation by pressing on the Million-Dollar Point, by using the scrotal tug, by pressing on the tip of your penis. You can experiment and see which of these techniques works best for you. Most important of all, however, is paying close attention to your arousal and stopping in time, at least a few strokes before the point of no return.
6. If you feel that your sexual energy is getting too wild and difficult to control, try to draw this energy up your spine with your mine, and squeeze and release your PC muscle several times. If you are still feeling too hot and out of control, stop for ten or twenty seconds and focus on deep breathing.
7. Try to notice the contraction of your PC muscle and anus that occurs at contractile-phase orgasm.
8. After you have peaked several times without ejaculating, stop. You will feel peaceful and/or energized afterward. Try to notice your sexual energy circulating in your body, which you will feel as a tingling, itching, or prickling.

In exercise 6, you will use these techniques to help cool you down as you start to get highly aroused. Again, you will try to experience the pleasurable involuntary pumping of the prostate and anus (contractile-phase orgasms) without ejaculating. One multi-orgasmic man described how he is able to orgasm without ejaculating: "I do a number or things. [1] Variation seems to help, not doing the same over and over again, varying the depth of the thrust when I am making love, or suing different strokes when it's just me and my hand. [2] Slowing down when I feel close to the edge. [3] Deep-breathing exercises. And [4] moving the accumulated *chi* up my spine and *through* the Microcosmic Orbit."

Whatever techniques you use to heat yourself up and cool yourself down, *the most important parts of the practice are breathing, squeezing your PC muscle, and learning to relax into a non-ejaculatory orgasm.*

FINDING THE WAY

Pelvic Pressure

Pressure in your pelvic area is a natural result of the increased blood and *chi* that have been pumped to the area and your increased sexual energy. If the pressure feels uncomfortable, go on and ejaculate or use deep breathing, PC Pull-Ups, and perineum massage (which we describe later in the section called "The Finger Lock") to relieve the tension. As you learn to feel your prostate pulsate and draw your sexual energy up, you will be far less likely to experience pressure in your genitals (often called *blue balls*). One multi-orgasmic man described his experience: "When I stop, my penis will often stay hard for a couple more minutes, but I am not tense or uncomfortable. I don't get blue balls, because I do deep breathing and draw the energy up. I just feel relaxed."

Learning to Control Your Sexual Energy

In the next section you are going to learn the Cool Draw, the Taoist technique for drawing your sexual energy out of your testicles and circulating it through the body *before* you get hot and bothered. In the following section, you will learn the Big Draw, which you can do once you are already hot and bothered. However, it is much easier for you to work with your sexual energy when it is still "cool," and we therefore strongly encourage you to learn this exercise before attempting the Big Draw. If you learn to do the Cool Draw successfully, you will rarely need to use the Big Draw. The earlier you are able

to draw the sexual energy away from your genitals, the easier it will be for you to multiply and experience whole-body orgasms and, eventually, use your sexual energy for health and healing.

When you're being sexual with yourself or a partner, the Cool Draw will allow you to decrease the urge to ejaculate. When you are feeling sexual but are not interested in being sexual or not able to be, the Cool Draw will allow you to relieve the sexual "pressure" of arousal and transform this energy into greater creativity and vitality. Michael Winn explains: "I have taught this technique to thousands of Western men and found that it is the quickest and safest way for men to relieve feelings of sexual frustration and horniness as well as to increase the flow of creative energy to their heart and brain. This technique lets a man cultivate his sexual energy anytime and anyplace, standing in line at the bank, sitting in his office, or even when he wakes up in the middle of the night from a sexual dream with an erection."

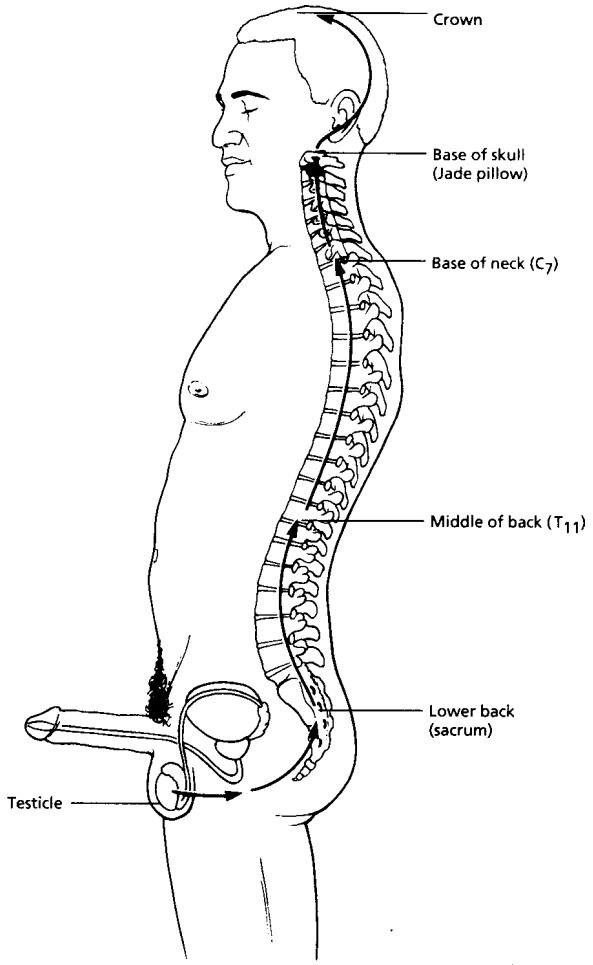

Figure 10 - DRAWING ENERGY UP TO THE CROWN OF YOUR HEAD

The Cool Draw

The Cool Draw is also called *testicle breathing*, because the technique causes your testicles to rise and fall as if they were breathing. In actual fact, you are using your mind and muscles to raise and lower your testicles and to draw sexual energy out of your genitals and up to your brain. For Taoists, non-ejaculatory orgasm allows men not only to avoid the loss of semen (and the hormones, proteins, minerals, vitamins, and amino acids it contains), but also to avoid losing the bioelectric energy (the *ching-chi*) generated by the sperm. Your testicles are the factories of your sexual hormones and sexual energy, and it is from here that you draw the energy up your spine to your brain (see figure 10). This will allow you to decrease the sexual energy in your genitals and eventually to draw a refreshing, revitalizing wave of energy up your spine, stimulating all the nerves of the body along the way. You will be able to feel this orgasmic wave of pleasure at any time without even having to be sexually aroused. That could certainly make your day, maybe even your week, your month, or your life!

EXERCISE 7

THE COOL DRAW

1. *Touch or cup your testicles* with one hand to warm them up until you feel a slight tingling or the first stirring of your sexual energy. (If you are in a public place, you can simply think a sexual thought or fantasy.)

2. *Inhale and gently pull up* on the muscles around the testicles, the perineum, and the anus. As you inhale and pull your muscles up, imagine the you are sipping this sexual energy and drawing it from your testicles to your perineum and on to your anus and tailbone.

3. *Exhale and relax* your muscles, but keep your attention on your rising sexual energy.

4. *Continue to inhale and pull up and then exhale and relax* several more times until you can feel a warm or tingling sensation at your perineum. Once your are able to move this sexual energy, you can simply begin using the spine like a straw, sipping the energy from your testicles and perineum right up the entire length of your spine to the base of your skull. (Gently tucking your chin in will help the energy move from your spine into your head.) Do this for five to ten minutes or until you become aware of a light or tingling feeling in your head. With your mind, try to circle the energy in your head.

5. *Finally, touch your tongue to the roof of your mouth* half and inch behind your front teeth where the palate curves down (see figure 11). Your tongue works like a light switch that connects your font and back channels, allowing the energy to flow down the front of your body to your navel.

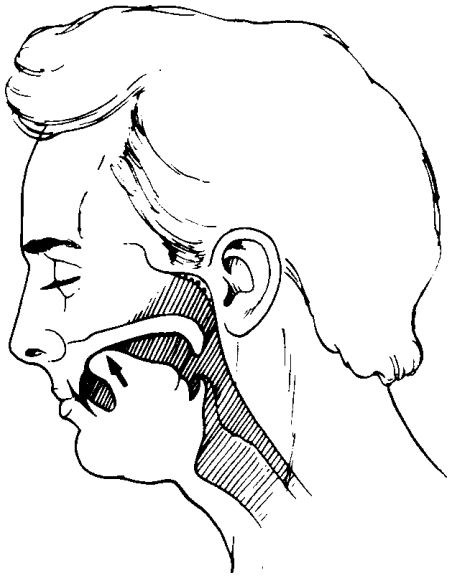

Figure 11 - TOUCHING YOUR TONGUE TO YOUR PALETE

DRAWING YOUR ENERGY UP

Learning to circulate this energy may take some time, so don't get discouraged, especially if you have not had much experience with meditation or other internal arts. You also may find that you feel the energy at certain points along your spine but not at others. As long as you feel the energy reach your brain, you will know that you have successfully performed the exercise.

You may be surprised to find that you are able to move this energy almost immediately. As we mentioned earlier, much will depend on your sexual strength and sensitivity. One multi-orgasmic man explained his experience: "Ever since I was a teenager I have had really intense sexual energy, which has led to a lot of sexual frustration. I thought you had to be some yogi living in a cave for thirty years before you could learn to control your sexual energy. After I learned this simple exercise, I was astounded to discover that within ten minutes I was experiencing tingling in my spine and head. Within a couple of months I was able to control my continual horniness and to eliminate the feelings of frustration I had felt for so many years."

FINDING THE WAY

Loosening Up

If your back or pelvis is tight, it will be difficult for you to draw sexual energy up through your spine. It is important for you to loosen up your pelvic area, spinal column, and neck. Imagine that you are sitting on a galloping horse, and rock your pelvis back and forth, letting your chin bob up and down. Your spinal cord should rock like a wave.

DRAWING YOUR ENERGY DOWN

In addition to drawing sexual energy from the genitals up to the brain along the Back Channel, it is also essential for you to bring the energy down along the Front Channel to your belly, where it can be safely stored. This is much more difficult for men than drawing the energy up. Michael Winn explains: "A lot of men find it is easy to bring energy up their spine. There is a connection between the balls and the brain. Some even discover this pathway naturally, but most men have a harder time bringing the energy down the front where their organs are and where they unconsciously hold a lot of their emotional energy. Women who do the practice usually have an easier time drawing the energy down the front and may have more difficulty drawing it up the spine. In a few cases I have encountered men who find it easier to draw the sexual energy up the Front Channel, in which case I recommend that they simply circulate in the reverse direction."

Although each step helps move the energy up, *contracting your anus is the most important part of the practice because it is this squeezing action that literally pumps the energy up your spine.* Eventually, you will be able to rely on your mind and a quick squeeze of your anus alone to bring the energy to your head.

At first you will be working on drawing the energy up to your head, which will help you experience a "brain" or whole-body orgasm and feel energized. However, it is equally important that you draw the energy down to your navel to keep yourself balanced and to allow your body to store the energy for later use (see figure 12). The Taoists knew the truth of the expression "What goes up must come down."

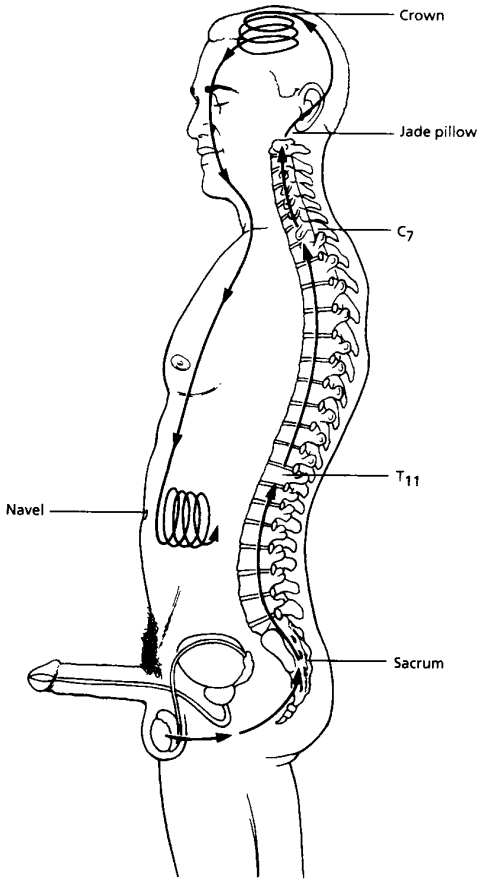

Figure 12 - BRINGING ENERGY DOWN TO YOUR NAVEL

Westerners often joke about yogis who sit and contemplate their navels. Most people think the navel is simply the vestigial scar of the umbilical cord, but the navel is in fact our physical and energetic center. The navel was our first connection with the outside world; all oxygen, blood, and nutrients flowed into our fetal body through this abdominal gateway. There is an energetic reservoir at your navel where you can safely store the energy you have generated through your practice. The body can then "digest" this energy as it is needed. Also, if you are not able to raise the sexual energy all the way to the head first, you can raise it up along your spine to your abdomen and channel it directly into this reservoir at your navel. With a little practice you should be able to draw the energy all the way up very soon.

FINDING THE WAY

What You Might Experience

I DON'T FEEL MY SEXUAL ENERGY

Unaroused sexual energy is easy to draw up and easy for your body to digest because it is not too hot. However, if you cannot feel enough sexual energy by simply touching your testicles or thinking a sexual thought, you can stimulate your genitals more directly.

I CAN'T RAISE THE ENERGY UP MY SPINE

If you are having problems drawing the energy up your spine, you can help the energy rise by using your spine's natural pumps. Your cerebrospinal fluid bathes the brain and spine. Pumps at your sacrum (the back of your pelvis) and the base of your skull help this fluid circulate and can also help you draw energy up your spine (see figure 13). These pumps, which are utilized by osteopathic physicians today, were well known to the ancient Taoists several thousand years ago. You can do the following exercise standing or sitting.

1. Activate your sacral pump by squeezing your anus up toward the tailbone and rocking your pelvis back and forth.

2. Activate your cranial pump (at the base of your skull) by drawing your chin in and up and then back out in a soft gentle circle. Keep the jaw and neck muscles relaxed.

3. After activating the sacral and cranial pumps, rest and begin drawing the energy up your spine into your brain. Looking up with your eyes toward the top of your head will also help direct the energy up to the crown of your head. Repeatedly activate these pumps until you feel the energy move up.

I CAN'T BRING THE ENERGY DOWN

As we mentioned earlier, many men and some women have difficulty bringing the energy down. With your hands you can stroke the Front Channel along the midline of your body from your forehead down your throat and chest and to your belly. You can also try "swallowing" the energy using your saliva. (If this doesn't work, you may have a blockage in your Front Channel. See "Finding the Way: Opening Blocks in Your Front Channel.")

1. Swirl your tongue around your mouth, which will activate your salivary glands.

2. Once you have a large pool of saliva, draw the sexual energy now in your brain into the saliva by focusing on the saliva. (Remember, the energy follows your mind.)

3. Swallow this pool of saliva in one gulp and follow it with your mind as it flows down your esophagus and into your stomach. Repeat this swallowing and imagine the energy collecting in a pool at your stomach.

4. Finally, with both hands stroke the front of your body from your throat straight down to your belly.

Most people today carry around a great deal of physical and emotional tension. As you are trying to circulate energy, you may notice tightness or congestion in your back or chest. Men in particular are prone to holding in their emotions, which often can lead to energetic blockages in the Front Channel, along which emotions are stored, that is, in your heart, solar plexus, stomach, and intestines. It is essential that you open these blockages before attempting the Big Draw. (If you are still having a problem bringing the energy down, even after opening any blocks in your Front Channel, try the powerful Venting exercise described in the next section.)

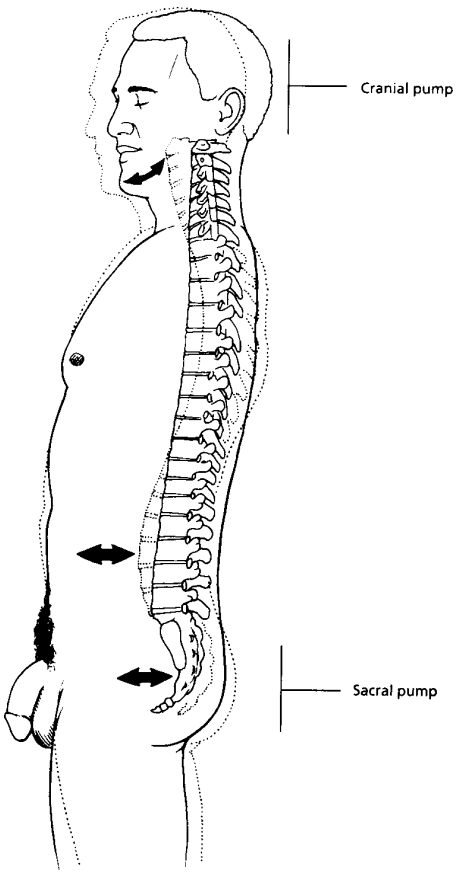

Figure 13 - SACRAL AND CRAINAL PUMPS

Help the energy rise up your spine by rocking your sacrum and drawing your chin in and up.

FINDING THE WAY

Opening Blocks in Your Front Channel

If you are having difficulty drawing the energy down and suspect you might have a blockage, try the following:

1. Put your left hand on your belly and put your right hand at the base of your throat just above your heart center.

2. Imagine as you inhale that you are drawing energy up the Front Channel to your right hand and from there up your throat to the top of your tongue.

3. As you exhale, imagine your are reversing the flow so it descends back down past your heart to your belly. This will help open any energy blocks in your Front Channel.

The Big Draw

Now that you have learned to circulate your sexual energy when it is not too aroused, you need to learn how to circulate and control this energy when it *is* aroused. Here the energy will be hotter, more explosive, and harder to keep from shooting out your penis. However, before attempting the Big Draw, you must make sure you are able to circulate your energy as described in the last exercise. Stopping aroused sexual energy is like trying to stop a team of horses who are speeding toward a cliff. Before you attempt this with the Big Draw, your must make sure you know how to ride, which is what the Cool Draw exercise teaches you.

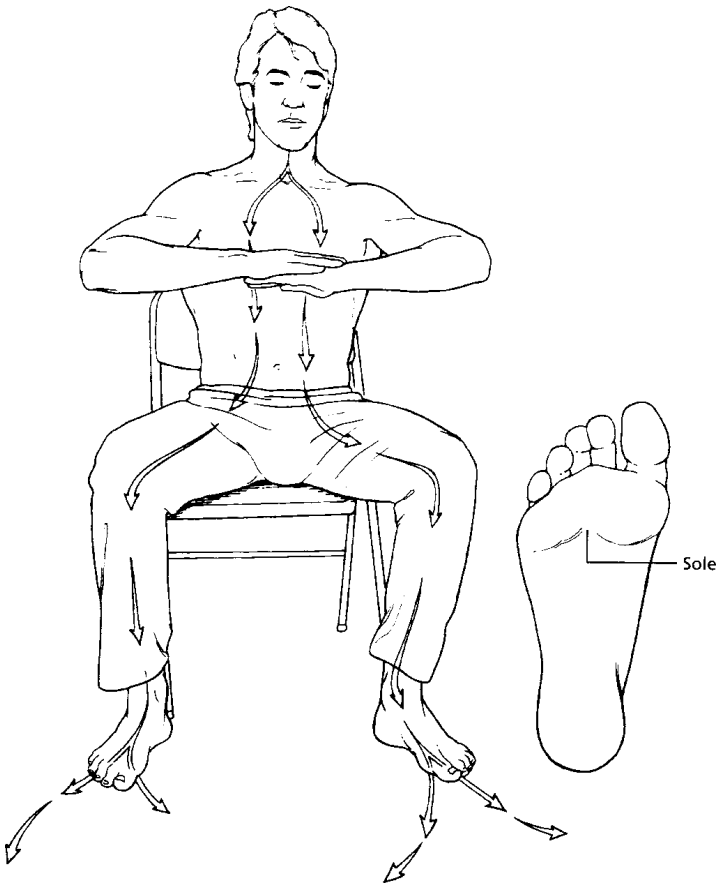

Figure 14 - BRINGING ENERGY DOWN TO YOUR FEET AND TOES

Ejaculation is simply an involuntary muscle spasm, which you are learning to make voluntary so that you can choose if and when you want to ejaculate. Michael Winn explains how the Big Draw works: "Ejaculation can happen only if there is enough energy in the local nerves and enough blood in the local muscles to trigger the muscle spasm. There's nothing mystical about the Big Draw technique for stopping the ejaculatory spasm. You squeeze the PC muscles around the sperm ducts and then progressively pump the big muscles in the buttocks (and, if necessary, the foot, fist, and jaw muscles). These big muscles draw the blood away from the genitals. At the same time, you draw the energy away from the genital nerves by shifting your mental focus into a wave of nerve sensations traveling up your spine into your brain. The combination of these actions simply removes the blood and energy the genital muscles need in order to involuntarily spasm. It is as simple as that. All the squeezing and clenching is a bit crude, but it works. If any man practices properly and regularly, eventually he'll get it. I have hundreds of students who have proved this."

When you begin learning the Big Draw, you will need to use the various techniques described in this section. Eventually, when doing the Big Draw you will be able to use just your mind and maybe a quick squeeze of your PC muscle. According to one multi-orgasmic man, "In the beginning, I had to contract my muscles, especially the perineum and the anus, while concentrating on drawing the energy up with my mind. How the energy moves up almost by itself."

FINDING THE WAY

Cautions

The Big Draw is a very powerful practice, and you need to make sure you follow a few safety tips.

NEVER LEAVE SEXUAL ENERGY IN THE BRAIN FOR LONG PERIODS OF TIME

Remember to touch your tongue to your palate to allow this energy to come down through the Front Channel to the navel, where it can be safely stored. In the past, many teachers of Eastern sexuality taught students how to draw energy up to their brain without teaching them how to bring it back down again. This resulted in what has been call *the Kundalini syndrome.* The Taoists knew the

importance of completing the circle. Anytime you feel like you have too much energy, inhale to your abdomen, and as your exhale, bring the energy all the way down to your toes and the soles of your feet (see figure 14).

MAKE SURE YOU ARE FEELING BALANCED

Remember that the sexual energy you will be circulating through your body will amplify any emotions you are feeling. Michael Winn explains: "The most important thing is to first try to clear out your emotional extremes and avoid practicing when your are feeling extreme anger or extreme anything." You should also avoid practicing if you are too tired. If you have a medical condition, you should speak with a Healing Tao instructor before you begin this practice.

TAKE IT EASY

Although it may not seem very important, your attitude toward the practice is in fact essential. As Healing Tao instructor Walter Beckley explains, "A lot of men to into the practice gung ho, which is good, but they need to be careful not to jam the energy up their spine or they can hurt themselves. Your attitude needs to be playful and joyful. You need to be soft with your body. It is better for you to lose the energy, to ejaculate, than to try to force the energy up your spine."

PREPARE YOURSELF

Practice on an empty, but not hungry, stomach whenever possible. Always wait at least one hour after eating. The body needs energy to digest the food you have just eaten, which means there will be less energy for you to circulate. Also, wear loose clothes. Although there should be a gentle flow of clean air in the room, avoid drafts or wind. And remember to always breathe through your nose.

POSITION YOURSELF

In the beginning, do not lie on your back during these exercises, since the rising energy may stick in your chest and cause pain. At first, sit, stand, or lie on your side. If you lie on your side, always do so on your right side. (Lying on the left side puts too much strain on your heart.) Once you master these exercises, you can do them in any position. Also, never place any objects (such as a pillow) under you while lying on your right side, since this will bend the channel of energy and can cause back pain.

WARNING

If you have an active herpes sore, do not do this practice until you have healed. If you have herpes but in is in remission (that is, if you have no visible sore), you can do this practice.

At first you will use your big muscles to help draw the energy upward. Soon you will use these muscles less and learn to rely more on your PC muscle. Eventually you will be able to concentrate your attention at the top of your head and draw the energy up effortlessly. It may take you some time to learn to do this, but eventually you will be able to direct an invigorating streak of energy up your spine just by thinking about it.

Once you have mastered the Big Draw, you will be able to draw the energy up in any situation: while you are walking, standing inline, driving your car, or lying in bed. In the beginning, however choose a quiet time when you will not be interrupted so that you can concentrate on directing this subtle and life-giving flow of energy through your body.

Do not be concerned if you feel little effect after the first few days or even weeks of practice. Each person needs a different amount of time to learn to circulate energy in the body. If you have practiced other mental exercises such as meditation, yoga, or martial arts, you will find it easier to do these exercises. If this is your first attempt at the internal arts, don't get frustrated. It takes time to learn concentration. Though this may seem difficult, you will be amazed at how quickly you begin to notice the energy moving in your body. Since the energy flows along natural circuits, the energy guides your mind even as your mind guides the energy. And as we mentioned earlier, you will soon be able to forget about most of the steps in the exercise and just guide the energy up with your mind. But, as with driving a car, before you can forget the individual steps, you must learn them.

Pumping energy up your spine through the Big Draw works on the same principle as a water pump. By pumping your muscles, you are creating the pressure and suctions to draw the energy up, but it is while you are relaxing that the energy will be easiest to guide up your spine. During the resting periods, your mind should stay focused on the flow of energy.

EXERCISE 8

THE BIG DRAW

1. Stand and pleasure yourself until you have a strong erection but well before you reach the point of no return (thirty seconds to a minute before you would otherwise ejaculate).

2. Stop stimulating yourself and rest for a moment to regain control. Then simultaneously contract your PC muscle firmly *around your prostate gland* and clamp your toes down on the floor.

3. Inhale and draw your sexual energy away from the perineum toward your anus and spine by squeezing your buttocks tightly.

4. As if you were pumping the brakes on a car, contract in waves the muscles from your anus up your spine, each time taking a short inhalation. Rocking your spine back and forth as if you were riding a horse will also help the energy to move up the spine.

5. As the energy reaches the base of your skull, make sure your shin is tucked in gently to help the energy move from the spine into your head.

6. Roll your eyes up as if you were looking at the top of your head, which will help bring the energy all the way up to the crown of your head.

7. When you have pumped the energy up to the crown of your head, you have done one Big Draw. The state of your erection is a measure of how successfully you have been doing the Big Draw: as you draw the energy out of your genitals and up your spine, your erection should decrease.

8. Repeat steps 3 through 6 eight more times.

9. After you have pumped the energy up to the crown of your head nine times, use your mind, your eyes, and all your senses to spiral this creative sexual energy in your brain nine, eighteen, or thirty-six times, first in one direction, and then the other. When you have finished spiraling, rest for a while and experience the sensational feeling of energy in your brain, often felt as warmth and tingling, like a mini-orgasm.

10. When you feel that your brain is full, touch your tongue to your palate and let the energy flow down the Front Channel from your brain first to between your eyebrows, then to your nose, throat, heart, and solar plexus, and finally to your navel, where it can be stored.

It is best to practice in the morning or afternoon, since at night the increased energy you will have after doing the Big Draw may make it difficult for you to sleep. If this happens or if you find you have too much "nervous" energy, simply touch your tongue to your palate (which will connect the Back and Front Channels) and draw the energy down from your head to your navel, where it can be stored. You can also spiral the energy in your head, as we mentioned earlier, and use the techniques you learned in the Cool Draw. If the problem of increased energy still persists, you can use the Venting exercise described later.

FINDING THE WAY

What You Might Experience

I DON'T FEEL ANYTHING

We have suggested that you do the Big Draw when your sexual energy is not too aroused. The hotter it is, the more difficult it is to control and the more likely you are to ejaculate, losing the energy you are trying to draw up. However, if you do not feel enough sexual energy, arouse yourself 95 to 99 percent of the way to orgasm. Once you are able to orgasm without ejaculating, you can arouse yourself all the way to orgasm and still draw the energy up to your brain. When you are about to orgasm or are orgasming, stop, and practice the Big Draw three to nine times, or until the orgasmic feeling moves upward.

EXERCISE 9

VENTING

1. Lie down on your back. Elevate your knees with a pillow if you feel any pain in the small of your back or lumbar area.

2. Place your hands in front of your mouth so that the tips of your fingers touch and so that your palms are facing toward your feet.

3. Close your eyes and take a deep breath. Feel your stomach and chest expand gently.

4. Smile and exhale quietly, making the sound *heeeeee*. As you are exhaling, push your hands towards your feet and image that your body is a hollow tube that you are emptying with your hands.

5. Repeat this sound and movement three, six, or nine times, each time imagining that you are pushing this excess energy from your head, past your heart and belly, though your legs, and out your feet. You can also try the exercise while standing or sitting. If you are still having a problem venting your energy, contact a Healing Tao instructor or an acupuncturist.

IT'S TOO HOT

You may find that your energy is too hot, too explosive, and you are either ejaculating or having a hard time drawing the energy up your spine. If that is the case, arouse yourself less. You need to have enough energy that you can draw it up, but at first, at least, you don't want to have too much energy.

I KEEP EJACULATING

If you get too close to the point of no return, you should try continuously contracting your PC muscle so as to firmly grasp your prostate and stop yourself from ejaculating. You can keep your PC muscle clenched while you are pumping your buttock muscles. If you are close to ejaculation and need additional force to redirect the energy up, at the same time that you squeeze your buttocks, also tighten your hands into fists and clench your jaw muscles and teeth. This will increase the pressure of your pumping action. However, this last technique should be avoided by men who store tension in their neck and jaw.

MY BACK HURTS

It is sometimes a little difficult to draw the energy into the base of the spine, and some people experience a little pain, tingling, or "pins and needles" when this energy first enters the sacrum. If this happens to you, do not be alarmed. You can help pass the energy through by gently massaging the area with your fingers.

MY EYES HURT

When you roll your eyes up or around, you may find that your eye muscles ache or your head aches. This is a typical sign of sore muscles and is nothing to worry about. It this problem persists, go easy on this part of the practice or contact a Healing Tao instructor.

MY HEAD HURTS

If your head hurts, you feel "wired," or you are having difficulty sleeping, you may be leaving too much stagnant energy in your head. The energy can overheat if it stays in one place, a problem that can be easily solved by keeping the energy moving. Make sure to circulate the energy in your head nine, eighteen, or thirty-six times in one direction and then the other. (Like in cooking, you need to stir the pot so no part of the stew overcooks.) Once you have circled the energy in your heat, let it flow down the front of your body through the Front Channel. If you are having a problem bringing the energy down the Front Channel, you can let it descend back down your spine.

I AM FEELING IRRITABLE AND ANGRY

In addition to amplifying anger that you may already have, the new energy can also cause you to overheat and develop negative emotions, such as anger, if you are not circulating the energy enough. In this case try to focus on recycling this anger and other negative emotions into loving-kindness. Also see the section called "When to Ejaculate".

OTHER SIDE EFFECTS

A small percentage of men who try these techniques experience excess energy stuck in their upper body. Symptoms of this vary from person to person but may include insomnia, a ringing in the ears, heart palpitations, or tension headaches that persist for several days. If you have any of these symptoms, immediately stop the practice and do the Venting exercise described later in this section. If they persist, contact a Healing Tao instructor or acupuncturist. Most Western doctors will not be able to correctly diagnose or treat the problem, since they are not trained to understand the movement of energy in the body and its physical effects. It is worth mentioning that the problems are not caused by the circulation of your sexual energy but by preexisting emotional and physical tensions trapped in the upper body. The sexual energy simply amplifies these problems, which is why it is essential for you to address these underlying issues before advancing further with your sexual practice.

As already mentioned, if you are having a problem drawing the energy down, you may have a block in your Front Channel. The Taoists use sounds to open up blocked energy channels and to heal the body. This technique is call the Six Healing Sounds. The sound that will open up your Front Channel and help you vent excess energy is known as the *triple warmer* or *triple heater* sound.

After each practice session of the Big Draw, be sure to massage your genitals. This will disperse any energy that did not get drawn up and will alleviate any feelings of congestion or fullness. Also massage your perineum, your coccyx, and your sacrum as described in the Pelvic Massage exercise given later.

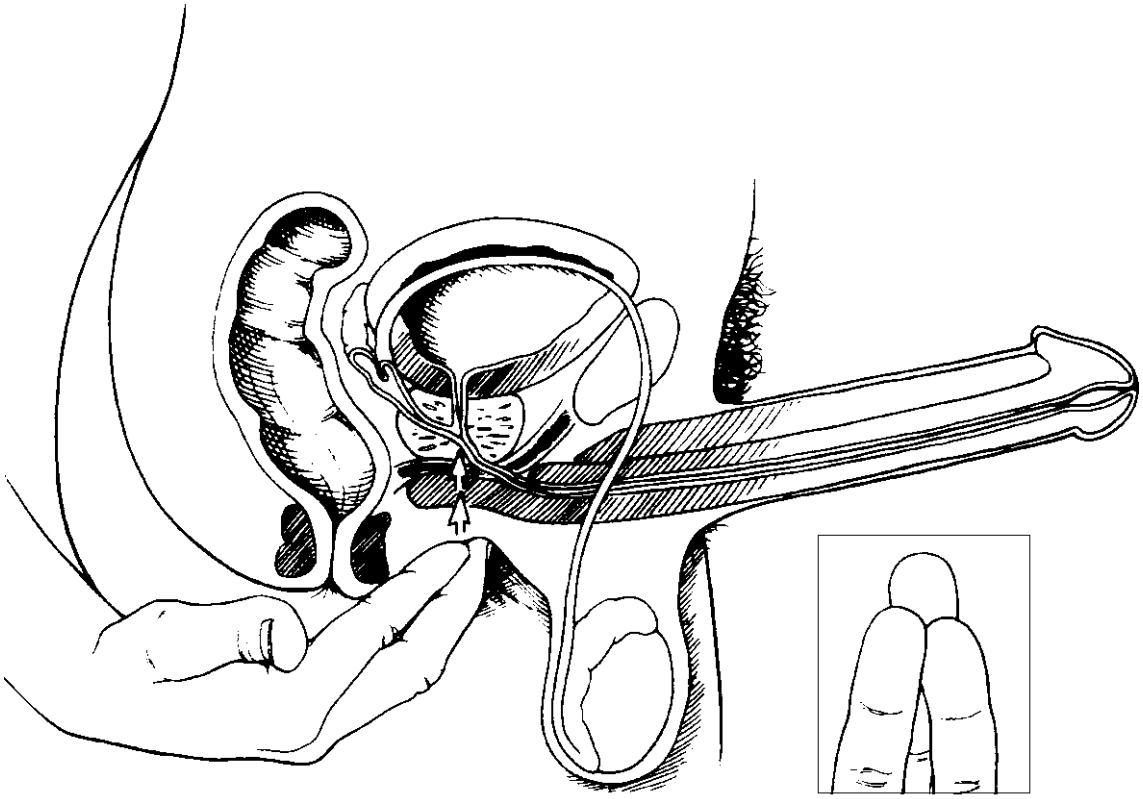

Figure 15 - THE FINGER LOCK

The Finger Lock

Now we are going to show you how to stop the semen once you are passing what Masters and Johnson call *ejaculatory inevitability*, in other words, when you are going past the point of no return. It is best to use the Big Draw whenever possible, and increasingly to use your mind to stop yourself from ejaculating rather then your fingers, which can be awkward. Use this technique when you need to conserve your energy, such as when you are sick or working hard, but have been unable to stop yourself from ejaculating. When you use the Finger Lock to block the semen from coming out once you have passed the point of no return, you will lose your erection. However you may find that it returns more quickly. One multi-orgasmic man explained: "After using the Finger Lock I could get an erection and have sex again very soon."

EXERCISE 10

THE FINGER LOCK

1. When you feel that ejaculation is inevitable, press the three middle fingers (in other words, not your pinkie or thumb) of your dominant hand into the Million-Dollar Point just hard enough to stop the flow of semen.

2. Your fingers should be curbed slightly and your middle finger should push directly against the urethral tube. This tube expands when you near ejaculation, so it should be easy to find. Your other two fingers should press on each side of the tube to hold it in place.

3. Contract your PC muscle, which encircles the prostate, and pull up your perineum. Draw the orgasmic energy up to the spine and to your brain.

4. Hold your fingers in place before, during, and after the contractions.

5. When the pumping has stopped completely, remove your fingers.

In the last section we discussed the Million-Dollar Point as a place where you could press to delay ejaculation. The Million-Dollar Point is also the place where you can actually block the semen from leaving your body once you have passed the point of no return. Once multi-orgasmic man described when it was that he found the Finger Lock most helpful: "In the beginning I used the Finger Lock during self-cultivation. I could train myself to go closer and closer to the point of no return because I could use it if I went over. I would recommend practicing it first in self-cultivation so it is not awkward during lovemaking."

Basically, the Finger Lock involves pressing the Million-Dollar Point, the indentation directly in front of your anus, with the three middle fingers of your right hand (see figure 15). If you're a lefty, use your left hand, you will need the strength of your dominant hand to use this technique. (Also, make sure your fingernails are cut short and filed so you don't hurt yourself.) You need to press here just as you feel yourself passing the point of no return, but before you actually start ejaculating, and to continue pressing until the ejaculatory contractions stop.

You will be pushing down on the spot where the ejaculatory duct and the membranous urethra meet. One multi-orgasmic man suggests: "You should realize that the concentration and pressure that you need during your orgasm will reduce your enjoyment of the orgasmic contractions in the beginning. Knowing this, you will better be able to continue applying the pressure to the end." Not to worry: this will get easier and less distracting with time.

If you're applying pressure to the right place, no semen will come out. If semen does come out, you have not yet found your Million-Dollar Point. Try moving your fingers slightly closer to the anus next time, and make sure you are pushing firmly into the indentation.

If you are curious to see whether you did the exercise correctly, you can urinate into a cup. If the urine is clear, you are doing it right. If the urine is very cloudy, the semen went into your bladder in a retrograde ejaculation. If this happened, the next time try moving your three fingers back slightly toward your anus.

When you block the semen with your fingers, most of the fluid returns to the epididymis and the seminal vesicles. The tissues in this region are extremely elastic and are not harmed by this technique, but it is very important after this exercise to massage the pelvic areas (see the Pelvic Massage exercise), to do PC Pull-Ups, and, ideally, to circulate your sexual energy through your body as described in the previous section. You may feel some pressure or even pain when you begin using the Finger Lock, which will mean it is all the more important to help your body reabsorb the semen. One multi-orgasmic man explained his experience: "You have to be careful with the Finger Lock not to push too hard. One night my pumpers were starting to pump and I really pressed hard, but it hurt afterward for a while."

You can relieve much of the pressure you may feel in your pelvis after using the Finger Lock or Big Draw by massaging several key points in your pelvic area. First and most important is to massage your perineum (the s[pot between the root of your penis and your anus) and testicles. This will relieve a lot of the pressure and help your body reabsorb the semen.

Six Healing Sounds of Chinese Medicine

Sun Si Miao was most probably a Taoist Monk who lived circa. 690 A.D. in the Tang Dynasty. A man of many talents, he was responsible for the invention of gun powder, which is considered as one of the four greatest inventions of ancient China. The other three are the compass, paper, and typeprint to speed the produciton of books. He also organized a method of sound therapy. Although the Chinese people had been using sound as a tool for healing for many thousands of years, Sun distilled the core of the art into six healing sounds, and created a system for using them.

Sound therapy is a form of vibrational medicine and a health practice. The vibration stems from sounds created by different positions of the mouth and tongue. These various sounds affect different parts of the body, organs, and meridians. The sounds are also related to the seasons. Sun was the first to record these different sound-body-season combinations.

The following will give an overview of the six healing sounds and an approximation of what they sound like. If the reader is interested in practicing this art, it would be best to have someone who knows, personally demonstrate the sounds.

1. **Su** - Sounds like "**shhh**"
Season - Spring
Organ - Liver (also relates to the eyes)

2. **He** - Sounds like "**huh**"
Season - Summer
Organ - Heart and Circulatory System
(Also relates to tongue)

3. **Hu** - Sounds like "**who**"
Season - Occurs between all seasons
Organ - Spleen and systems of digestion

4. **SI** - Sounds like "**ssss**"
Season - Fall
Organ - Lung and Respiritory System
(Also Relates to the nose)

5. **Chui** - Sounds like "**chewee**"
Season - Winter
Organ - Kidney and Systems of Elimination and Hormones
(Also relates to the ears)

6. **Xi** - Sounds like "**ssea**"
Season - Occurs between all seasons
Organ - Triple Burner System - For absorbing energy from food

To use the system effectively, practice Wu Chi first and then the healing sounds. Repeat the first sound six times and then go on to the next and repeat it six times. Do this for all the sounds. For additional benefit, repeat the one sound that refers to the current season six more times at the end of the set. It is important to follow the exact order of the sounds as they are listed here. When first learning the sounds, it will be necessary to whisper the sounds, to insure correct mouth/tongue placement. Once the placement is correct, the sounds are created with just the breath - no audible sound is heard. This practice can be used for a particular health issue, but may also be used to maintain good health.

It is also important to massage your tailbone, specifically, where there is an indentation between your anus and your tailbone (see figure 16) and the eight holes of your sacrum (see figure 17). This will help your body absorb the sexual energy you have generated.

EXERCISE 11

PELVIC MASSAGE

1. Using your fingers, massage your Million-Dollar Point in a circle, first in one direction and then the other.
2. Repeat this massage between your anus and tailbone.
3. Repeat this massage at each of the eight holes of the sacrum. If you can't find the individual holes, massage the general area in several different places, circling first in one direction and then the other.

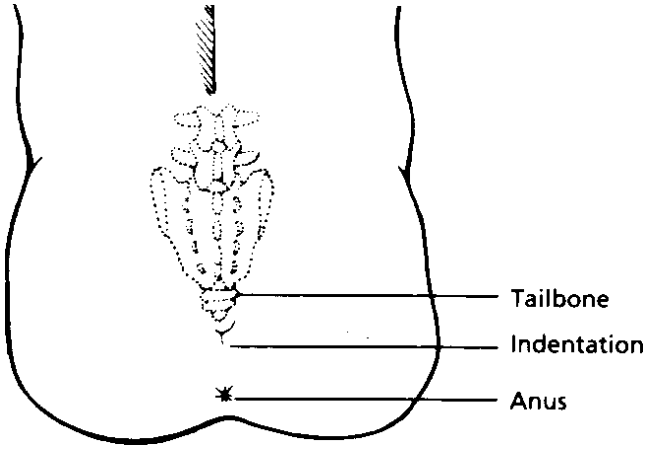

Figure 16 - MASSAGING THE INDENTATION BETWEEN THE TAILBONE AND ANUS

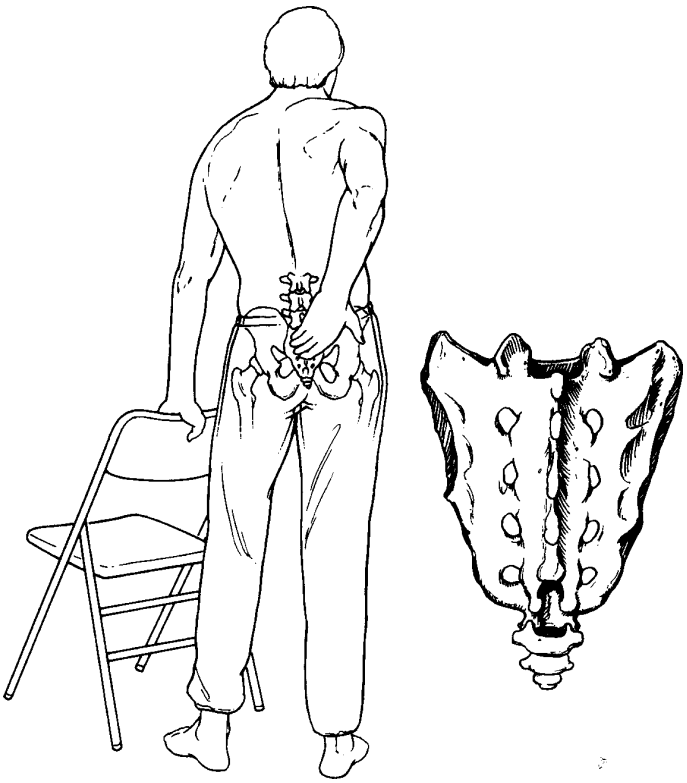

Figure 17 - MASSAGING THE HOLES OF THE SACRUM

FINDING THE WAY

Pain

If you have intense pain, you are probably pushing too far forward or too late. When this happens, the urethra, which is like a hose that has been pinched, swells up with fluid and can hurt. You need to turn off the faucet before the water (or, in this case, semen) enters the hose. Make sure you push farther back and/or sooner next time. Also make sure you are not pushing too hard. Some discomfort is common, especially during the first few weeks, from the pressure you apply with your fingers and the fluid pressure in your pelvis, but it shouldn't hurt for long. If you are experiencing pain, try to refine the technique or forget this stopgap measure and learn the more important Big Draw.

A small amount of semen will leak out once you lose your erection, so this is not a method of birth control or safe sex. Using it with other forms of contraception, however, will improve their effectiveness. Since you still lose some of your energy with this technique, the sooner you are able to learn the Big Draw, the better off you will be. Although at first you may feel fatigued, your energy will return sooner than if you had ejaculated.

This is a powerful practice, which you should not use more than once every two or three days when you start. If you are elderly or ill, you should not use this practice more than twice a week when you begin. The retained sexual energy may cause you to feel hot or thirsty. If so, try drinking more water. After you have practiced this technique for one to three months, and sometimes sooner, you will notice your sex drive increase and your erections become more frequent. Increase your sexual activities (solo and duo) moderately; try not to overdo it.

FINDING THE WAY

Pressure in Your Head

After a month or more of practice, you may find that you feel pressure in your head, a result of the increased energy in your body. This is a sign of progress, that your body has more energy than before. For some this can be experienced as a pleasurable tingling, like static electricity without the shock. (This is the same Kundalini energy popularized by Tantric teachers in the West.) However, if this power grows uncomfortable, it once again can be circulated to the rest of the body by pressing your tongue to the roof of your mouth and letting the energy flow down.

If you have high blood pressure, you should keep your tongue in your lower jaw (rather than touching your palate) and also bring the energy all the way down to the soles of your feet (see figure 14). Physical exercise, massaging your feet, and a heavy grain diet will also help you ground the energy. If you are not ready to learn how to circulate your sexual energy, you can simply ejaculate once or twice to release the extra energy.

When to Stop

Most men stop masturbating or having sex when they ejaculate, but after you learn the Big Draw and become multi-orgasmic, you may be faced with the very real question of when to stop. There will be days when you want to self-pleasure or make love for a long time, and there will be other days when you want a satisfying multi-orgasmic quickie. The choice is really yours and will depend on what is happening in your life. Your and your partner's desire and satisfaction should guide you.

It is important, however, not to overdo it, especially at first. As senior Healing Tao instructor Masahiro Ouchi explains, "Men feel very powerful when they start practicing Sexual Kung Fu, and often they don't know when to stop. Take it slow, and let your body and your partner adjust." You will also need to make sure your partner has enough sexual strength to keep up with the new intensity in your lovemaking. You can always practice on your own.

Many people worry about masturbating too much or think that they will neglect other parts of their life if they let themselves experience too much pleasure. According to the Tao, if you are able to pleasure and satisfy yourself, you will not need to constantly run after superficial sex or other unsatisfying stimulation.

FINDING THE WAY

Let Your Erection Decrease Every Twenty Minutes

If you regularly pleasure yourself or make love for more than twenty minutes, which you very well may do after you become multi-orgasmic, *it is important to let your erection decrease somewhat about every twenty minutes to allow the blood to recirculate through the body*. It is worth mentioning again that Sexual Kung Fu is not an endurance test. Pleasure and cultivate yourself as long as you have the time and the desire.

When to Ejaculate

Every time you orgasm, you draw more sexual energy into your body, therefore, if you eventually ejaculate, you lose less energy than you would have had you not had multiple orgasms beforehand. For example:

1. If you have half a dozen orgasms (each time circulating the energy to your brain and the rest of your body) and then ejaculate, you will lose about 50 percent of your sexual energy.

2. If you have half a dozen orgasms and then use the Finger Lock, you will lose about a quarter of your sexual energy.

3. If you have half a dozen orgasms and then use the Big Draw (and don't ejaculate), you will not lose any of your sexual energy.

The final option will give you the greatest opportunity to cultivate the ecstatic orgasms that you feel in your brain and throughout your body. It will also allow you to cultivate this energy for your overall health. However, by generating and containing this much energy, you risk overheating unless you are able to circulate the energy through the Microcosmic Orbit.

FINDING THE WAY

Preventing Overheating

According to the Tao, erection energy is wood (or liver) energy. So when you don't ejaculate and you pull up the orgasmic energy, you will increase this energy in your liver. If this increasing energy is not transformed into love and kindness, it will transform into anger and hatred. So when you have a lot of energy, practice being especially kind and loving to your partner or, if you do not have a partner, to other people in your life.

Other techniques for preventing yourself from overheating include drinking a lot of water and even swallowing your own saliva, which has a cooling effect on the body. Your emotional state can also affect the energy in your body. If you feel calm and loving, the body can much more easily absorb the energy. If you feel anger or disdain for yourself or your partner, you run a greater risk of overheating. If you are overheating or feel you have more energy than you can absorb, you should probably ejaculate. If the problem persists, try practicing the Inner Smile or the Six Healing Sounds described in *Taoist Ways to Transform Stress into Vitality*, or contact a Healing Tao Instructor.

The Taoist ideal is to ejaculate as infrequently as you can, but every man can and should refrain from ejaculating for a period of time suited to him. In the words of Su Nü, "One must measure one's own strength and ejaculate accordingly. Anything else is simply force and foolishness." Your strength depends on your age, your health, your state of mind, and your willpower.

Sun Ssu-miao, one of the leading physicians of ancient China recommended that *men attain good health and longevity by ejaculating twice a month*, as long as they ate healthily and exercised. He also offered the following more specific guidelines.

A man at *twenty* can ejaculate once every *four* days.
A man at *thirty* can ejaculate once every *eight* days.
A man at *forty* can ejaculate once every *ten* days.
A man at *fifty* can ejaculate once every *twenty* days.
A man at *sixty* should *no long ejaculate*.

It goes without saying that his prescription did not limit the number of times a man of any age could have sex and non-ejaculatory orgasms. This restriction on ejaculation may sound like a disappointment, but once you have had multiple non-ejaculatory orgasms, you won't miss ejaculating at all. In the words of one multi-orgasmic man, "Once you have multi's [non-ejaculatory orgasms], you never want to go back to squirt [ejaculatory] orgasms. Squirt orgasms are just in your genitals, multi's are whole-body orgasms."

Sun Ssu-miao, who lived to 101, ejaculated only after making love one hundred times. But rather than adhering to any rigid numerical formula, you should try to pay attention to your body. If you are exhausted or sick, drunk or stuffed with food, you should avoid ejaculating. If you are working hard you will want to conserve your semen, but if you are on vacation you may wish to ejaculate a little more often. The ancient Taoists, who lived close to nature, also believed that just as plants and animals conserve their energy in winter, so should people. Besides the seasons, there are other rhythms that will determine the number of times you ejaculate. If you are trying to conceive a child, you will need to ejaculate whenever your partner is ovulating.

In general, when you ejaculate you should feel refreshed and energetic. If ejaculating leaves you feeling empty, depressed, or exhausted, you need to increase the amount of time between ejaculations or avoid ejaculating altogether until you build up your sexual energy. When you do ejaculate, you can conserve some semen and sexual energy by approaching the point of no return slowly rather than thrusting vigorously to a climax. After you ejaculate, you can also practice PC contractions to tighten your pelvic muscles and reduce the amount of energy that typically leaks out after ejaculation.

At the same time it is important not to become obsessive about non-ejaculation and not to give yourself a hard time when you do ejaculate. As Michael Winn explains, "It is very important not to be fanatical about non-ejaculation. A lot of men who learn about Sexual Kung Fu think, 'Wow, this is great. It makes sense. I want to do it.' And then they have a problem controlling their ejaculation. And then they start passing judgment on themselves and feeling guilty. They are missing the point, which is not even whether you ejaculate or not, but whether you are able to recycle some of the sexual energy up through your body before you ejaculate. Obviously, the longer you can delay your ejaculation, the greater your opportunity to cultivate this energy for creative and spiritual growth. *If you need to ejaculate and it's coming and you can't stop it, just go for it. Don't beat yourself up. Because what is really important ultimately is not just the energy in the sperm, but the overall love between you and your partner*."

Remember that the energy is more than just the sperm; if you are able to draw any energy out of the sperm, you are far ahead of where you were before you started, in terms both of the level of pleasure you will be able to experience and of the energy you will be able to circulate for your health. True sexual satisfaction comes from both pleasure and health.

POWER AND SEXUALITY

The practices that you are learning are very powerful, and once you learn them it is natural for you to be proud of your ability to master your sexual energy and of your newfound skill in bed. However, it is essential that you avoid the bravado and machismo that accompany so much male sexuality. As Senior Healing Tao instruction Masahiro Ouchi explains, "Sexual Kung Fu is quite easy to learn, and many men start feeling very powerful in bed, but it must not become a power trip. Power is about conquest, which is the opposite of love and any real spiritual practice." Ouchi, who holds a black belt in karate, compares Sexual Kung Fu to what he has observed in karate: "Most people who have black belts use this power incorrectly. They become more rigid and egotistical and lose the sensitivity and gentleness that are the real source of this power."

To practice Sexual Kung Fu correctly, you need to open your heart and practice with a spirit of humility and loving-kindness, not arrogance and self-centeredness. Egotism is just an expression of insecurity, and as you learn real sexual confidence, you will be able to let go of pretension and posturing. Remember that this practice and your new sexual energy will magnify your emotions. So it is essential that you cultivate them. If arrogance and egotism are problems for you, try to practice the Six Healing Sounds (see *Taoist Ways to Transform Stress into Vitality*). If you do not address these emotions, they will limit your practice, your pleasure and your partnership.

THE ART OF LOVEMAKING

Many men who begin practicing Sexual Kung Fu get so involved with their own practice that they lose touch with their partner and with the spontaneous and ecstatic process of lovemaking. You can practice as of as you want on your own, but when you are with your partner, it is extremely important to remember that it is not just *your* practice. The point of lovemaking is to make love, and from this love comes pleasure and health, it is not about generating sexual energy for yourself or demonstrating your skill. As Masahiro Ouchi explains, "The technique is just that, technique. It is not the real art. You need to learn the technique well enough that you can forget about it. Just like playing a musical instrument, at first you need to learn the scales, but then you need to forget about them and just play from the heart."

Know Your Partner

"Among the skills possessed by men, a knowledge of women is indispensable," explains *Discourse on the Highest Tao Under Heaven.* "When one does have a woman, only the skillful are equal to the task." The union of man and woman has been the foundation of Sexual Kung Fu, for through this primal bond, it was believed, infinite pleasure and priceless health could be attained. With this incentive, the Taoists refined lovemaking into a high art of intimacy and ecstasy.

A harmonious love life was considered essential to conjugal happiness, and newlyweds were given "pillow hooks" that graphically demonstrated how they could achieve this bliss. We wou1d never think of 1earning to cook without some guidance or a cookbook or two, but in lovemaking, which is certainly as complex as cooking, Western men and women are forced to discover for themselves the mysterious world of sex with only a few hopelessly romanticized images from the movies and television to guide them.

Hollywood sex is not good sex; it is just fast sex. The passionate, urgent embrace portrayed in most films in which the woman is instantly lubricated and immediately satisfied by a few minutes of coital writhing would he laughable if it did not leave so many viewers are trying to imitate this unrealistic model of lovemaking. It is worth remembering that the director's imperative of keeping the plot moving, and the public's intolerance for watching the body in pleasure, make it impossible to explore on-screen the subtle nuances of lovemaking. Candace Bergen described her formula for cinematic orgasm' in *Esquire* magazine: "Ten seconds of heavy breathing, roll your head from side to side, simulate a slight asthma attack, and die a little." So much for foreplay.

Porn films, in which the "plot" is generally just celluloid glue between the sex scenes, should offer the opportunity to learn a richer sexual repertoire. However, the frantic, nonstop thrusting in most pornography is timed more to the masturbatory stroke of a man's hand than to the subtle and profound sensations of real flesh-and-blood lovemaking.

It is no wonder that Western men, weaned on movies, television and porn, ejaculate so quickly. Almost 80 percent of the men Kinsey studied ejaculated less than two minutes after entering their partner. Both men and women may lose out in this rapid-fire coitus. Hartman and Fithian speculate that this quick intercourse does not allow enough time for the natural chemicals that accompany touch and sexual arousal to be released into the bloodstream, short-circuiting the general sense of well-being that usually accompanies lovemaking. The Taoists would say that in such hasty sex the man and woman are not able to exchange sexual energy and to harmonize with one another, and may even drain each other of energy. This does not mean that quickies are not sometimes just what the doctor ordered, especially if you and your partner have a practice of ecstatic lovemaking that allows you to harmonize and satisfy each other quickly.

Almost a quarter century after Kinsey published his findings – in the wake of the sexual revolution and women's liberation – Morton Hunt found in a follow-up study that men were lasting ten minutes instead of two. Though still rather short by Taoist standards, this increase is a 400 percent improvement nonetheless. Although men are generally portrayed as insensitive lovers, guided in bed exclusively by their own self-interest, clearly a major motivation for men learning to last longer in bed in recent years has g been their desire to pleasure their partners, who were beginning to discover that they could be orgasmic or even multi-orgasmic. In interviews with four thousand men, Anthony Pietropinto found that a surprising 80 percent judged their own sexual satisfaction by whether they had been able to give their partner one or more orgasms. Once you are multi-orgasmic, you will be able to satisfy your partner no matter how long she takes to orgasm.

In learning to satisfy your partner, however, the first thing you must do is remove your ego. You are not "giving" her an orgasm. You are not trying to he the best lover she has ever had. Too many men get caught up with sexual performance. If you are able to replace performance with pleasure – hers and yours – you will be able to satisfy even the lustiest of lovers. Remember, the best lovers are men who are completely relaxed and aware of what is going on in both their own and their partner's bodies. You began learning how to understand what happens in your body, and in this chapter you will learn how to recognize what is happening in your lovers.

There is one last point worth keeping in mind. It is much easier to practice Sexual Kung Fu with a regular partner with whom you have a deep emotional as well as physical bond. In their study of multi-orgasmic men, Dunn and Trost found that it was much easier for men to become multi-orgasmic with a familiar partner with whom there was emotional closeness and the opportunity for leisurely sex. Each man they interviewed mentioned that the goal was not to have multiple orgasms but to have pleasurable and satisfying lovemaking. Multiple orgasms are just one of the many treasures you will discover along the path to intimate and ever more ecstatic lovemaking,

Her Body

Women's sexuality has been the source of much mystery and mystification throughout Western history. Women's largely internal (as opposed to men's largely external) sex organs have made them the subject of much study and even more confusion. Every man (and woman) needs to know a few basic facts about women's bodies (see figure 18), Bear in mind that these are generic descriptions and that sexual anatomy, women's and men's, varies as much from person to person as does the rest of our anatomy.

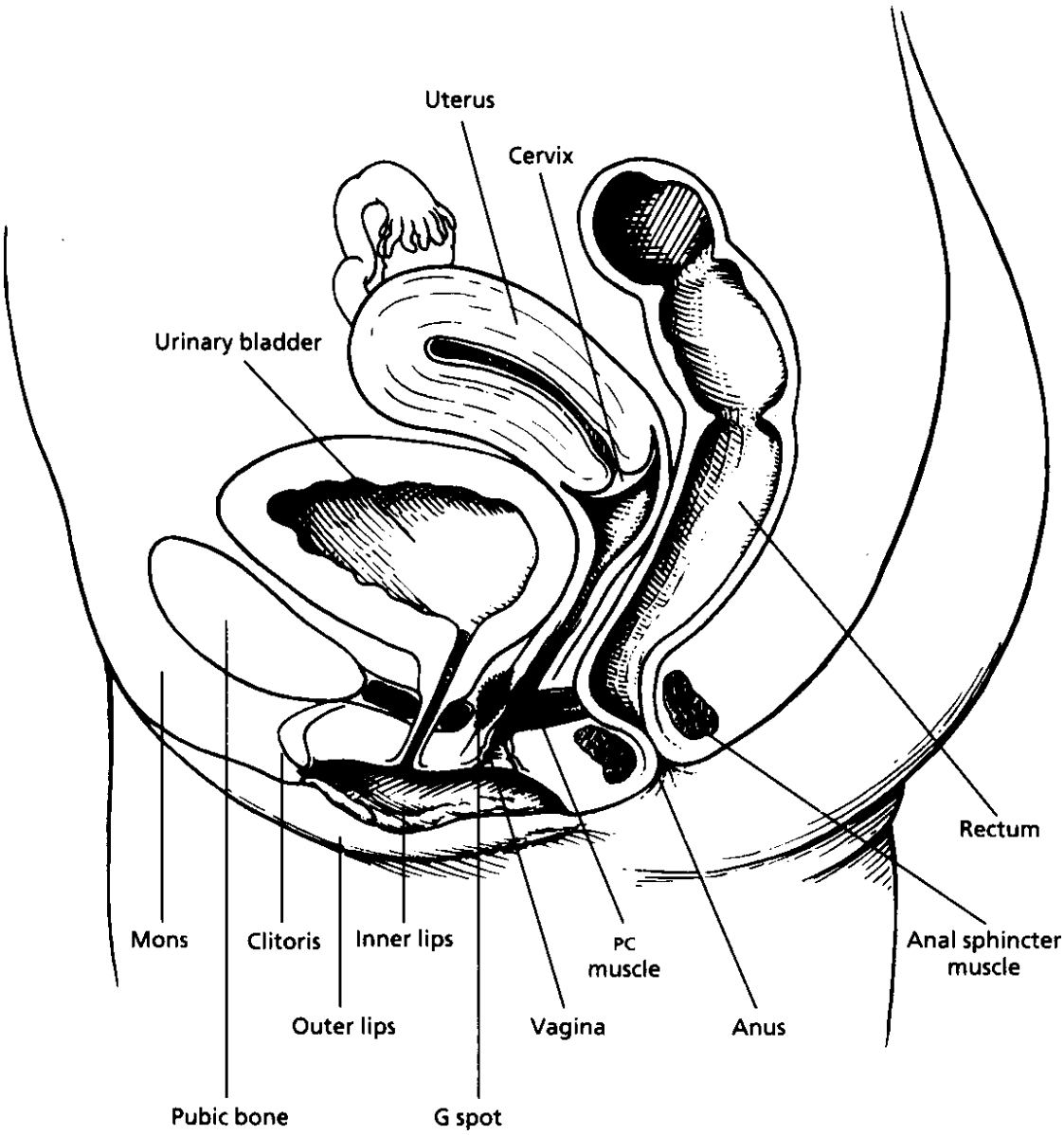

Figure 18 - WOMAN'S SEXUAL ANATOMY

MONS VENERIS

Descending down from a woman's belly, you will first see her mons veneris, which in Latin means "mount of Venus." Venus, of course, was the goddess of love. The mons (for short) is the layer of padded, generally hair-covered skin on top of the pubic bone. As a teenager you probably felt this part of your girlfriend's body if you ever "bumped and grinded" with your clothes on. The mons is just above the clitoris; some women find this area to be sensitive to touch and pressure, while others will want you to focus farther down.

OUTER LIPS

The mons as it descends between a woman's thighs separates into two large outer lips. Although these are called "lips," when a woman is not aroused they are relatively flat and don't look very liplike.

INNER LIPS

Unlike the outer lips, the inner lips are hairless and are related to other mucous membranes like the lips of the mouth. When unaroused, they vary in color from pink to maroon or purple. During sexual arousal, they become engorged, darken, and thicken. They can sometimes swell as much as two to three times their normal size and change in color to bright red. These changes are also a sign of great arousal and approaching orgasm.

CLITORIS

Follow the inner lips up to where they meet just below the mons. There they form the hood that protects the sensitive glans of the clitoris, which is similar to the glans (head) of a man's penis in its abundance of sensitive nerves. Usually the glans is nestled under the hood, but it can be seen by pulling the hood gently back. The glans is so sensitive that quite a few women find direct stimulation painful. These women often prefer stimulation of the shaft of the clitoris, which stretches up toward the mons and can be felt under the skin as a movable cord. After orgasm, many women find that their clitoris is too sensitive to be touched directly for up to several minutes. This hypersensitivity is similar to what many men experience after ejaculating.

Like the penis, the clitoris is made of erectile tissue, and the glans engorges with blood when excited. Many people compare the clitoris to the head of the penis, and developmentally they originate from the same embryonic tissue. The clitoris, however, is unique in being the only organ in either sex that exists exclusively for sexual pleasure. So much for the belief that women are less lusty than men: they are the ones who have a part of their body wholly dedicated to getting them hot and bothered.

URETHRA

Down from the clitoris is the opening to the urethra, which leads to the bladder. Unlike men, whose urethra is relatively long (extending through their penis), women have a relatively short tube to the bladder, which is a major reason women tend to get more urinary-tract and bladder infections than men. The in-out thrusting of intercourse can push bacteria up a woman's urethra. If your partner gets infections frequently, encourage her to urinate after lovemaking. This will help flush out bacteria.

VAGINA

Down from the clitoris and urethra is the entrance to the vagina. The walls of the vagina rest against one another, creating a potential space rather than an actual one. The walls of the vagina have many folds, which explains the vagina's ability to accommodate almost any size penis, not to mention a baby during childbirth. This ability to expand and contract, even to fit snugly around a finger, is the reason differences in penis size are not usually a problem.

At rest, the back wall of the vagina is about three inches long and the front wall is about two and a half inches long. As a woman is aroused, her vagina widens and lengthens. The inner two-thirds of the vagina balloons out, which often reduces the stimulation in the back, but the outer third actually tightens as it becomes engorged, which is one reason a woman can hold on to even a small penis. As we mentioned in the last chapter, the stronger your partner's PC muscles, the more she can contract her vagina around your penis and increase stimulation for both of you. If your partner enjoys deep penetration and you have difficulty stimulating the back of her vagina, especially once it has expanded, you will be pleased to hear that there are positions that shorten her vagina and make deep thrusting easier (see the section called "Positions for Pleasure and Health" in the next chapter).

Many women report that they are most sensitive near the opening of the vagina, but other women report sensitivity at other places throughout the vagina, including the back walls and even the cervix (see the following section, "The G Spot and Other Sensitive Spots"). There are no universals about sexual stimulation, even with the best efforts of researchers like Masters and Johnson to find them. So explore with your partner, and let her tell you what feels best.

THE G SPOT AND OTHER SENSITIVE SPOTS

You may have heard about a place in a woman's vagina that when touched can drive her wild. This spot is often called the G spot, named for physician Ernest Gräfenberg, who first described it in 1950. Although not new, the idea of the G spot is still controversial, some women finding it and others not. The current theory is that the G spot is a collection of glands, ducts, blood vessels, and nerve endings that surround a woman's urethra.

So where exactly is it? Most women who report finding the G spot locate it one and a half to two inches from the opening of the vagina on the upper front wall, just behind the pubic bone. (Some women, however, find their G spot farther back.) If you look at your partner s vagina and imagine a clock with the clitoris as twelve o'clock, the G spot is usually somewhere between eleven and one.

When a woman is not aroused, the G spot is more difficult to find, but you may be able to feel some bumpy or ridged skin. When stimulated it can swell to the size of a dime or larger, standing out from the wall of the vagina. Alan and Donna Brauer suggest that the best time to find it is just after a woman orgasms: "It is already somewhat enlarged and sensitive." They recommend stroking it at a rate of about once a second and experimenting with both lighter and heavier pressure. Another good time to stimulate the G spot is when your partner is just approaching orgasm. Either way, your partner is more likely to enjoy this stroking if you do it once she is already highly aroused. Try licking her clitoris with your tongue while touching her G spot with your finger and see how she responds!

You should know that some women feel initial discomfort or the urge to urinate when their G spot is stroked, so you should probably discuss your exploratory plans with your partner first and explain that this reaction, if it happens, is normal. The Brauers also suggest lightening your touch. It may take as much as a minute for the discomfort or seeming need to urinate to be replaced with pleasurable sensations. If she is uncomfortable or too concerned about urinating to enjoy your stroking, you might suggest that she try to find the G spot on her own at first. It is easiest for her to find it while sitting or squatting. (If she is concerned about feeling the need to urinate, have your partner sit on the toilet or urinate before lovemaking, which will convince her that her bladder is empty.)

Intercourse in the common face-to-face "missionary" position often misses the G spot completely. It is easier to stimulate this area with your penis if your partner lies on her stomach and you enter her from behind, or if she is on top, where she can position herself for her pleasure. Shallow thrusting is also best for stimulating her G spot. Fingers, however, are usually the most direct and effective way to stimulate her G spot at first.

Some women report that their most sensitive spots are located at the four o'clock and eight o'clock positions, about midway back along the walls of the vagina. There are nerve bundles at these locations, which may explain their sensitivity to pressure. Through stroking her vagina or thrusting in different directions, you may already have discovered that your partner has additional spots all her own.

Remember, though, that not all women have a G spot or any other particular "spot," and if your partner doesn't, the last thing you want to do is pressure her or make her feel inadequate. This whole exploration is for her pleasure and is not an attempt to find buttons or knobs that turn her on. Make G-spot stimulation a part of the smorgasbord of pleasure you offer her.

EJACULATION

Female ejaculation? A number of sexologists have in fact described the G spot's ability to "ejaculate" a clear liquid when highly aroused. This has led some to conclude that the G spot may be analogous to a man's prostate gland. (As we mentioned earlier, men's and women's sex organs develop out of the same tissue in the embryo.) Many women who ejaculate worry that they are urinating and, as we mentioned above, may feel an initial need to urinate when their G spot is touched. However, the liquid is definitely not urine, and the urge to urinate usually subsides quickly with increased arousal.

You may at some point feel a "spray" against your penis when making love. Occasionally this spray is even visible. A small number of women ejaculate a teaspoon or less of liquid out of their urethra when they orgasm. (Women who ejaculate should also try to draw their sexual energy up, since they will lose some energy through ejaculating – though less than a man does.) According to researcher Lonnie Barbach, "recent chemical analysis of the [female] ejaculatory fluid suggests that it is unlike either urine or vaginal lubrication, but rather is like male ejaculatory fluid in its high levels of glucose and acid phosphatase. It is believed that the source of the fluid is a system of glands and ducts called the paraurethral glands. These surround the female urethra and develop from the same embryological tissue that develops into the prostate in the male." Explainable or not, this female ejaculate can be quite startling if you are unfamiliar with it. One man described getting hit in the face the first time he went down on his girlfriend. This propulsive force is probably a rare occurrence, but don't be shocked if you find that with some women you need oral-sex goggles.

ANUS

For some women the anus is an erogenous zone, and for others it is off-limits. You should ask how your partner feels. If you and she are interested in anal intercourse or anal sex play (touching and entering her anus with your finger), it is always best to start slowly and sensitively and to make sure you have plenty of lubricant. If her anus constricts while you are stimulating it, you need to apply less stimulation. If her anus is relaxed, you can apply more stimulation.

BREASTS

Compared with the rest of a woman's sexual anatomy, breasts are relatively simple. The nipples rest on top of the dark circles of the areolae and become erect when aroused. For all their erotic significance, the breasts are really quite similar to sweat glands, and their primary role, as any breast-feeding mother will attest, is as a source of warm milk for babies. One could come up with interesting theories as to why in our bottle-fed, nurture-starved Western culture, large breasts have become such a powerful symbol of desire. Whatever the reason is, this flood of images has led many men (and women) to the mistaken belief that size reflects sexual appetite: the larger the breasts, the more sexually desirous a

woman is. In actual fact, a woman's sexual sensitivity, experience, and self-perception determine the responsiveness of her breasts, as they do with her sexuality in general. Size has nothing to do with it.

In the "buttons and knobs" view of arousal, men often zero in on their partner's nipples. Though some women enjoy immediate nipple stimulation, many prefer a lighter, more indirect touch to begin with. Generally, try to circle around your partner's breasts to increase her anticipation and desire before actually touching the nipples themselves. Some women, however, experience very little sensation when their breasts or nipples are touched, so don't be disappointed. Rubbing your fingers together to warm them before touching her nipples will increase the amount of *chi,* or energy, and can help stimulate her. As you touch her nipples lightly, you may be able to feel a current of electricity flowing between your finger and her nipple. Licking her nipples with your tongue is often very effective since your tongue has a lot of *chi.* Sometimes, as with many men, the nerve pathways to the nipples need activating, which can occur with gentle, gradual stimulation over time. But your partner needs to be open to this slow awakening.

FERTILITY

The cycles of a woman's fertility and menstruation are especially bewildering for most men and have resulted in much fear and confusion. This is not the place for a biology lesson, but there are a few biological facts that every man should know about his lover's body. For example, did you know that although a woman's egg lives for only twelve to twenty-four hours, she can actually get pregnant as long as five days after intercourse?

How is this possible? Before a woman's ovary releases an egg, her cervical glands release "fertile" mucus. This mucus helps the semen reach the egg, and within ten minutes after ejaculation sperm are already in the fallopian tubes "breathlessly" flapping their tails toward the egg. Other sperm, however, stay in the lining of the cervical canal, where they are nourished and released over a period of three to five days. So if you have intercourse on Saturday night and she has fertile mucus but doesn't ovulate until Tuesday, you could still become a father on Wednesday. (This is a public-service announcement from your local chapter of Planned Parenthood.)

Many women complain that their partners do not take an active role in thinking about, planning, and participating in contraception. With the increased use of condoms, this situation is changing, but not enough. It's good to know the difference between fertile and nonfertile mucus, since condoms do break and no birth control is flawless. Fertile mucus is clear, slick, and stretchy. If you place some between your thumb and forefinger, it will stretch as you separate your fingers, connecting them by a thin, clear thread of mucus. If her mucus is not fertile, it will be white, sticky, and less abundant. Most noticeably, it does not stretch like fertile mucus.

If a woman does not become pregnant, the blood and cells that were prepared to nourish the fertilized egg slough off, beginning her menstruation. The menstrual cycle varies tremendously. Few women have an exact twenty-eight-day cycle. Regular cycles can range from three to seven weeks, and some women menstruate only two or three times a year. Although menstruation is different for every woman, the typical pattern of bleeding starts with a light flow of pink-tinged mucus or drops of blood, increasing to a heavy flow of red blood, and then decreasing to brownish "spotting" before stopping altogether. Some women bleed a lot, others a little, but most stop bleeding within a week.

During menstruation many women experience symptoms such as sore breasts, bloatedness, pimples, headaches, lower-back pain, diarrhea, and constipation. (Women with chronic herpes may break out around this time as well,) As you can imagine, given all of these discomforts, not to mention the stigma that still surrounds menstruation, many women do not feel very sexual during this time. Others, however, find that menstruation is the time of their greatest arousal, and indeed every part of the cycle is experienced by some women as the time of their most intense desire. For a number of women intercourse during menstruation can even relieve cramping. The more you understand about your partner's cycle and the more understanding you can be, the more you can harmonize with her through the rhythmic flow of living as well as the rhythmic flow of lovemaking.

Her Orgasm

The female orgasm has been the source of centuries, if not millennia, of curiosity and controversy, with widespread acceptance by the medical establishment of its existence occurring only in the last hundred years. Even with its existence acknowledged, the female orgasm has endured much ignorance and confusion during this century. The main debate was waged over the differences between, and the relative "maturity" of, clitoral orgasms and vaginal orgasms.' We now know that some women have orgasms more easily when their clitoris is stimulated and others have orgasms more easily when their vagina is stimulated. It is as simple as that. The one is no better than the other.

CLITORAL AND VAGINAL ORGASMS

A current theory suggests that there are actually two distinct nerves that are responsible for the two different orgasms. The pudendal nerve goes to the clitoris, among other places, and the pelvic nerve goes to the vagina and uterus – vaginal orgasms often actually involve contractions of the uterus as well (see figure 30). Of the two nerves, the pudendal has more nerve endings, which may be the reason more women have clitoral orgasms than have vaginal orgasms. The fact that the two nerves overlap in the spinal cord also might explain why some women have "blended" orgasms, which arise

from both the clitoris and deep inside the vagina. Two factors seem to influence whether women have vaginal orgasms: the strength of their PC muscles and the sensitivity of their G spots or other internal spots.

Women who have both orgasms often notice a difference. Shere Hite, in her famous report on female sexuality, quotes a woman who explains her experience: “During masturbation I experience a clitoral orgasm that approximates my idea of male orgasm – a buildup of overall sensation in the general area of my clitoris, and a ‘muscle spasm’ feeling. A vaginal orgasm is a more pervasive sensation through the whole body, less concrete to describe – wider waves of feeling.” As we described, men can be said to have two different orgasms as well: a genital (or penis) orgasm and a pelvic (or prostate) orgasm. According to Taoist sexuality, there are actually numerous kinds of orgasms, which can take place in different parts and, believe it or not, different organs of the body, such as your heart and liver. If you are able to circulate your sexual energy to your brain, you may experience a “brain orgasm.” Remember, an orgasm is simply the contraction and expansion, or “pulsation,” and this pulsation can happen throughout your entire body.

TOUCHING HER CLITORIS DURING LOVEMAKING

Shere Hite reports that about 70 percent of the women she surveyed required at least some stimulation of their clitoris in order to have an orgasm. As already mentioned, your partner’s clitoris is equivalent to the head of your penis. For the majority of men, the head is the most sensitive part of their sexual anatomy – as is the clitoris for most women. Asking a woman to have an orgasm without stimulating her clitoris is like asking a man to have an orgasm without stimulating the head of his penis. It can be done, but it takes a lot longer,

It is not surprising then that in the missionary position many women are not able to have an orgasm, since the most sensitive part of their anatomy – the clitoris – is only indirectly being stimulated. Sometimes the man’s pubic bone will rub against the clitoris or the hood of the clitoris will be pulled against it during intercourse, but these are clearly no substitute for direct stimulation by your penis, fingers, or mouth, It s not surprising that Kinsey, Hunt, and Hite have all found that nearly half of American women never or rarely experience orgasm during intercourse.

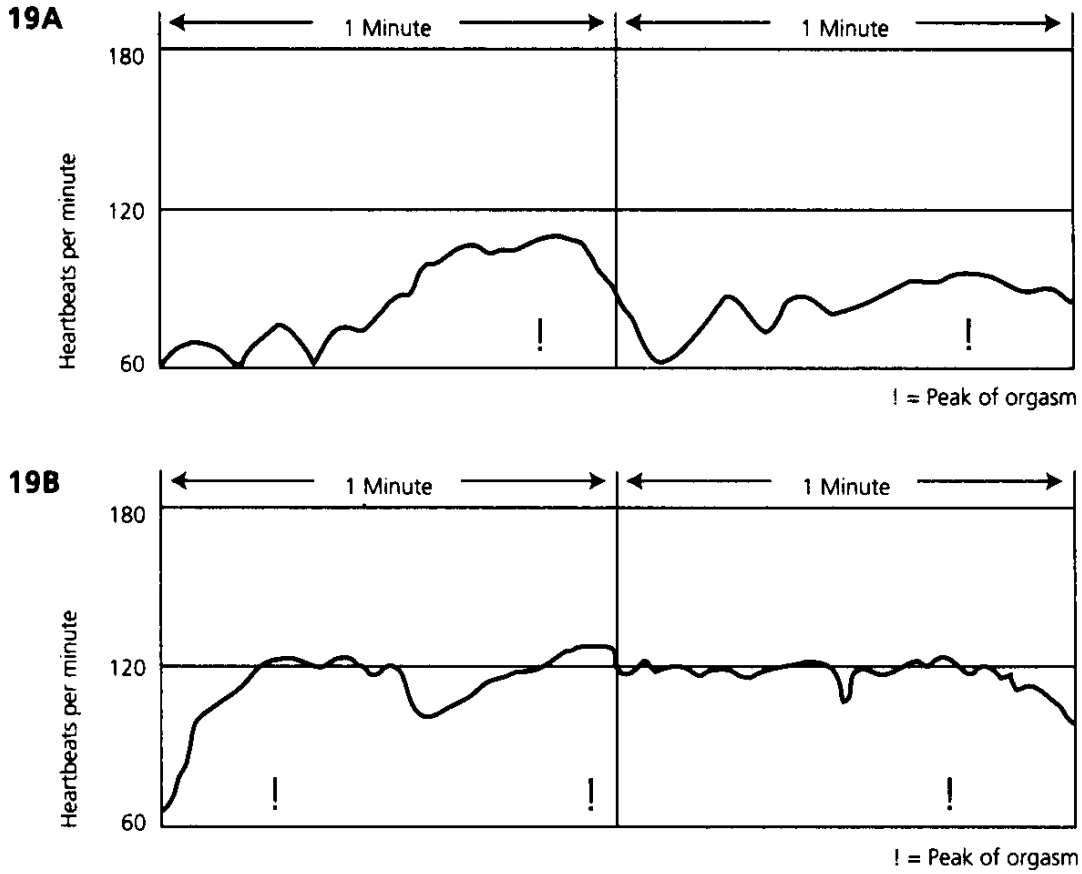

Figure 19 - DISCRETE (A) AND CONTINUOUS (B) FEMALE MULTIPLE ORGASMS

Many women are much more easily orgasmic during intercourse if they, or their partners, also stimulate their clitoris. Men usually can orgasm much more quickly than women during intercourse (two or three minutes versus twenty), but women seem to be able to orgasm just as quickly as men when they masturbate – presumably because they are directly stimulating their clitoris and because they know what they like. One multi-orgasmic man recounted his experience of stroking his partner's clitoris while making love: “When I’m behind or she’s on top, my hands are free to play with her clitoris. It really drives her wild. She starts moaning so loud that once we had to stop and close the windows.”

Some men and women may complain that using hands to stimulate your partner’s clitoris during intercourse is unnatural or overly mechanical. As one multi-orgasmic man remembered, “For a long time I thought it was a sign of weakness for a man to have to use his fingers. But I’ve found that there are some times when a woman really enjoys or would even rather have your fingers or tongue, because it is a whole different feeling.” Surely this kind of stimulation cannot be considered unnatural or a sign of a man’s weakness if almost three-quarters of all women require it to be sexually satisfied. Men who are not used to using their hands when they have intercourse may find that they need a little time to coordinate their strokes and their thrusts. With practice, this coordination becomes increasingly easy, especially if you slow your thrusting down and allow your partner (and yourself) to savor every thrust and every stroke. You need to be careful not to become overly focused on your partner’s clitoris and lose the connection of lovemaking. Also be careful not to lose track of what your hand is doing, or your partner may start to feel like it *is* becoming mechanical. If you can walk and chew gum at the same time; you should be able to simultaneously thrust and stroke.

If your partner is willing to touch herself, all the better. One man told his girlfriend that because she was involved in bringing herself to orgasm, he felt like she was using him to “masturbate.” This reaction might be understandable if a man feels that it is his responsibility (and his right) to "give” his partner orgasms. This mind-set no doubt underlies women’s faking orgasm to please their partners or to show their partners they have been pleased. Since, as we explained orgasm takes place primarily in the brain, you cannot “give" your partner an orgasm. She must experience it in her own mind (and body).

As more and more women have discovered their ability to orgasm once or multiple times, men have felt increasing pressure to satisfy this ever higher orgasmic potential. Men’s desire to satisfy women is noble and necessary, but the accompanying pressure is not and can increase already too common feelings of performance anxiety among men. You will have a more realistic approach, and feel much less pressure, if you realize that you are simply helping your partner reach her own orgasmic potential.

ORGASMIC FINGERPRINTING

Clitoral, vaginal, and blended orgasms are just three categories that sexologists use to describe genital orgasms in women. Sexologists also make distinctions between brief, *discrete* orgasms and longer, *continuous* orgasms (see figure 19). Some women have discrete orgasms, others have continuous orgasms, and still others have a combination. Hartman, Fithian, and coauthor Berry Campbell suggest that each woman’s pattern of orgasm is so individual that it should be called an “orgasmic fingerprint." As Lonnie Barbach has pointed out, physiology as well as personal and cultural expectations influence how your partner (and you) experience orgasm, which is probably one of the reasons people tend to have a "standard” orgasmic pattern. Some women have one powerful orgasm, some have one gentle orgasm, and some have one continuous orgasm. Women who are multi-orgasmic can have any combination of the above. It is important to remember that your partner’s orgasm (like your own) will be somewhat different each time.

According to Sexual Kung Fu, women can also direct their energy out of their pelvis and up to their brain, and expand their orgasms throughout their entire body. This circulation of *chi* will energize your partner just as it energizes you. Women in general are less genitally focused than men and, as a result, have an easier time experiencing and expanding their orgasms throughout their bodies. Perhaps as a result of this diffusion, many women are genitally “preorgasmic” (that is, have never had a genital orgasm). In a later chapter we offer techniques for preorgasmic women to become orgasmic as well as techniques for orgasmic women to become multi-orgasmic.

It will be much easier for you to become a multi-orgasmic man if your partner enjoys long periods of lovemaking. More couples suffer from the man's not being able to last long enough than from the woman's growing tired before the man. However, the latter can he the case if you become multi-orgasmic and she does not. Although it is important not to pressure her and to accept her desires for more or less pleasure, you should encourage her to explore her potential through the chapter written for her. We also offer suggestions for couples for whom there is a serious imbalance in sexual appetite. Most women, however, will want to help their partners become multi-orgasmic, and the most important thing your partner can do to help is to explore her own pleasure and cultivate her own sexual satisfaction.

Her Arousal

Most women take longer to become aroused than most men, but once women are aroused, their desire can generally outlast that of their partners. (As a Sexual Kung Fu practitioner, you will be an exception to the second part of this rule.) According to Taoism, men are like fire and women are like water. Fire ignites quickly but can easily be quenched by water. To satisfy your lover, you need to bring her desire to a boil, which requires that you keep your fire burning long

enough to do so. The secret to satisfying your partner is to understand the stages of her arousal and to learn how to synchronize your arousal with hers.

HOW DO I KNOW WHEN A WOMAN'S DESIRE IS BOILING? Taoist physicians recorded the stages of arousal they noticed in women. Many of their observations have been confirmed by Western research, especially by Kinsey in a chapter of his *Sexual Behavior in the Human Female* entitled "Physiology of Sexual Response and Orgasm." We note the stages here not to make women feel self-conscious but to help men understand how to better satisfy their partner's desires. As you are reading about these general stages, it is important to keep in mind Kinseys conclusion about the uniqueness of each person's sexuality: "There is nothing more characteristic of the sexual response than the fact that it is not the same in any two individuals."

With this said, we could not have a better guide to a general description of women's arousal than Su Nü, one of the Yellow Emperor's trusted female advisers. The Yellow Emperor once asked her, "How can I tell if the woman is experiencing pleasure?" Su Nü replied that there are Five Signs, Five Desires, and Ten Movements that demonstrate a woman's growing arousal. The Five Signs and Five Desires describe what happens to a woman's body as she becomes aroused, while the Ten Movements describe how her actions convey what she wants you to do next.

Before describing these secrets of women's arousal, it is worth mentioning that we live in more open and direct times than did Su Nü, and you do not have to limit yourself to reading the tea leaves of your partner's body. You can also ask her what she wants; better still, she may tell you. However, the throes of lovemaking are not always conducive to speech, let alone a clear statement of preferences. Passion overwhelms language, and it is at this time that it will help if you have learned to recognize a woman's mounting pleasure. Before or after lovemaking, you can discuss with your partner whether Su Nü understood her individual desires. It should go without saying that consent is essential in any sexual encounter, and the fact that you notice that the body of the woman you are dating is becoming aroused means nothing unless her mind wants to act on it. "No" means no, regardless of what her body says.

The Taoist texts were at times extremely direct and at other times quite vague. Some of the stages of arousal will seem clear, even obvious, while others may seem too subtle to detect. The Signs, Desires, and Movements overlap somewhat and are difficult to keep straight, so we will try to simplify them below. Remember that these are general signposts and not an exact road map. Don't expect to notice each stage each time you make love, and do not wait to check on each one before proceeding. Above all, lovemaking should be fluid and spontaneous, and these signposts will simply help you stay on the right course.

THE SIGNS OF DESIRE

As ejaculatory control begins with breathing, so too does passion, and the first signal you will have of your lover's desire is a change in her breathing, which will become increasingly rapid and shallow. According to Su Nü, if her nostrils flare and her mouth widens and she embraces you with both arms, she wants your and her genitals to touch. When her body quivers, she wants you to touch her genitals gently, If her face becomes flushed, she wants you to play with the head of your penis around her mons, and when she stretches out her legs, she wants you to rub the head of your penis against her clitoris and the entrance to her vagina.

Su Nü continues: If her nipples harden and she pushes out her belly, slowly and shallowly enter her. If her throat is dry and she swallows saliva, slowly begin to move inside her. If she starts to move her bottom, she is experiencing great pleasure. If her vagina is well lubricated or if she raises her legs to encircle you, enter her more deeply. If she presses her thighs together, her pleasure is becoming overwhelming. If she moves from side to side, she wants you to thrust deeply from side to side. If she is perspiring enough to dampen the sheets or she straightens her body and closes her eyes, she wants to orgasm. If she arches her body against yours, her pleasure has peaked. If she stretches out and relaxes, pleasure fills her entire body. If her vaginal secretions spread down her thighs and over her buttocks, she is fully satisfied and you should slowly withdraw.

Now that we have discussed what signs to *recognize* in your partner's mounting desire, we must discuss how to *satisfy* that desire, which we do in the following chapter.

Becoming a Multi-Orgasmic Couple

Controlling your ejaculation while self-pleasuring is one thing, but controlling it during the throes of lovemaking is quite another. The control you have developed over your breathing, your concentration, your PC muscles, and, most important, your sexual energy will help you immeasurably in becoming multi-orgasmic with your partner, but you also need to know the duo practice for lovemaking.

Pleasuring Your Partner

Unlike men's arousal, women's has no precipice. True, many women will have orgasms that they find so fully satisfying (and climactic) that they do not need to continue making love. And as we discussed earlier, some women even ejaculate. But since women do not have to worry about losing an erection or spilling their seed, they can generally surrender themselves to pleasure in a way that men cannot. Nevertheless, women do not fall into bliss without effort. Reaching orgasm, multiple orgasms, and expanded orgasms requires knowledge, skill, and effort of women just as it does of men. Here's how you can help.

In Sexual Kung Fu all aspects of touch are seen as part of the union between man and woman. Touching hands or lips is as much a part of harmonizing with one another as is intercourse. As with self-pleasuring, you probably have your own way of pleasuring your partner, and though most women have the same general erogenous zones, each woman, of course, has different sensitivities at different times. Try out these Taoist techniques, but let your partner's preferences be your guide.

"The essence of foreplay is slowness," states the *Discourse on the Highest Tao Under Heaven.* "If one proceeds slowly and patiently, the woman will be exceedingly joyful. She will adore you like a brother and love you like a parent. One who has mastered this Tao deserves to be called a heavenly gentleman." Because anticipation and growing intensity are important in bringing your partner's desire to a boil, you should begin with passionate kissing. Begin at her extremities rather than her genitals. Caress, massage, and kiss her hands and wrists as well as her feet and ankles. Move up her arms and legs to her abdomen. Stimulating points along the meridians of her body (energy channels) will help increase her sexual excitement: there are many points along or near her spine (the Back Channel), such as the small of her back, her neck, and her ears. The underside of the arms and the inside of the thighs are also very sensitive on most women. By *caress,* we mean that your touch should generally be featherweight, although it can be heavier when you are stimulating larger muscles such as her buttocks.

HER BREASTS

As we mentioned earlier, when you approach her breasts, spiral around them in ever narrower circles until you slowly reach her nipples. Most men go for the nipples too soon. (Old breast-feeding instincts, perhaps.) Circling them slowly will draw her sexual energy to her nipples. Also, remember to rub your thumbs and forefingers together to generate more *chi.* Finally, touch her nipples lightly, and try rolling them between your thumbs and index fingers. (You can touch both breasts or just focus on one at a time.) Some women enjoy harder squeezing and fondling, but let your partner's responses guide you. As we already mentioned, your tongue is highly charged with *chi,* and using it to lick, spiral around, and suck on her nipple is often an excellent way to arouse her. If her nipples become engorged and erect, you are doing something right.

HER GENITALS

In approaching your partner's genitals, it is best to stimulate her inner thighs, mons, and vaginal lips before approaching the clitoris. Imagine that you are moving through concentric circles of increasing pleasure and intensity. When you finally approach her clitoris, her sexual energy and excitement will be enormous.

Each woman likes to have her clitoris touched differently, and you need to become the expert in her particular pleasure. Even more important than where to touch is how to touch. Using your finger, stroke or spiral evenly – not too fast, not too slow. Avoid big movements: the clitoris's sensitivity is far more concentrated than that of the penis, and you are better off with more focused, subtler movements than with the kind of vigorous stimulation that most men enjoy.

As for where to touch, you are best off starting with the less sensitive parts of this very sensitive sex organ. Try stroking the base and sides of the clitoris. Then try stroking the hood and rolling the clitoris between your thumb and index finger – gently! Remember to touch the hood first, before touching the extremely sensitive glans. Experiment with different strokes and varying degrees of pressure. If your partner likes it, she will push her genitals slightly toward you for more stimulation. Moans, sighs, pants, jerking muscles, curling toes, and sweat, as well as smiles and other facial expressions, are all good signs. If your touch is too heavy or uncomfortable, she will pull her pelvis slightly away. Lighten up or try another stroke.

TONGUE KUNG FU

Although effective, fingers are not ideal, because they are not nearly as sensitive as your partner's clitoris. The hardness of the bones in your fingers and the sharpness of your nails can be painful. (Always make sure your nails are short and smooth.) For this reason, your tongue is much better suited to the task.

There have been many jokes about oral sex and its attendant smells and tastes. There are men who grimace at the thought and men who smile with fond memories. One multi-orgasmic man described his conversion to an oral-sex fan: "In the past, I definitely didn't like to use my tongue because it felt like I wasn't getting anything out of it. I was kind of selfish, really – I was a getter. And now my partner will be having these incredible orgasms because of what I am doing with my tongue, and it feels great to watch. I even start tingling in my body. It's true what the Tao says about when you are in tune. I get by giving. This is something a lot of guys miss. I know I did for a long time." Whatever your personal feelings are about oral sex, you should know that it is probably the fastest way to get a woman's vaginal juices flowing in preparation for lovemaking. As we discussed earlier, it is also the easiest, and for some women the only, way in which they have an orgasm.

If you are not a cunnilingus fan, you do not have to dive in headfirst. If you use your tongue on your partner's clitoris, your nose and face will be nearest her mons and lower abdomen. If it is the odor that you object to, you and she can try bathing together or using scented oils. (We should mention that many men are turned on by, or overtime come to be turned on by, the smell of their partner's vagina.) Best, of course, is not to focus initially or exclusively on her clitoris: use your tongue to touch her inner lips, the sensitive spot at the base of her vagina, and her perineum as well.

It is also important not to get overly fixated on her genitals to the exclusion of the rest of her body. Some women feel disconnected during oral sex, and this feeling can be lessened by using your hands to continue caressing her legs, belly, breasts, hands, and face. Many women find that having their nipples stimulated during oral sex can heighten their pleasure immensely. Other women find that this distracts them from the intensity of clitoral stimulation. As for clitoral techniques, you probably will want to try a combination of brushing with your lips, flicking with your tongue, and sucking with your mouth. Alternating between using your tongue and gently sucking her clitoris into your mouth can be extremely pleasurable. Again, be careful of too much pressure. Light, consistent, and rhythmic pressure is generally best.

Many men mistakenly think that oral sex involves inserting their tongue into their partner's vagina. This is not generally the case, since the tongue is usually too short and too soft to stimulate a woman's vagina successfully, although Taoists do recommend a technique for stimulating the G spot by hooking your tongue and pulling back. It's worth a try – especially if you have a strong tongue!

(You actually can strengthen your tongue by sticking it out and then pulling it in like a snake as fast as you can for a minute or two. Practice as often as you can.)

ENTERING HER

Generally, your fingers are more effective than your tongue for stimulating the inside of your partner's vagina. You can use one finger (or, if she's very aroused, two fingers) to enter her. Circle around the wall of her vagina to find where she is most sensitive. Don't forget to try the G spot about an inch or two behind her clitoris. You may also wish to thrust your fingers in and out (slowly at first), simulating the action of your penis.

At this point, your partner's desire is probably close to boiling and she is eager for you to enter her. But do not enter her quite yet. Hold your penis in your hand as if you were about to guide it into her vagina. But before entering, rub the head of your penis against her clitoris. This will help bring her passion to a rapid boil. Then enter her gradually, first about an inch, then two, and then pull back a little so that your penis is just inside the entrance to her vagina. This slow, lingering approach will help you control your own desire and will allow you to begin a thrusting pattern, which will bring both of you to the peak of pleasure many times.

If she is multi-orgasmic, you may want to help bring her to orgasm before you enter her, or you may want to wait until you have entered her. If she has already orgasmed at least once, she may be more patient with your need to stop momentarily during lovemaking as you approach the point of no return. Also, when you are making love her orgasms actually will help you control your ejaculation. As the Taoists understand it, water (vaginal fluid) cools down fire. As you gain greater mastery over your urge to ejaculate, this will be less of a concern because you will be able to use your breath and your mind more effectively to control this urge and will need to interrupt the rhythm of lovemaking less often.

CHARGING HER EROTIC CIRCUITS

While pleasuring your partner, you should try to avoid sexual Scripts or patterns of lovemaking that can become routine. The sequence for pleasuring your partner described in the previous section is not the only one. It generally follows the pattern of arousal for most women, but not necessarily all women and certainly not at all times. During a "quickie," for example, you might want to jump right to oral sex. Mix and match. See what your partner wants and what the mood of

the moment is. Although techniques can help you satisfy your partner, it is worth bearing in mind Herant Katchadourian's advice in his *Fundamentals of Human Sexuality:* "A simplistic search for bodily levers and push-buttons, leads to mechanical sex since the energy that charges the erotic circuits is emotion." Knowledge of your partner's body is essential, but there is no substitute for sincere affection.

Thrusting Techniques

Most porn movies portray men thrusting in and out, sawing away until they ejaculate. It is no surprise that this is therefore what most men think they should do. In fact, this thrusting rhythm is a recipe for fast ejaculation and little satisfaction for either the man or the woman. The Taoists recognized that proper thrusting was essential for coital pleasure, ejaculatory control, and sexual health. Yet even more important than any particular technique is making sure your partner is already highly aroused. Thrusting in too soon (before she is highly lubricated) should be avoided at all costs. Even if she is eager for you to enter her, a slow hand and pelvis will raise her anticipation and help you control your ejaculation.

FINDING YOUR RHYTHM

The Taoists developed numerous different thrusting patterns, most of which involved varying between shallow thrusts and deep thrusts (see figure 20). All of these patterns encouraged the man to thrust shallowly a number of times before thrusting deeply, the most common involving *nine shallow and one deep.* (As you learn to control your ejaculation, you can lessen the ratio to six or even three shallow to one deep.)

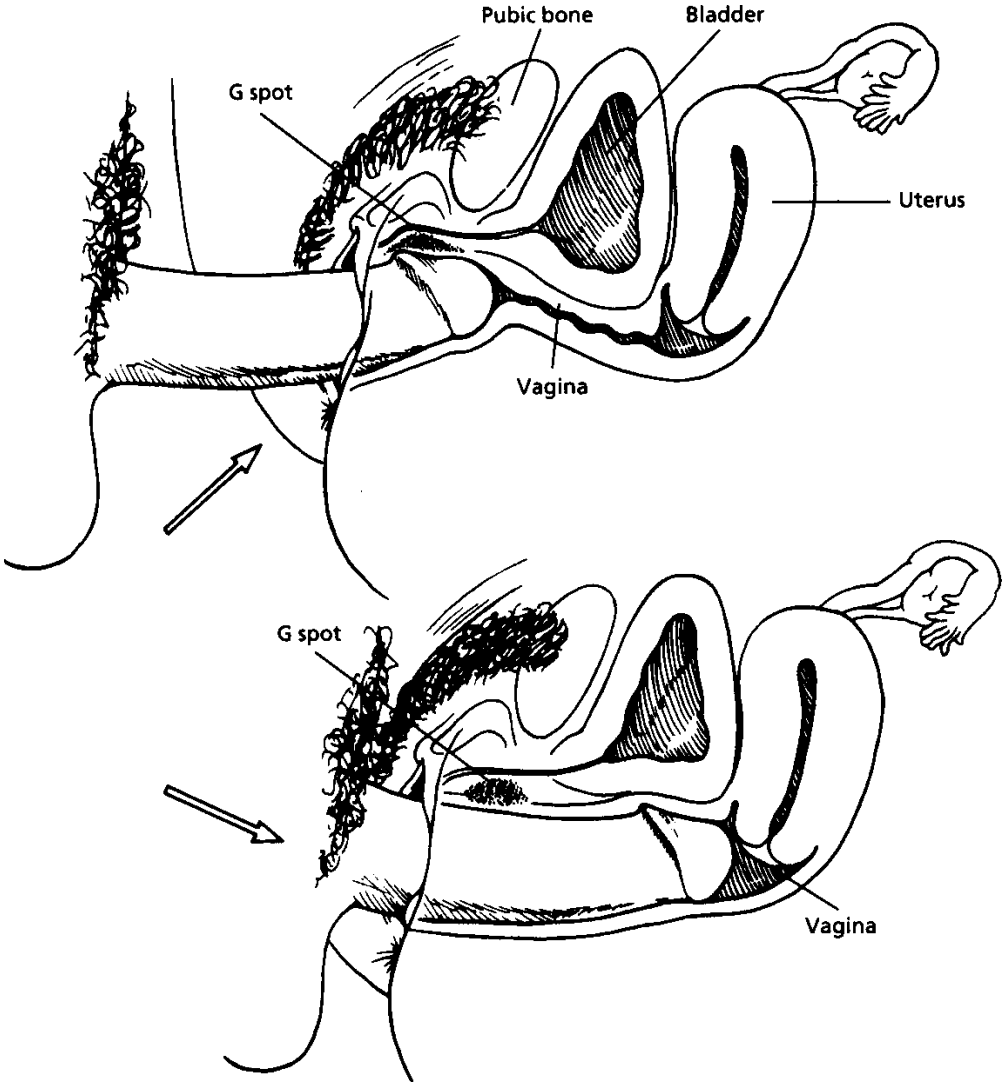

Figure 20 - SHALLOW AND DEEP THRUSTS

Alternating between shallow and deep thrusts will not only help you last longer; it will also thrill your partner. The deep thrust pushes all of the air out of her vagina, creating a vacuum, which the shallow thrusts intensify. You want to avoid withdrawing completely, which breaks the seal of the vacuum; instead, pull back so that you are about an inch or so inside her. One multi-orgasmic man described his experience: "When I read about this Taoist thrusting technique I really didn't believe it would work, but women just go crazy: they *love* the shallow and deep. They orgasm a lot quicker and can have two or three before I get to one. In the past, I couldn't last long enough to get a woman to that point."

More important than any particular number of shallow and deep thrusts is practicing a basic rhythm that you can maintain and that both you and your partner can enjoy for prolonged periods of time. Don't allow your thrusting to become mechanical by getting lost in counting off numbers.

DEEP THRUSTS

When most men thrust deeply, they pull back all the way, which rubs the head of their penis – their most sensitive spot – against the full length of their partner's vagina. If you have difficulty getting or maintaining an erection, this in-out deep thrust is especially valuable (see the Soft Entry exercise). However, as you can imagine, this thrust is also highly arousing and ordinarily leads to quick ejaculation.

For this reason, the Taoist masters developed the up-down deep thrust. This thrust uses the base of your penis, which is your least sensitive spot, to stimulate your partner's clitoris, which is her most sensitive spot (see figure 21). The benefits for postponing ejaculation are obvious. Instead of pulling back, you can stay deep inside your partner and thrust up and down repeatedly. This is especially important when she is in the midst of orgasming and wants you deep inside her but you are close to the edge.

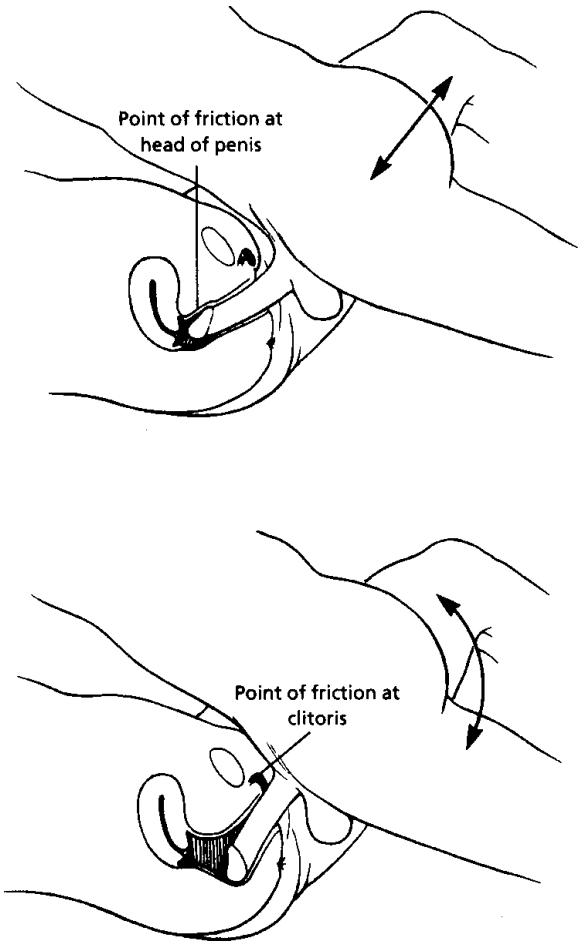

Figure 21 - IN-OUT THRUST VS. UP-DOWN THRUST

Keep in mind that women's clitorises differ in their proximity to the vagina, which may be one reason that some women are more easily orgasmic during intercourse than others. You will be able to stimulate some women clitorally just by using the up-down deep thrust, while others will need the help of your fingers. Either way, this thrust will help you immeasurably during the most intense throes of lovemaking.

DIFFERENT DIRECTIONS

In addition to depth, you can also vary the direction in which you thrust. According to Chinese medicine, the parts of the vagina, like the parts of the penis, correspond to the organs and glands of the body (see figure 22). To truly satisfy and energize your partner, you will need to stimulate her entire vagina during lovemaking. This may seem like a lot of work, and you will not be able to do it every time you make love, but the more of her vagina you can massage with your penis, the better.

Begin by thrusting shallow – left and right, top and bottom. Then thrust deep and, while staying deep, use the base of your shaft to rub up and down against your partner's clitoris and the head of your penis to rub gently against her cervix. Now pull back at an angle, which stimulates the walls of her vagina. (Once you have learned to differentiate between shallow and deep, you can also explore the middle depth.) Remember, women have different spots of greatest sensitivity, so thrusting in different directions has the greatest chance of satisfying your partner.

In addition to depth and direction, you can also vary the speed at which you thrust. The seventh-century physician Li Tung-hsüan Tzu waxed poetic about nine different kinds of thrusts that offer your partner a range of depths, directions, and speeds:

1. Strike left and right as a brave general breaking through the enemy's ranks. [The battle-of-the-sexes imagery was not completely absent from Taoist sexuality.]

2. Rise and suddenly plunge like a wild horse bucking through a mountain stream.

3. Push in and pull out like a flock of seagulls playing on the waves.

4. Use deep thrusts and shallow teasing strokes, like a sparrow plucking pieces of rice.

5. Make shallow and then deeper thrusts in steady succession [to the left and right], like a large stone sinking into the sea.

6. Push in slowly as a snake entering its hole.

7. Charge quickly like a frightened mouse running into its hole.

8. Hover and then strike like an eagle catching an elusive hare.

9. Rise up and then plunge down low like a great sailboat in a wild wind.

In the end you will put the various thrusts you have learned together in your own special pelvic rhythm depending on the time and place – and the pleasure desired.

The Advanced Art of Screwing

When most men thrust, they stimulate only a small part of their partner's entire vagina. This is why advanced Sexual Kung Fu involves "screwing" rather than "thrusting." Although the word *screw* has come to have vulgar connotations in our culture, it is actually quite accurate to describe the spiraling action the Tao suggests for truly pleasuring your partner (and yourself). Instead of thrusting forward and pulling back, you should "screw" your hips or ideally your sacrum in half circles, first on one side and then the other. One multi-orgasmic man explained his technique: "I will go in circling and come out circling. Play with one side and then play with the other side. I go shallow and then I go deeper, playing with one side and then the other. And then I do a lot more circles. And I've found that a lot of women really love this, especially when having their later orgasms."

More experienced lovers the world over have discovered the effectiveness of moving their hips during lovemaking, and many men find that rocking their shoulders initially helps them to rotate their sacrum or their hips. Your hips, however, are not nearly as subtle and effective as your sacrum, which sits at the center of the pelvis (see figure 23), According to the Tao, it is the sacrum that controls the penis.

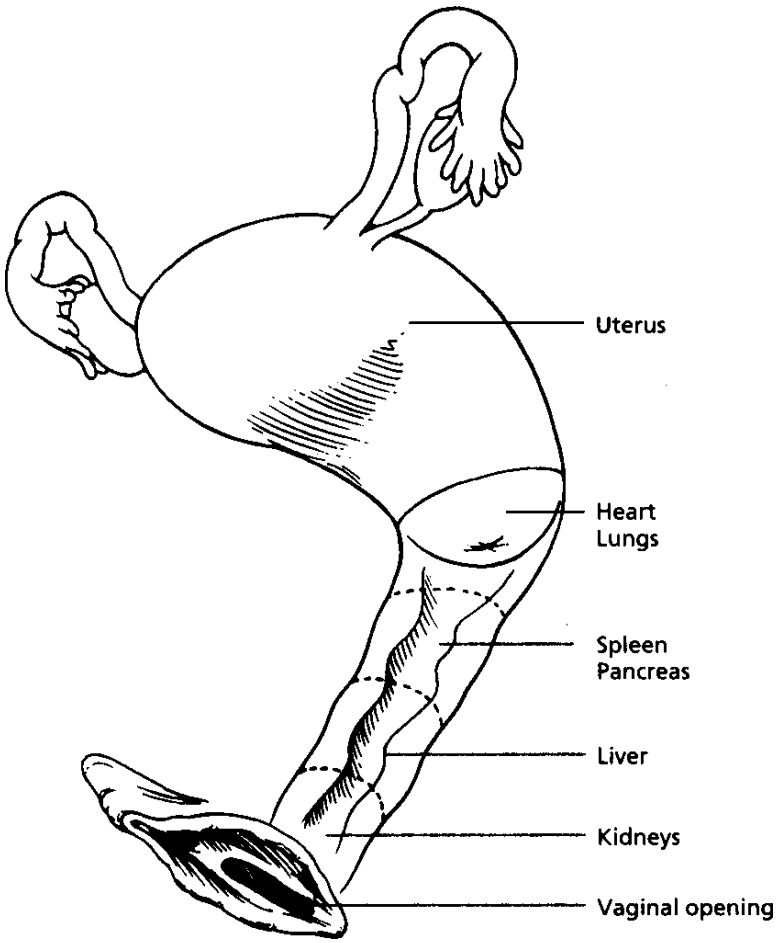

Figure 22 - REFLEXOLOGY POINTS OF THE VAGINA

FINDING THE WAY

Rotating Your Sacrum

At first your rotations will probably come from your hips or pelvis, since, unless you do a lot of Latin or African dance, you are probably not used to rotating your sacrum. Give it time, hut eventually you will be able to spiral, to “screw,” with subtle movements of your sacrum. To isolate your sacrum, put one hand on your pubis and one hand on your sacrum and try to spiral left and then right. Next, try tilting your penis up as you push your tailbone (the base of your sacrum) forward (curving your back out slightly), and then try tilting your penis down as you push your tailbone back (arching your spine slightly). Once you have isolated your sacrum, you can really screw.

According to the Tao, a nail (thrusting straight in) comes out easily, but a screw (circling) stays in a long time. Elvis Presley used these pelvic (actually, sacral) gyrations onstage to great effect and great popularity, and you will find that you are met with similar applause in the headroom once you master this technique.

There is even a time and a place for the old bedspring-squeaking hard thrusting, especially if' your partner likes very deep penetration and you have a lot at' control. One multi-orgasmic man explained: “Women usually like the hard thrusting later on after they are relaxed. If it's too soon, it can be a bit painful. So as the night goes on I find myself thrusting harder because their passion is ready for it. If it gets to be too much for me, I really need to breathe and if absolutely necessary sometimes to pull out and use my tongue and fingers.” One of the benefits of using a condom – one that we discuss in the section called "When to Start: A Few Words About Safer Sex” later in this chapter – is that by desensitizing your penis you can make your lovemaking last longer, especially if your partner wants you to thrust hard and deep. But you need to make sure you stay connected to your groin and monitor your rising arousal rate.

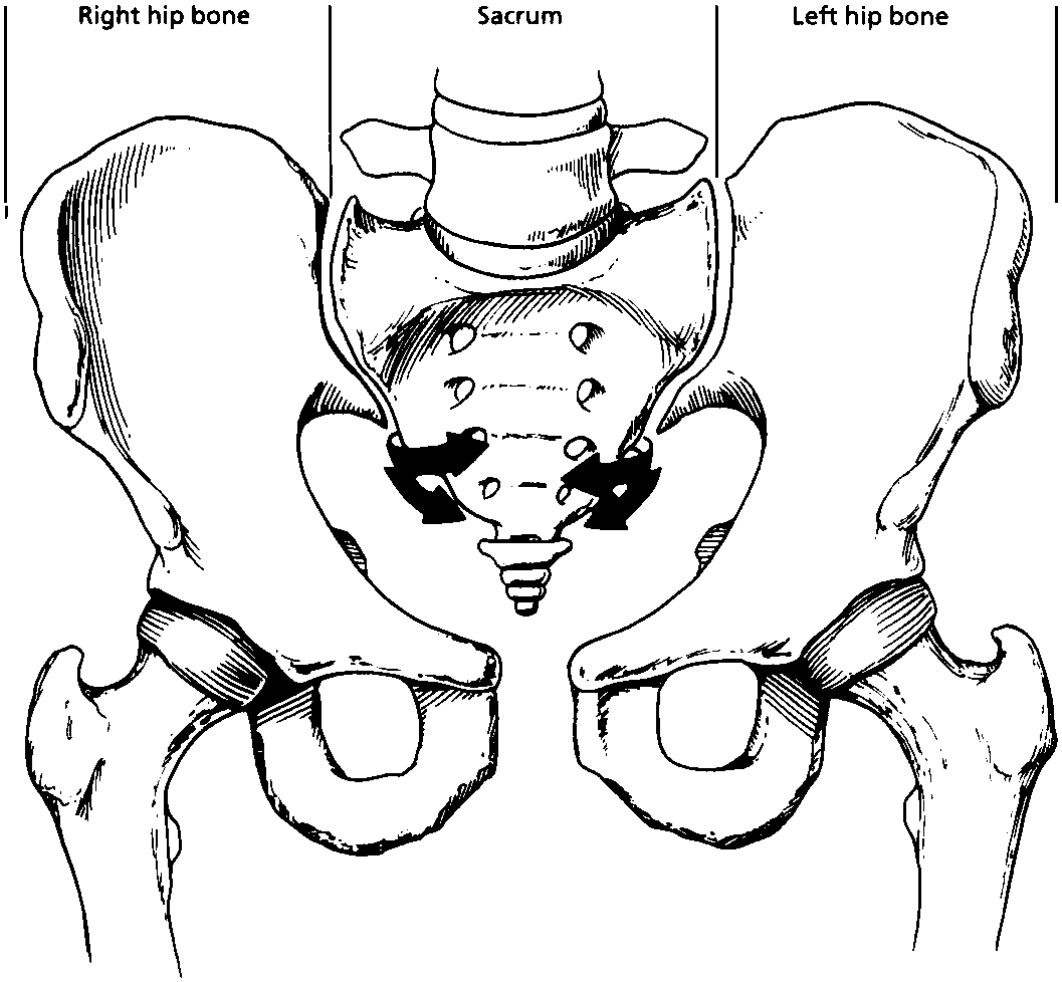

Figure 23 - ROTATING YOUR SACRUM

The more you practice, the more control you will develop and the less you will need to pull out. One multi-orgasmic man explained what he does when he approaches the point of no return: “When I am making love and start feeling like I am going to come, I really try to listen to my body, and share with my partner where I am and how close I am getting. And if I get real close, I’ll stop and do the deep breathing, which will get my body to relax.”

You are almost always better off starting with slow thrusts or spirals. (The Taoist practice is the opposite of the hurried, short, and selfish sentiment expressed in the popular description of male sexuality "Wham, barn, thank you, "ma’am.”) Like all physical and spiritual practices, lovemaking requires both discipline and innovation. You are interested in both: a general pattern of pleasurable thrusting/screwing and a variety of spontaneous changes in depth, speed, and direction.

The Big Draw for Two

We introduced the Big Draw technique before but will discuss it here for you to practice with your partner. In the Big Draw during lovemaking, you will both be trying to multiply and expand your orgasms within yourselves. In the Soul-Mating exercise described later in this chapter, you will also learn to exchange sexual energy with your partner, but for now simply learn to circulate your sexual energy within your own body.

We have divided this practice into its sequential stages so that you can learn it more easily, but when you use it with your partner, it should blend together into a fluid and graceful experience.

It may seem difficult at first to stop yourself from ejaculating given all the pleasurable sensations and expansive desire you feel with your partner. You should keep in mind that you are training your body in this practice and that each time you succeed it becomes easier the next time.

The time between when you start to experience arousal and when an orgasm is imminent is the time you should draw the energy up. If you wait too long, you may not be able to stop it from pouring out. As you become able to separate orgasm from ejaculation, you can draw the energy up as you are experiencing the contractile-phase genital contractions, expanding the orgasm throughout your body.

If you have trouble drawing the energy up to your head, first draw it up to your tailbone and feel it entering your sacrum and the point on your spine opposite your navel from where you can pour the energy into the navel. Once it has pooled there, try to draw it the rest of the way to your head.

TALKING WITH YOUR PARTNER

At first the Sexual Kung Fu practice may seem a little awkward and an interruption in your lovemaking, but it will quickly become increasingly natural and part of a less frenetic, but much more meaningful and pleasurable, style of lovemaking. However, in the meantime it will require support and patience from your partner, which is why it is important to explain to your partner what you are doing. One multi-orgasmic man remembered: “My girlfriend responded in a very open and positive way. Her reaction was certainly influenced by the fact that our sex quickly became more beautiful. It was also quite important that I practiced often by myself so I rarely had to interrupt our lovemaking to control ejaculation. Of course, it was certainly necessary to explain to my partner what I was doing so she could understand the process.”

You can encourage your partner to read, but if timing and passion do not afford you this opportunity, you will want to tell her in a few breathless words what you are doing. One multi-orgasmic man described how he explains his practice: “I tell the woman I am with that my sexual philosophy now is this Taoist philosophy. And I ask her for help. Usually I wait until after we’ve been in bed for a while, and I’ll say, ‘There’s going to come a time where I may need you to help me to stop. You know, I might need to withdraw, I might need to have a little bit of slowing down.’ So I let them know why I might want to do that, and what my thinking is. I find that women really respect it and they love hearing about it and it is exciting to them.”

EXERCISE 12

THE BIG DRAW DURING LOVEMAKING

EMBRACE When you are both highly aroused, stop and hold each other. Look deeply into each other's eyes. Truly see your partner's inner goodness, and express the depth of your love for her with your eyes. Keeping your eyes open also helps bring the energy up. Send each other energy through your gaze, your lips, the palms of your hands, and the surface of your skin.

THRUST/SCREW When your partner is highly aroused, use the head of your penis to rub her inner vaginal lips and especially her clitoris. When she is ready, you will be able to tell by her swollen lips and clitoris and the abundance of her vaginal juices. Enter your partner slowly. You may want to start with a pattern of nine shallow thrusts and one deep thrust. (Remember, these are general guidelines, not rules.)

CONTRACT While still inside your partner, lightly contract the head and base of your penis and your PC muscle. You will be using your mind as well as your pelvic muscles to squeeze these "round" muscles. If necessary, use your fingers to squeeze the base of your penis.

PAUSE When you feel you are near orgasm, pull back so that only about an inch or two of your penis (the head, mostly) is inside your partner's vagina. Make sure you communicate to your partner that you are close to the edge and that she needs to avoid pushing you over the edge. (Pull out all the way only if absolutely necessary.)

DRAW Squeeze your anus and use your mind to draw the energy up from the tip of your penis, through your perineum and tailbone, and up your spine to your head (see the Cool Draw and the Big Draw). This will help spread the orgasmic energy from your genitals, decreasing the urge to ejaculate while expanding your orgasm from a genital orgasm to a whole-body orgasm.

RELAX Relaxing allows the blood vessels in your penis to dilate and allows you to exchange more of your sexual energy with your partner. Your erection may decrease somewhat, which will let the hormone-filled blood return to fortify the rest of your body and allow new blood to flow into your penis when you get hard again. Continue holding each other, kissing, and circulating energy. When ready, you can continue thrusting/screwing and repeat the Big Draw until both of you are completely satisfied.

It is essential that you tell your partner enough so that she can support your practice. As one multi-orgasmic man explained, “When I am really starting to feel my pumpers wanting to start to pump, I have to slow down more often and sort of just breathe and do the practice. And that’s when I start explaining to them what I am doing and why I am doing it, why it is important to me and I think it is important to both of us. Before I explain what I am doing, a lot of women,

when I say I am about to come, will say, 'Well, come, come. I like it when you come.' That's when I say, 'I really appreciate that you want to do that for me, but I don't want to come because I don't want to fall asleep right away. I want to have fun. I want to keep my energy up.' And they just understand why, every once in a while, I will need to pull back and take some deep breaths."

Positions for Pleasure and Health

The Taoists were highly inventive in coming up with new and interesting sexual positions, However, for the Taoists these positions were not just for variety; each had a different energetic and healing function. They believed that love expressed through sexuality was the most potent medicine, and a Taoist physician might prescribe several weeks of dedicated lovemaking in a specific position for a particular ailment. If you want to explore these various positions with your partner and use them for self-healing, they are described in *Healing Lowe Through the Tao: Cultivating Female Sexual Energy* (see appendix). Here we will give the basic and most important positions;, as well as some general advice for whatever position you choose. These positions can help enormously in accommodating different body sizes and genital sizes, as well as stimulating different sexual sensitivities. As you and your partner refine your understanding of your sexual pleasures, you will be able to select positions that match these preferences.

FINDING THE WAY

Basic Guidelines

Before we discuss specific positions, there are two basic guidelines that will help you select the correct position for the mood and moment.

1. For relaxing and harmonizing with your partner, place similar body parts together: lips to lips, hands to hands, genitals to genitals. For stimulating and exciting one another, place dissimilar body parts together: lips to ear, mouth to genitals, genitals to anus.

2. The person who moves (generally the person on top) gives the most energy to the other partner. The person underneath can move as well to complement the movement of the person on top. This will help expand, circulate, and exchange the *chi* more quickly. In the West we assume that the person on top is dominant. How different is the Taoist understanding that the person on top is actually serving the other by sending the most healing energy to him or her. Passion and health, not power, are the main concerns of the skilled Taoist. Your lovemaking should observe these guidelines so that you and your partner both harmonize and excite, heal and are healed.

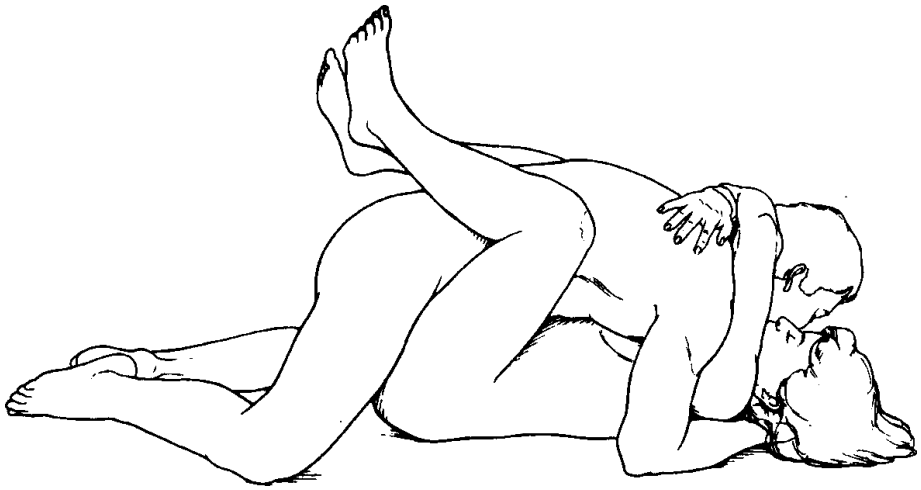

Figure 24 - MAN-ON-TOP POSITION

MAN ON TOP

Even before missionaries made their way to China, the Taoists were well acquainted with the position in which the man lies on top of the woman, usually supporting himself on his hands or elbows. One of the primary benefits of this position is that you and your partner can gaze into each other's eyes and kiss passionately. The face-to-face position is deeply satisfying to your emotions and sense organs, all five of which (eyes, tongue, ear, nose, and skin) come into direct contact. These organs, especially your tongue and eyes, are major carriers of life-force energy (see "Sexing the Spirit" later in this chapter).

In this position your partner can run her hand along your spine to help you draw your energy up to your head. Also in this position many parts of your body – legs, belly, chest, and so on – are in contact with hers, and your weight on your partner's pubic bone and breasts can help her become aroused quickly. This position also allows you to use your thrusting and screwing techniques, both to satisfy your partner and to maintain control of your arousal.

The main drawbacks of the position are that your hands are usually involved in holding yourself up and that your partner's G spot is bypassed almost entirely unless you tilt your sacrum and angle your penis up. You can address this problem by having your partner place a pillow under her buttocks so that her pelvis is tilted back. She can also drape her legs over your arms or shoulders, which has the same effect as the pillow and also allows you to penetrate more deeply. The higher her legs, the deeper the penetration. This is especially helpful if your partner has a relatively large vagina and you have a relatively small penis.

Remember that according to Taoism, man is like fire and woman is like water. Since women take longer to boil, it is often good for the man to begin on top. When the woman's desire is boiling and risks quenching the man's fire (causing him to ejaculate), you may wish to switch to the woman-on-top position, which allows the man to concentrate more easily. In this position, however, the woman must be willing to stop as the man draws close to the point of no return.

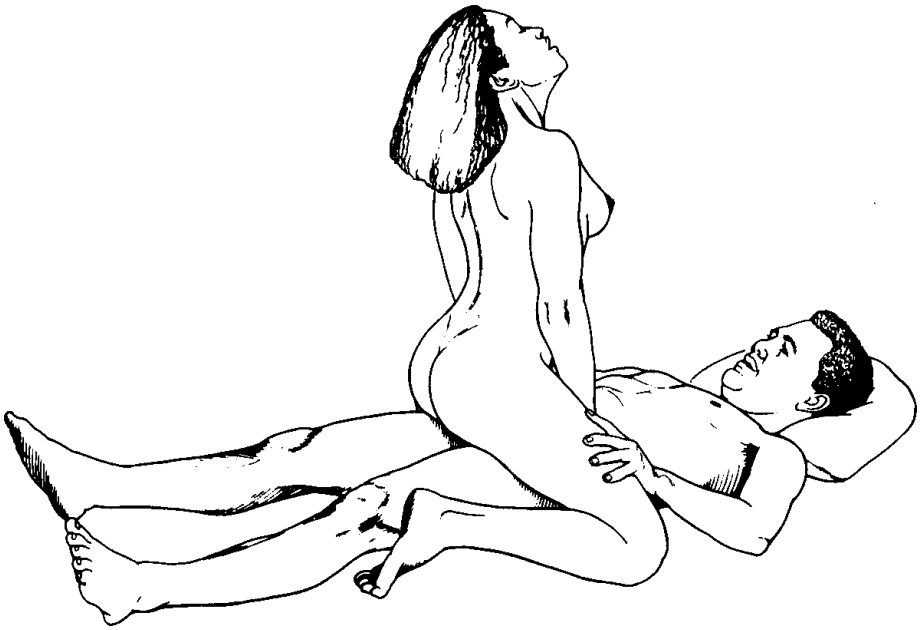

Figure 25 - WOMAN-ON-TOP POSITION

WOMAN ON TOP

In this position, the man lies on his back and the woman straddles him. Most men find that this is the easiest position in which to learn to control their ejaculations and to become multi-orgasmic. The reason for this is that you can relax your pelvic muscles in this position and pay close attention to your arousal rate. Gravity also assists in ejaculatory control, and the man can focus on directing the energy up his spine.

Your partner, in this position, can also direct your penis to the most sensitive places in her vagina, including her G spot, which is one reason that for many women this is the easiest position in which to be (multi-)orgasmic. Your partner can also keep the head of your penis in the most sensitive outer two inches of her vagina. It is difficult for a man to remain in only the first two inches when he is on top, since he tends to want to plunge deeper into the tighter area – which, of course, also finishes him off faster. In this position your partner can spiral her sacrum so that your penis rubs against the walls of her vagina at any depth and in any direction.

In this position, you can also use your fingers to stimulate her clitoris and help her to climax. Another benefit of this position is that you can suck or fondle your partner's breasts while making love. According to the ancient Taoists, you can drink in your partner's sexual energy from her lips, her vagina, *and* her breasts.

This position is also especially good when the man is significantly larger than the woman or tends to ejaculate quickly, or when the woman is in the later months of pregnancy (her growing belly does not get squeezed). Older men and men with heart problems also find this position of great value, since they are not required to exert a lot of energy.

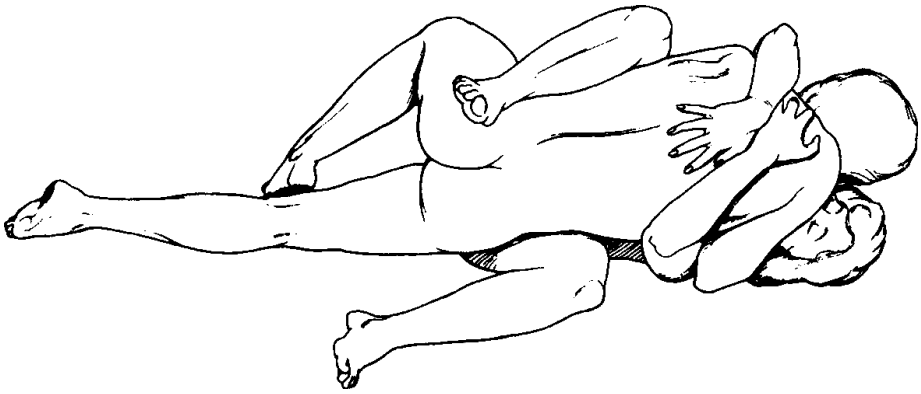

Figure 26 - SIDE-BY-SIDE POSITION

SIDE BY SIDE

This position requires relatively little exertion from either partner and is therefore good for later stages of lovemaking. It does require some skill to achieve and some coordination to maintain, so it is best for lovers who know each other well. It may be easiest to begin with you on top and for you to roll to the right or left into the side-by-side position. In addition to not requiring a great deal of strenuous effort, the position has the benefit of face-to-face and Whole-body contact, both of which allow for greater exchange of energy. However, it can be uncomfortable or awkward unless your partner's body movements and your own are well synchronized. And in this position the penetration of the penis is also quite shallow.

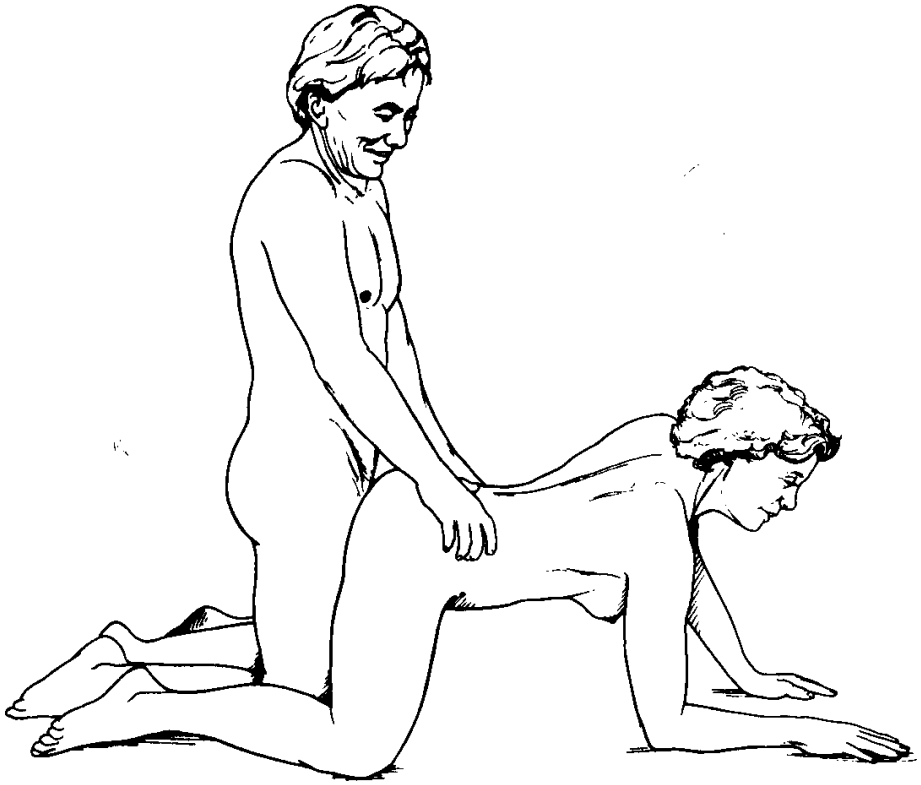

Figure 27 - MAN-BEHIND POSITION

MAN FROM BEHIND

This is the way animals, whose main motivation is impregnation, do it, and with good reason. In this position, as you may have noticed, your partner's vagina feels especially tight, which makes ejaculatory control more difficult. This position is therefore best when you are feeling less aroused or have developed your skill at ejaculatory control. The reason your

partner feels especially tight is that in this position you enter her deeply, which is the reason women who like especially deep penetration tend to favor this position. The depth can be controlled by your partner's angle: the more forward she bends, the deeper the penetration. This position is especially good for men with smaller penises or women with larger vaginas. This position also allows direct stimulation of your partner's G spot, although her clitoris receives relatively indirect stimulation – a situation you can remedy with your fingers.

EXERCISE 13

SOUL-MATING (Exchanging Sexual Energy)

EXPANDING The pleasuring and thrusting and screwing techniques described earlier in this chapter will expand your and your partner's sexual energy to a point where it is ready to circulate. The more lubricated a woman is, the more yin energy she has. As we alluded to before, you can even drink her yin directly through oral sex or from the nipples of her breasts. It will help if you (and, ideally, your partner) have drawn the energy up and are circulating it through your own bodies (that is, through your Microcosmic Orbits).

EMBRACING Embrace your partner in *a* face-to-face position with most of your bodies in contact. If the woman is significantly lighter or weaker, she should be on top. Otherwise, it doesn't matter which person is on top. Remember to look deeply into each other's eyes: eye contact, as mentioned above, is extremely important. Send each other love and energy through your gaze.

BREATHING Coordinating your breathing is essential for exchanging *chi.* Now that you have stopped thrusting or screwing and are holding your partner close, place your nose next to your partner's ear and your ear next to your partner's nose. This will help you hear one another's breathing. Then synchronize your breathing: you can both inhale and exhale simultaneously, or one of you can inhale while the other exhales. Keep your thoughts focused on one another and be conscious of your chests rising and falling in rhythm with one another.

CIRCULATING To harmonize, both you and your partner must be able to circulate energy through your own Microcosmic Orbit as the first step toward balancing the Back Channel, which runs up your spine and is more yang, and the Front Channel, which runs down the front midline of your body and is more yin. Remember to draw energy up by contracting your anus and/or using your mind, and then to guide energy down the front of your body through your tongue.

EXCHANGING

1. After you have been breathing with one another for a while, you should each draw your energy from your genitals up to the crown of your head.

2. Then, while you are both inhaling, you should envision drawing her cool yin energy in from her vagina to your penis. (She should envision drawing your hot yang energy from your penis into her vagina.)

3. You should both continue drawing this energy back to your perineum and then up to your tailbone and finally up your spine to the crown of your head.

4. Then exhale and let the energy descend from the crown of your head through the midline between your eyebrows down your face and through your tongue – which, if your tongue is touching your partner's, will allow you to exchange energy through your mouths. From your tongue, the energy should be brought down the rest of your Front Channel to your navel. (You can also exchange energy from your heart through your chest to her breasts and from there down her Front Channel. She can do the same for you.)

5. Continue breathing and exchanging energy nine to eighteen times, or as long as you like.

Sexing the Spirit

It is no secret that most people experience transcendence more intensely in their bedrooms than they do in their churches, synagogues, temples, or mosques, Lovemaking allows us to transcend the limits of our physical body, to fuse with another human being, and occasionally even to feel at one with the universe.

According to the Tao, heaven and earth are constantly in sexual union, balancing and harmonizing one another. When we make love we can connect with this universal energy. Healing Tao instructor Stefan Siegrist explained: "With Taoist sexuality one can re-experience the lost harmony (or spiritual oneness) with nature and the universe that is often talked about in philosophy and religion." Unlike some religions, however, Taoism views sexuality and spirituality as inseparable. Spirituality is "embodied," and spirit is seen as permeating the entire physical world, including our own bodies.

According to the Tao, each of us has three overlapping types of energy. In this book, we have been working primarily with the most physical of these three, our *ching-chi,* or sexual energy. But as we cultivate this sexual energy, it is refined into *chi,* or bioelectric energy, which then spreads throughout our entire body. And this in turn is refined into *shen,* or spiritual energy. All three are interrelated and are connected to the body. In this section you will learn to circulate and refine your sexual energy with your partner. This technique will help you expand your orgasm from a purely physical experience to a spiritual one: this is the true nature of soul-mating.

YIN AND YANG

Most people who know anything about Taoism have heard about yin and yang and their complementary and cyclical positions in the symbol of the Tao. Most people know that yin is the *feminine* energy in the universe and that yang is its *masculine* counterpart. These two primordial energies are the electron and proton that allow all creation to occur and allow you and your partner to harmonize and refine your sexual energy. In the words of the *I Ching,* “The interaction of one yin and one yang is called Tao, and the resulting constant generative process is called 'change.'"

According to Su Nü, "Yang can function only with the cooperation of yin, yin can grow only in the presence of yang.” We have both masculine and feminine energies inside each of us, and yin and yang are dynamic forces that actually can change into one another. Many people in the West now argue that *male* and *female* are simply socially constructed gender terms. According to the Tao, however, although there is much variability from individual to individual, men generally have more yang (masculine) energy and women generally have more yin (feminine) energy. The Tao has always recognized that men are also partly feminine and women also partly masculine and that any binary opposition is clearly false. This idea is represented in the symbol of the Tao by a small circle representing the masculine within the feminine symbol and a small circle representing the feminine within the masculine symbol. Each contains a part of the other.

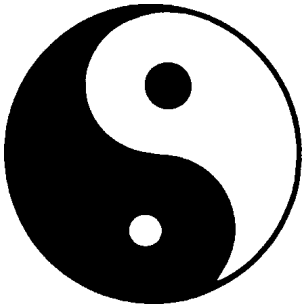

Figure 28 - SYMBOL OF THE TAO

Though we should avoid binary opposition, we must be aware of our different needs, especially in the bedroom, or suffer the consequences. For example, yang is more quickly aroused and also more quickly extinguished; yin is more slowly aroused and more slowly extinguished. Because men tend to be more yang and women more yin, they also can help bring each other into better balance through the exchange of their energy during lovemaking. It is ideal if both partners are consciously aware of how this exchange takes place, and in the next chapter we explain what your partner will need to know about channeling her own energy. It is possible to feel the exchange of energy with a loving partner even if she does not know about Taoist sexuality, but it will be difficult to do exercise 13 without her active and informed participation. The more you can share with her, the easier and more powerful the exchange will be.

Figure 29 - ENERGY EXCHANGE

If you are having difficulty drawing your partner's energy up, you should contract your penis, your perineum, and your anus. Pumping these muscles lightly several times will help you draw the energy up. (You can also rhythmically sip up her energy with short breaths as in the Cool Draw exercise.) Once you have good control over your sexual energy and are not worried about ejaculating, you can send your hot yang energy out your penis and into your partner. She in turn should imagine sending her cool yin energy from her vagina to your penis. You cannot receive her yin energy without giving her your yang energy. Allowing her to absorb your excess yang energy will also help you avoid building up too much energy in your genitals and ejaculating. If you ejaculate, it is difficult to exchange energy, because you lose most of yours. Remember, it is the exchange that is important.

You will probably not be able to open all the points along the spine during your first exchange of sexual energy. It may take many times – it may even take months – but eventually you will feel the warm current between your mouths and between your genitals. "Sometimes," described one multi-orgasmic man, "when we are both orgasming we will be kissing passionately and will feel the energy going right through the both of us. Just driving through our tongues, down my body, through my penis, into her vagina, and up through her body back to our tongues, It is incredible."

At first the energy may seem so explosive that you have a hard time distinguishing between your and your partner's energy. However, eventually you will be able to distinguish between your partner's cool yin energy and your hot yang energy. If your partner does not know how to circulate her own energy, you can help her by a guiding the energy from your penis to her vagina, up her spine to her crown, down to her tongue and yours, and then back down her front to her vagina.

FINDING THE WAY

Spontaneous Energy Movements

Don't be surprised if at first the energy moves spontaneously and unpredictably. You may experience energy rising up the front midline of your bodies between you and your partner. Some couples experience energy shooting to the top of their heads and showering down over them, while others report feeling surrounded by a cocoon of energy. If you experience any of these, don't get worried. Just relax and enjoy the movement of these subtle energies through or around your bodies.

CULTIVATING YOUR ENERGY

After considerable practice, you will be able to open ever higher centers of energy, called *tan-tien* (or reservoirs; pronounced *DON TYEN)* by the Chinese. According to Taoism, one of these reservoirs exists at the level of your navel, another at your heart, and a third at your head (see figure 3). Michael Winn explains: "While in actual fact the entire body is one large interconnected *tan tien,* or field of energy, it is easiest to try to open each center sequentially. You must open the lower centers first to provide a strong platform for the higher ones."

Some yoga-trained Westerners confuse these reservoirs with the Hindu chakras, which have become popular synonyms for energy centers in the body. The seven or twelve chakras are generally more local and separated than the *tan-tien,* which are part of one large energy circuit, the Microcosmic Orbit, that envelops the entire body. Although Hindu Tantric philosophy is similar in many ways to Taoism, especially in its emphasis on conserving and transforming the power of sperm, the specific methods used in Tantra are different.

BECOMING ONE

This mutual opening of the Microcosmic Orbits of two lovers is the true fusion of sexual and spiritual energy. It can eventually result, after refining your sexual energy through elevated lovemaking and through meditation, in a prolonged orgasm and even an altered state of consciousness. According to Taoism, this orgasmic fusion of lovers occurs when yin and yang are in complete harmony. The more you learn to relax and to surrender yourself completely to your partner, the more likely it is that you will experience this extraordinary connection. According to one multi-orgasmic man, "Sex with my girlfriend is not the mechanical battle of bodies groping for momentary pleasure that it was, but a real exchange and a real union of our two bodies – almost as if our two bodies were merging into one.

This form of harmonizing is very powerful. When you can open and receive the loving energy of your partner, and in turn have your partner open to receive your energy, you will experience a blending and intimacy unlike anything else. Both of your energies, yin and yang, are part of the same universal energy; they are just charged differently. This is how you and your partner can truly become one flesh. When this flow of sexual energy between you reaches the right intensity and balance, your individual bodies will seem to dissolve into the ecstatic vibration of your circulating and pulsating energies. This is a true orgasm of body and soul. Assuming that other channels of communication and sharing are open in your relationship, this exchange of energy will help your love grow, and your mutual love will enrich those around you.

We often call healthy sexual union *making love,* and this is exactly what you are doing. Sexual energy expands and intensifies our emotions and attitudes. This is why sexual pleasure is popularly considered the highest bliss, and why the feeling of being in love is so intense and all-encompassing. On the negative side, it is also why lovers' quarrels are the most intense. So it is of paramount importance that you and your partner try to resolve emotional conflicts *before* you attempt to circulate sexual energy. Put another way, sexual energy is like fire: it can cook your food, and it can also burn your house down. It all depends on how it is used. If negative emotions arise while you are making love, stop or try to transform them into positive emotions by smiling and thinking about the positive qualities of your partner.

A genuine smile transmits loving energy, which has the power to warm and to heal. Recall a time when you were upset or physically ill and someone gave you a big smile; suddenly you felt better. Norman Cousins, a former editor of the *Saturday Review,* writes in *Anatomy of an Illness* that he cured himself of a rare connective tissue disease by watching old Marx Brothers movies. Smiling and laughter have the ability to transform negative energy into positive energy and to heal our bodies and minds. If you have a lot of negativity in general, you should try practicing the Inner Smile and the Six Healing Sounds.

When to Stop

As we mentioned most couples stop making love when the man ejaculates. There may be some cuddling or, during new hot and steamy relationships, another round of lovemaking after a refractory period (the time it takes to get another erection once you have ejaculated). But most people call it a night (or a morning or an afternoon) once the man ejaculates. As you may have guessed, with non-ejaculatory, multi-orgasmic sex, this ordinary end marker no longer exists. You and your partner can make love as long as you want.

Though, as we mentioned earlier, Taoist sexuality should not be an endurance test, when time allows, you may wish to spend an hour or two or more in a passionate and harmonizing embrace. *(Don't forget to let your erection decrease some around every twenty minutes so the blood can recirculate.)* The classic Taoist texts suggest that it takes one thousand loving thrusts to fully satisfy a woman. This may seem to involve man awful lot of effort and to demand great physical strength, but as Jolan Chang points out in his *Tao of Love and Sex,* if half an hour's run requires at least two-thousand steps, why shouldn't prolonged lovemaking involve a thousand or more thrusts? Of course, for most of us, our lives do not afford the time for this kind of intense session every night, and no couple will want such intensity all the time. However, to reach the higher levels of orgasmic and energizing lovemaking, it is important to set aside times when the phone is off the hook so that you and you partner can discover your true potential for pleasure. It's certainly better than going to the movies!

If your partner generally has more desire than you, Sexual Kung Fu may help save your love life. It will increase your sexual energy significantly and allow you to satisfy your partner's desire with ease. Though for most women one thousand loving thrusts will be paradise, for others with less sexual desire it may be purgatory. If your partner generally has less desire than you, she should definitely read the next chapter and try to expand her passion and her pleasure. Of course, if there are deeper psychological reasons that prevent either of you from expressing your sexual selves fully, you should seek help from a professional therapist. The ability of both partners to have multiple orgasms is a powerful aphrodisiac, but real, lasting satisfaction comes from a relationship based on sexual and emotional harmony.

How you end lovemaking is as important as how you start. As we explained in chapter 1, the loss of energy that most men experience after ejaculating makes it difficult for them to remain attentive and affectionate toward their partners. Since female sexuality is less precipitous, most women want to disengage more gradually, with tender words and caresses. As you master Sexual Kung Fu, you will no longer fall off the ejaculatory cliff and will be able to conclude lovemaking more gradually.

One multi-orgasmic man explained his experience: "Before, I didn't understand or want the kind of caressing and love talk after sex that my girlfriend did. Once I had had my ejaculation, I had no desire to caress my partner, to talk to her, or even to kiss her. But now during and even *after* lovemaking I have a deep desire to caress her body and to be tender to her. Her skin often feels like it is tingling with an electrical charge, which makes it soft like silk."

If your partner is (or becomes) multi-orgasmic, you will find that you can ride the waves of orgasm together for as long as you like, tuning your passion and your pleasure. If your partner is not multi-orgasmic, or even orgasmic, one thousand loving thrusts will give her the best possible chance of becoming so. More important, Taoist sexuality allows you to experience a profound intimacy that is difficult to describe in words and impossible to count in orgasms.

When to Start: A Few Words About Safer Sex

In his stand-up routine about sexually transmitted diseases, comedian Eddie Murphy echoed the general cultural anxiety around sex today: "AIDS, that ain't like the good old days when venereal disease was simple. In the good old days ya got gonorrhea, your dick hurt, you go get a shot – clear it right up. Then they came out with herpes. You keep that shit forever – like luggage. Now they got AIDS, that just kills motherfuckers. I say, What's next? I guess you just put your dick in and it explodes."

It is difficult to focus on the greater pleasure, intimacy, and spiritual growth possible through sexuality when you are worried about the health of your and your partner's physical body. For this reason, it is worth discussing the realities and logistics of safer sex. You may also be relieved to know that according to the Tao, when you practice Sexual Kung Fu and don't ejaculate, you greatly strengthen your immune system. You also obviously reduce the risk of exchanging a sexually transmitted disease through bodily fluids.

AIDS – acquired immune deficiency syndrome – is the disease that results from infection by the human immunodeficiency virus (HIV). Although AIDS is not the only sexually transmitted disease you need to be concerned about, it is certainly the most dangerous. AIDS is currently thought to be universally fatal, although it is not clear whether all people who are living with HIV will eventually develop AIDS. Those who die from AIDS usually do so because their immune system is so compromised that they cannot fight the opportunistic infections that often accompany AIDS. HIV is spread through bodily fluids – specifically, blood and semen. There is no evidence so far to suggest that HIV can be transmitted through saliva. Sexual practices that are safe or very low risk include hugging, massage, dry kissing (without exchanging saliva), and mutual masturbation. Sexual practices that are probably safe include French kissing, fellatio (without ejaculation), cunnilingus, and vaginal and anal intercourse with a condom.

Though the two main groups at risk are homosexual or bisexual men and intravenous drug users, heterosexual men and women are also at risk. This fact has created an atmosphere of panic that, although valuable in mobilizing the medical community and helping raise awareness about the importance of sexual education, has left most people with bedroom jitters.

Asking potential partners whether they have had an AIDS test or inquiring about their sexual history is as much a part of dating these days as asking about their employment or relatives. Many couples are getting tested for AIDS together. Although not yet considered a romantic date, getting tested is one way for couples to express their love and concern for one another's health and well-being.

Safer sex is recommended for any couple in which one partner could have been exposed to HIV. Couples interested in getting sexually involved should first have an HIV test, then use safer-sex techniques for six months, and then get a confirming HIV test. (It may take up to six months after infection for a person to test positive.) If both tests are negative, chances are very, very low that there is any more reason for concern, so long as the couple remains monogamous.

In the six months during which couples are waiting to take a second HIV test, they can engage in safer-sex techniques such as intercourse with a condom and mutual masturbation. In addition, they can each practice solo-cultivation techniques to develop their individual sexual and spiritual potential. Not only can using your hands to satisfy one another, a technique we mentioned earlier, allow you to have safer sex during the six-month waiting period, but it can also allow each of you to learn the subtle nuances of your individual arousal and pleasure that will help you become multi-orgasmic. Interrupting the routine also can allow you to explore new sensual and sexual pleasures while avoiding old coital scripts. Most important, harmonizing with your partner, according to the Tao, occurs at an energetic level that does not require intercourse. Caressing and even mutual meditation when gazing into one another's eyes can be profoundly intimate and satisfying experiences.

SAFER SAFER SEX

By not ejaculating, the man does not transfer as much bodily fluid (and, potentially, as many bacteria and viruses) to the woman. Also, by not ejaculating he does not draw in as much fluid (and, potentially, as many bacteria and viruses) from the woman. If you can excuse the comparison, your penis is a little like a turkey baster. When you ejaculate, you squeeze out your semen, creating a low-pressure vacuum, which then draws in liquid from your partner. By not creating this vacuum, you have less chance of transferring bacteria or viruses to or from your partner.

During nonejaculatory sex, bodily fluids can still be transferred (which is also the reason nonejaculatory sex alone is not a reliable birth-control technique). Still, nonejaculatory sex is safer than ejaculatory sex, especially if the condom breaks. (It also makes whatever birth-control method you use all the more effective.)

FINDING THE WAY

The Art and Science of Using Condoms

The good news about condoms is that the decreased sensitivity that most men experience can help a man control his ejaculation. The bad news about condoms is that they *do* decrease a man's sensitivity. Some men actually have difficulty keeping an erection while wearing a condom. If this is your situation, you or your partner should keep stroking your genitals while you put on the condom. Putting a small amount of lubricant on your penis before putting on the condom will also increase your sensitivity without causing the condom to slip off. Following are a few other things to keep in mind when using condoms.

1. Always use a condom before vaginal or anal intercourse. Also, try to use a condom with spermicide that contains nonoxyno1-9, which is effective in killing a variety of sexually transmitted diseases, including HIV. (If you develop a bright red inflammation on your penis or vulva as a reaction to nonoxyno1-9, switch to a brand without this germicide, but be extra careful.)

2. Always use a condom before your partner performs oral sex. In this case, your partner will probably want you to use a "dry" condom that is not lubricated and does not have nonoxyno1-9, which has a medicinal taste.

3. Leave half an inch of space at the top of plain-tip condoms. Reservoir-tip condoms are designed to create this space. Make sure that the condom covers your entire penis, and smooth the condom to squeeze out any air bubbles. If you are uncircumcised, pull back your foreskin before putting on the condom. If the condom starts to slip off, you can hold it on with your fingers.

4. Apply plenty of lubricant to the outside of the condom. (Not putting on enough lubricant is one of the major reasons that condoms break.) Use only *water-based* lubricants such as K-Y jelly or Astroglide. Petroleum-based lubricants such as Vaseline can cause latex condoms, dams, or gloves to disintegrate.

5. After intercourse, withdraw while you are still erect and hold the base of the condom to make sure it does not slip off. Throw away the condom and, especially if you have ejaculated, wash off your penis or put on a new condom before continuing to caress one another.

6. A condom generally slips off or breaks because it wasn't put on correctly, because sex was "too" vigorous, or because the condom was not held during withdrawal. If the condom breaks or comes off and you have not ejaculated or if the tear is near the base of the condom, you probably don't need to worry. Just remove the broken condom and put on a new one. If the condom breaks and you have ejaculated, safer-sex experts recommend that your partner urinate and insert spermicidal foam or jelly into her vagina to help destroy the sperm, viruses, and bacteria. She should leave the spermicide there for at least an hour. If you and your partner are concerned that she will get pregnant, your partner may wish to take the "morning after" pill, which she can obtain from her physician.

THE POWER TO CREATE AND DESTROY

The ease with which AIDS and other sexually transmitted diseases spread is the pathological reminder of an essential Taoist insight into the nature of sexual intimacy: lovemaking is a physical and energetic exchange that can profoundly influence the health and well-being of both partners. In our Western emphasis on individuality and independence we have forgotten about this interdependence and interpenetration. The sexual revolution did not fully take into account the significance of this exchange. As sexually transmitted diseases such as herpes and AIDS will not let us forget, we are deeply affected by our sexual histories.

Although Western medicine recognizes that bacteria and viruses can be transmitted during intercourse, it has yet to recognize the rest of the biochemical and energetic exchange that takes place during sex. According to the Taoists, every time you and your partner make love you exchange hormones, enzymes, vitamins, and so on through your sexual secretions. This seems straightforward enough. Through the entwining of your bodies and your engorged genitals, the Taoists also believe, you exchange much more – physically, emotionally, and spiritually. It may be some time before Western science can distill and quantify the various components of this exchange, but if you practice Sexual Kung Fu, you will have the proof of this exchange in your own body.

Caution is an important response to the AIDS epidemic, but the fear that stalks our bedrooms misses the point. Sexuality has always been powerful; intercourse has always had the potential for miraculous creation or tragic destruction. Sex can heal us or hurt us. Respect and even awe, rather than fear, are the appropriate components of a healthy attitude toward sexuality, which the Taoists have always known was the true alchemy, the source of our life and health.

Satisfaction Guaranteed

For Women

This chapter is written for you as the female partner of a man who is practicing Sexual Kung Fu. *(Kung fu* literally means “practice," so *Sexual Kung Fu* simply means “sexual practice.”) This chapter will give you a brief explanation of what Taoist sexuality is and how it can help you and your partner have a more pleasurable, healthier, and more intimate love life.

Multiple Orgasms for Men?

The fact that men can have multiple orgasms is still so shocking to most of us, women and men alike, that you may find it hard to believe. As we mentioned in the introduction, it is worth remembering that only in the last forty years have female multiple orgasms been recognized and accepted as normal. Even more incredible is the number of women who have become multi-orgasmic – once they realized it was possible. Since the fifties, when Alfred Kinsey was conducting his famous studies of human sexuality, the percentage of women who experience multiple orgasms has tripled, from 14 percent to over 50 percent.

In the 1980s, sexologists William Hartman and Marilyn Fithian found that about 12 percent of the men they studied were multi-orgasmic. As your partner begins to recognize that he also has this potential and as you help him learn some simple techniques, he too will experience multiple orgasms. One partner of a multi-orgasmic man recalled: “The first time my boyfriend had an orgasm without ejaculating I couldn’t believe it. He was clearly experiencing as much pleasure as usual and I could feel his penis pulsating, but much to my surprise there was no semen and moments later we were able to continue making love. It’s still amazing to me that he can have such intense orgasms without ejaculating. Now I am surprised when he does ejaculate.” Another partner of a multi-orgasmic man described what she experiences when her partner has an orgasm without ejaculating: “My partner stops moving for a moment and moans and trembles. I can feel the strong throbbing of his penis deep inside me. Ordinarily that would be it, but not now.”

Yet multiple orgasms are just the beginning. In the West, we tend to see the "big 0" as the be-all and end-all of sexuality, and many women spend a great deal of time worrying about whether they are orgasmic, when they are orgasmic, and how they are orgasmic. In Taoist sexuality, experiencing an orgasm, one or many, is not the goal. These peaks of pleasure are just part of an ecstatic process of lovemaking. Once you and your partner learn to circulate sexual energy through your bodies, you can experience orgasmic waves of pleasure as often as you like. When you make love, you will experience a depth of intimacy – a physical, emotional, and even spiritual bond – that you may have rarely, if ever, felt before.

Why Me? Why Him? Why This?

Any kind of self-improvement, sexual as much as any other, requires some effort, and this book is written to teach your partner and you in clear, simple terms how to deepen your sexual lives and your relationship to one another.

If your partner has given you this chapter to read, you may be somewhat skeptical about this newfangled sexual practice x and wonder why you (and he) need it. You should know that the Tao (pronounced DOW) of sexuality is anything but new. It is at least a three-thousand-year-old tradition of accumulated wisdom recording how people can make love most pleasurably and most healthfully. Even the most seasoned lover can probably learn something from this treasure trove of experience. Interestingly, in the Taoist tradition most of the sex advisers (including the emperor’s own consultants) were women. How different from the West, where until recently almost all sex advice was given by men – if given at all.

Especially if your sexual relationship is already rich and satisfying, you may be wondering why you need to read a book about "doing what comes naturally.” Though all people have instinctual sexual desire, what we do with this desire and how we maintain and cultivate it over a lifetime are anything but obvious. In the West, we take for granted that couples will lose their passion for one another over the years, but according to the Tao this is not a law of nature and in fact this attraction never needs to wither. (We talk more about this in the final chapter, “Making Love for a Lifetime.”)

If you bought this book for your partner or to learn more about male sexuality, you may be very eager to help your lover become multi-orgasmic. Nonetheless, you may feel that you spend too much time trying to please your partner, and certainly there are many women who do just that. This book, however, is not about your pleasing him. One of the main benefits of Taoist sexuality is that it teaches your partner how he can cultivate his sexual skill and how he can better please you. Though this book is entitled *The Multi-Orgasmic Man,* it could just as well have been called *The Multi-Orgasmic Couple.* In the words of one partner of a multi-orgasmic man, "When my husband started practicing Sexual Kung Fu, I began experiencing multiple orgasms much more often. This is a *very* special gift."

LASTING PLEASURE

In our society, women are told that they need to please their men sexually. In Taoist sexuality, a great many of the techniques were developed to help men please women. In the end, however, one partner's pleasure is inseparable from the other's, according to the Tao. The stereotype of marital relations in our society is of the frigid wife and the ever-desirous husband, but the truth is that there are many women who are more interested in making love than their partners, especially if their partners are being exhausted by sex that focuses on ejaculation.

The image of the unsatisfied woman whose lover ejaculates, grunts, and collapses on top of her is so common it has become a cultural joke. It is no wonder that many women lose interest in sex that is frenetic and lacks real connection, physical and emotional. This, too, is a stereotype, and all surveys show that in recent years men have been trying harder to please their partners and to last longer in bed.

Your lover probably does not grunt or collapse on top of you if he is interested enough in his and your sexuality to read this book, but Taoist masters have long known that it is difficult for men to maintain an interest in satisfying their partners or in being intimate once they have ejaculated. One multi-orgasmic man explained his experience: "After I ejaculated I didn't want to and didn't understand her need to caress and talk after sex. Now that I don't ejaculate, after lovemaking I love for us to lie together and caress each other slowly, almost in sort of a meditation."

BEYOND THE BIG BANG

Fortunately, the Taoists also discovered almost three thousand years ago that orgasm and ejaculation are not the same thing and that men can have orgasms (in fact, multiple orgasms) without ejaculating. This is possible because orgasm and ejaculation are two distinct physical processes, as has more recently been confirmed by Western medical science. The partner of a multi-orgasmic man explained how her husband changed once he learned to orgasm without ejaculating: "My husband used to get tired quickly after he ejaculated. And sometimes he would want to drink alcohol and he would tend to get impatient or annoyed easily. Now he is so energetic and loving.

Male sexuality in the West remains incorrectly focused on the inevitably disappointing goal of ejaculation ("getting off") instead of on the orgasmic process of lovemaking. *The Multi-Orgasmic Man* teaches your partner how to separate orgasm and ejaculation in his own body, allowing him to move beyond focusing on the momentary release of' ejaculation and to cultivate longer-lasting and more profound levels of sexual pleasure with you. Taoist sexuality will allow your partner to be more sensitive to your body as he becomes more sensitive to his own. By moving beyond the Big Bang theory of sexuality, which has often left women unsatisfied, it also allows men and women to harmonize their sexuality for ever-higher levels of intimacy and ecstasy.

SEXUAL HEALING

Sexual pleasure is, however, just one part of feeling good. Taoist sexuality can also help you and your partner stay healthier and possibly even, believe it or not, live longer. Sexual Kung Fu began as a branch of Chinese medicine, and the ancient Taoists were themselves doctors. As physicians they were concerned as much with the body's physical well-being as they were with its sexual satisfaction. Sexuality was seen as the most potent medicine, both curative and preventive. If you were sick, a Taoist doctor might very well prescribe – in addition to herbs and acupuncture – a two-week regimen of' lovemaking in certain positions. Now that's (to quote Aretha Franklin) Dr. Feel Good in the Morning.

There are other, more obvious benefits. With nonejaculatory lovemaking – in which the man orgasms but does not ejaculate – whatever birth control you use will be even more effective. Equally as important in these days of sexually transmitted diseases and concern over the transfer of bodily fluids, nonejaculatory sex is also safer sex. Whatever other safer-sex precautions you take (using a condom, to take an obvious example) will be all the safer if your partner is not ejaculating. An added benefit is that nonejaculatory sex is less messy – no more wet spots or arguing over who has to sleep on them. Many Women also appreciate not having their partner's semen dripping out of their vagina, As one partner of a multi-orgasmic man put it, "My vagina felt like it was sparkling with my own secretions. I liked not having his sperm dripping out of me all night."

The kind of profound sexual intimacy that Taoist sexuality allows is not a relationship cure-all, or a replacement for other forms of communication, but it can deepen your love. Open and honest communication is an essential part of this practice, and it won't work if you just grin and bear it. There will be moments, as your partner is learning to control his ejaculation, when he asks you to stop moving or to help in some other way, but in general this momentary sacrifice will be rewarded with many, many more moments, minutes, hours of pleasure. However, sex should never be a sacrifice one partner makes for the other, and if necessary, he can always practice the techniques in this book on his own. This solo cultivation" is an important part of the practice and is not regarded with the same stigma that is associated with masturbation in the West. The most important factor in your partner's ability to become multi-orgasmic and in your and his ability to become a multi-orgasmic couple is your support and your sincere desire.

Helping Your Partner Become Multi-Orgasmic

The first thing you need to do before you can help your partner is overcome any resistance you may have to wanting him to become multi-orgasmic or to his doing the Sexual Kung Fu practice.

WILL OUR LOVEMAKING BECOME MECHANICAL? At first many women worry that lovemaking with their partner will become mechanical. As Dr. Barbara Keesling points out in her recent book, *How to Make Love All Night (And Drive a Woman Wild),* many women fear that the techniques for becoming multi-orgasmic that their partners learn will "turn their stud into a mechanical bull." She testifies that the experience takes a man "into his body, not away from it." As a sex therapist and former sex surrogate who has trained over one hundred men to become multi-orgasmic, she speaks from personal as well as professional experience.

Like learning to play a musical instrument, learning Sexual Kung Fu will take some time and effort and may be a little awkward at first. The best approach is to relax and have fun with it. One multi-orgasmic man described how Taoist sexuality can relax the tension that often exists around sexuality: "It is fun to talk about it; it is fun to laugh about it. It can relax the whole bedroom tension. Because I am talking frankly about my body, women will talk about theirs. I was with one woman who I was telling about my practice and all of a sudden she pulled out her vibrator, and she said, 'I was never going to show this to anyone because I've been so uptight about my sexuality. But I feel I can share anything with you because you were able to share this with me.'And that was really cool."

Most men learn about sex through masturbation and pornography. For whatever reasons – guilt, inexperience, fear of getting caught – most men learn to masturbate quickly. Pornography also generally takes men away from their bodies. It is no surprise then that most men are not very connected to their bodies or aware of their arousal rates. Taoist sexuality teaches men to learn their body's true potential to experience pleasure and to pleasure their partners. Although at first your partner will need to concentrate on learning to control his arousal rate and his urge to ejaculate, once he has this control he will be much better able to concentrate on you and on the profound process of lovemaking you are both engaged in.

DOESN'T A MAN NEED TO EJACULATE TO BE TRULY SATISFIED? Some women feel that pleasing their man means helping him ejaculate. This feeling is not surprising since most men do ejaculate at the end of lovemaking and many women hear from their first partners during the fever of adolescent petting that they will have pain in their genitals (often called *blue balls* or *lover's nuts)* if they don't ejaculate. This may be true for the bumping and grinding that often occurs during adolescence, but when your partner practices Sexual Kung Fu, he will no longer have the same need to ejaculate. One multi-orgasmic man explained: "Sometimes during lovemaking, especially if it was long and beautiful, my girlfriend wanted me to ejaculate. Still, I usually didn't ejaculate, and later she would see that there was no need for me to ejaculate and that I could much more deeply satisfy her and myself if I didn't."

After years of' having lovemaking concluded by your partner's ejaculating, however, you may have feelings about his no longer ejaculating every time. At first some women feel that they are less sexy or less capable lovers. Although this feeling is understandable, it is certainly not the case that they are any less sexy or capable, and it won't take long for you to see that your real success as a lover is dependent not on your partner's ejaculation but on his – and your – pleasure.

GETTING HIM HOT

Before you begin learning specific techniques to help your partner, there are a few basics you should know about male sexuality, if you don't already. This section is meant as a brief overview. A longer discussion of the subject appears in a previous chapter. (Also, you will find figure 2 useful in figuring out where everything is.) We tend to think of male sexuality as the penis – and what could be complex or hidden about this most obvious of organs? But the penis is really just the beginning.

Although most men can learn to experience sensation throughout their entire bodies through the whole-body orgasms described in this book, most of a man's sexual sensitivity remains, at least initially, in his groin. As Dr. Alex Comfort writes in his *The New Joy of Sex,* "Genital approach is how men get into the mood." Lampoon it, rail against it, or excuse it, but the truth is, that's the way it is for most men. The genitals are of central importance to most male sexuality, but the genitals are not simply the penis.

Besides the penis itself, and especially the head of the penis, which has the most nerve endings, the testicles are often very sensitive for a man (although they must be treated more gently than the penis). It is important to keep in mind that your partner may not get an erection or may even lose his erection when his testicles are being stimulated. This does not mean he is not experiencing intense pleasure, but the lack or loss of an erection can often cause him or you to worry. Your conveying to him that you know this is a normal part of his arousal will help him lay these fears to rest.

It is worth keeping in mind that when a man lies on his back, a gravity draws blood away from his erection. If your partner is having trouble getting or maintaining an erection, it is best for him *not* to be on his back. You can also help him get an erection by encircling the base of his penis with your thumb and forefinger. By squeezing these together in a snug ring, you can help prevent the blood from leaving his erection as you stimulate him with your other hand or mouth.

The perineum, the area between the testicles and anus, is also highly sensitive. The anus, too, is very sensitive, but for many men – as for many women – it is taboo, so approach slowly or ask first. The inner thighs can also be very responsive. Many men also enjoy nipple stimulation and experience nipple erections just like women. Some require persistent, regular stimulation to awaken these nerves, while others never warm to this touch no matter how much they (or you) try.

It is also worth remembering that a man's erection is directly connected to his self-esteem. The famous fragile male ego is all the more fragile in bed. Most men know very little about the bedroom arts and not only worry about what they don't know but feel they are supposed to know everything. As a result, it is best to try not to criticize. If your partner is doing something you don't like, tell him what you would like him to do rather than criticize what he is doing wrong. (Later, away from the heat of passion, you can for future reference tell him what you don't like. Developing an open channel of communication about sex away from the bedroom is very important for a healthy sex life.) Finally, the sound of a woman's genuine pleasure is the greatest aphrodisiac. The more you can share your enjoyment with him, the more he'll know what you like and the more excited he will become. Your sexual pleasure will expand his, as his will yours.

COOLING HIM OFF

Now that we've discussed how to get your partner all hot and bothered, it's time to learn how to cool him off. This is the real challenge for most men, and anything you can do to help will be much appreciated. You can tell when he is approaching the point of no return ("ejaculatory inevitability") by reading his bodily signs. Before your partner can ejaculate, his scrotum will have to draw in close to his body. (This happens less as men get older.) The muscles in his thighs and stomach may also become tense and his body rigid, and his voice or breathing may change.

STOPPING The most important thing you can do to help him keep from going beyond the point of no return is to stop moving when he signals with his voice or body that he is getting too close. Male orgasm takes place just before the precipice of ejaculation. For your partner to become multi-orgasmic, he must learn to experience an orgasm without falling over the edge of ejaculation.

Imagine that your partner is in a hang glider. He is running toward a cliff, and he must learn to take off and soar into nonejaculatory orgasms just before he falls down the steep slope of ejaculation. If you move when he is close to the edge, you may push him over and down into the ravine of postejaculatory stupor. If you are able to stop for a moment while he regains control of his arousal, you will be able to soar together. If he goes over the cliff, he will be lying on the rocks below just as you are ready to take off.

ASKING Helping your partner to be aware of his arousal and his proximity to the point of no return will also help him at first. This does not mean you have to be detached or act as an observer, but simply that you let him know if you notice he is getting too close to the edge. One multi-orgasmic man described how his partner helps: "My girlfriend will ask whether I am close if she sees that I am. And that really helps remind me to be aware of my arousal. You might think that talking about how close I am would interrupt lovemaking, but it never does. It makes it fuller because there is more sharing, there is better communication, which is the key to any relationship whether you are in the bedroom or not."

ENCOURAGING It is better to focus on the process of lovemaking than on not ejaculating. As one multi-orgasmic man explained, "My wife would say, 'Don't come yet.' Well, that would (make me ejaculate more quickly because I would be focusing on ejaculating. What we found is that when she says, 'I feel good' or 'This is great!' this stroking, if you will, of the male ego helps me regain my control and not ejaculate." Any successful coach tells her team what they should do, not what they shouldn't, since the body is more likely to do what the mind is thinking about.

BREATHING Your partner will also be using his breathing to help him control his arousal. When he gets close to ejaculating, he may breathe deeply and slowly or shallowly and quickly. The first helps him control his sexual energy and the second helps him disperse it. Whichever he finds works for him, it is very helpful if you remind him to breathe or breathe with him. Harmonizing your and his breathing is also part of the couples practice which can help the two of you connect with one another more deeply.

CIRCULATING The most important technique your partner will be using to delay ejaculation is the pumping of his sexual energy away from his genitals and up through his spine to the rest of his body. If the sexual energy continues to build up in his groin, it will eventually he too great to control and will shoot out in the most direct way it can – through his penis. However, if he draws this energy away, it will be much easier for him to stop his urge to ejaculate.

Learning to circulate energy through the body is the secret to whole-body orgasms for both of you. You can help your partner circulate his sexual energy by running your hands up his spine from his tailbone to his head, helping him to draw the energy up. In general, as Senior Healing Tao instructor Michael Winn explains, "The more a woman can touch and stroke a man's whole body and help him be less penis oriented, the easier it will be for him to move the energy out of his penis and to other parts of his body." Circulating energy yourself can help intensify your own orgasms and energize you. It will also help you to experience greater intimacy and ecstasy together.

The techniques we have described are essential for helping your partner keep his cool when you are in the throes of passionate lovemaking. You or your partner can also use a number of more mechanical techniques to help him avoid ejaculating as well.

SQUEEZING The *squeeze* technique was originally developed for men who ejaculate "prematurely." (If your partner ejaculates quickly, be sure you and he read the section called "It's Not Over Till It's Over: Ending Premature Ejaculation".) The squeeze technique is quite simple: when your partner is getting close to ejaculating, you can place your thumb on the underside of his penis and squeeze. Another method is for one of you to grip his penis as you would the handlebar of a bicycle and to press your thumb down on the tip (see figure 8b). You or he can also squeeze the base of his penis between your thumb and first two fingers. Any of these methods will help your partner stop the urge to ejaculate and draw his sexual energy out of his penis and away from his genitals.

The obvious problem with the squeeze technique is that you need to stop intercourse and your partner will need to pull out. In the past, women who practiced the Tao were able to use their vaginal (what we now call the PC) muscle to squeeze the head of their partner's penis, which would also help prevent him from ejaculating. You may want to experiment with this technique as well after reading the section later in this chapter called "Strengthening Your Sex Muscle."

PRESSING The Taoist sages discovered a spot on the perineum, called the Million-Dollar Point, that they found was extremely helpful in stopping men from ejaculating. It was originally called the Million-Gold-Piece Point because that is what it cost a man to have a Taoist master show him where it was. (The Taoist sages were not too holy to get paid.) Your partner's Million-Dollar Point is located just in front of his anus (see figure 2). There should he an indentation at the correct spot. If your partner presses his finger into this spot and contracts his PC muscle, he can help delay ejaculation by focusing his attention and interrupting his ejaculatory reflex. It is important for you to know what he is doing if he starts pushing on his perineum during lovemaking. If you and your partner know each other's bodies well and have a lot of experience in bed together, you can help him delay ejaculation by pressing on this spot during intercourse. You will need to push your finger in up to about your first joint. It is necessary to apply firm (although not too hard), consistent pressure for a moment or two.

Once he has passed the point of no return, your partner can also press on this spot while squeezing his PC muscle to stop the semen from leaving his body and thus avoid losing all of the hormones and nutrients in his semen. This more complex manipulation, which we call the Finger Lock and described is probably best left up to him, but you should know what he is up to. If he uses the Finger Lock to conserve his semen, he will still lose his erection, but many men report that it returns more quickly. Keep in mind that the Finger Lock should not be used as a form of birth control or safer sex, since some semen may leak out.

You can also press your finger rhythmically at the Million-Dollar Point, an action that mimics the prostate contractions he experiences during orgasm and that can be very pleasurable for your partner. However, this rhythmic pressure should *not* be used when he is close to the edge, for it will very likely push him over into ejaculation.

PULLING Because your partner's testicles have to pull up close to his body in order for the semen to be propelled out of the testes, pulling them away from the body can delay his ejaculating. You can help him by gently pulling down on his testicles. Circle your thumb and forefinger just as you did earlier to help him maintain his erection. Instead of circling the base of his penis, however, this time you will circle the top of his testicles (see figure 9 on page 51). Then you will pull down firmly. (Remember, a man's testicles are extremely sensitive and should be handled with care.)

The more you support your partner's practice, the easier it will be for him and the better your lovemaking will become. As a woman, your sexual ability is naturally stronger than your partner's. The Taoists compare a man's sexual arousal to fire and a woman's to water. Fire is easily ignited but easily extinguished. Water is slow to boil but able to maintain its heat for a long time. Water is always stronger than fire and can easily quench it. The Taoists strive to v teach men how they can last long enough to bring their partner's desire to the boiling point. This ability, they know, is the basis for sexual satisfaction for both partners. In addition to helping your partner control his fire, you can also learn to help bring yourself to the boiling point. Whether you are currently preorgasmic, orgasmic, or multi-orgasmic, the most important thing you can do to help your partner and yourself is to cultivate your own sexuality and to realize your own potential for pleasure.

Helping Yourself Become Multi-Orgasmic

Unlike the male orgasm, which has received very little scrutiny, the female orgasm has been the subject of countless volumes over the last century – most written by men, of course. (We discuss this research and its most important findings in the section called "Her Orgasm".) In the West, much controversy has surrounded the exact nature of the female orgasm – vaginal, clitoral, or a blend of the two. Unfortunately, much of this investigation has really been an attempt to create an "ideal" female orgasm. We believe, along with sexologists Hartman, Fithian, and Campbell, that each woman has an orgasmic pattern that is so individual it can be called her *orgasmic fingerprint.* We also recognize that, even for the same woman, each orgasm has its own specific characteristics, sensations, and levels of satisfaction. (As men move beyond the Big Bang ejaculatory orgasm, they discover that they can have a variety of orgasms, too.)

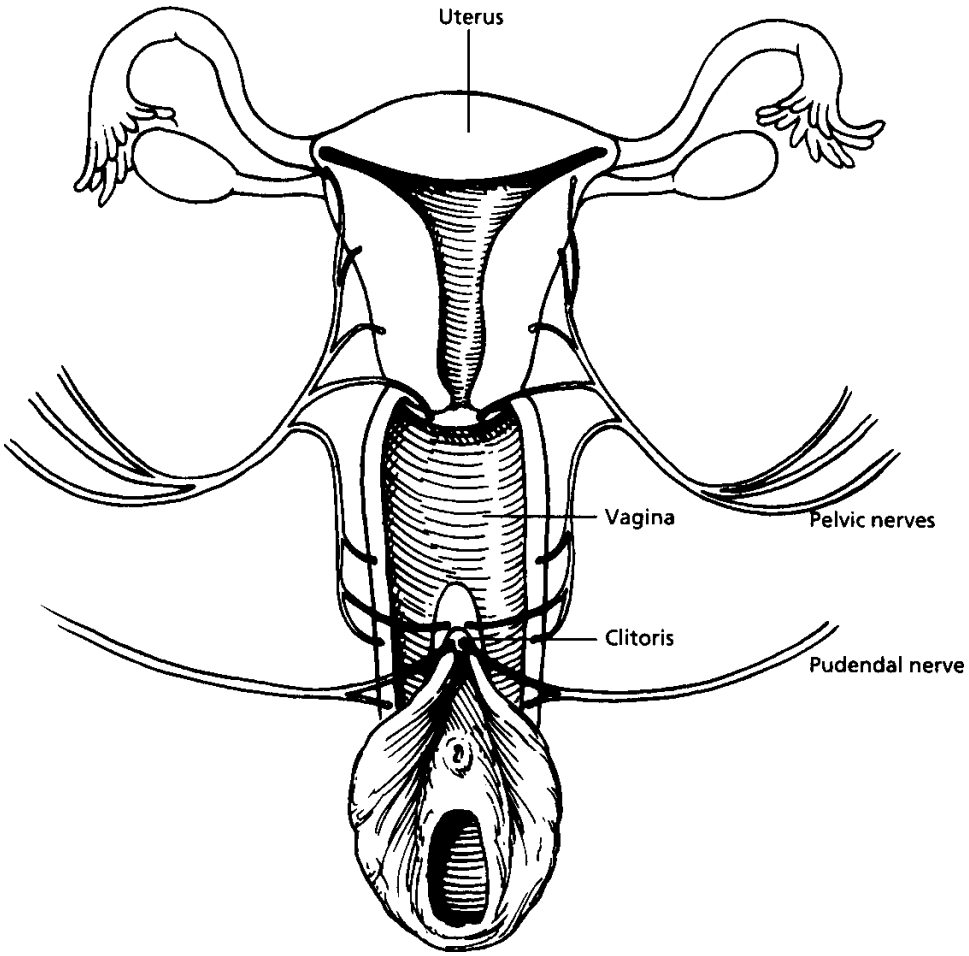

Figure 30 - PUDENDAL AND PELVIC NERVES

As far as women's genital orgasms go, the most recent research suggests that there are actually two different nerves involved: the pudendal nerve, which goes to the clitoris; and the pelvic nerve, which goes to the vagina and uterus (see figure 30). The fact that there are two nerves might explain why many women experience clitoral and vaginal orgasms differently. The fact that the two nerves overlap in the spine may also explain why some women experience "blended" orgasms. According to the Tao, genital orgasms – clitoral, vaginal, or blended – are just the beginning. The Taoists have known all along that you can feel orgasmic pulsations and pleasure in any part of your body – your clitoris, your vagina, your brain, even your internal organs.

YOUR CLITORIS

About 70 percent of all women require some clitoral stimulation to have an orgasm, perhaps because the pudendal nerve, which goes to the clitoris, has more nerve endings than the pelvic nerve to the vagina. In most lovemaking positions, the man directly stimulates the most sensitive part of his penis, the head, while the woman only indirectly stimulates the most sensitive part of her sexual anatomy, the clitoris.

Encouraging your partner, as we do in this book, to stimulate your clitoris during lovemaking is a clear way to help yourself become more orgasmic. Though it may seem a little awkward at first as he is learning to coordinate the rhythm of his fingers with the rhythm of his hips, it will soon become a smooth and satisfying part of your lovemaking. You can also help him by guiding his hand to where you would like it to be and even using your fingers to press his fingers into your clitoris, which will show him the place and the amount of pressure you like. If you are vaginally orgasmic you may not need or want clitoral stimulation all the time when you are making love. Your hand can guide your partner's, depending on what your pleasure calls for.

Some women are bashful about asking for what they want, but many studies have shown that women who are able to ask for or show their partners what they want will much more often get it. Female sexual passivity and reticence are an outdated holdover from Victorian attitudes. There are few things as arousing to a man as an active and excited partner. Passive and active, according to the Tao, are complementary parts of all sexuality, both male and female.

Sometimes it may be easiest for you to help yourself have an orgasm by squeezing your thighs or directly touching your clitoris during lovemaking. You may be interested to know that although we often think of men as able to reach orgasm much faster than women during intercourse, women have actually been shown to be able to orgasm just as quickly as men when they pleasure themselves. According to a study of multi-orgasmic women conducted by sex researchers at the University of Wisconsin, multi-orgasmic women were more likely to "enhance clitoral stimulation during intercourse by thigh pressure or masturbation."' The multi-orgasmic women were also more likely to enjoy having their breasts fondled and their nipples kissed, to give and receive oral sex, to use erotic fantasies, literature, and films, and to have a sensitive partner to whom they could communicate their needs. The study concluded that women don't become multi-orgasmic by accident. They choose the techniques that maximize their pleasure and tell their partners about them.

Many women are ashamed to self-pleasure with their partner or even by themselves. With the amount of stigma surrounding masturbation, this anxiety is quite understandable. If this is an issue for you, please read the section called "Self-Pleasuring and Self-Cultivation". Here let us just say that self-pleasuring is a healthy and important way of cultivating your sexuality that complements lovemaking and does not replace it. *Human Sexuality,* a book published by the American Medical Association states that women tend to self-pleasure more as they grow older. The more you take an active role in your pleasure, the more likely you are to reach your full sexual potential. In the wise words of one businesswoman in her late fifties, "In life, everyone is responsible for their own orgasm."

There are two factors that generally influence whether a woman is able to have vaginal or blended orgasms as well as clitoral orgasms: the sensitivity of her G spot or other internal spots, and the strength of her PC muscle.

YOUR G SPOT AND OTHER SENSITIVE SPOTS

You may have heard about a place in your vagina that when touched is supposed to drive you wild. This place is often called the G *spot,* named for physician Ernest Gräfenberg, who first described it in 1950. More recently, it has also been called the *inner trigger point* and the *urethral sponge.* Although the idea of the G spot is not new, it is still controversial, some women finding the G spot and others not. The current theory is that the G spot is a collection of glands, ducts, blood vessels, and nerve endings that surround a woman's urethra.

So where exactly is it? Most women who report finding their G spot describe it as located one and a half to two inches from the opening of their vagina. You can feel it through the upper front wall, just behind your pubic bone (see figure 18). If you imagine a clock with your clitoris as twelve o'clock, the G spot is usually somewhere between eleven and one.

When you are not aroused, your G spot is difficult to find. When stimulated, it can swell to the size of a dime or larger, standing out from the wall of the vagina. Alan and Donna Brauer suggest that the best time to find it is just after you have orgasmed: "It is already somewhat enlarged and sensitive. It often feels like little ridges or tiny bumps." They recommend stroking it (or having your partner stroke it) at the rate of about once a second and experimenting with both lighter and heavier pressure. Another good time to stimulate the G spot is when you are just approaching orgasm, since you are more likely to enjoy G-spot stimulation once you are already highly aroused.

You should be aware that some women feel initial discomfort or the urge to urinate when their G spot is stimulated. This is normal. If it happens to you, the Brauers suggest lightening your touch or telling your partner to lighten his. It may take as much as a minute for the discomfort or seeming need to urinate to be replaced with pleasurable sensations. If you are concerned about urinating, you might urinate before lovemaking or try finding the G spot while sitting on the toilet, which will allow you to feel confident that your bladder is empty.

In the common face-to-face or missionary position, your partner's penis often misses your G spot completely. It is easier for your partner to stimulate it if you lie on your stomach and your partner enters you from behind, or if you are on top, where you can position yourself for maximum pleasure. Shallow thrusting is also best for stimulating the G spot. However, fingers (yours or his) are usually the most direct and effective way to get to the G spot at first.

Some women report that their most sensitive spots are located at the four o'clock and eight o'clock positions about midway back along the walls of the vagina. There are nerve bundles at these locations, which may explain their sensitivity to pressure. Other women find that they are most sensitive at the back of their vagina. As your partner learns shallow and deep thrusting in different directions (what we call *screwing),* he will be able to stimulate these spots and others that are all your own.

Most women are able to rotate their pelvis when they are on top to direct their partner's penis to their most sensitive spots. As we discussed, there are many benefits to this woman-on-top position, and not only for the woman, since many men have an easier time learning to be multi-orgasmic when they are on the bottom. However, this position also has its disadvantages: the angle of penetration in this position can make your partner's penis seem as much as an inch shorter

than in other positions, and it is more difficult for your partner to maintain an erection for an extended period of time, since gravity tends to draw blood out of his penis. When women are on the bottom, they often do not realize that they can actively rotate their pelvis, and especially their sacrum, to guide their partner's penis to their most sensitive spots. Once you and your partner learn to rock 'n' roll your pelvises, you will really be "dirty" dancing. (For a longer discussion about various lovemaking positions, see the section called "Positions for Pleasure and Health".)

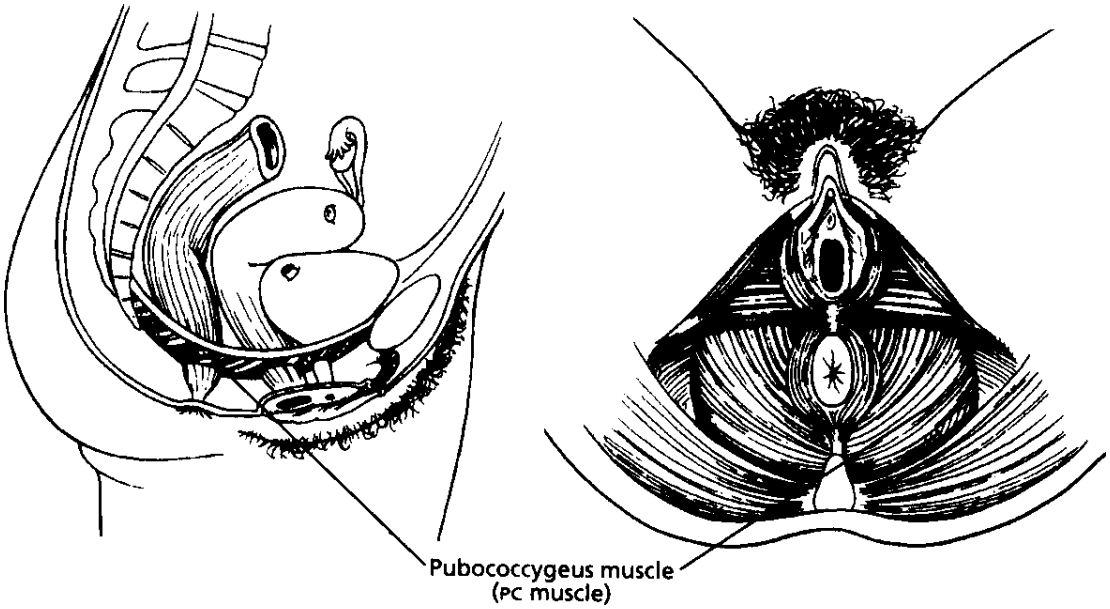

Figure 31 - WOMAN'S PC MUSCLE

YOUR SEX MUSCLE

Your sex muscle, or pubococcygeus muscle (often simply called the *PC* muscle), is the muscular sling that stretches from your pubic bone in front to your tailbone in back (see figure 31), encircling your urethra, vagina, and anus. It forms a sling that supports not only your uterus, fallopian tubes, and ovaries, but all of your internal organs. If your PC muscle isn't strong, you have no foundation for your organs and they can begin to sag.

Most women will recognize the PC as the muscle they use to stop themselves from urinating when they can't find a toilet. It is also the perineal muscle that must be strong and flexible to avoid tearing during childbirth. Still, the strain of childbirth can weaken your PC muscle. As Senior Healing Tao instructor and acupuncturist Dr. Angela Shen explains, "Especially after a woman has a baby, she has a tendency to get tired more easily and not to enjoy sex as much. Not all women, but many." For these women, Sexual Kung
Fu can help them regain their energy and sexual strength.

The importance of the PC muscle was discovered in the West during the 1940s by Arnold Kegel, a gynecologist. He developed the famous Kegel (pronounced *KAY-gul)* exercises, which helped many women control their bladders and ease childbirth. Later, women began to use these exercises to increase their sexual desire, intensify their orgasms, and become multi-orgasmic. Dr. Shen points out: "All women can experience more orgasms and expand the ones they have by doing these practices."

FINDING YOUR PC MUSCLE

The easiest way to find your PC muscle is to stop the flow of urine by clamping down the muscles in your pelvis the next time you are urinating. Make sure you keep your stomach and legs relaxed. You want to try to isolate your PC muscle. If you have a strong PC muscle, you should be able to stop the flow of urine midstream and then start it again. If this is difficult for you and some urine dribbles out during your contraction, your PC muscle is weak, Not to worry: it will quickly strengthen with practice. If you find it easy to stop and start your urine flow, your PC muscle is strong. Nonetheless, you will still expand your sexual pleasure and your overall health by practicing PC exercises.

Strengthening this muscle will not only improve your sex life, but will also help you avoid bladder problems in the future (or improve bladder problems that you may already have). Stopping the flow of urine may sting at first. This is a perfectly normal reaction and should stop within a few weeks, unless for some reason you have an infection, in which case you should wait until you have seen a doctor and cleared it up before continuing with the practice. If your muscles become sore, you just need practice.

PARTNER EXERCISE 1

STOPPING THE STREAM

1. Exhale slowly and forcefully, pushing out the urine.
2. Inhale and contract your PC muscle to stop the flow of urine midstream. (Make sure your stomach and legs are relaxed.)
3. Exhale and start urinating again.
4. Repeat steps 2 and 3 four or five times or until you have finished urinating.

PARTNER EXERCISE 2

PC PULL-UPS

1. Inhale and concentrate on your vagina.
2. As you exhale, contract your PC muscle and the muscles around your eyes and mouth.
3. Inhale and relax, releasing your PC, eye, and mouth muscles.
4. Repeat, contracting your muscles as you exhale and releasing them as you inhale, nine to thirty-six times.

STRENGTHENING YOUR SEX MUSCLE

There are many different exercises for strengthening your PC muscle that have been taught in the West, most of them adaptations of Kegel's original technique. All of these teach you to contract and relax the PC muscle, although the number of repetitions and the amount of time they suggest you hold the contractions vary widely. The PC Pull-Ups exercise is based on a traditional Taoist technique. It also uses the Taoist awareness that the circular muscles of the body (those in your eyes, mouth, perineum, and anus) are connected. By squeezing the muscles around your eyes and mouth, you can increase the force of your PC Pull-Ups.

Although contracting your eyes and lips will help you squeeze your PC muscle around your vagina, *the most important part of the practice is simply contracting and releasing your PC muscle as often as you can,* which you can do practically anywhere – while driving, while watching TV, while sending a fax, while in a boring meeting. You can see how many contractions you can do during a red light, or you can hold a single contraction until the light turns green.

Eventually you will be able to do the contractions with less effort and without contracting your eyes and lips. Try to do the exercise at least two or three times a day, although you can do it is as many times as you like. Your muscles may get sore, just as they do after you do any exercise. Don't push yourself too far; just increase the repetitions gradually. Consistency is more important than quantity. One way to develop a daily routine is to connect your practice to daily events, like getting up in the morning, taking a shower, or lying in bed at night.

Another, even more effective way to strengthen your PC muscle is to squeeze the muscle against something – your finger, your partner's finger, a vibrator, a dildo, or your partner's penis. The resistance will help you better squeeze the muscle. Try squeezing your fist. You can tighten it only so much, but if you try squeezing your fist around a finger or two of your other hand, you will be able to tighten it even more. The same concept applies to your PC muscle. If you are practicing with a partner, you can squeeze on your partner's finger or penis and he can tell you how strong your PC muscle is. If you are having intercourse, each of you can alternate squeezing your PC muscles. When you contract yours, you will tighten around his penis and increase sensations for both of you. When he squeezes his, he will raise his erection toward his belly and possibly stimulate your G spot. Another highly enjoyable practice is for you to relax your PC muscle when you thrust together and then tighten your PC muscle when you separate. This will increase the feeling of suction during intercourse and can be very arousing for both of you.

STRENGTHENING YOUR ENTIRE VAGINA

In China, women used a special egg-shaped stone to strengthen their PC and other vaginal muscles. We have found jade stone, shaped like an egg, to be best. Doing PC Pull-Ups will certainly strengthen your PC muscle considerably, but you can accelerate the process dramatically by using a stone egg for resistance. In the West, physicians are now prescribing exercises with stainless-steel weights, called *weighted tampons,* to strengthen women's pelvic muscles, especially for women who have trouble controlling their bladder, often after childbirth.' But childbirth and pelvic health are not the only

reasons to do the egg practice. Women who are knowledgeable in the Tao have used this practice for millennia to increase their vaginal-muscle control for increasing their and their partner's sexual pleasure.

PARTNER EXERCISE 3

STRENGTHENING YOUR ENTIRE VAGINA

1. Insert a stone egg while standing or sitting. (If you do not feel sufficiently lubricated, you can moisten the egg with water, saliva, or a water-soluble lubricant (for example, K-Y jelly).
2. Contract your PC muscle to pull the egg into your vagina and then bear down slightly and push the egg out toward the opening of your vagina.
3. Repeat this in-and-out movement nine, eighteen, or thirty-six times.
4. When you are done, bear down more forcefully and expel your egg.

The egg practice is quite simple. You insert a lubricated egg into your vagina (as you would a tampon) and then use your vaginal muscles to move it up and down. Once the egg is deeper inside, you may not feel it at all, but you can continue moving the egg up and down by squeezing your perineum and vagina to move the egg up and then bearing down slightly (as you would to have a bowel movement) to move the egg back down (see figure 32). Then you can squeeze your perineum and vagina to push it up once again and then push it back down. You can do this exercise for two minutes and then, bearing down more forcefully, expel the egg.

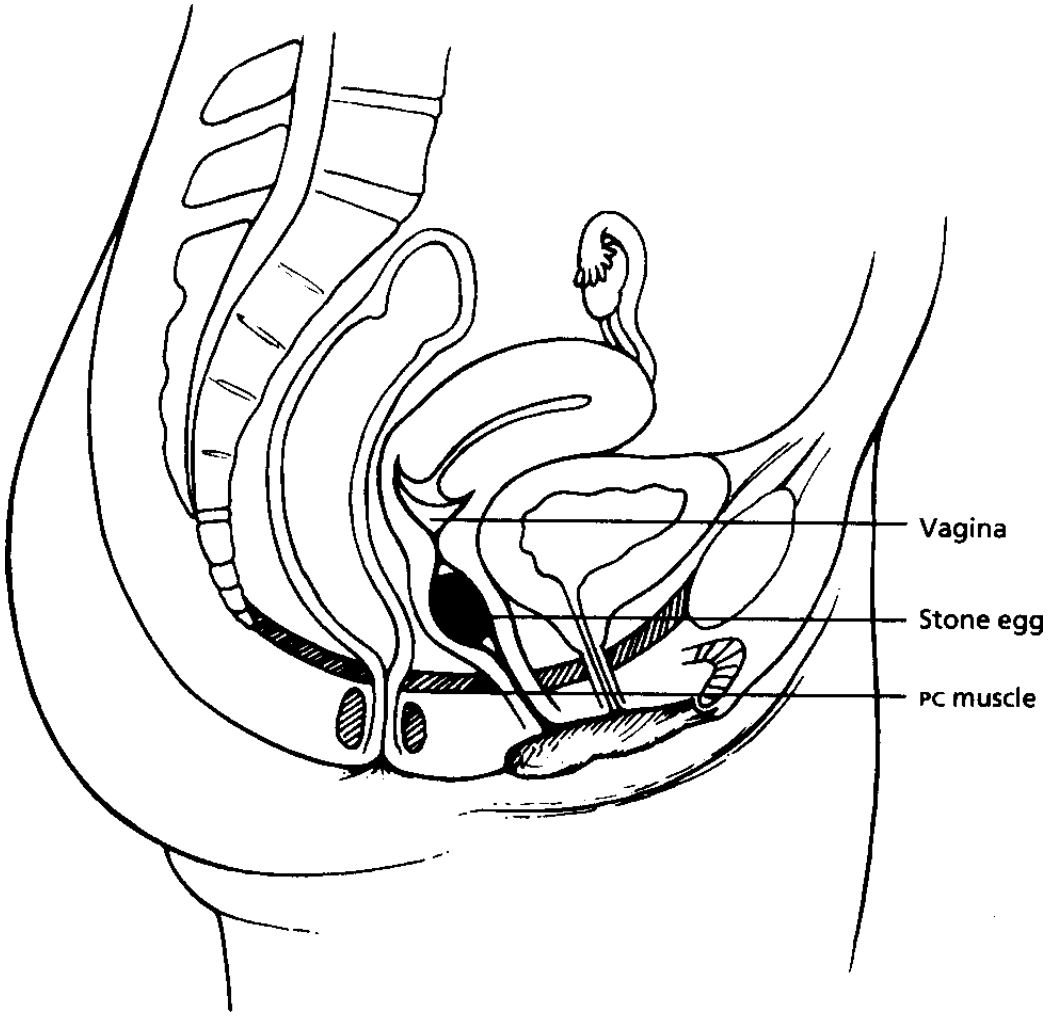

Figure 32 - STONE-EGG EXERCISE

Senior Healing Tao instructor Marcia Kerwit explains how to prepare and take care of your stone egg: “When you get your egg home, you first want to sterilize it, which you can do by boiling it for ten minutes or soaking it in a solution of one part household bleach to ten parts of water for ten minutes. Rinse it well. You need to sterilize your egg only the first time you use it. After that, you can rinse it off with soap and water after each use, or just soak it in a vinegar solution.”

You can order a drilled jade egg from the Healing Tao Center, which will allow you to loop dental floss through your egg and leave the floss hanging outside your vagina, so that after practicing you can pull it out easily, just like a tampon. One advantage of using the drilled egg with the dental-floss tail is that as you move your egg up and down in your vagina, you can feel the string moving as well, so you will feel that it is actually moving and how far. (You will find more details about the egg exercise and other Sexual Kung Fu exercises for women in *Healing Love Through the Tao: (cultivating Female Sexual Energy*)

FINDING THE WAY

What If...

MY EGG IS STUCK

If you use an egg *without* a string, it may occasionally feel like it’s stuck. If this happens, the most important thing is not to panic. Remember, the egg can’t go very far. Calmly, see if your vagina feels dry inside. If so, you can use your finger to put some more (water-based) lubricant in your vagina and around the opening. Try squatting down or sitting on the toilet and bearing down to push the egg out. If the egg still does not come out, you can try jumping up and down and laughing. Then try squatting and bearing down again. If the egg still has not come out, go do something else.

During this time, your muscles will relax and the egg will most likely move on its own and be easier to expel. Finally, you can insert your finger (or, more easily, a friend or partner can insert one) and direct the egg out. This should allow you to get the egg out, but if you are still having a problem, call a Healing Tao instructor. If you use a drilled egg that has string looped through it, you will never have this problem.

MY EGG SMELLS FUNNY WHEN I TAKE IT OUT

An unusual smell to your secretions could indicate a vaginal infection. This has nothing to do with using the egg, but you should not do the egg exercises (or the Big Draw) until the infection is gone. There are many simple home remedies for vaginal infections. Speak to someone at a women’s clinic or to a health practitioner.

You may find that doing these exercises and strengthening your PC muscle in general can cause you to become sexually aroused. The reason to develop your PC muscle in the first place is to reach your orgasmic potential, and if your partner is a multi-orgasmic man, you should have no problem satisfying your increased desire. If you do not have a partner or your partner is not around, you can either pleasure yourself or use the Big Draw exercise described later in this chapter to move your sexual energy away from your genitals and to the rest of your body, where it will energize and rejuvenate you.

DEEP VAGINAL AND UTERINE ORGASMS

As we mentioned earlier, women have two different genital nerves: the pudendal, which connects to the clitoris and surrounding skin; and the pelvic, which connects to the vagina and the uterus. With some awareness and a little practice women can experience deep vaginal and uterine contractions. One multi-orgasmic woman described her experience: “First, I practiced by myself. I would tighten and release my vaginal muscles and then move these contractions up toward my uterus. Soon, the contractions would begin involuntarily during lovemaking. They were truly incredible."

These extremely pleasurable and powerful orgasms were well known in China to women who practiced the Tao and who were able to control their vaginal and uterine muscles through the egg practice. In the 1980s the Brauers studied these deep pelvic “push-out” contractions, which they called “extended sexual response." They even noticed from electrical brain recordings (EEGs) that a woman’s brain waves during these uterine orgasms seemed to resemble those observed in people who are in deep meditation. The Taoists have always taught women that they can help themselves experience these profound orgasms by developing their awareness of and connection to their deep vaginal and uterine muscles.

PARTNER EXERCISE 4

DEEPENING YOUR ORGASMS

1. Picture what your uterus looks like (see figure 33). When you are able to envision a part of your body, you are able to make a stronger connection to it, linking your mind and your body.

2. Next find out where *your* uterus is located. Stand and place your thumbs together at your navel and make a triangle with your index fingers (see figure 34). Where your index fingers touch is approximately the level of your uterus. Your uterus is the size of *a* small plum. (Where your little fingers naturally fall is approximately where your ovaries are.)

3. Inhale, and as you exhale contract your eyes and your mouth lightly and feel the back of your vagina deep inside you contracting (where your cervix is). When you do this correctly, you will have a light orgasmic feeling deep inside you.

CIRCULATING SEXUAL ENERGY

If you learn to circulate energy yourself, you will be able to expand your orgasms throughout your body. Dr. Angela Shen explains: "If you draw energy up before and during your orgasm it will be more intense and last longer. You will also be less tired afterward." Circulating sexual energy brings healing energy to your entire body and allows you and your partner to have truly ecstatic lovemaking. This ability to circulate sexual energy is the basis for both transcendent sexuality and vibrant health. (If you ejaculate it is even more important that you practice conserving and circulating this energy, because otherwise you will become drained.)

The Big Draw for Women exercise will help you circulate your sexual energy through your body. Many women are able to start drawing the energy up without much practice. As one multi-orgasmic man recalls, "Without having had any meditation practice or experience, my girlfriend was able to draw up the energy in her body instinctively, as apparently many women are."

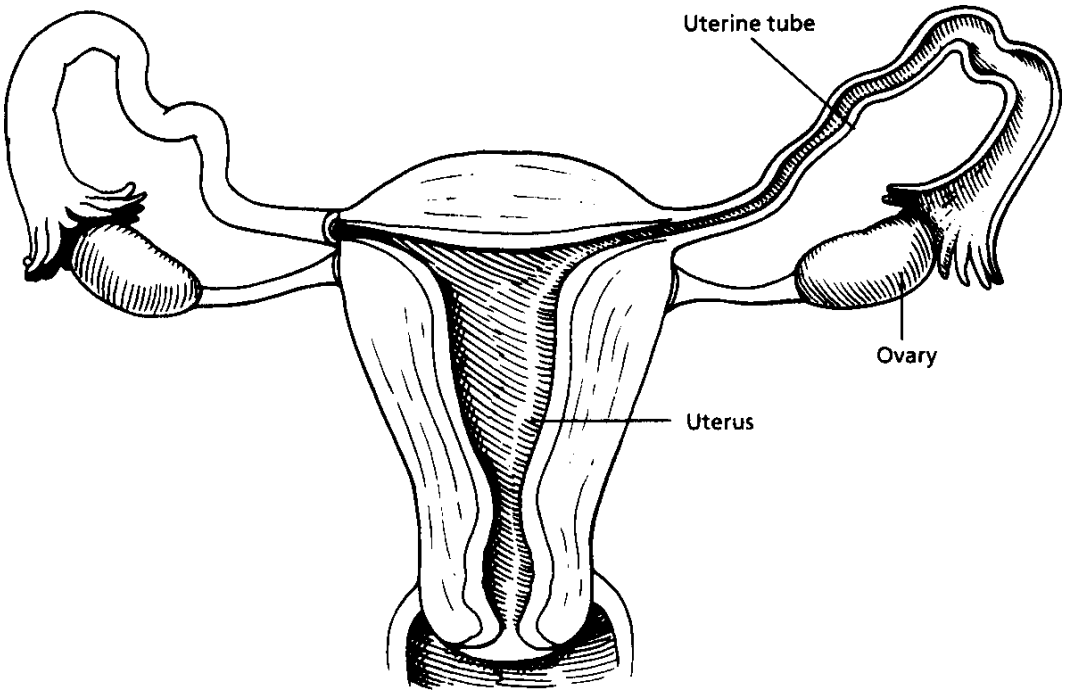

Figure 33 - THE UTERUS

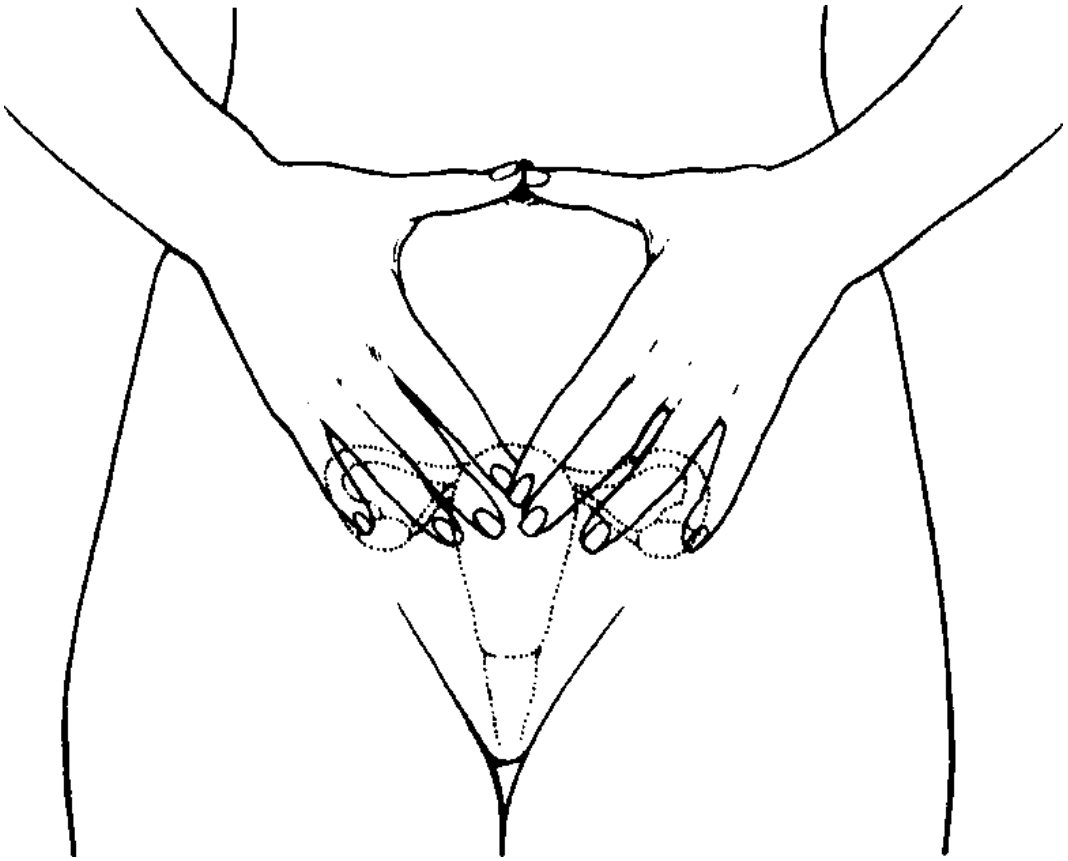

Figure 34 - LOCATING YOUR UTERUS

Overcoming Difficulty

As we discuss in the section called “Brain Waves and Reflexes”, Western science has recently confirmed that orgasm is as much a state of mind as a state of body. And the state of your mind has much to do with what you learn. Back in 1939, anthropologist Margaret Mead demonstrated how much orgasm is dependent on cultural expectations. She compared two neighboring peoples living on the Pacific island of New Guinea. The Mundugumor believed that women have orgasms, whereas their neighbors the Arapash did not. Not surprisingly, most Mundugumor women were orgasmic, whereas most Arapash women were not. Given the importance of cultural permission for pleasure, many women around the globe and throughout history have had their orgasmic potential limited by societal expectations.

Women generally have one of two kinds of orgasmic problems. If you have never had an orgasm, you are *preorgasmic.* If you orgasm on some occasions but not others, by yourself but not with a partner, or with some partners but not others, you are *situationally orgasmic.* Almost all women who are preorgasmic can learn to have orgasms fairly easily. The most important factor is a willingness to learn to pleasure yourself and to take charge of your pleasure during lovemaking. First, of course, you must be willing to stimulate yourself'. (If this is difficult for you, see the discussion earlier in this chapter and in the section called “Self-Pleasuring and Self-Cultivation".)

First, you need to begin by getting acquainted with your body and your sexuality. Negative feelings about your body or how you look during lovemaking can distract you and short-circuit your ability to experience pleasure and have an orgasm. Start by taking a non-critical look at yourself in the mirror. Appreciate your body for its beauty and its ability to give you pleasure. Then start to explore your body. Be sure to stroke your entire body before focusing on your genitals. You may want to use oil, which can magnify the stimulation. Sex therapists are fond of pointing out that your brain is your most important sex organ, so be sure to put yourself into an erotic frame of mind. You may wish to remember a particularly satisfying experience of lovemaking, to read erotica, or to create a fantasy out of your own imagination’s rich storehouse of fantasies and desires.

PARTNER EXERCISE 5

THE BIG DRAW FOR WOMEN

1. Picture your vagina and clitoris. If you don't know what they look like, use a mirror and have a look.
2. Lightly touch the lips of your vagina and your clitoris until you are starting to get aroused.
3. Inhale, and as you exhale, lightly contract your vagina, squeezing around your clitoris.
4. Inhale and release, imagining your vagina expanding like a flower blossoming.
5. Repeat exhaling and contracting, then inhaling and releasing, nine to thirty-six times.
6. Imagine your uterus and ovaries also opening and closing like flowers blossoming.
7. When you feel your sexual energy expanding, relax and bring the energy to your tailbone and sacrum and then up your spine to your brain (see figure 35). Or if you are having difficulty bringing the energy up, try contracting your vagina and your anus as you direct the orgasmic feeling back to your tailbone and sacrum and then up the spine to your brain. (If you still do not feel your energy moving up, you may want to try activating your sacral and cranial pumps.)
8. Let the orgasmic energy flow down through the rest of your body or direct it to any part of your body that needs healing or strengthening.

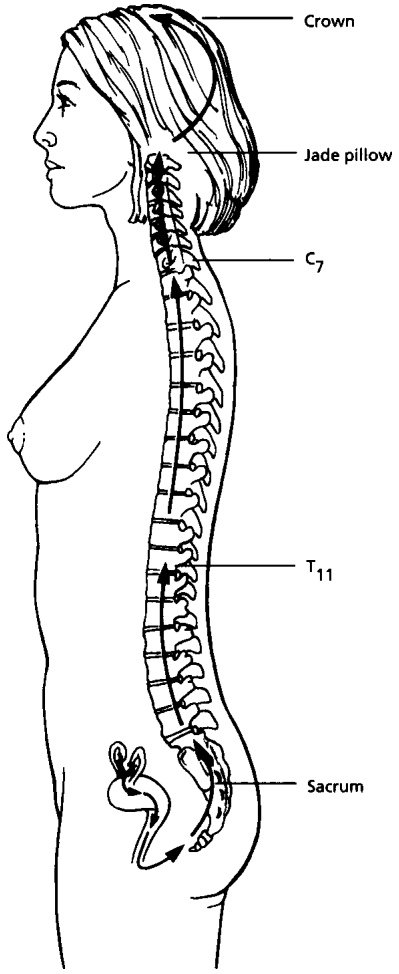

Figure 35 - DRAWING SEXUAL ENERGY UP

According to both Kinsey and Hite, four out of five women who self-pleasure rely on clitoral stimulation to experience an orgasm. The type of clitoral stroke depends on you: hard or soft, stimulation of the shaft or head, up and down, side to side, or circular touch. Experiment and see what you find pleasurable. You may also find that a vibrator can help you reach orgasm. Find one that you like. Almost all women can learn to orgasm through self-pleasuring. Remember that all orgasms are not the same. Many orgasmic women think they are not so because they expect their orgasm to match someone else's pattern or to involve the earth moving and the stars tumbling down. According to Lonnie Barbach, "Most women's initial experience of orgasm is mild, while their expectations reflect the proverbial fireworks." She adds that vaginal orgasms can be very diffuse and tame while clitoral orgasms tend to be more discrete and recognizable.

When you are ready to "go public," let your partner stimulate you in the ways you have found you enjoy. Make sure to tell him what you like or to show him. When you are ready, try intercourse. Remember that you can take responsibility for your own pleasure. Position yourself where you find the best stimulation and continue to touch yourself or guide your partner's hand to your clitoris. During intercourse, guide your partner's penis with your pelvis to where you feel the greatest stimulation.

If you have had orgasms at some point in your life but no longer do, you need to determine what has changed. Is your health different? Are you suffering from an infection or taking medication that might decrease your arousal? Many women experience reduced arousal during pregnancy or while breast-feeding, although others do not. If you think the problem is physical, consult a physician. Certain drugs and certain conditions, such as diabetes, can inhibit orgasm. Has your partner changed? Or has your relationship changed in some way? Do you have feelings of anger or resentment that you are not expressing? Are you distracted by children or work? It is important to address any or all of these situations before you work on expanding your pleasure.

If you are orgasmic when self-pleasuring but not when making love, you may need to determine what you are not getting with your partner. Are you too focused on his pleasure Are you too self-conscious? Are you not getting fully aroused? Try extending foreplay and making sure that you are totally aroused before intercourse, or forget about intercourse for the time being and focus on pleasuring each other with your hands and mouths. Orgasming before you have intercourse also will make it easier for you to orgasm when you are having intercourse.

If you are able to experience orgasm through manual or oral loving but not through intercourse, are you experiencing pain during intercourse? If so, are you lubricated enough? Are you able to choose the angle and amount of thrusting? If not, try another position. If pain is not the problem but you are still not orgasmic during intercourse, have your partner use his hands or mouth to bring you to orgasm before you engage in a coital embrace. Also explore or let your partner explore your G spot or other sensitive spots. Try the positions – you on top, rear entry, sitting in his lap – that tend to stimulate the G spot most. And remember to use your trusty fingers, with or without his, to reach orgasm.

If you are still unable to have an orgasm, do not despair. There are lots of resources for preorgasmic women, including books, groups, and counseling. In addition, you should know that with Taoist sexuality you can experience extremely high levels of pleasure throughout your entire body whether you have orgasms or not. Learning to circulate sexual energy and pleasure throughout your body will allow you to experience a fusion of energy with yourself and your partner that makes the "Did you or didn't you?" question largely irrelevant. More important than reaching orgasm or becoming multi-orgasmic is learning to experience the heights of pleasure and intimacy that come from the true union of body, heart, mind, and spirit.

Yang and Yang For Gay Men

China, like all civilizations, has long acknowledged the practice of homosexuality. Historically it was called *lung-yang,* after the name of a fourth-century B.c. prince's male lover, or *tuan-hsiu,* "the cut sleeve," recalling an emperor who was said to have cut off his sleeve to avoid waking his sleeping lover. Although sexual relationships between men were at times condoned and at other times discouraged by the imperial court – no doubt depending on who was sleeping in the royal bed – Taoism has never condemned homosexuality. Taoism avoids condemning any part of human sexual experience, since it is all considered a part of the Tao. Rather, Taoism tries to teach people how to stay healthy, whatever their sexual preferences. Gay men simply need to know the practices that will help them have satisfying and healthy sexual relationships.

Can't Stop Till I Get Enough

A gay writer and activist was doing a radio interview about his book on life in the pre-AIDS bathhouses, where gay men often would have numerous sexual encounters per night. When asked about whether the desire for multiple sexual experiences is characteristic of gay men in general, the author shot back that it is characteristic of all male sexuality, but that straight men are usually constrained by female sexuality. If, he continued, we really want to see what male sexuality is like, uninfluenced by female sexuality, we just need to look at gay men.

The Taoist understands this characteristic of male sexuality in terms of the properties of masculine energy, or yang (see chapter 5 for an explanation of yin and yang). Yang is active, volatile, and expansive. During heterosexual sex, the woman's yin receives and balances the man's yang. (As we mentioned in chapter 5, yin and yang are variable qualities that exist in both men and women. There are some men who are more yin and some women who are more yang. According to the Taoists the universe always seeks balance in relationships as in nature.)

In general, when two gay men make love, each man's yang charges the other's, increasing rather than diminishing their sexual desire. Gay Healing Tao instructor B. J. Santerre explains the value of multiple orgasms for gay men: "Gay men really need multiple orgasms. Most straight men are going to do it once or twice in an evening. For gay men it's really common that they need more than that in a night. With this practice you are going to be able to fully satisfy this desire whether you have a partner or not."
The expansiveness of yang energy is hard to contain and often will want to escape through the most direct route – the penis. It is no surprise that the object of much gay male sexuality, according to gay sex educator and healer Joseph Kramer, is "to get it up and off." This emphasis on ejaculation is understandable because it allows you to satisfy your sexual desire; once a man ejaculates he becomes more yin – in other words, stable, internal, and contractive.

To avoid this endless cycle of ejaculation, which is extremely depleting to your body and your immune system, you need to cultivate your own yin energy and to spread your expanding yang energy throughout your body. Channeling this energy and containing it is also, as we explained earlier, the way to become multi-orgasmic and to experience whole-body orgasms that will be more satisfying
than the genital "getting off" that most men are accustomed to. As B. J. Santerre explains, "If you conserve your semen, you are going to be able to go back to the heydays when people would go to the bathhouses and have orgasms all night long. When you learn this practice, you are able to do the same thing, but you won't exhaust yourself and you won't even need to leave home!"

Cultivating Your Sexual Energy

Gay men, like all men, need to learn to circulate their sexual energy though their body both to expand their orgasms and to benefit from the power and healing potential of their sexual energy. During nonejaculatory sex, it is even more important for men to draw this energy up in order to satisfy their desire and transform the volatile sexual energy *(ching-chi)* into the more refined and stable *chi.* We discussed the techniques for circulating your sexual energy and for separating orgasm from ejaculation. Here we just want to describe the importance of these practices for gay men and gay male couples.

One multi-orgasmic gay man described his experience: "I had a lover in New York, and I was so much into the Tao, I said, 'You have to get into it.' I didn't give him a choice. When we felt like fooling around, we'd start playing with one another. When each of us would feel ready we would do the Big Draw at our own speed. When we did it together, even if we didn't circulate the energy at the same time, we would be satisfied at the same point. We would fall asleep in two minutes. That sharing of energy keeps going on as you sleep in one another's arms, because you are both charged with sexual energy."

As we said these practices can be done on your own or even if your partner is not "into the Tao." As one multi-orgasmic gay man explained, "After pleasing myself or making love and doing the Big Draw four or five times, I am done. After that if the most gorgeous guy is right in front of me and he says, 'Let me suck you off,' I'll say, *'Please,* leave me alone.' I'm satisfied even though I haven't ejaculated."

If you find you are having difficulty controlling your yang sexual energy, you may be in need of some balancing and calming yin energy. Fortunately, there are many sources of yin energy, since both yin and yang exist in all of nature, from the cosmic (earth and heaven) to the microcosmic (your body). Since each of us has both yin and yang, you can cultivate within yourself the qualities of yin such as gentleness, kindness, and self-respect. (For a fuller discussion of learning how to cultivate these qualities and how to deal with emotional imbalances, see Mantak Chia's *Taoist Ways to Transform Stress into Vitality.)* From the environment, you can balance your energy by eating yin foods such as vegetables and fish or by absorbing yin energy directly from the earth. According to Taoism (as well as many other traditions), the earth is feminine (that is, yin). Men can absorb yin energy from the earth simply through spending time in nature and gardening or can absorb it in a more concentrated form by drawing energy up from the earth when practicing the Cool Draw.

Being Versatile

Most gay men are aware of the pleasure potential of their prostate and their anus (if you are not, see "Prostate" in chapter 2). Yet some gay men still disparage men who are "bottoms." This attitude is not surprising given the negative stigma associated with "getting fucked" and the links in Western society between power and being on top. As we mentioned in chapter 5 in regard to heterosexual couples, Taoism sees the person on top not as dominating but as healing his or her partner. The person on top (or the more active partner) gives more sexual energy (and healing) to the person on the bottom (or the more passive partner).
According to the Tao, everything that is active must also be passive, and therefore it is recommended that gay men be versatile – both "tops" and "bottoms." As one multi-orgasmic man explained, the sexual benefits are obvious: "A guy who has been both a top and a bottom is a great lover because he knows what it is like to satisfy his partner and to be satisfied. If you are only a top, you know only one version. The same if you are a bottom."

When you are the bottom, you also have the benefit of having your prostate massaged during anal intercourse. According to Stephen T. Chang in his book *The Tao of Sexology,* gay men who generally are bottoms have far fewer prostate problems than tops
and heterosexual men.' Nevertheless, most men have their preference and may not want to experiment.

If you are a top who is not willing to be a bottom, you can still benefit from having your anus stimulated and from exercising your anal-sphincter muscle. B. J. Santerre explains: "When people think about penetration, everybody just thinks about a big ten-inch dick or a dildo, but it can be a small finger. Being penetrated needs some practice, like everything else. You need the proper partner to take it easy, and you need to relax those muscles. It's not on the first day that you are going to get fucked. And if you don't like to be penetrated, you can still play with your anus. Even stimulating the outside of the anus is very important because you can strengthen your butt muscles, which are essential for circulating the sexual energy.

It is also worth mentioning that bottoms can be active as well as passive. The more you exercise your PC muscle and your anal sphincter, the more you can massage your partner's penis and pleasure both of you. B. J. Santerre continues: "If your anus is really strong, you are going to be a great fuck for your partner. You are going to massage his penis as he is penetrating you. You are not totally passive and just waiting for it to happen. You take part in it by contracting and releasing the lower part or the higher part. You can contract it really fast two or three times in a row or just let your partner get a little bit deeper and surprise him by squeezing it."

Gay and straight men who are just beginning to experiment with anal stimulation sometimes worry that they may tear the skin of the anus or the colon. The solution here is simply to use enough lubrication and to have a gentle partner. Other gay men worry whether repeated anal sex will weaken their anal sphincter. There is no evidence to suggest that this is the case, and anal sex may in fact strengthen the muscles of your anus. Nonetheless, if you are concerned or feel that your anal muscles are weak, you can try the sphincter exercise to strengthen them.

Monogamy and Multiple Partners

The age of AIDS has fostered a new ethic of monogamy for gay men ca (as well as heterosexuals). Assuming you are using safer-sex techniques, however, there is nothing inherently wrong with multiple partners. The Taoist texts actually instructed heterosexual men about the benefits of a number of partners. But there is a challenge with multiple partners: the practices given in this book require a profound connection of body, heart, mind, and spirit, which is difficult to achieve with even one partner, let alone many. According to the Tao, one profound sexual union, gay or straight, is better than countless superficial ones.

The anonymous sex that has characterized much Western sexuality is diametrically opposed to the kind of physical, emotional, and spiritual connection that Sexual Kung Fu facilitates and requires. Whether you are exchanging bodily fluids or not, you are always exchanging energy. So choose a partner (or partners) wisely.

Safer Sex

Most gay men are highly aware of the need for safer sex and are well informed about the specifics of safer-sex techniques, so we will not discuss the subject at length here. (Should you want more detail about the art and science of condom use and other tricks of the safer-sex trade, see the section called "When to Start: A Few Words About Safer Sex".) Suffice it to say that we strongly recommend safer sex and that in fact the kind of nonejaculatory sex advocated by the Tao has obvious benefits for reducing the exchange of bodily fluids.

With nonejaculation, not only do you decrease the outflow, you also decrease the inflow. As we mentioned when you pump out your semen, you create a low-pressure vacuum that draws in liquid or anything else in the environment, such as bacteria or viruses (just as a turkey baster draws up gravy when you squeeze out the air). So when you don't ejaculate, you run less of a risk of drawing in bacteria or viruses. (As you can imagine, this is especially important for anal sex, since the colon naturally has a great many bacteria.)

Bear in mind that even when you practice Sexual Kung Fu, a small amount of ejaculate is often emitted, so you should not forgo other safer-sex precautions.

Sexual Healing

Most people do not understand the healing potential of sexuality. The Taoists have always recognized that sex can both hurt and heal us. Genital sexuality that culminates in ejaculation is draining to the body. As Joseph Kramer has pointed out, we build up life-giving sexual energy in our groin, but instead of bringing this energy up to our brain and heart, where it can begin to help heal us, we clamp down by tightening our chest muscles and holding our breath. With nowhere to go, this energy is stuck in our groin and eventually becomes too great to be contained and forces its way out of our penis as we ejaculate.

In Sexual kung Fu, you stay very close to the point of no return and even feel the orgasmic contractions, but you do not ejaculate. You do this by learning about your arousal rate, using the techniques described in chapter 3, and, most important, drawing the energy away from your genitals up through your spine and the rest of your body.

Once you have built up this energy, you can also exchange it with your partner. This energy exchange profoundly affects the health and well-being of both partners and takes place even through the walls of latex that we now must necessarily put between us. It is only our Western isolation and individualism that wrongly lead us to believe we can engage in sex without this intimacy and interpenetration. But if we look at the very definition of the word *intercourse,* we find its meaning to be very close to the Taoist understanding: "connection," "exchange," "communion."

Unfortunately, instead of using the appropriate yardstick for sex, which is health, we in the West have used a moral measure. This approach has led us to size up sex according to criteria such as pleasure/pain and purity/perversity, depending on the censors' own predilections. Over the centuries, gay sex, along with much other sexuality, including self-pleasuring, has been defined as perverse, sinful, sick, and unnatural. Saint Augustine and Thomas Aquinas went so far as to call all sexuality that does not lead to conception unnatural.

Because the Taoists were able to see in sex a powerful source of the body's life-sustaining energy, *chi,* they were able to recognize its importance to the overall health of our body, our emotions, our mind, and our spirit. Since the 1980s, we have been tragically reminded of sex's ability to bring illness, but in our frenzy of fear we z have forgotten sex's ability to make us well.

Cultivating your sexual energy is therefore especially important if you are living with HIV or AIDS, Many people who are confronting life-threatening illnesses lose their appetite for sex. But this is the very time when they need their sexual energy the most. B. J. Santerre, who has been living with HIV for eleven years, explains: "Sexual energy is so important for the flow of energy in the body that you cannot afford to not use it. Waking up with an erection is an important sign of vitality that many men who are sick no longer experience. When you wake up with a hard-on, you will know your health is improving."

For men (and women) who are sick with AIDS or other sexually transmitted diseases, there are often two additional resistances to
utilizing the healing power of sexuality: guilt ("I got it through sex") and fear ("I don't want to get others sick"). These feelings are understandable but misguided. Similarly, having gotten sick through sex doesn't mean you don't need the healing power of your sexuality. People who get sick through the air or from food do not stop breathing or eating. If you are afraid of getting others sick, you can take comfort in the fact that nonejaculatory sex, as we mentioned earlier, makes safer sex even safer. If you remain concerned, you can still do the solo Sexual Kung Fu.

It goes without saying that according to the Tao, it is all the more important to conserve your semen when you are confronting
a life-threatening disease or any serious sexual illness. As B. J. Santerre explained, "We don't have a cure for AIDS yet, but we do know that some people die right away and others live a long time. When your body is having to make new sperm, it is not going to be making white blood cells."

When you are using Sexual Kung Fu to help heal serious illness, it is essential that you give your body time to “digest” this growing energy. As one multi-orgasmic man, who had overcome a serious health problem, explained, “The sexual energy is very healing, but this healing process is a lot of work for your body. It can even be uncomfortable in the beginning. Old symptoms may come back.” Develop your practice slowly as you learn to work with this powerful healing force within your body. In addition to Sexual Kung Fu, you can gain great benefit from the other Taoist healing arts. (See the appendix for a listing of additional Healing Tao books and resources.)

Before You Call the Plumber

At some point in our lives, most of us experience some kind of sexual problem. You may find yourself ejaculating quickly with a new partner or having difficulty getting an erection with an old one. It is most important to recognize that these are temporary frustrations that reflect the different seasons of our lives and relationships.

In the West, we have a tendency to get fixated on often unhelpful labels like *premature ejaculation* and *impotence,* which cripple a man's self-esteem and his ability to deal with the changes in his sexuality in an easy, relaxed, and even lighthearted way. A sense of humor is often the best antidote to the overly serious way in which we deal with "sexual problems." The biggest danger, as Masters and Johnson and other sex therapists have pointed out, is getting caught in the cycle of "fear-failure-shame-fear" that often causes these difficulties to take up residence in our bedroom. So, even if you are not currently troubled by one of the following concerns, it is a good idea to read this section so that you will know what to expect and how to deal with these unwelcome guests should they someday crash the party.

It's Not Over Till It's Over: Ending Premature Ejaculation

According to Taoist sexuality, there is really no such thing as "premature ejaculation." We don't say this to put sex therapists and sex surrogates out of business, or to deny that many men ejaculate too soon to satisfy their partners, or for that matter themselves. The point is simply that from the Taoist standpoint, the vast majority of men ejaculate "prematurely." According to Sexual Kung Fu, you should be able to choose when you want to ejaculate, so any unwanted ejaculation is premature. Moreover, if ejaculation is no longer the goal, and you can have orgasms without ejaculation, then most ejaculations are by definition premature, or at least superfluous.

So the question is not whether you can last for a certain number of minutes on the stopwatch but whether you and your partner are satisfied with the duration of your lovemaking. If you practice the exercises you will learn to postpone your ejaculation for as long as you and your partner wish.

If the problem persists or is especially troublesome, you might want to seek professional help. A sex therapist or sex surrogate will help you figure out if there are deeper psychological reasons you are ejaculating quickly (for example, fear of getting caught," fear of losing your erection, and so on). A professional may give you a series of exercises with which you can build up your sexual confidence. Following is an example of a sequence of exercises that will help you build your staying power. They are based on the understanding that you must learn to detect, and eventually control, your arousal rate.

LEARNING CONTROL

First, you should have your partner stimulate you manually while you focus on the sensations in your genitals and on stopping as you get close to ejaculating. Once you feel confident of your ability to detect and postpone your ejaculation, you can try intercourse with the woman on top, so that you can continue to focus on your sensations. Next you can try intercourse in different positions, and finally you can try slowing don n instead of stopping. You also may want to avoid being on top, since the blood that gravity drains into your penis makes it more difficult for you to maintain control.

It is also best to be with a partner whom you know well and with whom there is no performance pressure. It is also good if your partner can encourage you and help you stay aware of your arousal rate ("That's great," "Nice and slow," "Relax"). Your partner also can learn how to move her hips and sacrum to rub your penis in different directions while you stay still. If your partner can learn this practice, you will both experience very high orgasmic levels without ejaculating.

Bear in mind that almost all young men are relatively quick ejaculators, and as men get older they generally have an easier time lasting longer. Also, as you may have noticed in your experience, the longer it's been since you had sex, the more difficult it is to control the ejaculatory urge. Therefore, the more you have sex, the easier it is to control your ejaculation. As we mentioned in the last section on safer sex, condoms can also help men diminish some of the sensitivity in their penis.

LEARNING SEXUAL SENSITIVITY

Many men think that a few drinks might distract them from their pleasure and help delay ejaculation. As one multi-orgasmic man recalls, "One of the things I used to do, and I think a lot of guys have learned to do, is to have a few drinks before you go to bed and suddenly you are not very connected with your groin and you can make love longer because it is harder to have an orgasm because you're buzzed and you are not really there. But it was very frustrating because I would usually ejaculate anyway." It may seem like ejaculating too quickly is the result of too much genital sensitivity, but in fact it is the result of too little. Alcohol is an anesthetic and therefore numbs sensation. Though alcohol may dampen your arousal, it also diminishes your ability to control it. The key to developing real, lasting control is more sensitivity, not less. For this reason baseball statistics also don't work. In addition, it is much more difficult to be airfare of your partner's needs when you are drunk or trying to remember Pete Rose's batting average.

Alcohol can also cause the other major male sexual complaint – impotence, or the inability to get an erection, sometimes called *whiskey dick.* Marijuana also has its sexual drawbacks if used regularly. Daily marijuana use has been found to lower androgens, which are directly responsible for your sex drive. This effect can cause decreased interest in sex and difficulty in getting erections. Other studies have shown that repeated use of marijuana can lower your sperm count. Prolonged lovemaking and multiple orgasms have been shown to increase the levels of your body's natural pleasure drug, endorphin. You are much better off skipping the social lubricants in favor of sexual lubricants. Not to mention, endorphins don't give you a hangover.

Snake Charming: Overcoming Impotence

The Yellow Emperor said, "I want to have intercourse but my penis will not rise. I feel so embarrassed that my perspiration comes out like pearls. In my heart I crave to make love and I wish I could help with my hands. How can I help? I wish to hear the Tao." Su Nü replied, "Your Majesty's problem is a problem of all men."

At some point in their sexual lives, all men have the experience of not being able to get an erection or of losing the one they have. The machinery is too complex to be foolproof, but most of the time there is little to worry about. Physical stress (exhaustion, a cold, intoxication) or emotional stress (adjusting to a new partner, performance anxiety, tension in the relationship) can cause your penis to remain limp or to shrink at an inopportune moment. The most important thing to remember at these troubling times is that it is best to take the situation in stride, with a sense of humor and without blaming yourself or your partner. It does not mean that you are any less of a man or that your partner is any less of a woman. Su Nü's first suggestion to the Yellow Emperor was to relax and try to harmonize with his partner.

EXERCISE 14

SOFT ENTRY

1. Your partner must be fully lubricated, and you should pleasure her until her fluids are flowing. If necessary, you can use a lubricant on her vagina or your penis or both.

2. It is generally easiest for you to be on top so that gravity helps draw the blood into your penis and so that you have as much freedom to move as possible.

3. Circle your thumb and forefinger around the base of your penis to form a finger ring and squeeze gently to push the blood into the shaft and head.

4. Carefully insert your penis into your partner and begin thrusting, keeping your finger ring around the base of your penis.

5. Focus on the blood and sexual energy that are filling your penis and concentrate on the sensations in your penis. Squeeze your perineum and buttocks to push blood into your genitals.

6. Your partner can help stimulate you by playing with your testicles, perineum, and anus.

7. Adjust the tightness of your finger ring to keep your penis engorged enough for thrusting and then remove your fingers when your penis is sufficiently erect for continued thrusting.

8. Reapply the finger ring if your erection wanes (although you generally won't need to do so).

ENTER SOFT, EXIT HARD

Recognizing that all men experience situational impotence at some time or another, the Taoists developed a fail-safe technique they called Soft Entry. The Taoists realized that a man could *help with his hands,* just as the Yellow Emperor had wished. With this technique and with the cooperation of your partner, you can enter your partner even when you are completely flaccid. Once you are inside your partner, the warmth and sensation of lovemaking will allow you to get an erection in short order. The Soft Entry technique dispels the old belief that a man must have a steel-hard erection before having intercourse, and it is a useful part of any man's sexual repertoire. Knowing that you have mastered this technique and can use it when necessary will give you greater confidence when faced with the awkward, but common, situation of a penis that is slain to rise.

CAUSE FOR CONCERN

If you tend to have erection problems every time you make love, you may be one of the 22 million men in America who have a more serious erection problem. First, you should make sure a physiological cause can be ruled out. Diabetes, prostate surgery, hardening of the arteries, alcoholism, spinal-cord injuries, and back problems, among other things, can cause impotence. Medications such as tranquilizers, antidepressants, and antihypertensives (for high blood pressure) can

also cause impotence. In the 1950s, few cases of impotence (about 10 percent) were believed to have an organic source, but most urologists now believe that as many as half of all cases, and more in older patients, have some biological basis.' (Bear in mind that urologists have a vested interest in cases having a biological basis, since that's what they know how to treat and what they get paid to do.) To see if this is your problem, you can do a little self-diagnosis.

While sleeping at night, most men have at least one or two erections, each lasting about a half hour. First, try to recall whether you have awakened in the last week or two with a medium to hard erection. If so, you probably do not have a physiological condition. If you can't remember, there is a simple test you can do at home. Before going to sleep, lick a strip of postage stamps and attach them in a ring around the base of your limp penis. If, upon awakening, the ring is broken, you are physically capable of getting erections. If the ring is unbroken and you are unable to get an erection through solo cultivation, you should see your doctor.

Even if you do have an organic condition, you should remember that this need not stop you from practicing Sexual Kung Fu. Just as orgasm and ejaculation are separate, so too are erection and orgasm. Hartman and Fithian tell the story of an older couple who had a very happy sex life throughout their marriage, although the man was completely impotent as a result of diabetes. Though he and his wife relied on oral and manual lovemaking, both of them were multi-orgasmic. As you learn to expand your orgasms throughout your inhale body, your genital erections and genital orgasms will no longer be the alpha and omega of your sexual life.

GETTING AN ERECTION

Perhaps because our model of male sexuality is based on the experiences of eighteen-year-old men, who tend to get hard quickly and frequently, we think in terms of having a hard-on or not, of being fully erect or not. In reality, there are a number of stages of erection and a number of changes that our penises undergo in becoming erect. As we mentioned, the Taoists noticed that there are actually four stages of erection, or four *attainments,* as they called them: firmness (also referred to as *lengthening),* swelling, hardness, and heat.

A common reason for erection trouble is mechanical – not getting enough stimulation of your genitals. Most men need their penises directly touched, rubbed, or massaged to get hard, and this need increases as men get older. Since women often prefer to have their genitals approached slowly and in ever-smaller circles of touch, they think that men do too. Most men, however, prefer quick and direct stimulation. (Don't forget, this is how most men learn to masturbate.)

Your partner should take a very active role in directly stimulating your genitals with her hands and mouth. Tell your partner what you need and how it feels. You should also be willing to use your hands to help yourself get or keep an erection.

Some men, however, find that too much focus on them and their genitals results in pressure to get an erection. It may help for you and your partner to recognize that soft penises have as many nerve endings as hard penises and can be extremely pleasurable. Certain kinds of touch, especially of the testicles, can be highly pleasurable without leading to an erection. Let your partner know that she can pleasure you even if you don't get hard right away. If you find that focusing on your genitals only makes you more anxious, switch the focus to your partner, which was Su Nü's second suggestion. Taking a detour from the man's erection and simultaneously focusing on the woman's pleasure can often be very arousing to the man.

THE WISDOM OF THE PENIS

The process of erection is dependent on both physical and psychological factors. Assuming you have found that your plumbing is working and that you are getting the right amount of direct stimulation, you need to consider the possibility that the problem may be related to performance anxiety, guilt, fear, stress, or other psychological reasons. Occasional impotence, once again, may result from what Bernie Zilbergeld aptly calls "the wisdom of the penis," reminding your brain that you don't really want to be sexual at that moment. We assume that erections should be as automatic as salivation and that "real" men should be able to have sex at any moment, but neither is true. So the first thing you want to do is have a heart-to-crotch conversation and decide if you are really doing what you want to be doing. If the answer is no, tell your partner why and/or suggest a better time.

If the answer is yes, and you still have erection trouble, you may want to seek out psychological or sexual therapy. It is no wonder, given all the misinformation and hype about men's penises and male sexuality in general, that most men see sex as in some way a performance. The more you can shift your focus from how you did, how long you lasted, and how much you satisfied your partner to the pleasure that you and your partner are experiencing, the better off you and your erection will be. As Bernie Zilbergeld wisely points out, "It can help men to realize that most women are less concerned about a man's performance than they are about his reaction to it and to her. Women are more likely to get upset about the man's negative reaction to a performance problem (anger, guilt, constant apologies, withdrawal) than to the problem itself."

PHYSICAL EXHAUSTION

According to the Taoist physicians, erection trouble is caused not only by physiological or psychological problems. It can also be caused by an energetic problem – specifically, weak sexual energy. Difficulty in getting or maintaining an erection is understood as resulting from a man's physical and sexual exhaustion. Many older men who have not conserved their seed suffer from this problem. The cure for impotence is to cultivate the sexual energy while avoiding ejaculation at all costs. As we mentioned, a man is generally more yang than yin. As he becomes more and more aroused, he becomes more and more yang, but after ejaculating he becomes yin. Men who have erection trouble need to become more yang and therefore must avoid ejaculation even more vigilantly than other men.

EXERCISE 15

TESTICLE MASSAGE

1. Rub your hands together to warm them up.
2. Hold one testicle between the thumb and fingers of each hand (see figure 36). (Your testicles should feel like small apricots between your fingers.)
3. Firmly but gently massage your testicles with your thumbs and fingers for a minute or two. If your testicles ache or are sensitive, rub lighter but longer, until the pain goes away. The pain is caused by a blockage, and the massage will help bring blood and sexual energy to the area, which will disperse any blockage.
4. Hold your penis up to expose your testicles and tap them with your longest finger for a minute or two (see figure 37). This helps invigorate your testes and increase sperm production.
5. Finally, hold your penis and scrotum with your thumb and forefinger (see figure 38). Now lightly pull your penis and scrotum forward with your hand as you pull back with your pelvic muscles. Then repeat, pulling to the right with your hand and to the left with your pelvic muscles. Then pull to the left with your hand and to the right with your pelvic muscles. Finish by pulling your hand down and your pelvic muscles up. Do this exercise nine, eighteen, or thirty-six times. It will keep the ducts that carry your sperm healthy.

TESTICLE MASSAGE

The Taoists also developed exercises to help you generate more sexual energy. Lovemaking (using the Soft Entry technique, if necessary) and the Big Draw were a commonly prescribed duo-cultivation method. In addition, there were a number of solo-cultivation exercises that would help a man restore his sexual energy. According to the Taoists, your sexual energy is dependent on three things: the abundance of your sexual hormones, the strength of your kidneys, and the circulation of your bioelectric energy, or *chi.* Western medicine has confirmed that the sex hormone testosterone is produced in your testicles, and Taoists believe that you can increase the production of sex hormones by using the Testicle Massage exercise. This exercise is an excellent way to strengthen your sexual energy in general and also to relieve any pressure that you may feel after lovemaking. By massaging your testicles, you also help circulate the blood through them and keep them healthy.

A WHOLE-BODY APPROACH

The Taoists saw illness, including impotence, as an expression of the health of your whole body. They recognized that your penis was just part of the problem. Poor circulation, superficial breathing, and an unhealthy diet could all make it worse. Smoking is especially bad for your circulation, since it causes the blood vessels and arteries to constrict and interferes with your breathing. Alcohol and caffeine also drain the body and should be avoided while you are trying to strengthen your sexual energy. An erection problem is a condition that must be treated throughout your body by strengthening your sexual energy and by maintaining proper health.

Please, Sir, May I Have Some More: Enlarging Your Penis

Any man who has been in a locker room knows that there are differences in the size and shape of men's penises. But these differences have little to do with the pleasure a woman experiences during lovemaking – especially if a man practices Sexual Kung Fu. In the words of Su Nü, "There are indeed distinctions in physical endowment. Large and small, long and short, and physical differences are matters of external appearance. Deriving pleasure from sexual intercourse is a matter of inner emotion. If you first bind them with love and respect and press them with true sentiments; then of what relevance are large and small, long and short?"

Even with this and other assurances, many men still worry about the size of their penis, and quite a few men have even undergone “penile enhancement” surgery. This new surgical procedure typically involves lengthening the penis by cutting the suspensory ligament that connects the base of the penis to the pubic bone (see figure 39). In addition to the lengthening procedure, men can also have their penis “thickened” by having fat that has been liposuctioned from their thighs, pubic area, or hips injected into the shaft of the penis."

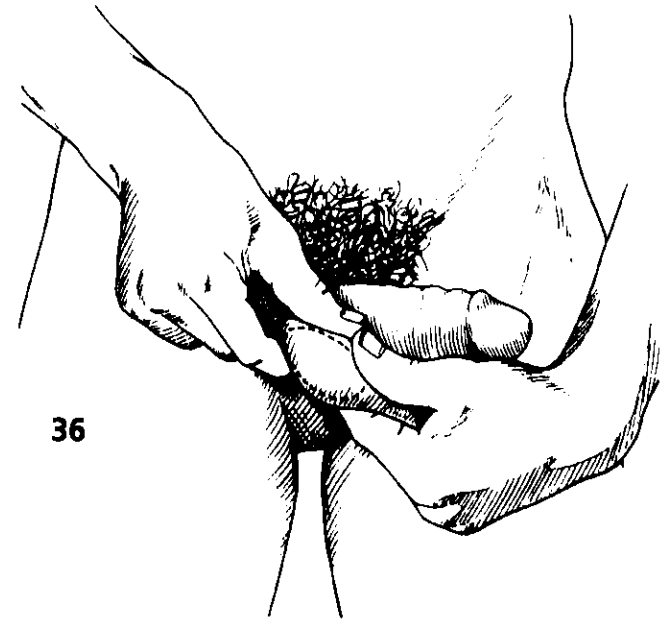

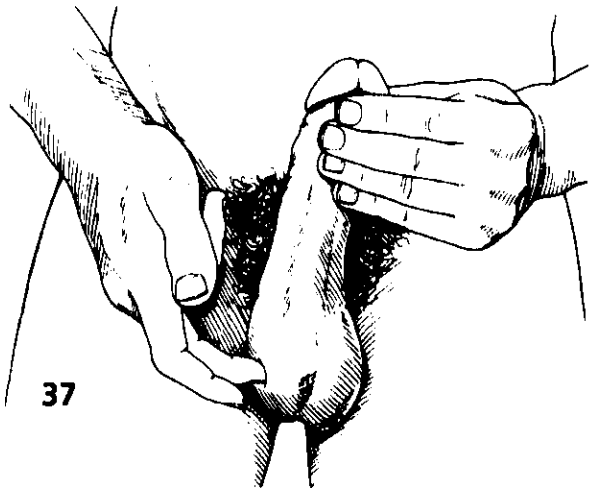

Figure 36 - MASSAGING YOUR TESTICLES
Figure 37 - TAPPING YOUR TESTICLES
Figure 38 - STRETCHING PENIS AND TESTICLE TENDONS

IF IT AIN'T BROKE, DON'T FIX IT

What man wouldn’t like a few extra inches? But before you run out and have surgery, you should know that there are serious risks. According to an article in the *San Francisco Chronicle,* the lengthening procedure can result in nerve damage and decreased sensation, impotence, lower angle of erection, skin protrusions, scarring, infection, and gangrene. The thickening procedure can cause an embolism in the heart or brain from the fat released during liposuction, tissue death from reduced blood supply in the penis caused by too much fat in the penis, or a lumpy or lopsided penis.

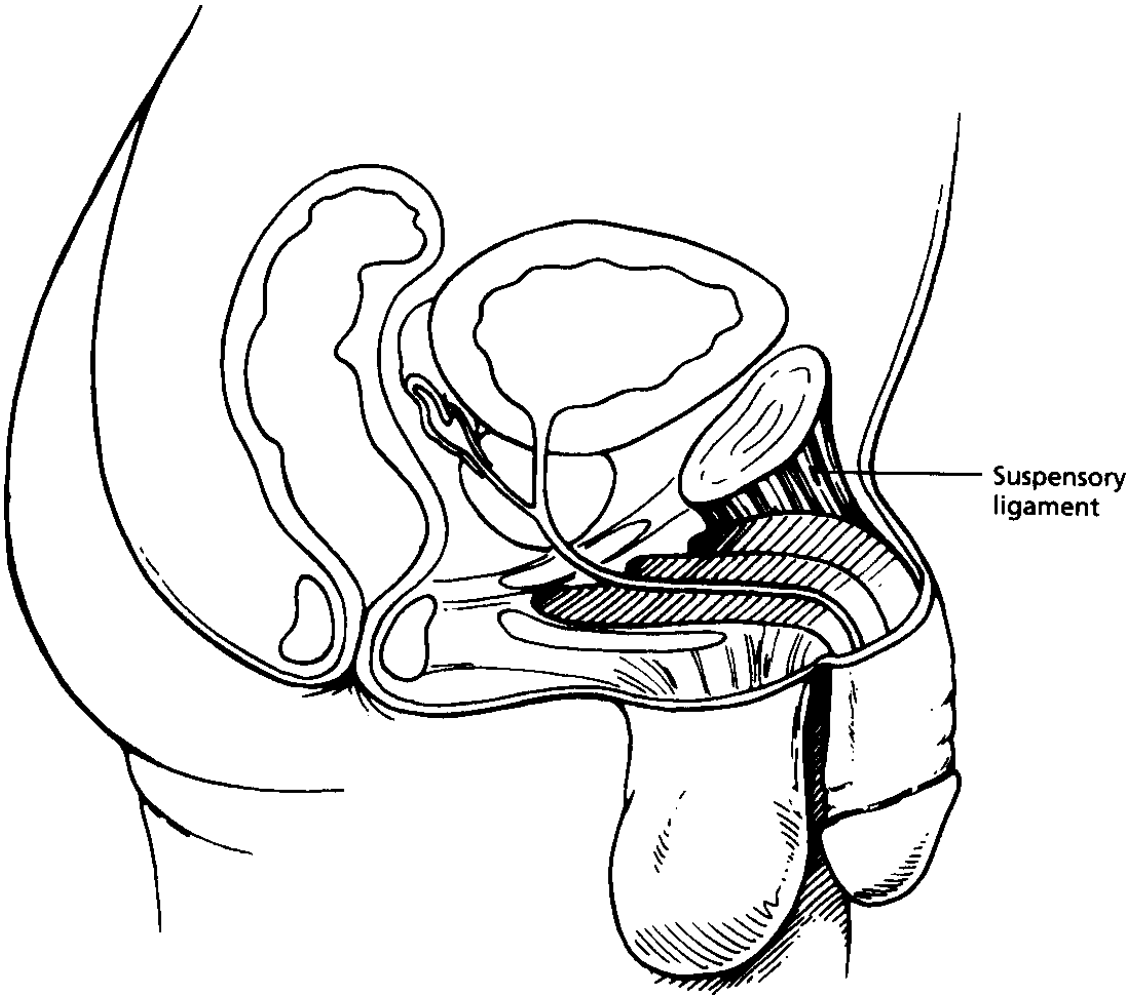

Figure 39 - THE SUSPENSORY LIGAMENT THAT CONNECTS THE BASE OF THE PENIS TO THE PUBIC BONE

The article in the *Chronicle* also describes the experience of a thirty-five-year-old auto mechanic who had a number of complications from the surgery, including a “grotesque lump” at the base of his penis. His penis was also black and blue for several weeks. “I thought it was going to fall off. I thought I was left deformed for life.” He finally took his “new” penis to a urologist, who did repair surgery. Dr. C. Eugene Carlton, president of the American Urological Association, also states that he has heard reports of a dozen serious infections and several cases of impotence. He had to treat one man with an infection so severe he required skin grafting to replace half the skin on his penis.

Even putting aside these medical risks and horror stories, penile-enhancement surgery is misguided according to the Tao. The *strength* of an erection is much more important than its *size.* After their suspensory ligaments have been cut, men often have a lower angle of erection and the increased fat adds girth but not strength. To have an erection your penis needs blood and sexual energy. If the penis is made too large, without enough blood and sexual energy you will have difficulty getting hard. According to Su Nü, "Long and large, but weak and soft, does not compare to short and small, but firm and hard.”

IN THE LOCKER ROOM

The truth is, it is in the locker room that most men are concerned about the size of their penis – not in the bedroom. For this reason, it is worth keeping in mind that there is more variation in flaccid penises than in erect ones. Penises that look small in the locker room expand more in the bedroom than ones that look bigger in the locker room. Also, given the particular angle from which you look at your penis, it seems smaller to you than to anyone else – a cruel divine joke that is guaranteed to cause inferiority complexes. Try looking down at yourself and then look in the mirror. Surprise! You just gained an inch or two. Most men have an exaggerated sense of how big other men are, partly because of the angle of observation and partly because they don’t know the facts. According to urologist Claudio Teloken, who injected 150 men with a medicine that causes erections and then measured their penises from the pubic bone to the tip of the glans, the

"average" man's erect penis is 5.7 inches long. Contrary to popular belief, neither race nor body type makes any significant difference, and the size of the penis has nothing to do with sexual sensitivity.

If you are still concerned about the size of your penis, there is an ancient Taoist exercise for extending your penis that is certainly worth trying before you go to the expense and danger of surgery. It is based on exercising and stretching your penis. There is little scientific confirmation for the success of penis-enlargement exercises, but Alan and Donna Brauer report that 110 men who undertook their extensive sexual-enhancement program reported permanent increases in the size of their penis, from a quarter of an inch to an inch.' It is clear that lack of use can cause the penis to shrink – literally to retract into the body – so it should also stand to reason that frequent use should cause it to extend slightly.

You have no doubt noticed some shrinkage after a swim in cold water. The reason this occurs, and that some expansion may be possible, is that your penis actually extends back into your body two to four inches. These additional inches are held in place by your suspensory ligament, which is what the penile-enhancement surgeons cut. It is probable that frequent erection and sexual activity can cause this ligament to stretch, allowing the hidden part of the penis to move out of the body somewhat.

The time-tested Enlarging Your Penis exercise has been known to extend the penis by as much as an inch within a month or two, but this will depend on your body structure, your health, and your age. The exercise is more likely to work for younger men, whose bodies are still elastic. Weak circulation will make it more difficult. You can determine any gains by measuring your erect penis before you begin and over the duration of your practice. (Make sure you measure from your pubic bone to the tip of your penis and that your erection is at a ninety-degree angle from your body.) No matter what success you have in stretching your penis, this exercise also massages and energizes the entire urogenital system, including the prostate gland.

EXERCISE 16

ENLARGING YOUR PENIS

1. Inhale through you nose into your throat and then swallow this bubble of air, pressing it down into your stomach. (It should not stay in your chest.)

2. Imagine this breath as a ball of energy, *chi*, which you want to push down from your stomach through your pelvis and out into your penis. This will help you bring more energy to your penis.

3. Once you have pushed this ball of energy into your penis, use the three middle fingers of your left hand to press the Million-Dollar Point between the anus and scrotum. This will lock the energy into the penis.

4. Breathe normally while keeping your fingers on the Million-Dollar Point. At the same time, begin the following stretches.

5. With the right hand, grip your penis and begin rhythmically pulling it forward and away from your body. Pull six to nine times. Them pull to the right six to nine times. Then pull to the left six to nine times. Finally, pull down six to nine times.

6. Use your thumb to rub the head of your penis. Rub the penis until it becomes erect. If your are not getting erect, pull some more while you rub, until you have an erection.

7. Holding the shaft of the penis, circle the penis at its base with your thumb and forefinger and pull forward about an inch. This forces the energy to the head of your penis. Do this nine times.

8. Pull the penis to the right with your right hand and rotate the penis in small circles. Do this six to nine times in one direction and then the other, maintaining the outward pressure. Repeat, pulling it to the left and making six to nine small circles in one direction and then the other.

9. In the final stretch, gently slap your erect penis against your inner right thigh, remembering also to keep pulling outward. Do this six to nine times and then repeat the motion against your inner left thigh.

10. After completing these stretches, soak your penis in warm water for a minute. This will help your penis absorb the warm (yang) energy and expand.

IN THE BEDROOM

If you are concerned more about the bedroom than the locker room, there is something you can do for your partner that is much better than undergoing penile surgery or even doing penis-extension exercises; Arouse her fully before entering her. If her vagina is engorged, your penis will seem larger to her. As we mentioned earlier, women generally experience the most sensation in their clitoris and the first couple of inches of their vagina, which means that even a man with a small penis can reach these most sensitive spots. The position adjustments we described will also help any couple accommodate differences in genital size.

Some couples actually have the opposite problem: the man's penis is too large for his partner. Though a woman's vagina can expand considerably, this imbalance can be painful if the partners are truly mismatched. One solution is to tie a handkerchief or a shoelace around the base of the man's penis at the point of desired depth. This also has the added benefit of expanding the head of the man's penis, which can give greater pleasure to both partners. Just as you must allow your penis size to decrease about every twenty minutes to allow the blood to circulate, you must make sure to remove the handkerchief or any other tie on your penis so that the blood does not stagnate. The woman-on-top position also helps the woman control the depth and make sure intercourse does not become painful.

It is worth repeating that *if you practice Sexual Kung Fu, you and your partner's sexual desires will be so satisfied that concern about your penis size will fade into a distant memory.* You will wonder how something as insignificant as having large ears or small ears could have taken up so much mental energy. In the words of the wise and experienced Su Nü, "When two hearts are in harmony and the energy flows freely throughout the body, then the short and the small naturally become longer and larger, the soft and the weak naturally firm and hard."

How Many Sperm Does One Man Need? Raising Your Sperm Count

According to the research of Danish endocrinologist Niels Skakkebaek, sperm counts of men in the United States and twenty other countries have fallen dramatically over the last half century – by as much as 50 percent. The cause of this precipitous decline is still being debated, and possible culprits range from tight underwear to chemical pollutants. In reporting on the environmental dangers that seem at least partly to blame, University of Florida researcher Louis Guillette told a panel of U.S. Congressmen, "Every man in this room is half the man his grandfather divas."

Low sperm counts are a major reason that couples have difficulty conceiving a child. Given the declining sperm counts, it may not come as a surprise that infertility is an increasing problem worldwide. The World Health Organization has reported that one in ten couples are involuntarily infertile. In the United States, a staggering one in six couples is infertile – twice as many as ten years ago. It is worth mentioning that *infertility* is a vague and imprecise diagnosis that, like *impotence,* has a tendency to become stigmatized. More to the point, this diagnosis of infertility is simply made after a certain amount of time has passed (usually a year of unprotected intercourse) without conception. According to one medical textbook, "Pregnancy is the only irrefutable proof of the sperm's capability to fertilize." You are diagnosed as infertile until you conceive. Guilty until proven innocent! So even if you have a low sperm count, you may still be able to conceive a child.

Problems in ovulation are also a significant cause of infertility, and if there is no egg to fertilize, it doesn't matter how many sperm you have. Nevertheless, if there is an egg, the more sperm you have, the better the chances of your partner getting pregnant. Though only one sperm finally joins with the egg, all the sperm actually work together to get through the uterus and fallopian tubes and fertilize the egg.

If you have a low sperm count, you will be relieved to know that there are Sexual Kung Fu exercises you can use to help raise it. Engaging in nonejaculatory sex is the most important thing you can do to increase the volume, concentration, and count of your sperm. According to Western medical research, each day you do not ejaculate, you raise your sperm count by 50 to 90 million sperm.

In addition to storing up your sperm, you can help your testicles produce more by shaking, massaging, and tapping them. When our testicles were able to swing freely (before tight underwear and pants), they rubbed together and against our thighs naturally, but now that we sit most of the day and spend very little time running through the jungle naked, we must help them. You can stand with pants that are loose in the crotch and shake your testicles up and down. Then rock your lumbar region and sacrum left and right and forward and back (this will help bring blood to your genital area). The Testicle Massage exercise described earlier in this chapter is also quite effective – especially step 4, which involves tapping your testicles.

My What? Preventing and Helping Prostate Problems

Many men only hear about their prostate gland when they are diagnosed with a prostate problem, such as infection, enlargement, or cancer. Almost one in ten men is eventually diagnosed with prostate cancer, which is now so common an ailment that the medical profession generally assumes that if a man lives long enough, he will develop it. According to the Taoists this disease is not inevitable, and Sexual Kung Fu can help keep your prostate healthy.

Two exercises described – Stopping the Stream and PC Pull-Ups – will help you to strengthen your PC muscle, which surrounds your prostate. By squeezing this muscle you can keep your prostate healthy. As we mentioned, the pubococcygeus is actually a group of muscles that stretch between your pubic bone ("pubo") and your coccyx ("coccygeus"). Make sure you squeeze lightly. If you squeeze too hard, you may find that you are too tense to breathe correctly. You can do the prostate exercise every day, as often as you like. Remember, as with any exercise, you may have initial soreness if you practice a lot. According to Taoism your prostate is closely related to your brain's hypothalamus, so if you squeeze correctly, you will eventually feel a sensation in your brain.

In addition to exercising your prostate, you can also massage your prostate directly, which is what the doctor does when you have a prostate infection. The doctor massages your prostate through your anus, which you can also do. You can also massage your prostate by pressing in at your Million-Dollar Point and making small circles in one direction and then the other (see the Pelvic Massage exercise). Using the Big Draw when you self-pleasure or make love will also help keep your prostate healthy. If you have prostate problems, make sure you use the Finger Lock when you ejaculate.

One multi-orgasmic man explained his experience with prostate pain before and after he started practicing Sexual Kung Fu: "I used to have serious pain in my prostate gland that began during adolescence. Several times a month, I would experience terribly sharp pain in that area that would last several minutes. One time the pain was so bad that a friend of mine claimed that my face actually turned green. Doctors suggested ejaculating regularly to relieve the pressure in the prostate gland. This helped somewhat, but I always knew that letting all that semen out was a tremendous waste of energy. When I was in my late twenties, I discovered Sexual Kung Fu. Within several weeks of practicing the PC muscle contractions, the prostate and testicle massage, and the Big Draw and Finger Lock, the problems with my prostate virtually disappeared. I have not had prostate pain for several years now, and though there was some prostate swelling initially after I stopped ejaculating, this condition gradually declined. Given the number of men who suffer from prostate trouble, these techniques are nothing short of miraculous if they work for others like they did for me."

EXERCISE 17

HELPING YOUR PROSTATE

1. Exhale completely, at the same time lightly contracting your perineum and anus.
2. Inhale, and then as you exhale, picture your prostate, which is just above your perineum, and contract your ac muscle around your prostate.
3. Inhale and relax.
4. Repeat this exercise nine or eighteen times.

Sex Is Not Like Pizza: Healing Sexual Trauma

There is a joke attributed to Yankees coach Yogi Berra that goes: "Sex is like pizza. When it's good, it's *really* good. And when it's bad, it's *still* pretty good." Unfortunately, sex is not really like pizza, as many men who have had negative sexual experiences can testify.

Bad sexual experiences can linger in our libidos, returning at moments of intimacy years later.

Consensual sex sometimes ends up being hurtful, but coercive sex almost always does. Over the last few years there has been an enormous increase in the reporting of sexual abuse, sexual harassment, and sexual assault. Our willingness to address these formerly taboo subjects is an extremely important societal advance. Understandably, the shocking (and not uncontested) statistics about the prevalence of these social ills have resulted in an ever-greater desire to define exactly what consensual sex is. Although most of the media attention has focused on the sexual abuse of women, men can also be victims of exploitative sex. And both women and men can experience consensual sex that goes bad.

Consent (or the lack of it) is sometimes clear and sometimes not, since sexual partners are almost never totally equal in age, strength, experience, power, and so on. In communicating sexual interest, it is best to be as explicit as possible, rather than relying on silent signals. Fortunately, as women have discovered that they are sexual beings as much as men are, we are abandoning the confusing and dangerous mixed messages of earlier generations. "No" can finally mean *No!* and "Yes" can finally mean *Yes!*

If you have experienced coercive sex or consensual sex that went bad, you may be left with sexual scars that can cause sexual or emotional problems. If this is the case, you will probably want to seek professional therapy or sex counseling. However, there are also some things you can do on your own to help you stay focused on the pleasure of the present rather than the pain of the past.

Staying present and in your body is a challenge for anyone who has experienced sexual trauma. Paying close attention to the sensations in your body, both positive and negative, is far better than allowing your thoughts to wander or to "rise above" your body, causing you to become an observer instead of a participant. The Belly Breathing and the Century Count exercises described in chapter 3 will help you improve your concentration and your ability to stay focused. Sound, whether in the form of mantras or moans, can also clear your mind of distracting thoughts. Positive reinforcement will also help you stay present. Remind yourself as often as necessary of where you are, whom you are with, and how good it feels. When old feelings arise, it is generally best to stop what you are doing and share with your partner the feelings that are coming up.

EXERCISE 18

TOUCH MEDITATION

1. Sit facing one another with your legs crossed or on your heels. The lighting should be low, preferably candlelight.
2. Using both hands, start touching your body, generally from head to toe. (Avoid any parts of your body that you do not want your partner to touch and generally avoid your genitals or leave them until last.)
3. Your partner should use her hands to follow yours, touching each place that you have just touched.
4. Switch and have your partner use her hands followed by your hands to introduce you to her body.
5. Hug and feel each other breathing.

If you do not feel comfortable discussing your sexual trauma with your partner, especially if she is a new partner, you should try to tell her what you do want now. If she is doing something that is uncomfortable or does not feel good, tell her, but do so by saying what you'd prefer her to do rather than criticizing what she is doing. If you are not feeling particularly sexual, suggest that you hold each other, massage each other, or meditate with each other by looking into one another's eyes. You can also suggest that you do the Touch Meditation exercise. It is especially good at reestablishing intimacy that has been damaged in some way.

With Touch Meditation you reconnect with your body and share with your partner the parts of your body that you feel good about sharing. You will probably find that your partner is responsive to taking it slow and developing greater intimacy before being sexual. If your mind and body are not present, you will have very little sexual energy to share with your partner. Neither you nor she will benefit much from your lovemaking, and your pleasure will be minimal. By taking it slow and stroking your entire body, you will be able to gather your sexual energy and have an experience that is both passionate and meaningful. As already mentioned, the Taoists recognized long ago that sex has great power for healing or for harm, so use this power wisely and lovingly.

Making Love for a Lifetime

In Taoism, our bodies are considered to be microcosms of the natural world, so we must think of ourselves and our sexuality as changing like the seasons: spring, summer, fall, winter. Yet the Taoist masters were able to turn the seasons one more time, experiencing a second springtime in old age. Consumed with the search for immortality, they found in Sexual Kung Fu a true fountain of youth. Indeed, all modern studies show that an active sex life is essential for counteracting the effects of aging and for maintaining one's health. We will now explore how sex can actually help you live longer and what specifically you need to know as your sexuality changes.

Sex and Aging

You are never too *young* to read about sex and aging. In the West, we tend to think of aging as something that happens late in life, but the aging process begins at birth, and our sexuality changes every few years. As Kinsey put it, "The sexagenarian – or octogenarian – who suddenly becomes interested in the problems of aging is nearly a lifetime beyond the point at which he became involved in that process."' The sooner you read this section, the better off you'll be.

You are also never too *old* to read this chapter, for according to the Tao, sex is a lifelong activity that is possible and desirable until the day you die. In the West, older men who are still interested in sex are considered lecherous – "dirty old men." The Tao never had this prejudice; on the contrary, sex was seen to be even more important for the health and longevity of men and women in old age, or what we now call *late adulthood.* The Chinese are not alone in this belief. A cross-cultural survey has shown that sex is vitally important for older men in 70 percent of cultures and for older women in 80 percent.

Closer to home, a *Consumer Reports* survey demonstrated how different the realities of sexuality among the elderly are from the cultural stereotypes: among those surveyed, over 80 percent of the married men and 75 percent of the unmarried men over seventy years old remained sexually active. Fifty-eight percent had sex at least once a week, 75 percent reported "high enjoyment of sex," and 43 percent still masturbated.' You also shouldn't assume that your partner's sexual appetite diminishes after menopause. Many women find that their interest in sex actually increases after menopause, perhaps because of their changing hormonal levels.

In the West, we glorify adolescent male sexuality and see a man's sexual power as peaking at age eighteen and declining steadily thereafter. In the words of one sexologist, "The adolescent penis is the penis at its ultimate power. From here on until the end of life, there is a gradual tapering off." The problem comes from a general misunderstanding of sexual power in the West. In terms of potency, it is true that a man's ability to produce sperm peaks during early adulthood, but this is important only if we are concerned with reproduction. A woman's fertility and ability to bear a child also peak in early adulthood.

However, in terms of pleasure rather than potency, a man's ability to satisfy his partner and himself only increases as he gains more experience and control. Although a man may no longer get hard instantly or be able to shoot his ejaculate as far as he could as an adolescent, these changes hardly compromise his ability as a lover. The Taoists knew that as a man leaves the fever of adolescent sexuality with its quick ejaculation. his Sexual Kung Fu practice and his partner's pleasure only increase.

AS YOUR BODY CHANGES

Inevitably, there are a number of physiological changes that take place as you age. For example, if you are over fifty, you probably need more direct stimulation of your genitals to get an erection than you did when you were younger: this is not because your sexual appetite or your attraction to your partner has disappeared, but simply because your physiology changes as you get older. Also, your erection is probably less firm and angles down more than it did when you were younger. In addition, if you ejaculate, the force of the ejaculate is less and your recovery time is longer.

These changes of decreased physical strength and stamina are no different from changes in any other physical ability as you get older. You don't expect to be able to run as fast or as far at sixty as you could at twenty. But there is one difference between sex and sports with regard to aging: your ability in bed may actually improve. Older men can actually maintain an erection longer than before (although if you lose your erection for whatever reason, it will be more difficult to regain). This will make it easier for you to satisfy your partner and to become multi-orgasmic without ejaculating. In Dunn and Trost's recent study, half the men had become multi-orgasmic after the age of thirty-five. A number had become multi-orgasmic between the ages of forty-five and fifty-five. And the older men who had learned to become multi-orgasmic, all now over fifty, were still multi-orgasmic and going strong.

Most of the western sexual literature also suggests that the intensity of the sexual experience diminishes as a man ages. This is not the case according to the Tao. The Taoists do not measure intensity according to the number of genital contractions, which do decrease as you get older. Since they recognize that sexual energy is a inhale-body affair, they judge the intensity of sex on a man's ability to cultivate and circulate his sexual energy, Which only increases as he gets

more experience. Your sexuality will no doubt change over time, and you may miss some of the feeding frenzy of youth, but the more refined pleasures of older age are just as delectable, if not more so.

YOUR BODY AND SEX

We hope you now understand that sexuality for the older man is not a slippery slope to sexual inadequacy. Still, you will find that you are able to climb much more easily to the peaks of pleasure if you observe the basic needs of your older body. First, a healthy body and regular exercise are essential. One reason so many people's sex lives shrivel as they age is that their bodies become weak or ill. The wisdom of the East and all physiological studies in the West have concluded that exercise not only improves sexual ability but increases sexual desire and orgasms. Your abdomen, hips, buttocks, and thighs are especially important large muscles, as is the smaller PC muscle we discussed earlier. Keeping these muscles strong is essential for maintaining sexual vitality. Although swimming, jogging, and other Western sports are excellent ways of maintaining physical health (as long as they are not overdone), regular sex is as important, if not more so. *Use it or lose it* quite accurately describes the aging male body.

According to the Tao, a great deal of sexual energy leaks out of our anus and buttocks. Try squeezing your buttocks together and you will see how powerful this muscle is for containing energy and sending it up your spine. The Taoist doctors considered the strength of a person's anal sphincter an important sign of health. A loose, weak sphincter is a sign of poor health; a tight, strong sphincter, a sign of good health. You can strengthen your anus and buttocks by using the following exercise. In addition, this exercise will help you relieve stress while energizing your body and developing your sexual control. It also will help energize your prostate and Cowper's glands and circulate your blood and strengthen your erections. It has even been known to help cure hemorrhoids.

EXERCISE 19

STRENGTHENING YOUR ANUS

1. Exhale completely through your nose and then pump and pull up the muscles in your anus and buttocks for several seconds (You will be repeatedly squeezing and releasing these muscles.)

2. Inhale slowly and relax.

3. Repeat steps 1 and 2 nine, eighteen, or thirty-six times, or until your groin and anus start to feel warm. This energy may gradually spread to your head and down to your navel, or you can draw it up consciously to the tailbone and the sacrum, *and* up the spine to the head along the Microcosmic Orbit. Rest and spiral the energy in the head eighteen to thirty-six times. If you feel too much energy, remember to touch your tongue to the roof of your mouth to let the energy come down to your navel.

EJACULATION AND AGING

By now it should be obvious that the place you lose the most energy is out your penis through ejaculating. For aging men, nonejaculatory lovemaking is even more important as each ejaculation becomes more exhausting to the body. As we mentioned once before, the long-lived Chinese physician Sun Ssu-miao recommended that men at forty ejaculate no more than once in ten days, that men of fifty ejaculate no more than once in twenty days, and that men at sixty no longer ejaculate. These are maximum amounts, and if you are able to transform your sexual energy by drawing it up, the less frequently you ejaculate, the better off you will be. This may be difficult at first if you are just starting to practice Sexual Kung Fu, but once you experience the pleasure of nonejaculatory orgasms and understand their health benefits, you will be extremely motivated to learn quickly. Even better, if you start when you are younger, your appetite for ejaculation will quickly decrease and as you get older you will have little or no interest in it.

Sun Ssu-miao's recommended frequencies are just guidelines, and every few years you can simply decrease the number of times you ejaculate. This will naturally allow you to keep your frequency of ejaculation in line with your increasing needs for conservation. It is interesting to point out that even Masters and Johnson recognized that men do not need to ejaculate every time they make love, especially once they reach the age of fifty. If a man recognizes this important point, they concluded, "he is potentially a most effective sexual partner."' Once again, it is important that you not become obsessed with nonejaculation and that you not berate yourself if you do ejaculate. If you ejaculate, let go and enjoy it.

Keeping Love Alive

In the West, we tend to think that love and passion peak on the wedding night and die shortly thereafter. The reasons for this decline are never fully explained to *us,* but it seems that after the thrill of courtship is over, boredom (supposedly) sets in. For Taoists, the wedding night is just the beginning of a lifetime of expanding love and intimacy. With Sexual Kung Fu, love and sex are better at fifty or even sixty than they are at twenty. Here's why.

MAINTAINING THE SEXUAL CHARGE

According to Taoism, our attraction to our partner is dependent on the strength of the yin-yang charge that exists between us. The greater the charge, the greater the passion. The lesser the charge, the lesser the passion. The loss of this charge is the reason many relationships become flat or boring. (It is also the reason many of these couples experience a flicker of passion after one of the partners has been away on a business trip, since-temporary separation tends to recharge the polarity of the partners.)

One of the main reasons for the loss of this charge over time is ejaculatory sex. When the man ejaculates, he depletes his yang charge. Whether consciously or not, the man also starts to realize he is being exhausted by lovemaking. This can often lead to resentment and a desire to withhold sex. Although as mentioned the more common stereotype is of the ever-desirous husband and the frigid wife, the truth is that men as often as women determine the frequency of lovemaking. Over time, the depletion of a man's energy and specifically his yang charge can lead to disinterest and boredom for both partners.

Some couples are able to temporarily recharge their relationship by sleeping in separate beds or spending time apart. Duo cultivation allows couples to maintain this polarity and keep their relationship fully charged. There is no reason that love must go flat or that boredom must set in. Though there are numerous reasons that people have extramarital affairs, boredom and sexual dissatisfaction are certainly two of the main ones. Maintaining the power of attraction in your relationship decreases the desire to seek out the charge of a new lover. Inexhaustible pleasure exists in every couple if they are able to conserve and exchange sexual energy. One multi-orgasmic man describes his and his partner's experience: "The practice has deepened our relationship, our love is growing, and the magnetic attraction for each other seems not to decrease, but rather to intensify."

Contrary to the stereotypical idea that sex in marriage is unsatisfying, most studies show that married couples have *better* sex with one another than they have in affairs. Bernie Zilbergeld points out that men and women tend to have *less* variety and to experiment *less* in affairs than in marriage and that women tend to be far more orgasmic with their husbands than with lovers. Women are not the only ones who are more orgasmic with their spouses. Kinsey also found that men often fail to reach orgasm in extramarital affairs but almost never experience this failure with their wives.

Good sex is not the only benefit of long-term relationships. A study conducted at the University of California at Berkeley concluded that couples in long-term marriages become happier and more affectionate as they age. In our society, we endlessly praise new love in songs, literature, and films. We dismiss love between older couples as passionless and boring. "What we actually thought we would see is a kind of fatigue quality in these relationships," said Robert Levenson, one of the researchers. "But that's not what we see. They're vibrant, they're alive, they're emotional, they're fun, they're sexy, they're not burned out." Recent biological studies suggest that the presence of a long-term lover increases the body's production of endorphins, natural painkillers that give partners a sense of serenity and security in their lives.'

Couples who do choose to love one another without getting married can have lovemaking that is just as holy and intimate as the lovemaking of those who have the state's official stamp of approval – as long as they practice the union of yin and yang. Yet it is important to keep in mind that it takes years to reach the heights of physical, emotional, and spiritual intimacy and to master the union of yin and yang. It is said in Taoism that it takes seven years to know a seaman's body, seven years to know her mind, and seven years to know her spirit. The saving does not mean that after this you stop learning or start growing bored; rather, it simply means that it takes twenty-one years to really get acquainted.

The Seasons of Our Sex Lives

Relationships, the Taoists knew, are not linear. They do not peak on the wedding night or on any other night. Rather, they wax and wane with the cycles of family, work, health, and even nature. It is important to be aware of these cycles and to know how to live harmoniously with them, in and out of the bedroom.

First and foremost is the need to communicate with your partner about these cycles, to be aware of your own waxing and waning desire, and to be able to talk about it in such a way that neither of you feels judged or blamed. Many women (and an increasing number of men) see a direct correlation between their partner's desire and their own attractiveness. It is important for you and your partner to escape this trap by recognizing that sex has as much to do with your hearts, minds, and spirits as it does with your bodies.

Western materialism encourages us to look at one another's bodies as commodities. We are taught to "get off" on a woman's full breasts or a man's washboard stomach. Our fetishes and media-generated fantasies are endless. So when our bodies age, we think we should stop having sex or should look for partners who are "new and improved." Taoists view the body as dynamic, realizing that the real charge comes from the interplay of subtle energies and not from the pounding together of two hard, static bodies.

Joseph Kramer explains the difference in Taoist sexuality: "In the Eastern tradition, there is eye contact almost all the time during sex. 'I am having sex with *you*. I am breathing with *you*. I am relaxed with *you*. I am connected in the heart

with *you.* I am connected in the genitals with *you*. Sex in a Taoist relationship is better at sixty than at twenty." Legs, stomachs, and genitals get old, but eyes just gross adviser.

SEX BEGINS LONG BEFORE YOU TOUCH

Since sex is a dynamic force, you need to be very conscious of the energy you bring to it. Sex really begins as much as forty-eight hours before you actually make love; the energy and emotions that you have accumulated during this time follow you into the bedroom. So, a day or two before making love, try to work through any negative emotions, especially anger that will block the exchange of energy between you. The more calm and connected you are when you begin, the easier it will be to reach higher levels of intimacy and ecstasy. Clearly, few couples plan sex two days in advance, so you need to be conscious of your emotions in general and try to work them through as soon as possible.

Foreplay, too, begins before you touch one another. The setting you create – candles, soothing music, and romantic, loving words – will help harmonize your energies. During and after lovemaking be sure to stay present with your partner: remember the eyes. You are trying to experience a more profound state of being together, not just a momentary climax.

If lovemaking becomes routine or mechanical, stop for a while. This will allow the polar passion between you to recharge. Yet don't forget the importance of touch and intimacy. The fact that you are not making love does not mean you should not hold each other or be emotionally intimate. In fact, observing a "sex fast" can allow you to focus on these other parts of your relationship, which are as important. Focus on the quality of your love, and the quality of your sex will naturally improve.

THE CYCLES OF YOUR DESIRE

You will also find that the cycles of your sexual desire do not always coincide. At times you will feel more desire than your partner, and at times you will feel less. No one who is truly in touch with his or her body and emotions wants sex all the time. However, what should you do if one of you is interested in sex but the other one is not. There are several options that correspond to different ways of making love.

Let's assume that tonight you are feeling aroused and your partner is not. Of course, if your partner is interested, she can pleasure you orally or manually. If she is not in the mood, she may be milling to touch or hold you as you pleasure yourself. If she is not in the mood for this, either, she may be willing to exchange nonsexual touch. You can exchange a great deal of powerful, healing energy through holding each other or touching each other. (The Touch Meditation exercise is one option.)

If sex is specifically what you need and sex is specifically not what your partner is interested in, you can of course make love to yourself (that is, self-pleasure). Remember, all of us have yin and yang, feminine and masculine aspects, within ourselves. Self-intercourse, or the union of these two aspects, is a very powerful part of the Taoist practice. Michael Winn explains: "It is possible to harness the sexual energy of the genitals and kidneys and the emotional energy of the heart through meditation. This meditation practice, known as the water-and-fire method (called the *Lesser Kan* and *Li),* allows you to literally make love inside yourself and have an even higher level of orgasm, one that dissolves the boundaries between your body and spirit. This practice also has a great many health benefits and was traditionally referred to as a method of repairing the body and the soul."

Because of the societal stigma regarding masturbation, many people are too embarrassed to self-pleasure when anyone else, including their partner, is around. However, if this natural part of human sexuality can be discussed in an open sexual dialogue, you will find that you can harmonize your individual sexual cycles with ease and a great deal of pleasure.

INTEGRATING YOUR SEXUAL ENERGY INTO YOUR LIFE

Often people turn to sex when all they really need is loving touch. As one multi-orgasmic man explains, "The biggest discovery for me was that I could have sex with my clothes on, just by being with somebody and sharing the energy. It feels very sexual, just touching and holding hands and feeling the sexual energy flow through your bodies. This is really sexual freedom, because sex is not just something you engage in periodically. Your sexuality is integrated into our whole life, adding color and intensity, interest and passion to everything."

If you are a parent dealing with the demands of work and family or a person who has an extremely demanding career, the increased energy that comes from practicing Sexual Kung Fu can help you avoid burning out. The ever-increasing demands of work and family in our overcommitted, overworked, overstressed lives are enough to exhaust anyone. Once you are able to cultivate your energy both in and out of the bedroom, you will find that you have more energy than you ever thought possible.

FANTASIES

Many Western sex experts recommend having an active fantasy life, and indeed fantasies can help you to generate sexual energy when you are self-pleasuring. When you are with your partner, however, there is a danger in relying on sexual fantasies. The exchange of yin and yang energy with your partner is real, not imaginary. If you focus your sexual attention on some idealized lover or some pornographic image, you will not be able to feel the real and profound flow of energy between you and your partner. Fantasies prevent you from being present and from appreciating what is truly fantastic about your partner and about your potential to experience the heights of ecstasy together.

NATURAL RHYTHMS

Finally, remember to observe the general rhythms of your body and of nature. Avoid making love right after a big meal. After you have eaten, your body needs to focus its blood and energy on digestion. When you finish a meal, you should be satisfied, not stuffed, with a little hunger remaining. (As the food settles, you will become full.) When you finish lovemaking, you also should be satisfied but not sated, with a little desire left over. (As your energy settles, you will become content.)

If you are ill, remember to make love with your partner on top so that you can absorb her healing energy. And remember the seasons of nature. Plants and animals all reproduce in the spring. Though humans are unique in their ability to make love all year long, don't expect yourself or your partner to be as sexually active in the fall and printer as you are in the spring and summer.

Sexual Kung Fu offers you the potential for multi-orgasmic lovemaking far beyond what most people settle for in their sex lives, but this does not mean that you need to reach the heights of ecstasy every time you are intimate with your partner. Listen to the rhythms of your body and your desire.

AVOID INCREASING THE STAKES

Every time a sexual possibility is introduced to Western readers, the sexual stakes tend to get raised. Once women's orgasms were "discovered," couples were expected to start having simultaneous orgasms. When some women were found to be multi-orgasmic and to have G spots, all women were expected to have multiple orgasms and G spots. Every man has the potential to become multi-orgasmic and to experience whole-body orgasms, but not every man will want to experience them every time. Try to avoid creating performance expectations and anxiety. The Taoist sexual techniques we are teaching are also called the *healing love.* If you focus on love and healing, for yourself and for your partner, the rest will naturally follow.

No Free Love

Monogamy is back, even if as nothing more than a health precaution. But monogamy is much more than an onerous requirement of the times. With the right partner, it can be a crucible for a most powerful alchemical process of physical pleasure, emotional intimacy, and spiritual growth.

If the indiscriminate accumulation of sexual energy where the goal of Sexual Kung Fu, it might be best to sleep with as many people as possible and to exchange energy with all of them. And indeed, there were ancient texts that recommended this practice. But it is not just the amount of sexual energy you have that is important, it is also the quality of that energy. The goal of Sexual Kung Fu is to eventually transform sexual energy, into more refined and subtle energies of the heart, mind, and spirit.

SEXUAL ENERGY AND EMOTIONS

If you are sleeping with people who have a great many negative emotions (such as anger or sadness), you will internalize their emotions. *No matter how much latex you put between you and your partner, you are always exchanging emotional and spiritual (as well as sexual) energy.* So avoid violating your bodily, emotional, and spiritual integrity by having sex with someone you do not respect and love. In choosing a partner, you are quite literally choosing your spiritual destiny.

In reality, men (and women) who have not found a loving partner have sexual urges that need satisfaction – an itch that needs to be scratched. If this is your situation, you would be better off practicing solo cultivation and learning to circulate and transform your sexual energy. This training period will allow you to raise the level of your internal energy; eventually you will attract an equally aware and mature partner. If you sleep with someone you do not love, your energy will be in disharmony and either drain you or cause imbalances. For the same reason, you should make love with your partner only when you feel true affection for her. If you feel you must sleep with women you do not love, try to be as kind and loving to them as you can be. Otherwise, it will be impossible for you to truly practice Sexual Kung Fu.

Quite a few men find they are attracted to or interested in being in a relationship with more than one woman. Few men, however, can love more than one woman at a time and feel true serenity. If you think you can, be prepared to spend a great deal of effort trying to transform and balance their energies.

Remember, sexual energy simply magnifies whatever emotions you are feeling. Sex is the most powerful tool for cultivating a relationship and joining our lives together, but it can also be a sharp weapon that can sever those ties and leave lasting scars. As many who experienced the sexual revolution of the 1960s learned, there is no "free love": sexual knowledge comes at a high price and should be cherished accordingly.

Teaching Our Sons

Chances are you were not told about Sexual Kung Fu when you were growing up and learning about your sexuality. Few people are so fortunate. Most boys learn very little about sexuality and practically nothing that is of use. They are left to grope in the dark for sexual intimacy and pleasure. As one multi-orgasmic man explained, “For me, discovering Taoist sexuality was like coming across information and guidance that I felt should have been explained to me from the beginning. It felt like the right way to make love, and the old way seemed so ridiculous, embarrassing, even selfish.” You have a chance to help your son avoid this situation and save him from a great deal of the fear and frustration we mistakenly assume is an inevitable part of growing up.

NO BIRDS AND NO BEES

Both parents have an important role to play in the sexual education of their sons and daughters, but since this is primarily a book for men, we will focus specifically on fathers and sons, although much of what we have to say is applicable to mothers and daughters as well. When most people think about discussions of sex between fathers and sons, they generally think of the famous man-to-man talks about the birds and the bees when a boy comes of age. Kids grow up much too fast today to make quaint discussions about birds and bees of any use – if they ever were. Adolescence is in reality much too late a time in your son’s development for you to begin establishing a dialogue with him about sexuality.

If you succeed in maintaining an open relationship with your son, such a talk will never be necessary. Children’s curiosity about sex begins early, and their sexuality begins even earlier. Anyone who has witnessed an infant boy touching and pulling on his penis and scrotum (often quite hard!) knows that this is not just random exploration. The boy is receiving pleasure – more than he receives when, for example, he pulls on his toes.

Babies are sexual beings, or perhaps we should say *sensual* beings, since we generally associate sexuality with later stages of development. However, their physical and genital pleasure is undeniable – as much as we try to deny it. Freud called infant sensuality "polymorphous perversity," but there is nothing perverse about it except our own attempts to repress it. How you respond to your son’s explorations of and questions about his and your bodies will teach him a great deal about his sexuality. *Developing a healthy, lowing relationship to your sexuality and encouraging him to develop the same with his sexuality is the first thing you can do for your son.*

YOUR RELATIONSHIP TO YOUR PARTNER

Children also learn a great deal about intimacy from watching their parents. How you treat your wife or partner will be a model for how your son should treat girls and, later, women. Learning about sex is really learning about sex roles, about communication, about love. What you model will have a much greater impact on your son than what you say, so remember that you are always teaching – when you are hollering at one another as well as when you are holding hands.

In this culture, we worry about children seeing their parents being physically affectionate with one another, but there is nothing wrong with children witnessing these expressions of love. In fact, there may be a problem with them not witnessing it. Its absence not only leaves children often wondering whether their parents love each other but also leaves them without models of how to express affection to their own partners. *Modeling a healthy, loving relationship with your partner is the second thing you can do for your son – not to mention for your partner and yourself.*

YOUR RELATIONSHIP TO YOUR SON

Many men are becoming more involved in child care than their fathers were, and this naturally leads to more affectionate and loving father-son relationships. However, a lot of fathers still feel uncomfortable expressing affection, especially physical affection, toward their sons – holding them, hugging them, or kissing them.

Or, if they are able to do this with their young sons, they quickly stop as the boys grow older. Many of these men never experienced this love from their fathers and have no model for how to express it.

Some men worry that if they are too affectionate, their boys will become soft, or sissies, or gay. There is no evidence in support of any of these ideas, but it is clear that homophobia in our culture prevents men from expressing their affection for one another and, most tragically, for their sons. Over the last ten years, another issue has begun to prevent fathers

from being physically affectionate toward their sons or daughters. The legitimate concern over protecting children from sexual abuse and incest has led to a suspicion of all male physical affection – since most of the perpetrators, although certainly not all, are men.

Touch is the most basic of human needs, and several studies report that babies who did not receive enough of it died. But babies are not the only ones who need touch. Your son will need your loving touch throughout his life. Don't be surprised, however, if your son goes through stages in which he refuses your affection – especially around adolescence, when he may be concerned about his peers' opinions or may be trying to become more independent. However, if you have maintained an open and loving relationship with him, this separation will be only temporary. Martial artist and actor Chuck Norris recounted one of his greatest joys in raising his two sons: "One of my biggest gratifications today is that my grownup sons aren't embarrassed to kiss me hello or good-bye in front of anyone and that they come willingly to me for advice or help if they have problems."

Physical affection is just part of a loving relationship. Emotional intimacy and respect for your son are essential for keeping an open dialogue. Norris, whose father was alcoholic, explains how he tried to present a different role model: "I wanted my sons to know that I was there, that I cared, and that I was always in their corner. I am very close to my sons. I have played with them, listened to their problems, held them in my arms when they were hurt, and shared most of the major events, crises, and successes of their lives." Listening to your son and acknowledging his feelings and his fears will allow him to know he can come to you. If you are willing to hear his pain, he will also be able to share with you his questions about pleasure. *Building a healthy, loving relationship with your son is no doubt the most important thing you can do for him.*

SHARING TAOIST SEXUALITY WITH OUR SONS

Though people are never too old to benefit from the Tao, the earlier they begin to practice, the more they will gain. This is also true for our sons. If you are able to share with your son some of the Taoist insights in this book, you will help him avoid a great deal of suffering and wasted energy.

Since sexual practices are done in privacy, your son cannot learn from your actions. Sexual Kung Fu is something you must tell him about through words – your own or others.

Long before boys are interested in sex, they experience sexual energy. Boys (and men) get erections and aroused for all sorts of reasons – boredom, among others. (Remember those "woodies" during math class?) One multi-orgasmic man described his experience: "My son called to me from the bathroom one morning and said, 'Dad, I can't pee.' I went into the bathroom and noticed that he had woken up with an erection, which was preventing him from being able to pee. I taught him the Cool Draw, which he has been able to use ever since to manage his sexual energy." Boys are often tortured by their inability to understand and control their sexual energy. If you can help your son understand how to channel this vital energy, you will save him from an enormous amount of sexual frustration.

Young people, however, are often not able to understand the Tao. In the words of Dr. Sun Ssu-miao in his *Priceless Prescriptions,* "When a man is in his youth, he usually does not understand the Tao. Or even if he does hear or read about it, he is not likely to believe it fully and practice it. When he reaches his vulnerable old age, he will, however, realize the significance of the Tao. But by then it is often too late, for he is usually too sick to benefit fully from it."

You can wait for an opportunity when your son has approached you for advice, or you can give him this book or other materials to read, explaining that you wish you had read about these practices when you were his age. If you leave this book on your bookshelf or out in a conspicuous place, you may find that he reads it on his own, but it is important for him to realize that he does not have to lock himself in his bedroom or the bathroom to read it. You may worry that he should not read books (such as this one) that are explicit about sexuality until he reaches an appropriate age, but the appropriate age is really when he is curious enough to want to read them. Rest assured that he will not read them before he is ready, and that when he is ready, he will learn about sex one way or another.

Sexuality, Secrecy, and the Tao

It should be quite clear by now that Taoism, unlike many other spiritual traditions, encourages *us* to acknowledge the fact that we are embodied and that sexuality is a vital part of our humanity. For most Westerners who have been taught to be ashamed of their bodies in one way or another, this is a revolutionary idea. Ironically (some would say hypocritically), Western culture titillates at the same time that it condemns. So, for most people who are used to seeing sex being used to sell everything from beer to automobiles, the idea that sexuality is also a spiritual practice is equally revolutionary.

In this book, we have tried to explain the ancient Taoist insights about love and lovemaking and how they can be used by people today. If you do nothing more than practice the techniques in this book, your life will certainly be enriched. However, we would be negligent if we did not explain that sexuality is just part of the Taoist practice and that there are equally powerful insights and exercises for cultivating your body, your emotions, your mind, and your spirit outside the bedroom as well.

The medical traditions of Taoism, known in the West as Chinese medicine and acupuncture, have helped countless people regain their health; *chi-kung* and Tai-chi exercises have been the foundation of the internal martial arts now popular around the world; and the core philosophical text of Taoism, the *Tao Te Ching* (pronounced *DOW DE JING),* is one of the most translated and read works of world literature. In addition, over the last twenty years, the arts of the bedchamber have begun to transform the sexual lives of people all over the globe. Taoism has a great deal of practical wisdom to offer – wisdom that can help people of any religion live healthy and meaningful lives today.

The philosophy and practices that we have taught in this book were for millennia closely guarded secrets handed down from mater to disciple after years of training. We have presented them here because we believe that human culture as a whole can benefit from their dissemination. Carnal confusion is just one of the many dilemmas we face today, but as we heal ourselves and our relationships, we will begin to heal the planet itself – for, according to the Tao, we are as much a part of nature as nature is a part of us. We believe that this healing must begin in the bedroom, for it is here that the next generation is conceived. It is through love and sex that humanity continues, and it is in loving and in making love that the power of transformation is perhaps the greatest.

However, these teachings are not to be taken any less seriously or valued any less because you did not have to pay a million gold pieces or study for a decade with a master to learn them. Cherish them and they will reward you in manifold ways. Read, reread, practice, and share them with others. The more pleasure you give, the more pleasure you receive. The more you heal, the more you are healed. This is the true secret of Taoist sexuality.

Healing Love through the Tao

Cultivating Female Sexual Energy

Mantak Chia

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I have come upon Master Chia's Taoist practice in my old age and find it the most satisfying and enriching practice of all those I have encountered in a long life of seeking and practicing.

Felix Morrow, Senior Publisher

Healing Love through the Tao

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying ma

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using the Dark Room technology creating a complete environment for the higher level Taoist practices.

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Without my mother and my son, Max, the book would have been academic—for their gifts, my gratitude and love.

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

The book does not give any diagnoses or suggestions for medication. It does provide a means to improve your health in order to overcome imbalances in your system and to provide a richly rewarding sexual experience. People who have high blood pressure, heart disease, or a generally weak condition, should proceed slowly in the practice, particularly Ovarian Breathing. If there is a medical condition, a medical doctor should be consulted.

Author's Note

In the last pages of this book, the reader will find descriptions of the courses and workshops offered by our Universal Tao Centers. This material is also in effect a comprehensive description of the whole Taoist System. All of my books together will be a composite of this "Taoist world view. Each of my books is thus an exposition of one important part of this system. Each sets forth a method of healing and life-enhancement which can be studied and practiced by itself, if the reader so chooses. However, each of these methods implies the others and is best practiced in combination with the others.

The foundation of all practices in the Taoist System, the Microcosmic Orbit Meditation, is the way to circulate Chi energy throughout the body and is described in my book *Awaken Healing Energy through the Tao*. This practice is followed by the meditations of the Inner Smile and the Six Healing Sounds, set forth in my book *Taoist Ways to Transform Stress into Vitality*. All three meditations are emphasized throughout the Taoist System, and their mastery is essential to your successful practice of Healing Love.

As you read the information provided in this book and become aware of concepts not contained in Western thought, you will deepen your understanding of the relevancy of these practices to your physical, emotional and spiritual advancement.

Mantak Chia

Chapter 1
Taoist View of Women's Chi Energy

A. How Energy is Used.

The Taoist sages looked at their own energy as a total unit. In one day for instance, a young and healthy person earns 100 percent of his required energy from eating, resting, and exercise, and spends approximately 60 to 70 percent maintaining his daily life: working, eating, digesting, breathing, walking, etc. One might consider 100 percent energy as 100 energy credits, similar to bank credit. But, as he ages, he gradually earns less and less, even though his body requires the same expenditures, and he starts to overdraw his account by drawing energy from the vital organs-the kidneys, liver spleen, lungs, heart, pancreas and glands and, finally, from the brain.

Taoism explains that the major way men lose energy is through ejaculation, while women's major loss of energy occurs through menstruation, and not through sexual intercourse. For a young, healthy woman, this means an additional energy expenditure as she carries on her daily business. Assuming that a woman starts having periods at age twelve and continues through menopause in her fifties, she could have as many as 300 to 500 menstrual periods in her lifetime. Each month the ovaries produce an egg that contains highly perfected creative energy. A great deal of energy also goes into creating necessary hormones as well as the uterine lining, which provides a nest for a fertilized egg. If we consider our tremendous population today we cannot afford many children, but we can afford one or two. This means we use only one or two eggs. The remaining 300 to 500 highly charged eggs are eliminated. This expenditure accounts for 30 to 40 percent of a woman's daily energy allotment. If this sexual energy is continually permitted to pour outward, she loses 30 to 40 percent of her life-force energy. However: there is a way to transform this energy into vital energy for the organs, glands, brain, bone marrow and into spiritual energy.

B. Principal Energy-"Ching"

We are all born with an abundance of energy that the Taoists call the principal energy, or "Ching." In women it is Ching, the generative or creative energy, that is necessary to make the eggs, create the uterine lining and hormones, and keep a woman sexually active. The Ching energy, supplemented with the energy of the air we breathe and the food we eat, permits the woman's body to endow her eggs with the life-force energy that will be carried into the next generation.

The Ching energy also converts into life-force energy for the organs, which energy is called "Chi." The ancient Taoists, after identifying this type of energy, observed that conserving or restoring Jing energy could promote a longer and healthier life.*

Sexual energy (creative energy) is the only energy that can be doubled, tripled or increased even more. Therefore, if we want to conserve or restore lost principal energy, sexual energy provides the means to create that extra power if we conserve, recycle, and transform it back into principal energy. We then will have more energy available to transform into Chi, which in turn becomes transformed into another type of energy called "Shen." The word "Shen" means spiritual energy (Fig. 1.1)

C. Emotional Expense

When we are young and healthy we expend this principal energy, or Ching, freely, which serves us well until we reach the age of approximately 24 years. Although in the Tao System it is believed that each person is born with the good virtues of gentleness, kindness, respect, honesty, fairness and righteousness, when he

Ching: Generative or creative energy. Ching is the most refined substance a person is born with. It is also referred to as the "principal Energy" as it is essential for carrying out the functions of the body All other energies in the body are dependent on Ching. Ching is transformed into Chi or life force as it interacts with the vital organs. The conservation and nurturing of ching energy is the basis for the Taoist Internal practices. Jing is stored in all living tissue, especially the kidneys, sperm and ova. Part of Ching is Essential Energy. Ching is the energy produced by the sexual organs. In women it is the energy of the ovaries, in men, that of the sperm. Ching energy is denser than Chi and therefore moves slower when circulated in the body. As Ching energy circulates inside the body the organs are revitalized and nourished.

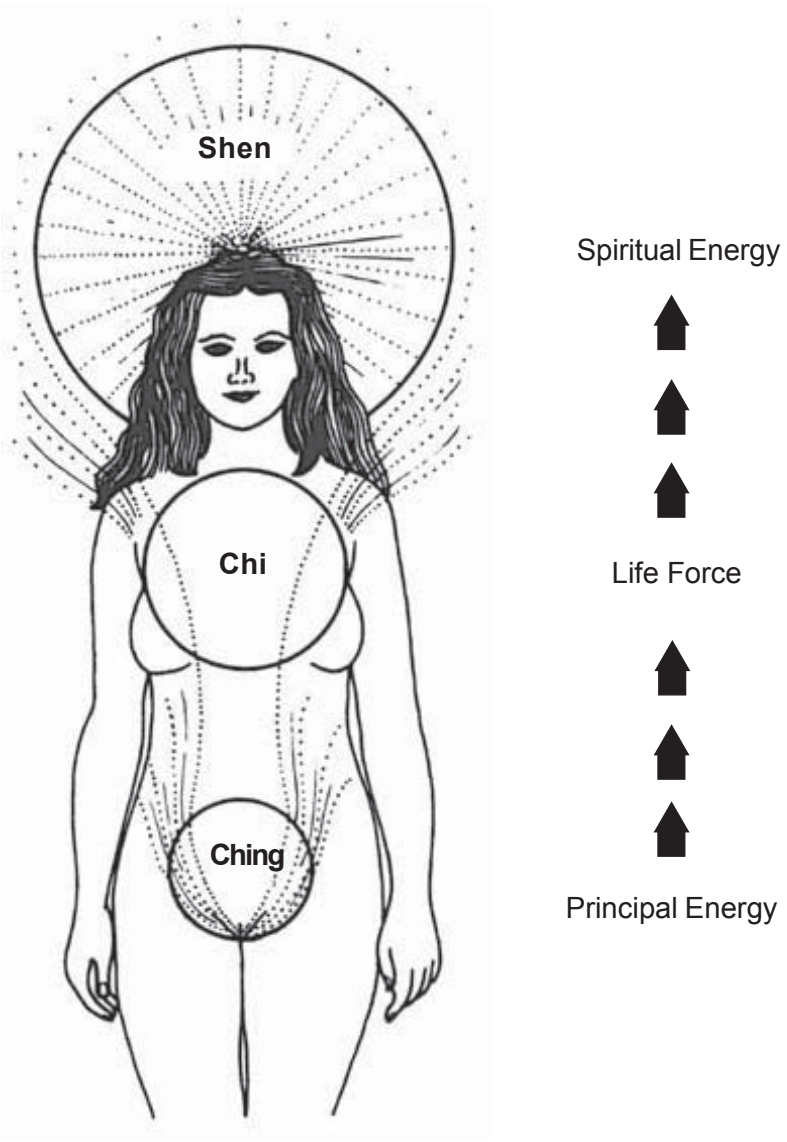

Fig. 1.1 *Transformation of Principal Energy into Life-Force and Spiritual Energy.*

or she grows up all kinds of cultural and social influences gradually change all the good virtues. The person begins to live under constant stress, feeling the pressures of hastiness, anger fear worry and other negative emotions. These gradually eat up the principal life-force, lessening the sexual creative energy. By the age of 24 too much of life's stress has developed and accumulated, accompanied by emotional disturbances or problems, and over stimulated sexual activity. The principal energy, spent so freely in younger years, begins to be transformed into a negative energy, stimulating and forcing more emotional energy and increasing sexual activity

As the negative emotions drain the life-force from us, robbing us of our sexual energy, they can account for a loss of anywhere from 10 to 60 percent of our life-force energy. Too much negative emotional energy leaves us with less life-force energy to work with, and therefore less energy to build hormones and replace the lost sexual energy. There will not be enough energy left with which to build and feed the soul and spirit.

1. "Dumping" Negative Emotions

People regard negative emotions as "garbage energy" which must be disposed of in some way. Since negative emotional energy and sexual energy still constitute our life-force energy, if we dispose of or dump out this "garbage energy," we are also dumping out our life-force. Now, to supply the needs of our bodies, we continue to draw from our principal energy, and by the time we are 40, we have spent 50 to 60 percent of it. By the age of 65 most of us are living from a dwindling amount of this vital energy until finally we run out of it.

The law of energy is that energy cannot be destroyed, it can only be transformed. When you dispose of this negative or "garbage energy" by "dumping" it out, someone else has to pick it up. When you dump your anger on someone, that person also has to dump it, and if he or she cannot dump it on you, it will be dumped onto someone else. This anger will eventually come back to you again with extra force, bringing with it fear, sadness, haste and all kinds of stress. This is also impossible to bear so you again find a way to dump it. There will be no end to the dumping, and the negative emotions will continue to multiply. This will greatly reduce sexual, creative, and generative energy.

D. Life Force Energy (Chi)

1. Transforming Negative Energy into Life-Force Energy (Chi)

You need to know how to transform negative energy into positive energy and good feelings. In this book you will learn how to gradually restore lost sexual, creative and generative energy by opening a certain channel that runs through your body. Once you have your channel open through techniques such as Ovarian Breathing, you can circulate both the negative energy and the sexual energy through this channel. As these two energies are combined and circulated, a natural process of combustion changes the negative energy to life-force energy. This creates a positive energy cycle, giving you more vital energy to cope with your negative emotions.

There is another way to deal with negative emotional energy: by directly transforming it back into positive Chi later in the Healing Tao practice, by learning the Fusion of the Five Elements, the second part of the Taoist meditation, we will learn how to harmonize the different types of emotional energy with the organs that have come to be associated with them. We differentiate these associations (hot/heart/impatient/hasty, cold/kidney/fearful, warm/liver/angry, mild/warm/spleen/worry, and cool/dry/lung/sad/grief), becoming aware of their presence or appearance, as well as the different kinds of negative energy that remain trapped in our organs where they may later turn into illnesses. By using Fusion of the Five Elements, we can counteract, harmonize and transform the negative energy into positive life-force.

2. Gaining Additional Chi through Lovemaking

The only way to gain additional Chi is to transform sexual energy that would normally be released in lovemaking by recycling it back into Chi , thereby providing us with an extra 30 to 40 percent of life-force. In this book you will learn the Taoist methods of Healing Love to accomplish this: namely Ovarian Breathing and the Orgasmic Upward Draw. Both methods will help to recycle and transform a part of the sexual energy into Chi .

3. Chi is the Key to Attaining Good Health.

The Taoist masters view Chi as the key to attaining good health and realize that good health enables us to condense and transfer

more Chi to a higher grade of energy. This enables us to have even more Chi available to build up the energy body or soul body and create and nourish the most important thing in each of our lives: our immortal spirit, or spirit body With our present rate of energy expenditure, we have no extra energy to accomplish this.

In the health field today there are many methods available to help us increase life-force (Chi), such as massage, acupressure, shiatsu, jin shin do, jin shin jyutsu, tai chi chuan, chi kung, health food, herbs, meditation, yoga, etc. However it is the Taoist Masters' view that the most abundant and easiest energy that can be transformed into Chi and a higher grade of energy is sexual energy. In the Healing Love practice we show very clearly a way to recycle sexual energy and store it, but it is most important to transform it first into Chi and then spiritual energy. Otherwise you will gradually build up too much Chi, which can lead to serious imbalances.

Young people, for example, have a lot of life-force energy available, but they do not know how to channel it properly. Their answer is to bum up excess energy in the fastest way: by using drugs, consuming alcohol, smoking, or other stimulants. These methods of stimulation initially give the user ten or twenty times as much energy, but they draw all the energy out from wherever it is available, namely, the organs, glands, and brain. Afterwards the user is left with low-key energy. When he or she wants to return to the same high level of energy, it means a return to the stimulants, but this time the user has less energy to draw from, and the high will not be the same. The result is a higher dosage, or changing to a more powerful stimulant. A person who is in a low-key Chi energy state will not be as affected by the drug because the drug does not have much life-force energy to draw from. For this reason young people become much more easily dependent upon drugs, sex, or other addictions. Transforming the abundant Chi properly will eliminate the need to burn the energy up with stimulants or participate in excessive sexual activity.

E. Creative Force--Sexual Energy

The basic function of sex is reproduction. Beyond that, each time we are sexually active we generate a lot of life-force energy. When we have a normal orgasm, the life-force pours out of us into the universe. If we can learn to redirect the orgasmic energy inward and upward instead of outward, the energy will reach a higher center

of the body and we will experience the even greater orgasmic experience known as total body orgasm, or organs' and glands' orgasm, an experience never felt as a result of normal sex. Thus, we can create more energy: store it, and transform it into life-force energy, thereby increasing our total energy.

1. Positive Energy Will Increase Sexual Creative Energy

Thus far: in keeping with the teachings of the Taoist Masters, we have been classifying our body energy into many different types of energy: positive and negative, sexual, life-force, etc. All of these energies have very different properties. If we identify them, we can start to control them, transforming everything negative into positive, and cultivating the good energies that please us.

Just as negative emotions deplete our life-force, thereby reducing sexual creative energy, cultivating good virtue increases sexual creative energy. By using the Orgasmic Upward Draw method taught in this book, instead of losing sexual energy through outward-leaking orgasms, we bring the highly charged sexual creative energy up to wrap, pack and energy the organs and glands. In the Tao System it is within the organs that our emotions, or virtues, are stored. Once an organ is restored to its original healthy condition, good virtue will emerge and can be cultivated to produce more positive energy to nurture each of the other organs and the glands. As weak, sick organs begin to produce good energy they will gradually affect other organs, making them healthy as well.

2. Good Virtue-the Heart of the Universal Tao

Practicing good virtue is the heart of the Universal Tao. The entire system depends upon the energy of love, joy, kindness, gentleness, respect, and honesty In the Universal Tao we believe that good nature is basic to humans, not because we are afraid of going to hell and burning eternally, of returning as a lower animal form, or of suffering in our next life, but because we believe that doing good for other is equally and immediately beneficial to ourselves. It is a simple concept. When you are kind to others, you are kind to your liver, the organ associated with kindness. Your liver becomes stronger as you give it more Chi. The idea is that you do good to others as you do to yourself, but not out of fear of being punished.

In the Healing Love practice we return the how of our sexual creative energy into our organs and glands to strengthen the

weakened body and increase the life-force. The development of more good life-force helps in the transformation of all anger, fear, sadness and depression.

3. Losing-Energy Pleasure and Gaining-Energy Pleasure

If a woman is not interested in having a baby, her sexual activity is for pleasure only. The Taoists identify two kinds of pleasure: "losing-energy pleasure" and "gaining-energy pleasure." Most of us are well experienced in losing-energy pleasure.

We have described the brief, intense pleasure that drugs, such as marijuana, heroin, cocaine, or amphetamines, introduce into the system as they quickly draw and burn up life-force from a person's organs, brain, and glands. This is like a bonfire started with gasoline; it burns very intensely and is very gratifying, but the fuel is gone and the fire becomes extinguished all too soon. The increased desire to experience that intense excitement, followed by the increased use of drugs, draws out the vital energy from the organs as well as from the brain and bone marrow.

Some of the entertainment we seek is also losing-energy pleasure. When we are entertained in excess with activities such as watching television, energy from our organs is required to pay attention, and so our life-force energy is drawn out toward the event we are watching and hearing. We imagine ourselves to feel good because we perceive ourselves as relaxing, thereby decreasing our stress. We do feel the release, but our vital organs are being drained of their life-force by this excessive energy expenditure. This stress to our organs creates a negative energy: and if they do not have the means to transform it back into positive energy, we will accumulate too much and eventually our negative emotions will burst out.

Even though something such as quiet music can help us relax and create a sense of harmony in the body, too much attention to it will make our eyes, ears and nervous system lose energy to the outside. Afterwards, we continually seek new songs, movies and shows because these things are never satisfying our needs, but are further arousing and increasing our need for stimulation. The more we try to satisfy one or two of the senses by an outside means, the greater the need for satisfaction we create for all the senses. When you try to satisfy the mouth and tongue, the eyes, ears and nose need something to stimulate them. It is a never-ending,

increasing requirement of the senses. Multibillion-dollar businesses have arisen to satisfy our senses. They make tremendous profits because ultimately they do not really satisfy us or bring us true joy and true happiness. If these companies created entertainment that would satisfy us for a long time, they would go out of business.

The Taoists regard our organs as the body's parents and the senses as the children. When they separate there is no harmony, but rather disharmony and need. People try to search for happiness, satisfaction and love outside of themselves rather than within. They listen to the desires of their bodies rather than their minds and spirits. The more they search, the more they create a need and will never really find what they are looking force Instead they create a deterioration within themselves. True happiness, true joy and true satisfaction come with inner peace.

By turning inward we will not lose the energy outward, and so can gain energy for ourselves. For example, if we eat a tasty food but do not have an inner harmony in our organs and senses, our eyes will want more, like children in a toy store. We might decide to see a movie, and then the ears want to be stimulated as well. We then might decide to go to a nightclub or a bar In the end we might feel the need to get drunk, to smoke, or take drugs. Turning sexual energy and the resultant orgasm inward is the first step to gaining-energy pleasure and to a control of the senses. Once you have more sexual energy inside, the organs will become stronger and will then be able to control, satisfy: and balance the senses.

4. Beyond Orgasm

The normal outward-pouring orgasm is a form of losing-energy pleasure, i.e., we release life-force energy out and we experience pleasure. In the Taoist view of arousal, however it is the fusion of all the energy contributed by the organs and glands with the highly refined sexual energy that creates orgasmic energy. Rather than releasing orgasms outward, as in the normal sexual act, we learn to turn this energy inward to recycle, increase and highly refine it. Through the practice of the life-force meditation known as the Microcosmic Orbit meditation, we begin to learn how to recycle the ovaries' energy. In the beginning it is difficult and you must practice to retain the energy within yourself, but once you feel and gain control of your own energy: you will experience new pleasures which are indescribable. This sensation is called "Beyond Orgasm" or "Valley Orgasm."

The concept of an orgasm that is "Beyond Orgasm" is difficult to explain because we do not have a word in Western languages or a cultural concept to express it. It is a new idea to us. Remember however that when the automobile was invented, few people thought it could replace the horse. Later people realized the benefits of the horseless carriage.

Cultivation of "Beyond Orgasm" can be compared to climbing a 10,000-foot mountain. In normal orgasm we run up 1,000 feet and run back down and try again tomorrow to get past 1,000 feet. Most people climb the mountain this way, perhaps reaching 2,000 feet on a good day The sensations may be limited to the genitals or rhythmic pulsations, and relaxation may be experienced throughout the entire body, but the energy itself is lost to the universe and can no longer be developed inside the body. "Beyond Orgasm" goes further and further each time. When you climb this 10,000-foot mountain, you climb to 1,000 feet, rest, set up camp and spend the night. The next day you climb further, rest and camp, and you continue in this manner until you reach the peak. There you enter another realm of pleasure.

F. What is Ovarian Kung Fu?

Originally the Taoist sexual exercises were called "Ovarian Kung Fu". Some students feel this sounds too violent or too much like martial arts. The term "kung fu," however means discipline or intensive work, referring to one who puts time into practice. Ovarian Kung Fu implies an expression of power and control, of the ability to take command of one's body and sexual life.

In the Universal Tao System's Ovarian Kung Fu training, we practice to gain, increase, collect and transform ovarian (sexual) energy; It is important to remember that building up energy in your body without knowing what to do with it is dangerous. Some systems advocate releasing the energy from time to time in some way, like releasing a pressure valve. They will recommend occasional outward-pouring orgasms for this purpose. The Universal Tao System, however: stresses the importance of learning the Microcosmic Orbit, the means by which the energy can be circulated in the body ultimately to be stored in a safe area (the navel) for later use and transformation into a higher form of energy. If you consider a computer analogy, learning how to push a button will not teach you how to operate a computer. Although pushing the

button will give you a result, until you know and understand the system, you will not be able to control that result. To insure proper training in the art of Healing Love, the concepts, the steps involved, and an idea of the pleasure that lies ahead will be explained in detail.

G. Women's Sexual Energy

1. The Ovaries contain Life Force Energy.

As previously stated, the Ching (principal) energy of a woman provides her with life-force energy. This life-force energy is contained to a large extent in the ovaries. It is here that the hormones are produced that determine a woman's breasts, voice, etc. The ovaries constantly produce sexual energy. The Ovarian Breathing Process to be taught in this book releases the energy produced by the ovaries, and makes it possible to store this energy, which has a Yang (active) quality, in the woman's body After ovulation and before menstruation the energy is milder as the properties of the energy change from Yang to Yin (passive). Also, during this part of the cycle the energy is at its highest stage of development for absorption and transformation.

Ovarian Breathing, if practiced every day, can start the absorption process and conserve the life-force energy that otherwise would be lost through menstruation. This is the process by which the sexual energy is transformed to Chi. As a result of this practice, women often notice a distinct shortening of the duration of the menstrual flow, or a decrease of cramps or other problems associated with their periods. With continued practice menstruation may cease, because all the sexual energy is being transformed into a higher life-force energy.

Under ordinary circumstances menstruation can stop for a variety of reasons, such as poor diet, depression, emotional stress, childbirth or menopause. Since a functioning body draws its energy from every resource it has, a body requiring additional energy makes compensations to supply that energy where it is needed. A nursing mother for example, will not experience menstruation, because the blood normally involved in the menstrual cycle would be drawn to the breast and converted into milk. Menstruation resumes only when nursing stops. Women athletes, when under strict training, will cease menstruating because all the energy has

been transferred into physical fitness. Similarly, it should be noted that many women, after menopause, lead very active, healthy lives, and usually do well in pursuing their careers, because their bodies now have the benefit of energy formerly required to maintain their monthly cycles.

It is beneficial to understand that menstruation is for the purpose of the next generation. Energy not used for this purpose but conserved through Ovarian Breathing becomes part of the vital energy of the body thereby prolonging youth and providing ample energy for transformation into a higher form of energy. The transformed energy is a creative and healing energy which can raise a woman's life-force potential and ultimately increase her spiritual energy. Also, the cessation of menstruation can be reversed at any time and restored to normal flow after a few months of stopping the practice.

2. Ovarian Energy Develops a Higher Consciousness

Ovarian energy is the energy used for the development of one's higher consciousness. These practices that transform the sexual energy into Chi provide the foundation for the spiritual exercises that transform sexual and Chi energy into Shen, a sheer spiritual energy. The process of cleansing the internal organs of negative emotions described previously is called "inner alchemy" by the Taoists, and it is this inner alchemy that restores to the organs their birthright of love, joy, gentleness, kindness, respect, honesty fairness, and righteousness. Once the organs are cleansed and healthy, and you have developed the ability to transfer and transform sexual energy into life-force energy, the spiritual development can begin. It is at this level that the generative energy of the ovaries is used in what the Taoists call "giving birth to yourself,. which means developing the spirit body from which you will attain enlightenment.

3. Ovary Energy--the Best Cosmetic

The ovaries contribute most of their energy during sexual arousal. Many other organs are contributors--the liver spleen, kidneys, heart, lungs, and brain, as well as glands-the pineal, pituitary thymus, thyroid and adrenal. All of these energies blend together to form sexual energy, a highly charged force that brings us to the point of orgasm. It is at this point that our habit of losing-energy

pleasure must be over come. By doing Ovarian Kung Fu exercises, we can transfer this energy to a higher quality energy by moving it up the spine to the brain. Because the property of sexual energy during arousal is Yang (or active) in nature, you can revitalize the nervous system, increase brain power and memory, and stay healthy and youthful. As a great secret taught by the Taoist sages to empresses and concubines, these methods enabled the women in an emperor's court to maintain their sexual activity, beauty, and health for a long time. Many Taoist women consider the results of these exercises to be the best cosmetic in existence.

4. Duration of a Woman's Sexual Life

In ancient Chinese history very little was written about the sexual experiences of women, although there does exist the documentation of Su Nu, the medical and spiritual guide to the Yellow Emperor who in almost endless lists detailed the voluptuous responses of women to their capable lovers. We also have read that nuns in Buddhist convents could learn exercises that would eliminate their menstrual cycles forever: (The exercises were called "Slaying the Red Dragon). Therefore, what knowledge we now have of the duration of a Taoist woman's sexual life passed down to us verbally from the Taoist sages varies greatly with the outlook and lineage of the Master: Some Taoist Masters advise women to stop having sex after 40, due to the supposed worn out state of the body caused by childbirth. With the Ovarian Kung Fu method as it is now taught by The Universal Tao, a woman can continue sexual activity for as long as she desires because no energy is lost: in fact, energy is gained through the transformation of her sexual energy.

5. Organs' Orgasm--the True Orgasm

A. Outward Orgasm

Generally the orgasmic feeling is a pulsation of the vagina, the ovaries and the cervix. In the Tao System we say that a lower center or genital, orgasm happens only in the genital region and pours outward: we call this an "outward orgasm." It takes a short time to occur but it takes a long time to bring the woman to this kind of orgasm.

B. Inward Orgasm

The "inward orgasm," or the "organs' and glands' orgasm," is extended for the woman. Her partner must stimulate her to bring the orgasm inward and upward, stage by stage, and organ by organ. The orgasmic feeling can be amplified intensely in this way but how much it intensifies depends upon how much she practices. By moving the pulsation into the organs, a new field of orgasm is opened up that she has never felt before.

In usual sexual practices, muscles are tense and the fluids of the glands pour out, losing in this outward flow the sexual energy of these glands as well. This kind of orgasm is temporary, short and not continuous. In Taoism it is said that when all the energy pours out, that is the end of the glands.

In an inward orgasm, or organs' orgasm, the orgasm actually travels through all the organs, glands and nervous system, thrilling and revitalizing them with the life-force of sexual, creative and generative energy.

6. Who is Responsible for your Orgasm?

Many women have sexual experiences but are unable to experience an orgasm. Often a woman will blame her male partner saying that he does not know how to bring her to orgasm, and that he ejaculates too soon. Sex is a two-person happening. The energies of both people must bring their hormones into harmony.

H. Good Sexual Relationship--the 3 Levels of Sexual Energy

To establish and maintain a good sexual relationship, the energies of both partners must be on the same level: they both must be healthy physically and emotionally and their spiritual levels must be the same. Then, when the two people are together their energies--physical, emotional, and, finally, spiritual--unite as one.

1. Physical Level

Tuning yourself before making love is very important. How much differs from woman to woman, depending upon her level of energy. The practices of Ovarian Breathing and the Orgasmic Upward Draw strengthen a woman's vagina and direct the Chi flow to her sexual organs. Many women who do not exercise the lower region--the ovaries, cervix and vagina--lack Chi flow and lose muscle tone.

Eventually the energy leaks out, turning the sexual region cold. Their menstrual periods might come at the wrong time. They might have pre-menstrual syndrome, headaches, lower abdominal aches, or adverse emotional reactions, any of which can affect their energy levels, lowering their sexual energy as well as their general energy. It takes a much longer time for a woman to be aroused to her "boiling point," or point of orgasm, than it takes a man to become aroused. It takes more heat and energy to bring ice water to a boil, just as it takes longer for a partner to arouse a woman if her sexual region is cold. If a man is low in "fire energy" (male sexual Yang energy) he will not have enough energy to melt the "ice" and will not be able to bring the woman to her "boiling point."

For men the recycling of sexual energy is very important. Such techniques as Testicle Breathing, Scrotal Compression and the Big Draw recycle a man's sexual energy and increase his Yang (hot) sexual potential. These techniques are presented in the book *Taoist Secrets of Love: Cultivating Male Sexual Energy*.

2. Emotional Level

Often when a man and woman first meet, there is an unexplained attraction for one another. The reason might be that at the time they both have a high energy level, as well as emotional and spiritual levels. It is as if a strong magnetic force has drawn them together. Sometimes, after marriage stress occurs because of family troubles, children, etc., and their energies are drained, gradually wearing out their magnetic forces until there no longer is a strong attraction between them. During this period the man and woman seem far apart and alone. We see many people starting out in the practices of the Microcosmic Orbit and Taoist Secrets of Love become aware of and improve the foods they eat and do regular exercises to increase their romantic forces and reestablish a close feeling with their partner. Orgasms come much easier then.

3. Spiritual Level

If a couple can find time to do meditation together, sit with each other or do palm-to-palm touching of one another, they will quiet down and be able to feel the energy of the partner. Energy can still be exchanged with your partner even if he is low in energy and unable to move it. You can expand your Microcosmic Orbit into his,

and he can do the same with you so that you can help one another move the energy.

If he is in a low mood, you can assist him by sending him your smiling energy. If you learn the Fusion of the Five Elements, you can actually absorb his negative emotions and fuse them to return good life-force back to him. He can do the same to you.

A good sexual relationship can involve many other factors, but it must have a good beginning, like fine wine.

I. Goal of Taoist Meditation

1. Discovery of Chi

Long ago it was discovered that the most effective way to observe the subtle workings of the Tao and the inner nature of men and women was through quieting the mind in sitting meditation. It was the practice of sitting meditation that revealed the existence of Chi as a subtle electromagnetic force flowing within the body The pathways the Chi followed revealed the meridian system of the human body.

2. The Body is composed of Three Parts.

Through such meditation the early Taoists developed a greater refinement and increased awareness of the body as a composite of three parts: the physical body, soul body and spirit body. (Fig. 1-2) These three bodies were studied to differentiate each one's nature and purpose.

Unlike other meditative traditions of Asia, which cultivate the soul and spirit at the expense of the physical body, the ancient Taoists considered all three bodies important. The Taoists found a way to climb consciously into the spiritual realms, and equally important, to climb back into the physical world to be creatively active here.

3. Developing the Physical Body

The novice in the Universal Tao System begins with a wide range of exercises which develop the physical body into an efficient and healthy organism, capable of living peacefully in the world, and yet

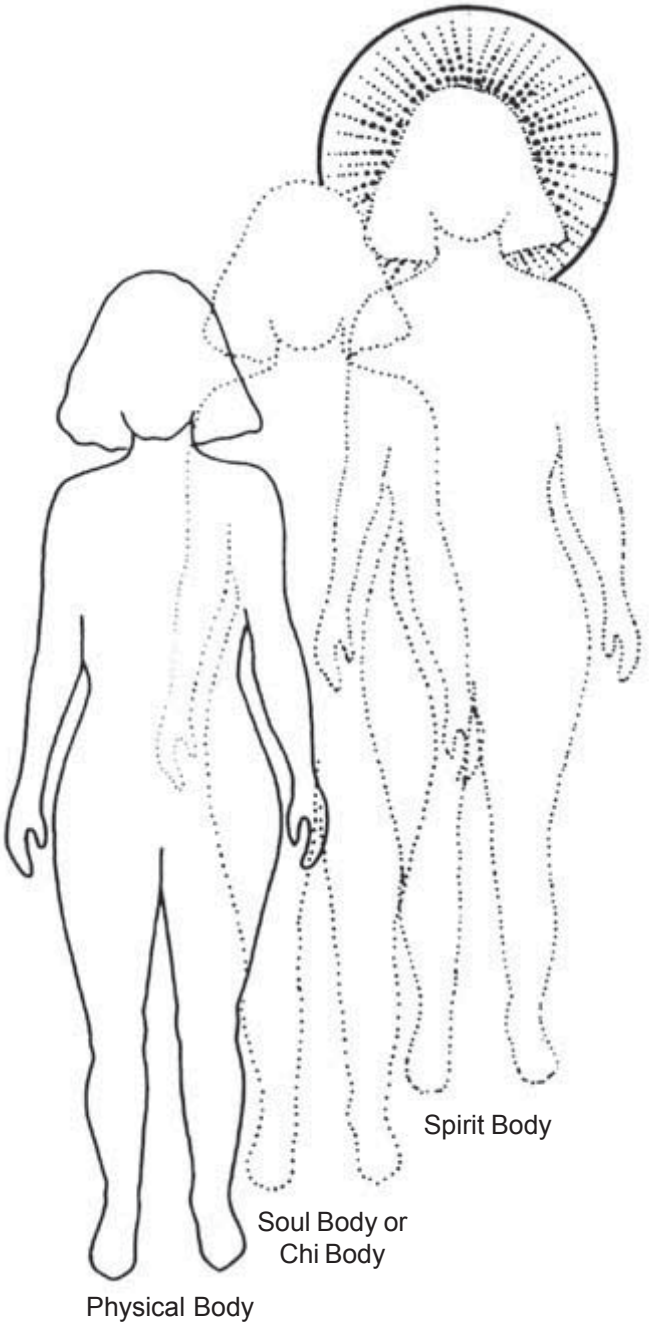

Fig. 1.2 *Three Bodies*

free of the tensions and stresses of ordinary daily life. The aim of the first level is to develop self-awareness of the physical body and its energy relationship with the environment and other people. At this level one learns to heal oneself by learning to sense and direct the circulation of Chi within the meridian system of the body (the Microcosmic Orbit Meditation). The practice of loving self-awareness generates a positive energy condition in which greater respect and love for others radiates constantly without conscious effort. The healthier the body is, the more Chi it can produce and transfer into spiritual energy. By practicing in this life to transfer Chi energy into spiritual energy, we give birth to ourselves, raise our souls and spirits, and educate them.

The first level of Taoist practice is accomplished by utilizing the Microcosmic Orbit Meditation, Six Healing Sounds, Inner Smile, Fusion of the Five Elements, Tai Chi Chi Kung, Five Elements Nutrition, and Iron Shirt Chi Kung. As the awareness of the physical body is developed, increased levels of energy are made available by controlling and transforming sexual energy through Seminal Kung Fu and Ovarian Kung Fu practices.

4. Giving Birth to the Self, the Soul Body

Giving birth to the self, the goal of Taoist meditation, is awakening that part of oneself which perceives and acts free of the boundaries of environmental education and karmic conditioning. The birth of the self is not a symbolic image or poetic metaphor: it is an actual process of energy conversion leading to the formation of a subtle body with the capacity to develop reasoning, feelings and a will of its own.

Chapter 2
Women's Sexual Anatomy

The publication of Masters and Johnson's *Human Sexual Response* in 1966 opened the floodgates for books, articles, and seminars that interlocked with the sexual revolution of the sixties and seventies. The little-known profession of sexology burgeoned.

Gradually sexologists began to pay attention to the particular sexual needs of women. They noticed that it was a rare man who went to his grave without ever having an orgasm, yet there were quite a number of women having little experience in sexual orgasm. Lonnie Barbash addressed herself to "pre-orgasmic" women in her book *For Yourself*. In *The Hite Report* Shere Hite disclosed how women brought themselves to orgasm, based on the anecdotal responses of hundreds of women to her vast questionnaire. Compiled by the Federation of Feminist Women's Health Centers, the book entitled *A New View of a Woman's Body* took a new look at women's genitals and redefined the clitoris.

It is a social fact that most women have never looked closely at another woman's genitals. Of the women who picked up a mirror to scrutinize their own (after making sure the door was locked or that no one else was home), many were left with the feeling that somehow they were not put together entirely correctly The sexual isolation of women results in the complete absence of a socially acceptable word that encompasses everything we can see in a mirror, "Down there" is probably the closest we have come to saying that there exists a large area that we recognize as being our sexual organs. (Fig. 2.1)

A. Mount of Venus

Starting at the front and top is the Mount of Venus (also called the mons veneris, or mons, for short). (Fig. 2.2) The color, amount, texture and distribution of hair will depend a great deal upon age and inherited characteristics and can vary from a few straight hairs to a bushy growth extending up the abdomen or down the thighs. The mons is a cushion of fat protecting the pubic bone underneath. The pubic bone is the place where the pelvic bones are joined.

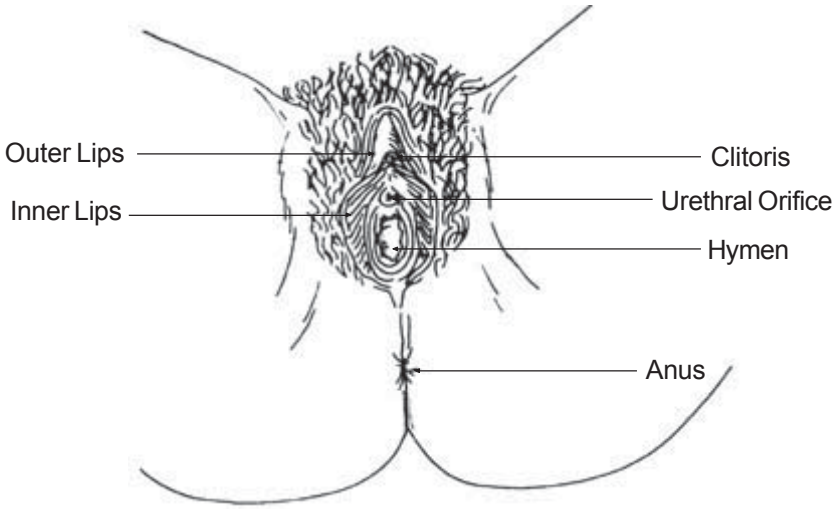

Fig. 2.1 *Woman's Genitals*

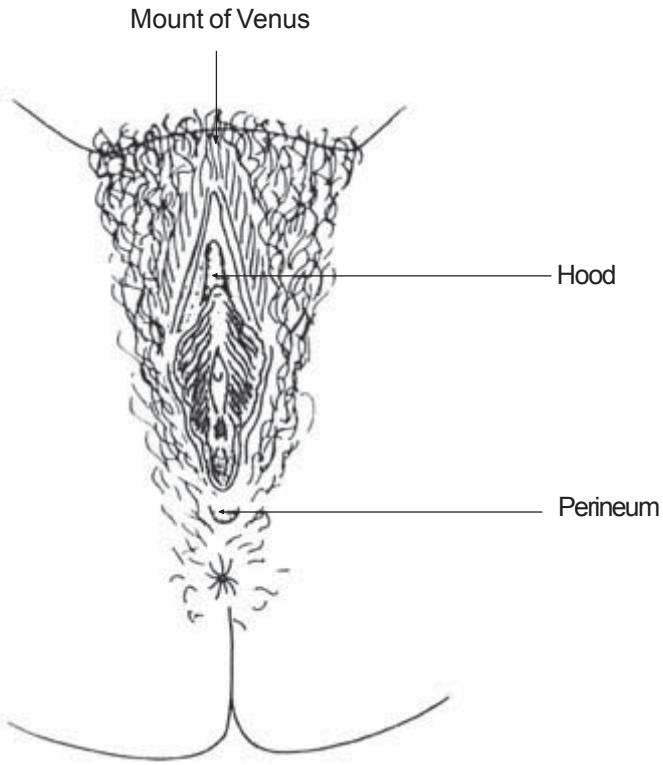

Fig. 2.2 *Mount of Venus*

together by cartilage, which during pregnancy softens so that the bones can separate, if necessary, during childbirth. The mons divides and separates into what is called the outer lips, or labia majora, which are of similar skin and hairiness to the mons.

B. Inner Lips

Inside the outer lips are the inner lips, the labia minora. The skin of the inner lips is very different in color and texture because of their relation to the mucous surfaces, in the same way that the lips of the mouth are different from the skin of the face. In an unaroused state the inner lips can vary in color from pink to dusky pink to dark maroon or purple. Sometimes the inner lips are pink and ridged, and sometimes they are long and wavy. Some women's inner lips are larger than the outer lips, and when these women are standing up, the inner lips can be seen protruding from between the outer lips. During sexual arousal the inner lips, richly supplied with blood vessels, become engorged and swell to two or three times their resting size. As orgasm approaches they can go through a dramatic color change, sometimes turning crimson or a dark wine color:

C. Glans of the Clitoris

Following the small lips to the top, they join together to form the hood that protects the glans of the clitoris. Usually the glans in the unerect state is nestled under the hood. (Fig. 2.3 (a)) You can see it by pulling back on the hood. The glans of the clitoris is loaded with nerves, and for most women the glans is the most acutely sensitive spot in their sexual anatomy. Some women find that it is so sensitive that direct stimulation can be irritating. The shaft of the clitoris feels like a strong rubber band under the surface between the glans and the mons. As sexual excitement mounts, the shaft thickens and shortens, and the glans, shaft and supporting structures become erect. As with men, there can be a dramatic change in size and shape. (Fig. 2.3(b)) Some women find that with intense prolonged arousal the swollen inner lips can obscure the glans almost entirely.

D. Urethra and Vagina

Down from the glans is the opening to the urethra. Below this is the opening to the vagina. A woman's urethra is about one and a

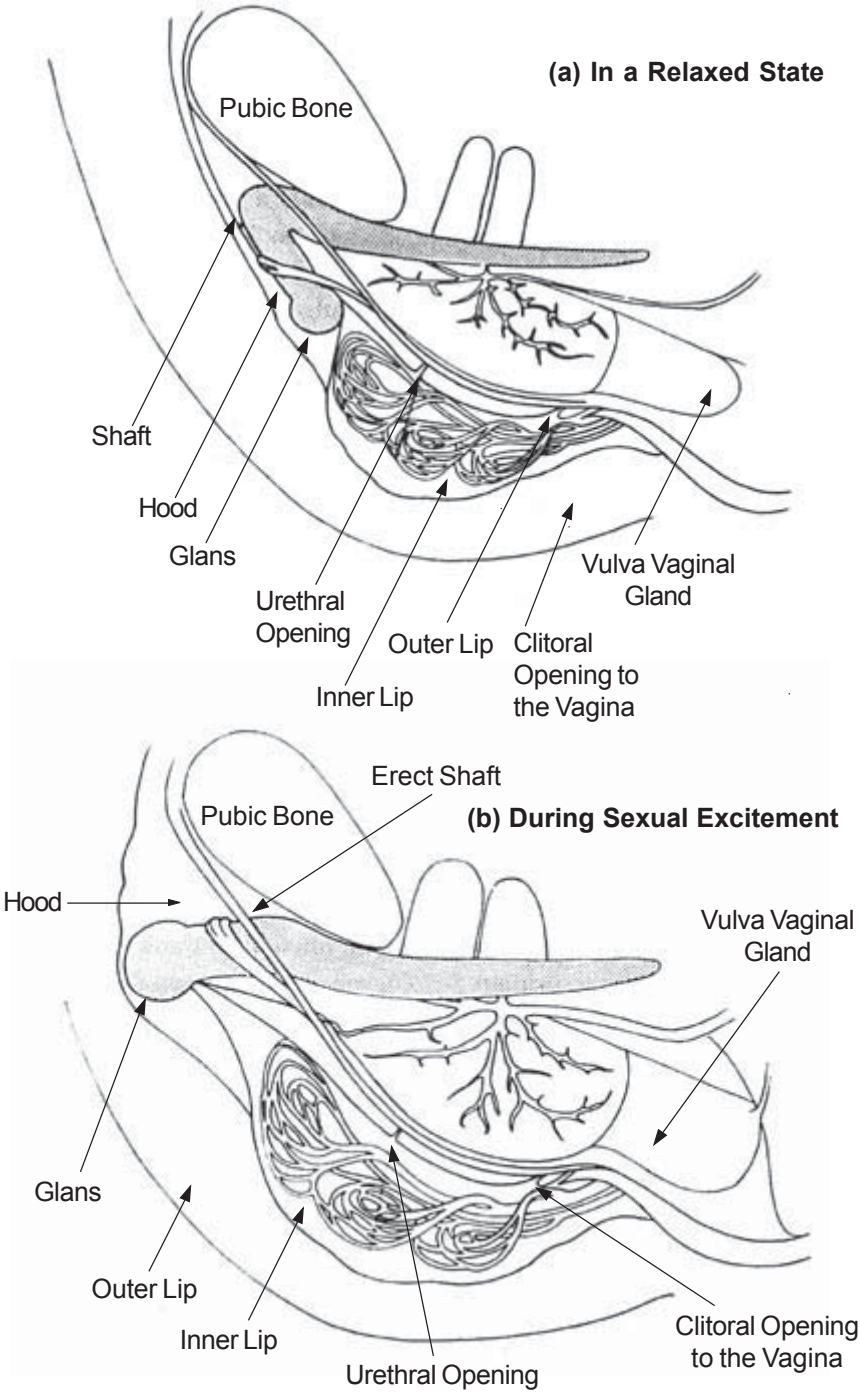

Fig. 2.3 *Cross- Section of the Clitoris*

half inches long from the outside to where it opens into the bladder: This short distance from the outside to the inside helps explain women's propensity toward bladder infections (cystitis).

E. G-Spot

Surrounding the urethra is a plexus of blood vessels. Since these blood vessels had no name in medical books, a group of women named the area the urethral sponge. (See *A New View of a Woman's Body*.) During sexual excitement the blood vessels engorge and a bulge can be felt through the vaginal wall. This bulge has been named the "G-Spot," after Grafenberg, one of the first sexologists. It can be explored by feeling around the front and upper part of the inside of the vagina. (It has also been said that the G-Spot is located one-half inch deeper than a woman's longest finger)

The G-Spot can be difficult to reach during intercourse in a face-to-face position, except with those men whose penises, when erect, press up against their bellies. A change in position may be necessary if a woman wants her G-Spot stimulated more directly. Rear entry is one way. Fingers are often effective and direct. A woman stimulating herself might choose to squat or lie down with her legs up in the air in order to reach it better. Her partner might find it easier to reach if she is lying on her stomach. During coitus, if the woman is on top she can position herself pretty precisely for such stimulation. (Fig. 2.4(a) and (b))

Some women, while holding their partners tightly, enjoy the sensation of an erect penis pushing on their lower abdomen, immediately above the pubic bone, stimulating the G-Spot from the other side.

When the G-Spot is massaged, often a woman's first impression is that she has to urinate. Sexologists assure women that if the pressure is continued there will be a transition to sexual arousal.

One of my students reported: "When I worked in a women-controlled clinic, we always talked rather glowingly of the virtues of the diaphragm. Every once in a while a woman would tell us that she didn't like the diaphragm because it interfered with her sexual enjoyment, that it covered up something. That was before the G-Spot became well known, and I think now that that was probably what these women were talking about."

Some women find that stimulation of the G-Spot can trigger an

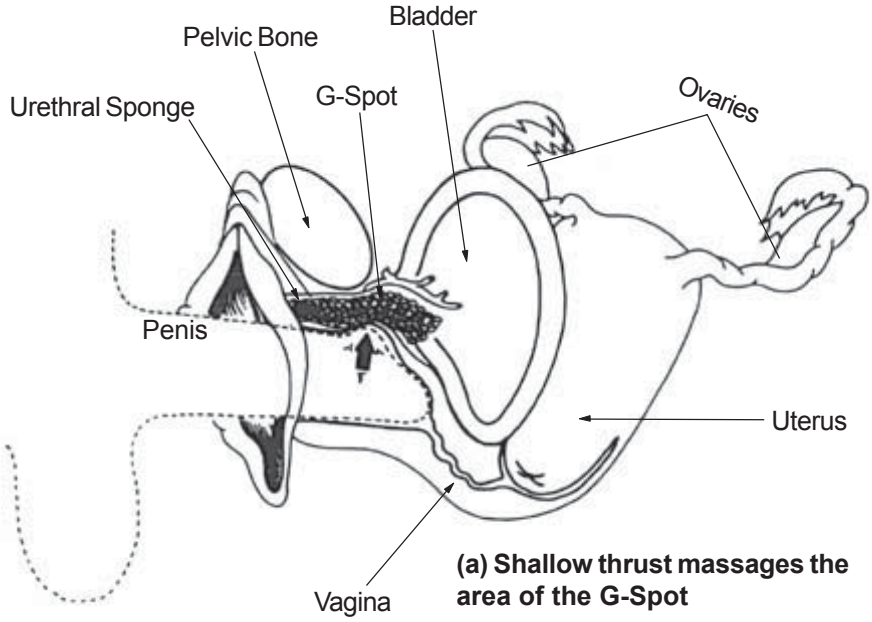

(a) Shallow thrust massages the area of the G-Spot

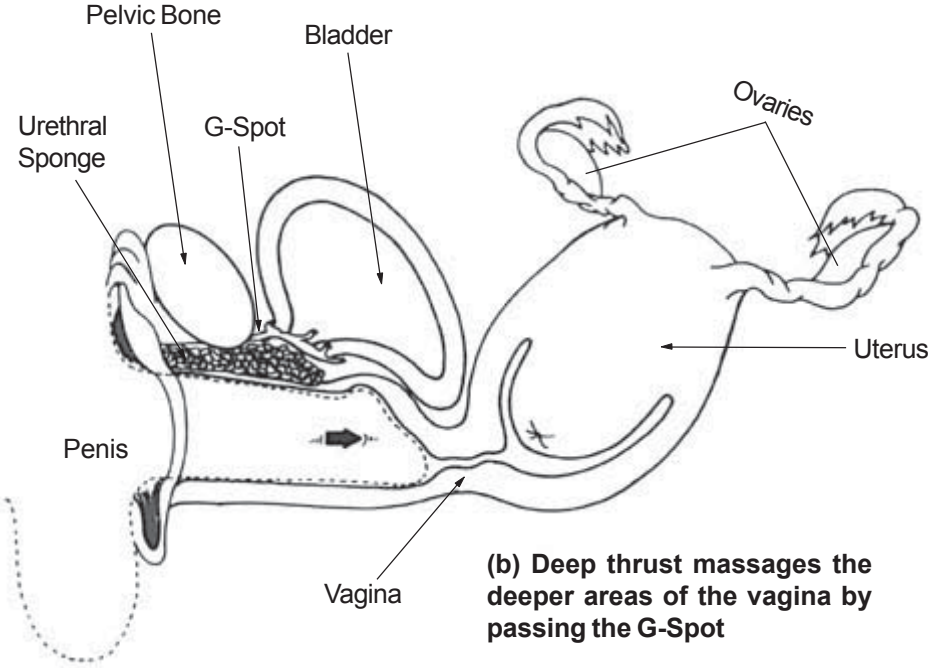

(b) Deep thrust massages the deeper areas of the vagina by passing the G-Spot

Fig. 2.4 *Shallow and Deep Thrust*

orgasm, while many women enjoy G-Spot stimulation as part of the whole panoply of sexual stimulation.

F. Female Ejaculation

An ancient Taoist Master discovered that a woman, when reaching a higher point of orgasm, had different responses which ejaculated different "waters." Three waters, or types of fluid, involved in female orgasms were found to exist. The lubrication experienced during arousal is considered the first water: the fluids emitted during a normal orgasm are the second water: and the third water of a female ejaculation, never experienced by many women, is released from the G-Spot. However with or without G-Spot stimulation, there are women who ejaculate when they have an orgasm. This ejaculation, which can be quite copious, produces fluid that is much like seminal fluid. It is definitely not urine. However many women who have experienced ejaculation report that they were dismayed and embarrassed, feeling certain that they had urinated. They then learned to withhold this reaction. Now that the fact of women's ejaculations is known, there will probably be much relief, relaxation, and increased pleasure by the women who have this capacity. As yet, no research has discovered where this fluid is made or stored.

G. First Lubricative Fluid of the Vagina

Inside the vagina the walls rest against each other: but the potential for space exists. With a plastic speculum, flashlight and mirror you can look inside the vagina yourself. You will probably first see the pink, ridged walls of the vagina. The many folds account for its tremendous elasticity During sexual arousal, lubricative fluid oozes out of the walls in a kind of sweating action. At the back of the vagina is the cervix, the only portion of the uterus visible in the vagina. The cervix is round with a hole or slit in it. This is the opening of the cervical canal which goes into the uterus. Most sexologists agree that women have little sensation beyond the outer third section of the vagina. However many women strongly disagree, saying that they experience terrific pleasure with deep penetration either by penis or finger at the back of the vagina, and many women feel pleasurable contractions of the uterus during orgasm.

There may be mucous dispersing from the cervix. The source and purpose of the mucous will be discussed in the next section.

H. PC Muscle and Chi Muscle

Feeling around the periphery of the vagina at about the depth of one knuckle, you may be able to discern the edges of the Pubococcygeal Muscle (PC, also sometimes referred to as the Love Muscle. (Fig. 2.5)

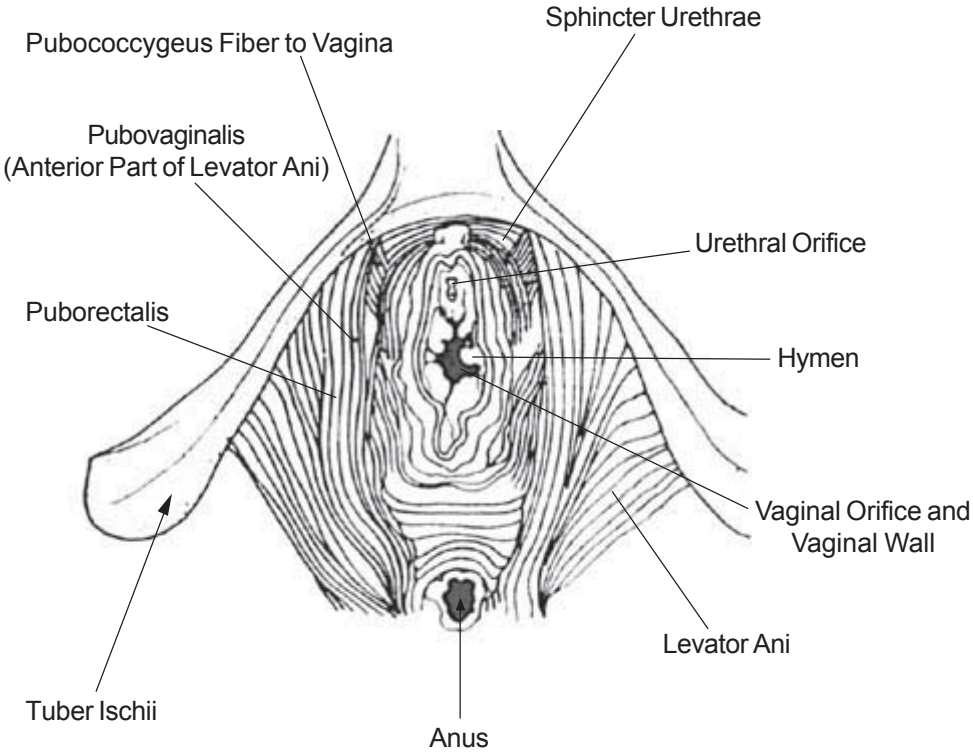

Fig. 2.5 *Love Muscle includes the Pubococcygeus (PC Muscle), Pubovaginalis and Pubo-Rectalis*

A contraction of the vagina is a contraction of the PC Muscle. You can tell for sure that that is what you are feeling if you can squeeze your fingers with it. The PC Muscle is one part of a group of muscles we refer to as the Chi Muscle. The Chi Muscle surrounds the anus, vagina, and urethra and provides support for the reproductive organs. (Fig. 2.6) This is the muscle of Perineum Power and is associated by the Taoists with many organs of the body, as will be described in Chapter 5.

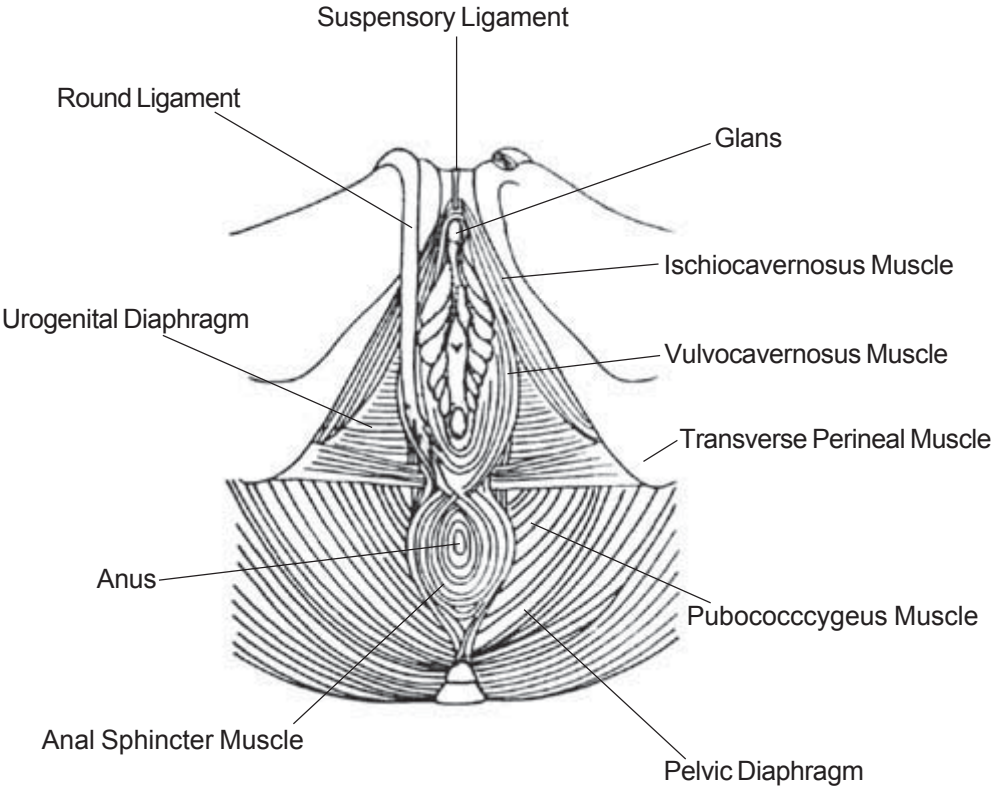

Fig. 2.6 *Chi Muscle includes the Urogenital Diaphragm, the Pelvic Diaphragm, the Anal Sphincter Muscle and Pubococcygeus (PC Muscle).*

A well-exercised PC Muscle is considered by some sexologists to be the key to healthy sexual functioning for both men and women. Poor muscle tone leads to sexual difficulties as well as other physiologic problems, such as difficulty in childbirth and urinary incontinence. In fact, the first professional to publicize the importance of good PC tone taught exercises to women in preparation for childbirth. His name, Kegel, is still associated with these exercises. The PC Muscle is crucial to Ovarian Kung Fu exercises.

You can test the tone of the PC Muscle by interrupting a stream of urine. This ability is due solely to the PC Muscle. Many women have become dexterous at squeezing this muscle because they

found it enhanced their sexual pleasure.

Sexologist Bryce Britton, in her book *The Love Muscle: Every woman's Guide to Intensifying Sexual Pleasure*, includes detailed descriptions of how to use the PC Muscle as well as outlining an exercise program for sexual fitness.

I. Perineal Sponge

Inside the back part of the entrance to the vagina is another area of blood vessels called the perineal sponge. (Fig. 2.7) During sexual arousal the perineal sponge thickens, narrowing the entrance to the vagina.

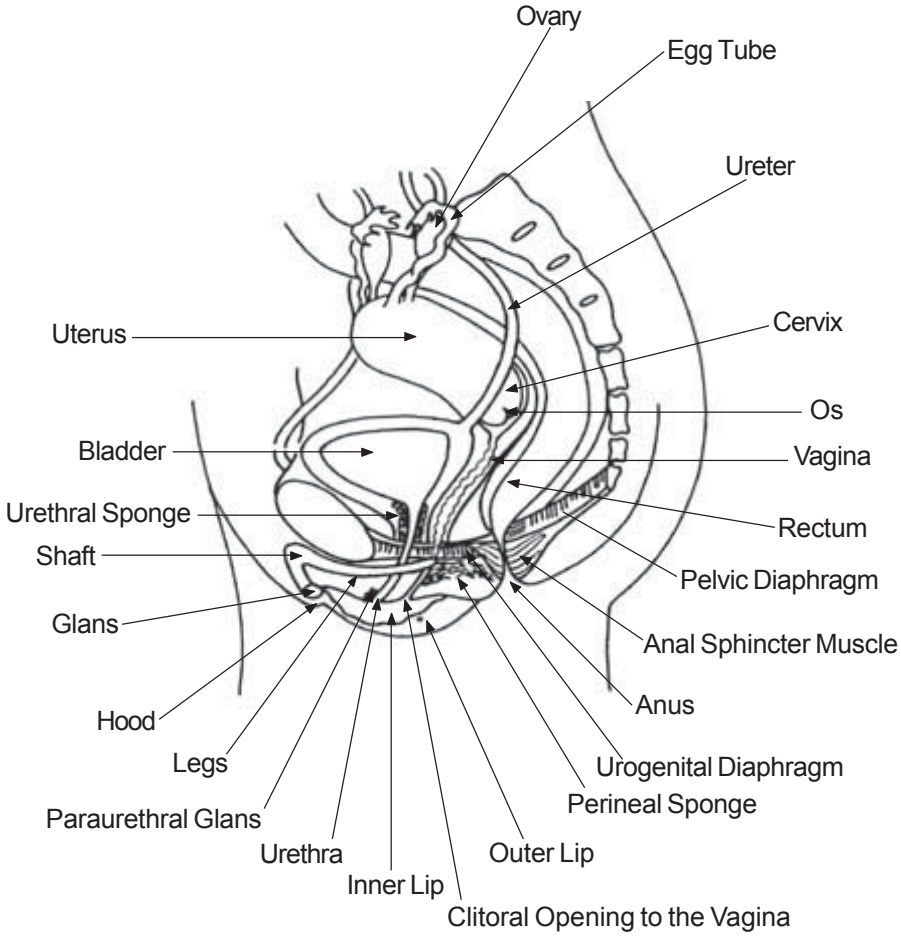

Fig. 2.7 *Perineal Sponge*

J. Perineum

The perineum region includes the anus and sexual organs, but the point of the perineum is located between the back of the vaginal opening and the anus. (Fig. 2.8)

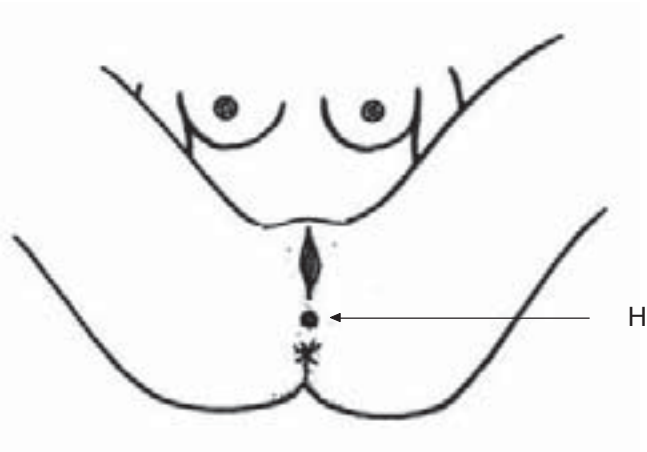

Fig. 2.8 *Perineum (Hui- Yin)*

The anus is a sexual orifice for some women, and quite sexually taboo for others. To prevent vaginal and bladder infections all women should know that fingers or penis should be washed after anal contact.

Fig. 2.9 *Love Making*

Chapter 3
Sexual Response Cycle

Women's sexual responses were described by Masters and Johnson as being in four phases: excitement, plateau, orgasm, and resolution. These phases are demarcated by physiological changes in the sexual organs. In the excitement phase the vagina sweats, and the broad ligament which supports the uterus pulls up: this in turn enlarges the back of the vagina in the plateau phase. A myriad of changes occur during orgasm, including for some women changes in skin color on the back and chest, or tingling or contractions in the hands and feet. In the resolution phase there is a gradual return to the resting state. (Fig. 3-1)

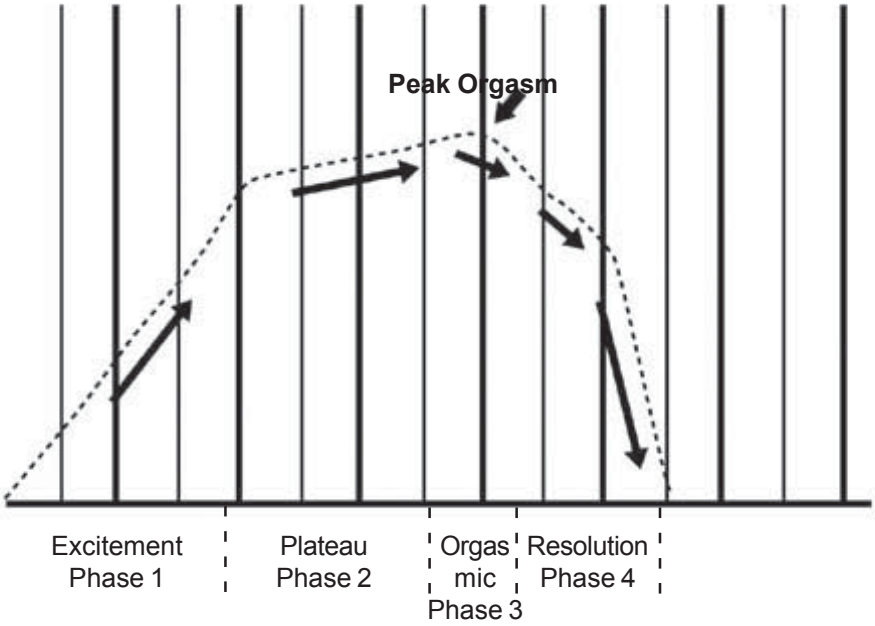

Fig. 3.1 *Ordinary Peak Orgasm*

Most writings on women's sexual responses describe women as having a long arousal period. Yet in Shere Hite's research (*The Hite Report*) most women describe themselves as reaching orgasm within minutes after they start masturbating. Does this long arousal period indicate the flexibility of women's sexual responses? Or is it due to inept lovers or women's reticence to tell their partners what would please them?

A. Clitoris and Vaginal Orgasm

Most sexologists and other people limit the definition of the clitoris to the glans. The vagina and the inner lips are seen as separate and distinct entities, the inner lips having no purpose other than to protect the urethral and vaginal openings. Even though Masters and Johnson described the vivid changes of the inner lips during sexual excitement, they still did not identify them as being part of the woman's sexual organs.

For over half a century a battle raged over the location of women's orgasms. Freud and many of his followers maintained that clitoral orgasms were experienced by girls, but that adult women transferred their sexual response to the vagina. Masters and Johnson concluded from their studies that all orgasms are clitoral in origin.

Feminists, concerned about the effects on women's psyches and sex lives, did a lot of research, both in medical libraries and among themselves in self-help groups, and they talked to numerous women about their sexual experiences. From all these sources they concluded that women have one unified sex organ, but that all parts react during sexual arousal no matter what part is being stimulated.

When all the aspects of this sexual organ are viewed together we see the erectile tissue of the small lips, glans and shaft, urethral sponge and perineal sponge. Add this all together and inch-for-inch women seem to have about as much erectile tissue as men. This similarity in structure suggests a similarity in function also, and further suggests a possible similarity in men's and women's sexual drives and responses. How much is related to how we are constructed, and how much is from our socialization?

B. Depletion of Sexual Energy

Most men are aware of the depletion of energy they feel as a result of ejaculation, and most women are also aware of a depletion. The Taoists observed that while men lose their energy through ejaculation, women lose most of their energy through their menstrual periods. Although many women do not perceive a loss of energy, certainly those whose periods are preceded by a week or two of breast tenderness, water retention, or pelvic congestion, or whose periods are accompanied by strong cramps, heavy bleeding, backache, nausea, diarrhea, or outbreaks of herpes, etc., will notice the draining effect of these cyclical functions.

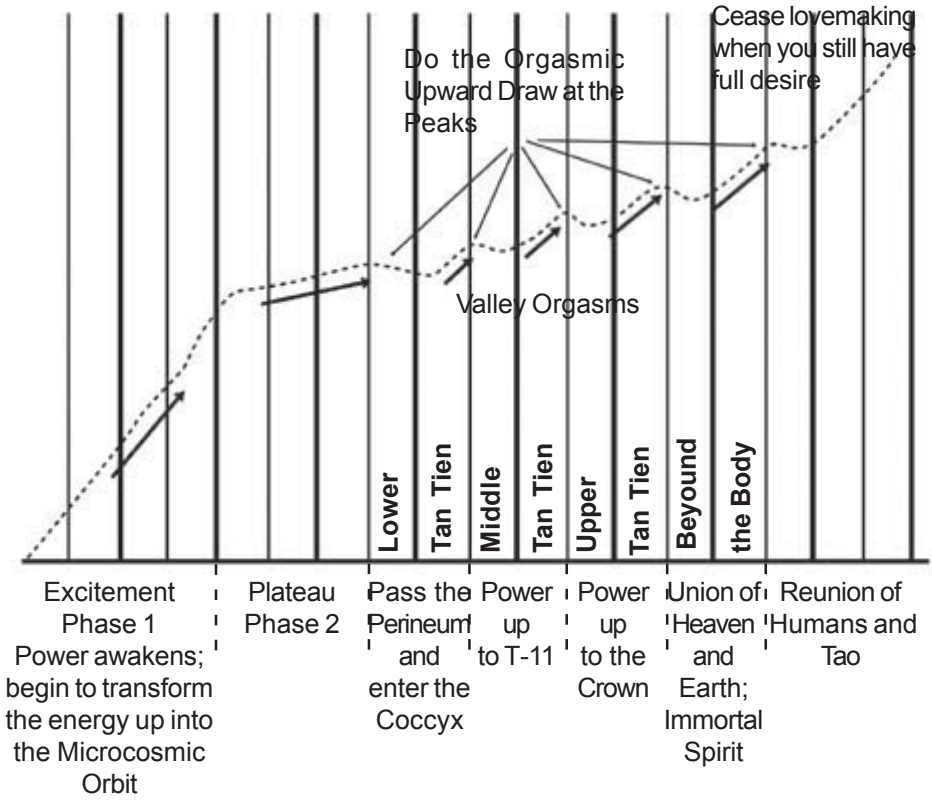

Fig. 3.2 Sexual Energy Chart

C. Ovarian Kung Fu

The Ovarian Kung Fu exercises are practiced in two parts: The first part, Ovarian Breathing, retrieves the biological energy that goes into making eggs, uterine lining, cervical mucous, and the attendant hormones produced in the ovaries and the adrenal and pituitary glands.

The second part, the Orgasmic (Inward and) Upward Draw, involves the transformation of sexual energy, i.e., the circulation of the aroused energy back into the body rather than the discharge of it into the universe.

Both exercises involve bringing the energy from the reproductive and sexual organs up the spine to the brain. Once the brain is filled with energy, the energy will travel down the front of the body to the heart, and then continue down to be stored at the navel.

The first exercise helps reduce the loss of energy from menstruation, enabling women to experience shorter, less troublesome periods. The second exercise conserves the biological energy lost through orgasm, prolongs and emphasizes the orgasm, and brings it up into the organs as well as to a higher energy center there to attain a higher state of consciousness. It also brings intense pleasure. (Fig. 3.2)

In the process of learning these exercises women come into closer contact with their cycles, learning to make finer discriminations in their muscle movements and energy flow, and to increase, deepen and extend their sexual pleasure. Ultimately they will zero in on the process of transformation, recognizing and achieving the link between sexuality and spirituality

Fig. 3.3 *Sexual Energy Connection*

Chapter 4
Microcosmic Orbit

"Reject all reasoning about sex: practice special exercises. To be able to make love and not emit is the secret of returning the semen. Increasing and aiding the semen is then the way of the life-force." Plain Woman's advice to the Yellow Emperor second century B.C.

In centuries past the Emperor of China invariably called in the court sages, usually Taoist, to obtain advice on his sex life. Before accepting the advice of any sage, so the story goes, the Emperor required any prospective Master to prove his sexual control. He did this by offering the would-be advisor a full glass of wine and demanding the sage insert his penis into it. If he was truly a Master he could absorb the wine into his penis, and then release it back into the wine glass. This was taken as absolute proof that the sage could also absorb a woman's sexual fluids, her Yin essence, and therefore knew the secrets of immortality.

Today women can learn the secrets of the Taoist Immortals, be in control of their sexuality and embark on a journey with a partner that will enrich them both. When they master these techniques for retaining their sexual power and then willingly share it, they will feel differently about themselves and each other:

A. Learn to circulate your Chi in the Microcosmic Orbit

By far the most powerful energy exchange between two partners occurs at the level of subtle energy. The Taoists have been studying the circulation of subtle energy through certain energy points in the body for thousands of years and have verified, in detail, their importance. These energy points form the basis for acupuncture. Although Western medical research has acknowledged acupuncture as being clinically effective, scientists admit they cannot fully explain why the system works. The circulation of energy through these energy points, or meridians, is called the Microcosmic Orbit. (Fig. 4.1)

All students of the Universal Tao System are taught to circulate their Chi in the Microcosmic Orbit, a necessary step to understanding the cultivation of Ching from the raw physical level

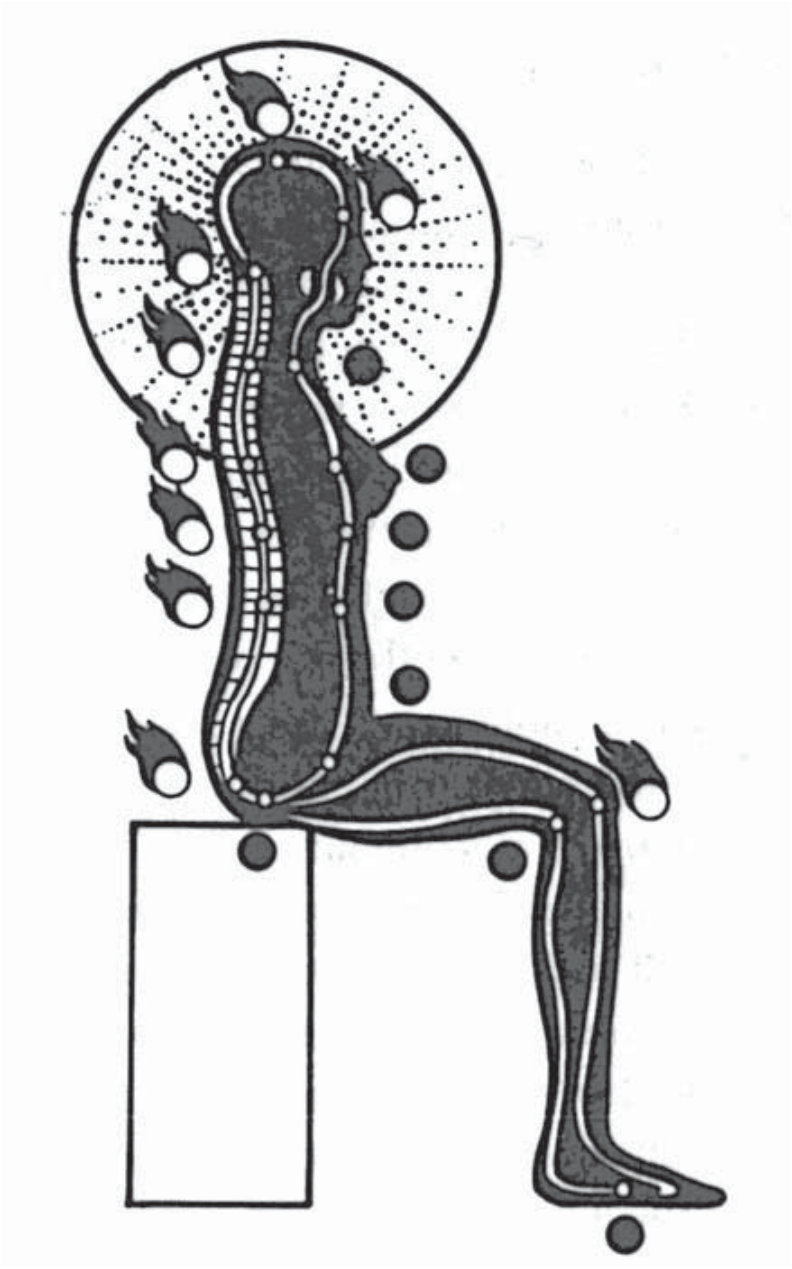

Fig. 4.1 *Microcosmic Orbit*

of eggs to the refined subtle energy of a Shen, or spiritual being. Once they have opened their Microcosmic Orbit, they have already experienced a minor enlightenment. The mind has begun to realize it has control over its own subtle energy. Ultimately one learns that the movement of subtle energy is totally a power of the mind.

B. Discovery of the Microcosmic Orbit

A few thousand years ago everything in the world was so simple: there were no televisions, radios, theaters, or nightclubs as entertainment, and no houses to care for; all of which drain energy and disturb the mind. The air was pure. Natural energy was abundant to humans.

When the sun set, people could not fall asleep right away, and they dared not roam around the jungle in the dark. One way to occupy their time was to sit down and quiet themselves. Once they were able to quiet their minds to a certain extent, their body functions started to quiet down as well. They started to notice the flow of something in the body. The flow began in the navel, traveled down to the perineum and up the spine to the head, down the front through the tongue, to the throat and then down to the navel. The circulation of energy through this route came to be known as the Microcosmic Orbit.

The more they were able to still their minds and bodies, the more intense the flow would be. As they continued to still their minds, they began to discover more paths opening and to feel the energy flow in a straight direction, up and down. From the perineum up to the head, the flow was then felt passing through the major organs in three channels, which later became known as the Thrusting Channels. As their practice continued, they felt the energy start to flow in a circular motion, similar to a belt, around a major energy center that they discovered in the navel, the Belt Channel.

As time went on they discovered that there existed in their bodies 32 energy channels, each one corresponding to a specific organ. They passed down this knowledge they had learned generation after generation until more and more people practiced it, and in this way identified the acupuncture meridians which became basic to the Taoist System.

Every person has the same body, the same channels, and has a soul and spirit. After many hundreds of years of practice, trial and

error, improving and passing down, the Taoist Esoteric Yoga System came into being.

C. Two Major Energy Channels of the Microcosmic Orbit - Functional and Governor

It is much easier to cultivate your energy if you first understand the major paths of energy circulation in your body. The nervous system in humans is very complex and is capable of directing energy wherever it is needed. However the ancient Taoist Masters discovered there are two energy channels that carry an especially strong current.

One channel, the “Functional” or “Yin” Channel, begins at the base of the trunk midway between the vagina and the anus at the perineum point. It goes up the front of the body past the mons, abdominal organs, heart, and throat and ends at the tip of the tongue. The second channel, the “Governor” or “Yang” Channel, starts in the same place. It flows from the perineum upward into the tail bone, then up through the spine into the brain and back down to the roof of the mouth. (Fig. 4.2)

The tongue is like a switch that connects these two currents when it is touched to the roof of the mouth just behind the front teeth, the energy can flow in a circle up the spine and back down the front. The two channels form a single circuit that the energy loops around. This vital current circulates past the major organs and nervous systems of the body, giving cells the juice they need to grow, heal, and function.

D. Sexual Energy

1. Primordial Energy

The sexual energy that moves in the Microcosmic Orbit is a primordial energy. Human life begins with the union of an egg and a sperm cell. This is the original act of Kung Fu in the balancing of Yin and Yang. Ovarian Kung Fu is the re-creation of that act within the female body. However instead of forming a fetus from a fertilized egg growing inside the womb, the ovarian energy mounts to higher energy centers inside the body, and we give birth to ourselves on a spiritual level. The sexual energy is drawn upward through the Microcosmic Channel where it literally gives rebirth, a “new life”--

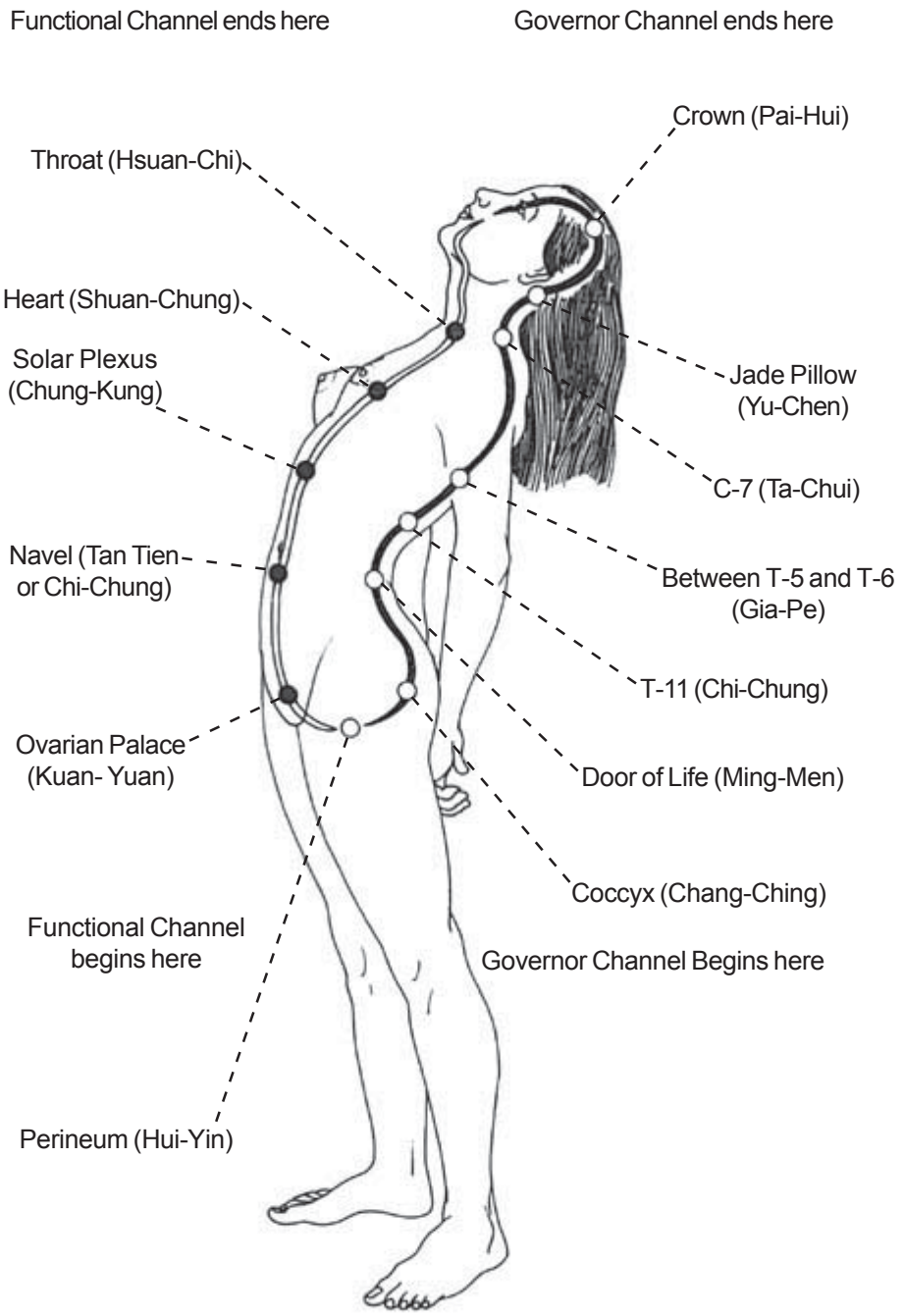

Fig. 4.2 *Functional and Governor Channels*

and brings the confidence of controlling a powerful flow of creative energy and the satisfaction of a deep sense and higher balance of harmony with the world.

2. A Powerful, Versatile Energy

The methods of Chi cultivation explained in detail in this book from Ovarian Breathing to the Ovarian Upward Draw method to Beyond Orgasm all involve drawing sexual energy stored in the ovaries up the spinal column and into the brain. When the brain is full, this energy will travel down the front into the throat, heart and navel. The brain and pituitary gland will aid in distributing this powerful energy to wherever it is needed. This is a unique attribute of sexual energy, or Ching, over other types of Chi that have their own special functions, e.g., liver Chi. Sexual energy is extraordinarily versatile and can be transformed into many different functions. This is one reason it is so nourishing to our spiritual being. Our inner spiritual being can easily digest it, almost as if it were baby food.

The loop of energy circulating about the body in the Microcosmic Orbit, carrying the sexual current from the ovaries and spreading vitality to other parts of the body, also has a profound effect on health in a specific way. It is this energy that triggers the glands to release the sex-stimulating hormones which regulate body chemistry and ultimately affect your ability to do anything. It has an especially strong influence on the quality of your lovemaking, because on the biological level sex is largely a question of hormonal balance.

The benefits of the Microcosmic Orbit extend beyond facilitating the flow of sexual energy: they include the prevention of aging and the healing of many illnesses, ranging from high blood pressure, insomnia and headaches to arthritis. Whether it be for fighting off an illness, answering a child's question, painting, or making love, the energy that flows in the Microcosmic Orbit is available when we need it.

E. Sealing the Energy within the Body

After opening up the Microcosmic energy channel, it is important to keep it clear of physical or mental blockages, thereby making it possible to pump a greater amount of sexual energy up the spine. If this channel is blocked by tension during the sexual excitement of lovemaking, ovarian energy will not be able to rise to the brain.

The sexual power is then lost until the body goes through the long and physically taxing process of manufacturing more ovarian energy. The Microcosmic Orbit is an important step to sealing this energy within the body so that it will circulate and revitalize all parts of the mind and body. Otherwise, when intense sexual energy pressure builds in the head, much of it escapes out of the eyes, ears, nose and mouth and is lost.

F. Opening the Microcosmic Energy Channel

The easiest way to open the Microcosmic energy channel is to sit in meditation a few minutes each morning and relax. Allow your energy to automatically complete the loop by letting your mind flow along with it. Start in the eyes, and mentally circulate your attention with the energy as it goes down the front through your tongue, throat, chest and navel, and then up the tail bone and spine to the head.

At first it may feel like nothing is happening, but eventually the current will begin to feel warm in some places as it loops around. The key is simply to relax and try to bring your mind directly into the part of the loop being focused on. This is different from visualizing an image inside your head of what that part of the body looks like or is feeling. Experience actual Chi flow. Relax and let your mind flow with the Chi in the physical body along a natural circuit to any desired point, e g., your navel, perineum, etc.

Even if you do not sit daily and circulate the Microcosmic current, just being aware that it exists in your body and functions automatically during these practices should help you more quickly master the methods of Taoist loving. You may even learn it through your lovemaking: all it takes is attention. The best lover is a fully relaxed woman who understands what is going on inside her.

A way to become more in touch with your energy is to lie next to your partner with your ear or nose near your partner's nose. Synchronize your breathing and begin to feel the mingling of your breaths and energies. You might also hug each other for a prolonged period and begin to feel the energy in the abdomen with each breath. The woman who masters this easy flow of energy inside her body's Micro cosmic Orbit will find tapping into her sexual powers a simple and natural step.

The more conscious you become of the functioning of subtle Chi energy in your body, mind, and spirit, the greater your freedom

to creatively love and be yourself.

Those interested in fully mastering this method of relaxation and opening the Microcosmic Orbit can refer to my first book, *Awaken Healing Energy Through the Tao.*

Study of the Microcosmic Orbit is highly recommended to all students of Sexual Kung Fu who seek to truly master the techniques taught here. Progress to the higher levels of transforming sexual energy without first learning the Microcosmic Orbit is very difficult. Many people may already have open channels and simply need to be made aware of them. Anyone can start to relax in a pleasing, natural setting.

Mastering the Microcosmic current also prepares the serious student for utilizing other energy-conserving techniques that complement Sexual Kung Fu, such as Iron Shirt Chi Kung I, II, and III, a method of packing and storing Chi energy into vital organs. Another powerful technique is Tai Chi Chi Kung, a condensed form of Tai Chi Chuan that circulates Chi energy among body, mind, and spirit, and strengthens muscles, tendons and bones.

Fig. 4.3 *Loving Energy*

Chapter 5
Cultivating Ovarian Power

I. Activation and Control of Ovarian Energy

A. Importance of Sexual Organs' Exercise

America is presently exercise oriented. However with the exception of sexual intercourse, few exercises strengthen the crucial pelvic muscles. Pelvic exercises do exist which can increase Chi in these areas, thereby greatly strengthening the reproductive organs and the complex network of tendons surrounding them.

Strength in this region is of inestimable importance. Leading into the pelvis is a vast number of nerves, blood vessels and lymph glands. Here terminate tissues communicating with every square inch of the body. All of the major acupuncture meridians, which carry Chi to the vital organs, pass through this area. If it is blocked or weak, energy will dissipate, and the organs, as well as the brain, will suffer. This is what happens to many people in old age. As their rectal and pelvic muscles sag and become loose, their vital Chi energy slowly drains out, leaving them weak and feeble.

1. Celibates

No matter who you are, sexual energy is constantly building up and accumulating in the sexual region. Some negative evidence has been collected regarding the health of celibates based on studies of priests and nuns who use only willpower to suppress the sexual fire within. !t has been found that the practice of celibacy by women has brought on the eventual deterioration of the sexual organs caused by long-term congestion in the ovaries or breasts, in turn affecting the internal organs.

Some celibates are able to transform their sexual energy naturally, and as a result no problems arise in the celibate state. A woman who is not so naturally enlightened will find an accumulation in her body and sexual organs of too much sexual energy. This energy tends to need a release, and if the woman has no way to handle the problem properly, the energy can affect her adversely, multiplying her negative emotions. Without properly cultivating

sexual energy and opening the energy channels between the lower and upper body the sexual energy is blocked, thereby congesting blood and hormones in the woman's genitals, ovaries, and cervix. Such problems can be avoided by practicing the Ovarian Breathing and Orgasmic Upward Draw exercises.

B. Ovarian Breathing Cultivates Ovarian Power

1. Woman's Menstrual Cycle

It is said that anatomy is destiny: women are born to be mothers. A baby girl's ovaries are immature, small and smooth, but they contain the power necessary to create the 300-500 eggs she will produce in her reproductive years and a reserve of potentially 450,000 eggs.

Every woman has a profound connection with her menstrual cycle. Women students of the Universal Tao System have revealed how sensitive they are to what seems to be subtle changes in their cycles: they notice right away if their periods are one day early or late, if they last a day longer or are a day shorter and if the consistency or color varies from what they have come to expect.

Apparently many women remember an event that occurred the day they received their first periods. Those memories may be pleasant or unpleasant, but they remain indelible. One woman remembers it was the first time a man tried to pick her up: another woman remembers that her mother slapped her face (a gesture of welcome into the world of being a woman): another woman hit a home run in a softball game that day.

Many women's cycles become a source of much confusion and uncertainty. They are unsure about fertile times, are ashamed of secretions and odors, are discontent with available birth control methods, develop anger at common childbirth practices, or harbor a simultaneous dependency on and distrust of the medical profession.

Some women go through life with few problems during their cycles, having easy periods, uncomplicated births, or smooth transitions into menopause. Others have distressing problems with their periods, such as recurrent vaginal infections, abnormal Pap smears, difficult births, hysterectomies, or they take synthetic hormones because of disabling hot flashes.

Major changes can occur in the menstrual cycles as well as in many other aspects in the lives of some women simply by practicing Ovarian Breathing.

The point is that, even if a woman has two or three children and does not plan to have more, her body continues cyclically to produce ovary energy. Instead of wasting that energy, it can be conserved through transformation into another form for later use. The Ovarian exercises provide a way to use that Ovarian power:

2. Yang Energy and the Menstrual Cycle

There are three distinct parts to the menstrual cycle. First, there is the period itself. Following menstruation, an ovary spurts several immature eggs into action, and usually one egg matures completely. Surrounded by a jelly-like covering, it breaks out of the ovary. That period of time, from the end of the bleeding until ovulation, is the time of maximum ovary power During this part of the cycle the Taoists believe that the ovaries' energy is at its most Yang, or most hot.

After ovulation the ruptured area of the ovary heals and forms the corpus luteum, or yellow body. This yellow body produces progesterone. The function of progesterone is to keep the uterine lining from sloughing off. If the egg unites with a sperm and a pregnancy starts, progesterone will be secreted during the entire pregnancy. If there is no fertilization, the ovary will produce a spurt of estrogen, and the menstruation cycle will begin.

The Taoists note, and women's experiences to date confirm, that the part of the cycle between menstruation and ovulation is the time that a woman will receive the maximum benefit from the practice of Ovarian Breathing, with continued practice then being optional until the next cycle. The process of Ovarian Breathing will draw energy out of the egg. Imagine having access to an energy that is powerful enough to bestow life!

C. Diaphragms

The body possesses not one but several diaphragms. Everyone is familiar with the thoracic diaphragm in the chest, separating the heart and lungs from the abdominal organs and assisting us in breathing. When you inhale, this diaphragm lowers, thus increasing the space in the chest and allowing the lungs to fill: the deeper the breath, the lower the diaphragm moves.

Less is known about the pelvic and urogenital diaphragms, which separate the pelvis from the perineum. To practice Ovarian Breathing properly you must use not only the chest diaphragm, but also the pelvic and urogenital diaphragms. (Fig. 5.1) These serve as flood gates, opening to spurt energy to the organs, or as pistons, pumping the energy up to higher centers. True breathing comes from these lower diaphragms. It is an exceedingly important element in the Taoist practice of transmitting the energy generated from the sexual organs into a higher energy form.

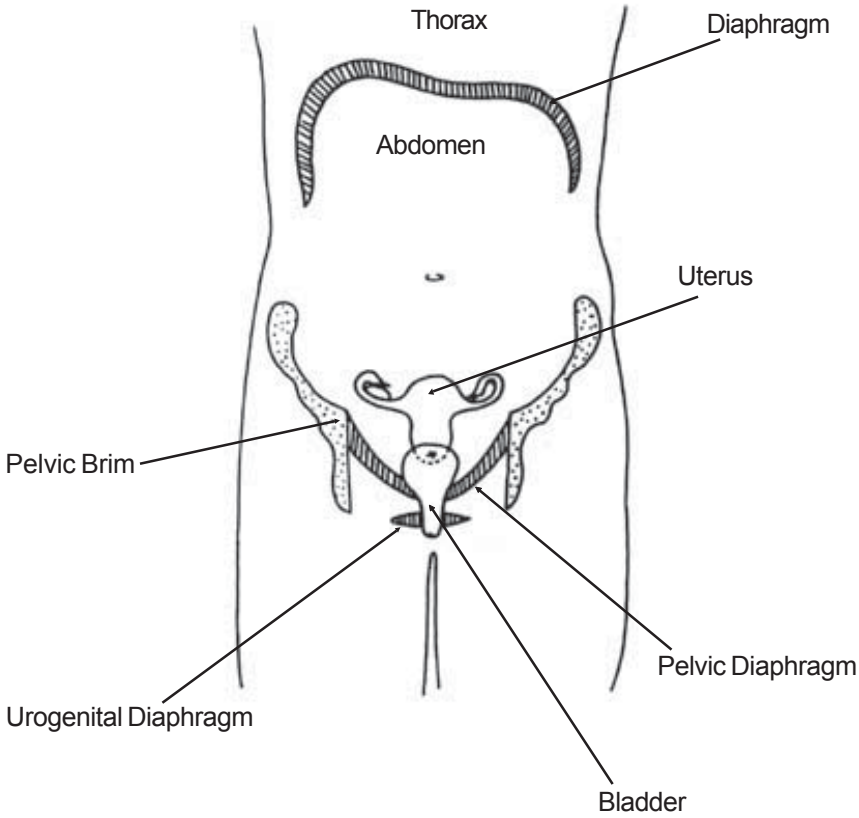

Fig. 5.1 *Deep breathing issues from pelvic and urogenital diaphragms.*

1. Pelvic Diaphragm

The pelvic diaphragm is a muscular wall that extends across the lower part of the torso. It is suspended between the symphyses

pubis (pubic bones) in front and the coccyx (at the bottom of the spine) in back. (Fig. 5.2) There are several organs that penetrate this muscular partition as it lies between the pelvic cavity and the perineum. These organs are the urethra, the vagina and the rectum. One function of the pelvic diaphragm is to support these organs: therefore, control over this diaphragm provides you with greater control over these organs. The pelvic diaphragm is also the floor of the abdominal cavity, which contains the stomach, small and large intestines, liver bladder and kidneys. It lifts up and helps shape these vital organs.

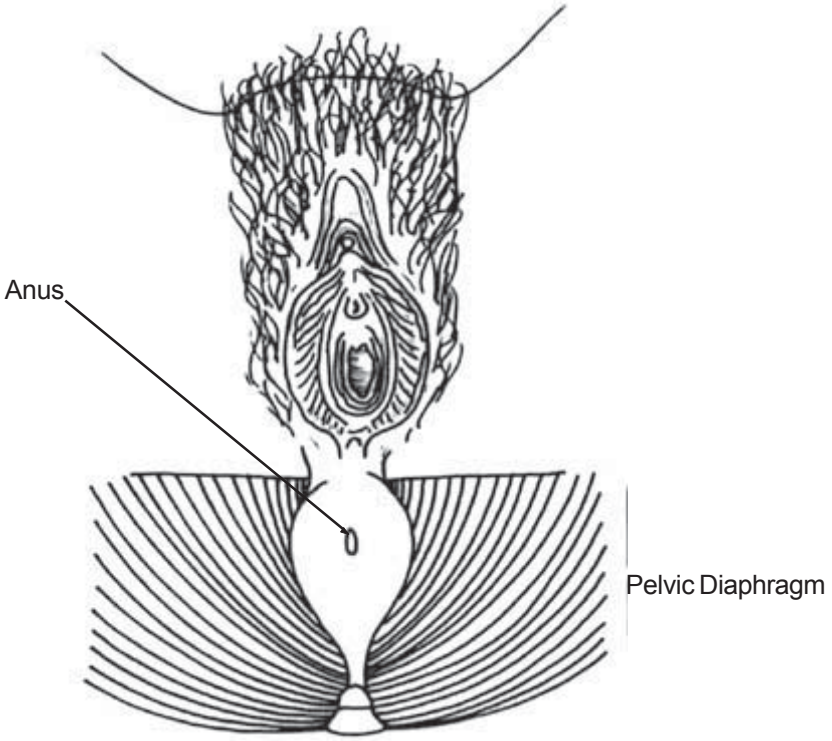

Fig. 5.2 *Pelvic Diaphragm*

2. Urogenital Diaphragm

At the perineum, the point midway between the anus and vagina below the pelvic diaphragm, is another muscular diaphragm, the urogenital diaphragm. This is penetrated by the urethra, and on its underside is attached the shaft of the clitoris. (Fig. 5.3)

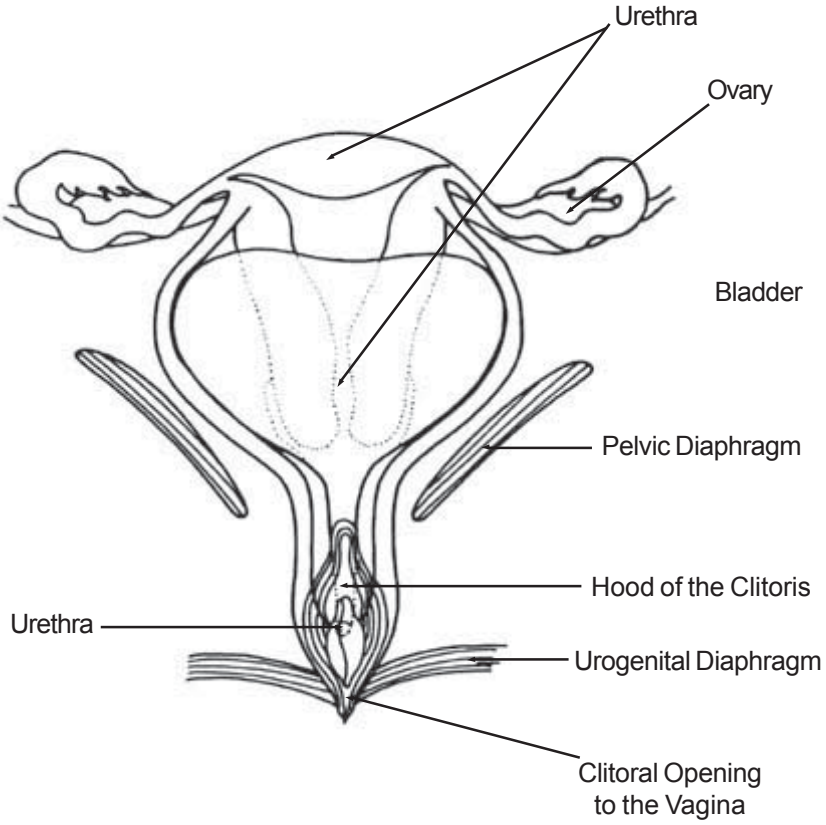

Fig. 5.3 *Urogenital Diaphragm*

These two diaphragms seal and hold the life-force, or Chi energy to prevent its escape through the lower openings in the body when the openings passing through these diaphragms are tightly sealed, Chi pressure will be increased in the abdomen. When Chi pressure (pounds per square inch, or psi) strengthens, it will invigorate the vital organs, helping to improve the flow of Chi and blood.

The importance of these anatomical structures will become apparent as you study the Universal Tao System in its entirety. As previously mentioned, Iron Shirt Chi Kung exercises also help to develop power and strength in these areas and are a perfect complement for anyone seeking a daily regimen that will assist in the practice of Ovarian Kung Fu. (See the section at the end of this book entitled “The Universal Tao System” for a further description.)

D. Sacral and Cranial Pumps move Chi up the Spine

Contained and protected within your spinal column and skull is the very “heart” of your nervous system. (Fig. 5.4(a)) Cushioning it is the cerebrospinal fluid, “cerebro” for the head and “spinal” for the vertebrae. This fluid, as described by the Taoists long ago, is circulated by two pumps. One is located in the sacrum and is known as the Sacral Pump. The other is in the region of your upper neck and head and is known as the Cranial Pump. (Fig. 5.4(b)) Many people who have activated these pumps have reported the sensation of a “big bubble” of energy traveling up their spine during Ovarian Breathing.

1. Sacral Pump

Taoists regard the sacrum, containing the Sacral Pump, as a point at which the sexual energy coming up from the ovaries and perineum can be held and then transformed as it is given an upward push. It can be compared with a way station that refines the ovaries’ energy, or Ching Chi, as it circulates in the body. If the opening of the sacrum to the spinal column (the sacral histus) is blocked, the life-force cannot enter and flow up to the higher center:

2. Cranial Pump

The cranium of the skull has long been regarded by Taoists as a major pump for the circulation of energy from the lower centers to the higher centers. Medical research has recently confirmed that minute movements of the joints of the eight cranial bones occur during breathing. Cranial movement is responsible for the production and function of the cerebrospinal fluid surrounding the brain and spinal cord, and this is necessary for normal nerve and energy patterns in the entire body. Strengthening the cranial joints can increase energy and alleviate symptoms such as headaches, sinus problems, visual disturbances and neck problems.

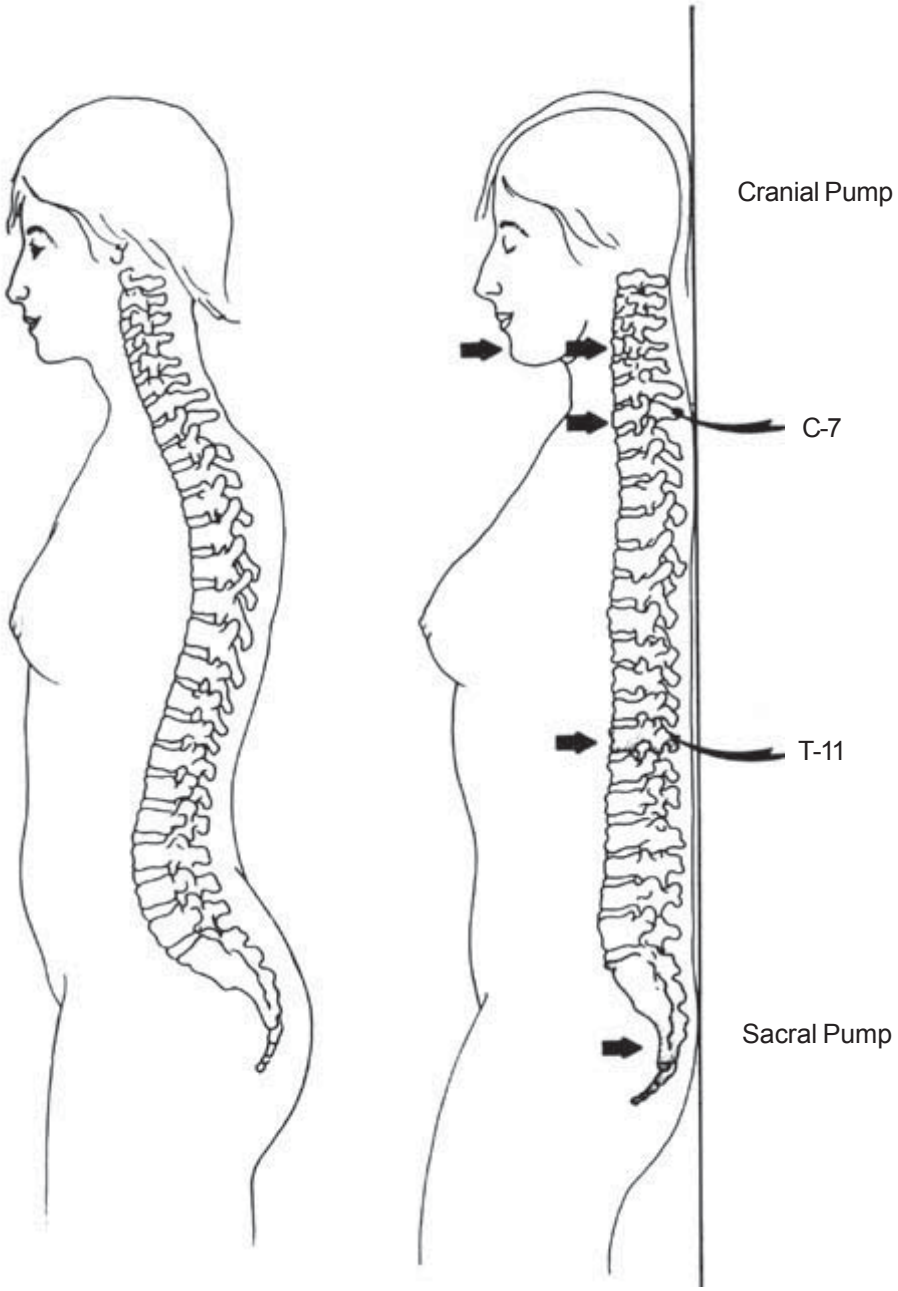

Fig. 5.4(a) Natural Curvature of the Spine (b) Sacral Pump and Cranial Pump

In Taoism, cultivation of the movement of the pelvis, perineum, urogenital disphragm, anus, and the Sacral and Cranial Pumps is very important and necessary in helping to move the sexual energy up the spine.

In Ovarian Breathing, we use the mind and a slight tensing of the neck and jaw to help activate the Sacral and Cranial Pumps. In the Orgasmic Upward Draw we use a stronger power lock of the neck, teeth and muscles, a deep breath, and eye movement to assist in the activation of these pumps.

E. Chi Muscle assists in controlling the flow of Chi.

As we have already learned, one of the main objectives of the Taoist practice is to increase the flow of Chi, our life-force, to our organs and glands. The Inner Smile and Microcosmic Orbit Meditation are very important methods of reaching this objective, especially in the Healing Love practice, because they can help you open the channel through which the sexual energy has to flow up, assisting you in controlling the flow of sexual power. However without directing sexual healing energy to the organs, lovemaking becomes a normal social act, ending up in the loss and depletion of gland and organ energies. Crucial to the ability to control this flow of sexual energy is the development of a strong Chi Muscle.

1. Perineum Power

Included in the perineum region are the anus and sexual organs. The perineum region is known as the seat of Yin (cold) energy, and is closely connected to the organs and glands. (Fig. 5.5) The Chinese term for perineum, Hui-Yin, means the collection point of all Yin energy, or the lowest abdominal energy collection point. It is also known as the Gate of Death and Life. This point lies between the two main gates. The front gate, or sexual organs' gate, is the big life-force opening: here the life-force can easily leak out and deplete the organs' function. Although the walls of the vagina are tight during youth and after a refreshing sleep, they become looser as we age or when fatigued. The walls of the vagina, housing the PC Muscle, must be strong in order to permit the life-force energy to flow and increase their strength. The second gate, the back gate, is the anus.

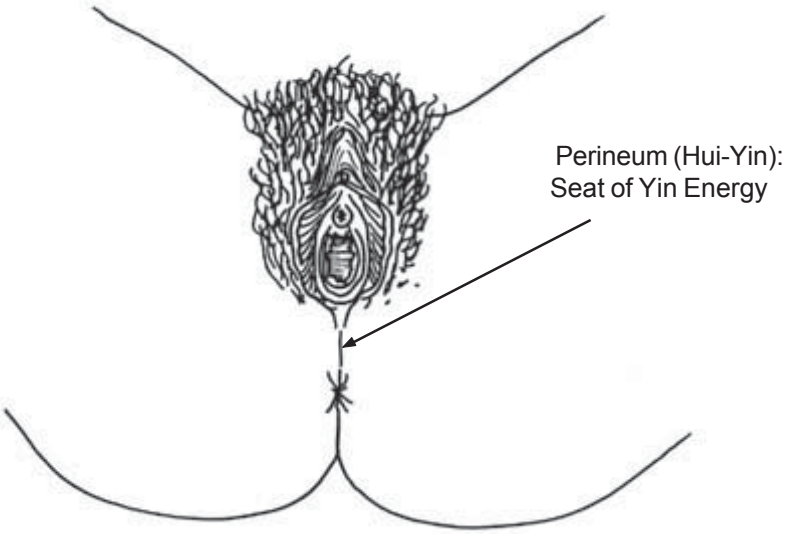

Fig. 5.5 *Perineum*

Taoists regard the perineum region as the lowest disphragm, one that functions like a pump. Control of the Chi Muscle, consisting of the PC Muscle, the muscles of the pelvic and urogenital disphragms, the sphincter muscle of the anus, and many involuntary muscles located in this perineum region, influences the pumping action. As Ovarian Breathing floods this region with energy, the perineum, vagina and anus begin to tighten almost immediately. In the Tao practices, especially in Iron Shirt Chi Kung, the perineum's power to tighten, close and draw the life-force back up the spine is an important factor.

2. Anus is connected to Organ Energy.

The various sections of the anus region are closely linked with the organs' and glands' Chi. When not sealed or closed tight, we can easily lose the nutrition needed for our life-force and sexual energy through 'a river of no return": they will flow out and will not recycle.

3. Anus Region is divided into Five Sections.

The anus is divided into five sections: (a) middle, (b) front, (c) back, (d) left, and (e) right. (Fig. 5.6) By contracting and pulling up the various sections of the anus, you are also pulling up the perineum region, which partially consists of the anus.

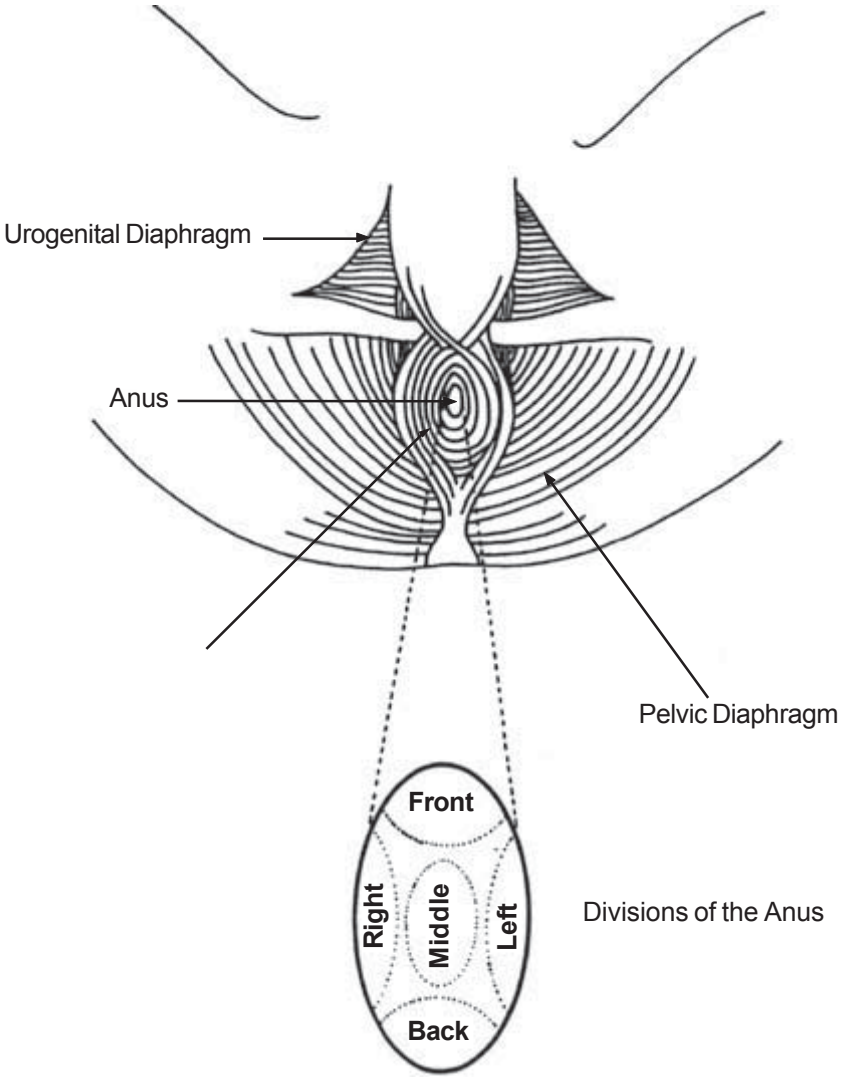

Fig. 5.6 *Anus is divided into Five Regions.*

A. Middle Part

The middle of the anus Chi is connected with the organs and glands as follows: the vagina-uterus, aorta and vena cava, stomach, heart, thyroid, parathyroid, pituitary and pineal glands and top of the head. (Fig. 5.7).

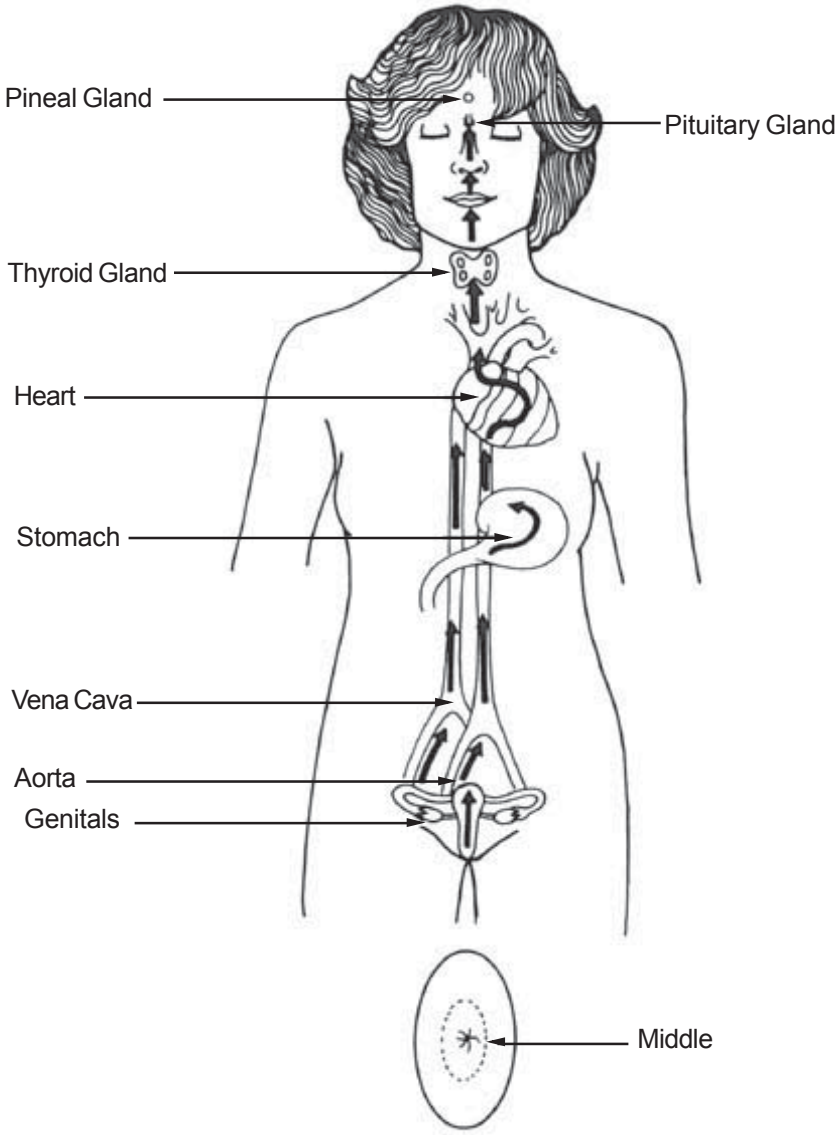

Fig. 5.7 *Middle Part Anus Pull Up*

B. Front Part

The front of the anus Chi is connected with the following organs and glands: the bladder: cervix, small intestine, stomach, thymus and thyroid glands and front part of the brain. (Fig. 5.8)

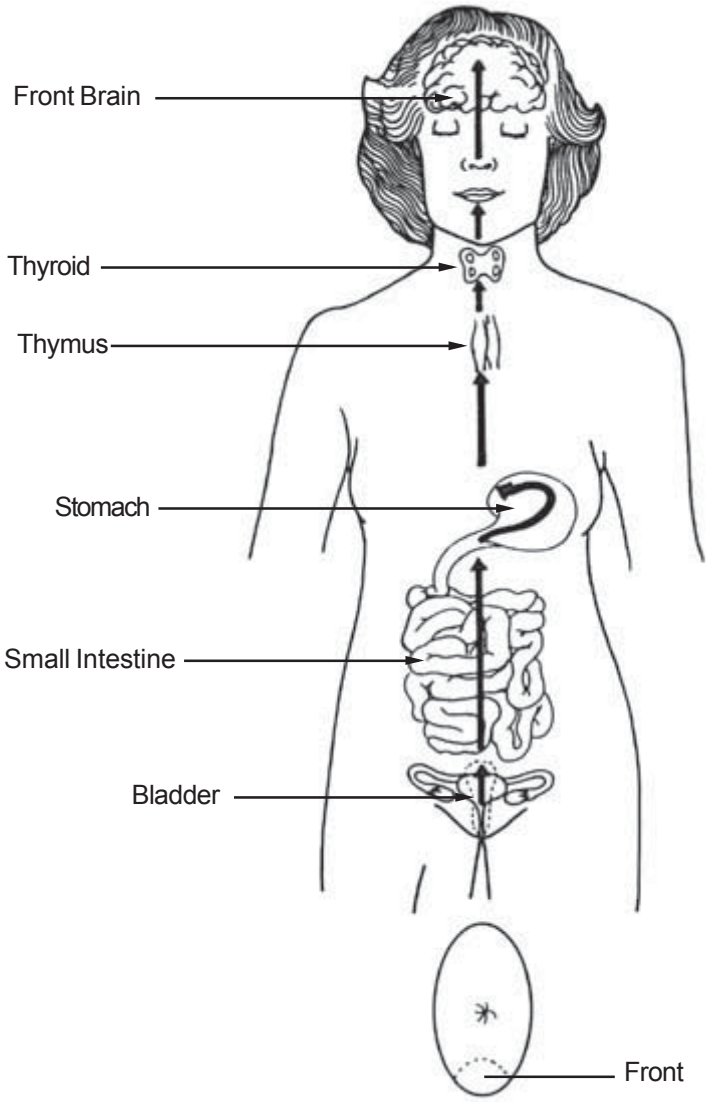

Fig. 5.8 *Front Part Anus Pull Up*

C. Back Part

The back part of the anus Chi is connected with the organ and gland energies of: the sacrum, lower lumbar,: twelve thoracic vertebrae, seven cervical vertebra: and small brain (cerebellum). (Fig. 5.9)

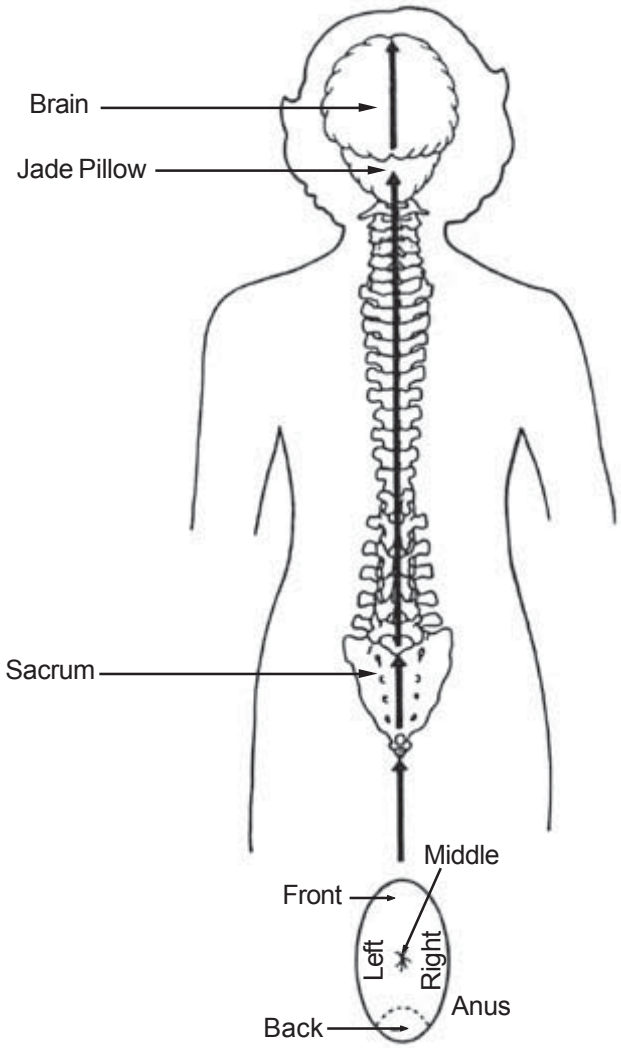

Fig. 5.9 *Back Part Anus Pull Up*

D. Left Part

The left part of the anus Chi is connected with the organ and energies of: the left ovary, large intestine, left kidney, left adrenal gland, splee, left lung and left hemisphere of the brain. (Fig. 5.10)

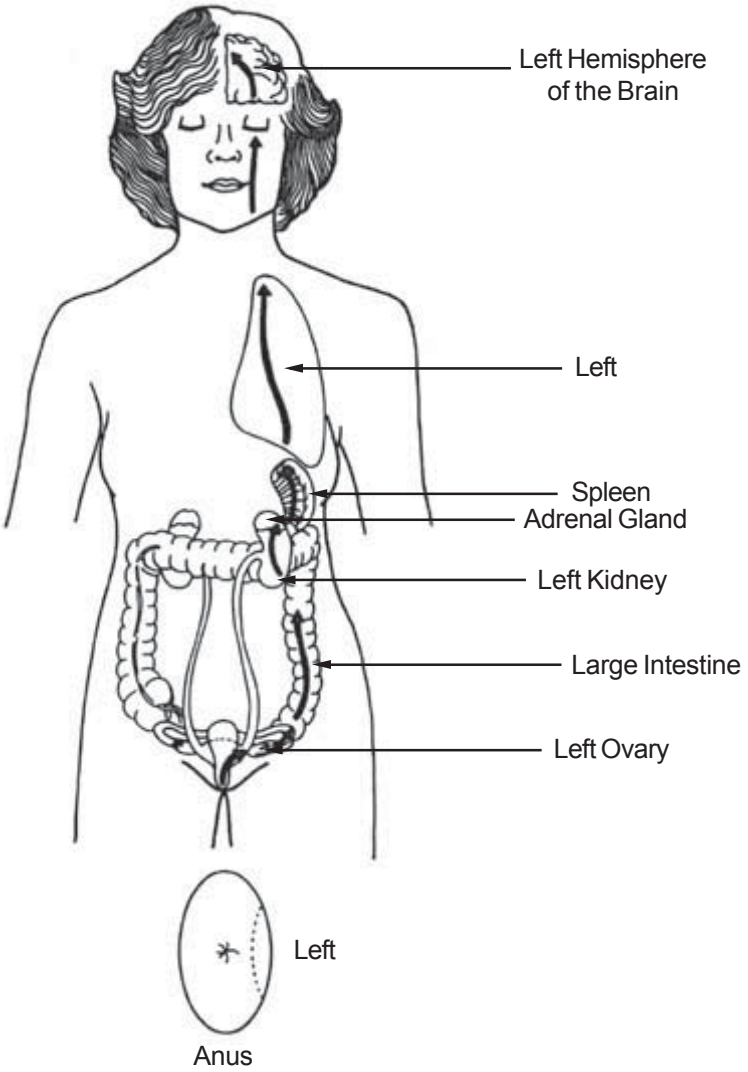

Fig. 5.10 *Left Part Anus Pull Up*

E. Right Part

The right part of the anus Chi is connected with the organ and gland energies as follows: the right ovary, large intestine, right kidney, right adrenal gland, liver, gall bladder, right lung and right hemisphere of the brain. (Fig. 5.11)

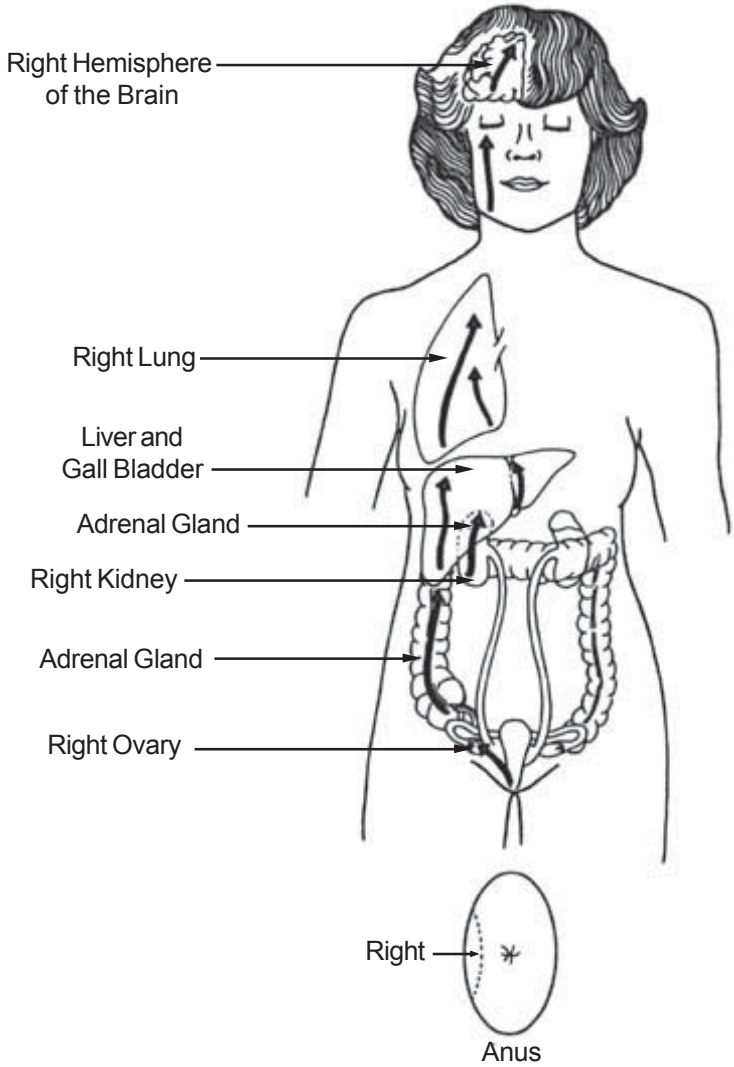

Fig. 5.11 *Right Part Anus Pull Up*

Once you are well trained in controlling the Chi Muscle, you can easily guide the sexual healing energy to the particular organs or glands that you need to heal, or guide the energy to help your partner during lovemaking. In the latter part of the Orgasmic Upward Draw, you will learn how to guide your orgasms to the organs and glands.

F. Yang Ovaries' Energy-Healing and Creative Power

The ancient Taoists had extraordinarily astute powers of observation, and their findings on the subject of sex are surprisingly consistent over long stretches of time, which in China means not hundreds but thousands of years. This is significant because many groups did not know of any others' abilities, whereabouts, or even existence, since these esoteric practices were kept very secret.

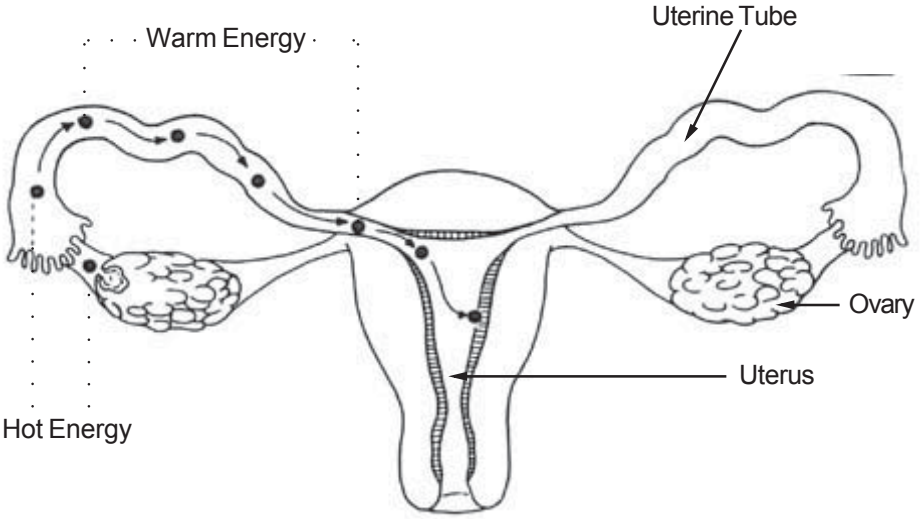

During the first stages of ovulation the erengy is hot. As the egg travels toward the uterus the energy turns warm.

Fig. 5.11 *Energy of Ovulation*

They noted that the ovaries, as the factory that produces sexual energy in the form of eggs and female hormones, are of prime importance, because all of the vital organs, such as the brain, must contribute some of their own reserves to create and maintain them. Further their records point out that in the first part of a woman's cycle, there is a tremendous storage taking place of hot life-force

energy which they called Yang Ching Chi (Ovarian Chi). (Fig. 5.12) As previously noted, Yang energy activates and charges an egg during a woman's ovulation with full potential life-force, and this is a sign of a strong and youthful energy with the power to create and heal.

Ovarian Chi, or Ching Chi, is denser than the life-force, or Chi, that normally circulates in the Microcosmic Orbit. Since it is thicker and slower to move, this energy needs all the help it can get to move upward to a higher energy center. Therefore it is important to be sure the channel of the Microcosmic Orbit is open and the Chi is flowing before proceeding to Orgasmic Breathing or the Orgasmic Upward Draw. Then the more inward the orgasm, and the more you can bring it upward, the more you will heal and revitalize as the Ching Chi (sexual energy) travels through the channel in its loop up the spine to the head and down the front through the navel, genitals and perineum, linking the various organs and glands with each other and with the brain. This energy can also be used to heal and revitalize your partner:

As the woman's cycle continues and the egg moves out of the body the experience of heat gives way to what has been described as a mildly warm quality. All sexual energy, whether male or female, is Yin in its latent or resting state. At this time the aroused sexual energy, now more Yin in nature, is more healing than creative. It is important to use this sexual energy and not let its vitality pour outward. IF it does, you have to start the process all over again.

II. Single Cultivatlon: Ovarlan Breathing, Ovarian and Vaginal Compression

Ovarian Breathing: The Ovarian Breathing exercise that follows will help you to open and utilize the channels of the Microcosmic Orbit, a process described briefly in Chapter 4 and in depth in the book *Awaken Healing, Energy Through the Tao*. In Ovarian Breathing you use your mind to draw the warm, Yang, vital egg energy up the spine to your head and to the third eye (located mid-eyebrow), down through the tongue, the heart, the solar plexus, finally to be stored in the navel. You will be drawing on the energy generated by the ovaries, eggs and hormones themselves. At first the process is slow, but later a simple thought will send delightful waves of energy up your back to your head.

Ovarian Compression: The second exercise, Ovarian Compression, trains you to have more control of the Chi Muscle to build up warm Ching energy in the ovaries and to move this energy safely upward.

Orgasmic Upward Draw: A third exercise, the Orgasmic Upward Draw, is the subject of Chapter 6. You will learn how to contend with the Ching energy when it is aroused, and how to extend the orgasm inward and upward. This is the most powerful way to energize and revitalize the organs, glands and brain. Like a wild mare, this energy is the most difficult to control. It is recommended that in the beginning you practice this exercise alone, using self-arousal, before attempting to tame your sexual energy at its most explosive time, i.e., with a lover during lovemaking.

A. Ovarian Breathing

1. Overview of the Exercise

The Ovarian Breathing exercise involves a gentle contraction of the Chi Muscle, as delicate as the closing petals of a flower and so minimal that any less would do nothing at all. The various postures will be described below, although it would be best to try this exercise standing up or sitting on the edge of a chair

You will be bringing your awareness to both ovaries. Then you will gather more energy in the area to be described as the “Ovarian Palace,” from which you will move the energy through the uterus to the perineum. From there you will guide it up your back to the brain, and then using your tongue as a switch, you will guide it down to your navel, where it can be stored.

We have noted that the energy of the ovaries is regarded as hot energy and, as such, can be stored in the heart center or navel center Some people store too much energy in the heart and find it causes heartburn and difficulty in breathing. This means there is excess energy that is not circulating sufficiently. Therefore, in the early stages of your practice, we advise you to store the sexual energy in the navel, and as your practice continues, store it in the heart to increase love, joy and compassion.

2. Postures

There are three postures in which to practice Ovarian Breathing: sitting, standing and lying.

A. Sitting

For simplicity and comfort, sit on a chair (Fig. 5.13) Sitting lends ease to a practice that favors relaxation and good concentration.

Fig. 5.13 *Sitting Posture*

Sit on the edge of a chair with both the legs and buttocks supporting your weight. Do not put all the weight on the sitting bones because in time this can create sciatic nerve pain. The vagina and perineum should not be constricted but should be covered with comfortable underwear or loose clothing to protect them from any draft. As a helpful technique used since olden times, a woman can place a hard, round object, perhaps a ball, in such a way that it presses directly on her vagina and clitoris during practice, or she can sit on the heel of one foot, pressing it tightly against the clitoris to help the Chi activate easily. If you practice the Microcosmic Orbit circulation and Iron Shirt Chi Kung, you should be well practiced at directing energy upward and can omit this step.

Raise the tongue to the roof of the mouth: this is essential in circulating the Chi and completing the loop between the front and back channels of the Microcosmic Orbit. (Fig. 5.14) The feet are firmly planted on the floor with the hands resting palms-down on the knees. The back should be quite straight at the waist, but slightly round at the shoulders and neck. This very minor forward curvature of the upper back tends to relax the chest, and helps the power flow through the neck, chest, and abdomen. Keep the chin slightly tucked in. Military posture, with shoulders thrown back and head held high, tends to lodge power in the upper body and prevent its circulating back down to lower centers.

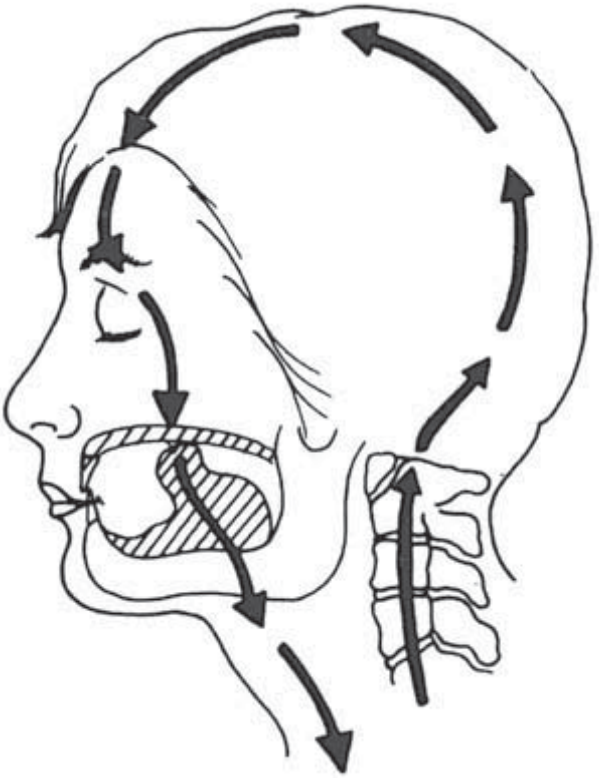

Fig. 5.14 *Tongue touches the palate so the energy can flow down.*

A variant of the sitting position is to sit cross-legged, either in the lotus position or American Indian style. We appreciate the esoteric virtues of the lotus position, but Chinese practice attributes serious disadvantages to this sitting position. Some monks suffered severe sciatic nerve pain or were crippled by lengthy meditation in the lotus position. Also, turning the soles of the feet away from the ground prevents you from directly drawing in through the feet the earth's Yin power. When you are very good at controlling and directing the energy, you can sit in any position and still direct the energy as you wish. Howeve, the human body is designed to absorb earth energy through the kidney (K-1 point) and other meridians in the feet and filter it before passing it up to the coccyx and brain. Some people can develop problems if they absorb too much "raw" earth Chi directly into their perineum and sacrum, as occurs in the lotus position. Eventually they become allergic to this undigested energy and experience numerous unpleasant reactions. Nevertheless, the lotus position may be used by those accustomed and devoted to it, as long as they are comfortable and can apply their whole attention to the exercise. Few cross-legged positions afford the relaxation of the perineum provided by sitting on the edge of a chair.

B. Standing

Another good position is standing. The above instructions on raising the tongue tip to the palate and maintaining correct posture apply equally to this position.

Standing is particularly favorable for Ovarian Breathing because the sacrum and pelvis can relax. Standing up straight in a relaxed manner encourages good posture. The hands are at the aides and the feet are shoulders' width apart. Discipline yourself to relax if you feel too tense, or the Chi power may stick in the heart region and make you irritable.

C. Lying

In the beginning, before you learn to control the energy, do not lie flat on your back when performing these exercises. In this position the chest sits higher than the abdomen and receives too much energy. Nor should you lie on the left side. Both of these positions unduly stress the heart. The proper lying position is on the right

side. A pillow placed beneath the head should raise it about three or four inches, so that the head sits squarely on the shoulders. The four fingers of the right hand are placed immediately in front of the right ear while the thumb sits behind the ear and folds it slightly forward to keep it open. The ear must stay open to permit air to flow through the Eustachian tube and keep the left and right ears' pressures balanced. This is important because you can create a lot of Chi pressure during this practice. The left hand rests on the outer left thigh. The right leg is straight: the left leg, which rests on the right, is slightly bent. (Fig. 5.15)

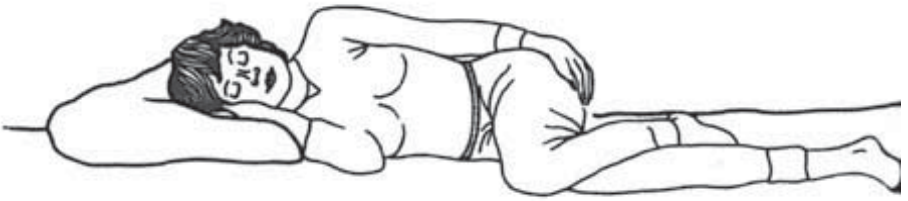

Fig. 5.15 *Best way to practice Ovarian Breathing lying down is on the right side of the body with a pillow beneath the head, the right leg extended, the left leg resting on the right thigh, and the right hand supporting the head.*

Lions often sleep in a similar position. Animals have a wise instinct since this position frees the spinal column from the pressure of gravity, allowing it to assume its natural curvature. Lying on the right side can relieve the spine from stress.

As mentioned previously, when you have mastered the energy well, you can lie on your back to practice, but make sure that the energy is not stuck in the chest and the heart. Do not lie on the left side.

3. Step-By-Step Guide

In this section we will explain each step in great detail. In Section 4 we guide you through the practice. Finally, in Section 5 we give a summary of the practice, to be used as a guideline only when you are more advanced.

Unless otherwise specifically indicated, all breathing is to be done through the nose. Nasal breathing affords better control of the air in haled. It filters and warms the air and supplies life-force of a well-balanced quality.

Sit erect on the edge of your chair with your feet flat on the floor approximately shoulders' width apart. Remember to wear loose pants or comfortable underwear to protect the vaginal opening from drafts and to avoid leakage of Chi. Do not practice naked in a cold room, or you will lose a lot of Chi.

Make sure you feel very relaxed. If you are tense, do some stretching exercises or take a walk first in order to disperse tension.

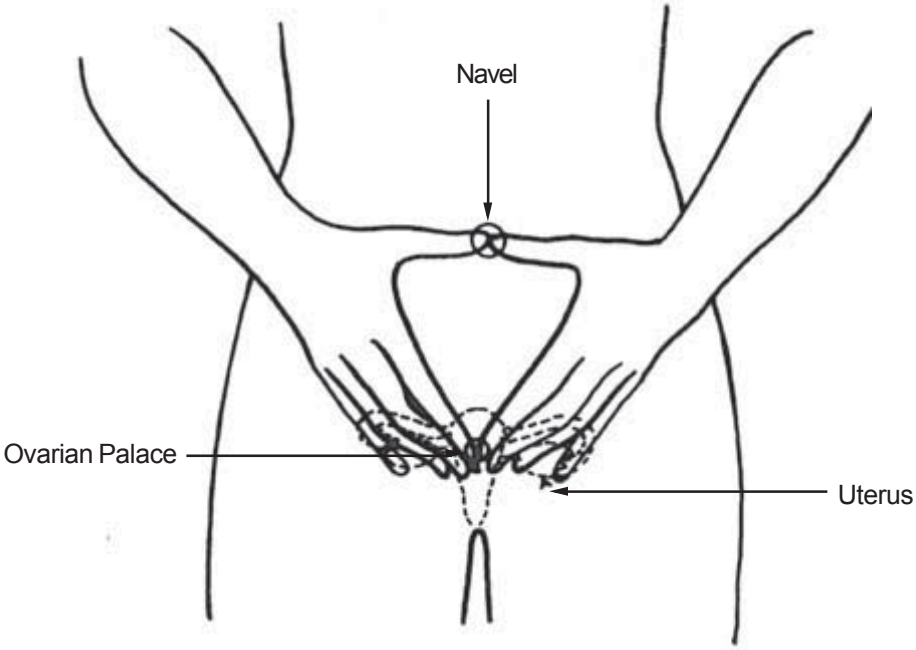

Fig. 5.16 *Locating the Ovaries and the Ovarian Palace*

A. Bringing Energy into the Ovarisn Palace and Down to the First Station: Perineum

(1) Bringing Energy into the Ovarian Palace

Begin the exercise by locating the Ovarian Palace. Place both thumbs on the navel and use your index fingers to form a triangle. The place where the index fingers touch is the Ovarian Palace. Spread out your little fingers evenly: underneath the points where they rest are the ovaries. (Fig. 5.16) As your little fingers rest on them, become aware of them. Rub the ovaries until you feel them warming. Concentrate in order to produce more energy from the ovaries and eggs. Simultaneously use your mind to control the P-C Muscle to close and open slightly the vagina as delicately as the petals of a flower: The energy may begin to manifest itself with such sensations as warmth, tightness, swelling. tingling, etc. Each person can react differently from the energy. When you start to feel something, inhale and bring the energy to the Ovarian Palace (where the index fingers touch). The gentle opening and closing of the vagina and the concentration of your mind gradually will enable you to collect and absorb the ovaries' energy into the Ovarian Palace.

(2) First Station: Perineum

Inhale a short sip of air only land inhale in this manner every time you are asked to inhale throughout this exercise). As you inhale, pull the ovaries' energy down from the Ovarian Palace to the perineum by contracting both the outer and inner lips of the vagina, pulling downward toward the perineum, and then contract and pull up the front of the anus (perineum). Remember that contraction of the vagina is a contraction of the PC (Pubococcygeal) Muscle, one part of a group of muscles we refer to as the Chi Muscle. This action initiates the contraction of the entire Chi Muscle group, which continues when the anus is contracted and pulled up. Since the anus belongs to the area known as the perineum, we can say that "to contract and pull up the anus" is "to contract and pull up the perineum." To avoid confusion from this point on in describe the contractions used in Ovarian Breathing, we will describing the contraction of the Chi Muscle as "to contract and pull up the perineum." You might feel the route the energy follows, i.e., traveling from the top of the uterus down into the uterus, through the cervical canal and vagina, and down to the perineum. The energy might

make a detour to the shaft and glans of the clitoris before arriving at the perineum. In any case, you should feel the energy move from the Ovarian Palace to the perineum, whether or not you experience the exact route it follows. Hold your breath, inhale in short sips, close the vagina tightly and retain the ovaries' energy at the front part of the perineum for a while. (Fig. 5.17)

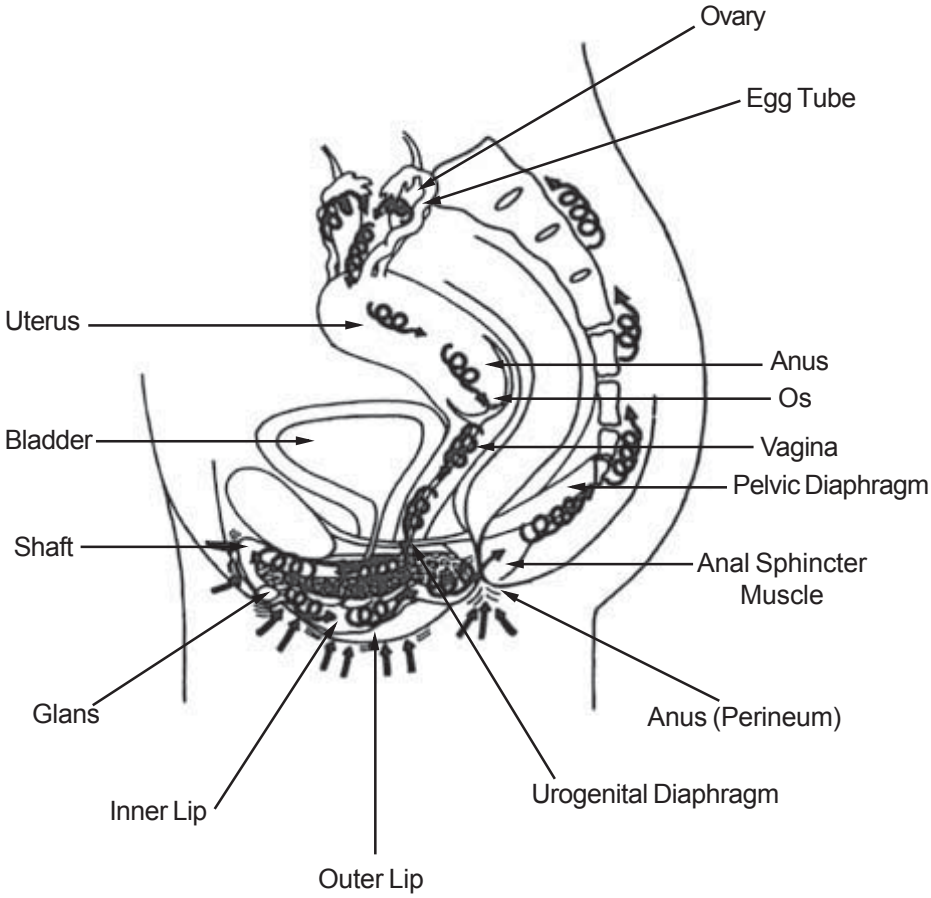

Fig. 5.17 *Ovarian Breathing*

Exhale. Now concentrate on that warm feeling and mentally guide it from your ovaries to the front part of your perineum, letting the energy flow to the perineum via the uterus, down through the cervical canal and along the back wall of the vagina. Feel the flow as it

travels the few inches to the perineum, an action induced by setting your mind at the perineum to hold the energy there. It is important to learn to maintain your attention at the perineum, because if you release it, the warm sexual energy will leak out. Be aware of the energy now flowing from the Ovarian Palace to the perineum. With each inhalation and exhalation counting as one, repeat the process nine times per session. Each time return to the ovaries, and while there inhale and exhale several times to build up more energy before you begin the process again.

(3) Retention of Sexual Energy at the Perineum Point

Think of drinking a full glass of water through a straw. You cannot draw all the water in one sip, you have to break the flow in order to breathe, and if you do not hold or retain the water that you already have in the straw, the water will flow out. In order to drink again you will have to begin drawing through the straw all over again. However if you place your finger over the top of the straw while you breathe short sips of air you can hold the water inside it. Similarly, the retention of the Ching Chi at the perineum is very important, for if you release your attention, the warm energy will drop down to the sexual organs and leak out of the vagina. By practicing, you will learn to use the power of the mind to hold the energy there. Practice for several days or until you are successful.

(4) Returning to the Ovarian Palace

As you strive to reach each energy transformation point in Ovarian Breathing, you must begin each time by returning to the Ovarian Palace to collect the ovaries' energy. Practice Ovarian Breathing by opening and closing the vagina slightly in order to collect the energy in the Ovarian Palace. Once you feel that enough ovaries' energy has been collected, repeat the process of bringing energy to the perineum: each time inhale a little sip of air and close the vagina with minimal movement of the Chi Muscle. At the same time that you close the vagina, pull slightly downward toward the perineum, and then contract and pull up the front part of the perineum. Hold your breath, inhale in short sips, close the vagina tightly and use your mind to create an awareness of the perineum point, thereby drawing the ovaries' energy to this point. Retain the energy at the front part of the perineum. Upon exhalation rest for a while, mentally guiding and feeling the Ching Chi as it travels from

the Ovarian palace down to the vagina, clitoris and perineum, while maintaining your awareness of the perineum point and continuing to hold energy there.

In the Taoist practice sexual energy is the primary energy. If you only exercise the muscles and have no knowledge about life-force and sexual energy, then the benefits are less. Practice to this point for one to two weeks, or until you can definitely feel the energy at the perineum, the ovaries and the Ovarian Palace. There will be a sensation of energy traveling down to the vagina. and then there will be a strong feeling as the energy travels gradually to the clitoris.

Remember: unless specifically indicated otherwise, all breathing is to be done through the nose since nasal breathing affords better control of the air inhaled. Also, all inhalations are short sips of air:

The whole body must relax. Allow all tension to flow out of you as if you were in meditation. Use the mind alone to raise and lower the sexual energy. With practice you will learn to identify the hot Ching Chi stored in the ovaries' area. Always start your breathing and collecting in the ovaries first, until you get in touch with the energy

B. Moving the energy up the Spine through the Second Station: Sacrum, First Energy Transformation Point

Along with the ability to hold sexual energy; the sacrum also helps transform it into the first stage of life-force energy.

(1) Guiding Energy to the Sacrum

Guide the ovaries' warm energy down from the Ovarian Palace to the perineum and up to the sacrum by first inhaling a short sip of air slightly contracting and closing the vagina's outer and inner lips, pulling downward toward the perineum, and then contracting and pulling up the front part of the perineum. Pause for a while, holding your breath, inhale in short sips, close the vagina tightly and retain the ovaries' energy at the front part of the perineum. Be aware of the Ching Chi as it flows to this point. Exhale and return to the ovaries, maintaining a part of your awareness at the perineum to retain the energy that you have brought there. Practice Ovarian Breathing by opening and closing the vagina slightly and collect the energy in the Ovarian Palace. Once you feel that enough ovaries' energy has been collected, inhale and close the vagina, pulling

downward toward the perineum, and then contract and pull the front part of the perineum upward to bring energy to this area. Rest briefly and be aware of the energy that travels from the ovaries down to the vagina, clitoris and perineum. Inhale slightly. Now pull up the middle part of the perineum, and at the same time pull up the back part of the perineum toward the coccyx at the very bottom of your spine.

(2) Activating the Sacral Pump

Slightly arch your lower back outward thereby tilting the sacrum downward to bring the energy to this point. As you pull the Ovarian energy up the front, middle and back parts of the perineum to the

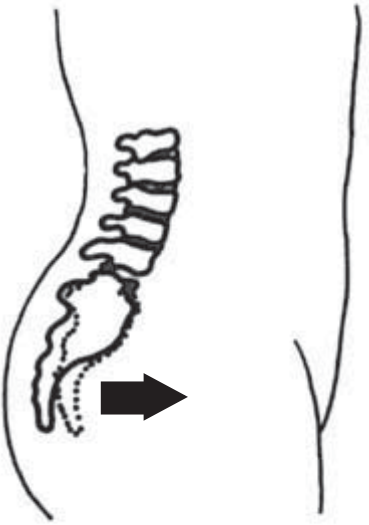

Fig. 5.18 *Activating the Sacral Pump involves tilting the sacrum down without moving the hip bone.*

coccyx and then to the sacrum, hold the sacrum down to help activate the Sacral Pump (Fig. 5.18), which action will be further accentuated if you gently tighten the back of your neck and skull bones. In the beginning use a wall as a guide by pushing the sacrum against the wall, thereby exerting force on it. Hold the energy at the sacrum for a while, then exhale, but continue to focus your attention on this point.

(3) Opening the Sacral Hiatus

The hiatus opening of the sacrum is an indentation in the bone of the sacrum located a little up from the tip of your spine, and is the place through which, once opened, you will draw your warm, ovarian energy into the spine, (Fig. 5.19) It is usually a little difficult to work because ovarian energy is denser than Chi and has to be pumped through. Some people experience pain, a tingling sensation, or "pins and needles" when this energy enters the hiatus. If this happens to you, do not be upset. You can help pass the energy through the hiatus if you are having trouble by gently massaging the area with a silk cloth from time to time.

(4) Resting to Feel the Energy move Unassisted

Now let your sacrum and neck relax back to their normal positions. As they relax you will feel the energy move by itself, assisted by the activation of both the Sacral and Cranial Pumps. At the same time practice Ovarian Breathing. Bring the energy up to the sacrum again and hold it there until you can feel the hiatus at the sacrum open and the energy gradually move up. You will actually feel the warm energy move up a little at a time. Practice nine times, then rest. The resting period is very important. Many times while you are resting the energy will rise up through the point you had been focusing on. If you can, still your mind and use it to guide the energy along the pathway you have been working on for a while, and then rest your mind and let the energy move by itself: the energy will automatically flow through this pathway

(5) Exercise to help open the Sacrum

If you have trouble feeling the energy at the sacrum, the following exercise can be helpful in opening the sacrum. Try rocking your sacrum back and forth and then hold the hips stationary moving the sacrum only. The sacrum and the hips are three separate pieces of bone which eventually become fused because we do not exercise them. (Fig. 5.20) Use both hands to hold the hips and try to rock the sacrum. In the beginning it is difficult to do, but after a while you will gradually separate the hips from the sacrum. You can also ask a friend to hold your sacrum with one hand while his other hand is on your hip in order to let you know if it is the hip or the sacrum that you are moving. After this exercise hold still and observe the effect of the pumping.

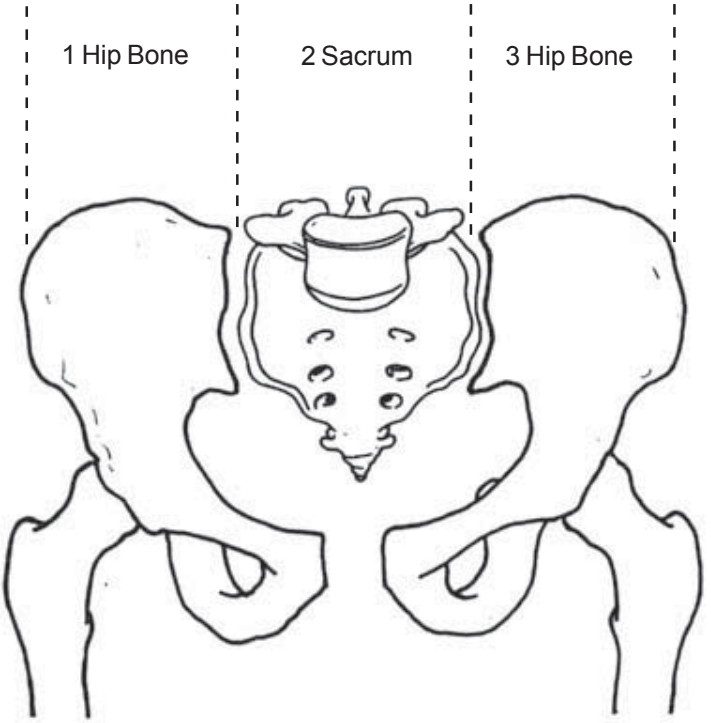

Fig. 5.20 *Sacrum and the hip bones are three separate pieces of bone which, through lack of exercise, become fused.*

(6) Sacrum assists in transforming Raw Sexual Energy into Life-Force Energy.

The Taoist masters discovered that the sacrum has the ability to transform sexual energy into a life-force energy that is more readily accepted by the organs and glands. Therefore, the practitioner must be aware of the state of the energy entering the middle part of the body. Some people practice by pulling up only the middle part of the perineum, causing the raw ovaries' energy to shoot up the middle part of the body and become stuck in the organs and glands. Unaccustomed to handling this kind of raw sexual energy, the organs and glands will suffer from such disorders as indigestion, overheating (especially the liver), pain in the kidneys and back, and worst of all, heart congestion. These and other symptoms have come to be known as the "Kundalini Syndrome," and they occur because the person is not open enough to channel

this raw sexual energy before it enters the vital organs. This phenomenon is mentioned in the books entitled *Kwantida-Psychotic or Transcendental*, by Lee Sanella, M.D., and *Stalking the Wild Pendulum*, by Itzhak Bentov. These books contain examples of many people who suffer from the inability to control the rising energy. The energy they hold in their hearts or in their heads is either too raw or too hot for those organs, with parts of the organs having an allergic reaction to that energy. However the symptoms disappeared once they learned about and felt the connection of the tongue to the roof of the mouth during the Microcosmic Orbit meditation. This connection allows the energy flowing up the spine through the major stations to transform into life-force energy and flow down to the navel. Many never know how to escape their problem of too much raw sexual energy rising up because they never learn how to bring the energy to the proper channels to circulate it back down.

Once you have practiced Ovarian Breathing and have felt the sexual energy circulate and become transformed, your organs will begin to adapt to and withstand the ovaries raw sexual energy. This energy can then be directly transformed and refuted whenever the body requires it without problems arising.

C. Third Station: T-11, Sexual- Energy Transformation Point

If you have managed to bring the energy up through the sacrum, spend the next week drawing the ovaries' energy to T-11 (the eleventh thoracic vertebra) in your mid-back opposite your solar plexus. T-11 also has the ability to transform the sexual energy into life-force energy.

(1) Collecting Energy in the Ovarian Palace

In the same manner as above, start with Ovarian Breathing, collecting the ovaries' energy in the Ovarian Palace by opening and closing the vagina with a minimal movement of the Chi Muscle. Inhale with a short sip, close the vagina slightly, pulling the energy downward toward the perineum. Then contract and pull up the front part of the perineum and pause for a while, holding your breath and retaining the energy at this point. Be aware of the Ching Chi that has been brought there. Inhale in short sips, close the vagina tightly and concentrate on retaining the ovaries' energy at the front part of the perineum. Exhale and return to the ovaries, but maintain a part

of your awareness at the perineum to retain the energy that you have brought there. Continue to practice Ovarian Breathing by opening and closing the vagina slightly and collecting the energy in the Ovarian Palace.

(2) Drawing Energy to T-11

Once you feel that enough ovaries' energy has been collected, inhale using a short sip and close the vagina by pulling downward, thereby pulling the energy down to the perineum, and then contract and pull the front part of the perineum upward to bring energy to this area. Rest for a while and be aware of the energy that travels from the ovaries down to the vagina, clitoris and perineum. Inhale a short sip and pull up the middle and back part of the perineum toward the coccyx to bring the energy to the sacrum. Slightly tilt the sacrum outward as if you were pushing the sacrum to the wall. Pause for a while and feel the Sacral Pump activate. Inhale a short sip again without exhaling, and tilt your spine outward against the imaginary wall to straighten T-11. This will create an upward pumping action which will pull the ovaries' energy up to T-11. (Fig. 5-21) Retain the energy at this point until the area feels full and until you feel the energy continue to open T-n and move up by itself. When you feel uncomfortable exhale and regulate your breath.

(3) Flexing the T-11 Point assists in activating the Sacral and Cranial Pumps and the Adrenal Minipump.

As previously noted, Ovarian energy is denser than Chi. You will have to accommodate it by flexing the part of your back housing T-11 in and out, thereby straightening the spine at this point and loosening it for freer passage of the warm energy. Then allow your sacrum, T-11 and neck to relax back to their normal positions. This action will help to activate both the Sacral and Cranial Pumps, as well as another mini pump located at the adrenal glands, a little at a time. If you have trouble feeling this, return again to the Ovarian Palace and repeat the process. Practice nine times, then exhale and relax every part of the body. Concentrate on T-11 and feel the energy flow up to this point.

In Taoist practice we regard T-11 as the adrenal glands' energy center The adrenal glands sit atop your kidneys end can act as a mini pump. When you arch the T-11 point you create a vacuum (or mini pump) in this area to push the energy up higher. The sacrum,

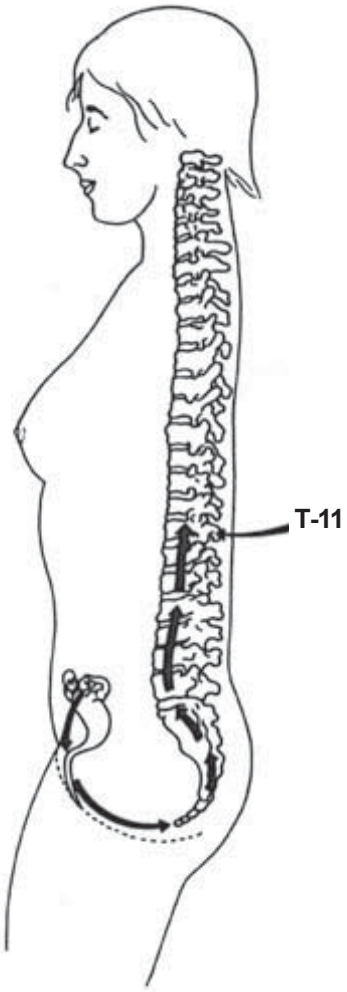

Fig. 5.21 *Guiding Energy up to T-11.*

T-11, C-7 and Jade Pillow in Taoism all are regarded as places that have the ability to transform sexual energy into life-force energy. In the T-11 area the Door of Life (the Ming Men, or mid-point of the spine) is also located. The Ming Men does not have this property, but in the Microcosmic Orbit it is regarded as a very important safety point, as well as the strengthening point of the kidneys.

D. Fourth Station: C-7, Sexual Energy Transformation Point

Your next stopping point is at cervical-7, or C-7, located at the point of your spine at the base of your neck. You can feel it as the vertebra that sticks out when you bend your head down. This point controls the energy provided to the hands and neck, and is the connecting point providing power to the scapulae and spinal cord. This point also has the ability to transform sexual energy into life-force energy.

(1) Collecting Energy in the Ovarian Palace

Practice in the same manner described above. Collect the ovaries' energy at the Ovarian Palace. Inhale with a short sip, close the vagina slightly, pulling the energy downward toward the perineum. Then contract and pull up the front part of the perineum and pause for a while, holding your breath and retaining the energy at this point. Be aware of the Ching Chi that has been brought there. Inhale in short sips, close the vagina tightly and concentrate on retaining the ovaries' energy at the front part of the perineum. Exhale and return to the ovaries, but maintain a part of your awareness at the perineum to retain the energy that you have brought there. Continue to practice Ovarian Breathing by opening and closing the vagina slightly and collecting the energy in the Ovarian Palace.

(2) Drawing Energy to C-7

Once you feel that enough ovaries' energy has been collected, inhale a short sip of air and close the vagina, pulling the ovaries' energy downward toward the perineum, and then pull the front part of the perineum upward to bring energy to this area. Rest for a while and be aware of the energy that travels from the ovaries downto the vagina, clitoris and perineum. Inhale a short sip and contact the middle and back part of the perineum, and then pull the energy up to the sacrum, T-11 and C-7. When you reach C-7, push slightly from the sternum, to the back, and feel the push of C-7 and both shoulders as they activate to draw the energy up. (Fig. 5.22) This action will activate the thymus gland to increase the upward pulling power. Hold the energy at this point as comfortably as you can. Now during practice you will find that gradually you are able to hold your breath longer and increase your capacity to intake

air. Exhale, and then let your sacrum, T-11 and neck relax, returning to their normal positions. Concentrate on C-7. This action will help to activate all three pumps (Sacral, Adrenal and Cranial) a little at a time. If you have trouble feeling this action, return to the Ovarian Palace and repeat the process. Practice nine times. Remember that you must return to the source of energy in order to bring it to the higher center

Fig. 5.22 *Guiding Energy up to C-7.*

E. Fifth Station: Jade Pillow, Mini-Storage and Transformation Point for Sexual Energy

Your next stopping place is your Jade Pillow. This is located at the back of your head between cervical-1, or C-1, and the base of the skull. This point also can serve as a small storage and transformation point for sexual energy.

(1) Collecting Energy in the Ovarian Palace

Practice in the same manner as previously described. Collect the ovaries' energy at the Ovarian Palace. Close the vagina with a minimal movement of the Chi Muscle, pulling down the ovaries' energy to the perineum. Feel the sensation as the vagina closes, and then pull up the front part of the perineum to bring the ovaries' energy to this point. Hold your breath and retain the energy at the front part of the perineum. Be aware of the Ching Chi that has been brought there. Exhale and return to the ovaries, but maintain an awareness of the perineum to retain the energy that you have brought there. Practice Ovarian Breathing by opening and closing the vagina slightly in order to collect the energy in the Ovarian Palace.

(2) Drawing Energy to the Jade Pillow

Once you feel that enough ovaries' energy has been collected, inhale a short sip and close the vagina, pulling the ovaries' energy downward to the perineum, and then contract and pull the front part of the perineum upward to bring energy to this area. Rest for a while and be aware of the energy that travels from the ovaries down to the vagina, clitoris and perineum. Inhale another short sip and bring the energy up to the sacrum, T-11, and C-7, and then slightly push the chin down and pull it back, moving it toward the back of the neck at the base of the skull. (Fig. 5.23) Feel this push create a force that activates the Cranial Pump, which will help to pump the dense ovaries' energy. Hold the energy at this point for a while, feeling it being stored and transformed. Exhale, then permit your sacrum, T-11 and neck to relax in their normal positions. This action will help to activate the Adrenal, Sacral and Cranial Pumps again. Retain the energy at the base of the skull. Repeat this entire process nine times.

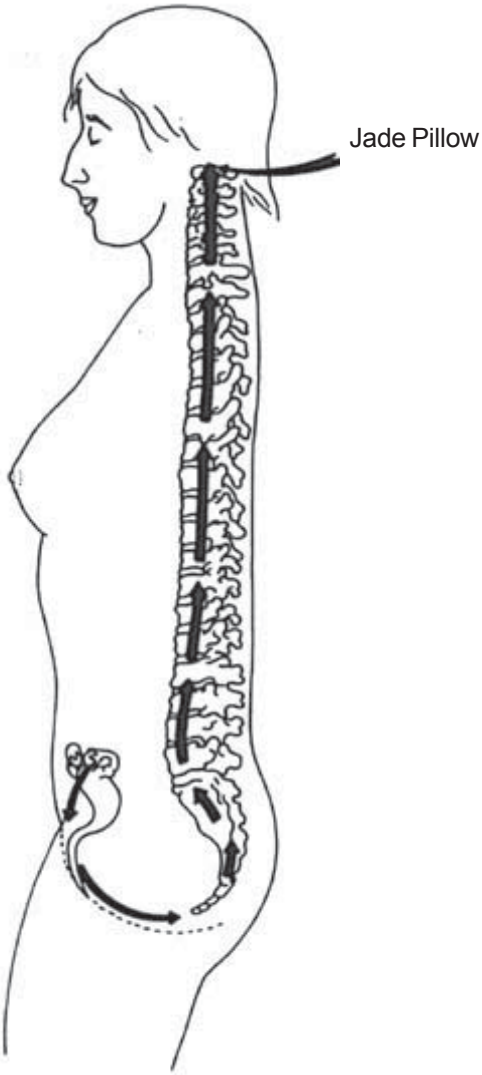

Fig. 5.23 *Guiding Energy up to the Jade Pillow.*

F. Sixth Station: Crown Point, Larger Storage Point For Sexual Energy

Your next stopping point is called the Pai-Hui, located at the midpoint or crown, of your head and is the center housing the pineal gland. This point is a larger storage point.

(1) Collecting Energy in the Ovarian Palace

Practice in the same manner: only this time you will fill the "straw" to the top. Collect the ovaries' energy at the Ovarian Palace. Close the vagina with a minimal movement of the Chi Muscle, pulling the ovaries' energy down to the perineum, and feeling the sensation as the vagina closes: contract and pull down the front part of the perineum to bring the energy there. Hold your breath and retain the energy at the perineum. Be aware of the Ching Chi that has been brought to this place. Exhale and return to the ovaries, but maintain an awareness at the perineum to retain the energy that you have brought there. Practice Ovarian Breathing by opening and closing the vagina slightly in order to collect the energy in the Ovarian Palace.

(2) Drawing Energy to the Crown Point

Once you feel that enough ovaries' energy has been collected, inhale a short sip and close the vagina by pulling downward to bring the ovaries' energy to the perineum, and then contract and pull up the front part of the perineum to bring energy to this area. Rest for a while and be aware of the energy that travels from the ovaries down to the vagina, clitoris and perineum. Inhale and tilt the sacrum and T-11 to the back in order to straighten the spinal curve out a little bit and thereby help activate the lower Sacral Pump. At the same time push the sternum in toward the back, tuck your chin in a little, and squeeze the back of your skull: this will activate the upper Cranial Pump. Continue pulling up to the point at the top, the center of the head. (Fig. 5.24) As you continue to inhale, bring the energy down to the perineum, up to the sacrum, T-11, C-7, lade Pillow, and then turn your eyes and other senses upward to help guide the energy up to the point of the Pai-Hui, or crown point, and the pineal gland.

(3) Resting and using your mind to guide energy to the Brain

Once the energy finally has completed its course up into your head, use your eyes and other senses to help retain it in the brain, holding it at the top of your brain as comfortably as possible. Exhale, then let your sacrum, T-11 and neck relax, returning to their normal positions. This will help to activate the three pumps: Sacral, Adrenal and Cranial. Use your mind to guide the energy station-to-station up the spine to the top of the head. Fix your attention and eyes at

the crow·n point. Remember it is the resting, period that is the strongest in guiding the energy to the brain. Repeat this process nine times.

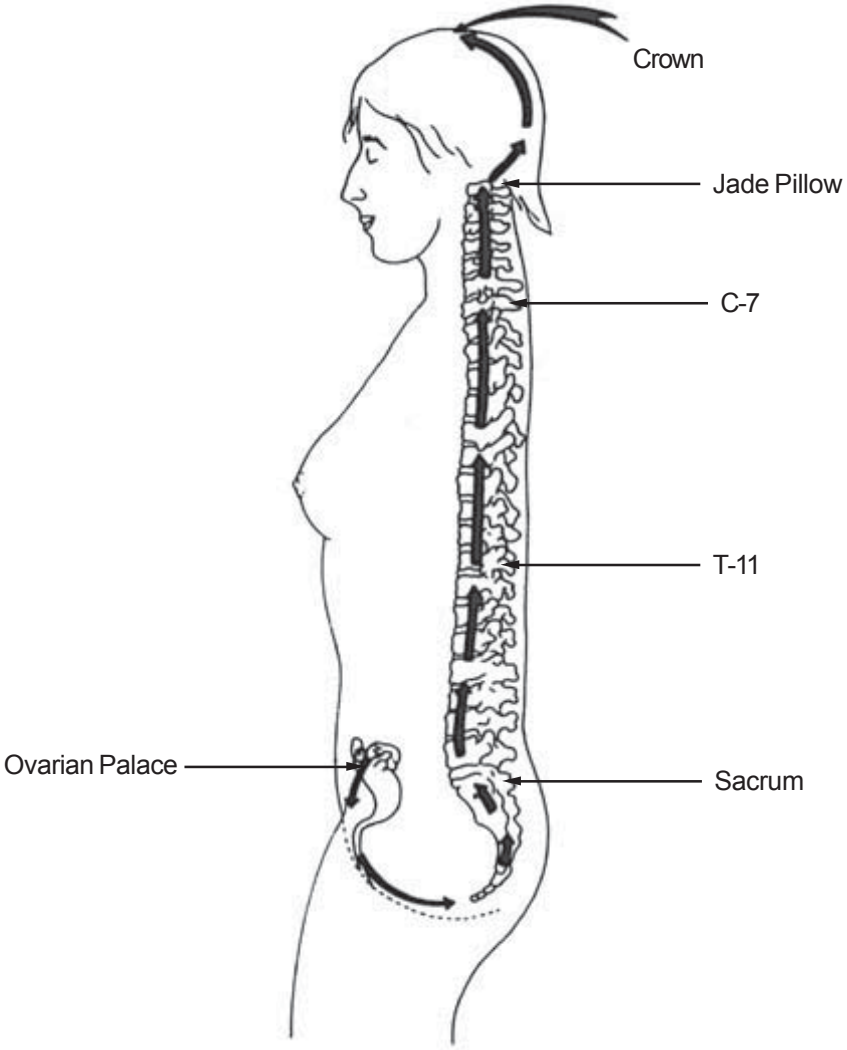

Fig. 5.24 *Guiding Energy up to the Crown Point.*

G. Circulating the Energy in the Brain

(I) Filling the Brain Cavity with Creative Sexual Enengy

When you have finished practicing nine times, and can feel the ovaries' sexual energy fill the brain, start to circulate the energy in the brain for nine, eighteen, or thirty-six counterclockwise revolutions. There is a very distinct feeling of spinning outward. (Fig. 5.25(a)) When this circulation is completed, turn the energy back into the center of the brain for nine, eighteen, or thirty-six clockwise revolutions. (Fig. 5.25(b)) This should feel pleasant and energetic and will help to balance the left and right sides of the brain, vitalizing it to increase memory and think more clearly, and it will introduce you to the beginning stages of the ability to control sexual energy and emotional frustrations. As people age and use up much of their Chi, they gradually drain themselves of brain energy and spinal fluids, drying them up and leaving a cavity. Ovarian Breathing transports creative sexual energy to refill this cavity and thereby revitalize the brain. Taoists regard sexual energy as similar to brain energy.

(2) Touching the Tongue to the Palate to Permit the Energy to flow down to the Navel for Storage.

Be sure the tongue is touching the palate (behind the front teeth will suffice), so that the warm ovaries' energy can flow down to the third eye, to the inside of your nose, and through the tongue from which it is now able to travel down the throat to the heart center.

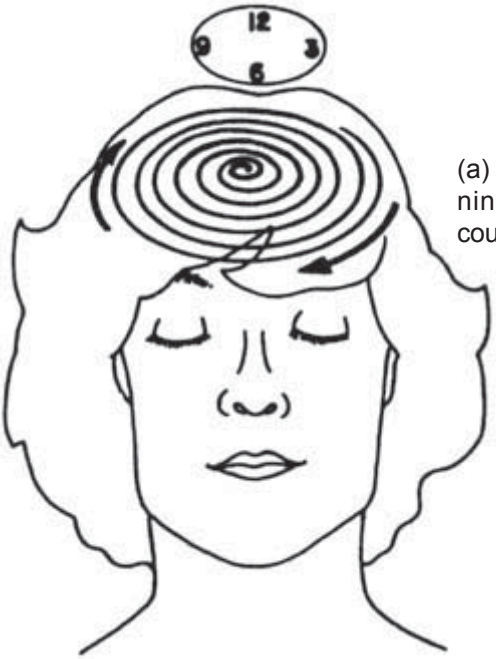

(a) Circulate the energy in the brain nine, eighteen or thirty-six times counterclockwise (Spinning outward).

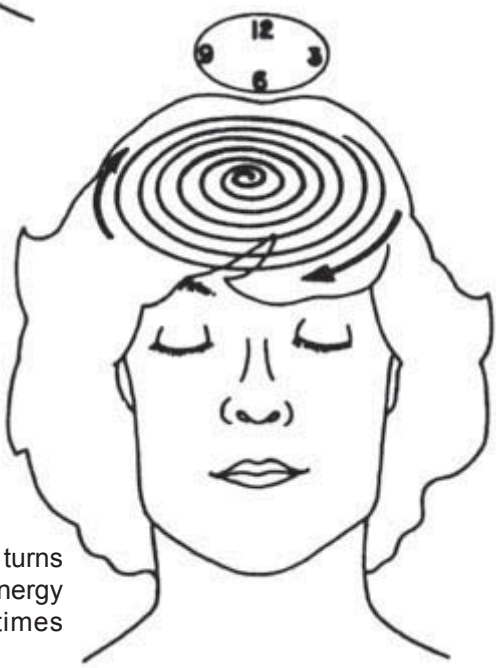

(b) When the counterclockwise turns are completed, circulate the energy nine, eighteen or thirty-six times clockwise (Spinning inward).

Fig. 5.25 *Circulating Energy in the Crown*

(Fig. 5-26) Retain the energy in the heart center for a while, filling it with energy until it feels open: enjoy the feeling of love, joy and peace: then bring it down to the solar plexus and to the navel. Collect the sexual energy at the navel where it can be safety stored.

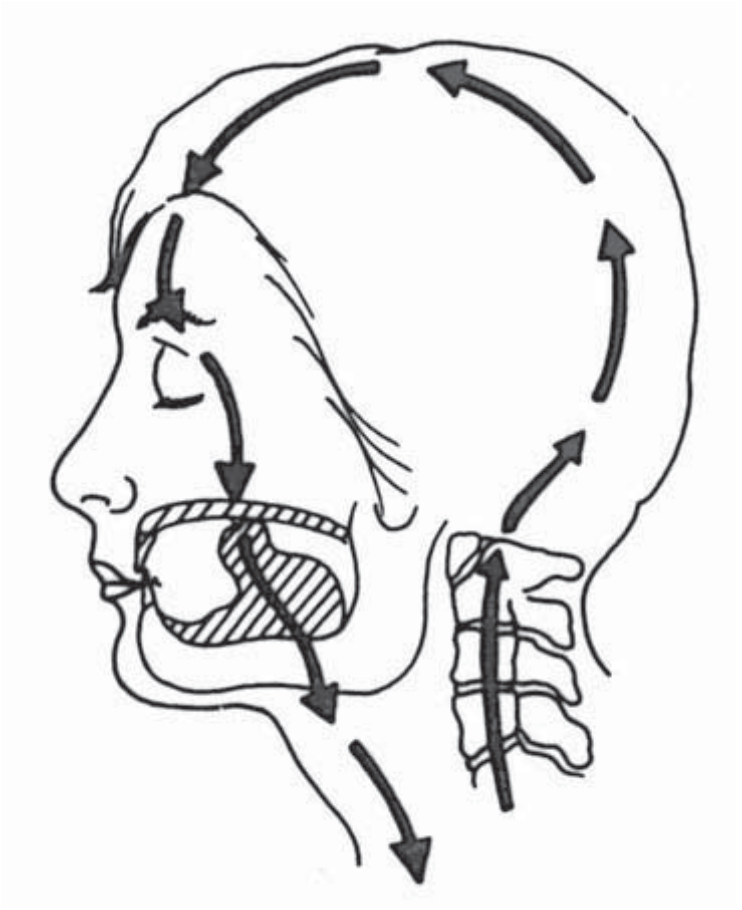

Fig. 5.26 *Tongue touches the palate so the energy can flow down.*

H. Collecting the Ovaries' Sexual Energy at the Navel

It is very important to end by storing the energy in the navel. Most ill effects of the practice are caused by an excess of energy in the head or the heart. The navel can safely handle the increased energy generated by the ovaries.

(1) Spiraling the Energy around your Navel Center

To collect the ovaries' energy concentrate on your navel area, which is about one and a half inches inside your body. Use your mind, eyes and other senses to mentally move the energy in and out, spiraling it around your navel 36 times. Do not spiral above the thoracic diaphragm or below the pubic bone. Start by spiraling counterclockwise outward. (Fig. 5.27(a)) Then reverse the direction of the spiral and bring it back to the navel, circling it clockwise 24 times. (Fig. 5.27(b)) Use your finger as a guide the first few times. The energy is now safely stored in your navel, available to you whenever and wherever your body needs it.

(a) Collect the energy in the navel, circling it 36 times counterclockwise, and

Fig. 5.27 *Collecting Smiling Energy in the Navel*

(b) 24 times clockwise

Fig. 5.27 *Collecting Smiling Energy in the Navel*

I. Collecting Energy in the Heart

The energy can also be stored in the heart. If you are a Yang body type (meaning your energy runs hotter than most people, perhaps manifesting in a hot temper), you should not start by storing the sexual energy in the heart center. Instead, begin by storing it in the navel. Once the navel is filled, this is an indication that the channels are open enough to begin to store energy in the heart without problems.

The heart center is a powerhouse for a woman. It is the seat of love, joy, happiness, and is the center of rejuvenation since it is the site of the thymus gland. With this center open a woman will experience these positive emotions along with an energetic

approach toward herself, and she will be provided with abundant healing energy to heal herself and others. If the heart center is opened before she is ready, the Microcosmic Orbit will not be complete and the energy will not circulate property. The sexual energy can adhere to the heart, and the heat generated and congested there can cause great problems such as uneasiness, shortness of breath, or pain in the chest. If these problems happen to you, practice the Healing Sound of the heart as detailed in the book *Taoist Ways to Transform Stress into Vitality*, lightly tap the chest and the heart, and use your hands to brush your chest down· ward until you belch to release the trapped energy.

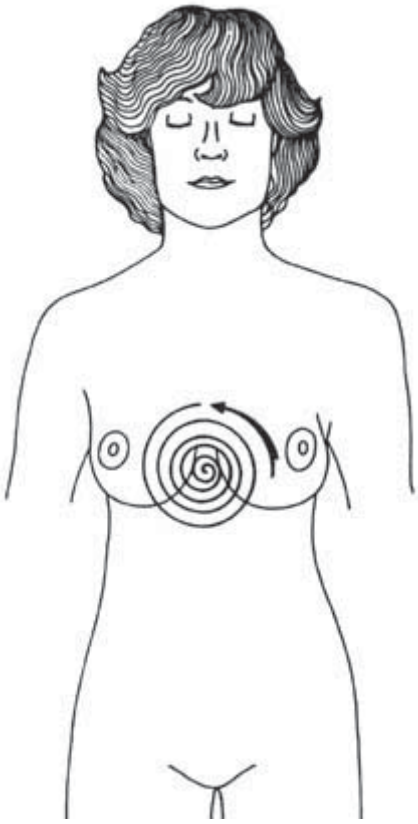

(a) To collect the energy in the heart,
Spiral around the heart collection point 36
times counterclockwise, and

Fig. 5.28 *Collecting Smiling Energy in the Heart*

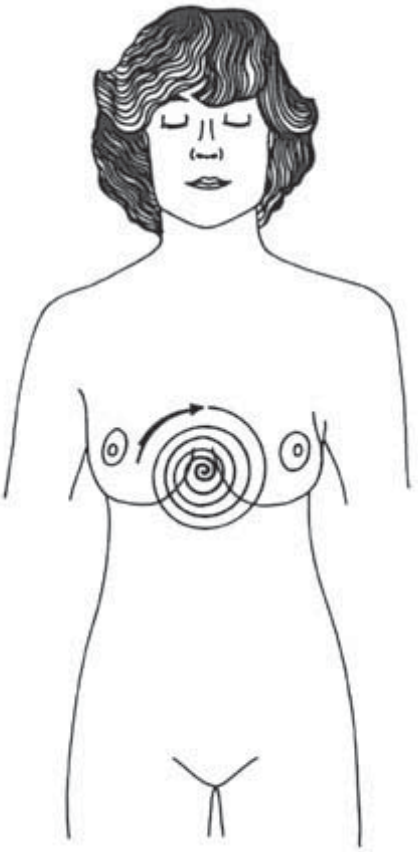

(b) 24 times clockwise.

Fig. 5.28 *Collecting Smiling Energy in the Heart*

(1) Spiraiing the Energy around your Heart Center

To collect the ovaries' energy in the heart, concentrate on your heart center located up one inch from the lower tip of the sternum, and about one and a half inches inside your body. It is approximately three inches in dimension. Use your mind, eyes and other senses to mentally move the energy in and out, spiraling around your heart center 36 times. (Fig. 5.28(a)) Do not spiral above the diaphragm or below the pubic bone. Start by spiraling counterclockwise outward. Then reverse the direction of the spiral, returning the energy to the heart center circling it 24 times. (Fig. 5.28(b)) Use your finger

as a guide for the first few times. The energy is now safely stored in your heart center available whenever and wherever your body needs it.

J. Bringing Energy to the Brain With One Action

In the beginning travel from station to station, until you feel that the back channel, or Governor Channel, is more open. Once you have mastered the process you can practice the Ovarian Breathing exercise and the energy will travel up to the brain in one sweet drawing-up of the "straw," using a single, clean inhalation and one contraction of the vagina. Exhale, then inhale and bring the energy up again. Practice this a few times, but since the ovarian energy is warm, be sure to put your tongue up to your palate and bring the energy down to the navel. Eventually all you will need is your concentration on both your ovaries and the crown of your head to mentally move the sexual energy from the ovaries all the way up to the brain in one step.

K. Effects of Ovarian Energy

This subtle exercise puts you in touch with your Ovarian energy. Women report that they feel the energy moving up their spine: some say it feels wide, thick like honey, and slow. Most women who perceive the temperature at all say it feels warm. Some women experience it as cool at first, but after practicing for a while, notice it changes to warm. Some experience sensations in their genitals or on their thighs, usually describing them as warm to hot. Many women describe the energy as warmer wider heavier or thicker than the organ Chi energy circulated in the Microcosmic Orbit. This is because the Ovarian energy is heavier and denser:

It is not unusual that the energy feels cold when there is a lot of healing going on, such as in women who have menstrual problems. The sensations can vary over time. What is important to know is that if the energy feels warm, it must be circulated and not left up in the head.

One session of Ovarian Breathing should take about ten minutes. When completed four to seven times a week, women have reported noticeable changes in their menstrual cycles, such as less bleeding, leas cramping, and a reduction in breast pain. With continued practice, menstruation ceases. The energy conserved in such a manner becomes part of the vital energy of the body increasing the

available energy for transformation into a higher form. Also, there is historical evidence that the women who practice Ovarian Kung Fu, when they decide to have children, will produce very healthy well-balanced children.

Some perform Ovarian Breathing and then proceed directly to the Microcosmic Orbit Meditation. The practice can be done any time and virtually anywhere, once you have achieved the direct pathway from the ovaries to the brain. When you find yourself with unstructured time, e.g., waiting in line, commuting, at your desk, looking at television, in bed, etc., carry out several series of contractions. as many as you choose to fill the time available. The main consideration is that the back be properly straight, the chest relaxed, and the vagina protected from the breeze. You must also remember to touch your tongue to your palate after you practice three or four times.

Take your time to really feel the warmth when you practice. Do not rush it, and always maintain the action of the pumps as you breathe in and out. Use a more mental than physical pull when you do the exercise. Let the warm feeling be your guide. Always remember to bring the energy down to the navel after a few breaths, since the navel is roomy and a safe place to store this warm vital energy.

It is highly desirable to use Ovarian Breathing to tone the pelvic diaphragm. The whole lower abdomen is deeply massaged each time the pelvic diaphragm flexes. Life-force flows into the region through periodic waves of breath which stimulate the glands and vital organs.

Ovarian Breathing has tremendous implications for women's control over their reproductive systems. There is not enough evidence to conclude that women can control their fertility through this method. History records, however that when a woman practices the Orgasmic Upward Draw, she can control her cervix and urethra very well, squeezing the urethra (before the cervix) tightly so a man's sperm cannot enter the cervix to join with her egg.

There is too little evidence to come to any conclusions about the effectiveness or reversibility of this method when used for birth control. However some women are experimenting with this method, trusting that it will be reversible just by stopping the practice for a couple of months. These women feel justified in using themselves

as their own laboratories, since the method is gentle and appears to be under control. So many women, out of desperation to control their reproductive systems, have already accepted the wholesale experimentation of dangerous birth control methods, by supposedly trustworthy institutions, such as IUDs, DES, morning-after pills, sequential birth control pills, and forced sterilization.

4. Steps to Practice

The following is a step-by-step guide through the practice.

a. Sit erect on the edge of your chair with your feet flat on the floor about shoulders' width apart. Make sure you feel very relaxed. If you are tense, do some stretching exercises, practice the Inner Smile to the tense part, or take a walk to disperse tension.

b. Find the Ovarian Palace by placing both thumbs at the navel and forming a triangle with your index fingers. Spread your little fingers: the place where they come to rest is the site of your ovaries. Become aware of them. Rub the ovaries until they become warm. Concentrate to produce more energy from the ovaries and eggs. Use your mind and very little pressure on the P-C Muscle to close and open the vagina. When you feel enough energy has been generated, inhale a short sip of air, bringing the energy to the Ovarian Palace.

c. Inhale another sip of air and create a downward pulling action of the ovaries' energy to the perineum by contracting the outer and inner lips of the vagina. Then contract and pull up the front part of the perineum so that the energy will travel there. Maintain an awareness of the front part of the perineum for a while.

d. Exhale and breathe normally Rest and guide the warm feeling from your ovaries to your perineum, letting the energy flow to the perineum via the uterus, down through the cervical canal and along the back wall of the vagina. At the same time feel it flow the few inches to the perineum, an action induced by putting your mind at the perineum and maintaining your attention there. Inhale and exhale several times from the ovaries to build up more energy. The retention of the ovaries' sexual energy (Ching Chi) at the perineum is very important, for if you release your attention, the warm energy will leak out.

e. Start at the Ovarian Palace and use Ovarian Breathing, inhaling and exhaling until you feel that the energy is ready. Inhaling in short sips, draw the warm energy from your ovaries to the perineum,

and then by pulling up the middle and back of the perineum, draw the energy up to your coccyx, located at the very bottom end of your spine. The sacral hiatus, an area made mostly of bone and located a little up from the tip of your spine at the sacrum, is the opening through which the energy must pass.

Once you have pulled the warm energy of the ovaries down to the perineum, contracted the front of the perineum, and then pulled up the middle and back part of the perineum, follow by tilting the sacrum, slightly arching your lower back outward and pushing the bottom of your sacrum as if you were standing with your back against and wall and flattening against it. Then tilt the sacrum downward and hold it in this position in order to activate the Sacral Pump, which will be further accentuated if you gently tuck in your chin and straighten the back of your neck and skull. Hold the energy at the sacrum for a while, then exhale but continue to maintain your attention at the sacrum. Repeat the process nine times.

f. Once you have managed to bring the energy up through your coccyx and sacral hiatus, spend the next week drawing the warm energy to the eleventh thoracic vertebra (T-11) in your mid-back opposite the solar plexus. Practice in the same manner, inhaling short sips of air while pulling and guiding the energy from the perineum up your spine to the sacrum, and then to T-11. Pull up and retain the energy at T-11, tilt to the back, and feel the point fill with energy and continue to open as the energy moves up by itself.

T-11 is the energy center for the adrenal glands, which sit on top of your kidneys. In Taoist practice we regard the adrenal glands as a mini pump. As you arch, you will create a vacuum here to push the energy up higher:

g. Your next stopping place is at the base of the neck, called cervical-7, or C-7. Practice in the same manner as described above: inhaling short sips of air and pumping energy from the ovaries down to the perineum and up to the sacrum and T-11. Slightly push from the sacrum to bring the energy to C-7, and then pull and guide it there. Repeat this process nine times.

h. Your next stopping place is your Jade Pillow. This is located at the back of your head, between cervical-1, or C-1, and the base of the skull. Practice in the same manner as described above, inhaling short sips as you continue to pump the ovaries' energy down to the perineum and up to the sacrum, T-11, C-7, C-1 and Jade Pillow. There is a small storage place in this area where you

can store the ovaries' energy for further use, although it is the upper part of the brain that is the largest storage place for energy. Repeat the process nine times.

i. Your next stopping point and a larger storage place for the energy is the Pai-Hui, located at the crown of your head. Practice in the same manner only this time fill the "straw" to the top. Tilt the sacrum to the back in order to straighten the curve of the spine outward a little bit: this will help to activate the lower pump. At the same time push the sternum to C-7, tuck in your chin a little, and squeeze the back of your skull. This will activate the upper Cranial Pump. Continue to pull up to the point at the center of the top of the head. Repeat nine times.

j. Touch the tongue to the palate to permit the energy to flow down to the third eye, to the inside of your nose, through the tongue and down to the heart center. Pause for a while at the heart center and feel the energy fill and open this center as it transforms into loving energy. Then bring the energy down to the navel center for storage. Here spiral the energy 36 times counterclockwise and outward, then reverse and circle inward 24 times.

Once you finish the last set of nine, and you feel the ovaries' sexual energy fill the brain, begin to turn the energy to circulate it in the brain counterclockwise for nine, eighteen, or thirty-six revolutions, and then change directions, circulating the energy clockwise for nine, eighteen, or thirty-six revolutions. Use your mind, eyes and senses to assist you. Rest and mentally guide the energy from the Ovarian palace to the top of the crown.

5. Summary of Ovarian Breathing

a. Bring your attention to your ovaries and breathe into them.

b. Direct your attention to the Ovarian Palace, lying between the ovaries.

c. Contract the vagina slightly, pulling the ovaries' energy down to the perineum, then contract and pull up the front part of the perineum to bring the energy there while simultaneously inhaling a short sip of air. Rest, holding your breath, and feel the flow of the energy, from the Ovarian Palace to the vagina, the clitoris and the perineum. Exhale, with your mind retaining the energy there. Repeat this procedure nine times.

d. Continue to retain the ovaries' energy at the perineum, and at the same time return your partial attention to the ovaries and the

Ovarian Palace. Collect the energy there, then simultaneously inhaling short sips, very slightly contract the vagina, the front part of the perineum, then the middle and back part of the perineum, and inhale the ovaries' energy to the coccyx and up to the sacrum. Exhale. Repeat nine times.

e. Holding the ovaries' energy at the sacrum, return your attention to the ovaries, and bring the energy to the Ovarian Palace. Inhale short sips of air as you lightly close the vagina and simultaneously contract the front part of the perineum. Bring the Chi to the perineum, pause for a while, and inhale. Pull up the middle and then back parts of the anus. Pull the energy up to the coccyx and sacrum. Pause and inhale and push the sacrum back as if it were pushed against a wall to open the hiatus so that Chi can enter the spinal cord. Move the energy to T-11. Exhale. Repeat nine times.

f. Holding the Ovarian energy at T-11, return your attention to the ovaries and the Ovarian Palace. Inhale short sips of air, lightly closing the vagina while simultaneously contracting the front, middle and back of the perineum. Move the energy from the ovaries to the perineum, sacrum, T-11 and C-7. Hold and retain it there. Exhale. Repeat nine times.

g. Holding the Ovarian energy at C-7, return your attention to the ovaries and to the Ovarian Palace. Inhale short sips of air slightly close the vagina while simultaneously lightly contracting the front, middle and back of the perineum, and move the energy from the ovaries to the perineum, sacrum, T-11, C-7 and Jade Pillow. Exhale. Repeat nine times.

h. Holding the Ovarian energy at the Jade Pillow, return your attention to the ovaries and repeat the process, proceeding from the ovaries to the brain, to the top of the head, to the crown. Repeat nine times. When the energy has filled the brain, permit it to spiral in the brain nine, eighteen, or thirty-six counterclockwise revolutions and then nine, eighteen, or thirty-six clockwise revolutions. Place the tongue up on the palate and allow the energy to flow down to the third eye, tongue, throat and heart. Pause for a while at the heart and feel the sexual (creative) energy transfer into loving energy, and then move down to the solar plexus and the navel. Collect the energy at the navel.

Remember! The Energy from the Ovaries in Ovarian Breathing is Warm Energy. Be sure to bring it down after Four Inhalations!

B. Ovarian and Vaginal Compression

1. Compressing Air into the Ovaries increases Sexual Power.

Many benefits of Ovarian Breathing are magnified when performed in conjunction with the Ovarian and Vaginal Compression exercise. This exercise reduces mental problems, strengthens the ovaries and the cervix, and increases the power of the vaginal muscles. It helps you consciously to direct energy into and out of the pelvic region. It builds your sexual power dynamically by using the vital Chi from the upper part pushed by the compressed air and packed try its charge into your ovaries to increase the ovaries' energy. By packing the Chi into the ovaries and the vagina, you warm up the sexual region so that you can be more sexually active, easily aroused, and easily have an orgasm. When the sexual region has less Chi, it gets cold and is difficult to arouse. This can be compared to attempting to boil ice water as opposed to room temperature water: it takes much more heat to bring the ice water to the boiling point.

Of the three suggested positions, sitting or standing are preferable. Inhale a fairly large amount of air into the throat and swallow the air. Swallowing drives the air down to the solar plexus. From the solar plexus the air is rolled down into the pelvic region. From there it will be driven down both sides of the vagina to be compressed there. (Fig. 5.29) This is accomplished by contracting the abdominal muscles downward in a slow wave. The vagina seems to expand, a flush of heat is experienced, and after a short time the power driven into it flows up the spine to the head, which also becomes very warm.

2. Ovarian and Vaginal Compression Exercise Step-By-Step

a. Sit on the edge of your chair with your feet flat on the floor about as far apart as your shoulders' width. Feel the feet support a part of the weight; do not place it all on the sitting bones. Wear loose clothing so that it will be easy to compact the Chi.

b. Inhale through the nostrils into the throat. From there swallow the air down to the solar plexus, midway between your heart and your navel. Do not stop at the heart center. Imagine air as a ball.

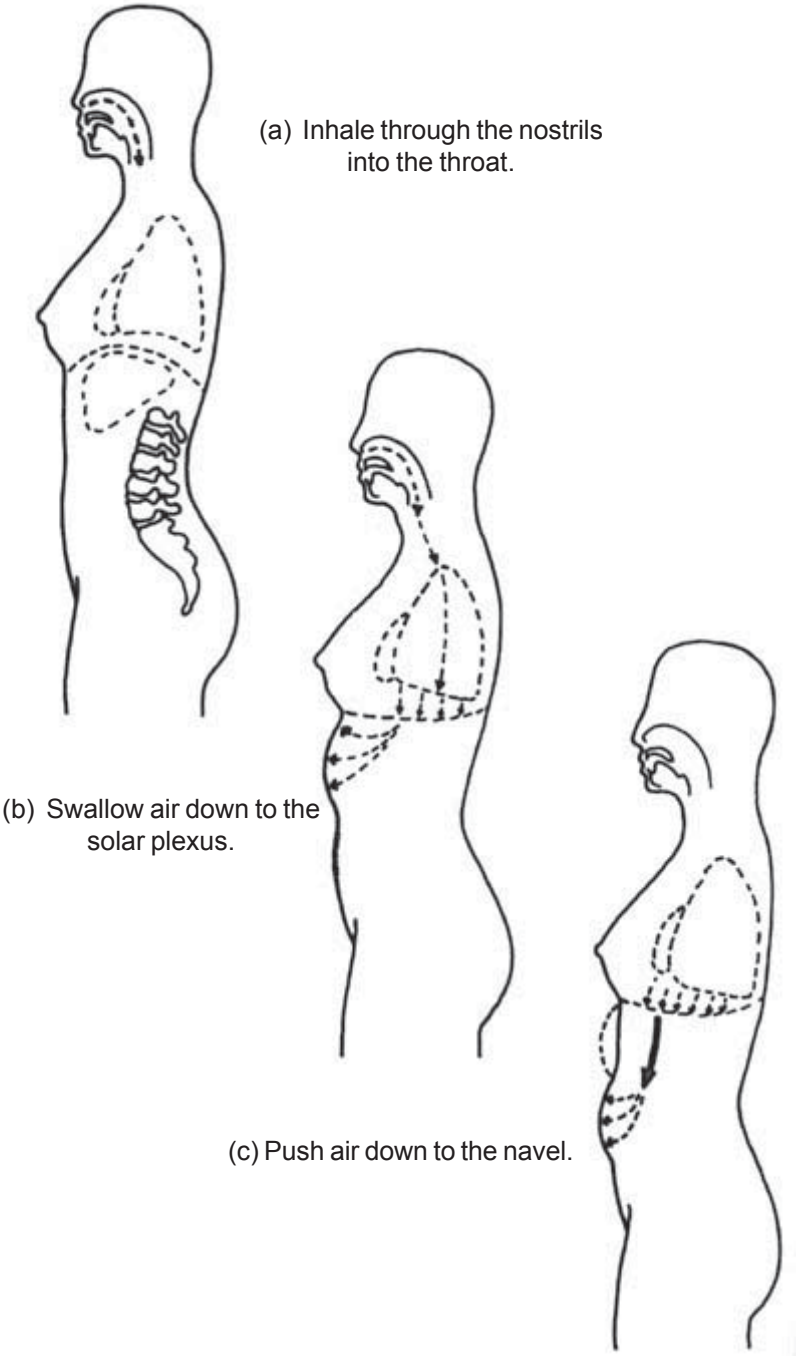

Fig. 5.29 *Ovarian and Vaginal Compressing*

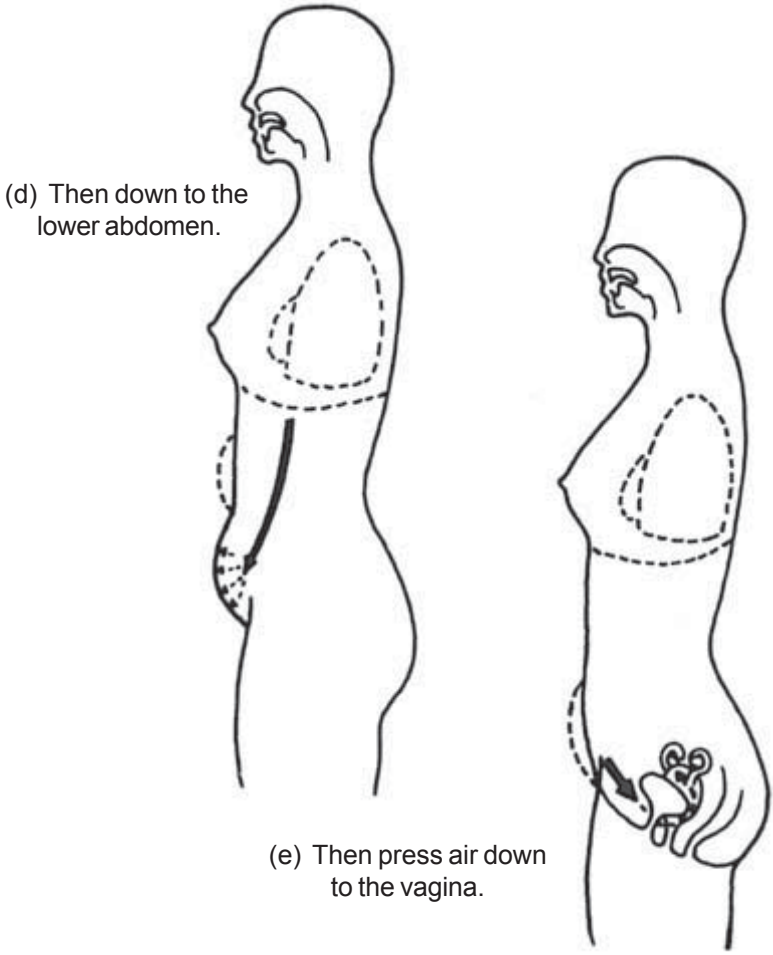

c. First the ball sits behind the solar plexus. From this point roll it down to the navel, then into the pelvis, and spread it out to both sides of the ovaries. This is accomplished by contracting the abdominal muscles downward in a slow wave. Feel the Chi pressure drop around the ovaries, pack and compress the ovaries to energy them, and gradually pack the cervix. Squeeze the inner and outer lips of the vagina tightly and keep on pushing into the vagina as if you were blowing up a balloon, until the vagina feels like it is expanding.

d. Forcibly compress the air into the ovaries for as long as you can. Once the air is driven into the ovaries, you will experience a

flush of heat. After a short time the power driven into the ovaries flows up the spine to the head, which also becomes very warm. The minimum period for each compression should be 30 to 40 seconds. Slowly work up to at least one minute. Every single Ovarian Compression shoots tremendous energy into the vagina. With compression lasting an entire minute the exercise takes full effect. The anal sphincter and perineum muscles must be squeezed tightly during this exercise to prevent leakage of energy.

e. When you have finished the compression, exhale and relax completely. Saliva accumulates in the mouth during compression: swallow it before exhaling.

f. After complete exhalation, take a number of quick, short breaths to recover your wind. Dart the air in and out of the nostrils to quickly regain capacity for another compression. Remember to breathe through the nose, and do not inhale unduly large quantities of air. This process is called “Bellows Breathing” because you must pump your lower abdomen in and out quickly in order to do it.

This exercise quickly charges the whole body. If you feel ill or out of sorts, several Ovarian Compressions will restore you to good form. Perform the exercises in the following sequence:

(1) First practice one Ovarian Compression.

(2) Then, rotate the waist with the arms at shoulder level.

(3) Rest for a moment and repeat the exercise.

Remember to keep the tongue up on the palate when compressing the air. In the beginning perform two to three compressions, gradually increasing to five.

When you have grown stronger you may do five compressions in succession, and then rest by rotating your body from the waist. Begin a second series of five compressions. Keep the breathing between compressions short and shallow so you do not lodge power high in the body.

Practice Ovarian Breathing and Ovarian and Vaginal Compression twice a day for approximately fifteen minutes in the morning and fifteen minutes in the evening. Regular practice of these breathing techniques yields many benefits in addition to those already mentioned, such as a decrease in insomnia and nervousness, and an improvement in overall energy.

The exercise should start to take effect within three days after its commencement. The ovaries feel warm and may itch, or feel

somewhat tingly an indication that the ovaries are receiving unusually high amounts of vital force. These signs occur only if the exercise is done properly. A month or two of exercise will produce substantial increases in strength and well-being.

3. Summary of Ovarian and Vaginal Compression

a. Choose your preferred position.

b. Breathe in very slowly through the nose, concentrating on the throat. Compress the air in the throat until you can inhale no further:

c. Swallow strongly to the solar plexus and hold the air there as if it were a ball.

d. Press the ball of air down to the navel region.

e. From the navel press the ball of air down to the pelvic region.

f. Press the ball strongly and continuously into the ovaries until you can hold your breath no longer: At the end of your breath capacity swallow the saliva strongly

g. Rest by taking quick, shallow breaths through the nose.

h. Relax by rotating the waist several times.

i. Start with 5 repetitions and increase slowly to 36 at a sitting.

j. Keep the tongue up on the palate.

C. Venting Exercises for High Blood Pressure

After practicing Ovarian Compression for two to six weeks, some women with high blood pressure notice a large flow of Chi energy to the head. They feel tension in the head because the blood has followed the upward flow of the vital power. This is not unlike a mild symptom of the “Kundalini Syndrome,” in which freed energy races about the body out of control.

If you suffer from high blood pressure and have not practiced meditation to open the Microcosmic Omit, which distributes the energy evenly throughout the circuits of the body, you can meditate on two points to vent excess pressure. These are the Ming-Men, or Door of Life, on the spine directly opposite the navel (between lumbar 2 and 3), and the Yuang Chuan (K-1 point), the kidney point, on the soles of your feet.

To locate the Ming-Men, place a string around the waist like a belt. Make it perfectly horizontal and place it across the navel. The Ming-Men lies where the string meets the spine. When you bend over backward from the waist, the point feels like a hole in the spine. (Fig. 5.30)

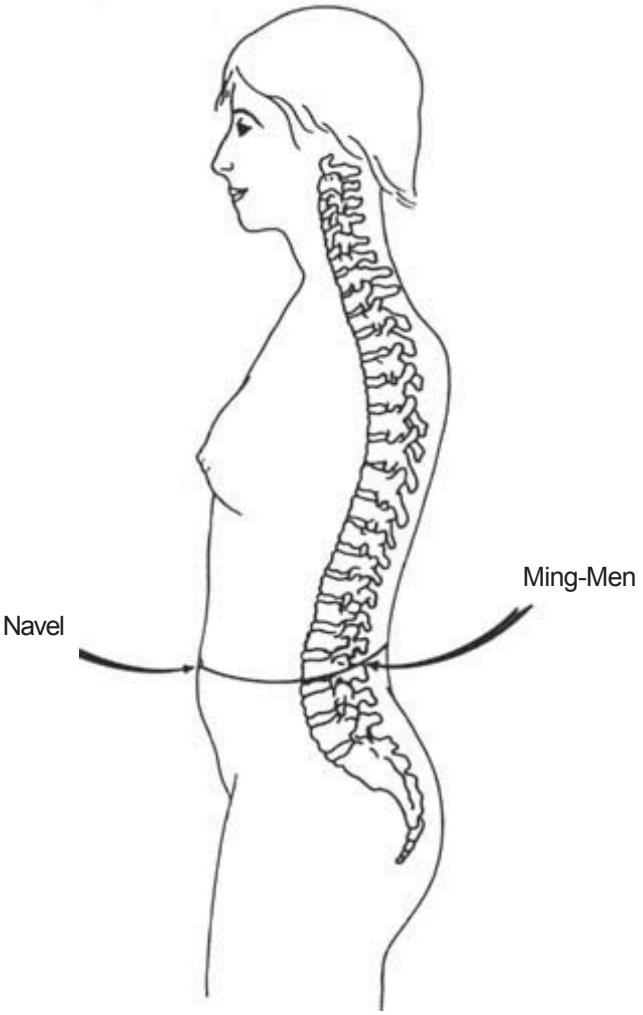

The Ming-Men is located opposite the navel
between the second and third lumbar vertebrae.

Fig. 5.30 *Ming-Men Point*

Excess energy down to the Ming-Men. This draws the Chi and blood there. The hand can help to induce the Chi now. The right hand, like a pitcher sends out energy; the left hand, like a catcher receives the energy. In this way the energy can be brought down more easily.

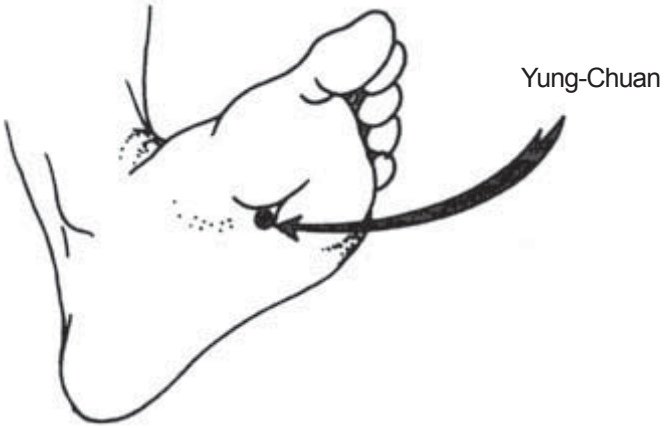

Fig. 5.31 *Yuang Chuan (K-1) Point*

The Yuang Chuan Point: The Yuang Chuan point is the Yin-energy entry point. The Taoists regard the soles of the feet as the roots of the body, and the root is important as the foundation for the work of the spirit body. Once you have found the points on both feet, tape onto them spiny little balls such as prickly chestnuts or plain tree seed pods. Place both soles on the ground and press firmly on the spiny ball while concentrating on the kidney-1 point (also known as the bubbling spring"). You can help guide the energy down to the soles by placing your left palm on the sacrum, and the right palm on the top of the head guide the energy from the crown to the Ming-Men, down to the sacrum, down to the backs of the knees, and finally to the soles through the backs of the legs.

After a short time of practice you will feel the power flow to the Ming-Men. Direct it down through the spine and backs of the legs to the Yuang Chuan. Press down on the balls of the feet so that you feel the soles very distinctly. In severe cases it may take a month or two to get the power into the Ming-Men and bring it down to the Yuang Chuan.

If blood flows too strongly to the head during or after compression, vent the power by practicing the Ming-Men and Yuang Chuan exercises right after compression. Imbalanced force will flow down the body through these two points. After practicing the exercises, many students open the Microcosmic Orbit so that their energy

flows in a continuous circuit, and there will be no need to bring the energy down through the back to the soles. You can also bring it down the front of the body through the heart and navel, down to the perineum, and down to the backs of the knees to the soles. This alone has often ended high blood pressure.

Many benefits of Ovarian Breathing are magnified when performed in conjunction with the Ovarian Compression exercise. If the ovaries are too cold, there will be a reduction in desire for sex. Ovarian Compression, by warming the ovaries, will warm your heart as well. It helps you calm down when sexually over-excited by teaching you to consciously direct energy into and out of the pelvic region. It builds your sexual power dynamically by using the vital Chi taken from the air and packing its charge into your Ching Chi.

Refer to Chapter 6 for more safety tips in performing the exercises in this chapter.

Fig. 5.32 *Healing Love Connection*

Chapter 6
Orgasmic Upward Draw

A. Sexual Energy and Women

In ancient times the Taoists saw men and women as worthy partners and adversaries. Their sexual union reflected the union of Yin and Yang on the cosmic level. Their different approaches to life and problem-solving brought harmony to the earth.

Taoists regard man as fire and woman as water: Fire, when started, burns very fast and does not last long. As we mentioned earlier it takes time for water to reach its boiling point, just as it takes time to bring a woman to her boiling point. Once she reaches that point, she will maintain it for a long time.

Taoists have described women as sexually superior to men, yet we see today that many women are sexually unhappy. Because the response times of men and women are different, the sexual embrace occurs, many times, without the full arousal of the woman. The vaginal spasms which occur at this arousal level are mistaken as the total orgasm. However since the woman has reached only half of her potential for orgasm, she reports feeling let down, frustrated, alienated, angry, restless, and isolated.

To experience the multilevel of a complete orgasm, a woman must be aware that there are many steps she must climb, with each step energizing certain parts of the body. The complete orgasm is desirable because it energizes and brings pleasure to the entire body. Conversely the repeated interruption of orgasm at lower levels creates energy imbalances, since only some of the organs and glands are stimulated and not the entire body. If a man can prolong his erection, he can help bring the woman to higher levels with simple movements, and the couple will be able to reach the highest harmony they can attain in lovemaking.

The Orgasmic Upward Draw (more simply referred to in this chapter as the Orgasmic Draw) exercise taught here is a way to increase the sexual potential of a woman by warming up her sexual region ahead of time to avoid this depressing chain of events.

In all of the basic sexual studies conducted, many parallels have

been made between a man's orgasm and a woman's orgasm, especially in what is called rhythmic pulsations, which have been measured at eight-tenths of a second. Research has also found' that when a woman's sexual organs are considered as one functioning unit, the amount of erectile tissue is about the same as for a man. Therefore, there is no reason to believe that women's orgasms are any less strong or powerful than men's.

The Taoist sages noted that through internal alchemy, women, using the same method used by men of turning their aroused sexual energy inward and upward, can transform this energy into a power which fills certain reservoirs in their bodies, eventually enabling them to reach the ultimate spiritual accomplishment. The Orgasmic Draw is a preparation for the spiritual practices of Kan and Li, which rely on the power of the stored sexual energy (Ching) to be transferred into a new life-force energy (Chi), and Chi into spiritual energy (Shen).

Women have the capacity for virtually inexhaustible sexual pleasure, far greater than the capacity of men. Even though women do not lose very much energy during intercourse as a result of orgasm, that small unit of sexual energy multiplies, and the longer an orgasm lasts, the more sexual energy can be produced. If thought of in units, the energy can be multiplied by the woman from 10 units to 100, 1000, or to hundreds of thousands of units. However if this small unit of energy is disposed of, it no longer is within reach, and there will be no opportunity to transform it to the higher energy level.

On a day-to-day level, this storehouse of sexual energy expresses itself as an abundance of loving and healing energy enough for each woman to not only love and heal herself physically and psychically but to extend that loving and healing to various relationships in her life and commitments in her community and global sphere. It is no accident that women become involved in professions such as nursing and teaching, occupations which require the generation of tremendous amounts of loving, caring, and healing energy.

Aside from being a thrilling experience, the Orgasmic Draw is a technique reaping benefits such as organ and gland rejuvenation. Every time aroused sexual energy is routed to the brain, memory improves, cell are nourished, and a wonderful feeling engulfs the body from the top of the scalp to the tips of the toes.

B. Ovarian Breathing and the Orgasmic Draw

Up to this point you have learned Ovarian Breathing as a means to pump quiet sexual energy created in the ovaries to the brain. The Orgasmic Draw will teach you how to draw the far denser "aroused" sexual energy upward. The means by which you will accomplish this initially is muscle power: You will use it not only to stop the outward movement of the orgasm, but to actually change the direction of the energy inward and upward. Eventually the control will become more internal, the muscles of the pelvic diaphragm will begin to develop, and you will be controlling the Orgasmic Draw with your mind.

The temperature of sexual energy is the second major difference between Ovarian Breathing and the Orgasmic Draw. The aroused sexual energy cultivated in the Orgasmic Draw is cooler than the biologic, reproductive (or sexual) energy that is produced by the ovaries and harnessed during the process of Ovarian Breathing. It is also cooler than aroused sexual energy in men, which is considered hot Yang energy. It is the cool quality of this energy that enables it to be stored in the brain for future use.

As in Ovarian Breathing, the Chi Muscle plays a great role in directing the energy. To review briefly: contracting the front of the anus (part of the perineum region) brings the energy from the ovaries (the Ovarian Palace) to the perineum point. Pulling up the middle and contracting the back of the anus (the perineum region) directs the energy from the perineum to the coccyx. This maneuver is useful while you are still at the basic level of practice. As your practice continues, the control becomes both automatic and internal.

1. Single and Dual Cultivation

Even though most people settle upon a particular formula of how they like to have sex and stick to this formula, this does not mean that they would not like another means of gratification if it were offered in a safe and caring way A woman can enrich her life both physically and spiritually by learning the Orgasmic Draw as taught here using two pathways: Single and Dual Cultivation, which are by no means mutually exclusive. Single Cultivation is usually practiced by the woman who does not have a sexual partner or whose sexual partner is not practicing the Big Draw (the man's version of the Orgasmic Draw. Many women who practice Dual

Cultivation, i.e., with a partner who practices the Big Draw, find that the route of Single Cultivation (Ovarian Breathing, the Orgasmic Draw and meditation, as well as Iron Shirt Chi Kung and Tai Chi) cannot be overlooked.

A woman who practices alone begins to feel the spaciousness inside of her, the blending of her body with the universe, and an increased sensitivity to those around her. Sometimes these experiences are mere glimpses, but with continued practice they can become part of her living reality.

A woman practicing with a partner can learn how to share energy with her partner and can begin to approach the experience of the "Valley Orgasm" or "Beyond Orgasm" state, an experience of heightened awareness for both partners. As the two different souls or two spirits (Yin and Yang) unite, an alchemical fusion of energy occurs that gives birth to a new consciousness for both partners. As they reach the point of "Beyond Orgasm," each having opened their Microcosmic Or bit, Thrusting Channel and Belt Channel, both will feel the sexual energy shoot out of their hearts to the tops of their heads.

A. Solo Practice

The importance of Single Cultivation, especially at the beginning, is strongly recommended. With solo practice you will be better able to tune into your own responses and thereby have more control over your sexual energy. Between the time you start to experience sexual excitement and the time an orgasm is imminent is a gap you can play within. If you start the Orgasmic Draw when you are only slightly aroused, you will not feel very much sensation. If you wait until you are at the point of pouring the energy out, you may or may not be able to capture and prevent it from leaving your body. Your solo practice is invaluable in enabling you to sense these distinctions and turn them into reflexes.

After you have practiced and feel you have learned the Orgasmic Draw well, you can try it with a partner but it should be a partner who is interested in these practices or who is aware that you want to recycle your sexual energy. It is important to be perfectly frank with your partner so that both of you know what is going on.

B. Practicing with a Partner

If you have a partner who is also practicing the Big Draw and Testicle Breathing, you are one of the luckier ones. You will have the opportunity to experience the exchange of energy with your partner and the possibility of entering into the "Beyond Orgasm" state mentioned above. If, however you have mastered the techniques of the Healing Love exercise, and your male partner does not practice these Taoist Secrets of Love techniques, you will be far superior to him. Then, if you use the Orgasmic Draw on him, you will drain his life-force from him, possibly causing him great harm and creating negative forces within yourself.

The word Tao means "way" and, as described above, those who seek union with the Tao are trying to find the "way" of the universe from which all of nature proceeds. There are many paths to travel along this "way" and many have sought a path in which sex is perceived as spiritually undesirable. Such people recoil from Taoist Dual Cultivation and label those who practice it as following the "Left-Hand Path" (as opposed to the "Right-Hand Path" of celibacy). Dual Cultivation, properly practiced, is a safe path, reaping benefits for the body mind and spirit.

C. Overview of the Orgasmic Draw

In the Ovarian Breathing exercise you moved warm reproductive sexual energy (ovarian energy or Ching Chi), that lies in the ovarian in its Yang state, up to the head and then down into the body. With the Ovarian Compression exercise you forced the Chi energy that is produced in the vital organs and glands-heart, Lungs, spleen, thymus and, etc: down to mix with the warm Ching Chi resting in the sexual organs to heat up this region. Then you moved the resulting warm energy upward and circulated it.

In the Orgasmic Draw you will arouse yourself in the direction of an orgasm, collect all the organs' and glands' energy to mix with the sexual energy): move that orgasmic feeling inward and extend it longer and at a higher center to be then moved into the organs, glands and finally the nervous system, so that the orgasm reaches energy cell of the body. As a result you will experience a new kind of orgasm which you have never experienced before. The cool, Yin, sexual energy stored in the ovaries is at your command. You can gather it quickly and build rapidly to a climax, turning it inward and thereby extending the orgasm for as long as you desire, or you

can deposit it in the “slow cooker” for a longer and more voluptuous experience. Ultimately the erection of the clitoris and the internal sensations of fullness and expansion will result in a rhythmic outpouring release. Once you master this Taoist technique, you will find the easiest flowing channel in the body flows directly up to the brain and higher center of the body. Practice is essential since initially you must learn to control the anus Chi Muscle and the involuntary muscle of the pelvic diaphragm to change the rhythmic outpouring of energy into an inward and upward draw of energy, and to help push the sexual energy up through the spine into the upper body

1. Four Levels of the Orgasmic Upward Draw Practice

A. Beginning Stage

You will use the muscles of the fists, jaws, neck, feet, perineum, buttocks, and abdomen to help activate the Sacral and Cranial Pumps, divert the ovarian energy and orgasmic feeling, and push the energy upward into the organs and glands in the amused state.

B. Intermediate Stage

You will use less muscles tension of the fists. jaws and feet, increase your reliance on the Chi Muscle of the perineum, pelvic diaphragm and sphincter and employ the Sacral and Cranial Pumps to help move the sexual energy upward.

C. Advanced Stage

Less muscle tension of the Chi Muscle of the perineum will be required and more use of the Sacral and Cranial Pumps to provide greater power for the mind to move Ching Chi to the crown center. By concentrating power at the upper part of the crown, you will draw the energy from the lower center to the higher center.

D. Most Advanced Stage

You will only use pure mind control: there is no need for use of muscles. The mind’s power will command the ovaries’ sexual power to move up and down into the organs, glands and nervous system, and to envelop, pack and revitalize it at your will.

2. Explanation of Procedure

In this exercise you will need to arouse yourself 95 to 99 percent of the way to orgasm. As you master the Orgasmic Draw, you may fine tune your orgasm and gradually cultivate it to go beyond 100 to 200 percent arousal, even up to 1,000 percent. To initially achieve arousal you will massage the breasts. Once you feel that orgasm is imminent, you will stop and practice the Orgasmic Draw method three to nine times per session, or until the orgasm turns inward, flowing into the Microcosmic Orbit and entering into the organs and glands as the lower-center arousal subsides. This will count as one exercise. You will repeat this procedure: stimulating yourself, and then practicing the Orgasmic Draw until the arousal subsides and the orgasmic feeling moves upward.

Practice makes perfect. Once you totally gain control of your sexual organs and the energy involved in solo practice, you will naturally have full control during sexual intercourse. You can continue to have sex and practice at the level you have reached. Some will naturally become skillful much more quickly than others if they have trained their minds through yoga, meditation or other mental disciplines. If you are not involved in a program of daily physical discipline, do some warm-up exercises and stretching before practicing the Orgasmic Draw. Iron Shirt breathing and packing directly assists in the execution of the Orgasmic Draw. These exercises will tone up the energy in your organs, making it easier to feel your internal Chi energies, and thus speed up the command of your sexual energy:

People spending years and years earning a doctorate in medicine or a Ph.D. in any high technological science know that such knowledge is important to making a living in this worldly life. However, people must also consider learning the high technology about themselves, one involving an energy body and a spiritual body and earning a doctorate in preparation for the next life. All of the energy practices of this life can be transferred to your next life if you start to practice while you still have an abundance of that energy. Consciously you will transfer your own identification to a spiritual body. Therefore, it is worthwhile to spend time on practice to earn this highest of human technological degrees.

D. Orgasmic Draw, or How to transform aroused Sexual Energy into total body orgasm.

1. Practice in an Unaroused State

A. Pre-Exercise

While learning the exercise, first practice in an unaroused state.

(1) Lower Abdominal Breathing

From your practice of the Microcosmic Orbit you may now find yourself breathing normally in the lower abdomen, with little or no movement of the chest and shoulders. Lower abdominal breathing is the way we breathe when we are babies, and the way we breathe when we are asleep or in deep relaxation. Many of us have to relearn how to breathe into the lower abdomen when awake and alert, Lower abdominal breathing causes the diaphragm to move lower during inhalation, thus elongating the lungs and providing more lung area to be filled with air. Check yourself at random during the day and discover from which area you are breathing. You can practice lower abdominal breathing anytime. In addition to increasing lung capacity abdominal breathing will also greatly strengthen the lower abdominal muscles, which will help you to control lower abdominal energy. (Fig. 6-1)

(2) Diaphragm

Sit or stand in a comfortable position. Exhale, flatten your abdomen, and exhale once more, relaxing the diaphragm down to press against the organs, especially the adrenal glands (located on top of each kidney). Relaxing the diaphragm in the exhale position requires practice. Your mind can help to guide the diaphragm and you can use the Inner Smile to smile to it. The diaphragm can become stuck on the rib cage if is too tight, and this will make it difficult to move it up and down. You can assist its movement by rubbing along the bottom of the rib cage until the tightness and pain are gone. This will enable the diaphragm to stretch and you will find your breath becoming deeper: making it easier to practice abdominal breathing.

(3) Energy Ball

Now inhale without expanding the abdomen. You should feel a

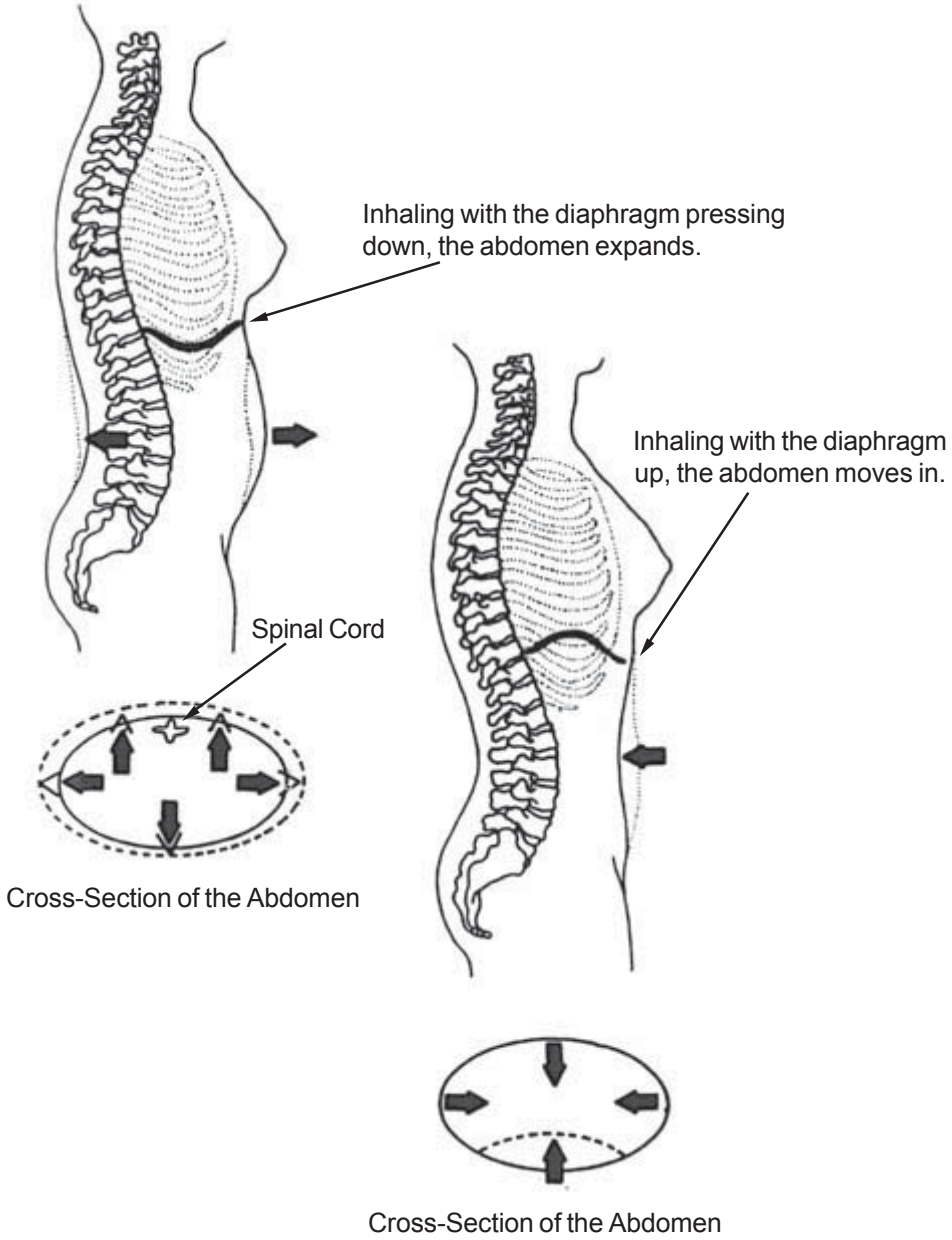

Fig. 6.1 *Lower Abdominal Breathing: Breathe as a round shape, expanding all sides and not the stomach only.*

pressure on the lower abdomen which serves to pack the organs into a smaller place. This will help to concentrate the energy in the lower center and pack and condense the energy into an energy ball, which we call a “crystal” ball. Exhale and relax. This condensed energy· will be of tremendous use in later higher practice of the Taoist system as you form the energy body and spiritual body that give birth to the soul and spirit.

B. Relationship of the Palate to the Organs

The palate and the tongue are closely related to the organs and glands. Knowing how to activate the palate, the floor of the Cranial Pump, will enable you to trigger that pump’s action, thereby assisting the flow of Chi.

(1) Front Palate

The front part of the palate near the teeth and the inside gum is related to, and is the reflex point of, the heart and small intestine.

(2) Middle Palate

The middle part of the palate before the soft palate is related to, and is the reflex point of, the liver and gall bladder:

(3) Back Palate

The soft palate located toward the back of the mouth is related to, and is the reflex point of, the kidneys and bladder.

(4) Front of The Mouth

The point at the front of the mouth between the upper and lower teeth is related to, and is the reflex point of, the lungs and large intestine.

(5) Jaw Line

The jaw line between the lower teeth and gums is related to, and is the reflex point of, the spleen, stomach and pancreas.

C. Activating the Pumps

In these exercises, we combine lower abdominal breathing together with muscle power locks.

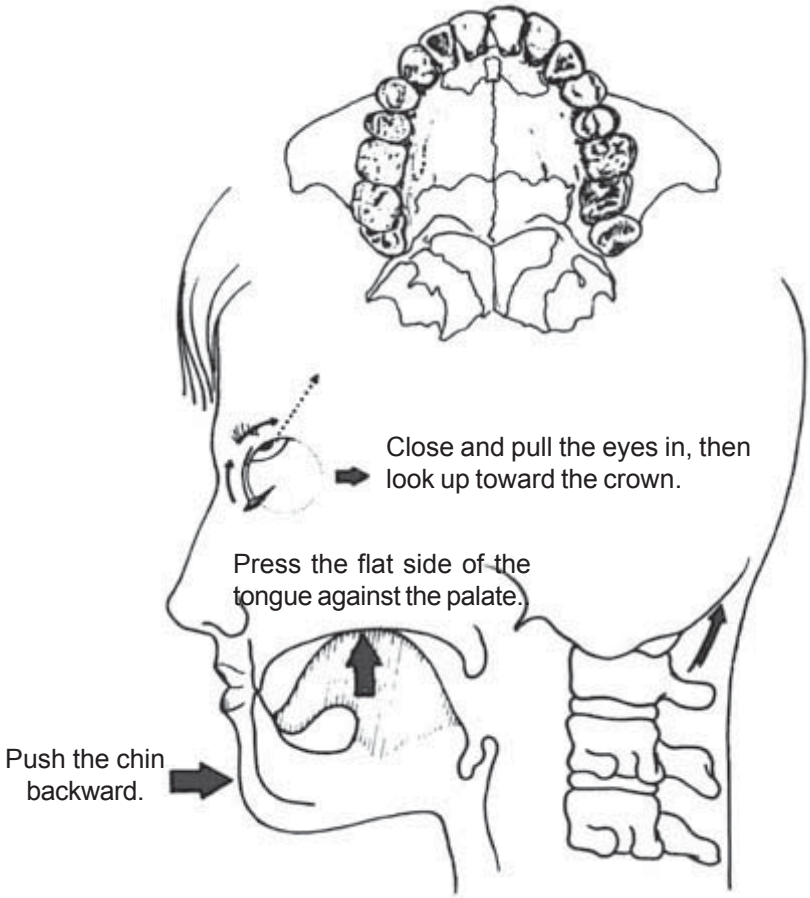

Fig. 6.2 *Activating the Cranial Pump.*

(1) Activation of the Cranial Pump (Fig. 6-2)

The muscle power lock that is responsible for activating the Cranial Pump is accomplished by squeezing the muscles of the tongue against the palate and teeth, while simultaneously squeezing the muscle at the back and base of the skull, thereby activating the Cranial Pump as well as all of the pumps in the body.

(A) Teeth

Clenching the teeth will help to squeeze the temporal bones, and when released will activate the Cranial Pump. The cranial bone,

located at the palate, is called the palatine bone. Clenching the teeth will also stimulate the lungs and large intestine.

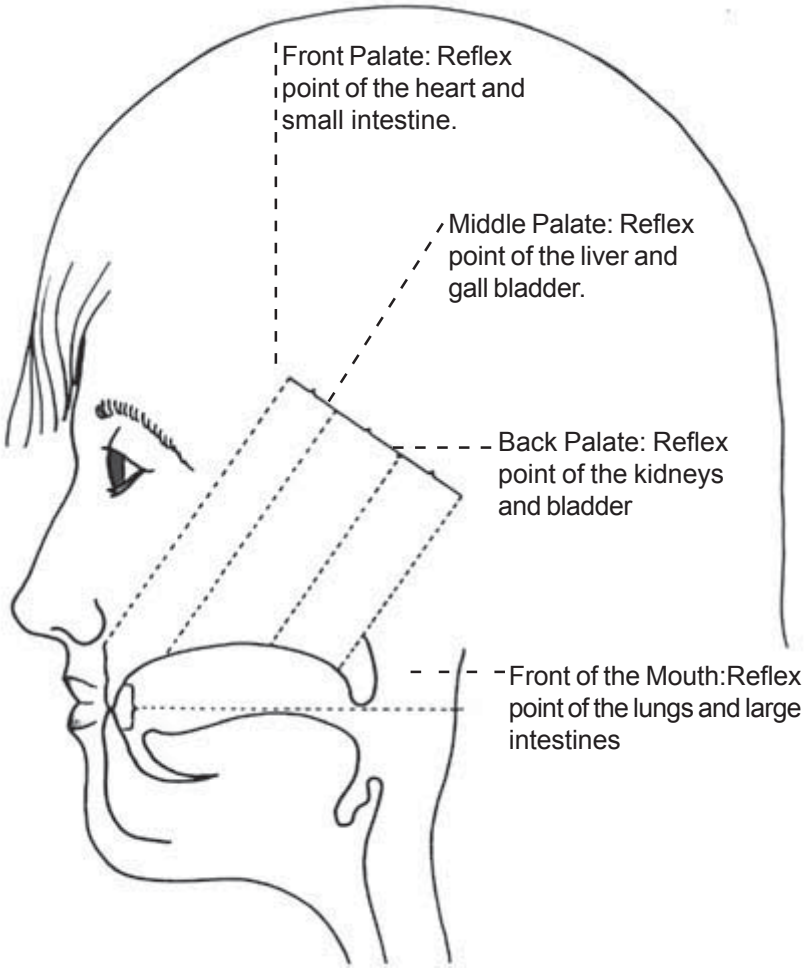

Fig. 6.3 *Relationship between the Palate and the Organs*

(B) Tongue

Press the flat side of the tongue to the middle of the palatine bone and the tip of the tongue against the lower front comer made by the gum and teeth. Pressing the tongue firmly to the palate, the floor of the Cranial Pump, will help activate the Cranial Pump and stimulate the palate, the reflex point of the liver and gall bladder. It

also stimulates the jaw line, the reflex point of the spleen, stomach and pancreas, and the tip of the tongue. (Fig. 6-3)

(C) Chin

Activate the back side of the Cranial Pump by pushing the chin backward (not up or down). You will feel a tightening at the back and base of the skull, or occipital bone. In the beginning, you will have to squeeze the muscle at the back of the skull to activate the base of the Cranial Pump.

(D) Eyes

The eyes contain many muscles around the orbital bones (the cavities of the skull containing the eyes) which will also help to increase the pumping action. Rolling and pulling up the eyes and squeezing the muscles into the orbital bones will also help to activate the Cranial Pump. Look up and slightly pull the eyes up toward the crown at the top of the head. You will feel a pressure there. This will activate the top of the Cranial Pump.

You are now clenching the teeth and pressing the tongue to the palate, pushing the chin to the back, looking up with your eyes and focusing them on the top, or crown, of the head. Once the Cranial and Sacral Pumps are properly activated, the pulling-up action (or suction) will increase, thereby helping to pull the sexual energy up. In the higher part of spiritual practice, the pumping action of the Cranial Pump is very useful in thrusting the spiritual body out of the physical body through the crown.

(2) Activation of the Musculatory Pump

Activating the Musculatory Pump will create a pumping action to draw the sexual energy upward. Taoist Masters discovered that as you create other muscle power locks by squeezing the muscles to the bones of various parts of the body and then releasing them, you will increase the pumping action of the fluids in the body. As you continue in your practice to train your mind to perform this squeeze, the pumping action of the body will greatly improve.

We often feel our hands and feet as the first parts of our bodies to grow cold. Since the arms and legs are the body's extremities, the circulation of fluids to them tends to slow down as time goes by, resulting in the accumulation of many toxins in these areas.

(A) Arms

To activate the arms' pumping action, start by clenching your fists and rolling four fingers of each hand (excluding the thumb) under pressing them firmly to the palms. When you feel the pressure, roll the fingers as if you were rolling paper. Press your thumbs firmly to the fingers. (Fig. 6.4) Inhale and squeeze the lower arms' muscles to the ulnae and radii (two forearm bones). Hold for a while and release. You will gradually feel a strong pumping action beginning. Gradually increase the squeeze to include the upper arms, squeezing the muscles around the humeri (upper arm bones). Practice until you master this, and then continue to the next step. These movements will assist in drawing the sexual energy up.

Clench the fists to activate the arms' pumping action

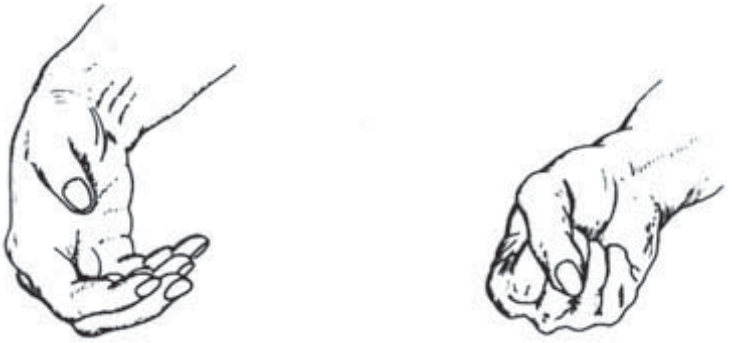

Fig. 6.4 *Arm's Pumping Action*

(B) Legs

To activate the legs' pumping action, start by pressing the soles of the feet to the floor firmly and spreading out the toes. First spread the small toes outward, then the fourth, third, second and finally, the big toes. (Fig. 6.5(a)) This spreading action will greatly activate the muscles and tendons of the legs to create the pumping action. Since the feet have very dense tendons, pressing the toes firmly to the floor will feel like a clawing action. Now curl the toes up, keeping them spread apart with the soles still touching the floor (Fig. 6.5(b))

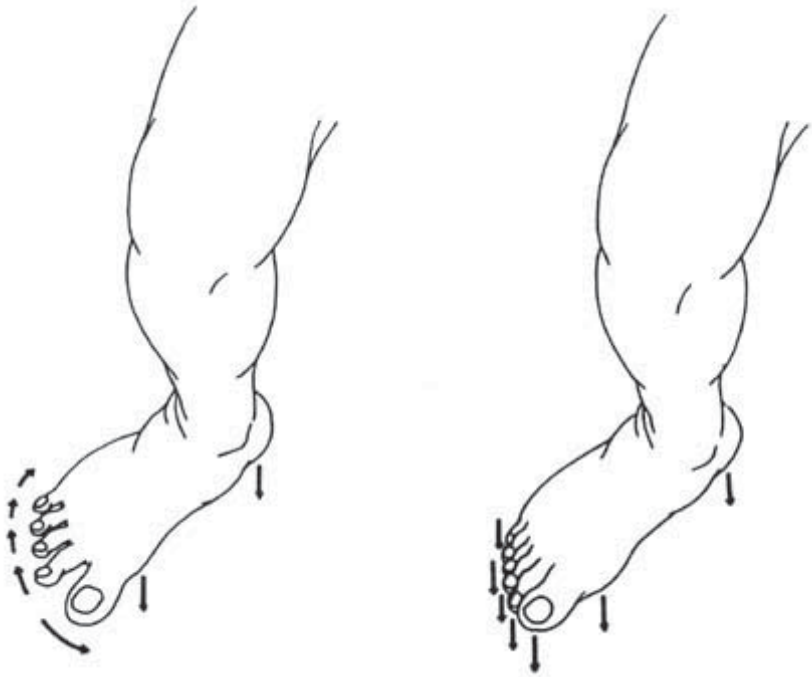

(a) Press down and spread out the toes to activate the muscles and tendons of the legs.

(b) Curl the toes up, keeping them fully in contact with the ground.

Fig. 6.5 *Leg's Pumping Action*

Feel as though you are inhaling through your feet, and squeeze the muscles of the legs to the tibiae and fibulae bones (lower leg bones). Hold for a while, then release them. Gradually move up to the femurs (thigh bones), squeeze the muscles tightly to the bones, and release them to increase the pumping action. These movements will assist in drawing the sexual energy, upward when you perform the Orgasmic Upward Draw.

(C) Buttocks

The buttocks consist of many large muscles and are a major factor in assisting the upward flow. Activate these muscles by inhaling as if through the buttocks and pulling up both buttocks, squeezing them toward the anus. You will physically feel as though lifted from the chair you are sitting on. Continue the squeeze, which

now moves into the pelvic bones. Hold for a while, and release. Practice a few times, until you master it.

Although the squeezing described seems like many separate actions, mastering them in this way, step-by step, enables you ultimately to put them together in such a fashion that they become one effort.

(3) Combining the Steps

(a) Sit on the edge of a chair or stand with the feet comfortably apart and the knees slightly bent. Feel yourself relax and smile to your self. Then, make your body tense, and relax again. Such activity will induce greater relaxation.

(b) Begin abdominal breathing nine, eighteen or thirty-six times. Exhale, flattening the abdomen, and inhale without expanding the abdomen.

(c) Clench the teeth. Press the tip of the tongue against the lower front corner of the jaws and teeth and the flat part to the palate, and push the chin to the back. Squeeze the fists and arms' muscles, spread the toes, press the toes and the feet to the ground, and squeeze the muscles to both leg bones. Hold for a couple of moments. Again, although these steps seem disjointed when practiced individually, as they all are mastered and then combined, they will become one unified action easily performed.

(d) Exhale and relax.

(e) Now inhale, hold, and clench the feet, fists, teeth, perineum, and buttocks. Exhale and relax.

(f) Inhale again, hold, and clench the teeth, fists, feet, perineum, and buttocks: tilt the sacrum back, slightly arching the back to help the energy flow more easily into the spine. Exhale and relax.

(g) This time, add an upward movement of the eyes: looking up will help focus the energy toward the brain. Practice again: inhale, hold, clench everything, and look up. Exhale and relax.

(h) Now it is time to add the last item, which will force the energy up into the brain. Perform all the clenching, and then a series of nine strong contractions of the perineum. These contractions are essential to keep the orgasm in the body and propel it upward.

2. Practice in an Aroused State

A. Overview

Now that you have practiced all the clenching exercises, you are ready to try the Orgasmic Draw in an aroused state. To reach an aroused state you will massage the breasts, and stimulate the clitoris, in whatever position you are accustomed to. As you approach what you consider to be a high state of arousal, provide enough time before you know you will climax. Then clench everything, and while holding your breath, simultaneously execute nine hard contractions. Later when we fully describe the Orgasmic Upward Draw, we will go into detail on how to move the sexual energy up.

You will notice that after your first Orgasmic Draw there will be a transfer of aroused energy upward, first moving up the spine to the top of the head and to the pineal gland (through the Governor Channel), then down (through the Functional Channel) as the energy continues in the Microcosmic Orbit. When you feel the energy fill the Orbit, you will start to move the orgasm s aroused energy into the ovaries, then into the left and right kidneys, to the liver spleen and lungs, and finally up to the left and right sides of the brain, completing what we call the "organs' and glands' orgasm." Additional stimulation will again raise the level of sexual arousal, and you will be able to practice another Orgasmic Draw. If you wish, you can then continue to complete a set of three to six draws. Practice three to six repetitions once or twice a day, and you will quickly refine your ability to do the Orgasmic Draw. Practice until you can fully control the manner of transferring the orgasm upward, using your mind to circulate the orgasm through the Microcosmic Orbit to all of the glands and organs, thereby increasing the amount of energy going to the brain. You will find that as control of the Orgasmic Draw gradually moves inside, the process will require less and less physical clenching. Ultimately, after perhaps six months to a year of practice, the control will be totally internalized.

B. Importance of Virtue Energy

Raising the organs' and glands' Chi to increase the ovaries' sexual energy is one of the most important ways to rejuvenate the organs and glands and start the return of youthful feelings. The

most rejuvenating energy, virtue energy: is generated from the organs:

(1) Gentleness from the kidneys and bladder:
(2) Kindness from the liver and gall bladder:
(3) Honor respect, joy and happiness from the heart and small intestine:
(4) Fairness from the spleen, stomach and pancreas:
(5) Righteousness from the lungs and large intestine.

The sexual organs are linked to all of the major organs and glands. With proper stimulation, as the Taoists classically state, the energy of the glands and organs will contribute to full sexually aroused energy: and all the good virtue energy emerging from them will combine into the best energy we know; the energy of compassion. If you can redirect the energy of compassion back to the organs, you will charge them to their fullest extent, and negative energy will have no room to remain. If you have too much negative energy in the organs and do not try to remove it, when you begin to multiply your sexual energy, the negative energy will increase, and so will your negative emotions.

The Microcosmic Orbit Meditation, Inner Smile, Six Healing Sounds, and Healing Love practices all help to transform negative emotional energy into good virtue energy. A more extensive practice of transforming negative energy into good virtue and blending all virtues with the energy of compassion will be explained in a later practice of the Healing Tao, called Fusion of the Five Elements. When fully aroused sexually the glands, organs and nervous system will be exercised to their fullest extent as well.

C. Massaging breasts will raise the Organs and Glands' Chi.

When you massage the breasts or the clitoris, be aware of the Chi energy that is activated as you stimulate the many nerves they contain. The nerves are connected to all the major organs and glands of the body beginning at the top of the crown with the pineal gland. From this point you will begin to feel the stimulation of all the glands and organs as the sensation descends and flows throughout your body Use your mind to guide the glands' and organs' Chi to flow to the breasts, blending their energies to produce the best possible glands' and organs' Chi. This special blending of organs' and glands' Chi can have a very powerful creative and healing effect.

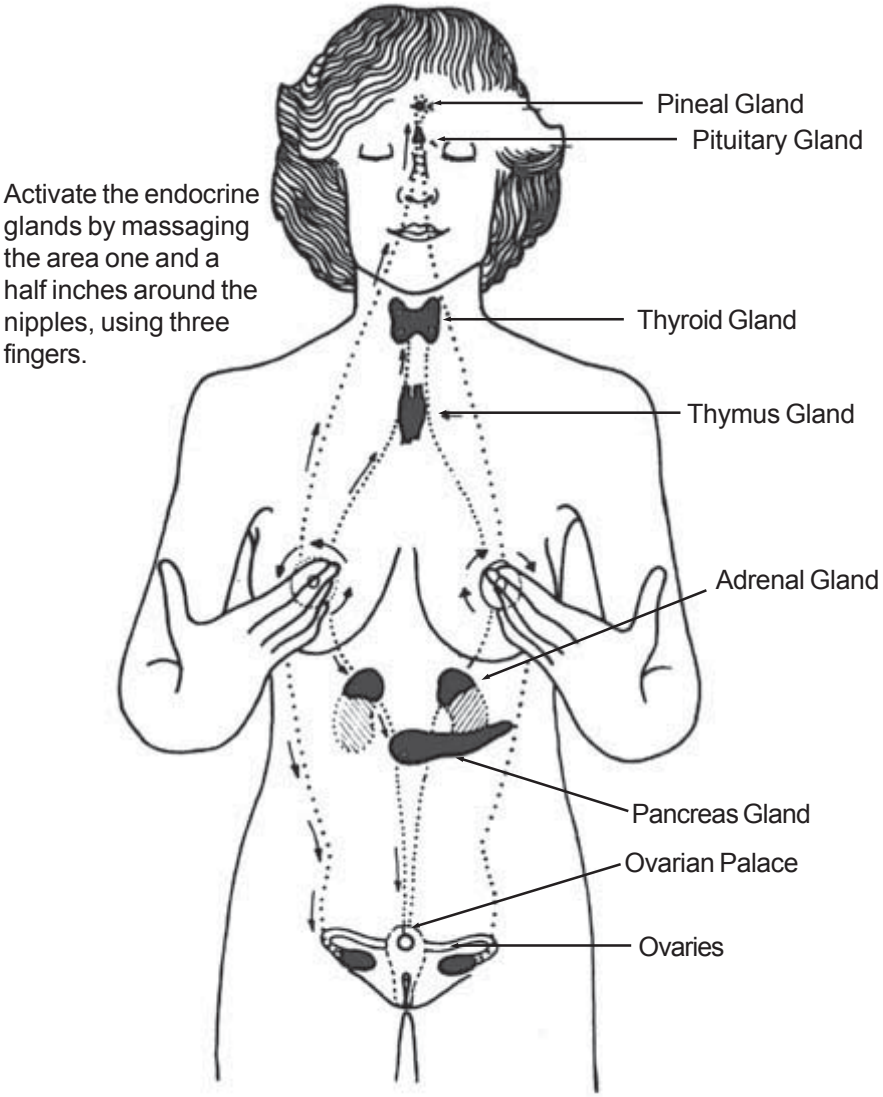

Fig. 6.6 *Activating the Endocrine Glands*

(1) Gland Chi Arousai

When certain glands are stimulated to secrete their hormones (Fig. 6.6), the organs with which they are associated become activated, and eventually every cell of the body is affected. Stimulation of the breasts especially affects the pineal, pituitary and thymus glands.

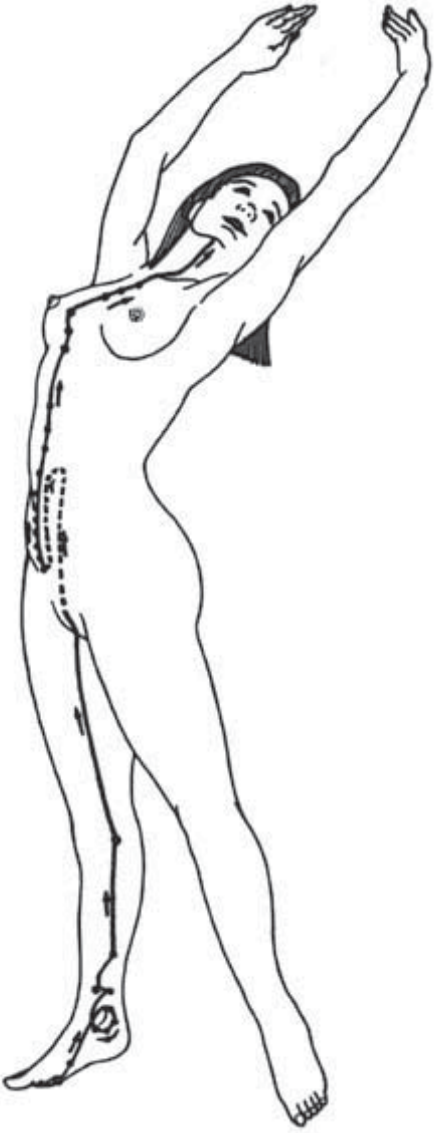

Fig. 6.7 *Course of the Kidney Meridian*

(A) Pineal Gland Chi

The kidney meridian passes through the breasts (Fig. 6.7), and as you use your fingers to gently massage the nipples, their stimulation activates the kidneys and bladder as well, which, in turn, help to activate the sexual glands. The clitoris, having a direct relationship to the pineal gland at the hormonal pathway, responds and brings the sensation to this point. The pineal gland is the body's time clock and compass and in later practice has the ability to reflect light. When it is fully developed, it can see the true light of creation and will guide the spirit back to the place of its origin. (Fig. 6.8)

(B) Pituitary Gland Chi

From the pineal gland the sensation descends into the next gland along the hormonal pathway the pituitary gland, situated at the hind part of the third eye energy center. This gland has a wide range of effects upon growth, metabolism and other functions of the body. Taoists believe the pituitary gland governs intelligence, thought and memory. The pituitary is the master gland from which all other glands are activated.

(C) Thyroid and Parathyroid Glands' Chi

As the energy continues to descend the hormonal pathway the thyroid and parathyroid glands become activated. The thyroid gland is situated on either side of the trachea, or windpipe, close to the larynx and arising from the same tissue, and almost from the same spot, as the anterior of the pituitary gland. Opposite the C-7 point, the thyroid gland corresponds to the C-7 energy center. It is the gland that is vitally important to growth. Heavier in the female than in the male, this gland becomes enlarged during sexual excitement, menstruation, and pregnancy. The Taoists consider this an energy gland, regulating the metabolism of the cells in the body, and one of the most important centers because it controls the growth and development of the body and mind. It is also considered the great link between the brain and the reproductive organs.

(D) Thymus Gland Chi

Next in the descending order of the hormonal pathway is the thymus gland, or gland of rejuvenation, located at the gland of

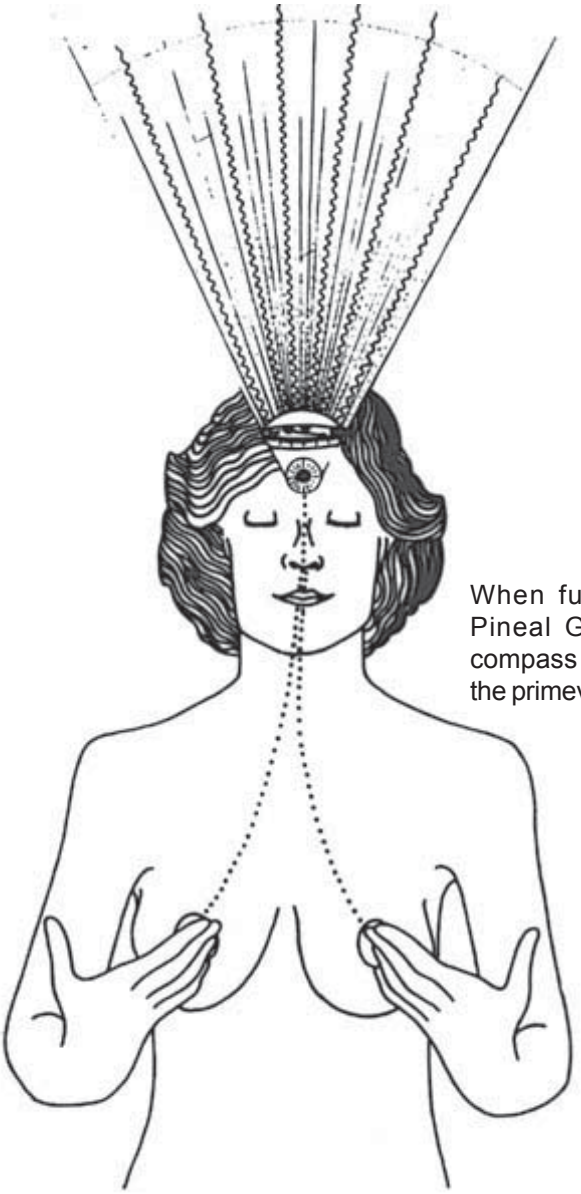

When fully developed, the Pineal Gland becomes the compass guiding the spirit to the primeval Tao.

Fig. 6.8 *Activating the Pineal Gland*

heart energy center and descending from, covering and overlapping the upper portion of the heart. This is a lymphoid organ (related to the lymphatic glands which reaches its greatest size at the beginning of puberty and gradually diminishes in side and activity as time goes on. The Taoists consider this to be a gland that, when properly activated and harmonized with the energy from the pituitary gland energy center and the generative force of the sexual organs, can reverse the aging process.

(E) Pancreas Gland Chi

The energy then descends to the pancreas, located between the lower part of the stomach between the liver and spleen. The pancreas is a gland that maintains control over digestion, body temperature and blood sugar levels.

(F) Adrenal Glands Chi

Next, in descending order are the adrenal glands situated atop the kidneys at the adrenal glands' energy center or T-11. The adrenal glands', or energy glands', function is to support the kidneys, but they are also the major producers of adrenalin in the body. Adrenalin is a hormone which stimulates the heart, thymus gland, liver spleen and pancreas. In addition, the adrenal glands support the functions of the kidneys, spine and nervous system, brain, bones and bone marrow. Stimulation of the adrenal glands adds strength and alertness to both physical and mental activity.

(G) Sex Glands Chi

Stimulation of the kidneys occurs when the kidney meridian running through the breasts is massaged. In turn, all the other glands become stimulated until finally the sexual organs, last in descending order of the hormone pathway, become energized. Hormone secretions from the sex glands are responsible for sexual response, sexual energy and reproduction. The sex glands include the vagina, uterus and breasts, but it is the Ovarian Palace which houses the woman's sexual energy center. All other energy now is awakened.

Balancing and raising the energy level of the glands in the body is an important part of the Taoist way of developing, healing and strengthening the physical body. This is crucial to the higher levels of practice in which all the glands provide nourishment to the formation of a spiritual body.

(2) Organ Chi Arousal

With the glands activated, a response can be felt in the organs. This response will have physical and mental manifestations described as follows:

(A) Lung and Large Intestine Chi *(Fig. 6.9)*

The first Chi that can be felt is the Chi of the lungs and their associated organ, the large intestine. The properties of the lungs are dryness and coolness: their virtue energies are courage and righteousness. The feeling of righteousness can be as different as each person. It might feel straight or tall, or like a bright white color pure, fresh and uplifting. Feel this energy generate from the lungs.

The negative emotions of the lungs are sadness and grief. The feelings can be experienced as flat, or like a collapsed ball: they can be gray, musty, cold and low, with no force: downtrodden. Since you do not like to feel this way, cultivate good virtue and connect yourself with the good feelings of the lungs mentioned above: pure, fresh, uplifting. Bring these good feelings to the breasts.

The lungs' Chi readiness is manifested physically by faster breathing and copious saliva, which you feel must be swallowed quickly. These signs indicate that the Chi of the lungs is ready to come forth.

(B) Heart and Small Intestine Chi *(Fig. 6.10)*

Second is heart Chi: the heart's associated organ is the small intestine. The heart contains hot energy. Its virtues are honor; respect, joy and happiness. These virtues are manifested in feeling straight and open: they are bright red, warm, full, comfortable, secure and satisfying. The negative manifestations of heart and small intestine Chi are impatience, hastiness and cruelty. This can feel spiny or sharp, muddy, burnt, noisy, irregular and irritating, all feelings that you do not like to have in your system.

The physical manifestations of heart energy are revealed by observing the tongue becoming mobile, saliva seeming to overflow, and a growling sound emanating from the throat. These are signs that the Chi of the heart is prepared.

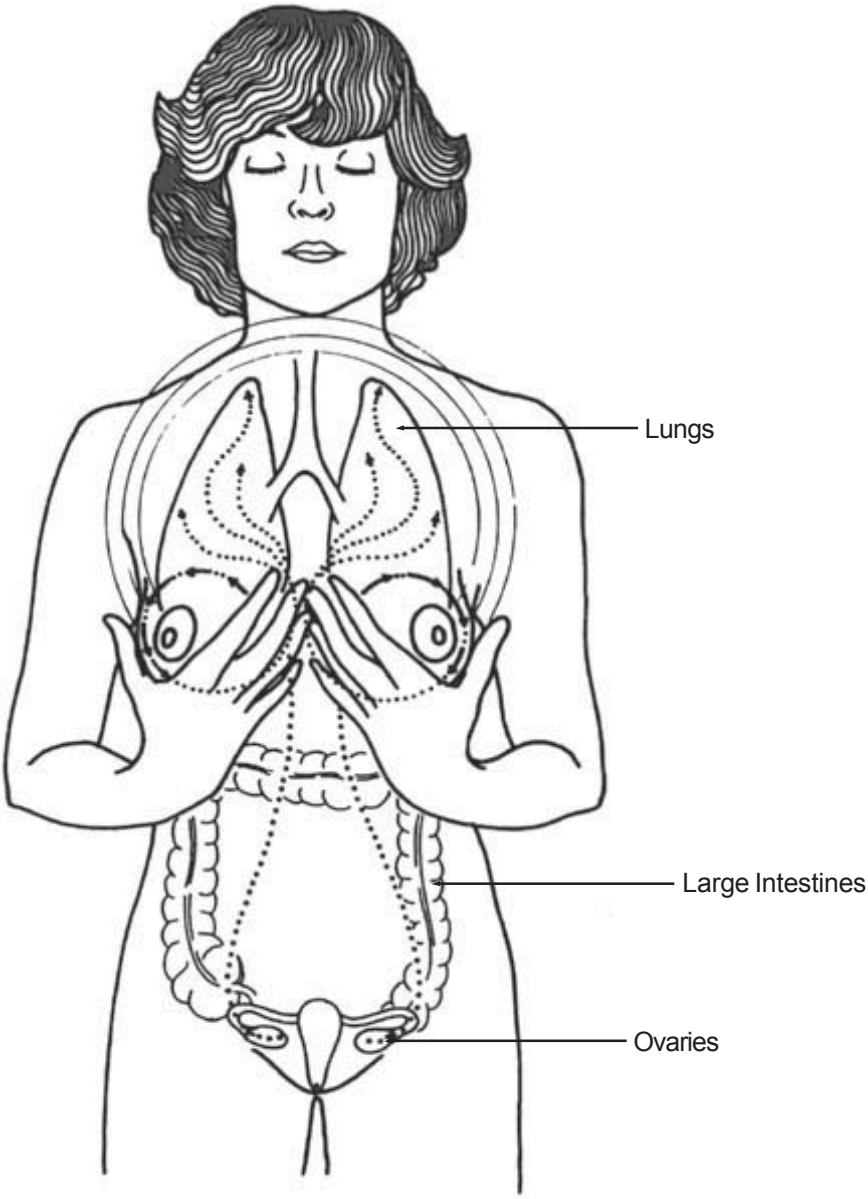

Fig. 6.9 *Lungs and Large Intestine Chi*

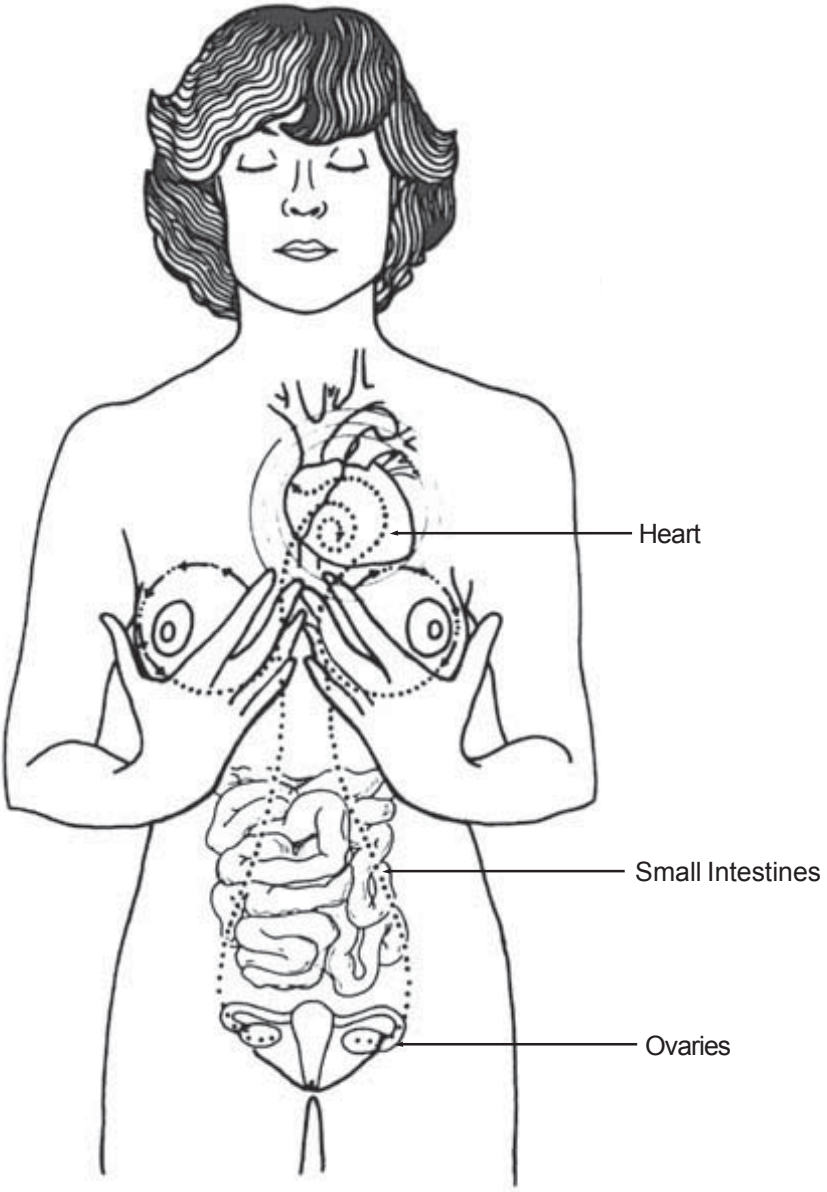

Fig. 6.10 *Heart and Small Intestine Chi*

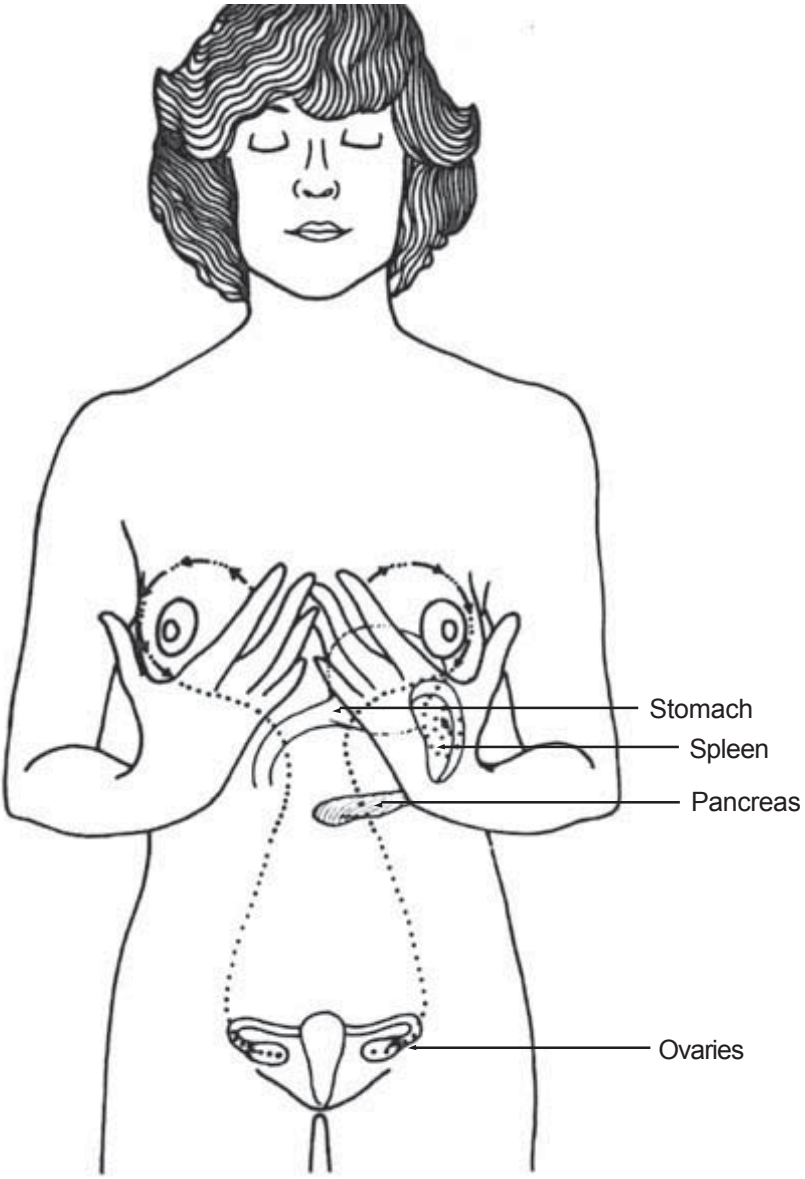

Fig. 6.11 *Spleen, stomach and Pancreas Chi*

(C) Spleen, Stomach and Pancreas Chi *(Fig. 6.11)*

The third Chi is felt from the spleen and its associated organs, the stomach and pancreas. Mild, harmonic energy is the property of the spleen. Fairness its good virtue, and the feeling can be a wide-open chest, clean, soft and balanced, even smooth. The negative emotion of worry feels irregular cloudy, humid, uncertain and out of proportion.

The physical manifestation of these organs' energy can be observed when your hands have the desire to grasp and squeeze the breasts. This indicates that the spleen energy is in readiness.

(D) Kidneys and Bladder Chi *(Fig. 6.12)*

Next is the Chi of the kidneys and their associated organ, the bladder; Their property is cold energy, and their virtues are gentleness. alertness and stillness. This can feel round, full, expansive, bright blue, fresh, cool and comfortable, pleasant to the ear: mild, and honey-like in taste. The negative feelings are fear, stress, fright, awkwardness, tiny, compressed, dark, gray, cloudy, a cold chill, tight or closed in, and scattered.

The physical manifestation of these organs' Chi can be observed when you feel as if you are drowning with fluid in the vagina. This means that the Chi of the kidneys is ready.

(E) Liver and Gall Bladder Chi *(Fig. 6.13)*

Liver Chi will be felt next. The liver's associated organ is the gall bladder. Its properties are warm and energetic. The virtues are kindness and self-expansion. They can feel round, smooth, soft, green, sweet, fragrant, warm and pleasant, nurturing, and as if they were gently expanding. The negative emotions are anger aggression, arrogance and can feel spear-like or sharp, cloudy, hot and explosive, loud, painful, tough, rough, and bitter.

The physical manifestation of these organs' Chi can be observed when the eyes become watery. This is the indication that the Chi of the liver is ready.

(F) Bone Chi

The next Chi that will be felt is bone Chi. When you feel like sucking the tongue, the Chi from the bones is prepared.

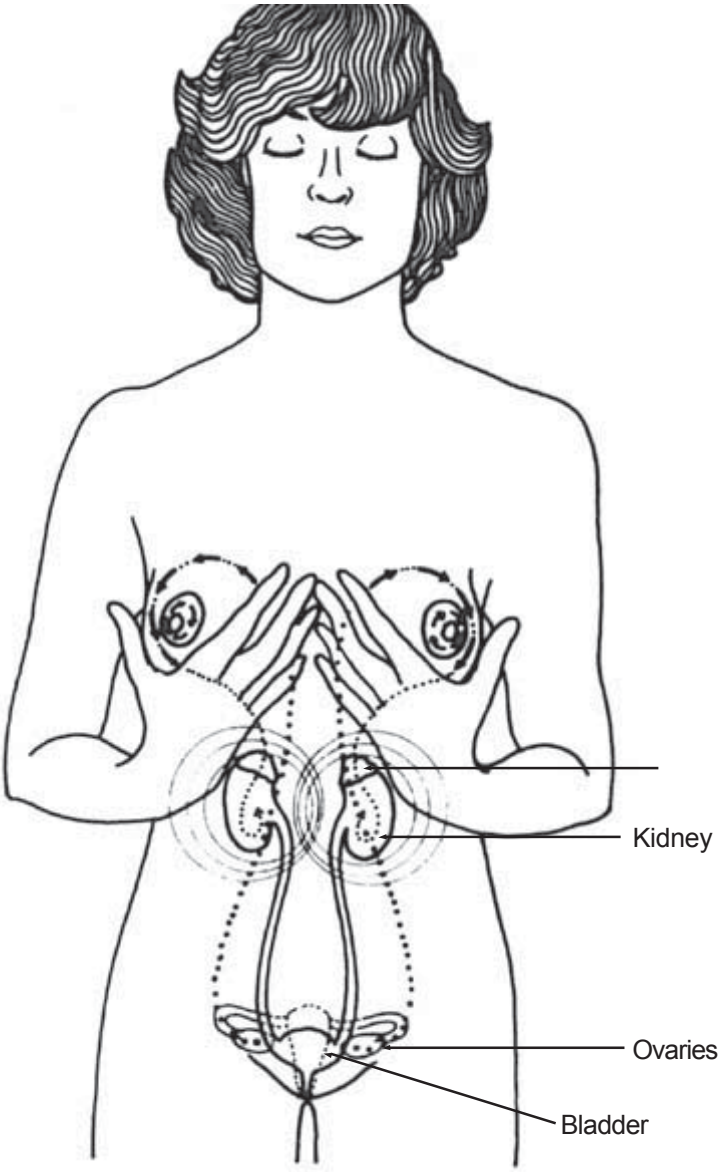

Fig. 6.12 *Kidneys, Adrenal Glands and Bladder Chi*

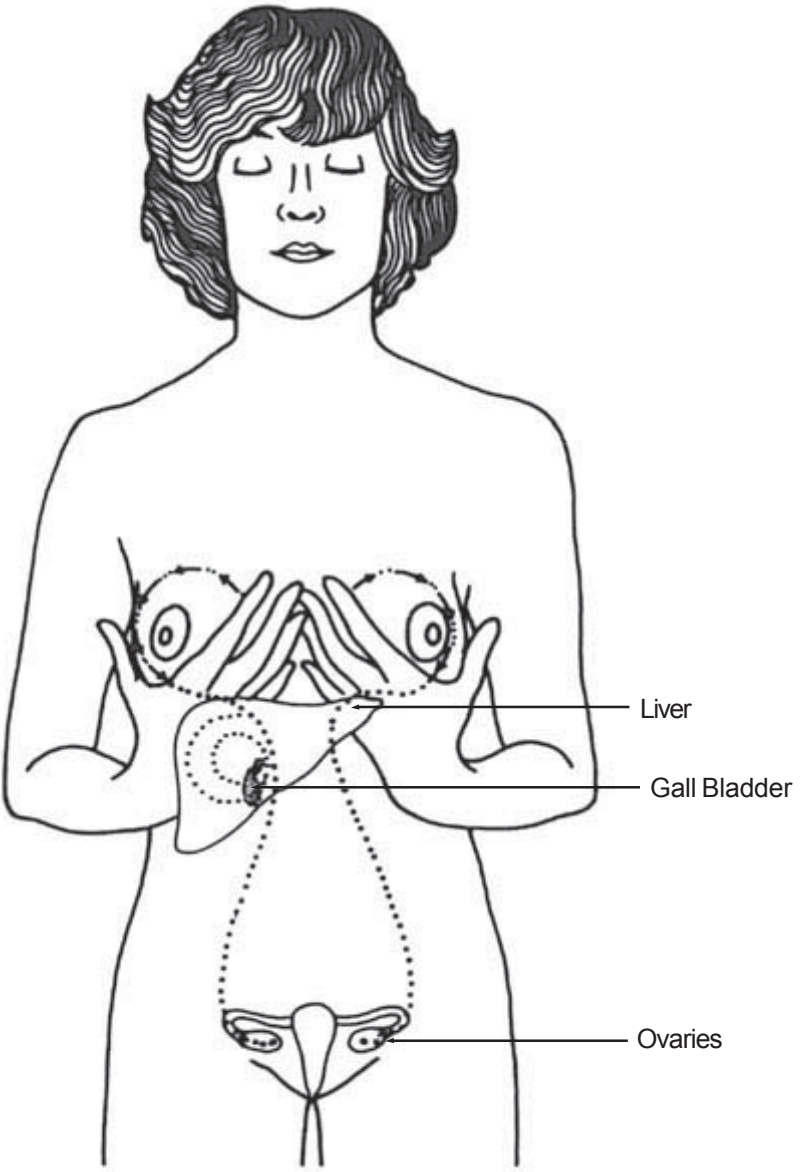

Fig. 6.13 *Liver and Gall Bladder Chi*

(G) Tendons and Sinews Chi

Tendons and sinews Chi is ready and will manifest itself you feel like raising your legs.

(H) Blood Chi

Blood Chi is ready when you are moved to touch your vagina and clitoris.

(I) Chi of the Flesh

Finally you will feel the Chi of the flesh. You will feel that this Chi is ready when the urge is to massage the nipples, vagina and clitoris.

3. Procedure of Massaging the Breasts

Begin the procedure by massaging the breasts to activate the ovaries' sexual energy, which in turn will activate the energy of the glands and organs. This exercise can be performed while sitting on a chair or on the edge of a bed.

A. Begin in a Sitting Position.

Be seated. As in Ovarian Breathing, you will want a steady and fairly firm pressure on the vagina's opening, especially on the clitoris. Sit on a fairly hard, round object such as a ball or a rolled-up washcloth. You may immediately experience a pleasant sensation due to the stimulation of the genital area. If you are well-practiced in Iron Shirt and the Microcosmic Orbit, you will not require an object.

B. Bring Chi up the Spinal Cord.

At this stage of your practice, you should be able to pull the middle and the back part of the anus up, thereby bringing the Chi up through the spinal cord, and then all the way up to the pineal gland. Hold it there for a while. Then pull up the left and right sides of the anus, and bring the Chi to the left and right nipples.

C. Warm your Hands.

Inhale and rub your hands together vigorously. This will create heat in your hands by bringing the energy of your body into your palms and fingers. Place your hands on your breasts in order to feel the heat from your hands entering the skin.

D. Massage the Glands

(1) Place the tongue on the roof of the mouth.

(2) Maintaining constant contact with the skin, very lightly massage your breasts using the second, middle and fourth fingertips of both hands. Moving your right hand clockwise and your left hand counterclockwise, gently press the breasts against the rib cage, proceeding very slowly down to the area of the xyphoid process under the base of the sternum. Bring your awareness there.

(3) To activate the glands, press your three fingers to the kidney point located approximately one and a half inches in from the nipple. This point is determined by taking the second joint on the middle finger of each hand and placing it directly on the nipple with the hands against the sides of the body The fingers will automatically fall so that the tips are at this kidney point. Use the same three fingers and massage, circling around toward the center (right hand clockwise, left hand counterclockwise). That circle will touch the kidney liver pericardium and spleen meridians.

(4) Continue to massage your breasts with your fingertips barely touching the skin and gently rotating. Massage them very slowly in an outward, circular motion (right hand clockwise, left hand counterclockwise). Bring your awareness there.

(5) When you feel the clitoris is activated, the sexual energy will surge to the head and activate the pineal gland. You might feel a pressure present in the head as the energy begins to radiate, like a beacon from a lighthouse, to the pituitary gland.

(6) Continue massaging and move your attention down to the pituitary gland, feeling the intense pressure in the forehead as it radiates a blue light.

(7) Permit the activated energy to descend to the thyroid and parathyroid glands. Feel the expansion of these two glands as they become activated by the Chi of the sexual, pineal and pituitary glands, and then feel them radiate the energy outward. Blend their Chi together with the Chi of the two higher glands. Let this special blend of glands' Chi flow down to the thymus.

(8) Continue to gently massage the breasts and settle your mind on the thymus gland, activating that gland. Feel it expand and blossom like a flower. Blend all the glands Chi gathered together thus far and permit their energy to radiate to the breast. Use your mind to blend their Chi in the breasts.

(9) Let the specially blended Chi flow down to the pancreas and feel the pancreas activate. Let the pancreas energy flow to the breasts.

(10) Allow the mind to concentrate on the adrenal glands, letting the special blend of energy you have created activate the adrenal glands. As you feel them activate, expand and release this special energy: bring this energy up to the breasts, where all the glands' energy is blending together .This glands' energy will help to activate the organs' Chi.

E. Massage the Organs

(1) Be aware of your nose and lungs, and continue to rub your breasts slowly, feeling the Chi from the thymus activate the breasts' and lungs' Chi. Feel the energy of righteousness as straight, bright white, pure and expanding. Fill the lungs and direct their Chi to the breasts.

(2) Be aware of your tongue and heart. Feel the Chi from the heart in the form of joy, happiness, respect and honor and direct this energy to the breasts. Think of the breasts as melting pots that will melt the glands' and organs' energy, fusing them into a very special kind of hormonal energy and the kind of compassion which is capable of rejuvenating the glands, organs and whole system.

(3) Direct your attention to your mouth: move your mouth around and be aware of the sexually aroused energy as it activates the spleen energy. Raise the virtuous energy of fairness, and feel it manifested in a wide open feeling in the chest. Feel the Chi of the spleen and direct it to the breasts. Feel the virtues fuse.

(4) Now direct the sexual Chi, which started from the clitoris and the breasts, to the kidneys. Activate the kidneys' Chi and expand the virtuous energy of gentleness, alertness and stillness, bringing it to the breasts. As you rub your breasts and activate each organ's Chi, this Chi will automatically be drawn to the breasts. Feel the Chi start to fuse with all the other Chi virtues, combining into a very special Chi.

(5) Direct the sexual Chi to the liver to activate the liver's Chi. Raise the kindness virtue and the feeling of self-expansion, also drawing these feelings to the breasts. At this time you should feel the vagina moistening from a sweating action of the vaginal walls, plus the secretion of glandular fluid. Soon the clitoris will become

engorged with blood and will become erect, and the nipples will become firmer: The outer lips of the vagina will become swollen to nearly twice their size. The inner lips will also swell.

(6) Then, place the palms of the hands on the knees, place your attention upon your breasts, and experience the energy there. By now you have accumulated a lot of energy in the breasts, where it all has melted together into compassion Chi. The nipples have become hard and erect with the swelling of the breasts. Let the energy flow like a funnel into the nipples as you feel the tingling warmth of sexual arousal. Wait a few moments as the breast energy accumulates in the nipples, and then using your concentration let the energy drop like a plumb line down into the ovaries. Your "inner eye" can help to direct the Chi there. Pause and feel the accumulated breast energy and wary energy.

(7) Become aware of your breathing and concentrate your attention on the ovaries, sending each exhalation directly to the ovaries. Concentrate on the ovaries, and use your mind and some muscles to move the lips of the vagina until you feel them swell. The PC Muscle will be tense, and then will relax and begin to pulsate. Feel an increase in the pulsation of the vagina, and feel it open and close like the petals of a flower: When this energy becomes strong, let the vagina close in and draw the energy from both ovaries to merge in the Ovarian Palace (located three inches below the navel at the cervix). You can slightly squeeze, tensing the cervix, and concentrate the sexual energy at this point. You are entering the orgasmic phase. With these practices you can direct the orgasm inward, and you can extend the orgasm more than you have ever dreamed you could. You have now completed stage one of the Orgasmic Draw. The Chi, which is ready is now comprised of the organs', glands', virtues' and sexual energies. Practice this stage, activating the clitoris and the thymus and pineal glands, for a week before you proceed with the Orgamic Draw. You will actuallyfeel the Chi in these areas. Then continue with this exercise, now moving to the lungs, the heart and spleen, etc., for another week. Once you are able to practice the entire sequence well, activating and collecting the glands' and organs' Chi will take only five to ten minutes per session. When you feel that the sexual Chi is ready at the Ovarian Palace, you can begin the Orgasmic Draw.

4. Procedure of the Orgasmic Draw: Moving the Aroused Organs' and Glands' Chi Upward Step-By-Step

A. Begin in with the Breast Message.

Use the same sitting position as you did previously for the breast massage. If sitting on a chair have your feet fist on the floor: If you need some more stimulation you can use the hard, round object previously described to press against the opening of your vagina, touching your clitoris. Stimulate yourself by rubbing your breasts, activating the organs' and glands' Chi. Fuse this with the sexual energy to become the energy of healing and compassion. Direct the sexual energy from the nipples down to the ovaries, and expand the energy into the ovaries and genitals, finally concentrating it in the Ovarian Palace.

B. Perform Muscle Contractions at the Point of Orgasm.

Inhale deeply through your nose when you are near or in the midst of orgasm. Simultaneously clench both fists and claw your feet down, making them feel like vacuum pumps sucking at the floor: At the same time clench your jaw, tighten the Cranial Pump at the back of your neck, and press your tongue firmly to the roof of your mouth.

C. Bring the sexual energy down to the Perineum (Hui-Yin).

Inhale once more and draw up the entire genital-anus region, concentrating on the Hui-Yin (perineum), urogenital diaphragm, and especially the front part of the perineum. Pull the energy from the Ovarian Palace downward to the perineum by squeezing the vagina's outer and inner lips as tightly as possible, feeling the force squeeze the clitoris. Holding your breath for a while, inhale again, contract and pull down the front part of the anus, holding your breath for a while. Feel the sexual energy being pulled down and collected at the perineum. With all muscles flexed, inhale, clench, and pull up your Ovarian Palace and sexual region repeatedly, holding the energy at the front part of the perineum. Practice nine of these hard contractions, inhaling without exhaling. Each time pull down from the Ovarian Palace to the front part of the perineum. Retention of the energy at the perineum is very important. If it is released, the sexual energy will drop down to the sexual organs or leak out the vagina, and you will have to start the exercise again. To retain the

energy at a certain point means you must settle your mind and concentrate on that point. When you become out of breath, exhale and release all the muscles in the body: You may feel energy rush up, down and around the sexual region, especially during this resting period. Use your mind to guide the energy from the Ovarian Palace to the front part of the perineum.

After practicing this exercise for a week or two, you may begin to feel the muscle contractions automatically pull your vagina in and squeeze the clitoris. The anus will feel as though closed very tightly. Remember that unless otherwise indicated, all breathing is through the nose. The whole body must relax on the exhale. Allow all tension to flow out of you as if you were in meditation. Practice this exercise for at least one week.

D. Raise the sexual energy to the sacrum by arching the sacrum and activating the sacral pump.

Start with arousing the breasts to stimulate the glands' and organs' energies to fuse with the sexual energy. Clench the fists, feet, neck and jaws on inhalation. Draw up the entire genital area, urogenital diaphragm, anus, and especially the vagina. Squeeze the energy tightly to the clitoris and pull it up to the perineum. Rest for a while, inhale again and contract the front part of the anus, drawing the sexual energy down from the ovaries to the perineum. Holding your breath for a while, inhale again, and contract the middle part of the anus. At the same time contract the back part of the anus and pull up toward the coccyx, a little up from the bottom tip of your spine, drawing the sexual energy up through the perineum, and continue to draw it up to your coccyx. Feel it enter the hiatus in the sacrum.

Activate your Sacral Pump by arching the sacrum back and outward thereby straightening the sacrum. This makes it easier for the Chi to rise. Hold the energy at the sacral area and continue to inhale and pull the sexual energy in from the Ovarian Palace and sexual organs, until you feel the energy in your clitoris and your vagina begin to subside. Sometimes this requires three to nine inhalations with increasingly harder contractions. Squeezing the buttocks more tightly may help you force the sexual healing energy (Ching Chi) into the sacrum. When you are out of breath, exhale. Then relax and let your sacrum and neck return to their normal positions. This resting period will induce the activation of the Sacral

and Cranial Pumps. You will gradually have the sensation of something entering into the spinal cord as the sacrum begins to open for more Chi to flow.

If you are well practiced in Ovarian Breathing, or have already opened your Microcosmic Orbit, this step of the Orgasmic Draw will be much easier. Otherwise, the sacral area is usually a little difficult to pump the energy through since, as previously noted, sexual energy is denser than other types of Chi, and aroused sexual energy is denser still. This is where the Sacral Pump enters in. As mentioned in the Ovarian Breathing exercise, some people will experience pain, tingling, or a “pins and needles” sensation when the sexual energy enters the sacral hiatus. This should not be alarming. Remember you can assist the sexual energy in its upward push past the coccyx by gently massaging the area with a silk cloth from time to time.

E. Draw sexual energy to T-11 by bowing the spine outward.

Once you are able to move the energy through your sacrum, spend the next week drawing the energy to T-11 (on the spine, opposite your solar plexus). Repeat the same procedure: arousing, clenching, and inhaling. Pump the energy up to the perineum, sacrum, and then to T-11. Again, because sexual energy is denser than life-force (Chi), you have to accommodate it by bowing your spine outward, as if you were backing up against a wall and pushing toward it to straighten your spine. This will increase the pumping action and allow for a freer passage of Ching Chi. Retain the energy at T-11 until this point feels full of energy. Practice nine hard contractions. Each time bring the energy from its source at the Ovarian Palace to T-11: each time inhale without exhaling. Then exhale and relax every part of your body, mentally guiding the Chi to flow from the Ovarian Palace to T-11.

F. Push from the sternum and bring sexual energy to C-7. Your next station is C-7 (at the base of your neck). Practice in the same manner as described above: continue to draw the energy down to the perineum and up to the sacrum (arching the sacrum), up to T-11 (bowing the spine outward), to C-7, and push the top of the sternum back toward C-7 at the base of the neck. This will help increase the pumping action of the spine, activate the thymus gland, join the thoracic and cervical vertebrae, and help push the sexual energy up.

G. Straighten the spine and bring the sexual energy to the base of the skull Jade Pillow).

The next stopping place is your Jade Pillow (located at the back of your head between C-1 and the base of the skull). Practice in the same manner as previously described: continue to draw the energy down from the Ovarian Palace to the perineum, up to the sacrum (arching the sacrum), up to T-11 (bowing the T-11 outward), up to C-7 (pushing from the sternum to C-7), thereby straightening the entire spine. Inhale and pull up to the Jade Pillow, then push the chin in toward the back and base of the skull. This will activate the Cranial Pump. At this point clench the teeth, squeeze the muscles at the back of the skull, and press your tongue hard to the palate. All of these movements will increase the Cranial pumping action. The Cranial Pump, as it fills with energy and begins to move the energy through, may pound furiously.

H. Activate the cranial pump and bring the sexual energy to the crown (Pai-Hui).

The next station for energy is the Pai-Hui (located at the crown of your head). Draw two imaginary lines from the tip of your nose and the tip of an ear straight up to the top of the head. The point where they meet is the center of your head, or crown. Press around this area and find the most sensitive spot. This is the Pai-Hui. You will be able to confirm this as the proper spot when you feel the energy reach this point.

Repeat the same process of arousing the sexual energy by massaging the breasts. When you are ready bring the energy down from the Ovarian Palace, draw it up to the sacrum, T-11, and C-7, straighten the spine, and draw the energy up to the Jade Pillow. Tuck your chin in slightly and squeeze the skull to further activate the upper Cranial Pump. Maintain a straight upper spine. Turn your eyes and all your senses up to the top of the crown. Press your tongue firmly to the palate to help activate the Cranial Pump located there. Persist in pulling the energy to the top of your head until you feel the aroused energy at the lower center subside, all the energy having been transferred to the higher center. Practice nine hard contractions and continue to inhale, each time pulling the energy from the Ovarian Palace up to the crown. Use your mind, eyes and all of your senses to spiral the sexual creative energy nine, eighteen, or thirty-six times, first in a clockwise, and then in a

counterclockwise direction. Some people feel the energy first start to flow counterclockwise. If this is the case, simply let it flow. When the spiraling has finished, rest for a while and be aware of the sensational feeling as the energy enters the brain. Let the extra energy flow down the front channel, or Functional Channel, to the third eye, nose, throat, heart center, solar plexus, and finally to the navel where this extra energy can be stored.

When the energy finally goes up into your head, it will produce a very distinct warm and tingling sensation. The usual immediate response is that it feels good and amazingly refreshing. Some people claim they can think more clearly and are more creative. This is possible once they have reached the stage where they can easily convert the Ching Chi into expanded consciousness automatically. As previously emphasized, this sexual energy is later converted into original Chi, the pure Life-force, during the spiritual levels of the Taoist practice.

Remember that all the organs and glands are activated as a result of this massage.

5. Learn to use your mind to direct the aroused Organs' and glands' CMI.

Practice the Orgasmic Draw until you can pull the sexual energy up from the ovaries to the pineal gland in one draw of the "straw." In the beginning simply move from one station to another. Later this back channel, the Governor Channel, will feel more open. Eventually you will be able to settle your mind on the ovaries and the pineal gland at the crown of the head, and bring the sexual energy from the ovaries all the way up to the brain through what has been previously described as the Thrusting Channel, using only the power of the mind and all the senses. Up to this point in your practice, you had incorporated the assistance of muscle power to direct the sexual energy upward. At this stage, through practice, the muscles have become well developed and are responding automatically This allows you the freedom to eventually use only the power of your mind and senses to direct the aroused organs' and glands' Chi upward.

You must take time to really feel the sexual energy when you practice. Do not rush, and always maintain that pumping action after the exercise as you breathe in and out. Gradually use your mind more and your body less as you practice. Let the feeling of the energy be your guide.

A. Golden Nectar

Since this sexual energy, compared to other sexual energy is cooler and more creative, it cannot harm you if left in the head. When you feel that the energy has filled the brain, you will feel a honey-like fluid flow from the pituitary gland down to the nose, palate and tongue. The taste will vary with different people and on different days. It is called “Golden Nectar” and can taste delicate, like champagne, honey, coconut juice, or perhaps slightly metallic. It can feel like a warm tingling sensation on your tongue. For some people the energy flows from the brain into the pituitary gland, down the nose, palate and mouth, to the throat, heart, solar plexus, and finally to the navel. As your practice grows, the ovaries’ energy will flow thicker eventually feeling like honey flowing from a jar (the brain) into a cauldron (the navel).

B. Circulating the Energy during Lovemaking

During lovemaking we need to move the energy in a circle, and not just store it in the brain, in order to direct the excess energy to revitalize the organs and glands. This circulation is aided by the internal pressures you create during the Orgasmic Draw as you squeeze the perineum and buttocks. As you press the lower trunk energy into and up the spine, press the energy in your upper body downward, and hold the contraction as long as you can. When you exhale completely relax the entire body. The natural direction of the Chi is to continue in a circle up the back of your body and down the front to the navel.

Continue cycling the sexual energy in this way until your orgasm travels upward into the organs, glands and higher center In the beginning this might take three to nine such cycles, but after you have practiced for a while, one such round is enough.

6. Organs’ Orgasm

A. Characteristics of Each Organ

In the Tao system we believe the organs and glands are the creation and storage places of the positive and negative emotions of our life. Each organ and gland stores and accumulates different kinds of emotional energy. Once the organ is depleted and weak, the negative emotions easily settle in, or the organ is influenced by the

other organs of the body. If we become aware of the source of unwanted energy; we will have a way to correct it. Each organ's characteristics (i.e., associated organ, element, etc.) are as follows:

(1) Lungs

Associated organ: large intestine. Element: metal. Season: autumn-dryness. Negative emotions: sadness, grief, sorrow. Positive emotions: righteousness, surrender letting-go, emptiness. Parts of the body: chest, inner arms, thumbs. Senses: nose-smell, mucous, skin, touch.

(2) Kidneys

Associated organ: bladder, Element: water, Season: winter, Negative emotion: fear. Positive emotions: gentleness, alertness, stillness. Parts of the body: side of foot, inner legs, chest. Senses: ears- hearing, bones.

(3) Liver

Associated organ: gall bladder, Element: wood. Season: spring. Negative emotions: anger, aggression. Positive emotions: kindness, self-expansion, identity Parts of the body: inner legs, groin, diaphragm, ribs. Senses: eyes-sight, tears.

(4) Heart

Associated organ: small intestine. Element: fire. Season: summer, Negative emotions: impatience, arrogance, hastiness, cruelty, violence. Positive emotions: joy, honor sincerity creativity, enthusiasm, spirit, radiance, light. Parts of the body: armpits, inner arms. Senses: tongue-taste, speech.

(5) Spleen

Associated organs: pancreas, stomach. Element: earth. Season: Indian summer, Negative emotions: worry, sympathy pity. Positive emotions: fairness, compassion, centering, music-making. Parts of the body: neck. Senses: mouth-taste, appetite.

(6) Triple Warmer (Circulation Sex)

There is no element, season or emotion associated with the Triple Warmer. The Triple Warmer refers to the three energy centers of the body:

The upper level: brain, heart, lungs. Property: hot.

The middle level: liver kidneys, stomach, pancreas, spleen. Property: warm.

The lower level: large and small intestines, bladder sexual organs. Property: cool.

The main goal of the organs' orgasm is to strengthen, satisfy and restore the organs to their natural state in order to generate good virtue and healing for ourselves and others.

B. Organs' Orgasm Practice Step-By-Step

Once you have practiced the steps above and have become successful in moving the aroused sexual Chi in the Microcosmic Orbit, you can begin to move this orgasm energy into the organs. Remember as you follow the steps below, always move the Chi in the Microcosmic Orbit first before continuing.

(1) Once the sexual energy is aroused, inhale and pull up the left and right anus to draw the energy to the left and right ovaries. Circulate the energy in the Microcosmic Orbit, and then drop the sexual Chi into the ovaries.

(2) When you begin to feel the sexual energy in the ovaries, move it to the left and right kidneys. Wrap the orgasmic energy: now highly refined by all of the organs and glands, with all of the combined virtues of those organs into compassion energy. Feel the kidneys bathe in this healing, creative and revitalizing energy. The actual sensation of a kidneys' orgasm is different from anything else. In fact, as you bring the compassion energy to each organ, each will have a different type of orgasmic feeling that is beyond words. It is greater than anything you have ever experienced. The organs' orgasms have a longer-lasting orgasmic feeling, bringing good health, fulfillment, joy and happiness. This kind of joy and fulfillment comes only from the sexual, creative, and generative qualities of the compassion energy that fills the organs.

Every time you move the orgasmic energy in the Microcosmic Orbit, pull it up to the ovaries, then to the left and right kidneys, and proceed, moving the energy up to:

(3) the spleen (on the left) and the liver (on the right):

(4) the left and right lungs: and

(5) the left and right sides of the brain.

(6) When you have become proficient in the Microcosmic Orbit

and moving the energy to the left and right organs, contract the middle anus to bring the sexual energy to the cervix:

(7) the aorta and venacava:

(8) the pancreas: and

(9) the heart. Be very careful moving the energy to the heart because problems can be created here. Be careful in the beginning not to draw too much sexual Chi into the heart.

(10) Next take the energy to the thymus gland. This is very important for women because when this center is rejuvenated, the sexual energy will be able to increase a great deal with the assistance of that gland, thereby increasing the assistance of the other glands.

(11) Next bring the energy to the thyroid and parathyroid glands:

(12) then to the pituitary gland:

(13) to the pineal gland; and

(14) up to the crown.

(15) A final refinement to remember is that the lower contraction is not centered In the stomach or abdominal region. You must not tighten your stomach muscles during the Orgasmic Draw as this will draw Chi away from the Microcosmic Orbit. We must concentrate on the front of the undertrunk, i.e., the vagina, perineum, and urogenital diaphragm. Our goal is to so train these muscles that by using them we can flood the body with restorative energy. Directing power from the lower trunk toward the center of the body pours energy into the navel region. Since ovary and egg energy, like the blood, tend to follow the Chi energy, the navel, in effect, grips the ovary and egg energy and pulls it up into the body through the spine. Therefore, if you contract the urogenital diaphragm as if you were holding in a bladderful of urine, you will lock the passages so tightly that no internal urge can burst through the sealing rings of muscle. Make sure that there is no infection in the urinary tract which can cause infection in the bladder when you stop the urine.

C. Daily Practice

Nothing will come of nothing. You must spend time in practice to reap the benefits. An ounce of practice is worth a ton of theory. Modem life, it seems, affords little time for anything but acquiring and spending. You must be willing to surrender some time to advance. The practice must become part of your daily routine. You will make some progress if you do the exercise more often than

not. If, however you practice as regularly as getting out of bed in the morning, progress will be swift, Chi will begin to build in your upper body, and you will be able to collect it at your navel.

Once you have mastered this technique, it requires only a few minutes each day to bring the sexual Chi to all the organs and glands with simply a few Orgasmic Draws. After a while when you do the Orgasmic Draw a few times you will feel, all at once, the sexual energy filling the organs and glands quickly.

If you can, practice six or nine complete contractions of the Orgasmic Draw, with each complete draw consisting of nine hard contractions. If possible, practice both in the morning and at night, and you will progress quickly. Once you have mastered the technique, eighteen to thirty-six repetitions performed morning and night should not be unduly strenuous. If you become extremely aroused, do fewer repetitions. With such intensity of training, you will easily develop the muscle tone required within a month or two. How quickly you progress is not important: what is essential is that you progress steadily. Rock bottom minimum should be one round per day; just to maintain the practice.

The preferred times for these exercises are from eleven a.m. until one pm., and eleven pm. until one a.m. During these periods the tide of Yin energy changes to Yang, and vice versa. At these times the power flows very well. If it is impossible to practice during these hours, do not be discouraged because as long as you exercise daily, you will definitely advance.

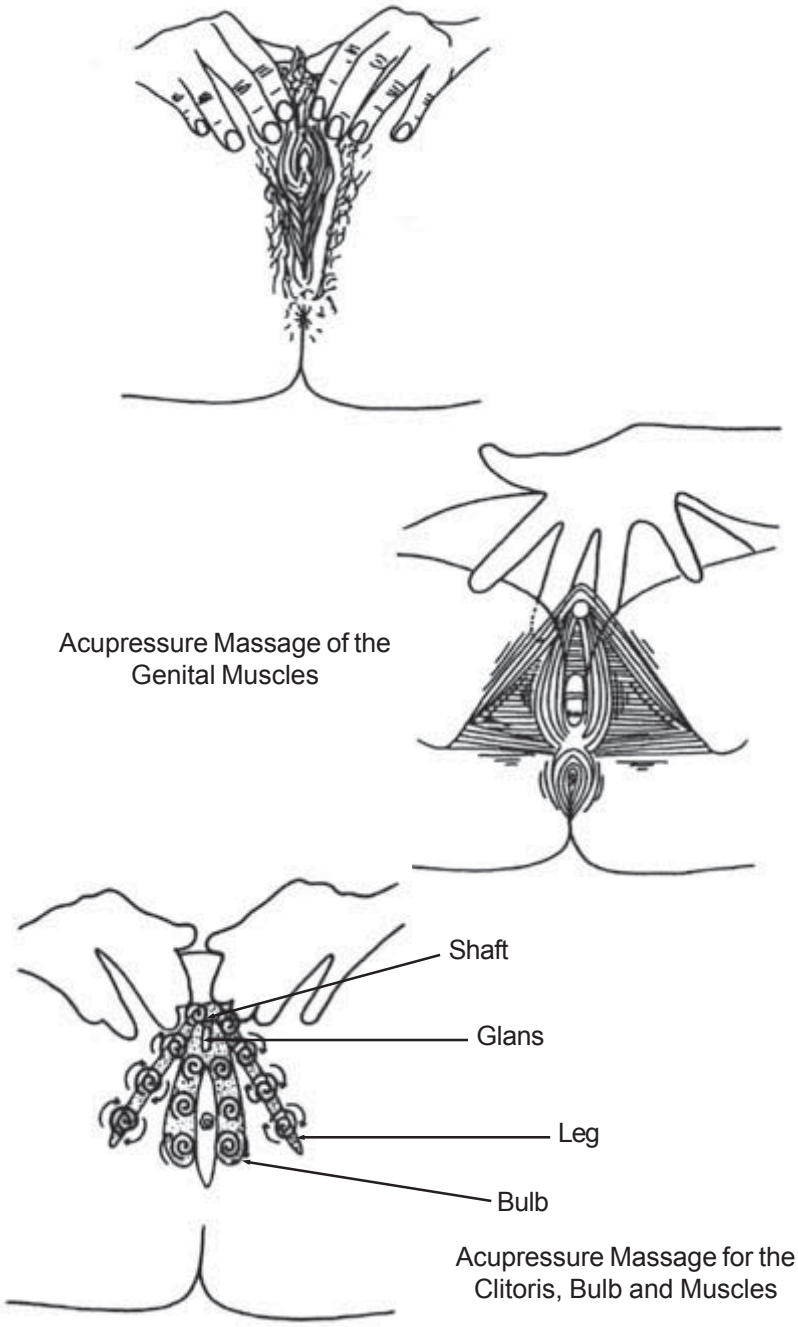

Fig. 6.14 *Massaging the Genitals after Practice*

D. Massage

After each practice session of the Orgasmic Draw, be sure to massage your breasts and genitals. This will disperse any energy that did not get drawn up and will alleviate any feelings of congestion or fullness.

Use your hands or a silk or taffeta scarf. Briskly rub your breasts in a circular motion, pressing them against your ribs. Then massage the mons and outer lips of the vagina, the perineum and the sacrum. This active massage should be done until you feel a cleanliness in your breasts and genitals. (Fig. 6.14)

One woman reported that she stopped the massaging step because she did not think it was important, and then noticed an increase in breast congestion right before her period. When she resumed the massage practice, she did not have any more problems premenstrually.

E. Safety Points for Ovarian Breathing, Ovarian Compression, and the Orgasmic Draw

1. Never lie flat on your back during these exercises. The Chi power may stick in your chest, causing considerable irritability and undue pressure on your heart.

2. Never lie on your left side when practicing. This also stresses the heart and overfills it with energy.

3. Never place any objects under your side while in the lying position. This will bend the channel of energy and way cause back pain.

If any of the problems mentioned in points 1 to 3 arise, release the energy safely by using the venting exercise described in Chapter 5. Any pain or discomfort should disappear within one week of beginning to vent.

4. Practice on an empty, but not hungry, stomach whenever possible. Always wait at least one hour after eating.

5. Wear loose clothes or wrap yourself in a light blanket during this practice. You will perspire if the exercises are done properly and will suffer a chill if you are not covered. After practice, change your clothes so that you are removed from the moisture of the fabric. There should be a gentle flow of clean air in the room. Avoid any drafts or wind. Wind tends to blow the Chi power away. It might cause your energy to become cold easily.

6. As you advance, beads of sweat may accumulate on your brow. Rub this sweat into the skin--it has desirable properties which should be returned to the body.

7. Do not breathe through the mouth during these exercises. It is easier to control the flow of air when breathing through the nose. Inhalation through the nose charges the air with energy and invigorates the brain.

8. Do not be concerned if you feel little effect during the first days or weeks of practice. Each person needs a varying amount of time before heat flows from her ovaries.

9. You must develop intense concentration. Keep your mind from wandering. Alow thoughts and images to leave without following them. Empty the vessel of the mind of thoughts, and powerful energy will stream into the void. Your power of concentration will develop greatly if you persist in this discipline. Learn the Microcosmic Orbit meditation, and carry it out immediately after practicing the Orgasmic Draw.

10. During the resting period close the eyes and follow the energy's path. The mind should not stray to thoughts or fantasies, but should flow with the course of the energy. This may sound very difficult. You will be amazed at how quickly you can become sensitive to your own energy. When you experience these energies within yourself, you will know exactly what we mean. Since the energy flows along natural courses, it guides your mind even as your mind guides the energy.

11. Those who suffer from constipation should practice in the morning. These exercises will help greatly to remedy the problem.

12. If you are infected with venereal disease, thoroughly cure your self before engaging in this exercise. Otherwise the pain will be quite severe when you draw so much blood and power to the pubic region.

F. Cleansing Side Effects

Although they may appear elementary. the exercises in this and the preceding chapter are highly refined techniques for increasing vital power. They are like sharp swords which must be used with care to perform their functions without harming oneself. If you follow the instructions closely you will not suffer any distressing side effects. Study the methods with seriousness, assimilate every line of the text, and persist until you have succeeded.

1. It has been our experience that many students of this method soon begin to move their bowels with unaccustomed ease. Some will pass an unusual amount of gas for a time and move the bowels two or three times per day. In this way the body uses its new resources thoroughly to cleanse and purify itself by completely natural means. The unusual number of evacuations and gas decreases within one or two months.

2. This purgative detoxification is followed by regular bowel movements and a deep sense of bodily purity and strength. The saliva becomes lighter and sweeter. Improvement in bowel function arises from the increased flow of vital energy into the entrails. This energizes the involuntary muscles and allows them to function with ease. There may also be a noticeable increase in burping, which is a healthy exhalation of impurities and noxious gas within the body Burping also lessens after a time, as the body becomes more refreshed.

3. The Orgasmic Draw is excellent for improvement of hemorrhoids. Hemorrhoids are caused by sedentary life styles, accumulated heavy toxins, gravitational pooling of blood, stressful bowel movements, and depressed levels of Chi energy in the Hui-Yin. In already existing hemorrhoids, the Orgasmic Draw may cause increased hemorrhoids bleeding for two to four weeks. If the bleeding is not excessive, perform the exercise at half strength. You will gradually be cured. The exercise remedies specific causes of hemorrhoids by evacuating stagnant blood from the anal blood vessels. While performing the Orgasmic Draw as a cure for hemorrhoids, you may use medication to speed the healing process. Horsetail Grass (Equisetum Narvensis) is an excellent remedy used as a tea and in sitz baths. People who have serious hemorrhoid problems should consult a doctor:

G. Summary of the Orgasmic Draw Exercise

1. Sit with your feet flat on the floor. Use the stimulation of a hard object against your vagina and clitoris, if necessary. Rub your breasts to stimulate yourself. Direct the sexual energy from the nipples down to the ovaries, and expand the energy in the ovaries and genitals, finally concentrating it in the Ovarian Palace.

2. Inhale deeply through your nose when you are near or in the midst of orgasm while simultaneously clenching both fists, clawing your feet, clenching your jaws, tightening the Cranial Pump at the

back of your neck, and pressing your tongue firmly to the roof of your mouth.

3. Inhale once more, drawing up the entire genital-anus region, especially concentrating on the front part of the Hui-Yin (perineum) and the urogenital diaphragm. Pull the energy from the Ovarian Palace downward to the perineum by squeezing the vagina's outer and inner lips as tightly as possible, thereby squeezing the clitoris. Hold your breath for a while, inhale again, contract and pull down the front part of the anus, again holding your breath. Feel the sexual energy collect at the perineum. With all muscles flexed, inhale without exhaling, clench, and pull up your sexual region nine times, holding the energy at the front part of the perineum. Retention of the energy here is very important. When out of breath exhale and release all the muscles in the body. Rest. Use your mind to guide the energy from the Ovarian Palace to The front part of the perineum.

4. Arouse the breasts again, and with an inhalation clench the fists, feet, neck and jaws. Draw up the entire genital area, urogenital diaphragm, anus, and especially the vagina, squeezing the energy tightly to the clitoris and pulling it up to the perineum. Rest for a while, inhale again and contract the front part of the anus, pulling the sexual energy down from the ovaries to the perineum. Hold your breath for a while and inhale again, contract the middle part of the anus and then the back part of the anus, pull the sexual energy up through the perineum, and continue to draw it up to your coccyx to enter the hiatus in the sacrum.

Arch the sacrum back and outward, straightening it, to activate the Sacral Pump. Hold the energy here and continue to inhale three to nine times, pulling the sexual energy in from the Ovarian Palace and sexual organs, with increasingly harder contractions if necessary, until the energy in your clitoris and your vagina subsides. Squeezing the buttocks mote tightly may be helpful. When you are out of breath, exhale: then relax and let your sacrum and neck return to their normal positions, and rest to induce the activation of the Sacral and Cranial Pumps as the Chi enters the spinal cord through the sacrum.

5. To draw the energy to T-11, repeat the same procedure described in 1. through 4. above. Bow your spine outward and straighten your spine to accommodate the dense sexual energy and increase the pumping action. Retain the energy at T-11 until

this point fills with energy. Bring the energy from the Ovarian Palace to T-11 nine times with hard contractions, inhaling each time without exhaling. Exhale and relax every part of your body, mentally guiding the Chi to flow from the Ovarian Palace to T-11.

6. To draw the energy to C-7, practice in the same manner as described above. As you bring the energy to C-7, inhale and push the top of the sternum back toward the base of the neck to straighten the entire spine, increase the pumping-up of the energy, activate the thymus gland, and join the thoracic and cervical vertebrae.

7. To draw the energy to your Jade Pillow, practice in the same manner as previously described. Inhale and pull up to the Jade Pillow, pushing the chin in toward the back and base of the skull to activate the Cranial Pump. Clench the teeth, squeeze the muscles at the back of the skull, and press your tongue hard to the palate to increase the pumping action.

8. Next draw the energy to the Pai-Hui, or crown of the head. Repeat the same process, maintaining a straight upper spine. Turn your eyes and all your senses up to the top of the skull. Press your tongue firmly to the palate to help activate the Cranial Pump. Continue to pull the energy to the top of your head until you feel the aroused energy at the lower center subside. Practice nine hard contractions and continue to inhale, each time pulling the energy from the Ovarian Palace up to the crown. Use your mind, eyes and all your senses to spiral the sexual creative energy nine, eighteen, or thirty-six times, first in a clockwise, and then in a counterclockwise direction. When the spiraling has finished, rest for a while and feel the energy enter the brain. Eventually by settling your mind on the ovaries and the gland at the crown of the head, you will bring the sexual energy from the ovaries to the brain by using only the power of the mind and all the senses.

9. The cool energy can be left in the brain or when you feel the brain is full, let the extra energy (Golden Nectar) flow down the Functional (front) Channel to the third eye, nose, throat, heart center solar plexus, and finally to the navel where it can be stored.

10. During lovemaking do not store the energy in the brain, but circulate it to direct the excess energy to revitalize the organs and glands. Squeeze your buttocks and perineum, and press the lower-trunk energy into and up the spine. At the same time press the energy in your upper body downward, holding the contraction as long as possible. Then exhale completely and relax the entire body

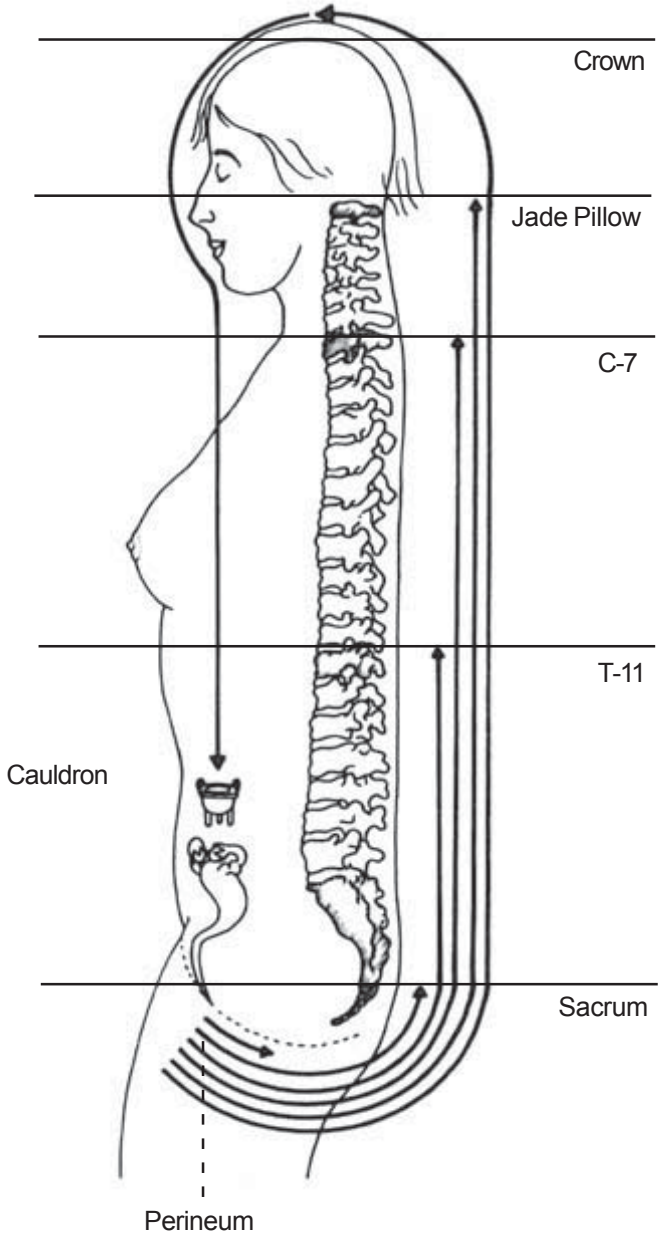

Fig. 6.15 *Internal Alchemy begins at the Cauldron.*

The Chi will continue to circle up the back and down the front of your body to the navel. Continue cycling the sexual energy in this way until your orgasm travels upward into the organs, glands and higher center

H. The Orgasmic Draw is the Basis for Alchemical Sex

To make full use of the Chi Ching gathered at the navel requires study of the Taoist methods of meditation. Slightly behind or below the navel is the Lower Tan Tien Center, the lower field of energy in the body within which the Taoists store Chi before refining it back upward. The Chi moves in circles among the lower, middle, and upper Tan Tien. Each time it spirals past it is refined into a higher quality of Chi. The process of refining and balancing the energy is taught in the Microcosmic Orbit, the Fusion of Five Elements, and the Lesser Enlightenment of Kan and Li courses.

It is not unlike taking crude honey mixed with wax, dirt and dead bees, and methodically refining it into the sweetest of nectars. Taoists treat the ovaries like raw honey. The Orgasmic Draw is the step of preventing the raw honey from leaking out of an old bucket and storing it in a new and well-sealed "jar" In this "jar" or "cauldron," placed at the level of the navel about two-thirds of the way back toward the spine, the ancient Masters mixed and cooked the different Chi energies of the body in a process they called "alchemy" the precursor of modern chemistry. (Fig. 6.15)

The secret alchemical agent they used was nothing more than ordinary sexual "essence," i.e., Ching. Without it, however, none of the higher levels of alchemical meditation would work. The Sexual Kung Fu exercises of Ovarian Breathing, Ovarian Compression, and the Orgasmic Draw may seem simple and too rudimentary to affect spiritual development, but their proper mastery is essential before you can move on to a loving relationship in full command of your sexual and spiritual powers. Your sexual essence is an elixir of life and the fountain of your youth, and is well worth training vigorously to safeguard.

Fig. 6.16 *Internal Alchemy begins at Cauldron with the Sexual Center.*

Chapter 7
Egg Exercises
Tips to Increase Sexual Energy

A.Introduction to Egg Exercises- Vaginal Weight Lifting

The use of a stone egg to strengthen the vagina is a practice which evolved in ancient China. As time went on, the secret of this practice remained in the Royal Palace and was taught only to the queen and concubines. Many who mastered the technique experienced very good health, remaining young and bountiful, with sexual organs in old age as tight and resilient as those of a young, unmarried lady. Some believe that the queen and concubines practiced the technique in order to please the king while making love. Originally, however the Egg Exercise and Vaginal Weight Lifting were implemented for improving health, both physically and spiritually, since these exercises provide more power to the Chi Muscle to lift the sexual energy inward and upward where it will be transformed into higher spiritual energy.

The egg is a marvelous way to strengthen and control the Chi Muscle. It is easier to practice control of this muscle with an egg in the vagina since, as the egg moves, you can feel the direction in which the Chi Muscle moves more distinctly. Controlling this voluntary muscle means control of the many involuntary muscles in this area as well. Also, as you master the use of this muscle of the vagina and perineum, you simultaneously tone up the lower abdomen. Thus, your performance of Ovarian Breathing, the Orgasmic Draw, and the Organs' Orgasm greatly improves, and the flow of sexual hormones increases.

Vaginal Weight Lifting is a very powerful practice to strengthen, in addition to the Chi Muscle, the urogenital and pelvic diaphragms. The strength of these two diaphragms is very important since these diaphragms serve as floors to the sexual organs and all vital organs. When the Chi Muscle and diaphragms are loose, Chi pressure will leak out from the organs as they stack upon each other, dropping all their weight to rest upon the perineum. When strong, the muscle

and the diaphragm function as seals, preventing leakage of life-force and sexual energies.

1. Selection of your Egg

Gem and mineral shops generally have a large selection of sizes and materials as well as prices. We researched and tested several different materials and found a volcanic rock called obsidian carved into egg shapes which contained the properties that we are looking for: embracing the Yang power of the volcano, but originating from the Yin power of the center of the Earth. These characteristics attract and concentrate the Yin essence of a woman. Further details, as well as the eggs themselves, can be obtained from the UniversalTao System.

When you look at the eggs you will have to decide what size looks like it might feel comfortable in your vagina. The eggs range in size from that of a quail egg to jumbo supermarket eggs. Most women choose a medium-sized one, that is, an egg approximately one inch in diameter made of either stone or wood. Wooden eggs can be easily drilled for the attachment of weights, and are therefore suited for the Vaginal Weight Lifting practice. We prefer to use stone eggs, such as obsidian, for the internal sucking exercise because of their smooth, non-porous nature. The smaller the egg, the more work your muscles will have to do because they will have to contract more strongly to cause any movement of the egg. Select an egg with a smooth surface.

2. Care for the Egg

Proper attention and care to one's feminine hygiene is an absolute necessity prior to beginning this practice. Cleanliness of the vaginal canal and the eggs are equally important. Wooden eggs should be boiled or cleaned every one to two months with a diluted vinegar solution (one tablespoon per quart of water) and allowed to dry for at least one hour; since the wooden egg easily absorbs vaginal fluid and can be a culture for germs if permitted to remain wet. A stone egg should be boiled by bringing it to the boiling point, and then allowing it to cool down. Boiling the stone egg is necessary prior to its first use. After that, simply wash it with water after each time you use it. A word of caution about using soap or detergent: some people are allergic to certain chemicals that are found in

soap and detergent, especially when inserted into the channel where the membranes are very sensitive. Also, many women are unknowingly allergic to alcohol (isopropyl or rubbing type), therefore its use should be avoided for cleansing purposes.

3. Caution in Practicing the Egg Exercises

a. Before practicing the egg exercises, you must first master Ovarian Breathing.

b. You must be fully aroused before inserting the egg. If you produce very little fluid naturally, use a lubricant.

c. Married women should use a smaller egg.

d. Do not practice lying down.

e. If a problem arises and the egg becomes stuck, do not panic. Lie down and relax and the egg will come out.

4. Using the Egg

A. Beginning the Exercise

The first time you use the egg, you will probably want to, and should, exercise all precaution until you become accustomed to it. Each time before practicing the egg exercise, you must warm yourself by massaging the breasts, making sure the vagina is expanded and some lubricating fluid is being emitted. In this chapter we provide you with a simple breast massage to warm you up. If you decide to practice immediately after the Orgasmic Draw, there is no need to try this simple version of massage because you have already massaged the breasts before the Orgasmic Draw. Once you master the Egg Exercise you can practice it in conjunction with the Orgasmic Draw or Ovarian Breathing by placing the egg in the vagina while practicing. However it is important that you, separate every exercise at first, and then join them at a later time when you become more proficient.

To assist you in inserting the egg easily if necessary, use a lubricating jelly: any spermicidal jelly or cream that is not petroleum based, any natural lubricating oil, such as a raw cooking oil, that you know is safe, or any lubricant that you have used that you do not have a chemical reaction to. Always insert the wider end of the egg first. Once inserted, assume the standard Horse Stance posture (feet shoulders' width apart and firmly grounded: ankles and knees bent: groin folded: spine and neck in alignment). Elevate

your arms in front of you to a 45-degree angle with your palms facing upward. Assume a clenched fist position. It is from this basic rooting stance that each of the Egg Exercises is Performed. (Fig. 7.1(a) and (b))

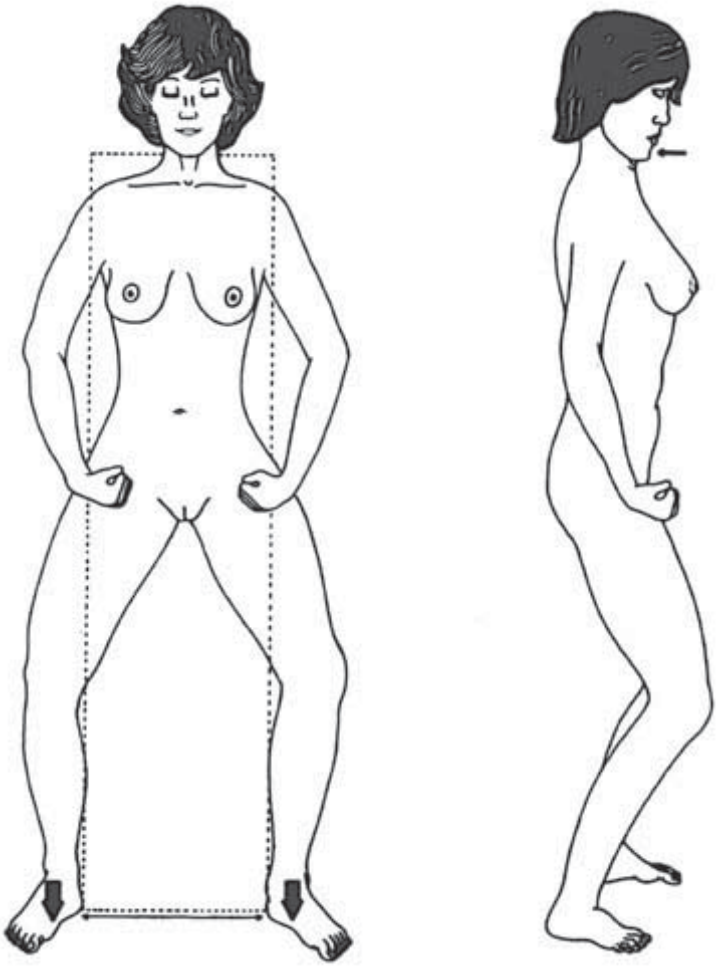

(a) Feet shoulder's width apart and firmly grounded.

(b) Side View

Fig. 7.1 *Horse Stance for the Egg Exercise*

The cervix represents the back limit of the vagina. Squeezing the muscles the way you would to have a bowel movement will expel the egg. In the beginning make sure not to practice on a cement floor so that if the egg drops out, it will not break. You can also place a towel under your feet.

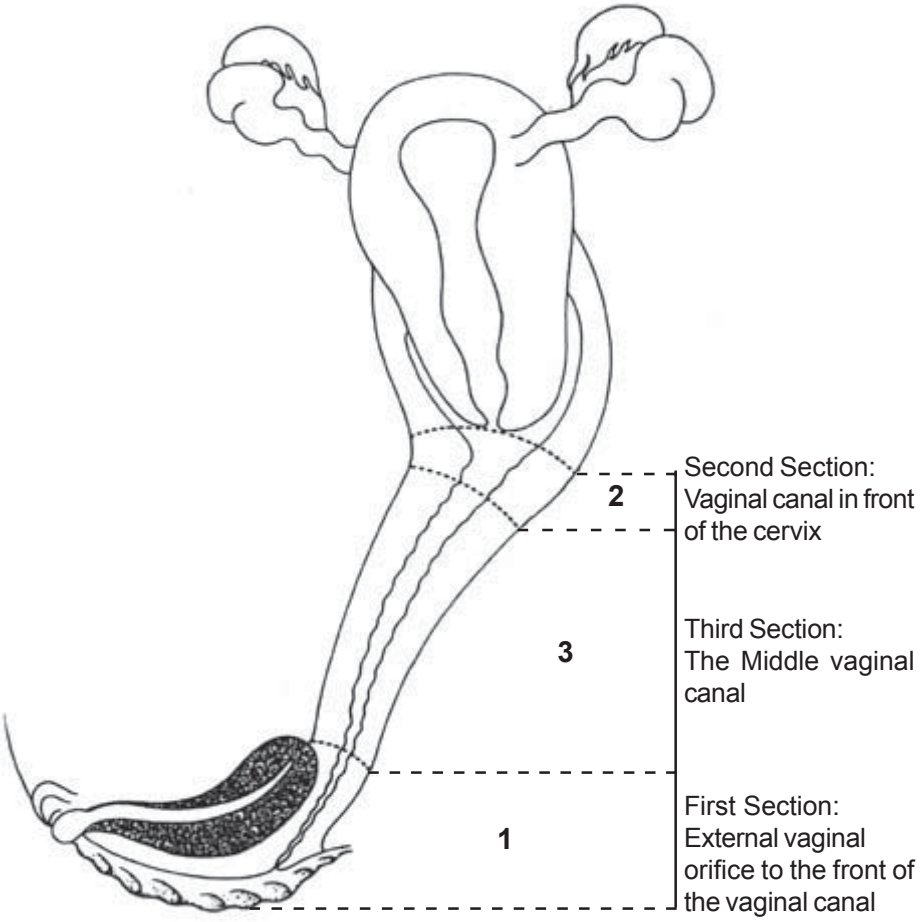

Fig. 7.2 *Three Sections of the Vagina*

B. Three Sections of the Vaginal Canal *(Fig. 7.2)*

With the practices of Ovarian Breathing and the Orgasmic Draw, you began to gain control of your Chi Muscle. To gain further control

through the Egg Exercise, we divide the vaginal canal into three sections.

(1) The external vaginal orifice and front of the vaginal canal

The first section includes the muscles of the external vaginal orifice and the front part of the vaginal canal. When the egg is inserted, you will contract the uterus, closing the orifice tightly so that the egg cannot drop out.

(2) The anterior of the cervix

The second section to be contracted consists of the muscles of the vaginal canal immediately in front of the cervix.

(3) The middle of the vaginal canal

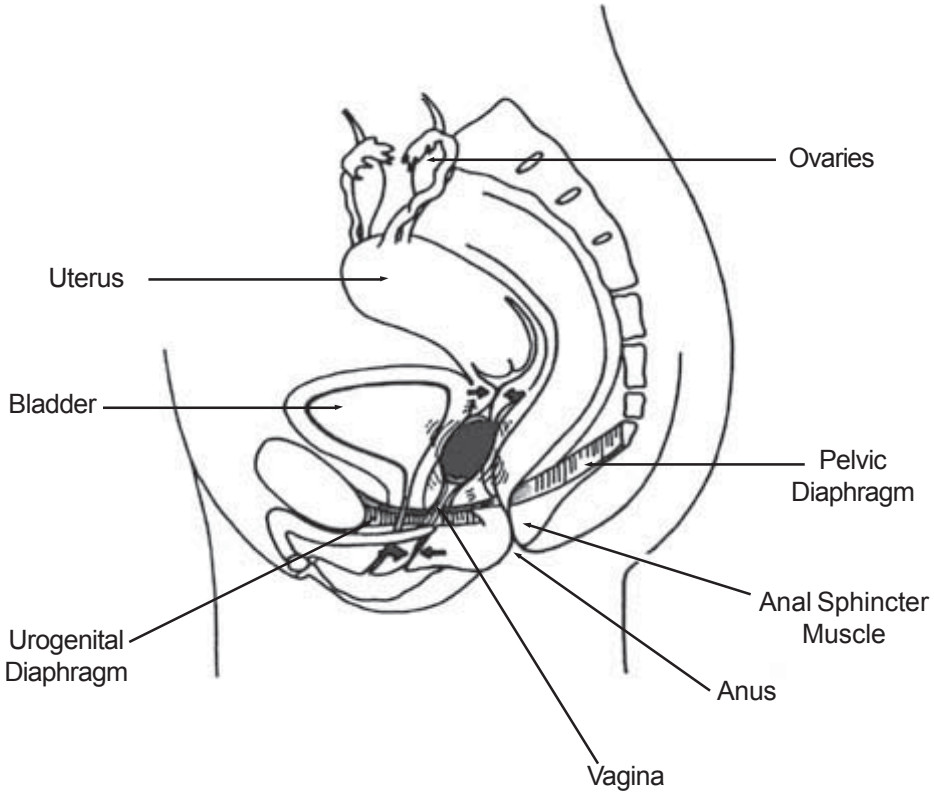

Fig. 7.3 *Moving the Egg*

The third section encompasses the muscles of the middle of the vaginal canal. These are the muscles that will move the egg up and down, left and right, and tilt it in different directions. (Fig. 7.3) You will practice moving and using these muscles until you master their movement as easily as using your hand. As you play with the direction you will learn to differentiate each movement of these muscles. If you have a male partner he will soon notice the results of this practice. Practice for a few minutes at a time, as often as you like. Insert the egg before practicing Tai Chi, Iron Shirt, or any of the other physical practices. Gradually increase the length of time you retain it. Just remember that it is there, since laughing, sneezing, or coughing can sometimes cause the egg to blast out of the vagina quite unexpectedly.

5. Two Eggs Technique

You can upgrade the practice by using two eggs in the vagina at the same time, moving them up and down, in different directions, or banging them together to achieve a vibration that will stimulate the inside organs. (Fig. 7.4) Two eggs are more difficult to manage, quite like drawing a square and circle simultaneously using both hands. It is important to know how to manage one egg well first.

Once you are well trained and are master of the Chi Muscle, you can dispense with the eggs, using your mind and the appropriate muscles to move the sexual energy as you wish.

B. Breast Massage Techniques Preliminary to the Egg Exercise

The importance of a preliminary massage before practicing the Egg Exercise and Vaginal Weight Lifting cannot be overlooked. Its purpose is to stimulate hormone secretion from the breasts and ovaries. Once ejected from their glandular source, these hormones become available for transformation into higher energy as they travel along the pathway of the Orgasmic Draw. Performing the massage with a silk or taffeta cloth creates a certain friction which is more conducive to hormonal stimulation, and is, therefore, more efficient in obtaining results.

Begin the massage by gently but firmly pushing the fatty tissue of the mound of each breast against the rib cage, moving two or three fingers of each hand in small circular movements. Start at

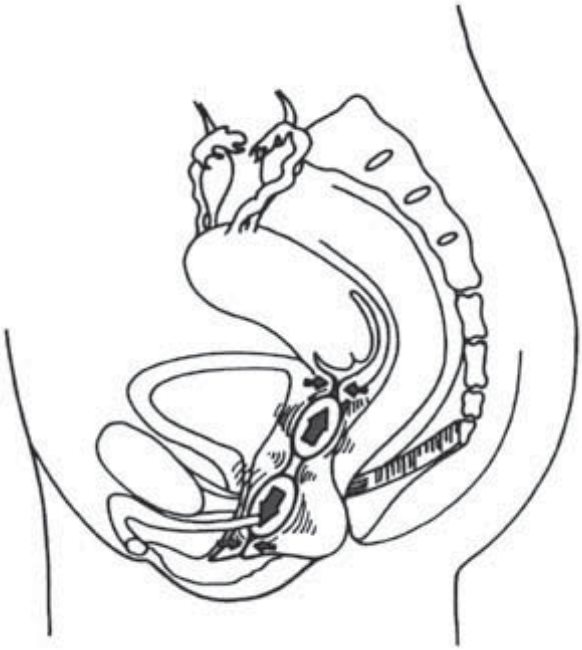

Squeezing Two Eggs Apart

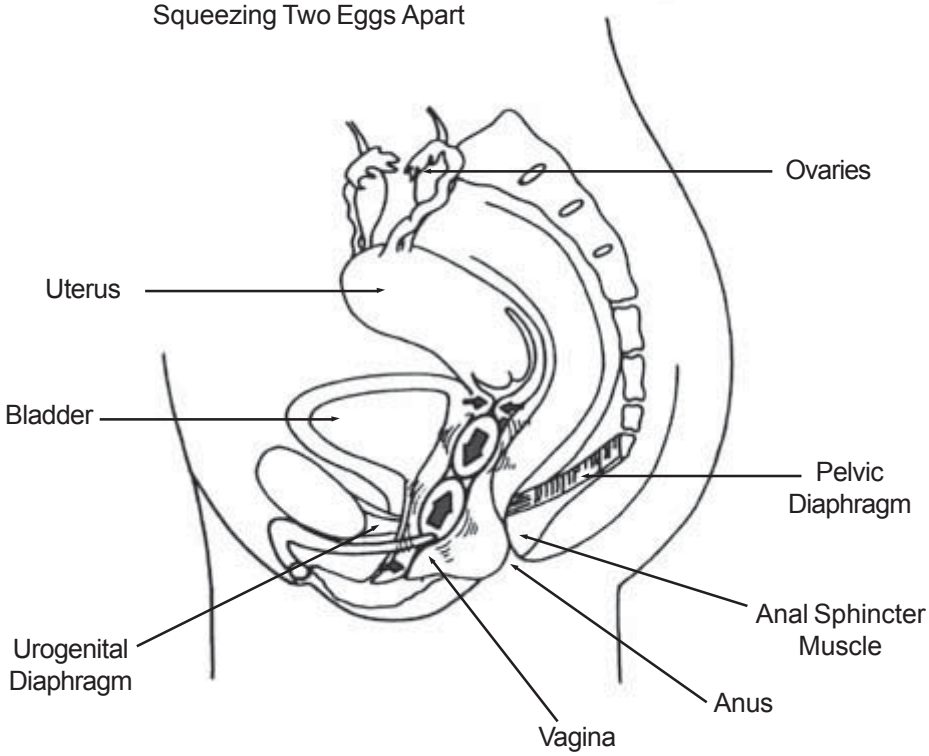

Fig. 7.4 *Squeezing Two Eggs Together*

the central nipple areas and work your way around and outward until each entire breast has been massaged. When using a cloth both sizes can be worked simultaneously if a long enough piece of cloth is used (three feet by ten feet is a good size to work with).

Be observant of the body's signals that the hormone secreting process has begun: erect nipples and a subtle filling or hardness of the breast are two positive indicators. Breast massage will increase the energy flow to the breasts, thereby helping to break down congestion which, over a long period of time, can contribute to the development of cancer.

Breast cancer is the leading cause of cancer death in women. If discovered early enough, it can be cured. In the interest of broadening our awareness of the body's ever-changing state of health, we suggest that once a month, ideally after each menstrual period, women regularly incorporate into their practice a simple technique of breast self-examination for early detection of breast cancer. Always look thoroughly for any changes that your breasts may have undergone since your last checkup. Stand in front of a mirror and become familiar with their appearance. Is there any unusual dimpling or puckering of the skin, discoloration, ulceration, hardening or lump? Have the superficial blood vessels grown larger or increased in number? Has the size, shape or contour of your breasts changed? Next, elevate your hands above your head and ask yourself the same questions.

After completing the breast massage, the genital area should be massaged. Using the same cloth and fingertip circular motions, cover the entire mons and labial area inch by inch. After having sufficiently stimulated the clitoris, warm, moist vaginal secretions will mark the body's readiness for the egg's insertion. (For a more detailed approach to breast massage, return to Chapter 6).

C. Summary of Egg Exercises Step-By-Step

1. Insert the Egg

When you feel you are ready, insert the egg into the vagina, large end first.

2. Horse Stance Alignment

Align your body in the basic Horse Stance described earlier.

3. Contract the First Section

Isolate and contract the muscle groups responsible for closing the external vaginal orifice tightly. This will help to keep the egg in the vaginal canal.

4. Contract the Second Section

Inhale and contract the vaginal canal muscles immediately in front of the cervix so that you are now contracting two sections at the same time. Keep both points closed. There is no need to use hard muscle contractions. The strength required depends a great deal on the control of these muscles you have gained by practicing the Ovarian exercises of Chapters 5 and 6.

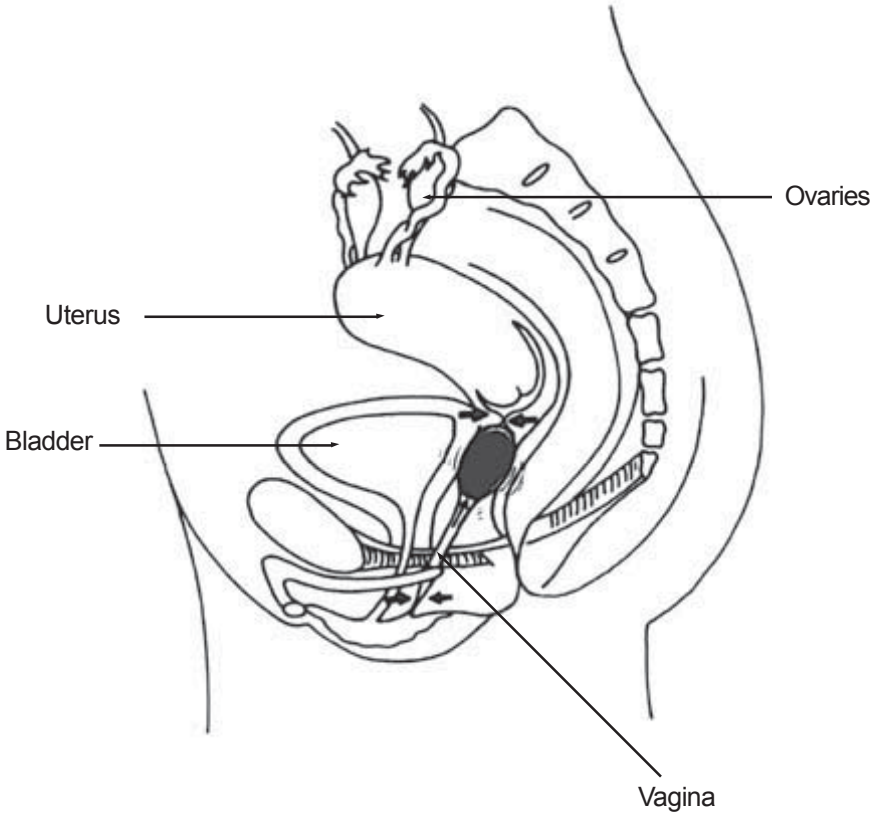

Fig. 7.5 *Moving the Egg up.*

5. Squeeze the Third Section

Slightly squeeze the egg from the middle of the vaginal canal until you feel that you have a good grip on it. Inhale and squeeze again, gradually increasing the squeeze, and then inhale more and squeeze harder (Fig. 7.5) Once you feel you have a good grip on the egg, slowly move it up and down. Start with a slow motion, gradually increasing to a fast motion. When you are out of breath, exhale and rest. The resting period is very important. It is at this time that you will feel Chi build up in this area. Try to master each movement before continuing to the next step.

Fig. 7.6 *Using the Second Section to move the Egg Sideways.*

6. Use the Second Section to Move the Egg Left and Right

Next move the egg left and right using the top, or second, section. Practice until you master this action. (Fig. 7.6)

7. Use the First Section to Move the Egg Left and Right

Next move the egg left and right from the bottom, or first, section. Using the mind and some muscle movement are important since you cannot move the egg with hard muscle contractions alone. There are many involuntary muscles within the vaginal canal which the mind and Chi Muscle help to move.

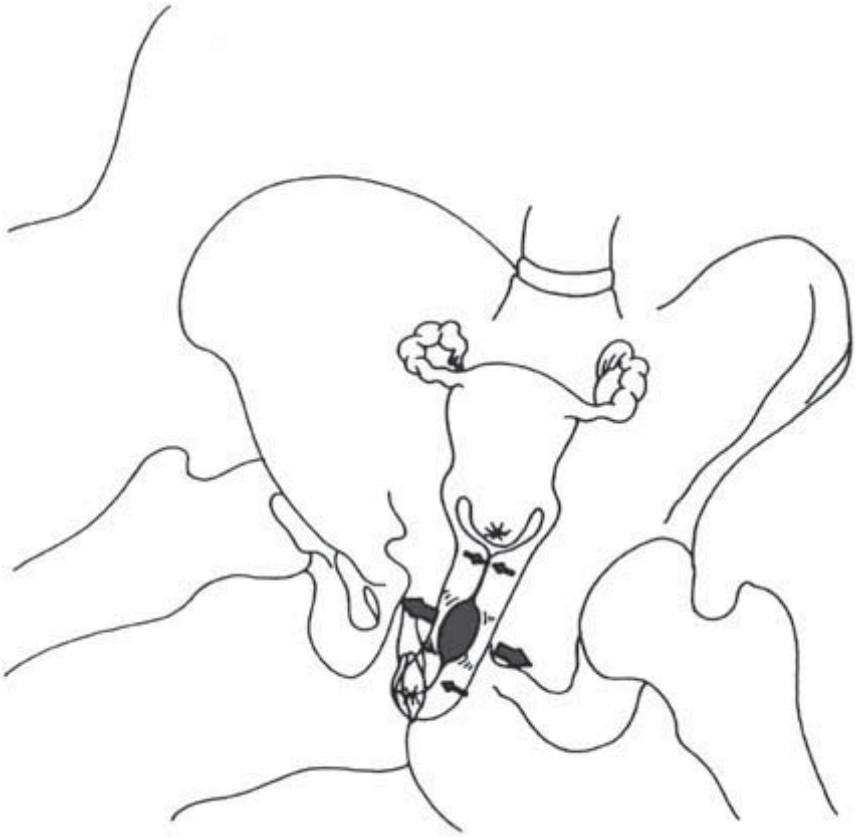

Fig. 7.7 *Using Both Sections to move the Egg Sideways.*

8. Use Both Sections to Move the Egg Left and Right

Now move the egg left and right as you wish, holding it by the top and bottom muscles. Master this step before continuing to the next exercise. (Fig. 7.7)

9. Use Both Sections to Tilt the Egg

Next tilt the egg up and down from the top and the bottom. Master this action.

10. Combine all Movements

Combine all of these movements, moving the egg left and right, tilting it up and down, moving it up to touch the cervix, and then down to the external vaginal orifice. Rest. All during the Egg Exercise the contraction of the vaginal canal in the area in front of the cervix and the external orifice is to remain constant until you have finished moving the egg.

This particular Egg Exercise should be practiced two to three times per week. You may, and should, perform this very same exercise daily without actually inserting the egg by following the same sequence using the contractile strength of the vaginal muscles to suck in an imaginary egg and move it up, down, left and right.

To enhance your development you should begin using a smaller egg. Later the larger eggs may be used to mark the progress in your “sucking” abilities. Eventually the practice of egg-sucking will become so mastered that you will be able to suck the egg into the vagina from the outside with a vacuum-like force. Such a powerful sucking activity enhances experiences in your life such as childbearing or lovemaking. Imagine the intense pleasure of your lover as you demonstrate to him your power and skill.

D. Egg Exercise during Ovarian Breathing and Orgasmic Draw

Once you master the Egg Exercise described above, you can combine the practice with Ovarian Breathing and the Orgasmic Draw. Each will enhance the others practice.

1. Prepare with Breast Massage

Prepare with the breast massage until you feel yourself ready, and insert the egg into your vagina.

2. Align Yourself in the Horse Stance

Align your body in the basic Horse Stance described earlier.

3. Close the External Vaginal Orifice

Isolate and contract the individual muscle groups responsible for tightly closing the external vaginal orifice.

4. Gather the Energy at the Ovarian Palace

Gather the energy from the ovaries and the breasts at the Ovarian Palace. Inhale slowly and deeply. Draw the sexual energy down through the uterus to the clitoris and hold it there.

5. Grip and Move the Egg

Contract and hold the lower; then middle and upper vaginal muscles and feel your grip on the egg. Then push the egg deeply up into the vaginal canal. Move it up and down and feel the increasing sexual energy.

6. Begin Ovarian Breathing and the Orgasmic Draw

As you feel more energy gather at the vaginal canal, follow the procedures of Ovarian Breathing and the Orgasmic Draw. Pull the energy to the front part of the perineum, to the sacrum, T-11, C-7, C-1, Jade Pillow, and crown. Circulate the energy in the brain and bring it down the front channel to the third eye, tongue, throat, heart center solar plexus and navel. Collect the energy at the navel. Please review the details of the practice of Ovarian Breathing and the Orgasmic Draw in Chapters 5 and 6.

E. Vaginal Weight Lifting (Fig. 7.8)

The only difference between the Egg Exercise and Vaginal Weight Lifting procedure is the addition of a weight to the specially drilled egg. As mentioned earlier in weight lifting, we use wooden eggs. Usually an egg is chosen of approximately a one-inch diameter with holes drilled in it through which a string can be threaded for attachment to a weight. Use a sturdy string that can sustain at least ten to twenty pounds of weight, or use three strands of string. Begin with a one-half pound weight. You can buy a half-pound plate that has a hole through which the string can be tied, or use a small cotton or plastic bag into which a weight can be placed and the bag easily attached to the egg's string and hung.

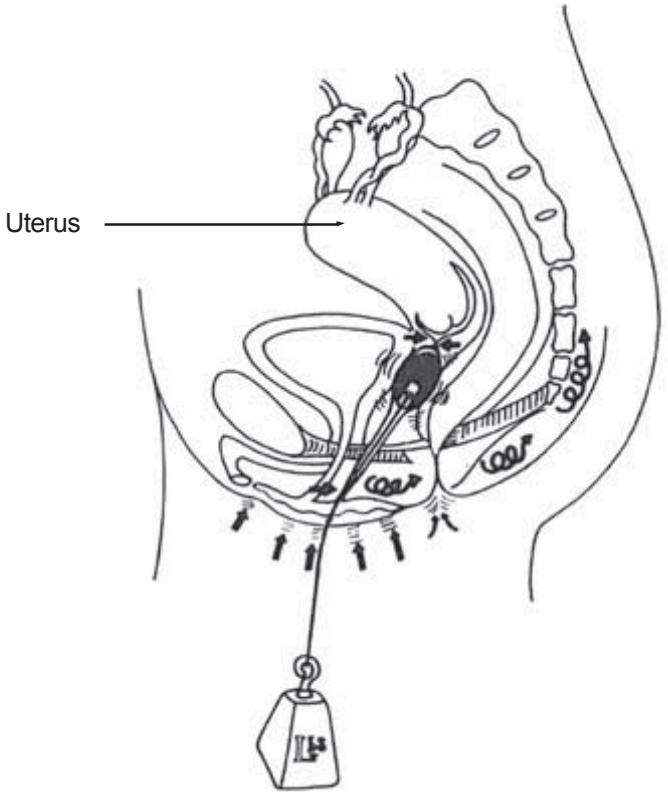

Fig. 7.8 *Vaginal Weight Lifting*

Suspending weights from the egg is a most effective way to increase the strength of the pelvic and urogenital diaphragms and the vaginal muscles. This is also a tremendous exercise for the cervix, the ovaries, and the organs and glands. With the increase in weight the vagina alone does not have enough strength to lift the weight, making it necessary for all the internal organs and glands to join in contributing to the strength. The heavier the weight the more counter pressure must be exerted by the vagina, the cervix, the ovaries, the diaphragm, the organs and glands. This extended effort will result in increased Chi pressure and hormone production. Make sure you can handle the weight well before adding more to it.

The exact sequence of steps is then followed as described in the Egg Exercise above. This time, however do not move the egg up and down. Hold it by tightening and squeezing the external and middle sections of the vaginal canal around the egg and pulling the egg up. Do not release it. This exercise is to be performed one time only, two to three times per week, with the weight gradually increasing in one-half pound increments, and not exceeding ten pounds.

1. Practical Exercise Step-By-Step

A. Insert the egg while holding the string and weight.

Place a chair in front of you and then place the weight on the chair: If you are not already prepared, start with the breast massage, followed by massaging the mons, the perineum, and the coccyx. When you feel the Chi is ready insert the wooden egg with the string attached into the vagina, always attempting to increase the force of suction used to draw it in. Use the other hand to hold the string with the weight.

B. Assume the Horse Stance.

Align your body in the basic Horse Stance described earlier.

C. Grip the egg using the muscles of the vaginal canal and release the string and weight.

Inhale, closing the external and internal vagina tightly. At the same time contract the uterus so that the vaginal canal has been closed on both ends. Inhale, squeeze the egg tightly, and pull it up until you feel you have gripped the egg firmly, then slowly release the string with the weight attached. Do not remove your hand in case you did not grip the egg firmly enough. If the egg with the weight attached falls out, it might hurt you.

D. Use the cervix to pull the weight up.

Hold your breath and contract harder. Inhale and start to pull from the cervix and feel the force of the cervix helping to pull up the weight. When you feel you are holding the egg with the weight securely start to rock the pelvis, thus rocking the weight, 30 to 60 times. (Fig. 7.9) This will generate a tremendous energy. When

you feel the energy build up, inhale slowly and deeply down to the ovaries, gathering your sexual energy, and carry it through the uterus and down to the clitoris. Hold it there.

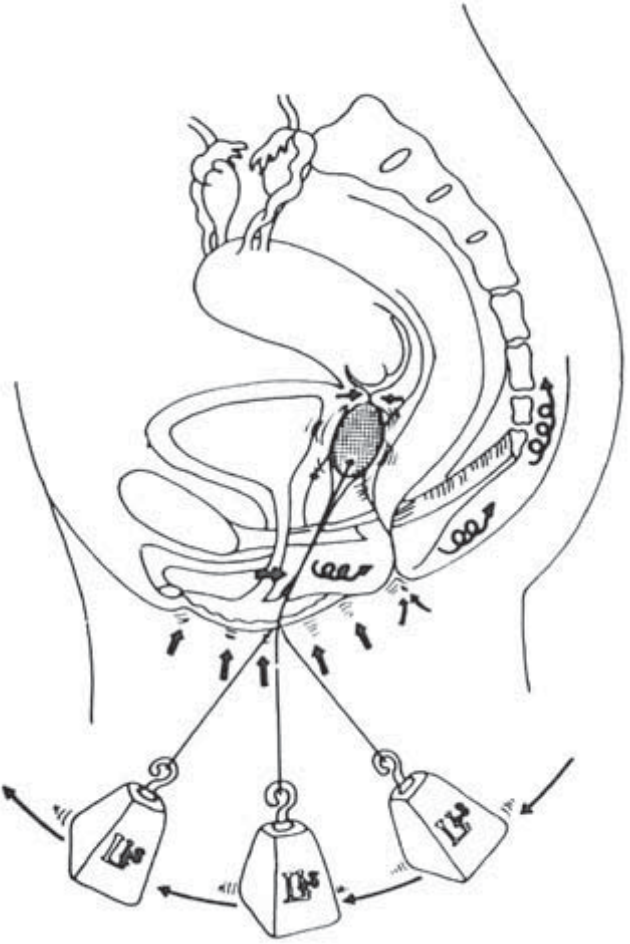

Fig. 7.9 *Swinging the Weight Back and Forth.*

E. Employ all the muscles of the vaginal canal.

Contract and hold the lower then the middle and upper vaginal muscles, so that the egg pushes deeply up into the vaginal canal and the weight will not pull the egg out.

F. Bring the energy into the head.

Now draw all the energy you have just gathered up the spine and into the head, as you continue to hold the egg deeply inside of you

G. Continue pulling the energy into the brain.

Still holding the same breath, continue gathering and pulling the sexual energy up into the head, where the brain can now be bathed in this wondrous nourishment.

H. Hold the energy in the brain.

Hold this energy in your brain, initially for 30 to 45 seconds, and gradually increase this time period.

I. Bring the energy to the navel.

Finally, stick the tongue up to the palate, exhale, bring the energy down, and collect it in the navel point.

J. Rest the weight on the chair and expel the egg.

Grip the string on the weight and place the weight on the chair Let the egg go, utilizing the contractile strength of the vaginal muscles to expel it.

K. The ovaries pull and lift the egg and weight upward.

When you feel you can pull from the cervix well, begin to use the force of the ovaries. You will try only the left side first, then the right ovary; and finally both sizes together When you feel you can once again secure the egg in the vaginal canal, use your mind and start to contract the left ovary, wrap the Chi around that ovary, and then pull from the left ovary toward the cervix and the vaginal canal, pulling The egg and attached weight upward. Do the same on the right side, and then both sides together.

L. The kidneys pull the egg and weight.

Next move to the kidneys and the adrenal glands situated on top of them. Practice using the force of each kidney separately first in order to identify the feeling. Inhale and use the contraction of both kidneys to help pull the weight up. Then, starting with the left kidney

and making sure you feel the force coming from there, use your mind to contract the muscles around the left kidney even more, and wrap it with Chi. Then pull the left kidney down again, pulling it toward the left ovary and the bladder. The ovary, in turn, will pull on the cervix: the cervix will pull on the vaginal canal; the vaginal canal will pull on the egg: and the egg will pull on the weight. In other words, once you have secured the egg in the vaginal canal, you will pull with the higher organs and glands which, in turn, will pull on the lower organs and glands, and they, in their turn, will pull on the egg and weight. Practice the same procedure with the right kidney. Once you have mastered the left and right kidneys, combine both kidneys in the practice. This will give you a great deal of internal force to pull an even heavier weight.

M. The spleen and liver pull the egg and weight.

Next move up to the spleen and liver. Start again on the left side, contracting the muscles around the spleen, situated beneath the left side of the rib cage. Contract and wrap the Chi around and into the spleen. Pull the spleen toward the left kidney, pull the kidney to the bladder and left ovary, the left ovary to the cervix, the cervix to the vaginal canal, and the vaginal canal to the egg and weight. Practice the same procedure on the liver which lies under the right side of the rib cage. Pack, wrap and pull the liver up and toward the right kidney, to the bladder and right ovary, to the cervix, to the vaginal canal, and to the egg and weight.

N. The lungs are employed next.

Moving to the lungs, start with the left lung first. Practice contracting the left lung and wrapping Chi around it until you actually feel the lung contracting. When you have again secured the egg in the vagina, begin to contract the lung with more force and pull from the lung to the spleen, then to the kidney, bladder and left ovary, cervix, vaginal canal, and egg and weight. Practice in the same manner on the right side, beginning with the right lung.

O. Be cautious with the heart as it pulls on the egg and weight.

As you move on to the next organ, the heart, be cautious, making sure that you are well in control of the other organs first. The heart and lungs can easily become congested with energy and can cause

chest pain and difficulty in breathing. If you have this problem, tap the area around the heart and practice the healing sound of the heart (as described in the book *Taoist Ways to Transform Stress into Vitality*). Practice until you can control the contraction of the heart muscle and wrap the Chi around the heart. Again, secure the egg in the vaginal canal, contract the heart and lungs and pull up toward the spleen, liver adrenal glands and kidneys, bladder and ovaries, cervix, vaginal canal, egg and weight.

P. The thymus gland is difficult to contract.

The thymus gland is difficult to contract because of its location under the sternum. The only way to do this is to sink the chest and sternum down, press the sternum to the back, and contract and wrap it with Chi. Mastering this contraction and wrapping the heart and lungs with Chi will help greatly in contracting the thymus gland. Once again, secure the egg in the vaginal canal, sink the sternum to the back and contract the lungs, from left to right, toward the thymus under the sternum, then contract the heart to the thymus which is in close proximity. Pressing and contracting the heart will greatly increase the force of the thymus. Feel all three organs and the gland create the force to pull the spleen, liver, kidneys, bladder ovaries, cervix, vaginal canal, egg and weight.

Q. Pulling from the pituitary and pineal glands all the way to the brain.

The pituitary and pineal glands are the most difficult to master If, however you master all the other organs, these glands will be easier to learn to control. The tongue and eyes act as major tools in exerting force on the pituitary and pineal glands. Practice first, by pressing the tongue to the palate and turning the eyes upward. Contract the eye muscles toward the middle of the brain to the pituitary gland. Contract the muscles of the skull and squeeze the brain into itself toward the pituitary gland, located in the middle of the brain. Concentrate on and contract the middle part of the anus and pull all the way up into the brain. Contract the lungs, heart and thymus gland and push up toward the middle of the brain. Now secure the egg in the vaginal canal, press your tongue firmly to the palate with the tip of the tongue, touching the lower jaw behind the teeth and the flat part of the tongue touching the middle of the palate. Turn

your eyes up toward the middle of the brain, and squeeze the head muscles toward the brain's middle area. Contract the lungs, heart, and thymus gland, and press upward to the middle section of the brain. The pituitary gland, together with all of the other glands and organs pull up the spleen, liver kidneys, bladder, ovaries, cervix, vaginal canal, egg and weight. Repeat the practice, now focusing on the pineal gland.

When finished with all of these steps, make sure that you circulate the energy for a few rounds in the Microcosmic Orbit, finally collecting it in the navel. Since all the steps of this exercise are very important and extremely powerful, you must use caution. Gradually you will feel all the organs and glands contributing to the internal force that will pull the weight. If you have already mastered the organs' orgasm, you will handle this exercise with ease.

R. Cleanse the Egg Thoroughly.

Since the mucous secretions on the egg are an ideal medium for bacterial growth, be sure to cleanse the egg thoroughly after each use.

S. Massage yourself.

Massage the Hui-Yin point in the perineum. Massage the mons and the coccyx. This massaging after each exercise is very important. It will help you clear the remaining energy so that the body can absorb it easily.

T. Channel the energy in the Microcosmic Orbit.

Gently tap the lower abdomen with your palm to remove the excess energy from the ovaries, vagina and clitoris. Sit down quietly and channel the excess energy in the Microcosmic Orbit, so that all your organs will benefit.

F. Herbs to Tone Your Ovaries - Special Recipes for Women

Women who experience any weakness of their sexual organs will find it quite to their advantage to follow two of Maneewan Chia's simple and delicious recipes.

1. Ovaries' Strengthening Tonic

To gradually increase the energy flow in the ovaries, sample this

mixture.

1 cup whiskey
1 cup honey
1 cup lemon juice

Stir the mixture well until the honey dissolves. Store the mixture in a previously sterilized jar. Shake the jar well before each use. Drink one to two tablespoons daily.

Caution: If you are experiencing a very heavy menstrual flow, refrain from taking the mixture for a few days until you have normalized. This recipe will last several months, and the more it ages, the better it becomes. Store it in a cool dry place.

2. Don Quai-Chicken Soup

As an herb containing numerous invaluable properties, Don Quai should become an integral component of a woman's health care regimen.

Loaded with good nutrition for the ovaries and hormones, this herb is essentially required by a woman's body throughout her lifetime. It is especially good as a blood tonic, being quite rich in iron, and it is great for alleviating a variety of menstrual problems. Don Quai is taken only one to two times per month and only after the menstrual cycle has ended, never during the cycle.

This herb can be obtained in Chinese herb stores located in every Chinatown. Many of these stores have mail order services.

Simply place one to two heads of the herb (about one inch in size) in chicken broth or soup, and season as desired. Simmer in a slow cooker for approximately three to five hours.

Vegetarians can make Don Quai in the same manner using the slow cooker and a meatless broth.

After using Don Quai on a regular basis for a one- or two-month peroid, you will notice a definite increase in your strength.

G. Sunning (Fig. 7.10)

If you are lucky enough to have a sunny area with some privacy; you will probably enjoy this practice.

The sun's energy is very healing and soothing to the genitals and can be absorbed by the ovaries through the genitals. The best time of day is in the early morning (between seven a.m. and nine a.m.) and in the late afternoon (between three p.m. and five p.m.)

Absorbing Yang Energy

This position completes the energy circulation through the hands and feet.

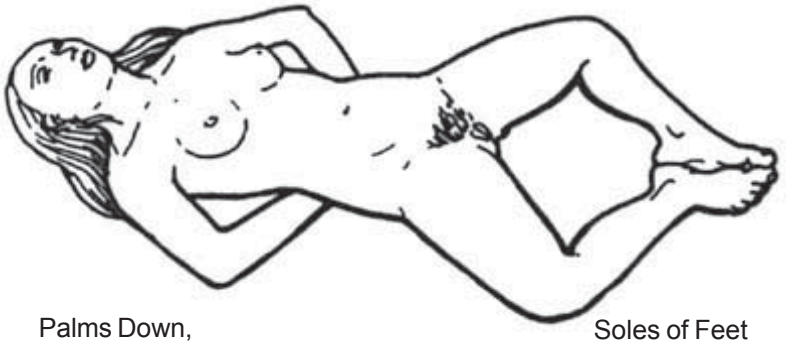

Palms Down,
Thumbs Touching

Soles of Feet
are touching.

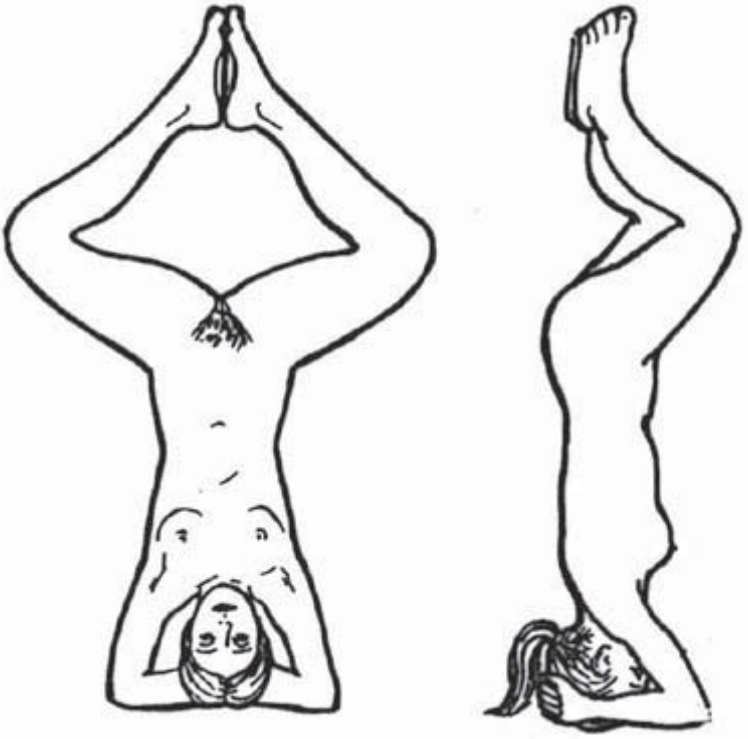

Fig. 7.10 *Sunning*

Sunning should be done no more than five minutes in the beginning eventually working up to ten minutes.

Massage the mons area and alongside the outer lips. Open the labia to the sun and use your mind to draw the solar energy into your ovaries. Let this energy mix with your own energy as you circulate it in the Microcosmic Orbit.

Fig. 7.11 *Loving*

Chapter 8
Dual Cultivation

A. Introduction to Dual Cultivation

1. Opening the Healing Love Energy Channel

Most people would agree that sex is enjoyable. In this book you are learning how to utilize the normal sexual energy that you create and how to multiply it. By now you should be aware of the fact that if you do not transform the sexual energy that you produce, but let it drain out, you lessen your vitality. This is accompanied by more and more psychologically draining effects, such as tiredness or depression, or actual physical suffering, such as pain in the back or kidney areas. If you continue to deplete yourself, eventually you will drain the vitality from all the organs and glands, making the body weak, sick and old.

As previous chapters have indicated, in order to transform the sexual energy, you must direct it upward to a higher energy center. Doing this requires channeling the flow of this energy. We have stressed the need and importance of opening the channels of the Microcosmic Orbit, the main route through which the energy begins to travel.

In ancient times, the ways to develop Chi flow were regarded as top secret, especially the way to channel sexual healing energy. Sexual energy is extremely powerful as a means to attain rejuvenation and a higher spiritual energy. There are textbooks, such as the Plain Lady book, a sexology book written thousands of years ago in ancient China by an unknown author, demonstrating various traditional positions for having sex and promoting healing. But these books do not show how to channel the energy. At the time this book became available, the Taoist system of channeling energy was not available to the general public, but remained a secret taught only verbally to the Emperor and a few others who were not permitted to put it into writing.

We feel today that the time is right to teach people how to benefit from this transformed energy, or Healing Love, because many people misuse their sexual energy, hurting themselves and others.

Our purpose in writing this book is to help people benefit from the channeling of this energy.

2. Sexual Organs are the Roots of Life.

The Taoist system regards the sexual organs as the roots of life, connected to all other glands and organs. Once you begin to practice the methods taught in this book, you will begin to feel the close relationship of the glands and organs, especially the pineal and pituitary glands, kidneys, liver, lungs, and heart.

3. Energizing all the Organs and Glands

The ovaries have a close connection with the sexual organs, and by properly channeling their energy using certain lovemaking and hand positions, we can learn to use sexual healing energy to vitalize our entire systems. There are hundreds of lovemaking positions and hand gestures. The purpose of a position is to stimulate, according to reflexes, and to energize all the internal organs. These positions help only if the energy channel through which you move the energy upward is open; otherwise, the lovemaking positions and hand gestures will not have much meaning. The exercises described in this book are part of the Healing Love practice: however to a certain extent, they can also stand alone as guidelines to your own sexual practice. In particular the Anus Chi Muscle exercise and the Breast Massage will help you get in touch with your organs' and glands' energy.

4. Exchanging Energy with your Partner

Many couples have used the techniques described here; they are no longer mysterious and they are no longer only in the province of Taoist Masters. These techniques can increase the possibility that you will experience Beyond Orgasm (Valley Orgasm) whenever you have the desire. This is one of the goals of this book.

Synchronizing your breathing with your partner's and then harmonizing your breathing seems to come quite naturally to many people. Lying with noses in proximity, you begin to feel the two breaths be come one. Breathing in and out together is the principal way to begin to build up Chi in both you and your partner: This buildup of Chi can be a relaxing time, or it can be arousing, depending upon your intention.

No doubt you and your partner are both eager to enjoy your sexual pleasures together. Use this book as a tool in learning how to practice and use the Orgasmic Draw in order to multiply your orgasms and bring you both to the point of Valley Orgasm. As you practice the Orgasmic Draw, your partner practices the Big Draw as taught in the companion book *Taoist Secrets of Love: Cultivating Male Sexual Energy*. These practices will give you both a great deal of energy to share. This energy can be transferred back and forth between you and your partner through your tongues or genitals--each organ acting as a switch to transfer energy between the two channels that complete each one's Microcosmic Orbit. In fact, with practice you will be able to exchange energy in a variety of ways, including over physical distance. Some people will actually feel the energy circulate in their own Microcosmic Orbit and will feel that energy transfer into their partner. Some couples have described the feeling of the energy as a cocoon surrounding them, and some feel the energy between them or above them.

5. Valley Orgasm and Hhw to get there.

Difficult to explain in words, a person must reach a certain level in lovemaking to understand what is meant by Valley Orgasm (Beyond Orgasm). The major sensation is the atmosphere between you and your lover. If you are both in a low mood, or one of you is in a low energy cycle, it becomes difficult to reach this point. Meditating to move the energy in the Microcosmic Orbit will help bring each of you to the same energy level and is most important to the initiation of sexual pleasure. The more you and your partner can meditate and practice the Orgasmic and Big Draw together the more both of you will harmonically tune in to each other.

Practicing such techniques as Tongue Kung Fu, as described in the book *Taoist Secrets of Love: Cultivating Male Sexual Energy,* will greatly contribute to foreplay and sexual arousal. When you feel you are ready to engage in lovemaking, and have built up sexual arousal substantially you can begin to use the Orgasmic Draw, while your partner uses the Big Draw. After each Orgasmic or Big Draw, the energy starts to move between you, fusing you into an energetic or meditative state that can make you both feel connected and simultaneously experience a cosmic tranquility. You can understand how difficult it is to describe this state; it is similar to

describing what meditation feels like. You must experience it yourself. In order for you and your partner to experience the energy, you must begin with the basic training described in this chapter initially using some external help (i.e., breathing techniques, muscle locks, placing of hands, etc.) to guide you into the internal practice (mind control). We will elaborate on a few lovemaking and hand positions to help you and your partner open the channels faster so that the exchange of Valley Orgasms will be easier.

6. Sexual Organs' Exercise Positions

There are a few basic positions that we use in lovemaking, and from these basic few come hundreds of others. Many simply alter the positions of the legs: one leg up and one leg down, or both legs up, etc. This slight differential accounts for many positions, but as we have emphasized, although certain positions help you to reach a certain area of the sexual organs to stimulate certain reflexes, it is the channeling of the sexual healing energy that is most important. If you cannot channel the energy; these positions and hands gestures are meaningless. The nine basic positions are as follows:

A. Face to Face

(1) The woman lies on her back with the man on top. (Fig. 8.1(a))

(2) The woman lies on her side with her hips twisted so that her pelvis is facing upward. (Fig. 8.1(b))

(3) The man lies on his back with the woman on top. (Fig. 8.1(c))

(4) The man is in a sitting position and the woman sits on his lap. (Fig. 8.1(d))

(5) The man and woman lies on their sides facing each other (Fig. 8.1(e))

B. Back Facing

(1) The woman bends over: supporting herself with her hands and knees, and the man kneels behind her: (Fig. 8.2(a))

(2) The man lies on his back, while the woman is on her knees facing his feet. (Fig. 8.2 (b))

(3) The man sits up, and the woman sits on his lap facing his feet. (Fig. 8.2(c))

(4) The man and woman lies on their sides with the man facing the woman's back. (Fig. 8.2(d))

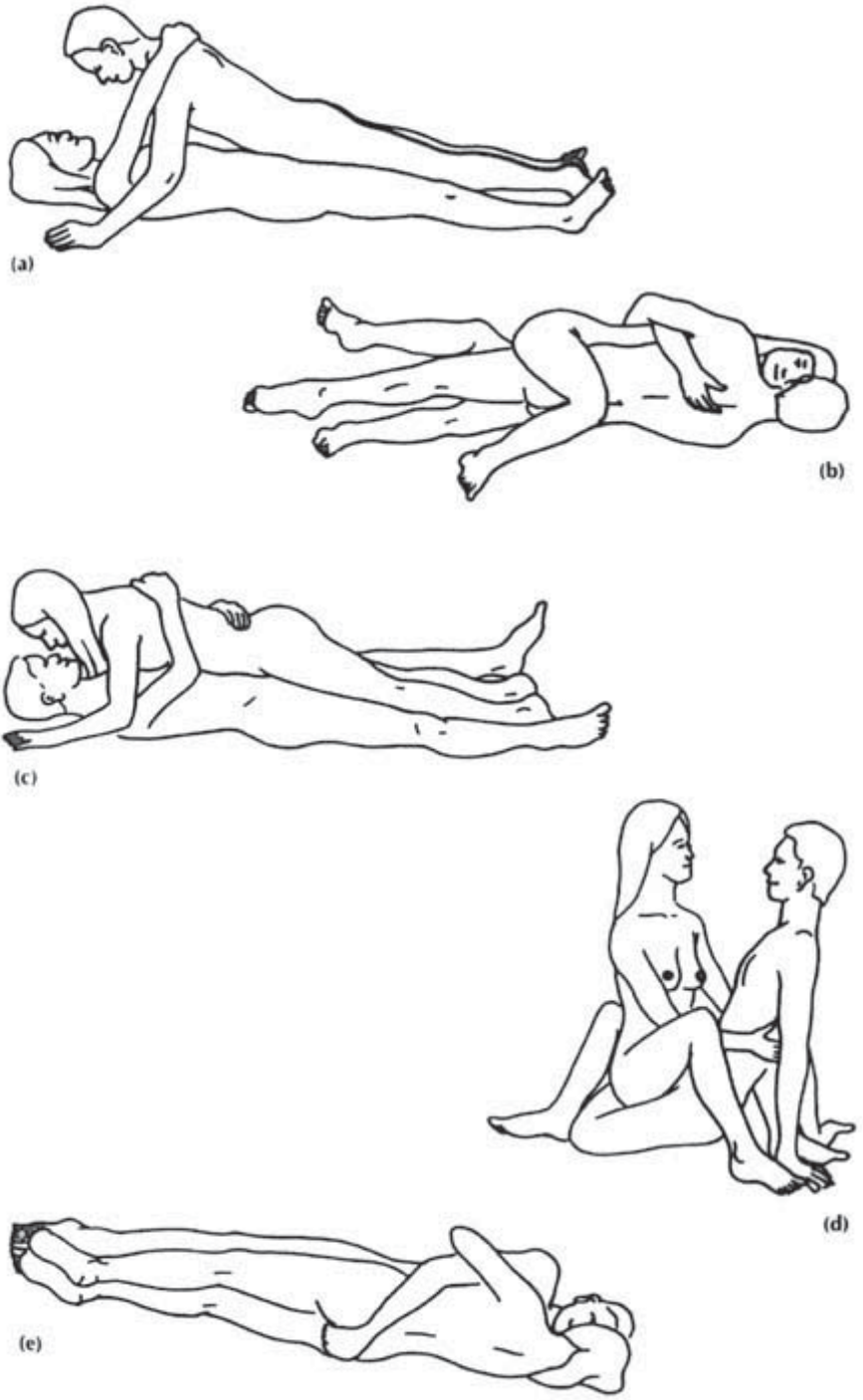

Fig. 8.1 *Face-to-Face Positions*

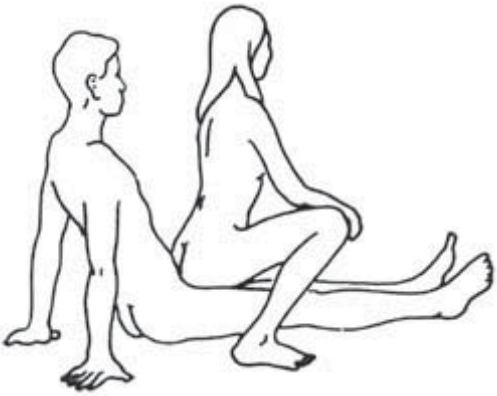

Fig. 8.2 *Back-Facing*

The basic principle is that the one who moves is the one who brings healing to the other while the one who does not move receives the healing. The inactive person can easily concentrate. When the mind is quiet, this partner will be able to feel his or her partner's sexual healing energy.

7. Hand Gestures link the Meridians of the Fingers and Toes with their Corresponding Organs.

The hands and feet are the outer extremities of the body and they are linked to the organs, glands and nervous system through a system of meridians, or energy routes, through which the energy of the organs and glands flows. Finger gestures have been used frequently in the ritual Taoist practices and are most useful to join the circuit and channel the energy through the meridians.

In lovemaking we stimulate and increase the sexual healing energy to flow through the subtle meridian channels. If we do not direct the energy back from the extremities, the energy can leak out through the hands and feet. Knowing the fingers' and toes' corresponding meridians can help to develop the ability to channel the outward flow of energy back through the meridians to the area you choose to direct it.

There are hundreds of hand gestures used in various other systems. If you are not trained and familiar with their usage, you will not be able to discern their power, although many people claim to have such ability. Some people spend a lot of time learning many gestures which in actuality have similar uses or only one use. When careful study is made, there are only a few basic hand positions that are effective. The simplest ones are the most useful; however the most important factor is the energy flow, not the simplicity.

A. Fingers and their Corresponding Organs

The fingers correspond to certain organs as described below and this connection influences bodily functions.

(1) The thumbs correspond to the lungs meridian (Fig. 8-3(a));

(2) The index fingers correspond to the large intestine meridian (Fig. 8-3(b)):

(3) The middle fingers correspond to the pericardium meridian (Fig. 8-3 (b)):

(4) The ring fingers correspond to the triple warmer meridian (Fig. 8-3(b)):

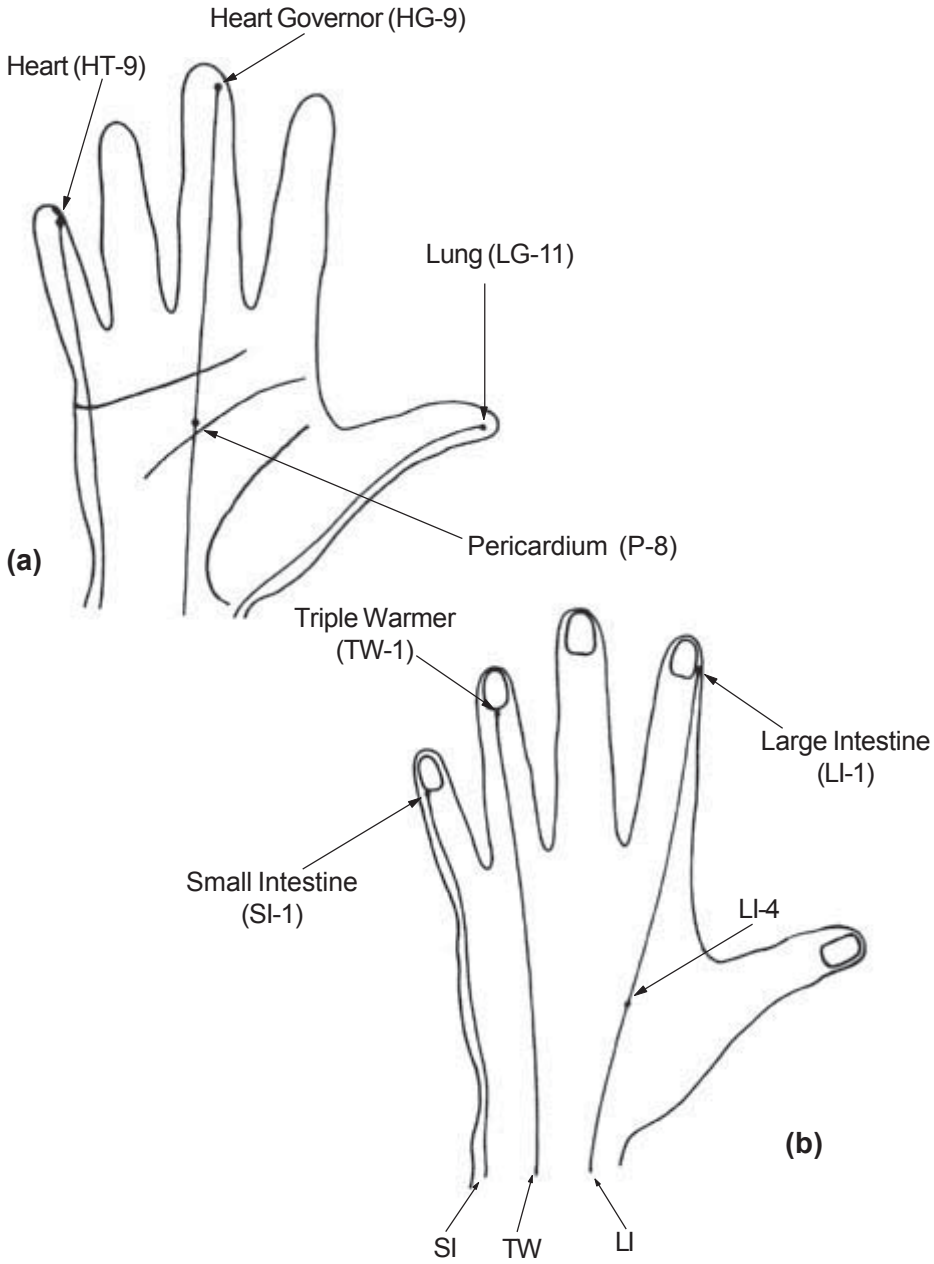

Fig. 8.3 *Fingers and Corresponding Organs*

(5) The pinkie fingers correspond to the heart and small intestine meridian. (Fig. 8-3(a) and (b)).

B. The toes correspond to specific organs

The toes also correspond to specific organs, thereby affecting the body's functions. (Fig. 8.4)

(1) The big toes correspond to the liver and spleen meridian;
(2) The second toes correspond to the stomach meridian;
(3) The fourth toes correspond to the gall bladder meridian;
(4) The small toes correspond to the bladder meridian.

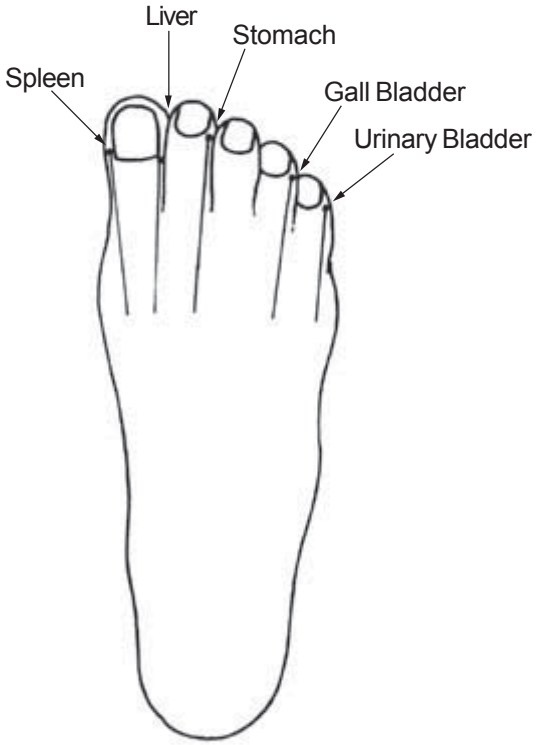

Fig. 8.4 *Energy Meridians in the Toes*

B. Descriptions of Positions and Hand Gestures for Healing Love

1. Love Making Positions

According to the *Plain Lady* book mentioned above (also called *Shu Nu Ching, or White Madame*), there are eight healing positions for men and seven for women. All these positions are helpful to heighten the lovemaking experience, but their most important

function is healing: through the use of the energy that is generated. Since the *Plain Lady,* book does not teach moving energy, a process which requires meditation practice, all the positions described in that book for healing have to be practiced many times a day for many days to reap any benefits. In the sexual healing energy practice we are describing here, we began, with such energy practices as Ovarian Breathing, the Orgasmic Upward Draw, the Egg Exercise, etc., all of which assist you in gaining control of your sexual energy and directing the energy to the place that you designate without merely depending upon reflexes and the positions used.

Although we will describe in detail only two positions, these two positions can be used to benefit both partners. As both partners alternately move, they alternately bring Chi to the area, gland or organ of his or her partner: Remember the basic principle is that the one who moves is the one who brings healing to the other while the one who does not move can easily quiet the mind and concentrate to feel and receive the partner's sexual healing energy.

Once you master the energy and can direct the energy as you wish using the mind and some muscles, the positions and gestures will not be very important.

A. Man on Top Position (Fig. 8.5)

This is the most common of the lovemaking positions. The woman lies on her back with her legs spread. She may have a pillow under her buttocks to raise her pelvis. The man lies flat on top of the woman or supports some or all of his weight on his elbows, hands or knees. Remember the Taoist theory that men are like fire and women are like water: Fire is easy to light, or is activated faster and burns easily, as most men usually become active sexually initially and seem aggressive. A woman, like water may be passive in the beginning, and usually needs to be moved to lovemaking by a man. So in the beginning of lovemaking, it is beneficial for the woman to lies on her back and the man to use foreplay to bring the woman to the boiling point. Once a woman is active and aroused, she should play an active, or aggressive, part also by such activities as kissing him, playing with his tongue and ears, and holding and massaging his penis. All these activities will create a sense of harmony. Ordinarily the couple will then first move into the basic position, and then continue with other positions, most likely ending up in the basic man on top position again.

Fig. 8.5 *Man on Top Position*

8. Benefits of the Man on Top Position

There are benefits to this position.

(1) First, the entire systems of both the woman and man become energized. The *Plain Lady* book recommends practicing three sets of nine shallow penetrations and one deep penetration three times a day for twenty days. (The nine shallow thrusts stimulate the plexus of nerves surrounding the woman's G-Spot and are best for exchanging sexual energies, while the deep thrust forces air out of the vagina, creating a vacuum inside the woman during the nine shallow thrusts that follow. This has a very stimulating effect on the

woman.) In many years of experience in teaching and practice, we have found that both partners can be energied in one extended lovemaking session in which sexual healing energy is brought directly to the organs and glands. We stress the importance of the man not ejaculating and thus losing the energy. In this more passive position it is easy for the woman to draw and direct the healing energy up the spine, as she learned to do in Single Cultivation practicing the Orgasmic Upward Draw, and then down the front channel. In this way she will be able to guide the sexual healing energy to her organs and eventually through her partner's Orbit to his organs.

(2) Secondly, the face to face position is greatly satisfying to the senses and emotions. It permits all five sensory organs of both partners to come in contact: the tongues, ears, eyes, mouths, noses, and all hair and skin. These senses, especially the tongues and eyes, are the major carriers of life-force energy. We have mentioned that the tongue works like a switch. Once you have completed the Microcosmic Orbit by using the connective tongue, the Chi flows through the tongue. As you kiss and move your tongue to touch your partner or his tongue touches your sensory organs, you can feel those senses become stimulated which, in turn, stimulate the flow of energy from your corresponding organs.

(3) In this position it is easy for the woman and man to help each other open or clear their Microcosmic Orbit channels easily by moving a hand to the point that needs the energy flow.

(4) This position also gives a woman the greatest stimulation. Her clitoris is stimulated, and the man is able to reach her G-Spot. The weight of the man on top gives pressure to the woman's pubic bone, as well as to her breasts, and these pressures will help the woman become stimulated much faster.

(5) The woman can follow rhythmically by wriggling her hips, bumping and grinding in response to the pressure of the man as he presses down and thrusts inside. These movements create a certain kind of Chi pressure in the organs and glands, doubling the Chi in the cavities of the body, thereby permitting the energy to circulate much faster and exchange more easily.

(6) In this position, the farther up in the air the woman legs are, the deeper the penetration the man can accomplish in his thrusting, making this a particularly good position for a couple trying for a pregnancy. It is important, however to make sure that the uterus is not penetrated.

Fig. 8.6 *Woman on Top Position*

C. Woman on Top Position (Fig. 8.6)

Known as the sixth position in the *Plain Lady* book, the position with the woman on top will help to increase blood circulation.

As we live our modern lives, we have a tendency to overeat fatty foods which cause the blood to clot and settle in certain parts of the organs. This clotting causes a slow-down of the blood flow and creates a situation in which heat cannot be released or circulated to a cooler part of the body where the temperatures can be exchanged. The temperature of the whole body rises, resulting in an overheating of the organs. During lovemaking when we generate sexual, organ, and gland energy and fuse them into a very special kind of energy which we call Love's Special Energy, a harmonic

fusion occurs which helps to dissolve these blood clots. The kidneys and liver play the major role in this work.

In this position, the man can easily pull sexual energy to the kidneys and liver. When the woman is on top, the woman is freer to be active and so it is easy for her to direct the stimulation of the vagina and clitoris and maintain a certain angle to her sexual organs in a way that only she knows will stimulate her. Therefore, this position can help a woman with menstrual problems, such as cramps, most of which are caused by insufficient blood circulation in the ovaries and cervix. By directly stimulating the sexual glands, the clitoris, and the G-Spot, and pulling the sexual healing energy directly to the ovaries and cervix, the problem can be alleviated.

To attain this position the man lies on his back and the woman, on her knees and facing him, lowers herself onto his erect penis. Either the man or woman can guide the penis into the vagina. Couples may start in this position or arrive at it by rolling over from the man on top or the side by side position. Begin with the man in motion in order for the woman to receive the healing energy and reach the boiling point. Embrace each other making sure you do not bend the penis or let it slip out of the vagina.

D. Benefits and Drawbacks of the Woman on Top Position

There are both good and bad points to this position.

(1) The woman on top makes the woman experience a more active role, a sense of superiority, a free feeling of movement, and a sense of doing whatever she wishes. This helps to make the woman more open to the world and able to better understand men. Some women become tense when they consider that men try to rule the world in every respect. However it is the rule of nature that Yin and Yang must be balanced. In every situation women play an equally important role. In Taoism we regard timing as very important. When the Yang is too extreme, the Yin takes over. When the Yin is too extreme, the Yang takes over. Likewise, during the beginning of sex the man is on top to arouse the woman, because he, like fire, is aroused more easily than the woman. Once the woman is aroused, she will assume the top position to arouse the man. In this way the roles are interchangeable.

In the top position the woman can experience putting the penis into her vagina, and can take as long as she desires to insert it to give the feeling of prolonged genital sensitivity. Both will feel the

gentleness of the slowly spreading vagina as the penis is inserted.

(2) The woman can direct the glans of the penis to stimulate it in the most sensitive way by placing it only in the two inches that form the outer vagina. It is difficult for a man to remain in only the first two inches. The man tends to want to plunge deeper into the tighter area which alleviates his anticipation, but which also, because of its tightness, makes him finish fast.

The woman receives the sexual healing energy by permitting the man to do the thrusting as she guides his penis to the area she would like to have stimulated. In this position the man or woman can use their hands to stimulate the clitoris which will help the woman reach the boiling point faster.

(3) The man can enjoy the stimulation of liver energy by using his eyes to watch the expression of the aroused woman, her face and her breasts, and see the sexual organs in contact, moving in and out of each other. Once the eyes are stimulated, the man can bring the sexual energy to the liver by slightly contracting the right size of the anus. The woman can use her free hand to arouse her nipples, or her partner's nipples. This will greatly stimulate both partners' organs and glands.

(4) The woman on top is a good position for the later months of pregnancy since it allows intercourse without her growing belly getting in the way. It is also good for the man who has a big stomach in relieving the pressure since, during the sexual act, the stomachs will meet first rather than the sex organs. Older men, and men who have heart problems, are also helped by this position since the man does not expend vigorous energy Because the man can be less active, he can easily guide the energy to strengthen the heart.

(5) The woman on top has to be very careful that she does not move too vigorously which may bend and hurt the erect penis. This type of injury takes a long time to heal. Make sure that the penis has a full erection. If the penis becomes soft, start with slow movements to build up again to the high energy point. When the penis is soft, or during vigorous thrusting, the penis can slip out or half-way out of the vagina, and this is when it can get hurt easily

2. Traditional Lovemaking Positions and Healing

The following are a few classic lovemaking and healing positions as outlined in the *Plain Lady* book. We list these positions for your reference only. With a properly opened energy channel you can guide the energy to heal yourself as you wish at any time and in

any position, so it does not matter at all how many positions you use. For the most part you can use the few basic positions as outlined and change them into hundreds of positions. We want you to concentrate on the energy, not on the positions or gestures. Practice will help you to understand the energy. Many people like to read and listen to philosophy but if they do not practice and experience it, they find it very difficult to understand. Working on the energy is the best way to experience the higher spiritual work.

There are several positions of healing for men and women. Remember that when the man is more active, he gives the healing. The woman lies still to receive it, quieting her mind to feel the energy., and using her concentration to guide the energy only for the purpose and to the place she needs healing. When the man lies still, the woman does the healing.

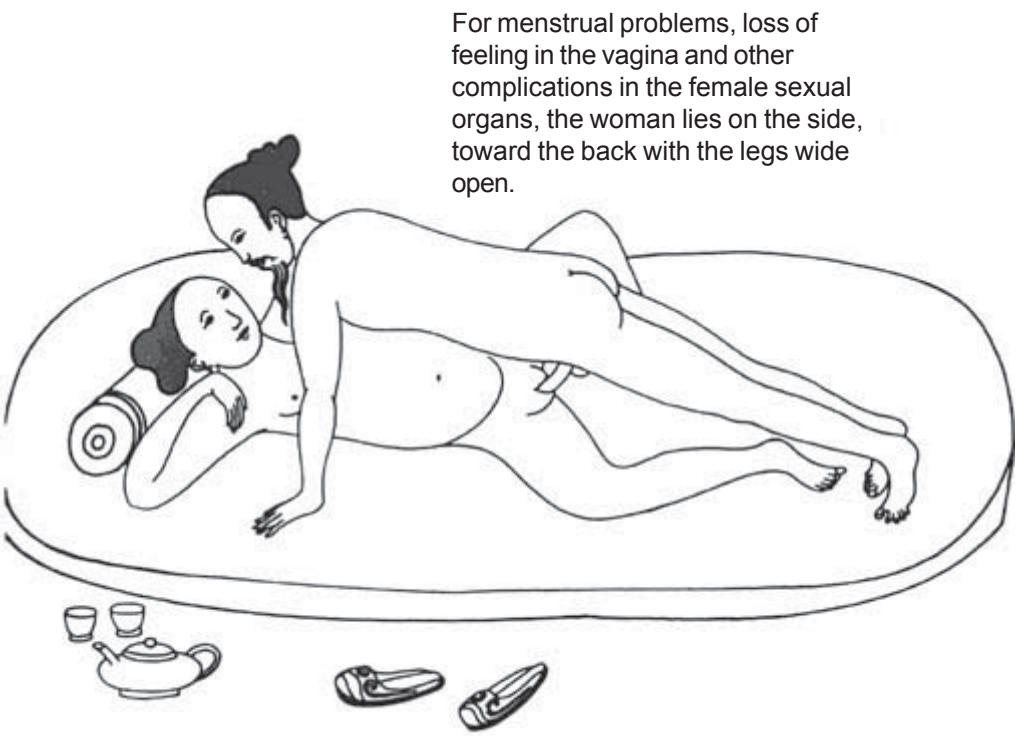

Fig. 8.7 *First Position is for Healing.*

A. The First Position is for Healing (Fig. 8.7).

The first position is for healing, supplying energy for women who are experiencing any kind of menstrual problem, such as cramps or excessive bleeding, loss of feeling in the vagina, or any other female problem. The woman, lying on either side or on her back with her legs spread wide open, has the task simply to maintain that position and receive the healing energy of the man who is accommodating her position with his own and is penetrating. Practice up to two sets of nine penetrations in this position per day for fifteen days.

Fig. 8.8 *Second Position is for Energizing the Body and Healing the Sexual Organs.*

B. The Second Position is for energizing the body and healing the sexual organs. (Fig. 8.8)

Position number two is for energizing the body, and is especially beneficial to those who suffer from low energy. By healing the female sexual organs, the basic energizing organs of the body, general weakness and lack of energy will be improved. To achieve this

position, the woman lies on her back with her head and shoulders supported by a big pillow, and the legs spread wide apart. This position tilts the head forward and tends to curve the vaginal channel. The man enters from the front, penetrating in three sets of nine, three times a day for twenty days.

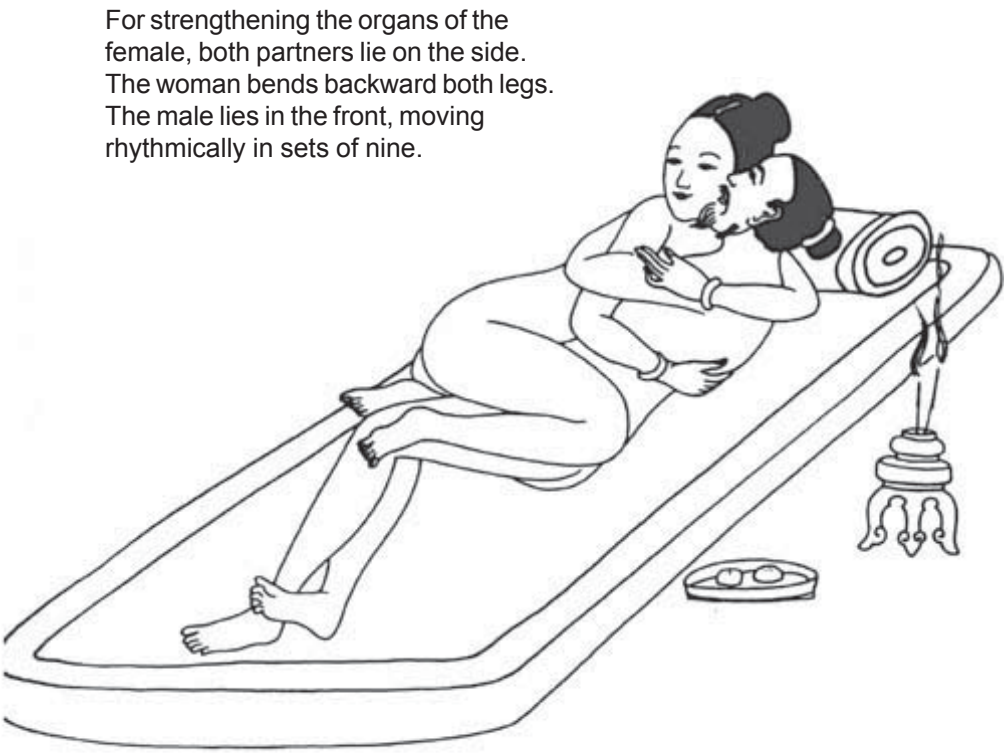

Fig. 8.9 *Third Position is for Strengthening all the Internal Organs*

C. Position Three is for strengthening all the Internal Organs .(Fig. 8.9)

The third position is for healing and strengthening all the internal organs. The woman lies on either side with both legs held together and bent backward from the knees. The man, lying in front of her: penetrates from the front, performing four sets of nine penetrations up to four times a day for twenty days.

D. Position Four is for Healing Bone Problems.(Fig. 8.10)

The fourth position is for healing any kind of bone problems, such as bone weakness. In addition to helping speed up the healing process of broken bones, this position also alleviates circulatory system problems and heals arthritis. (One cause of arthritis, according to Chinese medicine, is bad circulation.) By increasing metabolism and thereby circulation, the risk of disease of the bone marrow, or leukemia, is also lessened. To attain this position, the woman lies on her left side with the left leg bent backward as far as possible, and her right leg stretched out straight and free. The man faces the woman to penetrate, practicing five sets of nine penetrations, up to five times a day for ten days.

For weakness in the bones and joints and circulation problems, the woman lies on the left side with the left bent backwards as far as possible. The right leg should be straight. the man lies on his right side facing the woman, penetrating gently in a rhythm of nine.

Fig. 8.10 *Fourth Position is for Healing Bone Problems.*

E. The Fifth Position heals Blood Vessel Problems. (Fig. 8.11)

Position number five is for any kind of blood vessel problem, such as varicose veins, hardening of the arteries, high or low blood pressure, or blood clots. Excessive blood clotting, practically ignored in Western medicine, is a very important part of the theory of pathology in Chinese medicine, and is treated as a kind of blood disease. The position is the same as the fourth position, except it is executed with the woman on her right side in six sets of nine penetrations, up to six times a day for ten days.

For blood vessel problems, varicose veins, hardening of the arteries and high blood pressure, the woman lies on her right side with the right leg bent back as far as possible. the left leg is straight while the man penetrates, moving in a rhythm of nine

Fig. 8.11 *Fifth Position Heals Blood Vessel Problems*

For increasing blood production, high blood pressure or other blood-related problems, the man lies on his back while the woman sits on top facing him. The woman remains passive while the man moves.

Fig. 8.12 *Sixth Position increases Blood Count.*

F. Position Six increases Blood Count. (Fig. 8.12)

This position is for generating and building more blood, especially in those who lack the capacity for generating new blood, such as a woman who bleeds excessively or is anemic. It is also beneficial in stabilizing blood pressure. For this position the man is on his back in a relaxed position and the woman is upright, facing him, on her knees and on top of him. She does not move; it is the man who moves up and down beneath her: The woman must spread her legs appropriately to be able to hold this position properly.

G. Position Seven is for Lymphatic System Problems.(Fig. 8.13)

This position improves the functioning of the lymphatic system.The man again lies on his back and relaxes while the woman kneels over him facing toward his feet on her hands and knees. the man penetrates and moves in this position. The woman can move slightly if she chooses, but basically it is the man who is giving the healing.

For problems related to the lymphatic system, the man lies on his back, the woman over him on her knees. The woman remains still, while the man moves in sets of nine.

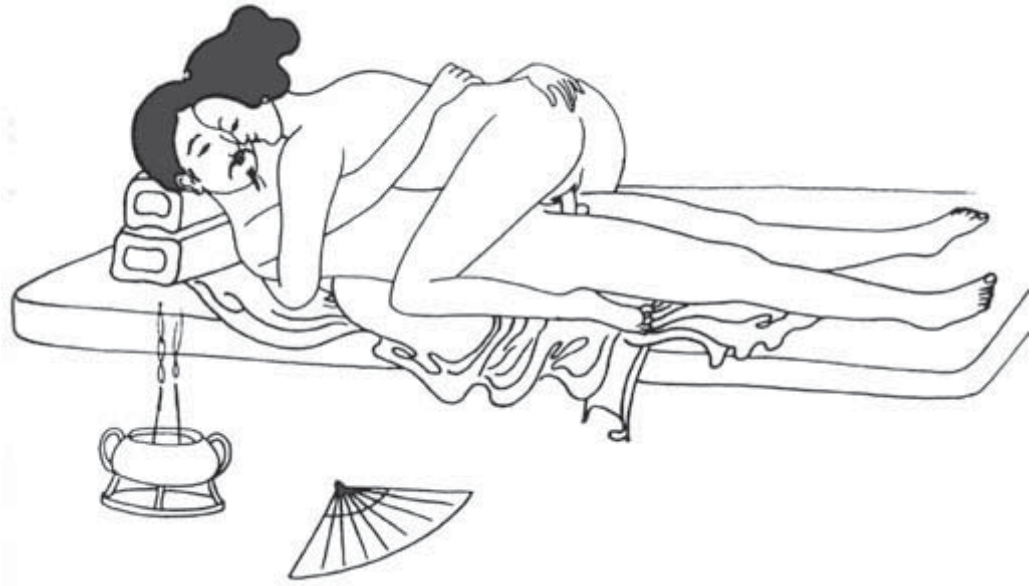

Fig. 8.13 *Seventh Position is for Lymphatic System Position.*

H. Position Eight is to tone the entire Body. (Fig. 8.14)

This position is for healing the body in general. It is a difficult position. The woman is on her knees and bending all the way over backwards, as far back as she can go. The farther she can bend and the closer she comes to a backbend, the more ideal. If it is impossible to go very far, use a pillow to prop yourself up, and bend

as far back as you can without hurting yourself, spreading the legs wide enough so that the man can penetrate from the front. He performs most of the movement.

For all-purpose healing the woman should lie on her back with the legs bent at the knees and the back flat on the bed. The man penetrates from the front, moving in sets of nine.

Fig. 8.14 *Eighth Position is to tone the Entire Body.*

I. Position Nine is for lack of Energy. (Fig. 8.15)

This position is for those who feel weak all the time, have blurry eyes, perspire frequently and profusely often feel faint, experience fast heartbeats, or any similar symptoms. During contact in this position, the woman is basically the one who moves, rotating her hips in a circular pattern, and it is she who does the healing. If the man becomes too excited and in danger of ejaculating, the woman

has to rest for a while. The man can perform the, Big Draw to regain control or rest so that he does not ejaculate. The woman is on her back, and the man, leaning on his hands so as not to put all of his weight on her penetrates from the front as deeply as possible. This will allow enough room for the woman to rotate, first nine times in a clockwise direction, resting, rotating nine times in a counterclockwise direction, and then resting again. If it is comfortable, she can rotate all the way around. She is doing the work, and should continue to do so until she feels she has generated enough energy. This can be practiced nine times a day for ten days.

Fig. 8.15 *Nine Position is for Lack of Energy.*

J. Position Ten heals the Sexual Glands and Organs, the Endocrine Glands, the Pancreas and Liver. (Fig. 8.16)

This position helps to heal and improve the functioning of the sexual glands, sexual organs, endocrine glands and liver. It is particularly good for those suffering from diabetes. For this position the woman lies on her back and wraps her legs around the man's thighs, not his buttocks or back. The man penetrates shallowly an inch and a half using only the head of the penis. The woman rotates her hips both clockwise and counterclockwise for nine times and then rests. Initially she can rotate nine times in one direction and then rest, and then return nine times in the opposite direction and rest.

Fig. 8.16 *Tenth Position heals the Sexual Glands and Organs, the Endocrine Glands, and the Pancreas and Liver*

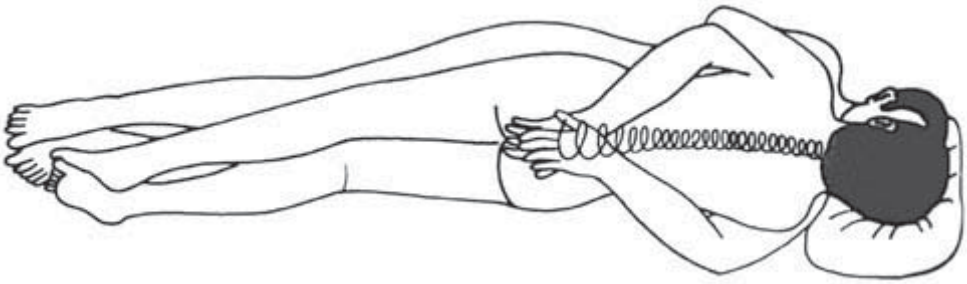

Fig. 8.17 *Sacral Pump Energy Point*

3. Basic Hand Positions to Energize the Body. (Fig. 8.17)

Using hands to assist in the circulation of sexual healing energy in the Microcosmic Orbit to energize the system is one of the most important aids in this Taoist practice. During lovemaking the more you can extend and draw an orgasm upward rather than outward, by performing the Orgasmic Draw while your male partner uses the Big Draw to draw in his own sexual healing and control the loss of semen, the more the sexual energy can be increased. At this point if we can guide the energy flow into the proper channels, the benefit will be tremendous.

There are distinctions among our different energy centers which expand as our awareness expands. As we open ourselves up and discover these distinctions, we open ourselves to their possibilities. It is important to realize that even when you keep yourself open to recognize the distinctions as they exist in you, others may recognize some you may not be aware of. Do not let your ego limit you. As your awareness expands, it is the quality of your maturing awareness that makes the distinctions. Working at something to develop awareness of it and being able to make distinctions are what opens up a subject for us.

The first area in which you begin to feel the energy is in the sex centers, which, as you have learned, are located differently in men and women. In males it is found at the base of the penis and the pubic bone area, while in females, in the Ovarian Palace. When the sex center is not activated and becomes “closed,” many different sexual difficulties arise, as well as feelings of self-destructiveness, self-hatred, a negative attitude and orientation toward life, low or no

energy or enthusiasm, and listlessness. The feeling is agitated and lazy at the same time. This all promotes violent behavior. Bring your attention to this area and radiate, like the sun radiates, your sexual energy from your organs. When energy begins to move and the sex center begins to open up, the sense is one of creative and personal power with the ability to get things done. There is an appreciation for fun and pleasure in life, and vitality.

The perineum area has the characteristics of being grounded, solid, and peaceful when it is open, resulting in a certainty and a security within ourselves and a security within change. When it is closed, there is paranoia, or fear of change. Feeling insecure, wishy-washy, fickle, upset or lonely are the sensations experienced. During the process of your practice, when energy is stuck there, you can feel shaking, jerking or chills. Radiate your sexual energy down into the perineum and create a star or sun glowing there that is beautiful. Feel grounded, solid, peaceful, filled with certainty and the ability to be secure within change. You are now ready to bring the sexual energy to the first energizing point.

A. Sacral Pump Energy Point

As you or your partner approach orgasm and you practice your respective Draws, exchange the excess Yin and Yang energies and feel the orgasm move upward. Lie still and quiet for a moment, embracing each other and put both of your palms on your partner's buttocks, with the fingers touching the crest of the buttocks, and the palms covering the buttocks toward the sacrum. (Fig. 8.17) The man should do the same to the woman in each of these exercises. Feel the sexual healing energy from your partner's hands pass to your buttocks and give you assistance in raising your own sexual healing energy up the spine. At the same time slightly pull up the vagina and the front part of the anus, and then pull up the middle and back part of the anus to draw up the sexual healing energy, to the Sacral Pump. Feel a warmth and tingling in the sacrum, or other sensations as this point opens up.

Enjoy this moment of peace. Feel the tension and stress begin to melt away in the legs, hips, pelvis, chest and head as you radiate this point. Think of this point as the place containing rootedness to past and present that goes down into the legs, connecting with the nerves there. When it is closed, the past seems a prison, housing unconscious fears and hopelessness that things will remain as

they always have been, never improving. Sense and radiate at this point all the treasures in your past that will become your resource, and the blossoming of all your deep potentials as they become part of your daily living, balancing you in time and space. The feeling is often wide because the energy is awake everywhere. Here is the place where we can blend the earth energy, sexual energy and refined energy. Take as long as you wish to enjoy this point.

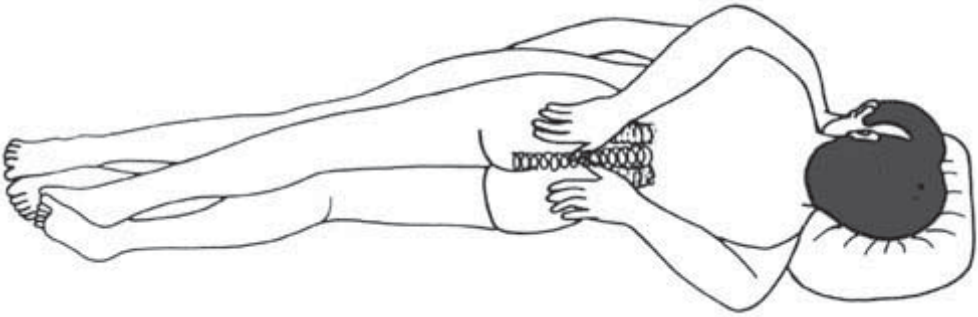

Fig. 8.18 *Kidneys' Energy Point*

B. Kidneys' Energy Point

When the feeling in the sexual organs subsides, the energy flow is low and you can resume lovemaking, building up to the height of sexual healing energy. Perform the Orgasmic and Big Draw again, exchange the excess Yin and Yang energies, and embrace again in stillness. Both partners should now place their hands and palms on the other's left and right hips with the fingers touching each other on the hips, and the palms covering the hips and facing toward the kidneys and adrenal glands. (Fig. 8.18) These points are key energy sources. At the same time slightly pull up the front, middle, and back parts of the anus and bring the sexual-healing energy up to the Door of Life point (located opposite the navel between Lumbar 2 and Lumbar 3). Hold the energy at this point for a while, then slightly pull up the left and right part of the anus, bringing more energy directly to the kidneys. Wrap the sexual energy around the kidneys like a cocoon, and then pack the energy into the kidneys.

The Taoist system regards the kidneys as transformers. When the kidneys are strong, they fill with Chi pressure, enabling them to

perform the very important task of cleaning out the toxins and waste materials which have become embedded in the cells. Once the toxins are cleaned out, the cells will energize. Taoists also regard the kidneys and each kidney's surrounding area as the places where prenatal energy (our principal energy) and sexual essences are stored. The refined foods, pollution, toxins, etc., of modern life gradually deplete the kidneys as a source of energy. Energy depletion from the kidneys, blockage of energy flow, or a closing of the kidney point are believed to be major causes of many disturbances, such as back pain, imbalance, depression, the feeling of being taken advantage of and fear.

(1) Excessive loss of semen creates fear.

Excessive loss of sperm energy drains the kidneys. This depletion is the major reason for fear in men, causing them to lose confidence in sex and in life, not an uncommon situation for men in today's world. Using sexual stimulants creates a speedy depletion of a man's sexual energy, similar to trying to pour gasoline onto old half-burned wood; you only speed up and use up the vital energy stored in the body that is so necessary to life. If your partner ejaculates, holding him at these specific kidney points will be the most important way to revitalize him, thereby helping him to recover lost energy much faster than any kind of drug or sexual stimulant.

Holding your partner's little fingers can also help to overcome this fear. The little fingers are the beginning and ending of the heart and small intestine meridian. When the kidneys generate fear, this fear will first affect the adrenal glands, and these glands will stimulate hormones that affect the heart, thereby increasing the meridian energy, a condition that can tilt the whole system off balance. Holding the little fingers will regulate the flow and balance of energy. In this way your partner can recover his confidence, and give his heart to you. Remember that lovemaking is caring about each other. If he cares about you, you must care about him.

When the kidney point is open and radiating, there is a sense of openness, generosity, abundance and balance. All fears are outshone in that radiance.

Fig. 8.19 *Adrenal Glands Point at T-11*

C. Adrenal Glands Point at T-11

When you feel that the sexual energy is low, resume lovemaking to the point of high energy. Next move the energy up to the rejuvenation energy center or Thoracic-11 (T-11), located at the spinal joint of the two lowest floating ribs. You and your partner should put the heel of both palms on each of these lowest ribs with the palms covering between the second and third lumbar vertebrae. (Fig. 8.19) These areas are where the kidneys are located, above which the adrenals rest. The adrenal glands, located on a long muscular band which can be felt along the entire back in this area, secrete certain hormones to increase the growth and vital force of the trillions of cells of the body. It is the adrenal glands that will make cells last longer and stay younger.

Our modern lives abound with tremendous stress. We are fearful on the streets, in planes, and in the working place. We are burdened with all kinds of excitement, such as the stimulation of television or radio commercials constantly trying to sell more things to us. All of this stress depletes the adrenal glands' function, and this depletion locks the adrenal glands' point and becomes the main cause of hypertension, listlessness, depression, sadness, frustration, insomnia, and low-key performance.

To bring the sexual energy to the adrenal glands, slightly pull up the front, middle, and back of the anus, and thus the Chi Muscle. Pull the sexual energy up to T-11 and feel the energy there. Then contract the left and right anus and pull up more energy to the kidneys and the adrenal glands. Wrap and pack the energy there, and feel the warm sexual energy vitalize the glands. Remember that these exercises can be performed simultaneously by both partners.

When the adrenal glands' point is open, you will feel energetic, confident, filled with a sense of vitality, and the ability to get things accomplished.

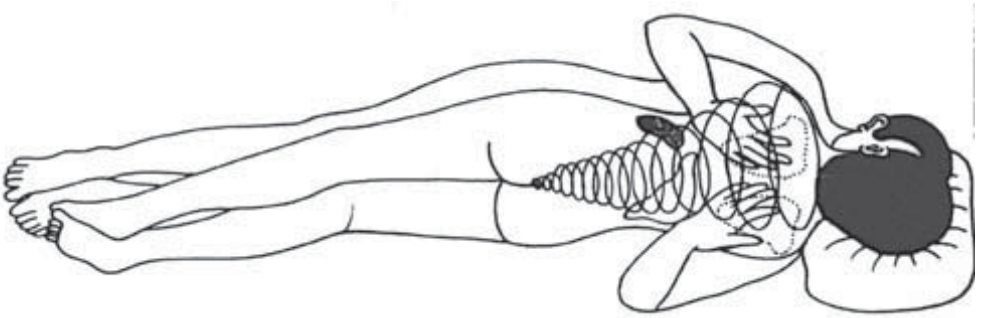

Fig. 8.20 *Liver and Spleen Point*

D. Liver and Spleen Energy Point

The fourth Upward Draw (or Big Draw for your partner) energizing point is the liver and spleen point, situated at the ninth and tenth ribs and on the muscular band just below the scapulae. Put your fingers on the scapulae with the middle of the palms immediately below the lower tip of the scapulae. (Fig. 8.20) As you cover this area, feel your Chi energy activate your partner's energy Slightly contract the front, middle, back and then the left and right sides of the anus, and bring your own energy up to the liver and spleen, continuing up to the point between the scapulae. The liver is the main storage house of energy and contains the capacity for natural beauty. The liver and spleen energy point, when open, provides a sense of freedom and the ability to take risks for ourselves and others. Opening this energy point and radiating energy there can also help to relieve anger, panic, worry and anxiety, fears of the past, back pain, release the tension of the diaphragm, generate deeper breaths, and improve digestion. You might release gas and begin to yawn a great deal as your digestive system is clearing itself. You sense an opening to the present moment.

In the beginning you can practice drawing upward to one or two points only. When you are more advanced, all of these upward contractions will become more automatic, and eventually you will be able to energize the whole line of points at once. Do not, however

confuse the points with the actual organs. These points simply correspond to the organs.

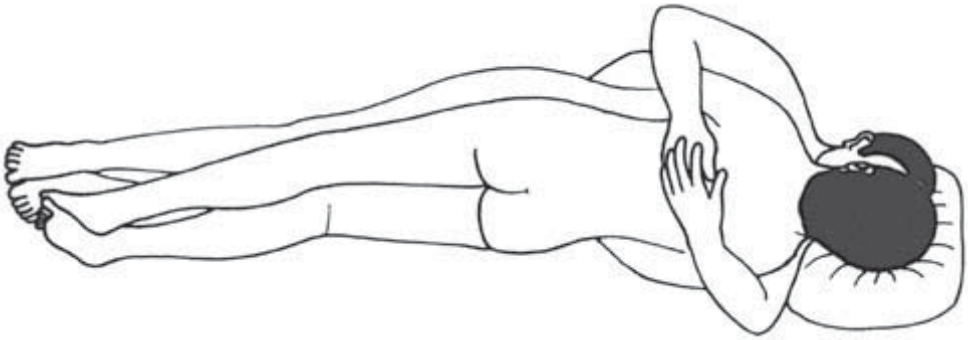

Fig. 8.21 *Heart and Lungs' Point*

E. Heart and Lungs' Point

The fifth Upward Draw (or Big Draw) point is the heart and lungs energizing point, located between the fourth and fifth ribs. Feel the crest of the scapulae and follow each scapula down to the center point between them at the spinal cord, opposite the heart center. Use your palms to cover the area between the scapulae and the spinal cord. (Fig. 8.21) Feel your energy pass to your partner and your partner's energy pass to you. Slightly contract the front, middle, back, left and right parts of the anus, and bring the sexual energy to the lungs and heart. Be very careful in pulling the energy to the heart and lungs since excess energy at these points can cause pain in the chest. The completion of the Microcosmic Orbit is very helpful in preventing such congestion. The Healing Sounds of the heart and lungs are also helpful in relieving congestion, as are brushing-down with the palms or stroking or tapping the chest. (See the book *Taoist Ways to Transform Stress into Vitality* for an elaboration of the Six Healing Sounds).

In addition to chest pains the heart center, when closed, leaves us with a feeling of ignorance of our real relationship to things. We may feel sorry for ourselves, unloved, and incapable of love. We often feel under attack. We can feel overwhelmed, rushed, cruel, arrogant and lonely. Usually the worst feeling is one of unworthiness or lack of deserving. When that heart center is open, we feel sunshine from the inside. We have a sense of joy and love that is

sometimes a floating sensation. In all of our meditations it is important to fill our hearts with loving, smiling energy, because when we feel love, we are truly related to all things. There is a sense of honor and respect. When open this point will also help to increase circulation and improve respiration, which will quickly energize the entire body. It can help to relieve upper back pain, shoulder: neck and arm tensions and pains, and provide a way to recover from tiredness. Allow this energy to circulate through your being to create the feeling of gratitude that will be the catalyst for all your spiritual work and enlightenment.

F. C-7 Point

The sixth energizing point is the C-7 point, the largest protrusion of the spinal column located at the junction of the shoulder and the base of the neck. This point controls all the tendons of the body. The Taoists regard this as the great union point of the Chi flow connecting the hands, head and spine. Opening and connecting this point is very important to the practices of Healing Hand Kung Fu, Iron Shirt Chi Kung, and Tai Chi Chi Kung. (A description of these practices can be found in the last chapter of this book entitled *The Universal Tao System: Courses Given in Various Centers*). Place your left hand on C-7 and the right hand on the sacrum. (Fig. 8.22) Contract and bring the sexual energy up to this point.

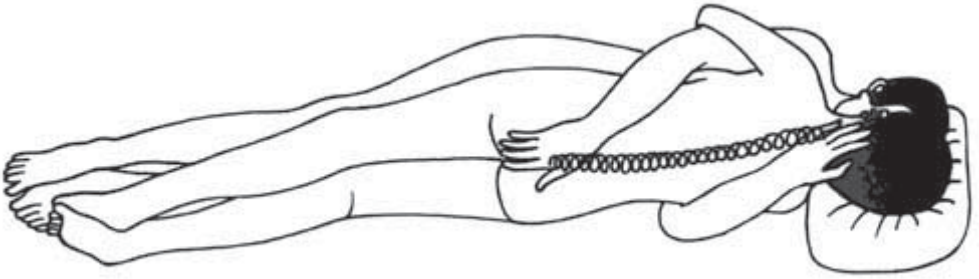

Fig. 8.22 *C-7 Point*

The C-7 energy point, when it is closed, stirs within us the feeling of denial of our connectedness, as if we stand as individuals against the rest of the world. It also creates the feeling of being inappropriate

and ill-fitting, or not being in the right place. It is demonstrated in a stubborn viewpoint, while at the same time being burdened by our inappropriateness. As the point opens up and radiates the energy, the experience is as though a mantle is being draped from our necks down onto our arms, giving us the ability to embrace each other in our humanity, opening our viewpoints and flexibility, our appropriateness, manifested in the feeling of connectedness. As the feeling spreads farther down our arms to our hands, we become mote aware of the healing ability in our palms.

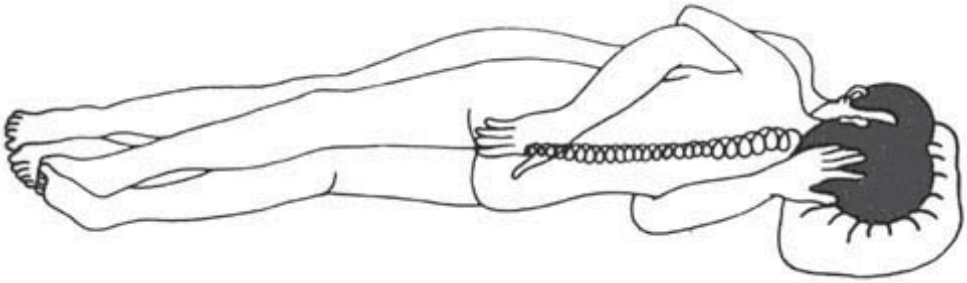

Fig. 8.23 *Neck Point*

G. Neck Point

The seventh energizing point is located at the middle of the back of the neck, between the third and fourth cervical vertebrae. Use your left palm to cover this point and the right palm to cover the sacrum as you slightly contract the front, middle, and back parts of the anus. (Fig. 8.23) (There is no need to contract the left and right parts.) Bring the energy to the neck and feel the neck energize. The neck is the busiest traffic area in the body. All the controls of the body including all emotions, are signaled from the brain and pass through this “bottleneck.” When under stress and emotional strain, the neck begins to accumulate and jam with tension.

The neck is the passageway of many meridians channeling the organs’ Chi energy to and from higher centers. In the middle of the neck runs the Governor Channel, while the bladder, triple warmer and large intestine meridians travel along the sizes of the neck. Emotions, generating from the organs (anger from the liver fear from the kidneys and bladder, grief from the lungs and large intestine.

hastiness from the heart and the small intestine, and worry from the spleen, stomach, and pancreas) “jam” in the neck causing the neck to be stiff.

Oftentimes when your partner has lost too much sexual energy, it will result in an increase in tension, creating a greater emotional “jamming” in the neck. As a result your partner will be easily angered, fearful, and frustrated. The neck point is a marvelous place to release the tensions arid emotions of your partner. Hold this point gently.

There is no need to contract the anus, just hold your partner and mentally guide the sexual healing energy to melt the tensions and emotions away. You can lightly massage to help release the tension. This will increase your partner’s relaxation tremendously

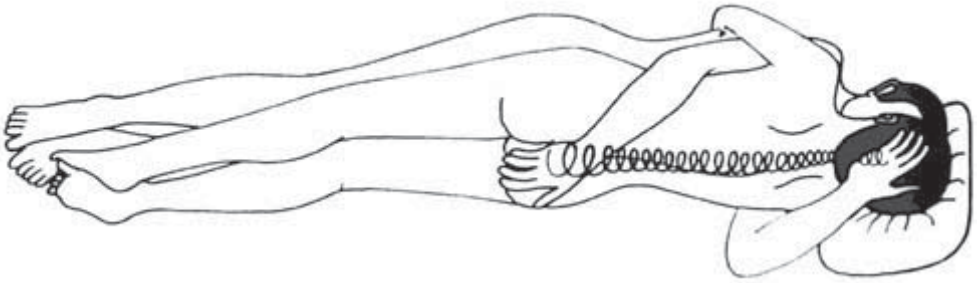

Fig. 8.24 *Base of the Skull (Jade Pillow) Energizing Point*

H. Jade Pillow Energizing Point

The eighth energizing point, the Jade Pillow, is located between C-1 and the base of the skull (the occipital bone) in a little hollow between two muscle bands and outsize of the spinal column. Embrace your partner quietly and place your left palm over the base of the skull on the hollow place, with the right palm over his sacrum. (Fig. 8-24) Feel the heat that is generated as the sexual healing energy passes to your partner while your partner’s energy passes to you. There is no need to contract the anus. Use your concentration to direct your energy to melt tension and clear the mind.

Radiating the energy in the Jade Pillow will impart to you a sense of being able to draw inspiration in. This point is connected very much with our breathing, as well as a part of the brain that is located there. When it is blocked, the sensation is of a burden that is suffocating you. As you guide sexual energy to this point, and the energy accumulates there, you can work out this block. The brain revitalizes, the mind clears, consciousness increases, and memory improves. There is a limitless feeling as of a sky. As it opens, breathing becomes easier and an inspirational sensation occurs, as if something beyond our imagination can enter and operate through us. Rest your attention at this point, quieting the mind, and look into the spaciousness and luminosity. This point also influences the eyes, ears, nose and mouth.

I. Crown Energizing Point

The ninth point, at the top of the head above the mid-brain, is called the crown point (the Pai-Hui, or GO-20), and is the seat of the pineal body. Its functions are related to sensitivity and the sexual cycle. The crown point governs hearing, body rhythms, equilibrium, the perception of light through the eyes and skin, and is the superior counter support of the brain and spinal cord. In Chinese it is called the “Hundred Point Joint:”.

When the crown energy point is closed, we do not feel in charge of our lives, but rather out of control and reckless. We are filled with delusions and pride, and experience erratic mood swings and headaches. When the crown is open, we are guided by higher forces. We radiate happiness, blossoming like a flower giving off a fragrance. We rule over our own expression and experience.

In the latter part of the higher Taoist practice, this point serves as a compass directing a person’s soul and spirit to the place where he or she is eventually supposed to go. Once this point is fully developed, you will see a clear creative light, giving direction and sustenance to your spirit body.

Once you reach this higher level of sexual healing energy, very slightly pull up the front, middle and back of the anus and the Chi Muscle, and bring the Chi to the top of the head. (Fig. 8-25) Assist this movement by looking up with your eyes while concentrating on the highest point. In the beginning you might feel pressure or a sense of expansion in the middle of the head. This is an indication of energy reaching this point. Use your mind, your eyes and all the

senses to move the energy in a clockwise motion, circulating it nine: eighteen, twenty-four, or thirty-six times, depending upon how you feel.

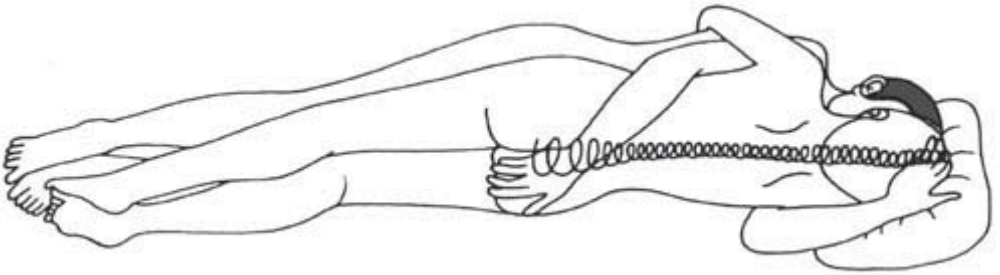

Fig. 8.25 *Crown Energizing Point*

Again it is important to emphasize the opening of the Microcosmic Orbit. With the Orbit open, you will easily be able to guide the sexual healing energy up to the top of the head, and when energy has filled this point, it will overflow, pouring down to the middle of the eyebrows where the pituitary gland is housed. The Taoists regard this point as the "Original Cavity of the Spirit." The crown energizing point houses the master endocrine control gland, the pineal gland, regulating growth, gonadal, adrenal and thyroid functions.

J. Third Eye Point

The third eye point, located between the eyes in the center of the forehead, radiates like sunshine, or the opening of a flower as the sexual energy flows down from the top of the head to this area. When the forehead is open there is a sense of purpose, a direct and simple knowledge, an intuitive wisdom and sense of direction in life. A sense of your own personal being emerges. As the positive energy accumulates there and ripens, you smell fragrances, taste the nectar trickling down onto the tongue, or see a beautiful, blue pearl. When closed, the feeling is of the mind wandering and indecisive, fickle, and often agitated. An internal dialogue of self-criticism and invalidation continues endlessly. When this center is closed, you feel you have no direct knowledge or perception.

K. Throat Center

From the third eye point, the energy will continue to flow down to the nasal passages, the palate, the tongue, the throat center .The throat center is located at the notch at the base of the throat and top of the sternum. It is a place of communication and change. When open, our expressions flow, both verbal and non-verbal. This point has the power of the word: what you say and what you ask for come about. Openness in that center promotes speech, so that the sentences we use are the ones we live out. An open throat center also brings about lucidity in dreams, the expressions between our souls and our other selves. When the center is closed, you can feel choked up, as with guilt, and you may have difficulty swallowing, as if there were a lump in the throat. You may feel an unwillingness to change. Feel the energy radiate into the throat, as though you are sunbathing there. Let go of all things and all memories of that closed feeling. Feel the throat open and blossom with the power of speech. Be aware of the lucidity in your dreams and a flexibility manifested in your ability to express yourself.

The energy continues to flow down to the heart center again, at the middle of the breast, one inch from the lower end of the sternum. This heart center point is a very important point in the woman's practice. It is the seat of energy transformation, and thus the seat of healing and loving energy in a woman. From the heart point the energy will flow down to the solar plexus, and then down to the navel.

L. Navel Center

As the navel center opens, we feel a sense of balance, equanimity and centeredness, of allowing ourselves to be as we are, and everything else to be as it is, which takes no effort. The experience is one of mindfulness. An open navel center allows us to let things be, put a value on everything, and feel true abundance. When it is closed, there is a lack of balance and centering. The navel center is a storage place for excess energy, and so is a storage place for the energy of our work. As we continue to bring the energy to the navel center the navel naturally centers and opens. As you feel the energy accumulating in the navel, you will find it to be the place of value, the original connection you had with your mother and the place of nourishment as you came into this world. Here we feel the natural abundance of all things.

Try to practice holding one point at a time, and move up one by one in sequence. Do not practice all the points in one session in the beginning. Once you feel that all your partner's channels are open, you can choose the appropriste points to use at that time. Judge by the needs of your partner. Discuss the hand positions ahead of time with your partner describing what you would like to accomplish, and share the entire book with him so that he can understand the practice. Your mutual understanding and working together on the practices described here will result in harmony.

Once you have completely opened your partner's back channel with the help of your hands, you can use the hands to help speed up the flow of sexual energy.

C. Step-By-Step Practice to Balance and Harmonize the Total System

While your sexual organs are in contact with your partner, you are joining with his or her front channel, the Functional Channel. The energy flowing through each one's. Functional Channel is more easily joined when there is sexual arousal. At this time a lot of energy is generated from the organs and glands, and it all flows down to the sexual region. Remember that if you do not redirect it up, the most vital force that your body creates will be lost to the universe, with no benefit to you at all unless your intention is to bear a child.

1. Guide the Aroused Sexual Energy up the Spine.

Begin by guiding the aroused sexual healing energy up the spinal column to the points listed below one at a time with the assistance of the hands. As you become more advanced in the practice, you can put your hands on different points, thereby causing the energy to jump faster.

A. Kidneys' Point

Start with foreplay to bring your partner or your partner to bring you, up to the boiling point. Remember that if the organs, glands and sexual energy are not ready when you engage in lovemaking, there will be less energy to exchange. This can be harmful to the organs, glands, and sex organs. When you feel the sexual healing energy is activated, embrace each other for a while. Then both of you can begin to use your hands simultaneously or one can

singularly touch the other if you both choose. Put your right hand on the sacrum with the middle finger touching the tip of the coccyx and the palm covering the sacrum, especially the opening of the sacral hiatus. (Fig. 8.26) Feel the heat being absorbed into the spinal cord as it helps to activate the Sacral Pump which moves the energy upward. Place your left hand on the Door of Life, opposite the navel and between Lumbar 2 and Lumbar 3. Feel the sexual energy moving upward from the sexual region, past the sacrum and up to the kidneys' point. Use the anus muscle to hold and guide the energy up, if necessary At this time you can inhale to pack and wrap the sexual healing energy, bathing the kidneys with healing, creative and generative energy.

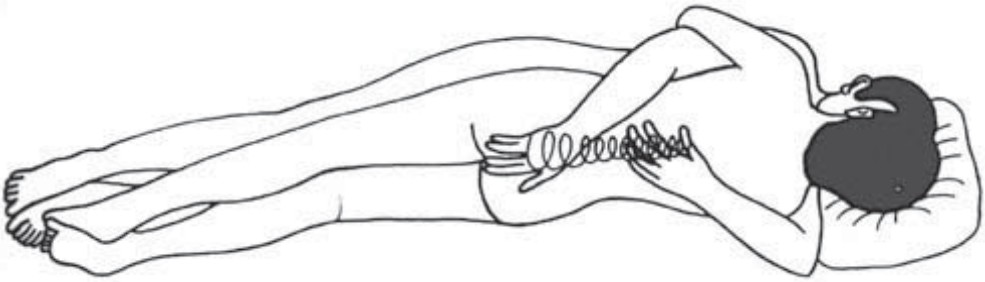

Fig. 8.26 *Move the Energy to the Kidneys Point.*

B. T-11 Point

When you feel the sexual energy level is low, your partner or you should resume a three shallow-one deep, a six shallow-one deep, or a nine shallow-one deep series of penetrations. Taoist Masters discovered the G-Spot many thousands of years ago. In all their manuals on sex they always advised shallow thrusts because the glans, or head, of the man's penis will stimulate the glans, or clitoris, of the woman, and fit right behind the pelvic bone where the G-Spot is. Build the energy to the point in which both of you can exchange the energy. Embrace quietly for a while with the right hand still holding the sacrum, and move the left hand to the T-11, the point of the adrenal glands. (Fig. 8.27) Hold this position until both of you feel the energy move.

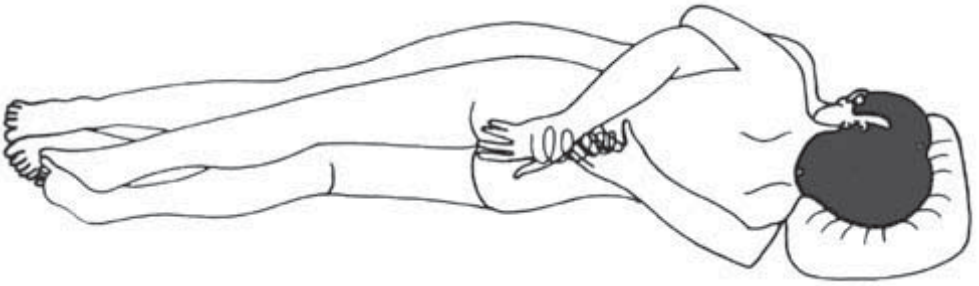

Fig. 8.27 *Move the Energy to the T-11 Point.*

C. Liver and Spleen Point

Repeat the above step, but this time move the left hand to your partner's liver and the spleen point, below and between the scapulae. (Fig. 8.28)

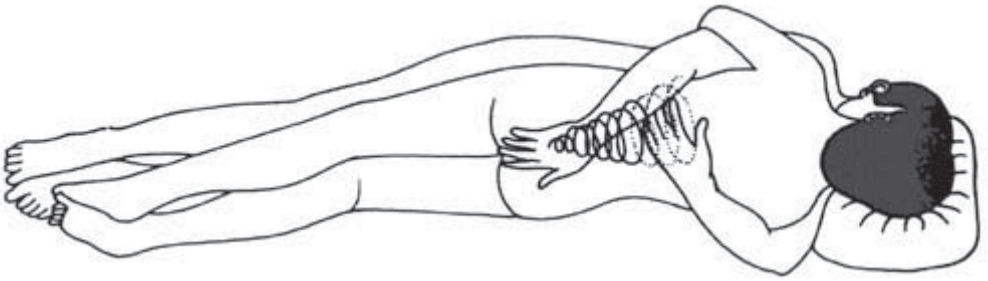

Fig. 8.28 *Move the Energy to the Liver and Spleen Point.*

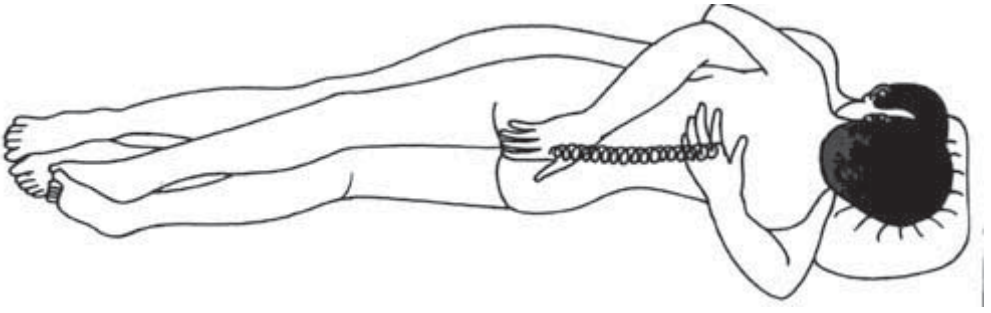

Fig. 8.29 *Move the Energy to the Heart Point.*

D. Heart Point

Repeat step (b) again. After both of you have built up to the height of sexual-healing energy, embrace again. The right hand remains at the sacrum and the left hand moves to the heart point, located opposite the heart center and between the fourth and fifth ribs. (Fig. 8.29)

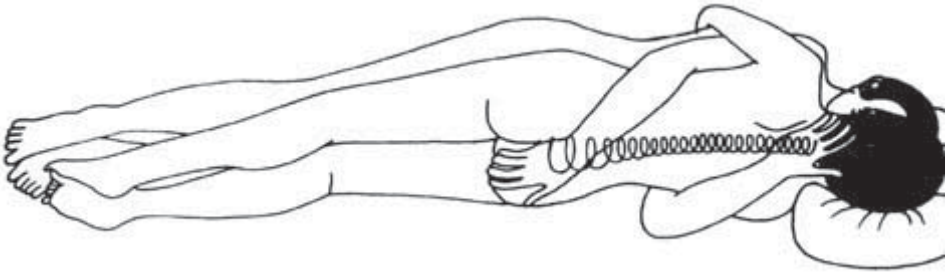

Fig. 8.30 *Move the Energy to the C-7 Point.*

E. G-7 Point

Build the sexual energy to its highest point again and embrace. Maintain the position of the right hand and move the left hand to the C-7 point at the base of the neck. (Fig. 8.30) Feel the sexual energy being drawn up, activated toy your partner's palms, the anus Chi Muscle, and the eyes-mind concentration.

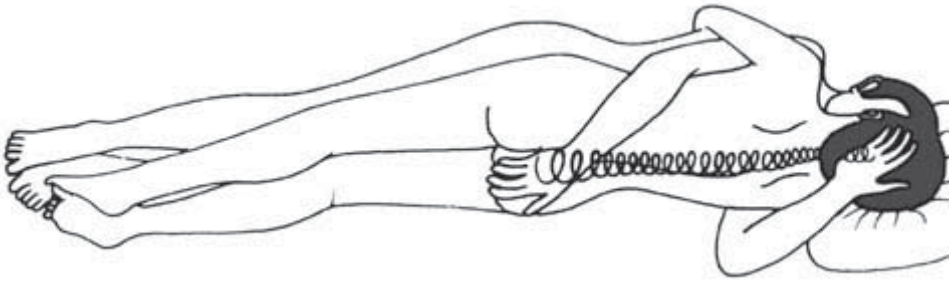

Fig. 8.31 *Move the Energy to the Jade Pillow Point.*

F. Jade Pillow Point

Build up the sexual energy and embrace. The right hand remains on the sacrum. The left hand is moved to the base of the skull.

(Fig. 8.31) When you join this point with the sacrum point, you will activate the Sacral Pump and Cranial Pump, and so will greatly feel the flow of sexual energy. The consistent increase in the activity of these pumps is very important to your health, and mental and spiritual practice.

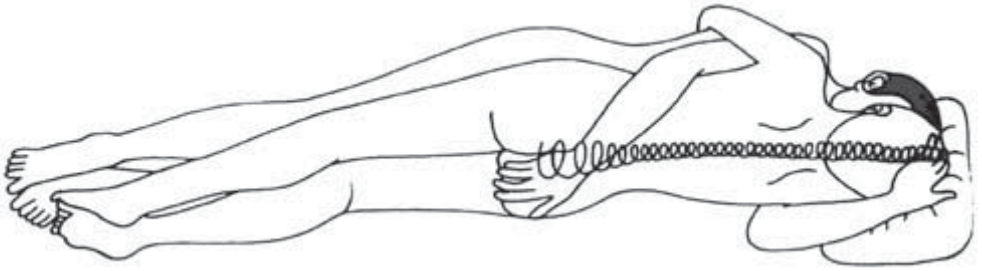

Fig. 8.32 *Move the Energy to the Crown Point.*

G. Crown Point

Build up to highest point of sexual energy arousal and embrace, with the right hand remaining on the sacrum. Move the left hand to the top of the crown. (Fig. 8.32) If the channels are well open, you will gradually feel energy flow like a fountain of youth up to the head, and then a sprinkling of the energy in the brain. Once it fills the brain, the energy will shower down the front channel to the tongue, the heart, and then down to the navel.

H. Exchange the energy using the eyes, nose and tongue.

Now look into your partner's eyes. At this point there is a lot of energy in the eyes that can be exchanged. You can feel that you are looking into your partner's soul. His and your eyes, like magnets, draw and pull from each other: At this moment the energy exchange through the eyes and tongue is very deep.

Rub your nose against your partner's nose. Feel a spark of energy jump from one to the other.

Move your tongue into your partner's mouth. Touch his tongue and massage it with your tongue. Feel the sparkling energy pass from your tongue to your partner's tongue. The fragrance of the energy flowing from mouth to mouth, from palate to palate, is beyond words.

The eyes, nose and tongue of each of you help to join and encourage the flow of sexual energy down the front channels. If you and your partner now have a lot of saliva, be sure that you both are in good health before swallowing it.

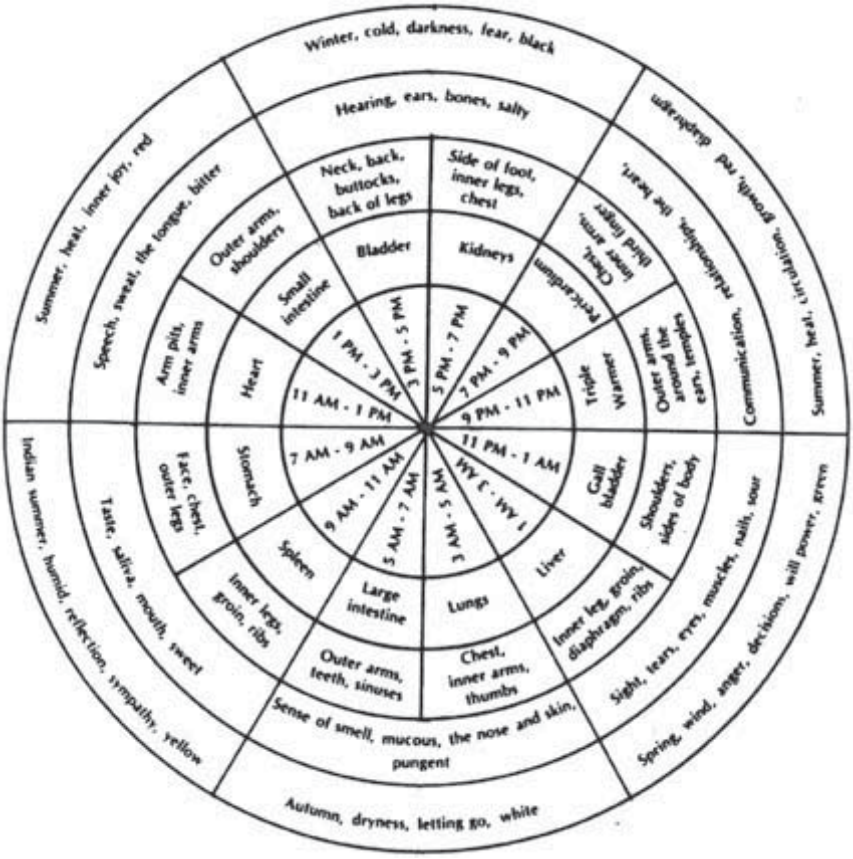

Fig. 8.33 *Body Clock Chart*

I. Certain times of the day heighten the Healing effect. (Fig. 8.33)

The Taoists believe that the organs of the body and their corresponding meridians are activated and stimulated during certain times of the day. Since good health exists when there is a complete

balance of energy within the organs and meridians of the body, sexual activity being stimulating and energizing when properly done, can further deplete a body that is suffering from an energy imbalance when practiced at a low energy time. Since the sex act leaves a person open and vulnerable to universal energies, it is wise to choose a time when the universal energy will be beneficial.

The best time for sex is in the early morning when your body is well rested. A particularly bad time for sex is in the late evening, especially when you are tired or under emotional stress, because the organs' energy is not strong enough to handle the sexual energy. A nap or rest beforehand is recommended if this is the only time convenient for you.

The hand positions described in this chapter are used in most of the positions that we described previously in this chapter: These positions can help you and your partner stimulate each other in one particular area of the sexual organs to initiate a greater reflex of the organs. But the most important part of the practice is to open the channels so that the sexual energy can abundantly flow directly to the organs and glands to stimulate them as well. Once you master the opening of the channels, you can direct the sexual energy more with your mind and less with your hands, or without using the hands entirely.

Try to practice one position at a time to make sure you both feel the opening of the channels. If you are quite sure you are open, make sure that your partner is also open. If you cannot open your partner's channel, you can send some more of your sexual energy to him, or if you cannot open your channel, your partner can send his sexual energy to you. When a woman sends her sexual energy at this time, as well as during the time of exchanging energy she enhances the lovemaking and helps her partner by squeezing his penis tightly. First she must be sure that her partner is in a safe stage of arousal, or he may ejaculate. Squeeze and hold for a while, then release. (Fig. 8.34)

Exhale and mentally send the sexual energy to the point where your partner needs help, covering it with your palms. With practice you will feel your energy pass more easily through your hands to reach the point that you intended. You will sense the energy, even taste it.

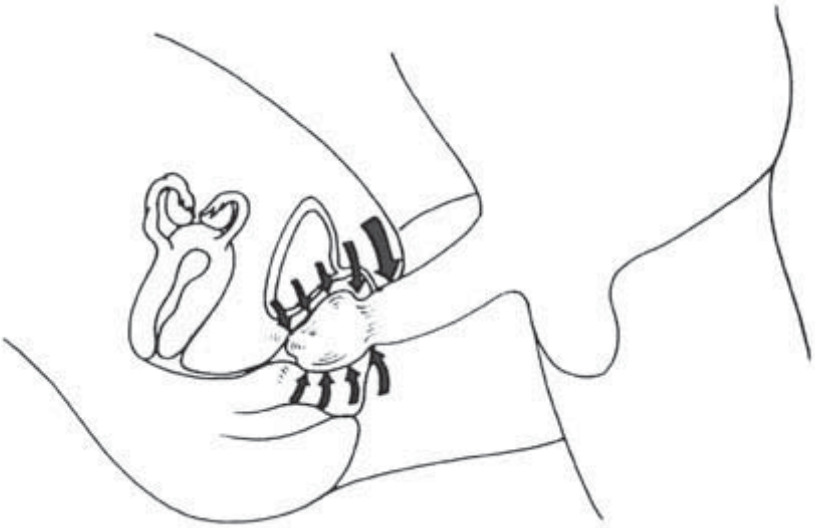

Fig. 8.34 *To help the man delay or stop ejaculation, the woman grips tightly with her vagina the head and shaft of the penis.*

D. Valley Orgasm

A Valley Orgasm is the means to attaining more pleasure, more healing energy, and more energy to transform into a higher spiritual energy. A Valley Orgasm in a man occurs when he is 99 percent of the way to ejaculation. At this point he pulls out of the vagina and, practices the Big Draw to milk his prostate gland of semen, and rather than release it outwardly, send it in an inward and upward direction where the energy will be transformed. He relaxes, allowing the sexual organs to settle down to approximately a 60 percent arousal, and then he begins again by practicing sets of nine shallow-one deep penetrations to bring him again 99 percent of the way to ejaculation. Again he does the Big Draw, the exchange, and then relaxes, setting down a bit and then coming back up again. Each time he draws back and sends the energy upward, he doubles and triples his sexual energy. He can continue to multiply it in this way and draw the energy to higher centers as long as he does not let the sexual energy escape. Sexual energy is the one energy that can be multiplied without end and can continue increasing. Each time the orgasmic feeling will come up higher than the last time:

each time it is brought through the Microcosmic Orbit to all the organs and glands. This kind of higher center organs' and glands' orgasm is very different from the lower orgasm which is confined to the genitals, very brief and leads to vital energy loss.

Do not confuse the orgasm with ejaculation: they are two different things. An orgasm can last as long as you want, and can travel as high as you want. Once the man has ejaculated, however the orgasm is gone. The most pleasurable time is the peak of the orgasm right before ejaculation. Many people want to go beyond that point, however and if they have not been trained to control it, the point beyond ejaculation will be the end of the orgasm, and thus the end of the buildup of sexual energy at that time.

The Valley Orgasm in women is more intense than in men. Women can achieve almost as high an orgasm as they desire, and can cultivate their orgasm higher and higher. In an earlier chapter we stated that women do not lose much energy in normal sex, and that most of their energy is lost during menstruation. Even though women can have an ejaculation during sexual intercourse as men do, they lose only fluid and not an egg. Men during ejaculation lose about 200 million sperm. Women can arrive 99 percent of the way to the point of orgasm, perform the Orgasmic Draw to bring the orgasm higher in the Microcosmic Orbit, exchange energy with the organs, rest, and begin again to achieve a higher orgasm. Each time the woman holds back, the sexual energy doubles, triples and keeps on growing as long as she holds back, drawing the energy upward and inward.

Compared with men, women have a much easier time learning the sexual draw exercise, since women do not have to control ejaculation. Also, the emotional hookup that ties men to their ejaculations is not true for women and their periods. The notion of reducing menstrual tension does not threaten most women's view of their femininity.

1. Increasing Sexual Energy through Several Upward Draws

As we have described, in a Valley Orgasm we use several upward draws to bring the energy inward and upward. It seems that the more that is drawn up, the more energy is produced again in inexhaustible amounts, provided the energy is not released outward. This drawing up or holding back consists of one round of both partners approaching 99 percent of orgasm, drawing the sexual

energy up, and controlling the sexual organs to return them to 60 percent orgasm. Each time you perform the upward draw you will increase internal energy significantly and it will become more and more internal. Instead of losing all that energy as in ordinary sex, and feeling depressed and exhausted afterwards, after an upward draw you will have more energy than before and feel refreshed and filled with healing energy.

In some cases people have so much tension and anger that when they allow their sexual energy to release outward, they feel they have released the tension too. However in actuality the tension is building up again and now they have no other way to handle it. The only way to rid themselves of it is to dump out their life-force, mixing their sexual energy with anger and other negative emotions.

The ancient Taoist System described the benefits of these methods in detail as follows:

A. First Upward Draw

After you or your partner have reached the 99 percent of orgasm point and have first used the Orgasmic or Big Draw to draw the sexual orgasm energy upward, this sexual energy will rise to increase the energy of the entire body.

B. Second Upward Draw

The second upward draw will strengthen the senses and rejuvenate the entire body.

C. Third Upward Draw

With the third upward draw the body starts to improve the immune system to resist disease, illness, flus and colds. Many of my students have used this system to help them overcome a cold or the flu.

D. Fourth Upward Draw

The fourth upward draw will help to stabilize and balance the internal organs. Many people are born with misplaced or unstabilized organs. One person's ears are lower while another's are higher or of a different shape. The same thing holds true for internal anatomy as for external anatomy. In some the kidneys may be too far back, or too far forward. The stomach may be in a dropped

position, the pancreas too high, or the lungs too high, too low, too big, or too small. These unstabilized organs can cause all kinds of physical problems for us. Chronic problems, unbeknownst to the afflicted individual, could be caused by a mislocation of his or her organs. A dropped stomach or uterus, for example, can be improved by the power of sexual energy. Once you can increase the internal Chi pressure, it will start to stabilize the organs.

E. Fifth Upward Draw

The fifth upward draw improves blood vessel problems or high blood pressure, and, in an anemia's case, increases blood production.

F. Sixth Upward Draw

The sixth upward draw can help to strengthen lower back problems.

G. Seventh Upward Draw

The seventh upward draw strengthens the extremities, bones and bone marrow.

H. Eighth Upward Draw

The eighth upward draw can help to strengthen the spleen and the body's aura. This will help to protect the person from bad emotions being thrust upon him or her externally.

I. Ninth Upward Draw

The ninth upward draw will help to build and strengthen the spiritualized body and serves as spiritual food.

J. Tenth Upward Draw

The tenth upward draw is a completely spiritualized or psychic state, not limited by time and space.

2. Dual Cultivation of the Valley Orgasm

A. Solo Practice as Preparation

Initially the Orgasmic Draw is physically demanding. However with solo practice the orgasm is moved more smoothly from the genital area up to the brain by internal control and eventually is directed solely by the mind. It is important to do a lot of solo practice before attempting this with a partner mainly to avoid discouragement. According to Shere Hite, author of *The Hite Report*, most women who masturbate achieve orgasm within a few minutes. However with a partner a woman can prolong the arousal period and often become distinctly more aroused. The precision and timing of the Orgasmic and Big Draw come with practice. With a cooperative partner there is yet another world to experience.

B. Exchanging Energy

When you approach orgasm and do the Orgasmic Draw, the aroused ovary energy goes up to the brain. As you pump it up, this cool energy accumulates in the head. If you have practiced the Microcosmic Orbit you know that the tongue acts as a switch in your own body, uniting the two acupuncture meridians that make up the Orbit. The genitals also are a switch, and thus, no matter what your position, energy that has been built up can now be funneled into your partner's Microcosmic Orbit and vice versa.

The energy can travel in a variety of routes. One route can be from your tongue to your partner's tongue, down your partner's Functional Channel to the navel, then down to his genitals, switching over to your genitals, up your spine and round and round. It can circulate through both of your Microcosmic Orbits simultaneously, or you both might experience the energy outside of your bodies, feeling like a cocoon around you both, or a presence above your heads, etc. Since a woman's aroused energy is not as hot as a man's, your partner might perceive the cool energy from you, or you may notice warm energy from him entering your body.

Each woman's perception can be different. Some might feel cold energy, like a draft, traveling through her head. Some might feel like permitting the pulsation to go out, and then pulling it in and drawing it up.

C. Sexual Vampirism

The issue of one partner draining the other's sexual/life-force energy is an old one in Taoist circles. Legend has it that old men in China would seek out young women who did not have any children women who, in the old man's frame of reference, had a maximum of Yin energy. Then, without letting the woman know what they were doing, they would do the Big Draw while their penis was in the vagina, and drain out the women's Yin energy thereby increasing their own energy at the woman's expense. A woman who masters this system can be more powerful than a man. Woman can drain a man's energy many times faster than man can drain woman's. There are many stories existing about people who have used the system in the wrong way and with the wrong intention, and who have become too powerful in an evil way. Using the system in a selfish way tends to lead to an evil energy, which will eventually destroy the practitioner. However the same sexual energy properly used can help you achieve good health and higher spiritual attainment.

According to the Taoists, even assuming no evil intentions, the draining of a partner's energy can happen unintentionally especially if only one partner knows the practice. The safeguard against this is the circulation of the energy through both partners' bodies. This exchange of energy eliminates the possibility of one partner gaining energy while the other one loses.

3. Transforming Sexual Energy into Spiritual Love: Cultivating the Valley Orgasm

A. Yin and Yang Exchange

"Yang can function only with the cooperation of Yin, Yin can grow only in the presence of Yang". -*Yellow Emperor's Female Consultant on Sex.*

Our universe changes perpetually because of the eternal flow of Yin and Yang energies. The very essence of Yin-Yang exchange is the cyclical alternation of day and night. Due to this alternating energy flow, or respiration of the heavens, living things can grow. Were there only day and no night, all would be burnt: or if there were only night and no day, nothing would have strength to grow. As living things, humans are also subject to the law of Yin and Yang exchange.

The human being can live happily only if he or she is in harmony with the principles of life. If one violates the law of the Yin and Yang interchange, by forbidding the sexual communion of Yin and Yang energy, energy will not flow in the body. The life-force will slowly stagnate and leak out. Life will become a long slide into depression, interspersed by spasms of enslavement to the passions.

If you have learned to increase your orgasm through the Orgasmic Upward Draw, you are on the threshold of a new experience. That experience will alter your perceptions of your own body and mind. It will change the way you see your lover and change your understanding of sex and love.

"Drawing Nectar up to the Golden Flower" is incomplete without the exchange of Yin and Yang energy. (Fig. 8.35) The Golden Flower is the light at the crown of the head. The Orgasmic Draw pulls up and conserves your nectar, or sexual essence. It is the exchange of your Ching with your lover's that transforms it, and in the process gives an experience of sex which is deeply shared as love. Your orgasm be totally unlike that known as a simple, local, outward-pouring and short orgasm. As you make love over a period of time, the pleasure spreads, filling the Microcosmic Orbit and the entire body Unlike the ordinary quick orgasm, or peak orgasm, whose thrilling moment is confined primarily to the genital area, this orgasm will deliver to you a new sense of equilibrium that will be stored in your body long after your pleasure has become a fleeting memory

Taoists advocate the Valley Orgasm as a continual rolling expansion of the orgasm throughout the whole body prolonging inward orgasm to a half-hour one hour two hours, or longer in a gradual, but ultimately greatly heightened ecstasy. You can enjoy this form of sexual love indefinitely without paying for your pleasure with your life-force.

During the Valley Orgasm, lovers can relax and have all the time in the world to share their tenderness. There is no frenzied explosion, only wave after wave of higher subtle energies bathing the entwined man and woman. The Valley Orgasm is not a technique, but rather a certain kind of experience that the lovers allow to happen to themselves, encouraged by a time-tested process.

The Valley Orgasm is made up of all the methods you have learned thus far: the Orgasmic Draw for women, the Big Draw for men, the healing positions, the hand-energized positions, and

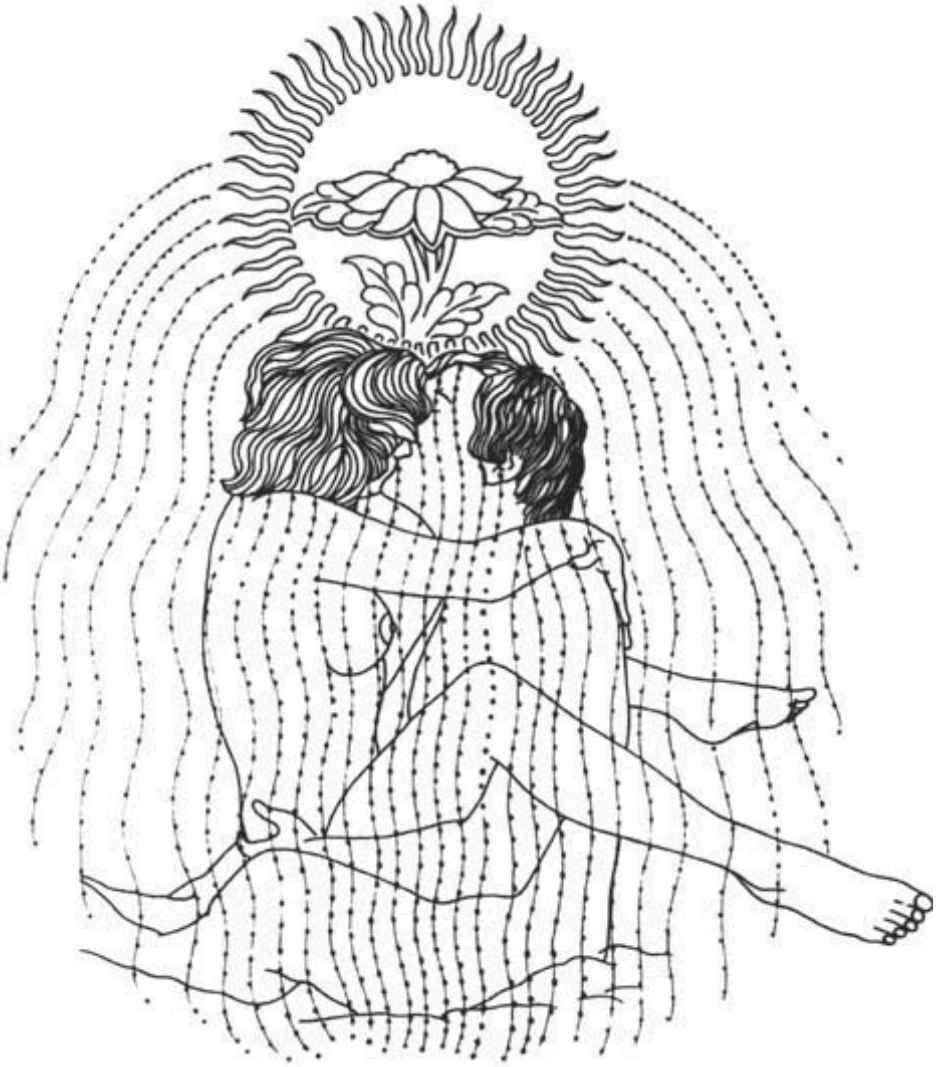

Fig. 8.35 *"Drawing Nectar Up to the Golden Flower"*

increasing sexual energy through the upward draw. All this combines to make the best orgasm you can have. Yin and Yang exchange is one of the major parts of the Valley Orgasm.

4. Valley Orgasm Step-By-Step

A. First Upward Draw

(1) Timing

Bear in mind that when the woman is active, she can control the thrusting of nine shallow-one deep in order to stimulate the glans of the clitoris and the G-Spot, with the shallow thrusts entering only approximately two inches into the vaginal orifice, thereby touching the G-Spot. When you become stimulated, start to amplify the orgasm to a higher more intense sensation. Use the Ovarian Breathing technique, gently open and close the vagina, and slightly pull the Chi Muscle up to bring the orgasm higher. When you reach the point of orgasm, rest with the glans of your partner's penis touching the G-Spot. If it is in the proper spot, it will feel as though fitting in a slot. Rest here and exchange the sexual energy.

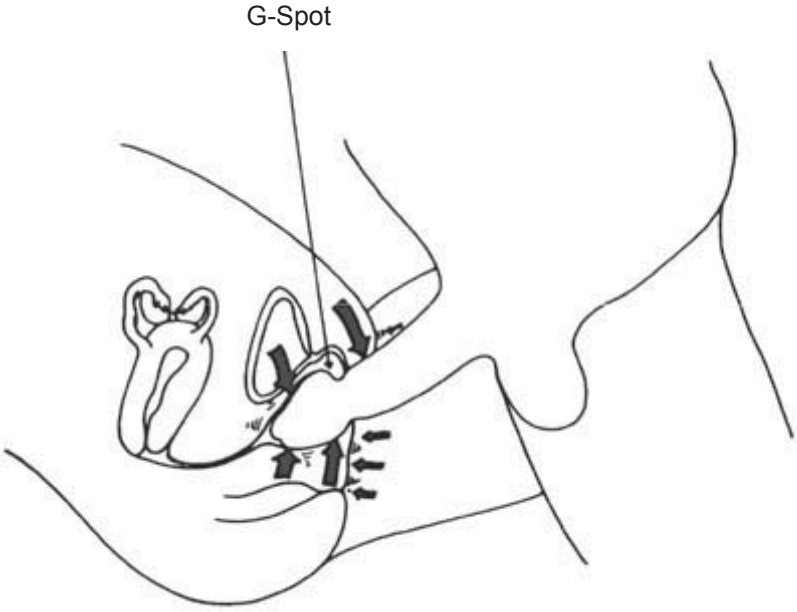

Fig. 8.36 *The woman holds tightly the head of the penis in the ares of the G-Spot. Through muscular pressure she massages the penis.*

You must take care that your partner does not reach the point of no return. When he is near of ejaculation, pull his penis out to the point of your G-Spot where the energy can be exchanged. Rest at this point. If you are good at helping your partner to stop or control the ejaculation. you can squeeze the base, not the head, of the glans of the penis, and this will block the urge to ejaculate. (Fig. 8.36) There is danger in bad timing; therefore, if you do not master this firm gripping technique, your partner can lose his semen. This means that you must use this grip before the urge to ejaculate occurs, and not right at the moment of ejaculation. A firm grip accounts for the success of this technique. Important to developing this grip are the Orgasmic Draw and the Egg and Vaginal Weight Lifting exercises. Delaying ejaculation will also help your partner to maintain his erection, enabling you both to proceed to the next exchange faster (Fig. 8.37) For additional information on delaying ejaculation in men, please read the section entitled “The Secrets of Semen Retention” in the book *Taoist Secrets of Love: Cultivating Male Sexual Energy*.

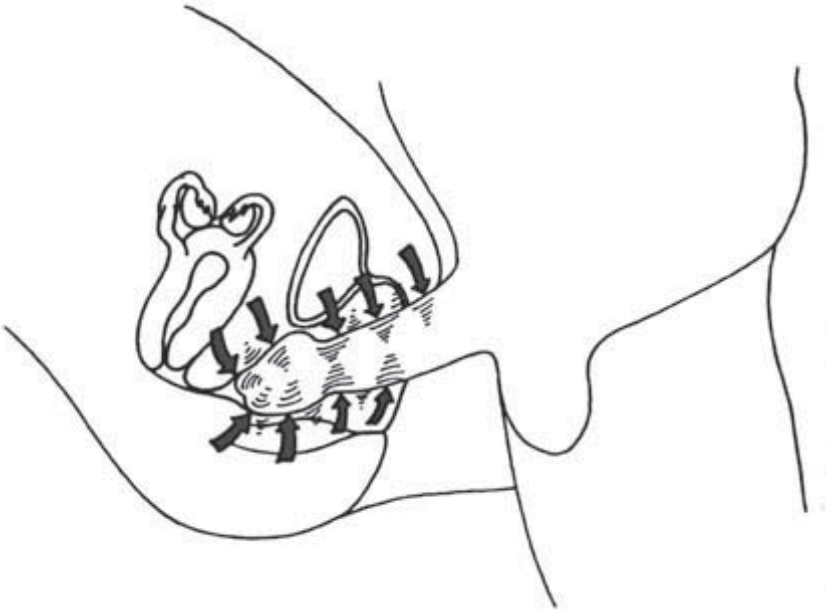

Fig. 8.37 *The woman presses on the penis to prevent loss of erection.*

Fig. 8.38 *Exhale and let cool woman's Yin energy flow into your partner.*

Relax and exchange the energy. At this point, it would be good for your partner to practice the hard contractions of the Big Draw first until he is able to move his Yang sexual energy upward and gain control of it. Once he learns and masters this, you will not have to grip the glans of his penis to assist him in this control. Feel his hot, male, Yang energy begin to pass to you. This hot energy is unlike your energy. Once you feel it, inhale and take your turn to practice the Orgasmic Draw, drawing your Yin sexual energy plus his Yang sexual energy up to the higher center. First permit the energy to flow into your Microcosmic Orbit. Then exhale, and let the cool, female Yin energy flow into your partner .(Fig. 8.38) At this point your partner can use the gentleness of Testicle Breathing (as

described later in this chapter) to absorb the cold Yin testicle energy into his system.

Remember you cannot receive his power without giving freely of your own. The exchange heals both partners. Man needs the soft receptive energies a woman provides to achieve perfect balance. Similarly, woman needs the expanding male energies to attain her own higher harmony. This is nature's underlying reason for attraction between the sexes.

If the man has been inactive, he will now perform the thrusting. When he approaches the point of orgasm, again he should withdraw the penis to the area of the G-Spot and execute the hard contractions of the Big Draw until he gains control again, exhaling his excess Yang energy to you. You will follow with the Orgasmic Draw to draw your energy plus his upward, and send him your excess Yin energy.

(2) Embracing after Lovemaking

When you cease active lovemaking, begin your embrace in any pleasing position. If the man is heavy, the woman is usually on top. If the woman is stronger than the man, she is usually on the bottom so that he can draw the power more readily. If the woman is weak, she may be on top where she can draw easily. In any case, make sure it is a position you can rest in for a long while. You should keep two extra pillows handy for this purpose.

(3) Coordinate your Breathing with your Lover's.

Remember that "Chi" means "air" or "breath" in Chinese. Life is breath. All living activity has the quality of inhalation, exhalation, or some Combination of the two. This is why Chinese philosophy classifies everything as Yin (exhalation) or Yang (inhalation) to a greater or lesser degree. The act of love is essentially an act of respiration. You breathe your Ching into your lover's body and soul. You inhale this life energy by drawing it up to the head, and exhale it by venting it to your partner.

It follows that after both of you have exchanged the sexual energy and embraced, you will coordinate your breathing. In a chest to chest position, each partner places an ear near the other's nose. In this position you can easily feel the other's breathing. In the act of love the breathing cycles stimulate and harmonize all of life's

processes. Physically breathing together unifies the two partners and focuses the rhythm of all of their energies so that together they may contact the source of their own life current. You should become so sensitive to the presence of your partner's breathing that each deep, strong breath is as powerful as the feeling of your partner pushing his penis into your vagina.

To coordinate your breathing you will exhale deeply first and feel the Yin essence of breath penetrate into your partner. Wait for your partner to inhale and absorb this Yin essence, and then exhale, sending the Yang essence of his breath to you. (Fig. 8-39) Continue to coordinate the breathing until both of you feel in balance.

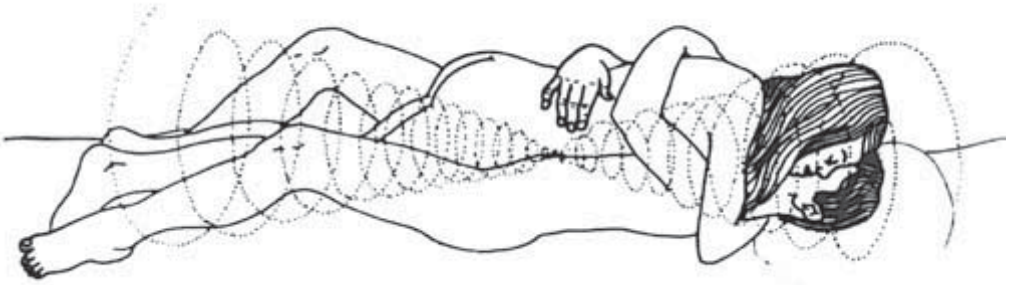

Fig. 8.39 *Absorb Yin and Yang after Lovemaking.*

(4) Inhale Power up the Spine to the Head:

Exhale out the G-Spot and Penis

After you breathe together for a time, gradually draw the power up to the crown of the head. Upon inhalation the man mentally conceives the Yin power moving from the vagina into the penis: the woman uses her mind to bring the Yang power from the penis into the G-Spot and clitoris. Both draw the power back to the perineum, or Hui-Yin, and the coccyx, or Chang-Chiang, and bring it up to T-11, C-7, C-1, the Jade Pillow and up to the crown, or Pai-Hui. From there the energy travels through the tongue which, throughout the entire exercise, is to be raised to the top of the mouth. The goal is not to use muscular force, as in the Orgasmic Draw or Big Draw, but simply to use the power of thought to direct the sexual energy. "Think" the energy up to the crown point. Although this instruction

seems incomprehensible at first, those who have begun the practice of Sexual Kung Fu will begin to feel the power and will understand intuitively what is meant. The power will rise to the head eventually as your mind learns how to direct its own Chi energy to connect mind and body.

In the beginning you can accelerate the exchange of Yin and Yang power with the help of the hands' energizing points and long, deep, muscular contractions. When you feel the expansion and heat from the glans of your partner and your vagina fills with fluids, inhale slowly and deeply through the nostrils. While you inhale, contract the vagina, perineum, anus and buttocks, and as you slightly tighten this contraction, "think" the energy into the clitoris and G-Spot, past the Hui-Yin, into the Chang-Chiang and up the spine to the crown of the head. When you have finished the inhalation, hold the breath and contraction for as long as possible. Keep drawing the power up to the head until you can hold the breath no longer.

When your partner releases his breath, consciously giving you his excess hot, Yang energy, you must exhale deeply to bestow the Yin energy upon him. Release all tension by relaxing the head, throat, chest, abdomen and pelvis. Let the relaxation spread from the top to the bottom of the body in a wave. When the gentle wave reaches the pelvic region, send the Yin energy into your partner through the clitoris and G-Spot. This contraction and relaxation should be executed gently, creating a feeling of pulsation traveling between your body and his.

Lovingly offer him the essential energy. This surrender shall carry with it all the emotions of love and devotion. This is not sentimentality. It with inspire him to surrender his nourishing Yang essence and to totally embrace the Yin within Yang. This is the nature of a woman's fulfillment. If you attempt to withhold your energy, he will sense, consciously or unconsciously, your feeling of separateness, even though it may be nothing more than an obstruction in the energy flow (usually in the heart). Allow him to absorb the Yin energy he needs as you surrender the excess. The Yang energy will flood your entire body while the Yin floods his.

If you are just beginning to practice, you may be so overwhelmed by the sensation of sexual love that it will seem impossible to distinguish his Yang energy from your Yin. Everything may seem hot and explosive and as though comprised of a single energy. As

you build up your nervous system to handle higher charges of energy using the healing and meditative techniques, the exchange of Yin and Yang energy will gradually evolve into awareness. If you build energy at successive points in the body, greater powers of exchange will be available to you and your partner. Begin by drawing the power to the Hui-Yin, or perineum, and meditating there.

In this first upward draw of the Valley Orgasm, if both of you have an open Microcosmic Orbit and can circulate the healing and energizing sexual energy, the Orbits will fill with energy, passing it through all the organs and glands, thereby helping to energize the entire body system.

(5) Helping your partner to Clear and Open a Blockage.

If you have more power than your partner; help him now to open his centers by directing your power to his unopened centers. Both must concentrate on these points. The Chi will flow to whatever place the mind focuses on. Proceed one point at a time. Both can use the palm-energizing method and concentration to help open the blockage.

Remember that you cannot open all the points in one sexual embrace. To open one point may take many exchanges of Yin and Yang. If your partner ejaculates there will be no energy to exchange since most of it will be lost and little will remain to be transferred.

The resting periods are most important since it is at this time that you can actually feel the energy exchange. This is the time that you and your partner can assist each other in clearing blockages, or you can help him to open his Microcosmic Orbit.

(a) Embrace each other and then put your right hand on your partner's sacrum with the middle finger touching the tip of the coccyx and the palm covering the sacrum, especially the opening of the hiatus. Feel the heat being absorbed into the spinal column and helping to activate the Sacral Pump, which will be instrumental in moving the energy upward. Place your left palm on his Door of Life, opposite the navel and between Lumbar 2 and Lumbar 3. This will help your partner move the sexual energy up to the kidneys' area. Your partner does the same to you. Once you become adept at this and feel the point opening, move up to the next point.

(b) Move the left hand to the T-11, the adrenal glands' point, with your right hand remaining on the sacrum.

(c) Next move the left hand up to the liver and spleen point,

below and between the scapulae, maintaining the right hand on the sacrum.

(d) The next point is the heart and lung point, located between the fourth and fifth ribs and opposite the heart center. Again, place the left hand on this point, leaving the right hand on the sacrum.

(e) Progress upward through the remaining points: the C-7, the middle of the back of the neck, the Jade Pillow near the base of the skull, and the top of the crown. Move onto each point gradually to make sure it is open. For more details on the hands' energizing points, refer to earlier descriptions in this chapter.

It is also possible to jump over a point if you feel you need more energy at another moment in time. If both of you are fairly open, you can both simply place your right hands on your sacrum, and your left hands on the bases of the skulls or the tops of the crowns.

(6) Return to Lovemaking

Decide on who is to be the active one and return to lovemaking. After another round of 81 shallow and 9 deep thrusts, as you again approach orgasm or your partner ejaculation, you will gradually feel the orgasm move up the spine a little bit. It can spread to the entire back, or climb higher than the normal orgasms you have had before. With the first Valley Orgasm, feel the orgasm climb, approaching the organs. Rest, drop down into the valley again, and this time climb higher. Rest again, drop down into the next valley and climb even higher. You will find that each valley will have a different orgasmic sensation, and you will not always return to the same old valley.

B. Second Upward Draw

Resume lovemaking, build up the sexual energy to the limit that you can tolerate. Rest with the penis glans touching the G-Spot. Permit your partner to perform the Big Draw a second time to prevent ejaculation in order for the orgasm to rise higher. When your partner releases his Yang energy, you can perform the Orgasmic Draw, bringing the energy all the way up to the head and the senses by means of the sacrum and the spine. This upward draw can help to strengthen the senses.

Using gentle contractions and pull-ups of the Chi Muscle is very important in directing the energy to the senses.

(1) Bring the Sexual Energy to both Eyes.

Pull up the left and right perineum to bring the sexual energy to both eyes. When you feel either hot or cold energy at the eyes, move them around beginning with a clockwise direction (Fig. 8.40(a)) and returning in a counterclockwise direction in order to absorb the energy inward. (Fig. 8.40(b))

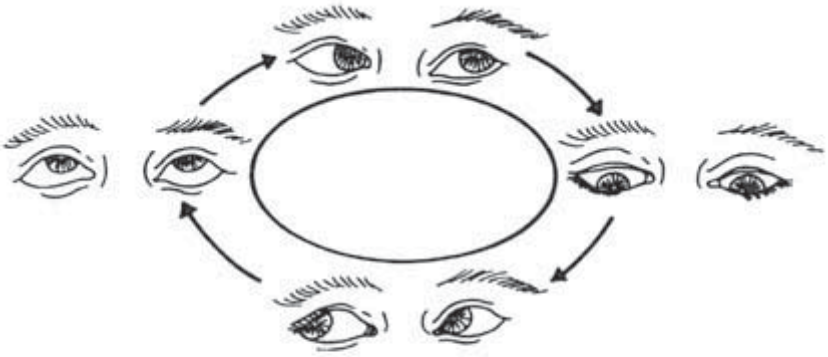

(a) Use the mind and eyes to help circulate the energy nine times,

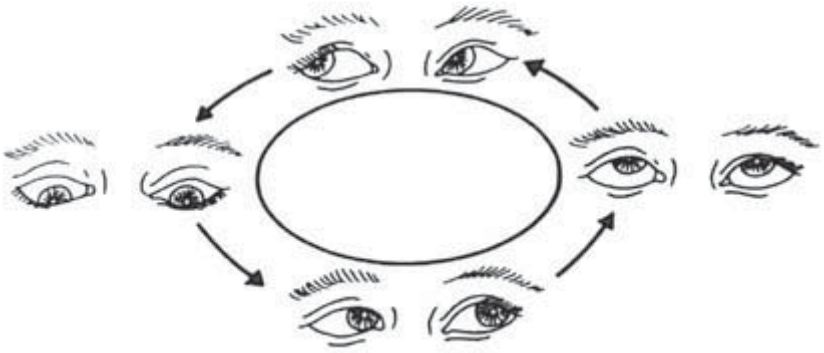

(b) and counterclockwise nine times.

Fig. 8.40 *Using the Eyes to direct the Sexual Energy.*

(2) Bring the Healing Energy to both Ears.

Bring the healing energy to both ears by pulling up the left and right sides of the perineum and moving your ears around if possible. If this is impossible, mentally move the energy around the ears.

(3) Bring the Healing Energy to the Tongue.

Contract and pull up the middle part of the perineum, and bring the healing energy to the tongue. Move the tongue around.

(4) Bring the Energy to the Nose.

Contract and pull up the front part of the perineum, and bring the energy to the nose. When finished, exchange the energy with your partner:

C. Third Upward Draw

It requires practice for you to control the sexual energy well enough to proceed to the third upward draw. Proceed gradually, making certain that as you continue along each step, you have firm control over your sexual energy first. Meanwhile, your partner also plays a big part since he must control his own sexual energy.

(1) Bring the Energy up the Spine to the Crown.

Resume lovemaking, building up the sexual energy to the limit that you can take. Rest the penis glans at the G-Spot. Let your partner perform the Big Draw a third time to prevent ejaculation so that the Orgasm can be raised higher. When your partner releases his Yang energy you can perform the Orgasmic Draw, bringing the energy through the sacrum all the way up the spine to the crown. Remember that the third upward draw helps to improve the immune system's resistance to disease. The glands, especially the thymus gland, and the bone marrow play a substantial role in a healthy immune system.

(2) Use your Eyes and Mind to move the Energy.

When the energy reaches the brain, turn your eyes, ears, and tongue up to the pineal and pituitary glands, moving the eyes and using the mind to move the generative sexual energy for the purpose of revitalizing the glands.

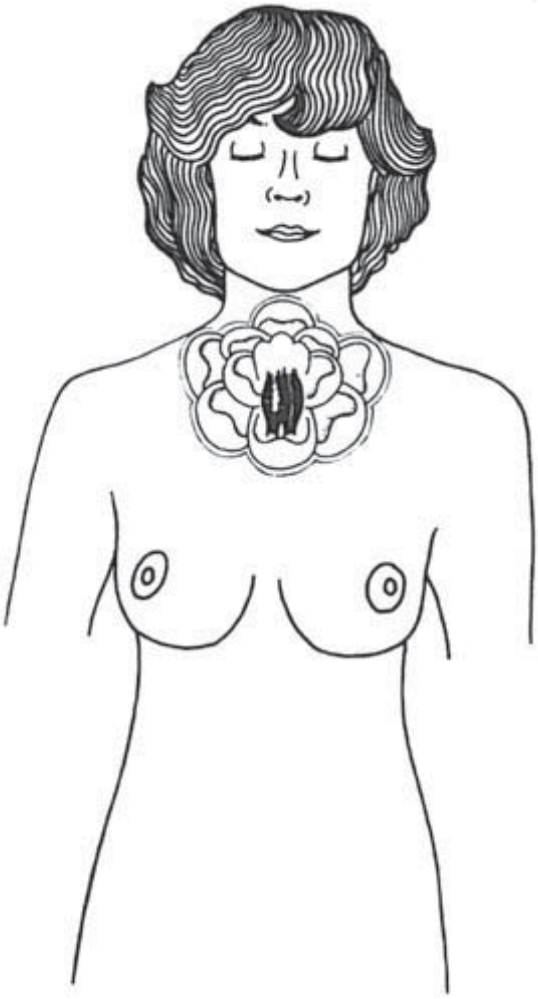

Fig. 8.41 *Blossoming of the Thymus Gland*

(3) Flow of Nectar to the Thymus Gland.

When the pineal and pituitary glands are filled with the sexual energy, they will produce a certain kind of fluid that we have been describing as nectar. This nectar is a mixture of sexual energy and hormones released from the glands. The property of this very special kind of hormone has special life-giving and healing energy. It will flow down through the palate to the throat and thymus gland.

Creative sexual energy has a very close relationship with the thymus gland, with each one enhancing the other: When there is an excessive loss of sexual or ovaries' energy the first to 6e affected are the pineal, pituitary and thymus glands.

As the fluid and the energy flow into the thymus gland, you gradually will feel the gland blossom like a Flower (Fig. 8.41) this will be manifested in a sensation of fullness underneath the sternum. The thymus gland is regarded by Taoists as the seat of greater enlightenment, the seat of love and the seat of life-force or Chi, energy.

(4) The Ribs absorb the overflow of Nectar.

Once the nectar has filled the thymus gland, the overflow of energy, will be absorbed into the ribs, thereby helping to increase bone marrow in which is produced white blood cells, which help protect the body against foreign substances and infection. The flat chest bones are the major producers of white blood cells.

D. The Fourth Upward Draw will help to stabilize the internal organs.

Once you can master the third upward draw, and have filled the glands with the energy, you can begin to bring the sexual energy to the organs. Again you will employ the assistance of the Chi Muscle in the perineum region as an important aid. You will use gentle contractions and slight pull-ups to help. By the time you have reached this level of practice, your body has become more adept at controlling the sexual energy. You will now bring the sexual energy directly to the organs to transform it into a higher energy, otherwise the system can become allergic to its own raw sexual energy. The Taoist Masters discovered that all the energizing points of the spine (the sacrum, T-11, C-7, C-1, Jade Pillow, etc.) can help to transform the raw sexual energy into what will be the primary stage of life-force energy.

(1) Bring the Sexual Energy and the orgasmic vibration to the Ovaries and Kidneys. (Fig. 8.42)

Proceed as before, approach the high point of orgasm, rest and exchange the energy. After the exchange, begin to bring the energy to the ovaries and then to the kidneys. Using gentle contractions

Fig. 8.42 *Bringing Sexual Energy to the Kidneys*

and slight pull-ups, left and right, of the Chi Muscle as an aid, bring the sexual energy and the vibration of the orgasm to the ovaries. Start with the left side first, and wrap the energy around the left ovary. Then bring the vibration of the orgasm and the sexual energy to wrap the left kidney. Gradually you will feel the energy start to vitalize the glands and organs. This orgasmic vibration felt at the ovary and kidney has a very different sensation than genital orgasm. It can feel gentle, cool, and clean, filling you with the sensational fulfillment of a true orgasm. Each organ and gland will create a different kind of orgasm from the other but all will be different and more fulfilling than genital orgasm. Once you have mastered bringing the sexual energy and orgasmic vibration to the left ovary and kidney, begin to bring the energy to the right side. When you feel the fulfillment on the right side, bring this fulfillment to both sides simultaneously. You will gradually feel the kidneys' and ovaries' region as stronger warmer and filled with life-force. You should master each organ, then gradually move on to the next one, continuing one at a time.

(2) Bring the Sexual Energy and orgasmic vibration to the Spleen and Liver.

The next organs to bring the energy to are the spleen and liver: Using gentle contractions again and slightly pulling up the left and right sides of the Chi Muscle, bring the sexual energy and its orgasmic vibration up to the left ovary. Pause for a while. Bring it up to the left kidney; pause and wrap the energy and the orgasm around this kidney, inhaling and pulling it up to the left side underneath the rib cage to the spleen. Wrap the sexual energy and the orgasmic vibration around the spleen, gradually increasing the orgasmic sensation which, again, will feel very different from the other organs' orgasm, and more fulfilling than a genital orgasm. Next, bring the energy and orgasm to the right side and the right ovary, the right kidney and then the liver. Giving a more intense orgasm than any other organ, the liver can generate the sensations of warmth, expansion, energy, loveliness, kindness, and a very euphoric and satisfying kind of feeling.

(3) Bring the Orgasm and Sexual Energy to the Lungs.

Next bring the orgasm and the sexual energy to the left lung, first passing through the left ovary, left kidney, spleen, and finally to the lung. Once you master the left side, begin to bring the energy to the right side, and then both sides together. Each person can have a different orgasmic feeling.

E. The Fifth Upward Draw increases the amount of blood vessels and blood circulation.

(1) Wrap and energize the cervix with the sexual energy.

After the fifth exchange of energy, pull the middle part of the Chi Muscle at the perineum up toward the cervix, which has a great supply of blood flowing through it. When strong, it will help tremendously in increasing blood circulation as it is wrapped and energized with the orgasmic feeling.

(2) Pull the energy up to the aorta and vena cava.

Next pull up to the aorta and vena cava, the main arteries and veins leading from and to the heart, respectively. When these are strong, the flow of blood will increase. Bringing the orgasmic

vibration and sexual energy to these vessels will help increase the flow of blood through the heart. In the later practice of the higher levels of the Universal Tao, the mind is used to amplify the orgasmic vibrations in these vessels to create an even greater flow of blood.

(3) Pull up the Sexual Energy to the Heart.

Next pull up sexual energy to the heart, the organ responsible for pumping the blood. Wrap and energize the heart, bring the orgasmic vibration there, and feel the heart unfold like a blossoming flower.

Remember that in attempting to bring the energy to the heart you must be very cautious, since the heart easily becomes congested with excess energy causing pain and breathing difficulties. As previously indicated, if you experience these problems, practice the Heart Sound, gently tap the chest around the heart, and brush down your chest with your hands to try to force the excess energy out of this area. Then do not practice the heart upward draw for several days. Instead, return to the fourth upward draw until you master that.

F. Sixth Upward Draw, the plateau phase: circulate your microcosmic orbit into your lover's orbit.

Depending upon the level of vital energy and the spiritual development of the individual lovers, a couple over time will experience new "openings" that occur during their lovemaking. This means you will suddenly find you have made a quantum leap in your feelings and awareness. This usually happens during the plateau phase of the Yin Yang exchange. The period of lovemaking when you are not thrusting passionately is referred to as the "plateau" phase, as opposed to the `peaks," the moments prior to the orgasm that is averted by doing the Orgasmic Draw and Big Draw. The plateau is the physically passive exchange of energy that occurs between the peaks.

The subtle energies within your resting bodies are not passive at all, but are moving dynamically between partners, building to a new level of sexual-electromagnetic tension. It is an internal wave of energy building up, similar to an ocean wave that gathers momentum and crashes, only to be replaced by the next wave. After the sexual energy has been raised to a high intensity by thrusting and drawing it up the spine on the route of the Microcosmic

Orbit with the Orgasmic Draw and the Big Draw, the Yin-Yang exchange can begin to happen in many different ways.

Fig. 8.43 *Fusion of the Microcosmic Orbits*

(1) Joining the Two Microcosmic Orbits

In the beginning the energy exchange between lovers may seem to be chaotic and occurring between any two points of bodily contact. As you grow more accustomed to the energy gained by stopping the man's ejaculation, you will begin to discriminate the clearly defined channels of the Microcosmic Orbit rising up the spine and descending the front of the body. During the plateau phase of lovemaking you may feel a warm flowing current passing between your vagina and his penis and between your lips.

These are two individual Microcosmic Orbits joined into one larger flow circling your two bodies. (Fig. 8.43) This experience will greatly enhance the balance of energy in both lovers and deepen the bond of loving in their life. The Chi flow is increased in amplitude; you may even feel like a warm electric current is passing between you. This effect often occurs in lovers in good health, who have practiced the Orgasmic Draw and the Big Draw, after only a few lovemaking sessions.

Both the man's and woman's Microcosmic circuits can be joined in a number of different ways. The most common is the intersection of their two circular Orbits at the mouths and genitals, forming a Figure eight. The Figure eight can cross as the Microcosmic energy drawn by the man up his spine is passed into the woman through his tongue, which acts like an electrical switch. The male energy then enters her Microcosmic Orbit and travels down her front, or Functional Channel, and down through her vagina, into his penis and back up his spine.

The woman circulates her Orbit in a parallel fashion, up her back channel and down his front channel, before it reenters her body at the vagina and proceeds back to her perineum and spine. This is the simplest way to direct this level of exchange of Yin and Yang energy.

Each couple can play with different Figure eight patterns of exchange. At first you may verbally tell your lover what you are concentrating on. Later as you become more sensitive to your own and your lover's energy, the Chi exchange itself will become a silent language, punctuated by the pleasure of sending a tingling warm current into your lover the Figure eight may cross at your mouths only, or at your genitals. It may snake around your Governor Channels, up your spine and down his, or vice versa.

At this level many couples experience spontaneous openings of some of the eight special psychic channels taught in the Fusion of the Five Elements Meditation of theUniversal Tao. (Fig. 8.44) These channels include the positive and negative arm and leg routes, the Belt Routes spiraling around the body and the Thrusting Route up the center of the body. Do not be alarmed if your energy begins moving in ways you are not accustomed to. Many lovers experience a column of energy rising on a line midway between their bodies. If this is your experience, simply relax and enjoy the interplay of these subtle energies. Some couples report the Chi shooting up to the top of their heads and showering down a fountain of “nectar”. Others feel as though wrapped in a cocoon with their lover with lines of invisible energy being spun around them.

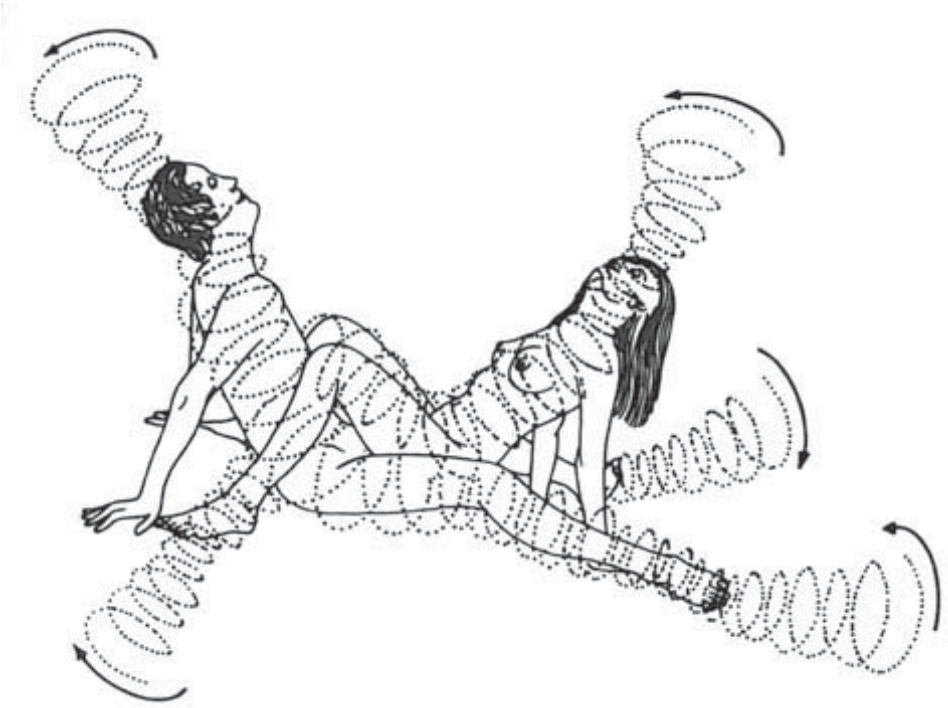

Fig. 8.44 *Spontaneous Opening of the Nine Belt Routes during Heightened States of Energy Arousal*

When you have opened all your psychic channels and you know what is possible in terms of energy exchanges, you will then be free to choose the path of expressing your love at will. It is interesting that lovers who know nothing of these esoteric methods sometimes have similar experiences during normal sex. Although unable to exchange energy at will, they do know the sensations first-hand from the spontaneous opening of their subtle energy channels. The Taoist practices of Healing Love are designed to focus your awareness on the infinite possibilities that lie within you. This concentrated awareness is what spontaneously sparks these experiences of divine energy exchange. In this sense love is universally the path to the greatest freedom: thus, the more you share with your lover; the more choices are open to you.

5. Cultivating the Valley Orgasm

The Valley Orgasm is a true fusion of two lovers' beings, shared in an intensified and balanced way. As an even higher experience of Yin Yang exchange that goes beyond the Microcosmic, it may occur spontaneously in any couple dedicated to expanding their love and spiritual awareness. No technique can guarantee it will happen, but the methods taught here vastly increase the probability of a couple enjoying regular Valley Orgasms during lovemaking. It is a state of prolonged orgasm, the balancing of Yin and Yang, a function of opposites, a melting. However do not be disappointed if you learn to block ejaculation and master the Orgasmic Draw and Big Draw, but do not soon have a Valley Orgasm. This happens frequently and should be expected, especially in a stressful urban setting where there are so many distracting forces working against the sustained balance of subtle energies.

A.Cultivation in the Three Tan Tiens

During a Valley Orgasm the lovers simultaneously experience an opening of a specific energy center. This releases a tremendous energy that is truly thrilling as it radiates to fill every cell of your body and joins you with your lover. The Hindus call these centers "chakras". The Taoists refer to them as lower middle and upper Tan Tiens, and locate them in the abdomen, heart, and head. (Fig. 8-45)

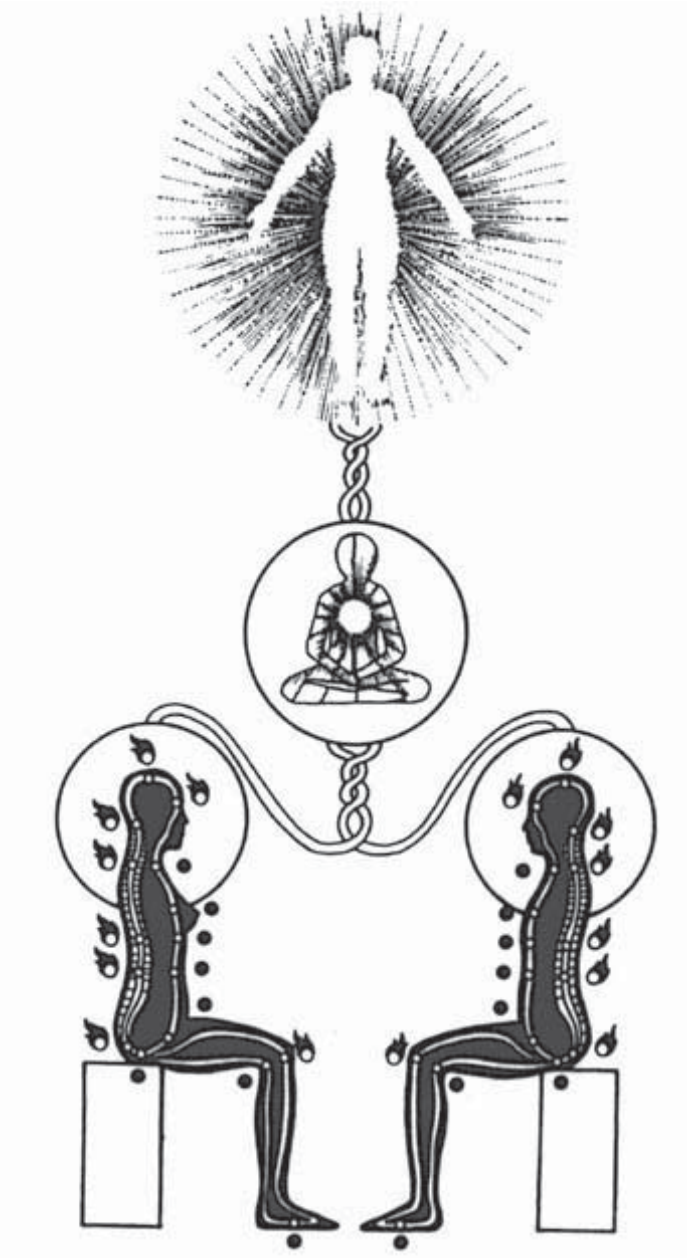

Fig. 8.45 *Taoist Practices of Healing Love open the Way to experience the Greatest Freedom.*

In truth, the entire body is one Tan Tien, or energy center but in practice it is easier to learn with smaller vortexes of energy until you can handle the greater power. The sequence of opening them is generally to start with the lowest center and move up. If the higher centers open before the lower ones, the energy may be unstable and short-lived. In that case the lovers should direct their higher energy into the lower centers to create a more grounded polarity. Filling the lower body with higher energies will lend greater fullness to the feeling of intimacy and create a greater foundation for future exploration of the spiritual world of the two lovers.

By opening these energy centers you transform your sexual essence into spirit. The Valley Orgasm is actually a fusion of Ching, Chi and Shen (sexual, life-force and spiritual energy) in two lovers. (Fig. 8.46) All three are normally present in everyone, but in a divided and weakened state. The two lovers can supply energies missing in their partner and bring out recessive energies with the simple presence of the opposite subtle polar energy. When you open a new energy center your mind makes a leap in awareness by fusing these three in a spontaneous alchemical process. Your own spirit is purified and is one step closer to becoming centered in your body. It is important to know that these centers cannot be forced open, any more than a child can suddenly be forced to grow up. There are natural stages. That is why you must relax to entice the Tan Tiens to open; then you will experience a Valley Orgasm as a spontaneous gift, a sparkling jewel bestowed upon you by the Tao. This state has been described as one of profound clarity and serenity but even these phrases are insufficient to convey its deep beauty and truth.

B. Cultivation of Deep Relaxation

The more deeply you learn to relax during the Yin-Yang exchange, the more deeply you can surrender yourself to your lover the more likely you are to reach the balance of polar forces needed to open each center. This process happens in a split second, but can take months or years of subtle fine tuning of energy between lovers. That is why a commitment is usually needed to get to the higher levels of Dual Cultivation--it requires a great deal of time to understand the play of subtle forces, and to refine your more gross physical and emotional energies.

Fig. 8.46 *Bringing Sexual Energy to the Kidneys*

C. Development of a Strong Nervous System

Your nervous system must also be strong enough to handle the increased flow of Chi experienced during a Valley Orgasm. Any Tai Chi, Yoga, Chi Kung or other purifying meditative work is invaluable

in developing this kind of strength as it speeds up and clarifies the process.

D. Mental Spiraling of the Energy

The Valley Orgasm can happen when both lovers have harmonized their will power and their breathing during the Yin-Yang exchange. The energy is flowing between the man and woman as they collectively focus their attentions on each center. It helps to mentally spiral the energy in a three-inch diameter circle (male clockwise, female counter clockwise) at a point about three inches inside the body near each center You should experiment with the location of the point you focus on, as some people find the energy is more powerful a little closer to the spine.

The Chi energy likes to move in a spiraling motion; therefore, by mentally spiraling at key points, you may trigger the release of a far more powerful Valley Orgasm. This spiraling movement of the Chi itself is caused by the interaction of male and female energies. This can be seen geometrically in the symbol of the female--the circle, and that of the male--a straight line with an arrowhead. The fusion of these two signs is a spiral: a circular energy containing a linear energy moving toward the center of the circle. When a man and woman make love, the same thing occurs: the Yang Chi enters the circle of the Yin Chi. The Chi fuses, and the circle of energy expands and spirals upward through both bodies. The energy will naturally travel in a sequence, spiraling through the following centers.

(1) Navel Center, or Lower Tan Tien

Many routes of the body join at the navel center or lower Tan Tien. When the navel is open, all routes in the body will be joined. You will regain something of the terrific vitality of the newborn baby for its energy has been fed to it by the mother through the navel.

(2) Solar Plexus

The solar plexus controls the digestive system, stomach, spleen and liver. This will greatly strengthen your health and will. At the solar plexus center the power is much stronger purer and widespread. However you must first open the navel for the power to flow up.

(3) Heart Center, or Middle Tan Tien

Important to strengthening the heart, lungs and thymus gland and to amplify your power of love, sympathy and rejuvenation is your heart center. This is the center of the middle Tan Tien, and extends into the areas immediately above and below it.

Fig. 8.47 *The Vallrey Orgasm is actually the fusion of Ching (Essential Energy), Shen (Spirit) andChi (Vital Energy).*

(4) Throat

The throat energy center is the thyroid gland and is the energy's doorway between man and heaven. Since it controls speech, it is also known as the center.

(5) Yin-Tang, or Third Eye

The Yin-Yang, or third eye, is located between the eyebrows, and controls the nervous system and soul. Its development calms the person and lessens the influence of stress and fear.

(6) Pai-Hui (Crown) or Upper Tan Tien

Finally direct the power to the Pai-Hui, the crown, the center of spiritual knowledge, and the doorway to higher spiritual evolution.

6. Valley Orgasm Summary

a. First make love actively using three or six shallow strokes for each deep one, or nine shallow and one deep.

b. Stop thrusting when you feel you are approaching orgasm. Use the Orgasmic Upward Draw, or your male partner the Big Draw, to bring power up to the Pai- Hui (crown).

c. Embrace and synchronize the breathing. Place yourselves in comfortable positions without undue stress on the limbs.

d. Open the Microcosmic Orbit by directing your Chi around the circuit with the power of thought.

e. Exchange power by circulating your energy in and around your entwined bodies using meditation. Focus your attention on the polar balance of energy in your lower Tan Tien. When the power builds, move it upward in a wave toward your middle and upper Tan Tien.

f. When your energy has been transformed up, or you feel the loss of 50 percent of your arousal, start to thrust again if you wish and build up more energy, keeping the urogenital diaphragm closed, and stopping before ejaculation.

g. Exchange power several times. Each time try to bring the energy up to increasingly higher centers, meditating on each Tan Tien for as long as you feel comfortable.

The exchanging practice is a mental and spiritual operation. The higher energy in woman is different from man, a study that merits a complete undertaking and is projected for a later volume.

E. Helpful Hints

Many women who have partners will want to share the techniques learned here with their partners to enhance their mutual experiences. The following are some helpful hints in sharing the practice.

1. For Lesbian Couples

Women who share these techniques with their women partners will find it easy to communicate the information, since they both practice the same exercises. One area that the Taoists claim is important is the polarity of Yin and Yang. For Valley Orgasm to be experienced, the Taoists say that the polarity of Yin and Yang work together to produce a synthesis of their opposing qualities. If both partners are women, therefore Yin in nature, there may not be enough tension, or magnetic energy available to "lift off: ' as it were. One way to increase the polarization is for one partner to acquire more Yang energy. Since the most Yang source in our environment is the sun, one partner can take more sun, the absorption of which will increase her Yang energy. If possible, she can take the solar energy into her ovaries via the genitals, if she has the privacy to do this. Otherwise, she can sit in the sun and "think," or mentally direct, the energy into her ovaries.

2. In Teaching your Man

Once a woman masters these techniques, she can more easily share the information with her partner. The best way would be for him to carefully read the instructions in the companion volume, *Taoist Secrets Of Love: Cultivating Male Sexual Energy*. Short of that, a woman should know that when teaching a man, there are some essential differences that must be considered.

A. Testicle Breathing

Testicle Breathing is performed similarly to Ovarian Breathing. A man has a visible testimony of his testicles lifting up with a contraction of the pubococcygeal muscle (PC Muscle). Also, temperature-wise, the energy for the man is cool or cold (remember the ovarian energy during Ovarian Breathing is warm). Therefore, it is not necessary to emphasize bringing down this energy into the navel--the cool energy in his head will not harm the brain. He is

welcome, of course, to bring the energy down to the navel and circulate it in the Microcosmic Orbit.

B. Big Draw for Men

Having a partner who believes that withholding ejaculation is an acceptable idea removes one major obstacle. The will to want to try this method is already a step in the right direction, and you will soon have a partner with whom to practice and with whom to escalate the pleasure of sexual contact. Teaching the Big Draw to a man is a matter of great magnitude since men have a hard time controlling ejaculation. First of all, it will take a lot of solo practice before he feels comfortable with his control over his ejaculation. With you the additional excitement makes it more difficult to control. The role of coach and trainer, willing to guide him through the steps of the Big Draw, will serve you both best.

We have received varying reports from women students who have helped to cultivate the practice in their partners. One described her experience as if she were at a sporting event, rooting him on, which made her feel involved in his Big Draw and gave her something to do as she waited. Another woman felt neglected, noting that all the emphasis was on his Big Draw. In her workshop training it was emphasized that the woman had to be patient for a time in order to help him. Therefore, attitude plays a large role in your success.

C. Stopping Ejaculation

The Brauers, in their book *ESO: Extended Sexual Orgasm*, offer several techniques for delaying ejaculation and orgasm. One simple way is for both men and women to push down, as though having a bowel movement, and feel the genitals bulge. Holding the breath naturally accompanies this maneuver. It seems to work very temporarily however: while you are actually bearing down the sexual sensations do not exist, then when you inhale and relax you are almost back where you started. It is, though, a chance to switch gears to a different kind of stimulation.

Another technique to delay ejaculation described in the Brauers' book is called the "scrotal pull." Its effectiveness is based on the fact that ejaculation will not occur when the testicles are low rather than being pressed against the body. You can both learn how to do

this. The Bauers instruct the man to “grasp the scrotum between your testicles with the thumb and forefinger of your left hand. When you are near orgasm, pull firmly down.” Another way is to “make a ring with your left thumb and forefinger between your testicles and body and pull downward.”‘

The companion book for men, *Taoist Secrets of Love: Cultivating Male Sexual Energy*, describes other helpful techniques to delay ejaculation in men. The “Cold Water Skinny-Dip” is one method: that is, having a bowl of cold water by the bed for him to stick his penis in if he wishes to take a breather to get more control over himself. Another technique is the “Century Count,” which is counting to 100 very slowly.

Sharing the techniques of the practice of Healing Love promotes kindness, understanding, selflessness, pleasure and happiness in you and your partner and is well worth the time spent in learning.

Fig. 8.48 *Vallrey Orgasmic Couple*

Chapter 9
Interview: Ovarian Kung Fu Practitioner

The following interview with a 43-year-old Ovarian Kung Fu Practitioner and movement teacher was conducted by a Taoist teacher: Michael Winn.

Question: How long have you been practicing Ovarian Kung Fu?

Answer: For three years.

Question: Did you find the techniques difficult to learn?

Answer: I found them easy to learn, especially since from the very beginning the benefits were so immediately obvious. I was motivated to practice, but it did require a certain amount of time to completely embody them and make them a part of my life.

Question: Did you learn them alone or with a partner?

Answer: Initially I practiced alone having just ended a relationship. I immediately found they empowered me with control of my own sexual energy, and rediscovered sexuality as a resource for cultivating myself.

Question: What do you mean by resource?

Answer: In the sense that the Taoists speak of cultivating one's nature, refining energy for personal and spiritual development, with sexual energy being one raw material from which that refinement is accomplished. I actually had the experience of being able to direct my sexual energy within my body, and watch it transform my body and my emotions.

Question: Did you have a sense of sexual energy as a resource before you began Taoist practices?

Answer: No, not specifically as a resource. I felt confused after growing up in this Western culture which perpetuates a sense of separation of body and spirit. I am naturally a very sensuous person and totally enjoy the physical aspects of sex. I always had a sense of the mystical quality or spiritual communion possible in a sexually and emotionally intimate relationship. I longed for inner union and knew I would need to experience that union within myself before I would be able to experience it with a partner. This longing fueled my spiritual quest, leading me to meditation and eventually to the

Taoist sexual practices.

Learning the Taoist sexual practices helped ground my meditations in my body and in my daily relationships. I was attracted to them because of the value placed on harmonizing heaven and earth, spirit and body. Sexual energy became for me a valuable resource as a fuel for my spiritual journey. I discovered I could enjoy sex and transform it into spiritual energy at the same time. The pleasure of sex actually became more intense and exquisite. Pleasure became ecstasy and ecstasy grew into bliss.

Question: Does this mean that sex is now something that you can have with yourself?

Answer: Yes. Almost like a twenty-four-hour-a-day experience of my being alive as a sexual being. That energy is now there and available to me constantly. Before I was stuck in a bit of a polarity: I was either blocking the sexual energy if I wasn't in a relationship in which I could express it, or feeling impelled to get involved in a relationship in order to experience it. Now I feel more sexually aroused and alive. I feel my energy is at its fullest potential, and are more "turned on" by life all the time. Now I don't feel that I always have to interact with a man in order to express it. Because my sexual energy flows in clearer channels, I can tolerate a higher level of energy without feeling an urgency to discharge it.

Question: What happens with the sexual energy when you are not interacting and making love?

Answer: When I first began doing Ovarian Breathing, I discovered immediately that I could move the sexual energy easily from my genitals throughout my whole body. It's very simple, but very powerful. I can increase my ability to be connected and present in life. Over time I have been able to refine it so that I can share more energy with other people in my work and daily relationships. It doesn't come across necessarily as purely sexual, but I know it is my sexual energy that I have transformed into healing and loving energy.

Question: Do you think that men are more attracted to you now that you do the Ovarian practice?

Answer: They seem to be.

Question: Has it changed the kind of men that you attract?

Answer: I would say that I seem to be more attractive to people in general. Although I seem to be more attractive to men, judging by the feedback that I get, I am attracting in a way that feels

comfortable. I do not feel that men are leering at me. I used to feel that whenever I was strongly in touch with the full power of my sexual energy that I was somehow putting out a strong sexual message, inviting a kind of response that I really didn't want. Now I feel that people are interested in me as a whole person.

Question: Would you call this a personal magnetism?

Answer: Yes. A personal magnetism.

Question: Have you ever practiced Ovarian Kung Fu with a man?

Answer: Yes. I practiced by myself for about three months, and then I was very fortunate in attracting a man who had been doing the Taoist sexual practices for a period of time.

Question: During those first three months, did you see any changes in your menstrual period, or did you experience any other physical changes?

Answer: My periods had been healthy and trouble-free so I really didn't notice any change. But friends who have begun the practice who have had any kind of difficulty before have experienced dramatic improvement in terms of a relief of menstrual cramps, a shorter flow, and fewer pre-menstrual symptoms.

Question: What about emotions? Sexuality is supposed to be linked with emotions in many different ways. Once you began this practice, did change your connection to your emotions?

Answer: Yes. Since at the time I began Ovarian Kung Fu I was already involved with other Taoist practices, it's difficult to differentiate which was having the effect on my emotions. I know that the Fusion of the Five Elements, Part I. had a profound effect on my emotional state since it involved recycling negative emotions into a purer form of energy. Combining that with the Taoist sexual practice, I gained a tremendous sense of personal responsibility of being in charge of and able to direct both my sexual and emotional energy

Question: Do you feel the Fusion and Ovarian Kung Fu practices go together?

Answer: Yes. It is wonderful to do the Taoist sexual practice with a partner but it is extremely helpful to do the Fusion practice because it keeps the emotional energy so clear. It puts a relationship on a wholly different level without the normal kind of emotional confusion that often comes into a male-female relationship.

Question: Do you feel it is dangerous for someone to do just the sexual practice if it is not balanced by clearing out all the negative emotions?

Answer: I would say that really depends upon the person. If two people are very responsible about their emotions, acknowledging them so that they are able to let them go, then they will probably do well with just the sexual practices. But they would still benefit from doing the rest of the meditation practices as well. For couples who have any emotional confusion, I would say it is essential to do Fusion at the same time as the regular sexual practices.

Question: Do you know of anyone who is doing these practices who has had problems with them?

Answer: No, I don't. Everyone I know who has practiced them has been quite enthusiastic about the benefits.

Question: And there are no side effects?

Answer: I have never known anyone, male or female, who has had any side effects. This practice allows sexual energy to be transmuted and not just conserved. It also refines and spreads it throughout the body, revitalizing the whole body in mind and spirit. So the practice itself removes the negative side effects of sexual desire, which for most people appears as sexual frustration. Sexual frustration is simply blocked sexual energy.

Question: Once you became involved with your lover; did you find a big difference between the other lovers you've had who were not doing these practices?

Answer: Yes. It was quite dramatically and wonderfully different. This relationship, which continues happily, has all the elements that had been wonderful in my other relationships in terms of closeness and pleasure, but goes far beyond anything that I have ever experienced before. The whole quality of the relationship is very clear.

We experience very clear communication, a flow, and a true bonding on many, many levels that I hadn't experienced before. We are connected emotionally, mentally and psychically, and are often able to know what the other is thinking. We feel that even at long distances we are able to make love. We have a feeling of the spiritual connection that is very, very satisfying.

Question: What about women who learned the practices but who have been unable to find a man who would do these practices? Do you have any friends like that?

Answer: I think everyone I have known who has learned the practices has wanted to find a partner. It is interesting to me that people I speak with about the benefits of the practice are all initially

cynical and suspicious. Most of us experience a lot of our greatest pleasure in life sexually, so we do not really want to give up the known for the unknown. Since this practice has spiritual benefits, most people think that it won't feel quite as good on the physical level. People are often a little reluctant initially to try. But everyone I know, once they learn the practices, wants to find a partner with whom to practice because they find the quality of their sexual experience far more pleasurable and satisfying, and they want to find someone with whom to share.

Question: What problems exist for the woman who does the practice, while her partner does not?

Answer: The quality of these relationships is probably better than previous relationships. Some of the refined sexual energy spills over and the partner probably picks up on it on subconscious levels.

Question: Do you think there is danger of abuse, of someone drawing the energy out from the other person, something like "sexual vampirism"?

Answer: A method can always be abused. It is very important for anyone planning to do these practices with a partner to have a clear commitment to sharing fully to attain mutual spiritual growth.

Question: Can you describe your experience of orgasm with your partner?

Answer: The orgasm is a Valley Orgasm, rather than a Peak Orgasm. I experience a slow wave of energy rising within me. This actively stimulating phase rises to a prolonged peak of excitement, then I deeply relax in the "valley" for a period. I repeat this cycle two, three or more times. Each succeeding peak of excitement is higher and each valley is more deeply relaxing so that more and more of my whole body-mind-spirit is at the same time aroused and deeply surrendering.

The Valley Orgasm occurs spontaneously in the state of deep relaxation, and it is a very powerful experience which I feel in every cell, every particle of my being as an exquisite, ecstatic melting. The feeling of connection with my partner is profound. My whole being is shared with his, and his with mine, as one flow that knows no boundaries.

Sometimes our awareness expands to include the whole cosmos, and there is a powerful sense of being omnipresent and a part of all things. Sometimes the orgasm has felt like nuclear fusion and fusion occurring simultaneously as though I am both

expanding infinitely and fusing into a point of nothingness. I have experienced a tremendous spectrum of sensations each time. In the beginning sometimes we spent the whole day making love and meditating with the energy we generated. I am always in awe of the tremendous power residing in male and female. We are all closer to being gods and goddesses than we think.

Question: Are you able to distinguish your energy from his during the cycling and sharing?

Answer: I definitely can distinguish his energy and can also feel the quality of the merging. I had been practicing the Microcosmic Orbit Meditation for about a year before I began doing the sexual practice, and had practiced the Single Cultivation of Ovarian Kung Fu for several months before actually being with my partner: Because my partner was also experienced in the practice, our merging was really spontaneous without any need to control it. I could feel from our first sharing the energy moving naturally into the Microcosmic, Belt and Thrusting Channels. If you meditate in these channels daily, your lovemaking energy will flow effortlessly into them.

Question: How long do you make love during this practice?

Answer: Several hours. Sometimes two hours, sometimes three or four. Quite frequently we experience the peaks and valleys all night, but with naps during some of the valleys. There is a saying that in love there is no sense of time. This really describes Taoist lovemaking. There is a sense of all the time in the world, of being in eternity and of having more and more energy available. Now that we have created so many connections, we don't really need to spend as much time. Once we made love for only 30 seconds before experiencing a Valley Orgasm, but the polarity between us was so powerful that the Valley Orgasm lasted for hours. Now we are much more tuned to each other and feel that we are making love all the time.

Question: Are these cycles of the peaks and valleys determined by the male's erection?

Answer: I would say that the cycles of peaks and valleys is deter mined by both people. Both partners move to greater and greater excitement, and when a partner feels he or she is coming to the point of no return, then both partners pull the energy up to mingle it and share it in the quiet valley stage. It has always seemed spontaneous when another crest and wave begins, drawing both

of us into it.

Question: During that resting period when you have reached the high peak of stimulation and have allowed that Chi energy to move up the body until the whole body feels tingling, warm and vibrant, is there a danger of feeling unconscious with this energy?

Answer: If I'm extremely fatigued there is a tendency to be more unconscious with it. My experience in general is of going into a totally altered state, finding a melting point with my partner in which I am very aware and yet very at ease. Then I can meditate and further refine our lovemaking.

Question: The technique of the Valley Orgasm as it is described requires you to meditate at different levels, or Tan Tiens. Did you find yourself able to meditate at specific centers with this energy?

Answer: It's very hard to generalize because every experience is unique. I found initially that the energy first moved in the Microcosmic Orbit, but I also started noticing that it would move through the whole body. It would tend with each valley to move up through another center. There would be times in the valleys when it would seem like a showering-up, sometimes more in the center or in the back, while at other times it would be like the rush of a rocket taking off, straight up.

Question: Does this feeling linger after lovemaking?

Answer: There is the sense of being a unique male and female each in our respective bodies, and yet being all man and all woman, god and goddess. I have clearly experienced this before in other sexual relationships, but in this relationship it exists all the time.

Question: After practicing in this relationship for almost three years, what has been the evolution of this practice?

Answer: I would say that one of the aspects of all the Taoist practices is the sense of active awareness of drawing energy in directly from the stars, the sun, the earth, and from one's sexual partner What I feel is that I have been able to absorb, be nourished by, and bring into my own life some of the real masculine, Yang, qualities of my partner. With my partner's Yang energy as a resource available to me, I have been able to be more assertive, more creative, and more outspoken. The exchange with my partner of the whole essence of his being has enabled me to amplify my own personality and to include his qualities.

Question: How has the male energy you absorbed affected your daily meditations?

Answer: I want to be more integrated, including integrating the male and female energies within myself. Becoming more integrated and more balanced is one of the benefits of this practice. Being able to exchange with my partner has really enhanced my spiritual growth.

The same energy that could have been lost at times in emotional confusion or through miscommunication has become an energy resource that is available for my own growth. There is clarity that is illuminating in terms of my emotional and spiritual life. It is also more refined energy.

My partner's energy is now available for my spiritual growth, and my energy is available for him.

Question: What do you feel is the highest level of this practice?

Answer: Refinement of one's own sexual, emotional, and mental energies into subtle spiritual energy and into a spiritual body that lives within the physical body yet is free to move anywhere in time and space is the highest level. The sexual practice conserves and refines the fuel, but it is within the Kan and Li meditations that the real alchemy occurs. The essence of the Kan and Li practice is fire and water male and female energies uniting creatively within each Tan Tien or center in the body.

Through the self-intercourse of Kan and Li, one impregnates oneself, nourishes the fetus, and finally gives birth to a spiritual child that dwells within. Then the challenge is to nourish the spiritual child with strong, refined energy and virtue through the ups and downs of daily living. And how does my partner fit into this? I enhance his self-generation as he helps me with mine.

Question: You can be both the mother and father of this spiritual child by having the additional help of outside masculine energy?

Answer: Yes. What I like so much about the Taoist practices is that in cultivating our own nature, we attain our fullest flowering and give birth to ourselves. With a partner in Dual Cultivation, there is obviously an added energy and mutual support in addition to joy and pleasure. I also know that I can cultivate my own sexual energy myself, and be creative with it.

Question: Do you feel the sexual cultivation practice is essential to your spiritual growth?

Answer: Yes, but it is not essential to have a partner. These practices can be done by a woman who has a commitment to

celibacy as a way of utilizing her sexual energy for her own spiritual growth and directing the transformed energy toward service to others. For a woman who does want a partner eventually Single Cultivation allows her to take her time to choose her partner well without rushing into a relationship purely to satisfy sexual needs. So I would say Single Cultivation is essential. Dual Cultivation is valuable, but optional.

There is something else that I feel is very important since we are talking about the benefits. From the beginning these practices were very tranformative, enhancing my sense of being in control of my own energy and my own destiny. I have grown more responsible and able to use my energies creatively.

Question: Is the Tao all about controlling your emotions and energies? How does this figure in being effortless and flowing free?

Answer: I think about life as a river. Before I practiced Fusion and Ovarian Kung Fu, I felt in my emotional and sexual life as if I were a leaf on a current, and it was the current of circumstance that would sometimes direct me. Now, knowing these Taoist practices, I feel that t am more like a raft, and I can use the current for the purpose of following the river. When I look at my past and all the suffering that I went through in some of my emotional and sexual relationships, and I look at friends now, I see that the Taoist practices allow us to be in the river in a way that's harmonious and flowing without being knocked against the rocks. We are the navigators.

Question: Let's talk a little about the psychology of relationships. How do you feel this practice changes the psychology of the battle of the sexes?

Answer: I think it is essential for both partners to enter into a relationship with the intention of moving the energy up and fully sharing, because it is an exchange of energy designed to be redirected toward growth. This growth will naturally take its own direction, emotionally and spiritually. As the energy moves up during the practice, it takes care of itself. Everything else will flow naturally from that. The power struggle tends to dissolve. When things occur that must be clarified, the tools are available. It seems there is a harmony and a flow that is present that really extends far beyond the sexual act. There is also the other tremendous benefit of feeling attuned to the other person, wherever he might be.

Question: Why do you think this happens?

Answer: My experience is that as the energy moves up there

are bondings, at the heart level, and the mental and spiritual level, and those bondings are very profound.

Question: I have some specific questions about the actual technique. Do you really feel the energy flow up the spine in very direct pathways? It seems when you are making love these energies all get mixed together: This is a little confusing.

Answer: I think there is an interesting distinction between practicing on my own, if I am stimulating myself, my whole being is totally involved with another person. More of my whole body gets aroused when I am with my partner. So when the energies move up, they are more likely to expand and to fill my whole body. When I am alone I have a clearer sense of the energy going up my spine. If I'm with my partner I have a sense of the energy moving up through my whole body. Sometimes I have the sense of not only my own energy but also of his, as one column or wave moving upward.

Question: Have you discovered any additional techniques to aid this sexual practice?

Answer: My lover and I have discovered certain things spontaneously. It requires a great deal more discipline for men to cultivate this practice than it does for women. For women, it is really control of the pelvic-floor muscles.

All I really need to do is contract my pelvic-floor muscles in the direction of my coccyx and tilt my pelvis slightly and the energy will just begin to move up. Sometime I will stroke up my partner's spine with my hand or he will stroke up my back as we are beginning to go into the resting phase. This gives us both the clear sense that we are directing the energy up. Sometimes we touch each other's heads on the crown, and this helps focus the energy there. The energy then begins to shower down. One of the most delicious and exquisite qualities of the Valley Orgasm is that the energy moves up the whole body and through the crown, sometimes moving out of the body and then showers down like an exquisitely delicious nectar showering down through all the cells and all the atoms of the body.

Question: Have you found the practice has increased or decreased your sexual desire?

Answer: My sexual desire is about the same, but I feel much more satisfied. Also, my perception of sex and sexual relationships has continued to expand. I feel I am very slowly moving toward my goal of being totally alive, making love with the whole universe in

every movement. I feel immensely grateful to have a partner with whom to practice loving.

We feel that we are always together and whether we are physically together or apart, we can make love and share our energies. Our transformed sexual and emotional energies nourish our spirits and are shared with others as love.

Fig. 9.1 *Loving Couple*

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Healing Love through the Tao

Cultivating Female Sexual Energy

Mantak Chia

Illustrated by Juan Li

The sexual guidance and exercises presented in this book are being introduced plainly to the Western public for the first time. For thousands of years Taoist Masters only taught these secrets to very small numbers of people (who were sworn to silence), in the royal courts and in esoteric circles. This Taoist Master, as a practitioner of this ancient sexology, feels the need to share this knowledge with the world.

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There are two other preparatory exercises taught by the Master Mantak Chia. They are a series of exercises with an egg of wood or stone which is used to strengthen the urogenital and pelvic diaphragms, the glands, tendons and nervous system. These exercises lend themselves to titters by the uninformed, but in fact have been successfully practiced for thousands of years to enhance the potency and pleasure of the women fortunate enough to know about them.

Master Mantak Chia, born in Thailand, comes from the ancient lineage of Taoist Masters. Now based in Northern Thailand, he is also the author of *Awaken Healing Energy through the Tao, Taoist Secrets of Love: Cultivating Male Sexual Energy, Taoist Ways to Transform Stress into Vitality, Awaken Healing Light, Chi Self-Massage, Iron Shirt Chi Kung I, Bone Marrow Nei Kung, Fusion of the Five Elements I, Chi Nei Tsang I, Tao Yin, Tai Chi Chi Kung I, Chi Nei Tsang II, Multi-Orgasmic Man, Cosmic Healing I, Mutli-Orgasmic Couple* and *Cosmic Healing II*.

For women of all ages, for women single, married or lesbian, for those who seriously want to cultivate their sexual energy.

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Taoist Ways to Improve your Health by Rejuvenating your Bone Marrow and Blood

Mantak Chia

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I have come upon Master Chia's Taoist practice in my old age and find it the most satisfying and enriching practice of all those I have encountered in a long life of seeking and practicing.

Felix Morrow, Senior Publisher

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using the Dark Room technology creating a complete environment for the higher level Taoist practices.

He has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper/Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper/Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002

Many of the books above are available in the following foreign languages:
Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

Important Notice

The practices described in this book have been done successfully for thousands of years by Taoists under individual instruction. Readers who undertake Bone Marrow Nei Kung without personal training by the Universal Tao must realize that certain of these practices, if improperly done, may cause injury or result in health problems.

The use of common sense is necessary, and you must strictly follow the instructions and heed the notices and warnings that accompany each exercise and practice.

If you have not had previous experience with moving energy in the body through meditation, you must realize that this process is real and necessary for your safety. Adverse health effects can be caused by leaving excess energy in the organs or head; therefore, it is particularly important to move this energy through the Microcosmic Orbit and to store it in the Tan Tien as prescribed in the instructions.

The Chi Weight Lifting practice described in Chapter Five is restricted to persons who have been individually trained in a Universal Tao program. It is explained here so that information on this practice is available, and also to serve as a guide for those who have had Universal Tao instruction. Anyone who undertakes these practices on the basis of this book does so entirely at his or her own risk.

We urge every reader to study the exercises carefully before beginning any practice. Do exercises which must be done together and in proper sequence, and strictly follow the instructions, notes, and warnings.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. Where the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

Acknowledgments

I wish to thank foremost those Taoist Masters who were kind enough to share their knowledge with me, never dreaming it would be so enthusiastically received by the Western world.

I thank the artist, Juan Li, for his illustrations and for the artwork on the cover of this book. I also thank the editors, Charles Soupios and Valerie Meszaros, for their suggestions and many long hours devoted to the completion of Bone Marrow Nei Kung.

Further, I wish to express my gratitude to the contributing editors, Michael Winn, Dennis O'Connor, Eric Edelstein, Juan Li, and particularly Ron Diana, all of whom contributed much to the technical aspects of this practice.

There were many other contributors who graciously offered their time and advice to help communicate this system, including Gunther Weil, Ph.D., Rylin Malone, and John-Robert Zielinski. Special thanks are extended to David Miller for overseeing the design and production, and to John Sillari and Marlene San Miguel Groner for proofreading the text.

Without my mother and my son Max, the book would have been academic. For their gifts, I offer my eternal gratitude and love.

Finally, the Universal Tao will remember Felix Morrow, publisher of Universal Tao Books, who died in May 1988 before the completion of Bone Marrow Nei Kung. We are sorry that he could not see the results of his valuable advice and assistance.

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

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The book does not give any diagnoses or suggestions for medication. It does provide a means to improve your health in order to overcome imbalances in your system and to provide a richly rewarding sexual experience. People who have high blood pressure, heart disease, or a generally weak condition, should proceed slowly in the practice, particularly Ovarian Breathing. If there is a medical condition, a medical doctor should be consulted.

Introduction

Bone Marrow Nei Kung is a Taoist art of internal cultivation which employs mental and physical techniques to rejuvenate the bone marrow, thereby enhancing the blood and nourishing the life-force within. It is offered by the Universal Tao as a modern approach to health and longevity, but its heritage can be traced back thousands of years to ancient China. The barriers between cultures and the exclusivity of Taoism had hidden its benefits from the West until the recent introduction of acupuncture. Today, Taoist methods are gaining respect throughout the world. The reason for this is simple: they appeal to the body, the mind, and the spirit.

The Universal Tao system is a "living" philosophy in its own right, which means that to use it in life increases one's understanding of it. Indeed, with so many philosophies delineating the "best" way to live, perhaps it is appropriate that the Taoist practices can be applied in this way. A philosophy that cannot be practiced in daily life will rarely be retained, and is therefore not truly alive. If you consider your own mental, physical and spiritual aspirations in this light, perhaps the philosophy of the Tao is already understood.

A. Self-enhancement Through Taoist Practices

One objective of the Universal Tao System is to create an environment conducive to self-cultivation. The idea of changing a government, a belief system, or a society has little value to Taoism because more can be achieved by nurturing the growth of the individual. Those who seek knowledge often inspire others to do the same. This may seem strange to those whose philosophies advocate service to God, or "self surrender." The validity of this concept, however, is not diminished simply because its ideals seem contrary. In fact, one might find that self-cultivation and self-surrender are different expressions of the same ideal as both foster the individual's spiritual growth.

The practice of Taoism builds internal strength and creates peace of mind. It is pointless to worry about the world's problems while still vulnerable to your own. Do not concern yourself with the lack of peace and harmony in your family or among your friends until you have established peace within yourself. Your capacity to

help another human being depends upon the surplus of energy that you can channel towards that purpose. Such internal strength cannot be provided for the benefit of others unless you cultivate it within yourself first.

You can only share what you have in abundance. Otherwise, you will drain the energies of those around you as your needs become excessive. An emotion such as love exemplifies this truth. Taoism teaches that the body needs love from the inner self to survive and to nurture those energies that can be shared. Further, you cannot share the energy of love until it overflows beyond the needs of your body. In other words, you must love yourself to cultivate love for others.

In a spirit of altruism, people often demonstrate their desire to assist others beyond the point of necessity. This kind of "help" is detrimental to all concerned. Remember that the tradition of the Universal Tao does not tolerate self-righteousness and condescension among its students. These attitudes limit the freedom of others to choose their own paths in life The world must be accepted on its own terms, for we cannot change it. We have a responsibility, however, to change ourselves. If you can set an example for the rest of the world through your life's endeavors, then you have found the best way to create an impetus for change.

B. Decisions for Life

We assume that it is natural to age and to die, yet we often overlook the unnatural aspects of these processes by anticipating them. In truth, today's society simply lacks the education to understand how aging and death are choices we have made in our worldly endeavors. This is not to say that the human race is unknowingly immortal, but rather that we have far more control over these factors than we know. Death can be a choice in the sense that we can choose to live longer. Aging is a choice in that our bodies need not deteriorate as an effect of time. The effects of aging can be counteracted if we make the choice to do so. Certainly we all die, but we have forgotten that we all have options as to how and when.

Taoists choose to prolong life to create the best circumstances under which they can leave it. Since people know little about realities beyond physical existence, they often fear such knowledge, leaving it in the hands of God. This is how our race has learned survival

under the most rigorous conditions of faith. However, this fear has often negated the inner knowledge that God is not responsible for mankind's spiritual search; man is responsible. In Taoism, destiny lies solely in the hands of the participant and not in the hands of God, for we choose our actions in life.

The Taoist practice of temporarily leaving the body to explore the higher realms is as old as the most ancient of civilizations. This need not involve any confrontation with religion. It is part of a philosophy of life using physical and meditative means to cultivate spiritual energy. In the practice of the Universal Tao, this philosophy is not considered to be a religion because it lacks the rituals and worship of deities normally associated with religion. Consider, however, that religion is not necessarily synonymous with spirituality, since our true spiritual nature underlies the beliefs we grow into. Taoist philosophy simply offers a means of spiritual growth without the necessity of pondering religious questions. In the search for truth, one can leave the questions in order to experience the answers.

For some people, the idea of planning to journey beyond what can be physically touched or seen is totally inappropriate. This is perfectly reasonable in terms of spiritual growth because there is much to be learned in the world that we know. There is no reason for anyone to suffer in this reality, when good health can be achieved through these techniques. If one so chooses, one can develop the beginning of a spiritual afterlife before physical death would normally occur. For those who prefer to cultivate only the physical aspects of life, the copious health benefits of the Tao should be rewarding enough. The choice is simple in any case as the system is now available to everyone.

Remember that there is no place in Taoism for the glorification of masters. They are not saints, devils, or deities. These teachers consider it a wasteful expenditure of energy for students to pay them anything more than a casual, but genuine, respect. Taoist philosophy suggests that no "middle-man" is worth the expense when we can find our own answers. The enlightenment we seek demands that our efforts be channeled directly into the spiritual paths we choose. Those who would teach should only be considered helpful guides who offer assistance rather than salvation.

There are many more disciplines available than we need to attain enlightenment. Our spiritual inclinations, therefore, must eventually focus upon choosing wisely rather than searching endlessly. A Taoist cannot rely upon the good graces of a spiritual hierarchy because it is one's own responsibility to learn what spiritual needs are and how to fulfill them. The physical life we have chosen has many tools to offer. The Tao is simply a finger pointing the way.

Preface

Chinese Secrets of Bone Power

By Michael Winn

When I began doing Bone Marrow Nei Kung exercises seven years ago, I had absolutely no feeling for my bones. They seemed hard, rigid, and dense, the very opposite of the qualities I was seeking to cultivate in myself through Tai Chi Chuan movements and meditation. I didn't know my bones were alive and growing every minute, that my life depended on the quality of blood they produced or that I could have a major effect on my health by interacting with them.

I was amazed and surprised that with even the simplest exercises like "Bone Breathing," my bones quickly responded with a wonderful feeling of just having sprung to life. They tingled and began to rhythmically purr like a cat. When I did Tai Chi Chuan, my flesh and organs would disappear, and I could feel my skeleton dancing lightly through the air.

Over the years, doing the same simple practice of breathing and spiraling my Chi around my bones, I am still literally "thrilled to the bone." After I practice "Hitting" my bones gently, it feels like a deep massage that keeps vibrating all day long. The practices have greatly reduced latent fears I had of aging and finding my bones reduced to peanut brittle. Instead, I have the opposite problem, and I'm tickled when my wife complains that my bones have gotten too heavy as she tosses off my arm resting on her in the middle of the night.

Any lingering skepticism I had was erased when I discovered that hitting my jawbone with the wire device for three minutes daily was the most effective cure I had ever found for relieving tight jaw muscles. Jaws have some of the most powerful muscles in the body which is why TMJ (Temporal Mandibular Joint) Syndrome (a symptom of which is tight jaw muscles) is so difficult to cure. Apparently vibrating the jawbone loosens the hold of the tense muscles. This method offers promising relief for the many people suffering from tight jaw muscles in high stress urban areas.

My bones and I have become the best of friends now that I've learned how to play with them and meditate on them. Bone Marrow Nei Kung has given me a practical way to connect the densest part

of my physical body with the most subtle emanations of my spirit. The meaning of a Yang family classic Tai Chi Chuan training poem sudenly became clear once I understood the importance of moving from within our bones

> The mind moves the Chi
> So that it may sink deeply and penetrate the bones
> When the Chi flows freely,
> The body easily follows the mind

"Cleansing" my bone marrow was not always smooth sailing. In the beginning, the process of heavy detoxification was not always pleasant, and I occasionally felt ill for a day or two. There were psychological adjustments as well. Exercises like "Chi Weight Lifting" with the sexual organs and the Hitting practice seemed a bit far out at first. I cracked a lot of nervous jokes about religious fanatics flagellating themselves with whips, and I secretly wondered if I had fallen prey to same extreme teaching.

Having practiced these exercises for almost seven years now, I can assure the reader that the Bone Morrow Nei Kung practices are legitimate exercises for physical and spiritual health. The ancient Chinese were incredibly precise, even scientific in their methods of tapping bone power. Mantak Chia hay taken this one step further by integrating modern scientific knowledge of bone chemistry with the ancient knowledge of Chi functioning in the human bones and body.

The name "Bone Marrow Nei Kung" sounds pretty mysterious and esoteric. Master Chia originally taught it as an advanced level of "Iron Shirt Chi Kung." It may help to understand the cultural context of these Chinese terms. In China there are thousands of different "Chi Kung" practices taught by martial artists and meditation masters. Chi Kung literally means "practicing with the breath," which can include any exercise that uses breathing to energize the body. The physical breath activates the "Chi," also interpreted as "subtle breath," which generates increased physical and psychic strength.

Chi Kung is still so popular that on a recent trip to China I saw hundreds of Chinese flock to circus-like traveling road shows that gave Chi Kung top billing. These Chi Kung artists, with no apparent muscular buildup, perform feats like bending thick steel rods pushed into the soft spot on their necks. They break bricks on their heads, let trucks drive over them, and resist sharp knives with their bare skin.

These are high levels of physical accomplishment, but unfortunately they miss the real point of Chi Kung, which is to prepare the body for higher spiritual energies. Through Kung Fu movies and Chi Kung showmen, the practice of Chi Kung has been glorified as a path to superhuman physical power. This frightens off ordinary people from learning the true practices which are simple and give great benefits to health.

"Nei Kung" is a very close relative to Chi Kung. It means "practicing with your internal power" and implies building body-mind power without using physical breathing techniques. Mental concentration, internal imaging, and development of a deep inner sensing of psychophysical processes are the marks of Nei Kung techniques.

Most of the methods of internal alchemy taught at the Universal Tao Centers--the Inner Smile, Microcosmic Orbit, Fusion of the Five Elements, Kan and Li--are all "Nei Kung" techniques. Perhaps because they are more subtle than Chi Kung methods, the Nei Kung methods are fewer in number, and traditionally many have been kept very secret.

When Master Chia visited Taiwan in 1987, he discovered that the going price to learn Bone Marrow Nei Kung was about four thousand U.S. dollars for ten hours of instruction. Plus you had to take an oath of absolute secrecy not to teach anyone else. Master Chia had already learned the practice in Hong Kong more than a decade earlier from Master Cheng Yao-Lun.

When Master Chia learned the method of "Cleansing the Bone Marrow," the price was years of slavish devotion until your teacher, or "Sifu," entrusted you with the secrets. When he completed his training, it was Chia's very impatience with this slow process that inspired him to publish these closely guarded secrets to benefit the thousands of Westerners seeking accurate and practical instruction in Chinese internal arts.

The previously secret Bone Marrow Nei Kung methods of this book are the same ones associated with stories of masters achieving an "iron shirt" or building a "steel body." Contrary to movie legend, this is not a superman body of hardened flesh and muscle, but the inner strength of a body whose bones and organs are so packed with Chi energy that it resists aging and disease. The resilience to withstand the physical stress of hard blows or sudden falls comes from packing the fasciae with Chi that helps the body to "bounce off" outside forces.

Bone Marrow Nei Kung does generate tremendous amounts of Chi, and this makes it a dangerous practice for overzealous students who lack the self discipline lo refine this Chi through meditation. The body can overheat from excess energy, and meditation is the safety valve that transforms this raw energy back into its original spirit or "shen."

This is why in the Universal Tao System it is necessary to learn the Microcosmic Orbit Meditation before one even begins generating additional energy through Chi Kung. Without some way to refine and use the energy, what is the point of cultivating internal power?

I know one advanced student who eagerly did the Chi Weight Lifting exercises of Bone Marrow Nei Kung to generate more sexual energy. He then vibrated it into his bones with the device used in the Hitting practice. He was lifting very heavy weights from his genitals, far in excess of the ten pounds recommended in this book. He was so addicted to his practice that he would carry a suitcase full of weights with him wherever he traveled.

The student made the serious mistake of not meditating to assimilate all of the energy he was creating. He began having dreams that various creatures and people were feeding on him, and he started to become very paranoid. He finally quit the practice altogether after a psychic told him that many low level spirits were parasitically absorbing his excess sexual energy. He quit lifting excessive weights and his energy returned to normal. This is a bizarre and somewhat incredible story, but it should serve as a warning to people who tend to go overboard on a new thing.

Even masters are not exempt from the dangers of over-zealousness. The Taiwanese teacher who was selling the Chi Weight Lifting techniques for thousands of dollars claimed to be able to briefly lift 300 pounds from his genitals. It proved to be too much for him as he recently died at a very young age, allegedly from a blood clot in his testicles that may have travelled up to his brain. Had he chosen to be more practical, using light weights in a regimen balanced with meditation, he might still he alive today.

In ancient China the Taoists who practiced internal cultivation of Chi saw a deep "bone consciousness" as an essential step on their long journey to realizing their immortality. According to the classic Taoist texts, when the postnatal Chi--all the energy acquired by food, sex, thoughts, and emotions since birth--circulates in the Microcosmic Orbit, it stirs loose the prenatal Chi stored in the bone marrow and the brain.

It is this prenatal Chi, also called pre-heaven or primordial Chi, that is refined into spiritual consciousness and gives birth to the immortal embryo in the lower abdomen. This grows up to become the spiritual child and eventually crystallizes into the “light body’ or “immortal body” of the spiritually mature human.

For the Taoists, the bones were a secret key to stabilizing or “grounding” the life of the spirit within the human body. Before this could be done, the bones had to be cleansed, and their vibratory rate--bone consciousness--had to be raised to a more refined level. The movement of Chi in the bones was used to amplify the process of cleansing and purifying the Chi flowing through the meridian system, blood, internal organs, glands, and nervous system.

The bones create the vertical structure in man which allows special energy channels to function in the body such as the “Chung-mo,” which is the thrusting route in the center of the body, and the “belt routes” spiraling around the body. These channels allow man to act as an antenna and receive energy from the electromagnetic fields of the earth, moon, sun, and stars--the stepping stones to our sense of divinity.

In this light, an entire book on Bone Marrow Nei Kung does not seem like such an impossibly esoteric topic. A few years ago this topic would have drawn interest from only select circles of martial artists. Yet Bone Marrow Nei Kung practices can be done by ordinary people who simply wish to be more embodied, more grounded, and healthier in their physical being. These practices were once extremely secret in old China, but today the secrets of the Tao are opening like a flower, and the sweet fragrance is available to anyone drawn to it.

Modern popular literature on bone health is limited mostly to diet and mineral supplement advice on preventing osteoporosis. This disease, which makes bones brittle with age as they become depleted of calcium, is a major tragedy for the elderly, especially women after menopause. Recent studies show that calcium supplements are of dubious value in stopping osteoporosis.

According to scientific studies, what does reverse the process of osteoporosis are exercises that put gentle pressure on the bones and keep them fit, combined with the proper hormonal balance in the body. Bone Marrow Nei Kung gives the bones exercise, increases bone density, and the Sexual Energy Massage technique helps to stimulate hormonal production. Millions of women would benefit from to these exercises as a preventative measure against osteoporosis.

One exception to the gap in modern literature on bones is Gabriel Cousen's landmark book, *Spiritual Nutrition and the Rainbow Diet* (Cassandra Press, 1986). He points out that our bones are the only solid crystalline substance in our bodies and that scientists have actually been able to measure the electromagnetic fields that bones receive and send to our organs: meridians, blood cells, and nerves. The electrical generating ability of bones is called the "piezo-electric effect" and has been documented by a number of scientific studies. He states:

"The brain, nervous system, and heart also give off electromagnetic fields that resonate with our bones and other crystalline like structures. The crystalline bone structure then amplifies and radiates this energy and information to the rest of the system down to the cellular and subcellular crystalline structures."

This suggests the bones are nothing less than the tuning fork for our whole body. It is the solidity of the bones that makes them such stable transmitters of the deep, rhythmic pulsating energy that biologically connects our smallest atoms to the primordial rhythms of the stars. Bone Marrow Nei Kung gives us a way to systematically increase the purity and range of our body's tuning fork so it hums with a crystal clear vibration.

Bone consciousness has manifested in a variety of other interesting ways outside of the martial arts. In the mainstream Chinese culture a deep reverence for bones is revealed in the great importance placed on burial and ancestor worship. If the bones of your parents or grandparents are buried near a disturbing environment with noise and traffic, or in a site with the wrong elemental balance of water, wind, mountain, etc., then your own life will be disturbed.

According to Chinese theory, this "bone magic" works because the vibrational frequency of your body is very close to the vibrational frequencies of your parents' bodies. If their bones are disturbed, your bones will also be disturbed as we always remain in subtle communication with those closest to ourselves. Our bones never die. They continue acting as transmitters for the departed spirit.

Our bones are like invisible wands concealed within the shrouds of our flesh. We wave them about in life like an orchestra conductor invoking the magic of the higher harmonies. It is when we get old that our bones feel empty and brittle, without the sparkle and dash needed to play life's symphony. And small wonder since we pound

them, run and joggle them, use and abuse them in a thousand ways without even giving a thought to making them stronger. Gravity adds its stress by pulling down on them without allowing any relief.

Bone Marrow Nei Kung offers an opportunity to explore the core of our physical body and to learn how to root our spiritual being within that solid physical anchor. The benefits are universal, teaching us to use the unconscious power deep within our bones and make it available for mundane everyday use, as well as for spiritual goals.

The next step is up to us. We must experiment with the Bone Marrow Nei Kung exercises until we feel this ancient knowledge of Chi as a living presence in our bones. As Mantak Chia is fond of saying, "You do it, you get it."

New York City, July 4, 1988

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Chapter I
Understanding Bone Marrow Nei Kung

A. Internal Discipline vs External Exercise

The Western world generally believes that daily physical exercise helps to slow the aging process. In our society physical fitness is gauged according to the external manifestations of arduous training. An example of this is the trend towards muscular development through weight lifting. Athletic competition has also influenced many of our concepts of health and well-being. If one considers, however, that body builders and athletes enjoy the same life span as the average human, one might reconsider the assumption that they are the most "physically fit."

The professional athletes we admire expend enormous amounts of energy to attain top positions in their sports. As they overdraw on their resources for long periods of time, their internal organs often lose the capability to feed such exhaustive energy requirements. The inexorable effects of aging then impede them until they can no longer compete. Some may delay the exhaustion of their energy sources through vitamins and nutrition, but their digestive capabilities usually decrease with age, making a dependency upon food and vitamins even less promising. Nutrition and physical exercise are not comprehensive approaches to health, even when they are combined.

In your own fitness training, you may be indirectly exercising the internal organs and glands; however, if you do not emphasize their cultivation above and beyond that of the muscular system, you can ultimately do more damage than good. The organs and glands nourish every function of the body just as the bone marrow nourishes them through the production of blood. Still, we unknowingly tax the internal system beyond its limits because we believe that muscular development should take precedence. Without the energy supplied by the internal organs and glands,

there can be no lasting muscular development. In short, muscular strength and stamina may not be the best medium by which to judge overall physical health.

The Taoist approach to health is very different from Western concepts of exercise because the Taoist disciplines are always internally focused. These exercises, therefore, emphasize the cultivation of the organs and glands. After the organs and glands have been enhanced, the needs of the tendons, bones, and muscles are fulfilled accordingly. Bone Marrow Nei Kung replenishes the blood supply and strengthens the internal system, thereby improving every aspect of the body.

Energizing the bone marrow is crucial to the development of that internal power which has a lasting quality unknown to external systems of health. We have all heard that inner beauty lasts when outer beauty begins to fade. The Taoist practices cultivate inner strength and lasting beauty, as they enhance the external aspects of the body.

B. Bone Marrow Nei Kung and the Practice of the Universal Tao

1. Internal Energy Known as Chi

Taoists describe the world as an interaction of positively and negatively charged electromagnetic energies. “Chi” is an overall term used for these energies, which comprise the ultimate nourishment derived from food, air, moon, sun, and stars. Chi is also generated within our bodies by the organs and glands, and it extends around us as part of our emanation. This is why the cultivation of our organ, and glands is so important to the enhancement of our life-force energies.

Just as the positive and negative terminals of a battery must both be engaged to generate power in an electrical circuit, the “Yin” and “Yang” qualities of Chi must both be engaged for the proper functioning of the body. Yin is analogous to the negative charge, and represents a cool, gentle energy often associated with femininity. Yang is the positive charge, and represents a hot, volatile energy that is characteristic of masculinity. Both qualities can be found within us, although there is often a lack of harmony between

them. The knowledge of Yin and Yang and their proper balance is critical to our daily lives because an imbalance can create a negative effect.

Chi-also known as “Qi” is a constant factor in every part of our lives. Unfortunately, we often lose it at a faster rate than we can amass it. As our internal sources of energy are not inexhaustible, we can unknowingly drain them beyond repair, creating the possibility of painful aging and an early demise. If the organs and glands could regenerate themselves, however, such possibilities would become remote. Fortunately, what we have sacrificed of our bodies in our worldly pursuits can often be replaced through the absorption and recycling of Chi. In other words, this energy can be used to replenish its sources within our bodies so that we can regenerate our internal systems and better maintain them.

Chi cultivation is the underlying purpose of the Universal Tao. This is the essence of all that a practitioner of this system aspires to. If one wishes to be a healer, success depends upon the ability to channel energy through the hands. If one wishes to be an athlete, success depends upon the ability, to convert energy into strength and endurance. If one wishes to he free of negative influences, success depends upon the ability to transform negative energy into positive energy. One who seeks enlightenment is searching for the highest source of all energy.

2. Bone Marrow Nei Kung in Theory

The purpose of Bone Marrow Nei Kung is to regenerate the blood-producing red marrow of the bones to enhance the blood and the sources of Chi within the body. The system consists of five practices related to the following functions:

a. Breathing in energy from external sources
b. Drawing in and circulating sexual energy throughout the body
c. Vibrating the bones to open their pores for energy absorption
d. Compressing the combined energies into the bones to eliminate fat
e. Enhancing the nervous and lymphatic systems while detoxifying the skin

The techniques of Bone Marrow Nei Kung reverse the effects of aging by regenerating the bone marrow with sexual energy while

eliminating the accumulated fat which restricts the production of blood. Exercises are also used to detoxify the body and improve the functions of the nervous and lymphatic systems. Finally, a sixth practice is used by advanced practitioners to further strengthen the internal organs and glands by exercising the fascial layers which surround them. A higher concentration of sexual energy--referred to as Ching Chi--is released into the body through this technique.

Men have reported increased strength, endurance, and sexual powers upon mastering Bone Marrow Nei Kung. Women have reported that the Hitting techniques, used in conjunction with other exercises, are a perfect weapon against cellulite. Bone Marrow Nei Kung is also an excellent medium for weight control as it generates intense heat within the body to burn up large quantities of fat. This system can he used to enhance one's capabilities in all activities, including martial arts, running, weight lifting, football, aerobics, dance, and so on.

The exercises of Bone Marrow Nei Kung should not be considered a strict regimen. Progress is not contingent upon arduous practice except in a martial arts context where the goals are different. Those who cannot devote much time to esoteric disciplines should still be able to progress slowly but steadily to better health. Upon developing a reasonable proficiency with these techniques, practice can be curtailed to every other day, if necessary, to maintain that level of proficiency. These exercises and their prerequisites should only take from 35 minutes to one hour to complete.

C. Overview of Bone Marrow Nei Kung and Related Disciplines

1. Practices of Bone Marrow Nei Kung

Bone Marrow Nei Kung--sometimes referred to as Iron Shirt Chi Kung III--consists of the five interrelated practices. Chi Weight Lifting is a sixth technique described in Chapter Five for advanced practitioners. With the exception of Chi Weight Lifting, all of the following exercises, including the supplemental practices, should be used in your training schedule to some extent. If you wish to

receive instruction in these disciplines, it is advised that you contact the Universal Tao for information on the seminars in which Bone Marrow Nei Kung is taught.

a. The Bone Breathing Process: Bone Breathing uses the power of the mind with deep, relaxed inhalations to establish an inward flow of external energy through the fingertips and toes. This energy is used to complement previously stored sexual energy which is released into the body through the Sexual Energy Massage or Chi Weight Lifting and then compressed into the bones. The external energy helps to eliminate the fat accumulated in the bone marrow, thereby assisting in the marrow's regeneration. Bone Breathing may be used with or without Bone Compression, but they are presented as a combined practice in this book.

b. Bone Compression: After external energy has been breathed into a particular area, the muscle contractions of this process force the combined energies into the hones to burn the fat not of the marrow. While Bone Breathing is a mental process used in conjunction with long, soft breath cycles, Bone Compression is a physical process of contracting the muscles, thereby squeezing Chi into the bones. Combining the mental with the physical in this way enhances the results of Bone Marrow Nei Kung.

c. The purpose of the Sexual Energy Massage is to release Ching Chi from the genitals so that it can be disseminated throughout the body and absorbed into the bones. (The term "Ching Chi" actually refers to sexual energy and sexual hormones combined.) The fingers massage the genitals while meditative breathing is used to draw the sexual energy and hormones upward from the genitals into the body. The genitals are later replenished by the rejuvenated organs and the return flow of the microcosmic Orbit Meditation, described in Chapter Six.

Although the combined energies from sexual and external sources are used to burn fat out of the bones, only Ching Chi can regenerate bone marrow. The massage techniques release tremendous amounts of Ching Chi into the body for this purpose. The release of sexual hormones into the bloodstream also stimulates the pineal and pituitary glands. Western science believes that the pituitary gland produces an aging hormone in the absence of this stimulation, contributing to an early death.

d. The first Hitting technique has two applications: one uses a form of compression to force Chi into the bones, the other works

without any muscle tension, “Hitting with Packing” amplifies the Bone Compression practice using a special device to strike each successive area of the body or limbs that is being compressed. The device creates vibrations throughout the body which open the pores of the bones to receive condensed energy. Specific lines correlating with known acupuncture meridians are hit along their respective lengths to open their channels for the energy flow.

In the second application, “Hitting to Detoxify,” the striking device is applied without any form of Bone Compression, and the muscles stay relaxed. This detoxifies the body, helping it to absorb Chi. Hitting to Detoxify is recommended for beginning students because it has a less overwhelming effect on the body than the packing method. In both applications, Hitting is one of the most efficient techniques available for detoxifying the body.

e. The last technique, “Hitting with Rattan Sticks,” employs a similar striking sequence to stimulate the nervous and lymphatic systems. The sticks do not emphasize vibrations as the wire device does, but the shock of their contact strengthens skin, muscles, tendons, and bones. They should not be applied to the bones directly.) This method also detoxifies the skin, thereby improving the complexion. Hitting with Rattan Sticks completes the basic procedures of Bone Marrow Nei Kung.

f. Chi Weight Lifting is the last practice described in this text because of its advanced nature and its dependence on the other disciplines. It is similar to the Sexual Energy Massage, but weights are used to increase the pressure on the genitals. The procedure should not be attempted until all of the massage techniques in Chapter Three have been thoroughly mastered. Chi Weight Lifting differs from the Sexual Energy Massage in that it develops strength in the layers of fasciae surrounding the organs and glands. These tissues are engaged to counteract the downward pull of the weight against the genitals, thereby creating an upward flow of energy from the sexual center.

Note**:** Chi Weight Lifting is included herein to document its practice for instructors and trained students. It is not recommended for beginners or casual readers without a full understanding of its applications as taught at Universal Tao seminars.

g. Using the Bone Marrow Nei Kung Practices

(1) Practitioners usually begin with Bone Breathing and Bone Compression to draw external energies into the body. (In advanced

practice, you may prefer to use these steps only during the Hitting with Packing process.)

(2) Either the Sexual Energy Massage or Chi Weight Lifting techniques are then used to release Ching Chi, which is combined with the external energies.

(3) Finally, the Hitting practices must follow the release of sexual energy. First the vibrations are created to help the body assimilate the combined energies into the bones. Then the rattan sticks are used to strengthen the skin and nerves.

2. Required Supplemental Practices for Bone Marrow Nei Kung

The Universal Tao employs many other disciplines integral to Bone Marrow Nei Kung. Most of these practices can be used alone; however, a working knowledge of them all, including certain meditations, is necessary for Bone Marrow Nei Kung. It is the working knowledge of these other disciplines that creates a safer practice. After learning the required supplements, you may emphasize particular aspects of your training according to the needs of your body.

Tremendous energy is released during practice, which can cause an imbalance if one does not know how or where to channel and store an overflow of Chi. This could create problems that would require an acupuncturist to correct in order to avoid dangerous side effects. As a rule, hot energy is never allowed to remain in the organs and glands because it can overheat them. The supplemental practices used with Bone Marrow Nei Kung remove such an overflow of energy to the proper storage areas.

a. Microcosmic Orbit and the Inner Smile

A common denominator of all the physical disciplines, as well as the mental and spiritual work, is the Microcosmic Orbit Meditation, which is initiated by the “Inner Smile.” (See Chapter Six.) In relation to Bone Marrow Nei Kung, the flow of the Microcosmic Orbit is necessary for channeling sexual energy. (Fig. 1.1) Ching Chi is drawn up from the lower centers into this flow and distributed throughout the body. In this way, meditation assists in creating blood cells by circulating Chi to enhance bone marrow.

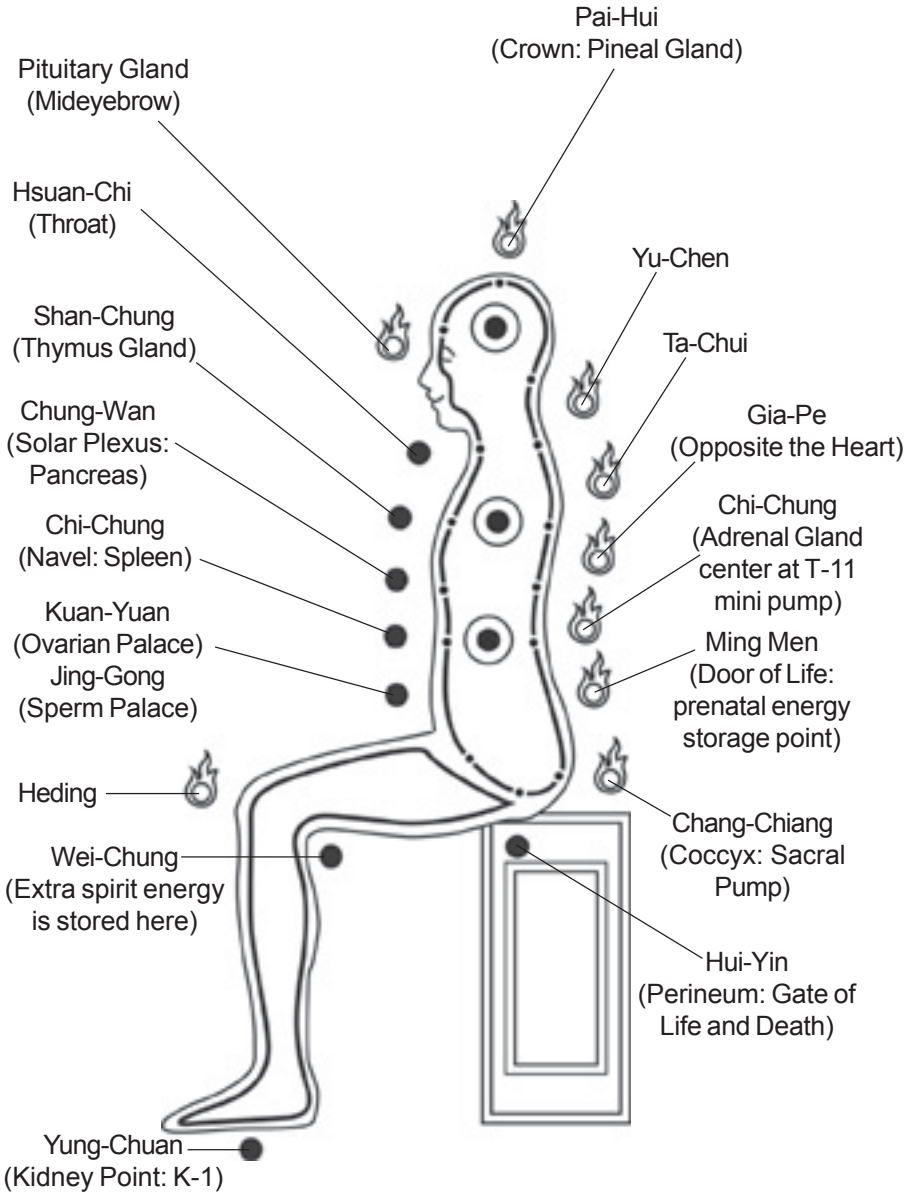

Fig. 1.1 *Stations of the Microcosmic Orbit*

Warning: To practice without the Microcosmic Orbit Meditation can cause irregular heartbeat, chest congestion, headaches, pain in the chest or back, and other problems. This meditation is a prerequisite for Bone Marrow Nei Kung. Ignore it at your own peril.

b. Healing Love

Another important exercise for Bone Morrow Nei Kung is the Healing Love practice used in all sexual activities. The loss of sexual energy, or "Ching Chi," depletes the bone marrow and the vital organs which must replace what was lost. Unless one learns how to retain this energy and build up a healthy reserve, the organs and glands must sacrifice one third of their energy to replenish the genitals which produce Ching Chi.

The Healing Love methods for both men and women involve drawing in orgasmic energy and channeling it upward to higher centers, thereby reversing the outward flow of Ching Chi that is normally released during sex. When used in conjunction with the Sexual Energy Massage, these techniques combine to release tremendous amounts of Ching Chi upward into the body, making this practice very useful to Bone Marrow Nei Kung. When used alone, Healing Love methods release abundant sexual energy which can then be stored and cultivated for mental, physical, and spiritual use.

Sexual energy can be transformed into life-force energy, compounded regularly by the Healing Love practice. The use of these methods not only improves the internal organs and glands but also enhances one's sexual satisfaction. The libido lasts for many more hours during sex, and for many more years in one's life. Furthermore, sexual stimulation reaches far beyond the conventional idea of a "climax."

c. Iron Shirt Chi Kung I

The postures of Iron Shirt I can be an excellent medium for the practice of Bone Marrow Nei Kung. In the Iron Shirt techniques, one learns to compress energy into the fasciae surrounding the organs and glands. These protective sheaths of tissue are most conducive to the Chi flow that nourishes the internal system.

Compression of Chi creates its storage space within the fasciae as the fat lodged within the muscles, tendons, and bones is purged

and then transformed into more energy. A brief synopsis of the related postures is included in Appendix 1. Iron Shirt Chi Kung I is detailed in the Universal Tao book of the same name.

d. Six Healing Sounds

The Six Healing Sounds are produced sub-vocally and correspond to specific organs: the lungs, kidneys, liver, heart, and spleen. The sixth sound is the "Triple Warmer" which evenly distributes energy throughout the body. When used independently of Bone Marrow Nei Kung, each sound creates its own energy to enhance and detoxify the internal system. All six sounds and their related postures decelerate the body after practice and remove excess heat accumulated in vital areas. These exercises are fully explained in Appendix 1 and also in the Universal Tao book, *Taoist Ways to Transform Stress into Vitality.*

D. Importance of Internal Exercises

Master of Internal Strength

There once was a master who was very powerful. Many people wanted to learn from him, but he was difficult to have an audience with. This master felt that, unless one had patience, no one was worthy of his lessons. There was a very determined man, however, who waited three years, day after day, to see him. But the master would only appear to discourage those who waited. He would send them away, and they would all leave, except for this one man. Finally, the master became curious about this man who remained each day only to receive such disappointment.

One day the master asked the man, "If I tell you to do something, will you do it?" "I will try my best," the man answered. So the master told him to go over to a tree that grew nearby and pull it out of the ground for him. The man looked at the tree and decided to try it, since this was better than waiting for the treatment that the other people would get. He went over to the tree, grabbed it, and pulled at it. He did this day after day, year after year.

With each passing year, the tree grew bigger, but with each passing year, the man developed more internal strength. Finally one day, after ten years of daily effort, he became very determined

to pull that tree out. He felt his body fill with Chi as he approached the tree and grabbed it. His feet were firmly planted on the ground, and he was wrapped around the tree in such a way that his internal strength could best be applied. With great force, he finally pulled the tree out.

The man went to the master and excitedly reported his great triumph. The master said that was fine, and then told him to leave. The man was very surprised and disturbed by the master's response. It appeared that he had been shunned without ever learning from this master after all. The master looked at him and said, "If you can pull that tree out of the ground, whoever in the world would want to fight you?" The man smiled upon realizing that he had indeed been taught what he most needed to know: patience, self-discipline, and internal power. (Fig. 1.2)

Fig. 1.2 *Embracing the Tree*

1. Chi flow assists the Heart.

This system regards the heart as both a muscle and a vital organ. Taoists would agree that even a strong heart should never be overworked. The heart never truly rests from the time it begins to

beat. As blood carries oxygen and nutrients throughout the body, its circulation can be a burden to the heart if physical stress remains constant. (Fig. 1.3) When energized with Chi, however, the blood becomes lighter and easier to move, allowing the heart to work less and maintain a higher energy level. The practice of Bone Marrow Nei Kung helps to develop the Chi flow while improving the heart's capabilities.

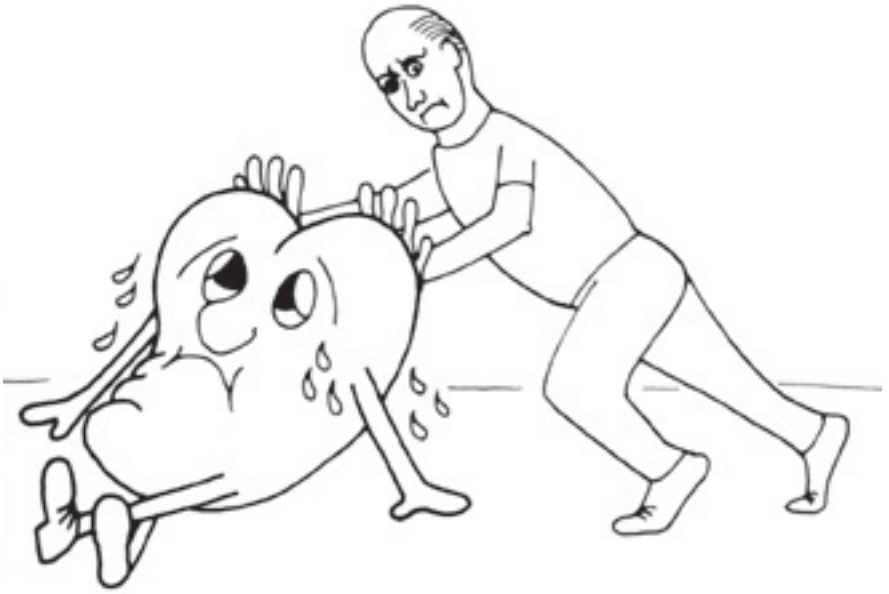

Fig. 1.3 *The more we push the heart, the more we exhaust its energy.*

2. Mind moves Energy

The flow of Chi can be controlled by the mind to greatly reduce the work of the heart. If, for example, your hands and legs are cold, you may concentrate and direct the Chi to flow with the blood to warm those areas. "Pulsing" is a meditation technique used to make the blood flow with less dependence on the pumping of the heart. Pulsing can direct the Chi to help circulate blood throughout the body. The method amplifies the pulse at the crown and at the perineum so that blood can be directed from all three points rather than from the heart alone. This practice is used to assist the heart in Bone Marrow Nei Kung, and it exemplifies some of the physical manifestations of meditation.

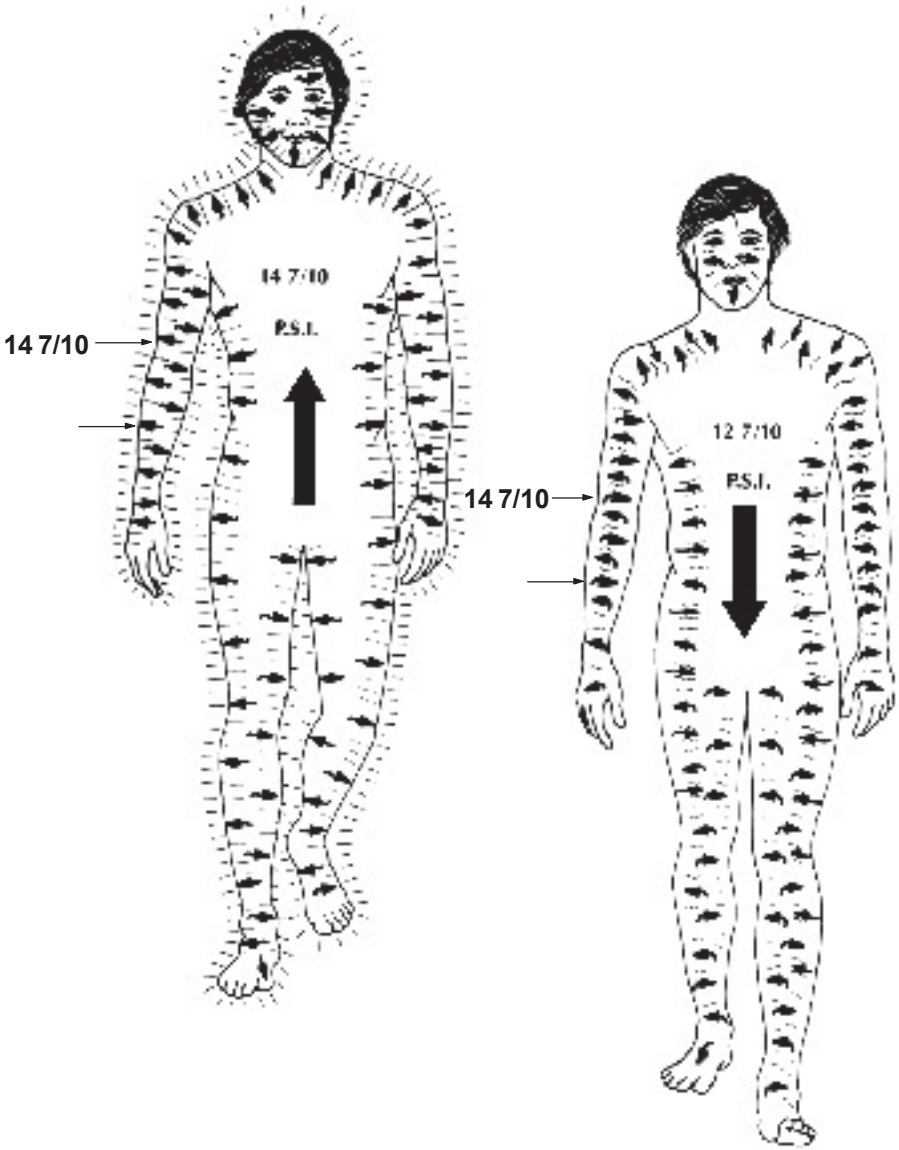

Fig. 1.4 *A healthy body has an internal pressure of fourteen and seven-tenths pounds of pressure per square inch (P.S.I.) Any reduction of this pressure increases the chances of illness and overall weakness.*

3. Developing Chi Pressure

Chi pressure is important in Bone Marrow Nei Kung as energy is compressed into the cavities of the body to provide for the vital functions of the internal system. A healthy body has a Chi pressure level of about fourteen and seven-tenths pounds per square inch. When we are sick, or become old, this pressure decreases, and the body reacts like a car tire losing air. (Fig. 1.4) Bone Marrow Nei Kung employs special breathing techniques, first introduced in Iron Shirt I, to double the Chi pressure in and around the organs and glands. This is like creating an additional, powerful heart to improve one's internal capabilities. The Chi pressure also protects the body from internal injury resulting from external forces.

4. Circulating and Storing Chi through Acupuncture Meridians

During the development of acupuncture, the Taoist masters discovered a network of pathways through which energy could be distributed to all areas of the body. Modern science describes these pathways as conductors of electric current with storage compartments of electromagnetic energy. The Taoists simply referred to them as routes, meridians, or channels. As Chi flows through each channel, it energizes the particular organs associated with that channel. In the practice of Bone Marrow Nei Kung, energy is conducted through these acupuncture meridians to enhance the organs, glands, fasciae, muscles, and bones, rejuvenating the entire body.

5. Chi and the Crystalline Properties of Bones in Western Research

Dr. Gabriel Cousens has compiled many documented studies pertaining to the crystalline properties of the human bone structure. In his book, *Spiritual Nutrition and the Rainbow Diet*, he reports that bones can receive and emanate electromagnetic fields in the same manner as other crystalline structures. These fields can affect cell nutrition, cell functions, enzyme activity, energy transfer, and many other internal activities. Bone-generated electromagnetic fields relate directly to the assimilation of nutrient energy, which means that they affect our intake of energy from external sources such as food.

The fact that externally created electromagnetic fields can affect the crystalline properties of bones might explain how a small electrical current can be used to help the bones heal themselves. Calcium lost in osteoporosis has been replaced through this technique. It is unknown how this process works, but Taoists suggested its use long before electrical impulses could be generated by anything other than the body.

These findings may someday help the West to accept Taoist ideas about the use of energy as a healing tool. Research has already confirmed the effects of electromagnetic energy on bone functions, and Taoist concepts seem to intrigue Western medicine as electrical current is now being used to heal bones. (Bone Breathing and Bone Compression exemplify how this process was originally employed.) It would appear that Taoist practices offer an approach to healing similar to electro medicine, but in fact these practices actually prevent bone problems and other disorders from ever occurring.

6. Taoist Practices strengthen the Immune System.

Western science is conducting studies to ascertain the effects of Taoist methods--and those of various other disciplines--on the immune system. Research is being conducted in the fields of psycho-neuroimmunology, behavioral medicine, and movement therapy. So far there is no evidence that would establish any single discipline as a comprehensive approach to strengthening the immune system. One may conclude, however, that self-induced healing, as advocated by Taoists, is creating a foundation for such a program. This ancient approach has illuminated the link between the immune system and the power of the mind. The “Inner Smile” meditation clearly exemplifies the benefits of this connection. (Fig. 1.5 (a) and (b))

7. Cultivation of Sexual Energy leads to Personal Power.

Nurturing Ching Chi through Bone Marrow Nei Kung and Healing Love practices eventually brings great personal power as sexual energy begins to radiate from the body. This energy has a magnetic quality that attracts people. It nourishes those who do not have the knowledge to store Chi for themselves, but it can also attract those who have other energies to share. In other words, you may attract the yin counterpart lo your yang energy or vice versa. When such

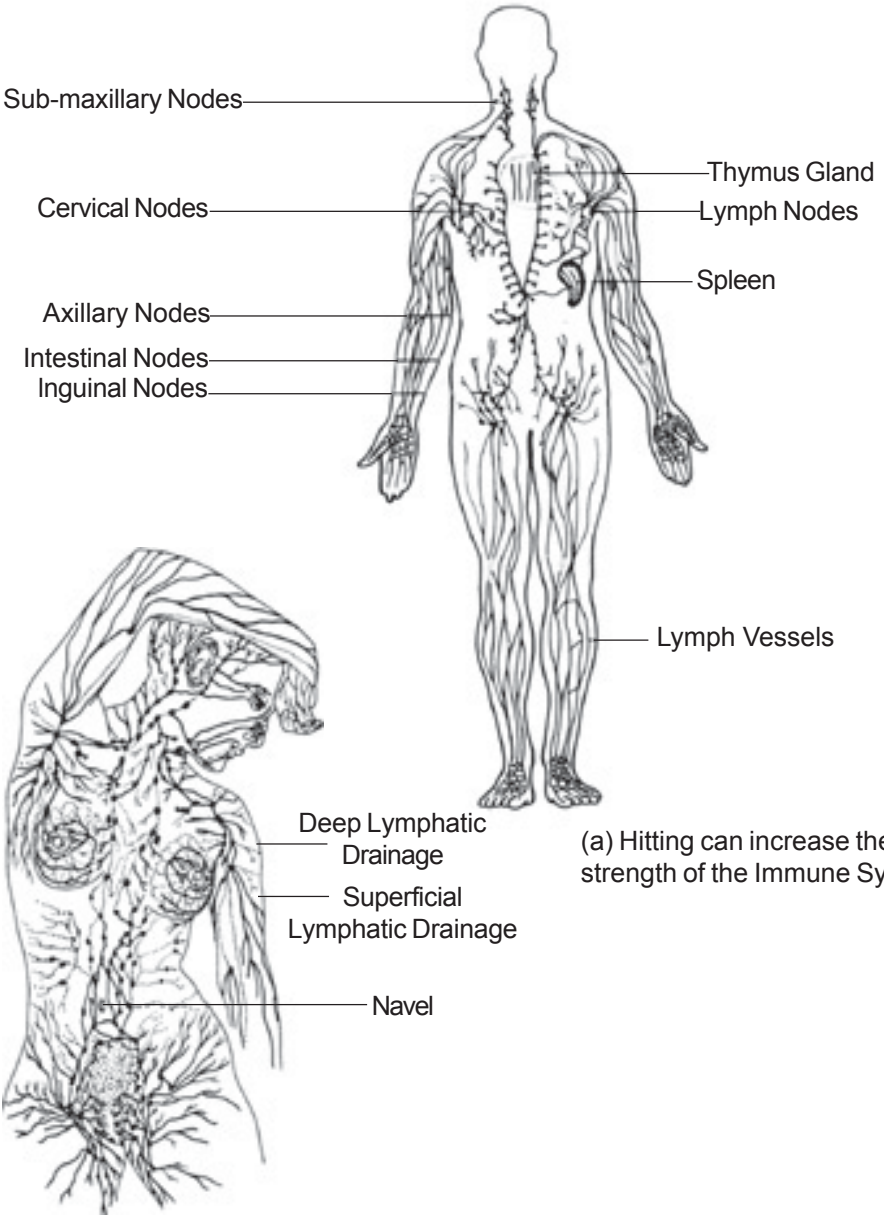

(a) Hitting can increase the strength of the Immune System.

(b) The superficial and deep lymphatic drainage of the head, arms, and torso is increased by Hitting with Rattan Sticks.

Fig. 1.5 *Immune System*

Fig. 1.6 *Spirit Body*

a meeting occurs the abundance of sexual energy becomes even more important as it can be shared to create the foundation for a spiritual bonding. Two can share in this joy when the energies overflow from both participants.

8. Developing the Spirit Body with Internal Energy

During its journey through the Microcosmic Orbit, sexual energy transforms into life force energy, which ultimately transforms into spiritual energy. This final transformation yields the raw material for the creation of a "spirit body," which is used as a vehicle for the ethereal being within each of us. (Fig. 1.6) This metaphysical part of ourselves is vulnerable unless we use our energies to fortify it. By creating the spirit body, the spirit is strengthened and given a safe means of transportation to and from other realms. The cultivation of this vehicle leads to the ultimate experience of the Tao.

E. Summary

1. Bone Marrow Nei Kung was created to fulfill several functions leading to the rejuvenation of the bone marrow and the enhancement of the blood:

a. Breathing in energy from external sources.
b. Drawing in and circulating sexual energy throughout the body.
c. Vibrating the bones to open their pores for energy absorption.
d.Compressing the combined energies into the bones to eliminate fat.
e.Enhancing the nervous and lymphatic systems while detoxifying the skin.

2. These functions are served by the following practices:

a. Bone Breathing draws in external energy through the fingertips and the toes and circulates it throughout the body.
b. Bone Compression combines external and sexual energies while compressing them into the bones.
c. The Sexual Energy Massage releases Ching Chi upward into the body so that it can be used to regrow the bone marrow.
d. The first Hitting form creates vibrations which open the pores of the bones to absorb external and sexual energies as the body detoxifies.
e. The second Hitting form improves the nervous system and the external aspects of the body as the skin detoxifies.
f. Chi Weight Lifting releases the highest concentration of sexual

energy and hormones as it strengthens the fasciae surrounding the organs.

3. Four practices must be used with Bone Marrow Nei Kung:

a. The Inner Smile and Microcosmic Orbit meditations energize the body and open channels for the circulation of energy to the organs and glands.

b. The Healing Love practice retains sexual energy for healing the internal organs and glands as the brain is stimulated.

c. The Iron Shirt I practice packs Chi into the layers of fasciae surrounding the organs and glands, thereby storing energy for their use.

d. The Six Healing Sounds decelerate the body after practice and release excessive heat from the internal system.

4. Energy known as “Chi” is important because:

a. Chi can regrow the bone marrow and energize the blood.

b. The mind can move Chi to assist the heart and heal the body.

c. Chi pressure creates strength and resilience within the body.

d. Chi can strengthen the immune system, increase one’s sexual and personal power, and enhance one’s spiritual perspectives.

Chapter II
Healthy Bones: Bone Breathing and Bone Compression

There are many health benefits to bone Breathing and Bone Compression. These techniques can be used independently of the other Bone Marrow Nei Kung exercises. They can be practiced anywhere, even while riding on a bus or waiting on line, as long as there are no serious distractions. They help to remove fat from the bone marrow and create space for the marrow to grow, thereby increasing one's ability to produce blood cells. They also relieve tension in the muscles, permitting Chi and blood to circulate freely.

The spinal cord benefits from the energy Bone Breathing draws into it. People with back problems can concentrate on Bone Breathing in and around the spinal cord to relieve discomfort in the area while strengthening the back. Back tension and pain are released from the body as the vertebrae are gently separated and cushioned by the Chi.

The overall results will be a healthier body with increased internal power.

Cosmic energy constantly comes to the earth in the form of extremely fine particles produced as stars evolve through their life cycles. All forms of life on earth, including humans, depend on this energy which is absorbed through breathing and assimilating food.

The use of external energy to fortify the bones is a meditative process which uses long, deep breathing cycles. Bone Breathing draws Chi in through the fingertips, the toes, and all of the protruding bones, spreading it throughout the skeletal structure. (Fig. 2.1) This energy is then compressed into the bones through muscular contractions, forcing Chi into the cavities of the body. Bone Compression thus completes the Bone Breathing process by retaining the accumulated energy.

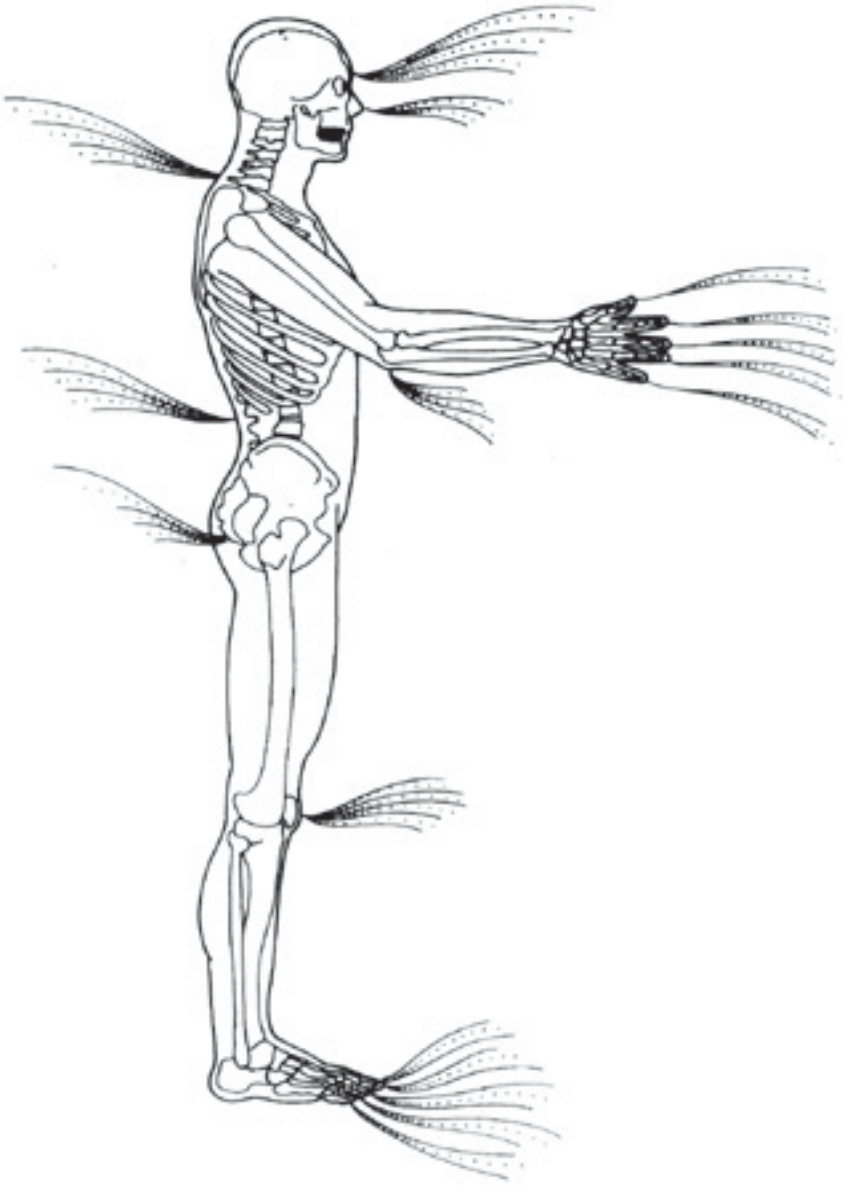

Fig. 2.1 *Energy is most effectively absorbed by the protruding bones of the body.*

A. Benefits of Bone Breathing and Bone Compression

1. Healthy Bones and the Production of Blood

Red blood cells are produced by the long bones of the body such as those found in the shins, thighs and arms. They circulate oxygen and eliminate carbon dioxide. White blood cells are produced by the flat bones such as the pelvis, sternum, scapulae and skull. They are vital to the body's defense system. Both red and white blood cells are produced in the marrow of the bones; which type of cells are produced depends on the type of marrow that predominates.

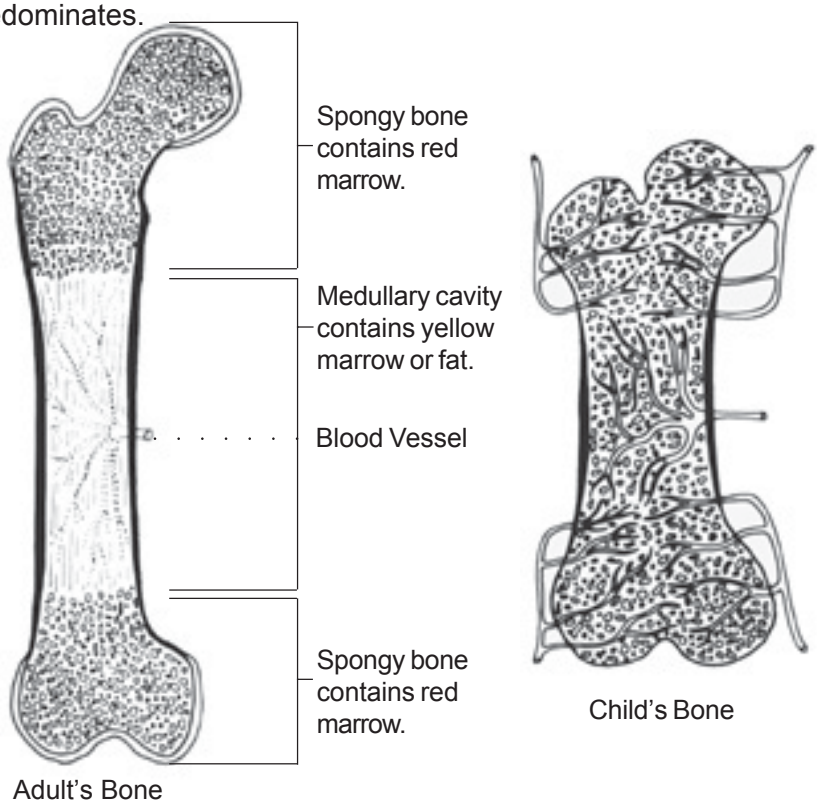

Fig. 2.2 *Bones of child are made up exclusively of red marrow with abundant blood vessels, while adult bones have red marrow at the extremities and a central area containing fat (yellow marrow).*

Healthy bones contain more red marrow, which produces blood cells. Yellow bone marrow also exists, producing fat which accumulates as the body ages. When neglected through lack of exercise, this accumulation can decrease the proportion of red marrow crucial to the production of blood. Although yellow marrow can also produce blood cells, healthy blood production is contingent upon a higher proportion of red marrow in the bones and less fat. For this reason, Bone Marrow Nei Kung practitioners always seek to increase the growth of red marrow while eliminating fat. (Fig. 2.2)

2. Improving the Heart Function

In the advanced practice of Bone Breathing, the process of "Pulsing" can relieve the heart of excessive work while increasing circulation in other parts of the body. Pulsing uses the mind to amplify the pulse in the crown and perineum points. The pulse from these outer regions can then be used to move the Chi, and thereby move the blood. Through this process, the heart uses less force in its pumping action, and there is less need to tap its energy reserves.

You can also feel the pulse from the outer regions and mentally slow it down at the source. Hold either wrist between the thumb and forefinger of the opposite hand to determine the pulse. Then, by mentally decreasing the number of beats per second in the crown and perineum points, you can decrease the rate of the heart's pumping action. Both methods of reducing the heart's work can be applied simultaneously. Simply increase the strength of each beat from the crown and perineum as you slow down the heart rate.

B. Overview of Bone Breathing and Bone Compression

Bones are extremely porous, and they are always "breathing." (Fig. 2.3) The pores allow the passage of oxygen, blood, and nutrition through the bones in the same way a sponge absorbs and releases water. Bone Breathing draws external Chi in through the skin, muscles, and tendons to be combined with sexual energy and compressed into the marrow of the bones through the Bone

Compression practice. This process uses the combined energies to create the heat necessary to bum the fat out of the marrow. (Fig. 2.4)

Fig. 2.3 *Bones are extremely porous and are always "breathing".*

Fig. 2.4 *Prolonged Bone Marrow Nei Kung practice helps to clear the fat from the bones, nurturing the regrowth of the red marrow.*

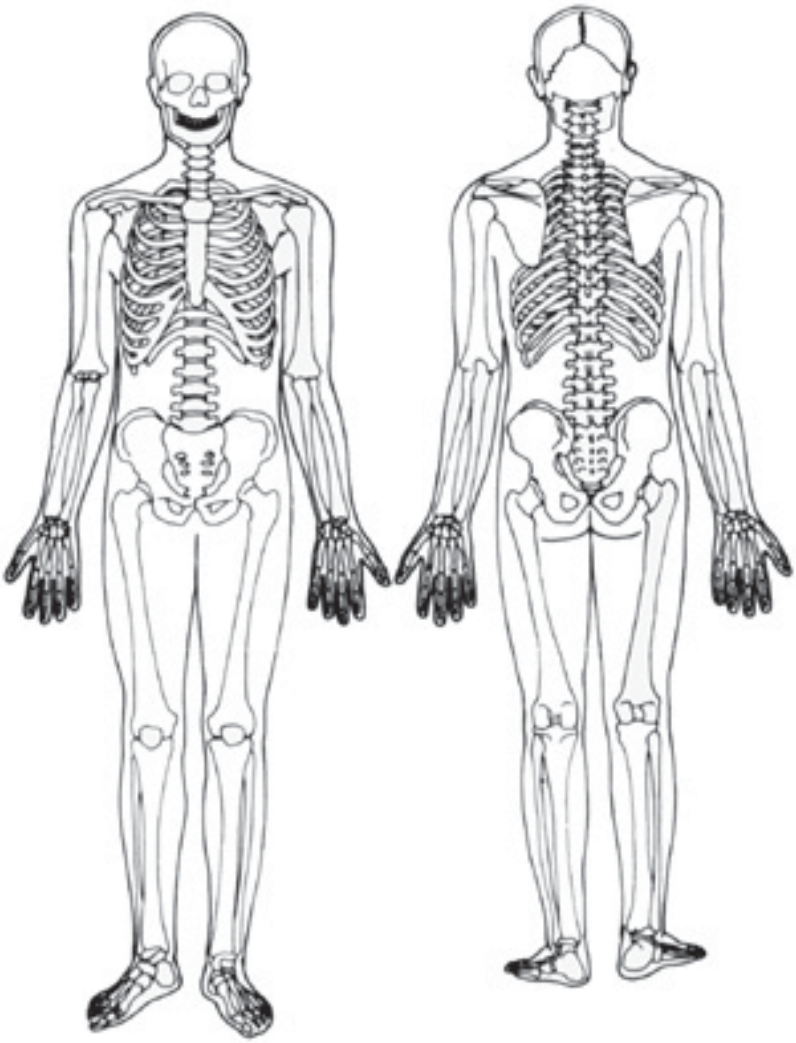

Fig. 2.5 *Skeletal Structure*

1. Bone Breathing

Look closely at the skeletal structure illustrated in Fig. 2.5. Prepare to draw in external Chi through the tips of your fingers and toes as you breathe in and out through them. (Fig. 2.6) Energy can be drawn

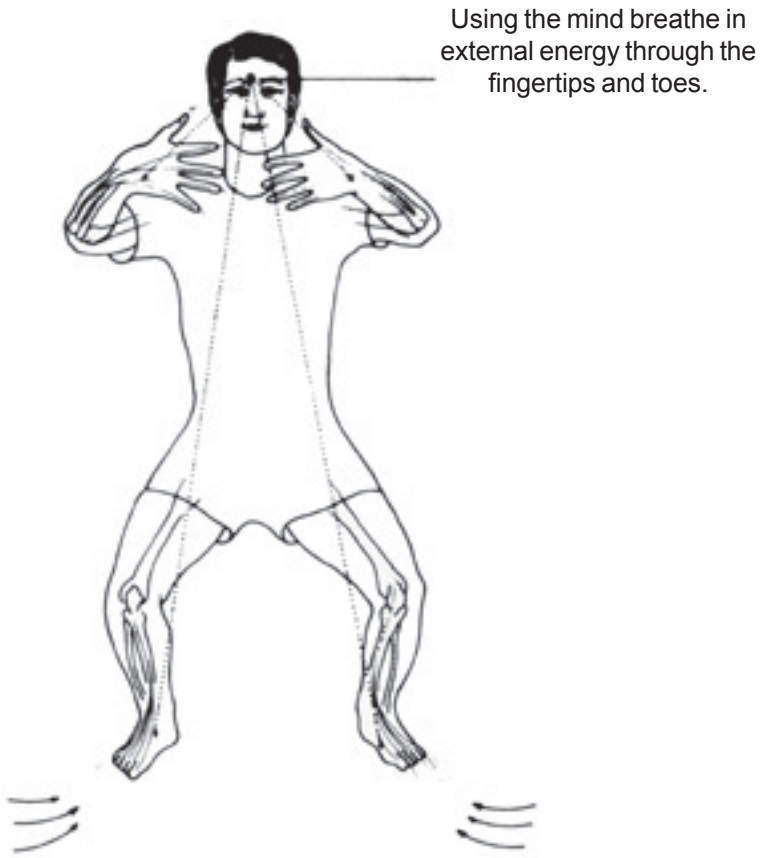

Fig. 2.6 *Bone Breathing*

in through the hands and feet by fostering a sense of coolness in them. This imagined cold will actually attract warm external energies. When you inhale through the fingers, the feeling is usually cool. When you exhale, the feeling is warm. Once you have established the feeling of the energy in your fingers, use your mind to guide the Chi upward into the limbs and the body as you inhale.

Each time you exhale and release the Chi, you can draw it back further into each limb with more force like a battering ram. This opens the channels of the arms and legs so that more energy can be drawn into the body. By the time the energy passes beyond your elbows and knees, however, you may not feel that you can expel the energy as your limbs may seem longer than your breath cycles. A physical feeling will indicate that the energy is being retained.

Note: These techniques should initially be practiced from a seated position until you are able to draw the energy while standing in the "Embracing the Tree" posture. (See Appendix 1.) If possible, try to keep your feet bare since shoes and socks impede the drawing of energy through the lower limbs.

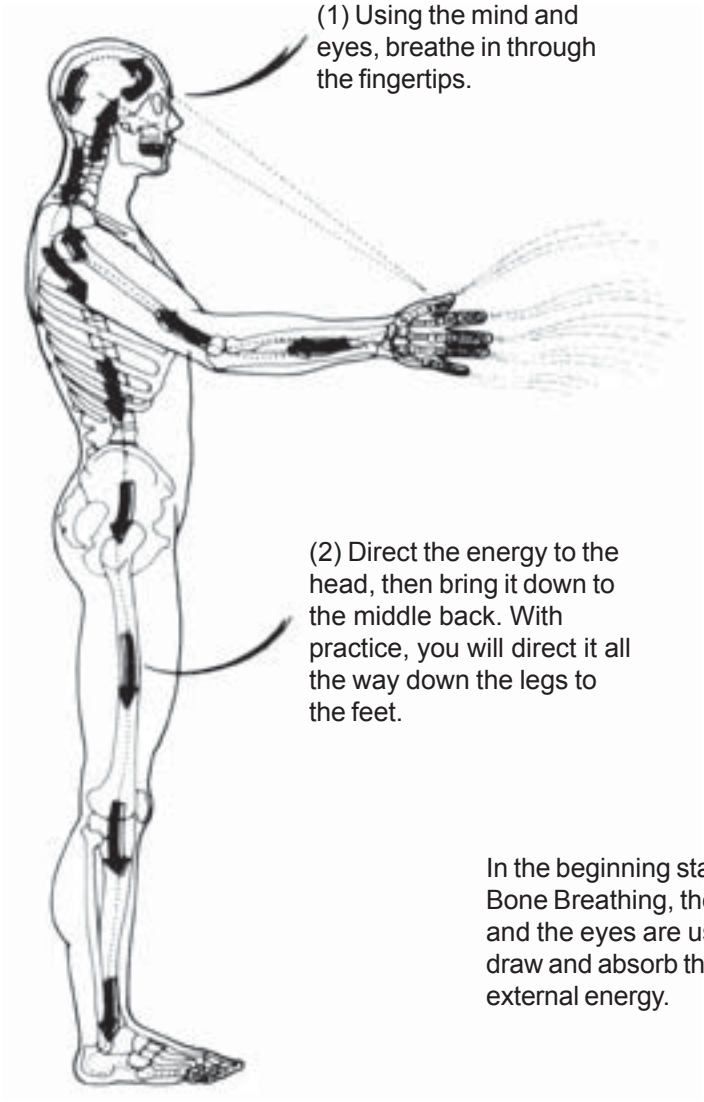

Fig. 2.7 *Stage One: Respiration through the Fingers*

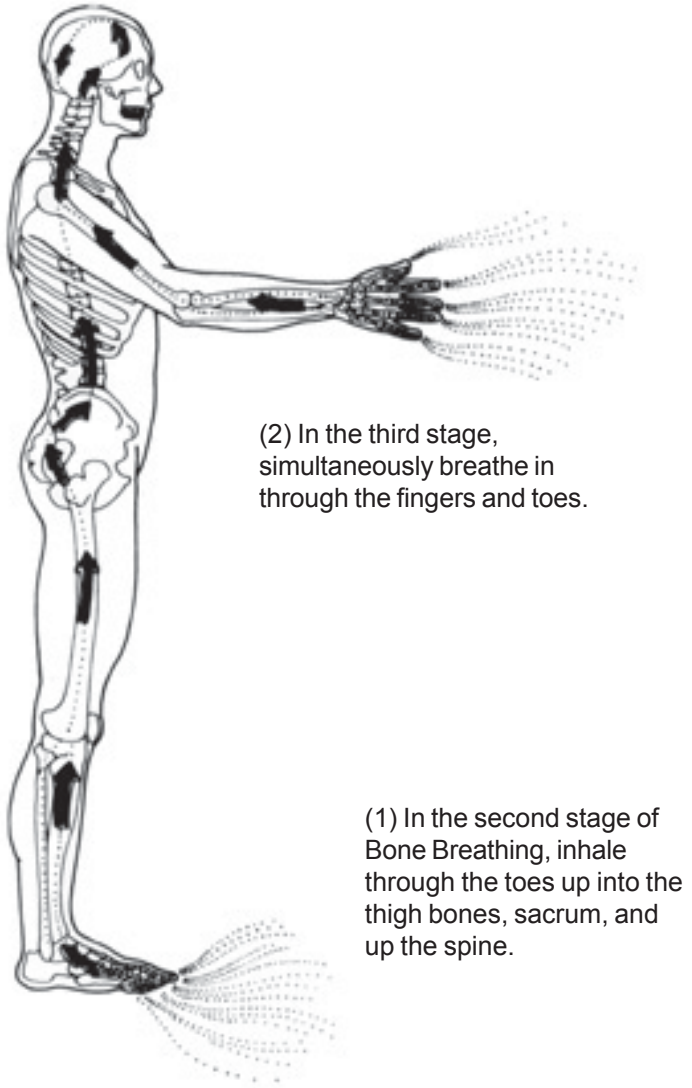

Fig. 2.8 *Stage Two and Three: Respiration through the Toes and simultaneous practices.*

a. Respiration through the Fingers: In the first stage of Bone Breathing, use lower abdominal breathing to draw energy in through the fingertips. Then gradually move the Chi up through the hands, arms, shoulders and scapulae, up to the skull, and then back down the spinal column to the middle back. (Fig. 2.7) Mentally create a cool feeling in the hands to attract the warm external Chi. Briefly

hold each breath before releasing the Chi as you exhale. Draw the energy in further with each new breath as you continue to open the pathways for its travel.

b. Respiration through the Toes: When your feet feel cool, inhale through the toes, and then by degrees into the thigh bones, hips, and sacrum. Most people feel the breathing sensation very powerfully in their legs. Each time you inhale, hold your breath--but not so long that you experience discomfort. Then, exhale down and out through the legs and toes. You may feel the energy surge from the sacrum up the back and circulate throughout the nervous system as you breathe up the spine. (Fig. 2.8)

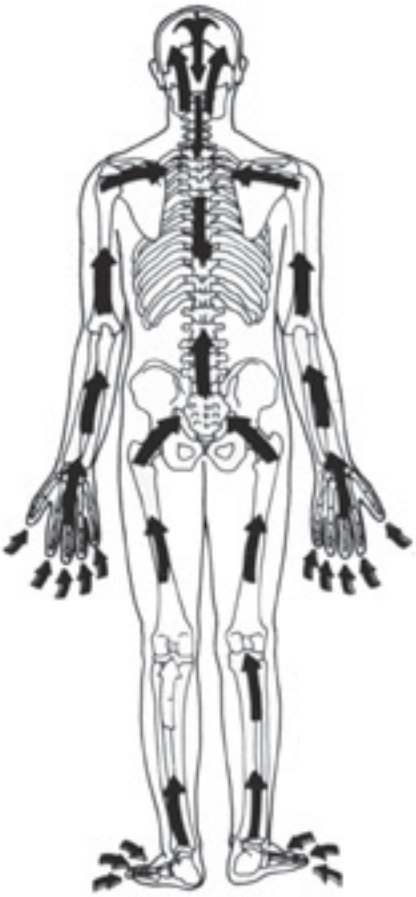

Fig. 2.9 *In the Third Stage of Bone Breathing: Energy is breathed in through the fingertips and toes, gradually moving up and connecting at the spine.*

c. Simultaneous practice: Eventually, practice both of the previous stages together. With experience, there will be no need to work the arms and the legs separately. Breathe up through the toes, the legs, and up the spine in one direction as you simultaneously breathe in through the fingers, into the arms, the shoulders and scapulae, up to the head, and return down the spine from the opposite direction. (Fig. 2.9)

d. The energy connects the upper and lower halves of the body near the middle of the spine. The combined energies then travel back up the spine to your skull. The Chi spirals through the facial bones and returns down the spine to the point at which the two sources connect.

e. After the Chi from both sources has returned to the upper spine, the energy will spread out through the rib cage and recombine at the sternum. The Chi travels from the back of the rib cage to the front. The sternum is filled with the spiraling Chi from all twelve ribs simultaneously.

2. Bone Compression

There are three steps to Bone Compression: The first is to inhale the Chi in a spiraling motion, drawing it in through the fingers and toes to surround the bones of the arms, legs, and body. The second step is to pack the Chi in between the muscles and bones. The third step squeezes the muscles, thereby compressing the Chi into the marrow through the pores of the bones. The sequence of steps is: inhale, spiral, pack, and squeeze Chi into each part of the limbs and body successively. (Fig. 2.10) (The first two steps are actually a single process.)

***Note*:** Unlike the early stages of Bone Breathing, Chi is not expelled upon exhalation during Bone Compression. As you spiral the energy inward, concentrate on those parts of the body that have received the inhaled Chi. It will remain at those points until you are ready to compress it into the skeletal structure.

a. In the first stage of Bone Compression, inhale Chi into each part of the skeletal system in a manner similar to Bone Breathing, but spiral the energy as you draw it in. Do not release it. As you use your mind to draw in the external Chi through your arms and legs, envision it travelling through each limb in a spiraling motion, circling

clockwise through your right arm and leg, and counterclockwise through your left arm and leg. Spiraling helps to combine the external and sexual energies, while allowing the Chi to cover more internal space.

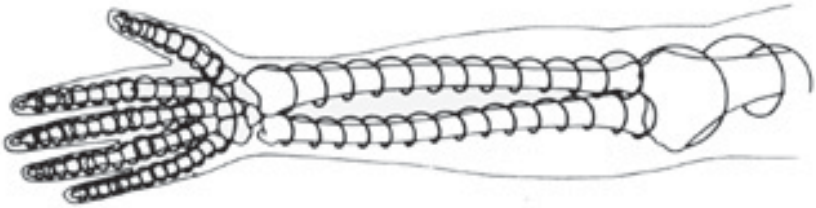

(1) Spiraling the energy.

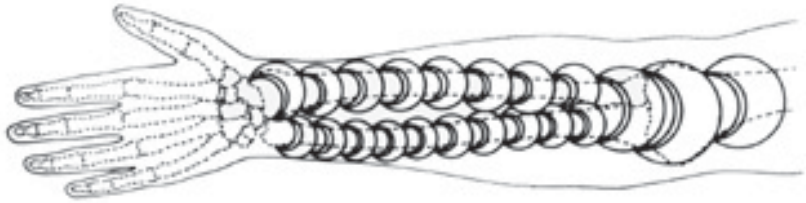

(2) Packing around the bones.

(3) Squeezing the energy into the bones.

Fig. 2.10 *Spiral, Pack, Squeeze*

b. While spiraling helps to bring Chi into more internal areas, packing condenses it into less space. This step creates more room for the energy in every part of the limbs and body before it is compressed into the bones. Once the heart rate is audible to your "inner ear," you may amplify the pulse at the crown, the perineum, the hands, and the feet, maintaining it throughout each compression in order to decrease the work of the heart.

c. Squeeze the muscles of each hand and forearm individually after you have inhaled, spiralled, and packed Chi into them. (Fig. 2.11) When you are familiar with the way it feels, work both hands

at the same time. Hold your breath for a comfortable period of time as you maintain each squeeze. This helps to compress Chi into the pores of the bones. Relax your muscles as you exhale.

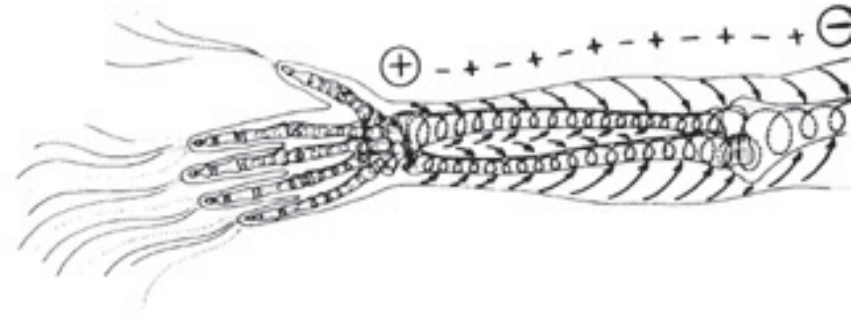

Fig. 2.11 *By inhaling through the fingertips, packing, spiraling, and squeezing energy into the bones, an electrical impulse is created.*

The resting period is extremely important. You will feel the most profound sensation of Chi at this time. Absorption during rest periods is a continuation of the compression process, using mind control instead of muscular contraction. When you release your hold, use the mind to relax the muscles and to absorb more energy into the bone marrow. The muscles and tendons should feel like cotton wrapped around your bones.

Note**:** Eventually, Bone Compression can be practiced upon all of the body simultaneously.

C. Bone Breathing Process Step By Step

Note**:** The following is a detailed analysis intended for reference. Upon becoming familiar with Bone Marrow Nei Kung, students may use the summary at the end of each chapter as a practice guide.

1. Preparations

You should be certain that the Microcosmic Orbit is clear of any blockages before starting. Regulate your breathing, then circulate your energy through the Microcosmic Orbit for several cycles. (You

may wish to do this from the Iron Shirt posture so that your body will feel like an integrated unit.)

Look at the illustration of the human skeleton. (Fig. 2.12) Notice the size, shape, and placement of the bones. Then, one arm at a time, trace your way up from the fingertips, through the bones of the hand and wrist, the radius and ulna of the forearm, the humerus of the upper arm, the collar bone (clavicle) in front, and the shoulder blade in back. Trace the legs in the same manner. This illustration should help as a guide for the energy flow in your practice.

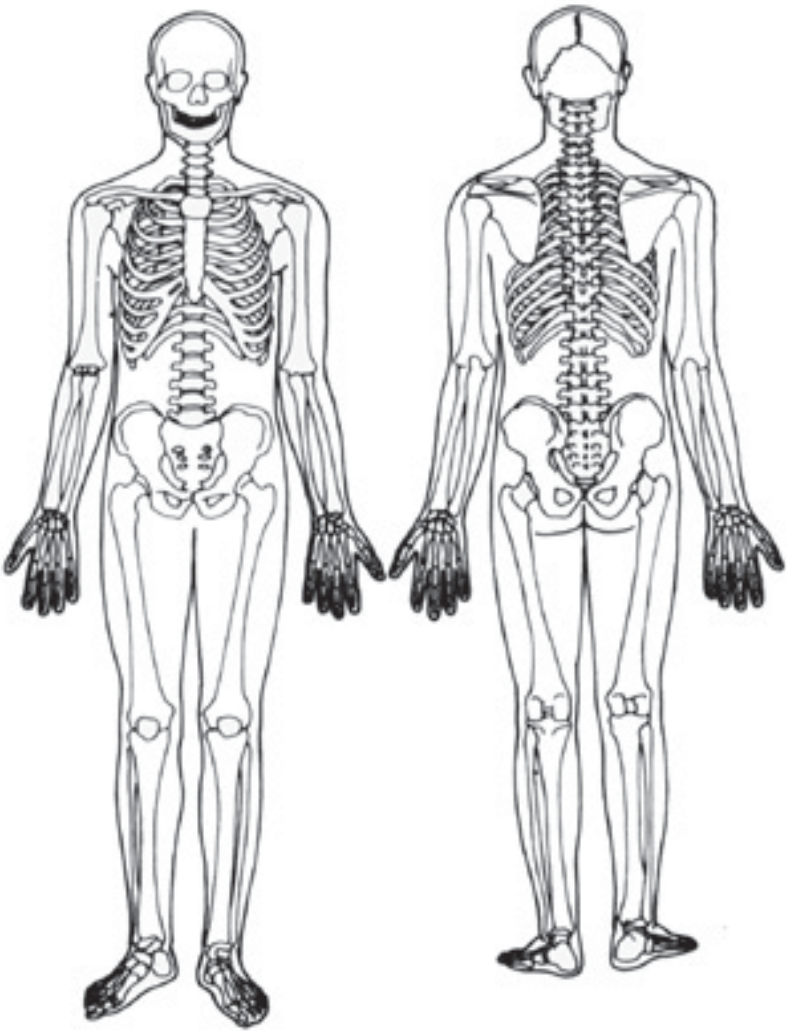

Fig. 2.12 *Observe the skeletal structure.*

Initiate Bone Breathing with the fingers of one hand until you feel energy, moving in and out of that hand. Continue breathing up into each section of the arm. Begin your practice with the fingers of the right hand if you are right handed, or with the left hand if you are left handed. Practice using the fingers of the opposite hand, and then both hands together, moving up both arms, and so on. Similarly, practice on the right (or left) toes, and then the toes of the opposite foot, and then continue up the legs.

Fig. 2.13 *Sink the elbows, face the palms down, and relax the fingers. Gently pull up the sexual organ and the anus.*

Some people find it useful to extend the hand they intend to breathe into, palm down, pointing outward horizontally, at chest level. (Fig. 2.13) This aids in concentrating on the fingers of that hand. Between each step, rest for as long as you feel the need to do so. Place your hands on your legs, palms up, and close your eyes during each testing period.

2. Initiating Bone Breathing: Breathing through the Fingers

With your hand raised gently pull up the sexual organs and anus with each breath. Draw the energy in as you inhale; push the energy out as you exhale. As you inhale, sink the elbow down, and draw the energy in. Then exhale, extend your hand out slightly from the rising elbow and release the energy. As you watch with your mind's eye, see the fingers beginning to breathe. Breathe through your nose in long, deep, but gentle cycles.

a. Start with the Index Finger

The bones in the tips of the fingers are pointed and can draw in energy. Begin the Bone Breathing process from the index finger, which offers the most sensation of the energy entering and leaving. (Fig. 2.14) Bend and sink the elbow while holding the, lower arm up. Relax the wrist, hands, and fingers.

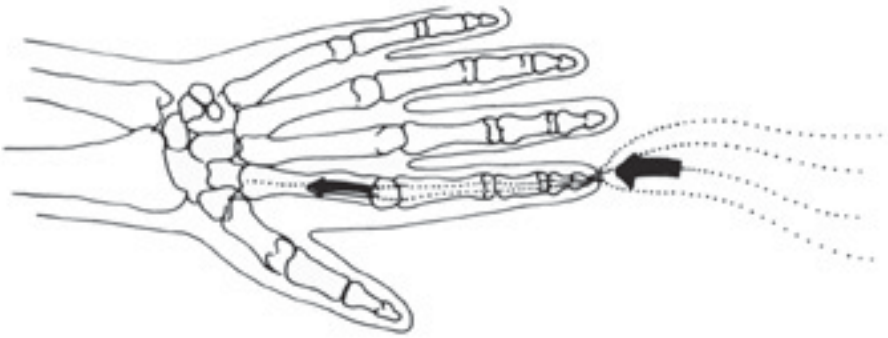

Fig. 2.14 *Begin Bone Breathing through the index finger.*

Note: If it helps you to become more aware of your index finger, press its tip with a fingernail from the other hand until you feel a sharp pain indicating the bone.

b. Draw warm energy into the cool fingertip.

Sense a cold feeling in the tip of your index finger. Sink your elbow, and slowly pull in the entire hand--finger extended--with a long, gentle breath. Be aware of the energy as it enters into the tip of that finger only.

c. Release the energy with the breath.

Exhale, permitting the elbow to rise slightly as you slowly extend the hand. Feel the sensation of the energy leaving the extended finger.

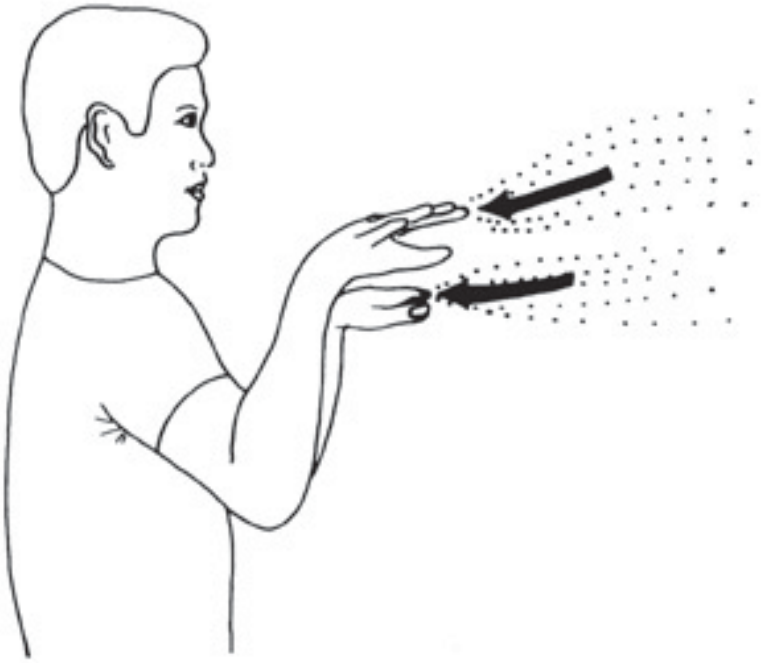

Fig. 2.15 *Draw the energy simultaneously into all the fingers of both hands.*

d. Breathe into the Fingers individually.

Next, breathe into the second, third, and fourth fingers, and finally the thumb. These need not be done individually every time you practice. This is intended only to help you to isolate the feeling of energy by concentrating on one small area at a time.

Eventually all fingers will be used to draw energy simultaneously into both hands. (Fig. 2.15) The finger bones do not have much fat; hence, there is little resistance to the energy. Once you bring the energy past the finger bones into the ulna and radius bones of the arm, you will encounter more fat; therefore, breathing into them may require more practice. Now compare the fingers of the hand that have experienced Bone Breathing with the fingers of the hand that you have not yet worked on. You should notice a difference.

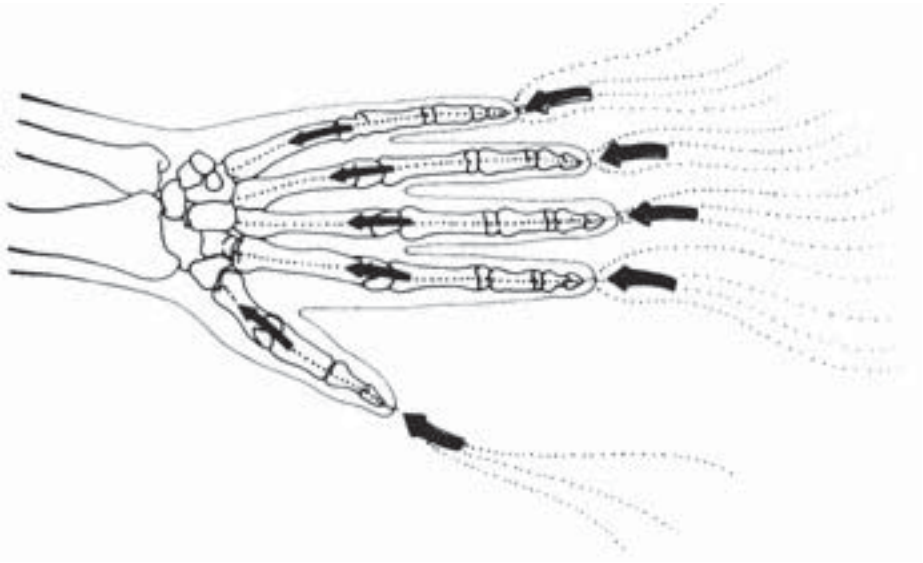

Fig. 2.16 *Breathe into the entire hand at once, and visualize all the bones.*

3. Breathing into the Entire Hand

At this point you should be able to inhale through all of your fingertips, filling the knuckles with Chi. Pull up slightly on the sexual organs as you draw energy in through your fingers. Then inhale,

and hold for a while, feeling the energy as an increasing fullness, or swelling, in all fingers. Exhale, and rest. Now breathe into your entire hand, visualizing all the bones you observed in the illustration of the skeleton. (Fig. 2.16) Then exhale, releasing the energy. From this point on you will always breathe into the whole hand when you begin the exercise.

Note**:** Use the Bone Breathing illustrations as reference guides Although your objective is to learn how to feel the shape and size of each bone, the beginning stages often require more visualization.

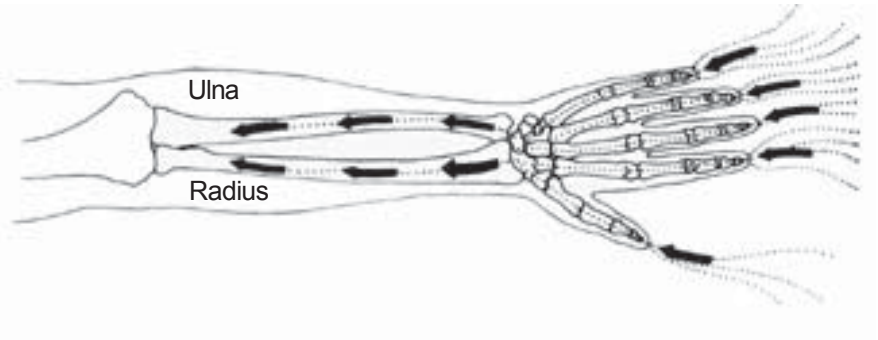

Fig. 2.17 *Breathe into the ulna and radius bones of the forearm.*

4. Forearm and the Ulna and Radius Bones

This time send the Chi up through your hand to the wrist, and into the many small bones there. Inhale as you pull the energy up from the fingertips through the hand all the way to the ulna and radius bones of the forearm. (Fig. 2.17) Hold each breath and feel the ulna and radius start to expand. Allow your eyes to close. Exhale, releasing the energy. Continue to breathe in and out of these bones several times in the same way. Exhale, and rest. Now practice breathing into the fingertips of the opposite hand, then the hand itself, and finally, into the forearm.

5. Breathing into the Upper Arm and the Humerus Bone

By now you have a good idea of the Bone Breathing process, and you should be able to expand it to the upper arm. Now you can

breathe into the humerus bones of both arms simultaneously. Inhale, relax the fingers, draw energy into the bones, sink the shoulders and the humeri. Breathe through the fingers, hands and forearms into the humeri. (Fig. 2.18) Exhale and continue breathing into and out of the bones. Drop the elbows and shoulders and breathe in through the arms to the humeri again. Exhale, regulate the breath, and rest.

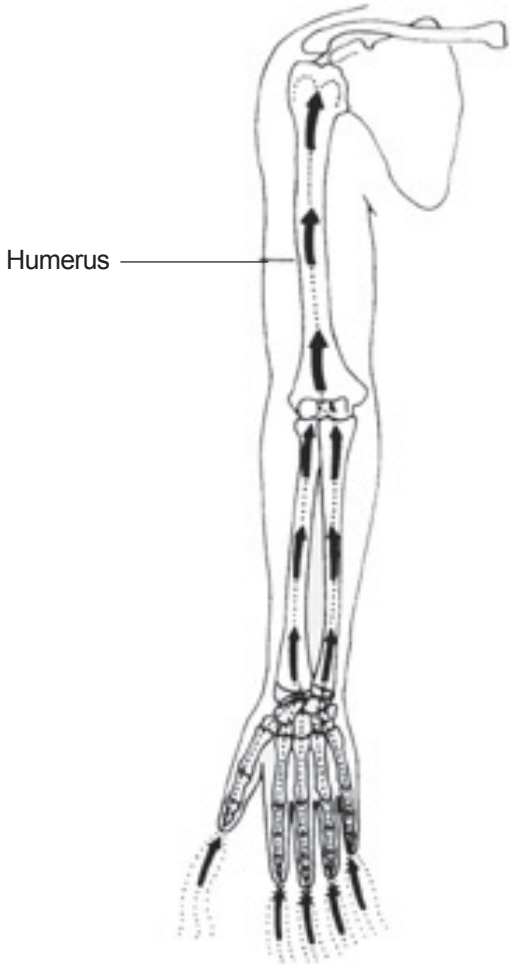

Fig. 2.18 *Breathe into humerus bone of the upper arm.*

6. Scapulae, C-7 Point of the Neck and the Head

Begin the exercise again. With eyes closed, breathe energy into the bones through the hands, arms, and humeri. Be certain to maintain dropped elbows and shoulders. Exhale, and then inhale again to draw energy up to both scapulae (shoulder blades) and to the C-7 point on the neck. Hold the energy there, continue breathing in and out, and then rest. Again draw the energy through the fingertips, hands, arms, humeri, scapulae, C-7, and continue to bring it all the way up into the head. Hold it there at the base of the skull. (Fig. 2.19) Exhale, regulate your breathing, and rest.

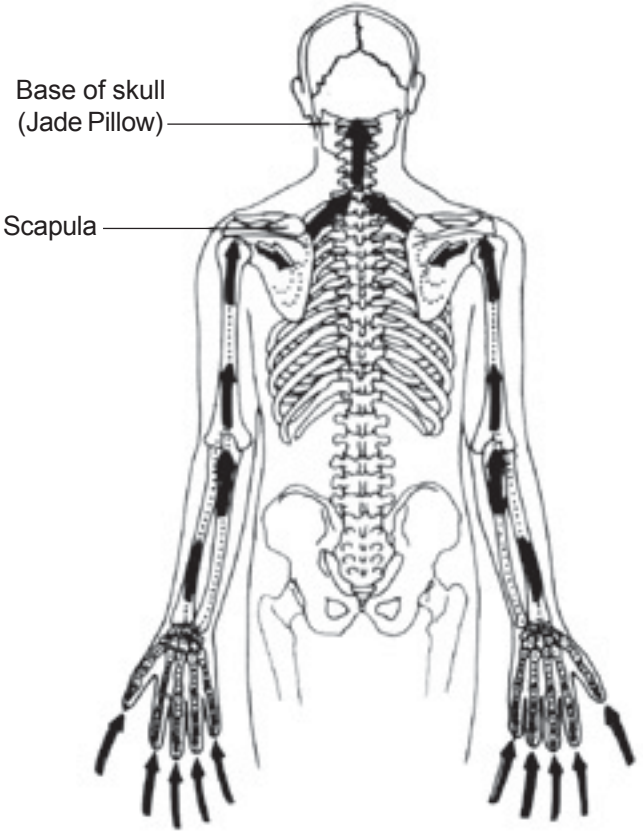

Fig. 2.19 *Breathe into the scapulae and the base of the skull.*

Note**:** If for some reason you should stop at this point, do not leave the energy in the head. Press the tongue up to the roof of the mouth, and bring the energy down to the navel. When you are ready to combine the procedures for the arms and legs, you will not draw the Chi directly to the skull from the arms. You will first combine the energy from the two sources at the center of the spine, and then move it upwards into the skull.

7. Breathing into the Toes

Breathe into the toes one at a time. Start with the big toe of either foot, then move to the second, third, fourth and fifth toes. Finally inhale as you draw energy into all five toes simultaneously, then exhale, allowing it to be released. (Fig. 2.20) Breathe in this manner for a minute or two, then inhale strongly, drawing the energy in more forcefully--like a battering ram--to open the channels of the foot.

Fig. 2.20 *Inhale, and draw the energy through all the toes.*

Note: Do not pull your feet up with the breath. Let them remain fiat on the floor. Remember that keeping your feet bare is the best way to absorb energy into your legs. Wearing synthetic materials on your feet will impede this process.

8. Breathing into the Feet

Inhale, and draw energy through all of the toes into the entire foot. (Fig. 2.21) Exhale, and release the energy Continue breathing energy in and out. Then begin breathing through the toes of the opposite foot, in the same manner described above, until you can breathe into that entire foot.

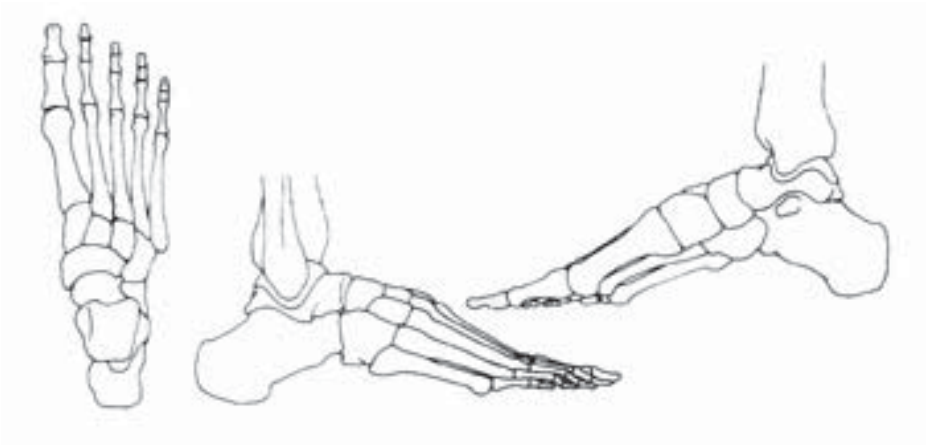

Fig. 2.21 *Bones of the feet and ankles.*

Concentrating on both feet, inhale, and bring the energy up into both feet simultaneously. Feel breath enter through all of the bones, hold it for a while, and then let the energy flow out. Inhale the energy again, close your eyes, and feel all of the bones of both feet, up to and including the small ankle bones, as they become more alive with each breath. Return to regulated breathing, ending with an exhalation, and then rest.

9. Tibia and Fibula Bones of the Lower Legs

With your eyes closed, draw energy into the tibia and fibula bones

of both lower legs. (Fig. 2.22) Hold it for a while, then release your breath and the energy. Inhale, and pull the energy up through the lower legs with more force. Exhale, and release it. Continue to breathe in and out of these bones, drawing in more energy with each breath while preparing to travel further into the upper legs.

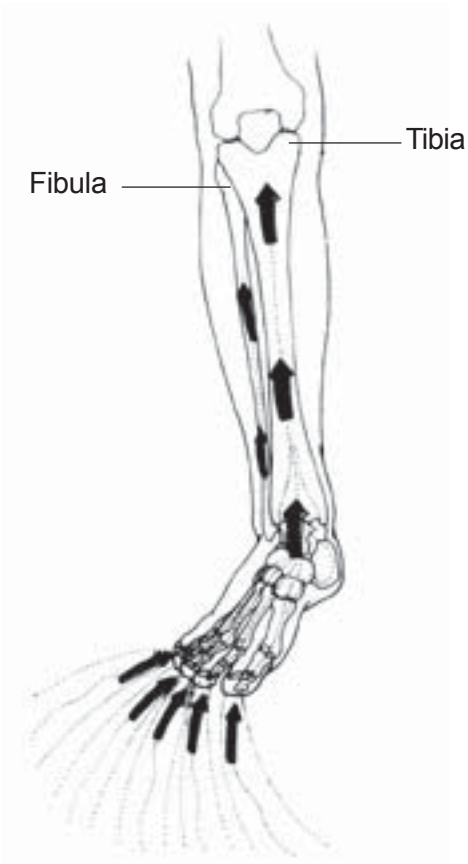

Fig. 2.22 *Bones of the feet and ankles.*

10. Thigh Bones, Hips, and Sacrum

Inhale from the tips of the toes all the way through the feet, ankles, tibia, and fibula bones of both legs, and draw energy up to each leg's femur or thigh bone. Hold your breath and the energy there, and then exhale. If you cannot feel the connection between the thigh bones and the hips, look at the illustration to avoid any

confusion. Also note how the hip bones connect to the sacrum. Breathe up the entire length of both legs into the hip bones and into the sacrum. (Fig. 2.23) Exhale, and rest.

Fig. 2.23 *Inhale, and draw the energy all the way into the sacrum.*

11. Breathing into the Hands and Feet Together

In the next step of Bone Breathing, breathe into both hands and feet simultaneously. Inhale all the way up to the shoulders and scapulae through the arms, and up to the thigh and hip bones through the legs, Hold your breath, then exhale. With practice you will learn to divide your concentration between the absorption points of the feet and hands. Combine the energy at the middle of the spine. (Fig. 2.24)

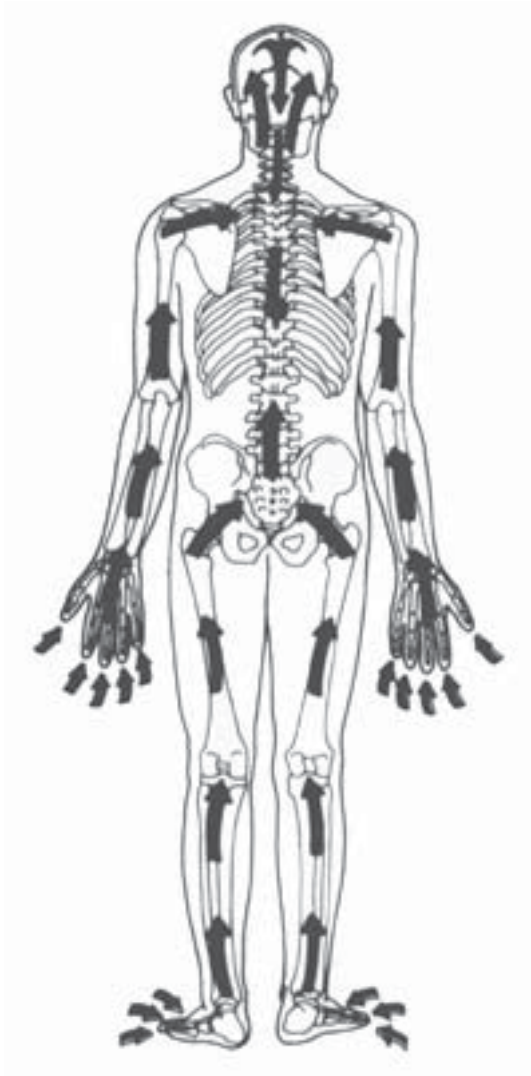

Fig. 2.24 *Breathe in through the hands and feet simultaneously, and combine the energy at the middle of the spine.*

12. Breathing into the Sacrum and Spine

You may wish to stand during this step of the exercise. This will help energy travel up the spine. The “Embracing the Tree” posture of Iron Shirt I is useful here. The next point to breathe into from the legs is the plate-like structure at the base of the spine referred to as the sacrum. Feel the sacrum with your fingertips. As you breathe

in again up through the legs and hip bones, draw the energy from the legs together at the sacrum point.

When energy reaches this point it may take off on its own, travelling the length of the spine. If the energy does not travel up the spine spontaneously, continue to breathe up the back until the spine receives energy from the sacrum. Then include the breathed-in Chi from the length of the arms. The two energies of the arms and legs should meet beneath the shoulder blades on the spine at T-11. Combine the two energies, sending them to the shoulders, to C-7, and into the head. (Fig. 2.25)

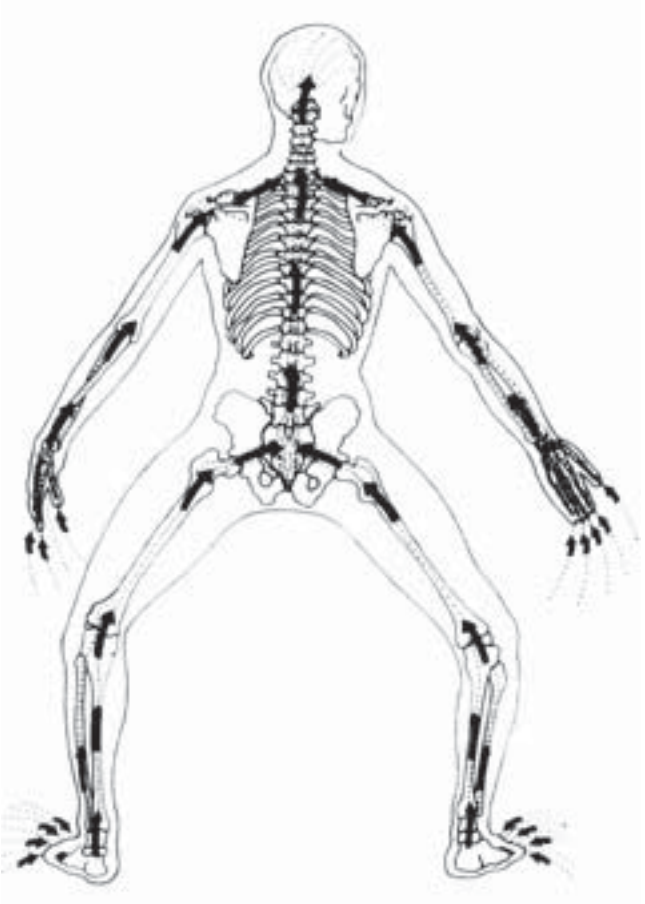

Fig. 2.25 *Breathing into the sacrum and spine.*

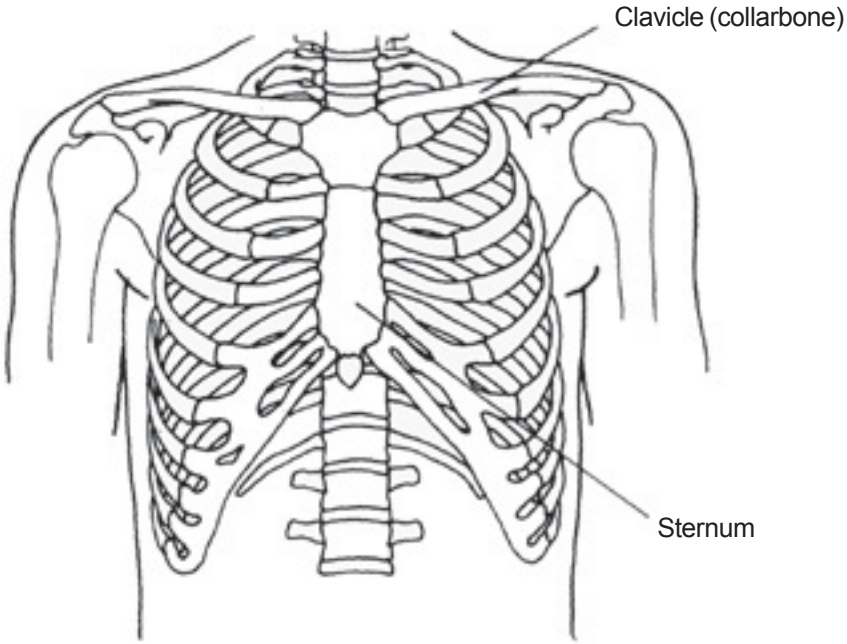

(a) *Clavicle, Sternum, and Rib Cage.*

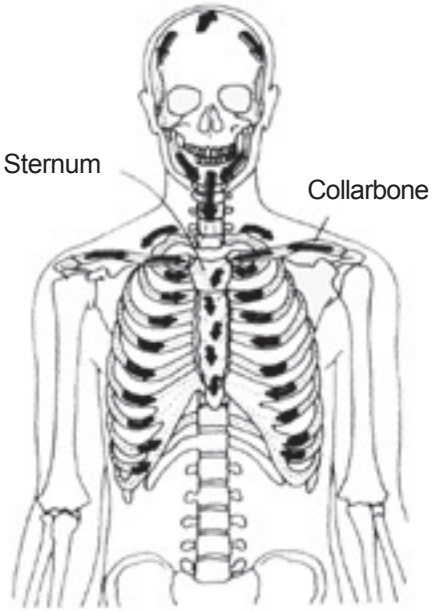

(b) *Breathing into the Collarbone, Sternum, and Ribs*

Fig. 2.26 *Bone Breathing in the Chest*

13. Breathing into the Collarbone, Sternum and Ribs

Locate the collarbone at the front of the body and the sternum, or breastbone, at the middle of the chest where the ribs are attached. (Fig. 2-26(a)) Feel the way the ribs arch away from the sternum in the front and connect to the spine in the back. These are difficult structures to breathe Chi into requiring your utmost concentration.

The combined Chi from the legs and the arms is first breathed into the cranial area before it is sent back down the spinal cord to the point at which the ribs extend. Spiral Chi throughout the head and facial bones. From there, bring it into the spine and collarbone, spreading energy throughout the ribs, finally reaching the sternum. (Fig. 2.26(b))

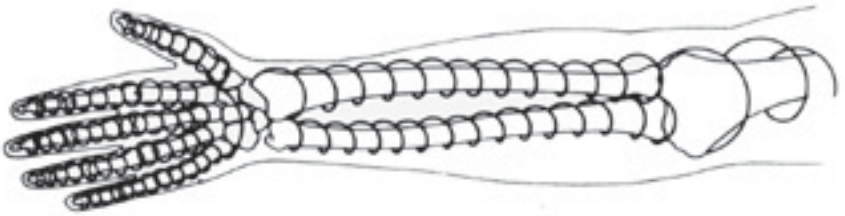

(1) Spiraling the energy.

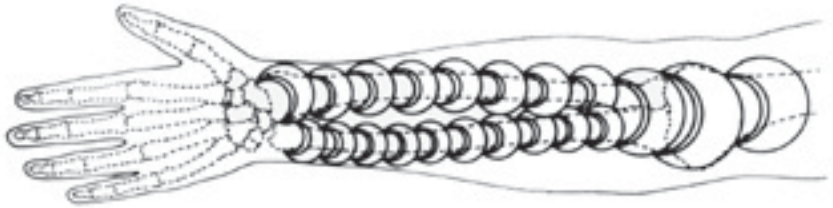

(2) Packing around the bones.

(3) Squeezing the energy into the bones.

Fig. 2.27 *Bone Breathing in the Arm*

D. Bone Compression Process Step By Step

The sequence used in Bone Breathing is also used in Bone Compression. The circulation of the energy differs, however, in that it spirals around the bones while rising into each limb. Then, as it accumulates, the energy is packed tightly and compressed into the bones. Refer to Fig. 2.27(b) for an illustration of what spiraling might look like to your inner eye. Fig. 2.27(b) and (c) demonstrate the difference between packing and squeezing: One process pulls Chi between the muscles and bones: the other compresses it into the bones. As stated earlier, packing is a mental process, while squeezing is a physical process.

1. One Hand and Forearm

Practice with either hand alone first, inhaling into your fingers, wrist, and then the ulna and radius hones, holding the intake from each breath. Use your inner eye to spiral energy around these bones as Chi rises into each successive limb. Visualize a clockwise spiraling motion rising in the right arm, or a counterclockwise spiraling motion if you are using the left arm.

After spiraling, inhale again, and pack the energy, mentally condensing it as it accumulates. Pull up the sexual organs and the anus as you pack energy in between the muscles and bones. Continue this process until the hand and forearm begin to feel swollen. Then, using hard muscular contractions, squeeze Chi into the bones, feeling its heat in the marrow. Apply a little more tension to reach the deeper areas of your bone structure. Hold it, exhale, and release. It is not necessary to hold each breath to the point of discomfort.

2. Right and Left Hands together

When you become familiar with the way this compression feels, work with both hands at the same time. After packing, hold each muscular contraction along with your breath in a long squeeze, and then release it. When you release your hold, use your mind to absorb energy into the bones. The bones, muscles and tendons

should begin to feel as though they are wrapped in cotton. Always concentrate on feeling energy penetrate into the bone.

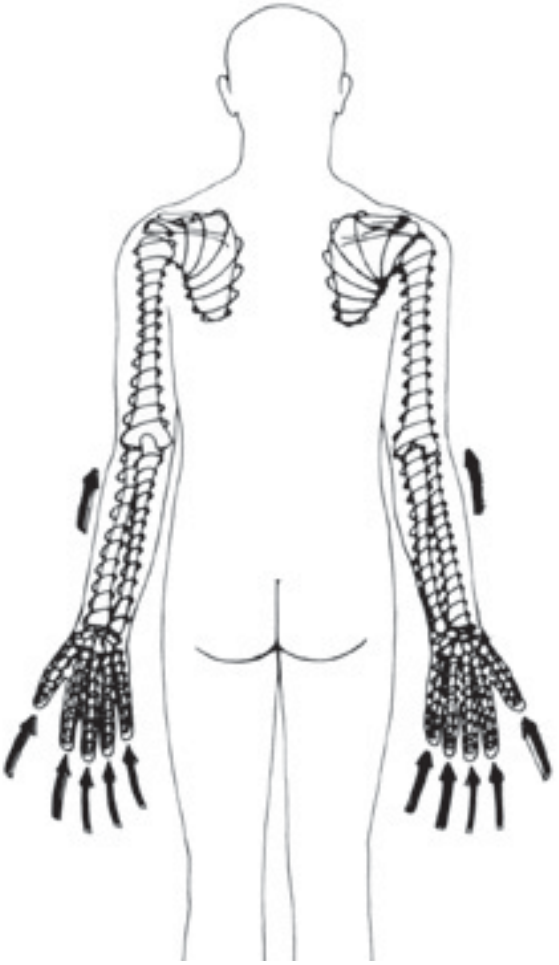

Fig. 2.28 *Spiral both hands and forearms together, and squeeze the muscles.*

3. Both Arms Together

Now practice spiraling both hands and forearms together. Pull up the sexual organs and anus. Inhale, spiral, pack and squeeze the muscles of the lower arms repeatedly with each breath. (Fig. 2.28)

Exhale, and release. As you release the muscles, the Chi will not dissipate because its density is increased by packing until it can no longer escape through the skin. Next, inhale, spiral, pack and squeeze Chi into both humeri, continuing the process into the shoulders and scapulae. Exhale, and release.

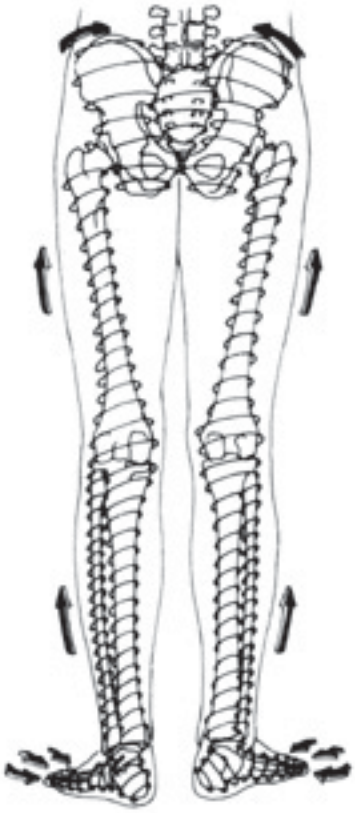

Fig. 2.29 *Bring the energy up both legs, spiraling into the sacrum.*

4. Legs

Next inhale into both legs all the way up to the sacrum. (Fig. 2.29) Hold the energy in the bones. Continue to inhale, spiral, and pack. Then inhale again, squeeze, hold the tension, and release. It is important to be aware of your mind controlling your muscles. Inhale energy and squeeze your muscles to the bones again, proceeding

from the lower to the upper parts of the legs. Exhale, and rest. Use your mind to relax the muscles. Finish by shaking your legs.

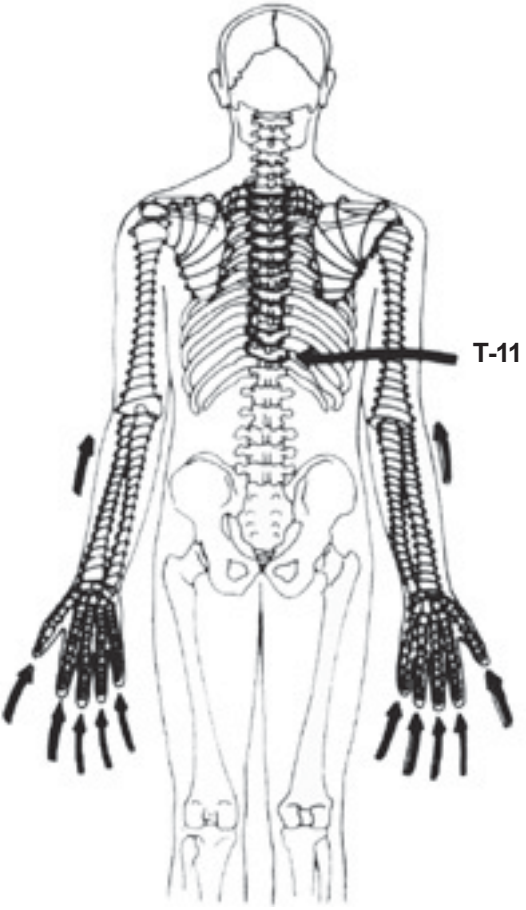

Fig. 2.30 *Bring the energy through the arms to the shoulder blades, and down the spine to T-11.*

5. Lumbar Region of the Spine

You may wish to use the "Embracing the Tree" posture to assist in drawing energy up into the sacrum, although it can also be done while seated erect. Again, inhale, spiral, pack and squeeze the energy successively from the legs to the lower region of the spine. As you pack and squeeze Chi into the sacrum, the Sacral Pump is

activated, which helps the upward flow of energy to the higher centers.

Inhale, and spiral energy from the legs, through the sacrum, and up the spine to the first lumbar. Hold the energy. Inhale again, and pack from the lower part of the leg and up so that the entire lower region feels the compression. Pack into the sacrum and the spine, then squeeze the Chi into the bones by contracting the muscles of the legs, hips, buttocks and lower back. Hold the contraction with your breath, then release it as you exhale.

6. Spine through the Collarbone and Scapulae

Inhale, spiraling energy upward from your fingertips successively through the hands, ulnae, radii, humeri, shoulders, and into the scapulae and collarbone. Continue to pack from the scapulae into the spine down to T-11. (Fig. 2.30) Squeeze the muscles surrounding the hands, arms, scapulae and spine, thereby compressing Chi into the bones of the upper region. Exhale, and rest. It is approximately at T-11 on the spine that the energy from the upper region combines with that of the lower region.

7. Cranial Bones and the Cranial Pump

From the T-11 point inhale and spiral the combined energies further up the spine, through the cervical hones in the neck, and up into the head. (Fig. 2.31) When you reach the head, spiral throughout the entire cranial area, pressing your tongue to your palate. (Fig. 2.32(a)) Clench your teeth and squeeze Chi into the cranial bones. This increases the activity of the Cranial Pump, which is similar to the Sacral Pump. (Fig. 2.32(b)) Both of these pumps move tremendous amounts of energy into the spine.

8. Rib Cage and Sternum

Energizing the rib cage and sternum can be problematic since the rib cage is not directly in the path of energy drawn in from either hands or feet. Success here depends on how well you have thus far managed to spiral Chi throughout the spine. When you return the combined flow of Chi from the cranium down through the spine

to where the lower ribs expand outward, spiral the Chi through all twelve ribs simultaneously from their connection at the spine to the sternum in front. (Fig. 2.33)

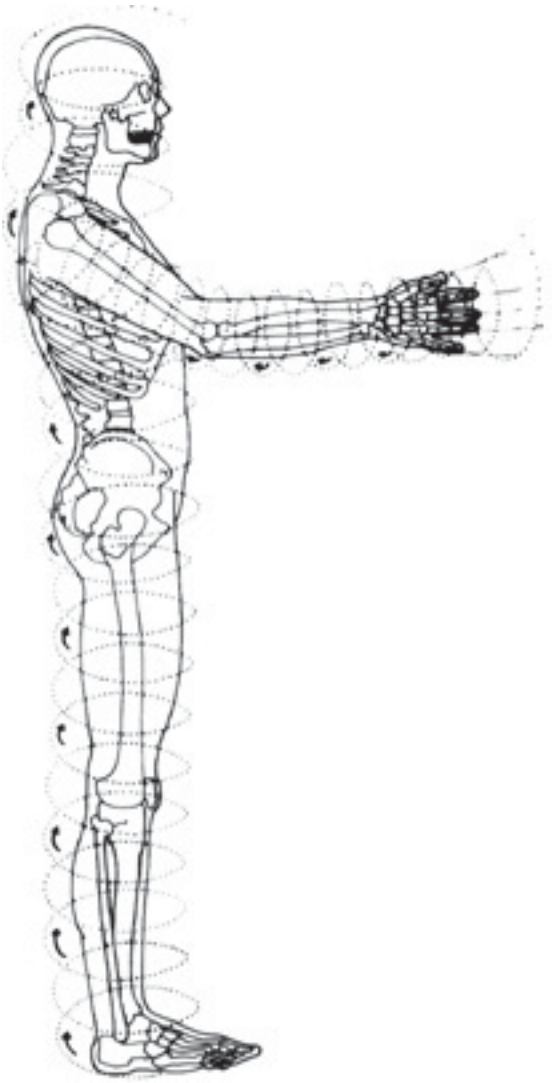

Fig. 2.31 *Spiral the energy from the legs up the spine. At the same time, spiral from the hands to the upper spine and into the head.*

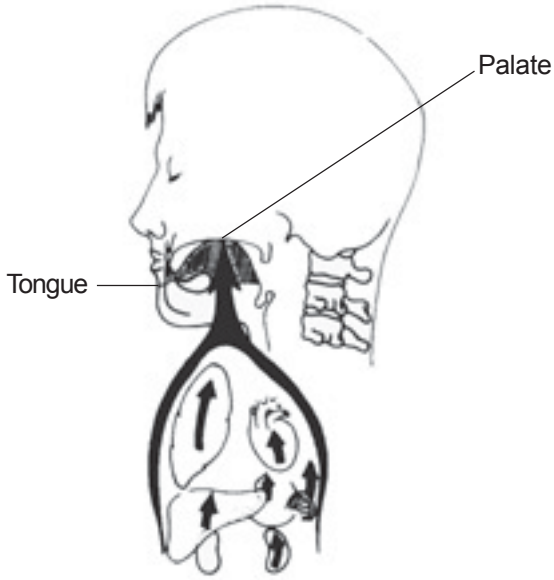

(a) Press the tongue to the roof of the mouth with the combined power of all the einternal organs.

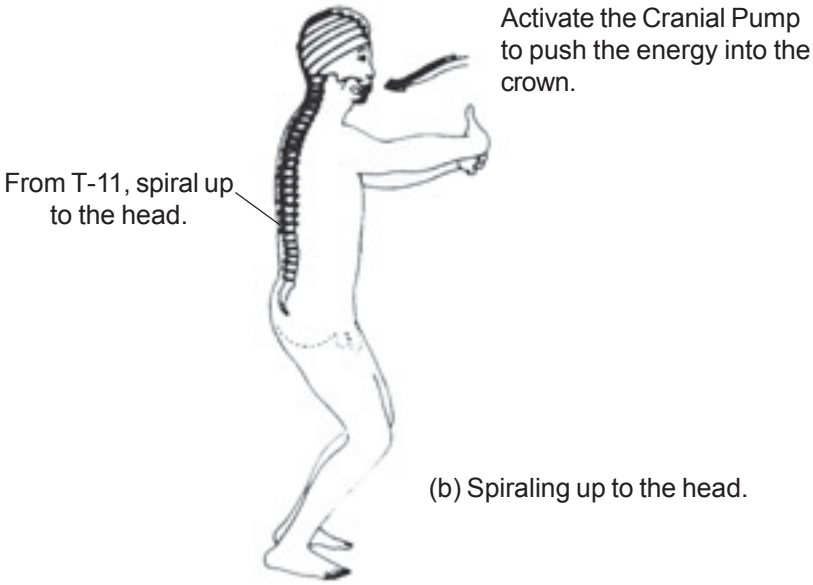

(b) Spiraling up to the head.

Fig. 2.32 *Bone Breathing in the Spine*

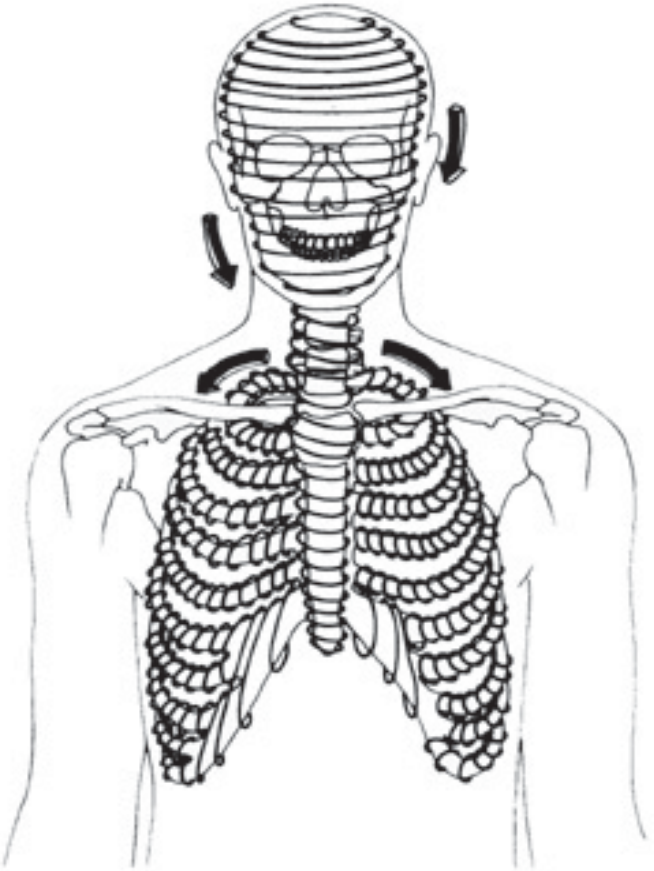

Fig. 2.33 *Spiraling from the head down to the ribs and sternum.*

The spiraling will not feel as it did in the limbs; however, the same results are achieved by mentally creating a circular motion with the energy as it travels through each rib. Packing will feel the same, although there may be less muscle available to squeeze Chi into the ribs and sternum. Compress energy into the sternum by sinking your chest slightly, and squeeze into it from the surrounding muscles of the chest.

Finally, exhale. Sit or stand quietly and feel how the energy moves within the structure of your bones. Use your mind to relax the muscles in your spine and ribs, and feel the heat as energy moves into your bones. Shake your hands, fingers, and legs, and flex your spine. Be sure that your chest is relaxed so the energy does not congest there.

E. Summary of Bone Breathing and Bone Compression

Although Bone Breathing and Bone Compression are most easily practiced from a seated position, advanced practitioners usually graduate to the Embracing the Tree posture as used in the practice of Iron Shirt I. This posture also suits the Hitting practices because Bone Breathing, Compression, and Hitting are later combined.

1. Bone Breathing in Practice

a. Create a sensation of coolness in the fingers of either hand. Inhale, and draw warm external energies into that hand through the fingers. Apply this to the opposite hand. Exhale, and release the energy.

b. Pull up your genitals slightly as you breathe Chi further up into the ulna and radius bones of the lower arm. Practice first on each arm, then on both together. Exhale, and release.

c. Apply the same procedure to the upper arms, drawing Chi to the humerus bones. Exhale, and release the energy. Remember to draw energy in with more force with each new inhalation, thereby accessing further points within each limb.

d. Draw Chi up through the scapulae and collarbone to reach the C-7 point and the cranium but do not leave it there. Either combine it with the energy drawn from the legs or store it in the navel.

e. Create a sensation of coolness in the toes of either foot. Inhale and draw the warm external energies into that foot through the toes. Apply this to the opposite foot. Exhale, and release the energy.

f. Pull up the genitals slightly as you breathe Chi further up into the tibia and fibula bones of the lower legs. If necessary, practice on each leg individually, and then draw Chi into both legs together. Exhale, and release.

g. Draw the Chi further up with each breath into the femur bones of the upper legs, into the hips, and then to the sacrum. Exhale, but retain the energy you have breathed into these areas.

h. If you choose to combine the procedures for the arms and legs, do not draw the energy to the skull from the arms directly, but instead recombine it at the center of the spine. First breathe into

both hands and feet simultaneously. Inhale Chi all the way up to the shoulders and scapulae through the arms, and up to the thigh and hip bones through the legs. Recombine this energy at the middle of the spine after it has reached the sacrum and the scapulae from their respective sources. From the center of the spine, move the energy up to the head, and then back down the spine to where the ribs begin. Exhale as needed.

i. Breathe the energy outward through the twelve ribs, encompassing the rib cage from the front to the back, and recombine the Chi at the sternum. Breathe into the sternum. Exhale.

2. Bone Compression in Practice

a. Inhale, pulling up the undertrunk, then spiral the energy up from the fingers and toes throughout the arms and legs to meet at the center of the spine. Use the same steps as in Bone Breathing, but retain the Chi by spiraling it throughout the limbs.

b. Having recombined the external energy drawn from both sources at the center of the spine, expand the Chi outward through the twelve ribs, spiraling it into the sternum.

c. The body's capacity has been reached when you can no longer spiral new Chi into the arms. Begin to pack the Chi, condensing it into the same space as the energy which has been accumulated.

d. Squeeze the muscles of the hands and arms with each breath. Hold the breath with each contraction.

e. Exhale as you release the contraction. When you release your hold, use your mind to absorb the energy into the bones through the pores of the skin. During resting periods, the sensation of drawing in energy through the skin should be felt throughout the body. Bones, muscles and tendons should begin to feel as though they are wrapped in cotton.

f. As you maintain your stance, feel the pulsing of the heart, and bring that pulse to all of the major points--particularly the crown, perineum, hands and feet. As you decrease the force of the heart's pumping, you may also reduce the heart rate. If necessary, check either wrist to feel the pulse. After you have practiced for a while, feel the sensation inside your bones. If you have a lot of fat, the feeling will be very hot. This is the fat beginning to melt. It is a good idea to practice with the tongue on the palate because the energy will begin to move through the Microcosmic Orbit.

Chapter III
Sexual Energy Massage

Taoists regard sexual energy as having creative and rejuvenative powers. They acknowledge its role in the conception of human life, but when procreation is not intended, they advocate other applications for Ching Chi. In the Healing Love practice, this energy is used to heal the internal organs and glands, increase the brain's capacity and further open the channels of the Microcosmic Orbit. In the more advanced practice of the Sexual Energy Massage, it is also used to replenish and cultivate the blood-producing red marrow of the bones. Ching Chi is the term for sexual energy.

The Sexual Energy Massage is one of the most important practices in Bone Marrow Nei Kung. It is a beginner's equivalent to Chi Weight Lifting, which requires much more experience. The massage draws sexual energy and hormones into the body and promotes a healthy flow of blood and Chi within the sexual center. It also brings more internal energy into the genitals, and increases the production of Ching Chi. Using these techniques, men find that prostate problems can be greatly reduced, and women often alleviate the problems associated with menstruation.

The accumulation of external energy through Bone Breathing was discussed earlier as a meditative approach to harvesting Chi. For the most effective application of Bone Compression, however, sexual energy should also be harvested and subsequently compressed into the marrow along with the external Chi. This chapter explains how to disseminate sexual energy throughout the body so that it can be combined with external energy, for the "cleansing of the marrow," one of the main functions of Bone Marrow Nei Kung.

A. Three Taoist approaches to Sexual Energy.

This section is a brief explanation of the three methods used to draw sexual energy and hormones into the body. These methods

provide men and women with the means of achieving great personal power through increased sexual energy. Although some of the techniques in this chapter may be similar to those found in other Universal Tao books, their application in Bone Marrow Nei Kung produces a different quality of Ching Chi. The massage techniques and exercises, such as the Power Lock, release unaroused Ching Chi into the body. This differentiates them from the Healing Love practices that require sexual stimulation.

Warning for Men and Women**:** Do not practice if you have any, venereal infections or skin rashes in the genital area. Methods used to draw sexual energy into the body can spread existing venereal diseases to the organs.

1. Healing Love

Healing Love is a cultivation practice that does not fulfill the requirements of Bone Marrow Nei Kung by itself; however, its practice is necessary to prevent the loss of Ching Chi during all sexual activities. Healing Love also helps to open the Microcosmic Orbit to its maximum capacity while rejuvenating the internal organs and glands with sexual energy. The techniques reverse the usual outward flow of sexual energy during the orgasmic phase of sex, and draw the Ching Chi upward into the body, thereby enhancing one's internal healing capabilities. Through this practice concentrated sexual energy, extracted through the advanced disciplines, is also drawn into the Microcosmic Orbit.

NOTE: The actual release of Ching Chi into the body through the Sexual Energy Massage or Chi Weight Lifting methods presupposes that it is already abundant within the sexual center. If one suffers from chronic impotence, weakened kidneys, or any internal dysfunctions, the Healing Love methods should be mastered to accumulate Ching Chi before Bone Marrow Chi Kung is attempted.

2. Sexual Energy Massage

For the purposes of Bone Marrow Nei Kung, the Sexual Energy Massage is the primary practice. It not only releases Ching Chi into the body, but also extracts a higher concentration of sexual

hormones from the genitals to stimulate the hypothalamus, the pituitary and the pineal glands. Stimulation of the pituitary gland is believed to prevent the production of an aging hormone that ultimately brings death.

Healing Love prevents the loss of Ching Chi and rejuvenates the internal system. The Sexual Energy Massage releases higher concentrations of Ching Chi into the body for cultivating the bone marrow and stimulating the endocrine glands. When used together, the two practices constitute a safer method of disseminating sexual energy than Chi Weight Lifting.

3. Chi Weight Lifting

Chi Weight Lifting releases sexual energy and hormones to a much greater degree than the other practices. In addition, the technique exercises the fascial connections between the genitals and the internal system, thereby strengthening the organs and glands. Its practice provides the greatest abundance of Ching Chi for rejuvenating the bone marrow. It also releases maximum quantities of sexual hormones for the stimulation of the pituitary gland to prevent aging. Chi Weight lifting is the highest level of physical practice in Bone Marrow Nei Kung.

Chi Weight Lifting should not be attempted without the proper Training. After having received instruction, a student may proceed with caution to lift light weights using the genitals. At this level, the Sexual Energy Massage is used before and after Chi Weight Lifting: first to prepare the genitals, and afterwards to replenish the circulation in the sexual center, which helps to avoid blood clots. The Healing Love practices that require sexual arousal are no longer necessary because Chi Weight Lifting supplies the body with abundant Ching Chi. Healing Love must still be practiced during sex, however, unless the time is right for procreation.

4. Three Practices in Relation to Bone Marrow Nei Kung

The Sexual Energy Massage techniques offer a greater release of Ching Chi than the Healing Love methods alone, and they can be practiced with much more safety than Chi Weight Lifting. The

(a) Combine the three middle fingers.

(b) Where to apply pressure.

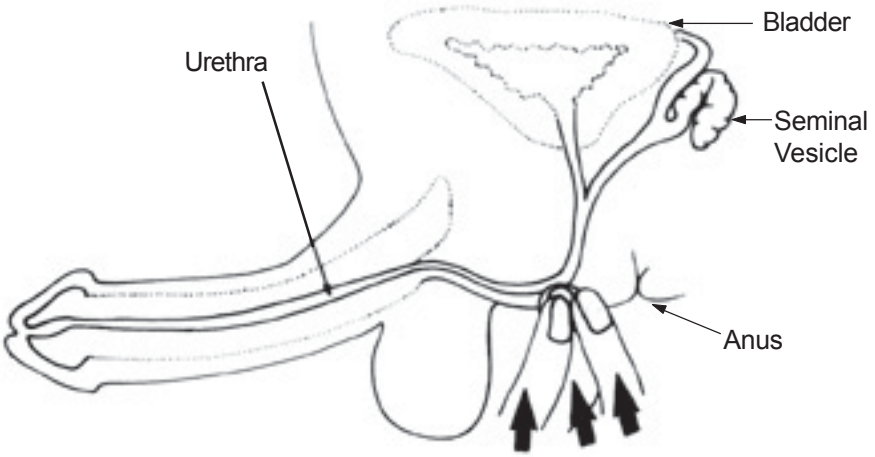

(c) Press the urethra just in front of the anus.

Fig. 3.1 *The external blocking procedure involves pressing the urethra from a point at the back of the perineum, near the anus.*

"Power Lock" and "Genital Compression" exercises are derived from the Healing Love practice and used as non-sexual techniques in Bone Marrow Nei Kung to channel unaroused sexual energy into the Microcosmic Orbit. The sexual application of the Power Lock is described in Appendix 1 because it is essential for maintaining Ching Chi in both men and women. Students should understand both versions before attempting Bone Marrow Nei Kung.

B. Power Lock Exercise for Men and Women

The detailed descriptions of these exercises which follow are for learning the practice and for reference. Study them carefully. Then use the chapter summary as a quick practice guide.

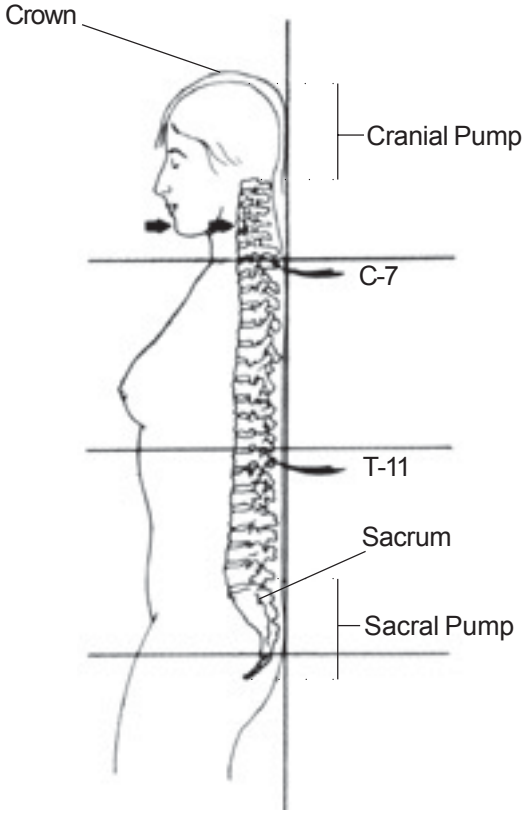

Fig. 3.2 *Sacral Pump and Cranial Pump*

1. Synopsis

The Power Lock exercise is used before and after the Sexual Energy Massage. Air is sipped in through the nose as the genitals, perineum and anus are contracted to draw Ching Chi up from the perineum into the higher centers. The three middle fingers of either hand are applied to a point located at the back of the perineum--in front of the anus--to lock the energy into the upward flow after each contraction. (Fig. 3.1) Clenching the teeth and the buttocks activates the Cranial Pump and the Sacral Pump, thereby helping the energy to reach its destination at the crown point. (Fig. 3.2)

Warning: Before you begin drawing Ching Chi up to the higher centers, remember that you should never leave hot sexual energy in the head for long periods of time. Always draw it down to the navel through the Functional Channel of the Microcosmic Orbit at the end of your practice. (See Chapter Six for details regarding the Microcosmic Orbit.) There is an old Chinese saying: “Don’t cook your brain.” When in doubt about the hot or cold status of your energy, store it in the navel.

a. Five Stations

There are five points used as stations for Ching Chi in the Power Lock exercise: the sacrum, T-11, C-7, the base of the skull, and the crown. Activate the respective pumps for these stations, starting with the Sacral Pump, until the Ching Chi rises to the crown. This is done in sets using nine muscular contractions of the undertrunk simultaneously with nine sips of air to draw the energy up to each point from the perineum. The exercise then starts again at the genitals after each station has been completed, although the energy is actually held at the previous station. (Fig. 3.2)

b. Where to apply external pressure?

Locate the Gate of Death and Life (the perineum, or Hui-Yin) between the sex organ and the anus. (Fig. 3.3) Use your fingers to find the slight depression directly in front of the anus, at the back of the perineum, and focus your attention there. Fingernails should be cut short and filed.

Fig. 3.3 *Perineum and the depression in front of the anus.*

c. How to apply external pressure with the fingers.

Using either hand, combine the three middle fingers into a triangle. Immediately after each inhalation, press the three fingertips on the point in front of the anus to lock the Ching Chi into its upward journey, preventing its return to the perineum. (Women may forego using the fingers if it causes discomfort.) Release the fingertips as you sip in more air and then re-apply them as each breath is held. Press the point only for as long as you hold each breath and muscular contraction, then release. Do not apply the fingers as you inhale because you will block the energy from rising. Remember that the fingers help to push the energy upward.

d. Contractions activate the Sacral and Cranial Pumps.

Each of the five stations has a “pump” to move energy, but the Sacral and Cranial Pumps require the most concentration to become activated. The muscles of the undertrunk help to draw the energy, into the sacral area. Tilt the sacrum slightly and clench the buttocks as you contract the anus and perineum to direct the energy

up the spine. (Fig. 3.4(a)) As the Sacral Pump is activated, it creates a vacuum in the urogenital diaphragm which draws the Ching Chi from the sexual center.

The Cranial Pump is activated by first pressing the flat part of the tongue up to the roof of the mouth as the tip of the tongue presses the lower jaw behind the teeth. (Fig. 3.4 (b)) Slightly clench the teeth as you pull in the chin towards the back of the head. Take in ten percent of your lung capacity with each sip of air through your nose as you pull up the genitalia, apply pressure with the three fingers, and contract the individual sections of the undertrunk. Simultaneously, push up your tongue, pull in your eyes, and look up to your crown.

Note**:** Remember never to contract the chest muscles. This can cause energy to congest around the area of the heart.

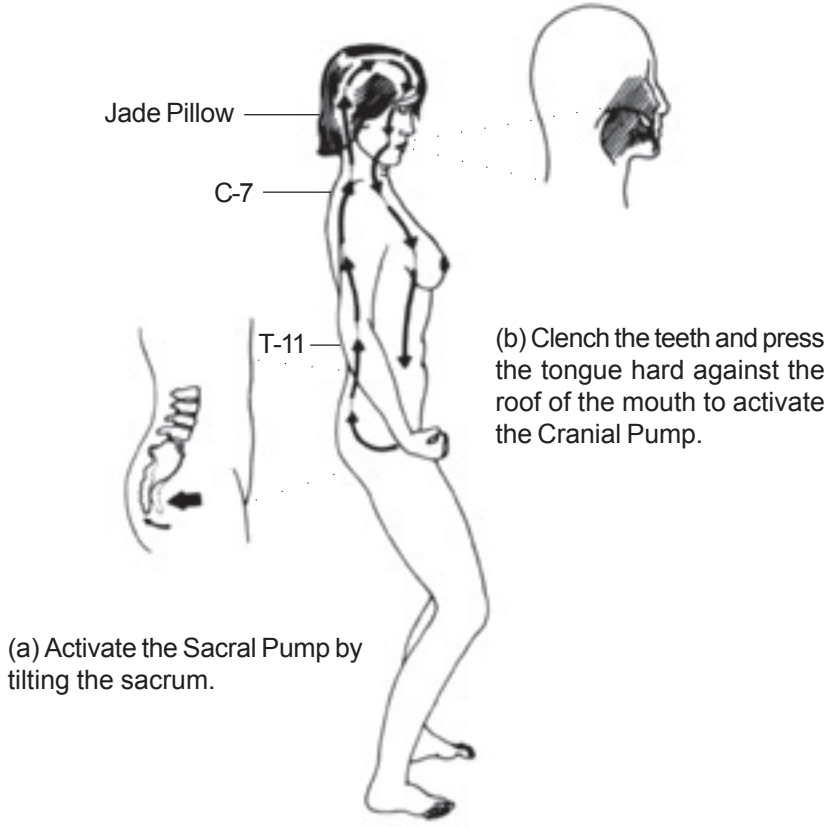

Fig. 3.4 *Activating the Cranial Pump*

e. Sequence

Men draw sexual energy from the genitals into the perineum through Testicle Breathing. Women use Ovarian Breathing, slightly contracting the vagina to accumulate Ching Chi in the Ovarian Palace. (Refer to Chapter Six for information about these techniques.) Use a short inhalation to draw the energy through each successive point leading up to the first station. Remember to apply the fingers as you hold each sip of air. First inhale, and contract the perineum. Then inhale again as you contract the anus. With the next sip of air, pull up the back part of the anus as you draw the energy up to the sacrum. After covering these points, use several sets of nine contractions to push the energy into the sacrum. This entire sequence is repeated for each subsequent station, starting at the sexual center.

As Ching Chi expands in the sexual center, use one sip of air with each contraction to draw it up through the aforementioned points. At least one set of nine contractions should be used for each station that was previously opened. Then emphasize each new station with several sets of nine contractions. Although a week or two may be required to open each station completely, you can practice using all of the stations, concentrating more on the difficult points. Exhale after the ninth sip of air, and release the tension as you repeat the process.

f. Power Lock Practice Step By Step For Men and Women

(1) Station One--the Sacrum

(a) Be aware of the sexual organ.

(b) When you feel the Ching Chi expanding, inhale and contract the perineum, drawing sexual energy into the perineum. Use your fingers to press on the point each time you contract, releasing them briefly before each subsequent contraction.

(c) Inhale, contract the anus, and draw the energy up to the anus.

(d) Inhale, contract, and draw the energy up to the back part of the anus.

(e) Inhale, and tilt the sacrum as you clench the buttocks to activate the Sacral Pump. Draw the energy up to the sacrum.

(f) Use nine contractions with nine sips of air to draw Ching Chi from the sexual center to the sacrum. (Fig. 3.5)

(g) Hold the energy at the sacrum as you exhale and return your attention to the sexual organ.

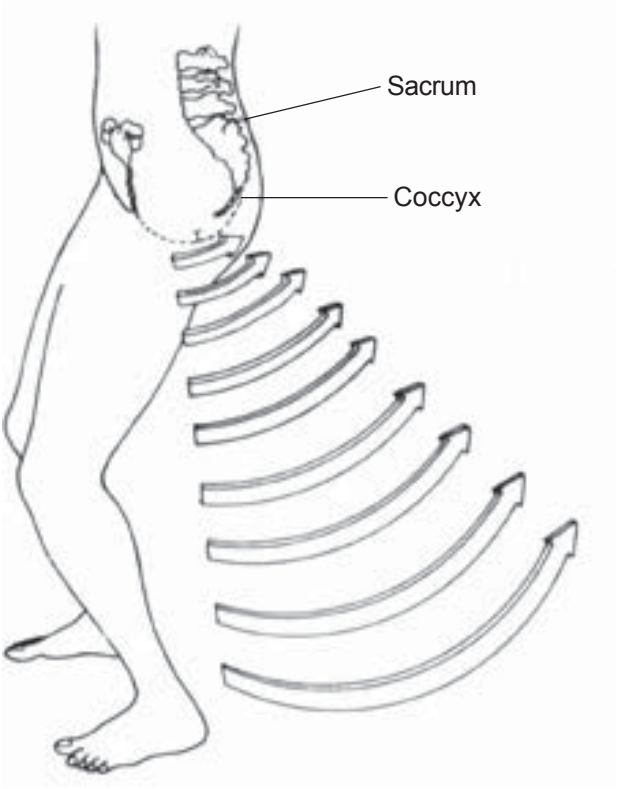

Fig. 3.5 *Collect the energy at the sexual center, then do nine contractions to draw the energy to the sacrum*

(2) Station Two--the T-11 Point

(a) Repeat the previous steps, drawing the energy up through the sacrum until you reach the T-11 point.

(b) Use nine contractions with nine sips of air to draw the Ching Chi from the sexual center to T-11 on the spine. (Activate the T-11 pump by pushing the spine outward at that point.)

(c) Hold the energy there as you exhale and return your attention to the sexual organ.

(3) Station Three--the C-7 Point

(a) Repeat the previous steps, drawing the energy up through T-11 until you reach the C-7 point.

(b) Use nine contractions with nine sips of air to draw Ching Chi from the sexual center to the C-7 point. (Push the C-7 out, and pull back the chin slightly to help activate the C-7 pump.)

(c) Hold the energy there as you exhale and return your attention to the sexual organ.

(4) Station Four--the Base of the Skull

(a) Repeat the previous steps, drawing the energy up through C-7 until you reach the base of the skull.

(b) Use nine contractions with nine sips of air to draw Ching Chi from the sexual center to the base of the skull as you activate the cranial pump. (Pull the chin back once again.)

(c) Hold the energy there as you exhale and return your attention to the sexual organ.

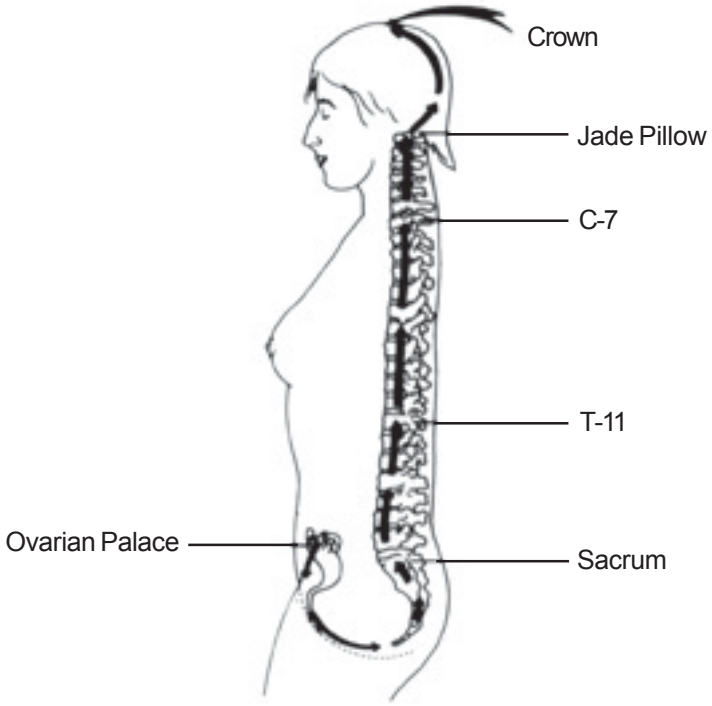

Fig. 3.6 *Power Lock guiding the energy up to the crown.*

(5) Station Five--the Crown

(a) Repeat the previous steps, drawing the energy up through the base of the skull until you reach the crown point. (Fig. 3. 6)

(b) Use nine contractions with nine sips of air to draw Ching Chi from the sexual center to the crown. (Fig. 3.7)

(c) Exhale and rest as you spiral this energy nine times outward from the crown, and then nine times inward.

(d) Finally, bring the energy down and store it in the navel.

Fig. 3.7 *Power Lock drawing the energy from thesexual center to the crown.*

g. Completion of the Power Lock

Men**:** Cover your navel with both palms, left hand over right. Collect and mentally spiral the energy outwardly at the navel 36 times clockwise, and then inwardly 24 times counterclockwise. (Fig. 3.8(a))

Women: Cover your navel with both palms, right hand over left. Collect and mentally spiral the energy outwardly from the navel 36 times counterclockwise, and then inwardly 24 times clockwise. (Fig. 3.8(b))

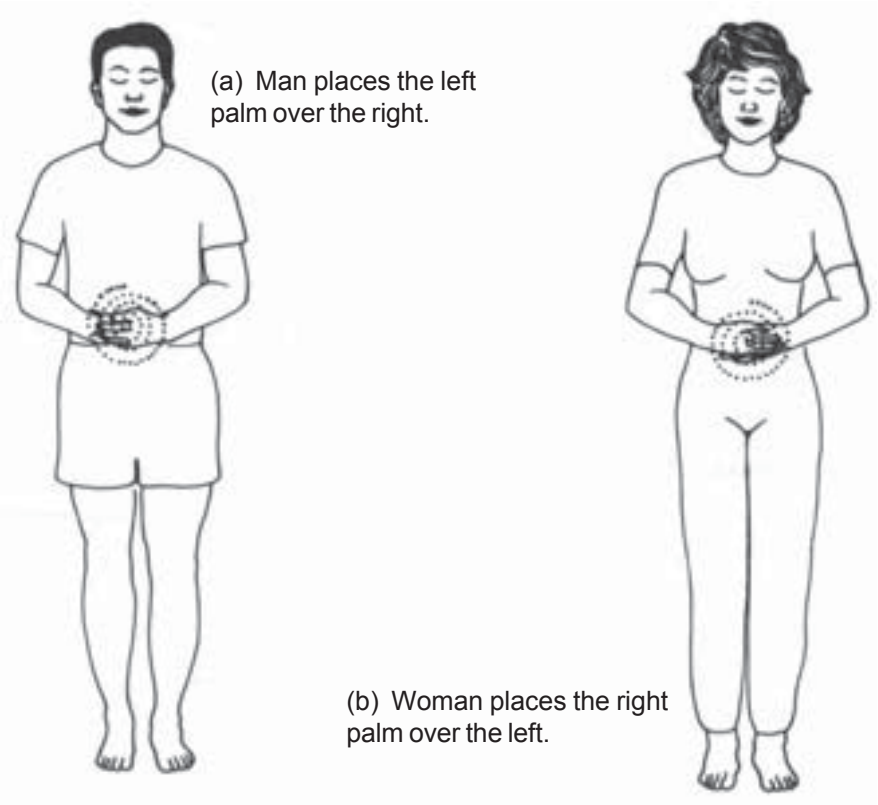

Fig. 3.8 *Collect the Energy.*

h. Massage after the Power Lock

The final step helps to increase the blood and Chi flow in the sexual center. Apply a silk cloth in a circular motion to the perineum, coccyx, and sacrum. Starting at the perineum use the cloth to massage the area in a clockwise motion nine to eighteen times, then counterclockwise nine to eighteen times. (Fig. 3.9) Apply the cloth to the coccyx for the same number of repetitions, and finish at the sacrum.

Fig. 3.9 *Massage the Perineum.*

C. Genital Compression for Men and Women Step By Step

The Genital Compression Exercise dynamically builds sexual power by packing electromagnetically charged energy into the testicles or the ovaries. As an expanding sensation fills the genitals, sexual energy increases, eventually reaching into higher centers of the body through the Microcosmic Orbit, as it is needed. This practice is particularly important to use after the Sexual Energy Massage or Chi Weight Lifting to replenish the energy extracted from the genitals.

(1) Loosen your pants or take them off. Sit on the edge of a chair. Men should allow the testicles to hang loose over the edge.

(2) Inhale slowly but deeply through your nostrils into the lungs, expanding the solar plexus. Simultaneously contract the anus, and pull Chi into the upper abdomen.

(3) Feel the energy of each breath culminate at a point behind the solar plexus. Use your mind and some abdominal muscles to compress the energy into a sphere at the solar plexus point. Imagine this as a ball of Chi which you will roll down the front of your body by contracting the upper abdominal muscles.

(4) Let the “Chi Ball” fortify itself with each breath, and then roll it

downward from the solar plexus, through the lower abdomen, to the sexual center near the pelvis. Keep your chest relaxed to prevent any congestion of energy there. Use your mind to guide the Chi flow to the sexual center and genitals. (Fig. 3.10)

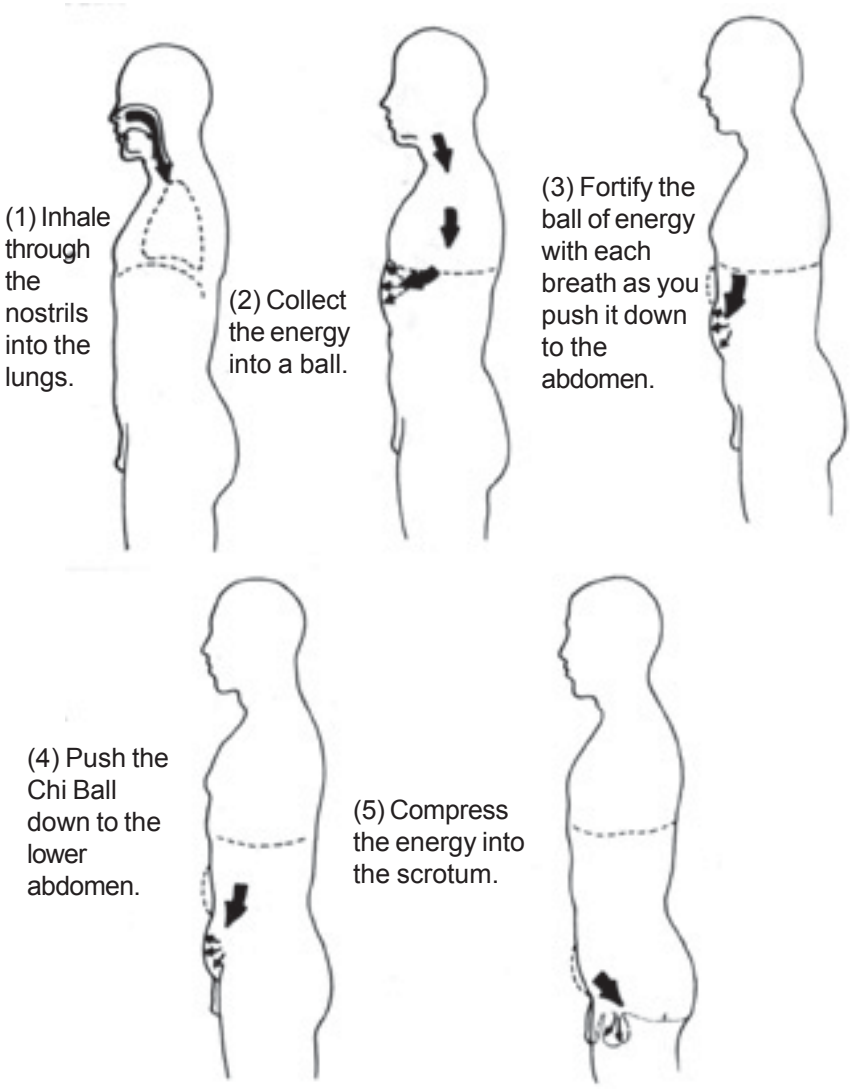

Fig. 3.10 *Genital Compression*

(5) Men: Compress Chi into the scrotum for as long as you can. Squeeze the anus, and gently tighten the perineum to prevent energy loss. Eventually only the power of the mind will be necessary to contract these areas. The muscles of the lower abdomen should also be used as you force the scrotum to expand with energy.

(6) Women: Compress the energy into the lower abdomen and the pelvic region while contracting the perineum, the anus, and the vagina. Locate the ovaries as they are shown in Fig. 3.11. Direct the energy into both ovaries, and feel them expand with warmth.

Fig. 3.11 *Locating the Ovaries and the Ovarian Palace*

Note for Women: In the beginning it is helpful to locate the ovaries by placing both thumbs, tip facing tip, on the navel with the fingers extending downward, outlining a triangle over the lower abdomen. Where the index fingertips meet is the Ovarian Palace. Next, spread all of the fingers out from that point while maintaining the position of the index fingers. Where the tips of the pinky fingers fall on the abdomen is the approximate location of the ovaries.

(7) While still in the compression process, keep your tongue pressed against the roof of your mouth to maintain the flow of energy through the Microcosmic Orbit. Move it around to stimulate the saliva flow. Swallow deeply into the sexual center to enhance the compression. With practice, you should be able to hold the compression for as long as 30 seconds.

(8) Exhale. Take a few, quick, short breaths by pulling your lower abdomen in and pushing it out (Energizer Breathing) until you are able to breathe normally. Relax completely.

(9) Repeat the exercise from three to nine times until you feel the testicles or ovaries become warm.

Remember to keep the tongue against the palate, and breathe only through the nose. When you perform Genital Compressions, especially after having practiced Bone Marrow Nei Kung for about a month, you will feel more Chi being guided to the sexual organs. It is important to practice these compressions in the morning or afternoon, but not before you go to sleep.

D. Preliminary Cloth Massage for Men And Women

The preliminary Cloth Massage of the sexual center is an extremely important preparation for the Sexual Energy Massage techniques. It stimulates the energy and prepares the sexual organs for the role at hand. The perineum and sacrum are also massaged since they are powerful stimulators of life-force energy. First, the silk cloth is applied to activate Ching Chi. The Sexual Energy Massage then releases the Ching Chi to be assimilated into the body. While massaging with the cloth, men should feel their testicles fill with energy as they become firm. Women should feel the breasts enlarge slightly as the vagina becomes moist with secretions. Using the cloth should help you feel the Chi routes open as they are stimulated.

Note: After the Sexual Energy Massage or Chi Weight Lifting, the Cloth Massage of the sexual center, perineum, and sacrum should be repeated to replenish the circulation of blood and Chi in the sexual center.

1. Hold the cloth using the three middle fingers of either hand. Apply it to the sexual center in clockwise and counterclockwise motions for 36 rotations in each direction. (Fig. 3.12) Men should apply the cloth directly to the genitals. Women should cover the entire mons and labial area. Massage the vaginal muscles, pressing in on the sides of the groin.

2. Locate the perineum, and use the cloth to massage it clockwise 36 times, and then counterclockwise 36 times.

Fig. 3.12 *Massage the perineum with the cloth 36 times clockwise, and 36 times counterclockwise.*

3. Apply the cloth to the coccyx and massage its tip, gradually applying more pressure to activate the Sacral Pump. Massage clockwise and then counterclockwise 36 times. Move up to the sacrum and massage it clockwise, then counterclockwise 36 times. (Fig. 3.13)

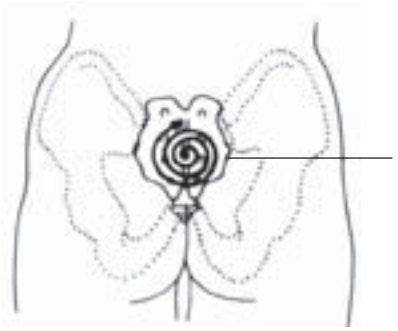

Fig. 3.13 *Sacrum Massage*

E. Sexual Energy Massage

At this point, although the practices for men and women differ greatly, the purposes and results are the same. To avoid confusion, the remainder of this chapter is divided into separate sections for

men and women. The Sexual Energy Massage helps both men and women clear blockages in the Chi flow while directing energy and blood into the sexual center and enhancing the production of Ching Chi. These techniques are the main focus of this book in preparation for the higher level practices, such as Chi Weight Lifting.

The Sexual Energy Massage often causes enough stimulation to require the Healing Love techniques to avoid sexual arousal. If arousal occurs, draw the activated sexual energy into the Microcosmic Orbit. Both men and women must use the Power Lock-without arousal before the Sexual Energy Massage to prepare for the procedures, and afterwards to draw Ching Chi up through the stations of the Microcosmic Orbit. At least two to three sets are recommended at both times.

***Note for Women*:** The second part of this section explains the techniques which are special to your needs. Study the Breast Massage described in "Procedures for Women." Section F details the "Internal Egg Exercise" as a preparation for women's Chi Weight Lifting

1. Sexual Energy Massage for Men Step by Step

Warning: If you know that you have a blood clot in the area of the scrotum, consult a physician before applying the Sexual Energy Massage or Chi Weight Lifting techniques. Although the massage techniques in this chapter help to prevent blood clots from forming, medical advice is necessary to determine their safety with existing blood clots. Refer to Precaution 15 in Chapter Five for further information.

Note: In all of the following exercises, you may wrap the testicles with the cloth as you massage them.

a. Finger Massage of the Testicles

(1) Inhale Chi into the testicles as in the Genital Compression exercise. Rub your hands to warm them, and use them to warm the testicles.

(2) Hold the right testicle with the right hand. Place the pinky, fourth, third, and second fingertips on the bottom of the testicle. Place the right thumb on the top of the testicle. Hold the left testicle with the left hand in the same manner. (Fig. 3.14)

Fig. 3.14 *Finger Massage of the Testicles*

(3) Use your thumbs to gently press on each testicle, with the other four fingers holding the bottom of each. Then use your thumbs to massage around the testicles 36 times clockwise, and then 36 times counterclockwise. (Fig. 3.15)

Fig. 3.15 *Rub the testicles in each direction up to 36 times.*

(4) Use your thumbs to hold the testicles in place while the other four fingers of each hand roll them to the left and right or back and Forth 36 times in both directions. Draw the energy upward. (Fig.

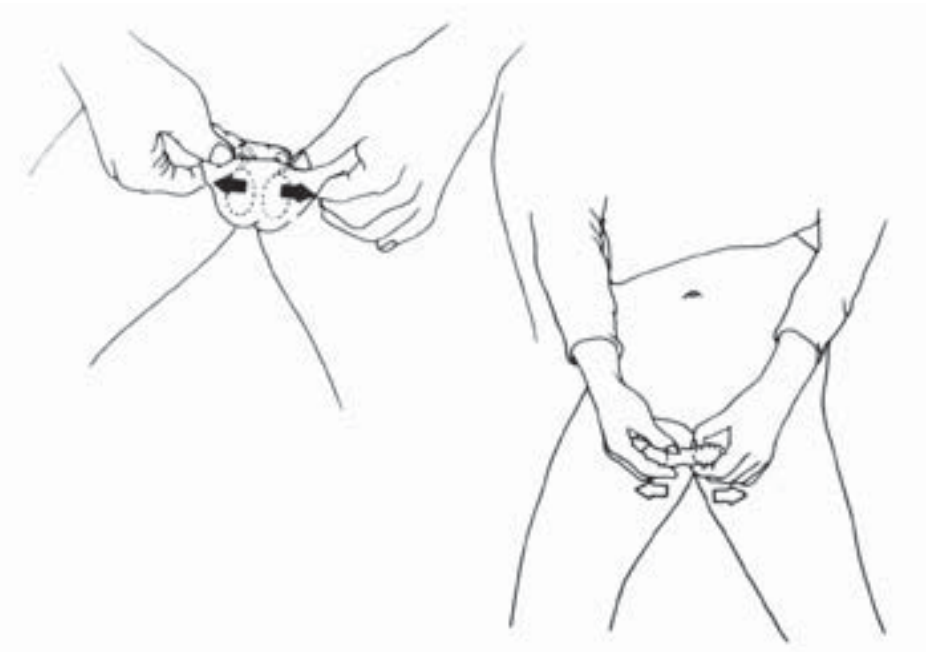

Fig. 3.16 *Roll the testicles in each direction up to 36 times.*

b. Palm Massage of the Testicles

(1) Inhale Chi into the testicles. Rub your hands together until they are hot, and warm the testicles with them.

(2) Move the penis toward the right with the right thumb and fore finger, covering the top of the testicles with the lower edge of the right hand.

(3) Place the left palm on the bottom cupping the testicles.

(4) Keeping the penis to the right, begin to lightly press the testicles with both hands, and then gently rub the testicles with the left palm 36 times, both clockwise and counterclockwise. (Fig. 3.17)

(5) Warm the hands again, and reverse the hand positions. Then gently rub the testicles with your right palm 36 times in both directions. Draw the energy upward.

Fig. 3.17 *Massage the Testicles.*

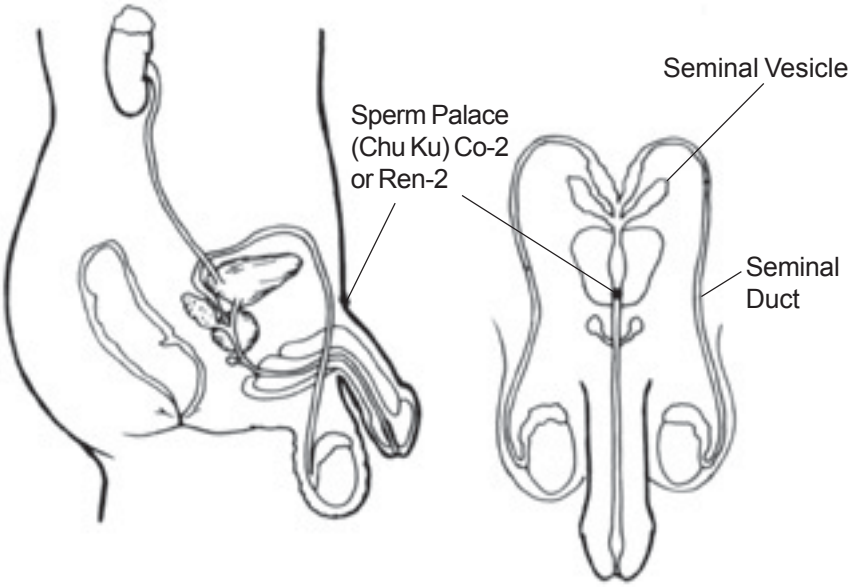

Fig. 3.18 *Trace the ducts of the testicles.*

c. Ducts Elongation Rubbing

(1) Rub your hands together to warm them, cup the testicles with them, and then trace the ducts extending upward from the rear of the testicles. (Fig. 3.18)

(2) Gently use your thumbs and index fingers to massage the ducts near the point at which they connect to the testicles. Rub towards the back of each duct with your index finger and use your thumb to rub towards the front. Gradually move along the ducts up toward the body. (Fig. 3.19) Be careful.

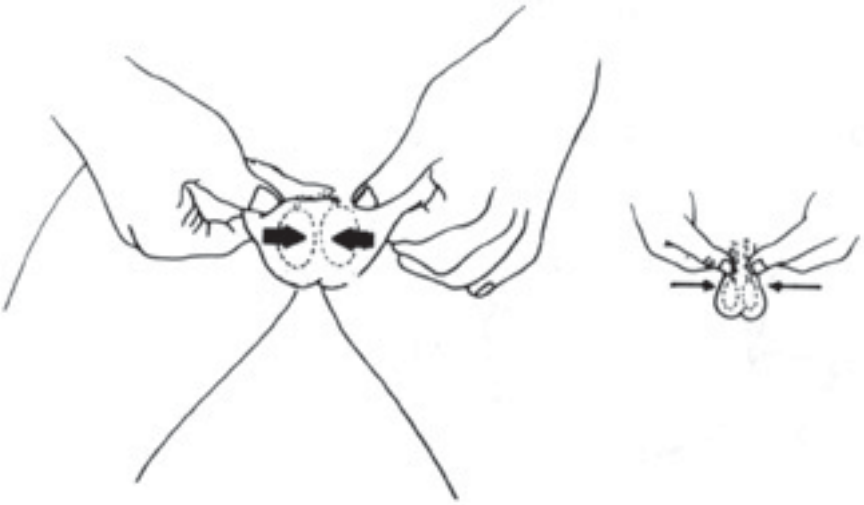

Fig. 3.19 *Ducts Elongation Rubbing*

(3) Reverse finger positions and return downward toward the testicles, now using the thumb to rub the back, and the index fingers to rub the front. Continue running 36 times. Each up and down movement counts as one time.) Draw the energy into the Microcosmic Orbit.

d. Stretching the Ducts Gently with Massage

(1) Use the thumbs and index fingers to hold the ducts, thumbs in front.

(2) Use the right thumb to rub toward the left, and use the right index finger to rub and gently pull the right testicle out, stretching the duct.

(3) Next use the left thumb to rub towards the right, and the left index finger to rub and gently, pull the Left testicle out, stretching the duct. (Fig. 3.20)

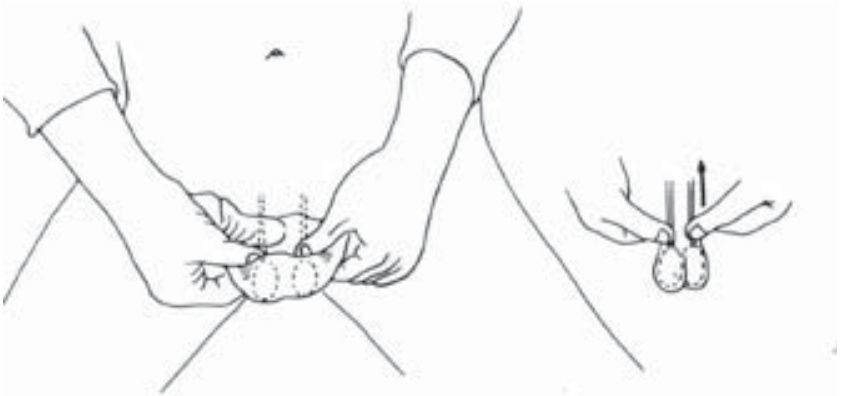

Rub the ducts between thumbs and index fingers,
gently squeezing them upward.

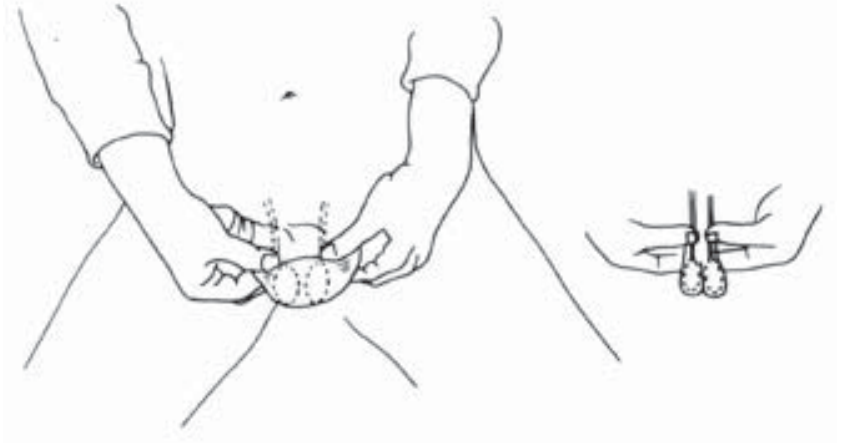

Gently stretch the ducts downward.

Fig. 3.20 *Stretching the ducts gently with massage.*

(4) Gently palm massage both testicles, and repeat the stretching.

(5) Now you may simultaneously rub the testicles using the thumbs and index fingers of both hands up to 36 times. Draw the energy upward.

e. Stretching the Scrotum and Penis Tendons

(1) Pre-stretching Exercise

(a) Warm both hands by rubbing them together.

(b) Encircle the base of the penis with the thumb and forefinger as all of the fingers encircle the scrotum, surrounding the testicles.

(c) Gradually pull the entire groin down towards the tip of the penis as you pull the internal organs up, opposing the outward force with your hand. (Fig. 3.21) First, pull straight down with the hand, and then pull down to the left and right in equal counts. (Fig. 3.22) Simultaneously pull up the internal organs from the perineum. hold for a while, and then release.

(d) Pull downward in a circular motion nine to 36 times clockwise and then counterclockwise. Draw the energy upward.

Fig. 3.21 *Gently pull down on the penis and testicles as you pull up from the internal organs.*

(2) Massage the penis

(a) Rub the hands together until they are hot. Use the thumbs and index lingers of both hands to hold the base of the penis from the sides.

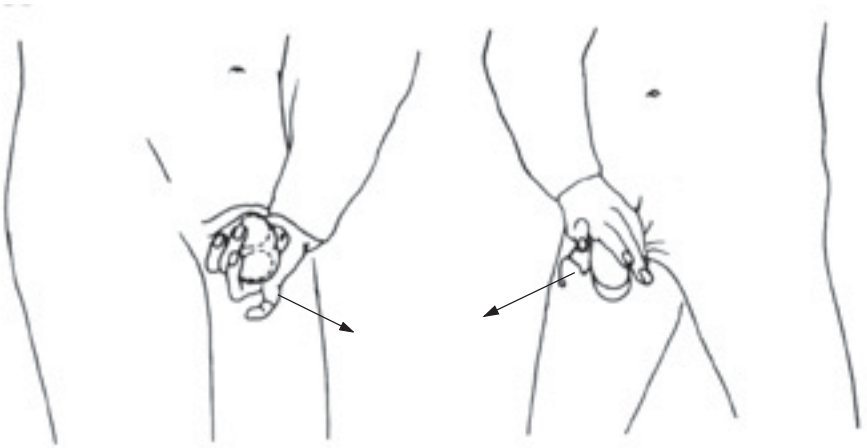

Fig. 3.22 *Stretching the scrotum and penis tendons.*

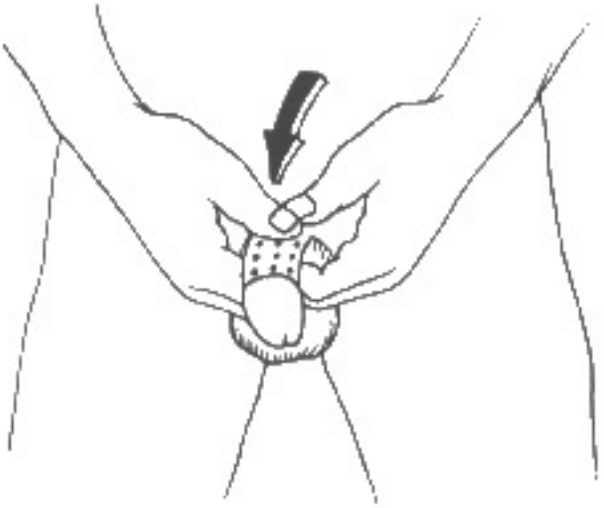

Fig. 3.23 *Massage the penis along three lines from the base to the head.*

(b) Massage the penis along three lines. Begin with the left line, using the left thumb and index finger to massage from the base of the penis to the tip and back. (Fig. 3.23) When use the right thumb and index finger to massage the right line in the same manner.

(c) Next place both thumbs and index fingers on the middle line at the base, and massage down to the glans and back. Massage all three lines, counting up and down as one time, up to 36 times.

f. Tapping the Testicles.

(1) Stand in a Horse Stance with the pants off.

(2) Inhale Chi directly, into the testicles, slightly pulling them up, and hold your breath. Clench the teeth, contract the perineum and anus, but only contract the testicles very slightly.

(3) Use the fingertips to lightly tap the right testicle. Tap in sets of six, seven, or nine. Exhale, rest, and draw the energy up the spine. Use the same procedures with the left testicle. (Fig. 3.24)

Fig. 3.24 *Tap the testicles lightly.*

g. Resting

Resting after massaging is very important. Use your mind to channel your breathing into long, smooth, soft breaths. Then draw the energy of these breaths to the point on which you are working.

h. Suggested Timetable

Practice the Sexual Energy Massage lightly for the first ten days. If you do not have time for all the techniques, try at least one of them daily. You can divide the exercises so that different sets are practiced on alternate days. Practice in sets of up to 36 repetitions, as long as you are comfortable with this regimen. Forego practice, or at least decrease it, whenever you do not feel comfortable. Once you are skilled, these exercises can be completed very quickly.

After ten days you may increase the force of each exercise as you decrease the number of repetitions per set. You may also use fewer sets per exercise. After 50 days, further increase the force as you decrease the repetitions and sets, spending more time on the palm and finger massages. After this, men who have taken instruction in Bone Marrow Nei Kung may feel ready to attach the weight hanging bar to the cloth, first by itself, and then with very light weights. (See Chapter 5)

2. Sexual Energy Massage for Women Step by Step

Note**:** Remember to apply the preliminary Cloth Massage of the sexual center, perineum, and sacrum as prescribed earlier in this chapter.

The Sexual Energy Massage for Women is followed by the Internal Egg Exercise, which is useful in all sexual activities and is a prerequisite for Chi Weight Lifting.

a. Breast Massage

Massaging the breasts activates the sexual energy of the ovaries, which subsequently activates the energy of the glands and the organs. It is also possible to prevent lumps from forming within the breasts, or to dissolve them, by using this practice. You should find that this practice greatly enhances your health and sexuality.

(1) Begin in a seated position, either naked or wearing loose pants. You should feel a firm pressure against the vagina. To achieve this, sit up against a hard object, or place a rolled up towel between your legs. If you are naked, use a sanitary cover for protection.

(2) Pull up the middle and back parts of the anus, drawing the Chi up through the spinal cold. (Fig. 3.25(a) and (b)) Then pull up the left and right sides of the anus, and bring Chi directly up to the left and right nipples.

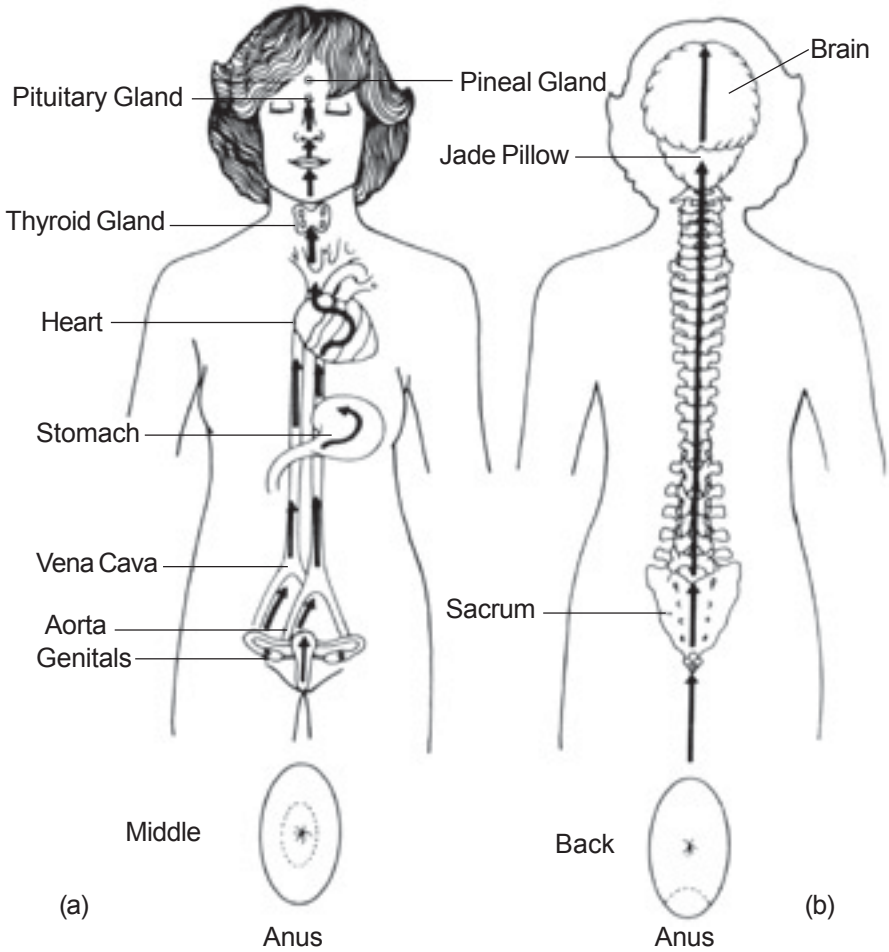

Fig. 3.25 *Pull up the middle and back parts of the anus.*

(3) Warm the hands by rubbing them together as you inhale, and press the tongue against the roof of the mouth. Place the second joint of the middle finger of each hand directly on the nipple of its respective breast. Cup the outside of the breasts with your palms.

b. Massaging the glands with accumulated Chi.

Note**:** As you do the following exercise, combine the Chi stimulated in the breasts with the additional energy of each successive gland or organ, drawing it back up to the breasts as the energy of each is activated. Return to the breasts after each of the following steps. Think of the breasts as melting pots for the combined ingredients of Chi from the organs and glands.

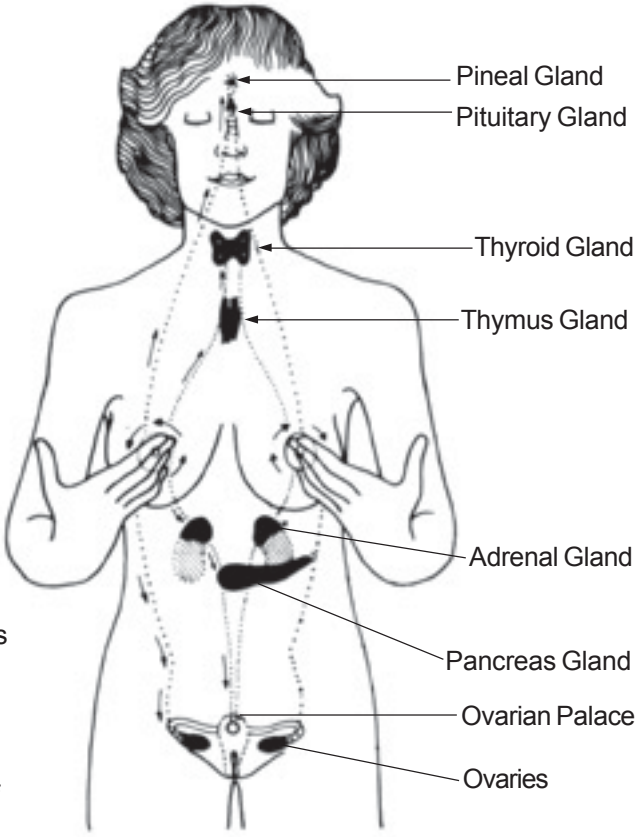

Activate the endocrine glands by massaging the area around the nipples, using the three middle fingers of each hand.

Fig. 3.26 *Activating the Endocrine Glands.*

(1) Use the three middle fingers on each breast to circle outward from the nipples, and then inward again. Move your right hand clockwise, and your left hand counterclockwise, then reverse. Direct the Chi accumulated in the breasts to the glands. (Fig. 3.26)

(2) When the clitoris is energized, the sexual energy surges to the head and activates the pineal gland at the crown. Return your attention to the breasts.

(3) Continue massaging as you move your attention to the pituitary gland, behind the “third eye “ You may feel pressure in the head as the energy descends to the pituitary gland. Return your attention to the breasts.

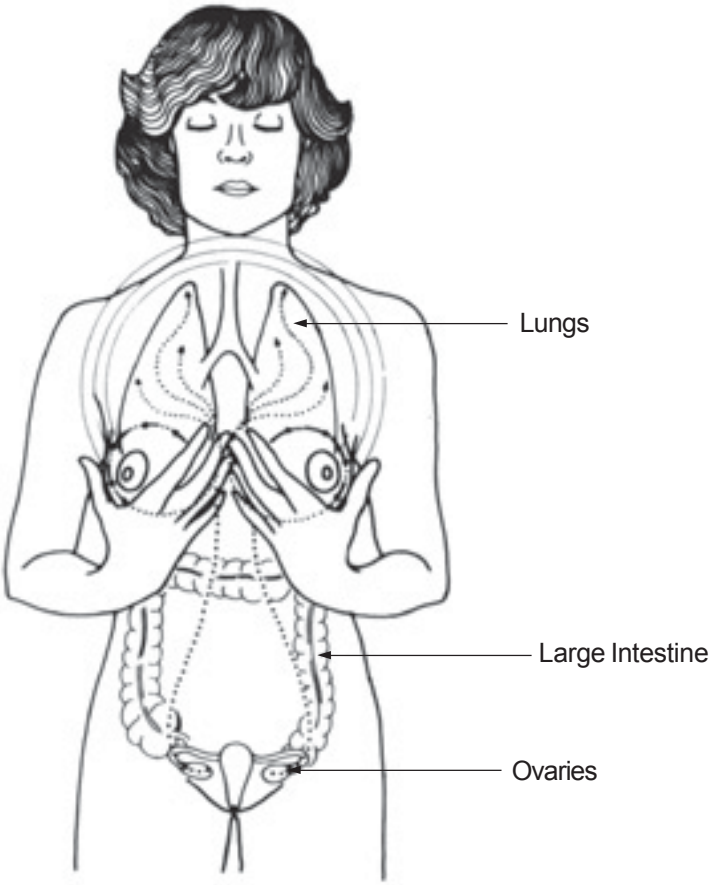

Fig. 3.27 *Chi of the Lungs and Large Intestines*

(4) Draw the activated energy down to the thyroid and parathyroid glands, Feel the expansion of these two glands as they become activated. Return both your attention and the Chi to the breasts.

(5) Continue to gently massage the breasts, and settle your attention on the thymus gland in order to activate its energy. Return your attention to the breasts with the combined Chi.

(6) Let the Chi flow down to the pancreas to activate it. Return the combined Chi to the breasts.

(7) Activate the adrenal glands with the energy, and bring it up to the breasts to blend with all the energies of the other glands. This accumulation will help to activate the organs' Chi.

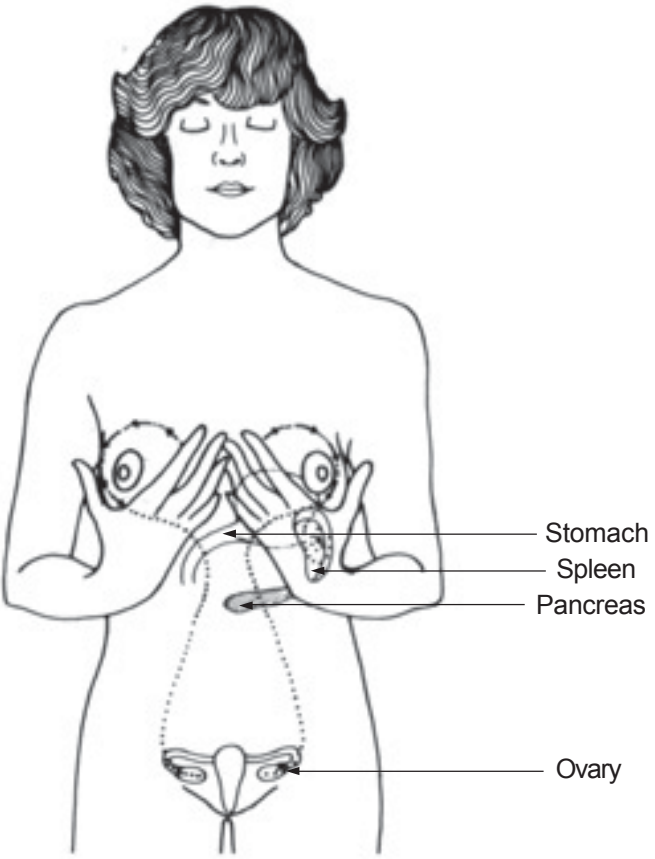

Fig. 3.28 *Spleen, Stomach and Pancreas Chi*

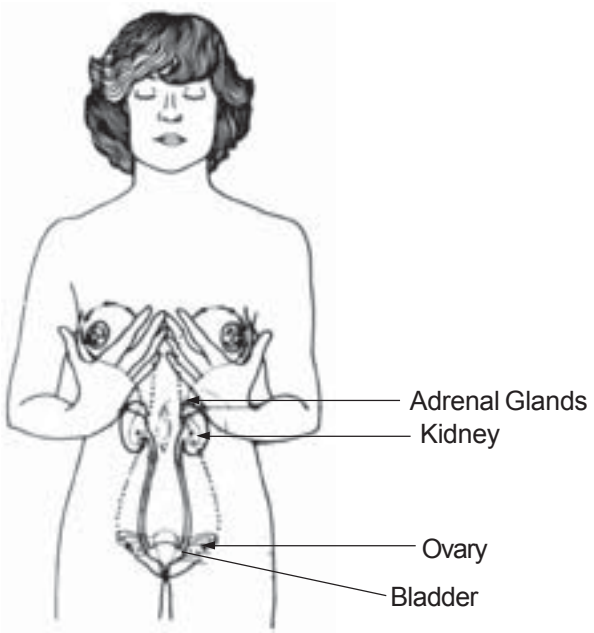

Fig. 3.29 *Kidneys, Adrenal Glands and Bladder Chi*

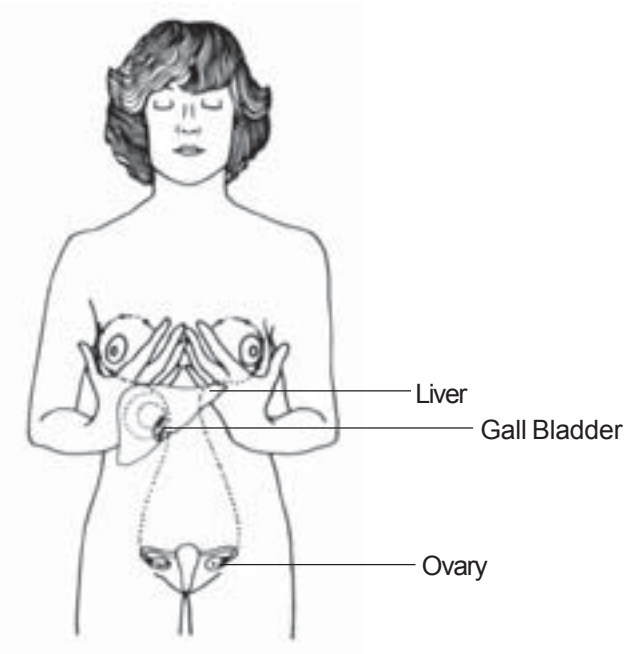

Fig. 3.30 *Liver and Gall Bladder Chi*

c. Massaging the Organs with Accumulated Chi

(1) Again, rub your palms together until they are hot, and cover your breasts with your hands. Feel the Chi from the thymus and the breasts activate the energy of the lungs. (Fig. 3.27) Direct this Chi back to the breasts.

(2) Activate the heart's energy with the accumulated Chi, and direct this energy to the breasts.

(3) Direct your attention to your spleen, and allow the accumulated Chi to activate the spleen's energy. (Fig. 3.28) Feel the Chi of the spleen, and direct it to the breasts.

(4) Now direct the Chi to the kidneys. (Fig. 3.29) Activate the energy of the kidneys, and direct it to the breasts.

(5) Direct the Chi to the liver, and activate the livers energy. (Fig. 3.30) Draw the liver's energy into the breasts.

(6) Place your palms on your knees as you focus your attention upon your breasts. Experience the energy that has accumulated in them. Let the energy expand into the nipples as you feel a tingling warmth. Wait a few moments as the breast energy accumulates in the nipples, and then let the energy flow directly down into the ovaries. Pause, and feel the accumulated energy in the ovaries.

(7) Become aware of your breath and concentrate on the ovaries, breathing directly into them. Use your mind and a slight muscular contraction to move the lips of the vagina. Feel an increase in the pulsation of the vagina, and feel it open and close like the petals of a flower: When this energy becomes strong, let the vagina close in, and then draw the energy from both ovaries to merge in the Ovarian Palace three inches directly below the navel. Slightly squeeze in, tensing the cervix and concentrate the sexual energy at this point.

D. Massaging the Ovaries

After completing the breast massage, place each hand over its respective ovary at a hand's breadth below the navel on each side of the abdomen (Fig. 3.31), and massage the ovaries 36 times in both directions as you did with the breasts. Once you have sufficiently stimulated the breasts and the clitoris, the warm, moist vaginal secretions indicate that the body is ready for the egg to be inserted. The Chi that is now available for your practice is comprised of energy from the organs, the glands, and the sexual center.

Fig. 3.31 *Massage the ovaries circling 36 times counterclockwise.*

F. Internal Egg Exercise for Women

1. Overview

In ancient China the egg exercise was a closely guarded secret of the queen and concubines who aimed to please the king. Taoist women used it to strengthen the sexual region, thereby increasing both the Ching Chi and life-force energy that was available to them. This practice also develops internal strength and control over one's sexuality. As the egg is inserted into the vagina, the subsequent exertion used to move it within the vaginal canal increases the strength of the lower abdomen. This internal "work out" helps you develop a mastery over the Chi Muscle (refer to Chapter Five) and its functions. It also aids in gaining control over many of the involuntary muscles in the same area.

The Sexual Energy Massage is used to prepare the vagina for the insertion of the egg by training the muscles surrounding the vaginal canal, especially the Chi Muscle. The egg's use, however, is unnecessary if you prefer to initiate the internal contractions without it. (In that case the egg is only needed for Chi Weight Lifting.) The following steps also serve as a preparation for Chi Weight Lifting.

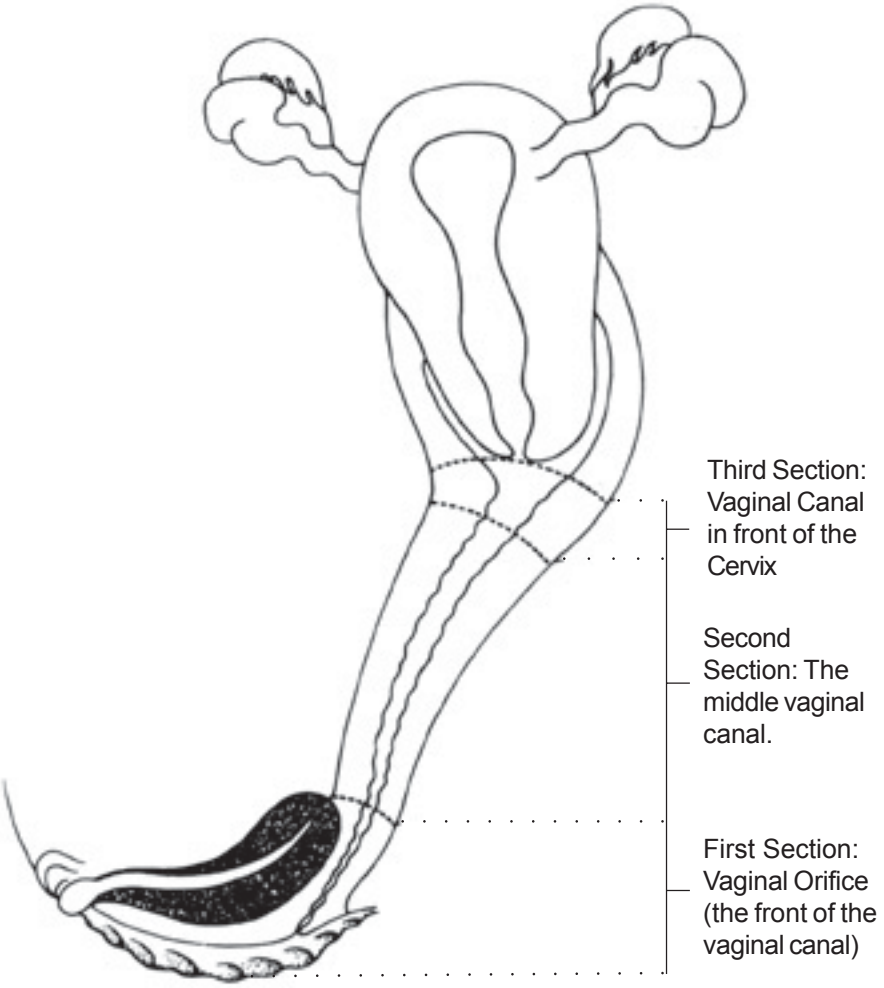

Fig. 3.32 *Three Sections of the Vagina*

Examine Fig.3.32. The egg is used as a guideline for contractions in three specific locations:

a. The first is the front of the vaginal canal, within the external orifice.

b. The second is the middle of the canal between the first and third sections.

c. The third is directly beneath the cervix, near the end of the canal.

In contraction exercises without an egg, one simply uses the Chi Muscle to contract the three sections of the vaginal canal. Each section is contracted individually, beginning with the external orifice, then the middle canal, and then the anterior of the cervix, which is contracted before beginning once more at the orifice. The egg exercise, used in conjunction with the massage, creates more resistance within the canal. Chi Weight Lifting is the final stage of the practice in which maximum resistance can be attained.

2. Equipment

The recommended eggs to use are made of jade. Jade and obsidian eggs can be drilled to accommodate a string passed through their centers for the advanced weight lifting practice. The obsidian eggs may require a diamond drill bit. It is recommended that any egg should be drilled, even if weights are not used. The string may help in removing the egg. Jade eggs are preferable because they are sturdy. smooth and non-porous. You may also find that jade eggs are far less expensive. These eggs are available through theUniversal Tao. Additional information on their use can be found in Chapter Five.

Warning**:** Wooden eggs, or any eggs with painted or chemical finishes, should be avoided.

3. Suggestions for the Internal Egg Exercise

a. As a useful addition to this technique, it is recommended that Ovarian Breathing be practiced concurrently with the egg exercise. (Refer to *Healing Love Through the Tao: Cultivating Female Sexual Energy*.)

b. Do not practice lying down.

c. If you have a tight vagina, or if you are a beginner, use the egg with a string to eliminate any fears of the egg becoming stuck. Ultimately, you will learn how to expel the egg without the help of the string. If an egg without a string attached gets stuck, do not panic. Relax and allow the muscles to rest until you can gradually expel the egg. When the perineum grows stronger you may wish to advance to a double egg system.

d. Remember that this exercise should not be attempted if you have a vaginal infection or if you are menstruating. Wait at least two days until after your period is over before starting practice.

4. Preparation for Inserting the Egg

a. Personal Hygiene

Proper feminine hygiene is an absolute necessity for Bone Marrow Nei Kung. Remember that morning, preferably after bathing is the best time to practice the Sexual Energy Massage and the Internal Egg Exercise.

b. Cleanliness of the Egg

Cleanliness of the egg is extremely important. All eggs should be boiled prior to their first use, and washed after every training session. Because some women may be unknowingly allergic to isopropyl or rubbing alcohol, avoid using them to clean the egg.

c. Lubrication

If the preliminary massage does not provide enough natural lubrication, lubricate the egg with a non-toxic oil or gel prior to its insertion. Be sure that the lubricant is not petroleum-based.

5. Internal Egg Exercise Step by Step

a. Inserting the Egg

(I) Insert the egg into the vagina, larger end first. After some practice, you should begin to increase the force of the suction used to draw it in.

(2) Once inserted, assume the “Embracing the Tree” posture described in Appendix 1, or stand with your feet parallel, at shoulder width, and the knees slightly bent. Elevate your arms in front of you to a 45 degree angle, palms facing upward, and clench your fists. Use this standing posture to practice the egg technique and to lift weights.

b. Positioning the Egg (Fig. 3.33)

(1) Isolate and contract the muscles that close the external vaginal orifice.

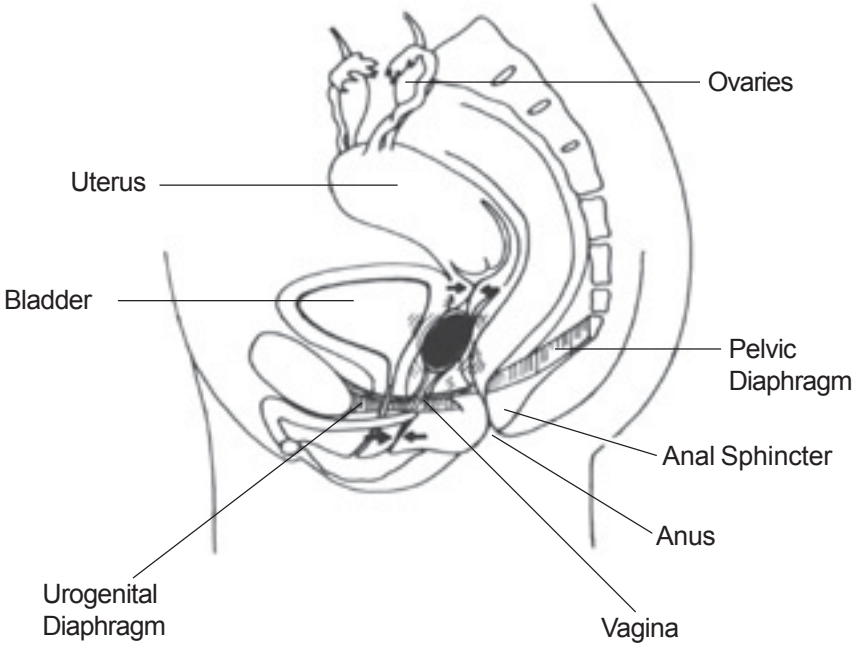

Fig. 3.33 *Woman's Sexual Glands*

(2) Inhale slowly and deeply down into the ovaries as you gather your sexual energy. Bring it down through the uterus, to the clitoris, and then hold it there.

(3) Contract and hold the lower, middle, and upper vaginal muscles so that the egg pushes into the vaginal canal.

c. Contracting the Three Sections

As the egg is pushed into the vaginal canal, an internal sucking action is begun by contracting the three sections of the canal to move the egg in and out of each section. The sequence of contractions is as follows:

(1) First the orifice is contracted to draw the egg into the canal.

(2) Next, the Chi Muscle at the anterior of the cervix--third section--is contracted to force the egg back into the middle canal. At this point, the two sections are being contracted simultaneously below and above the egg.

(3) The middle canal is then gradually squeezed to establish a grip on the egg as pressure is increased to move it up and down in the canal at will. (Fig. 3.34)

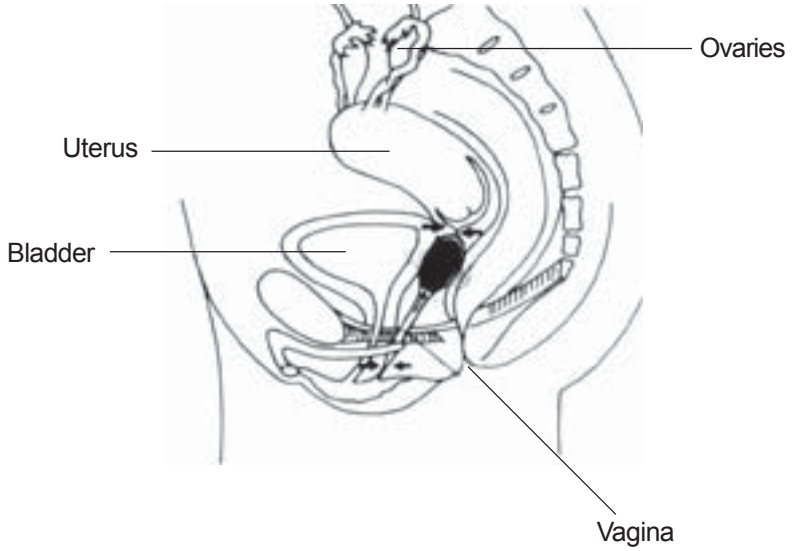

Fig. 3.34 *Moving the Egg up.*

(4) The speed of the motion should eventually be increased and maintained until you feel the need to rest. The rest period is important as Chi will start to accumulate in the area.

(5) At this point take a deep breath and draw the accumulated energy into the Microcosmic Orbit as described earlier in this chapter. This is done after every Bone Marrow Nei Kung exercise.

d. Removing the Egg

You should remove the egg by contracting the vaginal muscles to expel it. At first, a squatting position mad be necessary. Try elevating one leg on a short chair to facilitate the egg's removal. If you are using an egg with a string attached, removal should be very simple, although your internal capabilities should be allowed to develop without too much external help.

e. Massage

Massage the breasts and vaginal areas with a silk cloth after practicing the egg exercise. (Fig. 3.35) Next, massage the perineum in a circular motion counterclockwise for nine, eighteen, or 36 times, and then clockwise for nine, eighteen, or 36 times. Massage the

coccyx and sacrum in the same manner using a counterclockwise motion, and then reverse for the same number of repetitions. This will enhance the action of the Sacral Pump and increase the upward flow of Chi, transforming raw sexual energy into life-force energy.

Fig. 3.35 *Massage the breasts with the cloth.*

f. Rest

Rest, then practice two or three of the Six Healing Sounds, particularly the Lung and Heart Sounds. Also practice the Microcosmic Orbit Meditation to circulate the tremendous energy you have generated throughout your body. Sit comfortably concentrate on the navel, and use the mind to move the energy. (See Appendix 1 for the Six Healing Sounds.)

g. Clean the Egg

The mucous secretions on the egg are an ideal medium for bacterial growth, so be sure to clean the egg thoroughly after each use.

Jade eggs can be boiled daily, although washing may suffice. Boil the egg at least once a week for complete safety, and never let anyone else use your egg.

Warning To All Practltioners**:** The Sexual Energy Massage and Chi Weight Lifting practices both require that the Hitting techniques described in Chapter Four be applied immediately, after the dissemination of Ching Chi and hormones into the body. This is to help assimilate the energy before too much of it accumulates in the head.

G. Summary

1. At this stage of Taoist practice, there are three approaches to sexual energy: Healing Love, Sexual Energy, Massage, and Chi Weight Lifting.

a. Healing Love retains sexual energy, stimulates the brain, and rejuvenates the organs and glands to increase the production of Ching Chi.

b. The Sexual Energy Massage uses more of this energy as well as sexual hormones to fortify the bones, regrow marrow, and replenish the blood while strengthening the genitals and internal system. These techniques comprise one of the most important practices of Bone Marrow Nei Kung.

c. Chi Weight Lifting is the ultimate practice for releasing sexual energy into the body. It extracts the highest concentration of Ching Chi from the genitals while strengthening the fasciae genitals, and internal system. The release of sexual hormones stimulates the pituitary gland.

2. The Power Lock: This is practiced before and after the Sexual Energy Massage to assist in the upward draw of released energy and sexual hormones. The Power Lock employs nine short sips of breath with nine contractions of the genital, anal, and perineal areas. The tongue is pushed against the palate, and the buttocks and teeth are clenched to activate the cranial and sacral pumps. In conjunction with these contractions, the three middle fingers of cither hand press a point at the back of the perineum, near the anus, to help guide the rising energy up to the five stations of the sacrum, T-11, C-7, base of the skull, and the crown. The goal is to draw sexual energy from the perineum to the crown.

3. Genital Compression: This exercise replenishes the energy drawn from the genitals during the other practices. This is not a Bone Marrow Nei Kung technique in itself, but rather a separate practice for use afterwards. The method compresses energy into the genitals to enhance their production of Ching Chi.

4. Preliminary Cloth Massage: A silk cloth is used to massage the genital area, the perineum, the coccyx, and the sacrum. This is done before and after the Sexual Energy Massage to first prepare the genitals for the exercise, and later to replenish the flow of blood and Chi to the sexual center. This is particularly useful in preventing blood coagulation and subsequent blood clots from occurring in the genitals of male practitioners.

5. Sexual Energy Massage For Men:
   a. Finger Massage of the Testicles
   b. Palm Massage of the Testicles
   c. Ducts Elongation Rubbing
   d. Stretching the Ducts Gently with Massage
   e. Stretching the Scrotum and Penis Tendons
   f. Tapping the Testicles

6. Sexual Energy Massage for Women:
   a. Breast Massage
   b. Massage of the Glands with Accumulated Chi
   c. Massage of the Organs with Accumulated Chi
   d. Massage the Ovaries

7. Internal Egg Exercise: This exercise uses the jade egg as a guideline for contracting the three sections of the vaginal canal to strengthen them. The first section is the front of the vaginal canal, within the external orifice. The second section is the middle of the canal between the first and third sections. The third section is directly beneath the cervix, near the end of the canal.

Chapter IV
Hitting

An interdependence exists among the Bone Marrow Nei Kung disciplines. Although some benefits are derived from these exercises individually, only their combined practice can produce the coveted “Steel Body” that transcends human frailties and disease. For example, Bone Breathing and Bone Compression work best when combined with the Hitting practice. Hitting is also used after Chi Weight Lifting to enhance the body’s assimilation of Ching Chi, The practice does not depend upon the other disciplines, but it dramatically increases their effectiveness by promoting a much deeper penetration of energy into the body.

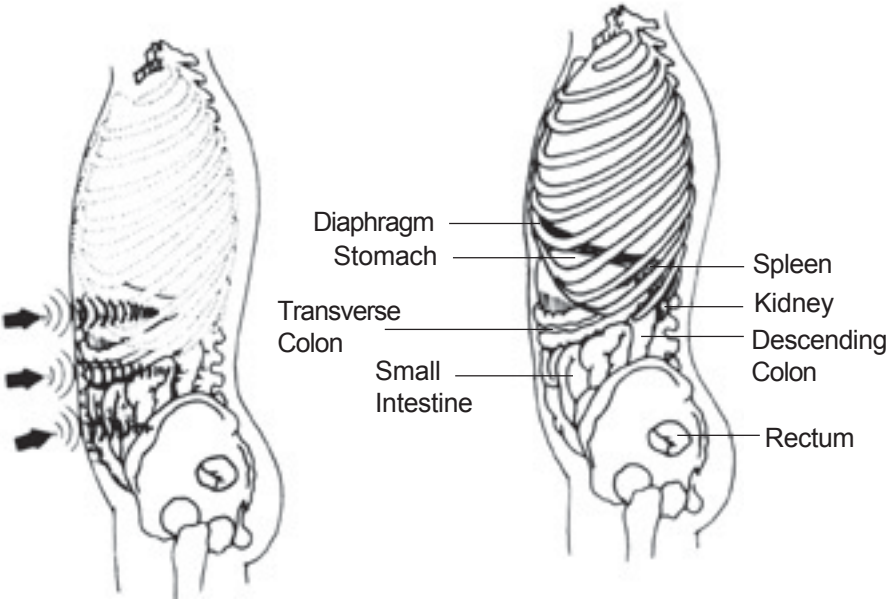

Fig. 4.1 *Vibrations from Hitting breaks up toxic substances deep within the body.*

A. Overview of Hitting

In the primary form of Hitting, a bundle of wire rods is used to strike specific lines along the body and limbs. (A long bean bag filled with mung and black beans may be used instead.) The wire rods create vibrations which serve to open the pores of the bones for the accumulated energies to access the bone marrow. These vibrations also shake any toxins out of the fasciae, muscles and internal organs, while breaking up deposits of uric acid and releasing tension from the body. (Fig. 4.1) A second form of Hitting uses rattan sticks along the same lines to improve the exterior of the body and increase the strength of the nervous system.

The specific lines used for Hitting correspond to known acupuncture meridians that accommodate the Chi flow throughout the body. As you hit along each line, vibrations penetrate into its respective organs through the associated meridians. The Hitting device also vibrates the fascial layers, separating them while the accumulated energy inflates them like cushions to protect the internal system. The resulting increase in Chi pressure creates a resilience within the organs, enabling them to bounce back from each strike. This rebound creates shock waves in the Chi flow from which the organs, glands, and bones can absorb more energy. (Fig. 4.2)

B. Methods of Hitting

Note: Of the two forms of Hitting, the first focuses primarily on internal health. whereas the second is geared towards external improvements.

1. There are three methods at the first form of Hitting:

(a) “Hitting with Packing” is the most comprehensive approach to Hitting. It is the only method explained in detail here, since it encompasses the other methods. The technique works in conjunction with a Bone Breathing and Bone Compression process referred to as “Packing.” This process requires that you inhale, spiral, pack and squeeze energy into the bones of a specific limb or part of the body, and then maintain the compression as you hit along the lines of that area. The process continues for each section of the arms, legs and body in succession as described below.

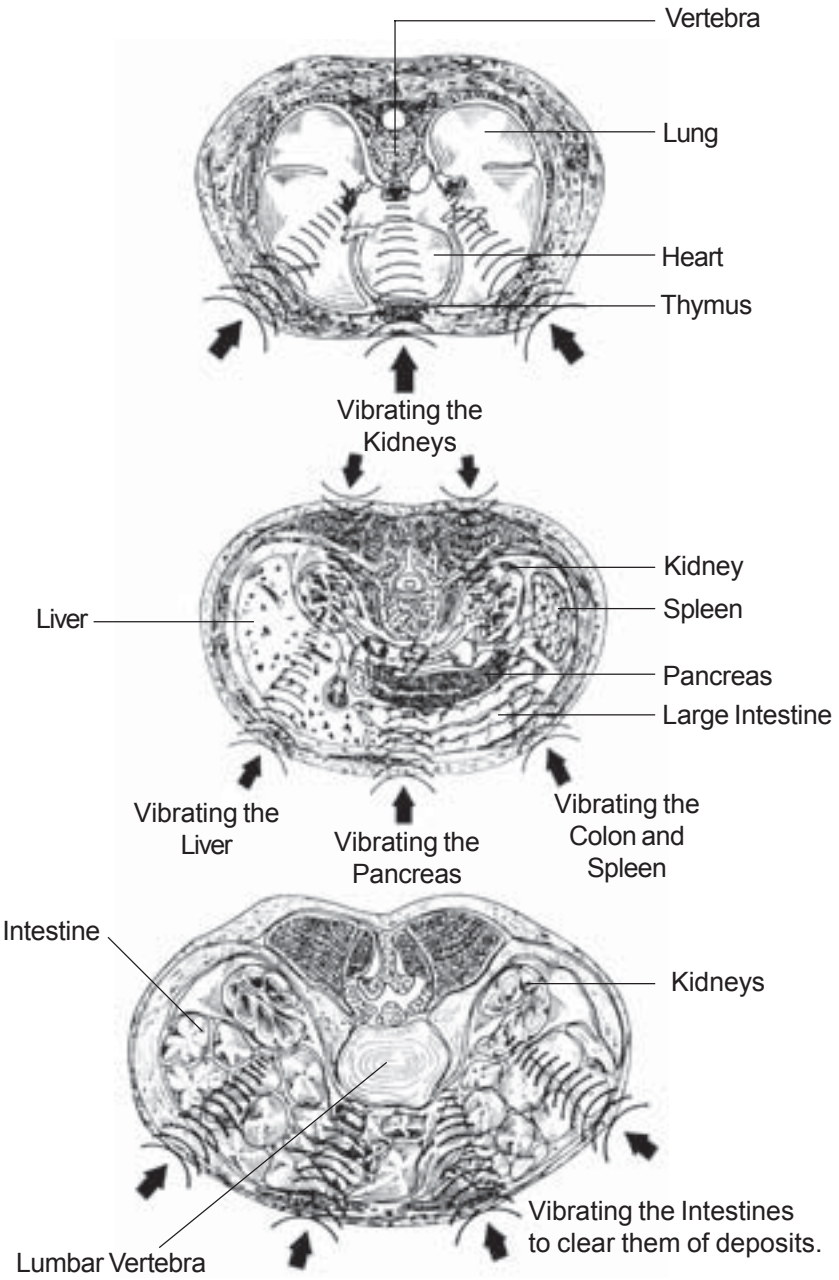

Fig. 4.2 *Cross sections of the torso showing how the vibrations reach the organs.*

(b) “Hitting with a Long Bean Bag” uses a sack of mung and black beans eighteen inches long instead of the wire device. The sack has a cooling effect which alleviates the problem of too much heat that arises from the other Hitting practices. The long bean bag absorbs heat and toxins while helping the hones to absorb Ching Chi and external energy. This method is useful for beginners and those who are physically weak.

(c) “Hitting to Detoxify” also uses the same Hitting lines as the other methods, but it does not include any Bone Breathing or Bone Compression since there is no Packing involved. This method relies solely on the vibrations of the wire device or the use of the bean bag to cleanse the internal system. This detoxification process can he used as a preparation for the other methods, or as a practice by itself.

2. The second form of this practice “Hitting with Rattan Sticks,” is used to improve the nervous and lymphatic systems while strengthening the skin and external features of the body. Most of the same lines are used, hut no bones are hit, and Packing is unnecessary. Hitting with rattan sticks can be done immediately after any of the other Hitting methods. It is usually the final Bone Marrow Nei Kung procedure before the closing meditation and the Six Healing Sounds.

C. Hitting Equipment

Vibrations in the Hitting practice are created by a special striking instrument made of bundled wires. From 100 to 110 pieces of twelve gauge wire, cut to eighteen inch lengths, are bound together at one end with duct tape covering approximately six inches of the bundle. The bound end should be covered with enough tape to feel comfortable in your hand. The free end should be about twelve inches long. The wires at the free end should be separated slightly to help distribute the impact and create vibrations during the Hitting process. (Fig. 4.3)

Note**:** Women may prefer to use a lighter wire device with 50 to 75 pieces of wire in the bundle.

The wire device can be replaced by a long bean bag, eighteen inches long by three inches wide, of strong material filled with mung and black beans. This device is not intended to create vibrations,

but it helps to absorb any excess heat that the body cannot assimilate. The bag can be used after the wire device to eliminate the problem of overheating.

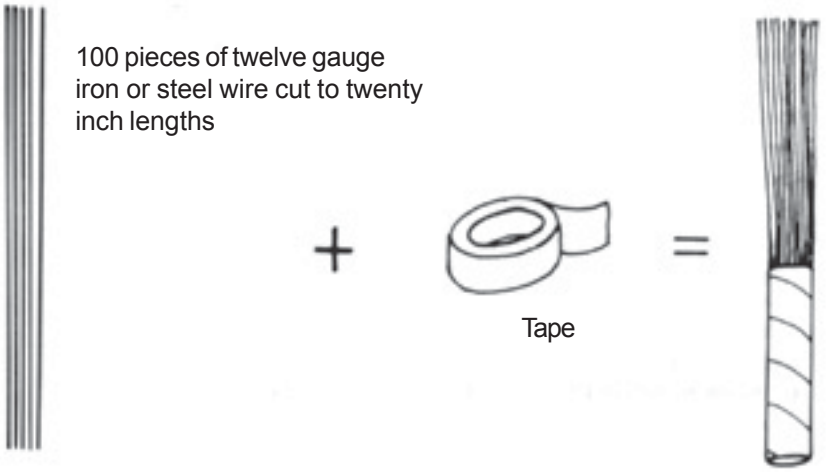

Fig. 4.3 *Wire Hitter*

The rattan sticks are cut from a very, light hardwood to a length of about two feet. Two sticks are wrapped together with duct tape at approximately two inches from each end as they are held together. (Fig. 4.4) The rattan sticks are used for external stimulation, which strengthens the nervous and lymphatic systems through the shock of contact with the skin.

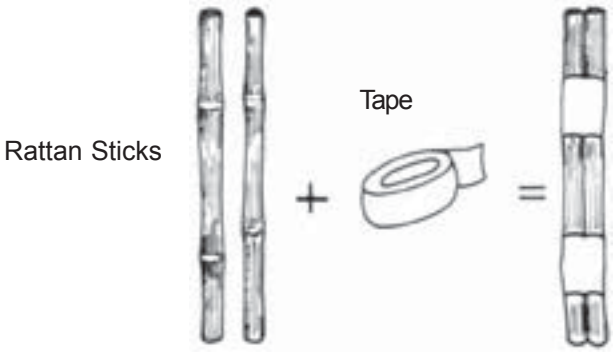

Fig. 4.4 Rattan *Hitter*

D. Choosing the Right Approach

The format that will hest serve you depends upon your goals and your physical condition, since your needs may not require a full regimen of Hitting on a daily basis. Those involved in martial arts can benefit from a complete training program, but a less comprehensive schedule is adequate for those who are interested only in detoxifying the body or improving the skin. In any case, it is recommended that the abdominal lines be hit daily as part of the detoxifying process. Include the insides of the elbows, the backs of the knees, and the Ming Men point an the back opposite the navel.

In the beginning you should only use the Hitting to Detoxify method without any Packing. Gently hit along each line without tensing your muscles, and use only three strikes to emphasize each point. The spares between these points should also he randomly brushed in a steady rhythm. Because the vibrations of the wire device penetrate up to six inches beneath the skin, there should be little concern that some meridians and corresponding organs will miss the shock waves if any points are merely brushed over. These waves spread out as the device makes contact. Follow this with a light application of the rattan sticks.

Note**:** Hitting with Packing can also be used to detoxify but it should not be practiced until the detoxification process works without overheating or exhausting your body.

When you advance enough to use Packing, remember to pull up the sexual organs and the urogenital and pelvic diaphragms as you compress Chi into each area. First become aware of the limb or part of the body you intend to hit. Then inhale, spiral, pack, and squeeze Chi into it, maintaining the compression as you strike the lines of that area with either Hitting device. All tension is released by exhaling after each series of hits. As you strike the body, the free hand can either be clenched in a fist or used to cover the kidney on the opposite side from that which you are Hitting. Continue this process with each successive area.

Eventually you can increase the number of times that you hit each point from three to nine as your practice evolves into a continuous, rhythmic motion. You may also increase the force with which you hit, provided that you maintain a sensible approach, since the effects of overzealous practice can be detrimental. None of the exercises in this book is intended to be difficult or strenuous in any

way. After a line is hit it is important to rest and feel the heat that is generated so that you can direct it into the upward flow of the Microcosmic Orbit.

Important**:** Even if you do not intend to use Packing it is Recommended that you first read Section E to learn the sequence, and then practice from the summary, which does not include the Packing process. Read the precautions in Section G carefully before you begin the practice.

E. Hitting with Packing in Detail

Hit gently, especially in the beginning. If you use the wire device, your goal is to create a spring-like action which will initiate gentle shock waves in the body's energy flow. (The free ends of the wires should be slightly spread to accommodate this action.) Vibrations resulting from this exercise activate the Chi and create the space its absorption.

1. Awaken the Energy and Detoxify

The following steps constitute a warm-up exercise to prepare for Hitting. These steps are designed to stimulate the energies stored in the navel and to detoxify the places where toxins accumulate most heavily. Always hit gently, using light to medium force. Rest and practice Bone Breathing in between rounds. (Fig. 4.5) After finishing the Hitting sequence, hit these four areas again to complete the practice.

a. Tan Tien--Lower Abdomen: Hit three times the lower abdomen point located three inches directly below the navel. As you hit the navel and the Tan Tien, feel the warmth spread throughout your body. (Fig. 4.6) Hit again three times with packing if you like, and then rest briefly.

b. Ming Men: Hit the Ming Men point--also known as the "Door of Life"--on the spine opposite the navel three times. (Fig. 4.7) When Packing this area, inhale, and draw the energy up from the perineum, through the sacrum, and into the Ming Men, Also pack the two kidneys while pulling up the left and right sides of the anus. Hit the Ming Men three times again, and then rest. Be aware of the point,

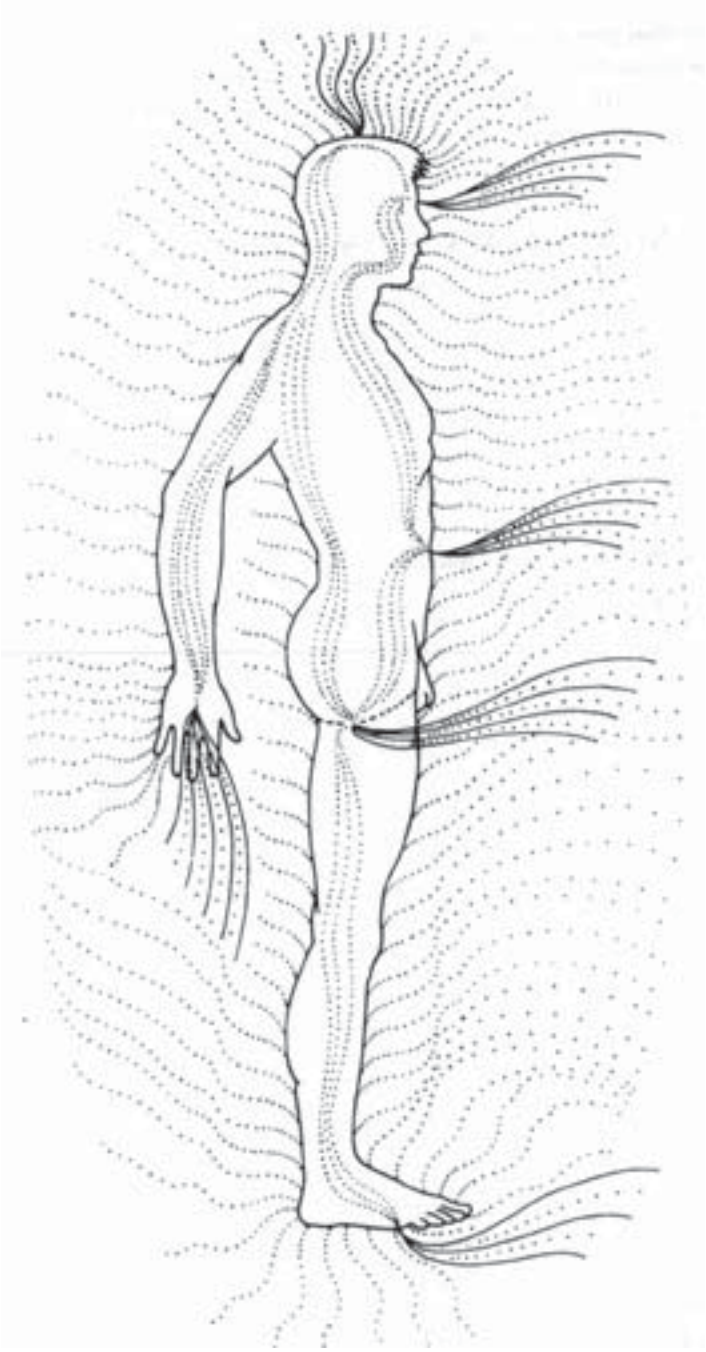

Fig. 4.5 *Rest and practice Bone Breathing, using the mind to absorb energy into the bones and through the whole body.*

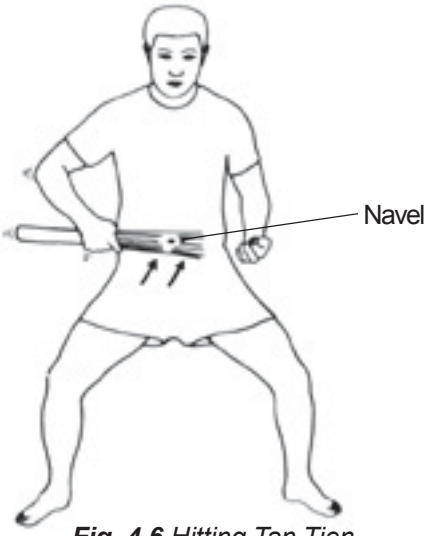

Fig. 4.6 *Hitting Tan Tien.*

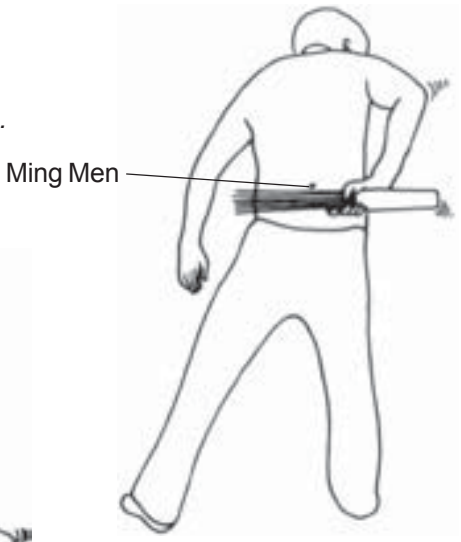

Fig. 4.7 *Hitting back.*

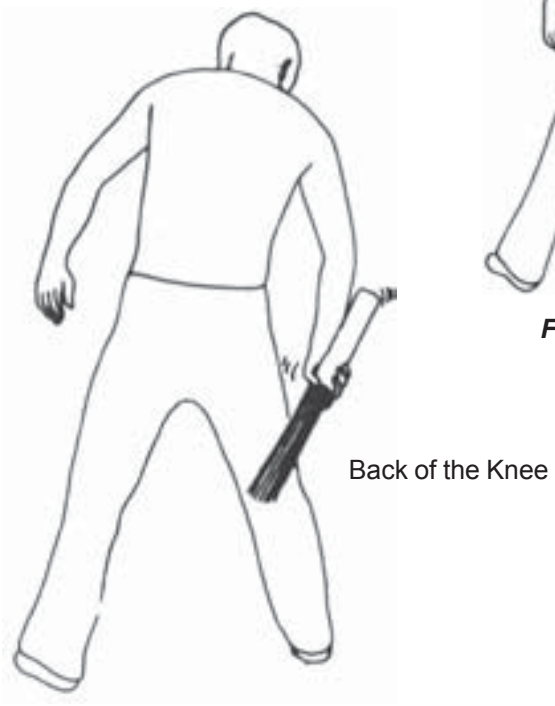

Fig. 4.8 *Hitting leg.*

and use your mind to absorb the energy into the spine through the Ming Men.

c. The Back of the Knee: Hitting this point will release an enormous amount of toxins which accumulate there. (Fig. 4.8) Hit three times, and then rest as you breathe energy into the bones, (Fig. 4.5) Repeat the procedure.

d. Inside of the Elbow: Hitting this point initiates powerful detoxifying vibrations throughout the arms. (Fig. 4.9) Hit three times. Rest as you feel the energy flow. Repeat once more.

Fig. 4.9 *Inside of the Elbow*

2. Hitting the Abdominal Area

Practice should start with the five vertical lines of the abdomen between the rib cage and the pubic bone. (Fig. 4.10) As you breathe in Chi, directing it to the navel, do not over-compress the air into your lungs. Sip in small amounts of air--less than ten percent of your lung capacity--as you concentrate on raising the Chi pressure in the navel area. Make sure you feel the pressure at the navel and not in the chest. (Fig. 4.11)

a. Center Line: Standing in a Horse Stance position, inhale, pulling up the genitals and the pelvic and urogenital diaphragms. After you have drawn Chi into the navel with your breath, spiral,

Fig. 4.10 *Five Lines of the Abdomen*

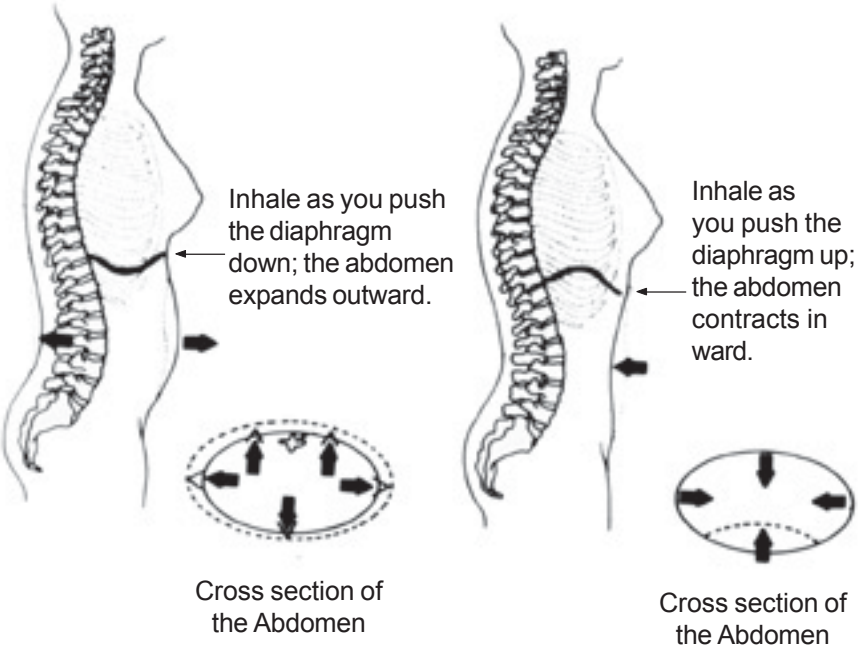

Fig. 4.11 *Breathing in Chi*

pack, and squeeze it as you strike the compressed area three times. Apply the same procedures to the Lower Tan Tien, continuing down to the pubic bone, and then back up this line to the solar plexus. (Fig. 4.12) Exhale, relax, and absorb the Chi.

Fig. 4.12 *Pack and hit from the navel down to the pubic bone and back up to the solar plexus.*

b. Interior Left Abdomen: Inhale pull up, spiral, pack, and squeeze energy into the interior left abdominal line. This channel runs parallel to the center line vertically between the ribs and the pubic bone, one and a half inches to the left of the navel. While maintaining the pressure, hit down to the pubic bone and then back up the same line to a point just below the rib cage. (Fig. 4.13) Exhale, relax, and absorb the Chi.

c. Exterior Left Abdomen: Inhale again, pull up, and pack into the exterior left abdominal line that runs parallel to lines (a) and (b) at about three inches to the left of the navel. With the left hand raised to avoid obstructing the process, use the right hand to hit down to a point near the hip, then hit back up the same line to a point just below the rib cage. (Fig. 4.14) Exhale, relax, and absorb the Chi.

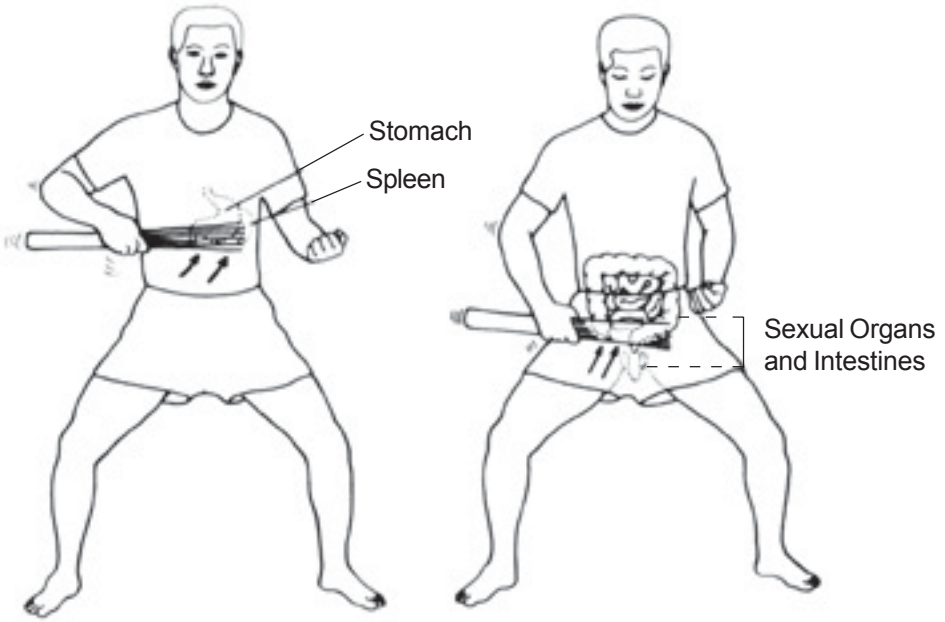

Fig. 4.13 *Hitting the abdomen.*

Fig. 4.14 *Hitting the exterior left abdomen.*

d. Hitting the interior and exterior lines on the right side of the abdomen uses the same steps as above. Use the left hand to hit as the right hand covers the right kidney, or remains in a fist. (Fig. 4.15) These are lines (d) and (e) of the abdomen.

Fig. 4.15 *Hitting a vertical line paralled to the line at the navel*

3. Hitting the Sides of the Body

The next line is located on the far left side of the body, extending downward vertically from the armpit. Raise the left arm overhead to access the left side line with the right hand. Start hitting from the floating rib--at the level of the navel--down the left side to the hip, then back up to the rib cage, continuing up to the armpit, and back down the left side again to the floating rib. Exhale, rest, and absorb the Chi. The right side line is exactly the same as the left, but this time the device is held in the left hand as the right arm is raised to facilitate Hitting. (Fig. 4.16)

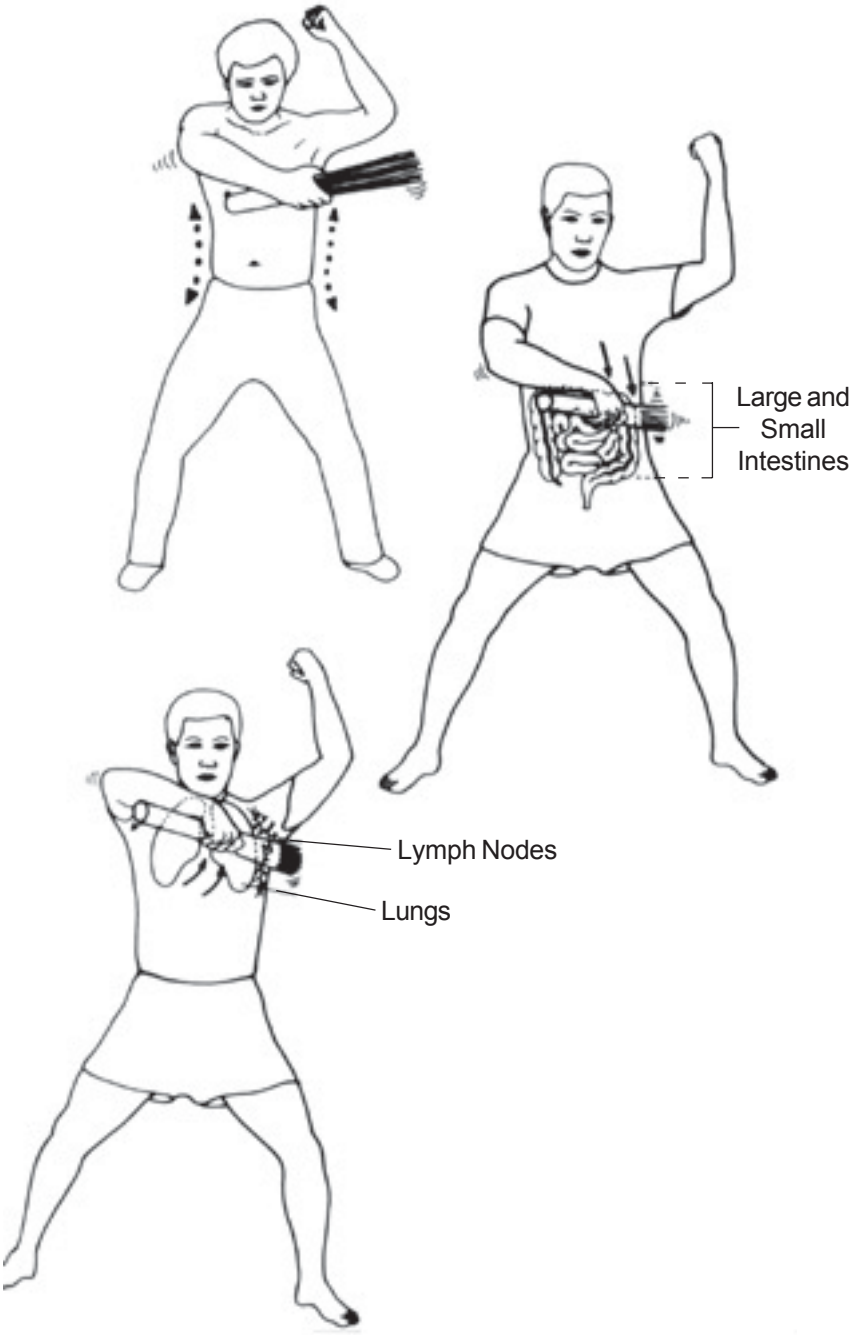

Fig. 4.16 *Hitting the sides of the body from the floating ribs to the hip*

Fig. 4.17 *Hitting the ribs from the sternum outward horizontally.*

Fig. 4.18 *Hitting the sternum and the collarbone (the vibrations stimulate the thymus gland).*

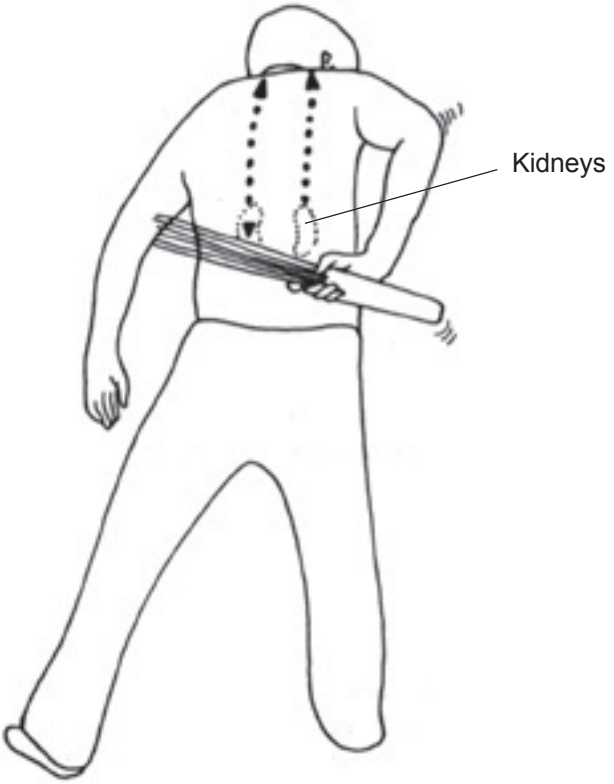

Fig. 4.19 *Hitting the lines extending from the kidneys to the base of the skull.*

4. Hitting the Rib Cage

(a) The rib cage is gently hit across the chest in horizontal lines, starting from the sternum and proceeding in either direction. (Fig. 4.17) Reposition the wire device at the sternum after each rib is hit, working from the bottom ribs to the top. Follow the curvature of the ribs as they guide you towards the spine.

Begin at the base of the left chest, near the sternum, with the lowest rib. (The false ribs, which are not attached to the sternum, can be hit either as part of the back. or along with the side lines which extend from beneath the armpits.) Pull up the left side of the anus as you breathe into the left side and pack Chi into it. Hit the left rib cage, moving up about one and a half inches for each rib,

starting each from the sternum. Then, using the left hand, hit the right rib cage in the same manner while pulling up the right anus.

(b) The last sections to hit are the sternum and the collarbone on both sides. Hit this area from the base of the sternum, along the collarbone, and finally out to the shoulder. (Fig. 4.18) Use caution while Hitting the sternum. Exhale, relax, and absorb the energy.

5. Hitting the Back

Note: It is always preferable to have a partner hit the lines of the back for you. This allows you to concentrate more on the absorption process and less on trying to access hard to reach areas.

a. The Lines of the Back: Hit a point three inches directly to the left of the Ming Men three times, using the right hand. (Fig. 4-19) Then, round the scapulae by extending your left arm and shoulder as you sink in the chest. Pack and hit the left kidney gently and then hit vertically all the way up to the neck. Pull your chin towards the back of the head, clench your teeth, and press your tongue to the palate as you reach the base of the skull. Return down this line to a point to the left of the sacrum, and then go back up to the starting point. Rest, and absorb the Chi. Hit the line three inches to the right of the Ming Men in the same manner.

6. Hitting around the Head and Jaw

Gently hit around the head, tapping at the level of the hairline, but never on top or near the crown. Then lightly tap around the outside edges of your lower jaw. (Fig. 4.20) Always pull back the chin, clench your teeth, and press your tongue to the palate when Hitting the head.

7. Left and Right Inside Elbows

Note: The insides of the elbows should be hit separately before Hitting the lines of the arms, and then again afterwards to conclude the exercise. First inhale, pack, and pull up the undertrunk while contracting the muscles around the left inner elbow. Concentrate on this area, and hit the inside of the joint three times. (Fig. 4.21) Exhale, relax, and absorb the Chi. Hit the inside joint of the right

Fig. 4.20 *Gently tapping the head and jaw.*

Fig. 4.21 *Hitting the left and right inside elbows.*

arm in the same manner. The back of each knee joint should also be hit this way before starting the leg sequences.

There are six meridians on the arms: the three inside lines of the middle finger, the thumb, and the pinky, and the outside lines of the index finger, the fourth finger, and the pinky. If you find that you have little time to hit all six lines, then only hit the two inside lines of the middle finger and the thumb, and the two outside lines of the pinky and the back of the hand. (These four lines are used in the chapter Summary.) Always lower the arm to reach the outside meridian associated with the small finger. See Fig. 4.22 for the six meridians of the arms.

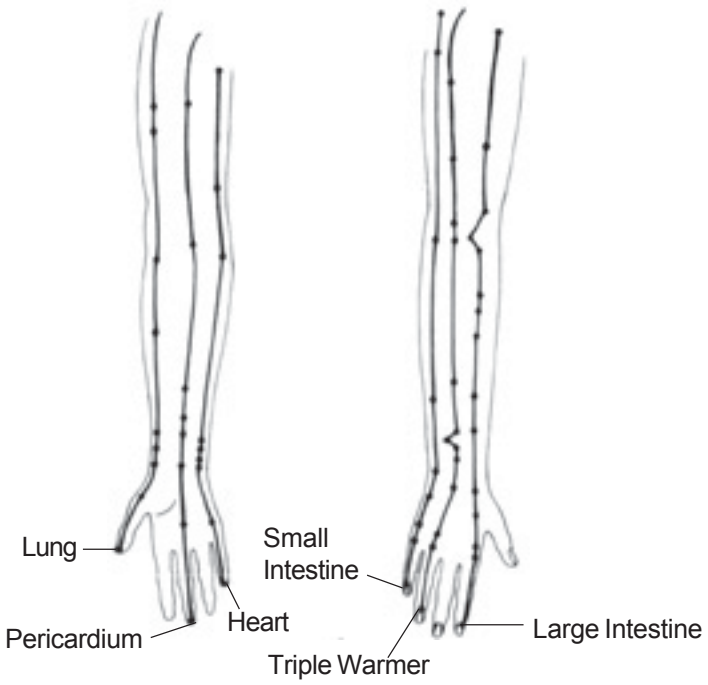

Fig. 4.22 *Six Meridians of the Arms*

8. Inside Elbow--Middle Finger Line

Extend your left arm above the level of your shoulders with the palm facing up. Hit the inside of the left elbow three more times, then continue Hitting along the center of the arm to the inside wrist,

through the palm, to the tip of the middle finger. (Fig. 4.23) Return using the same route, traversing the inner elbow, to reach the shoulder at the front of the collarbone. Rest, absorb the energy, then move to the next line.

Fig. 4.23 *Hitting the Middle Finger Line*

9. Inside Elbow--Thumb Line

With the arm extended above the shoulder, and the palm facing up, hit three times the point located near the outside part of the inner elbow, slightly to the left of its center, where the radius bone begins. Hit towards the hand from this point, over the upper part of the inner wrist, to the inside tip of the thumb, and then return by the same line to the shoulder at the top of the collarbone, over the clavicle. (Fig. 4.24) Rest, absorb the energy then move to the next line.

10. Inside Elbow--Pinky Finger Line

With the arm raised above the shoulder and the palm facing up, hit three times the point inside of the inner left elbow, slightly to the right of its center, where the ulna bone begins. Hit towards the hand, over the lower part of the inner left wrist, to the inside tip of

Fig. 4.24 *Hitting the Thumb Line from the shoulder to the thumb.*

Fig. 4.25 *Inside Pinky Finger Line*

the pinky finger. (Fig. 4.25) Return by this same line to the shoulder near the chest Rest, absorb the energy, then move on lo the next line.

11. Outside Elbow--Index Finger Line

With the arm raised above the shoulders, palm face down, and thumb slightly lower than the pinky, hit a point to the right of the outside left elbow three times. From this position the point should appear almost directly between the centers of the inside and the outside of the elbow, on top of the radius bone. Hit towards the back of the hand from this point until you reach the outside tip of the index finger, then return along the same line to the left shoulder. (Fig. 4.26) Rest, absorb the energy, then move on to the next line.

Fig. 4.26 *Outside Index Finger Line*

12. Outside Elbow--Fourth Finger Line

Lower the arm, extending it beneath the shoulder level with the palm facing down. Turn the wrist so that the thumb is lower than

the pinky finger. Bend the left elbow and feel the depression located slightly inward from the tip of the outer elbow, between the tip and the first visible protrusion of the elbow joint. Straighten the left arm and hit this point three times. Continue to hit along this line toward the back of the hand, traversing the outside wrist, over the knuckles, to the tip of the fourth finger. (Fig. 4.27) Return the Hitting process all the way back up this same line to the top part of the shoulder. Rest, absorb the energy, then move on to the next line.

Fig. 4.27 *Fourth Finger Line*

13. Outside Elbow--Pinky Finger Line

Lower the left arm with the palm directly facing outward, turning the wrist vertically so that the pinky finger is the highest point directly over the thumb, which should point to the floor. Begin Hitting three times the point near the tip of the outside left elbow, continuing the process all the way along the ulna bone, over the outside wrist, to the tip of the pinky finger. (Fig. 4.28) Return along the same line to the back of the shoulder by the scapula, near the armpit.

Finish the left arm by again Hitting the center point of the inside elbow three times. The right arm should be hit in the same manner as the left in order to cover the other aspects of the same meridians. Rest, absorb the energy, and then move on to the lines of the right arm. You may hit the left arm and leg together before practicing on the right arm and right leg.

Back side of
the pinky finger

Fig. 4.28 *Hitting the Qutside Pinky Line from the shoulder to the fingertip.*

14. Left and Right Posterior Knee Joints

The six leg meridians are accessed through four Hitting lines--one in back, two on the sides, and one that passes down the middle in front. Start awakening the energy of the legs by Hitting the sacrum three times, since energy tends to concentrate there. Then pack and hit the inside of each knee joint the same way you did the insides of the elbows. (Fig. 4.29)

15. Back Side of the Left Leg--Heel Line

Begin by moving your right leg forward and bending it slightly, while the left leg remains straight at a comfortable angle. With the device held in your left hand, hit the back of the left knee three more times,

Fig. 4.29 *Heel Line*

Fig. 4.30 *Heel Line - Back Side of the Leg*

then pack and hit from the left buttocks down to the heel of the left foot. (Fig. 4.30) Return the process hack up along the same line, covering the starting position, lo a point on the back three inches directly to the left of the Ming Men. Rest, absorb the energy, then move on to the next line,

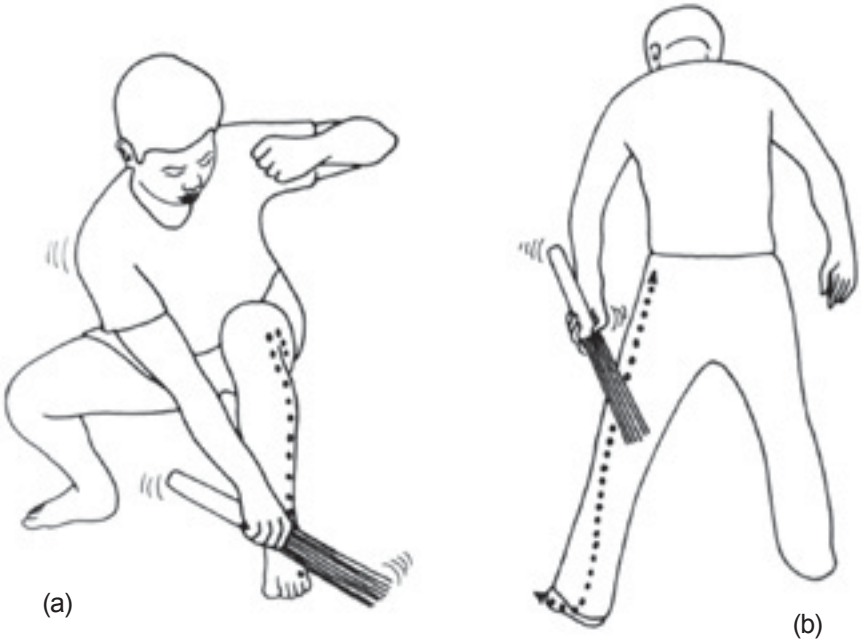

Fig. 4.31 *Heel Line - Back Side of the Leg*

16. Outside Left Leg--Small Toe Line

Maintain the stance above, and hit the point left of center on the outside of the left knee three times. Pack and hit the outside of the leg from the hip down to the outer edge of the ankle, ending at the tip of the small toe. (Fig. 4.31 (a)) Return back up this same route to finish where you began, (Fig. 4.31(b)) Rest, absorb the energy, and then move to the next line.

17. Inside Left Leg--Big Toe Line

With your feet parallel, move your left leg one half-step to the side. Men should use the right hand to cover the genitals, pulling them

away from the left side. Pack and hit three times the point located on the inner side of the joint, to the right of the knee, between the kneecap and the back of the leg.

From a point near your genitals, which are protected, continue Packing and Hitting down along the inside of the leg, covering the inside of the ankle completely, to the tip of the big toe. Hit the ankle area three additional times since the spleen, liver, and kidney meridians meet near the ankle on this line. (Avoid Hitting the protrusion of the ankle bone directly.) Return back up this same line to the starting point near the genitals. (Fig. 4.32) Rest, absorb the energy, and then move on to the next line.

Fig. 4.32 *Hitting the big Toe Line of the Leg.*

18. Front of the Leg--Middle Toe Line

Stand with the left leg forward slightly, and hold the device in the right hand. Hit a point below the center of the left kneecap three times gently. (Hit beneath the kneecap, not directly on it.) Reposition the Hitting device to the point at which the leg meets the body in the middle of the leg, directly between the hip and the sexual center.

Hit down the front of the leg, covering the knee, over the tarsus of the foot, to the tip of the middle toe. (Fig. 4.33) Gently hit the area at the top of the foot, in the middle, an additional three times. Return back up this line to end where you started the process. Hit the point at the back of the knee three times to finish the process. Rest, absorb the energy, and then move on to the lines of the right leg.

Fig. 4.33 *Hitting the Middle Line of the Leg.*

19. Sole of the Foot or "Bubbling Spring"

Hitting the bottom of each foot helps to increase the Chi flow and the circulation, returning blood to the heart faster through the veins. It also helps to open a channel for earth energy to be drawn into the body. You may sit on a chair and strike the point illustrated in Fig. 4.34 from nine to 36 times. Rest, and absorb the energy.

F. Hitting with Rattan Sticks

Warning**:** The neck, ribs, kneecaps, sacrum, spine, and all joints must be carefully avoided when using the rattan sticks. With this in mind, you may apply this procedure to the lines described in the summary after carefully reading the precautions in Section G.

Fig. 4.34 *Hitting the Sole of the Foot ("Bubbling Spring").*

Hitting with Rattan Sticks does not create vibrations within the body as does Hitting with the wire device, but it increases your tolerance for pain and releases tension in the muscles, detoxifies the skin, and enhances lymphocyte production. It also helps the nerves to conduct impulses more effectively while increasing the production of hormones. The Hitting lines for rattan sticks are identical to those used for the other methods, but several areas must be avoided.

This practice is usually done immediately after the other Hitting methods. It is important to remember not to use any Packing, and to avoid Hitting the bones. Never hit the sacrum or the spinal cord with the rattans. Unlike the other methods, the rattan sticks are used sparsely on the two side lines extending over the kidneys. During this procedure, the scapulae must be rounded and separated by extending the arms as you hit their respective lines. For this reason it is best to have a partner apply the device for you.

Fig. 4.35 *Hitting the bones of the lower arms with the rattan sticks will toughen them.*

Fig. 4.36 *Carefully Hitting the shins with the Rattan Sticks.*

Fig. 4.37 *Hitting below the navel with the Rattan Sticks.*

Certain areas, such as the shin hones and the ulna and radius bones of the lower arm, can be toughened to improve one's abilities in martial arts or in contact sports. (Fig. 4.35) The shins tend to be very sensitive, so the rattan sticks should be applied very lightly from the top of the shins down, and then back up again. (Fig. 4.35) As a rule, however, it is best to hit where there are not too many bones. (Fig. 4.37) You should also be especially careful to avoid the face, neck, spine, and kneecaps. The point here is to absorb the shock of wood upon skin, thereby detoxifying the skin and strengthening the nerves while the pain is transformed into energy.

G. Precautions

Warning**:** Never apply any hitting device to an area that has been bruised or recently scarred in any way. this will only increase the pain and inhibit the healing process. Also avoid hitting any sores or open wounds that can become infected or bleed as a result of this practice.

1. If you have psychological or physical illnesses, or any sexually related problems, consult a doctor or psychologist before attempting this practice.

2. If the Microcosmic Orbit has not been opened, you cannot experience Hitting safely. To avoid severe discomfort and possible damage to your system, be certain that you have a clear flow of internal energy. When Packing is used with Hitting, Chi pressure is increased to the point where energy flows up to the head in quantities greater than the brain can safely handle. A channel must therefore be opened for this energy to travel down from the head to the navel. Be sure that the Microcosmic Orbit is open in order to avoid serious consequences.

3. When Hitting remove all watches, pens, and jewelry that will obstruct your practice, and put them in a safe place.

4. If you are weak or in poor health, you should not use Hitting with Packing because the rush of energy that is produced can be overwhelming to your internal system. Practice Hitting to Detoxify--without Packing--until your health improves.

Note: People with high blood pressure, heart disease, or blood clots should refrain from Packing altogether. A physician must be consulted before attempting any form of the Hitting practice in this case.

5. Always use a Hitting technique with the wire device or the long bean bag immediately after the Sexual Energy Massage or Chi Weight Lifting. This is required to help the body assimilate the energy before too much of it rushes to the head with potentially dangerous results.

6. Always try to relax the upper part of the body while practicing. If there is tension in the muscles of the chest, the heart and lungs may become congested with Chi and overheat. If any difficulties occur such as chest pain, reduce or stop your practice until you are comfortable.

7. Although the sacrum is lightly tapped in detoxifying, do not in any way hit the spinal cord.

8. When Hitting around the neck or the head, clench your teeth, and place your tongue up against the roof of your mouth to avoid damaging your teeth or biting your tongue.

9. Do not practice Hitting on a full stomach, and do not eat immediately after Hitting, Wait at least two hours after a moderate meal before practicing. Also, it is best to empty the bladder and

bowels before a practice session; otherwise large amounts of Chi may be passed out of the body.

10. It is important to remember not to take a shower or bath for at least an hour after you have practiced Hitting, especially if you sweat. Water can wash away external energy, thereby reducing some of the energy you are trying to store. Shower before practicing.

11. Even if you are in good health, if you feel just a little out of sorts or weak, do not practice Hitting or any exercise that requires Hitting. If you decide to practice at such times, hit only your arms, legs, and back very lightly. Wait at least a day or two, or until you again feel alert and vigorous, before striking areas where the impact might reach vital organs.

12. Make sure that you get sufficient rest after Hitting; the detoxification may exhaust you. Drink plenty of pure water to help the cleansing process.

13. Burp freely during practice: your body will feel the need to eliminate the trapped toxins and gases that are released from within.

H. Summary of Hitting

The following summary can he used with or without Packing for all applications. The areas to avoid with the rattan sticks are indicated.

1. Abdomen

a. Preliminary Hitting: To stimulate energies and detoxify, hit three times the Lower Tan Tien (below the navel), the Ming Men (opposite the navel on the spine), the inside of both elbows, and the backs of both knees. Remember to hit the inside elbows three times before and after practicing on the lines of the arms. Also hit the backs of the knees before and after Hitting the legs.

b. Hit from the navel down to the pubic bone, and then back up lo the sternum.

c. Hit down a parallel line from a point one and a half inches to the left of the navel, and then back up to beneath the ribs.

d. Hit down a parallel line from a point three inches to the left of the navel and then hack up to the ribs.

e. Apply the same procedures to lines running parallel on the right side of the abdomen at one and a half inches and three inches respectively.

2. Rib Cage

Do not use rattan sticks to hit the rib cage.

a. Apply the wire device to the ribs from the sternum extending outward horizontally, starting at the base of the rib cage, Hitting towards the left side, then repositioning the device higher at the sternum for each rib. Apply the same procedures to the right side of the chest. (Always hold the device at an angle, pointing out to the side.)

b. Gently tap the sternum to stimulate the thymus, then extend the Hitting lines upward and out to both sides of the collarbone.

3. Lines of the Back

Avoid the sacrum and spine when Hitting with the rattan sticks. Sink in the chest as you round out both scapulae by extending your arms. Using the wire device, lightly hit from the left kidney up to the left side of the neck at the base of the skull, and then back down. Change the hand holding the device if necessary. Always clench the teeth. Apply the same procedures to the right side.

4. Left and Right Sides of the Body

Raise your left arm and hit downward from the floating ribs to the left hip. Then hit back up to the armpit, returning finally to the floating ribs. Repeat the same procedure on the right side.

5. Head and Jaw

Do not apply the rattan sticks to the head and jaw.

Gently tap with the wire device from the forehead around the skull, avoiding the crown. Use the device cautiously around the lower jaw. Remember to clench the teeth whenever you hit the neck, head, or jaw.

6. Lines of the Arms

Avoid Hitting wrists, knuckles, and elbows with the rattan sticks. Although there are six meridians in each arm and leg, there are four Hitting lines commonly used to access them from the surface of each limb. Use these four lines when you do not have time to hit all six.

Note**:** Three of the following Hitting lines require that either arm be held up higher than its shoulder as it is hit. Only the Pinky Line requires that the arm be held down.

a. Middle Finger Line

Raise the left arm, palm up, fingers extended. Hit the inside of the elbow three times, then continue Hitting as you move the striker toward the middle finger on the palm side. Use the same process as you return toward the shoulder, up to the base of the neck. End by Hitting the inner elbow three more times.

b. Thumb Line

Raise the left arm, thumb side up, and hit from the top of the inner elbow--close to the outside of the arm--to the end of the thumb, and then back towards the shoulder until you reach the neck line.

c. Back of the Hand

Raise the left arm, palm down, and hit from the side of the elbow down to the tip of the middle finger and then back to the shoulder once again.

d. Pinky Line

Lower your left arm in front of you, thumb pointing down, palm facing out vertically so that the small finger is on top. Hit from the base of the elbow to the tip of' the pinky finger, and then back up to the posterior of the collarbone.

You may apply the device to the other arm now, or you may hit the lines of the left leg before using these procedures on the right arm and leg.

7. Lines of the Legs

Avoid kneecaps, toes, and ankle bones when Hitting with the rattan sticks.

a. Middle Line

Hit from the top of the left leg--where it joins the body in front--down to the tips of the toes, and then back up to the starting point.

b. Big Toe Line

Men should cover the genital area. Hit the inner leg from the inner thigh down to the inside of the big toe, and then back up to the starting point.

c. Small Toe Line

Hit the outer left leg from the hip joint down to the small toe, and then back up to the starting point.

d. Back of the Leg

Hit from the buttocks to the heel of the left foot, emphasizing the back of the knee, then return up this route to the starting point. Hit the back of the knee three more times to finish the left leg. You may now reposition the Hitting device and begin the process on the same four lines of the right leg, or on the right arm and leg together.

8. Soles of the Feet (“Bubbling Spring”)

You may sit in a chair to hit the soles of the feet. Hit each from nine to 36 times, rest, and absorb the energy.

Chapter V
Chi Weight Lifting

Warning: Chi Weight Lifting is included in this text solely for the documentation of its procedure to serve as a guide for instructors and trained students of the Universal Tao. It is not intended for beginning students. Universal Tao cannot and will not be held responsible for any reader of this book who attemps Chi Weight Lifting without first receiving qualified instruction from the Universal Tao. Even trained students must thoroughly master the exercises in Chapter Three before practicing Chi Weight Lifting.

The ancient Taoist masters discovered that the genitals were connected to the organs and glands in an area of the perineum called the "Chi Muscle," which encompasses the anal, perineal, and pubic coccygeal muscles. (Fig. 5.1) With this knowledge they developed the Healing Love techniques, using the Chi Muscle to create an upward flow of sexual energy into the higher centers of the body. They eventually learned to increase this Chi flow by developing the "fasciae," which are connective tissues engaged by the organs and glands to lift weights externally anchored to the genitals in the Chi Weight Lifting practice. (Fig. 5.2) The beneficial aspects of strengthening the internal system through the fasciae became an integral part of Bone Marrow Nei Kung.

Originally men accomplished Chi Weight Lifting by placing stones in a basket and hanging the basket from their groins. Today, male and female Taoists use light weights to draw a special formula of sexual energy from the genitals upward into the body. This sexual energy, or Ching Chi, is combined with external energy and compressed into the skeletal structure through the methods described in this book. As sexual energy transforms into life-force energy, Chi Weight Lifting enhances the life-force of the men and women who practice it. The genitals are replenished by the rejuvenated organs and glands as the transformed energy returns through the Microcosmic Orbit.

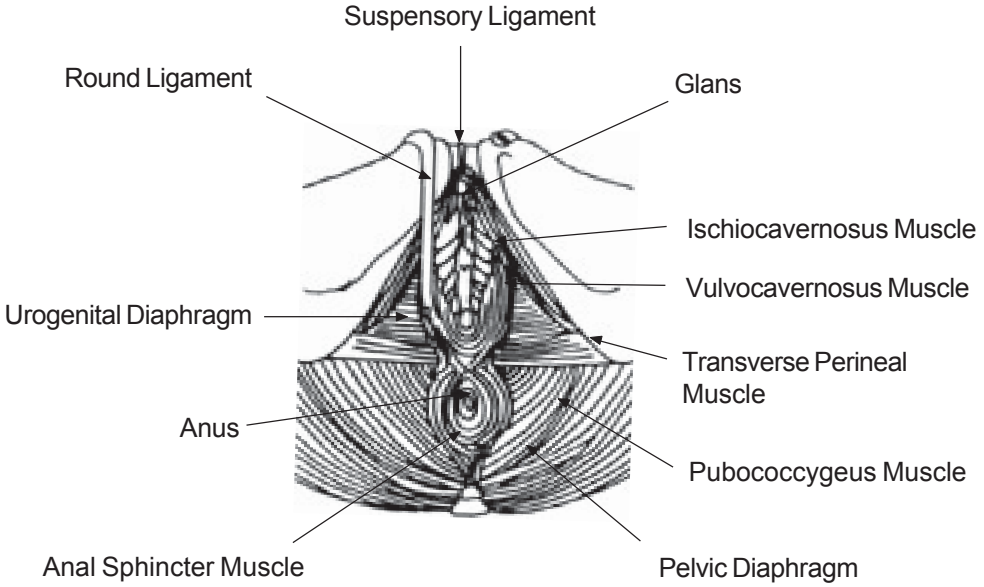

Fig. 5.1 *Chi Muscle includes the urogenital diaphragm, the pelvic diaphragm, the anal spincter muscle, and the pubococcygeus (PC) muscle.*

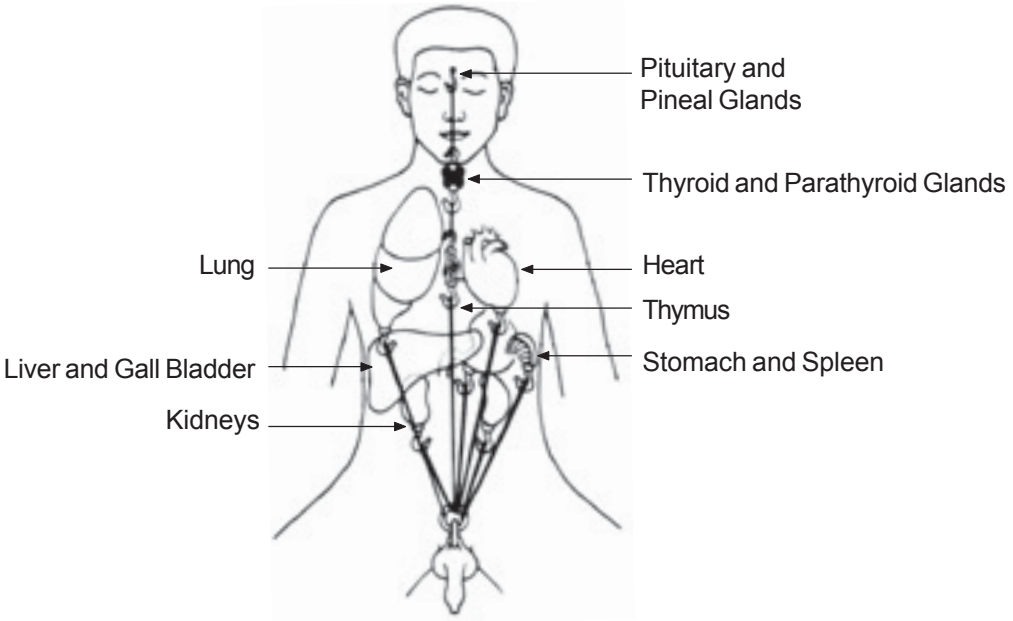

Fig. 5.2 *Sexual organs are joined to all of the organs, glands, tendons, and muscles.*

A. Applications for Chi Weight Lifting

1. Strengthening the Fasciae Network

An upward counterforce is created by the internal organs and glands to resist the weight placed upon the genitals. This force is strengthened by the Chi released from the sexual center as the internal system engages the fasciae to pull up against the weight. The fasciae, therefore, contribute greatly to the distribution of energy. They also serve as the connection between the genitalia and the pelvic and urogenital diaphragms. When this connection is loose, the Chi Muscle and the diaphragms allow the organs to drop their weight onto the perineum, thereby reducing the Chi pressure. When the connection is kept strong, the organs and glands are held in place and the Chi pressure is maintained.

2. Chi Weight Lifting for Powerful Urogenital and Pelvic Diaphragms

The human body has many diaphragms holding the internal organs and glands in place, such as the thoracic, pelvic, and urogenital diaphragms. During Chi Weight Lifting these contribute greatly to the upward counterforce deployed against the downward pull of the weights anchored to the genitals. (Fig. 5.3) The pelvic and urogenital diaphragms, considered the floor of the organs, and the Chi Muscle, are all strengthened by this practice which helps to prevent any loss of energy through them. Their increased strength also helps to alleviate the protruding abdomen caused by organs stacking up on the pelvic area. (Fig. 5.4)

Chi Weight Lifting is credited with many other benefits related to the improved functioning of the diaphragms, such as the lifting of dropped kidneys. Furthermore, the practice helps to seal the openings of the anus and sex organ to prevent the leakage of Chi. Taoists believe that this helps to redirect the spirit away from these openings as one prepares to finally leave the body. The upward flow of energy that is developed through Taoist practices will point toward the crown as the proper exit for the spirit to use at the end of life.

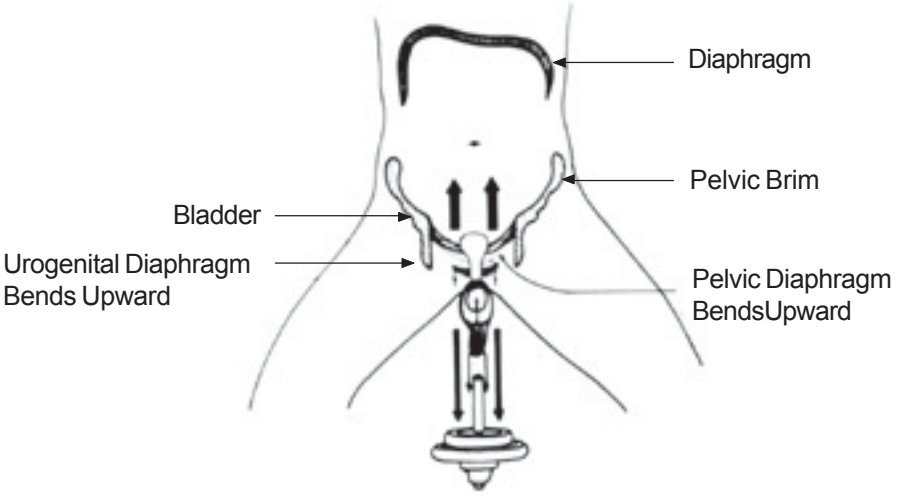

Fig. 5.3 *Pelvic and urogenital diaphragms provide counterforce to the weights.*

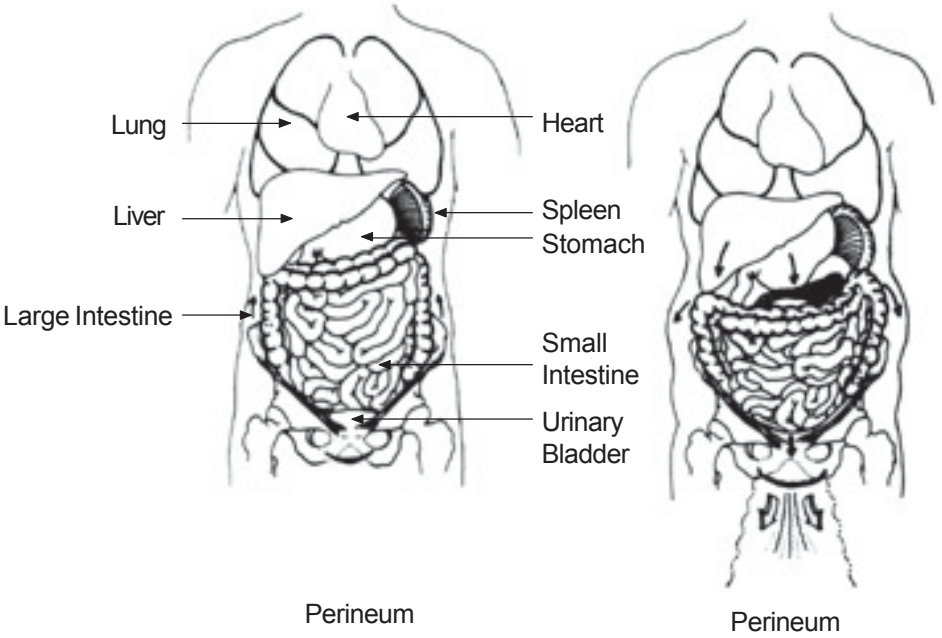

Fig. 5.4 *Organs*

3. Sexual Hormones Delay the Aging Process

The release of sexual hormones stimulates the pituitary gland to prevent the production of an aging hormone. It has been proposed that one function of this gland may be to measure the growth of mutated reproductive cells. Scientific studies have found some evidence that the aging hormone is released when these mutations are allowed to increase beyond a certain level. Theoretically their growth should he impeded by a healthy reserve of sexual hormones. Otherwise, upon sensing the reduced presence of Ching Chi within the body, the pituitary gland can cause a premature death by producing the aging hormone. It is therefore wise to maintain sexual energy and hormones through the Taoist practices.

4. Sexual Hormone Stimulation of the Brain

The right side of the brain is also influenced by the sexual hormones to promote the healing and rejuvenation of the body. Since Ching Chi revitalizes the internal system and regrows the bone marrow, hormonal stimulation of the brain greatly enhances these processes. This effect also serves Taoist spiritual work because practitioners find it to he an invigorating experience on all levels. The health of the body and the mind directly affects the spirit.

B. Equipment and External Preparations

1. Cloth for the Massage and Lifting the Weight

Men and women use a silk cloth for the Sexual Energy Massage techniques to increase the flow of Chi and blood in their sexual centers. Silk works well because it develops considerable static energy when rubbed. This is important for the stimulation of Chi in the sexual organs, perineum and sacrum. Women also use the cloth to massage their breasts. Men use the cloth after the massage techniques to lift the weight from a special holding apparatus.

Men: Two sizes of cloth can be used to lift the weight, depending on the method chosen for practice. The smaller cloth, which is used for lifting the weight from a table or chair, should measure approximately three and one-half by eight inches. If you choose to

lift the weight from the floor, the length of the cloth can very according to the length of your legs. When the cloth has been cut to size, you can sew the edges to prevent unraveling and to avoid abrasions of the skin.

2. Equipment for Men and Women

a. Equipment For Men

Men require a special device by which the weight can be held to the cloth. (Fig. 5.5) Cut a ten inch length of galvanized pipe for an apparatus to be used from the floor. Cut an eight inch length for an apparatus to be used from a chair. (Either size is adaptable to either method if necessary.) Drill a one-quarter inch hole through the pipe one-half inch from either end.

Secure a piece of chain two links long to the pipe with a one quarter inch bolt inserted through the hole and fastened by a nut and washer at its end. At the end of the chain, a heavy ring one and a half inches in diameter is attached. Several types of clamps may be used on the opposite end of the pipe to hold the weights. After the silk cloth has been tied gently, but firmly, around the groin, it can then be attached to the ring in order to lift the entire weight-holding apparatus.

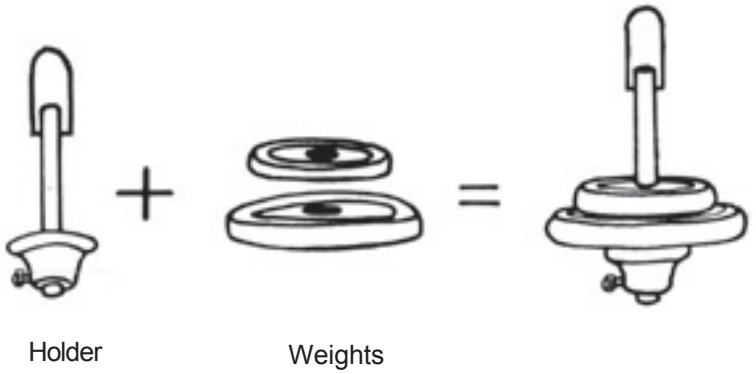

Fig. 5.5 *Weight lifting device for men.*

Some men can begin Chi Weight Lifting with a two and one-half pound weight; however it is safer to start with the apparatus alone, or with one or two weight clamps attached to it. (These are used in standard barbell sets.) If you use two weight clamps, their weight should equal one pound, plus the weight of the apparatus itself. Some stores that carry sporting equipment sell one and a half pound weights. Add on more weight gradually, but only as much as you feel comfortable with. Do not advance to higher weights unless you can lift the current weight easily for one minute.

b. Equipment for Women

Women require a special egg drilled lengthwise for the insertion of a string which holds the weight. (See Chapter Three.) The egg is inserted into the vagina, large end first, with the string tied to the weight. Squatting may make it easier to insert the egg as the weight rests on the floor. The weight is then lifted and swung like a pendulum. Jade eggs are recommended. Obsidian eggs can also be drilled to accommodate the string, but they may require a diamond drill bit.

It is recommended that all eggs be drilled, even if weights are not used, because the string can help in removing the egg. Jade eggs are preferable because they are sturdy, smooth, and non-porous. You may also find that jade eggs are far less expensive. Wooden eggs, or any eggs with painted or chemical finishes should be avoided. Prior to Chi Weight Lifting, training with the egg should begin with the techniques explained in Chapter Three. The egg exercise must first be mastered without any weight.

Women can begin Chi Weight Lifting with a one-half pound weight, gradually adding one-half pound at a time. A string can be tied to the men's weight lifting apparatus, first using the bar alone as a trial weight. (Fig. 5.6) (Light weights are also available that can be tied directly onto the string without the bar.) Later, try using the men's apparatus with one or two weight clamps. which are used in standard barbell sets. Finally, when you are ready, try lifting the apparatus with a weight held on by one of the clamps. It is better to lift lighter weights for longer periods than heavier weights for shorter periods. Never exceed one minute.

Fig. 5.6 *Women can begin lifting by using the lifting apparatus alone.*

3. Preparations for Men and Women

After learning one of the tying methods, or how to use the egg, test yourself with the weight-holding apparatus before you add any weights to it. If it feels light to you, begin adding the weight clamps. Later, you may start adding standard weights. When you are ready, you can increase the w·eight until a maximum of two and a half pounds Is reached. ***Do not attempt to exceed this level on the first day.*** Instead, try to sustain the weight for longer periods, but less than a minute, to release more energy.

Swinging the weight will gently increase the pressure. This is preferable to increasing the weights too fast, or to lifting them too long. Each swing back and forth can be counted as one second.

Practice at each level until you can easily lift the weight for up to 60 seconds. Men must be careful not to cut off the circulation to the testicles. Lifting for more than a minute can impede circulation.

The room in which you practice should be quiet and well ventilated, hut not cold. Keep a hard chair available for your meditation and as a place to rest the weight, unless you lift from the floor. As suggested earlier, the best time for these exercises is the morning after you shower and relieve your bladder and bowels. If you can, face the sun as you practice in the early morning hours, but never look directly into it at any time.

C. Starting the Practice

1. When to Start

Men: In determining when it is safe to begin Chi Weight Lifting, consider the condition of your testicles and scrotum. If the scrotum is very loose and hanging weakly and the testicles feel weak, practice only the massage techniques. Do not practice Chi Weight Lifting. If the testicles are too tight and close to the body, none of the tying methods will work. Massage the testicles until they loosen.

The optimum condition for weight lifting is when the testicles are slightly loose, but firm. The strength of the testicles can be felt internally rather than with the fingers. In other words, when they are massaged their resilience and ability to withstand the massage without pain will indicate their condition. A slight pain from the first massage may be the result of a beginner's apprehensions. Do not begin to practice weight lifting until you are comfortable emotionally as well as physically.

Women: There is less danger for women in the Chi Weight Lifting practice. You are ready when, after massaging the breasts and genitals, the vagina is moist with secretions. If not enough moisture is present, prepare the vagina with a natural lubricating cream. Women can feel reasonably safe with these practices--provided that the egg and string are kept sanitary--because the weight can be easily released if it proves too heavy to lift.

2. Weight Lifting Goals

The Universal Tao does not recommend anyone try to lift over ten pounds without supervision. On the basis of this book; ten pounds should be considered the absolute maximum goal. Women may find that their lifting capabilities are slightly different because they have no way to anchor the weight and are therefore more dependent upon internal power. It is certainly no shame for men and women to lift less than the one or two pounds recommended for beginners. If you choose to lift beyond five pounds, exercise more than the usual caution.

Warning: Lifting heaver weights without supervision is both foolish and contrary to the recommendations of this book. In systems where excessive weights are used for practice, broken veins or blood clots have occurred in some overzealous men, resulting in serious injury. (There are no statistics available concerning possible deaths that may have occurred). Further instruction in Bone Marrow Nei Kung is necessary for Chi Weight Lifting with heavier weight. Contact the Universal Tao Center for information on advanced instruction.

D. Genital Massage and Preparatory Exercises for Men and Women

1. Massage Techniques

Review Chapter Three for the Cloth Massage and Sexual Energy Massage practices. These stimulate internal energies and prepare the genitals for the role at hand. (Fig. 5.7) First, the silk cloth is applied to the sexual center, perineum, and sacrum to activate the Chi. Men should feel the testicles fill with energy as they become firm. Women should feel the breasts enlarge slightly as the vagina becomes moist with secretions. The Sexual Energy Massage techniques should then be used to condition the genitals for Chi Weight Lifting. After the weights are removed, the massage techniques must be repeated to restore the circulation of blood and Chi to the sexual center.

Men: Although not all six techniques are required the Sexual Energy Massage must be emphasized by men after the weights have been removed to ensure that the genital area will be clear of any blood coagulation which can lead to blood clots.

Fig. 5.7 *Cloth Massage*

2. Outline of Pre-Chi Weight Lifting Exercises

Review Chapter Three for the practices listed here. Both men and women should specifically review the Power Lock which is used before the Sexual Energy Massage and again immediately after the weights have been removed. The Kidney and Chi Pressure exercises are included herein.

Men:
(a) Increasing Chi Pressure Exercise
(b) Increasing Kidney Pressure
(c) Power Lock-two or three times up to the Crown
(d) Cloth Massage
(e) Finger Massage of the Testicles
(f) Palm Massage of the Testicles
(g) Ducts Elongation Rubbing
(h) Stretching the Ducts Gently with Massage
(i) Stretching the Scrotum and Penis Tendons
(j) Tapping the Testicles

Women: (a) Increasing Chi Pressure exercise
(b) Increasing Kidney Pressure
(c) Power Lock-two or three times up to the crown
(d) Cloth Massage
(e) Breast Massage
(f) Massage the Glands with Accumulated Chi
(g) Massage the Organs with Accumulated Chi
(h) Massage the Ovaries
(i) Egg Exercise (optional)

a. Increasing Chi Pressure

Before you initiate the Power Lock exercise, you should be certain that the abdomen is full of Chi. Place the middle finger of each hand about one and one-half inches below the navel. Concentrate on the Lower Tan Tien as you inhale Chi into it, expanding the point with the resulting pressure. Your mental power increases the energy flow to this area. Exhale, and release the pressure. (Fig. 5.8) Repeat this exercise up to 81 times.

Fig. 5.8 *Inhale and Exhale up to 81 times to the lower abdomen to increase Chi pressure. Use the fingers to press in.*

b. Increasing Kidney Pressure

Stand in a Horse Stance with your feet slightly wider than shoulder width. Rub your hands together until they are warm, and then apply their warmth to the kidneys by placing your energized palms on them from the back. (Fig. 5.9 (a) and (b)) Bend your upper body forward slightly as you inhale, and pull up the left and right sides of the anus as you draw Chi up to the kidneys. (Fig. 5.9(c)) Exhale, and deflate the kidneys. Follow this sequence up to 36 times, and finish by warming the hands and again placing them on the kidneys.

Fig. 5.9 *Increasing Kidney Pressure*

E. Chi Weight Lifting

Warning: Do not attempt Chi Weight Lifting without studying the precautions in Section F.

Students are expected to receive instruction before attempting Chi Weight Lifting; however, the following detailed synopsis will clarify this practice for novices. Students are not expected to remember every detail. In advanced practice, the steps which follow are combined into a very brief exercise. Although the summary is concise enough to be used as a practice guide for trained practitioners, all practitioners are advised to first read the details.

1. Attaching the Weight--Men

a. Position of the Weights

Chi Weight Lifting can be initiated from either a kneeling or standing position. (Fig. 5.10) If you cannot kneel, set the weight on a chair in front of you. It may be necessary to relieve the pressure of the weights quickly at times, particularly if they are too heavy and the knot beneath the testicles is tight. For this reason, keep the weight close to a place where it can be quickly removed. Consider tying one end of the cloth to the ring while leaving the other end in a loop--folded beneath the knot--so that the knot will undo itself if that end is pulled.

b. Standard Method of Tying the Cloth

Warning: Do not tie the cloth around the testicles alone.

(1) Fold the cloth lengthwise several times to a width of about one inch. (Fig. 5.11) This creates a thick padding.

(2) Hold the cloth beneath the perineum, and bring it up behind the testicles. Be sure that the edge of the cloth is folded away from the skin so that if does not cut into the groin.

(3) Wrap both ends of the cloth upward around the penis and testicles, and secure the cloth at the surface of the penis base by tying a knot.

Note: If you prefer, you can place the cloth on top of the penis and tie the knot beneath the testicles. In either case, the knot must eventually be positioned at the perineum. (Fig. 5.12(a), (b) and (c))

Fig. 5.10 *Chi Weight Lifting can be initated from either a kneeling or a standing position.*

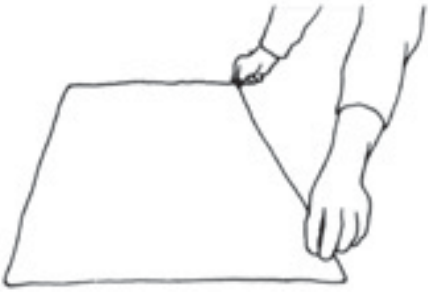

(a) Lay the cloth flat.

(b) Fold it in half with the edges matched.

(c) Fold it in half again.

(d) Fold it again into a thick strip of padding.

Fig. 5.11 *Folding the Cloth*

(4) Move the knot behind the testicles and beneath the perineum. The ends of cloth should hang to the floor. Before tightening the knot, you can use one end to create a loop between the knot and the groin so that the cloth and apparatus can be quickly removed.

(5) Contract the muscles of the undertrunk and tighten the knot. The penis and testicles should bulge slightly from the pressure to insure against slippage. Do not cut off the circulation to the testicles.

(6) Tie one end of the cloth to the weight that you have placed on the floor, or on a chair. (Fig. 5.12 (d), (e) and (f)) If the weight is on the floor, tie the cloth to it from a kneeling position.

(7) To remove the weight at the end of practice, kneel in front of the chair--or near the floor--and untie the cloth attached to the holding apparatus, then remove the cloth from the groin.

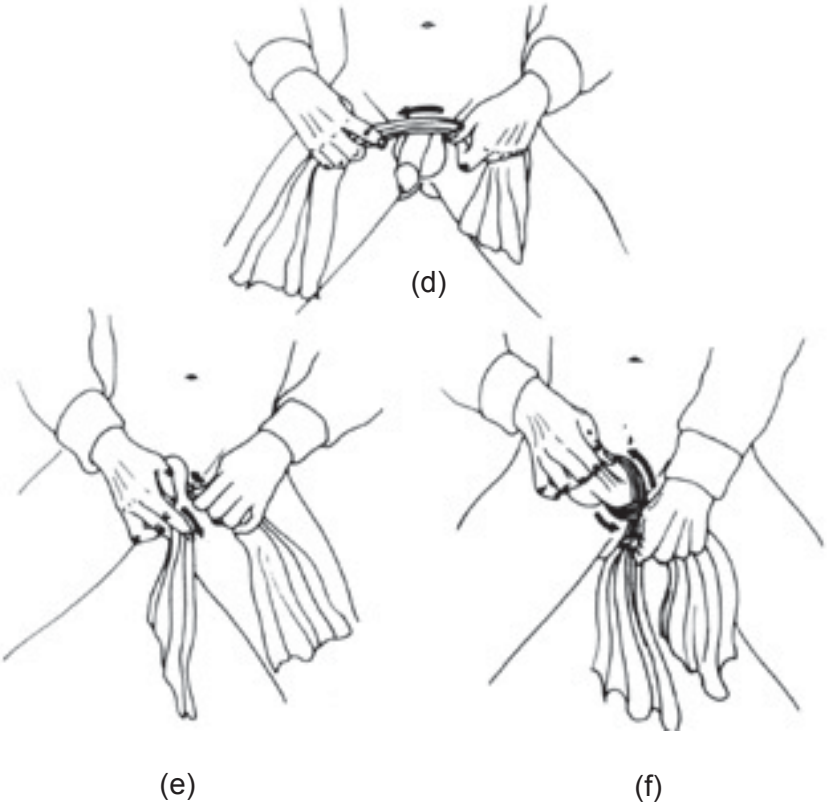

Fig. 5.12 *Tying the Silk Cloth around the genitals.*

2. Attaching the Weight--Women

Note: The Internal Egg Exercise described in Chapter Three can be used as a preparation for Chi Weight Lifting. During the actual lifting of weights, however, the egg is held deep inside the vaginal canal. Do not move it up and down, and do not release it.

a. Tying the String to the Weight

After the string has been passed through the egg and secured with a knot at the egg's large end, tie the weight to the string. The weight can also be placed inside a bag or container attached to the string. The weight holder prescribed for men can also be used, first without any weight, and then with the gradual addition of the holding clamp and the weight. Either place a chair in front of you and rest the weight on it, or place the weight on the floor and squat down to facilitate the egg's insertion. (Remember to hold the weight with your fingers as you stand up.)

b. Inserting the Egg

After you have massaged your breasts and vaginal areas in the prescribed manner, kneel down near where the weight is resting, and insert the egg into the vagina, large end first. (Use a lubricant if necessary.) Close the vagina, contracting the muscles around the egg to hold it. (Fig. 5.13)

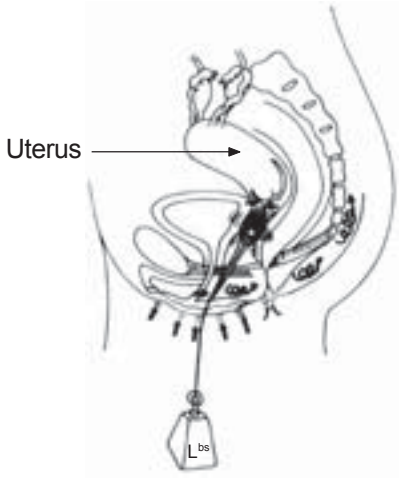

Fig. 5.13 *Vaginal Weight Lifting*

3. Testing and Lifting the Weight--Men and Women

(1) Slowly stand up, holding the cloth or the weight in your hand, and assume a weight lifting stance. (Keep the feet parallel at about shoulder width, and bend the knees slightly.) By using your index and middle fingers to test the weight, you can sense whether or not it is too heavy.

(2) Inhale a sip of air and pull up the anus, perineum, and genitals. Inhale again, and pull up both sides of the anus as you draw Chi into the left and right kidneys respectively.

(3) Press the tongue firmly up to the roof of your mouth to increase your internal power. Increasing pressure on this connection will accelerate the upward force of the Chi.

(4) Then, slowly release the cloth or the string from your fingers. You are now sustaining the weight from the sexual organ, and you should begin to pull against it using internal strength, particularly from the kidneys.

(5) With the fingers of one hand nearby, feel the pull of the weight, and determine whether or not your genitals can sustain it. Men in particular should be certain that they are reasonably comfortable.

(6) Inhale, pull up the right, left, front and back sides of the anus and wrap the energy around the kidneys. (Fig. 5.14)

(7) Gently swing the weight drawing the energy up to the coccyx, and then to the sacrum. You can practice up to the sacrum for the first few weeks. When you feel more energy you can gradually move it up the spine to T-11, C-7, the Jade Pillow, and all the way to the crown. When you are ready to store the energy press your tongue to the palate, and bring the energy down to the navel, completing the Microcosmic Orbit.

Note: Remember that in advanced practice, a separate round is used to lift the same weight from the internal organs and glands. Rather than remove the weight you may hold it as you rest between rounds.

(8) To finish the practice kneel as you place the weight on the chair again, or the floor, and remove the egg and weight holding apparatus. Men should untie the cloth after the apparatus has been removed. The Power Lock should be practiced immediately afterward.

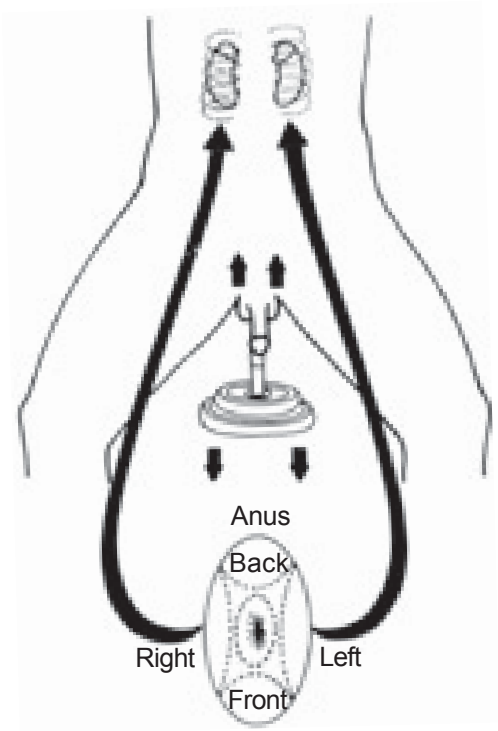

Fig. 5.14 *When you feel the pull of the weight, inhale and pull up the right, left, front, and back parts of the anus. Wrap the Chi around the Kidneys.*

a. Swinging the Weight

Swinging the weight gives the practitioner control over the amount of pressure on the groin, which is why lighter weights are recommended The Chi from the Fascial connection between the perineum and the kidneys is used to pull the weight. In the beginning swing the weights gently as you determine the amount of pressure that is comfortable for you.

Inhale as you contract the anus and perineum. Swing the attached weight from 36 to 49 times. Synchronize your breathing with each swing. Inhale as the weight swings forward, and exhale as it swings backward. (Fig. 5.15) Pull up against the weight internally with each forward swing, and draw the energy up to the coccyx, the sacrum, and, eventually all the way through the Microcosmic Orbit. (Fig. 5.16) Each completed swing back and forth should approximate one second.

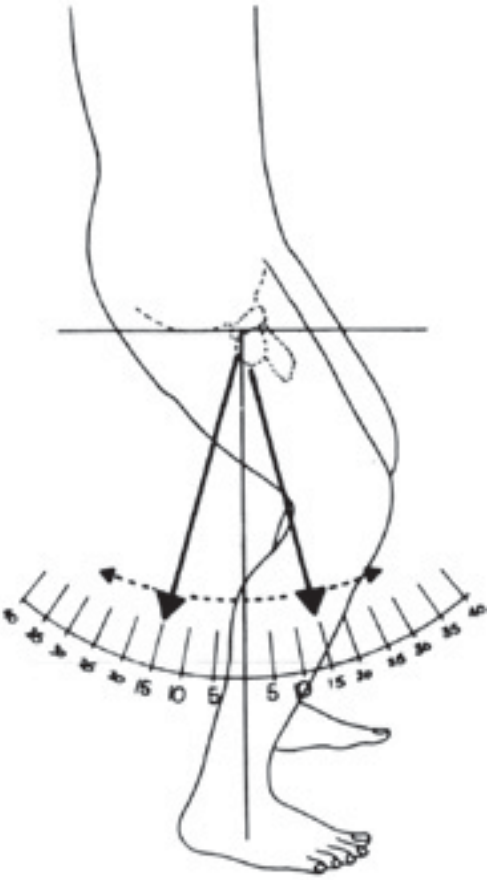

Fig. 5.15 *Swing the Weight at an angle between 15 and 30 degrees.*

After a week, try to swing the weight for 60 counts. More pressure results from the counter-force exerted by the Chi Muscle when heavier weights are swung, but it is wiser to increase this pressure with lighter weights by adding more power to each swing. The lighter weights should be used to their maximum potential, thereby strengthening the Chi Muscle and producing more hormones.

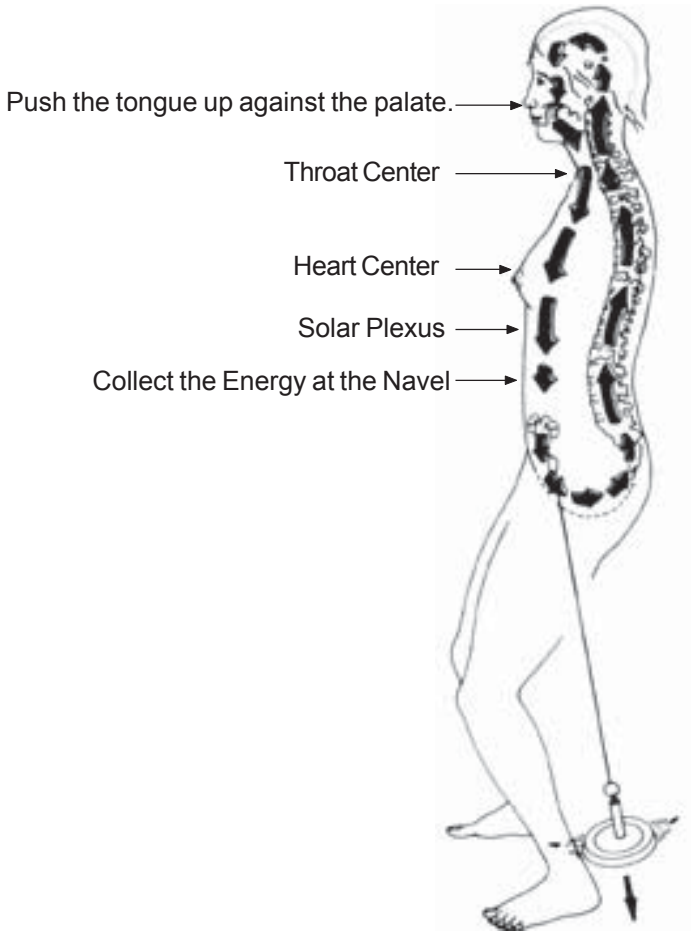

Fig. 5.16 *Circulate the Chi all the way around the Microcosmic Orbit and collect the energy at the navel.*

b. ***Finish with the Power Lock and Massage Techniques***

Practice the Power Lock for at least two or three rounds after releasing the weight. Then apply the Cloth Massage and the Sexual Energy, Massage techniques. Rest, and practice the Microcosmic Orbit Meditation to circulate the tremendous energy you have generated, finally collecting it in the navel.

4. Lifting Weights from the Microcosmic Orbit: Men and Women

After you have practiced for two to four weeks, and feel comfortable with Chi Weight Lifting, begin to lift the weight from the stations of the Microcosmic Orbit. As you bring the Chi up into the sacrum and higher centers, use this energy to pull the weight from each station, Take your time, and don't rush. Each point can take one or two weeks before you feel the flow of the Microcosmic Orbit working as part of the counterforce.

a. Step by Step Procedures

(1) Sacrum: When you lift the weights from the sexual organs, pull up the front, back, right and left of the anus to bring the energy up to the sacrum. (Fig. 5.17) Hold it there. Breathe normally, and gently swing the weights. Feel a line of energy from the sexual center up to the sacrum.

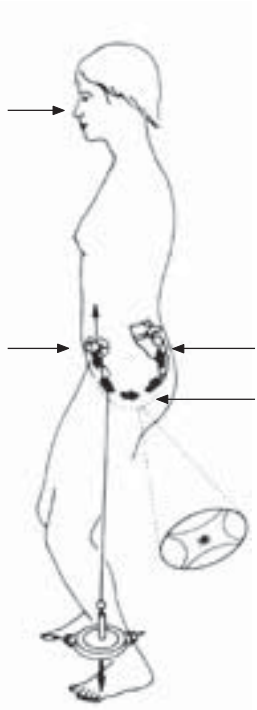

Fig. 5.17 *Swing the weight, pull the anus at the front, back, and left sides, and feel a line of energy between the sex organ and the sacrum.*

(2) Door of Life: Once you feel the Chi in the sacrum, bring it to the Door of Life on the spine, opposite the navel. (Fig. 5.18) Hold the Chi there, and continue to swing the weights. Every time you swing, pull up more.

(3) T-11 Point: From the Door of Life, bring the energy up to T 11 on the spine, opposite the solar plexus. (Fig. 5.19) Feel the line of energy as it moves up to T-11.

(4) C-7 Point: Pull the energy from the sexual center, passing it through the sacrum, Door of Life, T-11, and up to C-7 at the base of the neck. (Fig. 5.20) Feel the line of energy from the sexual organs up to C-7.

(5) Base of the Skull: Next draw the Chi through the sacrum, Door of Life, T 11, and C-7, and up to the base of the skull. (Fig. 5.21) Feel the line of Chi flow from the sexual organs up to the base of the skull.

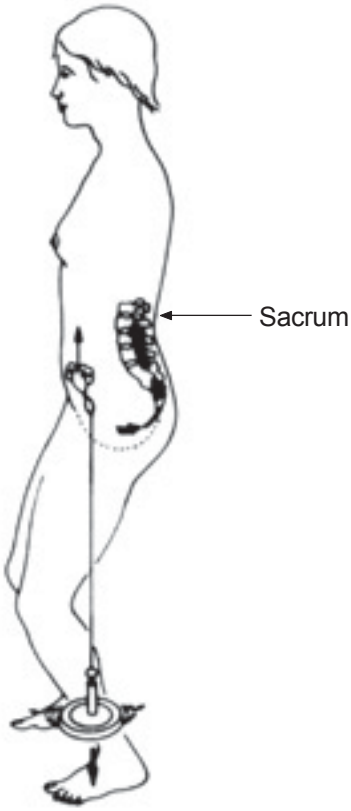

Fig. 5.18 *From the sacrum bring the Chi to the Door of Life (Ming Men).*

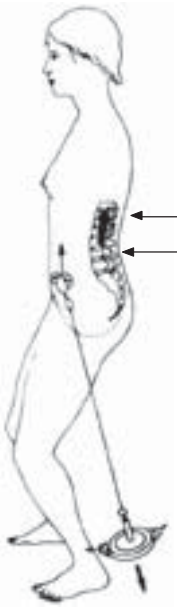

Fig. 5.19 *From the Door of Life bring the energy up to T-11 .*

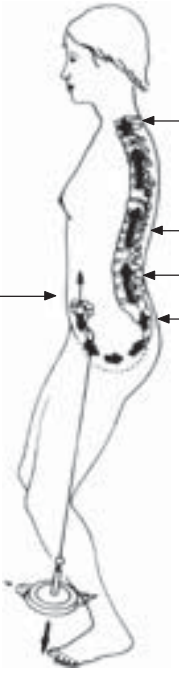

Fig. 5.20 *Pull the energy from the sexual center all the way up to C-7.*

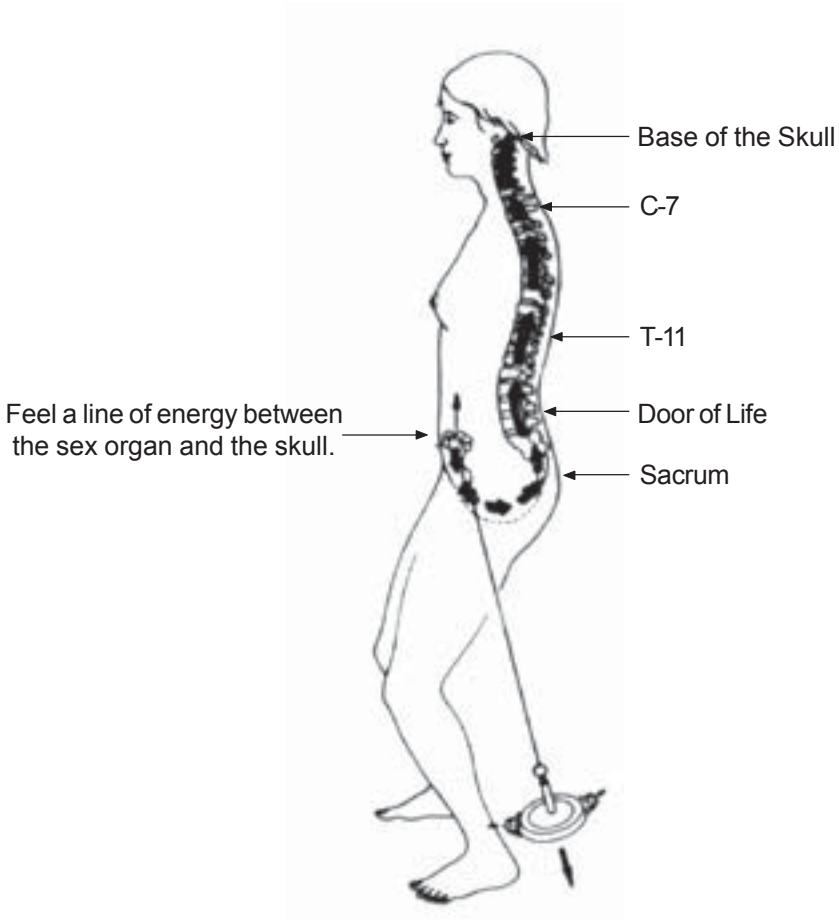

Fig. 5.21 *Pull the energy from the sex organ all the way up to the base of the skull.*

(6) Crown Point and the Pineal Gland: Draw the Chi up to the crown point where the pineal gland is located. (Fig. 5.22) Remember that the sexual glands are closely related to the pineal and pituitary glands. You may feel this connection as these glands are stimulated.

(7) The Third Eye: Bring the Chi to the "Third Eye" (mideyebrow), also called the "Crystal Room," where the pituitary gland is located. (Fig. 5.23)

(8) With the tongue on the palate, bring the Chi down to the throat center, the heart center, the solar plexus, and finally down to the navel. (Fig. 5.24) The overflow will spill back down to the sexual center.

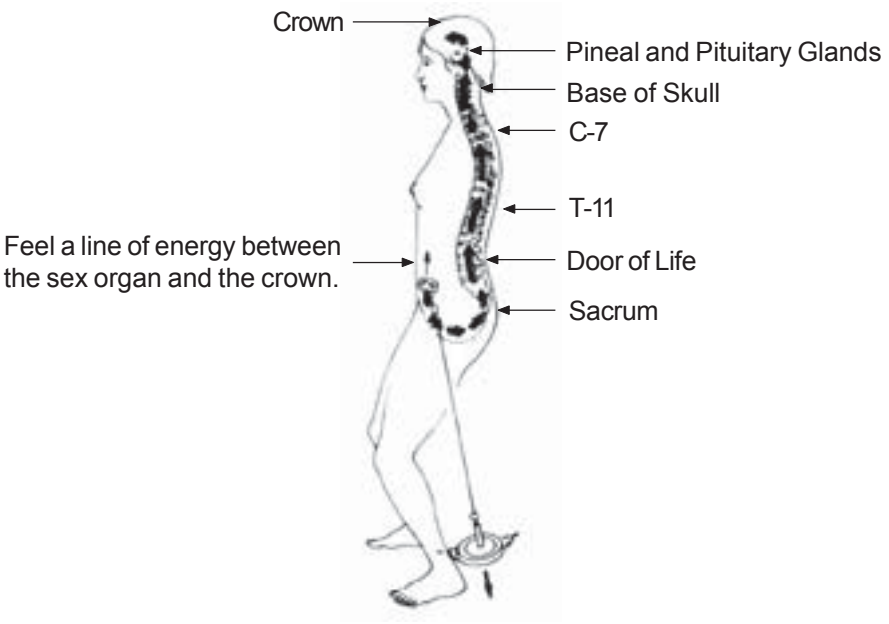

Fig. 5.22 *Pull the energy from the sex organ all the way to the crown.*

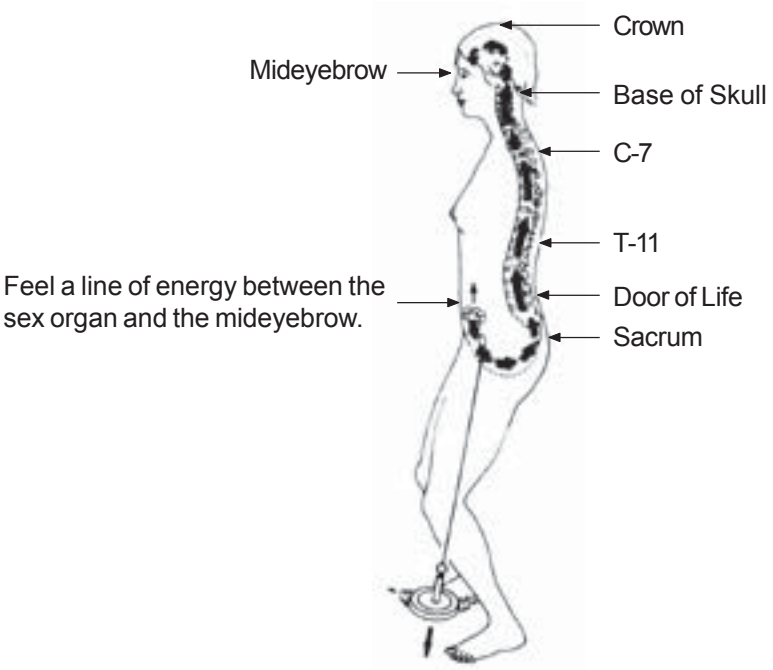

Fig. 5.23 *Pull the energy from the sex organ all the way to the mideyebrow.*

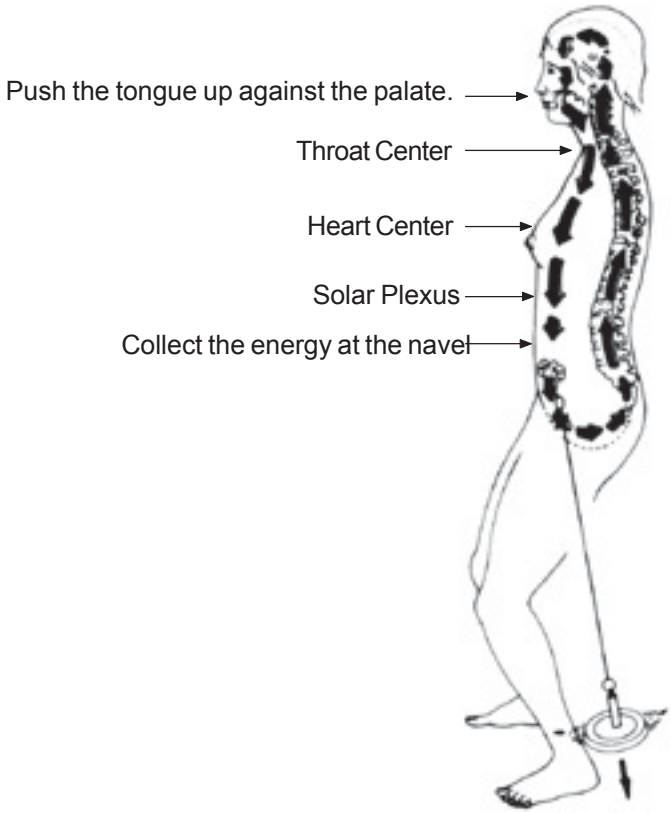

Fig. 5.24 *Circulate the Chi all the way around the Microcosmic Orbit and collect the energy at the navel.*

(9) At this point you have successfully brought the energy from the sexual organs up through the spine, over the top of the hand, down the front to the navel, and back again to the sexual organs, circulating it through the Microcosmic Orbit. This process refines and enhances Chi as it moves through the energy centers.

(10) Once the Microcosmic Orbit is open to the flowing sexual energy, all you need do is pull the energy up to the head, and then down to the navel through the tongue. Concentrate on drawing the energy, circulating it in the Microcosmic Orbit, and storing it in the navel. The Chi will flow very quickly through all the centers. You will no longer need to bring it up through the points of the spine one by one.

5. Advanced Chi Weight Lifting Using the Internal Organs: Men And Women

a. Kidneys Help Pull the Weight

In the beginning stages of Chi Weight Lifting, it is the power of the kidneys that provides real internal counterforce. (Fig. 5.25) Once you can feel that power, it becomes easier to tap the force of the other organs to help lift heavier weights. As you begin to increase the weight, start to use the strength of the other organs and glands to increase the upward counterforce. The main secret of internal power is to press the tongue against the roof of the mouth as you direct the force of the organ's energy toward it.

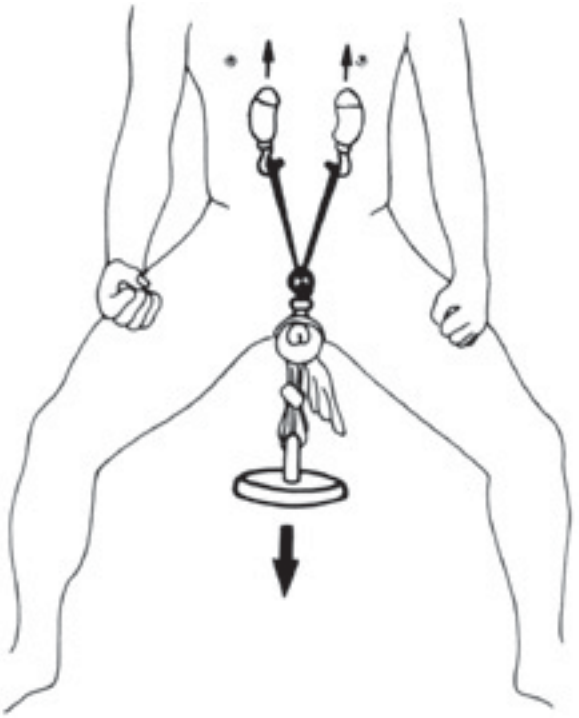

Fig. 5.25 *In the beginning stages of Chi Weight Lifting it is the kidneys that provide the internal counterforce.*

(1) Always begin by pulling the energy up to the head several rimes to make sure of its flow within the Microcosmic Orbit.

(2) Inhale with small sips, pull up the left side of the anus, and spiral the energy to the left kidney. Inhale again, pull up the right side of the anus, and spiral the energy into the right kidney. (Fig. 5.26) Hold the energy there, and feel the Chi in the kidneys pull up towards the tongue, resisting the weight. Some people report that they can immediately feel the kidneys as they help lift the weight.

(3) Exhale, maintaining the pulling action of the perineum and kidneys, and then breathe normally. With each swing, pull up more on the sexual organs and kidneys. Practice from 36 to 49 swings. Untie the weight, massage the sexual organs, and start Hitting.

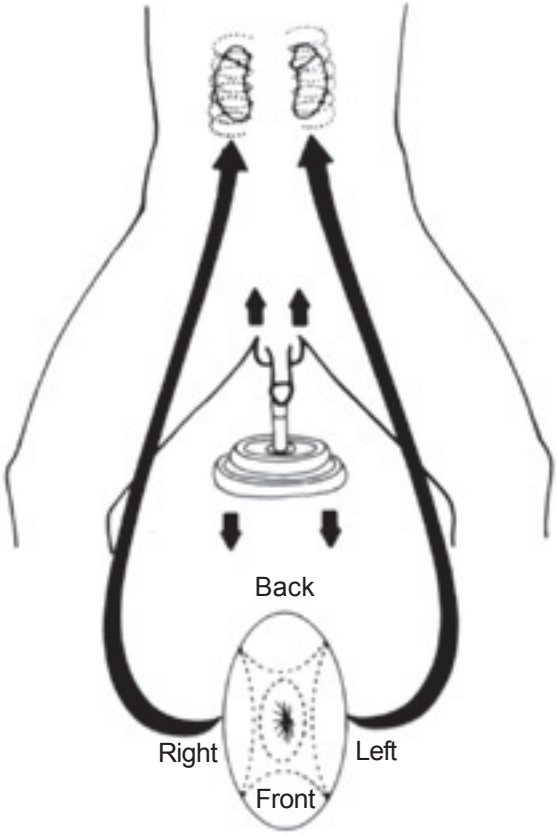

Fig. 5.26 *When you feel the weight, Inhale and pull up the right and left side of the anus. Wrap the Energy around the kidneys.*

b. Spleen and Liver Pull the Weight

Note: Always keep the chest relaxed during these procedures. You can practice lifting from the spleen and liver as a separate exercise, or together as one exercise.

(1) Spleen: Start again on the left side by pulling up the left side of the anus and perineum. Become aware of the spleen situated beneath the left side of the rib cage. Contract the left anus, and pull the Chi up to the spleen and left kidney with one more sip. Wrap the Chi around and into the spleen. (The spleen is located toward the back, slightly above the left kidney and adrenal gland.) Keep the tongue pressed to the roof of your mouth. Then, as you feel its connection to the genitals, pull the spleen energy up towards the tongue, Lift the genitals thereby lifting the weight.

(2) Liver: Practice the same procedure on the liver, which lies under the right side of the rib cage. Pull up the right side of the anus and perineum. First draw the Chi up to the right kidney. Then become aware of your liver, and pull the Chi up to it twice. Pack and wrap the liver with Chi. Pull the energy toward the hack, near the right kidney and adrenal gland. Push the tongue against the roof of your mouth. Then, as you feel its connection to the genitals, draw the liver energy up to the tongue. Pull up the genitals, thereby lifting the weight.

(3) Combine the procedures of the spleen from the left side and the liver from the right side in order to help lift the weight. (Fig. 5.27) Pull their combined energies up towards the tongue.

C. Lifting with the Lungs

Lifting a weight with the lungs is an advanced procedure and is more difficult than lifting with other organs and glands. Before you try to apply Chi Weight lifting using the lungs, practice pulling energy up to each of the lower organs in succession, drawing the organ energy up toward the tongue. Pull up the Chi of the lower organs until you actually feel each lung contracting. Each step should first be practiced separately. Later, all of the steps can be combined into one practice. The procedure is as follows.

(1) First draw the Chi up from the sexual center through each of the organs and glands in succession, Lift with the kidneys, the spleen, and then with the left lung as the Chi reaches it. Inhale, and expand the upper left stomach near the left rib cage. Inhale again, and pull the stomach in toward the spine, up to the left rib cage,

and then to the left lung. Push your left shoulder and side slightly towards the front.

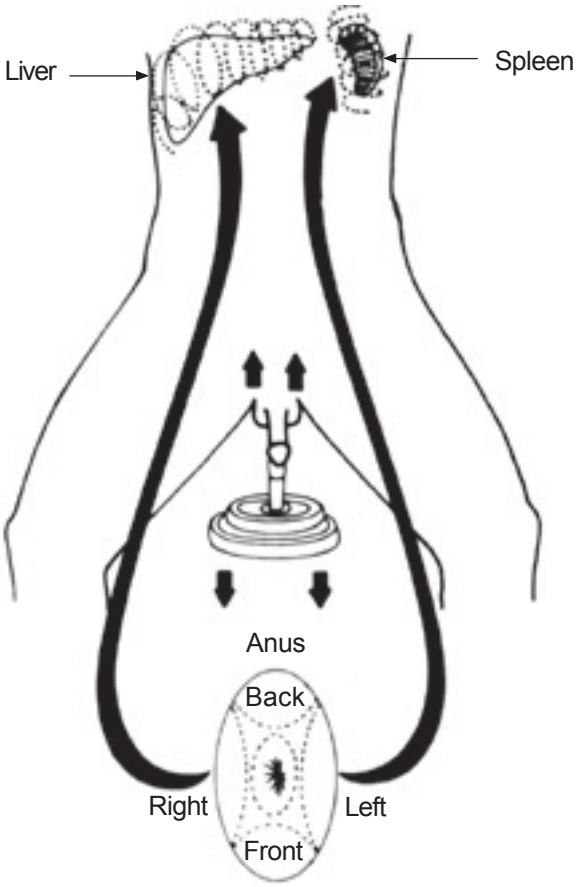

Fig. 5.27 *Inhale and pull up the right side of the anus, directing the energy to the liver. Inhale and pull up the left side of the anus, directing the energy to the spleen, Wrap the energy around these organs.*

(2) Inhale a sip of air pull up the left anus toward the left lung as you pull up the sexual organs. Pull up the left kidney, and then pull up the spleen. Feel the left kidney and the spleen assisting the left lung. Contract the muscles around the left lung, and draw the Chi up to and around that lung through the lower organs.

(3) Pull the Chi up from the left side of the anus to the bladder, left kidney, adrenal gland and spleen until you feel the lung contracting. Feel all of these organs in a line between the lung and

the genitals. Use the organs to pull up towards the tongue. Push your tongue hard against the roof of your mouth as you draw the Chi up through the organs to the left lung.

Use the same procedure with the right side until the same line can be felt passing through the associated organs, such as the liver, to your right lung. When you feel the fascial connection to the genitals, use all of the lower organs to pull the genitals up toward the lungs, helping them lift the weights. Once you can exert this power from the lungs, you may eliminate the procedure of expanding the stomach area. (Fig. 5.28)

Note: Don't use force. Use your Chi to lift the weight in conjunction with light muscular action and strong mental power.

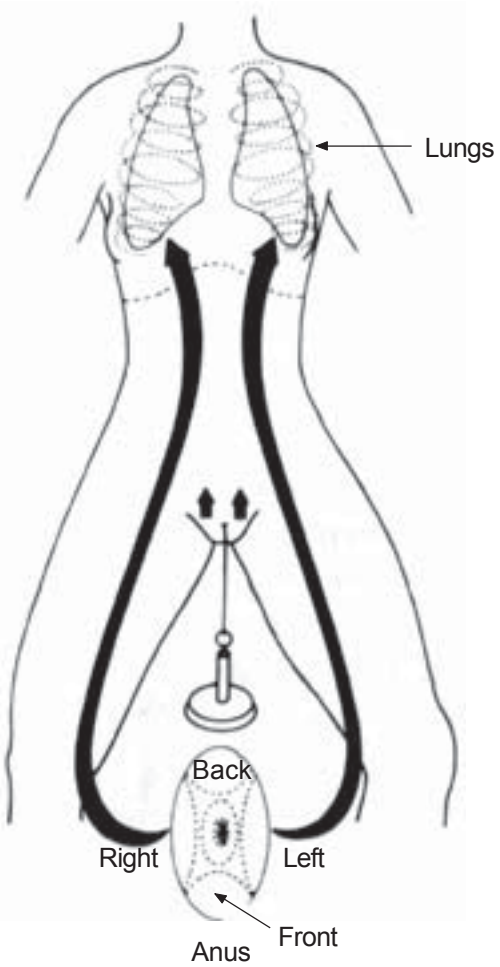

Fig. 5.28 *Inhale and pull up the right side of the anus, directing the energy to the lungs. Wrap the energy around the lungs.*

d. Lifting with the Heart--Cautiously

As you progress to the heart, be sure that you are in control of the other organs first. The heart and lungs can easily become congested with energy causing chest pain and difficult breathing. If you have this problem, tap the area around the heart and practice the Healing Sound associated with that organ. (The Six Healing Sounds are described in Appendix I and in the book, *Taoist Ways to Transform Stress into Vitality*.)

Before lifting the weight, practice drawing up the Chi and wrapping it into and around the heart. Proceed as follows with caution:

(1) Create a ball of energy in the center of the stomach, above the navel. Inhale a sip of air, pull up the front part of the anus, and expand the "Chi Ball" upward towards the rib cage. Inhale another sip, draw the Chi Ball inward, and then pull it up under the sternum. Expand it under the sternum towards the back and to the left side. Push your tongue up against the roof of your mouth, push the left shoulder towards the front, and feel your heart. (Fig. 5.29) Slowly exhale, and regulate your breath.

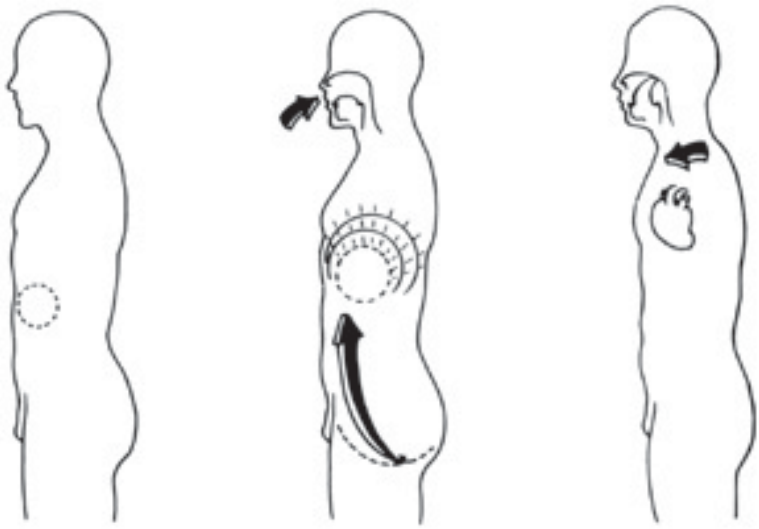

1. Create a ball of energy above the navel.

2. Inhale and pull up the front part of the anus, and expand the "Chi Ball" beneath the sacrum.

3. Press the tongue against the roof of the mouth and push the left shooulder forward. Feel the heart.

Fig. 5.29 *Chi Ball*

(2) When you are well practiced, eliminate the step of expanding the stomach area. Simply inhale in sips, pull up the front part of the anus as you pull up the sexual organs. Pull up the stomach to the rib cage, and pull the Chi to the heart, using the power of the heart. Wrap the Chi into and around the heart.

(3) Pull up the genitals, bladder, kidneys, liver and spleen towards the tongue. Contract the muscles around the heart and lungs, and successively pull the Chi up through each of the lower organs. Start lifting with the lower organs, and draw the Chi upward through each of them to reach the heart.

(4) When you are ready to practice Chi Weight Lifting from the heart, simply pull up the front part of the anus, the genitals, bladder, kidneys, liver, and spleen to the heart. (Fig. 5.30) Employ the power of the heart and lungs to help the other organs and glands pull against the genitals, thereby lifting the weight.

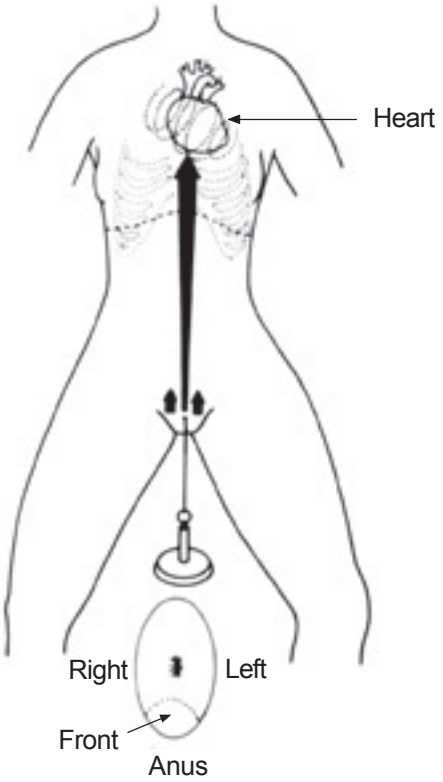

Fig. 5.30 *Pull up the front part of the anus and directing the energy to the heart.Wrap the energy around the heart.*

e. Thymus Gland adds Power to the Heart and Lungs.

Sink the sternum to the back as you exhale, and push the lungs towards the thymus under the sternum. Then connect the Chi of the heart to the thymus, which is in close proximity to the heart. Contracting the muscles around the thymus, heart and lungs will greatly increase their combined force, enabling them to draw Chi up through the lower organs, pull up the genitals, and lift the weight. (Fig. 5.31)

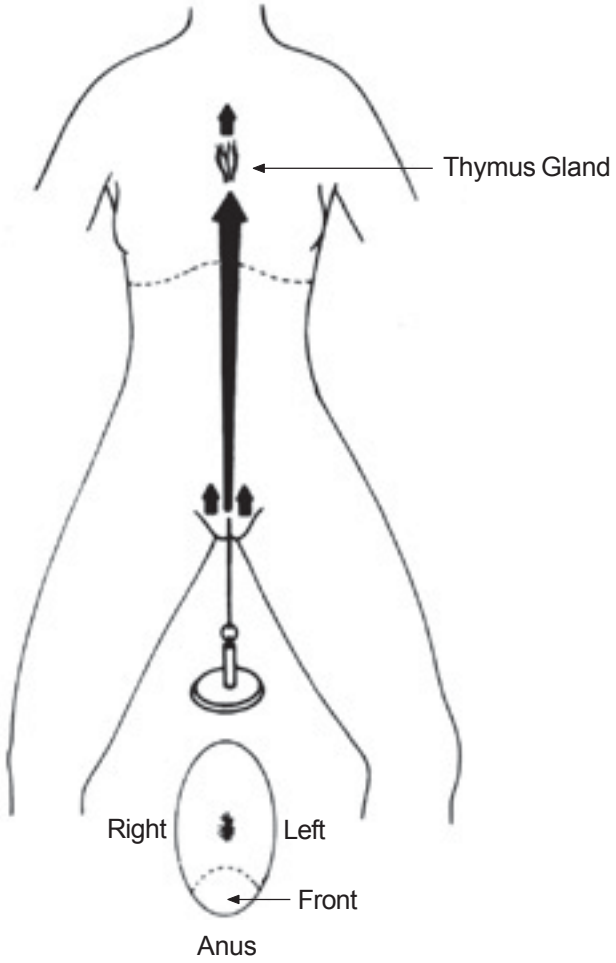

Fig. 5.31 *Pull up the weight by contracting the thymus.*

f. Pulling from the Pituitary and Pineal Glands

The tongue and eyes act as major tools in exerting control over the pituitary and pineal glands.

(1) Practice first by pressing the tongue to the palate, and turn the eyes upward.

(2) Contract the eye muscles towards the middle of the brain to the pituitary gland.

(3) Contract the cranium from all sides: Squeeze in from the crown, the base of the lower jaw near the throat, the front, back, and left and right sides of the skull, gently compressing the center of the brain. Concentrating on the center point behind the "third eye," prepare to draw the energy up to the pituitary gland. (Fig. 5.32) You are using the muscles of the skull to increase the pressure on this area.

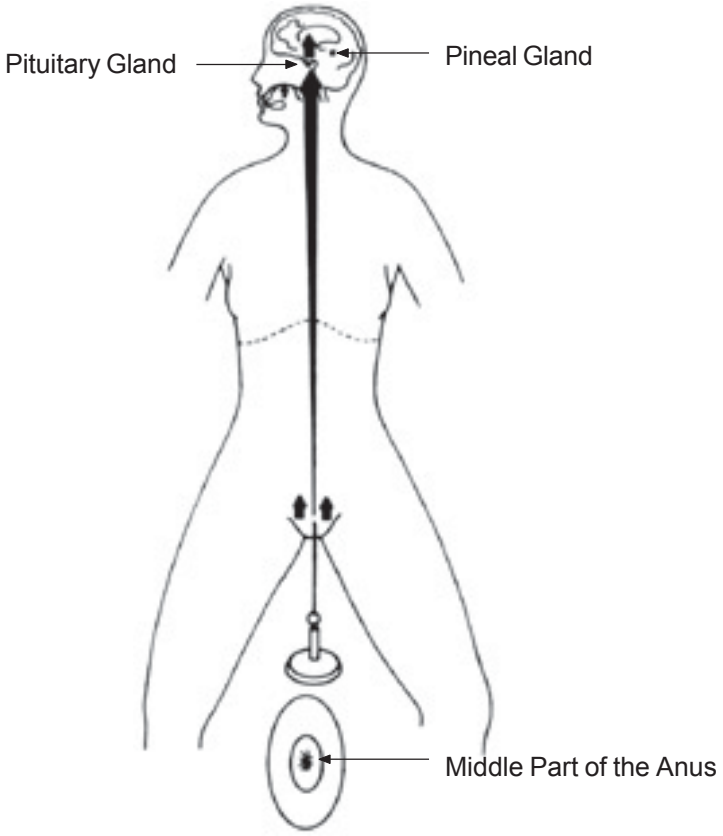

Fig. 5.32 *Contract the middle part of the anus, and pull up all the way to the brain. Lift the weight by contracting the pituitary gland.*

(4) Contract the middle part of the anus, and pull the Chi all the way up into the brain.

(5) Contract the lungs, heart and thymus gland, and push their energy up towards the center of the brain. The pituitary gland pulls energy from the thymus gland, heart, lungs, spleen, liver, adrenal glands, kidneys, bladder, and sexual organs. All of these parts will then work together to pull up the weight.

(6) Repeat the practice, now focusing on the pineal gland at the crown of the head.

g. Circulate the Microcosmic Orbit

Since all the steps of this exercise are extremely powerful, use caution. The Microcosmic Orbit meditation is a very important safety measure. When finished with all of these steps, circulate the energy in the Microcosmic Orbit several times, collecting it in the navel. Finally, remove the weight.

6. Finish Chi Weight Lifting

After you have released the weights, practice the Power Lock two or three times up to the crown, and massage the sexual organs again. First massage the genitals, sacrum, and perineum with the cloth, then practice the Sexual Energy Massage techniques. As stated earlier, the Universal Tao is not responsible for your use or misuse of this practice. The massage techniques are your best protection. Do not neglect them at any time.

F. Precautions and Suggestions for Practice

Note: The best precaution is common sense. Read this section carefully!

Although most of these suggestions are directed at men because they are at a greater risk, women can also be affected in adverse ways by this practice if they are not careful. Read all of the following precautions to fully understand this practice

1. Be sure that the Microcosmic Orbit is clear of any blockages.

2. Men and Women: Be well versed in all of the prerequisites before attempting this practice. Without a degree of mastery of Iron Shirt Chi Kung I, a student may not be grounded enough to safely accumulate external energies. Without the Six Healing

Sounds, the organs may overheat. Without the Microcosmic Orbit Meditation, there is no point in doing any practice taught in this system. Trouble would be the only result.

3. ***Men:*** If you have not mastered the Sexual Power Lock, and therefore cannot prevent an ejaculation, you should not practice Chi Weight Lifting. Practice Healing Love instead. If you have mastered these techniques, but you lose your seminal fluid accidentally, abstain from Chi Weight Lifting for at least two to three days after the accident. Be prepared to drastically reduce the weight you would normally lift, since Chi diminishes with the loss of seminal fluid, making the practice unsafe. (See Appendix 1.) Further information is available in the book, *Taoist Secrets of Love; Cultivating Male Sexual Energy.*

Note: It is safe to practice Chi Weight Lifting after sex, provided that the seminal fluid is retained. You should still be prepared to reduce the weight, however, if the act of sex drains you in any way.

4. Women: If you have not mastered the Orgasmic Draw, do so before you practice Chi Weight Lifting. Although Chi Weight Lifting is actually safer for women than it is for men, less Chi will be available for the internal organs to pull the weight if too much sexual energy is expended. The remedy is not celibacy, but rather the practice of the Orgasmic Draw. (See Appendix 9.) Further information can be found in the book, *Healing Love Through the Tao: Cultivating Female Sexual Energy.*

5. Women should Never continue Chi Weight Lifting during a menstrual period, vaginal infection, or at any stage of pregnancy. When these times have passed, practice may be resumed. Wait at least two or three days until after menstruation has finished.

6. Men and Women: The ancient Taoist masters advised that one abstain from sex for the first one hundred days of this practice. For the best results in the modern world, abstain at least until you have comfortably mastered the lightest weights. Do not try to speed up your progress for this purpose. This is recommended because men and women must fully retain their sexual energy before they can safely practice Chi Weight Lifting.

7. Men and Women: Take extra care not to allow the accumulation of too much sexual energy in the head. Headaches, numbness, or discomfort can be alleviated by pressing the tongue to the roof of the mouth and drawing the pressure out of the head, down through the tongue, and into the navel. Spiral the energy,

following the same procedures used at the end of the Microcosmic Orbit Meditation.

8. Remember that the Genital Compression exercises found in Chapter three are the best ways to replenish the sexual energy you are extracting from the ovaries or testicles. Use this after the Chi Weight Lifting practice.

9. Men may find, upon mastering Chi Weight Lifting, their Power Draw is so powerful that the testicles are drawn into the body after the weights are removed. Do not be alarmed. No harm will come of this, provided that you relax and don't cause yourself any harm through fear or rash action. You may employ the Genital Compression technique, but it is not absolutely necessary. The testicles descend by themselves within a few minutes or at the most, a few hours.

In ancient times it was considered a priceless asset for a male martial artist to be able to retract his testicles into the body to avoid having them crushed or damaged by an opponent. In spiritual circles, this was a valued practice because the maintenance of Ching Chi could no longer tax the organs and glands if no sperm were produced. (The testicles cannot produce sperm in a retracted state.) Taoist adepts who practice to this end will eventually acquire full access to their internal energy.

Note for Men and Women: Sexual energy transforms into life-force energy, which transforms into spiritual energy. The ability to stop the actual production of sperm or eggs means there is one less transformation for energy to go through, since life-force e energy becomes directly available. This should not be taken to mean that such a practice is being advocated, but to inform you of its ramifications. The ancient masters saw this as a short-cut to the cultivation of spiritual energy, leaving one with fewer steps to cover on the spiritual path.

10. Men: Never try to lift weights without using the entire groin. The cloth must be tied around the penis and the testicles together. Using the testicles alone defies common sense; however, there are those who can be tempted to try new things without first reading the instructions.

11. Men: Never lift weights with an erection. This can lead to a great deal of pain as the pressure of the weight expands into the already engorged head of the penis. Further, lifting with an erection may create conditions which can lead to blood clots.

12. Men: To help prevent painful slippage of the cloth, tighten the knot at the base of the testicles so that it almost touches the perineum. Try to avoid too much slack around the groin while lifting, but do not cut off circulation.

13. In the beginning stages of practice, a man might feel a little pain in the groin or in the abdomen caused by the lifting of the weight. Massage very carefully before and after Chi Weight Lifting, and follow the procedures with caution. The massage should reduce any pain you may experience.

Note: Once your sexual organs become stronger, the pain gradually goes away. This is not unlike the muscle pain that occurs in normal weight lifting. Some may experience fever; however, there have been no reports of infections of the testes resulting from this practice. You may wish to use only the massage techniques until the pain stops, and then resume lifting.

14. Men and Women: If you feel pain in your internal organs after training, practice the Microcosmic Orbit Meditation and the Six Healing Sounds until the pain is gone. The pain may be a sign of overheating which means that Chi Weight Lifting should be discontinued until the pain subsides. This may also be an indication that your internal organs are not in a healthy condition. If so, resume practicing the less advanced techniques instead of Chi Weight Lifting until you can comfortably lift weights.

15. Warning for Men: If you know that you already have a blood clot from circumstances which pre-date this practice, consult a physician about the severity of the problem before attempting Chi Weight Lifting.

A blood clot should be fully dissipated for complete safety in these practices. Otherwise, it can dislodge and relocate in a vital area bringing serious or lethal consequences. A medical consultation should reveal whether or not the Sexual Energy Massage or Chi Weight Lifting techniques can be safely used with an existing blood clot. If not, ask your doctor about options to help circumvent or alleviate the problem. There are medical methods of eliminating blood clots. The Universal Tao is not responsible for your choice, however. Your physician's advice and your internal sensitivities must be your guidelines in such matters.

16. Men and Women: If you scratch the skin of the sexual organs, clean the area, and allow it to heal before you do this practice. You can practice Hitting with the massage techniques, but it is best to

avoid lifting weights if the groin is hurt. You may apply medications that you have used before, providing that the sexual organs are kept dry. (Hydrogen peroxide is useful for keeping a wound clean and dry.) Men should avoid using most medications on or around the sensitive tip of the penis.

17. Women: See a physician or gynecologist for wounds within the vaginal wall that require medication. Do not use any medications internally without a doctor's advice.

18. Although it is better to lift less weight for longer periods of time than to lift heavier weights for shorter periods, avoid lifting any weight for more than 60 seconds. Men in particular must avoid cutting off the circulation of blood to the testicles.

19. Do not try to outdo yourself or anyone else because you then stand a good chance of getting hurt. If you feel any strain at all, remove the weight immediately.

20. If you haven't practiced for more than a week, do not return to the same weight you were able to lift before the layoff. Build up again slowly to avoid injuring yourself.

Note: When energy is low, and you still choose to practice, spend more time massaging the genitals, and less time hanging the weight. (Women should massage the breasts as well.) When you have finished Chi Weight Lifting, hit your hands, legs and back only. For al least two or three days refrain from striking areas where the impact might reach vital organs, or wait until you again feel alert and vigorous.

21. When some people detoxify, diarrhea, nausea, or pain in some of the organs may result as they are cleansed by the process. These are all temporary; however, Chi Weight Lifting and Hitting can also initiate some long term effects which are ultimately good:

a. During the first 100 days of practice, a reduced sex drive may result from the sexual energy transferring up to the higher centers to heal the organs and glands. Once the body has had a chance to repair itself, the sexual energy will increase greatly, thereby restoring the sex drive.
b. A need to drink more water may result from changes in one's metabolism.
c. Practice may cause either an increase or loss of appetite, accompanied by exhaustion. This may be part of the re-balancing process that the body goes through as energy is being assimilated. Some overweight people begin to lose

weight; some underweight people find that they are eating more.

d. When you practice Chi Weight Lifting you may feel heat, muscle spasms, shakiness, coldness, breezes, or simply an overall "funny" feeling. The body may not yet be adjusted to the increase in Chi, or the energy may be fighting diseases in the body, thereby causing such symptoms. Use your own judgment as to whether you should continue the process, but if serious physical problems persist, consult your doctor.

e. As certain levels of practice are attained, some people dream profusely. This may be because they are practicing Chi Weight Lifting and Hitting in excess, or they may be Hitting too hard. This causes the organs to overheat. Also, if the physical body is too hard and tight, emotions may be locked in the muscles and organs. The Hitting process may release them. Pain felt in the tendons and muscles can cause a great deal of dreaming. The increase in Chi, and its fight against diseases of the body, can cause great internal changes which may also be the source of excessive dreaming.

22. Be especially careful if you suffer from high blood pressure. The Power Draw and Orgasmic Draw can raise the blood pressure considerably if you do not have your Microcosmic Orbit opened sufficiently. If the Microcosmic Orbit is open and flowing, the blood pressure can be reduced and eventually controlled.

23. Do not practice Chi Weight Lifting and Hitting on a full stomach. Wait at least one hour after a meal before practicing. Also, to keep from losing Chi when you have finished exercising, do not eat for one-half hour to an hour.

24. Do not shower right away after practice, especially if you sweat. Allow your body to cool down for a while. You are still absorbing Chi at this point; therefore, it is better to avoid washing away external energy.

25. Men: If you have washed before practicing, be sure to dry yourself thoroughly. Otherwise, you may abrade yourself if your skin is still moist when you apply the weight.

26. Men: You may wish to cut your pubic hair short. If it is left long, pain may result since it is pulled during Chi Weight Lifting.

27. Urinate or have a bowel movement before practice. If this is not possible, try to wait one or two hours after practice before fulfilling these functions in order to prevent any loss of accumulated Chi.

This will give the body time to absorb the Chi into the bones, organs, and glands. Collect the energy in the navel.

28. In hot weather, do not drink too much cold water because the body must expend a great deal of internal energy to warm it. This may result in too much cold energy in the heart, which can be harmful.

29. Many people have reported a loss of desire for alcohol, drugs, tobacco, coffee and tea as a result of the detoxification initiated by Chi Weight Lifting and Hitting. It is best to avoid these toxic substances in any case, but keep in mind that they will satisfy you less if you detoxify faster than these substances are taken in. The stimulation they offer may not occur if they arc forced out of the body before they can affect you.

30. Do not stand on a cold floor during practice. If there is no rug, stand on a towel. A cold floor will draw away your energy.

31. In the early stages, avoid practicing at night, because you may not be able to sleep. When you become proficient, you should be able to practice at any time.

32. Remember that the purpose of your training is to raise your energy levels and to rid your body of toxins. It is NOT to promote violence or foolishness. Do not walk into your local bar and make claims to being the sexual weight lifting champion of the Universal Tao. You may find that this particular subject is not well received in certain social atmospheres.

33. Be aware that practices that draw sexual energy into the body can spread any existing venereal infection. Be sure that you are free of such problems before attempting the Sexual Energy Massage or Chi Weight Lifting.

34. Warning for Men and Women: Be aware of your body's reactions to Chi Weight Lifting. Although this system is known for its many safeguards to avoid side effects, it is difficult to account for the internal differences in people. ANY problems that do not appear to be covered in this book must be directed to the Universal Tao. In such cases, Chi Weight Lifting should be discontinued until you are fully aware of your status.

G. Summary of Chi Weight Lifting

1. Pre-Chi Weight Lifting Exercises:

   a. Increasing Chi Pressure: Practice from nine to 81 times.
   b. Increasing Kidney Pressure: Practice from six to 36 times.
   c. Power Lock Exercise Practice two to three times up to the crown.
   d. Cloth Massage of Sexual Center, Perineum, and Sacrum
   e. Sexual Energy Massage:

Men: (1) Finger Massage of the Testicles
(2) Palm Massage of the Testicles
(3) Ducts Elongation Rubbing
(4) Stretching the Ducts Gently with Massage I
(5) Stretching the Scrotum and Penis Tendons
(6) Tapping the Testicles

Women: (1) Breast Massage
(2) Massage the Glands with Accumulated Chi
(3) Massage the Organs with Accumulated Chi
(4) Massage the Ovaries
(5) Internal Egg Exercise (optional)

2. Chi Weight Lifting

a. Prepare the weight on the floor or a chair. (Women: After inserting the string through the egg, tie it to the weight or the weight apparatus.)

b. Men: Fold the cloth, and tie it around the penis and testicles. Then tie one end of the cloth to the weight holding apparatus.

c. Women: Insert the egg into the vagina, larger end first.

Note for Men and Women: Always hold the weight or the cloth with your hands while standing up to assume a weight lifting posture. Test the weight with the index and middle fingers before releasing it.

d. While testing the weight with your fingers, pull up the left and right sides of the anus to the left and right kidneys respectively, and contract the perineum.

e. If it does not feel too heavy, gently release the string or cloth from the fingers, and hold the weight with the genitals.

f. Swing the weight from 30 to 60 times, inhaling as you pull up with each forward swing. Exhale as the weight moves backward.

g. First lift the weight from each station of the Microcosmic Orbit (You will actually be lifting the weight using the power of your mind.)

h. Rest as you hold the weight manually, or place it on a high surface, such as a table top. (You may prefer to remove it while resting, and then attach it again to resume lifting.) Collect the energy in the navel during the rest period.

i. Gently release the weight between your legs once again to lift it with the power of the organs and glands, starting with the kidneys.

j. Men: Lower the weight to the chair or the floor, and untie the cloth from the holding apparatus. Then remove the cloth from the groin.

k. Women: Lower the weight to the chair or the floor, and then remove the egg.

3. Men and Women: Practice the Power Lock exercise two or three times up to the crown.

4. Cloth Massage of the Sexual Center Perineum, and Sacrum

5. Sexual Energy Massage

Note: Men in particular should repeat at least two or three of the aforementioned massage techniques to replenish the circulation of blood in the sexual center, and to help dissipate any coagulation which can lead to blood clots. Women repeat the same procedures at their own pace.

6. Hitting (See Chapter Four.)

7. Use at least two or three of the Six Healing Sounds, especially the Heart and Lung Sounds. All of them are useful if you have the time to do them.

8. Practice the Microcosmic Orbit meditation for several minutes. In conjunction with this meditation, you can also practice Bone Breathing. Use your mind to absorb the released Ching Chi into the bones.

Chapter VI
Summary

This chapter is both a summary of Bone Marrow Nei Kung and a sample of its use with other Taoist physical disciplines. You may tailor your own training schedule from this information provided that you have thoroughly studied each exercise, and you know the precautions associated with each. Do not start training until you have fully understood the previous chapters.

When practiced together, these exercises can be completed within 45 minutes in an abbreviated format. There are nine distinct disciplines in this particular schedule. The Inner Smile, Microcosmic Orbit, Healing Love, Iron Shirt Chi Kung I, and the Six Healing Sounds are included as part of the regimen. When some degree of proficiency has been reached, practice according to your needs; however do not neglect any of these disciplines entirely.

A. Beginner's Approach to Bone Marrow Nei Kung

In the beginning, people are apprehensive about the time and effort required to achieve goals within this system. Indeed, the regimen may appear overwhelming to a novice. Similar questions arise among experienced practitioners, but for a different reason. The concern of the novice is how to create the time for such an esoteric discipline. The concern of the adept is that nothing interfere with the time allotted for practice.

Obviously, the most difficult task is getting started. People spend twelve to eighteen years obtaining the education they need to create the best possible foundation for a career, family, and social life. In the process they must often temporarily neglect their physical and spiritual health in favor of earning a living. The need for entertainment and social interaction often compounds the situation. Eventually, you must consider just how "temporary" the situation really is concerning your health and well-being.

Once Bone Marrow Nei Kung is established as a daily regimen,

people often find more time, energy, and pleasure in their lives. Internal health provides a wider range of capabilities and increased efficiency in your daily functions. The cultivation of internal power leads first to self-healing, then to radiant health, and ultimately to a better overall perspective. In this system, you will learn how to improve your capabilities to create more time for the pleasures of life.

B. General Features of Training

1. The Inner Smile is the most important aspect of early Taoist training because it draws positive energy to the internal organs and glands. It is taught as part of the Microcosmic Orbit meditation, but it is also distinct in that the Inner Smile makes new energy accessible through the mid eyebrow and the eyes. The Microcosmic Orbit is actually the pathway through which the associated meditation circulates internally stored energy while distributing new energy absorbed from the Inner Smile.

2. The Microcosmic Orbit Meditation should be used as part of the Bone Marrow Nei Kung regimen as well as being practiced regularly by itself. In this meditation energy is circulated through twelve stations located along two major pathways of the body. The first extends from the palate to the perineum, and the second extends from the perineum to the crown, returning to the palate through the mideyebrow. With the Inner Smile, this meditation should be practiced in the morning before your day begins and, along with the Six Healing Sounds, in the evening to decelerate the body.

3. The Healing Love is crucial to Bone Marrow Nei Kung in order to prevent the loss of sexual energy. The practice includes a sexual version of the Power Lock, the Genital Compression exercise, and Testicle/Ovarian Breathing. (The Sexual Power Lock is explained in Appendix 1.) In Bone Marrow Nei Kung, the Power Lock is used without any sexual arousal to draw Ching Chi into the Microcosmic Orbit. The Sexual Power Lock prevents the loss of Ching Chi during sex by drawing this energy into the body rather than expelling it. This also reduces the energy loss suffered by women during menstruation.

4. Iron Shirt I can be simplified to accommodate some of the Bone Marrow Nei Kung exercises, such as Bone Breathing and Bone Compression, which can be initiated from the “Embracing

the Tree" posture. Unless you wish to emphasize Iron Shirt Chi Kung I in your regimen, the other five postures can be done later in the day, or when ever you feel more ambitious about your training. It is useful for rooting the body and drawing energy from the earth. Refer to the book, *Iron Shirt Chi Kung I* for the complete practice.

5. Bone Breathing and Bone Compression can he practiced anywhere as separate exercises or to initiate Bone Marrow Nei Kung. Simply inhale, pack, spiral and squeeze Chi successively into the limbs and the body from a seated position or from the "Embracing the Tree" posture of Iron Shirt Chi Kung I. You may also use Bone Breathing and Bone Compression as part of the Hitting practice, combining them for the ultimate compression of sexual and external energy into the body.

6.The Sexual Energy Massage releases Ching Chi from the sexual center into the Microcosmic Orbit to be disseminated throughout the body and compressed into the bones. It is the primary practice because it is extremely powerful when combined with Healing Love techniques, and it is much safer that Chi Weight Lifting. The exercises related to the Sexual Energy Massage techniques are the Power Lock (non-sexual). Genital Compression and the Preliminary Cloth Massage Theses prepare the genitals by stimulating the Ching Chi for its ascension into the body. They also replenish the circulation of blood and Chi in the sexual center after practice.

7. As stated throughout this text, Chi Weight Lifting is documented for those students who have received the necessary training. The Sexual Energy Massage techniques will suffice for the purposes of Bone Marrow Nei Kung, and they must certainly be mastered prior to attempting this practice. Chi Weight Lifting differs from the massage techniques in that it further strengthens the fasciae which connect the genitals to the internal organs and glands. This is achieved by lifting light weights, and gradually increasing the length of time they are held, but never exceeding sixty seconds.

Note: Do not neglect the Power Lock, Cloth Massage, and Sexual Energy Massage techniques before and after Chi Weight Lifting.

8. The Hitting practice has two forms: one uses a wire device, the other uses rattan sticks. (Either can be used with packing.) The first form initiates strong vibrations, opening the pores of the bones to absorb new energies while detoxifying the system. The second form strengthens the nervous system by increasing the

skin's tolerance for external contact while stimulating lymphocyte production used in the creation of antibodies.

9. The Six Healing Sounds should complete the training in order to release trapped tension and excess heat from the body. These sounds are practiced from a seated posture after the Hitting techniques and the Microcosmic Orbit meditation. They serve to decelerate the body since its metabolic rate will be extremely high by the end of a Bone Marrow Nei Kung training session.

Note: The Microcosmic Orbit meditation still takes precedence over all other facets of this regimen. If you have little time for meditation, spend less time on each discipline; otherwise, do not practice until you can make the time for both the practice and the meditation.

C. Sample Training Schedule

At this point you have enough information on each practice to combine them into a Bone Marrow Nei Kung regimen. This summary is intended to help you assimilate what you have learned into your practice. Keep the book nearby and open to this page when you are ready to begin.

1. Inner Smile

a. Sit on the edge of a chair with your hands held together and eyes closed.

b. Re-create a happy emotional state, and express it with your best smile. Also smile by lifting the outer corners of your eyelids to enhance the process.

c. Picture a radiant smile of energy on the face of a glowing sun directly in front of you.

d. Sense a coolness in your eyes to attract and absorb the warm energy.

e. Mentally enhance the radiance and any color, or perceptions of warmth, until your eyes are filled with it.

f. Let the smiling energy spread down to the organs as you smile to your heart, lungs, liver, spleen, and kidneys. It is your smile that will give the energy its positive charge.

g. Draw in more energy through the mideyebrow and the eyes to stimulate the entire system. The process can take up to fifteen

minutes before you are ready to circulate the energy in the Microcosmic Orbit.

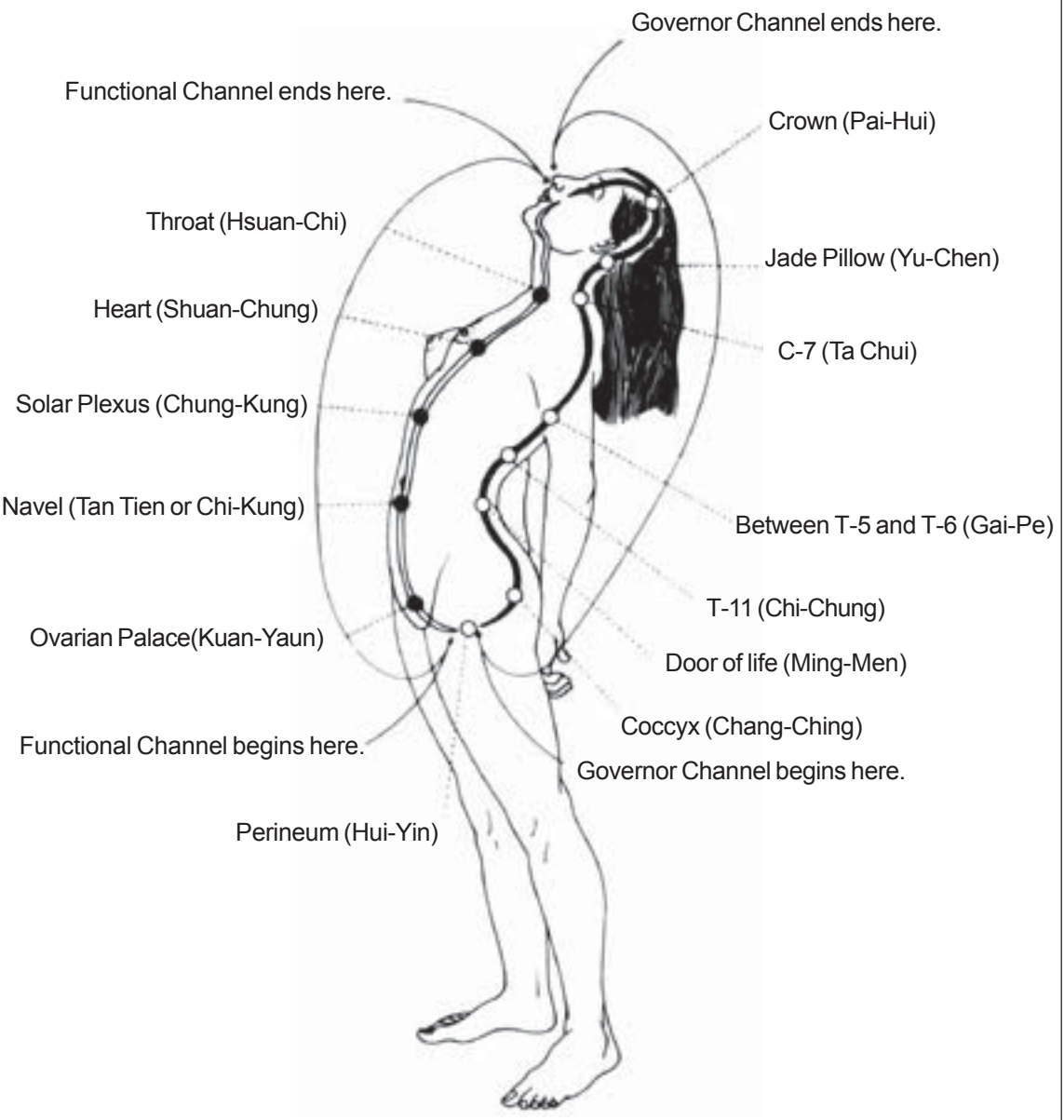

Fig. 6.1 *Functional and Governor Channels of the Microcosmic Orbit*

2. Microcosmic Orbit

a. After smiling down, collect the energy at the navel.
b. Let the energy flow down to the sexual center.
c. Move the energy from the sexual center to the perineum.
d. Draw the energy up from the perineum to the sacrum.
e. Draw the energy up to the Ming Men, opposite the navel.
f. Draw the energy up to the T-11 vertebrae.
g. Draw the energy up to the base of the skull.
h. Draw the energy up to the crown and circulate it.
i. Move the energy crown from the crown to the mideyebrow.
j. Pass the energy down through the tongue to the throat center.
k. Bring the energy down from the throat to the heart center.
l. Bring the energy down to the solar plexus.
m. Bring the energy back to the navel.
n. Circulate the energy through this entire sequence at least nine or ten tunes.
o. Collect the energy at the navel.

Men: Cover your navel with both palms, left hand over right. Collect and mentally spiral the energy outward at the navel 36 times clockwise, and then inward 24 times counterclockwise. (Fig. 6.2)

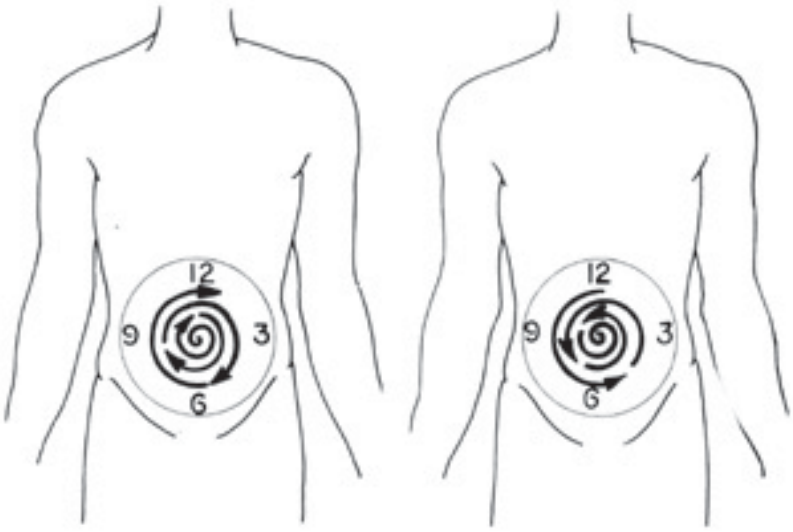

1. Collect the energy by spiraling outwardly from the navel 36 times clockwise.

2. Then spiral inwardly 24 times clockwise, finishing at the navel.

Fig. 6.2 *Men's collection of the Energy*

Women: Cover your navel with both palms, right hand over left. Collect and mentally spiral the energy outward from the navel 36 times counterclockwise, and then inward 24 times clockwise. (Fig. 6.3)

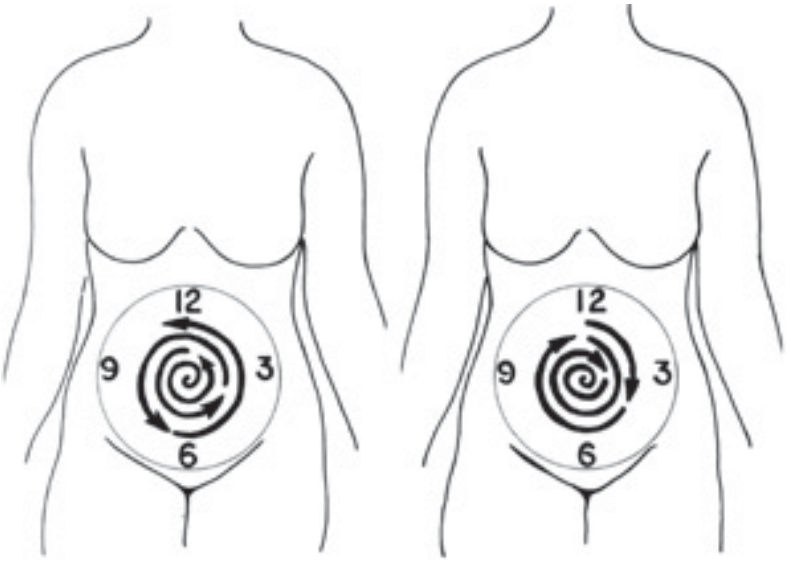

1. Collect the energy by spiraling outwardly from the navel 36 times counterclockwise.

2. Then spiral inwardly 24 times clockwise, finishing at the navel.

Fig. 6.3 *Women's collection of the Energy*

3. Testicle and Ovarian Breathing

a. Inhale and use mental power and a slight muscular contraction to draw the testicles upward. Hold the energy, as you exhale, and slowly lower the testicles. Women inhale, and squeeze the vagina, drawing the energy of the ovaries to the Ovarian Palace.

b. Guide the unaroused sexual energy up through the perineum by inhaling and pulling up the testes or contracting the vagina slightly.

c. Guide the Ching Chi up the back as if sipping on a straw. Slightly arch the lower back outward as if flattening the back against a wall. This will activate the Sacral and Cranial Pumps. Hold the attention at the sacrum and exhale slowly.

d. Relax the sacrum and neck back to their normal positions.

e. Inhale and guide the energy up to T-11 repeating steps 4, 5 and 6.

f. The next stopping place is the Jade Pillow at the base of the skull.

g. Guide the energy up to the head and spiral the energy nine times clockwise and nine times counterclockwise.

h. Men can leave the cold energy in the head for a while. Women should bring the resultant hot energy down the Microcosmic Route immediately.

4. Iron Shirt Chi Kung I: Embracing the Tree Posture

Use this posture for practicing Bone Breathing and Bone Compression, Iron Shirt I techniques, weight lifting, and so on.

a. Stand with the feet parallel at a foot-to-knee distance from each other.

b. Dig firmly into the ground by slightly turning out the balls of the feet.

c. Rotate your pelvis back until the thigh tendons can relax.

d. Feel that the sacrum is pulling the spine down.

e. Relax the chest and ribs.

f. Keep the back as straight as possible. The neck is gently, but firmly pushed back at the C-7 point.

g. Pull back the lower jaw towards the Jade Pillow of the skull.

h. Hold the hands vertically at shoulder level with the fingers spread and the elbows dropped beneath them. Point the fingers towards those of the opposite hand.

i. Position the arms as if they were encircling a tree. Hold the thumbs outward slightly, with the pinkies directed inward, and relax the other fingers.

j. Drop the shoulders, round the scapulae, and sink the chest.

k. Relax the neck, and feel the Chi connecting the hip joints with the knee and ankle joint, and feel their energy connecting with the ground.

5. Bone Breathing and Bone Compression

Note: These may be done in conjunction with Hitting rather than as separate practices.

a. From either a seated position or the posture outlined above, draw in external energy through the fingers as you inhale; release it as you exhale.

b. Inhale and exhale through the lower and upper arms successively. Begin to spiral the energy as you draw it in.

c. Breathe into the toes in the same manner.

d. Continue to breathe into the legs, the pelvis, and spiral the energy.

e. Combine the draw of external energy from both sources and allow them to meet at the spine.

f. Draw the combined energy, up to the head, and spiral it.

g. Breathe the energy into the ribs and sternum from the spine, and continue to spiral it.

h. Inhale, spiral, pack, and squeeze into all sections simultaneously; hold your breath as you compress the energy into your bones; then exhale.

6. Sexual Energy Massage

a. Power Lock

The Power Lock is practiced before and after the Sexual Energy Massage to assist in the upward draw of the released energy and sexual hormones. It employs nine short sips of breath with nine contractions of the genital, anal and perineal areas. The tongue is pushed against the palate, and the buttocks and teeth are clenched to activate the Cranial and Sacral Pumps. Together with these contractions, the three middle fingers of either hand are used to press a point at the back of the perineum, near the anus, to help guide the rising energy, up to the five stations of the sacrum,T-11 point C-7 point, base of the skull, and the crown point. The goal is to draw sexual energy from the perineum to the crown.

b. Genital Compression

This exercise replenishes the energy drawn from the genitals during the other practices. This is not a Bone Marrow Nei Kung technique in itself, but rather a separate practice for use afterwards. The method compresses energy into the genitals of men or women to increase their production of Ching Chi.

c. Preliminary Cloth Massage

A silk cloth is used to massage in circular motions the genital area, perineum, coccyx, and sacrum. This is used before and after the Sexual Energy Massage to first prepare the genitals for the and then later to replenish the flow of blood and Chi to the sexual center. This is particularly useful in preventing blood coagulation and subsequent blood clots from occurring in the genitals of male practitioners.

d. Sexual Energy Massage for Men

(1) Finger Massage of the Testicles
(2) Palm Massage of the Testicles
(3) Ducts Elongation Rubbing
(4) Stretching the Ducts Gently with Massage
(5) Stretching the Scrotum and Penis Tendons
(6) Tapping the Testicles

e. Sexual Energy Massage for Women

(1) Breast Massage
(2) Massage of the Glands with Accumulated Chi
(3) Massage of the Organs with Accumulated Chi
(4) Massage the Ovaries

f. Internal Egg Exercise

This exercise uses a jade egg to resist internal contractions of the vaginal canal, thereby strengthening its three sections. The first section is the front of the vaginal canal, within the external orifice. The second section is the middle of the canal between the first and third sections. The third section is directly beneath the cervix, near the end of the canal.

7. Chi Weight Lifting for Men and Women

As you swing the weights, first pull them from the Microcosmic Orbit as the energy flow resisting the pressure of the weights passes through the perineum, sacrum, T-11 and C-7 vertebrae. Jade Pillow, and crown. Later, as you continue to lift from the perineum, both sides of the anus should be pulled up as you pack Chi around both kidneys. Starting at the kidneys, lift from the lower organs successively upwards, eventually employing the higher organs, and finally lift from the pineal and pituitary glands. Circulate the released energy through the Microcosmic Orbit upon removing the weights.

a. Start with the Power Lock, Cloth Massage, and Sexual Energy Massage. The weight should be placed on a chair or the floor.

b. Men: Tie the cloth around the entire groin (not the testicles alone). Attach a light weight to the cloth. Women: Attach a light weight to the string held by the egg, then insert the egg into the vagina.

c. Lift the weight from its resting place, and swing it, using the strength of the Microcosmic Orbit to create the upward force. Begin by pulling up the front, middle, and back anus to bring the Chi to the sacrum from where it will be pulled up the spine to the head. Use every station of the Microcosmic Orbit to assist in pulling the weight.

d. Concentrate on the kidneys. Pull up the right and left anus as you wrap Chi around the kidneys, and then lift the weight from the kidneys.

e. Pull up the right and left anus. Wrap Chi around the spleen and the liver. Pull the weight from the spleen and the liver.

f. Use the same procedure lo lift from the lungs. Pull the weights from a straight line though the organs beneath each lung.

g. Pull up as you contract the heart, lungs, spleen livers adrenals, kidneys and thereby the weights. Feel the fascial connection between all of these organs and the genitals.

h. Add the strength of the thymus gland to the upward draw of the organs.

i. Finally, press the tongue to the palate, pull up both sides of the anus, contract the muscles of the skull, and lift from the pituitary and pineal glands through all of the previous organs.

j. After you release the weights repeat the Power Lock exercise Cloth Massage and Sexual Energy Massage.

8. Hitting with Packing

Inhale, spiral, pack, and squeeze external and sexual energy into each area as you prepare to apply the Hitting device; hold the breath and muscle tension as you hit; then exhale and release the tension. When Hitting with the rattans avoid contact with the spine.

a. Preliminary Hitting: To stimulate energies and detoxify, hit three times the lower Tan Tien (below the navel), the Ming Men (opposite the navel on the spine), the inside of both elbows, and the back of both knees. This is optional when using the rattans.

b. Hit the five abdominal lines.

c. Hit the rib cage and the sternum very lightly at an angle.

d. Hit the three, lines of the back (two lines with the rattans).

e. Hit the left and right sides, of the body.

f. Gently tap the head and jaw.

g. Hit the four lines of each arm: the Middle Finger Line, the Thumb Line, the Back of the Hand Line, and the Pinky Line.

h. Hit the four lines of the legs: The Middle Line (down the front), the Big Toe Line, the Small Toe Line, and the Back of the Leg Line.

9. Six Healing Sounds

Do the Lung Sound and the Heart Sound as described in Appendix 1. The other four sounds and related postures are optional, but they are useful in helping the body to decelerate at the end of this regimen. You may wish to begin any of the higher level meditations, or else practice the Inner Smile and Microcosmic Orbit again.

10. Combining the Practices

When you are well acquainted with the supplemental disciplines, you can combine them into one practice from the Embracing the Tree posture.

a. Assume the Embracing the Tree posture.

b. Smile down to the organs, glands, and navel.

c. Practice “Energizer Breathing” by pushing and pulling the lower abdomen out and in to emphasize each inhalation and exhalation for nine, eighteen, or 36 breaths.

d. Do the three stages of packing for Iron Shirt Chi Kung I as described in Appendix 1.

e. Practice Bone Breathing.

f. Practice Testicle/Ovarian Breathing.
g. Do the Genital Compression exercise two or three times.
h. Do from three to six sets of the Power Lock exercise.
i. Practice the Microcosmic Orbit for three to six rounds.
j. Collect the energy in the navel.

D. Planning your Practice

1. Bone Marrow Nei Kung Regimen

a. Ideally, you should begin by spending from fifteen to 30 minutes on the Microcosmic Orbit with the Inner Smile, and ten minutes practicing Iron Shirt Chi Kung I.

b. Begin the Cloth Massage and practice the Power Lock exercise to start the flow of sexual enerygv to the higher energy centers.

c. Begin the Sexual Energy Massage. Then, providing that you have received training, you may follow the massage techniques with Chi Weight Lifting.

d. Repeat the Power Lock exercise for at least two or three rounds, then repeat the Cloth Massage.

e. Repeat two or three of the Sexual Energy Massage techniques after Chi Weight Lifting to replenish the circulation of blood and Chi in the sexual center, thereby avoiding blood clots in the male genitals.

f. Begin the Hitting practice. Use the bundled wires to create the vibrations that will force the sexual energy into the bones, organs, and glands as you pack and spiral the energy. Rest after you hit each line.

g. Use the rattan sticks to strengthen the skin, muscles, nervous and lymphatic systems. Rest after you hit each line.

h. Finish the entire process with the Microcosmic Orbit Meditation and the Six Healing Sounds.

2. Time for Practice

The best time to practice as previously, mentioned, is in the morning after you have eliminated body wastes and bathed but you can also practice in the afternoon. You are advised not to practice in the evening because you are creating a great deal of energy and

you may have difficulty sleeping. Try to maintain a specific schedule until you are proficient.

3. Frequency of Practice

In the very beginning practice two to three times a week. Once you are proficient, you may begin to practice on a daily basis. As in all the other Universal Tao disciplines, Chi Weight Lifting and Hitting take time to learn. Eventually, all the steps will begin to blend together into an easily practiced sequence which will increase your energy as your body becomes stronger and healthier.

4. Practice during Travel

The Sexual Energy Massage, Healing Love Bone Breathing and Bone Compression can be practiced easily while traveling. You can also practice Chi Weight Lifting and Hitting, though it may be hard to carry the weights and devices. The Universal Tao suggests the following to help you maintain these disciplines.

a. The bean hag and rattan sticks are light and should present no problems for travel. If necessary, you may use your hands to hit the Door of Life point on the back, and the lower Tan Tien point below the navel. Then use the palms to hit the limbs and the body.

b. For Chi Weight Lifting, carry the cloth—or the egg—and a small, strong bag in which you can place an object to serve as a weight. Always weigh this object on a scale to determine whether or not it is within your capacity to lift.

Appendix I
Supplemental Exercises

Once the Microcosmic Orbit has been opened, a novice can practice Bone Marrow Nei Kung. However, the most benefit is derived from combining this discipline with other aspects of the system. The following is an abridged review only. Each supplemental exercise requires time to master, and each is further described in other Universal Tao books.

***Note*:** These disciplines ate not presented as part of a regimen or in any specific order for practice.

A. Healing Love

The effects of Bone Marrow Nei Kung are dependent upon the practice of Healing Love, which rechannels sexual energy to heal the internal system. For the purposes of this book, the sexual version of the Power Lock is given because it encompasses the "Power Draw" technique used by men and the "Orgasmic Draw" technique used by women in the Healing Love practice. These exercises are combined with the three finger technique and the internal contractions of the Power Lock to draw Ching Chi into the Microcosmic Orbit.

1. Power Draw

For men, the practice of orgasmic redirection employs a form of non-ejaculatory sex which results in the highest internal stimulation that can be achieved. The energy that is normally lost during an ejaculation is instead channelled into the body. When it reaches the organs and glands, this energy causes body orgasms that last longer, feel superior, and lack the exhaustion normally felt after sex. The loss of sexual energy through ejaculation deprives the bone marrow of nourishment and depletes the internal organs and glands of one third of their energy. Ejaculation drains energy from the internal system to replace Ching Chi lost with the seminal fluid.

2. Orgasmic Draw

Women who practice the Orgasmic Draw also experience superior orgasms, shorter menstrual periods, and an increase in life-force energy as Ching Chi is retained for use by the body. The problem women face is the loss of enormous quantities of sexual energy through their menstrual periods. This loss can be limited or completely prevented through the Healing Love practice. Further, the exchange of energies during sex becomes far more valuable to a woman when the Yang Chi imparted by her lover is absorbed into her Microcosmic Orbit. Otherwise, the energy received, as well as her own, will be expelled at the end of her cycle and wasted.

3. Health and Sexual Benefits

Not only do the organs retain their full capacity when Ching Chi is saved, but internal energy compounds itself when it is allowed to accumulate on a regular basis. In other words, men and women who consciously save the internal power normally lost during sex will receive a one-third increase in their life-force energy, which accrues regularly with practice. Consider this to be the interest you collect on your savings which is paid off in strength, health, and superior orgasms. The body improves itself regularly through intelligent sex, and the excess energy can be used to fortify every aspect of your life.

4. Sexual Power Lock Practice

Review the Power Lock exercise of Chapter Three for the proper sequence of contractions. Healing Love is practiced in an amused state with or without a partner. In solo practice, use several sets of nine short inhalations--”sips”--with nine simultaneous contractions to each station. Continue to repeat this process, drawing the energy up towards the crown. Remember to push the flat part of the tongue against the roof of the mouth as you force the tip of the tongue against the lower jaw behind the teeth. This opens the crown and increases the force of the energy travelling up the spine.

***Men*:** During the act of sex, reach behind the buttocks to use the three fingertips on the point in front of the anus. (Fig. App. 1.1)

Apply pressure after each sip of air. In solo practice, use sets of nine contractions until your erection subsides through your drawing power. Repeat this procedure several times. In both cases, maintain the finger pressure if you are near an ejaculation. Do not release it until the urge to expel the semen is gone. Timing is important. If you feel near ejaculation, do not wait to start a set of nine contractions, and be prepared to hold the finger pressure if necessary.

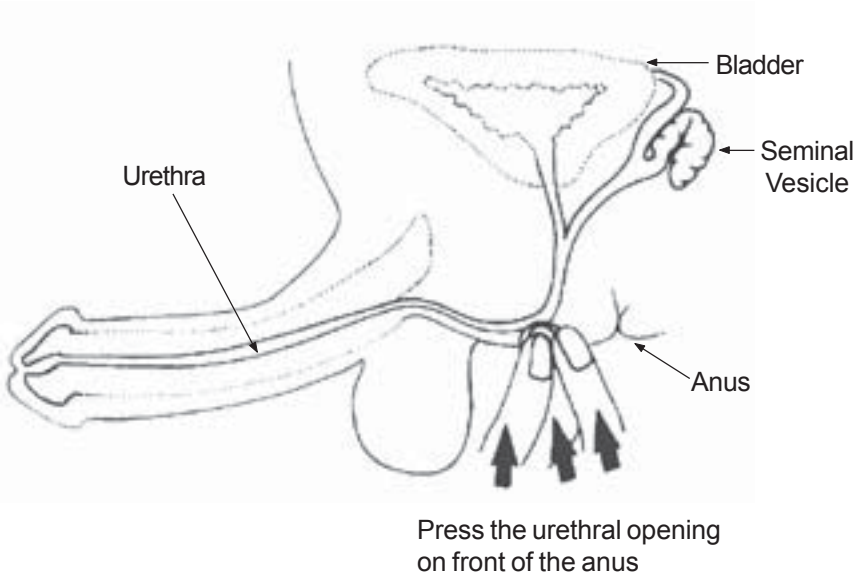

Fig. App.1.1 *Sexual Power Lock for men includes pressing against the urethra from a point at the back of the perineum, in front of the anus.*

Women: The three fingertips need not be applied by women during the sexual practices. Their main concern is to draw the energy of each orgasm up through the five stations to the crown point, and then to circulate it. (If your Microcosmic Orbit is open, you can draw the energy directly up to the crown.) Finish by storing the energy in the navel. In solo practice, always begin by drawing Ching Chi from the ovaries and sexual center into the perineum. Do not allow it to remain in the sexual center.

Men and Women

a. As you initiate the Sexual Power Lock, draw in towards the sacrum with every sip of air. (Men apply the fingers as you hold each contraction.) Pull up the genitals, anus, and perineum, simultaneously clenching the teeth and buttocks. (Fig. App. 1.2)

Fig. App.1.2 *Initiate the Sexual Power Lock.*

b. Inhale, and pull up the anus to the sacrum. Tilt the sacrum, pull up further to T-11 at the center of the back, opposite the solar plexus, and then up to C-7 at the base of the neck. Inhale again, and pull up higher to the 6ase of the skull and then all the way up to the crown point. (Fig. App. 1.3) Spiral the energy, then bring it down to the third eye between the eyebrows: and hold it there for a while.

***Note*:** If the Governor channel is completely open, you can draw Ching Chi all the way up to the crown. Always avoid leaving Ching Chi at the Ming Men point opposite the navel because it causes an allergic type of reaction in both kidneys.

c. Exhale, place the tongue on the palate, and let the energy flow down through the tongue to the throat center. Then bring the energy down to the heart. Rest, and concentrate on the navel, Bring the energy down to the solar plexus, and finally down to the navel. Cover the navel, and spiral the Chi.

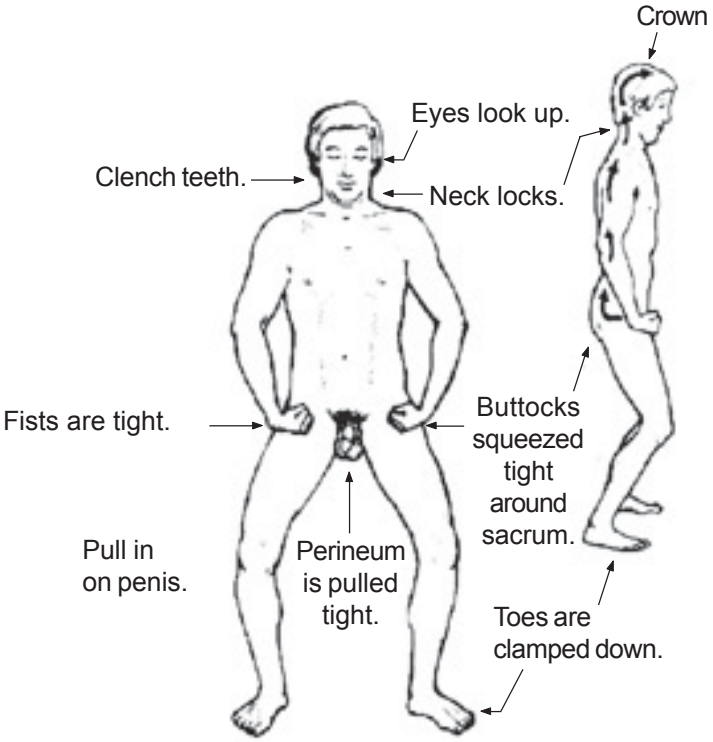

Fig. App.1.3 *Inhale and pull all the way up to the crown.*

d. Cloth Massage after the Sexual Power Lock: Apply the cloth using circular motions to the perineum, the coccyx, and the sacrum. Starting at the perineum, use the cloth folded lengthwise to massage in a clockwise motion nine to eighteen times, then in a counterclockwise motion nine to eighteen times. Apply the cloth in the same manner to the coccyx, and finally to the sacrum.

Note: More information un the Healing Love techniques can be found in the books, *Taoist Secrets of Love: Cultivating Male Sexual Energy and Healing Love Through the Tao: Cultivating Female Sexual Energy.*

B. Iron Shirt Chi Kung I

1. Energizer Breathing

Begin with Abdominal Breathing (also known as Energizer Breathing) by expanding the lower abdomen on all sides like a ball as you inhale. Breathe into both kidneys and lower the diaphragm as you inhale, making sure to keep the chest relaxed and sunk down. As you exhale, flatten the abdomen completely. Regulate this breathing using quick, short sips to inhale and exhale.

Reverse Abdominal Breathing is practiced in the opposite manner by extending the abdomen as you exhale and retracting it as you inhale. Keep the chest relaxed throughout. Contract the pelvic and urogenital diaphragms, and slightly pull up the Chi Muscle during these exercises.

***Note*:** In Iron Shirt I, packing is initiated by contracting the muscles of a given area as you mentally condense the Chi there. Always breathe through the nose in all Universal Tao exercises.

2. Embracing the Tree

This basic rooting posture is similar to the Horse Stance, which is often used in the practice of Chi Weight Lifting. The Embracing the Tree stance is created as follows: Stand with the feet parallel at a heel-to-knee distance from each other. Dig firmly into the ground by slightly turning out the balls of the feet in a gripping motion. Maintain this force throughout the duration of the posture, and do not curl the toes up. The pelvis is rotated back until the thigh tendons can relax. Feel the sacrum pulling the spine down.

Keep the chest relaxed and the back as straight as possible. The neck is gently, but firmly, pushed back at the C-7 point. This is accomplished by pushing back the lower jaw slightly until you feel the C-7 point and the base of the skull aligned with the spine. The head should feel as though it is being lifted from the crown.

The hands are held vertically at shoulder level with the fingers spread and elbows dropped beneath them. Point the fingers towards those of the opposite hand, and position the arms as if they were encircling a tree. Hold the thumbs slightly outward with

the pinkies directed inward. Drop the shoulders, joining the scapulae with the spine by rounding the scapulae and sinking, the chest. Relax the neck. Feel the connection from the hip joints down to the knee and ankle joints, and feel their connection with the ground. (Fig. App. 1.4)

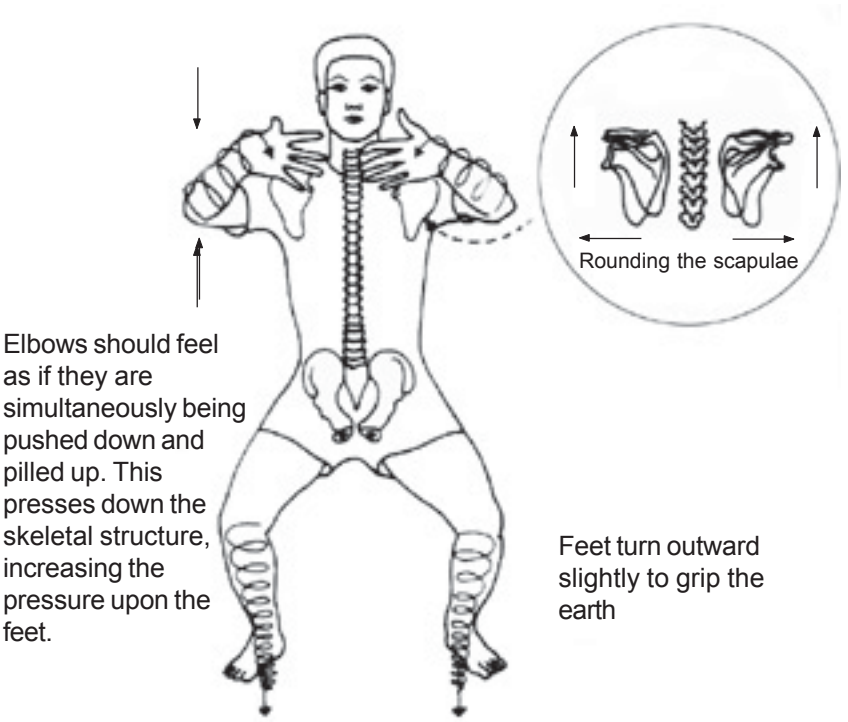

Fig. App.1.4 *Full Embracing the Tree Posture - Front View*

The exercise usually associated with this posture is presented in three stages. If you cannot complete these stages for any reason, it is important that you collect the Chi in the navel. If time does not allow for much work in this area, just use this posture for Bone Breathing and Bone Compression. The actual Iron Shirt I techniques can be done later in a separate practice if necessary.

***Note*:** The same precautions for Hitting with Packing apply to this practice. Check with a physician if you have high blood pressure. Women should not use any packing or compression during a menstrual period, or if they are pregnant.

a. Stage One

(1) Assume the posture described above. Press the sacrum down, round the scapulae, relax the chest, and hold the head erect.

(2) Begin Energizer Breathing by pushing and pulling the abdomen out and in to emphasize each inhalation and exhalation. Practice nine to eighteen breaths in this manner.

(3) Exhale, flatten the stomach, and lower the diaphragm. Exhale again, and pull up the pelvic and urogenital diaphragms and the sexual organs.

(4) Inhale in short sips holding about ten percent of your lung capacity, and tighten the perineum. Sip in twice, and pull up the left and right sides of the anus to the kidneys with each sip. Pack Chi into the kidneys. Do not release the breath until your lungs are comfortably full.

(5) Pull up the sexual organs, sip in air, and pack Chi into the navel. Keep the chest relaxed, and spiral the energy nine times clockwise then nine times counterclockwise as you hold the compression around the kidneys and the navel. Do not move your hands.

(6) Breathe into the middle abdomen (one and a half inches below the navel) without spiraling, and pack.

(7) Breathe into the lower abdomen (three inches below the navel) without spiraling, and pack.

(8) Breathe into the perineum, and feel it bulge.

(9) Exhale down through the legs and the feet into the ground approximately six inches. Initiate breathing energy through your palms and soles. Use Energizer Breathing from the lower abdomen for up to eighteen breaths. Feel the energy flowing in the Microcosmic Orbit. (A form of Bone Breathing can also be done at this time.)

b. Stage Two

(10) Exhale, flatten the stomach, and pull up the left and right anus. Inhale, lighten the perineum, and squeeze the soles of the feet into the ground. Inhale ten percent of your lung capacity as you pull up the left anus. Hold, and then sip in more air as you pull up the right anus. Pack the kidneys. Claw the toes as though you are gripping the earth, and spiral at the Kidney Points (K-1) on the soles of both feet simultaneously, nine times clockwise and nine times

counter-clockwise. Use the mind, coordinated with eye movements, to help circulate the energy.

(11) Inhale, bringing the energy from the earth up to the knees. Lock the knees with no spiraling,

(12) Inhale the Chi up to the perineum, and spiral nine times clockwise and nine times counterclockwise. Feel the perineum bulge.

(13) Exhale. Regulate the breath with Energizer Breathing, practice Bone Breathing, and be aware of the soles and palms absorbing and releasing energy. Relax, practice the Inner Smile, and send smiling energy to all of the organs. Feel the energy flow in your Microcosmic Orbit.

c. Stage Three

(14) Now exhale again twice and flatten the stomach. Inhale ten percent of your lung capacity, and pull up the front, middle and finally the back part of the anus so that you can direct the Chi into the sacrum. Tilt the sacrum, pack Chi into it, and spiral the energy nine times clockwise and nine times counterclockwise. This will strengthen and activate the Sacral Pump.

(15) Inhale Chi up to T-11, inflating the kidney area, and press out on the lower back to straighten the curve there, spiraling nine times clockwise and nine times counterclockwise.

(16) Inhale up to C-7, straighten the curve at the neck, and lock the neck. Spiral the energy at C-7 nine times clockwise and nine times counterclockwise.

(17) Inhale to the base of the skull, Push the tongue against the palate, clench the teeth tightly, push the chin back, and squeeze the skull and temple hones to activate the Cranial Pump. Spiral nine times clockwise and nine times counterclockwise.

(18) Inhale to the crown (pineal gland) and spiral the energy nine times clockwise and nine times counterclockwise. (Fig. App. 1.5)

(19) Concentrate on the space between the eyebrows until you feel Chi build up there. Regulate the breath with Energizer Breathing. Exhale, holding the tongue up to the palate to connect the Governor and Functional channels.

(20) Bring the Chi down through the throat, heart center, and solar plexus. Bring the Chi down to the navel. Collect the energy,

there by covering the navel with the palms and spiraling in the prescribed manner.

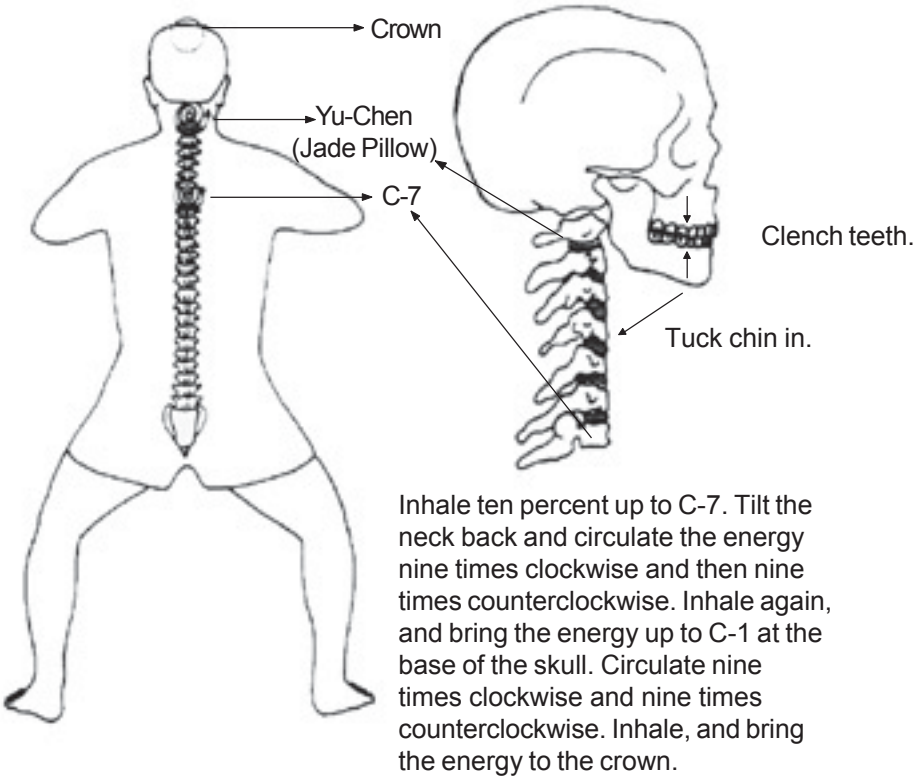

Fig. App.1.5 *Stage Three of Embracing the Tree*

C. Six Healing Sounds

Emotional problems, pollution, poor food, injuries, and sudden or overly strenuous exercise can overheat the internal organs and glands. The Six Healing Sounds and their associated postures serve to cool and cleanse the vital organs, stimulating the flow of Chi energy to them. There are specific positions that you can assume to liberate any heat that may be trapped within the cooling sacs that surround each vital organ.

Note: Typical side effects of these practices are yawning, burping, or passing wind, all of which are beneficial.

1. Lungs: First Healing Sound

Associated Organ: Large Intestine
Element: Metal
Season: Autumn
Color: White
Emotions: Grief and Sadness, Courage and Righteousness
Parts of the body: Chest, Inner Arms, Thumbs
Senses: Smell (Nose) and Touch (Skin)
Taste: Pungent
Sound: ***Sssssssssss*** (tongue behind teeth)

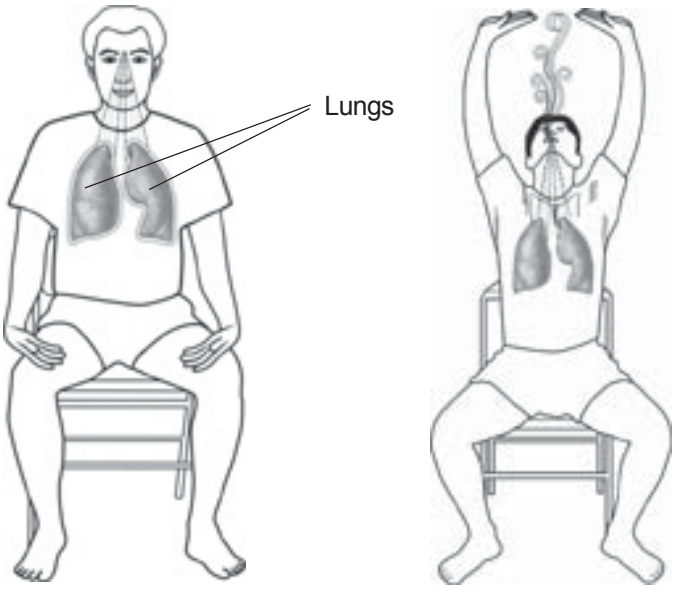

(a) Become aware of the lungs

(b) Picture and feel the sac covering the lungs compress.

Fig. App.1.6 *Lungs Sound*

a. Position: Sit up straight on the edge of a chair with the backs of your hands resting on your thighs. (Fig. App.1.6 (a)) While looking at your palms, take a deep breath, and raise your arms out in front of you. When the hands are at eye level, begin to rotate the palms and bring them up above your head until the fingers of each hand point toward each other, and the palms face upward and outward.

Keep the elbows rounded out to either side. Do not straighten your arms.

b. Sound: Close the jaw·s so that the teeth meet gently, and part the lips slightly. As you look up, push up through your palms, draw the corners of the mouth back, and exhale the sound "***Sssssssssss***" sub-vocally, slowly and evenly in one breath. Picture and feel the sac covering the lungs compress and expel the excess heat, sick energy, sadness, sorrow, and grief. (Fig. App. 1.6 (b))

c. Rest and Concentrate: When you have exhaled completely, rotate the palms down, gently lowering the shoulders, and slowly lower your hands to your lap, resting them on your thighs, palms up. Close your eyes, and be aware of your lungs, imagining that you are still making the sound. Breathe into the lungs normally to strengthen them. Visualize the color white and smile into the lungs. Try to feel the exchange of cool, fresh energy replacing the hot, wasted energy. Feel righteousness and courage grow within you.

d. Repeat the Lung Sound three to six times. For colds, flu, toothaches, asthma, emphysema, or depression, repeat the exercise six, nine, twelve, or 24 times.

2. Kidneys: Second Healing Sound

Associated Organ: Bladder
Element:: Water
Season: Winter
Color: Black or Dark Blue
Emotions: Fear, Gentleness
Parts of the body: Side of Foot, Inner Legs, Chest
Senses: Hearing (Ears), Bones
Taste: Salty
Sound: ***Chooooooooo*** (as when blowing out a candle, the lips forming an "O")

a. Position: Bring your legs together, ankles and knees touching, then take a deep breath and lean forward. Clasp the fingers of your tight hand around your left, and embrace your knees with the joined hands. (Fig. App. 1.7(a)) Pull back on the arms, straightening them. Allow your back to sag so that it protrudes in the area of your kidneys. Then tilt your head back slightly, and feel the pull on the spine.

b. Sound: Round the lips, and exhale the sound "***Chooooooooo***" as if you are blowing out a candle (Fig. App. 1.7 (b)) At the same

time, contract your abdomen in toward your kidneys. Keep the lips rounded. Imagine the excess heat, the sick energy, and the fear being squeezed out from the membranes surrounding the kidneys.

c. Rest and Concentrate: When you have fully exhaled, sit erect, separate the legs, and place your hands on your thighs with palms up. Close your eyes, breathe into the kidneys, and be aware of them. Visualize the color blue in the kidneys. Smile to them, imagining that you are still making the sound, and feel gentleness there. Be aware of the flowing energy.

d. Repeat the Kidney Sound three to six times. Practice more to alleviate problems of fatigue, dizziness, ringing in the ears, or back pain.

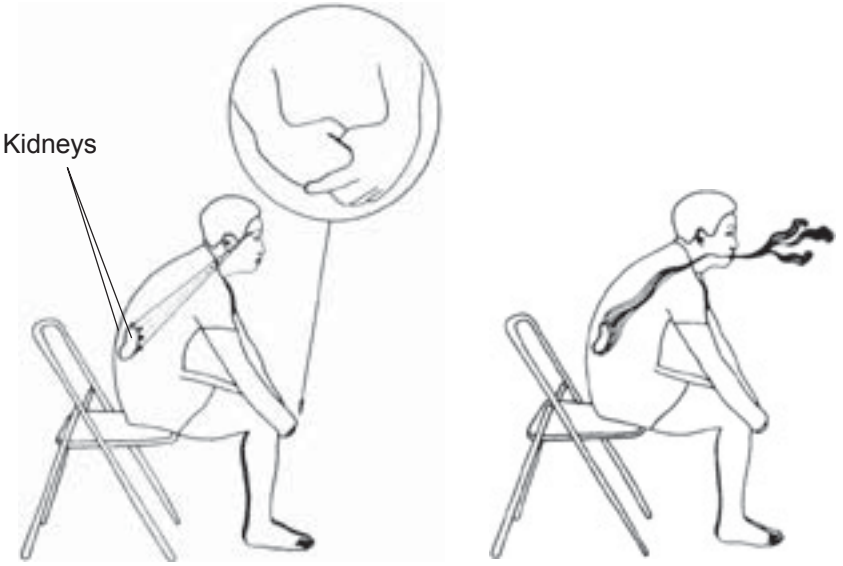

(a) Hook the hands around the knees. Become aware of the kidneys.

(b) Round the lips, making the sound one makes when blowing out a candle.

Fig. App.1.7 *Kidneys Sounds*

3. Liver: Third Healing Sound

Associated Organ: Gall Bladder
Element: Wood
Season: Spring

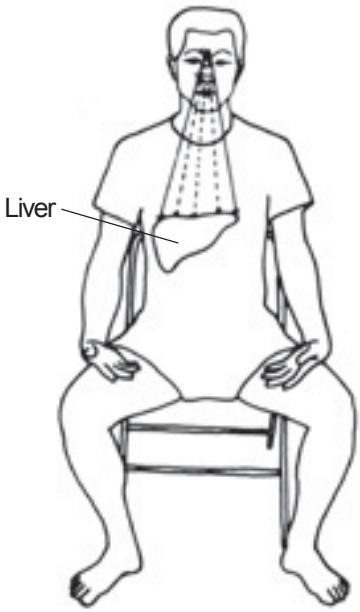

(a) Become aware of the liver.

(b) Feel that a sac encloses the liver, compresing it.

(c) Close your eyes and smile down to the liver.

Fig. App.1.8 *Liver Sound*

Color: Green
Emotions: Anger, Kindness
Parts of the body: Inner Legs, Groin, Diaphragm, Ribs
Senses: Sight (Eyes), Tears
Taste: Sour
Sound: ***Shhhhhh*** (tongue near palate)

a. Position: Sit on the edge of your chain and extend your arms out to the sides, palms up. (Fig. App. 1-8 (a)) Take a deep breath as you slowly swing your arms up and over your head following this action with your eyes. Interlace the fingers and turn your joined hands over to face the ceiling, palms up. Push out at the heel of the palms and feel the stretch through the arms into the shoulders, Bend slightly to the left, exerting a gentle pull on the liver.

b. Sound: Open your eyes wide as they are the openings of the liver. Slowly exhale, and sub-vocally emit the sound "***Shhhhhh***." Envision the excess heat and anger being expelled from the liver as the sac enveloping the liver is gently compressed. (Fig. App. 1.8 (b))

c. Rest and Concentrate: When you have fully exhaled, turn the hands over, separate them, and slowly bring the arms down to your sides. Bring the hands to rest on your thighs, palms up. Smile down to the liver. Close your eves, breathe into the liver, and be aware of it beneath the right rib cage. (Fig. App. 1.8 (c)) Imagine that you are still making the Liver Sound. Feel kindness grow there and visualize the color green.

d. Repeat the Liver Sound three to six times. Practice more times to expel anger, clear the eyes of any irritations, remove a sour or bitter taste, or to detoxify the liver.

4. Heart: Fourth Healing Sound

Associated Organ: Small Intestine
Element: Fire
Season: Summer
Color: Red
Emotions: Hastiness, Arrogance, Cruelty, Joy, Honor, Sincerity
Parts of the body: Armpits, Inner arms
Senses: Tongue, Speech
Taste: Bitter
Sound: ***Hawwwwwwww*** (mouth wide open)

a. Position: Take a deep breath and assume the same position as for the Liver Sound (Fig. App. 1.9(a)), but lean slightly to the right since the heart is located slightly to the left of center in your chest. Focus on the heart and feel the tongue's connection to it.

b. Sound: Open the mouth, round the lips, and exhale the sound "***Hawwwwwwww*** " sub-vocally. Picture the sac which surrounds the heart expelling heat, impatience hastiness, arrogance, and cruelty. (Fig. App. 1.9 (b))

(a) Assume the same position as for the Liver Sound. Become aware of the heart.

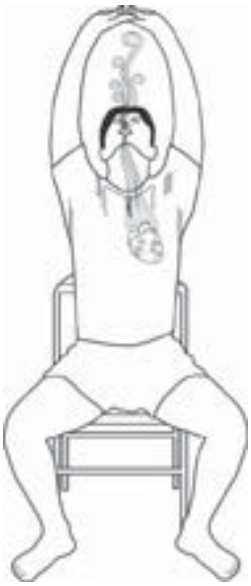

(b) Open your mouth round your lips, and exhale the sound.

Fig. App.1.9 *Heart Sound*

c. Rest and Concentrate: After exhaling, smile down to the heart, and visualize a bright red color. Feel joy, honor, and sincerity grow in the heart.

d. Repeat the Heart Sound three to six times. Practice more to alleviate problems such as a sore throat, cold sores, swollen gums or tongue, jumpiness, moodiness and heart disease.

5. Spleen: Fifth Healing Sound

Associated Organs: Pancreas, Stomach
Element: Earth
Season: Indian Summer
Color: Yellow
Emotions: Worry, Fairness
Parts of the body: Lips, Mouth
Senses:Taste
Taste: Sweet, Neutral
Sound: ***Whooooo*** (from the throat, guttural)

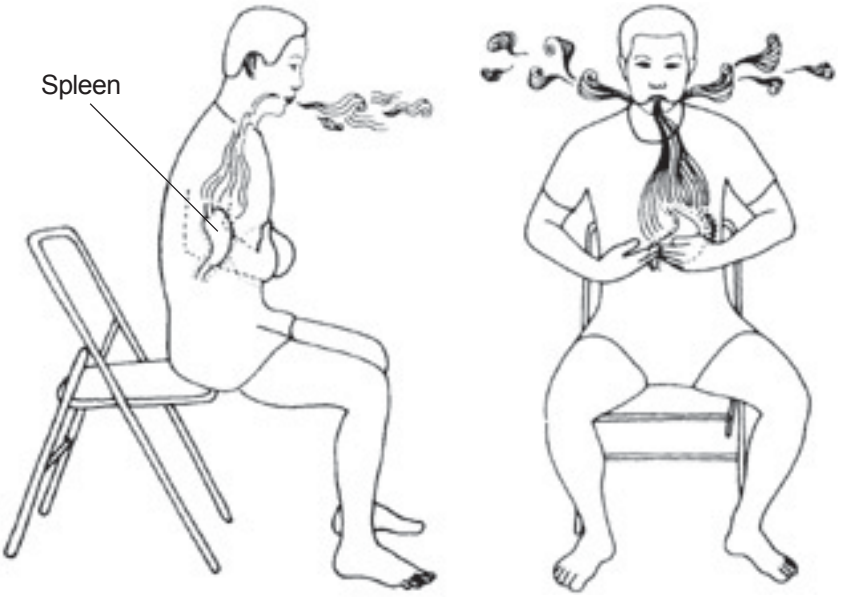

Fig. App.1.10 *Spleen Sound*
Place your hands with the three middle fingers resting at the bottom of the sternum, slightly to the left. Press in with the fingers

a. Position: Take a deep breath as you place your hands beneath the sternum with the index fingers resting at the bottom rib, slightly to the left and above the navel. Press in with the fingers as you push out the middle back. (Fig. App. 1.10)

b. Sound: Look up, and gently push your fingertips into the solar plexus area. Exhale the sound "***Whooooo*** " sub-vocally. Feel the sound vibrate the vocal cords. Feel pour worries being expelled.

c. Rest and Concentrate: Once you have fully exhaled, close your eyes. Place your hands on your thighs, palms up, and concentrate your smiling energy on the spleen, pancreas, and stomach. Breathe into these organs. Imagine a bright yellow light shining, and feel the emotions associated with fairness growing.

d. Repeat the Spleen Sound three to six times. Practice more times to eliminate indigestion, nausea, and diarrhea.

6. Triple Warmer: Sixth Healing Sound

The Triple Warmer refers to the three energy centers of the body: the upper section (brain, heart and lungs) is hot; the middle section (liver, kidneys stomach, pancreas and spleen) is warm; and the lower section (large and small intestines, bladder, and sexual organs) is cool. The Triple Warmer Sound, "***Heeeeeee***." serves to balance the temperature between the three centers.

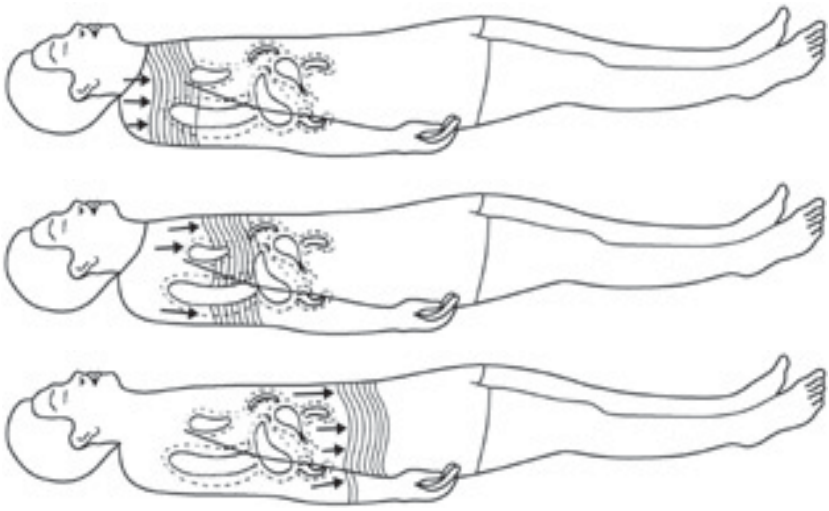

Fig. App.1.11 *Triple Warmer*

a. Position: Lie on your back with your arms resting at your sides, palms up, and your eyes closed. Inhale fully into all three cavities: chest, solar plexus, and lower abdomen.

b. Sound: Exhale the sound "***Heeeeeee***" sub-vocally, first flattening your chest, then your solar plexus, and finally your lower abdomen. (Fig. App. 1.11) Imagine a large roller pressing out your breath from your forehead to the pubic area.

c. Rest and Concentrate: When you have fully exhaled, concentrate on the entire digestive tract; that is, most of the torso.

d. Repeat the Triple Warmer Sound three to six times. Practice more to relieve insomnia (until you fall asleep) and stress.

Appendix 2
Meridian Points

The following illustrations define each meridian by certain well-known acupuncture points. Most points are indicated by an abbreviation of the specific meridian and a number. (i.e., P-3 is point number 3 on the Pericardium Meridian.) There are two good books of reference outlining, these points: *Acupuncture: A Comprehensive Text*—The Shanghai College of Traditional Medicine, translated and edited by John O'Conner and Dan Bensky, and *Anatomical Atlas of Chinese Acupuncture Points*, published by the Shandong Science and Technology Press.

The numbers are not always exactly the same for each point in both texts: therefore, the second label for a given point in this text is shown in parentheses. (This number represents the point indicated by the *Anatomical Atlas of Chinese Acupuncture Points*.) In addition you will find Chinese names labeling the more important points of this text in parentheses. You do not need to learn the points of each meridian. You only need to know the lines associated with each meridian. The points are illustrated as guidelines and for informational purposes.

1. Hit to awaken, detoxify, and strengthen the lower Abdomen (Lower Tan Tien, or Chi Hai) (Fig. App. 2.1)
2. Hit the Ming Men, or Door of Life, GV-4 (Fig. App. 2.2)
3. Hit the Insides of the Elbows, P-3 (Quze.) (Fig. App. 2.3)
4. Hit the Backs of the Knees, B1-54 (BL40) (Wei Chung.) (Fig. App.2.4)
5. Six Channels of the Left Arm and Hand:

a. Inside Elbow—Middle Finger Line—the Pericardium Meridian (Fig. App.2.5): Hit Point P-3 (Quze) three times. The specific points along the length of the meridian are hit as follows: P-2, P-3, P-4, P-5, P-6, P-7, wrist, P-8, palm, and middle finger.

b. Inside Elbow—Thumb Line—the Lung Meridian (Fig. App. 2.6): Hit Point LU-5 (Chize) three times. The route runs through the following points: LU-1, LU-2, LU-3, LU-4, LU-5, LU-6, LU-7, LU-8, LU-9, and LU-10.

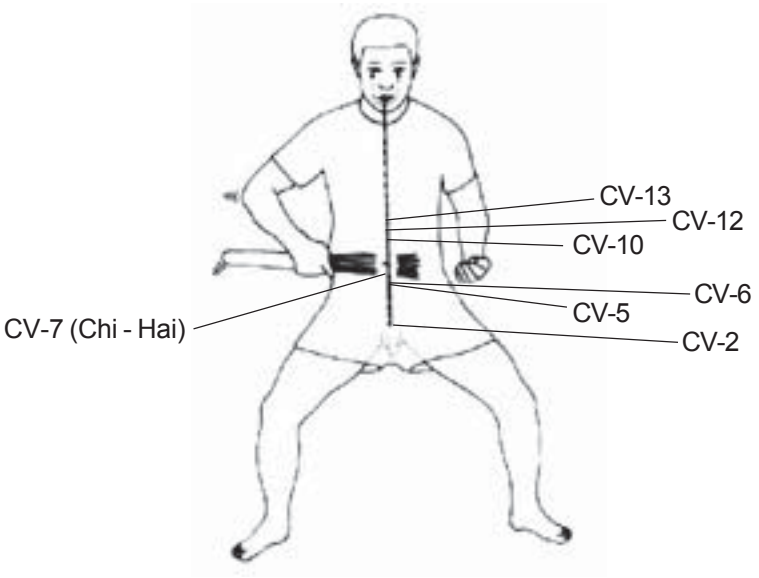

Fig. App.2.1 *Functional Meridian*

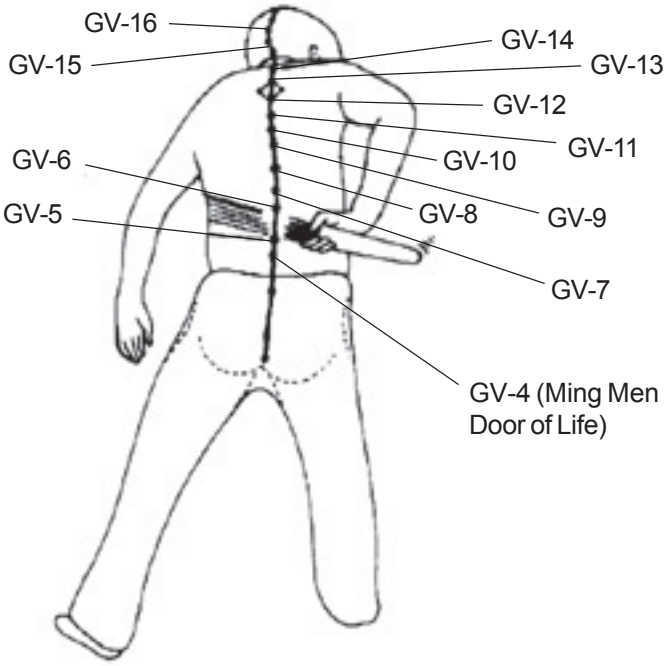

Fig. App.2.2 *Governor Channel*

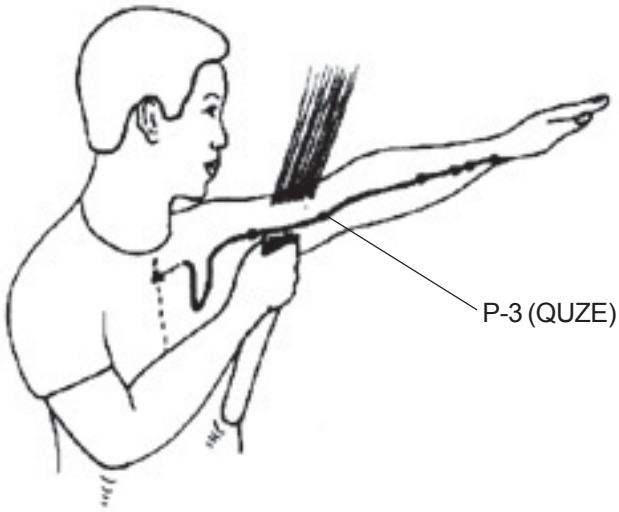

Fig. App.2.3 *Section of the Pericardium Meridian*

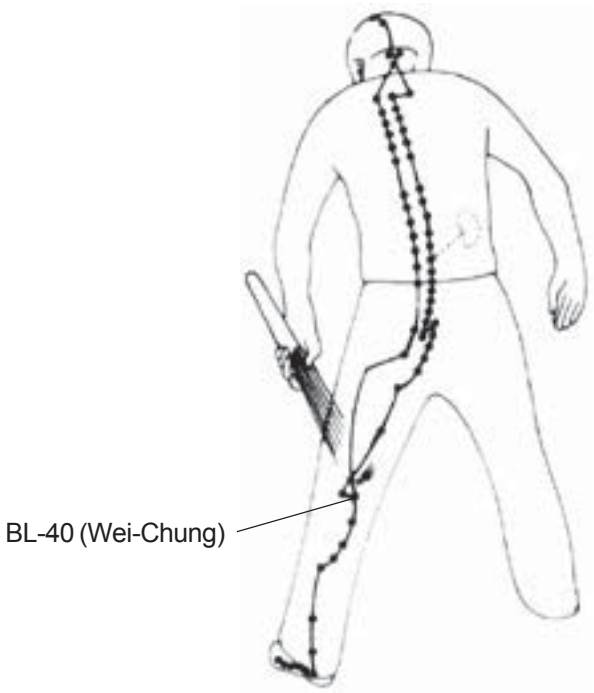

Fig. App.2.4 *Urinary Bladder Meridian*

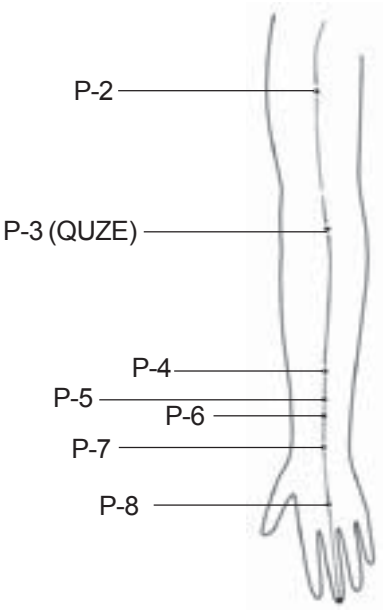

Fig. App.2.5 *Pericardium Meridian*

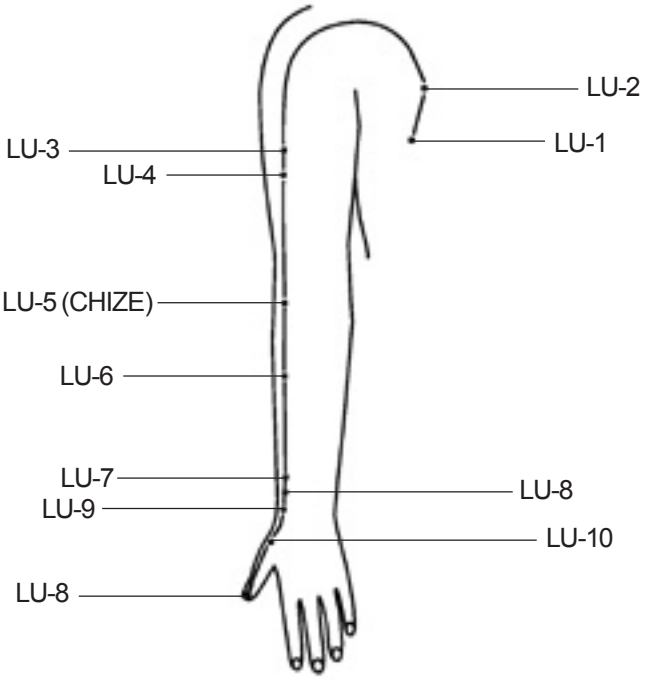

Fig. App.2.6 *Lung Meridian*

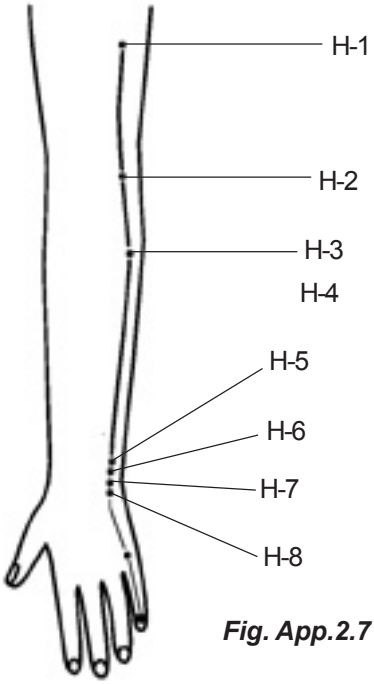

Fig. App.2.7 *Heart Meridian*

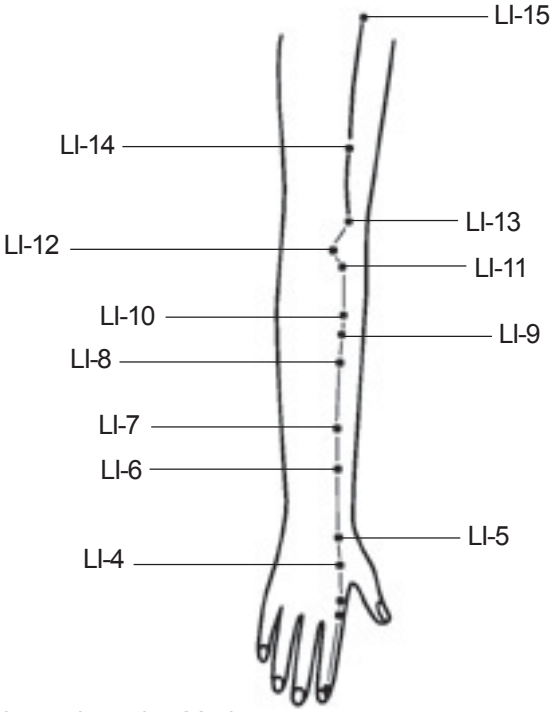

Fig. App.2.8 *Large Intestine Meridian*

c. Inside Elbow—Pinky Finger Line—the Heart Meridian (Fig. App. 2.7): Hit Point H-3 (Shaohai) three times. The route runs as follows: H-1, H-2, H-3, H-4, H-5, H-6, H-7, and H-8.

d. Outside Elbow-Index Finger Line-the Large Intestine Meridian (Fig. App. 2.8): Hit Point LI-5 (Quchi) three times. The points of the route are as follows: LI-15, LI-14, LI-13, LI-12, L1-11, LI-10, LI-9, LI-8, LI-7, LI-6, LI-5, and LI-4.

e. Outside Elbow—Four Finger Line—the Triple Warmer Meridian (Fig. App 2.9): Hit Point TB-10 (Tian Jing) three times. The route runs as follows: TB-14, TB-13, TB-12, TB-11, TB-10, TB-9, TB-8, TB-7, TB-6, TB-5, TB-4, and TB-3.

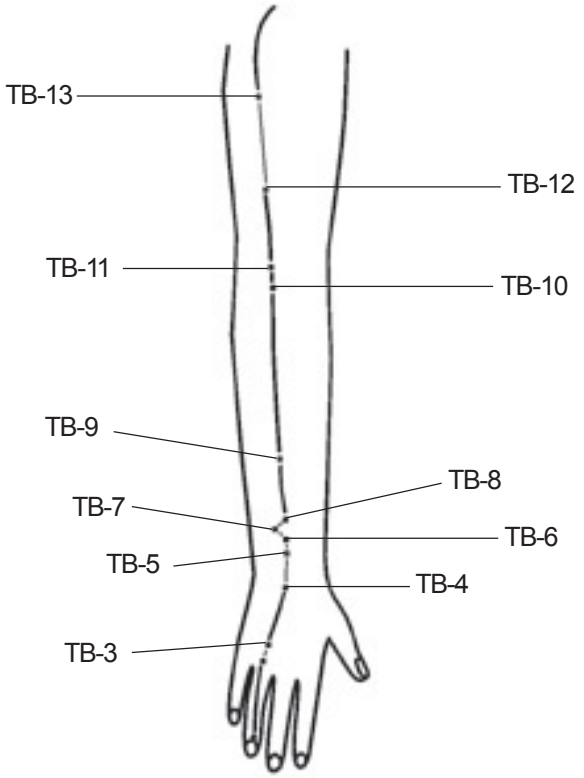

Fig. App.2.9 *Triple Warmer Meridian*

f. Outside Elbow-Pinky Finger Line-the Small Intestine Meridian (Fig. App. 2-10): Hit Point SI-8 (Xiao Hai) three times. The route runs as follows: SI-9, SI-8: SI-7, SI-6, SI-5, and SI-4.

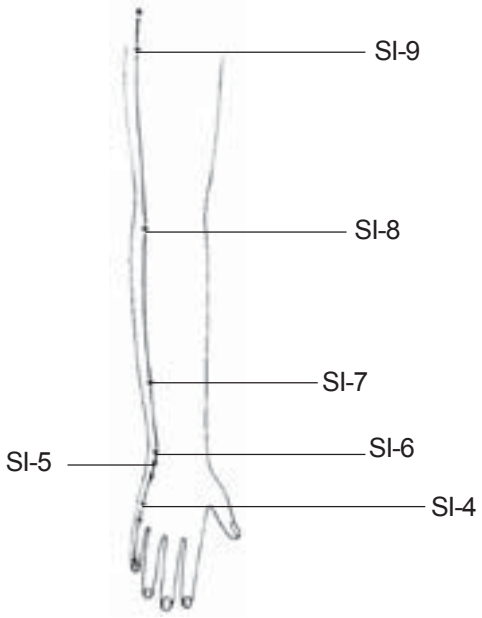

Fig. App.2.10 *Small Intestine Meridian*

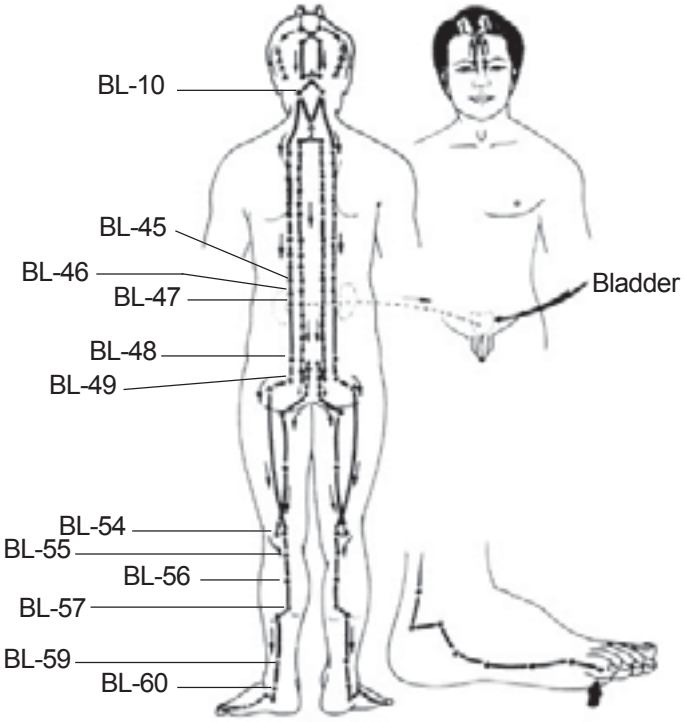

Fig. App.2.11 *Urinary Bladder Meridian*

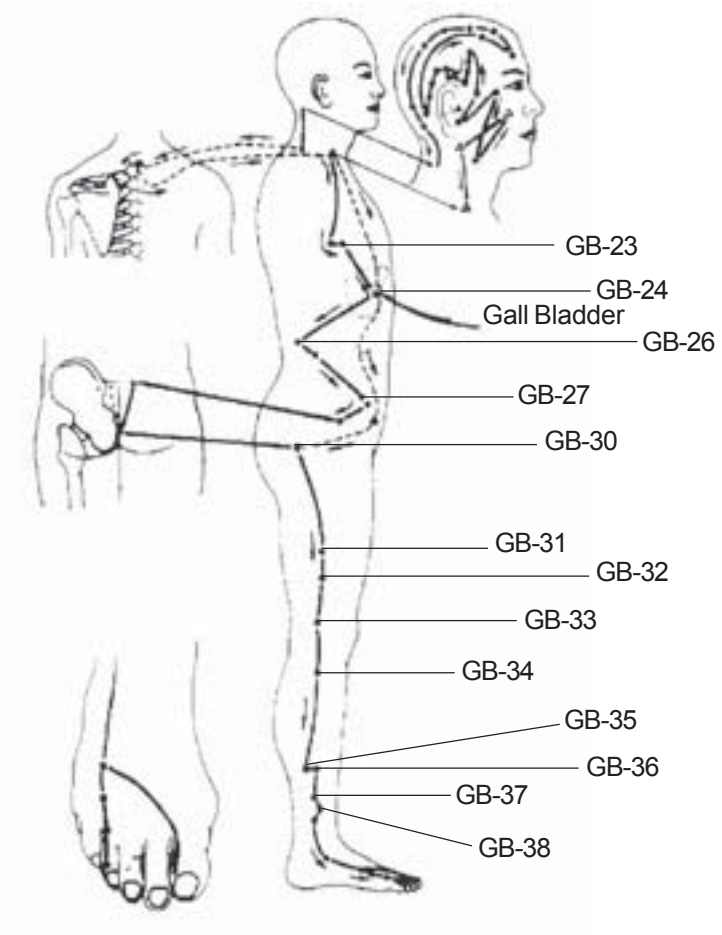

Fig. App.2.12 *Gall Bladder Meridian*

6. Six Meridians of the Leg

a. Back Side of Left Leg-Heel Line-the Bladder Meridian (Fig. App. 2.11): The Bladder Meridian points are as follows: BL-54 (BL-40) (Wei Chung) (at the back of the knee), up to BL-49, BL-48, BL-47 (BL-52) (three inches to the left of the Door of Life). Hit back down the same line, returning to the back of' the knee, and continue down to BL-55, BL-56, BL-57, BL-59, and BL-60.

b. Outside of the Left Leg—Fourth Toe Line—the Gall Bladder Meridian (Fig. App. 2.12): The Gall Bladder Meridian points are as follows: GB-33 (Yang Kuan) (on the outside of the left kneel, up to GB-32, GB-31, and GB-30 (Huan Tiao) (at the hip), and then back down to the knee GB-34, GB-35, GB-36, GB-37, and GB-38.

c. Inside of Left Leg—Big Toe Line—the Spleen, Liver, Kidney Meridians (Fig. App. 2.13): The Spleen Meridian points are as follows: SP-9 (Yin Ling Chuan), up to SP-10. SP-11, and then downward past SP-9 again, to SP-8, SP-7, and SP-6 (San Yin Chiao) (Where the Spleen, Liver and Kidney Meridians meet). Hit SP-6 three extra limes, then hit to the upper part of SP-5, and to the big toe.

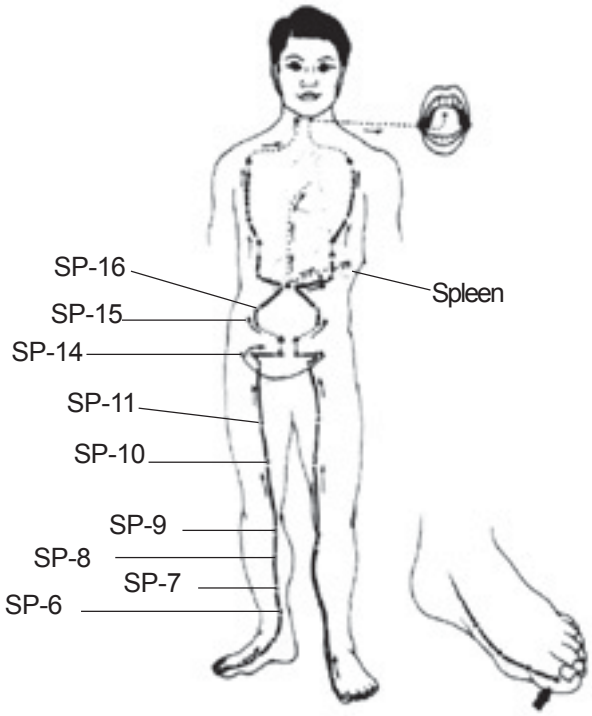

Fig. App.2.13 *Spleen Meridian*

d. Front Side of Left Leg—Middle Toe Line—the Stomach Meridian (Fig. App. 2.14): The Stomach Meridian points are as follows: ST-35 (Tu Pi) (under the kneecap), up to ST-34, ST-33, ST-32, ST-31, and back down the same route past the kneecap to ST-36, ST-37, ST-38, ST-39, ST-40, and ST-41. Hit ST-41 three extra times. End the Hitting of this leg by Hitting Point BL-54 I (BL-40) (Wei Chung) at the center of the inside of the knee.

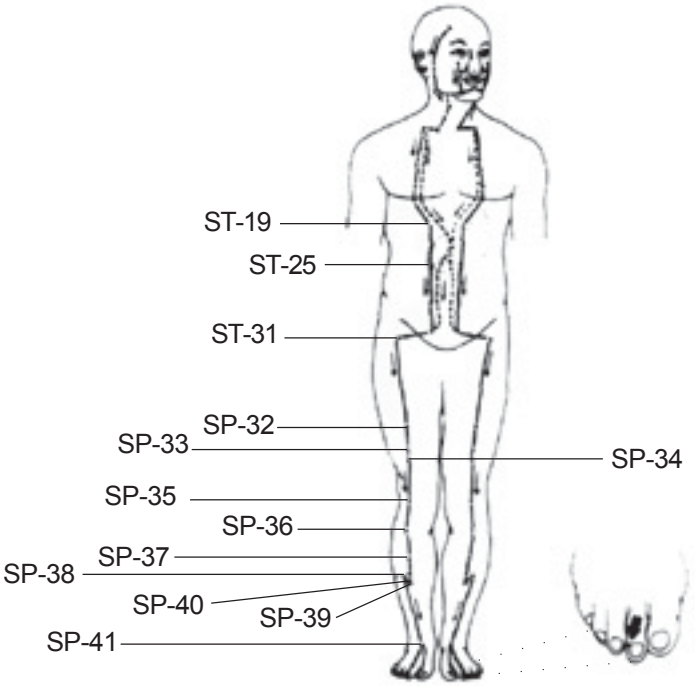

Fig. App.2.14 *Stomach Meridian*

7. The Meridians of the Back:

a. The Middle Line of the Back—the Govemor Meridian (Fig. App. 2.15): Hit GV-4 (the Ming Men Point, or Door of Life) three times. The points of the route are as follows: GV-6, GV-7, GV-8 GV-9, GV-10, GV-11, GV-12, GV-13, GV-14. GV-15 (Yamen), and GV-16 (Feng Fu). Gently hit this area an extra three times, then hit down to GV-2 (the sacrum).

b. The Left and Right Lines of the Back-the Bladder Meridian (Fig. App. 2-16): Hit BL-47 (BL-52) (Zhishi) three times. The points of this route are as follows: BL-47 (BL-52), BL-46 (BL-51), BL-45 (BL-50), up to BL-10 and BL-9. Hit these points an extra three times, and down again past BL-47 (BL-52), down to BL-49 (BL-54) (at the side of the sacrum). Hit this point an extra three times. Then hit back up again to BL-47 (BL-52) (the Door of Life), hitting it an extra three times.

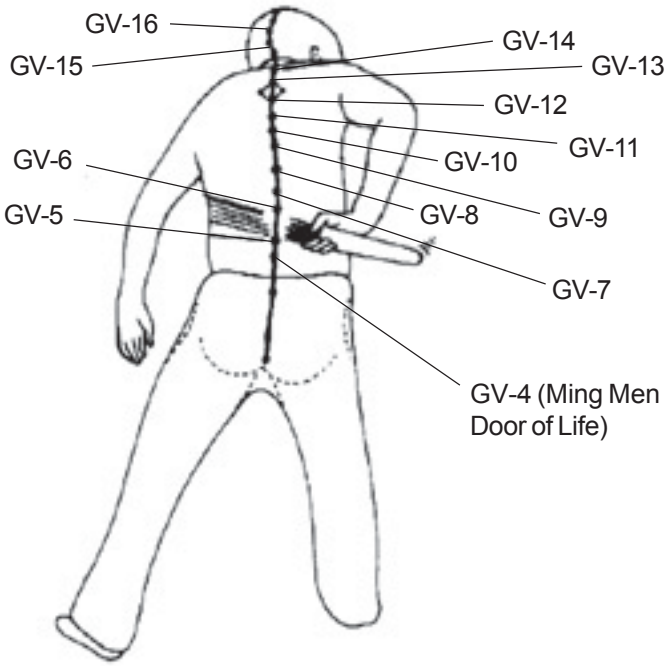

Fig. App.2.15 *Governor Channel*

8.The Front Part of the Body:

a. The Conception Vessel Meridian (Fig. App. 2.17):

(1) Hit the Lower Tan Tien one and a half inches below the navel in men; three inches below the navel in women.

(2) The Conception Vessel Meridian-Above the Navel: Begin by Hitting Point CV-13, just below the xiphoid process. Hit downward to CV-12, midpoint between the xiphoid process and navel, and hit in a rolling fashion to CV-10, about an inch and a half above the navel.

(3) Navel, Sexual Organs, Prostate/Ovaries of the Conception Vessel Meridian—the Middle Tan Tien: The Conception Vessel Meridian points below the navel are as follows: CV-8 (Chi Cgung) (the middle of the navel), down to CV-7, CV-6 (Chi Hai; one and a half inches below the navel—the Lower Tan Tien of men), down to CV-5, CV-4 (Kuan Yuan) (about three inches below the navel—the Lower Tan Tien of women), CV-3, CV-2, and back up to the navel.

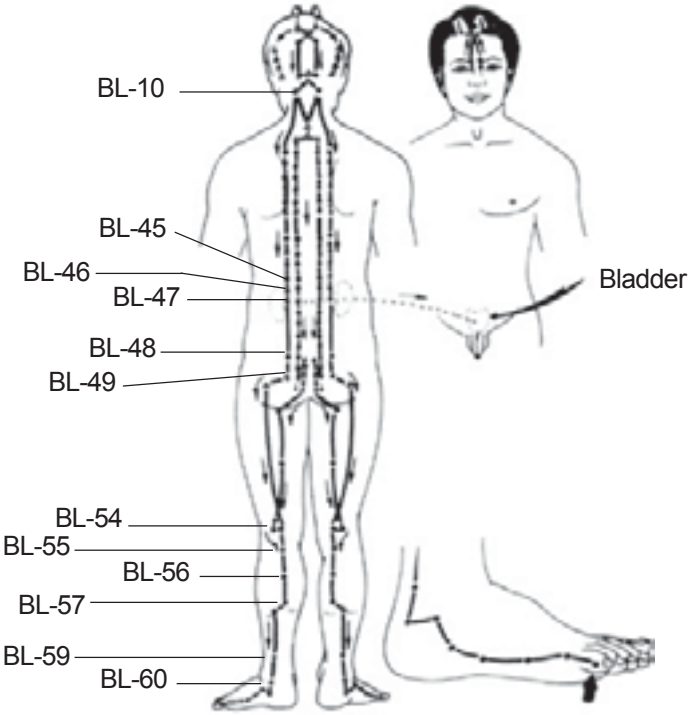

Fig. App.2.16 *Urinary Bladder Meridian*

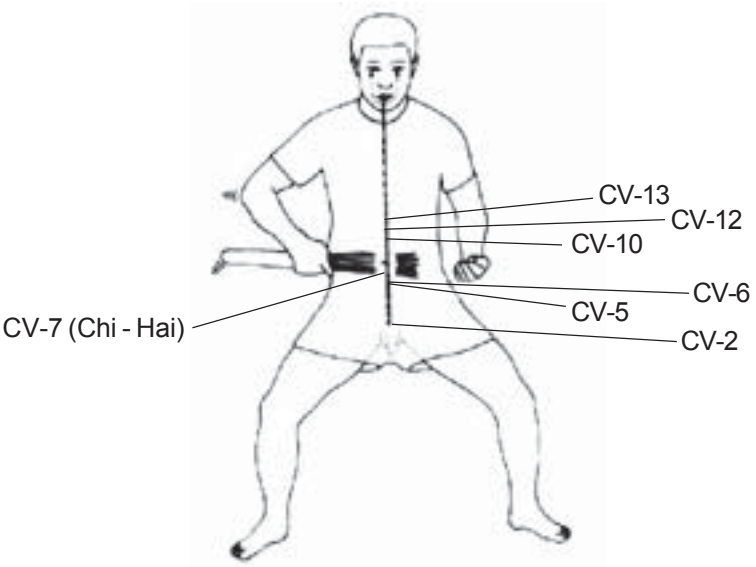

Fig. App.2.17 *Conception Vessel Meridian*

Fig. App.2.18 *Stomach Meridian*

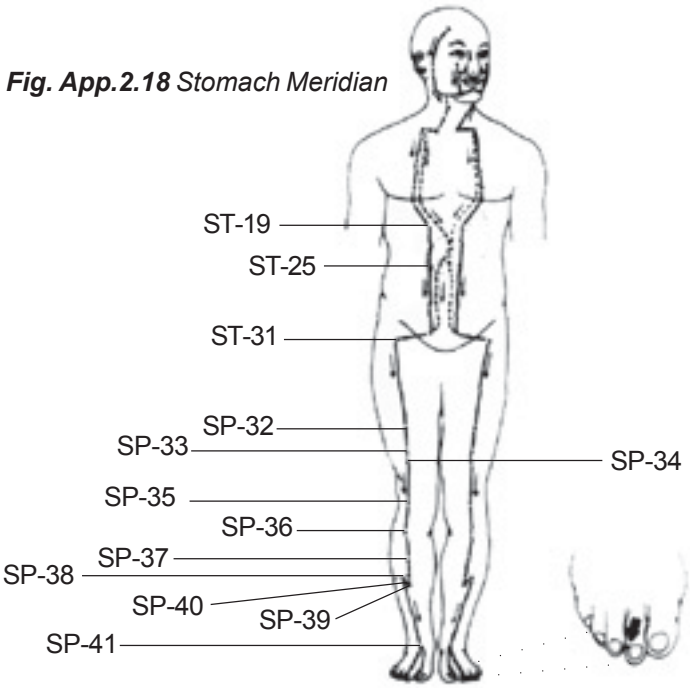

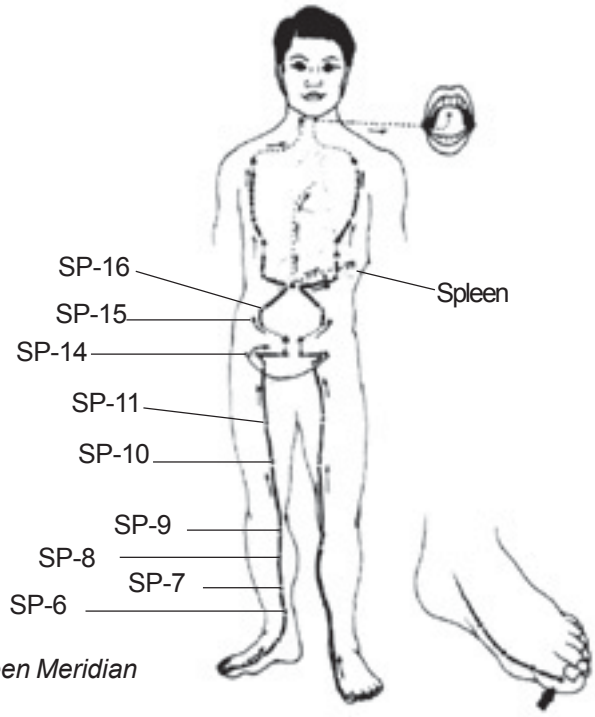

Fig. App.2.19 *Spleen Meridian*

b. Left Abdomen—the Stomach Meridian, one and a half inches to the left of the navel (Fig. App. 2-18): The Stomach Meridian points are as follows: ST-25 (Tien Shu; one and a half inches to the left of the navel, down to ST-24, ST-23, ST-22, ST-21, ST-20, ST-19, up to just below the rib cage, and down to the left of the navel.

c. Left Abdomen—the Spleen Meridian, three inches to the left of the navel (Fig. App. 2-19): The Spleen Meridian points are as follows: SP-15 (Ta Heng) (three inches to the left of the navel), downward to SP-14, SP-13, up the same line to SP-16 (below the rib cage), and back down to SP-15.

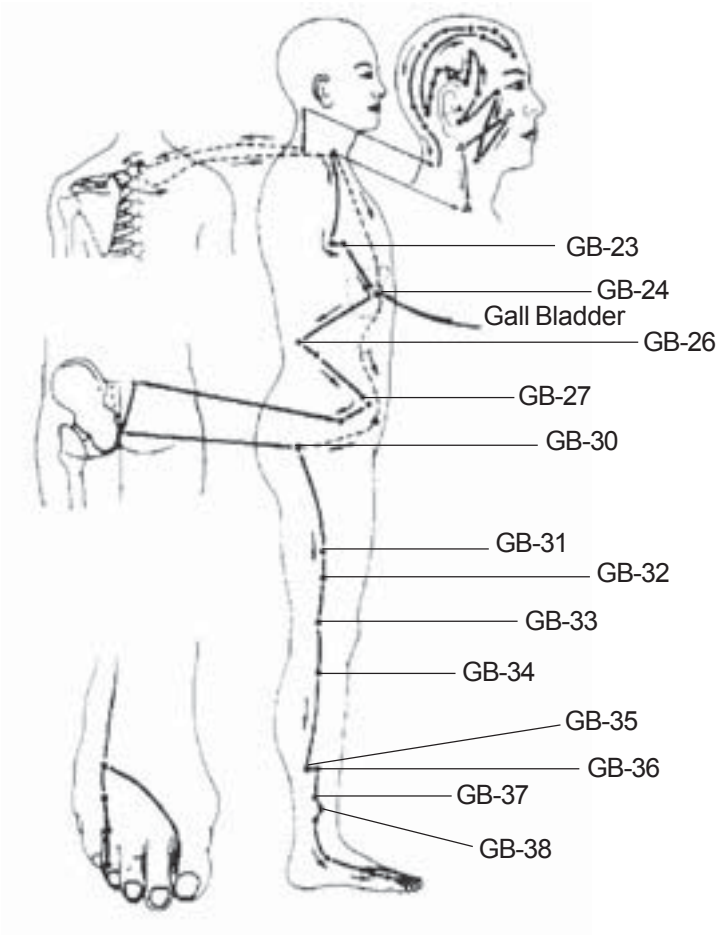

Fig. App.2.20 *Gall Bladder Meridian*

d. Side of the Left Abdomen—the Gall Bladder Meridian far left side of the body (Fig. App. 2.20): The Gall Bladder Meridian points are as follows: the GB-26 (Tai Mo), also know as the Belt Channel point, is very important in the development of the Belt Channel. Hit down to the left hip GB-27, and up GB-25, GB-24, GB-23, GB-22, and to the armpit.

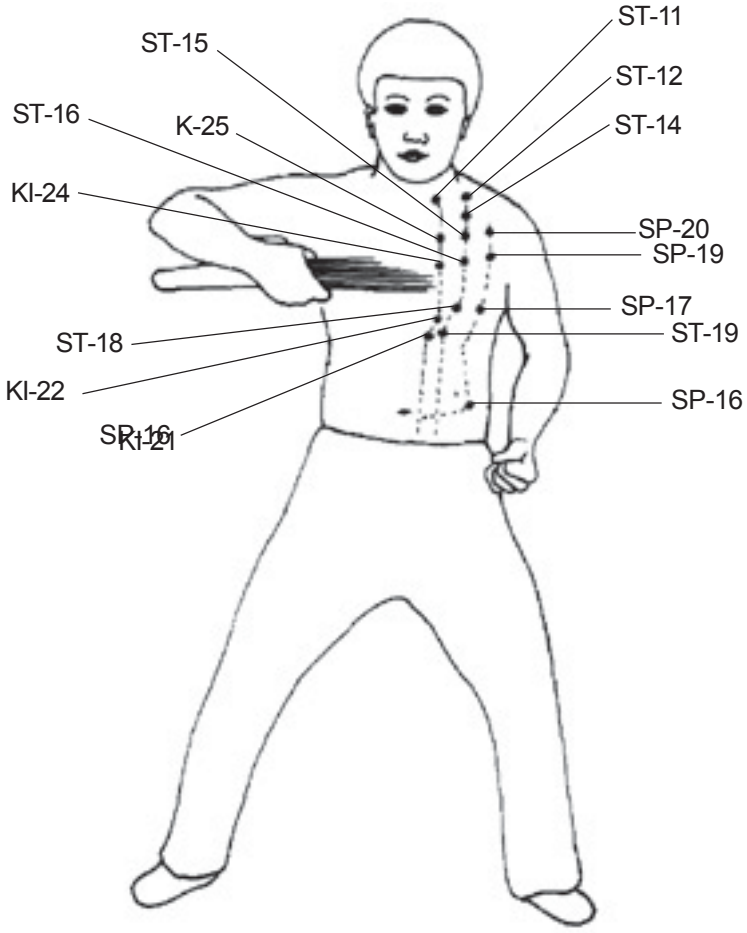

Fig. App.2.21 *Point on the Left Rib Cage*

e. Hitting the Left Rib Gage (Fig. App. 2.21):

(1) Start at the bottom, right side of the left rib cage, directly at the center of the chest where the sternum is located. Hit following the downward angle of the rib the meridian points: KI-21, ST-19, and SP-16.

(2) Hit down the meridian line just below the nipple along the next rib beginning near the sternum the meridian points: KI-22, ST-18, and SP-17.

(3) Hit down the meridian line just above the nipple, along the next higher rib, from the sternum down through the meridian points: KI-24, ST-16, and SP-19.

(4) Hit along the next higher rib, hitting from near the sternum downward, the meridian points: KI-25, ST-15, and SP-20.

(5) Hit downward along the next higher rib, just below the collarbone, beginning near the sternum the meridian points: KI-26 and ST-14.

(6) Hit along the collarbone, starting from the top of the sternum and out toward the shoulder to the meridian points ST-11 and ST-12.

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Taoist Ways to Improve your Health by Rejuvenating your Bone Marrow and Blood

Mantak Chia

Illustrated By Juan Li

Bone Marrow Nei Kung is a system of health developed by the ancient Taoist Masters for the cultivation of internal power. They discovered that, through the process of absorbing energy into the bones, bone marrow can be revitalized to replenish the blood and nourish the life-force within. Many healers have sought these methods, which are known to make the body impervious to illness and disease. In ancient times, the "Steel Body" attained through this practice was a coveted asset in the fields of Chinese medicine and martial arts.

Today the copious health benefits of this art are sought after by health enthusiasts from all walks of life. The Taoist methods of "regrowing" the bone marrow are crucial to the rejuvenation of the body, which in turn rejuvenates the mind and the spirit. These secrets have never before been revealed, but now their disclosure is necessay to instill the sensibilities of the masters into an energy-deficient society. In this book, Master Mantak Chia divulges the step-by-step practices of his predecessors in a useful and informative work, written for the health and spiritual well-being of today's world.

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Mantak Chia

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Goal of this Book

All Universal Tao books are based on the real experiences of the many people who practice the system diligently. This book is for both beginning and advanced students. It reflects the many refinements and improvements in the Universal Tao system developed over 20 years of teaching, hundreds of workshops, and feedback from thousands of students. I present this book to you to introduce the foundations of the Universal Tao System. You will find simple and easy-to-follow instructions on how to awaken the Healing Light, Chi, or life-force within. May the Chi be with you!

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using the Dark Room technology creating a complete environment for the higher level Taoist practices.

He has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper/Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper/Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002

Many of the books above are available in the following foreign languages:
Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

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Finally, we wish to thank our certified instructors, students, and sponsors throughout the world for their ongoing contributions to the system and for preserving the vitality of the Universal Tao practices.

Preface
What is the Tao of Cultivating Inner Light?

by Michael Winn

Ten years ago, I was among a handful of curious Westerners sitting in a tiny office in New York's Chinatown, listening to a boyish-looking 38-year-old Chinese immigrant from Thailand named Mantak Chia. He was teaching us ancient Taoist methods of self-transformation, which he had received by oral transmission. His teacher, the Hermit White Cloud, lived in the mountains of China and had attained the rarefied state of "breatharian." This meant he was living on subtle "airs" and no solid food. White Cloud's story might have ended there, as has been the case with similar teachers for several millennia, were it not for the drive of this young Taoist master to clarify for modem minds the Tao of regulating the human bioenergetics system.

I was eager for a spiritual path with practical application for all areas of life. At the time, I was working as a war correspondent in Africa, and the Six Healing Sounds were very effective in relieving high levels of stress. I found Taoist "energy medicine," closely allied with noninvasive medicine like acupuncture and herbs, to be an extremely portable self-health system. Taoism had a fresh psychology that was spirit-based, yet was successful in helping me deal with chronic anger and other emotional imbalances.

Most important, Taoism taught sexual vitality as an essential aspect of spiritual development. I used the sexual practices to cure myself of chronic sexual frustration and to "get clear" enough to attract a wonderful wife. On a deeper level, my soul was seeking a mystical expression in which the uniqueness of my individuality was recognized, and in which all the Separate strains of my fragmented self were woven together in a meditational process of spiritual tranquility. I wanted a silent inner path that didn't require joining a new religion or bowing at someone else's feet—in short, the Tao. Inspired by how quick and effective the Taoist methods were, Master Chia's small group of students joined him in forming the Universal Tao Center. Over the next decade, this organization succeeded

in making many of the most arcane secrets of Chinese internal alchemy accessible to Westerners. This is evidenced by a worldwide network of 200 instructors and tens of thousands of practitioners from all walks of life and religions happily cultivating their Chi, or life-force.

The Microcosmic Orbit is the key to balancing energies in the body. The book that launched this wave of interest was Chia's *Awaken Healing Energy Through the Tao* (Aurora Press, 1983), a classic in its field that offers the essentials on how to guide the life-force so it flows in a loop, known as the basic Microcosmic Orbit, up the spine and down the front acupuncture channels of the body. Its impact has been widespread, as it provided the piece of the puzzle missing from many of the partial teachings arriving in the West from India. These only showed the energy ascending up the spine, a practice that can lead to spaciness and which ultimately weakens the body if the aroused bioenergy is transferred to the head center prematurely.

Happily, some yoga manuals are now beginning to show the descending, or Yin, channel, which may also reflect a growing respect for the spiritual power of the feminine/goddess energy. Taoism is one of the oldest spiritual paths to openly advocate cultivating the feminine to gain balance and wholeness. Taoism is rooted in an underlying deep ecology of the body that affirms the importance of the body in the spiritual process. It teaches that one can reach heaven only by first harmonizing one's soul with the earth.

Awaken Healing Light of the Tao is a sequel that expands on the basic methods of cultivating Chi in the Microcosmic Orbit. It offers a deeper glimpse of Taoist spiritual theory and more advanced meditational methods for absorbing higher frequencies of energy into the basic Orbit. Following the classical Chinese model of the "three treasures," these frequencies are identified as the Earth Force, the Higher Self or Cosmic Force, and the Universal Force. This teaching is neither religion nor philosophy, but a spiritual science that emphasizes practical benefits to health, sexual vitality, and emotional and mental balance, and which promises–like a shining carrot at the end of a very long stick–physical immortality.

Cultivating "inner breath" is a science. There are many excellent yoga and martial arts teachers with effective methods of cultivating Chi (or prana, as it is known in India). Most of these teachings rely on "outer breath" methods. They use special

postures, gentle circular movements such as Tai Chi Chuan, and physical breathing to stimulate and regulate the flow of Chi. These methods are known as pranayama in India and Wai Dan Chi Kung in China.

The Universal Tao also uses many Chi Kung methods, and this book includes a new section on spinal Chi Kung. But its primary emphasis is on Nei Kung or "inner breath" methods which directly focus the mind within the physical body and awaken subtle body energies using pure awareness. This method may seen more difficult to beginners, but after some concentration power is developed it is truly effortless, and far more profound. I found it simple and satisfying to integrate these internal Taoist practices into yoga, Tai Chi, and other kinds of meditation.

The energy body is the key to manifesting spirit. The Universal Tao system offers an inner map and a series of practical methods that help one more quickly experience the energetic system which links the physical body with the emotions, thoughts, individual soul, and universal spirit. This internal map we simply refer to as "the energy body," a term that lumps together the whole spectrum of intermediate levels between the physical body and the pure spirit.

Exercising these intermediate levels of life-force is essential in Taoism to bridge the gap between God as spirit and what the Chinese sages called the "Great Clod," the mundane material level of earth life. Knowing the connection between the body and spirit keeps one focused in the present moment and balances whatever aspect of oneself is crying for attention. Chi, the life-force, is not worshipped like some abstract or distant deity; it is seen as the power of God or divine love (to use Western terms), stepped down into the everyday world.

Chi is the process of the "Ta" functioning at many different levels simultaneously within us. It is the key to healing and the practical means of manifesting love and harmony. The highest power one can manifest in this dimension is physical immortality. I found this idea hard to swallow at first. But it stands to reason: If in each moment one can stay aware of the Tao, the eternal source of life, one's biological cells will constantly be rejuvenated by its pure vitality. The Bible mentions elders living 900 years, and stories from Atlantis talk of people living thousands of years. Modern human beings have degenerated, but I accept the Taoist teaching that it is

never too late to change oneself.

Awakening the "healing light" refers to a more subtle level of the life-force, sometimes referred to in Western esoteric traditions as the higher "astral light" of the soul. This inner light is also experienced along a whole rainbow spectrum of color as the Original Chi, the clear light or pure neutral light of the soul, shines through the more dense or material subtle body, which is polarized into Yin and Yang energy patterns.

Each frequency or vibrational density is associated by the Taoists with specific kinds of subtle energy: the earth's water and plant energy emits a blue-green color, spinal/bone marrow energy is white. Higher Self (Cosmic Force) energy is golden, and Universal energy is violet as it is stepped down through the polestar. The generative force of the earth (reflected in the seven stars of the Big Dipper) is red, and sexual energy in humans is pink, the mixing of blood and semen. Black is the color of the unborn Tao, the absolute void of the Wu Chi from which all spirit emanates. It is important to note that some people are not at all visually oriented and may never see any colors with their inner eye. They are more apt to "feel" the quality of these different frequencies, with the same end effect.

Chakras and the Microcosmic Orbit. How are the seven chakras related to the Microcosmic Orbit? As a longtime student of hatha yoga, kundalini yoga, and kriya yoga, I feel qualified to answer that the Microcosmic Orbit balances and integrates all the chakra into a single unified chakra. The term chakra means "wheel," which implies energy in motion. Contrary to popular New Age conception, the chakras have no individual power and are only minor nodal points through which larger forces flow.

You cannot "open" or "close" a single chakra. To step up the energy level of one chakra requires more energy flowing through the entire system. The Chinese call the two most primordial forces Yin (the receptive) and Yang (the radiant). Rotating Chi in the Orbit up the spine and down the front channel regulates the positively and negatively charged points opposite the chakras. I believe these polarities create the minor vortices called chakras, causing them to spin like wheels. By increasing Chi flow in the Orbit, the energies flowing through all the chakras are amplified and balanced simultaneously. Eventually these polarized energy currents link together to open a neutral channel in the center of the body, called the Trusting Channel, which is the birth canal for spiritual rebirth as an immortal.

The Orbit around the body is like an empty vessel that reflects whatever energies one allows to flow in it. The quality of the energy changes in the Orbit as one expands one's consciousness to include more frequencies of inner light. As the simple loop of the Orbit fills with Chi and overflows into the other acupuncture meridians and vital organs, it becomes the "energy egg" of a radiant human aura. One "cracks" this egg by pulsing into and opening the five gates in the feet, perineum, heart/palms of the hands. Third Eye, and crown that connect the Microcosmic Orbit to the three macrocosmic energies of the Earth, Higher Self, and Universe.

In this book, different Taoist practices are described that help amplify and refine reception of these energies: Iron Shirt Chi Kung for rooting the Earth Force, Fusion of the five Elements for transmuting emotional energy, Healing Love for harnessing sexual impulses for spiritual purposes, and Kan and Li ("water and fire") meditations for stabilizing the Higher Self and dissolving all boundaries so as to receive guidance and love from the Universal Force.

To a beginner, these many different practices and energies can be a bit overwhelming. For this reason, beginners may find it easier to first read *Awaken Healing Energy Through the Tao* (Aurora Press, 1983) to get a simple and firm grounding in the basic orbit and inner smile, without worrying about absorbing higher frequencies from Earth or Heaven. It is a major shift for most people to even examine the existing vibrational patterns in their own body. *Awaken Healing Light of the Tao* will provide a more sophisticated overview of spiritual practices that range from beginning to advanced. It is best to proceed slowly, starting with the basic Orbit, and eventually all the practices will become familiar and simple variations on one theme: how to play with your life-force. It will speed your growth if you can connect with a Taoist instructor or community, or come to a week-long Universal Tao summer retreat.

More advanced cultivators will soon find themselves in the opposite position—recognizing that energy-cultivation methods are only tools, meant to be dropped when they are no longer needed. Once you have stabilized changes in your energy body, you can focus more on the Yin or receptive phase: sitting in stillness and growing your Shen, your immortal body, which is nothing more than your spirit descended into and stabilized within this physical dimension.

Your life is your own unique spiritual path, and if you cultivate your inner light, it will always shine on the Great Way or Great Tao.

May the life-force be with you as you explore these precious methods!

Winter Solstice 1992

Michael Winn was a general editor of Healing Tao Books, and a senior Universal Tao instructor. He is co-author with Mantak Chia of *Taoist Secrets of Love: Cultivating Male Sexual Energy* (Aurora Press, 1984). He lives on a mountaintop with his wife, Joyce Gayheart, where they grow younger each year. He teaches Taoist meditation, sexology, and self-healing privately in North Carolina.

Chi and the Medicine

by Lawrence Young, M.D.

It is a widespread belief that we have some kind of energy inside our bodies called life-force. Those who have strong and abundant life-force enjoy perfect health and vitality. In old age and sickness, this life-force gets weaker. When it becomes totally dissipated, the flesh-and blood body dies.

Unfortunately, most people have only a vague notion of life-force; medical doctors and scientists are just beginning to investigate this energy. Serious study of the life-force was, however, a closely guarded secret in most esoteric schools throughout history in such diverse parts of the world as Egypt, the Himalayas, and Tibet, and among various traditions of shamanic and psychic healers. Secrecy was thought necessary because exploiting such knowledge for selfish purposes could lead to great harm to others and eventually backfire on oneself as well. The destruction of the legendary Atlantis was frequently cited as the foremost example of such misuse.

China was an exception to this rule of secrecy. Over the last five thousand years, tens of millions of Chinese have practiced Chi Kung, healing their own illnesses and in many cases actually saving their own lives. Millions more have benefited from acupuncture, which has cured many diseases and relieved much suffering.

Acupuncture employs mechanical means, such as needles, to manipulate the body's life-force for treating various illnesses. The theory and practice of traditional Chinese medicine is based on restoring the normal physiological flow of Chi energy in the body and correcting abnormal flow with herbs, needles, focused heat application (moxibustion), focal point massage, and other means. This knowledge was not limited to monks and hermits, nor were royalty and the rich the only people helped by such knowledge; peasants and scholars, merchants and officials alike have practiced Chi-Kung and benefited from acupuncture.

Why is it that in China the study of life-force energy was not secretly guarded, as in other parts of the world? Acupuncture and Chi-Kung are like the many nuclear reactors all over the world operated by the civilian sector to generate electric power. Such facilities are carefully regulated, but the secrecy and security is in no way comparable to the security at military installations or at

companies manufacturing nuclear weaponry. Acupuncture and Chi-Kung are benign forms of life-force study proven to be safe and effective for wide dissemination and practical application, as borne out by their track records over the past five thousand years in China.

Since it took over 40 years ago, the Communist regime has sought to destroy all religious and esoteric teachings in China. But it has recently encouraged extensive research into the Chi phenomena of acupuncture and Chi Kung. Although scientists under the Communist regime do not view Chi in the same context as the esoteric schools, they have nevertheless validated the phenomena of Chi during the application of acupuncture needles. Through cooperative efforts, they have mapped out the routes of Chi flow sensation during acupuncture, and the map so recorded agrees exactly with the meridians of energy flow used by acupuncturists for the last five thousand years.

These modern Chinese scientists have also tabulated the reported Chi flow experienced by people practicing Chi Kung, and the energy routes agree exactly with the acupuncture and Chi Kung texts passed down through the centuries. The scientists had an unlimited source of data to work with, because Communist China under the old leadership pursued a policy of isolation, independence, and self-dependence. Western drugs and medical technology were accepted and honored by the Communist regime but were in scarce supply. The Communist state therefore made an all-out effort to encourage the use of acupuncture, Chi Kung, and herbs for treating illness and in preventive medicine.

In so doing, Communist China has inadvertently helped validate the phenomenon of life-force energy in the human body and disseminate this esoteric knowledge far and wide. There is an extensive list of illnesses and conditions for which Communist China officially sanctions the use of Chi Kung. The list spans the gamut of disease, from hypertension to cancer, functional organ disorders to postoperative convalescence. Numerous magazines reporting anecdotal cures as well as serious scientific journals on Chi Kung are published regularly. Even energies radiated from the palms of Chi Kung practitioners have been documented. That radiated Chi is reported to have the properties of wave forms as well as of particles of matter. It has been observed to alter the molecular structure of water and other chemicals.

Although Communist China is not the only place in the world

expounding the benefits of Chi Kung in recent years, in terms of sheer numbers, it has made the greatest contribution. The same holds true for scientific research on Chi; no other country or institution to date has done as much as China. However, when the Communists took over China 40 years ago, countless numbers of Chi Kung practitioners fled to other countries. Although few claimed to be master teachers, nevertheless, having benefited personally from activating their Chi, even to the extent of saving their own lives, these otherwise quite ordinary citizens frequently had an urge to show others how to do it as well. This grassroots approach has kept Chi Kung alive and flourishing for thousands of years in China, despite the lack of official sponsorship. There were no organized schools or universities for Chi Kung until the Communists took over in China. But because Chi Kung had stayed alive at the grassroots level, the mass exodus of Chinese from Communist China has also inadvertently helped spread Chi Kung all over the World.

I have had a general internist medical practice in the Chinese community in New York City since 1976. I employ only conventional Western medical methods. I have a license to use acupuncture on my patients, but I usually refer them to more skillful practitioners. Whenever my patients have had all the appropriate tests and conventional Western treatments and are still not feeling better, I suggest they add Chi Kung to their regimen.

The word got around that I was the Chi Kung doctor in the community. As a result, people who had previously benefited from Chi Kung came to me to tell their stories. Gradually, I collected enough anecdotal cases to write a book about the medical effects of Chi Kung. One version of the book was in Chinese, and since its publication, many more people have come forward unsolicited to tell me their experiences with Chi Kung. Their stories have confirmed my lifelong conviction that the Chi described in Chi Kung and acupuncture is a universal phenomenon, a normal component of physiology universally present in everyone, irrespective of age, color, sex, race, or creed.

In Communist China, people learn Chi Kung primarily from state sponsored schools or classes. In the rest of the world, most Chinese people learn Chi Kung from an uncle, a neighbor, a friend at work, or just about anyone who has benefited from Chi Kung. Close to a quarter of these teachers are self-taught; they read written

activate their life-force energy, and achieve the healing they need. The best-known book on Chi Kung healing in China is *Meditation According to Master Yun*, written by Master Yun in 1914 when he was 42 years old.

Master Yun wrote of suffering from a full-blown case of pulmonary tuberculosis at the age of 28; death seemed just around the corner. He had no formal instruction in Chi Kung, just a book. He had enough time to hurriedly ask for some pointers on Chi Kung just after his brother died of tuberculosis, like so many others in his village, across China, and around the world at the time. Yun then withdrew to the country, where he devoted himself to intensive practice of Chi Kung. He completely cured himself in only 85 days, activating a classical sensation of acupuncture energy flow in the front and back acupuncture meridians. He was surprised by that sensation, which was both intense and alarming. In 1954 he wrote his final book, drawn from his wealth of firsthand experience in Chi Kung healing and meditation. Master Yun eventually passed on in his 90s without sickness.

Many self-taught practitioners followed Master Yun's instructions written almost 80 years ago, activating their life-force and healing without much difficulty. I am not saying everyone can or should learn Chi Kung by reading an antique text; I simply observe that this life-force is universal, and that making use of Chi is everyone's birthright.

In 1980, I gave a lecture at the annual convention of the American Holistic Medical Association on the healing power of Chi Kung. At this same convention, Master Mantak Chia conducted a practical Chi Kung workshop. Before the workshop, Master Chia gave a brief demonstration of Chi Kung methodology. One medical doctor and two nurses instantly experienced the acupuncture energy flow during these brief 10-minute sessions. One of the trio felt the Chi energy spinning around the front and back meridians nonstop all that day and night until the next afternoon, when Master Chia showed her how to cool it down during the formal workshop.

There is one additional observation worth mention in the 1980 AHMA experience. The doctors and nurses who instantly activated their Chi energy flow vividly and intensely all had 5 to 15 years of experience in regular meditation of various types (mostly Transcendental Meditation). But for most of Master Chia's students, prior experience with meditation is not necessary; among my Chinese

accounts of other people's experience, follow the suggested procedures, patients in New York, neither the word meditation nor the principles of meditation were even mentioned, yet they all benefited from Chi Kung. Since then, Master Chia has helped tens of thousands of non-Chinese, spanning the whole spectrum of socioeconomic strata in many major nations around the world, activate their Chi energy.

Quite independently of talking to Master Chia's students, my own contacts from my medical practice in New York's Chinatown have brought me other medical doctors, pharmacists, nurses, artists, writers, bankers, businesspeople, Catholic and Protestant clergy, and laypersons; all these people have told me of the great benefits Chi Kung practice has brought to their lives.

Although Communist China has contributed greatly in the last 40 years to the scientific validation of Chi Kung and has recently caused the practice to become extremely popular in Communist China, through its atheistic fervor the Communist hierarchy has practically destroyed the root source of Chi Kung—the Taoist monasteries and adepts. Nearly all Taoist monasteries were torn down, and the adepts and novices were burned alive unless they were willing to forsake their faith and return to the production line of the Communist Party. All the esoteric texts the Communists found were burned. The only adepts left were those who managed to flee the country, go underground, or outwardly go along with the Communists while inwardly waiting for the sun to come out again.

So, essentially, the Chinese Communists took the golden egg out of Mother Goose and then did away with her. While the Communists have promoted and validated Chi Kung for health maintenance, disease prevention, and the treatment of certain sicknesses, advanced studies for qualified students in China are no longer possible because the high teachers have been killed and the high-level texts destroyed.

Fortunately, with the exodus of people into Hong Kong, Taiwan, and Southeast Asia in the late 1940s and early 1950s, some of these high-level texts were somehow smuggled out. Some fairly advanced Taoist adepts also managed to escape into Southeast Asia and Taiwan. When President Nixon opened up dialogue and travel restrictions with China, more Taoist texts that had been hidden underground were able to be smuggled out. So not every high teaching on Chi is forever lost. But who can understand these archaic texts? Who is scholarly enough to be able to expound on these ancient writings, and yet has had enough personal experience with

life-force energies to really make any sense out of these texts and impart their essence to their students?

Master Mantak Chia is such a teacher, if not the only such uniquely qualified Taoist teacher in the Western world. He studied with several high teachers who were lucky enough to have escaped from China to reside in Southeast Asia. Master Chia has had access to many Taoist texts saved from Communist destruction. After China opened up somewhat, a number of Taoists who had safely kept the high teaching and ancient texts underground imparted all they had to Master Chia. His mastery of the Chinese language, both spoken and written, enabled him to read all these ancient texts, while his high-level personal experience with the life-force, both in himself and in his students, enabled him to understand and impart the ancient teachings. His fluency in English and knowledge of medical science further enables him to communicate fully in a form that is both intelligible and sensible to Westerners.

Lawrence Young, M.D.
December 25, 1992
New York City

Lawrence Young, M.D., is an internist in private practice in New York City. He is a member of the American Medical Association and a licensed acupuncturist. He has studied and practiced Chi Kung since he was 12. He is widely read in Taoist texts and takes every opportunity to talk to Chi Kung practitioners. He has authored a book in *Chinese Chi Kung and Healing* and one in English, *Report of the National Clearing House on Meditation and Relaxation*.

Chapter 1
An Overview of Taoist Inner Alchemy

The Foundations for Transformation:

External and Internal Alchemy

For mare than five thousand years, the Taoist masters researched and developed various practices to attain happiness and immortality. Many of these were methods of *External Alchemy*, which included the Immortal Pill (Fig. 1.1) and potions that used mercury, crystals, crystal essences, flower essences, herbs, precious stones, and so forth. The wisest of the masters realized that external methods were a limited approach and that certain ingredients were often hard to find. Their solution was to develop methods of Internal Alchemy, in which the body's energies could be combined with those of the earth and the cosmos and transformed to serve as the ingredients for immortality and happiness. After many centuries of testing, these internal methods have proven fat more effective in enhancing health and developing the spirit.

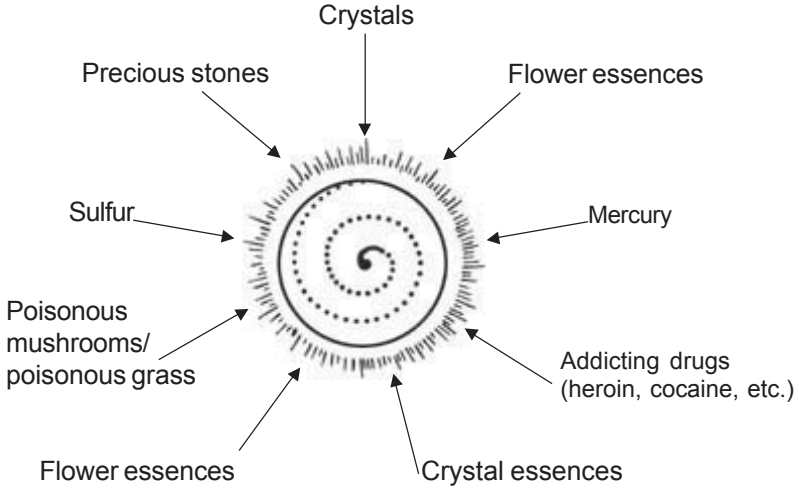

Fig. 1.1 *Immortal Pill*

In their constant search for an unlimited source of energy, the Taoists turned their attention inward to uncover the mysteries surrounding their life-force. They discovered a universe within and found that it perfectly reflected the outer universe. The masters reasoned that to become connected to the outer universe, one must first gain control of this inner universe, which they experienced as a flow of energy, or Chi, through their bodies.

Scientific studies corroborate the Taoist findings, indicating many parallels between the inner and outer worlds. In their book Powers of Ten, Phillip and Phyllis Morrison reflect this research as they explore the relationships between the microcosm of the human body and the macrocosm of the universe. The authors note that a telescopic view of one thousand light-years into space appears almost identical with a microscopic view of human cells enlarged to one angstrom. Although the ancient Taoists could feel this relationship internally, they had no means of providing any tangible evidence.

By meditating and practicing internal exercises, the masters developed their inner senses so they could learn more about the inner universe. They eventually discovered the Microcosmic Orbit, the pathway through which the distilled essence of internal energy runs up the spine and down the front of the body (Fig. 1.2). They perceived that this circuit connects out physical, energy, and spiritual bodies, and that it can ultimately be used to fuse these into one immortal body. The study of Internal Alchemy was born out of this perception.

Wu Chi and the Universe: Religion and Science

Ancient Taoism is rooted in profound observation of naturally occurring universal processes and their effects on human nature. The West's Newtonian physics understands these processes as the mechanics of cause and effect. Taoism, however, understands them as the interactions of a vast sea of energy that is constantly creating and recreating the universe in an infinite number of ways. Most religions and esoteric systems study these processes through scriptures and practices based on the immaterial. By contrast, Taoists study both the material and immaterial aspects of nature and the universe in the belief that the immaterial is both the source of the material and a product of it. In other words, physical and

nonphysical processes are sources for each other, and both are essential in the co- creation and evolution of the universe (Fig. 1.3).

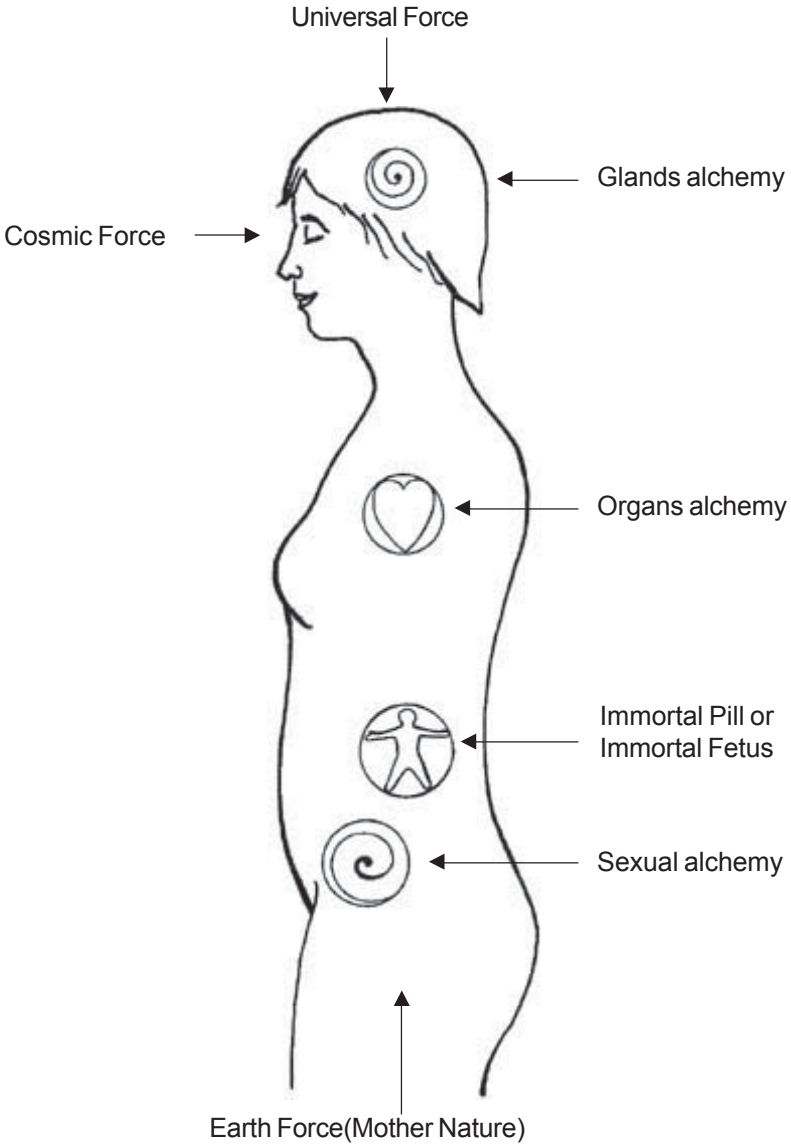

Fig. 1.2 *Inner Alchemy: Combination forming the Immortal Pill or the Immortal Fetus*

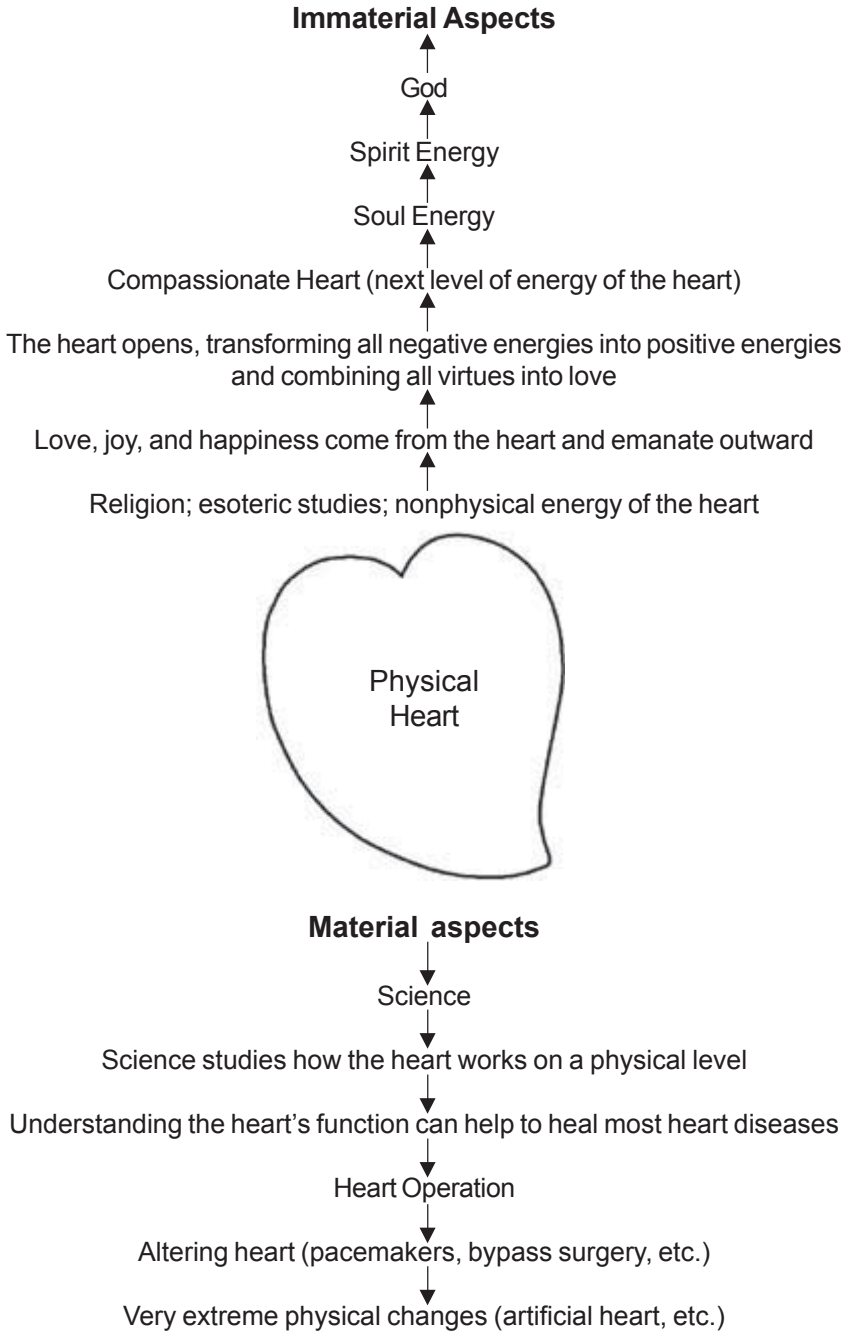

Fig. 1.3 *Physical and nonphysical processes are sources for each other, and both are essential in the co-creation and evolution of the universe*

Wu Chi: Our Original Source

Through observing nature and the effects of energy within the human body, the ancient Taoists were able to trace the universal energy back to its point of origin. Having developed an empirical approach with which to contact this source of observable phenomena, they established the concept of the primordial void as the point of departure for all creation. This void was given the name Wu Chi (Fig. 1.4). It is depicted as an empty circle in traditional Taoist art because it is beyond human description. For energy to begin generating the effects and forms of nature and the universe, something had to stir within the Wu Chi. This first stirring created the division between the material and the immaterial, and all the processes of the universe began at this time.

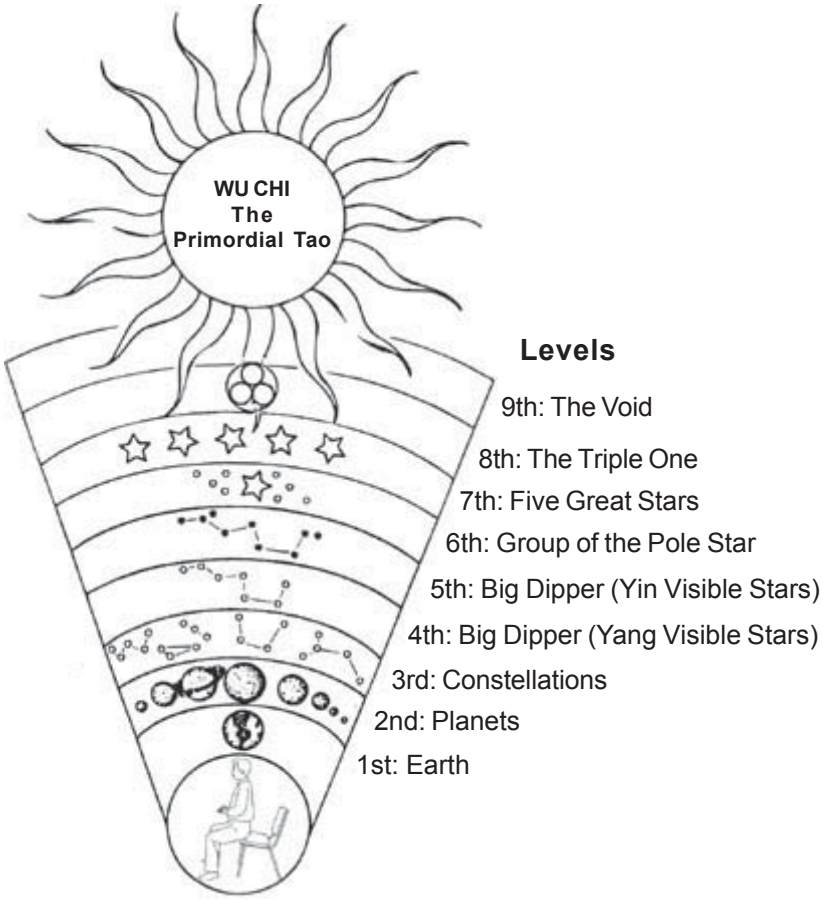

Fig. 1.4 *Wu Chi—the Primordial Tao*

Yin and Yang

Taoists refer to the first observable variations of the Universal Force, which emanates from the Wu Chi, as Yin and Yang. The two qualities of this force can be understood as the positive and negative poles of the primordial energy. Yin and Yang are inseparable tendencies of all energy, and it is impossible to have one without the other. Their interactions are the root of all universal action; hence, the polarity of Yin and Yang is a factor intrinsic to all creation (Fig. 1.5).

Western science has in recent decades developed a concept of original creation similar to that of ancient Taoism. Physical scientists believe that the origin of all matter and universal processes was an explosion referred to as the Big Bang. This original event resulted in the creation of elemental particles arrayed in increasingly complex con figurations. These particles eventually became the building blocks of all matter. The Big Bang is estimated to have taken place some 15 to 20 billion years ago, initiating the process of time and shaping the known universe.

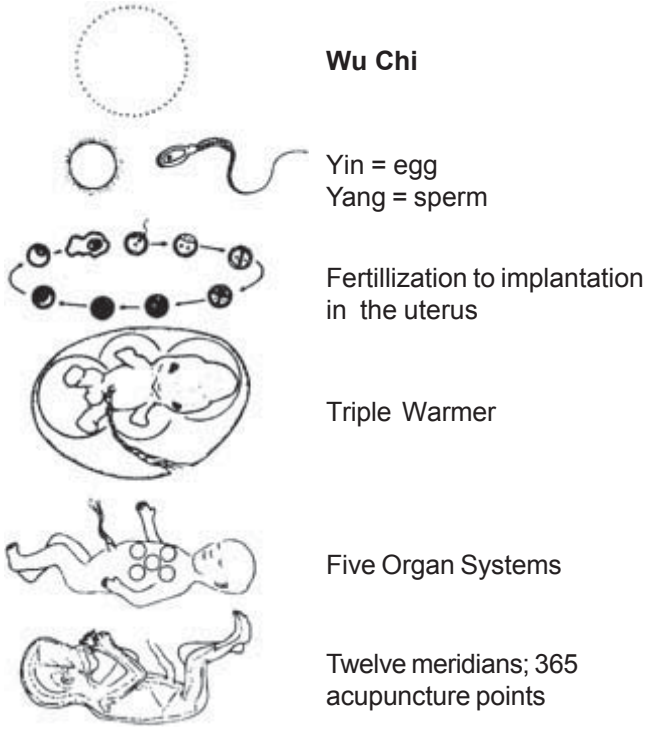

Fig. 1.5 *The formation of a child mirrors the formation of the universe.*

The Five Major Processes of Energy

The Taoists observed that Yin and Yang interactions universally follow five basic patterns, which came to be known as the Five Processes of Energy (or Five Phases or Five Forces). Such interactions have been erroneously translated as five elements, thereby confusing the process with the actual physical elements. In Taoism the physical elements found in nature symbolically express the motion of the Five Processes of Energy. Thus fire represents energy rising; water represents energy sinking; wood represents energy expanding; metal represents energy solidifying; and earth represents stable or centered energy. Each of the Five Processes of Energy depends on the interactions of Yin and Yang emanating from the primordial void.

These five elemental processes are expressions of energy that can be observed in nature and throughout the universe. In space they regulate the motions of all the planets, stars, and cosmic phenomena. In nature they promote interactions between the five elements of fire, water, wood, metal, and earth. Within the human body they affect the five major organs: the heart, kidneys, liver, lungs, and spleen. Just as Western science understands atoms and subatomic particles to be the fundamental units of all matter, the Five Processes of Energy are understood in Taoism to be the essence of all processes. The forces that regulate the cosmos are identical with those that physically affect our planet and our bodies.

The Influence of Stars and Light on Our Inner Universe

Another example of the parallels between the inner and outer universes is the way star energies affect our lives. The energy of stars can manifest as different colors of light, various sound frequencies, or as cosmic dust. The Taoist masters discovered that each human life is developed, structured, and influenced by various groups of stars (including their planets and the cosmic particles they produce), and that these influences control the birth, death, life-force, and good or bad fortunes of each individual (Fig. 1.6).

To explore the patterns of these stellar energies in detail, the Taoists developed the science of astrology to a very high level. They also learned about another important form of energy they called the *Earth Force*, which derives from the stats, but is accessed through the earth. Chinese astrology differs from Western astrology in that it places more emphasis on the earth, which is closest to us and has a disproportionately greater influence on us than other planets. The Taoist masters saw the earth as a great, intelligent being whose elemental changes and seasons dominated the changes in human life.

Although astrology is only one esoteric aspect of cosmic study, the effects of stellar energies on humans are real, just as the radiation from the sun (which is also a star) is real. Each day of a person's life reflects a continuing need to absorb energy from the planets, stars, and cosmic particles. The absorption of these energies from the earth and stars nourishes the organs, glands, senses, soul, and spirit of a human being.

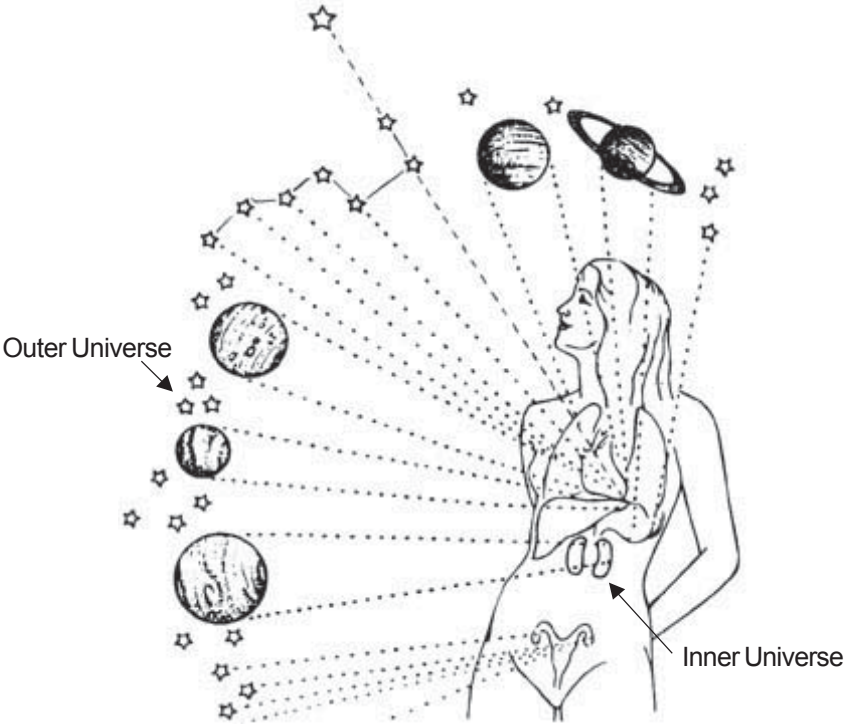

Fig. 1.6 *Human life, birth, death, good and bad fortunes are influenced by light, sound, and frequency.*

The Three Main Sources of External Chi

What Are the Three Forces?

The first force is called the Universal Force, or Heavenly Chi. It includes the energies of all planets, stars, and galaxies and the presence of Universal Love. This vast, all-pervading force nourishes soul, spirit, and Chi within each individual and in every living thing. Taoists say that the moon, which can be considered a planet, has a strong magnetic field that combines with the earth's field to draw Chi from hundreds of billions of stars and planets within out galaxy (Fig. 1.7). In meditation, we access this energy through the crown point at the top of the skull.

The energy of the Higher Self, or Cosmic, Chi is the second force of nature. Cosmic wave/particles (particles of light) are part of the Original Chi that spirals into matter to form the stars and planets. The magnetic powers of the earth, on, and universe cause these particles to drift through our atmosphere like dust. It is the Taoists' belief that human flesh is formed from the fallen cosmic dust of the universe, just as is suggested in the Bible.

These particles nourish the mind and the essences of all the internal organs, glands, and senses within this physical dimension. Humans are considered to be the highest manifestation of the Cosmic or Higher Self Force, capable of gathering this energy into their bodies through meditation and returning it to its primordial source. Out main doorway for absorbing this energy is the mideyebrow point.

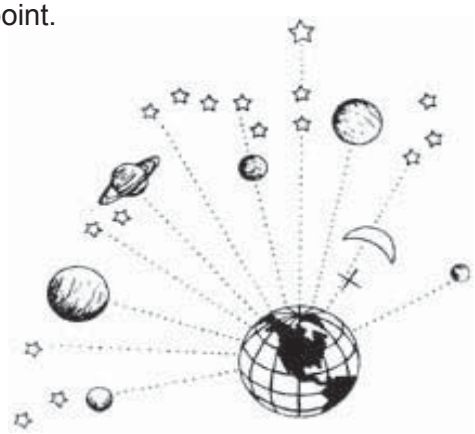

Fig. 1.7 *The earth and moon form a unique combination which has the power to draw Chi from billions of stars within our galaxy.*

The *Earth Force* is the third force of nature, which includes the energies of Mother Earth: all plants, animals, water, minerals, and natural formations (oceans, mountains, etc.) on out planet. The earth's gravitational force, the electromagnetic field that surrounds the earth, and the earthly Five Elements are some of the major aspects of this energy. We access the Earth Force through the soles of the feet and bring it into the torso at the perineum and sexual organ. These energies nourish the physical body, supplying our daily life-force and giving us the power to heal ourselves. They also nourish the soul and spirit within us as the Yin force balances the Yang force from above.

The Three Forces Sustain All Life Forms

The Universal Force, the Higher Self Force of human beings, and the Earth Force work together in harmony to sustain all life forms (Fig. 1.8). The ancient Taoists referred to these ruling forces as the *Three Pure Ones*, far they were the first energies to emerge from the Wu Chi, the Great Emptiness. Traditionally they were visualized as three emperors residing in the three Tan Tiens, the upper, middle, and lower palaces of the body. Through the cultivation of these three forces, which manifest in the human body as Ching, Chi, and Shen, we enhance the development of the physical, energy, and spiritual bodies respectively.

The *Upper Tan Tien* connects to the brain, the glands, and the universal and cosmic energies through the force of Shen or spirit. This includes the Third Eye, the crown, and the entire head.

The *Middle Tan Tien* connects to the heart and all other organs through the natural force of our soul, known as Chi.

The *Lower Tan Tien* connects the physical body, the sexual energy, and Mother Earth through the force known as Ching (sometimes spelled Jing). It is centered between the navel and the kidneys.

Vegetables, Animals, and Minerals: Our Secondary Sources of the Universal Force

The Taoists observed that plants and trees are always extending themselves upward to absorb the Universal Farce in the form of light and invisible cosmic waves from the sun, moon, and stars.

The animals, in turn, consume the vegetation to absorb this force indirectly, and humans receive it from both plant and animal life. Plants, animals, and minerals predigest the Universal Force and provide us with food which, together with the breath, has become our only means of absorbing energy, because we have gradually forgotten how to receive it directly.

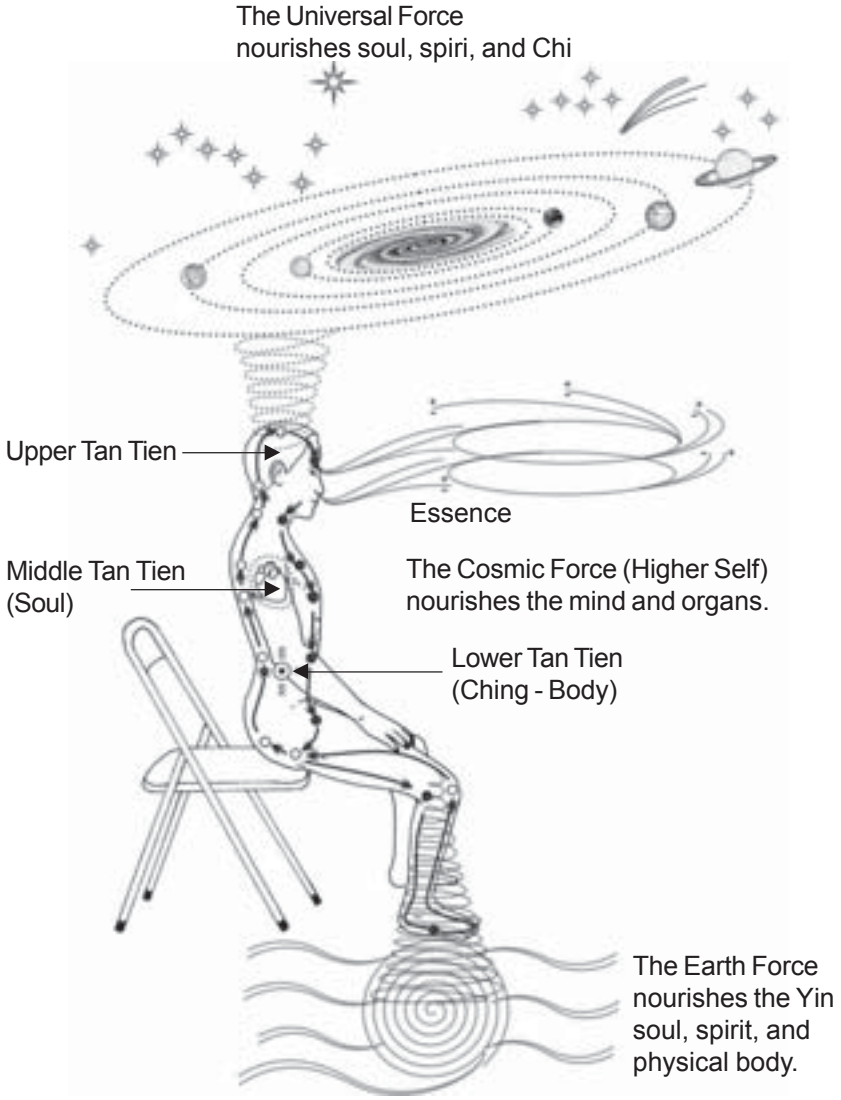

Fig. 1.8 *The Three Forces sustain all life forms.*

Digesting food is an inefficient method of absorbing Chi from secondary sources. Because we have become so dependent on these sources, the vibratory rates of our energy body have been lowered to receive these minute amounts of energy, which are all they can supply. This is why the Inner Smile and Microcosmic Orbit meditations are so important, as they are the means by which we can absorb these forces directly once again.

Humans as Channels for the Universal and Earth Forces

In a limited way, we naturally receive some of the life-giving forces directly, although meditative practices are necessary to store them in the body. The Taoists noted that, unlike other animals, humans stand in an erect position, which directs the head toward the heavens and the tailbone toward the earth, creating a direct channel for the Universal and Earth Forces. In this erect posture, the coccyx directs the Earth Force upward as the head's position directs the Universal Force downward. Both forces combine in the brain and spread out to the whole body, which is thereby nourished and strengthened (Fig. 1.9).

This channel is the source of our mental development, which, according to Taoism, has surpassed that of the known animal kingdom because these forces naturally enhance the powers of the mind. Animals, particularly quadrupeds, tend to raise their tails up to the heavens to channel the Universal Force downward while drawing the Earth Force up through the four feet (Fig. 1. 9). This type of channeling enhances the body before the energy reaches the brain (although both forces eventually circulate to the head), thereby giving the animals increased physical strength instead of the superior mental capacity that humans receive.

In humans, the Universal Farce flows downward in a clockwise spiral to the crown, where it penetrates and nourishes all the glands within the head before continuing down through the palate. The Earth Force ascends through the soles of the feet and up through the genitals, perineum, and coccyx, passing the heart's center, until it reaches the salivary glands of the tongue. Another path draws the Earth Force up the spine and into the brain. In this way humans have the ability to channel the essences of the Universal and Earth Forces to balance and strengthen body, mind, and spirit (Fig. 1. 10). Pushing the tongue up against the palate connects the two

channels of the Microcosmic Orbit and activates the forces in the saliva, which becomes sweeter and refreshed with energy. (Taoists regard the saliva as a mixture of the Universal and Earth Forces.)

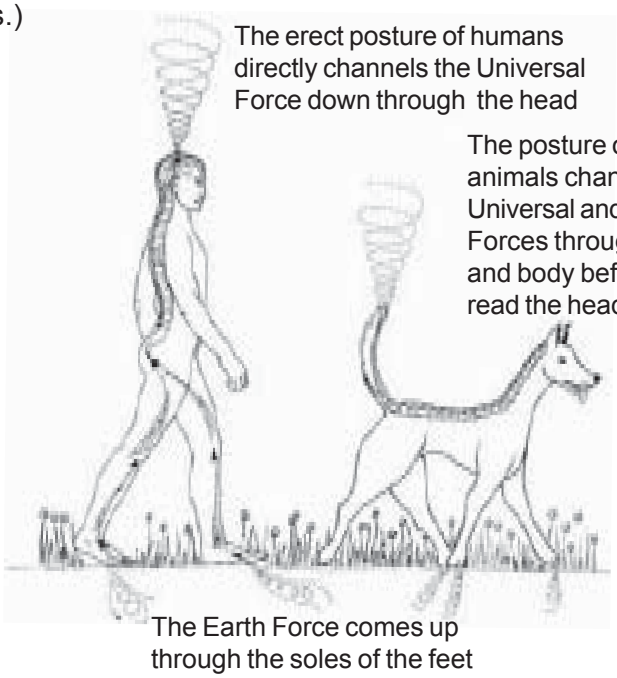

Fig. 1.9 *Humans as channels for Universal ans Earth Forces*

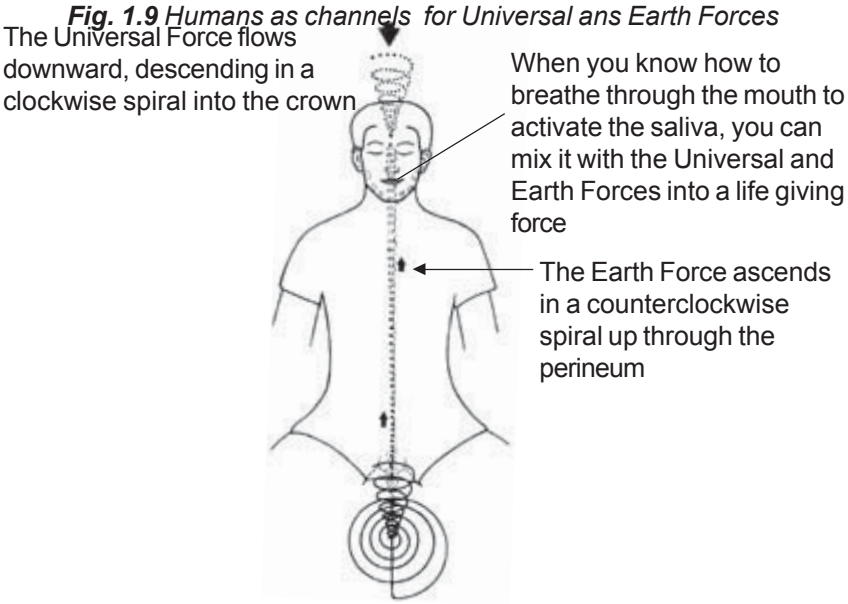

Fig. 1.10 *Humans have the ability to channel the essences of the Universal and Earth Forces to balance and strengthen body, mind, and spirit.*

The Greater Heavenly Cycle and the Smaller Heavenly Cycle

All living creatures absorb the three main forces in accordance with the earth's orbit around the sun. The earth's motion through the universe, making a full orbit every 365.25 days, is part of the Macrocosmic Orbit of the Universal Force, which causes the four seasons and associated changes in the earth's energy (Fig. 1.11). If our principal force (Original Chi) is not abundant enough to draw and absorb the Universal Force, we receive less energy than we expend in our daily lives, thereby depleting our bodies and promoting the onset of old age, sickness, and death. This is similar to how battery cells, when we forget to recharge them, become drained and lose their ability to hold a new charge.

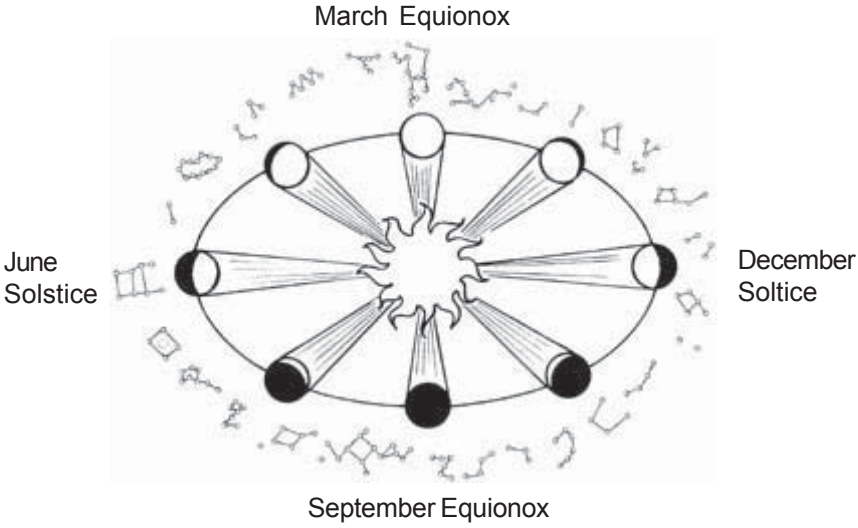

Fig. 1.11 *Each orbit of the earth around the sun is analogous to one round of the Macrocosmic Orbit.*

By opening the Microcosmic Orbit (Smaller Heavenly Cycle) within out bodies, we can develop a connecting link to the Macrocosmic Orbit (Greater Heavenly Cycle) of the universe, through which we can tap into and absorb the original source of all power (Fig. 1.12). Taoists learn to absorb and transform this force directly, rather than depending entirely on plants, animals, and

motions of the earth to provide energy. After developing the Energy Body and extending it into space, they learn to access energies that are purer and more highly refined (Fig. 1-13). This means that humans are not necessarily restricted by the earth's orbit. We can extend ourselves into the universe to draw the forces we need to replenish our life force (Fig. 1.13 and 1.14).

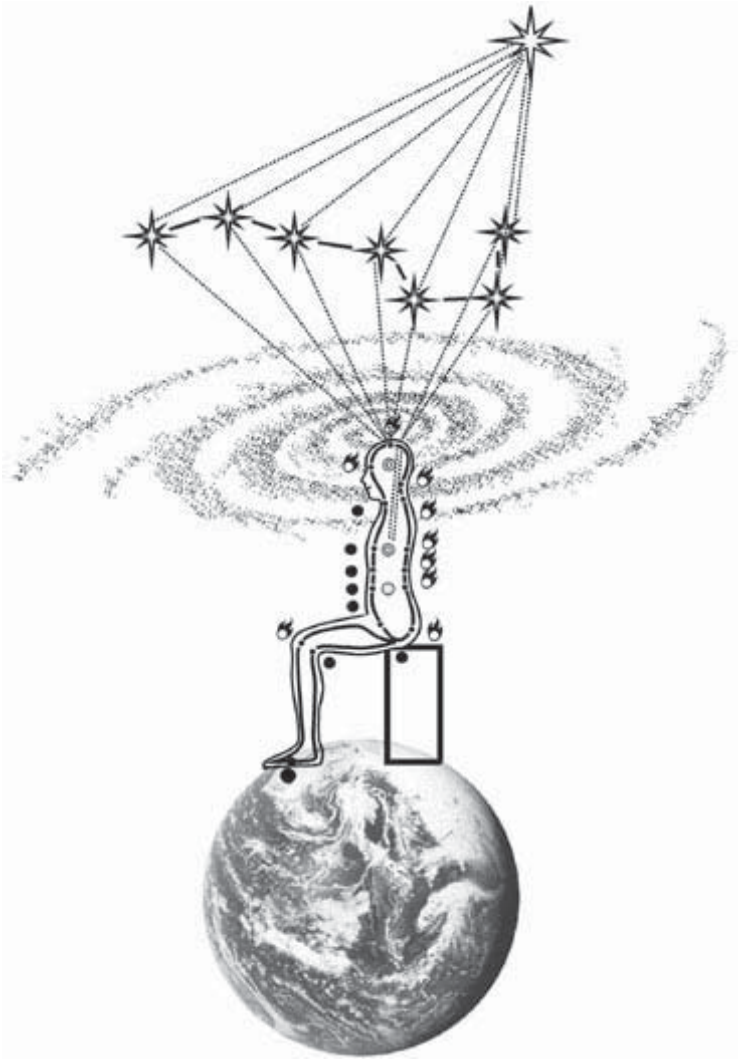

Fig. 1.12 *By opening the Microcosmic Orbit and connecting to the cycle of the Universal Macrocosm, we can draw in more of the Universal Force.*

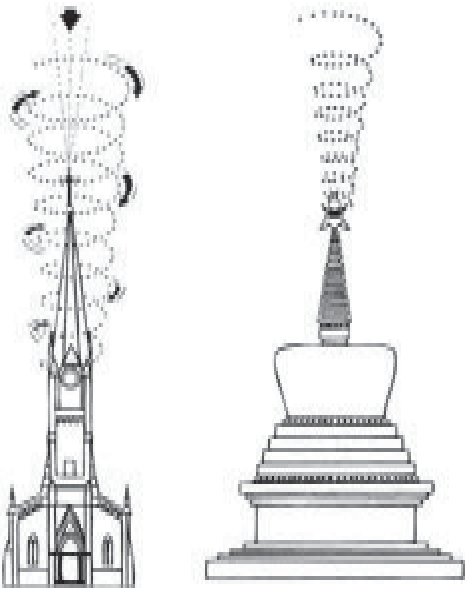

Fig. 1.13 *Churches and temple extend into the sky to capture the Universal Force and channel it down to people who do not know how to access it by themselve*

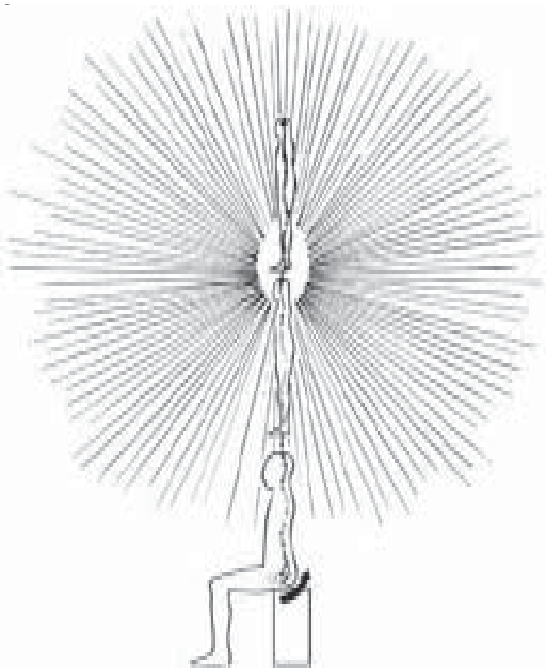

Fig. 1.14 *If we develop spirit and soul bodies, we can extend ourselves out further into the universe without having to depend on others.*

The Three Pure Ones are the sources of our Prenatal or Original Chi. In turn, it is our Original Chi that helps us draw and absorb the Universal, Higher Self, and Earth Forces. By understanding how to absorb and digest more energy from the these three forces, we can eventually replace any lost Original Chi that has been depleted during the course of our lives (Fig. 1.15). An abundance of this Original Chi makes all other forms of energy much more assailable. Combining the external forces with our internal energies produces a healthy body and a stronger life-force. With meditative practices, such as the Microcosmic Orbit, this process is enhanced tenfold.

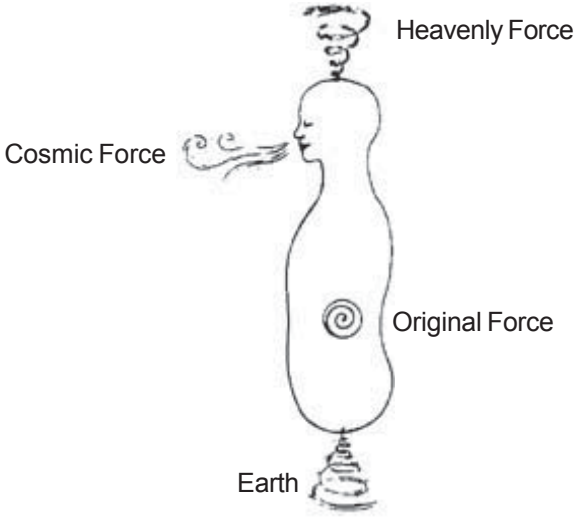

Fig. 1.15 *The Original Force is like a battery in our bodies because it can be recharged with practice.*

Chapter 2
Chi

Fig. 2.1 *Chi is the movement in the universe, but not the intelligence.*

What is Chi ?

Perhaps the most basic and general principle of Taoist thought is the concept of Chi. Its status in Chinese philosophy is developed in the popular works of Lao Tzu (604-511 B.C.) and Chuang Tzu (399-295 B.C.), but its origins go back much further. The word Chi has many translations, such as energy, air, breath, wind, vital breath, vital essence, and so forth. Although difficult to define, it can be thought of as the activating energy of the universe.

Chi condenses and disperses in alternating cycles of negative and positive (Yin and Yang) energy, materializing in different ways, forms, and shapes. It can be neither created nor destroyed. Instead, Chi transforms itself and reappears in new states of existence. All states of existence, therefore, are temporary manifestations of Chi, especially those of physical matter.

Chi is the source of all movement in the universe (Fig. 2.1). The motions of the stars and planets, the radiation from the sun, and the patterns of our thoughts and emotions occur because of Chi. It is considered to be the source of our life force and the animating factor in all living beings.

Chi also binds things together. It is what keeps the constituents of our bodies from separating and dissipating. When the human body loses its breath of life, the original energy (life-force) leaves it, allowing the body to decompose.

Chi holds the organs, glands, blood vessels, and other bodily parts in place. When the body's Chi becomes weak, a loosening of the organs can occur in which they drop from their normal positions, leading to poor functioning and ill health. Chi also warms the body; any increase or decrease in bodily heat indicates the strength of its flow. We think of warmth in mammals as a "vital sign", showing that Chi is present.

The Chi that forms the heavens and earth is essentially the same as the Chi that forms living beings. This was expressed by the ancient Chinese philosophers as follows:

Wu Chi (The Great Void) consists of Chi. Chi condenses to become the myriad things. Things of necessity disintegrate and return to the Wu Chi. If Chi condenses, its visibility becomes effective and physical form appears, Chi in dispersion is substance, and so is it in condensation, Every birth is a condensation, every death a dispersal. Birth is not a gain, death not a loss.... When condensed, Chi becomes a living being; when dispersed, it is the substratum of change.—Zhang Tsai (1020-1077 A.D.)

A human being results from the Chi of Heaven and Earth. The union of the Chi of Heaven and Earth is called human being.—*Simple Question*, Chapter 25 (Fig. 2.2)

In *The Foundations of Chinese Medicine*, Giovanni Maciocia explains:

According to the Chinese, there are many different "types" of human Chi, ranging from the tenuous and rarefied, to the very dense and coarse. All the various types of Chi, however, are ultimately one Chi, merely manifesting in different forms.

The Bible's Book of Genesis says, "God created man in His image." Similarly, in Chinese thought, human beings are a microcosm of the universe. Thus, Chi flows throughout the universe, and it also flows through humans. Through studying how our own Chi works, we can also understand the workings of the universe. In Taoist Inner Alchemy, we begin the process of spiritual exploration within the laboratory of our own body and mind.

The highest goal of Taoist Inner Alchemy is to transform our cells to unite with Cosmic (Higher Self) Energy and become immortal cosmic cells of the universe (Fig. 2.3).

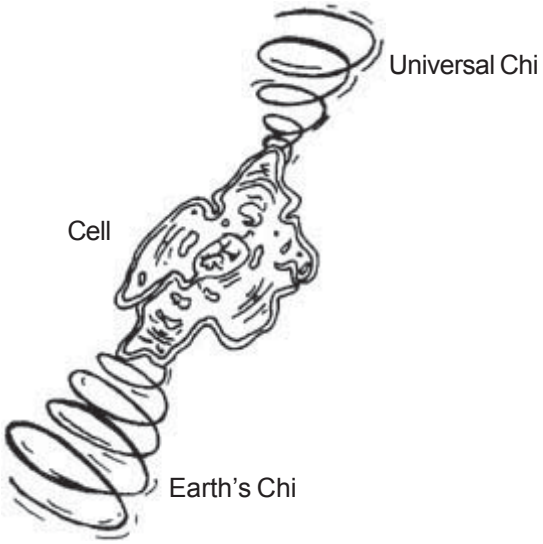

Fig. 2.2 *Living cells are capable of using external Chi to develop intelligence, contracting and creating as they build on themselves with more energy.*

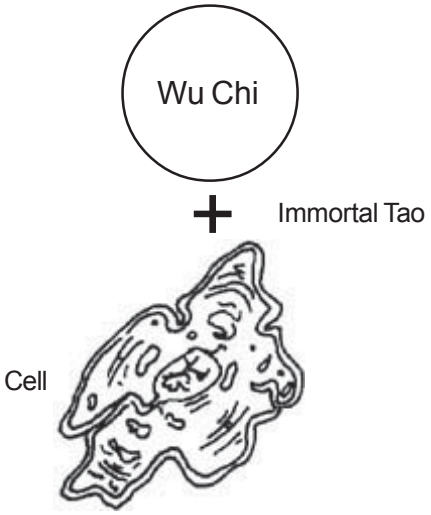

Fig. 2.3 *The highest goal of Taoist Inner Alchemy is to transform our cells to unite with and become the cosmic cells of the universe. These cells are capable of living forever.*

Chi in other Cultures

The idea of Chi is not unique to the Chinese. Nearly every culture in the world has a word to express this concept. Dr. John Mann and Larry Short, authors of *The Body of Light*, count 49 cultures around the world that articulate the concept of Chi in one form or another. In Hebrew, the word is *Ruach*, and it appears in the first chapter of the Book of Genesis:

In the beginning God created the heavens and the earth. The world was without form and void, and darkness was upon the face of the deep; and the Ruach [spirit, wind, or breath] of God was moving over the face of the waters. —Genesis 1:1-2

Ruach was present at the creation of the universe, even before light. The term means Breath of God or Divine Breath.

In Japanese, the term *Ki* expands the concept of Chi to include the Chinese idea of *Yi* or *intention*, indicating that our mind or will is a major influence governing the movement of Chi, which is very important in meditation and in the martial arts.

In Sanskrit, the word for Chi is *Prana*. The Tibetan word is *Lung*. In Lakota Sioux it is known as *Neyatoneyah*. The Bush People of the Kalahari speak of it as Num, which means Boiling Energy. In the Islamic world Chi is referred to as *Barraka*. Although many cultures possess an awareness of Chi, the Chinese have refined this concept and integrated it into their culture to an unparalleled degree. Chi is a pivotal factor in Chinese medicine, martial arts, meditation, science, painting, calligraphy, architecture, interior design, and poetry.

Western View of Chi

In contrast to most world cultures, the concept of Chi appears to be generally absent from contemporary Western medicine and the more conservative establishment scientific circles. Not surprisingly, however, the idea of life-force energy and its relationship to healing has been embraced and explored by many Western researchers. F.A. Mesmer (1734-1815), the famous Austrian physician, was a pioneer in Western research involving energetic principles. He conducted many experiments and public demonstrations of the phenomenon he called “animal magnetism.” Mesmer believed he could

harness a universal magnetic power and direct it with his hands to heal people. He had many successes, especially with cases of hysteria, but his ideas were not accepted by conventional physicians. Because Mesmer never proved the existence of animal magnetism in a laboratory, they viewed him as a fraud. Eventually the local medical establishment pressured him to leave Vienna. Mesmer was confronted with similar attitudes when, after he moved to Paris, the Parisian medical community appointed a commission to investigate his practices. The commission had to admit Mesmer's methods worked, but they refused to accept his explanation of animal magnetism and chose not to attribute his successes to any known scientific principles. Originally called mesmerism, his methods later became known as hypnosis.

More recently, Wilhelm Reich, an early disciple of Sigmund Freud, became intrigued with something he called "orgone," a form of primordial cosmic energy (Chi), which he related to sexual energy. He received much criticism and was persecuted for his theories, despite his many clinical successes. The U.S. Food and Drug Administration won an uncontested injunction against him, which prohibited him from selling orgone-accumulating devices on the grounds that the existence of orgone could not be proven. Reich refused to defend his scientific ideas in court and ignored the injunction. He was tried for contempt of court, convicted, and sentenced to two years in a federal penitentiary. He died in Lewisburg Prison in 1957.

Attitudes began to change in the West after President Richard Nixon reestablished diplomatic relations with China in 1972. In Beijing, Chinese doctors performed emergency surgery on *New York Times* correspondent James Reston, using only acupuncture for anesthesia. Since then many delegations of Western physicians to China have witnessed similar events. Eventually, Western medicine had to admit that Chinese doctors have practical applications of Chi that can indeed heal the human body. In a few short years, many Chinese medical schools were established throughout the United States and Europe, and most Western cities now have many acupuncturists to serve the ailing.

Because the concept of Chi is not limited to any single area of current Western science, it is difficult for Westerners to understand. It is not easily pigeonholed into either physics, electrical engineering, biochemistry, medicine, or psychology, and yet it is clearly

related to all of them. Now a few scientific synthesizers are emerging who have broad enough training and sufficient curiosity to research Chi. Interestingly, the discovery of endorphins, the body's natural painkillers, resulted from an investigation into how acupuncture anesthesia works. This is only the first of many scientific breakthroughs that will occur as scientists continue their research into Chi.

Currently, several reputable scientists are exploring the phenomena of Chi. Dr. Herbert Benson, physician and author of The Relaxation Response, is currently conducting a research project on Chi Kung. Dr. David Eisenberg, a Harvard Medical School graduate, wrote Encounters with Chi, a book about his experiences with acupuncture and Chi Kung masters while a student at an acupuncture college in China. Dr. Robert Becker, a Syracuse University orthopedist and author of *The Body Electric* (Fig. 2.4), is seeking to explain Chi in light of his research into bioelectricity and its relationship to the mind and healing. It was Dr. Becker's research into electricity and its role in regeneration that led to the current method of using low-level electrical currents to stimulate mending of fractures.

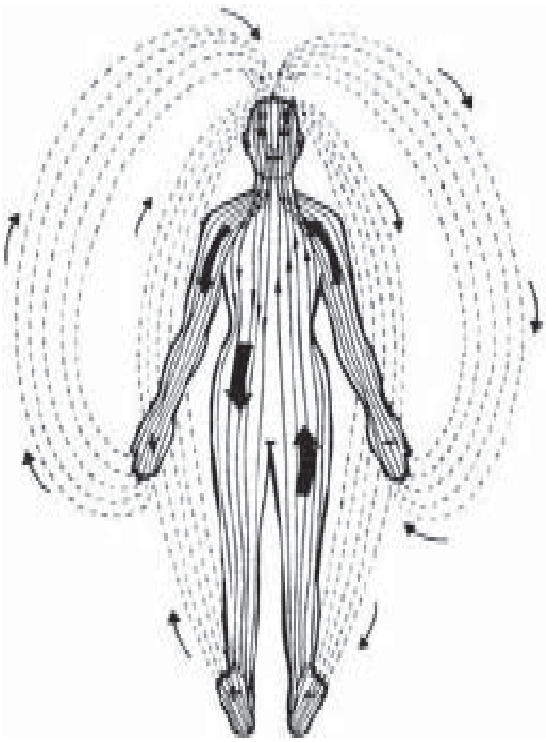

Fig. 2.4 *Body Electric*

Chi and Self-Healing

From the Taoist perspective, health and healing depend on the quantity and quality of Chi in the body. Acupuncture, acupressure, herbal medicine and many other healing arts work directly to balance internal energy. Chi is a causal factor in a wide range of bodily phenomena. For example, a deficiency of Chi in the kidneys may result in a physical and psychological illness characterized by nervousness, sexual inhibition, or impotence. (Either an excess or deficiency of Chi can cause illness.)

Exercise fortifies the muscles with the body's energy, enhancing our ability to consume more Chi. The Taoists discovered that opening the major energy channels can increase the Chi circulation more effectively, amplifying it with energy absorbed from external sources. They assert that meditation, a proper diet, and exercise are very important to one's life and spiritual growth.

Most illnesses and pain result from blockages of Chi, as too many protons condense in the wrong places. This impedes the flow of electrons through major channels of the body. By releasing such blockages and increasing the Chi flow, we can often heal ourselves without resorting to medical treatments. Working with Chi to heal the body is a form of "needle-less" acupuncture. By using the inner senses to circulate Chi through the Microcosmic Orbit, we establish a clear and open channel, so our internal health can maintain itself. Not only are blockages removed as the body's natural Chi flow is enhanced, but practice also helps the body absorb more Chi from other sources (Fig. 2.5).

External Chi received from the earth, sun, and stars can be transformed and refined into enhanced life force for self-healing and spiritual growth. The centers of the Microcosmic Orbit receive surplus Chi from these sources as well as from the organs and glands. The circulation of this energy feeds any points that are deficient and balances the body's Chi in general, lessening the need for acupuncture and other healing arts. Internal work provides the best form of health maintenance and preventive medicine.

Taoist masters of modem times can see the energetic deficiencies that cause illnesses in people. They also know how difficult it can be to teach people to heal themselves, especially those who

are very sick. Still, the masters realize that teaching self-healing is better than allowing others to become dependent on them for healing. But there are times when self-healing techniques may be beyond someone's capabilities. For this reason the Taoists developed various forms of Chi meditation, Internal Alchemy, and acupuncture, which can use mind power, certain Chi Kung exercises, or needles to open any blockages that cause pain and sickness.

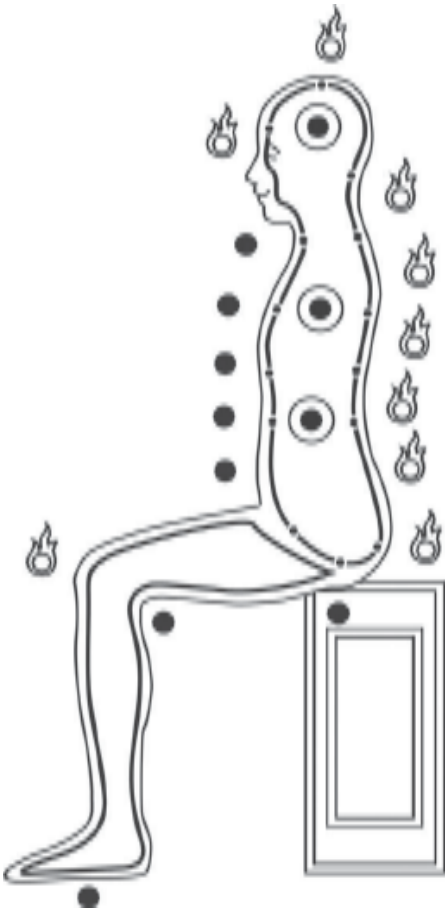

Fig. 2.5 Practice with the Microcosmic Orbit
will increase the bioelectric flow (Chi).

Two Types of Internal Chi: Hereditary and Acquired

Although there are many different types of Chi, they all fall under two basic categories: Hereditary Chi and Acquired Chi.

Hereditary Chi

Hereditary Chi is the Chi that is with us from conception to death. It nourishes us in the womb and is the foundation of our life-force until we die. The Chinese call this type of Chi *Pre-Heavenly Force, Early Heavenly Chi, Pre-Birth Breath*, or *Prenatal Energy.* Although there are several types of Hereditary Chi, the most important form for our purposes at this time is the *Original Chi or Original Force* (

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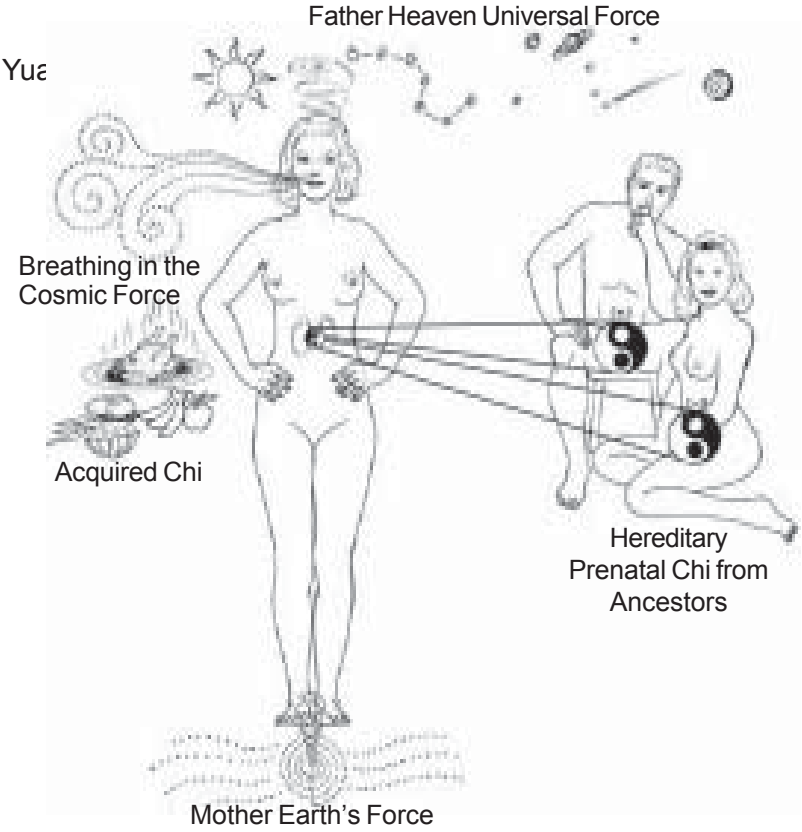

Fig. 2.6 *There are many different types of Chi, in two basic categories: Hereditary Chi and Acquired Chi.*

Acquired Chi

Acquired Chi includes all the types of Chi that are produced after birth. The Chinese call this type of Chi *Post-Heavenly Breath, Later Heavenly Force, Post-Birth Chi,* or *Postnatal Energy*. (It is important to understand that these colorful terms are all just different translations of the same words in Chinese.)

The primary sources of this Chi are the food we eat, the water we drink, and the air we breathe. In addition, whether we are conscious of it or not, we are constantly receiving energy from the Three Forces: Universal or Heavenly Energy, Higher Self or Cosmic Energy, and Earth Energy. Many Taoist practices are directed toward teaching us to better attune to, absorb, and digest the energies of these Three Forces.

Original Chi in Humans

Original Chi: Our Source of Life-Force

Although it derives from the forces of Heaven and Earth, Original Chi is instilled in our bodies through the love and sexual union of our parents. Taoists believe that during the act of love and sex, all bodily essences of man and woman condense into orgasmic Chi, which draws in and reunites the Universal, Higher Self, and Earth Forces. Yin and Yang orgasmic energies combine with these external forces as the sperm and egg unite, establishing our Original Chi at conception (Fig. 2.7). Taoists refer to this as the Reunion of Heaven and Earth.

Once these forces are united, they draw in even higher forces from the Wu Chi. The act of love and sexual union draws in so much of these powerful forces that it can create a new human life (Fig. 2.8). During pregnancy and after birth, an infant is continuously nourished by these forces through the nutrients supplied by its mother (first through the umbilical cord, later through breast-feeding).

Original Chi: The Body's Battery

When the umbilical cord is cut and we start to breathe, Original Chi is stored within our bodies, just like the charge of a battery. In Taoist physiology, the Original Chi is stored in the space between the navel, the kidneys, and the sexual center, slightly above the

pelvic area (Fig. 2.9). During every moment of every day we draw on this Chi for combustion of energy from external sources, such as food, air, and energies from the earth, moon, sun, and stars.

The process is similar to the electrical system in a car, which depends on the battery to initiate its operation (Fig. 2.10). The spark from the battery, combined with air and fuel, produces internal combustion. The force of the internal combustion powers the engine, which, in turn, runs the car. After ignition has been achieved and the engine is running, the battery is no longer required to produce the spark because the generator or alternator takes over to maintain the current. The generator then restores any lost charge back to the battery. When the battery is in good condition it can be recharged continually, just as Original Chi can be replenished with energy indirectly with Chi taken from the vital organs, food, and air, or directly through any of the Three Major Forces.

Original Chi can escape the body in many ways, such as excess talking, working, reading, daydreaming, or sexual activity. In other words, we deplete out Original Chi when we don't use our senses and sexual energy in the proper way. Taoists regard sexual energy as a major part of the Original Force.

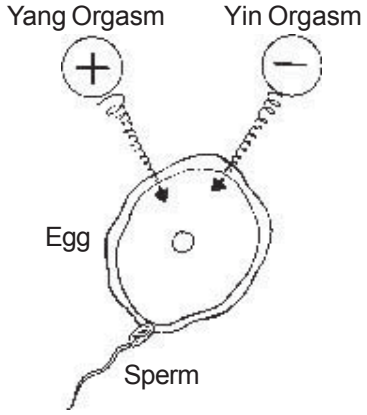

Fig. 2.7. *Reunion of Yin and Yang, the Original Chi in humans.*

Today we are tempted to dissipate our life-force in many directions. Many magazine advertisement and television commercials, for instance, are designed to activate our sexual desires. Once sexual desire is activated, it stimulates sensual desires as well. These desires drain our Original Force out to combine with the message of the advertisement. Our senses become charged with

craving for every sort of stimulation and product, just as the advertisers intend (Fig. 2.11). We are convinced to buy and consume many things we do not need. This over consumption saps the life-force and prevents us from using it for more productive healing and spiritual purposes.

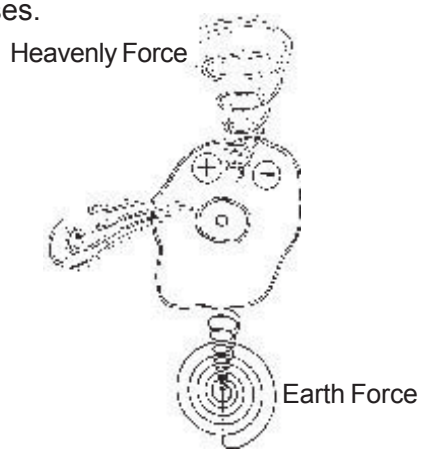

Fig. 2.8. *The first complete cells have the power to draw and unite the Heaven, Earth, and Cosmic Forces.*

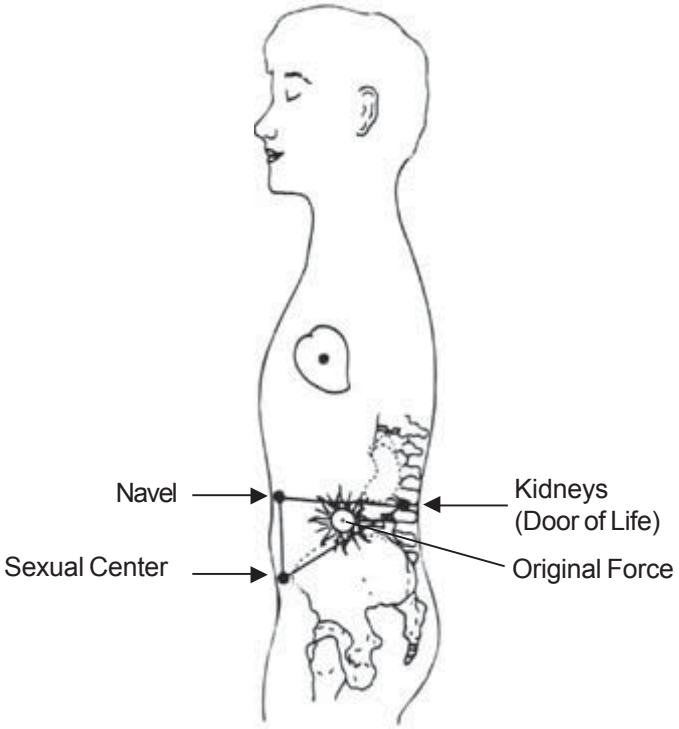

Fig. 2.9. *The Original Chi is stored in the space between the space between the navel and the sexual center.*

Fig. 2.10. *Original Chi is like a battery powering the body. We use this energy in our daily lives.*

Fig. 2.11. *Once our sexual desires activate and leak out, our senses become charged with cravings for many kinds of stimulation. This further drains our energies.*

Many other factors in daily life drain our Original Force and sexual energy reserves. When too much sexual energy is lost through ejaculation or menstruation, both the will (which is related to the kidney and sexual energy) and the body begin to grow weak. When the will is weak, unhealthy eating habits develop. Bad diet, criticizing other people, sexual harassment, and foul language cause more loss of sexual energy through the mouth. Focusing on the shortcomings of others and viewing pornography drain sexual energy through the eyes and weaken the liver. Listening to gossip and criticism hurts the ears and kidneys and directly drains the sexual energy. Negative thinking, obscene thoughts, daydreams, and excessive sexual fantasies drain the brain, marrow, and sexual energy (Fig. 2.12).

The ancient Taoist masters warned, “Guard your senses and sexual energy!” We have become accustomed to the constant onslaught, on our senses and accept it as part of our culture, but we must recognize the danger of advertising and break free from its mind-numbing effects. If we want to be in control of our lives, we must guard and conserve our life-force and sexual energy.

By maintaining the Original Chi, we call increase endurance and longevity. But if we neglect to recharge ourselves, our “internal batteries” will become weak.

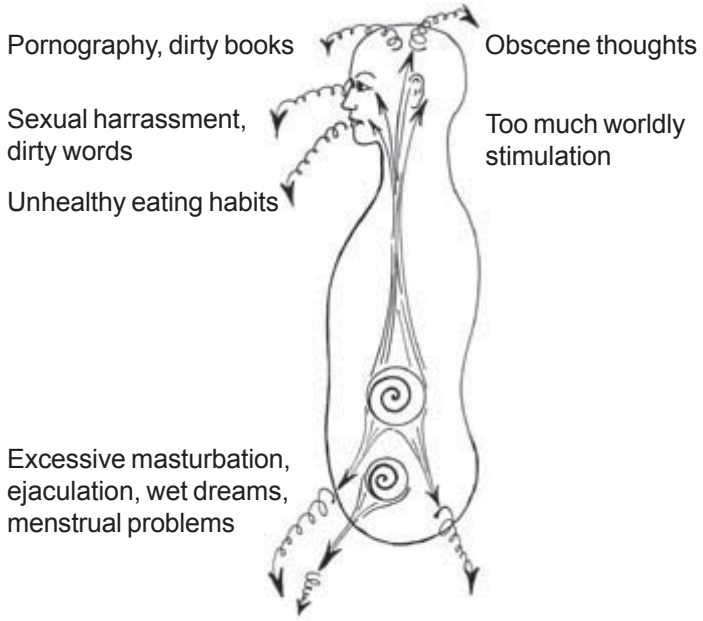

Fig. 2.12. *Sexual energy leaks out in many ways.*

Every time we inhale, the Original Breath from the lower abdomen rises to the mouth and mixes with externally drawn air. We can learn how to draw the Earth Force through the sexual organ, perineum, and sacrum; the Cosmic Force through the mid-eyebrow; and the Universal Force through the crown. The advanced breathing techniques enable one to breathe through the whole body (Fig. 2.13).

Proper inhalation and exhalation of air move internal energy up, then down through the Functional Channel at the mouth. If we do not know how to bring this energy down to the navel, or if we neglect to do so, it will flow out the nose or mouth with each exhalation. We can lose even more Original Chi if we overexert ourselves and become short of breath.

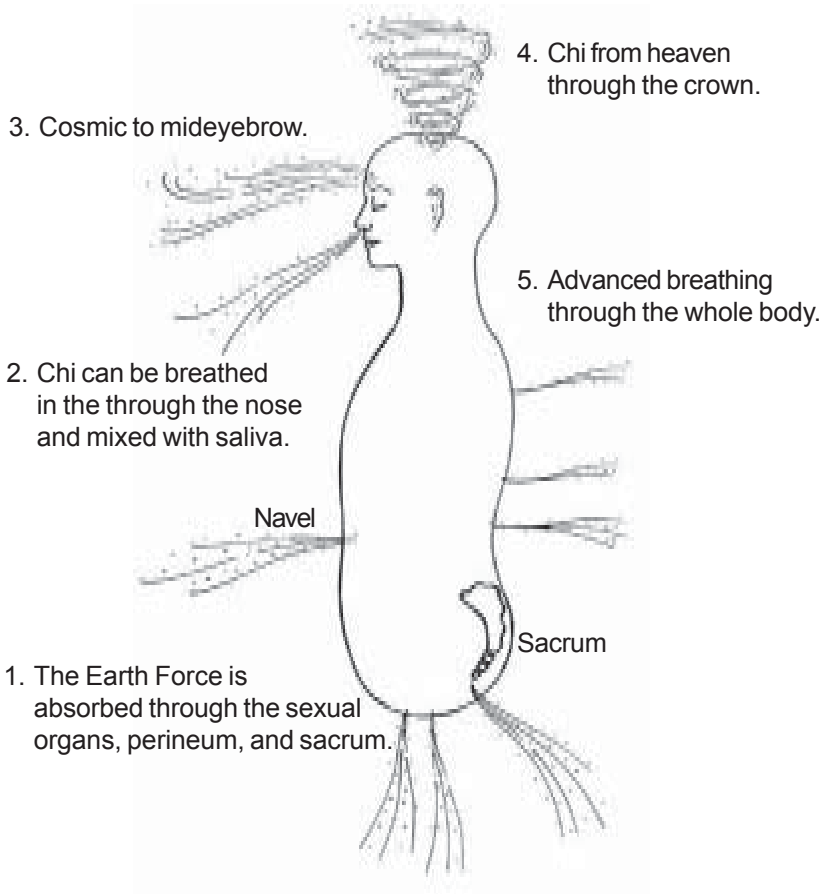

Fig. 2.13. *Each time we inhale, we draw in energy.*

How to Increase and Restore the Original Chi

Focusing your vital Chi until it is supremely soft, can you be like a baby? —Lao Tsu

If we have a free moment during the day, it is helpful to turn the senses and sexual desires inward and fix the mind, eyes, and heart on the Original Force. This will help conserve and increase the Force (Fig. 2.14).

Proper Breathing and the Microcosmic Orbit

One of the major reasons for practicing the Microcosmic Orbit is to return the body to a state of innocence and virtue, as in infancy when our energy was pure and full. According to the Bible, Jesus said that we can only return to God as children. Through the Microcosmic Orbit meditation we can give birth to a new self, restore our lost Original Force, and return to a childlike energy.

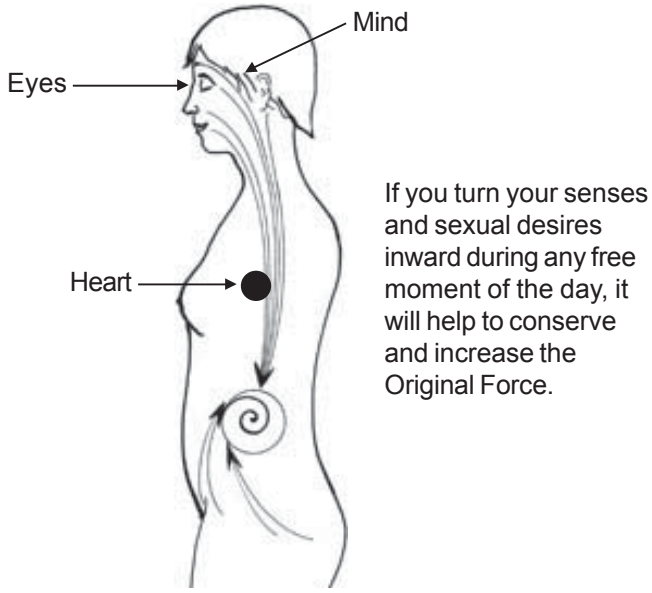

Fig. 2.14. *Many of our worldly vices are related to sexual desires. Our unbalanced sexual energies cause us to seek many forms of gratification in material things we don't really need.*

As stated earlier, the Original Breath moves upward to the mouth where it mixes with the food we eat and the air we breathe. We can learn to consciously take in the Universal, Higher Self, and Earth Forces to mix them with our Original Chi, and then bring these down through the Functional Channel to the navel, where they can be refined to increase and restore our Original Chi.

Learning and practicing the Microcosmic Orbit meditation is the best way to maintain the Original Chi. By keeping the channels open and flowing, and by drawing external energy into the body, we conserve our Original Chi and increase our ability to digest and use the energies we take in from outside, which we call external Chi or Acquired Chi. As in making investments, it is better to spend the interest we collect from what we have saved and inherited than to deplete our principal by spending more than we take in or earn.

Breathing In Cosmic Energy

Taoists say there is life-force in the air, but it is separate from the major elements of oxygen, nitrogen, and carbon dioxide. The air is also made up of ions (charge protons and electrons), which are often depleted by pollution, overcrowded conditions in our cities, air conditioning, concrete buildings, and other features of modern society. Without these energy particles, people become weak and tired. Science is studying ways to replace these particles in areas depleted by human tampering, but to absorb their energies, we must separate them from the air, just as fish separate oxygen from the water. Taoist masters use the mind, the inner eye, and the heart to distinguish and categorize the various forms of Chi in nature and the universe (Fig. 2.15).

Breathing is one of the most important functions that sustains our lives. What most of us don't realize, however, is that the cosmic particle of energy in our atmosphere are just as important to our survival as oxygen. (These ionized particles are also referred to as the *Later Heavenly Force*.) Charged electrons supply the electrical current within our cells. If these are depleted, we can become weak, tired, and depressed, or we might suffer from negative emotional states and even physical illness.

The Taoists realized that breathing external energies into the lungs does not make the best use of them for the body. They also discovered that Chi can be separated from the air as it is being inhaled and mixed with the Original Force in our saliva. We can

then swallow this energy with the saliva so that it can be used immediately and more efficiently by the body. We can also use the mid-eyebrow point, the palms, and the skin to absorb energies for the body's use. Taoist masters created many exercises to help us take in external forces, such as Chi Kung, Tai Chi, and various forms of meditation. Meditations, such as the Microcosmic Orbit, are the most direct way to take in these energies.

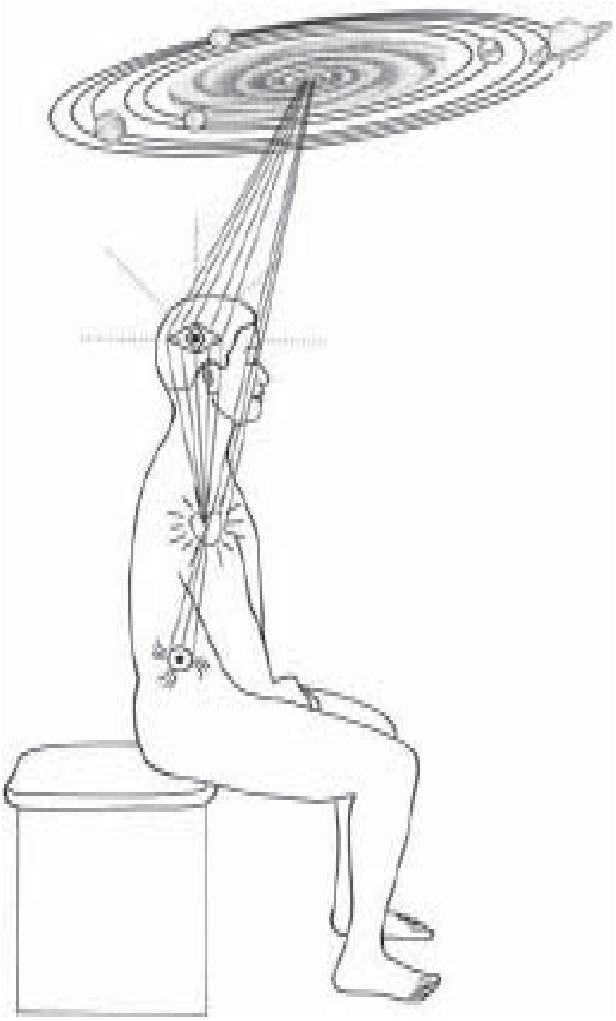

Fig. 2.15. *Taoist masters use the mind, the inner eye, and theheart to distinguish and categorize the various forms of Chi in nature and the universe.*

Conserving Sexual Energy Maintains and Rebuilds Our Original Force

We must also maintain our sexual energy, which is referred to as *Ching Chi* by Taoists. It is part of our Original Force, and it can be increased, provided the Ching Chi is conserved. When supplemented by the energies of the air we breathe and the food we eat, our Original Force helps the body produce sexual energy. People unknowingly deplete themselves of this energy, however, through excessive ejaculation and menstruation, wasting an incredible source of potential life-force. By redirecting sexual energy into the internal organs and glands (Fig. 2.16), people can have wonderful sex and an abundance of energy to heal and rejuvenate their bodies. Sexual energy, or Ching Chi, was discovered to be the most powerful force within the body when it is recycled internally. This process heals and strengthens the other organs and glands, increasing their production of Chi.

Redirecting sexual energy into organs and glands.

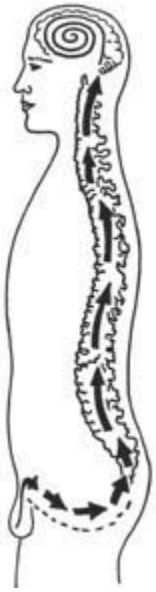

Fig. 2.16. *Sexual Energy (Ching Chi)—part of the Original Force*

Sperm and ovum are the condensed essences of the Universal and Earth Forces, and their power, Ching Chi, compounds itself regularly if it Is recycled. Drawing on these sources of energy increases the life-force tremendously, and an enhanced life-force translates into nourishment for body, mind, and spirit. The first step

in transforming sexual energy into life-force is to open the channels of the Microcosmic Orbit so that positive Chi can be circulated into the higher centers and transformed to fulfill the body's needs.

Chi and Meditation

Thousands of years ago, Taoist masters discovered the body's Chi centers through internal observation. This involved removing the body from external stimuli and meditating, so that the inner senses could be activated. By quieting the mental and physical processes and using their inner senses, the masters discovered that some parts of the body have more Chi than others. They serve as gathering points of nourishment for particular organs and glands. These centers can receive Chi from outside sources such as electromagnetic power, the earth's vibration, light, and frequency or sound from the moon, sun, and stars. The Universal Force, in the form of the red and violet light of unconditional love, adds to this nourishment (Fig. 2.17).

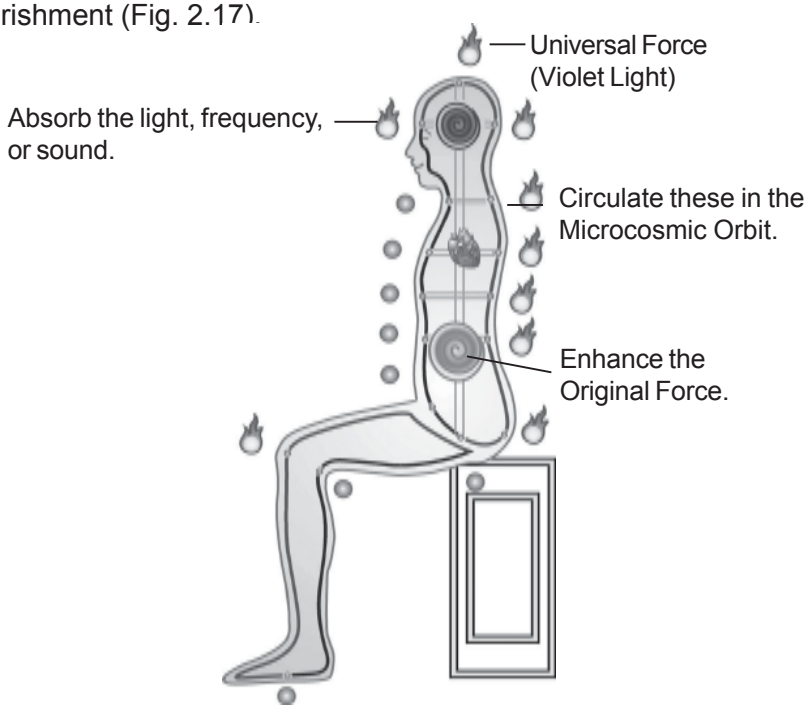

Absorb electromagnetic power—vibration—through the soles.

Fig. 2.17. *Microcosmic Orbit*

The masters learned that these centers connect to form a pathway, which they called the Microcosmic Orbit. At that time, they had no concept of electricity as we know it today. Nonetheless, they were able to access the body's electromagnetic energy flow (Chi).

The masters learned to use the mind and the inner eye to guide Chi through this pathway. They used it to heal themselves, thus creating a foundation for spiritual work. As they developed their inner senses to distinguish and categorize Chi according to its various sources (sun, moon, stars, etc.), they also leaned how to absorb more Chi from each source into their bodies.

The Microcosmic Orbit pathway is composed of two major channels, referred to as the Governor and Functional Channels. The Governor Channel runs from the perineum up the spine and over the head, ending at the palate of the mouth. The Functional Channel runs from the perineum up the front of the body, ending at the tip of the tongue. Touching the tip of the tongue to the palate connects both channels.

The Microcosmic Orbit is like a large reservoir of Chi that supplies nourishing Chi to the test of the body. First, it fills the Extraordinary or Ancestral Channels. (There are eight Extraordinary Channels in total. The Governor and Functional Channels—the channels of the Microcosmic Orbit—are the first two. These feed the remaining six Extraordinary Channels.) Then it fills the twelve Ordinary Channels: the six Yin channels and the six Yang channels. The Yin and Yang channels are each connected to one of the vital organs. This is how the Microcosmic Orbit meditation sends nourishing Chi throughout the entire body.

All people are born with the Microcosmic Orbit route open and flowing. Even in the mother's womb, the Chi of a fetus flows through its own Microcosmic Orbit (Fig. 2.18). After birth, this route usually stays clear and open until the onset of puberty, when the body experiences the stress of hormonal change and rapid growth and the emotions run strong during the awkward phase of adolescence. Stress is one of the major factors behind the Chi blockages that occur in the channels of the body during adulthood. By consciously reopening the Microcosmic Orbit, we can increase the efficiency of our energy consumption and begin to replenish any losses of Chi.

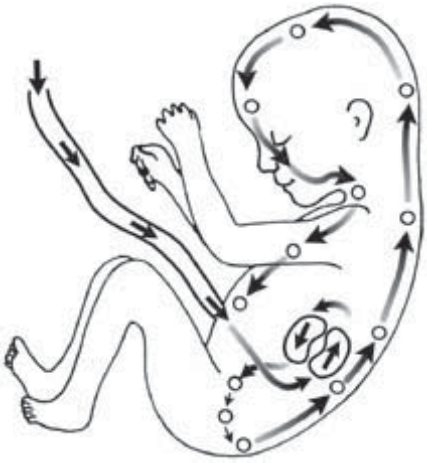

Fig. 2.18. *The Microcosmic Orbit circulates Chi in the fetus while it is still in the mother's womb.*

Because the spiritual qualities, or virtues, are linked with our vital organs, Taoists practice restoring and keeping the physical body in robust health as the foundation for spiritual work. When an organ is not receiving enough Chi, the physical health of the organ may become impaired; at the same time, it will be more difficult for the virtue linked with that organ to manifest.

Chi acts as a link between the physical body, the energy (soul) body, and the spirit body (Fig. 2.19), in the same way that fuel in a boat's engine creates the force that pushes it across water. Chi is the fuel for each of these bodies. Just as a boat can be stranded without gas, so too can the body, soul, and spirit be hindered by low energy.

This does not mean that people who are sick are incapable of spiritual growth. It is more difficult to concentrate on spirituality when the need for healing is great, but the healing process itself can be a spiritual experience if one embraces it wholeheartedly.

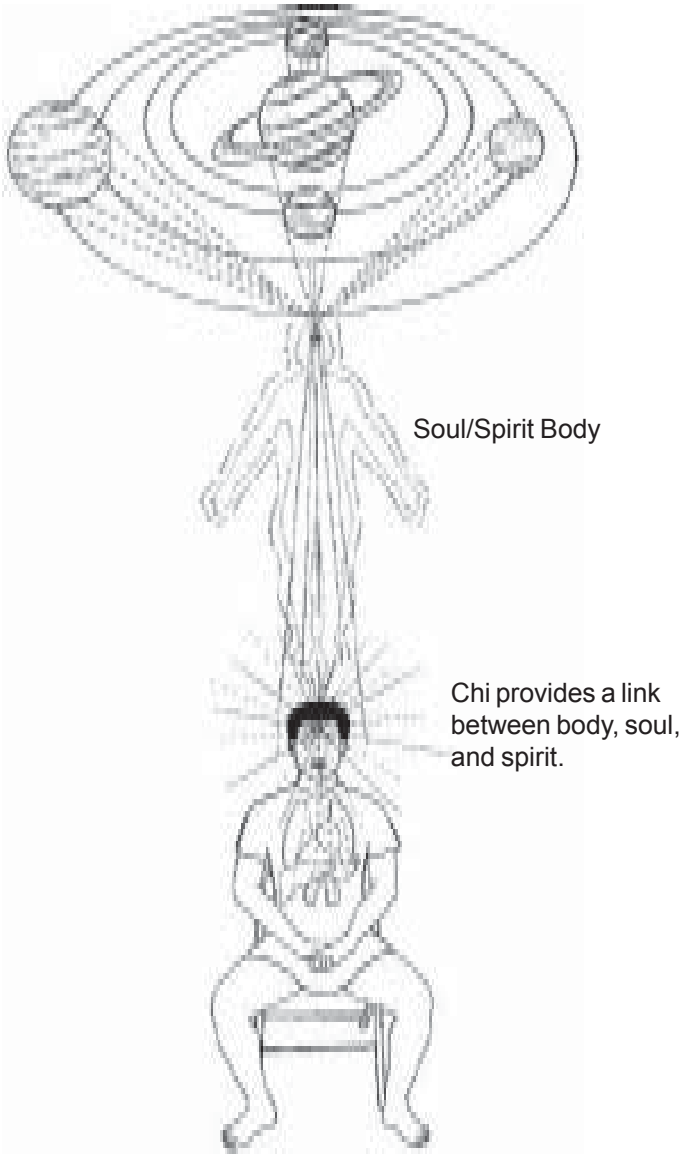

Fig. 2.19. *Physical health is the foundation of spiritual work.*

Inner Alchemy: Working with Emotions and Chi

In the Taoist way of Inner Alchemy, emotional work goes hand in hand with energy work. Many of the blockages that occur along the channels are created by, or linked with, negative emotions (Fig. 2.20). Through the Inner Smile and the Six Healing Sounds, we learn to listen to our bodies and to get in better touch with our emotions, positive and negative. Developing virtuous energies helps clear blockages, promote healing, and gather more energy.

In addition, as we practice the Microcosmic Orbit meditation, we may discover physical tensions at various important energy points. Physical tensions are often the results of negative emotions that we are holding onto. When we can move our Chi through these points, we learn to release those tensions; this helps us process their associated negative emotions, bringing that trapped energy back into the flow of life.

Once we have cleared away negative emotions and transformed that trapped energy back into usable Chi, we can then enhance the natural qualities of the organs: the virtues, which are the organs' essential energies. In other words, when the virtues are being expressed, the Chi of their associated organs is at its peak. This pure, natural energy becomes the food for the refinement and development of the soul and spirit bodies.

Fig. 2.20. *Tension and negative emotions can create blockages along the channels.*

If we neglect to nurture our good emotions and just work on bringing more energy into the body, we may energize our negative emotions, making them more powerful and thus more difficult to control and transform. This is why some spiritual leaders become corrupt; they become entranced with power but neglect the daily practice of refining their Chi and nourishing their virtuous energies. Development of the virtues must continue until it becomes an automatic process. Only then can one truly understand what it means to be called a master.

Developing the Power of the Mind

All systems of meditation aim to quiet the mind and nurture the spirit. When the mind is agitated, it overflows with thoughts and feelings, reacts to everything, and often overreacts, causing the life-force to become scattered. Because the mind is so occupied with this flow, it cannot give its full power to any one thought or feeling; lacking incisive power, it becomes scattered and diffuse. It is like the rays of the sun: when the sun's rays are diffused, they have some warmth. But if they are focused through a magnifying glass or lens, they have enough heat to burn paper. In the same way, when we quiet the mind through meditation, it becomes focused and strong. This is what we mean by "mind power."

To quiet the mind, the mind must first become focused on something. We call that something "the object of meditation." Other systems use many different things as the object of meditation: mantras, kaons, the breath, visualizations, analytical subjects to ponder, and so forth. In the Universal Tao, the object of meditation is Chi.

Chi is our life-force. This makes it unique as an object of meditation. When you use your mind power (thought), eye power (senses), and heart power (organs) to focus on your life-force itself, you not only gain control of your mind, you learn to control your life as well. All these powers combine to become the highest state of consciousness, which Taoists call Yi (Fig. 2.21).

Taoist meditations help still the mind and body so we can absorb, recycle, refine, and conserve higher energies. Most of the common meditation techniques have similar goals but are less direct in their approaches. The differences are especially obvious between *passive* meditations, which are commonly taught to

Westerners for relaxation purposes, and the *active* methods practiced in Taoism.

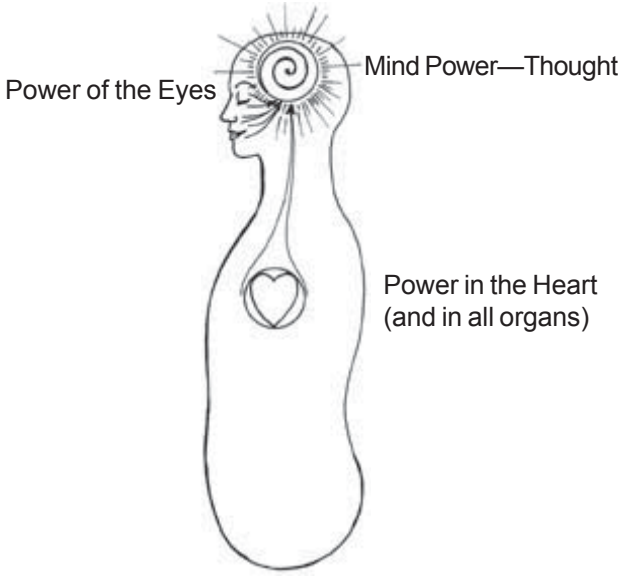

Fig. 2.21. *All these powers combine to become the highest state of awareness, which Taoists call Yi.*

Passive meditations usually consist of "silent sitting," which involves facing a blank wall and observing thoughts to silence the mind. This often includes mantras or chanting to lull the mind into deeper states of consciousness where thought processes are minimal. Active meditations focus the mind to open channels for the circulation of energy, which nourishes body, mind, and spirit.

The energy transformations of the Universal Tao are active processes in that we consciously transform negative emotions into positive virtues, and sexual energy into life-force and spiritual energy. Passive techniques may attain some of these benefits inadvertently, but the Taoist methods help us consciously achieve our goals by working actively and directly with our internal energies. Taoists use the passive state after practice to just sit quietly with the effects of the practice, letting things happen as they need to. This is called *Wu Chi*, sitting still and doing nothing. Yang is active, and Yin is passive. The main practice of the Taoist is training the mind, eyes, and heart to tap the Universal, Cosmic, and Earth Forces to help increase our Original Force (Fig. 2-22).

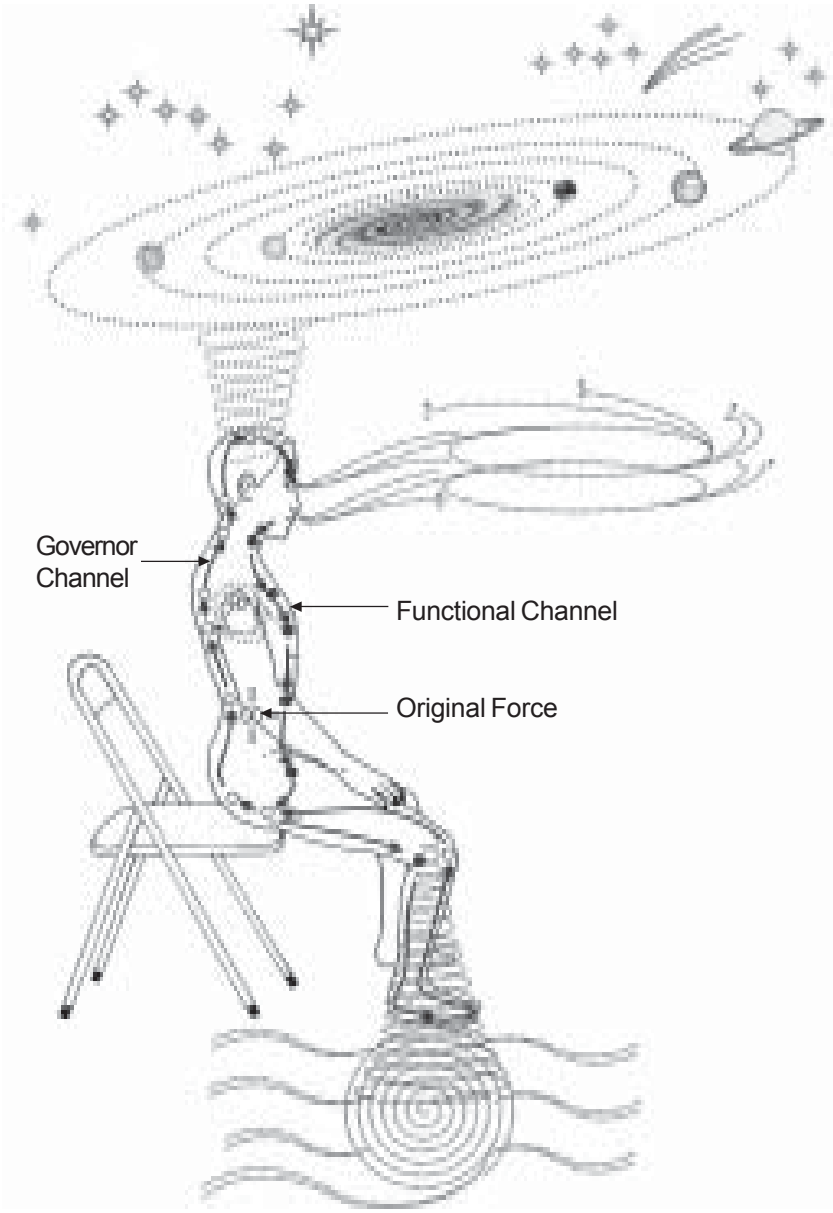

Fig. 2.22. *Training the mind, eyes and heart to tap the Universal and Cosmic Force increases our Original Force.*

Taoist Meditations: A Practical Approach

The true goal of all meditations is pure awareness or enlightenment, which produces a higher vibration, light, or frequency in our life-force. The Universal Tao approach accumulates, circulates, and refines life-force energy to enhance all bodily functions, including the production of spiritual energies that derive from our organs and glands. Instead of silencing the mind, this system uses it to increase the flow of Chi throughout the body, enhancing our health and our spiritual growth. The *Healing Light* meditation serves this purpose as the foundation of all Universal Tao practices.

The secrets of Chi circulation have been passed down for thousands of year through several Taoist lineages. Those in China who were fortunate enough to receive this essential knowledge experienced great improvements in the quality of their lives. The Universal Tao teaches these secrets to help us become responsible for our lives. We can become our own master by focusing on spiritual growth, rather than awaiting death and judgment for what we have neglected in life. As we learn to control our life-force, we gradually develop the means to control our own destinies.

Chapter 3
Virtues

Opening the Mind and the Heart

There are two major approaches to spiritual disciplines. One may embrace concepts related to faith, good deeds, prayer, right action, confession of sins, and so forth. This approach gradually changes a person's negativity into virtuous energy, which is close to the Original Force, or Wu Chi. Taoism offers another approach, involving the creation of a vehicle in the form of the *energy body* and eventually the *spirit body*. These subtle bodies act as space shuttles, allowing consciousness to travel back to its source (Fig. 3.1). Some systems describe the heavenly realms but offer only faith as a means of returning to them. Faith is helpful, but other preparations during life can provide a more direct means of accessing a desired heavenly place before physical death occurs.

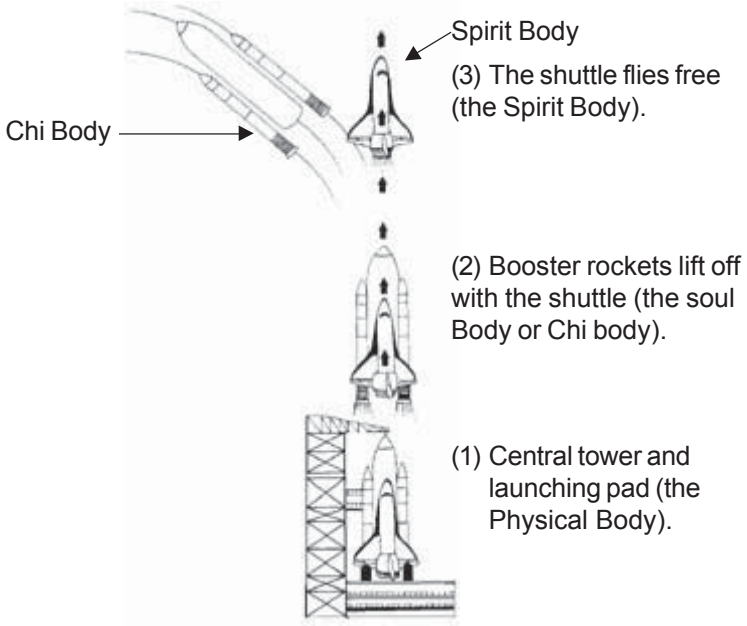

Fig. 3.1 *The booster rocket separates from the shuttle (The soul body completes the lifting of the spirit body).*

Taoism recognizes both the development of virtuous energies and the cultivation of life-force to create the soul and spirit bodies as important aspects of spiritual growth. Both approaches are related, because retaining and recycling internal energy into life-force can help open and pacify our minds and hearts, bringing forth love, joy, happiness, respect, and honor. These virtues then bring forth other virtuous energies, such as kindness, gentleness, courage, openness, and fairness.

The heart is like a cauldron (Fig. 3.2) that can be used to combine all the virtues into the energy of compassion, the ultimate virtue and a necessary attribute for our spiritual being. At the same time, our spiritual essence and life essence can be combined into one force, giving birth to the energy body (the vehicle) and the spirit body (the captain). We can train these subtle bodies to connect our consciousness to our source before we must depart from this world.

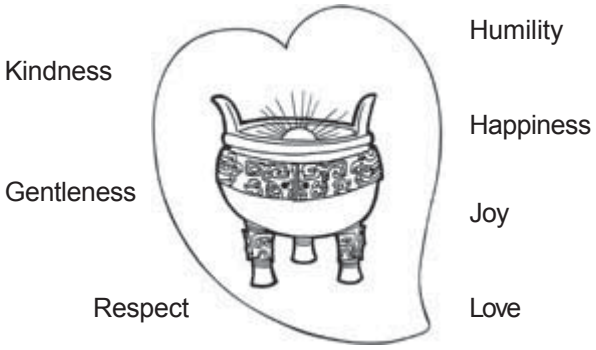

Fig. 3.2 *The energy of our virtues combine in the heart and are refined into compassion, the ultimate spiritual energy.*

Virtues:
Heart of the Universal Tao Practices

The quality of our internal energy is just as important to our health and spiritual development as the quantity. As we increase our internal energy flow and accumulate a surplus of Chi, we must also emphasize spiritual development to maintain balance in our daily lives. In essence, our spiritual qualities are our positive attributes, or what the Taoists call *virtues*.

We need food to sustain our lives. Physically we need material food, but we must also nourish other, subtler bodies within us, known as the soul and spirit bodies. The energies of our virtues, the universe, the stars, and the planets provide a source of spiritual food. Although we are trained to depend on our religious beliefs (Fig. 3.3) to provide this nourishment, spiritual food is actually all around us. We just need to be taught how to absorb and digest it. Taoism offers the means by which we can access these energies to cultivate the soul and spirit and enhance our total being.

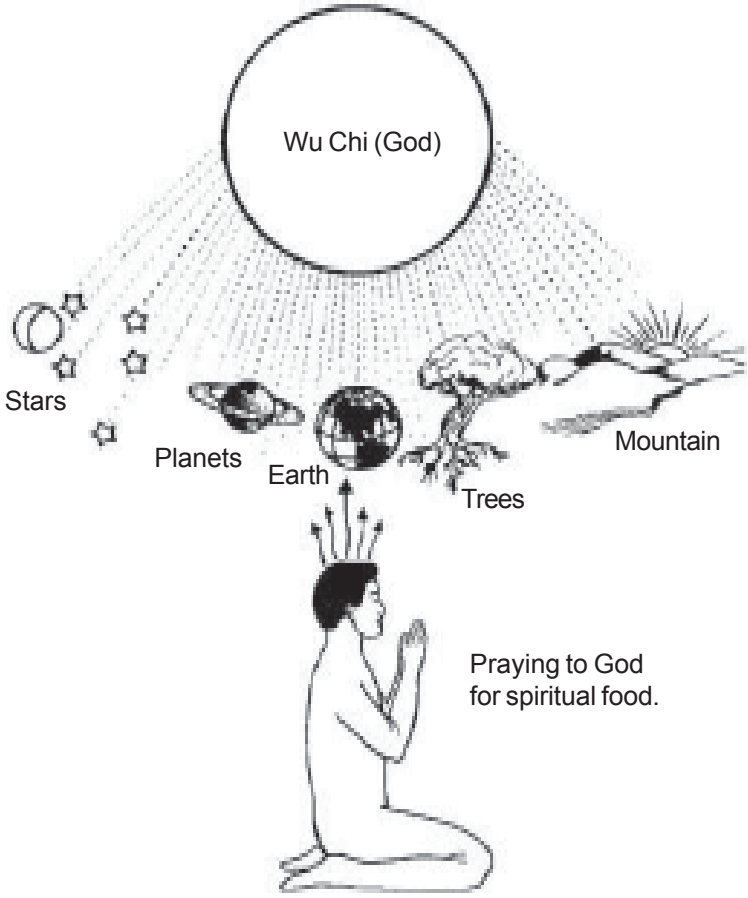

Fig. 3.3 *Spiritual leaders train us to absorb these forces in the form of God.*

Understanding our Virtues

Taoists believe that we are all born with the virtues of love, gentleness, kindness, respect, honesty, fairness, justice, and righteousness. These are actually higher aspects of our emotions, which are derived from the positive energies of our organs. When we are abundant with virtues, our life-force flows smoothly and efficiently. If we neglect to cultivate the virtues, however, we run the risk of channeling our accumulated energies directly into our negative emotions, exacerbating any negative or neurotic tendencies we may have. (Keep in mind that we usually exude the emotional energies that are most prevalent within us.)

Unfortunately, as we mature and encounter more stress in our daily lives, negative emotions such as fear, anger, cruelty, impatience, worry, sadness, and grief often predominate. These have deleterious effects on the internal organs and glands and can drain our life-force, causing our bodies to function on less energy and at a lower vibratory rate. Medical science acknowledges that the presence of negative emotions can wear down the body's resistance to disease before any clinical evidence of disease exists.

Transforming negative emotions into virtuous energies is a much better option, because it enhances our life-force (Fig. 3.4). The Universal Tao system emphasizes this through recycling, transforming, and refining internal and external Chi to accentuate our positive traits (rather than our negative ones). When we learn to detoxify the organs through Taoist practices, we can reestablish our virtues and become self-regulating individuals, able to make decisions and control our destinies. Transforming internal energy also promotes a higher vibratory rate and enhances our spiritual growth.

Compassion: Combining the Virtues

Compassion is the highest expression of human emotion, and virtuous energy. It is a level of development that takes hard work and serious meditation before it can blossom in one's life. It is not a single virtue, but the distillation and culmination of all virtues, expressed at any given moment as a blend of fairness, kindness, gentleness, honesty and respect, courage and love (Fig. 3.5). The power to express any or all of these virtues at the appropriate

moment indicates that a person has internally unified himself or herself into a state of compassion.

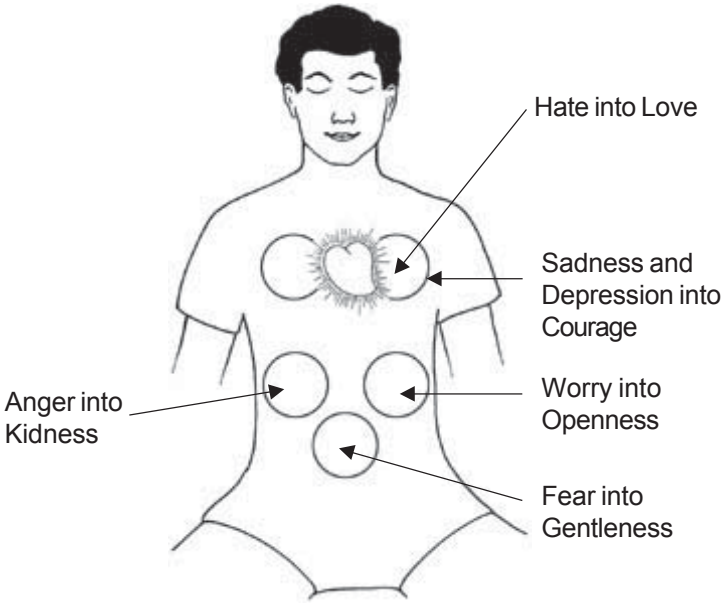

Fig. 3.4 *Transform negative energy into positive energy through the Inner Smile practice.*

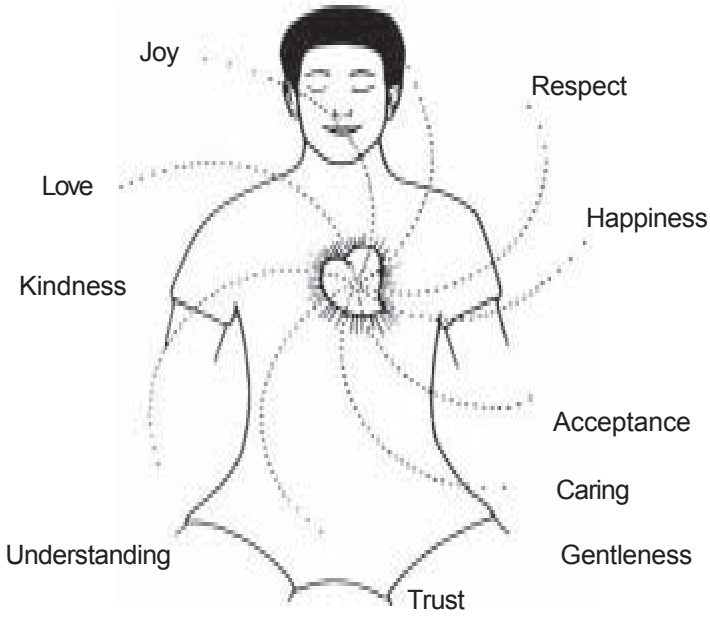

Fig. 3.5 *Compassion derives from the combined energies of our virtues.*

Compassion is often misunderstood to be based on sympathy, which is actually a weakness individuals show when they are easily affected by the emotions of others. In fact, the combined strengths of the virtues produce an energy more closely related to empathy, which is a superior state that can acknowledge the emotional outpourings of others without being thrown off balance by them. The difference between empathy and compassion, however, is that compassion is not an emotion or a feeling, but a higher state of consciousness that naturally radiates the best human qualities.

Taoists regard compassion as the finest form of Chi; it is very easy to refine and transform into life-force.

Developing a Foundation for Higher Emotional States

In the early stages of the Universal Tao system, students begin absorbing and transforming energy for the development of the physical, energy, and soul bodies. Cultivating the virtues and compassion is the other half of the practice, which refines the relationship among these bodies. The more virtuous energy you develop, the more easily you will be able to clear your channels of any blockages to your energy flow as you transform and refine your energy by circulating it in the Microcosmic Orbit.

You can't grow a healthy garden in a place full of weeds. Many of us strive to live virtuous lives and conscientiously try to be loving in our dealings with others. But if we open our hearts prematurely, before we have weeded our "internal gardens" by first cleansing our energy channels, we can end up polluting even the most loving intentions with emotional debris. To have a healthy garden, you must first clear away the weeds.

Furthermore, we must build up an abundance of loving energy before we can truly share it. Otherwise, how can we give good energy to others if we haven't got enough for ourselves?

Born to Be Equal

We are all created equal; kings and commoners alike share the same human experiences of being born and growing through childhood and adolescence to maturity (Fig. 3.6). Yet if we don't know how to access higher forms of energetic nourishment, we

have to depend on others who do know how. Many religions and spiritual teachers have the highest ethics and are willing to share their wisdom openly, while others keep their knowledge secret in order to hold on to their wealth, power, and position.

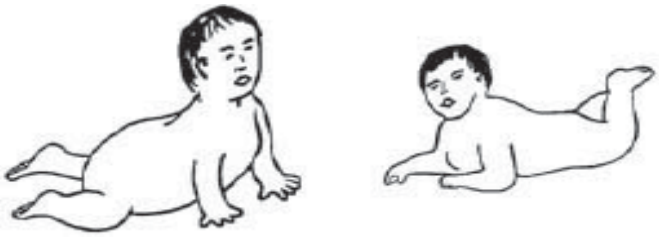

Fig. 3.6 *In the beginning we are all born equal.*

Taoists observe that one's energy is unprotected when one has not learned to open and clear the Microcosmic Orbit and develop the virtues. Such an individual is highly vulnerable to unethical people who may try to drain his or her life-force to build their own immortality.

In many religions and spiritual organizations, people are taught to surrender themselves, drop their egotism, practice self-sacrifice, and love others before they have accumulated enough energy and virtue to love themselves, much less the people close to them (Fig. 3.7). Sometimes they are influenced to surrender themselves and their energy in subtle ways they don't consciously recognize. This is a form of energy vampirism. They gradually became weaker and poorer, eventually losing their life-force to others who are in turn becoming stronger, wealthier, and more powerful (Fig. 3.8).

Our spiritual ignorance is reflected in the habits of our society. Not knowing how to nurture true spiritual growth, millions of people are slipping further away from their spiritual essence as they search for fulfillment through material gain.

Fig. 3.7 *When we don't know to cultivate love and Chi within, the more energy we give out, the smaller we become.*

Fig. 3.8 *Some systems or religions demand that we give up more Chi.*

Understanding the Energy of Love

When studying the virtues, we must examine love as a category unto itself to better understand its energetic influences. The Taoists view love as an internal energy of the heart rather than a product of the mind. Although we generally think of love as a positive force, what we commonly call love can actually evoke more negativity in our lives than all the other negative energies combined. For example, we know that extreme love can often quickly turn to hatred of the most bitter and violent kind (Fig. 3.9).

The misunderstanding of love can also create a vehicle that allows our negative emotions to drain our life-force away in the form of self-sacrifice. True compassion, which controls sexual desire, comes from a combination of compassion energy in the heart and sexual energy (Fig. 3.10). While our personal supply of energy is limited, the loving energy of the universe is inexhaustible. When we know how to connect to this wellspring, we will always have enough love for ourselves and for others. Yet if we are not taught how to tap into the higher forces to enhance and replenish our supply, we often end up giving away more than we can afford. Eventually this can cause us to drain out our sexual energy and burn out the love in our hearts (Fig. 3.11).

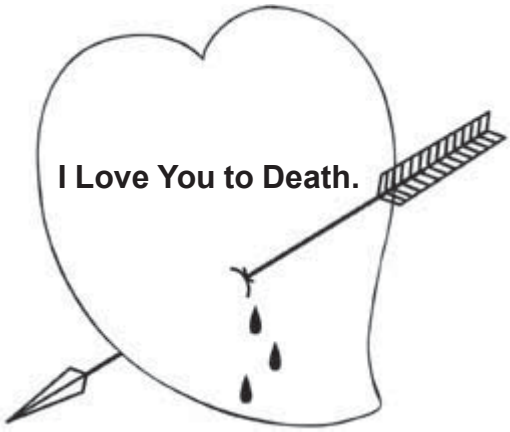

Fig. 3.9 *Love alone can change to extreme hate.*

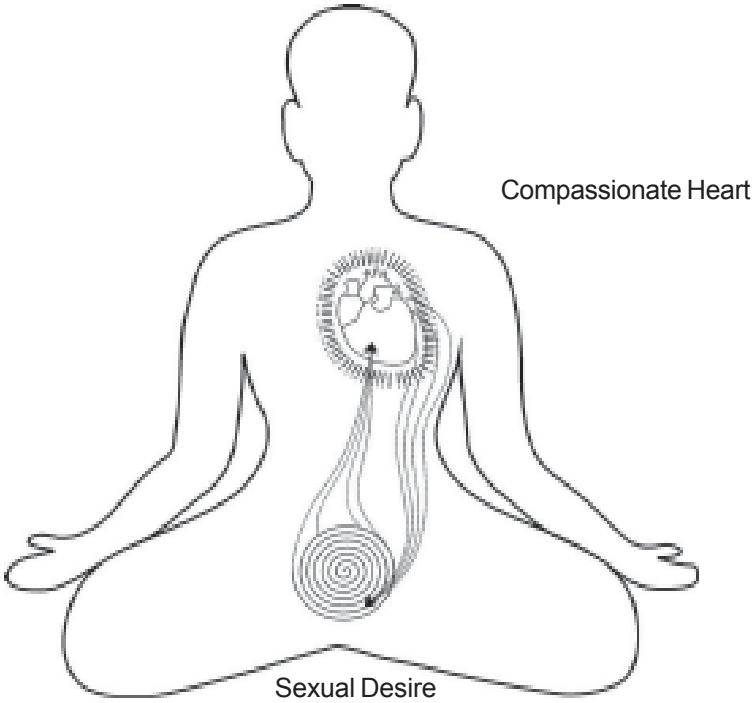

Fig. 3.10 *True compassion, which controls sexual desire, comes from a combination of compassion energy (in the heart) and sexual energy.*

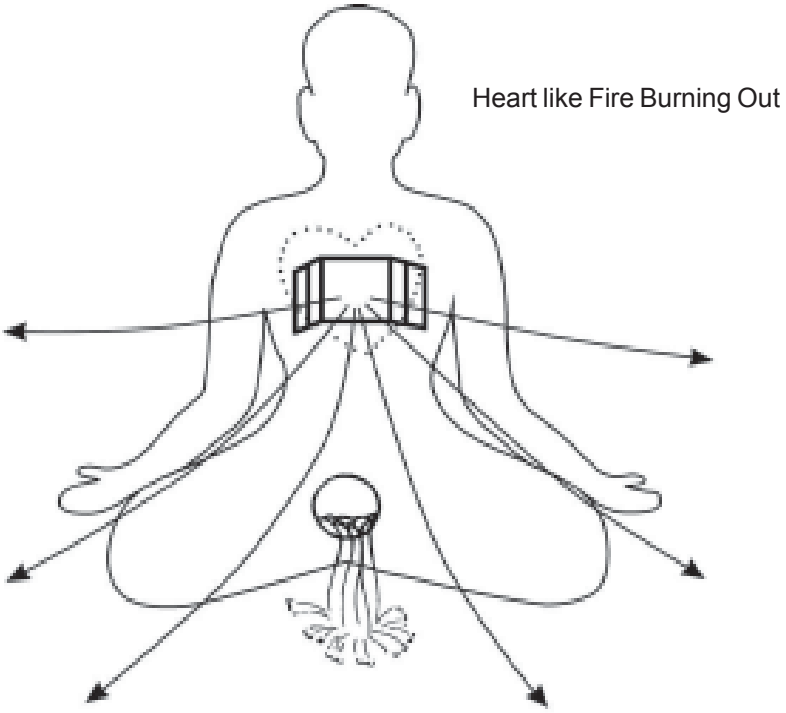

Fig. 3.11. *Some systems only promote giving love in the form of self-sacrifice, giving more than we have to give. Eventually this can cause us to burn out. Many worldly endeavors also drain our sexual energy, causing it to dry up.*

We assume love exists at all levels of life, but because it is promoted so much, we often become desensitized to what it is and what it really feels like. We expect love in a personal way from those who are close to us, and in a spiritual way from those who become our role models. Yet our needs are almost never fulfilled by the words and actions of others. Even in dreams we seek love, which indicates our inner needs for acceptance and companionship from others. The question of what love is has puzzled men and women for centuries. The answer can only be found within ourselves.

The Inner Source of Love

A major problem in our modern world is that we always look outside ourselves to fulfill our needs without realizing that others seek fulfillment in the same way. It in our nature to assume, for one reason or another, that everyone else has what we need, just as others make the same assumption about us. Out of habit, we all seek love externally without nurturing our own source of that energy from within (Fig. 3.12). This leaves us with very little to share.

Logically, if others are also seeking love, they expect us to have enough loving energy to fulfill them in some way. If we do not cultivate love within ourselves, however, we can only drain their energies until the relationship comes to an end. Success in any relationship depends on the ability of two parties to share in an abundance of love that derives from both sources. The key word here is abundance. Once we are full of love within, we can connect to the unlimited love in the universe and share it abundantly with others.

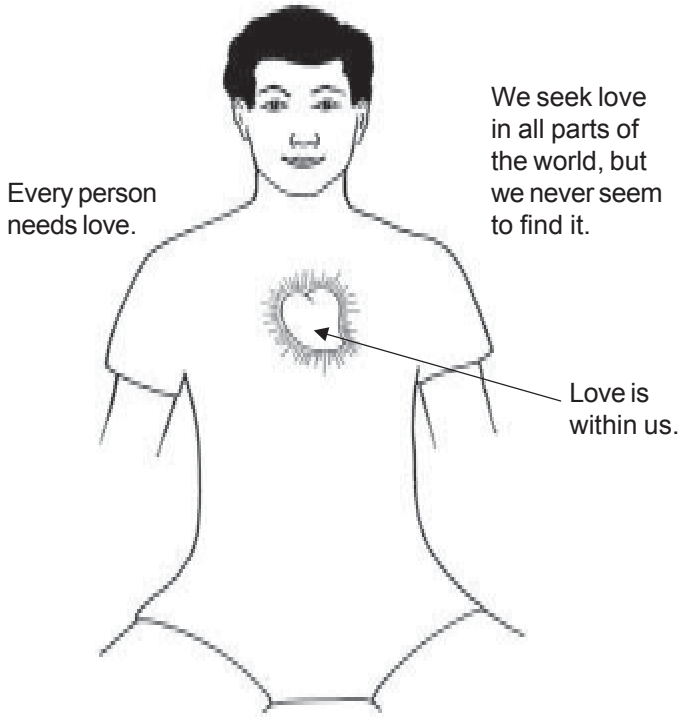

Fig. 3.12 *Love is within our heart.*

Some people believe love has value only if it comes from others, but they fail to realize love can turn against them if they do not have enough of that energy to reciprocate. The point is, without judging the ability of others to love, we must turn our attention inward to nurture and develop our own sources of loving energy and establish a state of abundance within ourselves. This could reduce some of the problems causing the high divorce rate in our society.

Learning Self-Love

Taoists say we can't really love others until we can love ourselves. This a crucial step in learning to love others (Fig. 3.13), because we can extend the energy of love only when it overflows beyond the needs of our bodies.

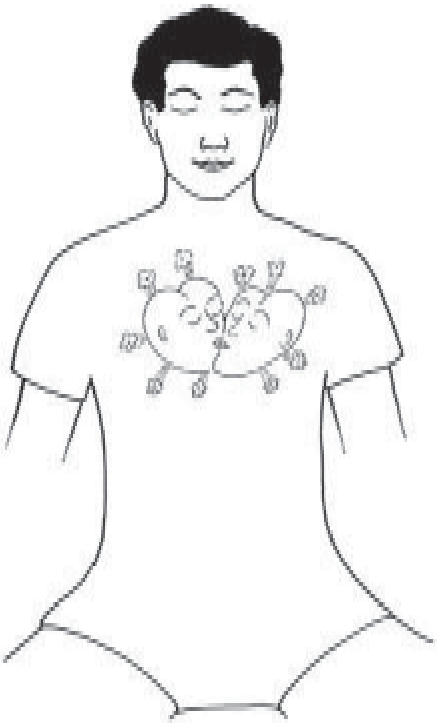

Fig. 3.13 *Learning to love ourselves is the first crucial step in learning to love others.*

The stress of trying to give away too freely what you don't have enough of can create blockages in the Microcosmic Orbit and can also block the unconditional love from Heaven and from Mother Earth (Fig. 3.14).Taoists also say love is truly an energy that resides in the heart. It can be activated by external stimuli, but we can also awaken it from within. Because loving energy is accessible from within, we can resolve our primary need for love by using this energy first to replenish the internal organs and glands. Practices such as the Inner Smile help us achieve this.

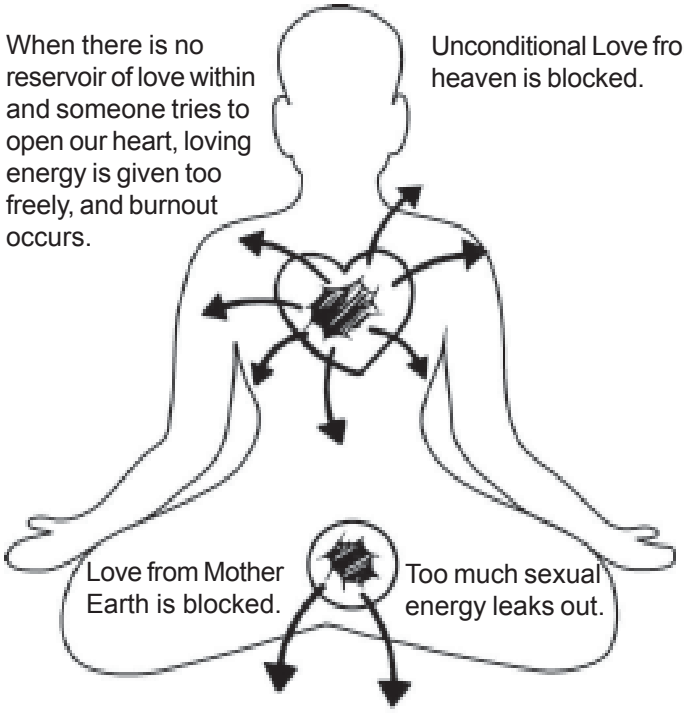

Fig. 3.14 *Blockages are created when we let love and sex drain out.*

While learning self-love, one should remember that even the loving energy within us derives from the Original Force of the Wu Chi. This means the heart's energy provides a connection to our divine source, Universal Love. Many people have problems comprehending their relationship with this source and thereby feel abandoned. This is often because they are so out of touch with their inner selves that they have forgotten how to reach the love within and have consequently lost their sense of this connection.

Although divine love is unlimited, its manifestation within us occurs in the much smaller vessel of our bodies, and the connection between these inner and outer sources requires constant attention and alignment. We must cultivate love within ourselves first to have the power to draw in unconditional love from Heaven and gentleness and kindness from Mother Earth (Fig. 3.15).

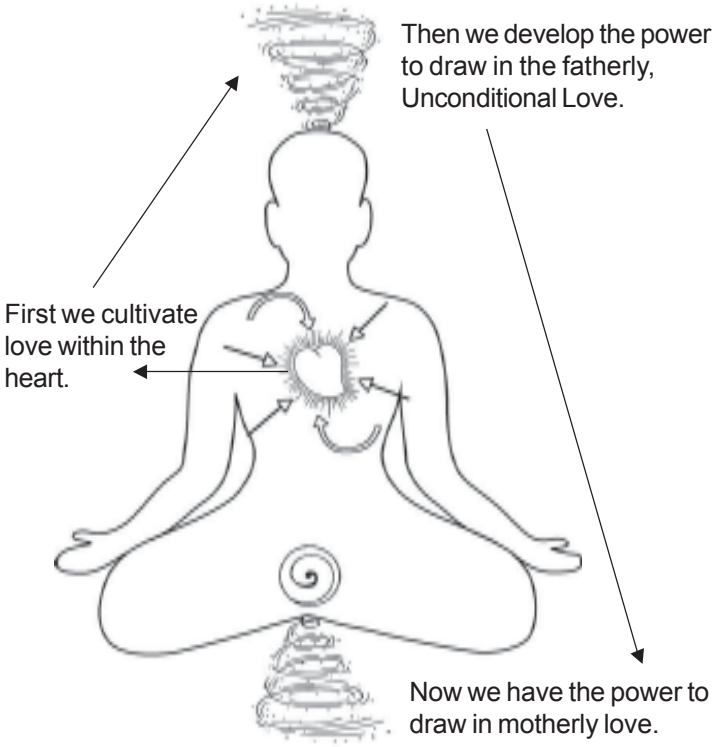

Fig. 3.15 *With compassion, one can love unconditionally.*

In Taoism, each internal organ is believed to have its own individual soul, spirit, and courageous energy. By practicing love and respect to cultivate these aspects of the organs, the whole body improves, and one learns to love the body as a whole. Gradually, changes become noticeable in the character and attitudes displayed in one's daily life, which indicate that the loving effect is expanding to all parts of body, mind, and spirit. After learning self-love—which is not to be confused with egotism or narcissism—and connecting with Universal Love, one becomes abundant with loving energy to share with others. Practice is the key.

Unconditional Love Reflects Compassion

Nature and the universe seem cruel. Only the strong can survive, and only humans have sympathy for weakness, because we ourselves are weak. It is through human weakness that we try to place conditions on love, which, in truth, has no conditions. Taoists revere compassion as the highest form of virtue because its basis is empathy, not sympathy, and it elevates the consciousness beyond human weakness. With compassion, one can love unconditionally and thereby accept the world on its own terms without suffering.

System Based on Virtues:
Highest Chi

The system I learned from my master is based on the positive energies of love, kindness, gentleness, respect, and honesty; this is the highest Chi Kung practice. With these energies an adept can counteract all kinds of evil (Fig. 3.16). It is said that even fire cannot hurt one who has perfected their use. My master's teacher, the grand master, had studied under Taoist masters in the temples for 40 years. When this grand master understood enough, he retired to a cave to practice in solitude. He could not duplicate the environment of the temple in a cave, however. There were no statues, and no one else was around to appreciate such things as rituals or ceremonies.

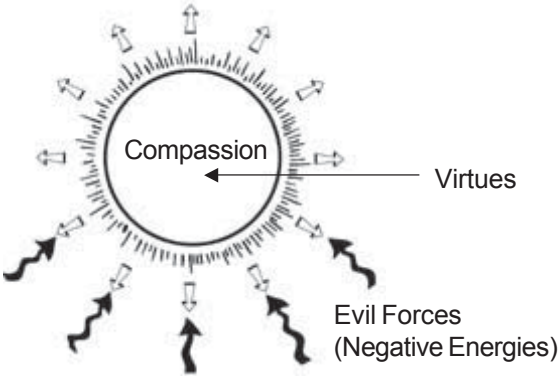

Fig. 3.16 *Virtue can counteract all negative forces.*

After about 10 years of studying in the Taoist temples, my master decided to apprentice himself to the grand master in the cave. But like many adepts of his time, this highly advanced teacher lived a secluded life in a very inaccessible place. It was difficult even to carry enough food for the journey. Eventually my teacher made his way to this master's cave, but after a short period of introduction, the grand master left his body during meditation and did not return to it for weeks. My master ran of food and had to leave.

The next time, he was smarter. When he went to the cave, he took more food and a brush. He dusted off the grand master's body, which was in a state of suspended animation, and protected it from predatory animals. The grand master would occasionally come back, open his eyes, and see that he was being taken care of before he would leave his body again.

Finally, when the grand master came back and realized he would soon be leaving his body for good, he began to teach the system to my master, who stayed with him for about three years. My master practiced the system and thought about many others he had learned during his travels. He realized that there are many paths to choose from in this world, and some work better for some people than others.

Today, it is not necessary to study in temples or search for masters in the wilderness. There is no need to depend on statues, temples, ceremonies, and rituals to aid in your spiritual growth. With the Healing Tao system, you learn to depend completely on your senses, glands, and organs—the inner universe, by which you can make the connection in the outer universe (Fig. 3.17). You can also maintain your family, career, and lifestyle while learning the same practices that the masters had to struggle for.

Transforming Negative Emotional Energies

Our society is known for its fast pace, its stressful conditions, and its inability to handle the tons of garbage it produces daily. This includes not only trash from our homes, but also the emotional garbage produced within our bodies. Both are expensive to remove from the environment. One requires sanitation services; the other is sometimes relieved by medical or psychological methods.

According to an article in Newsweek magazine (November 1989), a family of three throws out approximately 7 bags, or 87.5

gallons, of garbage per week. Average disposal per month amounts to about 29 bags, or 379 gallons; and every year the same family of three disposes of approximately 350 bags, or 4,550 gallons of garbage. The accumulation of stress and negative emotions is likewise enormous.

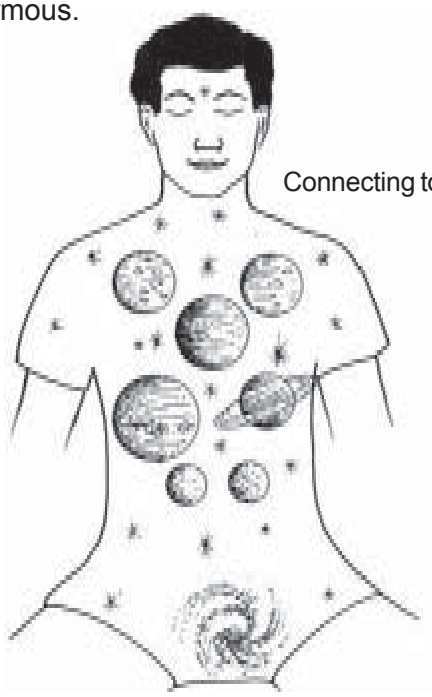

Fig. 3.17 *Students of the Universal Tao system do not depend on temples, churches, stories, ceremonies, or rituals, but on inner and outer Universal Force.*

Problem of Dumping Emotional Garbage

No community likes to have trash dumped near it, and garbage disposal becomes more expensive as trash must be hauled farther away. People often try to solve this problem by illegally dumping their garbage across state lines near someone else's home, but this is a short-term solution, as lawsuits are brought and fines must be paid. Efforts to build new landfills or expand old ones are hampered by the communities that want them built elsewhere. Unable to stop creating garbage in our homes or inside our bodies, we continue to dump it in some other state (Fig. 3.18) or on someone else's shoulders (Fig. 3.19).

Fig. 3.18 *We have no problems dumping garbage in other states.*

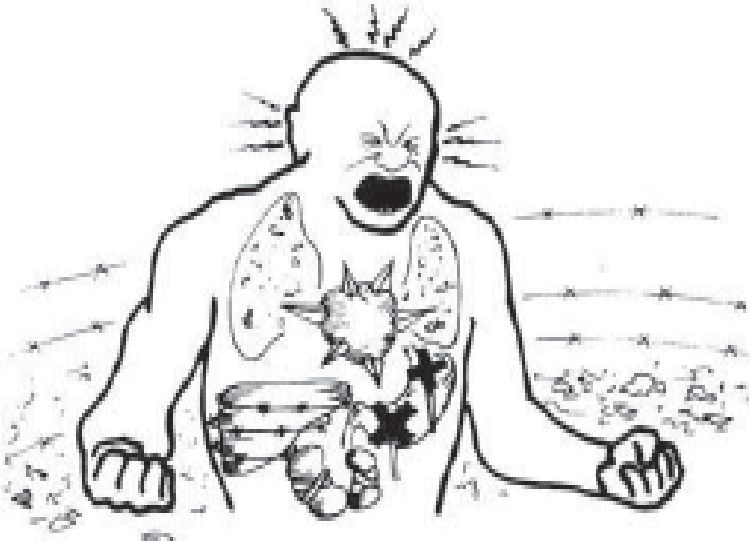

Fig. 3.19 *We don't want our own garbage, but we have no problem dumping it on someone else.*

Americans collect over 160 million tons of garbage each year, and the cost for its removal is enormous. With the figures mentioned for external waste, one can only imagine the cost to our health of trying to relieve the emotional stresses that accumulate during the same period. Just as new landfills are hard to find where we can dump our garbage, new storage space for our negative emotional energies is also scarce when our bodily systems become clogged with internal trash. The only alternative to disposing of garbage from internal or external sources is to recycle it.

Recycling Negative Emotional Energies

Recycling is the most Important practice in energetic and ecological conservation. Consider that the expense of turning bauxite into new aluminum is 10 times that of reprocessing used cans, yet every three months we throw out enough aluminum to rebuild the nation's entire airline fleet (Fig. 3.20). Glass, paper, and certain plastics can all be recycled. Kitchen wastes, dead leaves, and grass clippings from the lawn can all be turned into compost, but people prefer to spend money on expensive fertilizers, allowing useful by products to become garbage.

Because our society is uneducated about how to take care of these problems, the suffering they cause is exacerbated year by year. We can, however, learn from Taoism about personal conservation: just as garbage can be turned into compost, we can recycle negative emotional energies such as hatred into positive ones like love (Fig. 3.21 and Fig. 3.22).

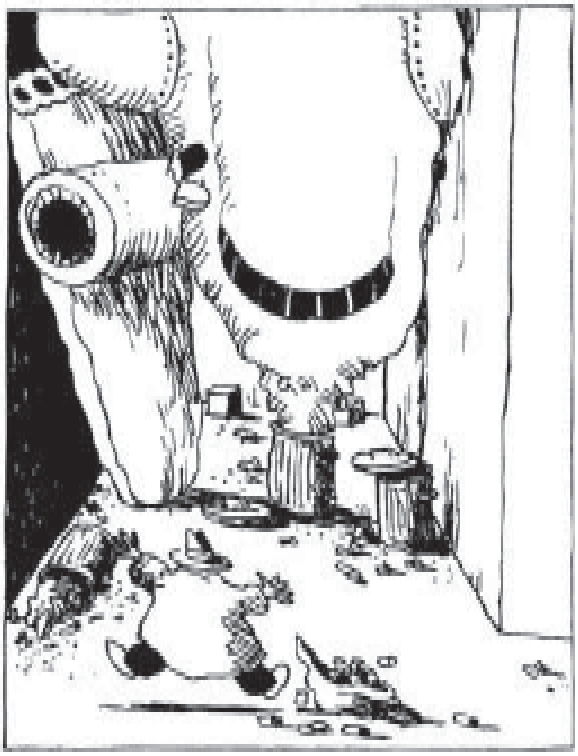

Fig. 3.20 *There is enough wasted aluminum in our garbage to rebuild every airline fleet in the nation.*

Fig. 3.21 *Recycle garbage into compost.*

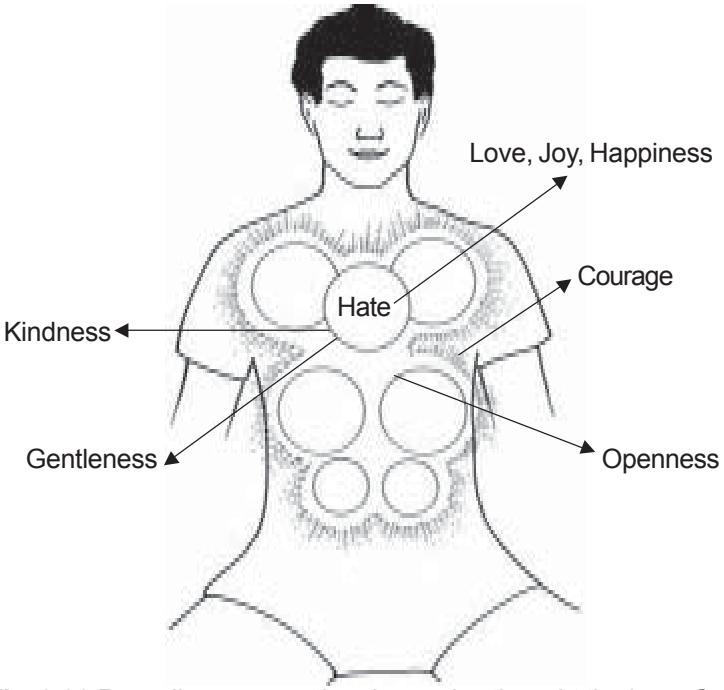

Fig. 3.22 *Recycling our emotional energies thought the Inner Smile and Six Healing Sounds.*

Dumping negative emotions on our fellow human beings has become as common is taking out the garbage. In fact, when we harbor hate, anger, and fear inside, we tend to be obsessed with our own problems and less concerned for others; as a result, we also produce more external garbage (Fig. 3.23). None of us wants other people to dump on him or her but most of us can't prevent our own negative wastes from pouring out when circumstances force our bodies and minds to overload. Although we have psychological methods to help release built-up emotional stress, these solutions are costly, slow, and not always applicable to new problems. Preventive measures, such as Taoist meditative practices, offer a much longer-lasting approach to personal health and energetic conservation. The focus of these disciplines is to recycle emotional garbage into energy that enhances our Me- Force, rather than to release it from the body.

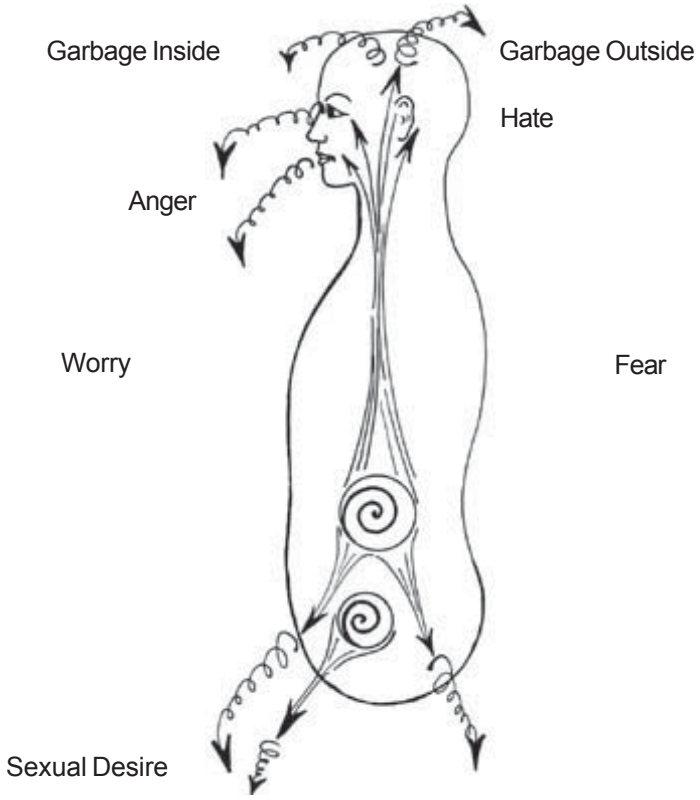

Fig. 3.23 *The more garbage we have inside, the more garbage we produce outside.*

This principle is related to our sexual energy as well. In our society, we have been taught that sexuality is sinful or dirty like garbage, and should therefore be suppressed. It is true that sexual desire is a major producer of negative emotions, but instead of repressing it, we can recycle and transform that same sexual energy into pure life-force energy. The holy sages of many traditions know how to do this and have attained spiritual mastery as a result.

Fig. 3.24 *Many useful energies are suppressed because most of us have not learned how to recycle them properly.*

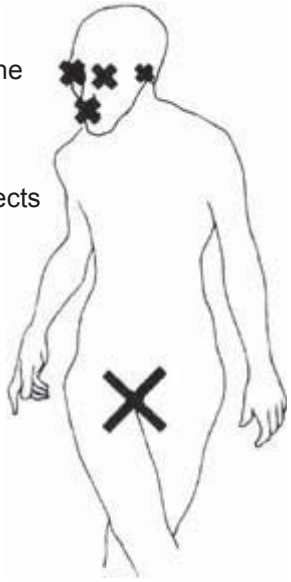

Fig. 3.25 *When suppressed or regarded as sinful or dirty sexual energy becomes like garbage. We have nowhere to dump it, and no knowledge of how to recycle it.*

Although religion and society often try to suppress our sexual energy, the problem is that they offer no positive alternatives. They have not taught us how to recycle and transform this powerful force. When sexual energy is suppressed, it may end up expressing itself in other sense desires (Fig. 3-24). Sexual desire may affect the ear as a desire to hear dirty jokes or perverse sexual conversations. It may go out to the eye as a need to see pornographic movies. It can affect the mouth and manifest in foul language or sexual harassment (Fig. 3-25). Suppressed sexual desire can also create other negative emotions such as hate, anger, cruelty, and violence (Fig. 3-26). All these things pollute our society.

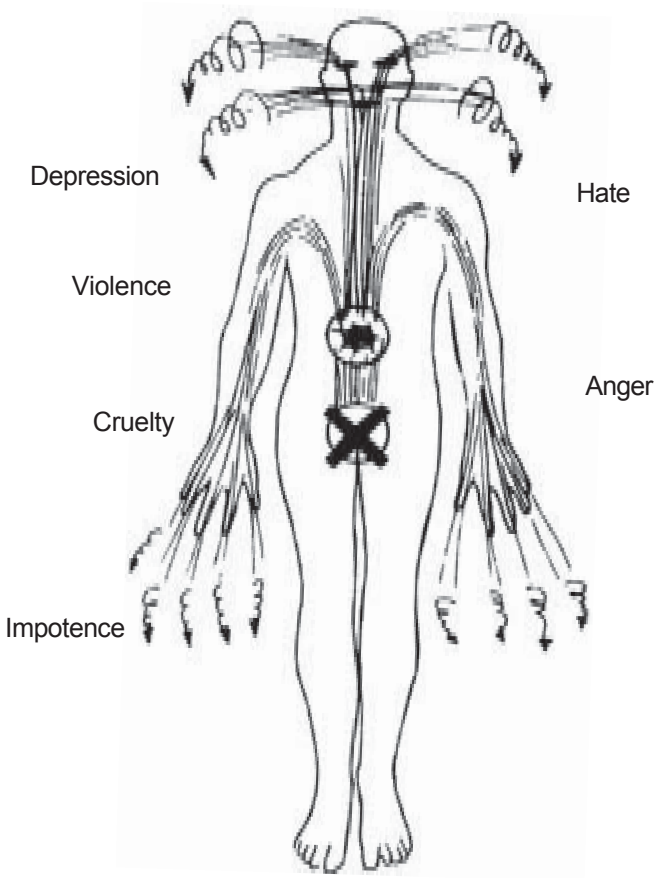

Fig. 3.26 *Sexual desires also create a foundation for other problems and more emotional garbage.*

Enhancing Our Life-Force with Recycled Energy

Taoist theory regards all positive and negative internal energies as parts of our life-force. When we become angry, it means that some of our life-force has been stored with a negative charge, empowering the reaction of anger (Fig. 3.27). To prevent future responses of anger, we can locate the source of that energy and transform it, so that whenever we are confronted by upsets in our lives, we can apply more effective emotional responses, such as patience. If someone or something triggers in us a response of anger, frustration, sadness, or depression, it is simply because we have not prepared ourselves by transforming our negative energies into positive life-force. Tremendous amounts of life-force can become negative emotional energies if we allow this to happen, just like a disease spreading throughout the body.

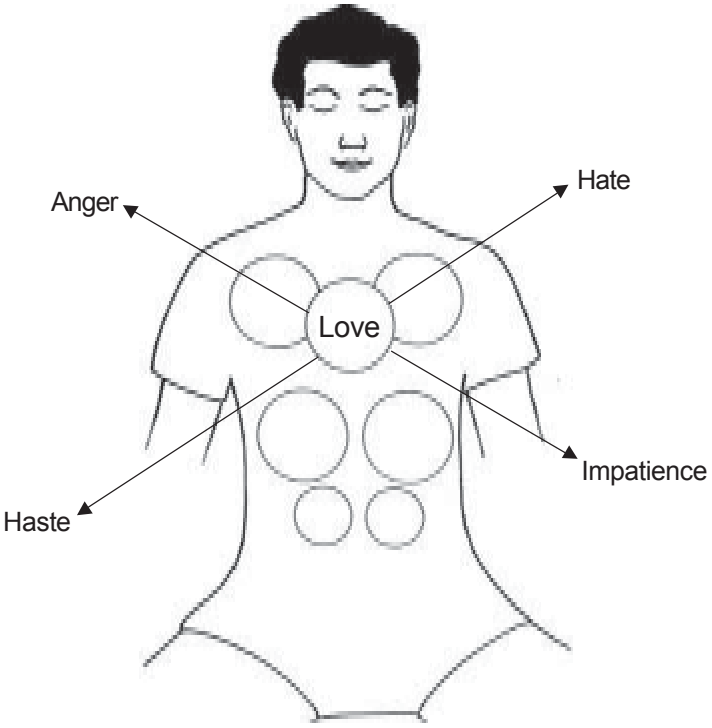

Fig. 3.27 *Negative energies and emotions are not necessarily sinful, but they indicate that our life-force has been changed.*

Taoist Ways To Transform Stress Into Vitality

There are a few basic Healing Tao practices that people can easily learn to transform any stressful energies. Many other approaches also work. Some emphasize positive thinking (without actually transforming the negative energy), others simply try to release the negative emotion (as stated earlier). Taoists do not judge these methods; instead, they offer a time-proven approach that begins with energy transformation through the basic exercises of the Inner Smile and the Six Healing Sounds.

Inner Smile

Understanding the Body

One should begin by studying the internal organs and glands. When problems exist within the organs, certain emotions may arise. When someone is sick or weak in the lungs, the emotions of sadness or depression may occur. Overheating or congestion of the liver can cause anger or moodiness. Weakness in the liver can cause a drop in productivity and a lack of control or balance. When the heart overheats, it can cause impatience, hate, and cruelty to arise. Weakness in the heart can result in a lack of warmth and vitality. Weakness in the spleen, stomach, or pancreas can produce worry, anxiety, and a lack of stability. Weakness in the kidneys can cause fear and a lack of willpower and ambition (Fig. 3.28).

Basic Inner Smile

Once you know the general locations of the organs and glands, close your eyes and smile to them, beginning with the pituitary and pineal glands in the head. Smile down to the thyroid, parathyroid, thymus, and heart. Feel love and happiness grow from the heart, center. As you smile to the lungs, feel courage arise. As you smile to the spleen, stomach, and pancreas, feel openness and fairness. As you smile to the liver and gall bladder, feel kindness. As you smile to the kidneys and the bladder, feel gentleness. As you smile to the sexual organs, feel creativity. When you smile to the organs, negative energies will gradually change into positive life-force.

Eventually, you will learn how to use the inner eye to get in touch with every part of your body. You will also learn how to sense good feeling and to enhance energies within the organs by practicing the Inner Smile as you transform any negative energies you feel. In time these sensations will become programmed into your mind, and you will be able to simply recall the feeling of moving energy to help speed up your practice.

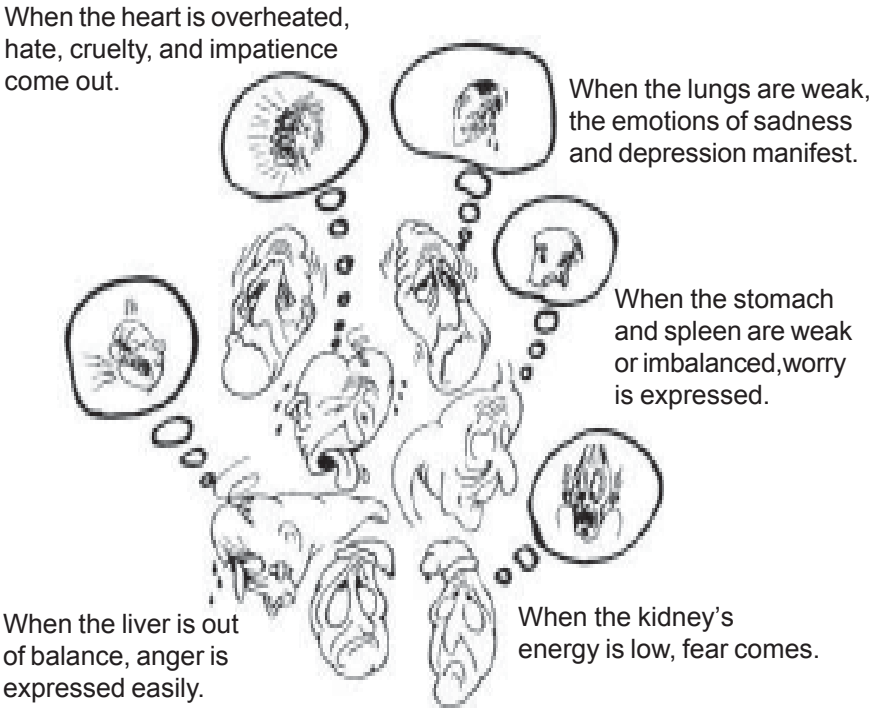

Fig. 3.28 *Weak organs can produce negative emotional state.*

Inner Smile and Practice of Forgiveness

The Taoist way of forgiveness is to practice the Inner Smile. When you sense negative feeling (emotions) arising, practice no judgment of people or events. Simply get in touch with your inner self, and use the Inner Smile meditation to transform your negative feeling into the positive energy of the virtues (Fig. 3.29 and 3.30). This requires daily practice to master, but the effects will eventually influence people around you, who will appreciate your higher vibration.

Fig. 3.29 *The Inner Smile is the Taoist way to practice forgiveness.*

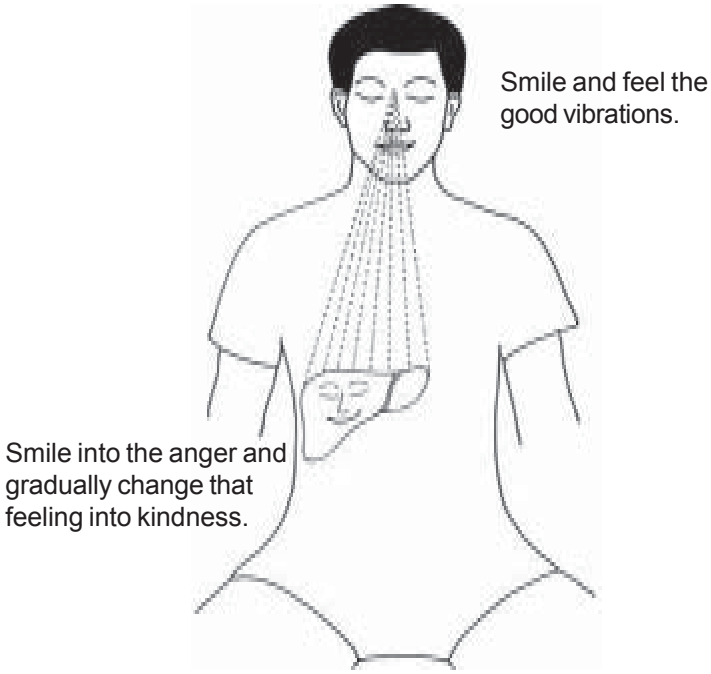

Fig. 3.30 *Tranform negative into positive energy.*

Once you learn to love yourself and connect to the unlimited reservoir of Universal Love, you will have such an abundance of love that you will overflow with it. You can send love to your loved ones and to people who are suffering. You can open your heart still further by learning to love your enemy.

Inner Smile Meditation

The Inner Smile is used to begin every meditation in the Healing Tao system, and it is presented here in complete detail. Once you have mastered it, you can decide where in your body you wish to send smiling energy and for how long it is needed. In the beginning, it may be necessary to spend up to 20 minutes to complete this exercise as described. Daily practice will shorten this period, however, and you will feel the Inner Smile take effect on your body and consciousness more rapidly. After you learn the steps here, you can use abridged version as a guideline for practice.

You can do the Inner Smile any time and place that are convenient. Some students spend more time on the Inner Smile if their bodies need it, but most use it to energize their bodies quickly before they go on to the Microcosmic Orbit meditation, which is the major part of their beginning practice, Even during the advanced meditations, students should always maintain an awareness of the Inner Smile. Whenever there is trouble in an organ, or if you are particularly tense, you can use the inner eye to smile inwardly, healing your body and relieving your state of being (Fig. 3.31).

Note: *This is a good time to make use of your anatomy book. Check the location of each organ and gland before you meditate, and keep the book open in front of you as you practice. Note the color and shape of each organ and learn to feel the texture and disposition of each with your internal senses. Getting to know your internal system takes some time, and a good, colorful reference source will prove invaluable.*

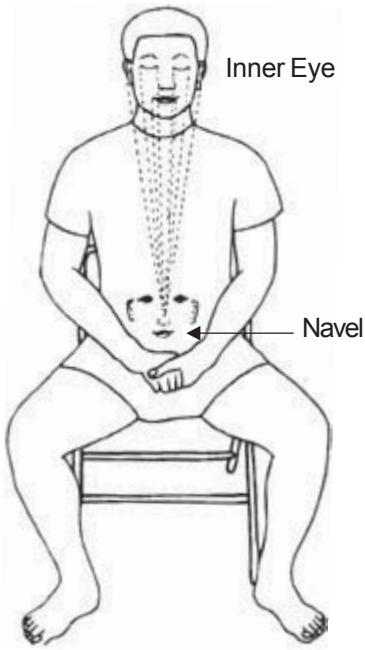

Fig. 3.31 *Smile inwardly.*

Eyes: Source of Your True Smiling and Healing Power

A smile is an incredibly powerful tool of communication. If we arrive in a foreign land, or are in a group of strangers, a sincere smile from another person helps us feel at ease immediately, almost as if we were with old friends instead of in a sea of unfamiliar faces. For a smile is familiar; it gives us the message of acceptance, love and understanding, appreciation and safety. As a result, when we receive a truly warm and loving smile, we relax and let down our defenses. It activates our parasympathetic nervous system's "relaxation response," producing distinct physiological changes in our enforcing glands, our nervous system, our musculature, our circulatory system, our respiration, and our digestive tract; in fact, nearly every system in the body can be dramatically affected by the simple fact of receiving a smile.

Just as a smile is effective in communicating with other people, it is also an amazingly powerful healing tool in communicating with ourselves. For we are always communicating with ourselves, consciously or subconsciously, but unfortunately the message is not always positive. Self-loathing and low self-esteem are all too com-

mon in modern society, and, aside from the psychological and sociological effects of a negative self-image, our own health may suffer as a result. Many serious illnesses, such as cancer, heart disease, and diabetes, are often preceded by long periods of chronic negative emotions.

In contrast, smiling inward helps us feel a sense of self- respect and gratitude for our organs and glands (Fig. 3.32). As we contemplate our anatomy and physiology, we can marvel and feel joy that our bodily parts are doing their jobs to keep us alive and healthy. It is hard not feel a sense of awe and wonder when we pay attention to the marvelous design of our bodies, to the intricate network of systems working together to keep us in balance. When we turn our awareness inward and smile to our organs with love and appreciation, it sets into motion the same chain of positive physiological changes associated with the relaxation response that is activated when we smile.

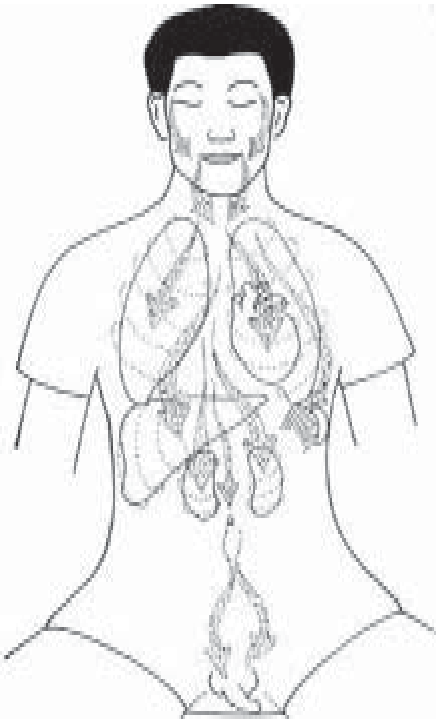

Fig. 3.32 *Smile inwardly and feel gratitude for your glands and organs.*

Smiling to the Glands and Organs

1. Sit comfortably near the edge of your chair with your feel flat on the floor. Keep your back straight, but not stiff. Stay relaxed, and clasp your palms together in your lap, left palm on bottom, right palm on top.
2. Close your eyes and become aware of the soles of your feet. Feel their connection to the ground and the energy of the earth (Fig. 3.33).
3. Become aware of yourself sitting on the chair with the hands together and the tongue pressed against the palate. Create a source of smiling energy up to three feet in front of you. This can be an image of your own smiling face, or of someone or something you love and respect, or any memory of a time in which you felt deeply at peace, perhaps feeling sunshine, being by the ocean, or walking in a forest.

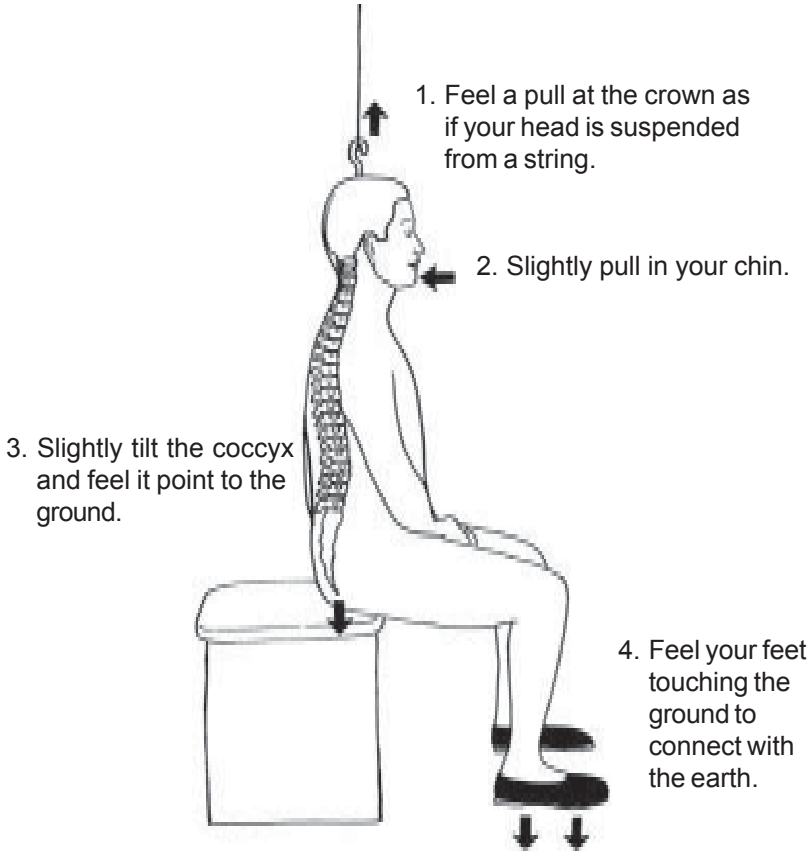

Fig. 3.33 *Correct Sitting Position.*

4. Become aware of the midpoint between your eyebrows through which you will draw this abundant smiling energy in front of and around you. Let your forehead relax, and allow the Third Eye to open. As the smiling energy accumulates at the mideyebrow, it will eventually overflow into your body.
5. Allow the smiling energy to flow down from the mid-eyebrow through your face, relaxing the cheeks, nose, mouth, and all the facial muscles. Let it flow down through your neck. You can roll your head slowly and gently from side to side as you do this.
6. **Thymus Gland**: Let the smiling energy continue to flow down to your thymus gland, which is located behind the upper part of your sternum, and picture it glowing with vibrant health (Fig. 3.34 and 3.35). Feel the thymus gland become warm as it begins to vibrate and expand like flower blossoming.

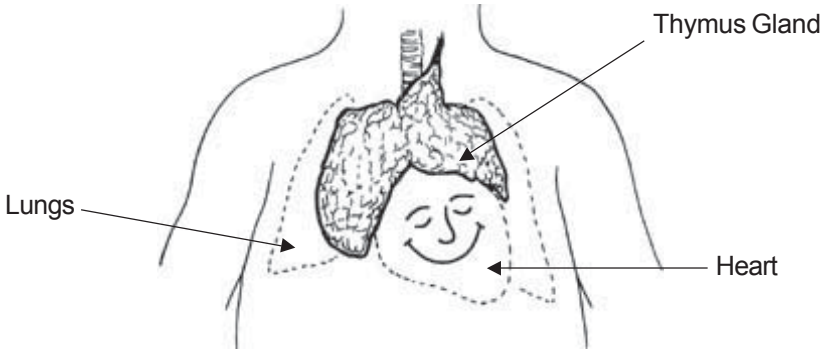

Fig. 3.34 *In children, the thymus gland is larger.*

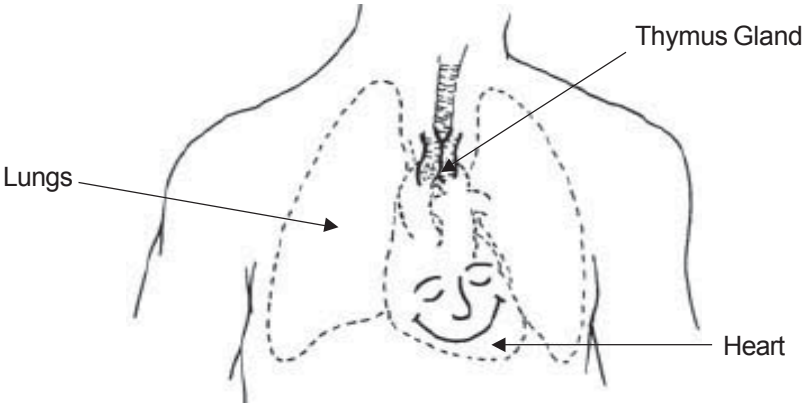

Fig. 3.35 *Let the thymus gland smile to the heart, and let the heart smile back.*

7. **Heart**: To help activate the heart energy, you can raise the clasped palms and place both thumbs lightly against the heart center. Let the warm, smiling energy spread from the thymus gland into the heart. Draw more smiling energy from the source you created through the mid-eyebrow, and let it flow like a waterfall down into the heart. When you smile inwardly to the heart, it will generate the virtues of joy and happiness. Spend as much time here as you need to feel the heart relax and expand with loving energy. This expansion will feel like a flower blossoming. Try to remember your best experience of love, whether it was emotionally or divinely inspired, and fill your heart with that same feeling again. Love your heart. The heart is associated with the negative emotional energies of hastiness, arrogance, and cruelty. When you smile into the heart, these energies will dissipate, creating the space for the virtuous energies of love and joy to expand. Smile to the heart until it smiles back to you (Fig. 3.36 and 3.37).

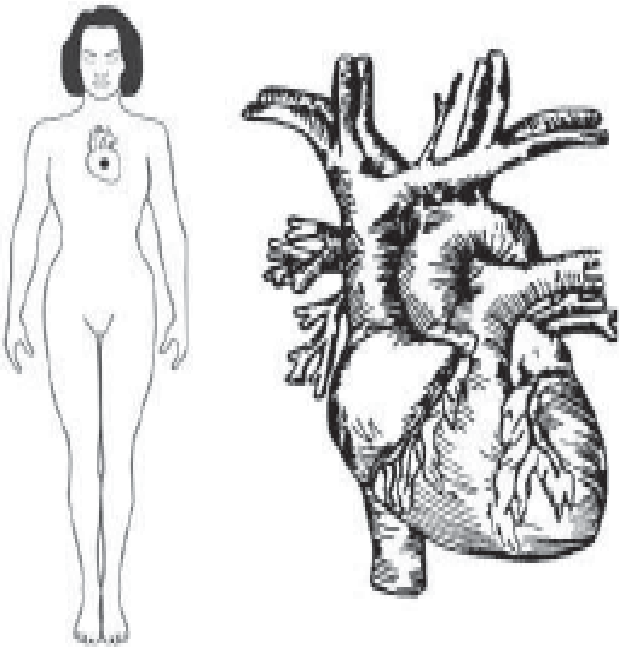

Fig. 3.36 *Picture the heart and smile to it. Feel it smile back to you.*

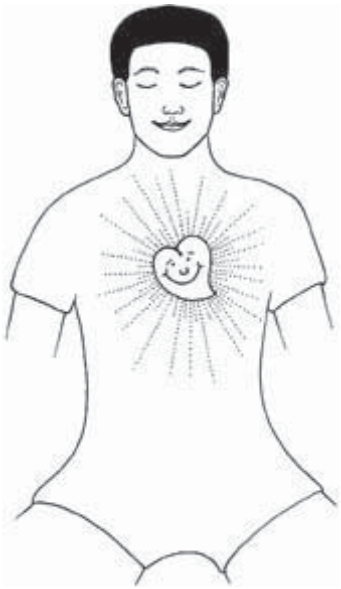

Fig. 3.37 *Feel the heart smiling back to you.*

8. **Lungs**: Let the joy and happiness generated in the heart expand outward to your lungs (Fig. 3.38). Feel the lungs open as the happy, smiling energy flows into them. If you are a visually oriented person, look into the lungs with your inner sight, or if you are more feeling oriented, feel the lungs expand with positive energy. The lungs may appear to be pink and spongy, or they may feel abundantly full. If there is anything you see or feel in the lungs that is unpleasant to you, get rid of it. You can clear the lungs of energetic, emotional, and physical pollution by smiling into them as you mentally increase the amount of Chi absorbed with each breath. Feel the air flow from the tip of the nose down into the lungs, following it all the way out to the tiny air sacs where oxygen is exchanged for carbon dioxide. Thank your lungs for breathing and helping sustain your life.

   You should feel your entire chest cavity filling with smiling, loving energy. The lungs are associated with the negative emotional energies of sadness and depression and the virtuous energies of courage and righteousness. When you smile into the lungs, you will dissolve any sadness or negative feelings, creating space for courage and righteousness to expand.

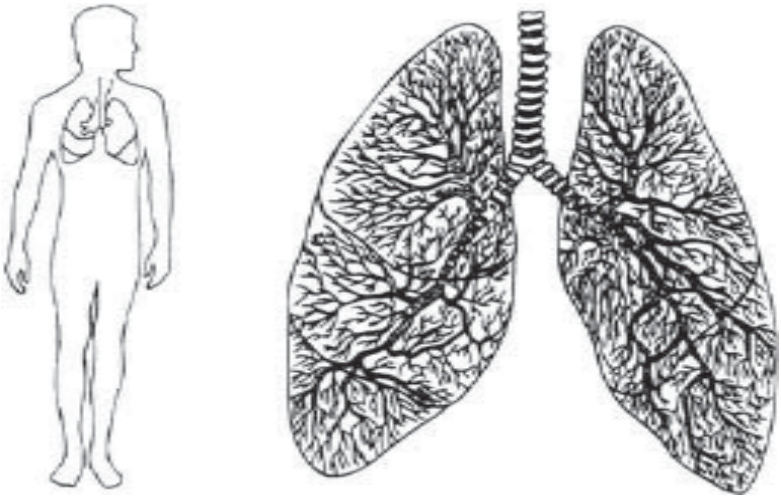

Fig. 3.38 *Smile to the lungs, and let the lungs smile back to you.*

Note: *Remember you can go back to the source of smiling energy in front of you—your vision or memory of a happy moment—to get more energy any time during the meditation, If you feel your attention wandering, or it you feel the effect of the Inner Smile becoming weak or diluted, just gather more smiling energy from the source. The Chinese say," If you want water, you should go to the well. "*

9. **Liver**: Let the smiling, loving energy continue to build up in the heart and flow out to the lungs. Next you will direct it to the liver (Fig. 3.39), which is the largest internal organ, located just below the right lung within the lower rib cage. Feel the liver become immersed in smiling, loving, joyous energy. The liver is associated with the sense of sight, as it controls the energy of the eyes. Use your inner vision to see the liver and determine its condition. Its surface should be smooth and glossy, and it should feel relaxed and uncongested. You can use your eyes to smooth out any part of its surface or to relax any area that seems tense. Feel gratitude for the liver's work in detoxifying the body, helping to store blood, and producing bile.

   The liver is associated with the emotion of anger and the virtue of kindness. When you smile to the liver, you will dissolve any anger and allow the kindness energy more space to expand. The Chinese suggest this also helps strengthen your decision-making power.

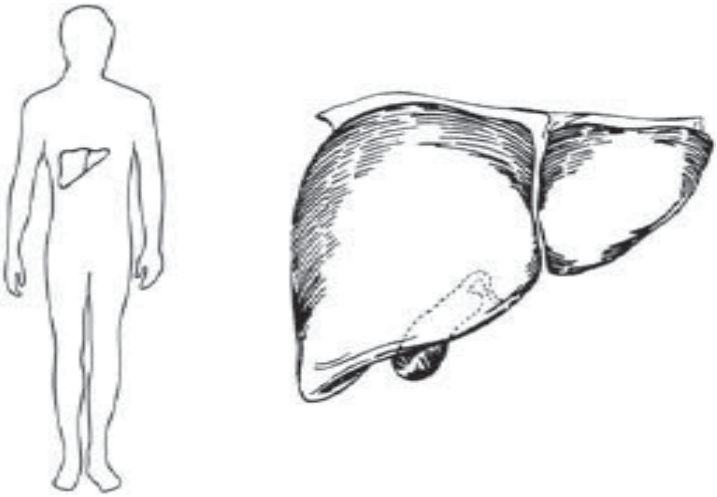

Fig. 3.39 *Smile to the liver, and let the liver smile back to you.*

10. **Pancreas**: Let the smiling energy now flow from the liver across the abdomen into the pancreas, which is located within the left lower rib cage, extending from the solar plexus area under the liver and directly beneath the left lung. Thank the pancreas for making digestive enzymes, producing insulin, and regulating blood sugar. As you smile into the pancreas, see that it is healthy and functioning smoothly.
11. **Spleen**: Continuing around to the left smile into the spleen (Fig. 3.40), which is just next to the left kidney. Don't worry if you don't know exactly where it is. If you smile in that direction, you will gradually get in touch with it. If you need to, return to the source of smiling energy in front of you, and let the smiling energy flow in through the mid-eyebrow and down to the area of the spleen. As smiling, loving energy builds up in the spleen, let it flow into the kidneys.
12. **Kidneys**: Smile down to the kidneys and feel them begin to expand with radiant energy (Fig. 3.41). You can use your inner vision to inspect the kidneys to be sure their surface is smooth and glossy and that they are filtering properly without any congestion. The kidneys are associated with the emotion of fear. As you smile into them, fear melts away, and the virtue of gentleness can grow. Keep smiling into the kidneys, and let the smiling energy build up until they are full.

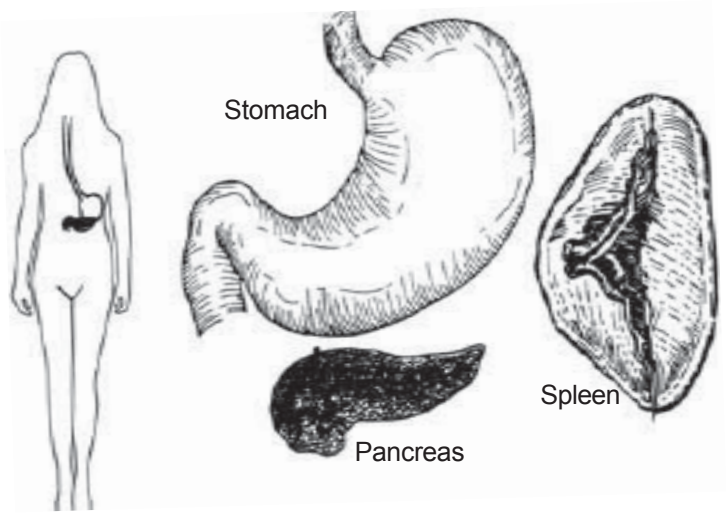

Fig. 3.40 *Smile to the spleen/pancreas, and let them smile back to you.*

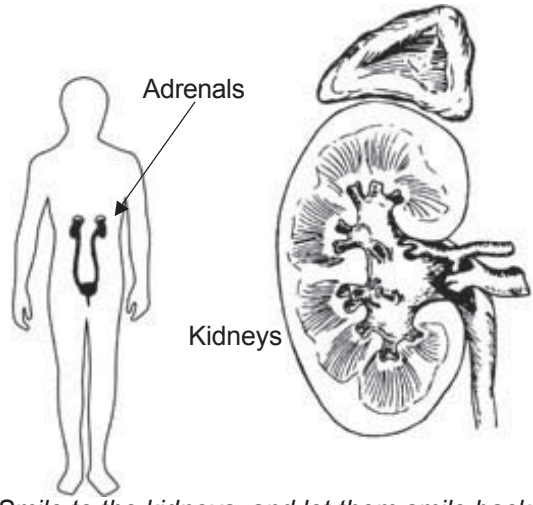

Fig. 3.41 *Smile to the kidneys, and let them smile back to you.*

13. Next, send the smiling energy down into the urinary bladder, urethra, genitals, and perineum.

    Women: The collection point for female sexual energy is known as the Ovarian Palace, located about three inches below the navel, midway between the ovaries. Smile the accumulated energies into the ovaries, uterus, and vagina. Thanks the ovaries for making hormones and giving you sexual energy. Bring the combined sexual, smiling, and virtue energies up to

the navel, and visualize the energies spiraling into that point.

Men: The collection point for male sexual energy is know as the Sperm Palace, located one-and-a-half inches above the base of the penis in the area of the prostate gland and seminal vesicles. Smile, and visualize spiraling the accumulated energies down into the prostate gland and testicles. Thank them for making hormones and giving you sexual energy. Bring the combined sexual, smiling, and virtue energies up to the navel, and spiral them into that point (Fig. 3.42).

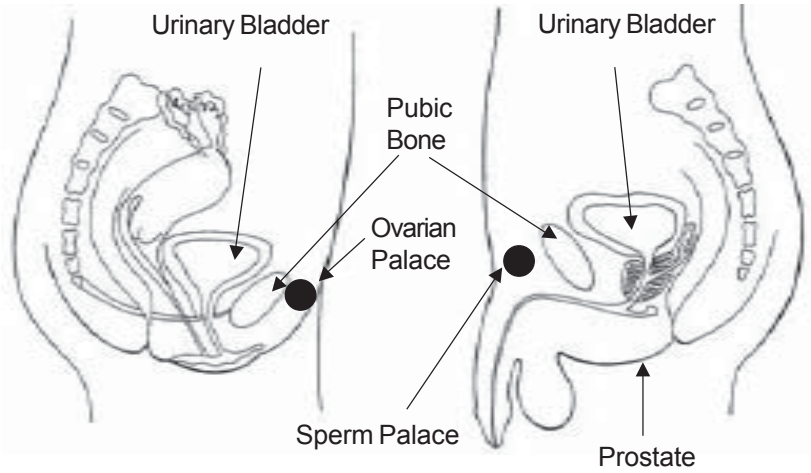

Fig. 3.42 *Sexual Center*

14. Return the attention to the source of smiling energy in front of you. Be aware of the mid-eyebrow point, and allow more smiling energy to flow in through it like a waterfall pouring down into the organs. Once again immerse the thymus, heart, lungs, liver, pancreas, spleen, kidneys, urinary bladder (Fig. 3.43), and sex organs in smiling energy. At this point you should be feeling calm and peaceful. If you wish to stop now, you can smile into the navel and collect the energy by spiraling it to the center as you cover the navel with the palms.

Smiling into the Digestive Tract

Again, after you have finished smiling to the organs, you can return your attention to the source of smiling energy in front of you before directing this energy down into the digestive tract. As you amass an abundance of Chi, let it overflow down behind the nose and into

the mouth. You will then use the saliva as a vehicle for this energy to permeate the digestive system (Fig. 3.44).

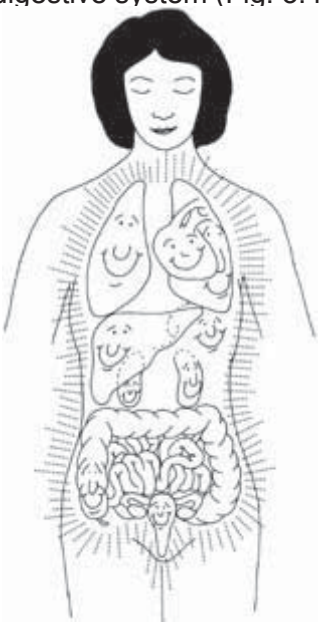

Fig. 3.43 *Feel all the organs smile back at you.*

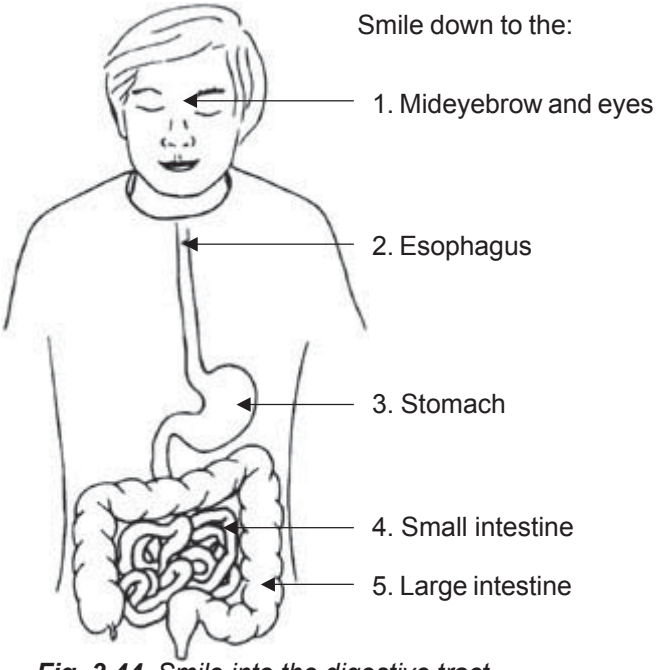

Fig. 3.44 *Smile into the digestive tract.*

Activating the saliva. The saliva is considered a precious fluid in Taoism. It has been called the Long Life Wine or Jade Fluid. There are many special techniques involving the saliva and the act of swallowing. Moving your tongue around inside your mouth generates more saliva. There is a Taoist method to enhance the process.

Slide the tongue around the outside of the teeth, with the tip running along the gums. Start from the upper back teeth on the left side, and slide the tongue over to the upper right side. Then continue to circle back from the lower teeth on the right side, pointing the tip of the tongue down to the lower gums, and slide over to the lower left side again. Return again to the upper teeth on the left side. You
can continue going around the mouth this way a few times (the Taoists recommend 36 times), then do the same thing on the inside surface of the teeth and gums. This helps generate an abundance of saliva.

Swallowing the Chi. Now imagine your saliva is imbued with all the smiling energy flowing from the mid-eyebrow point. Gather the saliva into a ball resting on the middle of the tongue. Put the tongue up to the roof of the mouth, and swallow the saliva quickly with a big gulp into the stomach, thereby swallowing the Chi into the digestive tract. As you do this, you will bring smiling energy down through the esophagus, stomach, small intestine, large intestine, rectum, and anus.

The digestive system is very sensitive to emotions, and many people experience digestive problems when they are under stress. When the body is on alert, as in the fight-or-flight response, digestion stops and the stomach's digestive juices stop flowing. So pay particular attention to relaxing the stomach and intestines, and be sure to notice if the inner surfaces of these organs are irritated. Spend as much time as you need to bring smiling energy to any places where you feel discomfort.

Smiling to the Glands, Nervous System, Bone Marrow

After you finish smiling to the organs and the digestive tract, once again bring your attention back to the source of smiling energy, which is located up to three feet in front of you.

1. Draw the smiling energy in through the mid-eyebrow point directly into the left and right brain. Move the eyes around clock-

wise and counterclockwise 9 to 18 times to balance the left and right brain hemispheres. As you do this, feel the Chi in the brain spiraling with the eye motions as it amasses. Let the smiling energy accumulate here.

2. Locate the pituitary, thalamus, and pineal glands (Fig. 3.45). Smile into the pineal gland, three or four inches behind the Third Eye and feel it blossom. Smile into the thalamus gland, located directly above the spinal cord, slightly behind and above the pituitary gland. Smile into the pineal gland at the crown.
3. Now project the smiling energy, using the power of your mind and eyes, like a flashlight beam into the vault of the skull. Let it shine through the left brain, then sweep across the skull, shining through the right brain, and then back again. You can let the smiling energy spiral around inside the brain, and then concentrate it once again in the brain's center.
4. Let the smiling energy continue to flow to the back of the skull. Feel the skull breathing; absorb the Chi into the skull and into the marrow. Then let it flow down the spinal column, vertebra by vertebra. As stated earlier, you have 24 separate vertebrae: 7 cervical vertebrae, 12 thoracic vertebrae, and 5 lumbar vertebrae. Bring your smiling energy around each vertebra and disc, one by one. Then continue smiling down to the 5 fused vertebrae of the sacrum and the 4 fused vertebrae of the coccyx (Fig. 3.46).

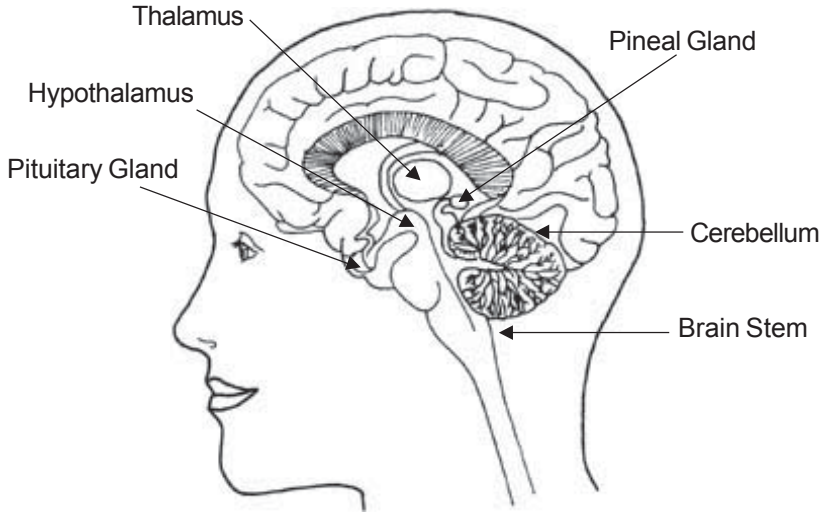

Fig. 3.45 *Smile to the brain and the glands.*

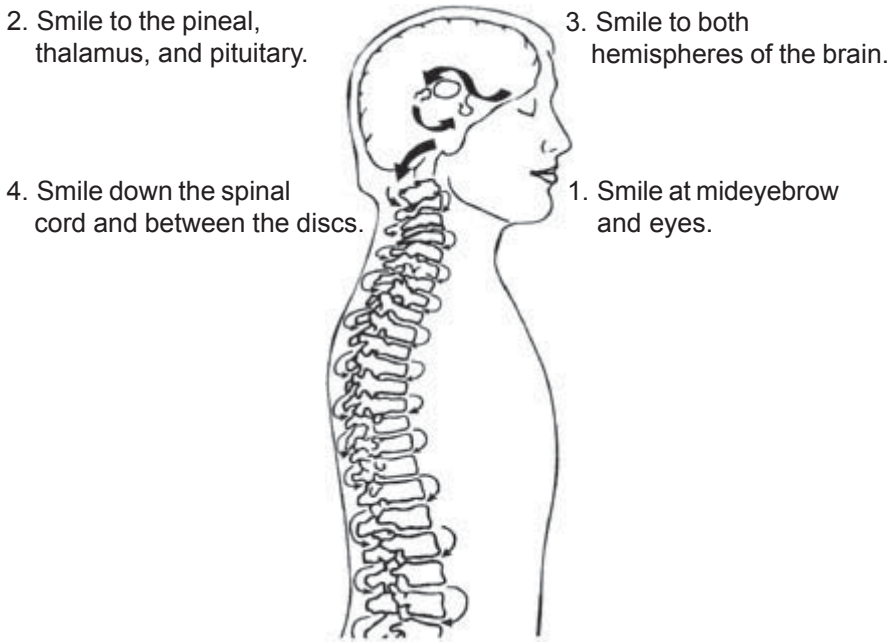

Fig. 3.46 *Smile to the spinal cord and bone marrow.*

Collecting and Storing Energy at the Navel

Men: Cover the navel with both palms, left over right. Massage with a spiraling motion down toward the right side (clockwise) 36 times (Fig. 3.47 and 3.48)

Women: Cover the navel with both palms, right over left. Massage with a spiraling motion down toward the left side (counterclockwise) 36 times (Fig 3.49)

Men and women: Reverse directions, and spiral back into the navel 24 times (Fig. 3.48 and 3.49). (Men spiral counterclockwise; women spiral clockwise.) Move closer to the navel with each cycle. You have now completed the Inner Smile and should feel an increase in your flow of Chi. Practice this exercise as soon as you wake up. It is the best stress reducer in the world.

Fig. 3.47 *Collecting and storing the energy.*

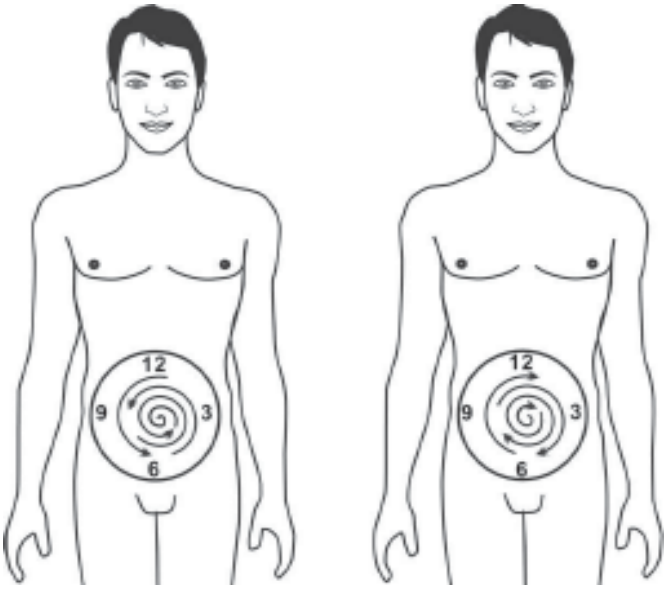

Men collect the energy by spiralling outwardly from the navel 36 times clockwise.

Then they spiral inwardly 24 times counterclockwise, ending at the navel.

Fig. 3.48 *How men collect energy.*

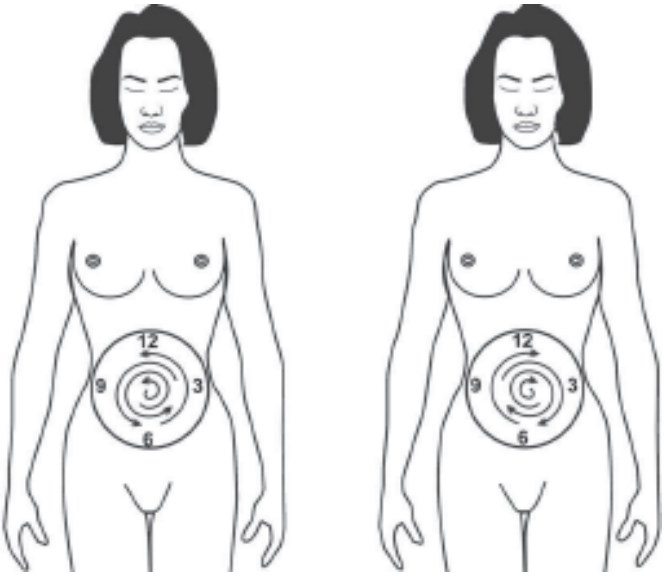

Women collect the energy by spiralling outwardly from the navel 36 times counterclockwise.

Than they spiral inwardly 24 times clockwise, ending at the navel.

Fig. 3.49 *How women collect energy.*

Six Healing Sounds

The Six Healing Sounds help us emphasize the good vibrations of the organs by strengthening their positive energies. They also heal the organs while balancing their individual functions with the rest of the internal system. Each sound can be performed from any position, but serious practice is usually initiated from a seated position. The most important aspect of practice is to feel any negative emotional energies so you can transform them into positive life-force. Once you are familiar with the organs and their correlating sounds, you may begin.

Lung Sound: Place your tongue behind your closed teeth, and with a long, slow exhalation, create the sound ***Sssssssssss*** (like the sound of steam coming from a radiator). During each resting period (as you slowly inhale), smile to the lungs. Picture them surrounded by white light, and concentrate on feeling the virtue of courage, which is directly related to the lungs' energy. (This will help enhance the positive energy of the lungs.)

Kidney Sound: Form an O with the lips, as if preparing to blow out a candle, and with a long, slow exhalation, produce the sound ***Wooooooo***. During each resting period, smile to the kidneys as you picture them surrounded by a bright blue color. Feel the virtue of gentleness, which will enhance the positive energy of the kidneys.

Liver Sound: Place the tongue near the palate, and with long, slow exhalation, produce the sound ***Shhhhhhhhhh***. During each resting period, smile to the liver. Picture it surrounded by a bright green color, and feel the virtue of kindness. This will enhance the positive energy of the liver.

Heart Sound: With the mouth wide open, exhale a deep breath slowly, and produce the sound ***Hawwwwwwww***. During each resting period, smile to the heart, and picture it surrounded by the color red. Feel love, joy, and happiness to enhance the positive energy in the heart.

Spleen Sound: Again place the tongue near the palate, and with a long, slow exhalation, produce the sound ***Whoooooo*** from the throat, like the sound of an owl. (This is more guttural than the Kidney Sound.) During each resting period, smile to the spleen, and picture it surrounded by a bright yellow color. Feel the virtue of fairness, which will enhance the positive energy of the spleen.

Triple Warmer Sound: *(Practice this while lying down, if possible.)* With your mouth open, exhale slowly as you produce the sound ***Heeeeeeee***. During each resting period, try to imagine a huge rolling pin flattening out your body from the forehead down to the toes. This will balance all the energies activated by the other sounds and help relax the body thoroughly.

With daily practice, you will find negative emotional energies have little or no room to grow. It always helps to spend some time sorting out emotional trash. See what can be recycled internally, just as paper, glass, and plastic from your home can be recycled. You will feel much better as you learn to transform negative energies into positive life-force, rather than dumping them on others.

Chapter 4
Energetic Preparations for the Healing Light Meditations

We will begin by learning a few techniques to loosen the body, open channels, and activate the Chi flow. This will enable you to draw the Universal, Higher Self, and Earth Forces into the bone to "wash the marrow" and to absorb these energies so the bone marrow will regenerate and grow. This also establishes a good foundation for the Microcosmic Orbit meditation by making it easier for you to feel the energy you will be working with. Descriptions of these preparations require many words, but the movements are simple. Once you understand these movements, they can be performed within minutes.

Creating bodily awarenes: From a comfortable posture, you will relax and smile inwardly, focusing your attention on the mid-eyebrow to open and expand it. Then you will concentrate on loosening the muscles of the perineum.

Spinal Cord Breathing and Spinal Cord Rocking: Although Spinal Cord Breathing and Spinal Cord Rocking are not included in this chapter, we mention them here because these two methods for loosening the spinal cord are extremely important and should be practiced before every meditation session. For a detailed description of Spinal Cord Breathing and Spinal Cord Rocking, please refer to the Appendix in the back of this book.

Techniques for enhancing the sensation of Chi: You will learn
several effective ways of feeling Chi. Then you will explore various methods for guiding your Chi and increasing the Chi flow to specific places, including the use of the mind and eyes, touching the points of the Microcosmic Orbit, and breathing techniques.

Preparing for the Microcosmic Orbit Meditation: Preparations for the Microcosmic Orbit meditation include finding a quiet and pleasant environment conducive to practice and precise procedures for establishing a good meditation posture.

Activating the Original Chi in the Lower Tan Tien: Warming the Stove. The Lower Tan Tien (located between the navel,

kidneys, and sexual center) is the foundation of Taoist meditation, the place where we begin and end each round of practice. You will be guided through the ways of awakening the Original Chi stored in the Lower Tan Tien. This aroused Original Chi will later be used to start the flow of Chi through the Microcosmic Orbit.

Creating Bodily Awareness

You can do this exercise standing, sitting, or lying down. Try to keep the spine straight and aligned with the hips, shoulders, and head.

If you choose to stand, keep the feet at shoulders' width, maintaining 70 percent of the weight on the heels and 30 percent on the balls of the feet. Also keep the toes slightly apart.

Getting Started

1. Relax all the joints by lightly shaking the body, the hands, and the spine (Fig. 4.1). Rest, be aware of the spinal cord, and keep the joints very loose. Straighten the mid-back (T-11 area) and maintain the alignment of the spine.
2. Relax the shoulders, keeping the neck straight. The head should feel as if it is suspended. The most important thing is to relax.
3. Keep the knees loose and flexible without bending them. They should be comfortably straight, but not locked.
4. Breathe normally. Don't try to control the breath, but gradually forget about breathing. The breath should be naturally gentle and soft.
5. If you choose to sit or lie down, the same rules apply: relax and stay comfortable while gently maintaining the alignment of the spine. Breathe normally without trying to control the breath. If you are sitting, the feet should be flat on the floor at the same width as the shoulders. In a lying position, you may put a pillow beneath the knees to keep them slightly bent.

Opening and Expanding the Third Eye

The ***Third Eye*** (mideyebrow) lies in a slight depression of the forehead located above and in between the eyebrows (Fig. 4.2). When this point is opened through meditation, it opens the conscious-

ness to truth, wisdom, benevolence, and psychic powers. It also enhances latent powers of healing and the body's vibrations. This center can be used to send energies out to others, or to receive them from the universe. Frequencies emanating from the Third Eye can be used to explore unknown realms for higher sources of energy. By amplifying and transmitting the vibratory rates of our virtues, we can attract higher frequencies and light to be absorbed and used internally.

Fig. 4.1 *Shake all the joints loose and feel them open.*

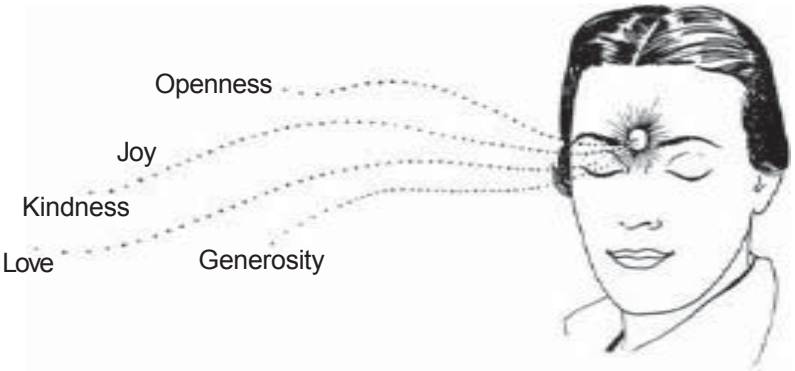

Fig. 4.2 *Focus the smiling energy on the mideyebrow point. Feel the virtues of openness, love, kindness, and generosity.*

1. The first step in opening the point at the Third Eye is to smile inwardly as you relax the muscles of the forehead (between the eyebrows). You can use the fingers to massage in a spiraling motion around the area to loosen it (Fig. 4.3). You may also bend the index fingers and gently press both knuckles (second joints) together on the Third Eye, then maintain the pressure of the knuckles against each other as you slowly pull them away from the point.

Fig. 4.3 *You can use the fingers to massage the muscles of the forehead (between the eyebrows) in a spiraling motion to loosen the area.*

2. Focus the energy of your smile on this point, then feel the smiling energy radiate out through it. Also try to feel the virtues of openness, kindness, love, and generosity expanding within you. Smiling energy will gradually arise from the heart and radiate out from the Third Eye.
3. Relax the body, smile from the heart, and radiate the smiling energy out through the mideyebrow point (Fig. 4.4). Internal energies will calm down, and the Yin and Yang qualities will start to come into balance.

Relaxing the Muscles of the Perineum

The perineum's center (also known as the *Gate of Life and Death*) lies between the genitals and the anus. The specific point you will focus on is a depression located directly beneath the anus (Fig.

4.5). This gate is extremely important because it controls the flow of sexual energy, guiding it upward to the higher centers, and prevents the organs' energies from leaking out through the base of the body (Fig. 4.6). The perineum is also considered the "floor" of the internal organs because it must withstand the pressure of their combined weight. When it is kept healthy and strong, the perineum holds the organs in place, preventing them from sagging down and losing their energy through its gate.

Fig. 4.4 *Smile to the heart and let the heart smile back to your mideyebrow.*

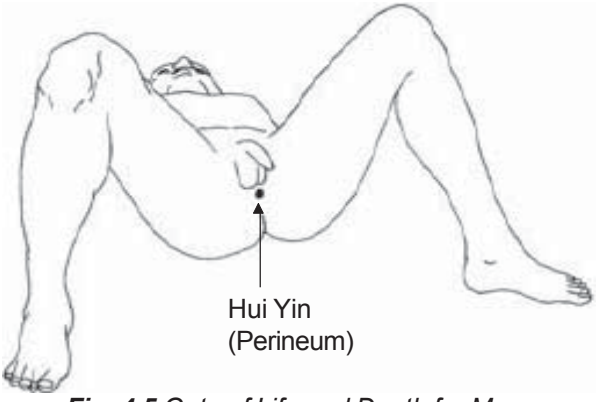

Fig. 4.5 *Gate of Life and Death for Men*

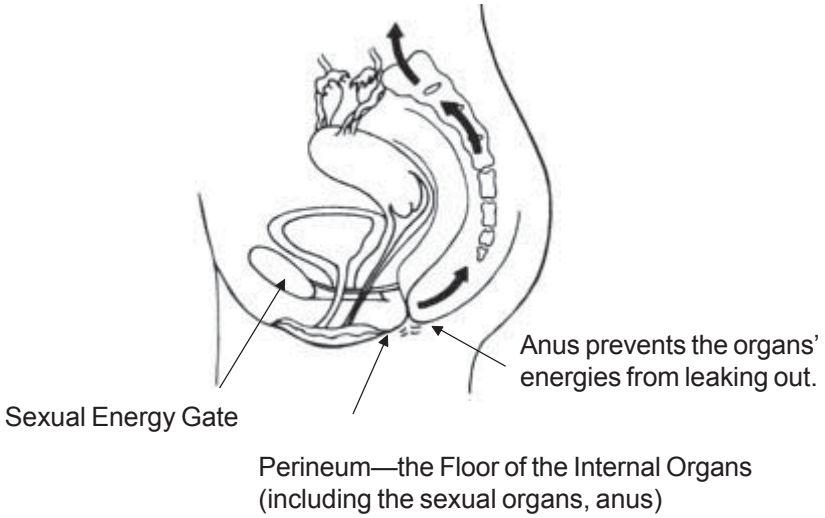

Fig. 4.6 *Gate of Life and Death for Women*

This center also connects the body to the Earth Force, which can be used to cleanse and rejuvenate the bone marrow. (Bone marrow is one of the major sources of Chi.) This will help open channels and balance the Higher Self and Universal Forces absorbed from above (Fig. 4.7). When sexual energy is activated, passing through the perineum, it helps establish the connection between these forces. It reunites the *Pre-Heaven Force* (the original life-force we receive from our parents) with the *Post-Heaven Forces* absorbed from food, air, sun and stars. All energies absorbed after birth help us maintain the life-force. Such interactions depend on the strength of the perineum and its energetic connections.

The muscles of the perineum (Fig. 4.8) can be difficult to relax, which is one reason we often lose the feeling of their connection to the coccyx and the spine. When they become weak and consistently loose, we become more susceptible to illness.

The following steps help develop more sensitivity in this center:

1. Use the fingers to massage the perineal point until you feel it relax (Fig. 4.9), then contract the muscles around it.
2. **Man**. Relax and contact the point three, six, or nine times, holding each contraction tightly for about five seconds as one set. Do three to six sets.

   Women. Relax and contract this point two, four, or six times,

holding each contraction for about five seconds (Fig. 4.10) as one set. Do three to six sets.

3. Rest, and smile to the center of the perineum. Feel its connection to the coccyx and spine.

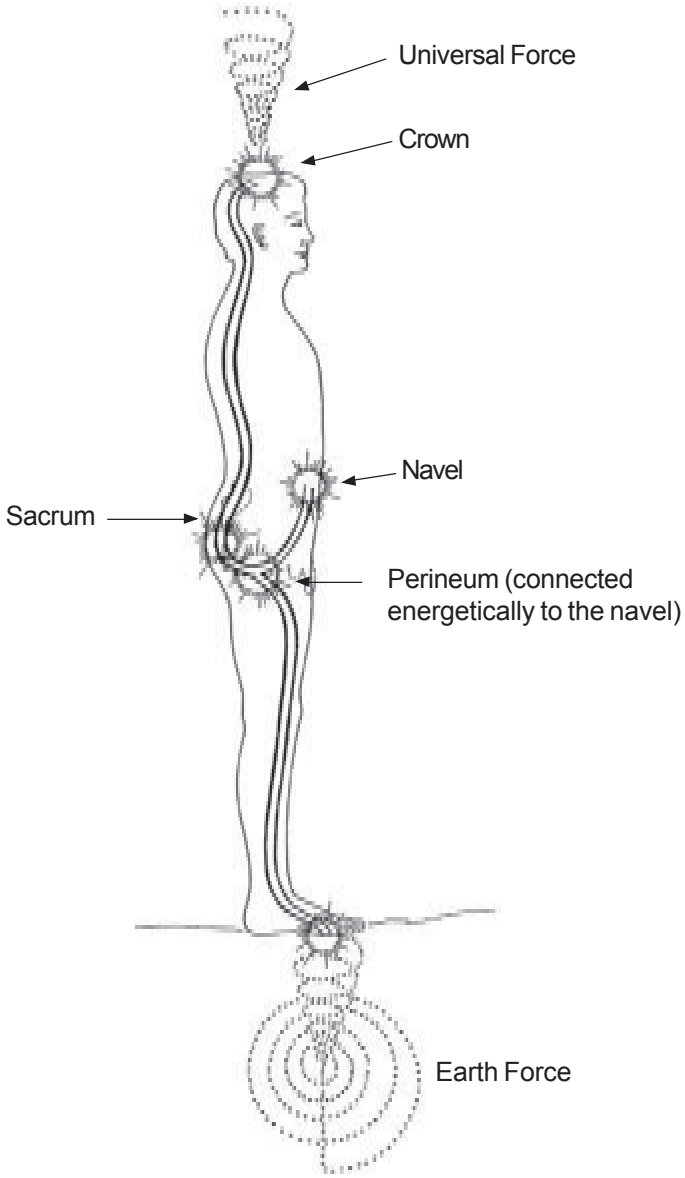

Fig 4.7 *Perineum Connection*

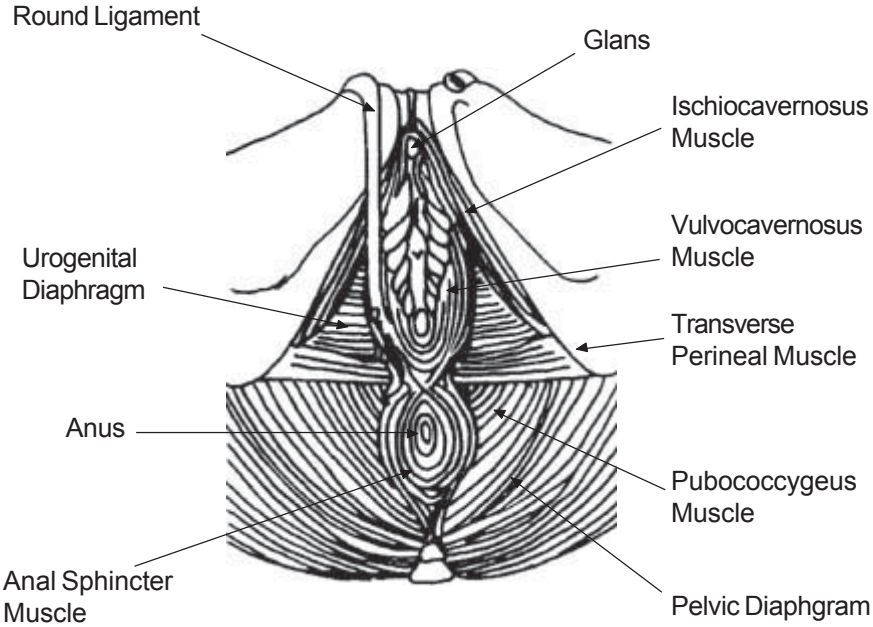

Fig. 4.8 *Muscles of the Perineum*

Fig. 4.9 *Massaging the Perineal Point*

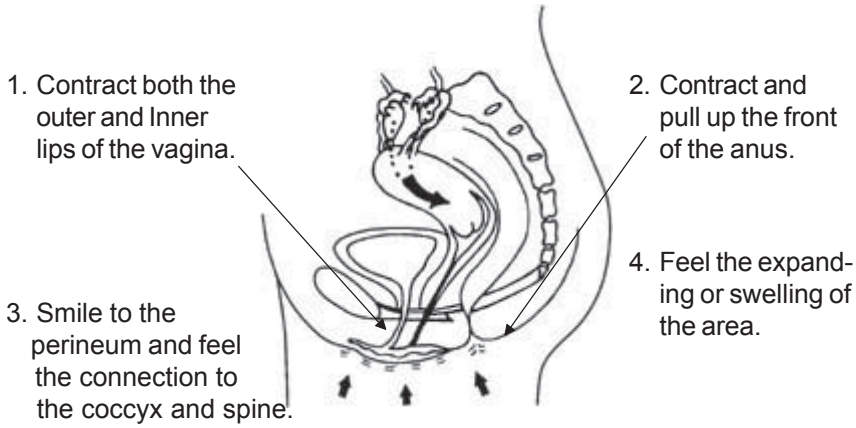

Fig. 4.10 *Contracting the muscles around the perineum.*

Feeling Your Energetic Centers

You will learn to feel the energy of your body and its individual organs and glands. This will make it possible for you to distinguish between negative and positive influences and to use the mind and inner eye to change bad feelings into good feelings. Once you know your own Internal energies, it will be easier for you to feel the Universal, Higher Self, and Earth Forces. The feeling can be different for each person.

Some may feel the naval area expanding or swelling. Some may feel the insides of the legs become warm as a line of warm energy extends down to the feet. If you feel this sensation, you can absorb it deep into the bones to help regenerate the bone marrow.

The sexual organs may feel an electric numbness or some form of arousal. Later this feeling can spread up through the body, and you may experience the balance of the inner and outer energies. The whole body may feel a pleasant tingling sensation. To finish the exercise, smile as you relax the mideyebrow and focus smiling energy from the heart to the perineal area. You can practice smiling and relaxing the Third Eye and the perineum any time you have a few moments to sit or lie down quietly.

Once you have mastered these exercises, they need not be repeated before each meditation session as a warm-up. Instead, you will find them incorporated within the main practice of the Microcosmic Orbit.

Techniques for Enhancing the Sensation of Chi in Meditation

Circulating Chi in the Microcosmic Orbit

What Does Chi Feel Like?

The essence of the Microcosmic Orbit meditation is to use the mind to move Chi in a loop through the body, beginning and ending at the navel. You will naturally want to ask at this point, "What does Chi feel like?" and "When I feel the Chi, how do I get it to move where I want it to go?"

The fact is that you already have Chi moving through every part of your body. It is the life-force that animates your body. Without it, there is no life! Unfortunately, most of us do not know how to identify the sensations associated with the movement of Chi.

Chi has many sensations. Some of the most common are tingling, heat, expansion, an electrical sensation (like the feeling of static electricity), magnetic energy, pulsation, or effervescence. These are not the actual Chi itself, but the signs of increasing Chi in an area. Chi itself is more mysterious, subtle beyond definition. Detecting the signs of Chi movement is most important for now.

Mind Leads the Chi

There is a saying in the Taoist classics, "The mind moves and the Chi follows." Wherever we focus our attention, the Chi will tend to gather and increase. Because Chi is the force behind all movement, simply focusing the attention on an area of the body will cause increased activity in the nerves in that area. Muscular activity, lymphatic flow, and blood circulation may also be affected. All these systems are moved by Chi, so the Chi circulation to an area must increase when these other systems increase their activity. This means we are automatically affecting the Chi flow to an area merely by focusing the attention on that area (Fig. 4.11).

As we learn the Microcosmic Orbit practice, we will also learn a variety of related techniques, such as spiraling, touching the points, applying hand positions (mudras), and breathing, to activate the points. All these methods help us use more of our mental powers to enhance our concentration on each point. The stronger the focus, the greater the movement of Chi. Understanding this is crucial to

developing an effective practice of the Microcosmic Orbit meditation.

When your energy flows effortlessly through the pathways and you no longer need to use your hands, breath, or spiraling to activate the points, you will have reached a higher level of skill. If you then feel your mental concentration is strong enough to gather and direct Chi without these additional techniques, you may use them at your own discretion, or forego using them altogether. Keep in mind that they are simply auxiliary techniques to enhance the essential practice when necessary.

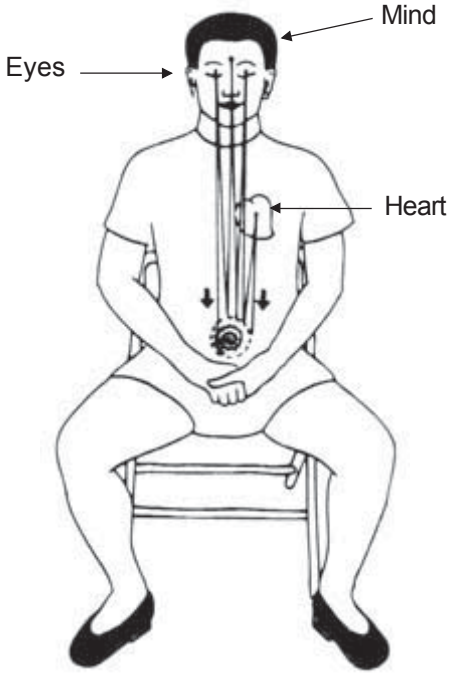

Fig. 4.11 *The mind moves and Chi follows.*

The Methods

1. Spiraling: *The Mind/Eye Connection*

From whirlpools, tornadoes, and the spiraling electrons of our cells to the spiraling formations of galaxies and nebulae, nature moves in spirals. Spirals initiate vortex-like force-fields of energy that gather, draw in, and condense other energies. Just as nature uses spirals throughout the universe, we can use them to improve the functions of our bodies through meditation.

In this method we use the power of the mind, the eyes, and the heart to draw energy into the centers of the Microcosmic Orbit, spiraling and condensing the Chi into each point. You will turn the mind, eyes, and awareness inward to feel the centers, focusing on each one individually until a sensation of energy occurs. Then you will continue using the mind and the eyes to guide the energy of each center to the next successive center along the Microcosmic route, activating them in turn and connecting them energetically, which produces a kinesthetic (bodily) sensation that outlines the Orbit's pathway.

You can practice in stages to learn inner-eye power training, as you would practice the alphabet before learning how to write. In the Microcosmic Orbit meditation, we use all these techniques to enhance our Chi. The energy at this beginning level may feel as if it is just under the skin or flowing through the more superficial layers of the body.

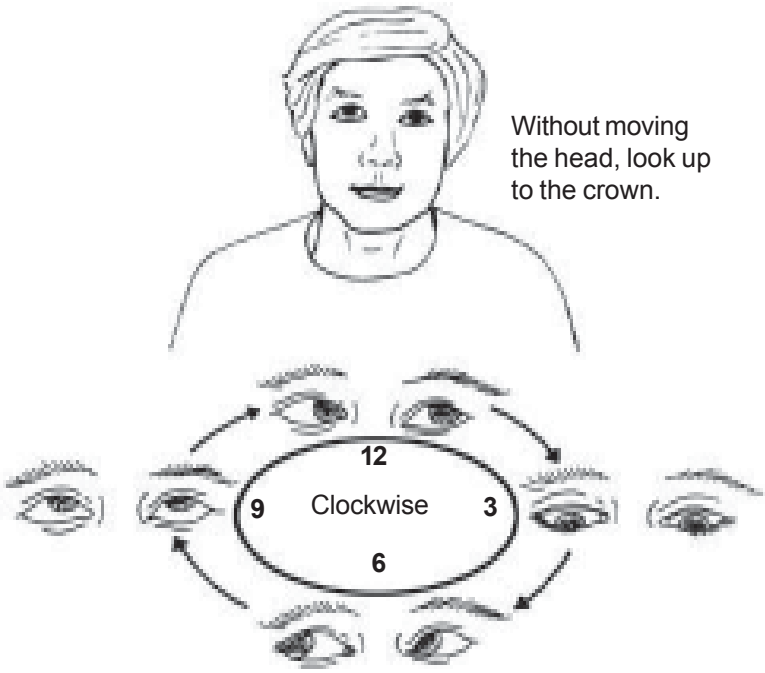

Fig. 4.12 *Move the eyes one quarter of a circle at a time.*

In the beginning, you will learn to feel the Chi through the physical stimulus you create by moving the eyes as you develop the ability to mentally control the spiraling process. If you cannot feel the Chi after using the mind and eye movements alone, try touching each point lightly with your hands during practice, and focus behind the point of contact. (Eventually you won't need any eye movements or physical assistance.) The exercises that follow will help you learn to feel the Chi as you spiral it at each station.

Fig. 4.13 *Rest and feel the energy spiraling at the mideyebrow.*

A. Spiraling power with eyes open (Fig 4.12, 4.13, and 4.14). Spiraling clockwise from the center has the power to condense the Chi at the center.

1. Open the eyes, and without moving the head, look up to the crown of the head, then to the right, then straight down, and then left.
2. Look up again.
3. Repeat these steps from 9 to 36 times.
4. Close the eyes, inhale, and feel the energy or Chi ball produced by the spiraling. Exhale and feel the energy condense between your eyebrows. When the condensing power is great enough, it will reverse and expand like a mini-orgasm or explosion, releasing the pressure.
5. Reverse spiraling in a counterclockwise direction outward from the center has the power to expand the inner Chi to connect with the external Chi outside the body. At the point of maximum

expansion, the flow will reverse itself and pulse back toward you.

Repeat the same steps as for spiraling clockwise, but move the eyes counterclockwise instead.

6. This exercise can also be performed on a horizontal plane: look front, look right, look behind you (suck the eyes in lightly), and look left. Then reverse. This is the pattern you will use to gather Chi at your navel. Imagine you have a ball at the navel, and practice rotating it to the left (counterclockwise as you look down) and then reversing and spinning it to the right. You can coordinate the eye movement with the rotations. Some Taoists visualize a spinning Tai Chi symbol.

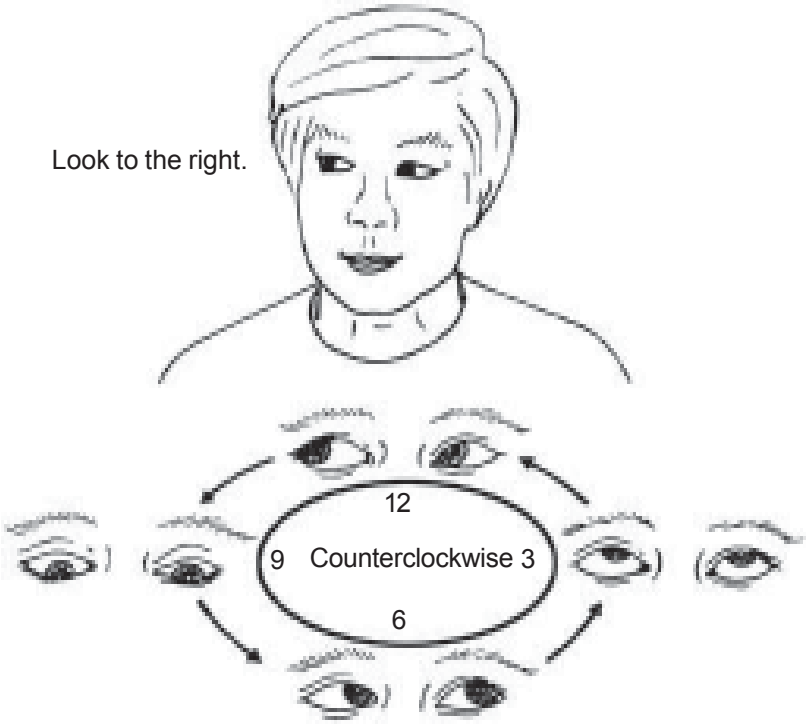

Fig. 4.14 *Reverse spiraling in a counterclockwise direction.*

B. Mind/eye spiraling power with eyes closed. This is the same as the previous exercise, except it is done with eyes closed. Repeat the steps from 9 to 36 times spiraling clockwise, then repeat spiraling counterclockwise (Fig. 4.15).

C. Advanced mind/eye spiraling power with no physical eye movement. This practice truly involves mind/eye power and will help you learn to use your inner vision. You will feel a certain kind of energy, and your mind will form an image of the crown of the head through the "inner eye."

You can use the inner eye to check yourself internally and to help heal parts of your body whenever necessary.

1. Close the eyes, and without physically moving them (or the head), use the mind to look up to the crown, then to the right, then straight down, and then left.

Fig. 4.15 *Close the eyes, and without moving the head, move the eyes clockwise and counterclockwise.*

2. Look up again.
3. Repeat these steps from 9 to 36 times.
4. Rest, and feel the energy produced by the spiraling.
5. Repeat the same procedures in a counterclockwise spiral.
6. Repeat the exercise, using the inner eye to move horizontally: front, right, back, and left, then reverse.

Note*: From this point on, you can use the power of the mind to work with the inner eye (if you are visually inclined), or you can continue to move the physical eyes to help spiral the energy.*

D. Most advanced mind/eye training: Contracting and relaxing to condense in and pulse out Chi. We can use the unique muscle power of our eyes both to activate our own Chi and to draw in and condense the unlimited Chi of nature.

The eyes are an outer extension of the brain. They have a close connection to both the parasympathetic and sympathetic nervous systems. In fact, the eyes are so important that 4 out of 12 of the cranial nerves are involved solely with vision and eye muscle movement (Fig. 4.16).

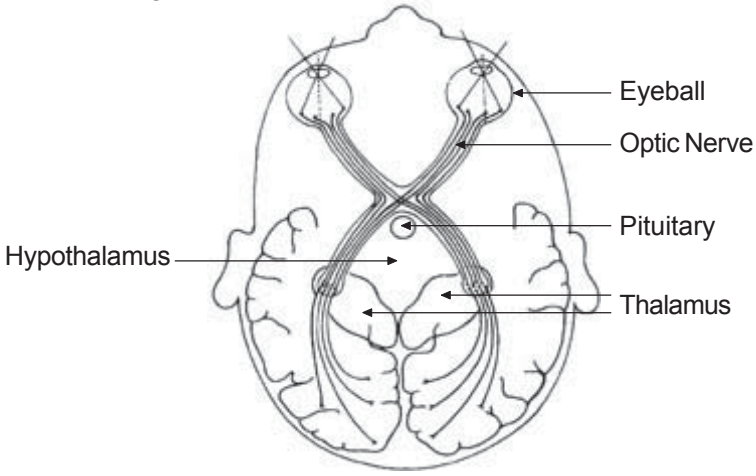

Fig. 4.16 *The eyes are the outer extensions of the brain.*

Fig. 4.17 *Contract the iris with the circular muscle.*

The muscles in the iris are classified as Yin or Yang according to their functions. The circular muscle (sphincter pupillae muscles) of the iris decreases pupil size when there is too much light, so it is regarded as Yin. It is activated by the parasympathetic nervous system, the Yin branch of the nervous system associated with rest and repose, the "relaxation response," slowing the heart rate, and other Yin functions.

The circular muscle of the iris (Fig. 4.17) is related to the other sphincter muscles in the body, such as the sphincter muscles around the eyes and the mouth, the anal sphincter muscles (please see Fig. 4.8), the urogenital diaphragm, the muscles around the vagina, and the penis. The heart also has the same type of circular muscle. Contracting and releasing the iris and the other muscles around the eye will help create and activate a pulsing reflexive resonance with all the other circular muscles. When all these muscles are activated, they have the power to gather and condense the mind/eye power (Fig. 4.18).

The radial muscle of the iris (dilator pupillae muscle) dilates the pupil; it is regarded as Yang. It is activated by the sympathetic nervous system, the Yang branch of the nervous system associated with the "fight or flight" response, increased heart rate, rapid breathing, and other stress or danger reactions. The radial muscles have the power to extend energy out and connect to distant energies. The circular muscles of the iris have the power to draw in and condense those distant energies.

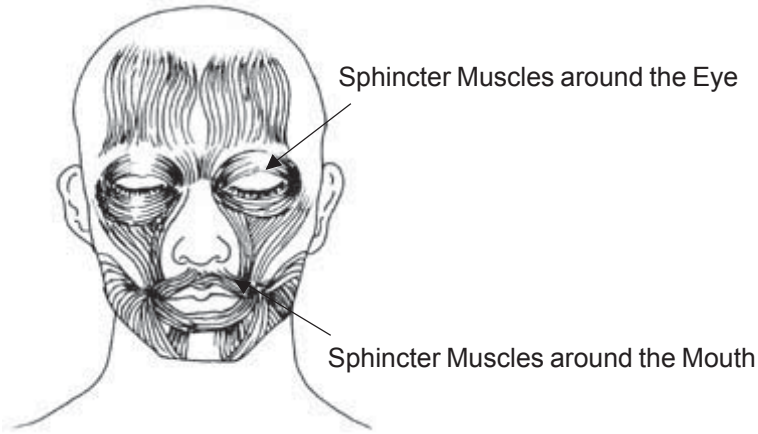

Fig. 4.18 *When all these muscles are activated, they have the power to gather and condense mind/eye power.*

When you use advanced mind/eye power, you tightly contract and relax the circular muscles of the iris and the muscles surrounding the eye. These contraction automatically activate the anus and the sexual sphincter muscles. Once this bodily pulsing and pumping is activated, you will find it very easy to inhale as you draw in energy and then condense it within you as you exhale by focusing inwardly.

Pupil size (Yin), creating a suction power. When there is little light (Yin), the iris increases the pupil size (Yang), allowing your Chi to expand.

Practice condensing light into the body (Fig. 4.19). Use a candle or look at the sunlight; the safest time is the sunrise or sunset, when the sun is just above the horizon. To protect the retina from damage in the bright or strong sun, you need to blink the eyes and lightly move the head back and forth. At sunset and sunrise, the eye can look without blinking. If no sunlight is available, you also can use candlelight, or a 60 watt bulb to start with, gradually moving up to 100 watts.

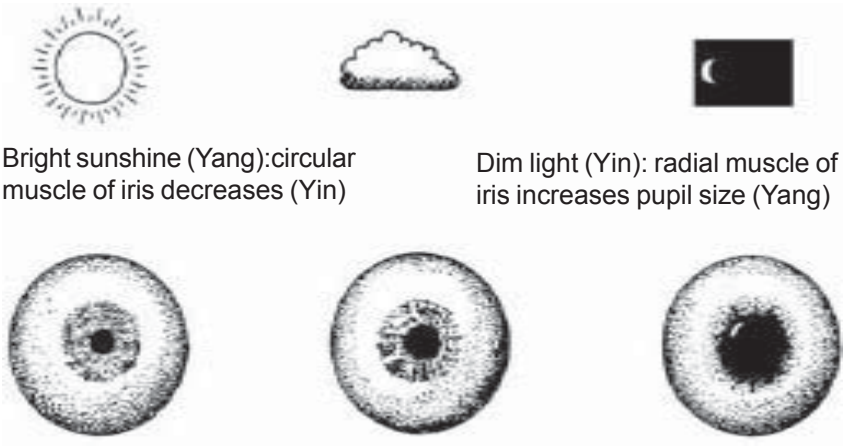

Fig. 4.19 *Condensing light into the body.*

1. Look at light, inhale into the mideyebrow and the mouth, and partially close the eyelids and lightly dim the irises down. Feel yourself drawing in the light and hold it for 10 or 15 seconds.
2. Exhale, lightly open the eyes, and condense the light Chi in the mouth. Relax and let the Chi expand in the mouth. Gradually you will feel the essence of the sun, known as the solar essence, get thicker and thicker.

If you are looking at bright sunlight, start by blinking the eyes 20 to 30 times. Lightly close the eyes and see the light in front of you. Inhale lightly, dim the eyes, and draw the light into you. You can gather the moon essence in the same manner, only you don't have to blink the eyes and move the head (Fig. 4.20). Please see Chapter 11, "Chi of the Sun and Moon."

Next, we will add to the exercise the sphincter muscles of the eyes, mouth, anus, and perineum. Smiling will help activate the sphincter muscles in the eyes and mouth.

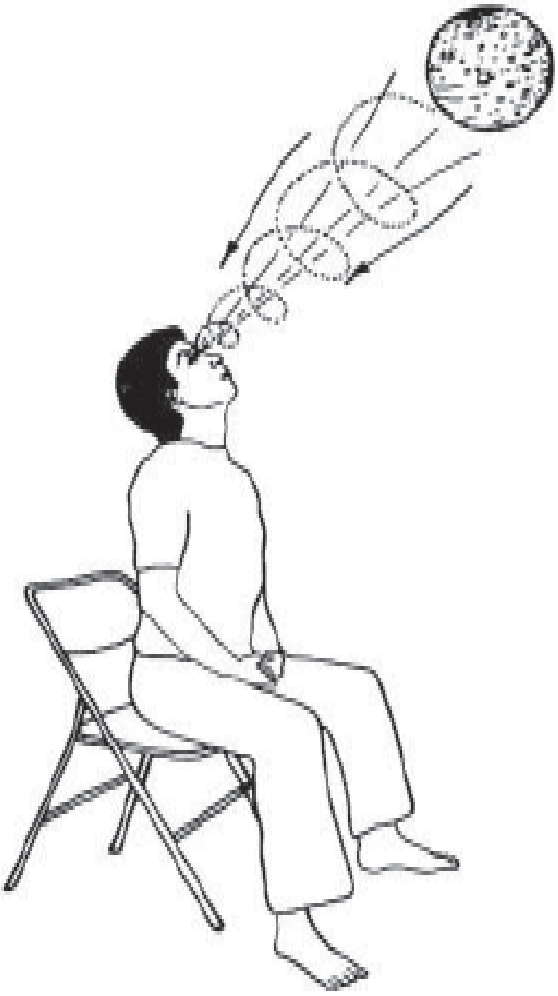

Fig. 4.20 *Looking at the sun/moon to gather the light essence.*

3. Smile, inhale lightly, dim the eyes, and lightly contract the muscles around the eyes and the mouth. At the same time, also feel the anus, perineum, and sexual organ lightly contract.
4. Feel these as you draw the light energy into the mideyebrow and the mouth, charging the saliva with it.
5. Exhale, lightly open the eyes, and condense the light Chi in the mouth by focusing the mind on the mouth and saliva as you exhale.

   Don't use force, or you will feel a cramp in the stomach. If you get a cramp, exhale and relax into the cramp a few times to help release it. You may also swallow the saliva (charged with Chi from absorbed light) into the stomach (Fig. 4.21).

Fig. 4.21 *Swallow saliva to the stomach (Original Force).*

6. Add the tongue. Inhale, press the tongue up to the palate, dim the eyes, and contract all the muscles as above.
7. Exhale and relax the tongue but continue to touch it to the palate. Follow the entire procedure (steps 1 through 7) six to nine times and rest. Feel the Chi ball in the mouth increase and the tongue start to vibrate as if electricity is flowing.

2. Using the Hands to Help Guide the Chi

Note: *This section includes explanations of the different methods you will use in later chapters. You may want to refer back to these explanations as you progress in your practice.*

A. Touching the Points. Another very effective method of enhancing the sensation of Chi at each center is to touch that point with your hand and focus behind the point of contact as you go through the Microcosmic Orbit meditation. To use this method, keep the right palm over your navel and move the left hand or fingers to touch whatever point or energy center you are focusing on. You can either place the palm so that the Lao Gung point on the center of your palm is directly over that point, or you may simply touch the point with the three middle fingers (Fig. 4.22). (This is useful in places where it is too awkward to use the palm.)

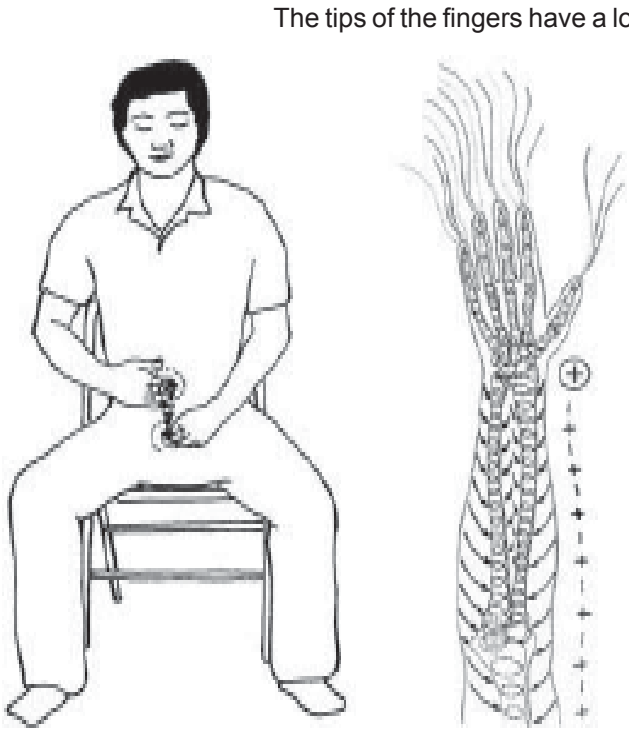

Fig. 4.22 *Touching the Navel and Sexual Center.*

The hands have abundant Chi flowing into them, and they can help guide additional Chi into the energy centers to activate them. Touching the points will also help you focus more attention on those areas. The more you focus the mind/eye on each point, the more Chi gathers there, Eventually, with practice, you will become more sensitive to the subtle sensations of Chi at each center, and you will no longer need to touch each point. In the beginning stages, however, touching the energy centers will help your practice of the Microcosmic Orbit meditation immensely.

B. Holding the palms above each point.

In this technique, the emphasis is on healing. It can help enhance your concentration and increase your inner sensitivity to the organs, glands, and nervous system. By holding the palms over each center and adding their external focus to your mental concentration, you can help guide and condense the energy into each center (Fig. 4.23).

Palm Lao Gung Point (Pericardium 8 Point).

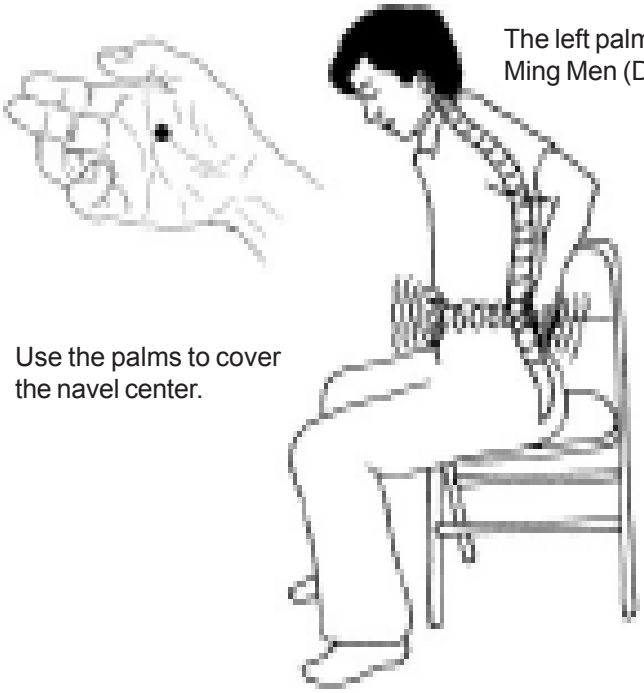

Fig. 4.23 Use the Lao Gung point on the palms to cover the navel and the Ming Men point.

Hold the hands about two or three inches away from each station until you feel the energy radiating from the palms into each center. This method can also be used for self-healing on any part of the body that needs it, including the internal organs and glands. Just use the mind to channel the Universal Force (or light) through the palms to any painful areas.

Using the hands this way also helps focus the attention so the mind doesn't wander during meditation. At this level of your practice, you may feel the energy has started to move deeper inside you. As you learn through practice to see and feel deeply into the organs, your ability to sense the connecting energy channels will improve greatly.

3. Using Breath to Regulate Chi Flow

A. Small Sip Breathing to stimulate Chi flow. Small Sip Breathing stimulates Chi flow into the olfactory nerve. Long Sip Breathing stimulates the thalamus, hypothalamus, and pituitary gland, which activates the center of the brain and stimulates the nerves (Fig 4.24 and 4.25).

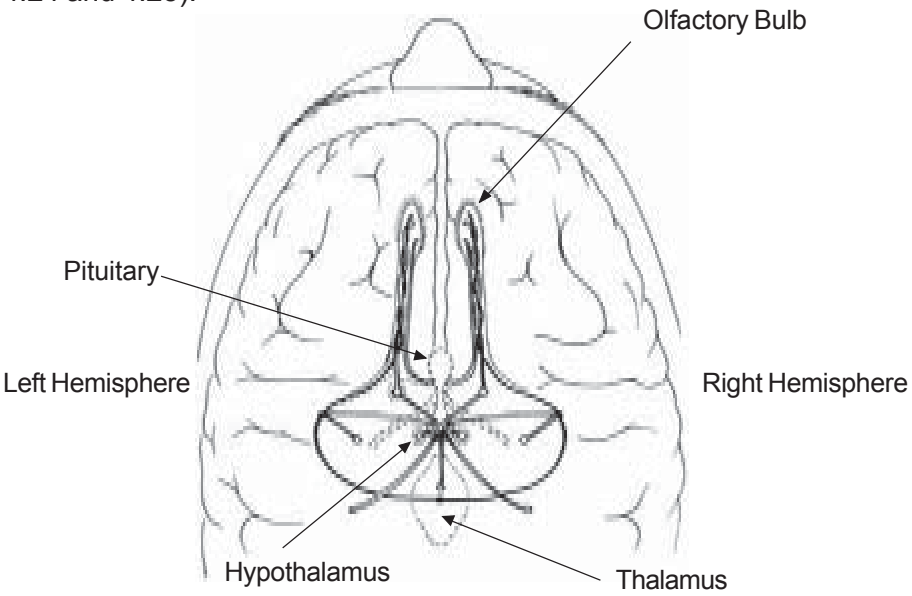

Fig. 4.24 *The olfactory nerve has a connection to the thalamus,hypothalamus and pituitary glands. The olfactory bulb connects the hypothalamus to all the other glands.*

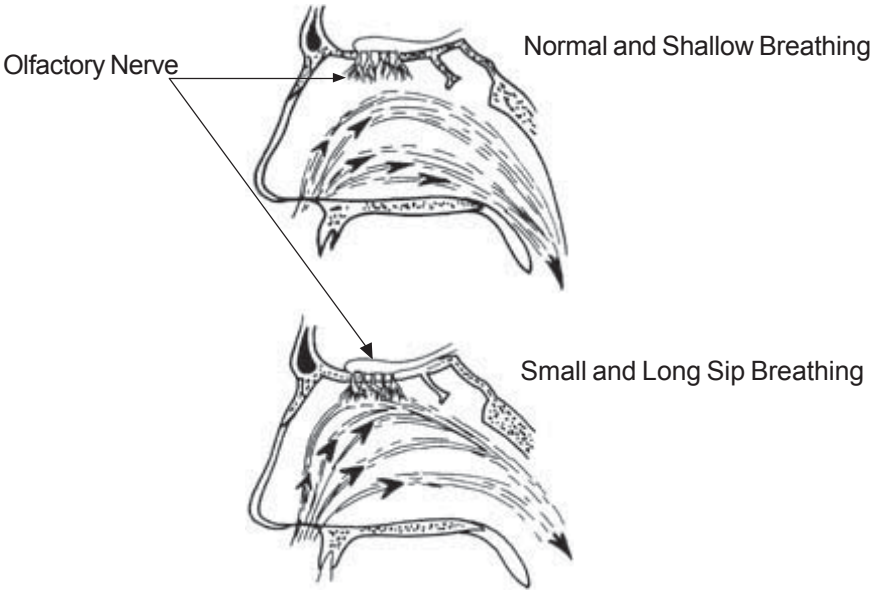

Fig. 4.25 *Normal and shallow breathing will not stimulate the olfactory nerve. Small and Long Sip Breathing will stimulate the olfactory bulb and thereby all the other glands.*

Small Sip Breathing combines the powers of the mind, the eyes, the heart, and the breath to open any energy point (Fig. 4.26). For this technique, you will need to hold the breath, as this condenses more Chi into each point. With each inhalation you will take three, six, or more shallow sips of air. (Those who cannot comfortably hold their breath for long periods should practice using the other methods until their capacity improves.) Small Sip Breathing is especially useful for people with low energy, or for people with normal energy levels who nevertheless cannot feel any Chi flow.

Caution should be used with this and any other ChiKung practice that alters the natural pattern of breathing. In some cases, when the chest is too tight or the abdomen feels too full, holding the breath can cause chest pain. People with lung and heart problems, glaucoma, high blood pressure, hemophilia, arteriosclerosis, or other serious problems should not use this method.

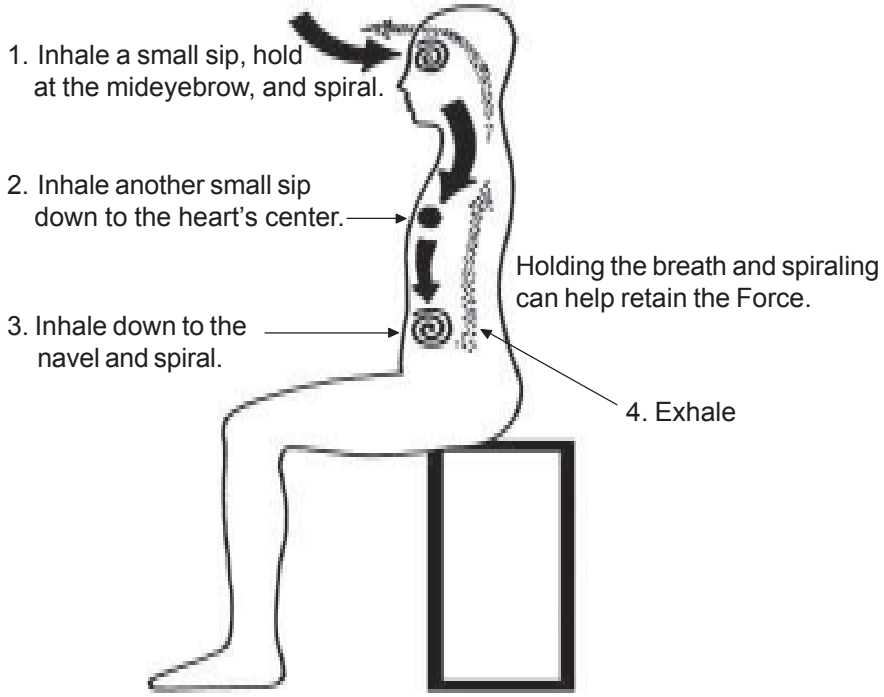

Fig. 4.26 *Small Sip Breathing combines the power of the mind, the eyes, the heart, and the breath to open any energy point.*

1. Inhale several small sips of air without exhaling, then hold the breath for five seconds as you spiral the energy at any given center. Then exhale, rest, and repeat.
2. Now focus the attention at the navel. Inhale three to six small sips toward the navel without exhaling. Exhale, condense, and retain the energy of the breath at the navel with mind/eye power.
3. You take three to six short sips into each point at first. After a while, you may need to sip only one to three times into each point to activate it, and then go on to the next point without exhaling if you are still comfortable. As you progress, you may be able to cover several points in one inhalation.

Caution: be sure to exhale anytime you feel uncomfortable or short of breath! The practice is not enhanced by holding the breath longer if you are straining to do it. Do not strain! Remain relaxed and comfortable.

B. Long Sip Breathing to calm and condense the essence of Chi (Fig. 4.27). Long Sip Breathing is useful for anxious or hypersensitive persons, for acute pain, and for emotionally or mentally disturbed states of mind. It is also used for the transition from Small Sip Breathing to a deeper meditative state.

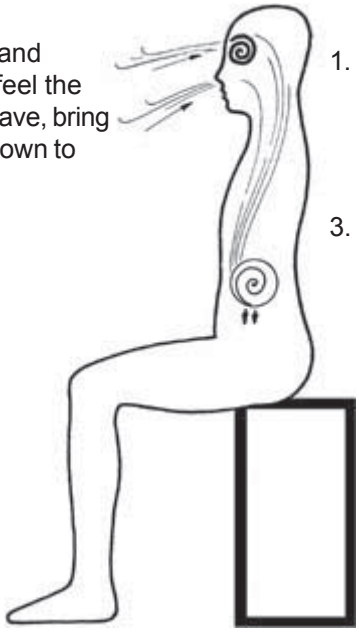

Fig. 4.27 *Long Sip Breathing*

1. Be aware of the iris and sphincter muscles of the eyes, mouth, anus, and perineum.
2. Inhale lightly and contract the iris and sphincter muscles. Breathe slowly and gently, as if you were pulling a strand of silk through the mideyebrow and down into the mouth, and slowly draw the breath to any given point. Start by practicing at the navel.
3. Then exhale and relax all the muscles, exhaling slowly and softly into the point, and feel that you are retaining the essence of Chi there (even though you are breathing out). At the end of the exhalation, condense the Chi into the point. Pause for a moment at the end of the exhalation. As you pause, you will feel more energy as your breath activates that point.

Make sure to keep 95 percent of the awareness on the Original Force behind the navel and in front of the kidneys (even while you are focusing on other points along the channel).

C. Internal Breathing: Spontaneous pulsation of Chi.
There are thousands of Chi Kung breathing techniques. These techniques can be very helpful in moving and directing energy in the beginning. Eventually you will want to move beyond them, to "graduate," and allow the inner breath or Chi to circulate naturally through the mind/eye/heart power.

Internal Breathing is a much gentler and safer method than Small Sip Breathing. In this method, your breath must become long, slow, soft, quiet, gentle, smooth, deep, and even. At no time should the breath be forced to be longer, slower, softer, and so forth. Instead it should be like water: if water is left alone, any sediment gradually settles to the bottom, and the water becomes clear without any effort being made to filter it. Similarly, the waves on the surface of the water gradually subside and the surface becomes calm and still like a mirror.

In Taoism we often refer to the power of *Wu Wei* or "not-doing." We say that by not doing, nothing is left undone, and things take care of themselves. That is how we achieve Internal Breathing: when we let go of trying to breathe in any special way, the body takes over, and the natural state of Inner Breathing arises by itself. At higher levels, the out breath may cease completely for short periods with no ill effect.

This induces a state of deep relaxation and heightened inner sensitivity. The flow of the Internal Breath and Chi will move at its own pace, and the Chi flow will in turn guide the pace of the breathing.

Preparing for the Microcosmic Orbit Meditation

Prepare the Environment

Find a quiet place to meditate. When you are beginning the practice of meditation, it is best to find a place where there are no distractions. However, once you have mastered the Microcosmic Orbit meditation, you will be able to meditate anywhere: while you are walking, standing in line, driving your car, or lying in bed, or just about anytime.

Some places have naturally peaceful Chi, and just being there will help you get into a meditative mood. Meditators have tradition-

ally sought out mountains, forests, caves, gardens, monasteries, or beautifully designed meditation rooms. Once you have experienced such a place, you can just recall it. Most of us live in the city or suburbs and lead active lives. You will do fine to set aside a room or corner of your room for your practice and recall your connection to the forces of nature.

Keep your meditation place clean and pleasant. Decorating it with fresh flowers or plants can also be helpful. (Cactus plants are not usually conducive to energetic meditations, however.) Some plants or flowers may not agree with your energy; some can actually drain you or make you ill. The way to find out is to stand in front of plants, trees, or flowers and extend your right hand to feel them. Train your right hand to scan them for positive energies, and train your left hand to scan them for negative energies. Try to feel any good sensations through your right hand first, then shake your left palm loose and put it over the same plant to feel any negative sensations. Whichever hand receives the sensation indicates the plant's energetic output; you should not feel good and bad sensations from the same plant. Try to feel the difference between the two hands. You should be able to distinguish a good feeling from a bad one.

After your right hand has learned to feel positive energies and your left hand can feel negative energies, comparisons will become easy. If you like a particular sensation, bring it within yourself, and feel how it affects you and your energies. If you don't like the energies you feel from a plant, move it out of the room or get rid of it. (Once you have felt a good sensation, you shouldn't feel anything negative coming from the same plant.)

A pleasant work of art or a picture of a natural setting will also help create a meditative atmosphere. It is best if the space you set aside has a feeling of privacy and is not near an area through which people may travel and interrupt your practice. When you meditate, keep all pets away from your space. Pets have their own energies, which may confuse or disturb your energies. Their odors can also distract you when you are trying to quiet down.

Avoid interruptions. You will do better in your practice if you strategically plan not to be interrupted. Plan to meditate early in the morning before other people are awake and before the phone starts ringing. The morning is usually best because the body is rested, the air is fresh, and the earth itself is energized. Late at night is also fine if you are a night owl. The major point is to select a time that works well for you with your own rhythms and schedule.

When you are preparing to meditate, turn the answering machine on and your telephone ringer off, or take the phone off the hook. If you have to meditate when other people are in the house and awake, make an agreement with them not to disturb you while you are meditating. If they are not sympathetic to meditation, tell them you are resting, which indeed you are, and that you are not taking any calls.

Every person has the right to some quiet time to recharge, and this is exactly what meditation is. When you are recharged, you have more to give others. If you do not take care of yourself, at some point others may have to take care of you!

Physical hygiene is a habit with most of us; we would not think of going a day without brushing our teeth or combing our hair. Mental hygiene is even more important, yet most of us neglect it. If you allow yourself time each day to cleanse your emotional, energetic, and physical bodies, you will soon reap the rewards in every area of your life.

Conserve Energy and Purify your Body with an Appropriate Diet

During the beginning stages of learning the Microcosmic Orbit meditation, it is best to conserve your energy and purify yourself. If you can, abstain from sex for the first 100 days of practice to conserve sexual energy and to build up a reservoir of surplus Chi to aid in opening the Microcosmic Orbit. Intentional celibacy can be easy and quite pleasurable when practiced using Taoist methods to strengthen your sexuality. (Refer to other Universal Tao books on cultivating sexual energy to gain a clear perspective on this.)

Taoists believe in moderation, realizing that celibacy is very difficult for many people, so this is only a recommendation, not an absolute requirement. It will also help to reduce the amount of meat, fish, and poultry you eat and to increase the amount of fiber in your diet to clear your digestive tract. Unless your dietary needs are completely vegetarian, it is recommended that you eat about 80 percent grains and vegetables, 10 to 15 percent fish, and only 5 percent meat and chicken during your first 100 days of practice.

Loosen, Stretch, and Warm Up the Body *Before Meditating*

Once you have a quiet place and are ready to meditate, it is very helpful if you first spend a few minutes loosening up the body, particularly the spine, before you sit down to practice.

In the Healing Tao, we like to do some stretching exercises, Chi Kung, and Tai Chi before sitting down to meditate. These exercises are both invigorating and relaxing; they relieve muscle tensions, stimulate the blood circulation, get rid of stale air in the lungs, and oxygenate the blood. If you are unfamiliar with these exercises, you can take a relaxing stroll outside before meditating instead. Doing some movement before entering the stillness of meditation will add to the richness of your sessions. It can help you shake off the sluggishness that comes from being too sedentary and can also ease the tensions that might build up during a hectic day. Then when you sit down, you are ready to begin. Use the exercises in the Appendix at the back of the book to loosen your spine first, such as:

Spinal Cord Breathing
Spinal Cord Rocking
Crane-Neck Rocking
Combined Movement Rocking
Shaking the spine up and down to loosen it

Wear Loose and Comfortable Clothing

The clothing you wear for meditation should be loose and comfortable. It is very important that your clothes restrict neither the Chi flow, the blood circulation, the nervous system, nor the breathing. Tight clothes may be attractive and fashionable, but they are usually not suitable for practice. Warm up outfits or sweat clothes are excellent for practice, and long skirts are fine for women. Shorts are also fine in warm weather. Elastic waistbands are best, as they do not impede breathing. If your outfit does not have an elastic waistband, it is often a good idea to loosen the belt and perhaps the top button of your lower garment so that the lower abdomen is not restricted.

Many people are more comfortable meditating with their shoes off; it helps create a more relaxed feeling. However, if your shoes

are comfortable, it is all right to leave your shoes on while practicing. Because you will be sitting still for a while, it is often a good idea to dress a little more warmly than you might think necessary if the weather is on the cool side, especially since your body may tend to cool down. This is not always the case, however; some people become quite warm during the practice, so use your own judgment.

It is preferable to wear clothing of natural fibers so your body can breathe. Synthetic materials tend to close the pores of the skin, impeding its ability to absorb energy. People who cover most of their bodies with synthetic socks, pants, and shirts often become closed to external energies. Because the head is the only area exposed to external Chi, all interactions between the body's energies and the external Chi must occur there. This causes too much heat to rush up to the brain. This is especially problematic for people who are mentally oriented. When most of the body's parts are sealed off, more internal energy rises to the head, causing overheating and even hair loss. During meditation, all the pores open wider, and breathing in energy through them requires looser clothing. When you have learned to breathe through the skin, your body will need to contact more fresh air.

Establish a Stable Sitting Position

The body must be stable for the mind to be stable. It has been said "An anxious mind cannot exist in a relaxed body." The mind and body are clearly connected, and when the body and breath become peaceful, the mind easily follows.

If your posture is firm and balanced, it will be easy for you to relax and you will already be halfway toward achieving a tranquil and focused mind. Conversely, if your posture lacks balance and stability, your muscles will soon tire and become tense. You will find it difficult to relax, and your attention will waver like a candle in the wind. Thus it is well worth taking a few minutes to adjust your posture.

There are seven points to consider in preparing a good meditation posture: base, hands, spine, shoulders, chin, eyes, and tongue.

1. Base: Your base is the foundation of a good meditation posture, so it is the first point on which to focus. Many styles of meditation advocate sitting on the floor in cross-legged or lotus position. The advantage of these postures is that they help gather the Chi of

the extremities in toward the center of the body, which can be beneficial. These postures can also be very stable if one can sit in them comfortably. The full lotus posture (also called the full-locked position) enables one to sit in deep samadhi-like meditation for hours, days, or weeks, and to go out of the body without falling over (Fig. 4.28).

Fig. 4.28 *The advantage of the lotus position is that it helps gather the Chi of the extremities in toward the center of the body.*

The disadvantage of these postures is that they do not always accommodate the movement of internal and external forces tapped in the Taoist practices. In all energy-oriented disciplines, including the Microcosmic Orbit meditation, one needs to establish a good connection with the earth's energy to stay grounded. The more Chi one moves through the body, the more important grounding becomes to prevent overheating of the organs and other negative side effects. The soles of the feet provide an ideal connection to the earth through the Yung Chuan (Bubbling Spring) points. These are specifically designed to absorb the earth's energy and conduct it up into the body. The legs also help filter the raw energy to make it more readily digestible; crossed legs cannot do this.

Most people who are used to sitting in chairs are neither comfortable nor stable sitting on the ground for long periods of time. For this reason, being required to sit on the ground to meditate can present a real obstacle. To facilitate practice and properly absorb the earth's energy, it is recommended that you sit on a chair to practice the Microcosmic Orbit meditation. A dining room chair or a padded folding chair would be the best choice.

Your weight should be evenly divided over four points, just as the weight of a table is distributed between its four legs. For us, the four points are the two feet and the ischial tuberosities, or the two points of the ischium (sitting bones) (Fig. 4.29). The feet should be placed flat on the floor at about the same distance apart as the hips. They should neither be drawn in too close to the chair nor extended too far away, and the calves of the legs should be vertical, like pillars. If possible, try to have the knees and hips at the same level, or keep the knees slightly higher.

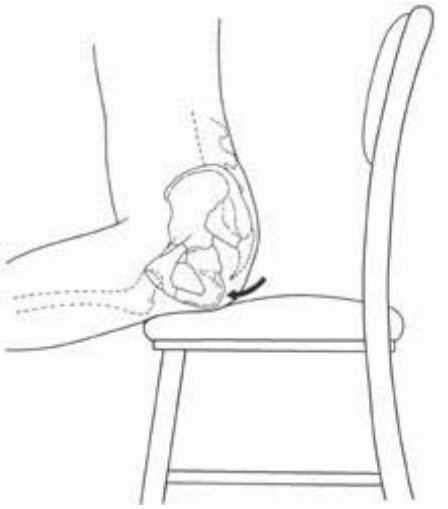

Fig. 4.29 *Sitting Bones*

The part of the pelvis known as the ischium is structurally designed to hold a tremendous amount of weight. Architects have copied its design to use as a base for skyscrapers. Many people have the bad habit of leaning back and sitting on the coccyx and sacrum instead of the ischium. This puts pressure on the sacrum, which is one of the major pumps in the spine for cerebrospinal fluid, a vital cushion for the nervous system. It is therefore wise to honor Mother

Nature's design by sitting on the ischium and not on the tailbone. Once you have found an appropriate base position, check to make sure your weight is evenly distributed over the four points. Then you will have established a solid base to support the body during meditation.

2. Hands: Let your hands rest in your lap, clasped together with the right palm over the left palm and the right thumb and forefinger wrapped around the base of the left thumb. If it feels more comfortable, it is also fine to place a pillow on your lap and rest the hands on the pillow in the clasped position (Fig. 4.30). We use different hand positions for different forces, and these will be discussed later on.

Fig. 4.30 *Using a small pillow helps release shoulder stress.*

There are probably as many different hand positions (often called mudras) as there as different systems of meditation. Those who have learned other systems of meditation may be attached to the mudras they have previously learned. We recommend that you use the hand position described above. It works especially well to consolidate and balance the energies generated during the Microcosmic Orbit meditation. Also, if you use another hand position, it may trigger old associations, and you may discover in the middle of your session that you are unconsciously doing your old meditation practice instead of the Microcosmic Orbit.

3. Spine. The spine should be straight but not stiff, and in good vertical alignment with gravity. You may find it helpful to imagine your head is being pulled up by a string. As the head rises, allow the spine to elongate, increasing the space between each vertebra (Fig. 4.31).

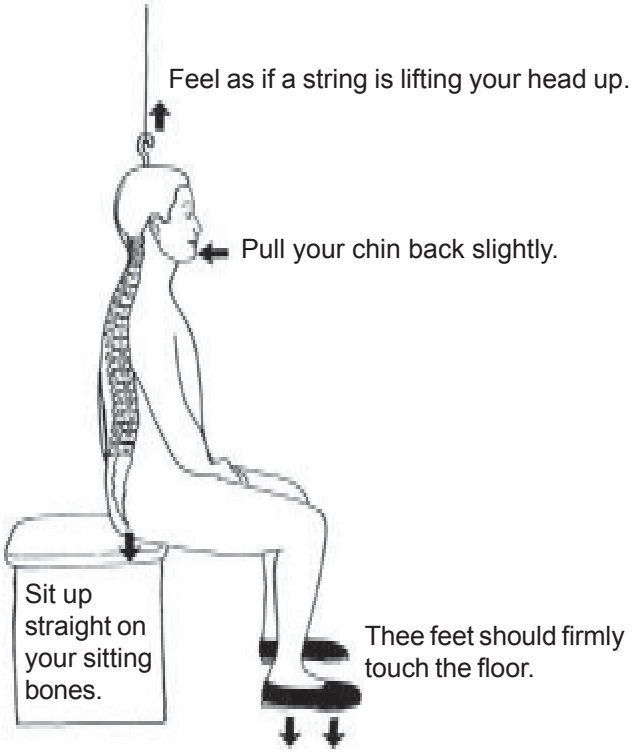

Fig. 4.31 *Correct Sitting Position*

Some people find their backs become tired during long rounds of meditation. Good alignment is very helpful in preventing this, because it takes some of the stress off the muscles and puts it instead on the skeletal structure where it belongs. The skeletal structure can support hundreds of pounds without effort when properly aligned. Practicing Iron Shirt Chi Kung and Tai Chi can also be very helpful for strengthening the muscles you use in sitting and for learning the body mechanics of good alignment.

The spinal column houses many nerves, and it is also a major part of the Microcosmic Orbit pathway. If the spine feels relaxed, clear, and open, the mind will feel more awake and alert too. (See the Appendix for Spinal Cord Exercises.)

4. Shoulders: The shoulders should be relaxed and balanced over the hips. The armpits should be slightly open, allowing enough space to hold a Ping Pong ball (Fig. 4.32). This permits free circulation of blood and Chi into the arms and also keeps the nerves flowing into the arms from being impinged.

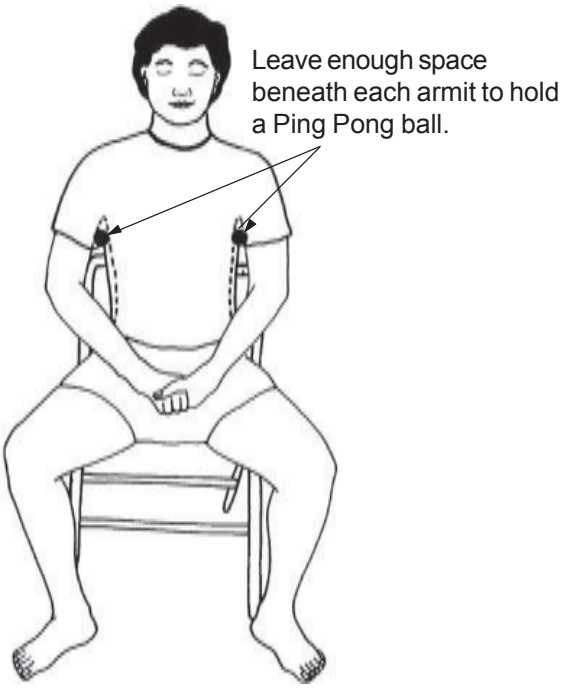

Fig. 4.32 *Arms' Position*

5. Chin: The chin should be drawn back slightly so that the ears are over the shoulders. This should be done with as little strain as possible; if you strain too much to bring the head back, your muscles will soon tire and you will not be able to hold still in your position through the entire round of meditation.

6. Eyes: Your eyes should generally be closed during the practice. This eliminates visual distractions and helps you turn the attention inward. It is also more relaxing to have the eyes closed. If you are not comfortable having the eyes closed, or if you become sleepy or start to lose your equilibrium, it is all right to have the eyes slightly open with the gaze directed downward, or focus on the nose, and from the nose focus into the heart. You can open the eyes for a while if you feel sleepy or distracted, and then close them as you turn your focus inward (Fig. 4.33).

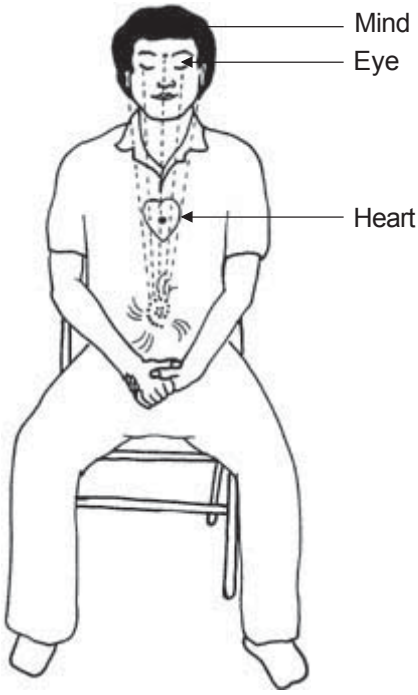

Fig. 4.33 *Turn the mind and eyes inward. Focus into the heart and then down into the navel.*

7. Tongue: The tip of the tongue should be touching the upper palate (Fig. 4.34). This connection acts like a switch in that it connects the Tu Mo and Ren Mo, the Governor and Functional Channels. The exact location of the connection point may vary. Traditionally there are three possible locations: the Wind Point, the Fire Point, and the Water Point (Fig. 4.35).

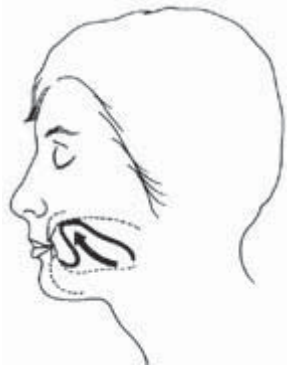

Fig. 4.34 *Touch the tip of your tongue against the upper palate.*

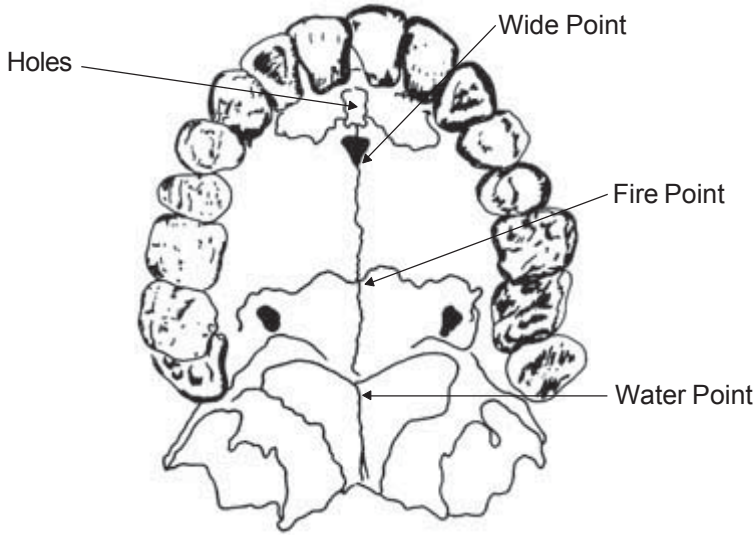

Fig. 4.35 *Palate*

Wind Point: The Wind Point is on the hard palate about one-half to one inch from where the teeth and gums meet. This point of contact is recommended by most Tai Chi and Zen masters; however, the Taoist classics warn that if the tongue is held in this position, one may develop "internal wind" and become sleepy. In some Taoist systems, the tongue is held in this position to aid the energy flow in the Wind Pathway.

Fire Point: The Fire Point is on the middle of the palate. The Taoist classics caution that if the tongue is held in this position, the mouth may become too dry. In some Taoist systems, the tongue is held here to facilitate the energy flow through the Fire Pathway.

Water Point: The Water Point is toward the back of the mouth where the hard and soft areas of the palate meet. It is also called the Heavenly Pool point, because when the tongue is held in this position, the saliva tends to flow copiously. Taoists traditionally favor this point because saliva is highly valued as an expression of Original Chi, which blends with the Chi absorbed from food and drink while helping us absorb external Chi from the universe. The Water Point is also used in some Taoist systems to help the energy flow through the Water Pathway.

Even though the Water Point has some positive benefits, stretching the tongue to this point and holding it there for a long time is a

strain for many people. Yogis in India and China sometimes cut the small piece of flesh under the tongue, the frenulum, to make it easier for the tongue to reach back to this point. It is neither necessary nor desirable to go to this extreme; the points closer to the front of the mouth can be just as effective in making the connection. If you are using the Wind or Fire Point and find yourself growing sleepy or dry in the mouth, simply bring your tongue back to the Water Point for a short time until the problem goes away. Then you can return your tongue to a more comfortable position.

The best point for you to use is the one where you feel the strongest sensation of Chi. To determine this:

1. Rub the tip of the tongue vigorously from the front to the back of the palate 9 to 18 times.
2. Then, starting at the front, slowly move the tip of the tongue from the front (Wind Point) toward the back (Water Point).
3. Eventually, you will experience one or more of the following sensations on the tongue: tingling, metallic taste, electrical sensation, heat, or a general feeling of increased sensation in the tongue. This will indicate the place that is the optimal connection point for you. Your optimal connection point may vary from day to day, and it may not be in the exact location of any of the points described above. The most important factor is that a good connection is made each time you practice.

Activating the Original Force: Warming the Stove

We start the process of activating the Original Chi by focusing the attention in the area between the navel, the Door of Life, and the sexual center to “warm the stove” as a preparation for stimulating the Original Chi that flows into the body through this point. One manifestation of successfully stimulating the Original Chi is heat or warmth. Original Chi is like a battery. It provides the spark to start the energy flowing strongly through the Microcosmic Orbit.

There are five processes underlying all the practices.

1. Generating the Force to activate the movement of energy.
2. Gathering the Chi that has been generated into a Chi ball.
3. Condensing the Chi ball into a Chi dot or pearl.
4. Expanding or pulsating the Chi inside you.
5. Storing the Chi in the Tan Tien center or at any point you are working on. Rest and do nothing; allow the Chi to move itself.

1. Bellows Breathing: Generating the Force

Sit on a chair with the back straight and the feet touching the floor about as far apart as the hips. Place the hands over the navel. Start with the Inner Smile practice described in Chapter 3. Notice the sensations of energy as you smile to the area about one and a half inches behind the navel. At this time, some people may already feel a strong sensation of heat or warmth in the navel region. If not, just continue to be aware of the sensations at the navel with your smiling awareness (Fig. 4.36).

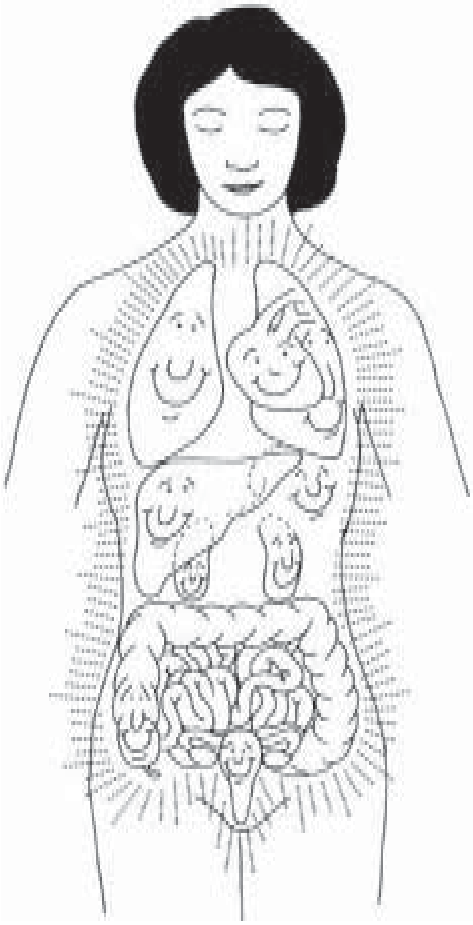

Fig. 4.36 *Smile to the organs and feel the organs smile back to you.*

When you inhale, expand the lower abdomen at the navel area (below and around it) so that it bulges outward. Feel the diaphragm descend. Then, keeping your chest relaxed, exhale with some force to pull the lower abdomen back in, as if you were pulling the navel back toward the spine. Feel the sexual organs pull up also. Repeat 18 to 36 times (Fig. 4.37)

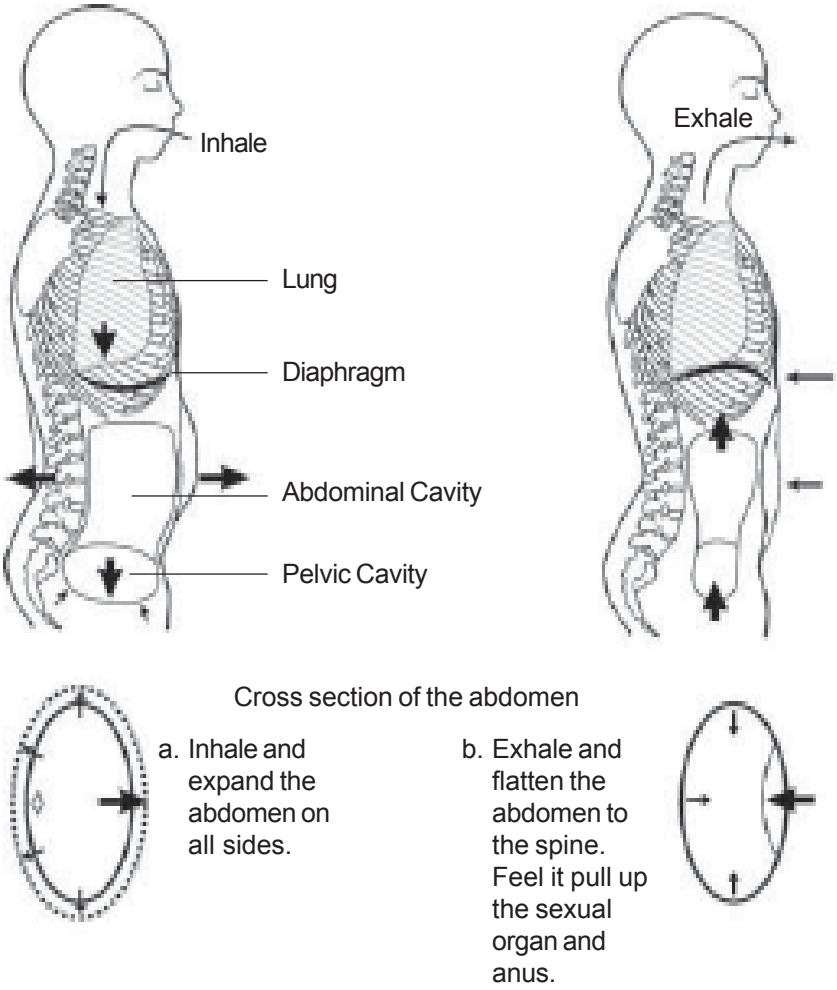

Fig. 4.37 *Inhalation and Exhalation*

This massages the organs, especially the kidneys and the aorta and the vena cava pathways to and from the heart, emptying them of trapped energy and toxins.

2. Rest and Gather the Chi at the Navel

Rest, and keep the hands covering the navel. Lightly close the eyes and use the mind/eye power to help gather and condense the energy you have been generating. (For details, see the instructions for Most Advanced Mind/Eye Training above.) Inhale, lightly contract the iris and sphincter muscles into the mideyebrow and mouth and gather the energy into a Chi ball.

Exhale very slowly down to the navel and relax all the muscles. Try to really feel the warmth. Use the mind/eye power to gather it into a Chi ball just behind the navel. For some people this is very easy, and for others it takes time. Counting from one to nine while you are focusing on the navel may help your concentration (Fig. 4.38).

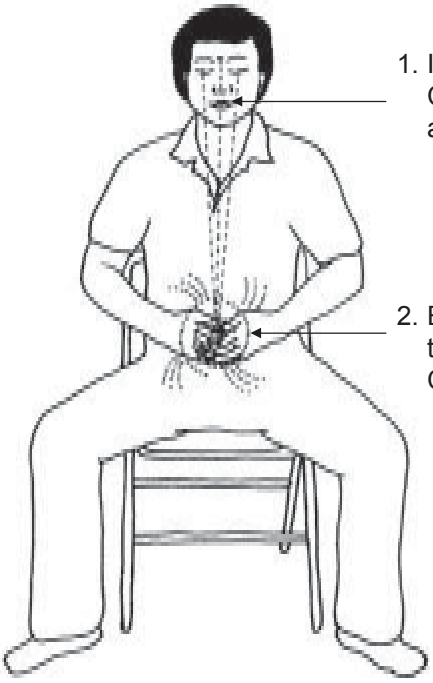

Fig. 4.38 *Gathering the force*

Condense the Chi Ball into a Chi Dot

Once you feel the warmth of the Chi ball, rest, then inhale and exhale normally. Use just the mind/eye power, not the muscles, to gather and condense the Chi.

When you exhale, feel the navel slowly begin to grow warm. Use the mind/eye power to condense the Chi ball into a Chi dot from the heat retained there (Fig. 4.39).

Fig. 4.39 *Exhale and condense the Chi ball into a Chi dot.*

For some people, using a sound helps. Repeat the word "Chi" in your mind, or count nine to one and one to nine, as you exhale and breathe down into the dot. Feel the energy in that area. When you use the word "Chi," it may help you concentrate, and you can increase the warm feeling more effectively. Feel the pulse of the aorta and vena cava in this area.

> **Note:** *Just after you exhale, you will feel something in the navel. In the beginning, the sensation may be just in the skin layer. At this time, you can increase the sensation of warmth by condensing the Chi dot up to nine times.*

Expansion or Pulsation of the Chi

When you exhale very slowly and condense the energy at one point, you will feel the Chi pack into that point. When you relax the mind/eye power, you will feel a sudden pulsation, like a mini-orgasm or explosion in the mind and the point or center you are working on. The Chi pressure moves the Chi with great force. Sometimes the Chi suddenly goes to the crown, to the feet, to the hands, or to the back. The condensing and pulsation happen automatically (Fig. 4.40).

Fig. 4.40 Relax and feel an expansion or pulsation.

Storing the Force

Once you can feel the Chi condensing and expanding, keep the mind/eye power easily focused at any given point. The Chi will feel stronger and more stable and will not scatter or weaken. We call this stage Storing the Force. Once you have achieved this relaxed state of concentration, the Chi may move on its own power to heal or balance you in any part of your body-mind.

Radiance Practice: Now move the hand about two or three inches in front of the navel and see if you can still feel the sensation of warmth radiating around you and protecting your energy field. This practice trains the mind, eyes, and heart to cultivate the energy. In the beginning you will just feel the warmth in the skin layers. That is enough for now. Later you will feel it radiate into your entire aura.

Rest, and relax the body and mind for a moment. Feel the energy around the navel area. If you have digestive problems, the abdomen may be cold at first. As you progress in your practice, it will feel warm, and the problems may improve.

3. Loosening the Intestines with Spiraling Movements

1.Cover the navel with the hands. Lightly massage the abdomen and intestines by moving the hands in clockwise direction, from the bottom to the right to the top to the left (Fig 4.41).

2. Pay close attention to what you are doing as you begin to slowly circle your hands around your abdomen and simultaneously use the stomach muscles to move your body in a spiraling motion This is very important, because it activates the intestines. When the Chi is stuck in the intestines, the Chi does not move well throughout the whole body. Do this 36 times.

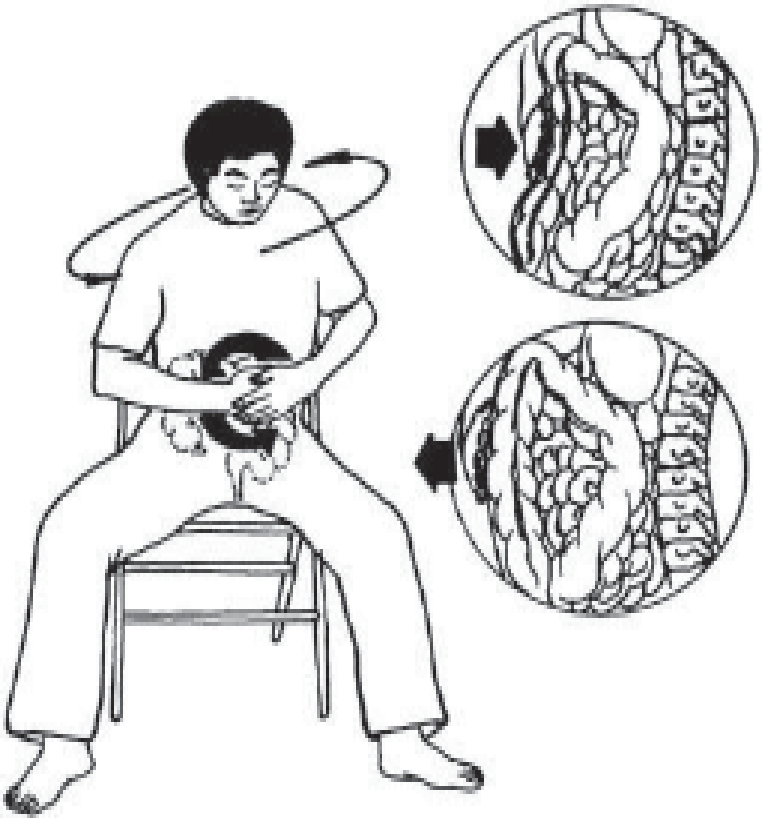

Fig. 4.41 *Massage the abdomen.*

3. Then rest. Close the eyes, keep the hands over the navel, relax, and feel the navel's warmth. Exhale into the navel, sending the essence of the breath to the navel.

Although you will exhale, you will feel something going down into the navel. When you feel the energy, gather it into the Chi ball you have previously formed at the navel.

4.Rest. Just sit back quietly, but still feel the pleasant, warm sensation inside you. These two exercises will help you warm up the navel.

4. Warming Up the Kidneys and Activating the Door of Life

Moving the Chi between the two kidneys is very important in Taoism. We believe the kidneys store part of the Original Chi. They also store sexual energy, activate the Chi in the two kidneys, and balance them in the Door of Life. To do this practice, close the eyes, and see the kidneys with the mind's eye. Taoist practice depends heavily on this mode of internal sensing, because all the organs are connected with the universe. If you want to access the universe, you must access it through the subtle energies of your organs (Fig. 4.42).

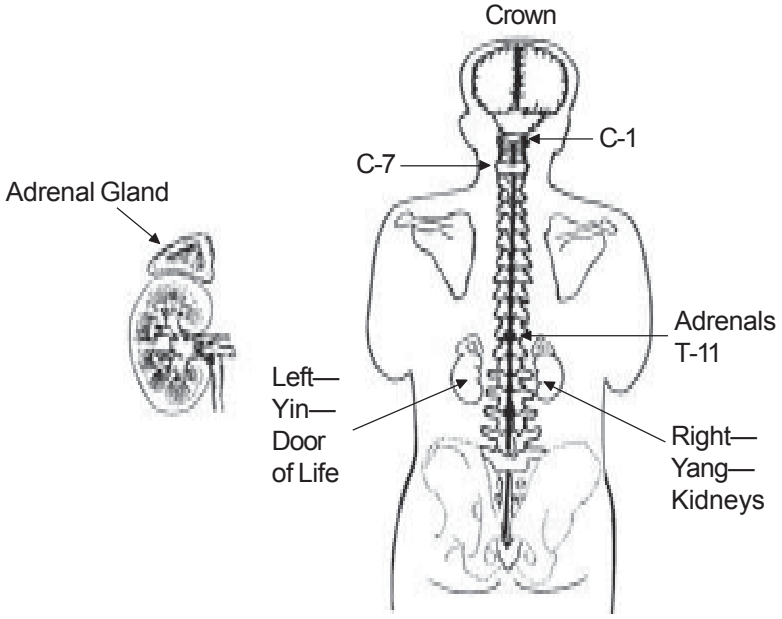

Fig. 4.42 *Warm up the kidneys and activate the Door of Life.*

Generating the Force

1.Put the right hand over the right kidney and place the fingertips of the left hand just above and to the right of the navel. Inhale and exhale to the right kidney as you make a spiraling movement with the waist and pull the right side of the stomach in toward the right kidney. When you pull the stomach in toward the back, you will feel something in the back; that is your right kidney. Repeat 9 to 18 times.

2. Rest. Keep the hand on the back over the right kidney. Now compare your right side and your left side. You may feel the right side is more open, warmer, and lighter. When you do the exercise with awareness, you are starting to direct energy into the area at the kidneys.
3. Put the left hand on the left kidney and place the fingertips of the right hand just above and to the left of the navel. Repeat the steps for Bellows Breathing and Loosening the Intestines described above, but spiral at the waist to the left side (Fig. 4.43).

Fig. 4.43 *Massage the kidneys and spiral the lumbar region to help open the Door of Life.*

Gathering the Force

4. Rest. Now put the right hand on the navel and the left hand over the Door of Life (located on the spine opposite the navel and between the two kidneys). Close the eyes and just be aware of the warm feeling at the Door of Life. Relax, inhale, and very slowly exhale to the Door of Life. Use mind/eye/muscle power to form a Chi ball at the Door of Life. Repeat 9 times. Feel nice and comfortable (Fig. 4.44).

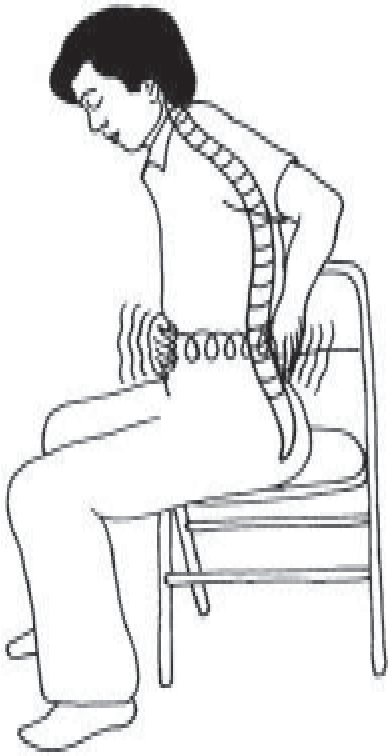

Fig. 4.44 *The right palm covers the navel; the left palm covers the Door of Life.*

Condensing the Force

5. The exhalation is very important. The energy of the out-breath is gathered by the mind. Condense it and relax; let the energy pulse or expand into the kidneys. When you feel a lot of energy generated, gather the energy into one dot or pearl of light between the kidneys at the Door of Life, using the word "Chi" to help you concentrate.

6. Next, store the Chi between the kidneys. Relax the breath and let the energy flow, but keep the mind focused between the kidneys.

5. Activating the Original Force

1.Place one hand over the Door of Life and the other hand over the navel. Feel the navel become warm. When you feel both hands become warm, they will activate together. When you feel the navel and the Door of Life are warm, picture in between them, in the center, a single yellow ball of fire or red flame of energy about the size of a Ping Pong ball. We call this "the Original Energy in the center."

2.Direct the mind's eye to look inward down into the center, and focus 95 percent of the awareness on the warm Chi ball there. Use the other 5 percent to gather the energy from the front (navel) and back (Door of Life) into one ball in the center (Lower Tan Tien). As the fire in the Tan Tien grows warm, the navel and Door of Life will also grow warm. All you have to do is warm the navel and Door of Life, let the warmth condense into the two Chi balls, and draw these two Chi balls or dots together; the space in between will start getting warmer by itself (Fig. 4.45). We call this "Training the mind to gather and condense the Force."

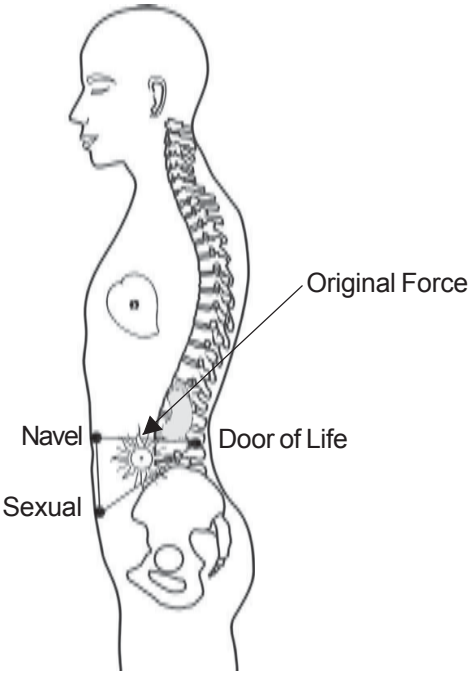

Fig. 4.45 *Original Force*

3. Now bring the hands back to the front and cover the navel, but still be aware of the center. When you feel the center become warm, continue to exhale into it, and say the word "Chi." Even though you are exhaling, feel that you are still retaining the energetic essence of each breath at the center. Exhale, pause, and just use the mind and the word "Chi" to concentrate on that dot. The dot will feel warmer. Rest.

4. Gather some saliva (which the Taoists traditionally refer to as the Jade Nectar or the Water of Life) by rolling the tongue around in the mouth. When you have accumulated a good amount, swallow the saliva and direct it with the mind down toward the Tan Tien. At the same time, use the mind power to warm the Tan Tien region. Be aware of the pulse at the Tan Tien and focus the mind on it. As the region starts to heat up, let the warmth radiate out, extending back toward the kidneys and pulsing down toward the sexual organs. Enjoy this pulsing feeling as the red dot or Chi ball at the Tan Tien expands and contracts rhythmically.

6. Activating the Sexual Energy Center and Amplifying the Original Chi

1. **Men**. Gently massage the kidneys, the testicles, and the navel area. **Women**. Gently massage the breasts, kidneys, ovaries, and waist (for more detail, see Chapter 10).

When you feel the energy begin to expand at the sexual center, move the palms to cover the sexual center. Using mind/eye power, lightly contract and relax the muscles around the eyes. Also lightly contract and relax the circular testicle/vaginal and anus muscles several times. This will help gather the sexual energy you have activated.

2. Pause for a while. Feel the energy expand at the sexual center.

3. Cover the sexual center with the left hand and the navel with the right hand. Feel the navel, sexual center, and the Door of Life become warm. Suddenly you will feel the Original Chi activate in the Lower Tan Tien.

4. Now it is very important to rest. Lightly, effortlessly, using only the power of the mind, eyes, and heart, feel the sexual organs and anus close and lightly pull up toward the Original Chi in the Lower Tan Tien. Draw the sexual energy up to activate and join with the

Original Chi, as if you were, sipping it up through a long straw.

5. Inhale, and then exhale down to the center spot of the Original Force. Feel a pressure there. Gradually feel the Original Force start a light suction to pull up the sexual organ and the anus toward the force. You can also imagine that the Original Force has a mouth and nose and is breathing and pulsing inside. Do not strain (Fig. 4.46).

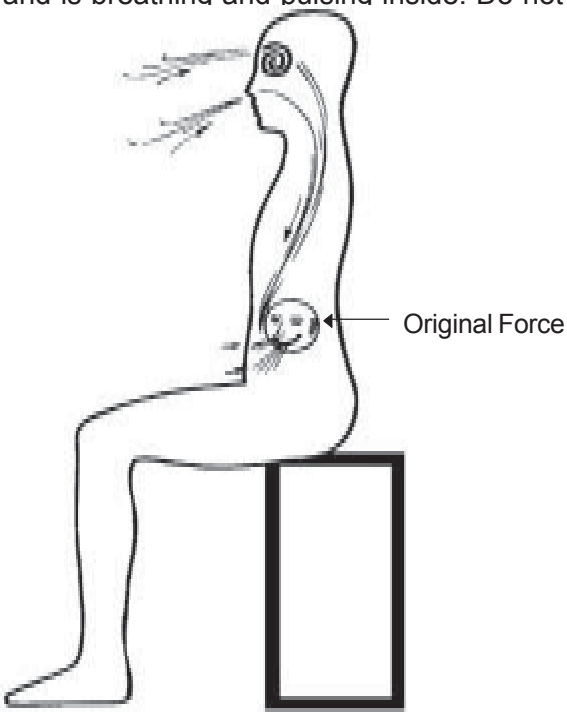

Fig. 4.46 *Feel the Original Force breathing.*

6. Use the mind and gentle breathing to amplify the pulse at the spot of the Original Chi. The aorta and vena cava pass through this area; they are the biggest circulatory pumps outside of the heart. The pulse is like a step-up transformer. When this pulse is activated and amplified, the heart does not have to work as hard, and the whole body benefits. Gathering the energy there also increases the flow of Chi and lymph. Gently press the fingers into the abdomen about an inch to the left and slightly above the navel; you will feel the pulsing of the aorta and vena cava. If you can actually feel the pulsing there, it will be very helpful (Fig. 4.47).

7. After you inhale with a feeling of gentle expansion, exhale with a slight natural contraction. Place the hands on the sides just below the ribs to feel yourself breathing from the lower abdomen. Relax the whole body, allowing the rib cage to hang gently. When you inhale, feel the sides of the lower abdomen and the lower back gently expanding in all directions simultaneously. Exhale naturally and observe the breath moving in and out of the Tan Tien.

Gradually feel the breath becoming slow, long, deep, fine, and even as it moves in and out with the Original Force (the "metaphysical womb"). Feel the breath become so fine that it seems as though you are not breathing at all: holding the essence, but not actually moving air. It may feel like pulsing, warmth, or tingling in the Tan Tien. Mentally say the word "Chi" as you inhale and exhale into the Original Force at the Tan Tien. Spend five to ten minutes with this feeling.

Collect and store the energy at the navel (see details in Chapter 3).

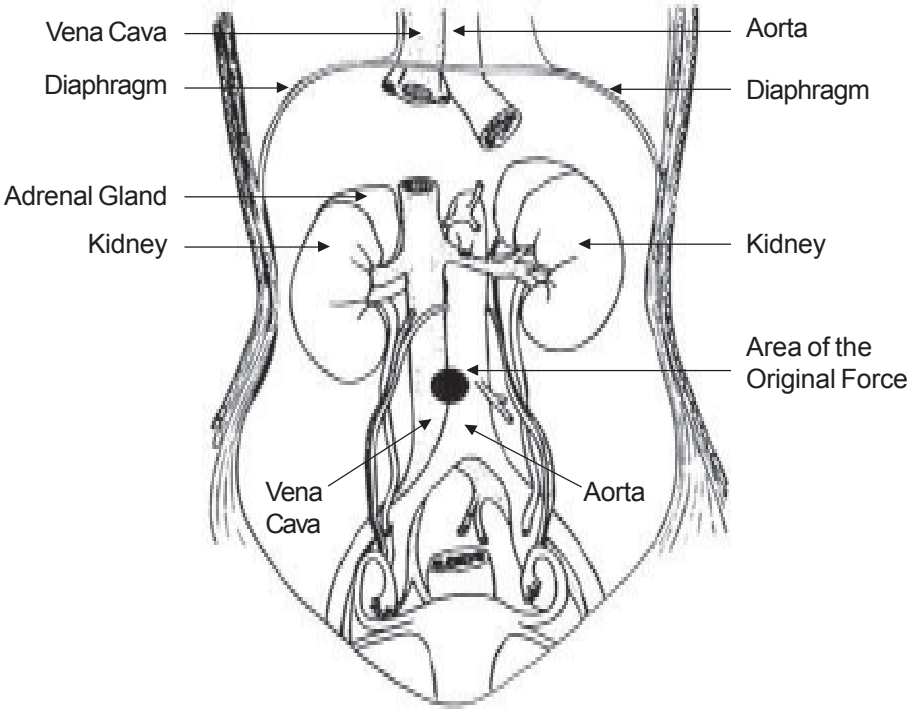

Fig. 4.47 *The aortic pulse is just above the navel and slightly off the center line.*

Daily Practice of Chi

A daily routine of Taoist meditation will help you feel happiness, joy, love, kindness, gentleness, and courage, and the Chi you generate will help you heal and maintain your body. When you are abundant with virtuous energies, they will automatically expand and radiate out to those around you. People will wonder why being near you changes their sadness into happiness and their depression into pleasure. By practicing the Cosmic Inner Smile and the Smaller Heavenly Cycle, you will receive healing light from the universe. Others will feel your energy and enjoy your presence.

When you sit down to practice these meditations, you will very quickly learn how to move energy into the Microcosmic Orbit and how to absorb the Universal and Earth Forces into the body. The more Chi you feel within yourself, the more easily you will be able to enhance your virtuous energies. If you have a lot of anger, you will also learn how to transform that negativity into positive energy. The more you practice, the sooner the healing forces will come to you.

The easiest way to feel your Chi and virtues at work is to interact with others, helping them feel the same good energies. Remember, however, that you should never interfere with another person's life just to gratify your own ego. People who truly want you to help them will always let you know it; otherwise, the best way to be of service is to exemplify the virtues in your own life. Practice with love in your heart, and others will learn from your example.

Important Points to Remember

1. The more you relax and allow the Chi inflow, the more quickly you will master these techniques. Relaxation also helps harmonize the body's energies to achieve the best results in healing. If you are too stiff when you try to meditate, you cannot get in touch with your own healing abilities. Also, if you relax too much without enough physical movement, your body will feel like it is falling apart and your Chi will drain out.
2. Relaxing the Third Eye (mid-eyebrow) will help you relax the whole body and absorb cosmic energies into the organs and bone structure.

3. When practicing, smile down the length of the spine as you look inward. Try to see your spine surrounded with Chi. You may feel warmth, numbness, or an electric current flowing through your body.
4. Feeling is the beginning of mastery. The inner senses must be developed so they can lead you to the awareness of internal energy. Taoist meditations are the most direct way to develop one's ability to feel energy and the mind/body connection.
5. The nerves in the spine serve as conductors of internal sensation. They will help you feel your internal energy flow because they are connected to all the organs, glands, and limbs of the body. Rocking the spine activates the organs and glands through the nerves. The more you remain loose, the better your nerves will conduct the impulses that sharpen your inner senses.
6. By smiling inwardly as you practice rocking, you will develop an inner balance of the energies flowing through the spine, thereby strengthening the spine and its connections to the organs and glands. This will enhance your ability to feel the organs and their energies.

Summary

Creating Bodily Awareness

1. Lightly shake the whole body
2. Open and expand the Third Eye.
3. Relax the muscles of the perineum.

Spinal Cord Breathing and Rocking

(See Appendix for details on the Spinal Cord Warm-ups.)

1. Start by sitting or standing erect with the back comfortably straight.
2. Do spinal cord breathing 18 to 36 times.
3. Hold the palms together (right over left) and rock the upper body back and forth from the waist. Relax and concentrate on releasing tensions and loosening the spine. Breathe into the spine and absorb Chi into the marrow. Keep the head and neck loose and maintain the clasped-hand position.
4. Rock the body from side to side.
5. Practice Crane-Neck Rocking.

6. Next, rotate the upper body from the waist in a circular motion. Lean forward slightly as you move to the right, then lean backward as you move to the left. The head motions should loosely follow the directions of the body.
7. Practice Circular Rocking of the upper body. First pull the right shoulder back, then pull the left shoulder back as you push the right shoulder forward Keep alternating these motions steadily with a constant flow. Move back and forth as you twist the body and keep the hands clasped.
8. Finally, combine all the previous motions while clasping the hand. You should be able to emulate a silkworm by moving the upper body in circular motions while twisting it from the shoulders. Stay relaxed and loose.
9. Rest, and smile to the spinal cord. Feel warm and comfortable.

Techniques for Enhancing the Sensation of Chi

1. **Mind/Eye Power Training**
   - A. **Spiraling power with eyes open.** *Be aware of the mid-eye brow. Lightly open the eyes and look to the front, then the right, then the back, then the left. Do this from 9 to 36 times, rest, and feel the mideyebrow open. Then repeat in the coun terclockwise direction from 9 to 36 times.*
   - B. **Mind/eye spiraling power with eyes closed.** *Close the eyes, and without moving the head look up to the crown. Move the eyes one quarter of a circle and look right, down, left, and up. Do this from 9 to 36 times, rest, and feel the mideyebrow open. Then reverse. Repeat at the navel, but rotate it front-right-back-left and vice-versa, using a small Chi ball or visualizing a spinning Tai Chi symbol.*
   - C. **Advanced mind/eye spiraling power with no physical eye movements.** *Close the eyes, and without physically moving them (or the head), use the mind to look up to the crown. Move the inner eye one quarter of a circle, and look right, down, left, and up. Do this from 9 to 36 times, rest, and feel the mideyebrow open. Reverse directions and spiral counterclockwise. Do this from 9 to* 36 *times*, *rest, and feel the mideyebrow open*.
   - D. **Most advanced mind/eye training.** *Contracting and re laxing to draw and condense. Lightly contract and relax*

the circular muscles of the iris and the muscles surrounding the eye. This automatically activates the anus and sexual sphincter muscles. Together these help you draw, in and condense energy at the advanced stages of practice described in this book.

2. Using Your Hands to Help Guide the Chi

A. Touching the points. *Use the palms or fingertips to touch each point as you focus the mind there during the Microcosmic Orbit meditation.*

B. Holding the palms above each point. *Hold the palms two to six inches out from the point. Focus the Lao Gong points in the center of the palm on that point and feel the Chi flowing between the point and the palms. Direct the energy into the point. This will increase the local energy at the point.*

3. Using Breath to Regulate Chi Flow

A. Small Sip Breathing to stimulate Chi flow. *First take a deep breath and exhale completely. Then gently breathe in three, six, or nine shallow sips without exhaling in between. Draw the energy of each breath to the point that you are concentrating on and condense it into the point. Exhale a bit and start over whenever you feel uncomfortable or short of breath. Do not strain.*

B. Long Sip Breathing to calm and condense the essence of Chi. *Inhale gently and direct the breath toward a given point. Then exhale slowly and softly into the point, and feel that you are retaining the essence of Chi there (even though you are breathing out). Condense the Chi into the point.*

C. Internal Breathing: Spontaneous pulsation of Chi. *Allow the breath to become long, slow soft, quiet, even, gentle, smooth, and deep. Let the Chi flow at its own pace, or simply use the mind to gently guide the Chi until it moves by itself. Make no effort to coordinate the Chi flow with the breathing. Just breathe naturally and let the energy move as it will.*

Preparing to Meditate
Prepare the Environment.

1. Find a quiet place to meditate.
2. Keep your meditation place clean and pleasant.
3. Plan so that you won't be interrupted; turn off the telephone or take the receiver off the hook.

Conserve your sexual and emotional energy and eat right.

Loosen your body before meditating.
Wear loose and comfortable clothing.
Establish a stable sitting posture.

1. Make a solid base sitting on the edge of the chair with the feet flat on the floor a hip's width apart.
2. Keep the hands held together resting on the lap, with the right hand over the left.
3. Make sure the back is relaxed but straight and in line with gravity.
4. Relax the shoulders and slightly open the armpits.
5. Bring the chin in slightly so that the weight of the head rests on the shoulders.
6. Keep the eyes closed (or half open, gazing downward).
7. Touch the tip of the tongue to the palate and keep it there.

Warming the Stove: Activate the Original Chi in the Lower Tan Tien

1. Start with Bellows Breathing, 18 to 36 times.
2. Rest and gather Chi at the navel with the hand covering the navel.
3. Loosen the intestines with spiraling body movements.
4. Warm up the kidneys and activate the Door of Life.
5. Activate the Original Force by drawing the energy from the navel and Door of Life and gathering it into the Lower Tan Tien.
6. Activate the sexual energy to amplify the Original Chi.

Chapter 5
Points of the Microcosmic Orbit

Two Major Channels of the Body

Through meditative practices, the ancient Taoist masters discovered a flowing current of energy in the human body. This *Chi flow* was found to follow fixed patterns through 60 major channels and approximately 365 points, or energy centers, where Chi gathers and condenses. The flow of Chi replenishes our life force. Our body's energy points have both positive and negative poles that spiral subtle wheels of energy. These points serve as focal centers through which external forces are drawn in absorbed, and transformed into life force. Higher centers, such as the crown, spiral at a higher rate than lower centers. They slow down the incoming energy, like step-down transformers, regulating and refining Chi for the body's use.

Each point produces its own quality of Chi to attract or repel energy from the other centers, to direct the Chi flow in a manner that connects the points, and to supply the proper energy to the entire body. Modern science now understands that this flow of human energy is actually an electromagnetic current. The body's many acupuncture channels serve as its "wiring," which guides the life force to nourish the organs and glands. Chi is the link between the physical body, the energy body, and the spirit body.

Knowledge of the energy flow in our bodies makes it easy to understand why the Microcosmic Orbit must be kept actively open to accommodate and enhance the movement of Chi. When we do not know how to conserve, recycle, and transform our internal force through this pathway, our energy consumption becomes as inefficient as a car that only gets five miles per gallon. By practicing the Microcosmic Orbit meditation, we can get in touch with our Chi flow and locate blockages or weak spots in its path so we can correct them. This will help us use our life-force more efficiently and achieve better internal "mileage."

The Microcosmic Orbit is composed of two channels, referred to as the *Governor* and *Functional Channels* (Fig. 5.1), which are

like two large rivers with many tributaries. Each channel supplies Chi to 12 subsidiary routes. (Both sides together comprise 24 energy pathways.) When the body is weak or ill, it cannot generate enough energy to properly nourish these meridians, which supply Chi to the organs and glands. By drawing in external energy and circulating it in the Microcosmic Orbit, you can fill these meridians and enhance all internal functions.

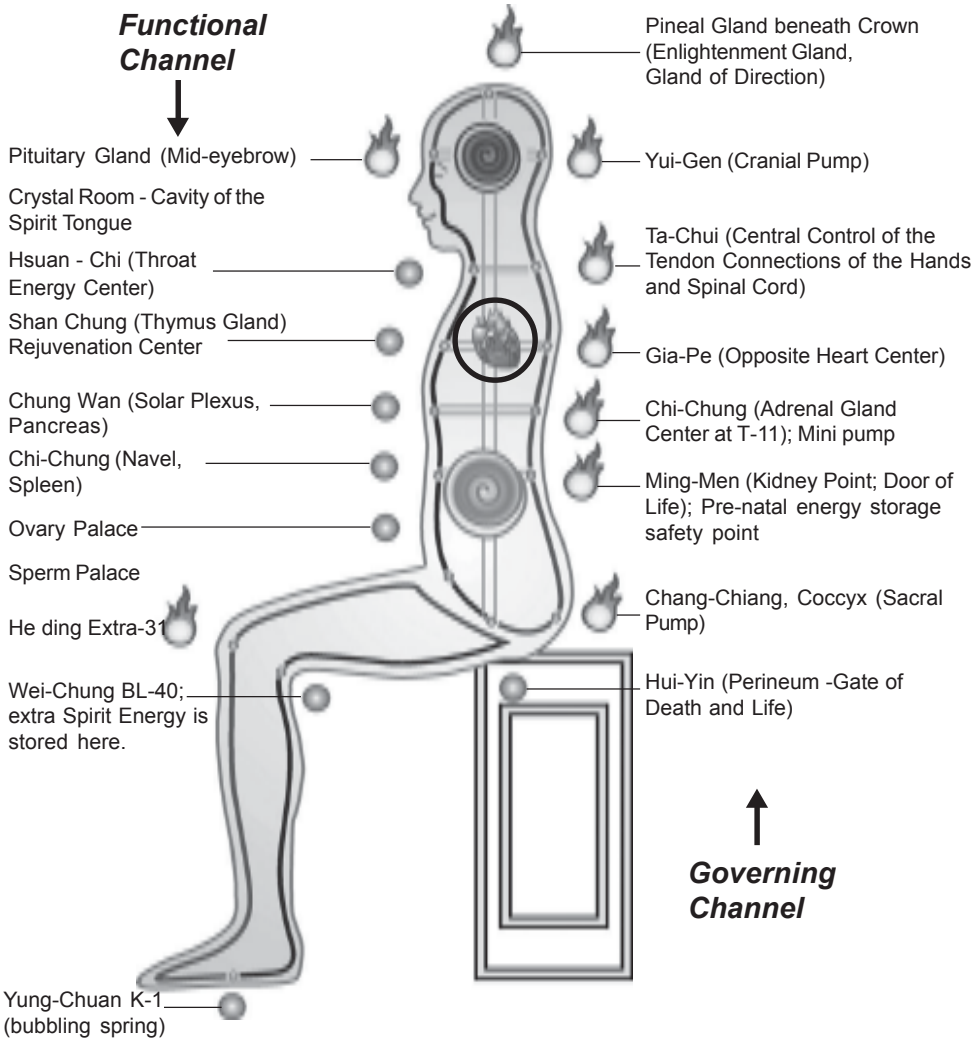

Fig. 5.1 *Learn to circulate your Chi in the Microcosmic Orbit. The tongue touches the roof of the palate to complete the circuit of the Governor and Functional Channels.*

Governor Channel (Du Mo or Tu Mo)

Function of the Governor Channel

The Governor Channel is the main Yang channel of the body. All the other Yang channels connect to this major pathway and are nourished by it, just as the electrical power cables leading to the individual houses on a street are fed by a main power line. Thus, if the flow through the Governor Channel is strong, the six ordinary Yang channels will have more energy flowing into them.

Exterior Location of the Governor Channel

The Governor Channel begins at the perineum and proceeds to the tip of the coccyx (tailbone). From the tip of the coccyx, it runs up the spinal column (just below the skin surface) and up the back of the neck, along the midline of the head to the crown. From the crown it travels down along the midline of the scalp, forehead, and nose and ends at the point between the base of the nose and the upper lip.

Interior Location of the Governor Channel

The interior path of the Governor Channel begins at the perineum and proceeds back to the tip of the coccyx. It runs up the outside of the sacrum and into the sacral hiatus (the eight holes), where it enters the spinal column. From there it runs up the interior of the spine and enters the skull. It flows through the back of the skull along the midline through the subarachnoid space along the fascia (connective tissue) on the surface of the brain (beneath the crown). There are also internal connections to deeper portions of the brain, such as the pineal gland, the pituitary gland, and the hypothalamus. The channel then descends about one-and-a-half inches below the skin's surface along the midline at the front of the face, ending at the upper palate.

Functional Channel (Ren Mo)

Function of the Functional Channel

The Functional Channel (also translated from the Chinese as the Conception Vessel) is the main Yin channel of the body. The six Yin Ordinary Channels connect to the Functional Channel and are nourished by it. The Functional Channel also connects with the Governor Channel at both ends; together, the two channels form the complete circular pathway known as the Microcosmic Orbit.

Exterior Location of the Functional Channel

The Functional Channel begins at the perineum or Hui Yin point (the point between the anus and the genitals). It flows up the front of the pubic region and along the midline of the front of the body to the throat. It continues upward along the midline, with its last point located just below the lower lip. For acupuncture and shiatsu purposes, the channel runs at varying depths, from one-sixteenth of an inch or less to one and a half inches.

Interior Location of the Functional Channel

The interior location of the Functional Channel is more commonly used for the Microcosmic Orbit meditation. It begins at the perineum (as does the Governor Channel), and runs up the front midline at an average depth ranging from a quarter of an inch at the throat to one and a half inches. It runs beneath the pubic bone and the sternum, enters the throat, and ends internally at the tip of the tongue. When you touch the tip of the tongue to your palate, this acts as a switch to connect the Functional Channel to the upper end of the Governor Channel.

When the body is healthy and abundant with Chi, many points along the Microcosmic Orbit receive surplus energy from the glands and organs. As this energy is circulated, it can feed points that are not receiving as much energy. This is how the Microcosmic Orbit balances the body's energy. When all the points are fully activated with Chi, you can proceed to open the other six "special" or "psychic" channels.

Energy Centers of the Microcosmic Orbit

This section explains the energy centers in detail and their use in the Microcosmic Orbit meditation. There is no need to learn all the centers at one time; you can work on each center individually until you can circulate Chi through all of them. After you have become acquainted with the locations of these centers (Fig. 5.1), you can learn to experience their energy by focusing on them one at a time in meditation. Eventually the energy will be felt even during other activities, as it enhances all aspects of life.

> **Note:** *In the beginning stages you will feel the centers just beneath the skin and facial layers. (Along the spine you will feel them between the skin and the spinal cord.) As you become more advanced and produce more energy, you will begin to feel the centers more deeply within the spine, organs, and glands. Eventually you will notice their sensations as deep as one-and-a-half inches inside the body.*

1. Navel: Mind Palace (Shen Ch'ue)

Location

The Microcosmic Orbit meditation begins and ends at the navel center. The navel center is located approximately one-and-a-half inches behind the navel. (As you develop in your practice, you will eventually learn its exact location by feeling its energy.)

Properties and Relationship to Its Organs

Westerners often joke about yogis who "contemplate their navels." Most people think the navel is simply the vestigial scar of the umbilical cord, and to those who know little about meditation, the idea of focusing so much attention on that funny little hole in the middle of the belly seems a bit ridiculous. Yet the navel center is a very profound part of our energetic anatomy, the wiring of our energy body.

Our first connection to the outside world. The navel area was our first connection with the outside world. All oxygen, blood, and nutrients flowed into our fetal forms through this abdominal

doorway (Fig. 5.2). As a result, the navel center has a special sensitivity that continues far beyond the cutting of the umbilical cord at birth; it stays with us throughout our entire lives.

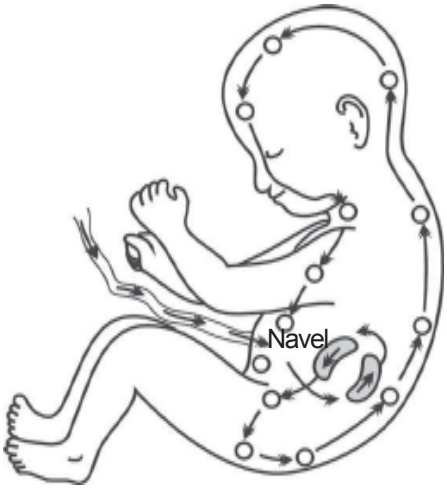

Fig. 5.2. *The umbilical cord was our first connection with the outsideworld.*

The navel is the physical center of the body. In terms of the Chinese Five Elements (Metal, Water, Wood, Fire, and Earth), the navel area is related to Earth. Each of the Five Elements corresponds to a direction: Metal, Water, Wood, and Fire are correlated with the qualities of West, North, East, and South, respectively (Fig. 5.3). Earth represents the center, the ground where we stand, looking out in the Four Directions. The center point of an object is usually also its balance point.

The navel is the physical center of the body, halfway between the upper and lower body. In martial arts, calligraphy, and other related disciplines, one often hears of the importance of centering. The center of the body, our center of gravity, is the most effective place from which to coordinate one's movements, and in these arts one learns to move from one's center, which is called the Lower Tan Tien in Chinese, or Hara in Japanese. With daily practice, you can gradually program the feeling of being centered into the navel and recall it by contacting the energy there (Fig. 5.4).

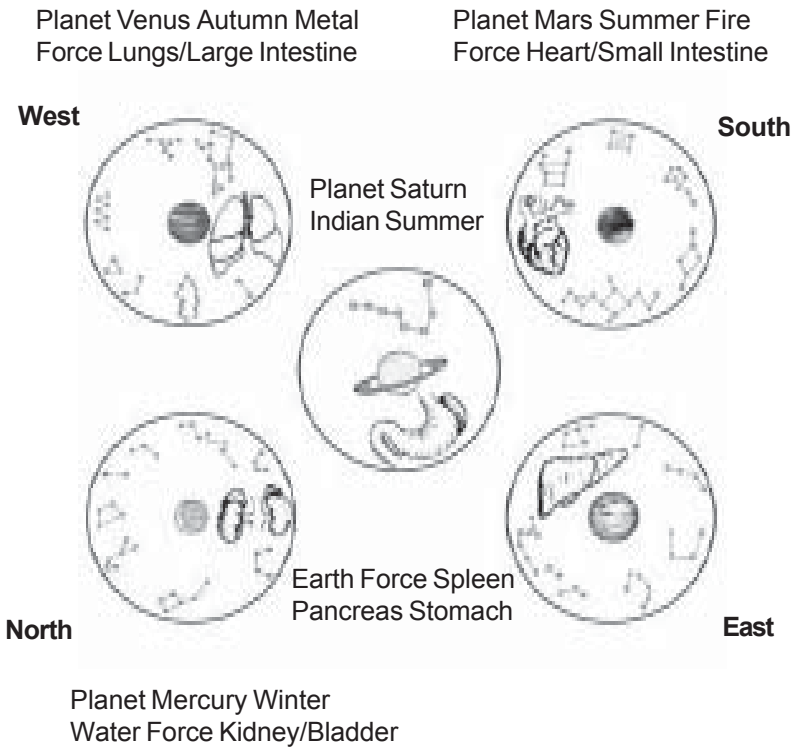

Fig. 5.3 *Five Elements, Organs, and Planets*

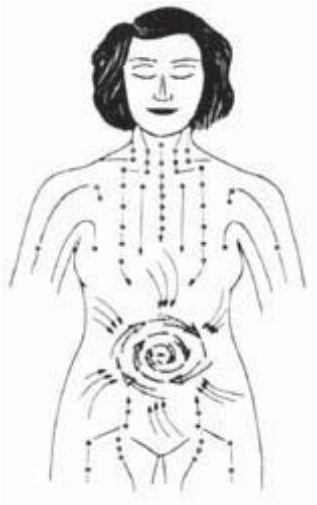

Fig. 5.4 *Behind the navel is the place to gather and blend Chi.*

The navel is the front door of the Cauldron. The external navel is actually the front door of the Lower Tan Tien, which lies deeper within the body. The exact location of the Lower Tan Tien varies somewhat from person to person, depending on physique. In some, it may be right at the level of the navel; in others, slightly below it; and in still others, slightly above the navel.

The Lower Tan Tien is also known as the Cauldron, because in the higher-level Taoist meditations, it is the place where we "gather, blend, and cook" the various energies of body, mind, and spirit for spiritual transformation (Fig. 5.5). There are actually three Tan Tiens: the Lower Tan Tien at the navel, the Middle Tan Tien at the solar plexus, and the Upper Tan Tien in the brain (Fig. 5.6). Tan Tien means "elixir field," signifying a place where the elixir of immotality is prepared as one progresses through the stages of Taoist Inner Alchemy .

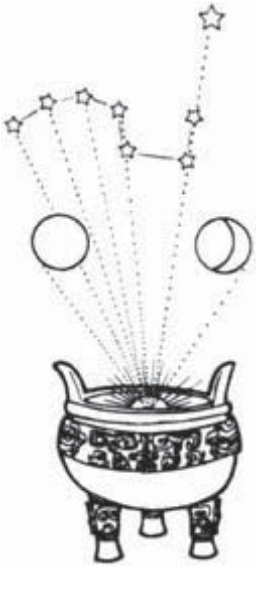

Fig. 5.5 *Cauldron*

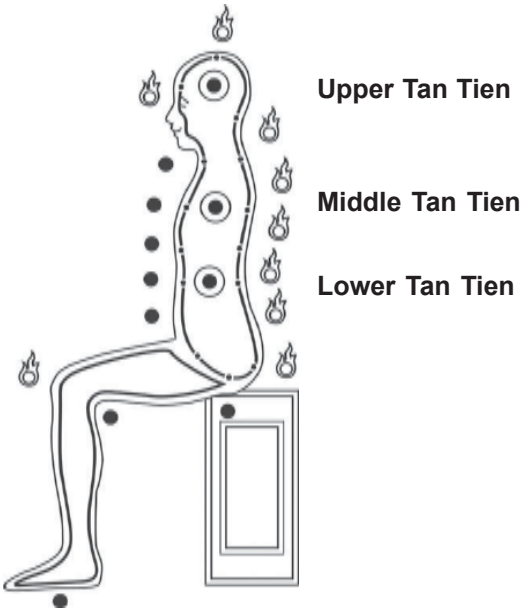

Fig.5.6 *Three Tan Tiens*

Just as the lowest part of a building, the foundation, must be made strong to support a stable structure on top of it, the elixir field needs to be cultivated to serve as a strong foundation for spiritual work. This means that working with the navel center, or "cultivating the field of the elixir," is the cornerstone for all Taoist practices.

Those who have studied Zen or Tai Chi may be familiar with the Chi Hai, or Sea of Chi point—located three finger-widths below the navel—as the traditional point of correspondence with the Cauldron. Both this point and the navel point provide access to the Cauldron, so it is technically correct to focus on either.

In the Universal Tao system, we use the actual navel point. After teaching the Microcosmic Orbit meditation for many years to tens of thousands of people, I have found that the navel is generally more sensitive and easier to feel and find, and therefore more effective as a focal point. The navel and the Sea of Chi point are two doors leading to the same place, so why not use the one that is more plainly marked?

The navel is our major Chi storage battery. Because the navel is at the center of the body, it is the point of balance of Yin and Yang energies. The body collects the Chi of both Heaven and Earth and stores, blends, and balances them at the navel. Because of this role, the navel has the capacity to safely store large charges of Chi.

Taoists regard this center as the *storage battery*. As the front door to the source of our Original Chi, it collects, transforms, and balances energies taken in from other sources, directing them to recharge the Original Chi at its source between the navel, kidneys, and sexual center (near the pelvis). The navel center has a close connection to all the energy channels, particularly those related to crown, sexual center, perineum, kidneys, and heart (Fig. 5.7).

We begin and end our practice by focusing on the navel. The Microcosmic Orbit meditation begins and ends at the navel. From the very beginning of life the navel is involved in harmonizing, processing, and transforming the body's Chi as the embryo receives nourishment through the umbilical cord. In the navel, unlike other areas of the body, energy can be collected, transformed, and stored with no ill effects (specifically between the navel, kidneys, and sexual center). When we begin meditation by focusing at the navel, we access the stored Chi behind the navel at the Cauldron. This gives our practice of the Microcosmic Orbit a "jump start" by

bringing out a strong energetic charge to circulate through the Governor and Functional Channels.

The navel influences the nearby organs. The navel is also important to the small and large intestines and the major lymphatic system (Fig. 5.7). By concentrating on the navel, you can activate the life force, creating warmth and expanding pressure that enhance digestion and absorption in the small intestine. Focusing on the navel also strengthens the large intestine for the elimination of waste material, while increasing the flow of the lymphatic system.

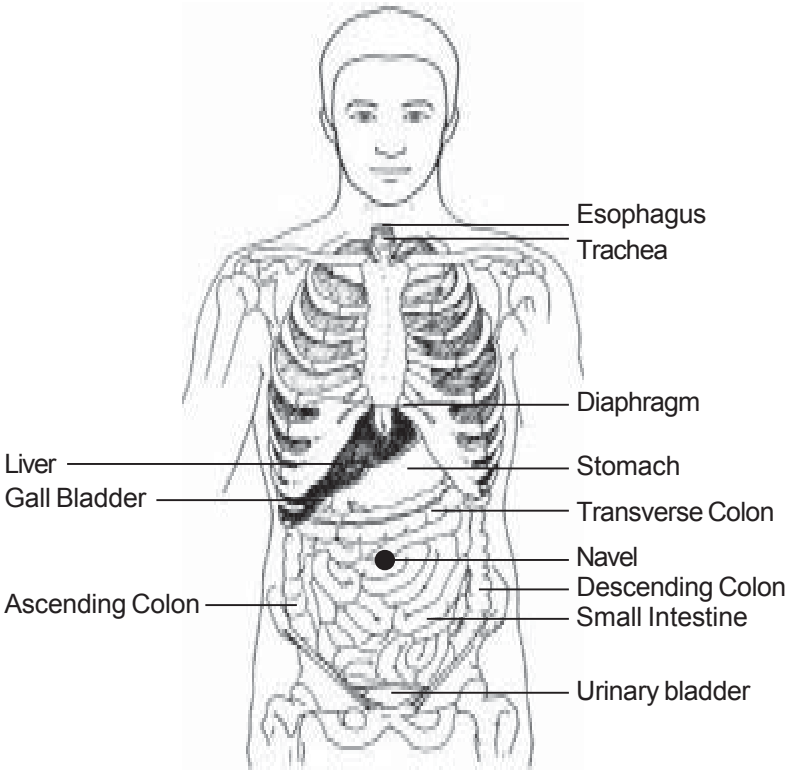

Fig. 5.7 *The navel influences the nearby organs.*

Emotional Influences

When the navel's center is open and connected with the other centers, one feels balanced; when it is blocked or closed, it manifests in sloppy, picky, or distracted behavior (Fig. 5.8).

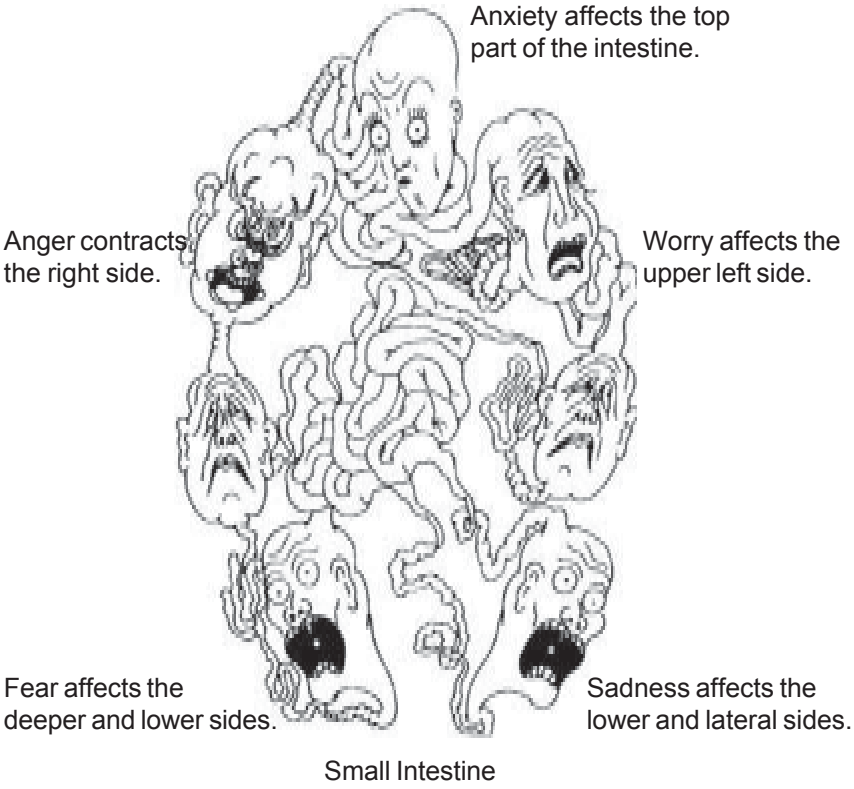

Fig. 5.8 *When the navel area is blocked, it can cause negative emotional states in the small intestine.*

Massaging the Navel to Release Negative Emotions

When negative emotions arise, they often get stuck in the navel area, blocking the flow of Chi and resulting in cramps. When this area becomes too congested, other maladies can also arise, and even your meditations may be affected. Massaging the area daily, or whenever such cramps arise, releases the blockages. The best time to massage is in the morning.

Lie on your back. Using one finger of either hand, apply a little pressure around the navel. (The other hand can be used to anchor the area.) Do not massage the navel itself, but circle around it until you find a tender spot. Sensitive areas may feel like a lump or knot. Massage any lumps with the tip of one finger, circling on and around the spot until you feel it dissipate. Some places are tighter than others, Using minimum pressure, hold for a while, release, and repeat until the lump dissolves (Fig. 5.9 and 5.10).

Fig. 5.9 *The navel connects to the other organs and when it is blocked, it can affect these organs.*

Fig. 5.10 *Massaging yourself*

2. Lower Tan Tien, Source of Original Chi: The Internal Battery

Location

The Lower Tan Tien is located between the navel, Door of Life (kidney center), and sexual center. These three centers form a triangle with the ability to nourish the Original Force by drawing on external sources (Fig. 5.11 and 5.12). This center's exact location can vary with different people. In a man with broad shoulders and a large abdomen, the center can be one-and-a-half inches below the navel in the center of the body. In a woman of large proportions, the center may be slightly above the navel. Many martial artists feel the Tan Tien's center of gravity is between the center axis of the body and the Door of Life. Some people may feel the center's position drop slightly as their energy accumulates. The center's exact location in your body is where the sensation of its energy is strongest.

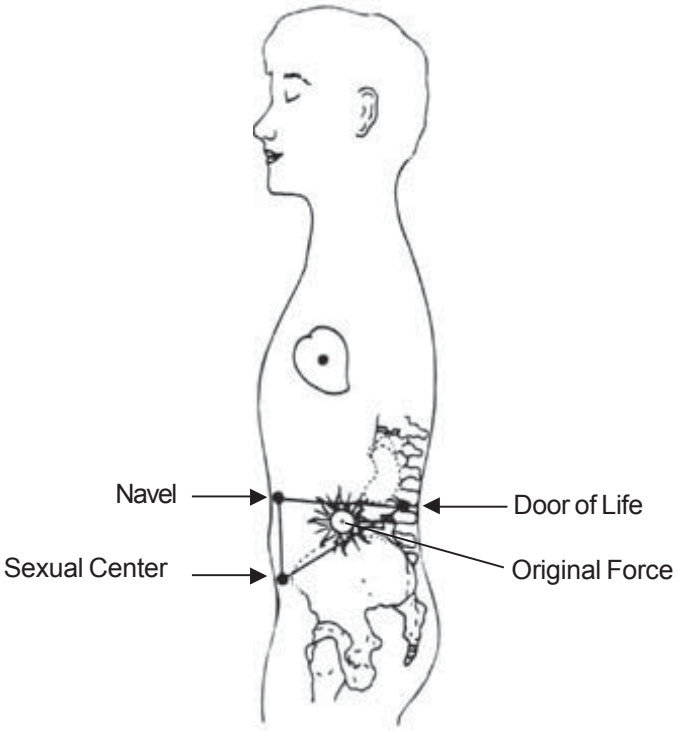

Fig. 5.11 *Lower Tan Tien-Original Force*

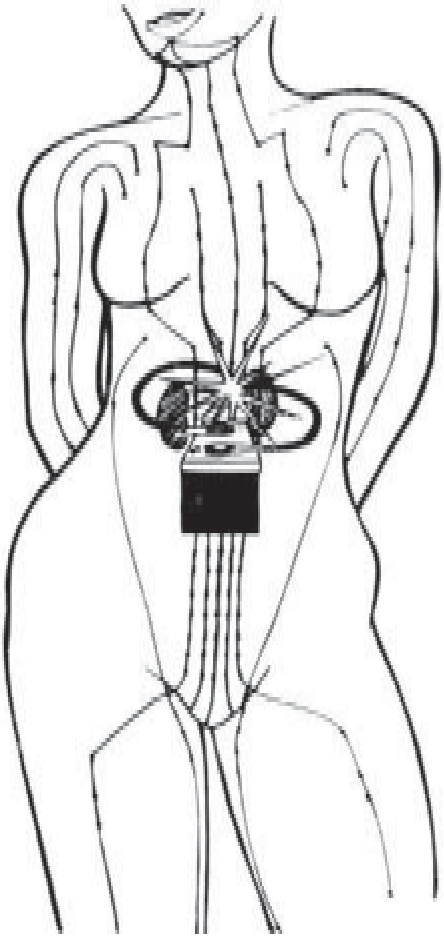

Fig. 5.12 *Internal Battery*

Properties and Relationship to Its Organs

The Lower Tan Tien, which stores the Original Chi, is also referred to as the Field of Pills or Cinnabar Field, in which Chi from all sources is blended and transformed into life-force (Fig. 5.13). The Original Chi we are born with comes from the union of Yin orgasmic energy (supplied by the mother and Yang orgasmic energy (supplied by the father). Orgasmic energy is the combination of love energy and sexual energy. When these energies combine, they also draw on the Universal and Earth Forces to create a new energy, *Prenatal Chi*, within the forming embryo, which is made up of cells derived from both parents.

Fig. 5.13 *Original Chi can be enhanced by all these forces and energies.*

We draw on the Prenatal Chi daily along with the Universal, Earth, and Higher Self (Cosmic) Forces. How healthy we are depends on the amount of Prenatal Chi we have stored. Prenatal Chi enhances our ability to attract the greater forces of the universe to strengthen all aspects of our being. By concentrating on the area between the navel, Door of Life, and sexual center, we can gradually restore our principal energy from these external forces (Fig. 5.14 and 5.15).

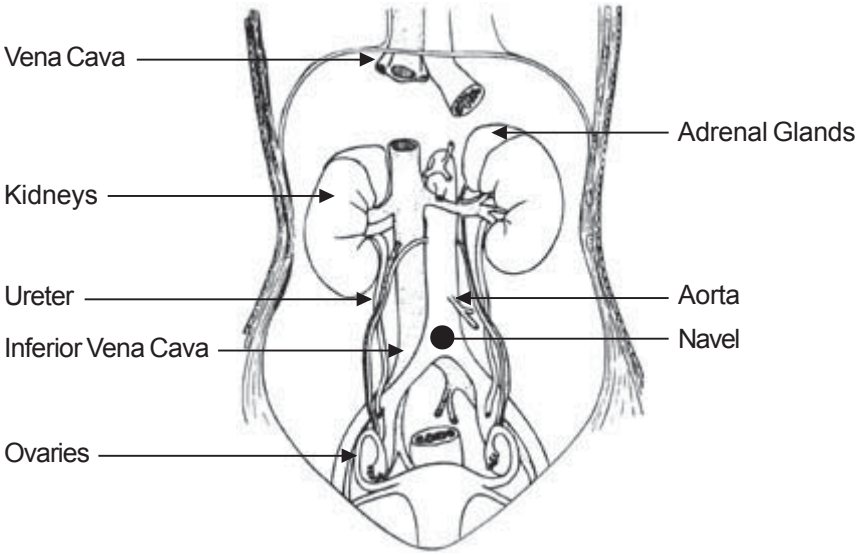

Fig. 5.14 *The area of the Original Force can affect the aorta and vena cava.*

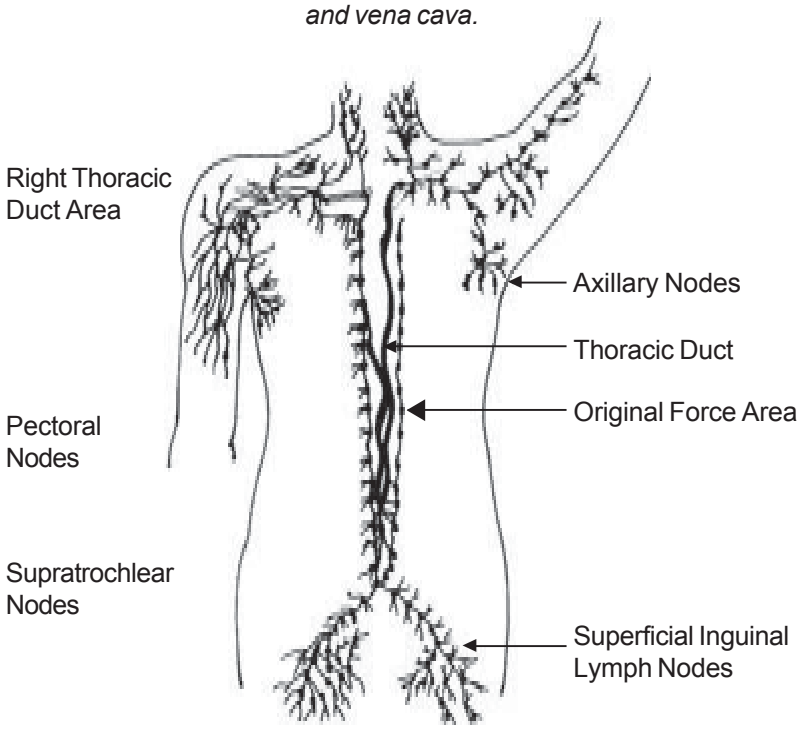

Fig. 5.15 *Lymphatic System*

The Lower Tan Tien lies near the center of the body in front of the aorta and vena cava. This area contains many large lymph nodes, such as the lumbar lymph node, common iliac node, and the main draining duct in the lower abdomen. Increasing the Chi gathered here enhances the flow of blood, lymph, and hormones and also reduces the work of the heart. Daily cultivation of the warmth of Original Chi conserves and recycles this energy instead of allowing it to drain out.

3. Sexual Center: Sperm/Ovarian Palace (Jing Gong/Zhongji)

Location and Functions

Men: The Sperm Palace (Jing Gong) is at the base of the penis, slightly behind and below the pubic bone (about one-and-a-half inches inside the body, between the prostate gland and the pubic bone). It corresponds to the second point on the Functional Channel in Chinese medicine. This center takes its energy from the sperm made and stored in the testicles, prostate gland, and seminal vesicles. A man can use this energy by controlling the ejaculatory function, but if the orgasmic energy is not redirected into the Microcosmic Orbit, it usually passes out of the body and is lost. By concentrating on this center, you can help supply Chi to the Original Force. Techniques for retaining a man's sexual energy are described in *Taoist Secrets of Love: Cultivating Male Sexual Energy* (Aurora Press, 1984).

Closing the two gates. It is important to notify the two main energetic gates where sexual energy tends to leak out.

The front gate is located on the glands of the penis at the urethral opening. The second gate is at the base of the penis above the argental diaphragm. Internally, it is at the base of the opening of the prostate gland, below where the seminal vesicles connect to the urethra.

Lightly contract these two gates in coordination with the circular muscle of the iris and the muscles around the eyes. Feel them lightly close, and feel that the Ching Chi has been retained. This conserves the life-force (Fig. 5.16).

Women: The Ovarian Palace (Zhongji) is above the pubic bone, corresponding roughly to the top of the uterus (approximately one palm's width below the navel). In women, this point corresponds to

the third point on the Functional Channel. To locate it, place the tips of the thumbs together at the navel and the extended index fingers together beneath them, forming an upside-down triangle. Where the index fingers meet indicates the Ovarian Palace (up to one-and-a-half inches inside the body). The areas where the little fingers naturally fall indicate the ovaries.

Energy from the ovaries accumulates in the Ovarian Palace. Each month the ovaries produce an egg from the body's finest substances and sexual energy, which is stored in the Ovarian Palace. If this egg is not fertilized, it eventually passes out of the body with all the blood and Chi reserved to nourish an embryo (Fig. 5.17). When procreation is not intended, this loss of energy is unnecessary and unhealthy; concentrating on this center, however, supplies Chi to the Original Force. *Ovarian Breathing* permits the essence of the egg to be retained, so it can be recycled and transformed into life-force. Methods for saving this energy are detailed in the book *Healing Love Through the Tao: Cultivating Female Sexual Energy*.

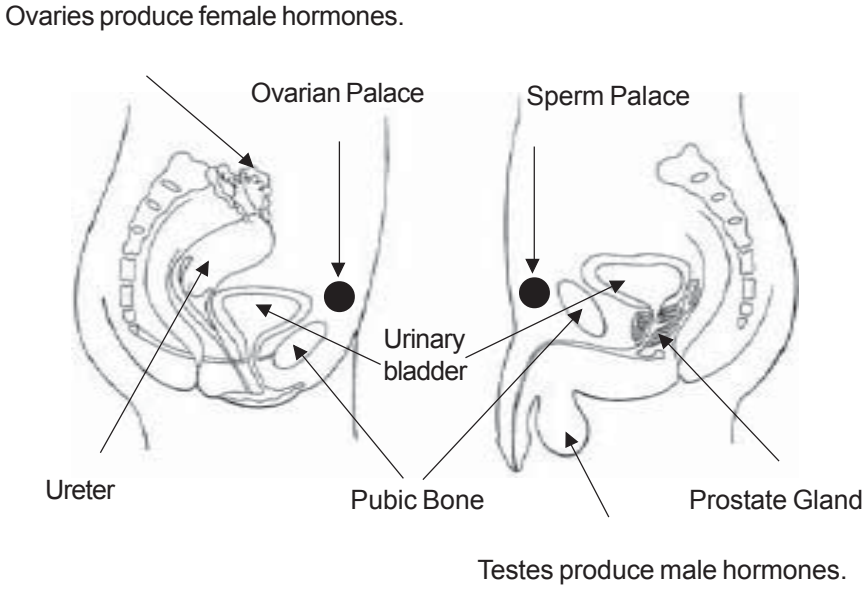

Fig. 5.16 *Sperm and Ovarian Palaces*

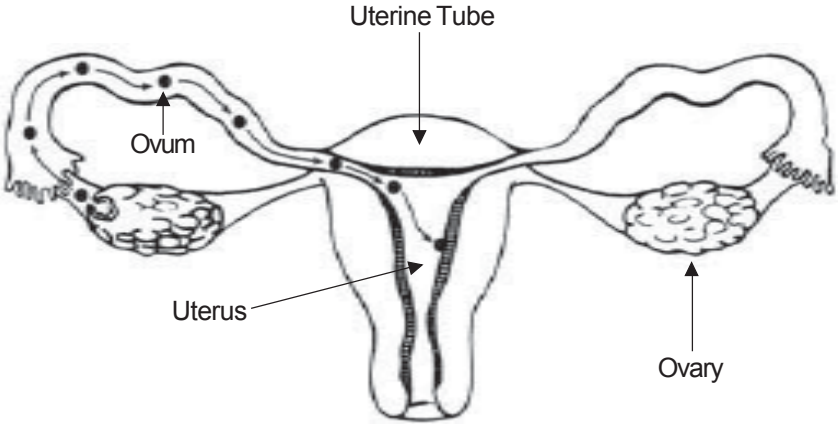

Fig. 5.17 *Uterus and Ovaries*

Closing the two gates.

In addition to practicing Ovarian Breathing, it is vital that women seal the two lower gates to prevent energy from leaking out. The front gate is at the vaginal orifice; the second is at the opening of the cervix.

Lightly close these two openings in coordination with the contraction of the iris and mind/eye muscles. This retains the sexual energy within.

Properties and Relationship to Its Organs

The sexual center includes the prostate gland, penis, and testicles in men; and the ovaries, cervix, and vagina in women. These organs contribute to the energy of the sexual center, which is regarded as the "generator," helping supply Chi to the Original Force. In men and women, the sexual center is the storage place for reproductive energy, which has creative and healing properties and is the body's most powerful Chi. When it is not being used for reproduction, this energy can be re-channeled and transformed into life force.

Sexual energy is the only energy that can be multiplied regularly if it is stored. In practice, this involves recycling orgasmic energy through the Microcosmic Orbit, rather than allowing it to pass out of the body. This way, instead of expending one-third of the body's energy to produce sperm and ova, this third can be saved and compounded regularly through intelligent sexual activity that does not lose any of the body's essences, At higher levels of practice, sexual energy can be transformed into spiritual energy.

As stated earlier, human life begins with the sexual energies of the Yin orgasm (female) and the Yang orgasm (male) as the egg and sperm connect and fuse through the act of love and sex. The process of conception draws the Universal and Earth Forces to be combined with these orgasmic energies, and the Cosmic (Higher Self) Force supplies nourishment for the fetus to grow. When a man and a woman make love to produce offspring, Taoists refer to the act as the Reunion of Heaven and Earth.

Men. In men, the testes produce testosterone and other androgens, hormones that govern the development of primary and secondary sexual characteristics and sexual urges. They also inhibit follicle-stimulating hormone (FSH), which is produced by the pituitary gland to regulate the production of sperm. The strength and quality of sexual energy is directly influenced by the levels of these hormones in the body. Hormones are a major part of this Chi.

Sexual energy and hormones gradually diminish with age, causing the pituitary gland to dry out and produce an aging hormone that promotes eventual death as all bodily functions gradually weaken (Fig. 5.18). If men do not maintain the vitality of the sexual center, they cannot regulate sexual energy and hormone levels to prevent aging and premature death. The practice of seminal retention not only maintains these levels but also enhances them, recycling the energy instead of allowing it to pass out of the body. This practice requires opening the Microcosmic Orbit through meditation.

Women. In women, each ovary is composed of two distinct areas, the follicles and the corpus luteum. The follicles produce estradiol and other estrogens, hormones that regulate cellular respiration, blood circulation, development of primary and secondary sexual characteristics, and sexual urges. They also inhibit follicle-stimulating hormone (FSH), which is produced by the pituitary gland to regulate the production of eggs. The corpus luteum manufactures progesterone, which stimulates secretions in the oviduct and interacts with the estrogens to regulate ovulation and menstruation. All these hormones contribute to a woman's sexual energy.

Taoists believe that for women, youth and vibrancy is maintained by increasing sexual hormone levels (thereby enhancing sexual energy) through the Healing Love practice, which gives a woman control over her menstrual cycle (Fig. 5.19). By practicing the Microcosmic Orbit meditation women can draw sexual energy up to the crown to stimulate, rebuild, and strengthen the glands.

Fig. 5.18 *Excessive loss of sexual energy depletes the body.*

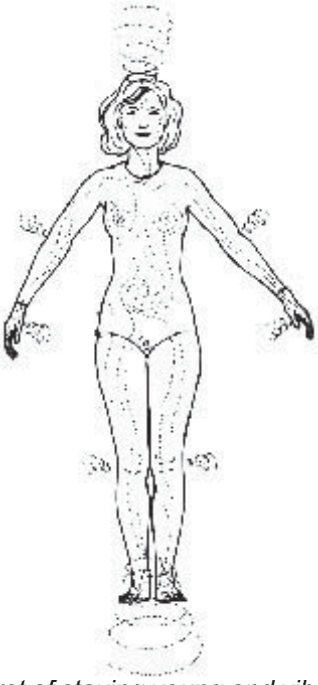

Fig. 5.19 *The secret of staying young and vibrant is to maintain and enhance sexual energy.*

Emotional Influences

When the Sperm or Ovarian Palace is open and connected to the other centers, one has a sense of creative and personal power; when either is blocked or closed, life is hard to enjoy.

4. Perineum: Gate of Life and Death (Hui Yin)

Location

The perineal center is located between the sexual organ and the anus (Fig. 5.20). This center encompasses other structures and functions in this area as well; specifically, the anus and the back part of the anus are also related to the Hui Yin point.

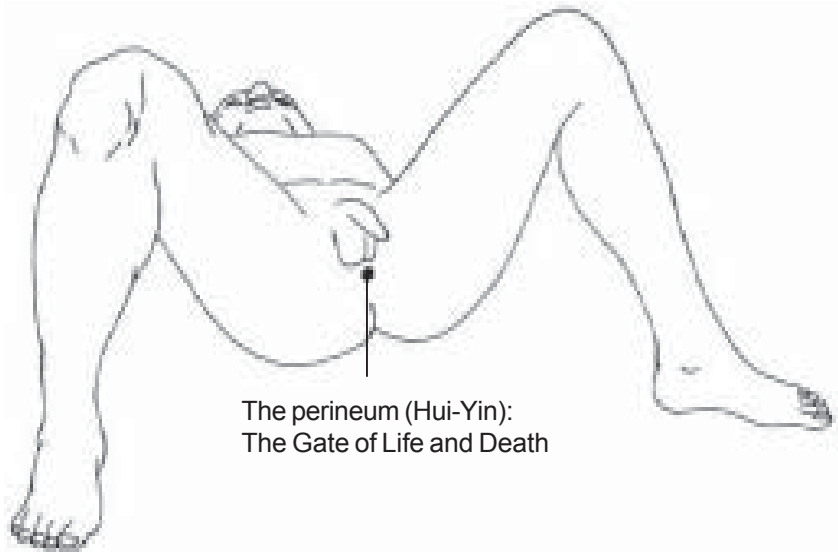

Four channels or “tunnels” extend from the perineum that relate to the front, back, top, and base of the body(Fig. 5.21).

1. The tunnel connected to the crown channels Yang (positive) universal electromagnetic energy.
2. The tunnel connected to the soles of the feet channels Yin (negative) energy from the earth.
3. The front tunnel, which connects to the navel and sexual centers, channels the body’s Original Chi.
4. The back tunnel, which connects to the coccyx and the sacrum, has eight holes and channels the electromagnetic force of nature.

During meditation, you can lightly contract and relax the perineum a few times. This enables you to feel the electricity flowing through these connections, which can be gathered and transformed into life-force.

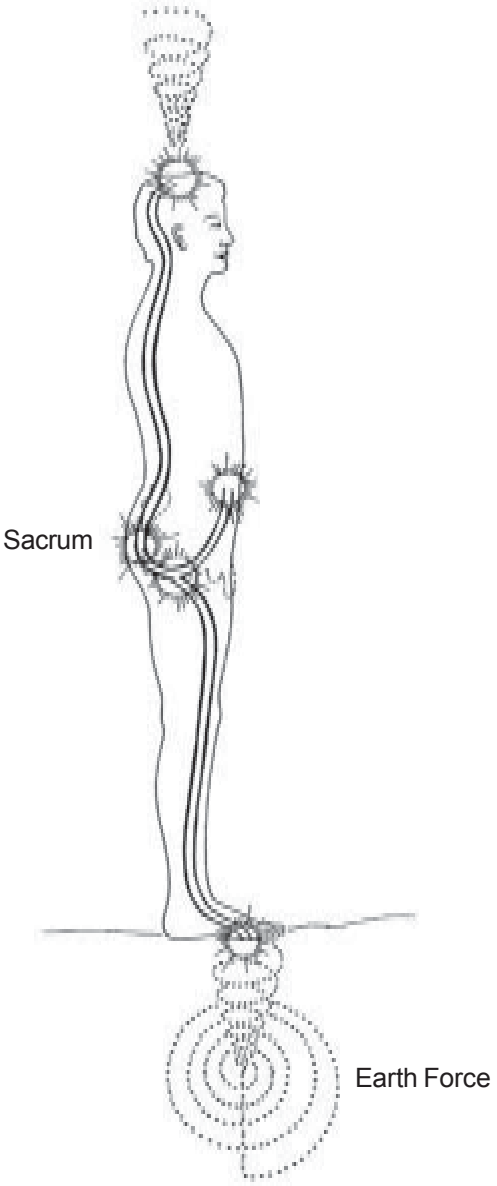

Fig.5.21 *Perineal Channels*

Properties and Relationship to Its Organs

The Hui Yin (perineum) houses an energy pump that pushes earth, sexual, and life-force energies up the spine, enhancing the flow of Chi in the Microcosmic Orbit. This center is also known as the Chi Bridge, because it connects the Governor and Functional Channels (Fig. 5.22). The term Hui Yin refers to the point where all the Yin Chi meets, connecting the Yin energy channels (especially the eight psychic channels).

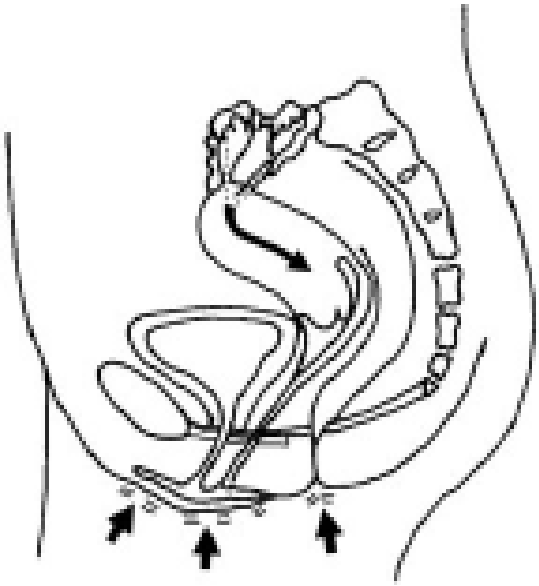

Fig. 5.22 *When contracted, the sexual organ and the anus act like a bridge and an energy pump for the ascending flow of Chi.*

Together with the anus and the back part of the anus, the perineum is known in Taoism as the “floodgate” of the organs. It is called the Gate of Death, because sexual energy and life force can be lost through this center if it is not properly controlled. It is also called the Gate of Life, because sexual energy and the Earth Force pass up through the soles of the feet to the higher centers through this center. The perineum is considered the “seat” or “floor” of the organs because their positions within the body depend on its strength. If the perineum is strong, the organs remain in place and stay firm and healthy; if it becomes weak, the organs may lose their cohesiveness and sag (Fig. 5.23 and 5.24). The perineum also works in

conjunction with the coccygeal body, which plays a vital role in activating and drawing energy up the spine. When there is less Chi in this area, the blood circulates too slowly, causing hemorrhoids and back pain.

The anus (nutrition gate) is also part of the Life and Death Gate. When its connection to the perineum is strong, the life-force is secure, because the anus can increase the flow of blood, lymph, and Chi. The anus is also part of the Chi Bridge and pump that sends energy up the spine. When this connection is weak or broken, life force can leak out, and the effectiveness of this important gate can be lost. Also, blockages to the Chi flow at this point can produce a clogged-up feeling, like constipation, which prevents the body from releasing impurities and toxins. This is another reason to keep the energy circulation in the Microcosmic Orbit.

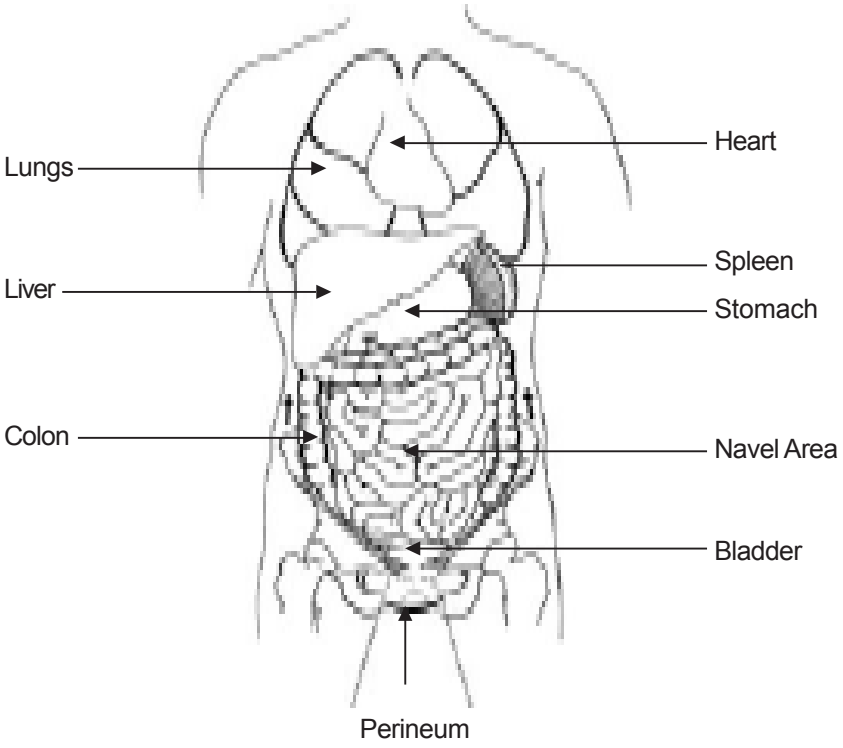

Fig. 5.23 *A strong perineum helps keep Chi in the body.*

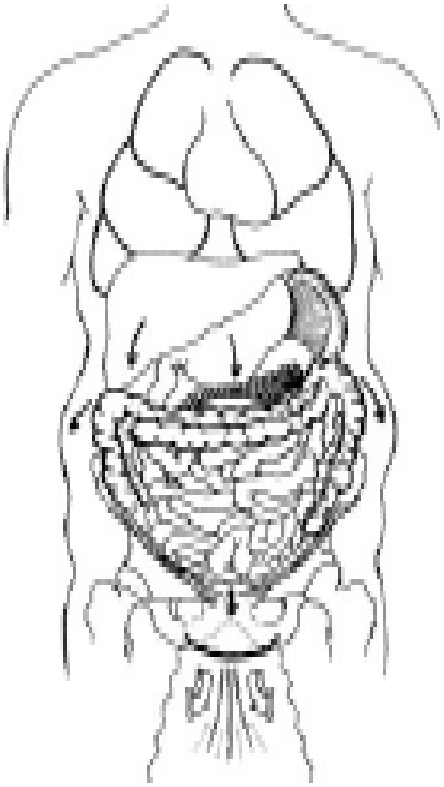

Fig. 5.24 *The perineum is the floor of the organs. If is allowed to become weak, Chi will leak out.*

The back part of the anus is located between the anus and the coccyx, where it harmonizes Yin and Yang energies(Fig. 5.25) . It also helps pump sexual, earth, and life-force energies up through the spine. The back part of the anus acts like a Chi Bridge, helping energy pass from the perineum to the coccyx.

All three—the perineum, the anus, and the back part of the anus—are connected with the earth. When you contract these toward the coccyx, you can feel the earth energy rise. Taoists meditate with their feet on the ground so the earth energy can easily flow upward through them. By developing this connection, Taoists maintain a very close relationship with Mother Earth.

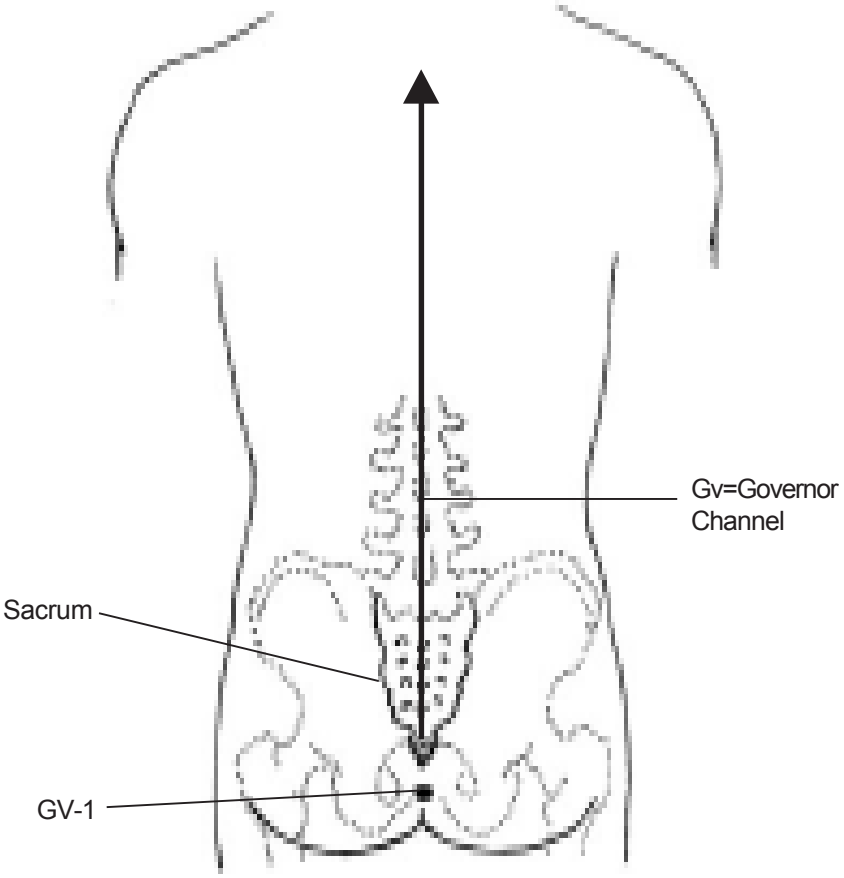

Fig. 5.25 *GV-1 point (Chong Giong)–Back part of the Anus*

Emotional Influences

When the perineum is open and connected, one feels grounded; when it is blocked or closed, one feels insecure.

5. Coccyx and Sacrum (Chang Qiang or Wei Lu)

In Chinese medicine, the tip of the coccyx and the sacral hiatus are considered the first two points on the Governor Channel(Fig. 5.26). For purposes of meditation, although we are aware of these two points as different, we treat the coccyx and sacrum as one center. We may refer to this center as either the coccyx of the sacrum, because of the energetic interaction of the two.

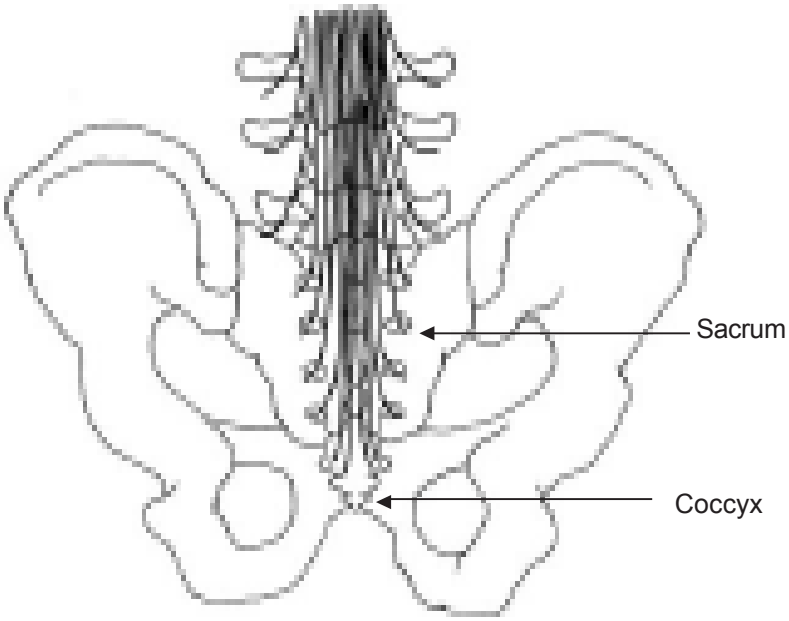

Fig. 5.26 *Nerves of the Sacrum and Coccyx*

Coccyx

At the coccyx, the tip of the tailbone, all forms of energy begin the journey up the spinal cord to the skull. The coccyx houses 12 branches of nerves that extend down to connect with the 12 earthly (terrestrial) branches of Yin Chi (Fig. 5.27). Activating the coccyx internally (or externally with the fingers) stimulates these nerves to strengthen the organs. The coccyx also has a twist that can be tilted toward the earth to help the body connect with earth energy. (Taoists believe pointed bones are strong conductors of Chi.)

The center of Original Chi and the coccyx have a very close relationship. When you lightly contract the anus and the back part of the anus toward the coccyx, you establish a connection to the Original Force, the Earth Force, and sexual energy, which access the higher centers through the spine (Fig. 5.28). These energies cannot travel beyond the lower centers if the coccygeal center is closed. Once this connection is made, it feels as if a power cable is sending electricity up the spine.

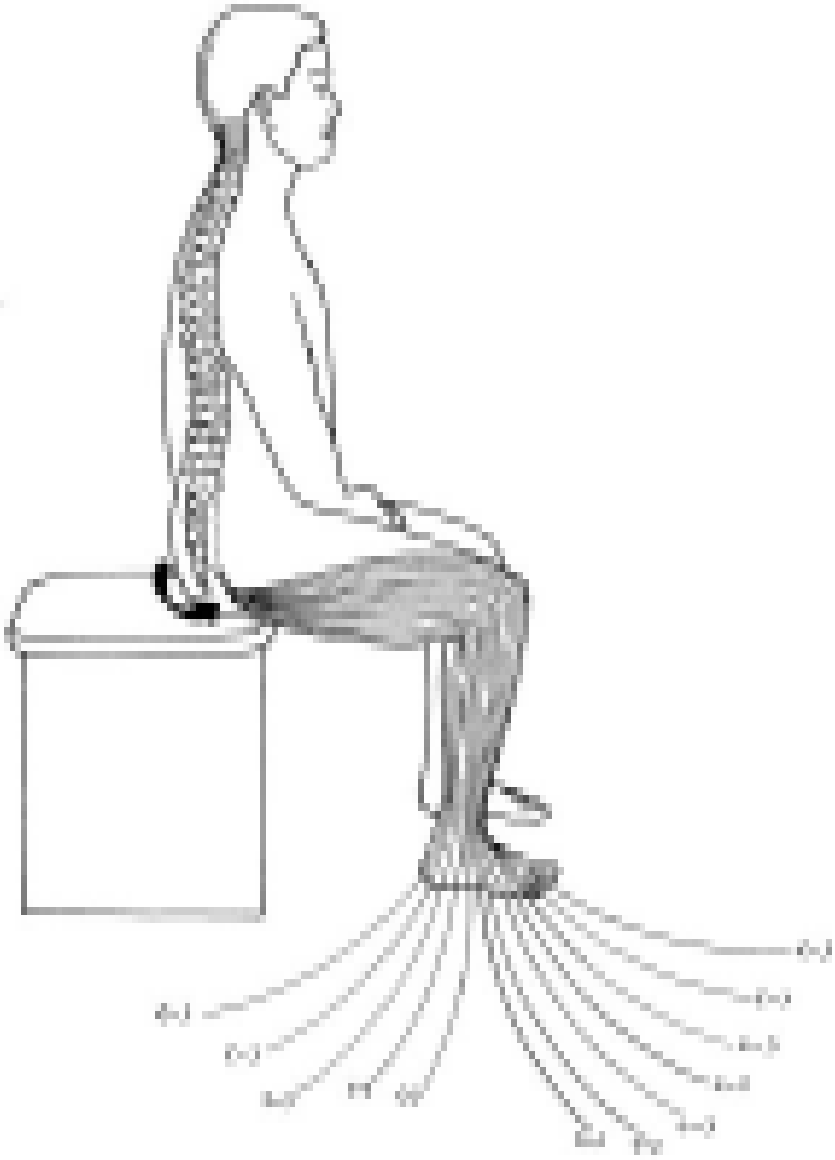

Yin—Negative Polarity Earth Energy

Fig. 5.27 *The nerves of the coccyx and sacrum connect to twelve earthly branches of energy.*

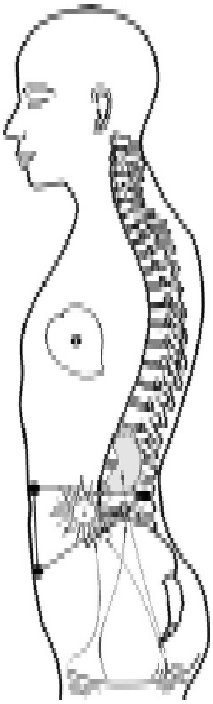

Fig. 5.28 *Lightly contract the anus, sexual organ, and the back part of the anus, pulling them toward the Original Force.*

Our connection to the Earth Force. As stated earlier, a major difference between humans and animals is the erect position assumed by humans, with the head upward and the tailbone downward, creating a channel for the Universal and Earth Forces. The coccyx directs the Universal Force downward, the head's position directs the Earth Force upward, and the brain is nourished by both forces. Taoists acknowledge this posture as the reason for the mental development of humans. Most animals raise their tails to channel the Universal Force downward as they draw the Earth Force up through the four feet, enhancing their bodies before their brains.

The Universal Force flows downward in a clockwise spiral to the crown, where it penetrates and nourishes all the glands within the head, then continues down through the palate. The Earth Force ascends through the soles of the feet and the genitals, perineum, and coccyx, passing the heart's center, until it reaches the salivary glands of the tongue another path draws the earth energy up the spine and into the brain.

Properties of the Coccyx

The coccyx and sacrum are the gathering centers of all major nerves and are closely connected to the organs and glands (Fig. 5.29). The tailbone also helps balance internal energy when it is open and connected to the other centers, enhancing their power and strength. When the tailbone is charged with life force, the body feels lighter, especially when one is practicing moving arts such as Tai Chi. The coccyx also transforms and refines sexual energy and the Earth Force before they enter the higher centers. When this point is blocked or closed, the body feels heavy and unbalanced.

Center of the Sacral Hiatus

Taoists regard the sacral center as the Immortal Bone. Its center is yellowish, and its essence is earth energy. The sacrum has eight holes (referred to as the Eight Immortal Caves). The left four holes are Yang and the right four are Yin. The sacrum connects the spinal marrow to the small brain (brainstem) and upper brain and to the marrow within the brain. When the sacrum is activated, it can generate a great current of Chi and connect it to the Original Force. Taoist practices emphasize opening and connecting both the sacrum and the coccyx to the other centers to establish a strong connection between the Universal and Earth Forces. (The eight holes reflect the eight-sided Preheavenly Pa Kua shape, which symbolizes the eight forces of the universe.) The sacrum and its holes also have a close connection to the Big Dipper, because they can absorb that constellation's energy and combine it with energy from the North Star, which are then stored at the crown.

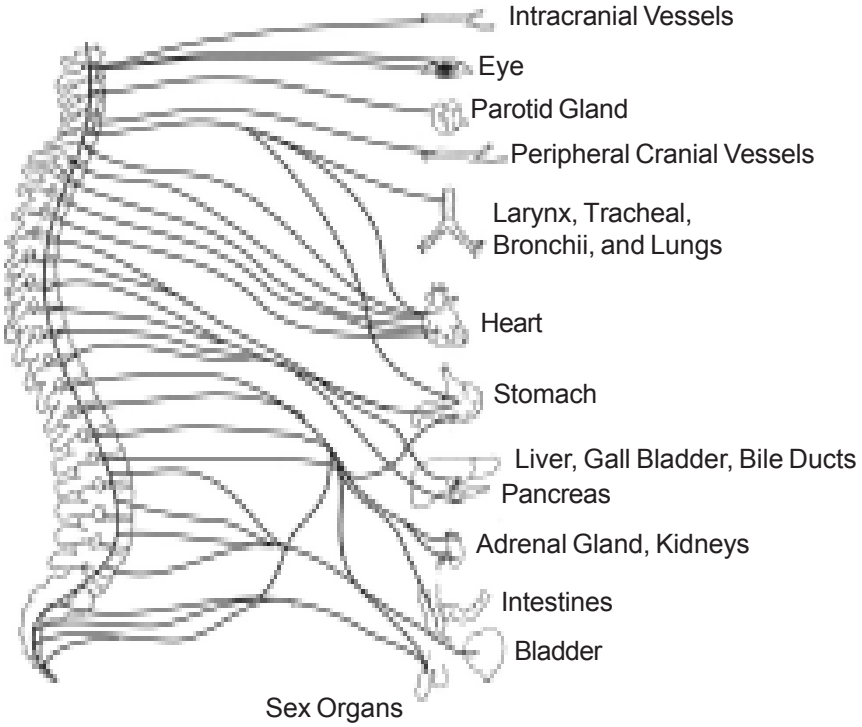

Fig. 5.29 *The coccyx and sacrum are connected to the organs and glands.*

Location

The sacral hiatus is located about one inch up from the tip of the coccyx. This is also the location of the sacral pump, which pumps spinal fluid up the spine. (Spinal fluid supplies nutrients to the brain and spinal cord.) Using the mind to increase the activity of this pump keeps the brain young (Fig. 5.30).

Properties

The coccyx and sacral hiatus centers are related to reincarnation and past lives. Taoism focuses on the present, however, holding that the cycle of reincarnation can be overcome by strengthening body, mind, and spirit and transferring the life-force to the soul and spirit bodies for the journey back to the Wu Chi, the origin of all things.

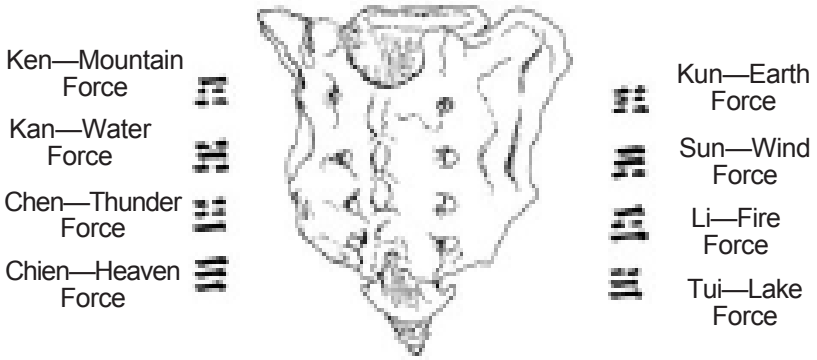

Fig. 5.30 *The Eight Immortal Holes can absorb natural forces.*

Emotional Influences

When the coccyx and sacral hiatus points are open and connected, one feels balanced; when they are closed, one feels imprisoned. The spinal cord is the major center for the nerves and the sympathetic nervous system, through which the brain communicates with the body. By developing the powers of the mind, eyes, and heart through meditation and by practicing the Inner Smile, one can enhance and control these systems. Taoists believe these nerves are also connected to the soul or energy body.

Bones are regarded as Yang (positive) Chi conductors; nerves conduct Yin (negative) Chi. (Bones and nerves have both Yin and Yang qualities in varying degrees.) When we combine the negative and positive charges of the bones and nerves, we can generate and conduct more Chi. Concentrating on the points along the spine enhances Chi flow and opens the spinal cord, expanding the space between the vertebral discs and creating a cushion of energy to protect them and the nerves.

6. Kidney Center: Door of Life (Ming Men)

Location

The kidney center is located between the two kidneys, directly between the second and third lumbar vertebrae on the spine (Fig. 5.31). Place a finger on the spine opposite your navel and bend forward, then backward. The vertebra that protrudes and recedes most marks the kidney center.

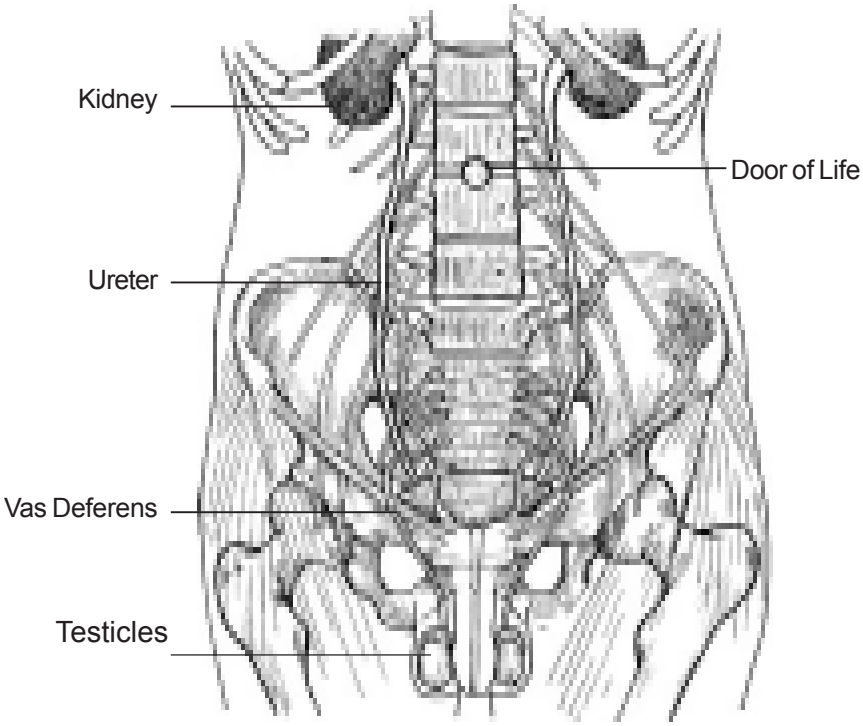

Fig. 5.31 *Front Side of the Body*

The kidneys are located on both sides of the spine at about waist level and are protected by the lower ribs (Fig. 5.32). The left kidney generates Yin (cold) Chi; the right kidney generates Yang (hot) Chi. Together they help balance Yin and Yang qualities in the body. They also clean the blood of toxins and waste, which are then passed out of the body in the urine.

Properties and Relationship to Its Organs

The kidneys store our sexual and energetic essences and purify the blood. The kidney center is called the Door of Life because it is also the center of Prenatal Chi, our inborn vitality. When a man loses sexual energy through too much sex, or when a woman loses it through pregnancy or menstruation, the kidneys become depleted, weakening the spinal cord and causing back pain. Because the kidneys are associated with the urinary bladder, reproductive organs, bone marrow, and brain, these areas can also be drained of energy if prenatal Chi is lost through uneducated sexual practices.

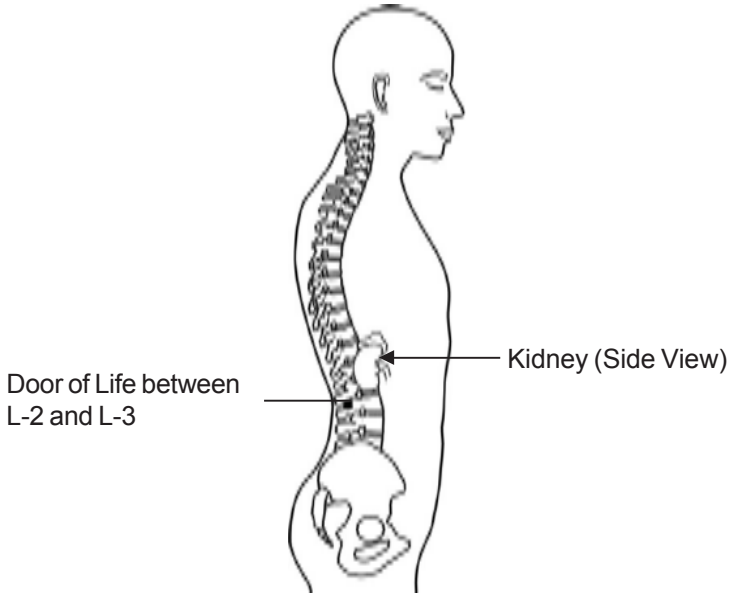

Fig. 5.32 *Kidney Location*

It was originally thought that prenatal Chi could not be replenished, but modern Taoists say meditation and exercise can restore lost vitality and strengthen the kidneys. It is important to practice the Healing Love techniques so sexual energy is not lost during sex. If the kidneys are drained by unhealthy sexual practices, back problems may also be compounded by high blood pressure and nervousness.

The kidneys work like step-up transformers to help stimulate the body's Chi when it is low. They are the source of our ambition and willpower and serve as the crossroads of the Belt Channel, a very important area in the higher stages of practice. When the kidneys are weak, we may experience less drive and personal power in our lives. They also store part of our Original Force. When the Universal and Higher Self (Cosmic) Energies enter the navel, they pass through it to both kidneys and down to the sexual center. These forces are then stored between the navel, kidney, and sexual center.

The kidney center is a safety point that can mitigate side effects from opening channels too quickly. If you have uncomfortable sensations in your head during meditation, concentrate on the kidney

center to draw excess energy from the head. Not only will the energy move out of the troubled areas, but it will also descend to the K-1 points on the soles of your feet, where you can access earth energy and recover your center. (This is especially beneficial for people with high blood pressure.)

Emotional Influences

When the kidney center is connected and open, one feels gentleness; when it is blocked, one fears being taken advantage of.

7. Adrenal Center, T-11 (Chi Chung)

Location

The adrenal center is between the adrenal glands and between the 11th and 12th thoracic vertebrae; it is often called T-11. Place a finger on the spine opposite the solar plexus. T-11 protrudes more than the other vertebrae when you bend well forward.

Properties and Relationship to Its Organs

The adrenal glands weigh about one-eighth of an ounce each and are located on top of the kidneys (Fig. 5.33). They produce the hormones that keep the heart pumping and provide a powerful resource of energy to increase the heartbeat and bodily strength in emergencies. When one experiences either physical or psychological stress, the adrenals increase their metabolism to brace one for either “fight or flight.” The adrenal center helps pump life force and sexual energy up the spine to the higher centers, where they are refined. Concentrating on T-11 can also help reduce addictive tendencies related to adrenaline.

The adrenals have two functioning parts, the medulla and the cortex. The medulla manufactures adrenaline and noradrenaline. Both hormones trigger a rapid response from the sympathetic nervous system, increasing heartbeat and respiration. The adrenal cortex, the outer portion of the gland, produces a number of steroid hormones, including cortisone. These hormones regulate the body’s retention and excretion of minerals, particularly sodium and potassium. Glucocorticoids, produced by the cortex, govern blood sugar levels. Dependence on stimulants, such as coffee, chocolate, nicotine, drugs, and certain herbs, gradually drains Chi from the adrenals and weakens these functions.

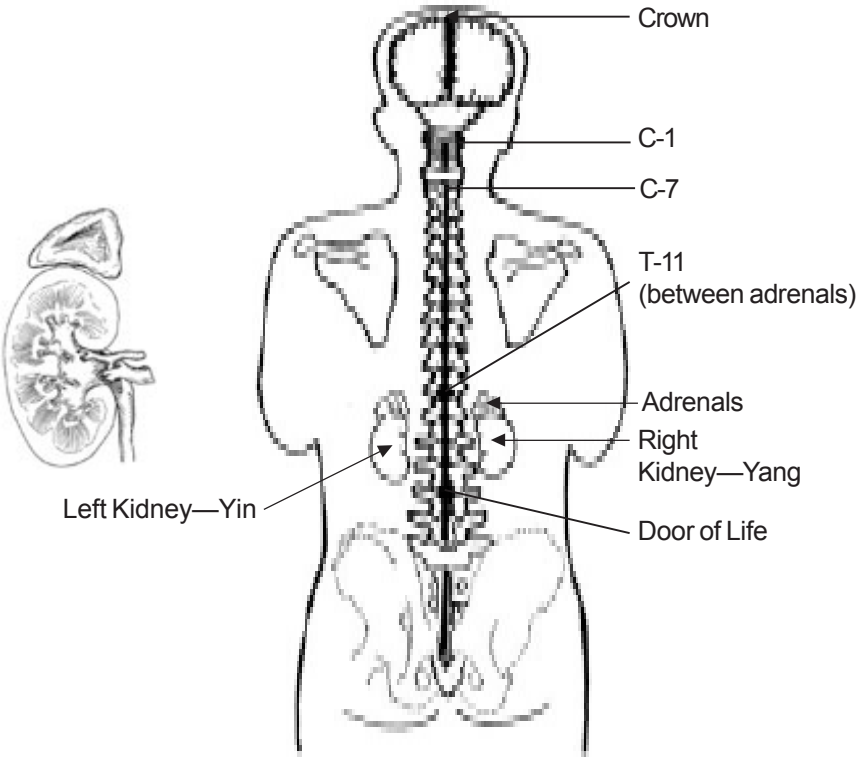

Fig. 5.33 *Back View*

Adrenal power. We all experience the power of adrenaline in our bodies, although most of us don't realize it until we are confronted with a fight-or-flight situation. Substances such as coffee, nicotine, and certain drugs cause a similar response of excitement by over stimulating the adrenal glands. As the desire for stimulation becomes habitual, one's dependence on these substances increases. Such habits deplete the adrenal glands and drain the life force. After practicing the Microcosmic Orbit meditation for a while, you will find your natural energy level increasing and your need for stimulation from external substances decreasing.

Drugs. Ingesting drugs is the fastest way to drain adrenal energy. Ancient Taoists and other esoteric scholars explored the external forms of alchemy by making "immortality pills" for their emperors and themselves. Composed of arsenic, mercury, lead, sulfur, phosphorus, silver, precious stones, and other toxic substances, these pills shortened the lives of many emperors and Taoists alike.

Some drugs were mild poisons that did not kill the experimenters right away. Instead, the drugs tricked their bodies into becoming aroused for an immediate life-or-death struggle. Just like the drug users of today, the subjects felt alert and energetic after taking the pills, but this was just a temporary manifestation. The experimenters' adrenal glands and every cell of their bodies were forced to give up their best essences to counteract the ingested poisons. The subjects saw visions, heard heavenly music, and believed they had found God. But when the drugs lost their effect these illusions ended, and the subjects thought they needed a stronger dose to attain the supreme state permanently. All they attained was death.

From these tragic lessons the Taoists learned that the "immortality pill" must be found internally, not in external chemicals. Sexual energy can provide a veritable fountain of life, because the body keeps the reproductive system active even when we do not need to procreate. We can learn to conserve out sexual energy and tap into the Universal Force. This gives us power for self-healing, replaces lost adrenal energy, and enhances creative and spiritual work.

Emotional Influences

When the adrenal center is connected and open, one has a sensation of freedom; when it is blocked or closed, one feels weighed down.

8. Center Opposite the Heart, T-5 (Gia Pe)

Location

The Gia Pe point is between the shoulder blades and between the fifth and sixth thoracic vertebrae (T-5 and T-6), opposite the heart center (Fig. 5.34 and 5.35).

Properties

The Gia Pe center has a close connection to the heart; it forms a halo of energy to protect the heart and crown centers. In higher levels of practice that involve space travel, it is known as the Wing Point, which protects the traveler (it is also called the Protecting Wing). The point also helps the heart center activate the energies of love, peace, joy, and happiness. You can activate this center by

allowing the sternum to sink slightly down to the back. It acts like a pump to send energy to the higher centers.

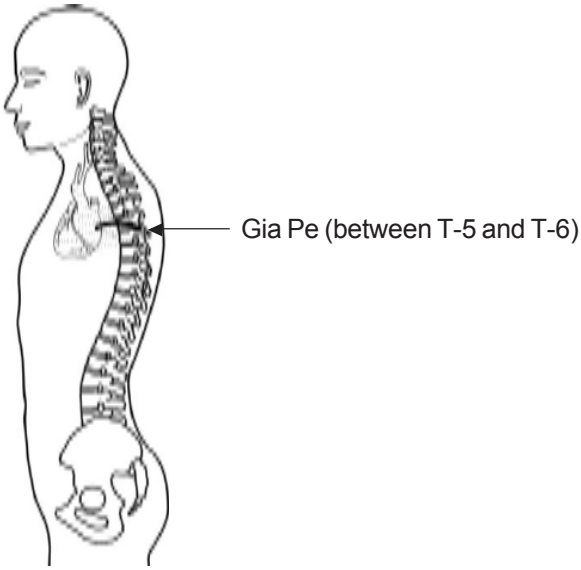

Fig. 5.34 *Center Opposite the Heart*

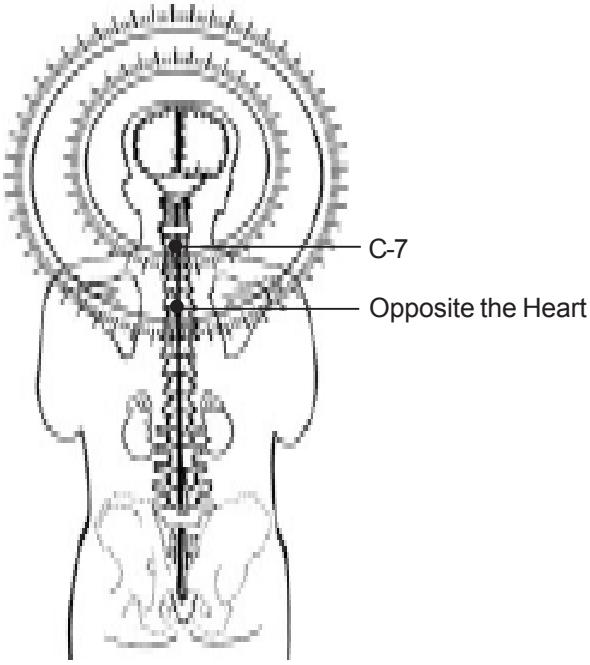

Fig. 5.35 *Center opposite the Heart, Back View*

Note: *The Gia Pe center is a region of hot energy. Concentration on this point by a person who is temperamentally impatient or hasty can overheat the pericardium and the heart. People with weaker hearts and cooler energy can concentrate on this point without any problems.*

Emotional Influences

The Gia Pe point is directly connected to the heart and can help activate the heart and thymus gland. When connected and open, the point gives one a feeling of freedom and a deep sense of life and its virtues; when it is blocked or closed, one has feelings of burden, hopelessness, melancholy, and chaos.

9. Point Opposite the Throat: Big Vertebra, C-7 (Ta Chui)

Location

The Ta Chui or C-7 point sits just below the seventh cervical vertebra. If you lean your head forward and run your fingers down your neck, you will feel a big vertebra protruding outward at the base of the neck where the neck meets the shoulders. Just below this bone is the C-7 point (Fig. 5.36).

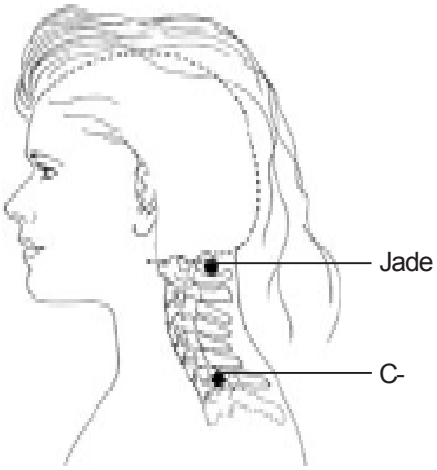

Fig. 5.36 *Point opposite the Throat*

Properties

The C-7 point is a central connection for the tendons and energies from the upper and lower regions of the body. It is also where the Yang channel of the legs connects with the Governor Channel, and it serves as a junction box for the nerves of the hands and legs. Any blockage at this point restricts the energy flow to the higher centers and redirects it to the hands and legs. This means that C-7 requires more concentration during practice so that the Chi can flow upward.

When healers, massage therapists, and martial artists concentrate on using their hands, they draw energy away from areas of the body where it is most needed. Such people should not focus too long on C-7 before the higher centers are fully opened, because it can increase the energy flow into the arms and legs. Energy should be allowed to build up in the Microcosmic Orbit and not become sidetracked or diluted by going through other channels. The C-7 point is also used extensively in other Healing Tao practices, such as Healing Love, Tai Chi, Iron Shirt, and Bone Marrow Nei Kung, to strengthen the connections between the neck, spine, and crown while enhancing the flow of energy (Fig. 5.37).

Emotional Influences

The seventh cervical vertebrae (C-7) is the largest bone in the neck. When it is connected and open, C-7 enables one to embrace others with humanity; when it is blocked or closed, the result is denial, stubbornness, and feelings of inadequacy.

10. Small Brain Point: Jade Pillow (Yu Chen)

Location

The Jade Pillow lies at the opening of the base of the skull, above the first cervical vertebra. It is part of the cranial pump that draws spinal fluid and Chi upward (Fig. 5.38). This area also houses the cerebellum and medulla oblongata, which are responsible for functions such as heartbeat, respiration, and muscle coordination.

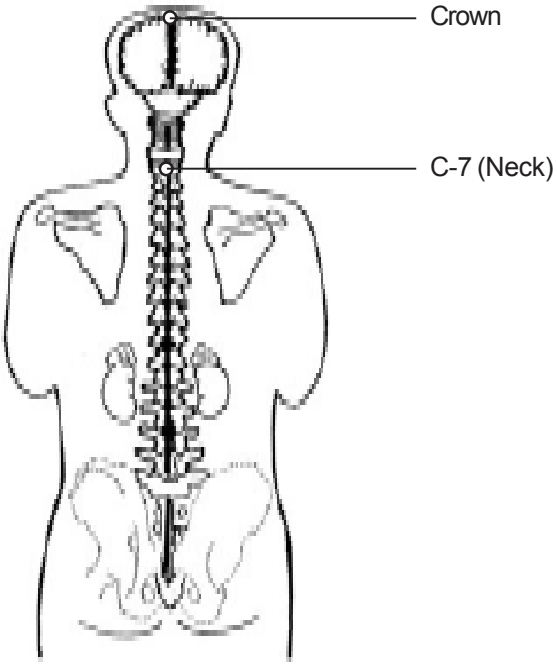

Fig. 5.37 Use C-7 to strengthen the connections between the neck, spine, and crown while enhancing the flow of energy. Once the Chi can pass down into the body through the crown, we can direct it to the hands and legs.

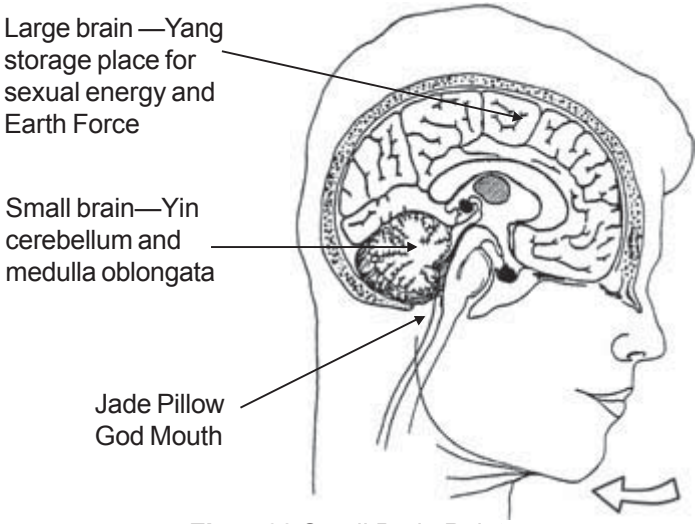

Fig. 5.38 *Small Brain Point*

Properties

The small-brain point promotes Yin energy, helping balance the Yang energy of the large brain and serving as a storage place for refined sexual energy and the Earth Force. It also has a direct connection to the crown and the Third Eye. Taoists believe the small brain has 12 energetic branches that extend down to the soles of the feet to connect to the 12 branches of earth energy.

The Jade Pillow controls the breath. The small-brain point controls breathing, and when it opens, breathing patterns can change. Sometimes it makes you breathe heavily, or slowly in long cycles. It can also cause the body to jerk uncontrollably, or it can even stop the breathing for a while. If something troublesome occurs, you can mentally tell yourself to stop at that moment and change the breathing pattern, or practice the Microcosmic Orbit, and the pattern should change.

If you're curious to see what happens with these abnormal breathing patterns, you can just let them continue for as long as you feel comfortable. After a while, your breathing should return to normal. Breathing methods are only used in the very beginning to stimulate the Microcosmic Orbit. Once you develop enough control, you will find you can use your mind alone to move the energy, which is much faster. At this point, your breathing will take care of itself naturally.

The Jade Pillow activates the back part of the cranial pump. This point is also part of the cranial pump. When you pull in the chin slightly toward the back of the neck and up toward the top of the skull, stretching the neck backward and upward, the space above the first cervical vertebra widens. This activates the Jade Pillow and stimulates the back part of the cranial pump, which sends cerebrospinal fluid, as well as Chi, into the brain (Fig. 5.39).

God Mouth: The God Mouth is another name for the Jade Pillow or small-brain point. By picturing the God Mouth opening wide, you expand the area's capacity while enhancing the cranial pump's action. Taoists regard this point as a storage place for extra energy and believe it receives information from above, like an antenna.

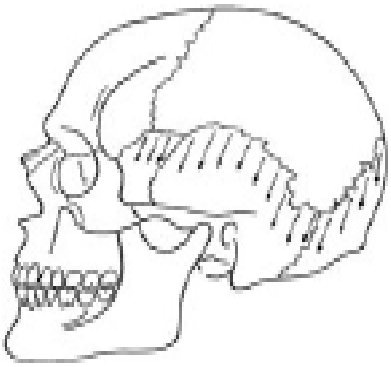

Fig. 5.39 *Cranial Pump*

Emotional Influences

When this point is blocked and disconnected from the other points, energy can enter the upper brain, increasing the pressure in that area. This can cause illusions and hinder meditative practices. Learning the locations of the pineal, thalamus, hypothalamus, and pituitary glands enables you to guide the energy to the proper points, rather than allowing it to run wild in the brain. (The Microcosmic Orbit meditation usually relieves such problems.) Congested energy may be effectively redirected with mind/eye power. When the small-brain point is open and connected, one feels inspiration; when it is blocked or closed, one feels suffocated. When the point is congested, it also causes neck pain.

11. Crown: One Hundred Meetings (Bai Hui)

Location

The crown point is at the top of the head along the midline. An imaginary line from ear to ear connecting the highest point of the ears over the top of the head crosses the midline at Bai Hui.

Related Points of the Crown Point

The pineal gland: The back part of the crown. The back-of-the-crown point (also known as Kun Lun Mountain, the highest point of the human being and the highest peak of heaven) connects to the pineal gland approximately three inches down from the crown within the brain (Fig. 5.40). The pineal gland has a close relationship with the pituitary gland behind the mideyebrow; when joined, they enhance personal power.

The pineal gland is considered the main receptor and "time clock" of the body. When stimulated during meditation, it controls inner vision allows us to see auras, and provides a sense of direction by acting as an internal compass (Fig. 5.41). In relation to spiritual disciplines, we can use the back part of the crown point to practice "overcoming death" by taking in external forces and combining them with sexual energy and the Original Force to form an "Immortal Body." With this body we can leave the physical body before the final transition (death) occurs. The crown point provides access to other worlds; contacting them is a major goal of Taoism.

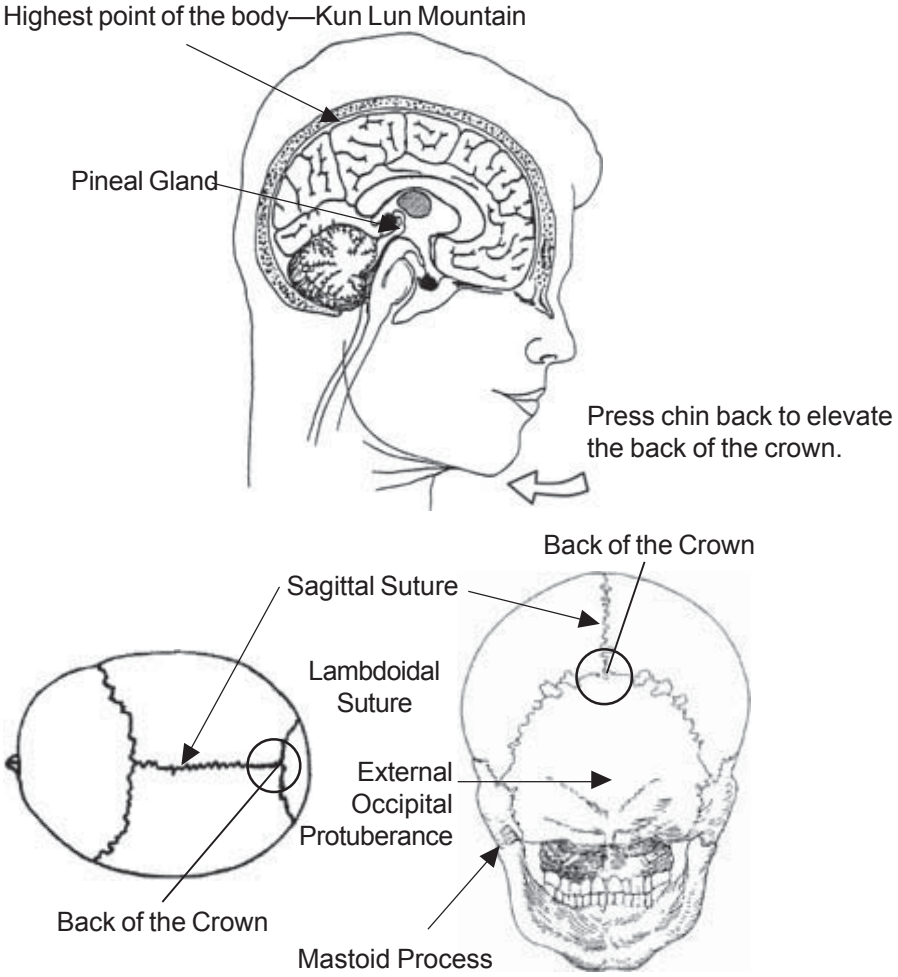

Fig. 5.40 *The back-of-the-crown point, Kun Lun Mountain*

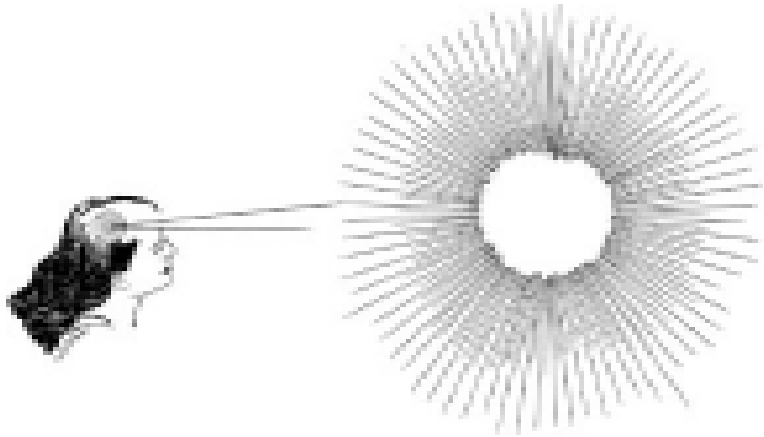

Fig. 5.41 The pineal gland is our time clock and inner compass, *the source of our inner vision.*

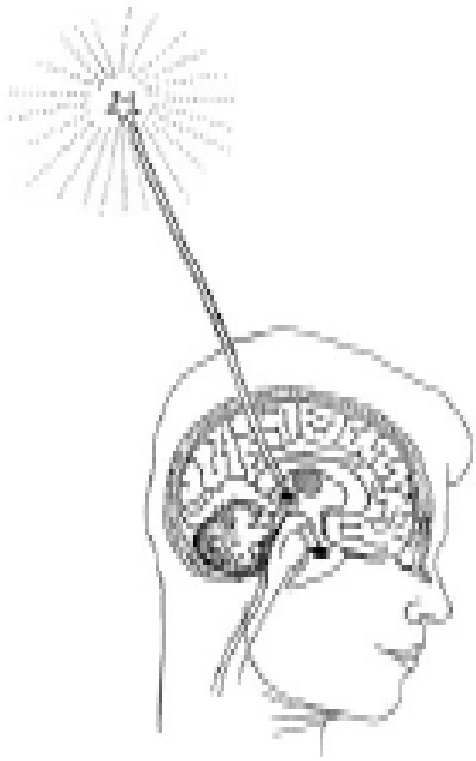

Fig. 5.42 The pineal gland has a close connection to the North Pole *and North Star.*

The Kun Lun Mountain point has a close connection to the North Pole and the North Star, giving us direction during out-of-body travel. (Taoists regard the North Pole as one of the Gates of Heaven.) By focusing on the tip of the Crystal Palace, the pineal gland, and the back of the crown, we can project ourselves to the North Pole or North Star as we attract its violet emanations (Fig. 5.42). The pineal gland senses light and dark and influences our sexual cycles. It regulates the body's biological clock and governs body rhythms. The human pineal gland and related brain structures may be important in the cause and treatment of winter depressions. Exposure to high-intensity full-spectrum lights for several hours before daybreak gives patients significant relief from seasonal depression. By practicing the Healing Light meditation, you can receive the light of the universe even with the eyes closed.

Thalamus and Hypothalamus: These points are also part of the cranial pump, and they help us access the energy of the Big Dipper constellation (Fig. 5.43). (Turning the inner eye inward to the center of the Crystal Palace also known as the Crystal Room—and the top of the crown helps activate the pump.) The points are located by tracing a line from the back of the opening of each ear to meet at the crown point of the head, then tracing another line from the mid-eyebrow to the crown (Fig. 5.44). Three inches down from the point of intersection, inside the skull, is the thalamus. The hypothalamus extends about one-half to one inch beneath it. (Up to one inch further back from this point is the region of the pineal gland.)

The hypothalamus is the central processing unit for the whole hormonal system. It receives signals from the autonomic nervous system (the sympathetic and parasympathetic nervous systems) and impulses from the optic nerve, olfactory bulbs, and thalamus. Conscious and subconscious thoughts also affect the hormonal system through neuronal connections between the cerebral cortex and the hypothalamus.

Hormonal activities from the entire hormonal system (the thyroid, adrenals, ovaries, testicles, etc.) also feed back into the hypothalamus, which in turn commands the anterior pituitary gland to readjust its "master hormone" secretions. The level of "master hormones" from the anterior pituitary controls the levels of activity of the thyroid, adrenals, ovaries, testicles, and so on—the health of the whole hormonal system.

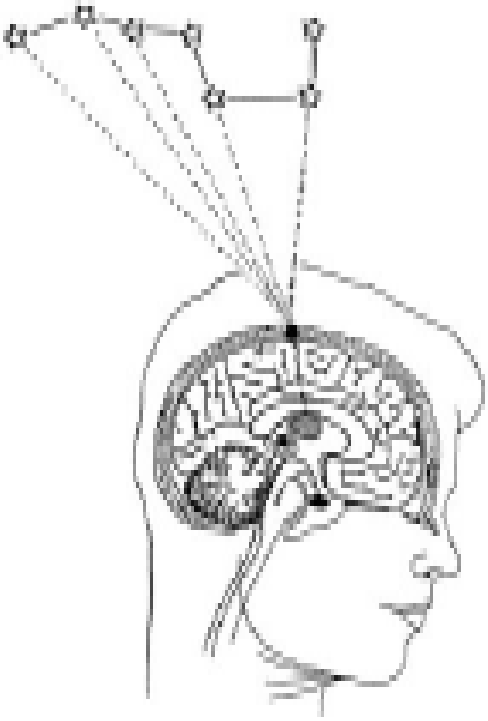

Fig. 5.43 *The thalamus and hypothalamus glands connect to the Big Dipper.*

From the Mideyebrow to the Base of the Skull

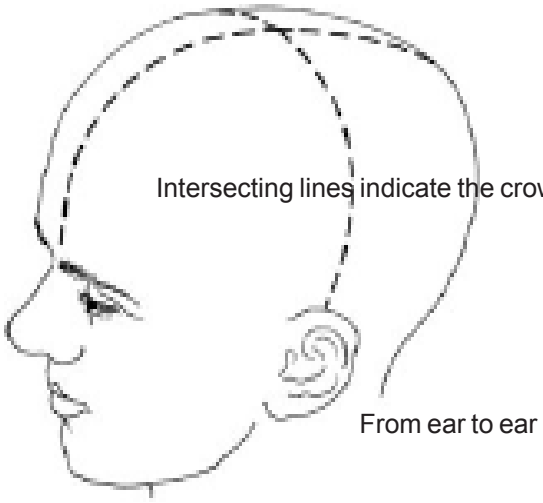

Fig. 5.44 *Location of the Crown*

The terminal axons of other hypothalamus neurons make up the posterior pituitary. The transmitters from these axons are released from the posterior pituitary directly into the bloodstream as two additional hormones to regulate other functions of the body (Fig. 5.45).

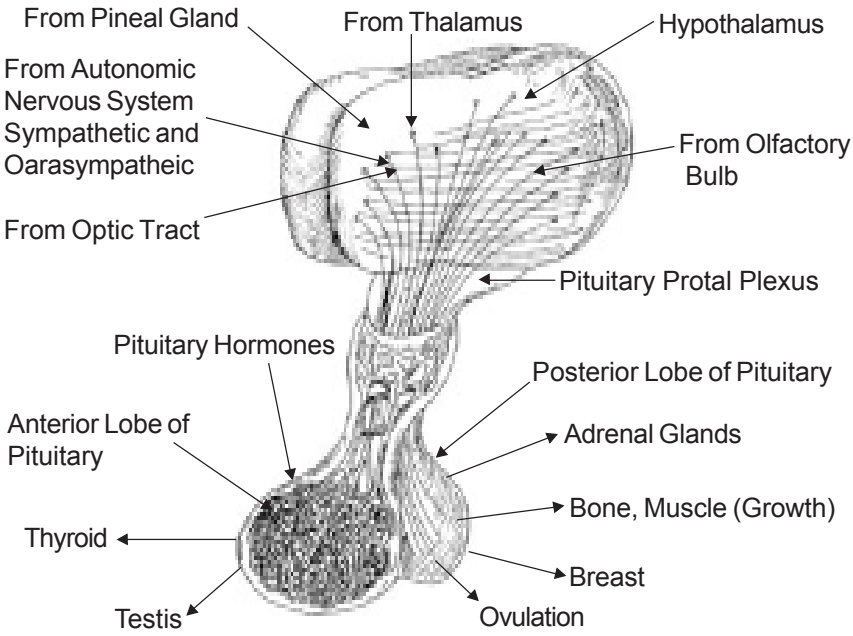

Fig. 5.45 *Hypothalamus, Pituitary Gand and the other Gands' Connections*

Taoists regard this point as the main switch of the Universal Force. When the spirit awakens, it resides in this place. The pineal gland acts as the male (positive) charge, and the hypothalamus acts as the female (negative) charge. When they are connected, they give out a powerful, balanced force. By focusing on this center and picturing the seven stars of the Big Dipper, you can access the constellation's energy, which emanates from the crown as a ray of red light.

Crystal Palace: The brain regulates all bodily processes, voluntary and involuntary. It records our perceptions and directs our

responses to the environment. By circulating Chi from the lower points upward, increasing the Chi in the brain, we can keep the brain healthy and enhance the memory.

The Crystal Palace lies in the middle of the brain (Fig. 5.46). If you imagine one line extending down from the crown, and another extending from the mid-eyebrow straight back (at the level of the tops of the ears), the intersection of the lines is the center of the Crystal Palace, which encompasses the pineal, thalamus, hypothalamus, and pituitary glands. Here the sensory and motor fibers and nerve tissues interlace in a dense network. In meditation the Crystal Palace appears like an oval crystal and shines like a mercury light.

The Crystal Palace is shaped like an egg; its tip points about 15 degrees toward the back of the crown. When we lightly pull in the chin, the small-brain point is elevated to help open the Crystal Palace and make it more accessible to the external forces we attract. The tip of the egg corresponds to the pineal gland; the center corresponds to the thalamus and hypothalamus; and the base corresponds to the pituitary gland.

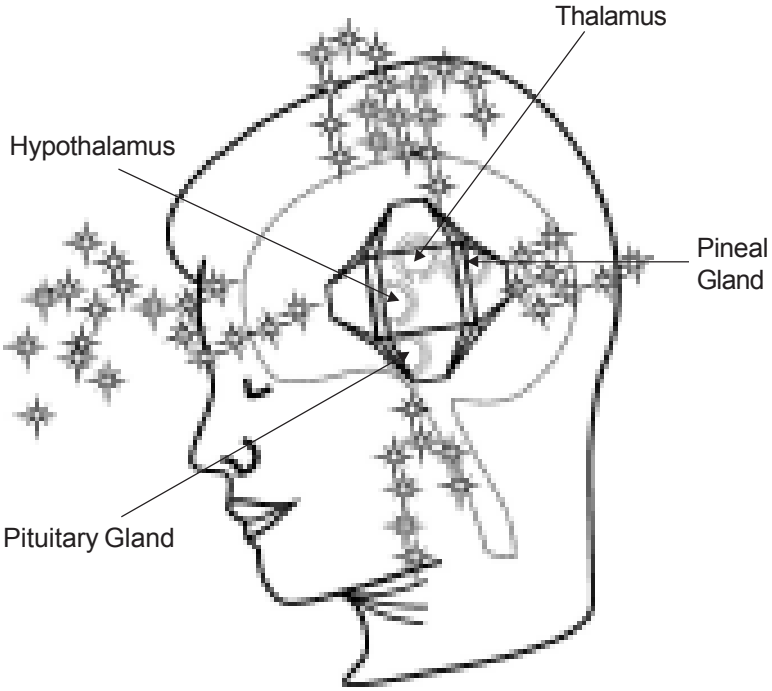

Fig. 5.46 *Crystal Palace*

Once the Crystal Palace is open, it becomes illuminated like millions of shining crystals. It can give and receive light and awaken our inner knowledge and deepest potentials. It receives light and knowledge from the universe and reflects it to the various organs and glands to enhance them (Fig. 5.47). The Crystal Palace also has 10 holes connected to the 10 Celestial Stems, which in Chinese astrology regulate all heavenly energies that influence the earth.

Properties

The crown point is involved in activities of all major regions of the central nervous system and the entire sensory system.

Emotional Influences

When the crown point is open and connected, one may feel radiant happiness and guidance from higher forces. One may also see auras and the “lead light” that guides journeys from the body (which do not only occur at death). If this point is blocked or closed, the result may be delusions, illusions, headaches, and erratic mood swings; or one may feel like a victim and slave.

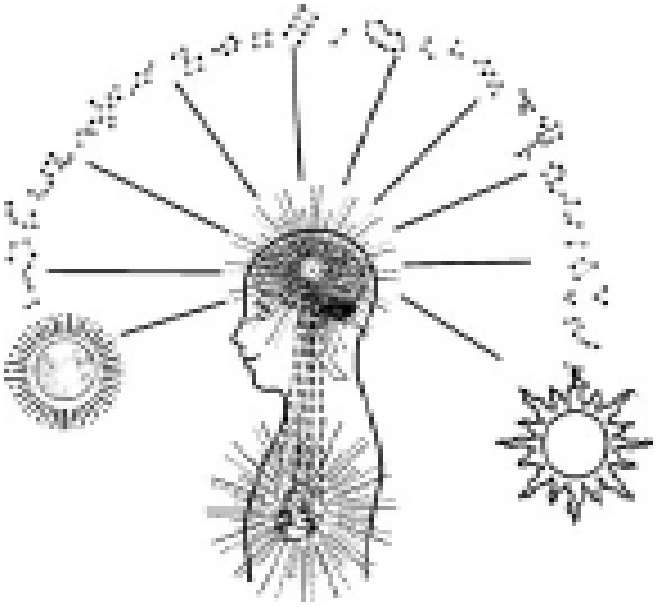

Fig. 5.47 *The Crystal Palace connects to the 10 Celestial Stems and the heart.*

12. Pituitary Point: Mideyebrow or Third Eye (Ying Tang)

Location

The pituitary gland is about three inches inside the skull from the mid-eyebrow point. The pituitary point is said to be where the spirit resides (Fig. 5.48).

The pituitary point is part of the Crystal Palace. It corresponds to three outer points: the midpoint of the forehead, which corresponds to the hypothalamus; the point between the eyebrows (Third Eye), which corresponds to the pituitary gland; and the point between the two eyes at the root of the nose.

The pituitary has connections to these other points:

- The pituitary is connected directly to the Jade Pillow.
- The midpoint of the forehead is connected to the crown.
- The point between the eyes is connected to the palate and the Functional Channel.
- The left side of the point is connected to the left (Yang) temple bone.
- The right side of the point is connected to the right (Yin) temple bone.

Properties

The pituitary is one of the most important endocrine (hormone-producing) glands. It receives the signals transmitted by the hypothalamus to produce many hormones that govern a wide range of bodily processes, such as thyrotropin, which stimulates thyroid functions; adrenocorticotropic hormone which stimulates activity of the adrenal cortex; follicle-stimulating hormone (FSH), which triggers the manufacture of testosterone in males and the corpus luteum in females; prolactin, which stimulates the secretion of breast milk; and growth hormones, which govern cellular metabolism. The mid-lobe stimulates the hormone intermedin, which regulates skin pigment cells.

The posterior pituitary influences water metabolism, blood pressure, kidney function, and the action of smooth muscle.

At more advanced levels of the Microcosmic Orbit meditation, we often start with the mid-eyebrow point, drawing Higher Self (Cosmic) Energy to activate the navel and other points along the Micro-

cosmic route. This point activates the Higher Self Force and filters incoming food for our internal well-being. The particle forces, when taken in through the mid-eyebrow and brought down through the tongue to be mixed in the mouth with the other forces, can be transformed into life-force, which Taoists know as the nectar, elixir, or water of life.

Emotional Influences

When the pituitary point is open one feels wisdom; when it is closed one feels incapable of making decisions.

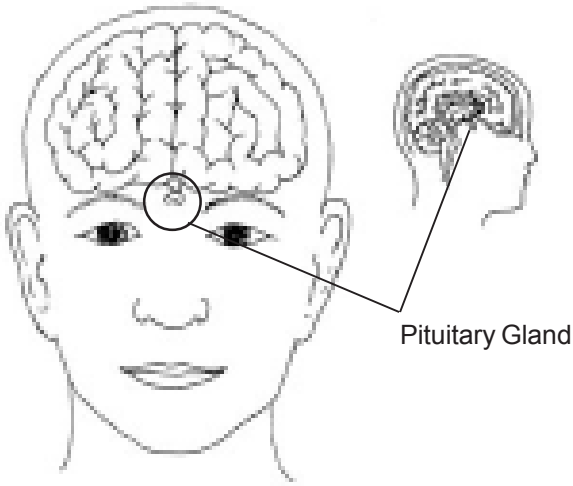

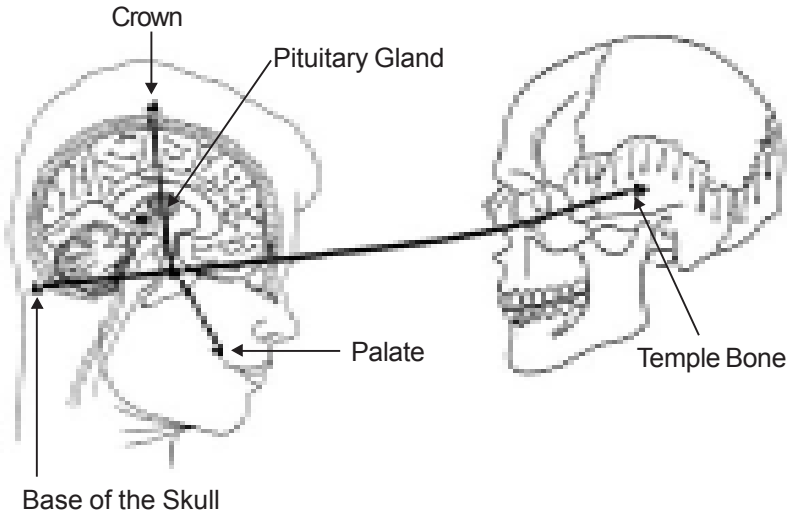

Fig.5.48 *Pituitary Gland Connection*

13. Heavenly Pool (Hsuan Ying)

The Heavenly Pool at the palate has three aspects: the palate, the tongue, and the saliva.

Palate

Located directly behind the teeth, the palate point is a depression or hole through which Chi flows strongly down into the body (Fig. 5.49).

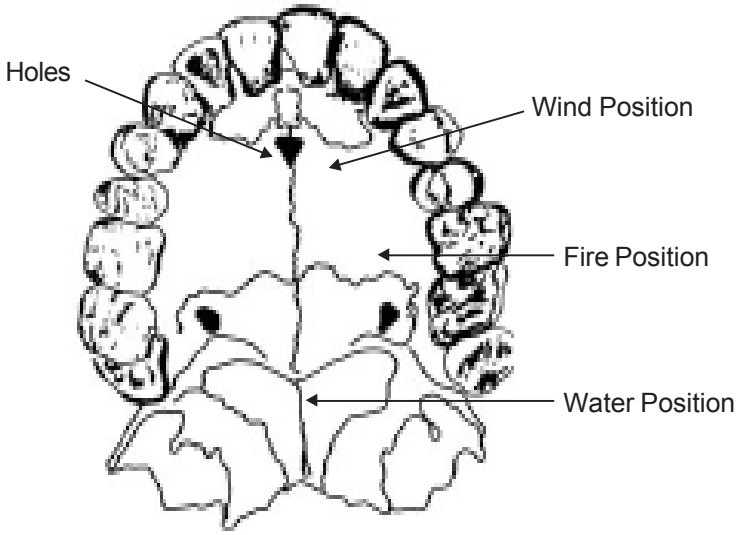

Fig. 5.49 *Three Positions of the Palate*

Three positions are associated with the palate point.

Wind Position: The Wind Position is behind the teeth at the center of the palate point in the middle of the depression.

Fire Position: The Fire Position is farther back on the hard palate, where it connects to the heart and stirs up “fire energy.”

Water Position: The Water Position is at the front part of the soft palate at the back of the mouth. It lies beneath the pituitary gland along the channel that connects to the Chi flow of the kidneys and sexual center. Touching the tongue to this point will draw the Yin essence of the sexual energy up into the brain.

Using the Three Positions: If you press the tongue behind the teeth and release it a few times, you will soon feel the Chi flow.

This is often experienced as coolness, warmth, numbness, tingling, or an electrical sensation. You can find the best position for the tongue by moving it back and forth against the palate until you feel the position where the Chi flows most strongly. (Usually this is near the teeth in the hole of the palate,) Concentrate on this area as you draw the Chi down into your body.

If you feel you need more Yin energy, shift your tongue back to the Water Position. If you need more Yang energy, shift your tongue to the Wind Position at the middle palate until you feel more fire, then move back to the Water Position again. In the beginning it may be hard to keep the tongue curled for long periods, so shift its position as necessary.

Tongue

The tongue has several major points (Fig. 5.50, 5.51, and 5.52). When they are activated by the Chi flow, they help move Chi through the Triple Warmer meridian.

Tip of the Tongue: When the tip of the tongue is placed on the lower jaw just below the teeth, the Chi flowing through it helps activate the spleen.

When the tip of tongue is held between the upper and lower teeth, the Chi flowing through it helps activate the lungs.

When the tip of the tongue is placed so it touches the upper jaw, just behind the teeth, the Chi flowing through it helps activate the heart.

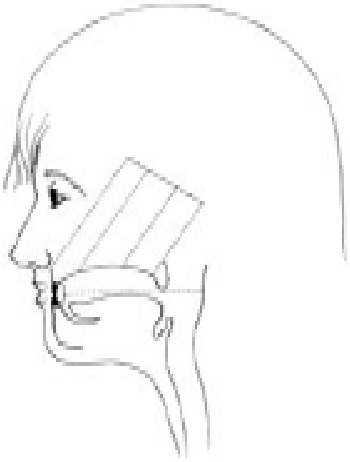

Fig. 5.50 *The upper palate connects to the organs.*

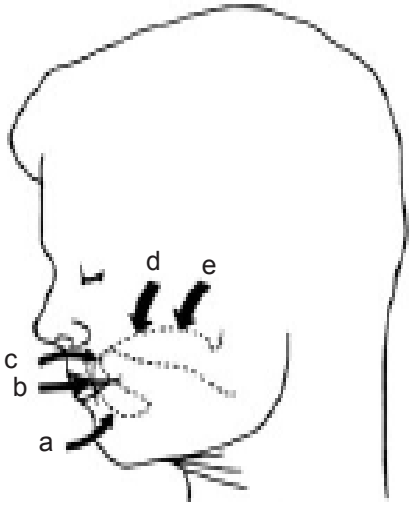

a. Lower jaw just below teeth-reflex point of the Triple Warmer
b. Front of the mount-reflex point of the lungs and large intestine
c. Front palate-reflex point of the heart and small intestine
d. Middle palate-reflex point of liver and gall bladder
e. Back palate-reflex point of the kidneys and bladder

Fig 5.51 *Relationship of the Palate and Tongue with the Organs*

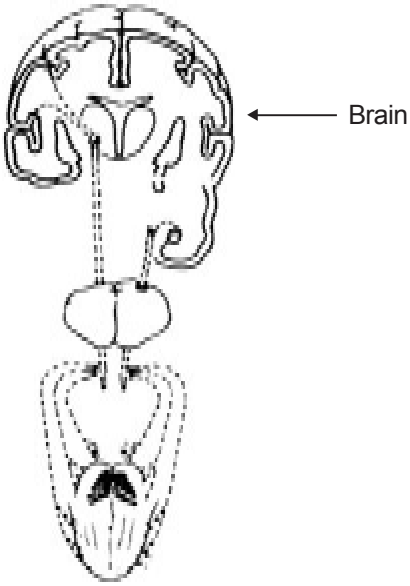

Fig. 5.52 *The tongue connects to the brain.*

When the tip of the tongue is placed on the hard palate, the Chi flowing through it helps activate the liver.

When the tip of the tongue is placed on the soft palate, the Chi flowing through it helps activate the kidneys.

Golden Liquid Point: On the left side of the tongue is a point called the Golden Liquid (or Golden Boy) point, which helps activate the Universal Force. It connects to the Governor Channel and the Crystal Palace with a positive charge.

Jade Liquid Point: On the right side of the tongue is the Jade Liquid (or Jade Girl) point, which helps activate the Earth Force. It connects to the Functional Channel, the kidneys, and the sexual center with a negative charge.

Gathering Spring Point: The center point of the tongue is called the Gathering Spring point, and it has a neutral charge of both Yin and Yang energy (Fig. 5.53). It connects to the middle Thrusting Channel, the heart, the center of the Original Force, and all the organs.

Double Dragons: Beneath the tongue are two green tendons known as the Double Dragons, which curl or move the tongue around to help activate the three major points and increase the flow of saliva (Fig. 5.54).

Saliva and the Elixir (Nectar)

When the electromagnetic life force flows through the palate, the tongue points, and the Double Dragons, it activates the saliva (Fig 5.55), which becomes sweet and fragrant. When you have a mouthful, you can swallow it down with a gulp to activate the points on both sides of the throat (the corresponding left and right Golden and Jade Liquid points). Taoist believe that saliva, when properly mixed with the external forces, has powerful anti-aging effects. It also cools and balances one's energy. When swallowed properly, saliva helps open the Functional Channel so energy can move down the front of body. (It is actually harder to bring energy down than to raise it.)

The saliva has several functions. It moisturizes the membranes of the mouth; it mixes with food to aid in digestion; it helps predigest carbohydrates, turning them into glucose; and it helps dissolve food before it enters the stomach. The saliva also contains some vitamins, such as B2 and K, and other digestive juices.

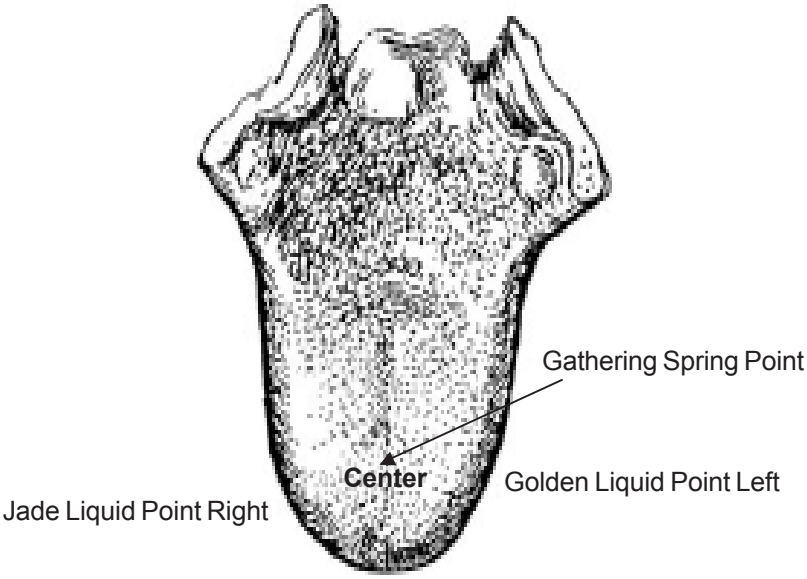

Fig. 5.53 *Tongue Connection*

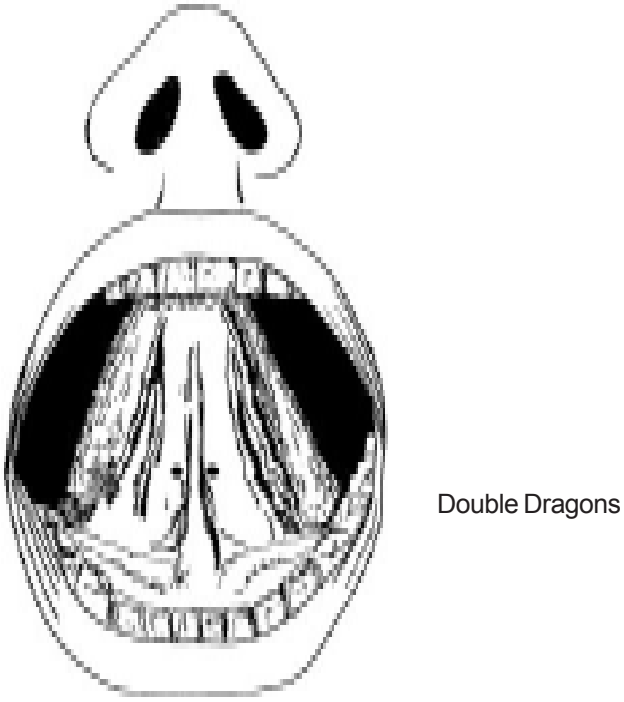

Fig. 5.54 *Point Below the Tongue*

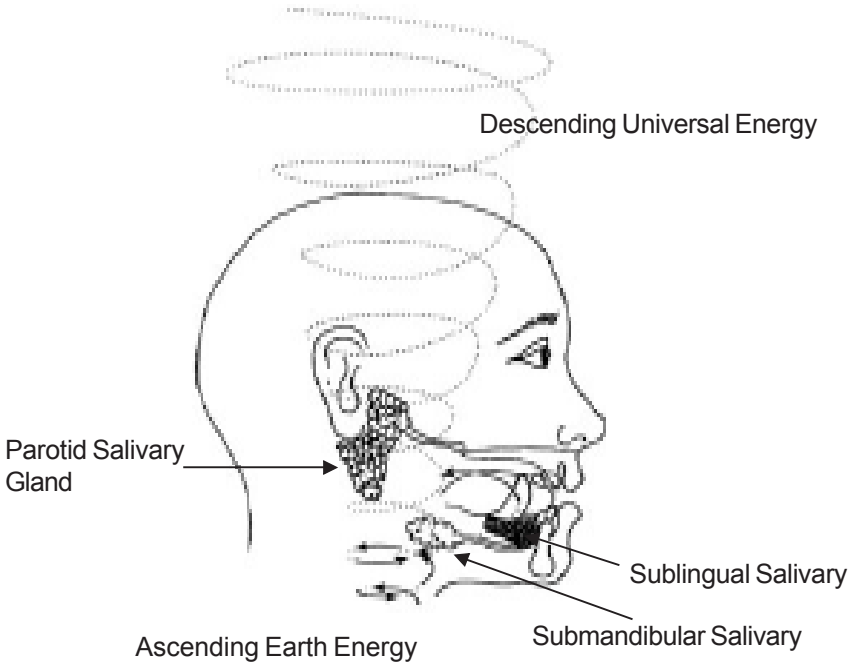

Fig. 5.55 *Saliva and the Elixir (Nectar)*

How to swallow the saliva. Intentionally swallowing the saliva is one of the best ways to maintain health. Mixing the saliva with the Universal, Higher Self, Earth, and Original Forces by swishing the tongue to stimulate the salivary glands has a number of benefits.

• It clears bitterness in the mouth, soothes a sore throat, and helps prevent tooth decay.

• It lubricates the stomach and small and large intestines while helping them digest food.

• It helps moisturize the organs and joints of the body.

• It helps cool down the heart if it is overheated, and it nourishes the skin.

• Swallowing the saliva several times in succession can stop the feeling of hunger.

• When you are not feeling well and energy or mucus is stuck in your throat and chest, you can concentrate to make the navel warm, move the tongue to mix all the forces with the saliva, and swallow three to six times. This should make you feel better quickly.

• Constant mixing and refinement of saliva through higher Taoist practices helps develop the Inner Pearl, the human soul essence.

• When you cannot sleep at night, you can swallow a few times to cool down your system, which prepares the body for sleep.

Saliva as the Upper Elixir (Nectar or Water of Life). I believe another fluid produced in the mouth is not the normal saliva, but a mixture of sexual energy and Original Force stored in the kidneys. When properly stimulated, these rise to the brain and activate the pineal, hypothalamus, and pituitary glands. These glands emit hormone secretions that flow down to the palate as an elixir—the "upper" water or Golden Elixir.

This occurs naturally when people make very good love together. The woman feels a moistness in her mouth that tastes like nectar, very sweet and fragrant. When properly swallowed, it is the best medicine to strengthen, heal, and enhance spiritual development.

When human love and sex combine, kidney energy is activated and rises through the Governor Channel to the crown, stimulating the glands. The fusion of human love and sexual energy also attracts Universal and Earth Forces to mix together.

14. Throat Point: Heaven's Projection (Tien Tu)

Location

The throat point is below the thyroid and parathyroid glands, just above the fosse of the suprasternal notch. If you run your finger down the midline of your neck, it will naturally fall into a V-like notch at the base of the neck and the top of the breastbone (sternum). This is the throat point (Fig. 5.56).

Properties

Speech and communication. The throat point is related to speech and communication. In Taoist physiology, the tongue is the sense organ associated with the heart. The heart (Hsin) is also the natural seat of the mind. The openness of the channel between one's heart/mind and one's tongue determines one's ability to speak one's mind strongly and clearly. The throat point lies right in the middle between the heart and the tongue. If the Chi flows strongly through this point, you will find it easy to express yourself, and your speech will be clear and smooth. If the point is blocked, you will find it very

hard to get the proper words out. Opening the throat point can greatly improve this situation.

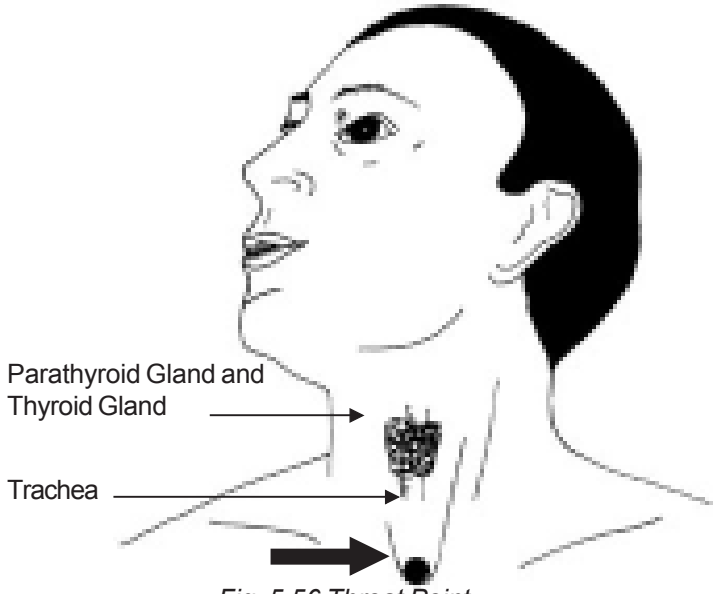

Fig. 5.56 Throat Point

Dreams: The throat point is strongly connected to dream consciousness. Over the last century, the Tibetans have become quite well known for their Dream Yoga or lucid-dreaming practice. Study of the Tibetan techniques has inspired much research into lucid dreaming and has led to many scientific discoveries about dreaming and the mind.

It is not as well known that Dream Yoga is also an important practice in many branches of Taoism. Taoists who practice Dream Yoga focus on the throat point when going to sleep so as to consciously cross the bridge between the waking state and the dream state. Being able to dream lucidly helps one gain greater control of one's Chi and also enables one to consciously bridge the gap between life and death.

Many people in the West are familiar with the famous Chinese folk novel, *Journey to the West*, which relates the story of the Monkey King and his many adventures. The Monkey King had 72 magical powers. These powers correspond to the 72,000 subtle energy channels in the body. Taoists practicing Dream Yoga seek to duplicate the Monkey King's 72 magical feats while dreaming. These

include such feats as flying, becoming invisible, making duplicate images of oneself, changing into other shapes and forms, and so forth.

Being able to perform these feats in the dream state prepares the practitioner for exercising the same magical powers in the waking state. The powers are not sought for their own sake; true Taoist students are seeking wisdom and harmony with the universe, not more egotistical power. The powers are merely an indication that one has gained more subtle control of one's energy body.

Other parallel practices accomplish the same goals, such as the Kan and Li and higher-level practices. In a more mundane sense, Taoists view dream activity as a necessary function to process emotions that were not resolved or let go during the course of the day. By practicing the Inner Smile, Six Healing Sounds, and Fusion of the Five Elements meditation, we can get in touch with our emotions, process them, and clear them out. We practice forgiving and forgetting, so that we may clear and purify our Chi and spirit. As a result, we will naturally dream less. When the mind is clear during sleep, the energy body can strengthen itself while we sleep, which speeds up spiritual work.

Energy Body: Because of the throat's connection to speech, the Taoists make two logical extensions. Speech is related to breath, and breath is related to Chi, so the throat point is one of the control points for the energy body.

The throat point is weak and hard to protect. If the throat point is opened before a connection is established to the other points, one's energy can be lost, or even controlled by ill-intentioned persons. Spirits or entities that wish to possess one's body are most likely to enter through the throat point. The Governor and Functional Channels should therefore be cleared and able to circulate Chi before this point is completely opened in meditation. If you are aware an attempted possession has been launched, you can counteract it by strongly circulating your Chi through the Microcosmic Orbit.

Thyroid Gland: The thyroid gland, just above the throat point and surrounding the trachea, is the largest of all the endocrine glands. It controls the metabolism through production of hormones. If hormone quantities are too small, an individual can become puffy-faced, obese, sluggish, dull-witted, and in extreme cases, a semi-vegetable. If too much is produced, the results can be a tremen-

dous appetite and a nervous disposition. The individual will gradually become thinner because of the speeded-up metabolic rate.

Iodine is the critical mineral for the thyroid, and only an extremely small amount is needed to produce the thyroid hormones. In an underactive gland, the cells multiply so they can leach the last bit of iodine out of the food consumed. In an overactive thyroid, the gland enlarges because of overproduction of the thyroid-stimulating hormone from the pituitary, or from an excess of iodine, although the latter is rare.

The thyroid hormones have several functions. They help regulate the rate of metabolism; they influence physical and mental growth; and they influence the differentiation of tissues and their development. They also help prevent a buildup of calcium in the blood by balancing the hormone from the parathyroids, which maintains blood levels of calcium by drawing calcium from the bones and teeth.

Once the Microcosmic Orbit is open and the throat point is connected to the other points, it can balance an overactive or under active thyroid gland.

Emotional Influences

When the throat point is open and connected, one is more eloquent; when it is blocked or closed, one feels an unwillingness to change.

15. Heart Point (Shan Zhong)

There are two points of the heart to be considered. One is the actual center of the physical heart (Fig. 5.57 and 5.58), which can be strengthened through meditation; the other is an energy center close to the sternum and in direct line with the points of the throat and solar plexus along Functional Channel 17 in acupuncture (Fig. 5.59). Here, we discuss the energy center, which is closely connected with both the physical heart and the thymus gland.

Location

The energetic heart center is midway between the nipples in men, and one inch up from the base of the sternum in women. It connects the center of the Original Force to T-5 and T-6 on the spine, as well as to the physical heart.

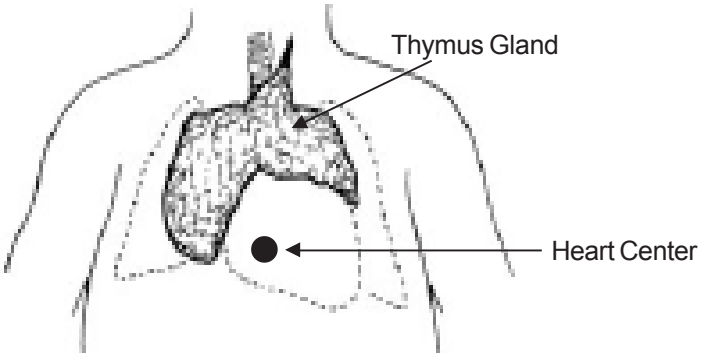

Fig. 5.57 *Child's Thymus Gland*

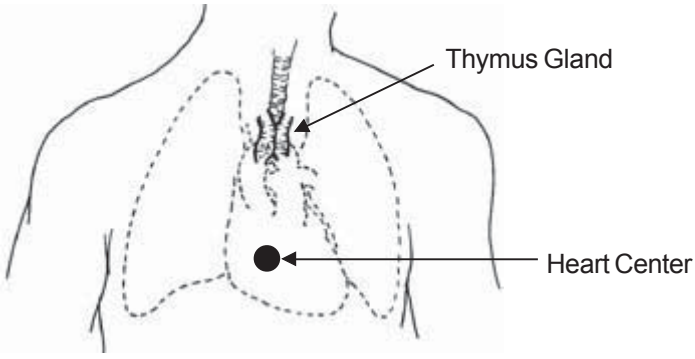

Fig. 5.58 *Adult's Thymus Gland*

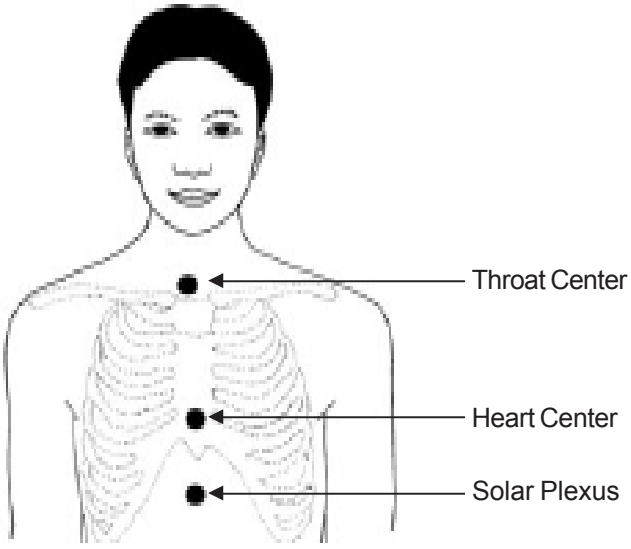

Fig. 5.59 *Heart Center*

Properties and Emotional Influences

The opening of the heart point is very small, so it takes time to fully open during meditation (Fig. 5.60). Occasionally energy congests the point and causes pain, discomfort, and shortness of breath. Massaging the sternum can relieve this. Most people also find that emotional pain is released as the associated negative energies disperse. Practicing the Heart Sound helps relieve both energetic and emotional congestion.

The virtuous emotions of love, joy, happiness, honesty, and respect are crucial properties of the heart. To help open this point, you should express these emotions, which you can cultivate through meditation, to others. After you have practiced the Inner Smile and Microcosmic Orbit meditations for a while, these virtues can be recalled very easily, because they are nourished by these disciplines. The heart point is also the gathering point of energy for the Upper Warmer meridian. When the heart is open, one feels love, joy, happiness, honesty, and respect (Fig. 5.61); when it is blocked or closed, one feels paranoia, self-pity, impatience, hastiness, and hatred.

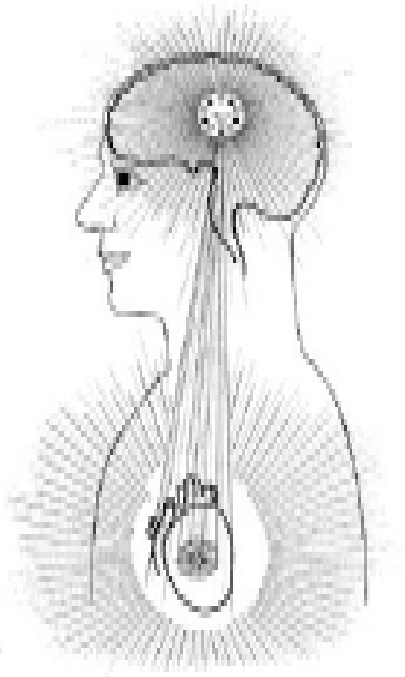

Fig. 5.60 *The opening of the heart is very small.*

> **Note:** *For Women: The heart's point and its positive emotional energies are very important for women to nurture so they can develop more control over their sexual energy, menstrual cycles, and spiritual growth. (It is also known as the Immortal Center for women.) When this point is open, its energy connects to the breasts, and it expands the virtues of the heat throughout the whole body.*

In higher-level practice, women can store the energy in the heart center. Once the Orbit is open, women can start the Orbit at the navel, move up to the heart, travel up to the throat and crown, back down the spine, and then up to the navel and heart again. In women (or very Yin men) the Orbit may naturally reverse its normal route, as the front of their bodies can be more Yang and the back more Yin. In the normal route, we use the Yang fire energy rising up the spine to help clear the Yin front water channel. However, if your water energy is stronger, it can also be used to clear obstructions in the fire channel.

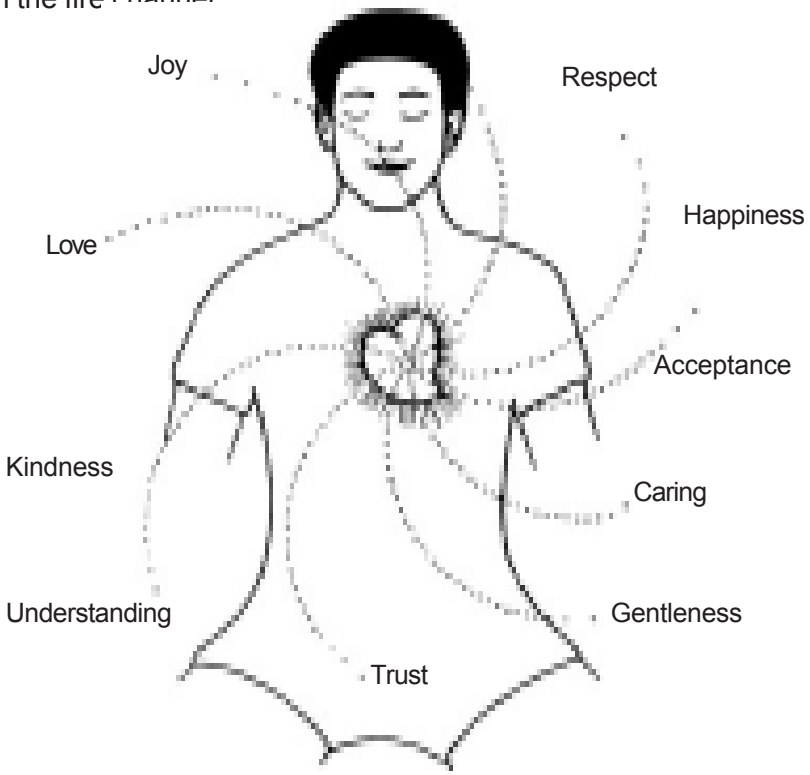

Fig. 5.61 *Opening of the Heart.*

Seat of Love

The heart point is the seat of love and can be used to connect with the loving energies of the Universal Love. It works like a cauldron to combine all the virtues into compassion. Taoists say that the heart stores our spiritual essence in its unawakened state. When the virtues are combined into compassion, the spirit awakens like a seed, which grows into a tree to bear fruit. When the heart point is opened too early, however, before the other points are opened and connected, one becomes susceptible to external influences, and loving energies can be lost.

Some religions use this center to enforce the concept of surrender, which they encourage their followers to translate into donations and charity. In these systems, people are encouraged to open their hearts, feel like flower blossom and give love before a sense of inner abundance and balance has been achieved (Fig. 5.62). This is spiritually unhealthy; the concept of surrender does not require self- sacrifice to this extent. Instead, surrender simply means giving up the whims and dictates of the ego and learning to live in higher states of consciousness as we become better vehicles for our divine source: the Tao

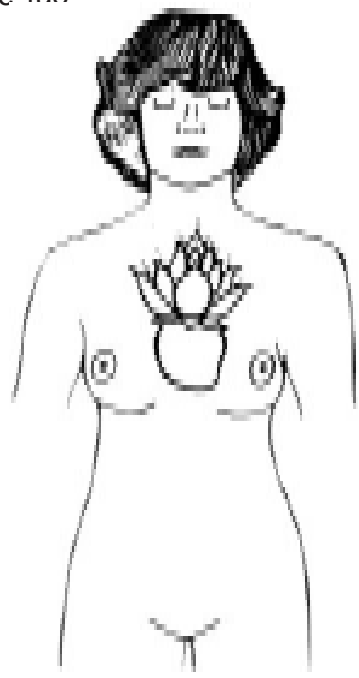

Fig. 5.62 *Feel the heart open like a flower blossoming.*

Note: *Respect is one of the most important energies in a loving heart. When people feel respect, the heart opens and easily receives transmission of the Universal and Earth Forces. This principle is applied in a student's relationship to his or her teacher.*

Forgiveness and love for those one dislikes or hates are very important to help open the heart. When one has hate in the heart, it closes up and is very hard to open again. If you cannot "love your enemies" at least try to feel detached from and neutral toward them. Feel compassion for their limitations.

Relationship to the Thymus Gland

Because the heart pumps blood through the body, it contains an intricate system of blood vessels to keep the heart muscle supplied with vital nutrients. The heart point controls the heart and the thymus gland, so it is important to focus on this point during meditation to strengthen these organs.

The thymus gland, at the forward base of the neck, plays a key role in the immunological defense system, stimulating production of the white blood cells that fight disease and infection. The thymus is fairly large at birth and continues to grow until adolescence, when it begins to shrink. By middle age the thymus is much smaller, but it is still an important factor in the immune system. During the first few weeks of life, T-lymphocytes created in the thymus migrate to the bloodstream and colonize lymph nodes throughout the body. These later begin to manufacture powerful antibodies vital for immunity.

Massaging the Sternum to Open the Heart Point

Massaging the sternum between the ribs releases negative emotions, stimulates the flow of lymph, and activates the thymus gland. Use either the index or middle finger knuckle to circle continuously from the top of the sternum to the bottom, and between the ribs at the base of the sternum (Fig.5.63). When you find a painful area, spend more time on it, massaging it cautiously until the pain is released. Do not overdo the massage in the beginning, because this can cause pain afterward.

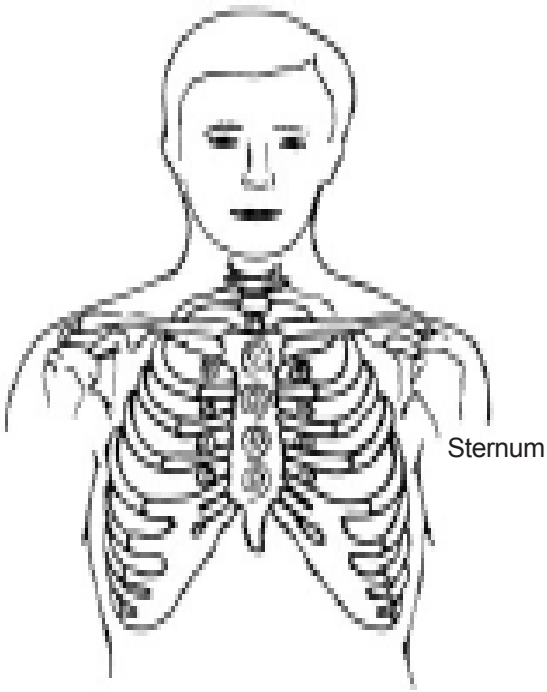

Fig. 5.63 *Massaging the sternum.*

Heart

The center of the heart is red and its core pure white. The heart center produces a positive charge, corresponding to the negative charge produced at the Door of Life and the kidneys, The two interact to harmonize the Chi flow in the whole body. Furthermore, the left side of the heart center is red and positively charged, while the right side of the heart is dark green and negatively charged. This combination produces the original spiritual energy that feeds the Shen or spirit, which is housed in the heart.

Taoists say this Original Chi splits into two parts after conception. Part of it is stored in the Crystal Palace of the brain, and part as sexual energy in the kidneys. When we combine the parts in the heart through meditation, we can restore our original spiritual essence.

16. Solar Plexus (Chung Kung) and Related Points

Location

The solar plexus point (Functional Channel 12) is slightly above the point halfway between the navel and the tip of the xiphoid process at the base of the sternum (Fig. 5.64).

Properties

The solar plexus is the point for the spleen, pancreas, stomach, and liver. This point controls the aura (the body's external energy field) and determines the location of the Middle Cauldron, in which sexual and life-force energies are transformed into spiritual energy. (It is in this cauldron that the body, soul, and spirit are combined.)

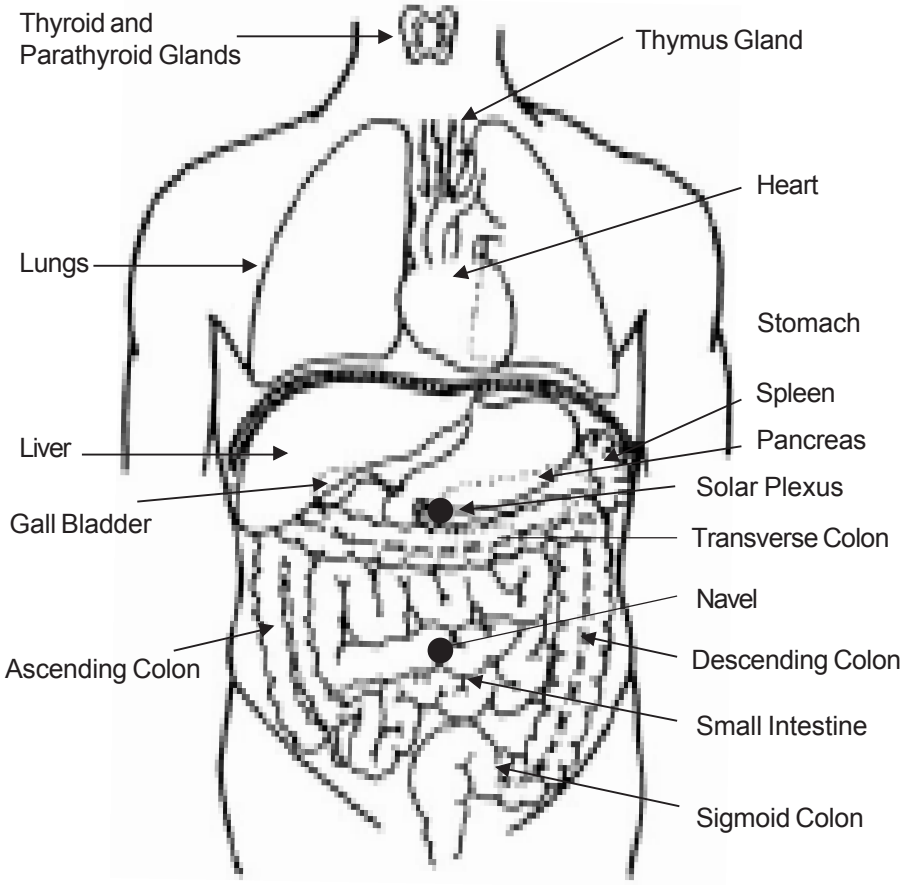

Fig. 5.64 *Solar Plexus and the Navel Center*

Spleen: The spleen is the largest of the lymphatic organs, the others being the thymus and tonsils. The spleen also forms blood cells, filters injurious substances from the bloodstream, stores iron for manufacturing hemoglobin, and produces the bile pigment bilirubin. Like the other lymphatic glands, the spleen is an integral part of the immune system and thus supports resistance to disease. In Chinese medicine, the spleen is responsible for transformation and transportation of Chi. The transformation occurs during digestion, in which the spleen (and the pancreas) play a major role. Blood circulation transports the nutrients (Chi) gleaned from the digestive process to all the cells in the body.

Pancreas: The pancreas, resting just below the stomach and liver, governs glucose metabolism. It is both an endocrine and exocrine gland. As an endocrine (hormone-producing) gland, the pancreas produces the hormones insulin and glucagon. Insulin is essential for the conversion of glucose (blood sugar) to energy, while glucagon converts the sugar stored by the liver back to blood sugar as needed. As an exocrine gland, the pancreas produces the digestive juices essential for the metabolism of carbohydrates, fats, and proteins, and secretes them into the small intestine. Chinese medicine does not differentiate between the pancreas and the spleen; their functions are both assigned to the spleen.

Stomach: Although we often think of the stomach as the main organ of digestion, the only foods the stomach actually breaks down are proteins. Other than aspirin and alcohol, almost no substance is absorbed in the stomach. In Chinese medicine, the stomach is responsible for the “rotting and ripening of food,” the transportation of food essences, the descent of Chi, and the origination of bodily fluids.

Liver: The liver weighs about four pounds and is the largest organ in the body. It has many functions. The liver produces bile, which emulsifies the fats in the diet so they can be easily digested when they reach the small intestine. It may surprise many people to learn that the liver is as important in glucose regulation as the pancreas, because it stores and releases sugar as needed.

Often considered a detoxifying gland, the liver breaks down nitrogenous wastes, alcohol, and other ingested substances that may be harmful. It produces lecithin, another fat emulsifier, and is supported by vitamin C. In addition to storing sugar, the liver also stores the fat-soluble vitamins, such as A, D. E, and K.

Aura: The aura is the energetic field around the body (Fig. 5.65). Virtually every process in the body, from digestion to muscular movement, is electrochemical. Because all functions of an electrical nature have an electromagnetic field surrounding them, many feel that the body's aura is its electromagnetic field.

Although only a few people can see auras without training, nearly everyone, consciously or subconsciously, can feel them. Electromagnetic fields interact when they overlap, and when we are around other people, our auras can influence each other. Our thoughts and feelings have electrical charges that affect our auras. It is important for the solar plexus point to be open, but if it is too open, one may be overly sensitive to the thoughts, feelings, and opinions of others, to the point of being unable to shut off mental and emotional static when in the company of others. This can be remedied by imagining a door or shield in front of the solar plexus point that can be raised or lowered as one wishes, depending on how intimate one chooses to be with one's present company.

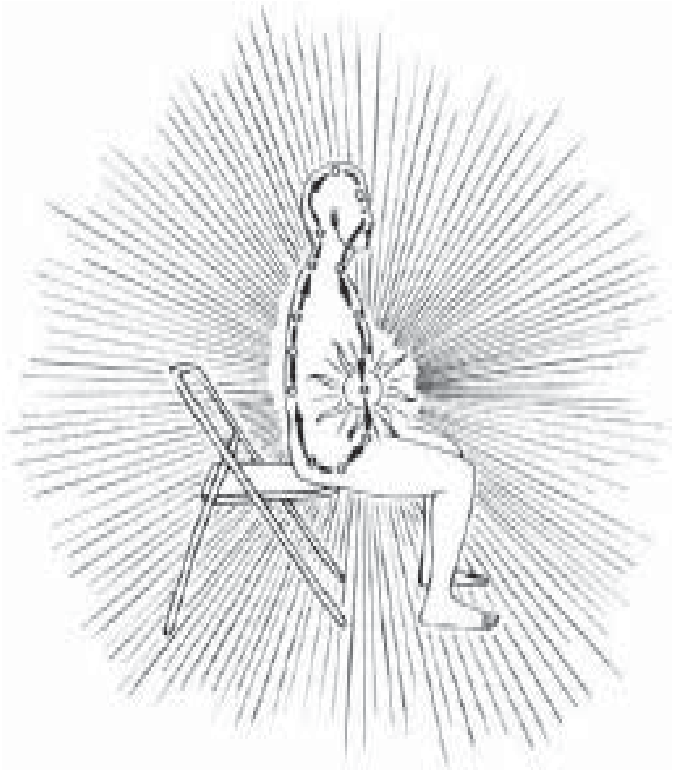

Fig. 5.65 *Aura from the Solar Plexus*

Some people may criticize the idea of shielding the solar plexus, maintaining it is important for people to be open to each other all the time. I say everyone is entitled to privacy. No one is expected to keep the door to one's home, office, bedroom, or bathroom open all the time; how much more so is this true of the door to one's feelings! You should be able to open the solar plexus point when you have established trust and confidence in the presence of another, but you should also be able to protect yourself in circumstances when privacy feels more comfortable. Even the greatest saints demanded privacy. We should respect our own needs as well.

Emotional Influences

When the solar plexus is connected and open, one feels daring and able to take risks; when it is blocked or closed, one feels panic and worry.

Exercise. Picture bright sunshine in the solar plexus and feel it connect to the sun in the heavens. Let the light shine out from the solar plexus to strengthen the aura. A strong solar plexus helps deflect negative energy emanating from others. You also can send your sunshine to other people when you connect with the unlimited source of light. This will help change the negative feelings someone may have toward you. The white light of the solar plexus makes you more visible to higher forces and to higher masters so they can guide and protect you more easily.

17. Backs of the Knees, BL-40 (Wei Zhong)

At the backs of the knees is storage space for extra energy collected during meditation (Fig. 5.66). In advanced spiritual practices, these spaces become resting places for the energy of the soul when it prepares to travel outside the body. The backs of the knees are difficult to access if a cross-legged position is used in meditation. The knees connect to the feet, which give support, flexibility, and freedom because of their connection to the Earth Force. When this connection is loose or weak, one feels inflexible and constricted.

18. Sole of the Foot: Bubbling Spring, K-1 (Yang Quan)

The K-1 point is located in the depression on the sole of each foot and is visible when either foot is flexed (Fig. 5.67). This center is also known as the Bubbling Spring, from which the earth energy "springs" upward into the body. The K- 1 point is directly connected to this energy and helps refine it before it enters the higher centers.

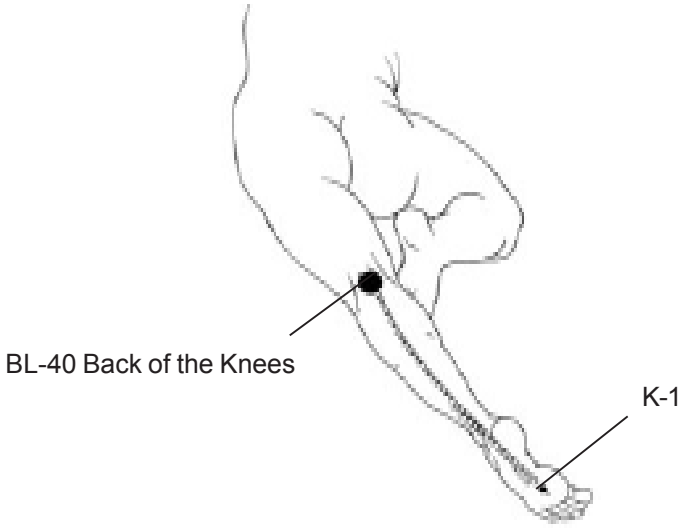

Fig. 5.66 K-1 Point; the sole of the foot (Yong-Quan)—"Bubbling Spring"

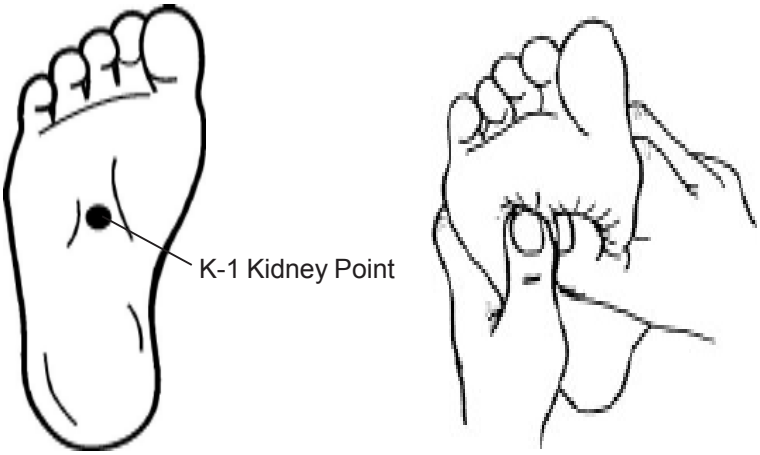

Fig. 5.67 *Sole of the Foot: Bubbling Spring*

Connections or the Soles

The soles of the feet have a close connection to the palms. When used properly, this connection can help readjust the body's internal clock. By using the mind and physical touch to connect the right palm to the left sole and the left palm to the right sole, you can run the Microcosmic Orbit (especially through the coccyx, sacrum, and base of the skull) to balance these points, helping the body overcome jet lag. The soles also have important connections to the crown of the head and perineum.

Properties

When these centers are open (on each foot), they help stabilize the body through their connection with the earth. When they are closed or blocked, one feels ungrounded or unstable because the connection with earth energy is weak.

Rubbing the Soles and Other Points of the Feet

Rubbing the soles before and after meditation helps activate the major energy channels. Massaging some of the major points of the feet also helps Chi move more easily and balances the Yin and Yang energies of the heart and kidneys (Fig. 5.68 and 5.69).

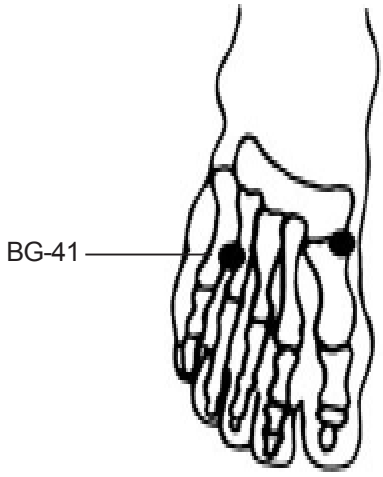

Fig. 5.68 *Lin Chi-attending the Crying Child Point*

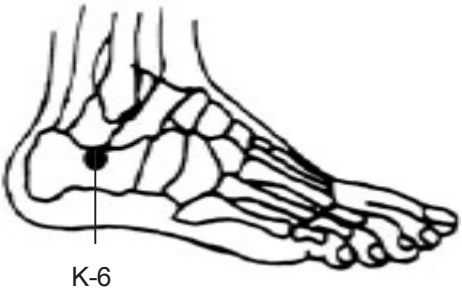

Fig. 5.69 *Chao Hai-the Shining Sea*

Chao Hai, the Shining Sea: The kidney point (K-6). This point is one finger's width below the inner ankle.

Kung Sun, the Grandson: The spleen point (S-4). This point is on the inside edge of the bottom of the foot, in the hollow behind the third joint of the big toe.

Lin Chi, Attending the Crying Child: The gall bladder point (GB-41). This point is on the top and outside of the foot at the joint in between the fourth and little toes.

Shenmai, Extending Vessel: The bladder point (BL-62). This point is on the outside of the ankle in the small depression just under and slightly behind the ankle bone.

19. Big Toe, LV-1 (Da Dun)

The Da Dun point is on the lateral side of the great toe, between the lateral comer of the toenail and the joint (Fig. 5.70). It helps harmonize and cleanse the spiritual energy passing through it.

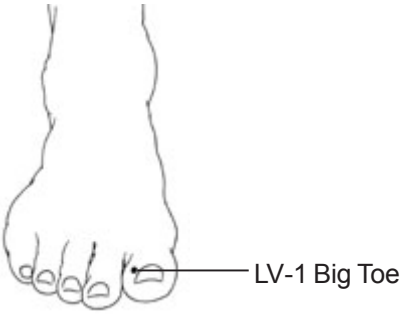

Fig. 5.70 *Da Dun Point*

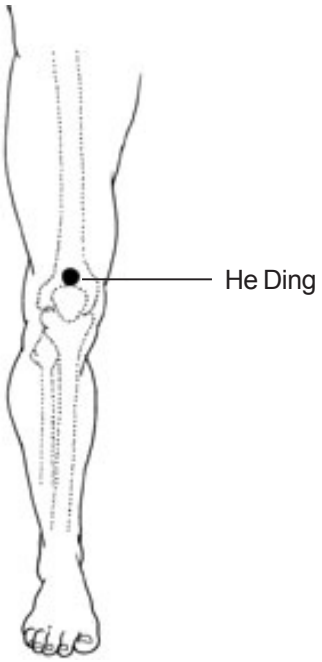

Fig 5.71 *Knee Point*

20. Kneecap (He Ding)

At the middle of the upper border of the kneecap, the He Ding point is a stopover or resting place for energy (Fig. 5.71). It also helps refine the Earth Force on its way up to the perineum.

Learning the Points

In the beginning, the most important thing to remember about the points is their locations. Take some time to find the points on your own body. If you have friends to work with, it is also helpful to find the points on them and have them locate the points on you. At your own pace, you will gradually memorize the functions of these points, but the most important thing is to practice. Once you have learned their locations, you can do the Microcosmic Orbit meditation. Eventually, depending on the strength of your practice, many functions of these points will be revealed to you, not just intellectually but through your own experience.

Chapter 6
Opening the Basic Microcosmic Orbit

Program for Mastering the Microcosmic Orbit

In this chapter, we will learn some new methods to open the basic Microcosmic Orbit. In following chapters we will learn step-by-step procedures for more advanced methods of working with the Microcosmic Orbit, including techniques for amplifying the energy at each point along its path. The advanced methods are all supplementary procedures to the basic Microcosmic Orbit practice taught in this chapter.

You are advised to loosely follow the methods and time frames set forth in this book, depending on your level of experience and success. It is important to thoroughly master each step before advancing to the next level. We recommend that you practice daily for at least two weeks at each level to achieve competence. This will help you really feel the energy and will lay a strong foundation for the next level of practice. Even if you understand the principles and are learning quickly, this does not mean you will master the practice overnight. Intellectual understanding and fast learning cannot establish the mind/body connection, which comes only with regular practice. You should know each step so well that you can do it almost automatically, without any effort. Your body, brain, and nervous system will learn best through repetition of each new level of practice at regular intervals for at least two weeks.

Stages of Learning and Enhancing the Microcosmic Orbit

Chapter 6: Opening the Basic Microcosmic Orbit as taught in *Awaken Healing Energy Through the Tao* (Aurora Press, 1983). This chapter supplements the basic practice of the Microcosmic Orbit and describes various new methods for opening the Microcosmic Orbit which I have refined over the last ten years of teaching Westerners.

Chapter7: Earth Energy and the Microcosmic Orbit. In Chapter 7, you learn how to connect with the energy of the earth, how to absorb this energy, and how to combine it with your Original Chi. You then learn how to circulate this fortified Chi through the Microcosmic Orbit to establish a “ground wire” for your Chi circulation practice.

Chapter 8: The Cosmic Force: Higher Self Energy and the Microcosmic Orbit. The methods introduced in Chapter 8 deepen your practice of the Microcosmic Orbit meditation, further opening the channels and related centers. You also learn to enhance and amplify your Chi by activating the mid-eyebrow point and drawing in energy from the Higher Self. Once you have connected to this golden energy, you learn to expand it into a golden ball of light to envelop and protect you during your practice.

Chapter 9: Opening Your Heart: Shen and the Microcosmic Orbit. In Chapter 9 you build on your practice by adding a step called Opening the Heart. Here you discover the connection between your emotions and your spirit, or Shen. After activating this important center, you use the energy of the heart to purify and balance the physical and emotional energy of the other internal organs. This practice strengthens the Microcosmic Orbit meditation and advances to the higher level of the Inner Smile.

Chapter 10: Sexual Energy and the Microcosmic Orbit. This chapter explains in detail the importance of sexual energy to Taoist practice. You focus on widening the Functional Channel, placing a special emphasis on the connection between the heart center and the sexual center. This strengthens the marriage of loving energy and sexual desire.

Chapter 11: Heavenly Chi and the Microcosmic Orbit. Chapter 11 explains the Heavenly or Universal Force (Heavenly Chi) and our links with this force through the physical, energy, and spirit bodies. It also explains the different varieties of Heavenly Chi and their significance in meditation. In the practice section you further open the Governor Channel. You learn to connect with Heavenly Chi from the North Star and the Big Dipper, merging them with your own for strength and healing. Finally, you learn the ancient Taoist methods of circulating these external energies in the Microcosmic Orbit and combining them with your Original Chi to restore the life-force.

Chapter 12: Summary of the Microcosmic Orbit: Basic and Advanced Practices. Chapter 12 summarizes all the steps of the advanced Microcosmic Orbit meditation.

Chapter 13: Further Advanced Practices: The Macrocosmic Orbit and the Five Pulses. Chapter 13 introduces you to advanced applications of the Microcosmic Orbit, including detailed instructions on how to tap into the limitless healing power of nature. You also learn the Macrocosmic Orbit, or the Greater Heavenly Cycle, enabling you to circulate your Chi through all four limbs, in addition to the Governor and Functional Channels.

Chapter 14: Oneness with the Tao: A Daily Practice Guide. Chapter 14 provides helpful advice to assure ongoing success with your Microcosmic Orbit practice, Inner Smile, and Six Healing Sounds. Included are recommendations for practicing with the seasons.

Chapter 15: Troubleshooting Guide: Helpful Hints and Home Remedies for Simple Problems. This chapter answers commonly asked questions about the practice and addresses difficulties that may occur. Refer to this chapter first if any questions or problems arise in your practice.

Chapter 16: The Tao of Healing and Health Maintenance. This special chapter on healing presents numerous self-healing applications of the Microcosmic Orbit, Inner Smile, and Six Healing Sounds. It includes specific remedies for particular health problems and general Taoist health and healing guidelines.

Overview:
Opening the Basic Microcosmic Orbit

General Description

The Microcosmic Orbit meditation is a very simple practice.

1. Loosen the spine with Spinal Cord Breathing and Spine Rocking. Then sit in a stable position.
2. Relax the mind and body with the Six Healing Sounds and Inner Smile.
3. Use your mind to lead your energy through the loop of the Microcosmic Orbit pathway as many times as you wish.
4. When you are ready to conclude the session, collect the energy at the navel.

5. End with a little Chi Self Massage to clear away any stiffness that you may have developed from sitting in one position during the practice.

The essence of the Microcosmic Orbit practice is to guide your Chi through a loop in your body. All other practices presented in the following chapters are merely variations, ways of drawing in other energies to enhance the circulation of Chi in the Microcosmic orbit.

Techniques for Opening the Microcosmic Orbit

Opening the basic Microcosmic Orbit is different from your practice of it once you have mastered it. In the beginning, you may need to rely on the techniques in this chapter to help you feel and direct your Chi. With practice, you will depend on these methods less and less, because your Chi will move easily with the slightest direction.

A number of techniques can be used to help open the Microcosmic Orbit.

- Mind/eye spiraling or rotating a Chi ball
- Hand touching
- Breathing into each point
- Small Sip Breathing around the Orbit
- Long Sip (Deep Slow) Breathing around the Orbit
- Holding the palms above the points to stimulate the aura
- Rocking forward and back to activate the front and back channels (while standing or sitting)
- Colors and visualization
- Knocking on the sacrum with loose fists
- Knocking the teeth together and pressing the tongue to the roof of the mouth
- Inner or Womb Breathing—spontaneous pulsation of Chi

Practice:
Preparations for the Basic Microcosmic Orbit

Note: *Refer to Chapter 3, Chapter 4, or the Appendix for a more detailed description of these practices.*

Loosen the body and spine with Chi Kung warm-ups. Lightly shake the whole body. Then practice Spinal Cord Breathing, Spinal Cord Rocking, and the Crane Neck Exercise.

Clear your emotions and warm up your organs with the Six Healing Sounds. Do 2 to 3 repetitions of the sounds for each organ. This helps you tune in to your body and brings your energy to a more balanced state for healing circulation.

Establish a stable sitting posture. Check your posture: stable base, hands clasped, spine straight and in line with gravity, shoulders relaxed and balanced, chin back slightly with ears over shoulders, eyes gently closed, and tongue touching the roof of the mouth.

Once you are in a good sitting position, take a few minutes to focus aud prepare yourself.

Prepare yourself to focus inward. Become aware of your surroundings. Feel the sensation of your feet touching the floor, of your hands clasping each other, of the chair beneath you.

Be aware of the sounds inside the room, outside the room, and within your body.

Be aware of your breath. Feel the body naturally expand as you inhale and contract as you exhale. This helps exercise the veins and arteries. Breathe in and out with awareness in this way at least 18 to 36 times.

Relax with the Inner Smile. Always relax first with the Inner Smile before beginning the Microcosmic Orbit meditation. The Inner Smile is a very effective way to deeply calm all parts of the body and mind and to get in touch with our positive aspects. Relaxation is important to health and well-being as an antidote to stress, but it is only the beginning of Taoist meditation, not the final goal. There is a saying, “Amateurs meditate to relax; professionals relax to meditate.” It is hard to reach a deep state of meditation if the body and mind are not relaxed; always be sure to allow enough time for the Inner Smile before beginning the Microcosmic Orbit meditation.

It is always best to smile to the whole body before you begin practice of the Microcosmic Orbit, but if time is short, you may do only part of the Inner Smile. In the early stages, you can focus on any of the front, middle, or back lines of the Inner Smile, as outlined in Chapter 3. In advanced practice of the Microcosmic Orbit meditation, however, it is vital to smile down to the organs of the front line first to activate the virtuous energies you will connect to the Universal, Cosmic, and Earth Forces. Bringing in too much raw energy without first tuning in to the frequencies of the virtues can give you “Chi indigestion”!

See “The Virtues” in Chapter 3 for detailed instructions on the Inner Smile (Fig. 6.1).

Warming the Stove: Activate the Original Chi in the Lower Tan Tien

1. Start with Bellows Breathing 18 to 36 times.
2. Rest and gather Chi at the navel, with your hands covering the navel.
3. Loosen the intestines with spiraling body movements.
4. Warm up the kidneys and activate the Door of Life.
5. Activate the Original Force by drawing energy from the navel and Door of Life and gathering it into the Lower Tan Tien.
6. Activate the sexual energy to amplify the Original Chi.
7. When you have completed the previous steps and can feel the pressure, pulsing, and suction, lightly pull up the sexual organ and the anus toward the area of the Original Force. Continue to breathe into this area and feel pressure build there.

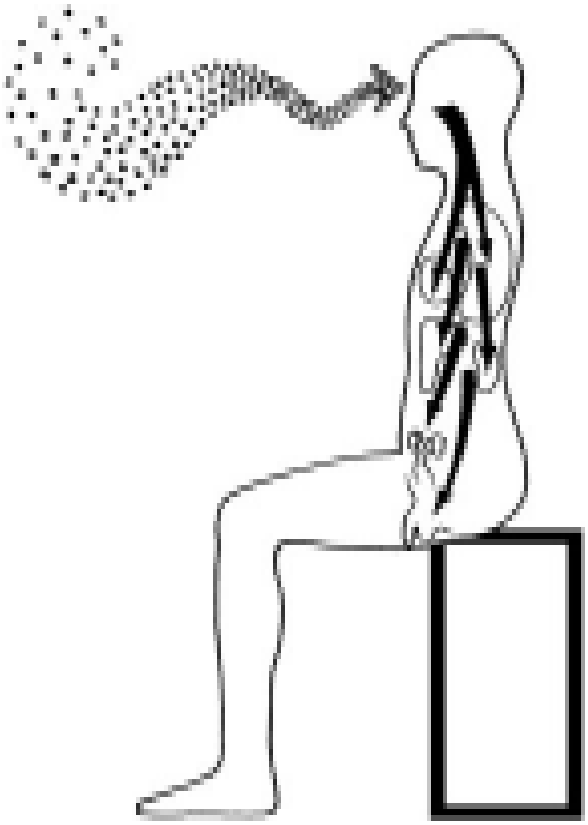

Fig. 6.1 *Smile to help activate the virtuous energies in the organs.*

8. As the pressure increases, you will feel the energy run strongly to you. Let the Original Chi radiate to wherever it wants. The Microcosmic Orbit may open far you spontaneously and effortlessly at this point; the energy may flow down to the coccyx, up the spine to the crown, and back down the Functional Channel in the front. The Chi may also rush to sick places anywhere in the body, places that need healing. Your Original Chi knows where it needs to go; it is the very best medicine for self-healing. You need not feel you have to direct it if it starts flowing and radiating by itself. Just relax and let it go wherever it wants.

It is important to have a strong feeling of the Original Chi at the navel center to complete the Microcosmic Orbit. It is the major source of Chi in the body, and if this reservoir is low, the Chi in the channels will also be low. For this reason, you should not be in a hurry. If you take some time to nurture Chi and bring your awareness to this spot, the Microcosmic Orbit will open more easily and naturally.

Practice: Opening the Microcosmic Orbit

In this first practice section, we recommend three techniques for enhancing the sensation of Chi: the mind/eye power method, the hand-touching method, and the natural breathing method. You use them in combination to draw energy into the centers of the Microcosmic Orbit.

Use mind/eye power to spiral and condense the Chi into each point. Use the hand-touching method to focus your awareness and move the Chi. **Always use the right hand to send energy and the left to receive it.** Finally, use deep, slow breathing to expand and open the centers. Breathe naturally into each point. Let your breath be long, deep, quiet, calm, smooth, soft, and even.

Awaken Healing Light: Transport the Force Through the Microcosmic Orbit

Note: *If you need practice with the mind/eye power method, refer to Chapter 4.*

A. Move Energy from the Navel to the Perineum

1. Place the fingers of the right hand on the navel center, and the fingers of the left on the sexual center (Fig. 6.2). Let the energy radiate from the Original Force and run down to the sexual center. Spiral at the sexual center with your mind and eyes 36 times counterclockwise to expand the energy at the center, then 36 times clockwise to condense the energy into the sexual center. Send energy from the right hand to the left and imagine the channel between these two points opening wide with the increased flow of Chi. Feel that you have made the connection.

As you inhale, breathe as if you were inhaling into the sexual center, filling it with fresh energy. As you exhale, again feel as if the breath is flowing into the sexual center, strengthening and energizing it. Mentally say the word “Chi” as you exhale and focus the mind on the sexual center to increase the energy there. Repeat the inhalation and exhalation 9 to 18 times. Concentrate on the sexual center until you can feel the Chi accumulate. Feel the line of energy extending from the navel down to the sexual center.

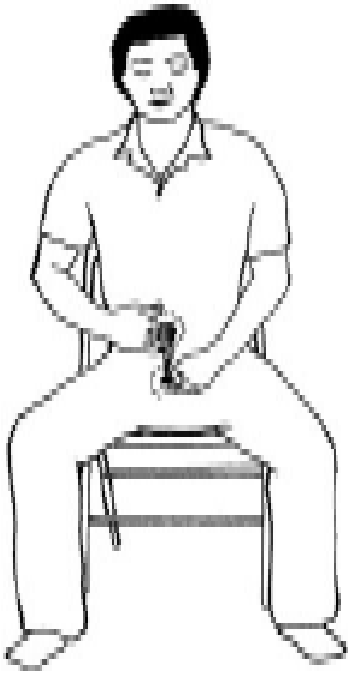

Fig. 6.2 *Touch the navel with the right hand and touch the sexual center with the left.*

2. Move the left hand to the perineum and touch the perineum with the fingers. Let the energy radiate from the navel and sexual center down to the perineum. Send energy from the right hand to the left, and imagine the channel between these points opening wide with the increased flow of Chi. Spiral your energy or rotate a Chi ball there with mind and eyes 36 times counterclockwise and 36 times clockwise.

Inhale and exhale into the perineum, using the word “Chi” to increase the energy there. Repeat 9 to 18 times.

3. Gather energy into a Chi ball at the Lower Tan Tien. Rotate this Chi ball (3 to 5 inches in diameter) top to front to bottom to back, as if rotating the ball in the same direction as the Orbit. Let it spin as fast or slowly as it wants. By resonance, this spinning ball helps stimulate the flow of the Orbit. Lower the Chi ball to the perineum.

B. Raising Energy Up the Spine

1. Move the left hand to the sacrum and coccyx. Place the palm over the sacrum and touch the tip of the coccyx with the tip of the middle finger. Place the right fingertips over the sexual center (Fig. 6.3).

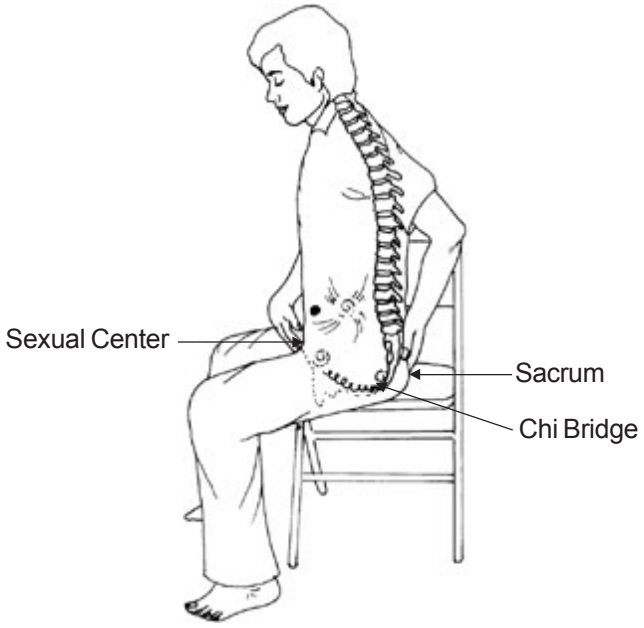

Fig. 6.3 *Chi Bridge*

2. To make a Chi Bridge, very slightly pull up on the perineum, using the mind more than muscle to close the sexual organs (men feel as if they are gently raising the testicles and retracting the penis; women lightly squeeze the vaginal muscles). Then gently tighten the anus, pulling it toward the coccyx. Finally, gently tighten the back part of the sphincter muscle between the anus and coccyx, and feel as if you were sipping energy into the coccyx and sacrum through a straw. Send energy from the right hand to the left, and imagine the channel between these points opening wide with the increased flow of Chi. Let the energy radiate from the navel, sexual center, and perineum into the coccyx and sacrum. Spiral or rotate there with the mind and eyes 36 times each way. Inhale and exhale into the coccyx and sacrum, using the word “Chi” to increase the energy there. Repeat 3 to 9 times.

3. Move the left hand to the Door of Life. Let the energy radiate up into the Door of Life. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the Door of Life, using the word “Chi” to increase the energy there. Repeat 9 to 18 times.

4. Move the left hand up to the T-11 point. Let the energy flow to the T-11 point. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the T-11 point, using the word “Chi” to increase the energy there. Repeat 3 to 9 times (Fig. 6.4).

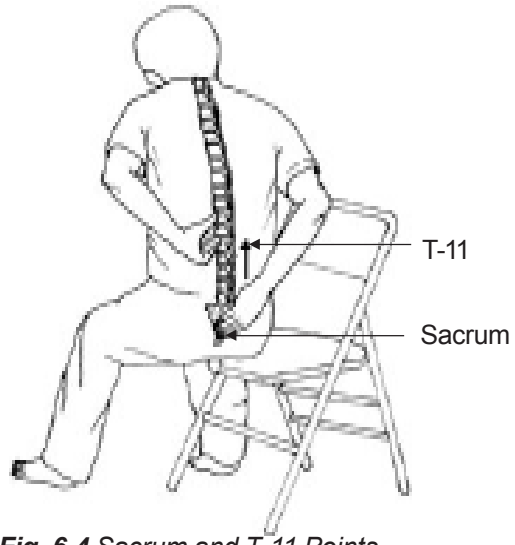

Fig. 6.4 *Sacrum and T-11 Points*

5. Let the energy radiate up to the Wing Point opposite the heart (between T-5 and T-6). Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into this point, using the word “Chi” to increase the energy there. Repeat 3 to 9 times.

6. Move the left hand up to the C-7 point. Let the energy radiate to the C-7 point. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the C-7 point, using the word “Chi” to increase the energy there. Repeat 3 to 9 times (Fig. 6.5).

7. Move the left hand up to the Jade Pillow point. Let the energy radiate up into the Jade Pillow. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the Jade Pillow, using the word “Chi” to increase the energy there. Repeat 3 to 9 times (Fig. 6.6).

8. Move the left hand up to the back of the crown point. Let the energy radiate to the back of the crown. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the back of the crown, using the word “Chi” to increase the energy there. Repeat 3 to 9 times.

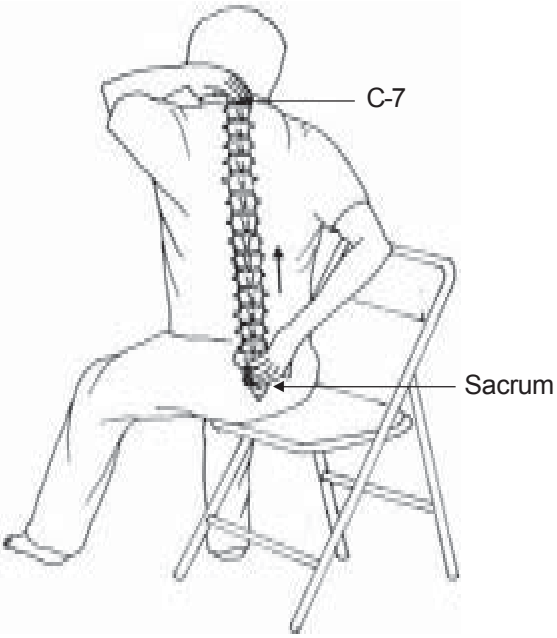

Fig. 6.5 *Sacrum and C-7 Points*

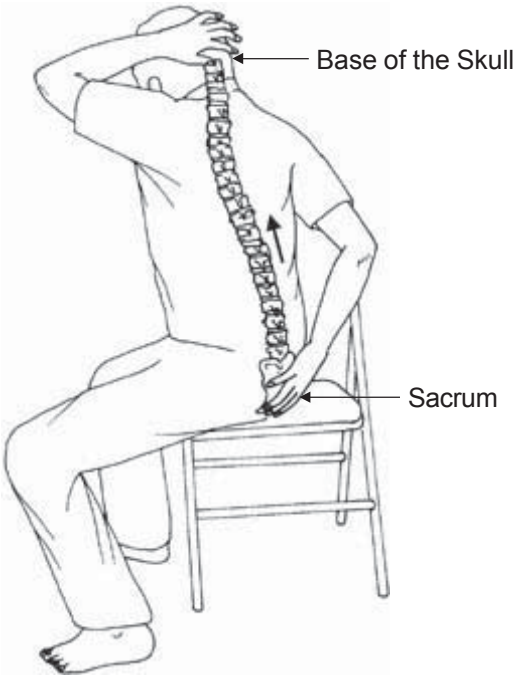

Fig. 6.6 *Sacrum and Base of Skull*

9. Move the left hand up to the top of the crown point. Let the energy radiate to the top of the crown. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the top of the crown, using the word “Chi” to increase the energy there. Repeat 3 to 9 times.

10. Move the left hand down to the mid-eyebrow point. Let the energy radiate to the mid-eyebrow. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the mid-eyebrow, using the word “Chi” to increase the energy there. Repeat 3 to 9 times.

Send Energy Down the Front Channel to the Navel.

1. Touch the tip of the tongue to the roof of the mouth. Press the tongue to the palate and then release the tension (Fig. 6.7). Do this 9 to 18 times. Knock the teeth together 18 to 36 times, then lightly clench and release them. This vibrates the bones and activates the bone marrow, to help transport the Chi through the denser matter of the bones.

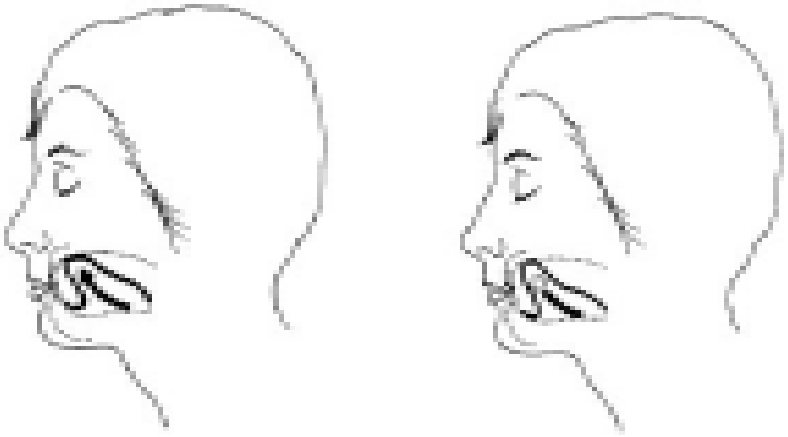

Fig. 6.7 *Press the tongue, then release it.*

Note: *Don't knock too hard if you have a lot of fillings in your teeth!*

Let the energy radiate to the palate. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the palate 3 to 9 times, using the word "Chi" to increase the energy there.

2. Move the left hand down to the throat center point and touch the point with three fingertips. Gather some saliva in the mouth and swallow down. Let the energy radiate down to the throat center. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the throat center, using the word "Chi" to increase the energy there. Repeat 3 to 9 times.

3. Move the left hand down to the heart center point and touch the point with three fingertips. Let the energy flow down to the heart point. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the heart point, using the word "Chi" to increase the energy there. Repeat 3 to 9 times (Fig. 6.8).

4. Move the left hand down to the solar plexus point and touch the point with three fingertips. Let the energy flow down to the solar plexus point. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the solar plexus point, using the word "Chi" to increase the energy there. Repeat 3 to 9 times.

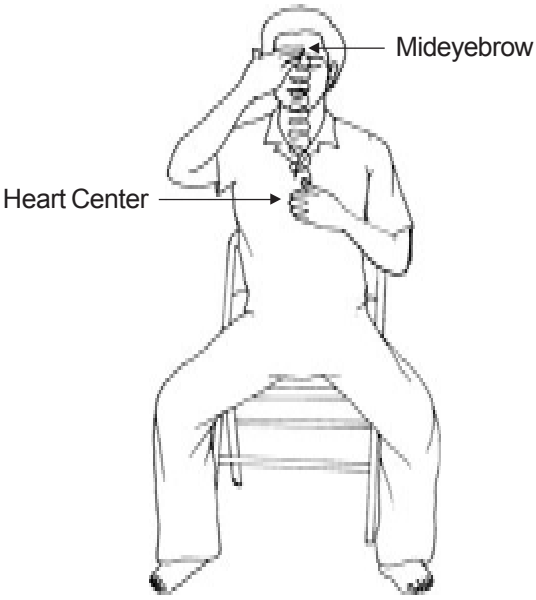

Fig. 6.8 *Mideyebrow and the Heart Center*

5**.** Let the energy return to the navel. Spiral the energy or rotate a Chi ball there using mind/eye power 36 times each way. Inhale and exhale into the navel point, using the word "Chi" to increase the energy there (Fig. 6.9) . Repeat 3 to 9 times or more if you need it, feeling the pulsing behind the navel. If you have any trouble bringing the energy down from the crown to the navel, use the hands to gently stroke the energy down. Repeat the stroking movements until you feel you have successfully brought any excess energy from the head, throat, or chest, or any stuck energy, down to the navel.

6. You can either end the active or Yang stage of your meditation here, or you can continue to guide the energy flow through the Microcosmic Orbit as many times as you like (Fig. 6.10).

Yin Stage: Rest in the Original Chi

1. Rest. Just relax your mind and body. Find the neutral point in the center of your body. It could be at the navel, the heart, or the head, whatever feels most neutral to you. Simply be there. Do nothing but absorb the fruits of having circulated the energy through the Microcosmic Orbit and balanced your Chi flow.

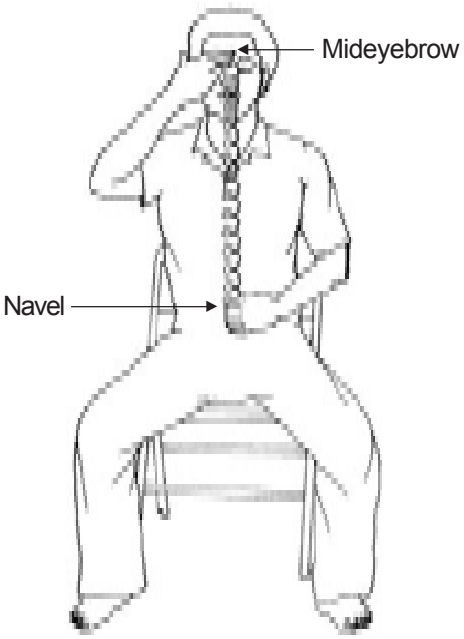

Fig. 6.9 *Mideyebrow and the Navel*

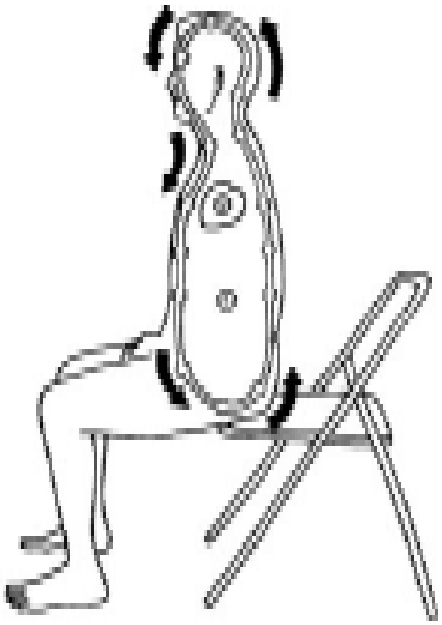

Fig. 6.10 *Use mind/eye/heart power to guide the Chi flow into the Microcosmic Orbit.*

2. Allow the energy to do whatever it wants to do. It may reverse direction; it may flow to other areas of the body; the body may shake and vibrate; you may hear high-pitched sounds. Spend five or ten minutes at this stage, giving yourself the chance to reap the fruit of your Microcosmic Orbit circulation: a sense of inner peace, calmness, and clarity. Let the physical body dissolve into your Original Chi, resting in the state of emptiness, making no effort whatsoever.

End the Meditation

1. When you are ready to conclude the session, bring the energy to the navel and collect the energy, letting it return to the area behind the navel and in front of the kidneys to recharge your Original Force. Spiral the energy or rotate a Tai Chi symbol around the navel 36 times outward and 24 times inward (men, clockwise out and counterclockwise in; women, counterclockwise out and clockwise in) (Fig. 6.11).

2. Rest for a moment and enjoy the comfortable peaceful feeling you have created in your meditation. Feel the spaciousness inside your body and mind now that you have cleared out physical and mental tensions.

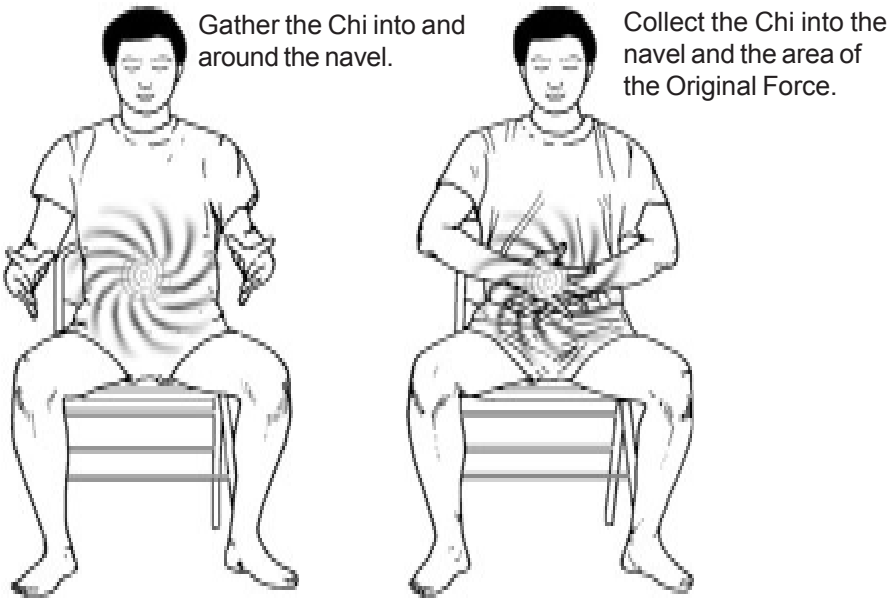

Fig. 6.11 *Gather and Store the Chi in the Navel.*

3. Finish with Chi Self-Massage.

4. Get up slowly and carry this feeling with you into activity. Whenever you are starting to feel sick or stressed, return the mind and the breath to the center. With regular practice, you will be able to recapture this pleasant feeling at any time.

Alternative Ways to Open the Microcosmic Orbit

If you prefer, you may use any of these other methods, either in addition to or instead of the mind/eye power and the hand-touching methods, to enhance the sensation or movement of Chi through the Orbit. The Preparation and Conclusion steps are the same as for the previous meditation.

Small Sip or Long Sip Breathing

Small Sip Breathing combines the powers of the mind/eyes/heart and the breath to open the centers. Those who cannot comfortably hold their breath for a series of short inhalations should practice the other methods until their capacity improves. It is a good method if you feel low energy or simply want more stimulation of your Chi flow. Do not use small sips when in an anxious or overactive emotional state.

If you are anxious, use the Long Sip method to calm the energy while guiding it through the Orbit. Long Sip Breathing has inhalations and exhalations of equal length. If you are very anxious or need to release pent-up emotion, you can lengthen the exhalation.

> ***Caution:*** *People with lung and heart problems, glaucoma, high blood pressure, hemophilia, atherosclerosis, insomnia, headache, or other serious problems should not use the small sip method, and they should test the long sip method for short periods of very gentle breathing to make sure it is not too stimulating.*

Preparations. Follow the same preparatory steps as in the previous meditation: Chi Kung Warm-Ups, Six Healing Sounds, stable sitting posture, Inner Smile, and Warming the Stove.

Microcosmic Orbit

1. Focus the mind at the navel. Gently inhale six small sips of air without exhaling, and feel that you are drawing Chi from the Lower Tan Tien to charge up the navel. Hold your breath as you spiral or rotate the energy at the navel using mind/eye power. Then exhale, rest, and retain the energy of the breath at the navel. Repeat 3 to 9 times. (You may sip up to 6 times into each point at first. After a while, you may need to sip only 1 to 3 times into each point to activate it and go on to the next point without exhaling if you are still comfortable. As you improve, you may be able to cover several points in one inhalation.)

> ***Caution:*** *Be sure to exhale anytime you feel uncomfortable or short of breath. The practice is not enhanced by holding your breath longer if you are straining to do it! Do not strain; remain relaxed and comfortable.*

2. Move the awareness to the sexual center. Inhale six small sips to draw energy from the navel to the sexual center, spiraling at the sexual center with each sip.

Exhale, rest, and repeat 3 to 9 times.

3. Continue in the same way to the perineum, sacrum, Door of Life, T-11 (T-5 and C-7 optional), Jade Pillow, and crown. Each time you will sip energy into the point of focus, drawing Chi from the previous point (Fig. 6.12).

4. Bring the energy down by exhaling in short sips from the crown to the Third Eye, palate, throat center, heart center, solar plexus, and back to the navel. When you bring the energy down, Small Sip Breathing is optional. You can use the mind/eye spiraling technique alone if you wish, or you may use one or more exhalations at each point on the front descending channe (Fig. 6.13).

5. Long Sip Breathing can be used immediately after a few rounds of Small Sip Breathing, or it can be used separately. It is very simple: inhale from the perineum up the spine to the crown in one long, slow, deep breath. Then exhale from the crown down the front to the navel and perineum. Repeat 6 to 9 cycles, then rest, and watch your Chi circulate in the orbit.

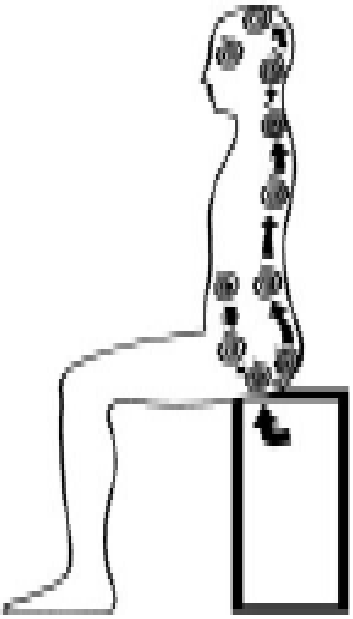

Fig. 6.12 *Small Sip Breathing guides the Chi flow from the navel down to the perineum and up to the crown.*

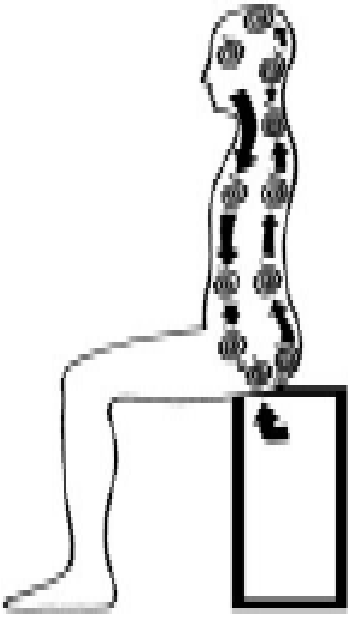

Fig. 6.13 *Small Sip or Long Sip Breathing guides the Chi flow into the Microcosmic Orbit.*

6. Repeat steps 2 through 5 as many times as you like. After a few cycles around the Orbit, you may find that you no longer need to rely on either Small or Long Sip Breathing, spiraling, or rotating a Chi ball; your energy will flow on its own or with gentle guidance by the mind.

7. When you are ready to conclude, bring your energy back to the navel. Rest in the Yin stage of meditation, as in the previous meditation.

Conclusion. Gather and collect energy at the navel, and use Chi Self-Massage as in the previous meditation.

Hold the Palms above the Microcosmic Orbit Points

This method works on the aura level of your energy field. In all other respects, it is the same as touching the points.

Preparations. As before.

Microcosmic Orbit

1. Bring the hands above the navel, with the palms facing inward about 2 to 6 inches away from the navel. Hold them there until you feel energy radiating from the center of the palms into the navel. The center of the palm is energetically connected to the heart (Fig. 6.14).

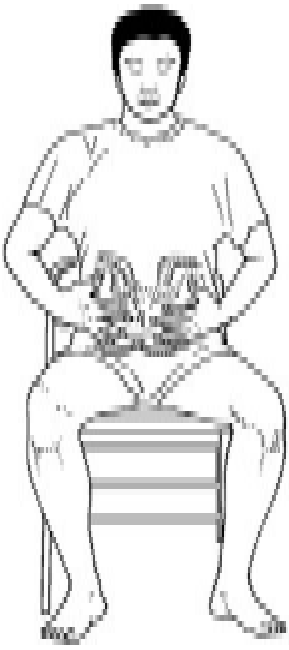

Fig. 6.14 *Palms above the Navel Center*

2. Move both palms down to cover the sexual center (Fig. 6.15).
3. Move the left palm to cover the sacrum. The right palm remains at the sexual center (Fig. 6.16).

Fig. 6.15 *Palms above the Sexual Center*

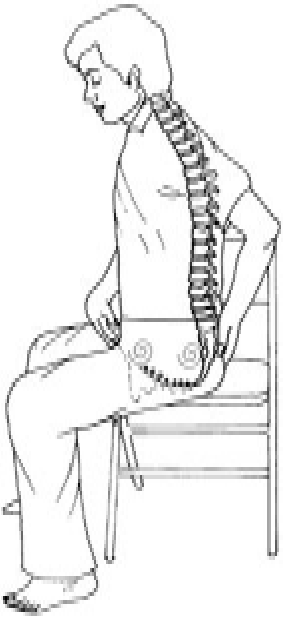

Fig. 6.16 *Right Palm above the Sexual Center and Left Palm over the Sacrum*

4. Move both palms along the Microcosmic Orbit pathway, stopping above the Door of Life, Jade Pillow, crown, Third Eye, palate, throat center, heart, solar plexus, and navel. Stop long enough at each point to feel pulsing and vibration (Fig. 6.17 through 6.20).

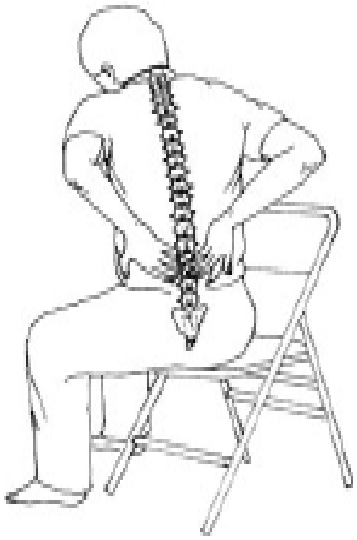

Fig. 6.17 Palms over the Door of Life

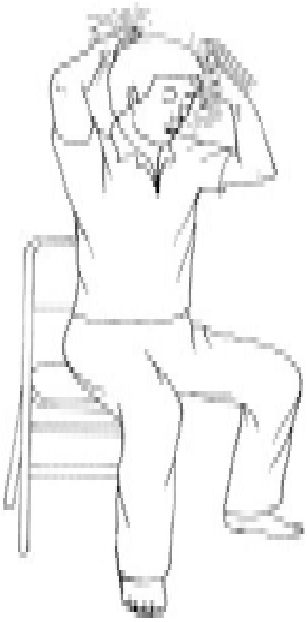

Fig. 6.18 Right palm over the base of the skull and left palm above the mideyebrow

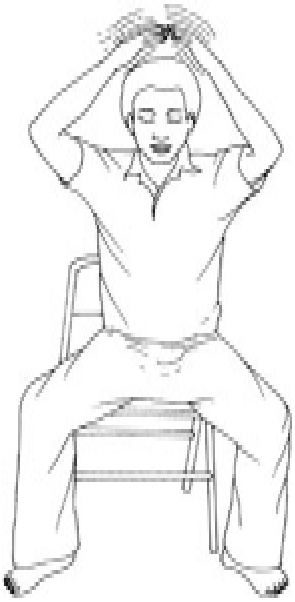

Fig. 6.19 *Palms over the Crown*

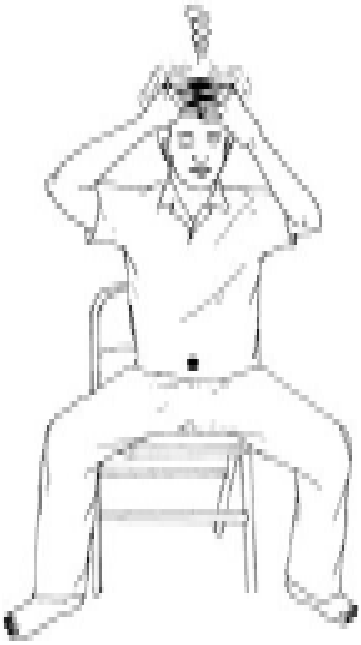

Fig. 6.20 *Palms over the Mideyebrow*

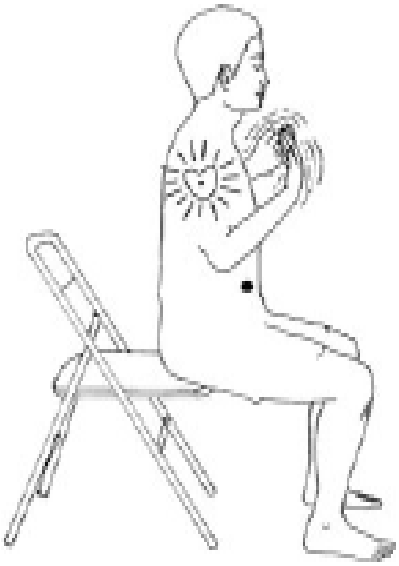

Fig. 6.21 *Palms over the Heart*

5. Repeat steps 1 through 4 as many times as you like.

Conclusion. Gather and collect energy at the navel, and use Chi Self-Massage as in the previous meditation.

Rock Forward and Back to Activate the Front and Back Channels

This method involves moving the body as if you were in a rocking chair. You rock back as the energy ascends the Governor Channel and rock forward as it descends the Functional Channel.

Preparations. As before.

Microcosmic Orbit

1. Be aware of the navel as you inhale.

2. Exhale slowly and deeply, and at the same time rock the upper body forward and direct the energy from the navel down to the perineum.

3. As you inhale slowly and deeply, rock back and gently draw the energy up the spine all the way to the crown.

4. Exhale slowly, rock forward and guide the energy the front channel to the perineum.

5. Repeat steps 3 and 4 as many times as you like.

6. When you are ready to finish your meditation, exhale, rock forward, and bring the energy back to the navel.

Conclusion. Gather and collect e

Practicing the Microcosmic Orbit using Internal Breathing means that you guide the Chi with the mind and intention alone. You bre athe naturally and let the Chi move at its own pace. You do not need to coordinate the movement of Chi with your breath.

Practicing the Microcosmic Orbit using Internal Breathing is a more advanced way of practice. You will probably find that this method works easily after you have practiced the previous methods for a while. In fact, you may find that you evolve to the Internal Breathing method spontaneously and naturally after practicing the other methods.

Knock the teeth together and press the tongue to the roof of the mouth

We have already used this method in the first meditation, and we mention it here to emphasize that this is a special technique to help connect the upper Magpie Bridge at the palate, the place where the Governor Channel and the Functional Channel meet. Once you have learned to connect these two channels, you can dispense with this method.

1. If you are having difficulty bringing the Chi down from the Third Eye to the palate, touch the tip of the tongue to the roof of the mouth. Press the tongue to the palate and then release the tension. Do this 9 to 36 times and feel the electric charge pass from the palate to the tongue.

2. Lightly knock the teeth together 18 to 36 times, and then clench and release them. This vibrates the bones and activates the bone marrow to help transport the Chi through the denser matter of the bones. Let the energy radiate into the palate.

Remember don't knock too hard if you have a lot of fillings in your teeth!

Colors and Visualization

With this method we are truly awakening the healing light. It is not generally used in the basic Microcosmic Orbit meditation, but will be used extensively in the following chapters. You will connect with the light frequencies of Heaven Chi, Earth Chi, and the Cosmic Force to amplify, energize, and widen your Microcosmic Orbit.

Summary

Stay at this level of opening and circulating in the basic Microcosmic Orbit for at least two to four weeks before proceeding to the advanced practices in the following chapters. Remember, all the proceeding practices are variations on the basic practice presented in this chapter. Spend as much time as you need to fully awaken and really feel the healing energy of your Original Chi, and to learn to feel its circulation through your Governor and Functional Channels. Do not be in a hurry to go further. You must get your basic energy wiring in place before working with practices that boost your fundamental energy.

Although the meditation is simple, the benefits are amazing. With regular practice, your mind will become calmer and clearer and your body will feel wonderful and healthy. Chronic aches and pains often disappear, and many people experience healing at a variety of levels.

These claims may seem extravagant, but no leap of faith is needed to determine whether the benefits are real or not. The proof is in your own experience; the results speak for themselves. As

you learn to control your life-force, you will gradually improve your entire physical being. As you open yourself to the energies of the universe, circulating them through your body, you will eventually experience a universal connection with all things.

Chapter 7
Earth Energy and the Microcosmic Orbit

Working with Earth Energy

Chi is like electricity. In fact, recent Western research suggests Chi may actually be the bioelectric force governing all life and movement in the body. As one begins to practice redirecting the Chi by means of the mind/eyes/heart, yoga, Chi Kung postures, or special movements, the Chi current can become very powerful. The mind/eyes/heart can gather and focus the Chi just as a magnifying glass can gather and focus the rays of the sun, making the energy more concentrated and intense. If you "wire" the energy of the body, the need for grounding arises, otherwise serious problems may occur. Drawing in the earth's energy is stabilizing and Yin. We can send excess Yang and sick energy into the earth. We can also absorb cool Yin healing earth energy directly into the body.

How Grounding Works

Electrical energy is powerful and must be treated with caution and respect. Electricity activates nearly every convenience in the modern world, from the spark plugs and batteries in cars, to computers, lights, stoves, refrigerators, and air conditioners. Electricity is extraordinarily helpful, but it can also harm or even kill us if we disregard its safely rules and precautions.
One of the most important rules is: the higher the voltage, the greater the need for grounding. Not all lower-voltage appliances require a ground wire, but higher-voltage equipment such as washers, dryers, power tools, and heavy machinery invariably have ground wires (Fig. 7.1).

Our Chi works in a similar way. In the normal day-to-day life of most people, "grounding the Chi" is beneficial but not essential. When one undertakes practices that focus, direct, and increase the flow of Chi, grounding is a critical factor in maintaining a safe and balanced practice.

Fig. 7.1 *The galaxy supplies the energies that the earth needs to recharge its self, but when we drain our planet's resources, the earth loses the ability to recharge itself.*

Chi, like electricity, tends to become hotter, or more Yang, as it increases in intensity. By contrast, earth energy is cool and Yin. When we connect our energy flow to that of the earth, we can discharge excess Yang energy into the earth. We can also absorb the cool Yin energy of the earth directly into our bodies to tonify the kidneys' Yin and blend it with our hot Chi to cool or balance it. It is much like adjusting the water temperature in the bathtub: if the water is too hot, add more cold; if too cold, add more hot.

By keeping our energy balanced in this way, we are able to effectively and safely manage and circulate greater amounts of Chi.

Just as larger and more powerful engines have more cylinders and consume more energy, we can become more productive and increase our spiritual potentials as we develop the ability and capacity to handle greater amounts of Chi.

In the higher-level practices of the Healing Tao, you can learn to draw Chi from outside sources: the sun, moon, earth, stars, Five Elements or Five Major Forces of heaven and earth, trees, plants, and animals. Drawing in, absorbing, and digesting this outer Chi

greatly strengthens the energy body and is very beneficial in this life and the next. All these practices require one to learn to ground oneself and to conserve, balance, and transform the various types of Chi inherent in the body, including emotional and sexual energy, before trying to manage large amounts of Chi from outside sources.

Side Effects of Ungrounded Energy Practices

Kundalini Psychosis

Without grounding, the practitioner may experience many negative side effects from energy practices. Among the many possible side effects, "Kundalini psychosis" (also known as "Kundalini syndrome" Fig. 7.2.) is one of the most common. Kundalini psychosis occurs when too much hot or Yang Chi rushes up the spine (or right or left psychic channel) to the brain and gets stuck there. Symptoms include intense heat and/or pressure in the head or heart, visual and auditory hallucinations, paranoia, disorientation, obsessive thinking, and insomnia. These symptoms can persist for days, weeks, or even longer.

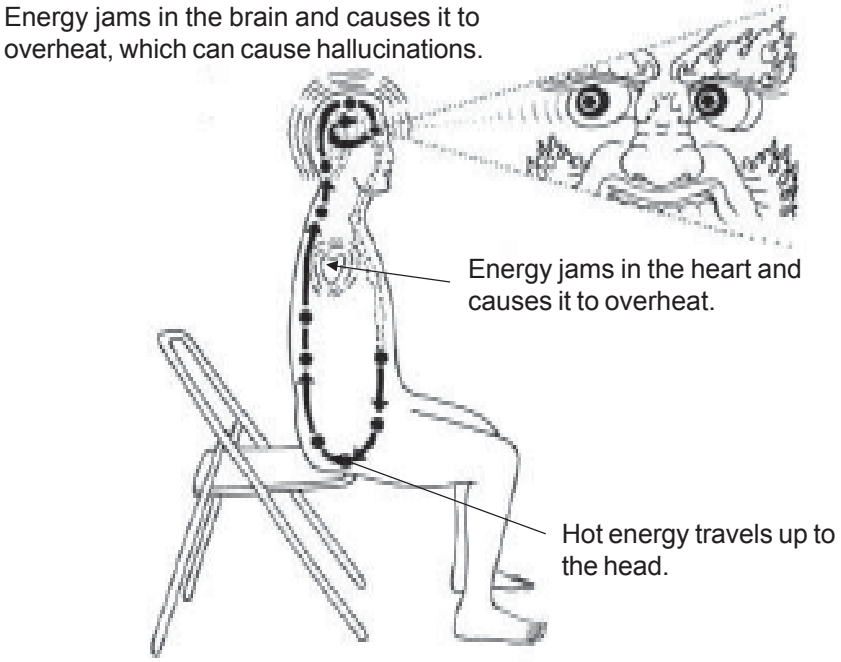

Fig. 7.2 *Kundalini Syndrome*

Some people have experienced Kundalini psychosis spontaneously without having done any energy practices at all. Others have activated it accidentally through recreational drug use. There are also some who have triggered Kundalini psychosis as result of doing meditation practices that do not emphasize balanced energy circulation. Hakuin Zenji, the father of the Japanese Rinzai school of Zen Buddhism, wrote in his famous book *The Embossed Tea Kettle* about the "Zen illness" that frequently afflicted his monks and nearly killed him. Hakuin finally went to a Taoist hermit for a cure.

In modern times, people who experience Kundalini psychosis usually do not know what is causing the problem and are often diagnosed as psychotic. Many have been institutionalized in psychiatric hospitals and treated, usually unsuccessfully, with strong medication and psychotherapy. Because the root of this disorder is actually energetic, the most effective cure for Kundalini psychosis is to lead the energy back down from the head to the navel or soles of the feet. This is accomplished by opening the Microcosmic Orbit.

Bringing the energy down is much easier if one learns grounding techniques. Earth energy, Yin and magnetic, helps attract the energy downward. One can also draw the Yin earth energy upward; this cools the heat in the head and increases the kidneys' Yin power. The rapidity and effectiveness of this cure can be dramatic; often symptoms are reduced almost immediately, and total cures can be brought about within two or three-weeks, if not days.

Other Side Effects

Other problems that can occur from lack of grounding include overheating, high blood pressure, headaches, heart palpitation or arrhythmia, lack of focus on the details of life, distractedness, or a general sense of "spiciness". All these symptoms can usually be effectively prevented through the simple technique of opening the Microcosmic Orbit and learning to connect to the energy of Mother Earth (Fig. 7.3).

You may need to practice more to vent any excess energies (or negative emotional energies) that tend to stick in the heart or in the head when the Microcosmic Orbit is first opened.

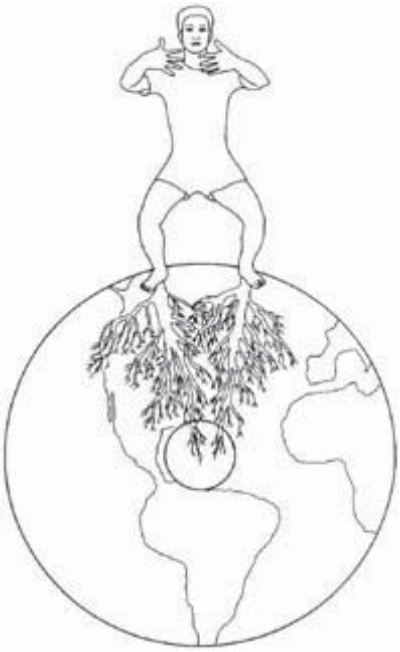

Fig. 7.3 *Rooting to Mother Earth's Energy.*

Connecting with Earth Energy: Grounding Training

Taoist adepts have traditionally emphasized a holistic approach to achieving harmony in life. A Taoist would not simply practice meditation alone; his or her practice would be reinforced with Chi Kung and/or martial arts exercise, proper diet, a peaceful life-style, and healthy environment. To the Taoists, skill in meditation was enhanced and reinforced by martial arts training such as Tai Chi, Hsing I, and Pa Kua Chuan, and martial arts training was improved and supplemented by Chi Kung practice. These are all important cornerstones in building a good foundation for long life and spiritual growth.

Grounding and the Microcosmic Orbit Meditation

In the Universal Tao System, we begin to learn how to connect with earth energy in the Microcosmic Orbit meditation. The first stage in opening the Microcosmic Orbit is to open the basic loop of the Governor Channel and Functional Channel. In all subsequent prac-

tices, we bring more Chi into the Microcosmic Orbit by means of either the Inner Elixir or the Outer Elixir. For all the reasons previously mentioned, it is extremely important that the first connection made is the one to Mother Earth. You should avoid opening your connections to Heavenly Energy until after you have mastered grounding.

In the Microcosmic Orbit practice, we always meditate sitting in chairs with the soles of our feet solidly touching the ground. The legs and feet are the best ground wires to connect us to earth energy. We learn to sense the cool, blue, soft, Yin, gentle, kind sensation of Mother Earth's energy in a passive way as it percolates up through the feet and legs and enters the Microcosmic Orbit at the premium. Even if you are in a room on the upper floor of a building, you will be able to ground through the building down into the earth, although direct contact with actual earth provides the strongest connection. Organic material like wood transmits a warmer quality of Chi than something like cement, which has a cold energy and can be draining. The earth's aura is so huge we take it for granted; you are swimming in it all the time. You can tune into it even if you are flying above the ground in an airplane.

We then allow this energy of Mother Earth to flow up the Governor Channel to the back of the head, pineal gland, and Bai Hui (crown) point and its corresponding point in the center of the brain, the thalamus gland. The crown is the most Yang part of our body, because it is closest to heaven (Yang). The ascending Yin energy of the earth helps cool, balance, relax, and refresh the hard-working Yang brain.

As the Microcosmic Orbit routes become more open and we are more easily able to receive and circulate the earth's Yin energy, we are then ready to open to other, more Yang energies with the confidence we are grounded enough to receive them safely.

In the Bible, the first human was called Adam. The name Adam means "earth creature". The Taoists were not the only ones to recognize our earthly connection! We are of the earth as part of our human birthright, regardless of our religion or philosophy. We therefore need never fear absorbing too much earth energy.

Mother Earth, the Great Recycler: The earth and its natural elements are unique in their ability to recycle and recharge energies. Dirty water can evaporate and become pure water. Trees take in carbon dioxide, which is poisonous to us, and convert it into

the oxygen we need. Human and animal waste can be composted, transformed into fertilizer, and used to nurture new life.

When humans extract ores from the earth through mining, it drains the earth's reserves and energy. If mining is excessive, Mother Earth is often unable to fully recharge herself, and she becomes sick.

In Taoism, water and oil are regarded as elements of Mother Earth's blood. The minerals are like her organs, and the precious stones are like her glands. Trees might be considered the earth's veins and arteries. When we lose any of these, Mother Earth cannot properly recharge herself from the energies of the planets and stars. The sun, stars, and planets help provide what Mother Earth needs, as long as she has the strength to draw on their energies. When we drain the earth's energy, it is like taking apart a battery. As Mother Earth continues to lose her ability to recharge and recycle, we gradually lose our most powerful healing source.

Mother Earth, the Great Healer: Mother Earth can transform our negative emotions and sick energies into nourishing energies for recharging herself. One way Mother Earth receives these sick energies is through our meditations, in which we send them down through the perineum and the soles of the feet, using mind/eye/heart power to direct them. If we dump them out in an emotional outburst, these energies simply infect the atmosphere until someone else walks by and picks them up, becoming sick or crazy.

Difference between Feelings and Emotions: Feelings and emotions are not the same, but they can be related. If a particular bad feeling is allowed to fester, it can eventually grow into a negative emotional state. The difference is that one can be more easily controlled than the other. Unchecked negative feelings can eventually lead to an uncontrollable emotional outburst. Although we may harbor feelings of anger, dislike, or distrust for others, we do not have to allow those feeling enough power to change our mental state. If we keep working to change negative feelings, we can prevent them from growing into negative emotions and possible outbursts. There is nothing wrong with good or bad feelings as long as we remain in control of them.

Most of us do not understand how this process works. People are all different, when we can iron out differences with other people, our angers and dislikes are controlled. There may be some bad feelings left, but no energy is allowed to empower them. If we in-

stead pour out negative emotions in an outburst, there is no longer any way to change that energy, and its effect on the people around us usually creates more problems. Such an outburst is like pouring scalding water on other people. Once it is spilled, you cannot take it back.

Learning to feel negative energies: In Taoist practice, we start by feeling the different forms of Chi in the body, such as the energies of organs and glands and sexual energy. One of the most important steps in all exercises is to feel. This includes feeling good and bad sensations. We can nurture the good feelings to help nourish and maintain our bodies, and we can transform any bad feelings through the Inner Smile, Six Healing Sounds, and Microcosmic Orbit meditation. Taoists also use the inner eye to observe and direct negative energies down to Mother Earth, where they can be transformed into life-force. People who do not train themselves to feel and observe these energies cannot sense when a negative emotional outburst is likely to occur. They may not realize negative energies are accumulating to cause an emotional explosion. Once we release the energy behind an emotion in this way, it is of no use to us or to Mother Earth. It floats in space, waiting to attack those who are susceptible to it.

Human help recharge Mother Earth: Humans are the only creatures who can absorb and utilize all Mother Earth's resources within their bodies. This makes us an important factor in healing the earth, as channels for healing forces. We draw in energies from the sun, moon, planets, and stars. These not only recharge us but also help recharge the earth. The magnetic power of our sexual energy actually attracts these energies, but we lose our Original Force and sexual energy through excessive ejaculations or menstruation, reducing our ability to draw in the heavenly forces. Additional stress weakens our channeling abilities even more. Internal blockages of the energy flow within our bodies can prevent Mother Earth from drawing in the external forces she needs to recharge.

Conserving, Recycling, and Transforming: Practicing the Microcosmic Orbit meditation is recycling. When you practice the Microcosmic Orbit and the Inner Smile, you compost any garbage energy and negative emotions within the body and recycle them into healthy life-force energy. If you instead release these energies from the body, dissipating the Original Force and sexual energy,

there is no way for recycling to occur. We must to learn to conserve and recycle our own force so we can help others and Mother Earth.

Grounding and Iron Shirt Chi Kung I

Although one is introduced to grounding and absorbing the earth's energy as an essential part of the Microcosmic Orbit meditation, mastery of the art of connecting to the earth comes through the more advanced practice of Iron Shirt Chi Kung I (Fig. 7.4).

Iron Shirt Chi Kung was originally practiced to make the body capable of withstanding blows in combat without injury. It includes a variety of levels and techniques for achieving this. Today, it is mainly practiced for health and spiritual development.

Iron Shirt Chi Kung training emphasizes moving earth energy through the arm and leg routes of the Microcosmic Orbit pathway; this is known as the Greater Heavenly Cycle or Microcosmic Orbit. For this reason, the Microcosmic Orbit Meditation is a prerequisite for the study of Iron Shirt Chi Kung.

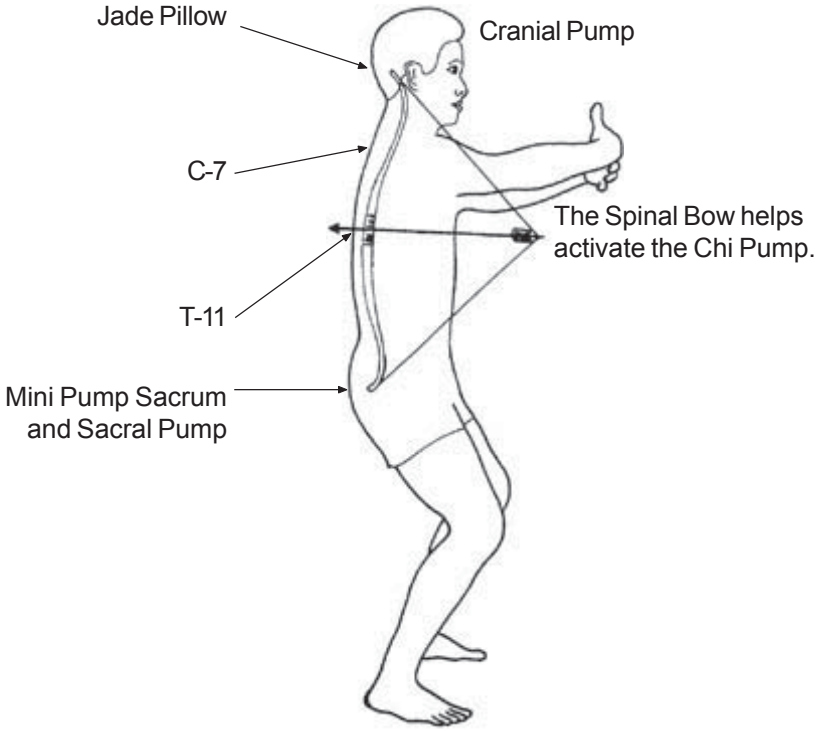

Fig. 7.4 *Pushing the sacrum and slightly arching the spine will help activate the sacral pump.*

In the practice of Iron Shirt Chi Kung, although you move the Chi through the same points as in the Microcosmic Orbit, the quality of the Chi is thicker and cooler. This is because of the sensations of the elemental energy of the earth and water entering through the soles of the feet at Kidney-1 (Bubbling Spring or Yung Chuan point) and at Spleen-1 (on the medial side of the big toe), rising up through the perineum, and entering the spinal column.

Part of Iron Shirt training involves gently "packing" energy at the navel to increase the Earth Force in the body. This packing process is done carefully and without strain. One can then store the earth's Chi at the navel, which is the central area of the body and corresponds to the earth (the Five Elements of the Earth Force are correlated with the Five Directions: metal, west; water, north; wood, east; fire, south; and center, earth).

The originators of Iron Shirt Chi Kung reasoned that one's ability to withstand blows would improve if one could stand like a solid oak tree, as if rooted to the ground. Adversaries would have a hard time knocking down a well rooted fighter, and the force of an opponent's blows would rebound, turning his force against himself.

To become proficient at Iron Shirt Chi Kung, one must seek the guidance of a competent teacher and then learn to perfectly align one's musculoskeletal structure with the magnetic force of the earth: gravity. One develops skill in Iron Shirt Chi Kung through daily practice in a variety of static standing postures. Each posture presents a slightly different energetic variation and teaches a new alignment skill. One thus learns to be grounded and rooted in a variety of positions, and to use the joints, bones, and meridian pathways to pulse the Earth Force into the physical body.

As you master Iron Shirt Chi Kung, you will become more and more sensitive to the subtleties and variations of earth energy, including weather, geology, power points, and so on, and you will learn to use them skillfully to your advantage, whether in business, daily life, or combat. Wearing your Iron Shirt will make you feel more confident, less easily intimidated; you will feel you can stand on your own two feet with the whole earth backing you up.

Grounding and Tai Chi Chi Kung

Once you have learned to connect to the earth's energy in the static standing postures of Iron Shirt, you may then progress to the mov-

ing practice of Tai Chi Chi Kung. Tai Chi Chi Kung teaches you how to incorporate the sense of rootedness to the earth into the movements of everyday life (Fig. 7.5).

Fig. 7.5 *Tai Chi teaches us how to become rooted to Mother Earth though movement.*

Inner Structure of Tai Chi and the Microcosmic Orbit: Training in Tai Chi Chi Kung emphasizes the "inner structure" of Tai Chi. Although all styles of Tai Chi and all true Tai Chi masters have this inner structure, few people achieve it today. This is largely because Tai Chi has become very popular, and in the hastiness to popularize and spread Tai Chi, the art has become watered down and divorced from its Taoist roots. Most students do not learn Tai Chi within the true holistic context of the Tao, which includes meditation, Chi Kung, and healing. Progress is painfully slow because, regrettably, most Tai Chi students learn only one isolated part of a whole Taoist system: relaxation. Learning the Microcosmic Orbit meditation and Iron Shirt Chi Kung first lays an excellent foundation for truly mastering the inner structure of Tai Chi.

Until I published my first book in English on opening the Microcosmic Orbit (*Awaken Healing Energy Through the Tao*, Aurora

Books, 1983), many Chinese martial arts teachers made their students wait five or ten years before teaching them the Microcosmic Orbit as the "inner secret." I believe the process should be reversed: the master should teach the student the Microcosmic Orbit immediately, and then have Tai Chi training complement the inner work of meditation and amplify its power with integrated movement.

Activating the Chi Pumps: The Tai Chi movements act as a slow-motion Chi pump that pulses and flow of Chi from the earth through the soles, legs, perineum pump, and sacrum pump, up the spine to the cranial pump, and back down the front of the body. The circular movements of the arms in Tai Chi enhance the opening of the channels and the flow of Chi through the arm routes of the Microcosmic Orbit and the Belt Routes of the Fusion II formulas.

In addition, many of the specific points emphasized in Tai Chi Chi Kung are the same as in the Microcosmic Orbit meditation. For example, we constantly align our balance over the Bubbling Spring point on the sole of the foot and over the heel, and receive the Earth Force into the trunk through the Hui Yin (perineum) point. The angle of sacral tilt is crucial in allowing a clear doorway for the earth energy to move up into the spinal column. The alignment of the Chi Chung (T-11) point is vital in connecting the upper and lower body. The Ta Chui (C-7) point must be open and aligned for the Chi to connect and flow from the torso to the arms. We also coordinate all the Tai Chi movements of our Three Bodies (physical, energy, and spirit) from the Lower Tan Tien (between the navel center, Door of Life, and sexual center). The Tai Chi classics tell us to "sink the chest and pluck up the back." This becomes more meaningful when we know that "sink the chest" means to relax and lower the sternum by focusing on easing unnecessary tension at the heart point, and that to "pluck up the back" means to apply a backward counter force at the Ta Chui (C-7) and Jade Pillow points.

The Tai Chi classics also tell us that "the head should be held as if suspended from above." This means that we want to align the Bai Hui (crown) point with the Hui Yin (perineum) point, so these points are effortlessly in line with the earth's gravity. When we practice, we feel the Universal Force coming in through the Bai Hui, and the gentle upward extension required in the Tai Chi classics is a natural result, it will automatically pull you up.

All these things seem very detailed and technical, but once you have grasped It, It becomes natural, a part of you. The purpose of Tai Chi is to teach you how to absorb the Chi through the major energy points, like the palms, soles, perineum, and mid- eyebrow, and to enhance your Original Force. When you can do this, the detailed practices are not necessary.

When you finish a round of Tai Chi Chi Kung practice, your whole body may be tingling with sensations of warm or cool Chi. This is why we always stand still and quiet, circulate energy through the Microcosmic Orbit, and then collect energy at the navel after completing the movements of Tai Chi Chi Kung; allowing the Chi to flow through the Microcosmic Orbit helps us absorb and digest the Chi of Heaven, Earth, and the Higher Self that we draw in when we do Tai Chi correctly.

Through practicing the Microcosmic Orbit, you will develop a vivid kinesthetic familiarity with all the aforementioned points, points that are outside the scope of most people's normal body awareness. You will not only improve your mechanical sense of these points, but you will be aware of the degree of Chi flowing through them as well, an awareness that will help you accurately check and adjust your alignment as you practice your Tai Chi movements. This knowledge gives you one of the priceless tools you need to raise your skills in Tai Chi from run-of-the-mill mediocrity to the heights of martial arts mastery.

Tai Chi Chi Kung and Self-Defense: Tai Chi Chi Kung is practiced not only for health, strength, relaxation, and meditation; it is also a very effective art of self-defense. Once you can move earth energy through your bone and tendon structure, you become as immovable as a mountain in defense. When you attack, you have the strength of the earth behind each punch or throw.

Tai Chi masters are respected throughout the world for their powers and abilities. Much of this incredible skill comes from simply opening to the earth's energy, a power that is freely offered to everyone at all times. We need only learn how to tap it

Tai Chi Chi Kung keeps the Chi pathways supple. In addition to teaching rooting and grounding, Tai Chi Chi Kung exercises the energy pathways of the body. Tai Chi Chi Kung practice helps keep the channels strong and supple and also aids in clearing blockages and tensions that would otherwise obstruct the smooth flow of Chi. Then Tai Chi Chi Kung is like doing "Microcosmic Orbit in motion."

With strong wiring and good grounding, you can progress more rapidly and with confidence to higher energy levels in Taoist meditation practice. The risks of negative side effects from the energy practices are minimized, and if they do occur, you have the tools to deal with them quickly and effectively.

Practice

Microcosmic Orbit: Feeling Mother Earth's Energy

In this round of practicing the Microcosmic Orbit, you will learn the special techniques for connecting to the unlimited healing Chi of Mother Earth (Di Chi in Chinese). After beginning the Microcosmic Orbit meditation with Chi Kung Warm-Ups, the Inner Smile, and Warming the Stove, you absorb earth energy up through your legs to your "stove," or Tan Tien, and merge the earth energy with your own Original Energy. This will greatly strengthen and enhance your Original Chi. You can then circulate this combined, heightened energy through the Microcosmic Orbit.

You will also learn the practice of Fanning and Venting, an important method of purifying the body of sick energy by dispersing it down into the earth so the earth can absorb and transform it.

At first the practice may seem a little complex. Keep in mind that the details are for training purposes only. Once you have captured the sense of it, you will not need to go through all the steps; when you sit down to meditate, you will discover that the earth's energy comes to you effortlessly and automatically, as if it were happening by itself.

A. Preparations

1. Begin with Chi Kung Warm-Ups, Spinal Cord Breathing, and Spine Rocking.
2. Clear your emotions and warm up your internal organs with a round of the Six Healing Sounds. Do 2 or 3 repetitions of each sound.
3. Do the Inner Smile, with an emphasis on relaxing and developing awareness of your internal organs.
4. Follow the practice instructions for "Warning the Stove" in Chapter 4.
5. Make sure you feel your Original Force activated:

Condense your Chi in the Lower Tan Tien. As it becomes more concentrated, it will begin to expand, and you will feel pressure building at the spot of the Original Energy. Imagine the Original Energy has a mouth and nose and is breathing into your body through that spot (Fig. 7.6). Now amplify the pulse you feel at the Original Energy spot. As you feel the pulse pumping, feel the suction drawing the sexual energy into the Tan Tien. Feel the sexual energy being drawn to you as if the Tan Tien were powerful magnet.

6. Circulate your Chi in the basic Microcosmic Orbit to prepare yourself for receiving fresh energy from Mother Earth. You can use Small Sip Breathing, Internal Breathing, mind/eye power spiraling, or any of the techniques you have learned to enhance the sensation of Chi. Make sure you feel your Microcosmic Orbit is open before going on to the next step.

Fig. 7.6 *Picture the Original Force within you with a nose and a mouth and the ability to breathe in through them.*

B. Feel the Force of Mother Earth Flow Through You

1. Massage the center of your palms (Fig. 7.7), soles of your feet (Fig. 7.8), perineum, and coccyx (Fig. 7.9). Place the hands at the sides with the palms facing toward the earth, and place the soles of the feet flat against the floor. You can also put a marble or a small steel ball under each sole at the Bubbling Spring (Kidney 1) point to stimulate it.

Be aware of the Bubbling Spring point on the two soles. Picture two small pipes extended up to the Hui Yin point at the perineum, up to the kidneys and the Original Force (Fig. 7.10).

Picture a pipe extending from the Lao Gong point on each palm to the heart center and down to the navel. The perineum, openings of the sexual center, anus, palms, and soles are gateways through which the nourishing energy of Mother Earth can flow into you.

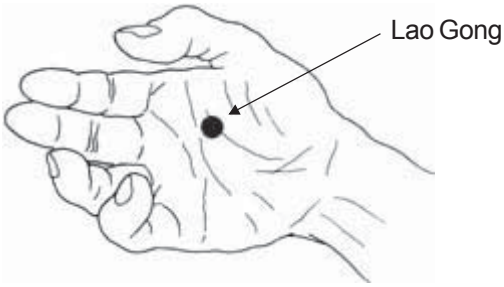

Fig. 7.7 *Massage the palm.*

Fig. 7.8 *Massage the sole of the foot.*

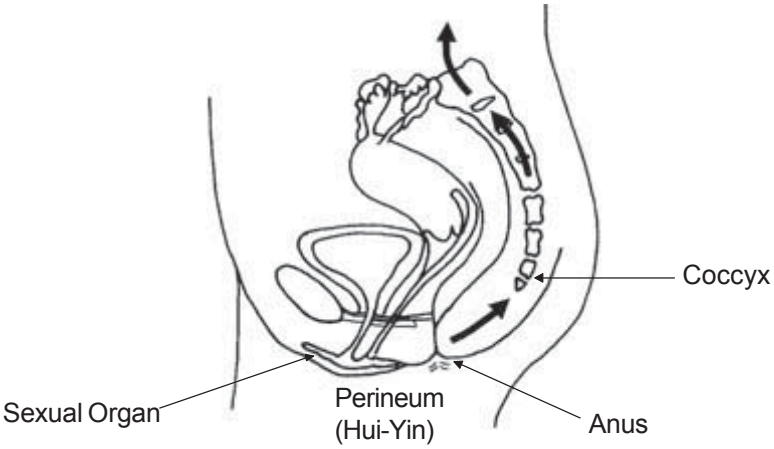

Fig. 7.9 *Massage the Perineum and Coccyx.*

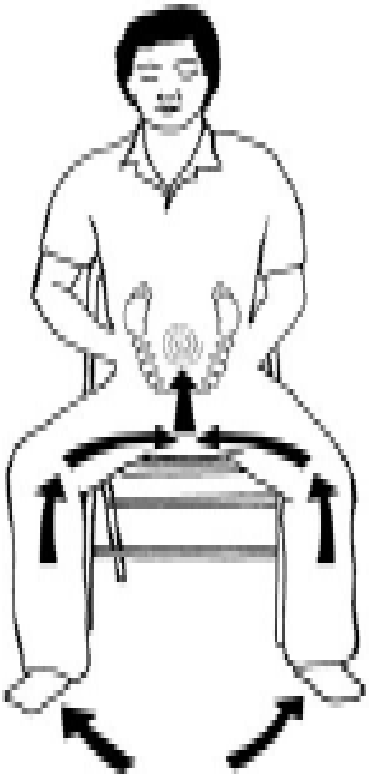

Fig. 7.10 *Rest. Be aware of the kidneys, and feel the Mother Earth force come up to fill the kidneys and the Original Force.*

2. After a short time, you will begin lo feel the palms and soles breathing by themselves. At the same time, you will feel the vagina and the perineum (Hui Yin) point start to naturally pull up and release in a pumping action, creating a suction in time with your breathing and/or the pulsing. You can also lightly contract and relax your eyes and pull up on the two gates of the sexual organs—the perineum and the anus—to help activate the pumping action (Fig 7.11). Do this 18 to 36 times, then exhale and rest.

3. Now focus your mind/eyes/heart about 95 percent on the Original Energy behind the navel, and about 5 percent on Earth Gates (perineum, sexual and anal openings, palms, and soles). Feel yourself grounded; feel connected to the earth. Relax. Feel your sitting bones connect to the earth. As you feel yourself sinking into the earth, you will also feel pulsing again. Water is the dominant energy of the planet, so you may sense Mother Earth's energy as a gentle blue force. The color blue is particularly healing to the bones and joints. Just relax and let it come in and up, feel the suction; feel the gentle blue earth energy pulsing into the navel, breathing in through the Five Earth Gates and pulsing and breathing into the Tan Tien ("stove") (Fig. 7.12).

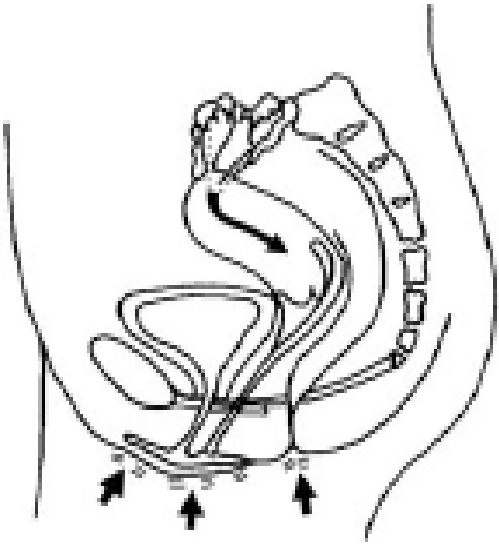

Fig. 7.11 *Lightly pull up the sexual organ, the perineum, and the anus.*

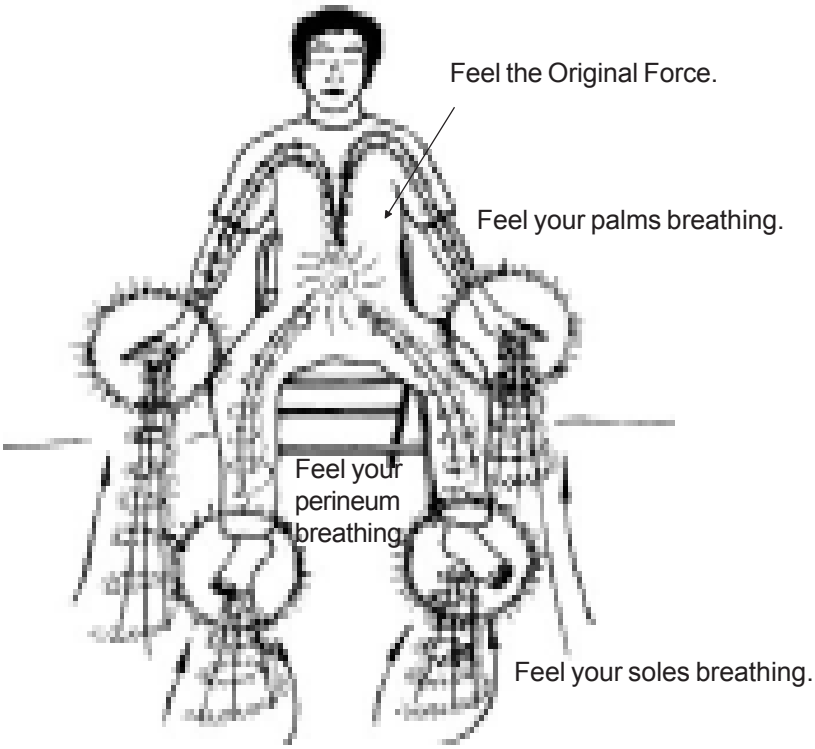

Fig. 7.12 *Feel the five earth gates pulsing and breathing.*

4. Mother Earth's energy strengthens the stove and enhances the Original Energy there. Feel the energy ball at the Tan Tien becoming more crystallized, more real. Your navel is connected to the earth now; your body feels connected to the body of Mother Earth.

5. Feel the Chi ball growing and expanding, filling the whole region between the navel, kidneys, and sexual center.

6. Finally, let the Original Energy radiate from the navel area and flow wherever it wants to go. As before, it may follow the path of the Microcosmic Orbit automatically, or it may flow in its own way. Just relax, and let it take its own course.

7. When you are ready to end your session, let the energy settle at the navel. Then finish and collect energy by spiraling at the navel.

C. Sedate the Heat of the Heart and Tonify the Kidneys' Yin

In this society, most people have overheating of the heart due to stress, pressure, impatience, and hatred. This drains out the kidneys' Yin, depleting the important reserve of basic life energy, the sexual energy. This exercise helps tone down the excess Yang so the cool earth Yin energy will rise automatically to the kidneys. Any time you feel the heart overheat, you can do this exercise to cool the heart (Fig. 7.13) and strengthen the kidneys. This will make you feel calm yet energized.

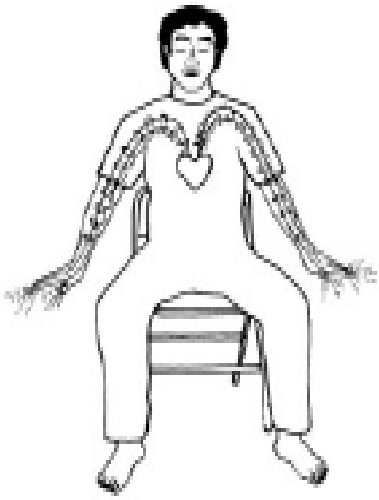

Fig. 7.13 *Sedate the heat of the heart.*

1. Sit in the same position as above, palms facing down. Be aware of the heat in your heart.

2. Use the Heart's Sound. ***Hawwwww. Hawwwww*** down to the heart and let it spread inside both arms, down to the tips of the fingers. Do this 6 to 9 times. Feel the heart cool down.

3. ***Hawwwww*** down to the heart and tips of the fingers; continue down to the tips of the toes (Fig. 7.14). Use long, soft exhalations and feel comfortable.

Rest; be aware of the soles of your feet. Feel the Mother Earth Yin, gentle and kind. Blue energy will come by itself up the feet to the kidneys without any effort (Fig. 7.15). Once the kidneys are filled with kidneys' Yin, the heart will be calm and cool and balanced, the fire and water will be in harmony. The more you relax, the more Yin energy comes up through you with no effort. Do this 9 to 18 times.

Note: *The resting period is very Important. Just rest and let the Mother Earth Yin energy come up to your kidneys. If you are very heated, sit in bathtub full of room-temperature water while you use this method.*

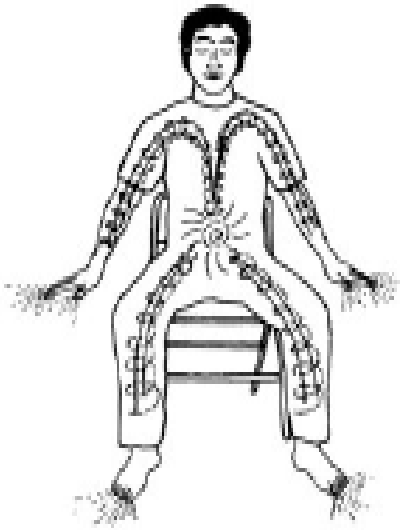

Fig. 7.14 Exhale excess heat out to the tips of the fingers and toes.

Fig. 7.15 Feel a nice, cool, gentle blue energy gathering like a pool of water around your feet.

D. Transporting the Earth's Force through the Microcosmic Orbit

While it is good to simply rest and allow the energy to flow in its own course through the body, you may want to use your mind to direct the Earth Force through the Microcosmic Orbital at this time. If so, please refer to the practice section in Chapter 6. The steps are the same, only this time you will feel your Original Chi reinforced and balanced by the earth's Chi.

You may notice the gentle blue Earth energy helps cool, smooth, and balance your Chi. Any time you feel any uncomfortable sensations of heat in the body during practice, just be aware of your connection to Mother Earth energy. Draw up more gentle blue energy from the earth and use your mind to direct it to that place of discomfort, pain, or sickness.

Yin Stage: Rest in the Original Chi

Rest. Just relax the mind and body Find the neutral point in the center of the body; it could be at the navel, heart, or head, whatever feels the most neutral to you. Simply be there. Do nothing but absorb the fruits of having circulated the energy through the Microcosmic Orbit and having balanced your Chi flow. Allow the energy to do whatever it wants to do. It may reverse direction; it may flow to other areas of the body. The body may shake and vibrate, and you may hear high-pitched sounds. Spend five or ten minutes at this stage, giving yourself the chance to reap the benefits of your Microcosmic Orbit circulation: a sense of inner peace, calmness, and clarity. Let your physical body dissolve into your Original Chi, resting in the state of emptiness, making no effort whatsoever.

Gather and Collect Energy at the Navel

1. When you are ready to conclude your session, bring the energy to the navel and collect it, letting it return to the area behind the navel and in front of the kidneys to recharge your Original Force. Enjoy the comfortable, peaceful feeling you have created in your meditation. Feel the spaciousness inside your body and mind now that you have cleared out physical and mental tensions.
2. Conclude with Chi Self-Massage.
3. Get up slowly and carry this feeling with you into your activity. Whenever you start to feel sick or stressed, return your mind and your breath to the center. With regular practice, you can recapture this pleasant feeling at any time.

Returning Sick Energy to the Earth

Fanning and Venting are ways of composting sick and emotional energies and returning them to Mother Earth. If you are able to transform them yourself, that is even better. But until you learn to regulate your own negative emotions with the Fusion of the Five Elements meditation, this will help you.

Fanning

Because tension causes a lot of sick, negative emotional energy to condense in the chest, the heart can easily become jammed. Long-term negative emotions such as hatred, impatience, and arrogance directly affect heart conditions and are a major cause of heart attacks. To protect yourself, you can activate the heart, draw the negative feelings and sick energy to the heart, and fan this energy out of the heart and body.

Purpose of Fanning

Taoists regard the soles of the feet, centers of the palms, fingertips, and tips of the toes as having a connection with the heart. Fanning negative and sick energy involves moving the energy from the heart down to the tips of the toes and fingers (Fig. 7.16). The theory is that when the sick energy is fanned down to the toes and fingers, the soles and toes connect with Mother Earth, who can accept the sick and negative energy and then utilize and transform it into useful energy. If the negative energy is expressed as emotions and dumped from the heart onto someone else, it cannot be received by Mother Earth and put to good use. Instead, these emotions will be passed on to other people involved in the person's life, which can cause sickness for them as well.

Position and Practice

Fanning originates in the upper diaphragm and the mind. With the palms facing down, raise the left hand to the chest at the level of the heart center, about one and one-half inches from the top of the sternum. Place the right hand parallel to and above the left hand, aligning the Lao Gong points of both hands.

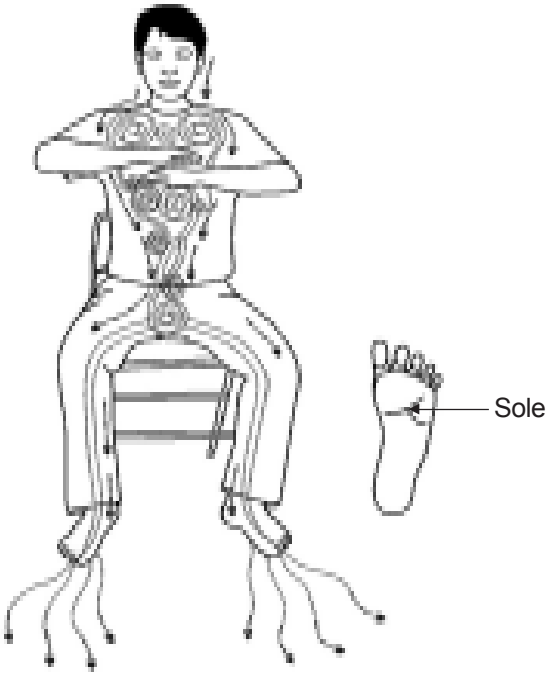

Fig. 7.16 *Fan sick energy and negative emotions from the heart to the soles of the feet.*

1. Practice the Heart's Sound (***Hawwwww***) and feel the heat from the heart start to burn, drawing in any negative feelings.

2. Exhale this energy (using the Heart's Sound) as you slowly lower both hands. Feel the negative energies burn out. Continue to exhale the energy down to the perineum, palms, backs of both feet, and tips of the toes and fingers. Then perceive Mother Earth absorbing it. Rest the palms on the knees, fingertips pointed toward the toes. Look down to the toes and feel a cloudy, gray, and cold or chilly energy go out. Rest again. Be sure to take a long time to rest, because this resting time is very important

3. Start over again by returning both hands to the heart level. Practice 18 to 36 times, for a total of five to ten minutes. As you clear yourself of the dirty, sick, negative energy, you will feel empty, but in a good mood. Feel the Heavenly Energy as a golden light coming down through the head and filling the body.

4. Rest for a while. You will also feel Mother Earth's Energy, a blue color, coming up through the soles of the feet.

Venting

Purpose of Venting

When negative emotions cause sickness in the organs, venting is another good practice to remove the undesirable energy. Venting gets rid of emotions and sick energy from all the other organs (Fig. 7.17 and Fig. 7.18). Because fingers and toes are connected with all the organs and glands (Fig. 7.19), sick energy tends to stagnate there, making them feel numb.

The kidneys connect to the soles, and the bladder to your little toes. Fear in the kidneys and bladder can be vented to change the color of their energy from a cloudy blue energy to a bright blue.

The liver connects to the big toes, and the gall bladder to the fourth toes. Anger can produce cloudiness in the liver and gall bladder's color, which can be changed from a cloudy green back to a bright, clear green.

The heart connects to the little finger, and the small intestines to the little finger. Hate can produce cloudiness in the heart's and small intestine's color, which can be changed from a cloudy red back to a bright, clear red.

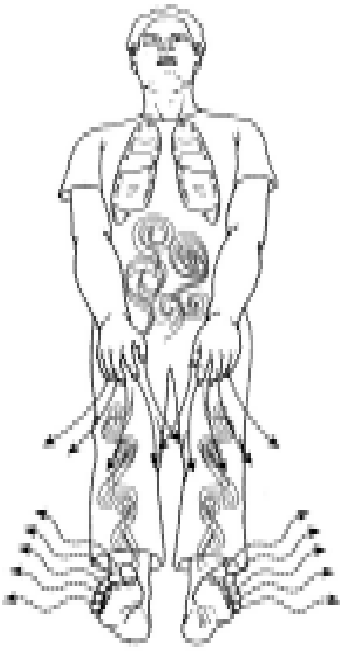

Fig. 7.17 *Vent sick energy from the diaphragm to the lower abdomen.*

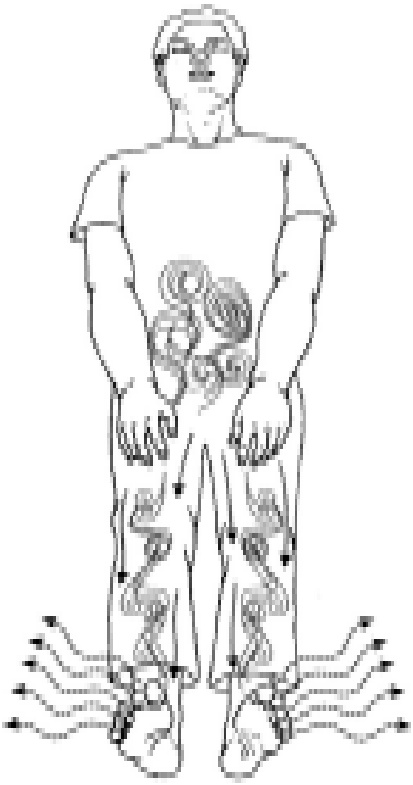

Fig. 7.18 *Vent sick energy from the organs to the lower abdomen and the toes.*

The lungs connect to the thumb, and the large intestine to the index finger. Sadness and depression can produce cloudiness in the lung's and large intestine's color, which can be changed from a cloudy white back to a bright, clear white.

The spleen connects to the big toes, and the stomach to the second toes. Worry can produce cloudiness in the spleen's and stomach's color, which can be changed from a cloudy yellow back to a bright, clear yellow.

The pericardium connects to the middle fingers. The purpose of the pericardium is to help cool down the heart.

The triple warmer connects to the fourth or ring fingers. It is closely connected to the glands and is the common repository for all the organs' excess energy.

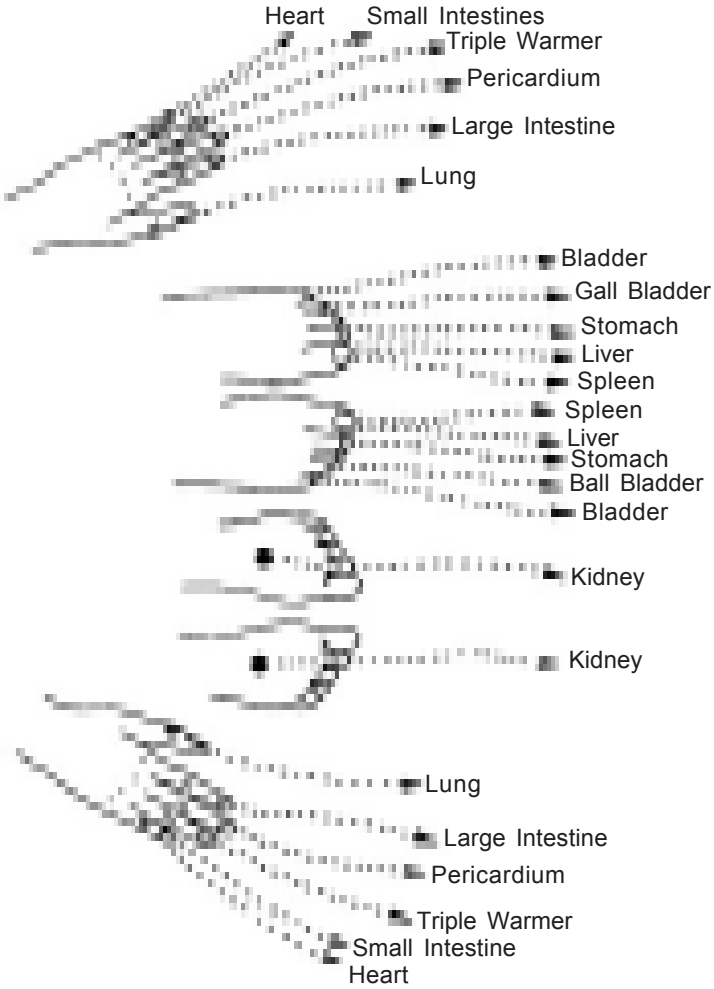

Fig. 7.19 *The toes and fingers correspond to the organs.*

Position and Practice

After you finish Fanning as above, remain in the same sitting position to begin the Venting exercise.

1. Place the hands on the knees. Keep the fingers slightly spread and pointed toward the toes.

2. Place the feet parallel to each other and point the toes up. Be aware of the area two or three inches above and directly between the big toes. Be aware of the tips of the big toes, then of all the toes and tips of the fingers.

3. If you have sick energy affecting an organ, look at Fig. 2.19 to determine the toes or fingers that correspond to that organ. During Venting, you can emphasize the fingers or toes corresponding to the organ in which you have sick or emotional energy to send more of the energy out of the body. For example, if you have a heart problem, you can concentrate on the little fingers. Feel the cloudy gray energy exiting through those fingers.

4. Practice the Triple Warmer's Sound (***Heeeee***) down to the navel, perineum, palms, toes, and fingers (Fig. 7.22 and 7.23). Feel the vibration of the ***Heeeee*** sound at and moving out of the tips of the fingers and toes.

5. Gradually feel you can see the steaming, dark, cloudy, cold or chilly, sick emotional energy emerging from the toes and fingers.

6. Picture it becoming brighter and brighter. Continue to look at the point between the big toes to see more sick energy and negative feelings emerge.

7. Be aware of the liver as you inhale fresh air, visualized as a green mist. See it become a bright green as it fills the liver, then the entire body, with green.

8. Be aware of the spleen and pancreas, and see them glow bright yellow as you inhale a yellow mist.

9. Be aware of the lungs, and see them glow with a white light as you inhale a cool white mist.

10. Be aware of the heart, and see it glow a bright red as you inhale red mist.

11. Be aware of the kidneys, see them glow with a bright blue light as you inhale a cool blue mist.

Each organ is a "doorway" for a certain color and healing frequency. Practice filling the organ and then the entire body with different-colored mists or rays.

Summary

Spend at least one to two weeks practicing with Mother Earth energy before going on to the next stage. Cultivate a strong sense of the cooling and balancing of the earth energy; it will help you at all levels of Taoist meditation and Chi Kung practice. We speak of needing a good foundation to build something on, and there is no better foundation than the earth on which to build a strong, solid and safe, meditation practice.

Many people just do Chi Kung, generate heat, feel good, and never gather or condense the Chi. This is not good energy cultivation. Instead, skillful energy cultivation should be like farming. First the farmers plant their rice. Then they allow it to grow. But at this stage, they are not yet finished. They must let it come to ripeness, and then they must harvest it at just the right time, when there is no rain. Having harvested it, they must store it properly, so it will not get wet and sprout. If t hey store it improperly, within two weeks it will sprout and go to waste.

Some Chi Kung and martial arts practitioners do not create a place to store their energy properly. The energy becomes overly intense and flows in every direction, and they begin to burn themselves out or to become emotional and arrogant. They crave the coolness of Yin; it is common for such practitioners to overindulge in sex, alcohol, or drugs, or to associate primarily with people who are Yin so they can dominate them. They never learned that the purest, best, and most balanced source of Yin is right at their feet—Mother Earth's energy. o grind it and take it to market; they have to create a channel to transfer the rice to its destination. If they do not take the rice to market, it is of no use.

In the same way, once your energy has matured through regular practice and has been gathered and stored, you need to direct it and open your energy channels so it can flow to wherever it is needed. Otherwise, it will tend to stagnate and cause problems, If you conscientiously follow the steps of practice in the right sequence, you can safety progress to the highest levels.

Chapter 8
Cosmic Force: Higher Self Energy and the Microcosmic Orbit

What is Higher Self (Cosmic) Energy?

Heaven, Earth and Humanity: Grand Trinity

It is Taoist belief that humanity is as vital in the "grand scheme" of the universe as heaven and earth (the primordial energies of Yang and Yin). Taoists also observed that, unlike heaven and earth, which appear to last forever, the physical human life-span is limited. They reasoned that this was not always so, that humans have the ability to achieve immortality, and that our current mortality is the result of having lost our state of harmony with nature, the universe, and the Tao. We need only restore that harmony to be as immortal as heaven and earth and to fulfill our rightful destiny as part of the Grand Trinity.

The human soul is a living ray of the cosmic soul; it is as if the original cosmic beam of sound/light divided itself into 6 billion individual rays or souls on planet earth. That why we speak of the energy of human beings as both human and cosmic energy. The universe is the macrocosm, and humans are a microcosm of the universe. The more accurately we reflect the natural patterns of the universe, the more we are in harmony with the Tao. The more we are in harmony with the Tao, the more easily we can open to, unite with, absorb, and enjoy the limitless energy of the universe. Harmony with the Tao is the key to immortality; Taoist sages therefore sought to understand these universal patterns and reflect them in their own being. Their goal was to become the process of the universe. Practically, this meant learning to tap the universal energies at all times, and, with this radiant force integrated into their being, to act for the purpose of helping all other creatures realize their own innate immortality.

Wu Chi

To understand ourselves as the microcosm, it is helpful to have a picture of how things unfold in the macrocosm. In the beginning, before heaven and earth even existed, there was a state of undifferentiated and unmanifest potential. The Taoists call this Wu Chi, or the Tao. In the Chinese picture character for this term, "Wu" means "nothing," and "Chi" means "absolute"; therefore Wu Chi means "absolute nothingness," a state before Yin and Yang even existed. Wu Chi is without boundary; it is pure openness, unobstructed, the possibility of infinite space, the vessel of the whole universe that is invisible and formless (Fig. 8.1).

Yin and Yang

Then, somehow, something stirred in the Wu Chi. Wu Chi reached a certain critical mass, and it exploded and manifested. This Primordial Duality took two forms: Yang and Yin. In the first nanosecond of their birth from Wu Chi, these two forces were separate, and then they collided with immeasurable impact and fused. Their union resulted in a third force: Chi. The fusion of Yin and Yang and the Chi created by this fusion is called Tai Chi, or "Supreme Harmony" (Fig. 8.1).

Primordial Breath

The Original Chi of the Universe (said to have first manifested as inner sound and light) is also called Primordial Breath, Primordial Chi, Original Light. Clear Light, Source Chi, Light of Creation, or Neutral Force (Fig. 8.1). In the Healing Tao, we access this energy from all three major forces in meditation. The Original Chi that emanates within our Cosmic or Higher Self energy is the easiest for us to access because It is closest in vibration to our "lower" or physical self and ego mind. It is from the essence of this Higher or Cosmic Self that we ourselves are made, just as individual particles of light crystallize from a long wave of energy. In the same way, the mind functrions from these invisible cosmic waves of energy, even as it appears that the body is solid.

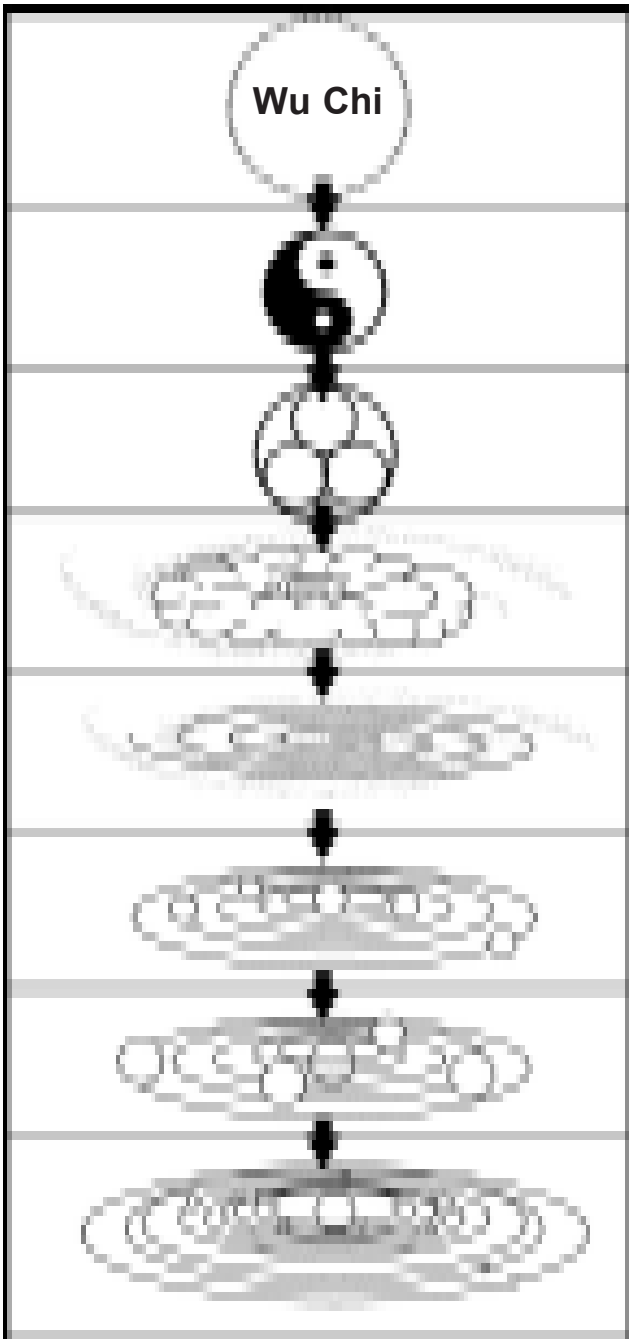

Fig. 8.1 *Wu Chi, Yin, Yang, and the Five Phases of Energy*

The Original Chi of the Universe thus encompasses both Yin and Yang. It is the balance point, the child or Yin and Yang, the result of their union, the neutral force or matrix in which all creation occurs as a play of positive and negative forces. From the Original Chi of the Universe came all the multiple forms of matter and energy. According to the Big Bang theory, one of the first distillations of this energy was stars. Many of these early stars later became supernovas and exploded, sending their particles off into space. These particles joined with other particles from other galaxies, forming new molecules and new types of energies.

Ten Thousand Things: The Birth of the Universe

Many of these particles clustered around stars and planets as they were drawn into the orbits of these heavenly bodies. Some of these compounds eventually drifted down to the planetary surface. In the case of our planet, some of the particles formed gases, which eventually became the earth's atmosphere. Others formed the beginnings of topsoil, making plant life possible. In this unique setting, conditions conducive to the formation of life were created, and eventually, along with plants and animals, humans emerged. Thus it is said that we are children of the stars. The essences and elements that compose our bodies are drawn from the cosmic dust that originated in the stars, and our minds are illumined by the living intelligence of the heavens, a stellar pattern imprinted on our individual genetic code at the moment of our conception.

Heaven, Earth and Man: The Three Pure Ones

"Man, Heaven, and Earth, all three, are mutually related, with the heart as master" (Huai-nan-tzu, Chapter 7, "On Seminal Essence Breath and Spirit"). In the earliest Taoist writings of Huang Ti, Lao Tzu. Chuang Tzu, and the I Ching, dating from about 2500 B.C. onward, the first three forces to emerge from Wu Chi were called Heaven, Earth, and Man (Primordial Yang, Primordial Yin, and Primordial Light or Original Chi) (Fig. 8. 2).

Around 700 years after the time of Lao Tzu (shortly after 100 A.D.), Buddhism was introduced into China. For the first time, Taoists had to compete with a new foreign religion for imperial favor and support. From the philosophical and meditative tradition of Taoism sprouted new branches of organized religious movements and Taoist sects.

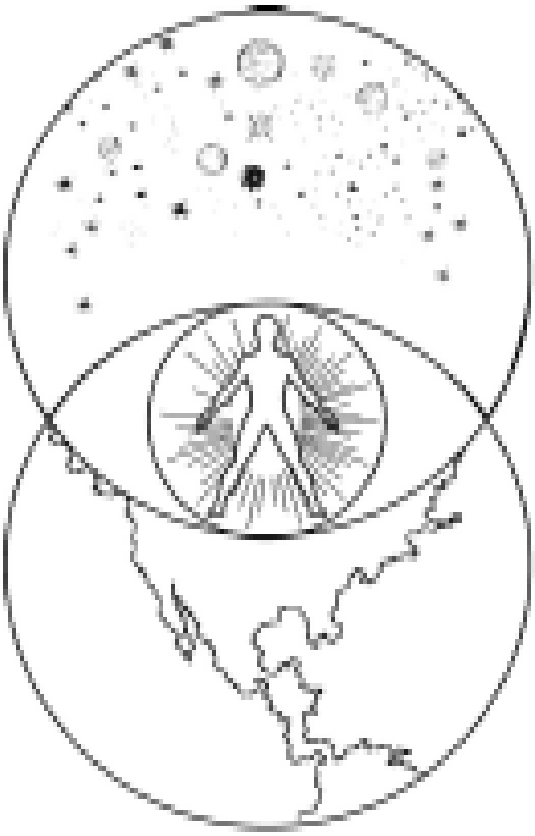

Fig. 8.2 *Heaven, Earth, and Man*

Many of the energies previously recognized as impersonal forces of nature were remade into gods that could compete with the colorful deities imported from India. Thus, in the writings of Chang Tao-Ling (said to have been channeled information from Lao Tzu), the founder of religious Taoism and the first Taoist pope of the Heavenly Master sect, the energies of Heaven, Earth, and Man became known as the Three Pure Ones, the lords of Heaven, Earth, and Man. Chang Tao-Ling also said that by receiving these three spirits into the microcosm of the body, one becomes a child of the Tao.

In religious Taoism (Tao Na), the Three Pure Ones are deified as the three highest gods of the Taoist pantheon and are said to reside in the highest of the nine levels of the heavenly realms. The

Three Pure Ones are also said to exist as giant stars in the center of the universe, constantly radiating their Chi, which pervades everything in time and space (Fig. 8.3). Because of the popularity of religious Taoism, the names of the Three Pure Ones became synonymous with Heaven, Earth, and Man throughout the many branches of Taoism. In the Healing Tao, however, although we often refer to these forces as the Three Pure Ones, it is not necessary to see them as gods or deities. You can understand them as primordial energies that can be explained by the language of physics and astronomy. In any event, the important thing is not what you believe; it is feeling and experiencing the cosmic energy that saturates your living being at every moment. Taoist alchemy is one method to regain your sensitivity in the patterns of energy movement in your subtle bodies.

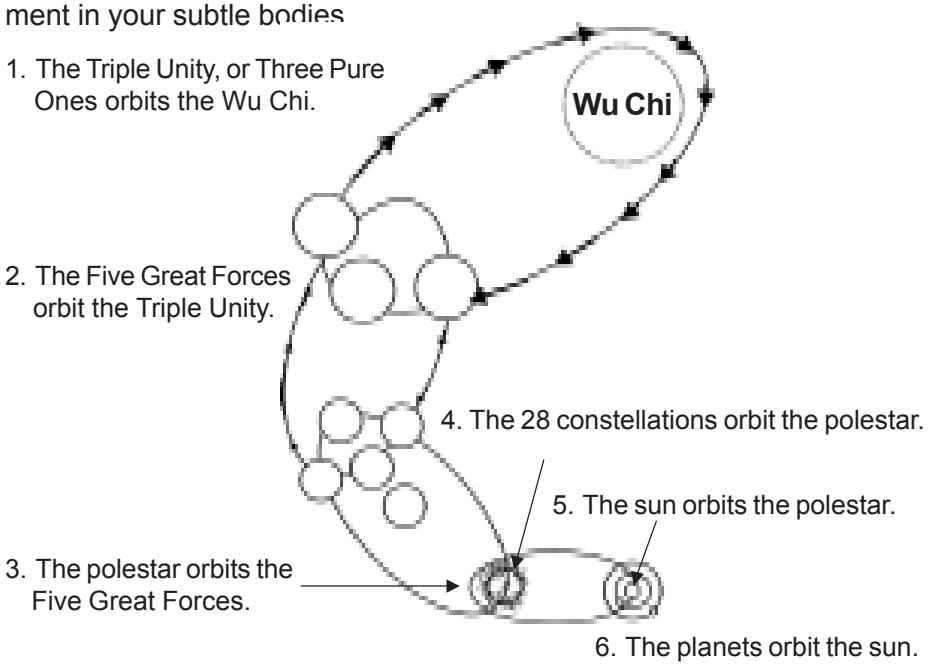

Fig. 8.3 *Universal Orbit*

Universe as a Hologram

Within the last century (and particularly the last 25 years), new breakthroughs in physics and biology have radically changed the way scientists look at the universe and have moved Taoism and physics closer together. The mechanical, Newtonian view of the universe, in which everything from atoms to planets is understood

to be made up of separate solid objects, has dissolved in light of relativity and field theory. What used to be called “things” are now viewed as both waves and particles; our world is made up not of solid objects but of wavelike patterns of interconnections. The universe is now thought to be a dynamic web of interwoven energy patterns with an underlying yet unmanifest order as its foundation. The entire universe is seen as one inseparably interconnected whole.

Physicist-turned metaphysician Barbara Ann Brennan says in her recent book, *Hands of Light*, “If the universe is indeed composed of such a web, there is (logically) no such thing as a part. Thus we are not separated parts of a whole. We are a Whole.”

In 1971, Dennis Gabor received a Nobel Prize for constructing the first hologram, which is essentially a three-dimensional photograph made of light. Every part of the hologram is an exact reflection of the whole, and each part will rebuild the entire image. In his book *The Implicate Order*, physicist David Bohm maintains that the model of the hologram is the best way to understand the holistic view of the universe.

Contemporary biologists such as Karl Pribram theorize that our brain also works holographically—that it structures and transmits sensory impressions throughout the system so that each fragment can reconstruct the entire picture of the whole. Dr. Pribram goes onto apply the same holographic model of the brain’s operation lo describe the operation of the universe. If the universe is like a hologram, each part of the universe reflects the whole. Events that appear to be separated in time and space are actually simultaneous and occur everywhere in time and space. This coincides with the Taoist understanding that all the energies or “gods” that exist throughout the heavens also exist simultaneously within the microcosm of our human body. The Three Pure Ones, therefore, do not simply exist in some remote part of the universe; they are ever-present in us, too. They are an integral part of each human being.

Microcosmic Orbit: A Mirror of the Universe within the Body

In Chinese, the Microcosmic Orbit is called Xiao Jou Tien (pronounced Shao Jo Tyen). This is translated as Smaller Heavenly Cycle. The Taoists saw the cosmos as having nine different levels

or dimensions and also saw a perfect mirroring of the heavens contained in the human body. Little Heaven is the equivalent Chinese term for microcosm; it is the Taoist way of saying “As above, so below”—as it is in the universe, so it is in the human body. The practice of circulating light/energy in the Microcosmic Orbit is a way of reconnecting these different dimensions of our selves, of rejoining our inner universe with the outer universe (Fig. 8.4).

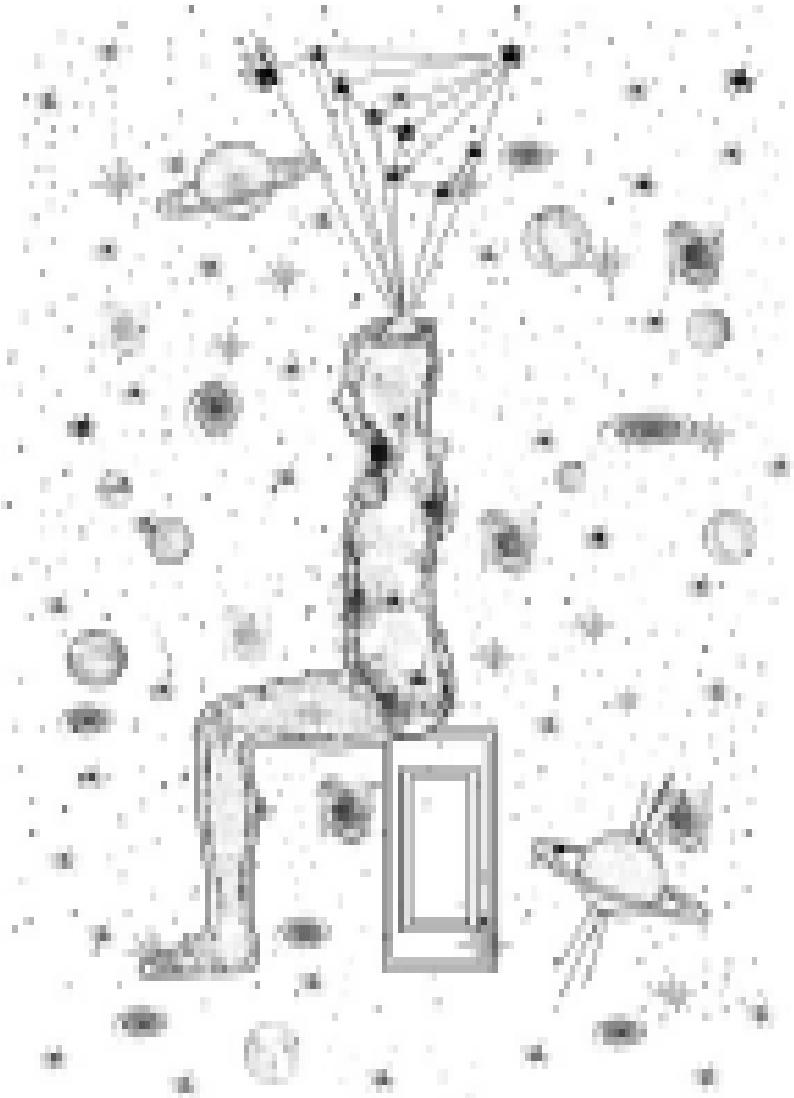

Fig. 8.4 God exists within us:
The Inner Universe and the Outer Universe.

The Three Pure Ones are lords of the Three Tan Tiens. In traditional religious Taoism, the Three Pure Ones were also called the lords or Emperors of the Three Tan Tiens (Cinnabar Fields or Elixir Fields), which were the three primary focal points in the human body for alchemical transformation of energy. The Three Pure Ones are said to reside and rule in these three places within each person: the Upper Tan Tien, or Palace of Ni Wan, in the brain; the Middle Tan Tien, or Crimson Palace, at the heart; and the Lower Tan Tien, or Yellow Court, at the navel area.

The Three Pure Ones become the Three Treasures in Man. On the human level, the Three Pure Ones become the Three Treasures: Ching (body essence and sexual energy), Chi (life-force energy), and Shen (spirit) (Fig. 8.5). Shen is the most subtle and intangible of our Three Treasures and so corresponds to the Upper Tan Tien and the force of Heaven; it is predominantly Yang. Chi, the vital breath of life energy, is more subtle than Ching, yet more condensed than Shen. Chi corresponds to the Middle Tan Tien, the soul, and the Higher Self/Cosmic Energy. Ching, our life essence and sexual energy, corresponds to the lower Tan Tien. As it is the most condensed of our Three Treasures, it relates to the force of Earth, and is mostly Yin. All these have their Yin and Yang aspects, as even pure Yin contains a seed of Yang, which will grow as the Yin evolves. Mother Earth's physical planet is thus matched by "Father" Spirit component of the Earth.

There is yet another set of correspondences between Heaven, Earth, and Man and the organs of the body. This is the Triple Warmer concept of Chinese medicine, which divides the human body into three zones of energetic activity. In this scheme, Shen corresponds to the parts of the body from the diaphragm up, to the heart, and to Heaven; Chi corresponds to the area between the diaphragm and navel, to the stomach/spleen, and to Man; and Ching corresponds to the parts of the body below the navel, to the kidneys, and to Earth. Chi Kung, herbs, Five Element nutrition, meditation, Chi Nei Tsang, and acupuncture help regulate the balance among these three centers of the physical body.

Although the Triple Warmers regulate the vital organs, it is in the alchemical cauldrons of the Three Tan Tiens or Elixir Fields that the vital substances of Ching, Chi, and Shen are brought to be refined, purified, and transformed in the Taoist inner alchemical path of spiritual development.

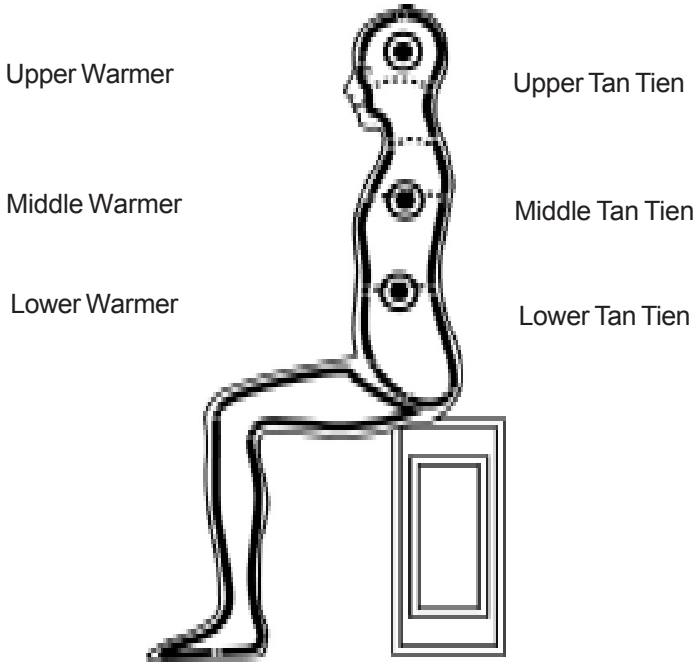

Fig. 8.5 *Three Tan Tiens*

Human Genesis reflects the Cosmic Unfolding.

Our personal genesis follows a pattern similar to the beginning of the universe. Before conception, we were nothing (Wu Chi). A desire for human birth arose spontaneously within the Cosmic Soul. Then, our father (Yang energy) and our mother (Yin energy) made love, and their Yin and Yang orgasm essences combined, creating a brand-new cell, called the zygote, made up of both energies (Tai Chi). Our uniquely individual life-force Chi created from that union of egg and sperm (Original Chi) powered the trillions of cellular divisions (the ten thousand things) that occurred after fertilization, until eventually that one cell had multiplied to the countless number of cells that make up a human being, with form, energy, and intelligence.

The most important Chi in our body is our Original Chi (Yuan Chi). Our Original Chi is the Chi within the microcosm of our body that most closely corresponds to the Higher Self (Cosmic) Energy on the microcosmic level. Remember that the Higher Self Energy (Cosmic Chi) is also referred to as the Original Chi of the Universe (Fig. 8.6).

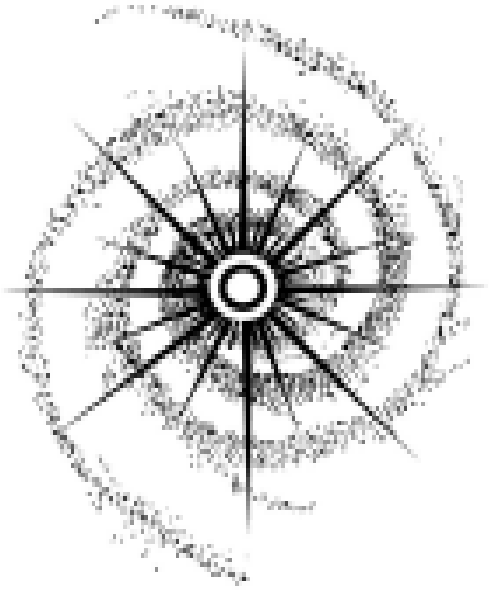

Fig. 8.6 *Cosmic Chi*

We are nourished Daily by the Cosmic Chi.

Food and air are derived from Cosmic Chi. To sustain our life and to replenish our Original Chi, we need to take in other forms of Chi or energy on a daily basis. Much of the Chi we take in comes from the food we eat and the water we drink. All the food we eat originates with plant life, which in turn derives its energy from the topsoil, the atmosphere, and light. Thus, all the forms nutrition we take in are related to Cosmic Chi.

Ions: Our subtle diet. We also take in Cosmic Chi in the air we breathe. This is primarily in the form of oxygen, but another subtle and less well understood form of Chi in the air is vital to the health of every bodily process. Ions are electrically charged particles essential for the functioning of the nervous system and blood circulation. The electrical charges of the ions are conducted in the body by electrolytes or salts, such as calcium, potassium, and sodium.

Although these substances are primarily introduced into the body through food and drink, they interact with and are affected by the ions in the atmosphere. The earth's charge is positive. To balance this and maintain optimal human performance, we need negative

ions. There are abundant negative ions in the air in the mountains and forests, by oceans, rivers, and waterfalls, after a rainstorm, and in grottoes. This is why sages of all traditions usually seek to live close to nature, for the Chi of nature is strong; it is conducive to clarity, health, and tranquility, all factors that nourish spiritual development and meditation.

In polluted cities and inside most houses, however, the negative ion count can decrease to near zero. When tins happens, people often feel enervated and sapped of energy; negative moods are a common response as well. Many people use devices called ionizers, "ion fountains" that pump mil lions of negative ions back into the air and help restore the atmospheric ionic balance in their homes and offices.

The Taoists discovered that breathing ions, cosmic particles, and Chi essence into the lungs alone makes it harder for of the body to assimilate and use these energies. The most effective way to absorb them is through the major energy centers, the mouth, saliva, and skin (Fig. 8.7). When we are young and healthy, we can absorb ions through our entire bodies, especially through the skin, palms, mid-eyebrow, and saliva (which attracts them). When our Original Force incomes weak and we lose too much sexual energy, it becomes harder for us to draw in ions from the air through the skin and these centers. By learning to open the energy centers and the pores of the skin through meditation and Chi Kung practices, we can absorb more Chi and thus maintain a higher level of health.

Food of Meditation: Thus there are many forms of Chi, both visible and invisible, that we as humans require to stay healthy and balanced. Without your noticing it, regardless of your knowledge and beliefs, no matter what age, color, or sex you are, the Three Forces continuously supply you with life-force energy. It is given unconditionally, whether you are bad or good, young or old, rich or poor. The only question is how much use you are able to make of it.

All the great sages realized this. Jesus said, "Man does not live by bread alone." The Tibetan Buddhists speak of yogis no longer needing ordinary food but living instead on the "food of meditation." Similarly, at the higher levels of Kan and Li meditation, some Taoists are also able to abandon eating ordinary food and live on the Cosmic Chi alone. The real job of the true Tao master is to help

you feel Chi and learn to absorb the subtle physical, energetic, and spiritual nutrients around you at every moment of your life.

Many of the ancient Taoists were great philosophers. They liked to explain and theorize about the origins of life and the universe and to explore intellectually the endless correspondences between the microcosm and macrocosm, between humans and the universe. This is important and helpful to a point, but if you are not able to put it into practice and learn how to use it, it will not add one minute to your life-span, nor will it help you at the hour of your death.

Fig. 8.7 *Absorb Chi through the major energy centers.*

Using Higher Self/Cosmic Energy In Meditation

Light of Creation

The light of creation, the Original Light, still saturates the universe and is simply waiting for us to capture it. On a subtle level, you can learn to access this Creation Light of Cosmic Chi during meditation through your mid-eyebrow, your palms, and the skin of the whole body, then absorb It into your system. Your respiratory and digestive systems take in energy from outside, process it, and send it to the heart, where it is distributed to every cell by the bloodstream. In the same way, we can absorb the Cosmic Chi and send it to the lower cauldron at the navel, where it will be "digested" and distributed to every part of the body through the energy channels.

This light shines from the Force to us. You may sense it with your inner eye as a benevolent golden cloud of light or luminous golden dust, very fine particles or waves of light floating in space in front of you at eye level and also radiating from your heart. Getting in touch with the Higher Self/Cosmic Energy in meditation can help strengthen and refresh your mind and spirit and can also help recharge and rebuild the Original Chi stored between your kidneys and navel.

Absorbing the Cosmic Chi will also heighten your practices of the Inner Smile and Microcosmic Orbit meditation. Using your mind to absorb light frequencies from external sources helps activate your internal light or soul. Just by connecting with the essences of the light frequencies, we start to awaken these different parts of ourselves; connecting with the Higher Self (Cosmic) energy causes a stepping-up of our corresponding energy on the human plane. It is usually not until you reach the higher meditation practices of Kan and Li that you reach your true soul level, where you actually merge with these energies. If Heaven Energy is related to your spirit body and Earth Energy is related to your physical body, then Man or Cosmic Chi is in turn related to your "soul body" or "energy body." At the level of Lesser Kan and Li, you are dealing with your own energies at a primordial soul level, at the level of Prenatal Chi.

At the beginning level of the Microcosmic Orbit, we are just starting to experience these energies, so we usually begin by connecting at a more simple mental level of visualization and inner focusing.

Higher Self: Protector and Advisor

0nce you establish the Original Force, you will automatically connect with the Higher Self. The Higher Self has been with us since birth, but we are not aware of it. We need to regrow our connection to it. If we have lost too much sexual energy, our life-force link to it becomes weaker and weaker, 0nce you feel the Original Force in the navel area and the golden light in mid-eyebrow, smile and be aware 6 to 12 feet above your head. You might feel a force or light above you. Simply let the force or light take form. It can be any form or color. Remember the form, so that next time you can recall it much faster. Let the form gradually touch you. Feel that you have a close connection with it. The place that it touches might open, and you can accept the Higher Self Energy into your body and merge it with the Original Force there. The place that the Higher Self touches will serve as a close connecting link between you and the Higher Self.

This Higher Self can give you advice, protection, and guidance in your life. If you can, constantly feel its presence.

Practice: The Microcosmic Orbit Feeling Higher Self/Cosmic Energy

Now, in addition to receiving the Earth energy and merging it with your Original Chi, you will learn the practice of connecting with and absorbing the Higher Self (Cosmic) Chi through the doorway of your mid- eyebrow point. You will begin this process with the Cosmic Inner Smile, an enhanced practice of the basic Inner Smile. Then, after warming the stove and connecting to Mother Earth Energy, you will activate the mid- eyebrow point, draw in the golden light of the Higher Self/Cosmic Energy, and expand it to form a protective sphere or shield around your body. Having done this, you will combine the golden light with your own Original Chi and then circulate the golden light or Golden Elixir through the Microcosmic Orbit. The final new practice introduced in this chapter teaches you how to connect the Upper Tan Tien (or Upper Elixir Field) with the Middle Tan Tien (or Middle Elixir Field).

1. Preparations

A. Chi Kung Warm-Ups

1. Begin by loosening the spine with Chi Kung Warm-Ups: Spinal Cord Breathing, the Crane Neck, the Turtle Neck, Spinal Cord Shaking, and Spinal Cord Rocking.
2. Rest. Feel the spine become open and relaxed. As you inhale, imagine that you are breathing a white mist down to the navel and gathering it at the tip of the coccyx, then raising it into the spine to purify, cleanse, and brighten the spinal cord. When you exhale, feel that you are breathing out any impurities from the spine as a cloudy gray mist. This will help strengthen the bones.
3. Now be aware of a golden mist in front of you. Inhale; gather and condense the mist of golden light in the mouth a few times, and draw it down or swallow it to the navel. Gather it at the tip of the coccyx, as above, and rotate it as a golden ball of Chi 9 to18 times. Then raise it into the spine to purify, cleanse, and brighten the spinal marrow. When you exhale, feel that you are breathing out any impurities from the spine as a cloudy gray mist Repeat this 9 to18 times.

B. Six Healing Sounds

Practice 2 or 3 repetitions of each of the Six Healing Sounds to clear the emotions, warm up the organs, and prepare the body to receive fresh, pure energy.

C. Cosmic Inner Smile

This simple version of the Inner Smile relaxes the Third Eye so that you can draw your Higher Self Force directly into the body. For a more detailed practice of the basic Inner Smile, please refer to Chapter 3.

In Taoist practices, it is very important to awaken the “mind’s eye” so you can feel and see the internal organs, glands, bone structure, and the marrow inside the bones. This will greatly help improve the marrow’s condition, and it will also help transform negative emotions into positive ones.

The organs, glands, and bone structure are not only the condensed essence of the Cosmic Force; they are also one medium

by which to receive this force. Bones have piezoelectric properties, just like quartz crystals, which serve to amplify and receive the Cosmic Force of the Higher Self. As you study the anatomical diagrams in this book, try to feel the organs, glands, and bones.

1. Sit properly, keeping the spine loose but straight. Tilt the head slightly forward and pull the chin in. Massage the mid-eyebrow point with the fingers. Then place the palms together (right hand on top) and hold them lightly in your lap. Close the eyes. Relax the Third Eye and the perineum as you slightly contract the sexual organs and the anus.
2. Be aware of the Higher Self (Cosmic) energy in front of you. Smile, and relax the mid-eyebrow. Inhale, and lightly contract the nostrils; simultaneously, gently contract and release the eye muscles in a pumping action. (The breathing should be slow and deep.) Feel these contractions amplify a pulsing sensation you will begin to feel al the mid-eyebrow. Feel a suction at the mid-eyebrow, and sense the golden light of the Cosmic Force run into the mid-eyebrow and be absorbed by it.
3. Begin smiling down the face, chin, and cheekbones as you lift the corners of the mouth. Feel the golden light flow to the places where you direct your smiling attention, and fill these places with loving energy.
4. Let the smiling energy spread down through the neck and down into the thymus gland, also known as the “little heart,” which speaks directly to the Higher Self. Feel the thymus open like a flower. Continue to smile into the rib cage, starting from the top ribs down to the floating ribs. Smile deeper, into the marrow, and thank the marrow for producing white blood cells, a vital part of the immune system.
5. Smile Into the heart and feel It open like a flower. Feel joy and happiness expand from its center, spreading out to all the other organs.
6. Spread this joy out to the lungs, liver, pancreas, spleen, and kidneys. Smile into these areas.
7. Smile down to the sexual organs. (Taoists acknowledge that the kidneys and sexual organs have a direct role in producing bone marrow.)
8. Return the attention to the Third Eye. Move the eyes around and feel them stimulate the brain. Smile, and feel the skull breathe. Draw the Cosmic Chi into the marrow.

9. Smile down the cervical vertebrae one by one. Feel yourself breathe into each, and feel them absorb the Cosmic Chi from outside into the spine and marrow.
10. Smile down to the thoracic vertebrae. Feel yourself breathe into each, and feel them absorb the Cosmic Chi into the marrow.
11. Smile down to the lumbar vertebrae. Feel them breathing and absorbing Cosmic Chi.
12. Smile down to the sacrum and the hips. Feel them breathing and drawing Cosmic Chi deep into the marrow.
13. Smile down to the femur bones, down to the tibiae, fibulae, and bones of the feet. Feel them breathing and absorbing Cosmic Chi into the marrow.
14. Finally, smile into the navel. You can use the hands to cover and help warm the navel, and also to strengthen the Original Force. When covering the navel with the palms, men place the left palm over the right; women place the right palm over the left. Mentally spiral the warm energy at the navel in any direction. (Focus one-and-a-half inches behind the navel.) Smile to your Original Chi.

2. Microcosmic Orbit Meditation

A. Warming the Stove: Generating and Gathering the Force

Make sure you feel the Original Force activate before going on to the other stages of this meditation.

1. Practice Bellows Breathing at least 18 to 36 times.
2. Activate the kidneys. Feel the Door of Life between the kidneys and the navel become warm. Spiral with the hands and body into the kidneys and Door of Life.
3. Activate the sexual organs. Inhale into the sexual center. When you exhale, feel yourself breathing out the toxins, while at the same time retaining the energetic essence of the breath at the sexual center. Then pause for a while. Feel the energy expand and radiate outward. Breathe in and out in this way at least 18 times. Then lightly tap the sexual center with the fingertips to wake up the energy.
4. Now rest a moment. Feel the navel warm. Feel the kidneys and Door of Life warm. Feel the sexual center warm. As you inhale,

feel the sexual organs, perineum, and anus very lightly pull up toward the Original Force.

5. Exhale, and push the diaphragm downward. Feel the pressure building at the Tan Tien. Picture the Original Energy with a mouth and nose, breathing into that spot (Fig. 8.8). Now lightly contract the circular muscles of the irises and the muscles around the eyes. At the same time, lightly inhale and contract the muscles of the nostrils, as if you were smelling a lovely fragrance. Contract and relax the eye and nose muscles in this way, and feel those contractions amplify the pulse in the Tan Tien. As you feel the pulse pumping, feel the pulsing at the sexual organs. Feel this combined pulsing and pumping, condensing and expanding, creating a suction and drawing the sexual energy into the Original Energy at the Tan lien. Feel the energy running into you. Spend at least 10 minutes warning the stove this way.

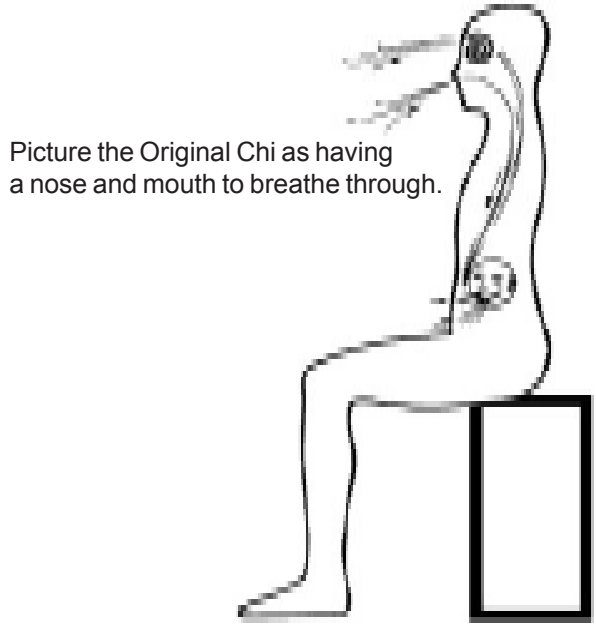

Fig. 8.8 *Warming the Chi Stove.*

B. Basic Microcosmic Orbit Circulation

Direct the Chi from the Tan Tien out to the navel. Then use any method you like to circulate the Chi through the basic loop of the Microcosmic Orbit several times. This will provide a matrix in which to receive the energy of the Earth and Cosmic Forces.

C. Feeling the Mother Earth Energy

1. Massage the palms and soles. Place the hands at the sides with the palms facing down toward the earth, and be sure the soles are flat against the ground. Also be aware of the Hui Yin (Functional Channel 1) point at the perineum.
2. After a short time, you will begin to feel the palms and soles breathing by themselves. Simultaneously, you will feel the vagina and Hui Yin (perineum) point starting to naturally pull up and release, pull up and release, in a pulsing and pumping action. You can time your breathing with the pulsing if you are having trouble feeling it. Do this 9 to 18 times. Then exhale and rest.
3. Now focus the mind about 95 percent on the Original Energy behind your navel, and about 5 percent on the Five Earth Gates (perineum, palms and soles, anus, and genital opening). Feel yourself grounded; feel connected to the earth. Just relax, and you will feel the pulsing again. Let it come in the Tan Tien as you breathe in though in though the Five Earth Gate (Fig. 8.9)
4. Feel the Chi ball growing and expanding in the Tan Tien, filling up the whole region between the navel, the kidneys, and the sexual center. Your Tan Tien is connected to the earth now; your body feels connected to the body of Mother Earth. Feel the Mother Earth energy strengthening the stove and enhancing the Original Energy at the Tan Tien. Once the Chi ball within the Original Force is full, it should automatically activate the mideyebrow. Alternately, you can lightly focus on the mideyebrow until you feel the pulsing.

D. 0pening the Mideyebrow Point and Activating the Higher Self/Cosmic Energy

1. Raise the right hand to the forehead. Using the index finger of the right hand, touch the mideyebrow point and spiral clockwise with the finger and the power of the mind and eyes. You can also lace the fingers of the two hands together, extend the index fingers together, and touch the mideyebrow point. You will feel as though a drill is spiraling from your finger into the middle of your brain (Fig. 8.10).

Fig. 8.9 *Opening the Mideyebrow Point.*

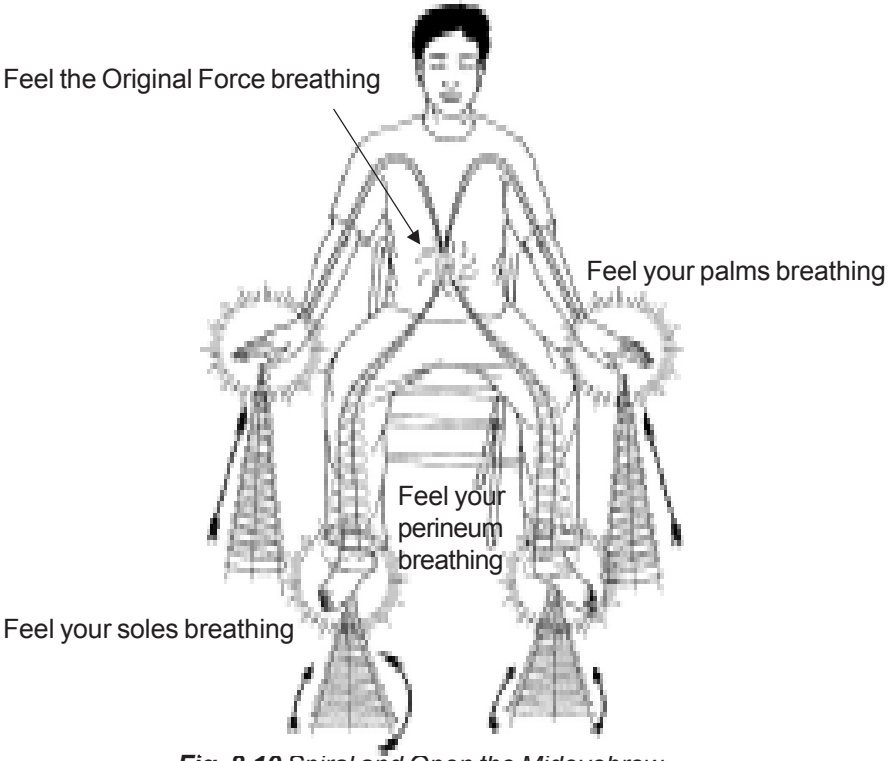

Fig. 8.10 *Spiral and Open the Mideyebrow.*

2. Lower the hands and breathe into the mid-eyebrow point. Feel it open as you exhale. Repeat this at least 3 to 9 times. Make sure you feel it open before you go on to the next step.
   Using the power of the mind, eyes, and heart is very important. In the beginning, you can actually move the eyes to follow the fingers, spiraling the eyes in a clockwise direction.
3. Be aware of the Original Energy behind the navel. Feel the Original Energy activate, and feel the suction there.
4. As you activate the Original Energy, be aware of the Original Energy in the Tan Tien, and at the same time feel the mid-eyebrow point pulsing and activating on its own.
5. Raise both hands to the forehead, this time with the palms facing out. Feel the mideyebrow point, the eyes, and the palms actively pulsing on their own. Be aware of them as you picture a golden light gathering into a ball in front of your face. Feel the palms and mideyebrow breathe in this golden light (Fig. 8.11).
6. Now project the awareness out to a favorite place in nature. Spiral counterclockwise with the power of the mind and eyes to connect with natural forces, such as a lake, an ocean, a forest, a waterfall, a mountain, a sunset, or a grotto. Picture them, and you will feel the Higher Self Forces come from them to you like a benevolent and refreshing golden mist of light.
7. As you inhale, feel yourself bringing all the power of nature into your body. Exhale, and feel yourself breathing out all the toxins and poisons through the nose. Inhale again, and feel the nostrils lightly contract so that you stimulate the nerves that are connected to the hairs in the nostrils; as you inhale in this way, feel the power and beauty of nature fill your whole being. Feel that you are actually inhaling the essence of nature into the palms and mid-eyebrow, then exhale any impurities.
8. Breathe the energetic golden light down into the mouth, and with the light begin to form a golden ball of Chi energy there.
9. Breathe the golden light into the saliva; let it merge and fuse with the saliva. Notice how the saliva changes. It may become very rich, sweet tasting, and alive, charged with life-force. The golden light mixes with the saliva and is known as the Golden Elixir (Fig. 8.12).

Fig. 8.11 *Breathe in the golden light.*

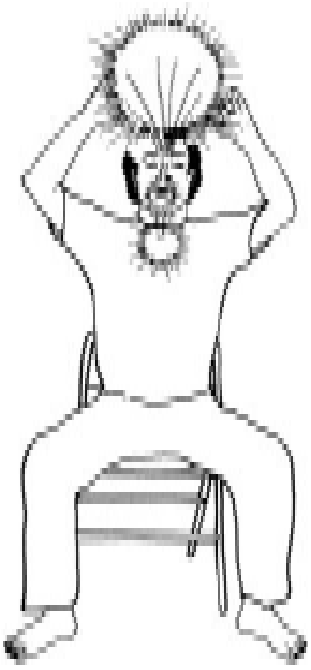

Fig. 8.12 *As you breathe in the golden light, mix it with the saliva. Then swallow the saliva.*

10. Lightly knock the teeth together 9 to 18 times. Then lightly clench and release the teeth 9 to 18 times. Press and release the tongue against the palate 9 to18 times. Press the upper and lower lips firmly together. Now swallow the elixir and follow the pathway of the golden light down with the mind. Picture a golden orbit that flows all the way down the front channel, through the perineum, to the coccyx, then feel it flow up the spine to the crown, and from the crown back down to the mideyebrow. Let it continue to flow through the Microcosmic Orbit pathway, circulating it through the Microcosmic Orbit 3 to 9 times.
11. Now picture a fine golden strand of light extending from either the Hui Yin point or the coccyx to the crown and mid-eyebrow, and feel it begin to expand (Fig. 8.13). Gradually expand it into a golden pillar within the body. Continue to feel it grow longer and wider, expanding outside the body until it merges with your aura.
12. See yourself sitting within an oval-shaped form of this light, as if a golden ball were enveloping your whole body. Being enveloped by a ball of golden light gives you a sense of comfort and safety within your own aura.

Fig. 8.13 *Let the golden light flow in the Microcosmic Orbit.*

13. Hold this image as you breathe naturally. It will energize and protect you. Feel the golden ball acting as a buffer or neutral zone to prevent any psychic attack or disruption from the negative energy of others. Feel that the golden light can help yon neutralize the negative energy or transform it into positive energy (Fig. 8.14). Continue to hold this image for 5 to 10 minutes.
14. Picture the oval shape of the golden light around your body condensing into a thin shaft extending from the coccyx up the spine. Continue to condense this shaft into a small strand, then gather it into a golden Chi ball at the mideyebrow.
15. Finally, condense the Chi ball into a Chi dot. Let it flow down to the mouth, through the chest, to the navel. You can use the mind to guide the golden light through the Orbit 6 to 9 times.

Fig. 8.14 *The golden ball of light covers your whole body, acting like a buffer or neutral zone to protect and energize you.*

E. Connecting the Upper Elixir Field and the Middle Elixir Field

1. Keep the fingers of the right hand on the mid-eyebrow center and move the left palm or fingers to touch the heart center. Inhale naturally and feel yourself breathing into the mid-eyebrow center. When you exhale, feel the energy of the breath drop down to the heart center (Fig. 8.15).

   Now focus on breathing in a golden mist. Exhale, and send the energy down to the area of the heart center. Follow your natural breathing patterns; do not force the breath or any movement of energy. With each breath, you are extracting and retaining the essence of the vital energy of life for your body's use. Do this from 9 to 18 times. Rest, and feel that the Upper and Middle Elixir Fields are open and connected.
2. This time when you inhale, feel the breath rising from the heart center up to the mid-eyebrow. Then, when you exhale, send it from the mid-eyebrow center down to the heart center. Use the breath to purify the space between these areas. Follow your natural breathing patterns without using any force. Use the power of the mind, eyes, and heart to direct the current of life-force within the body. Do this from 9 to 18 times.

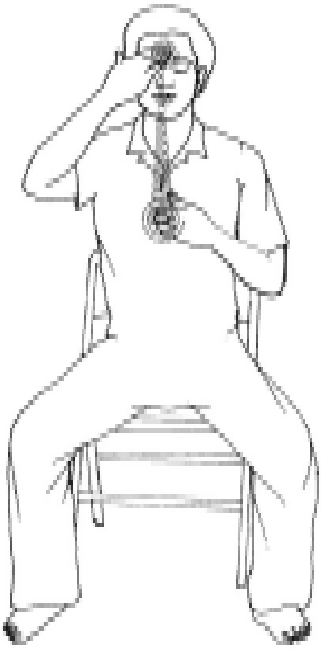

Fig. 8.15 *Connecting the Upper and Middle Elixir Fields.*

3. Now focus the mind about 95 percent on the Original Energy behind the navel and about 5 percent on the main Five Gates (perineum, palms, soles, and the mid-eyebrow and crown, not yet open). Use the mind/eye/heart power to condense and expand, and pulse the cosmic golden light and Mother Earth's gentle and kind blue energy into the Original Force. Be aware of the Higher Self above you. Feel your connection with it, and feel the Higher Self channel and absorb the force around you (Fig. 8.16). Spend 10 minutes on this practice.
4. Rest, and feel the sensations of condensation and expansion, energy, lightness, peace, and balance. Now inhale, breathe the golden mist into the heart center, and exhale it into the Tan Tien. Gather it into the Tan Tien; picture it as the sun sinking into an ocean of stillness. Store this Chi, and keep it ready to call on for protection, or to energize you any time you need it.

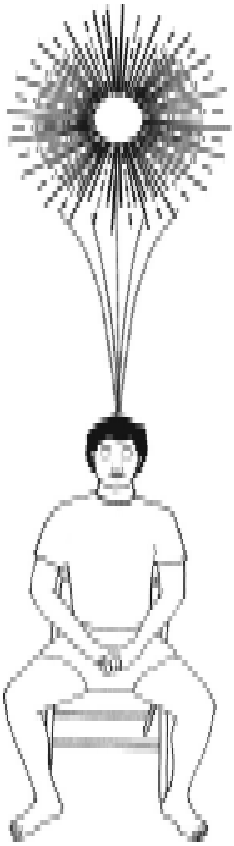

Fig. 8.16 *Make the connection to the Higher Self.*

3. Ending the Meditation: Collecting Energy at the Navel

1. When you feel ready to finish your round of meditation, use the mind to guide any excess energy back to the navel. You may also use the hands to guide the energy. Place the left hand on the navel and the right hand on the mideyebrow point. Feel the excess energy in the head or heart flowing between the two hands and beginning to flow strongly downward to the navel. It is important to take as much time as you feel you need to bring the energy down.
2. Focus the mind on the Original Energy behind the navel. Notice how quiet and peaceful you feel. Rest, and enjoy this feeling of being both relaxed and quiet in body and mind, yet energized at the same time.
3. Conclude the practice by spiraling outward 36 times at the navel and then spiraling inward 24 times to finish collecting the energy. Remember that the circles should be no larger than 6 inches in diameter, so the energy does not leak out into the heart or sexual organs. You may use your hands to help you spiral. At the abdomen, feel as though the intestines are physically spiraling, or use the mind alone as you become more familiar with the practice.
4. Finish with Chi Self-Massage.

Chapter 9
Opening your Heart: Shen and the Microcosmic Orbit

Role of Emotions in the Universal Tao System

Taoist View of Spirit

Many religions are based on philosophy, faith, and belief. Each has its value, but each also has drawbacks. Focusing on intellectual understanding alone is limiting and stifling. And while faith and belief can sometimes provide a stimulus to motivate people who might otherwise feel that life is without hope, some religions have degenerated to the point where they rely on these means exclusively.

A real practice teaches one how to feel within and derive authentic knowledge based on personal experience. In the Universal Tao, we emphasize the practice of understanding nature, getting in touch with the natural forces, and getting in touch with oneself. Then the principles of philosophy will reveal themselves. Then one can have real hope based on what is, not on empty promises that can never be proven.

All religions speak about spiritual growth, but it is not always easy to understand exactly what they mean by spiritual growth, or even what they mean by spirit. By contrast, the Taoist view of spirit, or Shen in Chinese, is quite simple. To Taoists, one major aspect of the spirit is one's attitude, one's emotional energy. This idea is not foreign to the Western world. People often remark, "Well, you're in good spirits today," or "Let's have some team spirit!"
We also speak of a "spirited performance" or a "spirited horse."

If a spiritual teacher or leader seems gentle, fearless, joyful, kind, and just, then we naturally develop respect for his or her spiritual attainments. We find it pleasant, nourishing, and inspiring to be in the teacher's presence.

However, if a spiritual teacher seems angry, frustrated, arrogant, impatient, fearful, worried, or depressed, then we will be disappointed. We will not feel confident that this teacher can guide us to peace and happiness, because the teacher has not found peace within himself or herself and has not yet learned to get along well with others. From this example, it is clear that we do indeed equate spirit with emotions and mental attitudes.

Virtues: Energetic Essence of Our Positive Emotions

In the Tao, we refer to the positive emotions as the virtues. However, the virtues are not merely positive emotions, which are limited to specific expressions in time and space. They are actually the true essence or seed Chi of our positive feelings, an aspect of our immortal soul essence, emanating from beyond time and space into our daily lives.

The virtues are our natural qualities; they are inherent in everyone. They do not have to be created in us; they need only to be uncovered, exercised, and nourished. This is the Taoist approach.

Our virtues have the nature of wisdom and love. They are wise because they reflect our interdependence with the Tao, with nature, with all life, and with the different parts of our own body; we cannot exhibit the virtues except in relation to another. The virtues are also wise in that they express love, the attitude that strengthens the positive bonds connecting everything in the universe. Thus the virtues promote life, health, and harmony. Cultivating the virtues is the basis of spiritual development in the Tao. We are born with these qualities in abundance.

The ancient Chinese correlated the virtues with the Five Elements, or Five Major Forces, as follows (Fig. 9.1):

Metal: lungs; contracting force; courage; righteousness; appropriateness

Water: kidneys; gathering force; gentleness; generosity; alert stillness

Wood: liver; generating force; kindness; forgiveness

Fire: heart; prospering force; love; joy; happiness; gratitude; respect; honor

Earth: spleen; stabilizing force; in the center, openness; fairness; justice

A correspondence also exists between the virtues and the internal organs. In fact, the virtues reside in the organs and in the channels associated with them, which form an energy network throughout the body. The virtues are the product of the healthy Chi of each organ. They are each an essential component of our immortal spirit.

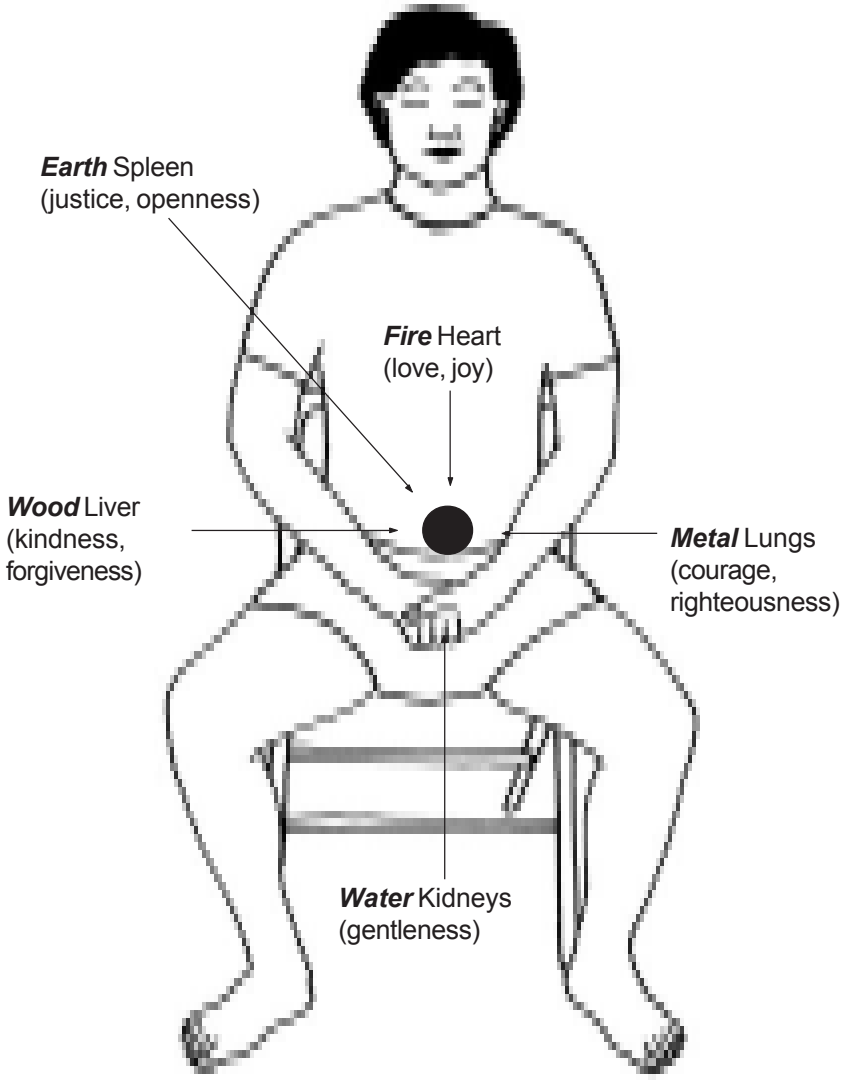

Fig. 9.1 *Virtues with Five Elements*

Negative Emotions: The Afflicted Expression of Our Natural Virtues

The Five Elements are also correlated with negative emotions and specific organs. Our Chi can be adversely affected when we are subjected to prolonged stress, injury, unhealthy environmental factors, poor posture, or ill-treatment and abuse from other people. When the virtuous Chi associated with our internal organs is disrupted, it opens the door to the negative emotions, which are considered the afflicted expression of our natural virtues. So, in essence, our organs act as "doorways" through which emotions manifest. For example, the heart manifests the positive qualities of respect, love, and joy, but when its virtuous Chi is disrupted, the heart becomes the doorway for cruelty, hatred, arrogance, and impatience.

The negative emotions are not our true nature, because they lead to unhappiness, and—if they become chronic—eventually to illness and even to death. In contrast, the virtues nurture happiness, health, and life. Negative emotions can depress the immune system, sap our energy, and scatter our life force. When negative emotions repeatedly arise and remain unchecked, they start to become habitual. It becomes easier and easier for anger, fear, worry, sadness, and impatience to be triggered; people easily "push our buttons" and control us, and we find that we are reacting to life more often than we are acting from our wise and stable center. (Please see Fig. 3.29 in Chapter 3.)

The question is: how do we change? How do we eliminate habits of negative emotion, our ineffective and destructive responses, and replace them with positive, effective, and life-affirming attitudes? What is the most effective way of reversing these patterns? What is the key?

Chi: The Bridge Between Body and Mind

To the Taoists the key is Chi. Chi the life-force energy, permeates and activates the body and mind; in fact, it is the bridge between the body and our consciousness. Because the body, Chi, and consciousness or spirit are linked, a change in one may easily affect the other two.

Relaxing Your Attitude to Heal Your Body

Over the past two decades, there has been significant research indicating that emotional stress has a depressive effect on the immune system, and that it can aggravate chronic physical conditions such as hypertension and diabetes. Research also shows that the onset of cancer is often preceded by chronic anxiety, depression, anger, or other negative emotions. Stress management studies indicate that a change in attitude can cause an improvement in physiological indications of health. For example, Norman Cousins cured himself of a degenerative connective tissue disease by leaving the hospital, checking into a hotel, and treating himself with "laughter therapy" by watching old Marx Brothers movies. This is only one of many cases demonstrating that generating a happy and positive frame of mind can have a correspondingly positive effect on the body.

Relaxing Your Body to Heal Your Mind

Similarly, doctors and psychologists who specialize in stress management and relaxation training have discovered that many stress-related mental and emotional tensions can be relieved by relaxing their associated bodily tensions. Dr. Edmund Jacobson, inventor of the first biofeedback machine and the "father of progressive relaxation training," went as far as to say, "An anxious mind cannot exist in a relaxed body."

Directing Your Chi to Heal Both Body and Mind

In the Taoist classics, it is said, "The mind leads and the Chi follows; the Chi leads and the body follows." Because Chi is at the midpoint between the body and mind, directing the Chi enables us to make changes in both body and mind. Meditation, Chi Kung, Chinese medicine, Feng-Shui (geomancy), and the martial arts all emphasize controlling, refining, and directing the Chi for both physical well-being and spiritual development. For example, acupuncture, working exclusively with the Chi, can effectively alleviate physical pain and illness as well as mental and emotional disorders.

Universal Tao System: A Three-Pronged Approach

The Universal Tao system uses a three-pronged approach to emotional healing and transformation, comprising body, Chi, and mind. Depending on the personality of the individual student, one approach may work better than another. For example, some people are out of touch with their bodily tensions and sensations but are in touch with their thoughts and emotions. For this type of person, affecting and healing the body and Chi can be approached on a mind/emotion/spirit level, such as with the Inner Smile. Other people may be very much in touch with their physical side but out of touch with their feelings, thoughts, and energy. The doorway for such a person's opening to the totality of his or her being may initially be the Microcosmic Orbit, Tai Chi Chi Kung, Iron Shirt, or the Six Healing Sounds.

The Taoist approach follows the way of nature; we do not try to force the student to adapt to one method. Instead, we have many different methods to suit the nature, capacity, and needs of each student. Ultimately the goal is to know ourselves as we really are and to reclaim all aspects of ourselves on every level. And because part of who we are is our energy body, our Chi network, all these Taoist practices help us discover and sense Chi as part of our continuum of being: the Chi in our bodies, in other people, and the Chi of nature all around us.

Over centuries and millennia, Taoists have devised many exercises and ways of training to nourish all three interrelated aspects of our totality—body, Chi, and spirit. But it is not enough just to understand that working with emotional energy is important. You have to do it! If you practice, you will soon see results that transform your life.

From Theory to Practice

Emotional Energy and the Inner Smile

In the Universal Tao system, the practice of bringing the body, Chi, and emotions into balance starts with the Inner Smile.

We often get so out of touch with our bodies and emotions that we do not notice inner disharmony developing until it finally manifests as a serious illness. Practicing the Inner Smile daily provides a regularly scheduled time to look inside—to keep in touch with the state of our inner organs, our Chi, our breath, and our emotions. We can then spot problems at their inception, making it easier to "nip them in the bud."

Low self-esteem is becoming endemic. If we are not taught or encouraged to love ourselves, we cannot have a healthy, loving relationship with other people or with the earth; witness the state of society and the environment as proof of this imbalance.

The Inner Smile teaches us to recognize our inherent positive qualities, not just our negativity. With regular practice, we get to know ourselves as we really are; we can discover our virtues as well as out afflictions. This helps us form a more authentic and healthier self-image, one that stays in close touch with reality. The Inner Smile exercises our ability to love, starting with our own bodies. As we learn to love and accept ourselves, it becomes natural and easy for us to extend this love outward and begin to love and accept other people, creatures, places, and things.

As one of the best exercises for stress management and self-healing, the Inner Smile induces a state of deep relaxation. Deep relaxation dissolves physical and mental tensions that can cause energy blockages and unhealthy Chi. For this reason, the Inner Smile is always used as a preparation or warm-up in other meditation and Chi Kung exercises that circulate the Chi.

Working with Emotions in the Microcosmic Orbit Meditation

Chinese medicine recognizes that negative emotions can be caused by blockages in Chi flow. If an organ or its channel becomes blocked due to injury, poor posture, pollution, poor diet, prolonged stress, or illness, that organ may get too much or too little Chi. The virtuous qualities of that organ are distorted, and its negative emotions may increase.

Similarly, chronic outbursts or bouts of negative emotions can cause energy blockages in an organ or its associated channel. For example, it is well known in Western medicine that chronic worry can cause indigestion or stomach ulcers. It is equally well known in Chinese medicine that chronic anger and frustration is the pri-

mary cause of Liver Chi stagnation. It works both ways: negative emotions can cause energy blockages and imbalances, and blockages can cause a rise in negative emotions.

The Microcosmic Orbit meditation circulates Chi through the Governor Channel and the Functional Channel (Conception Vessel). These two pathways are the primary source, or reservoir, channels for all other Yang and Yin channels in the body. Circulating the Microcosmic Orbit helps keep the reservoirs full, ensuring a strong flow of Chi through the other channels and organs in the body. By eliminating the blockages, we can alleviate the negative emotions that were exacerbated by these blockages.

The Microcosmic Orbit is also an important component in the higher-level Taoist meditation formulas, which work with emotional transformation and healing, such as the Fusion of the Five Elements and the Kan and Li practices.

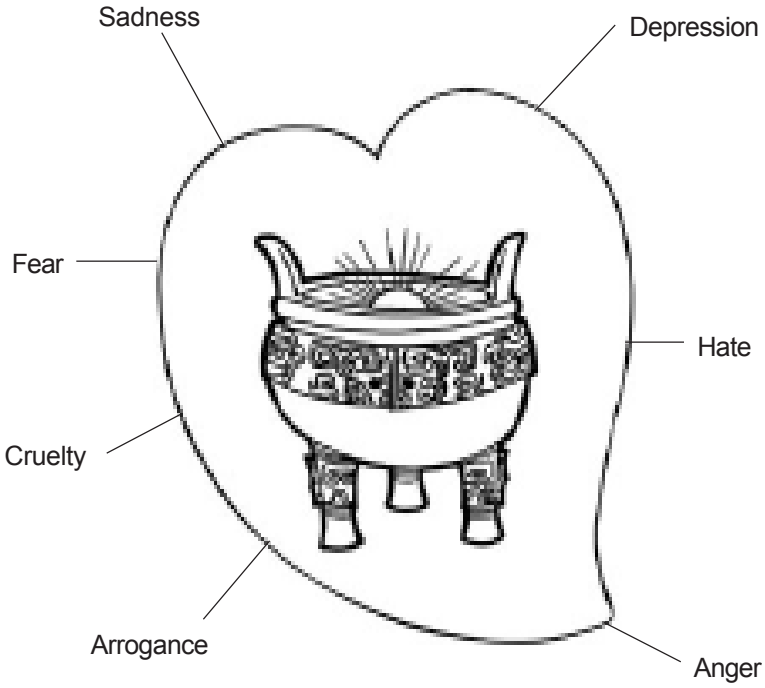

Fig. 9.2 *The heart is capable of tranforming negative energy into positive energy.*

Opening the Heart

Taoists regard the heart as a cauldron, capable of taking in negativity and processing it into positive energy. It is also a place to blend all the energies of our virtues to create the higher-grade energy of compassion (Fig. 9.2).

At the beginning of the Microcosmic Orbit, when we have opened the heart, it tends to draw in negativity from other organs and the body for processing. We should be careful to handle these negative energies properly; otherwise they can combine in the heart (just like the virtues) and cause more negative feelings.

Because this initial opening of the heart is very small, when negative energies are jammed into it, they can be hard to get out. For this reason the practices of venting and fanning to help drain negative and sick energies into the earth is very important. (Please see detailed practice in Chapter 7.) Shining out virtues toward other people is also important. The more we give sincere love, kindness, gentleness, and respect to others, without any expectation of return, the more we can open the heart and transform negative energies into positive ones.

Massaging the sternum can also help release these negative emotions, stimulate the flow of lymph, and activate the thymus gland.

Emotional Energy and the Six Healing Sounds

Together with the Microcosmic Orbit meditation and the Inner Smile, the Six Healing Sounds are an effective way of restoring and maintaining balance in your emotions and internal organs. When the thermoregulatory system of an organ becomes afflicted due to stress or other factors, the organs may overheat. In this condition, negative emotions and other adverse health problems related to the organs may arise.

The Six Healing Sounds use a combination of movement, sound, and mental imagery to cool and restore balance to the organs. As with the Inner Smile, we observe what our inner state is and then let go of any negative emotions. At the same time, we nourish the virtue energy in each organ. Although both the Inner Smile and Six Healing Sounds use the power of the mind to bring change to our inner climate, the Six Healing Sounds also use the more physical

approach of movement and sound, which may work better for some individuals or for certain types of ailments than mind power alone (Fig. 9.3).

While the emphasis of the Inner Smile is on relaxation, the emphasis of the Six Healing Sounds is more on cooling, balancing, and detoxifying the organs These two excellent techniques for restoring physical and mental health and balance are a perfect complement to each other.

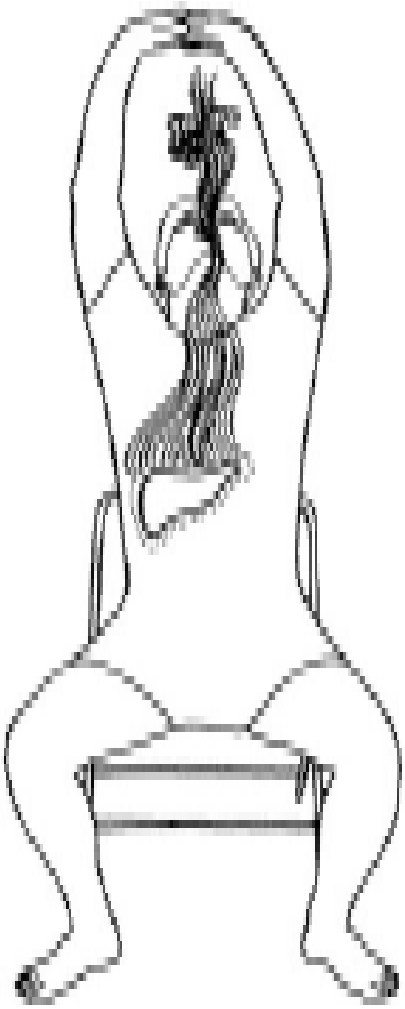

Fig. 9.3 *The Six Healing Sounds clear the negative energy out of the organs and grow positive energy.*

Fusion of the Five Elements

Once you have a firm foundation in the Microcosmic Orbit meditation, the Inner Smile, and the Six Healing Sounds, you are ready to progress to the more advanced formulas for transforming the emotions. When you begin the practices of the Fusion of the Five Elements, you will truly experience these "elements" as energy movements within your body. This will be your initiation into the beginning levels of Taoist Inner Alchemy.

Fusion of the Five Elements I: Purifying the Negative Emotions

The Fusion of the Five Elements practice is divided into three levels. Only the first two levels focus on emotional transformation. In the first level, Fusion I, you will learn how the Five Elements, with their corresponding emotions, seasons, senses, organs, and colors, can actually be experienced, and then harmonized and fused. This meditation first neutralizes the Chi of negative emotions through applying the Controlling Cycle of the Five Elements. This clears an inner space so the virtue energy has room to grow. The Chi is then distilled, collected into a "pearl" or condensed ball of Chi, the essence of the body, and circulated through the Microcosmic Orbit to strengthen and heal all the centers in the body (Fig. 9.4).

Fusion of the Five Elements II: Nourishing the Chi of the Inner Virtues

In the second level of the Fusion of the Five Elements, this freshly transformed energy of the negative emotions is recycled and used to nourish the organs, strengthen them, and increase their associated virtuous emotions. This is accomplished by applying the Creation or Nourishing Cycle of the Five Elements to grow and increase the natural virtues at their energetic roots, the Chi in the organs. The energy of the positive emotions of all the organs is absorbed into the pearl and then circulated in four of the eight special channels: the Microcosmic Orbit (Governor and Functional Channels), the Thrusting Routes, and the Belt Routes. The Thrusting Routes run through the center of the body, linking the "chakra" centers. The

Belt Routes spiral around the body, strengthening the aura and providing a form of psychic self-defense.

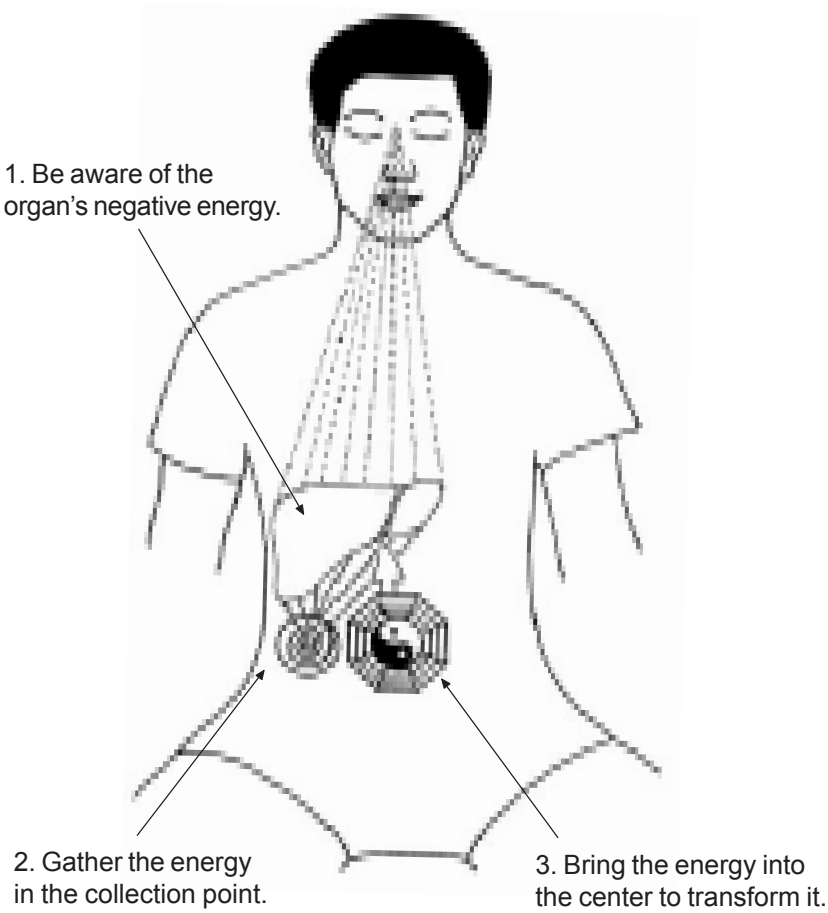

Fig. 9.4 *The Fusion practice helps transform negative energy to positive energy in a more powerful way.*

Fusion of the Five Elements III: Regulating Chi Flow in the Energy Body

The third level of the Fusion of the Five Elements practice directs the pearl to open the remaining four of the eight special channels: the Yin and Yang Bridge Routes and the Yin and Yang Regulator Routes. Additional routes are opened as well, giving greater cohesiveness to the energy body and making the physical body more permeable to the Chi. Successful completion of this level gives one greatly heightened sensitivity to the energy body and the ability to move the Chi at will to any place in the body.

Advanced Fusion Formulas: Projecting the Chi Beyond the Physical Body

Another important part of the Fusion of the Five Elements practice is learning how to temporarily separate the energy body and the physical body. In life, our three bodies—the physical body, energy body, and spirit body (consciousness)—all overlap and are generally inseparable. At death, the physical body is no longer a fit vehicle for holding the material Five Elements together, and Chi and consciousness are forced to leave. To avoid the traumatic disorientation and confusion that can occur at death when the energetic essence and consciousness are involuntarily thrust out of the physical body into unknown territory, we can familiarize ourselves with the "out-of-body realm" by temporarily separating the energy body from the physical body, as a "dress rehearsal" for death.

Consciousness always requires some sort of vehicle to manifest. Its gross vehicle is the physical body. Its more subtle vehicle is the energy body (sometimes referred to as the "subtle" body). We emphasized earlier that the virtues are the true energetic essence of our organs. Although we may identify ourselves more with our physical body than anything else in the world, it is our energetic essence, not our physical body, that survives after death and has the capacity to be immortal.

By regularly turning the awareness inward in the Fusion of the Five Elements practice, we gradually come to know our energetic essences as well as we know our face, our arms, and our legs. We learn to distill these essences into a pearl, as a sort of "space capsule" to carry our essential energy and consciousness out of the physical body. With regular practice, Taoists who follow the path of Inner Alchemy learn to move their energy body and consciousness in and out of their physical body as easily as one might walk from one room into another.

The Inner Elixir and the Outer Elixir

Just as it is important for the physical body to be strong so we can enjoy optimum health, it is also vital to strengthen the energy body so it becomes a sturdy vehicle for our consciousness. Strengthening Chi nourishes our health and spiritual qualities in this life and builds a strong energy body to carry us forth into the "afterlife" (which is, paradoxically, the here and now). We begin to strengthen the energy body through what is called in Taoist Inner Alchemy the

Inner Elixir. It is called the Inner Elixir because we are working with the energies already within our own body and converting them into elixir—like healing essences. Through the meditation practices of the Microcosmic Orbit and the Fusion of the Five Elements, we detoxify, nourish, and integrate the physical body, the energy body, and the emotions.

After we have learned to develop and nourish ourselves through the Inner Elixir, we are ready to tap the Outer Elixir. The energies of the Five Elements also exist beyond the body—the energy of the earth, the Planets, and the stars. This is the true or highest form of the Outer Elixir. Normally, we are incapable of absorbing and digesting the outer energies, but the points of the Microcosmic Orbit are connected to these energies. By opening the Microcosmic Orbit and mastering the Fusion of the Five Elements, we develop the capacity to absorb and digest the energies from these external sources of Five Element Chi.

Once we have purified and transformed the negative energy of the organs back into usable life-force energy (Fusion I), distilled this energy along with the virtue Chi of the organs into the pearl (Fusion II), and opened all our reservoirs or special channels, giving us a larger energetic capacity, we can increase our virtue energies further by connecting with the external sources of Five Elements Chi and directing the external Chi toward its associated organs. Moving the pearl out of the physical body makes it easier for the pearl to absorb these energies. It becomes like an antenna that receives the external Chi and conducts it into the physical body. In this way, we again nourish our health in this life as well at strengthening the energy body and spirit in preparation for the next.

Your Microcosmic Orbit practice will change dramatically after you learn the Fusion of the Five Elements meditations. When you first practice the Microcosmic Orbit, the energy you move through your channels is raw energy. By contrast, when you reach the level of Fusion practice, the energy is more refined and condensed, and it is therefore much more powerful. The Fusion practice includes the Microcosmic Orbit, so it might be said that the Fusion meditation is simply a more advanced way of practicing the Microcosmic Orbit meditation.

Way of Health and Immortality

Each stage of practice, from the Inner Smile to the Greatest Enlightenment of Kan and Li, is a vital step along the way to health and immortality. In fact, the Inner Smile, Microcosmic Orbit meditation, and Six Healing Sounds are used as an essential part of the Kan and Li meditations. So as a beginning or intermediate student in the Universal Tao, you need not be in a hurry to progress, nor do you need to be intimidated by the higher level practices. The most important ingredient in success is daily practice. Soon you will discover that you have mastered the system. Your skills will develop naturally, and you will find it easy to add new steps. One step at a time, you will travel down the road to immortality.

Practice

Microcosmic Orbit:Opening the Heart

This section emphasizes opening the heart and using the virtues of the heart to radiate cosmic Chi (or Higher Self energy) to the organs through the practice of the Cosmic Inner Smile. This is the same as the Inner Smile meditation, but it is more detailed, and more emphasis is placed on tapping into cosmic energy.

A. Preparations

Chi Kung Warm-Ups. Begin by loosening the spine with Chi Kung Warm-Ups: Spinal Cord Breathing, the Crane Neck, the Turtle Neck, Spinal Cord Shaking, and Spinal Cord Rocking.

Six Healing Sounds. Do 2 or 3 repetitions of each sound. Prepare to focus inward. Sit in good meditation position on a chair. Once you are in a good sitting position, take a few minutes to focus and prepare yourself. Become aware of your surroundings. Feel the sensation of your feet touching the floor, of your clasped hands, of the chair beneath you. Be aware of the sounds inside the room, outside the room, and within your body. Be aware of your breath. Feel your body naturally expand as you inhale and contract as you exhale. Breathe in and out with awareness in this way 9, 18, or 36 times. Then rest.

Picture your spine as open and relaxed. As you inhale, imagine you are breathing a white mist from the earth into your spine to purify, cleanse, and brighten your spinal cord. Then breathe the

golden mist of the Cosmic Force into the marrow in the same way. When you exhale, feel that you are breathing out any impurities from the spine as a cloudy gray mist. Repeat this 9 to 18 times.

B. Warming the Stove

1. Practice Bellows Breathing 18 or 36 times. Then activate the kidneys: feel the Door of Life, the kidneys, and the navel warm. Spiral with your hands and body into the kidneys and Door of Life. Activate and massage the sexual organs. Men, massage the testicles to transform sperm back into life-force. Women, massage the breasts to transform the blood (menstruation) into life-force. Inhale into the sexual center, and exhale, condensing the essence of the breath into the sexual center. Pause for a while. Feel the energy expand and radiate outward. Breathe in and out this way at least 18 times.

2. Rest a moment. Feel the navel warm. Feel the kidneys and Door of Life warm. Feel the sexual center warm. As you inhale, feel the sexual organs, perineum, and anus pull up toward the Original Force in the Tan Tien. Lightly push down as you exhale; feel the pressure building at the spot of the Original Force. Picture the Original Force with a mouth and nose, breathing into that spot.

3. Now amplify and feel the pulse in the area of the Original Energy. As you feel the pulse, feel the suction drawing the sexual energy up and combining it with the Original Energy. Feel the energy expanding within you. Spend at least 10 minutes warming the stove in this way. Adjust your breathing to be soft, long, slow, fine, and deep. Breathe in even cycles. The breath should gradually become so fine and light it would not move a down feather placed in front of your nostrils.

Make sure you feel the Original Force activate before going on to the other stages of this meditation.

C. Begin with the Basic Microcosmic Orbit

1. Move the awareness out from the Tan Tien to the navel. Then circulate your energy through the basic Microcosmic Orbit. You can try using the mind alone to guide the energy. If you prefer, you may use any of the previously mentioned ways to enhance the sensation of Chi in the Orbit: rotating, spiraling, touching the points with the hands, Small Sip Breathing, or Internal Breathing.

2. If the energy starts to flow on its own, stop trying to guide it and just allow it to move at its own pace. This is a good sign you have activated the Chi flow in the Microcosmic Orbit.

It is important always to establish the inner structure of the basic Microcosmic Orbit first, to provide a basis for the other energies you bring in through the mote advanced methods of practice.

3. Use the mind/eye/heart power to guide the energy flow through the Microcosmic Orbit 9 to 18 times. When you are ready to conclude the session, bring the energy to the navel and collect energy, letting it return to the area behind the navel and in front of the kidneys to recharge the Original Force.

D. Cosmic Inner Smile

The purpose of the Cosmic Inner Smile is to expand your awareness out to nature, to Mother Earth and the universe, to connect to the unlimited Tao so you can realize your true infinite and abundant essence. But first you have to recognize the basic loving energy already inside you, the feeling of true unconditional love within the microcosm of your heart. Once you have love inside; you can easily connect to the universe.

Simply be aware, and feel the abundant Universal Love above and all around you. Use mind/eye power to draw in and condense this loving energy into the heart or any part of the body. Feel yourself overflowing with Universal Love. When you feel abundantly full, you can give freely to others. Conversely, if you have hatred inside, you will connect to more hatred outside; you will actually attract more negativity.

1. Be aware of the Cosmic Energy in front of you. Be aware of your tongue touching the palate. Smile to the energy in front of you; relax the mideyebrow. Feel the energy smile back to you. Breathe in; draw in and gather the smiling energy in your mideyebrow and mouth. Then breathe out and condense the smiling energy in your mouth until you feel a Chi ball forming and the tongue vibrating, as if electricity were flowing through it. Do this 9 to 18 times.

2. Contract the round muscles of the nostrils, eyes, and anus to amplify the sensation of pulsing and pumping at the mideyebrow. Feel the suction drawing in the golden light of the Cosmic Force. Absorb it into the mouth.

3. Let your smiling energy and the golden light combine and expand in the mouth.

4. Swallow the golden light down to the heart.

E. Opening the Heart

1. To help activate the heart's energy, raise the clasped palms and place both thumbs lightly against the heart's center (Fig. 9.5). Draw more smiling energy from the source in front of you through your mideyebrow. Let it flow like a waterfall down to the thymus gland and into the heart. Smiling to the heart awakens the virtues of love, joy, and happiness (Fig. 9.6). Spend as much time here as you need. Feel your heart relax and expand with loving energy, like a flower blossoming. Remember your best experience of love, whether emotionally or divinely inspired, and fill your heart with that feeling. Love your heart.

The heart is associated with the negative emotional energies of hastiness, arrogance, impatience, hatred, and cruelty. When you smile into the heart, these energies will dissolve, creating the space for the virtuous energies of love and joy to expand.

Fig. 9.5 *Clasp the palms and place the thumbs on the thymus gland.*

2. Do the Heart Sound: ***Hawwwwww***. When you exhale, feel a small flame or fire burning in the heart. After you have completed the Heart Sounds and activated the fire in the heart, the negative energies from all the other organs will come into the heart to be burned out and purified. Do 6 to 9 Heart Sounds (Fig. 9.7).

(If you do not activate the fire in the heart, the energy you subsequently bring into it may jam up, and you may feel a tightness or pain in the chest and have difficulty breathing. Massaging the sternum will help keep the energy from jamming. Be certain to spend enough time generating a strong fire in the heart at this stage.)

3. Rest, and be aware of your loving heart. When you exhale, you may feel a cloudy, dull, dingy-red energy being released. Let any negativity you find in your heart ride out on this breath. At the same time, retain the ruby-red essence lovingly in the heart.

4. Be aware of the Universal Love as a red mist above and around you, the force of the cosmos that corresponds to the positive energy of the heart. Breathe this lovely red healing, nourishing essence into the heart. Feel the heart grow a deeper and deeper red, like a ruby, as it is moistened and strengthened. Smile to the heart. Gradually feel it open like a red rose, giving forth a pure and fresh fragrance of love. At the same time, open the palms and fingers outward like a flower blossoming and opening (Fig. 9.8).

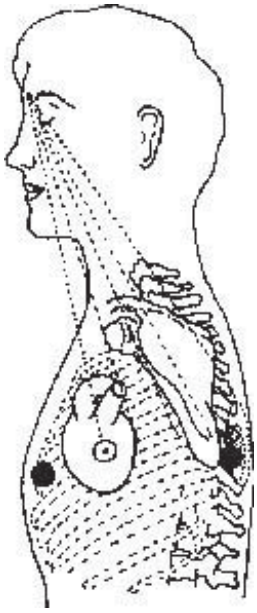

Fig. 9.6 *Be aware of the heart and the virtue energy.*

Fig. 9.7 *Open the mouth and round the tongue down to do the* ***Hawwwwww*** *sound.*

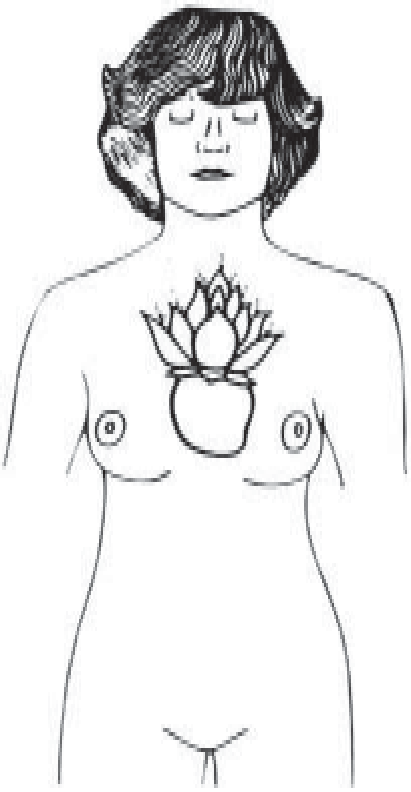

Fig. 9.8 *Feel the heart blossoming like a flower.*

5. Be aware of the small flame in your heart. Feel its heat and light, and let it gradually activate the loving Chi of the heart: joy, happiness, respect, and humility.

Inhale and draw more Universal Love from above you into the mouth and heart. Exhale, and condense this energy into the heart. Relax, and let the unconditional love expand and radiate. Do this 9 to 18 times, until you feel so much love within you that the love from your heart starts to overflow.

6. Let the love in your heart radiate to the lungs. Smile to the lungs until you feel them smile back to you. Be aware of the Universal Love around you and continue drawing it into the heart. Condense it into the heart and let it radiate and overflow out to the lungs. Completely fill the lungs with love and smiling energy. Feel the lungs glowing bright white, filling with courage.

7. Continue to radiate loving smiling energy down to the liver and gall bladder in the same way. Feel abundant kindness above and around you. Breathe in the kindness as a bright green mist into the liver and gall bladder. Condense this healing light energy into the liver and let it expand and radiate.

8. Continue down to the spleen and pancreas. Activate the feelings of openness and fairness of the spleen and pancreas. Fill the spleen and pancreas with loving, smiling, bright-yellow energy.

9. Continue down to the kidneys and bladder. Activate the feeling of gentleness within you. Fill the kidneys with gentleness, and with loving, smiling, bright-blue energy.

10. Be aware of the rainbow colors of love, kindness, and gentleness energy above and around you. Breathe in the rainbow light and draw the deepest state of love, peace, or bliss that you can imagine into the heart and all the organs. Breathe out and feel yourself absorb and condense this energy and these colors into each organ, filling every cell of your body with bliss and peace.

If you want to amplify the energy, hold the hands out with the palms facing the heart, left palm on the inside. Do this 9 to 18 times (Fig. 9.9).

11. Strengthen the heart by repeating these affirmations to yourself: “Respect. You lose nothing; eventually you will gain everything.

Disrespect. You gain nothing; eventually you will lose everything.” “Humility. You lose nothing; eventually you will gain everything. Arrogance. You gain nothing; eventually you will lose everything.”

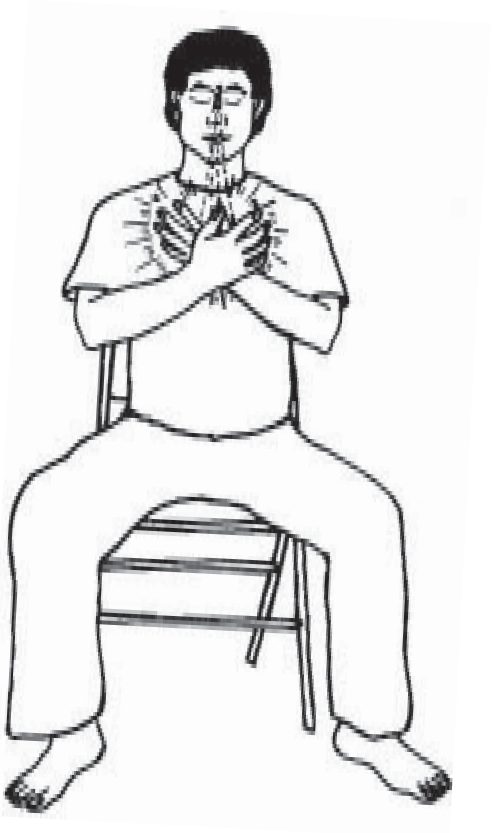

Fig. 9.9 *Face the palms toward the heart to help amplify the energy.*

F. Helping the Inner Peace Expand and Grow: Sending Love to Your Loved Ones

1. Hold the palms together near the heart's center. Picture a quiet, peaceful setting, like a beautiful sunset on a beach. Try to imagine the energy of that place, and gather it in front of you. Recall a pleasant experience from your past, or a feeling from a good dream or fantasy.

2. Once you feel your heart overflowing with love and peaceful feelings, recall your loved one. Let him or her take form in front of you. Smile to your loved one until he or she smiles back to you. Let your heart radiate unconditional love to your loved one.

Then continue to breathe peacefully. When you exhale, let the love radiate to your loved ones, your friends, your neighbors. Each

time you inhale, expand the loving and peaceful feeling, and each time you exhale, send it out to the ones you love, the people you come in contact with daily.

3. Feel your loved one fill with your love. Gradually let your loved one rise higher and higher until he or she finally disappears.

G. Loving Your Enemy

When you have little love within you, it is hard to give love to both your loved one and your enemy. When you can connect to the Universal Love and link it to your heart, you will begin to have enough love to give others. You can gradually expand it further; let your loving heart energy radiate to those you hate, to the people who create trouble and obstacles in your life.

Generate the energy of forgiveness. Forgive each one, and hold him or her in your heart. In this way you are connecting to your higher heart, the Middle Tan Tien, the seat of unconditional love. Feel this love radiating through your own body and beyond. Feel the connection of those you dislike to the higher heart energy, the same place that yours comes from (Fig. 9.10).

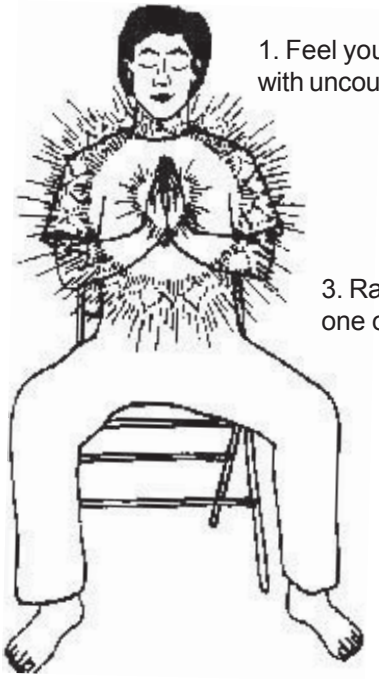

Fig. 9.10 *Love your enemy.*

1. Let the one with whom you have conflict take form in front of you. Smile to him or her, and radiate love and peace to this person.

2. Ask him or her what you can give to make both of you more balanced. Breathe in the first color or thought form that comes into your mind, and let it radiate to this person. Let the color fill both of you so you are both vibrating in the same color. This color may be what has been lacking, the source of what is causing the two of you to be in conflict.

3. Breathe, condense, and draw more loving energy into the heart. Let your heart radiate unconditional love to this person. Every time you inhale, draw in more loving and peaceful feelings, and every time you exhale, send it out to him or her. Gradually you will feel the conflict between you start to dissolve, and you will feel you understand the person better.

4. Feel him or her fill with your love. Gradually let this person rise higher and higher, until he or she finally disappears in space.

5. Once you can dissolve these knots inside yourself, observe this person in real life. You will notice him or her beginning to change. Sometimes you will need a few more repetitions of this exercise to untie the knots inside you and between you. When you feel him or her change, it will be easier to find a time to sit down to talk and dissolve the differences.

H. Middle Line and Back

Next, let the smile and loving energy flow through the digestive tract. Then let the golden light of your Cosmic Inner Smile flow to the brain and down the spine. Finally, after letting your healing smile flow to anyplace in the body in need of loving and smiling energy, smile to the navel and Tan Tien.

I. Stabilizing the Middle Tan Tien: The Cauldron at the Heart

1. Use smiling energy to activate the cosmic golden light energy. Breathe in through the mideyebrow and let the golden light radiate down to the heart. Use mind/eye/heart power to spiral the heart's energy of love, joy, and happiness 36 times clockwise out from the heart center and 36 times counterclockwise in toward the heart center (Figs. 9.11 and 9.12). Cross the hands, palms facing outward,

to help radiate the heart energy (Fig. 9.13). Rest for a while and feel the heart expanding and contracting (Fig. 9.14). Be aware of both the cosmic golden light mixing in the mouth and the golden cord connecting the mouth to the heart.

2. Smell the sweet fragrance of love, purity, joy, and happiness radiating from the heart.

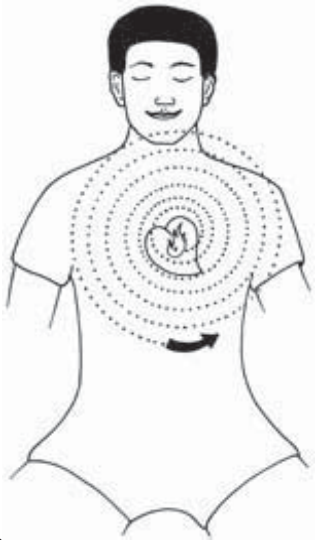

Fig. 9.11 *Use the mind/eye/heart power to spiral the heart energy and to the help open the heart.*

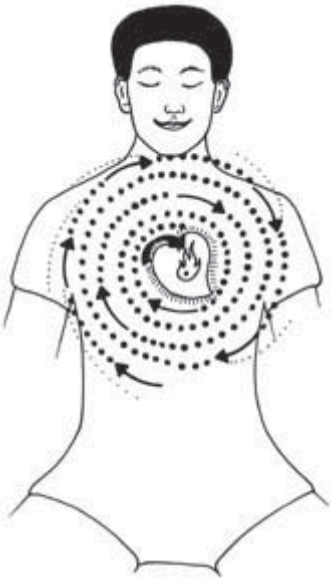

Fig. 9.12 *Continue to the mind/eye/heart power to spiral the energy and to help open the heart more.*

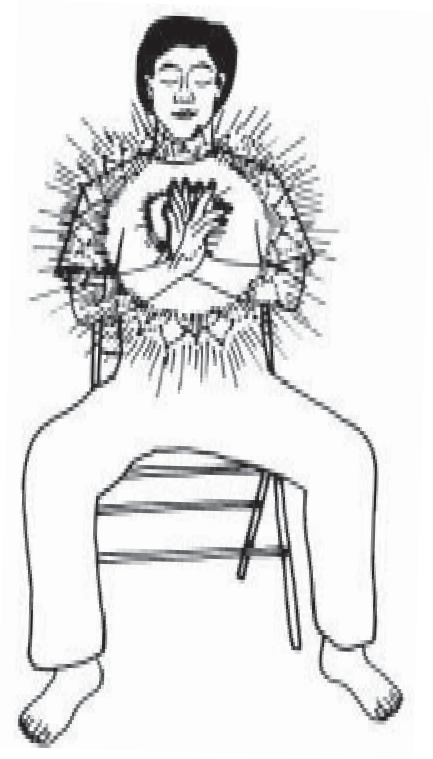

Fig. 9.13 *Cross your hands to help radiate heart energy.*

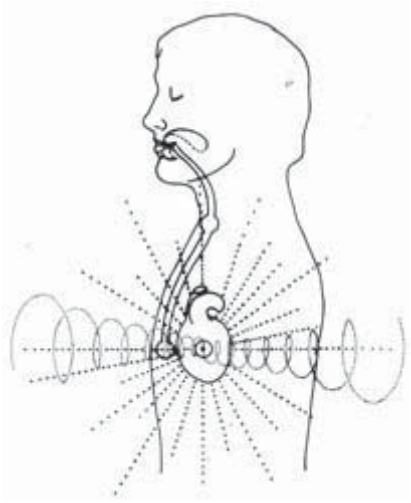

Fig. 9.14 *Feel the heart expanding, contracting, and radiating love.*

J. Love and Sexual Energy Combine as One

1. Be aware of the heart and sexual organs. Smile to the sexual organs, and feel your sexual energy activate. Recalling a good experience of love and sex can help you increase the orgasm feeling. At the same time, feel the love in your heart.

2. Inhale more love, joy, and happiness into the mid-eyebrow, mouth, and heart.

3. Exhale to the sexual organs and condense the loving energy together with the sexual energy. When you relax, the energy will expand, feeling as if it is exploding there. Feel the loving fire combine with the dense and watery sexual desire. The fire will not dry up the water, nor will it let the water sink or leak out. Feel the sexual energy become light with life, joy, and a peaceful orgasmic feeling (Fig. 9.15).

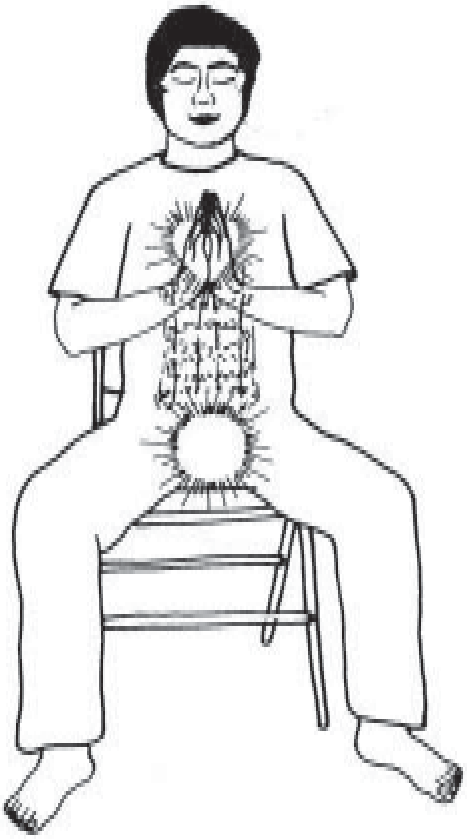

Fig. 9.15 *Combine the loving energy and the energy of sexual desire.*

4. Repeat 9 to 18 times, feeling the tremendous amount of orgasm and bliss inside, as the loving energy of the heart and the watery sexual energy combine within you. Let this energy expand like steam through the whole body and up to the crown.

5. Extend out and connect to the cosmic energy of your Higher Self. Become aware of your cosmic orgasm (the combination of love, sexual energy, and cosmic energy) or bliss above and around you. Breathe the blissfulness into the heart, the sexual organ, and the whole body. Let every cell fill with the energy of the cosmic orgasm. Love and sex ate the most basic energies of life.

6. Now breathe the blissful energy into the mouth and body. Exhale and condense it down into the Original Force behind the navel in the Lower Tan Tien. Relax and let the energy expand inside you. It will radiate to wherever your body needs it.

7. Repeat 9 to 18 times, until you feel the Original Force combining with the cosmic orgasm and expanding inside you.

K. Connecting the Middle Elixir Field and the Lower Elixir Field

1. Keep the left palm on the heart's center and move the right hand to the lower abdomen with the palm up, just below the navel. Inhale naturally, and feel yourself breathing into the heart's center. When you exhale, feel the energy of the breath drop to the Tan Tien.

2. Now focus on breathing in a golden mist through the mid-eyebrow down to the heart. Exhale, and condense the energy down to the Tan Tien. Follow your natural breathing patterns; do not force the breath or any movement of energy. With each breath, you are extracting and retaining the essence of the vital energy of life for the use of your body. Do this from 9 to 18 times.

3. Rest, and feel the Middle and Lower Elixir Fields open and connected (Fig. 9.16).

4. This time, when you inhale, feel the breath rising from the lower abdomen to the heart center. Then, when you exhale, send it from the heart center down to the Tan Tien. Use the breath to purify the space between these areas. Follow your natural breathing patterns without using any force. Use the power of the mind, eyes, and heart to direct the current of life-force within the body. Do this from 9 to 18 times.

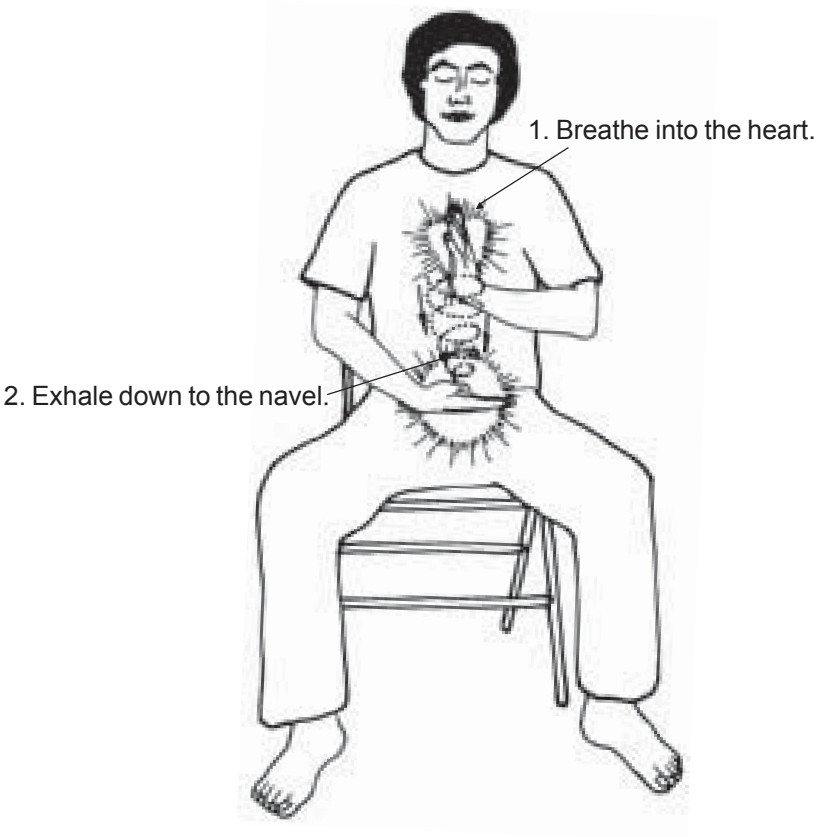

Fig. 9.16 *Connect the Middle and Lower Tan Tiens.*

5. Rest in the Original Force at the Lower Tan Tien. Feel the sensations of expansion, energy, lightness, peace, and balance.

L. Connecting to the Energy of Mother Earth

1. Place the hands at the sides with the palms facing down toward the earth, and be sure that the soles are flat against the ground. Be aware of the Hui Yin point at the perineum. After a short time, you will begin to feel the palms and soles breathing by themselves. At the same time, you will feel the vagina or scrotum and Hui Yin point starting to naturally pull up and release in a pumping or pulsing action in time with your breathing. Do this 3 to 9 times. Then exhale and rest.

2. Now focus the mind about 95 percent on the Original Energy behind the navel, and about 5 percent on the Five Gates (perineum,

palms and soles). Feel yourself grounded; feel connected to the earth. Just relax, and you will feel pulsing again. Let it come in and up. Feel the suction; feel the gentle blue Earth Energy drawn in through the Five Gates pulse in the navel.

3. Feel the Chi ball growing and expanding, filling the whole region between the navel, the kidneys, and the sexual center. Your navel is connected to the earth now; your body feels connected to the body of Mother Earth. Feel the Mother Earth energy strengthening the stove at the Tan Tien and enhancing the Original Energy there.

M. Activating the Cosmic (Higher Self) Chi

1. Breathe into the mideyebrow point. Feel it open as you exhale. Repeat this 3, 6, or 9 times. Make sure you feel it open before you go on to the next step.

2. Be aware of the Original Energy behind the navel. Feel the Original Energy activate, and feel the suction there. Simultaneously be aware of the mideyebrow point pulsing and activating on its own. Feel the golden light coming in. Now project the awareness out to a favorite place in nature: a lake, an ocean, a forest, a waterfall, a mountain, or a grotto. As you picture them, you will feel the Higher Self Force come to you from them, like a benevolent and refreshing golden mist of light.

3. Now breathe the energetic golden light down into the mouth. Condense and form a golden ball of Chi energy there. Do this a few times until you feel the tongue has an electrical charge. Breathe and merge the golden light with the saliva. Notice how the saliva changes. It may become very rich, sweet tasting, alive, and charged with life-force (Fig. 9.17).

4. Swallow the saliva, and, with the mind, follow the pathway of the golden light downward. Picture the golden light flowing through the throat center to the heart and navel and around the perineum to the coccyx. Then feel it flow up the spine to the crown, and from the crown back down to the mideyebrow. Let it continue to flow through the Microcosmic Orbit pathway. Feel the ball of light gradually expand until it covers your whole body. Feel it energize and protect you.

The Taoist way is not to worry about the whole world, but simply to concern yourself with the people and things around you. Make sure the people who are part of your life can feel your loving en-

ergy, rather than spreading your love so thin that nobody can feel anything,

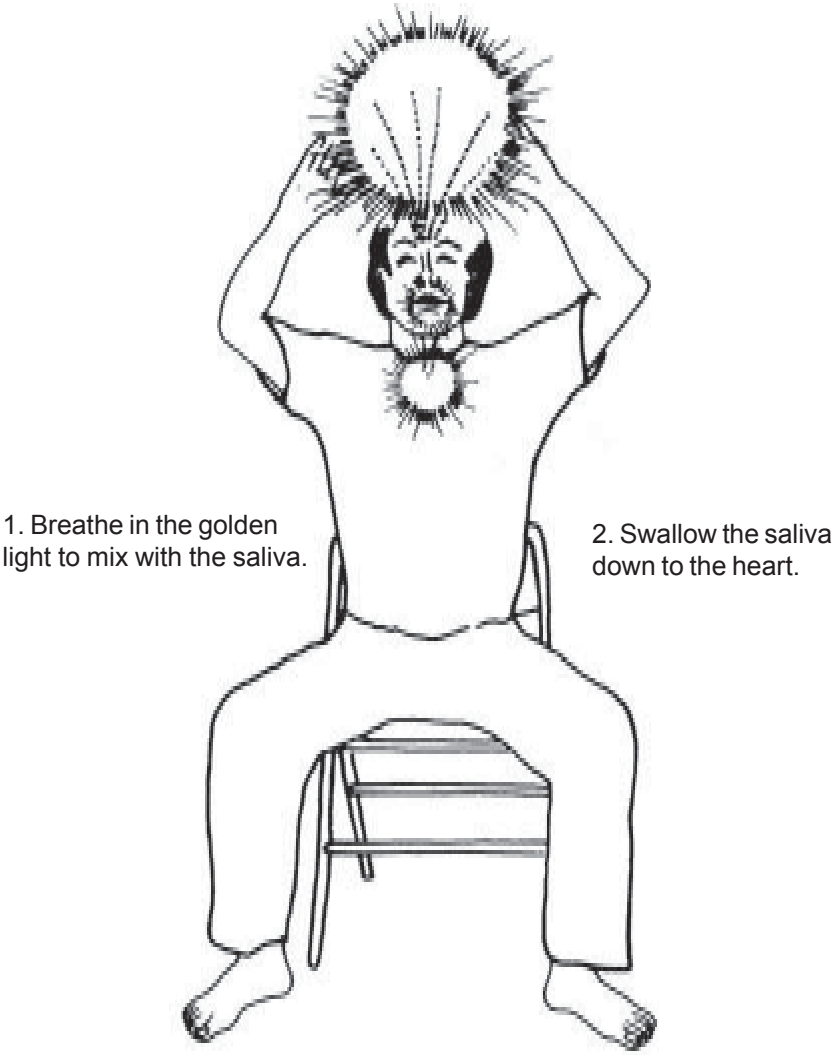

Fig. 9.17 *Swallowing the golden light and the saliva.*

N. Ending the Meditation: Collecting Energy at the Navel

1. Place both hands over the navel. Continue to focus the mind on the Original Energy behind the navel. Rest, and enjoy this feeling of being relaxed in body and mind, yet energized at the same time.

2. Conclude the practice by spiraling outward 36 times at the navel and then inward 24 times to finish collecting the energy.

3. Finish with Chi Self-Massage.

A Loving State

Remember the feeling of this practice. If at any time in your daily life you should feel down or depressed, impatient or hasty, anxious or afraid, frustrated or angry, you can recall the feeling and experience from your practice of Opening the Heart. Be aware of your heart, and feel the flame burning out any impatience or hastiness and generating joy and happiness. In just a few minutes, you will feel that you have more energy and Chi. The success of this method of recalling depends on your daily practice. The more you practice, repeat, enhance, and remember it, the more easily you can enter a loving state. This is the easiest way to cultivate Chi.

Practice at this stage for at least 1 to 2 weeks before going on to the next stage.

Chapter 10
Sexual Energy and the Microcosmic Orbit

Since the early Han dynasty (206 B.C. to 220 A.D.), Taoists have known that sexual energy, Ching Chi (or simply "jing"), has tremendous creative rejuvenative powers. Not only did they acknowledge that sexual energy is the foundation of human life, but they also observed that sexual energy is the wellspring of creative genius, drive, and self-healing power. They believed, with good reason, that mastery of the Tao of the bedroom arts could lead to happiness for both sexes, as well as improved health, longevity, and even immortality.

There were many references in the Han literature and thereafter to men who had mastered this art and lived in robust health to the ripe old age of l50 or more. In China, longevity has always been much sought after, for in Chinese society, as people grow older, more respect is paid to them. If one stayed healthy and fit, becoming elderly could be a great joy, the best time of one's life. The Chinese were particularly inspired by the example of the legendary Yellow Emperor, Huang Ti. Huang Ti is regarded as the sage-father of Taoism and of Chinese medicine because of his early and profound observations on medicine and physiology. He wrote them down in the famous Huang Ti Nei Ching (The Yellow Emperor's Classic of Internal Medicine), which after several millennia is still revered as the basic textbook for Chinese medical studies. In addition to his medical pursuits, Huang Ti was also intensely interested in the Tao of Love. According to the famous Han dynasty Chinese historian Ssu-ma Chien, Huang Ti held the throne for one hundred years. During this time, he intensively practiced the Tao of Love without emission, and as a result "ascended into Heaven in broad daylight as an Immortal." In an early Taoist sexual manual, Peng Tzu is quoted as saying, "The Yellow Emperor made love with control, and ascended as an Immortal, while normal people make love without control and only shorten their lives as a result. If a man loves the beauty of women and ejaculates frequently, he will damage his body and encounter all kinds of diseases. By doing this, he is actually seeking death."

Following Huang Ti's example, Taoists desiring to attain longevity and immortality have practiced making love without emission. They have studied the ancient sexual manuals of the Plain Girl, the Select Girl, and the Dark Girl, which describe Huang Ti's conversations with three women sexual initiators into the Tao of Love. These and other early Taoist erotic handbooks were generally kept secret; they were reserved for rulers and initiates who would use the heightened power gained through mastery of their sexual energy to increase their wisdom, compassion, and justice.

Sexual attitudes have changed since those times. Beginning in the 1960s, many people in the "baby-boomer", generation broke free from sexual repression and traditional values and explored the length and breadth of sexual freedom and liberation. After a time, what seemed to be lacking for many was not simply more new sexual partners but a strong spiritual basis for life, love, and relationships. AIDS, herpes, and other hard-to-cure venereal diseases have encouraged a fresh look at the advantages of monogamy. During this period, many people have also become aware of what the East has to teach about reconciling their sexual desire with their yearning for spiritual development.

The West has benefited the East, too. My master, I Yun, encouraged me to study Western anatomy and physiology to bring the ancient Taoist teachings up to date with modern discoveries. Natural science and the Tao do not conflict; the ancient Taoists were scientists who closely observed nature. They made great discoveries in the fields of astronomy (one of the world's first accurate calendars), chemistry (gunpowder), and biology (the circulation of blood) centuries before similar discoveries were made in the West. Now the world is more open; the time for secrecy is past. East and West can share their knowledge for the benefit of all the people on earth.

Abundance of Sexual Energy

The human body goes to great efforts to keep us in a state of reproductive readiness, with the amazing power to create new life on a regular basis if we so desire. In the average male, each ejaculation of semen contains 200 to 500 million sperm cells, and every one of them has the potential to become a human being. Add to this the fact that most men ejaculate thousands of times in their

lives, and the potential becomes astronomical. With one ejaculation, if every sperm cell met a willing egg, one man could repopulate the entire United States. With twenty ejaculations, that same man could become the father of the entire world's population!

Women are born with a store of 450,000 to 700,000 eggs. During their fertile years of menstruation, between 360 and 450 eggs make their way out of the ovaries in their journey down the Fallopian tubes to the uterus. On its trip to the womb, the egg may encounter a sperm cell and be fertilized. If no fertilization occurs, the uterine lining is sloughed off, and the egg and lining passes out with the menstrual blood once a month.

Importance of Conservation

Despite the body's extravagant reserves of trillions of sperm cells and hundreds of thousands of eggs, it is rare for a man and woman to produce as many as a dozen offspring. If nothing is done with the rest of the reproductive Chi, it is simply lost. Some may argue that this is the way of nature, but to the Taoist, whose goals are longevity and immortality through the transformation of the abundant supplies of energy within the body, the indiscriminate loss of one's rich reserves of Ching Chi is a tremendous waste.

Thus, for the past several thousand years, Taoists have developed and practiced ways of conserving Ching Chi. But Ching Chi is not simply hoarded; it is masterfully recycled, returned as a powerful nutrient to enrich both body and spirit. The major pathway for this recycling process is the Microcosmic Orbit.

Healing Love Through the Tao

In the Universal Tao system, the main applications of Ching Chi are improving physical and mental health, harmonizing and enhancing sexual relationships, and nourishing spiritual growth. This body of practices is called Healing Love Through the Tao, or Seminal and Ovarian Kung Fu. "Kung Fu" literally means skill or ability gained through hard work and discipline. Healing Love Through the Tao offers rewards that can transform your life beyond your wildest dreams, but you have to study, strive to understand what you have learned, and then practice hard if you want to reap those amazing benefits (Fig. 10.1).

Fig. 10.1 *Healing Love with couple.*

Before starting Healing Love, it is absolutely necessary that one first learn how to circulate the basic life-force Chi through the Microcosmic Orbit. Once the Orbit is opened, practicing Healing Love methods further opens the Microcosmic Orbit by circulating Ching Chi through the same pathways. The Microcosmic Orbit practice is also accompanied by the meditations of the Inner Smile and the Six Healing Sounds. All three meditations are emphasized throughout the Taoist system, and their mastery is essential to the successful practice of Healing Love. People who rush to practice sexual cultivation techniques motivated by sexual lust alone may endanger their physical and emotional health if they do not first accomplish these preparatory practices that clear the energetic pathways of the body and mind.

The two pillars of Healing Love are conservation and transformation. Although the principle of conservation applies to both men and women, the actual practices of conserving sexual energy dif-

fer. The main way that men lose sexual energy is through ejaculation. Women, by contrast, lose little sexual energy through orgasm, but instead lose Ching Chi primarily through menstruation and childbearing.

In both men and women, the major loss of Ching Chi occurs when the sperm cells or egg actually leave the body. Therefore, to conserve sexual energy, the Healing Love practices emphasize retaining the sperm and egg except when procreation is desired, and learning to reabsorb, transform, and recycle the Ching Chi of the egg and sperm. Several practices help accomplish this process.

Western folk wisdom has long agreed with the Taoists regarding the importance of conserving sexual energy. For example, most athletic coaches caution their athletes to refrain from sexual activities before an important competition or game. Similarly, in his famous book *Think and Grow Rich*, Napoleon Hill devotes an entire chapter to the necessity of conserving sexual energy to achieve great success in life.

Nonetheless, until recently Western biologists have clung to the belief that male sperm are produced relatively easily and "cheaply" by the body, with no significant drain produced through frequent ejaculation. This dogma was solidly challenged by recent scientific research reported in the December 3, 1992, New York Times by Natalie Angier. A scientist studying worms found that the simple act of making sperm substantially shortened the male worm's lifespan. Wayne A. Van Voorhees, a graduate student researcher at the University of Arizona in Tucson, discovered that male nematodes live much shorter lives than their mates and traced that discrepancy directly to sperm production.

When he experimentally altered the male worms so that "they lost their capacity to make sperm while retaining their taste for intercourse, the altered nematodes lived at least 50 percent longer than the normal, fertile males. The results suggest that creating sperm is far more difficult than scientists had imagined, demanding a diversion of resources that might otherwise go into ensuring a male's long-term health." Commenting on this study, other scientists maintained, according to the report, that it is possible "at least a fraction of the difference in life span between men and women just may be linked to sperm production," noting that women, on average, live about six years longer than men.

The study found that normal male worms prevented from mating lived about 11.1 days. Males allowed to mate at will, a state requiring steady sperm production, lived only 8. 1 days. But the altered males, freed from the demands of sperm production and allowed to mate as they pleased, survived almost 14 days. Hermaphrodite worms, which normally produced both eggs and sperm, lived an average of 11.8 days regardless of how much sex they engaged in. However, the altered hermaphrodites, still producing eggs but not sperm, lasted 19 days.

Although scientists aren't certain how much of the worm research applies to humans, over the past four thousand years Taoist masters have devised time-tested methods of making love without emission. The research suggests Taoist methods of conservation are far different than suppression of sex promoted by celibate priests, monks, and nuns of many religions. While Taoists are renowned for their longevity, celibate monks and nuns are not generally long-lived. One recent study found celibate Catholic priests experienced a 300 percent higher rate of prostate cancer than the normal population, indicating, from the perspective of Taoist medical knowledge, the adverse effects of "stagnant Chi."

Testicle and Ovarian Breathing

Healing Love practices of Testicle and Ovarian Breathing teach one how to recapture and recycle Chi that has gone into the reproductive system, returning it to nourish the rest of the body before it is lost through menstruation or ejaculation. This energy can heal the organs and glands, strengthen the brain, bones, and nervous system, energize the body, and further open the Microcosmic Orbit. Women often report great relief from symptoms of premenstrual syndrome (PMS), as well as lighter, shorter, and less painful periods. Since Testicle and Ovarian Breathing, recycle the Chi of the sperm cells and eggs, it is important to suspend the practice if procreation is desired. A high level of mastery offers a noninvasive form of birth control. Men should read *Taoist Secrets of Love* (Aurora Press, 1984) and women can read *Healing Love Through the Tao* (Universal Tao Books, 1986) to get the full details on these and other sexual techniques listed in this chapter.

Scrotal and Ovarian/Vaginal Compression

The practice of Scrotal and Ovarian/Vaginal Compression uses special breathing and muscle contractions to pack fresh Chi into the reproductive organs, which strengthens, energizes, and flushes the entire area. Regular practice can reduce mental problems. In men, it strengthens the prostate and testes; in women, it strengthens the ovaries and cervix and increases the power of the vaginal muscles.

Egg Exercise for Women

Many women today have never experienced an orgasm. According to recent sexual research, vaginal muscle tone, particularly that of the pubococcygeal muscle (PC muscle), is directly related to orgasmic potential. In one experiment, doctors measured the clenching power of the PC muscle and compared it with orgasmic ability. Totally nonorgasmic women registered a pressure of an average of 7.43 mmHg (millimeters of mercury) on a Kevel perineometer, whereas ditorally but not coitally (vaginally/G-spot) orgasmic women measured 12.31 mmHg. Women who were both culturally and capitally orgasmic measured 17 mmHg.

In the Universal Tao, women can strengthen their vaginal muscles with the Egg Exercise. The Egg Exercise involves inserting a small jade egg into the vagina and learning to tighten the vaginal muscles to move the egg around. Developing the vaginal muscles not only increases a woman's orgasmic capacity, it also increases her male partner's pleasure. In the harems of the ancient emperors of China, the queens and concubines who learned the Egg Exercise from their Taoist physicians kept it a closely guarded secret, for it improved their ability to please the emperor. Becoming a favorite consort raised a woman's rank and standing among the many concubines in the harem. All other factors being equal, those who had mastered the Egg Exercise (Fig. 10.2) had a definite edge on the competition.

In addition to its benefits in the boudoir, the Egg Exercise is a marvelous exercise for health. When one strengthens the ability to pull energy up, one can then draw more healing Mother Earth energy and sexual energy upward to balance and strengthen all the systems of the body. The Egg Exercise is also used as an aid in Ovarian

Breathing, the Orgasmic Upward Draw, and Bone Marrow Nei Kung to increase the marrow.

Orgasmic Upward Draw

Although this description confirms that the very nature of sexual arousal gathers and focuses the Chi (electrical energy) of the body, Reuben goes no further than a discussion of what Taoists refer to as "genital orgasm." Taoists say that orgasm energy is the best distillation of the body's essences, drawn from all our organs, glands, and cells by the amazing electrochemistry of the arousal process. The body thinks we are going to create new life, a child, so it releases its premium energies to start that new life. But for most people these days, the sexual act is usually aimed at recreation, not procreation. In ordinary sex, this energy is directed toward the genitals and then simply lost in what we call an "outward pour" orgasm. Men lose far more energy than women in the sexual act, but both men and women ordinarily release energy at orgasm. Taoists recognize the tremendous opportunity for inner alchemical cultivation during sexual arousal. The Taoist orgasm takes this intense focus of energy that has been drawn to the sexual organs and spreads it throughout the body. With this sexual "electricity," many other centers in the body are activated and revitalized. This is called an "inward pull" orgasm, achieved by the Orgasmic Upward Draw.

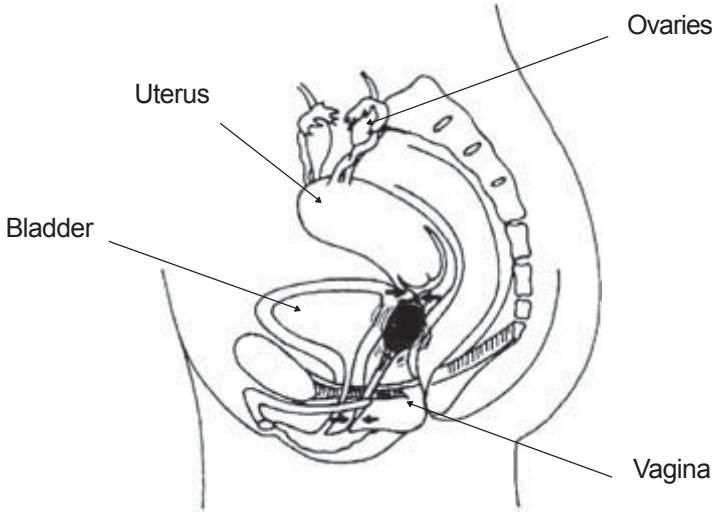

Fig. 10.2 *Egg Exercise.*

In the practice of the Orgasmic Upward Draw, all the Chi and hormones activated and released during sexual arousal are recaptured and circulated throughout the body. This shifts the orgasmic experience from a localized genital "outward pour" orgasm to a total-body "inward pull" orgasm. The inward-pull orgasm is more intense, blissful, and longer lasting. It enlivens and nourishes every system of the body, especially the brain, sensory organs, nervous system, and internal organs and glands (Fig. 10.3).

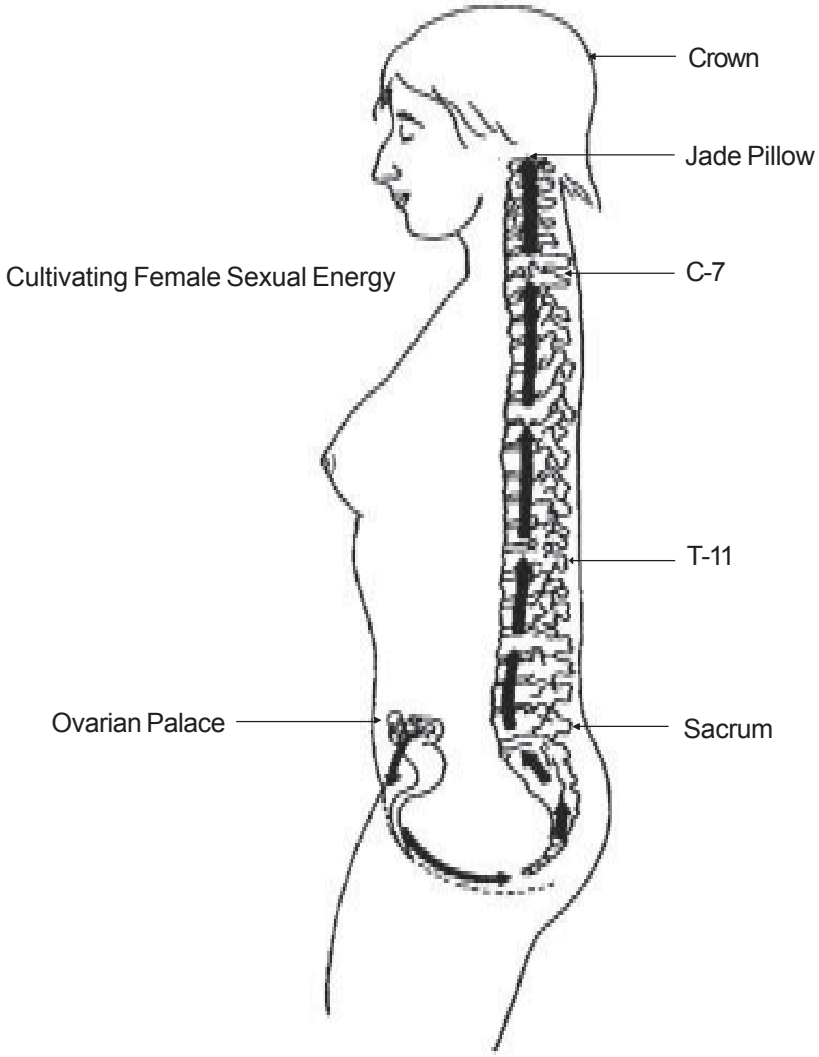

Fig. 10.3 *Orgasmic Upward Draw.*

Controlling aroused sexual energy is like trying to control a team of seven wild horses. Therefore, one usually practices the Orgasmic Upward Draw as a solo practice first. Once one has learned how to control one's powerful aroused sexual energy, one can use the same techniques when making love with a partner.

Dual Cultivation

Harmonizing Sexual Relationships

Male belongs to Yang.

Yang's uniqueness is that he gets aroused quickly,

But he also quickly retreats.

Female belongs to Yin.

Yin's uniqueness is that she is slower to be aroused,

But she also is slow to retreat.

—Wu Hsien, Han Dynasty Taoist

Balancing Kan and Li (Water and Fire, male and female) on the sexual level. Taoists say men are naturally Yang and are like fire: quick to get hot and quick to burn out. Women are naturally Yin and are like water: slow to bring to a boil, but once hot, they hold their heat for a long time. The art of Healing Love balances Yin and Yang so that both partners are totally satisfied.

In Dual Cultivation (practice with a partner), the first goal is to control male ejaculation. A man's ability to make love more frequently and for longer periods of time not only increases his pleasure but enhances his ability to satisfy the woman. The second goal is for the woman to become fully aroused and orgasmic. The couple must support each other to achieve these goals.

Intimacy and the exchange of Yin and Yang in the Microcosmic Orbit. Because men are more Yang and women are more Yin, they can help bring each other into better balance through exchange of their Chi during lovemaking. To do this, both partners need to have opened their Microcosmic Orbit as the first step toward balancing the Yang channel in the spine and the Yin channel

running down the front of the body. Then during their lovemaking, a man and a woman can circulate their aroused Chi through their own and their partner's Microcosmic Orbits.

If both partners have opened their Microcosmic Orbits, the natural polarity between man and woman is greatly amplified and the energetic flow much more powerful, because these two master channels feed all the vital organs and their associated meridians. This balancing and nourishing exchange of Yin and Yang energies is the heart of the Healing Love practice and is part of what eventually leads the dedicated student beyond sexual pleasure to longevity and immortality (Figure 10-4).

When you can open and receive the loving energy of your partner, and in turn have your partner open to receive your energy, you will experience a blending and intimacy unlike anything you have known before. You will grow to love each other more each day, and your mutual love will enrich those around you. In this way, sexual love blossoms and matures into a deeper, spiritual love.

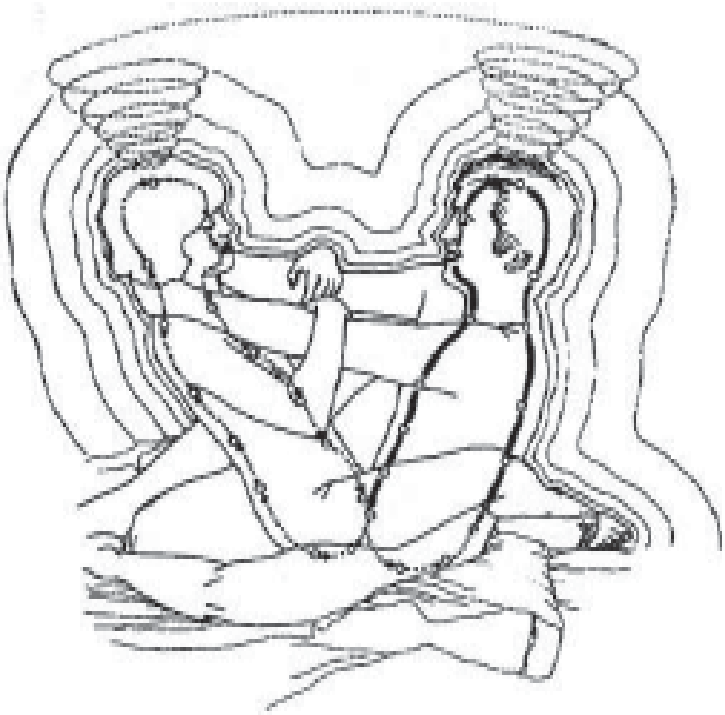

Fig. 10.4 *Yin and Yang sexual energy exchange.*
Dual Cultivation and Spiritual Development

Spiritual development is directly related to emotions and attitudes. As we have already mentioned, the emotions are housed in the bodily organs. Through the Inner Smile, the Six Healing Sounds, and later in the meditation of the Fusion of the Five Elements, we can learn to get in touch with our emotions at their source, our internal organs. We can then process, release, and transform our negative emotions and nourish our positive, constructive, and wise emotions.

The term Dual Cultivation is also used in ancient Taoist texts to describe a single person cultivating his or her dual Yin and Yang sexual energies. This kind of higher internal practice, known as the Alchemical Marriage, or self-intercourse, is covered in the chapter on Kan and Li.

The multiplying power of sexual energy. Healthy sexual union is often called "making love," and from the Taoist point of view; that is exactly what we are doing. Sexual energy is creative energy; it has the ability to multiply other energies exponentially. At conception, Ching Chi activates the initial two human cells-one egg and one sperm-to multiply into the trillions of cells that make up a mature human.

Just as it stimulates multiplication on a cellular level, our Ching Chi or sexual energy expands and intensifies our emotions and attitudes. This is why sexual pleasure is popularly considered the highest bliss known, and why the feeling of "being in love" is so intense and all-encompassing. On the negative side, it is also why lovers' quarrels are the most intense, and why so much fear, frustration, anger, worry, and depression often surround sexual performance. Many murders are related to the sexual issues of rape, jealousy, infidelity, and marital frustration and resentment stemming from sexual dissatisfaction.

Therefore, in Taoist Dual Cultivation practices, it is important to first dissolve and cleanse the organs of any negative emotions. Using the skills developed through the Inner Smile, Six Healing Sounds, and Fusion practices, one connects with the positive virtue qualities of one's spirit expressed through the organs. The sexual energy is then drawn up into that organ, and the effect is like throwing gasoline on a fire: the sexual energy takes the positive virtue quality being expressed by the organ and expands it manyfold. This multiplying ability can transform individual love into love for all creation. With practice, we can raise our virtues from an ordinary level

to the transcendent level of those of a saint or an immortal. This is the highest purpose to which we can direct our sexual energy-the goal of enlightenment.

Dual Cultivation and Sexual Healing

Throughout the ages, Taoist physicians have prescribed certain lovemaking postures and techniques for healing various ailments and for tonifying specific systems in the body. Some positions are more beneficial for the man, others for the woman, and still others are equally beneficial for both. In general, one partner is active while the other partner is passive. The active partner passes healing energy to the passive one.

These positions are described in detail in the *Su Nu Ching (The Book of the Plain Girl).* Several of the important postures are included in *Healing Love Through the Tao: Cultivating Female Sexual Energy.*

The *Su Nu Ching* does not go into detail about the circulation of energy in these positions. Once you learn how to control and direct your sexual energy through Testicle and Ovarian Breathing and the Orgasmic Upward Draw and have learned how to circulate and exchange it with your partner, the positions are not crucial. Energy can be directed at will, using mind power alone, to whatever place needs healing in your partner or yourself, regardless of position.

Sexual Energy, Tai Chi Chi Kung, and Iron Shirt Chi Kung

It is difficult to have a fully satisfactory sex life if you are not physically fit. Iron Shirt Chi Kung I and Tai Chi Chi Kung help strengthen not only the muscular system but also the skeletal, endocrine, digestive, cardiovascular, excretory, urinary, integumentary (skin), and nervous systems. By frequently exercising the perineum and anus, Iron Shirt Chi Kung builds and tones the love muscles in the pelvic floor, making it easier to accomplish the Orgasmic Upward Draw.

With regular practice of Tai Chi Chi Kung and Iron Shirt Chi Kung, greater amounts of Chi are generated, absorbed, and circulated. One feels fit, powerful, full of Chi energy, and unencumbered by physical weakness. With greater stamina, sensitivity, and flexibility, one is physically able to experiment with more postural varia-

tions in lovemaking, increasing the opportunities for new and undiscovered pleasures. Each practice brings a unique variety of energy—Earth, sexual, and vital-organ Chi—into the Microcosmic Orbit.

Even a physical disability need not be an obstacle to exercise; one can still exercise to the fullest extent possible. A well-known Tai Chi master once commented, "Anyone who is still breathing and is conscious can benefit from Chi Kung practice!"

Sexual Energy and Bone Marrow Nei Kung

Bone Marrow Nei Kung focuses on the relationship between the sexual energy and the skeletal system, which has long been acknowledged in traditional Chinese medicine. Bone Marrow Nei Kung strengthens the reproductive organs and releases Ching Chi and sexual hormones throughout the body. This energy is captured and stored in the bones.

Sexual Energy Massage

Massage is beneficial for every part of the body, including the reproductive organs. Regular Sexual Energy Massage stimulates the nerve receptors in the reproductive organs, enhances blood circulation, and increases the production of sexual hormones. Sexual Energy Massage differs for men and women, for the obvious reason that their sexual organs are different: male sexual organs are primarily external, while female sexual organs are mainly internal. Men learn a variety of techniques for massaging the kidneys, testes, penis, perineum, and scrotal sac. Women learn special techniques to massage the breasts, kidneys, ovaries, and uterus while using the mind and senses to activate the viscera and endocrine glands, in the same way as in the Orgasmic Upward Draw (see *Bone Marrow Nei Kung,* pp. 112- 116).

Bone Breathing

Sexual Energy Massage stimulates the production and release of sexual hormones. The sexual hormones are part of what is called Ching Chi in Chinese physiology. In addition to being related to the skeletal system, these hormones are related to many bodily processes, including aging. Taoists seek to keep the Ching Chi strong to retard the aging process and promoted rejuvenation and longevity.

Abundant Ching Chi is essential in the Taoist process of redrawing the bone marrow. The red and white blood cells of the body are produced in the bone marrow. One effect of the aging process is that the marrow begins to dry up, to be replaced by fat. This puts more stress on the remaining marrow to continue to produce an adequate supply of new blood cells. By redrawing the marrow, a rich supply of blood cells is assured. This helps maintain a strong flow of oxygen to all the body cells and builds a strong immune system.

Most bodily systems become stronger, more sensitive, and more responsive with regular exercise, and the reproductive system is no exception. We were never taught to exercise our sexual organs in school. The idea of doing so may sound strange at first, but the rewards of these practices are stronger and healthier organs, improved hormonal balance, and enhanced sexual performance and response.

Power of Sexual Energy

Sexual energy is one of our most powerful energies. Most people do not know how to use it, aside from procreation, so this rich source of energy is lost to them. For millennia, Taoists have developed skillful methods of conserving, balancing, and transforming sexual energy for improved physical and mental health, happier and more satisfying relationships, and rapid spiritual growth.

The conservation and transformation techniques and principles learned in the Microcosmic Orbit and Healing Love Through the Tao classes serve as a foundation for success in many other advanced practices of the Universal Tao.

Practice

Microcosmic Orbit: Connecting Loving Energy with Sexual Desire

In this round of practice, you focus on further opening the Functional Channel (Conception Vessel), with special emphasis on connecting the heart and sexual centers and on cultivating the connection between the Middle and Lower Tan Tiens. Almost every system of spiritual development recognizes the necessity of acti-

vating both the sexual energy and the heart. However, few systems explain how these two forces—compassion and sexual desire—can be harnessed together for spiritual development.

When you combine opening the heart and activating your sexual energy with the Original Force, you will feel your Original Force change. You will notice the change both in quality and quantity and will have a sense of peacefulness, delight, security, and comfort.

The compassion energy of the heart is cultivated to a deeper level with the second level of meditation in the Fusion of the Five Elements. Also, to fully awaken and control your sexual energy, you must master the practices taught in Healing Love Through the Tao. This book presents more advanced levels of the Microcosmic Orbit. Readers who have already mastered Fusion and Healing Love should accomplish this stage of combining energies with ease. Nonetheless, if you are still a beginner and practice well at the level of this book, you will reap many of the benefits.

The following sequence can be used when cultivating sexual energy and circulating it to the Orbit.

1. Chi Kung Warm-Ups. Begin by loosening the spine with Chi Kung Warm-ups: Spinal Cord Breathing, Iron Bridge, Crane Neck, Turtle Neck, Spinal Cord Shaking, and Spinal Cord Rocking. Then rest. Feel the spine open and relaxed. As you inhale, imagine breathing a white mist from the earth into the spine to purify, cleanse, and brighten the spinal cord. When you exhale, feel you are breathing out any impurities from the spine as a cloudy gray mist. Repeat this 9 to 18 times.

2. Six Healing Sounds. Practice the Six Healing Sounds.

3. Focus inward. Prepare yourself by sitting in good meditation position on a chair.

Become aware of your surroundings. Feel the sensation of you feet touching the floor, your hands clasped, the chair beneath you.

Be aware of the sounds inside the room, outside the room, and within your body.

Be aware of your breath. Feel the body naturally expand as you inhale and contract as you exhale. Breathe in and out with awareness in this way 9, 18, or 36 times.

4. Warm the Stove.

5. Open the basic Microcosmic Orbit.

6. Practice the Cosmic Inner Smile to align with your Higher Self.

7. Open the heart.

Fig. 10.5 *Massage the breasts outward.*

Activate the Sexual Center

Women: Transform blood into Chi.

1. Rub the hands together until they are warm. Cover and press the breasts with the palms and start to massage outward (Fig. 10.5). Be aware of the vagina and the pineal and pituitary glands. Circle inwardly up and outwardly down 18 times as one set. Rest with the fingers lightly touching the nipples and gather the energy from the breasts, sexual organs, and pineal and pituitary glands into the heart center. Repeat 2 to 4 times (Fig. 10.6).

2. Reverse the direction and gather the force back into the nipples. Make a connection to the back, on both sides of the spine between the T-5 and T-6 spinous processes, and connect down to the kidney. Do 2 to 4 sets. (Refer to Chapter 5, Figs. 5.34 and 5.35.)

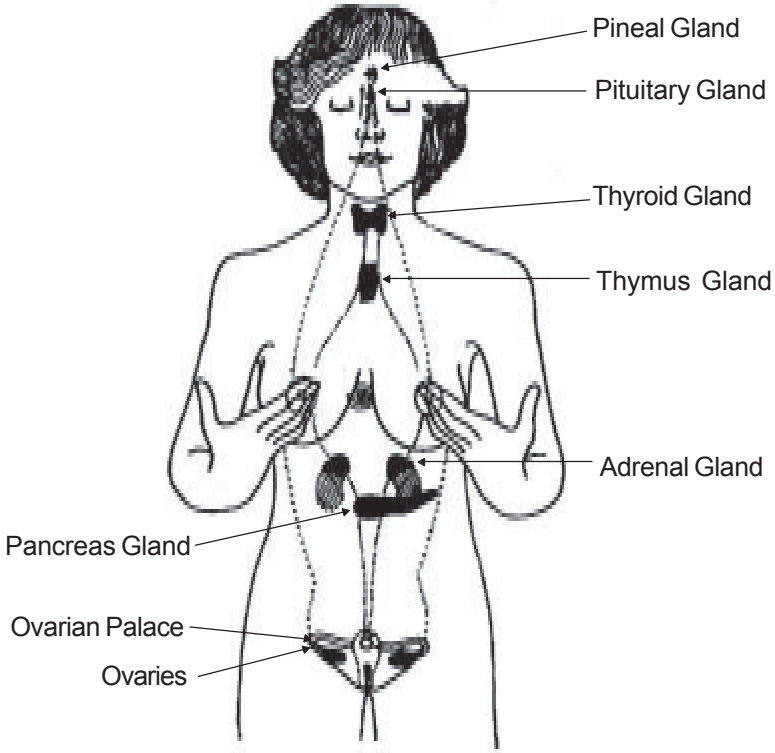

Fig. 10.6 *Touch the nipples with the fingers and gather the breasts' and sexual glands' energy into the heart center.*

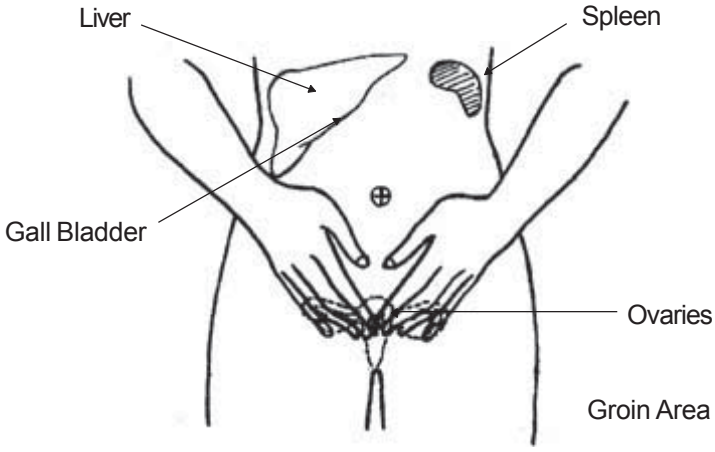

Fig. 10.7 *Massage the groin and the waist areas.*

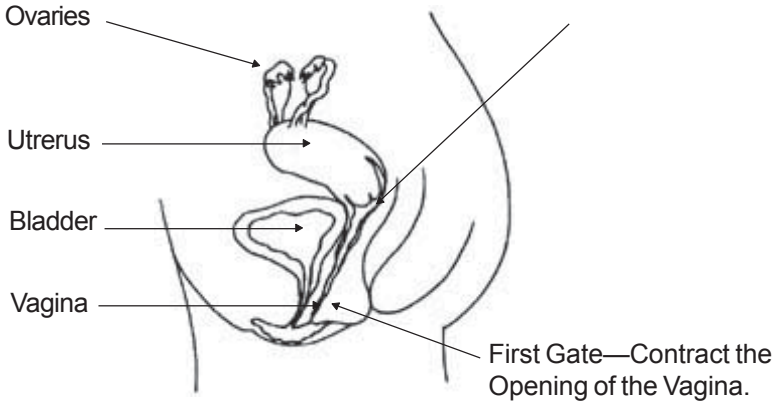

Fig. 10.8 *Close the two sexual gates.*

Fig. 10.9 *Massage and shake the kidneys.*

3. Move the hands to massage and lightly shake the kidneys 9 to 18 times. Rest and feel the kidneys warm. The massaging, shaking, and resting is one set. Do 2 or 3 sets.

4. Move the palms to the lower abdomen and massage the groin up to the ovaries. Then massage the area around the liver, gall bladder, and spleen, and return to the groin again. Start in an outward direction from the lower part, circling in and up to the top, and back out and down 36 times. Then reverse the direction and massage 36 times (Fig. 10.7).

5. Move the palms down and cover the sexual center (Ovarian Palace) (Fig. 10.8). Using mind/eye power, lightly contract the circular iris muscle and the muscles around the eyes. Feel them stimulate the vaginal muscles (the first sexual energy gate), the opening of the cervix (the second sexual energy gate), and the anal muscles to lightly contract as well. This helps gather the sexual energy you have activated.

6. Pause for a while. Feel the energy expand at the sexual center.

Men: Transform Ching (sperm) into Chi.

1. Rub the palms together until they are warm. Massage and lightly shake the kidneys 9 to 18 times. Rest and feel the kidneys warm. Use mind/eye power to gather energy from the kidneys. Inhale deeply into the kidneys, then exhale and condense the breath and energy into the Door of Life. This is one set. Do 2 to 4 sets (Fig. 10.9).

2. Make the connection from the kidneys to the sexual organs.

3. Rub the hands together until they are warm and massage the testicles 18 to 36 times. Rest, and feel the energy gather in the center of the testicles. Do 2 to 4 sets (Fig. 10.10).

4. With the left palm, hold the testicles; with the right palm, massage in a clockwise circle around the navel 36 to 81 times. Change hands: now the right palm holds the testicles, and the left palm massages in a counterclockwise direction 36 to 81 times (Fig. 10.11).

5. Move the palms down and cover the sexual center. Using mind/eye power, lightly contract the circular iris muscle and the muscles around the eyes. Feel this stimulate the perineum, the tip of the penis, the urogenital diaphragm, and the anal sphincter muscle to lightly contract as well. This helps gather the sexual energy you have activated (Fig. 10.12)

6. Pause for a while. Feel the energy expand at the sexual center.

Fig. 10.10 *Finger massage of the testicles.*

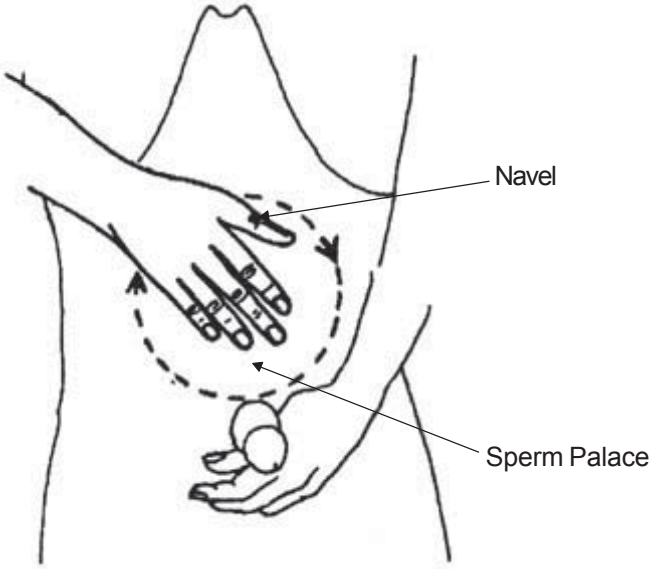

Fig. 10.11 *The left hand holds the testicles.*
The right hand massages the lower abdomen.

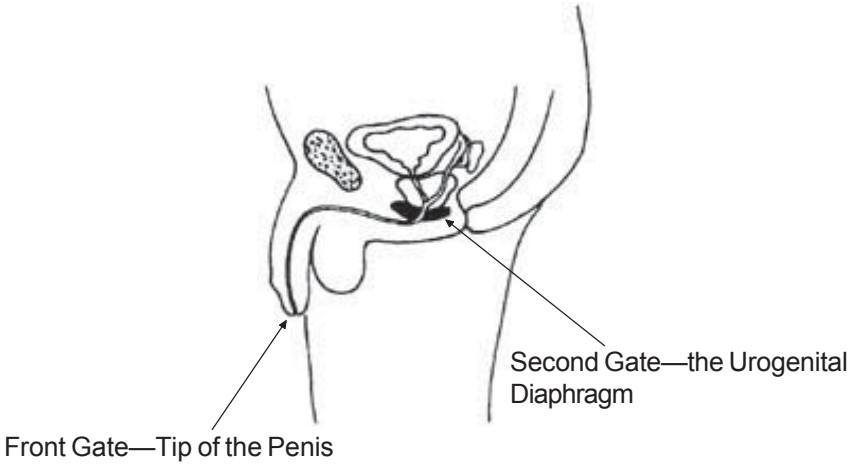

Fig. 10.12 *Close the two sexual gates with mind/eye power.*

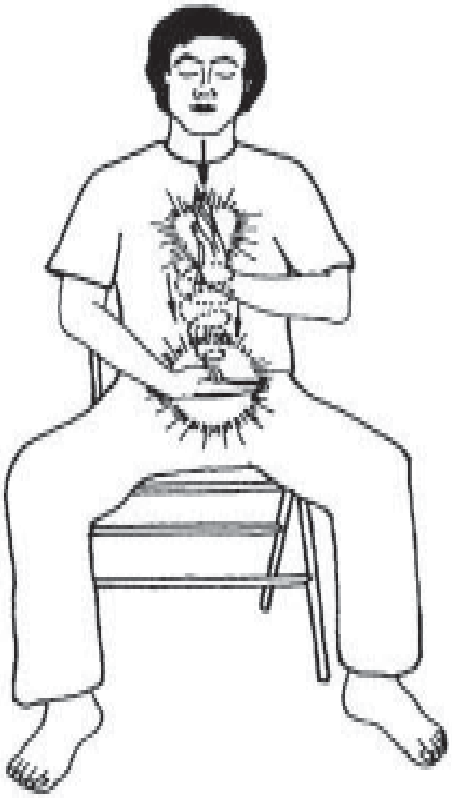

Fig. 10.13 *Connect the heart and sexual center.*

Men and women: Continue together, practicing in the same way.

7. Feel the joy, love, and happiness in your heart. At the same time, focus on your sexual energy at the sexual center. Be aware of the multiplying quality of your sexual energy, of its ability to expand and increase other energies many times.

8. Move the left hand up to touch the heart, and the right hand down to touch the sexual center, palm facing up (Fig. 10.13).

9. Become aware of the Universal Love above you. Inhale, and draw this love into your heart, filling it with love. Feel the heart overflowing with love. Exhale down to the sexual organs. Feel the loving energy from the heart and the sexual energy combine into a blissful orgasmic feeling. Repeat 6 to 9 times, or until you feel the orgasm and blissfulness pervade your body.

10. Feel a connection like a pipeline between the sexual center and the heart. Draw the sexual energy up into the heart, and feel the joy, love, and happiness expand until it feels as though it is filling all heaven and earth (Fig. 10.14).

11. Feel the love and sexual energy combine into an orgasm and gradually travel up the spine to the crown. Then feel it expand to connect with the Cosmic Orgasm.

12. Inhale; gather the Cosmic Orgasm into the mouth and the Original Force (navel area). Exhale and condense it in the navel area. Feel the heart and sexual energy drawn in also. Rest, and let it expand to the whole body. Feel every cell fill with this blissful energy, the most important energy in our cells. Spend 5 to 10 minutes absorbing and condensing the Cosmic Orgasm (blissful feeling).

Connect to Mother Earth Energy. Draw up Mother Earth Energy and circulate it through the Orbit.

Protecting the aura. Form a golden egg around the body for protection. Circulate the golden healing light of your Higher Self through the Microcosmic Orbit.

Widen the Functional Channel (Conception Vessel)

1. Return the awareness to the mideyebrow point. Draw in more golden light from the Higher Self Force. Use the mind to spiral at the mideyebrow point. Feel the mideyebrow point expanding and filling with energy.

2. Rub the tip of your tongue back and forth to massage the palate. Rest and be aware of the tongue and the palate.

3. Inhale, press the tongue to the palate, and draw Chi into the mideyebrow and the mouth. Exhale, condense the Chi in the mouth, then relax and let the Chi expend in the mouth. Feel the tongue's strong connection to the palate. Do this 9 to 18 times.

4. Rest, then touch the tip of the tongue to the roof of the mouth just behind the teeth and slowly begin to move the tongue toward the back of the mouth. Continue until you feel a tingling, metallic, or electric sensation where the tongue and palate touch. This means you have made a good connection and successfully linked the Governor and Functional Channels at the upper "Magpie Bridge."

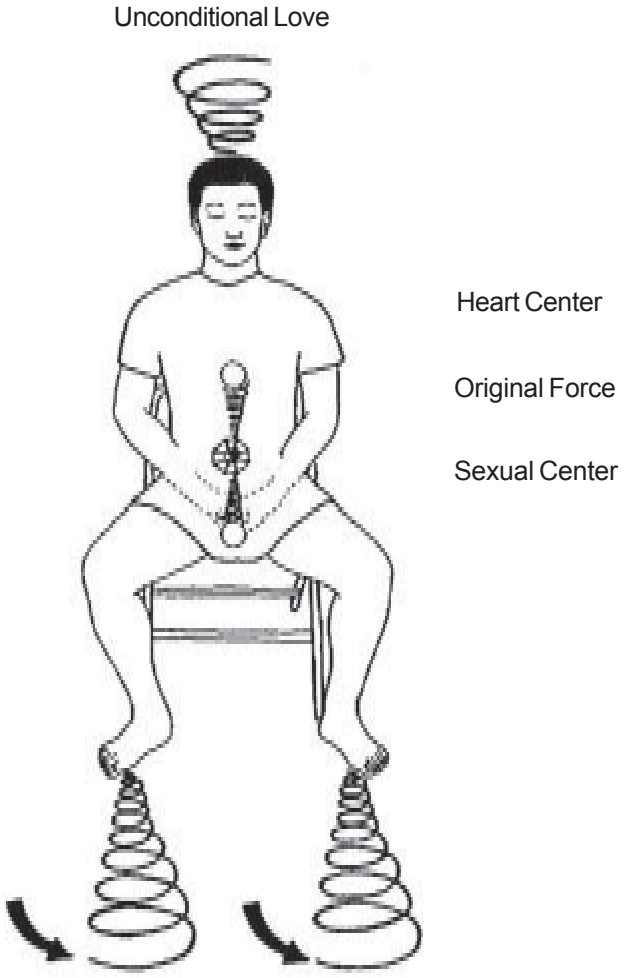

Fig. 10.14 *Draw the heaven/earth, heart, and sexual energy into the Original Force.*

5. Knock the teeth together 18 to 36 times, then lightly clench and release them. This vibrates the bones and activates the bone marrow to transport Chi through the denser matter of the bones. Let the energy radiate to the palate. Spiral there with the mind and eyes 36 times each way. Inhale and exhale into the palate 3 to 9 times, using the word “Chi” to increase the energy there.

6. Generate some saliva in the mouth, swallow down, gently breath the energy down, and spiral at the throat point. Feel the energy flowing down and expanding at the throat point. Repeat 3 to 9 times.

7. Gently breathe the energy down and rotate a Chi ball at the heart point. Feel the energy flowing down and expanding at the heart point. Feel the connection between the mideyebrow and heart, like a pipeline. Repeat 3 to 9 times.

8. Gently breathe the energy down and rotate at the solar plexus point. Feel the energy flowing down and expanding there. Repeat 3 to 9 times.

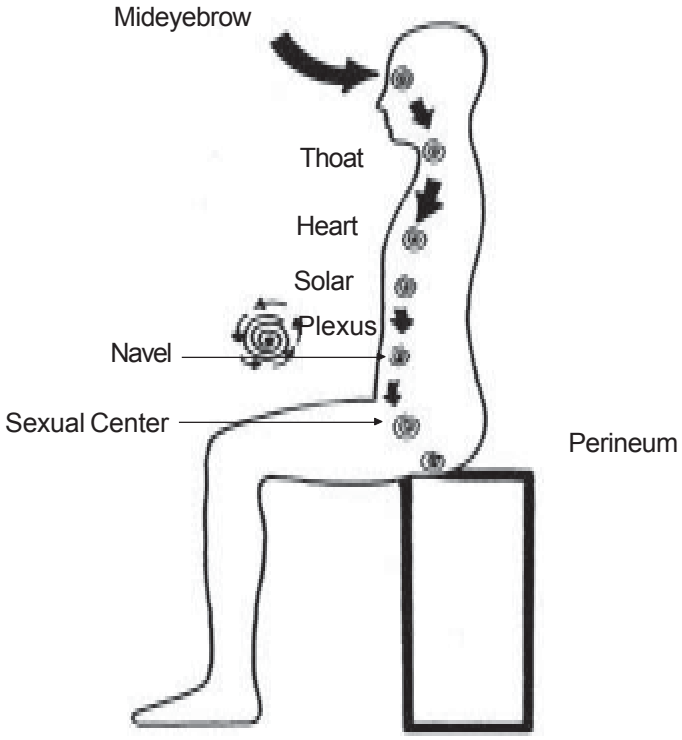

Fig. 10.15 *Widening the Funtional Channel.*

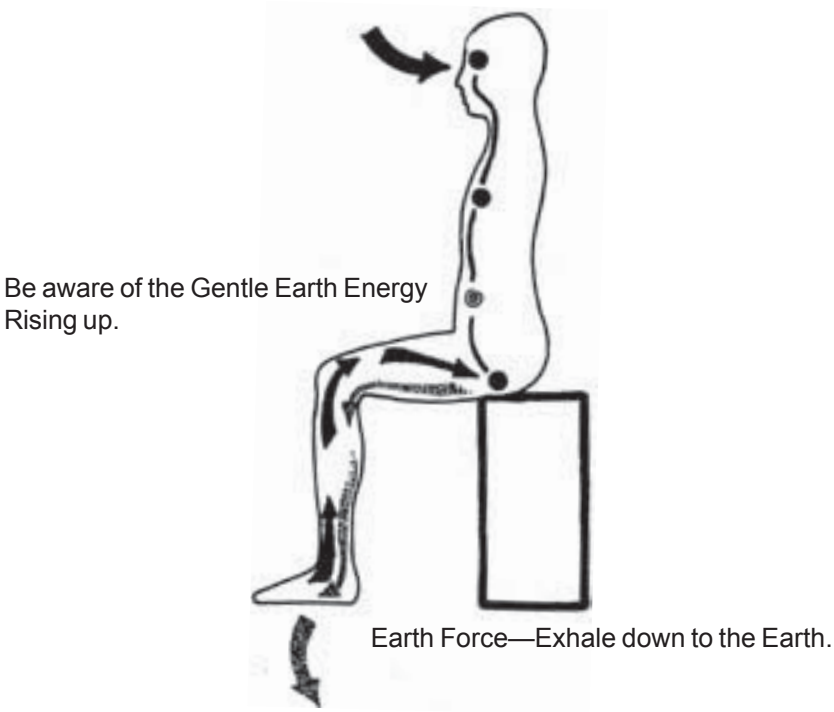

Fig. 10.16 *Connecting the heart chanel to the Earth Force.*

9. Gently breathe the energy down and rotate at the navel point. Feel the energy flowing down and expanding at the navel point. Repeat 3 to 9 times.

10. Gently breathe the energy down and rotate at the sexual center point. Feel the energy flowing down and expanding there. Feel your sexual energy activating and becoming even more energized as you bring additional energy in. Repeat 3 to 9 times.

11. Gently breathe the energy down and rotate at the perineum point. Feel the energy flowing down and expanding at the perineum point (Fig. 10.15). Repeat 3 to 9 times.

12. Continue to focus on the Hui Yin (perineum point). Inhale deeply; then, as you exhale, release the energy through the perineum and down through the legs, soles of the feet, and down into the earth (Fig. 10.16). Repeat 2 to 3 times. Feel as if you are releasing down into the center of the earth. Now be aware of the gentle blue Earth Energy rising through the soles and legs like a soothing, healing, and refreshing blue mist. Let it rise to merge with the Original Energy behind the navel. Use the mind to warm

the navel, kidneys, and sexual organs. This activates the Original Energy and helps you digest and assimilate the Earth Energy. Rest for a few minutes and enjoy the feeling of being peaceful and energized.

End the Meditation: Collect Energy at the Navel

1. Place both hands over the navel. Continue to focus the mind on the Original Energy behind the navel. Rest, and enjoy this feeling of being relaxed and quiet in body and mind, yet energized at the same time.

2. Conclude your practice by rotating outward 36 times at the navel, and then rotating inward 24 times to finish collecting the energy.

3. Finish with Chi Self-Massage.

Summary

Continue with this level of practice for at least several weeks before moving on to the practices in the next chapter.

In this practice we have concentrated on making the connection between the sexual energy and the heart energy. The higher levels of this practice occur after you have completed the Fusion of the Five Elements meditations and Healing Love through the Tao.

In this chapter we have also focused on opening and strengthening the Functional Channel (Conception Vessel) from the mideyebrow to the perineum. Having the Functional Channel open provides a vitally important vent for the energy you will bring up the spine and draw down from heaven in the following chapter. Be sure to practice until you really feel the energy descending from the mideyebrow all the way down to the navel and perineum.

As outlined in previous chapters, spend at least a week mastering bringing the energy down from the mideyebrow point to the heart point. Then spend a week mastering bringing the energy from the heart point to the navel point and sexual center. Finally, spend a few more days establishing a firm connection from the sexual center to the perineum.

Many systems teach the student to bring energy to the crown but do not say anything about providing a vent for it in case of ex-

cess Chi in the head, nor do they emphasize bringing the energy back down. In the Universal Tao, it is our experience that this can lead to many negative side effects, including the phenomena of Kundalini psychosis and “cooking your brain”—having so much Yang Chi in the head with nowhere else to go that the brain literally overheats and the tissue begins to cook. Therefore, we cannot overemphasize the importance of having the Functional Channel completely open in preparation for bringing energy into the crown point. Be certain to spend as much time as you need to open the Functional Channel before proceeding.

Chapter 11
Heavenly Chi and Microcosmic Orbit

Connecting with Universal Force

What is the Universal Force (Heavenly Chi)?

Since the dawn of time, people all over the world, including the Chinese, have been fascinated with the heavens—with the movements and mysteries of the sun, moon, stars, planets, comets, and meteors. They have instinctively felt that what happens in the skies above is somehow intimately related with life on earth, and that by better understanding the heavens, they could better understand themselves. From this conviction, generations of study eventually gave birth to the sciences of astrology and astronomy, alchemy, and physics.

Many world religions and philosophies, including Taoism, believed that humanity actually came from the stars, that human life originated not on earth but at some other place in the universe. Although there are myths and legends in many cultures supporting this belief, modern science has no way yet to either prove or disprove it. But interestingly, today's astronomers and physicists do theorize that life on this planet was seeded from other stars, that the forces vitalizing the inorganic elements into life forms originated elsewhere n the universe.

Heavenly Force Is Related to Our Spirit

Whatever the case may be, it is an ancient belief of humankind that the higher, more spiritual forces of the universe are in the heavens. Christians, Buddhists, and Taoists believe, as did the ancient Egyptians, that if one practices the virtues during this life, it is possible to be reborn in "Heaven," a purer and holier place, perhaps far away in space or merely in a different dimension that is impervious to profane vibrations. In the sacred and spiritual atmosphere of heaven, virtue and spiritual cultivation are much easier to practice than on earth.

Fig. 11.1 *Taoist Immortal riding off into a cloud on the back of a crane.*

Heaven Is Linked with Immortality

Taoist literature speaks of immortality as its ultimate goal and describes such people as the Yellow Emperor "ascending to Heaven in broad daylight as an immortal." Chinese art often depicts a sage riding off into the clouds on the back of a crane or dragon. Immortality thus seems to be linked with one's ability to access the pure heavenly realms and actually to go there in one form or another. Some describe attaining heaven as a one-way street and maintain that the Immortals go there never to return. But more often, Taoists see a more compassionate pattern to the universe, in which the sages who have attained immortality, as well as the primordial gods, continue to interact with humanity, going back and forth between heaven and earth. Thus, it is said that an Immortal can take thousands of different forms at once, manifesting as whatever is needed by humanity at any given time (Fig. 11.1).

To attain this type of immortality, a refinement of one's entire being is necessary. The impure aspects of one's body, Chi, and consciousness must be brought under control and transformed into purer forms. Spiritual mastery means that one's true nature, or original spirit, must be awakened to its heavenly connection. Recognizing our connection and place in the universe, our awakened original spirit becomes the rightful master of our personality, thoughts, feelings, and will. Then we are in accord with the Tao, and as a result we can be effortlessly and naturally in harmony with ourselves, our families, society, nature—with everything.

Cultivating the Immortal Tao

> The fading away of the Tao is when openness "Wu Chi" turns into spirit, spirit turn into Chi, and Chi turns into form. When form is born, everything is thereby stultified. The functioning of the Tao is when form turns into energy, energy turns into spirit, and spirit turns into openness [Wu Chi]. When openness is clear, everything thereby flows freely.
>
> Therefore ancient sages investigated the beginnings of free flow and stultification, found the source of evolution, forgot form to cultivate energy, forgot energy cultivate spirit, and forget spirit to cultivate Wu Chi. —Tan Jing-sheng, "Transformational Writings," 10th Century (trans. By Thomas Cheary, *Immortal Sisters).*

The Three Pure Ones of Heaven, Earth, and Humanity correspond to our Three Treasures in the human body: Shen (spirit), Ching (sexual energy), and Chi (life-force energy), respectively.

Heavenly Chi Is the Ordering Force of the Macrocosm

Heaven, or the Universal Force, is the most ethereal of the Three Pure Ones. It corresponds and is linked to our spirit, or Shen, which encompasses our consciousness, thoughts, and emotions.

In ancient Taoist writings, the term *Heaven* is often used to mean the ordering principle of the universe, or universal law, the law the ten thousand things have to follow. Sometimes Heaven is even used as a synonym for Tao. Heaven is the Yang principle of the universe; it is represented in the first hexagram of the I Ching as the Creative principle, being the first of the Three Pure Ones to emerge from Wu Chi. Heaven is thus the initiating force of all creation. (Please see Fig. 8.1.)

Spirit Is the Ordering Principle of Our Inner Universe

Just as the Universal Force (Heavenly Chi) is the ordering principle of the Three Pure Ones in the macrocosm, our spirit or consciousness is the ordering principle of our being in the microcosm of the body. As we said in a previous chapter, our individual consciousness is one ray of the light of universal consciousness. The bodily form and Chi may dissolve at death, but with cultivation, the spirit can be immortal; it can transcend the realms of Yin and Yang to reunite with Wu Chi. Thus it follows that the spirit or consciousness should be the ruler of the body and the Chi.

This relationship of the Three Treasures is reflected throughout Taoist practice; for example, in the Tai Chi classics it is said, “The mind leads and the Chi follows; the Chi leads and the body follows.”

This is not to say that these three (spirit, Chi, and body/Ching) do not interact and mutually influence each other. A wise ruler must listen to and respond appropriately to the limitations and requests of his ministers and subjects; one who does this is a skillful ruler indeed. Sensual pleasure is not evil in itself. The Taoists have always emphasized moderation as the key. If we can enjoy pleasures without being ruled by or addicted to them, they add to our joy and enrich our lives. Nonetheless, it is important that the ser-

vant not become the master, which happens in those of low spiritual cultivation. Sensual pleasure and the passions (such as greed, hatred, and heedlessness) become the dictating motivations of their lives, to the extent that they lose their spiritual integrity and their harmony with themselves, with those around them, and with the Tao.

Different Aspects of Shen (Spirit)

The ancient Taoists realized, just as did Freud, Jung, and other modern psychologists, that we have many parts to out consciousness. The word Shen can have several different meanings, depending on the context. Two different meanings in particular are most important for the understanding of Inner Alchemy.

The first meaning is that Shen is our mind and resides in the heart, rather than the brain. It refers to our whole range of mental activities, emotions, and spiritual aspects—not only those associated with the heart, but with all the other organs, glands, and systems as well.

The second view is that Shen is our Original and unconditioned Spirit, connected to Wu Chi as light rays are connected to the sun.

Shen is our Mind and Resides in the Heart

It is said in Chinese medical texts, as well as Taoist scriptures, that the Shen resides in the heart. In this context, Shen is more related to the ordinary mind, to the normal range of mental activities and consciousness. In fact, Hsin or Xin, the Chinese word far the heart, is often used as a synonym for mind. The heart thus affects mental activity, emotions, memory, alertness, thinking, consciousness, and sleep. Strong and balanced Heart Chi will promote a strong mind and a happy personality.

The heart governs the blood, and the blood flows to every cell in the body. In Chinese medicine, the mind itself is related to the blood in that the blood pervades the body, communicating with every cell, maintaining life and supporting metabolism throughout the organism.

If the heart becomes weak and unbalanced, one's mind will be scattered and lacking in concentration, and one's emotional state will be unstable. It may be hard to "open one's heart" to other people, and health as well as interpersonal relationships can suffer. Re-

cent medical research by Dean Ornish, M.D., indicates that keeping the heart closed to others can actually increase one's risk of heart attack.

The broader context of Shen refers to the entire complex of our mental, emotional, and spiritual consciousness. Shen thus relates not only to the heart, but also to the internal organs, glands, brain, memory, nervous system, senses, emotions, subtle bodies, and all the various aspects of our personality, both conscious and subconscious.

We have already mentioned that the internal organs each house a part of our consciousness. In addition to the positive and negative emotions of each organ, the five viscera also relate to other specific aspects of our spirit (Fig. 11.2):

The liver controls the Hun, our higher-level or ethereal soul.

The lungs control the Po, our lower-level or corporeal soul.

The spleen controls the I, our thinking and intelligence.

The kidneys control Zhi, our will power.

The heart controls the Shen, our spirit/consciousness.

The Liver and the Hun Soul. The liver houses the Hun, sometimes translated as our higher-level soul, or Ethereal Soul. The Hun is divided into three parts (Hun sub-souls) and is said to give us our positive Yang human nature. The Hun is thus considered to be the essence of the five virtues. The Hun is the subtle yet substantial expression of our higher level consciousness and is the seed of our immortal spirit body. It is like the Chi aspect of our spirit. Through inner alchemical refinement, the Hun becomes a strong, stable vehicle for out spirit; it is the basis of our subtle immortal spirit body, in which we can travel to the heavens.

The Lungs and the Po Soul. Our lower-level, corporeal or Po soul is divided into seven parts and resides in the lungs. It is that part of our consciousness that is the most earthbound, the most Yin, physical, material aspect of the soul. It is the part that fixates on things as being solid, separate, physical, and distinct. Not seeing how all things are connected and related in the grand scheme of things, this part tends to be the most selfish, and is related to the passions or negative emotions. The Po is connected to the physical body; it cannot leave this plane at death but stays with the bones in the tomb, and it is therefore sometimes called the White Essence Soul. The Po is related to the nervous system, limbic system, senses, sensations and feelings, and Ching. It is very much

affected by sadness. When a person is being treated for sadness and depression in traditional Chinese medicine, the points corresponding to the lungs and the Po would be treated. Much of the energy of the Po can be sublimated and transformed into the Hun.

The Spleen and the I. The spleen houses the I (pronounced Yee), our thought or intentions. It is thus particularly related to our intellectual and scholastic thinking, formulation of ideas and intentions, memory, studying, and concentrating. When Spleen Chi is strong, the mind will think clearly and memorization will be quick and easy. Too much study, mulling things over, pensiveness, or worry drains and weakens the spleen. Similarly, weak Spleen Chi dulls the mind, concentration, and memory.

Some recent Tai Chi authors have mistranslated the "I" of the Spleen as "mind" or "will" instead of intention. Mind is too broad a term, as all the organs participate as a part of the mind; the Spleen houses only one part of the mind, that associated with intention. "Will" is also very distinct from intention; the difference between intention and will is clearly illustrated by the old saying, "The road to hell is paved with good intentions." It is easy to have good intentions, such as losing weight, quitting smoking, or meditating at dawn every day, but intentions alone do not accomplish the deed; it takes willpower to carry out intentions. In both Taoist Internal Alchemy and traditional Chinese medicine, the willpower is associated with the kidneys, not the spleen.

The Kidneys and the Zhi (Willpower). The kidneys house the Zhi, or willpower. The kidneys nourish the brain and are related both to brain function and short-term memory. They are also the seat of our Ching Chi, as well as the strength of purpose that often accompanies sexual drive. Both good short-term memory that keeps us focused and mindful of our goals, and the drive and ambition to achieve them (an aspect of Ching) are thus related to the kidneys. If the kidneys are strong, the willpower will also be strong; if the kidneys are weak, short-term memory may be poor, and a person may lack willpower and be easily distracted from his or her goals.

The Heart and Shen. The heart is considered the coordinator or ruler of all the various aspects of mind, consciousness, and spirit. For this reason, in traditional Chinese it is often referred to as the Emperor or Master Controller. The heart regulates and coordinates all the functions of consciousness mediated through the five organs; it directs and processes our intention, willpower,

thought, memory, and nervous and sensory input in reaching life decisions.

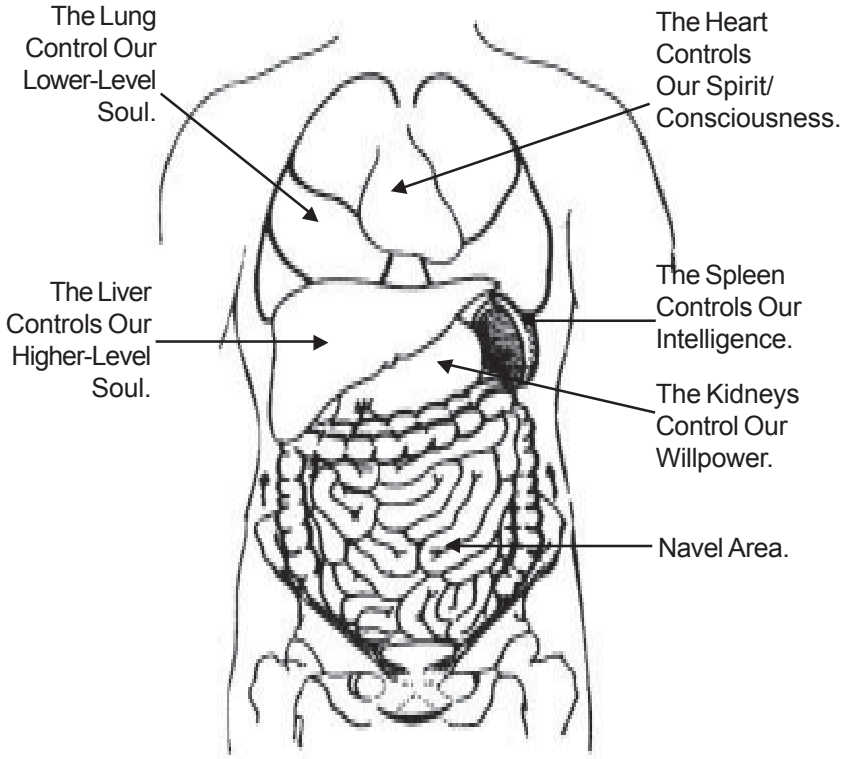

Fig. 11.2 *The internal organs each house a part of our consciousness.*

It must be emphasized that all the organs contribute to this higher meaning of Shen, not just the heart. The nervous system, the blood—in fact, virtually every cell of the body—are connected to Shen. Recent scientific research has indicated that the chemical components for consciousness exist not only in the brain but in cells throughout the body. This creates the biochemical potential for consciousness virtually anywhere in the body.

The heart is particularly related to memory. In contrast to the kidneys, the heart is more related to long-term memory. This distinction is often seen in people with Alzheimer's disease, many of whom have excellent long-term memory (strong heart function)

and can recall in great detail events from their childhood, but poor short-term memory (weak Kidney Ching/brain marrow).

Our Original Shen Is Our True Nature

A second level of meaning for Shen is our Original Shen (Yuan Shen), Original Mind, or Original Spirit. It differs from the meaning of Shen as our ordinary mind, which can be conditioned by relative experiences and circumstances. In Western religious terms, it might be compared to the difference between our individual soul and that part of us that is the Universal Spirit. Our Original Shen is unconditioned and limitless. It is often compared to a mirror or crystal ball, which is clear and empty and can thus reflect entire worlds. The Taoists sometimes referred to this mind as the Uncarved Block, because it has not been affected by the world and is full of potential. This is our true, highest spirit, the ray of the light of Wu Chi, unborn and undying. Therefore it is also called our immortal spirit (Fig. 11.3).

Fig. 11.3 *Our original Spirit*

We have opened the gates of immortality when we connect with or wake our Original Spirit. At first, we may only glimpse it in a flash; later, with practice, we may be able to maintain lucidity in our Original Spirit during meditation, first for short periods, then for longer and longer periods. Often at the beginning, as soon as we get up from our meditation seat, we resume our normal habitual patterns of thinking and quickly lose touch with our Original Spirit.

With more practice, we can maintain the light of our Original Spirit throughout the day. In this way the higher mind, coming from the light of Wu Chi, rules in the hierarchy of our being. All aspects of body and mind become servants of this highest Universal Mind; we can connect with the Tao whatever we do and wherever we go. When we can exist in this consciousness without lapse in the midst of every moment of daily life, we have reached the highest level of immortality; we have returned to the source, to our true origin, to Wu Chi.

Traveling to the Celestial Realms

On the path to Wu Chi, we must practice regularly to transform our ordinary state into an immortal state. One very important factor is the place where we practice. Although it is good to reach a stage in your practice where you can practice anywhere, in any circumstances, some places are more conducive to practice than others, and it is good to take advantage of them when you can. These places are usually quiet, protected from the elements and from danger, with good air and beautiful and inspiring scenery. It is also good if sages or yogis have meditated there before, or if the site is blessed or holy. (If you are planning an extended meditation retreat, it is helpful if there is a town or community not too far away and people who can bring you any necessities and provisions.) Once you have become familiar with such a place, however, it is not necessary to be there physically; you can make the connection through the mind.

Just as certain sites on earth are more conducive to practice, the Taoists seek to travel to the heavenly realms where the Immortals live (Fig, 11. 4). There, sages can guide their practice, and in this celestial and rarefied atmosphere, attainment of the highest fruits of spiritual realization is not far off. For this reason, Taoists seek to strengthen and refine their Three Treasures. By so doing, they may be able to attain the highest levels of immortality and visit

the heavenly realms during this very life, traveling in their soul and spirit bodies and then returning to the physical body. If they do not attain immortality during this life, they will already have prepared a purified vehicle for their consciousness to use at death to carry them to the heavenly realms.

Because the physical body is mortal, Taoists seek to transform the Ching, or physical essence of our energy, into Chi, and to refine Chi into Shen, ultimately to merge with Wu Chi. In doing so, Taoists also learn to absorb, digest, and transform energies from nature to use for these purposes. We have already spoken of the Earthly and Cosmic Chi, so now let us take a closer look at Heavenly Chi, examining both what it is and how it may be used by the Taoist adept.

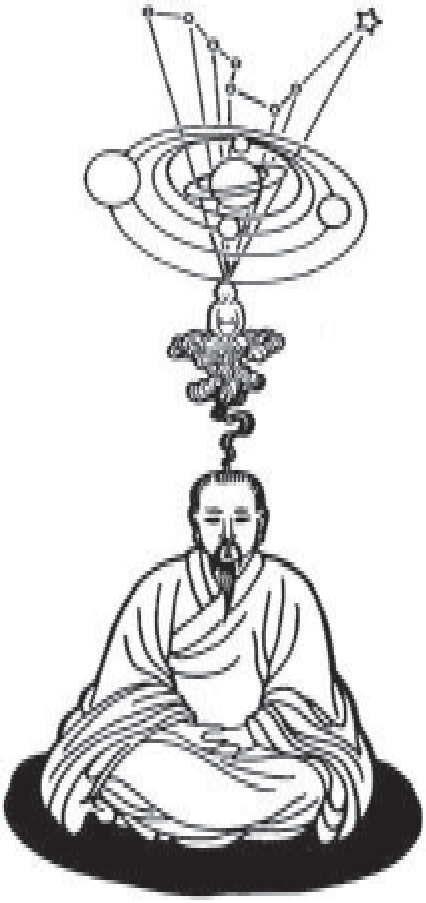

Fig. 11.4 *Travelling to the Celestial Realms.*

Varieties of Heavenly Chi

A simple way of thinking of Universal Force or Heavenly Chi is to perceive it as the Chi of the sun, moon, planets, and stars. There are many types of Heavenly or Universal Chi. Each type has its own correspondence with our microcosm and is used in different ways.

Chi of the Sun and Moon

The sun has very strong Chi that has an obvious and undeniable effect on life on earth. It is the essence of Greater Yang and is related to the heart and the fire element. The earth revolves around the sun and in one year completes a 360-degree circle. This solar cycle, called the Yellow Route, is divided by the Taoists into 24 solar periods, beginning with the Spring Equinox. Each period lasts 15 days and is considered a single season. Each period also has a special name that describes the climate in that phase of the year. (Please see Fig. 1.11.)

These periods also correspond, within the microcosm of our bodies, to the 24 separate vertebrae of the spine: the 5 lumbar, 12 thoracic, and 7 cervical vertebrae (the sacral and coccyx vertebrae are not included, as they are fused together); they also correspond to 24 primordial energies in the body (the circulation of the Chi through the 12 ordinary Chi channels on both sides of the body). Taoists have 24 sets of Chi Kung practices that correspond to these 24 periods and are practiced at those times to connect with the unique Chi of each season. (More details are provided in the Tao Body/Mind/Spirit Chart in the catalogue chapter.)

Despite this solar breakdown, the Chinese calendar is based on the moon, beginning 4681 years ago on the first new moon during the reign of the Yellow Emperor, Huang Ti. The moon is the essence of Yin and is related to the kidneys and water. Absorbing lunar energy helps one cultivate a strong Yin essence.

There are specific days of the solar cycle during which the sun and moon energies are particularly potent and accessible. The ancient Taoists observed that on the solstices and equinoxes, which mark the seasonal changes, the sun seems to stop in its movement. They called these stops Doors, and, according to ancient lore, the Taoist alchemical practitioner must pass through these doors to be received by the lord who grants the fruits of immortality unique to each celestial region.

The Spring Equinox is called the Golden Door and is the most important door of access to the sun. The Summer Solstice is called the Palace of Universal Yang; it marks the peak energy of the sun (the longest day of the year). The Autumn Equinox is called the Eastern Well and is the most important door of access to the moon. The Winter Solstice is called Great Cold or the Palace of Eternal Frost and marks the peak of the lunar energy (the longest night of the year).

The solar essence is gathered during the lunar month of the Sprine Equinox on the 3rd, 9th, 17th,21st,and 25th day of the month in which the sun enters the Golden Door. Gathering the Lunar essence is done during the lunar month of the Autumn Equinox on the 3rd, 15th, and 25th day of the month in which the moon enters the Eastern Well. There are optimal days for meditation and Chi Kung practices that draw the energy or "breath" of the sun and moon. The key days for gathering the Solar essences are at the solstices and the equinoxes, and the best days for gathering the Lunar essences are the new and full moon days. However, one can still draw the solar and lunar energies on other days; it will simply not be as powerful as on the key days.

These are advanced practiced begun at the level of Greatest Kan and Li and should not be undertaken until you have mastered the basic and advanced practices of the Microcosmic Orbit, as well as Fusion of the Five Elements, Lesser and Greater Kan and Li, Healing Love, and Iron Shirt.(For simple level of these practices, see "Most advanced mind/eye training" in Chapter 4.)

Once you have reached this level, the Chi you are circulating in the Microcosmic Orbit has become highly refined, and the eight Extraordinary or "psychic" channels, including the central or Thrusting Channel,have been opened as well.At this level you can thus more consciously direct the process. You are using more of yourself; there is more room for venting and storing the energies; and there is less likeihood of energy stagnation, heat, or malabsorption.

Chi of the Planets

In the Fusion of the Five Elements advanced formulas, we connect to the Chi of the nearby planets, which in turn directly enrich the Chi of our associated internal organs. The planet Jupiter is associated with wood and the liver; Mars with fire and the heart;

Saturn with earth and the spleen; Venus with metal and the lungs; and Mercury with water and the kidneys. These five planets in turn draw their energy from the Grand Farce of the Five Elements, the Five Primordial Emperors or Stars that originated from the Three Pure Ones (see "Heavenly Chi," below). Because the bodily organs are related to the planetary energies, we can build the essential energies of the organs when we connect to the planets in the Kan and Li Meditations. Drawing on the planetary energies helps empower, strengthen, and protect not only the physical body but the energy body as well. (Please see Fig. 5.3.)

We prepare ourselves for Fusion of the Five Elements and the Kan and Li practices with the Inner Smile and the Six Healing Sounds. These foundations teach us to feel our organs, to get to know their colors and qualities, to begin to connect to the energy of each particular element. In addition, the Microcosmic Orbit practice opens the way for circulating the planetary energies through the body so they can be better absorbed and digested. Neglecting these basics can lead to disappointment and trouble. A strong mastery of the Microcosmic Orbit, Inner Smile, and Six Healing Sounds paves the way to safe accomplishment of the higher level practices.

Heavenly Chi of the Stars and Constellations

The Three Pure Ones, the first forces to emerge from Wu Chi, gave birth to five huge "stars"—the Wu Tai, or Five Grand Forces of the Five Elements. These five huge elemental forces gave birth to the entire universe, including trillions of stars. According to Taoist cosmology, they created the North Star, which created smaller stars, among which were the stars making up the 28 major constellations. The constellations are grouped according to the four directions and the center, and these five groups are known as the Five Houses.

Stars and constellations have their own unique energy that corresponds to the body and our Chi. For example, just as the polestar or North Star is considered the still point or central axis around which the heavens revolve and which is the doorway to heaven, our lower Tan Tien is our central axis and is the doorway to the core of the body. In addition, the various bones of the skull are connected to the energy from the seven stars of the Big Dipper and the North Star and can easily draw these energies. The 28

Constellations in the Four Quadrants of Heaven are related to the Five Elements, the Five Seasons, the Five Directions, and the five organs of the body.

The Microcosmic Orbit Meditation and Stellar Heavenly Chi.

The first step in opening to the stellar energies is in the Microcosmic Orbit, where we open the door to the Heavenly Chi by focusing on the North Star and the Big Dipper energies, concentrating on their light, their color, and the associated feeling of their energy. Our main doorway to Heavenly Chi at this level is our crown or Bai Hui point. Internally, the hypothalamus is the point of correspondence to the Bai Hui. The back of the Crown point is also known as Kun Lun Mountain, the highest peak of humans and in heaven. The pineal is the point most sensitive to the light of heaven.

Once we are able to open to and tap the outer energy sources of the North Star and Big Dipper, we can use them to bring ourselves into balance by absorbing and blending them in much the same way we would adjust the temperature of the water in the bathtub by adding hot and cold as necessary to bring it to a perfect temperature. If we find we are too Yin, we can draw more Heavenly Chi; if too Yang, we can draw in more Earth Chi. In this way, we can harmonize our Yin and Yang energies with the Microcosmic Orbit practice.

Kan and Li Meditations and Stellar Heavenly Chi. At higher levels of practice, the Kan and Li practices and beyond, we explore the many other stellar connections between the heavenly macrocosm and the microcosm of the body. For example, in esoteric Judaism, it is said that when God created Adam, Adam was as big as the entire universe. Then God placed his hand on Adam's head, and Adam became small. Similarly, in higher-level Taoist meditations, you imagine that you are the legendary first man, Pan Gu, and that you have a giant body, billions of light-years from head to toe.

When this is done properly, you become the Cosmic Being, whose Crystal Palace is the North Star, who has constellations and planets for vital organs, whose heart is the sun, whose kidneys are the moon, and whose Tan Tien is the planet earth. This Cosmic Being-the mind of Tao-beams its exquisite rays to one cell of its being, the human sitting on a chair on planet earth, meditating on the stars. This practice cultivates our True Knowledge and awak-

ens our Real Senses; it develops cosmic consciousness and opens our three Tan Tiens to receive energy from their heavenly counterparts. Thus, Kan and Li teaches us how to tune to different frequencies from the stars as well as the earth, and to the different levels of consciousness associated with them. Eventually, we become who we really are by returning to the source.

Returning to the Source

> "Heaven, Earth and I are living together, and all things and I form an inseparable unity."—Chuang Tzu

In the science section of a recent issue of *The New York Times*, an astronomer was quoted as saying that life on this planet was seeded from other stars. We are thus connected to the stars through our bodies; the human form itself is a product of stellar energy and matter. Realizing that our essence is of the stars, the Taoists devised methods to tap the macrocosmic energies of the Three Pure Ones, the Five Elements, the North Star, the Big Dipper, the 28 Constellations, and the planets. The purpose is to enhance the processes corresponding to these energies within the microcosm of our bodies—to promote our health, refine our " spirits, and eventually reunite us with our source, the Wu Chi.

Deep within our subconscious minds we still carry memories of the unity and bliss that preceded our entry into the dense vibrations of the earth plane. Here it becomes easier to see our individuality, but more difficult to perceive our interconnectedness with the universe, than when we are in our energy or spirit body. Yet because of the subtlety of these latter bodies, many people are unaware of Chi and even forget that life has a spiritual side.

> When openness "Wu Chi" turns into spirit, spirit turns into Chi, Chi turns into form, and form turns into sexual energy [Ching], then sexual energy turns into attention. Attention turns into social gesturing, social gesturing turns into elevation and humbling. Elevation and humbling turns into high and low positioning, high and low positioning turns into discrimination.
>
> Discrimination turns into official status, status turns into carriages. Carriages turn into mansions, mansions into palaces. Palaces turns into banquet halls, banquet halls turn into extrava-

gance, extravagance turns into acquisitiveness, acquisitiveness turns into fraud. Fraud turns into punishment, punishment turns into rebellion. Rebellion turns into armament, armament turns into strife and plunder, and strife and plunder turns into defeat and destruction. —Tan Jing-sheng, *Transformational Writings,* 10th Century

The ultimate purpose of Taoist practice is to return to our original state—the source, the Wu Chi. One way of returning to the Wu Chi is through the practice of Internal Alchemy. Taoist Inner Alchemy begins with opening, cleansing, and purifying the energy pathways of the body through the Microcosmic Orbit meditation, Iron Shirt Chi Kung, and Healing Love techniques. The second stage of Internal Alchemy works directly with the Five Elemental Forces within out bodies and also within the earth through the practices of Fusion I, II, and III, Tai Chi, Five Element Nutrition, and Chi Nei Tsang (massage). These techniques begin to clear the way for advanced work with the energy body and the spirit body, the subtler aspects of our being.

Later stages of Internal Alchemy continue expanding our consciousness or awareness beyond the physical body into the vastness of inner and outer space. In the advanced disciplines of the Universal Tao, students begin to work more consciously with the Five Elemental Forces emanating from the cosmos. Advanced practices involve collecting and absorbing energy from different sources in the universe while traveling in the energy and spirit bodies. Yet it is important to understand that as we do the advanced practices, such as Greatest Kan and Li, we are using Water and Fire to dissolve the ego/mind's arbitrary boundaries between our inner world and outer space; we travel to the farthest reaches of the universe in order to return to the center of our own Tan Tien.

Wu Chi is beyond the boundaries of time and space, so for us as Taoist practitioners to "return to Wu Chi," we must broaden our minds and empty ourselves; we must let go of the fixed, limiting concepts of Newtonian physics and realize that we are the universe. A leap like this is not so easy! Generations of Taoist masters have refined and mapped the simplest and safest approaches. Because it is impossible to realize the Wu Chi in one step, the journey is divided into several stages.

Five Stages of Cultivating Heavenly Energy in the Universal Tao

First Stage: The North Star

The first stage utilizes the material aspects of the physical body to refine, strengthen, and transform energy into the immaterial forms of the spirit bodies. If successful, the first stage brings the practitioner to the North Star (or Polaris), which is the first station and the center of the visible constellations from the earthly perspective. Polaris is also known as the polestar because all constellations that are visible from the North Pole seem to rotate around it. The position of the earth's axis (marked by the North and South Poles) relative to the plane of the earth's orbit determines which star appears to be at the center of the constellations. Over thousands of years, as the axis gradually shifts its position, it points to different stars. (In 3000 B.C., the polestar was Thuban; thousands of years from now, it will be Vega.)

Taoists reach the North Star by expanding their energy and spirit bodies beyond the earth's sphere. This requires practitioners to learn to draw efficiently on the stars and the universe as sources of energy to fortify these bodies. The North Star and the seven stars of the Big Dipper are of primary importance for this purpose. Their energies can be identified with practice, because the stars of the Big Dipper radiate a red light, whereas the North Star emanates a violet light. The force of this violet light penetrates all matter, including the planets and other stars. It is important to note, however, that the violet light emanating from the North Star indicates the doorway of heaven; it is not the highest heavenly force. The light of the highest Heaven Force is clear.

Three steps are required to complete the first stage.

Taoist practice begins in the body. The first step of stage one is to upgrade and maintain your physical health while stabilizing your financial and social conditions. Your body is a vehicle for processing energy; the healthier you are, the more energy it can process, and at a faster rate. Your health and processing capabilities will be greatly enhanced through the Microcosmic Orbit, Six Healing Sounds, Inner Smile, Healing Love, and Iron Shirt Chi Kung practices. Your finances and social interactions should be stable so you can create space in your life for these disciplines. (It is difficult to concentrate if you do not know where your next meal is coming from.)

Travel beyond the body and beyond earth. Next, you will learn how to use accumulated energies for traveling beyond the earth plane to the moon, sun, and planets. This is similar to the way a space shuttle uses a booster rocket to push it beyond the earth's gravitational field. In Taoism, the Microcosmic Orbit and Fusion practices begin the process of creating the energy body, to help boost the immortal body (spirit body) beyond this world while you still remain present in it. The healthier you are internally, the more power you will be able to generate to expand your consciousness beyond the confines of the physical body and the field of planet earth. When you can expand beyond this reality and return, you will gain the raw materials necessary to build a more powerful energy body and spirit body for longer journeys. (Please see Fig. 1.14.)

Travel to the stars. The higher practices involve traveling to and from the stars and constellations—particularly the North Star and Big Dipper—using the energy and spirit bodies. During these journeys the physical body does not actually leave the earth. Rather, our consciousness merges with the earth, in its capacity as a heavenly body, which allow us to use it as an expanded ground connection so we may safely absorb the higher radiations and vibrations from the stars.

Second Stage: The Great Forces of the Five Elements

Beyond the polestar lies the second station of the ascending Taoist comprising the Great Forces of the Five Elements (origin of the Five Elemental Forces). These are represented as a group of five stars beyond our visual perception. Practitioners who attain the level of the Five Elements become one with the forces animating the universe. When the Five Elements are transcended, the Taoist enters the realign of the Triply Unity. This stage is achieved through the three levels of Kan and Li enlightenment practice.

Third Stage: The Three Pure Ones

In Taoist cosmology, the Three Pure Ones are symbolized as three massive stars beyond the Great Forces of the Five Elements. In actual practice, this level establishes union with the three forces of Chi, or vital energy; Ching, or vital essence (sexual energy); and Shen, or vital spirit. The universe unfolded from the unity of the Wu Chi into the multiplicity of stars, planets, and life. Taoists trace back

this process of unfolding primal energy through the practice of Sealing the Five Senses.

Fourth Stage: Primordial Yin and Yang

The next level beyond the Three Pure Ones reestablishes a union with the forces of Yin and Yang (male and female). All multiplicity is returned to the original polarity, preparing the way for complete reabsorption into the Wu Chi. This stage is achieved through the practice known as the Congress of Heaven and Earth. (Please see Fig. 1.4.)

Fifth Stage: Wu Chi

The attainment of Wu Chi is sometimes symbolized in Taoist cosmology as a physical journey, yet Wu Chi is always present within each in dividual, beyond the diversity of energy configurations. These energies, when passed through the filter and space, were polarized to appear separate from the Wu Chi. Primordial Yin and Yang energies dissolve back into their source, thereby ending the illusion of separation. The process of realization involves becoming fully conscious of the intrinsic identity of all universal energy. This stage is achieved through Reunion of Heaven and Man.

Practice

Microcosmic Orbit Meditation: Opening the Governor Channel and Connecting with the Heavenly Chi

1.Preparations

Chi Kung warm-ups. Begin by loosening your spine with Chi Kung Warm-Ups: Spinal Cord Breathing, Iron Bridge, Crane Neck, Turtle Neck, Spinal Cord Shaking, and Spinal Cord Rocking. Then rest. Picture your spine as open and relaxed. As you inhale, imagine you are breathing a white mist from the earth into your spine to purify, cleanse, and brighten your spinal cord. When you exhale, feel that you are breathing out any impurities from your spine in the form of a cloudy gray mist. Repeat this 9 to 18 times.

Practice the Six Healing Sounds.

Preparations for meditation. Begin by sitting in good medita-

tion position on a chair. Once you are in a good sitting position, take a few minutes to focus and prepare yourself.

1. Become aware of your surroundings. Feel the sensation of the feet touching the floor, of the hands clasped, of the chair beneath you.

2. Be aware of the sounds inside the room, outside the room, and within your body.

3. Be aware of the breath and of the tongue touching the palate. Feel the body naturally expand as you inhale and contract as you exhale. Breathe in and out with awareness this way at least 9 to 36 times.

2. Microcosmic Orbit Meditation: *Opening the Crown*

A. Activating and Connecting the Energies

1. Begin with the Cosmic Inner Smile.

2. Cosmic Inner Smile to your heart. Open your heart and continue the Cosmic Inner Smile. When you get to the sexual organs, spend more time connecting the loving energy of your heart with the sexual energy of desire. Combine their energy with your Original Force at the center.

3. Activate your Original Energy (Warming the Stove).

4. Circulate energy in the Basic Microcosmic Orbit.

5. Activate and connect with Mother Earth Energy.

6. Activate and connect with the Higher Self (Cosmic) Energy.

7. Expand the golden light to cover your body.

8. Activate your Functional Channel by spiraling through each point. Return your awareness to the mideyebrow and connect all the points to open the Functional Channel: drawing and spiraling energy to your mideyebrow point, palate, throat, heart, solar plexus, navel, sexual center, perineum, down to the soles and back up to the perineum.

B. Widening the Governor Channel to the Crown

In this phase, you move the energy up the spine point by point. You use Small Sip breathing and spiraling with the mind and eyes to assist the energy. Use whatever other methods you like to assist the energy: sound, color, touching. It is not important what method you use, but rather that you focus your awareness on all aspects

of your being and energy and have the sense of Chi moving up your spine.

Caution:
If you have high blood pressure, glaucoma, or any other health problem that would be adversely affected by holding your breath, do not use the small sip breathing method. use soft internal breathing instead, or simply use your mind to guide your chi.

1. Opening the sacrum. Massage and shake the coccyx and sacrum, especially the eight holes of the sacrum, in a circular fashion until you feel warmth there. Massage 9 times in one direction and 9 times in the other (Fig. 11. 5).

Inhale a small sip into the mideyebrow, and feel the suction as you lightly pull in the eyeballs and pull up on the perineum. Take a small sip, and delicately pull up on the anus; inhale another small sip and pull up on the back part of the anus. Slightly tilt the tip of the sacrum inward as you inhale 5 more small sips into the sacrum. As you exhale, condense the energy in the coccyx and feel the pulsing at the sacrum.

Exhale, and condense the energy at the coccyx. Keep the mind focused on the tip of the coccyx. You may also rotate a Chi ball inside the sacrum 9 to 18 times in each direction. For some people, this may suffice to stimulate the movement of Chi up the spine to the crown.

Although we will not mention it further in the instructions, you can pull up on the perineum, anus, and back part of the anus each time you do Small Sip breathing, to draw energy up from one point to the next, all the way up the Governor Channel to the crown. Also, remember to do each point 9 to 18 times.

2. Opening the Ming Men (Door of Life) center. Inhale a small sip, and draw the energy from the perineum through the sacrum and up to the Ming Men point between the kidneys. Spiral the energy into the Ming Men using mind/eye power. Take 3 to 9 more small sips and breathe more energy up from the sacrum to the Door of Life 9 to 18 times. (Please see Fig. 5.32.)

Now exhale, condense the energy at the Ming Men. Let the energy expand as you rest, breathing naturally. Just relax and feel the line of energy radiating up the perineum, coccyx, sacrum, and Door of Life.

3. Opening the Chi Chung (T-11) center. Focus the mind on or touch the T-11 point. Inhale a small sip, and draw the energy from the perineum up to the Door of Life and T-11. Spiral the energy into T-11. Take 3 to 9 more small sips to draw the energy up to T-11, spiraling more energy into T-11 with each sip. (please see Fig. 5.33)

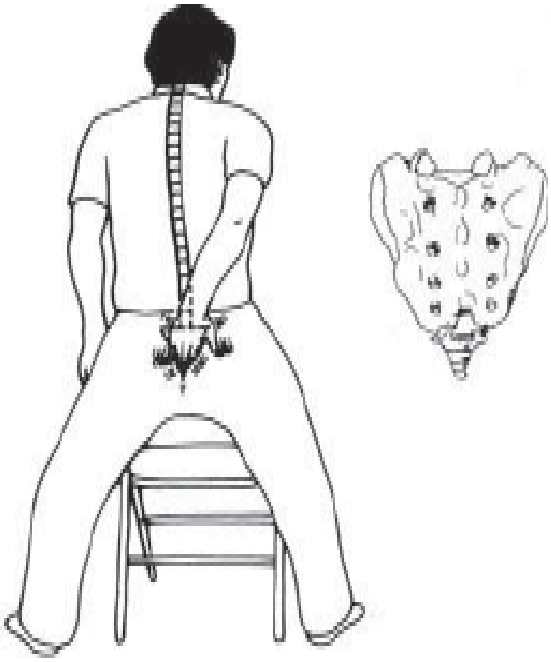

Fig. 11.5 *Massage the coccyx and sacrum.*

Exhale and rest. Feel the energy flow up to theT-11 point. Spiral at T-11 with your mind and eyes.

4. Opening the Wing Point (Shen Dao or T-5) center. Focus on the Wing Point opposite the heart (below T-5). Inhale a small sip, and draw energy from the perineum up to T-11 and to your Wing Point. Then take 3 to 9 more small sips to draw more energy up to your Wing Point, spiraling the energy into the Wing Point with each sip, using mind/eye power.(Please see Fig.5.35.)

Then exhale, condense the energy and allow it to expand as you rest. Now feel the energy flowing by it self up into the Wing Point. Feel the point expand and grow energized.

5. Opening the Da Zhui (C-7) point. Focus on the C-7 point. Inhale a small sip, and draw the energy up from the perineum to the Wing Point and then to C-7. Take 3 to 9 small sips into the C-7

point, using mind/eye power to spiral more energy into the C-7 point with each sip. (Please see Fig. 5.36.)

Exhale and rest. Feel more energy continue to flow up into C-7 on its own.

6. Opening the Jade Pillow (Yu Chen) point. Focus on the Jade Pillow point. Touch and massage the hollow at the back of your head. Inhale a small sip, and draw the energy up from C-7 to the Jade Pillow point. Take 3 to 9 more small sips to draw the energy up from the perineum to C-7 and the Jade Pillow, spiraling more energy into the Jade Pillow point with each sip. If you wish, you may rotate a Chi ball there in both directions using mind/eye power. (Please see Fig. 5.38.)

Exhale and rest. Feel more energy flowing up by itself into the Jade Pillow point.

7. Opening the crown point (Bai Hui). Focus on the crown (Bai Hui) point. Inhale a small sip of breath and draw the energy from the perineum up to the Jade Pillow point through the back of the crown and up to the top crown point. Take 3 to 9 more small sips to draw more energy up to Bai Hui spiraling more energy into the Bai Hui point with each sip. Exhale and rest. Feel the energy flowing, radiating by itself into the crown point. Using mind/eye power, rotate a luminous ball of Chi in both directions 9 to 18 times.

C. Connecting with the Heavenly Force

Not only do we draw Heavenly Chi in through the crown point, we also practice opening this point as a doorway for the soul and spirit to leave at the time of death. Some people have never closed their crown from infancy. The rest of us must practice so this doorway is clear.

If you exit through the crown, you need not return to earth after you die; you can continue to the heavenly realms. But do so, you need to practice opening the crown well before death.

D. Kun Lun Mountain (Back Part of the Crown)

The back part of the crown connects to the pineal gland in the brain and is the doorway by which the soul and spirit depart for the North Star at the time of death. The North Star is the easiest gateway to enter heaven, as it is aligned with the axis of the earth and the North and South Poles. Likewise, when we become aligned with

the axis in our body, we become aligned with the violet light of the North Star, the violet light of unconditional love. (Please see Fig. 5.42.)

E. The Crown

The middle of the crown connects with the hypothalamus and is the pathway to the Big Dipper. The light of the Big Dipper is a vibrant red, which reflects the vitality of the life-force manifesting.

The mideyebrow point connects to the pituitary gland and is the doorway to the Higher Self (Cosmic) Energy. It draws in the golden light, as mentioned earlier. Taoists refer to the area of the brain where the pineal gland, hypothalamus, and pituitary gland are housed as the Crystal Room. (Please see Fig. 5.46.)

1. Activate the back of the crown by tilting the chin in slightly. This tilting aligns the pineal gland with the back of the crown, which is now the highest point of the body. At the same time, touch and press the back of the crown with the fingers. Again, tilt the chin and press very lightly and easily.

2. Touch the middle of the crown and look up as if at the middle of the crown. Gently press and look up, and you will feel it open (Fig. 11.6).

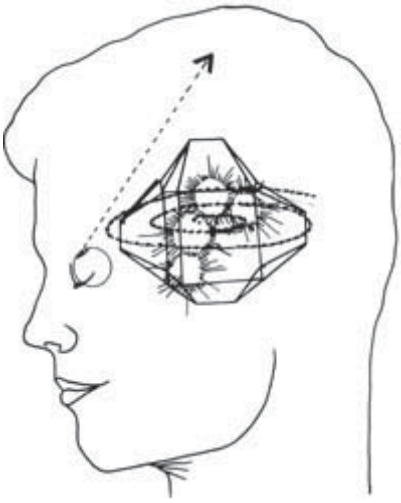

Fig. 11.6 *Activate the back part of the crown.*

3. Breathe in deeply, then exhale, softly whispering the Triple Warmer Sound: ***Heeeeeeeee***; the sound should be vibrated to-

ward the back part of the crown sub vocally. At the same time, raise the arms above the head with the palms pointing up. Release the energy through the crown and extend upward with your Chi, as though extending a pipeline toward the North Star. Feel it go up through the sky, through the earth's atmosphere, out into space; keep going until it reaches the North Star You will know you have made the connection when you are aware of the violet light of the North Star, or feel some other sensation or pressure on the crown. Do this 9 to 18 times. Rest and feel the sensation as pressure as energy is absorbed into the crown (Fig. 11.7).

Be aware of the center of the crown and the Big Dipper. Use the Triple Warmer sound as above to help activate the energy of the Big Dipper's seven stars and draw in the red essence of the Dipper. Do this 9 to 18 times (Fig. 11.8).

4. Look up and begin to move the trunk of your body in a circular pattern. Feel that you are creating a vortex of energy above your head as you circle. At the same time, turn the palms downward and angle them so they point toward the back of the crown. As you circle the body, feel relaxed and open. Picture the North Star, and let its light come to you, the violet light of unconditional love. Allow it to flow into the back of the crown and deeper inside, to the pineal gland. Feel it energizing, cleansing, and refreshing your brain.

5. Be aware of the red light of the Big Dipper. It is the higher astral fire of the earth. Picture the Big Dipper, and let the red light come to you. Let it flow in through the middle of the crown and into your brain, then down into your whole body. Feel your blood energized by it. The natural polarity to this astral fire is the blue water energy of the earth. Breathe in the blue light and let it neutralize the red light and gather this original energy at the Tan Tien.

6. Be aware of the universal violet light of the North Star flowing through the crown and down into the body. It may help to visualize a violet pearl at the crown, which you rotate in both directions. Now spiral the violet light down into your brain, first 9 times clockwise, then 9 times counterclockwise. The natural polarity to this universal violet light is the white light of your individual (Po) soul. Allow them to mix at the solar plexus. Rest for a few moments. Enjoy the peaceful, joyful feeling. Let the light flow anywhere in your body that needs healing (Figure 11-9).

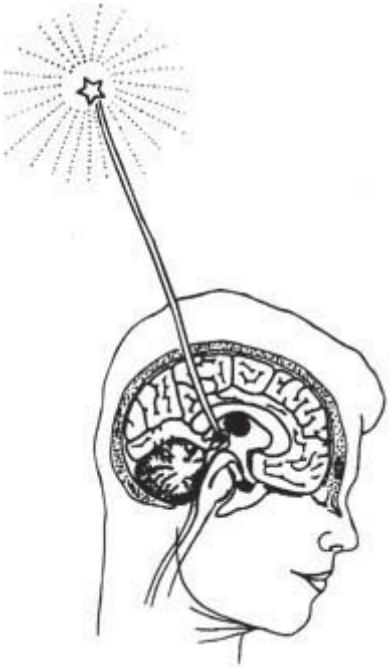

Fig. 11.7 *The pineal has a close conection to the North Pole and north Star.*

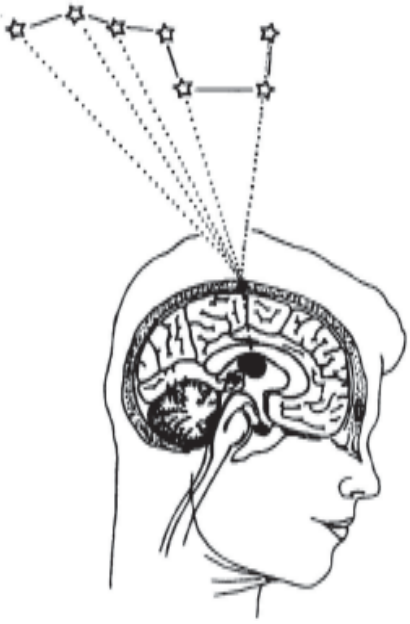

Fig. 11.8 *The thalamus and hypothalamus connect*

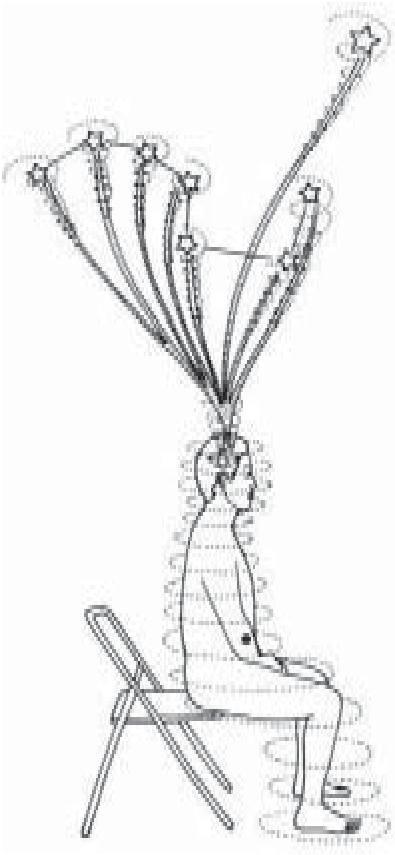

Fig. 11.9 *Spiral violet and red light energy through the whole body.*

F. Connecting the Crown to the Mid Eyebrow

1. Be aware of the crown and the mideyebrow point.

2. Inhale as though you were breathing in through the crown point; draw the violet light of the North Star in with the breath to the Crystal Room. Then exhale through the mideyebrow point.

3. Be aware of the golden light in front of you, the energy of mountains, oceans, lakes, waterfalls, and forests. Breathe that energy in through the mid-eyebrow point to the Crystal Room. Exhale through the crown. Repeat these last two steps 3 to 9 times (Fig. 11.10).

Then rest. Feel the line of connection between the crown point and the mideyebrow point.

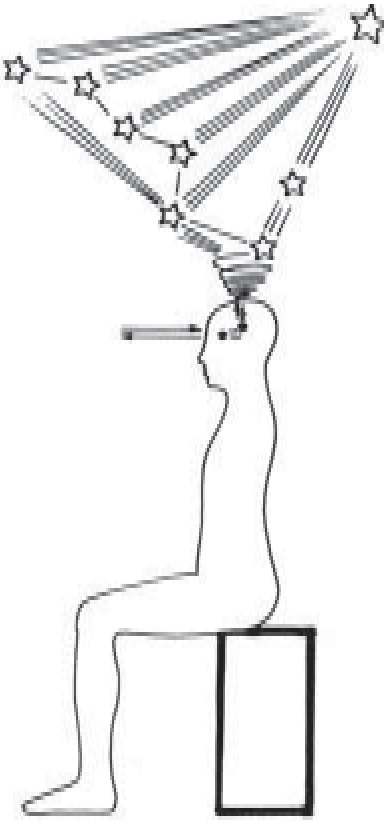

Fig. 11.10 *Make connections from the crown to the mideyebrow.*

G. Bring the Energy Down the Functional Channel to the Navel

Heavenly Energy is very Yang. The brain is also naturally Yang, because it is the part of the body that is closest to heaven. When we bring more Heavenly Chi into the brain to nourish the body, it is especially important to circulate this energy, to bring it down to the navel and to ground and balance it with the more Yin energies in the body. Then this energy can be very beneficial.

If you leave this Yang energy in your head, your brain may become too Yang. You may feel headachy, dizzy, space, lightheaded, or notice a sense of heat or pressure in your head. In the following steps, you will learn how to take extra care to bring the energy down.

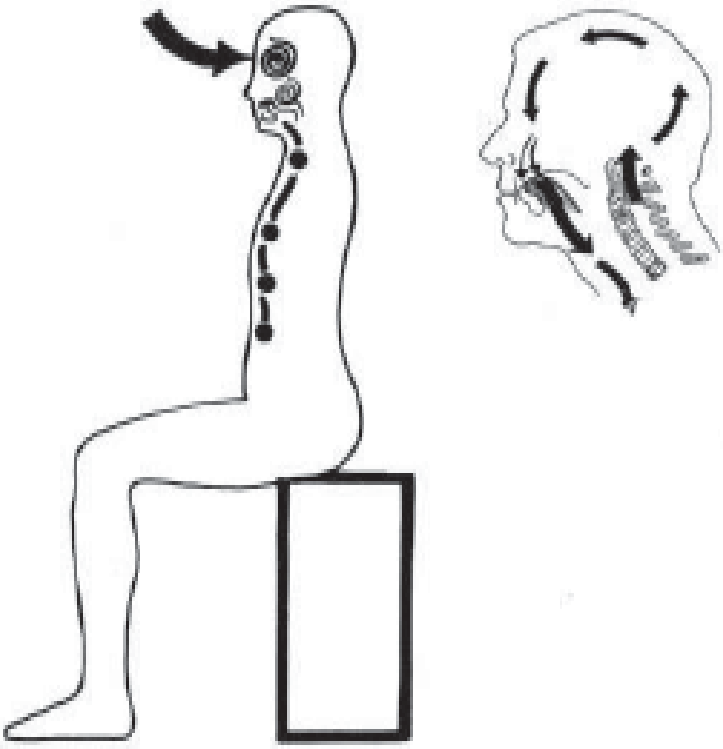

Fig. 11.11 *Touch the tip of the tongue to the roof of the mouth.*

1. Touch the tip of the tongue to the roof of the mouth. Inhale lightly (Fig. 11.11), and press the tongue against the palate. Exhale and relax the tongue as you condense the energy. Repeat 18 to 36 times. Lightly touch the tongue to the palate. Move the tip of the tongue from the front of the palate slowly toward the back until you feel the sensation of Chi contact: vibration, metallic taste, electric shock, tingling, or even slight pain. The tongue has an opening and will draw the Chi down.

2. Swirl the tongue around the gums and generate a pool of fluid; we call this the Jade Nectar, the high-potency Yin fluid of the body. Gather the Heavenly Chi into this fluid, stirring the Yang energy in with the Yin fluid. Swallow, and let the energy flow back down the Functional Channel through the throat point, heart point, and solar plexus. Use the mind and eyes to spiral at each point until you feel the points open and connect to each other.

3. Rotate a white Chi ball at the solar plexus and be aware of the

bright sunshine radiating from it (Fig. 11.12). Feel it connect to the larger sun above you. Let the bright light shine out from the solar plexus. You can focus it like a spotlight to strengthen any weak areas in your aura.

4. Place the right hand in front of the solar plexus, palm in, and feel the radiance of the light. Inhale; draw the white light of your earth (Po) soul into the mid-eyebrow and solar plexus. Exhale and condense the energy there. Rest, and let the energy expand and radiate from the solar plexus to the palm. Eventually, you can move your palm farther away and still feel the light. Do this 9 to 18 times.

A strong solar plexus will strengthen your spiritual willpower and will help protect you from the negative energy of others. You also can send your sunshine to other people when you connect with the unlimited source of light. This will help change the negative energy they direct toward you. The radiant white light of the solar plexus will make you more visible to higher forces, and the higher masters will be able to identify you and protect you more easily.

5. Go slowly, spending enough time at each point to feel it open (Fig. 11.13), and to feel that you have strongly drawn the energy down from the previous point. Feel the Chi flowing down like warm honey, filling each point with radiant, glowing energy. Notice a pleasant and expansive sensation in each point. If you wish, you can also use the power of the Inner Smile to relax, open, and further energize each point.

6. Finally, bring the energy back to the navel.

7. Now just be aware of the Original Force, and rest. Feel the pulsing at the place of your Original Force. Keeping 95 percent of the awareness on the Original Force, put 5 percent of the awareness on the soles of the feet, the crown points, and the mideyebrow point. Feel the pulsing. Feel that the Original Force has a suction force to pull energy into it, to absorb that energy and merge with it. (Please see Fig. 2.9.)

8. If you complete the steps above and still feel you have a great deal of energy in your head, repeat the steps again as many times as necessary, and use the hands to help guide the energy back down. Remember that the left hand will draw energy toward it, and the right hand will move energy away. Therefore, you should place the right hand on the place where the energy is stuck, and place the left hand on the center toward which you want to guide the energy. This will enable you to bring the excess energy back down to the navel.

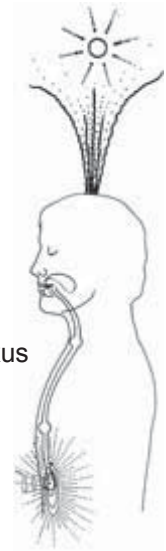

Fig. 11.12 *The solar plexus connects to the white light and radiates out.*

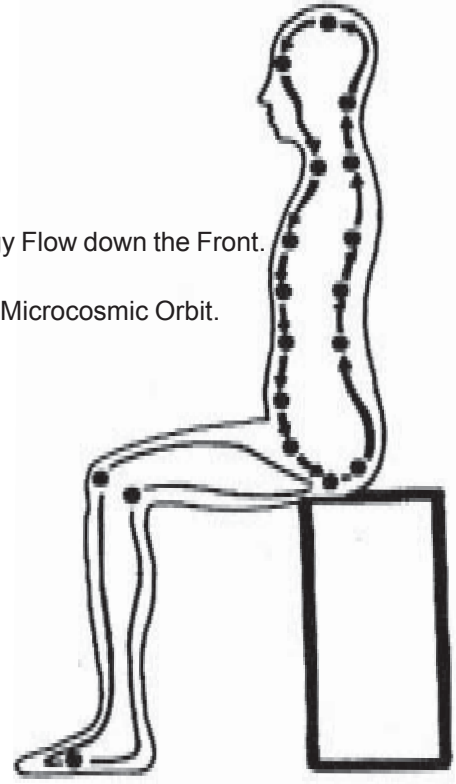

Fig. 11.13 *Chi flows in an orbit.*

H. The Yin Stage: Resting in Wu Chi

Then rest. Allow yourself to sit peacefully in total blackness and be open to receiving the clear light of the Original Chi. Whatever happens, let it happen; let the energy flow as it will. The energy may move to other parts of the body. Don't try to direct it; allow the intelligence of your life-force to nourish and heal the body according to its own wisdom. Be careful not to fall asleep; you can lightly open the eyes. Just relax, be neutral and open, and absorb the fruits of your practice: a deep feeling of peacefulness, an expanded alertness, and a pleasant sense of well-being. Spend at least 5 to 10 minutes at this stage.

Ending the Meditation

Conclude your practice by placing the hands over the navel and collecting energy. Spiral outward 36 times at the navel, then inward 24 times to times to finish collecting the energy.

Finish with Chi Self-Massage, allowing the Chi to flow from the fingertips into the skin and organs. This will help relieve the stiffness caused by sitting.

Regularity

Practice at least 20 minutes a day consistently. Being consistent is the most important part of your practice. A little every day is better than a long session one day and nothing the next. Avoid extremes. If you go to one extreme, you will tend to swing to the other. Do at least a little practice every day, and you will continue to deepen your practice of the Universal Tao.

Overview of Advanced Microcosmic Orbit Practice with Healing Light

Preparations

1. Start with Chi Kung Warm-Ups.

2. Practice the Six Healing Sounds; see the color of each organ.

3. Focus inward with the Inner Smile.

4. Breathe in the white mist to cleanse the marrow of the spine and brain.

5. Activate your Original Energy: Warm the Stove

(a) Begin with Bellows Breathing.

(b) Activate and massage the kidneys and open the Door of Life.

(c) Activate and massage the sexual centers.

(d) Gather the Original Force in the lower Tan Tien.

Microcosmic Orbit Meditation

1. Circulate your energy through all the points of the Microcosmic Orbit.

2. Draw in the blue light of the Earth Energy.

3. Activate the mideyebrow and draw in the golden light Higher Self.

4. Open the heart with the Cosmic Inner Smile.

5. Combine sexual desire with pink loving energy.

6. Activate the Functional Channel from mideyebrow to sacrum.

7. Activate the Governor Channel from the sacrum to the crown.

8. Draw in the violet Heavenly Chi of the North Star and the red Chi of the Big Dipper.

9. Bring the energy down to the mid-eyebrow and solar plexus, and fuse it with the Original Chi at the navel.

Yin Stage

Rest in the blackness and be aware of the clear light of the Original Chi.

Collect the Energy at the Navel.

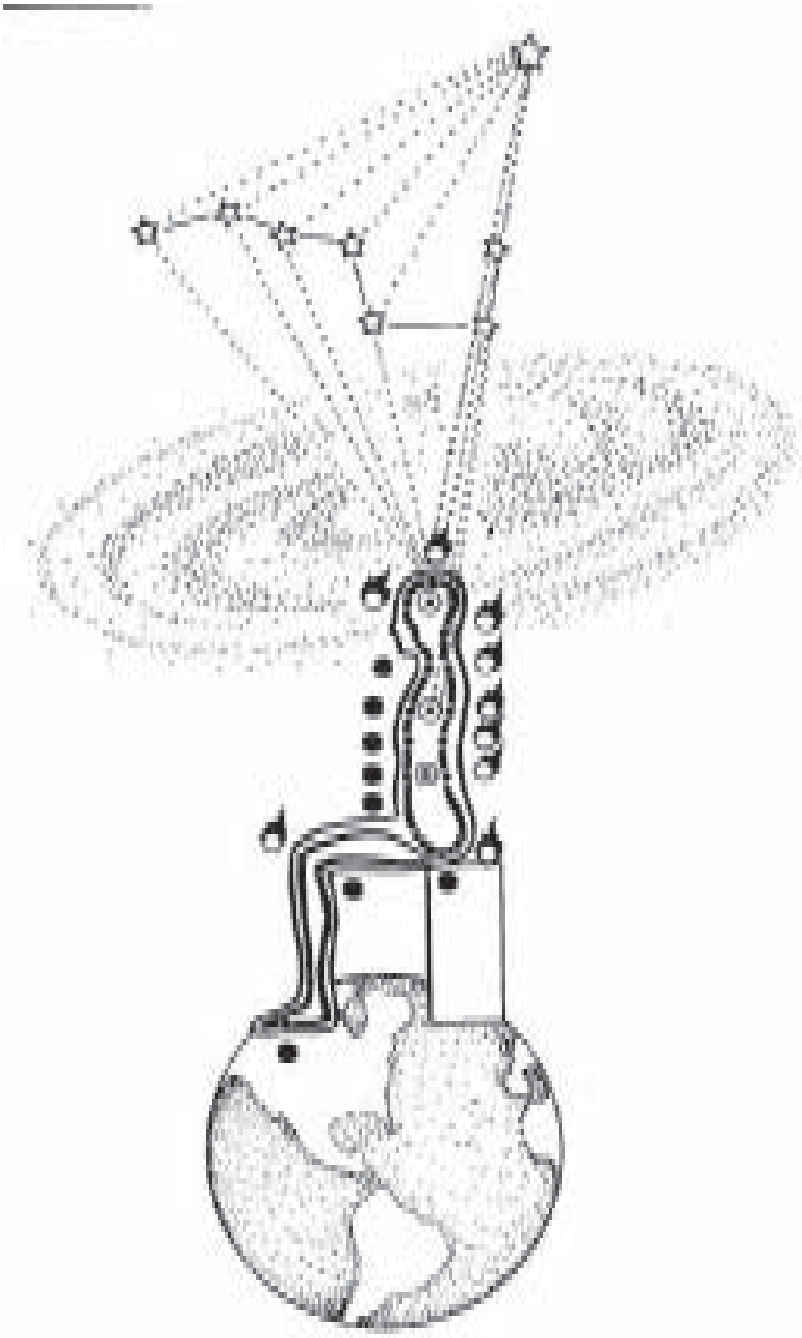

Fig. 11.14 *Feel yourself in touch with the universe,cosmic, and earth force.*

Chapter 12
Summary

In Chapters 6 through 11, we have outlined the practice of the Microcosmic Orbit step by step, from basic to advanced. In this chapter we present a summary of the entire practice.

Guidelines for Practicing the Microcosmic Orbit

The Seven Phases of the Microcosmic Orbit

In the first few weeks after having been introduced to the entire Microcosmic Orbit meditation, it is very important that you try to practice diligently. You can divide your practice into several sections. Your training should be progressive—that is, once you have mastered one section, you can progress to the next. Be sure to spend at least one or two weeks on each section, allowing enough time to master each part thoroughly before adding the next section. Remember that you should always do the Chi Kung Warm-Ups before beginning meditation; it is very important to loosen the spine before meditation.

We have divided the entire Microcosmic Orbit practice into seven phases.

1. Warming the Stove: Activating the Original Energy in the Lower Tan Tien. The first phase is the practice of activating your Original Force. You should practice this phase for one to three weeks or more if you need to, until you can actually feel the Original Energy. Once you do feel the energy, practice circulating it in the basic Microcosmic Orbit.

Many people who open the basic Orbit circulate at the outer level of the skin or aura. Regardless of whether you are just beginning or have been practicing for years, it is possible to circulate the Orbit so that it penetrates more deeply into the organs, bone marrow, and brain. As you penetrate more deeply, your aura will extend outward and you will become more radiant. Simultaneously, your capacity to absorb the various energies, such as Heaven and Earth Chi, into the Orbit will increase.

Your practice will become simpler with time. Once you have gained some experience with circulating through the Orbit, you can go through the entire basic Microcosmic Orbit in two breaths: inhaling up the spine and exhaling down the front. Many beginners open the Orbit after practicing the Inner Smile and the Six Healing Sounds, using this two-step breath method to "kick-start" the Microcosmic Orbit and activate the two channels. This practice can be enhanced by rocking back and forth: rocking back as you inhale up the spine, and rocking forward as you exhale down the front. This rocking can be done sitting or standing.

The Two Step Breathing method can be expanded to include tapping into the universal wells of energy in nature. We have outlined more advanced Nine Breath and Five Breath methods at the end of this chapter.

2. Connecting to the Mother Earth Force. The second phase begins with the Chi Kung Warm-Ups, Warming the Stove, the Inner Smile, and activating your Original Energy, and then focuses on connecting to Mother Earth Energy. The grounding techniques you learn at this stage are absolutely essential to the subsequent stages of the Microcosmic Orbit. Earth Energy is the first of the Three Forces that you will connect with, so it is vital to spend one to three weeks at this stage until you can begin to strongly feel and assimilate the Mother Earth Energy. Real rooting of the entire body is a discipline learned in Iron Shirt and Tai Chi Chi Kung and takes years to master fully.

Once you have successfully activated your own center of Original Chi and have established your grounding by connecting to Mother Earth Energy, spend at least one week circulating whatever Chi you have been able to gather through the basic Microcosmic Orbit. It may still feel very faint at this point; you may only feel it in a few places, such as the navel, Third Eye, or sexual center. Don't be discouraged. Often some of the energy will be circulating, but you will not be able to feel it at all the points. The goal is to change the flow from a small stream of Chi into a strong river. This happens gradually over time with regular practice; the practice will naturally deepen.

3. Activating the Higher Self (Cosmic) Energy and the golden light ball. In the third phase you begin widening and charging the Microcosmic Orbit by drawing in the Higher Self frequency through the Third Eye point. It is essential that you absorb and

digest this higher-level frequency by grounding it with Earth Energy at the navel and feet and fusing it with Original Chi at the Tan Tien, then circulating this mixture in the Orbit.

4. Opening the heart with the Cosmic Inner Smile. The fourth phase teaches you to use the power of the Cosmic (Higher Self) Energy to help open the heart. You also use this energy to enhance the Inner Smile. This further amplifies and deepens the purification and transformation of the emotional energy; it changes the quality of energy flow in the Orbit.

5. Clearing the Functional Channel and connecting the three Tan Tiens. In the fifth phase, you concentrate on deepening the flow of Chi in the Functional Channel (Conception Vessel) and on opening and connecting the heart with your sexual energy. The Functional Channel is the channel for the flow of Water or Yin energy, which softens and dissolves blockages in your basic Orbit.

6. Clearing the Governor Channel and connections to the Heavenly Chi. In the sixth phase, you strengthen the opening of the Governor Channel, bring the energy up to the crown, and connect with the Universal Force. The powerful light burns out impurities in your basic energies.

7. Connecting the crown and mideyebrow and joining the two channels. The seventh phase connects the Governor and Functional Channels and brings the energy back down the front to the navel, balancing Water and Fire, Yin and Yang.

Once you have completed these seven phases, you practice them all together.

Deepening the Microcosmic Orbit: A 100-Day Training Program

To master the seven phases of the Microcosmic Orbit, we recommend a 100-Day Training Program. By spending about two weeks at each phase, you can complete all seven stages in about 100 days. This program will benefit anyone seeking to improve his or her life and health and to circulate the Orbit at a deeper level. Everyone is at a different level of practice. Some who have had a great deal of meditation experience open up the Orbit with a few hours or days of practice. Although it may not take a full 100 days to experience results at the various stages, it is still helpful to follow the program to deepen and reinforce your understanding, and abilities in the practice.

Diet. During the 100 days of the program, you should eat a diet high in fiber, whole grains, fresh vegetables, and fruit. Limit intake of meat, poultry, fats, caffeine, and dairy products. This helps clean out your system, gives you more energy, and aids in the purification of your energy.

Sex. For best results, you should conserve your sexual energy during the 100 days. If you dissipate your sexual reserves, you will not have enough sexual energy to transform into Chi. Healing Love practice is very important.

Rest. Try to work less, rest more, and practice the Inner Smile throughout the day to reduce your level of stress. This helps conserve energy to enhance your practice.

As Your Practice Matures, Your Energy Will Move More Quickly and Easily

At the beginning, it is important to go through the steps of the Microcosmic Orbit meditation slowly and carefully in detail as you have been instructed in this book or in the workshop. As you mature and grow in your practice, however, you will find that your experience changes. One of the first changes you will notice is that you can do the practice more quickly. Your neural pathways become trained. As they become familiar with the meditation the more you practice, they will begin to activate very quickly and easily.

Another change you will notice is that your energy will begin to flow more readily. You will find you can move your energy more and more using mind power alone. When this happens, you can dispense with whatever methods seem unnecessary; you need no longer use your hands, Small Sip Breathing, or spiraling at the different points. It is fine to use these methods if you wish, but once you have reached the stage where you can move the Chi with your mind alone, the other methods are no longer an essential part of the practice.

Your Energy Will Flow Smoothly Without Stopping at the Points

You may also find that your Chi will flow smoothly through the Microcosmic Orbit by itself, with no conscious effort on your part and without stopping at any individual points or centers. This is a good sign. The most important sign of increasing skill is that your energy flows smoothly and with little effort through the pathways. After you

have the steps, you need not concentrate on each point as you move through the Microcosmic Orbit; you can simply let it flow. However, it is fine to spend more time at places you want to energize or heal.

SUMMARY
Open the Basic Microcosmic Orbit: Mind/Eye Rotating, Touching, Breath, and Color

We suggest you try using all the modalities to discover which ones work best for you.

1. Spiral or rotate a Chi ball at the points with the mind and eyes.
2. Touch the points with the fingers to draw Chi to the physical body.
3. Hold the hands a few inches away from the body to increase the flow in the aura energy field and draw in the outer energies.
4. Focus on the breath as you move it around the Orbit.
5. Visualize different colors to stimulate your energy body and to help open the Microcosmic Orbit.

It is not necessary to use every single method; in the beginning, choose the technique that appeals to you most. These techniques are only for training your body/mind and can be dropped once you have established a sense of the Chi flow. If you fix on any one method, such as breathing, you will limit your growth later on and may prevent the quality of your Chi flow from deepening. Eventually the feeling you are seeking to generate from these methods will be there effortlessly and spontaneously.

Chi Kung Warm-ups

Do Spinal Cord Breathing at least 9 to 18 times. Do the Crane Neck exercise, then Spine Shaking and Spine Rocking to the left and right. Rest. Picture the spine open and relaxed. Breathe a white mist into the bones to brighten, strengthen, and wash the spinal cord and bones. Breathe in a golden mist to strengthen and wash the marrow. When you exhale, feel that you are breathing out a cloudy gray mist, letting go of all impurities and diseases and any kind of negativity.

Sit in good meditation position on a chair. Then take a few minutes to focus and prepare yourself.

Become aware of your surroundings. Feel the sensation of your feet touching the floor, of your clasped hands, of the chair beneath you. Be aware of the sounds inside the room, outside the room, and within your body.

Be aware of the breath. Feel the body naturally expand as you inhale and contract as you exhale. This increases the flow of blood and Chi. Breathe in and out with awareness, feeling the veins and arteries expand and contract. Do this Veins and Arteries Exercise 18 to 36 times.

Activating Your Original Energy: Warming the Stove

Activate the Navel Chi

Begin with Bellows Breathing, at least 18 to 36 times. This activates the energy. Rest, and use mind/eye power to gather the energy into a Chi ball. Store the energy by condensing it into a Chi dot or pearl at the navel.

Open the Door of Life Between the Kidneys

Inhale, and pull the stomach in toward the right kidney. Spiral with the whole body into the kidney. Feel the energy activate in the right kidney and the Door of Life. Then do the same with the left kidney. Do this at least 18 to 36 times on each side. Cover the kidneys with both palms to gather the Chi in the kidneys and condense it into the Door of Life. Feel the Door of Life open and warm.

Place the right hand over the navel and the left hand over the Door of Life. Feel the Door of Life, kidneys, and navel become warm. Inhale, and gather the energy into two Chi balls with mind/eye power. Exhale, and condense it into two Chi pearls in the kidneys.

Activate the Sexual Center (Ovarian or Sperm Palace)

Women: Transform Blood into Chi

(1) Rub the hands together until they are warm. Cover and press the breasts with the palms, and start to massage outward.

Circle inwardly up and outwardly down 18 times. Rest and gather the sexual glands, and breast energy at the heart center. Do two to three sets.

(2) Reverse the direction for 18 repetitions and gather the force back into the heart center. Make a connection to the back, on both sides of the spine between the T-5 and T-6 spinous processes, and bring it down the spine to the kidneys and the Door of Life. Do two to three sets.

(3) Massage and lightly shake the kidneys 9 to 18 times. Rest; cover the kidneys and feel them warm. The massaging, shaking, and resting is one set. Do three sets.

(4) Move the palms down to the lower abdominal area and massage the ovaries and the waist (liver and spleen area). Start in an outward direction. From the lower part, circle in and up to the top, and back out and down 36 times. Then reverse the direction and massage 36 times.

(5) Move the palms to cover the sexual center. Using mind/eye power, lightly contract the circular iris muscle and the muscles around the eyes. Feel them stimulate the vagina and anus to lightly contract as well. This helps gather the sexual energy you have activated in the Ovarian Palace.

(6) Pause for a while. Feel the energy expand at the sexual center.

Men: Transform Ching (Sperm) into Chi

(1) Rub the palms together until they are warm. Massage and lightly shake the kidneys 9 to 18 times. Rest and feel the kidneys warm. This is one set. Do three sets.

(2) Make the connection from the kidneys to the sexual organs.

(3) Rub the hands together until they are warm, and massage the testicles 18 to 36 times. Rest; gather and condense the energy in the center of the scrotum. Do two to three sets.

(4) With the left palm, hold the testicles; with the right palm, massage the lower abdomen up to the navel and circle downward in a clockwise direction 36 to 81 times. Rest and feel the energy. Reverse the hand positions and the direction of the circular massage. Now the right palm holds the testicles and the left palm massages in a counterclockwise direction 36 to 81 times.

(5) Move the palms to cover the sexual center. Using mind/eye power, lightly contract the circular iris muscle and the muscles around the eyes. Feel them stimulate the perineum, sexual or-

gan, and anus to lightly contract also. This helps gather the sexual energy you have activated.

(6) Pause for a while. Feel the energy expand at the sexual center, the Sperm Palace.

Gather the Force in the Lower Tan Tien

Cover the navel with the right hand and place the left hand over the sexual center. Feel the navel, sexual center, and Door of Life warm. Breathe a small sip into the navel, breathe into the Door of Life, and then breathe into the sexual center. Breathe into each spot and exhale, but retain the essence of the breath at each place. Gather a Chi ball in the navel, the Door of Life, and the sexual center. Condense them into three Chi dots or pearls and draw them into the Lower Tan Tien, merging them to form one Chi ball. Feel them condensing together.

Stop the leakage of energy and conserve the Chi. Fix 95 percent of the awareness and senses on the Chi ball in the Tan Tien, 5 percent on the navel, Door of Life, and sexual center. Using mind/eye power, lightly contract the circular iris muscle and the muscles around the eyes. Lightly close the sexual organ gate and the anus. Exhale down and feel a pressure created at the Tan Tien. Exhale, and feel that you can condense and retain the essence of the breath at the center.

When you can hold your mind and eyes and feel the lower gates all seal toward the Original Force, you will feel you have “stopped the leakage and conserved the Chi.” You can practice this at any time in your daily life. Whenever you feel tired, turn the mind and eyes inward to the Lower Tan Tien and lightly close the sexual organs and the anus. You will immediately feel an increase in your Chi energy.

Spend at least 10 to 15 minutes at this stage to allow the Original Energy to build up in the Tan Tien. Feel it pulsing and breathing inside. If you want to finish, gather the energy in the navel.

Connecting to Mother Earth Energy

1. First increase the Original Force by fixing the mind and eye power there. Look for the sensation of vibration and pulsing and the feeling that the Original Energy has a mouth and nose and is breathing along with you. Feel the vibration and the

breathing; the vibration may start to extend up to the mideyebrow point, crown, palms, and soles.

2. Turn the palms facing the ground. Inhale, pull up, and very lightly contract the eye muscles, sexual organs, perineum, and anus. Exhale, and completely relax the sexual organs, perineum, and anus. Repeat 9 to 18 times. Feel the suction in the palms and soles of the feet.
3. On the last exhalation, breathe out into the fingers and toes. If you have any sick energy or negative emotions, you can purge them out and let them drain into the tips of the fingers and toes. Let the sick energy drain down into Mother Earth.
4. Feel the qualities of Earth Energy: a nice, soft, gentle, kind blue energy rising up through the legs like a mist from the earth to your Original Energy in the Tan Tien.
5. To sedate the heat of the heart and tonify the kidneys' Yin, do the Heart Sound, ***Hawwwwww***. From the heart let the sick or excess heat spread to the inside of both arms and leap down to the tips of the fingers and toes. Do this 6 to 9 times. Feel the heart cool down. Rest, and be aware of the soles of the feet. Feel the qualities of Mother Earth Yin-nice, soft, gentle, kind, blue energy rising by itself like a mist through the legs to the kidneys and the Original Energy in the Tan Tien. Spend at least 5 to 10 minutes at this stage to allow the Original Energy to build up. Feel it pulsing and breathing inside, and draw the Mother Earth Force in and up to the Original Force.

Activating the Mideyebrow and Drawing in the Higher Self (Cosmic) Energy

1. Feel your Original Energy expand from the Tan Tien until it begins to activate the mideyebrow. Lightly raise the hands to face out, or if you wish, you can touch the mideyebrow with the tips of fingers and spiral there. Spiral with the mind and eyes as well.
2. Expand outward and connect with the forces in nature: the ocean, sunset, full moon, forests, waterfalls, mountains, lakes, clouds, thunder. Feel yourself connecting with this ion-rich energy and draw it into your mind's eye as a glowing golden light. Breathe that golden light into the mideyebrow, eyes, and mouth. Feel the energy build up; feel it condense into the saliva.

3. Swallow the energized saliva. Feel it go down as a form of golden liquid Chi and merge with your Original Energy, strengthening and adding to your supply of Chi.
4 Imagine gathering the golden light in the coccyx. The golden light then rises up through the spine, up to the crown, Feel the golden light expand and cover the whole body; feel the whole body covered and protected by a golden ball of light energy. Put the hands over the heart. Feel that you are sitting safely in the golden light. Any negative feelings directed toward you, or any psychic attack, will be deflected by the golden light.

Opening the Heart: Cosmic Inner Smile

1. Now do the Heart Sound to clear out any negative emotions. Inhale, and exhale making the Heart Sound, ***Hawwwww***. The sound helps activate the flame to burn out any negativity in the heart. Rest, and feel the heart open. Repeat the Heart Sound at least 6 times.
2. Place the palms in the prayer position, facing each other at the level of the heart. Feel love, joy, gentleness, and kindness radiate out to the lungs. If you have a favorite affirmation for loving yourself and others, you may use it here.
3. Do the Pleasant Fragrance meditation. Open the hands like a flower blossoming, and smell the fragrance of the loving energy in your heart. Smell the joy and happiness energy; breathe in the fragrance of the gentleness and kindness Chi. Let it radiate to the lungs. Smile and draw in more cosmic golden light down to the lungs, and feel the courage in the lungs activate.
4. Radiate more loving energy from the heart to the liver, spleen and pancreas, kidneys, and sexual organs, in sequence. Feel the organs relax and open, and notice the positive qualities of the energy as each one smiles back to you. Allow the heart to receive and absorb the energy of each organ. Feel the heart glow even more strongly.
5. Middle line: Smile the cosmic golden light down into the digestive system. Gather the saliva in the mouth and radiate the cosmic smiling energy into the saliva, transforming it into a soothing, healing nectar. Swallow the saliva, smiling into it as it flows down to the stomach; feel it soothe and refresh the esophagus. Finally, smile down to the intestines and anus. Express

your gratitude for their important role in maintaining your good health.

6 Back line: Draw in more cosmic golden light and smile into the brain. Move the eyes as if looking back inside the brain and spiral the Chi in the brain with mind/eye power. Smile down the spine from the cervical vertebrae to the coccyx. Feel the spinal cord open, loose, and filled with light.

Combining Loving Energy with Sexual Desire

(1) Smile once again to the heart, and feel the heart radiate more loving energy down to the sexual organs.

(2) Inhale into the heart center. Feel the heart open and more love, joy, and happiness radiate from it. Hold for a while and swallow the saliva down to the heart. Exhale down to the sexual center. Feel the fire of your loving heart energy coming down to activate and blend with the cooler water of your sexual energy, transforming it into blissful orgasm energy. It may also feel like an expansive light, a heightened or tingling feeling of energy, or a rising warm mist. Do this 6 to 9 times.

(3) Be aware of the sexual organs. Women: inhale and lightly contract the vagina. Men: inhale and lightly pull up the testicles. Feel more loving energy floating down from the heart to combine with your sexual energy. Gather the force into the sexual center.

(4) When you feel you have gathered enough energy at the sexual center, use the mind's eye to create a luminous pink pipeline from the sexual center up to the heart. Inhale again into the heart and inhale love down the pink tube into the sexual center. Hold for a while, then exhale up the tube to the heart center. Do this 6 to 9 times. Rest and breathe naturally Feel the pipeline from the sexual organs to the heart. Feel the sexual passion expanding the heart's loving energy.

(5) Feel the heart and sexual energies pulsing together into a gentle orgasmic energy. Feel them radiating a pink light, and bring the energy into the Original Force.

(6) To develop this phase more deeply, refer to the practices of Testicle/Ovarian Breathing and the Power Lock exercises in the Healing Tao books on male and female sexual practices.

Opening the Functional Channel: Connecting the Three Tan Tiens

In this part of the practice, we want to clear the space between the Third Eye, heart, and navel and connect from the mideyebrow to the perineum along the path of the Functional Channel. For best results, spend a week connecting the mideyebrow to the heart, and then up to a week connecting the mideyebrow to the navel, sexual center, and perineum. As soon as you feel the connection at one point, allow the momentums of the energy flow to continue to the next one. Those with high blood pressure or insomnia should focus only on the navel and soles of the feet.

1. Feel the pulsing and breathing between the navel and kidneys. Draw more energy in from the mid-eyebrow
2 Inhale into the mideyebrow and rotate. Gather a mouthful of saliva and merge the golden light into the saliva. Swallow the saliva as you exhale down to the heart. Rest, and feel the mideyebrow connect to the heart center. Do this 6 to 9 times.
3. Inhale into the mideyebrow hold and rotate for a while. Inhale a small sip down to the heart and hold for a while. Exhale up to the mideyebrow. Rest, and feel the space in between has been cleaned out. Do this 6 to 9 times.
4. Inhale to the mideyebrow and down to the heart, and exhale to the navel center. Do this 6 to 9 times. Reverse the process, inhaling from the mideyebrow down the front channel to the navel and exhaling to the mideyebrow. Rest, and feel the space in between has been washed out and opened. Use mind/eye power to gather the energy into the three Tan Tiens, and feel them pulsing and breathing together.
5. Repeat the above procedure with the sexual center. Inhale to the mid eyebrow, heart, and navel and exhaling to the sexual center. Reverse by inhaling to the mideyebrow, heart, navel and sexual center and exhaling to the mideyebrow. Do this 6 to 9 times.
6. Repeat the same procedure with the perineum.
7. Repeat the same procedure with the toes. Inhale all the way to the perineum and exhale down to the toes. When the perineum center is activated, it works like a powerful suction pump. When you contract and pull up the perineum, it automatically draws down the Cosmic Energy from the mideyebrow, which you can then release down to the earth.

Opening the Microcosmic Orbit and, Connecting All the Points

Activate the Original Energy at the Lower Tan Tien

Return to your awareness of your Original Energy at the Tan Tien. Feel it pulsing and breathing. Focus there until again feel your Chi pulsing or vibrating from the Tan Tien up to the mideyebrow.

Open the Governor Channel

In this phase we connect from the perineum up to the crown and the mideyebrow. Spend a few days moving the energy to each point, until you feel some connection and opening: from the perineum up to sacrum, Door of Life, T 11, and C-7. Some people may need to spend more time. Spend up to a week moving the energy from the perineum up to the Jade Pillow and back part of the crown, and a few more days to move it from the crown down to the mideyebrow. Students who have previous experience with meditation will find they progress much more quickly.

1. Inhale, and lightly pull up the perineum, and feel it draw the energy down from the mideyebrow. Inhale again, and draw the Earth Force from the ground up until it meets mid-eyebrow energy at the perineum. Hold for a while. Inhale a small sip, and contract the anus and sexual organ up to the coccyx and the sacrum. Hold for a while. Rotate a Chi ball at sacrum, then exhale down to the toes. Rest, and feel all the points on the channel from the mideyebrow down to the toes are connected.
2 You can stimulate the movement of energy up the Governor Channel by using small sips of breath between the points. Inhale up to your Door of Life and hold for a while. Then exhale down to the fingers and toes and feel the navel, sexual center, perineum, soles of the feet sacrum, and Door of Life pulsing and connecting.
3. Do the same with the T-11 center 6 to 9 times.
4. Do the same with the C-7 center and up to the Jade Pillow point, touching and rotating at each point.
5. Rest a moment, and then inhale up to the back part of the crown point. Raise the hands above the head with palms facing up. Keep the spine and neck straight as you turn the eyes up and use the OM sound or the ***Heeeee*** sound. Feel a vibration go up

the spine, and feel yourself connecting the energy of the North Star to the back part of the crown and the Big Dipper to the center of the crown. The violet and red light descending to you is the love of Father Heaven. Feel you are like a child returning to and resting in the Fatherly love again.

6. Turn the palms to face down toward the crown. Feel the palms projecting energy down into the crown. Rotate the energy into the crown with your head eyes, and palms. Feel the crown open. Be aware of a pipeline connecting the back part of the crown to the North Star and the crown to the Big Dipper.
7. Turn the palms down toward the mideyebrow. Feel the palms projecting more Chi into the mideyebrow to help open the mideyebrow and connect to the crown.

Allow the Chi to Flow Down the Functional Channel

1. Now direct the Lao Gong points in the center of both the palms toward the face, and feel the energy descend to the palate point. Use the mind eyes, and hands to rotate at the palate point. Knock the teeth and press the tongue to the palate 9 to 36 times each.
2. Lower the hands. Line up the Lao Gong points of both hands and direct the palms toward the throat center. Inhale through the nose, then exhale into the throat center. Feel the palms project energy into the throat center, opening the center, and use the mind, eyes, and hands to spiral at the throat center.
3. Continue down the Functional Channel in this way, using the palms' energy in combination with the mind and eyes to open the heart point. Inhale into the throat center, and exhale down to the heart. To activate the flow of Chi to the heart, either cross the hands at the wrists with the fingers touching the heart, or hold them a few inches away. Be aware of the red color at the heart point.
4. Move the hands down to the solar plexus point. Touch the point with all 10 fingers, then slowly pull them away from the body, rotating with the mind only Inhale into the heart, and exhale into the solar plexus point. Feel a bright sun inside, and gradually radiate it to protect you and your aura.
5. Activate the five major pulses. Line up the palms and focus them toward the navel. Feel the palms activate more Chi in the navel. Inhale into the solar plexus point, and exhale to the navel.

Put the mind 95 percent on your Original Energy (Lower Tan Tien) and turn your eyes, mind and heart toward the Lower Tan Tien. Lightly contract the sexual organs, perineum, and anus. Feel the Chi ball expanding from the navel and starting to vibrate the crown, mid-eyebrow perineum, soles, and palms. If you have time, spend 10 to 15 minutes at this phase alone. The more you can feel your Original Energy activate, the more you will be able to heal yourself and maintain vibrant health.

6. Lightly use the mind to guide the flow in the Microcosmic Orbit down to the perineum, up to the sacrum, and up to the crown. Gently draw down more Heavenly Energy to the palate. Press and relax the tongue against the palate and feel the energy come down to the throat center, the heart center, the solar plexus center, and back to the navel. Do the circulation for 18 to 36 orbits.
7. Continue circulating energy around the Microcosmic Orbit in this way a few times. Do the circulation for 18 to 36 orbits. When you are ready to conclude your session, gently guide the energy back to the navel.

Yin Stage: Rest In the Original Chi

Rest. Just relax the mind and body. Find the neutral point in the center of the body; it could be at the navel, the heart, or the head, whatever feels the most neutral. Simply be there. Do nothing but absorb the fruits of having circulated the energy through the Microcosmic Orbit and having balanced your Chi flow. Allow the energy to do whatever it wants to do. It may reverse direction; it may flow to other areas of the body; the body may shake and vibrate; you may hear high-pitched sounds. Spend 5 or 10 minutes at this stage, giving yourself the chance to reap the fruit of your Microcosmic Orbit circulation: a sense of inner peace, calmness, and clarity. Let the physical body dissolve into your Original Chi, resting in the state of openness and emptiness, making no effort whatsoever.

Conclusion

Collect the energy at the navel by lightly spiraling at the lower abdomen 36 times outward from a small to a bigger spiral (clockwise for men, counterclockwise for women), and then spiral 24 times inward in the revere direction. Rest.

Rub the hands together until they are warm. Then rub your face with your hands. This is the best cosmetic there is. The hands are warm with the Chi from your meditation, so when you rub your face, it brings fresh energy to invigorate the flow of Chi and blood to the skin.

Finish with a thorough round of Chi Self-Massage.

Intermediate and Advanced Levels of the Microcosmic Orbit Meditation

Once you have opened all the centers and connected them, your mental powers will increase tremendously. As you practice more, you will find the Chi flows quickly and easily through the Microcosmic Orbit. At this stage, you can begin to streamline your practice. Instead of focusing on opening the centers, you will shift the attention to letting the Chi flow smoothly through the channels. The summaries that follow are simple guides to the practice of the Microcosmic Orbit once you have solidly opened the basic Orbit.

Nine Sip Breathing: Activating Internal Breathing

Start with Chi King Warm-Ups and Warming the Stove. Then you can go right to the Cosmic Inner Smile and opening the heart. Gather the energy into the Tan Tien.

l. Inhale, and draw the energy into the Tan Tien. Hold the breath gently for a few seconds without straining, and feel your Original Energy expand into the navel kidneys, and sexual organs.
2. Exhale, and release the energy down through the navel sexual center, perineum, legs, and toes into Mother Earth. Feel the soles of the feet pulsing as you hold the exhalation for a few seconds.
3. Inhale the cool blue Earth Energy up through the soles, legs, perineum, sacrum, and spine, all the way to the crown.
4. Exhale out through the crown and up to the North Star and Big Dipper. Feel the crown pulsing.
5. Inhale the violet and red light through the crown and spiral or rotate it around the top of the head and the brain.
6. Exhale out through the mideyebrow, connecting with the Higher Self Energy.
7. Inhale the golden light in through the mideyebrow.
8. Exhale the golden light down the Functional Channel to the navel.

9. Inhale into the navel and feel the energy merge and combine with your Original energy. Repeat the entire cycle. As you advance, the physical breath becomes less and less, and the internal breath and mind become more and more. The way to achieve this is to relax and spend more time in the neutral state or pauses between the inhalations and exhalations. You can continue to circulate in this way for 9, 18, or more rounds. If you like, you can simplify the practice even further as follows:

Five Sip Breathing: Connecting Heaven and Earth

1. Inhale, and expand the Original Energy at the navel with pulsing of the perineum, sexual organs, and kidneys.
2. Exhale from the navel out through the perineum, and down through the legs to the earth.
3. Inhale Earth Energy in through the soles, and perineum up the Governor Channel to the crown.
4. Exhale through the crown and connect to Heavenly Energy.
5. Inhale and breathe Heavenly Energy in through the crown and down through the Third Eye, palate, throat, and solar plexus to the navel. Feel it combine with your Original Energy.
6. Repeat the cycle by exhaling from the navel down through feet into the earth. You can continue in this way for as long as you like, balancing your own energy with the Yin and energies of Earth and Heaven. Gradually the outer breath becomes quieter, less important. As the breath quiets down so does the mind; you become more aware of circulating these energies from the effortless stillness of the mind. Enter the Yin stage, and rest in Wu Chi. End the meditation by gathering the energy at the navel Conclude with Chi Self-Massage.

Circulating the Light in the Orbit

Now you will use only the mind and inner eye to guide the Chi through the Microcosmic Orbit. Do not follow any breathing patterns; allow the body to breathe with its own natural rhythm.

1. Repeat all the preparations, Chi Kung Warm-Ups, and the Inner Smile. Then breathe the white mist into the bones to brighten and strengthen the spinal cord, bones, and marrow. When you exhale, feel you are breathing out a cloudy gray mist, letting go of all impurities, diseases, and negativity.

2. Activate the pulsing of your Original Energy at the Tan Tien. At this stage, simply focusing the awareness on your Original Energy at the Tan Tien should activate the pulsing of your Original Chi. Spend as much time as you can Warming the Stove. See if it begins to glow or radiate with a white or golden light.
3. Use the mind to create a pink tube between the heart and sexual center. Feel the compassion energy of the heart pulsing together with your sexual energy in the pink tube. Use the mind to guide this energy down to the perineum, through the backs of the legs, and out through the soles to connect to Mother Earth.
4. Draw the gentle blue light of the earth up through the soles, legs, perineum, sacrum, Door of Life, T-11, T-5, C-7, Jade Pillow, and crown.
5. Expand out through the crown to connect with the light of the North Star and the Big Dipper. Absorb the red light rays of the Big Dipper into the crown and circulate this red light into the Orbit. After you feel the red light circulating in the Orbit, expand it to fill the entire body and aura. Allow it to meet the cool watery blue light of Mother Earth, and feel both dissolve into the Original Energy at the navel.
6. Draw the violet of the North Star down into the crown. Spiral it around in the brain, absorbing it into the Crystal Room. Circulate the violet light in the Orbit and expand it to fill the whole body. Feel its vibration fuse with the white light of your earth-bound soul and dissolve into the Original Energy in all three Tan Tiens.
7. Then move the awareness down to the mideyebrow point. Extend out through the mideyebrow to connect with the golden light.
8. Draw the golden light into the mideyebrow. Then use the mind to direct the golden light rays down the front channel to the palate point throat center, heart center, and solar plexus center, and back to the navel. Circulate the light up the back channel and around the Orbit several times Return to the navel, absorb the golden light into the Lower Tan Tien, and feel it activate and further expand your Original Energy.
9. Continue to circulate your Chi in the Microcosmic Orbit 3, 6, 9, or more times. The more you relax, the more easily you can feel the qualities of the different forces.

Rest in the Wu Chi in total blackness, but notice that this dark

void is full of energy. Relax and do nothing. End the meditation by gathering the energy at the navel. Conclude with Chi Self-Massage.

Summary

You can practice this final level of the Microcosmic Orbit any time and any place. As you practice more, you will find it easy to do whether you are standing, sitting, lying down, riding in a car, or walking. Eventually you will be surprised to discover you are automatically circulating the Microcosmic Orbit almost all the time without even thinking about it!

You also can practice the Cosmic Inner Smile any time you need to recharge by feeling smiling and loving energy inside, above, and around you, drawing this energy in to fill the whole body.

Daily awareness of your connection with the Higher Self will give you the strength, power, and wisdom to run your life.

Chapter 13
Macrocosmic Orbit and the Five Pulses

Opening the Macrocosmic Orbit

Once you have successfully completed the Microcosmic Orbit, the next phase of practice is to extend the energy circulation through the arms and legs. This practice is traditionally called Da Jou Tien or the Macrocosmic Orbit.

You will feel a pleasant sense of wholeness when you integrate the arm and leg routes, because your awareness and Chi will fill the entire body, not just the torso and head.

1. Begin with Chi Kung Warm-Ups and preparations for meditation.

2. Activate your Original Chi: Warm the Stove.

3. Use mind and eye power to begin circulating energy through the Microcosmic Orbit. You do not need to connect to the Three Forces (Universal, Higher Self, and Earth) yet. Circulate energy through the entire Microcosmic Orbit 3 to 9 times.

4. On the last round, bring the energy down the front channel and pause for a moment at the perineum.

5. Inhale deeply, and exhale down the backs of the thighs, dividing the energy into two pathways. Spiral at the backs of the knees (Weizhong, Bladder 40).

6. Use the mind to continue guiding your Chi down the calves and around the outer ankles. Let the Chi revolve around the ankles several times. Then guide the Chi down to the soles of the feet and spiral at the Bubbling Spring (Yung Chuan) point. This is the first point of the kidney channel. Concentrating here strengthens the kidneys, lowers the blood pressure, calms the mind, and relieves fatigue. Concentrate on the Bubbling Spring points until you feel a strong sense of energy there.

7. Draw earth energy up to the tops of the big toes. Use the mind to activate the two points at the base corners of the big toes. Both the Liver and Spleen meridians originate at the big toe (Da

Dun, Liver 1; Yin Bai, Spleen 1). Concentrating here strengthens and energizes those organs. When you feel a numbness or a sensation like an ant bite at these points, move on to the next points.

8. Connect to earth energy and direct the Chi up along the shin bone (tibia) to the fronts of the knees. Spiral and revolve the Chi to encircle the kneecaps; this activates the Eye of the Knee points and strengthens the knees. It also invigorates the stomach and spleen and their meridians. In addition, it helps open the knees to prepare them for further passage of energy in the higher-level Taoist formulas. Hold your focus at the knees until you feel a sense of warmth or tingling.

9. Draw the energy up the insides of the thighs and back to the perineum, up to the coccyx and sacrum, and on to the Door of Life, T-11, and the Wing Point below T-5.

10. From the Wing Point, divide the Chi into two routes and direct it across the scapulae, under the armpits, and down the insides of the arms to the inner elbow crease. The lung, heart, and pericardium channels pass through here; focusing on the inner elbow creases invigorates the meridian circulation and strengthens these organs.

11. Direct the Chi down the insides of the forearms to the Lao Gong point (Labor Palace, Pericardium 8) in the middle of the palms. Concentrate here for a while; feel the energy flow out to the tips of the middle fingers.

12. From the tips of the middle fingers, direct the Chi over the backs of the palms and up the backs of the forearms to the outsides of the elbows. Feel the Chi flow continue up the backs of the upper arms and over the shoulders and reconnect to the Governor Channel at either T-5 up to C-7. In either case, move the Chi from T-5 up to C-7 and on through the Governor Channel up the back of the neck to the crown. Then allow it to descend to the tongue and follow the Functional Channel to the navel.

This completes the Macrocosmic Orbit. Repeat at least 3 to 9 times.

Five Pulses Practice
Activating and Connecting the Five Heart Pulses

The Five Pulses practice develops greater ability to feel, gather, and the natural forces. By first becoming like a child, innocent and open, you learn to activate the palms, soles of the feet, perineum, crown and mideyebrow. Eventually you will learn skin breathing, in which the skin opens wide to receive Chi from all around you.

Activate the Organs' Chi

Imagine you are like a child, able to receive unconditionally the Father Heaven and Mother Earth Forces. With daily practice of conserving, moving, and directing the life-force through the Microcosmic and Macrocosmic Orbits, your mind power will increase, and you will easily expand your awareness to the extremities and external forces.

The fingers are connected to many acupuncture meridians. The finger joints are also related to the internal organs and the corresponding senses and emotions. In fact, the entire body is mirrored in the hands and fingers. (Please see Fig. 7.17 in Chapter 7.)

Because the tips of the fingers and toes have little resistance to Chi flow, stimulating them also stimulates the organs. The tips of the fingers and toes have many tiny veins and arteries. When we are weak or sick Chi and blood do not flow well, and circulation to the extremities becomes stagnant. Often the first place we feel cold is in the hand and feet. To warm the whole body quickly, we can warm the hands and feet. By stimulating the flow of Chi and blood in the hands, we can benefit many other parts of the body.

How to Bring Chi to the Hands and Palms

1. Be aware of the palms. Inhale, and lightly contract the sexual organs, perineum, anus, and buttocks. (Note: Hold the breath comfortably; exhale any time you feel uncomfortable.) Emphasize pulling up on the left and right sides of the anus; this helps guide the Chi directly to the left and right hands. Hold the breath and hold the contractions. Lightly clench the teeth and press the tongue to the roof of the mouth as your rub the hands together.

2. Continue to rub the hands while holding the breath and contracting the lower parts. Feel the face and palms getting hot. Guide more Chi to the palms to activate them. Exhale and breathe naturally a few times.

3. Inhale again, hold the breath, and contract the lower parts as above. Press the palms together, then rotate the palms back and forth against each other. Do this 18 to 36 times (Fig. 13.1).

4. Massage the Lao Gong points in the centers of the palms. Use the thumbs to press the middle of the palms in a circular motion. Massage each palm at least 18 to 36 times.

5. Using the right fingers to hold the left thumb, pull from the base of the thumb toward the tip. Repeat 6 to 9 times. Do this with the index, middle, ring, and little fingers. Do the same with the right hand.

Massage the Feet

Like the hands, the energy meridians of the feet and soles are connected to the entire body. Massaging the feet stimulates the organs and glands and increases the circulation to the extremities. If you find any painful points, massage them until the pain goes away. This clears blockages of Chi flow.

1. Take off your shoes and stockings.

2. Rub the hands together until they are warm. Rest the left foot on the right knee. Massage the left foot up and down, left and right, until it feels warm.

3. Massage the kidney point (K-1; also called Bubbling Spring or Bubbling Well). Taoists regard Bubbling Spring as the “heart of the foot” because it has the closest connection to the healing Mother Earth.

4. Use both thumbs to massage the sole of the foot. Flex the foot to reach the deeper parts. Dig in deep; press and spiral around the sole with the fingers.

5. Using the fingers of the right hand, hold the left big toe and pull from the base to the tip. Repeat 6 to 9 times. Do the other toes the same way.

6. Repeat the same steps with the right foot.

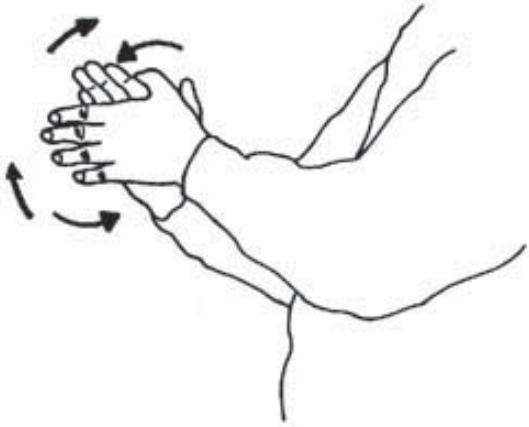

Fig. 13.1 *Rub the hands together.*

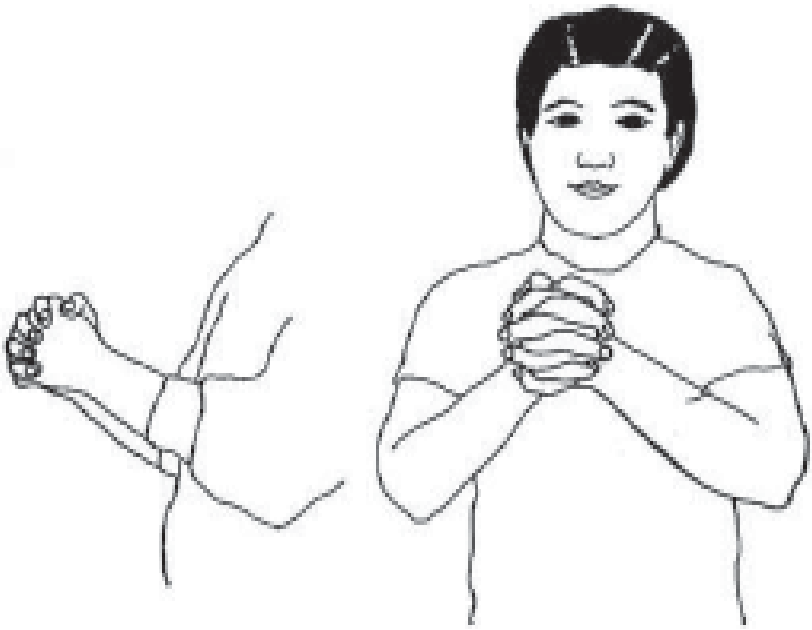

Fig. 13.2 *Lace the fingers and squeze the palms together.*

Activate the Chi

1. Lace the fingers together.

2. Press the palms together, tighten, and relax. Feel the heat produced (Fig. 13.2).

3. Press the fingers and the palms against each other. Rest, and be aware of the Chi in the palms and fingers. This activates the organs' Chi as well as the Chi in the hands.

4. Use the awareness to scan the heart, then the lungs, liver, pancreas, spleen, and kidneys. Feel the warmth inside each organ and its connection to the fingers.

Activate the Chi at the Palms and Fingertips

1. Hold the hands in front of the chest at heart level, palm to palm, until you feel heat build up.

2. Gradually separate the hands until the palms are about 1 inch (3 centimeters) apart. The fingers should be slightly curled, their tips facing each other, as if you were holding a big egg (Fig. 13.3).

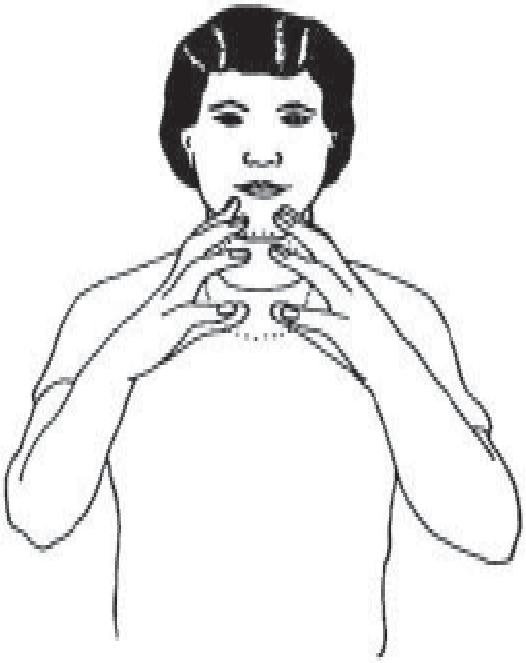

Fig. 13.3 *The fingers are slightly curled as though you are holding a big egg.*

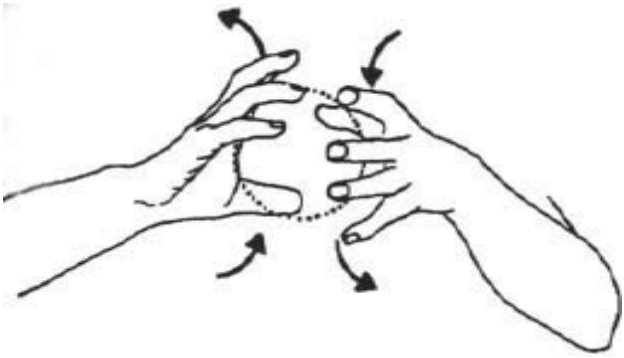

Fig. 13.4 *Slowly circle the tips of the fingers around each other.*

3. Look at the point between the two palms. The mind and eyes will help gather the force into the palms and fingers. Gradually feel a ball of energy growing between the hands.

4. Slowly move the hands in and out without touching them together. Slowly circle the fingertips around each other. Feel the radiating Chi, heat, or aura of one hand repelling that of the other. Some people may feel a gentle electric shock, an expansion, or a coolness in the fingertips. As you practice more, these sensations will intensify (Fig. 13.4). The abundance of energy at the fingertips activates Chi in the organs and glands.

5. Holding the palms and fingers 1 to 2 inches apart, be aware again of the Chi ball forming between the palms. Start to move the right palm up and down, left and right, but not so far that you lose the energetic connection between the palms (Fig. 13.5).

6. Once you can clearly feel the Chi in the palms, move both palms together, up and down, left and right.

7. Move the palms about 3 inches apart. The fingers will curve as if you were holding a ball 3 inches in diameter. Hold this position until you feel a Chi ball build up (Fig. 13.6).

8. Twist the palms in opposite directions. You will feel Chi pressure or sense a ball of energy.

9. Go back to the original holding-the-ball position. Gradually pull the palms apart until you feel the Chi ball expand and contract.

People whose hands are usually warm may have a dramatic sensation of heat or Chi. With continued practice, everyone will feel more Chi.

10. Rest with the hands in the lap, palms up. Be aware of the palms and soles. Feel the palms and soles breathing together with the external breath (Fig. 13.7).

Activate the Original Force

Use the palms to massage around the navel clockwise, gradually expanding the circle to the cover the whole abdomen. Rest and feel the warmth at the navel.

Activate the Door of Life and Gate of Heaven

1. Lightly contract the sexual organs, perineum, anus, and buttocks 3 to 6 times.

2. Gather the sexual essence at the sexual center, behind the pelvic bone.

3. Use your physical breath to breathe into the perineum and the Door of Life. Notice whatever quality is there; coolness, soreness, numbness, or sexual arousal. Expand the sexual energy and gather its essence into a ball of light at the perineum. Concentrate the light ball into a dot of light about the size of a small marble.

4. Visualize a small silver pipe extending up through the spinal cord from the perineum to the crown. Feel the Chi rise through the pipe to the crown, the Gate of Heaven.

5. Feel the crown warm and expand, or see a light at the crown point Condense the light or the feeling into a dot.

6. Split your attention between the dot at the crown and the dot at the perineum. Picture the spinal cord as a shining silver pipe connecting these two shining dots.

7. Gradually draw one dot down and the other up so they meet at the Tan Tien. Feel the energy condense further as these dots come together. The dots may give out more light (Fig. 13.8).

Once the base and crown have been connected by the pipe, you stop losing life-force and sexual essence and activate your true knowledge and wisdom. The feeling of Chi or arousal will gradually feel stronger and move up more clearly to the brain. Joy and peace will gradually fill the brain and the whole body.

Fig. 13.5 *Move the palms up and down to feel the Chi.*

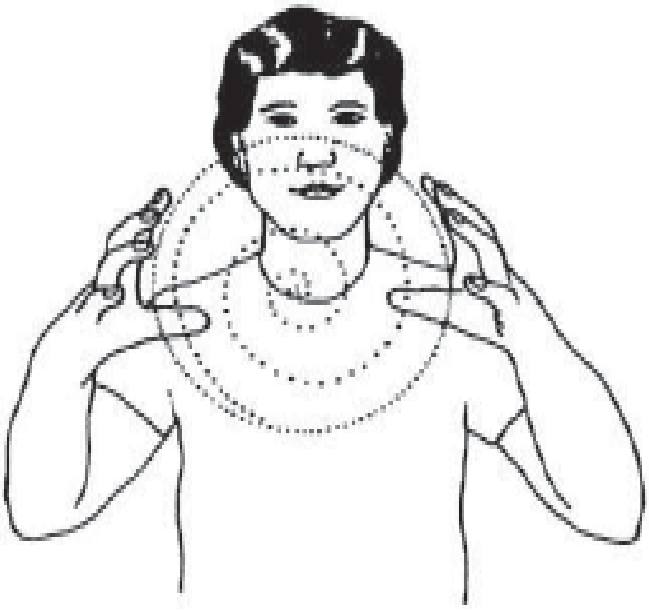

Fig. 13.6 *Holding a big Chi ball.*

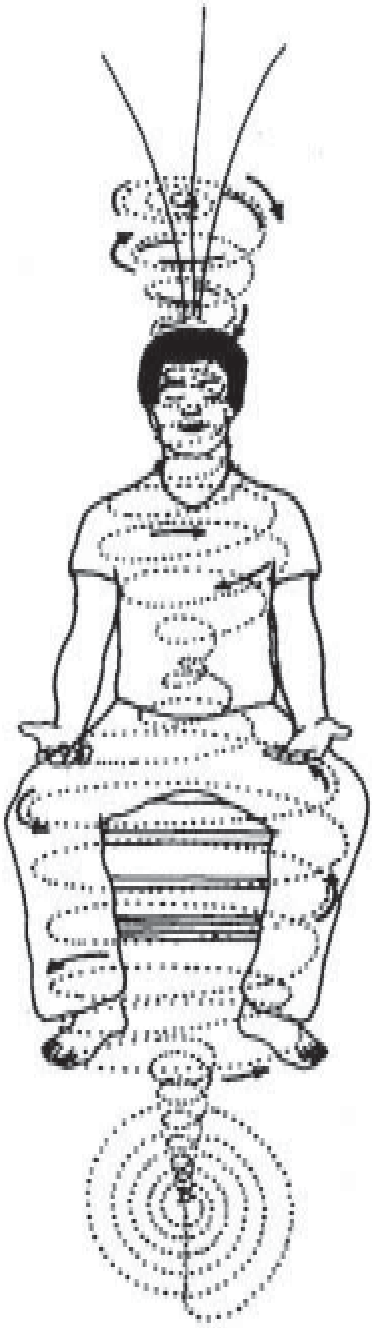

Fig. 13.7 *Place the palms on the lap facing upward.*
Feel the palms of the hands and the soles of the feet breating.

Connect Heaven and Earth

1. Be aware of the two dots, silver pipe, and navel center. Then bring the awareness down to the perineum. Feel the perineum and soles breathing. Picture the silver pipe dividing at the perineum and extending down into both soles. Condense the feeling or light into a dot at each sole.

2. Exhale through the soles and extend the silver pipe into the ground. Picture the pipe connecting to a cool blue lake. Feel an energy full of gentleness and kindness rise through the pipe to the soles and on up to the perineum.

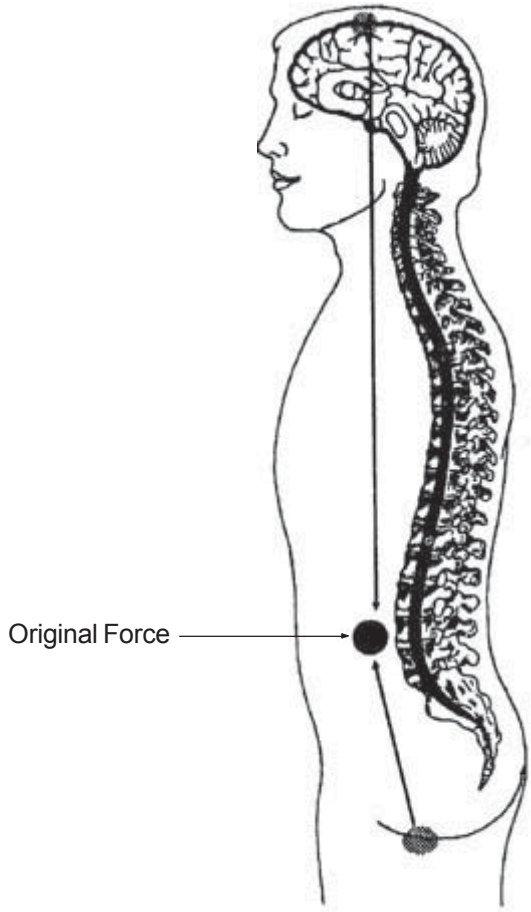

Fig. 13.8 *Gather the perineum and crown energy into the Original Force.*

3. Feel the energy rise up the spine through the silver pipe to the crown. Extend the pipe out the crown and connect it to the North Star and Big Dipper, or focus on a dot infinitely high above the head.

4. Feel the energy descend to the crown and navel center. As you inhale, draw down the golden light of your Higher Self or the violet or red light of the Heavenly (Universal) Force, and draw up the Earth Force as a blue light. Draw both forces to the navel. It may help to visualize the energies as colored dots.

5. Exhale through the palms and the soles down through the center of the earth to a light dot infinitely far away. Inhale from that dot, drawing energy into the palms, soles, and navel. Do this 6 to 9 times. As your mind power increases, repeat with a light dot infinitely far away above the crown.

6. Feel the palms, soles, crown, and perineum connected at the Tan Tien (the Original Force center) by the breath.

7. Circulate the energy you have gathered at the navel through the Microcosmic Orbit: down to the perineum, through the legs and out the soles to connect with the Earth Force, back up through the soles and legs to the perineum, up the spine to the crown, out the crown to connect with the Universal Force, down through the crown, and down the Functional Channel to the navel.

Activate the Mideyebrow, the Wisdom Center

1. Focus on a light ball or dot at the navel center. Inhale, and let the dot rise to the mideyebrow, the Wisdom Center. Exhale from the mideyebrow to a golden light dot at infinity.

2. Inhale the light dot, drawing it into the mideyebrow and down to the navel. Repeat 9 to 18 times.

3. Rest at the navel center for a while. Be aware of all five pulses: at the heart, crown, mid-eyebrow, perineum, soles, and palms (Fig. 13.9). Feel them inhaling and exhaling together.

4. Remember the positive feelings of being a child: soft, relaxed, and open. Feel the skin and pores open and breathing, absorbing Chi into the organs, glands, and marrow. The more you relax and the less effort you use, the more you will feel your whole body pulsing and breathing. This pulsing activates Chi flow and circulation of blood and lymph.

5. When you want to stop, gather the Chi back to the navel, and spiral and condense the Chi there.

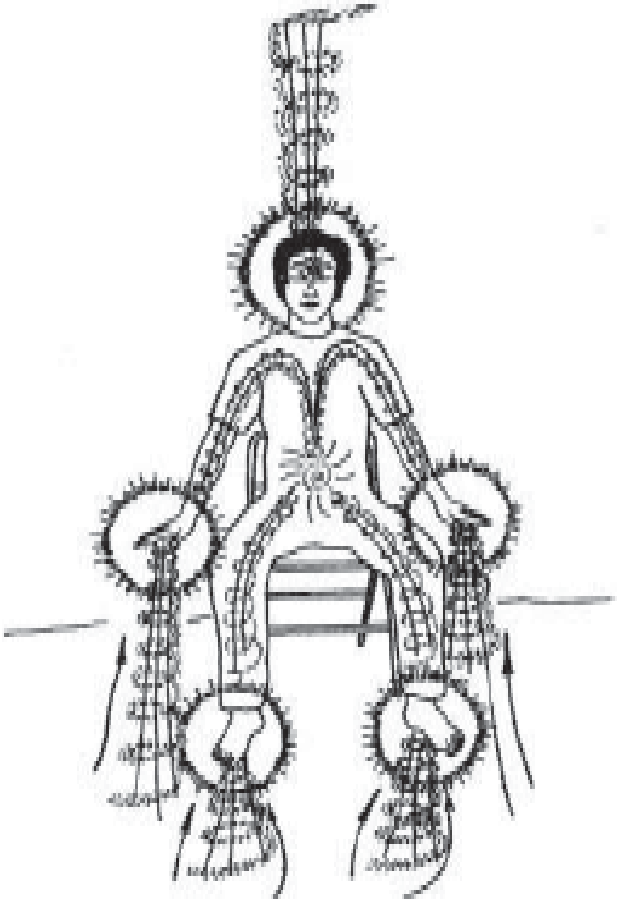

Fig. 13.9 *Activate the five pulses.*

Using the Palms to Absorb Chi

The hands and fingers are among our most wonderful possessions. With our hands we can build, create, and repair things, as well as heal ourselves and others. When the palms are trained to feel Chi inside and outside the body, you can use them to absorb Chi from nature and the universe. When you practice using mind/eye/heart power to gather, condense, transform, and move the life-force through the Orbit, this ability becomes stronger. You can use the palms to absorb Chi from places of concentrated higher energies, such as churches, temples, mountains, forests, caves, grot-

toes, and waterfalls. When you are able to absorb and transform these energies for your use, you no longer need energy from other people.

You can use the palms to test a place or a ceremony to determine whether it has power or Chi. Use the right palm to gradually spiral toward the person conducting the ceremony. Draw in the Chi and feel its strength and qualities.

Drawing and Sending Chi

1. Place the left palm on the lap. Raise and extend the right hand with the elbow slightly bent, palm facing down.

2. Be aware of the palm and fingertips. Inhale very slowly, drawing the Chi in front of you into the palm and fingers. Allow the Chi to travel up the arm to the mideyebrow and down to the navel (Fig. 13.10).

3. Exhale. Push the Chi from the navel up to the chest, out the arm, hand, palm, and fingers. Do this 9 to 18 times. Repeat 9 to 18 times using both hands. Then rest and continue to feel the palms breathing (Fig. 13.11).

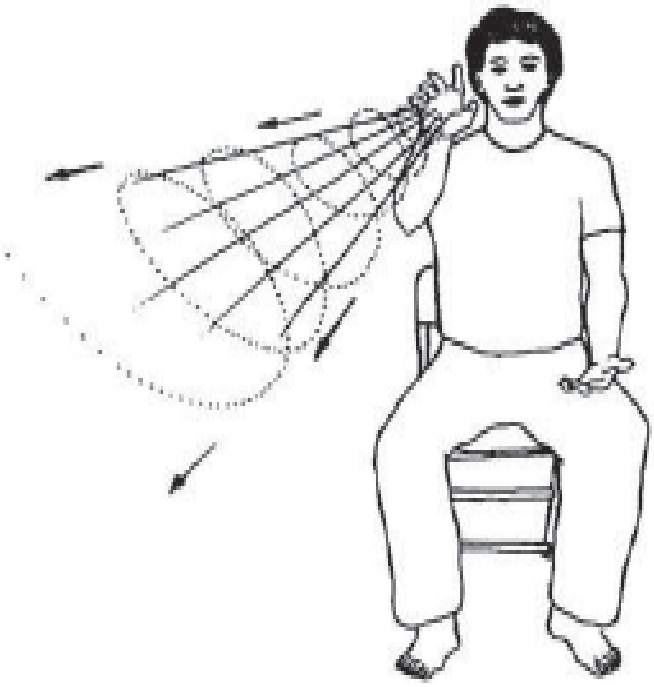

Fig. 13.10 *Draw chi into the palm and fingers.*

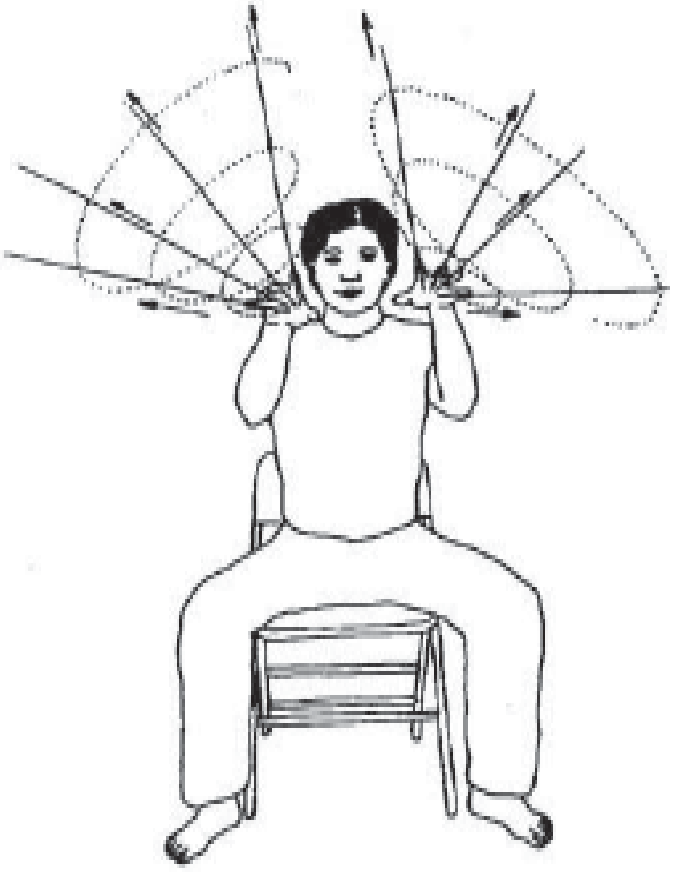

Fig. 13.11 *Draw Chi into both palms and fingers.*

Testing the Chi

This method can help you find a good house, hotel, or place to stay by telling you whether its energy promotes or conflicts with your own energy. The same method can be used with objects you are considering acquiring.

1. Raise the right hand in front of you at chest level. If you are in a group of people, you can hold the hand near your navel area.

2. Spiral the hand clockwise in a circle 6 to 10 inches in diameter to draw energy from the place or object into the palm and direct it to the navel center. Evaluate the quality of the energy. Eventually you will have no need to use your hand to draw the Chi; you will be able to do it with mind/eye power alone (Fig. 13.12).

Fig. 13.12 *Test the Chi by spiraling your hand clockwise.*

Gathering Spiritual Energy

Highly developed masters are connected to a higher force or source of spiritual energy. The energy is transferred to those who respect the master and are open enough to receive it. In the beginning of your practice, you can receive this higher force from your teacher. As your practice becomes stronger, you can gather it yourself.

1. Put both hands in front of you near the chest or navel, fingers lightly spread. Direct the palm toward the person conducting the meditation. Sense the spiritual energy. It feels different from other types of Chi, like a floating form of condensed energy. It is not spread out evenly like energy from the sun, the moon, mountains, or a holy site.

2. Spiral the energy clockwise into both hands. You can practice with just one hand until you feel the Chi strongly, then add the other
hand (Fig. 13.13).

3. When you feel the spirit or Chi come to you, absorb it into the palms, mideyebrow, and crown, and store it in the Crystal Palace or heart center.

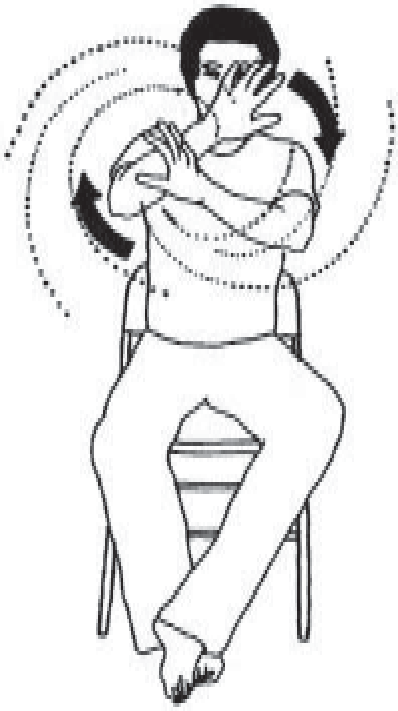

Fig. 13.13 *Gather the spiritual energy with both hands.*

Blocking Unwanted Chi

In our everyday lives, we encounter negative emotional energy in the form of anger, hate, and aggression. To reject this type of energy, people automatically raise their hands in front of their chests. To enhance the effectiveness of this response, in the Healing Tao we teach people to use smiling energy and mind/eye/heart power to repel any unwanted Chi.

When you sense Chi you do not want, cross the hands in front of the chest or navel with palms facing out. Quickly uncross the palms and bring the hands out to the sides to cut and block the unwanted Chi. Use mind/eye power to send the Chi to a distant place. Do not send it in the direction of a nearby person, or the person will pick up on it and feel uneasy. If there is a forest or a stand of trees in the vicinity, send it there. Trees transform negative energy into healing energy (Fig. 13.14).

Sensing Other People's Energy

If you are thinking about interacting with someone and want to make sure his or her energy is positive and congenial with yours, look the person directly in the eye. The eyes are windows of feeling and expression. Draw the person's Chi into your Third Eye, in the middle of the forehead, and into your mideyebrow point. Does the energy feel good to you or not?

During this contact, use your whole body like sonar to feel the energy coming from the other person. With practice, you can even feel the location of sickness or pain in the other person's body. You may feel the sickness in the corresponding part of your own body.

You may feel disturbing energy as a cold or chilly sensation coming from a person's abdomen or back. Try to direct it away from you, so it does not affect your own energy. With daily practice, you can repel sick energy easily.

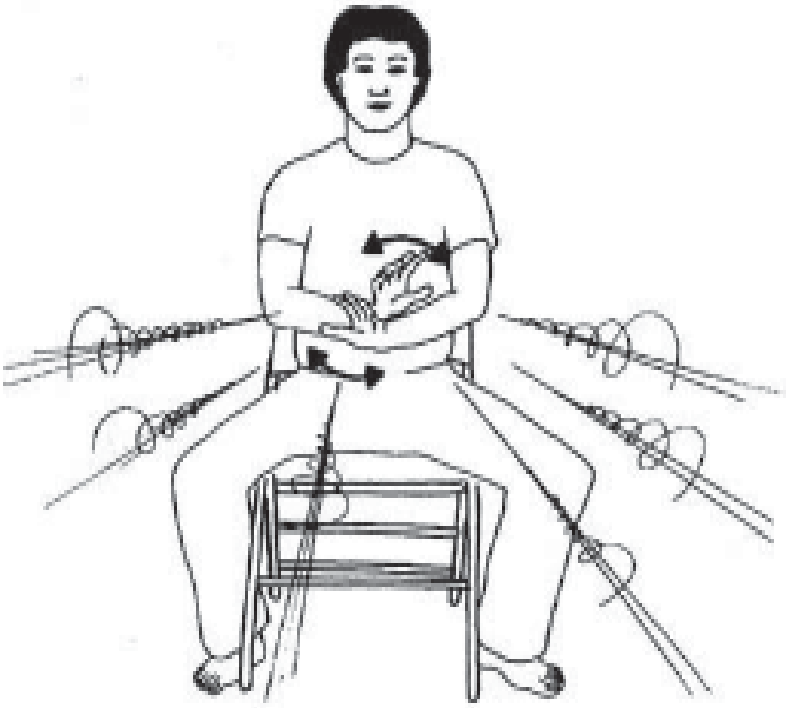

Fig. 13.14 *Block out the undesirable Chi by waving the hands.*

Chapter 14
Oneness with the Tao
A Daily Practice Guide

Inner Smile

Begin Your Day with the Inner Smile

Practicing the Inner Smile as soon as you wake up will improve your whole day. If you love your own body, you will be more loving toward others and more effective in your work. After you have learned the Inner Smile well, it only takes from 5 to 10 minutes to smile down to your entire body.

Try to maintain the sensation of the Inner Smile throughout the day. Keep reminding yourself to practice the Inner Smile. It is one of the best stress reducers in the world.

Protect Yourself with the Smiling Aura Field

Although they are unseen by the majority of people, there are subtle energies or "psychic forces" around us that have a strong influence on our health and well-being. Negative psychic energies from others can create stress and even cause illness. When a person has strong emotions toward you, the psychic energy associated with them disturbs the balance of your energies, jeopardizing your health. The Smiling Aura, a beautiful emanation of our highest energetic frequencies, protects us from the negative vibrations of others. Practice of the Inner Smile enhances this Smiling Aura.

By remaining conscious of the smiling energy in the mideyebrow, face, and navel, and especially the solar plexus, you can create a strong sunlight radiance and intensify the Smiling Aura field around your body to act as a shield to keep out negative vibrations. The Smiling Aura field can also help you transform your own negative energies into positive life-force. For instance, if you feel anger, smiling energy gives you the ability to smile into that emotion until it is transformed into kindness. With practice, you can use this force to transform hatred into love, sadness into courage, and fear into gentleness. After a while, the process becomes automatic.

Six Healing Sounds

Best Times to Practice the Six Healing Sounds

Practice the Six Healing Sounds before going to bed at night to slow down the body, promote sound sleep, and cool any organs that are overheated. You may also use these sounds to enhance any of the other Taoist exercises, such as the Microcosmic Orbit and the Inner Smile, whenever you wish. For health maintenance, do three repetitions of each sound per day. Be sure to rest for at least 1 to 3 breaths between each repetition. Once learned, the Six Healing Sounds take only 10 to 15 minutes to complete.

Transform Negative Emotions

Before you go to sleep, use the Six Healing Sounds to clear out any negative emotions and let the positive emotions grow. Feel a sense of openness as you relax your own mental activity and connect with Universal Consciousness. This will also reduce bad dreams during your sleep, allowing the body to recharge through its connection with the Heavenly Force. If you have any problems, stress, or illness, this is the best time to allow the Universal Consciousness to help you find the solution. When you wake up, smile inward and look for the answers that arise spontaneously.

Do More Sounds When Appropriate

If you have health problems related to a specific organ, do more repetitions of that sound. In each season, the organ associated with that season is more vulnerable, so it is advisable to do more repetitions for an organ during its particular season. In the fall, do more Lung Sounds; in winter, more Kidney Sounds; in spring, more Liver Sounds; in summer, more Heart Sounds; and during Indian summer, more Spleen sounds. Increase in multiples of 3: for example, from 3 repetitions to 6, 9, or even 18.

Follow the Natural Order and Do All the Sounds

The order of the Six Healing Sounds follows the natural progression of the seasons. Always begin with the Lung Sound and follow it with the Kidney, Liver, Heart, Spleen, and Triple Warmer Sounds, in that order.

Practice to Relieve Fatigue

If you are tired or depressed, whether at work or at home, practice the Six Healing Sounds to clear out the fatigue or low mood. If you do not have time to do three repetitions each, or it is late at night and you are very tired, do them once each. You can also do the Six Healing Sounds without the hand positions. It is always better to do a little practice each day than none at all.

Microcosmic Orbit Meditation

Open Your Heart in the Morning

Taoist tradition says to open your heart before you open your eyes. To open your heart, smile down to the heart area until you feel it open like a flower blossoming. Feel love, joy, and happiness radiate from the heart and spread to all the organs. When you wake up, do not immediately open your eyes and jump out of bed. In the Taoist system, we believe each organ has its own soul. When we are asleep, the souls of our organs are at rest too, and they take awhile to awaken. Also, sometimes they leave the body while you are asleep to travel to other realms and need time to return when you wake up. If you are too hasty, you can injure the souls of the organs.

Overcome Your Biorhythms and Astrological Chart

In Taoism, we believe that when you control your Chi (life-force), you control your life and future. Until you attain this level of mastery, forces such as the positions of the stars (astrology) and the peaks and valleys of your own energy system (biorhythms) heavily influence your life. To be aware of these forces and eventually overcome them, check your energy levels each morning. While you are still lying in bed, concentrate on your navel until you feel it become warm. Direct the energy to flow down to the perineum and up the spinal cord in the Microcosmic Orbit, then direct it back to the navel. If you can move through the Microcosmic Orbit quickly and smoothly, your physical, emotional, and mental energy levels are good.

On days when the Microcosmic Orbit moves slowly or not at all, the physical, emotional, and/or intellectual energies are in a low cycle, and your body's defense system is low. This may be asso-

ciated with your biorhythm cycle or your astrological chart. In either case, you may discover you are out of balance and more prone to accidents and illnesses, By consistently practicing the Healing Light meditation, you can eventually overcome your biorhythms and astrological influences.

Before Eating is the Best Time to Practice

Practicing the Microcosmic Orbit meditation is beneficial any time of day. When you have just learned the meditation, it is best to establish the habit of practicing 15 to 20 minutes in the morning before eating, and again in the evening before eating. It is easier to relax and enter a meditative state when the stomach is empty (but not when you are very hungry).

If it is physically difficult for you to sit for 20 minutes at the beginning, you can practice lying down, as long as you are rested enough not to fall asleep. If this time feels too long for you at the beginning, practice for shorter periods, increasing the time as you become used to sitting and your concentration improves.

Check Yourself for Blockages Daily

If you move Chi through the Microcosmic Orbit and feel an obstruction or blockage along the path, take a little more time to focus on the obstruction until it clears up. Chronic disease begins with a blockage of energy flow to the organs or glands along a major energy pathway (acupuncture channel). When the Chi flow to a major organ or gland is blocked, that organ either receives less energy, blood, and nutrition, or Chi and blood become stagnant, resulting in pain.

If the blockage continues over a long period, the organ or gland gradually works less effectively, until its function is critically impeded. By the time a doctor learns that the organ is not functioning well, it may be working at as little as 10 percent of its capacity. The malfunction can even lead to surgery or removal of that organ. To prevent such a catastrophe, as well as great expenditures of time and money, simply check yourself every day. Keep the channels open and maintain and strengthen your Chi by practicing the Healing Light meditations.

Diet, Sleep, Medicine, and Food Supplements: Listen to Your Body

When you recycle and conserve your Chi by circulating it in the Microcosmic Orbit daily, you will have more life-force. As a result, you may find you require less food, fewer vitamins and food supplements, lower doses of medication, and even less sleep. If you continue to consume the same amounts and sleep as much as before, too much energy may collect. This can produce excessive heat in the head, which can cause insomnia. You may also find that as your body begins to heal itself, you inadvertently overdose on your medication, and that can cause serious problems. Take time to listen to your body. It will let you know just how much food, vitamins, or medication you need.

If you can maintain peace and quiet and a thankful heart at mealtimes, your stomach will be well prepared for the meal; digestion and assimilation will improve as a result. (In the Healing Tao Five Element Nutrition practice, you will learn the correlation between food and the seasons, as well as other valuable information regarding digestion and the Tao of nutrition.)

Transform Negative Emotions into Healing Energy and Wisdom

When you practice the Inner Smile, you release negative energies trapped in the organs. As you concentrate on the navel and bring the accumulated Chi there, energy from the negative emotions also collects there. With the Inner Smile and Microcosmic Orbit meditations, you can refine, enhance, and circulate this energy through the main centers of the body, transforming the negative energy into vital healing energy.

For example, if you are angry, you may feel hot, explosive dull green or dingy red energy in the liver area. Use mind power to collect that energy and spiral it into the solar plexus center. Direct the negative energy down to the navel, smile to it, then move it through the Microcosmic Orbit. As it moves through the sacral center, Door of Life, T-11, and Jade Pillow, watch the color change into a clear, bright, luminous green; feel it transform into usable life-force energy.

If you are fearful, you may feel a cold and contractive blue-black energy from the kidneys in the lower back. Use mind power to

gather and spiral this energy into the Door of Life. Smile to it, then move it through the Microcosmic Orbit. Observe with your inner eye how the color changes from dull blue to bright, clear blue; feel it transform into usable life-force energy.

If you are sad or depressed, you may feel a cool and heavy grayish-white energy afflicting the lungs and being reflected in the upper back. Use your mind power to gather and spiral this energy at T-5 (center opposite the heart). Smile to it, then move it through the Microcosmic Orbit. Observe with your inner eye how the color changes from dull white to bright, clear white; feel it transform into usable life-force energy.

Each organ can produce negative Chi that can be transformed into vital, positive energy and wisdom. At this level of meditation, you may perceive this transformation in terms of change in color and sensation. In later practice, during the second level of the meditation called Fusion of the Five Elements, you will learn very precise and advanced methods for transforming negative emotions into positive life-force energy.

Breathe Naturally

Awareness of natural breathing is part of the Six Healing Sounds practice. With the Inner Smile and Microcosmic Orbit, the breath takes care of itself.

Many meditation systems rely on the breath to guide the energy. But the energy often flows a lot faster than the breath. If you let the body breathe by itself, the energy can flow as fast as it wants.

In fact, you will develop your own breathing patterns during the practice—the breathing suitable to your body. This may change; from time to time your breathing may become rapid or jumpy or may slow down, all of which are normal during meditation.

If your breathing changes while you are meditating and you don't like the change, tell yourself to go back to normal breathing, and you will. If there is a change in breathing and you are curious about it, you can simply observe it and see what happens.

Tips for Daily Practice

Practicing daily to maintain and increase Chi is one of the most important components in staying healthy and growing spiritually.

After we have begun to practice and have accumulated more Chi, we need to know how to use it wisely. We should avoid things that drain or destroy the life-force, such as tobacco, alcohol, coffee, drugs, and junk food. Daily cultivation and conservation of Chi includes practice of good life-style habits, such as eating right, exercising regularly, and getting enough rest.

1. Daily practice is the most important part of the cultivation and conservation of life-force. With daily practice of the Inner Smile, you will feel joyful, loving, kind, open, gentle, and courageous the first thing in, the morning. Extend all these good feelings and energies to your family, friends, neighbors, and the people around you. This will increase our life-force.

2. Learn to conserve sexual energy, one of the major components of your life-force. Learn to recycle it to revitalize the brain and the organs. This is taught in the Healing Love practices.

3. Learn to conserve Chi by talking less. Although we often think of Chi as energy, it is also intimately related to the breath. Too much talking dissipates your Chi. Speak less, and when you must talk, speak only constructively to help others.

4. Constantly be aware of the navel center and the Original Force. Use the mind to keep the navel warm. This increases your life-force.

5. You may know by now that peace is not found in the outer world; peace is found within. Guard the senses. Looking outward all the time and chasing after things drains Chi and weakens the mind. Learn when to let go of fame, excitement, and money, so you retain more mental strength and spiritual life-force.

6. Learn how to forgive by using the Six Healing Sounds to transform anger into kindness. This conserves Liver Chi. Holding onto anger burns up a tremendous amount of the Chi the liver needs for other functions. You may think forgiveness is being nice to others, but it is actually being nice to yourself, because it helps you maintain your life-force.

7. Eat more fresh steamed vegetables, fiber, and foods with high water content; eat less spicy food. This conserves the Blood Chi.

8. Consciously swallow your saliva 50 to 100 times each day. This increases digestive Chi, lubricates and moistens the organs, helps prevent tooth decay, eliminates gas, and maintains the intestines in good condition.

9. Don't eat to your full capacity. Eat no more than two-thirds of your stomach's volume; when you begin to feel full, stop eating. This gives the stomach room for digestion and conserves Chi in the stomach and intestines.

10. Worry less. Worry can sometimes help solve problems, but usually it makes them worse. Do more inner Chi cultivation so you have less time to worry and more Chi to face your problems. This conserves Heart and Spleen Chi.

11. Keep your life-style moderate. Don't overdo things; be moderate in work, sex, exercise, social activity, reading, and watching television. Excess activity drains your reserves of Chi. Living moderately conserves Chi and gives you energy for the important things.

Chapter 15
Troubleshooting Guide Helpful Hints and Home Remedies

This chapter provides answers to common questions and solutions to problems that may occur in relation to your practice of the Microcosmic Orbit meditation. If you are feeling an energetic disharmony and the information in this chapter does not solve the problem, contact the certified Healing Tao instructor nearest you. If there are no Healing Tao instructors nearby, contact your local acupuncturist; acupuncturists are familiar with the treatment of energetic problems.

If you are unable to contact any of these resources to satisfactorily solve your problem or answer your questions, then get in touch with the national Healing Tao Center in New York.

Overcoming Difficulties with the Healing Light Meditation

How will I know when my Orbit Is open?

Many people report feeling some Chi sensations up the spine yet nothing down the front channel. Because the five channels up the back are close to the spine, even if the energy is a little diffused, many students do feel sensation somewhere along the spine. However, there are seven channels coming down the front of the body, spread widely across the chest. Sometimes the energy diffuses, and the descent of the Chi is not felt until it reaches the navel.

Others report feeling energy at the sacrum and crown, but nothing, on the spine in between. This is because there are fewer nerve endings on the skin surface of the back, and we are not used to paying attention to subtle sensations there. With practice, you will gradually gain more sensitivity and begin to feel energy along the spine.

Some people feel intense sensations of Chi when they first open the Microcosmic Orbit, and then little or nothing thereafter. When a dry river bed is filled by a sudden flash flood, the contrast between the bed's dry state and its wet state is very dramatic; yet once it is filled, if the river rises or falls a few inches, it is hardly noticeable. It is the same with your Microcosmic Orbit. A lack of sensation does not mean no Chi is flowing; it may just mean you need more practice to increase your awareness of the often subtle Chi sensations.

Most people have some sensations during their meditation. These may be warmth, heat, or tingling at the sacrum, Ming Men, Third Eye, or tip of the tongue, or cold or numb areas. Some people feel an effervescence like champagne bubbles. You may experience mild electric-like shocks anywhere in the body; the body may shake rhythmically or suddenly jolt. The hands, feet, or whole body may become unusually hot; in fact, you may feel strong sensations of heat anywhere in the body. Those who are visually oriented may see a light inside their heads, or points along the orbit may light up. If you have any of these sensations, you can conclude that energy is circulating.

I don't feel anything during the meditation. What's wrong?

It may take some people longer than others to open the channels of the Microcosmic Orbit. Exactly how long it takes depends on the individual's energy level and the number of blockages in each channel. If after two weeks you have not completed this meditation successfully, reverse the energy flow one center at a time, starting at the last point reached. Spend one week concentrating on each center in reverse order. Your Microcosmic Orbit should then be clear and open.

Although most people have some sensation that tells them their energy is circulating, several of my students have been practicing for years without any specific sensations. Why do they continue to meditate? Because they feel so much better afterward! Their health has improved.

I have had students tell me they felt nothing, but I could see a substantial difference in their energy before and after meditation. When they came to class they looked tired and preoccupied. After the meditation, their eyes sparkled, their skin glowed, and there were a happy expressions on their faces.

The Microcosmic Orbit seems to be running the wrong way; it is coming up the front and going down the back.

This sometimes happens at the beginning, when the Yang energy in the back is not strong enough to overcome the rising Yin energy in the front.

It is nothing to worry about. There is no wrong way. Some people, especially women, have very strong Water energy and run it backward, using Water energy to clear the channel. Just keep meditating. After a while, the energy pattern will probably change, and you will feel the energy running up the back and down the front.

When I sit for 20 minutes, my mind wanders, and I get antsy.

Many people are troubled by what is sometimes called "monkey mind"; their thoughts jump all over the place, and they find it hard to concentrate. The Microcosmic Orbit meditation is actually well suited to people with this tendency.

When you practice the Microcosmic Orbit, you are constantly changing your state of consciousness. These changes can be observed with an electroencephalograph. The waves generated in the brain as you read and try to understand this book are called "beta." Beta waves indicate a state of mental alertness and active thinking. The first stage you enter in meditation is called "alpha." The next deeper state is called "theta." Theta is the state of purring cats as well as deep meditation.

In doing the Microcosmic Orbit meditation, you are first in beta as you tell yourself what you are going to do: "I am going to do the Inner Smile." When you actually begin the practice, you probably enter the alpha state. After a period of smiling to the thymus and heart, for instance, you tell yourself, "Now I'll smile to the lungs." At that point, you have gone back to beta. When you direct your attention to the lungs and return to the meditation, you will go down at least to alpha. So in the course of a meditation you can transfer easily from beta to alpha to theta, perhaps back to beta, and then more quickly into alpha and theta again.

My students with "monkey mind" had great difficulty when they tried other methods that involved watching the breath or emptying the mind. But because of the shifts in consciousness as well as the shift in focus to all the varied points along the Microcosmic Orbit, the "monkey, mind" is satisfied.

If you put your attention at the navel and then after a few minutes your mind wanders or you get restless, tell your mind to focus on the Sperm or Ovarian Palace, Ming Men, or any point you like. After a while you will find you are able to maintain your concentration at a point for longer periods. Counting from 1 to 9 and 9 to 1 can also help. The spiraling technique galvanizes your attention and your energy at a specific point.

If your body feels restless or if you become aware of stiffness in your back, you can calmly adjust your posture by gently bending or stretching without disturbing your meditation.

Sometimes during meditation my breathing seems to stop. Is this something I should be concerned about?

The Six Healing Sounds use awareness of the breath as part of the method. In practicing the Inner Smile and Microcosmic Orbit, the breath takes care of itself.

Many meditation systems rely on the breath to guide the energy. But the energy often flows a lot faster than the breath. If you let the body breathe by itself, the energy can flow as fast as it wants.

In fact, you will develop your own breathing patterns during the practice—the breathing suitable to your body. This may change; from time to time your breathing may become rapid or jumpy or may slow down, all of which are normal during meditation.

If your breathing changes while you are meditating and you don't like the change, tell yourself to go back to normal breathing, and you will. If there is a change in breathing and you are curious about it, you can simply observe it and see what happens.

I have been seeing a psychotherapist and am on medication. Is it safe for me to practice the Microcosmic Orbit?

Whenever you are under the regular care of a physician, psychotherapist, or other healthcare practitioner for any chronic mental or emotional problem, you may wish to consult your practitioner first to determine whether meditation might adversely affect your condition. If your practitioner gives you the go-ahead, you should still advise your meditation instructor of your condition before beginning training.

When meditation may be inappropriate. If you are in an extremely unstable period emotionally or mentally, or are suffering from severe schizophrenia or any serious mental or emotional prob-

lems, you should not practice the Microcosmic Orbit. It may bring more Chi to the problem areas and aggravate them instead of helping. Limit yourself to the Inner Smile and Six Healing Sounds. Even with the Six Healing Sounds, if they release more emotional energy than you can digest, stop right away. Later, when you feel more stable and able to deal with the traumas locked in your body, you can resume your practice.

When meditation may be beneficial for psychological problems. The Microcosmic Orbit meditation can be helpful in treating many psychological conditions and problems. The practice helps you slow down and become calmer, more relaxed and centered. Because of its calming effects, it is particularly helpful for stress and the negative emotions brought on by prolonged stress, nervous tension, and irritability.

The Microcosmic Orbit is the treatment of choice for Kundalini psychosis, in which too much energy rushes up to the head and becomes stuck there. We have had several cases in the Healing Tao where people previously confined to psychiatric hospitals due to lack of understanding and misdiagnosis of this phenomenon were completely restored to health through practice of the Microcosmic Orbit alone. In other cases, people learning the Microcosmic Orbit were able to give up powerful psychiatric medications with no further problems. We will say more about Kundalini syndrome later in this chapter.

The Microcosmic Orbit, Six Healing Sounds, and Inner Smile are also particularly helpful in dealing with low self-esteem, low energy or chronic fatigue syndrome, shyness, and emotional problems caused by blocked energy in the organs.

I sometimes become sexually aroused when I practice. Is this good, bad, or neither?

Sexual arousal is a healthy sign that you have an ample amount of sexual energy. It is also a sign your Microcosmic Orbit is open (at least to the sexual center) and that the Chi is flowing strongly.

However, if you have not yet learned the Taoist methods to redirect your sexual energy, arousal during meditation can be very distracting. By learning Testicle/Ovarian Breathing and the Power Lock exercise (taught in the Healing Love Through the Tao workshop), you will easily be able to draw the sexual energy up from the sexual organs to the sacrum and on up the spine through the Governor

Channel to the brain. This conserves and recycles sexual energy usually lost through ejaculation or: menstruation. By circulating the Ching Chi, or sexual energy, through the Microcosmic Orbit pathway, you can transform it into life-force energy to nourish the whole body.

If you have not yet learned these techniques, you can take several Small Sip breaths and pull up on the perineum, anus, and back of the anus, and draw the sexual energy from the genitals around to the sacrum. Then use the mind, eyes, spiraling, and Small Sip breathing to draw the energy around the Microcosmic Orbit and back to the navel.

Once the sexual energy is drawn away from the genitals, the arousal itself will subside and should no longer be a distraction. If it recurs, repeat the process of drawing the sexual energy up the spine.

Should I become celibate to obtain the highest results from the Microcosmic Orbit meditation?

Many religions recognize that sexual energy is important to spiritual work and accordingly require celibacy of serious practitioners. In Taoism, celibacy is not essential, but conservation of sexual energy is vital. For this reason, we often teach Taoist methods of conserving sexual energy, known as Healing Love Through the Tao, in the same seminar with the Microcosmic Orbit.

Even so, it takes time to master the techniques of conserving sexual energy. Try to abstain from orgasm for at least the first 100 days of practice while you are learning the Microcosmic Orbit. This will build up a reservoir of Chi to aid in opening the Orbit. This is somewhat more important for men than women, because men lose more energy through orgasm (with ejaculation) than women. The 100 days of celibacy are a recommendation, however, not a requirement. Taoism teaches moderation. It is important to maintain harmony and balance in one's life. Changes in life-style should feel natural; if it is too stressful for you or your partner to abstain, respect your needs and those of your partner. Simply recognize that while it may take longer to accumulate energy if you are having sex to orgasm, you are preserving balance in other areas of your life.

Is it safe for me to practice the Microcosmic Orbit during my menses?

Women's cycles are very personal; each woman's constitution is unique, so it is difficult to make any overall pronouncement. Generally, if you are not having any problems with your menses, it is fine to practice the Microcosmic Orbit during your period. In fact, many women have reported their practice of the Microcosmic Orbit has reduced or eliminated menstrual problems such as PMS, cramping, skipped periods, scant menstrual flow, and pain.

If there is substantial bleeding during your period, however, bring more Chi to the area of the uterus could increase the flow. If you experience excessive flow, observe the effect of your meditation practice. If the problem seems aggravated by meditation, discontinue the Microcosmic Orbit during your menses and instead emphasize the Inner Smile and the Six Healing Sounds.

Warming the Stove creates heat in the lower abdomen. If the heavy period is caused by excess heat in the blood, Warming the Stove could aggravate the excessive bleeding. However, many problems of painful menses and cramping are diagnosed in Chinese medicine as being caused by "internal coldness." In these cases, Warming the Stove would be helpful.

Female Healing Tao students who also practice Iron Shirt Chi Kung should not practice the packing process during their menses, but they can still benefit from other parts of the practice: standing, holding the postures, circulating energy without packing, and bone breathing.

Many female practitioners of the Healing Tao also report experiencing profound improvements in their overall health and menstrual cycles from Ovarian Breathing, a more advanced practice that circulates un-aroused sexual energy through the Microcosmic Orbit pathway. Ovarian Breathing is described in *Healing Love Through the Tao: Cultivating Female Sexual Energy.*

Sometimes my body starts shaking and vibrating when I meditate. Other times it involuntarily jerks suddenly and strongly. What is happening?

There are several reasons for shaking, jerking, and vibrating involuntarily during meditation and Chi Kung practice. There is a Chinese saying, The Chi moves and the body follows." When Chi flows

strongly and suddenly into areas previously blocked, it sometimes moves the body spontaneously and causes the practitioner to jerk.

Sometimes the meditation posture may be slightly off, blocking an energy channel. In this case, the body sometimes spontaneously and involuntarily moves to open the channel and allow the Chi to flow in. The body displays its own wisdom in these matters, bypassing the control of the conscious mind.

In other cases, the body starts moving rhythmically to help "pump" the Chi through the body. When practicing the Microcosmic Orbit, many people rock back and forth spontaneously in time to the flow up the Governor Channel and down the Functional Channel. This is also common among Jewish worshipers, who call it "divining". It is frequent among one Christian religious sect that drew its name from the experience: the Shakers.

Yet another reason is that we have begun to absorb Chi from Heaven, Earth, and the Higher Self, and our channels are widening to absorb additional bursts of Chi. This is similar to what happens when you suddenly increase the water pressure in a hose: the hose jerks and moves around.

The shaking process is beneficial. In fact, special forms of Chi Kung encourage the shaking process; one is even called Spontaneous Movement Chi Kung. Shaking releases nervous tension and helps Chi penetrate deeply into the body.

If the shaking becomes too violent or powerful, however, you can stop it by simply mentally ordering it to cease.

When Chi fills the organs, there may be specific shakings that occur:

The heart rules the blood vessels. When the heart fills with Chi, the body jumps up and down like a monkey at play.

The liver rules the tendons. When the liver fills with Chi, the legs and big toes may cramp as the Chi swims joyfully like a fish in an ocean of divine ecstasy.

The spleen rules the muscles and flesh. When the spleen fills with Chi, the muscles twitch like a bird hopping from branch to branch, and the place where the Chi rests feels like fire.

The lungs rule the skin. When the lungs fill with Chi, you will feel sensations of prickling, itching, and heat all over the body, as if ants were crawling all over you, especially on your face. This indicates the lung Chi is moving around.

The kidneys rule the bones. When the kidneys fill with Chi, you

will hear the sound of moving bones. As the Chi moves up the spine, you will sometimes also feel sexual arousal.

Will I get better results in my practice if I become a vegetarian, or is it helpful to eat meat?

In the beginning of your practice of the Microcosmic Orbit meditation, it is best to purify yourself. It is helpful to reduce the amount of meat, fish, and poultry you eat and to increase the amount of fiber in your diet to clear the digestive tract. If you are not totally vegetarian, we recommend that during your first 100 days of practice your diet consist of about 80 percent steamed vegetables and grains, 10 to 15 percent fish, and only 5 percent meat and chicken.

If you are doing a lot of practice, your metabolism and blood circulation will improve, as well as your Chi circulation. Heat is a common byproduct of this increase. If this happens, it is important to eat less warming food, such as meat and grains, and more cooling and cleansing food, such as high-water-content vegetables and fruit, and a moderate amount of fruit juice (but not too much; fruit juice can be overly cooling) to keep from overheating.

If you are not experiencing excess heat and are doing a lot of Tai Chi or physical Chi Kung practice along with intensive meditation, it can be beneficial to eat more building foods, such as meat and poultry. The Chinese have traditionally been partial to meat as a building food. There are also plentiful building foods, however, in a well-designed nonmeat diet; over the millennia, many Taoists have successfully practiced as vegetarians. Many Olympic athletes in recent years have also been exclusively vegetarian while training.

Modern research has implicated excessive meat consumption as a major factor in increasing the risk of heart disease and cancer. Meat eaters have a risk of heart attack over 300 percent greater than that of vegetarians. Taoists concerned with the balance of nature recognize that meat production is a major factor in the destruction of the world's rainforests. The Taoist path is the way of moderation. Be conscious of the implications of your life- style, and use your own good judgment as to what your needs are.

In any case, it is inadvisable to jump suddenly into a strict vegetarian diet without first educating yourself about it, because the changeover can create imbalances that may add to your problems.

I have heard meditations that work with energy are dangerous.
Is the Microcosmic Orbit meditation safe?

The major adverse side effect of energy meditations is having too much energy get stuck in the wrong places. The most common places for energy to get stuck are the head and heart.

In the Healing Tao, we teach the Microcosmic Orbit in a safe and systematic way. Because we emphasize both and upward and downward flow of energy, there are fewer problems than with other systems. We also teach appropriate safeguards to prevent difficulties. If you follow the stages as we have outlined, respect the precautions, and use common sense, you should have only positive experiences with the Microcosmic Orbit.

In this troubleshooting guide, we outline common problems. If you show any adverse signs you feel may be related to your practice, use good judgment and immediately apply the appropriate remedy.

Meditation practice is like medicine. It can be tremendously healing if used according to directions, but if you are careless and do not treat it with respect, you can incur negative side effects. Energy practices are powerful, like fire. Fire can warm your home, provide light, cook food, and run machinery; it can benefit you in many ways. But you must treat fire with respect. If you handle carelessly, it can destroy your home, burn you, even kill you.

Don't be foolhardy in your practice of meditation. Respect the system, respect your teacher, and follow the appropriate safeguards given throughout this book.

Sometimes I feel very tired after meditation. Why is that?

Sometimes when energy has been blocked for a while and the channel is suddenly opened, energy rushes into the previously blocked area. While the energy is flowing where it needs to go, it may feel as if steam has been let out from where it was before, or as if there has been a release of pressure.

If you feel tired, rest. Allow your body to heal itself. You have already aided the process by opening the door for the energy to flow. Healing and restoring balance in the body requires a lot of energy; it is natural to feel tired as a result. The fatigue usually disappears in a few weeks.

After practicing the meditation regularly for several months now, I find myself experiencing powerful emotions like anger, sadness, and fear. I thought meditation was supposed to make me more peaceful!

Emotional traumas often create energetic blockages or areas of chronic tension in the body. These tensions are created as "psychological armoring," to protect us from threatening situations we are unable to process at the time. We often maintain these tensions for years, holding patterns we may be completely unaware of.

When we practice the Microcosmic Orbit, we are beginning the work of opening up all the energy blockages in the body. Moving energy through these areas of tension is a conscious attempt to relax these areas and bring them back to life. As we do this, we often experience the emotions of the original trauma. A certain part of us may feel frightened, vulnerable, almost naked, as if the meditation is stripping us of our protective armor.

If you are to be truly free and no longer a slave to the old reactions of your unconscious, you need to process your emotions daily and let go of old anger, fears, and grief. Nonetheless, it is important to respect your emotional strengths and abilities in dealing with these old, repressed traumas. Many victims of physical and sexual abuse have completely shut out the memories of these incidents from their conscious minds, recollecting them only years later after something triggers the memories. This kind of severe trauma can be painful and difficult to deal with, so progress at your own pace.

As their meditation practice unlocks old emotional problems, brings them to the surface, and starts the process of healing and releasing, many people find it helpful to seek some form of counseling or therapy to aid recovery. Others find they are able to handle the release with meditation alone. A good counselor can be of great help in speeding the emotional healing process. You should respect your own needs.

How long should I practice the Microcosmic Orbit meditation before moving on to the higher levels of practice?

This is a highly personal matter, less a question of time than of accomplishment. Some people are ready to move on almost immediately, whereas others may practice for months or years be-

fore they are ready to move to the next stage. Generally speaking, once you have thoroughly mastered the Microcosmic Orbit instructions and have spent some time practicing, you can continue with such practices as Testicle or Ovarian Breathing, the Power Lock Exercise, and Fusion of the Five Elements meditations. These practices are advanced variations of the Microcosmic Orbit; the main difference is that they are moving a different form of Chi through the Orbit.

In fact, sometimes students who don't feel Chi moving in the Microcosmic Orbit or who don't have the sense of having opened the pathways should move on anyway. The sensation of sexual energy (Ching Chi) moving in the pathway is much more vivid and pronounced for many people, as is the sensation of the pearl formed in the Fusion practice. The more advanced practices may therefore actually help them open the Microcosmic Orbit.

Turning Awareness Inward Highlights Health Problems

Taoist meditations bring your attention back into yourself. The mind/body connection becomes stronger, and you can learn to foresee dangers to your health. Some people mistakenly blame newly discovered problems on the meditations. It would be wise to recognize that in most cases internal disorders have their roots in past experience, not in the practices that make us aware of them. The truth is that the meditations only expose these problems.

Nonetheless, when we begin to circulate energy, we sometimes encounter congestion. The situation is something like a roadblock: it isn't a problem until you try to drive your car past it! The following section describes common symptoms associated with congestion in particular organs. If you experience any of these symptoms, try the simple remedies suggested. These remedies are intended to alleviate the underlying problem, not just the symptoms.

Simple Remedies for Organ Congestion

Liver congestion. Symptoms of liver congestion include headaches due to perverse heat in the liver, being easily angered, constipation due to the heat of the liver, and painful eyes. The liver is congested and the Wood meridians are blocked, creating pain.

One reported remedy is the Chinese herb pill called Niu Huang

Chieh Du Pien, packaged eight to a bottle. The average dose is two to four the first night and two the following nights. After you finish one bottle, wait for the effects. Heat and anger may be reduced or may cool other emotions. You may have diarrhea, so avoid taking this pill before a long trip. (The pill is also available in a coated form, 20 in a bottle, enough for three treatments.)

Avoid the following: oily, greasy, or fried foods; butter and cheese with a lot of cream; alcohol; and hot and spicy foods. Do not overeat.

Beneficial foods include green leafy vegetables and lightly cooked black seaweed.

Do 9 Liver Sounds. Repeat as many times as necessary.

Spleen/stomach/pancreas congestion. Symptoms of spleen/stomach/pancreas congestion include indigestion due to heat in the stomach and intestines, feeling over-full or bloated after eating, pieces of food in the stool, abdominal discomfort, and dislike of having the abdomen touched.

A reported remedy is the Chinese herb pill called Huang Lien Shan Chin Pien, supplied eight pills in a bottle. Normal dose is two to four the first night and two the following nights, then wait for the results. Heat and emotions may be reduced. You may have diarrhea, so do not take this formula before a long trip.

Avoid the following: fried foods and foods rich in butter or cream; raw or cold foods; sugar, meat, and eggs.

Beneficial foods include mild soups; soft cooked cereal, such as rice cream; and kudzu drink or arrowroot.

Do the Spleen Sound 9 times. Repeat until you feel better.

Lung congestion. Symptoms of lung congestion include dry or sore throat, oral and nasal boils, toothache, yellowish or reddish urine, constipation due to heat, and depression. These stem from internal conditions due to perverse heat in the lungs and are not to be confused with similar symptoms caused by the flu.

A reported remedy is the Chinese herb pill called Ching Fei Yi Hua Pien, supplied eight to a bottle. Normal dose is two to four the first night and two the following nights, then wait for the effects. The heat and emotions may be reduced. Avoid taking these before a long trip.

Beneficial foods include relaxing teas and boiled pears.

Lightly tap the chest area all over with your palm.

Practice the Lung Sound 9 times. Repeat as many times as necessary.

Disharmony of the entire system. Symptoms include feeling faint due to sudden disharmony in the energy system at that moment, or from exhaustion.

Remedies: Immediately lower the head between the knees, or lie down with the feet slightly elevated. Press these points: Large Intestine 4 (at the base of the V-shaped web between the thumb and the first finger) Stomach 36 (on the lower calf).

If you are applying the points on another person and he or she faints completely, press Governor Channel 26, Renzhong, between the nose and the upper lip. Cover the person with a blanket and give some hot tea.

Signs of Detoxification

As the healing benefits of the Inner Smile, Six Healing Sounds, and Microcosmic Orbit begin to manifest, you may also find the process includes detoxification. For instance, with the Six Healing Sounds you may find yourself belching, yawning, and passing gas as you practice. That is an immediate form of detoxification and a good sign the practice is working.

You may find from time to time that you experience other signs of detoxification. The most common are listed below.

Diarrhea. You can distinguish the diarrhea of detoxification from the diarrhea of illness. For one thing, you will probably have the episode of diarrhea at the same time you would normally have a bowel movement. It will not be accompanied by the common signs of sick diarrhea: intestinal pain, fever, weakness, cold sweat, and so on. In fact, when the diarrhea is over, you may even feel more energetic. Some of my students say they have diarrhea at the time of a normal bowel movement perhaps three days in a row, and then no more. Or it may return from time to time as they reach new levels in their practice.

Sleeping a great deal. You may find yourself sleeping for long, stretches after you start the practice. This is another way the body handles detoxification. Also, at the beginning, your energy may be doing a lot of repair on your body, and you may feel tired after meditating. As long as this marathon sleeping (10 to 15 hours) doesn't last more than a few days, it is nothing to worry about.

Recurrence of old illnesses. One of the more disturbing signs of detoxification is the resurfacing of an old illness. This can happen with any type of disease, but it seems to be more common

with skin and lung conditions, particularly those treated with drugs to suppress the symptoms. It is like trying to keep a bunch of Ping-Pong balls underwater. When you take away the suppression, they bounce to the surface.

For many of my students, these recurrences are a way for the old diseases to fight their way out of the body entirely, but feeling sick or being disturbed by skin rashes is not pleasant or easy to tolerate. My only encouragement is that this is often the end of their old affliction. If the condition is not too troublesome, try some of the recommended herbs and dietary treatments mentioned in the previous section. Of course, if the problem appears serious or goes on too long, you should consult a health practitioner.

If it is physically possible, do not stop meditating when you are ill. Accelerated healing will continue to take place as long as you meditate for even 20 minutes a day.

Those who have had broken bones or surgery may experience some pain as energy flows through these areas. For the first time since the injury or surgery, energy links are being reestablished. The pain is often short-lived, intense but brief; then it vanishes and does not recur.

Circulation of Energy Prevents Blockages and Maintains Safety

Follow the Natural Patterns of Yin and Yang

Chinese medicine has roots in Taoism; it emphasizes developing and maintaining internal harmony and strength to help the body heal itself. All meditations, internal exercises, and martial arts of the Healing Tao system are based on these same concepts. They are gentle and safe because they circulate Chi, which enhances the body while recycling stagnant or negative energies. Taoists believe in the law of Yin and Yang: energy in nature moves in an appropriate and balanced way. The sun rises, and so it must set. The moon waxes and then wanes. If the sun remained still for several days or more, everything on one side of the planet would burn, and everything on the other side would freeze. If the moon remained still, its gravitational effect would upset the balance of the oceans. This is why the balancing of Yin and Yang energies is so important.

In the microcosm of the body, when you bring energy up to the

head and the heart, you must also bring it down again to avoid overheating these vital organs. Circulating energy regularly through the Microcosmic Orbit regulates the body's energies and maintains internal balance as essential part of practice. The Healing Light meditation is useful restoring health, but it also acts as a safety valve for other practice. Circulating Chi with this exercise protects the practitioner from dangerous side effects of drawing in too much energy.

Don't Cook Your Brain; Don't Cook Your Heart

There is an old Taoist saying: "Don't cook the brain, and don't cook heart." This means do not leave energy too long in the head or the heart. Under certain conditions, the body's Yin and Yang energies may separate, and the hot Yang energy will rise to the higher centers of the heart and brain. If it is not consciously circulated, it can overheat these organs and possibly damage them. When this hot energy is drawn down to the navel, the head and heart centers remain cool, and a surplus of Chi become available to the body.

Overheating the Brain: Kundalini Syndrome

Causes of Kundalini syndrome. Other systems advocate building up a great deal of energy through such practices as celibacy. This energy may spontaneously rise up the spine to the brain, resulting in Kundalini syndrome. When this powerful Yang energy surges up all at once, the body doesn't know how to handle it; all kinds of syndromes, psychoses, and damage to the organs and senses can result.

Kundalini syndrome can also occur if one focuses the attention for too long on the mideyebrow or Third Eye without having opened the Functional Channel to provide a Yin pathway for grounding, venting, and recycling the energy.

Symptoms of Kundalini syndrome. Complications that arise because of energy congestion in the head include sudden baldness; headaches, ringing in the ears, seeing flashing lights, and psychosis. These problems can occur if energy flows up the spine without being, released through the skull or circulated down the front channel to the navel. Incidents of this syndrome have caused acute suffering, especially to those who sought treatment from Western physicians, because Western medicine does not address

the flow of energy in the body. (For more information, read *The Kundalini Syndrome* by Lee Sannella, M.D.)

Avoiding and treating Kundalini syndrome. To avoid such problems, you need to open both channels of the Microcosmic Orbit and store all accumulated energies at the navel, The Microcosmic Orbit meditation balances Chi flow by circulating energy up through the warm vital centers and down through the cooler centers before it is stored in the navel. This naturally harmonizes the Yin and Yang (cold and hot) energies, in contrast to the emphasis in Kundalini practice on the Yang upward movement of energy without grounding it in cooling Yin energy.

It is also far better to bring the energy up gradually and in a controlled manner. The situation can be likened to trying to get water to the top story of a tall building. One possibility is to install a big pump on top of the building. It will work, but with a lot of difficulty. A better way is to install a pump at ground level and add more small pumps all the way up the building, so each pump sends water to the next pump.

Likewise, in Taoist practice we learn to activate several different pumps: at the perineum, anus, sacrum, adrenal glands, seventh cervical vertebra, and base of the skull (part of the cranial pump together with the crown) to help pump energy up the 24 vertebrae. Sending energy up the spine to the higher center daily and bringing it down the front enhances the organs and glands, reduces side effects, and more fully utilizes the vital life-force. In the Taoist way, Awakening Healing Light is an ongoing process. It does not happen suddenly, leaving you with no room to handle the excess.

Overheating the Heart

The main cause of the heart overheating is an excess of negative emotions blocked in the heart. Sometimes if people concentrate on the abdomen too long, either because of gastrointestinal problems or because they don't feel any Chi there, the energy rises up the front and overheats the heart as well. In women, Chi in the Functional Channel tends to rise up the front of the body to the head. When heart energy is not clear and open, the Chi can't pass through; it jams up in the pericardium, overheating the heart's cooling system. The heart then overheats, causing irritability, chest pain, and an accelerated heart rate.

1. To solve this problem, first move the concentration to the Door of Life. Feel the heat drain from the heart back to T-5 or T-6 and down to the Door of Life. Feel the heart cool down.

2. If this doesn't help or the heart still beats fast and causes profuse sweating, shift the concentration to the mideyebrow and move down to the navel and Door of Life. Moving the concentration back and forth should release the congestion of the heart.

3. Practice more of the Six Healing Sounds for the lungs, heart, liver. Do each 6 to 12 times and feel the organs cool down.

4. Feel love, joy, and happiness to open and cool the heart. Patience, hastiness, and hate overheat the heart and can lead to heart failure or heart attack.

5. Massage the sternum and between the ribs to help release the jamming-up of heat and energy in the heart.

6. Practice Fanning and Venting the excess heat out to the tips of the toes and fingers.

Appendix
Spinal Cord Breathing
Opening the Channels of the Spinal Cord

The spinal cord is a major pathway for energies from the earth and sexual center to move up to the higher centers of the body. Taoists regard each junction between the vertebrae as storage places for Chi. They also see the spinal cord contains the largest concentration of marrow in the body (Fig. A.1). The bones are regarded as Yang; the nerves are regarded as Yin.

When we exercise and shake the spinal cord loose, mentally stimulating the nerves, we generate an electrical current (Fig. A.2) that flows more intensely during practice. When Chi travels up the spinal cord, the health of the spine and brain improves greatly as the absorbed energies are refined into life-force. Keeping the spine relaxed and properly aligned with the shoulders and hips is important to prevent or release energetic obstructions. The more relaxed the spinal cord is, the more easily energy will flow.

Spinal Cord's Connection to Vital Parts of the Body

The nerves of the coccyx and sacrum are connected to the lower limbs, kidneys, bladder, sexual organs, external genitalia, rectum, and large intestine (partially).

The lumbars (L-1 to L-5) in the lower back are also connected to these areas.

The nerves of the thoracic vertebrae in the middle back (T-5 to T-12) are connected to the stomach, liver, gall bladder, pancreas, spleen, adrenals, small intestine, and abdominal blood vessels.

The nerves of the upper thoracic vertebrae (T-1 to T-4) are connected to the heart, larynx, trachea, bronchi, and lungs.

The nerves of the cervical vertebrae (C-1 to C-7) are connected to the organs, glands, and upper limbs.

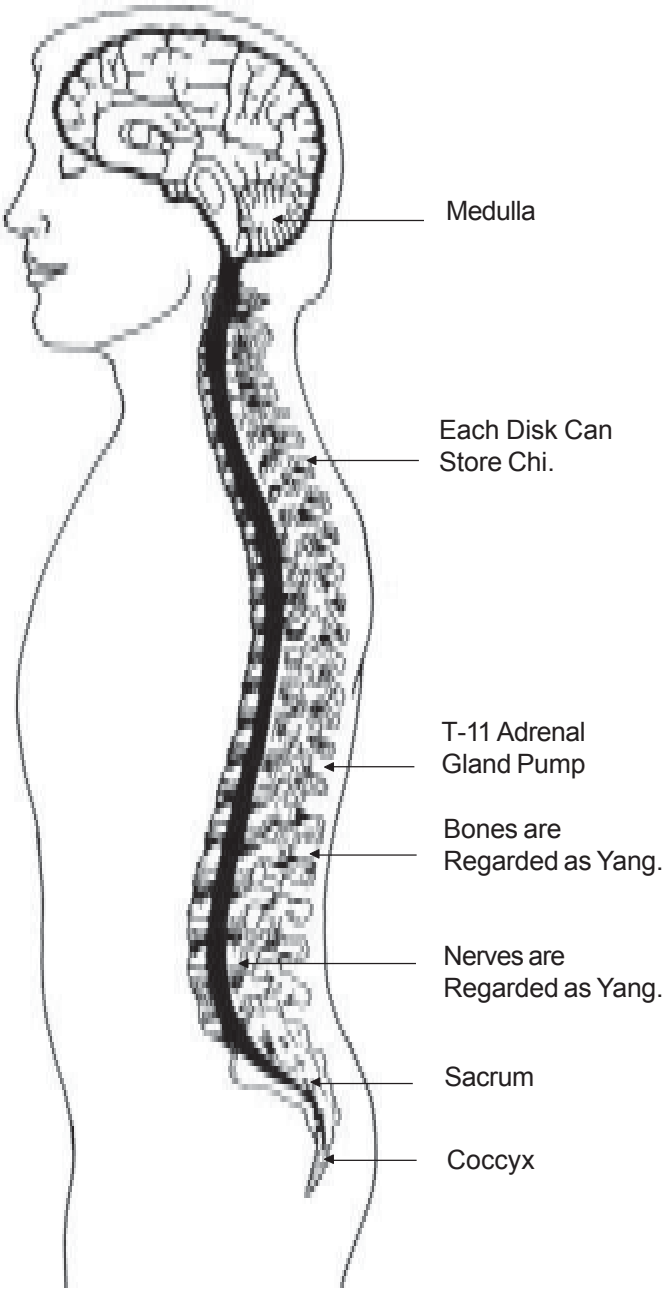

Fig. A.1 *The spinal cord contains the largest concentration of marrow in the body.*

Fig. A.2 *The nervous system runs though the spinal cord.*

Meditative practice

Look carefully at a good anatomy book, then close your eyes and try to see these connections as well as feel them (Fig. A.3). Smile down along the spine, covering these connections with smiling energy.

Practice: Spinal Cord Breathing Exercise

The Spinal Cord Breathing exercise helps relax the spine while activating the sacral and cranial pumps and adrenal and thymus glands.

Spinal Cord Breathing also helps relax the muscles of the back so you can remain comfortable while sitting for long periods of time. It can be practiced sitting or standing (Fig. A.4). Find a suitable chair and relax, keeping the spine comfortably straight without allowing it to touch the back of the chair.

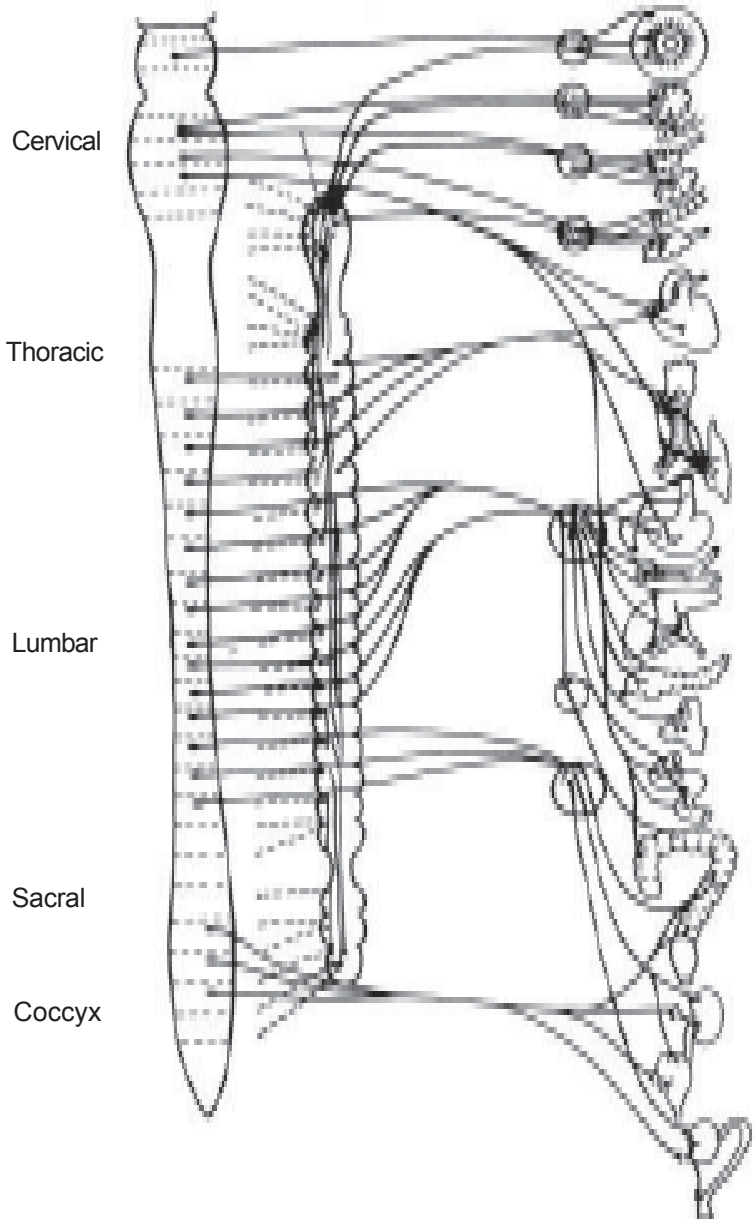

Fig. A.3 *The spinal cord is connected to vital parts of the body.*

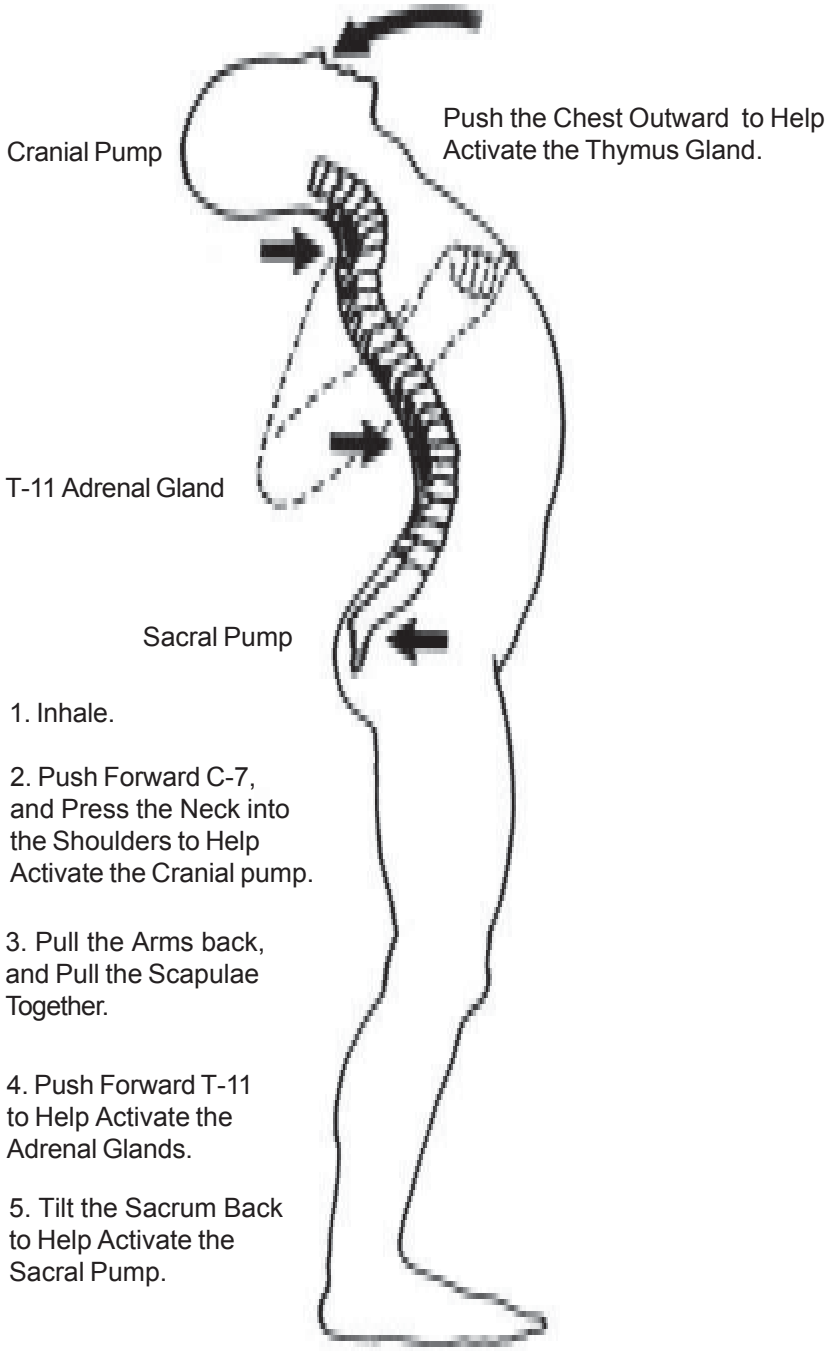

Fig. A.4 *Spinal Cord Breathing*

Men: If you sit, use a straight-backed chair, and sit on or near the edge of it so the testicles can hang over the edge freely. (If this is not comfortable, you can sit slightly farther back.) Wear loose clothing so the testicles are unrestricted and the male energy can flow without any obstructions.

Women: Sit comfortably without touching the back of the chair. Wear loose clothing so there are no obstructions of the perineum and the energy flowing through it. If you prefer to sit on the floor, use a thick cushion so the circulation of the legs is not impeded too much.

1. Begin by exhaling and feeling yourself relax.

2. Inhale, and gently tilt the sacrum and the head all the way back as yon arch the middle of the back and push the abdomen and chest outward. Expanding the rib cage activates the adrenal and thymus glands (Fig. A.5). Simultaneously pull back the shoulders and fists (which ate held near the shoulders), pulling the scapulae together (Fig. A.6) as you press the neck into the shoulders and lightly clench the teeth. This activates the cranial pump (Fig. A.7).

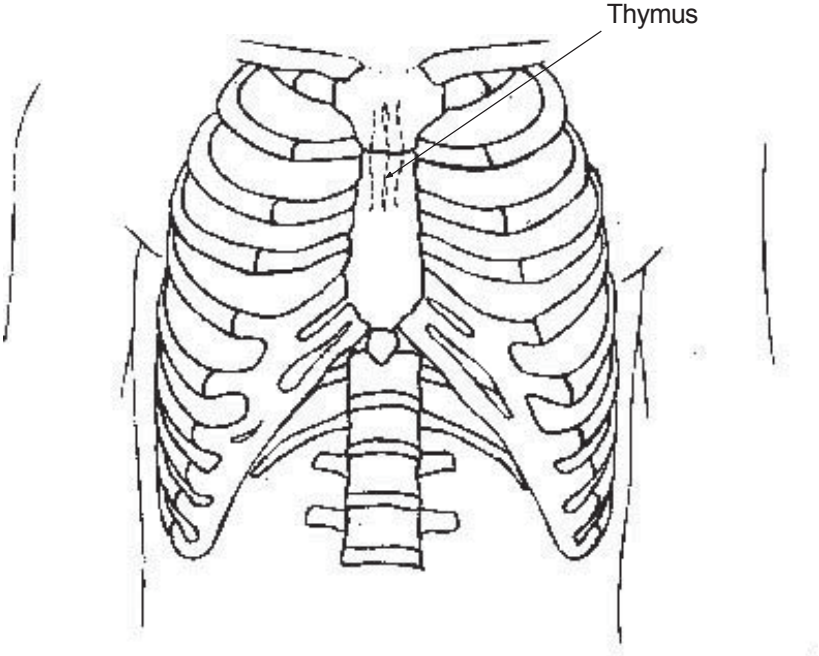

Fig. A.5 *The thymus gland is the major gland of rejuvenation and of the immune system.*

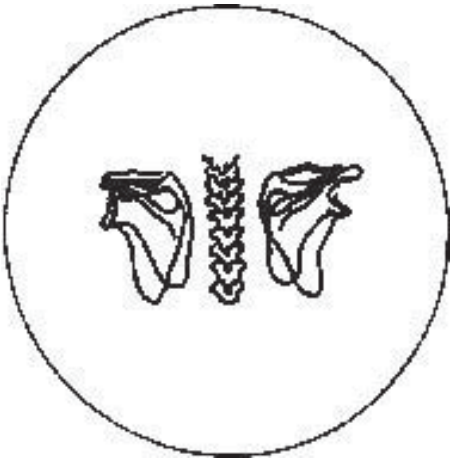

Fig. A.6 *By expanding and contracting the rib cage and the scapulae, we can help activate the thymus gland.*

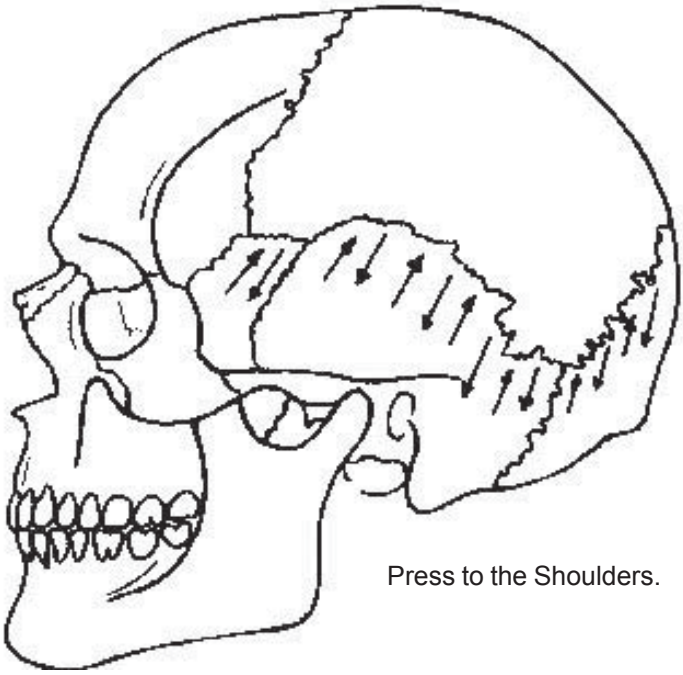

Fig. A.7 *The cranial pump becomes activated when you press the neck to the shoulders and lightly clench the teeth.*

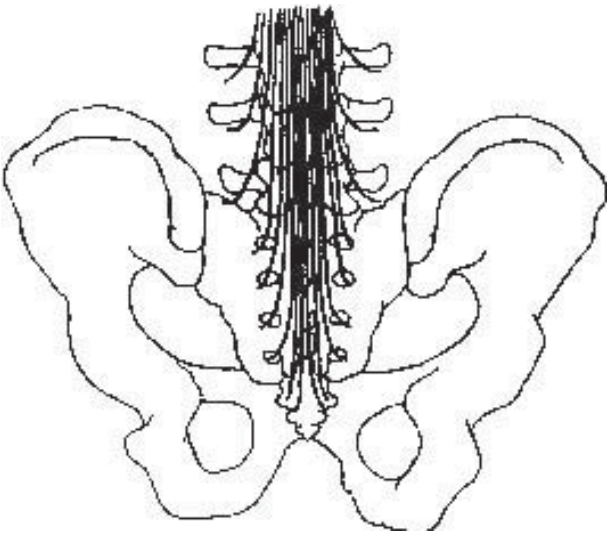

Fig. A.8 *Tilting the sacrum in and out will help activate the sacral pump and exercise the nerves.*

Hold this position and tighten the muscles. Tilting the sacrum activates the sacral pump and exercises the nerves (Fig. A.8).

3. Exhale, and push the sacrum and head forward, rounding the back. As you do this, bring the elbows forward, close the forearms and fists into the chest, and bring the chin down to the sternum (Fig. A.9). Don't tighten any muscles. Just relax.

4. Repeat. Inhale, tilt back the head and sacrum, arch the back as you push out the abdomen, and retract the shoulders and fists. Then exhale as you round the spine forward, tuck the chin in, and bring the arms to the front. Continue arching the back as you inhale and bending forward as you exhale. Do this 9, 18, or 36 times (Figs. A.10, A.11, and A.12).

5. Spinal marrow washing. Rest, and smile down the length of the whole spine. Breathe in white mist from the mideyebrow, golden light from heaven through the crown, and blue light from the soles to help wash the marrow (Fig. A.13). Feel the spinal cord tingle out to the nerves as they are stimulated and charged by a higher voltage of Chi (Fig. A.14). Feel electricity flow as you breathe energy into the area. Feel the Chi enter the bones. Become aware of the sacrum, cranial pump, and adrenal and thymus glands. Feel them become loose and warm as they begin to vibrate.

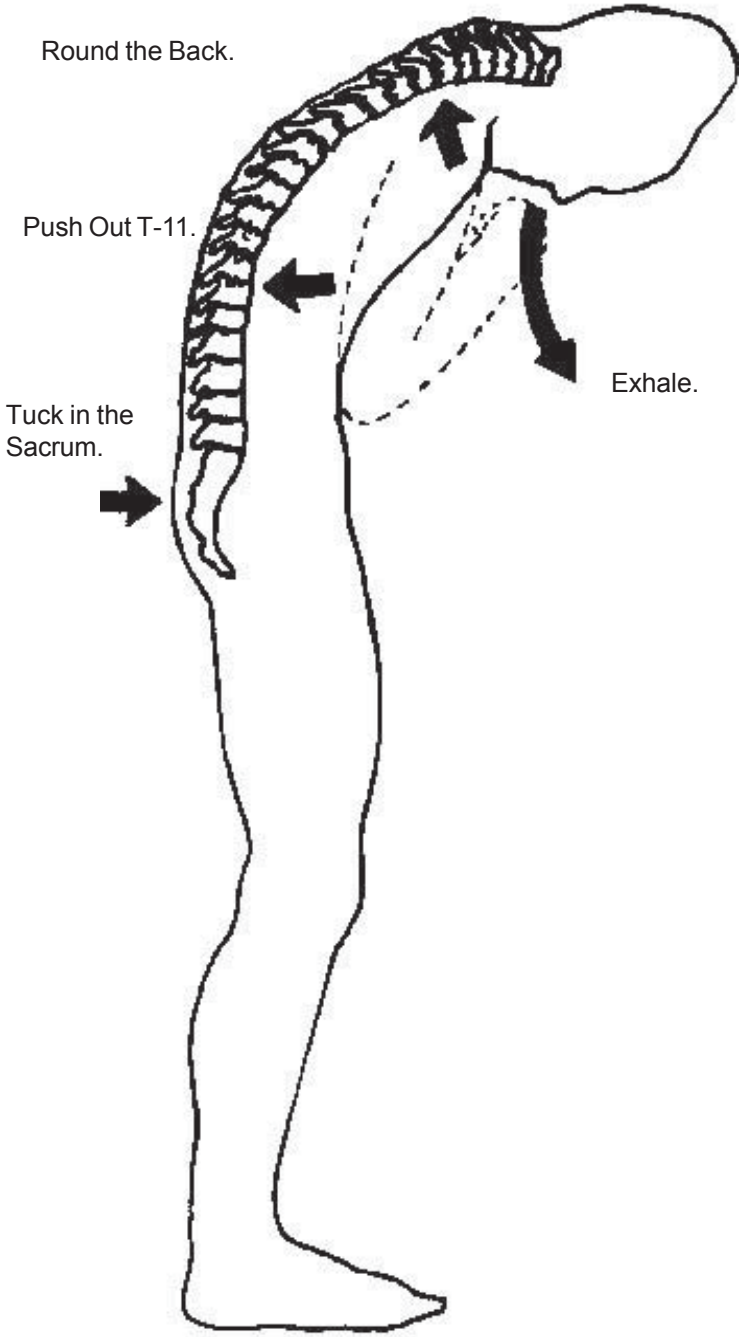

Fig. A.9 *Spinal Cord Breathing*

Fig. A.10 *Spinal Cord Breathing in sitting position, bending forward.*

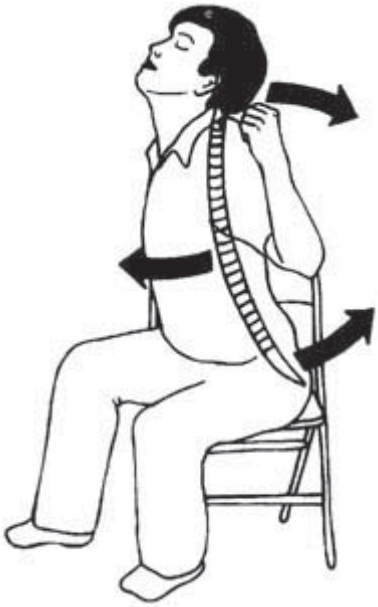

Fig. A.11 *Spinal Cord Breathing in sitting position, bending backward.*

Fig. A.12 *Spinal Cord Breathing from a sitting position.*

Fig. A.13 *Bone Marrow Washing*

Feel the Connection of the Nerves to the Spinal Cord.

Fig. A.14 *Nerves are conductors of Chi. Visualizing their connection to the vertebrae will increase the flow of the Chi.*

Spinal Cord Rocking

Rocking movements are very free and flexible. Each person is different, so once you learn the pattern of each exercise, just let the body express it naturally and enjoy the freedom of movement. The explanations may sound complicated, but the motions are really very easy. The more you let go of tensions, the more you benefit.

NOTE: Pay attention during each resting period. Feel the Earth Force enter the soles of the feet and travel up through the legs, bones, hips, sacrum, spine, rib cage, and brain. Feel this force washing the marrow as you absorb it into the bones. Round bones produce red blood cells, which carry oxygen and nutrients to the cells. Flat bones, such as the ribs, skull, and scapulae, produce white blood cells, which serve as the body's main defense system against disease. During each resting period, practice Heavenly Force Marrow Washing (or Fire Force Marrow Washing) by drawing Chi into the marrow of the bones (Figs. A.15 and A.16): Become

aware of the crown and feel numbness or heaviness spreading down into the brain, skull, neck, collar bone, sternum, and rib cage. Feel the nerves penetrate the bones as you generate more Chi.

Silkworm Rocking

Rock the spine like a silkworm climbing a tree. Use soft, gentle, slow movements of the body. The spinal cord should move like a little wave.

1. Start by smiling to the spinal cord. Try to feel the spine. Then close the eyes and visualize the spine (Fig. A.17).

2. Rock from the base of the spine gradually up to the head. Rock from the coccyx up to the sacrum, fifth lumbar vertebra, twelfth thoracic vertebra, cervical vertebrae, and up to the skull. Move as if you were creating a wave with the spine, like a silkworm (Fig. A.18).

3. Rock back down gradually from the head to the coccyx (Fig. A.19).

Men should practice 3, 6, or 9 times; women should practice 2, 4, or 6 times. Rest, and smile to the spine. Feel the spine absorb Chi into its marrow and radiate it up to the brain. Feel the spine become warm and relaxed.

Crane-Neck Rocking

This movement emulates a larger wave in the spine than Silkworm Rocking (Figs. A.20 and A.21). (It is an extended version of the Silkworm exercise.) Create a wavelike motion, loosely bending the middle and lower spine. While rocking, pay attention to the Door of Life and the L-2 and L-3 lumbers. Feel the wave move from the lumbars up to the neck (Figs. A.22 and A.23).

1. Start by arching lumbars L-2 and L-3 to the front as you stretch the neck to the back.

2. Stretch the neck like a crane. Stretch the chin out, curve it in, and touch it to the throat. At the same time, push back the lumbar area, creating a wavelike movement.

3. Rest, and smile down the length of the spine. Feel the spine and the brain breathing in Chi from the earth and the universe. Feel the spine become warm and relaxed.

4. Do this exercise from 18 to 36 times.

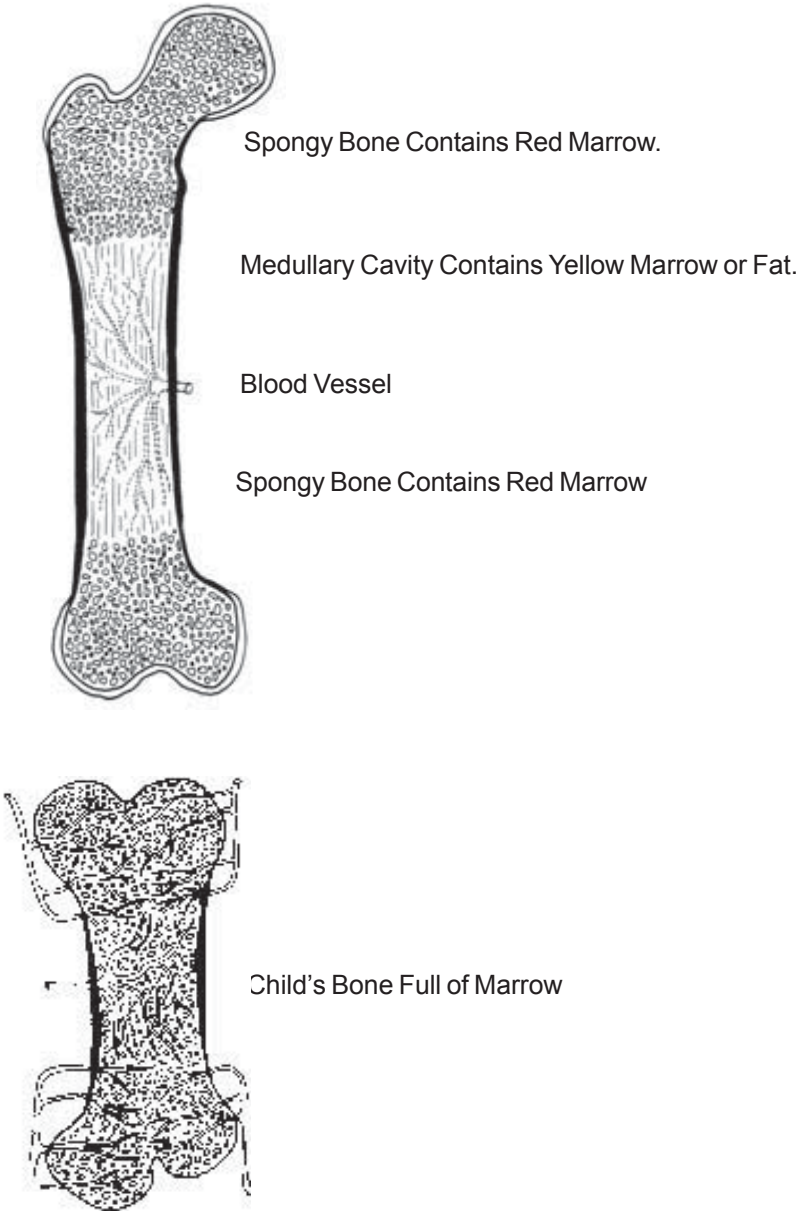

Fig. A.15 *The bones of a child are made exclusively of red marrow with abundant blood vessels, while adult bones have red marrow at the extremities and a central area containing fat (yellow marrow).*

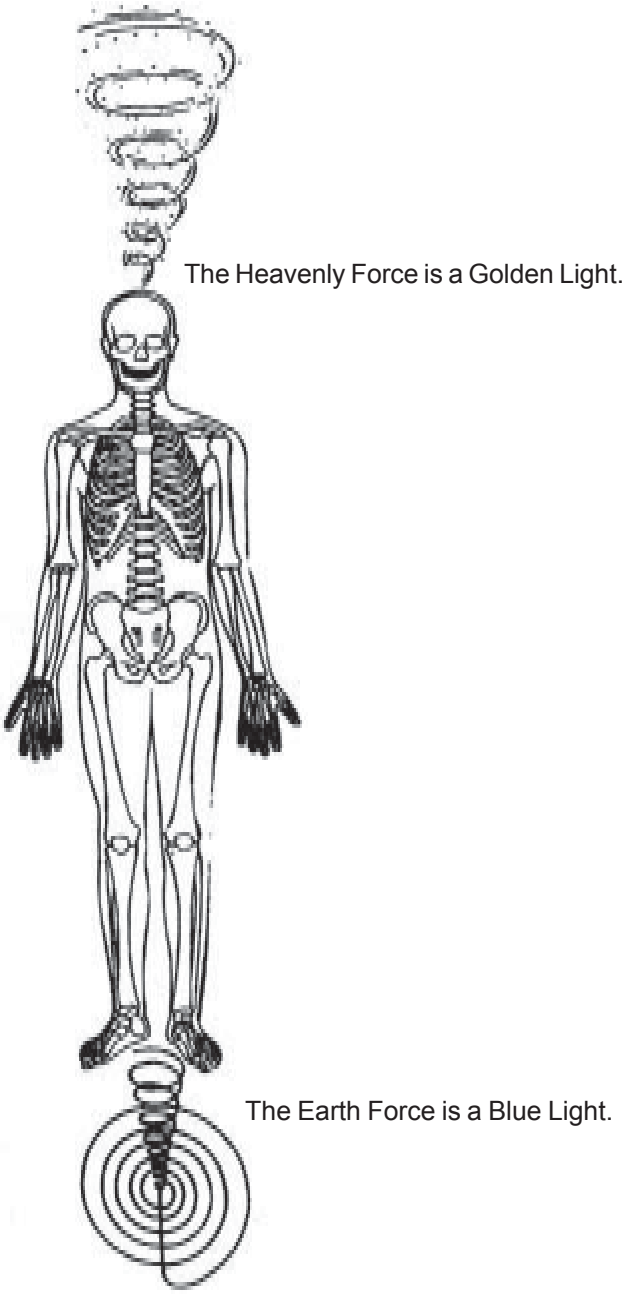

Fig. A.16 *Draw the Heaven and Earth Forces though the bone structure to help wash the bones.*

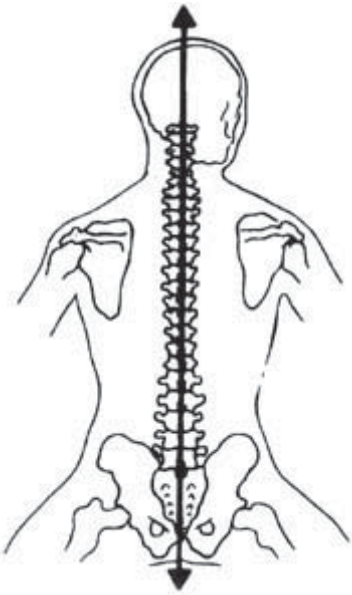

Fig. A.17 *Smile to the spine from top to bottom.*

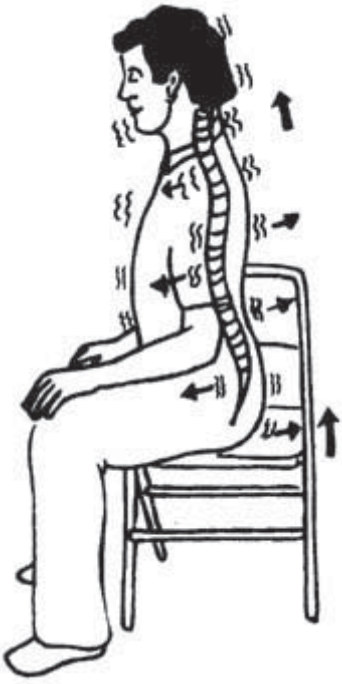

Fig. A.18 *Move the spinal cord like a wave from the base up to the head.*

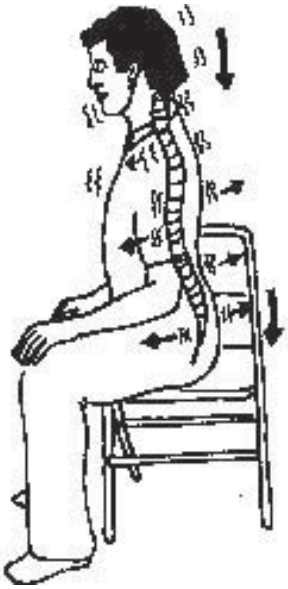

Fig. A.19 *Reverse from the head down to the sacrum.*

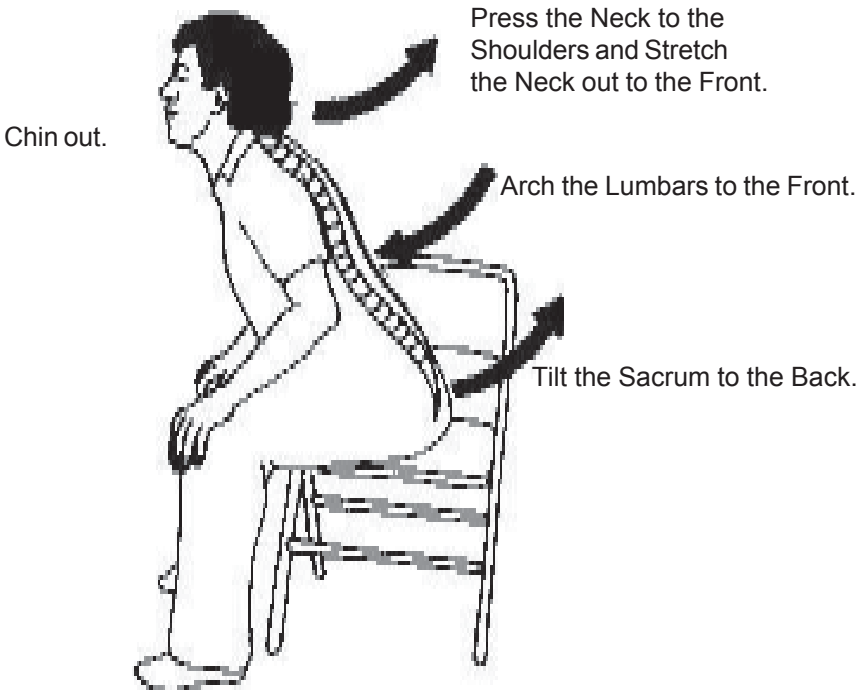

Fig. A.20 *Crane Neck, curving spine out.*

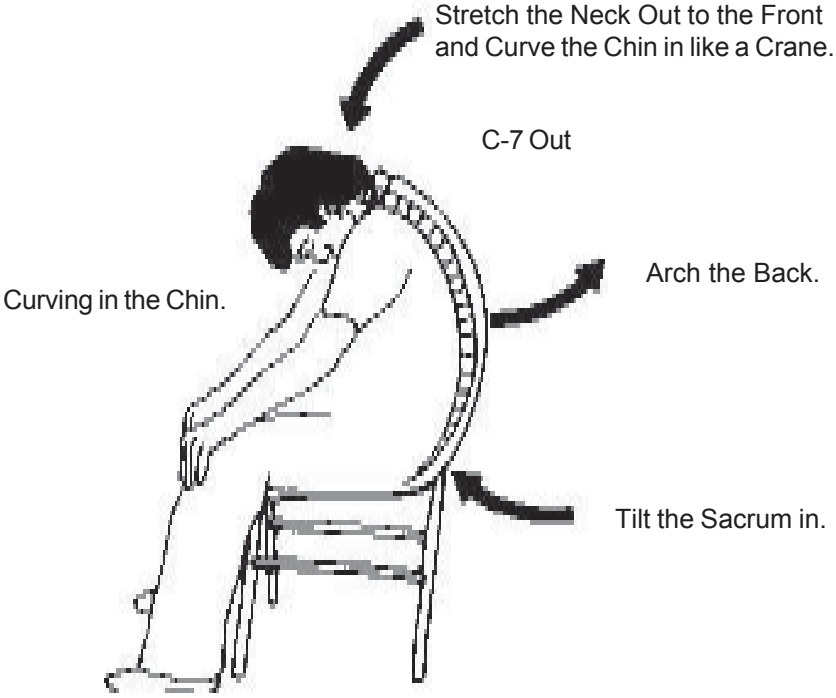

Fig. A.21 *Crane Neck, curving spine in.*

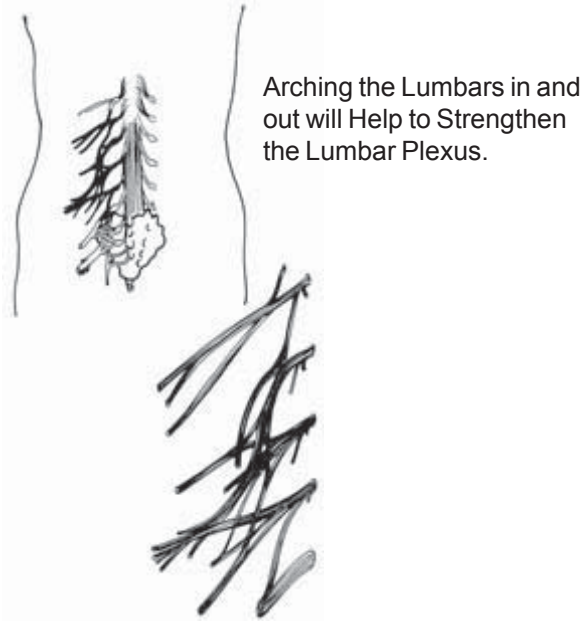

Fig. A.22 *Lumbar Plexus*

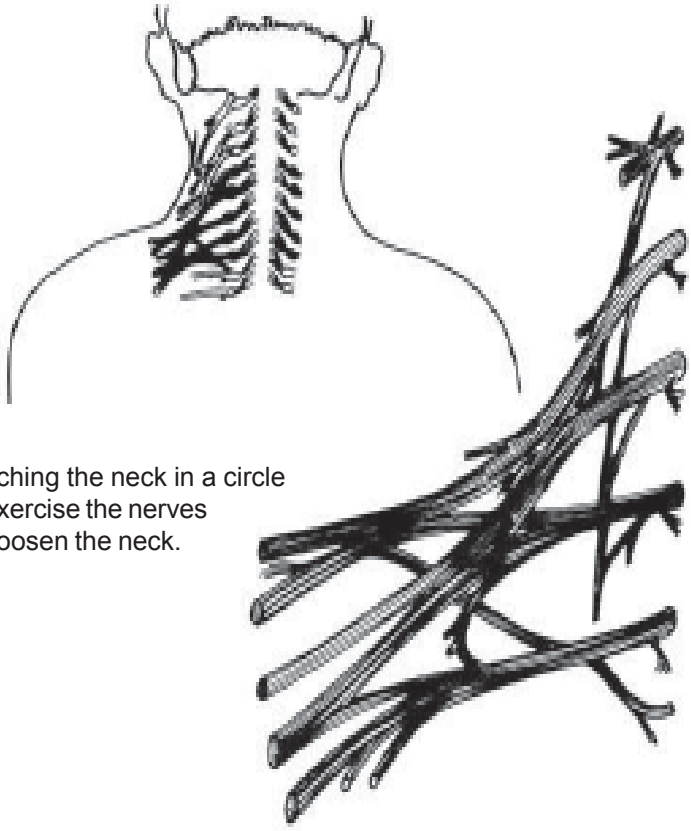

Stretching the neck in a circle will exercise the nerves and loosen the neck.

Fig. A.23 *Brachial Plexus*

Rocking Left and Right

1. Start rocking the body from left to right, gradually expanding the motion from the base of the spine (coccyx) up through the sacrum, lumbers, thoracic vertebrae, cervical vertebrae, and up to the head. Start by rocking from each section individually, then move up to the next section (Figs. A.24 and A.25).

2. From the top of the head, rock left and right down through each section, one by one, until you reach the coccyx. Rest, and smile down the length of the spine. Feel it become warm and loose. Feel the spine absorb Chi into the marrow and brain to increase the life-force in the bones.

3. Do this exercise from 18 to 36 times.

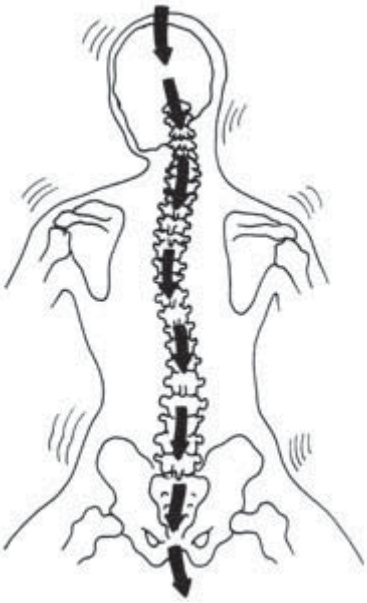

Fig. A.24 *Rock from left to right.*
Start rocking each vertebra up to the head.

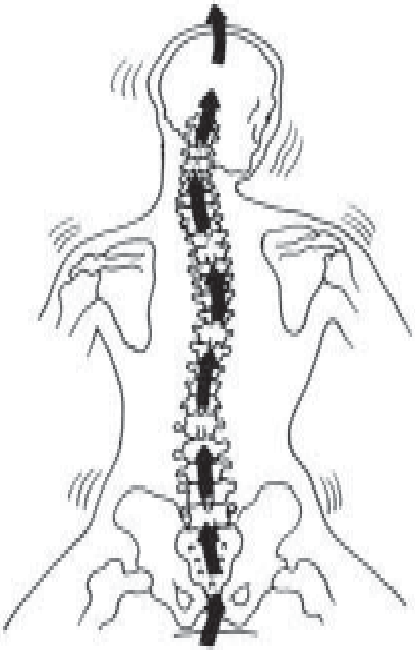

Fig. A.25 *Reverse the rocking from the head back down to the base.*

Circular Rocking (Twist-Rocking)

Follow the above procedures.

Starting from the coccyx, use soft, slow, circular movements to rock the body from left to right. To get a feeling for this exercise, start by moving one shoulder forward and the other backward, alternating these movements as you move the upper body. Begin Circular Rocking by gradually circling upward through each section, one by one, until you reach the head. Then rock back down to the coccyx. Do this exercise 18 to 36 times (Figs. A.26 through A.29).

Combined Movement Rocking

Combine all the rocking forms into a continuous movement. You may emphasize or interchange particular motions. Each movement should also contain all the other movements to some degree. Rock left and right, front and back, and practice Crane Neck and Circular Rocking at the same time. Let the body decide which motions it wants to emphasize. Each person will have a distinct and original pattern.

Rocking the Organs and Glands

The spinal cord has nerves branching out to all the organs, glands, and bones (Fig. A.30). When you smile down to the organs, try to feel this connection.

1. Start with Combined Movement Rocking from the coccyx and sacrum. Be aware of the sexual organs, bladder, large intestine, and lower limbs. Smile to the sexual organs and large intestine as you rock. Picture the nerves that extend from the coccyx and sacrum to these organs. You can also slightly contract the muscles around the anus, perineum, and lower abdomen.

2. Continue the rocking movement up to the lower lumbar region (L-5 to L-1). Be aware of the small intestine, kidneys, bladder, and sexual organs. Look at these organs in your anatomy book, close your eyes, and start to smile to them. Feel their connection to the spine. Continue rocking and gently contract the abdominal muscles to massage the organs, squeeze out any toxins, and create space for more life-force.

3. When you feel warm and comfortable, extend the movement up to the large intestine. Keep contracting the abdominal muscles gently.

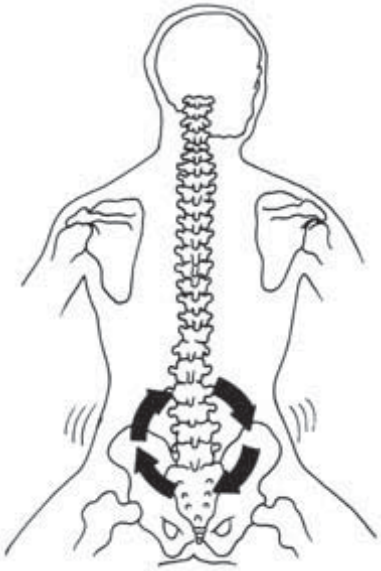

Fig. A.26 *Circular Rocking. Circle at the lower spine.*

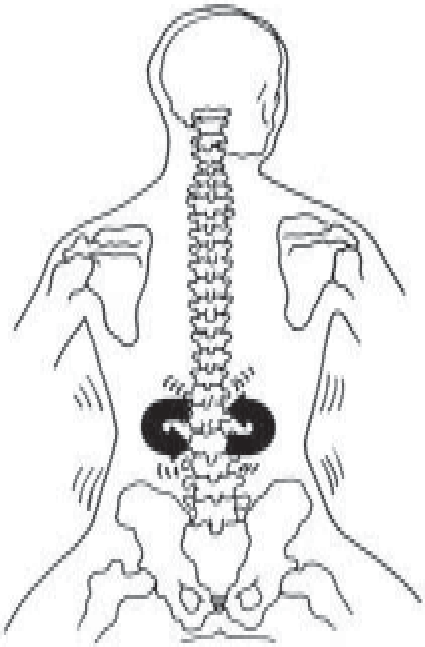

Fig. A.27 *Circular rocking of the lumbar area.*

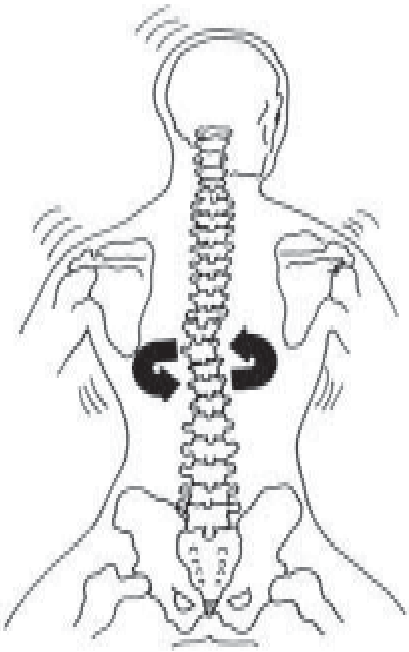

Fig. A.28 *Circular Rocking at the T-11 area.*

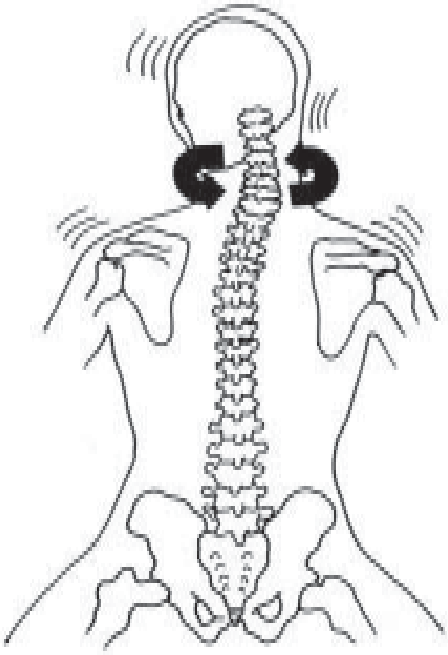

Fig. A.29 *Circular Rocking at C-7 and the neck.*

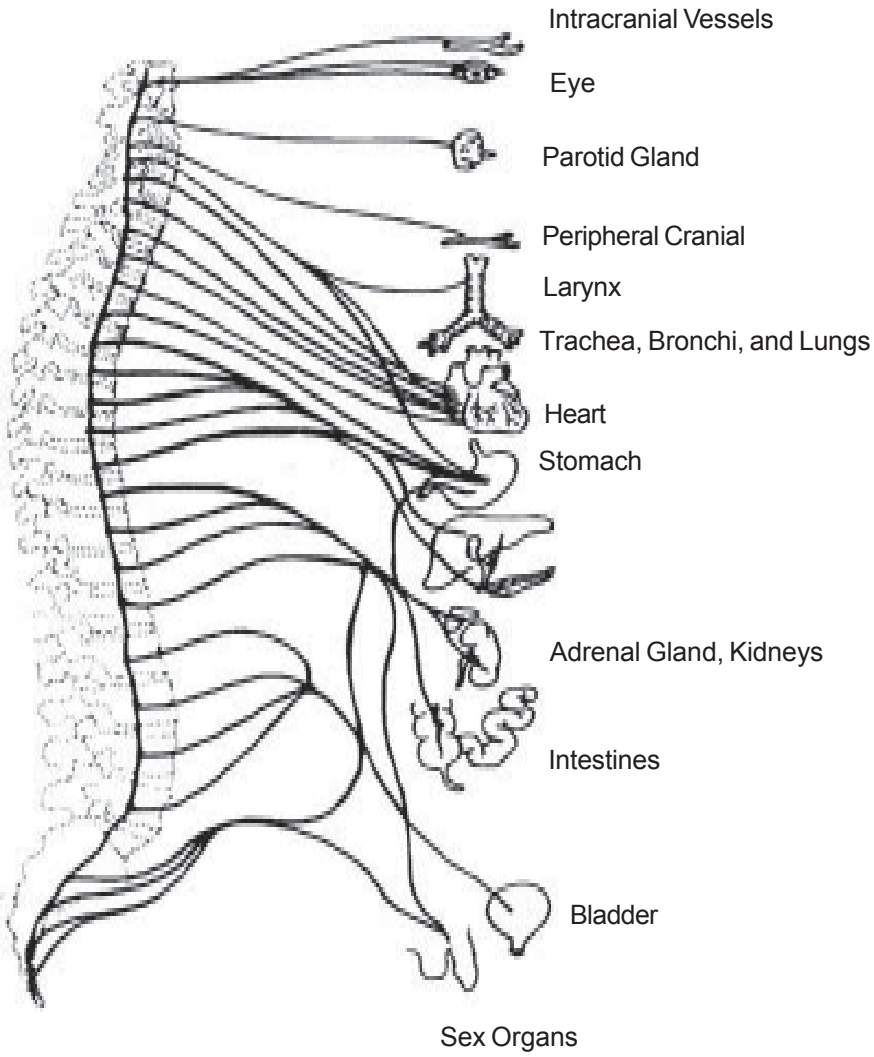

Fig. A.30 *Rocking the organs and glands.*

4. Continue rocking and be aware of the kidneys as you extend the movements up to them. Feel them connect to the spine and picture them branching out from the spine. Slightly pull the abdomen in toward the kidneys.

5. Continue to extend the movement up to the middle back (T-12 to T-5). Be aware of the liver, gall bladder, spleen, pancreas, stomach, small intestine, and abdominal blood vessels. Feel their connection to the spine. Try to see and feel the organs as you rock, circle, twist, and squeeze them. Focus on each organ individually, then work on all of them together.

6. Extend the movements to the thoracic vertebrae (T-4 to T-1). Be aware of the lungs, heart, and thymus gland. Feel their connection to the spine. Twist, rock, and squeeze them separately, then together in one continuous movement.

7. Extend the rocking movements up to the cervical vertebrae (C-7 to C-1). Feel the neck loosen as Chi flows to the hands. Here the spine connects to the thyroid and parathyroid glands and the throat. Concentrate on this connection. Always smile to these areas as you extend the rocking movements into them.

8. Continue rocking up to the head, where many glands reside in the brain. Smile into these glands as you move through the region (Fig. A.31). It is important to train your inner senses to see and feel the organs and glands and their connections to the spine through the nervous system.

9. Reverse directions by rocking downward until you reach the coccyx. You can do this 3 to 6 times.

10. Combine all the rocking movements into one continuous motion, traveling up and down the spine.

11. Rest, and smile down the length of the spine. Feel it become warm and relaxed. Feel the spine absorb Chi into the brain and marrow to increase the life-force in the bones. Men, practice 3, 6, or 9 times; women, practice 2, 4, or 6 times.

Advanced Practices (Optional)

In the beginning, some people do not feel much happening inside as they learn these exercises, but with continued practice, they eventually develop an internal awareness of the organs and nervous system.

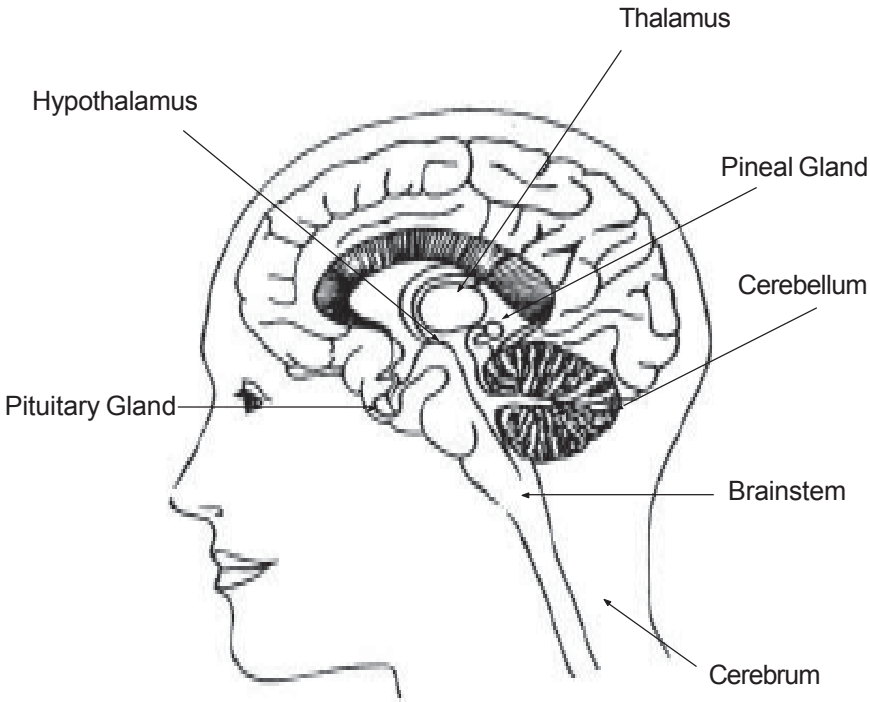

Fig. A.31 *Smile into the brain and the glands.*

External and Internal Rocking

This is an extension of the combination rocking exercise. Feel internal comfort and warmth surrounding the organs and glands and expanding to every cell in the body. Feel this warmth extend to the limbs, fingers, and toes, then radiate through the skin as you harmonize with the outer universe. Feel this warmth being drawn back in from the outer universe through the skin, limbs, and spinal cord, returning to the organs.

Rocking the Limbs to Enhance the Process

Moving the limbs as you rock the spine will help you feel and absorb external Chi into the body.

Silkworm Rocking with the Limbs

Place the hands at the sides and keep the knees slightly bent. Start rocking from the spinal cord like a wave, and simultaneously raise the hands up and down in a wavelike pattern to coordinate with the spinal movement. Also rock the feet back and forth with the spinal cord, hands, and knees.

Rocking Left and Right with the Limbs

Continue from the previous exercise, but start to change the movements, rocking the body from left to right. Simultaneously move the hands left and right, coordinating with the movements of the spinal cord. It is also important to rock the feet back and forth as you sway the body left and right. Feel the weight of the body shift from the heels to the balls of the feet as you alternate their positions against the left-and-right swaying of the body. This will help activate the energy of the earth, drawing it up the spine.

Rest, and smile down the length of the spine and limbs. Feel them become warm and relaxed. Feel the spine and limbs absorb Chi into the brain and bone marrow to increase the life-force in the bones.

Circular Rocking with the Limbs

Continue from the previous exercise, but start to change the movements by circling as you rock the spine. Circle as you rock from left to right, and simultaneously move the hands in front of the body, swaying them right and left. Also let the feet twist back and forth together with the movements of the spinal cord, hands, and knees. Some people may become dizzy. When this occurs, just change directions for a while, or stand still until the dizziness stops. Don't practice for too long if you don't feel well.

Combining the Motions While Absorbing the Cosmic Force

This exercise includes moving the limbs and internally massaging the organs and glands.

Practice using the combined rocking movements to relax the body as you smile inward to the organs and glands. Smile to the glands in the brain and down the face to the neck, then down to the

parathyroid, thyroid, thymus, adrenal glands, to the heart, lungs, liver, pancreas, spleen, stomach, small and large intestines, and sexual organs (Fig. A.32). Extend the limbs outward, relax the mid-eyebrow and perineum, and slightly contract the sexual organs and anus. Feel the cosmic energy being absorbed into the skin, spine, mideyebrow, perineum, and soles of the feet.

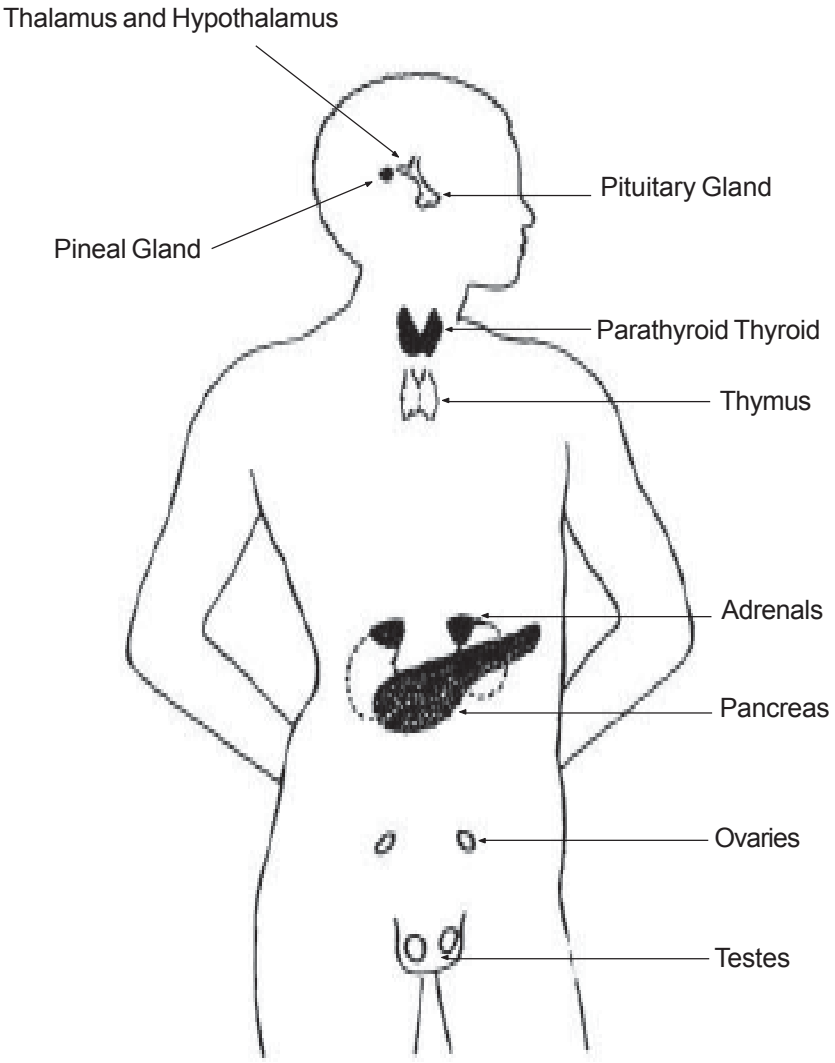

Fig. A.32 *Rock and smile inward to the glands.*

Continue the absorption process as you alternate between rocking the body and relaxing it. This harmonizes the inner and outer energies. Think of the alternating states of activity and rest as conditions of Yin and Yang. Rest, and smile down the length of the spine and limbs. Feel them become warm and loose. Feel the spine and limbs absorb Chi into the brain and bone marrow to increase the life-force in the bones. Practice 18 to 36 times.

Finish from a seated position. Put the palms together and touch the edges of the thumbs againt the heart center, which is located one inch up from the base of the sternum. This activates the heart's energy. Hold this position and practice the Inner Smile (Fig. A.33)

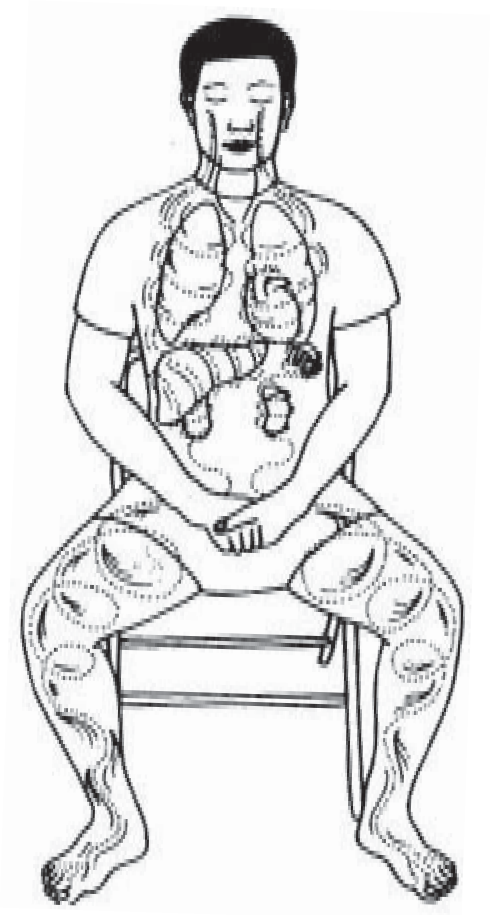

Fig. A.33 *Rock and smile inward to the organs.*
Finish in a sitting position and practice the Inner Smile.

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Mantak Chia

Awaken Healing Light of the Tao

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty-five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi Gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices were held at Tao Garden for the first time using the Darkness technology creating a complete environment for the higher level Taoist practices.

He has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper/Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper/Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002
Tan Tien Chi Kung - 2002

Many of the books above are available in the following foreign languages:
Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

Chapter 1
What is Universal Tao?

I. System

The Universal Tao is a self-help system for curing and preventing illness and stress, and for enhancing all aspects of life. Its key concept is increasing vital energy, or Chi, through easy techniques and physical exercises. This life force energy is then circulated through the acupuncture meridians of the body and channeled into health, vitality, balanced emotions, and creative and spiritual expression.

A practical system accessible to everybody, The Universal Tao is a modern expression of centuries-old Taoist practices. Many of these techniques were formerly known only to an elite group of Taoist Masters and hand-picked students. I have formulated these powerful practices into a comprehensive system which I began teaching to the public at large in my native Thailand in 1973. In 1978 I brought this system to the Western world. I then opened The Universal Tao Center in New York and began teaching the practices there. Today we teach our system in various places throughout the United States and Europe. Though spiritual in its foundation, The Universal Tao is not a religion. It is compatible with all religions, as well as with agnosticism and atheism. There are no rituals to perform and no gurus to surrender to. The Master and the Teacher are highly respected, but are not deified.

This book covers the beginning practices of Level I of the System:

1. Inner Smile
2. Six Healing Sounds

The entire system has three levels:

1. Level I concentrates on Universal energy, strengthening and calming the body;
2. Level II concentrates on changing negative emotions into strong, positive energy; and
3. Level III concentrates on creative and spiritual practices.

All levels include both mental (meditative) practices and physical disciplines, such as Tai Chi, Papua, and Iron Shirt Chi Kung. The foundation course called the Microcosmic Orbit is covered in my first book, *Awaken Healing Energy through the Tao*, but is also surveyed in this book as part of a Daily Practice. For a description of other courses and for the addresses and phone numbers of the Universal Tao centers, see the end of this book.

II. Taoism and Some Basic Concepts in Chinese Healing

Taoism is the 5000-8000 year old foundation of Chinese philosophy and medicine. It is also the mother of Acupuncture and the inspiration for modern body-oriented therapies, such as Acupressure, Rolfing and Feldenkrais. The Tao has been described as “natural law” or “natural order”, “the constantly changing cycle of the seasons”, “an art”, “a method”, “a power”, and “a path of direction”.

In the Taoist view, harmony and balance are essential for health. The body is seen as a whole; therefore, stress or injury to one organ, gland or system weakens the entire body. The body is also self-regulating and will naturally move toward balance if allowed to.

Illness is caused by a blockage of energy. Too much or too little energy in one part of the body results in disease to that part and stresses the entire body. The Universal Tao teaches us how to correct this imbalance by awakening the Chi, or vital energy, and circulating it to the needed areas.

The Taoist system links each organ to one of the five elements in nature: metal, water, wood, fire, or earth. It also connects them to a season of the year, a color, and a quality in nature (e.g., wet, dry, windy, etc.). This relationship often describes the characteristics of that organ. For example, the heart is linked to summer, fire and red; a healthy heart is associated with excitement and warmth. The season of an organ is the one in which the organ is dominant or working the hardest.

Body, mind, and spirit are totally integrated in the Taoist view. Therefore, Chinese medicine finds that negative emotions, such as anger, fear or cruelty, and excessive amounts of positive emotions, such as too much joy or excitement, can injure the organs and associated organs and cause disease. Both the Inner Smile and the Six Healing Sounds (covered in this book) help to balance the emotions as well as to improve health.

III. Illness starts as a Problem with One's Energy Level

World of Stress

A problem may exist for many years before it physically manifests itself as a disease. It may appear as a blockage or decreasing of the Chi energy level leading to a Chi imbalance in particular parts or organs of the body. If we become aware of the Chi imbalance when it first occurs, we have a long grace period in which to correct it.

Many people don't regard bad temper or negative emotions as sickness. In Taoism we regard these as the beginning of the imbalance of the Chi energy in the system, just like bad breath or body odor can be the beginning signs of weakness or illness of the liver, kidneys or stomach.

Stubbornness can be caused by an imbalance of the heart energy. Malodorous sweat can be due to a dysfunction of the kidneys, which have lost the filtering function to eliminate excess water contained in the body fluids. Cowardice and fear can be due to an imbalance of the lung or kidney energy. Back pain can be caused by an imbalance of the kidneys and bladder, and many other bad behaviors and physical ailments can be traced to an imbalance of the Chi energy in different parts of the body.

As we live our lives now, our attachment to the material world grows, and we become more and more drawn to material things, like various drugs, entertainment, services and unnatural foods. The more we feel that we need to have this and buy that, the more worry and mixed emotions we feel. We can get rid of all of these feelings by getting rid of our emotional attachment to these materials.

Conserving, increasing and transforming the Chi energy should be the first or primary preventive method practiced. When a person has a heart attack, he might use this method to prevent a second. When a bad kidney or bad back develops, the use of this method prevents it from getting worse. The primary preventive practices are started at the Chi level. In the Taoist system we map out all the organ energy meridians, which have a network extending from the organs throughout the body. When blocked or decreased the organs are the parts which will get less life force and will trap in the bad Chi (i.e., the Chi we know as sick energy in the organs or

the meridians.) If we are not in touch with our inner selves, it is very hard to notice much change internally. By knowing how to conserve, transform and increase the Chi, we have more Chi to open the blockage, increase the body's defensive powers and prevent illness. We can live the happy, healthy life we want to live and maintain our health as we age; we can live life not going from one illness to another, but instead have lifelong vitality and a will (desire) to live.

The Taoist system is geared to help you live a healthy life, free from illness, with vitality to help other fellow human beings. Many of my students had given up coffee, drinks, drugs, and certain kinds of "necessary" entertainment quite easily when they started to work on themselves to satisfy their organs and senses and thereby strengthen them.

I have one student who, at one time, had many factory workers and, therefore, had power over many people. However, he was deeply in debt because he couldn't give up endlessly buying things. Finally, he came to me and talked to me about his problem. I explained to him that stress and emotional energy created blockages due to energy imbalances in his organs. If he could strengthen his organs and senses and increase the circulation in his body, he would see the world from a different angle. After he completed the Microcosmic Orbit Meditation and practiced the Six Healing Sounds, Inner Smile and Tao Rejuvenation, he came to me and said, "Master Chia, I'm going on a long vacation". I asked, "What happened? " He replied that he had sold his factory, paid all of his debts and had a few thousand dollars left. "I want to rest, practice more of what you teach and come back and start all over again", he said. There was a tremendous change in his face.

IV. Best Investment is your own Health

Many people put all their life force into earning money, until their vitalities are depleted and illnesses set in. They have to spend more and more of their money on hospitals, surgery, medicine, and, finally, spend most of their time in bed.

Many people say, "I don't have time to practice. My day is filled with appointments and work, meetings, study and children." If you can improve your mind, body, and spiritual level of energy, your

mind will be clearer; you will be more physically fit; your work will usually take less time to accomplish; and your emotions will be calmer.

Many of my students have the same problem: it is hard to find time to practice the Microcosmic Orbit Meditation, Six Healing Sounds, Inner Smile, Tao Rejuvenation, Tai Chi Chi Kung, Iron Shirt and Fusion of the Five Elements. It takes time to learn in the beginning, but after you learn it, it becomes a part of your life. For example, you can do the Inner Smile while waiting in line. We spend a lot of time each day just waiting, and you can turn that time into practice time.

Many of our students study this system for a while and actually sleep less and eat less, so they end up having more time to do the practice. My knowledge and experience tell me that if people can put a 30-60 minute daily investment into their health each day, they will get 1-4 hours back and will be able to achieve more in less time. As a result, they will have more time to do more things.

V. Taoism in the Home

The Taoists do not regard differing characteristics or personal qualities of the husband and wife as the main sources of unhappiness in the family. The natural thing is for opposites to attract each other. The most important thing is to understand each other, look at each other's strong points, and help to overcome each other's weak points.

In order to understand the other person, you have to understand yourself first. The best way to understand yourself is to get in touch with your own organs through the inner system and senses. You can then strengthen the organs in order to transform negative energy and cultivate positive emotions and values.

Negative emotions are the main causes of energy imbalances in the body. The existence of negative energy in one family member will create negative emotions in other family members and disturb the energy balance in the entire family.

VI. Sexual Imbalances can be modified with Practice

Another factor in the breakdown of the family is an imbalance in the sex life of the married couple. Healthy vitality is a major source of sexual energy. The organs and glands are the main source of sexual energy, and therefore, healthy organs and glands will increase the happiness of a couple's sex life. A stressful life, pollution, and the vast regulations that govern life in our society rob people of their organ and sexual energies. They are left depressed, with their vitality and sexual energy depleted. This leads to psychological and marital problems. These problems can cause muscular weaknesses, such as impotence (inadequate erection) in men and lack of muscle tone in the sexual organs of women. For a couple, the question is how to increase and transform their sexual energies and therefore correct the physiological problems of the sexual organs. In this book we deal directly with strengthening the internal organs and senses.

VII. Peacefulness of Chi Energy

The balance of peaceful Chi energy in a person is very important because it can help to balance the Chi of another person who is close. Anything that is overly extreme will cause an imbalance of Chi energy and will destroy peacefulness. There are five types of peace necessary in a family:

Peace of mind,
Peace of the heart,
Peace of the body,
Peace of the organs, and
Peace of the senses.

Taoism says that too much noise will hurt the ears and their associated organs, including the kidneys and the bladder causing fear and disturbing the peace. Too much drinking or eating will hurt the spleen and indirectly, hurt the liver, which will result in anger and bad temper and will disturb the peace of the family. Too much looking at television or movies will hurt the eyes, which will hurt the liver and the gall bladder and cause a loss of energy, weakening the vitality of the entire body. Overexercising or overworking will hurt the tendons. Too much worry will hurt the nervous system.

Weakness of the organs or senses and nerves can cause certain types of unpleasant personal characteristics and bad habits which, in the long run, cause problems for the entire family. By understanding the sources of the problems and using the Inner Smile, Six Healing Sounds and the Tao Rejuvenation exercises and meditations together, the Chi energy imbalance and organ weakness can be treated. It is important to understand the problems and to use the Taoist practices to help family members get over them, in order to avoid larger disturbances. By practicing together, the energies of the family members are exchanged and balanced together as a family unit. When one of the family comes down with a sickness due to stress or negative emotional energy, other members of the family can help to balance that energy before further problems develop.

Chapter 2
Inner Smile

I. Benefits

A. Low Grade Energy vs. High Grade Energy

In Taoism we regard the negative emotions as low grade energy. Many people operate their lives in anger, sadness, depression, fear, worry, and other kinds of negative energy. These types of energy are bound to cause chronic disease and steal our major life force. The Inner Smile is the true smile for all parts of the body, including all the organs, glands, and muscles, as well as the nervous system. It will produce a high grade of energy that can heal and eventually be transformed into an even higher grade of energy. (Fig.2.1).

A genuine smile transmits loving energy, which has the power to warm and heal. Just recall a time when you were upset or physically ill and someone, perhaps a stranger, gave you a big smile—suddenly you felt better. Norman Cousins, former editor of The *Saturday Review*, writes in *Anatomy of an Illness* that he cured himself of a rare connective tissue disease by watching old Marx Brothers moves. One of my students cured herself of cancer of the breast by continually practicing the Inner Smile to the part that was sick.

In ancient China, the Taoist Masters recognized the power of smiling energy. They practiced an Inner Smile to themselves, which moved Chi energy and produced a high grade of Chi, and achieved health, happiness and longevity. Smiling to oneself is like basking in love, and love can repair and rejuvenate.

The Inner Smile directs smiling energy into our organs and glands, which are so vital to life. Ironically, although we often pay a great deal of attention to our outer appearance very few of us are aware of what the inner organs and glands look like, where they're located, or what their functions are. Worse yet, we are insensitive to the subtle warnings they send us when we mistreat them with poor diets and unhealthy life styles. We are like a boss who never pays any attention to his employees and is startled when things go wrong. If we're acquainted with our organs and glands, appreciate what they do, and learn to hear their messages, they will reward us with relaxation and vitality.

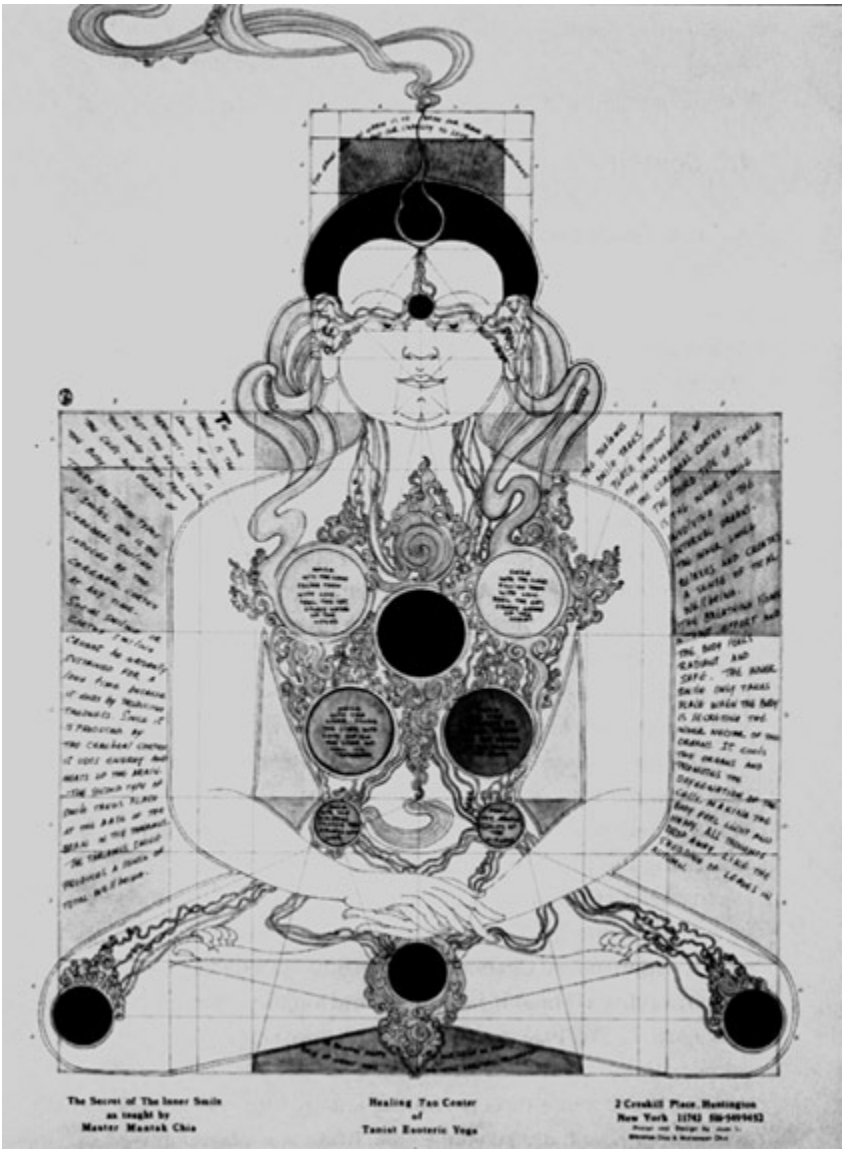

Fig. 2.1 *The Inner Smile will help you have more Chi energy and produces a high grade of Chi.*

B. Honey-like Secretion or Poisonous Secretion

The Inner Smile is most effective in counteracting the stresses of life. In our current society, we spend millions of dollars just to find a way to release stress. Often, these remedies provide only partial and temporary relief.

The Inner Smile has a close relationship with the thymus gland and will increase the activity of that gland. In the Taoist system, the thymus gland is the seat of greater enlightenment, the seat of love and the seat of the life force Chi energy. When we are under emotional stress, the thymus gland is the first to be affected. In the book *Your Body Doesn't Lie* by John Diamond, M.D., Dr. Diamond presents a study that shows that the thymus has a role as the master controller that directs the life-giving and healing energies of the body. The theory of cancer formulated by Sir MacFarlane Burnet, the Australian Nobel Prize winner, suggests that increasing the thymus gland's activity will result in a greater ability to ward off cancer. One type of cells produced by the thymus is T-cells. The function of the T-cells is to recognize abnormal cells and to destroy them. Of the billions of cells produced in the body each day, some will be abnormal. If Ihe T-cells are not activated by the thymus hormone, the abnormal cells will continue to proliferate and develop into clinical cancer. Hence, the thymus gland plays a critical role in the prevention of cancer throughout adult life.

In Applied Kinesiology, there is a way to test the strength or weakness of the thymus gland in which the Inner Smile will make an important difference. Have your partner try this test: Touch the thymus, located at the point where the second rib joins the breastbone below the throat. First have your partner not smile, but let the facial muscles drop and the corners of the mouth turn down. Have him keep one hand extended out to the side, while you press the hand down. Then, try it with your partner smiling and see the difference. This demonstrates that when you smile, you activate the thymus gland. (Fig. 2.2 and 2.3).

Taoist sages say that when you smile, your organs release a honey-like secretion which nourishes the whole body. When you are angry, fearful or under stress, they produce a poisonous secretion which blocks up the energy channels, settling in the organs and causing loss of appetite, indigestion, increased blood pressure, faster heart beat, insomnia and negative emotions.

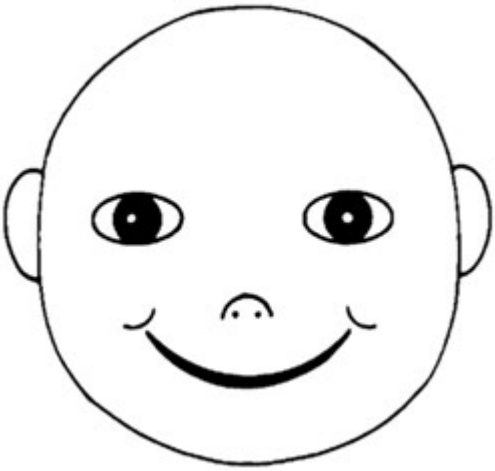

Fig. 2.2 *The expression in this picture will increase energy.*

Fig. 2.3 *The expression in this picture can affect your level of energy.*

Smiling into your organs also causes them to expand, become softer and moister and, therefore, more efficient. As a result, the liver, for example, has more room to store nutrients and detoxify harmful substances.

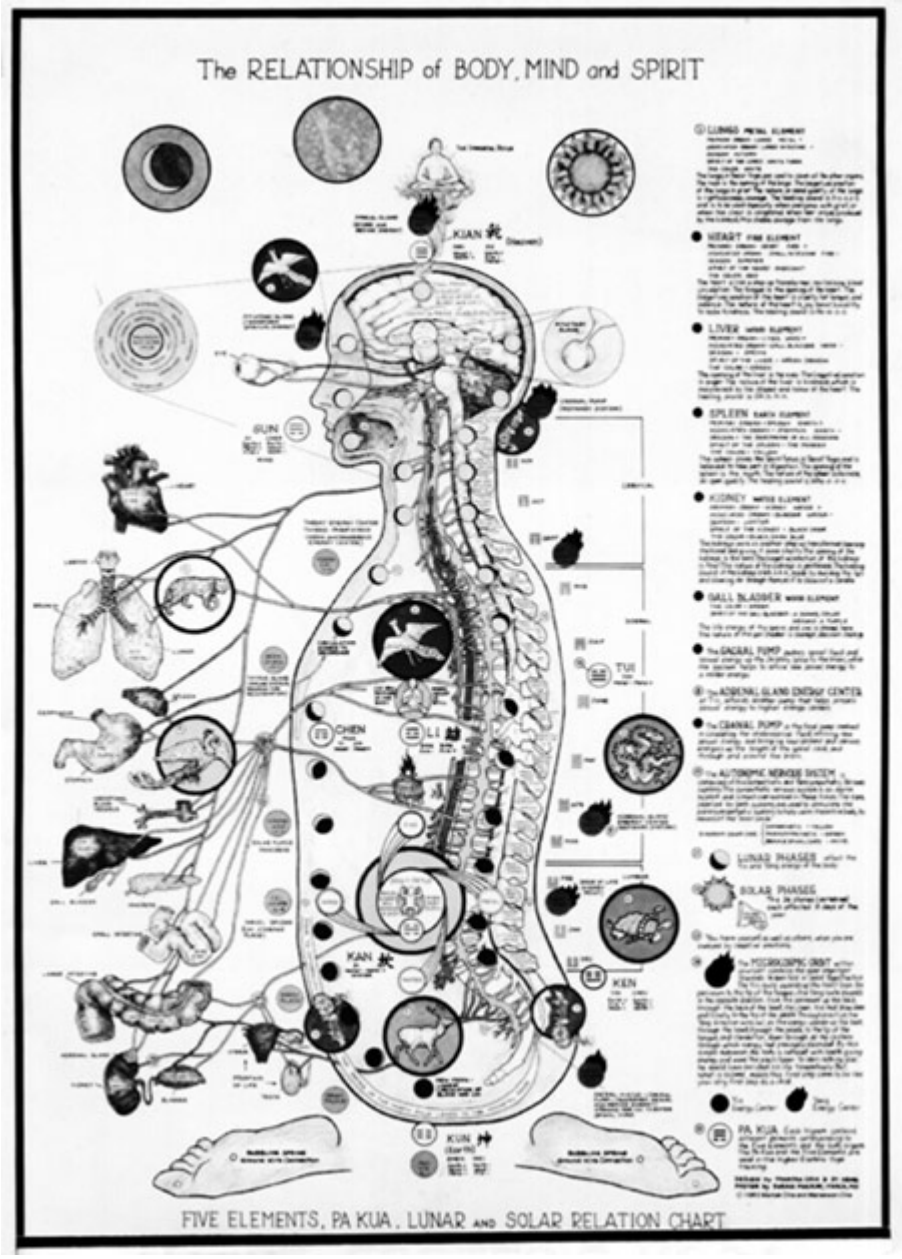

Fig. 2.4 *Eyes linked to autonomic nervous system can affect your level of energy.*

The practice of the Inner Smile begins in the eyes. They are linked to the autonomic nervous system, which regulates the action of the organs and glands. The eyes are the first to receive emotional signals and cause the organs and glands to accelerate at times of stress or danger (the “fight or flight” reaction) and to slow down when a crisis has passed. Ideally, the eyes maintain a calm and
balanced level of response. Therefore, by simply relaxing your eyes, you can relax your whole body and thus free your energy for the activity at hand. (Fig. 2.4).

C. Learning through the Inner Smile

When you are stressed, overly emotional or operating your life in anger or fear, your organs become obstructed and your performance levels are lowered. A lot of energy is eaten up, and you become dull, lacking alertness and playfulness. You are hindered in learning or developing new ideas, and if you try to force yourself to learn, the subject matter often will not remain in your mind and you will not be able to integrate it into yourself. In the Tao system, we believe that our organs, senses and parts of our bodies are involved in learning.

When you smile to your organs, senses and glands, you make a connection and have good communication with them.

When you are stressed or fearful, all the organs and senses are closed. For example, when you do not like someone, your body does not want to accept the person and, thus, is not able to accept that person’s teaching and ideas.

1. Main Sources of Auditory Energy

The main sources of auditory energy are the kidneys and their associated organ the bladder. For example, when the kidneys are functioning well you will be more alert and, thus, able to learn. The kidneys are connected to the openings of the ears. The auditory sense—hearing—is very important in learning. When the kidneys are strong, you will increase your auditory sharpness, which will enhance your learning.

The bladder helps in eliminating toxic fluids, which makes the blood cleaner and the fluids able to flow more freely. If the bladder is impaired, then the kidney functions will be affected.

2. Main Sources of the Power of Speech

The main sources of speech power are the heart and its associated organ, the small intestine. The heart provides the spirit for learning and is the seat of joy. Without eagerness or a spirit to learn, learning will be difficult. The secret of learning is joyfulness, fun and delight. When these are present your whole body will accept what you learn into itself. The heart is also the seat of respect and honesty. When you have respect, the heart is open. The tongue connects to the heart, and when that connection is open, you can start to accept and program your mind in bits and pieces, assimilating into order what you have learned.

The small intestine helps you assimilate. When the small intestine has a problem, the heart functions are affected. Many times, in order to learn new things, we need time to assimilate them into our systems.

3. Main Sources of Visual Energy

The main sources of visual energy are the liver and its associated organ, the gall bladder. When the liver is in good working order, you will be able to be more assertive, be able to make more decisions, and be able to integrate the things you learn. The opening for the liver is the eyes. When the liver is weak or sick, or you are under stress or are angry, you won't be able to make decisions and your vision will be impaired, making it difficult to program into your mind what you see and to integrate what you learn.

A healthy gall bladder helps you make decisions more easily, too.

4. Main Sources of Gestational Energy

The main sources of gestational energy are the spleen and stomach. The spleen gives the good sense of inclusiveness. It is the opening for the mouth and is involved with the sense of taste and in digesting what you learn.

The stomach is associated with the spleen. When the stomach is in good condition, you will be more receptive to new thoughts, ideas, and ways. Once you have accepted them as your own, you will be more willing to learn new things and more economic ways.

5. Main Sources of Olfactory and Kinesthetic Energies

The main sources of olfactory and kinesthetic energies are the lungs and the large intestine. The lungs are associated with good impulses, and their openings are the nose and skin. They are involved with kinesthetic feeling, the senses of the skin and the sense of touch and feeling, thereby increasing awareness of your surroundings and, so, tremendously increasing your ability to learn.

The large intestine is involved in elimination and release and makes you more open, physically and mentally. When you are constipated, you are more closed, not open to new ideas and not willing to change. Even though only a small step might be required to change, some students will not let go of old ways or ideas to succeed. The large intestine is the associate organ of the lungs and helps strengthen the lungs' functions.

6. Adrenal Glands' Energy gives you Enthusiasm to Learn

The adrenal gland gives you vitality and the hot energy, or Yang energy, of the kidney. It also energizes you and makes, you enthusiastic to learn. Without vitality you will feel lazy, sleepy and not eager to learn.

7. Thyroid and Parathyroid Glands help Power of Expression

The thyroid and parathyroid glands will help you increase your ability to express your opinions and your experiences so that all the senses can be involved in learning.

8. Thymus Gland helps Immune System

The thymus gland is the seat of energy, and it helps us in strengthening our immune systems. It creates energy in the form of enthusiasm and in this way gives you strength and energy to learn.

9. Sexual Organs' Energy increases Creative Power

The sexual organs are the seat of energy for creative power. When you have low sexual energy, you will be less creative and will be stuck in old, inefficient ways. When you know how to smile and increase your sexual energy, you will increase your power to solve problems in daily life.

10. Spine is Center of Communication

The spine is the center of control and the center of communication. Know how to smile down into your spine and relax it, and you will increase your communication powers; you will know how to communicate what you have learned through your spine into your organs and to accept new and more efficient ways into your system. The spine is also known as the controller of the networks.

11. Guidelines for Super-Learning

a. Smile throughout learning. Smile to the parts or organs that are resistant to new ideas. For example, if the heart is unwilling to be accepting and open, smile to it to release the joys and fun of learning. If the liver has too much anger, which shuts off vision, smile to it until it is open.

b. Let your hands, legs, head, chest, eyes, nose, mouth, ears, tongue, anus, etc. all be involved in learning by acting out. For example, if you are learning a new computer, let yourself act or imagine that you are a computer. Get inside and understand it; use your hands, eyes, ears, etc. and let them all be in contact with what you want to learn.

c. Smile to the senses and let them all open and feel light and happy to learn. Let them all be involved in learning. Start from vision; go through the auditory, olfactory, kinesthetic and gustatory senses. Imagine or involve what you are going to learn with your visual sense of what it looks like, with your auditory sense of how it will sound, with your olfactory sense of how it will smell, with your kinesthetic sense of how it will feel, and with your gustatory sense of how it will taste.

d. Use metaphors of your daily life that you know or use the most. For example, if you are a gardener or like flowers, you can connect the thing you know into gardening or flowers. Or if you are an animal lover, transform the things you learn into animals and the characteristics that are like the animals' characteristics.

e. Involve your total self in learning. Check out your whole system—your senses, your organs, your arms, your hands, etc. They are willing to learn and recognize what they don't want to learn. Smile to them; tell them you love them and want them to get involved.

D. Personal Power through the Inner Smile

1. The smile is the most powerful energy of personal power. The true inner smile from your organs will make all the organs contribute their own power to generate and streamline out to your senses, especially the eyes. The eyes connect to all the organs and senses. Once you know how, you can get power to all the organs.

Imagine we have 63 trillion cells. Each cell gives out a very small amount of energy. Multiplied by 63 trillion cells, the energy is tremendous. When you are relaxed and calm and you smile, you can maintain energy at its peak performance and always be ready to take action. The level of energy is always the main clue.

2. When your level of energy increases, you will have more energy to increase your skills, you will have more flexibility of action, and you will know better what you want and how to get it—i.e. specificity.

3. Smile to the sexual organs. The higher the level of sexual energy that you have, the more personal power you will have. When sexual power decreases, personal power decreases, too. Practice how to conserve and increase sexual energy by recycling it. Foods or drugs that claim to increase sexual power are not going to last long, if at all, and cannot increase energy or be effective in the long run. Knowing how to cultivate sexual energy is one of the main sources of power.

II. Preparation for the Inner Smile

A. Wait at least an hour after eating to begin the practice.

B. Choose a quiet spot. It might help in the beginning to disconnect the phone. Later on, you will be able to practice almost anywhere with any noise, but for now you need to eliminate distractions in order to develop your inner focus.

C. Dress warmly· enough so as not to be chilled. Wear loose fitting clothes and loosen your belt. Remove your glasses and watch.

D. Sit comfortably on your “sitting bones” at the edge of a chair. The genitals should be unsupported because they are an important energy center. This means if you are a man, the scrotal sac hangs free of the edge of the chair. If you are a woman practicing nude, you should cover your genitals with cloth to ensure no energy loss through them.

Incorrect Sitting Position

Correct Sitting Position

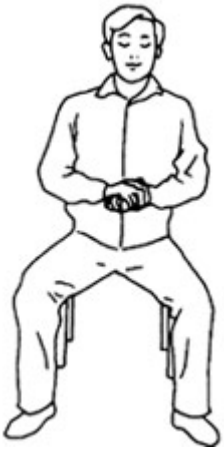

The back should be straight.
Fig. 2.5 *Sitting Posture*

E. The legs should be a hips' width apart and the feet should be solidly on the floor.

F. Sit comfortably erect with your shoulders relaxed and your chin slightly in.

G. Place your hands comfortably on your lap, the right palm on top of the left. You may find it easier for the back and shoulders to raise the level of your hands by placing a pillow under them. (Fig. 2.6)

Fig. 2.6 *Close the circuits in the hands, with the left hand on the bottom and the right hand on the top.*

H. Breathe normally. Close your eyes. While concentrating, the breath should be soft, long and smooth. After a while you can forget about your breath. Attention to breath will only distract the mind, which must focus on drawing energy to the desired points, There are thousands of esoteric breathing methods; you might spend your whole life mastering them and acquire no lasting energy.

I. Position of the tongue: The tongue is the bridge between the two channels. Its function is to govern and connect the energies of the thymus gland and pituitary gland, and it can balance the left and right brain energies. There are three positions for the tongue. For the beginning, place the tongue where it is most comfortable. If it is uncomfortable to place the tongue on the palate, place it near the teeth. (Fig. 2.7).

Fig. 2.7 *Tongue Position*

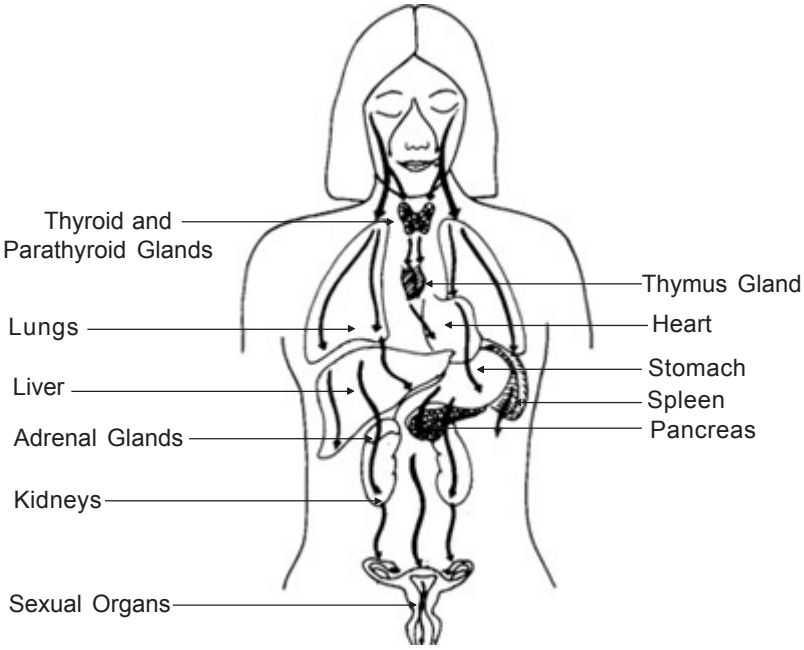

Fig. 2.8 *Front Line Smile: Major Vital Organs*

III. Practice

A. Smiling Down to the Organs—the Front Line

1. Relax your forehead. You can imagine meeting someone you love or seeing a beautiful sight. Feel that smiling energy in your eyes.

2. Then allow that smiling energy to flow to the midpoint between your eyebrows. Let it flow into the nose, then the cheeks. Feel it relaxing the facial skin, then going deep inside the face muscles; feel it warming your whole face. Let it flow into the mouth, and slightly lift up the corners of the mouth. Let it flow into the tongue. Float the tip of the tongue. Put your tongue up to the roof of the mouth and leave it there for the rest of the practice; this connects the two major channels of energy, the Governor and the Functional. Bring the smiling energy to the jaw. Feel the jaw releasing the tension that is commonly held there.

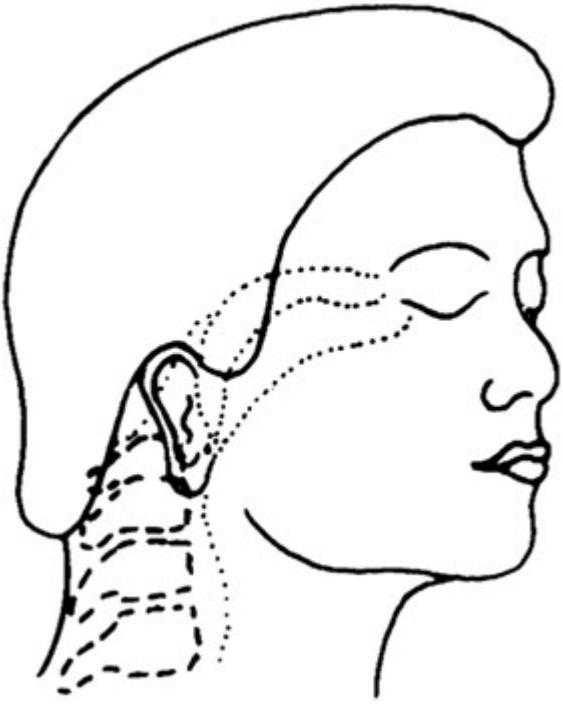

Fig. 2.9 *The neck is a major thoroughfare for most of the body's systems.*

3. Smile into your neck and throat, also common areas of tension. Although the neck is narrow, it is a major thoroughfare for most of the systems of the body. Air, food, blood, hormones, and signals from the nervous system all travel up und down the neck. (Fig. 2.9). When we are stressed, the systems are overworked; the neck is jammed with activity, and we get a stiff neck. Be like the Taoist Masters and think of your neck as a turtle's neck—let it sink down into its shell and let it rest from the burden of holding up your heavy head (Fig. 2.10). Smile into your neck and feel the energy opening your throat and melting away the tension.

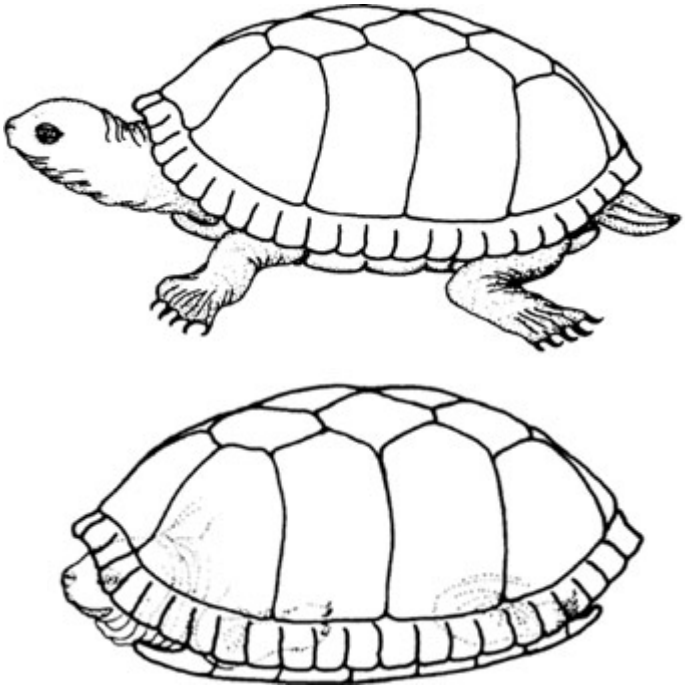

Fig. 2.10 *Think of your neck as a turtle's neck.*

4. Smile into the front part of your neck where the thyroid and parathyroid glands are. This is the seat of your power to speak and when it is stuck, Chi cannot flow. When it is tense and held back, you cannot express yourself. You will be frightened in front of a crowd, cowardly, and communications will break down. Smile down to the thyroid gland and feel the throat open, like a flower blossom. (Fig. 2.11)

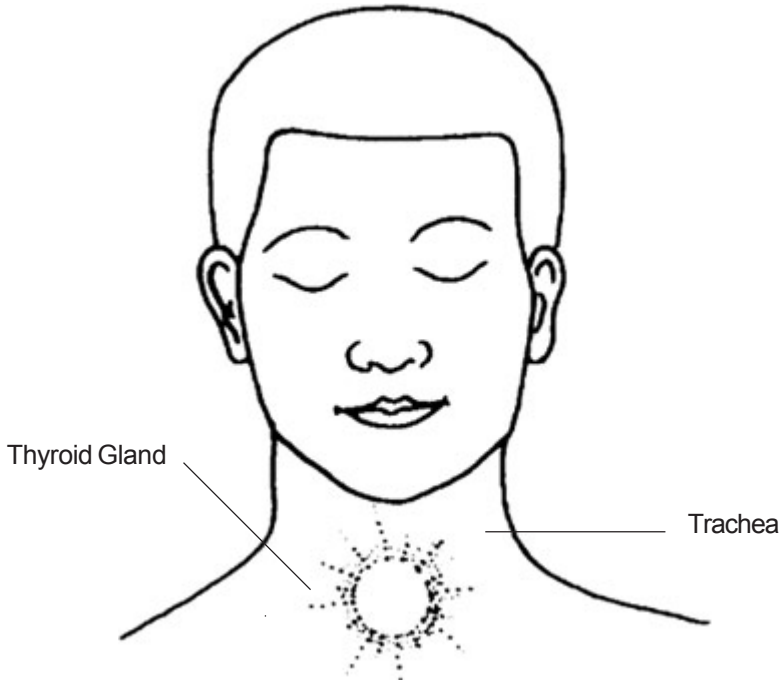

Fig. 2.11 *The throat is the seat of your power to speak.*

5. Let the energy of the smile flow down to the thymus gland, the seat of love, the seat of fire, the seat of Chi, and the seat of healing energy. Smile down into it, feel it start to soften and moisten. Feel it grow bigger, like a bulb, and gradually blossom. Feel the fragrance of warm energy and healing Chi flow out and down to the heart. (Fig. 2.12)

6. Let the smiling energy flow into your heart, which is the size of a fist and is located a little to the left of the center of the chest. The heart is the seat of love, the seat of compassion, the seat of honest respect and the seat of joy. Feel the heart, like a bulb, gradually blossom and send the fragrant warmth of Chi love, joy and compassion radiating throughout all the organs from the pumping of the heart. Let the smile energy fill your heart with joy. Thank your heart for its constant and essential work in pumping blood at the right pressure to circulate throughout your body. Feel it open and relax as it works more easily. (Fig. 2.13)

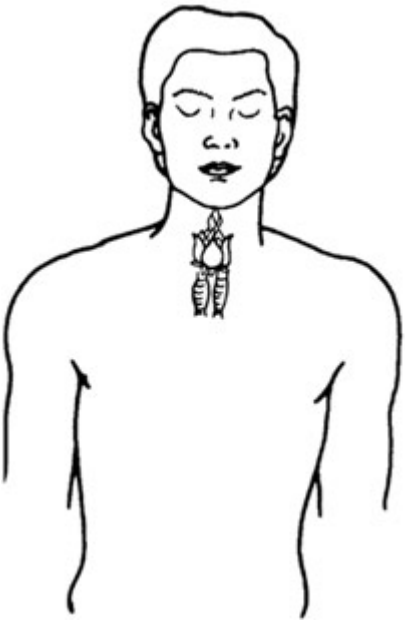

Fig. 2.12 *Feel the thymus gland gradually blossom.*

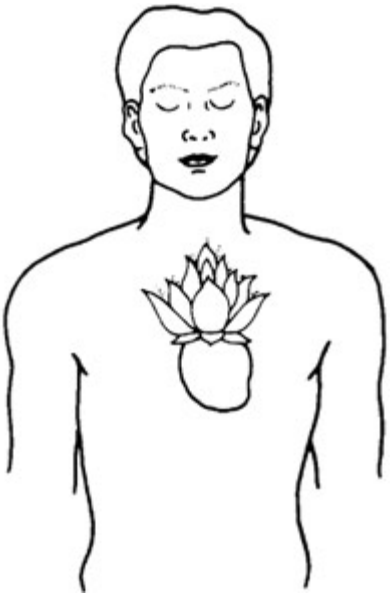

Fig. 2.13 *The heart is the seat of joy;*
feel it gradually open like a bulb.

7. Bring the smile and joyful energy from the heart to the lungs. Smile into every cell of your lungs. Thank your lungs for their wonderful work in supplying oxygen to the body and releasing carbon dioxide. Feel them soften and become spongier, moister. Feel them tingling with energy.

Smile into the lungs deep inside and smile your sadness and depression away. Fill the lungs with the fragrance of righteousness that is induced by the love, compassion and joy from the heart. Let the smile energy of joy, love and righteousness flow down to the liver.

8. Smile into your liver, the large organ located mainly on the right side at the bottom of the rib cage. Thank it for its marvelously complex part in digestion—processing, storing and releasing nutrients—and its work in detoxifying harmful substances. Feel it soften and grow moister.

Smile again and get deep into the liver. See any anger and hot temper lying in the liver. Smile them away and let the joyfulness, loveliness, righteousness and warm Chi induce the nature of the liver—kindness—to flow until it is full and overflows out to the kidneys and adrenal glands.

9. Bring the smiling energy into your kidneys, just inside the lower part of your rib cage in the back on either side of the spine. Thank them for their work in filtering the blood, excreting waste products and maintaining water balance. Feel them grow cooler, fresher, and cleaner. Smile into your adrenals, on top of your kidney's these produce adrenalin for "fight or flight" situations and several other hormones. Your adrenals may thank you by giving you a little extra shot of energy.

Smile again and get deep into the kidneys. See and feel if there is any fear lying inside the kidneys. Smile with the warmth of joy, love, and kindness, and melt your fears away. Let the nature of the kidneys—gentleness—come out and fill them until they overflow to the pancreas and spleen.

10. Smile into your pancreas and spleen. First smile into your pancreas, which is located at the center and to the left at and above waist level. Thank it for producing insulin to regulate your blood sugar level and enzymes for digestion. Then smile to the spleen,

which is at the bottom and left side of the rib cage. Thank it for producing antibodies against certain diseases. Feel it grow softer and fuller.

Smile again into the spleen and pancreas; feel and see deep inside if there is any worry hidden; let the warmth of joy, love, righteousness, kindness, and gentleness melt your worries away. Smile into the virtue of the spleen—fairness—bring it out and let it grow downward to the bladder and sexual region.

11. Bring the smiling energy down to the genital area in the lower abdomen. For women this is called the "ovarian palace" and is located about three inches below the navel midway between the ovaries. Smile into the ovaries, the uterus and the vagina.

For men this is called the "sperm palace" and is located one and a half inches above the base of the penis in the area of the prostate gland and seminal vesicles. Smile down to the prostate gland and the testicles. Thank them for making hormones and giving you sexual energy.

Let love, joy, kindness and gentleness flow into the genital organs so you can have power to overcome and eliminate uncontrollable sexual desires. You are the one who controls your sex drive; it does not control you. Thank your genitals for their work in making you the sex that you are. Sexual energy is the basic energy of life.

12. Return to your eyes again. Quickly smile down into all the organs in the Front Line, checking each one for any remaining tension. Smile into the tension until it is released.

B. Smiling Down the Digestive System—the Middle Line

1. Become aware once more of the smiling energy in your eyes. Let it flow down to your mouth. Become aware of your tongue, and make some saliva by working your mouth and swishing your tongue around. Put the tip of your tongue to the roof of the mouth, tighten the neck muscles, and swallow the saliva hard and quickly, making a gulping sound as you do. With your Inner Smile, follow the saliva down the esophagus to the stomach, located at the bottom and below the left side of the rib cage. Thank it for its important work in liquefying and digesting your food. Feel it grow calm and comfortable. Sometimes we abuse our stomachs with improper food. Make a promise to your stomach that you will give it good food to digest.

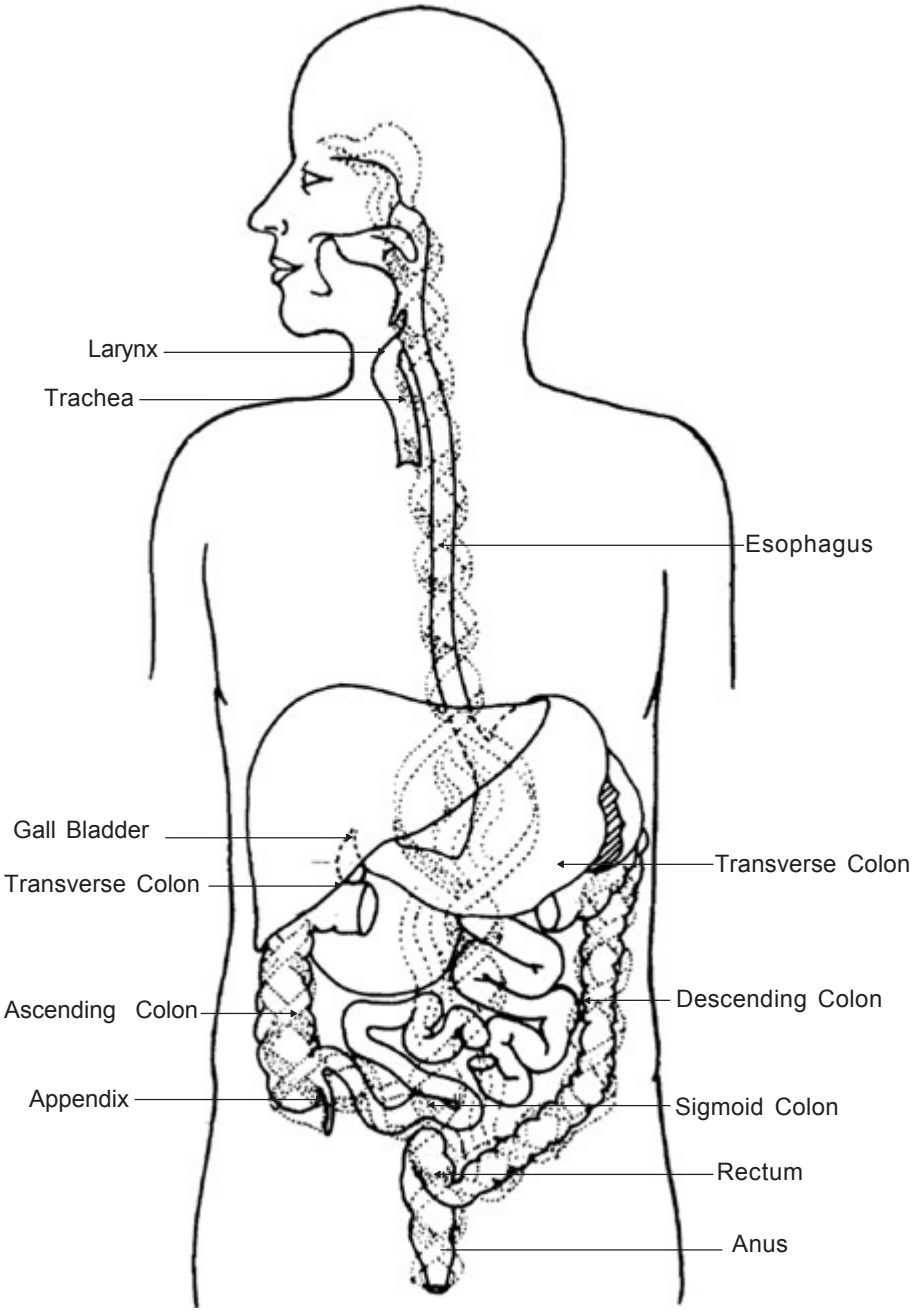

Fig. 2.14 *Smile down to the digestive system.*

2. Smile into the small intestine: the duodenum, the jejunum, and the ileum, in the middle of the abdomen. It is about seven meters long in an adult. Thank it for absorbing food nutrients to keep you vital and healthy.

3. Smile into the large intestine: the ascending colon, starting at the right side of the hipbone and passing upward to the undersurface of the right lobe of the liver; the transverse colon, which passes downward from the right liver region across the abdomen to the left beneath the lower end of the spleen; the descending colon, which passes downward through the left side of the lumbar region; and the sigmoid colon, which normally lies within the pelvis, the rectum and the anus. The large intestine is about 1.5 meters long. Thank it for eliminating wastes and for making you feel clean, fresh and open. Smile to it and feel it be warm, nice, clean, comfortable and calm.

4. Return to your eyes. Quickly smile down the Middle Line, checking for tension. Smile into the tension until it melts away.

C. Smiling Down the Spine-the Back Line (Fig. 2.18)

1. Bring your attention back to your eyes again.

2. Smile inward with both eyes; collect the power of the smile in the third eye (mideyebrow). With your inner eyesight direct your smile about three to four inches inside into the pituitary gland, and feel the gland blossom. Direct the smile with the eyes into the third ventricle (third room, the power room of the nervous system, highly magnified). Feel the room expand and grow with bright, golden light, shining throughout the brain. Smile into the thalamus, from where the truth and power of the smile will generate. Smile into the pineal gland and feel this tiny gland gradually swell and grow like a bulb. Move your smile's eyesight, like a bright, shining light, up to the left side of the brain. Move the inner smiling eyesight back and forth in the left brain and across to the right brain and cerebellum. This will balance the left and right brain and strengthen the nerves. (Fig. 2.15, 2.16, and 2.17)

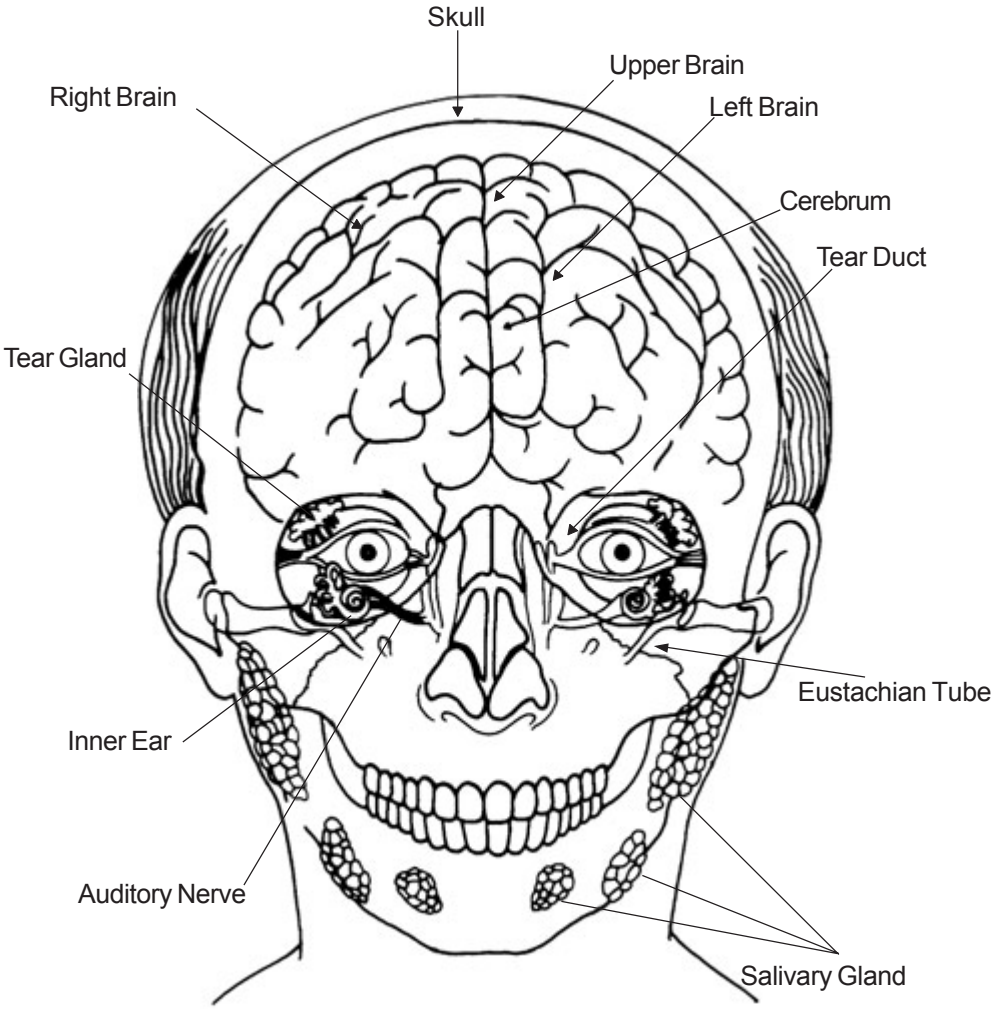

Fig. 2.15 *Parts of the Brain and Head*

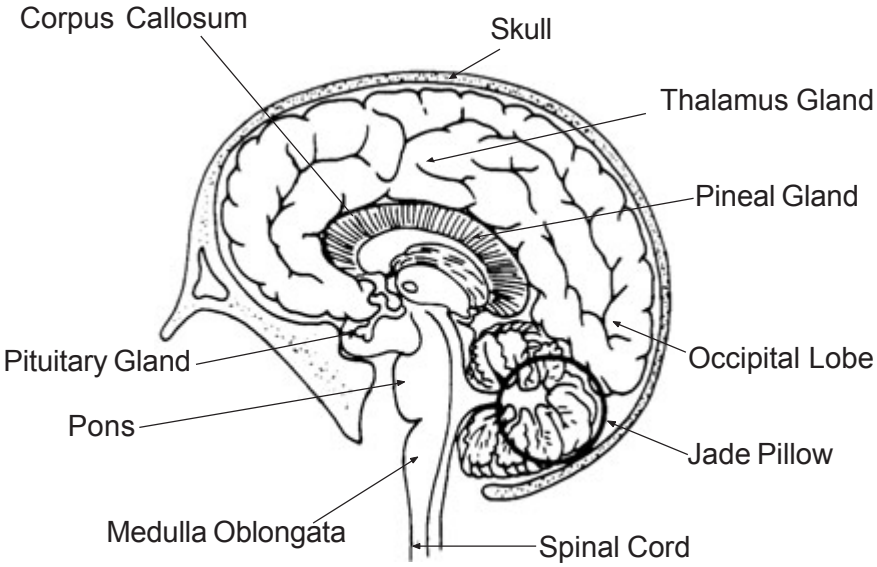

Fig. 2.16 *Side View of Mid-Brain Cross Section*

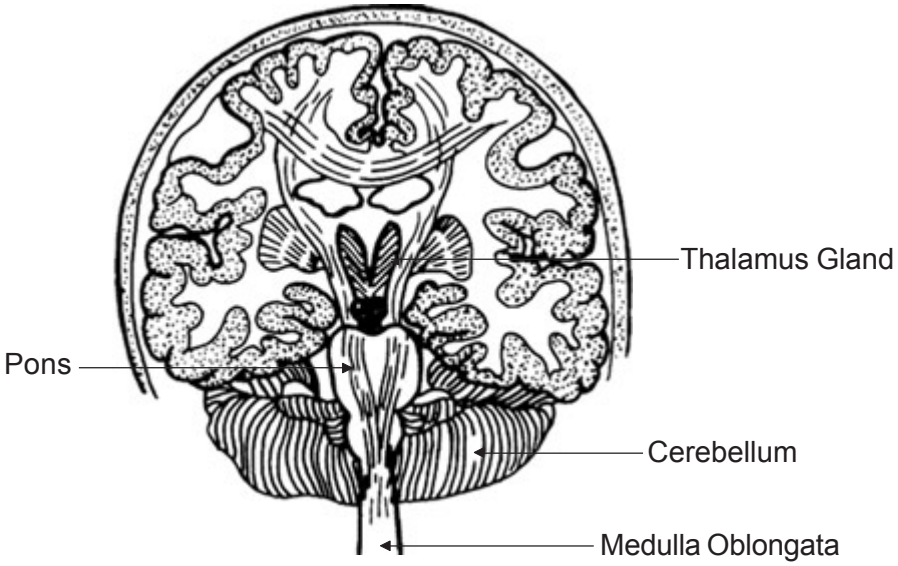

Fig. 2.17 *Frontal View of Mid-Brain Cross Section*

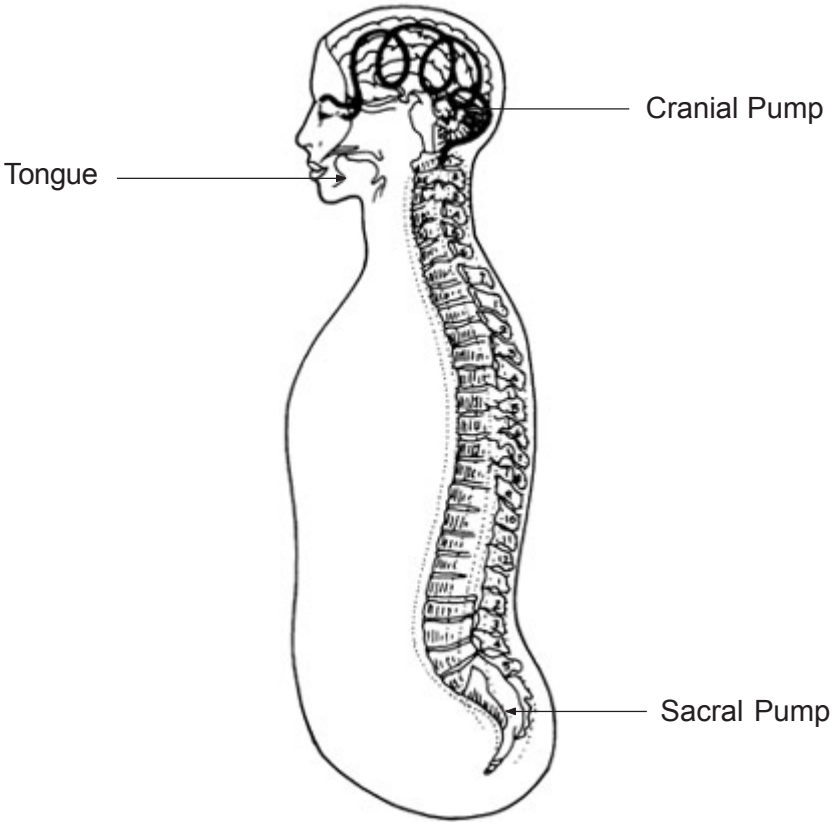

Fig. 2.18 *Side View of Mid-Brain Cross Section*

3. Move the inner smiling eyesight down to the midbrain. Feel it expand and soften and go down to the pons and oblongata (see illustrations) and to the spinal cord, starting from the cervical vetebra at the base of the skull. Move the inner smiling eyesight, bringing this loving energy down inside each vertebra and the disc below it. Count out each vertebra and disc as you smile down them: seven cervical (neck) vertebrae, twelve thoracic (chest), five lumbar (lower back), the triangular bone called the sacrum, and the coccyx (tail bone). Feel the spinal cord and the back becoming loose and comfortable. Feel the discs softening. Feel your spine expanding and elongating, making you taller.

4. Return to your eyes and quickly smile down the entire Back Line. Your whole body should feel relaxed, The Back Line exercise increases the flow of the spinal fluid and sedates the nervous system. Smiling into a disc keeps it from hardening and becoming deformed so it cannot properly absorb the force and weight of the body. Back pain can be prevented or relieved by smiling into the spine.

D. Smiling Down the Entire Length of your Body

Start at the eyes again. Direct your Inner Smile's eyesight. Quickly smile down the Front Line. Follow the smiling down the Middle Line and then the Back Line. When you are more experienced, smile down all three lines simultaneously, being aware of the organs and the spine.

Now, feel the energy descend down the entire length of your body, like a waterfall—a waterfall of smiles, joy and love. Feel your whole body being loved and appreciated. How marvelous it is!

E. Collecting the Smiling Energy at the Navel

1. It's very important to end by storing the smiling energy in the navel. Most ill effects of meditation are caused by excess energy in the head or heart. The navel area can safely handle the increased energy generated by the Inner Smile. (Fig. 2.19 and 2.20)

2. To collect the smile's energy, concentrate in your navel area, which is about one and a half inches inside your body. Then mentally move that energy in an outward spiral around your navel 36 times; don't go above the diaphragm or below the pubic bone. Women,
start the spiral counterclockwise. Men, start the spiral clockwise. Next, reverse the direction of the spiral and bring it back into the navel, circling it 24 times. Use your finger as a guide the first few times. The energy is now safely stored in your navel, available to you whenever you need it and for whatever part of your body needs it. You have now completed the Inner Smile.

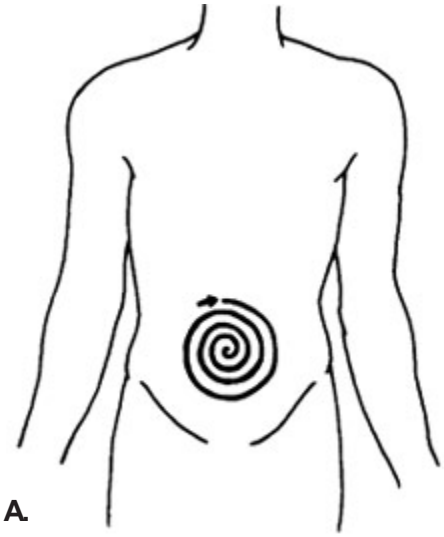

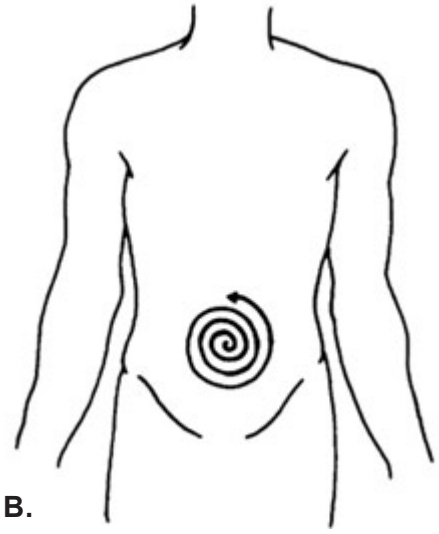

A. Collect the energy in the navel, circling it 36 times clockwise and
B. 24 times counterclockwise.

Fig. 2.19 *Collecting smiling energy at the navel for men.*

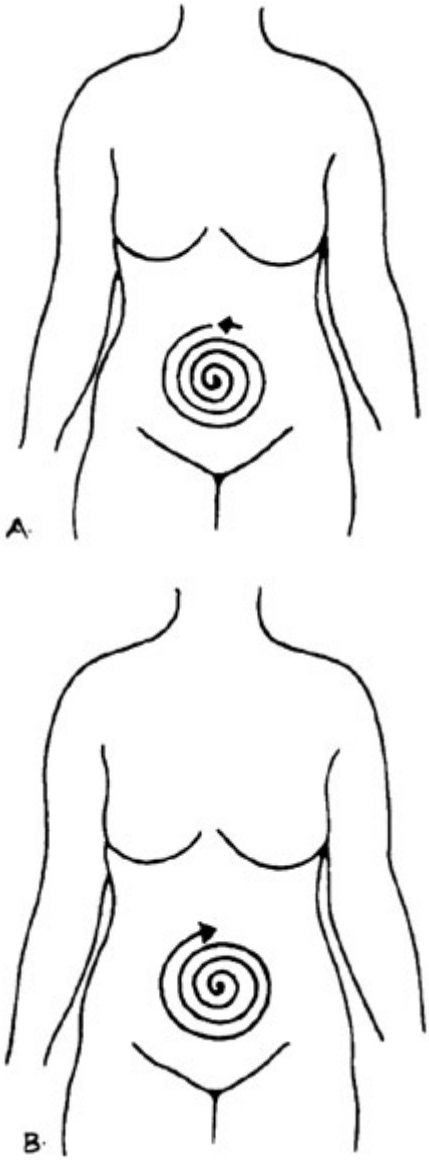

A. Collect the energy in the navel, circling it 36 times counterclockwise and B. 24 times clockwise.

Fig. 2.20 *Collecting smiling energy in the navel for women.*

F. Daily Use

Try to practice the Inner Smile every day as soon as you wake up. It will improve your whole day. If you love your own body, you will be more loving to others and more effective in your work. Once you have learned it and practiced it regularly you can, if you are short of time, do it more rapidly, in a few minutes.

G. Smile the Negative Emotions Away

Practice it also at times of stress, anger, fear, or depression. Smile down into the part that feels tension and strain, and gradually see the negative energy transform into positive vital life force energy. These draining, negative emotions will be turned into positive energy and vitality. Smile the emotions away. The smile's energy can change emotional energy into vital energy—provided you smile enough into the emotions—such as anger, stress, fear, and impatience.

H. Smile Pain and Sickness Away

If you feel pain and uneasiness in any part of your body, or feel sick in any part of the organs, keep on smiling to these parts; spend more time smiling to these parts, talk to them, get feedback from them, until you feel them get softer or more open or their color changes from dark to bright.

Chapter 4
Six Healing Sounds

I. Benefits and Theory

Thousands of years ago the Taoist Masters discovered in their meditations the six sounds which were the correct frequencies to keep the organs in optimal condition by preventing and alleviating illness. They discovered that a healthy organ vibrates at a particular frequency. To accompany the Six Healing Sounds, six accompanying postures were developed to activate the acupuncture meridians, or energy channels, of the organs. (Fig. 4.1)

A. Overheating of the Organs

What causes an organ to malfunction? There are many causes. Urban society creates a life full of physical and emotional stresses such as overcrowding, pollution, radiation, junk food, chemical additives, anxiety, loneliness, bad posture, and sudden or overly vigorous exercise. Separately and together, these stresses produce tension and start to block the free passage of energy flow in the body and, thus the organs overheat. In addition, the concrete jungle that we live in lacks the safety valves provided by nature: trees, open spaces, and running water, which give forth a cooling, purifying energy. Continued overheating causes an organ to contract and harden. This impairs its ability to function and results in illness. One of the surgeons working with The Universal Tao Center in New York reports that the hearts of patients who have died of heart attacks look as if they've been cooked! And the ancient Taoists have a saying: "Stress cooks your brain". (Fig. 4.2 and 4.3)

B. Cooling System of the Organs

Chinese medicine teaches that each organ is surrounded by a sac or membrane, called fascia, which regulates its temperature. Ideally, the membrane releases excess heat out through the skin, where it is exchanged for cool life force energy from nature. An overload of physical or emotional tension causes the membrane, or fascia, to stick to the organ so that it cannot properly release heat to the skin nor absorb cool energy from the skin.

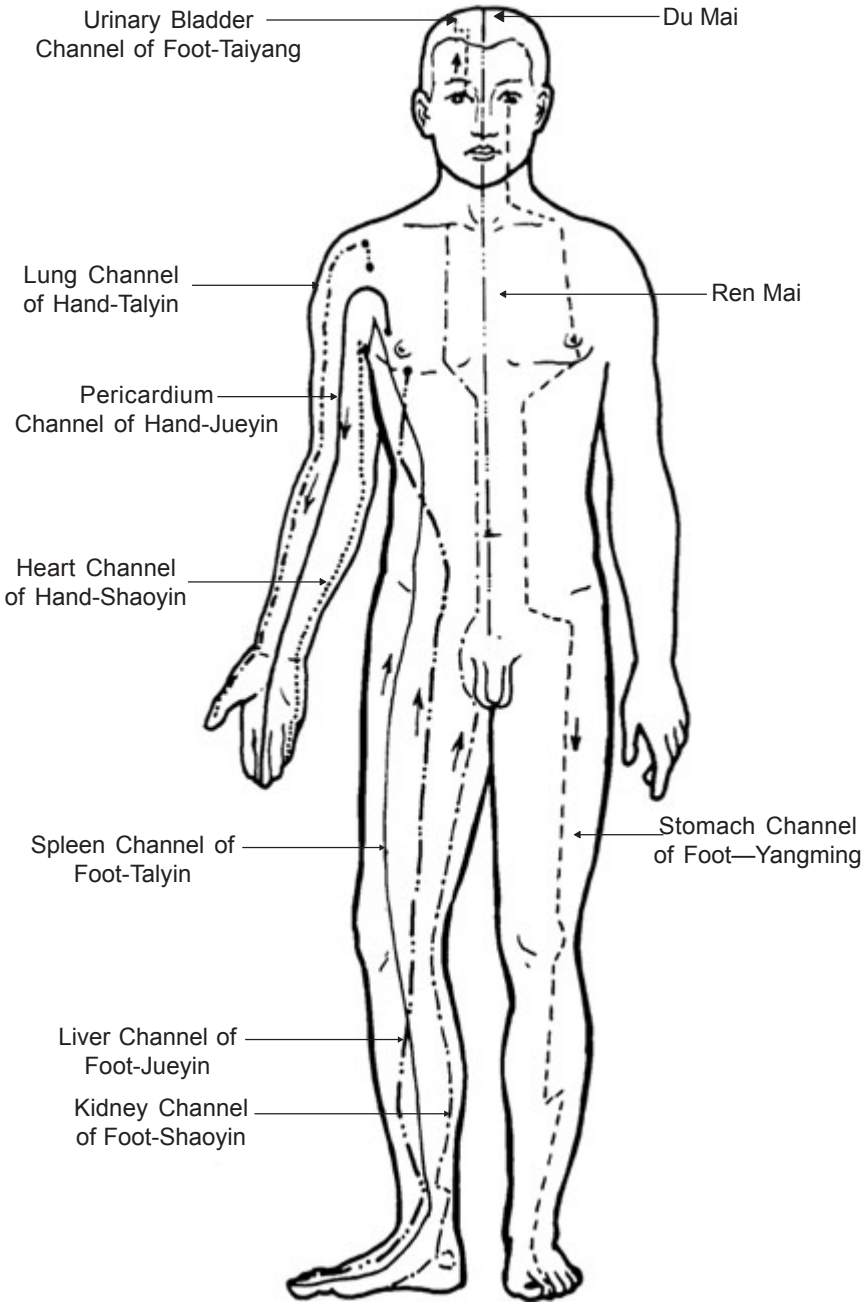

Fig. 4.1 *Distribution of Fourteen Channels—Anterior View*

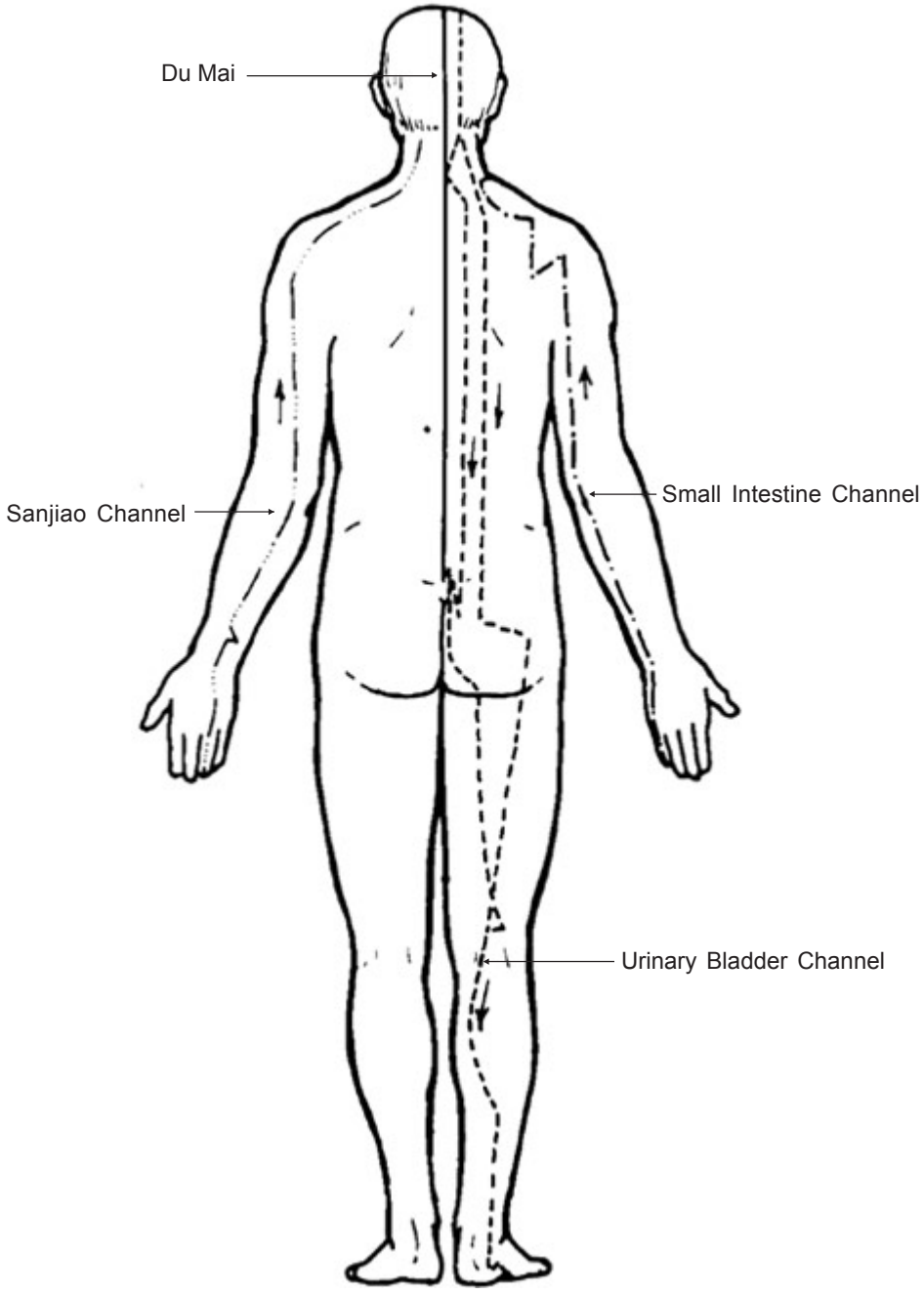

Exterior View

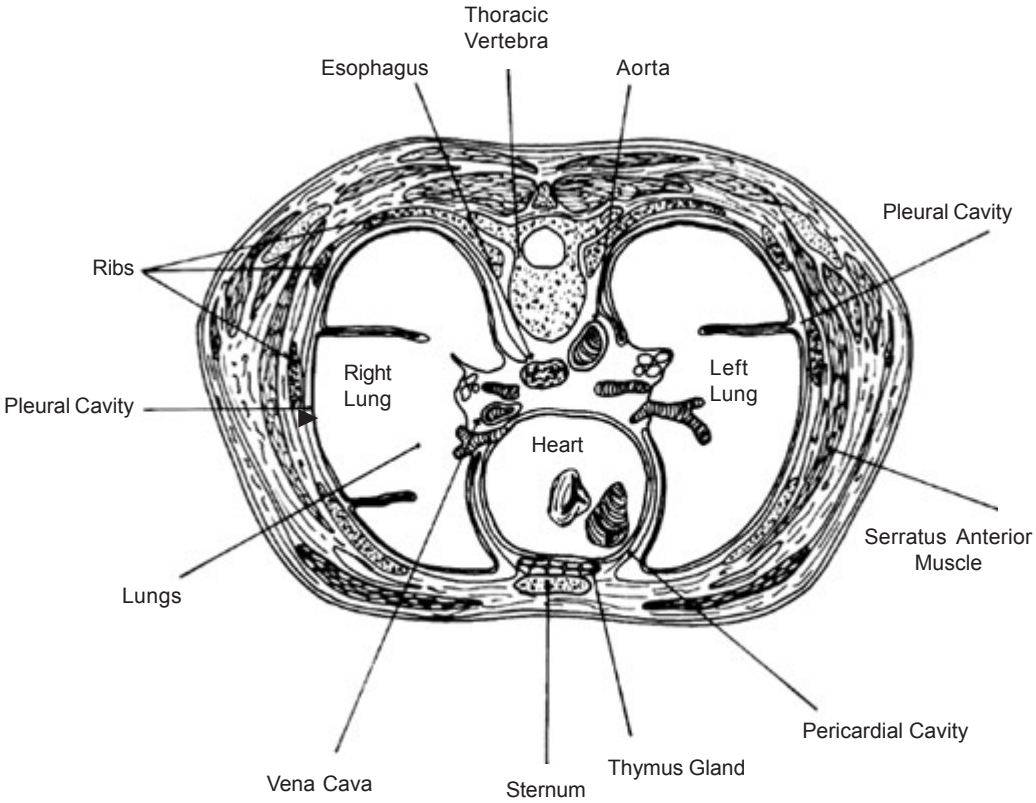

Fig. 4.2 *Cross Section of the Thorax*

The skin becomes clogged with toxins and the organ overheats. The Six Healing Sounds speed up the heat exchange through the digestive system and the mouth. The digestive system is more than 20 feet long and runs from the mouth to the anus as one pipe in the middle of the body in between all the organs. It helps release excess heat from the fascia, cooling and cleansing the organs and skin.

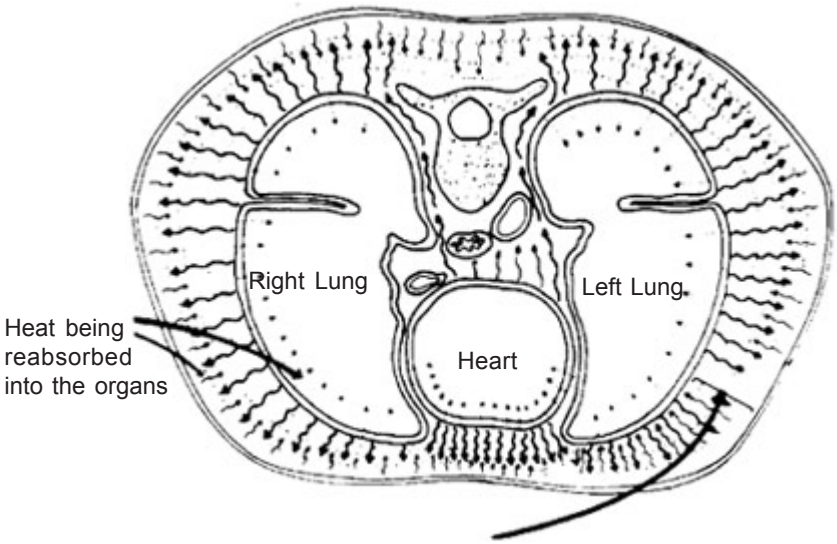

Toxic deposits on tissues and muscles block the free passage of heat generated by the organs. The heat is reflected back into the organs, causing pressure, overheating and eventual malfunction of the organs.

Fig. 4.3 *Overheating of the Organs*

When all the sounds and postures are done in the proper order, body heat is evenly distributed by the intestinal tract throughout the whole body, and each of the organs is at its correct temperature. (Fig. 4.4)

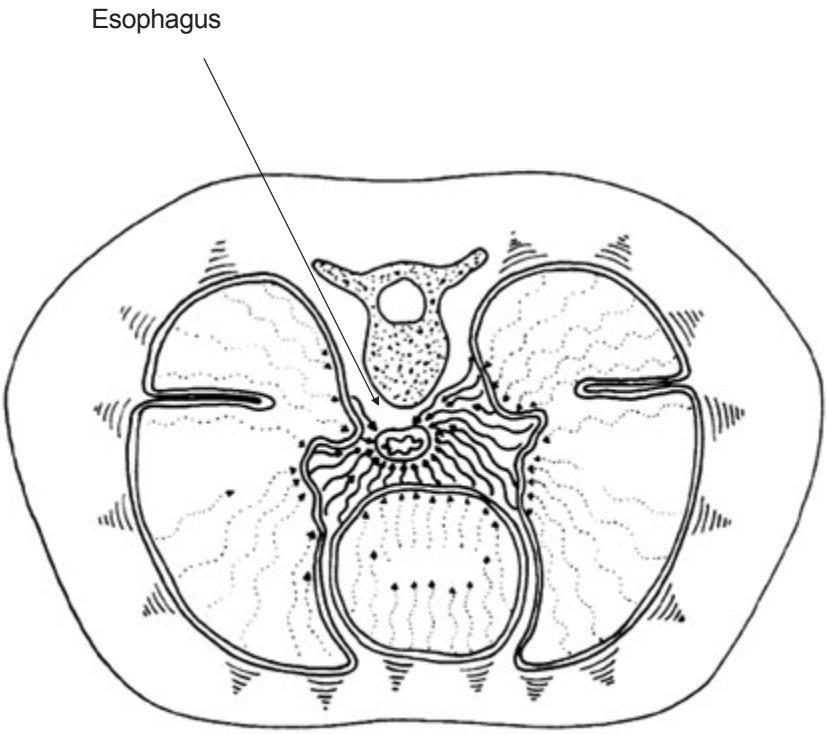

As the sound is made, the heat given off by the organs is transferred out of the body through the esophagus.

Fig. 4.4 *Cooling System of the Organs*

C. Sounds that Heal and Prevent

Daily practice of the Six Healing Sounds will restore and maintain calmness and good health. Greater sexual pleasure and improved digestion will occur. Minor ailments, such as colds, flu, and sore throats, can be prevented or thrown off easily. Many students of The Universal Tao have overcome their long-standing dependence on sleeping pills, tranquilizers, aspirin, and antacids. Heart attack victims have prevented further attacks. Several psychologists have taught some of their patients to use the Six Healing Sounds to relieve depression, anxiety or anger; and body work oriented healers have used the Six Healing Sounds to help speed up healing, and the healer spends less of his own life force energy.

Each of the five organs in the practice has an associate organ which responds together with it and in the same manner. When an organ is weak or overheated, its paired organ is similarly affected. Likewise, practicing the appropriate healing sound and posture improves the organ and its associate.

D. Sensations of the Resting Period

The sensations experienced during the “rest period” of the practice vary from individual to individual. You may feel coolness, tingling, vibration, or lightness or expansion in a particular organ, or your head, hands or legs. Or you may feel nothing specific, just a general feeling of relaxation. You may begin to sense the changes as your organs become softer, moister, spongier and more open.

E. Best Negative Emotion Control

The Six Healing Sounds are the fastest way to calm down the organs. The “concrete jungle” life that we live tends to trap the pollution and excess heat that surround us in our environment. All kinds of waves stimulate our bodies and organs to hyperactivity. Likewise, the circulation of the life force energy is obstructed, and the energy cannot flow efficiently or easily. When negative energy cannot be expelled from the body, it is circulated and trapped in the organs and in the membrane covering of the organs. The organs themselves begin to overheat, creating more negative emotional energy and added stress.

However, by simply pronouncing the organ sounds, one can release and exchange the gas trapped in the organs. Just as the Taoist Masters of olden times discovered certain sounds that had a close relationship with the organs and which would cool down the organs to their normal temperatures, so can we deliver fresh energy into the organ to release or transform our negative emotions into a more positive or life-giving energy.

F. Getting Rid of Bad Breath

Mouth odor is a most common problem. Many people are not aware of how greatly it affects them personally. People who come in contact with someone with bad breath feel uncomfortable and unpleasant. When you know your breath is bad and you cannot get rid of the persistent odor, you gradually lose confidence in yourself in social gatherings. One of the reasons for bad breath is tooth decay, which can be corrected by a dentist. The other major cause of bad breath is disease of the internal organs. The internal organs, when not healthy, will cause bad breath. A sickly liver, for example, will cause bad breath which smells like decaying meat. The kidneys, when not in a healthy state, will cause breath to smell like fermented urine. A weak or sickly stomach is the main cause of bad breath. When the stomach and the intestines reduce their healthy digestive activities, a great accumulation of partially undigested food remains in their walls, leading to bad breath. The Six Healing Sounds help to detoxify the body, strengthen the organs and release the trapped gases which cause bad breath.

G. Help Get Rid of Body Odor

Strong body odors also make people disliked, especially in the summer. Body odor can be caused by long term work under stress, which makes the organs more nervous and can cause organ pain, especially stomach pain. Stomach pain obstructs the digestive system and the Chi circulatory system. The odor that is secreted when perspiring, especially the odor secreted by the armpits (which tap the body's energy flow), becomes very strong. The Six Healing Sounds, especially the Lung Sound, can help to exchange the energy and make energy circulate. To do the Lung Sound you have to raise the hands above the head and expose the arm pits. This will help to increase circulating and exchanging the energy in the armpits so that the organs are more open and cleaner.

The Kidney Sound will also help eliminate bad perspiration. People who perspire easily with little movement or when nervous do so because they have weak kidneys. Their kidneys cannot filter the uric acid out of the body and into the blood stream. When the kidneys are weakened or sick, this filtering system breaks down and an excess build-up of uric acid occurs in the kidneys and throughout the body. This causes a foul smell in an individual's perspiration. When the excess water in the body cannot escape via the kidneys, the body becomes stressed and fear occurs easily, reflecting in foul smelling perspiration. Uttering the Kidney Sound and massaging the kidney area in the back by lightly tapping the kidneys can help to shake the stuck uric acid particles loose from the kidney filters. Massaging the feet at the kidney point, especially at the bubbling spring point on the soles of the feet, will also help greatly.

H. Yawning, Burping and Passing Gas

Yawning, burping or passing gas are common reactions during or shortly after doing the Six Healing Sounds. These aren't socially approved responses in North America, but they are actually beneficial. They're part of the process of releasing trapped bad breath, gas and hot energy from the digestive system. As you inhale, you take cool fresh life force energy into the esophagus and breathe into the organs. Exhaling and pronouncing the correct sound creates an exchange of energy, bringing the good energy to the organ and forcing out the waste energy. The world now spends billions of dollars on antacids and soft drinks to release trapped gas. The Six Healing Sounds do the same thing more efficiently and without expense.

I. Best Detoxification is through your own Life Force Energy

Detoxification through the Six Healing Sounds is by far one of the best ways to clean out the organs, because it employs fresh energy to clean them. People spend a lot of money for herbs and drugs in order to cleanse and detoxify the organs. A lot of times substances will enter and remain there, causing more toxicity. Some people will experience moving of gas, or loose or very bad smelling bowel movements; these also are indications of ongoing detoxification.

J. Tears and Saliva

Similar to yawning and burping, practice of the Six Healing Sounds may develop another sign of detoxification: tearing. Tearing helps prevent eye disease and cleanses the organs. Usually cleaning out will also be followed by a spring of saliva from the salivary glands of the mouth, which you will feel to be fresh and fragrant. When you have a lot of saliva, swallow down by pressing your tongue to the roof of your mouth, locking your neck and swallowing.

K. Sounds can increase the Range of Movement

Trapped bad energy in the organs can make the organs tense and painful to contract, thus slowing down many physical activities. However, the Six Healing Sounds release the trapped energy in the organs. In a study by Dr. G. Goodheart, the originator of a practice called Applied Kinesiology, he discovered that each large muscle was related to a body organ. A weakness in a muscle usually meant there was a problem in the Chi energy level of a corresponding organ. In the Taoist system, all organs are associated with movement and the extremities. If there is an obstruction of energy in an organ, trapped bad energy or negative emotions, movement of the muscles paired with that organ will be tense, painful and limited. The muscles are like the back-up tank of the organs. So the range of movement throughout the body will be greatly obstructed and limited when the organs are obstructed with tension or under stress. We find that many of our students improve their range of movement when the tensions are released from within their internal organs after practicing the Six Healing Sounds.

The chart below shows the details of the organs, muscles and emotions associated with them. (Fig. 4.5)

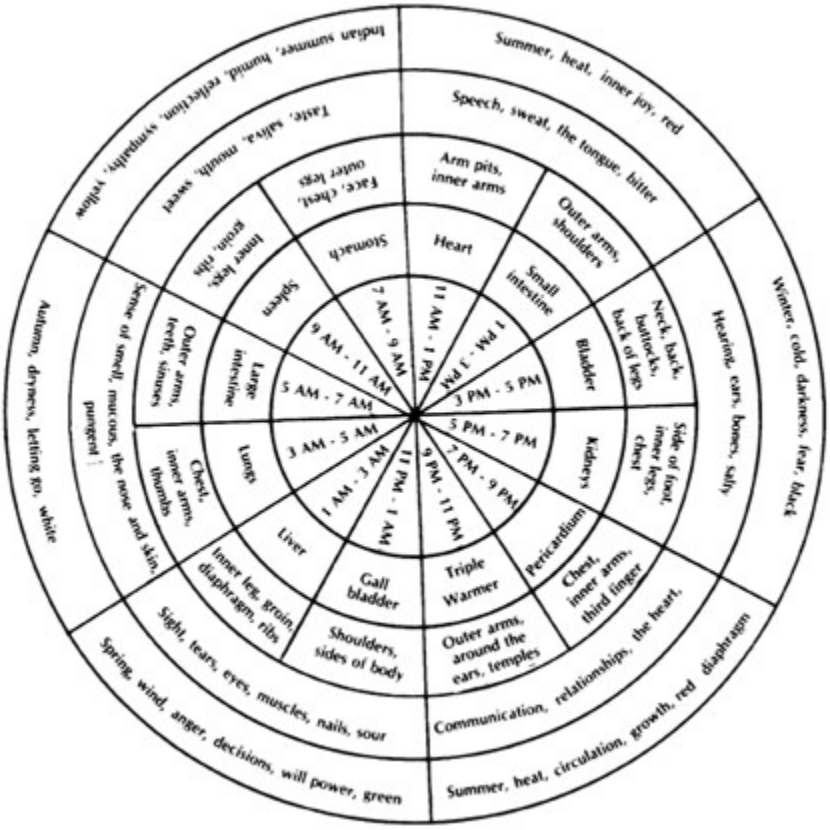

Fig. 4.5 *Body Clock Chart*

II. Preparation for the Six Healing Sounds

A. For maximum benefit, be precise in assuming the position and making the sound for each organ.

B. During all of the exhalation positions, you will be looking up at the ceiling with your head tilted back. This creates a straight path from the open mouth, through the esophagus, down to the organs, and permits a more efficient exchange of energy.

C. The sounds are done sub-vocally—that is, the lips, teeth and tongue produce the sound, but it is heard only internally; this intensifies its power. All sounds are made slowly and evenly.

D. Be sure to follow the order of the exercises as given. This enhances the even distribution of heat in the body. The order follows the natural order of the seasons, from autumn through Indian Summer.

E. Wait at least an hour after eating to begin the practice. However, if you have gas, nausea or stomach cramps you may do just the Spleen Sound right after eating.

F. Choose a quiet spot and take the phone off the hook. Until you've developed a strong inner focus, you need to eliminate distractions.

G. Dress warmly enough not to be chilled. Wear loose fitting clothes and loosen your belt. Remove your glasses and watch.

III. Position and Practice

A. Sit on your sitting bones at the edge of a chair. The genitals should be unsupported; they're an important energy center. (Fig. 4.6)

B. The legs should be a hip's width apart, and the feet should be solidly on the floor.

C. The back is straight, shoulders relaxed; sink the chest.

D. Keep the eyes open.

E. Rest the hands on the thighs, palms up. You are now ready to begin the exercises.

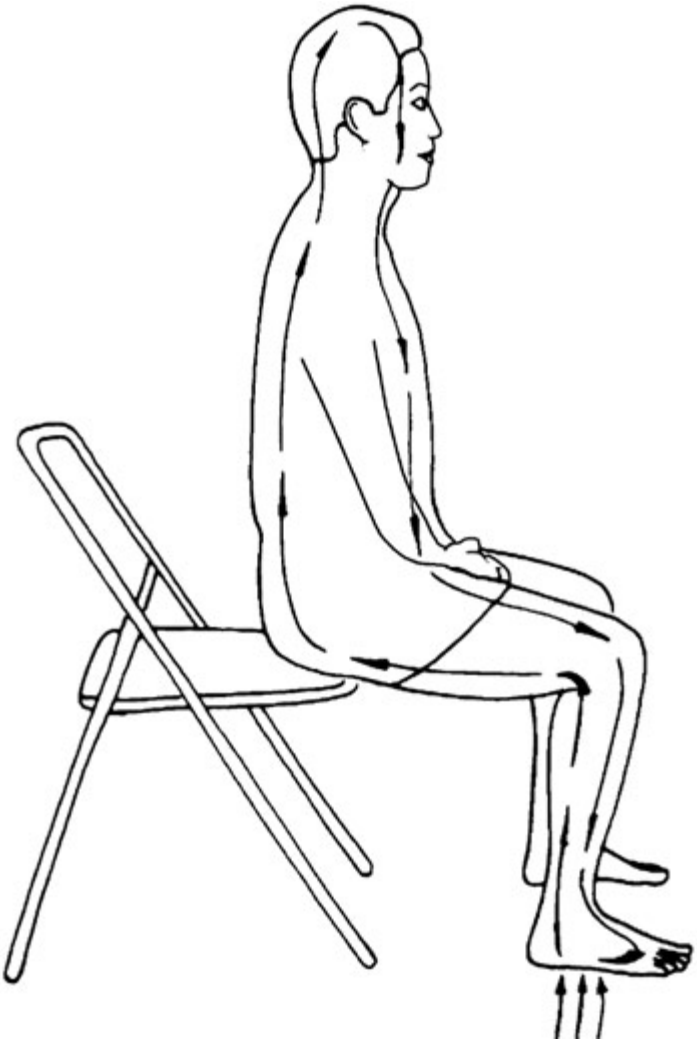

Fig. 4.6 *Sit on your sitting bones at the edge of a chair.*

IV. Lung Exercise: First Healing Sound

A. Characteristics
Lungs
Associated organ: large intestine
Element: metal
Season: autumn - dryness
Negative emotions: sadness, grief, sorrow

Positive emotions: righteousness, surrender, letting go, emptiness, courage

Sound: ***Sssssssss***
Parts of the body: chest, inner arms, thumbs
Senses: nose - smell, mucous, skin
Taste: pungent
Color: white

The lungs are dominant in autumn. Their element is metal and their associated color is white. The negative emotions are grief and sadness. The positive emotions are courage and righteousness.

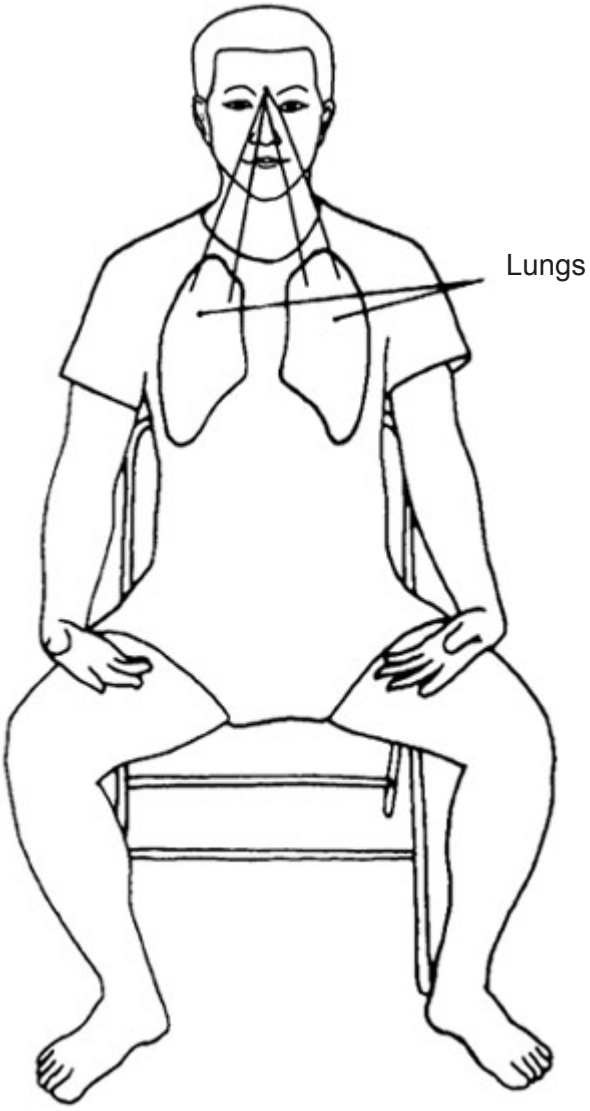

Fig. 4.7 *Become aware of your lungs.*

Fig. 4.8 *Rotate your palms and...*

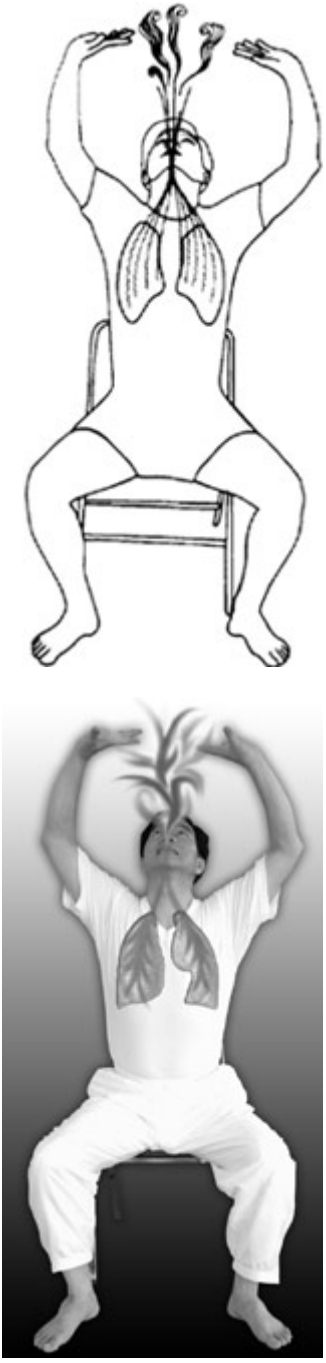

Fig. 4.9 *....bring them up above your head.*

B. Position and Practice

1. Become aware of your lungs. (Fig. 4.7)

2. Take a deep breath and, letting your eyes follow, raise the arms up in front of you. When the hands are at eye level, begin to rotate the palms and bring them up above the head. Keep the elbows rounded. You should feel a stretch that extends from the heels of the palms, along the forearms, over the elbows, along the upper arms and into the shoulders. The lungs and chest will feel open and breathing will be easier. (Fig. 4.8 and 4.9) Close the jaws so that the teeth meet gently, and part the lips slightly. Draw the corners of the mouth back, exhale, and allow your breath to escape through the spaces between the teeth, making the sound "***Sssssssss***", sub-vocally, slowly and evenly in one breath. (Fig. 4.10)

4. As you do this, picture and feel the pleura (the sac that covers the lungs) as being fully compressed, ejecting the "excess heat", sick energy, sadness, sorrow and grief. (Fig. 4.11).

5. When you have exhaled completely (without straining), rotate the palms down, close the eyes, and breathe in to the lungs to strengthen them. If you are color oriented, you can imagine a pure white light and quality of righteousness entering into your whole lungs. Float the arms down by gently lowering the shoulders. Slowly lower them to your lap so that they rest there, palms up. Feel the energy exchange in the hands and palms.

6. Close the eyes, breathe normally, smile down to the lungs, be aware of the lungs, and imagine that you are still making the sound. Pay attention to any sensations you may feel. Try to feel the exchange of cool, fresh energy replacing hot waste energy. (Fig. 4.12)

7. When your breathing calms down, repeat the sequence 3 to 6 times.

8. For colds, flu, mucous, toothaches, smoking, asthma, emphysema, or depression, or if you want to increase the range of movement of the chest and the inner arm, or for detoxifying the lungs, you can repeat the sound 9, 12, 18, 24, or 36 times.

9. The Lung Sound can help to eliminate nervousness when in front of a crowd. You can do the Lung Sound sub-vocally without the hand movements several times when you feel nervous in front of a crowd. This will help you to calm down. The Heart Sound and the Inner Smile will help also if the Lung Sound is not enough to calm you down.

Fig. 4.10 *Mouth Posittion for Lung Sound*
Close jaws so that the teeth meet. Draw the corners of the mouth back.

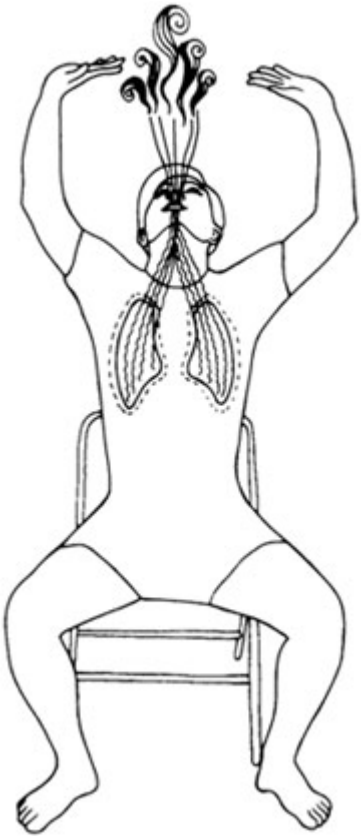

Fig. 4.11 *Picture and feel the sacs being fully compressed.*

Fig. 4.12 *Close the eyes; breathe normally; smile down to the lungs.*

V. Kidney Exercise: Second Healing Sound

A. Characteristics

Kidneys
Associated organ: bladder
Element: water
Season: winter
Negative emotion: fear
Positive emotions: gentleness, alertness, stillness
Sound: ***Chooooo***
Parts of the body: side of foot, inner leg, chest
Senses: hearing, ears, bones
Taste: salty
Color: black or dark blue

Winter is the season of the kidneys. Their element is water and their color is black or dark blue. The negative emotion is fear and the positive emotion is gentleness.

B. Position and Practice

1. Become aware of the kidneys. (Fig. 4.13).

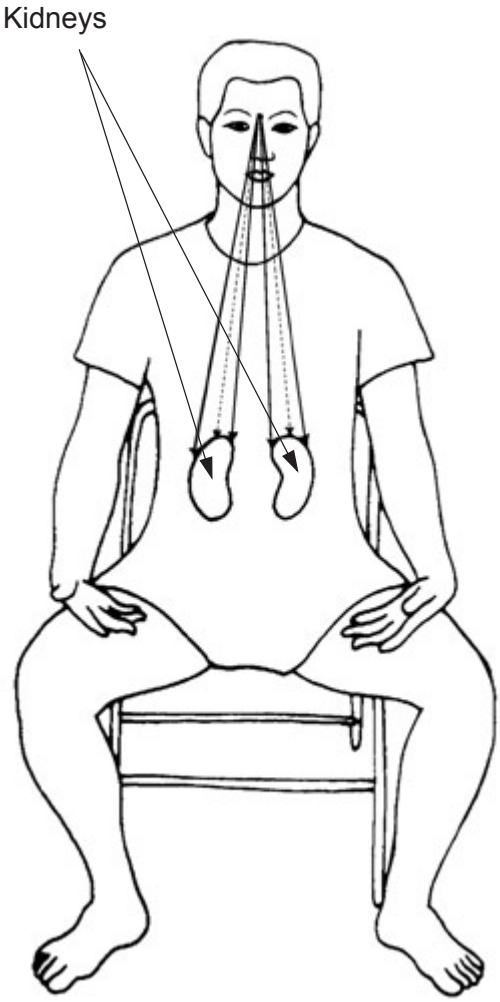

Fig 4.13 *Become aware of your kidneys.*

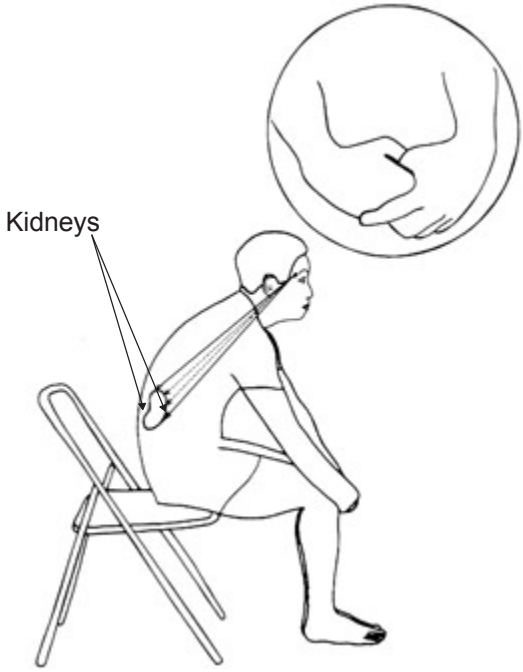

Fig. 4.14 and 4.15 *Hook the hands around the knees.*

2. Place the legs together, ankles and knees touching. Take a deep breath as you bend forward, and clasp one hand in the other; hook the hands around the knees and pull back on the arms. With the arms straight, feel the pull at the back where the kidneys are; look up, and tilt the head back without straining.(Fig. 4.14 and 4.15)

Fig. 4.16 and 4.17 *Round the lips, making the sound one makes when blowing out a candle.*

3. Round the lips and silently make the sound one makes in blowing out a candle. At the same time, press the middle abdomen, between the sternum and navel, toward the spine Imagine the excess heat, the wet, sick energy, and fear being squeezed out from the membrane around the kidneys. (Fig. 4.16, 4.17 and 4.18)

4. When you have exhaled completely, sit up and slowly breathe into the kidneys, imagining a bright blue energy as the quality of gentleness enters the kidneys. Separate the legs to a hip's width and rest the hands, palms up, on the thighs.

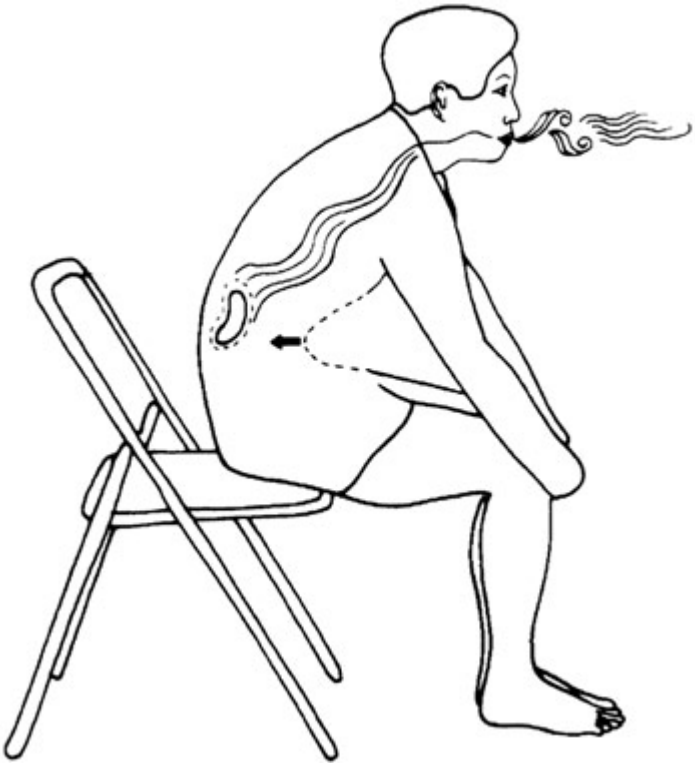

Fig. 4.18 *Press the middle abdomen toward the kidneys.*

5. Close the eyes and breathe normally. Smile to the kidneys, as you imagine that you are still making the sound. Pay attention to sensations. Be aware of the exchange of energy around the kidneys, and hands, head and legs. (Fig. 4.19)

6. When your breathing calms down, repeat 3 to 6 times.

7. For back pain, fatigue, dizziness, ringing in the ears, or detoxifying the kidneys, repeat 9 to 36 times.

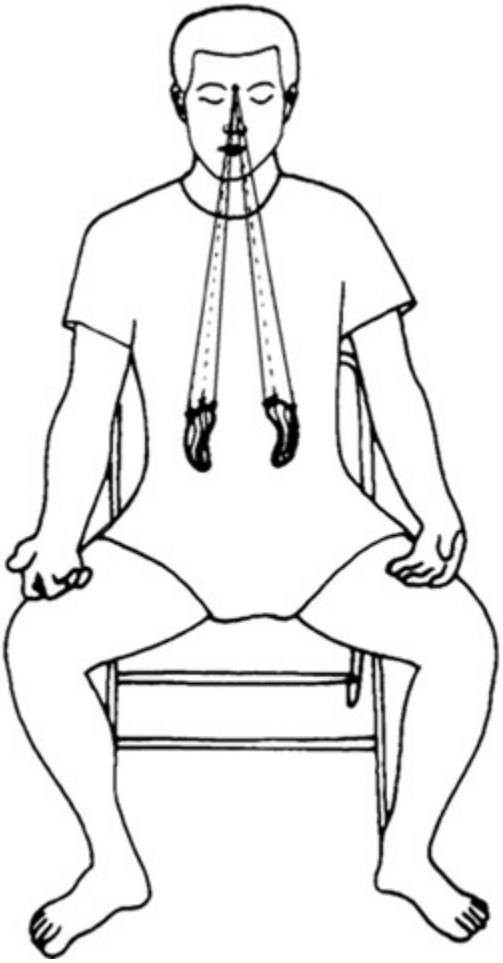

Fig. 4.19 *Close your eyes and smile down to the kidneys.*

VI. Liver Exercise: Third Healing Sound

A. Characteristics

Liver
Associated organ: gall bladder
Element: wood
Season: spring
Negative emotions: anger, aggression
Positive emotions: kindness, self-expansion, identity
Sound: ***Shhhhhh***
Parts of the body: inner legs, groin, diaphragm, ribs
Senses: sight, tears, eyes
Taste: sour
Color: green

The liver is dominant in spring. Wood is its element and green is its color. The negative emotion is anger. The positive emotion is kindness. The liver is especially important.

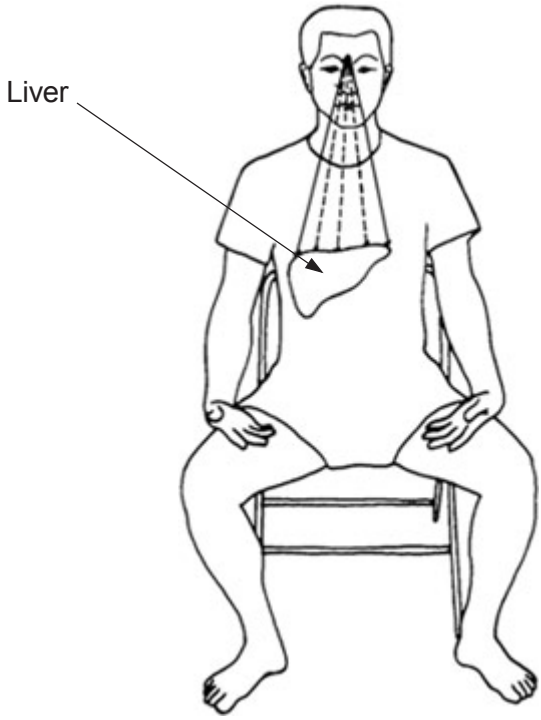

Fig. 4.20 *Become aware of the liver.*

B. Position and Practice

1. Become aware of the liver, and feel the connection between the eyes and the liver. (Fig. 4.20)

2. Place your arms at your sides, palms out. Take a deep breath as you slowly swing the arms up and over the head. Follow with the eyes. (Fig. 4.21)

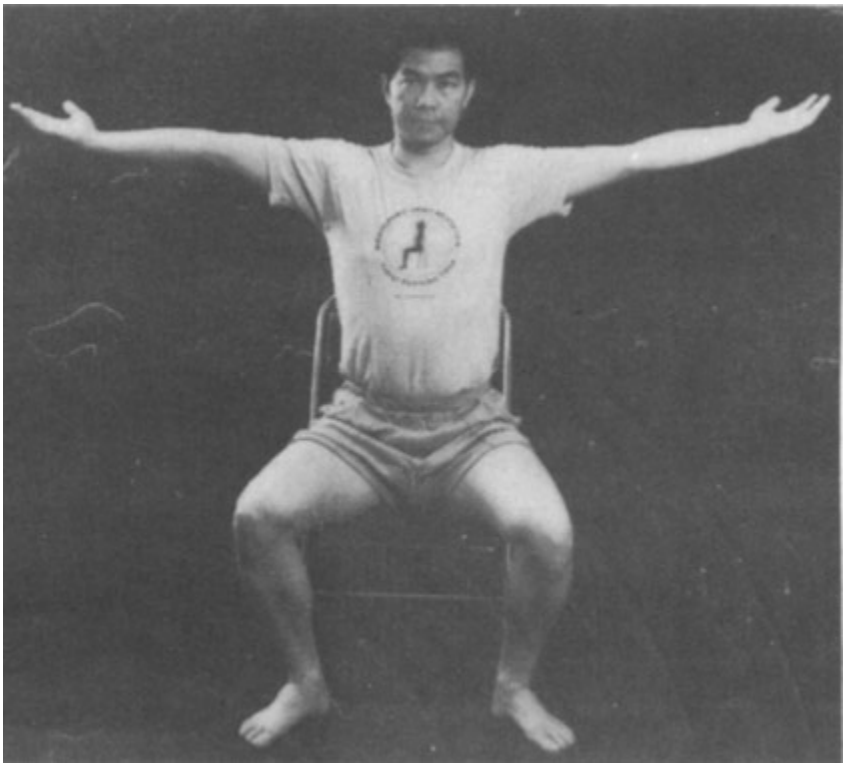

Fig. 4.21 *Slowly swing the arms up and over the head.*

3. Interlace the fingers and rotate the palms (Fig. 4.22) to face the ceiling. Push out at the heels of the palms (Fig4.23) and feel the stretch through the arms and into the shoulders. Bend slightly to the left, exerting a gentle pull on the liver. (Fig. 4.24)

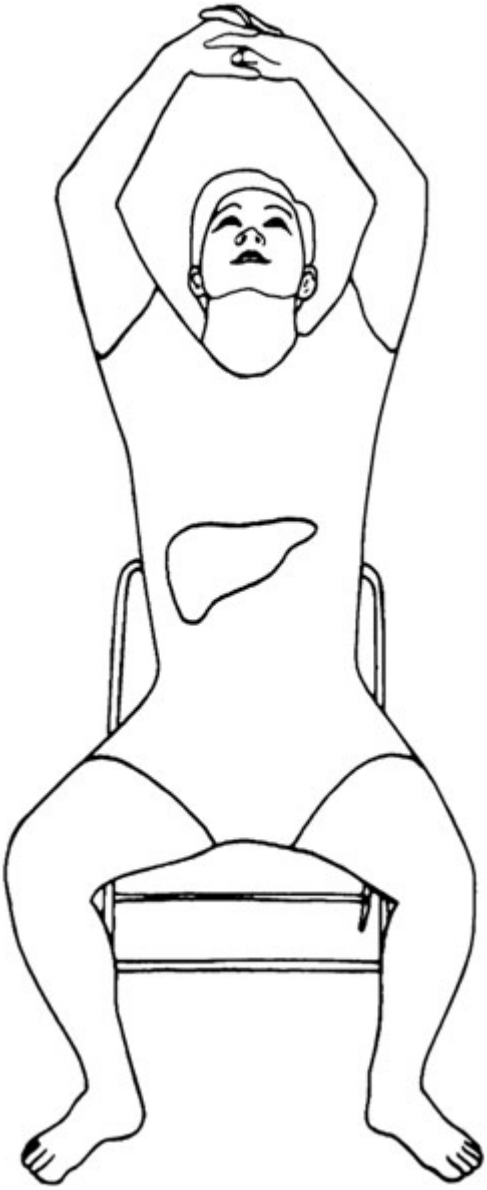

Fig. 4.22 *Interlace the fingers and rotate the palms.*

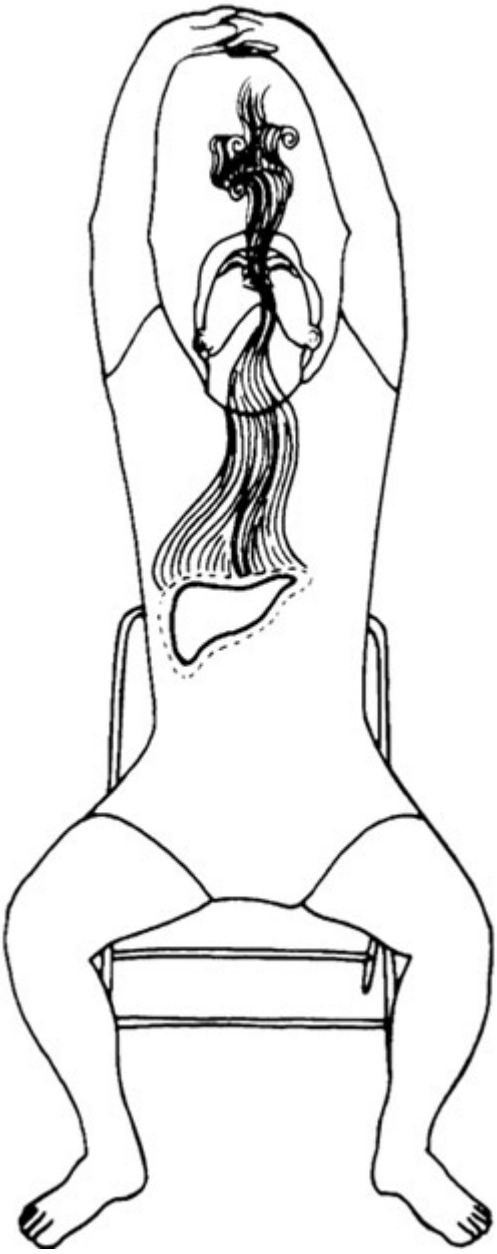

Fig. 4.23 *Push out at the heels of the palms.*

Fig. 4.24 *Push more with the right arm.*

4. Exhale on the sound, "***Shhhhhhh***" (Fig. 4.25), sub-vocally. Again, envision and feel that a sac encloses the liver and is compressing and expelling the excess heat and anger. (Fig. 4.26)

5. When you have exhaled completely, unlock the fingers, and pressing out with the heels of the palms (Fig. 4.27), breathe into the liver slowly; imagine a bright green color quality of kindness entering the liver. Gently bring the arms back to the side by lowering the shoulders. Place your hands on your lap, palms up, and rest.

6. Close the eyes, breathe normally, smile down to the liver and imagine you're still making the sound. Be aware of sensations. Sense the energy exchange. (Fig. 4.28)

7. Do this 3 to 6 times. For anger, red and watery eyes, or a sour or bitter taste, and for detoxifying the liver, repeat 9 to 36 times.

A Taoist axiom about controlling anger says: If you've done the Liver Sound 30 times and you are still angry at someone, you have the right to slap that person.

Fig. 4.25 *Exhale on the sound "**Shhhhhhh**".*

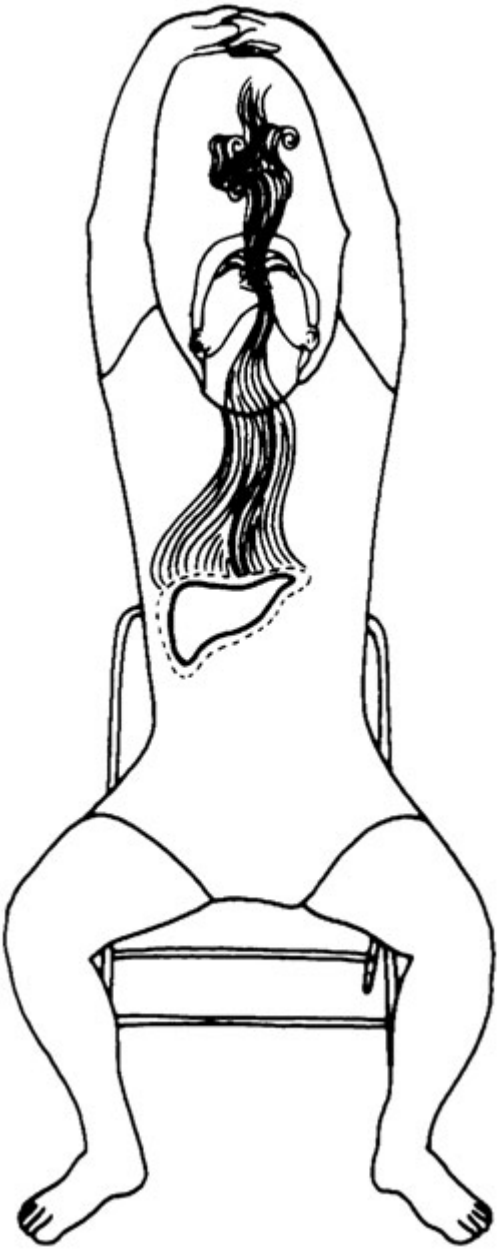

Fig. 4.26 *Feel that a sac encloses the liver and is compressing.*

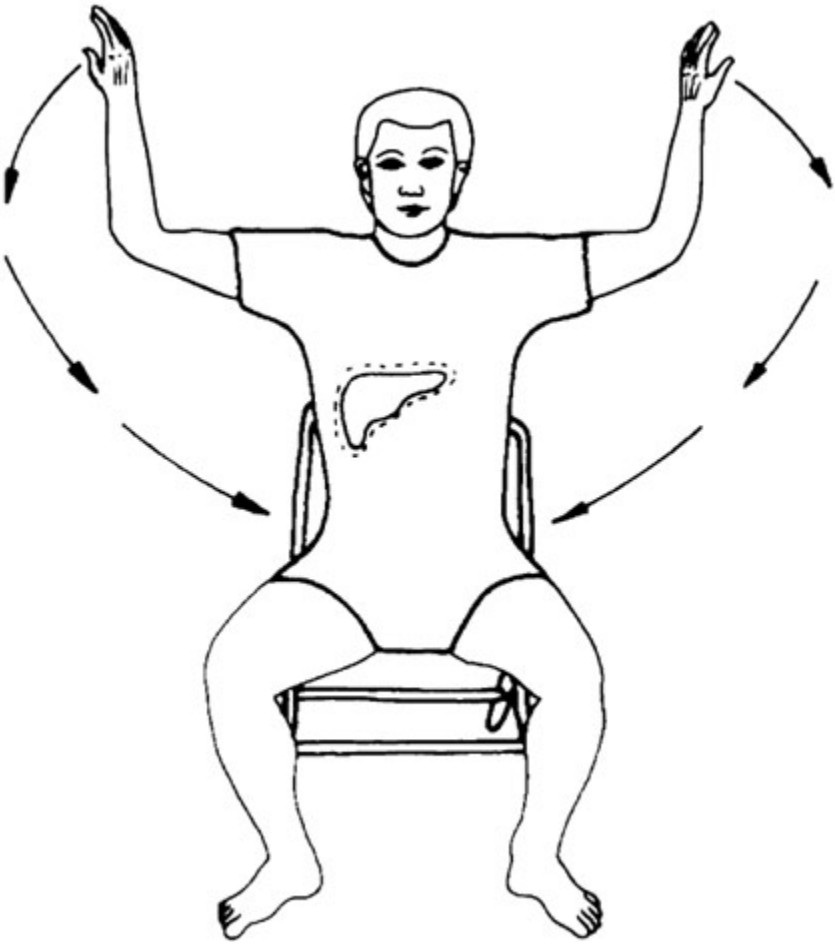

Fig. 4.27 *Press out with the heels of the palms.*

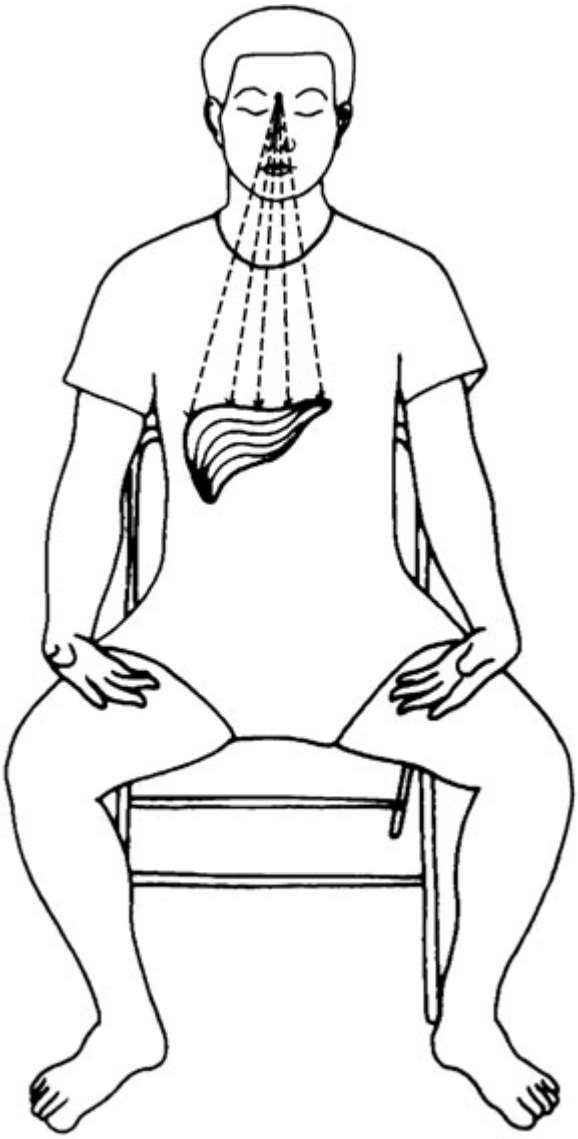

Fig. 4.28 *Close your eyes and smile down to the liver.*

VII. Heart Exercise: Fourth Healing Sound

A. Characteristics

Heart
Associated organ: small intestine
Element: fire
Season: summer
Negative emotions: impatience, arrogance, hastiness, cruelty, violence
Positive emotions: joy, honor, sincerity, creativity, enthusiasm, spirit, radiance, light
Sound: ***Hawwwwww***
Part of the body: armpits, inner arms
Senses: tongue, speech
Taste: bitter
Color: red

The heart is constantly working, beating at the rate of approximately 72 times a minute, 4,320 times an hour, 102,680 times each day. This naturally produces heat, which is dissipated by the heart's sac, the pericardium. In the Taoist view, the pericardium is important enough to be considered a separate organ.

B. Position and Practice

1. Become aware of the heart and feel the tongue connected with the heart. (Fig. 4.29).
2. Take a deep breath and assume the same position as for the Liver Sound (Fig. 4.30), but lean slightly to the right (Fig. 4.31).
3. Open the mouth somewhat (Fig. 4.32), round the lips and exhale on the sound "***Hawwwwwww***" (Fig. 4.33,4.34 and 4.35), sub-vocally, as you picture the pericardium releasing heat, impatience, arrogance and hastiness.
4. For the rest cycle, repeat the procedure for the Liver Sound, but focus attention on your heart (Fig. 4.36) and imagine a bright red color and the qualities of joy, honor, sincerity and creativity entering the heart.
5. Do 3 to 6 times. For a sore throat, cold sores, swollen gums or tongue, heart disease, heart pains, jumpiness, moodiness, and for detoxifying the heart, repeat 9 to 36 times.

Fig. 4.29 *Become aware of the heart.*

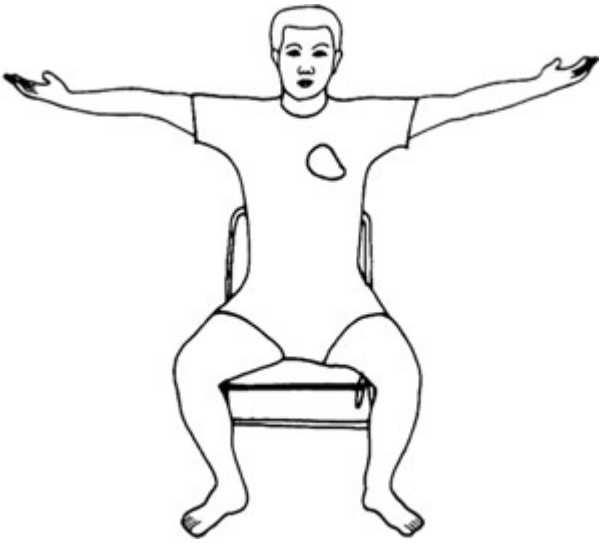

Fig. 4.30 *Assume the same position as for the Liver Sound.*

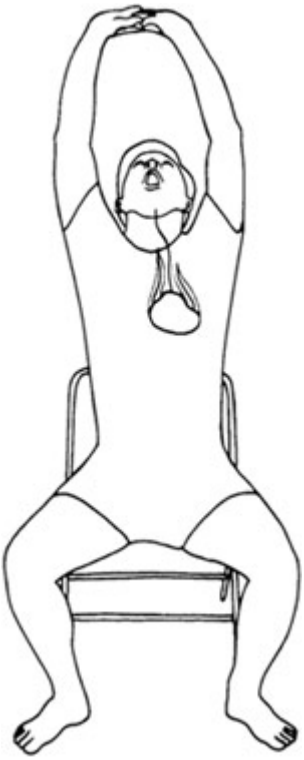

Fig. 4.31 *Push more with the left arm.*

Fig. 4.32 *Open mouth, rounded lips.*

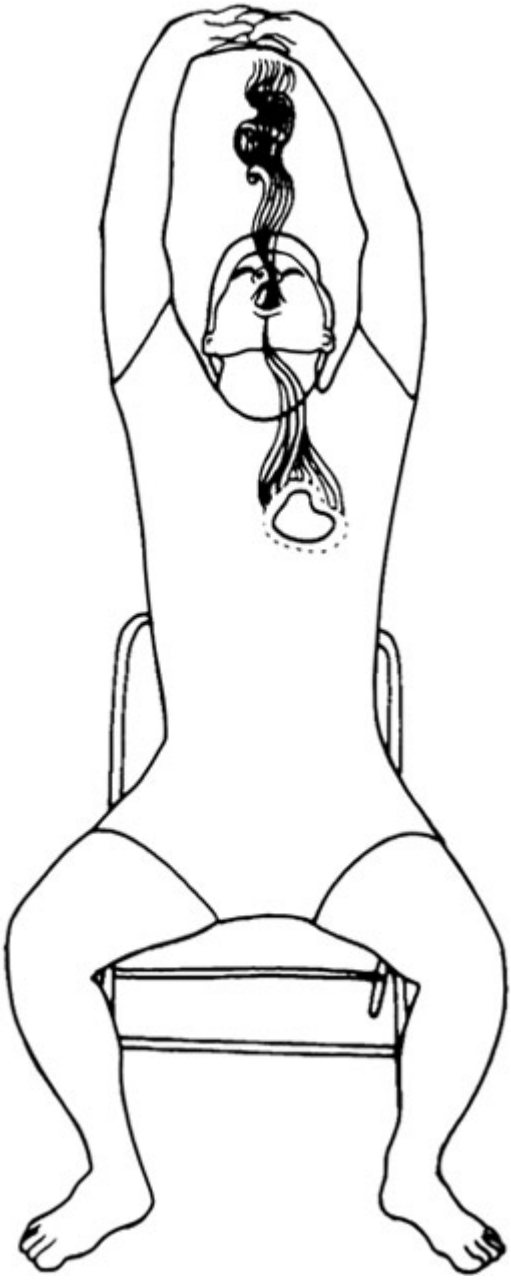

Fig. 4.33 Hawwwwww *Sound*

Fig. 4.34 *Breathe out Dark, Murky Energy.*

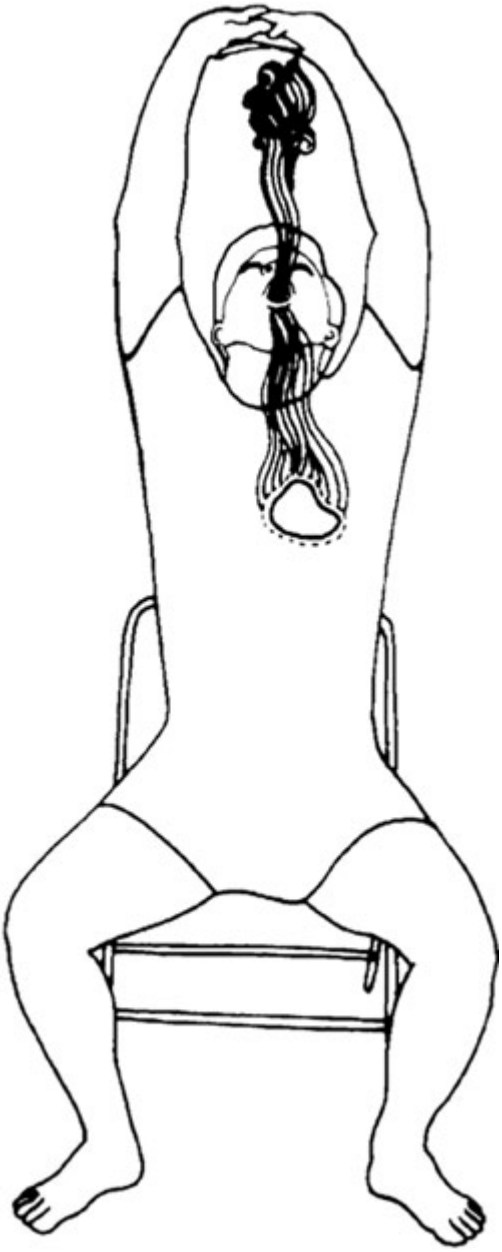

Fig. 4.35 *Open your mouth somewhat, round your lips and exhale on the sound "**Haaaaaw**".*

Fig. 4.36 *Close your eyes and smile down to the heart.*

VIII. Spleen Exercise: Fifth Healing Sound

A. Characteristics

Associated Organs: pancreas, stomach
Element: earth
Season: Indian summer
Negative Emotions: worry, sympathy, pity
Positive Emotions; fairness, compassion, centering, music Making
Sound: ***Whooooo***
Taste: neutral
Color: yellow

B. Position and Practice

1. Become aware of the spleen; feel the mouth and the spleen connect. (Fig. 4.37)

2. Take a deep breath as you place your hands (Fig. 4.38) with the index fingers resting at the bottom and slightly to the left of the sternum. (Fig. 4.39). Press in with the fingers as you push out with the middle back. (Fig. 4.40)

3. Exhale on the sound "***Whoooooo***" (Fig. 4.41), made sub-vocally and felt in the vocal chords (Fig. 4.42). Expel the excess heat, wetness and dampness, and worry, sympathy and pity.

4. Breathe into the spleen, pancreas, and stomach (Fig. 4.43), or imagine a bright yellow light, and the qualities of fairness, compassion, centering, and music making entering them.

5. Lower the hands slowly to your lap, palms up.

6. Close the eyes, breathe normally and imagine you are still making the sound. Be aware of sensations and the exchange of energy. (Fig. 4.44)

7. Repeat 3 to 6 times.

8. Repeat 9 to 36 times for indigestion, nausea and diarrhea, and for detoxifying the spleen. This sound, done in conjunction with the others, is more effective and healthier than using antacids. It is the only sound that can be done immediately after eating.

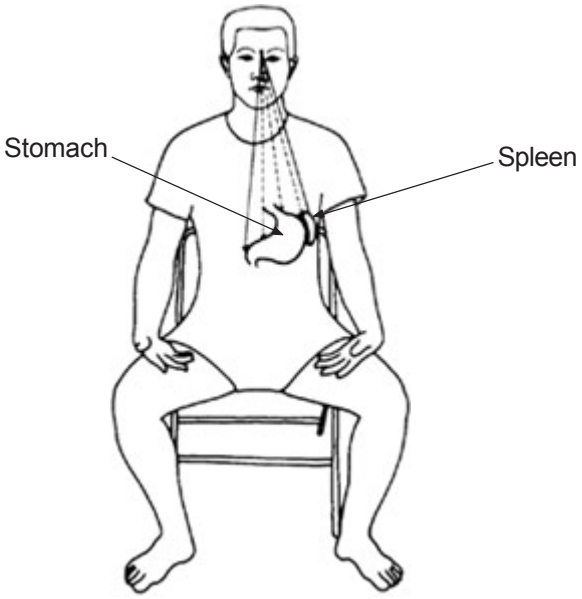

Fig. 4.37 *Become aware of the spleen.*

Fig. 4.38 *Take a deep breath.*

Fig. 4.39 *Place your hands with the index fingers resting at the bottom and slightly to the left of the sternum.*

Fig. 4.40 *Feel the sound in the vocal chords.*

Fig. 4.41 *Exhale on the sound "**Whoooooo**".*

Fig. 4.42 *Feel the sound in the vocal chords.*

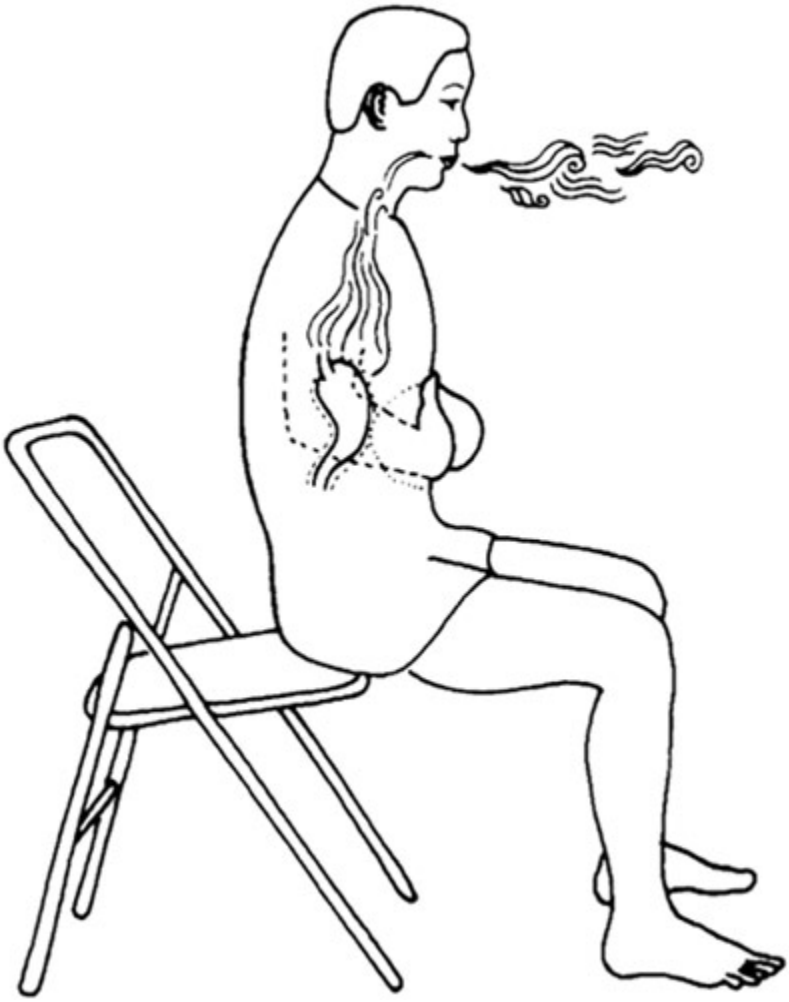

Fig. 4.43 *Breathe into the spleen, pancreas and stomach.*

Fig. 4.44 *Close your eyes and smile down to the spleen, pancreas and stomach.*

IX. Triple Warmer Exercise : Sixth Healing Sound

A. Characteristics

The Triple Warmer refers to the three energy centers of the body. The upper level, which consists of the brain, heart, and lungs, is hot. The middle section consisting of the liver, kidneys, stomach, pancreas, and spleen, is warm. The lower level containing the large and small intestines, the bladder, and the sexual organs, is cool.The Triple Warmer Sound balances the temperature of the three levels by bringing hot energy down to the lower center and cold energy up to the upper center, through the digestive tract. This induces a deep, relaxing sleep. A number of students have been able to break a long-standing dependence on sleeping pills by practicing this sound. It's also very effective for relieving stress.

There is no season, color, or emotion associated with the Triple Warmer.

Fig. 4.45 *Lie on your back; close the eyes; take a deep breath.*

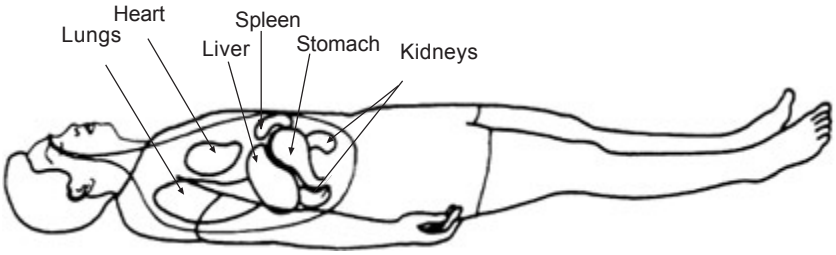

Fig. 4.46 *Organs' Diagram*

Fig. 4.47 Heeeee *Sound*

Fig. 4.48 *Breathe in Upper Body.*

Fig. 4.49 *Breathe in Middle Body.*

Fig. 4.50 *Breathe in Lower Body.*

B. Position and Practice

1. Lie down on your back. Elevate the knees with a pillow if you feel any pain in the small of the back or lumbar area.

2. Close the eyes and take a deep breath, expanding the stomach and chest without strain. (Fig. 4.45 and 4.46)

3. Exhale on the sound "***Heeeeeee***" (Fig. 4.47), made subvocally, as you picture and feel a large roller pressing out your breath, beginning at the top of the chest and ending at the lower abdomen. Imagine the chest and abdomen are as flat as a sheet of paper, and feel light, bright, and empty. (Figs. 4.48, 4.49, 4.50, 4.51 and 4.52) Rest by breathing normally. (Fig. 4.52)

4. Repeat 3 to 6 times, or more, if you are still wide awake. The Triple Warmer Sound also can be used to relax, without falling asleep, by lying on your side or sitting in a chair. (Fig. 4.53)

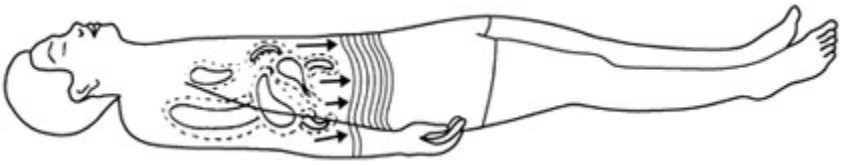

Fig. 4.51 *Breathe in everything.*

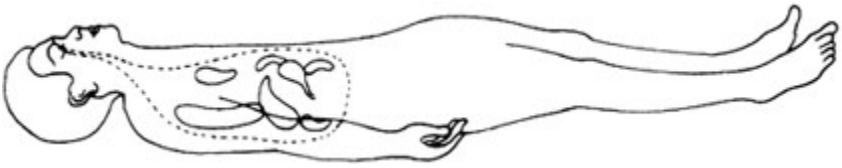

Fig. 4.52 *Rest by breathing normally.*

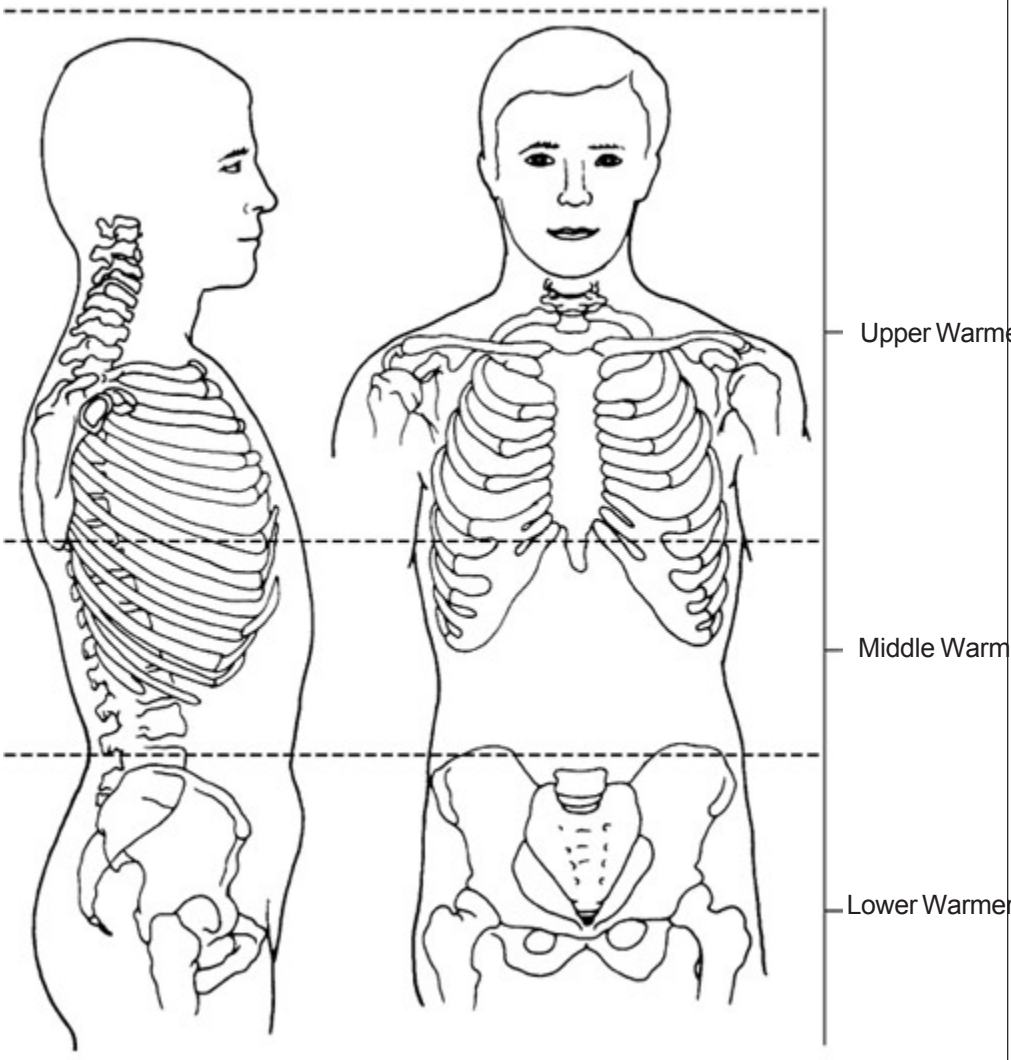

Fig. 4.53 *Triple Warmer*

X. Daily Use

A. Try to Practice the Six Healing Sounds Daily

Any time of the day is fine. It is especially effective at bedtime because it induces a deep, relaxing sleep. Once you have learned the procedure, it takes only 10-15 minutes.

B. Release the Heat after Vigorous Exercise

Do the Six Healing Sounds right after vigorous exercise, such as aerobics, jogging, martial arts, or after any type of yoga or meditation that creates a lot of heat in the upper warmer (the brain or the heart). This prevents the dangerous overheating of the organs that can otherwise occur. Do not take a cold shower right after vigorous exercise; it's too much of a shock to the organs.

C. Do the Sounds in Proper Sequence

1. Always do them in the proper sequence: Lung Sound (autumn), Kidney Sound (winter), Liver Sound (spring), Heart Sound (summer), Spleen Sound (Indian summer), Triple Warmer Sound.

2. If a particular organ or its accompanying symptom is bothering you, increase the number of times you do that individual sound without going through the whole sequence.

D. Season, Organ, and Sound

An organ works harder, and thus creates more heat, during the season in which it is dominant. Therefore, increase the number of times you do its exercise. For example, in spring do the Liver Sound 6 to 9 times while doing the other sounds 3 to 6 times.

If you are very pressed for time or very fatigued, only do the lung and kidney exercises.

E. Get in Touch During the Resting Period

The resting period in between each sound is very important. It is the time that you are becoming in touch with, and more aware of, the organs. Often times when you rest and smile into the organ, you can feel the exchange of the Chi energy in the organ, the hands and the legs. The head also feels the energy flow. Take as much time as you desire during the rest periods.

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Taoist Ways to Transform Stress into Vitality

Inner Smile • Six Healing Sounds

Mantak Chia

Profusely Illustrated by Juan Li

Western medical doctors have only recently discovered the disastrous effects on health of stressful living and their ways of coping with it are still in their infancy. They know nothing of the ancient, successful tradition of the Tao and its long record of transforming stress into vitality and power.

Here, in this book, the Taoist way is set forth and illustrated. The meditation technique of the Inner Smile teaches you how to get in touch with your inner organs, feel love for them and smile to them, so that stress and negative emotions are transformed into creativity, learning, healing and peak performance energy.

Here is also the Taoist way of the Six Healing Sounds, which help to cool down the systems, eliminate trapped energy, clean toxins out of the organs, and make it possible for organs to be in peak condition.

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Tao Yin

Exercises for Revitalization, Health and Longevity

Mantak Chia

Chapter VI: Set 1

Foundations: Conscious Breathing, Energy Balancing, Spine & Psoas Muscle Conditioning

Summary: The Practices learned in this chapter serve as a foundation to build on with the exercises in the succeeding chapters. First, Full Body Breathing serves to relax and calm the body so one can gain more benefit from doing the physical exercises. One develops the skill of conscious breathing, breathing with light, and learning to direct the subtle, electric breath throughout the body. This is a very important aspect of the practice during the passive resting phase between physical exertions and movements.

Structurally, special attention is given to conditioning and retraining the spine and psoas muscle – so important for the whole body. Energetically, one begins to balance the fire and water energies of the heart and kidneys, which has a dramatic impact on the psoas muscle (and vice versa). This energy balancing is accomplished through the combination of exercises, breathing and meditation.

Through these practices, one gradually develops their 'Yi' and trains the 'Second Brain' in the Tan Tien the control center in the lower abdomen.

Fig. 6.2.2 *River Flows into the Valley*

6.1 Full Body Breathing
6.2 River Flows into the Valley
6.3 Water Up and Fire Down
6.4 Lotus Meditation
6.5 Monkey Rests with Knees in Air
6.6 Crocodile Lifts Head
6.7 Monkey Clasps Knees
6.8 Monkey Pushes against Knees
6.9 Monkey 'Prays' with Elbows
6.10 Elbows Pray Counterpose: Clasp Knees
6.11 Twist Body like a Snake
6.12 Monkey Flaps Legs I and II

All the exercises in Set 1 begin in the lying-on-the-back posture.

Fig.6.0.1 Beginning Position: Lie on back with normal spinal curvature.

Full Body Breathing

The Tao Yin exercises always begin with the breath. Working with the breath is an integral part of the practice. The breath is a reliable guide for moving deeper into the body and deeper into the stretch. The breath is a bridge that connects the body with the mind and the mind with the spirit. Tao Yin is meditation-in-movement, integrating all of our separate parts into wholeness.

The control and coordination center in the body for smoothly integrating all of these bodily activities is the 'Second Brain' in the Tan Tien. Training this visceral brain – our 'gut' brain that feels and can achieve a high level of awareness – is a pleasant and very important part of Tao Yin practice.

1. First, bring the smiling sensation into the face, letting go of tension in the forehead and jaws, and bring softness to the skin throughout the face.
2. Direct this relaxed smile down to the heart and be aware of love, joy and happiness. Empty the mind and heart down to the Lower Tan Tien (abdomen from the navel down) to near the top of the pubic bone.
3. Keep the smiling sensation in the Lower Tan Tien and keep checking yourself to make sure that you maintain the relaxed smiling awareness there. This will help to coordinate the breath with the correct performance of the exercises.

Only when the breath is experienced as a fullness through the whole body do we begin the stretches. We begin with the breath because all the exercises in this book work with the combination of breath, movement, and flexibility. In general, the movement begins with the exhale and the resting period begins on the inhale. Be conscious of your breathing throughout the series of movements. Remind yourself to gently close your lips and to breathe in and out through the nose.

Normal breathing has no colors associated with it. We call this 'regular' breath. If you go to the forest and breathe this way, you take in 'unleaded regular,' a step up from city air, but still not the top. As you learn how to inhale golden light, you start to add 'super octane' fuel to your system. Smile to your lungs and visualize that you are connecting with smiling golden sunshine as you inhale, and draw the golden light into your body with your breath. This process helps to integrate the mind with the body.

When you exhale, visualize a cloudy gray color leaving the body. Be aware of your lungs and feel as if you were releasing all of the air from your lungs without tension. Visualize your lungs getting smaller and smaller.

When done regularly and correctly, this kind of breathing works to develop the psoas, diaphragm and abdominal muscles in a balanced way. Breathing in the golden color, you take in healing energy. As you exhale the cloudy gray color, you expel toxins and carbon dioxide. It is a very efficient way to release these substances. When you relax, you are able to release. When you are tense, you hold these toxins in your muscles and joints.

Fig.6.1.1 *Navel: Place your hands on your navel, the right hand on top of the left.*

1. **Navel:** Lie comfortably on your back, face-up, legs extended and slightly apart. Place your hands on your navel, the right hand on top of the left. Feel the weight of the palm resting on the belly. Take a few very deep breaths and relax. Smile down. As you inhale, expand the lower abdomen. Exhale, in a comfortable way, letting the abdomen relax. As you exhale, just let any negative energy flow out with your breath, imagining it to be a cloudy gray color.

   Continuing with your breathing: Inhale, expanding the navel area also. Exhale and relax. Exhaling the cloudy, gray color is a way to help eliminate toxins. When you inhale, breathe in a golden light, the color of “super octane” energy. Gradually extend the subtle breath so that the golden energy gathers in the area of your focused attention, behind the navel area under the hands. Continue breathing in this way for about a minute or so. Feel the golden light sink deeper with successive breaths. As you progress in your practice, you will sense the subtle breath very clearly.

Fig.6.1.2. Lower Abdomen: Continue breathing with your palms covering each side of the lower abdomen and your attention on the area beneath them.

2. **Lower Abdomen:** Move your palms down to the lower abdomen. Hands separated: right palm on right side, left palm on left side. Inhale, feeling the lower abdomen expand and exhale out the cloudy gray color, releasing any sickness or suppressed emotions. Inhale, visualizing the golden color entering the body as you fill the lower abdomen with energy. Continue breathing with your palms and your attention on the lower abdomen for about two minutes.

   Comment: Conscious breathing is very important because it is a way to eliminate toxins, tension and stress.

Fig.6.1.3 Upper Abdomen: Palms above the navel and below the ribcage.

3. **Upper Abdomen:** Cover the upper abdomen with your palms above the navel and below the ribcage. Take long, slow breaths, sinking the golden light deeply into the body. Exhale out the cloudy, gray substances. Feel calm and peaceful.

   Comment: These first three steps, Tan Tien breathing, are good to do anytime when you feel tired or depleted. It will help reduce tension and release toxins. Spend about ten minutes doing this Tan Tien breathing, and you will feel refreshed. The complete sequence of Full Body Breathing that follows is very beneficial, especially as a prelude to your Tao Yin practice.

   This conscious breathing is a much healthier habit than drinking a cup of coffee or smoking a cigarette! The nicotine and caffeine stimulate the adrenal glands, giving the impression that you are alert and refreshed. However, the benefits are short term and deplete the adrenal energy and the harmful effects accumulate. Instead, slow conscious breathing will energize and benefit the health of the body your entire life.

4. **Groin Area:** Put your palms on the groin area, inside the hips. Right hand on right side, left hand on left side. Spread your legs shoulder width apart. Be aware of the groin area and breathe to it. Eventually, you will feel the expansion and contraction of the groin. Release any tension you might be holding there. Tension can be held here because of sexual suppression. If it is very tight, or blocked, it is called the “Iron Gate.” Sexual tension, dissatisfaction and suppression are all held in this area. So, by breathing into this area, we allow it to open in an effective natural way. This is very simple breathing, but it is also very powerful. Feel the energy start to release in the sexual area and in the groin area. Let the tension release as cloudy gray color with each exhalation. Feel that you are exhaling down through the legs and out through the soles and toes. Inhale golden light. Continue breathing in this way.

Fig.6.1.4 Sacrum and Base of Skull: Bend your right knee up. Rotate your lower body a little to the left so you can comfortably put your right palm on your sacrum (tailbone).

5. **Sacrum and Base of Skull:** Bend your right knee up, placing your right foot flat on the floor. Rotate your lower body a little to the left so you can comfortably put your right palm on your sacrum (tailbone). Put your left palm at the base of the skull. Inhale fully and slowly, picturing the golden light in the whole spine. Exhale, gently squeezing out any cloudy gray color. Gradually feel the sacrum and base of the skull breathing, vibrating, contracting and moving without you doing anything. Just through the breath, you will eventually feel the movement there and the release of tension. These are sensations indicating that you are directing and conducting Chi – which is an essential aspect of Tao Yin.
6. **Lower Ribs:** Place your right palm on the left lower ribs and the left palm on your right lower ribs, crossing your arms and letting the diaphragm relax. Notice any pain or tension as you breathe. It's normal to feel some as you are releasing blockage. Feel the diaphragm moving up and down, the lungs moving up and down, the ribs moving in and out. Continue breathing with attention in your lower ribs.

Fig.6.1.5 Middle Chest: Place the palms on the sides of your ribs, the left palm under the right armpit and right palm under the left armpit.

7. **Middle Chest:** Move your hands up to the middle of your chest, crossing your arms. Place the palms on the sides of your ribs, the left palm under the right armpit and right palm under the left armpit. Feel the expansion of your lungs. Now as you inhale and exhale, imagine that you are also breathing through your palms – golden light in, the cloudy gray color out. Many people have problems in this area because of emo-

tional suppression, which can block the upper lungs and congest the chest. Inhale, and feel your palms on your ribs. Exhale the emotional tension out as a cloudy gray color. Inhale and extend your chest toward your palms. Exhale, gently squeezing your lungs smaller and smaller. Inhale and exhale with full attention on your breathing. Continue for about two minutes.

Fig.6.1.6 Upper Ribs: Your right palm covers the right side under the clavicle (the collar bone), and the left palm covers the left side.

8. **Upper Ribs:** Gently cover the upper ribs, at the top of the sternum with your hands. Your right palm covers the right side, the left palm covers the left side, under the clavicle (the collar bone). Breathe. Feel the expansion of your upper lungs. Inhale the golden color fully into your upper lungs. Exhale out the gray, cloudy color, feeling the breath move your ribs as you inhale and exhale, without effort.

Fig.6.1.7 Neck: Cover both sides of the neck gently with your palms: right side, left palm; left side, right palm.

9. **Sides of Neck:** Cover both sides of the neck gently with your palms: right side, left palm; left side, right palm. Feel the neck expanding and contracting. Be soft, flexible, and gentle. Breathe naturally. When you breathe well, you feel the energy, the Chi, moving from the bottom of your body to the top. Feel the subtle expansion and contraction of your neck as you breathe for a few minutes like this.

Fig.6.1.8 Temples: Left palm on the left temple bone, right palm on the right.

10. **Temple Bones:** Cover your temple bones with your palms – left palm on the left side, right palm on the right. Feel your temples breathe. Do not worry if it is difficult to sense it right away, just breathe naturally and soon you will feel them lightly expanding and contracting. Do not use any force – just let it happen. With close attention to your breathing and the contact of your hands on your temple bones, you will begin to feel the temples move very slightly with your breath. Breathe with full awareness.

Fig.6.1.9 Crown: Both hands gently on the top of the crown, sensing expansion and contraction.

11. **Crown:** Place both hands gently on the top of your crown, sensing expansion and contraction with each breath. Breathe in a steady stream of golden light, exhaling any cloudy gray color that may be left in your body. Bring total awareness to every breath as you feel your crown breathing.
12. **Balancing - Not Too Hot, Not Too Cold:** Relax, put your hands to your sides, breathing normally. Sense any part of your body that calls for your attention and breathe smiling golden light into that area. Now direct the Chi from your head down to the soles of your feet. Inhale, raising your hands very slowly toward your head, covering your face lightly with soft hands. Exhale and rub your hands down your throat, down your chest, down to your groin, and let the energy move down to your heels. Rest, inhale and exhale. Again, very slowly bringing your hands up, bring the Chi into you, down your face, down your neck and down your chest. Very slowly, guide it to your groin and to your heels and out, exhaling the cloudy gray color. Repeat this process several times. Feel your energy cooling, all the way down to your feet. The Tao is very concerned about balancing the energy, not too hot and not too cold. This is a good exercise to do before going to bed for a relaxed and deep, restful sleep. Repeat this several times and rest quietly, becoming aware of how you feel.

Note: *You don't have to do all of this breathing at once. You can break it up into segments. The effect of Conscious Chi Breathing is like breaking through ice, the frozen areas in the body. As the subtle Chi breath sinks deeper into the body, these tension areas begin to melt. With time, like ice in the warm sun, the frozen toxic/tension areas transform from ice into water, and from water into "Chi" gas – evaporating in the form of cloudy gray energy.*

Fig.6.2. Golden River and Valley (opposite page)**.** The 'energizing golden light' flows 'down the riverbed' (formed by the raised thoracic vertebrae of the spine) into the 'valley' (created by the lowered lumbars between the raised sacrum and thoracics). The conscious breathing process described in Full Body Breathing is used during the Tao Yin exercises. As shown in the following exercise, the golden life-giving energy is drawn in with the breath and,during the resting phase, the cloudy gray energy of released toxins and tensions flows down into Mother Earth where it is transformed. The energy is recycled up through the plants to help maintain a healthy balance in nature.

River Flows into the Valley

Meridian Activated: Yang: Bladder

Fig.6.2.1 Beginning Position:With knees up, move the coccyx, sacrum, lumbars and upper vertebrae are in normal position.

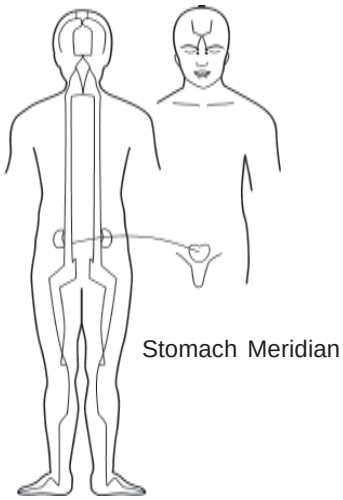

Please refer to the Appendix for descriptions of meridians mentioned in Chapters 6-10.

1. Lying face-up before the move, slide both feet up toward your buttocks, feet flat on the floor and knees up. Continue to breathe deeply.

Fig.6.2.2 Raised Position: The simultaneous lifting of the sacrum and the thoracic vertebrae as you press the lumbar vertebrae to the mat – combined with the exhale – creates the valley.

2. As you exhale, press your five lumbar vertebrae toward the mat, tilting your pelvis as you lift your sacrum gently. Do not move your head first (slightly tuck your chin to lock the neck) as you lift the upper body. Raise up from the lower thoracic vertebrae, letting the head follow in the arc of the crescent curvature created in the upper spine.

   The purpose of this controlled movement is to activate the psoas muscle. If you bring your head up too far, you contract the abdominal muscles excessively and cannot breathe well. In the theory of the Tao, we do not want the abdominal muscles too tight. If you bring your upper body up only slightly, you activate the psoas – not the abdominal muscles. The head only follows in this movement.
3. Inhale and relax, gently letting your 'lumbars' release and your sacrum return to the mat first, then the 'thoracics' one by one. Totally relax your spine and psoas. When you do it this way, the lumbar, hips, and sacrum are all moving. The resting period is very important. Rest and smile to the whole spine. Feel a stream of Chi flow from the head down the spine to the lumbars, psoas and to the sacrum/coccyx. Repeat this 3-6 times.
4. After the final movement, unbend your knees and take a longer rest. Do the conscious breathing to the areas affected by the movement, especially the lumbars and psoas muscle. Smile to an area and feel fully relaxed, drawing the smiling golden energizing light to it with your in-breath. Exhale the released tensions, toxins and tired energy in the form of cloudy gray color down through your legs and feet into a hole in the ground for Mother Earth to transform.

Comment: The *River Flows into the Valley* exercise is aptly named. When done correctly, you will understand with the mind, and you will 'get it' in your body. The simultaneous lifting of the sacrum and thoracic vertebrae as you press the lumbars to the mat while exhaling creates the valley below the abdomen in the area of the five lumbar vertebrae and the psoas.

Raising the upper body (the twelve thoracic vertebrae) forms the riverbed, and thus, the 'golden energizing light' flows 'down the river into the valley' from the head. The more you practice (a little every day), the more profound your realization of the river and valley and the energetic flow becomes.

This movement is fundamental to this set of Tao Yin exercises. Get this, and you will easily achieve results in the following positions. Let the river flow!

Water Up and Fire Down

Meridians Activated:
A. Yin: Kidney & Yang: Bladder
B. Yang: Stomach
C. Yin: Pericardium (Lao Gong Point)

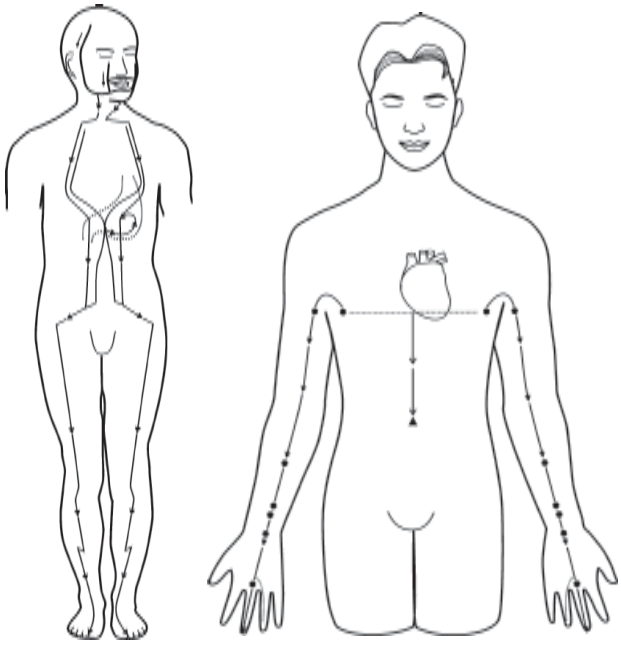

Stomach Meridian Pericardium Meridian

In Tao Yin, it is important to bring the excess heat from the heart down to the psoas muscle and kidneys. This relaxes and warms the psoas muscle and the lower back. From the bubbling spring point in the sole of each foot, you can raise the water energy up to the kidneys and up to the heart to nourish the fire or to cool excess heat. The psoas doesn't like cold. When it is cold, the muscle will contract and pull the spine towards the thigh. Cold and fear from the kidneys can affect the psoas, causing it to contract and thereby impact negatively on the body's condition. This exercise balances the fire and water elements in the body, creating harmony throughout the entire system.

Fig.6.3.1a Toes Flexed toward Head: Legs extended, gently flex toes back towards head activating the Bubbling Springs (Kidney Point, K-1).

Fig.6.3.1b
K-1 Point.

Part I: Activating the Bubbling Springs

1. **Inhale - Flex Toes Back:** Lie flat on your back, legs extended and slightly apart, arms at your sides. As you inhale, gently flex your toes back toward your head, feel like you are curving your toes back, and feel the soles of your feet stretch open. Feel a suction drawing the water energy up into your soles. Do this until you feel moderate tension in your calves.
2. **Hold - Feel Chi From Feet:** Be aware of the soles of the feet and feel some bubbling Chi rising up from the 'Bubbling Spring' points to the kidneys and onward, pouring into your heart.
3. **Exhale - Lumbars to Mat - Heat to Psoas:** As you exhale, relax your feet and sink your chest. Feel the heart sink down toward the spine and lightly press your lumbar toward the mat. Feel the excess heat from your pericardium and the heart flowing down through your spine to the psoas muscle and the kidneys, warming them up. The psoas will feel relaxed and expanded and fear will melt away from the kidneys.
4. **Rest - Heat in Psoas - Energy Pooling in Soles:** Rest. Smile to your psoas muscles. Be aware of how the psoas feels. The rest period is very important. Collect the energy. Feel the warmth and heat vibrating in the psoas muscles. Bring your attention to the soles of your feet and feel a pool of energy gathering there and rising up. Repeat a few times.

Part II: Activating the Lao Gong Pericardium Points

5. **Inhale - Flex Soles inward - Curl Toes in - Make Fist:** Inhale, flex your feet inward (sole toward sole) and curl your toes in. Close your hands into a fist and press into your palms with your middle fingers at the Lao Gong points, the pericardium points.

Fig.6.3.3a Toes Curled In: Flex your feet inward and curve your toes in. Make a fist and press your middle fingers into the Lao Gong points.

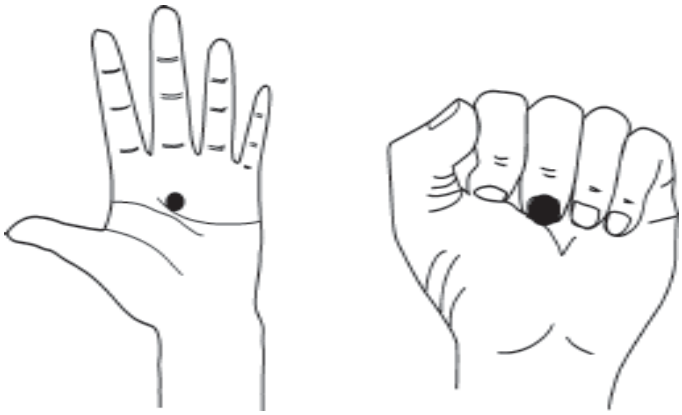

Fig 6.3.3b View of Lao Gong Point in hand.

6. **Exhale - Sink Chest to Spine - Lumbars to Mat - Heat Down:** Exhale, relaxing feet and fists and sink your chest. Feel the heart sink down toward the spine and lightly press your lumbars toward the mat. Feel the heat from the hands flow up the arms and shoulders to the spine at T5-T6 between the scapulas. At the same time, also feel the heat from the heart/pericardium flow down to your spine at T5-T6. Feel the combined heat flow down the spine to the psoas muscles and kidneys and finally to the soles of your feet. Feel your psoas muscles nice and warm, releasing any contractions and energize the lower back. Do this a few more times.
7. **Rest:** Smile and enjoy the full sensation of your body.

This could be a good time to enjoy a few minutes of the ***Lotus Meditation***.

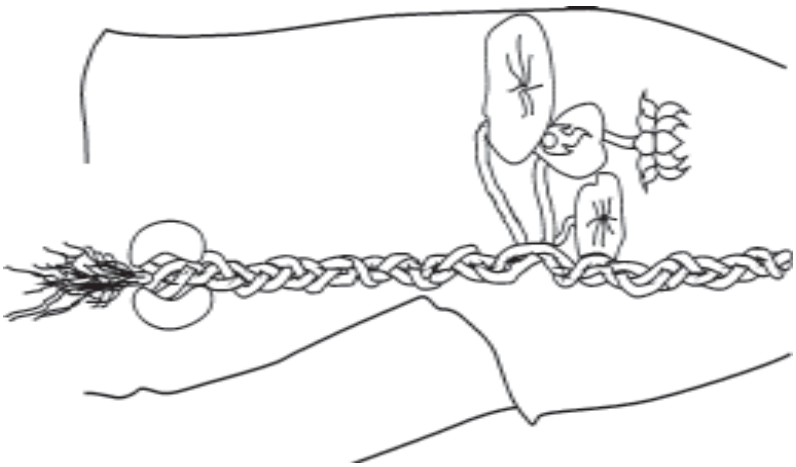

Fig 6.4.1 Lotus Meditation – Balancing the kidney and heart energy is vital to self healing.

Lotus Meditation

The Lotus meditation can be used during Tao Yin practice, and is especially useful during the rest periods between the movements. You can use the Lotus Meditation or Full Body breathing in any rest period. Choose the places that best suit you.

This meditation helps to achieve the balance of kidney and heart energy which is a vital part of self-healing. The balanced flow of water and fire energy will greatly help to transform the accumulated stress in the mind and body into a sense of well being.

Lotus/Heart/Kidney Energy Dreamscape (Opposite page). Imagine the heart as a red lotus flower and the pericardium (the heat-regulating membrane which encloses the heart) as the lotus pads. Visualize the kidneys as being bulbs, similar to the clusters or plexuses where the stems of the pads and the lotus flower join together. In a pond or pool there are usually several lotus plants that join together in a cluster, anchoring in the mud. From the kidneys (kidney bulbs/clusters), visualize roots extending down through the legs into the watery mud of the earth basin.

Through this dreamscape imagery of the body and the lotus merging in nature, sense these qualities of energy in your body. Feel the supporting connection with the same qualities of red and golden energy coming to us from the sun and the universe above, as well as that of the blue water energy coming from the earth and nature. Feel the warm red energy of the heart and the red and yellow/gold from above. Likewise, sense the cool, blue water energy of the kidneys and the refreshing blue water energy from the earth.

Lotus Energy Meditation:

1. **Breathe to the Tan Tien, and consider the lovely blooming lotus:** You can see the open flower, seeing it as red with yellow/gold petals in the center.
2. **Look at the pads, stem and roots:** The leaves float on the water's surface. See the stem as it descends from the bloom to the roots mired in the mud. Feel the roots sinking into the bed of the pond. The roots receive just the correct amount of nutrition from the wet earth.
3. **Sense the harmony of fire and water:** The pads and flower open to the sun and universe to soak up the life-sustaining rays. The sun is the source of fire energy. The earth holds the necessary water. Appreciate this life-giving harmony of the forces of fire and water, yang and yin, male and female.
4. **Connect images with your heart and kidneys:** As you continue with the Tan Tien breath, expanding and contracting, look inside to your heart and kidneys. The kidneys are the roots accessing water. The heart is the open lotus taking in the sun's

fiery gift. The spine is the healthy and supple stem connecting the two energies.

5. **Inhale to the heart and exhale to the kidneys:** Coordinate the Tan Tien breathing: Inhale into the heart, drawing the warmth from the sun, feeling it come down through the crown of the head and blend it with the love, joy and happiness in the red heart/ lotus. Draw this loving, hot heart energy back to the point opposite the heart center on the spine (the wing point between the scapulas, between T5 & T6) as you slowly inhale. Then exhale the hot energy down the lotus stem/spine to the cool kidneys, warming them with the loving heat from the heart. You may enhance the emotional balancing effect by subvocally exhaling with the heart sound, Hawwwww, (from the Cosmic Healing Sounds meditation) as you mentally direct the heart energy down the spine.
6. **Alternating, inhale into the kidneys and exhale up to the heart:** See the kidneys as the nourishing bulbs of the lotus with roots that extend down through the legs and soles of the feet into the mud, accessing the soothing blue water energy held by the earth. As you inhale to the kidneys, feel that the roots are drawing the cool, soothing, nourishing blue water energy up through the soles of the feet, up through the legs to the kidneys. In the kidneys, feel the gentle calm, peaceful feeling blending with the cool, soothing blue water energy that has percolated up through the legs. As you exhale, you may subvocally express the kidney sound, Chooooo, and send this soothing boost of gentle, cooling wet blue kidney energy up through the supple stem/ spine via the wing point to the grateful, happy heart.
7. **Continue alternating the breath this way for a few times:** Red light from the crown into the heart and down to the kidneys; blue light from the bubbling springs into the kidneys and up to the heart.
8. **Then, just relax and don't bother about the breath:** Simply move the smiling mind back and forth between the heart and kidneys along the connecting spinal stem. The balancing will automatically occur. Smile to the lotus perfection and beauty. Smile with gratitude to your kidneys, spine and heart. The lotus meditation is very calming, and naturally, the more it is used, the easier it is to realize this inner calm.

Monkey Rests with Knees in Air

Meridians Activated: Yin: Legs – Spleen, Kidney & Liver

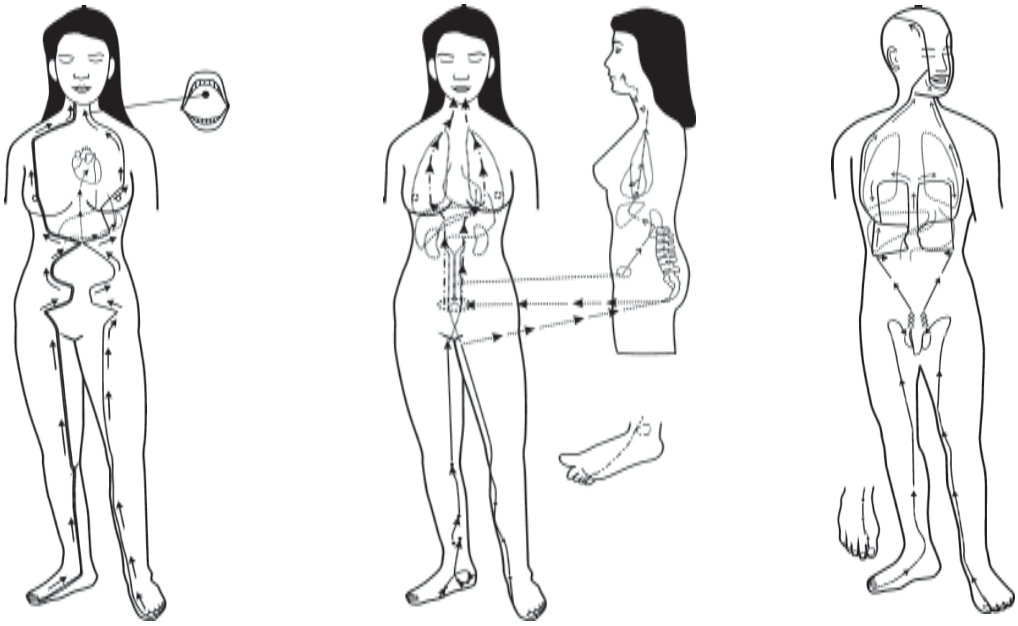

Spleen Meridian Kidney Meridian Liver Meridian

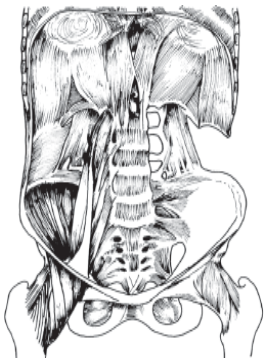

Fig.6.5.1 Hands Below Knees: Knees toward chest, hands on inside of knees, let knees part and stretch psoas muscle evenly on both sides.

1. Bring the knees up toward your chest, allowing the feet to hang in the air. Place your hands on the inside of the knees. Spread your legs evenly apart, then let gravity pull the knees apart so you start to feel the stretch of the psoas muscle evenly on both sides.
2. The most important part of this exercise is the breathing. First inhale. Then exhale the heat from the heart down to your psoas muscle and to the iliopsoas muscle that connects to the thigh on the inside of your groin. As you feel the muscles, breathe gently into them to release any tension that may be stored there. Breathe through the tension and relax, making sure both sides are even.

Fig.6.5.2 Hold Ankles: Move hands to ankles. Repeat stretch. Exhale heat from the heart down to psoas muscle connecting on inside of groin.

3. As you become comfortable in the position, repeat the movement, extending your arms down further so you hold your legs inside the shin – and eventually inside your ankles. Each time you assume the position, breathe into the muscles, exhaling any gray, cloudy energy and inhaling the golden light. Smile and enjoy the sensations.

Crocodile Lifts Head

Meridian Activated: Yang: Bladder

The most important part of this practice is not to lift up the head first, but to raise up from the lower thoracic vertebrae. The Crocodile cannot lift up the head alone without the lower body.

Fig.6.6.1 Begin: Bring left knee up toward chest, clasp both hands over knee. Right leg extended.

1. Inhale, bring your left knee up toward your chest and clasp both hands over your knee. Allow your right leg to extend straight along the floor (or you may choose to bend up at the knee somewhat to be more comfortable during the lift). You will not want to apply any force, such as pulling on the knee. Just hold the knee in a relaxed way.

Fig.6.6.2 Exhale Up: Tuck chin slightly, press lumbars onto mat and raise sacrum. Simultaneously lift spine from T-12 up the thoracics, then slightly relax head towards knee.

2. *Exhale, hold your head still by slightly tucking the chin to lock the neck,* press the lumbars down onto the mat and raise the sacrum. As the lumbar area presses down onto the mat and the sacrum rises slightly, lift up from the low back (thoracic vertebra T-12 and upper lumbar L-1 area) toward your knee. Feel a slight crescent curvature created along the upward vertebrae to the head, bringing the head closer to the knee.*
3. Bring head as close to knee as is comfortable. Maintain smiling sensation in Tan Tien, keeping abdominal muscles relaxed. Do not try to kiss the knee; there are no bonus points for even getting close to the knee – in fact, don't! Come only as close to the knee as the vertebral crescent brings you. Do not stick the head out or lead with the head! Maintain awareness of the smiling sensation in your 'second brain' in your Tan Tien, and keep the abdominal muscles as relaxed as possible. Keep your lumbar region pressed toward the floor, and feel your sacrum raised slightly off the mat. Hold that position for a few seconds.
4. Inhale and come down gently, feeling the thoracic vertebrae touch down one by one, softly maintaining flexibility.
5. Rest and smile down to the psoas muscles, which were activated in the lift. Do a few repetitions, repeat on the other side.

***To help the head not to lead, try the following:** Tuck the chin back slightly so that you can feel the neck muscles tighten a bit. Now the cervical vertebrae are 'locked' in place and the head cannot initiate movement, but only follow. Be careful not to create tension in the neck. Tuck the chin back, but not too much and not too little. After attaining the fully raised position, it is then OK to move the head a little more in order to release tension from the back of the neck and be more relaxed.

Monkey Clasps Knees

Meridian Activated: Yang: Bladder

Fig.6.7.1 Beginning Position: Bend and raise both legs, clasp hands over knees. Press lumbars down allowing sacrum and thoracics to rise, chin tucked in.

1. **Relax legs - raise sacrum and thoracics:** Raise both legs, clasping your hands over your knees. Exhale, press the lumbar area down onto the mat and allow the sacrum and thoracic vertebrae to raise off the floor. Tuck the chin slightly to avoid leading with the head as your body lifts up off the mat with the lumbars pressed down.
2. **After raising up off mat, then press knees up. Maintain Psoas Awareness:** Press your knees upward against the counter force of your hands and arms to activate the psoas – while you continue to press the lumbar area of the spine into the mat.

Fig.6.7.2 Knees Extended Counterforce: Press knees upward against hands and activate psoas and iliopsoas, **not** raising thoracics, neck or head further.

3. **Do not raise head and upper body any further:** Psoas and iliopsoas muscles activated, remember to maintain awareness of the smiling sensation in your Tan Tien, and check that your abdominal muscles are relatively relaxed. If you raise your head and the upper body, you are not doing the exercise properly. Feel your lumbar region pressing into the mat as you raise your sacrum and thoracics slightly. Notice your iliopsoas and psoas muscles as you do this exercise (awareness grows with practice). Hold without straining for several seconds.
4. **Release: Rest.** Release as you inhale. Rest and relax. Repeat several times.

Monkey Pushes against Knees

Wind Point Activates Heart & Small Intestine

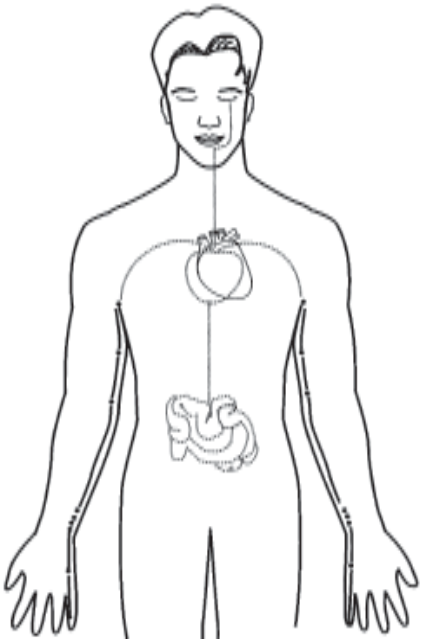

Heart Meridian

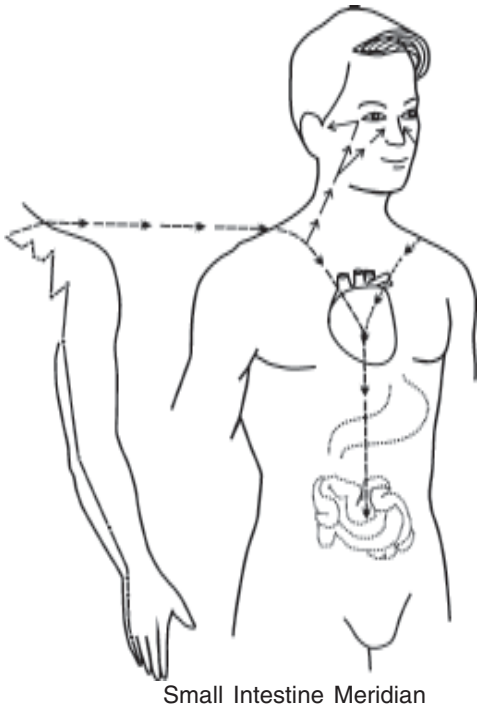

Small Intestine Meridian

In the following exercise, you will be clenching your teeth and pressing the tip of your tongue on the roof of your mouth behind the teeth. There is an important connection between the teeth, tongue, heart and the psoas muscle. By clenching your teeth and pressing your tongue on the roof of your mouth, you are increasing the power that can be generated by the psoas muscle. This will also help activate the cranial pump; it is an internal power process.

Fig.6.8.1 *Press Tongue on Roof behind Teeth.*

1. ***Get Ready:*** *Bring both knees toward the chest, letting the feet dangle in the air above your buttocks. Rest both hands on the upper knees. Clench your teeth a little and press the tip of the tongue to the roof of your mouth behind the teeth to give you the internal power.*

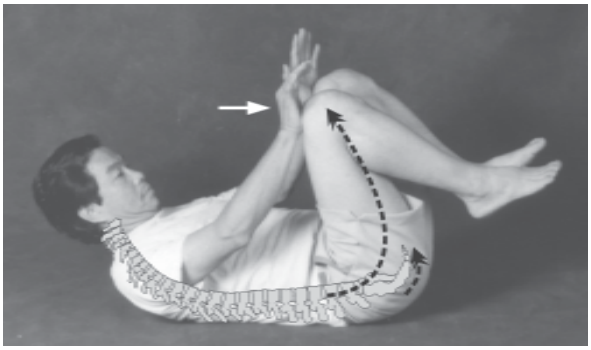

Fig.6.8.2 Shoulders Raised from T6 Opposite Heart: Press lumbars and T7 - 12 onto mat; raise sacrum, shoulders and tucked chin. Press knees against hands counterforces. Connect tongue, heart, T6 and heels of hands.

2. **Raise Up from T6:** Initiate the movement from your lumbar area: Exhale and, using your lower back muscles (specifically the psoas), press the lumbars into the mat and raise the sacrum off the mat slightly. Raise the thoracic vertebrae only from the T6 vertebra (known structurally as the Wing Point between the scapula bones – also known as the Wind Point for the Heart Meridian). This will allow the shoulders to be raised slightly off the floor. Keep the chin tucked and the lower thoracics from T7—T12 pressed onto the mat along with the lumbars.
3. **Elbows Locked, Connect Tongue, Heart, T6 and Hands:** Press the knees against your hands and press the hands against the knees, balancing the counter forces. Keep your elbows locked so that the force directed through the arms comes from the Wind Point at T6 (opposite the heart center in the front) through the scapulas and shoulders. Also, feel the connection of force from the tongue to heart and T6.
4. **Inhale and Relax:** Smile and feel Chi moving through your lower back and the psoas muscle. Repeat this exercise several times. Finally, lower the legs to the mat and do conscious breathing as you rest.

Comment: Do not press from the knees with the muscle power of the legs. Instead, transfer the power from the lower lumbars and the psoas muscles through your structure. This is very important. By generating the force for the movement from your lumbar region and transferring the force through the activated psoas muscles to the thigh bones and thence to the knees, resisting with your hands strengthens the psoas muscles. The lumbar vertebrae open into a straight line as the lower spine straightens (instead of being clumped together as in the normal curvature). Thus, the lumbar force can be effectively directed through to the thigh bones to the knees.

If you do these exercises properly, you will be able to do Tai Chi and all of the other exercises more effectively, generating the movement from the psoas and lumbar region.

Monkey 'Prays' with Elbows

Fig.6.9.1 Bend both knees toward chest. Place elbows so they touch the insides of the knees. Straighten arms and put palms together.

1. **Begin - Elbows between Knees:** Keeping your back on the mat, bring both knees toward your chest, letting the feet dangle in the air above your buttocks again. Place your elbows so that they touch the insides of the knees. Now straighten your arms up, putting the palms together. Be sure the exercise starts from the lumbar area, initiating the movement from the lower back, psoas and iliopsoas muscles – not from the knees or leg muscles.

Fig.6.9.2 Clench teeth gently, press tongue to roof of mouth. Press lumbars down, raise sacrum and thoracics, and then press the knees together while resisting with arms – elbows push out and knees push in.

2. **Tongue Press, Raise Up - Knees and Elbows Counter Push:** Clench your teeth and press the tip of your tongue to the roof of the mouth. Exhale, press the lumbars down, raise the sacrum and raise the body up from T12. Then, press your legs together while you resist with your arms.

   Keep your belly muscles relatively soft and relaxed. Your elbows push out, and your knees push in. Find the muscles that move your legs in and be sure you use the lumbar region to push your legs together, not the leg muscles. Don't forget your smile in the Tan Tien!
3. **Repeat then rest:** Inhale, lowering the body slowly, and relax. Repeat several times, then lower the legs and do conscious breathing. Smile and experience the sensation in the back, especially the psoas muscle. Breathe all the way down to the soles of your feet, exhaling the cloudy gray color. Inhale the golden light to the areas you feel affected. When you breathe, you are conducting the Chi, bringing the nutrients and energy to the psoas muscles.

Comment: Your mind and Tan Tien awareness (training the second brain) will become more attuned with practice. You will be able to easily direct the force through your structure from the lumbars and psoas to the knees. At the start, you may experience very little resistance when you do this because the muscles need strengthening to move in this way.

Elbows Pray Counterpose: Clasp Knees

Except for the position of the arms and the the direction of the counterforces, this exercise is similar to *Monkey 'Prays' with Elbows.*

1. **Begin: Arms clasp knees:** The knees are raised toward the chest and separated as in 'Monkey Prays.' Arms clasp knees so that the bends of the elbows fit comfortably around the knees.
2. **Knees press out, arms in:** Clench teeth, press tongue, raise up, transfer force from lumbars to knees. Knees press out, and arms hold an inward counterforce.
3. **Repeat and rest:** Same as 'Monkey Prays.'

Twist Body like a Snake

Meridian Activated: Yang: Gall Bladder

Fig.6.11.1 Upper Body Left & Lower Body Right:
Extend left arm to left side, palm up. Put right hand on left side of Tan Tien.
Knees bent, fall to the right. Turn head to left, shoulders remaining on mat.

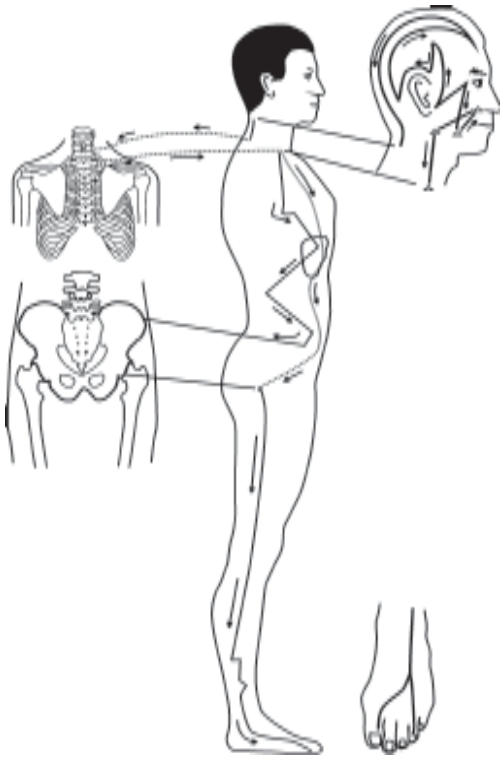

1. **Knees Right:** Lying on your back, bring both knees up and place your feet flat on the mat. Very slowly, let your knees fall to the right, coming as close to the mat as possible without strain. Extend your left arm out to the left side, palm up; put the right hand on the left side of the Tan Tien. Turn your head gently to the left, leaving both shoulders on the floor.
2. **Hold and Breathe Left:** Rest smile and breathe in this position. Breathe with your attention on your left side, inhaling golden energizing light and exhaling a cloudy gray color. Focus on expanding and elongating this area. Remain in this position for a few minutes, breathing with full awareness into your left rib cage, abdomen, lumbar region, hip joint, shoulders and neck. Smile and send positive energy into the spine.
3. **Center:** Bring your knees and head back to center and notice what your body is feeling.

Fig.6.11.2 Upper Right, Knees Left: Repeat on right side.
Hold posture and breathe to elongate right side.

4. **Knees Left:** Very slowly move both knees to the left until they come close to or touch the mat. Turn your head to the right. Extend the right arm out and place the left hand on the right side of the Tan Tien.
5. **Hold And Breathe Right:** Breathe fully into the right side for a few minutes, allowing the elongation and expansion of your right side. Do it in the same manner as you did above for the left side.
6. **Center:** Bring your knees and head back to the center position and relax. Be aware of your body as you rest on the mat.
7. **Rest:** Lower your legs to the mat and rest comfortably on your back. Relax and smile into the body.

Monkey Flaps Legs

Meridians Activated: Yin of Legs – Spleen, Kidney & Liver

Fig.6.12.1: Lift knees up, place soles of feet together and hold them with hands. Spread knees apart and lightly move knees back and forth.

1. **Loosening the Psoas Muscle:** Lie on your back, lift your knees up, put the soles of your feet together and hold them together with your hands (if you are unable to reach your feet, you can grasp higher up on the leg). Spread your knees apart and lightly move the legs gently back and forth. Feel the stretch in the groin area. Do not bounce too vigorously, just gentle flapping.
2. **Flap Knees Up and Down:** Place the arms a little out to the sides with palms down. Place legs on floor with soles of feet together and lumbars flat on mat. Move the knees up and down. Relax.

Fig.6.12.2 Feet together, arms out, flap legs.

3. **Rest:** Smile and breathe into your groin. Relax your legs.
4. **Comnent:** Eventually you may be able to comfortably lower your knees closer to the mat with the soles of the feet together without needing to use your hands. Place the arms out to the sides with palms down. Perform the exercise and rest as above.

Chi Self Massage

by Master Mantak Chia

Healing Hand

Humans can build all kinds of sophisticated instruments because of the magnificence of the hands and the fingers. Another higher function of the hands is the power of healing. Knowing the major points of the hands and fingers will enable you to stimulate and maintain the organs in good function.

I. Palms

The palms are where all major energies of Chi join. The palm can be the place from which the life-force is sent out to heal others or yourself. The palm also is the place where energy can be received and enter into the bone structure and into the major organs.

II. Pericardium

The pericardium (P-8) is the main place of energy concentration. You can collect the energy in this point and transmit stronger energy from this point. (Fig. 3.1)

III. Large Intestine

The large intestine (LI-4) is the major point which controls all the pain in the body, especially in the sense organs (eyes, ears, nose) and headaches. (Fig. 3.2)

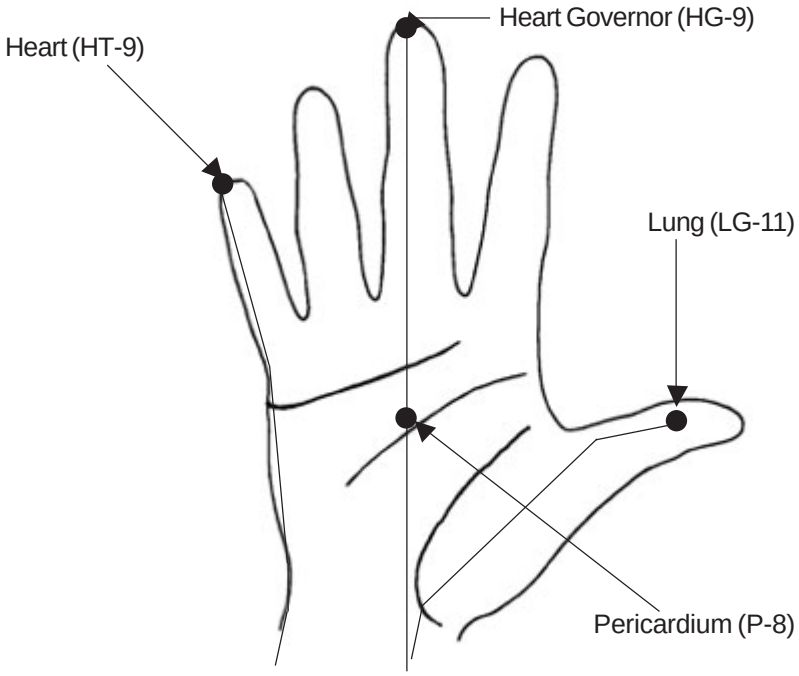

Fig. 3.1 *Pericardium*

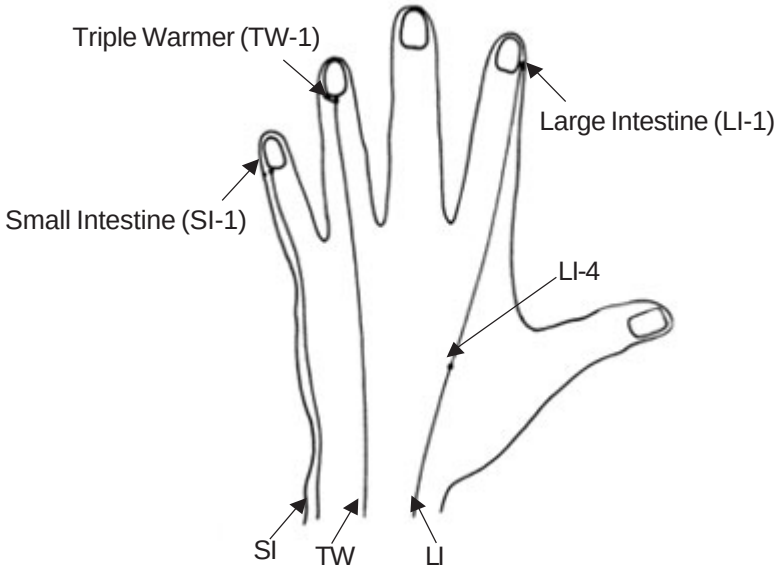

Fig. 3.2 *Large Intestine*

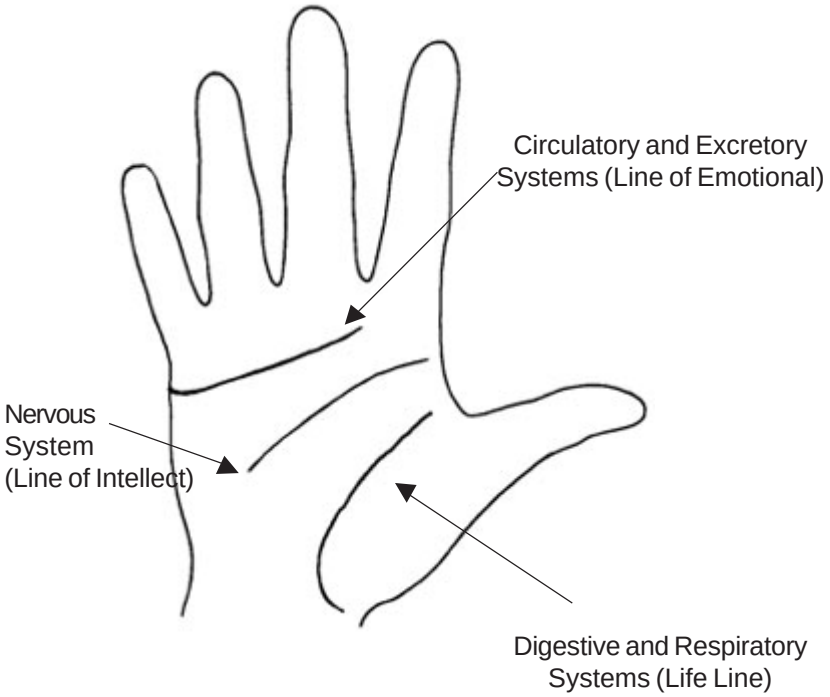

Fig 3.3 *Three Major Palm Lines*

IV. Major Palm Lines

The three major palm lines are the Life Line, the Line of Intellect and the Line of Emotion. (Fig. 3.3)

V. Fingers have corresponding Bodily Functions

The fingers are connected to the organs' meridians. (Fig. 3.4) The joints of the finger bones are also related to parts of the organs and their corresponding senses and emotions.

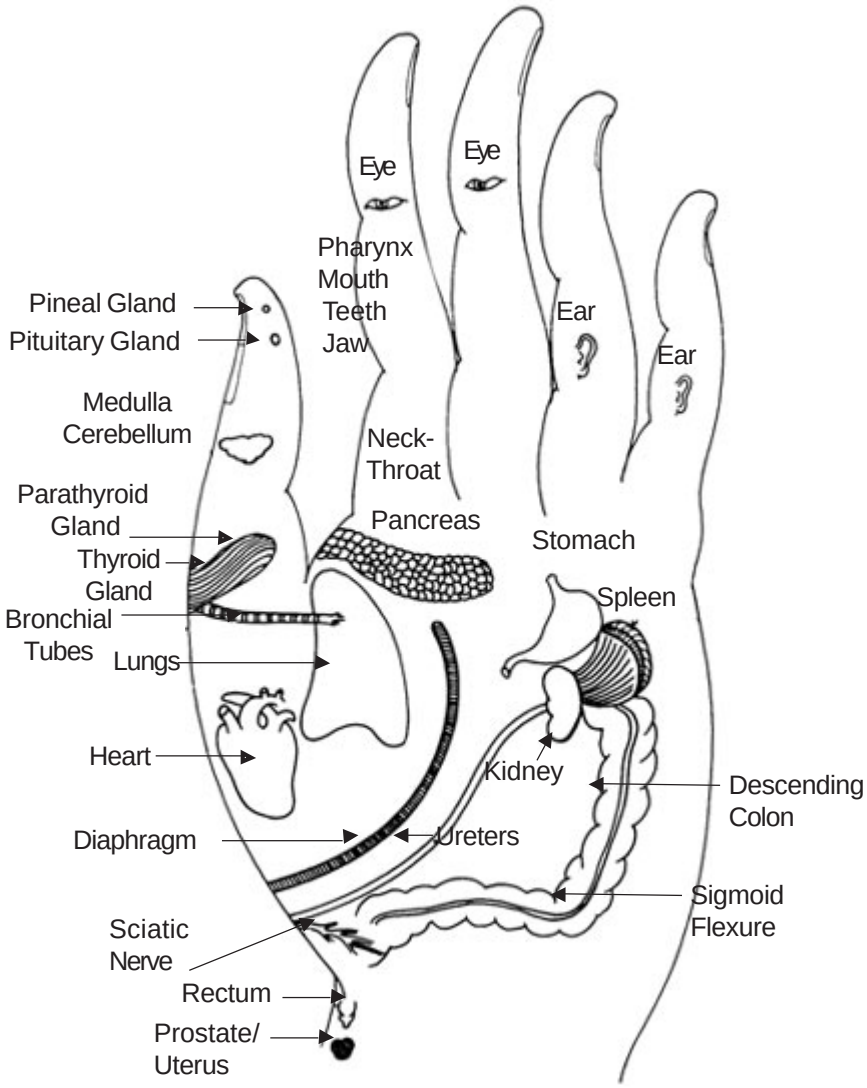

Fig. 3.4 *Fingers and Their Corresponding Bodily Functions Through the Organs' Meridians.*

VI. Strengthen the Extremities

Strengthening the ends of the extremities will help to stimulate the organs. The tips of the fingers have many tiny veins and arteries. (Fig. 3.5) When we get old and do not exercise enough the Chi does not flow well and its circulation becomes stuck. This can affect blood circulation, and the veins and arteries will become hardened. When we feel cool, the first places to feel cool are the hands. If you want to warm up quickly, you have to warm up the hands and feet first.

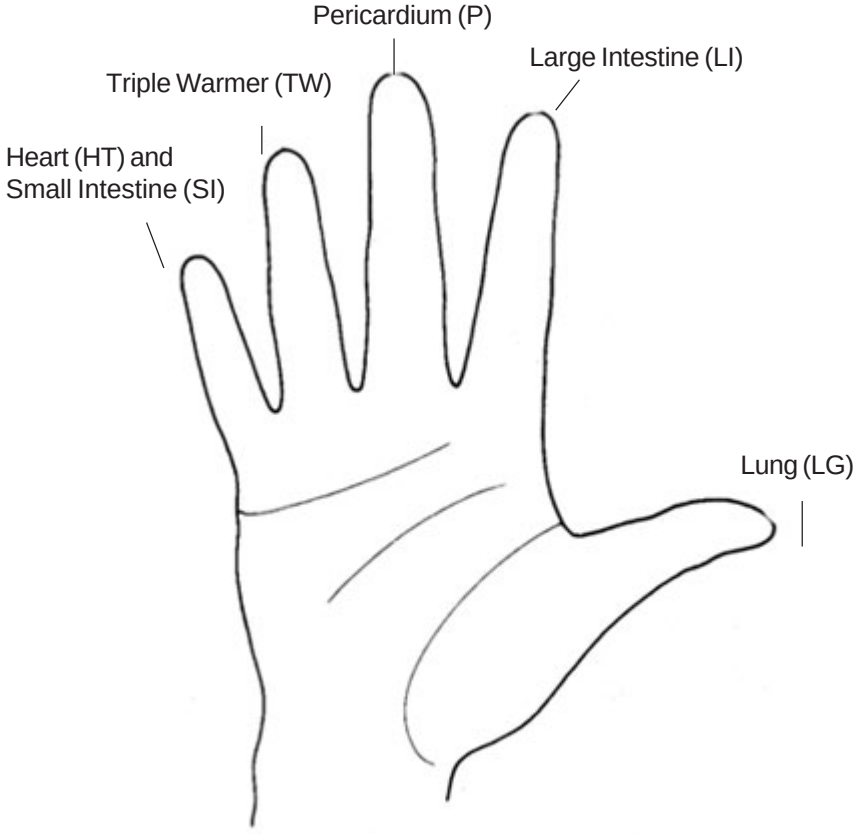

Fig. 3.5 *Strengthening the ends of the extremities will help to stimulate the organ.*

VII. Massage the Hands to increase the Flow of Chi.

Massaging the hands and palms will help to increase the flow of Chi along the related meridians and will result in a harmonious increase of the functions of respiration, circulation and digestion.

VIII. Preparation

A. Wait at least an hour after eating.

B. Try this practice immediately after doing the Inner Smile or Six Healing Sounds, *For the best results, if you have already learned the Microcosmic Orbit or Fusion Meditations, try this technique after practicing these as well.

C. Sit comfortably on your sitting bones at the edge of a chair. Make sure that your legs are grounded.

D. In general, massage each area six to nine times. Massage problem areas more.

E. Those people who cannot get out of bed can practice the routine there.

For a complete exposition of the Inner Smile and the Six Healing Sounds, see the author's preceding book, T*aoist Way to Transform Stress Into Vitality.*

IX. Practice

A. Bring Chi energy to the hands. (Fig. 3.6)

1. Inhale, contract your vagina or testicles, your buttocks, and also the part of the anus which is named—that is, the front, back, right, left, middle, or entire anus. At first you may not be sensitive to these distinctions, but eventually you will be. In general, the part of the anus which is contracted corresponds to the location of the area to be massaged. For example, you contract the left side of the anus when massaging the left lung.

2. Hold your breath and hold the contractions, clench your teeth together, and press your tongue to the roof of your mouth, as you rub your hands together vigorously. This stimulates the twelve meridians in the hands.

3. Continue to rub your hands while holding your breath and contracting your anus. Feel your face getting hot. Then, mentally picture energy flowing to your hands.

4. When your face and hands are hot, direct your attention to the appropriate area and massage that part until you are out of breath. Exhale and breathe normally. Smile and become aware of the part that is being massaged. Feel that the area is exceptionally warm and that energies are flowing.

5. Repeat this entire procedure for each area to be massaged or whenever your hands become cool. Your hands must always be very warm for self-massage. Cold hands will have very little effect on the massage.

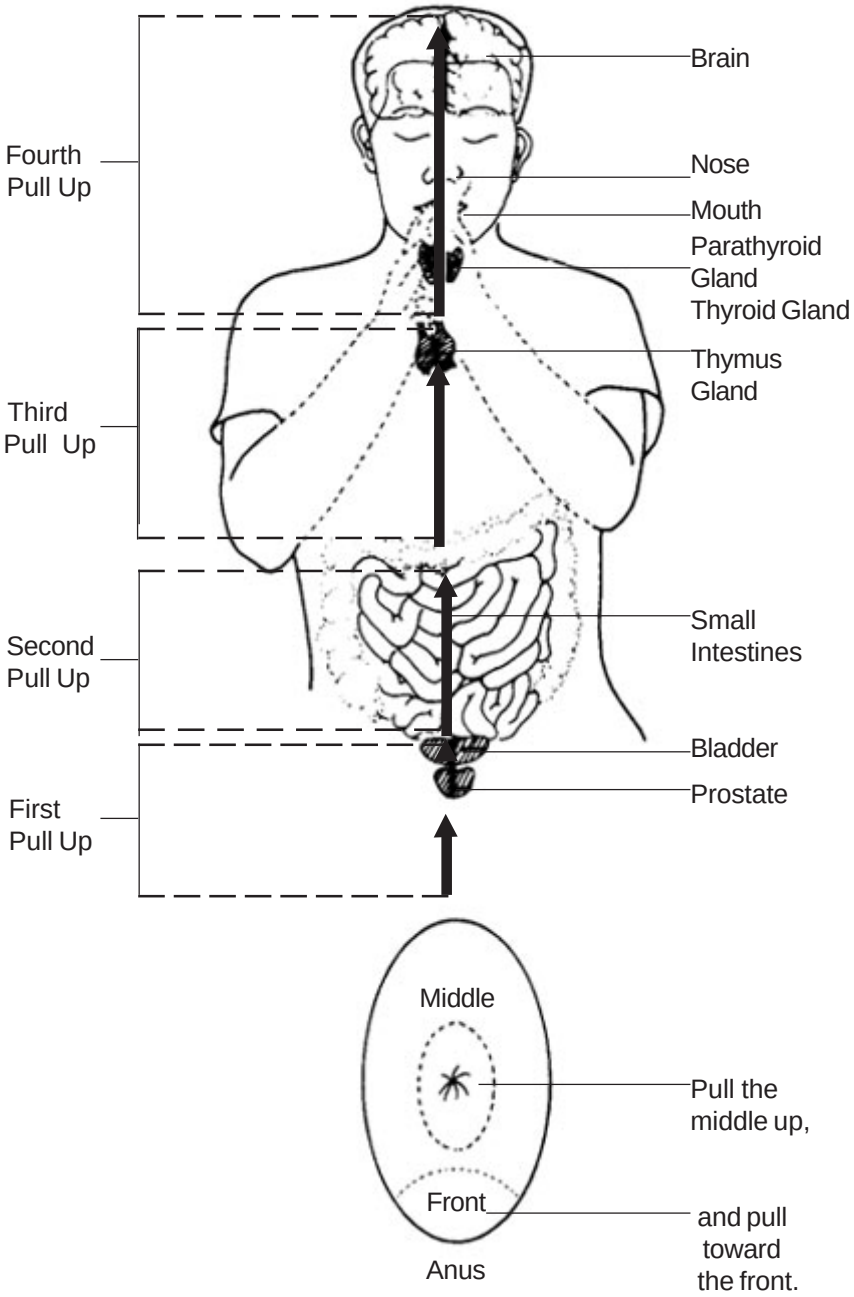

Fig. 3.6 *Bringing Chi Energy to the Hands.*

B. Massage the hands.

Always start by rubbing your hands until they are warm.

1. Massage the pericardium (P-8). Use the thumb to press the middle of the palm with a circular motion. (Fig. 3.7)

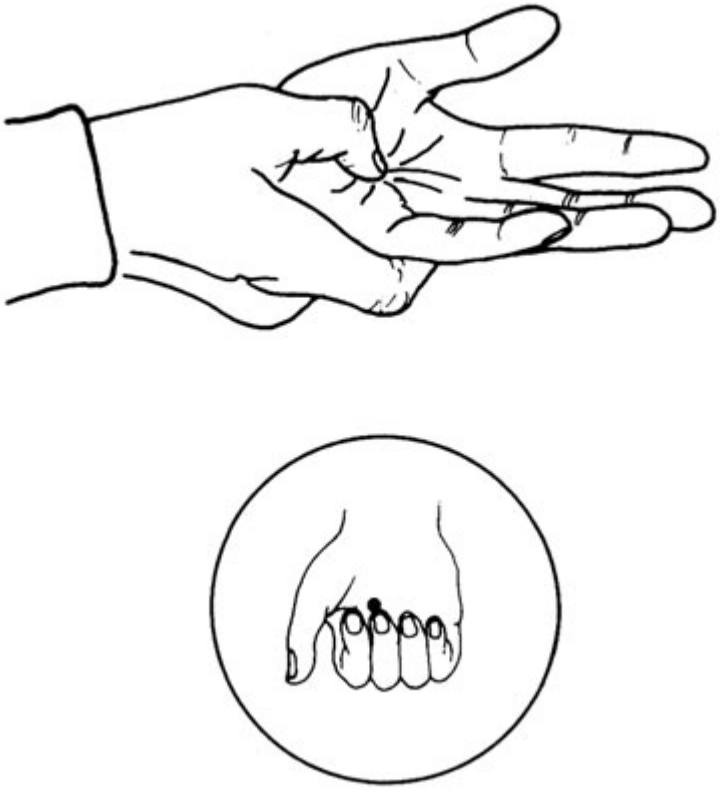

Fig. 3.7 *Massaging the Pericardium with fingers cupped in the palm in a half-fist, the pericardium is the point at the tip of the middle finger.*

2. Massage the hegu (LI-14). Press the thumb around the point in a circular motion, and press more at the index finger bone. Find the pain point and massage it away. (Fig. 3.8)

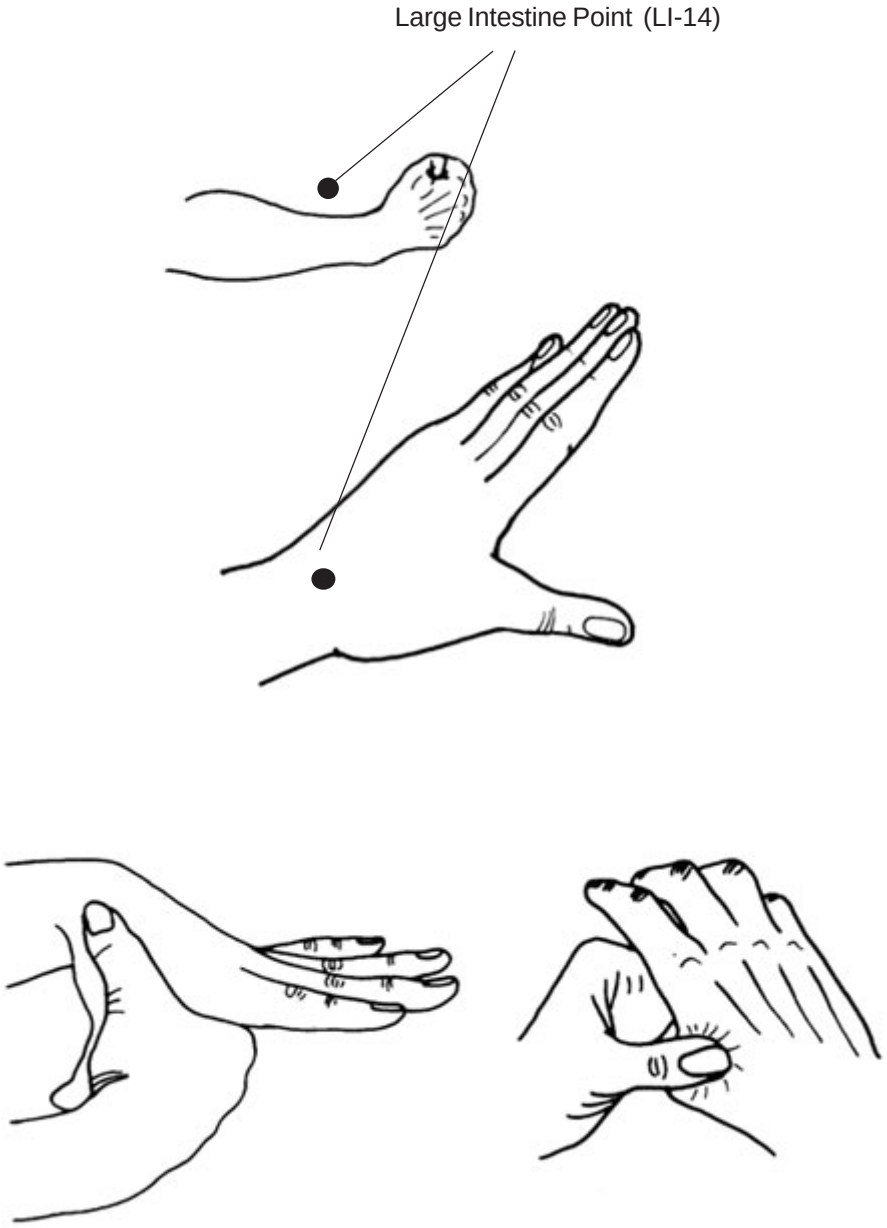

Fig.3.8 *Massaging LI-14.*

3. Massage the major palm lines. Use the thumb to massage along the palm lines. Massage more towards the thumb bone and along that bone. When a lot of emotion is held inside, find the sore point and massage it. (Fig. 3.9)

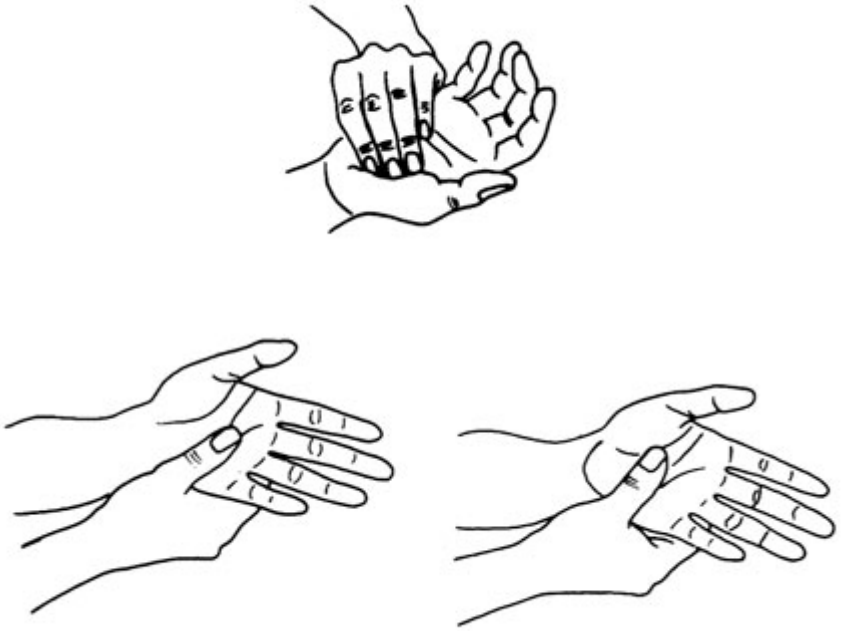

Fig. 3.9 *Massaging the Palm Lines.*

4. Massage the back of the hand. Use the thumb to press along the bones on the back of the hand. When you find a tender spot, take more time to work on it. (Figure 3-10)

5. Massage the fingers. Always rub your hands until warm. Use the right hand's fingers to wrap around the left thumb, and then, one by one, squeeze, hold and release each finger on the left hand three to six times. Start with the left hand and continue to the right hand's fingers, according to the elements of the finger. This will greatly help to control emotions. (Figure 3-11)

Fig. 3.10 *Massage the back of the hand.*

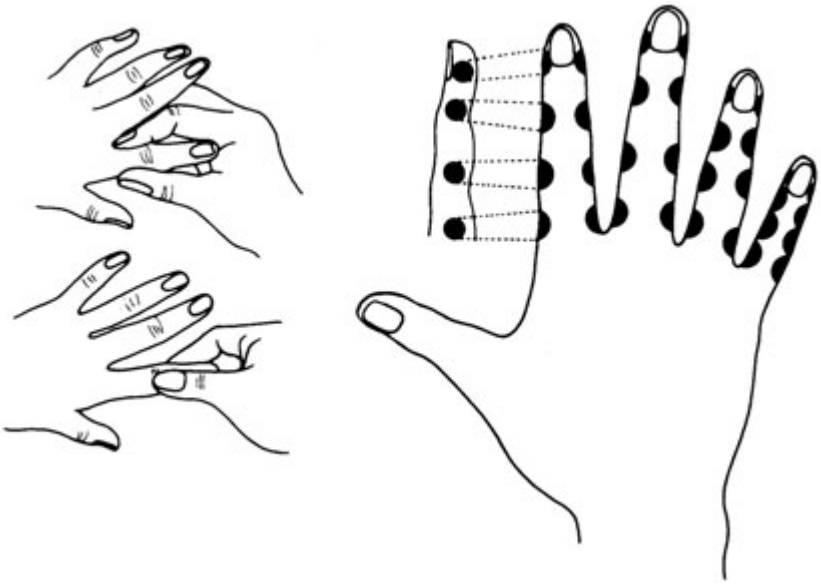

Fig. 3.11 *Massage the fingers.*

For example, if at any time you are frightened or fearful, you can wrap your fingers around the little finger, starting with the left side and moving to the right side. This can be a great help when you are in a difficult situation, such as talking before a group of people, going on an interview, or meeting important people. Practicing the Heart and Kidney Sounds in conjunction with the finger wrapping may also help. The ring finger controls anger; when you are going to get angry, try to wrap it a few times to see if you still get angry.

Daily practice of the Inner Smile and the Six Healing Sounds is the best way to gain control of negative emotions. Many students are addicted to smoking, drugs or alcohol. The toxic elements found in these substances settle in the organs and nervous system, stimulating them into over-activity, and in a short period of time make people high. When the effect is over, the users will start to feel low key energy, becoming emotional and nervous. In this situation, they can use the Inner Smile and Microcosmic Orbit circulation while holding the fingers, especially the ring finger. This will calm them down. Many people use this simple way to avoid the use of drugs, smoking and alcohol. The Tao practice will give to the disciple the strength and power to clean out accumulated toxins in the system, eliminating bad habits.

X. Fingers Correspond to Emotions, Elements and Organs.

A. Thumb corresponds to the element earth and is associated with the stomach. The corresponding emotion is worry.

B. Index finger corresponds to the element of metal and is associated with the lungs and large intestine. It links with the emotions of sadness, grief and depression.

C. Middle finger corresponds with the element of fire and is associated with the heart, small intestine, circulatory system and the respiratory system. It links with the emotions of impatience and hastiness.

D. Ring finger corresponds to the wood element and is associated with the liver, gall bladder and the nervous system; it corresponds to the anger emotion.

E. Pinky finger corresponds to the water element; it is associated with the kidneys, and corresponds with the emotion of fear.

Fig. 3.12 *Fingers' corresponding emotions, elements and organs.*

Head Massage

The head massage is for headaches, nervousness, and an imbalance of Chi energy in the brain. The causes of headaches and nervousness are very complex. The head is the place in which all the nerves are seated and is the central control of the whole system. Nowadays you see a lot of young people who are very nervous. This nervousness causes insomnia, loss of appetite, faster heart beat, difficulty in breathing, tiredness, laziness, etc. It seems that all of this is not symptomatic, but it greatly affects the efficiency of work and gradually is considered mental disease.

The skull massage will strengthen the nervous system. With the tongue touching the roof of the mouth as it is during the massage, and the eyes moving up to the left and then across to the right, you can feel the stimulation of the Chi energy from left to right. This balances the left and right hemispheres of the brain and will result in strengthening the glands, senses and organs.

The head and skull massage will increase the blood circulation and will increase the nutrition of the skull and hair. We have students whose white hair grew black and students whose falling hair became denser as more hair grew back. The hair also grows softer. In the morning and at night before sleeping, you should brush your hair at least 25-50 times. Find a good brush, and be careful of the scalp. Do not scratch the skull, which might result in a headache or sense of pain.

I. Head

A. Crown Point *(Fig. 4.1)*

This is located in the center of the crown; in the fontanelle area of an infant's skull there may still be a slight depression. The crown point is the junction of one hundred channels through which the energy of the body passes. Massage this area with both your middle fingers. This will relieve dizziness and headaches, which result from too much energy in the head. It also relieves high blood pressure and stimulates the nervous system.

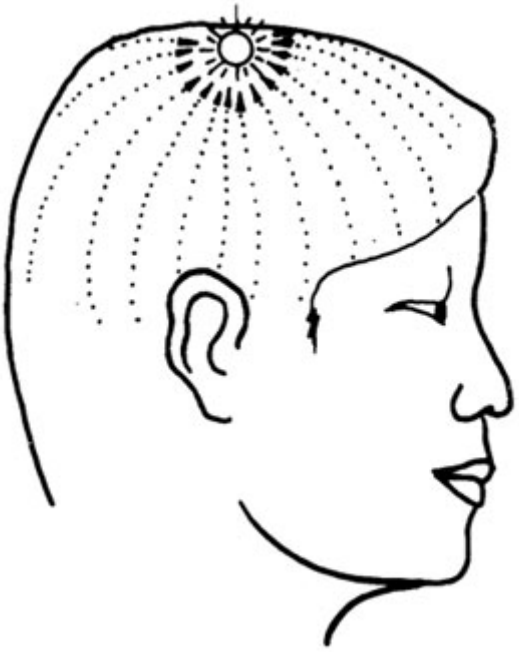

Fig. 4.1 *Crown Point is the junction point of one hundred energy channels.*

B. Bring Chi Energy to the Hands and Face.

Inhale, contract the sexual organ, buttocks. and middle of the anus. Rub the hands, clench the teeth, and put the tongue to the roof of the mouth. When the face, head, and hands are hot, breathe normally and begin to massage.

C. Knock the Head *(Fig. 4.2)*

Hit the head with the knuckles of the hand, knocking all around the head. Knocking the head lightly can help to clear your head, eliminate stubbornness and make your thinking sharper. Many of our students use this knocking of the head to release the pressures that they have from today's life of fast, advanced technology and the feeling of always having to keep up. This is especially true of those graduate students who feel a great deal of pressure and stress in keeping up with their studies. Each year students commit suicide because the pressures and stress accumulate too much in their heads, making them unable to think clearly: they start to feel everything in their society as too much pressure, which leads to worry, fear, sadness, and many, mixed emotions. The simple knocking of the head can release pressure and stress that accumulate there.

Fig.4.2 *Knocking the head.*

D. Hold your Breath to increase Chi flow.

Holding your breath will increase the Chi flow to the face. The head has many channels that join in the skull, especially in the crown point.

E. Scalp *(Fig. 4.3)*

Prepare your hands, head and scalp by warming up. Using both hands like a comb, press hard and move slowly, massage the scalp, going straight back from the hairline to the base of the skull. As you do this, mentally direct your energy from the back of the skull to your feet. Repeat 6-9 times. Massage more in any places in which you feel pain, until the pain goes away.

Fig.4.3 *Massaging the scalp.*

F. Crest *(Fig. 4.4)*

Using your thumbs, massage the crest (the edge) at the base of the skull until you feel no pain there. (Fig. 4.5) This will help you reduce headaches and eye aches and will increase vision. This place in Tao tradition is called the Pool of Wind which tends to collect the “evil wind”, the major cause of all the pain in the senses.

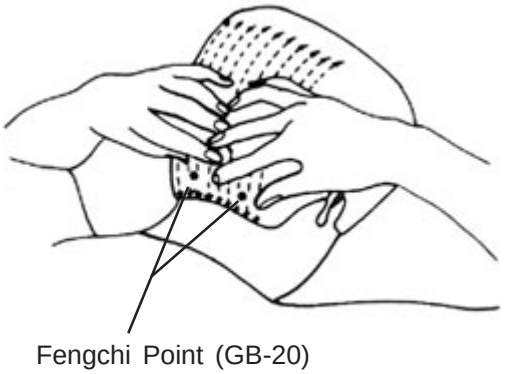

Fig. 4.4 Crest, the edge of the skull.

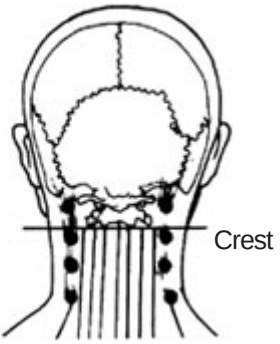

Fig. 4.5 *Go straight back from the hairline to the base of the skull.*

II. Face *(Figs. 4.6, 4.8 and 4.9)*

A. Natural Beauty

Massaging your face with Chi is a far more effective beauty treatment than the most expensive cream or cosmetic, (Fig. 4.10) Your skin will glow brightly and eventually become less wrinkled. There are many meridians passing through or ending at the face. When blocked, they result in reduced flow of Chi energy and circulation. The face is the first impression imprinted in other people’s minds. Chi circulation provides it with attractive personal energy.

B. Bring Chi Energy to the Face.

Inhale, contract your sexual organ, buttocks, and middle and front of the anus. Hold your breath, rub your hands together, clench your teeth, and put your tongue to the roof of your mouth. When your face feels hot, picture energy flowing to your hands. When your hands are very warm, bring your attention to your face and hold your breath until your face gets hot.

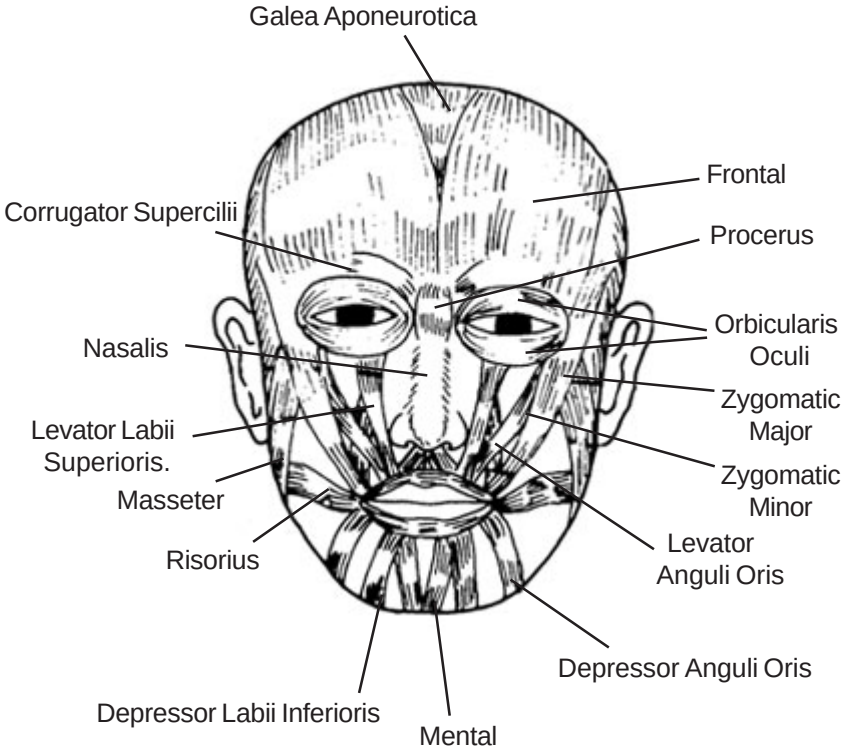

Fig. 4.6 *Facial Muscles*

C. Forehead *(Fig. 4.7)*

Using alternate hands, wipe your forehead from one side to the other six to nine times.

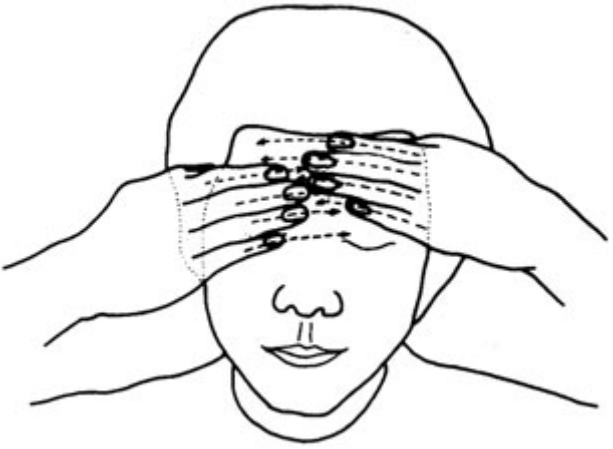

Fig. 4.7 *Wiping your forehead.*

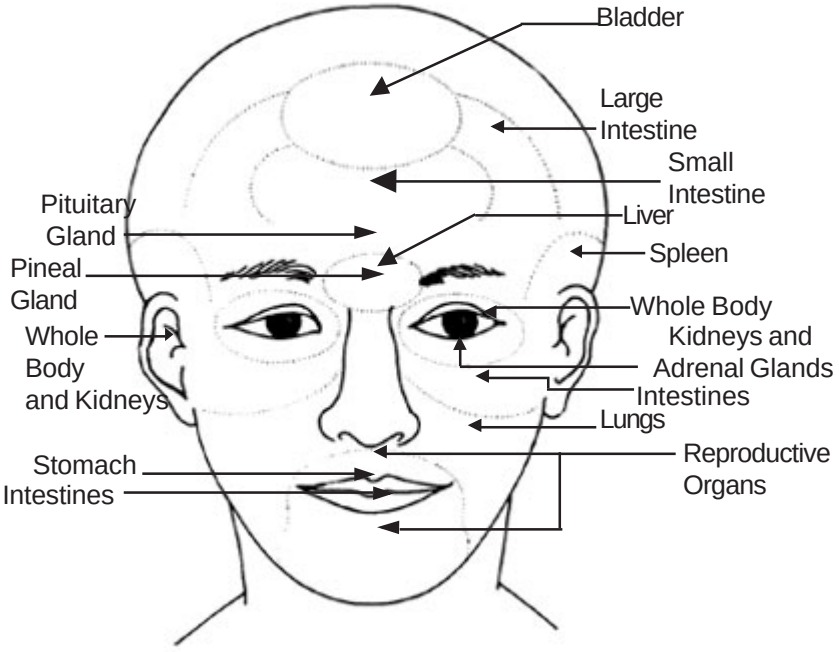

Fig.4.8 *Diagrams of the Face Corresponding to the Organs.*

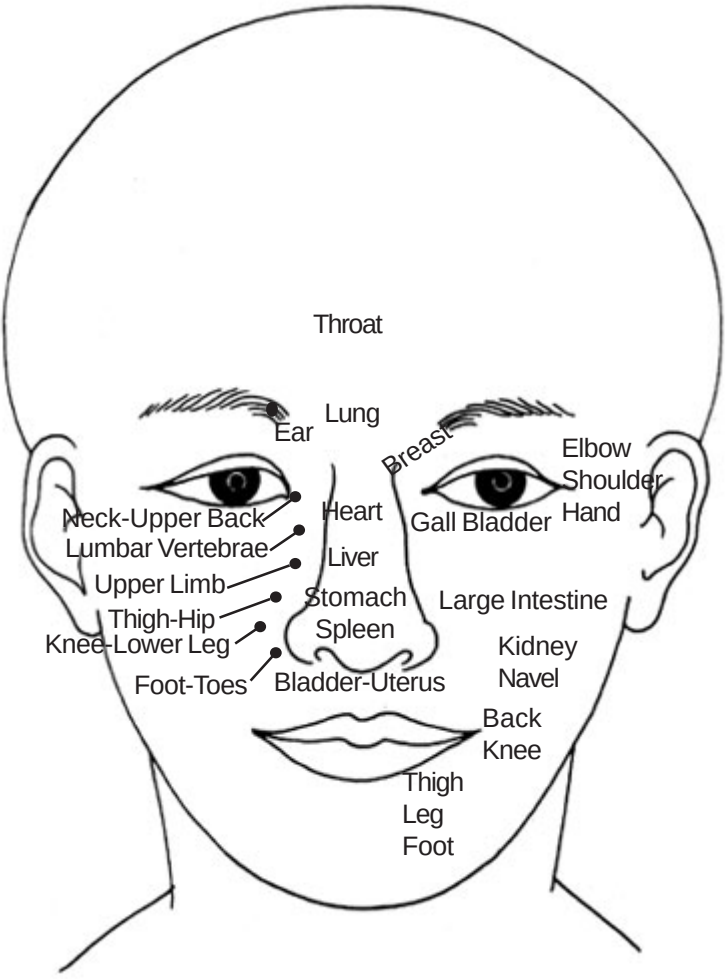

Fig. 4.9 *Head and Face.*

Fig. 4.10 *Your own Chi energy is the best cosmetic.*

D. Mid-Face

Wipe the middle section of the face, from the eyebrows to the tip of your nose.

E. Lower Face

Repeat for the lower section of the face, below the nose to your chin.

F. Whole Face

Repeat the procedure for bringing energy to your hands Inhale, cover your whole face with your palms and massage it. (Fig. 4.11) Use an upward motion to reduce wrinkles. Exhale and relax your face. Rest and smile to your face until you can feel it tingle with warmth.

G. Mid-Forehead

Use the second joint of alternate index fingers to massage the middle of the forehead, from the center to the temple. (Fig. 4.12)

Fig. 4.11 *Massage the whole face.*

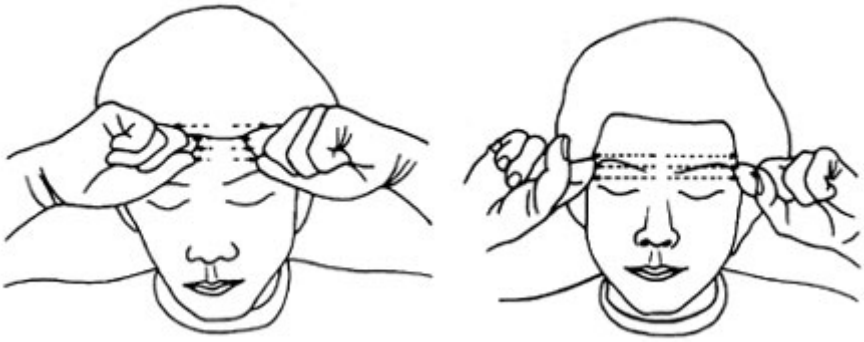

Fig. 4.12 *Massage the mid-forehead.*

III. Temples

Use your index fingers to massage the temples in a circular motion, first clockwise, then counterclockwise. Massage the forehead and the temples; use the knuckle rub from the middle of the forehead all the way to the temples ten to twenty times. (Fig. 4.13) These exercises will reduce headaches in the front and in the temples. Find the painful point and massage it until the pain is gone.

Fig. 4.13 *Massage the temples.*

IV. Mouth

Depression makes the corners of the mouth drop. Looking cheerful, delightful, more attractive and happy are dependent so much on the eyes and the corners of the mouth. When the muscles of the mouth are loose because of stress, depression, or sadness, the corners of the mouth drop and the energy system is depressed and in low key. No one likes to look at a sad face or a depressed face; it makes other people feel sad and depressed, too.

The flow of energy in the body and the expression of the face are the main attractive powers of a person. Massaging the mouth muscles up will help to lift the corners of the mouth. The Inner Smile and lifting up the corners of the mouth are very important to building up attractive energy.

A. Beautify the Mouth Massage

Using the thumb and the index finger of the right hand, touch both corners of the mouth and feel the Chi from the thumb and index finger pass to the corners of the mouth. Slowly press and push up about one inch, release and start again at the corners, pressing up ten to twenty times each day. (Fig. 4.14)

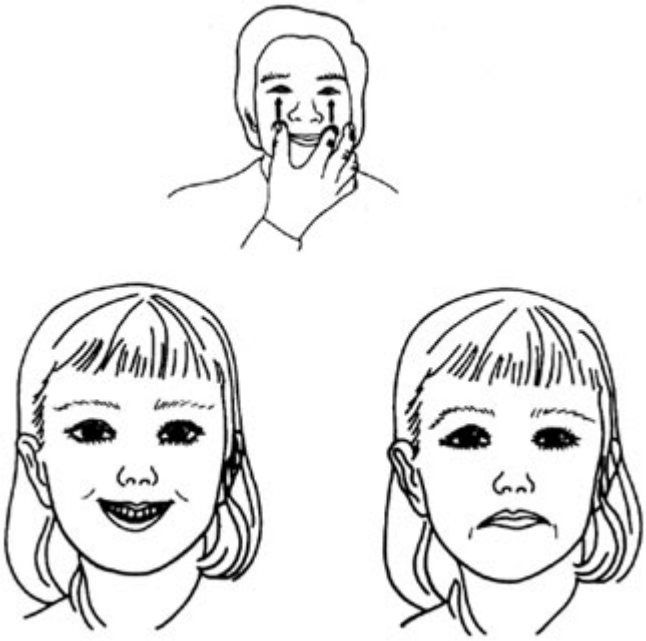

Cheeful delight.

Mouth corners drop.

Fig. 4.14 *Beautifying the mouth massage.*

V. Eyes

The eyes are the windows of the spirit. (Fig. 4.15) In Taoism we regard the eyes as Yang energy which will guide all Chi flow in the body. The eyes can greatly affect your personality Some people are born with a lot of white in their eyes--three portions of white to one portion of iris--sometimes called “thief eyes” or “danger attack eyes.” Such eyes can result in a suspicious look, portending unpleasant things. Through the exercises, you can gradually correct the white portion of the eyes.

Since the eyes are connected to the entire nervous system, they have a special importance. The eyes reveal the health of your entire body. Through the eyes we can tell which organs are weak and/or toxic. Massaging the eyes will remove stress from the vital organs. Nowadays people use their eyes much more than in the

past to read, watch television, and work with computers, electronics and microscopes. This strains them a great deal and makes the openings of the organs loose, so that much of the organ energy is drained out.

In Taoism, we regard the eyes as the doorways to the soul as well as the opening of the liver. (Fig. 4.16)

When rubbing near the corners of the eyes, do not rub too hard, because you can make the corners of the eyes drop down. Continue rubbing the corners of the eyes upward.

A. Bring Chi Energy to the Hands and Eyes.

Repeat the procedure for bringing energy to the hands by inhaling; holding the breath; and contracting the sexual organ, buttocks and middle of the anus and both the left and right sides of the anus. Direct the Chi to both eyes. Rub the hands, clench the teeth, place the tongue on the roof of your mouth. Direct the energy to the face and then the hands. When your hands are hot, focus on your eyes until you feel them filled with energy.

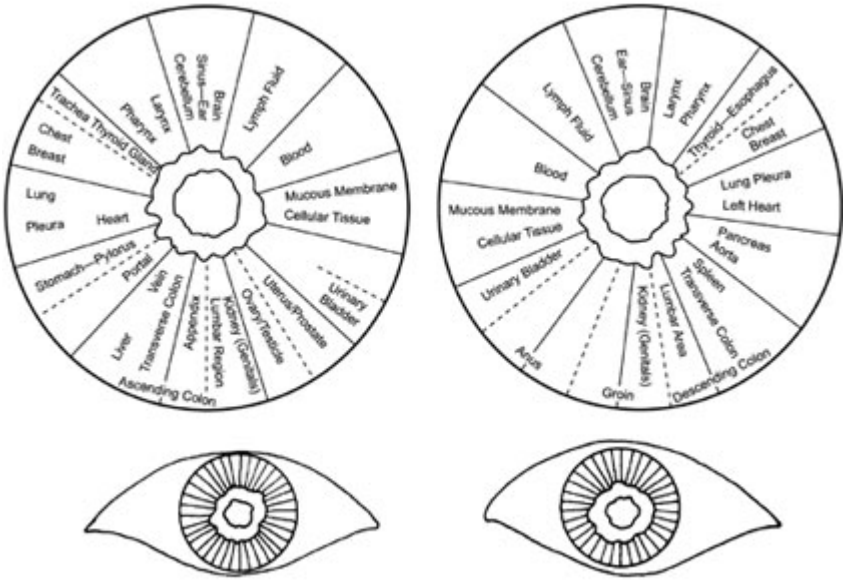

Fig.4.15 *Eyes are the windows of the spirit.*

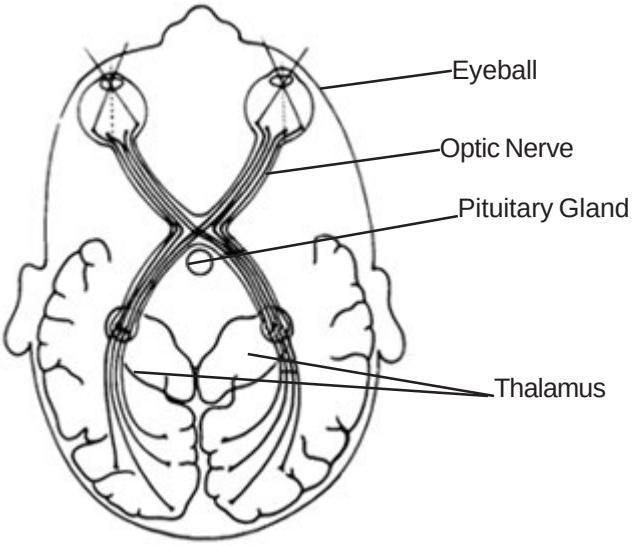

Fig. 4.16 *Eyes are the doorways to the soul.*

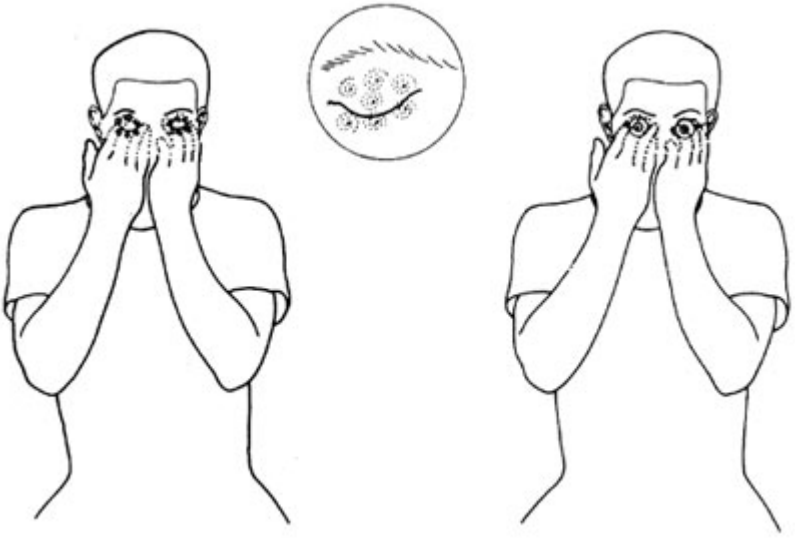

Fig.4.17 *Use the fingertips to gently massage the eyeballs.*

B. For the Eyeballs and Surrounding Area

Close your eyes. Use your fingertips to gently massage your eyeballs through your closed eyelids, six to nine times clockwise, then six to nine times counterclockwise. Then gently massage the area around the lids the same number of times. (Fig. 4.17) Be aware of painful spots and massage those places until the pain goes away. Pay special attention to the inner and outer corners of the eyes. These are points of the gall bladder meridian and will relieve eye ailments if massaged.

C. Pull up the Eyelids

Pulling up the eyelids will increase the fluid. Use the thumb and index finger to pinch, pull up and release the eyelids six to nine times. (Fig. 4.18)

Fig. 4-18 *Pull up the eyelids.*

D. For the Eye Sockets

Bend your index fingers and use the lower section (second phalanx) of each thumb to rub the upper and lower bones of the eye sockets six to nine times. (Fig. 4.19)

Fig.4.19 *Massage the eye sockets.*

E. For getting a Tear out

Hold an index finger up about eight inches from the eyes, or put a dot on the wall five or six feet away from you. Stare at it intently without blinking your eyes until you feel like a fire is burning in them. (Fig. 4.20) The Taoists believe that the toxins will burn out of the body through the eyes. They will begin to tear. Do this to strengthen your eyes. Then, rub your hands until warm; close your eyes and cover your eye sockets with your palms. Feel the Chi from the hands absorbed into the eyes. (Fig. 4.21) Rotate your eyes six to nine times, first in a clockwise direction, then counterclockwise.

Fig. 4.20 *Getting a tear out.* ***Fig. 4.21*** *Absorbing the Chi into the eyes.*

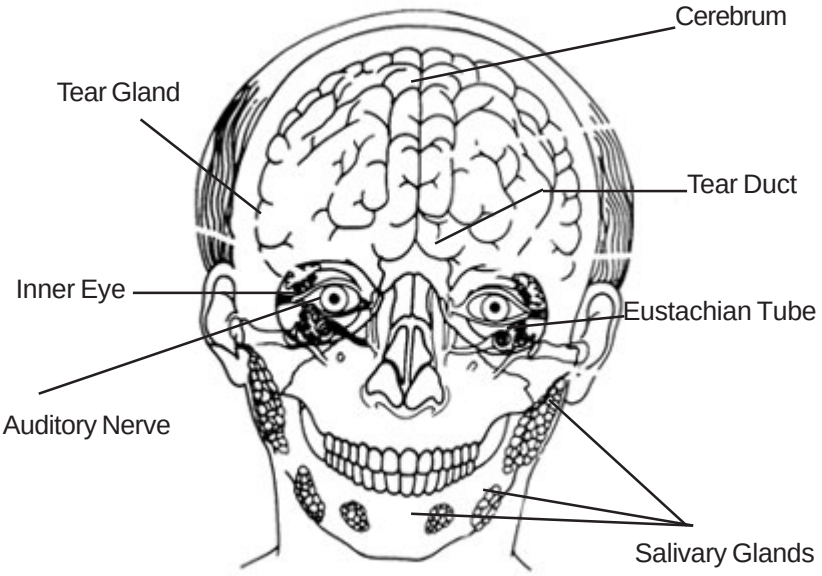

Fig. 4.22 *The parts of the eyes connect with senses and brain.*

F. Pull in the Eyeballs.

The eyes are divided into five parts. Each part is closely connected with the organs and nerves. (Fig. 4.22) Become aware of the eyes. (Fig. 4.23)

Pulling and pressing the eyeballs will exercise the organs, sense, glands and the brain. (Fig. 4.24) This is also the best exercise for the eye muscles. The eyes have many muscles which we do not exercise very much and, thus, they become weak, contributing to poor eyesight.

1. With the eyes still closed and cupped by the palms, inhale, contract the anus and sexual organ, and pull the eyeballs back into the sockets.
2. Contract the middle of the anus and the middles of the eyeballs.
3. Contract the front of the anus and the tops of the eyeballs.
4. Contract the back of the anus and the bottoms of the eyeballs.
5. Contract the right side of the anus and the right sides of the eyeballs.
6. Contract the left side of the anus and the left sides of the eyeballs. This exercise not only strengthens the eyes but also the pituitary and pineal glands and the inner ear including the ear drum and canals. When you pull the eyeballs in and upward and look toward the crown, you are exercising the upper muscles and stimulating the pituitary gland and pineal gland.

When you contract and pull in the middle of your eyeballs, you are exercising the back of the eye muscles and the inner ear.

When pulling in the outer corners of the eyes, you are strengthening the side eye muscles as well as the ear canals end the ear drums.

When pulling in the inner corners of the eyes, you are strengthening the inner side muscles, the tear ducts and the nose.

When pulling in the lower parts of the eyes, you are pressing the lower part of the ear canals and the nervous system.

Fig. 4.23 *Awareness of the eyes.*

(1) Pressing into the inner ear.

(2) Left eye pressing into the ear canal. Right eye pressing into the eustachian tube.

(3) Pressing into the pituitary gland.

(4) Right eye pressing into the ear canal. Left eye pressing into the eustachian tube.

(5) Pressing into the eustachian tube.

Fig. 4.24 *Moving the Eyes.*

A. Bring Chi energy to the hands

Repeat the procedure for bringing energy to your hands, contracting the front part of the anus.

B. Nostrils

Widen the nostrils. (Fig. 4.25) Using the thumb and index finger stick them into the nostrils and move them to the left and the right and up and down for ten to twenty times. This will widen the passage of air into the lungs. This can help your sinus problems and correct the smelling sense.

C. Bridge

For the bridge, use your thumb and index finger and massage the bridge of your nose by repeatedly pinching it. As you do this, inhale slowly and imagine you are breathing in clean air; exhale slowly and imagine you are exhaling dirty air. Do this nine to thirty-six times. (Fig. 4.26) This is effective for blocked sinuses.

Fig. 4.25 *Widen the noistrils.*

Fig. 4.26 *Massge the bridge.*

Fig. 4.27 *Massage the mid-nose.*

D. Mid-Nose

For the mid-nose, place your thumb and third finger or either side of your nose, right on the bone which runs perpendicular to the nose. Place your index finger on the bridge. Inhale and press in gently. Exhale and relax. (Fig. 4.27) Feel and absorb the heat from your fingers into the nose. This can increase your concentration and calm your mind.

E. Sides of the Nose

On the sides of the nose, use your index fingers, massage slowly and gradually increase up and down the sides of your nose nine to thirty-six times. (Fig. 4.28) This also helps blocked sinuses and stuffy noses. Do not do it too hard in the beginning because the sensitive tissues there are very tender and easily infected. Rub the sides of your nose up and down until you feel warm; this will help you in the cold winter and every morning when you get up.

F. Lower Nose

On the lower nose, massage slowly and gradually increase the pressure when you are sure you will not hurt yourself. Massage vigorously back and forth, using an index finger at a right angle to the nose immediately under it. (Fig. 4-29) This helps blocked sinuses and stuffy, runny noses.

Fig.4.28 *Massage the sides of the nose.*

Fig.4.29 *Massage the lower nose.*

VII. Ears

In China we believe that a person with thick, long ears will have a long, healthy life and that the personality will be more attractive. The following exercises can prevent hearing loss whic occurs gradually as we age. The ears are acupuncture maps of the whole body, containing 120 points. Many acupuncturists now use only the ear points to cure many ailments as well as for weight control.

A. Outer Ear

Repeat the method for bringing energy to the hands, contracting the left and right sides of the anus.

1. Front and back: Make a space between your index and ring fingers and simultaneously rub in front and in back of the ears. (Fig. 4.30(1))

2. Ear shells: Rub the ear shells with all your fingers. This will stimulate the autonomic nervous system and warm up your whole body, especially in the cold weather. (Fig. 4.30(2))

3. Ear lobes: Using your thumb and index finger, pull down on the ear lobes. (Fig. 4.30(3))

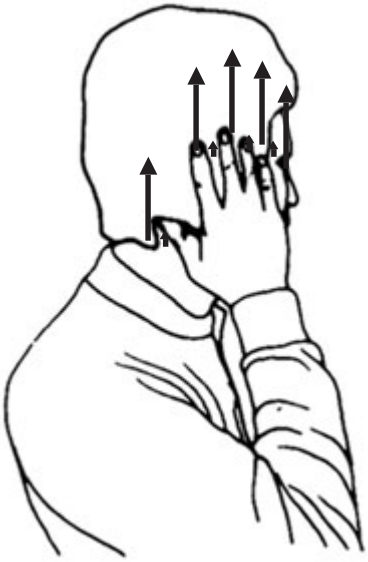

(1) Rub in front and back of ears.

(2) Rub the ear shells.

(3) Pull down on the ear lobes.

Fig. 4.30 *Rubbing the Ear.*

4. Ear drum exercises: For the outer ear drum, repeat the method for bringing energy to the hands, contracting the left and right sides of the anus. Inhale and then exhale completely. Put your index fingers in your ears; it should feel as if there is a vacuum in the ears. If it does not, then exhale more. Move your index fingers back and forth six to nine times at your own pace until you can feel that the insides of the ears are moving, and pull out the fingers with a quick movement. (Fig. 4.31) You should hear a “pop” sound, and you will feel that you can hear better and that your mind is clearer.

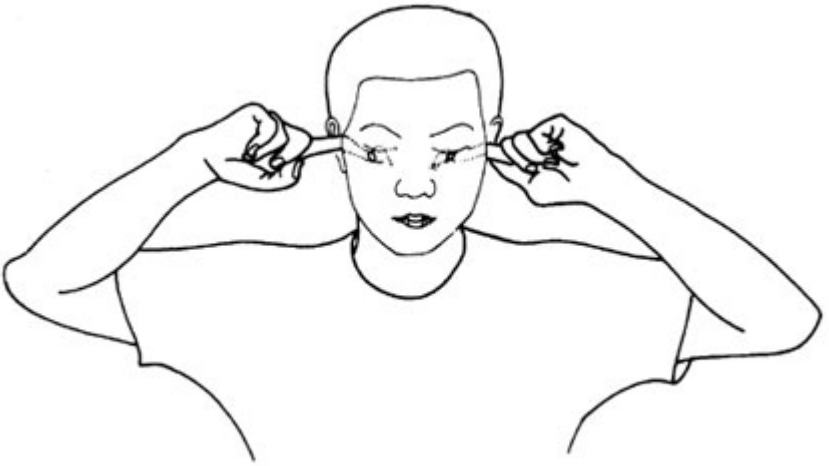

Fig. 4.31 *Outer ear drum exercise.*

B. Inner Ear *(Fig. 4.32)*

Repeat the method for bringing energy to the hands, contracting the left and right sides of the anus.

The inside of the inner ear, being inaccessible, is usually not exercised and grows weaker with age. These two exercises use air pressure and vibrations to strengthen the inner ear. The ear canals, the nose canal, and the mouth are connected together, so in this exercise we are using the pressure that builds in the lungs and bringing it back up to the mouth, thus adding pressure to the inner ear drums. This is how to exercise the inner ear drums.

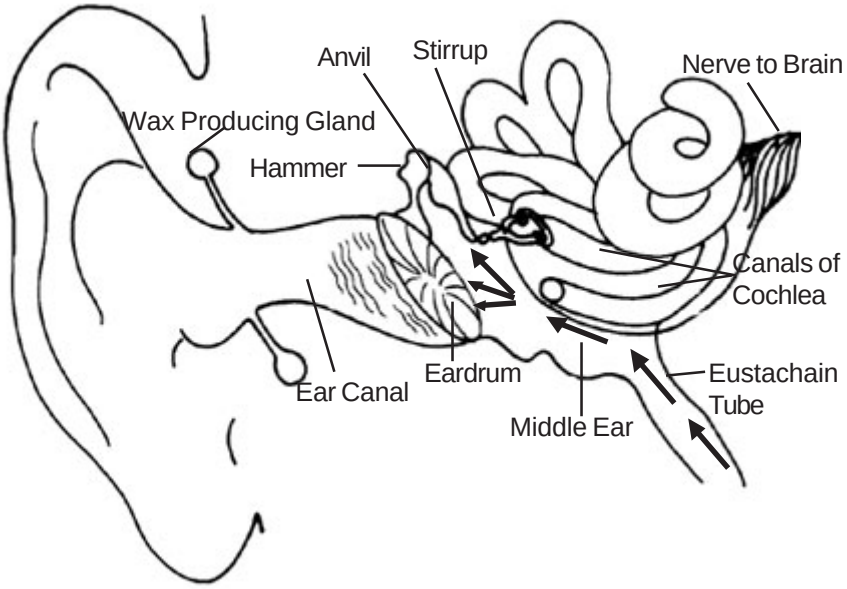

Fig. 4.32 *Diagram of Inner Ear Drum.*

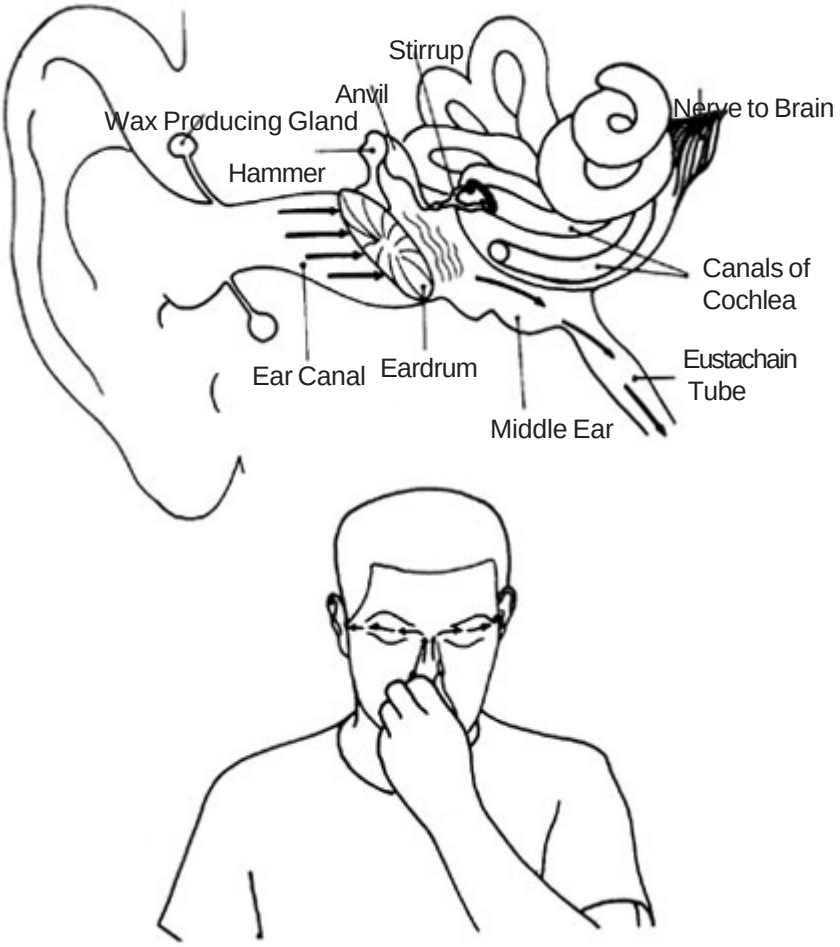

Fig. 4.33 *Inner ear drum exercise.*

1. Blowing exercise: Inhale, fill your lungs and nasal cavity with air; close your mouth and pinch your nostrils shut with your index finger and thumb. Blow slowly out through your closed nostrils and then swallow air. You should feel your ear drums popping. Repeat two to three times. (Fig. 4.33) Do not blow too hard; they can get hurt. You must do every exercise gently for the most benefit.

2. Ear nervous system exercise: hitting the ear drum. Cover your ears with your palms, fingers pointing toward the back of your head. In this position, flick your index fingers against your third fingers so that the index fingers drum on the lower edge, or occipital bone of the skull. This will sound quite loud. The flicking of the finger that hits the bones will vibrate and stimulate the nervous system, the ears and the inner ears' mechanism. Repeat nine or more times. (Fig. 4.34) The activity of the ear will be balanced and the mastoid sinus improved by this exercise.

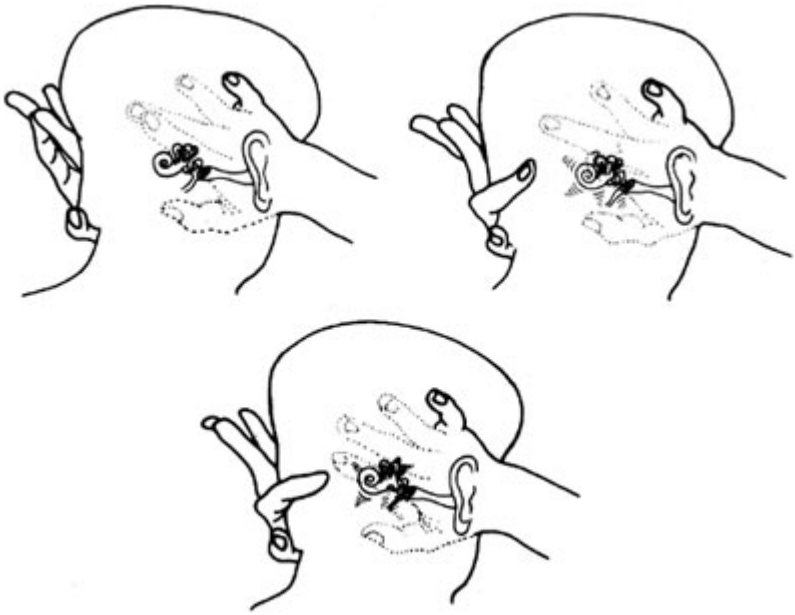

Fig. 4.34 *Hitting the ear drum.*

VIII. Gums, Tongue, Teeth

Healthy teeth require healthy gums as their foundation. These exercises will strengthen both the gums and teeth. Teeth are the excess energy of the bones, and when the teeth get stronger, so do the bones. When the teeth and tongue are strong, your breath improves as well, eliminating bad breath.

We regard saliva as an essential form of energy which can lubricate the organs and digestive system. The tongue is the opening of the heart, and both are made of similar tissue. A healthy and clean tongue will strengthen the organs, especially the heart. You should clean your tongue twice a day with a brush or scrape it with a tongue scraper, and massage your tongue with a tongue depressor or a clean finger. Find the painful spots and massage there until the pain goes away.

A. Bring Chi Energy to the Hands.

Repeat the procedure for bringing energy to the hands, contracting the middle of the anus.

B. Gums

Open your mouth and stretch your lips tautly over your teeth. Use three fingertips (index, middle, and ring fingers) to tap the skin around the upper and lower gums. Hit around until you feel warmth in the area. (Fig. 4.35)

C. Gums and Tongue

Massage your upper and lower gums with your tongue. Then suck in some saliva, press your tongue tightly against the roof of your mouth, and try to exercise the tongue. When you strengthen your tongue, you are strengthening your heart. Press around. Press the tongue to the roof of your mouth, tighten your neck muscles and swallow the saliva. This lubricates the digestive glands and organs.

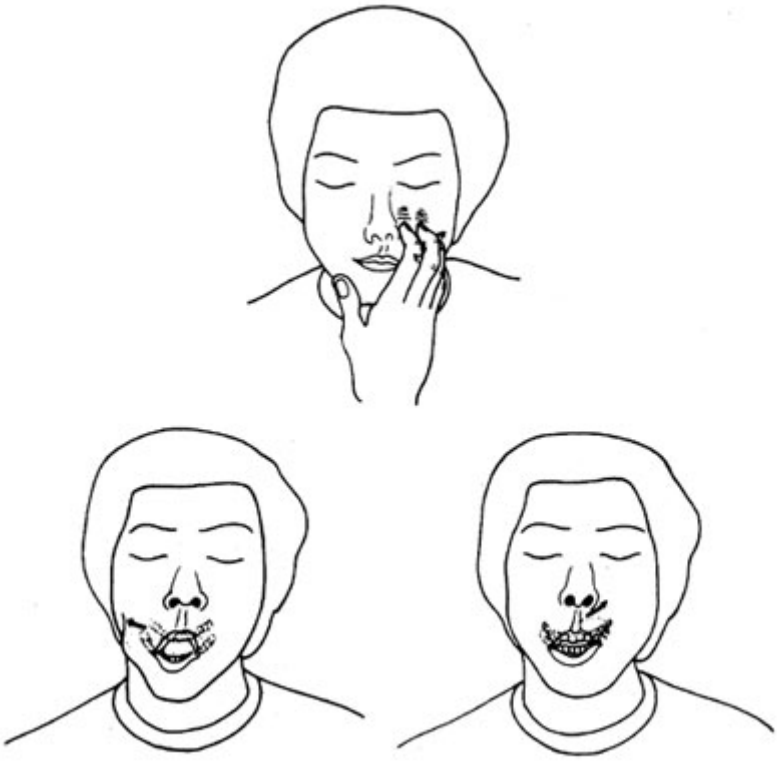

Fig. 4.35 *Hitting the gums exercise.Using the tongue, massage the upper and lower gums.*

D. Tongue *(Fig. 4.36 and 4.37)*

In a sitting position place the hands on the knees, palms down. Exhale and straighten the arms, spreading the fingers apart and keeping the hands on the knees. Open the mouth as wide as possible and thrust the tongue out and down, focused on the throat. With the tongue out as far possible, gaze at the tip of the nose. The whole body should be tense. Hold the breath for as long as you feel comfortable. Relax with inhalation and regulate the breath. This will help to strengthen the throat, the tongue and the power of speech. These exercises will help to improve foul breath and to clarify speech.

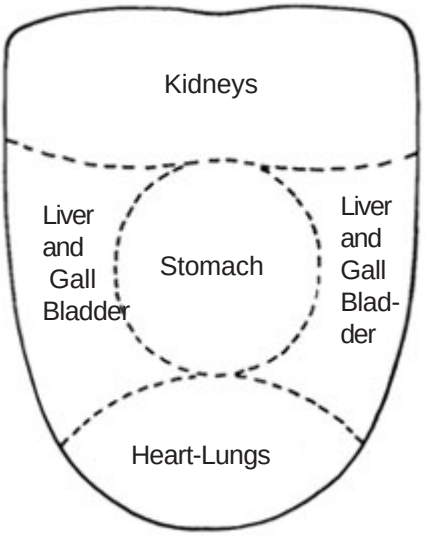

Fig. 4.36 *Diagram of tongue parts and corresponding organs.*

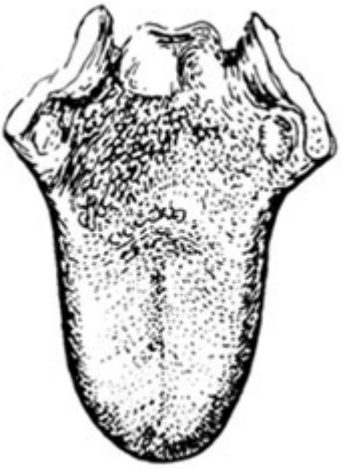

Fig. 4.37 *Tongue*

Fig. 4.38 *Press tongue to the roof of the mouth.*

Inhale, then exhale as you press your tongue out and down as far as you can. Follow by pulling the tongue in and curling it. Press your tongue to the roof of your mouth as hard as you can, contracting the middle of the anus and the esophagus to help the tongue. (Fig. 4.38) With more practice you will know how to use the inside force, the force from the organs, to press your tongue up. Even though the tongue has no bones to exert force, you will still be able to exercise the tongue well.

E. Teeth Clenching

Relax your lips. Click the teeth together lightly (Fig. 4.39) and then clench them hard (Fig. 4.40), as you inhale and pull up the middle of the anus. Do this six to nine times. Move your tongue and mouth to create a lot of saliva. The technique of swallowing the saliva is to put the tongue up to the palate and swallow quickly with a hard gulp, sending the saliva down the esophagus to your stomach.

F. Energy to Teeth

Close your mouth and let your teeth touch lightly. Direct the energy to your teeth. Gradually feel the electrical flow of energy there.

Fig. 4.39 *Click the teeth together lightly.*

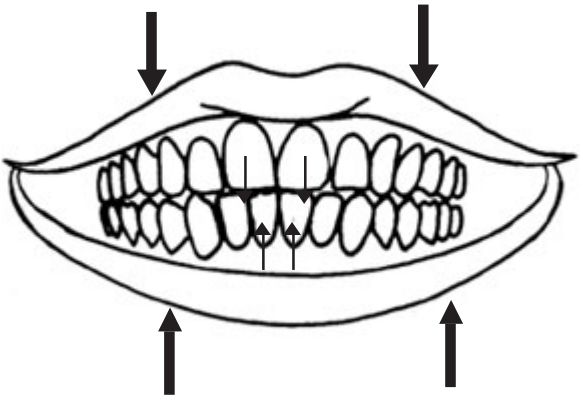

Fig. 4.40 *Clench the teeth together hard.*

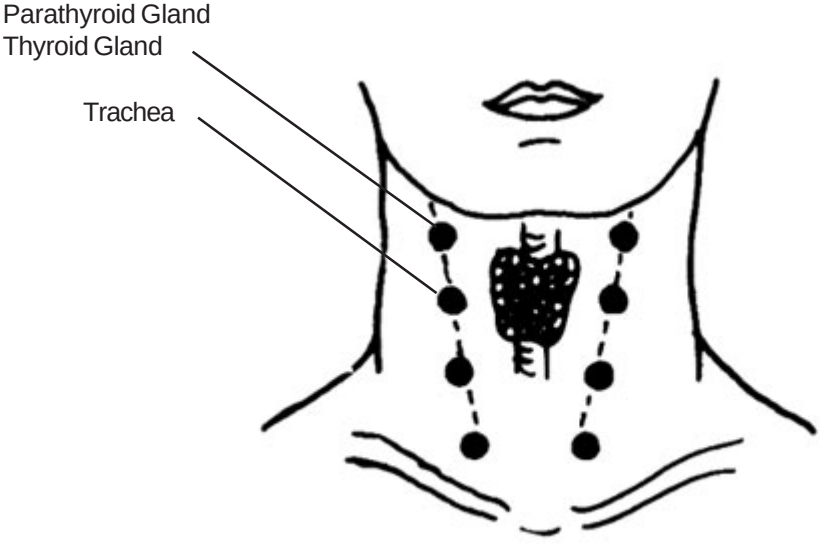

Fig. 4.41 *Throat Glands*

IX. Neck

A.Thyroid and Parathyroid: Site of Courage, the Power of Speech *(Fig. 4.41)*

The neck carries the busiest traffic in the body and is the seat of the thyroid and parathyroid glands. (Fig. 4.42) When you massage here, you increase the body's metabolism. Neck tension can also be caused by emotional imbalance. When we are tense and nervous, we are responding to negative emotions, such as anger, fear and sadness. The neck is similar to a traffic bottleneck. All of the signals, as well as the emotions, have to pass through it. When under stress and under emotional strain, the neck starts to accumulate and jam the tension. Unconsciously, the neck muscles tighten, attempting to block out pain. Keeping the neck soft will help Chi flow to the higher center that is located in the brain, keeping the mind and body in harmony together.

Tension in the neck can make you less courageous. When the neck is tense, it will block self expression in the throat. With proper flow of Chi energy, we can express ourselves appropriately at the proper time, place, and in a proper way.

The neck is the passageway of many meridians and is the channel of the Chi energy of the organs. In the middle is the Governor meridian. On the sides are the bladder meridian, the triple warmer meridian and the large intestine meridian. The emotions passing through the meridians of the neck may tense and jam up there.

Emotion:	Organ/Associate Organ:
Anger	Liver/Gall Bladder
Fear	Bladder/Kidneys
Grief	Large Intestine/Lungs
Hastiness	Heart/Small Intestine/Triple Warmer
Worry	Spleen/Stomach/Pancreas

B. Bring Chi Energy to the Hands.

Do the procedure for bringing energy to the hands and contract the front of the anus.

C. Whole Neck

Spread your thumbs apart from your other fingers. Alternating hands, rapidly wipe the neck from the chin to the base nine to thirty-six times. (Fig. 4.42)

D. Middle Neck

Alternating hands, use the middle three fingers to rapidly wipe down the middle of the neck from the chin to the base nine to thirty-six times. The thyroid and parathyroid glands are in the front section of the neck. Use your thumb and the three other fingers to massage these glands. Find the painful points and massage them until you feel them open. Massaging this area will help to increase metabolism and the power of speaking.

Fig. 4.42 *Wipe the neck from the chin to the base.*

E. Turtle Neck

Sink your chin down, then out and up. (Fig. 4.43) Feel your spine press down and then expand. This will help loosen the vertebrae and discs of your neck.

F. Crane Neck

Move your chin forward, circling out, then down, then up, and out again. (Fig. 4.44) Feel your spine expand and then contract.

G. Massage the Neck.

Massage the points along the back of the neck and on the back along the cervical vertebrae. Start from the shoulders and go up to the base of the skull. (Fig. 4.45) Use your fist to hit along the neck. (Fig. 4.46) Find any painful spots and any tense spots and massage until they are released. This will greatly help to release the tension of the neck and help to detoxify the toxic accumulations in the neck area, the causes of many headaches.

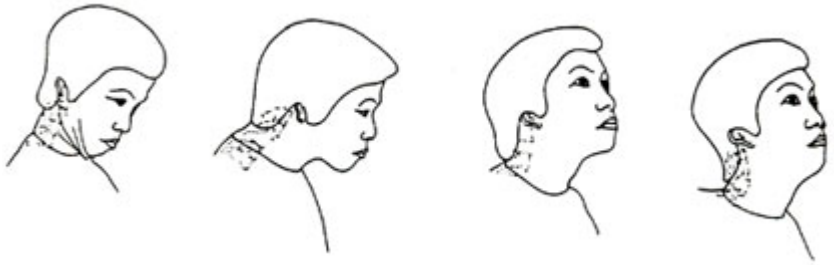

Fig. 4.43 *Turtle Neck*

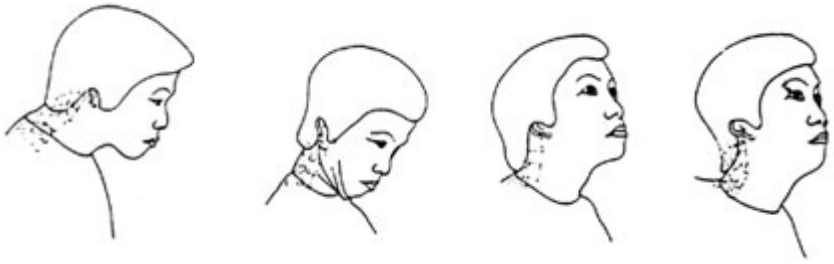

Fig. 4.44 *Crane Neck*

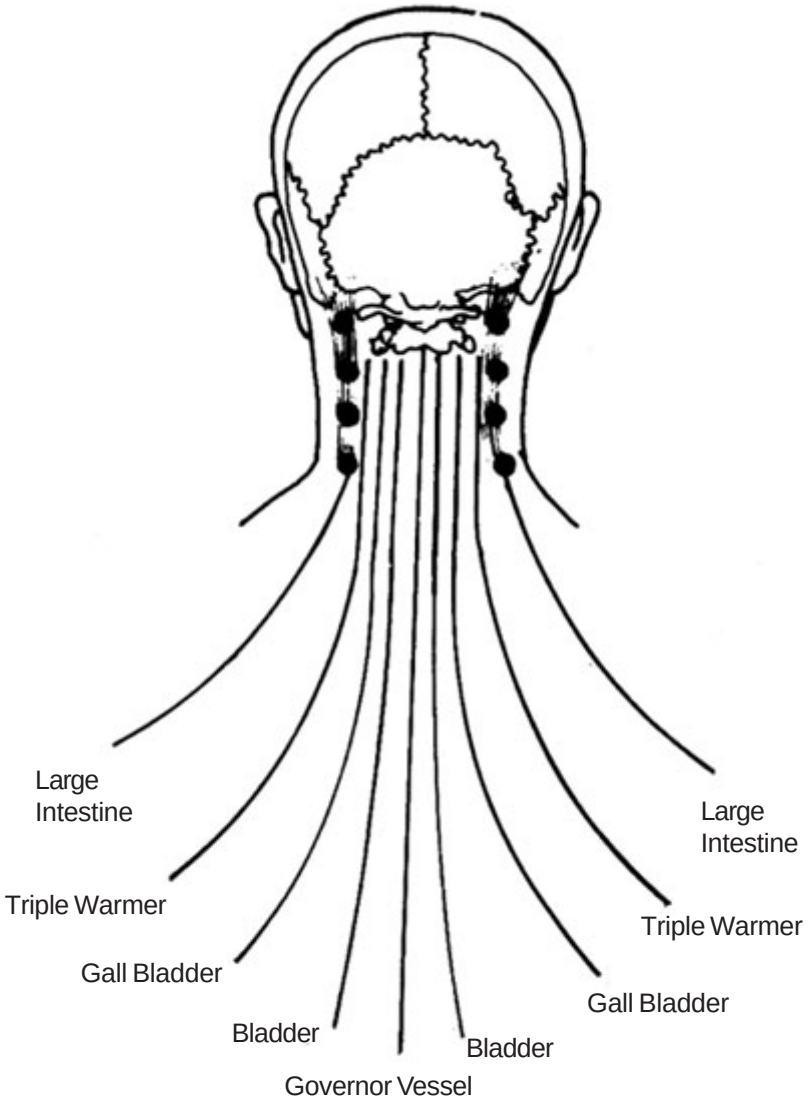

Fig. 4.45 *Massage the points along the neck.*

Fig. 4.46 *Use the fist to hit along the neck.*

X. Shoulders

Many people feel tense and worried, and their shoulders are tight and held up. The way to release the tension is by pulling up your shoulders to press against the neck, tightening the muscles of the neck and shoulders. Hold for a while, exhale deeply, and let them drop down, pulled by gravity like a sack of potatoes. (Fig. 4-47) Feel the burden, worry, and stress drop down to the feet and out to the ground. Feel yourself grounded. Do this three to nine times, and the tension and worry will go away.

Relax your shoulders and chest, exhale and release more, until you feel the tenseness gone.

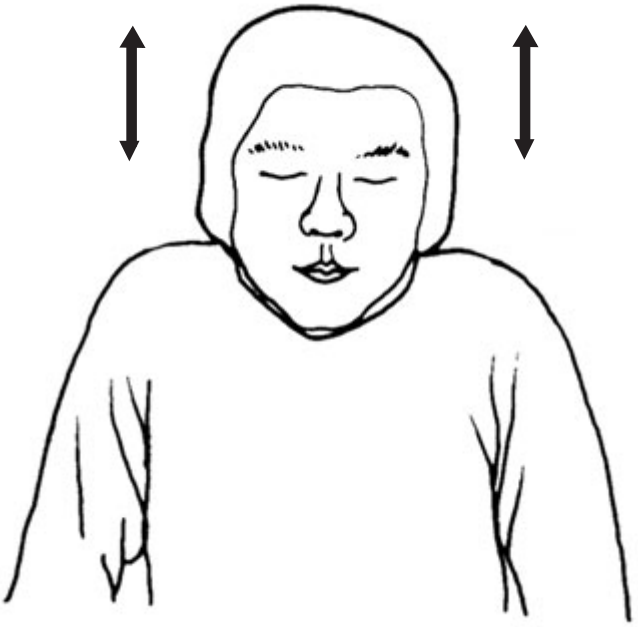

Fig. 4-47 *Dropping the shoulders will help to release tension and worry.*

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Chi Nei Tsang I

Internal Organs Chi Massage

Mantak Chia

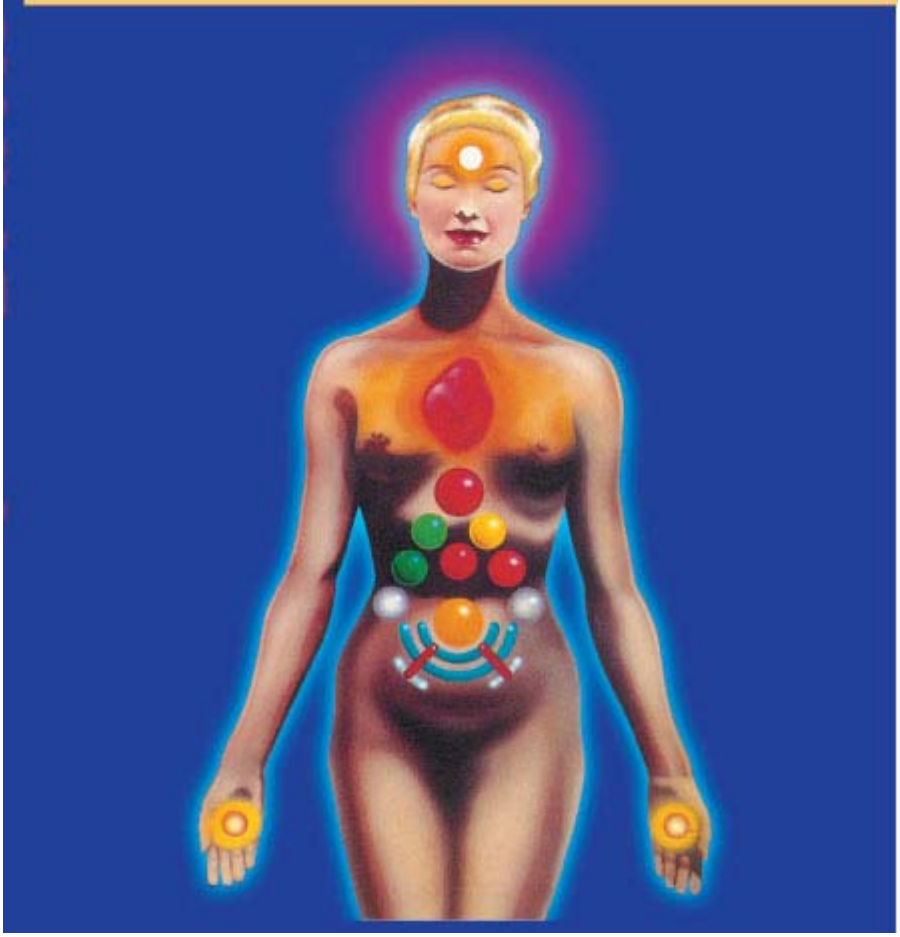

Chi Nei Tsang I

Internal Organs Chi Massage

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Dedicated to Healers Everywhere

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About the Author

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia, and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a laptop computer for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete 8 Court Recreational Facilities.

In February 2002, the Immortal Tao practices will be held at Tao Garden for the first time using the Dark Room technology creating a complete environment for the higher level Taoist practices.

He has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper/Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper/Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002

Many of the books above are available in the following foreign languages:
Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Russian, Serbo-Croatian, Slovenian, Spanish, & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

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Without remembering our parents, teachers, and our son, Max, our continued efforts in presenting the Universal Tao System would be without joy or satisfaction. For their gifts, we offer our eternal gratitude and love.

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Without my mother and my son, Max, the book would have been academic for their gifts, my gratitude and love.

Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

Chapter 1

Working in the Navel Center

The ancient Taoists were confident that the human body and spirit could live forever. Those venerable men and women expressed this deft knowledge in the gentle poems, personal histories, social criticisms, and cryptic “how-to” formulas that comprise the five thousand volume history of Taoism known as the “Taoist Canon.” Still largely untranslated, these books--sheaves of rice paper and wood block prints--now beckon us to explore a gifted culture of unsurpassed brightness and stunning human achievement.

The stories reveal that the ancients acquired and expressed such confidence only after centuries of testing and experimenting with the body’s supple energetic systems in its swirling, surrounding energy environment. Depending only on their experiences and observations, these skilled, spiritual empiricists discovered the layout of the body’s major and minor energy systems, its power sources, its “turbines,” and its “transformers.”

Moreover, they knew just where to go to get the right kind of energy to feed and balance those systems so that the body might proceed in a kind of perpetual motion. Had the energy not been right at hand, those agile adepts, having mastered the universal and Earthly laws of energy and matter, could not cultivate and harvest the needed energy. Gathering the desired energy sometimes meant sitting in a certain meditation. At other times it meant swallowing a bitter brew strained from a mash of roots, bark, and assorted herbs. For more experienced Taoists, stalking a potent restorative often meant gathering all their energies and essences and shooting themselves out of their earthbound bodies on exciting foraging journeys deep into space, to the edge of the Cosmos, to a place where they might pluck the perfect blend.

Whatever they did, wherever they went, the prized goal--a state of alertness--was to keep their organs free of emotional and environmental tensions and toxins, and to maintain a smooth and

abundant flow of the acquired and balanced energies throughout their bodies. This was the secret of good health and long life, gifts that you can practice and master in the art of Chi Nei Tsang (often referred to in this book as "CNT").

This book is concerned with how to maintain the body's systems to live a full, healthy, and extended life. The Taoists were especially adept at knowing how to stay healthy. Whether you believe in or come to believe in their ideas of immortality, you will discover that because the Taoists pursued it, you are now the benefactor. They have passed down a treasure of many wonderful life-extending techniques. Their skills resulted from their understanding of energy and the discovery that all energy is part of one indivisible system. Once they knew how the body was programmed and how the system worked, it was easy to merge into or become the programming. They discovered that the body was a continuous process of energy becoming matter and of matter dissolving into energy. Having successfully perceived this ebb and flow, they could easily monitor their health and make any necessary adjustments. It is very certain that you can learn to do this as well.

Henry Maspero, a French scholar, was one of the first from the West to analyze and write about Taoism. His perception of the Taoist concept of energy, body, spirit, and immortality from "*Taoism in Chinese Religion*" is worth your consideration.

> "And if the Taoists, in the search for Long Life, conceived this not as a spiritual immortality but as a material immortality of the body itself, this is not a deliberate choice between the various possible solutions of the problem of immortality in the other world, it was because for them this was the only possible solution. In the Greco-Roman world, the habit of opposing Spirit to Matter was accepted early; and in religious beliefs this was translated into an opposition between a unique spiritual soul and a material body. For the Chinese...the world is a continuum which passes without interruption from void to material things, the soul did not take on this role as invisible and spiritual counterpart to the visible and material body." (P. 266)

When applied to your health this means that it is important to acquire the knowledge and techniques for the proper physical care of the body and its vital organs as well as for the spiritual or invisible energies that are involved. What Maspero's perceptiveness should mean to you is that, if you want to stay healthy, you need to learn

how to treat both the “Spirit and Matter” of the body, for they are One. Learning, applying, and teaching such skills comprise the heart of Chi Nei Tsang.

With enough faith in lore and myth and enough practical experience with these techniques as they apply to the internal energy systems, it the Taoists’ belief that one day masses of women and men will again discover they have the ability to live greatly extended lives. The more highly evolved can have the choice to live in their physical form for centuries, or until the Tao calls them to perform their services on a different plane of existence.

It is encouraging and inspirational to pursue such bold physical and spiritual achievements, not as much by ancient legends and dreams as by real successes. These successes are achieved by using both the beginning and advanced energy techniques used and passed down so long ago. By starting with the most basic techniques, you can begin to feel better and have greater, more positive energy. Learn to start each day by smiling inwardly to your vital organs and thanking them for sustaining your life. As you extend your meditations and techniques into more intricate alchemical procedures, you will discover that they work. You will develop the confidence that if you follow the processes handed down so carefully from one generation of Taoists to the next, they will do what the ancients said they would do.

This kind of internal work involves careful attention to all the body/spirit systems. Along with the stationary and moving meditations, such as Iron Shirt Chi Kung and Tai Chi Chi Kung, it is advisable that you learn Chi Nei Tsang. You will become more able to determine the great range of your body/spirit system and will learn how to play with it to make it “sing.” You also can learn an extraordinarily effective means for sustaining the system in good running shape for a long time. Chi Nei Tsang is the best and only “hands-on” maintenance system known.

Whether any of us will live as long as storied ancients remains to be seen. Many people are less interested in the answer to this question than they would be in knowing how they could feel better right now, tomorrow, and next month. They would like to live out their average allotted life spans (60-80 years) in sustained good health. So while preparing for and pondering a long life, our experience and that of our students would easily allow us to handle such an everyday concern and you would receive the same advice

you might have heard 5000 years ago. If you want to feel better, massaging the abdomen is a healthy practice that anyone can do. (Fig. 1.1) If you read no further that would be advice enough to keep you going in good shape for a long time. You can now begin the journey to the center of your navel.

Fig. 1.1 *Massaging the abdomen is a healthy practice that anyone can do.*

A. Taoist View of Nature and the Universe

The Taoists always tried to understand what was happening inside the body by comparing and contrasting it with what was happening outside in nature. They could always find exact counterparts. The Laws of Nature were identical on every level and in every situation. When they found an exact match between the body's internal system and a system in the universe, they had an energy match upon which they could depend.

The paired parts of these systems were known as the macrocosm (big-the universe) and microcosm (small-the human being). In effect they deduced, "Things are big out there and little in here. I'll bring it inside, make it small and master it in miniature, where my consciousness is, and then project it out." In order to understand the beginning of the universe and of existence itself, the Taoists chose to examine their own individual births and the proximity of the birth process to the navel center. Then they drew comparisons.

The Taoists said that the beginning of a human's life must be similar to the beginning of the life of the universe. Understand your body and you can understand the entire universe. Why not? The birth of a new human being is no less spectacular or less important than the birth of the universe. A birth is a birth. The Laws of Nature are the same for all births and conceptions. The microcosm is a mirror image of the macrocosm. The universe within is the same as the universe without. (Fig. 1.2)

Fig. 1.2 *Microcosm and Macrocosm: the Universe within and without*

1. Wu Chi--Our Original Source

The Taoists noticed the effects of naturally occurring universal processes upon human nature. By observing nature and investigating the effects of its energy upon and within the human body, the Taoists traced nature's energy back to its source. They used meditation to make this "expedition." Their search led them to the discovery of a primordial void, a condition of nothingness. This void, recognized to have been the state of things at the beginning of all creation, was given the name Wu Chi.

The Wu Chi is depicted in Taoist art as an empty circle. Thus, the fountainhead of Taoism is the Wu Chi, the Great Emptiness, the beginning, nothingness--the Tao. You can compare this void to your own creation. Who knows or can say how you came to be? Trace yourself back as far as you can and you will come upon the same mystery that beguiled all of the ancients. Once you had the condition of "nothingness," and then you were born with all your splendor and force.

2. Your Original Energy

While the Tao was difficult to name and grasp, the ancients did describe primal forces emanating from it. The Tao Te Ching states,

> "The Tao produced the One;
> The One produced the two
> The two produced the three;
> The three produced all the myriad beings. "

The One is the highest unity, the primordial energy in the Cosmos. The well known Tai Chi symbol portrays this force in which Yin and Yang are perfectly balanced and still united. One can imagine it just about ready to burst out and create all the world. Yin and Yang separated and became the Two. Yin and Yang produced three elemental forces called the three Pure Ones. The Three Pure Ones created the Five Elemental Energy Phases of the Universe. These Five Forces (often called the Five Elements) were powerful enough to generate the "all the myriad beings," that is, all the familiar forms of Nature and the Universe, including you. (Fig. 1.3)

The energy born from the Wu Chi created the main energy forces that sustain our lives. They are: Universal Energy, Human Plane or Cosmic Particle Energy, and Earth Energy. These forces work together in harmony to sustain all existence. (Fig. 1.4)

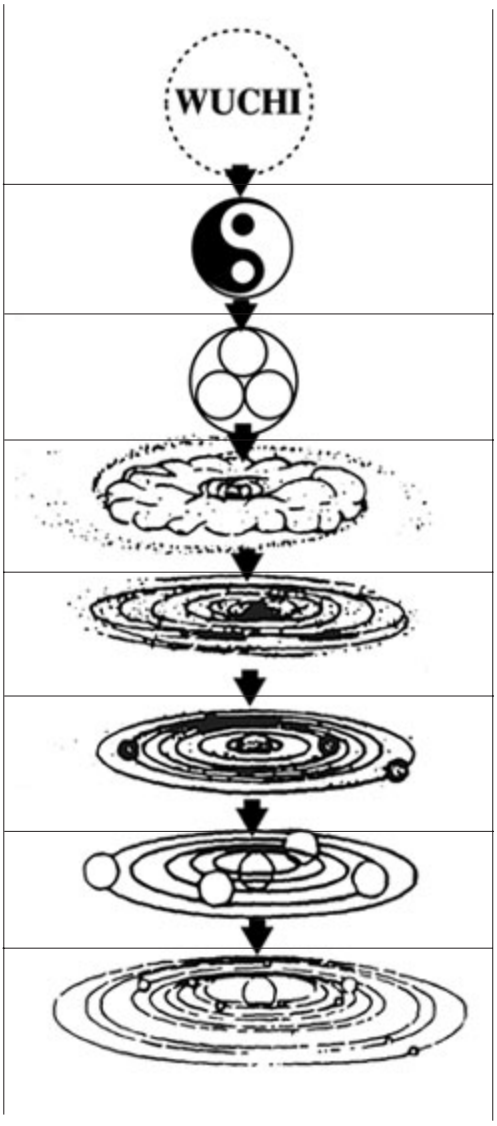

Fig. 1.3 *Creation of the Tai Chi, the Five Phases of Energy, and the Solar System*

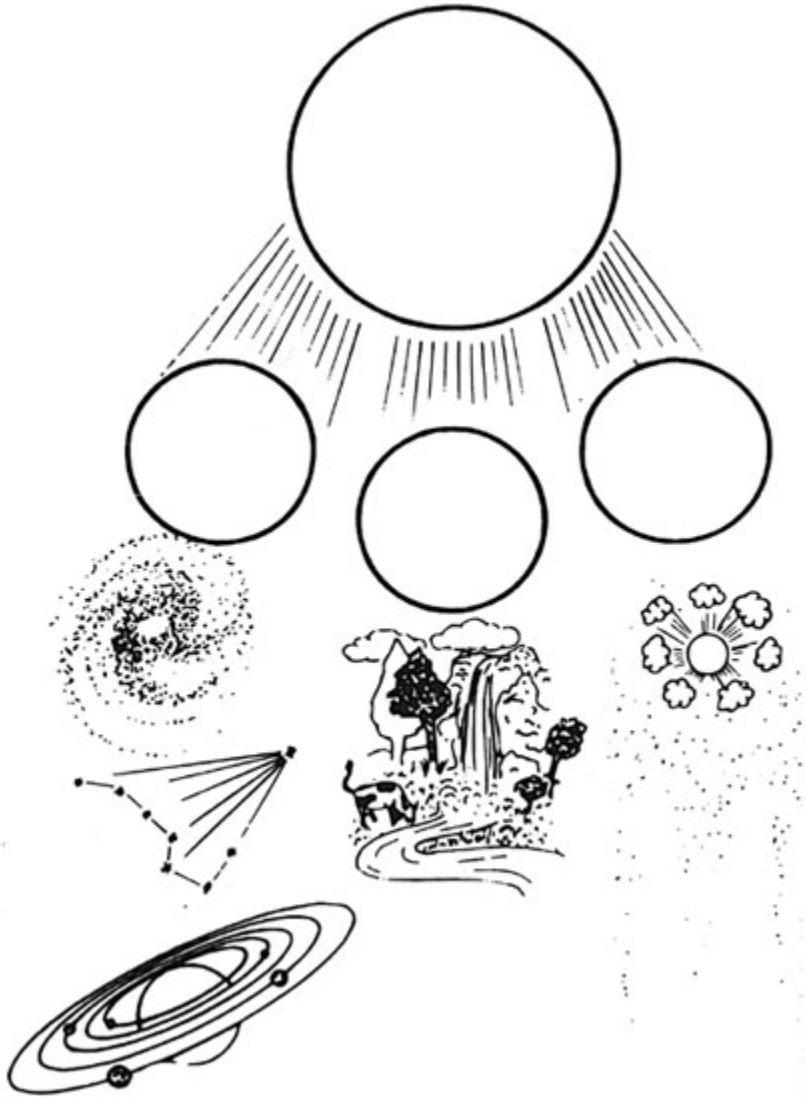

Fig. 1.4 *Energy born from the Wu Chi created Universal Energy, Human Plans (Cosmic Particle) Energy, and Earth Energy.*
They sustain all that exists.

3. Universal Energy

The first force of nature is the Universal Force, also called Heavenly Energy. It manifests itself as the energy of the stars, planets, and galaxies. This vast, all-pervading force nourishes the mind, soul, and spirit of each individual and everything else in the universe. The organs of the human body are the essence of the stars' and planets' energies. They are also the connecting points between the microcosm and macrocosm. (Fig. 1.5)

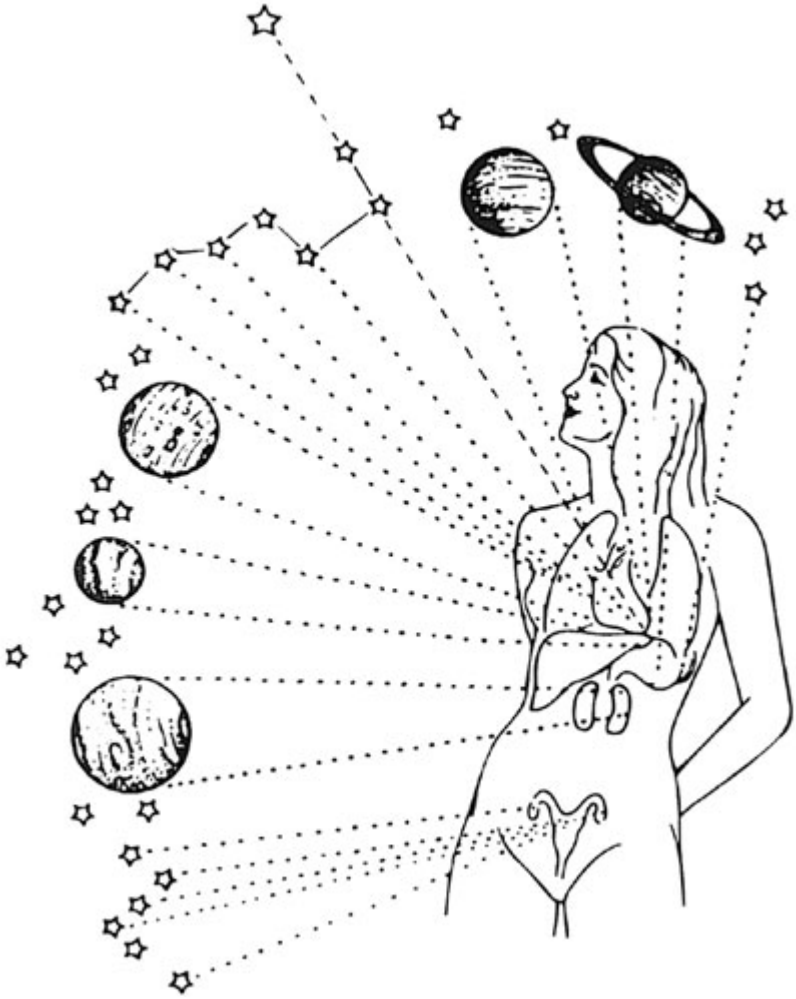

Fig. 1.5 *Organs are the essence of the stellar and planetary energies. They are also the connecting points between the microcosm and macrocosm.*

The Universal Force is concentrated on our planet because of the unique relationship between the Earth and its Moon.The combined forces of the Earth and the Moon create a very strong, magnetic power that attracts the energies of the stars in our galaxy. This force spirals down and energizes your body/mind/spirit. (Fig. 1.6)

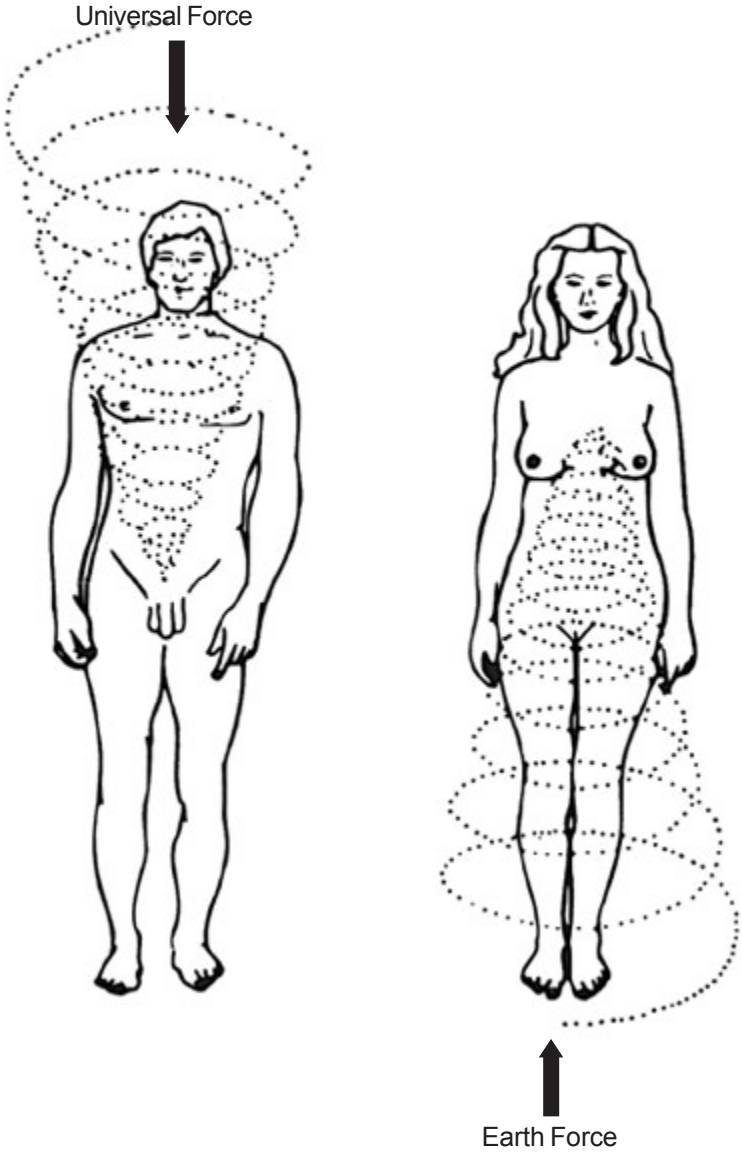

Fig. 1.6 *Universal Force descends from the heavens and the Earth Force rises from the Earth.*

Many people have a hard time accepting the notion that the stars and planets could affect our energy systems. Yet everyone is aware of the power of the sun. If the sun were to bumrn out, life on Earth would stop. Ignore its force and you are likely to end the day with a very bad sunburn. The sun is a star--the personal star of our planetary system. Many, especially women, also can feel the effect of the Moon. Because the other stars and planets are so remote, most people are not aware that they are projecting vital energy to us as well. Much of Taoist science and technique concerns itself with accessing and cultivating these additional beamed-down energies.

4. Human Plane or Cosmic Particle Energy

Human Plane or Cosmic Particle Energy is the second force of nature. Cosmic particles are part of the Original Energy that flows in space. The smallest are particles of light. Other particles resulted from exploded stars that have come to the end of their life cycles and are drifting in space as very fine particles. As the strong, magnetic power created by the Earth and Moon attracts many of these particles, they drift through the Earth's atmosphere as dust and eventually become topsoil.

It is a Taoists' belief that human flesh is formed by the falling cosmic dust of the universe. As the highest manifestation of Cosmic Particle Force, human beings breathe in its energy to nourish their organs, glands, and senses. You can gather this force easily during meditation.

5. Earth Energy

The Earth Force is the third force of nature. Yin in energy, it spirals up from the Earth (Fig. 1.6) and mixes with Yang Universal Energy. The Cosmic Particle and Earth Forces form the human physique, and the Universal Force forms the soul and spirit that energize the physical body. (Fig. 1.7)

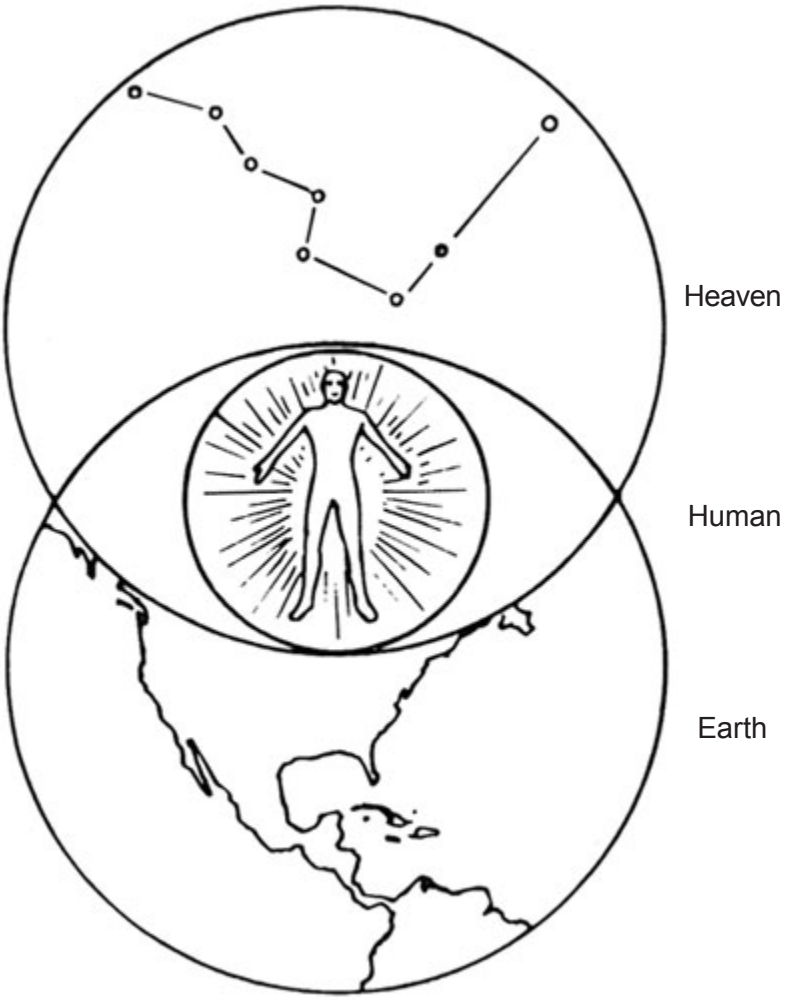

Fig. 1.7 A human being is a balance of the Universal and Earth Force

6. Chi

Chi (sometimes spelled Qi, Ki, or Ch'i) is the unseen life-force, cosmic breath, or vital force that permeates and nurtures everything under the sun, as well as the sun itself. You can conceive of it as an electromagnetic force. In humans this energy cannot be seen in its smallest unit but can be felt; its effect on the body is noticeable. Within the human body Chi flows in interconnected pathways called channels. Chi activates all body processes. Normally, Chi is accumulated through prenatal parental energy, breathing, and eating. (Food is also transformed into this invisible force.) Those trained in the practices of the Universal Tao learn that they can concentrate to draw in Chi through the eyes, hair, fingertips, tips of the toes, perineum, and entire surface of the skin.

Chi characteristics fluctuate back and forth from wave force to particle force, from having a frequency to having matter. Chi is both matter and energy. Chi is always revolving, condensing, and expanding.

Among many other things, Chi governs the mind and intention. It will do just about anything and go anywhere you ask. More than anything, its purpose is to be available to help generate life and love. As a CNT practitioner you need to know how to produce and circulate Chi in the body. You can help insure that its circulation is powerful and smooth.

If the Chi is not regulated and balanced, its control can be lost resulting in damage to the body. If the Chi cannot flow and becomes clogged, very hot or cold, or very weak, a person can become very ill.

The practice of CNT helps the Chi to flow and balance itself. Good Chi is properly flowing Chi. Bad Chi is stagnant Chi. Life is motion; death is lack of motion. Life is change and spontaneity; death is no change and rigidity.

In its full state of health and harmony, the body has the ability to monitor and regulate its Chi by itself. In CNT you try to bring the body end its Chi to a state of adaptability to any circumstance.

Similar to gold and diamonds, Chi has many different grades ranging from the very rare and ethereal to coarse. The coarsest Chi forms into matter. Another grade of Chi flows outside the channels of the body and on its surface, defending the body from

sickness. The finest Chi nourishes the most delicate body systems as well as the spirit. The body is formed from a condensed mixture of Universal Chi (Yang) and Earth Chi (Yin).

There are many expressions of Chi. The most precious is the Chi accumulated while you are in the womb. This is the Original, Prenatal or Ching Chi inherited from your parents. All Universal Tao practices encourage you to conserve this type of Chi since it is so nourishing. This Chi is the Original Force.

7. Chi and Blood

Chi and blood are the fundamental circulating energies in the body. Their condition and movement form the theoretical and practical basis for all healing in the Chinese healing arts. Blood is formed by combining Chi energy from food, Prenatal Chi or Original Force, and Chi in the air. It is a very dense form of Chi. It circulates through the heart, arteries, capillaries, and veins. Its course and function have been well charted by modem medicine. The arterial blood carries nutriments, oxygen, and nutritious Chi to all the body's cells. Venous blood is blood that has given up its nutrition and oxygen to the tissues, returning to the heart through the veins and carrying carbon dioxide to be eliminated through the lungs.

Blood and Chi flow side by side throughout the body wherever energy channels and blood vessels are parallel to one another. Chi is the motor force in blood and makes it lively, energetic, and supplies the power that allows it to course through the body. A famous saying captures their relationship, "When the Chi moves, the blood flows; if the Chi stagnates, the blood congeals."

Blood and Chi have tremendous healing power when they are full of nutrition and energy and can flow naturally and abundantly throughout the body. Problems arise with both vital energies when they are energy deficient, too hot, too cold, stagnant, or not moving forcefully enough. In practicing and teaching Chi Nei Tsang, you particularly will be concerned with the condition and flow of blood and Chi.

8. Yin and Yang

Yin and Yang are the two great polarities that emerged from the Original Chi to form all matter, including the human body. To discuss and evaluate Chi energy in the human body, it is necessary to determine whether it is Yin or Yang.

Yin is expressed as emotional, passive, receptive, empty, cerebral night, earth, interior, inertia, cold, water, dark, rest, and the moon. Yin usually contracts and flows downward and inward. Yin is hidden deep within the interior body. Intelligence is Yin in composition.

Yang is expressed as creative, full, active, day, motion, hot, exterior fire, heaven, and the sun. Yang expands and flows upward and outward. Yang is superficial; it is what you see. It is the expression of intelligence.

Although opposite in characteristics, they are not separate forces. They exist in relation to each other, having a constant and continuing influence on each other. Each holds a seed of the other, developing and eventually changing into the other. They are the front and back of the same coin. Yin and Yang are like a bar magnet with two energy poles functioning in a single energy field.

Taoists describe and define everything by the degree or proportion of Yin and Yang. Humans are created by a harmonious balance of these forces. You can stay healthy and live for a long time by keeping them in harmony. Perfect harmony means perfect health. Chi Nei Tsang aims toward achieving perfect harmony.

9. Five Phases of Chi

The Taoists observed that five basic energy transformations flow from the Yin and Yang interactions. They are the Five Movements or Five Elemental Phases of Energy, most commonly called the Five Elements. In Taoism the physical elements found in nature (wood, fire, earth, metal, and water) symbolically express the five tendencies of energy in motion. Chi passes through these phases. Thus, wood represents energy that is developing and generating. Fire represents energy that is expanding and radiating. Earth represents energy that is stabilizing and centering. Metal represents energy that is solidifying and contracting. Water is energy that is conserving, gathering, and sinking. Each of the five energies simultaneously express the interaction of Yin and Yang that is

continuously emanating from the Primordial Energy.

The Five Elemental Phases are expressions of energy that can be observed in nature and throughout the universe. In space they influence the motions of the stars, planets, and other cosmic phenomena. On Earth they manifest themselves as the four seasons: Winter, Spring, Summer, and Fall with the fifth mediating element of Earth itself represented as Late Summer. Within the human body they affect the five sets of organs: the kidneys/bladder (Water), the liver/gall bladder (Wood), the heart (small intestine (Fire), the lungs/large intestine (Metal), and the pancreas/spleen/stomach (Earth). The forces that influence the Cosmos are identical with those that affect nature and our bodies.

B. Prenatal Chi: A Human Being's Original Energy

Taoists believe that when a man and woman join to make a child, all their body's essences are condensed in the sperm (Yang) and egg (Yin). The orgasmic forces generated during the sexual union of the sperm and egg have the power to draw in and join the Universal, Human Plane (Cosmic Particle) and Earth Energies. Taoists refer to this process as the *Reunion of Heaven and Earth.* When these forces unite, they can draw in higher forces. These forces create the Prenatal Force that has no form and is like the Tao. Every new life starts with an "eyedropper" full of Prenatal Energy from the Tao.

All of these forces unite to form the first part of the embryo's Original Chi. The formation of the human body mirrors the formation of the Universe. First there is nothing. Then a human being starts to grow from the joining of one cell of the mother and one cell of the father. This is a mirror of the Tai Chi—the Great Primal Beginning. This cell generates the two primary forces of Yin and Yang which, in turn, generate three energy centers. These three energy centers form the Five Phases of Chi and the five paired organ systems whose energies extend throughout the body creating all its myriad parts. (Fig. 1.8)

From conception through the beginning of life at birth, the Original Chi remains as the force of life. As a principal force, it continues to be a dynamo of balanced Yin and Yang energy. If conserved and

carefully cultivated, Taoists contend that it could empower you forever.

The Navel Center of the body constitutes the core of your Original chi. All the functions of the body/mind/spirit revolve around the energetic Navel Center. It is the supplier of your energy, your "battery" or " power pack." It stores and transforms your most powerful energy. The area is known by the Taoists by many names. These names include the Ocean of Chi, the Sea of Energy, the cauldron, the lower Tan Tien, and the Navel Center. The Navel Center is the headquarters of our body and spirit. It is the main area you first will be concerned with and care for in Chi Nei Tsang. Later in your practice you will care for other centers.

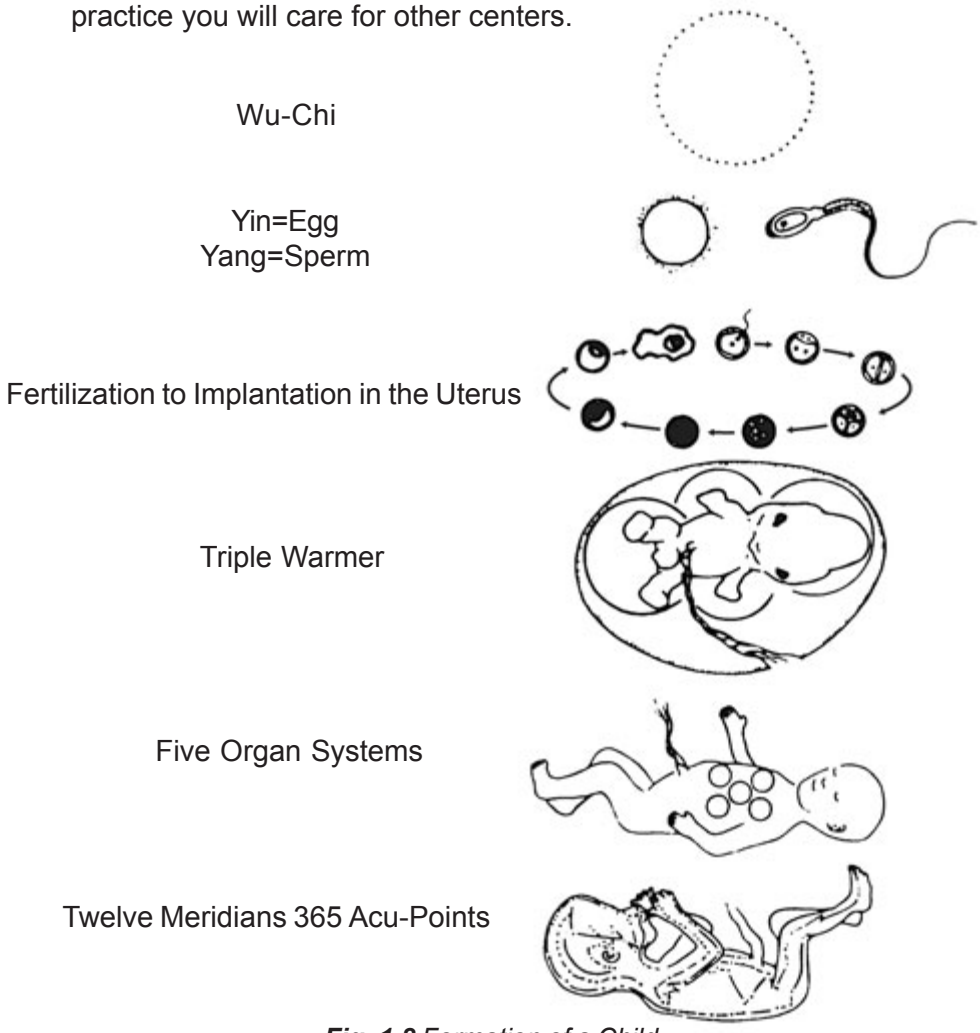

Fig. 1.8 *Formation of a Child*

C. Navel Center or Tan Tien

Although the exact location of the Navel Center can vary with each individual, it is generally located in an area centrally behind the navel and in front of the point between Lumbar 2 and 3 of the spine. Occasionally it can be found as far as one to one and a half inches below the navel. If you dissect the physical body, you will not find a Tan Tien. It is located in what Taoists call the subtle body, so the location in the physical body is approximate.

The Tan Tien is considered to be the center of the body. It is both a generator and storage place for Chi energy. Also called the "Medicine Field," it has the curative power of the Original Chi or Prenatal Energy gathered there. In Chi Nei Tsang, the energy from this center is used to help the body function normally. For Taoist spiritual practice, the Tan Tien is the chief laboratory and center of internal alchemy.

The Lower Tan Tien Center is one of three "cauldrons" (energy centers) in the body that transform energy frequencies. The Middle Tan Tien is in the heart/solar plexus and the Upper Tan Tien is in the center of the brain. The importance of the Tan Tien, or Navel Center, stems from its role in the development of the embryo.

At conception, the embryo immediately begins to divide and soon attaches to the wall of the uterus. The umbilical cord develops and through it the developing fetus is nourished. The point where the umbilical cord attaches to the baby is the baby's navel. While a fetus is still in its mother's womb, energy enters the navel through the umbilical cord. It then travels through the left kidney, then the right kidney, then down to the sexual center, through the perineum, and up through the spine to the head. Next it flows down through the tongue and back to the navel. This circulation route constitutes the Microcosmic Orbit which harmonizes the fetus' Yin and Yang energy. (Fig. 1.9)

The fetus is nourished by navel energy. Also, waste is eliminated through the navel. After birth, as the child's body grows, the body continues to eliminate toxins into the navel area. Chi Nei Tsang has many techniques that will cause the toxins to leave the navel area and the body. The Navel Center balances all forces and is the center of physical gravity. The body moves around this center when sitting, standing, or practicing Tai Chi. The Navel Center processes and transforms the Universal, Human Plane or Cosmic Particle, and

Earth Energies into life-force energy that is useful to the body. This function is similar to our physical digestive process. Taoists regard the navel as the place to transform, store, and receive the external forces. This area needs to be clear of congestion and tension so that energy can easily flow in and out. (Fig. 1.10) The importance of the navel area cannot be overemphasized.

The Navel Center is where you can unify your body, mind, and spirit. This is the body's forceful Chi Energy Center. (Fig. 1.11) If there is any problem with the energy in the Center, such as tangles, knots, blockages, or stagnation, then there may not be sufficient energy to feed the organs and their energy systems fully.

All Tao practices, including the Microcosmic Orbit, Tai Chi Chi Kung, Iron Shirt Chi Kung, and the higher practices, always end by bringing the energy back to the navel area. Energy is built up through the practices and exercises and stored in its storeroom--the Original Center. By keeping the center of the body filled with Chi and free of blockages, the energy can flow easily and powerfully, assuring good health, rejuvenation, and longevity.

Fig. 1.9 *Energy enters the human fetus at the navel and circulates in the Microcosmic Orbit, hamonizing Yin and Yang energies.*

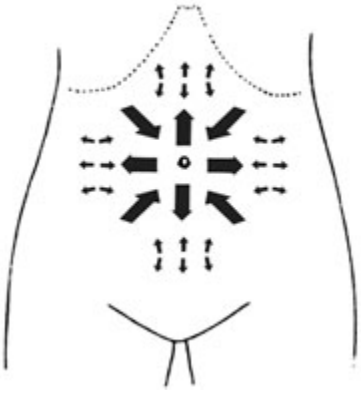

Fig. 1.10 Navel Center collects and transforms the Universal, Human Plane (Cosmic Particle), and Earth Forces into life-force energy. It needs to be clear of emotional and evironmental toxins so that energy can flow in and out.

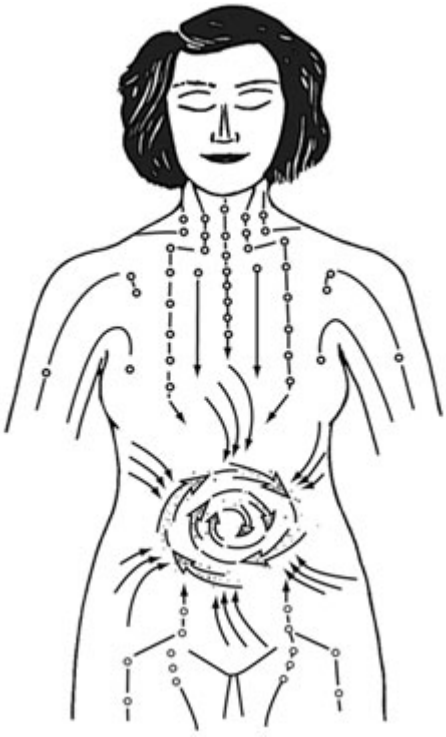

Fig. 1.11 *Navel Center is where you can unify your body, mind, and spirit. It is impossible to overemphasize its importance.*

D. Body's Channels Circulate Healing Energy

Having cleared the toxins and emotional tensions that stagnate and congest Chi and blood, the Chi Nei Tsang process revitalizes the energy in the Navel Center. Knots, tangles, lumps, masses, fibroids, fat, swellings, and tumors can form, cluster, and accumulate in the abdomen, hindering the free and forceful flow of energy from the body's generator. After having cleared the area and infusing it with Cosmic, Universal, and Earth Energies, nature takes over to restore, renew, and revive the area. Once the energy can flow forcefully in its channels and vessels, the body/spirit is well on the way to healing itself.

When you allow the body/spirit free space to gather and circulate the three energies, you have taken a big step toward developing the immortal body/spirit. Human Plane (Cosmic Particle), Universal, and Earth Energies are the immortal energies. They have been around since time began. The more energies you can receive and integrate, the more like the energies you become. These energies are drawn into the Navel Center where they are mixed, "cooked," used to form an elixir, and circulated as combined energy throughout the body. The natural gestation of these energies stimulates the formation of white blood cells and T-cells that form the basis of the immune system. They can make the body disease resistant and enhance your health for a long life.

The immortal energies' mixture has the power to make new cells and tissues and replace toxic cells and tissues. Although this kind of cellular restoration is possible, it requires constant work since the health of new cells continuously deteriorates. If practiced regularly the Universal Tao process will allow you to gather and store enough energy to keep you well ahead of the day-to-day needs of cells and tissues. You will be able to provide for their needs and have energy left over. With these additional energies you can begin slowly to build a new body/spirit composed of immortal energies.

1. Channels

The channels (often called meridians or routes) form an energy distribution network that connect and integrate all parts of the body. (Fig. 1.12) Joined internally to the organs, the channels flow to the surface of the body and connect the limbs and sensory organs. Chi flows through the channels. Chi Nei Tsang work helps to provide the proper energy to the organs and their systems.

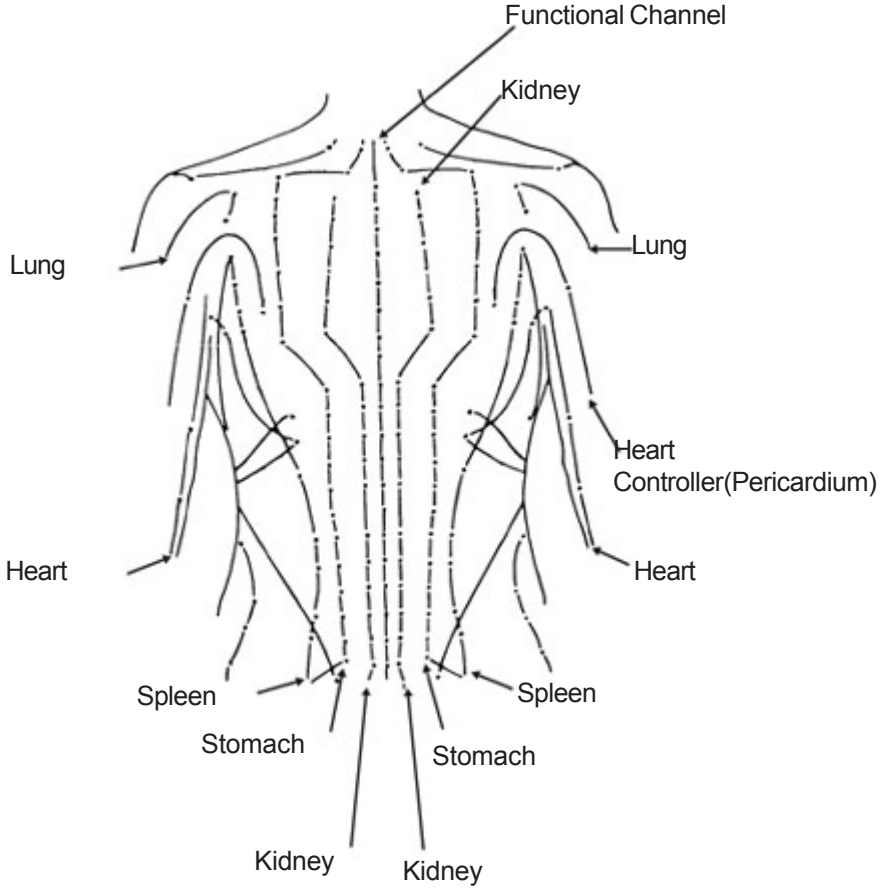

Fig. 1.12 *Meridians of the torso form part of the network of energy channels.*

2. Microcosmic Orbit

a. Governor Channel

The Govenor Channel moves the Yang Chi (Heavenly, Universal Energy) combining it with the Yin force that it channels up from the Earth. It runs from the perineum, up the spine, to the head. At the head it enters the brain, runs over the crown, down to the midpoint between the eyes, and ends at the roof of the mouth where it connects with the Functional Channel. (Fig. 1.13) The Governor Channel, sometimes called the Ocean of the Yang Channels, can feed the combined energies to all six Yang channels that constantly reunite and flow in and out of it. This channel is closely associated with the brain, spinal fluid, and the reproductive system. Abundant energy flowing through this channel can help to strengthen and lengthen the spine. You will feel taller and stronger.

b. Functional Channel

The Functional Channel moves the Yin Chi (Earth Energy) and helps channel the Yang force down from the Heavens to combine it with the Yin force. It normally runs up the front of the body from the perineum to the tip of the tongue. (Fig. 1.13) When this channel is opened during the Microcosmic practice, its flow is reversed to run down the front of the body as it did when in the womb. Thus, the Taoists learned to restore its prenatal flow. The Functional Channel, sometimes called the Ocean of the Yin Channels, can feed its combined energies to all six Yin channels that join it. This channel governs the fetus and the menstrual cycle.

3. Thrusting Channels

The Thrusting Channels are very important and powerful energy routes in the body. They are in vertical alignment with the spine, and they most directly connect the Universal and Earth Energy's axes in men and women. If the energy from the Navel Center can flow powerfully through these routes, the organs and glands can be detoxified and energized.

Each channel is approximately one to one and a half inches wide. The Fusion II practice opens the Thrusting Channels to a much wider width. It also increases your awareness of these channels. Nonetheless, these channels are open and working to some extent in everyone.

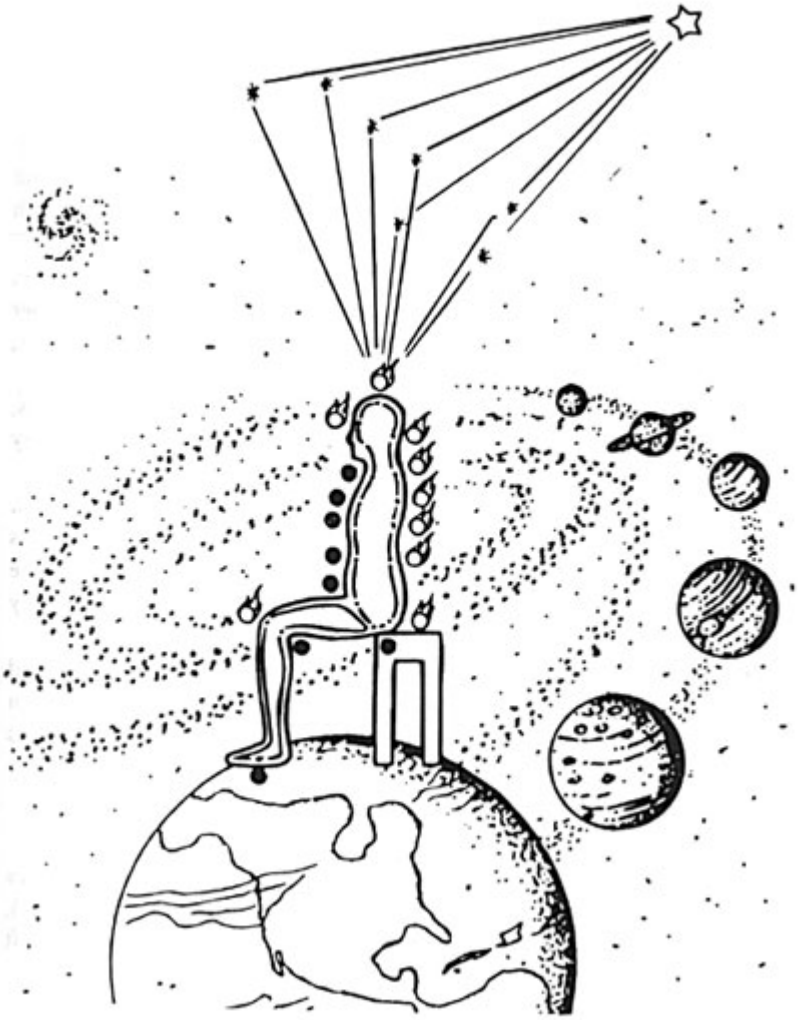

Fig. 1.13 *Functional Channel (black dots—Yin) and Governor Channel (flaming balls—Yang) help absorb and circulate three basic energies.*

Because the Thrusting Channels are connected to all the channels, they are considered a part of the Sea of the Twelve Channels. Thus, they can feed energy throughout the body.

Acupuncturists use the Middle Thrusting Channel, the Chong-Mai, to break up congested Chi and blood in the abdomen and chest. This channel is called the Sea of Blood. If you can clear out congestion in the abdomen and organs and vitalize the Navel Center, energy can flow freely through the Thrusting Channels to fortify the body.

The Thrusting Channels also extend down both legs to the feet and can be used to bring Earth Energy up into the lower cauldron. when practicing Chi Nei Tsang, you will be able to use the Thrusting Channels to draw in the Universal and Earth Energies and transfer them directly to your student.

a. Left Thrusting Channel

The Left Thrusting Channel starts in the left testicle (in men), passes through the left perineum, left side of the anus, left ovary (in women), left kidney, spleen, heart, lung, left parathyroid and thyroid glands, left ear and eye, and left hemisphere of the brain. (Fig. 1.14)

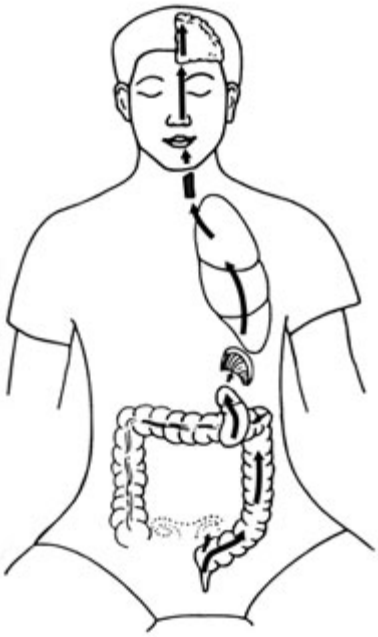

Fig. 1.14 *Left Thrusting Channel*

b. Middle Thrusting Channel

The Middle Thrusting Channel starts at the middle of the scrotum (in men), passes through the perineum, middle of the anus, cervix (in women), prostate (in men), aorta, vena cava, pancreas, stomach, part of the liver, heart, thymus gland, throat, tongue, pituitary, hypothalamus and pineal glands, and crown. (Fig. 1.15)

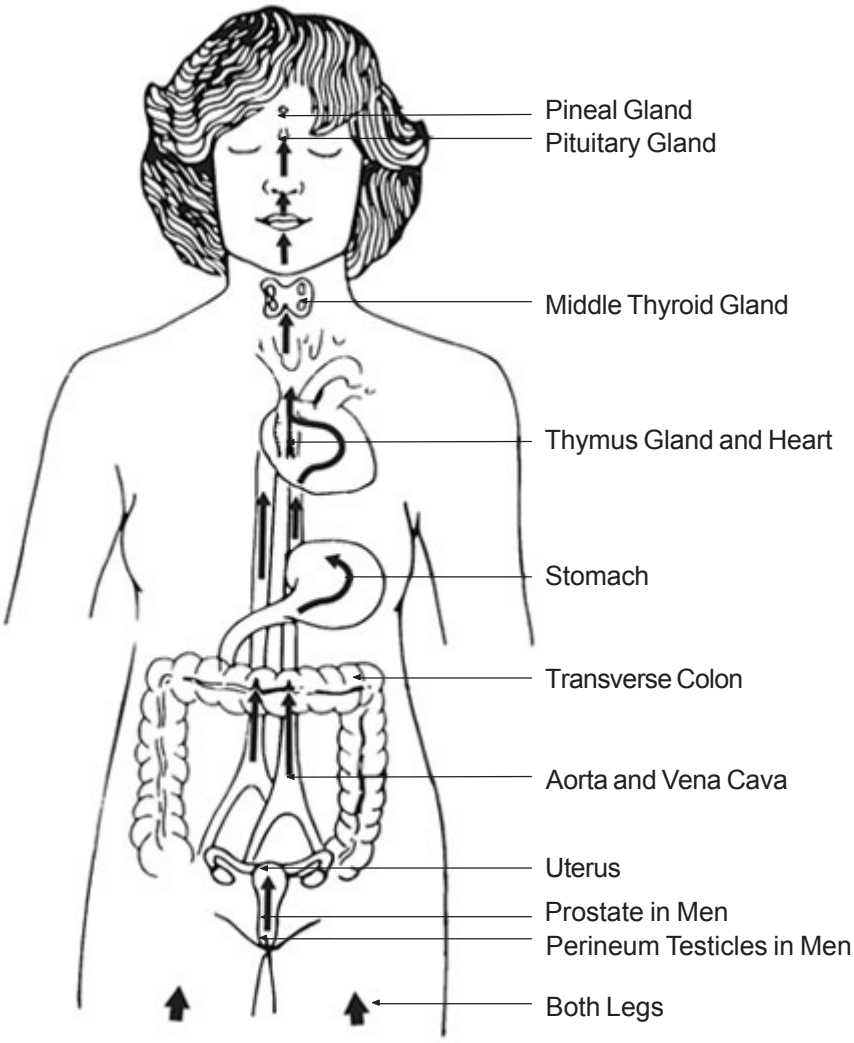

Fig. 1.15 *Path of the Middle Thrusting Channel*

c. Right Thrusting Channel

The Right Thrusting Channel starts from the right testicle (in men), passes through the right perineum, right side of the anus, right ovary (in women), right kidney, liver, lung, right parathyroid and thyroid glands, right ear and eye, and right hemisphere of the brain. (Fig. 1.16)

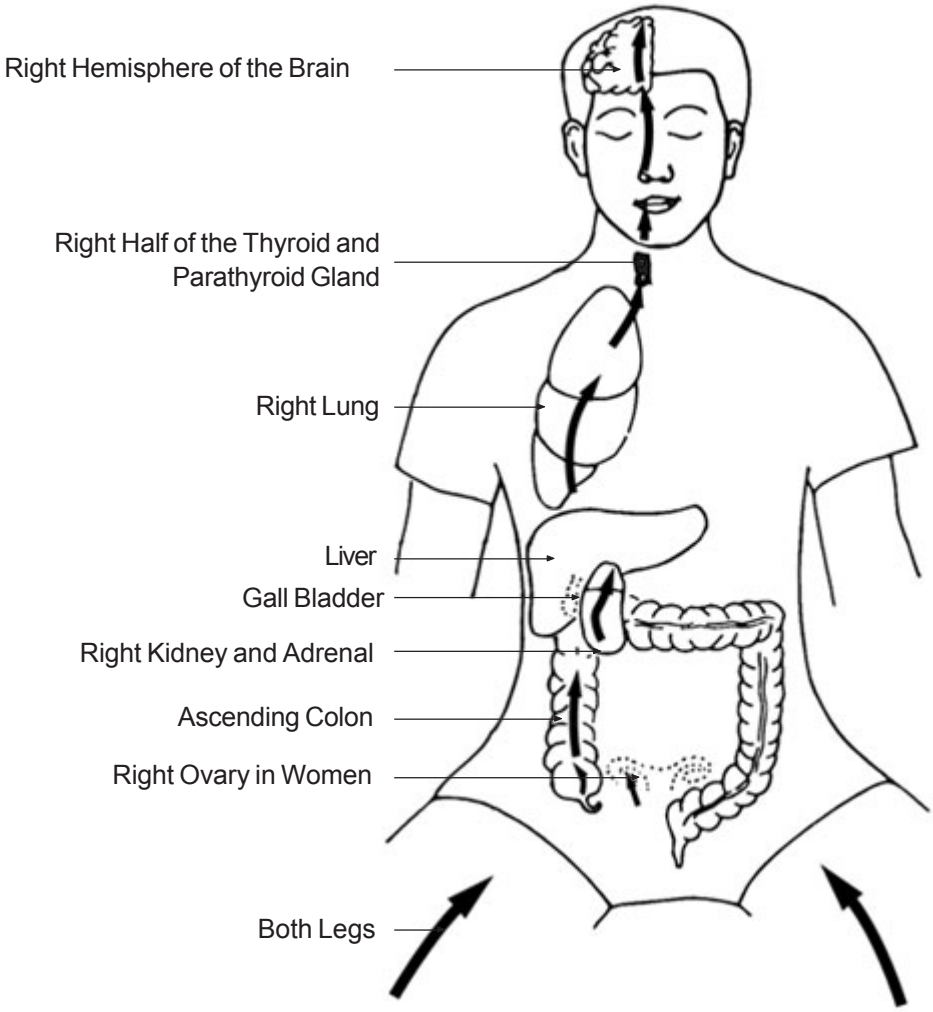

Fig. 1.16 *Path of the Right Thrusting Channel*

d. Three Thrusting Channels

The three Thrusting Channels form a central energy route. The Universal and Earth Energies flow up or down them through the navel region. (Fig. 1.17) They are interior to the Microcosmic Orbit.

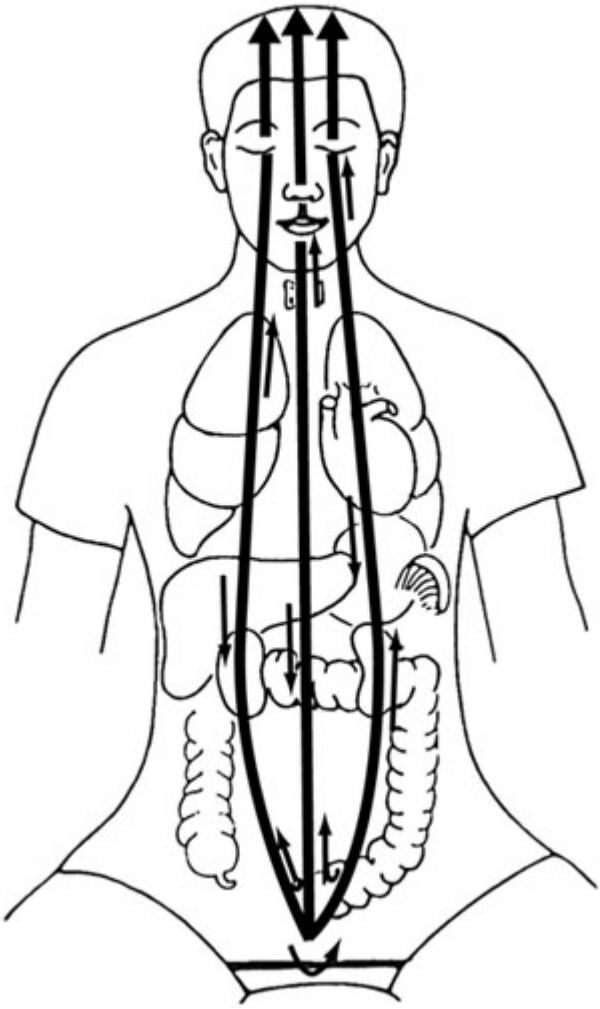

Fig. 1.17 *Three Thrusting Channels*

4. Belt Channel

The Belt Channel encircles the body with energy. Its circles protect and feed Chi to the surface of the body and help ward off negative energy from outside the body. Starting at the navel the Belt Channel crosses and encircles all the main energy centers of the torso, head, and legs. It connects and binds all the channels that run up and down the body, including all the pathways passing through the abdomen. (Fig. 1.18)

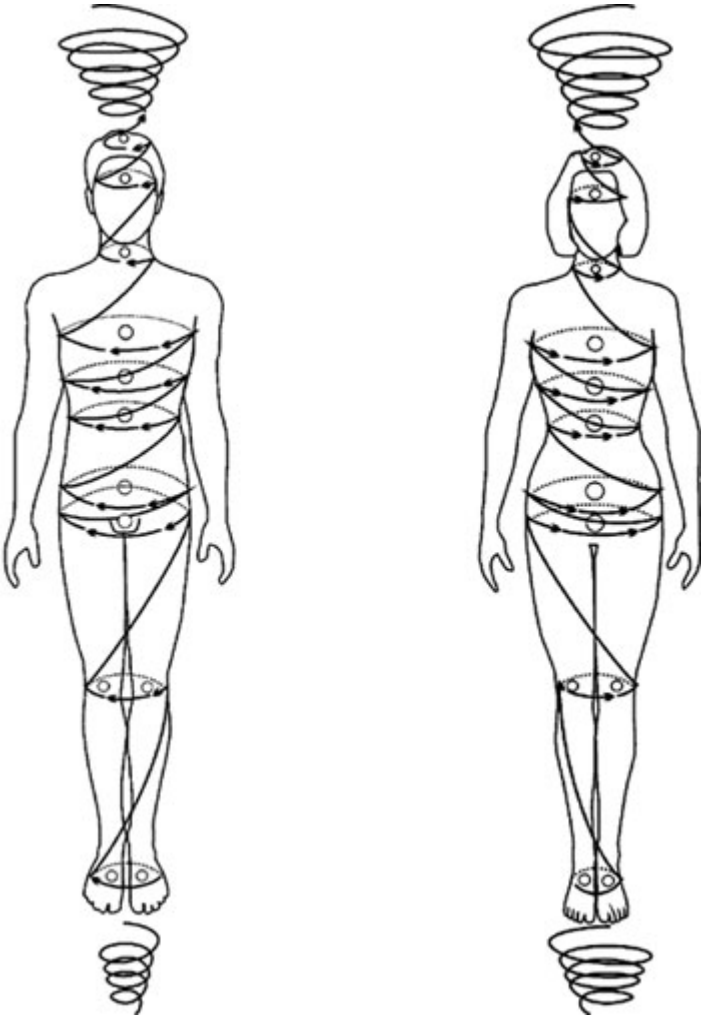

Fig. 1.18 *Belt Channel*

A cross section of the navel area shows that the Belt Channel connects all the vertical channels. At the front of the body, the Belt Channel connects with the Functional Channel. As the channel moves to the left side, it connects with the Left Thrusting Channel. In the back it connects with the Governor Channel. To the right it connects with the Right Thrusting Channel. Returning to the front, it completes the circle. (Figs. 1.19, 1.20, and 1.21)

Energy traveling around the Belt Channel can move clockwise or counterclockwise. In addition, the vertical channels (Thrusting and Microcosmic) are also linked and bridged. Chi can flow up, down, in circles, right and left, and to the front or back.

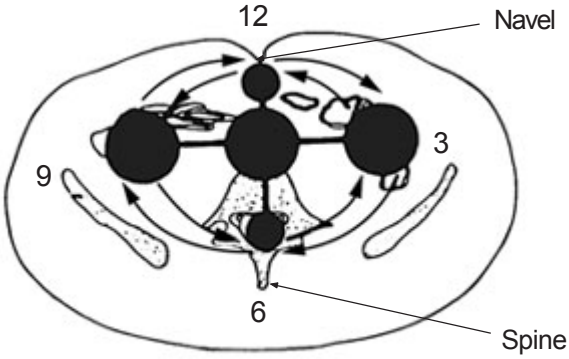

Fig. 1.19 *Belt and Thrusting Channels at the Level of the Navel. These energy channels run thoughout the body and are interconnected by energy bridges permitting energy to flow in many directions.*

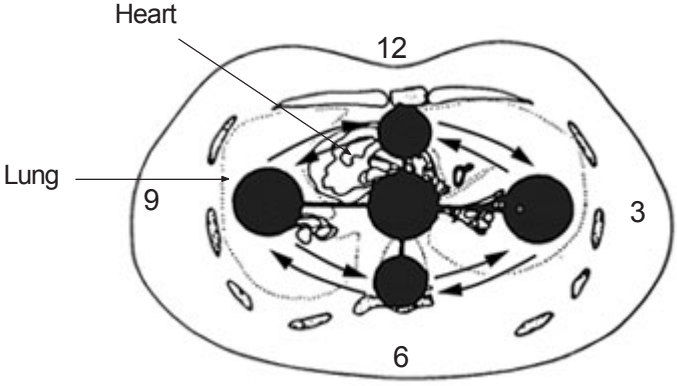

Fig. 1.20 *Belt and Thrusting Channels at the Level of the Heart*

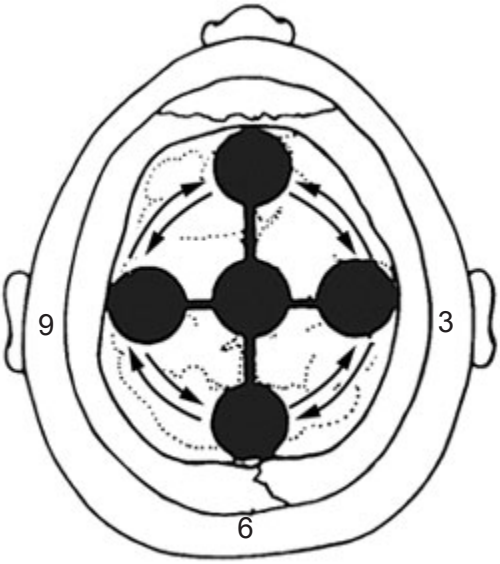

Fig. 1.21 *Belt and Thrusting Channels at the Level of the Crown*

5. Triple Warmer

The Triple Warmer is not recognized in Western medicine, but the Taoists believe it is Yang in quality and has three parts. The upper part includes the head, the heart, and the lungs. The middle part includes the digestive system. The lower part includes the kidneys, the lower intestines, and the reproductive system. (Fig. 1.22) The Chinese believe that the Triple Warmer is also related to the hypothalamus, the part of the brain in charge of basic life functions including appetite, body temperature, and fluid balance. CNT "tunes up" the Triple Warmer by harmonizing its three parts, thereby maintaining its good working condition.

The Triple Warmer is the body's thermostat, air conditioner, and heater for the energy that is flowing through it. When the heart is overheated, the Triple Warmer circulates heat down through the Middle Warmer to the lower area in the loins. There the hot energy is cooled and circulated beck to the heart where it can help cool it. The descended warmth prevents the lower cool energies from becoming too cold.

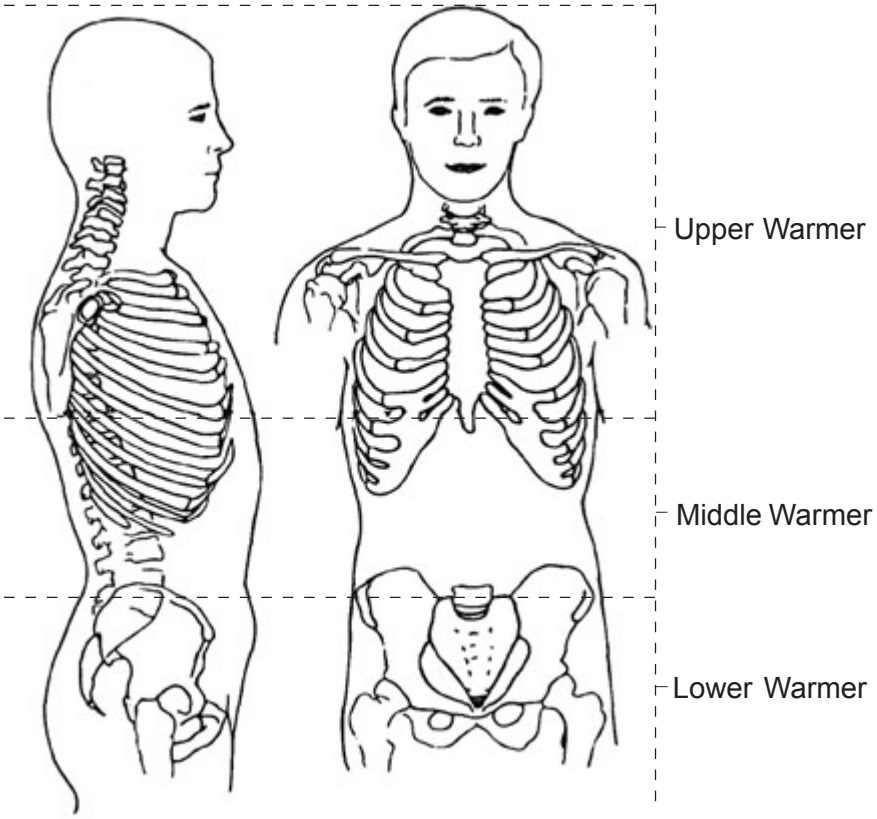

Fig. 1.22 *Triple Warmer*

6. Fasciae-Protective Layers of Chi

The fasciae are tissues that are the protective layers of every organ. They need to be moist to allow the free flow of energy. They are of varying thickness and strength and are found in all regions of the body surrounding the softer, more delicate organs. Medical books list 120 different types of fasciae. The deep and superficial fasciae hold our skin, muscles, bones, organs, and systems together, offering them a shield of protection and lubrication. (Fig. 1.23)

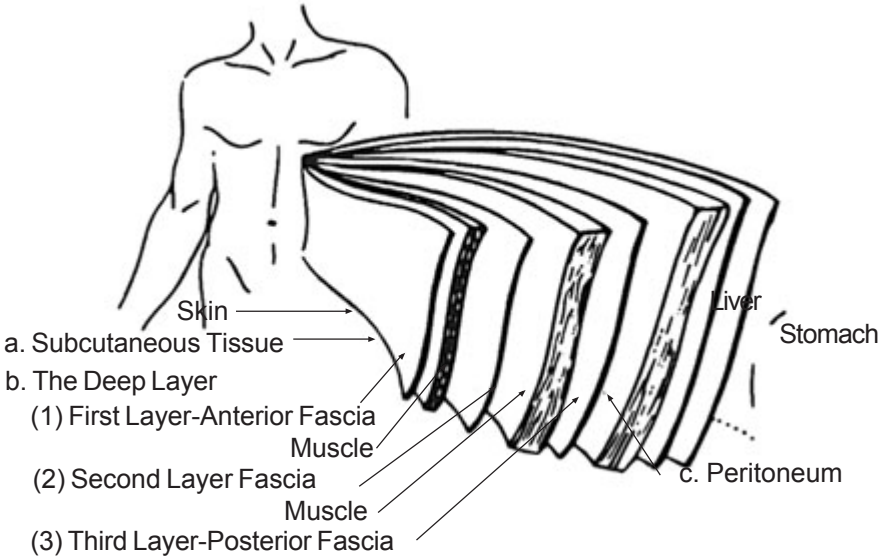

Fig.1.23 *Three Layer of the Fasciae of the Skin*

Fasciae are structures for Chi. Large amounts of Chi can be packed into the fasciae to make them strong and keep them moist. When they are deficient in Chi, they become dry, hard, and brittle. The fasciae are the conduits of Chi flowing in the body. The organ channels pass through the fasciae. When the fasciae are dry, Chi cannot flow well and the body can feel stiff and hard. Movement can become painful.

Good Chi flow through the fasciae means good flow everywhere. Healthy fasciae means good energy, flexibility, and structural integrity. Healthy fasciae feel like taut sheets of strong, thin material offering a flexible shield of protection. As you practice Chi Nei Tsang, especially skin detoxification, you are improving the fasciae and the organ or system you are focusing on.

The abdomen has many levels of fasciae; in fact, it has the greatest concentration of fasciae in the body.

E. Body's Energy Grid and Center

In combination all of these channels comprise the body's energy grid. The body is sufficiently well wired to send energy where it is needed. It is crucial that the abdominal region be clear so that pure energy coming from the energetic core is always free to flow. (Fig. 1.24)

The Navel Center is the doorway between the physical body and the energy body. All energy channels that create and sustain the physical body emerge from there and return there. You can feel and experience it. The Tan Tien is the Ocean of the Real Elixir (Original Chi, the mother of the body's energies). Original Chi can heal the human body and restore it to its original wholeness. The water from the cosmic, mother womb which flows into your body through the doorway of the Navel Center restores health and purity and balances cells. If blockages build up around its passageways, this marvelous energy cannot get through. Chi Nei Tsang massage can open the way for it so it can help restore your vim and vigor.

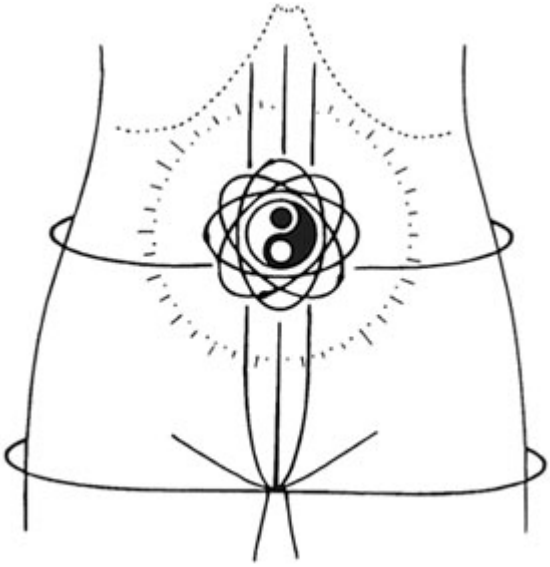

Fig. 1.24 *Navel Center and the Energy Grid this center feeds to the body/mind/spirit via the vertical and horizontal channels.*

F. Taoist View of the Human Energy System

1. Five Phases of Chi (the Five Elements)

The five energies that give birth to the Universe also form the organs and the personality. (Fig. 1.25) Thus, each human being, as a microcosm of these same elemental energies, reflects the Universe and its interacting forces. At the human level these Five Phases of Chi are constantly energizing and returning to the primordial Chi within the body's three Tan Tiens (navel, heart, and head). This is why Taoists view human beings as a microcosmic copy of the macrocosmic forces.

The organs and bowels each emanate their special form of Chi. The variety of energy relationships among the Five Phases of Chi allows the skilled Chi Nei Tsang practitioners, using techniques described in Chapter 3, to figure out the strengths and weaknesses of the prevailing energies and to respond to them.

One way to perceive the state of the body, the mind, and the spirit is through constant observation of the Five Phases and of the Yin and Yang components of all processes in Heaven, on Earth, and in human beings. Although conditions are constantly changing, they do so according to the Laws of Nature which constantly repeat themselves. In observing the seasons you can, if you are keen, see what is coming. This is no easy task, but the tools are available. You can learn to use them.

Author John Blofeld in his book, the *Quest for Immortality*, has captured the essence of the Taoists' understanding of these Five Phases as follows:

> "The Five Elements are not elements so much as activities. The sages who devised the science recognized five main types of natural processes whose interactions bear a certain resemblance to the interactions of wood, fire, earth, metal and water, the affinity being more allegorical than actual. They understood that nature's workings depend upon a system of fine balances among processes that may help, hinder or block one another according to the relative strength of each in a given situation. Having devoted much of their time to tranquil contemplation of nature, they had watched these sometimes conflicting forces at work and learnt to

predict the outcome of such conflicts, or even to manipulate that outcome within certain narrow limits, as when one...diverts the water in a stream. Mastery of the five element science conferred a degree of foresight that amounted to divination and the power to divert the course of nature in ways that must often have seemed spectacular to the uninitiated." (p. 6)

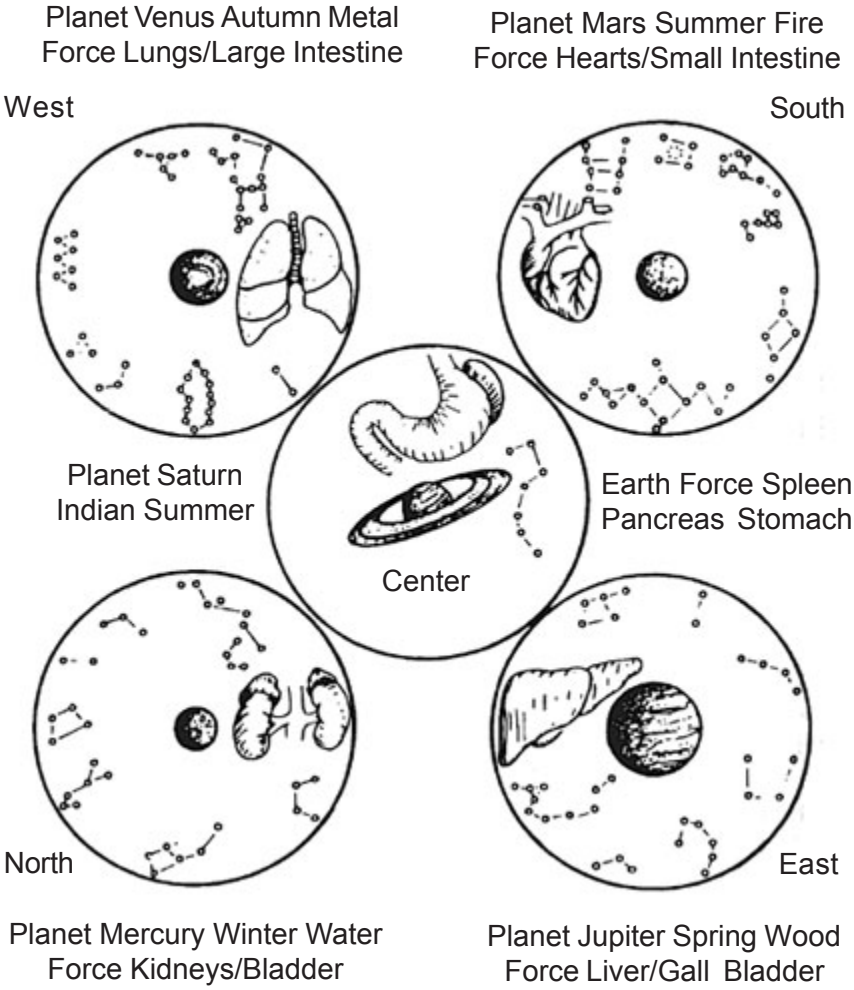

Fig.1.25 *Five Energy Phases, the Constellations, and the Organs Associated with them.*

a. Wood Phase of Energy and the Liver/Gall Bladder

The liver is the general in charge of defending the body. It is in charge of the smooth, unhampered flow of Chi and blood to all parts of the body. Its Chi flows upward and outward and approaches from the planet Jupiter and the East. The liver is associated with the Spring season. This energy is most powerful between one and three a.m.

The liver provides a growing, generating, developing, warm, moist, and fertile type of energy. Wood energy recalls that of an equatorial morning sun, the promise and potentiality of a newborn child, the rising sap in a young tree, or the full, abundant energy of a swollen spring river.

The liver stores and filters the blood, regulates the blood supply, and produces proteins. It also stores toxins until it has the time to transform them into healthy energy.

If the liver's Chi and blood is healthy, balanced, and abundant, then the nails will be healthy, the vision clear, the nerves calm, and the sinews and tendons will have sufficient energy.

The positive quality of the emotion in Wood is kindness tempered with intelligence. One tends to be cool-headed, discreet, relaxed, clear minded, creative, progressive, constructive, conciliatory, and willing to work with others.

The negative qualities of the Wood phase's emotion are anger, violence, or making big plans without knowing what one is doing. One tends to be opportunistic, short-tempered, hot-headed, loud, tight, pressured, rough, obsessed, stubborn, pedantic, formalistic, competitive, and antagonistic.

The idea that anger can affect the liver is recognized in the English language as the word "liverish," meaning irascible or short-tempered and full of anger.

Once sober, many recovering alcoholics who spent years poisoning their livers (for the liver collects toxins) are able and embarrassed to see how rough and full of anger they once were They are grateful and pleasantly surprised to discover that once they have stopped drinking, they are very gentle and solicitous about the feelings of others and are often overcome with many spontaneous acts of human kindness.

b. Fire Phase of Energy and the Heart/Small Intestine

The heart is the ruler of the body/mind/spirit. It transforms Chi and blood and is in charge of the circulation of the blood. Its Chi flows upward to the brain and downward to balance the organs. This Chi approaches from the South and from the planet Mars. It is associated with the Summer season. It is most active from eleven a.m. to one p.m.

The heart is the home of the spirit. The spirit comprises the best energy from all the organs: joy, compassion, courage, fairness, gentleness, kindness. The presence (or absence) of these qualities determines the personality.

Although the energies of all the organs are important because they balance each other and allow us to live varied and interesting lives, the heart is the favorite organ in every culture. In Chinese medicine, the heart is known as the Emperor of the Five Vital Organs. Its function is to issue the Imperial Fire Energy of love and compassion.

English speaking people recognize the warmth and centrality of the heart in such expressions as heart-warming, heartthrob, heart of gold, heart-to-heart, hearten, hearty, heart and soul. Those humans with negative energy in the heart are called heartless or hard-hearted. Their callousness often causes others to feel heartsick.

Fire Chi is youthful but mature energy that is available at any age. It is expansive and vigorous. It is like the energy of the full bloom of Summer. It fuels art, inspiration, creativity, the force of genius, and many functions most vital to the person, family, and society.

Fire Chi feeds the face and eyes. It is easy to recall the face of an absent friend who has abundant heart Chi, for his or her face has a radiant, rosy lustrous complexion and is bright, sparkling, and lively.

It is not surprising to learn that this energy also powers the will and feeds hormones and the endocrine system. As you continue working with the Fire Force, you will become more familiar with its central role and can teach your students how they can protect their Spirit and kindle a steady Fire Chi and warm glow.

The positive qualities of emotion in Fire are joy, happiness, spirituality, lovingness, virtuosity, heartiness, warmth, patience, respect, politeness refinement, brightness, and concern.

The negative aspects are cold, cruel, vicious, inconsiderate, obsequious, thoughtless, tasteless, impatient, dull, humorless, and hateful.

c. Earth Phase of Energy and the Spleen/Pancreas/Stomach

The Earth Force approaches from Saturn and is associated with the center of all directions.

If Wood is the infant or growing Chi, and Fire is the maturing, young adult Chi, then the Earth Force is the fully mature, adult Chi. Earth Chi provides a stabilizing energy. If the body/spirit was all Fire, one can easily burn out. Like a beautiful fiery comet, one can present a startling and glowing display, but a display that is too short-lived. The opposing force of the Earth Force is Water, powerful as an iceberg or glacier. If the body/spirit was all Water energy, then one could be considered cold and withdrawn.

The Earth Force refracts all the other energies as they pass from one phase to another. In this way it introduces a mediating factor in our systems that helps to balance and blend the other energies. This fits in with the central location of the spleen, pancreas, and stomach. This Earth Energy controls thought and provides mental clarity. It allows the kind of energy that is necessary to evaluate and review our lives and make necessary adjustments.

The spleen, pancreas, and stomach are the organs through which the Earth element functions. Operating like a switchboard, it is in charge of absorbing, forming, and transporting the energy and Chi from food. The Earth produces food and, so, the Earth Energy is the energy of Indian Summer or harvest time. In almost every land and culture, this is the time for assessment, reflection, planning, and preparation. This is when we feel the first chill of Autumn, which usually makes us momentarily ground and stabilize ourselves so that we can make sure that we are prepared for the coming Winter.

The positive qualities of Earth Energy are associated with sensitivity to others and feeling spontaneous, fair, open-minded, genuine, harmonious, centered, rooted, balanced in desire and appetite, punctual, synchronized, sociable, and hospitable.

Being prejudiced, overly prepared (not spontaneous), and too worried are the negative qualities of Earth. Timing is always off and one is always too soon or too late. The person lacking abundant and balanced Earth Energy tends to be artificial, fake, awkward,

disconnected, and imbalanced. Desire turns to envy. Any negative traits in the other four phases are amplified without the moderating influence of strong Earth Energy. The appetite turns into craving or there is no appetite at all. One becomes unfriendly and inconsiderate.

The English and French languages both contain a word that indicates that at one time people in the West were aware of the potential negative emotional content of the spleen, and the havoc its negative qualities of worry and anxiety could create. The words are splenetic and spleneitique, respectfully. Webster's dictionary defines splenetic as, "bad-tempered; irritable; peevish; spiteful; spleenful."

d. Metal Phase of Energy and the Lungs/Large Intestine

The force of Metal is said to be linked with the planet Venus, approaches from the West, and is strongest during the Fall season. Its energy is most active between three and five a.m.

Metal is the energy of the lungs. The Chinese word for this energy is gold which implies the highest and most evolved quality of metal.

It is appropriate that the Taoists named this phase of Chi Metal for the lungs are the body's energy forge. In the lungs Chi from the air mixes with Chi from food and Prenatal Chi to produce blood and two refined Chi's: nutritious and defensive. These types of Chi combine with the Prenatal Chi stored in the kidneys.

Nutritious Chi is the hardest working Chi in the body. It travels with the blood and in the channels throughout the system. When you feel full of energy or need a burst of energy you are drawing upon your reservoir of nutritious Chi. When abundant, this Chi warms the feet and hands, moistens the skin, and grows luxuriant hair.

The lungs also control the skin, pores, and sweat, and brings into play defensive Chi. Defensive Chi travels from the lungs to the surface fasciae. It inhabits the cells of surface skin as well as beneath the skin. When the Taoists developed Iron Shirt and Golden Bell, two legendary kung fu forms, they mastered the development of defensive Chi. They could pack the fasciae and concentrate the Chi on the surface so that they invincible and could absorb a punch or deflect a knife thrust.

Keeping defensive Chi plentiful and abundant works to your advantage because it protects you from outside germs and viruses that want to invade the body. These can include winds, dampness, flu, tuburculosis, and others.

The skin is also known as “the third lung” both in the East and West and helps the lungs eliminate carbon dioxide. In the Taoist exercises of Bone Marrow breathing, one learns to draw in Chi directly through the pores of the skin.

Good Metal Chi, like the Autumn air, helps one to experience clear, crisp, sharp, cool, and dry sensations and mental states.

Serious and sober, it is the energy of a steady gaze and heroic determination. This is the energy one can call upon to resolve any contradiction and get the job done. Metal energy fills one with courage, purity, rectitude, solidity, sharing, generosity, and forgiveness.

The negative qualities of Metal include hypocrisy, grief, sadness, depression, dishonesty, affectation, confusion, unreliability, irresponsibility, pettiness, stinginess, jealously, and resentment.

e. Water Phase of Energy and the Kidneys/Bladder

Water, associated with the kidneys, is the foundation energy in the body which feeds energy to all the organs. When it is abundant, the body is balanced, beautiful, and powerful. It is crucial to keep the kidneys healthy, producing this vital energy. All the organs are vital. If any one of them became dysfunctional, you could become very ill. If matched according to the vitality of the energy they can produce, the kidneys would easily be the most powerful. The Water phase is also associated with the planet Mercury, approaches from the Northern direction, and corresponds to the Winter season.

The Winter is a time for gathering and conserving. External life is chilled or frozen, but life continues internally. This is the season of hibernation both for bears and humans snowbound in warm homes and cabins. Trees, seeds, animals, and people are all saving and conserving their energies until they can again welcome the Spring-the season of growth and renewal.

Water means life. It is the element of birth, growth, purification, cleanliness, regeneration, and renewal. It is also the essence of the Earth. Life energy arises from the Water element. This follows most theories of evolution that portray the human being as a life form that emerged from the sea. The life that water gives also can be taken away by destructive floods or tidal waves.

The kidneys store the energy passed down from our ancestors and parents. The kidneys govern all the crucial functions of life

including birth, growth, reproduction, sexuality, and aging. Taoists say the kidneys also store the energy that determines the length of your life.

The negative emotion of fear originating in the kidneys can adversely effect the kidneys and the bladder, its paired organ. One sometimes hears stories of soldiers or airmen frightened in battle who have lost control of their bladder.

If you are balding, and it is not due to congenital defects, it is because you have a problem with the kidneys. The kidneys determine the strength of the bones and the health of bone marrow. They can also affect brain matter and can influence whether you are smart or dull-witted. Beside controlling hearing they are also in charge of the urethra, bladder, urine, and sperm. One of the most vital function of the kidneys is their control of the uterus.

Water controls the will; a strong will means that Water energy is abundant. If the kidneys' energy is weak, you may lose the power to decide what happens to you in your future.

The positive emotions of the Water phase of Chi are connected with a prudent, sensuous, and persistent power of alertness. Strong kidneys' energy helps to create men and women who are cool, comfortable, and unafraid, as opposed to those who feel cold, wet, and terrified.

Gentleness is the positive quality associated with Water energy. It is implied in the smooth rhythms of a bubbling brook, the placid calm of a high mountain lake, or the gentle but powerful movement of waves arising from the oceans' great depths.

Fear, as a negative emotion of Water, is fast and constricting. Other negative emotions are lewdness, paranoia, impermanence, coldness, small-mindedness, scatteredness, stagnancy, and running in circles without getting anywhere.

2. Chart of the Five Phases of Energy

A Chart of the Five Phases of Energy (Fig. 1.26) presents the qualities and relationships of Wood, Fire, Earth, Metal, and Water. Study and refer to it often and learn to distinguish their differences.

Element / Quality	Wood	Fire	Earth	Matal	Water
Yin Organ	Liver	Heart	Spleen /Pancreas	Lungs	Kidneys
Yang Organ	Gall Bladder	Small Intestine	Stomach	Large Intestine	Bladder
Positive Emotions	Kindness	Love,Joy, Respect	Fairness, Openness	Uprightness, Righteousness, Courage	Gentleness
Negative Emotions	Anger	Hate, Impatience	Worry, Anxiety	Sadness, Depression	Fear
Planet	Jupiter	Mars	Saturn	Venus	Mercury
Direction	East	South	Center	West	North
Quality of Energy	Growing, Developing,	Expanding, Radiating Generating	Stabilizing	Contracting	Conserving, Gathering
Growing Cycle	Seed Sprouting, Leaves Growing	Bloom, Fruit Growing	Fruit,Ripening, Harvest	Seed Falling	Dormant
Season	Spring	Summer	IndianSummer	Fall	Winter
Passage on Earth	Infancy	Youth	Adult	Old Age	Death
Body's Sound	Shouting	Laughing	Singing	Weeping	Groaning
Taste	Sour	Bitter	Sweet	Spicy,Pungent	Salty
Nourishes the	Nerves, Tendons	Blood Vessels, Vascular System	Muscles, Flesh,Fasciae	Skin	Bones, Teeth
Opens into and Commands the	Eyes	Tongue	Lips,Mouth	Nose	Ears
Temparature	Warm&Damp	Hot	Mild	Cool&Dry	Cold
Produces	Tears	Sweat	Saliva	Mucous	Urine
Body Scent	Rancid, Goatish	Burned, Scorched	Fragrant	Rank,Fleshy	Rotten,Putrid
Expands into	Nails	Facial Color	Lips	Body Hair	Hair on Head
Color	Green	Red	Yellow,Brown	White	Black,Dark,Blue
Sound	Shhhhhhh	H a w w w w w w	Whoooooo (Gutteral)	Sssssssss	Wooooooo

Element / Quality	Wood	Fire	Earth	Matal	Water
Function	Control & Decisiveness	Warmth, Vitality, Excitement	Ability to Integrate,Stablize, Feel Centered & Balanced	Strength & Stability	Ambition & Will Power
Relationship to Vital Function	Nervous System	Blood, Hormones Endocrine Systems	Digestion, Lymphatic & Muscular System	Respiratory System	Reproductive & Urinary System
Relationship with the Blood	Stores & Filters the Blood	Circulates the Blood	Stores& Cleanses the Blood	Eliminates Co_2 & Other Toxins, Oxygenates the Blood	Produces Blood in the Bone Marrow
Relationship with the Digestion of Food	Manufactures Proteins, Recycles Poisons, Distributes Nutrition	Absorption& Selection of Food in Small Intestine	Monitoring Food Intake,Sends Energy to Each Organ According to Taste	Elimination Through Large Intestine	Monitoring
Relationship to the Chi	Has a Warming Effect	Has a Heating Effect	Has a Balancing Effect Drying	Has a & Cooling Effect	Has a Chilling Effect
Animal Spirits	Green Dragon	Red Pheasant	Yellow Phoenix	White Tiger	Black Tortoise
Spiritual Home	Spiritual Souls	Spirit	Decision	Animal Souls	Intention
Mental Aspect	Mental Clarity	Intuition	Spontaneity	Emotional Sensitivity	Will Power, Creativity

Fig. 1.26 *Chart of Relationships of the Five Phases of Energy*

G. Laws of Creation and Control

1. Law of Creation

The Law of Creation establishes a cycle and an engendering Mother and Child relationship among the Five Phases. Spring/Liver/Wood provides the nourishment and helps maintain its child, Summer/Heart/Fire. This energy engenders, mothers, nourishes, and maintains its child, the Harvest/Spleen/Earth. The Harvest bears and brings forth the Autumn/Lungs/Metal which fosters the coming of Winter/Kidneys/Water. Winter ends the cycle, but in the way that it has always been, Winter will soon awaken the Spring. (Fig. 1.27)

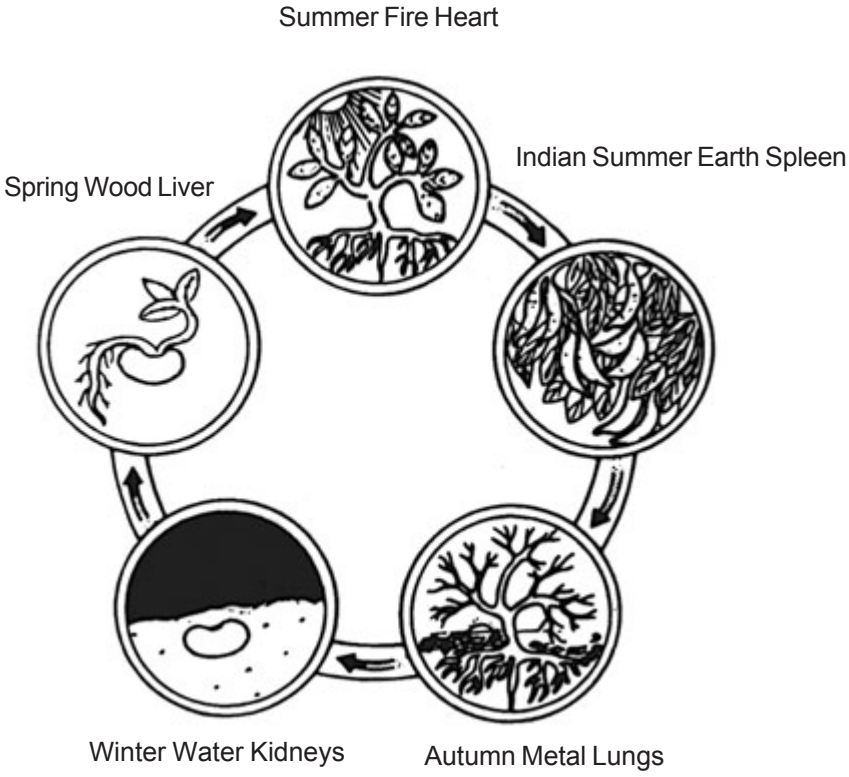

Fig. 1.27 *Creation Cycle*

For example, within the Law in the Creation, if an organ is weak, cold, and too Yin, or what Chinese medicine calls “deficient,” then strengthen the Season/Organ that precedes it in the Cycle. This would be the “mother” of the sick organ, the one from which the sick organ was born. The theory is that the Mother, when stronger, will pass on her excess energy to the child.

Similarly, if an organ has too much energy, is too hot, or too Yang, or has what Chinese medicine calls “excess” energy, you would take away some of the energy from the next organ, or child, in the cycle. This would give the excess energy in the troubled organ a place to go. Again, the mother will always give her excess energy to the child.

2. Law of Control

This concept establishes a way for an organ to cross check, constrain, and temper an organ that is trying to overwhelm a weaker organ. The image of an adult abusing a child, as grim as it is, captures this relationship. In this case you may call in another member of the family, perhaps an aunt or sister (organ), to restrain the overbearing parent and, rescue the child.

Under the Law of Control, the liver controls the spleen, the spleen controls the kidneys, the kidneys control the heart, the heart controls the lungs, the lungs control the liver. (Fig. 1.28)

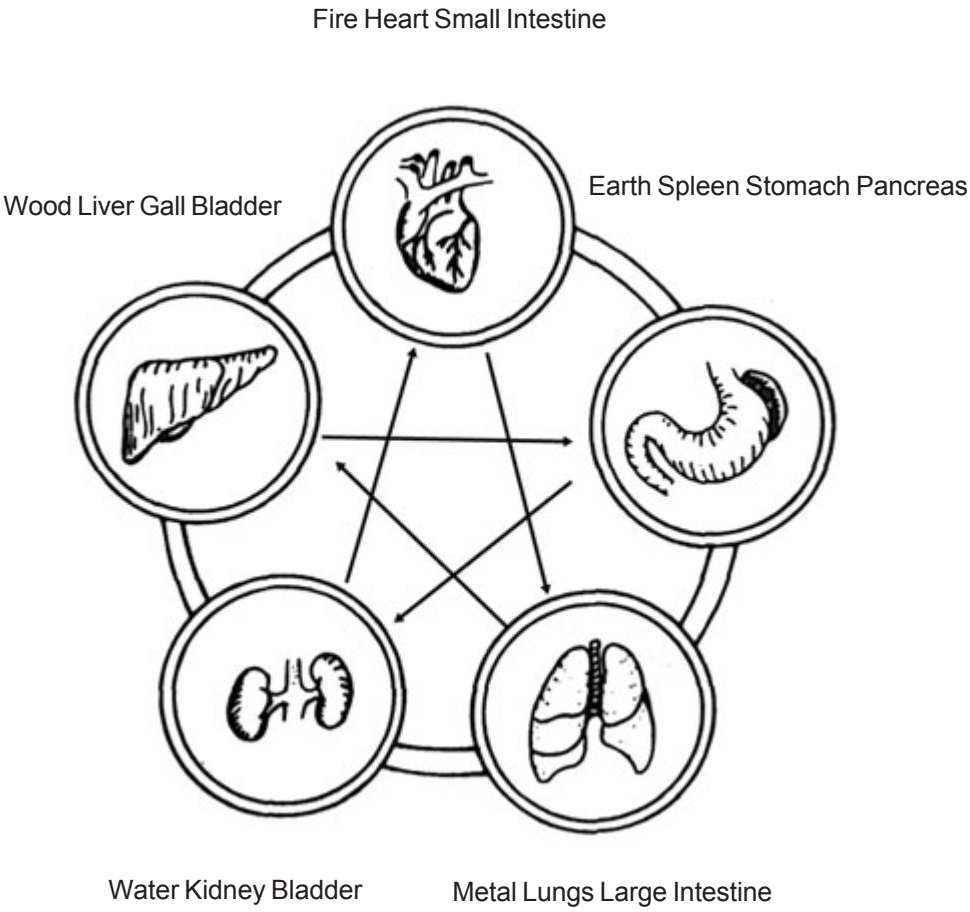

Fig. 1.28 *Control Cycle*

Chapter 2

Preparation, Training, and Protection

A. Adapting to the Healing Energy Environment

As a Chi Nei Tsang practitioner or instructor, you have the responsibility to maintain a clear, healthy body with a pure, strong blood and Chi flow. You are the standard of healthy energy and a healthy body to which you can compare the energy of your student. You then can distinguish any problems or foreign elements that may be blocking his or her energy flow. Remember that the process of Chi Nei Tsang involves not only direct channeling of the Universal, Cosmic Particle, and Earth Forces into your body, but also processing them within your body to make their energies suitable for others to use.

Any negative emotions that you may be feeling can be passed on to another person. Therefore, continually practicing Chi Nei Tsang on yourself is very important. Once you have cleared your abdominal area, you may find your emotional condition has changed and your attitude has improved. By releasing your blockages, you will be better equipped to help another release them.

In this chapter, many exercises are presented that will help you to keep your energy clear, balanced, and powerful. You do not need to do all the practices before working with someone. You can choose one practice and come back to the others later. Gradually, you can master them all.

1. Establishing a Strong Connection with your Sources of Energy

Since it is important to maintain your energy, it is first necessary to establish a connection with your sources of energy. You can connect with the energies of the Universe, Human Plane, and Earth, and unify and blend them into one energy. When you connect with these energies, you will be strong and the energy flowing through you will be of the correct quality and quantity to help your student.

2. Practicing Meditation Daily

To maintain your energy, meditate every day to reconnect with the outer forces and burn out sick and undesired energy. Often, those who lose touch with these outer forces find their egos rising and expanding. In such a situation you may believe you have the power to heal others, but you really are not equipped and can easily pick up sick energy.

The Healing Hands Meditation, when practiced every day, increases the ability of your hands to channel the Universal, Human Plane (Cosmic Particle), and Earth Energies. You will be able to feel the energy emerging from your palms and fingers as you touch the student.

3. Preventing the Depletion of your Energy

Most healing professionals inadvertently pick up sick energy from their students. Many discover they need to help themselves once they realize what has happened to them. The procedure followed in CNT is to channel the Universal, Human Plane Cosmic Particle, and Earth Forces and preserve your energy when possible.

4. Recognizing that Healing is a Gift of Nature

Everyone in good health can heal. The healing ability means having a powerful life-force. Having a powerful life-force means having a higher vibration, something that can be given to others to help them. When you send your life-force energy into another, your energy has to be greater or at a higher level to affect his or her energy.

Each person, however, has only a limited amount of energy. This is why it is important to connect with the Universal, Human Plane, and Earth Energies and let yourself become a channel through which the energy can flow. Your success will depend on your ability to open your channels and transform the energy.

Most people can transform outside energies into useful energy. ordinarily, it takes one year for a person to absorb enough Universal Energy to be effective. That is the time it takes for the Earth to revolve around the Sun. (Fig. 2.1) But with the practice of the Cosmic Particle Chi Circulation and the Tree exercises, you can quicken the process of energy absorption and transformation without overheating your system or creating a problem of cosmic energy indigestion. The energy is immediately useful.

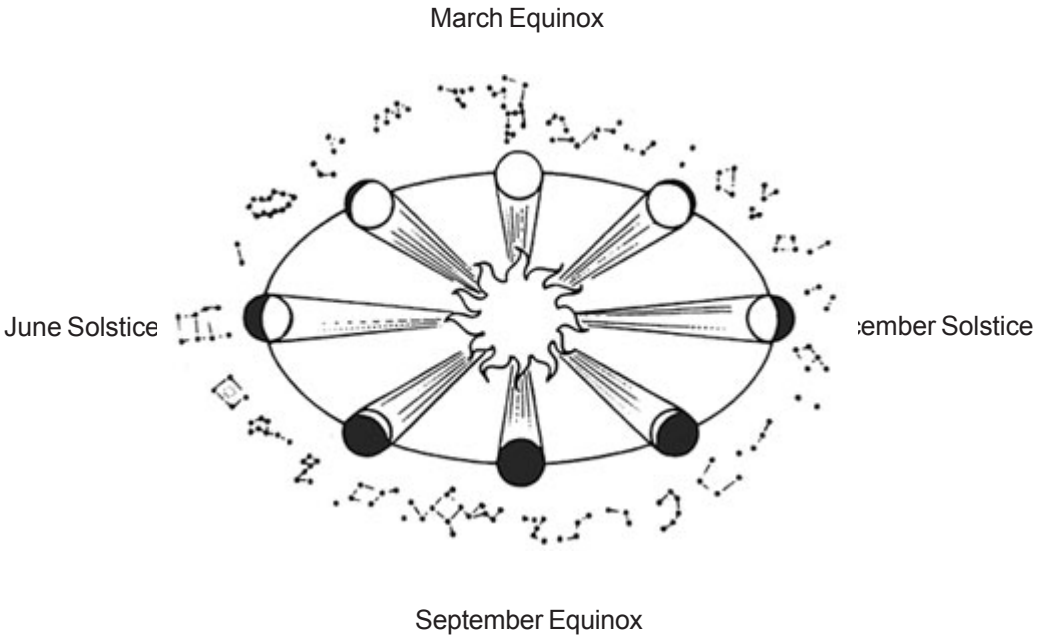

Fig. 2.1 *Ordinarily, it takes one year for a person to absorb enough Universal Energy to be an effective healer. Meditation can greatly quicken the absorption process.*

5. Transforming Energy

You cannot destroy energy, but you can transform it. As you engage in healing someone, Chi Nei Tsang techniques help you locate the problem and boost their level of energy. You help them to transform their energy. You start the fire, but the student has to maintain it and not let it die out. If you teach the student the Inner Smile, the Six Healing Sounds, and the Microcosmic Orbit, these techniques, along with the CNT training, will help them transform their sick, negative energy into good life-force energy.

6. Giving and Taking Energy

As you try to help a person and your life-force energy flows into him or her, be sure your energy is healthy. Otherwise any sick energy you send will create the same sickness in that person.

The reverse also holds true. As you send energy into a person, his or her energy passes to you. This means that this person's problems become your problems. There is no such thing as becoming involved with the healing without also becoming involved with the problem. This is how many people in the healing arts get sick. Their energy systems are not efficient enough to counteract the effects of the sick energy to which they have exposed themselves.

Young and healthy people who enter these professions can get by with no apparent ill effects because they have "energy to burn". However, they are depleting their energies and the sick energies they take on eventually do affect them. This is why it is important to think that you are not simply healing them, but you are a teacher and an adviser. Developing and maintaining an open channel to the Universal, Human Plane, and Earth Energies will help you avoid picking up sick energy and help you burn out the sick energy when it enters you.

7. Becoming a Channel for Powerful Forces

The more channels you open, the better off you are. Therefore, to receive energy, it is important to open at least the two major channels (Functional and Governor) of the Microcosmic Orbit. It is better still to add the Thrusting and Belt Channels. By doing so you

will know firsthand the way your energy flows. Then you can direct and draw in healthy energy, and use it to burn sick energy out of your system. By first opening the energy channels within yourself, you become more efficient as a healer and can avoid succumbing to the illnesses that you are removing from another.

The quickest way to open your Microcosmic Orbit is to take a weekend workshop with a certified Universal Tao Instructor. You may also teach yourself by using the *Awakening the Healing Light* book or video. To open the Thrusting and Belt Channels, you could study with us, a certified instructor, or teach yourself by using the *Fusion of the Five Elements* book and Fusion I, II, and III videos. Audio tapes are also available.

8. Restoring the Force after Each Session

It is important that after each practice session you sit and meditate. Be sure that you are free of sick energy before ending your meditation. You may feel coldness in the hands, itchy skin, and a lack of energy. Meditate until you feel warmth in your hands; it will burn out the sick energy. Use the Fusion I practice to get more energy into the navel and transform the sickness into positive life-force.

9. Protecting your Body from Sick Energy

When helping someone it is possible to accumulate sick energy on the surface of the skin of the hands and arms. Do not allow it to go beyond the shoulders and enter the body. If you practice daily, your mind's power can hold back the encroachment of the sick energy.

There are many different theories on how to get rid of this unwanted energy. Some people advocate washing the hands. If you do this, make sure that you use cold, running water, or you can drive the energy into your body further.

One method is to place your hands on a surface conductive to Earth Energy and connected to a ground (e.g., a water pipe). Iron will do, as will a brick or cement wall that has a footing. It will pass the sick energy down to the earth. The earth can help neutralize sick energy.

With some sick energies this grounding method is not effective or powerful enough. Therefore, our advice is that you meditate as well so that you are sure to be clean.

10. Using the Earth and Trees for Healing

Trees, especially pines, are excellent for taking the sick energy into the Earth, as are other trees and plants. Houseplants, however, do not receive the direct energy of the Sun, nor are they directly connected with the Earth. They can only absorb limited quantities of sick energy.

The sick energy of other people can seep into your inner organs and accumulate there. It is a very dense, coarse energy and can feel both cold and biting. This is, by far, the worst way to experience sick energy. A tree can handle this energy by sending it into the healing Earth.

11. Handling with Care

When you help other heart-to-heart and center-to-center, permitting the sick energy to enter you, it is very easy to exhaust your energy. You are then of no use to anyone. Evil or sick energy needs an outlet. If it is not eliminated, it will stay with you. Therefore, meditating as soon as possible after a session is extremely important. Do not ignore this advice.

The previously mentioned Healing Hands Meditation, used to expand your aura, and Cosmic Chi Kung (*Cosmic Healing I* Universal Tao book) are very important practices. They create a field of energy within and around you that will defend your body and spirit. This field of energy burns out and transforms the sick energy as it enters through your fingers before it has the chance to enter your organs. Iron Shirt Chi Kung is another very effective means of protecting your organs from another's sick energy.

Energies are very real and must be treated with respect. As your energy channels and aura become strong, you can control and have access to your energy. You can magnify your ability to sense what is happening in your hands. This will place you in a better position to deal with the presence of sick energies. You will learn a means of forcibly moving energy out through your fingertips, thereby strengthening all your energy systems.

A healer is knowledgeable and, above all, careful with his or her treatment of life-force energy. Only then can the healing experience be gratifying both for the teacher and the student. Risking affliction could be very costly.

12. Checking your Energy Level

Upon arising in the morning, spend a few moments checking your energy level. If your energy level is not good, take time to raise its level.

Never overdo anything. If your energy is low, or if you do not feel well, do not attempt to give a session to anyone. The meditations mentioned or described above and below are very important to help you raise your energy to a higher level. The Microcosmic Orbit and Fusion exercises are very powerful means of checking and replenishing your energy level. Fusion II is very useful for warding off most ill effects by using the Thrusting Channels, and, especially, the Belt Channel.

At all times it is wise to take precautions and to know what you are doing. Advice and warnings about healing energy and sick energy are consistently given throughout this book. It is extremely important that you follow instructions on how to care for yourself carefully.

B. Preparing yourself Physically

When creating the strong, healthy body necessary to practice CNT, bear in mind that energy flows to the place it is needed. If your energy is lower than your students, his energy will flow to you and he will become weaker. In emphasizing physical preparation, it is important to know that tendons, muscles, fasciae, channel systems, and bones draw in power that can be channeled to another.

1. Iron Shirt Chi Kung

The Iron Shirt Chi Kung exercises allow you to draw energy from the Earth, Cosmos, and Universe to strengthen the tendons and clean out and energize the fasciae. This provides protection and opens the channels so that they can receive more energy.

2. Tai Chi

By practicing Tai Chi you can learn to move the body in one unit using Chi instead of muscle power. You can build inner strength by circulating energy through the channels, muscles, tendons, bones, and fasciae. This ability is very important in CNT for protection and for storing and channeling energy. The Universal Tao's Tai Chi Chi Kung, which can be learned very quickly, is a short but powerful way of achieving such results.

3. Bone Marrow Breathing

The Universal Tao has published a book on the subject of bone marrow breathing entitled *Bone Marrow Nei Kung*. By studying and practicing bone marrow breathing, you can cleanse and grow bone marrow, refresh the blood, and develop enormous power. You can develop the ability to channel energy through breathing while using less muscular force and passing on more energy.

4. Diet

Whether or not you are familiar with cooking using the Five Phases of Energy theory, you may find it very interesting because it is so full of novelty and surprise. Culinary artists who incorporate the Five Phases of Energy (Five Element) theory in their cooking skills using the produce and foods of their countries or regions are quickly creating new and exciting trends in cooking.

The Five Element theory of cooking that pervades much of the world of Chinese cuisine is served in many wonderful restaurants. In fact, its cooking rules are a part of every Asian culture. Asian cooks balance their food in five ways, separating food according to five tastes, five colors, hot, cold, and PH balance. Then the foods are combined and beautifully prepared.

The stomach, spleen, and saliva sort out the food and distribute it to the organs according to taste and color. Each color and taste feeds energy to its own particular organ group. Each organ will only accept that energy designed for it by nature.

a. A Balanced Diet

A balanced diet is one that provides each organ with its own kind of energy. Each organ's energy also feeds primary energy to certain systems in the body. To nourish the body's various systems, you have to plan your meals accordingly. Thus, a balanced diet has equal parts of the following five tastes and colors:

The liver and gall bladder like food that is green and sour tasting. This food feeds the nerves.

The heart and small intestine like bitter tastes and food that is red. This food feeds the heart and its vessels.

The spleen, pancreas, and stomach like food that is sweet. This food feeds the muscles. This does not mean adding sugar or sweeteners, but refers to food that is naturally sweet.

The lungs and large intestine like food that is spicy and light colored. This food feeds the skin.

The kidneys and bladder like food that is dark and salty. This food feeds the bones. This does not mean adding salt, but refers to food that is naturally salty.

While food also has cold and hot, Yin/Yang properties that are important to understand and balance, many macrobiotic diets are incomplete because they only balance food according to Yin and Yang and do not include the Five Phases of Energy theory.

b. Chewing Well and Activating the Saliva

Another important aspect of diet is chewing. You should chew your food so that it becomes like liquid, because this starts the saliva flowing.

Saliva has tremendous power to help heal the intestines. First, the saliva determines the taste of the food. Then it sends a taste message along the channel or meridian to the stomach which begins to prepare the proper mixture of digestive fluids accordingly. You must, therefore, chew slowly. If you swallow too quickly, the stomach will not know what food is coming and will not be prepared. The food then travels to the stomach via the saliva where it can be sorted and easily assimilated. The spleen, meanwhile, has already figure out where it is going to assign the Chi of that particular food.

c. Combining the Heaven and Earth Forces in Saliva

In Taoism it is said that the Heaven and Earth forces combine to make saliva. (Fig. 2.2) Saliva is a major energy force similar to the energy of semen or the ovum. The Taoists also believe saliva is a major food. If you chew well until you have a mouth full of saliva, your stomach will receive one part food and two parts saliva. This is the best condition for digestion. It is important, then, to be careful not to drink too much liquid while eating for it could dilute all the naturally pre-assigned tasks of the saliva and digestive juices. Food that is too spicy or salty often can cause one to drink too much liquid with meals.

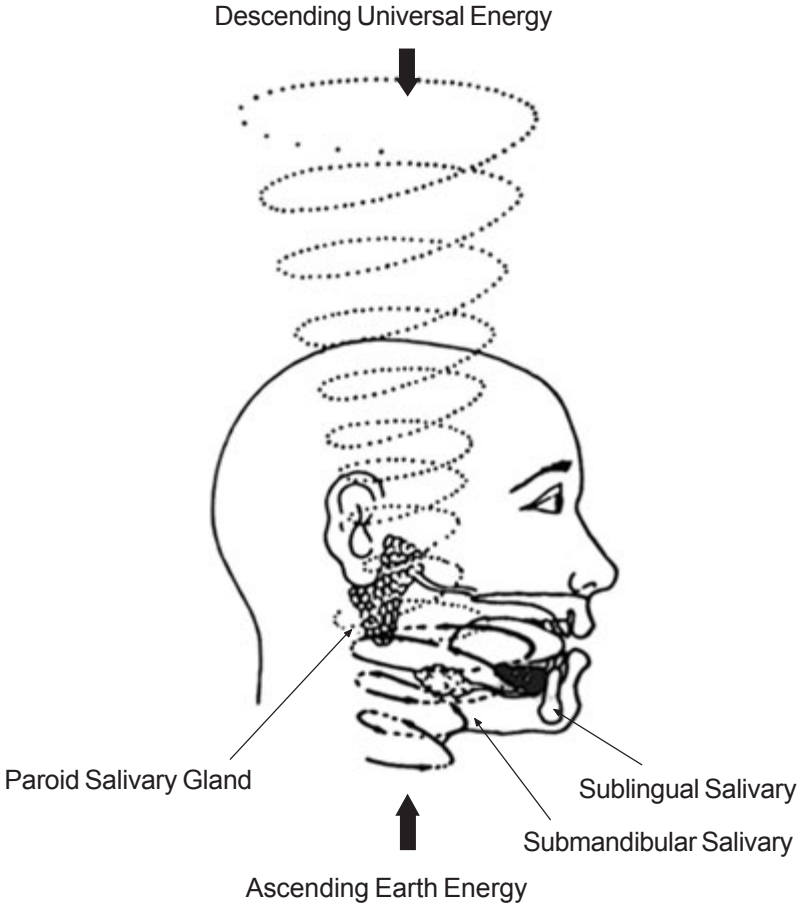

Fig. 2.2 *Universal and Earth Energies combine in the saliva*

C. Preparing yourself Emotionally: the Fusion Practices

In addition to a strong, healthy body, you need to work from a clear emotional base to practice CNT. You cannot help anyone if you are full of negative emotional energy. You need to have balanced emotions if you a going to touch someone, especially if you expect to help balance their emotions.

The Fusion of the Five Elements practices will allow you to clear out your negative emotional energy and transform it into positive emotional energy.

This is a very powerful and effective meditation and formulation. It is one technique for balancing the emotions. If you practice Fusion I, you will learn how the Five Energy Phases and their related organs can interact with one another. This technique teaches you how to construct an internal system of turbines, transformers, and vortexes which can be used to cleanse the emotions. If you know how to engage this system, you can switch it on while you are massaging someone and any negative and sick energies trying to invade your body can be quickly neutralized.

Fusion II teaches additional methods for gathering the pure energy of the five organs. With this practice you can increase your positive energy. If you need to pass on some positive energy to your student, this practice will provide you with reserves that you may draw upon to replenish yourself.

Fusion II and III also open and widen channels all over the body. The idea, in part, is to clear congestion out of energy passageways so that you can deliver energy through these channels to your students.

D. Using the Inner Smile and the Microcosmic Orbit

1. Inner Smile

The Inner Smile is a powerful relaxation technique which begins at the mideyebrow and eyes. It utilizes the expanding energy of happiness as a language to communicate with the internal organs of the body.

A genuine smile transmits loving energy that has the power to warm and heal. By learning to smile inwardly to the organs and glands, the whole body will feel loved and appreciated. You will feel the energy flow down the entire length of the body like a waterfall. This is a very powerful way to counteract stress and tension.

a. Sit on the edge of a chair with your hands clasped and eyes closed.

b. Begin the Inner Smile by picturing a radiant, smiling face in front of you.(Fig. 2.3)

c. Smile to activate the Cosmic Particle Energy. (Fig. 2.4)

d. Slightly lift the corners of the mouth.

e. Sense a coolness in your eyes to attract and absorb the warm energy. Inhale the energy through the mideyebrow and spiral it.

f. Smile down to the thymus gland and the heart. Feel the heart open with love, joy, and happiness.

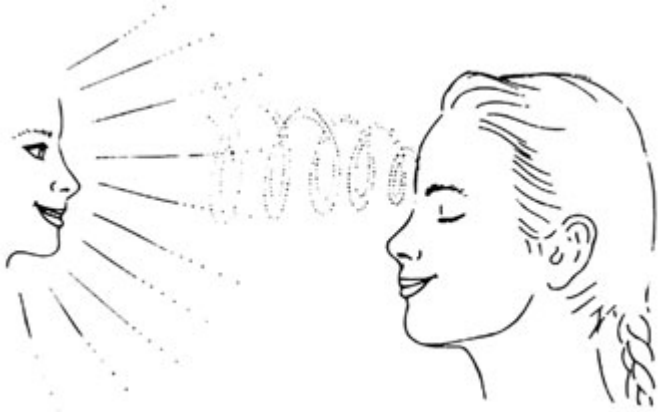

Fig. 2.3 *Begin the Inner Smile by picturing a radiant, smiling face in front of you.*

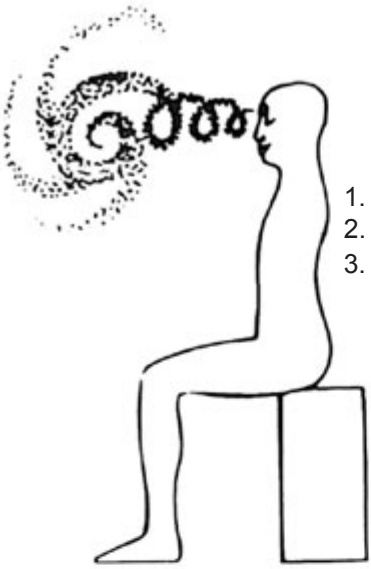

1. Smile to activate the Cosmic Particle Force.
2. Slightly lift the corners of the mouth.
3. Inhale though the mideyebrow and spiral.

4.Smile down to the thymus gland and the heart.
Feel the heart open with joy, love, and happiness.

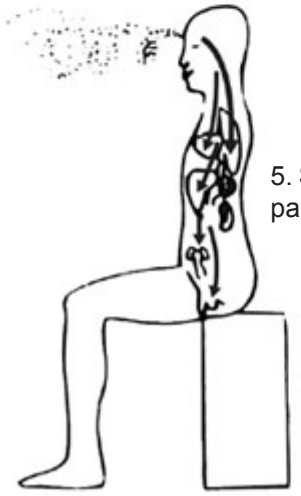

5. Smile down to all the organs (lungs, liver, pancreas, spleen, kidneys, and sexual organs).

Fig. 2.4 *Inner Smile*

g. Smile down to all the organs: lungs, liver, pancreas, spleen, kidneys, and sexual organs and reproductive system. Thank them for their work.

h. Return your attention to your eyes. Create a big smile and draw in the Cosmic Particle Energy.

i. Smile down the intestinal tract: the esophagus, stomach, small intestine, large intestine, bladder, and urethra.

j. Return your attention to your eyes. Create a big smile and draw in the Cosmic Particle Energy .

k. Smile to the brain and the pituitary, thalamus, and pineal glands. Smile down the spinal column.

l. Return your attention to your eyes.

m. Smile down to the whole body.

n. Collect the energy in the Navel Center.

2. Microcosmic Orbit

The Microcosmic Orbit meditation awakens, circulates, and directs Chi through the Functional Channel, which runs down the chest, and the Governor Channel, which ascends the middle of the back. (Fig. 2.5) Dedicated practice of this ancient esoteric method eliminates stress and nervous tension, massages internal organs, restores health to damaged tissues, and establishes a sense of well-being.

a. Practice the Inner Smile; collect the energy in the Navel Center.

b. Let the energy flow down to the sexual center, the Ovarian or Sperm Palace.

c. Move the energy from the sexual center to the perineum.

d. Draw the energy up from the perineum to the sacrum.

e. Draw the energy up to the Ming Men (Door of Life), located opposite the navel.

f. Draw the energy up to the T-11 vertebrae.

g. Draw the energy up to the base of the skull (Jade Pillow).

h. Draw the energy up to the crown.

i. Move the energy down from the crown to the mideyebrow.

j. Pass the energy down through the tongue to the Throat Center.

k. Bring the energy down from the throat to the Heart Center.

l. Bring the energy down to the solar plexus.

m. Bring the energy back to the navel.

n. Circulate the energy through this entire sequence at least nine or ten times.

o. Collect the energy at the navel.

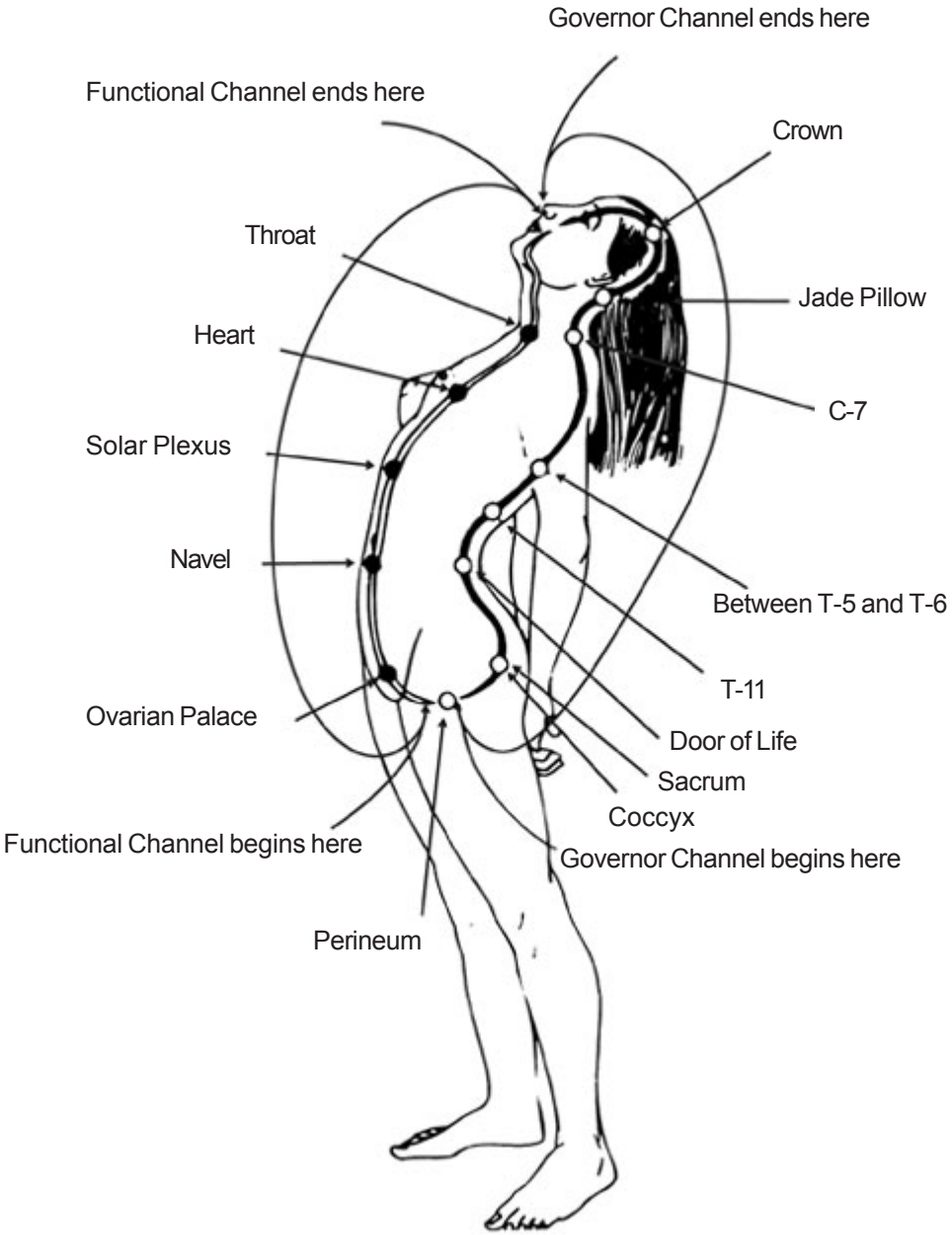

Fig. 2.5 *Functional and Governor Channels and the Stations of the Microcosmic Orbit.*

Men: Cover your navel with both palms, left hand over right. Collect and mentally spiral the energy outward at the navel 36 times clockwise, and then inward 24 times counterclockwise.

Women: Cover your navel with both palms, right hand over left.

Collect and mentally spiral the energy outward from the navel 36 times counterclockwise, and then inward 24 times clockwise.

E. Performing the Healing Hands Meditation

The more you are aware of your sources of energy, the more that energy will come to you from those sources. According to the wisdom of the ancient Taoists, the energy that you receive from meditating is superior to the energy that you obtain from food.

The Healing Hands Meditation will help to grow and strengthen the energy in your hands and fingers. Your hands will develop sensitivity and you will be able to feel the energy in your own and your student's organs and abdomen. You will find this to be very useful.

1. Meditating to expand the Aura

a. Practice the Inner Smile down to the organs and glands.

b. Bring the energy to your Navel Center and practice the Fusion Meditations.

(1) Form the four pakuas and the collection points.

(2) Clean out negative emotions by transforming them into positive, healing forces.

(3) Form their energies into a pearl.

Note: Anyone who is not familiar with the Fusion practice of the Universal Tao System can substitute his or her practice for clearing undesirable emotional energy at this time. If you have not yet learned the Fusion Meditations, do the Microcosmic Orbit at this time.

c. Circulate the energy in the Microcosmic Orbit faster and faster until it expands outward from your body.

d. Feel the energy expanding outward from your navel as you visualize the sun shining in that area. Feel the energy filling your aura with a warm, pleasant sensation. (Fig. 2.6)

Fig. 2.6 *Warm the navel and feel the warmth radiate from the body.*

e. Be aware of the North Star and Big Dipper above you and absorb their respective violet and red lights, the golden light of the Cosmic Particles and the blue force of the Earth into the navel. (Fig. 2.7)

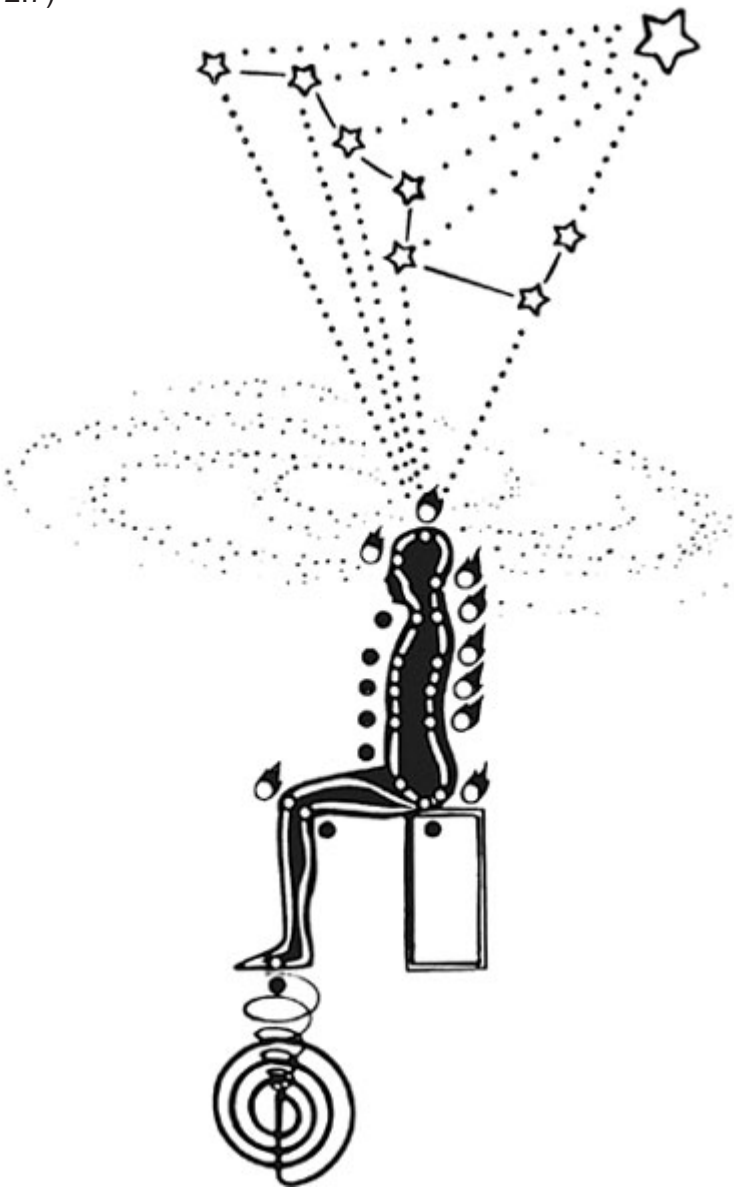

Fig. 2.7 *Absorb the violet light from the North Star, the red light from the Big Dipper, the golden light of the Human Plane, and the blue force from the Earth.*

f. When you feel your aura has expanded, maintain a distance of at least two square feet away from other people. If their auras are stronger than yours at this time, your aura may be squeezed and you will experience discomfort. After you have felt the outer forces strongly, proceed with the following meditation.

2. Channeling the Force through the Palms

a. Hold both of your hands in front of your eyes and gaze at both palms. (Fig. 2.8)

b. Focus on the middle of your palms by using the corners of both eyes to gaze at the palms' centers. The corners of the eyes have special cells that can see in very dim light. Using your eyes to focus this way will help you develop the ability to see auras and movements in the dark. Using the combined power of the mind and the eyes, you can cause the aura of each palm to grow and expand. (Fig. 2.9) The Chi can feel like it is contracting and absorbing, and the sensation can be of drawing the forces into the palms, or an expansion of the palms. You might see a ball of Chi or a ball of color between the palms through the corners of your eyes. (Fig. 2.10)

c. Be aware of the fingers. Feel your fingertips pulsing. Use your mind and eyes to absorb the Cosmic Chi into the right palm. Send the Chi from the right palm and fingers across to the left palm and fingers. Repeat nine times. (Fig. 2.11)

d. Next move the fingers of both hands until they nearly touch each other: thumb to thumb, index finger to index finger, etc. You can feel sensations like electric sparks traveling across from one fingertip to the other. (Fig. 2.12) Some can feel pain, swelling, or simply expansion in their fingertips.

e. Gradually spread the hands apart, but not so far that you permit the Chi connection to diminish or break. (Fig. 2.13) If this happens, stop moving them and project more energy with the mind to re-establish the connection. Spread the hands from nine to eighteen times.

This practice will increase your sensitivity to energy and your healing ability. Transforming the Universal and Cosmic Particle Forces for immediate use will prevent drainage of your life-force. The energy can feel warm and pleasant.

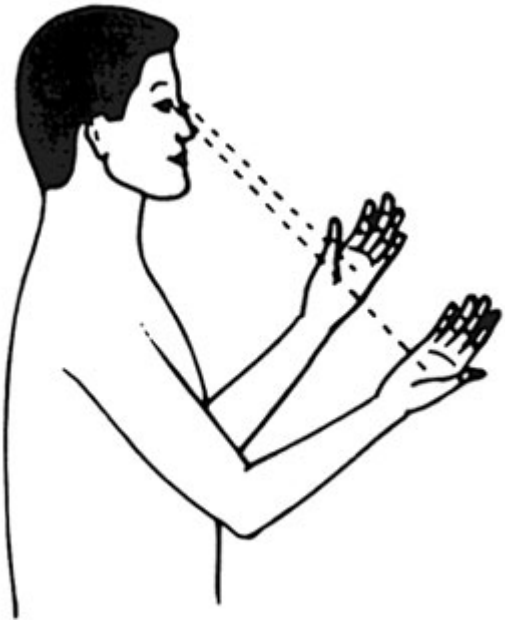

Fig. 2.8 *Gaze at the Center of the palms.*

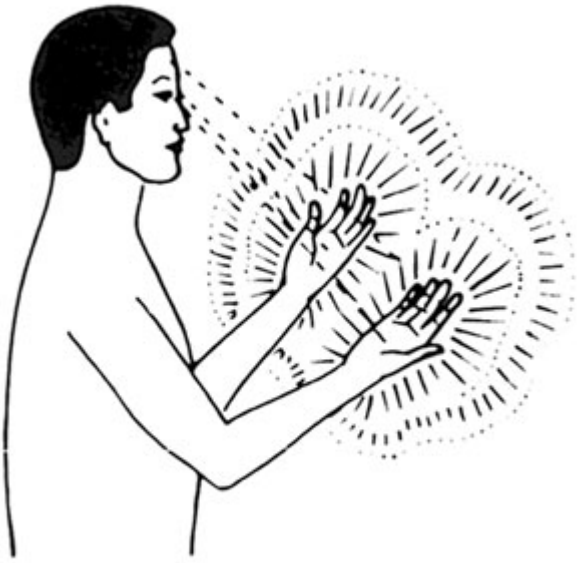

Fig. 2.9 *Use the mind and the eyes to expand the hand's aura.*

Fig. 2.10 *Feel an energy ball between the hands.*

Fig. 2.11 *Be aware of the fingers pulsing. Use the mind and eyes to send Chi from the right fingertips to the left. Repeat nine times.*

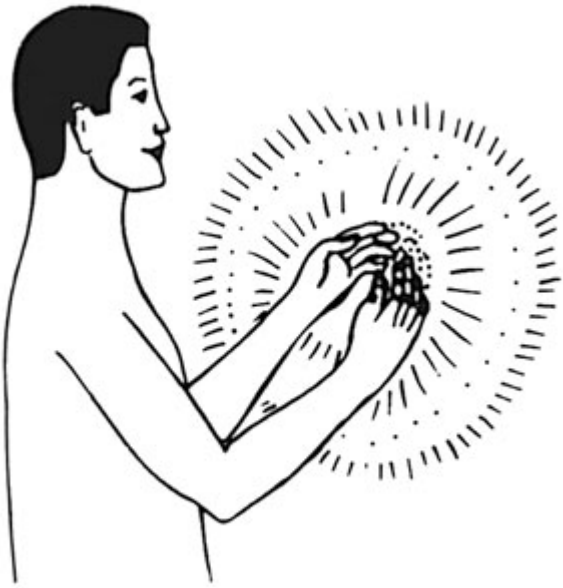

Fig. 2.12 *Bring the hands close together, with the fingertips nearly touching, and let the energy flow from one hand to the other.*

Fig. 2.13 *Slowly move the hands apart while feeling the Chi connection.*

3. Growing the Right Fingers' Auras

When your palms feel full of Chi, start to grow more Chi in the right hands' fingers.

a. With both hands' fingertips still raised in front of your eyes, begin by gazing at the right hand's fingers.

b. Use the corners of both eyes to gaze at the tips of the fingers. Focus on the tip of the index finger. Using the energy of your eyes, cause the aura of the index fingertip to grow and expand. (Fig. 2.14) Feel that fingertip pulsing. Make the energy cool and pleasant.

c. Next grow the middle finger, thumb, fourth finger, and pinky finger auras. (Figs. 2.15, 2.16, 2.17, and 2.18)

d. Choose your main healing finger(s) by observing and feeling which finger most noticeably permit(s) the energy to be absorbed in and passed out. Choose by comparing the length of the aura of each finger by the intensity of a tingling sensation or by any method that feels comfortable to you. Don't neglect the finger(s) that you do not select. Continue to practice with them as well.

Fig. 2.14 *Focus on the right hand's index finger and let the Aura grow.*

Fig. 2.15 *Focus on the right hand's middle finger, and let the aura grow.*

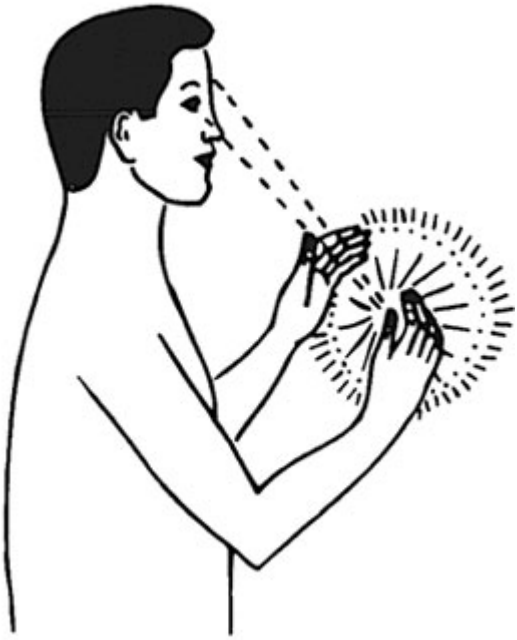

Fig. 2.16 *Grow the aura of the right hand's thumb.*

Fig. 2.17 *Grow the aura of the ring finger.*

Fig. 2.18 *Grow the aura of the pinky finger.*

4. Growing the Left Fingers' Auras

a. Inhale energy into the left hand and fingers.
b. Grow the thumb aura beginning with the tip. (Fig. 2.19)
c. Next, grow and absorb the auras of the index, middle, fourth, and little fingers. (Fig. 2.20) Receive and feel the Universal and Cosmic Particle Energies.

Fig. 2.19 *Grow the aura of the left thumb.*

Fiig. 2.20 *Grow and expand the auras of the left hand's index, middle, ring, and little fingers.*

d. Select the finger on the left hand with the strongest energy. Press that fingertip with the tip of the thumb, forming a circle. Keep the other fingers straight. Rest the left hand on your lap. This circle is the best way to receive Universe and Cosmic Particle Energies.

e. Curl the pinky and fourth fingers of the right hand and press them with the tip of the thumb, again forming a circle. Keep the index and middle fingers straight. (Fig. 2.21)

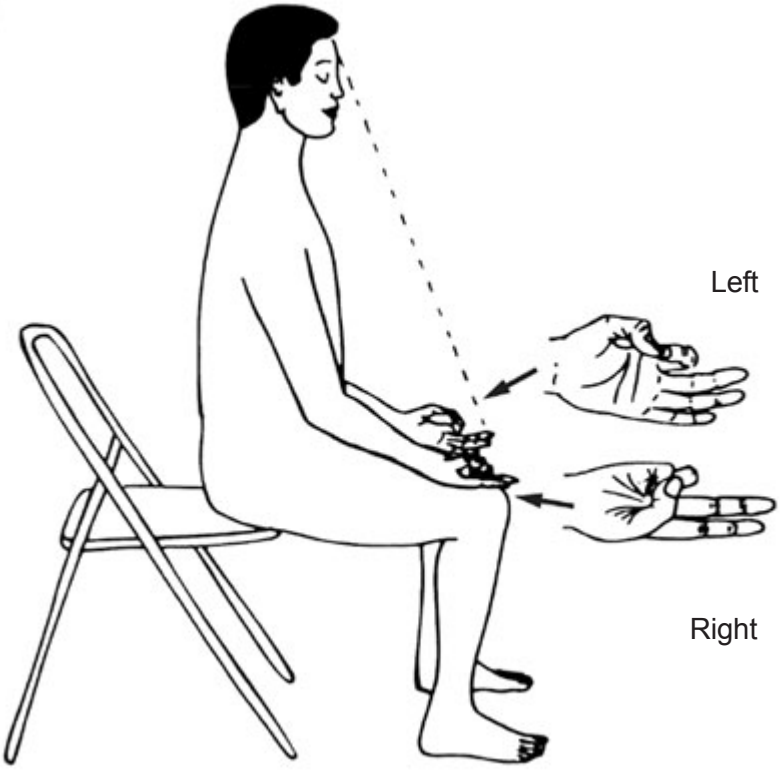

Fig. 2.21 *Choose which finger in the left hand has the strongest energy. Join the thumb with the strong finger, and place the left hand on the lap. Curve and join the right hand's little finger and ring finger with the thumb. Keep the other fingers straight.*

f. Form these circles and use your mind and eyes to absorb the external Cosmic Particle Force through the fingers of the left hand. Send it up through the left hand, outside the left arm and the left shoulder, to the back side of the left ear, and across the crown. Blend this energy with the Universal Force entering through the crown. Then send their combined energy down to the right ear, the right shoulder, the outside right of the right arm, and the right hand to its index and middle fingers. Send it out through these fingers and receive it again through the extended fingers of the left hand. Continue this practice for nine, eighteen, or 36 cycles. (Fig. 2.22)

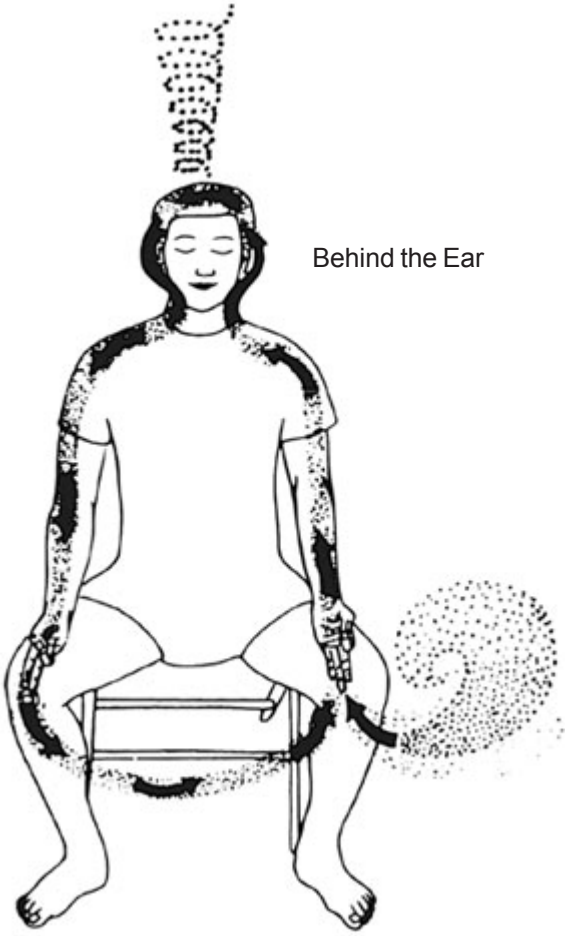

Fig. 2.22 *Absorb the Human Plane(Cosmic Particle) Energy through the left fingers. Circulate it and blend it with the Universal Force at the crown. circulate at energies down the right arm, out thoughthe index and the middle fingers, and back to the left fingers.*

5. Practicing Cosmic Chi Kung

Cosmic Chi Kung integrates both static and dynamic exercise forms to cultivate and nourish Chi. The Chi is accumulated in the organs, penetrates the fasciae, tendons, muscles, and bones and finally transfers itself out through the hands and fingers into your student. This is a higher level of practice that allows you to channel more Cosmic Particle and Universal Energies. The Cosmic Chi Kung practice is taught on video tape and is available at the Universal Tao Center.

F. Receiving the Universal and Earth Forces

1. Choosing a Personal Star Force

a. Picture a star over your head as your personal star, or choose the North Star and the Big Dipper constellation. Allow the energy from your star to flow into the top of your head.

b. Under your feet visualize a moon, which is symbolic of your connection with Mother Earth. Allow the energy of this moon to flow up your legs and into your body, mixing with the star energy in your navel, your heart, or your head. (Fig. 2.23)

c. This mixing may occur at different places (navel, heart, mid-eyebrow) and at different times, depending on the quality of energy you may need for a particular task. The navel is best for beginners.

d. Next, circulate this blended energy in your Microcosmic Orbit three times. (Fig. 2.24)

e. Then move the energy into your right arm channel. (Fig. 2.25) Maintain the circuit and flow.

f. To end the meditation, draw your energy into your Tan Tien (behind the navel, one and one half inches inside), and condense it with 36 spirals outward, and 24 spirals back inward. Men spiral clockwise 36 times, then counterclockwise 24 times; women spiral counterclockwise 36 times, then clockwise 24 times. (Fig. 2.26)

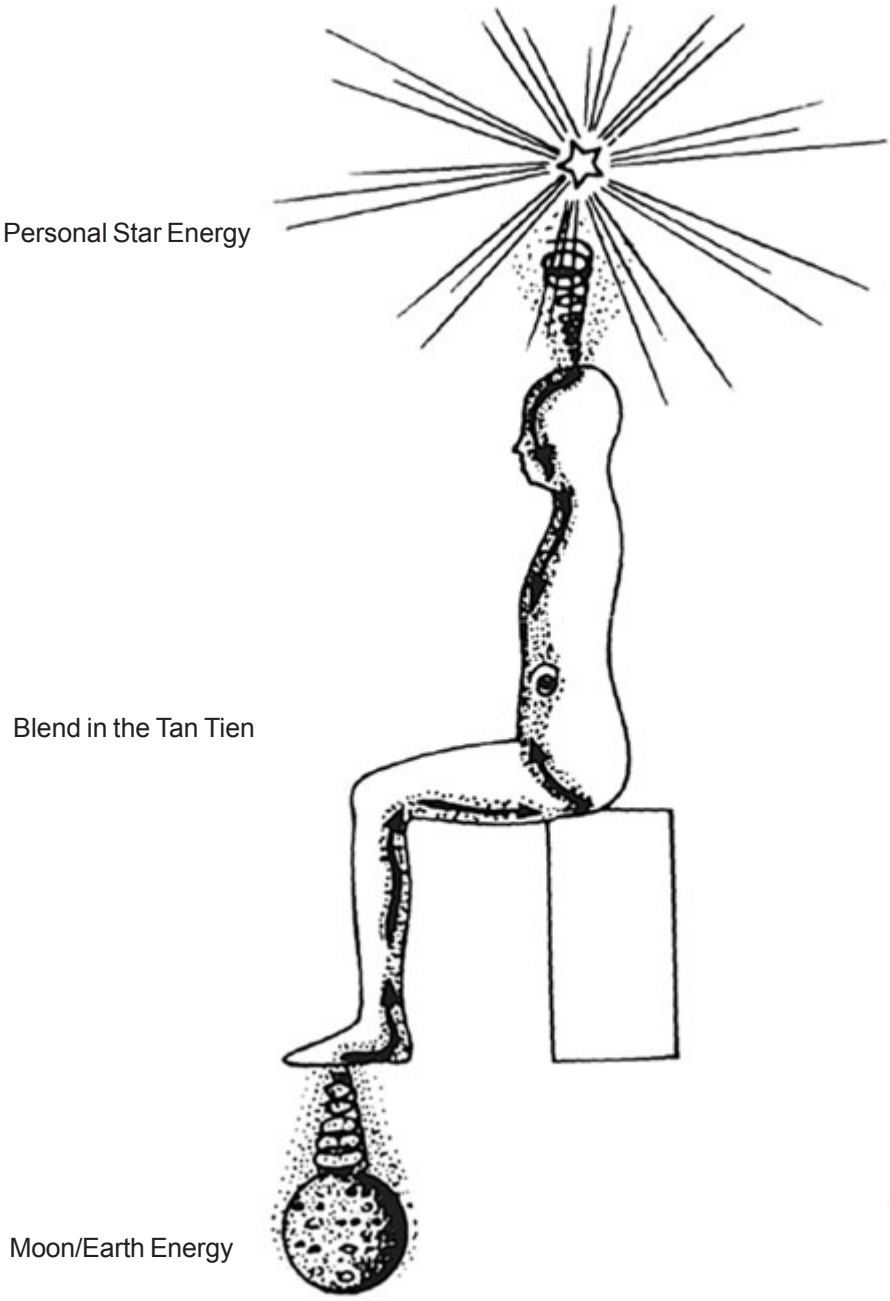

Fig. 2.23 *Absorb the energies of Heaven and Earth. Choose a Personal Star and picture it over your head. Visualize the Moon and Earth Energy under your feet. Draw the energies into your body and blend them in the Navel Center.*

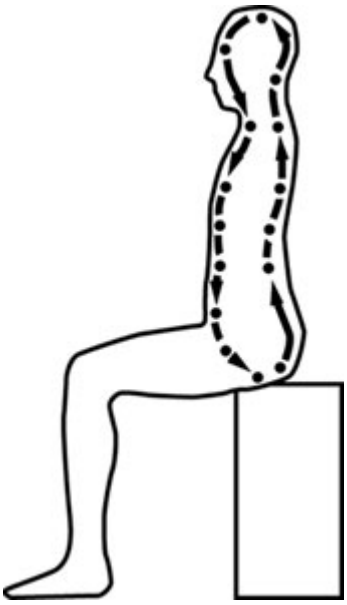

Fig. 2.24 *Circulate the energy in the Microcosmic Orbit*

Fig. 2.25 *Move the energy from the Microcosmic Orbit down into your right arm channel.*

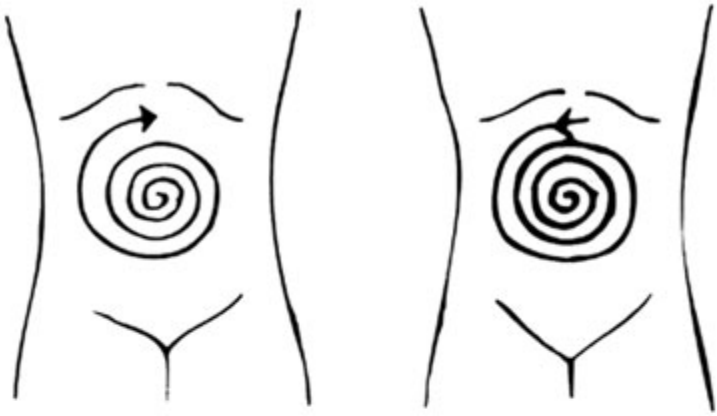

A. Men collect the energy in the navel and circle it 36 times clock wise, then 24 times counterclockwise.

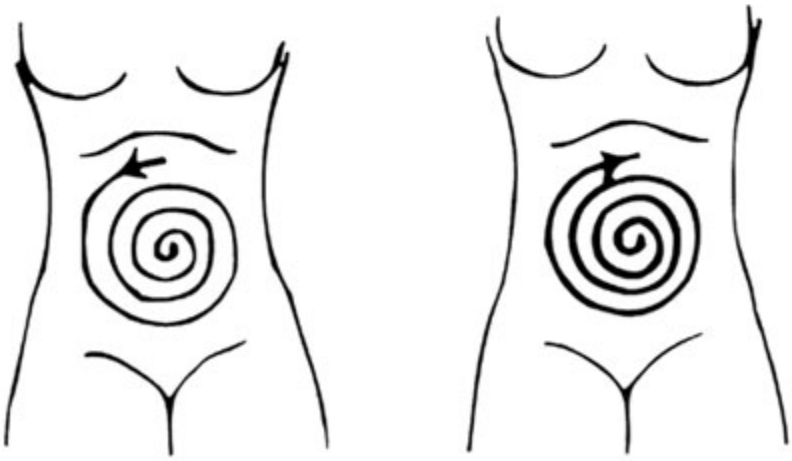

B. Women collect the energy in the navel and circle it 36 times counter-clockwise, then 24 times clockwise.

Fig. 2.26 *Finishing the Microcosmic Orbit.*

2. Healing with Love from the Heart's Center

When people come to you for healing, you should wish them well with all your heart. Give them your love, kindness, and openness, and you will feel your heart open. The healing force from the Universe will pour down to you and out to the people simultaneously.

Learning Iron Shirt Chi Kung is very important because it is the practice that will allow you to ground yourself when working with a student. This will help you ground your energy and help send the student's sick energy into the ground. You will also learn to feel the kindness, gentleness, and openness of the Earth Force and pass the Earth Force into your student.

Giving the gift of healing energy keeps the heart channels open and both the practitioner and student benefit. Practice the Microcosmic Orbit circulation and concentrate on the point opposite of the heart and feet it connect to the Heart Center in the front. This will help to open the heart. Feel the back and the front connected like a funnel. Once the heart is open, it will be very easy to receive the energy from the Universe.

Opening the Microcosmic Orbit is very important, since this will allow the energy to circulate, balance, recycle, and transform. The meditative practices of the Universal Tao will enable you to connect with the Heavenly Force from above and the Earth Force from below. Combine them into a powerful healing force--a healing force that can be used to heal yourself and others.

G. Collecting the Cosmic Particle Force

1. Practicing Circulation of the Human Plane Energy

a. Receiving Yang Energy to Balance Yin Energy

(1) Stand or sit for this practice. Concentrate on the navel until it feels warm. If you are familiar with the Fusion I meditation, practice it, and form a pearl.

(2) When you feel the energy intensify, move the energy up to the crown. Project it out and up approximately ten feet above your head while curving it slightly forward in an arc.

(3) Be aware of the pearl and the space above the head. Feel the pearl absorb the Cosmic Particle Force.

(4) Let the projected arc continue down to a place approximately two to three feet in front of you. Absorb the Cosmic Particle Energy through the mideyebrow, and accumulate it like a Chi ball. Direct the energy ball down through the throat, heart, navel, and sexual center.

(5) Let the rest of the Cosmic Particle energy travel down into the Earth approximately five to ten feet. Notice that the Earth is harder to penetrate than the air.

(6) Absorb the Earth Energy through the soles of the feet. Permit this energy to penetrate and travel up the soles or backs of your feet to the perineum, coccyx, sacrum, spine, and out of the head again.

(7) Eventually you will feel this energy throughout your feet. Bring the energy up both legs to the perineum. If you practice Fusion II and your Thrusting Channels are open, let the energy pass through them and nourish all the organs and glands along the path of the Thrusting Channels. If you only are familiar with the Microcosmic Orbit, then let the energy rise to the coccyx, the spine, and to the crown. Project it out again in a forward arc.

(8) Continue this practice for nine, eighteen, or 36 rounds. (Fig. 2.27) The purposes of this exercise are to balance, enhance, and purify your life-force as well as to give you practice in projecting and absorbing the force.

With continued practice absorbing the Cosmic Particle Chi and the Earth Force, you will feel the Chi thickening. You also may feel the energy around you becoming very sticky, like honey. When you project the energy out ward, you may see a light. When you absorb the Chi inward, you may see the light come into you. Store the light in your Navel Center.

b. Increasing Yin Energy to Balance Yang Energy

To increase your Yin energy, you can reverse the process. Shoot the energy or the pearl down into the ground approximately five to ten feet, absorb the Earth Force, and bring it up to the space two to three feet in front of you. Absorb the Cosmic Particle Force and bring the energy upward in an arc to about ten feet above your head. Bring the energy in through your crown, down the spine, and so on. (Fig. 2.28) With practice you can absorb more Cosmic Particle Chi which will enable you to help others to heal faster.

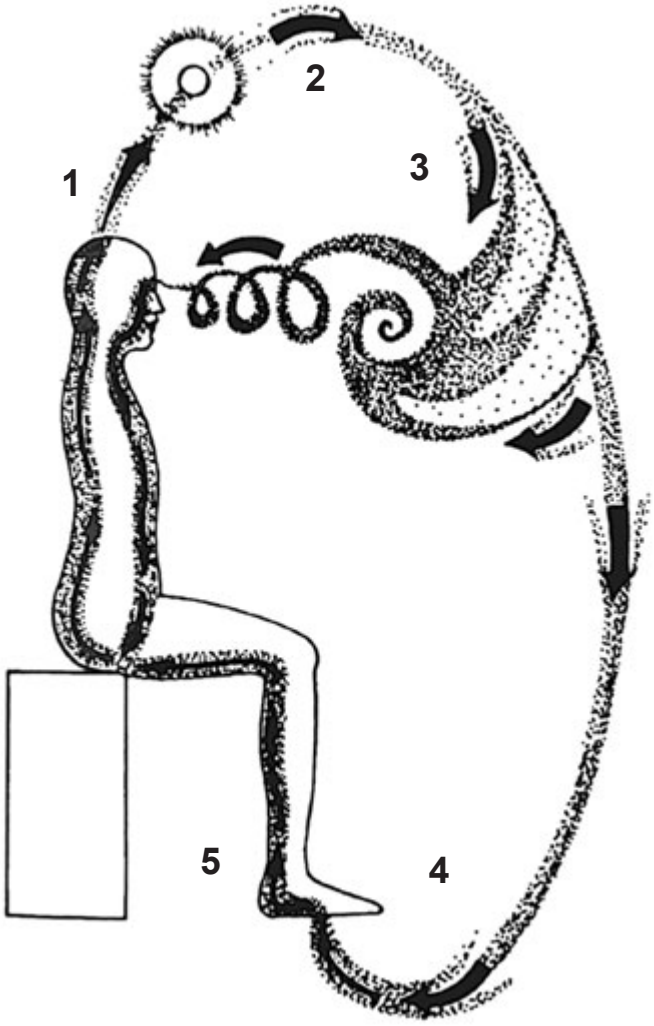

1. Send the energy out of the crown ten feet above
2. Circulate it down in front
3. Absorb the Cosmic Energy
4. Send it five feet into the Earth
5. Absorb Earth Energy though the soles up into the Microcosmic Orbit
6. Do this eighteen to 36 times using the pearl

Fig. 2.27 *Absorbing Yang Energy to Balance Yin Energy*

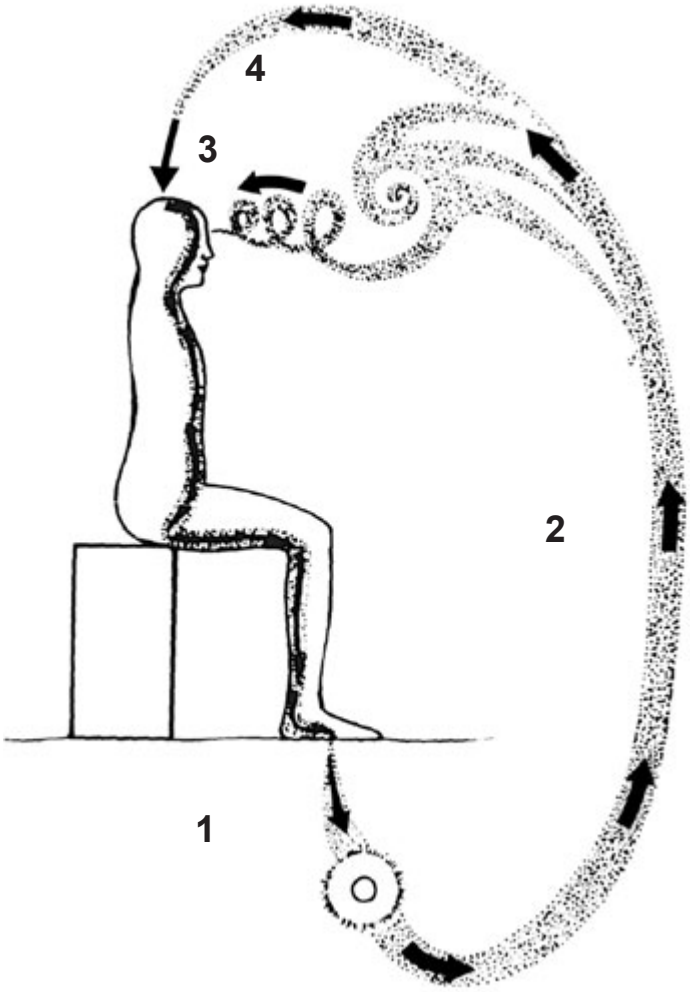

1. Send the energy out though the soles five feet into the ground
2. Bring it up the front
3. Absorb energy though the mideyebrow
4. Absorb erergy thoough the crown
5. Do this 18-36 times using the pearl

Fig. 2.28 *Absorb Yin Energy to Balance Yang Energy.*
Reverse the procedure in Fig. 2.27.

c. Practicing with a Partner

When you become proficient in directing the Chi force, you will find that you can stand about two to three feet in front of another person and perform the same Chi practice feeling the additional Chi flowing back and forth between you. If your practice partner is weaker than you, you will feel less because his or her body will absorb some Chi that you sent out and will not have as much to send back.

H. Collecting Tree Energy

1. Healing Abilities of Trees

Taoist Masters observed that trees are tremendously powerful plants. Not only can they absorb carbon dioxide and transform it into oxygen, but they can also absorb negative forces and transform them into good energy. Trees strongly root with the Earth, and the more rooted the tree, the higher it can extend to Heaven. Trees stand very still, absorbing the Earth's Energy and the Universal Force from the Heavens.

Trees and all plants have the ability to absorb the light of the energies and transform it into food; in fact, they depend on light for most of their nourishment, while water and earth minerals make up about 30% of their nutritional intake. Trees are able to live very long lives.

a. Tree as Healer and Friend

Trees are the largest and most spiritually advanced plants on earth. They are constantly in meditation, and subtle energy is their natural language. As your understanding of this language grows, you can begin to develop a relationship with them. They can help you open your energy channels and cultivate calm, presence, and vitality. You can reciprocate by helping them with their own blockages and devitalized areas. It is a mutually beneficial relationship that needs cultivation.

b. Choosing a Tree to Work With

Throughout history human beings have used all parts of the tree for healing and medicine. The best trees for healing are big trees, especially pines. Pine trees radiate Chi, nourish blood, strengthen

nervous systems, and contribute to long lives. They also nurture souls and spirits. Pines are the “Immortal Tree.” Early Chinese poetry and painting is full of admiration for pines.

Although pine trees are often the best choice, many other trees or plants can be used. The larger trees contain the most energy. Among the most powerful are trees growing near running water. Some trees feel warmer or hotter than others; some feel cooler or colder than others. Practice distinguishing the varying properties of different trees.

(1) Cypress and cedar trees reduce heat and nourish Yin energy.

(2) Willow trees help to expel sick winds, rid the body of excess dampness, reduce high blood pressure, and strengthen the urinary tract and bladder.

(3) Elm trees calm the mind and strengthen the stomach.

(4) Maple trees chase sick winds and help reduce pain.

(5) Locust trees help clear internal heat and help balance the weather of the heart.

(6) Banyan trees clear the heart and help to rid the body of dampness.

(7) Cinnamon trees can clear coldness from the heart and abdomen.

(8) Fir trees help clear up bruises, reduce swelling, and heal broken bones faster.

(9) Hawthorn trees help aid digestion, strengthen the intestines, and lower blood pressure.

(10) Birch trees help clear heat and dampness from the body and help to detoxify it.

(11) Plum trees nourish the spleen, stomach, and pancreas and calm the mind.

(12) Fig trees clear excess heat from the body, increase saliva, nourish the spleen, and help stop diarrhea.

(13) Ginco trees help strengthen the bladder and alleviate urinary problems in women.

You do not need to go far out into the forest to find an appropriate tree to work with. Trees that are used to having people around understand our energy and are actually more accessible and friendly than those far out in the wilderness. City parks and suburban yards are filled with powerful and accessible trees that would love to have closer relationships with the humans that dominate their environment.

There is a certain size range within which trees are most accessible to human beings. When a tree is too small, it does not have enough energy to make much of an impression on you. When the tree is too big, you have the opposite problem, so it takes more persistence to get large trees to take an interest in you. As a source of healing energy, it is best to choose a large, robust tree from within the accessible size range. For playful interaction it is best to choose a small to medium sized tree. While it is not necessary to climb the tree to develop a relationship, it does open up a whole new world. Climb gently and carefully so as not to harm the tree.

c. Establishing Communion with a Tree

There are certain methods to approaching, interacting with, retreating from, and taking leave of a tree. By following specific steps you create a ritual of silent communion that both you and the tree can understand, and so increase the potential for harmonious interaction. The steps were derived from observation of the natural course of events in subtle energy communion, and apply to communion with just about anything: tree, rock, human, or animal, although the following is concerned specifically with trees.

First of all, each tree, like each person, has a personality, desires, and a life of its own. Trees differ widely in their taste for human contact. Some are very generous and want to give you all the energy you can take. Others are weak or ill and need your comforting and healing energy. Some are just friendly souls who enjoy human company. Others are quite indifferent to you. You can learn and grow by working with all of them. Try to be open and respectful, rather than pressing the trees to serve your own purposes. In this way they will provide you with more than just another source of Chi: friendship, playful expression, and love.

Trees operate on a longer time scale than do human beings. You can help to bridge this gap by returning again and again to the same tree, so that a relationship develops. Visit regularly so that the tree knows when to expect you and can look forward to seeing you. You may have the distinct impression that the tree really misses you when you are gone for a longer time than usual.

Spiritual communion with trees resembles lovemaking more than any other human activity. As such, a quality of sensuality and tenderness should be present. You do not always have to be in control of the situation. Allow some time to just relax and melt into

the communion. Let the tree lead you into the wonders of its own inner life. Working with trees in this way can help to ease sexual frustration. You may find that some of the practices presented here can be easily adapted for use in lovemaking.

2. Practicing with a Tree and the Earth's Force

a. Use the Palms to Absorb Yin Chi and Help Balance Yang Energy

Morning to noon time is the best time to practice with a tree.

(1) Assume a Position. Stand or sit one or two feet in front of a tree.

(2) Open Yourself to a tree Relax and center yourself. Feel your boundaries soften. Allow yourself to become more receptive and some what vulnerable, ready to make contact with the tree. Feel your energy field open like a flower, neither emitting nor absorbing energy, just becoming open and available (Fig. 2.30).

Yin Cycle: Use the palms and insides of the arms
Yang Cycle: Use the fingertips and outsides

Fig. 2.29 *Practice with a tree to absorb Tree Energy and then return it to the tree.*

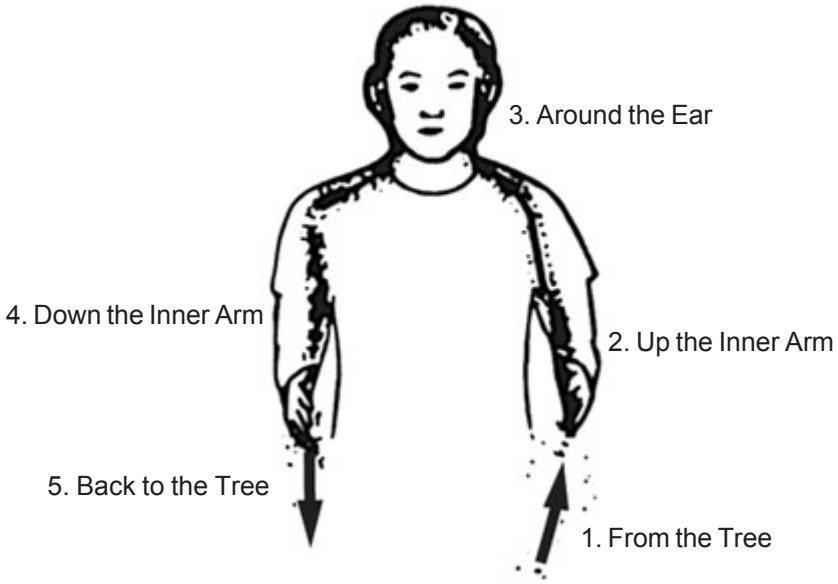

Fig. 2.30 *Women practice 24 cycles, Men practice 36 cycles.*

(3) Offer a Welcome. Extend your arms and face the palms of your hands toward the tree. Extend your energy toward the tree with a friendly "offering" attitude. When the tree responds by extending its energy to you, accept it, breathing it into your body with an attitude of "welcome."

Use your mind and eyes as follows. With the lower part of the eye concentrate on the tip of your nose. With the upper part of the eyes, look at your palms and at the tree.

Let your intuition guide you as you respond to the tree again with another "offering" gesture. Proceed with several of these exchanges. Take your time and really feel what is happening.

Use the left palm, the mind, and the upper part of the eyes to absorb the Chi.

(4) Parallel Tracking. Remain centered within yourself, neither approaching nor retreating, and simply observe the subtle relationship between you and the tree. Use meditative concentration to become very absorbed in your connection with the tree, without actively trying to change or analyze what is going on. Do not try to deepen the communion or lessen it. Control your own energy and watch the tree while the tree controls its own energy and watches you. This is known as Parallel Tracking. Such a neutral state may

occur several times during a session at deep as well as shallow levels of intimacy.

(5) Draw and Hold Close. Allow the energy field between you and the tree to intensify, thicken, and contract to Draw and Hold Close the two of you together. There may or may not be physical movement involved. The sensation is that the two of you are being enfolded in a cocoon of energy while more and more of your inner cores are exposed to each other. Finally you hold each other in an embrace of deep intimacy.

Drawing and Holding Close often happens spontaneously as the offering and welcoming escalates to become circulating and sharing, or as the circulating and sharing moves to deeper and deeper levels.

(6) Guide the Chi. As with all Universal Tao practices, it is necessary that you train your eyes and mind to move and guide the Chi. This practice is also useful in training yourself to recognize and be aware of the quality of the tree's energy. Feel the tree's energy when it enters your body. As you send if out to the tree, combine it with Human Plane (Cosmic Particle) Energy. Notice how the energy feels when it returns to you from the tree: enhanced with a cool, healing quality. Notice also how the quality of the energy changes after nine, eighteen, 24, and 36 cycles.

Move the upper part of the eyes to guide the Chi slowly up the inside (Yin side) of the left arm, to the left shoulder, the left side of the neck, the left ear, and the crown. From the crown move the Chi down the right side to the back side of the right ear, to the right neck, the right shoulder, inside the right arm, to the right palm. Project the Chi out into the tree trunk. Absorb the Chi again in a circle (the Yin Energy Circle): 36 cycles for men and 24 cycles for women. (Fig. 2.30)

(7) Extend to a Deeper Level. Now begin to exchange energy with the tree on a deeper level. To share with the tree on a deeper level means to place a particular part of your body in contact with a particular part of the tree's body, and breathing the energy back and forth between them. To circulate now means guiding the energy along a path which passes through both of your bodies and returns to its starting point. You can guide the Chi as in (6) above. Eventually you will discover many different patterns are possible.

(8) Drawing and Holding Back to End Gracefully. Drawing and Holding Back is very important. It prevents you from absorbing more

energy from the tree than you can harmoniously utilize. It also prevents you from draining too much energy from a small or weak tree, or leaving such a tree with too much of your unprocessed negative energy. In addition, it seals off the connections you have made with the tree so that energy is not leaked into the environment after you leave. All in all, it makes for an aesthetically complete meditation and shows respect for the tree. When you have had enough and wish to begin your return to normal consciousness or just to a less deep level of communion, try to do so slowly and gradually so as not to disturb the beauty of what you have just shared. The sensation is one of gradually returning to yourself, sorting out the energy that belongs to you from the energy that belongs to the tree, and re-establishing the boundary between you.

It is important to note at this time that if, after you have done the healing, you still feel a lot of energy in your hands, close the crown point to seal it so that your healing energy will not continue to flow out.

Trees have a great liking for human contact and you will probably be ready to go long before the tree is ready to have you leave.

(a) You need to gradually withdraw your attention from the contact, and turn your attention more upon yourself.

(b) As you do this, much of the shared energy will be drawn into your body. When this happens, just “push back” at the stream of tree energy to prevent most of it from entering your body while allowing your human energy to return.

(c) Then, when your polarities reverse, allow the tree energy to flow back into the tree, but keep your own conscious energy within your body.

(d) After a couple of exchanges, the tree will get the idea and begin to cooperate with you. In a little while you will be fully back in your own body and ready for the closing.

(e) To disengage from a powerful circulation pattern, gradually focus your attention on the navel area, the place to end the meditation. As the energy collects there, allow any excess to flow into the tree.

(f) If the tree tries to feed you energy from another point, push back at this flow in the manner described above.

(g) Eventually the pattern will cease, and you will be sharing energy with the tree at the selected point. Now you can sort out what energy belongs to you and what belongs to the tree to complete the drawing back.

(h) When you are very deep into communion with a tree, you will probably have “too far to go” to draw back in one step. Instead, after a partial drawing and holding back, resume circulating and sharing, but in a less intense manner. Gradually, after several of these steps, you will come wholly back to yourself.

(9) Closing. Always end with a closing. The closing is a precise and somewhat abrupt gesture which breaks the connection, locks into place any healing that my have occurred, and imparts a feeling of good will, all within a second or two. The closing may be a movement, a sound, or just a change in the subtle energy field, such as the clap of the hands, or a nod of the head. A smooth movement of a fist in an upward arc, ending with a little downward punch is very effective. The sounds “Ho” or “Amen” used to end prayers are also examples of closing gestures. So is a firm handshake, or a little squeeze at the end of a hug. Follow this with a little wave of the hand, or a quick kiss on the trunk to complete your closing.

Sections (7), (8), and (9) above are used to intensify, slow down, and end the exercises below and can be used at any time to end your communication with your selected tree.

b. Use the Fingers to Absorb Yang Energy to Help Balance the Yin Energy.

(1) Stand approximately one to two feet in front of a tree. Move slowly and smoothly, gradually approaching the tree. Feel the field of energy surrounding you become thick like honey.

(2) Extend your arms out toward the tree with your palms facing the tree and your fingers extended.

(3)As you slowly adjust your position to be closer and closer to the tree, less “honey” separates you from the bright energies found at its core.

(3) Similarly, your own radiance is revealed to the tree.

(4) At the same time the honey-like energy surrounding you acts like a protective cocoon, and your awareness of the outside world fades.

(5) As you arrive at the tree and wrap yourself around it in a big hug, your radiant energies link up with each other and you may lose yourself for a few moments in the bliss of union.

(6) After making contact in this way, you may need to hold still for a while until the new, deeper connections between you and the

tree stabilize and simplify. Soon you will find yourself in the state of parallel tracking described previously from which circulating and sharing will develop.

(7) Feel the energy of the tree first. When you feel the tree's Chi, use the mind, eyes, and lower part of the eyes to concentrate on the tip of the nose. The upper part of the eyes looks at the tips of the fingers and the tree.

(8) Use the left fingers, the mind, and the upper part of the eyes to absorb the Chi in ward.

(9) Move the upper part of the eyes slowly to guide the Chi up the outside (Yang side) of the left arm, to the left shoulder, the left side of the neck, and the left ear to the crown. Move the energy down the right side beginning with the back side of the right ear, to the right neck, the right shoulder, outside the right arm, to the right palm and fingers. Project the energy out from the fingers, combine it with Cosmic Particle Energy, and guide it into the tree trunk. Absorb it again in a circle. Men repeat the cycle 36 times; women repeat the cycle 24 times. (See Fig. 2.30)

(10) If you wish to end the experience at this or any point, follow the procedures of (a)(7), (8), and (9) above to intensify, slow down, and finally break your connection with the tree.

The Yang Energy Circle will help you become more sensitive to chronic and more superficial pain as well as the energy in the Yang organs (large and small intestines, gall bladder, bladder, and stomach).

c. Use the Palms to Absorb Tree Chi; the Yin Side.

(1) Sit or stand approximately one to two feet in front of a tree.

(2) Extend your arms out toward the tree with your palms facing the tree.(Fig. 2.31)

(3) Feel the energy of the tree first. When you feel the Chi of the tree, use your mind, eyes, and palms to absorb the Chi through your palms. Move the Chi up the inside (the Yin sides) of both arms to both shoulders, both sides of the neck, and the left and right ears, to the crown. From the crown move the energy down the Functional Channel to the mid-eyebrow, throat, heart, solar plexus, navel, and the cauldron behind the navel.

(4) Continue to move the energy down from the cauldron to the perineum, to the soles of the feet, and then approximately ten feet into the ground.

(5) Bring the energy up to the roots of the tree, then up into the tree trunk. Feel your energy flow through the tree, then emerge from the trunk into your palm. Repeat the cycle nine, eighteen, 24, or 36 times.

(6) Practice sending your energy through the tree trunk from the right palm, through the tree, to the left palm, and from the left palm, through the tree, to the right palm. Men should practice for 36 cycles; women should practice for 24 cycles. It is most important to feel your energy penetrate the tree.

(7) Practice distinguishing different parts of the tree. Start with the upper trunk. Send your energy into the trunk and feel it reverberate. Slowly kneel down to practice with the lower trunk. Then practice with the roots of the tree. Feel and exchange the force with the tree.

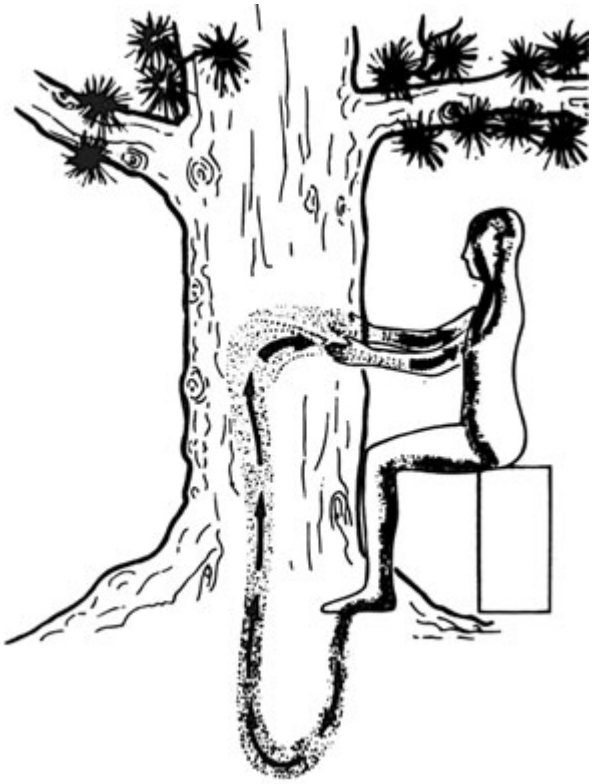

Fig. 2.31 *Use the Palms to absorb the tree Chi and send it down into the roots about ten feet.*

d. Absorb Tree Chi through the Crown.

(1) Stand approximately two to three feet in front of a tree with your arms at your side. Feel the tree's aura. (Fig. 2.32) If you do not feel it, you can move in closer.

(2) When you feel the tree's aura, use your crown to absorb the energy. The tree's balanced energy can Feel very gentle and soft and have a very powerful healing effect.

(3) Draw the tree energy into your crown and let it flow down through the Thrusting Channels or through the Functional Channel to the perineum, then down to both feet. Move the energy out through the soles of your feet into the ground. Bring the energy from the ground to the roots of the tree, then up its trunk.

(4) Feel yourself absorb the Earth Energy and the tree energy. (Fig. 2.33) Feel them purify your energy, removing negativity and sick energy. When you feel it emerge from the trunk of the tree, absorb the Human Plane (Cosmic Particle) Energy, and return the energy to your crown. You will feel the combined energies nourish your brain, glands, and organs. Repeat the process nine, eighteen, or 36 times.

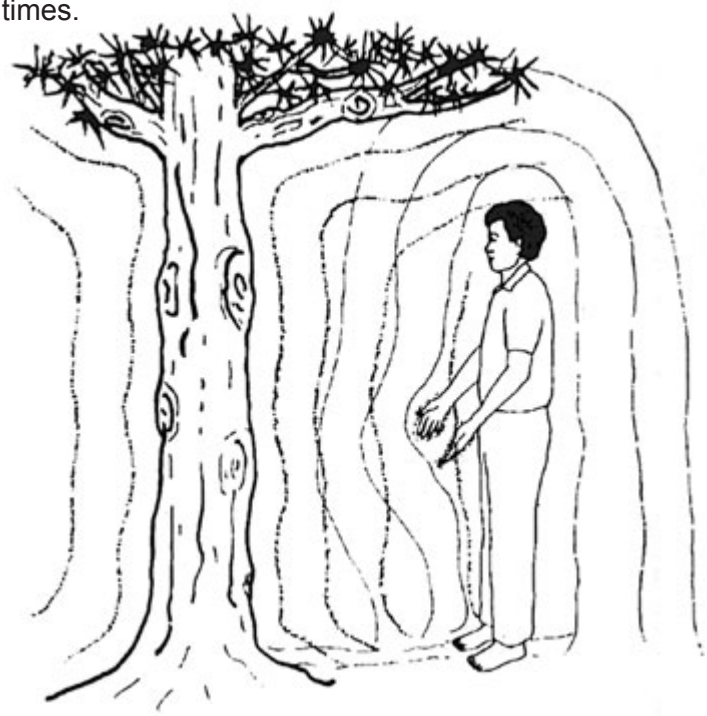

Fig. 3.32 *Allow the Tree's Aura to blend with your own.*

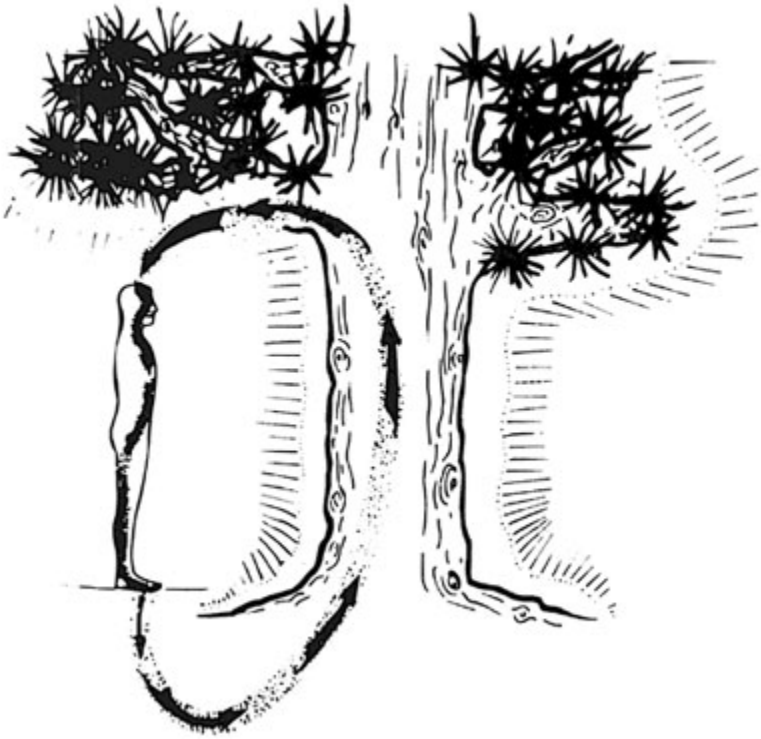

Fig. 2.33 *Absorb the tree Chi and Earth Energy through the crown.*

e. Share with the Tree from the Heart.

In this pattern tree energy is run through the arms and heart center. It may be used to clear a healer's arms of sick energy accumulated in work, or just to open the heart.

(1) Assume any comfortable position in which your hands can easily reach a branch.

(2) Reach one arm out to touch the tree with the palm or fingertips. Feel the vital energy just under the bark and make contact with it, allowing some time for the contact to develop.

(3) After a while you will feel the sharing begin as a gentle breathing back and forth between your hand and the tree.

(4) Gradually extend the process until you are breathing energy through the entire length of the arm, back and forth from your heart center to the tree. Let this back and forth sharing go on for some time.

(5) Next, get the other arm involved. It may rest on the same branch, near the other hand, or it may rest on an entirely different branch.

(6) Allow the tree energy to flow in along one arm, mix with your own energy in the heart center, and flow out the other arm. Every so often reverse the direction of flow in one or both arms.

(7) For a deeper experience try extending the flow from the heart down to the navel, letting it go from tree to heart, to navel, and back.

(8) Where does the energy go after it leaves your hands and enters the tree? By following it with your mind, you will begin to discover more about the subtle anatomy of the tree.

(9) You may find blocked or congested areas that you can work on by running energy out one hand and into the other. Feel the tree's response to your efforts, and let intuition guide you.

f. Absorb Earth Energy.

(1) Create warmth in your navel and bring the energy up to the crown.

(2) Project the Chi out into the top of the trunk of the tree. Enter the tree and feel that you have a connection with it.

(3) During this process you can stand farther away from the tree (ten to thirty feet). As your practice continues you can project your energy easily from far away into the tree. Let the tree take in your negative or sick energy. The energy you receive back will be balanced.

(4) Let your energy flow down the trunk of the tree to its roots and into the Earth. (Fig. 2.34) Let the Earth Energy purify your energy. Bring this combined energy up through the soles of your feet to the perineum, then up through the Thrusting Channels, or through the Governor Channel running up the spine. Let the energy flow up to the crown and project it outward again. Repeat the process nine, eighteen, or 36 times.

The more you repeat the process, the more your energy will refine and increase. You will notice the Thrusting Channels and the Microcosmic Orbit are cleaner and brighter. Once you have established a good connection with the tree, you can send your sick energy to the tree from a far distance to refine your energy or improve your health.

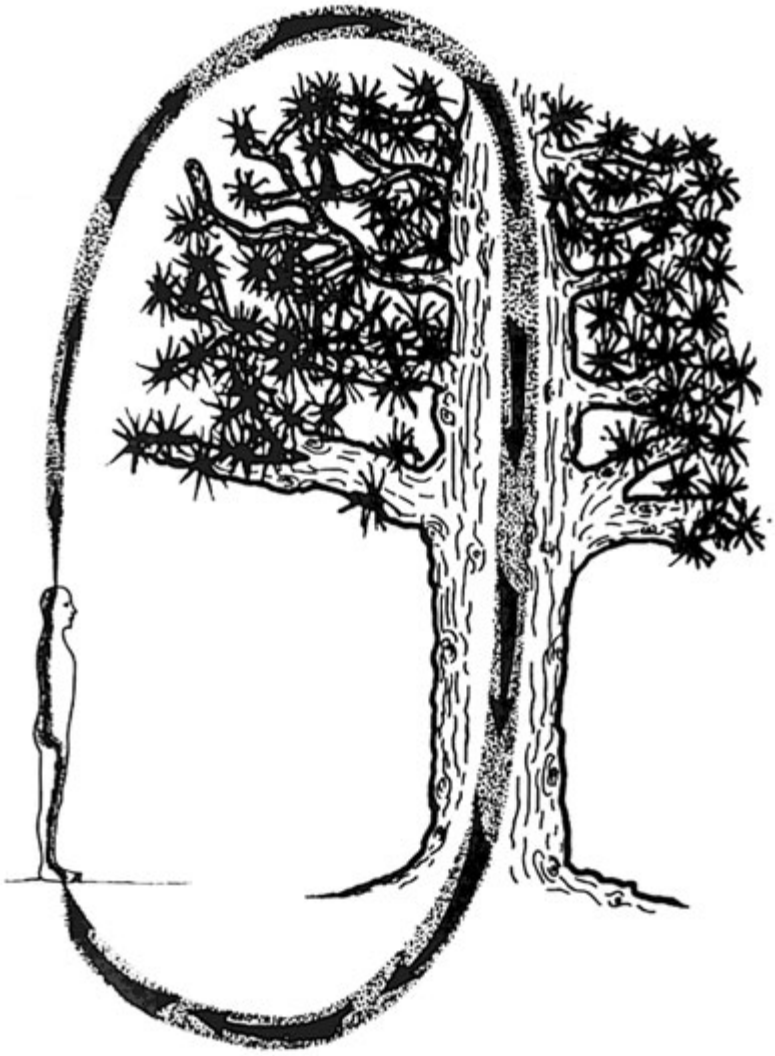

Fig. 2.34 *Absorb the Earth's Force. Circulate it through the tree after sending it out though the crown.*

g. Meditate While Sitting Under a Tree

Once you have developed the ability to feel the tree's Chi, you can sit under the tree and meditate. Draw the tree's energy into you through the stations (points) of the Microcosmic Orbit. (Fig. 2.35)

I. Six Healing Sounds

The Six Healing Sounds will help you sense the distinctive frequencies and colors generated by each organ. Practice the Healing Sounds until you can easily relate the sound to the organ and sense the qualities of that organ.

1. Six Healing Sounds initiate Healing

Everyone has heard stories about gifted beings who possess special healing powers. People seek out great healers. How much time can a great healer spend with you--one hour a week or one hour every day? What about the rest of the week or the rest of the day? One hour a day means one hour out of twenty-four. One hour a week means one out of 168 hours. This is why it is important for each person to learn how to clear his or her negative energy, and how to transform it into good energy. Regular practice of self-maintenance and self-healing enhances ongoing healing. The Six Healing Sounds are an easy practice to initiate healing. The Sounds are very simple, but very powerful.

When you are adept at the Six Healing Sounds and begin to practice Chi Nei Tsang, you will need to teach your students the Sounds. They can practice at home and help carry on the healing. You should teach one or two Sounds at each session and review them at each session.

2. How to do the Six Healing Sounds

a. Lungs' Sound

Associated Organ: Large Intestine
Element: Metal
Season: Fall
Color: White
Emotions: Negative—Grief, Sadness, Depression
Positive—Courage, Righteousness

Sound: ***Sssssssss*** (tongue behind teeth)

(1) Position: Sit with your back straight and the backs of your hand resting on your thighs. Smile down to your lungs. Take a deep breath an raise your arms out in front of you. When the hands are at eye level, begin. to rotate the palms, bringing them above your head until they are palm up, pushing outward. Point the fingers toward those of the opposite hand. Keep the elbows rounded out to the sides. Do not straighten your arms.

(2) Sound: Close the jaw so that the teeth gently meet and part the lips slightly. Inhale as you look up, eyes wide open, and push your palm upward and out as you slowly exhale through your teeth and make the, sound "***Sssssssss***." At first you can produce the Lungs' Sound aloud but eventually you should practice sub-vocally (vocalizing so softly that only you can hear the sound). Picture and feel excess heat, sick energy sadness, sorrow, depression, and grief expelled as the sacs surrounding the lungs compress. Exhale slowly and fully.

(3) Rest and Concentrate: Resting is very important because during rest you can communicate with your inner self and your internal system. When you have exhaled completely, rotate the palms down as you slowly lower the shoulders, and return your hands to your lap, palms up. Close your eyes and be aware of your lungs. Smile into them and imagine that you are still making the Lungs' Sound. Breathe normally and picture your lungs growing with a bright white color. This will strengthen your lung: and draw down the Universal Energy associated with them. With each breath, try to feel the exchange of cool, fresh energy as it replaces excessively hot energy.

Repeat six, nine, twelve, or 24 times. Practice more often to alleviate sadness, depression, colds, flu, toothaches, asthma, and emphysema.

b. Kidneys' Sound

Associated Organ: Bladder
Element: Water
Season: Winter
Color: Black or Dark Blue
Emotions: Negative—Fear
Positive—Gentleness

Sound: ***Chooooooo*** (as when blowing out a candle with the lips forming an "O")

(1) Position: Bring your legs together, ankles and knees touching. Be aware of your kidneys and smile into them. Take a deep breath, lean forward, and clasp the fingers of both hands together around your knees. Pull your arms straight from the lower back while bending the torso forward. (This allows your back to protrude in the area of the kidneys.) Simultaneously tilt your head upward as you look straight ahead and maintain the pull on your arms from the lower back. Feel your spine pull.

(2) Sound: Round the lips and slightly exhale the sound "***Chooooooo***" as if you were blowing out a candle. Simultaneously contract your abdomen, pulling it in toward your kidneys. Imagine the excess heat, fear, and wet, sick energies squeezed out from the fascia surrounding them.

(3) Rest and Concentrate: After you have fully exhaled, sit erect, separate the legs, and place your hands on your thighs, palms up. Close your eyes, breathe into the kidneys, and be aware of them. Picture the bright color blue in the kidneys. Smile into them, imagining that you are still making the Kidneys' Sound. Repeat the above steps three, six, twelve, or 24 times. Practice more often to alleviate fear, fatigue, dizziness, ringing in the ears, or back pain.

c. Liver's Sound

Associated Organ: Gall Bladder
Element: Wood
Season: Spring
Color: Green
Emotions: Negative—Anger
Positive—Kindness
Sound: ***Shhhhhhh*** (tongue near palate)

(1) Position: Sit comfortably and straight. Be aware of the liver and smile into it. When you feel you are in touch with the liver, extend your arms out to your sides, palms up. Take a deep breath as you slowly raise the arms up and over the head from the sides, following this action with your eyes. Interlace the fingers and turn your joined hands over to face the ceiling, palms up. Push out at the heel of the palms and stretch the arms out from the shoulders. Bend slightly to the left, exerting a gentle pull on the liver.

(2) Sound: Open your eyes wide because they are the openings of the liver. Slowly exhale the sound "***Shhhhhhh***" sub-vocally. Envision expelling excess heat and anger from the liver, as the fasciae around it compress.

(3) Rest and Concentrate: When you have fully exhaled, separate the hands, turn the palms down, and slowly bring the arms down to your sides, leading with the heels of the hands. Bring the hands to rest on your thighs, palms up. Smile down into the liver. Close your eyes, breathe into it, and imagine you are still making the Liver's Sound. Repeat three, six, twelve, or 24 times. Practice more often to alleviate anger, red or watery eyes, to remove a sour or bitter taste, and to detoxify the liver.

d. Heart's Sound

Associated Organ: Small Intestine
Element: Fire
Season: Summer
Color: Red
Emotions: Negative—Impatience, Hastiness, Arrogance, Cruelty
Positive—Joy, Honor, Sincerity
Sound: ***Hawwwwww*** (mouth wide open)

(1) Position: Be aware of the heart and smile into it. Take a deep breath and assume the same position as for the Liver's Sound. Unlike the former exercise, however, you will lean slightly to the right to pull gently against the heart, which is just to the left of the center of your chest. Focus on your heart, and feel the tongue.

(2) Sound: Open the mouth, round the lips, and slowly exhale the sound "***Hawwwwwww***" sub-vocally. Picture the sac around the heart expelling heat, impatience, hastiness, arrogance, and cruelty.

(3) Rest and Concentrate: After having exhaled, smile into the heart, and picture a bright red color. Repeat the steps above three to 24 times. Practice more often to relieve sore throats, cold sores, swollen gums or tongue, jumpiness, moodiness, and heart disease.

e. Spleen's Sound

Associated Organs: Pancreas, Stomach
Element: Earth
Season: Indian Summer
Color: Yellow
Emotions: Negative-Worry
Positive-Fairness
Sound: ***Whoooooo*** (from the throat, guttural)

(1) Position: Be aware of the spleen and smile into it. Take a

deep breath as you place the fingers of both hands just beneath the sternum on the left side. You will press in with the fingers as you push your middle back outward.

(2) Sound: Look up, and gently push your fingertips into the left of the solar plexus area, as you sub-vocally exhale the sound "***Whoooooo***." This is more guttural, or "throaty" than the Kidneys' Sound. Unlike blowing out a candle, this sound originates from the depths of the throat rather than from the mouth. Feel the Spleen's Sound vibrate the vocal cords. Feel any worries being transformed as the virtues of fairness and honesty arise.

(3) Rest and Concentrate: Once you have fully exhaled, close the eyes, place the hands on the thighs, palms up, and concentrate smiling energy on the spleen, pancreas, and stomach. Breathe into these organs as you picture a bright yellow light shining in the organs. Repeat the steps above three to 24 times. Practice more often to eliminate indigestion, nausea, and diarrhea.

f. Triple Warmer's Sound

The Triple Warmer refers to the three energy centers of the body; The upper section (brain, heart, and lungs) is hot; the middle section (liver, kidneys, stomach, pancreas, and spleen) is warm; and the lower section (large and small intestines, bladder, and sexual organs) is cool. The sound "***Heeeeeee***" balances the temperature of the three levels by bringing hot energy down to the lower center and cold energy up to the higher centers. Specifically, hot energy from the area of the heart moves to the colder sexual region, and cold energy from the lower abdomen is moved up to the heart's region.

(1) Position: Lie on your back with your arms resting palms up at your sides, and keep your eyes closed. Inhale fully into all three cavities: chest, solar plexus, and lower abdomen.

(2) Sound: Exhale the sound "***Heeeeeee***" sub-vocally, first flattening your chest, then your solar plexus, and finally your lower abdomen. Imagine a large roller pressing out your breath as it moves from your head down to your sexual center.

(3) Rest and Concentrate: When you have fully exhaled, concentrate on the entire body. Repeat the above steps from three to six times. Practice more often to relieve insomnia and stress.

3. Daily Practice Before Bedtime

Practice the Six Healing Sounds before going to bed at night. This will help decelerate the body, promote good sleep, and cool down any overheated organs. Before you go to sleep, clear the negative emotions so that the positive emotions can grow. Clearing out the negative emotions will chase away bad dreams and nightmares. You can sleep well and connect to the Universal Mind to recharge your energy.

If you have problems, difficulties, or feel ill, attain the sensation of emptiness and send these disturbances up into the Universal Mind. Trust that this force will help you. In the morning smile inwardly and see if you can find answers to your disturbances. Often the answer will be there for you when you awake.

The Six Healing Sounds and Inner Smile practices are more fully explained and illustrated in the Universal Tao book, *Taoist Ways to transform Stress into Vitality.*

J. Fanning and Venting Sick Energy

These exercises are particularly good for the CNT practitioner to practice daily to get rid of sick energy and negative emotions so that positive emotions can grow and circulate. They can also drain the excess heat from a student, but the student must practice regularly at home to receive their full benefit.

1. Fanning

Since tension causes a lot of sick, negative emotional energy to condense in the chest, the heart can easily become jammed. Some believe long term negative emotions such as hatred, impatience, and arrogance directly affect heart conditions or are a major cause of heart attacks. To protect yourself you can activate the heart. This process will draw the negative feelings and sick energy to the heart, and you will need to fan this energy out of the heart and body.

a. Purpose of Fanning

Taoists regard the soles of the feet and centers of the palms as having a connection with the heart. Therefore, Fanning sick energy involves moving the energy from the heart down to the soles of the feet. (Fig. 2.36) The theory is that when the sick energy is fanned down to the soles of the feet and further down to the Earth, the soles connect with Mother Earth who can accept the sick and negative energy to utilize and transform it into useful energy. This means that if the negative energy is expressed as emotions and "dumped" from the higher place of the heart, it will not be received by Mother Earth who can put it to good use. Instead, these emotions will be received by other people involved in the person's life, a situation that can cause sickness for them as well.

Fig. 2.36 *Fanning the Sick Energy and Negative Emotions from the Heart to the Soles of the Feet.*

b. Position and Practice

Fanning is an activity originating in the upper diaphragm and in the mind. With the palm facing downward, raise the left hand to the chest at the level of the Heart Center, about one and one half inches from the top of the sternum. Place the right hand parallel and above it, aligning its palm with pericardium 8.

(1) Practice the Heart's Sound (***Hawwwwww***) and feel the heat from the heart start to burn, drawing in any negative feelings.

(2) Exhale this energy (using the Heart's Sound) as simultaneously you lower both hands. Feel the negative energies bum out. Continue to exhale the energy down to the perineum, to the back of both feet, to the soles, and then perceive Mother Earth absorbing it. Rest the palms on the knees. Look down to the soles of the feet and feel a cloudy, grey, and cold or chilly energy go out. Rest again. Be sure to take a long time to rest since your resting time is very important.

(3) Start over again by returning both hands to the heart level. Practice eighteen to 36 times for a total of five to ten minutes. As you clear yourself of the dirty, sick energy, you will feel empty, but in a good mood. Feel the Heavenly Energy as a golden light coming down through the head and filling the body.

(4) Rest for a while. You also will feel Mother Earth's Energy, a blue color, coming up through the soles of your feet.

2. Venting

a. Purpose of Venting

When negative emotions are causing sickness in the organs, venting is another practice to remove the undesirable energy. For example, fear in the kidneys can be vented to change the color of their energy from a cloudy, blue energy to a bright blue. Anger produces cloudiness in the liver's color which can be changed from a cloudy green back to a bright, clear green.

b. Position and Practice

After you finish Fanning as above, remain in the same sitting position to begin the Venting exercise. Venting is practiced to get rid of emotions from all of the other organs. Since fingers and toes are connected with all the organs and glands (Fig. 2.37), sick energy tends to stagnate there making them feel numb.

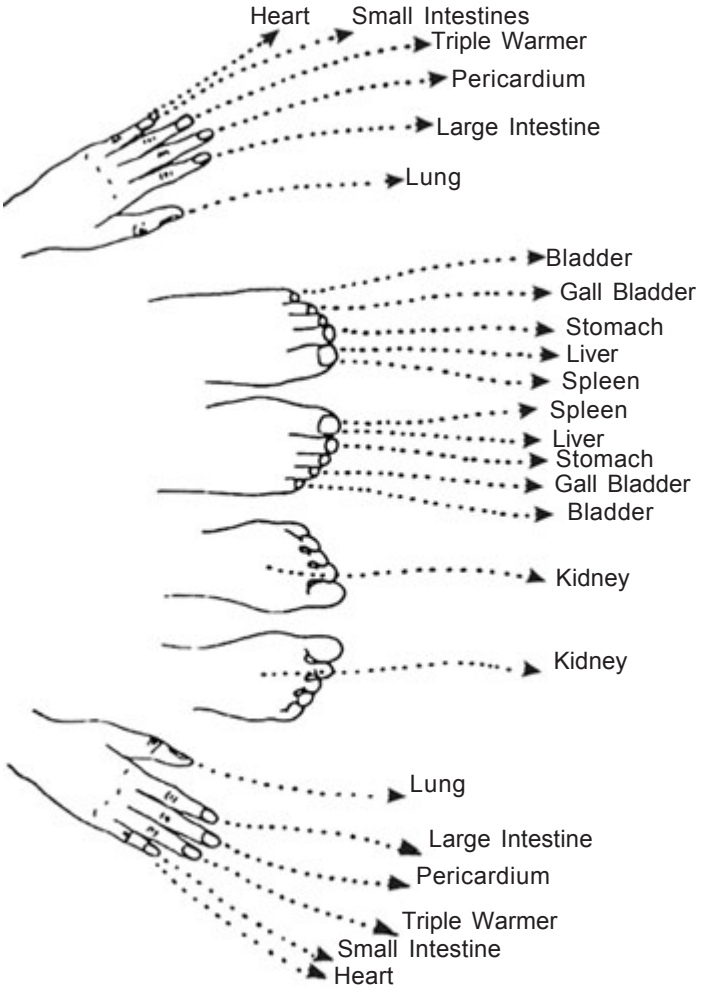

Fig. 2.37 *Toes and fingers correspond to the organs.*

(1) Sit and place your hands on your knees. Keep your fingers slightly spread apart and pointed toward the toes.

(2) Place your feet parallel to each other and point the toes up. Be aware of the area two or three inches up and directly between the big toes. Be aware of the tips of the big toes and then all of the toes.

(3) If you have sick energy affecting an organ, look at Fig. 2.37 to determine the toes or fingers that correspond to that organ. During Venting you can emphasize the fingers or toes corresponding to the organ in which you have the sick energy to send more of the energy out of the body. For example, if you have a heart problem, you can concentrate on the pinky fingers. Feel the cloudy, grey energy exiting through those fingers.

(4) Practice the Triple Warmer's Sound (***Heeeeeee***) down to the navel, perineum, and toes. (Figs. 2.38 and 2.39) With the (***Heeeeeee***) Sound, feel the vibration of the Sound at and moving out of the tips of the fingers and toes.

(5) Gradually feel a steaming, dark, cloudy, cold or chilly, sick emotional energy emerging from the toes and fingers.

(6) Picture it becoming brighter and brighter. Continue to look at the point between the big toes to see more sick energy and negative feelings emerge.

(7) Be aware of the liver and see it become a bright green.

(8) Be aware of the spleen and the pancreas, and see them glow with a bright yellow color.

(9) Be aware of the lungs and see them glow with a white light.

(10) Be aware of the heart and see it open with a bright red.

(11) Be aware of the kidneys; see them glow with a bright blue light.

Chapter 3

Observing the Body: Looking, Feeling, and Asking

The techniques of observing the student's body and spirit were developed over thousands of years. You can learn procedures for looking, feeling, and asking that will indicate which organs and areas of the abdomen need attention and massage. Some of the techniques, such as pulse and tongue reading, take time to master. It is not necessary to know all of them to do the massage techniques. You can start using the easier techniques right away and practice with the more difficult ones later.

Start by observing the shape of the navel and by feeling the abdomen. When you discover soreness, tightness, congestion, distension, and toxicity, you will learn that you can help many people by using a gentle, spiraling massage around the navel area. You will learn to let your fingers educate and guide you.

A. Abdomen

1. Physical Structure of the Abdominal Cavity within the Peritoneum

The physical structure of the abdominal cavity contains the large intestine, small intestine, liver, gall bladder, stomach, spleen, pancreas, bladder, sex organs, aorta and vena cava, many lymph nodes, nervous system, abdominal muscles, and fasciae. They are contained in the peritoneum, a membrane lining the abdominopelvic walls. The kidneys and the adrenal glands are located toward the back, between the peritoneum and ribs. The back of the cavity is protected by the ribs, spine and pelvis, and muscles. The internal organs and some blood vessels, lymph vessels, and nerves can be reached from the front of the body.

a. Feeling the Skin and Muscles of the Abdomen

The skin that covers the abdomen can help you decide the health of the organs that lie underneath it, Place your hand gently and without pressure on the abdomen. Move it in a circular motion to discern the condition of the skin. Unhealthy tissues can be too tight, too loose, or without elasticity (atonic). The better the elasticity, the healthier the organs. Healthy tissue has a normal elasticity because the nerves that influence the elasticity are not damaged by toxins. The texture and tone of the skin is normal, even, and elastic to the touch without any irregularity. Healthy skin covers the body like a well-fitting body suit. Unhealthy skin can be detoxified, and elasticity can be gradually restored.

The abdomen has many large sheets of muscles. Healthy muscles also help to create a healthy abdomen. Practice the same technique as when palpating the skin, but this time try a little more pressure. Feel the muscles under the skin and distinguish between a normal resistance of the muscle and a hard and tight resistance. If there is any inflammation in the abdominal cavity, the body will tighten up its abdominal muscles to protect the irritated area. Sometimes the abdomen feels very tough and hard. This is a good indication of an inflammation. A healthy abdomen feels soft and bouncy (like a baby's) with sufficient muscle tone to hold the organs in place. It should be without any tension or resistance, and show a clear outline of what is underneath. An overdeveloped, rock-like abdomen packs the organs too tightly and does not allow much room to expand. Such a muscle-bound abdomen also limits the range of movement of the spine, shoulders, and rib cage.

b. Breathing Properly from the Abdomen

Breathing patterns can reveal the health of the abdomen. The lungs occupy a large part of the upper chest. Under stress or emotional turmoil, a person will breathe tensely, using the chest. This causes shortness of breath and congestion in the chest. The normal breathing pattern of a healthy person is abdominal breathing. Only in this way can the lungs do their work most efficiently (oxygen exchange, activating peristaltic movements, processing Chi). Proper abdominal breathing will remove congestion and exercise all the organs.

During abdominal breathing the diaphragm moves up and down, creating a pumping and sucking massage of the intestines.

If there is a disorder or inflammation in the abdomen, or if the digestive system is unhealthy, the body provides a signal that there is a problem. To protect the irritated area, a reflex action will stop abdominal breathing and initiate chest breathing, thereby neutralizing any movement in the abdomen.

B. Body Structure and the Abdomen

In the last twenty years, the public has become more aware of the body's needs for healthy and nutritious food. However, even if the healthiest foods are consumed, the body cannot properly use the nourishment if the digestive system isn't healthy. The result is an increasingly unhealthy state. Since the abdomen is flexible, formed by muscles and tendons, and without a stiff form, it is possible to determine any changes in the normal appearance of the abdomen.

1. Unhealthy Intestines Distort the Shape

When gas accumulates in the corners of the large intestines, the rib cage is pressed upward and outward. This can be on one side of the rib cage only, or on both sides. The intensity of the deformation depends upon how much gas accumulation there is. If this state is chronic, the ribs deform themselves. Because the ribs are attached to the spine, the vertebrae also will start changing their positions.

If there is a gas accumulation only on one side, the spine will start twisting. If there is any traction in the normal structure, the body will naturally react with a movement to adjust to this position. Thus, the body intensifies the problem. For example, suppose there is a strong chronic gas accumulation on the left side of the large intestine. The rib cage will be lifted up on the left side, and the vertebrae will move and shift to the right. The body tries to adjust to this change in structure by contracting the muscles on the left side of the spine. This will not have any affect on the vertebrae that are moved by the ribs, but it will pull the vertebrae above and below that area to the other side. Through this counter-movement of the body, the structural problem grows larger. (Fig. 3.1)

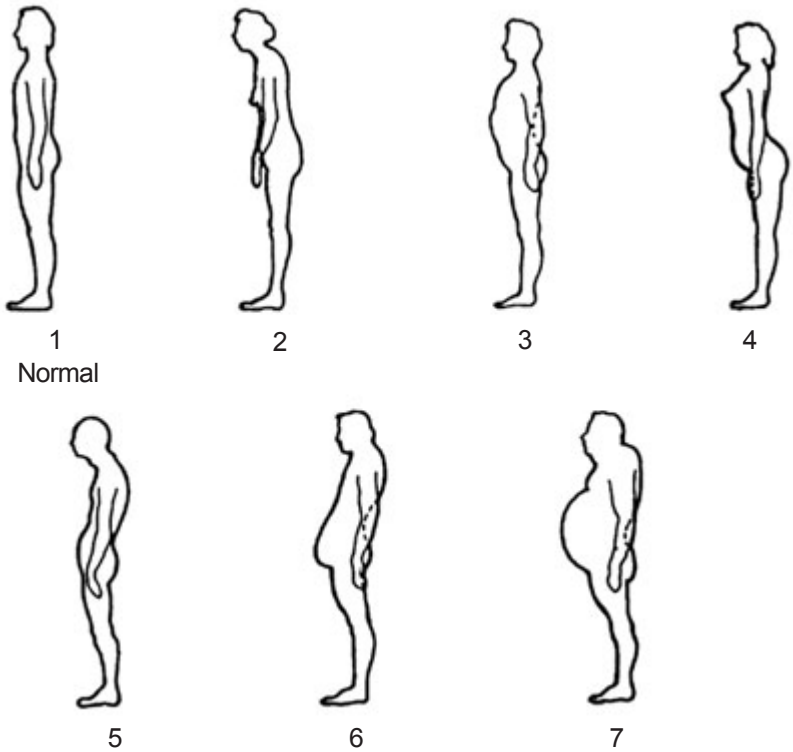

Fig. 3.1 *Distortion of the Structure due to an Unhealthy Abdomen.*

2. Expansion of the Lower Back

People with weak muscles, who straighten out the natural curve of the lower back (the lumbar vertebrae), can create more room for their unhealthy intestines. Because of this straightening, the head moves forward and the natural curve of the cervical spine is straightened as well.

3. Excessive Bending of the Lower Back

People with strong muscles who have problems in the upper abdomen tend to create more room for the intestines by tilting the hip down and bending the lower back excessively. Because the natural curve of the thorax straightens, the chest comes out, the neck is held tightly backward, and the scapulae close in on each other. This structure causes lower back pain and can be the reason for shortened breath.

4. Excessive Bending Combined with Extension-the Duck Position

People, especially women, with strong muscles and unhealthy intestines show a structure that is a combination of an extension of the lumbar region and an excessive bending of the junction of the lumbar vertebrae. The lower back is bent, and the buttocks stick out. The upper body is held backward, but the chest is pushed out. In this structure the weight of the intestines causes them to hang down toward the back, so they are no longer pressing on the female organs. This also makes room for intestines that are full of gas.

5. Excessive Bending of the Lumbar Region and Excessive Curving of the Thoracic Spine

Those with intestinal disorders, weak muscles, and fatigue try to create more room for their intestines by excessively bending the natural curve of the lower back and rounding the thoracic curve. As a result, the abdomen protrudes and the neck is stiffly held straight and forward. The scapulae are wide apart from each other, and the chest is flat or concave.

6. Hanging Intestines

This structure of the person with hanging intestines is similar to that described in 5 above. The lower back is curved inward, the buttocks move outward, and the thorax is held back to compensate for a weak and hanging belly.

The loose small intestinal bulge often hangs over and covers the genitals, creating a fold at the height of the pubic bone. This crease easily becomes inflamed.

7. Big Belly

This body posture is the result of a big, heavy tummy. The chest and diaphram are pushed upward and become wider. The neck is almost invisible, disappearing between the shoulders and a hump at the back of the neck.

C. Shape of the Navel

The Taoists learned by observing the most obvious things. They learned that it is possible to know a great deal about the condition of the abdominal area and organs just from examining the shape of the navel.

1. Examination of the Navel

Always note the shape and position of the navel before beginning a session. The navel is similar to a funnel, and it divides into three parts: the rim, the sidewall, and the bottom. The navel should be round, centered, and symmetrical. It should be firm and springy, not hard and tight, or soft and weak. The sidewalls should be symmetrical. The floor or bottom should be in the center of a circular rim.

The rim can be misshapen and off-center. The sidewall, and sometimes the rim, can be puffy, curved, high angled, or pulled in one or more directions. The floor of the navel can be puffy and congested, or it may be very deep. It may be twisted or pulled, and may or may not include the sidewall and rim.

The navel may be pulled in one or more directions. It may be vertical, horizontal, diagonal, teardropped, collapsed, blown out, or turned clockwise or counterclockwise.

With some practice, you will find that by reading the three parts of the navel, you can determine which way or ways it is being pulled. Distortion of the navel indicates the direction and location of tight, congested areas and blockages. Sometimes this will show which organs or systems are involved and at what depth.

2. Different Navel Pulls and their Effects

Imagine a pie six inches in diameter placed on the navel. Now divide that pie into eight sections. (Fig. 3.2) Note where the navel is pushing or pulling according to the eight directions. (Fig. 3.3) Notice if the navel is pulling in one or more directions simultaneously. When you learn which organs are in each pie piece and can associate them with the distortion of the navel, you will have a very good means of determining what imbalances are present in the body.

The pulling may only affect the superficial tissues or a specific organ or system. Usually the pulling affects the body's center, both superficial and deep, and involves more than one organ or system. Remember that any pulling distorts the body's center and the first system to be influenced is the Navel Center Chi system. When the Chi system is off-center, the physical body is also off-center, creating an imbalance in the emotions, systems, and organs.

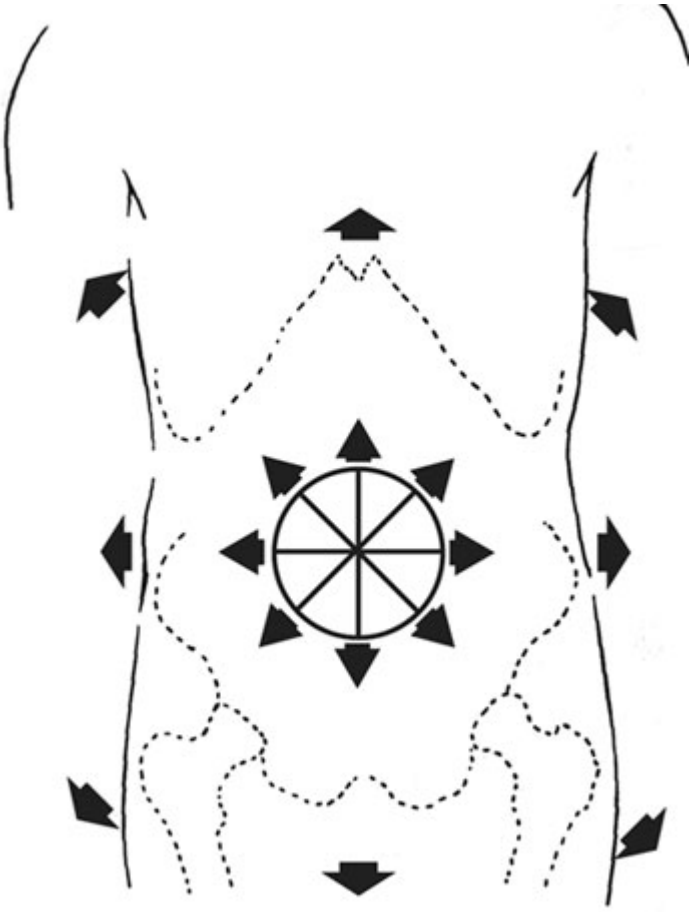

Fig. 3.2 *Chart for Reading Navel Pulls*

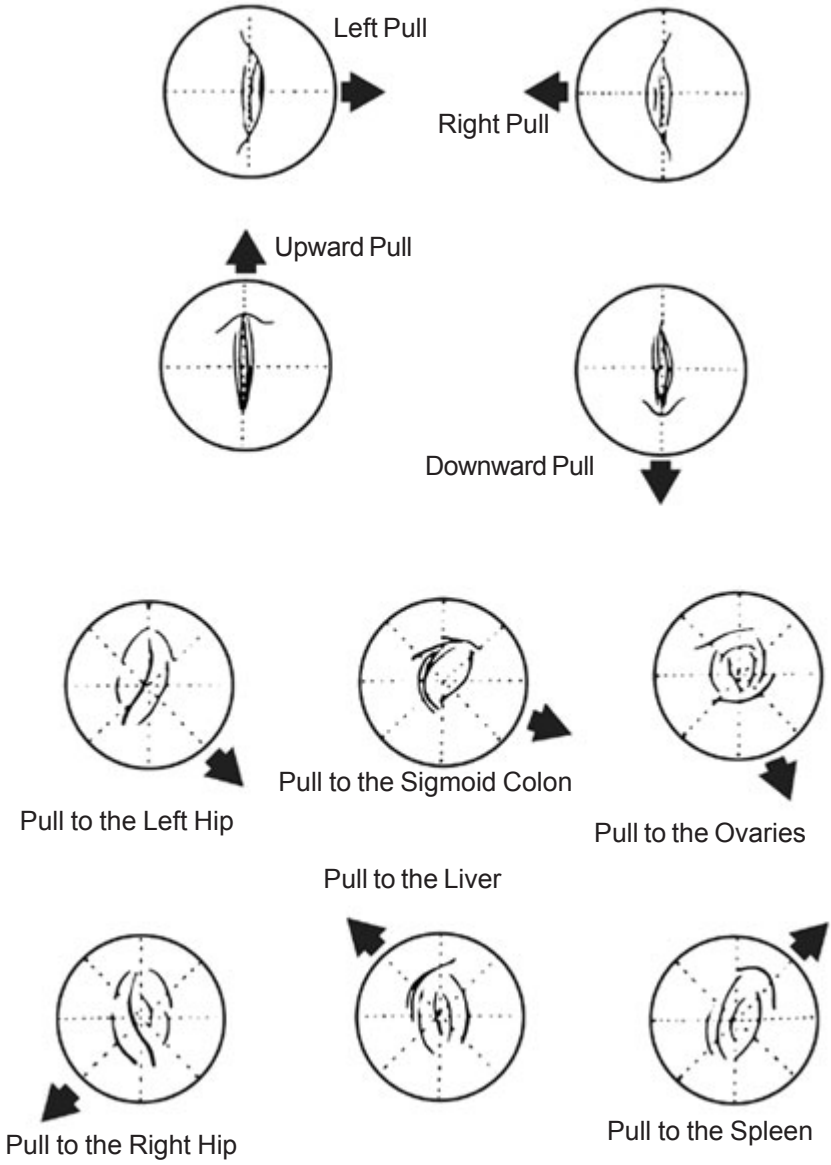

Fig. 3.3 *Navel Pulls*

a. Pulls to the Left Hip

(1) A navel that pulls toward the lower left side can be related to tension in the upper right side. This can affect the liver, gall bladder, duodenum, and right kidney and may cause pain in the lumbar plexus or the left leg.

(2) If the left ovary is pulled off its center, it can cause menstrual problems. Gently probe to the left side of the ovary and uterus and look for tension. There may be a knot near the ovary, or between the ovary and uterus.

b. Pulls Down

(1) When the navel pulls downward toward the center of the groin, there may be tension in the solar plexus and upper chest. The navel pulse may be pulled down as well.

(2) This can cause dyspepsia and chronic pain. It also could cause pressure against the intestines, possibly bringing on mental problems and bad dreams. The small intestines are the paired organs of the heart, so any digestive problems can cause the heart to overheat.

(3) The pull can affect the upper and lower side, so there could be pain in the lower side. Tension can cause the intestines to lock together.

(4) Women can experience menstrual and fertility problems if the cervix pulls off-center.

(5) In a man you might find a knot near the pubic bone, or below the bladder, near the prostate gland, which may be causing prostate or bladder problems.

c. Pulls to the Right Hip

(1) If the navel pulls toward the lower right part of the pelvis and is tense toward the upper left side, the student can be off-center. This can affect the pancreas, stomach, spleen, and left kidney, and could pull the lumbar plexus off-center causing pain in the right leg.

(2) In women, a right ovary that pulls to one side can be the cause of menstrual problems. Gently probing the right side of the ovary and uterus can reveal a knot near the ovary or between the ovary and uterus.

d. Pulls to the Right Side

(1) If the navel pulls toward the upper right side of the pelvis, the left side of the small intestine can feel tight and painful. Problems along that line can occur at both a superficial and a deep level. This can affect the function of the intestines and the right and left kidneys.

(2) A right side pull can cause tightness in the upper right side and affect the liver and gall bladder. The pull could cause tightness in the left leg and hip and can affect the sigmoid colon.

e. Pulls to the Upper Left Side

(1) A navel that pulls to the upper left side can cause tightness in the lower right side, pull the lumbar plexus off-center, and cause pain in the right. There is the possibility of problems in the pancreas, stomach, spleen, and left kidney.

(2) In women, menstrual problems can occur.

(3) This pull suggests problems in the ileocecal valve and the digestive process.

f. Pulls to the Left Side

(1) If the navel pulls to the left side of the pelvis, the right side of the intestine can feel tight and painful. This can cause a problem on the centerline, both deeply and superficially, and the kidneys may be affected.

g. Pulls to the Upper Right Side

(1) A navel that pulls to the upper right side can cause tightness in the lower left side, pull the lumbar plexus off-center, and cause left leg pain. There could be problems in the liver, gall bladder, and right kidney.

(2) In women, menstrual problems can occur.

(3) This pull suggests problems with the sigmoid colon and the digestive process.

h. Pulls Up

(1) Anavel that pulls up can pull the navel pulse above the umbilicus when it should be below. This can cause bad digestion, constipation, acidity, diseases of the heart, and an irritating personality.

(2) In women, this can pull the cervix off-center and cause menstrual problems.

D. Hand Scanning the Internal Organs

1. Each Organ emits a Different Aura

Each organ emits a different kind of force or aura through the skin. By passing a hand one to two inches above the skin, you can feel different sensations that reflect the condition or state of the internal organs. You need to develop the sensitivity to receive the vibration or frequency of each organ.

Practicing the Aura, Tree, and Healing Hand Meditations (see Chapter 2) will help develop such sensitivity.

a. Liver and Gall Bladder Scanning

(1) Healthy liver and gall bladder energy feels warm.

(2) Negative Emotions: When you pass your hand over the liver, under the right side of the rib cage, you will feel a charged energy come up to your hand. (Fig. 3.4) This is a sign of anger in the liver.

(3) Overactivity: When you pass your hand over the liver and feel rush of hot energy, this indicates that the liver is overheating because of toxins or emotional stress.

(4) Underactivity: When you pass your hand over the liver and you feel a dense and hot energy, the liver is weak, congested, and sick.

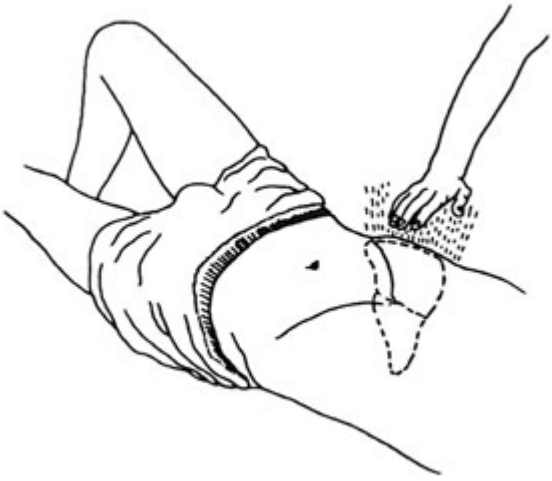

Fig. 3.4 *Scanning the Liver*

b. Lungs Scanning

(1) Healthy lung energy feels cool and dry.

(2) Negative Emotions: Pass your hand over the lungs. Do the Lungs' Sound and listen to the echo of the sound as it rebounds from the lungs. Sadness will feel like a deflating ball pressed between your hands

(3) Overactivity: Energy that feels dry and hot indicates an over worked organ.

(4) Underactivity: Energy that feels damp and cool under the scanning hand indicates underactive or congested lungs that can lead to respiratory problems.

c. Heart Scanning

(1) Healthy heart energy feels warm and energetic.

(2) Negative Emotions: Hot and charged energy indicates impatience, hastiness, and arrogance in the heart.

(3) Overactivity: If your hand detects hot, charging, and a more expansive energy, this indicates that the heart and blood may be overheating.

(4) Underactivity: Energy that feels cool and less expansive indicates an underactive or congested heart.

d. Spleen Scanning

(1) Healthy spleen energy feels lukewarm.

(2) Negative emotions: Energy that feels damp and sinking indicates excessive worry.

(3) Overactivity: The energy feels hot and damp when the spleen is overactive.

(4) Underactivity: The energy feels cool and damp.

e. Kidneys Scanning

(1) Healthy kidney energy feels cold, but not too cold.

(2) Negative emotions: Energy that feels cold and chilly indicates fear.

(3) Overactivity: When the kidneys are overworked or over-stimulated by excessive exercise or are affected by improper diet and liquid intake, the energy can feel damp, sticky, and hot.

(4) Underactivity: When toxins are blocking the organs, the energy can feel damp and cold.

E. Traditional Face Reading

Although the most important indication of the state of the organs is the shape of the navel, there are other traditional methods of Chinese medicine that check the state of health of the body such as Face Reading.

Since facial features have a direct correlation to the five major organs of the body (see Fig. 1.26), as well as to the circulatory, nervous, and other systems of the body, observing the face can be helpful in diagnosing problems. (Fig. 3.5)

Generally speaking, the health of a person will be reflected in an apparently balanced face. Signs of imbalances could be discoloration, deep lines, and enlarged or protruding features, such as eyes or lips. Since Face Reading is an entire study in itself, the following is only a sampling of some of the indications to look for.

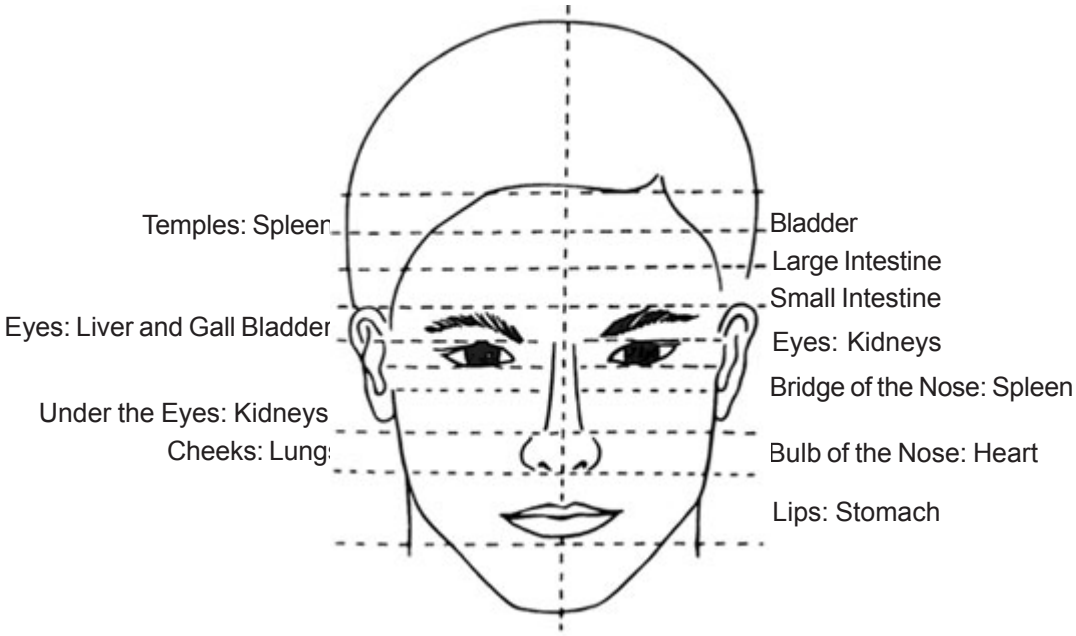

Fig. 3.5 *Face Reading*

1. Color of the Face

A red face indicates a problem in the cardiovascular system, especially if it is around the tip of the nose. Darkness in the face, especially around the eyes, points to kidney problems. A white, pale face suggests lung problems. A yellow-green face shows a liver problem; a yellow-orange color indicates a spleen problem.

2. Lines on the Face

The depth of the lines is an indication of the seriousness of the problem. Horizontal lines between the eyes on the bridge of the nose show congestion of the intestines and, possibly, menstrual problems for women. Horizontal lines on the forehead and under the eyes, which are caused by excess liquid in the system, can indicate a kidney problem. A deep, long vertical line above the nose and between the eyebrows indicates a liver problem.

3. Eyes

The eyes reflect the condition of every organ in the body, but perhaps most directly they reflect the liver's condition and thereby the related condition of the digestive system, and also that of the nervous system. In reflecting the liver's condition, a healthy liver is indicated by an iris with a soft, translucent quality. The pupil should be transparent; a deep black color indicates kidney trouble. Discoloration of the edges of the eyelids show an unhealthy spleen. The white of the eyes shows the condition of the lungs and, again, discoloration indicates a problem. Any bloodshot lines in the white of the eyes could indicate some imbalance in the body's condition, although four lines commonly do show in most people. Both corners of the eyes indicate the state of the heart.

4. Skin

The color of the skin can be an indication of the condition of the lungs. Observe the color of the cheeks to check for excessive whiteness. The skin of the nostrils is another indicator of the lungs' condition. Healthy skin contains a balanced moisture, so check for overly dry or overly moist skin in the nostrils.

5. Lips and Mouth

Different parts of the lips show the condition of different parts of the digestive system. The upper part of the upper lip corresponds to the upper stomach, the middle section of the upper lip corresponds to the middle of the stomach, and the lower part of the upper lip corresponds to the duodenum (the exit of the stomach, connected to the liver, gall bladder, and pancreas). The lower lip shows the condition of the intestines. If lips are swollen, the digestive tract is expanded. An outward swelling of the lower lip shows a tendency to constipation. Spots and sores on the lips show ulceration and stagnation of blood in the digestive system. Lips that are whitish in color show that the blood in the intestinal region is weak, and absorption is poor. Extreme tightness in the mouth shows that the intestines are tight, meaning absorption is poor. A healthy mouth, however, should appear fairly tight.

6. Appearance and Condition of the Tongue

Reading information from the tongue is a significant way to determine the condition of the body and spirit.

a. Areas

Various areas of the tongue reflect the state of the internal organs. the root of the tongue is related to the kidneys. The center of the tongue reflects the condition of the stomach and spleen. The tip of the tongue represents the state of heart. The area between the tip and the center shows the condition of the lungs. The right side of the tongue indicates the gall bladder. The left side of the tongue reflects the liver. (Fig. 3.6)

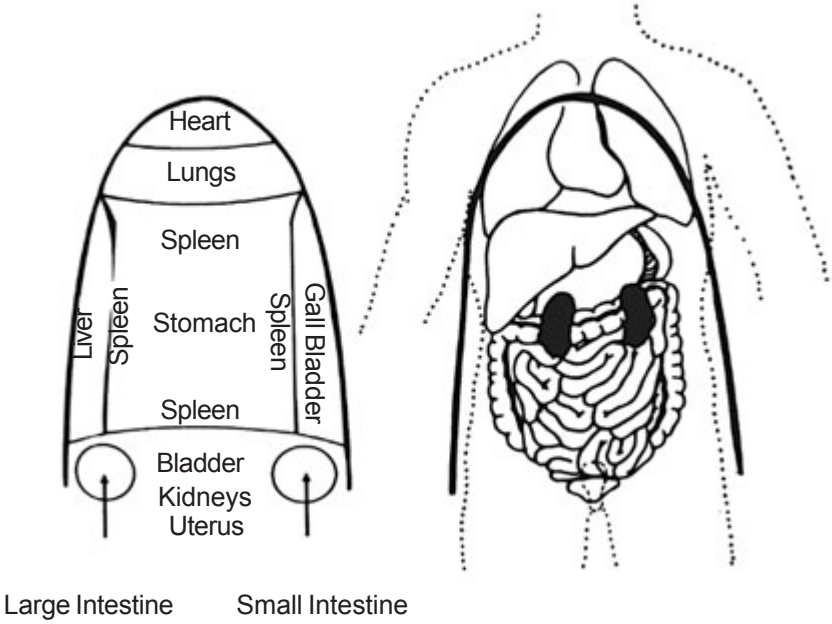

Fig. 3.6 *Areas of the tongue reflect areas of the body.*

b. Color

The color of the tongue indicates the state of the blood, nutritious Chi, and the Yin organs. The normal color of the tongue should be pale red. A very pale color indicates a deficiency of Yang or blood. When the sides of the tongue are pale, this indicates deficient blood in the liver.

If the tip of the tongue is crimson, it signifies too much heat in the heart. Crimson sides indicate too much heat in the liver or gall bladder, and, in severe cases, the sides may be swollen and display crimson spots. A crimson center indicates too much heat in the stomach.

An indigo tongue indicates stagnant blood. The flow of the blood and Chi has congealed. Deep purple indicates severe blood stasis, this may indicate serious liver or heart problems.

c. Shape

The shape of the tongue also indicates the state of the blood and nutritious Chi. A thin tongue indicates a blood deficiency if it is also pale, or a Yin deficiency if it is red and peeled. A swollen, pale tongue indicates dampness and Yang deficiency. A stiff tongue indicates wind problems. A flaccid tongue means not enough fluids. A long tongue means heat in the heart. A short, squat tongue indicates interior cold if pale and wet, or extreme Yin deficiency if red and peeled.

Short horizontal cracks indicate stomach Yin deficiency. A long, deep midline crack indicates heart problems. A shallow-wide crack in the midline that doesn't reach the tip indicates deficient Yin in the stomach. Short, transversal cracks on the sides and/or in the middle of the tongue indicate chronic Chi deficiency in the spleen. A quivering tongue also indicates deficient Chi in the spleen.

d. Coating

A normal tongue coating or tongue fur is thin, white, and moist. This indicates that the stomach is digesting food properly. A thick white coating indicates cold problems. A yellow fur means heat problems.

e. Moisture

A normal tongue should be very slightly moist. Too much moisture indicates that the fluids are not moving well. If it is too dry, there is too much heat in the body.

7. Tone of the Voice

A loud voice shows overactivity of the liver. If it is joyful and laughing (overexcited), there is an overactivity of the heart. If the voice is singing, there is an overactivity of the spleen. Overactivity or irritation in the lungs is indicated by a weeping sound. A weak or trembling voice shows weakness in the kidneys.

F. Wrist Pulses

The reading of the wrist pulses developed into a complex art. An experienced therapist can feel 28 pulses and tell a great deal about the body. Such an art takes a lifetime to master. However, a novice can learn valuable information about the organs. In CNT you only need to know a few simple pulse readings, for there are many other ways of determining the state of the organs.

1. Reading the Pulse

a. The purpose of pulse reading is to detect what is going on with the individual spiritually, emotionally, and physically. Feel the spirit of the pulse. See if the student is alert. Look at the big picture first, not the small details. If you grasp the big picture, the small details will fall into place Feel for clearness; if the pulse is turbid, the energy is not positive. Feel for consistency; note how pure, mixed, or unified the pulses are. People can change their pulses over a period of time. One can change their mind and make the pulse change.

The Taoists discovered that the pulse is the sound of the blood leaving an organ. If there is something in the organ to obstruct the blood, there will be a delay or distortion in the pulse. Each organ has a different sound or echo. If the person is healthy, there are probably no obstructions. Some blockages can't be changed, but many can be removed by working directly on the organ. This will cause a new and different pulse.

b. It is important to realize that where the Chi goes, the blood follows. Therefore, it is possible to find out the flow of a person's Chi by observing the blood flow. You can externally determine what someone's internal conditions are.

2. Locating the Wrist Pulses

When taking your own pulse, hold one hand palm upward and use the fingers of your other hand to locate the radial artery passing through the top of your wrist. Feel for a prominent bone (called the styloid process of the radial) that is about one inch below the outside of the wrist. Place the middle finger on this point. That is the center

of the pulse area. There are two other pulse positions, one on either side of this bone, where you can feel the artery pulsate. You can easily locate the other two pulse positions by placing your index and ring (or fourth) fingers on the artery. Your index finger will lie closest to the thumb, while your ring finger will lie farthest from the crease formed at the connection of the hand and wrist. (Fig. 3.7)

This pulse is located along the Lungs' Channel which starts in the shoulder area near the clavicle and runs down the arm around the biceps, passes the elbow crease, runs along the top of the wrist, and ends near the tip of the thumb. You can ascertain the condition of the whole body by feeling the pulses at the wrists along the Lungs' Channel.

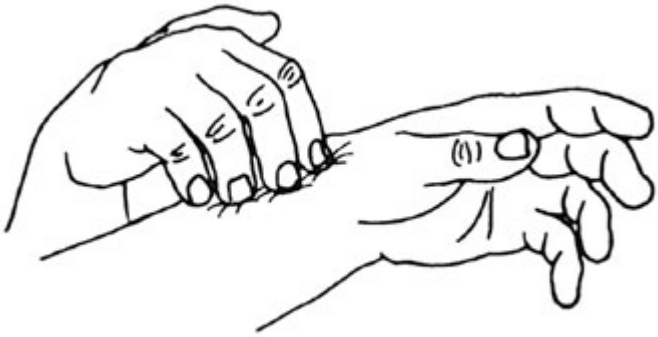

Fig. 3.7 *Locating the pulses on the left wrist.*

3. Feeling the Pulse

a. Feel what is called the area of the pulse. The pulse may extend in either direction, or the area may only feel tike the head of a pin.

b. You may not feel the pulse unless you press hard; or, again, it might not even have to be pressed because it is plainly visible. This is called the depth of the pulse.

c. Also feel for the quality of the pulse. There may be an urgent or fighting pulse that feels like it is banging against your fingers. Its opposite is the weak pulse, for it seems to disappear as you feel for it, like a ball of cotton.

4. Noting Some Common Pulse Qualities

a. Healthy Pulse: A healthy pulse feels moderate. It is not too fast or slow, too big or small, too strong or weak, too superficial or deep, and not too rough or hard. A healthy pulse is gentle, steady, clear, smooth, calm, balanced, and soft (but not too soft). It beats four beats per respiratory cycle. Visualize this healthy pulse when you start to take someone's pulse.

b. Empty Pulse: When you palpate this pulse, it feels as though you pushing down on a cotton ball. There is very little resistance. The body is weak and has low resistance.

c. Fast, Inflamed Pulse: A fast pulse is very Yang and beats more than five times per respiration. This pulse is so forceful that it feels as though it were trying to push your finger away. You can see it pounding. The heart may be beating quickly, which would indicate that there is excess energy in the heart, and, thus, not enough energy elsewhere

An increased pulse rate can suggest an inflammation.

d. Full pulse: This pulse is full and long, hard and forceful. It feels like the tight cords of a musical instrument. It is commonly associated with liver problems.

e. Slippery Pulse: A slippery pulse feels smooth and rounded like slippery pearls rolling around. It means that there is a mucous problem or stagnant Chi in the organ, perhaps due to digestion problems.

f. Choppy, or Rough Pulse: It feels rough, uneven. This indicates that the blood is deficient in Chi, because of a decreased organ function.

5. Observing the Body Type

Body type makes a difference. For a bigger person, expect a wider pulse; whereas someone thin will have a thinner pulse. Look at the trunk of the body; if it is thin, then a thin pulse is proper. Consistency of pulses and body type must exist. This means the consistency of the speed, depth, strength, shape, and length of the pulse must also be consistent with the body type. So, if the person is big and the pulses are small, then there is a serious imbalance.

6. Feeling the Lungs' Channel and the Pulse

The Lungs' Channel and lungs' energy are extremely important to the healthy functioning of the body. The heart and lungs both work closely together rhythmically circulating blood and Chi. The Lungs' energy carries the Chi and the Chi causes the blood to flow. This is how the energy of the lungs enters the blood. The Lungs' energy is also directly connected to the Triple Warmer. You can see the position of the pulses in relation to the Triple Warmer.

Rest the back of your left hand in the palm of your right and wrap the index finger, middle finger, and ring finger of your right hand around the thumb side of your left wrist. Now gently push with those three fingers, one at a time, until you find the strongest beating at each of those locations. With all three fingers depressed, connect your index finger to your chest. Connect your middle finger, resting on the styloid process with your digestive organs, spleen, liver, gall bladder, and pancreas. The lower position, farthest from the crease of the wrist, is the urogenital area, the place of Original Chi found between the kidneys.

7. Taking a Student's Pulse

When taking a student's pulse, it is best to work on the student from the side. Don't put your arm across the body. It is easiest to use your left hand on his or her right wrist. Place the tips (not pads) of your fingers on the wrist at a 90 degree angle. Line up your fingers as in Fig. 3.7.

Feel with sensitivity and receptiveness. Don't feel as though you were touching something; feel as though something was trying to touch you, to impress itself upon you. Relax, as if in meditation. A healthy pulse feels firm, not too strong or aggressive, and does not feel like it is hiding, weak, or vulnerable. Look for moderate resistance and moderate strength when treating someone.

Is the pulse weak in one of those three positions? Or is it weak in all of them? Perhaps it grows weak and strong, reflecting the student's energy level in response to a disease factor. The student may have an excessive pulse which feels tense. It may be tense in some places and weak in others. This is something to watch for. See if it relaxes and if some of the weak places fill up so that the pulsations even out.

It may feel as though you were pressing on the steel or fiberglass string of a musical instrument. The steel string feeling that really hits your fingers would be described as a wiry pulse. When it is a little softer, it is called a cord pulse. Both of these primarily reflect emotions. The wiry pulse is associated with disharmony in the liver and gall bladder.

Other qualities to look for are superficial and deep. Ideally, there should be a balance between the two with a presence of fullness. Some people may have a really faint pulse that is just superficial or deep. If you have to press very hard to sense anything then you would say that the energy is deep, and that there is not much energy on the surface of the body to defend itself. This could lead to catching cold easily. If the energy is superficial it is called a floating pulse. You hardly touch the wrist, and you already feel the pulse to be quite strong. With such a pulse you might have to strengthen the kidneys, spleen, or Yin energy.

If you have a problem in the lungs or large intestine, you may have a superficial pulse that shows the body's skin surface is struggling with sick energy and is in conflict with the rest of the body. You can feel that conflict when it is in the superficial part of the body as a floating pulse. The person might have a cold because the lungs and intestines are conceived of as a continuation of the skin.

The main pulses to work with when you are starting out are the excess and deficient, the full and strong, and the weak, thin, and empty. When you are feeling a blood vessel and it is thin, it indicates a lack of blood. Blood is something to which all the organs contribute. It is involved with supplying the entire body with food and oxygen, and with getting rid of waste and excess water. A weak, thin pulse is a sign of weakness while a full pulse that has a slippery quality shows that the blood is full of energy.

8. Working with Specific Pulses

You may also feel each organ individually along the wrist pulses. Feel for the different qualities listed above.

a. Pulses on the Left Wrist

On the left wrist (Fig. 3.8) the position of the index finger, nearest the crease of the wrist, reveals the condition of two organs. The

small intestine is the surface position. When you press down with your finger, you can read the condition of the heart.

Your middle finger reads the condition of the **gall** bladder superficially. Pressing down will reveal the state of the liver.

Your ring finger, farthest from the crease of the wrist, reads the bladder in the superficial position, and when you press down you can read the kidneys.

b. Pulses on the Right Wrist

When feeling the student's right hand pulses (Fig. 3.9), your index finger, placed closest to the crease of the wrist, feels the large intestine superficially and the lung at the deeper position.

Your middle finger reads the condition of the stomach at the surface position, and feels the spleen at the deeper position.

Your ring finger can feel the condition of the Triple Warmer at the superficial position, and it feels the condition of the pericardium or heart controller in the deep position.

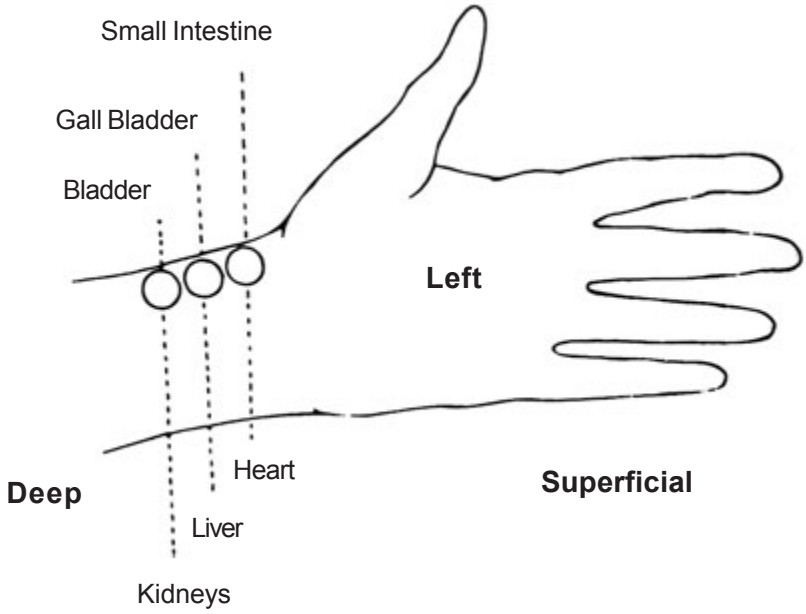

Fig. 3.8 *Pulses of the Left Wrist*

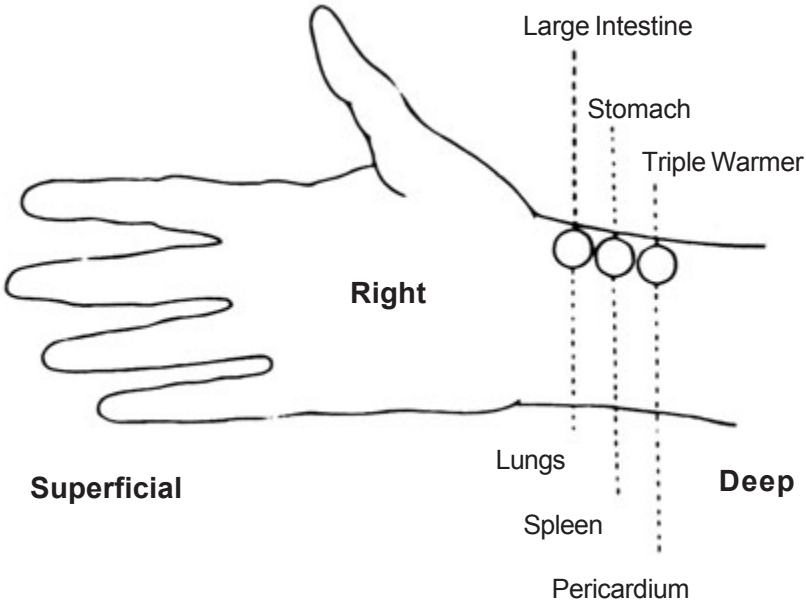

Fig. 3.9 *Pulses of the Right Wrist*

G. Tendons and Muscles

1. Emotions, Weather, and Toxins Can Harden the Tendons and Fasciae

An important factor affecting the smooth operation of the body is the condition of the tendons. The tendons have to be elastic and in their proper place at the proper time. Anger and very hot weather heat and expand the tendons. Negative emotions, such as fear, and very cold weather can cause contraction of the body's vital systems and the tendons which creates problems. As the tendons expand or contract, they do not always return to their original size, shape, and position. This can cause muscles and organs to be pulled out of shape and position. Knots and tangles start to form. As the knot lengthens and becomes larger, it becomes tighter. It then pulls the tendons, nerves, blood vessels, and lymph vessels tighter together.

Since the internal organs are also related to colors, temperatures, seasons, etc., when there is a change in the emotions, weather, or color of clothes you are wearing, there is also a change in the structure of the body, particularly of the tendons. The fasciae and tendons of the body are an integral part of the five major systems and the internal organs. Smooth operation of the tendons and fasciae is vital to good health.

2. Muscles: "Backup Tanks" of the Organs

Muscles are like backup tanks. When the organs become overloaded with negative emotions or toxins, they will unload their energies into the muscles. When you have problems in the organs, you will feel aches and pains in your muscles. The main causes of the problems are the organs, not the muscles. The organs are deep inside making their problems difficult to feel. Unless a problem is truly serious, it will usually first show up within a muscle.

In studying Chi Nei Tsang, the root of the problem is determined (usually in one or several of the organs) by feeling the abdominal conditions of the lymphatic system, the nervous system, the circulation system, and the Chi channel system (energy system). Once the major cause of the problem is corrected, the muscular system can be worked on. The muscles then gradually release their tensions, aches, and pains.

H. Questionnaire

Use this questionnaire to interview a new student before you start working on him or her. You can begin to get an accurate picture of what is going on with and within the student. Some conditions, explained in this book, should not be worked on with Chi Nei Tsang techniques. Type this list of observations and questions and make copies to distribute to your students.

Date: _____ Referred by_____
Name:_____
Address:_____
Tel:_____ Emergency # _____

Birth date:_____
Marital Status:_____Children:_____
Job: _____
Complaint: _____

1. Ask Questions

Ask about the following conditions, systems, and situations:

a. Problems with liver, heart, lungs, kidneys, spleen, pancreas, intestines, stomach, bladder, gall bladder
b. Urogenital or gynecological problems
c. Surgeries, hospitalization
d. Accidents
e. Under care of psychologist, psychotherapist, psychiatrist
f. Medications now being taken
g. Coffee, cigarettes, alcohol, drugs
h. Appetite, digestion
h. Dominant emotion, nerves
j. Sleeping trends
k. Sexual energy
l. Immune problems
m. Diabetes
n. Hernias, ulcers
o. Infectious diseases, inflammations, skin infections
p. Cancers
q. High blood pressure (Can the student exercise, run, walk up stairs?)
r. Stroke
s. Pacemaker for stimulating the heart, artificial hip joint or other artificial parts of the body
t. I.U.D. birth control device
u. Aneurism (a sac formed by the dilatation of the wall of a blood vessel)
v. Thrombosis (blood clots)
w. Phlebitis (inflammation of a vein)
x. Melanoma (tumor made up of dark pigmented cells, visible)
y. Lymphoma (disorder of the lymph nodes)

2. Observe

a. Face color, hues, lines
b. Breathing
c. Tone of voice
d. Gestures
e. Tics
f. Posture, build
g. Symmetries (shoulders, legs, eyes, mouth, muscle tension)
h. Skin texture, vascular spiders, pigmentation)
i. Varicose veins
j. Shape of the navel
k. Moles in or very near the navel
l. Tongue analysis
m.Mannerisms

3. Feel

Many CNT practitioners have made a copy of the CNT chart in Chapter 6 (Fig. 6.13) so that they can mark the problem areas.

a. Muscle and skin tone of the navel and abdomen
b. Knots, tangles, tensions in abdomen
c. Results of organ scanning
d. Pulses

Chapter 4

Opening the Gates and Chasing the Winds

If you are unfamiliar with Taoist concepts about the body, mind, and spirit, then in the first three chapters you have been introduced to more than a few novel and strange ideas: an invisible energy called Chi that powers the body; changes in the organs that generate varying emotions; and pulses in the wrist that reveal the condition of the organs. It is not important that you believe in these concepts to begin the practice of CNT. However, you need to be aware of the ideas and have an experimental attitude. One day they will become very real and evident to you.

This chapter discusses a similarly strange observation: there are winds circulating inside your body, affecting your health and emotional life. These winds are created inside and outside of the body. The idea of outside winds affecting us is not as foreign as you may think. The people of southern California and Los Angeles dread the late summer arrival of The "Santa Ana winds," which arise in the desert and are felt to be the cause of accidents and psychological problems. The serenity of people living in many valleys in Switzerland is often disturbed by the annual arrival of strange winds that descend on peaceful valleys. People who have lived long lives or live close to nature have learned to recognize that some winds and weather are more than what they seem.

Wind is Chi that can enter from the exterior of the body or can arise in the interior of the body. Winds enter and exit through the navel, back of the head, forearms, and lower legs. Good wind is Chi that is healthy and good for you. The ancient Taoists identified unhealthy, abnormal, and foul winds as winds that are pathological and perverse and called them evil winds. Evil winds become trapped as toxins, blockages, and energy that can't move. Chi composes these winds, and when they are expelled from the body, the Chi

becomes healthy again. The Chi itself is good, but it is in a bad situation. It is like having a room in your home that normally is full of good air, but if there is a dead fish or dead mouse in that room, then the air becomes unbearable and foul. Remove the offending cause, open the windows, and the air will be pleasant again.

Nature's winds arise from a difference in atmospheric pressure that moves the air from low pressure regions to high pressure regions, and by differences in temperature which move the wind from cold to hot regions. Who knows where the winds come from? Who can control them? They arise and come on quickly and easily shift directions.

Within the body there are different pressures as well. They arise at places of congestion, hyperactivity, obstructions, and movements. Different temperatures arise in hyper (high) and hypo (low) activity areas. Remember that the five organs' functions happen at different temperatures and levels of moisture or dryness. When the body is balanced, the heart is hot, the kidneys are cold, the lungs are cool and dry, the liver is warm and moist, and the spleen is damp and warm. The mixture of the "weather" in the body is pleasant. The organs maintain a homeostasis in the body by balancing each other automatically. The conditions of the organs are rarely ideal, and the organs are always going through different temperature changes. Such changes affect the body's "weather" and could cause winds or breezes to develop internally.

Winds carry toxicity out of the body. When winds exit the body they often exit as flatulence, a burp, a yawn, or a pop in a joint. Sometimes, the winds get trapped in the body and cause hiccups, wandering pain, itching, fevers, pain in the joints, heaviness, sluggishness, cramps, headaches, vertigo, and in extreme cases, gout, paralysis, and arthritis. Winds can cause the hands and limbs to feel heavy and numb. Cramps are winds that are trapped around nerves, pulling on them and causing pain. Winds also cause migraines, eye pains, kidney pains, muscle pains, and poorly functioning organs.

Skin rashes are the clearest sign of wind problems. Look for rashes in the crease of the elbow, around the neck, and at the back of the knees. This is a good sign, since it indicates that the winds are leaving the body. However, they are having a difficult time exiting, and you need to do more detoxification work.

A. Sick Winds (Trapped Gases)

Gases can be formed by certain kinds of food you eat, extremes in the weather, changes in seasons, toxic substances in the environment, negative emotions, and other factors. These gases can become trapped in knots, tangles, and blockages within the body's systems, vital organs, and spaces between, gradually to become sick or evil winds.

Opening the wind gates is the first procedure in Chi Nei Tsang massage. With the application of the CNT technique of applying pressure at appropriate points, the wind can be released and passed from the body.

Again, not all winds are sick. Wind is air or gas. The process of breathing, of moving air in and out of the body, involves wind. Each organ has an intrinsic wind. The wind becomes sick only when it is inappropriate to the part of the body in which it is found, or when it has been trapped and becomes stagnant. The trapped energy, taking the form of blockages or knots, needs to be released, so that the life-force wind can flow freely throughout the body. Good energy flow prevents more sick winds from arising.

1. Sick Winds can Run and Hide

The Chi Nei Tsang techniques are excellent for wind maintenance. Sick winds (bad gas) can be eliminated before they can cause any problems. Stiffness, tightness, and numbness from trapped energy (winds) can be alleviated. Although massage will sometimes give temporary relief to these problems, the sick winds can simply run away and hide in another place. The Chi Nei Tsang practitioner has to know how to chase the sick wind out of the body, since any trapped energy in the body prevents healing energy from circulating freely through the main channels and meridians.

Most people have blockages and trapped winds. Blockages affect circulation of the system directly involved and the circulation of other systems since they are all interconnected. Thus, it is vitally important to clear the abdominal area of blockages and trapped winds so that the Chi can flow freely through its various channels, and the body can function more efficiently.

2. Sick Winds can cause Illness

Traditionally in the Chinese system, sick winds cause illness. When there is sick Chi, toxins accumulate in the body. The body attempts to eliminate them through the lymphatic system. When a chronic state of sick Chi is present, the lymph nodes at the navel, neck, and armpits become hard and enlarged. Gently massaging these areas releases the toxins there and enables the lymph nodes to function more freely. Occasionally sick Chi gets trapped in the blood and travels in a bubble.

Each organ has a particular kind of wind or energy associated with it when it is unhealthy. Through CNT and the meditation practices of the Universl Tao System, sick energy can be cleared from the body.

3. What Sick Energy feels like

Some people see sick wind, but others sense the energy in different ways. You will be taught five of the sick energies found in the body's organs along with the sensation each produces.

a. The lungs can produce a crawling, itchy, and sick energy that can accumulate on the skin of the practitioner and will eventually penetrate into the body. On the student's skin it may appear as a rash which can easily be transferred to the practitioner. Though this energy may not be felt immediately, it can eventually produce a terrible urge to itch.

b. The kidneys, bladder, and other Yin organs produce a cold, chilly energy when they are not well. This chill can go into the bones and is very difficult to remove.

c. The liver makes a biting, sick energy, somewhat similar to itchy, sick energy but with more of a stinging quality. It feels like ants are pinching the skin.

d. The heart produces a hot, burning form of sick energy that surfaces as a red rash.

e. The spleen, stomach, and pancreas produce a damp energy. When it penetrates into the hand, it can feel wet and sticky.

4. Combinations of Itchy, Biting, Hot, and Cold Energies

As previously mentioned, the combination of cold and biting energy is, by far, the worst to experience. It is important for you, as a practitioner, not to allow this energy to penetrate into your body and rest inside one of your internal organs.

A practitioner may find that the skin is warm or hot to the touch because of the laws of convection currents that cause heat to rise. You will notice that this heat, generated in the internal organs and other tissues and spaces in the body, will rise to the upper torso, head, neck, and upper organs. This creates a thermal layer within the body. The cold, sick energy get trapped beneath a layer of hot energy that has risen. This is why people who have itchy, sick, and biting energies tend to develop rashes in the upper portions of the body.

You also may find that there are multiple layers of cold and hot energies within the body. Because of these layers of trapped energy, the resultant rashes also encourage rashes to develop in other portions of the body, such as behind the knees and in the creases of the elbows. It is important to remove these layers one at a time until you can reach the source of these problems.

The organs generate the different energies because of accumulated toxins. These toxins get trapped in the liver or the heart and often in the blood. When there are excess toxins in these systems, there is also excess heat produced.

5. A Closer Look at Cold, Sick Energy

a. Cold, Sick Energy Chills the Bones

People who have cold, sick energy will exude a cold chill into your hands when touched. This condition is caused by a cold wind that has been trapped in an organ or somewhere else in the body. A kidney or bladder disorder also causes this problem. This chill can travel into the bones and become very difficult to remove. Cold, sick energy is also slow to move, but will try to hide in a new location in the body.

b. Cold, Sick Energy feels Heavy

Cold, sick energy has a cold, wet nature, and is also heavy. It seeks out the depths of the body, and, in particular, the lower limbs and the lower internal organs because of gravitational force and convection currents. This cold, sick, heavy energy mixes with the accumulated toxins also trapped by gravity in the lower tissues of the body and the internal organs making it more difficult to remove.

c. Identifying Cold, Sick Energy

When looking at a person, you can easily identify cold, sick energy. You will notice a pale blue or gray color in the skin, especially in the face, around the cheeks, under the eyes, beside the nose, in the ears, the lips, the gums, and the tongue. The fingernails and toenails may be blue or pale, and the fingers and toes will be cold. The pulse will be slow, tight, weak, and feel cold, especially when taken at the aorta, vena cava, and other major vessels. You also will find varicose veins and sometimes skin mottling. After having practiced the Taoist meditations and Chi Nei Tsang for some time, you will become sensitive to cold, sick energy.

B. Opening the Wind Gates

It is important to master and clear out the winds at the beginning of every session. This will help to activate the abdominal energy and loosen the tightness and tension in that area. Some persons will have abdomens that are too painful to bear the pressure of this procedure. In such cases, first do gentle skin detoxification.

C. Techniques for Opening the Wind Gates

Sick winds can leave through the navel if they have a way to get out. By opening points around the navel, you can draw these winds from organs and different parts of the body. Numbers one through eight on the illustration of the Navel's Pressure Points (Fig. 4.1) list the sequence to follow; they also indicate which organs you will affect. The Wind Gate Chart (Fig. 4.2) is more detailed than Fig. 4.1 and serves as a daily guide to working on the Wind Gates.

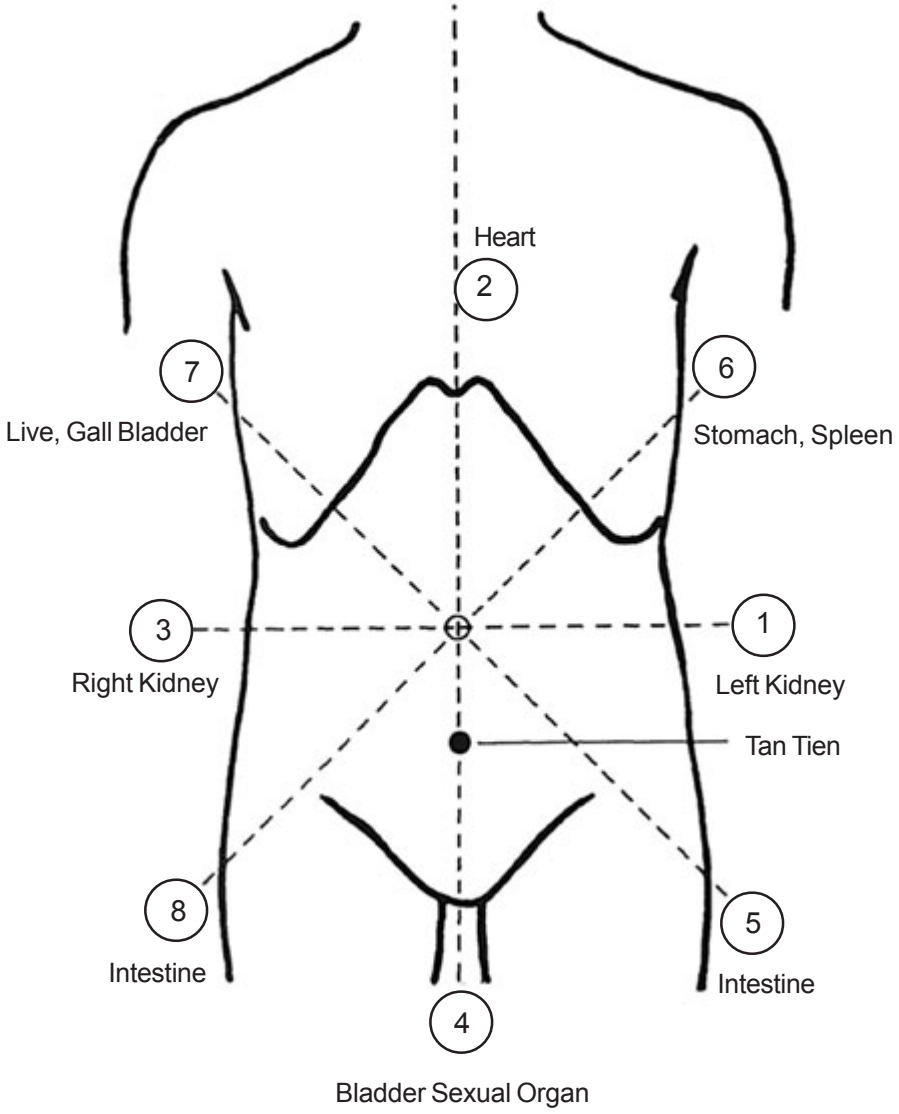

Fig. 4.1 *Pressure Points Around the Navel Number one though eight list the sequence to follow and indicate the organs you will affect.*

Chart of the Wind Gates

Point No. / Day	Tan Tien Point below Navel	1	2	3	4	5	6	7	8
Monday	15	8	17	19	21	10	12	6	15
Tuesday	8	17	19	21	10	12	6	15	8
Wednesday	17	19	21	10	12	6	15	8	17
Thursday	19	21	10	12	6	15	8	17	19
Friday	21	10	12	6	15	8	17	19	21
Saturday	10	12	6	15	8	17	19	21	10
Sunday	6	15	8	17	19	21	10	12	6

Working of a Student: Monday Sample

a. Press both groin areas with the knife edge of your hands for 36 to 72 pulses or count your own pulse.
b. Press your thumb or elbow on the Tan Tien (3 inches below the navel) for the indicated count (15 times). You won't feel the pulse.
c. Press the Navel Center points 1-8 for the indicated count.

On the left side is the aorta at which you can feel the pulse; on the right side is the vena cava at which you can feel the pulse strongly.

1. Left Kidney; 8 times or pulses.
2. Heart: 17 times or pulses.
3. Right Kidney: 19 times. you will not feel the pulses because of the vena cava.
4. Bladder and sexual organ: 21 times or pulses.
5. Large and small intestine: 10 times or pulses.
6. Spleen, right lung, stomach: 12 times or pulses.
7. Liver, left lung: 6 times or pulses.
8. Large and small intestine, right ovary: 15 times or pulses

Fig. 4.2 *Chart of the Wind Gates*

1. Wind Gate Chart

a. Open the winds gates in the order listed. (Fig. 4.2) Visualize the Tai Chi symbol as the navel.

b. Follow the navel center guides I-VIII and use the thumb or elbow to press at the point indicated. (Figs. 4.3 and 4.4) For example, after you do the groin gates and the Gate to the Sea of Winds (Tan Tien), go to point I and notice that on Monday the pulse is held for eight beats of the pulse. If it were Tuesday, you would hold the pulse for seventeen counts, on Wednesday nineteen counts, on Thursday 21 counts, and so on, through the end of the week.

c. Then go to point II. The point in that area would be held for seventeen counts Monday, nineteen counts Tuesday, and so on.

d. You will travel all round the navel opening the gates. After each point pause to let the effect take place and the energy settle. The daily number guide is traditional the Taoist numerology practice for opening the Wind Gates.

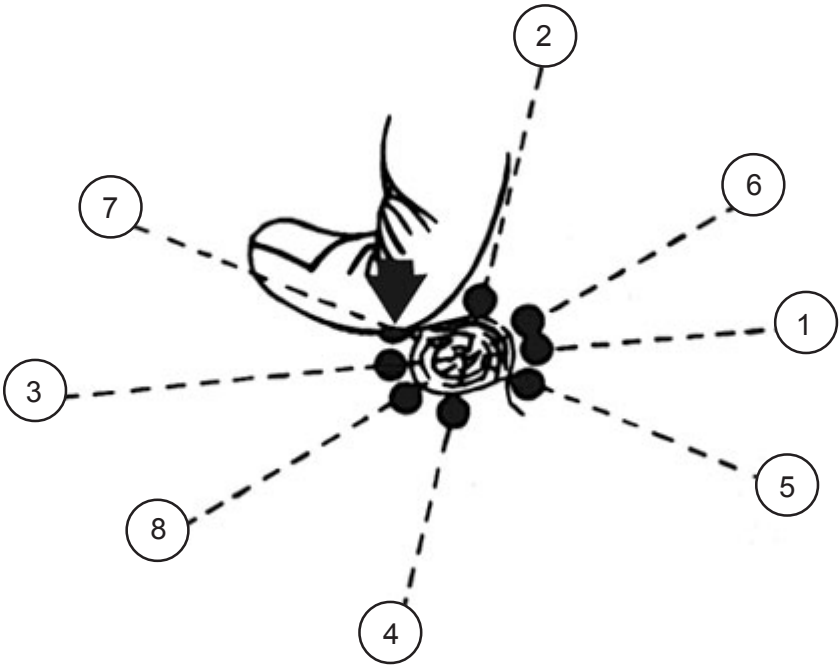

Fig. 4.3 *Wind Gate points are on the sides of the navel and not in the navel.*

Fig. 4.4 *If you are working on someone who is very heavy or muscular, you may need to use your elbow.*

2. Flushing the Blood at the Groin

a. Stand or kneel beside the student (unless the person is very large, in which case it is best to kneel between his or her legs.) Press the edge of each palm into the femoral artery pulse at the crease of each leg in the groin area. (Fig. 4.5)

b. One pulse will probably feel stronger than the other. In that case, press down on the pulse that is strongest. This will help bring more blood and Chi to the weaker pulse. You should feel them equalize.

c. Hold the pulse for 36 or 72 counts to stimulate the circulation in the lower abdomen and legs and break up obstructions. Some winds will exit through the legs. This procedure will open the passageways.

Note: Do not practice this technique on someone in danger of, or afflicted with, thrombosis or a severe case of varicose veins.

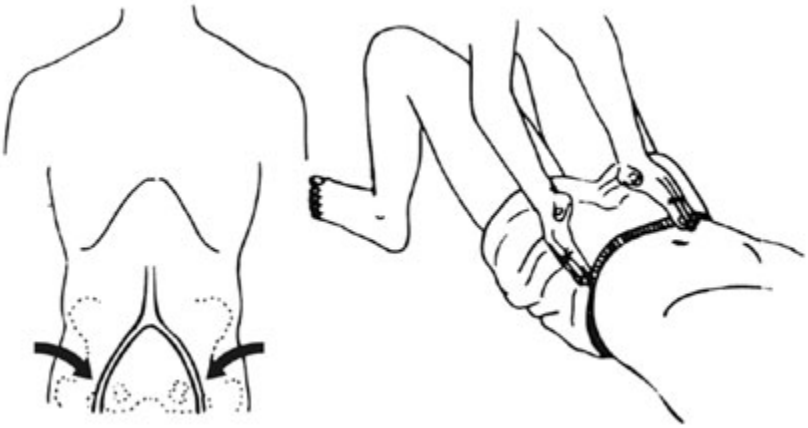

Fig. 4.5 *A. Pressure Points for Opening the Groin*
B. Opening the Wind Gates of the Groin

3. Opening the Gate to the Sea of Winds

You may remain between the student's legs, or move to the side of the body

a. Locate the Tan Tien pulse (the Gate to the Sea of Winds) in a depression approximately one and a half inches below the navel at six o'clock. (Fig. 4.6).

The first pulse you will feel is the aorta pulse which may feel more like an energy sensation. You may have to practice this procedure for some months before you can distinguish it. At all the other positions, just feel for the aorta pulse.

b. Press down until you feel the pulse. Usually a thumb is used; if you are working on someone who is very fat or very muscular, you may to use your elbow to find a pulse. (Fig. 4.4) Whether you use your finger or elbow, be gentle and don't slip. Sometimes you cannot find a pulse; in that case, all you can do is slowly count out the number for that day (one thousand, two thousand, three thousand, and so on.)

c. Fig. out the number of pulse counts you will hold for that day. Consult the chart under "Tan Tien." On a Monday you would hold for fifteen counts, Tuesday eight counts, Wednesday seventeen counts, and so on.

d. Release the pressure after the required number of counts has expired. The student should feel energy flowing down to the lower part of the body.

e. To gain experience you should do all the points or gates on yourself as well. (Fig. 4.7)

Fig. 4.6 *Opening the Gate to the Sea of Winds*

Fig. 4.7 *Working on yourself—Pressing the Navel Points*

4. Opening the Wind Gate to the Left Kidney - the Western Gate

a. Check point 1 on the chart to note the daily count.

b. Press the point just to the left of the navel at three o'clock until you feel the pulse. (Fig. 4.8)

c. Hold for the count.

d. Just before you release, direct the energy to the left kidney by using your mind and intention. The student may feel warmth and comfort spread to that area.

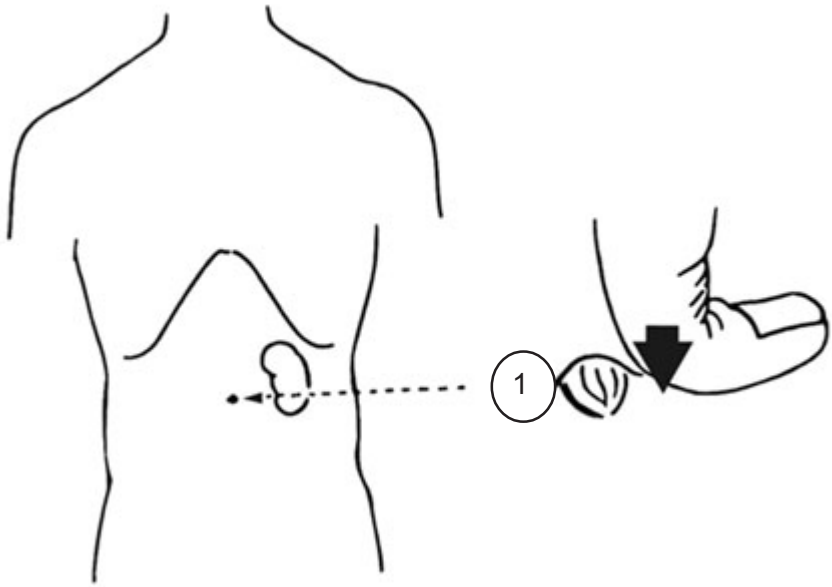

Fig. 4.8 *Opening the Gate to the Left Kidney*

5. Opening the Wind Gate to the Heart - the Southern Gate

a. Check the chart for point 2 and note the daily count.
b. Press the point above the navel at twelve o'clock. (Fig. 4.9)
c. Hold the count with moderate pressure.
d. Before you release, direct the energy toward the sternum. The student may feel warmth and comfort spread to the chest and heart area.

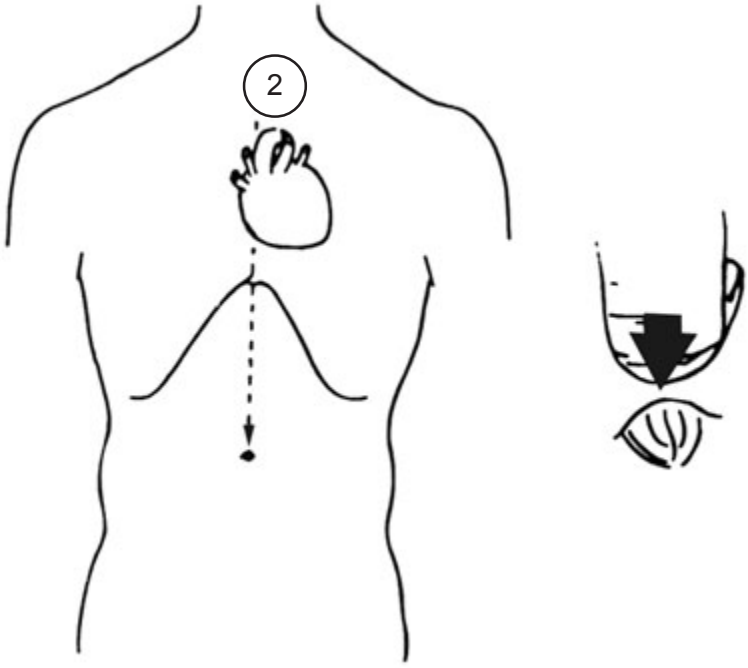

Fig. 4.9 *Opening the Gate to the Heart*

6. Opening the Wind Gate to the Right Kidney - the Eastern Gate

a. Get the daily pulse count from the chart for point 3 and press at nine o'clock.(Fig. 4.10)

b. Send the energy to the right kidney just before releasing.

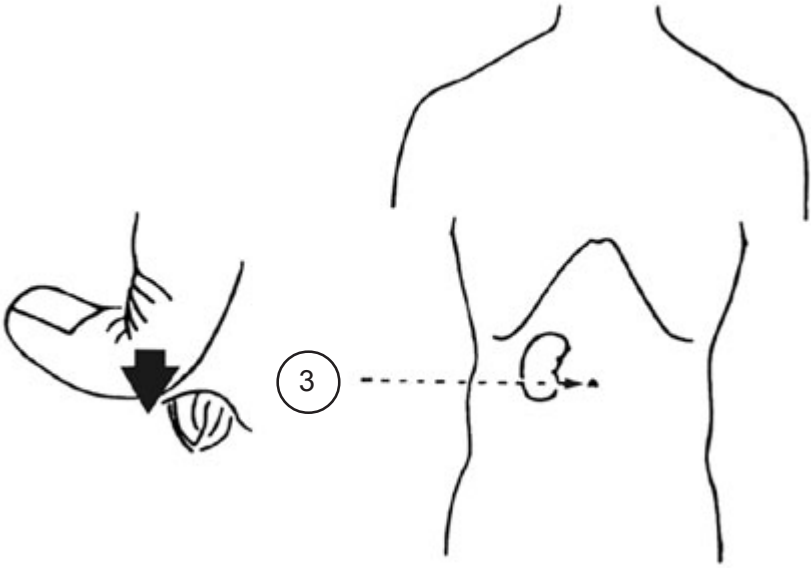

Fig. 4.10 *Opening the Gate to the Right Kidney*

7. Opening the Wind Gate to the Sexual Organs and Bladder - the Northern Gate

a. You should now be at point 4. Check the pulse count for that day.

b. Hold at six o'clock just below the navel. (Fig. 4.11)

c. Send the energy to the sexual center and bladder before releasing.

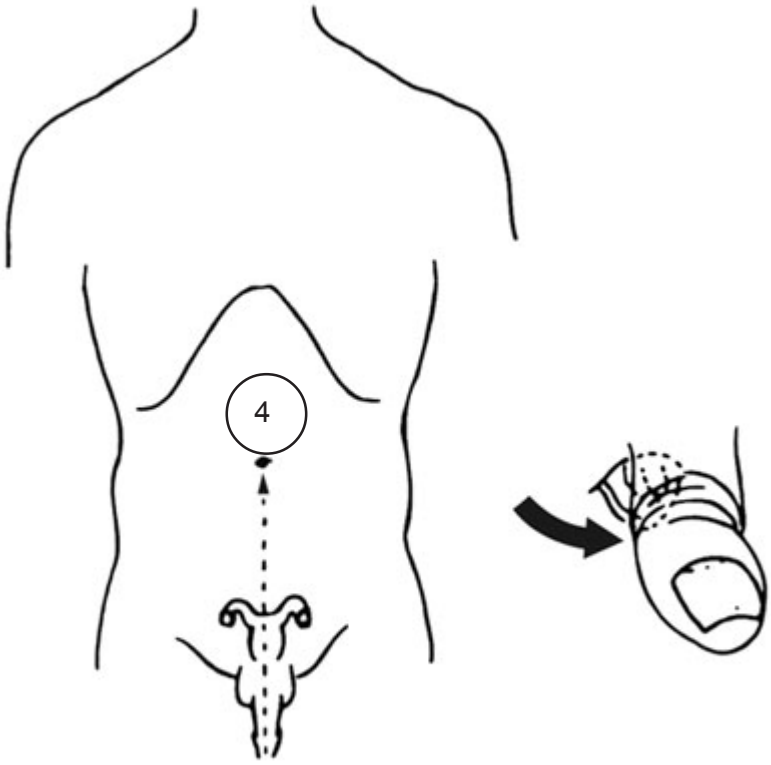

Fig. 4.11 *Opening the Gate to the Bladder and Sexual Organs*

8. Opening the Wind Gate to the Small and Large Intestines and the Left Ovary - the Northwestern Gate

a. See what the daily pulse count is for point 5.

b. Note that the point you will press is between four and five o'clock. (Fig. 4.12).

c. Press closely to the navel until you feel the pulse.

d. Direct the energy to both intestines and to the left ovary.

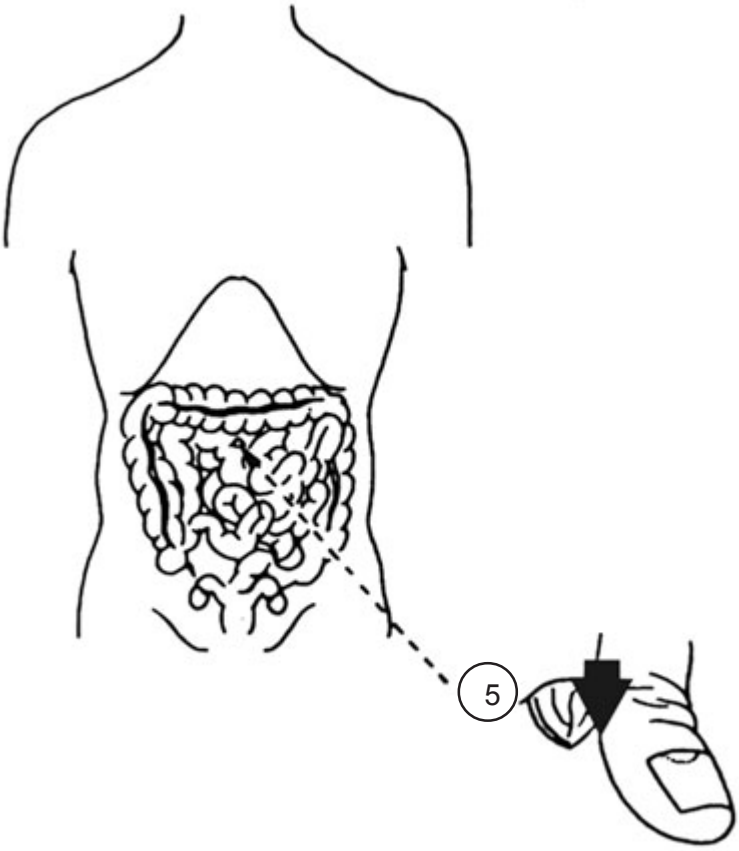

Fig. 4.12 *Opening the Gate to the Intestine and Left Ovary*

9. Opening the Wind Gate to the SPleen, Stomach, Pancreas, Triple Warmer, and Left Lung - the Southwestern Gate

a. Look at point 6 on the chart. Note the daily pulse count.
b. Find the pulse between one and two o'clock. (Fig. 4.13)
c. Press it for the required number.
d. There are five places to direct the energy, so be prepared. The student should feel blood and Chi flow to the spleen, stomach, pancreas, Triple Warmer, and Left Lung.

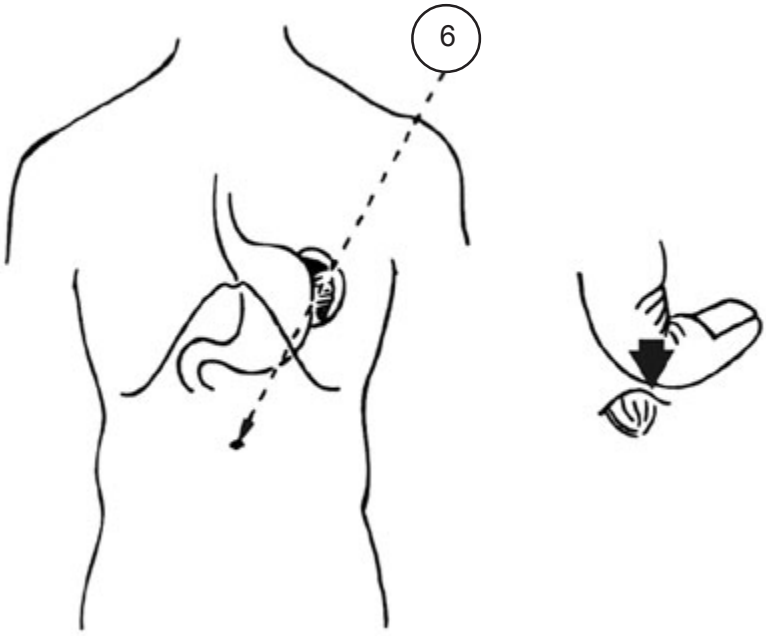

Fig. 4.13 *Opening the Gate to the Stomach and Spleen*

10. Opening the Wind Gate to the Liver, Gall Bladder, and Right Lung - the Southeastern Gate

a. Point 7 is between ten and eleven o'clock. (Fig. 4.14)
b. Press for the daily count. Be sure to feel the pulse.
c. When you are done, direct the energy into the liver, the gall bladder, and the right lung.

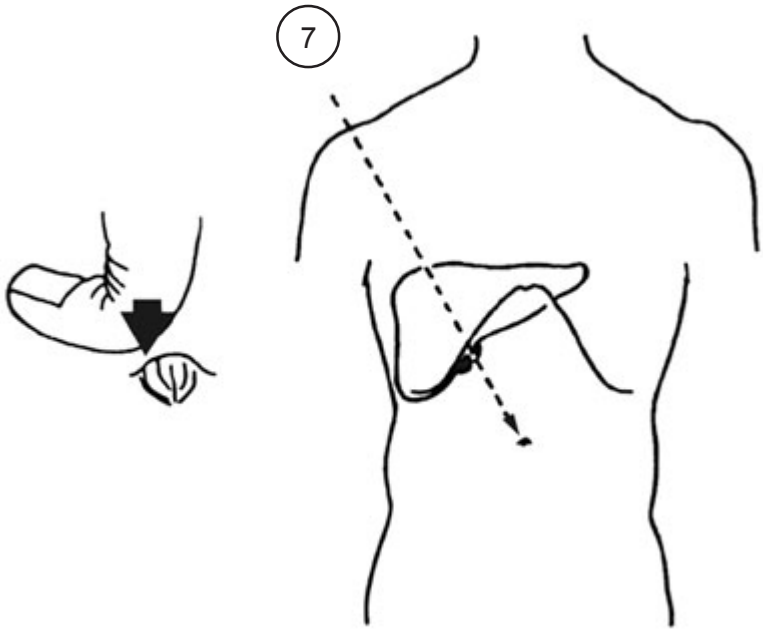

Fig. 4.14 *Opening the Gate to the Liver, Gall Bladder and Right Lung*

11. Opening the Wind Gate to the Small and Large Intestines and the Right Ovary - the Northeastern Gate

a. Check the chart for the last time. Get the count. Point 8 is between seven and eight o'clock.(Fig. 4.15)

b. Hold the point with moderate pressure, as you did at all the other points. Before you release the point, send the energy to the intestines and right ovary. The student may feel warmth and comfort in those areas.

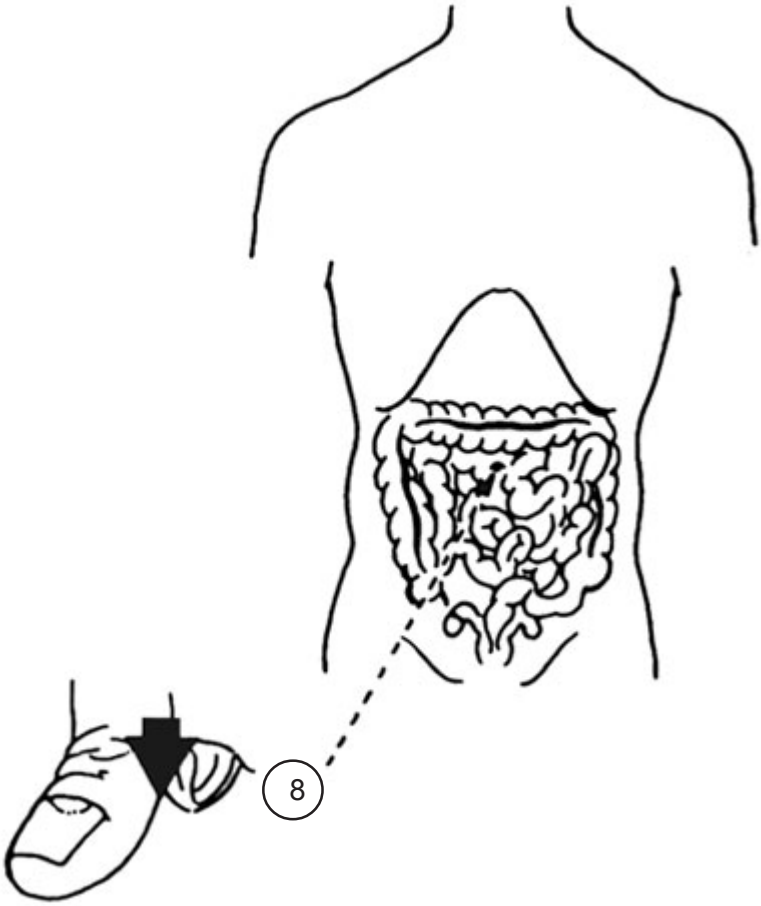

Fig. 4.15 *Opening the Gate to the Intestines and Right Ovary*

C. Baking Sick Winds

Use the baking technique to “cook” or “bake” sick winds, that are hot and expansive, or cold and contractive.

1. Baking not Wind

a. The best place to cook wind is in the small intestine. Place both hands over the small intestine and do the Heart’s Sound together with your student. This will attract the hot energy. You are calling the hot wind into the small intestine.

b. Feel the pressure and heat of the hot wind entering the small intestine. Leave the right hand on the abdomen over the areas where the winds are trapped. (Fig. 4.16)

c. Place the left hand on the back, opposite the right hand.

d. Do the Heart’s Sound together again to raise the temperature of the area just enough to move it or cook it.

2. Baking Cold Wind

a. Cold winds can be attracted and directed by placing the right hand on the cold wind and the left hand on the small intestine.

b. Attract the cold wind and build a cold ball in the small intestine by doing the Kidneys’ Sound together with your student. (Fig. 4.17)

c. After the cold wind has entered the small intestine, bake it by keeping one hand on the abdomen and placing the other hand beneath it on the back. Do the Heart’s Sound together and bake the wind. Be sure to bake the cold wind thoroughly to avoid cramps in the small intestine.

d. Using a vibrating or shaking palm speeds up the process. Tapping vigorously around the navel with the fingertips in a firm manner will also help purge these winds.

e. If the cold wind will not cook off, you can use your fingernails to lightly scrape the skin over the affected area. This will create a gate through which the winds can escape.

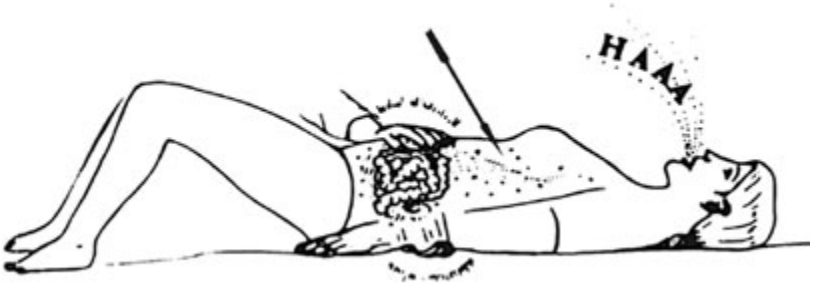

Fig. 4.16 *Baking the Small Intestine*

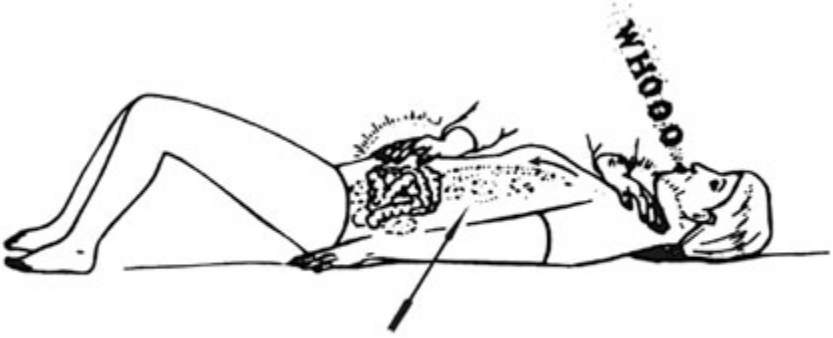

Fig. 4.17 *Moving a Cold Wind from the Chest to the Navel and baking it.*

3. Burning Sick Wind

a. For sick wind energy in the abdominal area, use the scooping technique to scoop the sick energy into the Tan Tien area, one and one half inches below the navel. You will gradually feel a cold or chilly energy form there.

b. Use your index and middle finger to press on the area, while your student concentrates on this point. (Figs. 4.18 and 4.19)

c. Concentrate on the area and spiral with the fingers. Feel a "sunshine" heat in that spot as you gradually feel the warmth displacing cold, chilly, sick wind.

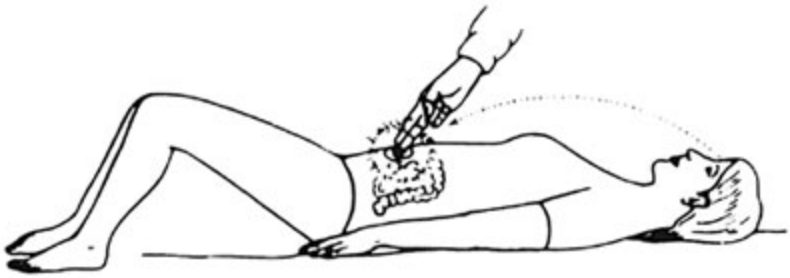

Fig. 4.18 *Student concentrates on the wind as it is burned out at the navel.*

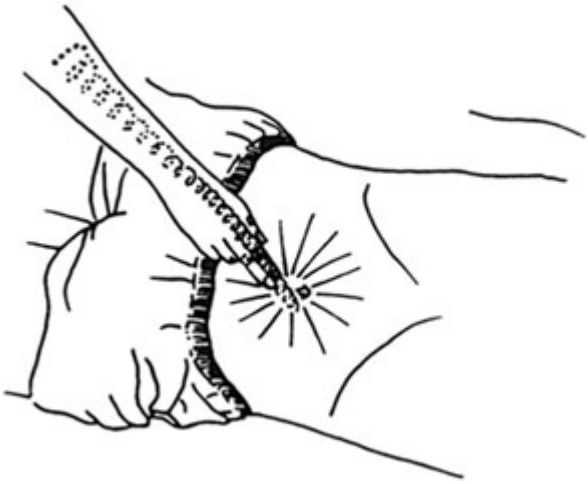

Fig. 4.19 *Burning a Sick Wind*

Chapter 5

Detoxifying the Skin and the Large and Small Intestines

The skin around the navel is an area that can be worked to reach deeper levels of the body's operations. When you press around the navel point, you can bypass muscle, fat, and intestines to reach the lymphatic, circulatory, and nervous systems. These systems tend to be blocked at the navel area, so toxins and waste material accumulate there. When the lymph system clots, the body's defense system is inefficient. When the circulatory system tangles or clots with fat and sediment, the blood will not circulate well. When the nervous system tangles, nerve impulses will travel very slowly through the whole system or will jam. When Chi backs up, growths and tumors develop.

Detoxification always comes first because the skin, organs, and lymph glands will not work efficiently unless they are detoxified. The body's systems make up a great part of a human being. When their work load piles up, the work rate slows down. When the work gets to be too much, these three systems want a rest.

CNT will help the skin, lymphatic system, and organs handle the overload. You will be doing their work with your fingers. Massaging primes these systems, "jump-starts" them, and gets them moving. When there is less work to do, they get more energy and can complete the task. Once the extra toxicity is eliminated, the next toxin to enter the body will be quickly eliminated.

When the organs try to cleanse themselves and cannot get rid of their excess toxins, they push the toxins out to the muscles and skin (the body's largest organ), and store them there. Poisons can be easily removed from the skin, but the organs will benefit greatly from the application of some special techniques.

Toxins exit the body in a variety of ways. Sometimes they evaporate through the skin; at other times they exit as pimples, rashes, boils, and sweat. They also exit via the large intestine or the bladder.

It is important not to over-eliminate toxins. You have to be aware of the body's ability to eliminate waste material. You should be particularly cautious when working on the very ill, old, and young. If too many toxins are released for the body to eliminate efficiently, the student can become sick or experience a cleansing crisis. This could show up as a rash, a fever, or nausea. There are limits to the body's ability to eliminate. It is possible that some material released, and not eliminated, will find its way back to where the body has become used to having it. It will then have to be released again in the next session.

A. Skin Detoxification

In CNT we treat the skin of the abdomen, starting at the navel. This is where the umbilicus of the fetus received nutrition and eliminated toxicity. As the original center of the body, the navel is still connected with all the organs. Whatever toxins the organs cannot process, they store in the navel for later detoxification.

By massaging the skin lightly and stimulating its surface, you can draw the pressure and toxicity from deep within all parts of the body to the surface. It is easier to reach the toxins on the skin to break them down. The longer you work on the skin, the easier it will be to work deeper later. The skin is a storage space for whatever extra toxicity the organs have. When you release the toxins stored in the skin, you create an open area on the skin. The organs can now release more toxins to the new storage space just made available. Instead of clearing, sometimes the skin may swell. This is because more toxins have been released from the organs to the skin. Once cleared, the skin will recover its balance.

The toxins, tightness, and tension in the abdomen also block the flow of energy from the vital Navel Center or Tan Tien. When you clear the area, the pre-natal Chi can begin to flow through the body more forcefully.

Warning and Caution: If there are any warts or moles very close to the rim of the navel, do not work on the student. This suggests that there is a serious viral problem and a doctor should be consulted. You can, however, teach the student to work on himself or herself.

1. Spiraling Technique

The Spiraling Technique is the main technique for skin detoxification. Gently use both hands on the abdomen to loosen the tissues. Begin by massaging with the thumbs, finger, or fingers together in small, tight, clockwise circular motions around the navel. (Fig. 5.1) The sequence for each point is to press in, spiral, and loosen the skin. Continue to create tight, clockwise circles outward from the previous points you have worked on. This will create a large spiral, extending from the navel to the outer edges of the abdomen. (Fig. 5.2) Although this procedure mainly influences the small intestine, the clockwise direction also follows the path and motion of the large intestine, the body's "great eliminator." With this movement toxins are encouraged to pass from the body. This technique is especially powerful for breaking up a constipated large intestine.

Conversely, if your student has diarrhea problems, you should teach him or her how to spiral in a counterclockwise direction. This will encourage the watery waste to slow its exit, until it has formed into normal stool consistency.

If your student's abdomen is tense, nervous, hot, hard, and too Yang, this means there is excessive energy and you should drain some off. Spiral counterclockwise to withdraw the energy. Use your concentration. Ask the energy to leave. Direct it into the Microcosmic Orbit, where it can be circulated and stored safely in the Navel Center. You can also direct it to go into the Navel Center.

If the abdomen is cold, soft, weak, sick, and too Yin, this means that there is deficient energy. Spiral clockwise to add energy. Concentrate to direct some of your energy to pass from your fingertips into the student's abdomen, to help warm the area. .

When you finish the finger spiraling technique, apply the following hand techniques. You will become very familiar with these techniques, for they are used repeatedly in CNT.

2. Scooping Technique

With your fingers together, press inwardly and scoop in, or press downward and scoop out. There are many variations to the direction and use of this technique. (Figs. 5.3, 5.4, and 5.5)

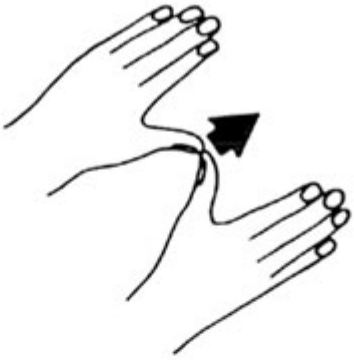

a. Use Two Thumbs

b. Use Four Finger

c. Use a Single Finger

Fig. 5.1 *Spiraling Technique: Use the (a) thumbs, (b) fingers, or (c) finger to press in, spiral, and loosen the toxins locked in the skin.*

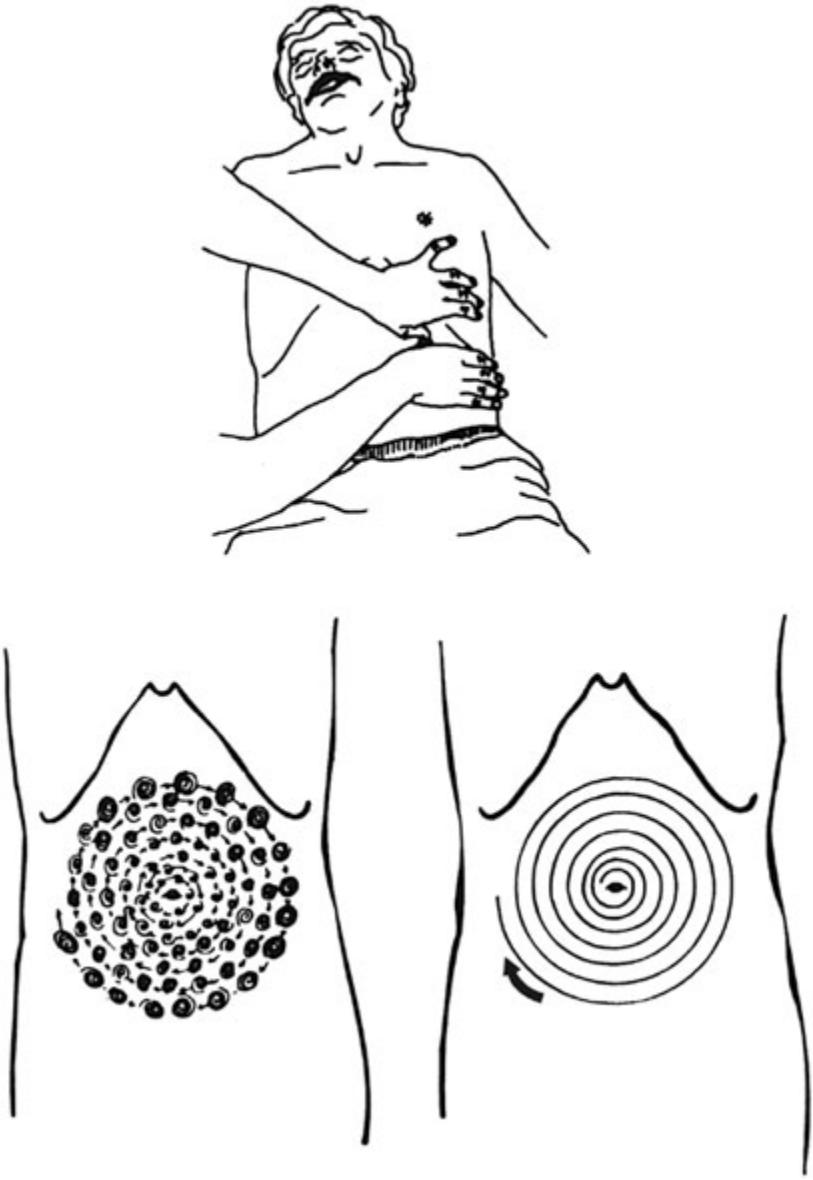

Fig. 5.2 *Create tight spirals. Move in clockwise circles begining the navel; gradually spiral out toward the perimeter of the abdomen.*

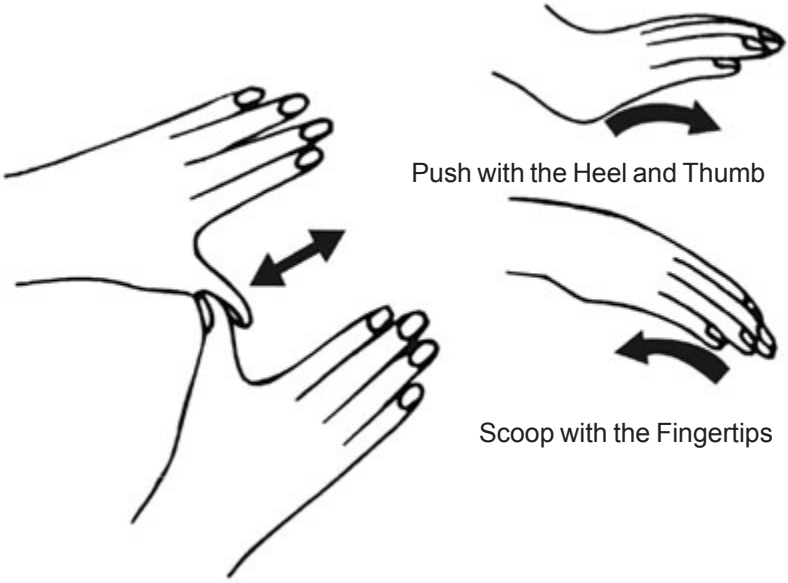

Fig. 5.3 *Pushing with the Palm-Heels and Scooping with the fingertips.*

Fig. 5.4 *Scooping with Two Hands*

Fig. 5.5 *Scooping with One Hand*

3. Rocking Technique

Use all the fingers to hold the abdominal muscles while rocking forward and back. Spread your fingers to cover the ascending and descending colon, or change the width and cover the small intestines. (Fig. 5.6)

4. Kneading Technique

Use all the fingers of both hands to scoop the intestine into the navel and central area. Follow by pressing with the heels of the palms into the navel and the central area as though you were kneading a loaf of bread. (Fig. 5.7)

5. Shaking Technique

Use either the index or middle finger to press on the knot or problem area. Move the finger quickly up and down or from side to side. Use two or three fingers to cover a larger area. (Fig. 5.8)

Fig. 5.6 *Rocking*

Fig. 5.7 *Kneading*

Fig.. 5.9 *Shaking*

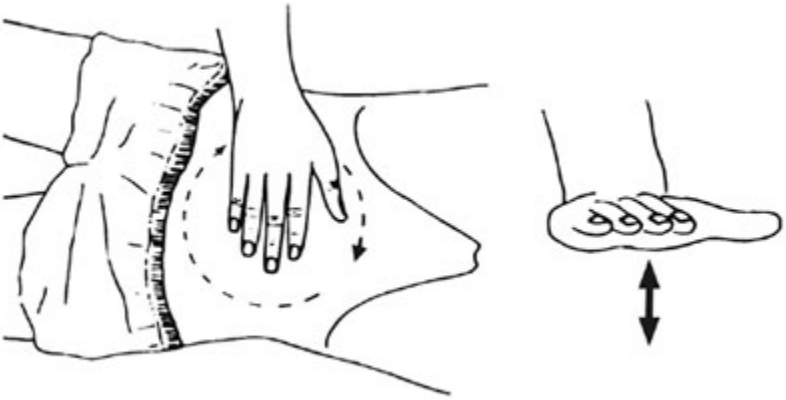

Fig. 5.9 *Patting*

6. Patting Technique

Pat around the navel and the entire abdominal area with the fingers and with a soft, open palm. (Fig. 5.9) (Patting is generally used to finish a CNT session.)

7. Elbow Press

Remember, if you are working on someone who is very large or very muscular, sometimes the only way you can have an effect is to use you elbow. Press straight down or spiral with your elbow. (Fig. 5.10)

Fig. 5.10 *Elbow Press*

B. Detoxifying the Large Intestine

1. Shape and Function of the Large Intestine

The large intestine includes the cecum, with the appendix, colon (divided into ascending, transverse, descending, and sigmoid parts), anal canal, and rectum. (Fig. 5.11) It is a tube five feet long that starts in the lower right side of the abdomen at the ileocecal valve (the junction with the small intestine), and ascends toward the liver. Under the liver it makes a left turn and goes across the body toward the spleen, where it makes another bend, and goes down the left side of the abdomen. It turns at the area of the left hipbone and becomes the sigmoid colon. It then curves into the middle of the pelvic cavity and ends in the rectum and anal canal. The bends in the large intestine, especially on the left side, are tucked away deep in the corners of the abdomen, and are not easily accessible.(Fig. 5.12)

Undigested food and other products pass through the colon. It absorbs whatever water, nutrients, and vitamins it can, and expels the unabsorbed products as feces. In its passage from the cecum to the rectum, the material is sloshed around and shifted by peristaltic movement. This alternating, worm-like, propelling movement is caused by the contraction of the longitudinal and circular muscles of the intestine. This action is especially noticeable during bowel movements, which are brief bursts of peristaltic movement.

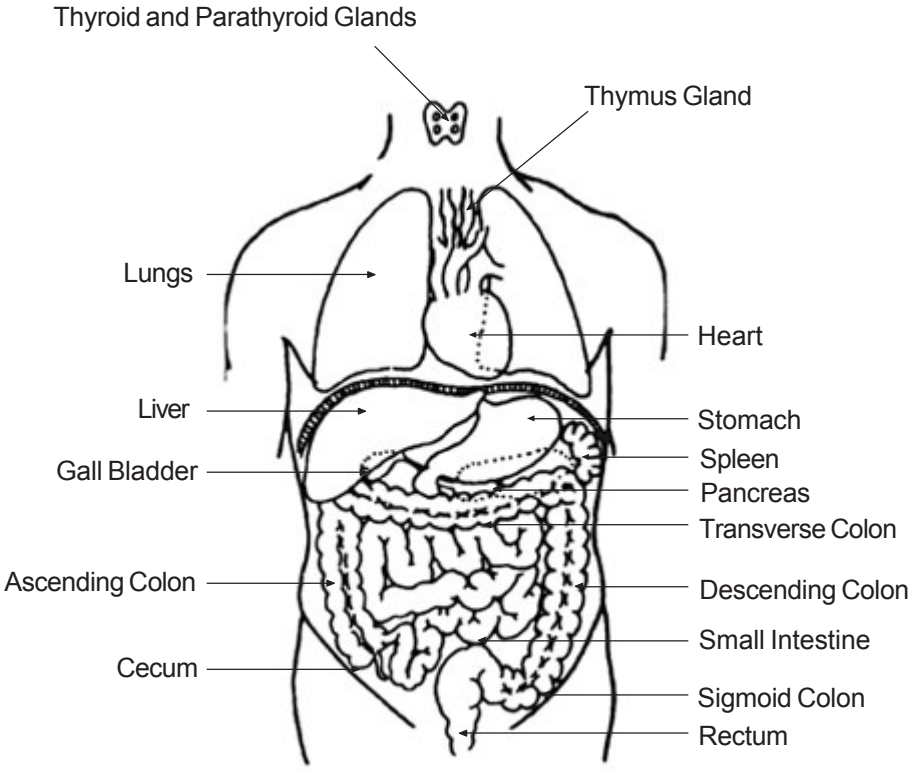

Fig. 5.11 *Large Intestine and the Viscera*

Fig. 5.12 *Corners of the Large Intestine are not easily accessible.*

2. Constipation

The peristaltic movement does not always propel the contents toward the rectum, sometime it sends it back toward the cecum. During this process the intestine is absorbing salts and water from its contents. Constipation can result when the intestine absorbs too much water and the material is too dry to move easily. Sometimes the cause is very simple, such as not paying attention to the need to eliminate. The stool backs up and gets very dry. Constipation can also be caused by the poor functioning of the intestine's muscles; they have lost their tone and strength, or have become spastic. Laxatives poison these muscles causing the intestine to twist and twitch like a dying snake.

To the Chinese the main cause of constipation is excess heat in the stomach and intestines, causing them to evaporate too much liquid. Another cause is stagnation of liver Chi, which also creates heat.

The processing of food is not the only cause of constipation. Some people lack the ability to commit themselves and hold back from normal human involvement, perhaps through fear. They may be unaware that this behavior may be the reason they are often constipated.

If the large intestine gets constipated and enlarges, it will stop the free motion of the diaphragm. Roemheld, a German doctor, discovered the syndrome that was later named after him (the Roemheld Syndrome). He found that gas pressure building up in the intestine causes increased contraction of the rib cage and attracts stagnant toxicity all along the length of the diaphragm area. This will eventually press against the heart area under the rib cage and can create feelings of anxiety, heart pains, and breathing difficulties. This energy back up is sometimes referred to as "constipation" of the heart. Constipation can cause an accumulation of mucus in the lungs resulting in asthmatic symptoms. It can also be the cause of psoas muscle, leg, and back pain.

3. Diarrhea

Diarrhea is the abnormal frequency and liquidity of the feces. Western medicine has named over 50 varieties. It can be caused by failure of the ileum (the lower part of the small intestine) and the colon to absorb sufficient water. Sometimes worry and anxiety causes over stimulation of the nerves, which cause hyper-peristaltic movement and premature discharge. Diarrhea can be beneficial if the body needs to expel toxins or parasites.

In Chinese medicine the most common cause of diarrhea is too much Yang energy in the spleen and kidneys. This energy needs to be balanced, a technique you will be taught in Chapter 7.

4. Colonic Irrigation

It bears mentioning that while CNT probably offers the best techniques available anywhere for irrigating and clearing the large intestine, it is advisable to have at least one high colonic irrigation to have a healthy digestive and elimination system. This involves full irrigation of the colon all the way to the cecum. The colon is full of cracks, fissures, and bend. Usually its walls are caked and lined with junk material that has been collecting there since childhood. The only way to clean it properly is to give it a good hosing; this

means running twenty to 30 gallons of filtered water (from a tap though a water purifier) through it. The constant water pressure will gradually eat away at the plaque and build-up. Complete irrigation on the entire large intestine is necessary to restore its function. After that, CNT and diet can help the normal process of the large intestine. Since it is very easy to rely on colonic irrigation, such reliance can interfere with the normal function of the large intestine and therefore, is only recommended as an initial cleansing.

We agree with V.E. Irons, a man who has spent his life trying to educate the public about this important organ. One of his handout addresses the problems with this organ. It is slightly overstated, but effective:

> "To no other single cause is it possible to attribute one-tenth as many various and widely diverse disorders. It may be said that almost every chronic disease known is directly or indirectly due to the influence of bacterial poisons absorbed from the large intestine. The colon may be justly looked upon as a veritable Pandora's box, out of which comes more human misery and suffering, mental and moral, as well as physical than from any other known source.
>
> The colon is a sewage system, but by neglect and abuse it becomes a cesspool. When it is clean and normal we are well and happy; let it stagnate, and it will distill the poisons of decay, fermentation and putrefaction into the blood, poisoning the brain and nervous system so that we become mentally depressed and irritable. It will poison the heart so that we are weak and listless; poison the lungs so that the breath is foul; poison the digestive organs so that we are distressed and bloated; and poison the blood so that the skin is sallow and unhealthy. In short, every organ of the body is poisoned, and we age prematurely, look and feel old, the joints are stiff and painful, neuritis, dull eyes and a sluggish brain overtake us; the pleasure of living is gone."

The ancient Taoists, and many country doctors early in this century, knew the importance of a healthy large intestine. In fact, Taoists would fast for years to make sure this organ was clean. Many modern health experts underplay the crucial rote of this organ. In the United States colon cancer takes the lives of more people than any other cancer, except lung cancer: typically one out of every

fifteen people. Pockets growing through the wall of the colon occur in one out of five people over the age of 45.

We would like to help reintroduce their wisdom and concern, especially since CNT makes it is so easy to care for the large intestine properly.

5. An Unhealthy Large Intestine

An intestine that is too tight is sensitive to pressure and feels like a tight string. Use two thumbs or the edge of your palm to probe the cecum and sigmoid colon. (Fig. 5.13) Use light, medium, or heavy pressure. If you use a very light touch on the cecum or sigmoid colon and cause pain, this indicates a very serious problem and heavy constipation. If you use medium pressure and there is pain, the problem is not so serious. If you use deep pressure and there is no pain, then this is very good and you can probably release the cecum and large intestine at once.

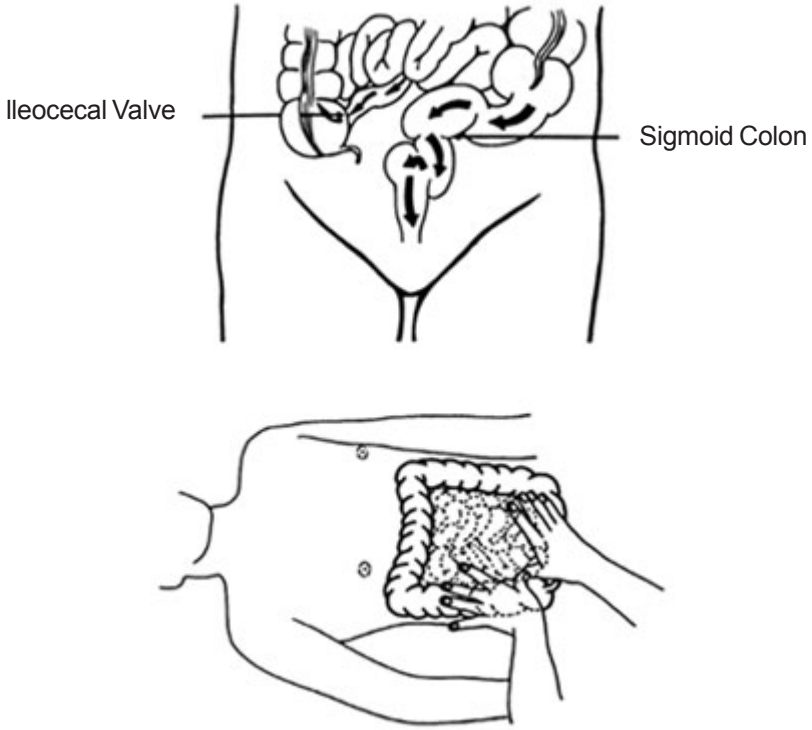

Fig. 5.13 *Probe the ileocecal valve and sigmoid to determine the condition of the large intestine and if there is constipation.*

A healthy large intestine that can be palpated with the hands without generating any pain or discomfort is rare. (Fig. 5.14) Sometimes it is often only a finger's width wide on the traverse section. A loose, clogged traverse colon hangs down in a big curve. (Fig. 5.15) Because of the extreme bending, there will be a blockage of stool in the left curve. This becomes fertile ground in which bacteria can grow, causing inflammation and pain. A large intestine full of gas pockets can push on the left side of the rib cage, deforming the structure and moving it off-center. (Figs. 5.16, 5.17) portrays some different types of unhealthy large and small intestines.

Fig. 5.14 *Feeling the Large Intestine*

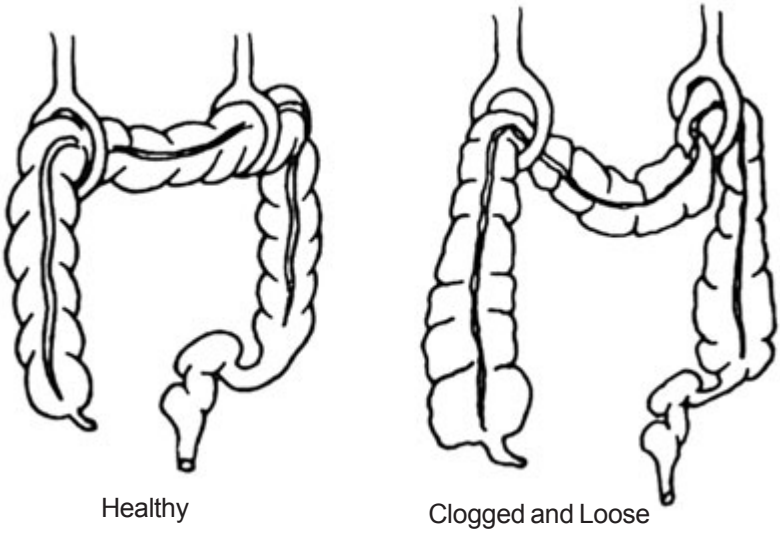

Fig. 5.15 *A healthy intestine hangs naturally; a clogged intestine sage and bulges.*

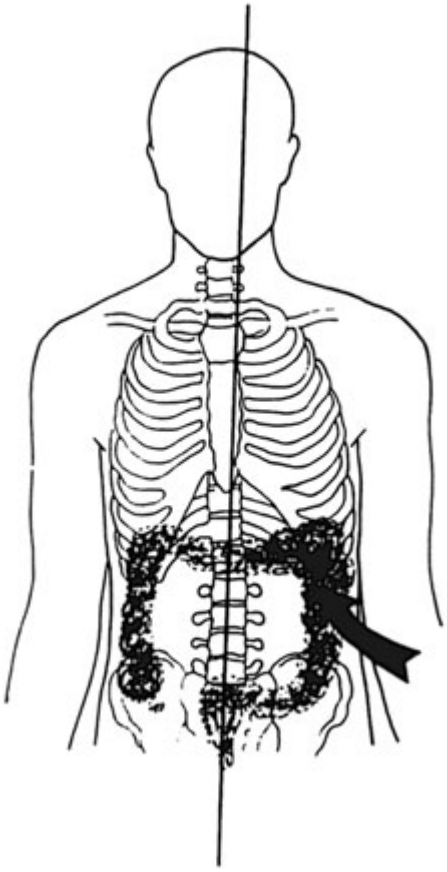

Fig. 5.16 *A large intestine full of gas pockets on the left side can deform the structure.*

6. Open the Large Intestine

Many of the problems with the large intestine occur at the cecum/ ileocecal valve or at the sigmoid colon. (Fig. 5.18) Your palpation of these areas should indicate the problem. If the problem is in the sigmoid area, don't start there but work around it. Never work directly on a painful area (in the large intestine or anywhere else); prepare a place for the pain and congestion to go. To release the congestion in the large intestine, start at the left side of the rib cage at the splenic bend. This will release congestion there and make room for more congestion coming from the problem area.

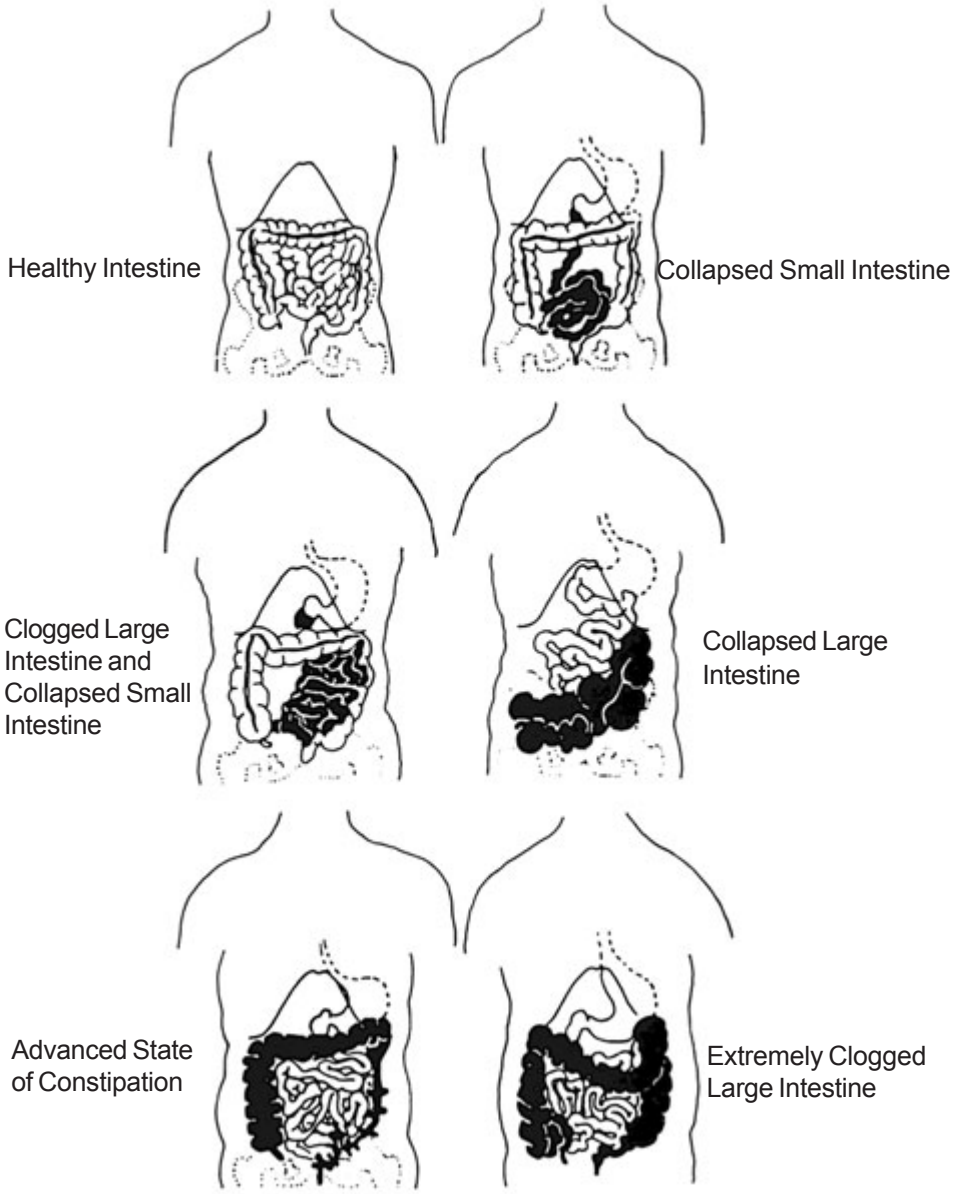

Fig. 5.17 *Healthy and Unhealthy States of the Large and Small Intestine.*

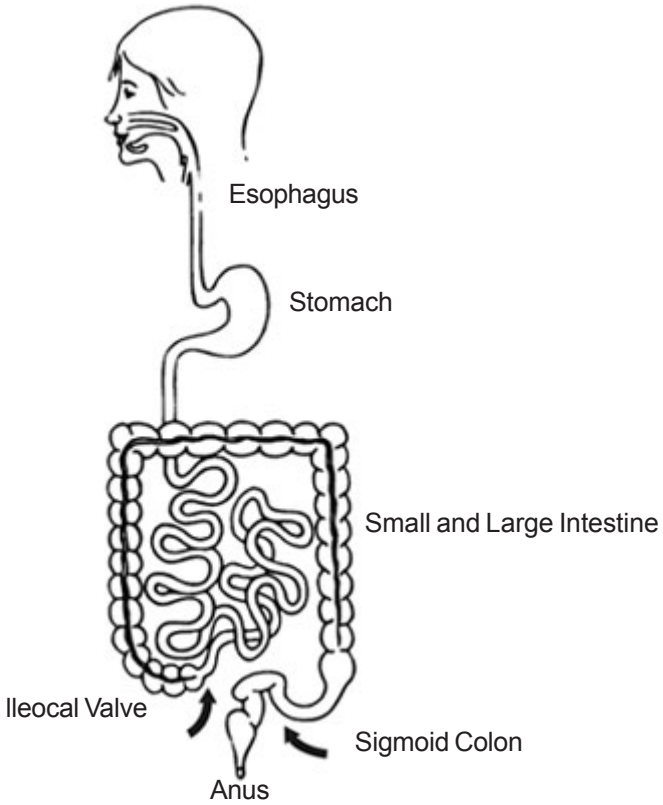

Fig. 5.18 *Digestive system is one continuous tube, beginning at the mouth and ending at the anus.*

a. Figure Five Technique

The Figure Five technique is a hand pattern that outlines the number "5." It can be used to open the descending colon at the splenic curve. (Fig. 5.19) Gas and matter get stuck in this area and need to be cleared out. This motion mimics the peristalsis movement and activates the intestine.

(1) Start by standing or sitting on the right side of the student's body to work on the left side of the body and colon. Reach over the body and stroke up with both palms toward the sternum. Use an overhand palm to brush on the left rib cage in the direction of the sternum. The hand action is a little more forceful than a brush. You want to move the rib cage as well. This will concentrate the fluids toward the center of the rib cage and release the splenic curve.

(2) Position the right thumb on tap of the sinking point below the nipple between the eighth and ninth rib. Stroke down toward the abdomen, in a line parallel to the midline, to a point midway between the sternum and the navel.

(3) Then circle to the left under the left rib cage and make a wide half-circle following the descending colon, ending at the sigmoid colon.

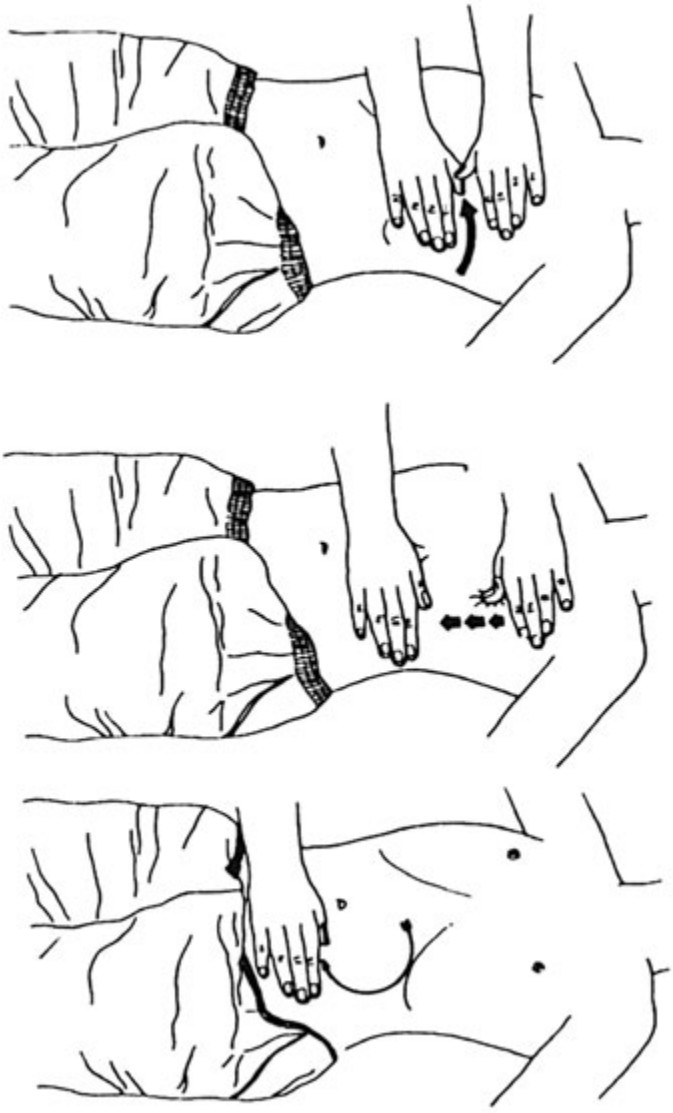

Fig. 5.19 *Figure Five Technique outlines the Arabic numeral "5" on the body.*

b. Mouse Technique

Starting at the cecum, use the fingers of each hand, side by side, to nibble like a little mouse in short two inch bursts along the large intestine. This nibbling movement mimics the normal peristaltic movement of the large intestine and will help the energy to flow again.

e. Scooping Technique

Use the scooping technique to move the large intestine into its proper position.

d. Clockwise Wave Technique

Practice the Wave Technique (Fig. 5.20) Reach into the abdomen with both hands and create a relaxing, alternating, rotating movement between the two hands. By creating a wave of motion inside the bowels, you will increase the peristaltic movement of the intestines. Do this two to three times or longer. This technique is always nice and relaxing in between other techniques.

Using the edge of the left palm, press down and upward along the ascending colon toward the transverse colon. Follow by using the fingers of the right hand along the descending colon. This will end in a circular motion as you bring your elbow in toward your rib cage on the right side and press the palm of your right hand toward the sigmoid.

e. Releasing the Sigmoid Colon

The sigmoid colon is inside the left hip and is part of the large intestine. Most problems occur here or in the ileocecal valve.

(1) Sit on the left side facing the student and have him raise the left knee. Using the edge of the right hand, place it against your student's left hip bone. Place the fingertips of your left hand on top of the pubic bone as counter pressure. (Fig. 5.21)

(2) With your right hand, press underneath the sigmoid. If you are on top of it, you can cause pain.

(3) As you feel underneath the sigmoid, roll out with the back of your right hand toward the rib cage. Feel the stretch of the sigmoid, which will release any blockages or knots. Repeat this motion several times.

(4) Finish by doing the Wave Technique three to six times.

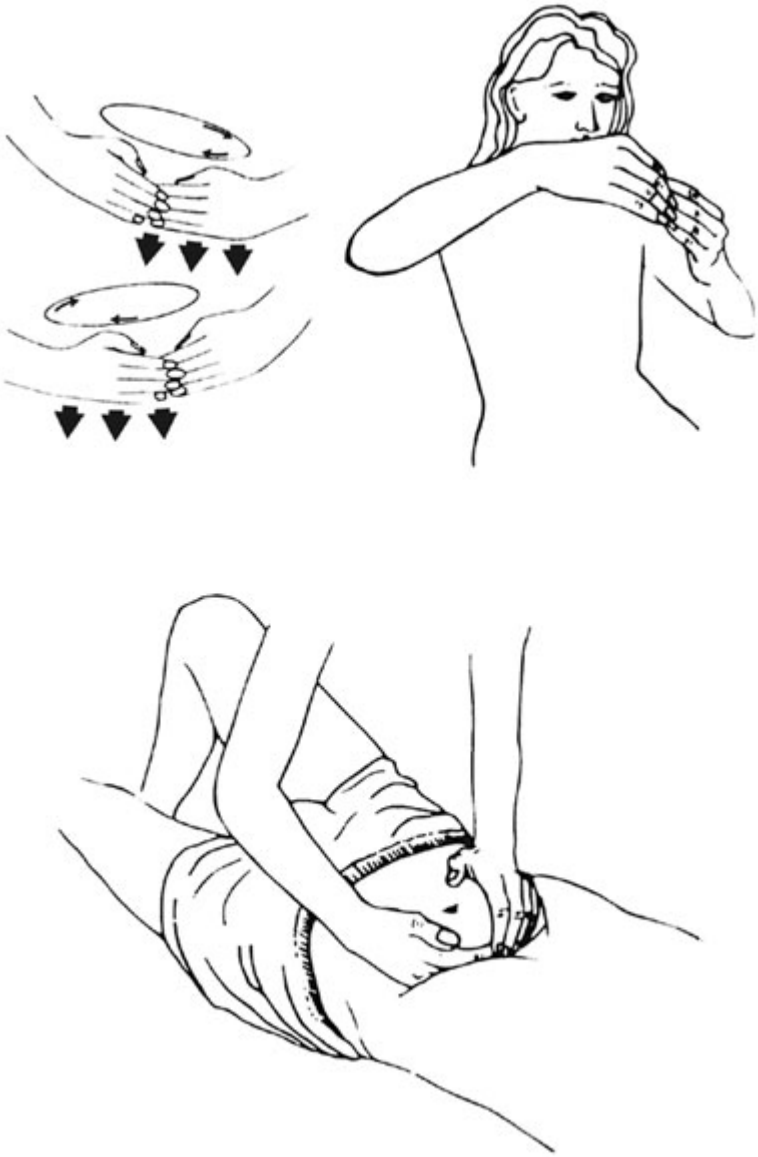

Fig. 5.20 *Hand Formation of the Wave Technique*

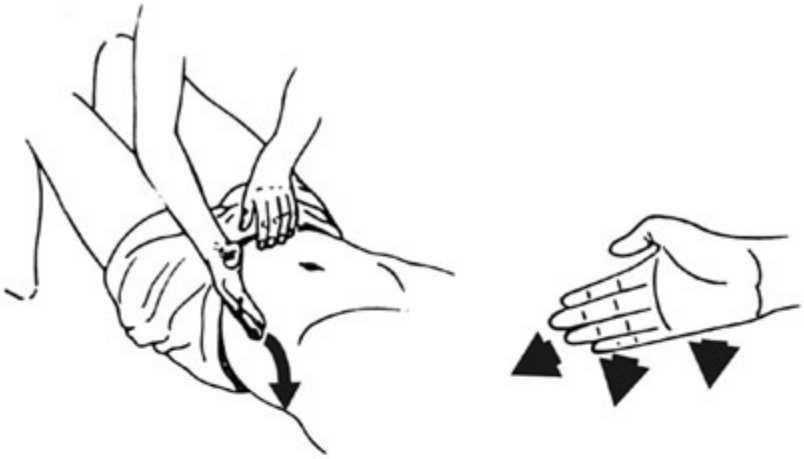

1. Pressing Underneath the Sigmoid

2. Turning Outward

Fig. 5.21 *Use the edge of the hand to release the sigmoid colon.*

f. Cecum

The cecum is inside the right hip (Fig. 5.22).

(1) Use your finger to press around the right hip and feel for a bulge, which can be about an inch long, just under the ileocecal valve. If this area is irritated or congested, it also will cause irritation or blockages of the appendix. This is where the large intestine starts. Sometime when you are able to release the tension and congestion in this area, you can feel an explosion of energy travel through and clear out the whole intestine.

(2) Be sure that you have first released the congestion at the splenic bend and liver bend to allow room for the congestion to move.

(3) Release by using your thumbs to inch up toward the ileocecal valve. Use a consistent and firm pressure, like squeezing a tube.

(4) Repeat two to three times until the area is clear of congestion, hardness, obstruction, or pain.

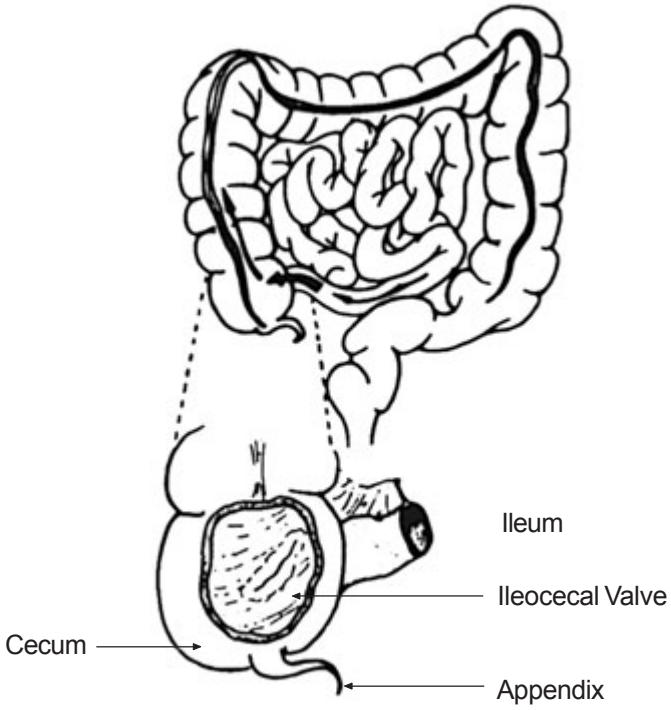

Fig. 5.22 *Cecum and Ileocecal Valve*

g. Ileocecal Valve

(1) The ileocecal valve should be about half way between the navel and the right hip bone. This valve is the connection between the large and small intestine. Blockages cause this valve to close. It is a one-way valve opening into the large intestine at the cecum. It opens when the pressure inside the cecum releases, and closes when the pressure inside the cecum builds. It is also activated by food entering the stomach, which initiates a contraction of the small intestine, expelling contents of the lower part of the small intestine into the large intestine.

This is a very important valve. If it is not working and closed, it causes constipation and headaches. If it is stuck open, it causes diarrhea. Again, to work on constipation, it is necessary to release the whole of the large intestine and the cecum. Then the ileocecal valve can open automatically. If it doesn't open automatically, do the following technique. When it opens, you will hear it make a gurgling sound and the cecum will fill.

(2) Place the edge of your right hand along the right hip bone and your left hand on the back, supporting the kidney.

(3) With the edge of your right hand, slowly apply downward pressure, then roll the palm of your hand up and out toward the rib cage at a diagonal. This is a small movement, used only to open this gate between the two intestines.

(4) Do not do this movement more than once or twice, since the tissue is very sensitive. You should remember to press before you make the movement.

(5) In cases of diarrhea, the large intestine is open. This causes the ileocecal valve to remain stuck wide open. Use your fingers to close it. Do a counterclockwise wave technique to re-establish its peristaltic contractions so that it may start to absorb moisture from the small intestine. Drink plenty of water to replace the lost fluid.

Cosmic Healing II

Taoist Cosmology and Universal Healing Connections

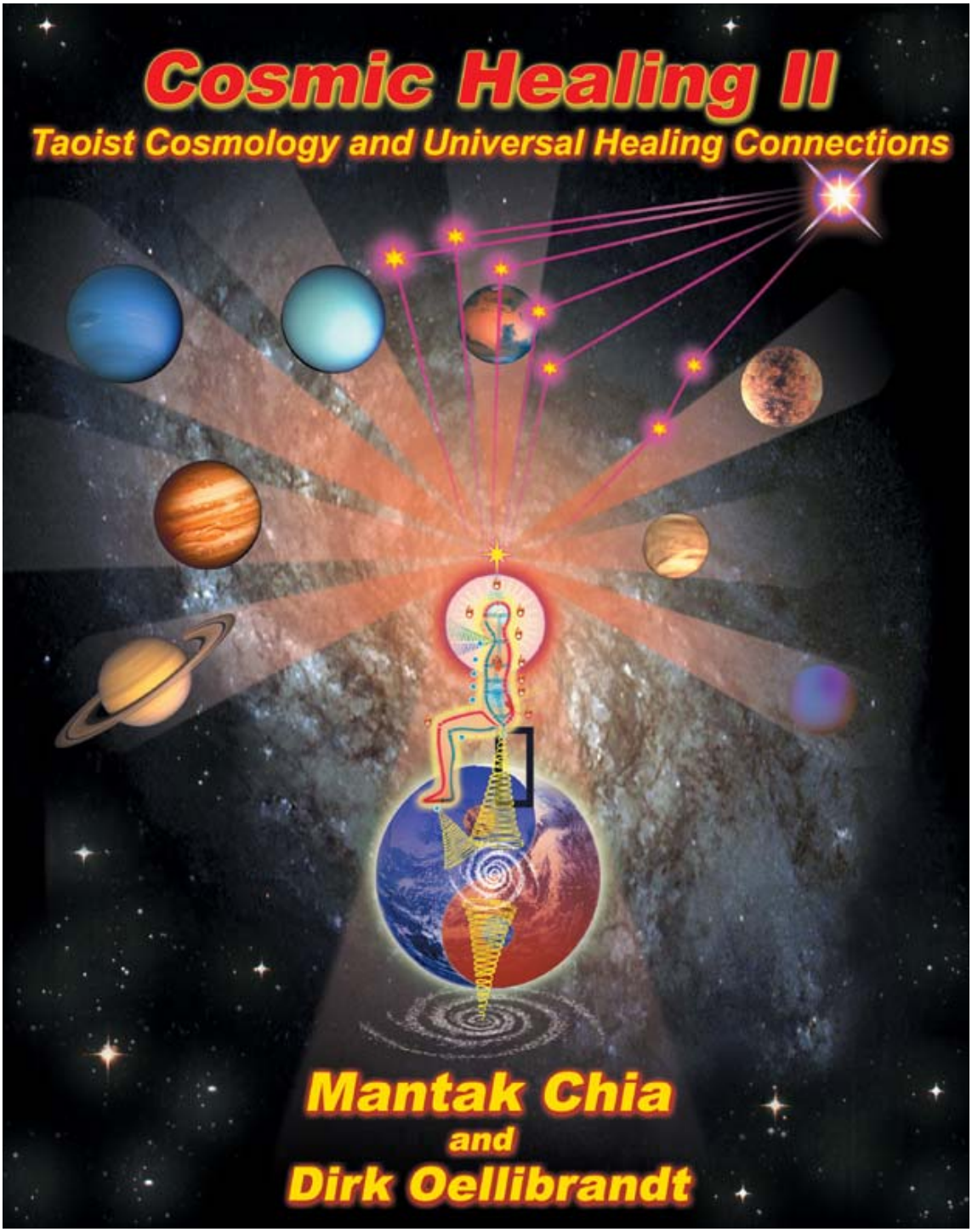

Mantak Chia
and
Dirk Oellibrandt

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About the Authors

Mantak Chia

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and "still the mind." While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 1,200 instructors and practitioners from all over the world. Universal Tao Centers and Chi Nei Tsang Institutes have opened in many locations in North America, Europe, Asia and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden, the Universal Tao Training Center in Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a word processor for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty five books to convey the full Universal Tao System. In June 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi Gong Master of the Year. He is the first recipient of this annual award.

He has previously written and published these Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy
co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love Through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi co-authored with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper/Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper/Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2001
Elixir Chi Kung - 2001

Also many of the books above are available in the following foreign languages:

Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Russian, Serbo-Croatian, Slovenian, Spanish and Turkish. There is a Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

Dirk Oellibrandt

Dirk has been practicing the principles of oriental martial arts since the age of 13. His training combined with a great passion for nature helped him to develop a solid base with a high sensitivity for energies. In his evolution as a martial artist he became fluent with theTaoist specialties and Shiatsu. At 25 he began withdrawing from the external martial arts and studied different forms of Chi Kung, Aikido, Tai Chi and Pakua. He also learned to apply his energy in the form of healings; he studied different shiatsu systems, oriental medicine, and osteopathic techniques. His most important sources of inspiration are Master Mantak Chia, Saul Goodman and Michio Kushi.

His gathered knowledge and experience from his studies, treatments and teachings combined with his inherent sense of the universal laws helped him to give life to a new approach to the field of bodywork and healing. He named it “4 DIMENSIONAL BODYWORK”.

Dirk and wife Katrien direct an international organisation centered in Belgium called “DU MAI” to further this work. The unique philosophy underlying the Du Mai program combined with Dirk’s vigorous and awakening teaching and treatment style has been a source of support and inspiration for many. Together with a team of colleagues including teachers and therapists he is exploring the dynamics between the universal laws and the constant re-creation of our human body. This approach suggests exciting possibilities and higher dimensions in the art of healing and bodywork.

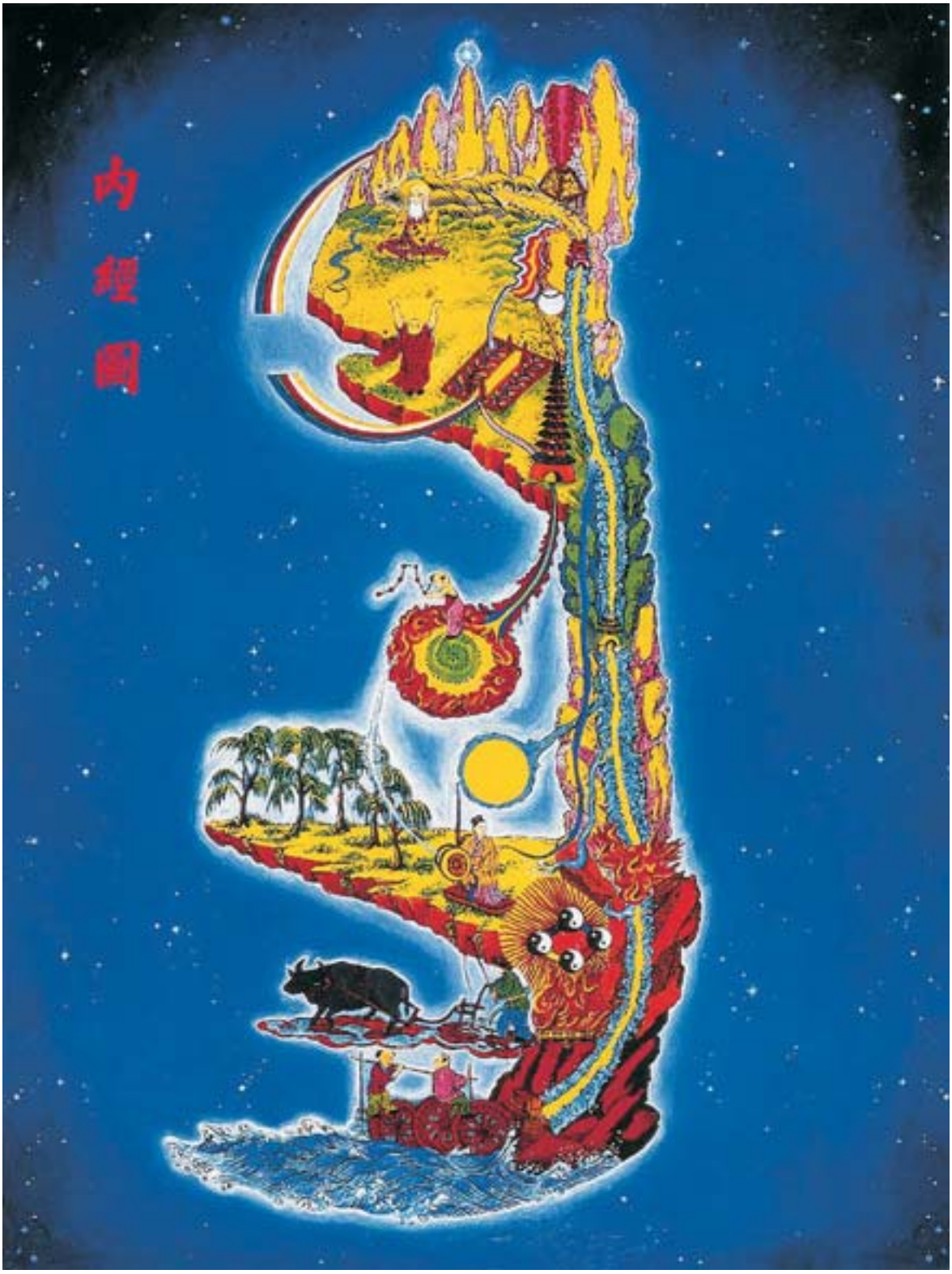
内經圖

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Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Chinese medicine emphasizes balancing and strengthening the body so that it can heal itself. The meditations, internal exercises and martial arts of the Universal Tao are basic approaches to this end. Follow the instructions for each exercise carefully and do not neglect the foundations, i.e, the Microcosmic Orbit and any other supplemental exercises. Also pay special attention to the warnings and suggestions in each chapter. People who have high blood pressure, heart disease or a generally weak condition should proceed cautiously, having prior consent from a qualified medical practitioner. Pregnant women should not practice Cosmic Healing. People with venereal disease should not attempt any practices involving sexual energy until they are free of the condition.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

The correct way to work with Cosmic Healing II is to read and practice the techniques in Cosmic Healing I by Mantak Chia, to fully obtain the benefits of this new work.

Preface
Taoist Cosmology
Stellar and Planetary Connections

Dirk Oellibrandt

We are moving towards unprecedented changes, at the turn of the millenium. The accelerating speed of global change shows us that society is moving towards a climax of tension and contraction, the center of the evolutionary spiral where things are turning towards their opposites. The ability to adapt to this breathtaking process is essential to survive. These changes are not always caused by natural disasters or climatic alterations, but by the effect of centuries of the human drive for power, temporarily forming an unstable social atmosphere on the planet. This tension field is magnified by universal astrological conditions.

In the modern world, many people have barely enough energy to follow the speed and direction of these changes much less have enough creative energy remaining to consider and set down their true tasks. A major part of the world population spends too much of its precious energy trying to survive. Some do this by imitating and using political and social structures that are controlled by the commerical industrial groups. In this way they are destroying the roots of their own culture. Natural rhythms are changed by obsessive striving for material goods. Superficial pleasure takes over, disconnecting people from their spiritual roots and a natural way of life.

A new orientation in life and guidance by leaders who understand the order of the universe and can see truth in the midst of the realm of phenomenon and events, is one of the most urgent needs we all experience today.

This book does not pretend to and does not claim to solve these needs for you. We do, however, trust that these practices can help you to reconnect with who you really are and that it may help you in finding the way back to your origin. Once we reconnect to this source of intelligence, everything around us acquires a new and a deeper meaning.

This book offers parts of the Taoist cosmology about the planetary and stellar world, some personal insights and an introduction into Taoist planetary and stellar practice. Once you have integrated these into your life, they will help you to cultivate inner light and clarity.

We hope this book will inspire you and help you, so that you will feel more liberated and at peace with yourself. May it enhance your sense of ‘coming home’ as well. Although most information comes out of the ancient oriental tradition, we want to point out that the true information source is the ***Tao*** itself, the essential you ,including all countries, traditions, races and so much more.

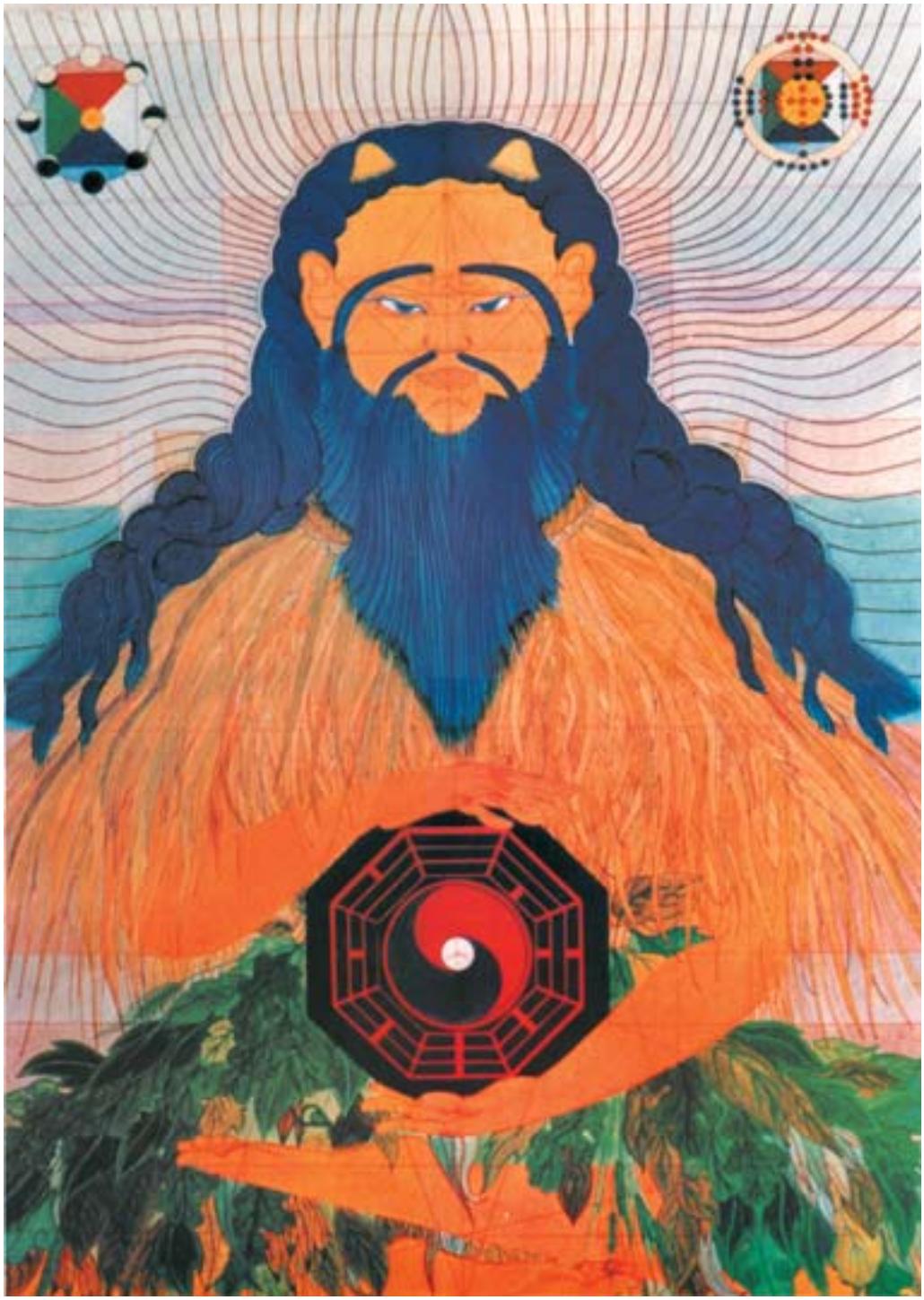

Fu Hsi - Creator of the I Ching (Drawing by Juan Li)

Chapter I
Taoist Cosmology and Universal Healing Connections

Introduction

Taoism is a practice of studying and living the laws of the universe. It has its roots in a body of knowledge that many masters have gathered over thousands of years. According to ancient Taoist records, this practice has been the fruit of deep meditative practice by highly advanced practitioners who lived an intimate relationship with the universe and nature, often in remote and isolated places.

A major role in the discovery of a practical way to work with the energy of the universe was played by Fu Hsi, who has been credited in Chinese history with the discovery of the pakua and who has been seen as the creator of the I Ching, the most ancient Taoist book of wisdom. There is agreement among historians of Chinese culture that it was the Yellow Emperor, who played a major role more than 5000 years ago, in synthesizing Taoist practices in the domains of health and healing as well as in the healing love practice. He integrated a wealth of insights and practices from a wide variety of Taoist masters. This process of synthesis and accumulation of theory and practice continued to grow in subsequent millennia, until today. It is still evolving.

Taoist practice as we understand it is not religious in conventional terms, nor is it based on a creed or on transcendental principles.

It is a practice of self-awareness and self-transformation through which we gradually become one with the cosmos. In this process we realize and actualize ourselves, as within the physical body, the energy body grows (in Taoism known as the soul body) and within the latter the spirit body (the light, diamond or rainbow body - see illustration on page 12) evolves. It is in this process of subsequent energy transformations, that we return to our origins and realize our original intrinsic nature of which peace and freedom are the natural fruits.

There is a firm insistence in the Taoist wisdom tradition that any advance in energy transformation or what in western culture is called spiritual advancement, needs to be well rooted in the earth: thus the initiation into the higher practices bears fruit, in the Taoist view, only to the extent that the practitioner is rooted and grounded. Taoist practice may help a person to lead a fascinating life and at the same time grow spiritually by realizing one's natural potential.

Essential to spiritual growth is that the Taoist practitioner cultivates a sense of purity, joyfulness in life and a sense of wonder, thereby regaining and enhancing the openness and excitement of a small child. Not surprisingly the virgin child stands in the Taoist tradition for purity and immortality. In this way the practitioner develops one's own sense of inner truth as a reflection of one's innate spiritual origin.

In the chapter which follows, we offer an approach which integrates ancient Taoist insights with knowledge and information from several more recent sources, exposing a wide range of possibilities. We hope that the information offered in the following chapters may help the reader to enhance his or her awareness, health and quality of relationships and may also serve to raise thereby, the quality of society in general. Knowledge of this material can also be used in personal healing and by those who engage themselves to help others to heal themselves. Promising effective results of this approach in thousands of treatments have encouraged us to share this information. In the near future a book may appear which will be specifically focused on the therapeutic possibilities of this work.

Three Ways

We propose that the reason for the generally poor quality of our lives and that of society is due to the perception we have of who we are, where we originated and what we are doing here on earth. The quality of our life as we live it does not reflect our full potential. In what follows, we describe three different kinds of people, typical of the most common visions and life styles. Also we will see how we as human beings gradually entered into a process of degeneration and how we lost our divine nature. Many centuries of conditioning by institutional religion as well as by modern science have lowered our energy frequencies and have locked up humankind into a horizontal, materialistic culture in which sensitivity to our true origin has become obscured and we live cut off from the energies of heaven.

Thus we have become trapped into a rational, materialistic way of life. At the same time, as a result of our repression and disconnection we tend to be lost in guilt, we project negative emotions on others and look for truth outside rather than within ourselves. This book is designed to help us to reactivate the deep memory of who we are beneath the crust and overgrowth of the various forms of domestication and slavery that we have been subject to in the history of our civilization.

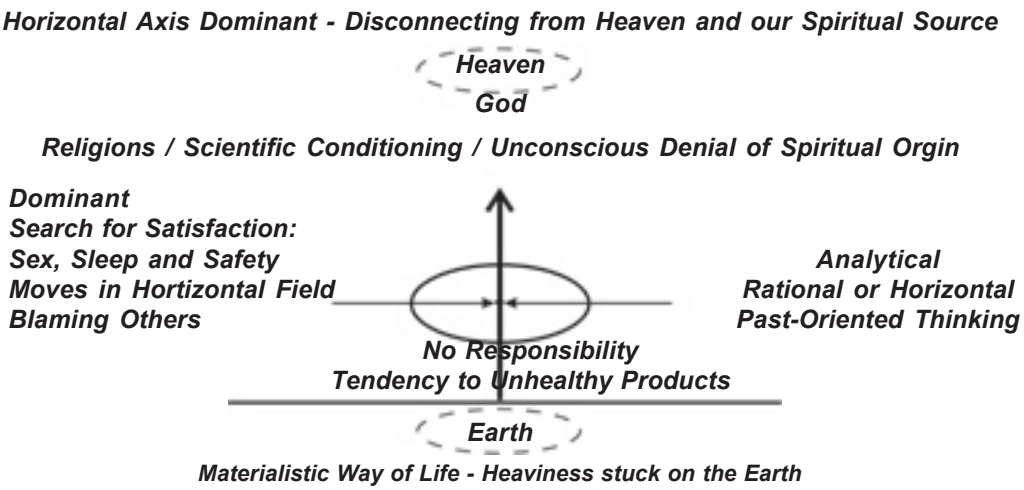

Fig. 1.1 *Horizontal Axis*

This state of spiritual disconnection has been further aggravated by unnatural ways of living, moving and eating. Spiritual disconnection and materialist obsession are at the very core of modern society. Since we turned away from the higher intelligence of the universe, which is our only source of true knowing, we became like a space shuttle without external information, depending and hoping for good luck.

Thus most of us in the world of today live in an unawakened, half numb state, unconscious that we are caught in the past, afraid to look at ourselves and where we are here and now.

As this is the dominant state of social energy, it is not easy to avoid being trapped in it. Most people are resigned to this state and if you would ask them how they feel and how they are doing, they would tell you: “We are doing okay”. Their lives basically revolve around eating, sleeping, mating, security and power. If they would look deeply inside and were honest to themselves, they would see that they are rather unhappy and feel empty inside. The deep fear of looking at this pain and emptiness prevent them noticing that they have gravely suppressed their godly nature.

As children of the universe we are not only created by the same intelligence and the same subtle substance, but if we allow it, we spontaneously will co-create its evolutionary process. We are not only children of the universe and its love which gave us life, we are also its fathers and mothers, whose love is co-responsible for the way it evolves. As an ancient expression says:“Embrace the universe as a mother embraces her first born child”.

Once we truly take responsibility for ourselves, our health, our spiritual origin and our life task, we can start to wake up from this numb state. Then we become aware of the fear and mechanisms we have cultivated to prevent ourselves from getting in touch with our true selves. Only when we have the courage to look beneath the surface of our ordinary consciousness, will we be able to open up and walk the path to freedom and spiritual independence.

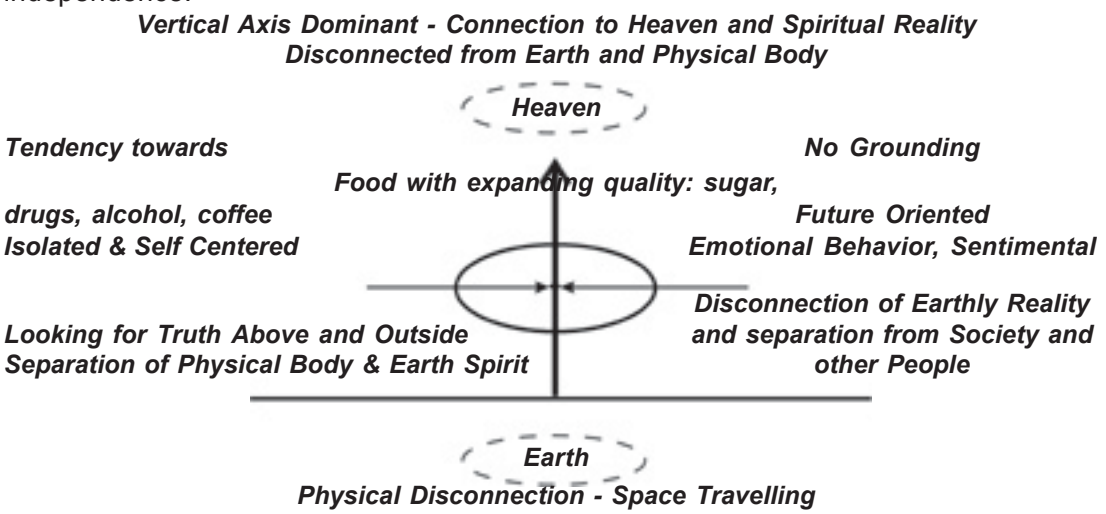

Fig. 1.2 *Vertical Axis*

The Flower Power period and the New Age movement may be seen as a reaction to the materialistic upsurge. However many followers of these movements, in their relative disdain of mundane and earthly material pursuits, have moved to the other extreme: a spiritualism without grounding 'roots' in the earth. Or they have the same fear pattern but now use a new emergency exit, which contains the same duality between heaven and earth and which has characterized most dominating religious and philosophical traditions.

People with poor groundings and a negative relationship with their body frequently face a host of problems in their daily lives regarding sex, money, health, self esteem and relationships. They often suffer from insecurity and have a weak relationship with the realities of life. They tend to seek ways to elude these realities, including their own physical existence, so that they experience a growing disconnection between body, mind and spirit. They do understand that they need to look for truth within themselves, as they carry the divine within. But they find this difficult because of the split which they have created within themselves between what is "above" and what is "below", between heaven and earth within themselves.

The pursuit in realizing freedom often causes such spiritual aspirants to imprison themselves in their search. As a result they are bound to end up as imbalanced as their materialist opposites. It is the deep pain they experience which pushes them to a spiritual path, free from all obstructions. Now the same ego is hidden behind a spiritual mask. When we turn our attention away from our body we cut the intelligence away from the 'matter'. In this way the body is ignorant, dependent and selfish. We dishonor the female nature, the holiest temple on earth. The higher frequencies are not balanced and integrated in the physical body, so the vital essence will gradually leave the body or will transform into high energy frequencies that can only be partly assimilated in the physical body. The balance of the energy will leave the body and find a new 'attraction'. Physically this person will start to weaken slowly and all kinds of symptoms will appear, ultimately leading to premature aging. Their heart-energy may be compared with to a flower which is not connected with the roots. Their spiritual condition is only momentary. They only live in the upper body, as they tend to ignore or are afraid of their sexuality; they lack a connection with the belly, their energy center. As love and sex are not connected, their relationships tend to be emotionally unstable and superficial. Let us be true to ourselves; we were not given our bodies to deny them. We can all contribute to the quality of life on this planet by dissolving the denseness and separation in our mind and our social mentality. The problem is not only in the body, but also in the absence and denial of an understanding of the infinite and unfathomable true spirit and universal mind. Taoist masters realize that truth lies in a spiritual life which includes the physical body. By consciously fusing the spirit with the core of physical existence a new quality of life arises.

Taoist self-healing practices can significantly help such people: by teaching them how to get in touch with the spiritual nature of their body, to care for it and make it healthy and strong. This is essential for the growth of a healthy energy body.

The initial focus of Taoist practice is on creating a healthy and strong physical body, well rooted in the source of life, the energy of our 'mother' earth. At the same time Taoist practice acknowledges that the origin of our spirit is in heaven. Our soul has chosen to incarnate on earth and seeks opportunities to grow and evolve, by learning from the universe. Since everything finds its nature in Tao or the great spirit, the human body, soul and spirit can be seen as different densities of the same substance.

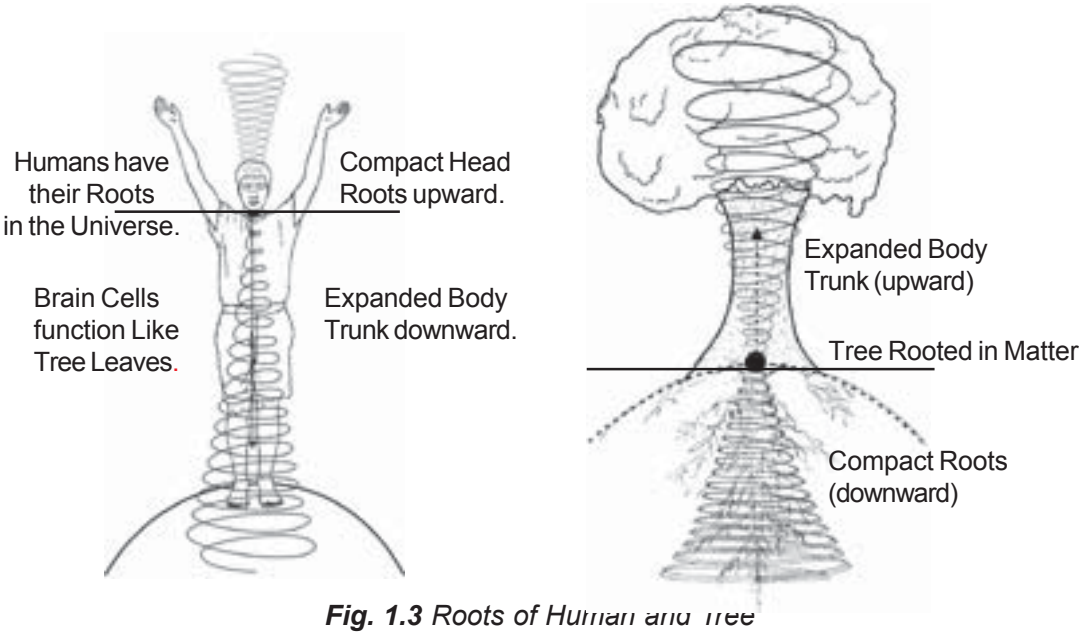

Fig. 1.3 *Roots of Human and Tree*

In view of our unawakened unconscious state, most of us tend to get trapped in one of the two poles: either by focusing on an earthly life at the expense of heaven or the other way around. This imbalanced polarity is well illustrated by the struggle between men and women.

Over the ages, Taoist masters have frequently obtained great insights in the art of cultivating their health and physical strength. Longevity was one of the fruits. In such a way they enjoyed much time and space to cultivate their spirit and to transform their physical and energy body into a light body. In the Taoist tradition this state of being has also been called "the crystal" or "the immortal body".

With the deepening of the grounding practice, the higher body can grow step by step and the emotions of daily life, with its ups and downs, gradually lose their uprooting effect. When one practices daily, a point may be reached where one feels the desire to withdraw from society, live away from the hustle and bustle of modern life, to facilitate a truly intimate relationship with the universe and nature for a certain period of time. This may speed up the transformation process, as has been demonstrated for centuries by monks of different spiritual traditions. Taoist masters have also advised their students to give up

their withdrawn lives and return to "the world" to maintain their roots in the realities of daily life. This advice was given by a master, if he observed that his students needed to mature and that they needed to get a taste of social life and experience desire, so that they could compare these two 'directions' and appreciate the experience of true peace in their meditation practice.

Thus, before achieving a higher level of awareness and mastery over their energy, they were sent for a few years into a busy town to work as a dishwasher or do other menial jobs. If the student had reached the stage where he could maintain his inner peace, even under difficult circumstances, then he was seen as becoming a master himself.

For most people, withdrawal from society and from social relations and earthly life may only be advisable after having learned and integrated different stages and levels of energy transformation within society. If we withdraw from society without the necessary maturity and insight, the mind is often bound to remain restless, as it continues to look unceasingly for physical, emotional and mental satisfaction.

When a Taoist student has achieved a strong navel center and enjoys a firm connection of heaven and earth within, then he can freely move "upward" and "downward" without getting lost. The relationship between heaven and earth may be represented by a vertical axis which goes up (heaven) and moves down (earth). Along this axis we can visualize the different centers and levels of energy and their transformations (body/soul/spirit). Because of the firm rooting, the Taoist way of energy transformation is a safe one. It has been tested for many centuries. The Universal Tao practice is actually a self-cultivation program we can make use of effectively and apply in our daily lives. The practices lead us step by step from an initial level to the highest or "immortal" practices. The Taoist way of life teaches you to reconnect and become aware of your true spiritual origin and bring this experience down into the lowest center of the physical body: the Lower Tan Tien. It brings spirit into matter or light on earth. After achieving this strong rooting process between heaven and earth (vertical axis), the practitioner can move freely into the materialistic world (horizontal axis) without losing his connection with the spiritual.

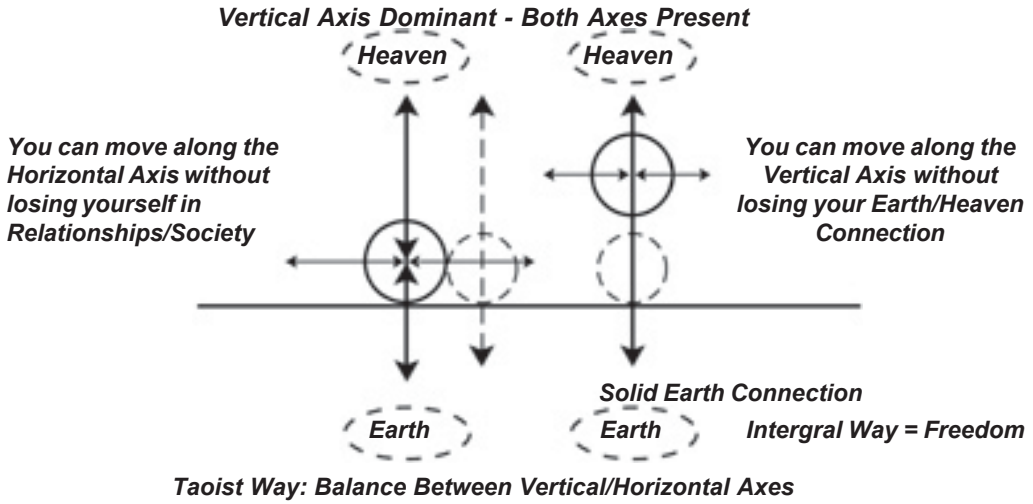

Fig. 1.4 *Both Axes*

Three Sources of External Chi

According to the Taoist view, the energy of the universe is comprised of three different realms.

The subtle origin of the universe or the Tao is the source of all life, all beings, all things, all energy and their various manifestations.

In the Tai Chi (See fig. 1.5) the circle represents the oneness and the yin and yang energies represent the intrinsic polarity of all forms of energy. Yin and yang represent a unity of opposites, always balancing, completing, embracing and containing each other. The interaction between yin and yang created the Three Pure Ones or the three energy sources in the universe: the cosmic force, the universal force and the earth force. Knowing that these energies contain the pure light of the Tao, we recognize the Three Pure Ones in the Tai Chi Tsu. The circle represents the cosmic light energy while yang and yin represent the universal and the earth energy.

Fig. 1.5 *Tao of Triple Unity*

Cosmic Chi is born out of the original Chi of the Tao and literally carries the intelligence and essence of life. Guided by this intelligence it spreads out into the universe and manifests in different densities and forms defined by the cosmic laws. This is how stars, planets, human cells, subatomic particles and all other forms of life take form and are nourished.

In particular, cosmic energy descends and materializes into the human baby, as it is attracted into the world by the magnetic field between the earth and the moon. Since most people have lost the ability to consciously and directly absorb the cosmic light, we can only do this in a materialized form: either by eating living substances that have absorbed cosmic light (plants) or by eating living creatures (animals) that have eaten the plants. This means that we only consume light in the more or less materialized form: cosmic dust, which in turn becomes plants and animals. Evolution is leading us to return to consume from the source: cosmic light. In this way yin and yang have become one another, as the circle leads us back into light.

Taoist practice focuses on restoring this direct connection with the cosmic source (light particles) so that we regain the ability to directly live from light energy. In this way we become less and less dependent on eating plants and animals. There is abundant evidence that throughout the ages many Taoist masters have been able to live for months or

even years without taking any food and without losing weight, while maintaining and even enhancing their vitality. Today, more and more people in different places all over the world and with different backgrounds are living only on water, tea or fruit juice. This practice is possible because such advanced practitioners tap into the original source of human life and all other forms of being: cosmic light.

Both universal and earth energy have their genesis in the original energy of the Tao. The universal force of heavenly Chi is the radiating force of all galaxies, stars and planets of the whole universe. It is this all pervasive force which nourishes the cosmic force in nature and all life forms. The earth force is the third force of nature which includes all the energies of mother earth. This force is activated by the electromagnetic field originating in the rotation of the earth. It is also integrated into all aspects of nature on our planet.

The earth energy is accessed through the soles of the feet, the perineum and the sexual organs. Earth energy nourishes the physical body. It supplies our daily life force and is one of the principal forces used to heal ourselves.

Human Energy in the Universe

In early times Taoist masters had an understanding of what a human being 'is', an understanding which is quite different from some present day theories. Human energy was understood to be the highest manifestation of the cosmic light. The primary responsibility of humankind as the highest manifestation of cosmic light, was seen as keeping the balance between heaven and earth.

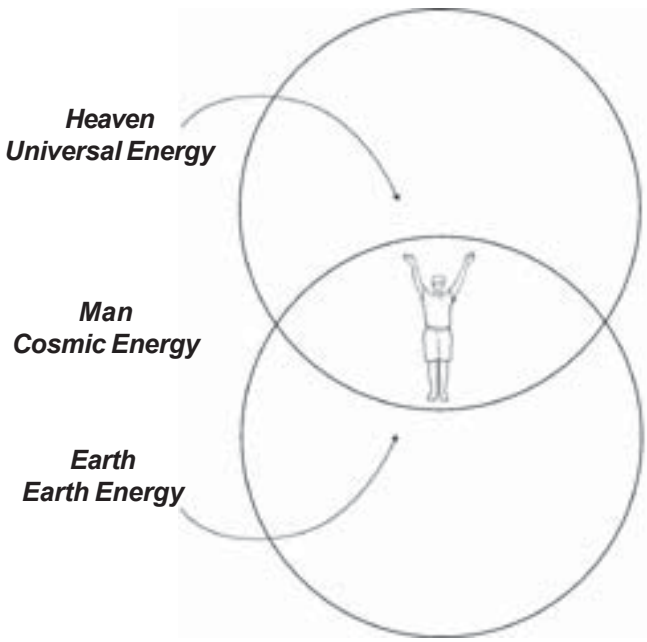

Fig. 1.6 *Balance between Heaven and Earth*

Today, responsibility is frequently experienced as a burden and not as an opportunity to grow. Supernatural powers of the 'Immortals' are not really extraordinary, as they are inherent to our natural position in the universe. Each of us holds the memory of the true potential of life and of human responsibility within our genetic code.

Three Levels of Existence

The threefold nature of the universe manifests itself in many different ways. In the Taoist vision, everything we see and experience around us has gone through three different realms or spheres of existence.

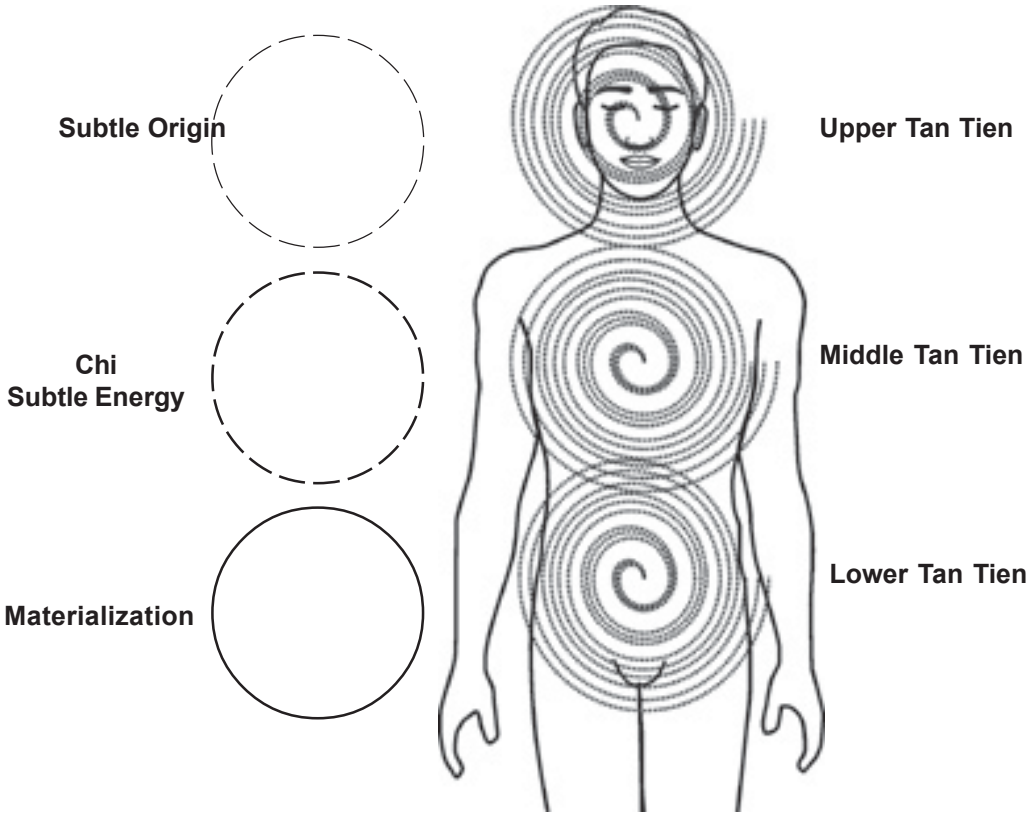

Fig. 1.7 *Three Tan Tiens in the Human Body*

The subtle origin is the source of everything: heaven and earth. It contains the realm of Chi and all phenomena.

1. The subtle origin or pure law of existence (Tao).
2. Chi, the subtle energy.
3. All phenomena, interactions, transformations of Chi.

The three realms are inseparable. Once we understand this threefold nature and experience its manifestation in our bodies, we have made a major step on our spiritual journey.

We have pointed to the necessity to open up the vertical axis and establish a deep rooting in both heaven and earth. The three principal energy centers in our body on this axis are called Tan Tiens. They are in reality the containers of the physical, soul and spirit energy. The way we become human is through a process of materialization (the body is the material densification of energy) in which the subtle energy of the Tao, connected to your spirit, has incarnated through your soul into your body. So heaven had descended into the earth and what is above and below have united.

The Tan Tiens (fig 1.7) each have specific energetic functions. The three main stages in Taoist spiritual cultivation are directly related to the Three Tan Tiens.

Three Tan Tiens and the Three Step Cultivation Process

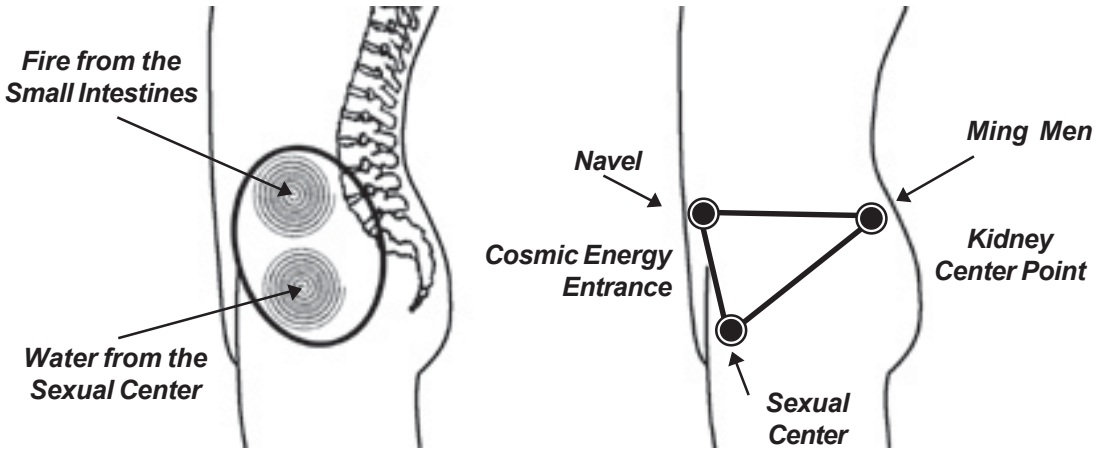

Fig. 1.8 *The Lower Tan Tien is found within the triangle.*

The lower energy center or Tan Tien is located behind and below the navel. It is located in the small intestine and is also called the lower fire. This center has a strong polarity because it governs the fire (small intestine) and the sexual water (kidneys) energy at the same time.

It is the center of the physical body and of physical strength. It contains a frequency of gross energy (compared to the two other two Tan Tiens). In the center point (see fig.1.8), the prenatal force is preserved by the power generated from the kidneys. When the Lower Tan Tien is strong, digestion is easy, emotions and experiences are easily transformed and there is much sexual energy.

The center point contains the basic spark which was created when your father's sperm penetrated your mother's egg. If this spark continues to be active and strong, it provides life force to the billions of cells throughout your body. The Lower Tan Tien is located in the triangle between the navel, the opposite point to the navel (in the spine between the second and third lumbar called the 'Gate of Life') and the sexual center. For men this is the prostate gland and for women it lies in the top of the cervix between the ovaries.

Control of sexual energy and its transformation into life force is essential if we wish to raise our energy level in the Lower Tan Tien. For men this implies that they need to preserve the life essence of the sperm during intercourse or self stimulation. Through controlling ejaculation they can transform the essence of the sperm into Chi. For women it means that they learn to regulate and control menstruation, thereby transforming blood into Chi. For healers, it is very important to learn how to transform sexual energy into spiritual energy. Because this original balance between love and sex, or water and fire contains in itself the essence of healing and creation. Self-transformation is a condition for being able to help others on the path of transforming sexual energy into spiritual energy. Once the energy in the Lower Tan Tien has become pure and strong, it will naturally ascend to the heart center, Middle Tan Tien.

When the Lower Tan Tien transforms negative emotions, a purer higher frequency energy arises and radiates from the heart. The state of compassion and of love as a high energy state is the fruit of the virtues of all organs. This should not be mistaken for the dualistic sentimental love that all of us have experienced temporarily and taken for a peak love experience at some time in our life.

The true godly nature of our being and our love starts radiating through our higher self connection in and from our heart center. In this state there is an abundance of energy, as the heart center is directly nourished by the cosmic light. In this state a deep oneness with people around us can be experienced.

This higher energy and awareness level allows us to help others while not losing energy ourselves. This **light of compassion** which is born from universal love can be cultivated and will gradually attract more pure divine light and spiritual essence.

This spiritual essence is attracted by the crystals (the glands) in our head at the core of the nervous system. This compact, spiral-formed spiritual center is also called the Upper Tan Tien.

In this process, the nature of our life changes and adopts a divine quality. The actions and directions you choose come from the laws of the universe and are no longer determined by animalistic behavior, emotional satisfaction or a drive for wealth and power.

The spiritual essence is gathered in the crystal body, a body that does not dissolve at the moment of death, a body that carries us to immortality.

The three step cultivation is a life long process of self cultivation that gradually takes us from the suffering of addiction and dependence, extreme emotions and ups and downs, into a life of freedom, spiritual independence and enlightenment.

The three step cultivation leads to:

- ☆ A healthy body and an abundance of life force.
- ☆ Control and balance on the emotional level and the growth of the **Compassionate Heart Center**. This compassion is raised by cultivating virtues and by good deeds and is stored in the soul body.
- ☆ When the soul body matures, it acts as a baby sitter to help nurture the spirit body.
- ☆ Body, soul and spirit are united deep into the Tan Tien, enlightening the person.
- ☆ The ability to share this light and wisdom with everybody around them.

Since the soul carries the seed of the immortal or spirit body within, the development of the spirit body is the condition for breaking through the law and the wheel of incarnation. When the three bodies are established and spiritual energy is dictating the quality of life, the practitioner can transform energy from the physical into the soul body and from the soul into the spirit body.

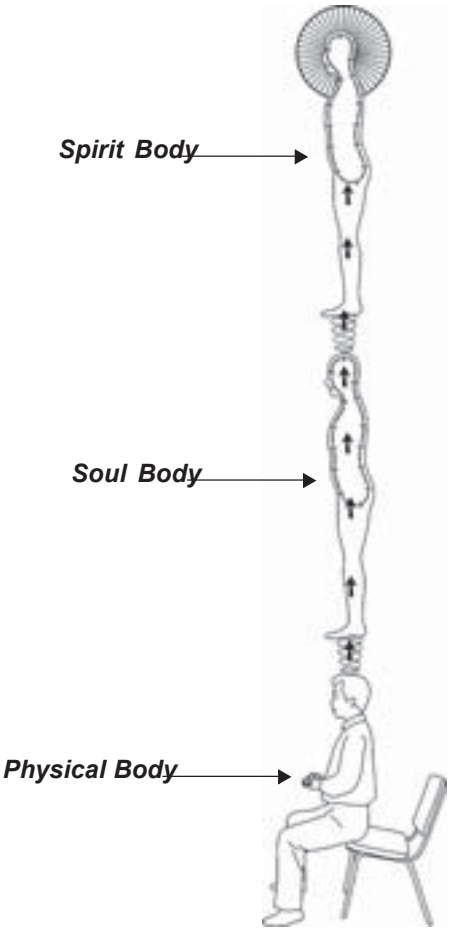

Fig. 1.9 *Three Bodies*

At the moment of death, the energy of the physical body will be partly or completely absorbed into the spirit body. This means that the physical body eventually dissolves. There are many records of Taoist masters who successfully dissolved their physical body rapidly into the spirit body, leaving only teeth, hair and nails.

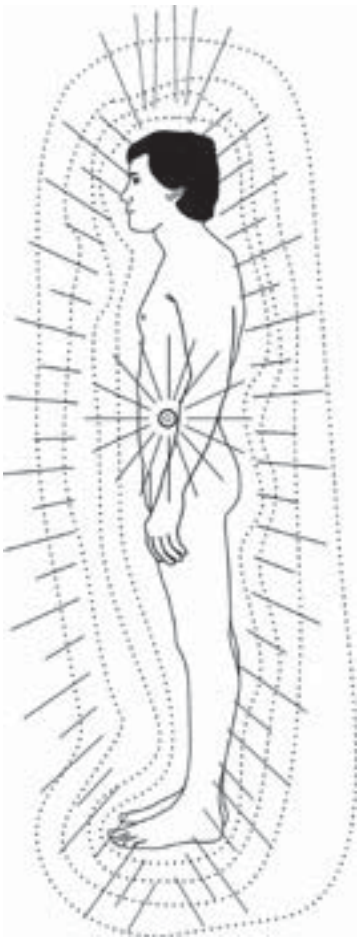

Fig. 1.10 *Pearl of Consciousness*

In the condensed state the soul body is kept as a pearl of consciousness with the spiritual essence deep inside. This consciousness center creates a bright protective awareness field.

Chapter II
Universal Tao Basic Practices and Preparation Exercises

Introduction

In the Universal Tao, we teach Cosmic Healing within a system of exercise and meditation. As a part of this system, Cosmic Healing comprises the art of healing oneself and others and focuses on energy work for projecting Chi. One can easily learn the simple movements of Cosmic Healing without doing any other Universal Tao practices, but if one truly wishes to master the art of Cosmic Healing, it is important to have a firm foundation in the basic Universal Tao practices. Therefore in this chapter we will introduce you to the basic Universal Tao practices that are used in conjunction with Cosmic Chi Kung.

The preparatory practice consists of a few parts. Work through each part at your own pace and eventually join them together as a whole.

Always start with **warming the stove** at the abdomen and direct the fire down to the Sexual Center to transform the sexual energy. Next practice the Cosmic Inner Smile. The Cosmic Inner Smile is a powerful relaxation and self-healing technique that uses the energy of love, courage, fairness, kindness and gentleness as a language to communicate with the internal organs of the body. Each organ is connected to a specific element and corresponds to a specific color, so that the kidneys are, for instance, connected to the water element and correspond to the blue color, whereas the heart is connected to fire and red, etc. This makes it very easy to guide the healing power into each organ by using the appropriate color. The practice also aids the transformation of negative emotions into positive energy. This transformation is a very powerful Chi Kung practice. A **genuine smile** transforms negative energy into loving energy that has the power to relax, balance and heal. By learning to smile inwardly to the organs and glands your whole body will feel loved and appreciated and enjoy more Chi. After the Inner Smile, practice Bone Breathing, Marrow Washing, Cosmic Healing and the Microcosmic Orbit.

Warm Up the Stove

1. Sit at the edge of a chair with your hands clasped together and your eyes closed.
2. Start with ‘bellows breathing’, moving your abdomen in and out quickly. Emphasize the exhalation by breathing out forcefully for 18 to 36 times. Rest, cover your navel and feel warm and nice.
3. Next do the “inner laughing” exercise, where you feel the abdomen vibrate inside you. Practice for a few minutes, allowing the movement of your inner laughter to grow

stronger. Then rest and use the mind and eye power to gather the Chi, now felt as a warm feeling behind the navel, into the Tan Tien. Picture a stove with fire burning behind your navel. Feel nice and warm.

Transform the Sexual Energy

Once you feel the Tan Tien warm enough, smile down and bring the warm Chi down to the sexual organs; women, down to the uterus; men, down to the testicles. It may feel like the sun shining on the water. The rays of the sun purify the water until it becomes steam and rises up high. Keep on smiling down to the sexual organs and feel the warm or fiery feeling from the navel area continue to flow down to the sexual organs, transforming the sexual energy into Chi. Raise the Chi up the spine into the brain; this will help activate the crown and mideyebrow.

Focus your awareness in the sacrum. At the very tip of the sacrum, the coccyx, there is a hole. Breathe into this hole until you feel some activity there. This may be felt as tingling, numbness or pulsing. If you can really activate this point it will have 'suction'. Be aware of the sacrum opening. Feel the hole in the tailbone (the sacral hiatus) having a suction-force; breathe into it until you feel it become activated. Once the sacrum is activated, you will very easily feel the suction and breathing in the cranium and mideyebrow also. Keep on gently smiling and softly breathing into the Tan Tien and feel the suction in the abdomen. Focus 95% in the Tan Tien and 5% in the sacrum, the crown and the mideyebrow. Be aware of the Tan Tien breathing and internally observe the pulsing and breathing in the sacrum, the mideyebrow and the crown. Do this 36 times.

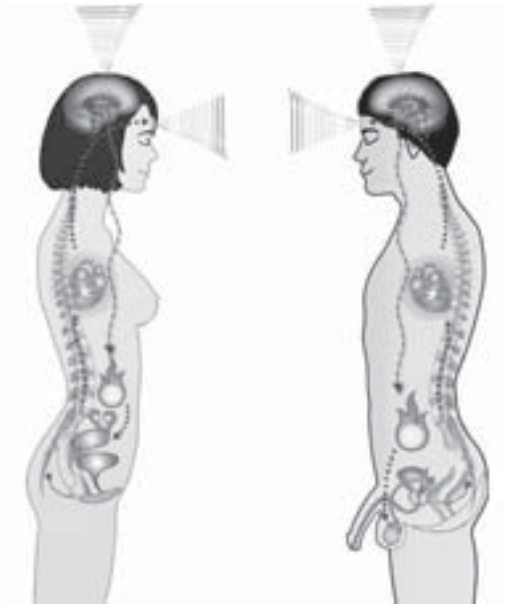

Fig. 2.1 *Breathing and pulsing in the sacrum, mideyebrow and crown.*

Cosmic Inner Smile

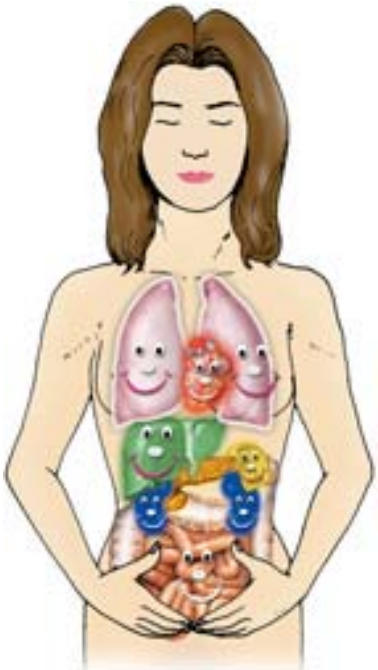

Fig. 2.2 *Smile down into the Organs.*

The Inner Smile begins at the eyes and the mideyebrow point and moves down to the heart. As you activate the heart, the loving energy will flow out and you will feel the energy of your Inner Smile flow down the entire length of your body like a waterfall. This is a very powerful and effective tool to counteract stress and tension.

1. Be aware of the **mideyebrow**, imagining that you are in one of your favorite places in the world, a place where you feel safe, relaxed and happy. Recall the sights you might have seen there, the sounds you might have heard, the scents, sensations and flavors that you associate with this place.
2. Imagine that one of your favorite people is standing in front of you, smiling to you with loving, happy, radiant shining eyes. **Smile** and slightly lift up the corners of your mouth.
3. Feel yourself responding to that special person's smile with a smile of your own. Feel your **eyes smiling** and relaxing.
4. Smile down to the thymus gland and picture a white flower blossoming. Gently inhale into the **thymus gland**, connecting your breath to the olfactory organ. Smell the good fragrance.
5. Aim your inner attention at your heart, picturing the image of the heart before your inner eye and smile to it. Smile until you feel the **heart smile** back to you. Picture your heart like a red tulip, gradually opening. This will activate the love and fire of compassion in the heart. Once you feel the red light and loving awareness it will activate the

cosmic **red healing light** or mist from above and around you.

6. Smile at the light or mist and very slowly, with a soft, long, deep breath draw the red mist, **love and compassion** into the mideyebrow, down through the mouth and throat, into the heart and gradually overflowing to the small intestine. Exhale, but retain the red light and the love and compassion in the heart and small intestine. At the same time exhale the cloudy, black or negative energy which holds hate, arrogance, heart-breaking traumas and irritation. Keep on doing this way of breathing for 18 to 36 times. Breathe until the heart becomes bright red before your inner vision and starts to radiate out to the tongue, mouth, nose, ears and eyes. Allow the red light to whirl around you and form a **red aura**. Feel your skin glowing with red energy.
7. Let the heart's loving energy radiate out to the lungs. Aim your attention at the lungs, picture the image of the lungs before your inner eye and smile to it. Smile until you feel the **lungs smile** back to you. Picture your lungs like a white flower, gradually opening and smell the good fragrance. This will activate the courage in the lungs. As soon as you invoke the white light and the courage into the lungs, you will also activate the cosmic **white healing light** or mist from above and around you.
8. Smile at the light or mist and very slowly, softly take a long deep breath and draw the white mist into the mideyebrow, the mouth and down to the lungs, gradually overflowing into the large intestine. Exhale but retain the white light and the feeling of courage in the lungs. At the same time exhale the cloudy, black or negative energy. Keep on doing this kind of breathing for 18 to 36 times. Until the lungs become bright white and start to radiate out to the nose, ears, eyes, tongue and mouth. Invite the white light to whirl around you and form a white aura covering your skin like autumn dew.
9. The **liver** and gall bladder connect to the green color of the wood element. Kindness replaces anger, which is expelled on breathing out. Do the same as above and create a green aura around you. Exhale the dark, cloudy heat. Inhale the **nourishing green** of the forests. Do 18 to 36 cycles, until the green light has completely filled the liver and starts to radiate out to your eyes, tongue, mouth, nose and ears. Invite the green light to form a **green aura** around you.
10. The **spleen**, pancreas and stomach correspond to the yellow color of the earth element. Connect to these organs and smile down into them from the mideyebrow. First connect to the heart, then attract the clear yellow light from above and around you. You might see the golden yellow aura of a wheat field ready for harvest. Expel feelings of worry; exhale the cloudy, sticky energy. Breathe in the golden yellow aura, filling your Spleen Center with **golden yellow light**. Repeat to complete 18 to 36 cycles, then allow the light to radiate out to your mouth, nose, ears, eyes and tongue. Wrap the **golden aura** around you, leaving a golden shine on your skin.
11. The **kidneys** and bladder correspond to the blue color of the water element. Gentleness is contained within the **blue healing light**. Inhale the blue aura into the kidneys. Expel feelings of fear or stress on breathing out. Allow your energy field to expand, breathing in and out the blue energy for 18-36 times, until it starts to radiate out from your kidneys to your ears, eyes, tongue, mouth and nose. Gather the blue mist on your skin, enveloping you with a **blue aura**.

12. Smile down to the **sexual organs** and reproductive system. Feel **love and the energy of sexual arousal**, the heart and sexual organs coming to union. Observe how this process transforms the sexual energy into Chi. Channel down pink and red light to the sexual organs. Thank them for their work in keeping you healthy and for giving you life force and creativity.

Cosmic Star and Earth Star

At the moment of conception, the two forces yin and yang connect with such a force, that only fractions of a moment later, the two forces explode into nine different energy centers. Seven of them we find in the body and two of them outside the body, forming our Personal Stars.

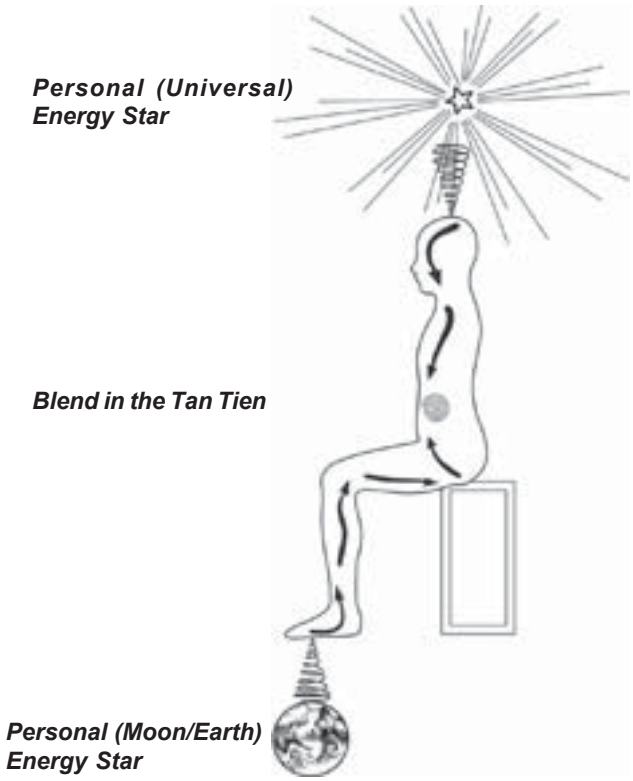

Fig. 2.3 *Personal Stars*

The two Personal Stars are in fact energy centers connecting the auric field of each individual with the universal forces and the earth forces. In a way one can see the aim of the Taoist Inner Alchemy in bringing these nine forces together, merging them in one force and thus, enabling them to return to the original force, the Wu Chi.

There is a star about 6 inches above your crown and 1 to 3 feet below the soles of your feet, also known as the higher self, guidance, protector, advisor. These stars are our connection to the cosmic force, the universal force and the earth deep below us.

Always make sure your Tan Tien is warm and the sacrum, cranium and mideyebrow are breathing. Be aware of the crown breathing and see a star or a small sun above you. Feel a light beam extend out of the crown and make a connection to the star above you. Keep on breathing until you feel a strong connection. Feel how the star above you is exercising a strong pulling force on your crown. Once you feel the pull on your crown you will also feel a strong pull down from the ground. Be aware of the star above and the earth and universal force below you. Feel that both of them have a strong 'pull' on you.

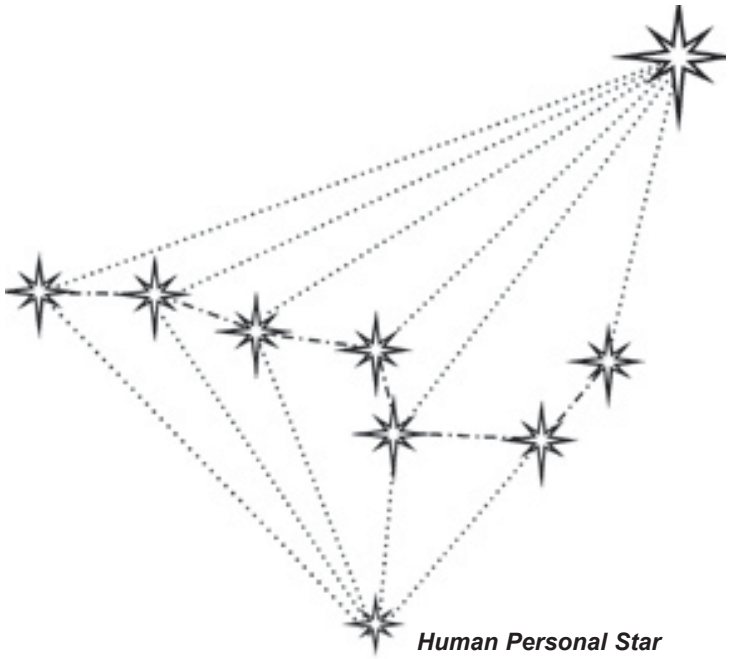

Fig. 2.4 *North Star, the Big Dipper and Human Personal Star*

In Taoism we consider the North Star as emitting a violet light (which is regarded as the highest healing light) and the Big Dipper as emitting a red light.

You can do these meditations sitting, or standing in the Chi Kung postures. The standing position will provide a stronger structure and allow for a better connection with the earth through the feet.

1. Reconfirm the star above you and the earth directly below you.
2. Fix the image of the North Star and the Big Dipper six to nine feet above your crown. See the cup of the Big Dipper filling with the violet light, which gathers Chi from the North Star and the universe.

3. Reach up with your right hand, and hold on to the handle of the Big Dipper. Pour the violet light down to your Personal Star 4 to 6 inches above your head, in order to predigest the energy of the violet light. Then let it flow down to your crown, into the Upper Tan Tien, to be processed and flow down to the Heart Center (Middle Tan Tien) or to the back of the head down to C-7 (Cervical 7) and T-2 (Thoracic 2) and down to the palms.

Fig. 2.5 *North Star and Big Dipper connecting with the Crown.*

4. Always remember to breathe in slowly so you can process the awareness of the Lower Tan Tien. Feel a suction, warmth (Chi) and continue to breathe in and be aware of the suction of the Crown, North Star and Big Dipper above you.

Fill the Joints with Chi

The bones have the ability to process cosmic Chi (Chi above and around you) to be used by your body. The joints are also able to store Chi which serves as a cushion between the bones.

1. Be aware of your index fingers and thumbs. Feel Chi enter the fingers and the joints; this will make them tense and stiff. The stiffness and tension come from the Chi filling in the joints and pushing the fingers to become longer. Keep all fingers tense with Chi and slightly raise the index fingers and open the thumbs to the sides. Feel the thumbs tense. Breathe into the fingertips, until you feel the sensation of Chi entering the fingers. Continue to breathe in the Chi and the stiff feeling will go from the fingers to the wrist, elbow and shoulder joints, making the whole area tense and stiff, so the fingers and the arms become one piece. Chi will gradually fill every joint of the body and make the whole body become one piece.

2. Be aware of the big toes, breathe into the toes and feel the toes grow longer. When the Chi fills the joints, the big toes become tense and stiff. Gradually it will fill the other toes and the feet and come up to the ankles, knees, femur bones and hips, until it reaches the sacrum and the spine. A sensation of numbness or an electric charge will start to flow up your legs. The legs and the spine become one piece.

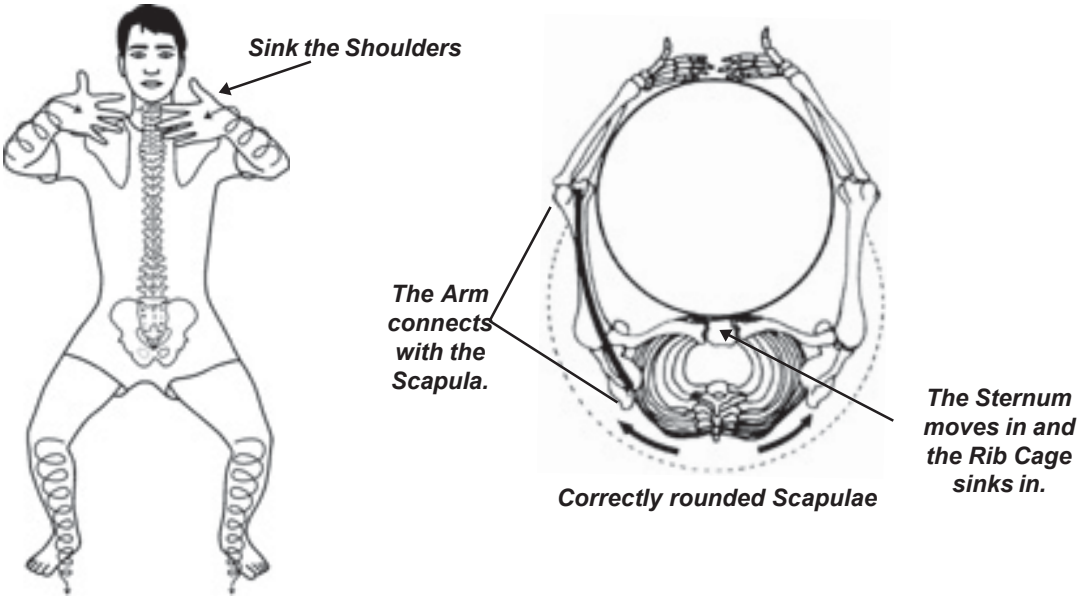

Fig. 2.6 *Bone Structure*

Bone Breathing and Marrow Washing

Bone Breathing is one of the main practices of the Cosmic Healing Chi Kung practice. This is a method of drawing external Chi through the skin into the bones to help regrow and replenish the bone marrow, thusly assisting in the production of white blood cells. Sending Chi into the bones will therefore enhance the immune system. This process also helps to clean out fat in the bone marrow ("Washing the Marrow"), one of the main causes of osteoporosis (brittleness of the bones). Tension in the muscles close to the bones is decreased so Chi and blood can flow into them easily, and the bones themselves become strong.

The Bone Breathing process uses the mind and the eyes to absorb Chi into the bones. The better your Bone Breathing is, the better your Cosmic Healing Chi Kung practice will be. Mind and eyes are also used immediately after the exercise to gather the energy at the navel. Once you have it, when you move your hand, the energy will follow easily. You will be able to absorb external Chi effortlessly, so you will not need to use your own energy in your healing work.

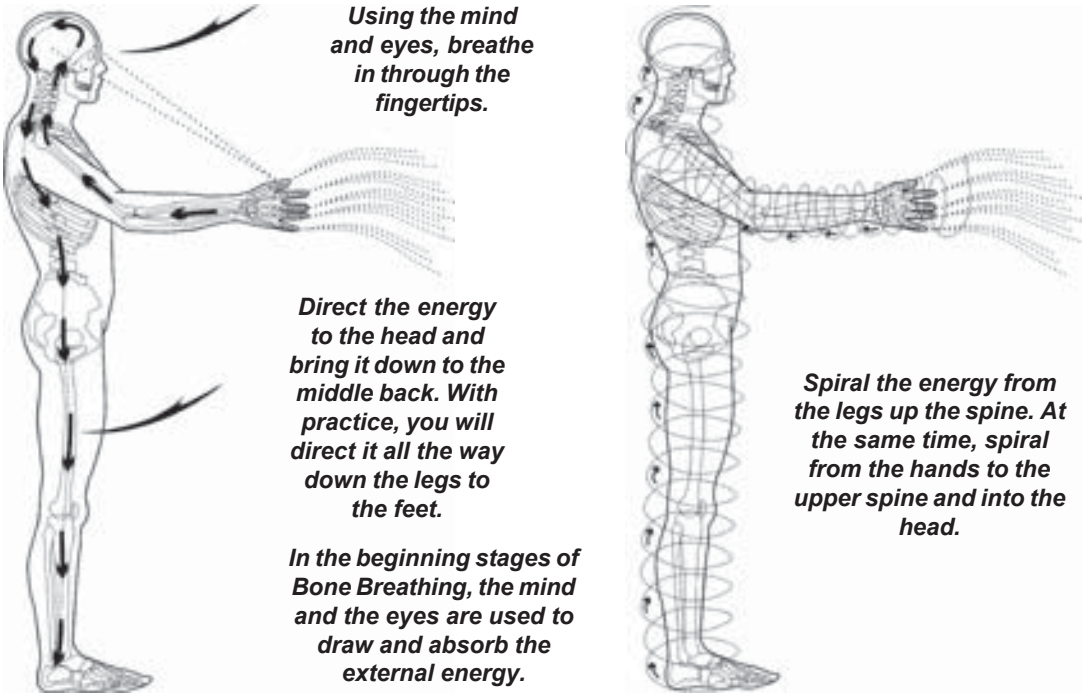

Fig. 2.7 *Bone Breathing through the Fingers*

Bone Breathing

There are several variations in the Bone Breathing and Marrow Washing process. Here we will introduce you to the first type of Bone Breathing, inhaling and exhaling Chi through the skin and packing it into the bones. In this method, you imagine that your bones are like hollow bamboo tubes and that you are breathing and drawing the Chi into them.

Bone Breathing is practiced in a three-stage process. Let your breathing follow a normal pace. Do not strain or hold your breath too long.

1. You can do this practice in the sitting position or in the Embracing the Tree posture (or any other Iron Shirt Chi Kung posture). You will use your mind and eye power to breathe in a short breath and at the same time feel suction. Suck the Chi of the atmosphere into your hands, eventually expand to the universe, breathe in a few times more. Use a combination of mind/eye/heart power (Yi) to suck the Chi from the atmosphere into your hands, while taking small sips of breath. **Smile.** Once you can clearly feel the increase of Chi-pressure in your hands, you extend the feeling throughout your arms, having the whole skin surface of the arms breathing in the Chi. Feel the skin hold Chi pressure.
2. Inhale one more deep breath and lightly contract the arm muscles to squeeze the Chi into the bones, hold for a while, condensing the Chi into the marrow of your bones. Exhale and at the same time, feel a distinct heaviness in the bone, meaning that the

Chi has been condensed and packed into the bones. Eventually you will use more mind power (mind/eyes/heart power) and less muscle and use soft breathing, to draw the force into the bones. Do this 6 to 9 times; rest and feel the Chi having been condensed into the bones.

3. Proceed in the same way, breathing in progressively through the bones of the forearms, upper arms, scapula, collarbone, sternum and ribs. You may feel a different sensation as you breathe in each area (in some areas the feeling is cool, in others warm or tingling depending on the bone structure and the quality of the marrow).
4. Inhale and exhale in the same way through the legs and then, in a step-by-step progression, inhale up through the calf bones, thigh bones, pelvis, coccyx and sacrum and up the spinal column to the C-7 vertebra.
5. Finally breathe in through the arms and legs simultaneously. Combine their energy as it flows up past C-7 and up through the neck and into the skull. Breathe in this way for at least nine breaths. Conclude by collecting energy at the navel.

Marrow Washing

You can wash your bone marrow with earth force, heavenly force or with cosmic force. This energy helps to cleanse and rejuvenate the bone marrow.

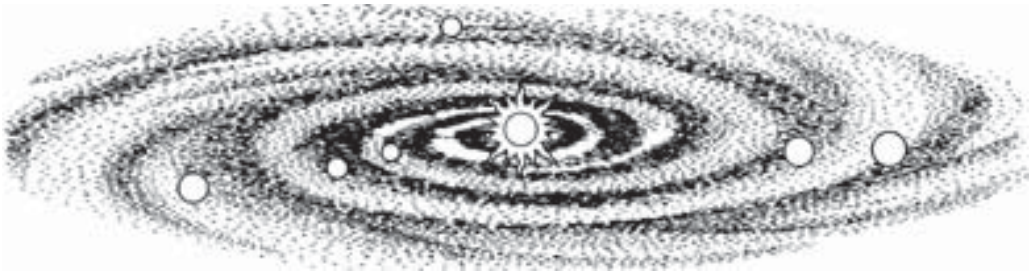

Fig. 2.8 *Star and the Direction of Spiral*

Heavenly Force Marrow Washing with Violet Light

1. Men place the left palm on the top of the head and cover with the right palm. Be aware of your Personal Star above. Slightly press the palms and spiral in a clockwise direction, meaning to spiral from the front to the right ear, to the back and the left ear for 9 times; rest and feel the increased Chi pressure in the crown. Do 3 sets.
2. Women place the right palm on the top of the head and cover with the left palm. Be aware of your Personal Star above you. Press the palms lightly and spiral in a counter clockwise direction, meaning to spiral from the front to the left ear, to the back and the right ear for 9 times. Rest and feel the increased Chi pressure in the crown. Do 3 sets.
3. **Smile**. Raise the arms, palms facing toward heaven and scoop the galactic Chi into a ball above your head. This Chi ball contains the North Star and the Big Dipper. See the Dipper cup fill with violet energy. Imagine you reach out your arms to hold the Dipper handle and pour the violet liquid over your crown. It will feel as if there is a numbness

descending down. Your palms face down now to empty Chi and the whole galaxy down into your crown. You may perceive this energy as a violet amethyst and red light frequency.

Fig. 2.9 *Your Hands scoop up the whole Universe through the North Star and the Big Dipper.*

4. Guide this sensation down to your skull, deep into your brain, sternum, cervical vertebrae, thoracic vertebrae, lumbar vertebrae and down through your legs. Feel it penetrating and enlivening your bones, deep into the bone marrow, washing, cleansing, energizing.

   This liquid like Chi spills all the way down to your feet. Feel it connecting with the earth through the soles of your feet; be aware of the bubbling springs (the K1 point of the kidney meridian) breathing and pulsating.

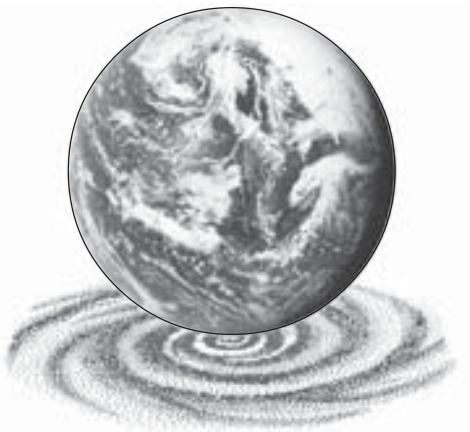

Fig 2.10 *Earth Force Marrow Washing Yellow Light*

1. Touch your navel with the fingers of your hand. Focus on the door of life and let the fire activate in the Tan Tien and kidneys. Chi will rise up to the brain.
2. Move your hands down touching your femur bones, feel your hands penetrate into the bones and into the bone marrow. It will feel like an electric shock, or tingling is moving all the way down through the bones of the legs and down to the soles of your feet.
3. Slowly move your fingers down touching the bones and the bone marrow until you are squatting with the heels touching the earth. Move your intention down through the earth to touch the universe on the other side. Raise your sacrum up and picture yellow light coming up from the earth and the other side of the universe, focus on the Lower Tan Tien and feel it fill with Chi. Do this three times.

Fig. 2.11 *The Hands circle to Gather Earth Chi in Squatting Position.*

4. Palms face down to the earth. **Smile**. Be aware of the galaxy and the yellow light, make three to six circles to gather the Chi below. Gather the yellow Chi to touch your heels and feel the yellow Chi rise up the leg bones. Feel it bubbling, like electric currents running up through the bones of your feet, tibia and fibula, femur, pelvis and spine. While touching your bones and bone marrow with your fingers, slide your hands along the whole route on the back of the legs, slowly coming all the way up to touch the coccyx and the sacrum. Concentrate on your Sexual Center so the energy will flow and spread out to the sexual organs. Go back to the navel and gather the Chi into your Tan Tien.

Source of Chi and Color

There are different sources of Chi in the universe. Cosmic (air), nature, earth and human to name a few. In humans, each part of the body has a different kind of energy and these energies correlate directly with the universe and nature. Each part of our body, organs and glands can produce, receive, transform and emit different types of Chi.

Earth Chi

While Cosmic Chi (the atmosphere over us and the universal force) is ethereal in nature, what is called earth chi is not. This Chi appears as the line visible above the horizon when the sun is low in the sky, and seems to hover just above the ground. It actually also sinks into the ground.

Earth Chi contains yellow and some white Chi. Earth and cosmic Chi, when combined, have a very powerful healing reaction in the body. It is very balancing and mild. When treating a problem, white Chi, in the proportion 7:3 (7 white to 3 of the selected color) acts as a brake on colors which are hot or too active. This enables the body to take in Chi more easily.

Simple Practice:
During and after sunrise (and before sunset) look at the edge of the sky and the earth. Stand still and extend your palms toward the sun, **smile** and absorb the colors in to you.

Human and Nature Chi

This Chi is derived from all the things we can see on the earth. In Cosmic Healing, we use energy from the mountains, lakes, oceans, forests, caves, valleys, rocks and precious stones. The Taoists classify the elements into five forces: earth, metal, water, wood and fire. There are five elements in our body, in nature, in the cosmos and in the universe.

According to Taoist tradition, once we make the connection to ourselves and control our internal bodily elements, we will quickly make connections to nature and the universal forces and employ them easily.

Solar Chi

Before sunrise or sunset there is more white Chi in the air which we can use abundantly for health and healing. White Chi affects the lungs and the large intestine, so we direct this Chi to these organs. This will generate further Chi to maintain our daily activities. White contains all the colors of the rainbow or spectrum.

Special Note: Many of the color references came from the following books: *"Let There be Light"* by Darius Dinshah and *"Advanced Pranic Healing"* by Master Choa Kok Sui.

Sun Essence

The best time for practice with the sun is at sunrise and sunset, when its glare is not too strong for the eyes. The sun spectrum from sunrise to 9 a.m. is violet, and can be used for all organs, especially for spiritual work. You can select any color that you need.

9-11 a.m. is blue and can be used to strengthen the kidneys.
11 a.m.-1 p.m. is green for the liver.
1-3 p.m. is orange for sexual energy.
3-5 p.m. is red for the heart.

Seasonal Sun Practice

You can **emphasize** practice of the sun 'spectrum' inside the organ that corresponds to the season and its color;

Winter in the kidneys, blue.
Spring in the liver, green.
Summer in the heart, red.
Fall in the lungs, white.
Indian summer in the spleen, yellow.

Absorbing the Breath of the Sun in the Four Seasons

In Spring, absorb the orange Chi of the sun *before* it sets. In fall, absorb the orange twilight Chi of the sun *after* it has set. In Winter, absorb the white vapors of midnight (sun shining on the moon). In Summer, absorb the perfect clarity of the meridional sun of midday (protect the eyes during midday sun absorption). Breathe each in deeply.

These four types of breath, in addition to the blue breath of heaven and the yellow breath of the earth, are called the **six breaths.**

Sun Practice

1. Practice with the sun during and after sunrise.
2. Start with the Inner Smile, 'Warm the Stove' and make the navel warm.
3. Be aware of the mideyebrow. **Smile** into your eyes. Make your eyes cool and soft.
4. Open your eyes, look at the sun and keep on blinking the eyes. Close your eyes for a while. The eyes should be facing the sun. (You might see a purple reddish and yellowish color). Select the yellow and breathe it in through the crown and mideyebrow and into the nose, eyes and mouth (mouth closed, but feel the color penetrate into it). Feel the bones in your skull, the brain and the bone marrow. Absorb the yellow spectrum to wash and help grow healthy marrow. Let this ray penetrate down to the neck. Some might feel numbness, like a wave penetrating deep into the bone marrow and each cell of the body.
5. Let this ray go down to the sternum and the rib cage and feel it activate the thymus gland. This will help to strengthen the immune system.

6. Let the color flow down to the spine and feel numbness, tingling or warmth in the interior of the bones. This feeling may spread out to the organs. Let it go down to the hips and sacrum. Feel that the bones and the bone marrow have been activated and let the Chi descend to the bones of the legs and feet. The sun practice can produce the effect of a cosmic baptism. Feel the sun's ray baptize your whole body.
7. Rest and let the body absorb all these cosmic nutrients.
8. After you practice, look at the sun; single out the colors and picture the organs and see the organs glow with their relevant color.

Follow with the Seasonal Sun Practice (previous page) for the relevant time of year. During fall, picture the white color in the lungs. Look at the sun, blink the eyes, then close the eyes; select the white color and breathe into the lungs.

Winter into the kidneys, blue rays.
Spring into the liver, green rays.
Summer into the heart, red rays.
Indian Summer into the spleen, yellow rays.

Sun Essence Captured in Water

The essence of the sun is captured in water by exposing the water to sun from sunrise to 9 a.m. This is for absorption of violet, which can be used for all organs and especially for spiritual work. The time from 9-11 a.m. is for the absorption of blue and can be used to strengthen the kidneys; 11 a.m. - 1 p.m. green for liver; 1 - 3 p.m. is orange for sexual energy; 3 - 5 p.m. is red for the heart.

A special water can be made on the first fifteen days of the month in which the sun comes to the Golden Door. This water is called "Mineral Light Mother of Waters".

To capture this sun essence, put purified rain or spring water in a sterilized bottle out in sunlight during the corresponding phase of the spectrum for one or more days.

You can drink the water, make herb tea or mix with food or medicine.

Solstice and Equinox

Taoists believe that the sun stops in its movement on the first day of each season. The moon stops on the days of the equinoxes and solstices. These stops are called "Doors". It is the "Golden Door" in the spring. This is the door of access to the sun. In Autumn it is the "Eastern Well", this is the door of access to the moon. The next stage is "Universal Yang" in the middle of summer when the sun culminates. "Great Cold" is the culmination of the moon in winter.

Symbolically, it is thought that the practitioner goes to be received by the Lord that grants the fruits of immortality. Gathering the sun essence at the "Golden Door" is done on the 3rd, 9th, 17th, 21st and 25th of the month in which the sun enters at the Golden Door. The exact same practice is done for the moon when it reaches her door. The days for gathering the moon essence are the 3rd, 15th and 25th.

Healing Colors

Blue Chi

The effect of blue chi is one of cooling, and hindering similar to yin or water energy. The opposite effect can be obtained with the use of red Chi. When we draw energy down, some people's bodies can't adjust to it immediately, so using blue Chi is always good. 'Water blue' is the one element that always brings harmony and does not cause any harm.

Pain and swelling can be treated with cool blue Chi, and an abnormal temperature can be reduced. Sleep and relaxation can also follow a treatment with blue Chi. Blue assists the blood in the clotting process, and, because of its association with the watery yin element, can remove Chi which is dark and negative, by flushing it out of the body.

Green Chi

Green Chi is mild and safe. To free up and flush out diseased material in the body, use green Chi. It has a 'loosening' effect on the ailment. Once loose, you can use the orange Chi to expel the disease. Negative energy can then be removed by localized sweeping, either through the arms or through the legs.

If you need to energize the organs, first energize with light green Chi. Cancerous growths can be treated with both tangerine and green Chi which is dark in color.

One should use green Chi before using orange. Pale tangerine and green chi should be used at the same time to increase their effectiveness in dealing with hard to remove deposits in the body.

Always use green Chi before colors of tangerine, purple or red.

"sick" energy which is difficult to remove can be dispersed using pale green Chi, then driven out of the body with pale tangerine.

To remove infection and toxins and disperse dead cells, green Chi can be employed. It is also helpful in getting rid of fevers and colds and in dispersing clots in the blood.

White Chi

The color of the chi from the air, earth and sun is always white and acts as a calming agent for the surplus chi produced by the other colors. It also redirects this Chi to areas of the body which need it. For this reason, use white in combination with another color in the proportion 7:3.

Experiment with blending white Chi with other forces:

Shining white Chi should be concentrated at the center, while colored Chi goes to the edge. This can also be reversed. It is also possible to blend the white and colored Chi together.

It is safe to use white Chi when you are not sure which color to use, especially when treating babies and toddlers or the elderly and the weak. People with minor problems can be treated with blue, green or mauve, while gold colored Chi or mauve/white Chi is better when the problem is serious.

White red has a stimulating and strengthening effect.

We have a soft violet and a very strong violet in the North Star. You can dilute these colors with white.

When it becomes necessary to switch from one color to another, an abrupt shaking movement of the hand should ensure a smooth transition to a new color.

Red Chi

Cerise Chi makes the area to which it is applied stronger, while crimson Chi has the opposite effect. When using color for healing, project luminous white in the center and cerise at the edges for a strengthening effect.

Cerise/white: Is useful for those with heart or breathing problems such as asthma as it opens the blood vessels and airways.

Cerise/white Chi, because of its ability to open blood vessels and air tubes, is particularly good for people with heart or breathing problems such as asthma. It also helps improve the flow of blood around the body and has a strengthening effect on the internal organs and weaker areas of the patient's body. If the patient has too much cold energy, this color can help to reduce it and also to drive out toxic and unwanted substances along with 'sick' energy. Allergy suffers can benefit from this color, and those who are unconscious can be revived, while the dying may live a little longer after its application.

Avoid the use of dark colors, which may cause an adverse reaction. Treating of sexually transmitted diseases with crimson chi is not advised, because this chi can result in swelling or tightening. It also encourages the proliferation of disease causing microbes.

Tangerine Chi

If you need to use the Tangerine Chi, you should first use the blue Chi to cool and calm the treated area. Because tangerine Chi has a lot of power it is better to use it in a diluted form by mixing it with white, and also not to use it on areas such as the spleen and spleen center, heart, eyes, head area or the throat. The large intestine benefits from the use of tangerine Chi, but this color should be used sparingly on areas like the solar plexus and navel. Appendix problems should not be treated with this color as it could exacerbate the problem. Tangerine chi has an effect on the bowel, and can also aid in returning an unconscious person to consciousness or in stimulating someone who is dying. To treat cancers of certain types, dark green and dark tangerine are suitable because of their ability to destroy.

Tangerine Chi:

- Forcible removal of waste products, toxic substances, 'sick' energy, viruses and bacteria
- Menstrual difficulties
- Waste elimination problems
- Freeing up 'sick' energy
- Breakdown of clots in the blood
- Problems of the urinary and respiratory systems
- Diseases of joints and connective tissue
- Common cold
- Problems caused by allergens
- Cysts

Yellow Chi

Yellow Chi has a close connection to the nerves, bones and the bone marrow. Yellow is also the color of the spleen. The spleen is involved in the assimilation of food and the appetite. So, when the spleen is balanced, the appetite will be controlled.

The effects of yellow chi are those of repairing – bones, skin, cells, nerves (by causing re-growth) and a general beneficial effect on the organs, bones and tissues.

Ordinary and Luminous Violet Chi

Comes from surrounding Chi: air, earth, solar energy and from the higher self, soul, crown point, North Star and Big Dipper, Divine or soul energy.

Bright purple chi has a much greater force than purple chi because it contains all the characteristics of the other colors and can help fast re-growth when organs or nerves are affected.

For cancers and other tumors, luminous dark purple Chi is suitable.

It develops the crown center, spiritual essence and core.
Good for psychological ailments.
There is more information about this light in Cosmic Healing I.

Internal Organs Chi

This Chi is manufactured by the body daily and is readily available. It is good to mix it with universal or cosmic Chi for healing.

A brief word about detoxifying organs' Chi. Before we can effectively use organs' Chi, we must be sure that it is healthy. Many of the organs hold excess negative emotional Chi. We call this an emotional link. Many diseases are caused by emotional links. People use psychology to deal with such problems and it can work to a certain level, but the energy tends to jam up in the organs if it is not released.

Commitment is of course necessary for successful practice. If you are teaching, tell your students that the **Inner Smile** should be done every day; also to contract the pelvic floor muscles 9-18 times, until they feel the energy radiating upwards. This will help strengthen the major organs. It is alright to insist that if they don't do the Inner Smile and toning up the body every day, they will not heal. If they do commit to doing some daily practice and they come to you for work on their energy field, you will be able to help. Using Chi, color and mind power helps to improve the organs.

Cosmic Healing works very well with Chi Nei Tsang (Chinese Internal Organs Massage). Cosmic Healing will do what it can. Chi Nei Tsang and the Universal Tao practices will do what they can. You have to allow the practices to take care of themselves, as the **Tao begins to flow through you.** Allow yourself to heal. When you combine the above practices you will open yourself to the forces of nature and the Divine.

The person you are treating should be under the supervision of a medical doctor. Such supervision is especially necessary with serious physical, emotional and mental disorders. The patient should have a balance between the prescribed medicine and the work with the Universal Tao. The doctor should be advised of what we intend to do with the patient.

When working with improving organ health, the major point is to draw in white Chi, breaking down red, orange, yellow, green, blue, and violet; then distribute it to all of the organs.

Ming Men Chi

Yellow, pelvic organs.
Kidney power: Regulates blood pressure and is good for increasing low vitality and aiding back problems, internal root of the meridian system and healing for prenatal traumas.

Solar Plexus and Liver Chi

It is very important to use the Inner Smile when using this Chi. The solar plexus is very strongly connected to the liver which is also a very strong emotional center. A lot of emotions (cloudy grey in appearance) get stuck in the solar plexus.

Navel Center Chi

Yellow, some violet - increasing original Chi - helps to circulate Chi in the meridians. Good for small and large intestines, constipation, loose bowels, inability to assimilate food and nutrients and aids in raising overall vitality.

Heart Center Chi

Golden and red Chi. The thymus gland and defense system. Energize the Heart and Lungs Center through the back of the Heart Center. The heart is the seat of compassion.

Throat Center Chi

Green for thyroid, parathyroid, lymphatic system, sex center, asthma.

Mideyebrow

Yellow and violet for pituitary, endocrine system, eye problems, cancer.

Forehead

Light violet for pineal, nervous system, cosmic consciousness.

Crown Center

Violet and golden for entry point of Divine energy.

Spleen Chi

Yellow: The spleen connects to the solar plexus and the navel. It is the major center that connects to all the organs. Holding solar energy or a white ball at the solar plexus will help distribute Chi to all the organs.

If the solar plexus gets clogged, the liver and spleen will be blocked as well. The spleen is linked with the 'Door of Life' (point opposite navel on the back) and the navel.

The spleen (located at the left side under the rib cage) can take in the white Chi and absorb it directly through the front or back, the spleen center or the navel area. The Chi will be broken down into color and distributed to other centers and to the organs.

If the spleen area is not clean, the immune system suffers and diseases of the joints and connective tissue promoted, along with blood full of impurities and bone problems.

Basic technique to improve health, reduce tension and reduce aging.

Green or blue light mixed with white. Localized sweeping of the front of the solar plexus 30 times counterclockwise, guiding dirty Chi to leave the organs. In other words; counterclockwise sweeping motions to move energy.

Brush locally in the areas of the solar plexus, liver, stomach and pancreas, using blue Chi.

Use white to bring energy to the brain, crown point, forehead and the back of the head.

Use white to brush the lungs and the heart, both front and back.

Brush the kidneys, lower abdomen, spine, and the front and back of the spleen with white.

Brush the sexual center using white Chi and use it for the sacral area too.

Brush the arms, hands and the legs and feet with white Chi.

After a session, patients who are particularly weak should not bathe for one full day. The energy which has been put into their bodies can thus be kept there by application of pale blue/white Chi at the end of the session.

Eye Problems

Use green and yellow.

Constipation

Use yellow and orange for the large intestines, diaphragm, liver, pancreas, stomach, heart lungs and energize the pancreas through the back of the solar plexus. When the intestines are exhausted, they can be revitalized at the solar plexus center.

Use Compassion, Love, Kindness

Microcosmic Orbit

The Microcosmic Orbit Meditation awakens, circulates and directs Chi through the Governing Channel, which ascends from the base of the spine up to the head and the Functional or Conception Channel, which runs from the tip of the tongue down the middle of the torso to the perineum. Dedicated practice of this ancient esoteric method eliminates stress and nervous tension, energizes the internal organs, restores health to damaged tissue, and builds a strong sense of personal well-being.

The Microcosmic Orbit is the foundation of Cosmic Healing practice. Each new practice is dependent upon the quality of your meditations and your ability to perfect the Microcosmic Orbit. In order to master Cosmic Healing, one must practice meditation daily.

The meditations in the Microcosmic Orbit 'system' also strengthen the Original Chi and teach you the basics of circulating energy. This enables the palms, the soles of the feet, the mideyebrow point and the crown to open. These specific locations are the major points where energy can be absorbed, condensed and transformed into fresh new life force.

Focus on the Lower Tan Tien (the area where the Original Chi is stored, between the navel, kidneys and sexual organs). Feel the pulsing in this area, observe whether this area feels tense or relaxed, cool or warm, expansive or contracting. Notice any sensations of Chi: tingling, heat, expansiveness, pulsing, electricity or magnetism. Allow these to grow and expand. Then let this energy flow out to the Navel Center.

Use your intention (mind/heart/eye power) to spiral in the point and guide and move the Chi. Let the energy flow down to the Sexual Center (the Ovarian or Sperm Palace).

Move the energy from the Sexual Center to the perineum and down to the soles of the feet.

Draw the energy up from the soles to the perineum and to the sacrum.

Draw the energy up from the sacrum to the Door of Life (the point in the spine opposite the navel).

Draw the energy up to the mid-spine point (T11 vertebra).

Draw the energy up to the base of the skull (Jade Pillow).

Draw the energy up to the crown.

Move the energy down from the crown to the mideyebrow point.

Touch the tip of your tongue to your upper palate; press and release a few times; then rest and lightly touch the tongue to the palate, sensing the electricity or tingling feeling of the energy flowing into the tongue. Move the energy down from the mideyebrow to where the tip of your tongue and palate meet.

Move the energy down from the palate through your tongue to the Throat Center.

Move the energy down from the throat to the Heart Center.

Bring the energy down from the heart to the solar plexus. Feel a small sun shining out.

Bring the energy back down to the navel.

Continue to circulate your energy through this entire sequence of points at least nine times. Once the pathways are open, you can let your energy flow continuously like a stream or river, without stopping at each point.

Conclude when you wish, by collecting energy at the navel.

Men: Cover your navel with both palms, left hand over right. Collect and mentally spiral the energy outward from the navel 36 times clockwise and then inward 24 times counter-clockwise.

Women: Cover your navel with both palms, right hand over left. Collect and mentally spiral the energy outward from the navel 36 times counterclockwise and then inward 24 times clockwise.

For more details of this practice please see the book, *'Awaken Healing Light' by Mantak Chia.*

Cosmic Inner Smile and the Six Healing Sounds

These are very important practices to make the connection between the organs, colors and the good virtue energy in each organ. The colors will help you to make the connection to the cosmic and universal healing power.

Red from heart
White from lungs
Yellow from the spleen
Blue from the kidneys
Green from the liver

Each organ has its own vital color and will radiate this color in abundance, as an aura for vitality, protection and healing. These colors are connected to the universe. Over a period of time, the power of each healing sound will help enhance the universal connection. Each sound will provide different healing power. The practices also help balance, refine and transform negative sick energy back to positive vital energy.

Iron Shirt Chi Kung and Bone Breathing

Iron Shirt Chi Kung and Bone Breathing are standing meditations. These exercises help you to become grounded and build good structure. They help you to take in greater force and connect to the earth force. In turn, this will help draw in the heavenly energy. The practices strengthen the body and enable it to contain a greater energetic charge. These abilities are essential prerequisites for handling increasing amounts of energy.

Iron Shirt Chi Kung also includes the art of Changing the Sinews and Washing the Marrow. Through these subsystems, you learn to absorb, store and discharge large amounts of energy through the tendons and bones. *These practices are outlined in detail in the books, 'Iron Shirt Chi Kung I and Bone Marrow Nei Kung' by Mantak Chia.*

To attain skill in Cosmic Healing, it will help if you practice the meditation above as a minimum requirement. If you already have other Chi Kung or meditation practices they will also be beneficial. Beyond this basic level, the Universal Tao System includes many other intermediate and advanced Chi Kung practices and meditations. The further one advances, the greater one's mastery of Chi.

Your increasing level of skill in the Universal Tao System will reflect immediately in your Cosmic Healing practice. Furthermore, you will discover that you can incorporate many of your Universal Tao practices directly into your practice of Cosmic Healing.

Activating the Six Directions and the Three Fires

This powerful energetic technique allows one to extend the mind, to touch the force, and to draw that energy back into the body.

The Six Directions teaches you how to expand your mind and chi for receiving healing power. By practicing the Six Directions daily this will help you increase your healing and cosmic power. Turn your mind and Chi into the cosmos, multiply them and draw them back.

Direction Below

When you achieve the three minds into one mind and expand into the six directions, press your hands down and start with the low direction. Picture yourself standing on the earth and expand yourself very far away – deep down into the earth. Very, very deep down into the earth. Your hands become very long; your feet become very long — they go all the way down into the earth and out past the galaxy below on the other side.

Push. When you push, connect with the galaxy below — pull and think about your Tan Tien filling with Chi. Push and pull. Push and pull. Fill your Tan Tien with Chi.

A. ***B.*** ***C.***

Fig. 2.12. A. *Hands expand through the Galaxy.* ***B.*** *Hands push forward and pull back.* ***C.*** *Smile to the Primordial Chi from Universe back to the Lower Tan Tien.*

1. Stand, feet together. Put your hands down, parallel to the ground. Expand your hands very far away and your mind very far away, touching the ground. Continue expanding your hands, feet and your mind very far away beyond the earth below. Go down through the galaxy, way beyond to the primordial force. It's just like you are extending all the way to the primordial force as it was about 30 billion years ago.
2. Push, moving the hands forward six inches only.
3. Pull, moving the hands back by the sides. Think about your Tan Tien and feel Chi coming to the primordial force in your Tan Tien. Smile to your Tan Tien, dark, deep and vast.
4. Push: touch the primordial force in the universe.

A. ***B.*** ***C.***

Fig. 2.13: A. *Primordial Forces enter the Lower Tan Tien.* ***B.*** *Activate the Tan Tien Fire.* ***C.*** *Fire burning Under the Sea.*

5. Pull back the dark primordial forces with your hands to your Tan Tien.

Push and pull: It's just like you go to an empty space – vast. Then you come back to your Tan Tien – also empty, just like the primordial condition before anything existed.That is where all the forces come from. Push and pull 3 – 9 times.

Front Direction and Tan Tien Fire

Next, be aware of the front direction; a huge fireball appears in front of you. Open your palms: scoop up the Chi, scoop up the fire. Bring the fire into your Tan Tien. Activate the Tan Tien Fire.

1. Start with a small dot of light inside you. Expand your awareness to the universe in front of you.
2. Become aware of a big fireball in front of you. Feel your hands become bigger and longer. Scoop up the fireball. You may close your eyes to help your inner sensing.
3. Use the fireball to light the fire in your Tan Tien. Feel the fire burning in the darkness, the 'fire burning under the sea.'

Fig. 2.14 *Smile to the Burning Fire.*

Back Direction and Kidney Fire

Be aware of the back of the Tan Tien, the Door of Life and the back or rear direction. Extend your mind very far away to the 'back'. Scoop up the fire and light up your 'Kidney Fire'.

Fig. 2.15 *Be aware of the back direction, move the arms toward the universe, Scoop up the Universal Fire.*

1. Expand your awareness all the way to the back. Move the arms toward the universe behind you.
2. Touch the universe; scoop up the fire. Activate the Kidney Fire. Maintain your awareness in the Tan Tien and expand out to the universe. The energetic spiral glows in the Tan Tien. Spiral in the heart, spiral in your crown and spiral in the universe.

Heart Fire

Raise your hands up under your armpits and feel yourself holding the two fireballs. Touch the heart by extending the fingers energetically in from the sides; feel your hands extending into your heart and very far away. Activate the Heart Fire.

Fig. 2.16 *Activate the Heart Fire.*

1. Move your hands up under your armpits and extend your fingers deep into your heart and very far away.
2. Tan Tien and the universe: you are connecting to the 'charger,' charging more fire into yourself.
3. Feel your heart soft in the center. Feel the warmth of the fire energy of love, joy and happiness in the heart.
4. Feel the connection with the unconditional love in the universe as you keep your heart consciousness in your Tan Tien and extend your awareness out to the universe.

Sacred Fire *(Chi Fire)*

Connect the Three Fires to combine into one Fire: *Heart to Kidneys to Navel to Heart*.

Fig. 2.17 *Connect the Three Fires and Sacred Fire.*

1. Move your hands together in front of your heart. Hold your hands together in front near the heart and feel the fire burning in there. Connect the Heart Fire to the Kidney Fire and from the kidneys to the Tan Tien Fire near the navel and back up to your heart — connecting them as one triangular Sacred Fire, doubling or tripling their collective power.

Open the Third Eye

Now, extend your hands out to the front, very far away – pushing, pushing, pushing. Turn your palms inward, and extend your middle fingers inward toward your third eye. Picture a crack in the middle of your forehead and pull the crack open. Feel the light from the heavens opening it and feel them shining into your brain.

1. Open your palms. Open your eyes, very dim eyes. Look to the universe. Extend your hands to the front, palms vertical. Extend the arms from the scapulas. Touch the universe.
2. Turn your palms inward and extend your middle fingers inward toward your third eye.

3. Picture a crack in the middle of your forehead and let the heavenly light shine into the brain; pull the crack open and let the light reflect into the organs.
4. Close the third eye. Again, open. Pull: open-open-open. Then, close. With the third eye open, the light from the heavens shines into your brain and reflects down to all your organs. Open and close the third eye 3 - 9 times.

Fig. 2.18 *Look as you touch the Universe in front of you.*

A. **B.**

Fig. 2.19 A. *Close the Third Eye.*

B. *Pull open the Third Eye and let Heaven's light shine into the Brain.*

Front Direction: Push/Pull Master Practice

Now, turn your palms, pushing out. Push. Pull. This is the master practice that is imperative for successful completion. When you first start practicing you should do it at least one hundred times and increase up to 200 times. Push and pull. When you push, you feel your hands extended very far away – very long – reach the sky. Touch the universe.

1. Push: Extend your arms and hands to the front, palms vertical. Extend the arms from the scapulas.
   Expand: smiling, smiling, touching the universe – touching the force, touch the cosmic Chi.

Fig. 2.20 *Master Practice - Touch the Universe.*

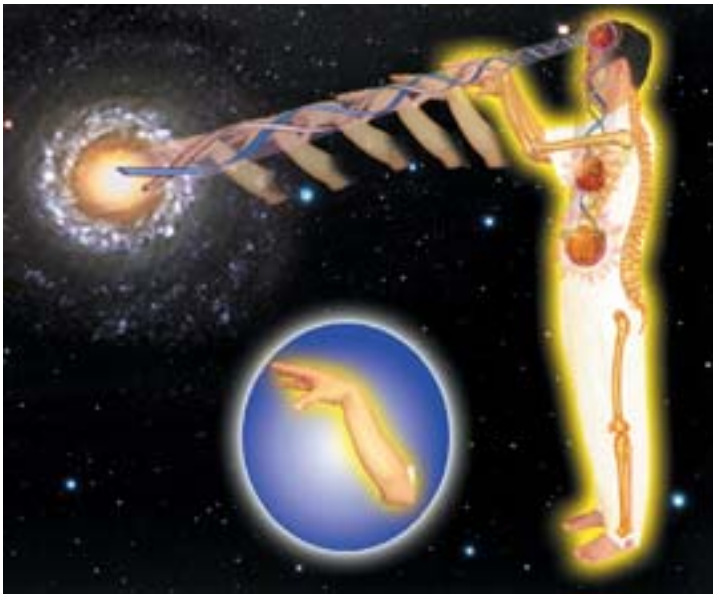

2. Pull: Draw the Chi back to you from the universe. Moving the arms from the scapulas, draw the hands toward your body in a horizontal position.

Fig. 2.21 *'Draw' Universal Chi and Think about your Tan Tien.*

Pull: Think and smile to your Tan Tien. Push, very far away to the universe.
Pull: Push: smile, relax and let go, touching the sky, touching the universe.

Fig. 2.22 *Let go - Push and touch the Universe. Repeat 6, 9 or 18 times.*

Left and Right Directions

Now, move your hands to the left and right directions. Pull the Universal energy in. Push; touch the universe. Pull; think about your Tan Tien. Push – all the way, touching-touching-touching the universe.

1. Move your extended hands from the front horizon to the left and right sides.

Fig. 2.23 *Touch Left and Right Universe.*

2. Pull. Tan Tien: Smile to your Tan Tien. Keep smiling to your Tan Tien.
3. Push to both sides. Expand all the way, touching the universe.

   Push/Pull: touching, touching the universe drawing the Chi into you from both sides.

   Repeat 3—6 times.

Fig. 2.24 *Pull, just think about your Tan Tien.*

Direction Above

Turn your palms up to the universe. Scoop up the Chi. Pour the Chi over your crown and touch your crown. Project the Chi all the way down to the perineum and down through the earth to the universe below. Tan Tien and universe; always feel your Tan Tien spiraling, heart spiraling, crown spiraling and the universe around you spiraling.

Fig. 2.25 A: *Raise the hands above the crown and feel it extend up to heaven.*
B: *Feel that the hands are big and long and that the bones are hollow. Fill and pack the bones with Chi.*

Raise your hands up to the universe and expand your hands as big as the universe - feel the Chi charge into your bones.

Fig. 2.26 *Scoop up the Universal Chi and pour it over the head.*

Open the Spine

1. Touch the back crown point. Pour the Chi all over your crown. Feel your soles and imagine that you feel like there is a waterfall of Chi flowing from your crown all the way down to your soles. Feel your fingers grow long and the Chi penetrate down through your spine to the coccyx. Leave the fingers touching the back of the crown, to maintain the energetic connection with the coccyx.

Fig. 2.27 *Chi 'Waterfall' Cleansing the Spine.*

Turn 'Three Minds into One Mind' at the Lower Tan Tien and expand the awareness to the universe. Let yourself be charged by the universe.

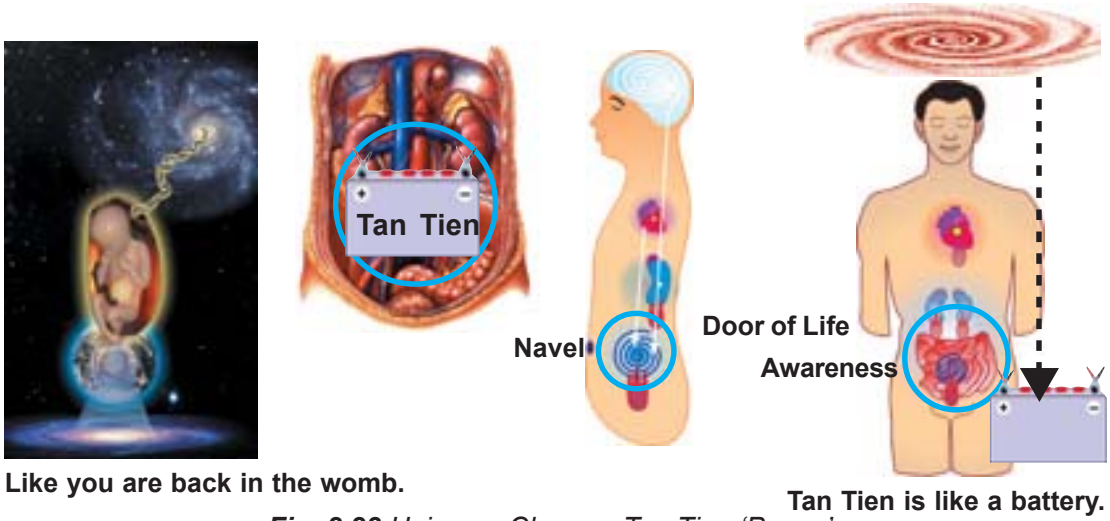

Fig. 2.28 *Universe Charges Tan Tien 'Power'.*

Be aware of the Tan Tien and spiral it like Universal energy in motion. Feel the heart center spiraling and the crown spiraling. Be aware of the universe spiraling above, below, front, back, left and right. Let all of the sick energy and the negative forces leave the body and go down into the ground, for Mother Earth to recycle. Extend the Chi from above, all the way down through the earth and the universe below.

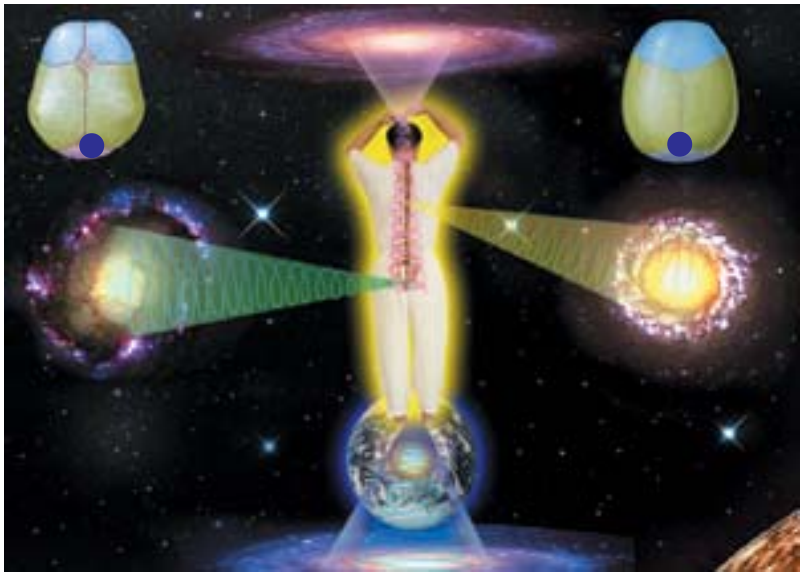

Fig. 2.29 *Feel the Lower Tan Tien, heart center and the crown spiraling and feel the Universe around is spiraling and charging the three Tan Tiens.*

Open the Middle Channel and Perineum

1. Move to the mid-crown point. Touch the point and project your fingers inwards; deeper, deeper through the middle of your body down to the perineum. Focus on the perineum. Feel the Chi from the universe flow right into your perineum. Look for one dot of light. Look into the darkness, the vast darkness, the immense darkness: this is the primordial force, a cloudy moving force. Look for a dot of light at the perineum and extend your awareness all the way down through the ground and the universe below.

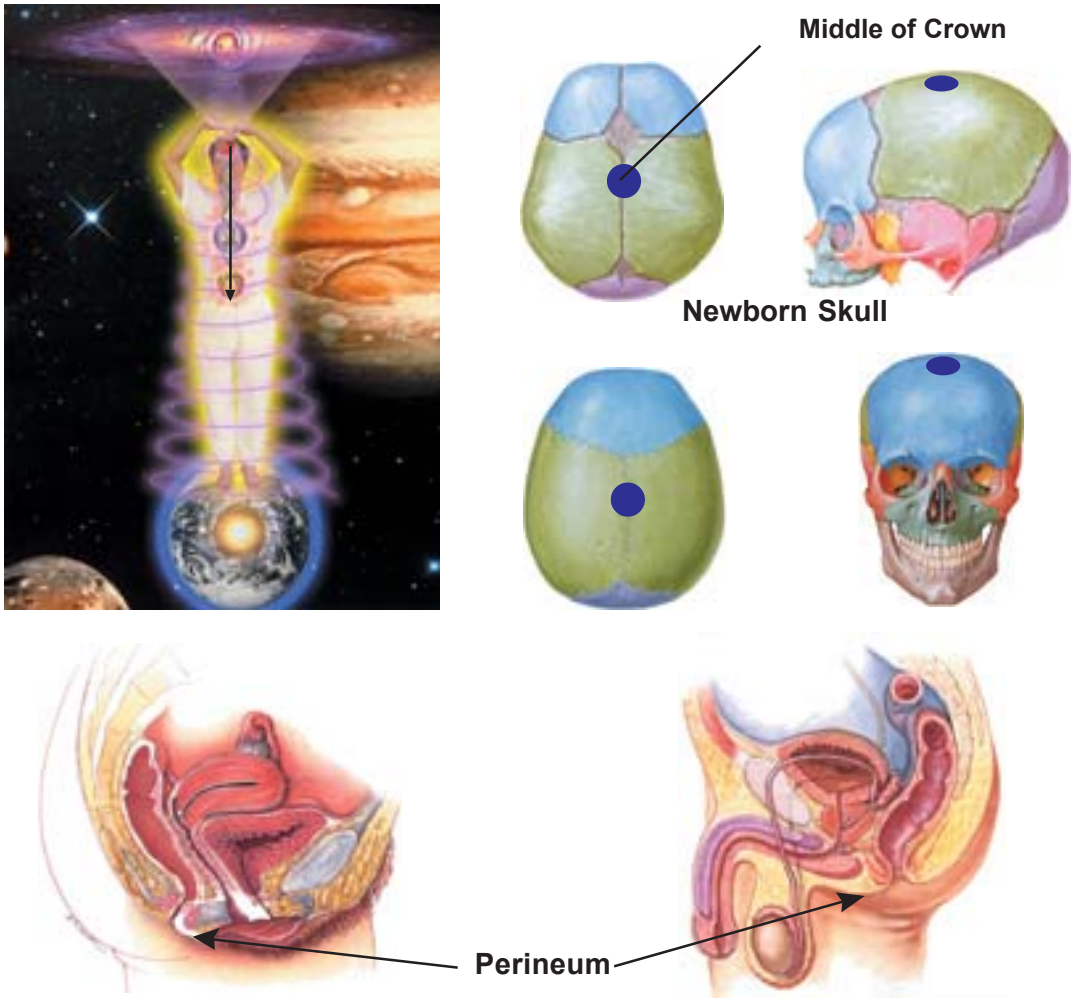

Fig. 2.30 *Universal Light shines from Crown to Perineum.*

When finished opening to the six directions and igniting the three fires, gather the Chi in the center and bring this expanded awareness into the healing session.

Tan Tien and the Universe

The expression, 'Tan Tien and the Universe', is a reminder to feel your Tan Tien, heart, mideyebrow and crown spiraling and that you are connected to the universe spiraling in the six directions around you.

1. Establish a Complete Location

You will use your Yi (the three-mind power), to recharge your Chi repeatedly for various purposes. You recharge by connecting to the Universal Chi in the six directions of the universe simultaneously. When you charge a particular area or direct Chi into the body to a particular point, you first establish a connection point for the Chi by placing the hand or fingers at an appropriate location on the surface. This is like giving a location for the Chi to go to. Once the location is established and the Chi starts to go there, leave your hands there.

Then you move your attention to where you want the Chi to go in the body. Feel the Chi connected to and charging the intended location.

2. Charge Tan Tien from Universe

When the address connection is established, be aware of your Tan Tien, heart center, mid-eyebrow and crown spiraling. Be sure that the conscious mind of the heart is lowered to the Tan Tien and the awareness mind of the abdomen is connected to the mideyebrow crown and out to the universe. Feel them connected to the spiraling energy in the six directions of the universe. Let the universe charge your Tan Tien.

3. Don't Stop at the Location

With your focus in the Tan Tien, the Chi will go from there to the 'location' indicated by your hands and then to the intended location in the body. Don't let Chi stop there, however.

4. Direct Chi out the Opposite Side to Universe

Direct your attention to the Chi and guide it through the body and out the opposite side. The idea is to clear out any blockages and prevent any others from accumulating and also to release sick energy and negative forces down into the earth. Let the Universal Chi flow out through the universe and beyond.

Open the Three Tan Tiens

Move your hands down to the mideyebrow. Touch the mideyebrow. We are going to open the three Tan Tiens, starting with the Upper Tan Tien.

Upper Tan Tien - Mideyebrow

1. Recharge. Remember: Tan Tien – heart consciousness in, awareness out. Spiral – Tan Tien, heart, third eye and crown. Universe – six directions spiraling.

Fig. 2.31 *Raise hands and charge the Universe Chi.*

2. Move your hands down and touch the mideyebrow. Feel your fingers grow very long (energetically) and penetrate all the way back to the base of the skull. Focus on the back. Remember: Tan Tien and the universe spiraling. With the spiraling, the Chi in the fingers will become hot. It will expand and penetrate out through the back of the head all the way to the universe behind.

Fig 2.32 *Fingers touch Mideyebrow and penetrate to the Universe.*

Fig 2.33 *Tan Tien and the Universe*

3. Picture your fingers like laser beams of Chi. 'Tan Tien and Universe': Feel your Tan Tien and the universe spiral and charge your fingers. Move your fingers out from the mid-eyebrow around the side of the head to the top of the ears. Your fingers are like lasers -cut-cut-cutting open your skull right in the middle, around to the top of the ear, cutting open your Upper Tan Tien. Cut and project your fingers long into the middle of your brain. Spiral your Tan Tien and the universe. Leave your fingers there. Concentrate on your Tan Tien spiraling your heart, crown, the universe above, below, front, back left and right all spiraling. Your Tan Tien is a big empty space: primordial force; darkness. You can put so much Chi inside there! The Chi penetrates into your brain.

Fig. 2.34 *Move the Fingers to the Top of the Ears and feel them Grow Longer. Cut Open the Center of the Skull.*

4. Move your hands all the way to the back, cutting to the back of the skull. Touch and feel the Upper Tan Tien open.
5. Touch the base of your skull. Focus on the mideyebrow. Feel the Chi flow like a laser beam from back to front and out to the universe in front. Complete the opening process by moving the hands back around to the mideyebrow, cutting as you go.

Fig. 2.35 *Chi moves like a Laser from Front to Back of Skull.*

6. Recharge in the universe. Feel your bones and your arms are hollow. Fill and compact them with Chi.
7. Scoop the Universal Chi and pour it down over your crown and all the way down, down to the Middle Tan Tien.

Fig. 2.36 *Recharge in the Universe:*
Scoop and Pour the Chi down to the Middle Tan Tien (Heart Center).

Middle Tan Tien - Heart Center - Conscious Mind

1. Move your hands all the way down to your heart center at the mid-sternum. Touch. Focus on the point opposite the heart, T5/T6 on the spine. Fingers 'long' as Chi penetrates into your thymus gland. Light – golden light – penetrates into your thymus. Feel the Chi penetrate through your heart all the way through T5/T6 to the universe behind. 'Tan Tien & the Universe' also feel your Chi Fingers penetrate into the bone and bone marrow and spread out into your rib cage.

Fig. 2.37 *Golden Light Enters the Heart, Thymus, Bones, Marrow and Penetrates to the Back and all the Way to the Universe.*

Recharge and cut around to the Armpits

1. Recharge in the universe: pour Chi over the crown down through the body and lower your hands down to the heart center. Touch with the fingertips. Move your hands around under your armpits, extending the Chi like laser beams cutting open this Middle Tan Tien. Pause under the armpits as you send the Chi into the center.

Fig. 2.38 *Cut Open the Middle Tan Tien by cutting around the Armpits.*

2. Continue to move your hands around to your back at T5/T6, touch and send the Chi from back to front. Let the beam of Chi penetrate out through the heart center to the universe in front of you. Then, move the hands back around the sides to the front, cutting as you go.

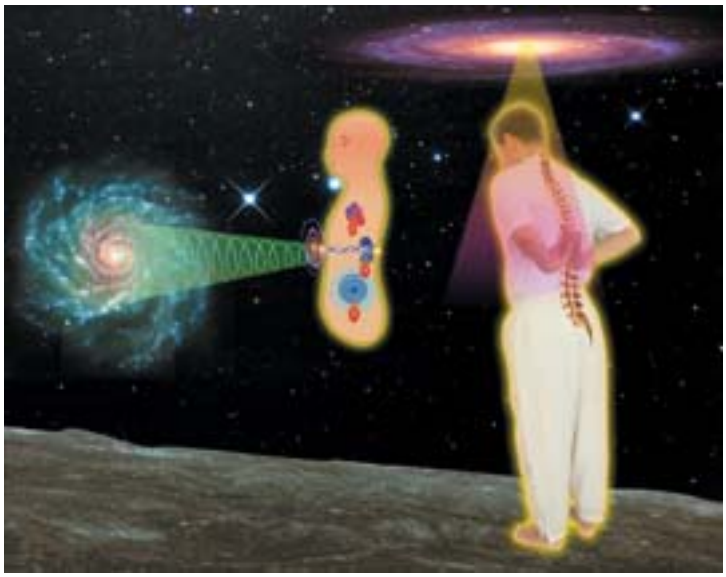

Fig. 2.39 *Chi Beam from the Door of Life penetrates the Heart Center in the front.*

Lower Tan Tien - Navel - Awareness Mind

1. Recharge with Universal Chi, Tan Tien and Universe: Again, raise your hands and charge with the Chi in the universe. Your hands are very big, very long. The bones are hollow and compacted with compressed Universal Chi. Scoop the Chi from above and guide it down. Pour all the way down, down, down, down to the navel. Touch the navel and focus on the Door of Life opposite, on the spine between L2/L3. Touch and feel the Chi penetrate to the Door of Life. Tan Tien and Universe: Feel the Chi penetrate through to the back and out to the universe behind.

A. ***B.***

Fig. 2.40 A. *Recharge the Lower Tan Tien and penetrate through to the Door of Life.* ***B.*** *Raise the hands up to the Universe & charge with Chi. Bring the Power down to the Lower Tan Tien.*

2. Open this Lower Tan Tien the same way as for the Upper and Middle Tan Tiens. Tan Tien and universe – charge more Chi into your hands and let them be like lasers cutting it open. Cut around to the sides. Pause. The fingers of the left and right hand are very long, extended energetically inside. Cut and feel the energy penetrate into the navel and Tan Tien .

Fig. 2.41 *'Cut' Open the Lower Tan Tien with Laser Fingers.*

3. Continue cutting to the Door of Life. Touch and send the Chi from the Door of Life back to the navel and out to the universe in front.
4. Move the hands back around the sides to the navel, extending the fingers and "cutting"the Tan Tien open as you go. Touch the navel: Tan Tien and the universe spiraling. Feel more Chi and feel the Tan Tien open.

Fig. 2.42 *'Cut' open the Door of Life and Send Chi to the Universe in Front.*

Activate Chi in the Bones of Hips, Legs and Sacrum

1. Now touch your pelvic bones by energetically extending your fingers from the front area near the hips to the back. Feel Chi penetrate into your pelvic bones: funny, laughing, happy bones.
2. Touch the femur bones. Tan Tien and Universe: Charge the fingers. Also, feel the funny, happy, laughing vibration inside the bones and in the bone marrow. Be aware of the Three Tan Tiens. Spiraling from the universe. Spiraling charging your Tan Tien. Charge your hands and your bones.

Fig. 2.43 *Touch the Femurs - Happy Laughing Legs!*

3. Now we are going to slowly lower the sensation of Chi down through the bones to the earth. Move the hands down the legs as you bend down.
4. Lower yourself all the way down to the ground and sit on your feet. Move the Chi with your hands down to your toes, down through the earth and the universe below.

A. ***Fig. 2.44*** ***B.***

A. *Sink the Chi into the Earth.* ***B.*** *Lower and Sink the mind and Chi down to the Universe.*

5. Raise your sacrum up, keeping your hands at the toes. Smile to your Tan Tien and feel the Chi from the universe rising to fill the Three Tan Tien.

Fig. 2.45 *Raise the Sacrum and smile to the Tan Tien.*

6. Lower down again. Lower the Chi down to the earth and the galaxy below.
7. Once more, raise your sacrum up, maintaining hand contact with your feet. Smile to your Tan Tien.
8. For the third time, lower down. Open your palms, gathering the Chi from the earth below. Gather and scoop the Chi.

Fig. 2.46 *Gather the Earth Chi.*

9. Touch your heels and feel your bones as you slowly rise up. Fill your bones with Chi as you guide it up with your hands.
10. Fill the bones in the upper legs as you move your hands up.

A. ***Fig. 2.47*** ***B.***

A. *Fill the Bones with Chi.* ***B.*** *Feel your fingers penetrate into the Bones as you rise.*

11. Feel your bones and fill them with Chi, all the way up to your coccyx. Touch your coccyx. Leave your fingers there and be aware of the Chi gradually feel the Chi rising up to the Tan Tien and the universe. Feel it charge the fingers and the spine.
12. Come up to the sacrum, Tan Tien and the universe.

A. ***Fig. 2.48*** ***B.***

A. *Bring the Chi to the Coccyx.*
B. *Move your hands up to the Sacrum and feel the Chi Rise up to the Crown.*

13. Come up to the 'Door of Life', and then back to the navel. You may sit down to continue the next step in the Cosmic Healing Practice. Practice daily until you feel the Chi. You will then be able to apply this Chi to the Healing Sessions.

Fig. 2.49 *Bring the Chi to the Door of Life and let it penetrate to the Navel.*

Sacred Water Practice

Invoke the power of the Sacred Water practice to cleanse and heal the body's sick, toxic or negative energy. **If you are working with a group of people, direct your energy through the energy body overhead and into each person's star, as you guide them through the procedure**.

Outline of Practice

I. Hold a glass one quarter full of water in your left hand, folding the middle and the ring fingers into the center of the palm.

II. Hold the glass in front of your body as you point the 'Sword Fingers' of your right hand up to Heaven.

III. Make a request to receive healing energy and feel yourself touch a heavenly pool of sacred water energy. Feel the pool pouring down heavenly water to fill your arm.

IV. Place your fingers on the cup and ask:
Command 1: ***"Yin power and good fortune come from the east. Yin power please dissolve all negative energy, all sickness and bad fortune".*** Make a cross over the top of the cup.

V. Bring your arm down and point the sword fingers around the inner rim of the glass. Smile as you circle the fingers around the rim.
Command 2: ***"By my request. Please carry out the order now."*** Repeat this three times, charging the water with Yin Power. Project your thoughts into the water.

VI. Use the thumb and index finger to remove the sick energy from the cup, without touching the water. Do this three times. Talk to the sick cells. Tell them to listen to your command:
Command 3: ***"All sick cells please listen: Clear, clean and bright, this Sacred Water will take all the sickness away."***

VII. Repeat the order and visualize yourself removing the sick energy from the cells and returning it to Mother Earth for recycling.

VIII. Hold the cup with both hands near your heart.
Command 4: ***"This Sacred Water will give me/you health, wealth and longevity."***
Project love, joy, thankfulness, gratefulness, appreciation and the energy of compassion into the cup.

IX. The Sacred Water will carry the message of the practice to all the cells, where it will remain. If you are practicing in a group, drink the water in unison. If you are working with a student, pass the glass using both hands.

Step I: Prepare the Hands and Arms to receive the Universal Chi.

Left Hand Position: Prepare to hold a cup or glass with the left hand by folding the ring and middle finger into the center of the palm. Hold the glass in front of the body.

A. ***B.***

Fig. 2.50 A. *Fold Ring and Middle Fingers.* ***B.*** *Hold Glass in front of Body.*

Step II: Prepare the Sword Hands to receive the Universal Chi.

Right Hand Position: Form the right hand into a 'sword hand' by folding the pinkie, ring fingers and thumb into the palm. Straighten and hold the index and middle fingers together and extend them upward.

Fig. 2.51 *Prepare to receive the Universal Chi.*

Step III: Fill your Arm with the Power of the Heavenly Pool.

Sense the sword fingers and the arm as being 'long' and 'big' as you raise them towards Heaven. Sense that the middle is hollow and the bottom is sealed at the shoulder. When the mind's attention is focused on merging with the primordial Chi of the Universe, the energy of your thoughts will be multiplied.

As you make your request to the Universe, feel that you are touching a heavenly pool of Sacred Water Energy. Feel that the pool is pouring down like a waterfall to fill the arm. When it is full compact and compress the Sacred Energy into it as much as you can.

Fig. 2.52 *Touch the Heavenly Pool.*

Step IV: Make the Cross on the top of the Cup.

Put Sword Fingers on top of the Cup. Ask for the Yin Power: **Command 1:** ***"Yin Power and good fortune, come from the east. Yin has the power to dissolve all negative energy, all sickness and bad fortune."***

Command 2: Make the cross on the top of the cup and say ***"By my request"***.

Fig. 2.53 *Fortune come from the East - Yin has the power to dissolve all Negative Energy, all Sickness and Bad Fortune."*

Step V: Charge the Water to transform it into Sacred Water.

Bring your arm down and point the sword fingers into the glass of water. Smile and circle the sword fingers around the inner rim of the glass.

Continue to order: ***"Please carry out the order now."*** Repeat 3 times to charge the water with the Yin Power. As you do this, project a good thought into the water.

Fig. 2.54 *"Please carry out the order now." Repeat three times, charging the water with the yin power.*

Step VI: Command 3: *"All sick cells please listen : Clear, Clean and Bright, this Sacred Water will take all the Sickness Away."*

Give the above command. Use the thumb and index finger to pick up sick energy from the cup, without touching the water. Do this three times.

Fig. 2.55 *"All sick cells please listen: Clear, Clean and Bright, this Sacred Water will take my/your Sickness Away."*

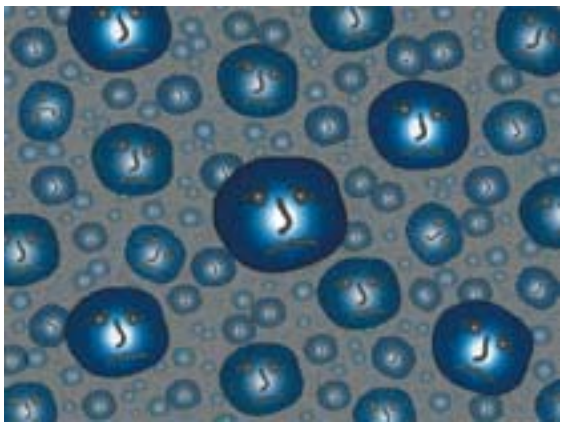

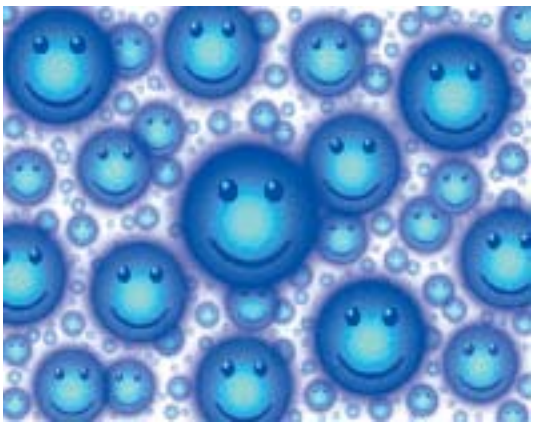

Fig. 2.56

A. *Ask for the power to see the cells - If they are toxic and dark, ask for them to be cleaned out.*

B. *"Clear, Clean and Bright".*

Step VII: Let go of the Sick Energy to be transformed by the Earth.

As you **repeat** the order, picture yourself removing the sick energy from the cells and discarding it down into the Earth to be transformed and recycled.

Step VIII: Fill the Water with Compassion.

Hold the cup with both hands near the heart and project goodness into the water.

Command 4: ***"This sacred water will give me/you health, wealth and longevity."***

Project love, joy, thankfulness, gratefulness, appreciation and the energy of compassion into the cup.

Fig. 2.57 *Sick Energy return to the Earth.*

Fig. 2.58 *"This Sacred Water will give you Health, Wealth and Longevity."*

Step IX: Drink the Sacred Water.

The Sacred Water will carry the message to all the cells. It will keep the message of the Sacred Water practice in all of the cells. Use both hands to pass the Sacred Water to the student you are working with, or drink it yourself and/or in unison with your group. **Feel the water go into all the cells of your body. Feel it removing the sick cells and purifying your body.**

You can also sprinkle it onto any area that requires healing.

Fig. 2.59 *Drink the Sacred Water.*

Chapter III
Taoist Astrology and the Structure of the Universe

Origin of Astrological Information

Thousands of years ago, people experienced the shimmering stars as their natural connection with heaven. Society was organized in accordance with the laws of the universe and people viewed their relations as a reflection of the configurations of the stars. Human arrogance, the drive for power and a growing disdain for nature led to the vision that the earth was the center of the universe. Instead the earth is our temporary home and is our central point from which we observe the universe.

At the same time, leaders began to rule their countries without being in touch with the heavens. A mixture of power, ambition, desire for wealth and religious conditioning led to an increasing disconnection from the natural receptivity to the energy from the universe.

Since then this self-created isolation has been growing and is dominant in present day society. Although there is a longing to reconnect, many healers, therapists and practitioners of meditation or astrology understand the ancient practices with their rational mind but miss the subtle connection.

We should remember that the knowledge with which astrologists work now comes originally from a direct experiential connection with the universe and the understanding that many masters cultivated throughout several thousand years. Many present day astrologists are guided solely by this ancient information.

The question may be raised as to how the early astrologists, who wrote down their experiences and transmitted them, gathered and collected their information? They had no sophisticated equipment like telescopes. Through a combination of observing the universe and relating it to changes in the energy on earth, in nature and human beings and through meditation or spiritual practices, they were able to assimilate their knowledge.

During the Tang dynasty many Taoist masters and students spent their whole lives in kuans or watch places (observatories). The masters had selected these unique locations in nature, based on the presence of strong cosmic energy. Most of the kuans were located high in the mountains, sometimes in very inaccessible places. The interaction of the strong natural forces with natural crystal antennas (mountains) and the planetary/star observations (meditations) formed a perfect platform for the Taoist astral travel and spiritual practices.

These masters clearly saw the cranium as our own bony planetarium. A key realization was to break through the illusion of the separate realities of ‘inner’ and ‘outer’. Their supernatural astrology helped them to realize the universe within the cranium and from there, into the Tan Tien.

Fig. 3.1 *Astrologer casting a horoscope.*

In the Taoist view, their highly advanced insights could only come about through the growth of the higher centers and glands which allowed them to perceive and understand the reality of the universe beyond the normal material and visible manifestations.

Of course, astronomy provides us with a great deal of interesting information. It has recently become clearer that astronomy parallels all universal law. We should realize that these laws can be further enhanced with the aid of high powered telescopes. Taoists say "without leaving the room, you can know heaven and earth".

The Newtonian view of the universe which uses a mechanical approach to reality by way of an exclusively rational concept at the expense of our body, our ability to sense and use our intuition and feelings, has gradually and increasingly disconnected us from the realm of the spirit and the living cosmos.

Strangely enough, the more we attempted to know the universe through observation with a telescope, the more we became separated from its subtle origin.

This is so, as the rational mind tends to move horizontally and may find it difficult to enter into the realm of the spiritual laws. Unless of course it is the rational mind of a spiritually evolved person. Each time an astronomer reaches further into the universe, finding new information, some scientists try to use it in a concept of how the history of nature formed and the universe must be. But these fundamental questions cannot be solved within the realm of time and space. It is good news to see that a growing number of modern scientists are becoming more open to the paradigm that the universe has a timeless and spaceless origin.

"As above, so below", we look at ourselves the same way that we look at the universe, even if we are not concerned about the direct connection between the two. If we try to understand the body, by way of observation with a microscope and chemical analysis, it may help us to see how the laws of energy and Chi manifest in the realm of matter. It may increase our ability to enhance the fundamental questions of life which lead to greater freedom and happiness.

Many scientists who previously subscribed to the Newtonian view now agree to the following: that the essence of the material world are frozen energy waves that *appear* as matter to the external senses.

Many scientists believe that by the year 2030, the computer will be able to take over the complete human brain function. This idea is well accepted in modern science but shows at the same time, the very limited understanding of the true quality of our intelligence and the human mind.

Centuries of religious repression have discouraged people's sense of responsibility for their lives as well as the search for freedom and spiritual independence. Hence, science, astronomy, religion and many other fields of experience can be useful in our search for spiritual achievements. All of these schools of thought merge into one, as they reconnect to our true origin.

Working with planetary and star energies gives us an access to the ground layers of our emotional, social and mental tendencies. The rational mind and emotions, higher mind and spirit are related to the planets and star/world. Star energy and higher mental energy have a higher frequency than planet and rational mind/emotional energy. The

separative, rational, more horizontal mind is related to the emotions; the higher mind or universal mind is related to the collective intellgence and our spirit.

More than likely you have observed that it is your emotions and thoughts which hold you back from reaching a balance in your life or progress in your meditation practice, or to focus and connect when you work as a healer.

The planets are far closer to us than the stars and their energy field has a much slower vibration. To give you an idea, the earth is 150 million kilometers away from the sun. Pluto, the planet farthest away from the sun has an orbit of about 6 billion kilometers. The closest star (except for the sun) in our universe is Proxima Centauri at a distance of 4.3 light-years or 270,000 times farther away from the sun (a light year is the distance that the light travels in one year at a speed of 300,000 kilometers per second).

How to use Astrological Information

Ancient peoples believed that under the influence of very specific conditions of stars and planets at the moment of birth, the basic quality of a human being is formed and the personality and tendencies in a person's life are basically patterned. It is important to see this constitutional quality as a strong tendency and not as a fatalistic prediction or inevitable course. This unique quality will indeed influence you for the rest of your life. But it is important to see that this condition works on our body and soul, not on our spirit. The reason for this is because the spirit is eternal. It has and always will exist. It is free from the laws of karma and reincarnation. It is therefore free from the laws governing individual incarnations. For that reason Taoist astrologists say that astrological conditions should not be seen as limitations but rather as directions based on universal influences. It just gives you clear information as to where you come from and how your tendencies may evolve. Since our spirit is timeless and spaceless, we can still move in any direction. An intelligent person moves with the flow or the intelligence of the universe, in order to keep the life force inside. It is good to remember that you can actually move in the direction you truly wish to move to, always following the truth within your heart. If you decide to join a football game, you are immediately fixed by the rules of the game. If you see all these rules as limitations, you would do better to play another game. The art of playing the game of life is to see, understand and accept the limits in the material world and learn how to move freely within them, whilst maintaining awareness of your connection with your unlimited spirit.

Two basic questions to ask when moving to a certain place are: "Where am I now?" When you know the answer; "What is the best way to achieve my goal?" Through the connection with our spiritual origin and planetary/galactic forces, we can strengthen the weaker points in our energy system and our personality. In this way we can use astrological information as a source of personal growth and not as an excuse for unconscious emotional behavior.

Brief History of Astrology

Chinese astrology is a very broad subject which contains much information and is highly complicated for the untrained mind. There are many ways of interpreting the universal conditions, which are brought together in different systems with their own specific diagrams and calculation methods.

In the ancient Taoist literature much attention is given to the subject of "astrology". The 18th century Imperial encyclopedia has 2500 chapters on astrology! What we wish to do in this book is to make you aware of the nature and origin of this wisdom and how it relates to spiritual practices and the laws of the universe.

In most Chinese astrological systems it is mentioned that between 4000 and 5000 years ago, the stars and planets were perfectly situated. At the moment it looks like no one can really describe what that means from a pragmatic point of view. What is clear is that this period may have seen a unique universal condition. From that point on, Chinese astrologists have counted the years, months and days and calculated movements by observing the sky. Noio, the Great Minister of the Yellow Emperor Hwang Ti set the beginning of the first 60 year cycle at 2637 B.C. (according to stems and branches) which means we are in the 78th sexagenary cycle now.

Most sources claim that Chinese astrology developed wholly independently from other cultures and traditions, but this is probably not the case. If we compare Chinese, Mayan and old European calendars and zodiacs and also the language and architecture we find parallels that simply cannot be accidental. It is clear that all these cultures were shaped by the same information source. The advanced spiritual development of these different cultures allowed them to translate information from the same source in the form of an astrological system reflecting the order of the universe. This translation happened in coordination with their specific location on the planet.

As you will see in the following overview, people all over the world were already observing the stars long before the start of the Chinese calendar 2637 B.C.

Although there is still discussion on the subject, the famous Egyptologist, Schwaller de Lubicz states that the Egyptian calendar has its starting point about 4240 B.C. This calendar was based on astronomical observations made during a period more than 6000 years ago.

Also in Egyptian civilization astronomy/astrology was used to crystallize the universal laws into human life. The great pyramid was built at approximately 2170 B.C. One of its functions was to serve as an astronomical observatory. The entire geometry of the pyramid was based upon astronomical positions and movements. Notes of astronomical observations from the Sumerian culture (3000 B.C.) have also been found. Different cultures describe the destruction of civilization about 12,000 years ago, under influence of the star Vega in the constellation of Lyra. An earth axis shift occurred and big floods destroyed civilizations.

Chinese astrology probably has its own roots but was later greatly influenced by Indian (Hindu) and old Babylonian astrology. The year 10,000 B.C. appears to have been a critical point in astrological history. Archeological findings in Europe, South America,

Africa and Asia prove the existence of a highly developed civilization that was strongly influenced by astronomical and astrological knowledge.

In a museum in Peru, a rock shows the engraving of a human figure looking through a telescope to the sky. This piece of art is estimated to be more than 30,000 years old. This is just one of the many archeological treasures that shows that there must have been other cultures before our culture was born less than 1,000 years ago.

The Greek historian Solon claimed that astronomical observations and calculations were made nine thousand years B.C. (or 11,000 years ago).

Oracle bones from the Shang dynasty (17th to 11th century B.C.) mention astronomical observations of stars more than 4000 years ago, which were then interpreted as being lucky or unlucky. In many parts of the 9 Chinese Classics and certainly in the 5 canons or "Ching books" astronomical/astrological observations are described as coming from this same period.

Differences between Chinese and Western Astrology

The main differences between Chinese and western astrology are their reference points. In western astrology, stellar positions are found and calculated in the ecliptic. The ecliptic is the trajectory the sun apparently makes around the earth, through the Milky Way. The plane of the ecliptic is inclined at an angle of 23 ½ degrees to the plane of the equator. The ecliptic is also known by Chinese astrologists as the yellow route, but they also work with the North Star as the central reference point in the sky and the celestial equator or red route as the base line. In this context the lunar zodiac is used where the moon cycle around the earth (28 days) is divided into parts of 1 day (thus, 28 segments). This is also related with the 28 years it takes Saturn to turn around the sun. The Chinese zodiac or 12 animal cycle also refers to the 12 years it takes planet Jupiter to move around the sun.

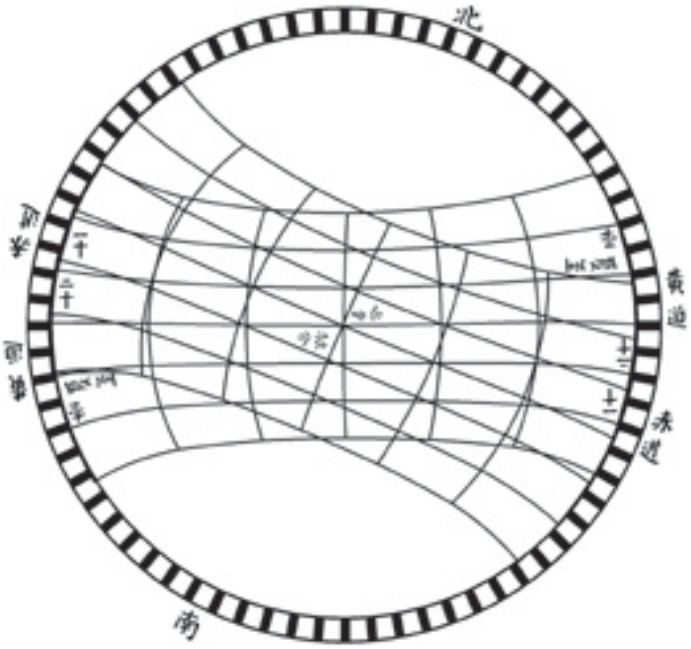

Fig. 3.2 *Diagram shows the Red Path and Yellow Path (the celestial equator and the ecliptic).*

The animal names used in Chinese astrology came to China from India. They were based on the legend of the Buddha. He was visited by 12 animals that came to say goodbye to him before he left the earth.

Before this, the earthly branches, in combination with the older decimal system of the 10 heavenly stems, was used. The combination of stems (10 or two times five) and branches (12) (gives a series of 60 based on the twelve animals and the five elements) was used to count the years and days and was also called 10 mothers and 12 children. Research shows the strongest difference between modern western and traditional Chinese astrology is the focus on the North Star as the 'Heavenly Gate'. This shows the direct relationship with the Taoist spiritual practices. Chinese astrology and direct astronomical observations have always been closely related. They made observations constantly and based many of their calculations directly upon them. The appearance and movement of a planet or star as well as its brightness, aura and shades were closely studied. Some Chinese Emperors had a 24 hour a day observation crew. In this way all signs from the universe were picked up and used to make personal and political decisions. Many stars and planets were connected to gods, emperors or sages. Changes in the expressions of heavenly bodies were seen as direct signs from the divine world.

Although they had no astronomical tools in their own terms, Taoist astronomers knew about supernovae (exploding stars), black holes (imploding stars), pulsars and quasars.

Chinese astrology is based on direct observation of the sky and it is used in this book as the information bridge to universal energy.

Many astrologists all over the world, focus on their tables and books, only looking down, instead of connecting with the universe. Even in China, the traditional art of astrology is hard to find these days. It has been taken over by western astrology or other methods of prediction. As Taoist Ming Shu stated, "very few are still combining their astrological calculations with spiritual practice and with observing the sky." This, of course, gives less depth to their work.

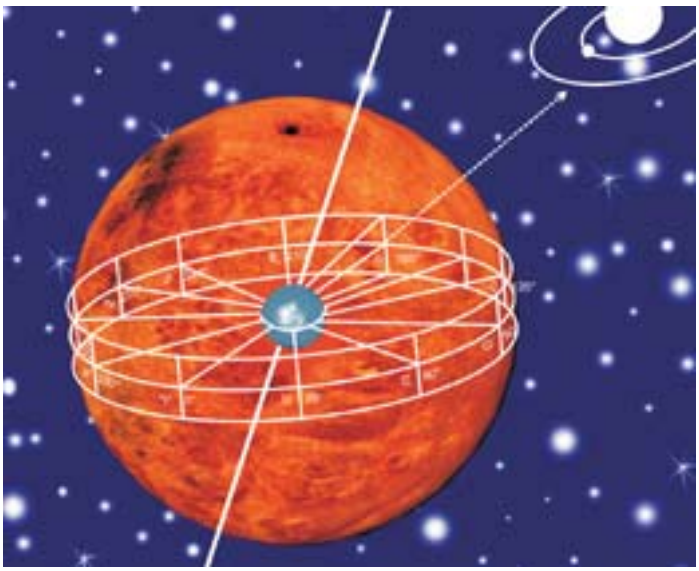

Fig. 3.3 *Western Zodiac, Zodiac Band and Plane of Ecliptic*

The Zodiac band extends above and below the plane of the ecliptic.The Zodiac with its 12 signs is known in many different cultures.

Fig. 3.4 *Lunar Zodiac*

Seven Days of the Week	Related Planets	Constellations East	North	West	South
Sunday	Sun	Fang Room	Hsu Void	Mao Pleiades	Niao Bird
Monday	Moon	Hsin Heart	Wei Danger	Pi Net	Chang Drawn Bow
Tuesday	Mars	Wei Tall	Shih House	Tsui Beak	Yi Wings
Wednesday	Mercury	Chi Basket	Pi Wall	Shen Orion	Chen Board
Thursday	Jupiter	Chio Horn	Tou Ladle	K'uei Astride	Tung Well
Friday	Venus	K'ang Neck	Niu Ox Boy	Lou Mound	Kuzi Ghosts
Saturday	Saturn	Ti Base	Nu Maiden	Wei Stomach	Liu

Willow

The 28 days of the Lunar Zodiac in relation to the 5 Palaces around the North Star, are the 28 segments. The Moon will rotate in each palace during seven days. This period is connected with the seven days of the week. This brings a cycle of the seven planets during the days of the week in the 28 constellations. Specific influence of the sun (moon + 5 planets) and the 28 constellations (4 x 7) each of the 7 days of the week.

Although much more information is recorded and transmitted in China compared to most other civilizations, the real meaning of many methods is very rare to find. The system of stems and branches is a good example of this. Today this system is used on computers and in the form of diagrams, by many practitioners of Chinese medicine all over the world, but very few of them know what the system really means and where it comes from.

Fig. 3.5 *Hindu Zodiac*

Fig. 3.6 *Star Palaces and Constellations*

Chinese Astrology and the Laws of the Universe

As human beings we are the highest manifestation of the Cosmic light which has its origin directly in the Tao, the oneness. The life we lead now originated from this source. From this one unlimited intelligence a process of densifying/materialization or multiplication has led to your individual incarnation or manifestation in the physical realm. Taoist philosophy describes this process as 'the one giving birth to the two'. The interaction between the two, further differentiates into the world of phenomena. To connect to the spiritualizing spiral of true intelligence that we are, will strengthen the connection to the Tao. This process will deepen through astronomical information (observation) and meditation (explained further, later in this book).

In Chinese cosmology and philosophy the world of duality yin/yang, gives birth to the triple unity. This triple unity we find in the three basic energies in the universe (universal, cosmic and earth) and the interaction between heaven, man and earth. In the body, the interaction of heaven and earth forces (two) gives birth to the three Tan Tiens.

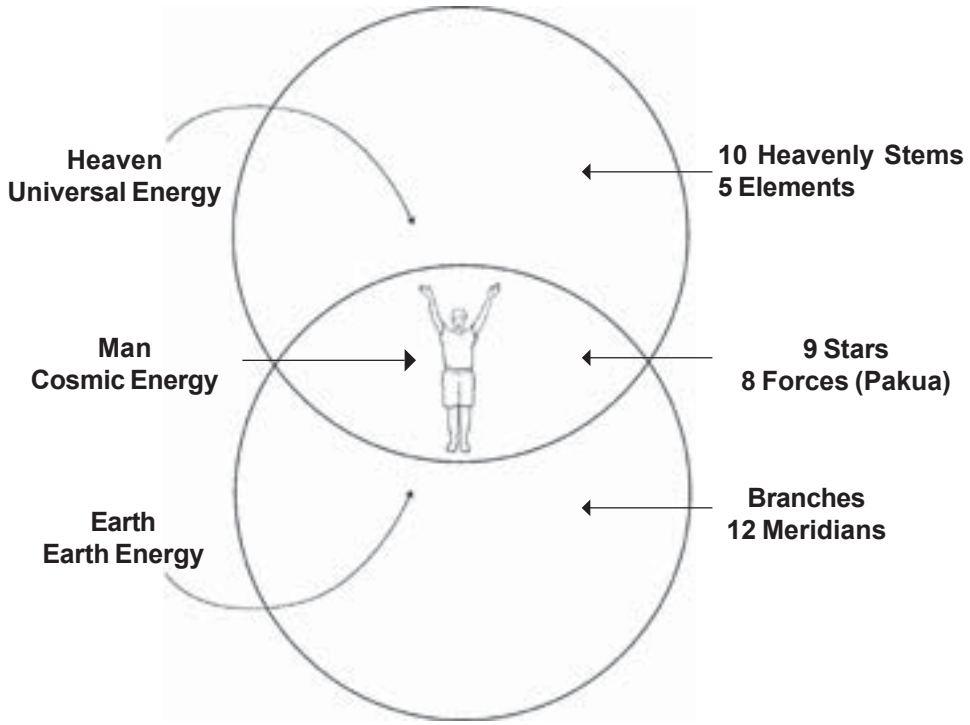

Fig. 3.7
Interaction of Man with the Realms of Heaven and Earth, the Pakua and the Stems and Branches

These three realms contain the main principles applied in Chinese philosophy and astrology. The ten heavenly stems are based on the yin and yang aspect of the five elements (related to yin/yang senses/organs/systems). The I Ching and its internal principle of the pakua or eight forces relates to the eight extraordinary meridians in the body. This more prenatal meridian system is nurtured by the eight planets (the sun and moon form the central aspect) and the eight related star essences. The principles of the pakua are also found in the Taoist 9 Star Astrology (8 forces + the central Tai Chi = 9). The North Star and Big Dipper energy are essential to the whole Taoist practice. Taoist masters observed that in the central star palace, 9 major energy points clearly reflect the changing energy quality of the universe and our planet. These 9 points are the 7 stars of the Big Dipper, the light of the yang star, Polaris and the light of the yin star, Vega.

The 12 earthly branches are in relationship with the earthly forces and also the 12 main acupuncture channels.

The heavenly stems have a high frequency energy - related to realm of cosmic law and Universal energy. The earthly branches have a lower frequency, related to the earth energy and the surroundings of the earth in the 12 different directions.

The principles of the five elements, the pakua and, to a lesser degree, the related stems and branches are fundamental for the planetary and stellar meditations. We will go deeper into these topics as we progress.

Five Elements

Every part of Chinese philosophy is connected with the five elements. The law of Yin and Yang, Five Elements and Pakua (eight forces) come from the unmanifested world and control the whole world of phenomena, including the world of stars and planets and life on earth. Written evidence of the use of the five elements has been found around 300 B.C. although they were certainly known and used before that time. Much confusion arises between the Greek four elements and the Chinese five elements. Both of them have a clear underlying philosophy. **The five basic planets are the physical manifestation of the five elements.**

Ancient Chinese astrology divides the sky into five palaces, also called the five cardinal points. The earth, or Central Palace, is the part of the sky which is visible throughout the whole year. The other four Palaces can be located as the earth moves through the four seasons during its annual rotation around the sun. Each of the outer 4 palaces covers an area of about 90 degrees in the sky.

The one (circle) gives birth to the two (Tai Chi), from there we find the three (e.g, heaven, earth and man), a further differentiation leads us to the pakua. Inside these eight trigrams we find the five elements (see figs 3.10 and 3.11). The combination of the eight trigrams gives us the 64 trigrams. This concept of the order of the universe and an understanding of these laws was traditionally necessary to be able to work with Chinese astrology.

The pakua can be looked at in different ways. In a common form the five elements are located as follows: earth as the center, south on top, north below, east left, west right. If the observers look to the south, following the main trajectory of the sun they see the chart as shown below.

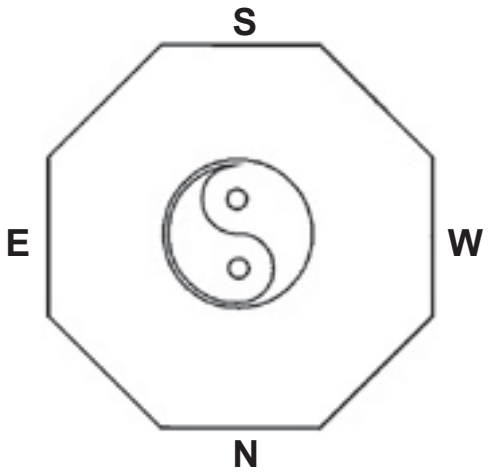

Fig. 3.8 *Five Directions - Pakua looking from the south.*

But if we move southward with the direction of the sun and look from that position to heaven then north would be on top, south bottom, east left, west right. The way the pakua is presented shows the point of view of the observer.

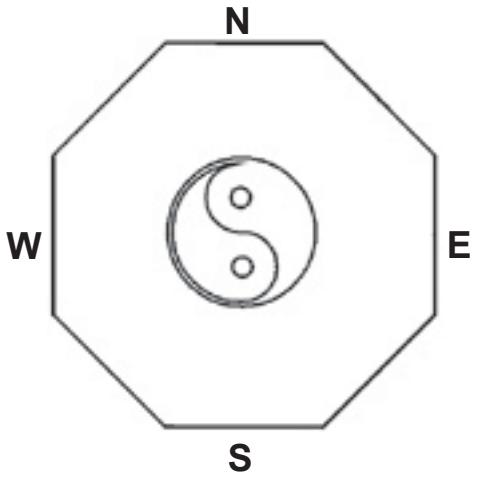

Fig. 3.9 *Five Directions - Pakua looking from the north.*

The most commonly applied system of using the five elements according to the seasons is with the earth element (Indian Summer) coming after the fire element (summer) (See fig. 3.10). Another less popular method uses the earth in its central aspect and places a short earth period in between every season (See fig. 3.11).

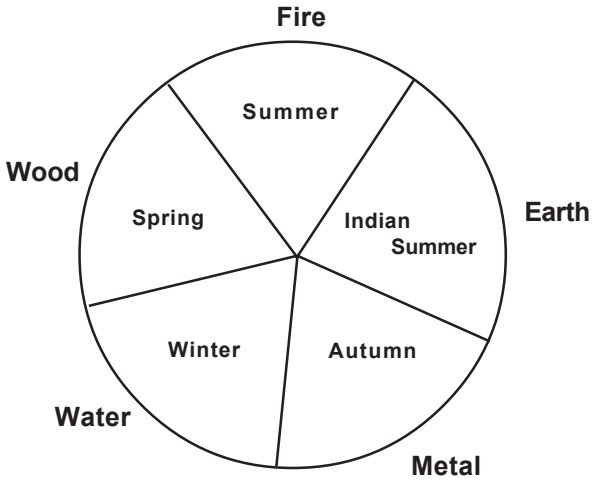

Fig. 3.10

Most common way of using the 5 elements in the year's cycle:
5 periods of 72 days each (the Astrological Year counted 360 days).

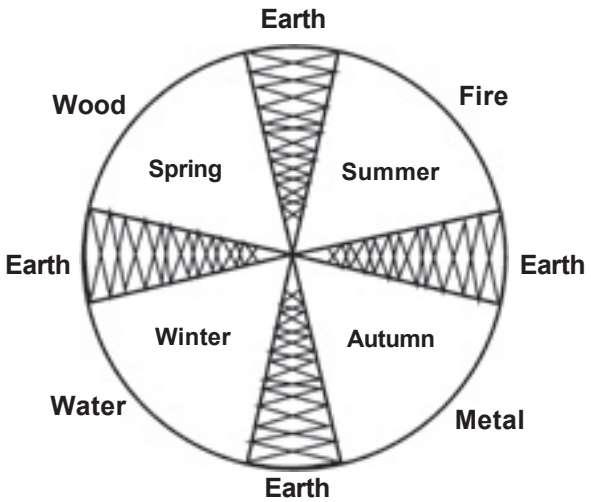

Fig. 3.11

Earth element seen as the changing and balancing point between the seasons.

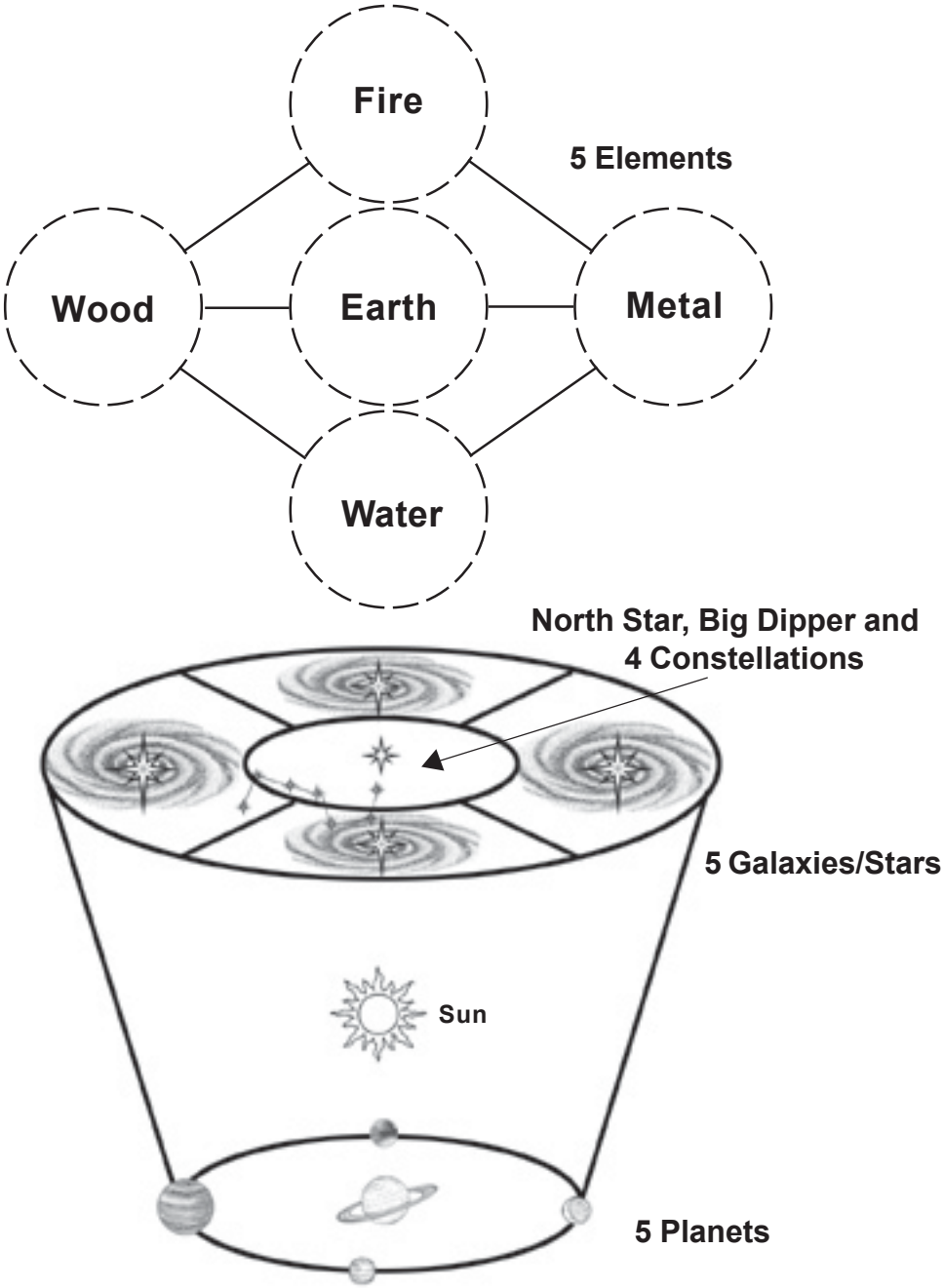

Fig. 3.12 *Five Elements through the Universe*

The dominance of one of the five elements in a person's basic energy will give a charge to the person's quality and way of living. Of course, all of us have some of all five elements but according to the year/month/day and in some systems also the hour/minute at the moment of birth, one of the five elements will be stronger than the other four. As mentioned before there are many different systems, all using different methods to make calculations. Most of them work well if we understand their point of view and if we use them as a 'whole'. Mixing different astrological systems tends to create much confusion.

The most typical positive or creative qualities of the different elements are:
Wood: Practical, creative, casual.
Fire: Lively, talkative, quick.
Earth: Stable, reliable, conservative, primitive.
Metal: Vigorous, progressive, determined, calculated.
Water: Contemplative, attentive, communicative, adjustable.

(For a better understanding of this topic, read: "Fusion of the Five Elements I", by Mantak Chia)

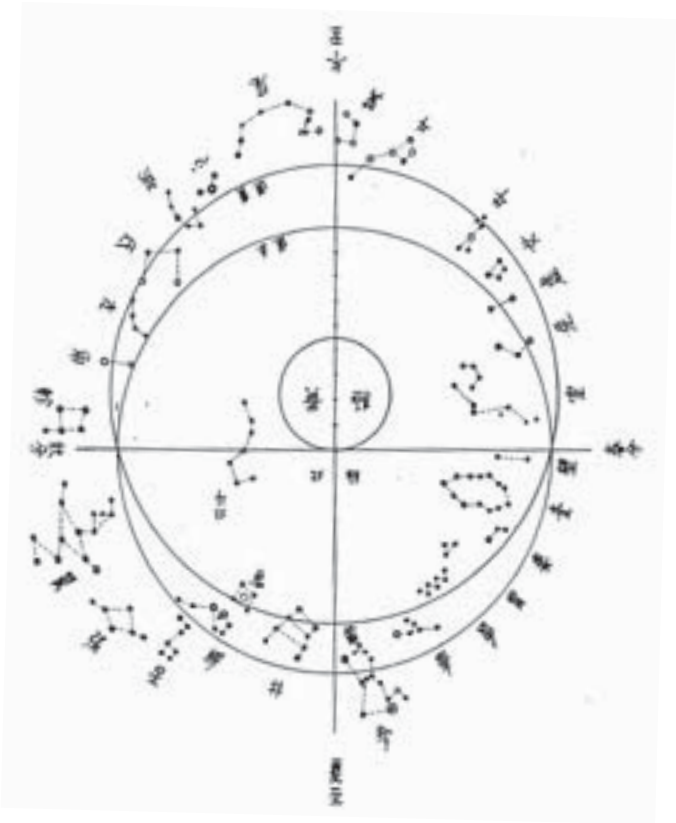

Fig. 3.13 *North Star - Big Dipper - 28 Constellations*

Pakua - Eight Forces

The pakua (or eight forces) were first described by Fu Hsi as a sign from heaven brought in the form of stripes on the back of a turtle. The I Ching or book of changes is based on the pakua. The combination of the eight directions gives birth to the 64 hexagrams also used in **I Ching** astrology. The eight directions and the center form the nine palaces used in the Chiu Kung Ming Li or Nine Star Astrology and also in the Lo-Pan, the basic tool of Chinese geomancy and in Feng Shui. The Lo Shu or Magic Square found its origin in the Lo Map and is used for prediction.

The eight different signs come from the combinations between the yin and the yang .

First there was Tai Ji (extremity) ; this produced the two poles yin and yang; the two poles yielded four phases, the four strengths: Greater Yang (Tai Yang), Lesser Yang (Shao Yang), Greater Yin (Tai Yin), and Lesser Yin (Shao Yin). The four phases yield the eight trigrams.

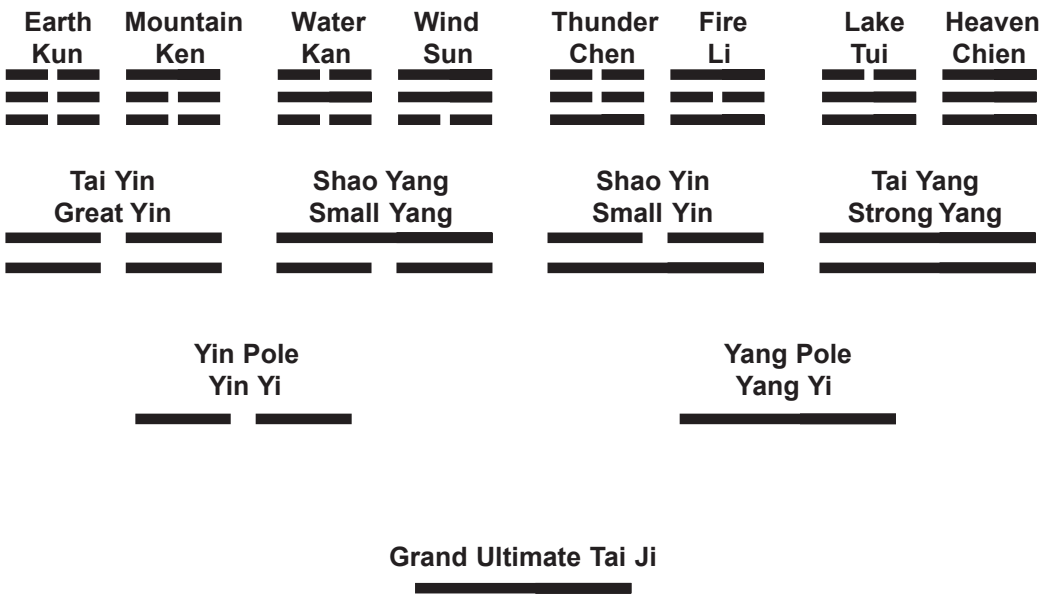

Fig. 3.14 *The eight trigrams are divided from Tai Ji.*

Fig. 3.15 *Lo-Pan or Net Tablet.*

The eight trigrams are used in different forms of Chinese and Japanese astrology and also in the Lo Shu, or Magic Square (See fig. 3.17), related to the nine main stars in the Central Palace. The eight directions and the center (9 palaces) each have their typical quality. Since the Central Palace is above the earth axis, it has the strongest effect on human energy and consciousness.

Taoist masters gave a name and a number to each of the nine stars describing the unique quality of each of them.

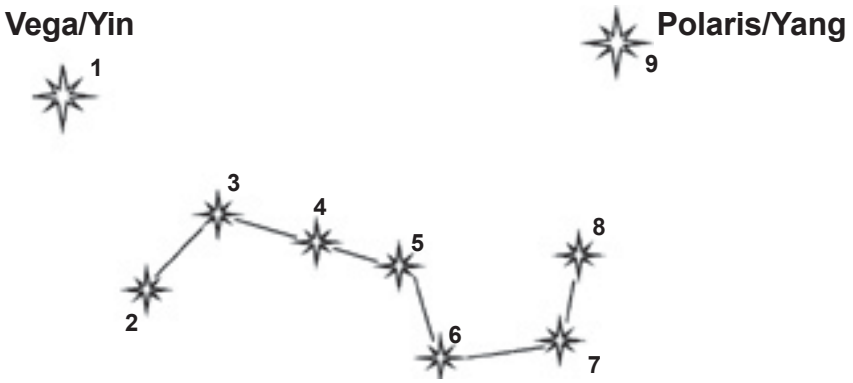

Fig. 3.16 *Nine Stars*

According to the time of birth, each of us is more or less influenced by one of the nine stars with its unique quality based on the five elements and the trigrams. During our lives we keep this basic quality but with time we will move with our numbers to other positions in the magic square (called the houses) each with its unique influence on us. While being influenced we are initiated into life's other possibilities.

4	9	2
3	5	7
8	1	6

Fig. 3.17 *Magic Square always adds up to fifteen.*

Your numbers are situated in the different palaces and will show you the Universal quality that is influencing you the most at that specific moment.
The typical qualities of the Nine Palaces are:

Chen 3	Thunder: the arousing, the new impulse, exciting.
Sun 4	Wind: the penetrating, gentleness.
Li 9	Fire: clarity, conscious, independent.
Kun 2	Earth: the receptive, trust, confidence, openness.
Tui 7	Lake: joyfulness, fullness, satisfaction.
Chien 6	Heaven: the creative, energetic, strong, light.
Kan 1	Water: prudence, dangerous, unreliable.
Ken 8	Mountain: keeping still, stability, rest.
Chung 5	Female Trigram: Kun-black earth, the receptive.
	Male Trigram: Ken-mountain, keeping still.

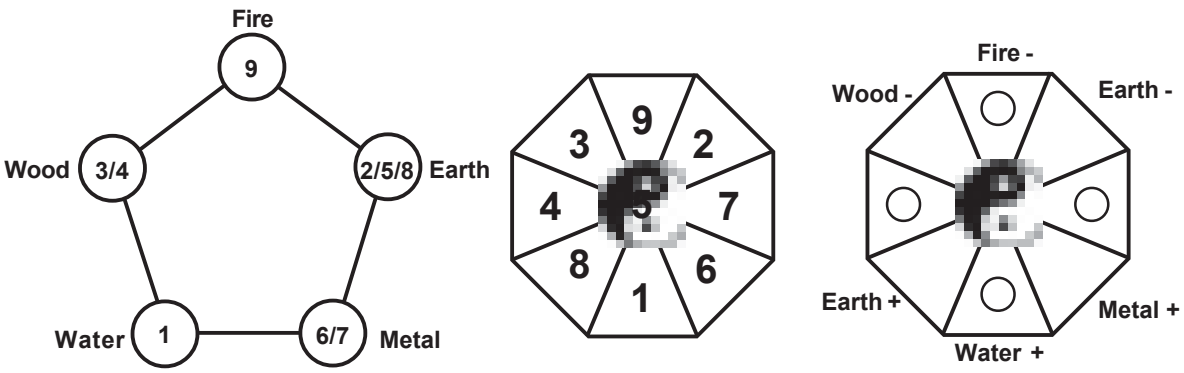

Fig. 3.18 *Numerology in the Pakua and the Five elements.*

The five elements and eight trigrams are deeply interwoven into Chinese philosophy and astrology. The eight trigrams can be seen as a further derivation of the five elements or from the four directions to the eight directions.

The symbolism in the eight trigrams is used in two different ways. One of them is called "the preheavenly pakua" according to the legendary Fu Hsi, named during the age of the five rulers (2852 B.C.). The other is the "postheavenly pakua" originally coming from King Wen of the Chou Dynasty (1122 B.C.) in his book called Yixici (YI 's related metrical composition) or Yi Da Zhnan (great biography of Yi). This is the first written explanation of the relationship between the preheavenly and postheavenly pakua. The preheavenly state is related to the time before the earth was formed, when everything was chaotic, like a cloud or mist. Nothing could be differentiated (state of Wu Chi).

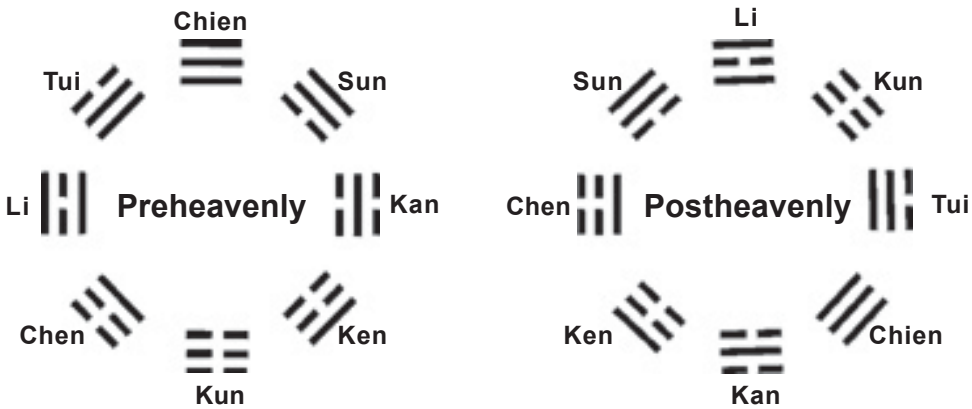

Fig. 3.19 *Preheavenly and Postheavenly Pakuas*

The preheavenly state can also be seen as the period before the time that the earth started to materialize and heaven and earth began to separate (Tai Chi or grand ultimate state). The postheavenly state begins at the time when heaven and earth were clearly distinguishable and the yin and yang pole were generated.

In human life the preheavenly and postheavenly states are separated by birth or the moment the baby can see the light or the sky.

The goal of the Universal Tao practice is to unify the pre and post heavenly states of being. The quality of the preheavenly state is the basic energy of the newborn baby, totally soft, natural and filled with its mother's essence, Chi and blood.

As well as this, intuition, flexibility, softness, tenderness and creativity are components of this preheavenly or virgin child state. In the Taoist Fusion and Kan and Li practice five virgin children are pictured to store and crystallize the pure virtue energy from the five elements.

Through the Universal Tao practices, the vital essences remain in the body until old age. The practitioner remains flexible, strong, and full of virtue. The unification of 'pre' and 'postheaven' is reached by first "training the postheaven to remedy the preheaven" and

then “training the postheaven to return to preheaven”. In the unified state the body and mind become one, in accordance with the heavenly principles.

Fig. 3.20 *Unify Postheaven into Preheaven.*

In the art of Pakua Palm (an internal martial art) the practitioner walks a circular path, stepping one by one through the different Kuas (directions) and then spiraling from one to another. In this way the embryonic formation is repeated and the deep cellular memory inside the DNA is activated. The Microcosmic Orbit has the same life spiral and intelligence inside as the DNA. Walking and spiraling in the Pakua Palm way is recreating your life process on a deep level.

Through meditation and exercises, the preheavenly mind will start to guide the postheavenly body so that the body will gradually turn into its preheavenly state.

Ten Stems and Twelve Branches

As described before the ten heavenly stems are the yin/yang poles of each of the five elements, while the twelve earthly branches are related to the twelve sections of the earth’s rotation field projected in the star world.

The 60 years of the stems and branches ‘cycle’ happens in correlation with the Jupiter/Saturn conjunction.

The whole system describes geometrical coordinates in time and space, with Polaris as the center point and other celestial bodies as references. The ten heavenly stems are often related with the planets and the five palaces in the star world.

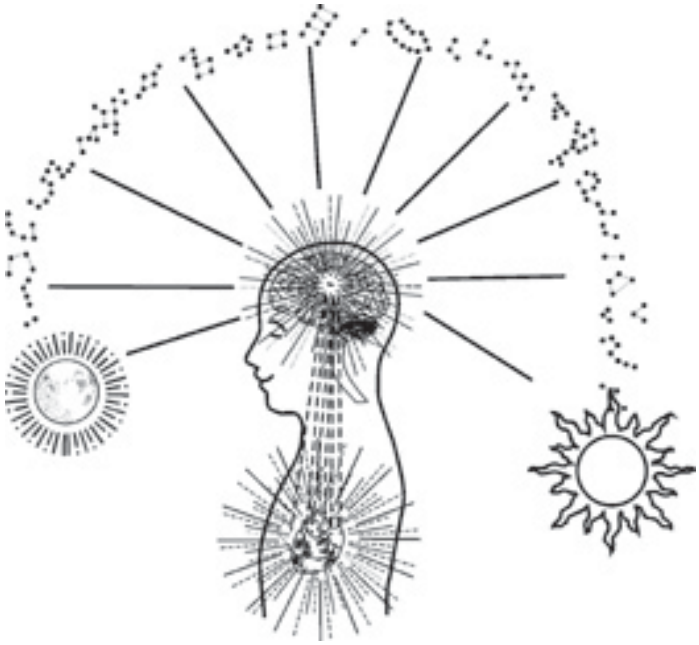

Fig. 3.21 *Ten Stems in the Sky*

Ten Stems

No.	Name	Transcription	Significance Related		
1	甲	**Chia**	Yang moving in the East; sprouting.	Fir Tree	**Wood**
2	乙	**Yi**	Plant growing in a crooked way; tendril; twig.	Bamboo	
3	丙	**Ping**	Growth in southern heart; bloom.	Torch-Flame	**Fire**
4	丁	**Ting**	Vegetation in warm season; summer.	Lamp-Light	
5	戊	**Wu**	Exuberance; substance of life.	Mountains	**Earth**
6	己	**Ki**	Winter; sleep, hibernation.	Level Ground	
7	庚	**Keng**	Fullness of crops; the West; autumn harvest.	Weapon	**Metal**
8	辛	**Sin**	Ripened fruit and its flavor; supposed to be metallic.	Cauldron	
9	壬	**Jen**	Yin at the height of its function; pregnancy.	Willow	**Water**
10	癸	**Kwei**	Water absorbed by earth; Yang preparing for spring.	Unruffled Stream	

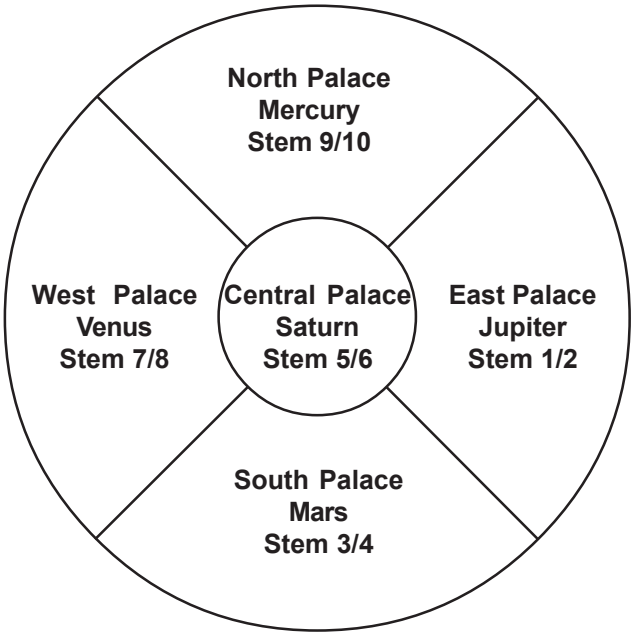

Fig. 3.22 *Branches*

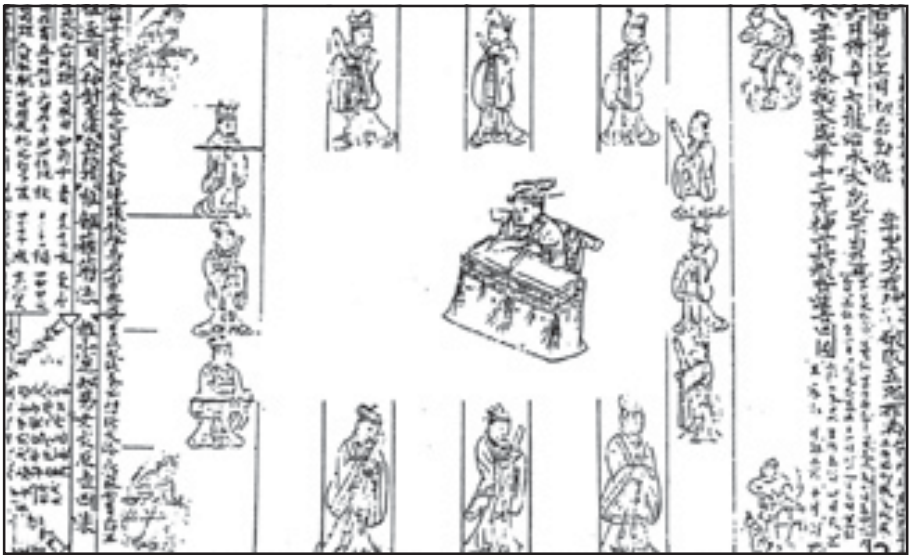

Fig. 3.23
The Deities of the Twelve Branches From a Tun Huang Manuscript Dated AD 978.

Twelve Earthly Branches or Duodenary Cycle / Twelve Animals

Twelve Branches							Twelve Animals	
No.	**Name**	**Tran-scrip-tion**	**Usual Meaning**	**Significance in the Duodenary Cycle**	**Symbol**	**Element to Which Related**	**Name**	**Meaning**
1	子	**Tze**	Child	Regeneration of vegetation	Yang stirring underground	**Water**	鼠	Rat
2	丑	**Chu**	Cord	Relaxation; untying a knot	Hand half-opened		牛	Ox
3	寅	**Yin**	To revere	Awakening of life; plants	Wriggling earthworm	**Wood**	虎	Tiger
4	卯	**Mao**	A period of time	Breaking through the soil	Opening a gate		兎	Hare
5	辰	**Chen**	Vibration	First vegetation; seed-time	Thunderstorm		龍	Dragon
6	巳	**Ssu**	End	Supremacy of Yang	Snake	**Fire**	蛇	Serpent
7	午	**Wu**	To oppose	Yin reasserting itself	Female principle in hidden growth		馬	Horse
8	未	**Wei**	Not yet	Taste of fruit	Tree in full bloom		羊	Goat
9	申	**Shen**	To expand	Yin growing strong	Clasped hands	**Metal**	猴	Monkey
10	酉	**Yu**	Ripe	Completion	Cider or wine-press		雞	Cock
11	戌	**Shu**	Guard	Exhaustion	Yang withdraw-ing underground		犬	Dog
12	亥	**Hai**	Kernel	Kernel or root	Yang in touch with Yin	**Earth**	猪	Boar

Structure of the Universe and the Process of Spiritualization

Evolving through the process of spiritualization, our spirit will enter different layers of Universal consciousness. As described in the previous chapter, the universe can be seen as three different realms: one of the pure law, one of Chi and one of the manifestations of law and Chi.

We have all arrived on this planet through a materialization process: a contracting spiral that led us through these three realms into the physical condensed form we have now. From the moment of birth and more so after the physical development has reached its biological peak. The spiritual process, an expanding spiral that projects our spirit into the universe, begins to grow.

When the level of consciousness grows, the intelligence and information network that connects each of us with the source will start to light up more and more; and we will, step by step, experience all the different dimensions of the universe, from our sexual energy to our spiritual origin. In the course of this process, you will find yourself projected into the whole universe.

Of course it is easier to take seven steps one by one, rather than trying to jump to the 7th at once. The same is true for the spiritual process. We will gradually grow through the 3 realms step by step. The seven meditations in this book will guide you all the way through the manifested world of earth, planets and stars to the world of pure Universal laws.

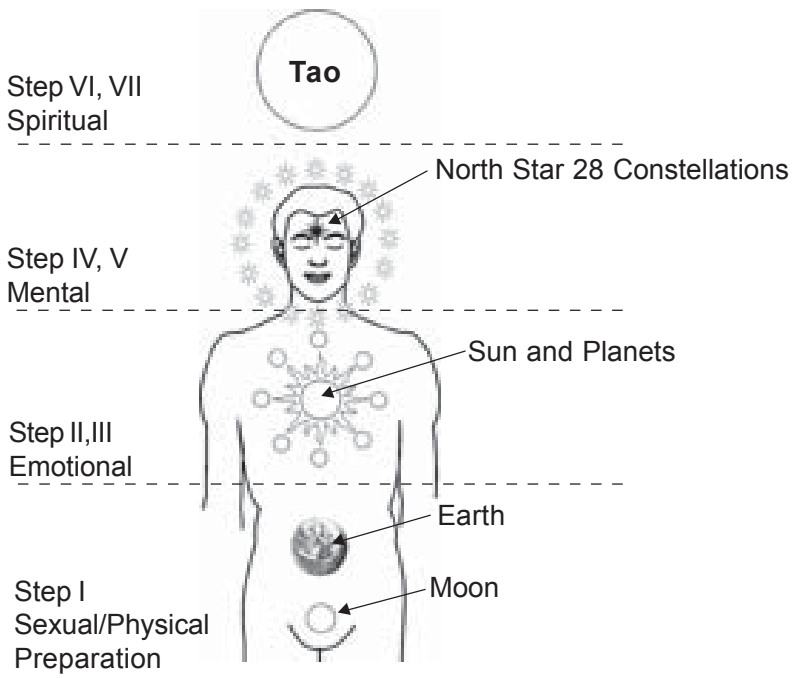

Fig. 3.24 *Seven Steps of the Spiritual Process*

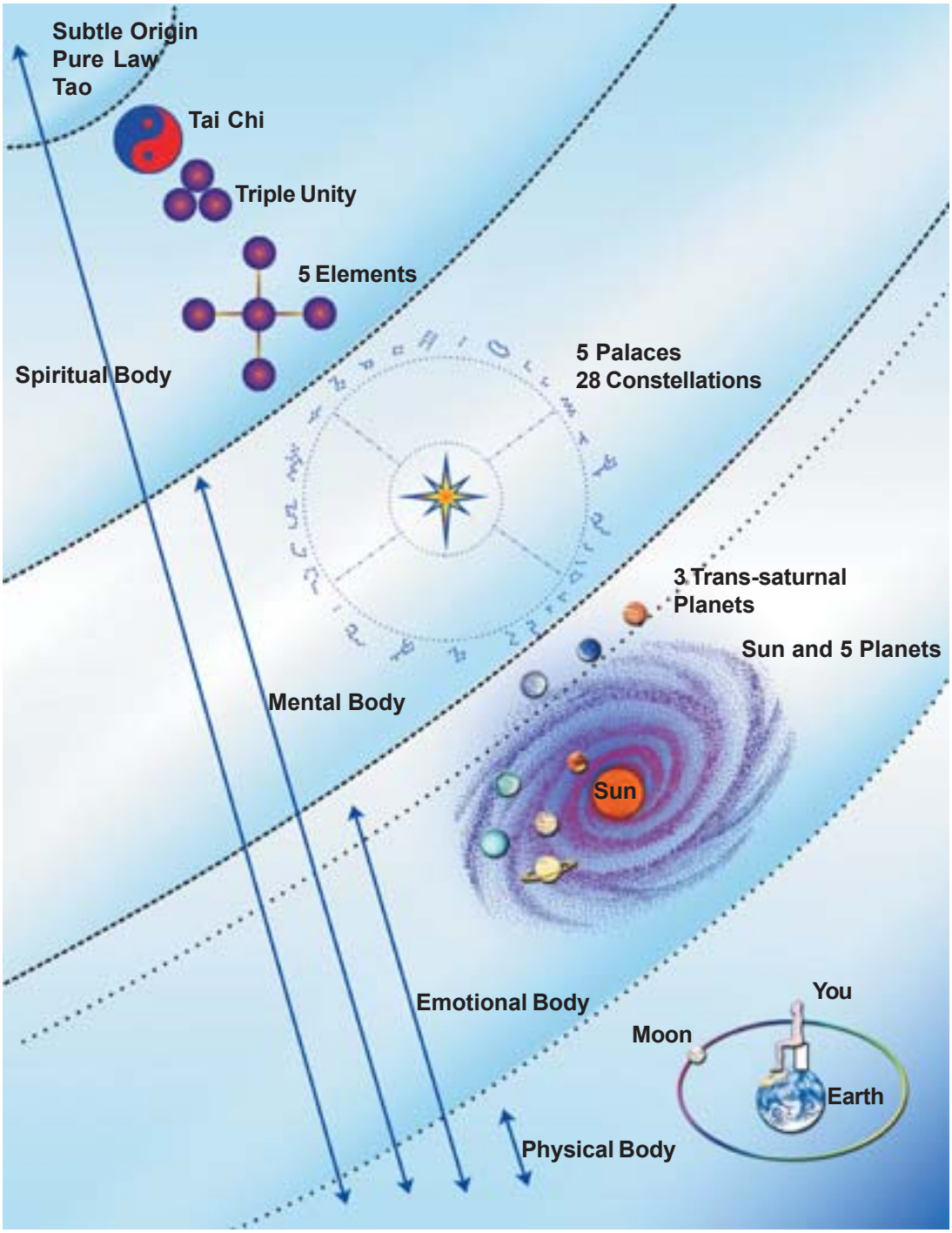

Fig. 3.25 *Human Energy in the Universe*

Step One: Earth/Sun/Moon Triangle

Before you go on this journey, it is wise to take care of your vehicle. You will need a healthy and strong body and put on your safety belt. This is the rooting or the connection with the earth.

Fig. 3.26 *Rooting to the Earth.*

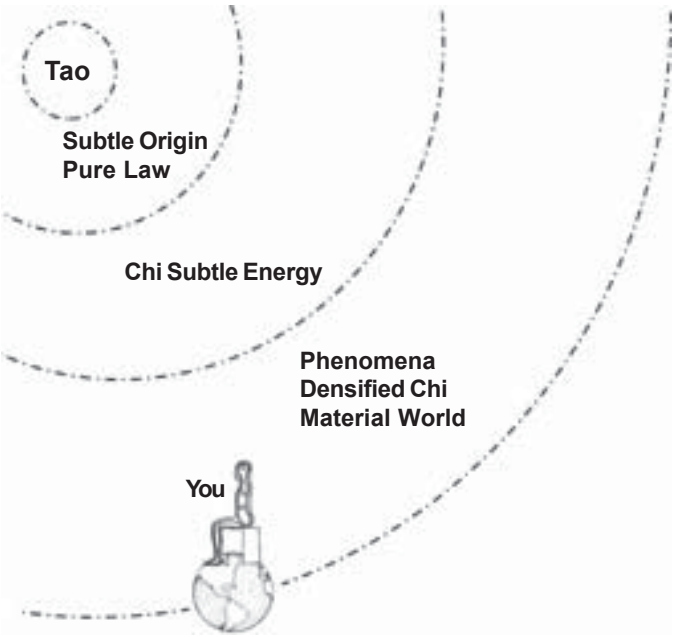

Fig. 3.27 *Three Realms in the Universe*

Now you need to learn to control, transform and use your sexual energy. Sexual energy is connected to the moon. The sun and the moon energies are easily experienced because we can see and feel them with our earthly senses. Most people do not consciously experience the effects of the moon. We cannot touch it like the earth or feel its radiant energy as easily as the heat from the sun.

The goal of our meditative practices is to tune into the energy frequencies and awareness field of the planets and stars and integrate these into our physical body. The moon is an important step in the development of our universal awareness because the moon meditation triggers deeply hidden layers of the unconscious mind connected with our sexual potential.

Our connection with the moon will help us to become profoundly aware of our sexual essence to which we cannot relate with our ordinary mind.

Through moon and sun meditations, the sexual essence which is stored deep inside the sexual organs and kidneys, becomes available and transforms from Jing into Shen, shifting unconsciousness into consciousness .

When we suppress or have no control over our sexual energy, the earth energy will be insufficient for us to keep balance and be stable enough to advance in the spiritual process. Unconsciously or consciously a part of us may be blocked by sexual frustration and its associated emotions.

All people in the modern world have a layer of heaviness and negativity on the level of their sexuality. This is based on the social/collective conditioning during many centuries of religious and scientific control.

Fig. 3.28 *Sun and Moon Balance*

Once you have built up a strong center in the Lower Tan Tien and are enjoying a good connection with the earth and have achieved control over your sexual energy, you can begin expanding your awareness field.

The Universal Tao practices lead you step by step through these levels. Without these preparations, the effects of your planetary and stellar meditations will be limited as you lack the power to attract, absorb and integrate the energy in your physical body.

Note

If you have not done any Universal Tao practices, you can also do the planetary/stellar meditations. In this case however, you have to build up your physical body/Lower Tan Tien and the star/planet connection simultaneously. Keep this balance. Build up regularly, but slowly.

The centering, rooting and cultivation process of the physical body and the sexual energy should be continuously developed because we also expand into and grow further with the universe. In this way you become like a big tree with long and deep roots and you grow the ability to lead information from the universe down into the earthly realm and into your physical body.

The picture (see Fig. 3.25) “Human Energy in the Universe” reflects how we can find ourselves back in the universal picture.

The cool moon energy in the lower body is balanced by the contact with the warm sun energy in the upper body. The sun will help us to open the heart center and feel connected to nature, the universe and other people. The sun is the central point of the solar system and governs a higher awareness than the other planets. The sun is a star in the planet world and a gate out of the planetary emotional and rational mind layer into the realm of the higher mind and the spirit. (See Fig. 3.28)

The sun and the moon need to be balanced inside to create peace between the love and sex energy, the conscious and unconscious.

Steps Two and Three

Step two in our universal awareness journey leads us deeper into our solar system. To the sun and the five basic planets. The five basic planets are a materialized form of the energy of the five elements. In the planetary world we find the sources of our collective emotional and lower mental tendencies.

First we connect with the sun and the five basic planets (Mars, Saturn, Venus, Mercury, Jupiter). We integrate their specific frequencies and their qualities/virtues and connect to these energies. The practice described in this book deals with the first five steps.

In step three we expand further out to the border of our solar system into the three planets beyond Saturn (Uranus, Neptune and Pluto). These three planets represent the part of the emotional social consciousness that has recently (the last centuries) formed along with the development of society and social awareness.

According to the Taoist tradition, the five planets can be placed in the cycle of the five elements. If we add the three trans-saturnal planets, we can link them up with these five and use them in the eight directions of the pakua (the eight-sided form). Since Chinese astrologists did not originally know about the three trans-saturnal planets, the use of the eight planets must have been introduced in this century.

Although some Chinese astrologists claim that the trans-saturnal planets were known long before their discovery in the west, we could not find any reference of astronomical/ astrological use of these planets in the old Chinese literature. Some additional planets that are used in China and known as 'counter planets' are instead energetic formations (not materialized). These same principles are also found in the Hindu and Aboriginal tradition.

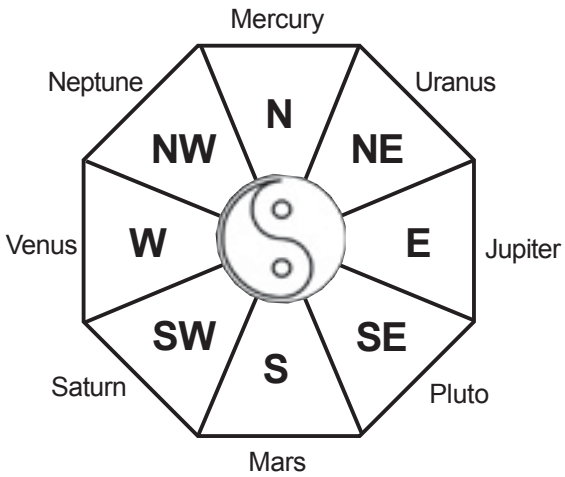

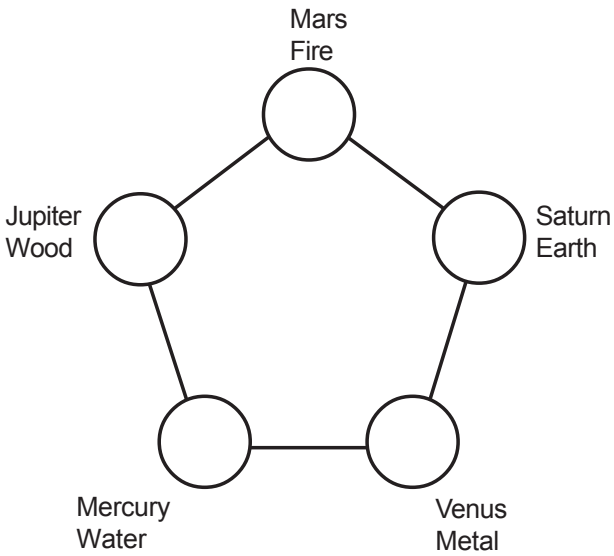

Fig. 3.29 *Five Elements*

Step Four

This step leads us to the world of the stars, star clouds and milky ways. This represents a finer quality of energy that is related to the higher world of the mind and the spirit. Taoist masters observed several thousand of years ago that the North Star always keeps its position while the 28 constellations turn around it.

For this reason Taoists have always seen the North Star as the center of the star world and also as the gate to the spiritual realm and the Tao. In the planetary and stellar meditation, we first connect with the North Star. In this way we deeply penetrate into the star world. Then connections with galaxies are established that are related to the Five Palaces/Elements.

Astrological studies of the 12 or 28 constellations combined with intensive meditation on the individual qualities of these signs can deepen our connection with the star world and can greatly accelerate our spiritual advancement. This is, however, a quite advanced and complex practice.

Step Five

We will combine the two most extreme poles in the star world: the ultra yang force of a quasar, with the ultra yin force of a black hole. We will use an uplifting spiral of these two to project an awareness in the pure yang unmanifested world.

Step Six

Here we go beyond the realm of phenomena and the realm of Chi into the realm of the spiritual laws, five elements, the triple unity, polarity and the pure law.

Step Seven

Figure 3.25 on the structure of the universe shows different layers in the universe and how to find them in the body.

The energy core of these different layers are all lined up on the Central Thrusting Channel that is located in the center between the perineum and the crown point. Step seven is what we call ‘being and living the source continuously in a state of absolute freedom’. We could also call this level zero because all separation will end in this state.

The connection and integration of the essence of these core points into our body will automatically raise our energy and awareness level and in this way trigger the connection with more subtle universal frequencies. In this way your body and the universe are becoming one. All your actions and your presence become an effortless reflection of the Tao itself.

Each of the seven steps described above is accompanied by major changes in all aspects of the practitioner’s life.

Chapter IV
Astronomical Overview

How to use the Astronomical Information in this Book

Astronomy is a valuable tool to understand and cultivate our relationship with the material universe. The accumulation of astronomical knowledge does, of course, not guarantee a higher energy and awareness level. The information presented may help you create a direct experiential link between where you are living now on the earth and the heavenly energies of planets and stars. Only when this direct, experiential contact is made, can the study of and meditation on the universe improve your quality of life.

In this chapter, we will summarize some basic astronomical facts. They are meant to increase your understanding of the world of stars and planets. If we study some basic astronomy and use it to expand our awareness, our intellectual mind will be more satisfied and will be able to function as a vehicle that can travel beyond time and space. Together with the accompanying pictures it is presented to give you some specific connection points during the meditations. After you have studied the information, simply put the picture in front of you and take it in deeply. Empty the mind of all other activity.

Then close your eyes, expand your awareness and travel with your intention in space. Be aware that the physical objects you are connecting to are just the materialized centers of an energy field or belt. It is the frequency and the energy in the belt that you are tuning into. So, relax.

Keep your hands on the Tan Tien and keep the energy deep inside. Repeat this process 4 to 5 times until you start to feel the connection. Use the meditation techniques as described in chapter XI.

Formation of the Solar System

Planet earth is a small planet that has an annual cycle around a middle-sized star, the sun. There are nine planets in our solar system. Together with the planetoids, satellites, comets, meteors and some gas and dust formations, they form our solar system.

The sun is 10 times as big as the biggest planet in our solar system, which is Jupiter and more than 100 times larger than the earth. Since the mass of the sun is 330,000 times greater than the earth, its gravitational force holds the earth in a fixed yearly cycle. Many believe the birth of the solar system was introduced by the implosion of a cloud of gas and dust. The reason for this implosion is still a mystery, but meteor analyses shows that an exploding star or supernova might have caused this.

Our solar system started its materialization process about 4.5 to 5 billion years ago. Around that time, a cloud charged with cosmic dust gathered at the edge of the Milky Way. The centripetal force in the cloud caused the formation of a more dense center. This created heat, which speeded up the rotational force and flattened the form. After millions of years the immense gathering of energy in the center caused a nuclear reaction and self-inflammation. At other places in this cloud smaller concentrations of gas and cosmic dust gathered as a result of the lower density. They did not inflame but materialized.

The specific place and orbit of each planet in our solar system is located at the balance point between the rotation force/centrifugal force and the gravitational force /centripetal force both in relation to the sun.

The planets closer to the sun were baked and became very hard because the gases were dispersed by the heat and the ion/electron wind sent into the universe by the sun. Further out from the sun, the temperature is much lower. The planets there materialized into big balls of fluid gas with a vast center, often with a crust of frozen substance.

Expansion and Contraction of the Solar System

Astronomical studies tell us that there are billions of milky ways in the universe and that there are also billions of stars in most of these milky ways. Our solar system travels through the universe at a speed of about 300 km/sec. Even at this speed it takes about 230 million years for our solar system to make a complete cycle through the Milky Way. During such a cycle or what is called a galactic year, the solar system is not always at the same distance from the center of the Milky Way.

When the solar system is closer to the center this is called the galactic summer. Our solar system responds to the stronger contractive force at this point in the galactic year. The planets come closer to the sun in this period, the atmosphere heats up and greatly enhances the size of the flora and fauna. When the solar system is further away from the center of the milky way, the solar system expands, so a greater distance arises between the earth and the sun. This creates lower temperatures and plants and animal species will be smaller (more arctic).

It is generally believed that the first life forms on earth appeared some 3.2 billion years ago. This means that the earth moved about 13 cycles in the milky way.

Fig. 4.1 *Formation of our Solar System*

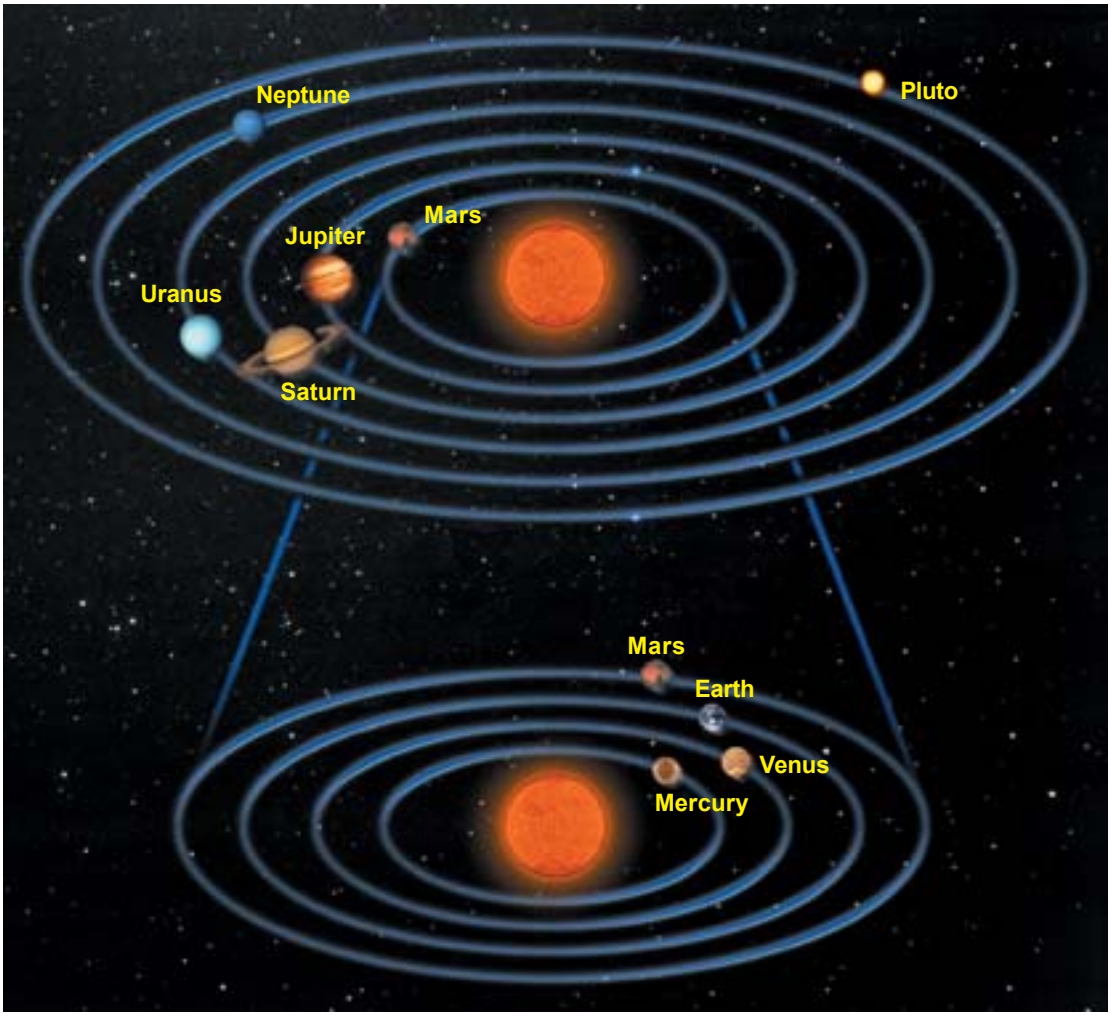

Fig. 4.2 *Overview of the Solar System*

Overview of the Planets in Our Solar System

Earth

Fig. 4.3 *Earth Field*

Planet earth is a blue planet with a moderately humid climate and a lightly unstable surface, 70% of which is covered by water. Its atmosphere consists mainly of nitrogen and oxygen. Under the 32km (approximately) thick earth crust we find a 3000 km thick inner mantle. The core of the earth is a moving sea of liquid nickel and iron, which creates a strong electromagnetic field. It rotates around its axis in one day and around the sun in one year.

Moon

Fig. 4.4 *Moon Field*

The moon is, in fact, not a planet but a satellite of the earth.

Since the moon has no protective atmosphere it has been bombarded out in space for the last 800 million years. The craters that we can see from the earth are 'scars' of this activity, their presence enabled by the absence of erosion. Stones have been found that are more than 4 billion years old, the same age as the solar system. The origin of the moon in relation to the earth is still a mystery. Its rotational speeds around its axis and around the earth are about equal; 28 days. For this reason we always see the same side of the moon. Temperature extremes vary between + 127 °C and - 173 °C.

Sun

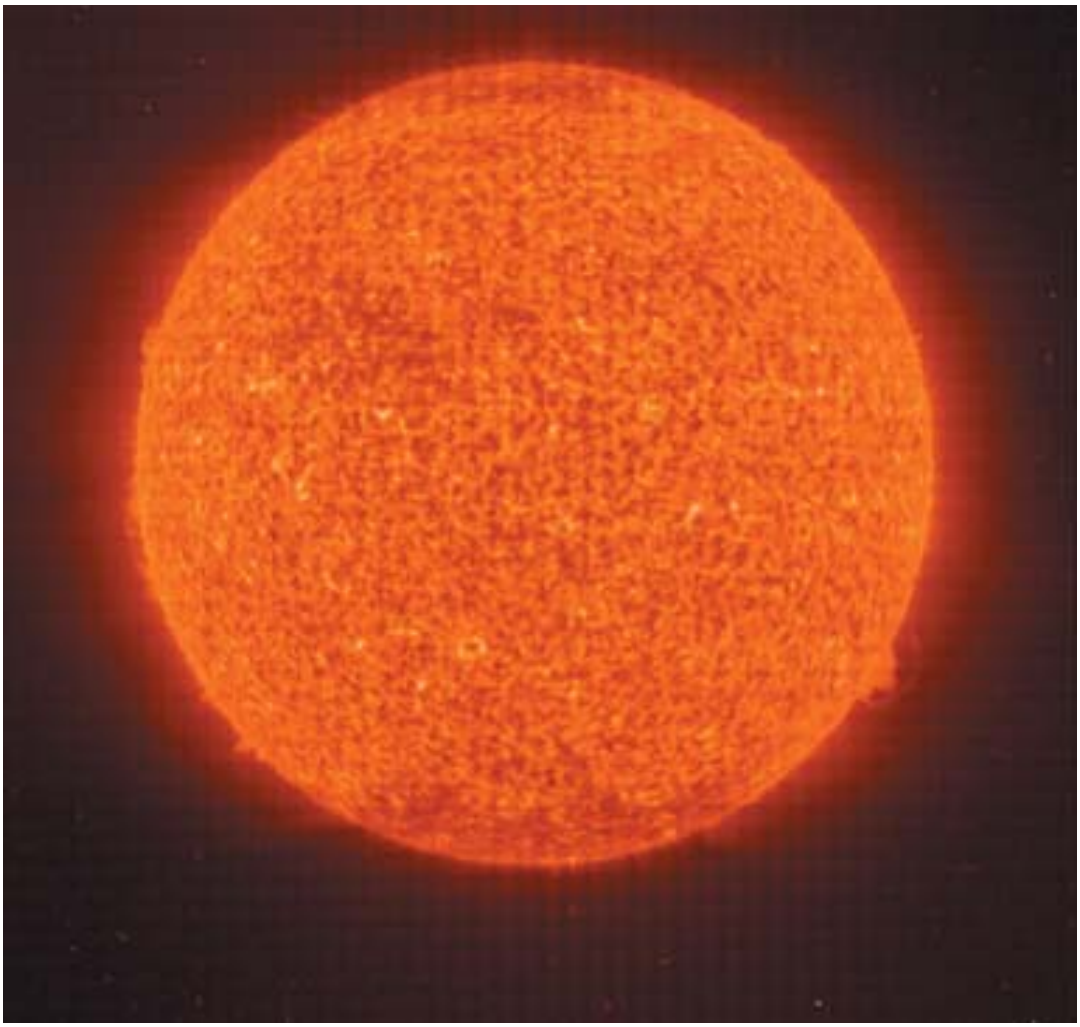

Fig. 4.5 *Sun Field*

The sun is the giant of our solar system, with a bigger mass than all planets put together. Compared to other stars it is small to medium sized. It is the main light source in our solar system and in this way generates life on our planet. Its main components are hydrogen and helium. The sun radiates enormous amounts of light particles and radioactivity. It turns around its axis in 246 days. The temperature in the center of the sun is about 15 million °C.

Each second the sun radiates more energy than man has used since the beginning of civilization.

Mercury

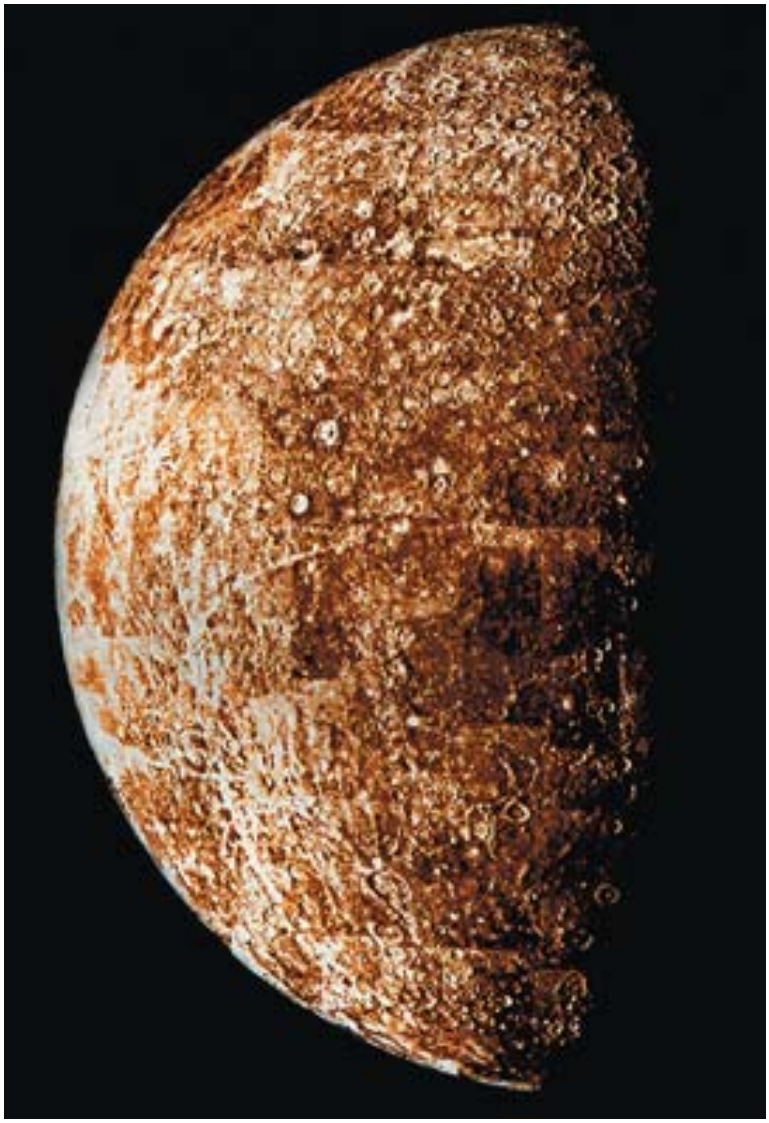

Fig. 4.6 *Mercury Field*

Mercury is like a giant cinder with a strong pockmarked surface.

Its proximity to the sun has caused its atmosphere to be burned away completely. On the sunny side the temperature rises to 430 °C, on the dark side it drops to - 170 °C. It turns around the sun in 88 days and has a rotational speed around its axis of 58.6 days. The marked surface may also be the effect of shrinkage.

Venus

Fig. 4.7 *Venus Field*

In the past, Venus was called the ‘clear morning star’ or by others the ‘clear evening star’. The reason for this is that when viewed from the earth it swings across our ‘planetary view’ over a period of about sixteen months. For about eight months it is clear in the morning and the other eight months it is clear in the evening. Its surface is covered under a thick atmosphere where temperature rises to 500 °C. The atmosphere allows sunlight in but not out, which causes a greenhouse effect. A constant acid rain (carbon dioxide and sulfuric acid) falls form the clouds. It turns around the sun in 225 days and around its axis in 243 days. The pressure of its atmosphere is about 90 times greater than that of earth.

Mars

Fig. 4.8 *Mars Field*

The red planet is a giant sand desert where huge storms occur regularly. It also has ice caps on the poles just like the earth and several giant volcanoes. The highest one is 2 ½ times as high as the Mount Everest.

It has a thin, pink atmosphere and a deep red surface. Temperatures are between + 20 and - 140°C. It rotates around the sun in 687 days. A Martian day also takes about 24 hours. It may have had water on its surface in the past and a denser atmosphere.

Jupiter

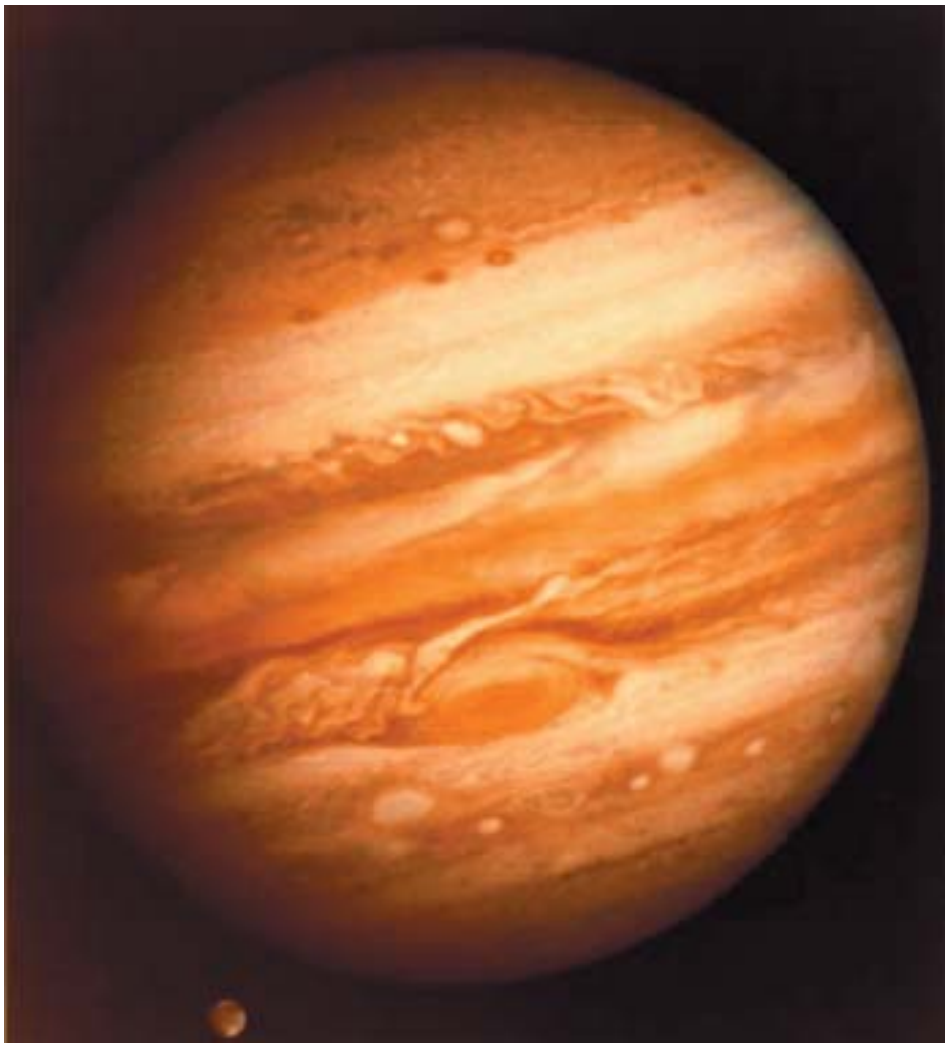

Fig. 4.9 *Jupiter Field*

The largest planet in the solar system with a diameter nine times greater than the earth. Because of its constant light during the night, the Greeks called the planet the supreme god. Giant storms with speeds of 350 km/h, lash the dust from the surface up to 25k.m. high. The atmosphere mainly contains hydrogen. Just like the sun, its composition is 9 parts hydrogen, 1 part helium. Because of its smaller mass, it never self-ignited, keeping its temperatures much lower (between + 25 and – 150°C). The center is about 20,000°C. If its mass was 50 times bigger, we would have had two stars in our solar system creating a completely different environment. Jupiter has 16 satellites.

Saturn

Fig. 4.10 *Saturn Field*

This pale yellow giant looks a little like Jupiter. It has the same 3-layer atmosphere and huge storms (speeds of more than 1500 km/h have been measured). It is surrounded by thousands of rings (containing ice and rocks), making it look like an old gramophone record. The temperatures on its surface are around -150°C. It is the lightest planet in our solar system. If we could drop it in water it would float. Seventeen satellites have been discovered around Saturn.

The Three Trans–Saturnal Planets

Uranus

Fig. 4.11 *Uranus Field*

Uranus is the only planet which lies on its side as it revolves around the sun. It is invisible to the naked eye and was unknown until 1781. The astronomer William Henschel discovered it with the use of a telescope. According to scientific models, the outer layer would consist of hydrogen and helium covering a mantle of fluid frozen methane, ammonia and water. Inside would consist of a stony center of metals and silicate. The temperature would be around – 215 °C. It has a diffuse belt of rings and 15 satellites.

Neptune

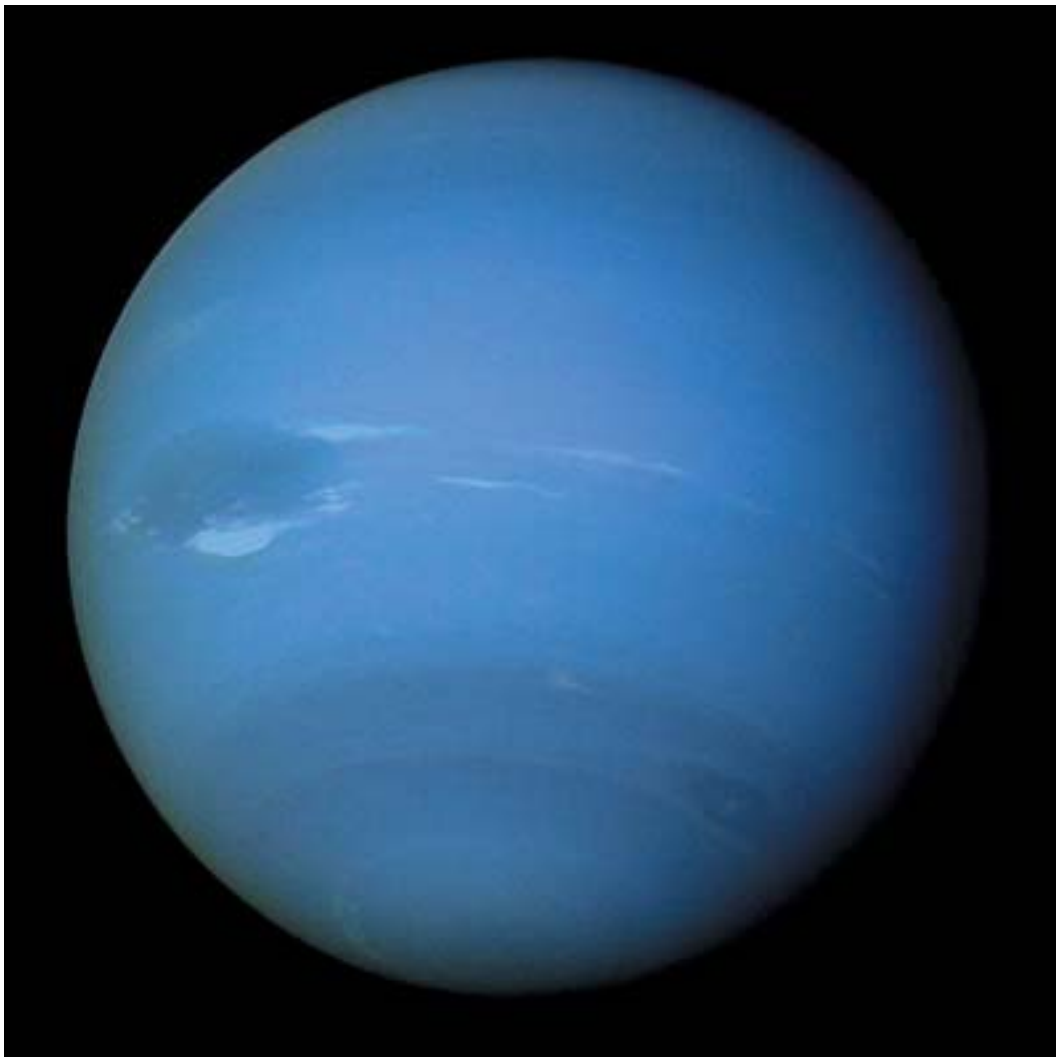

Fig. 4.12 *Neptune Field*

Neptune was first discovered through mathematical calculation before it was ever seen according to the changes in the orbit of Uranus. In 1846, J. Galle discovered Neptune where the mathematicians predicted it to be.

The scientific model developed for Neptune shows a very similar structure and composition to the earth.

Pluto

Fig. 4.13 *Pluto Field*

Clyde Tembough discovered Pluto in 1930. It has an orbit about 6 billion km away from the sun. It has a diameter of about 2300 km (the earth's moon is 3476km) and a mass more than 1/400 of the earth. This frozen stone clump has a thin atmosphere of methane and surface temperatures of – 210 °C. It has an orbital angle of 17°, which is unique in the planetary world. It also has a strong elliptical orbit causing a crossing of the Neptune orbit.

The inner part of the solar system contains four similar, more rocky planets: Mercury, Venus, Earth and Mars. This is followed by an asteroid belt containing millions of irregularly shaped stones. Further out are the four gas/ice giants, Jupiter, Saturn, Uranus and Neptune. Pluto is the farthest planet out in our solar system. It is a very 'small' frozen rock which might previously have been a satellite of Neptune. Many astrologists and astronomers talk about a 10th planet being further out in the solar system. This planet would have a mass twice to five times greater than the earth. This would explain the changes in the orbits of the outer planets. Since Pluto's mass is very small, another planet is probably causing this effect. The angle of the 10th planet's orbit would probably be about 75°.

The planetary field is the central area in our solar system. It is a very little part of the solar system. The cometary field is estimated to be 3850 times bigger than the planetary field. The outer edge our solar system almost touches other solar systems. The nearest solar system is Alpha Centauri. All together these solar systems move around the center of the Milky Way at a speed of 300 km/sec. It takes more than 200 million years to finish a complete cycle around the center of our Milky Way.

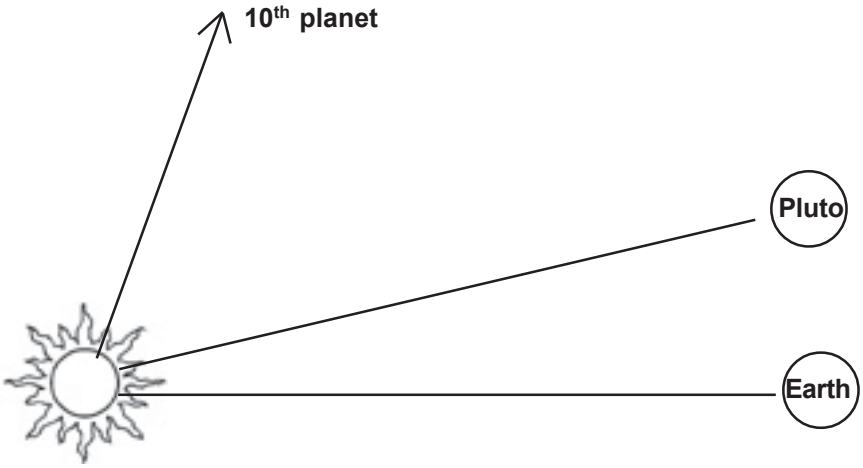

***Fig. 4.14 10th** 'Unnamed' Planet (Chiron), Pluto, Earth and Sun*

It is not accidental that the three outer planets (Uranus, Neptune and Pluto) were only discovered during the last 150 years. As human evolution moves towards the center of the spiral we experience an increasing speed of events (reaching a peak around 2100). This whirlpool of events strongly activates the collective consciousness field. If the body's energy system and the soul connection are not developed, this spiral and the trans-saturnal planets can create a great deal of confusion, exhaustion and mental and emotional imbalance.

But, if we can integrate these forces they will trigger unique human abilities at the level of mind and spirit and the collective social consciousness.

In 1977 a large asteroid like planet was discovered. It has its orbit at its closest point (to the sun) between Saturn and Uranus and at its farthest point far beyond the orbit of Pluto. In this way this planet connects the personal planets with the trans-saturnal planets which are related to the collective consciousness. Astronomers named it Chiron, which is the name of a Greek mythological figure being half-human/half-horse. It is a symbol for healing. Also, since 1977 healing arts have rapidly developed and spread on our planet.

As time goes by, more universal knowledge will be gained, always being connected to related changes in the personal and collective consciousness.

Stars and Galaxies

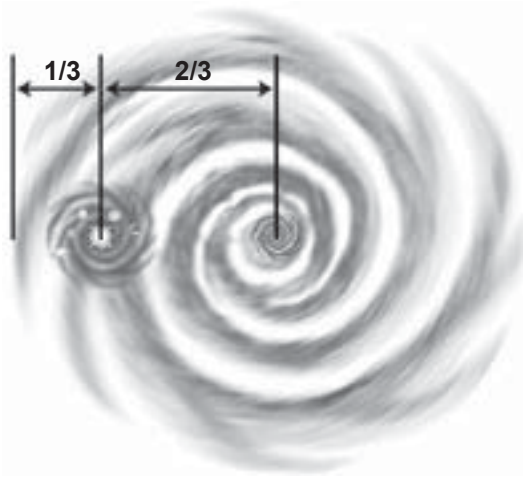

Fig. 4.15 Our Solar System in the Milky Way

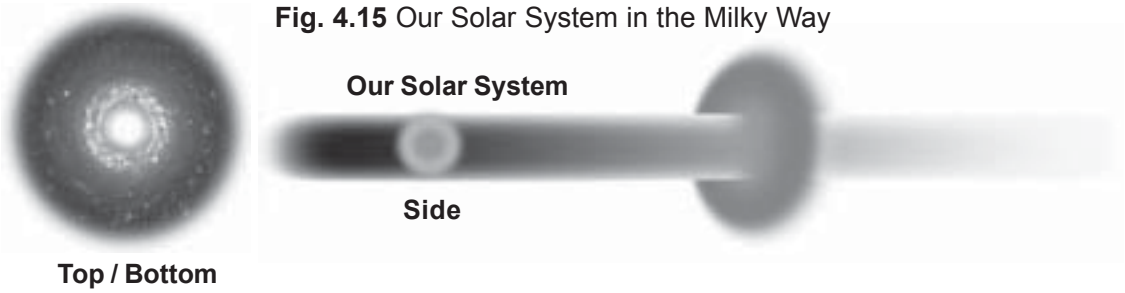

Fig. 4.16 *Shape of the Milky Way*

Images taken recently through the Hubble space telescope show the different stages in the birth process of stars. These pictures show that powerful energy, ultraviolet radiation and high speed gas clouds unleashed by adult stars are triggering the birth of new stars in the surroundings. Ultraviolet light emitted by the neighbor stars energizes the clouds. Inside these huge interstellar gas columns, the density can become so high that gravity takes over and causes the gas cloud to collapse and split into smaller clumps or gas eggs. When compression continues a nuclear fusion will ignite their cores so that they become fledgling stars.

The pressure and temperature in the cloud will rise to a point where nuclear reactions arise. After this point is reached, the star will shine for millions of years. A star like the sun, can live for over 10 billion years. Bigger stars are often burned out after 20 billion years. Generally speaking, we can say that the younger stars have violet/blue colors, the middle aged ones are yellowish, the older ones are red-brown and the oldest are black. As the star ages it might turn into a white dwarf through a lack of fuel, or into a supernova through explosion, or into a black hole through implosion. According to the estimated age of many stars, it is clear that our Milky Way must be over 12 billion years old.

Earth is about 1/3 of the way from the outside border in our galaxy. The galaxy has a diameter of about 100,000 light years and contains about 100 billion stars. The biggest concentration of stars is found in the central area. There are billions of other galaxies in the universe. These galaxies are grouped into clusters and in turn these clusters belong to super clusters. Our galaxy belongs to a group of about 30 other galaxies called “the local group”. The closest other big galaxy is the Andromeda nebula. We find this star nebula at a distance of 2,200,000 light years, which means that the pictures we see now were sent out 2.2 million years ago. On a dark clear night, we can see the Andromeda nebula without any binocular or telescope. Some of the stars we are seeing are in fact galaxies composed of billions of stars.

In Taoist astrology the sky is divided in 28 or 64 constellations. Astronomers often use the different distances of the stars in one constellation as proof that there is a connection between the stars in these constellations and in this way they affect the human condition. However, in the unique quality of each constellation, the real distance of the stars is just an aspect that co-creates the magnitude of the star as seen from the earth. The collective angle or direction of influence is what forms the specific group energy and connection between the stars in all constellations.

In the case of Polaris for instance, which is located in the center of the galaxy, it is certainly not the brightest star in the sky.

For the Big Dipper, the five most central stars belong to one star cluster which is at a distance between 59 and 75 light-years (the closest star cluster for us). The outer two stars are at a different distance and move in a different direction.

Different Galactic Forms

There are many different types of galaxies, but they are mostly divided into three main groups.

Fig. 4.17 *Spiral Galaxies*

Spiral galaxies, like the Milky Way, have a central elliptical region filled with many old stars. Around this center there is a sphere of old stars connected with the outer spiral arms, composed of younger stars and regions of gas and dust where stars are still born.

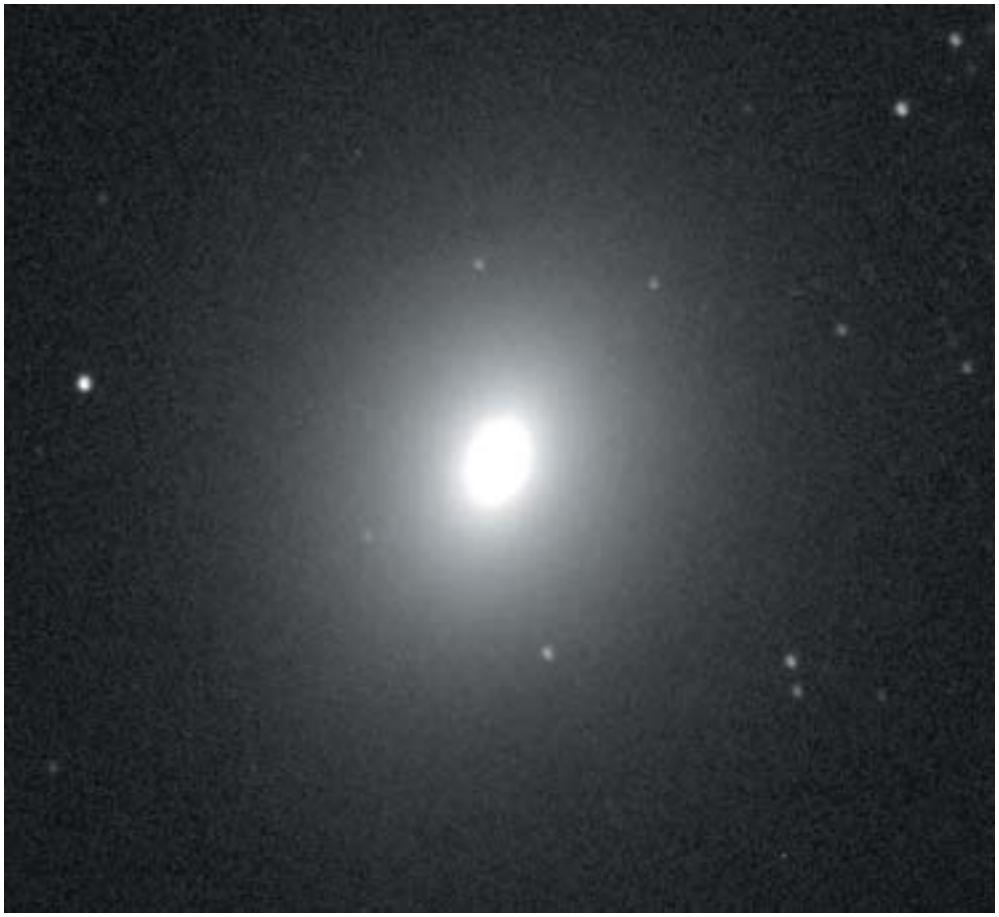

Fig. 4.18 *Elliptical Galaxies*

Elliptical galaxies contain very few young stars or gas and dust. They are mainly composed of older groupings of stars. Few stars are born here.

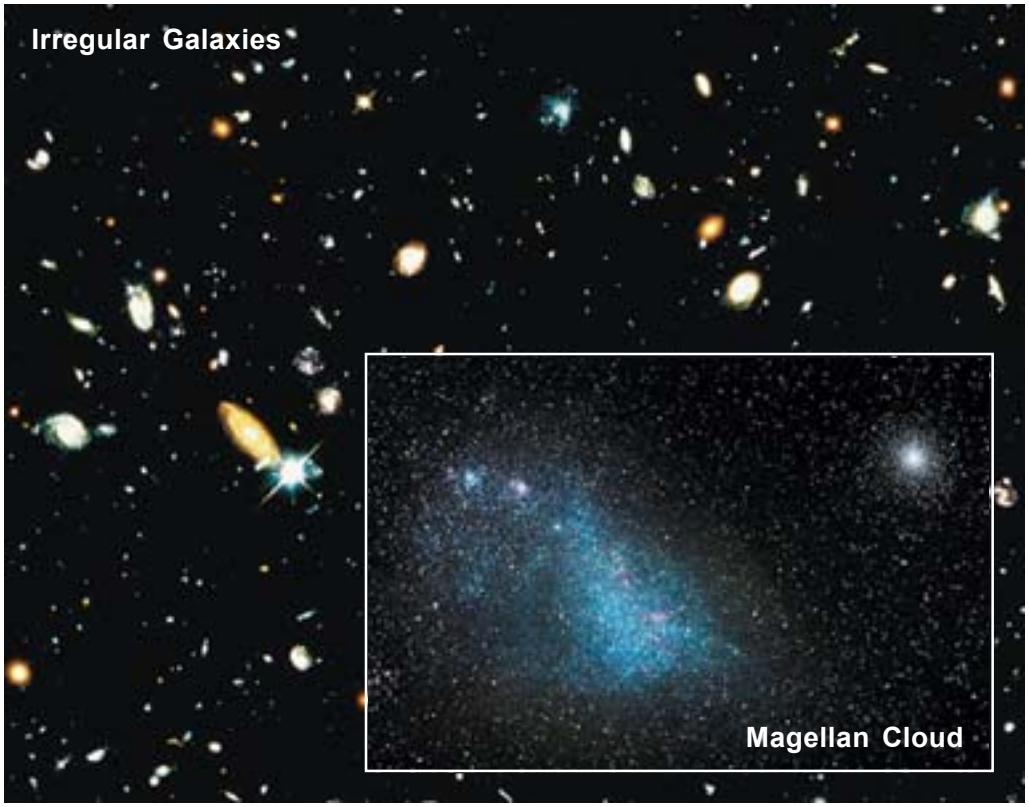

Fig. 4.19 *Irregular Galaxies*

Irregular galaxies without a particular form. One of these is the large Magellan Cloud, the companion of our solar system.

White Dwarfs, Supernovae, Black Holes, Pulsars and Quasars

As a star gets older it might turn into a white dwarf through a lack of fuel. It also can explode and in this way become a supernova, a star that is a bright as about 10 billion suns. The third possibility is implosion into a black hole, a concentration of extreme density and gravity so that according to most scientists no matter, radiation or light can escape from it. Astronomers believe that pulsars are fast rotating neutron stars that radiate light (or sound waves or radioactive waves) through a small beam, so that we can see it every time it is directed towards the earth.

Quasars are the brightest sky objects in the visible universe. They often shine with a brightness of 200 billion suns and are often visible with the bare eye even though they are at a distance of billions of light years.

Fig. 4.20 *Supernova*

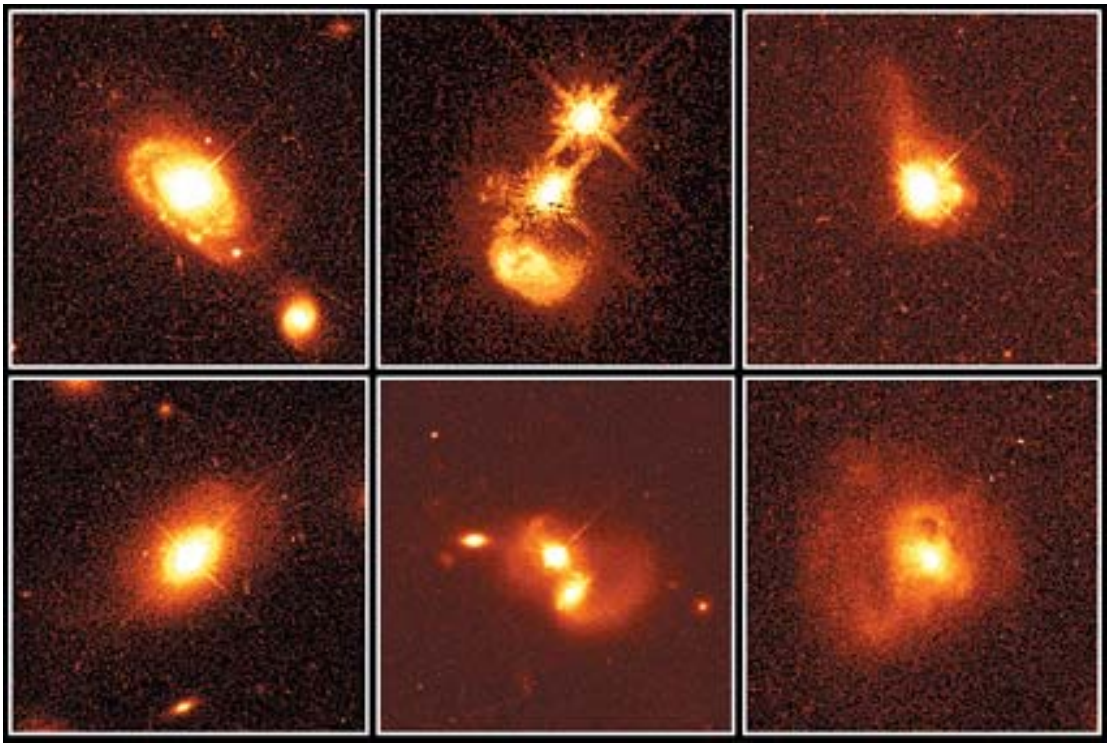

Fig. 4.21 *Quasars*

Chapter V
Taoist Star Practices and their Effect on Human Awareness

North Star and Big Dipper in the Taoist Practices

Ancient practices viewed the stars as having a material manifestation. The manifestation of the stars in brilliance, pulsation and color shows the constant interaction of these two forces. Stars were seen as the embryonic essence but also as a great source of Chi. In the stars we find high concentrations of the vital primal essence. The sun was seen as the fullest form of pure yang energy which then was divided out towards the different stars. Because of their inherent relation to the embryonic essence (like sexual essence in our body), stars were seen as forms of water energy. The expression of bright white light shows the inherent metal energy.

For the Taoists, stars are the places where immortal beings reside. Mostly in the central star palace but also in other locations. Newly born stars demonstrate that a high master has made the transition to heaven. One Han master, Ching Fong, predicted that after his death a new star would show up in Hercules and indeed, a supernova suddenly appeared just after he died.

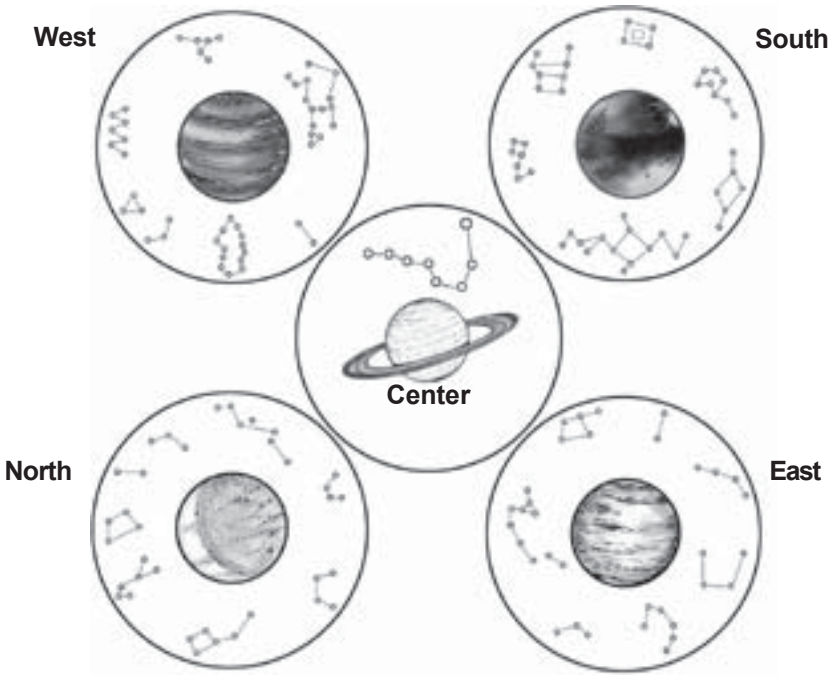

Fig. 5.1 *Five Planets, Directions and Constellations*

The Taoist masters viewed the North Star and Big Dipper as the greatest celestial sources of power. Their supernatural energy was shown by the name “yang luminosity”. The North Star has been used by many enlightened Taoist masters as a gate to the Tao. This North Star gate was used during the meditation practices and finally at the moment of dying. Other spiritual systems use other connection points or gates into the sky.

The Chinese Emperor was seen as a heavenly child. Many stars around the North Star have the name of an Emperor or one of his family members. The great one (Emperor) was often depicted with the Big Dipper in one hand and the North Star in his other hand.

Because of the wobbling of the earth axis in a cycle of 25,800 years, different stars will get aligned over the earth axis. This means that different stars will take the position of the North Star.

In some years ahead there will be a new “North Star”; it will be Vega again. From 1000 to 500 B.C. it was the star Kochab; during the time the Egyptian pyramids were being built it was Dra Thuban; about 13,000 years ago it was Vega (in Lyra). During the Ming Dynasty it was Tian Shu in the Big Dipper. Tian Shu is also the name for ‘ST 25’ the acupuncture point to either side of the umbilicus.

A name that is generally used for Pole stars is Zhong Ji - ‘Center of Heaven’, which means, “The best place in heaven” or Tai Yi “The great one”. Zhong Ji also relates to the acupuncture point ‘CV 3’ and Tai Chi with ‘ST 23’ showing the connection between the body’s meridian system in the Tan Tien area and the Taoist gate to the Universal light. Also the name ‘Pivot of Heaven’ was used. This same name was also used for Dubne, in the Big Dipper. The function of the North Star is to emit the essence, the embryonic energy flow.

The North Star has a close connection to the seven stars of the Big Dipper. The North Star is found at about 5 times the distance of the line projected from 6th and 7th Big Dipper stars. Traditionally the Big Dipper/North Star axis was used to determine the season. The North Star/Big Dipper axis is moving through the four palaces or regulating the four countrysides during the four seasons or one year.

The Dipper is the carriage of the North Star. When the spiritual essence of the Tai Yi spills over, the Dipper lets its essence fall through its seven bright gates of celestial power.

Fig. 5.2 *North Star and Big Dipper connecting with the human body.*

In the Taoist advanced practices the North Star and Big Dipper energies are connected with the differe

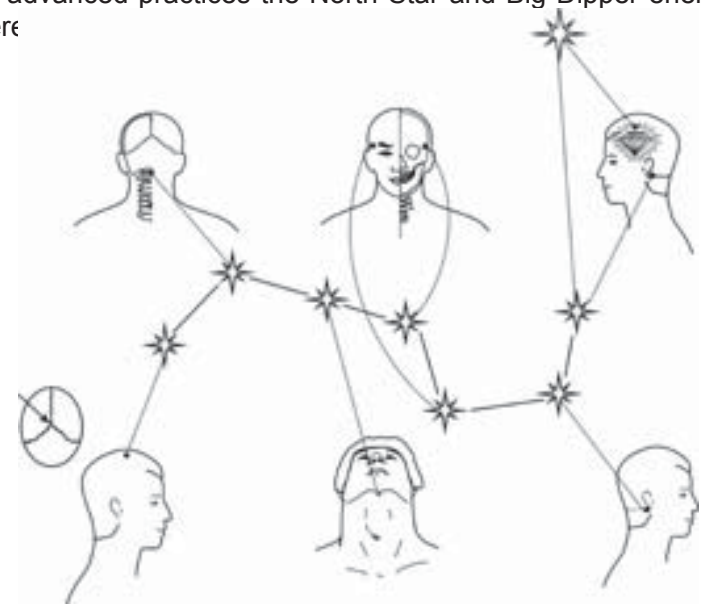

Fig. 5.3 *North Star and Big Dipper connecting with points of the skull.*

In this way the connection with the Universal Light is deeply integrated in the brain and the glands within the skull (Crystal Room/Palace, see Fig 5.5). Each of the stars has a connection with the lower planetary world (five planets, sun and moon) and with the higher vibrational world of the five elements and the pakua. According to the oracle texts of the Han Dynasty, each of the Big Dipper stars has a unique earthly manifestation in the animal and plant kingdom. The seven star principle is not unique to the Big Dipper. It can also be found back in the Pleiades, the Vermilion Bird and other constellations.

In one type of Taoist astrology the numbers 1 to 9 and the 9 energies of the pakua (8 directions and the center) were used as a form of numerology connected to the seven stars of the Big Dipper, Polaris and Vega. Since the star Vega, related to number 1 was known as a star related to destruction, it was not connected to the Crystal Room.

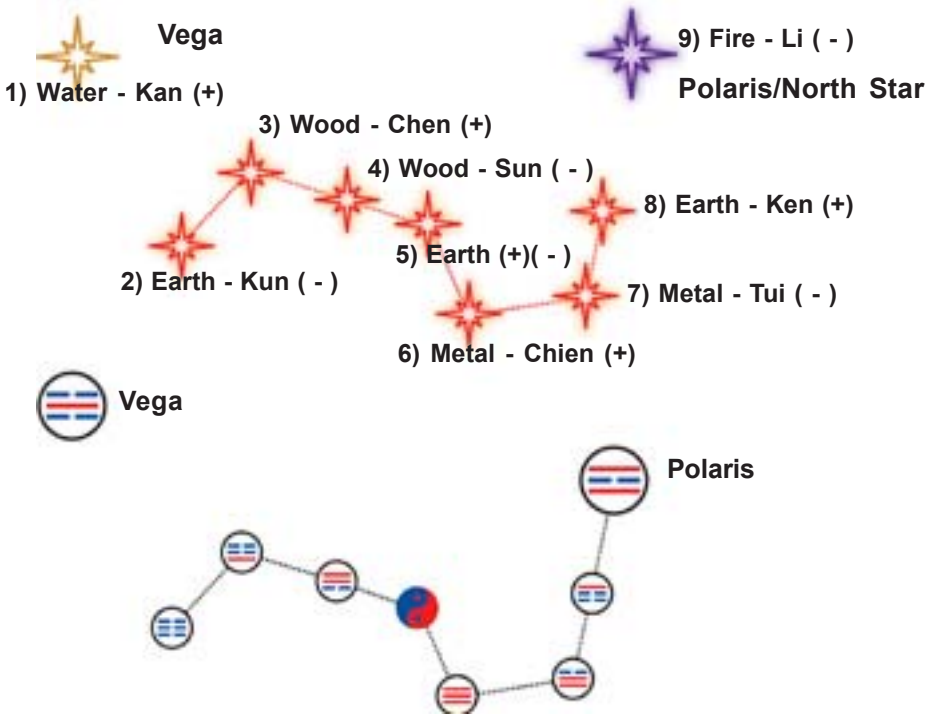

Fig. 5.4 *North Star, Vega, Big Dipper and Five Elements*

In Taoism, the nine stars of the true Dipper are used. There are the seven familiar ones and two hidden or invisible ones. According to one source these stars hold the embryonic essence (Ching) and actualizing spirit (Shen). One T'ang practice which is still used these days in China is the practice through the nine stars of the Dipper while visualizing the star Alcor and holding the breath. Just as the principle of counter planets in Chinese astrology and the modern astronomical theory that quasars and black holes might be functioning together, some Taoists believed that there are nine black stars underlying the nine Big Dipper stars.

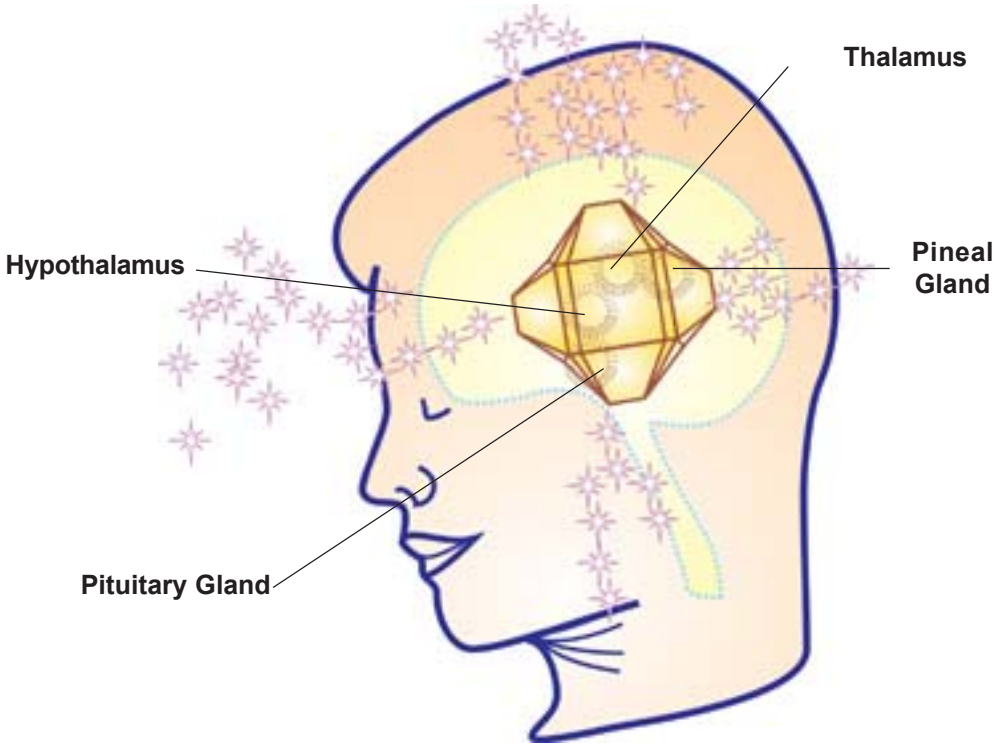

Fig. 5.5 *Crystal Palace*

In the Universal Tao meditation practices, we use the combined energy of the North Star and the Big Dipper to connect with the Universal Light.

The Big Dipper light (red) is absorbed by the thalamus and hypothalamus glands while the North Star (violet) relates to the pineal gland. The pineal gland is our internal compass, while the North Star is our external compass. Taoist masters believed that if the North Star was able to keep all the constellations in orbit, its size and mass would be enormous.

In Taoist cosmology, 28 constellations are ordered around the North Star and the Big Dipper. In each of the 28 days of the moon cycle one of the constellations reaches its maximum influence. The special magnetic field of moon and earth energies combined together, attracts these fine star energies creating a special spiritual condition on our planet.

Besides the 28 constellations around the North Star there are billions of milky ways each with billions of stars in their universe. All these stars have a direct connection with the billions of cells in our body, where at the moment of fertilization and birth a specific position gives you a unique charge and direction in life.

Through meditation practices and by way of integrating new insights and this higher awareness into your daily life, the information from these stars and your personal cells becomes synchronized. This brings you back to your true task in this life, but it also gives you access to the Universal information field. The direct connection with this intelligence will naturally provide you with all the information and life force required for you to fulfill the true life task.

The earth's rotation around its axis creates a strong electromagnetic field. The wobbling of the earth's axis creates different stellar influences with enormous effects on the conditions of our planet.

Fig. 5.6 *Earth's Rotation*

Earth Axis Wobbling and Poleshifts

The earth has three movements: it rotates around the sun (one year); it rotates around its own axis (one day); and the axis wobbles. The projection of the earth's axis to the north creates a circular form between Vega and Polaris. There is a strong electromagnetic belt around the earth because of the rotational force. This belt is strongest around the equator and weakest at the poles. The South Pole is directed towards the center of the Milky Way while the North Pole is directed towards the outside of the Milky Way.

For this reason the energy that comes through the North Pole is clearer and more subtle than the one which comes in from the South Pole. The northern sky is governed by the energy of the North Star and its 28 constellations and is considered richer in terms of star and galactic energies.

The wobbling movement of the axis of the earth has a strong effect on human civilization and the quality of life on earth. It takes 25,800 years for the earth to make a full 360° movement around its axis. The strongest activation of energy occurs when the axis is directed straight towards Polaris (the North Star at the turn of the millennium).

Around the year 2,102 the North Star will be in perfect line with the earth axis. This will highly increase the influence of spiritual energy on our planet.

The galactic year: Movement of our solar system around the center of the Milky Way. Speed 300 km/sec, 230 million years to make a complete cycle.

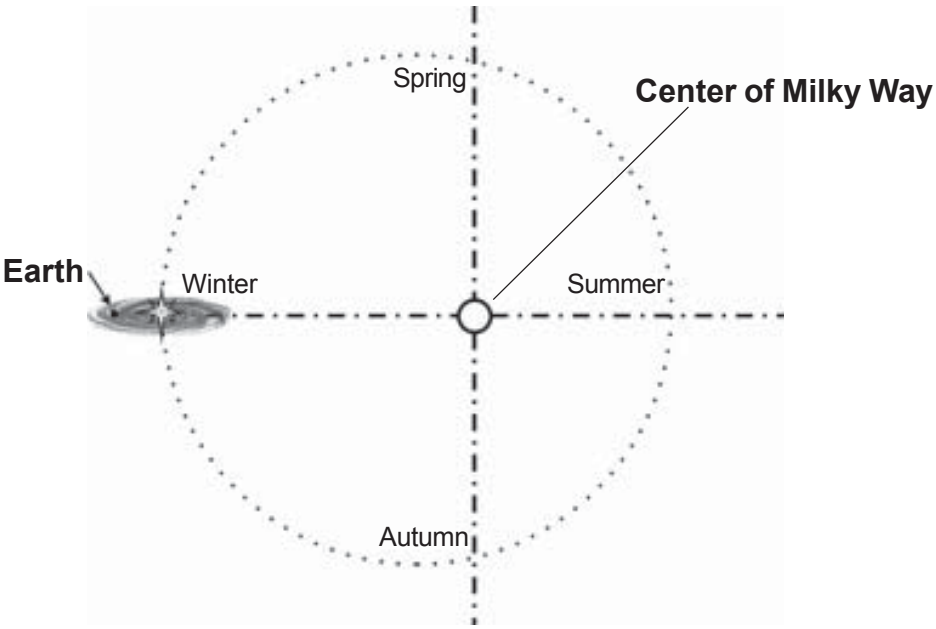

Fig. 5.7 *Galactic Year (230 Million Years)*

During the 230 million years (a galactic year) it takes our solar system to orbit the center of the Milky Way, it will be located at different distances from this center, which will create varying gravitational conditions in the solar system and on our planet.

The energy of Polaris is the yang energy from heaven related to the Governing Vessel. The energy of Vega is the yin energy from heaven related to the Conception Vessel.

During a 25,800 year cycle, the period of Polaris was traditionally seen as the light period. There was a flourishing spiritual life on earth and a period of happiness and good luck. The period of Vega (12,900 years later) is seen as the arrival of the dark period with destruction of society and a low spiritual level on our planet.

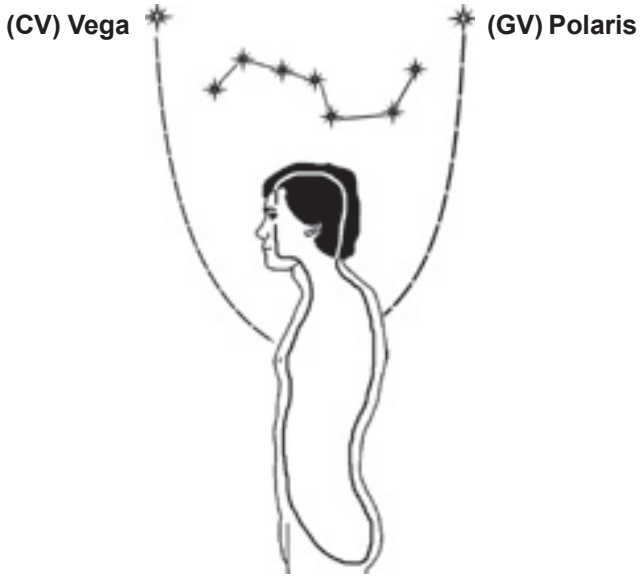

Fig. 5.8 *Nine Stars and Governing and Conception Vessels*

When Polaris is above the earth axis the Crystal Room Governing Vessel receives information and transfers it to the Conception Vessel where it is integrated. When Vega is above our earth axis, the energy is directly absorbed into the lower centers without the spiritual/universal connection. The result is isolation, arrogance and destruction.

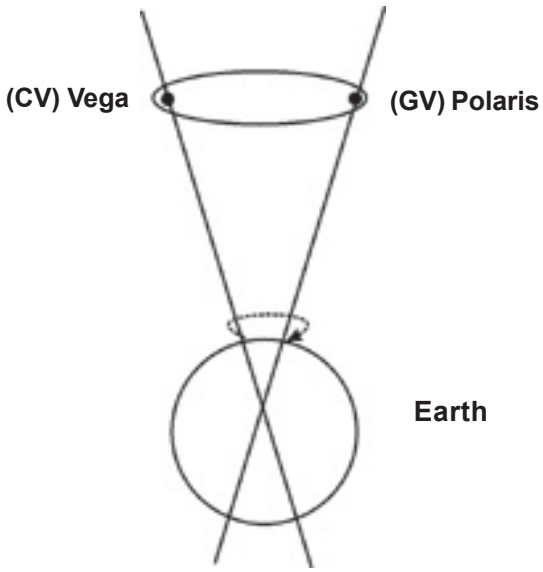

Fig. 5.9 *Pole Shifts*

Pole Shifts: The rotational force of the earth creates a centrifugal force. When this expanding force reaches a peak, an axis shift occurs. If we roll an egg away from us, at a certain point it starts wobbling and than suddenly flips over, creating another axis and new poles. According to some sources many of these pole shifts have occurred on earth. These shifts happen in a few days, creating giant shifts of the water and land and the death of millions of humans and animals. In different civilizations these shifts and floods have been known and described.

Although scientists do not agree, some believe that the famous sphinx from Giza in Egypt must have been built long before Pharaoh Chefren 2,700 B.C. The sphinx is the biggest one piece statue on earth. The famous Egyptologist, Schwaller de Lubicz, thinks that the erosion on the head of the sphinx could only have been caused by water. Around 15,000 BC the last ice age must have been at its peak. The big floods caused by the melting ice caps all happened between 10,000 and 12,000 B.C. As we explained before, these floods were caused by earth axis shifts under influence of the North Star of that time: Vega.

This data suggests that the sphinx might have come from a civilization of more than 12,000 years ago. This would also explain the mystery of Egyptian culture in many areas. Although the pyramids were built with an unknown skill and technology, the Egyptologist Borchardt states that at that time the Egyptian culture was certainly not yet highly advanced. Structures were probably built on the fragments of a lost civilization. Study of sediment in paleo-climatological research has shown that severe flooding must have occurred around 12,000 years ago. Many books from around the world speak of the lost civilization of Atlantis. It is believed to have been swallowed by the sea because of a great deluge about 12,000 years ago. Atlanteans knew of the impending destruction and sent out groups to other continents. Perhaps these emissaries from “lost Atlantis” were responsible for the spiritually advanced cultures that followed. There are other theories relating to the link between these ancient civilizations and extraterrestrial life; most notably between the Egyptian pyramids, spinning disk technology and life on Mars. Taoist masters were not alone in recognizing the 25,800 year earth axis wobble and polar shifts.

Fig. 5.10 *Sphinx and Great Pyramid in Giza, Egypt.*

As previously discussed there are many different influences affecting us at the same time. All of these influences have a unique rhythm. It is the concentration of all these rhythms, influences and positions that create a unique Universal condition at every moment of our lives. Another strong influence on human awareness is the Photon Belt. A field that our planet is slowly arriving into now. Satellites discovered the Photon Belt in 1961. Photons are very small light particles of electromagnetic energy, without mass and electrical charge and of an undefinable life span. These photons are in our atmosphere all the time but their number is gradually increasing because our planet is traveling through the Photon Belt for greater periods of time every year. From the year 2013, we will be constantly surrounded and immersed by these photons for a period of about 2000 years. The activity of the North Star and of the Photon Belt represents a unique spiritual possibility to all of us. The North American Indians, the Mayans, Tibetans and the Egyptians were amongst the ancient cultures that were quite aware of the age of light which would begin at the start of the 21st century.

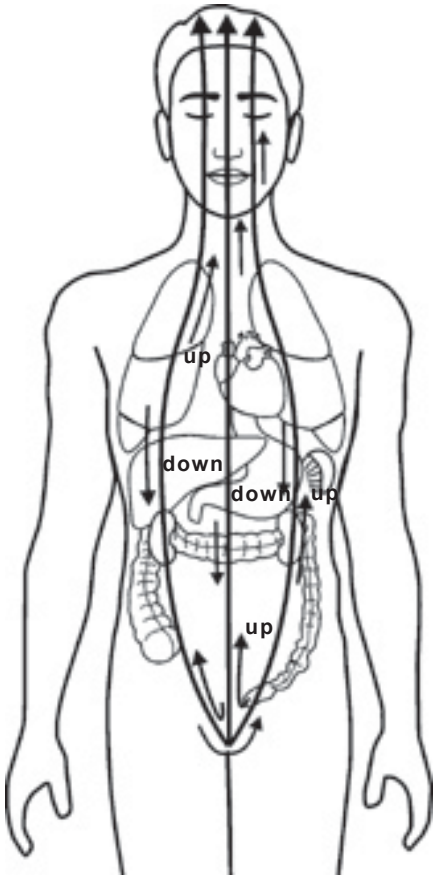

Fig. 5.11 *Three Thrusting Channels: Chi Energy can flow up or down.*

Universal Tao Practices that connect you with the unique Universal Conditions

The strong Polaris energy, which carries the information of all the stars of the northern sky, will shine straight down into the crown. It has a direct connection with the thrusting channels. These channels run through the central part of the body between the crown and the perineum.

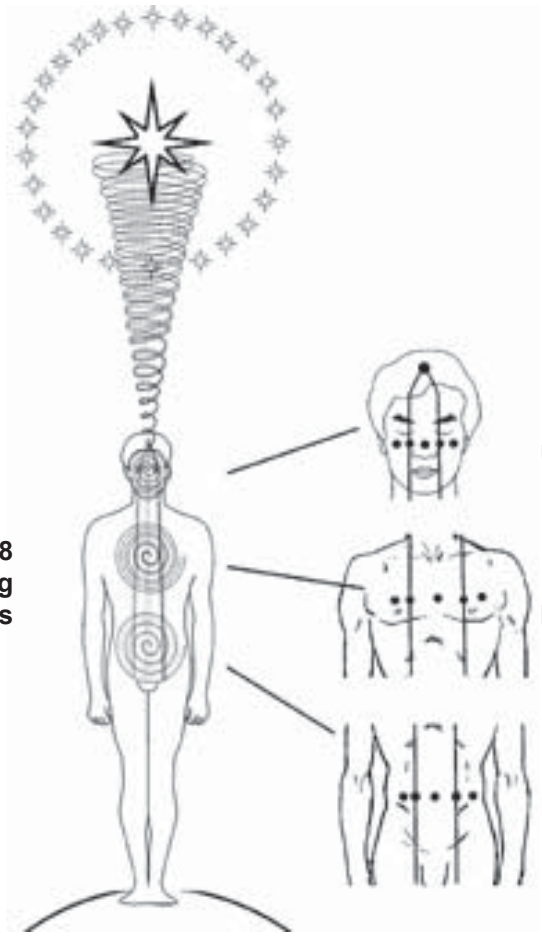

The North Star and the 28 Constellations activating the Thrusting Channels and the 3 Tan Tiens.

Fig. 5.12 *Polaris Energy connecting with Three Tan Tiens and Thrusting Channels*

There are Three Thrusting Channels: one central, one left and one right. They create left/right balance and a direct vertical connection between all the important organs. The influence of this spiritual activation is already quite apparent in present human behavior and interest. More and more people are attracted to meditation, spirituality and self-development. In the next century, their number and the depth of their spiritual growth will certainly increase.

Another clear sign that humanity is quickly moving towards a new phase in its evolution and into a new direction is the fact that many things in society are changing at a dazzling speed. More than any time before in human history, the pace of life has quickened; many people feel highly pressured and confused, as they desperately try to keep up with the changes in all dimensions of social life and social realities, with encompassing changes occurring in such domains as science and technology, family ties, communications and security. Many people experience this whirlpool of change as a direct challenge to their currently weak condition and as a major reason for loss of energy.

The arrival of the light period in connection with the North Star activation must be seen as a possibility we have to fill in ourselves and not as a gift that will be automatically delivered to our home.

Although the transformation of energy is in principle available to everybody, our overall condition and the direction of our focus will greatly determine the level of integrating the newly arising condition of energy in the universe.

It is important to remember that health and freedom greatly depend on our ability to follow and integrate these universal changes. In the same way as an amoebae opens and closes and the heart expands and contracts, human evolution goes through phases (every 25,800 years) in which it flourishes and enters into decline. These phases are dictated by the earth's axis in the northern sky.

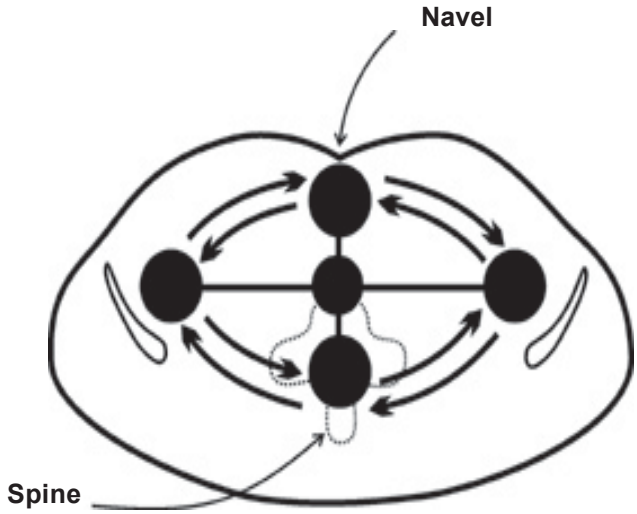

Fig. 5.13
Belt and Thrusting Channels at the Level of the Navel (Lower Tan Tien):
These Energy Channels run throughout the Body
and are Interconnected by Circular Horizontal Energy Bridges.

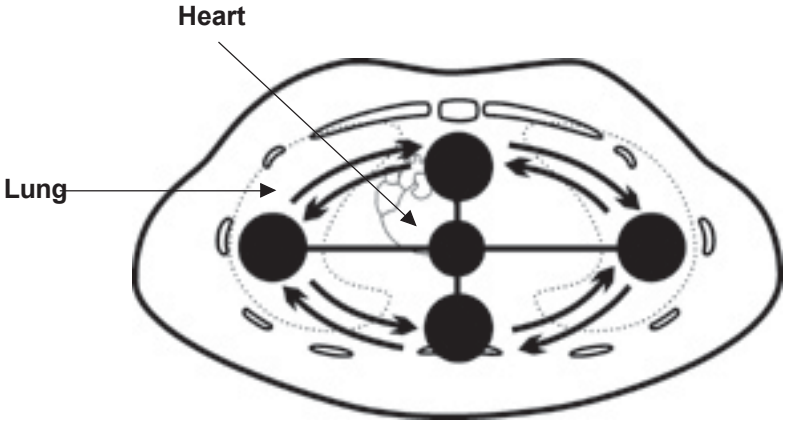

Fig. 5.14 *Belt and Thrusting Channels at the Level of the Heart (Middle Tan Tien)*

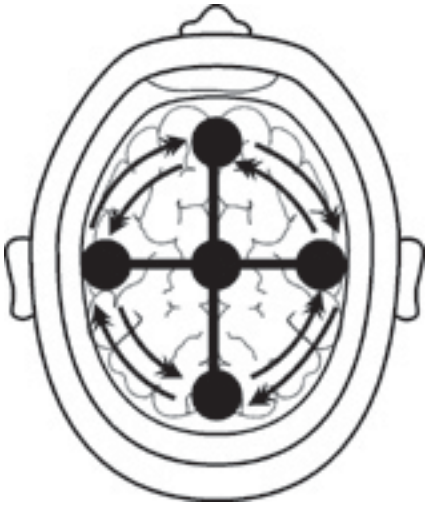

Fig. 5.15 *Belt and Thrusting Channels at the Level of the Crown (Upper Tan Tien)*

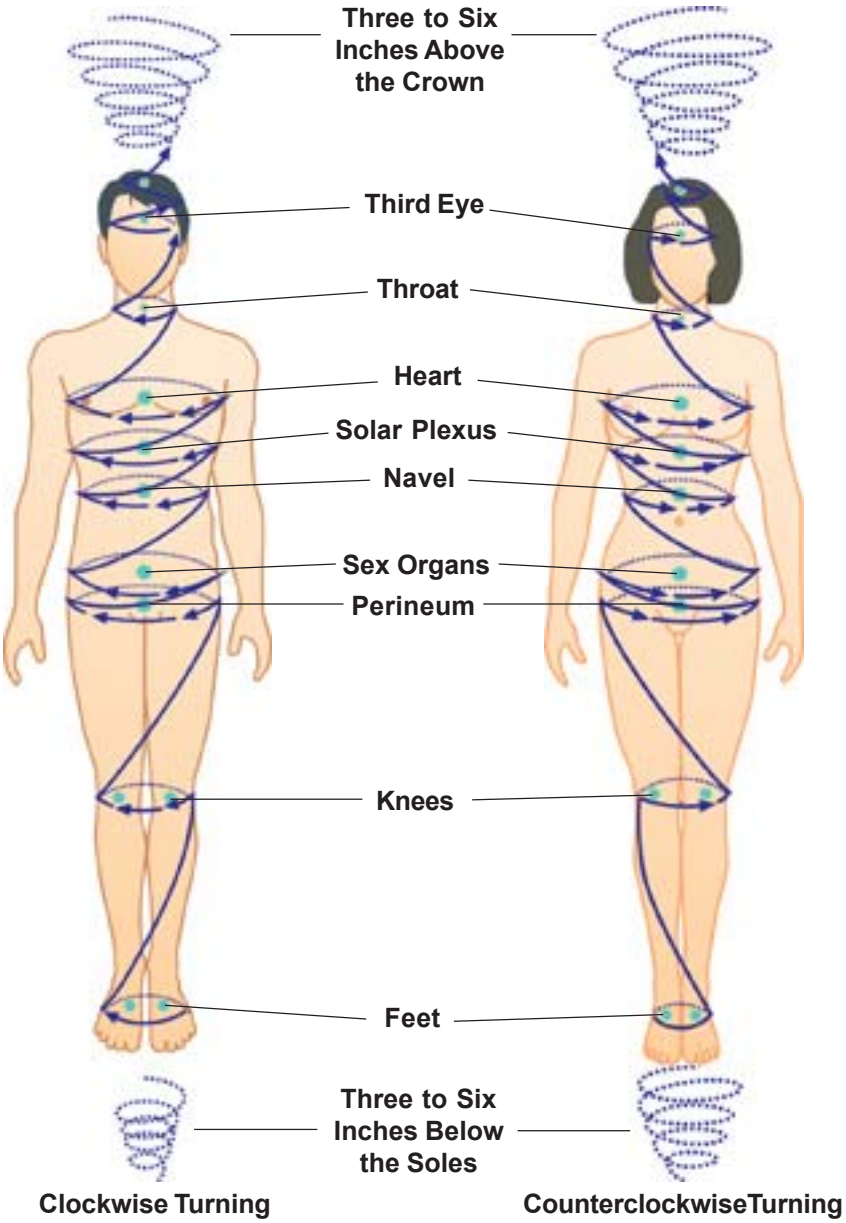

Fig. 5.16 *Belt Channels*

Practicing the Universal Tao techniques which will align you with this unique situation in the universe will open several spiritual channels.The first step in this process is the open-

ing of the Microcosmic Orbit (MCO). This is a channel directly connected to all the orbits in the universe reaching to the source. If this channel is open the information from the universe can be easily picked up and integrated. As you can see in Fig. 5.18, there are many different points on the MCO which need to be opened and connected.

These points are directly connected with the Tan Tiens (front and back) and with the points where the Tan Tiens are connected with each other and with the environment. As Fig. 5.18 shows, the MCO points, the Tan Tiens and the chakras (as they are known in the Hindu tradition) actually have the same location.

When the MCO opens and connects with the Tan Tiens, the Thrusting Channels will also start to open up. This enhances the heaven/earth connection, and energizes and detoxifies the body. Then all the five channels (the front and back channels and the three thrusting channels) connect with the Belt Channels. These are horizontal circular channels, which conserve and protect your life force. When these channels are open and connected, your energy level and your healing capacity will greatly increase. The Belt Channels connect Conception/Governing Vessels and Left/Right Thrusting Channels.

By activating the Tan Tiens and fusing the energy into one 'pearl' in the Tan Tien, the dualistic experience of time in a manifested past and a vibrational future diminishes and finally dissolves into one infinite experience of now.

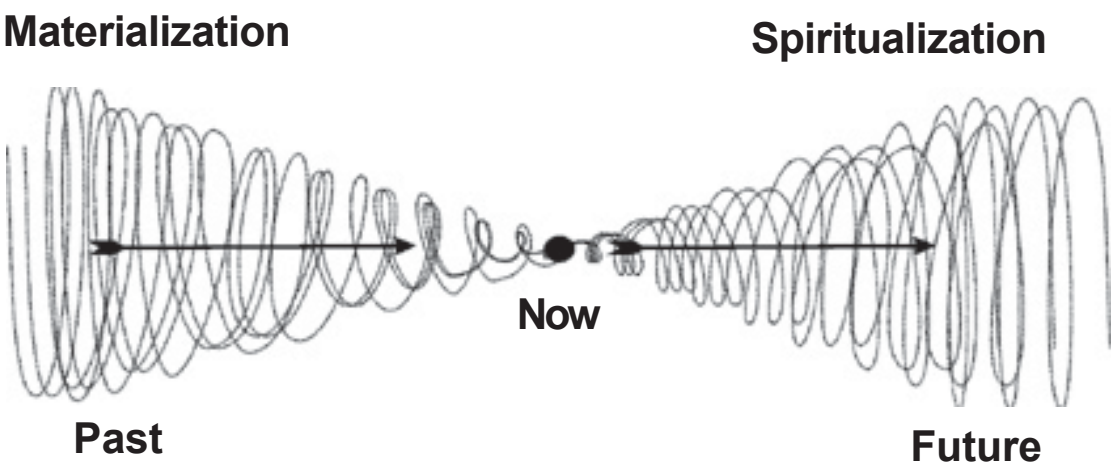

Fig. 5.17 *Human Evolution*

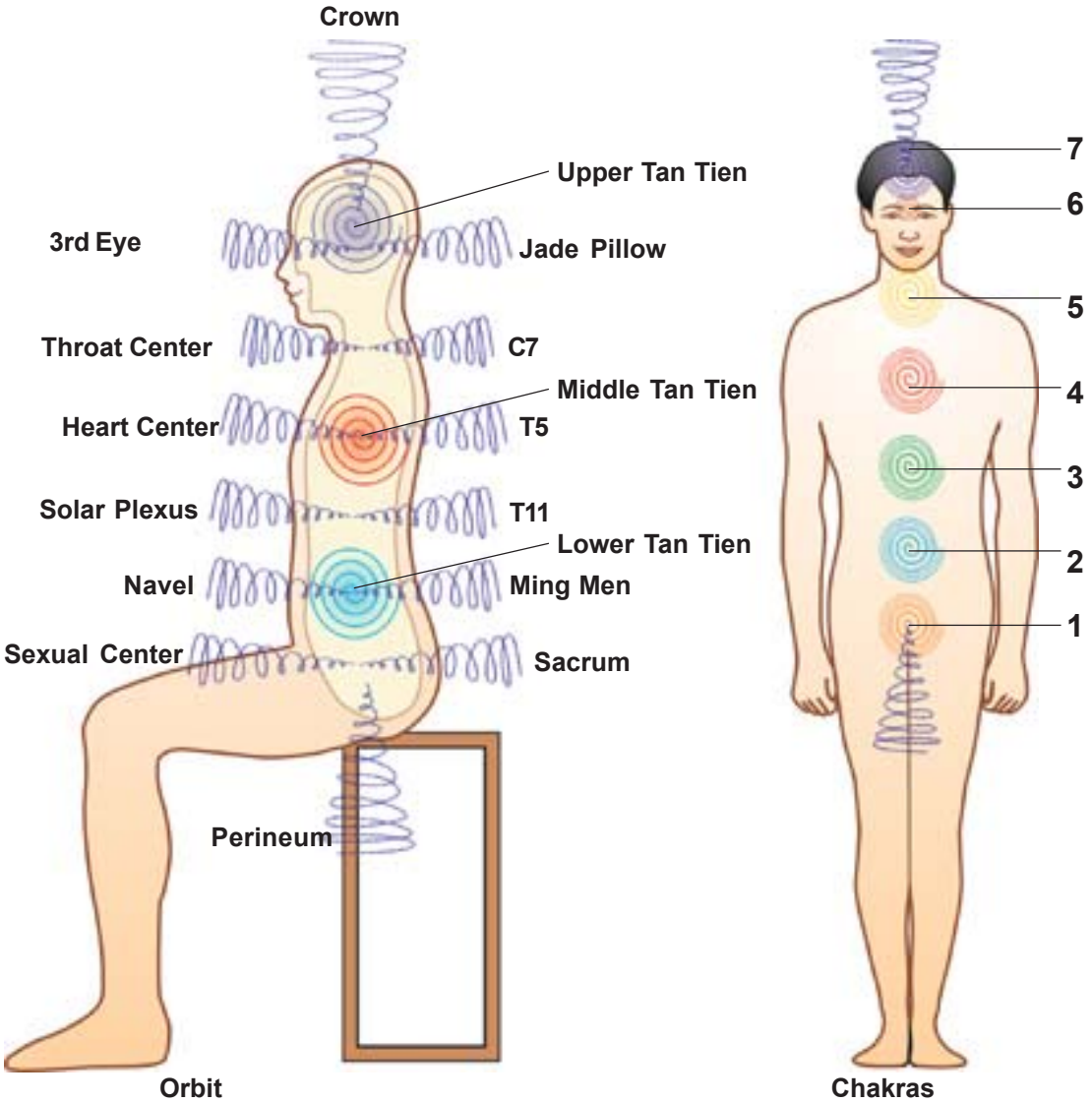

Fig. 5.18 *Microcosmic Orbit - Tan Tiens - Chakra Comparison*

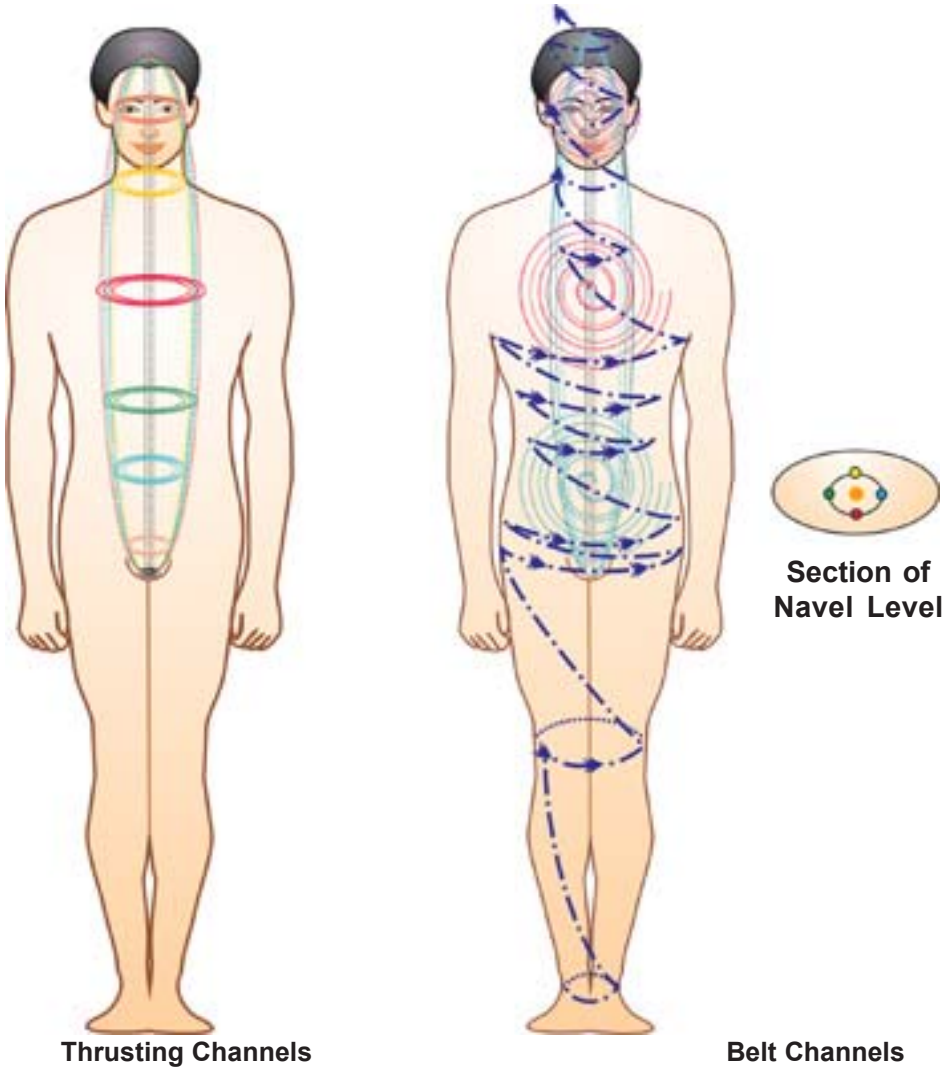

Fig. 5.19 *Microcosmic Orbit, Three Tan Tiens, Thrusting Channels, Belt Channels, Tan Tien Comparison.*

Chapter VI
Development of Humanity

Simultaneous Development of Humanity and the Universe

Our planet started its materialization process about 4.5 to 5 billion years ago. After the formation of a dense core and a protective atmosphere, the whole planet was covered with water. In this ancient sea, life emerged about 3.2 billion years ago, in its most primitive forms; viruses and bacteria. This, of course, is not when life began in the universe. We, in our true immortal state, are pure life and intelligence in human form. But around that time we began to manifest in physical existence.

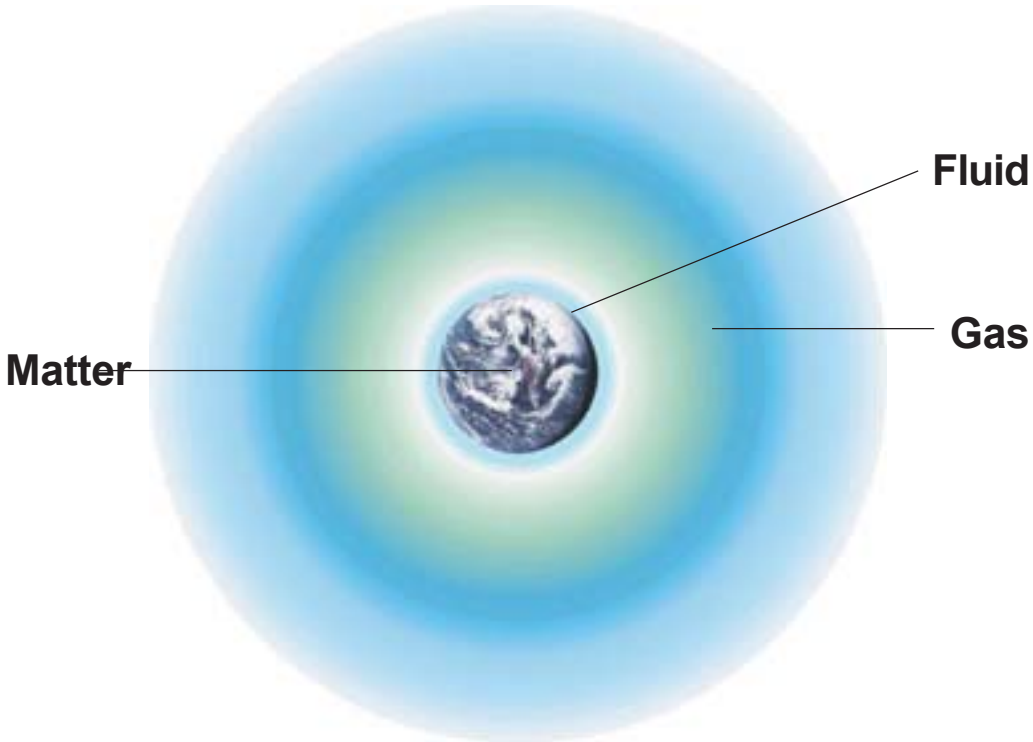

Fig. 6.1 *Materialization of Planet Earth*

The intelligence that materializes/manifests in the visible world and dematerializes/disappears in other dimensions is one and the same (omnipresent). When the solar system and the Milky Way developed further and became more structured, life on earth developed simultaneously. When the solar system started to form, the Milky Way had already been in existence for billions of years.

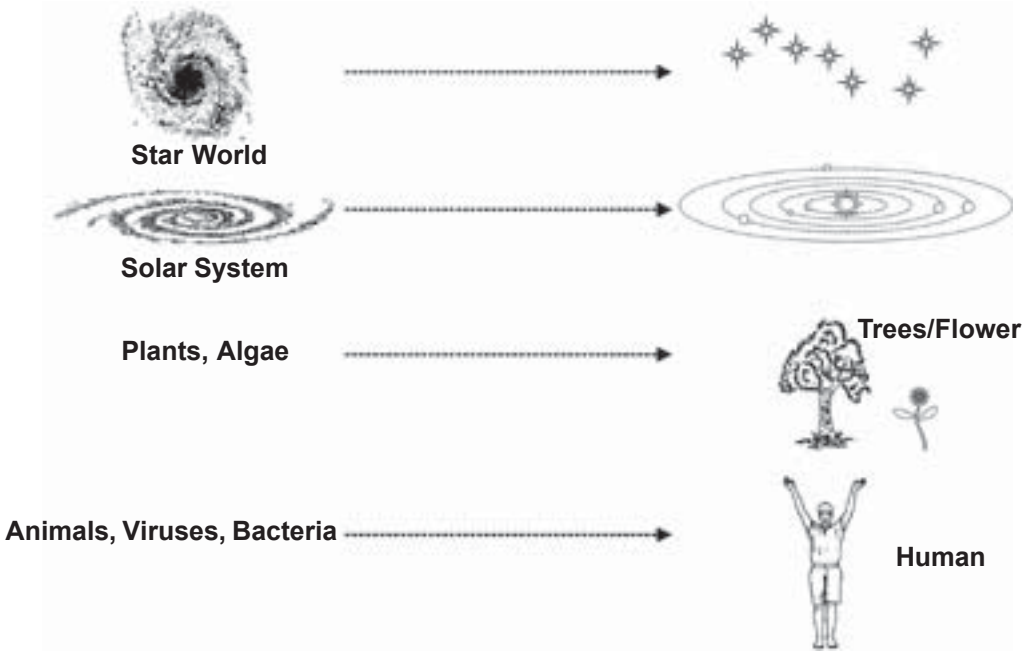

The formation of the solar system and humanity is due to a contracting/materializing force or spiral. This spiral crystallizes energetic laws and Chi causing the formation of our solar system and the earth. The unique earthly atmosphere has attracted life with humanity as its highest manifestation. Cosmic dust and particles gather and form elements around the already energetic (present in the world of law and Chi) human structure.

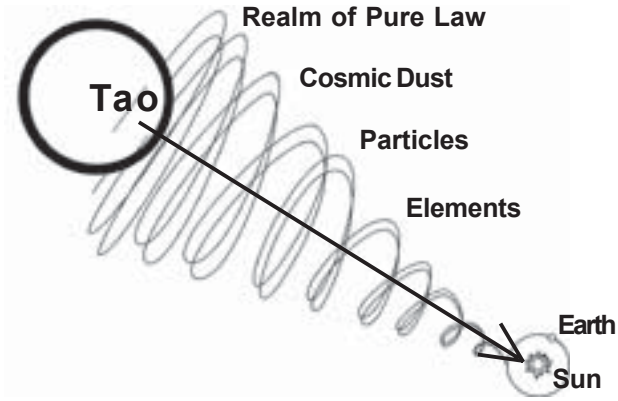

Fig. 6.3 *Humanity's Materializing Process*

Humankind in the Solar System

The human form can be seen in the solar system if we look at the deforming electromagnetic field of the earth, caused by the solar wind. This causes a flattening on the sunny side and an enlarging on the dark side of the field. An electromagnetic field is caused by the rotation around the earth's axis. In Figure 6.4, the earth would be at the place of the throat center. This center is seen as a center of expression but also of growth and the place where our two bodies (trunk and head) are fused. In an upright position on the earth, the body grows downwards and the head upwards from the throat.

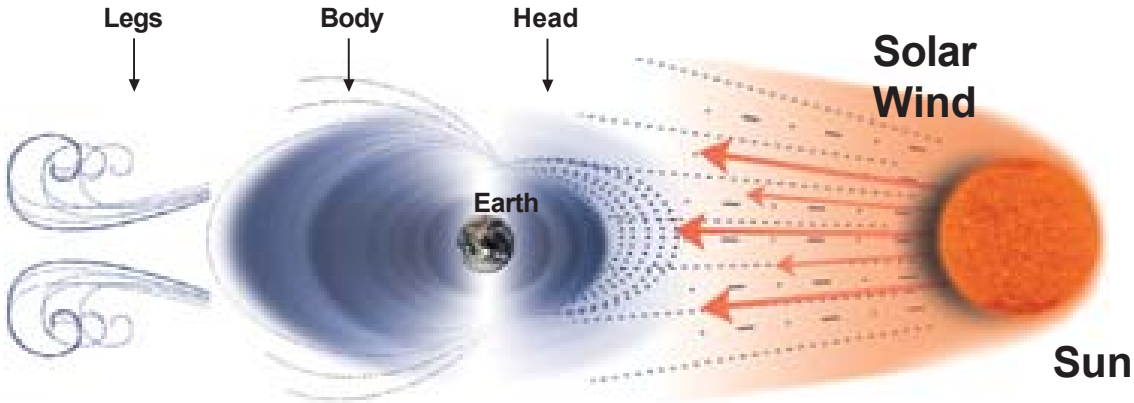

Force from the Outer Planets

Fig. 6.4 *Solar Wind - Earth - Human Body*

The earth and heaven forces are in a balance of about 1:7. The earth is creating the rising force or the formation of the head. The heaven is the descending force or the formation of the body. This is according to growth and development. If we look at the energetic functions of the head and the body, the head would be the heaven force center, the lower body would be the earth force center.

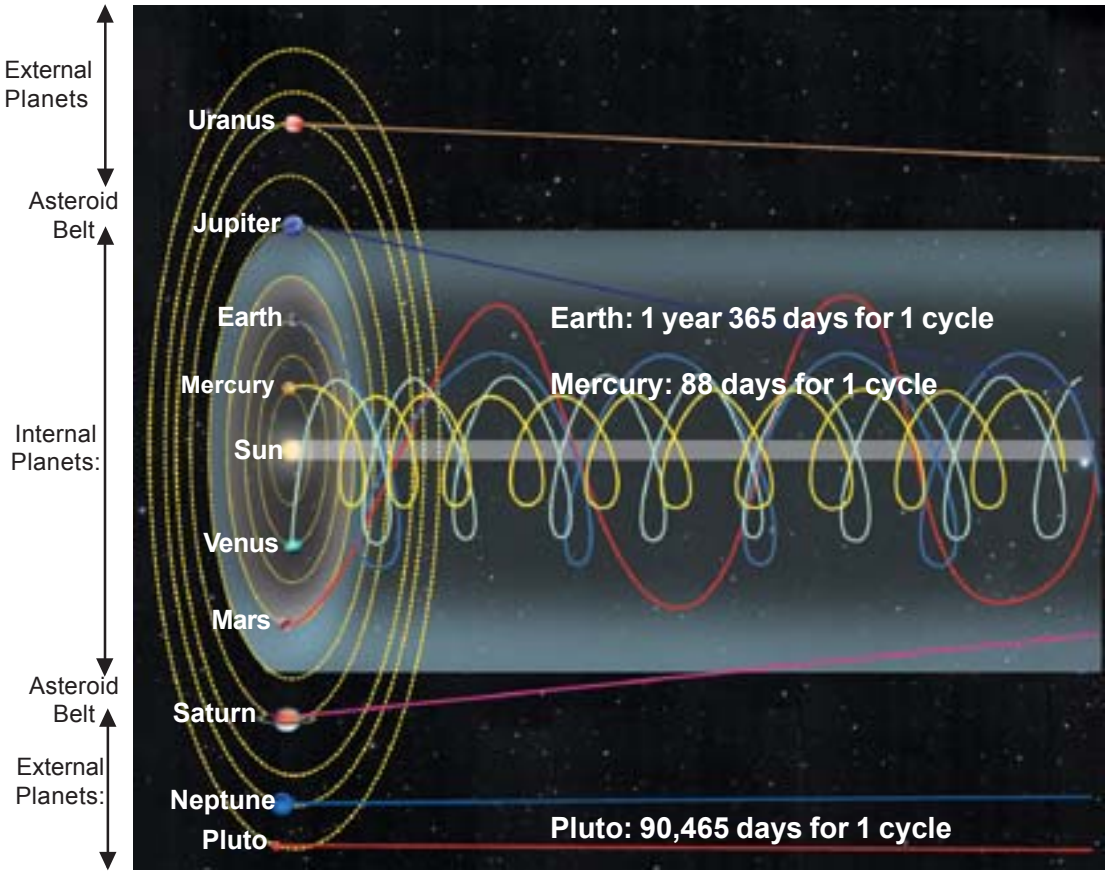

Fig. 6.5 *Movement of the Solar System through Space.*

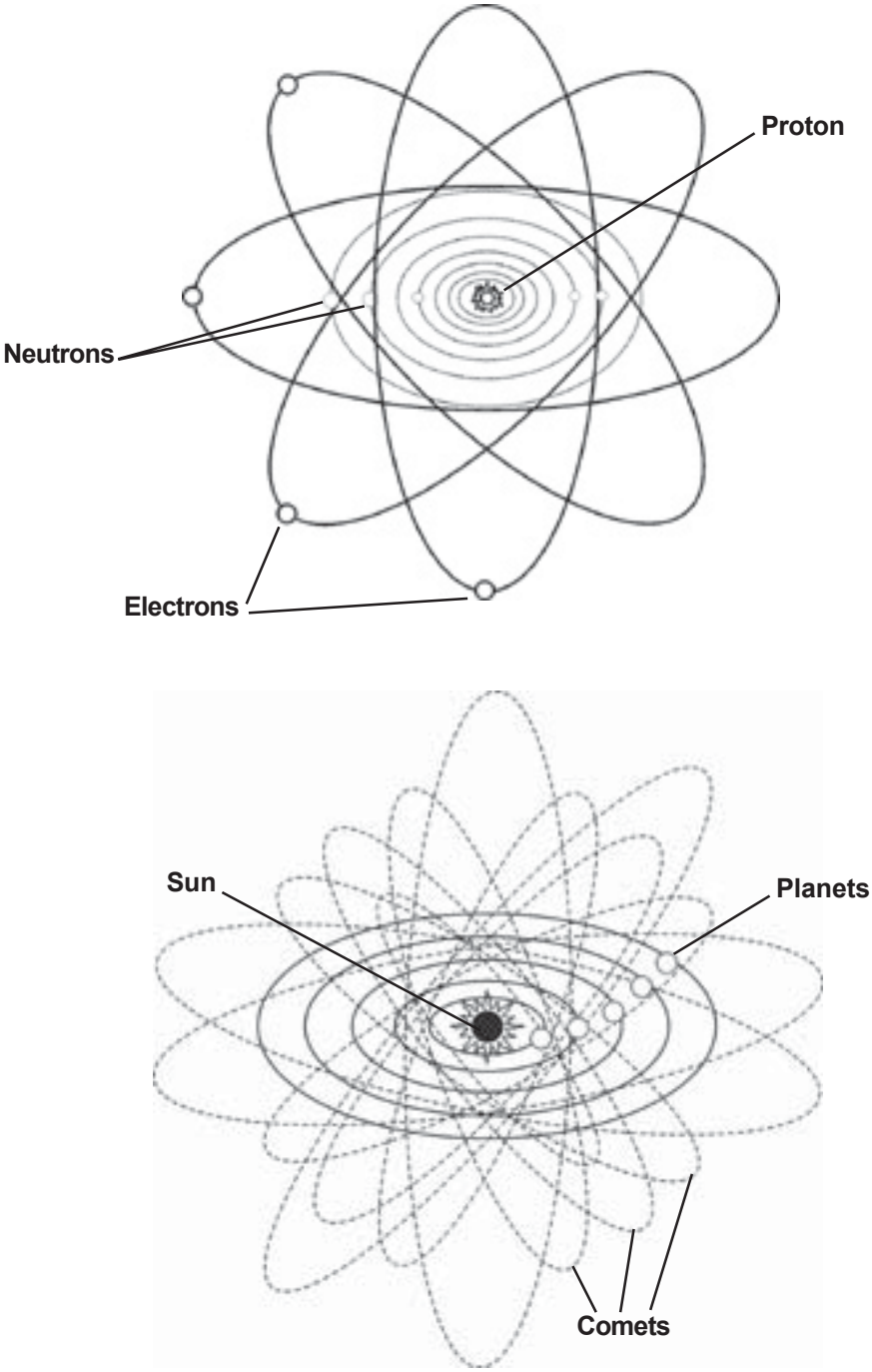

Fig 6.6 *Atomic Structure and Solar System Structure*

Comparison between Milky Way/Solar System and Human Cells/DNA Structure

If we look at the paths the sun and the planets are making, as they move around the center of the Milky Way, we observe a very interesting spiral structure. Because of the increasing rotation of the planets as we move outward through the solar system, the spiral structure becomes larger from Mercury to Pluto (rotation time for Mercury: 88 days, Pluto: 90,465 days).

The long stretched spiral shows a similarity to a DNA structure. These structures belong to the most fundamental building blocks of the body cells and also contain a complicated transmitter and receiver system that pick up the continuous changes in the solar system, the Milky Way and the vibrational world.

If we compare the form of the spiraling Milky Way and DNA seen below, the shape becomes even more similar.

Fig. 6.7 *DNA Double Helix*

The structure of the solar system is found to be very similar to the structure of an atom (See fig. 6.6). The sun and the planets represent the nucleus of the atom, the sun with a positive charge and the planets a balancing charge. The sun would be the proton and the planets the neutrons. The comets of the solar system are comparable with the electrons of an atom, carrying a negative charge. There's a striking relationship between the I Ching and the genetic structure, with the number 64 as the central aspect, illustrating the relationship between spiritual laws and genetic structure.

Energetic Embryology

The original unity of man and woman is symbolically seen in the Tai Chi Symbol. The yin and yang in perfect balance together. One stage before this they were still one indistinguishable entity; the Wu Chi state. The energy of man and woman also originates from this oneness. This state is still deeply inherent in all our body cells. So, before the egg and sperm physically fused, man and woman united on a vibrational level. The original oneness literally draws the egg and sperm together.

A recent research project found that in at least 85% of the cases, women were unconsciously acting on a deep drive to fertilize an egg. Something inside of them decides that now is the time. This strong desire then intuitively triggers the attention of the man. This shows the interaction of the karmic charge in the soul and the individual awareness field of human beings.

Fig. 6.8 *Egg and Sperm, the Universal Big Bang and the Little Bang*

At the moment of fertilization, or when the sperm penetrates through the egg's membrane wall, a mini light explosion happens. This series of events contains the complete evolutionary process of universe and humanity. Connected to the information of the egg and sperm and the Universal consciousness, the cell knows how to produce a human being.

This process is very much like the birth process of a star. Energy and then gas build up potential between different stars. The potential rises to a peak where a cloud implodes and falls into different eggs or cocoons. Through the increasing density and pressure a nuclear reaction follows automatically and a new star comes into existence.

The creative ability of the intelligence present in this one cell can only be called miraculous. Everyone could be enlightened from the abilities of the young embryo. Although modern science can demonstrate interesting observations and pictures of how a fully grown human being manifests from this one cell, it cannot understand the theological perspective as to why?

More open-minded scientists agree that the mystery of life cannot be explained by chemistry, genes and chromosomes. Many of them now realize that cells should not be thought of as a rigid unit, but rather as a momentary aspect of spatially ordered (submicroscopic), metabolic movement (same for tissues and organs). All normal cells in the

human ovum have the same chromosomes, yet they differ in various ways, so the way genes react must be dictated by external information that enters through the membrane into the cytoplasm and the nucleus.

The vibrational potential between the parents resonates with the soul, which is externally present and interactive long before conception. It enters the embryo around the 49th day after fertilization. The fertilized egg shows (during the first 3 days) a process of splitting, comparable to the earth axis shift that we described before in chapter V (see fig. 5.9). Three or four new axes are created during that time, bringing the number of cells to about 16. This process is also described in the I Ching.

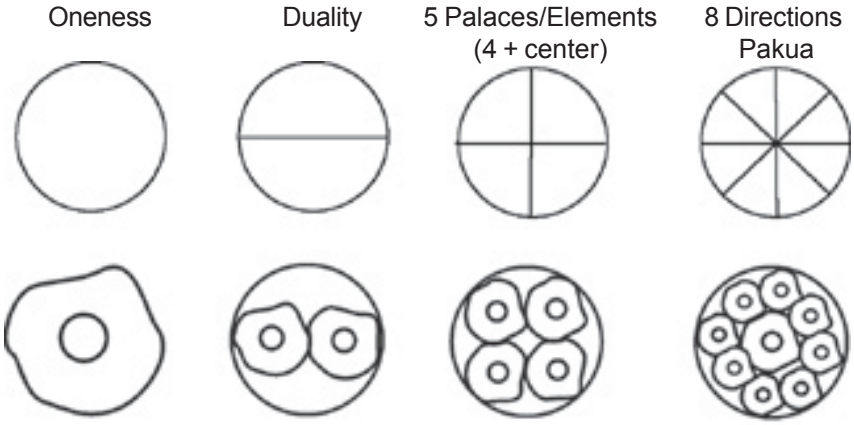

Fig. 6.9 *In Embryology this stage is called the Morula.*
One gives rise to two, two gives rise to four, four to eight.

The fertilized egg stores much of its information in the space and charge between the inside and the outside. The inside is related to the woman's energy and the Conception Vessel. The outside holds the fathers' energy and the Governing Vessel energy. The Governing Vessel functions as a receiving station that picks up all external vibrations. The Conception Vessel internalizes the information and acts as an internal transmission system. In later development the male energy stays more in the vibrational field and gathers around the nervous system and Governing Vessel.

The female energy gathers through the blood production system in the belly, organs, and the Conception Vessel. The Governing Vessel is seen as the source of yang vessels, the Conception Vessel as the source of yin vessels. Until day 16, the embryo consists of 2 layers: the ectoderm and endoderm. Around that time a third layer called the mesoderm will materialize along the central axis of the embryo. The Chong Mo (invisible axis of the cell) has been there all the time, but not in a manifested form. The Chong Mo creates the connection between the Jing (sex potential) and the Shen (spiritual potential).

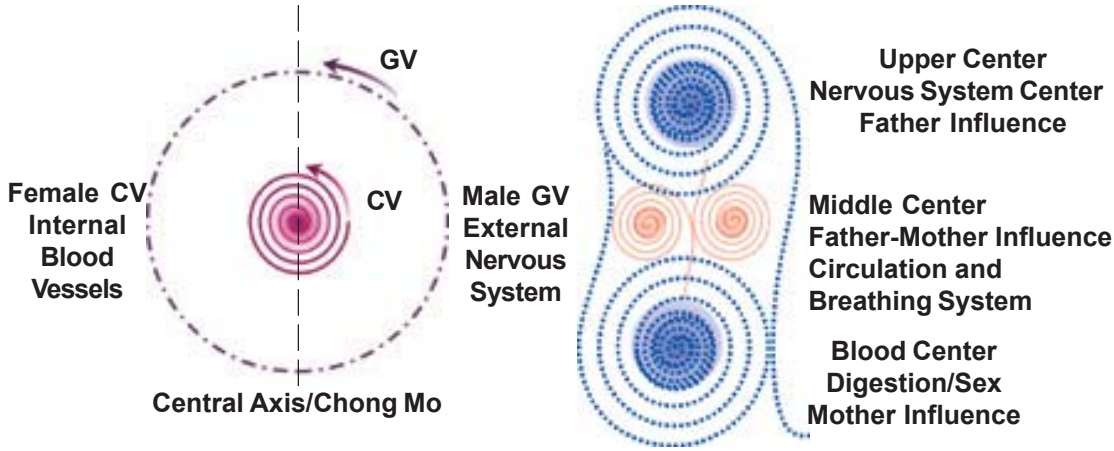

Fig. 6.10 *Parental influences on embryonic development.*

Energetic Human Model in the Universe

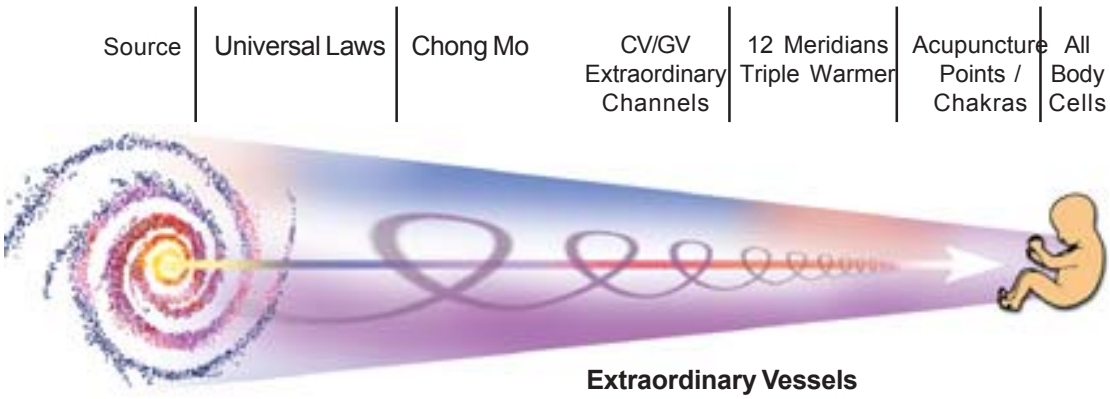

Fig. 6.11 *Embryo-Source*

In Chinese medicine, the triple warmer is directly related to the source. It is directly related to the fascia system as a mechanism to form or shape the fascia, according to the energetic spiral network. From the 3-layer embryo, the five different elements divide.

The fire element is divided into two parts: primary and secondary fire expressing the high complexity of the human heart/fire quality. So, six meridian couples are formed. This meridian network spreads out in the body with over a thousand vital points, where the electromagnetic force gathers.

➢ Ectoderm	- Secondary Fire	Triple Warmer
		Pericardium
	- Metal	Large Intestine
		Lungs
➢ Mesoderm	- Earth	Spleen
		Stomach
	- Wood	Liver
		Gallbladder
➢ Endoderm	- Primary Fire	Heart
		Small Intestine
	- Water	Kidneys
		Bladder

Fig. 6.12 *Human Cells- Six Meridians Couples - Twelve Meridians*

Waves of Endless Motion

As we have pointed out, humanity developed following one simultaneous materialization process that manifested the entire solar system, the earth and human society. We can say the universe is evolving as a whole. This can happen only with a wavelike motion of life and death or materialization and dematerialization. Just as stars and solar systems are born and come into existence all of it will one day be subject to destruction, decline and dematerialization. The model that is currently used on human development is mainly based on written history, although many facts show that there must have been highly developed civilizations over five thousand years ago. Egyptian, Mayan, Tibetan and Hindu cultures speak of previous civilizations dated long before the times that are generally accepted.

Fig. 6.13 *Waves of Endless Creation*

The old Newtonian material, rational identification with our external senses, prevents us seeing the authenticity of our true origin. It would be narrow minded to limit ourselves to written material as our only proof. The use of wisdom, life experience and intelligence is the way to penetrate deep behind the limits of the senses. Otherwise we block ourselves and only experience life in our physical boundaries, denying the endless, nature of life. As we see in fig. 6.14, all life comes out of this timeless and formless void, the source. The play, the interaction of polarity creates waves that differentiate in time and space, through the physical universe, the Milky Way, the solar system, the earth, in the body with all its cells, particles and waves. The deeper we go into our physical existence the lower the vibration. Freedom lies in the experience of all these different vibrations while relating to the same timeless and spaceless reality.

Expanding Human Consciousness through the Ages

The work of Rudolf Steiner, the founder of anthroposophy shows many interesting references to planetary energies and human development. This work is more connected to Greek mythology than to Chinese literature. It gives an interesting picture of the link between the universe and human development. Greek mythology places its own qualities on the planets, as do the Taoist or Chinese astrologers.

The planets are the purest symbols of the personality and emotional/social human behaviors. The planetary world is the world of the soul, with the sun as the middle point or the core of the field of consciousness. This chapter is inspired by philosophy of anthroposophy.

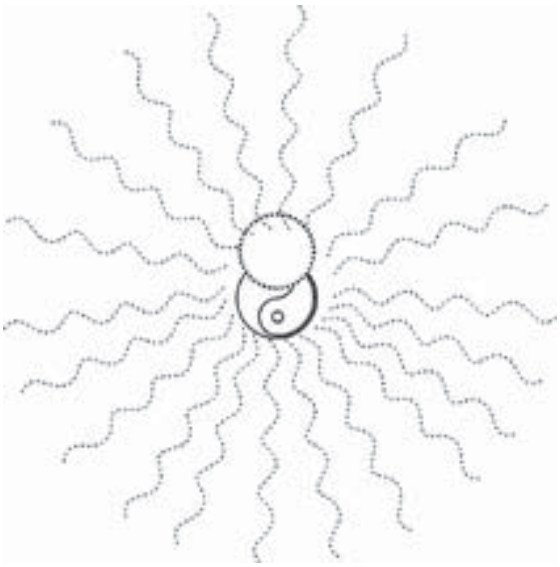

Fig. 6.14 *Sun expressing Cosmic Law and Chi*

For a long time in the West, astronomy was based on the Ptolemaic view of the solar system (second century Greek astronomer). In this view, the earth was the unmoving center of the universe and all planets circled around it (which is true of course looking from the standpoint of the observer). In anthroposophy, this Ptolemaic point of view is still used as a map to describe the evolution of the soul.

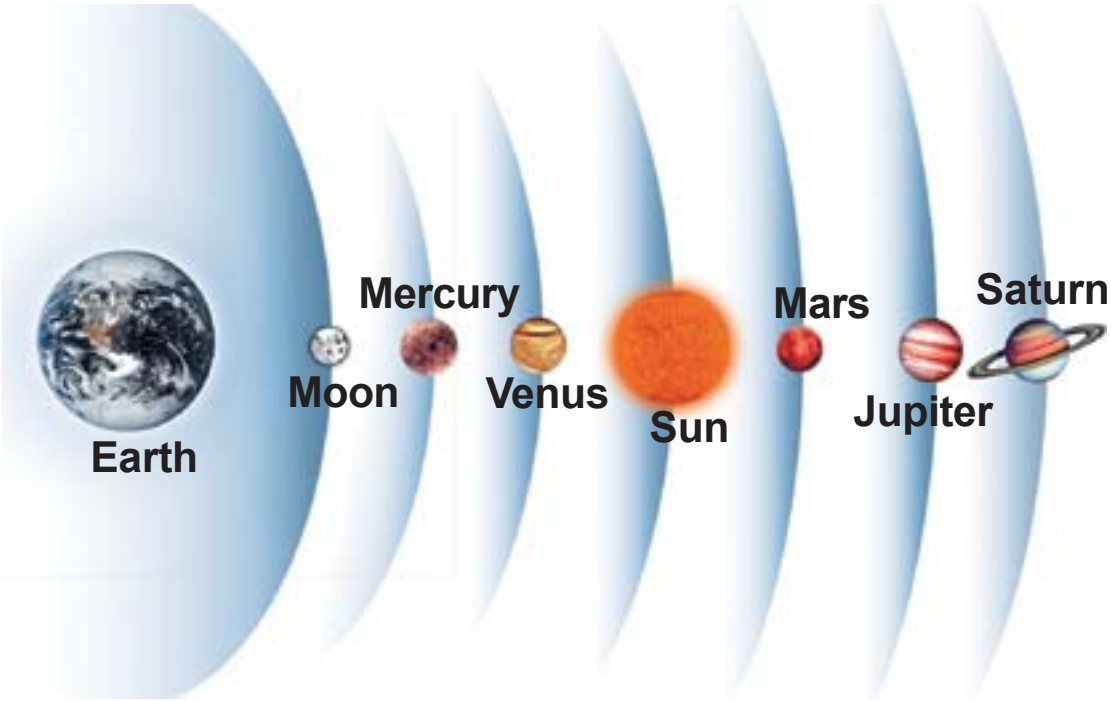

Fig. 6.15 *Solar System according to Ptolemy*

The earth is the physical place where the human soul connects with the body. Earth, sun and moon form the basic energies for the development of humanity. The deep contents of these energies rise when they meet each other. The meeting of sun and moon represents the interaction between the consciousness and unconsciousness. But on another level it can also be seen as consciousness of mind (sun) and consciousness of the body (moon).

Fig. 6.17 *Sun and Moon*

Mercury represents the ability to connect on a neutral, non-emotional basis. It connects the energy of sun and moon. Among primitive tribes, the group functions as a unit and is more important than the individual. Connection - the quality of Mercury - gives birth to the Venus quality, which has safety and security as its key attributes. They are the unconscious goal of forming a group. People gradually learned to increase their survival rate and enhanced their security through control of the environment (agriculture, hunting).

Mars is the desire to be independent. It stands for the formation of the conscious ego. This is a reaction to the contractive energy of the group. To create balance between this expanding and contractive force another energy was needed. This energy was found in the gods by rituals and prayers (religion). This quality is related to Jupiter. The deeper and higher unity within the group and growing consciousness. The experience of pleasure and pain related to the internal/external struggle in a search for balance and growing consciousness is related to Saturn. It highlights the process of decision making based on your experiences of pleasure and pain.

The discovery of the three trans-saturnal planets created an extra dimension or a higher octave in our solar system's awareness.

Chapter VII
Soul in the Planetary World

The solar system is an energy structure composed of a central area largely consisting of mass and light and nine awareness belts encircling its center. The planets are the materialized forms of these belts. Each of these belts has unique frequencies and qualities. Since the soul remains strongly connected to the sun, throughout life an evolution through the solar awareness belts takes place.

The Taoist masters clearly distinguish two forms of souls. The sun related cloud soul (hun) and the moon related white soul (p'o). The p'o (one of the stages of the soul) constituent of this dual soul comes into being immediately upon birth, preceding the emergence of the hun which is the yang element of the spiritual nature.

In the following pages we will not use the dualistic principle of the soul, but rather see the soul as one.

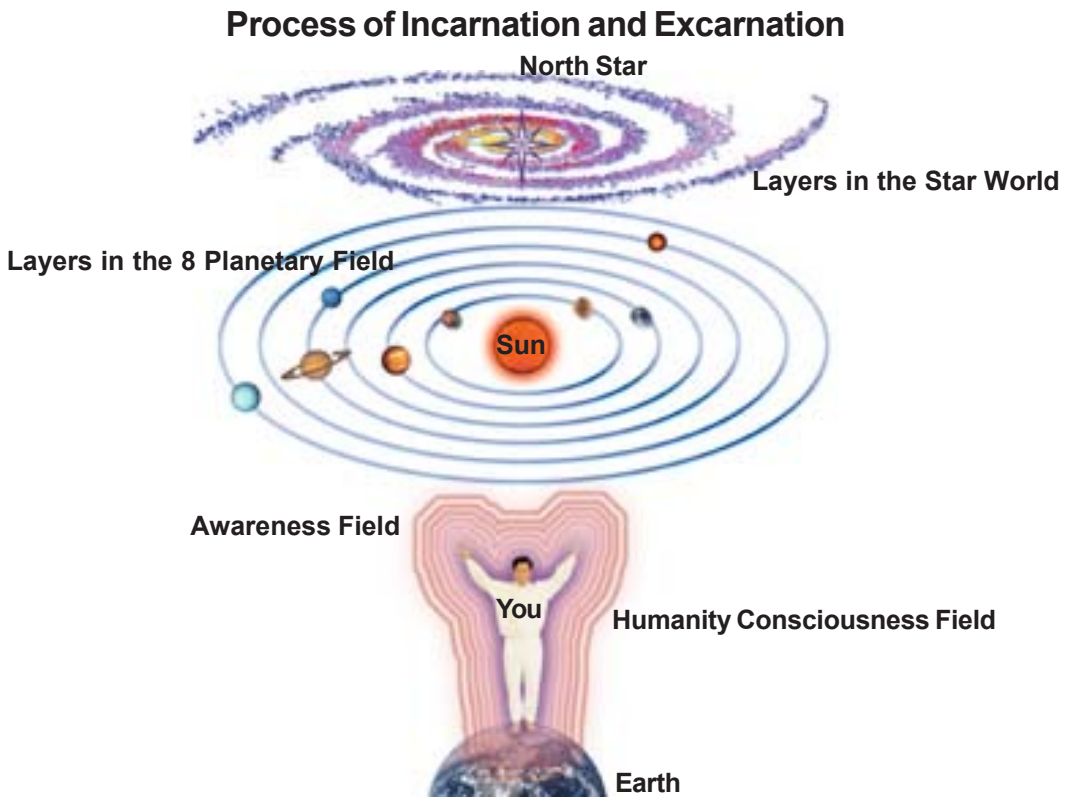

Fig. 7.1 *Star World - Planetary World - Human Awareness Field*

When the soul starts its incarnation process it moves through the world of stars and is attracted by the unity of our solar system with the sun as its medium. The sun (a star in the solar system) functions as a giant satellite station between the worlds of stars and planets.

According to the karmic information carried by the soul, it will remain a shorter or longer period in the frequencies of some planets. During these stays it receives the necessary information that will create or awaken our specific learning possibilities.

Each soul remains longer in one sphere than another, creating a very distinctive quality in the character of that person. We have greater connections to some of these planets and weaker ones to others. During this incarnation process the soul will move from the unmanifested world through the star world, the external planets, the internal planets and the moon-earth sphere; it will be constantly attracted by the force of the sun and later the earth. The electro-plasmic force of humanity around the earth functions as an awareness belt that connects the soul with life on earth.

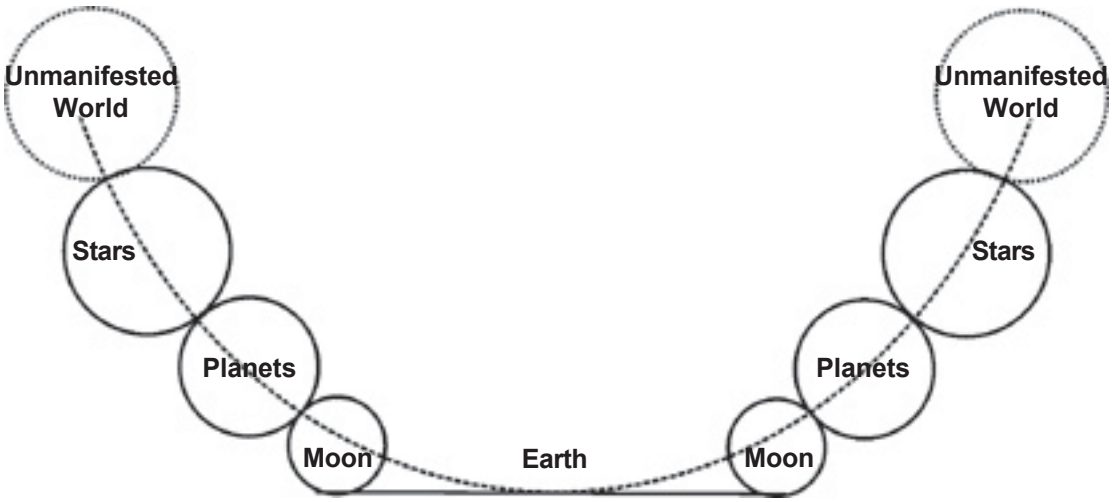

Fig. 7.2 *Birth - Life - Death*

When a baby is born, the incarnation process is not yet complete, as we can clearly see in the personality of the child. In the first two life cycles (7 year cycle) the full incarnation of the soul still has to be completed. Often around puberty, at the beginning of the third stage, the true personality reveals itself, sometimes even as a shock to the parents. The same happens in the last cycles of life. The person increasingly loses interest and connection with earth and life on the planet, as the soul withdraws towards the higher worlds. Although they are on the other side of the spiral of life, children and old people often dwell with their soul still or already in a higher realm.

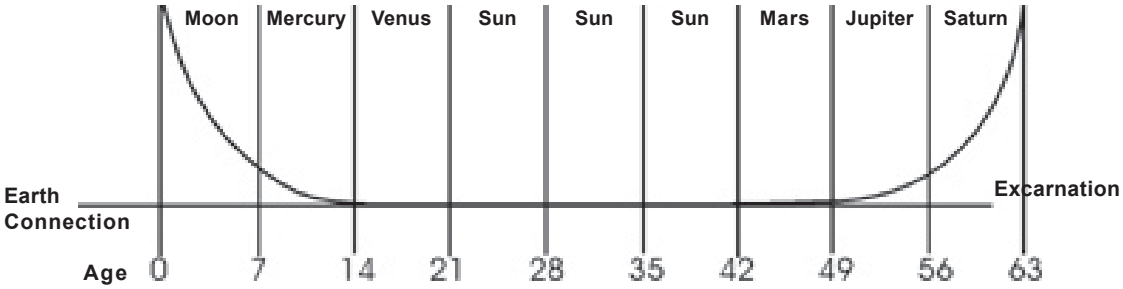

Fig. 7.3 *Development of the Soul through the Planetary World Based on Anthroposophical Theory.*

In the above picture based on the anthroposophical view of the growth of the soul, the earth is seen as the physical middle point and the sun as the center of soul development. The sun reflects the law of triple unity in the universe. Three planets are placed on each side, the sun is placed in threefold, in the central region.

The stages of incomplete incarnation would be in the stage of the moon and Mercury for the child and of beginning excarnation in the stage of Jupiter and Saturn for elder people.

The discovery of the three trans-saturnal planets has also occurred together with growing human life expectations. This creates a different schedule. In modern society the period of withdrawal from active life and into retirement has clearly become longer than in past centuries. This increased period extends in the trans-saturnal sphere of Uranus, Neptune and Pluto. Because of the low energy and awareness level of many people, this 21 extra years is simply an extension, which results in an increased life span but of a lower quality of life.

Most people have wasted most of their life force before they enter into the trans-saturnal period. This often creates an inability to integrate these planetary influences, with the result that the awareness level drastically diminishes during the last stages of life.

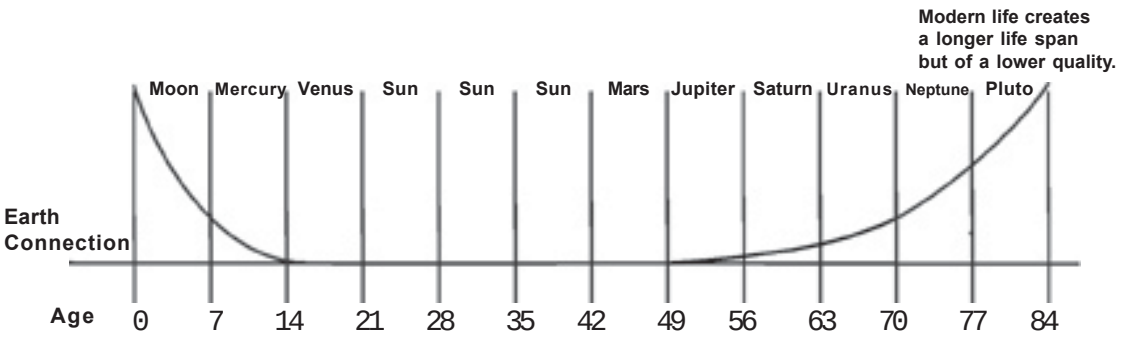

Fig. 7.4

Application in the Universal Tao Practice

In the Universal Tao practice the period of the sun (ages 21 to 42 years) is used to build up a strong connection with the sun and then the North Star consciousness (See fig. 7.5). The North Star is the Taoist spiritual gate. Once the connection with the source is established through the North Star and the Universal light, the effect of the planets on the practitioners' emotional and mental state will be reduced. To establish this sun/North Star connection, the five elemental forces must be balanced and the frequencies of the awareness belts around the sun (related to the planets) must be integrated. During the sun period, the collective consciousness inherent in each cell of our body will be nurtured by the high quality of the sun's frequency. This energy is mostly used to manifest oneself in the world; relationships, work, house, children, etc.

In Taoist practice the awakening light of the sun period is a perfect time to establish the North Star/spiritual connection. Once the connection with the spiritual realm is established we can distinguish two different realities. The planetary influences will still affect us but the rooting to earth and heaven will make it much easier to stay in connection with the spiritual laws, the life in our body and their interaction. This way we stop nurturing the ego and begin to live a life beyond the personality and the related planetary spheres.

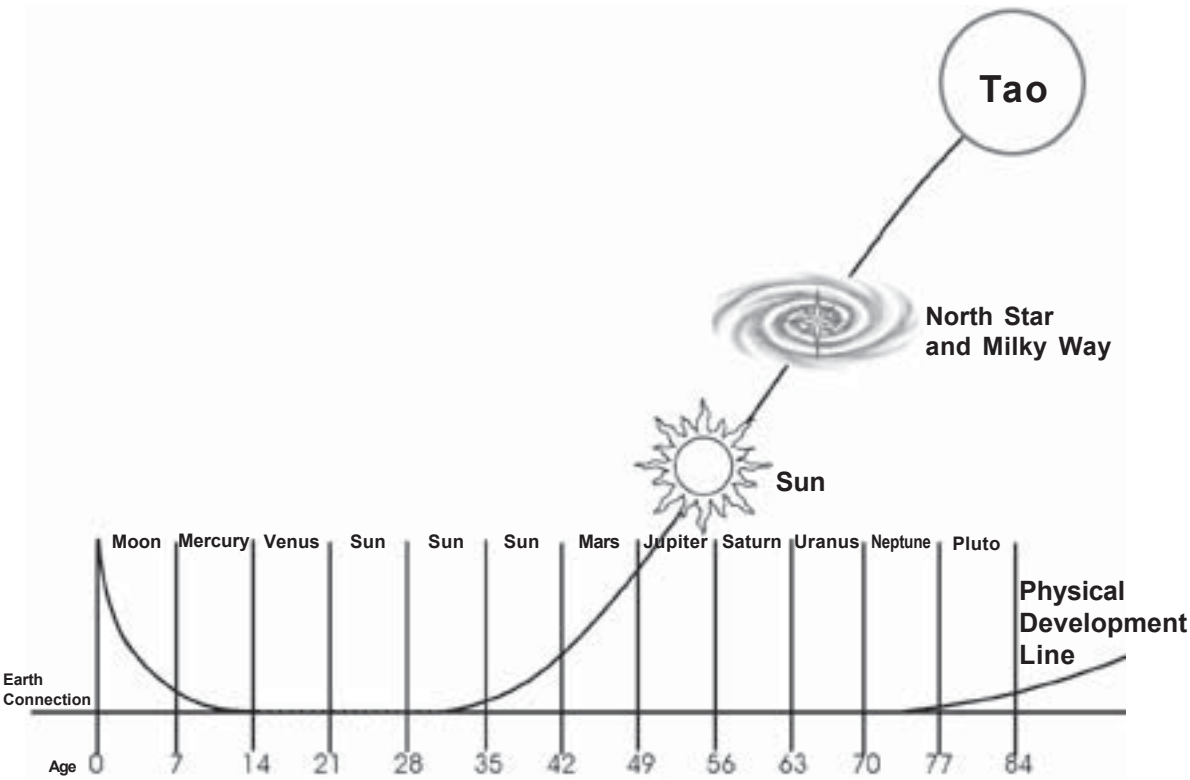

Fig. 7.5 *Taoist Development Line*

Through the Universal Tao practice the sun period can be used to cultivate the soul and spirit body. The soul is the medium between the physical plane and the spiritual world. The soul naturally follows the evolution through the planetary world but the spirit does not have this limitation. The determining factor is the point of identification and realization. The sun period is also the time when the level of Chi in the physical body is at its peak. The physical and biological development is at its peak at around 28 years of age in men and 24 years of age in women. At that time the body becomes a temple in which the soul and spirit can be cultivated. Taoist practitioners cultivate quantity (life span) combined with quality (spiritual realization).

Through the Universal Tao practices this peak state can be kept and even improved upon during the following decades. Just like many Taoist masters and some isolated tribes found that getting older does not have to mean getting weaker. They became fitter as they grew older, which was confirmed by western doctors. These people were wise and had clear connections to the gods. Is this not a better idea about getting older: “I get wiser, more experienced and intelligent, I integrate this in my body, so I will be fit and strong in my old age”. Since most people waste this energy upon superficial satisfaction, it leaks away and when they reach old age, when they have lost most of their energy, they feel weak, scattered and disconnected from their spiritual task. When the sun/North Star connection is open, your whole life will be inspired and guided by the unlimited wisdom of the universe. The connection with the light will enable you to lead an active but peaceful life. You will still experience the growth of the soul through the more emotional planetary world, but the spiritual connection will allow you to observe this process, see reality through the emotions and integrate it within the physical body.

In this way the energy of the experience is integrated to nurture the consciousness. Rudolf Steiner said that the goal in life is to balance the planetary qualities to reach the highest state in the solar system which he called “the sun awareness”. During the excarnation, the soul will move again through the planetary world and will be purified from all earthly, materialistic and emotional experiences. The fruits of the past life are harvested and condensed to form the seeds for the next life. This process is continued outside the planetary world in the world of stars and the immaterialized realm or the world of vibrations.

In the Universal Tao, the Fusion of the Five Elements practice is used to balance the qualities of the five elements in the body. This practice is also called internal alchemy. After strengthening and purifying the body during the basic practices and fusion practice, the energy and virtues of the five vital organs will be cultivated (kidney, heart, spleen, lungs, liver). These energies will be gathered in specific areas (pakuas) around the navel into the collection points. From the collection points, the energy will be drawn to other pakuas that is formed around the navel. From these pakuas the energy is blended, purified and stored in the center (Lower Tan Tien).

Fig. 7.6 *Immortal Meditating*

The energy will be condensed until it becomes a radiating pearl. This pearl will be held at the original meeting point, or the point where the information of the first cell or basic spark in your body is kept. Taoists use the metaphor of the pearl or crystal, to refer to the highly concentrated purified energy.

This pearl will be cultivated and slowly transformed into spiritual energy. It will become the house of the soul and spirit body, one's balance, control and Universal connection point.

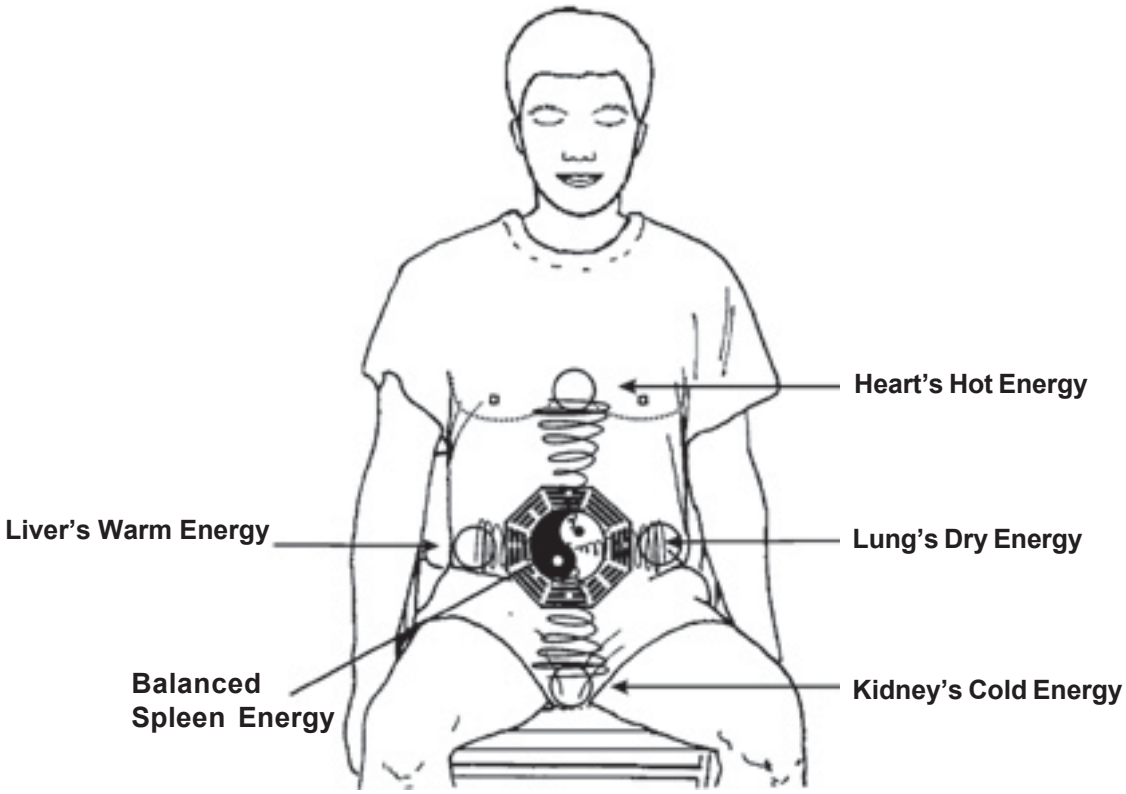

Fig. 7.7 *Pakua Collection Points*

The pearl will then serve to open different energy channels in the body and to travel outside the physical body through the world of planets/stars and vibrations. The pearl has the same function as the sun in our solar system: centering, collecting, controlling and connecting to higher realms. When the center is weak (no pearl), there is no central point of consciousness or control. This implies weakness and inability to decide where to go or what to do. When we use the mind to gather the energy at one point, the spark that is still glowing inside of you will create ignition and start to shine again. Just as our solar system formed some 5 billion years ago.

Comparing Solar System and Organ System

Fig. 7.8 *Contracting Spiral - Energy gathering in the Center - Spontaneous Inflammation*

When the pearl is shining and stable in the Lower Tan Tien, it will be the source of energy for all the organs. The place where the pearl is kept is the area of the small intestine. In Chinese medicine this is the yang meridian of primary fire, the center of transformation.

When the pearl is stronger and more refined, it can be moved towards the heart center. While the small intestine fire is more a physical fire, the fire of the heart carries a higher vibration. This fire is related to the quality of the sun, the soul and the state of compassion. It is the practitioner's task to create the right internal condition for this by self-cultivation and good deeds to the benefit of all beings. In the Kan and Li or Immortal Practices, the pearl moves up to the center of the head. It moves up by itself as the fruit of self-transformation. At this point the pearl changes and acquires a very high frequency, related to the world of spirit. During meditation practice it is good to expand one's energy field and connect with all forces of the universe. Subsequently contracting and storing in the Lower Tan Tien will make these energies available in your daily life. During meditation we can use the moon and earth force in the Lower Tan Tien, the sun energy in the Middle Tan Tien and the North Star energy in the Upper Tan Tien.

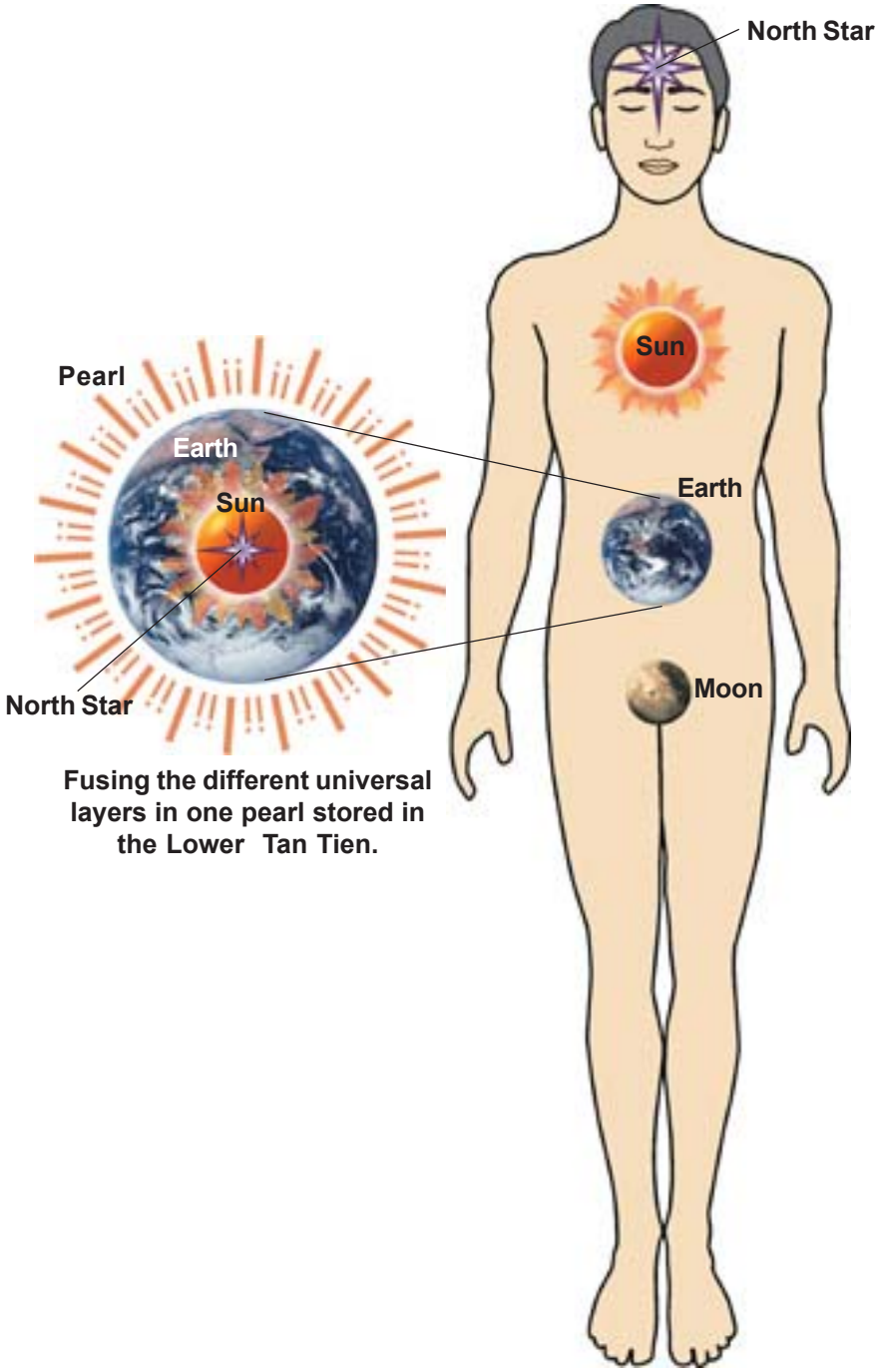

Fig. 7.9 *Fusing the Pearl*

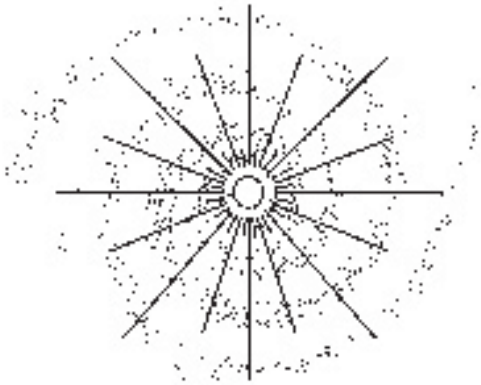

Fig. 7.10 *The Pearl in the Tan Tien has a function similar to that of the Sun in our Solar System.*

At the end of the meditation the North Star will be brought into the sun in the Middle Tan Tien. After that both will be put in the earth or the Lower Tan Tien ("Three in one principle"). This connective and gathering process symbolizes unification, or the spiritual world becoming the core of your life.

Use of Planetary Energies in East and West

Translation	Chinese English Spelling	Western Name	Element
Chronographic Star	Ch'en Hsing	Mercury	Water
Grand White	T'ai Po	Venus	Metal
Sparkling Diluter	Ying Huo	Mars	Fire
Year Star	Sui Hsing	Jupiter	Wood
Quelling Star	Chen Hsing	Saturn	Earth

In China the planets have been used in connection with the Five Elements and the Five Heavenly Palaces in their relationship with the 28 Lunar Mansions for thousands of years. The planets were called the "naked eye five" or the "five stars" or sometimes the "five pacers". The precise movements of the planets as seen from the earth was not a focus point for the ancient Taoist, although the trajectories were approximately known by about the fifth century. The translation of the Chinese name of the planets gives us an idea of the nature of their energy.

Outside China there is a long history of the astrological use of planets, recorded since the third millennium B.C. in the Babylonian civilization. The Babylonians also connected the planets with different gods and goddesses, a link found in many cultures.

Planet	Babylonian	Hindu	Egyptian	Greek	Roman
Sun	Shamash	Surya	Ra	Helios	Apollo
Moon	Sin	Chandra	Chamse	Artemis	Diana
Mercury	Nabu	Hanuman	Toth	Hermis	Mercurius
Venus	Ishtar	Lalita	Hathoor	Aphrodite	Venus
Mars	Nergal	Mangala	Horus	Ares	Mars
Jupiter	Marduk	Indra	Amoun	Zeus	Jupiter
Saturn	Ninurta	Brahma	Sebek	Kronos	Saturn

Western astrological signs are different, but comparable with Taoist astrology - the base of our stellar and planetary initiation. It uses signs for the planets that have slightly different connections with the world of soul and spirit, where the sun is the image of concentrated spirit.

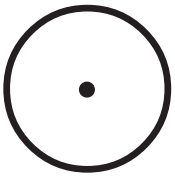

Fig. 7.11 *The circle is a sign of wholeness and the dot represents the center of the solar system.*

Fig. 7.12 *The vertical division of the circle, or the half circle is the symbol for the moon and also for the soul (divided consciousness).*

Fig. 7.13 *When we integrate matter or the cross in the circle of spirit we get the sign for the earth: matter in spirit.*

Fig. 7.14 *Venus is the Sign of Spirit over Matter.*

Fig. 7.15 *Mars shows the Cross of Matter over spirit.*

Fig. 7.16 *Mercury as the Planet of Connection mediates between the different Forces or is the Spirit as a Bridge between Soul and Body.*

Fig. 7.17 *Jupiter shows the Soul Elevated over the Cross of Matter.*

Fig. 7.18 *Saturn is the Cross of Matter above the Crescent of the Soul.*

In Greek mythology and related anthroposophical studies, soul types are described based on the expression of the planets. The observations of the expression of these heavenly bodies was the vehicle to get in contact with the higher psychic world.

In the Taoist practices the planets are seen from the Tao and its manifestation in the five elements and so the internal energy of the planets have a relation with the colors of the five elements and the seasonal cycle. Because of this different point of view (their interpretation of male/female planets), the connection they make with the body organs and systems and also the personality connected to a particular planet, is different between Chinese and Western astrology.

For instance in the West the planet Venus is a female planet connected with the Greek goddess of love and beauty, Aphrodite. While Jupiter is known as a male planet with a dominating, controlling energy and the god Zeus.

In the East, wood is the quality for spring. Spring gives birth to new life (so it is female). Since wood is the planet of Jupiter it is considered to be a female planet. Metal is the quality for autumn. In autumn life withdraws and contracts (male). Venus is in the West, so it is seen as a male planet. The planets Mercury and Venus seem to be used in opposite ways in the two systems. So, it is important to use the planets according to one system only and not to mix them together.

Modality	- Lungs +		- Kidneys +		- Liver +		- Heart +		- Spleen +	
Emotion	Sadness, Grief	Righteousness, Courage	Fear, Stress, Fright	Gentleness	Anger	Kindness	Impatience, Cruelty, Hate	Love, Honor, Respect	Worry	Fairness, Openness
Shape	Collapsed, Flattened Ball	Tall, Straight	Awkward, Tiny, Compressed	Round, Full, Expansive	Spear-like, Sharp	Round, Smooth	Moving, Spiny	Straight, Open	Irregular	Open, Wide, Big
Color	Grey	Bright White	Dark Grey, Cloudy	Bright Sky Blue	Red, Cloudy	Soft Green	Orange, Muddy	Bright Red	Cloudy	Mellow Yellow
Smell	Musty	Pure, Fresh	Foul, Urine	Fresh	Pungent	Sweet, Fragrant	Sharp Burnt	Aromatic Incense	Sour	Clean, Dry
Temperature	Cold	Comfortable, Warm	Cold, Chilly	Cool, Comfortable	Hot, Explosive	Warm, Pleasant	Unsteady	Warm, Full	Humid	Warm, Mid-range
Sound	Low, No Force	Strong Firm, Resonant	High-pitched Shrill	Whisper, Pleasant to the Ear	Flashing, Loud	Melodious	Noisy, Irregular	Deep, Stable, Steady, Solid	Shaky	Clear, Soft, in Tune
Feeling	No Energy, Exhausted	Uplifted	Tight, Closed in	Relaxed, High, Centered	Pain, Tough, Rough	Nurtured	Irregular	Stable, Protected	Uncertain	Balanced, Even
Texture	Crumpled	Firm but Comfortable	Slippery	Velvet	Rough	Soft	Cactus-like	Comfort-able, Secure	Sticky	Smooth, Firm
Size	Deflated, Low	Expanding Upward	Small	Limitless	Expanding, Exploding	Expanding, Gently	Small, Pointed	Expanding	Out of Proportion	Big, Deep
Taste	Salty	Satisfying	Salty	Mild, Honey	Bitter	Sweet	Acidic	Satisfying	Sour	Smooth, Clean
Direction	Downward	Upward	Scattered	Circular	Attacking	Enfolding	Scattered	Open, Steady	Con-stricted	Horizontal

Fig. 7.19 *Typical Qualities of the Five Vital Organs*

Chapter VIII

Cranium: Projection of the Five Elements, Five Star Palaces & Five Planetary Forces

Development of Craniosacral Rhythm

Taoist theory on the structure of the universe and the invisible world can be partly recognized on a more physical and chemical level in more recent discoveries in science and bodywork. An interesting link was discovered between the five elements - the five planets, the cranium and the five vital organs. These more recent discoveries make the Taoist esoteric knowledge pragmatic in meditations and treatments. Taoist masters always mentioned that the power of the Governing Vessel is controlled by the power in its two poles: the **sacrum** and the **cranium**.

Since the Governing Vessel is a reflection of the Universal orbits, coming all the way from the Tao, a free flow of energy between the two poles is essential to provide the body with the right information to function in accordance to the Universal law. The treatment of the physical manifestation of this system is developed in a specialized art of bodywork, deriving from osteopathy, called craniosacral therapy. Touching the crown to connect another person to the light is well known in several cultures and thousands of years old.

The Governing Vessel has been used as a spiritual channel for more than 5,000 years, but the art of working with craniosacral rhythm is about 100 years old and focuses on other energy levels of the human skull. The discovery of this bodily intelligence would appear to be directly connected with Universal and human evolution. It is a further development of awareness and sensitivity of the bioplasmic (personal aura) and electroplasmic field (shared with all other humans). Long ago humans were only aware of their rhythm of breathing. The primitive human being recognized the breath as a sign of life. They were strongly physically dependent and oriented. The breath provided them with vital energy (Cosmic light) and oxygen to nourish the exchange process between their and outer world and the transformation process in the belly.

The heart center was undeveloped and the cardiovascular system situated more deeply inside of the body. They were not aware of their heartbeat. The development of the heart center gave birth to a more conscious soul connection. As the breathing developed and grew into the heart center, the sociability of the lung energy came forward.

System	Level	Connection
* Meridian Rhythm (Cycle)	- Spiritual	- Unmanifested World
* Cranial Rhythm	- Higher Mental/Spiritual	- Star Connection
* Heart Rhythm	- Lower Mental/Social/Emotional	- Sun Connection
* Breathing Rhythm	- Physical	- Earth/Moon Connection

In the heart center, the connection with other beings, the emotions and virtues arise. When the heart center developed into a higher state, compassion evolved as a bridge to the higher mental and spiritual level. Chi and awareness in the nervous system or spiritual center is known in every spiritual tradition but the rhythm of the craniosacral system is a relatively new discovery.

Craniosacral System

The craniosacral rhythm develops through the subtle cranial shifts that occur during the unfolding of the embryonic nervous system and is a translation of the information in the Governing Vessel. The brain and its ventricles produce a liquid called cerebrospinal fluid. This fluid is rhythmically pumped into the sub-arachnoidal space around the spinal cord between the surrounding fascia layers (the meninges). The Governing Vessel is located at the back of the spinal cord - in the same space between the arachnoid and pia mater, all the way from the perineum to the upper lip (and internally back down to the perineum). In this way the Governing Vessel is constantly charging the cerebrospinal fluid and the spine.

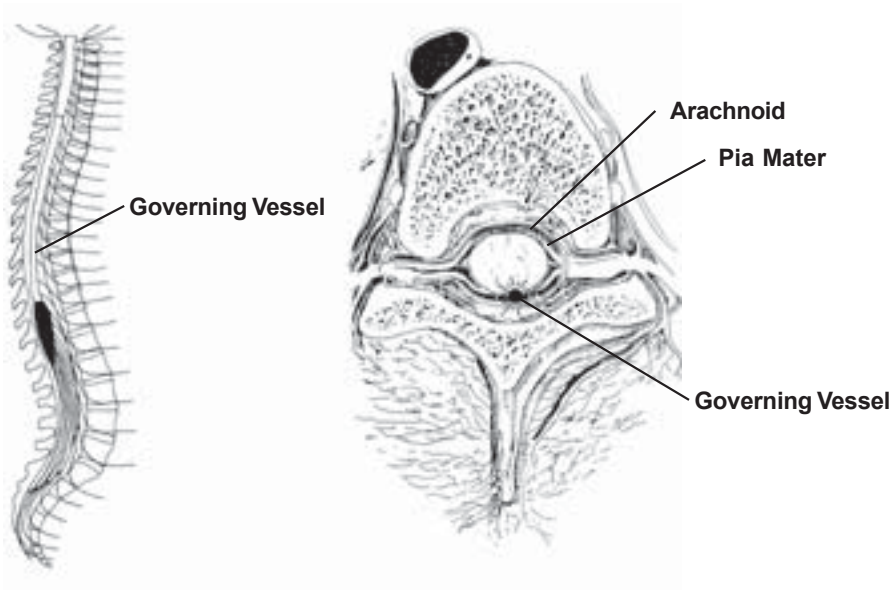

Fig. 8.1 *The Meningal System contains the Energy of the Governing Vessel.*

The cerebrospinal fluid is produced in the ventricles of the brain and is completely renewed every 5 to 6 hours. There is about 135 cm^3 of this fluid present in the body and the ventricles secrete more than half a litre daily. It must circulate continuously; take this information as encouragement to do **spinal cord breathing** frequently during the day. (refer to Cosmic Healing I). Besides the spiritual information in the Governing Vessel the cerebrospinal fluid contains the deep memory of biological evolution from the oldest planetary oceans. A period of more than three billions years of evolution from bacteria and viruses to human beings is stored there. The high and low "water marks" in the system have a rate of about 8 to 12 times per minute. During the phases the membrane system in the head contracts and expands causing the movement of cerebrospinal fluid in the spine. The cranial movements, created through these waves, are 0.04 to 1.5 millimeters, but with some training they can be felt throughout the whole body. It is important to remember that the craniosacral rhythm is fully independent of the breathing process.

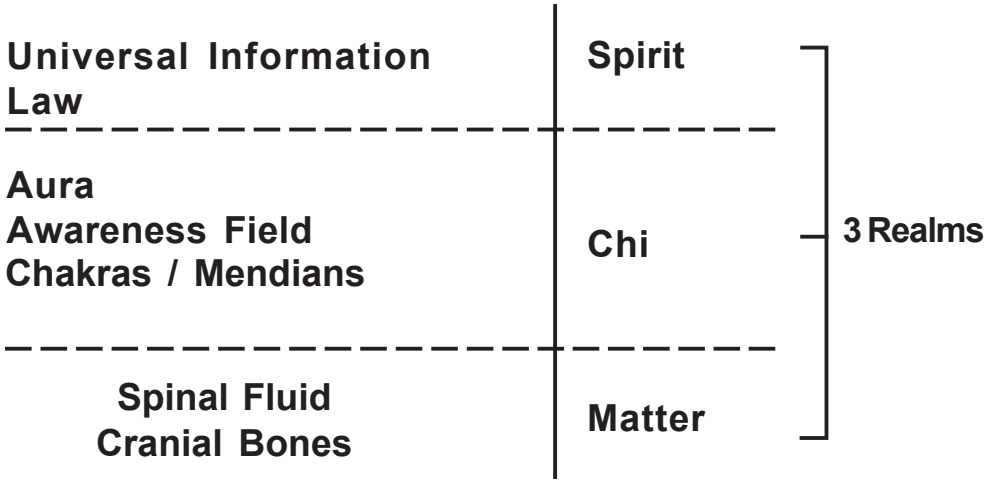

Fig. 8.2 *Three Realms in the Universe and in the Human Body*

In a meditative state confusion may occur between these two rhythms. Touching the skull very lightly and stopping the breathing for about 10 seconds in the outbreath can help you out of this confusion.

Even though the energy in the cranial system is more spiritually oriented, four different dimensions can be recognized (spiritual, mental, emotional, physical).

Any kind of impact on one of these four layers changes the quality and energy in the other three: treatment, meditation, thoughts, physical stress or strong emotions.

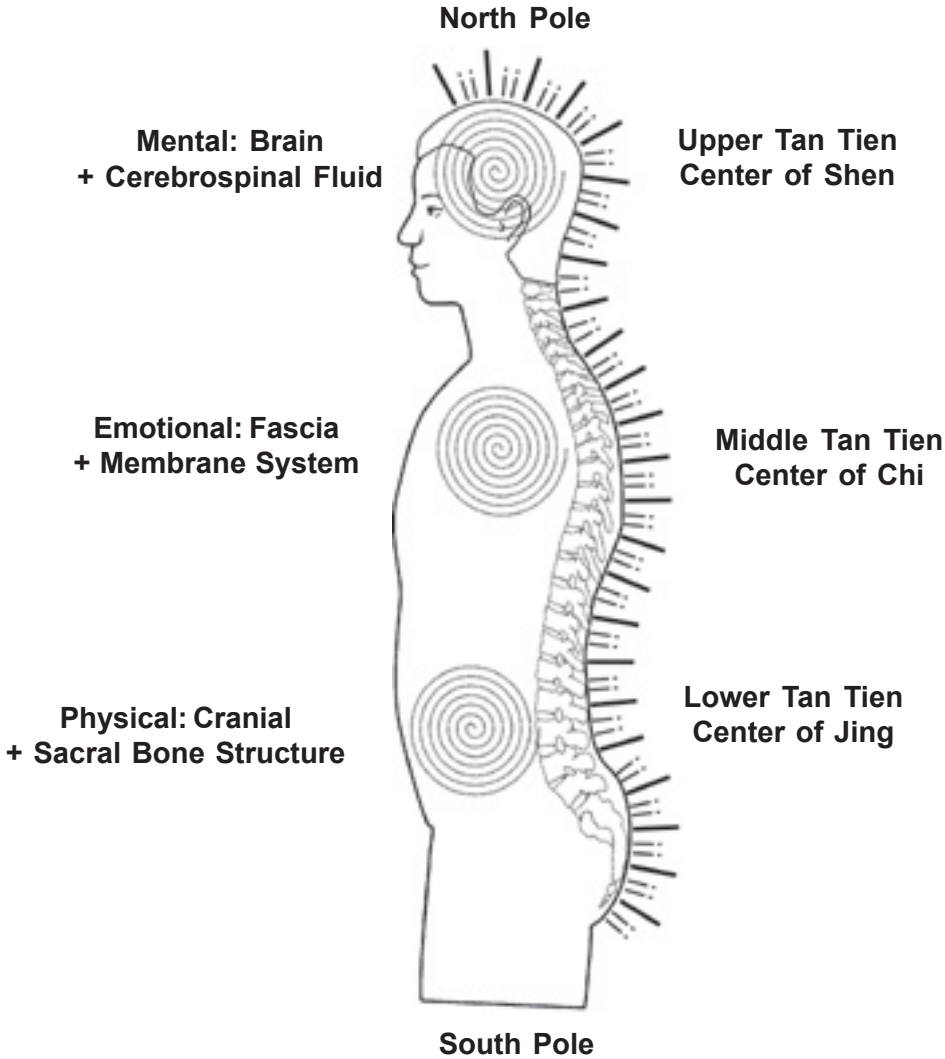

Fig. 8.3 *Spiritual Governing Vessel and its Aware Expression (Craniosacral System)*

The whole cranial system is a big antenna and transmitter of information to all the different energy levels in the body. To work with it in our treatments or just for our own meditations, it is necessary to practice, to feel and study the different layers of the system.

The physical layer (cranial bones) and the spiritual layer (Governing Vessel) are the most easy and most practical ones to register in your body. This mental/spinal fluid and emotional fascia needs more study and practice. The craniosacral system has a north pole, the cranium and a south pole, the sacrum. Under normal conditions they work together in perfect rhythm. The cranium is the pneumatic/mechanical driving force; the sacrum follows the cranium impulses. In cases of stress or blockages there can be small timing differences between the two.

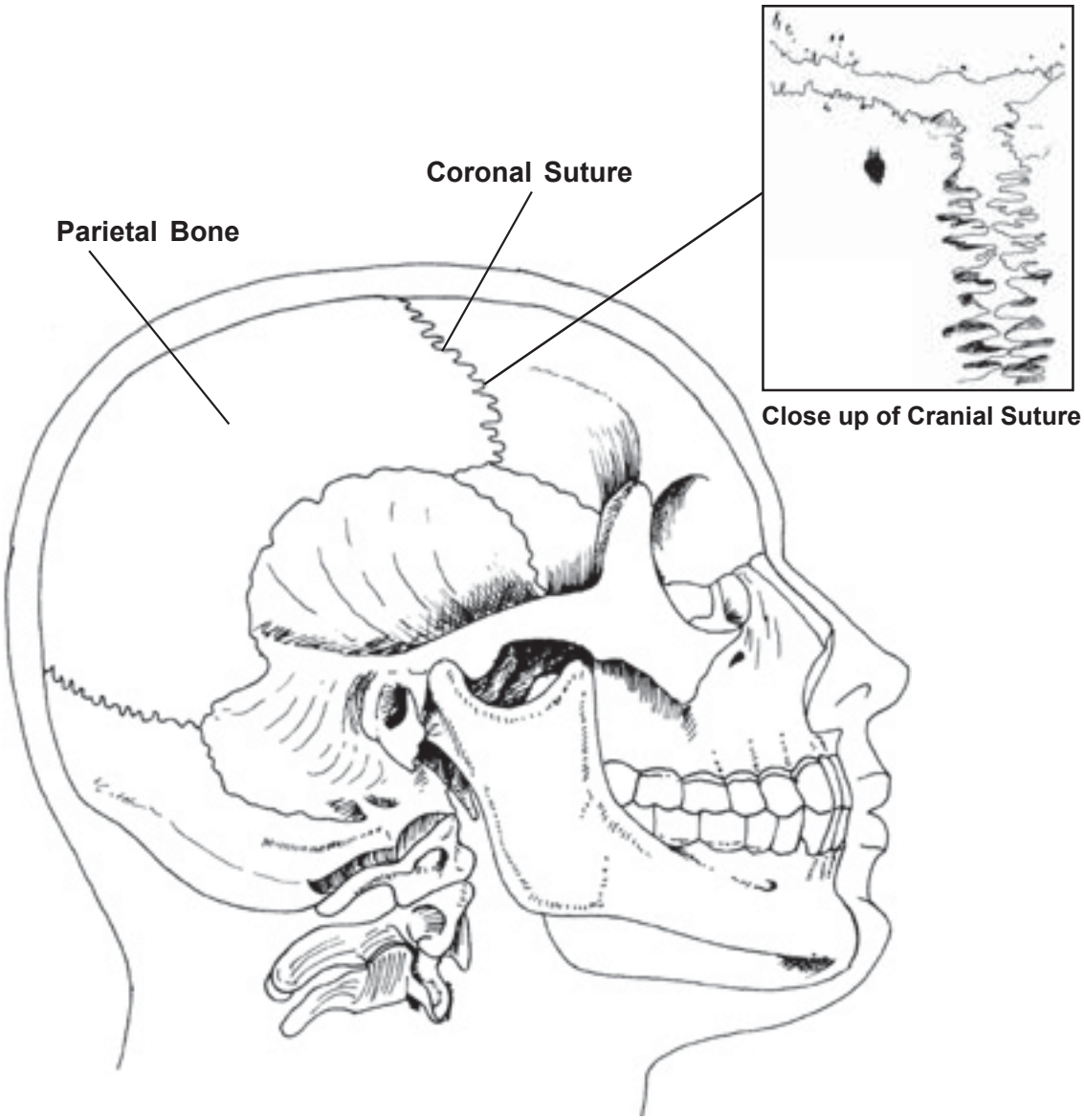

Fig.8.4 *Cranial Bone*

The suture lines in the cranial system form zigzag pointed protrusions that have a function in receiving stellar vibrations. From these structures subtle energy information channels spread out through the whole body.

Craniosacral Anatomy Sensitivity Exercises to become Aware of the Craniosacral Rhythm

To be able to understand the craniosacral system we have to look at some simple anatomical charts. The cranial bowl contains 10 major external bones, five of which will be used during our meditations: you can see them in the drawings below.

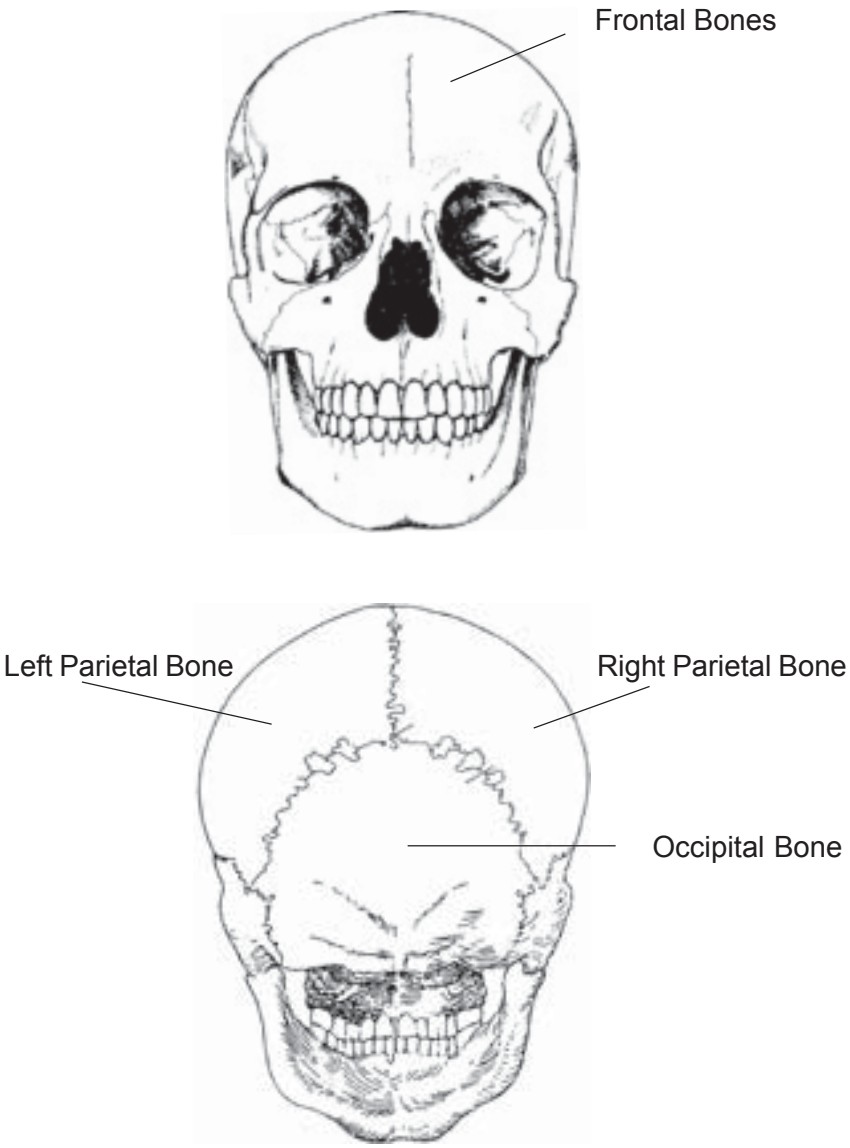

Fig.8.5 *Skull Front and Rear View*

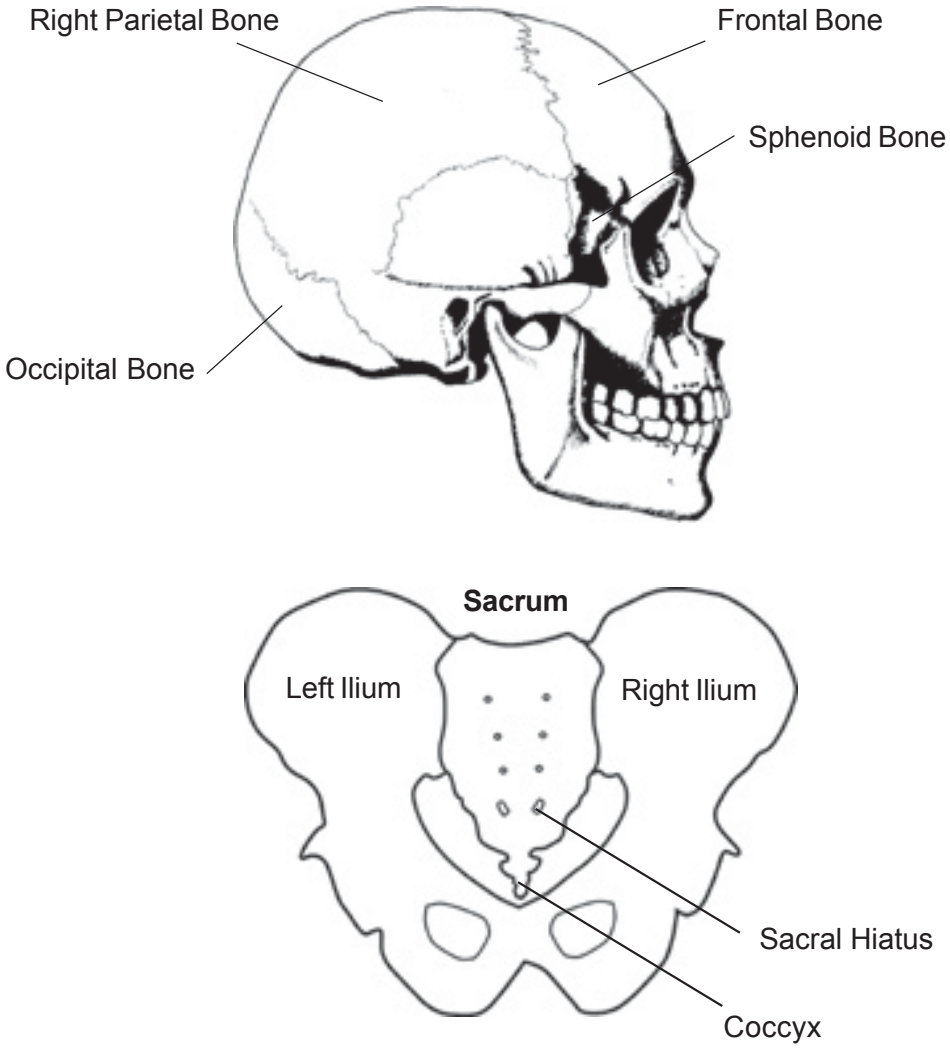

Fig. 8.6 *Craniosacral System*

As described before, the craniosacral system has a high and low tide according to the movement of the cranial bones and membranes in the cranium. Each individual bone has a very specific movement plus a bending factor of the bone itself. This means that the bones can actually bend like a piece of hard rubber. We can also see a general movement of the cranium (seen as one piece). In the flexion stage the cranium becomes wider and shorter. In the extension stage the skull becomes smaller and longer. You can compare it with a balloon you hold on both sides. If you softly press and release every 6 to 7 seconds, you get an effect similar to the cranium during flexion/extension.

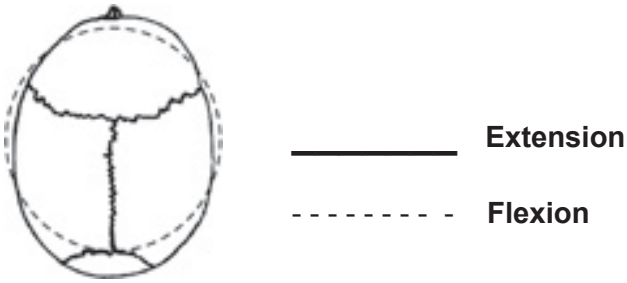

Fig. 8.7 *Flexion and Extension Stage*

Simultaneously, the sacrum will be in a more vertical position (if you lay down) in the flexion stage and a more horizontal position in the extension stage.

In the flexion stage, the arms/hands and legs/feet have a slight outward rotation. On the extension stage they make an inward rotation.

Spend some time feeling this rhythm in your head, arms, hips, sacrum, legs and expand the movements into the aural field. You will feel a deep relaxation and at the same time a great improvement in your sensitivity and body awareness.

Five Elements - Five Star Palaces - Five Planets - Five Cranial Bones

The five planets are the physical representation of the different awareness layers in the solar system and at the same time a materialized form of the law of the five elements. This five elements law is an important foundation in ancient and modern Chinese society. In medicine, astrology, politics as well as in a variety of other fields this principle of five elements is used.

There are Taoist meditation practices where the planets are linked with the cranial bones. But in some methods connections are made among the stars and the sutures between the crainal bones. One comparable Taoist meditation of unknown origin places the planet Saturn in the heart, Mars above the head, Mercury under the feet, Venus in the right palm and Jupiter in the left palm. The cranial system is our own compact mini-representation of the five planets or the more central part of the solar system and on a larger scale the five star palaces. It is in direct connection with this planetary/galactic/five element world and reacts directly on all information coming through this channel. From the cranial bowl, the energy moves down into the organs and different body systems.

Awareness of the cranial system and its connections to the planetary/galactic and five elemental forces helps us to:

* Create a direct contact with the universe. It is an enormous energy source.
* Get insight in our karmic charge, how the soul is basically influenced by some and less by other planets/stars.
* Develop the ability to understand our present lives, our reactions, our physical, emotional, mental condition.
* Acquire an ability to stabilize these imbalances.

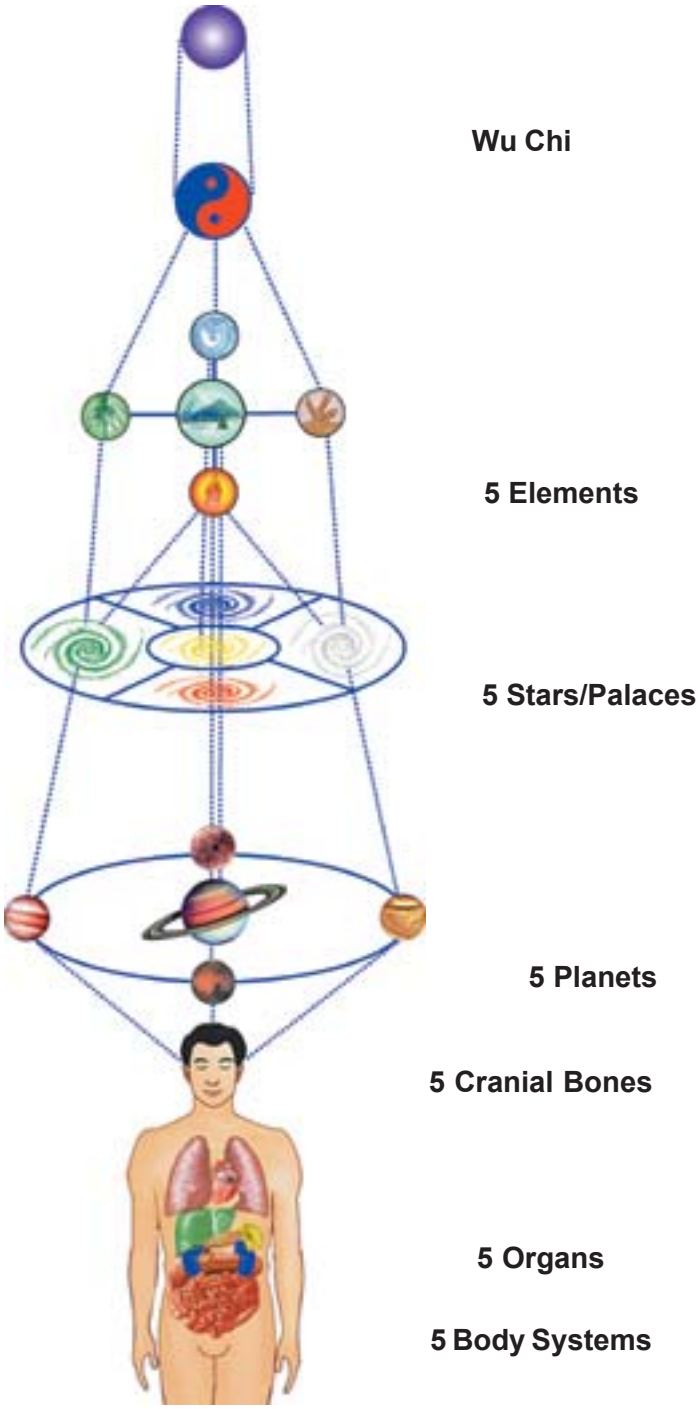

Fig. 8.8 *Five Elements, Palaces, Planets, Cranial Bones*

Once a clear connection with the planets is established, the galaxy energies from the five palaces can be integrated. See chapter 11, Meditation 4. On a high level, a direct contact with the law of five elements in the vibrational world can be achieved.

The bone structure is our most dense body system. The crystalline and mineral structure of the bones has (besides its supportive function) a primary function in attracting high frequencies. Also, the hormonal activities in the glands in the head have an important role. Both the hormones and mineral structures are very condensed substances that have the ability to attract extremely high vibrations: spiritual energies and star frequencies.

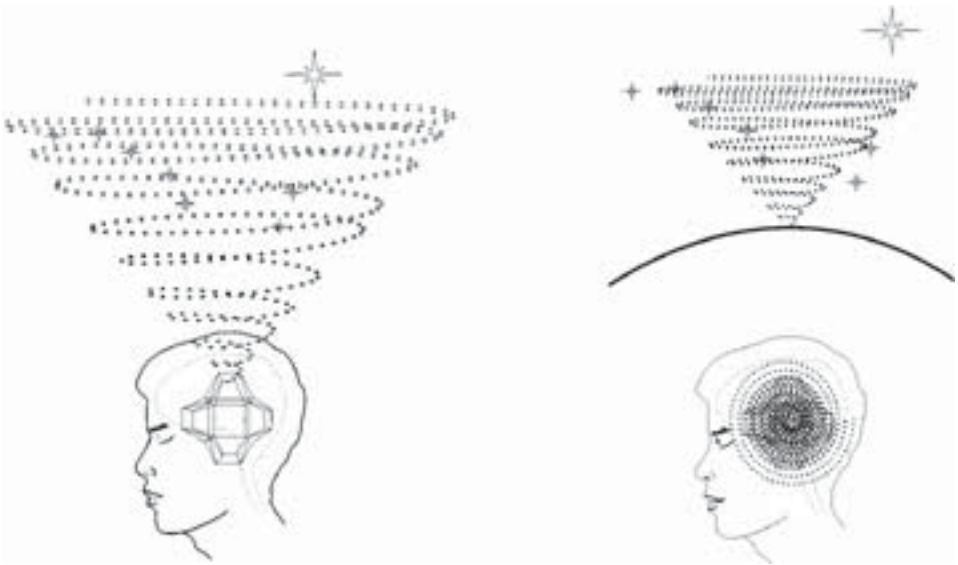

Fig. 8.9 *When the Crystal Room is open, there is a Universal Connection; when the Crystal Room is closed there is no Universal Connection caused by too much Mental Activity, Stress, Low Energy and Negative Emotion.*

The glands serve as transmitters and transformers of the subtle (high) energy frequencies, which can then enter into the organs and the layers of the body with a lower vibration. These vertical connecting channels can only be experienced in the silence of the empty spaces between the turbulent horizontal activity caused by the emotions and thoughts. The planetary and stellar connection generally depends on two different factors: prenatal and postnatal.

Prenatal

The karmic information, based on the tasks and messages the soul has received during the incarnation process (according to the sum of past life information).

Postnatal

The physical, emotional and mental condition determines the ability to receive information from the universe. If we get very busy, and mentally overactive, stress gathers in our body and the feeling of separation will increase in and outside of ourselves. In this way the left brain becomes very active and a state of separation from the environment and an inability to connect with ourselves arises. This condition makes it impossible to take in information from the universe.

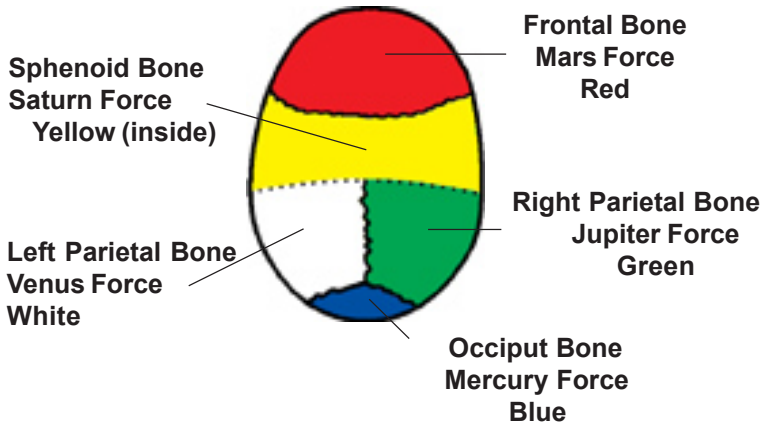

Fig. 8.10 *Top View of the Cranium*

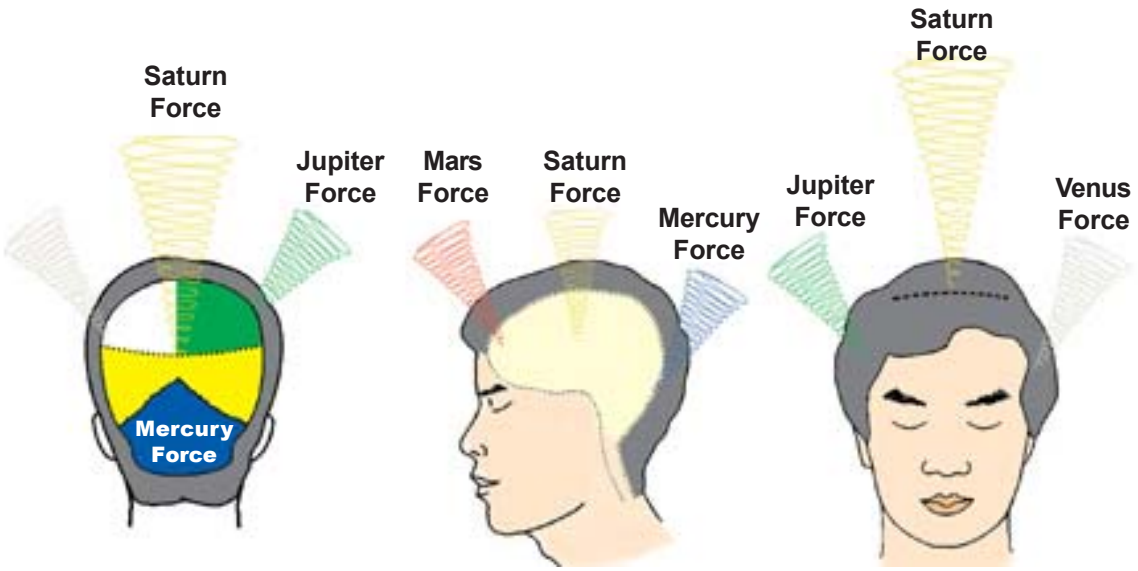

Fig. 8.11 *Back View, Left Side, Front Side of the Cranium and the Planet Forces*

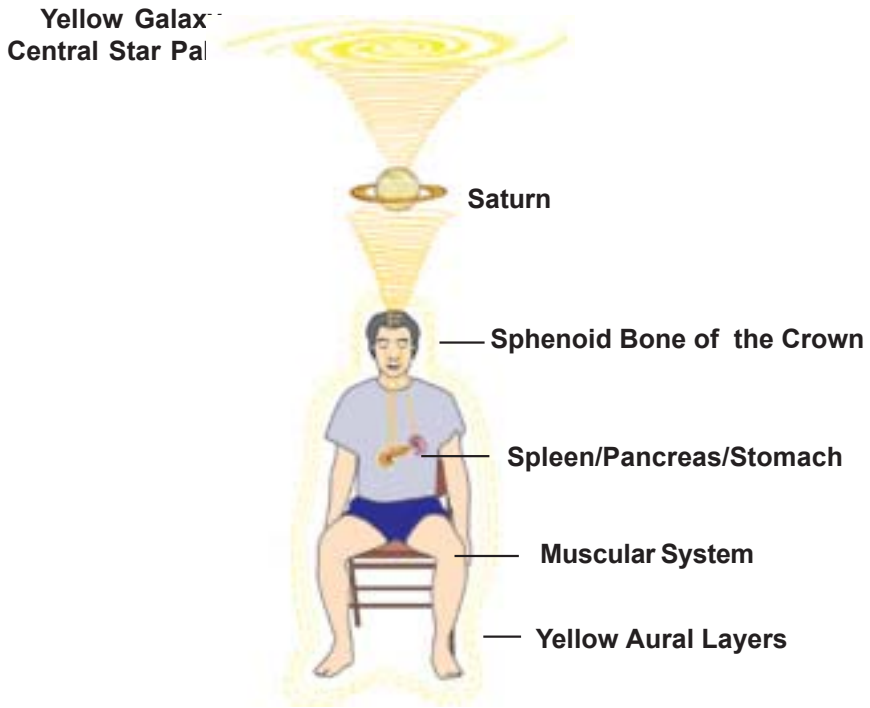

Fig. 8.12 *Earth Element*

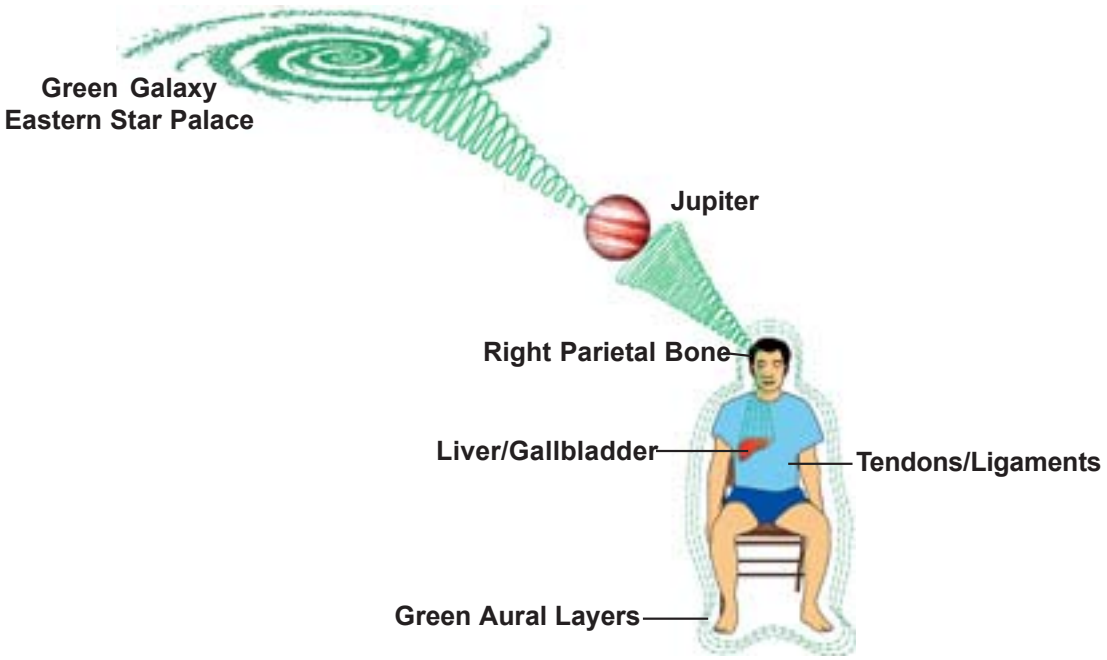

Fig. 8.13 *Wood Element*

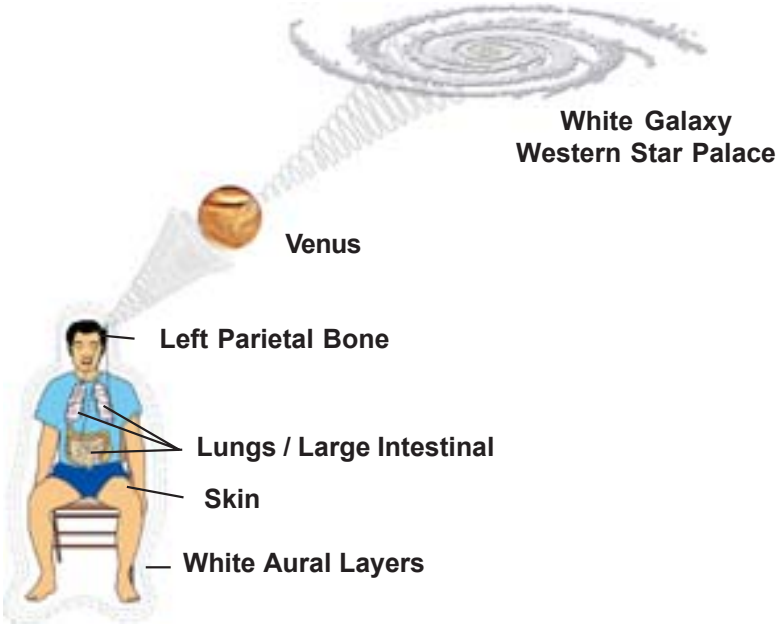

Fig. 8.14 *Metal Element*

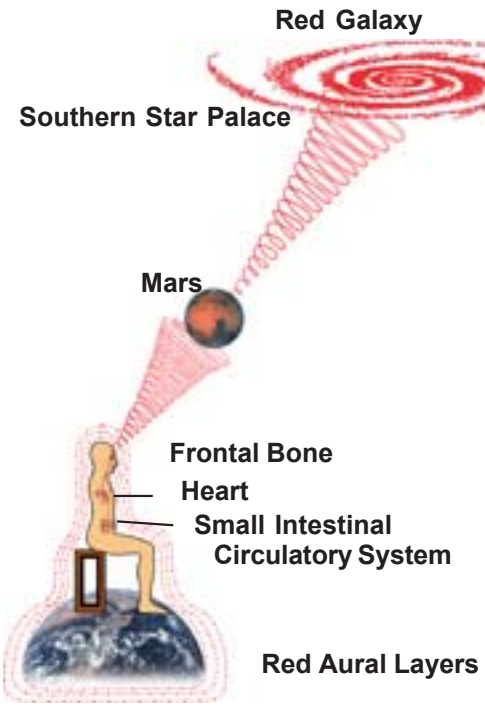

Fig. 8.15 *Fire Element*

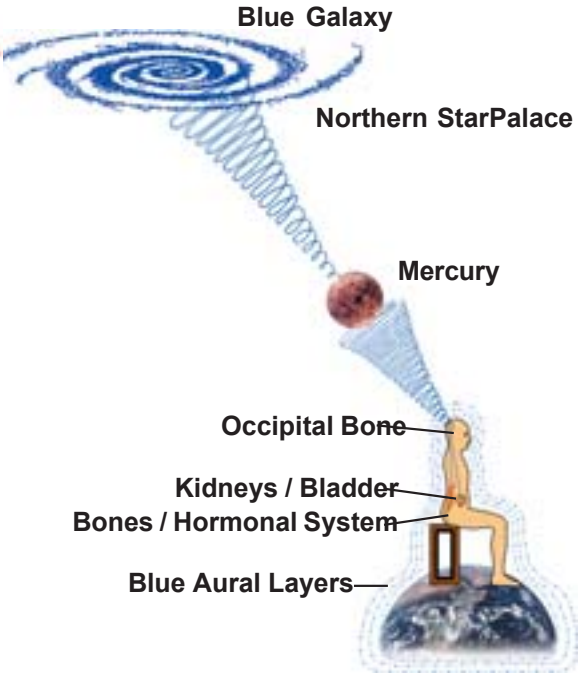

Fig. 8.16 *Water Element*

Balancing the Planetary Energy with Nature's Energy and the Earth Force creating a more Harmonious Energy Quality

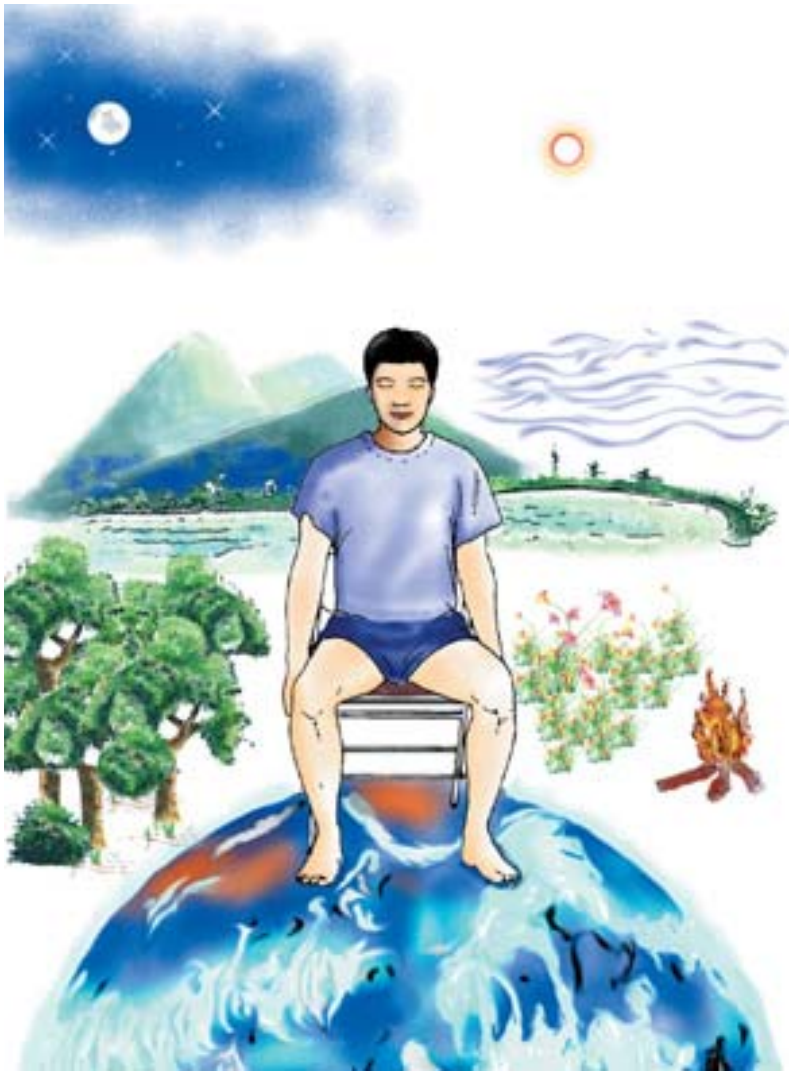

Fig. 8.17 *Inner Balance*

To prevent overheating it is necessary to mix the planetary or heavenly energy with the five nature forces and the cooling energy of the planet earth itself. The combination of planetary and five earthly elements gives a more balanced and stable energy. We can breathe in these energies through the third eye or the skin to the related organ or directly through the navel area in the center.

Five earthly connections for the planetary energies are:

Jupiter	-	Liver	-	Wood/Tree Energy	-	Green
Mars	-	Heart	-	Fire/Flame Energy	-	Red
Saturn	-	Spleen	-	Earth/Soil Energy	-	Yellow
Venus	-	Lungs	-	Metal/Mountain Energy	-	White
Mercury	-	Kidneys	-	Water/River Energy	-	Blue

The energies of the wind, sky, thunder, lightning, lakes and flowers are also very useful. All natural energies are a direct source of cosmic energy for us.

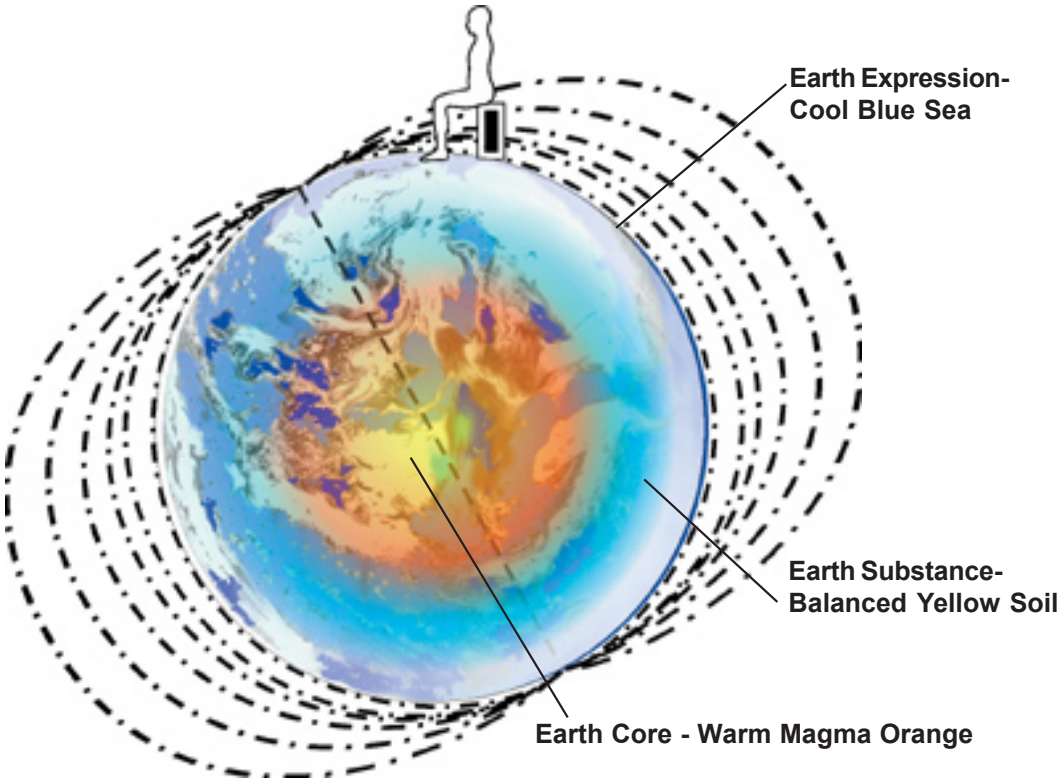

Fig. 8.18 *Three Aspects of the Earth Force*

Three Aspects of the Earth Force

The planet earth has three different energies. Many discussions about the energetic quality and color of the earth and other planets is based on the fact that different people tune in on different planetary layers or use another method of looking at things. Always give yourself enough space to perceive energies in your own way, but know at the same time that if you perceive the energy and color differently from someone else you are probably tuning in to a different energetic layer. If we tune into the earth, we connect to the earth/soil quality which is yellow. If we tune into the energy radiated by the earth created by the centrifugal force, we receive blue, cool energy.

If we go deeper into the earth with our mind and bring this energy into our body we can perceive orange/red, related to the more central part of the earth (fire, magma).

The inner earth has a very different quality. Not only is the temperature very different, but also the movement and speed of the central part varies with that of the outside layer.

The inner earth relates more to the deep female qualities while the expession of the earth is the male quality. Exactly the same discussions occur about male/female energy qualities as with planets and again it is just a matter of where you are tuning into.

According to the Taoist masters, women are more yin, in their overall energetic constitution. In the same way that the earth's (the female source) center has a different energy. Women are warmer inside than men. This warmth is also found in the quality of the eggs in the ovaries. Taoists knew long ago that the eggs and the earth/moon energy are directly related. Understanding this relationship, they knew that the fertilized ovum had a similar turning motion similar to the planet earth. Western science has discovered this turning motion only this century. Men on the other hand have a more warm energy on the outside, but deep inside their basic quality in accordance with the sperm is cool.

More earth force influence, more energy in the lower body; more density/warmth in the Lower Tan Tien (stability of the egg) and softer/cooler on the outside of the body.

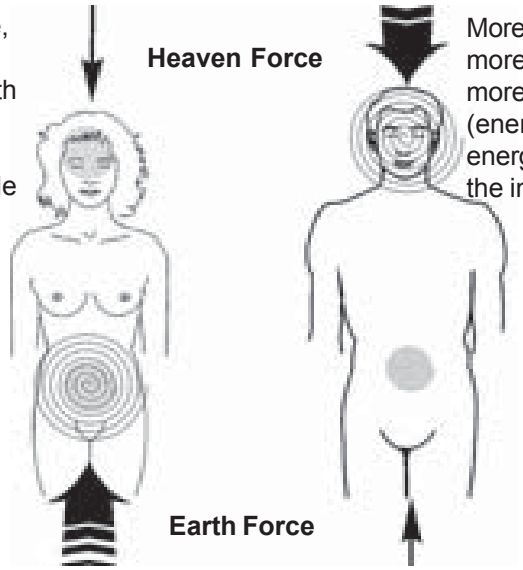

More heaven force influence, more energy in upper body; more dense/warm outer layer (energy related to the sperm energy) and softer/cooler on the inside of the body.

Fig. 8.19 *Heaven and Earth Forces*

The core of Taoist practices is to balance the Yin and Yang – Male/Female Forces. To be able to integrate the high frequency forces of the universe, we have to create counterforce in our own body and inside the earth. This, we can do most easily by activating the inner frequencies in the pelvic bones. They are very directly connected to the five inner colors from the earth that is originating in the Earth star. Especially for women, it is essential to have the pelvic region and the earthly five elements in their body consciousness. The greater depths of the unmanifested world cannot come into our awareness as long as the secrets of the earth and the physical/energetic body remain unknown to us.

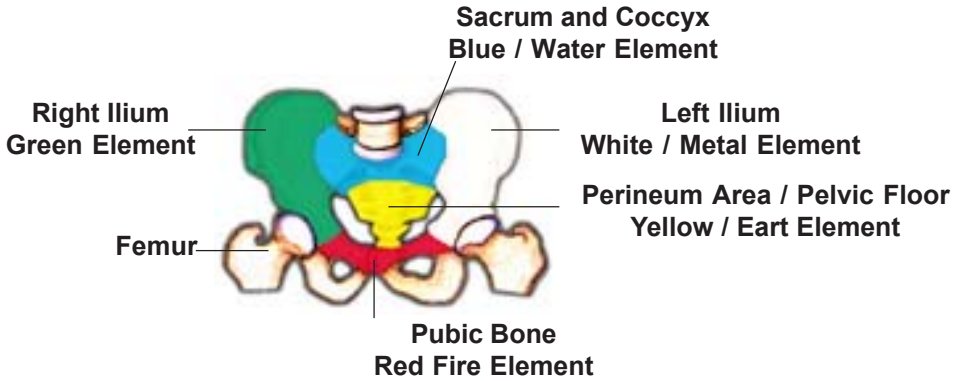

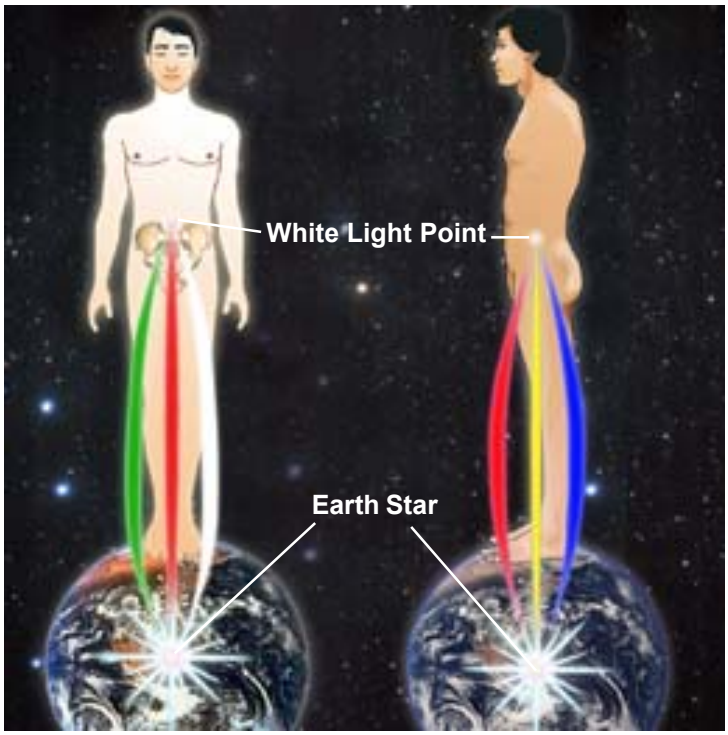

Fig. 8.20 *Pelvic Bones connecting with the Earth Star.*

Relationship between the Five Planets and the Star World

As in the planetary world, the star world is divided into five parts called the five palaces (four directions and one central part)

To concentrate the energy from the galaxies, all energy can be visualized in one central star in the middle of the galaxy.

The five palaces in relationship with the 28 lunar mansions are fundamental in Chinese astrology. The 28 constellations are divided into four groups of seven around the central palace of the North Star, the Big Dipper and related stars. There is a total of one hundred and eighty two stars collected around the central palace. In the past the four groups of constellations were seen as four giant constellations related to the following animals.

Green Dragon	- East	(32 Stars)
Blue or Black Turtle	- North	(35 Stars)
White Tiger	- West	(51 Stars)
Red Bird	- South	(64 Stars)

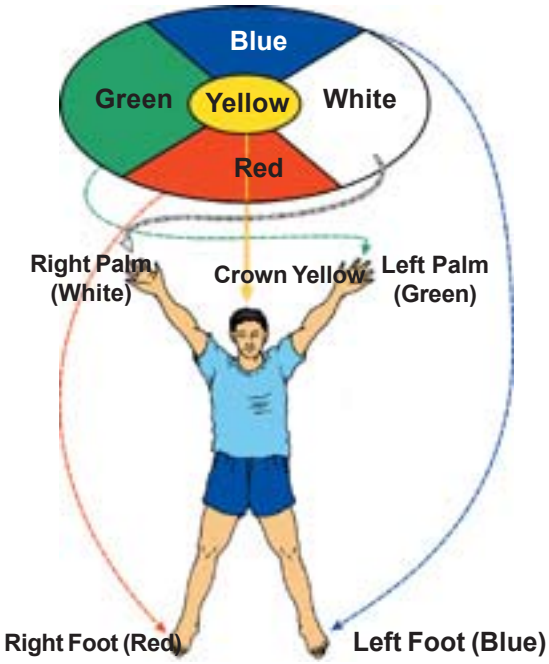

Fig. 8.21 *Colors*

These mythical animals were called the guardians of the four directional palaces.

In the Taoist immortality practices of Kan and Li, the palaces are connected with the hands and feet. Through the connection of the extremities and the crown with the five palaces we can integrate the galactic energy more easily.

Long ago the planets were seen as special stars related to the five elements :

Fire Star - Mars
Earth Star - Saturn
Metal Star - Venus
Water Star - Mercury
Wood Star - Jupiter

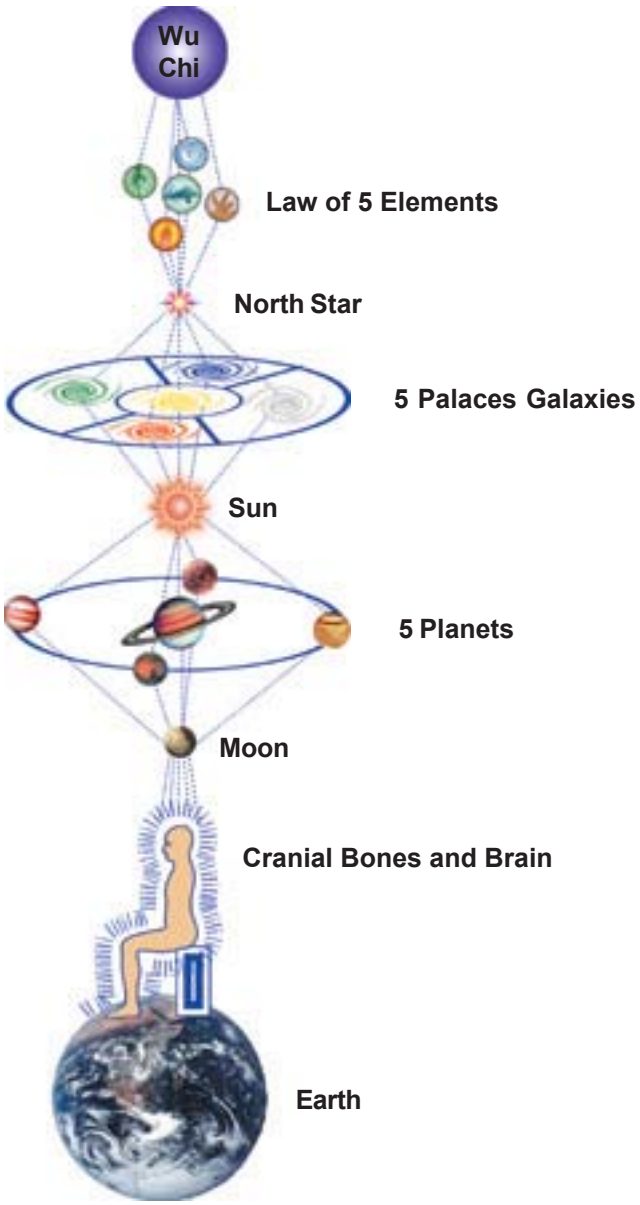

Fig. 8.22 *Universal Forces*

The North Star is the balancing point above the galaxies and the sun is the balancing point above the planets. The sun and the North Star are gates to a higher dimension and frequency in the universe. In order to pass through these gates a balance and integration of the underlying energies is required.

Earth and also the moon will be used to keep the grounding and to integrate the high frequency energy in the physical body.

The galaxy meditation of the five palaces brings the energies of all stars and galaxies placed in that direction of the sky together in one galaxy.

Balancing the Cranial System

Many therapists work with techniques on the craniosacral system these days. In the last 20 years craniosacral therapy has evolved to a great art of bodywork to create balance, release blockages and energize the body. Most of these therapists work with the bones, the membranes, the fascia and the cerebrospinal fluid. Planetary and stellar energies can create an extra dimension to this art because it helps to get closer to the origin of the system and how it relates to Universal principles. In many cases the craniosacral system is treated as a separate unit of the body or, by some therapists, as the only important system in the body. Miracle therapies have been brought forward many times throughout the ages but after a while it always becomes clear that they are just another part of the puzzle. The Universal laws organize all the parts of the puzzle. Stellar and planetary initiations can be a valuable method to create an extra dimension in the consciousness and deeper understanding of healers and bodyworkers.

The meditations described in this book demand only a basic theoretical and practical knowledge. Essential, however, is sensitivity and energy cultivation. Of course, people with a deeper understanding of the craniosacral system can integrate the meditation and awareness practices into their regular treatment method. More detailed descriptions of how to use the meditations during treatment will be published in a book on the therapeutic applications.

Since the origin of this method is located in the world of the soul and spirit, balancing the planet and star energies will result in deep, long lasting changes in the life of the practitioner and the patient. When the energies get balanced, Universal information naturally reaches you in a more harmonious way. Many of the blockages on a physical, emotional and mental level will get connected and receive the information that was missing before. As a result of the balancing they will gradually dissolve.

It is necessary to realize that the bodyworker/healer of the future will have an important teaching task. The qualities required to practice as a therapist in this new age are a fusion of awareness with knowledge and sensitivity with skill.

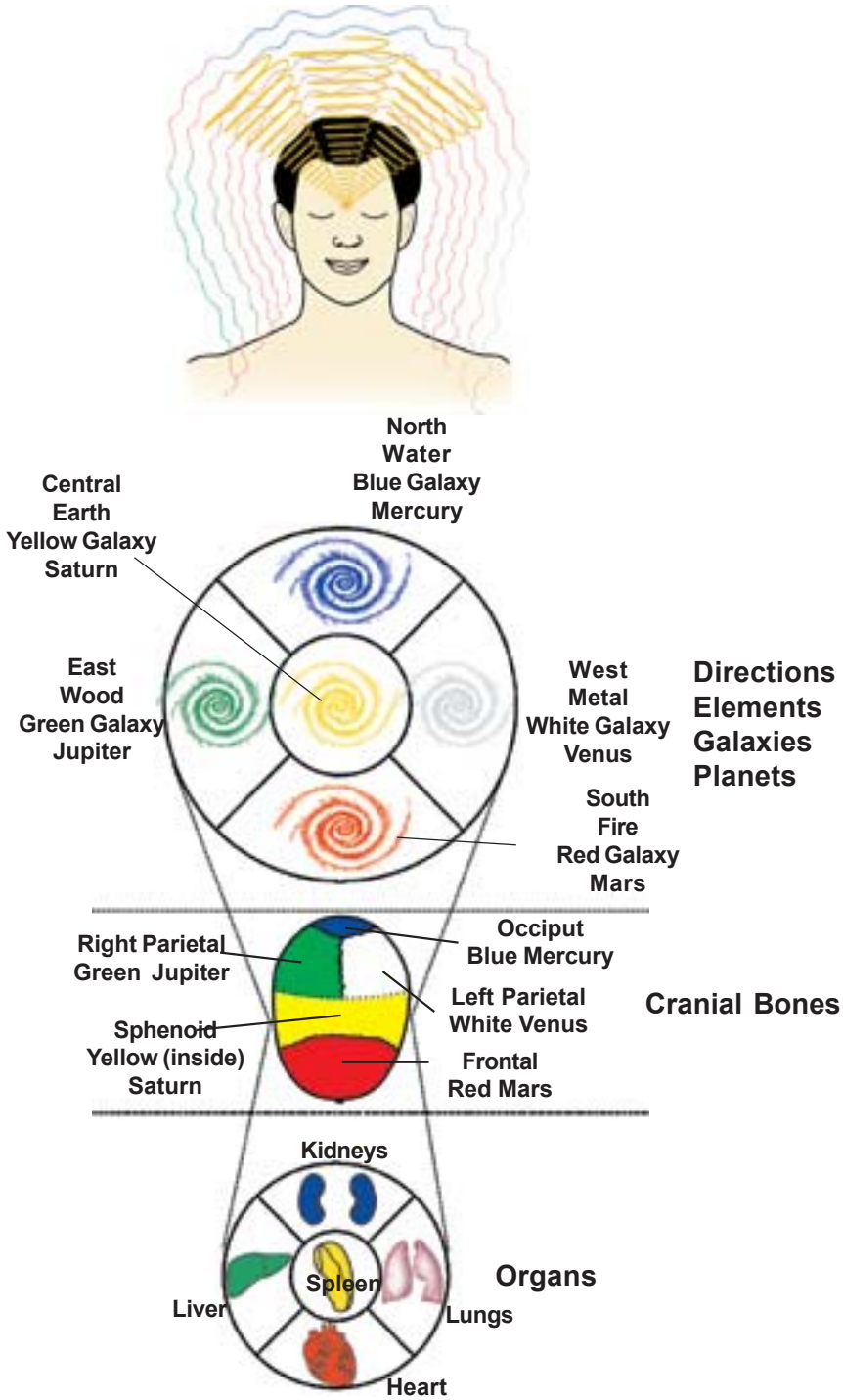

Fig. 8.23 *Integrating the Different Frequencies into the Cranium.*

Chapter IX
How to use Planetary Forces in your Life

In cranial osteopathy the sphenoid bone is considered to be the central, mechanical, driving bone. It connects the temple bones and forms the central axis of the cranium where all major cranial bones are attached. In the planetary world of our solar system, according to the five elements, the earth element and saturn are the central aspects. The central yellow galaxy with the yellow star in its core is the earth element of the star world. The four other planetary/galaxy connections of the cranium are functioning as two complementary couples paired up around the central point. The five planets are ruled by the sun.

Sun - Moon

The sun/moon balance is an important preparatory practice, (see also Meditation 1 in chapter 11). The sun and moon energies form a major influence in the development of human consciousness derived from the more primitive life forms (mammals and reptiles).

	Biological evolution
Neocortex: Self-Consciousness, Human	200 million years ago
Limbic System: Feelings, Emotions, Mammal State	300 million years ago
Brain Stem: Basic Life Features, Reptile State	500 million years ago

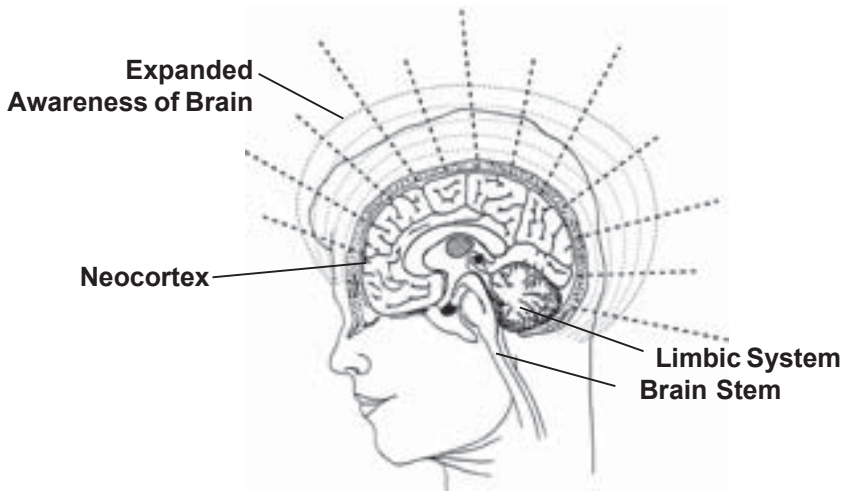

Fig. 9.1 *Limbic System - Brain Stem - Neocortex*

The development of the neocortex as well as the etheric brain is the end product of a 500 million year process. About 100 million years ago, the multiple layer structure of the neocortex was formed. This process is still in evolution. Only at the highest level of awareness can the neocortex expand energetically beyond the physical boundaries of the skull. This expanded aural brain shows connections to the godly level, clairvoyance, vision and enlightenment. This is similar to the golden crowns or halos that are seen in paintings of Christian saints.

The hot essence of accumulated yang energy generates fire and gives birth to the sun. The cold essence of accumulated yin makes water and gives birth to the moon. Sun's cloud soul and moon's white soul are the yin and yang manifestations of the energy around our planet.

As heaven is one, the yang is realized in three: heaven, sun and constellations. The associated animal with sun energy is the three legged crow. This sun crow stands for the lively consciousness. Names that were used for the sun are "Radiant Numen" (Yao Ling), "Vermilion Luminosity" (Chu Ming).

As in most cultures the Taoists saw the sun as the supreme life giving force on earth. The crow in the sun belongs to the west (metal energy), it is of the yin class and in this way clarifies and balances the light of the sun.

The moon is the grand yin aspect and complementary to the sun. The moon animal is the toad; its nature is cold and watery. The toad on the moon belongs to the east (wood energy); it is of the yang class, which strengthens and illuminates the moon.

The moon plays a vital role in planetary existence and its value is frequently underestimated. This point is based on the social status of women in the east but also the imbalanced view of male/female energy around the world. The moon is the 'potential' around the world - the receptive form of spirit. Its true brightness is latent and dependent on the light of the sun. But its cool yin energy is constant and independent. Men have lost the ability to see light and feel energy in the dark, due to a lack of inner peace and silence.

The moon is the magic mirror, reflecting consciousness in the sunrays and bringing them to the core of the body, to our sexual potential. The water energy is closely related to the sexual energy and all body fluids. The phase of the moon strongly influences all fluids in the body and from there, human behavior. The moon's journey around the earth represents the yin principle in the cosmos and in our world.

The sun has a connection with the third eye and the pituitary gland. It is the star connected with consciousness and future vision. It functions as a source of consciousness and compassion and a gate to the higher universe. The moon finds its most important entrance point in the sacrum (the sacred part) and represents the unconscious relation to the past, sexuality and basic instinctive reactions. The place where their essence is stored is located more centrally in the body.

The sun/moon energies contribute in keeping a balance between the Lower and Middle Tan Tien (belly/heart). Imbalances can also relate to the influences of the other five planets. When the five other planets are not in balance it will be hard to receive the deep frequencies of the sun and the sexual energy will get distorted. A strong connection to the sun will have a balancing function throughout the whole body.

Once the sun energy is collected in the heart and moon energy in the sexual center, these two energies can be moved towards the Lower Tan Tien. The most vital blood channels in the body, the aorta and the vena cava, can be used for this: The artery system, which the aorta belongs to, distributes the blood outward. It works with clear, red, oxygenated blood and is more yang/future oriented, so it has more sun qualities.

The vein structure like the vena cava withdraws the blood from the outside. More bluish or dark blood is transported here, which will first go through the kidneys to be purified. So it is a more yin/past oriented system and has moon-like qualities. Harmonizing the aorta/vena cava and the rest of the cardiovascular system will magnify the sun/moon meditations.

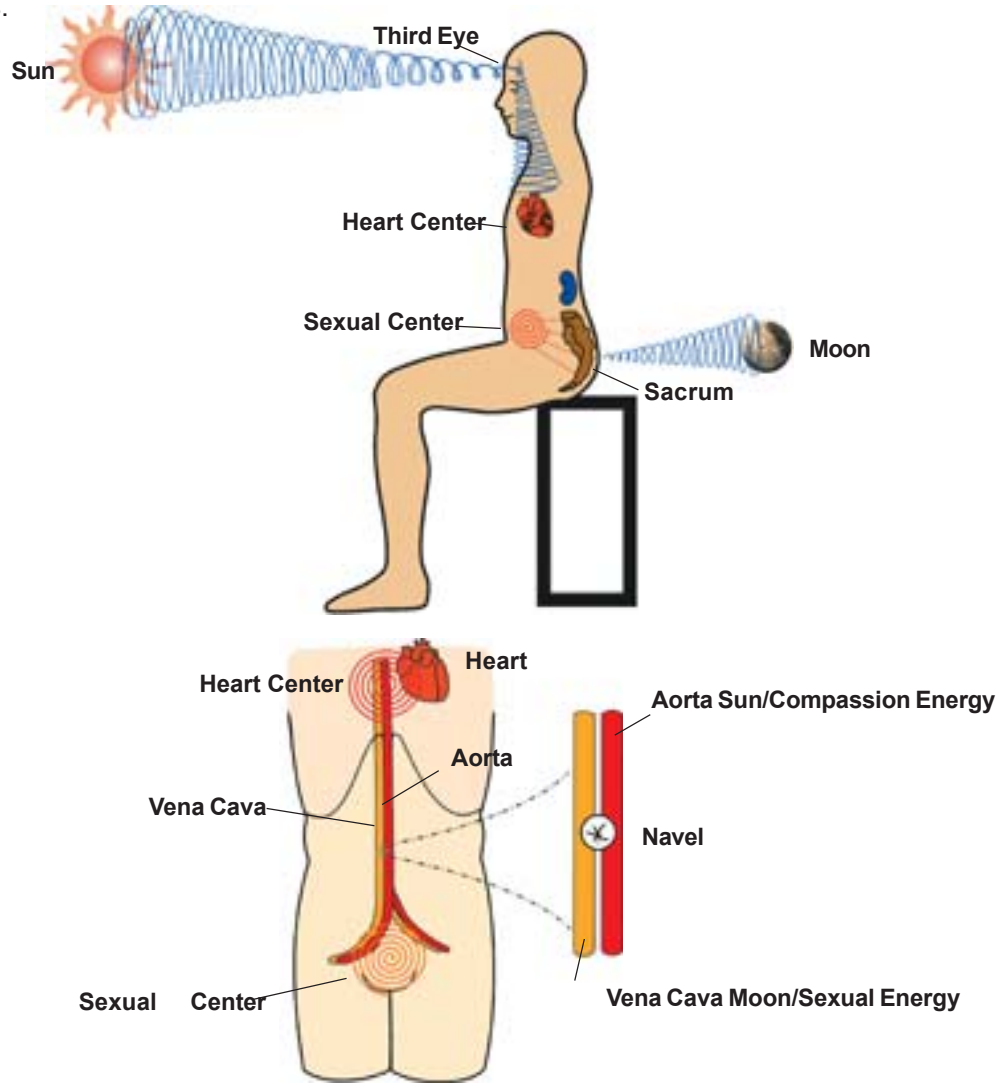

Fig. 9.2 *Internal Organs*

A strong moon connection can give access to deeper unconscious behavior and gives us the ability to shine a light in the dark or transform unconsciousness into consciousness. The sexual essence governed by the moon energy will stimulate all energies in the body, both positive and negative. A strong stimulus of the moon energy without an open sun connection can cause emotional problems and distorted sexual behavior.

In the Taoist way of energy cultivation the sun controls the hours between midnight and noon (yang energy). The moon controls the energy between noon and midnight (yin energy). Sometimes it is said: All hours of sleep before midnight count double, because of the strong yin energy which charges us at that time.

Taoist masters also saw the sun and moon as the eyes of heaven, corresponding to the human eyes. The left eye rational or intellectual brain relates to the sun, while the right eye more intuitive part of the brain relates to the moon.

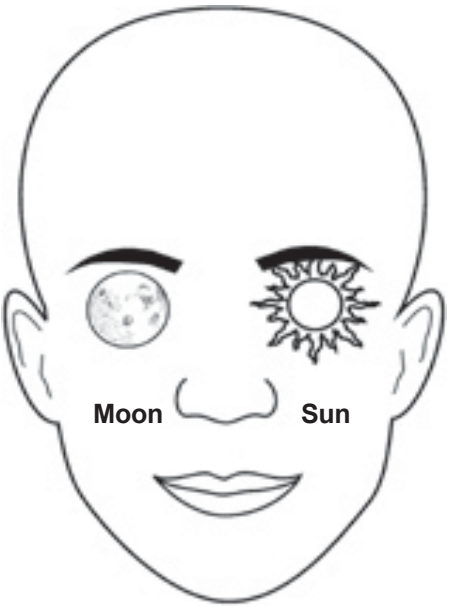

Fig. 9.3 *Moon and Sun*

We can use the sun/moon energies to create balance between the two hemispheres. If used during meditation, always integrate the sun/moon energies in the heart center, third eye and the sexual center/sacrum first. This is to prevent overheating the heart. Practice and integrate Meditation 1 in chapter 11 before you try this meditation.

It is important to utilize the moon/sun frequencies to get a balance between water and fire energy in the body and then to increase the amount of energy of both.

The moon's color is yellow, its essence is red and its rays are silver white. The Taoist practices for the moon are done according to the eight articulations of the moon power which occur during the two solstices, the two equinoxes and the first day of the four seasons.

In the second century manual “Can Dong Chi” the interaction of sun/moon is used in relation to the Daiwa, the twelve directions and the five elements. These pictures contain the deep secrets of the Taoist immortality practice.

Fig. 9.4 *Method of the Elixir*

Mars - Mercury

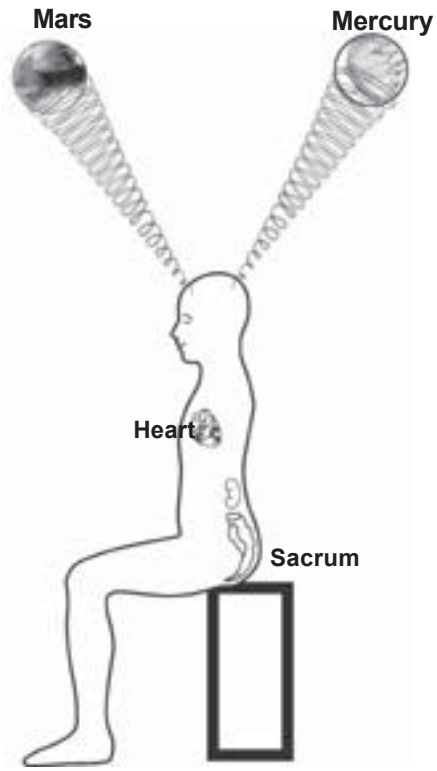

Fig. 9.5 *Mars and Mercury*

Mars and Mercury are the planets of fire and water respectively. They are on a lower vibration level compared to the sun.

The sun is the father of fire and Mars is the planet of fire. Mars relates to the tongue, speech and the physical heart. The heart is placed to the left of center in the chest; the sun is connected to the heart center, behind the sternum and is related to the heart governor. (pericardium). We can say that the sun has a controlling/regulating effect on the heart energy. Medical research on yogis has proved that their physical heart operates more efficiently after many years of meditation and that the tip of the tongue often makes a curve in the palate in the direction of the center of the crystal room.

Mars energy is more male and future oriented. If the Mars energy is too strong in comparison to the other energies, one may get aggressive and too talkative. This is often caused by weakness of the kidneys. Most heart problems are caused by depletion of the kidneys and the sexual energy. If Mars is too weak, the heart function/fire is withdrawn and the person feels weak.

Since the kidneys are the seat of the sexual essence and store the ancestral energy, they have a governing function on the sexual center. If the kidneys are depleted, sexual energy will also be weak. Fire is inactive in isolation and needs the presence of the other elements to stay balanced. Keep the fire in your stove and you won't burn your house down (see chapter II).

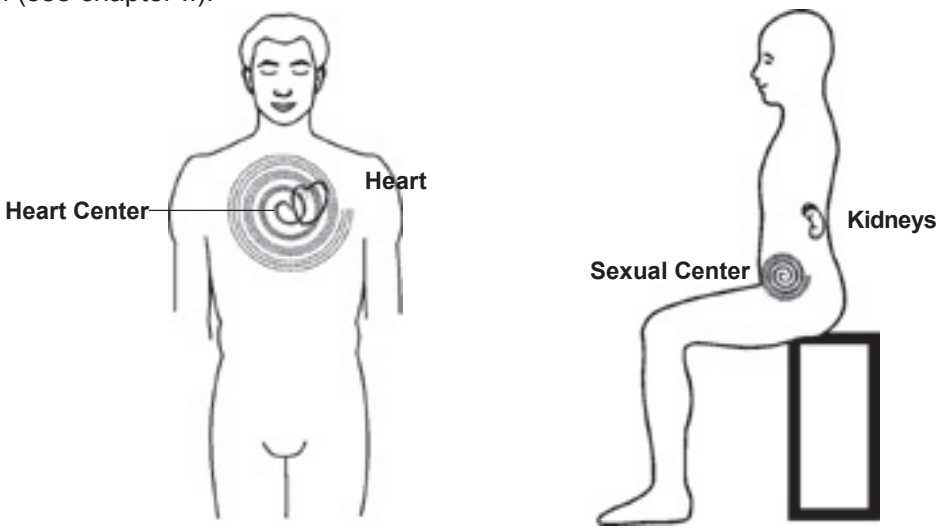

Fig. 9.6 *Heart and Kidneys*

The play between water and fire is found in the controlling cycle of the five elements. Mars and the sun can be seen as fire qualities - Mercury and the moon as water qualities; this demonstrates the double nature in the fire element (primary and secondary fires) and the double formation of the water element (urogenital system).

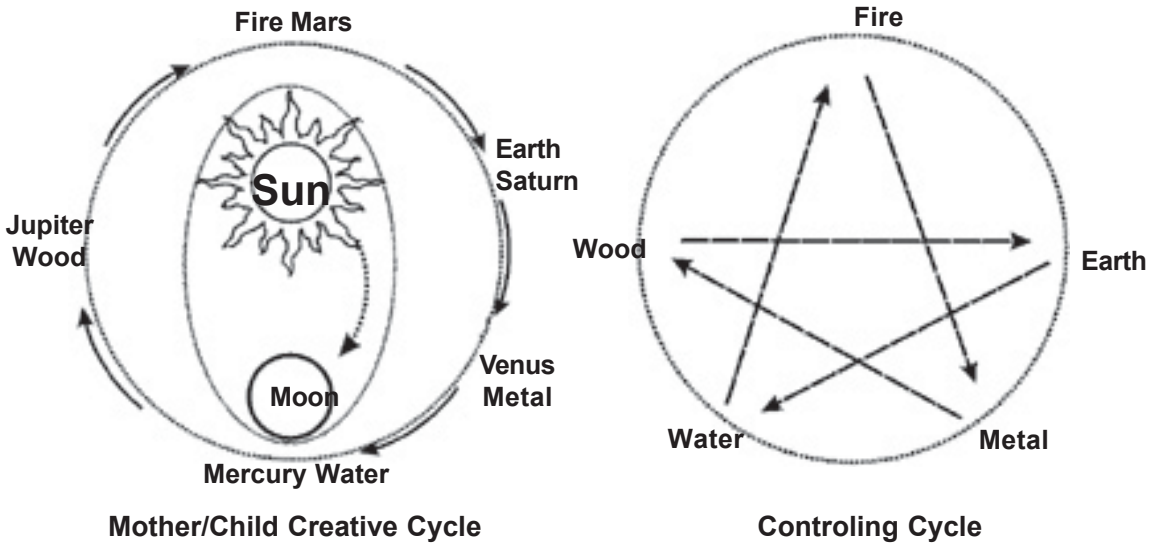

Fig. 9.6 *Creative and Controling Cycles*

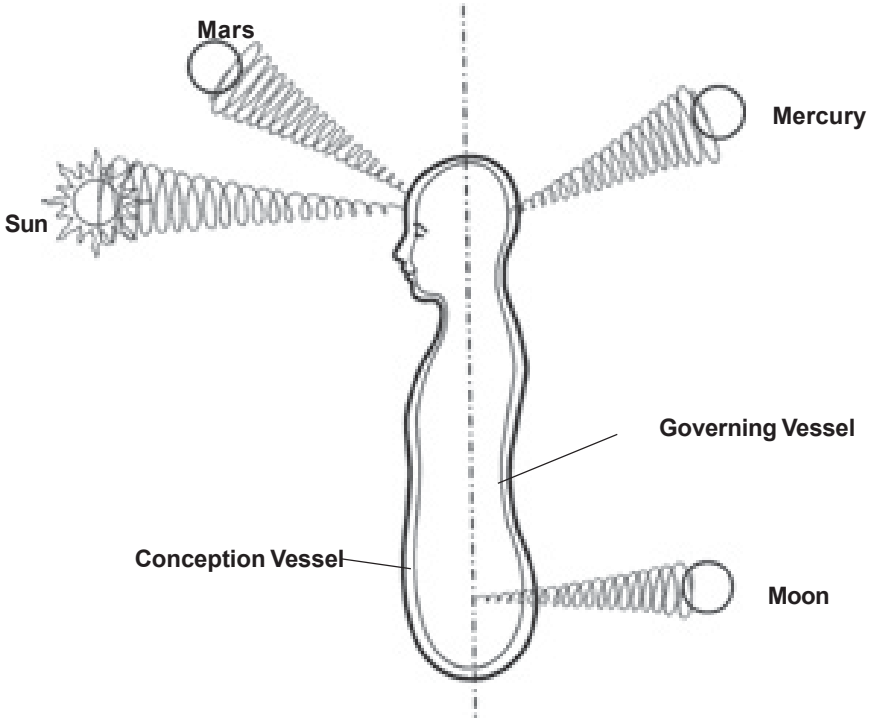

Fig. 9.8 *Conception Vessel Sun-Mars and Governing Vessel Moon-Mercury.*

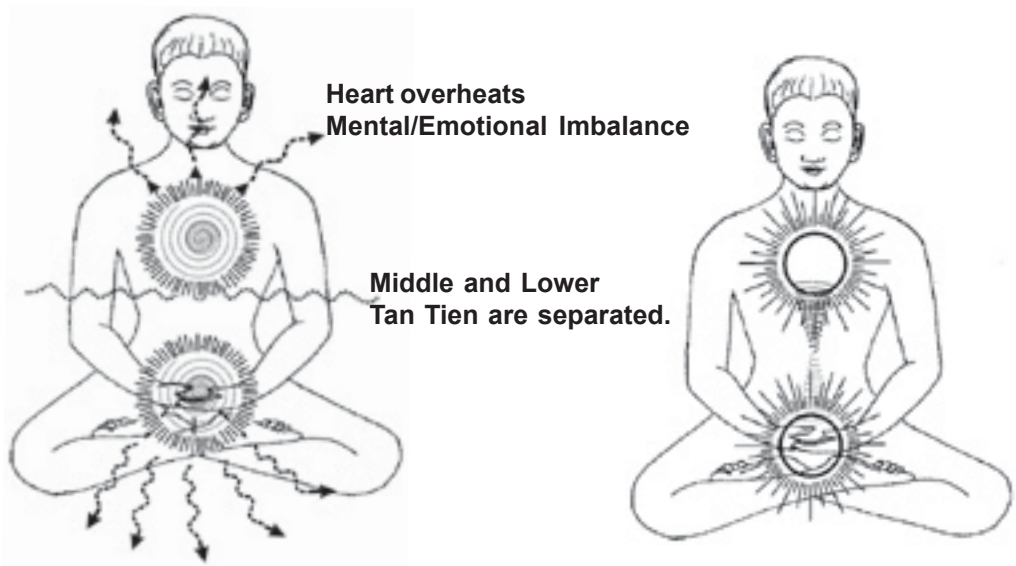

Kidney and Sexual Energy leak out.

Balanced Water and Fire Energy, Love and Sex lead to Strength and Inner Peace

Fig. 9.9 *Balancing Water and Fire*

The sun and moon can be placed internally. In the five element creative cycle water will give birth to wood, wood to fire, fire to earth, earth to metal. It is a cycle of expansion and contraction in five stages (see Fusion 1 book). In the Taoist spiritual practice this interaction is compared with cooking. Water controls fire. If the sexual energy potential dries up, the fire has no more control. At the same time there is a controlling cycle which balances the five elements. Water controls fire. So kidney/sex energy has a cooling balancing effect on heart and heart governor. On the other hand, if the fire is too weak, the body often gets very cold and the spine and hip area can become very stiff.

The water-fire balance is related to the Chi/Jing/Shen interaction and is a fundamental step in the Taoist Immortal Practice, Kan and Li.

The sun/moon meditation and to a lesser degree Mars/Mercury meditation can help people who have problems balancing their life according to the future and past. Today many people are stuck in past experiences. These experiences have an emotional charge and are connected with pain which may be constantly denied or at the most intellectually controlled. For these people, the sun connection will bring relief, more vision of the future and another view of their past. Some are only striving for future experiences, running away from themselves constantly. The moon/mercury meditations will bring them closer to where they come from and to the forces and influences which have shaped their emotional body.

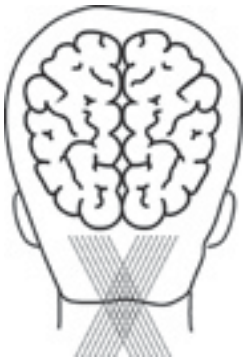

Nerves Crossing in the Neck

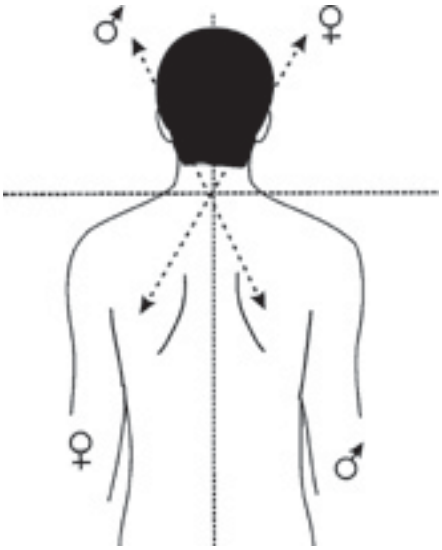

Fig. 9.10 *Body on a Mental/Emotional Level*

Venus - Jupiter

The left/right brain activity has been a popular topic for many decades. As stated before, the focus point in heaven and in the body determines how you will perceive this reality.

There is a strong influence of the five element forces with wood on the right, metal on the left and earth in the middle as the balance point. This is a direct influence from the realm of spiritual law straight down to the physical body (see Fig. 9.11). The Tan Tien energy shows the same structure, according to the energy collection points, just like the initial connection of the spirit with the deep body energy or the Shen with the Jing. This process happens without directly interfering with the lower mental/emotional field. The central stabilizing earth aspect is also found in the energy of the spleen and pancreas.

If we look from the perspective of stars and planets, the core of the activity will be on the emotional and mental level and related to the activity of the brain.

The white stars and Venus are activating the left, more rational and social part of the brain, more male energy. The green stars and Jupiter are activating the right, more emotional part of the brain, more female quality.

From this point of view the nerves are crossing in the neck. So the left brain is associated with the function of the nervous system, regulating the right side of the body with the liver as the center point. The right brain regulates the left side of the body, with the spleen and the pancreas as the center point. (see Fig. 9.10) These energies will enter more directly into the organs and body system.

The right brain is related to individual/body emotional awareness, downward energy related to the spleen. The left brain deals mostly with social, external, controlling, rational activities; more rising energy related to the liver and gall bladder. The elemental influence is weaker in this new point.

We have to remember that the cortex and the human brain consciousness developed from the limbic system, which is evolved from the mammal state. In these primitive states the mental, intellectual and social abilities are very limited. The limbic system has a basic center in both hemispheres of the brain. These centers called the amigdala, deal with deep emotional experiences (affection, safety and other primal needs). A human being is directly related with the neocortex and the ability to connect with other people and the universe. But we must not forget to be in touch with our feelings and our body. Just as the Taoist masters say: “Help and heal yourself and then help others”.

If the right brain is overactive and the left brain energy is blocked, the person will tend to feel isolated, overemotional and stuck in the past (no spirit connection).

If the left brain is overactive and the right brain energy is blocked, the person has a hard time getting in touch with the emotions and body awareness. They tend to rationalize things and they have a hard time feeling involved with others or even with themselves.

Left/right brain balance is crucial for a state of well-being. The planetary and star initiations can be a tremendous help in keeping or creating this balance.

In western astrology and Greek mythology these two planets are exactly in opposition (Venus/female-Jupiter/male) to the Taoist view.

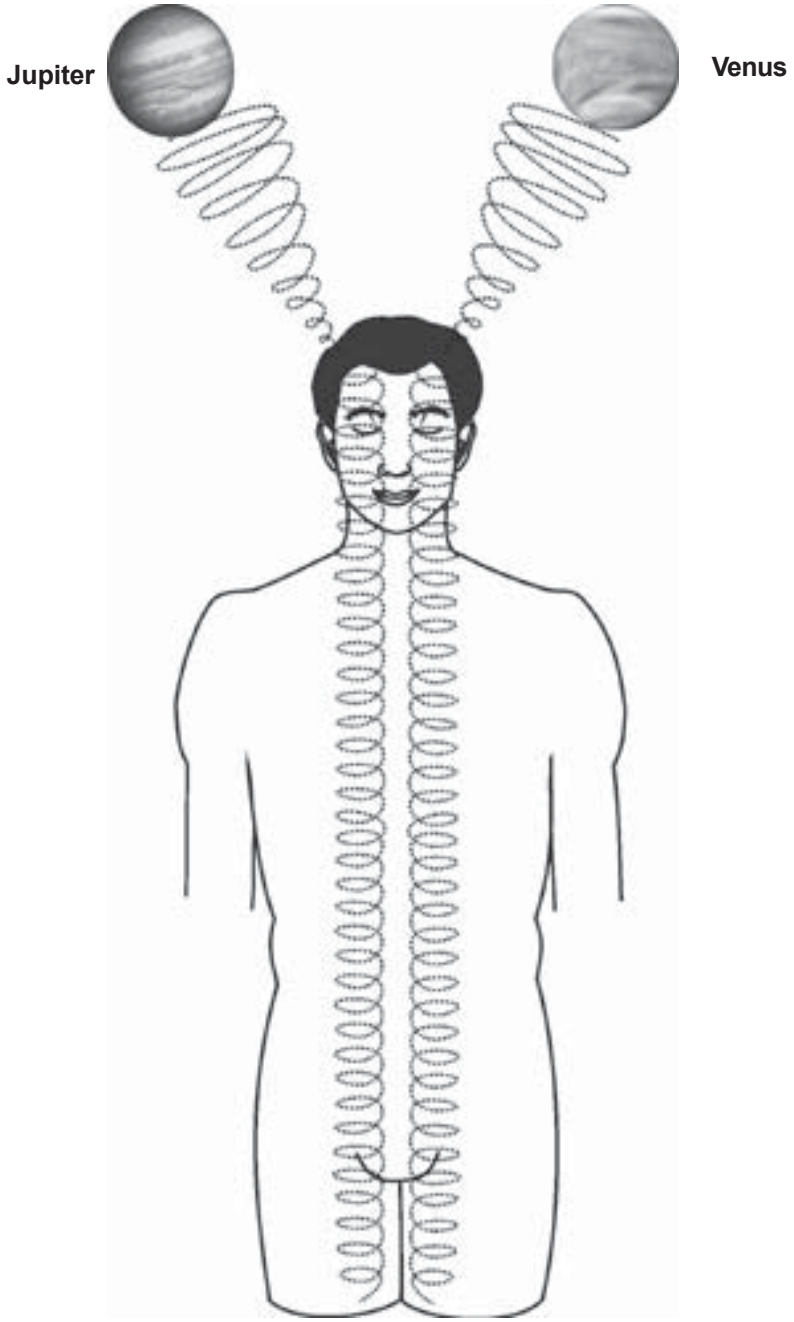

Fig. 9.11 *Jupiter and Venus*

Saturn Energy

The universal earth element is the center point in the planetary and star system. It balances the energies of Mars-Mercury and Jupiter-Venus. It is also related with the central thrusting channel. It connects the crown with the perineum. The universal earth quality of Saturn meets the earthly earth quality in the solar plexus and the Tan Tien. The Saturn and earth quality is of major importance to balance the energy in the solar plexus between liver/gall bladder and on the other side spleen/stomach. Bodily stress is created by an imbalance between the internal and external world, primarily stored in the solar plexus. These days most people have great trouble with their digestive system. Men tend to get a blocked and overheated liver/gall bladder, caused by irritation and anger. Women often suffer from spleen weakness; caused by worry/doubt, from which fear/kidney imbalances originate. Saturn energy has a strong balancing effect that is often experienced physically in the skull during meditations, in the form of movements, pain or pressure.

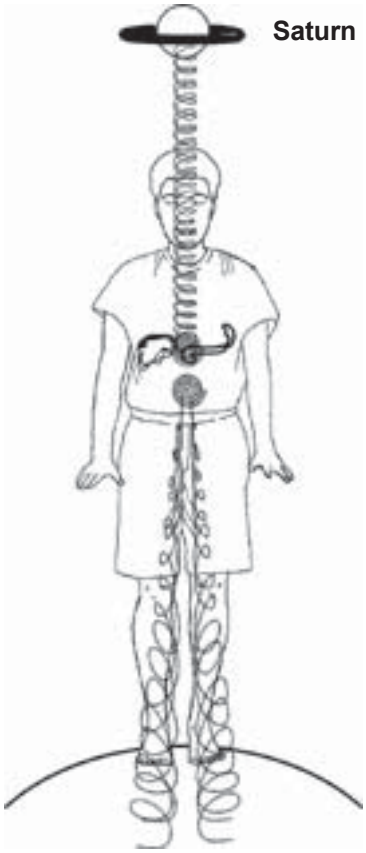

Fig. 9.12 *Let the Saturn Force go down through the Perineum.*

How to find your Strongest and Weakest Planet of Influence

The easiest way to do this is to observe how you connect with the qualities, colors and pictures that are used with each planet (reactions in your body, ability to feel the energy). If you take some time with each of them you will soon find which quality/element feels natural and easy. On the other hand you will also feel what is missing. If you study the typical qualities of this element you will recognize much in your daily life (also, use the meditations in chapter 11). Regular evaluation will soon make it clear that one of them is always there and another may be deficient. It is interesting to meet people who have an abundance of the qualities that you are missing. To some extent they are your masters, but often you will not like them because you feel that they confront you too much. Observe and feel where and how they get this energy. Remember that the first goal is the sun state. The sun state or the state of compassion will grow out of the virtues of all the other organs/planets.

Breaking through the Circle of Attractions and Addictions

Balancing the planetary/galactic/elemental forces brings us to the underlying cause of many problems in life, such as emotional patterns, addictions, irresponsible behavior and low self-esteem. At an emotional level they can only be temporarily released; at a mental level they are often ignored or rigidly controlled. When we get to the higher meaning and origin of these problems and balance the information and energy imbalances that are causing them, they lose their reason for existing and gradually dissolve.

Three Trans-Saturnal Planets

The trans-saturnal planets are not commonly used in the eastern astrological systems because they were undiscovered until the last century. They can be seen as the higher octaves or frequencies of the internal planets reflecting the co-evolution of human consciousness with universal changes.

Water	- Mercury	- Uranus	- Thyroid Gland
Metal	- Venus	- Neptune	- Thymus Gland
Fire	- Mars	- Pluto	- Adrenal Gland

It is not necessary to work with these planets in your meditations, but they can be used to provide an extra dimension. Sometimes they come up spontaneously during meditation. Because of their influence on the social field, they often occur in group meditations.

In the Universal Tao eight planets are used in the pakua as seen in fig. 9.13.

More study and meditation will bring clearer information on these three planets and their cranial connection. According to our and other practitioners' experiences during group meditations, the following entrance points can be used for the trans-saturnal planets.

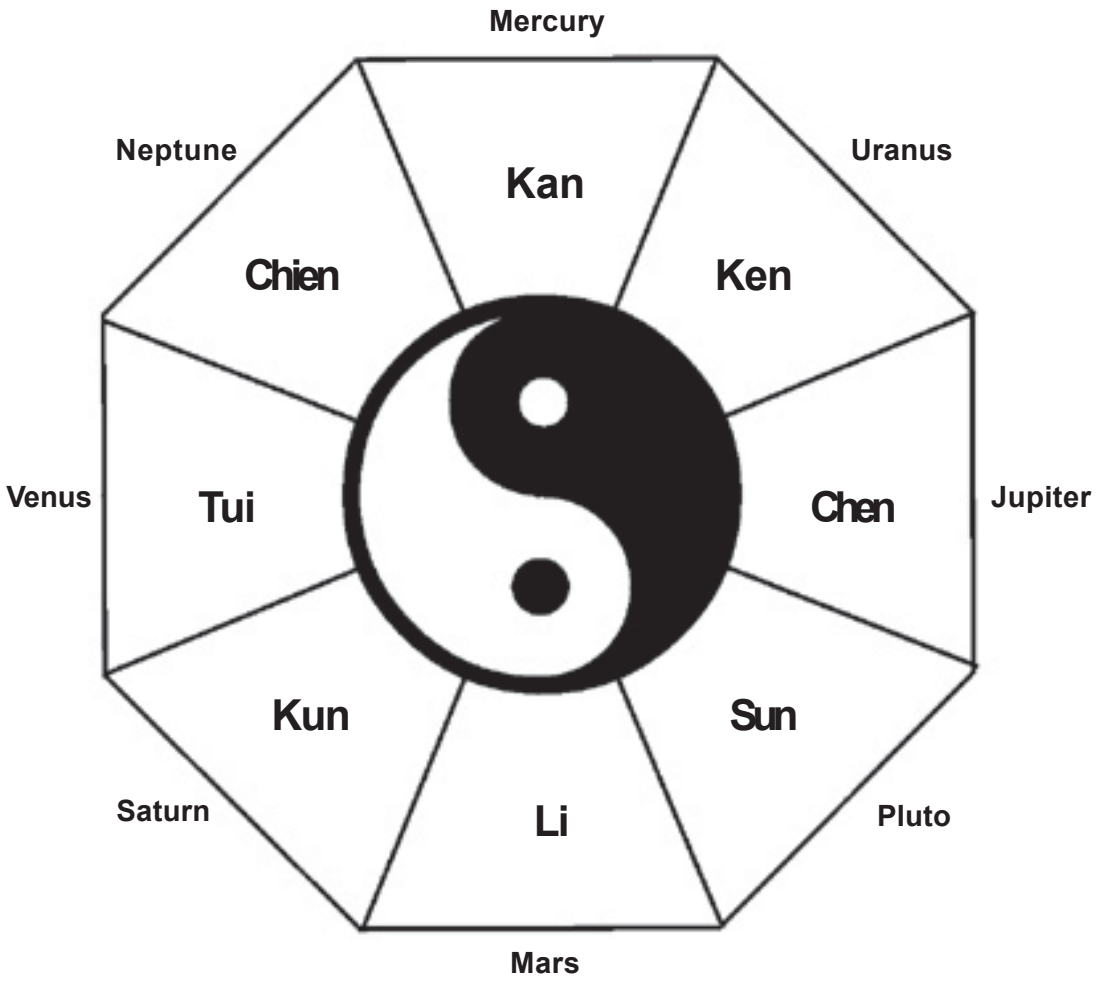

Fig. 9.13 *Pakua*

The trans-saturnal planets are the field between the basic planets (organs) and the stars (glands). They work on the lower frequency and the more physical, hormonal function of the glands.

Pluto enters above the Mars area.
Neptune around the hair spiral area above the Mercury area.
Uranus at an angle of about 45° (just a few cm above the ears).

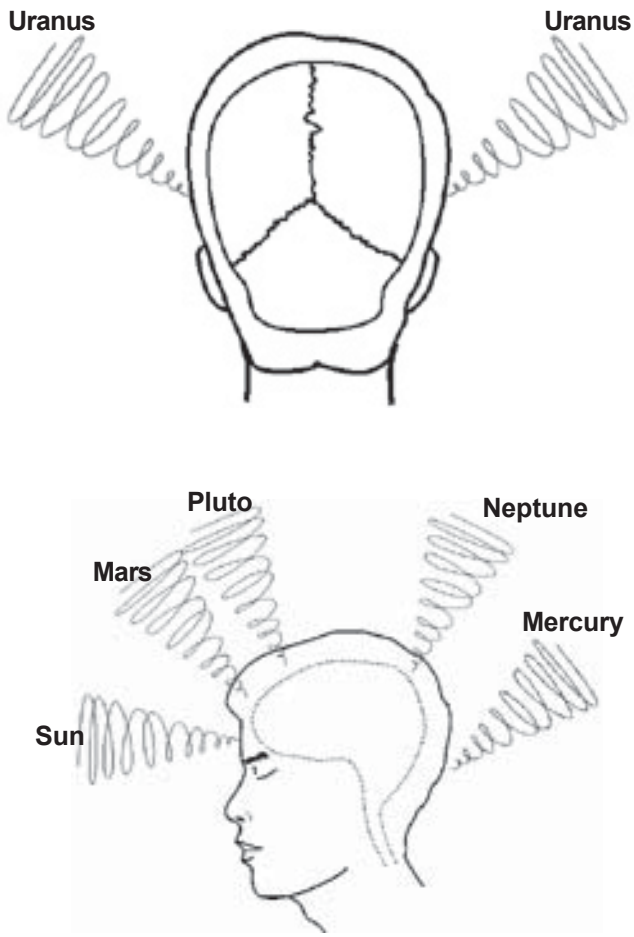

Fig. 9.14 *Planet Energies*

Chapter X
Universal Healing Connection

Create a Chi Field for Cosmic Healing

Visualization into Actualization!

Think of a Chi Field as being a containment area for all the Chi you might want for your Chi practice. The area can be as large or as small as you want. It could cover a city, a farm, your neighborhood or home, your room, a group of people, or just yourself. You can create Chi Fields within Chi Fields — as many as you like.

Use your power of visualization to project a dome-shaped protective covering around yourself, a group of people or whatever suits your situation. Think of the dome as being like a semipermeable membrane that will allow Chi in and that will not allow it to leak out. It will also prevent unwanted forces or emanations from coming into your space, somewhat like the ozone layer that protects Earth. The dome may be as large or small as you want it to be. This Chi Field will contain the Universal, Cosmic Particle and environmental Chi that you draw into it when you set it up.

You can create a Chi field to protect your house. In rural areas, Chi Fields have been used to protect and fortify farmlands, resulting in greatly enriched produce and increased yields of agricultural products. We should also cover ourselves with a Chi Field when we do our Chi cultivation practices. Teachers should create a Chi Field to work in, in order to impart more powerful experiences when guiding students in meditative processes for awareness and experience. A Cosmic Healing Practitioner should create a Chi Field for a powerful healing environment.

Organizing the Chi Field for Healing

1. Connect with the forces of the six directions and create a Chi Field. Creating a Chi Field is very important. It is like you are painting a beautiful picture inside yourself in the Chi Field. Sense thunder and lightning coming down. Create a domed Chi Field to cover the room you are doing a healing session in. Sense that the room has become electrified, that thunder and lightning has come in. Draw in the power of the lakes, forests, oceans, sun, stars, and high mountains. When you are ready, inhale; draw the energy from the Galaxy and Universe.
2. Be aware of your Lower Tan Tien and pour the energy over the crown. Feel the energy come to your crown and let the energy flow. Feel numbness and tingling. Focus on the soles of the feet.

3. Gradually feel that the room has become charged with Universal Chi. Close your eyes and feel the personal stars of the participants. Start to link them together from the left corner of the room.
4. Spiral out clockwise to link them together with your own personal star, you can project an individual vertical connection from the energy body to each participant. Link all the stars, including your own star, to an energy body.
5. Project an Energy Body above you in the dome. The size and shape of the Energy Body is not important; just have the idea and the sense that it is there for you to use. This tool provides you with an immediate resource to draw from when you distribute energy to the participants. When you are guiding and teaching a meditative process, keep your awareness of your Lower Tan Tien and the Universe and guide the students via the Energy Body for enhanced power and effectiveness. For yourself; first empty the mind down and fill the Lower Tan Tien with 'Smiling Sunshine' Chi. Be aware of your heart; empty love, joy and happiness into the Lower Tan Tien. Extend your Lower Tan Tien up to the Universe, multiply, draw down to the energy body and distribute it to those present.

Opening the Three Tan Tiens to the Six Directions

Introduction

Opening the Three Tan Tiens is a Chi Kung meditation that strengthens our connection to the Universe, opening us up to the primordial force of the Cosmos and the energy within Nature. We are dynamically connected to the infinite. "As above, so below" is an echo of wisdom heard from sages and mystics throughout the ages. When we can connect to and absorb the energy that surrounds us, we are able to tap into the many splendors of the Universe.

We exist because of the unique combination of the forces that are around and within us. The two main forces are electricity and magnetism. 'Bio-electro magnetism' is the Western term for life force and what the Tao refers to as Chi. For the last 5000 years, the Taoists have utilized this bio-electro-magnetic energy to enhance their way of life and establish a relationship with the Universe. Bio signifies life, electro refers to the universal energies (Yang) of the stars and planets and the magnetic force refers to the Earth force (Yin) or gravitational force present on all planets and stars. As we align ourselves with these forces, we become a conduit through which we can absorb and digest these energies through the body, mind and spirit establishing a direct connection with the Universe. The Taoists recognized this connection and created the Chi Kung form of 'Opening the Three Tan Tiens to the Six Directions' to enhance our relationship to and our understanding of this connection.

Humans normally access bio-electro-magnetic energy through their food and air. Plants take the universal energies of the sun and the magnetic energies of the earth and digest and transform them, thereby making these energies available to all living beings.

Taoists believe that the food sources with the purest form of energy are the green leafy vegetables. These have taken sunlight directly into their cells. Rather than waiting until the energy in the Universe is processed through plants, the Taoist goes directly to the source of this primordial energy. Through Chi Kung and meditation, the Taoists direct the energy of the Universe precisely. Opening the Three Tan Tiens is a meditational Chi Kung exercise that focuses on how to directly tap into the source of energy all around us.

Activating the Three Fires

The Three Fires refers to the fire energy contained within the lower abdomen, the Door of
Life (the adrenal fire) and the heart center. Opening these centers fills the body with energy and life force.

1. Stand with the feet together. Feel the connection to the Earth through the soles of the feet. Project your mind and extend your Chi into the Earth. Continue extending your mind power and Chi until you feel the connection to the infinite space beyond the Earth.
2. Hold the palms down, parallel to the ground, lifting up the fingers. Connect to the Earth energy through the center of the palms .
3. Move the arms and palms out slightly to the front of the body (palms still facing down). As the arms move, expand your mind and feel the connection to the Earth and the infinite space below you.
4. Gently, pull the hands and arms back toward the body. As the arms move, feel the Chi flow through your body and condensing into the Lower Tan Tien. Continue to push and pull 6-9 times, expanding your mind and gathering Chi from the infinite space into the Lower Tan Tien.
5. Lift your arms and face the palms toward the Lower Tan Tien. Feel as if you are holding a huge Chi ball on the Lower Tan Tien. Feel the connection between the fire in the Lower Tan Tien and the fire energy in the Universe. Feel the warmth spread through the entire body.
6. Expand your awareness to the infinite space behind you. Move your hands to the back and hold a huge Chi fire ball on the Door of Life (Ming Men).
7. Feel the Chi ball pulsing and breathing, drawing energy into the body from the infinite space behind you.
8. Lift the hands, palms facing up, to the sides of the body under the arm pits. Feel the Chi from the fingers extend into your chest igniting the fire in the Heart Center.
9. Allow the Heart Center to open, pulsing and breathing with Chi.
10. Feel all three fires activated and resonating together; the Lower Tan Tien, the Door of Life and the Heart Center.

Healing with the Chi Field and Energy Body

1. Ask the students to start to empty the mind down.
2. Connect with the energy body. Move your hands down. Touch your navel. Concentrate on the Lower Tan Tien. Ask your students to follow you. Your fingers touch the navel; focus on the Door of Life. Feel a numbness, a tingling sensation of energy flow. When you feel it, transfer it up to the crown. Expand to the Universe and multiply the feeling. Guide the Universal energy down to the Energy Body. Always spiral the energy in the Lower Tan Tien. Transfer, guide the energy, the feeling, down from the Universe to the Energy Body.
3. Take time to work with the Lower Tan Tien. Transfer your Chi (feeling) to the other people. When your Lower Tan Tien is very full, you actually feel the energy charge up the whole brain. So, your brain has a lot of Chi to extend up to the Universe.
4. At this level, there is no particular color for the energy body — it depends on what you are doing. Just transfer the feeling up, the feeling of the Chi. The Chi feeling gives you a pattern. And that pattern can multiply in the Universe. When it multiplies, it can be abundant when it comes back down.

You cannot teach somebody something that you do not first have yourself. When you are teaching, you are controlling the energy. You are guiding the students' energy. If you are happy, they feel happy. You feel joy and they feel joy. When you have the feeling of the bone marrow, you transfer the feeling of the bone marrow up. Therefore, the students can only be as good as you are at that moment. You may feel pain in your body at times; just pick out the good feeling and transfer that up. Otherwise, the student might feel pain and it is not his or her pain.

You have to multiply what you are feeling first before transferring your energy to the students. When you have that feeling (very nice, very good, happy, laughing bones, funny bones — tingling, numbness, etc.), transfer it up to the mind and out to the Universe. From there, you spiral a few times — just spiral the energy and multiply— and then bring the increased Chi down to the energy body and it will spread out to the participants by itself. (see the illustration on page 223)

World Link Meditation

Explanation

The Three Minds are the Upper, Middle and Lower or the Three Tan Tiens. The Upper Mind is good for planning and figuring out numbers, but any negative emotions that are present will stir up the brain with excess thinking and worrying. It spends and drains out too much energy. We should train this brain while resting to just observe. The key is to lower your Upper Mind and use it in the Lower Mind to do your thinking; “seek the released mind”.

At first, I did not understand this. When my Master taught me to lower and sink my mind down to the Lower Tan Tien, I started to understand. I understood this further, when I found that Western technology had discovered that the nerve endings in the stomach and intestines, especially related to emotional responses, are the same as those in the Upper Mind. So by just smiling to the lower Tan Tien you can activate the Lower Mind. By using the awareness, consciousness, and observing minds together in the abdomen you can do all your thinking.

The Upper Mind works practically all the time, stirring up the emotions and using up to 80% of your body energy. Western science has discovered that the Lower Mind can do a lot of things that the Upper Mind does without using the senses. The difference is it does it with pure awareness without questioning, as the Upper Mind does. If you can use the Lower Brain more, the Upper Mind can rest and listen (observe) from the abdomen. The Upper Mind, or as the Taoists refer to it, the monkey mind, when activated will suppress consciousness or awareness. Once the Upper Mind rests you can be conscious and aware of things you were never conscious or aware of before. You then can rest, be more aware and save energy using the Lower (second) Brain. So your Upper Brain can rest and build up strength for any daily tasks.

Three Minds

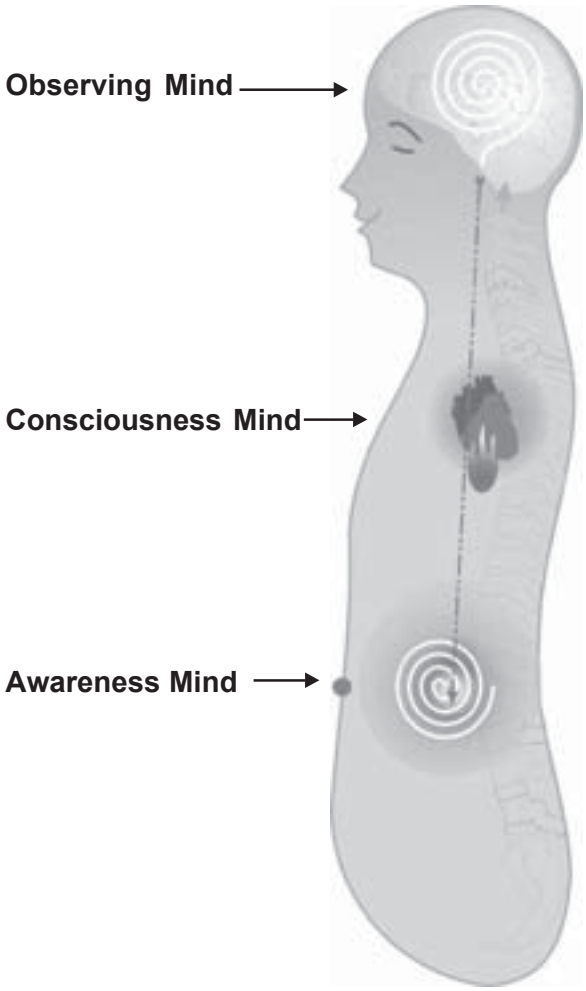

Fig. 10.1 *Empty your Mind Down to the Lower Tan Tien.*
Let the Awareness and Consciousness combine together.

Preparation

Stand or sit alone or with others in a group meditation. Relax and empty your mind down to the Tan Tien by smiling down to your lower abdomen. Bring your awareness to your abdomen and fill your abdominal brain with Chi.

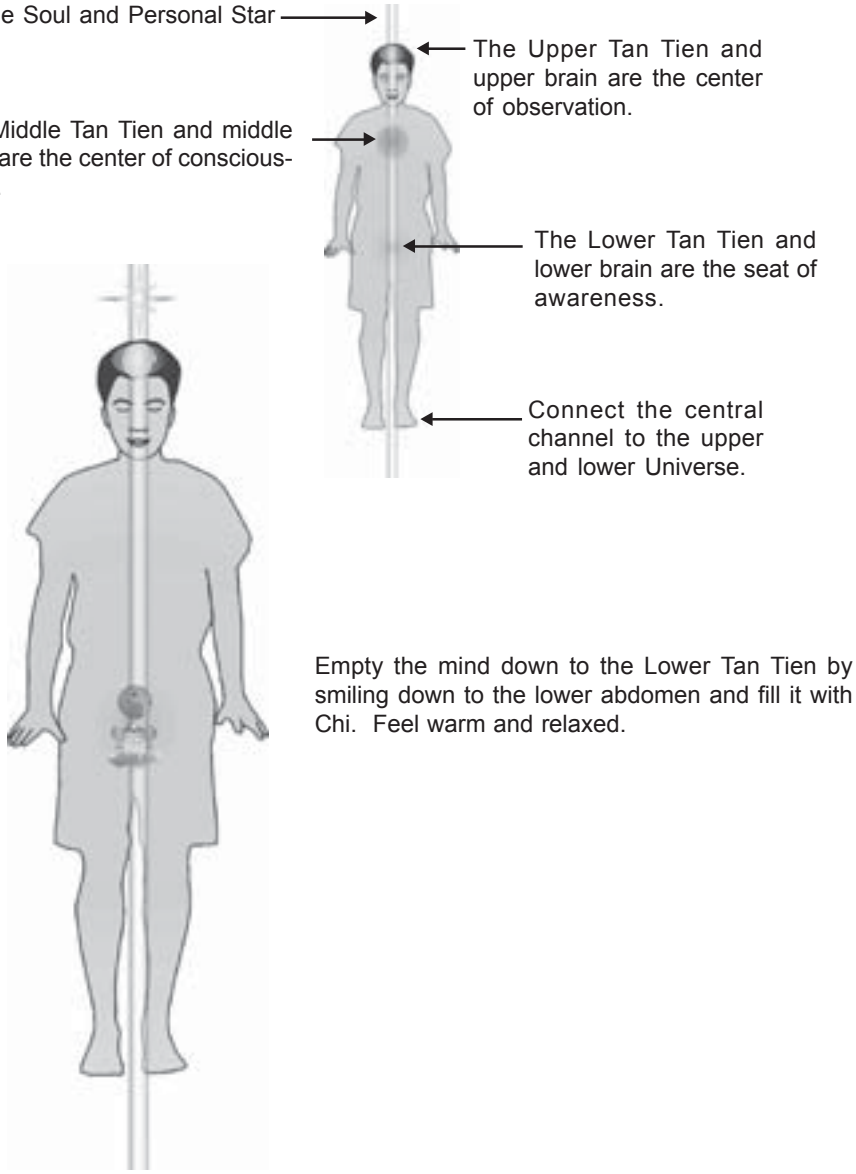

Fig. 10.2 *Three Tan Tiens*

Activate the Consciousness of the Three Fires

Tan Tien, Kidney and Heart Fires

1. **Tan Tien Fire (Abdomen):** Feel the energy behind the navel become warm as you direct a golden sunshine smile down from your face. Imagine that the energy in your abdomen is like a fireball behind the navel and below, a stove burning with fire. The stove is situated below the navel and close to the sacrum and lumbar vertebrae. Create the fireball above the stove behind the navel. The Taoists describe it as a burning stove that energizes the other fires in the body.

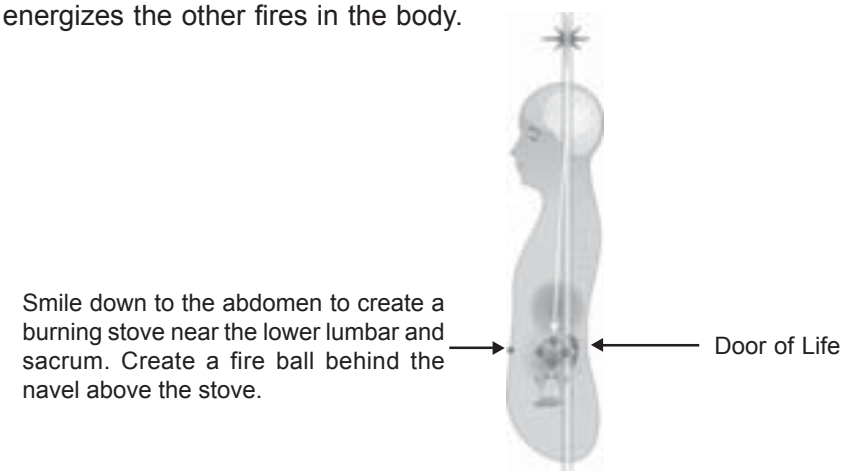

Fig. 10.3 *Tan Tien Fire*

2. **Fire under the Sea (Kidney):** Be aware of the Yang energy of the adrenals on top of the kidneys. Move that Yang energy down into the center of each kidney at the Door of Life (Yang within the Yin), thus lighting the Fire under the Sea. Expand the activated kidneys' energy to the Door of Life point on the spine opposite the navel just below the kidneys.

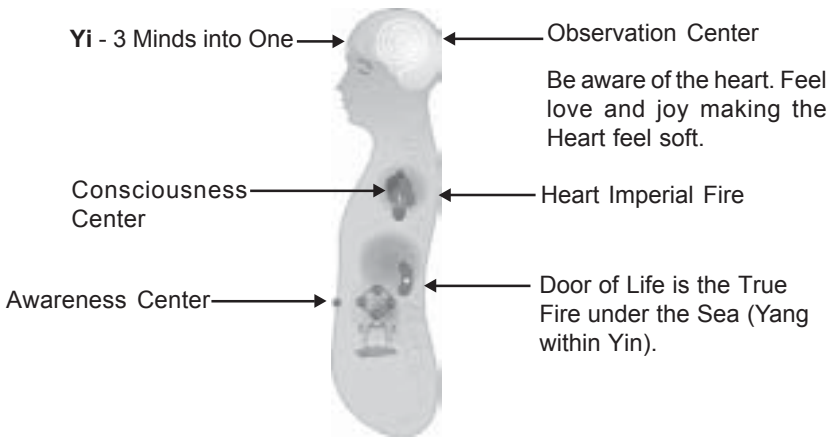

Fig. 10.4 *Kidney Fire*

3. **Imperial Fire (Heart):** Activate the consciousness by smiling down to the Heart making it feel soft. Be aware of the 'Fire in the Heart'. Feel the fire of love, joy, happiness and compassion creating softness in the Heart (Yin within the Yang). This will activate the consciousness of the Heart. Make a triangle, connecting the heart down to the kidneys and then down to the fireball behind the navel (Tan Tien). Connect the fireball to the kidneys and back to the Heart. This triangulation doubles or triples the Chi Fire Power.

Fuse the three minds into one mind *(Yi - pronounced "ee")*: When the abdomen is filled with Chi and feels nice and warm, it will rise and fill the upper brain with Chi. Lower the Upper Mind and the Middle Mind to the Lower Tan Tien, combining the three minds into one mind, ***Yi.*** The three mind powers will move to the mideyebrow. You can use this ***Yi*** to make correct decisions and to take the correct action or non-action.

Expand to the 6 Directions: Combine the power of the three minds with the power of the one mind, ***Yi***. Bring the ***Yi*** power into the third eye and expand it to the Six Directions of the Universe.

Link Personal Stars, Energy Body and Universe: With the ***Yi*** power connect to your ***Personal Star*** six inches above your head. Expand your awareness and consciousness to your Personal Star and out to the whole Universe. If in a group, spiral out and link with their Personal Stars. Create an Energy Body, linking everyone together with

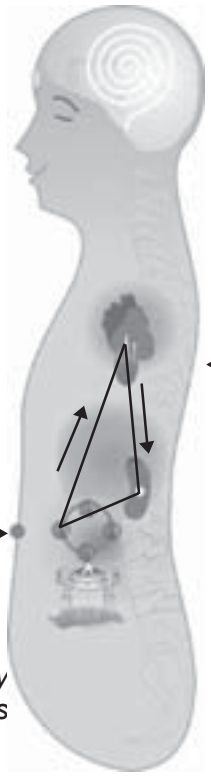

Fig. 10.5 *The Triple Force is the Holy Fire. Make a triangle: Heart to Kidneys to Navel (Tan Tien).*

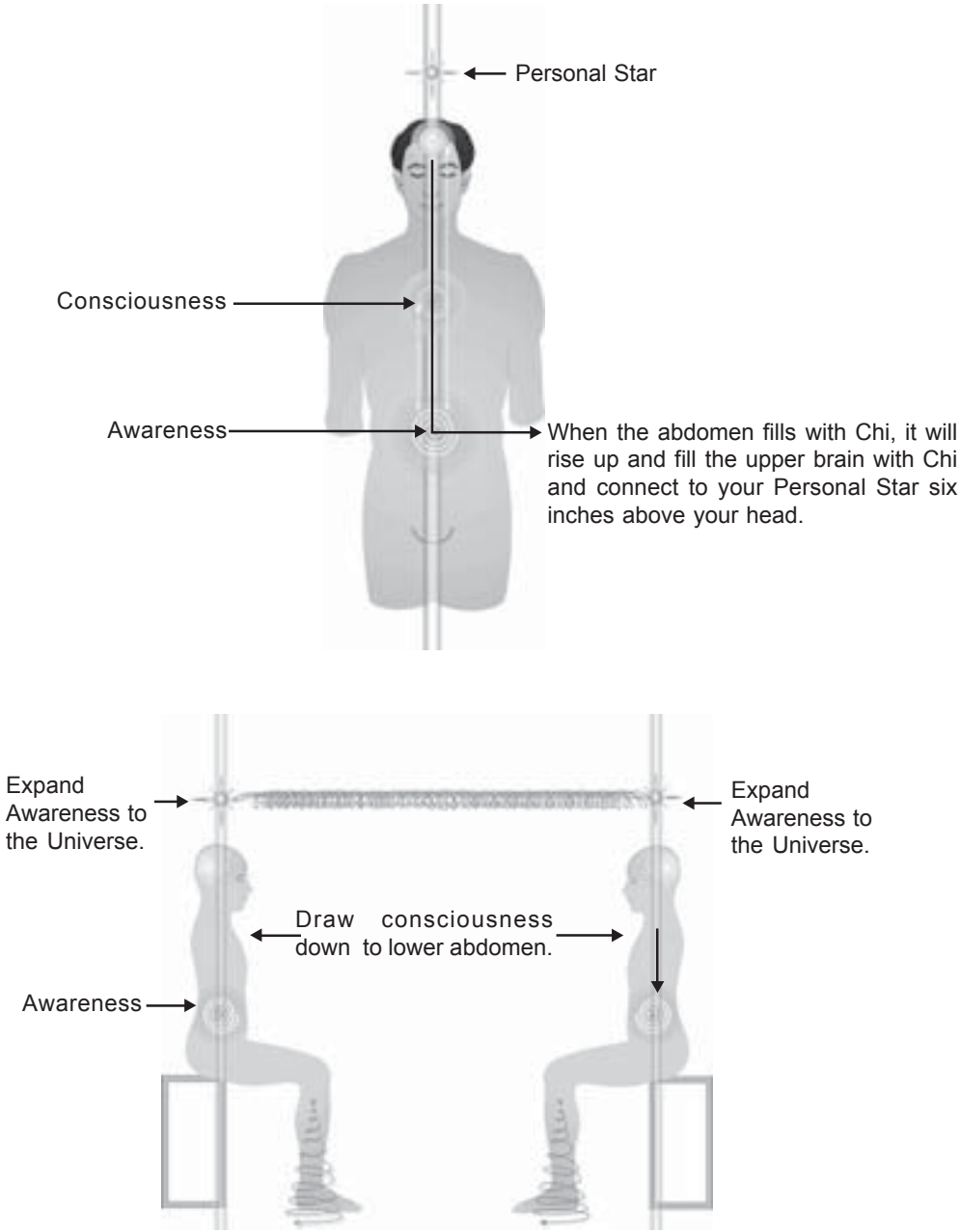

Fig. 10.6 *Link with other Personal Stars and expand the awareness from the abdomen.*

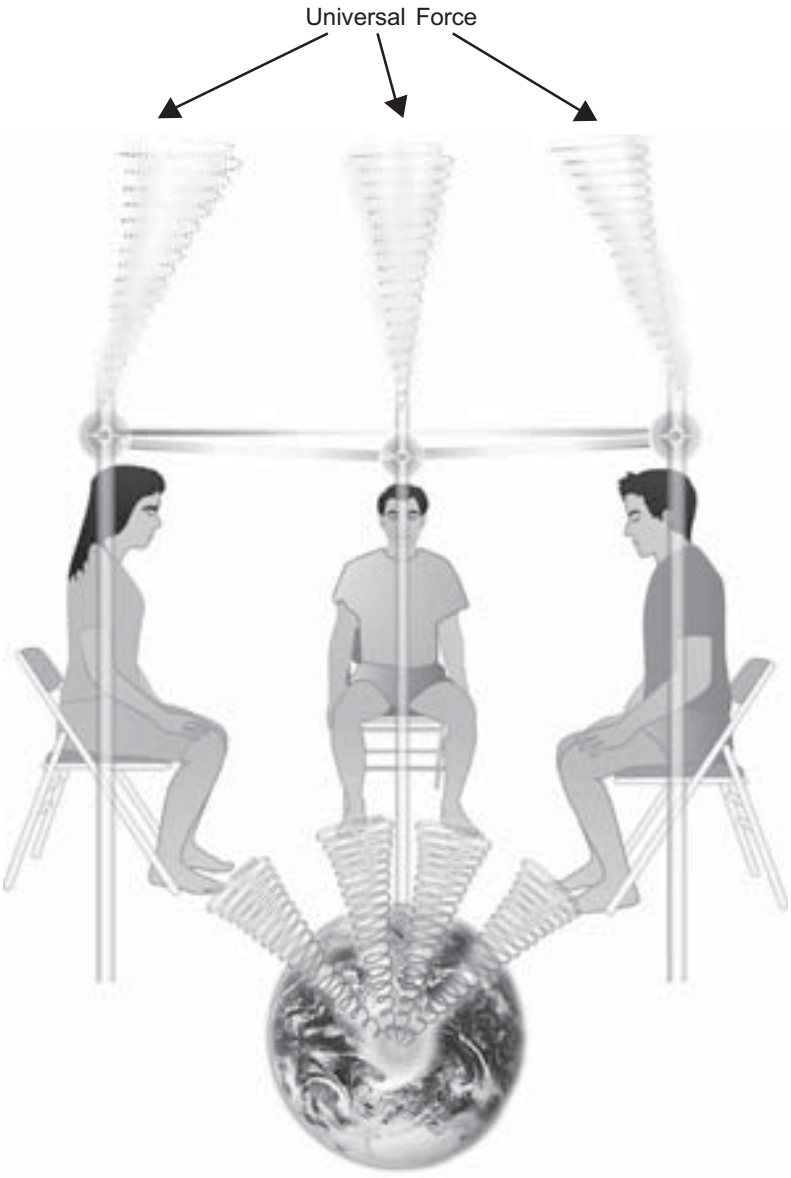

Fig. 10.7 *Link with other Personal Stars.*

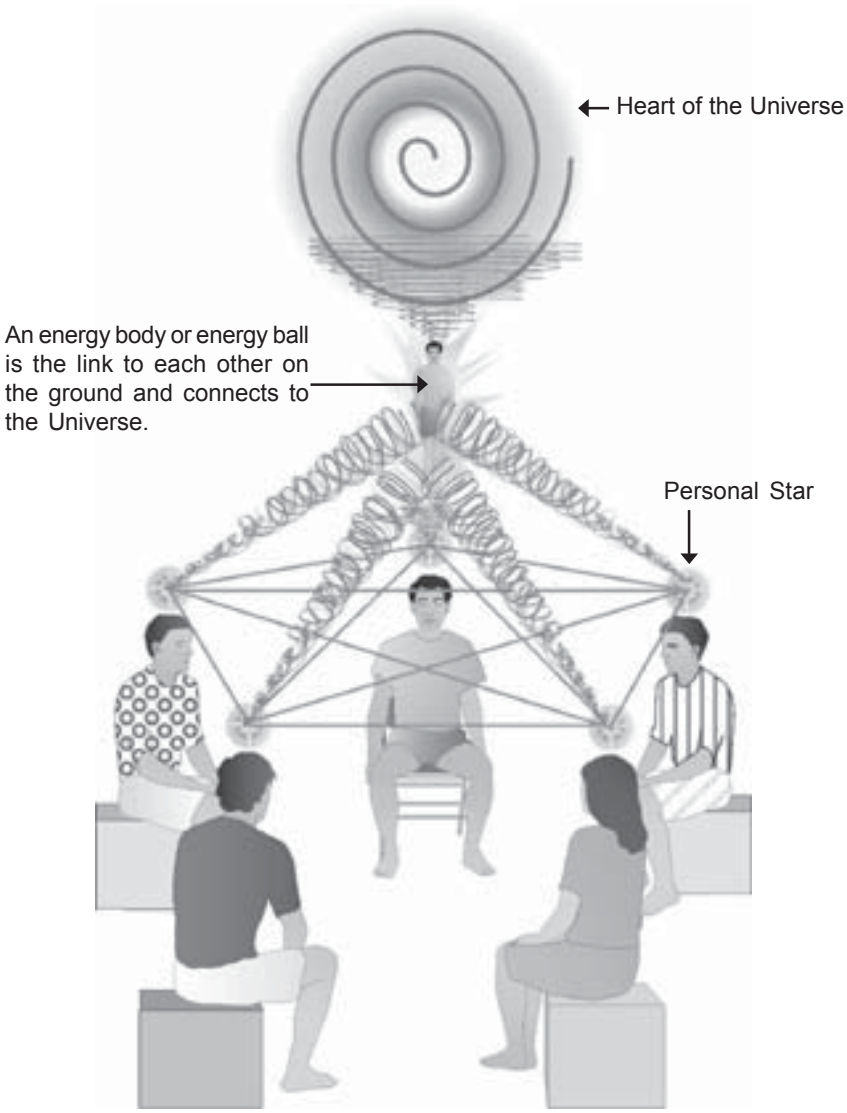

Fig. 10.8 *A Group can Link their Personal Stars Together.*

Link to friends, instructors, or others in the Universal Tao or to others who are doing similar work.

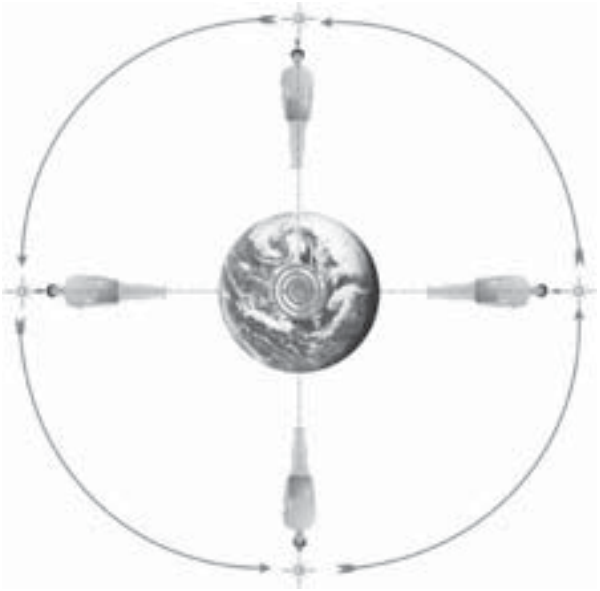

Fig. 10.9 *Like a Satellite, the World Link Meditators become a Communication Link between the Earth and the Universe.*

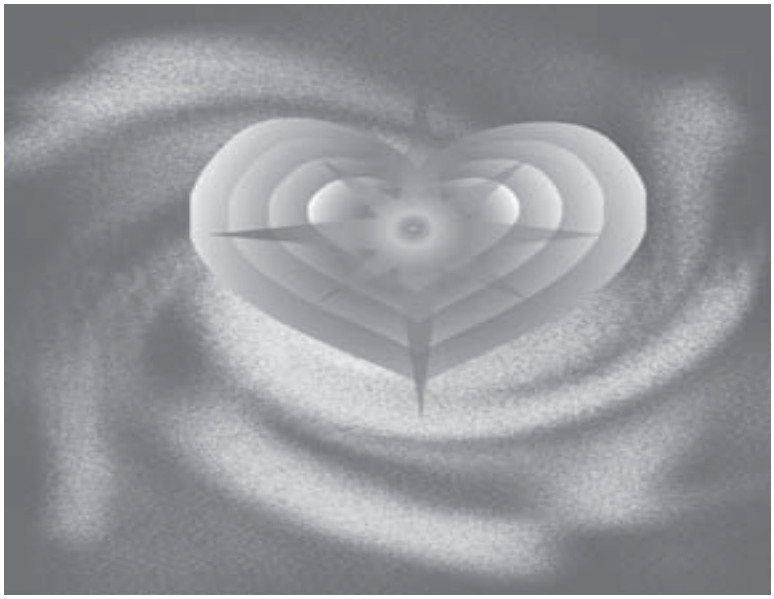

Fig. 10.10 *Linking to the Heart of the Universe (God) is a way of 'being in' Unconditional Love.*

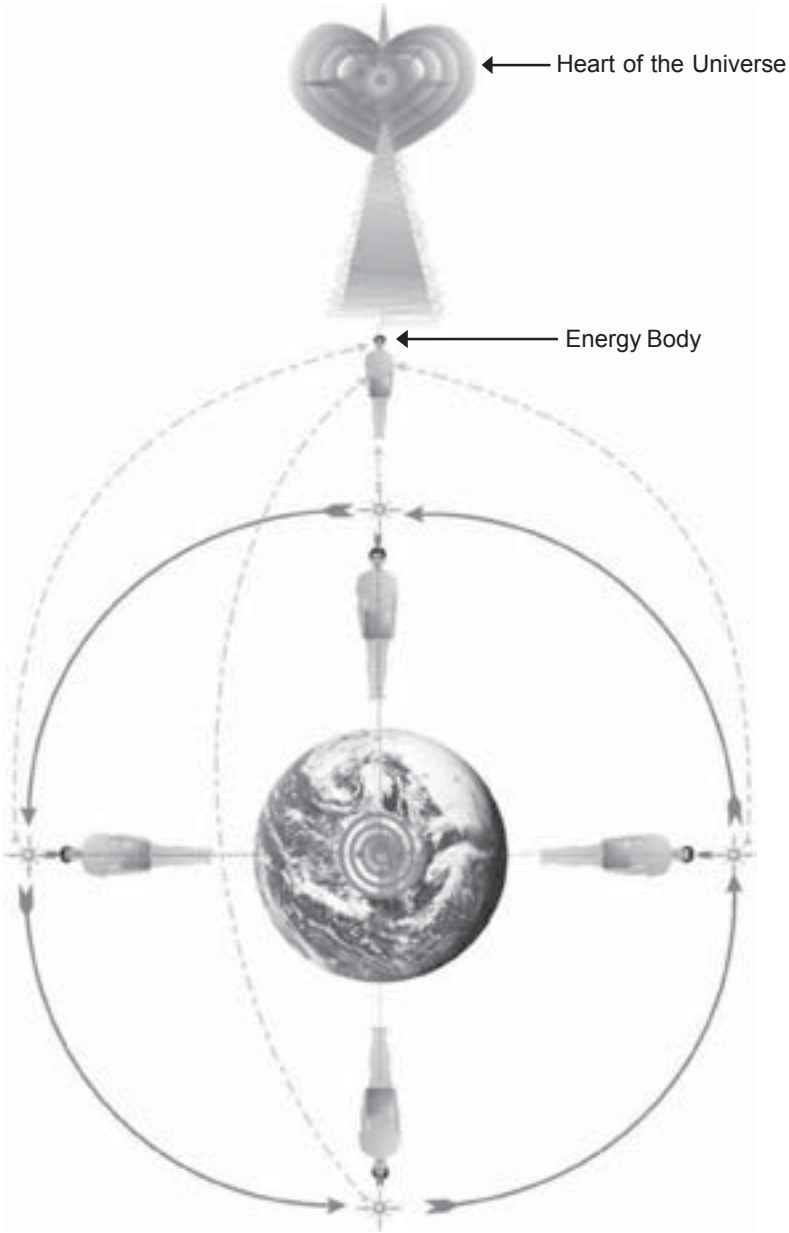

Fig. 10.11 *The Energy Command Communication Center for each person and group can connect to their 'own' Heart of the Universe.*

Protective Sacred Circle of Fire

The **Sacred Circle of Fire** has the power to protect us from all evil, whether it be sickness, misfortune or negative thinking from those around us. It allows us to connect with the power of the Universe. It helps us remove doubts of our own worthiness, so that we may reclaim the best that life has to offer; our birthright. Additionally, the **Protective Ring** connects us with the elemental essences of Forces in the Universe which both strengthen and protect us.

Sacred Fire Circle and Golden Chi Field

This method is an inner visualization using the power of the three minds (the observation, consciousness, and awareness) fused into one mind, the **Yi**. Its purpose is to get in touch with the **Guardian Essence (Guardian Angel)** or the forces of the **Six Protective Guardian Animals** of the **Six Directions**.

Fig. 10.12 *The Sacred Fire Circle and Golden Chi Field have the Power to protect us from Evil and Negative Thinking from around us.*

Visualization into Actualization

When we use awareness and consciousness, we turn our visualization into actualization; using our trust and belief, we can manifest and let it happen in consciousness and awareness, with good intentions.

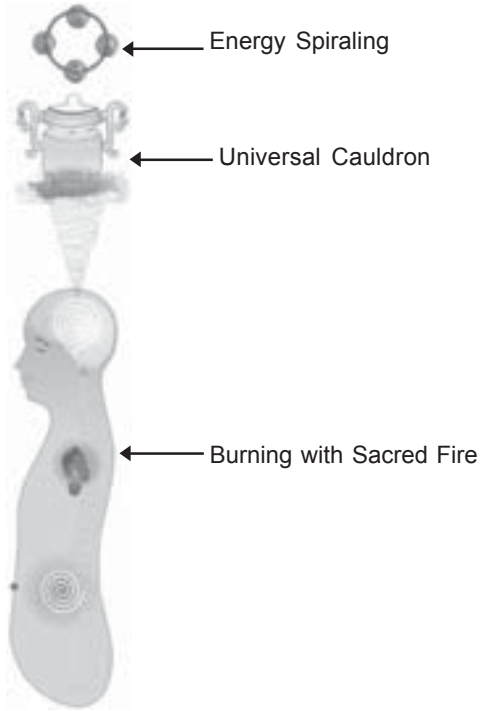

Fig. 10.13 *Project a Cauldron of Fire Burning in the Cosmos.*

1. Use visualization and imagine a big cauldron burning with fire in the cosmos. Feel the awareness and let it happen.

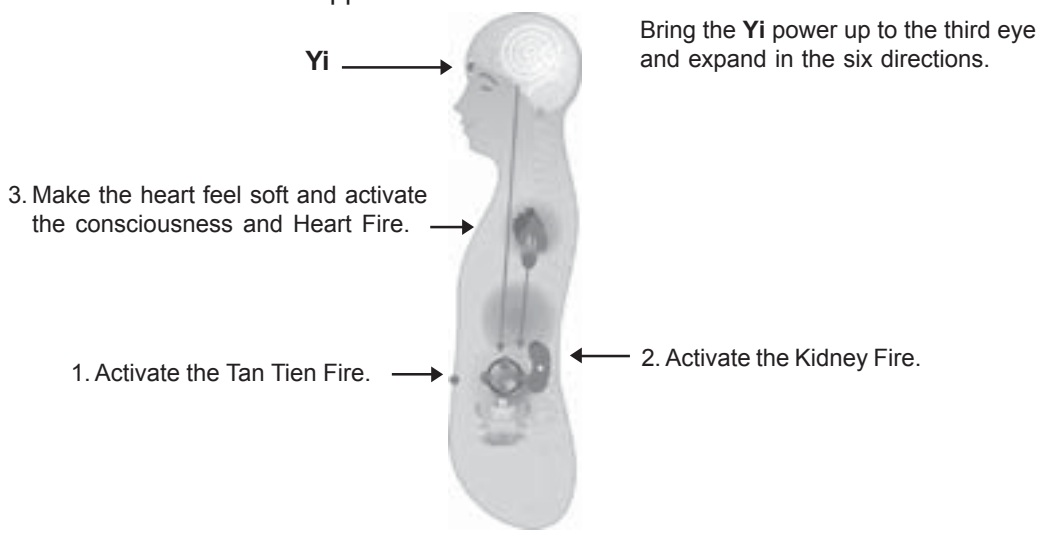

Fig. 10.14 *Three Fires and **Yi***

2. Be aware of yourself holding a long wand. Reach out to the cauldron and ignite the wand with fire.

Fig. 10.15 *Long Wand and Cauldron*

3. Use the Yi power to draw on the ground with the burning wand a Circle of Fire, 7 feet (2 meters) in diameter.

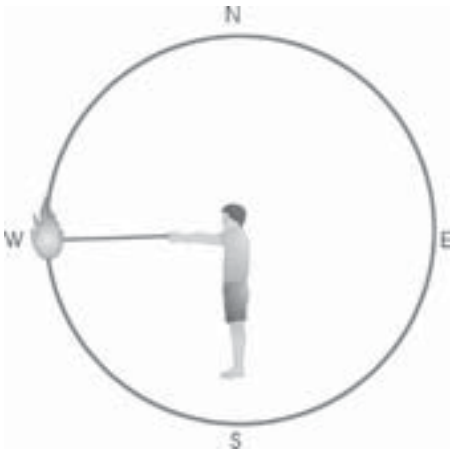

Fig.10.16 *Circle of Fire*

4. Stand in the center. Face the North. Imagine the burning wand and light up the Northern section outside the circle with fire. Pass the wand in an arc towards the South edge of the circle and ignite the Southern section with fire. Then swing it to the Eastern edge and ignite that section with fire.

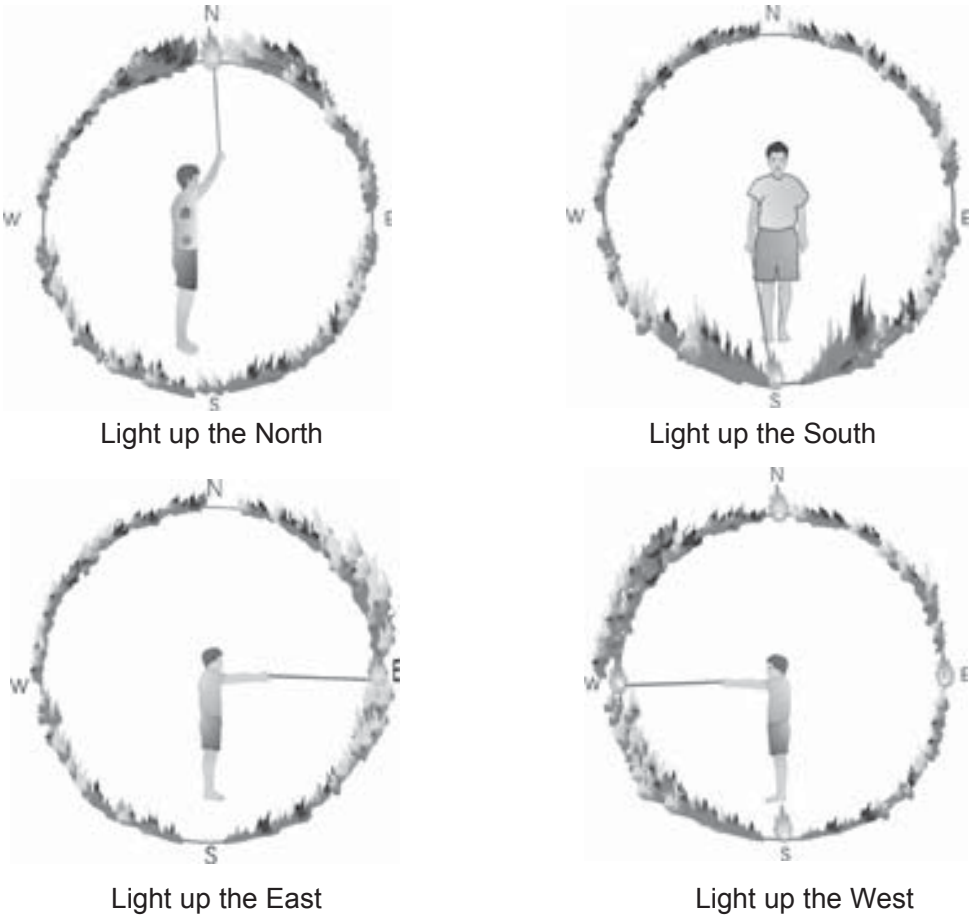

Fig. 10.17 *Four Directions*

5. Position the wand directly overhead. Turn left to face West and ignite it with fire.
6. Expand the fire to the whole circle, protecting you from all evil, whether it be in the form off sickness, misfortune or negative thinking from those around you. Place the wand at the edge of the circle.
7. Squat down facing North. In each direction place a Protective Animal (Guardian Essence or Angel): In front (North) place a Blue Tortoise, in back (South) a Red Pheasant, Right (East) a Green Dragon, Left (West) a White Tiger, Above (Center) a Yellow Phoenix, and Below (Earth) a Black Tortoise.
8. Create a protective Golden Dome Chi Field over you. Let go of all concerns and empty yourself. Ask each animal for protection. These Protective Animals of the 6 Directions are the same protective animals that are associated with the vital organs. Therefore, for energetic protection, ask the Blue Tortoise for Gentleness; Red Pheasant for Joy; Green Dragon for Kindness; White Tiger for Courage; Yellow Phoenix for

Fairness; and Black Tortoise for Stillness (Beneath). Connect with Universal Love, saying “I am worthy of Divine Love and Protection”.

9. Remain in this position for several minutes. Be aware of the Sacred Fire burning all around the circle and the Golden Dome Chi Field surrounding you. This forms a permanent magnetic Sacred Circle that is literally indestructible.

Fig. 10.18 *Golden Dome Chi Field*

Practice

Affirmations Peace within your own Heart

Calm the mind, emptying down to the abdomen and expand the awareness out to the Universe, repeating the following affirmations from the center of your awareness and consciousness.

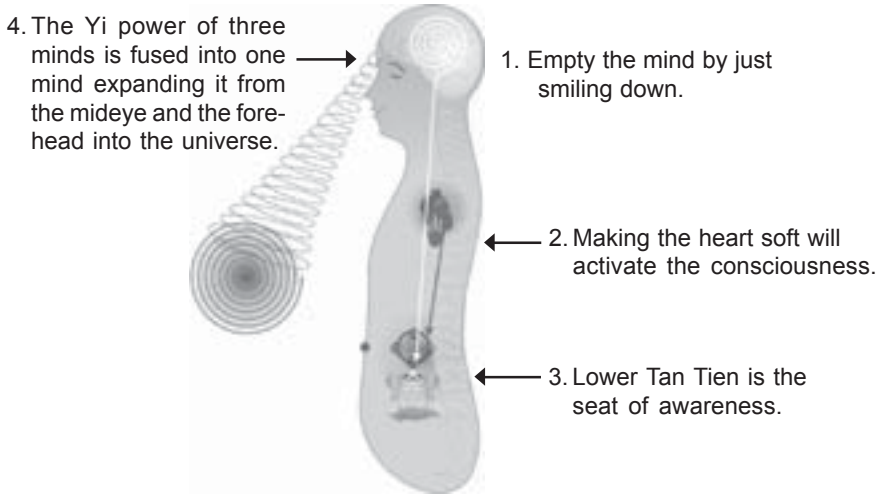

Fig. 10.19 *Activate three minds into one mind.*

Empty the mind by smiling to the Lower Tan Tien and direct the conscious mind of the Heart down to the awareness of the Lower Tan Tien, combining the three minds to fuse into the one mind (Yi). The Yi mind is the most powerful mind to connect with the universe.

I am at peace, feeling love and compassion in Myself (Touch Heart).
I am calm, warm, and still in my Center (Touch Lower Abdomen).
I am at peace with my Family and people close to me (Picture Them).
I am at peace with my Neighbors (Picture Them).
I am at peace with my Friends and Co-workers (Picture Them).
I am at peace with my Community (Picture Them).
I am at peace with myself and all sentient beings (Feel them).

Healing Yourself and Others

Personal Connection

1) Empty the Mind by starting a **smile** in your face. Let the Smiling Energy flow down to the neck and into the Heart area (the seat of consciousness). Make the Heart feel soft and full of love, joy and happiness activating the conscious mind.
2) Continue smiling and relaxing down to the abdomen (the center of awareness). Smile, emptying the mind and senses (eyes, ears, nose and mouth) down until the navel area feels warm, activating the awareness.
3) Feel the observing mind of the head and the conscious mind of the heart going down to combine with the awareness mind of the Lower Tan Tien. Combine and fuse these three minds into one mind: “Yi” at the mideye. Expand the awareness out from the abdomen beyond your physical limits to the cosmos and universe, connecting with the Universal Energy (God).

Take the Yi and spiral it upwards through the crown into the vast pool of energy in the universe. Continue spiraling in the universe and let it multiply. Then, spiral it down to your Personal Star and into your whole body.

Forest Green Energy

Picture an ancient forest with bright green leaves up in the universe. Picture a beautiful emerald green light coming from heaven and spiral it down to you. Spiral the green light down through your community, Tao Garden, your house and then into your crown. Let it clean your whole body, binding and absorbing any negativity, burdens, worries and sick energy and draining it all out of your body. Let it flow down deep into the ground. Dig a hole and bury the sick, negative energy in the ground. Let your heart be happy (3-6 times), for serious illness (36-81 times).

Forest Green Energy Keep the Tan Tien warm and expand the Yi mind to the universe, picturing a beautiful emerald green light in the universe.

Fig. 10.20

Spiral it down through your community, your home and then into your crown.

Fig. 10.21 *Forest Green Energy*

Let the energy cleanse all that it comes in contact with.
Then spiral it down into the ground.

Fig. 10.22

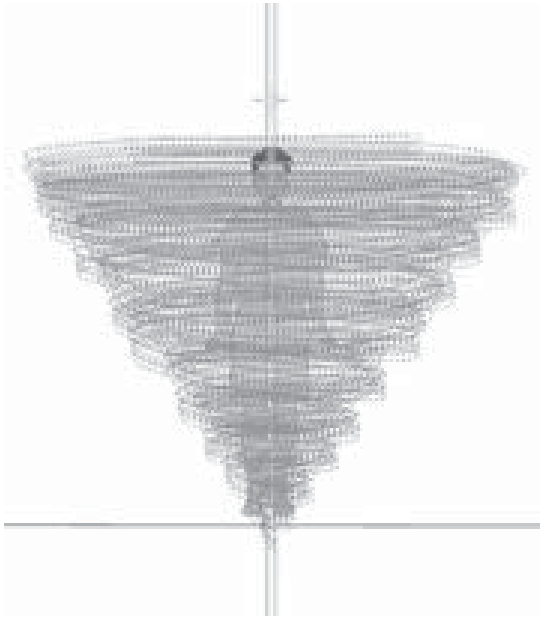

Dig a hole and bury the sick, negative energy deep into the ground, never to return. It will be transformed by the Earth into positive energy.

Fig. 10.23 *Bury the sick energy.*

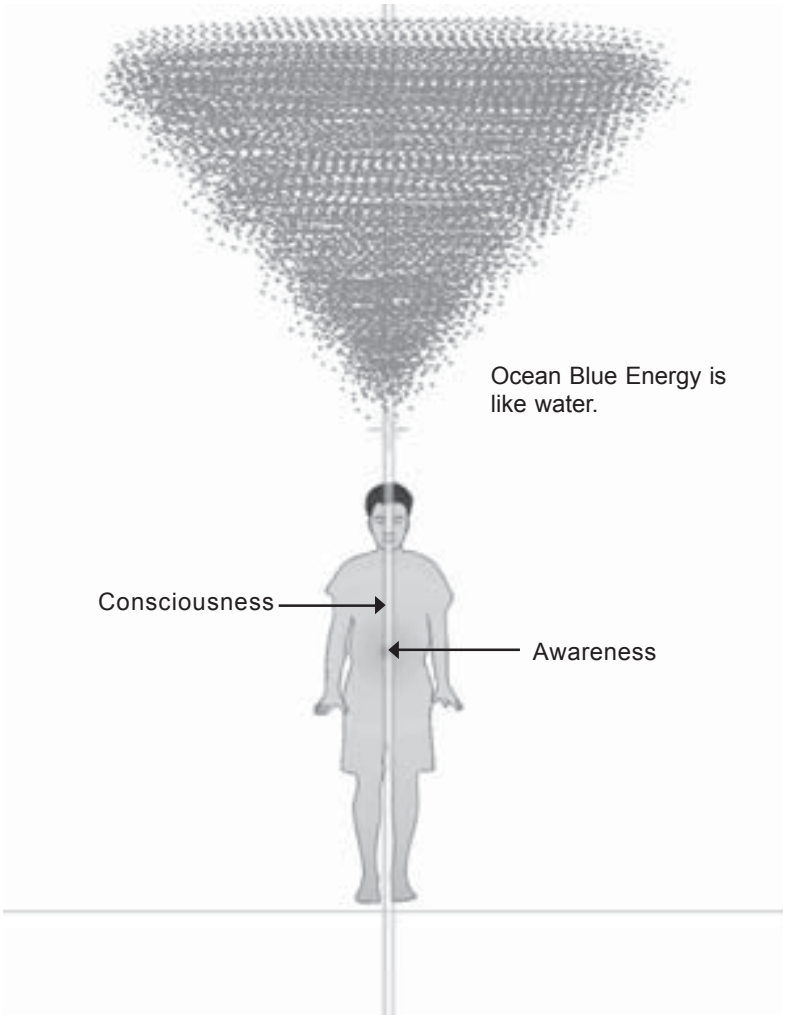

Fig. 10.24 *Keep the Tan Tien Warm.*
Stay Connected to the Awareness and Consciousness of the Yi as you Flush the Blue Light through your Body.

Electric/Universal Violet Energy

Picture violet light, the most abundant energy in the universe. Picture it coming from the North Star and the Big Dipper. Gather the energy in the cup of the Big Dipper. Hold the handle and pour the violet down over the Crown. Spiral the energy down and fill all the cells of your body, together with the Energy Body (6 times).

Fig. 10.25 *The North Star is a major source of violet light.*
The Big Dipper is a major source of red and infra-red light.

Healing and Strengthening the Whole Body

1. Fill the brain with violet light, saying "Let all sickness go away and let the brain be at its best."
2. Follow this method for your organs. Using the same affirmation for every organ. You can also group the organs;
   Eyes, ears, nose, mouth, tongue, teeth.
   Thyroid, parathyroid, thymus, pancreas, prostate, uterus.
   Lungs, heart, stomach, small intestines, large intestines.
   Liver, spleen, kidneys, ovaries, testicles.

   Doing this with your mind, stay conscious of the Lower Tan Tien. Expand your awareness to the universe and the universe will fill you with healing energy.

Activate the Immune System and Defense System

1. Touch the sacrum and feel your fingers grow 'long' with Chi and penetrate into the sacrum and bone marrow, activating the bone marrow. Put your mind into the Tan Tien and the universe. Hold until the universe fills the sacrum and Chi rises up the spine to the forehead. Feel the pulsating in the temple bones. This increases the production of healthy white blood cells for the immune system. Keep the Lower Tan Tien warm and feel the Chi flow up the spinal cord, then let it spiral up into the universe. The universe will fill you with healing energy.

Fig. 10.26 *Feel your whole body radiate, clean and shining with light.*

Fig. 10.27 *Hold until the universe fills the sacrum and Chi rises up the spine to the forehead.*

Activate the Immune System. Empty the mind down. Keep the Tan Tien warm. Touch above the pubic bone and feel your fingers grow 'long' with Chi. Let them penetrate into the sacrum and bone marrow to activate the immune system's production of red and white blood cells. Leave your fingers there and lower your mind into the Lower Tan Tien and the Universe'. Feel the funny, happy, laughing and tingling electrifying sensations in the bones.

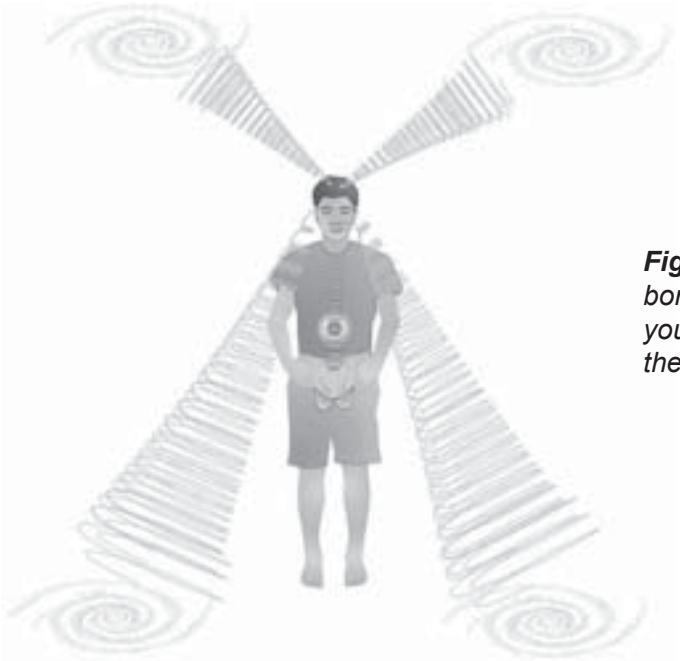

Fig. 10.28 *Touch and feel the pubic bone. Leave your fingers there. Lower your mind into the Lower Tan Tien and the Universe.*

Fig. 10.29 *Touch the sternum and let the Chi spread throughout the sternum, through the whole rib cage, in the Lower Tan Tien and the Universe, activating production of white blood cells.*

Touch the femur bone's middle point (upper legs) and feel your fingers grow 'long', penetrating the bone marrow of your legs. This should give a tingling sensation through the whole leg. It also increases the production of red blood cells.

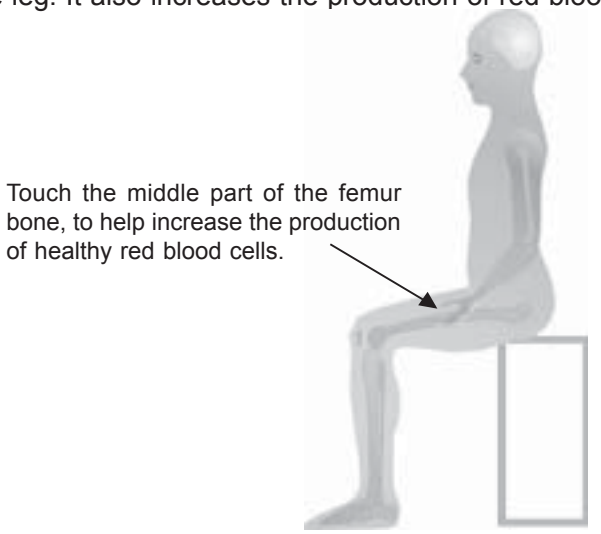

Fig. 10.30 *Touch the Middle Point of Femur Bones.*

1. Touch the middle point of the humerus (upper arm) and feel your fingers grow 'long' penetrating the bone marrow of the arm, activating production of healthy red blood cells.
2. Touch the sternum, feeling your fingers grow 'long' and project the Chi into the chest cavity activating the thymus gland. Feel the connection to the thyroid and parathyroid glands. This activates the immune system and increases the production of the T-cells (the anti-virus 'commando' cells of the body).

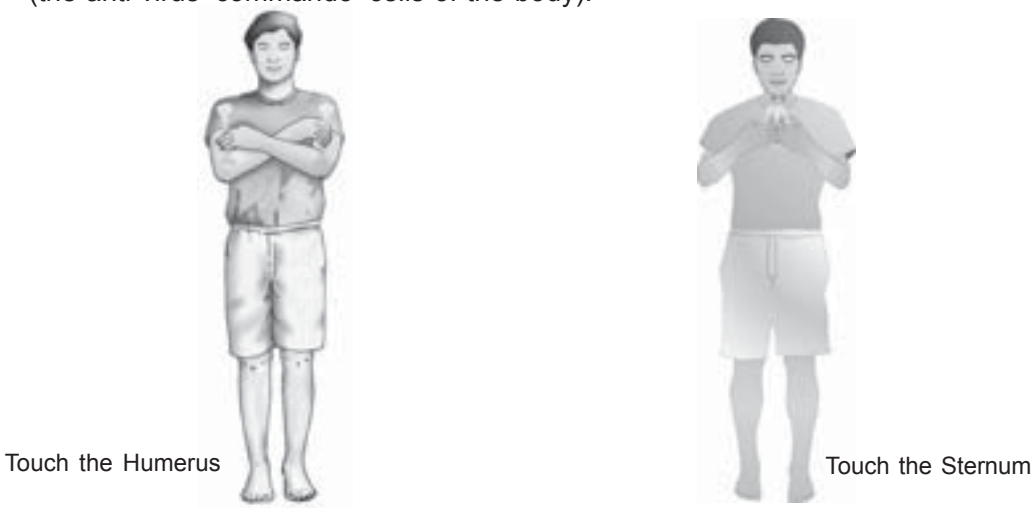

Fig. 10.31 *Humerus and Sternum*

Manifestations

Virtue Mind Power: our Subconscious Guilt

In order to increase the Virtue Mind Power, you need to get rid of subconscious guilt. Our subconscious guilt complexes are major obstacles to our health and progress. They are the major causes of illness and frustrations. It is as if we have an inner program that says we do not deserve to have health, wealth and happiness. This guilt makes us feel like powerless victims.

Other guilt complexes assume that we are sinners requiring punishment in the form of ill health or misfortune. We can never bring ourselves to ask the Universe for anything that we do not feel worthy to receive. God made the human in his own image. Humankind is naturally entitled to everything that the Earth and the Universe can provide for our happiness and well being. As children of God we deserve the best. We can command the Cosmos, providing that we make our command in the right way and with good intent.

Being Unwanted

Being unwanted is one of the worst situations for many people. This is true for all those who feel alone, especially children and old people, who might feel left all alone to die. Subconsciously, they will send out messages to the Cosmos to make themselves sick. The more attention that is given to sickness and ill health, the more energy is received from the Cosmos to make that happen. We get exactly what is projected by the subconscious mind.

Negative Self-Talk and Negative Thinking

Every thought whether positive or negative, is a command to the Universe. If our lives are not how we would like them to be, it is because we have unwittingly given negative commands to the Cosmos, we will receive negative results. Humans have a deep need for love and attention. Sometimes we become needy and try to get sympathy and attention through being sick, or by becoming a victim. If in our subconscious mind we believe that our motives are unrighteous or impure, then the Cosmos will keep us poor, sick, or both.

Your command to the Cosmos always brings results. We get exactly what we command, whether good or bad. Therefore, we must be careful of what we think, feel and say, if we want our lives to change for the better. We can remove all the unworthy, guilty, sinful thoughts and ideas, replacing them with the realization that we are the Children of God (the Cosmos). We can accept the best the Universe and Earth have to offer. Be glad to see other people have gained wealth honestly and that they are healthy and happy. If we develop jealous or negative feelings towards them, then we immediately return to the state of being self-righteously poor.

We need not accept the results of our negative thinking. We can initiate a positive course of action. To fully use this power you must replace negative thought patterns with

a new command of the cosmic force. You must take action when you receive the energy and information. The way to get extra energy is by breathing the red light into the heart 3 to 6 times letting it radiate into the whole body into the heart. You will feel a lot of energy helping you to take the actions necessary to complete your tasks.

Direct Command

To make a positive statement is to make a direct command. A command given in the present tense – in the now – is the most powerful command that we can give to the Cosmos. A command to the Cosmos should be phrased clearly, as an individual statement and always said aloud.

For example, if we make the command to ourselves, "I am well, I am healthy, I am happy, I am wealthy," it doesn't matter how sick or poor we are. The fact is, we have already begun to take on that quality because of the command that we have given. The change will begin very rapidly. The Cosmic force will begin work on our inner functions immediately, according to what qualities we have claimed. Success in using Cosmic power depends upon our working with and our exercise of the command, in the right way, to take action and responsibility. Practicing Positive Mind Power, fusing the three minds into one, the Inner Smile or Chi Kung will help.

Once you have set the cosmic force in motion with a direct command, you must take action. You must be willing to take responsibility for yourself. The Universe cannot accomplish everything on its own. The key is to use the Cosmic force to aid your actions. There is no limit to what the individual can accomplish when combining the Cosmic force with individual intent.

Manifestations: 'Yi' Mind Power

Start by smiling and empty the mind to fuse the three minds as one (Yi), in the lower abdomen. Move the Chi up to open the frontal lobe of the brain at the Third Eye. Create a triangle from the third eye to the temple bones filling it with Chi. Expand the awareness to the Universe.

Fig. 10.32 *Third Eye and Temple Bones are in a Triangle.*

Fig. 10.33 *Manifest the Mind Power, using the frontal lobe. Activate it by touching the sacrum. When the sacrum is filled with Chi, the Chi will rise up to fill up the frontal lobe.*

We manifest our affirmations in the physical, emotional, mental and spiritual body by starting to manifest from the center of awareness, by placing the attention in the abdomen. Next bring the thought that you want to manifest up to the heart connection, then to the upper mind, the frontal lobe and the mideyebrow. Broadcast it out to the entire Universe. This affirmation is multiplied many times by the abundant Universal energy. It will return to you to be manifested, but you must wait with your awareness anchored in the second brain - the lower abdomen.

Physical Image

Picture yourself at an age you would like to be, and hold that image very clearly. Hold it in the center of your second brain (lower abdomen) and move it up to the center of your consciousness in the heart area. Continue to hold this image very clearly and move it up to the forehead and then send it out to the Universe in all six directions, saying, “I am well and perfectly healthy.”

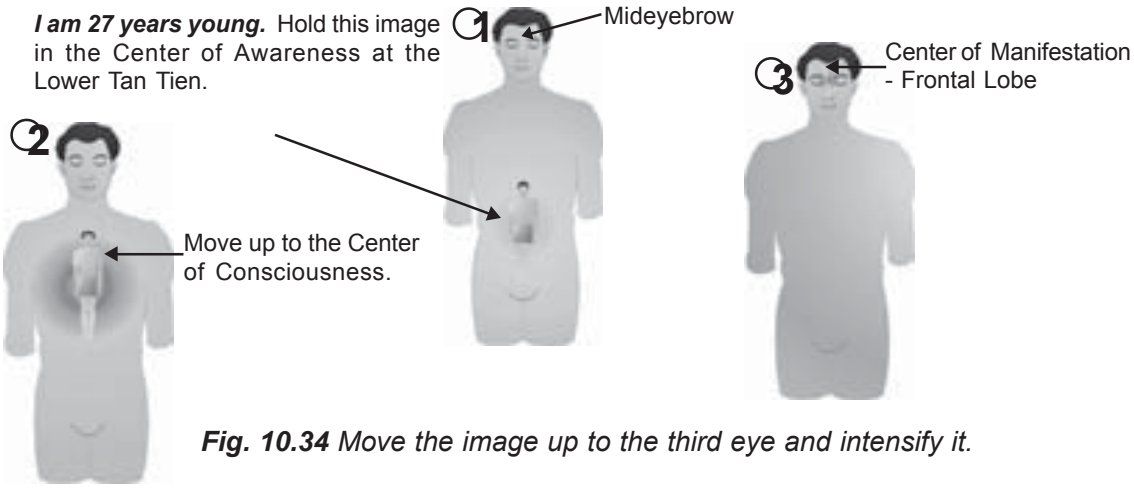

Fig. 10.34 *Move the image up to the third eye and intensify it.*

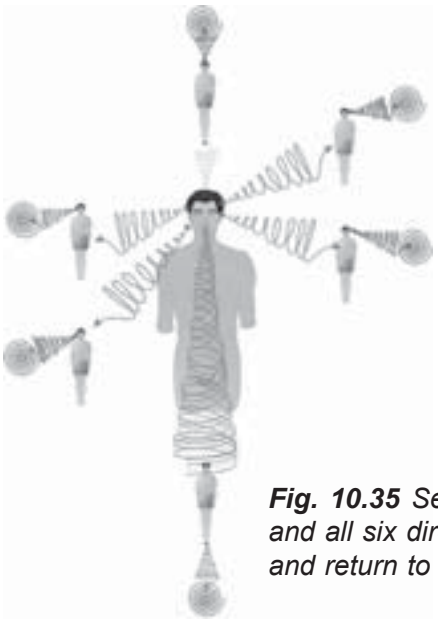

Fig. 10.35 *Send the image out into the Universe and all six directions. The affirmation will multiply and return to you to be manifested.*

Emotional Image

Picture your emotional body: See a body-shaped image close around your physical body, composed of all kinds of moving colors, saying: "I let go of old emotional experiences, seeing them for what they are and fill myself with radiant joy, love and compassion." Bring the image up the heart center and then to the frontal lobe. Send it out to the Universe and the Universe will multiply it many times and it will be sent back to you. Just wait for it to return with your awareness in the lower brain.

Affirm: "I let go of old emotional experiences, seeing them for what they are and fill myself with radiant joy, love and compassion."

Emotional Image.
See yourself as a happy, joyful person.

Fig. 10.36 *Emotional Image*

Mental Image

Picture your mental body, saying: "I make an agreement with myself to enjoy the best of life and to live the full wealth of my potential in harmony with Nature and the Universe." Follow the same sequence of moving the image up to the heart, the frontal lobe and out to the Universe. Wait for the return with your awareness in the lower brain.

Affirm: "I make an agreement with myself to enjoy the best of life and to live the full wealth of my potential."

Fig. 10.37 *Mental Image*

Spiritual Image

Picture your spiritual body and higher self, saying: "I am at one with my God (Source) within and manifest its Glory." Follow the same procedure as before.

Problem Solving

Answers and Solutions

A. Take the questions and problems that you have into your center of ***Awareness*** (Abdominal Brain) then to your ***Consciousness*** (Heart Brain) and send them out into the Universe through the third eye from your ***Observation Center*** (Mind Brain) broadcasting out to the entire Universe.
B. Wait for the best answers and solutions to return to you clearly and distinctly. Allow them to ripen into full understanding.
C. At any point in the future, if you have any questions or you need to take action or have a problem that needs to be solved, all you need to do is to inhale deeply and allow your awareness in the abdomen to expand far beyond your physical limits.
D. Exhale your problem into the Universe, open yourself, wait for a moment and let go of the problem. You will become conscious of the solutions to your questions or problems you presented. The more you practice this, the quicker and easier the results will come. You must take action when you receive the energy and information. The way to get extra energy is by breathing red light into the heart 3 to 6 times, letting it radiate into the whole body through the heart. You will feel a lot of energy enabling you to take action and complete the task.
E. You can use the same technique to project the goals and the time frame during which you wish to accomplish them. Sometimes it helps to ask for more wisdom from the Universe or Cosmos in order to understand our Life's purpose.

Finish the meditation by resting for a few moments and collecting the energy in your Lower Tan Tien.

Chapter XI
Planetary and Stellar Meditations to increase Awareness and Sensitivity

Feeling the direct connection with the planetary energies is a unique experience which carries multiple benefits for yourself and for the healing practices you carry out. Here follow some of the benefits we noted among practitioners of these meditations:

An increase in emotional stability and in understanding the origin of emotional patterns.
Ability to connect with information and energy from the universe.
Strong healing processes in the organs and the whole body.
A major increase in healing power.
A greater balance between the weak and strong points of character.
A rise in the ability to be deeply in touch with the different organs/systems in the body both of the practitioner and that of the person being treated.

We advise you to practice the opening of the Three Tan Tiens to the Six Directions first. (see Chapter II). Once the organs and energy centers are connected to the galaxies, the planetary forces can be integrated easily. The planetary meditations are divided into seven parts ; following each one represents a growing level of awareness/sensitivity.

Before you start with the first one, take some time to create a good contact and to integrate these energies into your body. Then proceed with the next one. A good sequence for building up the meditation practices from this book is the following:

Step 1: Iron Shirt Chi Kung, Inner Smile, Six Healing Sounds, Microcosmic Orbit. For those of you who have studied Cosmic Chi Kung (One Finger Art, see the book Cosmic Healing I) this practice is also a perfect preparation.

Step 2: Opening the Three Tan Tiens to the Six Directions.

Step 3: Planetary and Stellar Initiations 1 to 5.

To get a direct connection with the frequency of the planetary belts and galaxies, use the information and pictures in Chapter III; Taoist Astrology and the Structure of the Universe. As is the case with all new practices and meditations, it takes some time to build up the connection, but with practice it soon will become easier and once you really get it, you can connect to the energy at any moment during the day when you decide to tune into it.

As with anything in life, you will only get good at it if you master the basic principles and practice daily. If you want to go quickly in the beginning, you may have to return to the basics at a later stage.

It is important to realize that in these meditations you are interacting with enormous forces. It is not the effort, but the awareness and resonance that determine the results.

The openness to achieve the connection with these energies will give you just enough of what you need and what you are able to manage. This can cause strong emotional, mental and physical shifts in energy, but it is always available in amounts that you can handle. If you try to manipulate the universe you may well suddenly receive a lot more energy, just as you have asked. But you will discover soon that the ego led you in this direction. You will not be able to handle it and will 'burn' yourself. Thus your energy level will decline instead of rise, with disappointment being the result.

A good way to get in contact with the awareness belts in the solar system (planetary frequencies) is to study some basic astronomy and use the pictures of planets/stars in this book as a starting point. Once you have a better understanding of how the solar system really appears, the pictures can be used to tune into the planetary frequencies. Simply look at the pictures then close your eyes, look out through the cranium and expand your awareness. It is important to respect the correct sequence of building up this meditation practice. Start with what you can clearly register sensorially. Start with the sun (warmth/seeing it), then move to the earth (seeing, feeling gravity and energy), then shift to the moon (seeing, feeling). You need to contact with these three forces first before you will be able to connect to the other planets. Remember that you do not have to see these planets in order to feel them. What we are getting in contact with is the energy/awareness belts of the planets. The planets in their materialized form are only the center of this belt.

Practice with great respect. Do not try to pull these forces with your willpower. This will not work! Try to attract them. You can use the eastern or western astrological signs for the planets during the meditations by projecting them into the picture of the planets. But it's better to start with only the color and quality of the element.

Meditation 1
Earth - Sun - Moon Triangle

1. Warming up exercises (Inner Smile, Chi Kung, Tai Chi, Tao Yin and others)
2. Opening the Three Tan Tiens to the Six Directions, integrate the Inner Smile and the MCO.
3. Connect to Mother Earth. Breath deeply into the earth with every exhalation. Thank the earth for her love and nourishment. Breathe in the cool blue energy through the soles, the palms and the perineum. Store this energy in your center. This will be your safety belt and rooting during your planetary and galactic journey.
4. Bring your attention to the sacrum.
5. Picture a bright full moon behind you, shining on your sacrum. The color of the moon can be seen/felt as silver/white.

The moonlight will be mixed inside the sexual center with the blue sexual energy. Breathe it into the sacrum drawing the moonlight inside and further into the sexual center. At the same time draw the sexual energy inward. Men pull up the sexual organ, perineum and anus and gently squeeze the muscles around the prostate gland. Women softly close and contract the vagina, perineum and anus and gently squeeze the muscles around the ovaries and the uterus. On the exhalation (men and women) release the muscles about 90% but keep the Chi inside.

The squeezing should be very gentle and the other muscles in the body remain very relaxed. Gather the energy at the sexual center. Take about 5 to 10 minutes until you feel the moonlight directly entering into the sexual center.

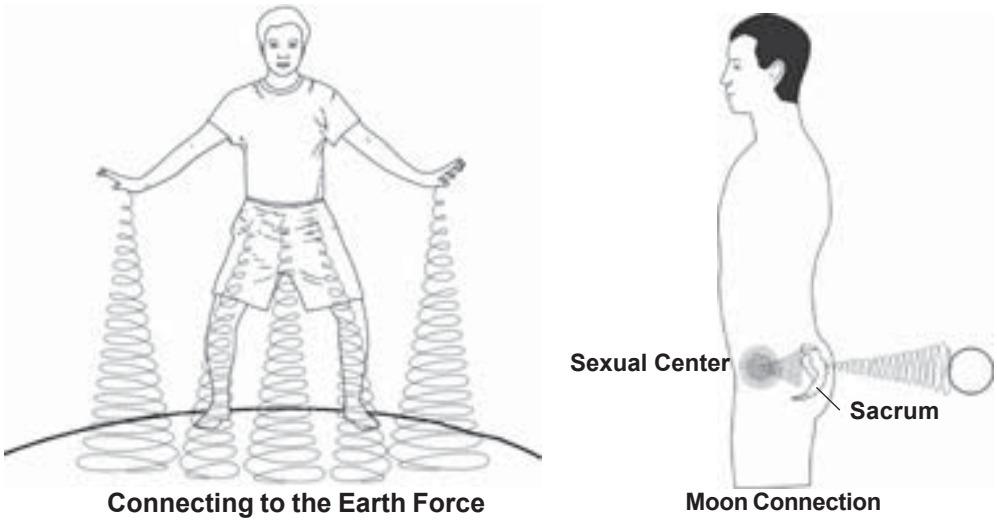

Fig. 11.1 *Sexual Energy*

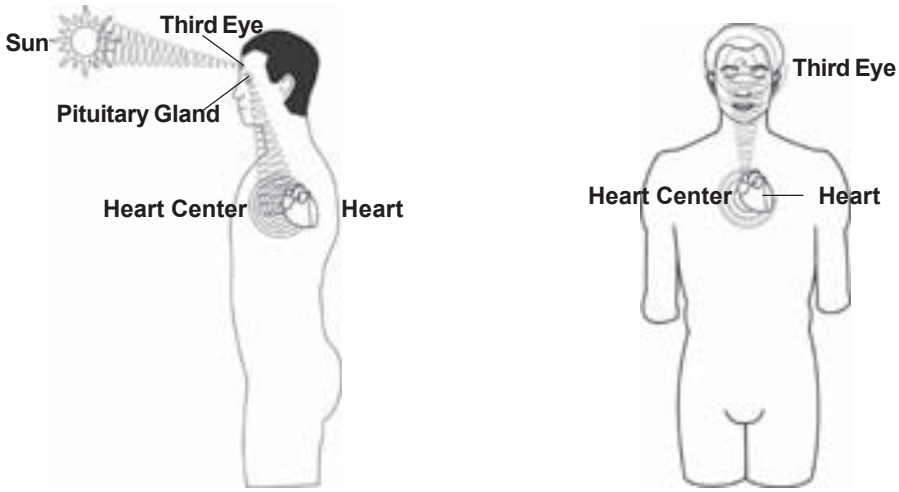

Fig. 11.2 *Connecting the Sun with the Third Eye and Pituitary Gland.*

6. Bring your attention to the third eye/mideyebrow point.
7. Picture a bright gold/yellow sun in front of you. Feel the light particles, the cosmic Chi tingling on your face. Absorb this light in the third eye and the pituitary gland.
8. Breathe in the light and guide it from the third eye and the pituitary gland down into the heart.
9. Make the heart sound to clean it and balance the heart energy. Feel love, peace, patience and respect, while you feel the sun directly shining in your heart. Shift your focus towards the heart center, right in the middle between the nipples, behind the sternum.

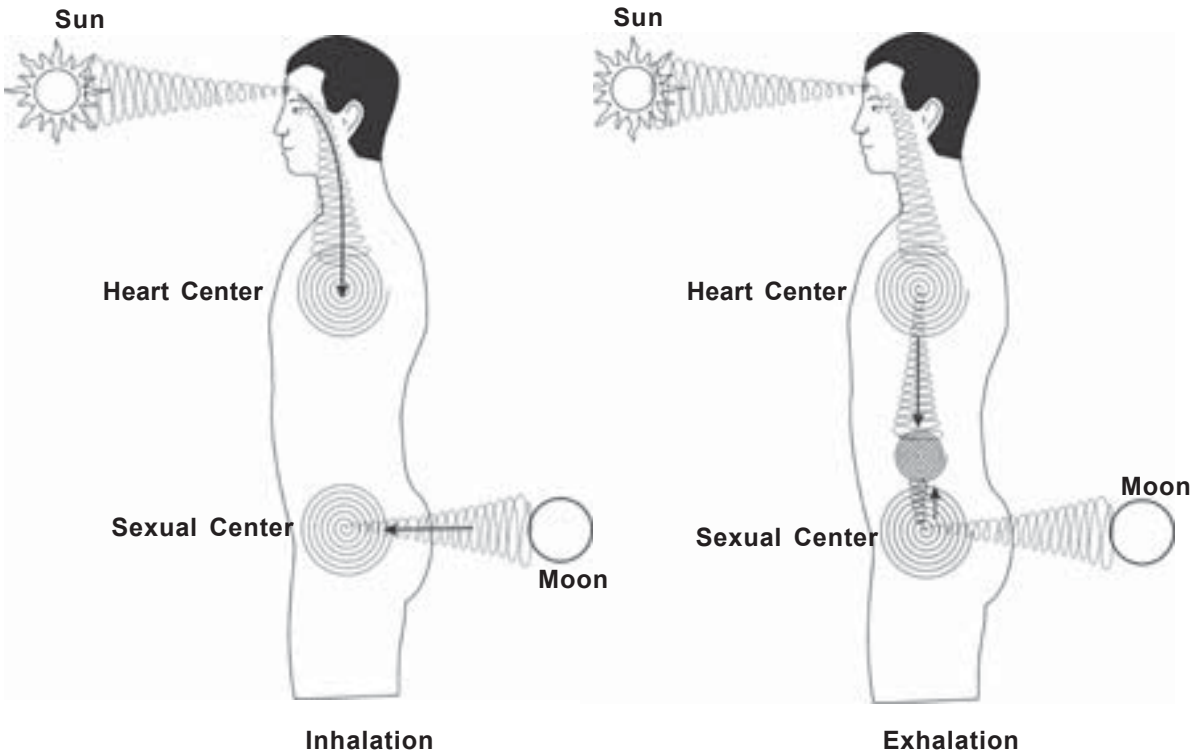

Fig. 11.3 *Connect the Sun and the Moon.*

10. Blend the golden/yellow sunlight with the bright red color of love and compassion in the heart center.
11. Gather more sunlight in the heart center. At a certain point the heart center will open up further and connect with the universal love. A deep yet unsentimental love can be experienced. This has been described as the 'blooming of compassion'.

12. On the inbreath draw the silver/white moonlight into the sacrum/sexual center (blue) and at the same time the golden/yellow sunlight into the third eye/heart center (red). On the outbreath condense these two energies in the central point behind the navel. Push the blue/silver/white energy up and the red/golden/yellow energy down. Keep drawing these energies in until you feel a clear connection (10-15 minutes).

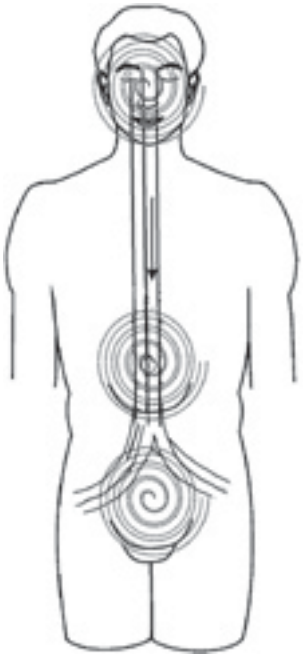

Fig. 11.4 *Sun and Moon Energy in the Body*

13. Bring the kidney and sexual energy up through the vena cava and the heart energy down through the aorta.
14. Mix both energies in the Tan Tien. If you have difficulties to connect with the aorta/ vena cava, just relax and let the two energies come together in the Lower Tan Tien.
15. When the love and sexual energy are combined in the center, a soft orgasmic feeling will start vibrating in the Lower Tan Tien and from there on through the whole body.
16. Combined with the sun and the moon force this energy can be multiplied. Start slowly; do not take in too much sun and moonlight or you will begin to overheat. Give your body the time to adjust to the new energy level. If you feel that you are getting too hot, or have any adverse reactions (unpleasant sensations), practice the Six Healing Sounds to cool down and regain equilibrium.

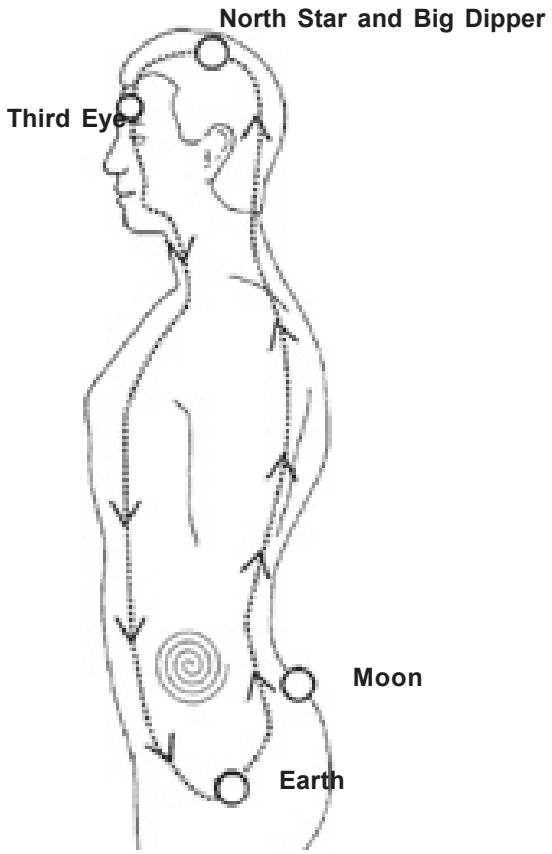

Fig. 11.5 *Microcosmic Orbit (MCO)*

17. Move the energy from the center down into the perineum and up the MCO.
18. Put the emphasis on the following points and connections:

    Perineum - Earth
    Sacrum - Moon
    Crown - North Star/Big Dipper
    Third Eye - Sun

19. Stop at each of these points and feel the external connection.
20. Circle the energy around 9 to 18 times in the MCO. Gather the energy in the center and rest. Observe your body and energy in the yin stage. Just notice where the energy is moving in your body. Remain in this state for 5 to 15 minutes.
21. End this meditation with Chi Self Massage.

Meditation 2
Strengthening the Organs and Balancing the Emotions

1. Warm up exercises (Inner Smile, Cosmic Chi Kung, Tai Chi, Tao Yin and others).
2. Opening the Three Tan Tiens to the Six Directions.
3. Integrate the Inner Smile and the MCO.
4. Make a firm condensed Chi ball in the center.
5. Connect to the Mother Earth force.
6. Bring your attention to the cranium and softly touch the cranial bones with a minimum of pressure. This touch is often called the butterfly touch, as it is compared with the pressure you feel when a butterfly is landing on your hand; connect to the craniosacral rhythm. Once you feel this rhythm, try to remain with it. Try it without hand contact. Touch without touching, holding your hand 1 to 2 centimeters from the skull.
7. Expand this cranial awareness to a distance of 5 to 50 centimeters away from the physical body. This will greatly increase the sensitivity in your skull and the craniosacral structure.
8. Make the connection between the organs, the cranium and the related planet.
9. Put one hand on the spleen/pancreas area, fill them with the bright yellow light of openness, fairness and trust. Put the second hand (in the form of a beak) softly on the crown point to make the internal connection with the sphenoid bone (See fig. 11.6).
10. Hold the position and let the Chi move between the hands or between the sphenoid and the pancreas/spleen. Once you feel the connection, put the hands together in front of the Tan Tien. Then expand your cranial structure and look up with your eyes through your crown.
11. Visualize a bright yellow planet above you, the planet Saturn. Let the light of the planet Saturn shine down into the crown and the sphenoid bone and than directly down into the spleen and the pancreas. Feel the direct connection and feel how the spleen and pancreas are activated through this direct contact.
12. Feeling this connection may take some time, but once it has been established, the planets become like powerful batteries, charging your organs.
    Use this same procedure for the planets and organs, following the Five Element Cycle:
    Spleen - Lungs - Kidneys - Liver - Heart
    Earth - Metal - Water - Wood - Fire
13. Use an open hand for the other bones in the cranial system and not a beak hand as on the sphenoid bone.
14. Use your giving hand (usually the predominant one) on the cranium and your receiving one on the organs.
15. Picture all five planets above the crown and let the light shine into the five cranial entrances and further down into the organs. Bring all these energies together in the center.
16. Move the energy in the MCO, making 9 -18 cycles.
17. Gather the energy back into the center, observe the yin stage.
18. End with Chi Self Massage

Fig. 11.6 *Spleen/Pancreas, Sphenoid Bone and Saturn*

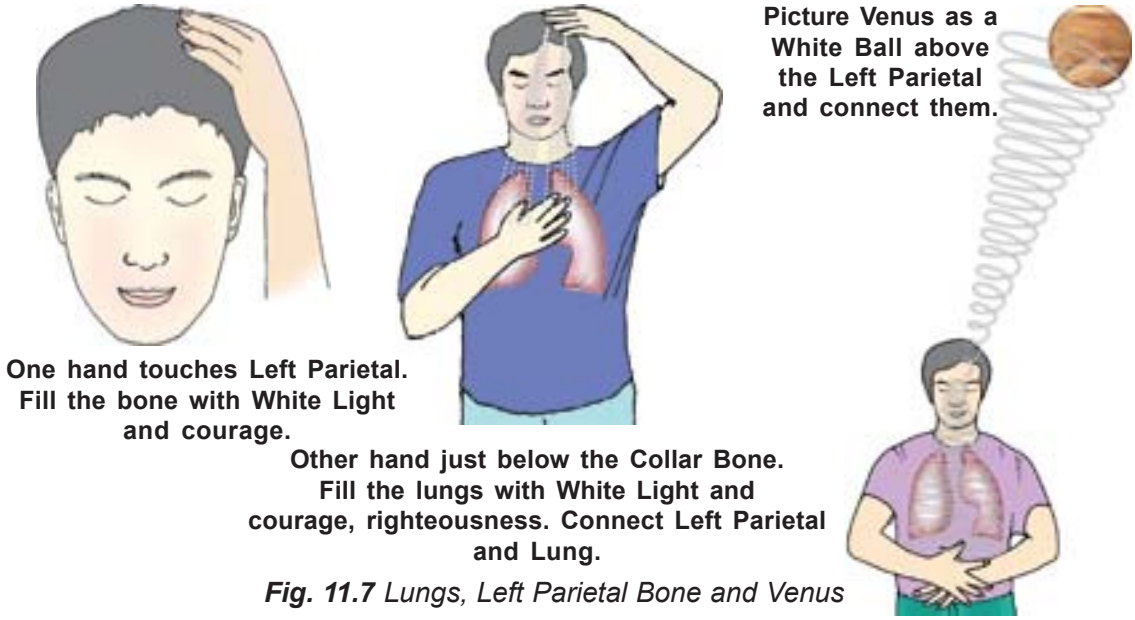

Fig. 11.7 *Lungs, Left Parietal Bone and Venus*

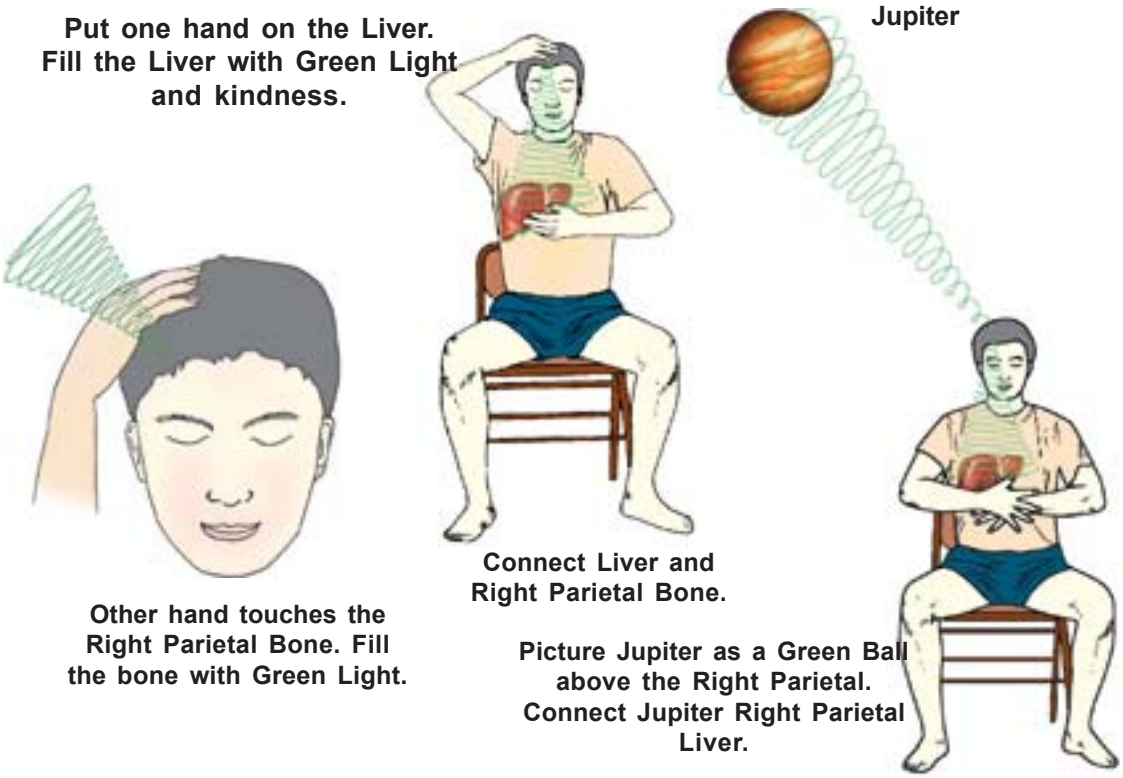

Fig. 11.8 *Liver, Right Parietal Bone and Jupiter*

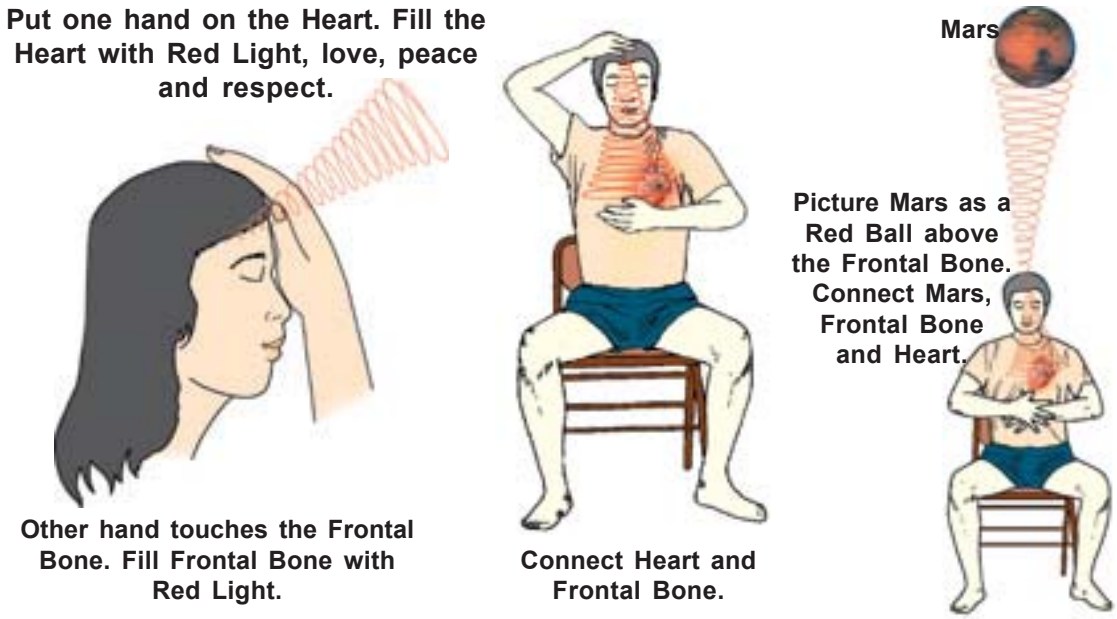

Fig. 11.9 *Heart, Frontal Bone and Mars*

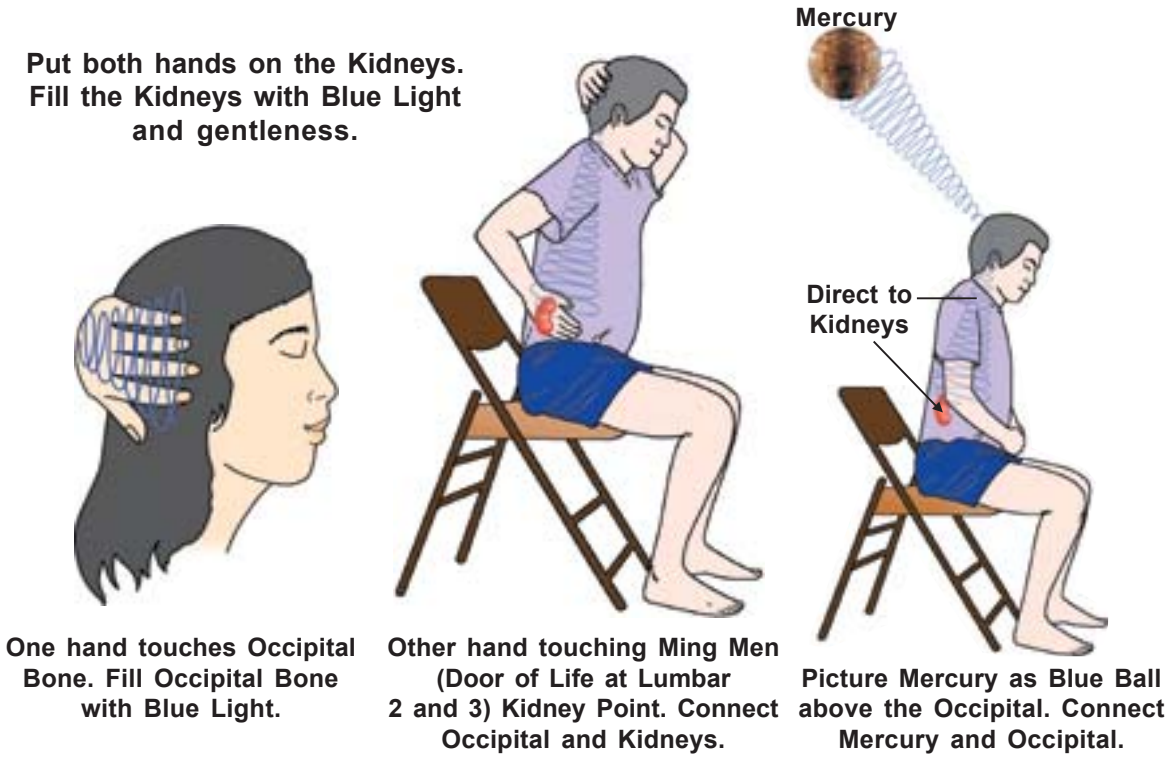

Fig. 11.9 *Kidneys, Occipital and Mercury*

Note: During the meditation you may meet different negative or undesirable emotions. Keep smiling down into the organs to enhance the virtue energy. If negative emotions keep bothering you, exhale them deeply into the earth and make the related healing sound. Fill the space with positive or virtue energy.

Meditation 3
Strengthening the Body Systems
Increasing the Energy Field

After you have practiced the second meditation for a while it will become easier to feel the connection with the planetary forces. This third meditation uses the technique of the second meditation but adds two factors:

Five Earthly Elemental Forces
Expansion of the Planet/Organ Energy into the Body Structures

This practice will strengthen the different organs and body systems. It will also create balance in your energy structures. Sickness and negative energy will be discharged. Your energy field will greatly improve.

1. Warm up exercises
2. Open the Three Tan Tiens to the Six Directions.
3. Make a firm, condensed Chi ball in the center.
4. Connect to the Mother Earth Force.
5. Go through the same five planets/organ cycle, as in meditation 2, but now add the earthly nature force related to that organ. Spend some time to build up a connection with the different nature forces.
6. Mix the earthly and planetary energy in the organ.
7. Let the energy/color/virtue expand in the muscular system until the whole body is filled with it and the energy radiates out into the aural field.
8. Earth Element: Spleen - Sphenoid Bone - Saturn - Earth/Soil Energy - Muscular System. Earth energy can also be used in the lymphatic system. Use the same strategy for the four other elements.
9. Metal Element: Lungs - Left - Parietal Bone - Venus - Lake/Metal Energy - Breathing System.
10. Water Element: Kidneys - Occipital Bone - Mercury - Water Energy - Bone Structure/ Hormonal System.
11. Wood Element: Liver - Right - Parietal Bone - Jupiter - Tree Energy - Tendon/Ligament System.
12. Fire Element: Heart - Frontal Bone - Mars - Fire Energy - Arterial/Veinous System.

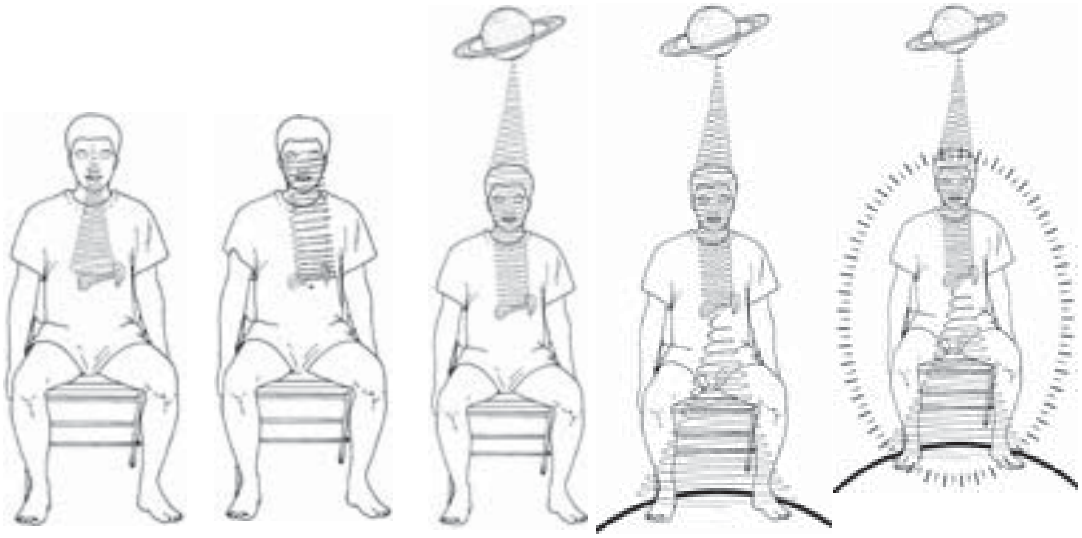

Smile deep into the Spleen and Pancreas.

Connect the Spleen/ Pancreas and the Sphenoid Bone.

Let the Yellow Light of Saturn down into the Sphenoid Bone Spleen/ Pancreas.

Take in the Earth/Soil Energy, mix it in the Spleen/ Pancreas with the light of Saturn.

Let the light and energy expand; fill up the whole body, until it shines out into the aural field.

Fig. 11.10 *Earth Element: Spleen, Sphenoid Bone, Saturn, Earth/Soil, Muscular System*

Fig. 11.11 *The Planets' Forces beam down to the Crystal Room.*

At the end you will feel a strong multicolored energy filling your whole body and surrounding you.

You can complete the meditation by adding the sun and moon energy. The sun is connected to the fire energy, the pericardium, third eye and lymph/immune system. The moon is connected to the water energy, the sexual organs, sacrum, hormonal system. Use the same order as in Meditation 1. This will increase the energy field.

13. At the end envision all of the planets above and around you. Just relax and let the energy move freely throughout your body.
14. Gather the energy in the Lower Tan Tein until you feel a Chi ball. Condense it firmly.
15. Circle the Chi ball in the Microcosmic Orbit.
16. Then gather in the center and observe the yin stage.
17. End with Chi Self Massage.

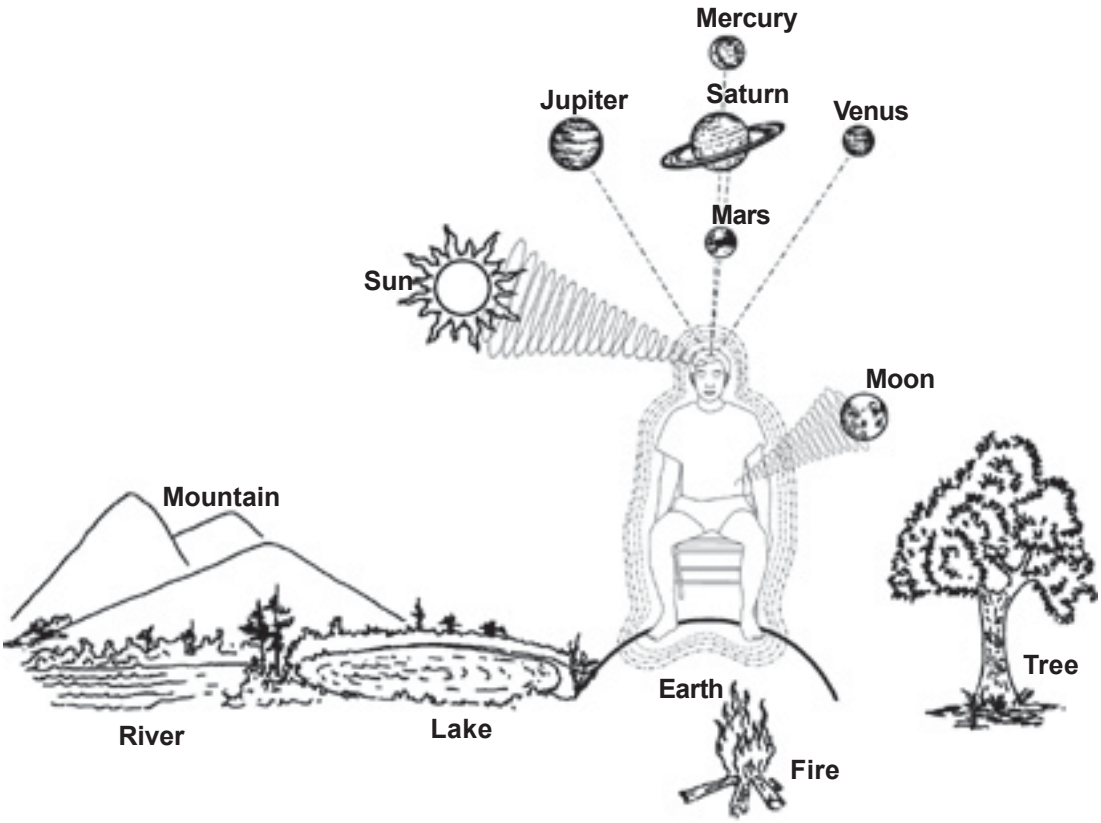

Fig. 11.12 *Natural Forces*

Meditation 4
Connecting to the Galactic Forces

To connect with the galaxies is a very strong meditation form. It brings enormous amounts of energy in your body. To work with them first use the preparation exercises from Chapter II.

The galactic energies can be used in two different ways:

1 Connect with Six Galaxies in the Six Directions.

2 Connect with the North Star and the Five Palaces.

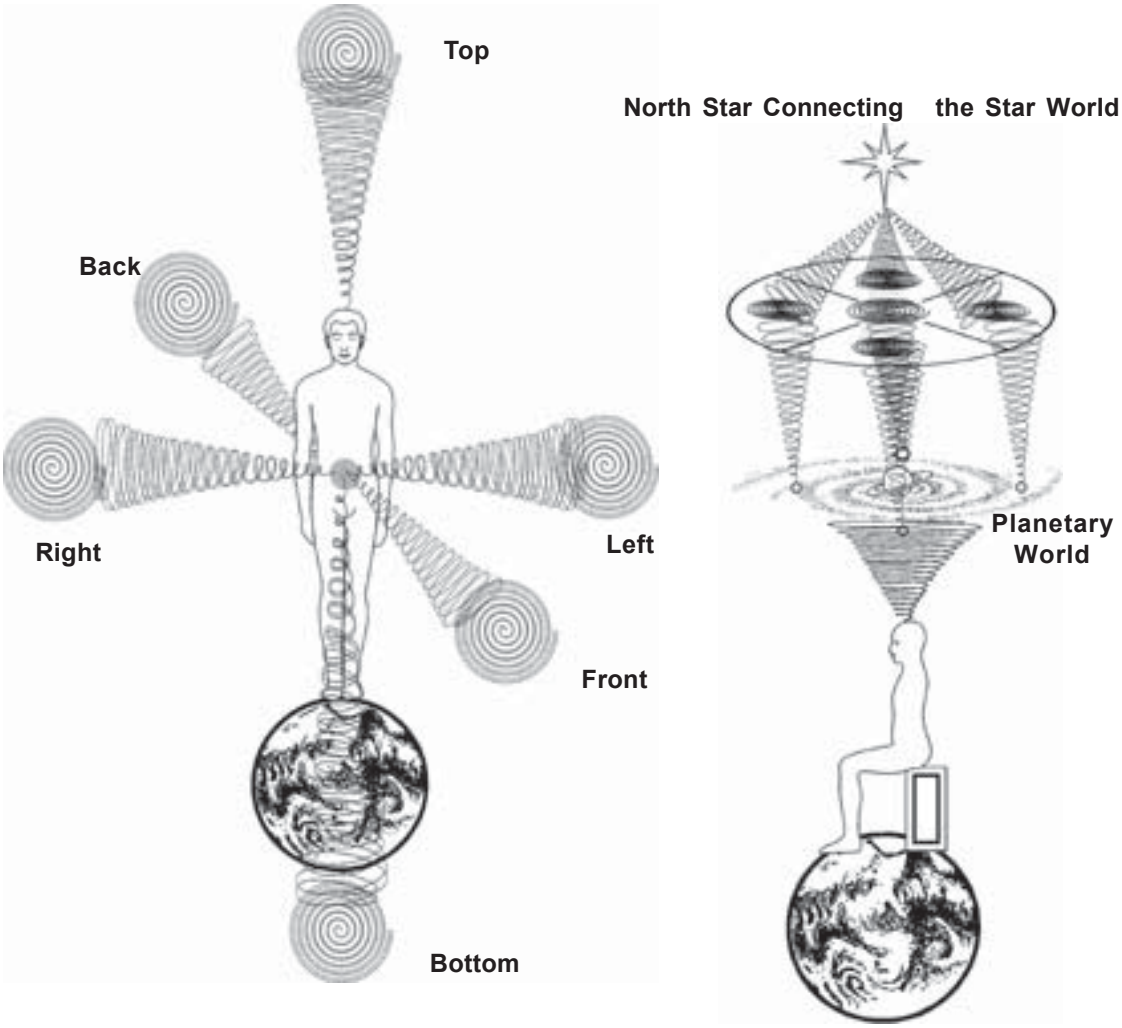

Fig. 11.13

Galaxy Connection in the Six Directions and Galaxy Connection with the Five Palaces

Six Direction Method

Golden yellow is the color used most frequently but any other colors can be incorporated as they manifest.

The entrance points are the crown, the third eye, the navel, the Door of Life (point in the lower back) and the feet. This meditation will balance the energy throughout the body since the connection points are in the head, body and legs. The bottom galaxy is reached through the earth, which means that good grounding is easy. This takes away the risk of overheating. Always remember that galactic energy is enormously powerful; maintain a respectful attitude as you work with these energies. The best way to build up is to work first with the six directions and then with the five palaces.

Five Palace Method

In this method, the energy is brought into the body through the cranium so there needs to be a good rooting and connection with the earth to balance this hot Universal energy in the head. Meditation 1, 'Balancing (Earth) Sun and Moon' or the preparation exercises in Chapter II, can be used first. It is advisable to begin with planetary connections and meditations. Their frequency and the subsequent amount of heat that is produced is lower than that of the galaxies. Once the planetary energies are balanced in the head. expand the awareness further beyond the Milky Way into the galactic world. Connect with the North Star and build up the connection with the five galaxies placed around the North Star.

Use the same colors and qualities as used in the five elements and bring the energy all the way down to the five organs.

Note: Once you have mastered this meditation you can increase the energy level, specifically by connecting the seven stars of the Big Dipper with the bones of the skull. (Details, see chapter V, page134)

Fig. 11.14 *Immortal*

Pictures of the channels between galaxies and organs can be used during or as a preparation for meditation.

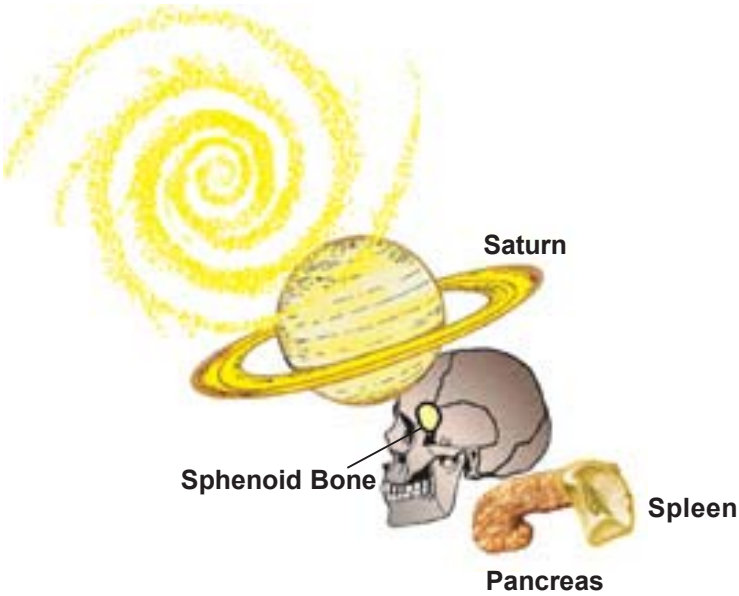

Fig. 11.15 Central Palace -Yellow Galaxy

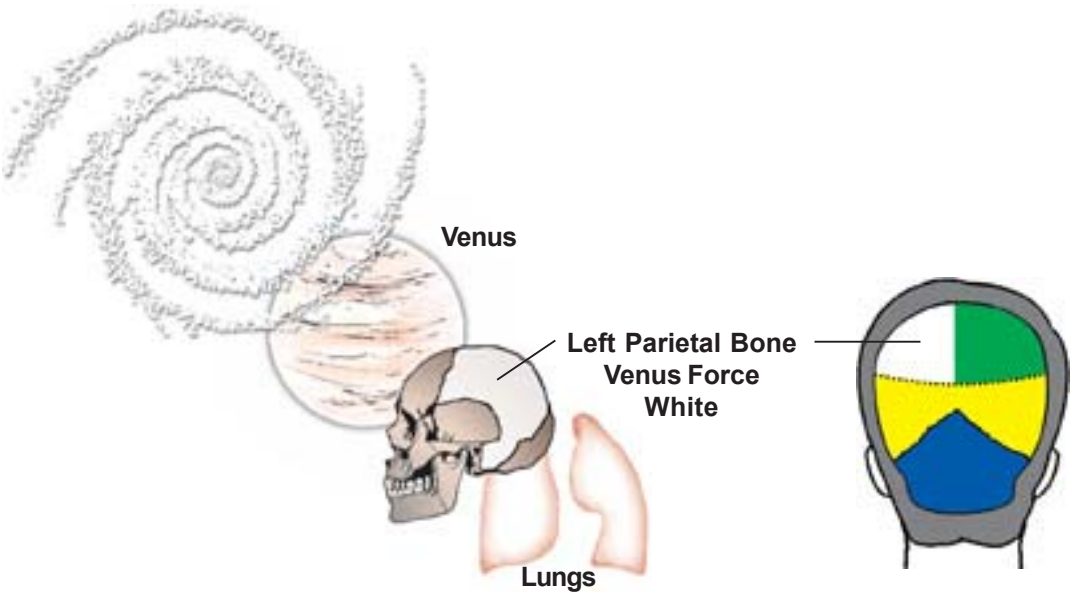

Fig. 11.16 West Palace - White Galaxy

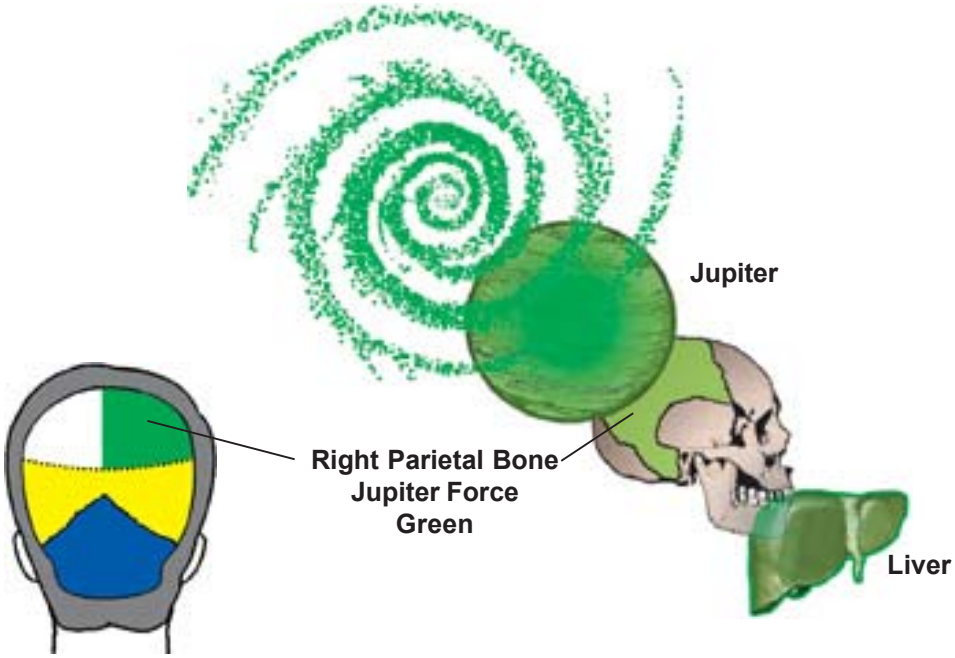

Fig. 11.17 East Palace - Green Galaxy

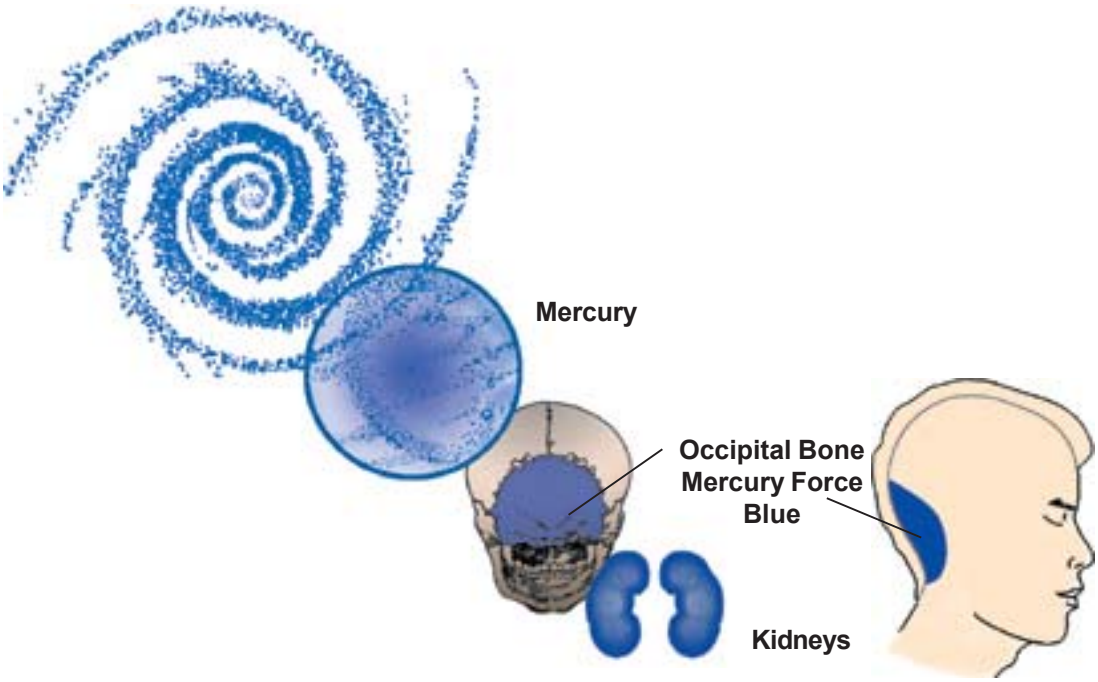

Fig. 11.18 North Palace - Blue Galaxy

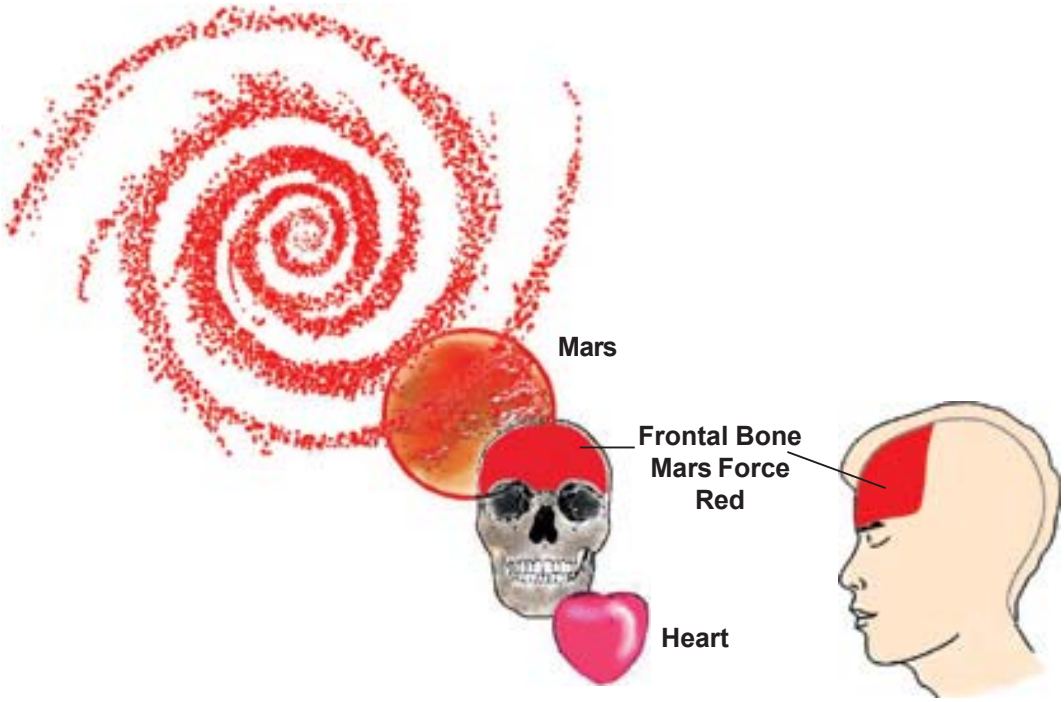

Fig. 11.19 Southern Palace - Red Galaxy

Meditation 5

Balancing the Planetary and Stellar Influences and increasing Emotional and Mental Stability

Regular practice of the first four meditations will give you a clear picture which of the five elements is your strong or weak point. It might show up in different ways - emotions, pain, and tension during the meditation. You might notice the weak element through an inability to feel its color, organ or planetary influence.
What you probably have accomplished by now is:

1. The ability to feel the connection with the related planetary and/or stellar frequency.
2. The ability to feel the connection between the cranial bone and the organ.
3. The ability to expand the energy into the related body system.

One of the five planets (sun/moon) - Star Palaces - cranium - organ - body systems will probably be very easy to feel, while another may seem to be absent. This difference originates in all kinds of physical, emotional, mental imbalances which are locked up in between the unconscious minds. It is also possible that you may feel the planetary connection and not the stars of the same direction or the other way around. Try to get the picture as clear as possible, it will give you a lot of information about your personality and also about your soul.

Once you have discovered how this imbalance is anchored in your system, you can use this during meditation as a tool to improve the weakness in your personality and in your physical body.

In this meditation we use the five galaxies and not the six directions method.

The principle of full and empty functions in the body is one of the most fundamental in oriental medicine. The cause of the problem lies basically in a lack of energy and information in one part of the energy system which is internally balanced by overactivity in other parts. Many people are hooked in a fanatical way on a certain more developed part of their personality and abilities. If they wish to balance themselves they must face their fear-based fanaticism which creates the empty or missing opposite.

The imbalance might already be found in the karmic information and can be related to the life task or it might come through in the way this person leads their life. Use the same principle as in the third meditation but work only with the strongest and weakest connection. As an example, let us say that you connect with the liver easily - right parietal bone - Jupiter- green galaxy and have difficulty with the lungs - left parietal bone - Venus - white galaxy. This might also show up in liver overactivity and lung weakness. You might notice a tendency to irritation, anger and on the other side depression, sadness, discouragement; good overviews on situations but tendency to over control.

The principle of this meditation is that you use the excess energy from the overactive organ to create a connection and nurture the deficient organ. If we put more vitality into the weak organ - the information of how to open this closed door often arises spontaneously.

1. Start with the same preparation as in Meditation 3.
2. When you have reached the part with the planetary connection, first make the connection with the strongest organ - cranium - planet/star connection, in this case the liver - right parietal bone - Jupiter - green galaxy and fill the body and aura with the related color (green).
3. Then change the color in the body and aural field with the one of the weakest function, in this case the lung/white. Draw this color inside of the lungs. Put both hands on the lungs, until you feel the energy tingling inside the organs.
4. Put one hand on the left parietal and feel the lung - left parietal connection.
5. Once you feel this connection, put your hands together in front of the navel and turn your eyes left and upward looking in and through the left parietal outside in the direction of Venus and the white galaxy.

6. Visualize a clear white ball above you. At a certain point the energy of Venus will shine down directly into the body; keep your attention and expand your awareness through Venus towards the white galaxy.

Do this transition of color from the strongest to the weakest function several times until the energy feels more balanced.

If the transition does not work, let the green light expand and project through the left parietal/Venus/white galaxy until you feel the white light clearly. Let the light shine on your skull and fill up the whole body and aura with this color.

Feel both liver/Jupiter/green galaxy and lung/Venus/white galaxy and balance them further into the body and the aural field.

7. To increase the effect, expand the energy in the respiratory system. Breathe through the skin of your whole body.
8. Gather the energy in the Lower Tan Tein, making a condensed Chi ball.
9. Circulate it through the MCO.
10. Then gather it again in the center and rest in the yin stage.
11. End with Chi Self Massage.

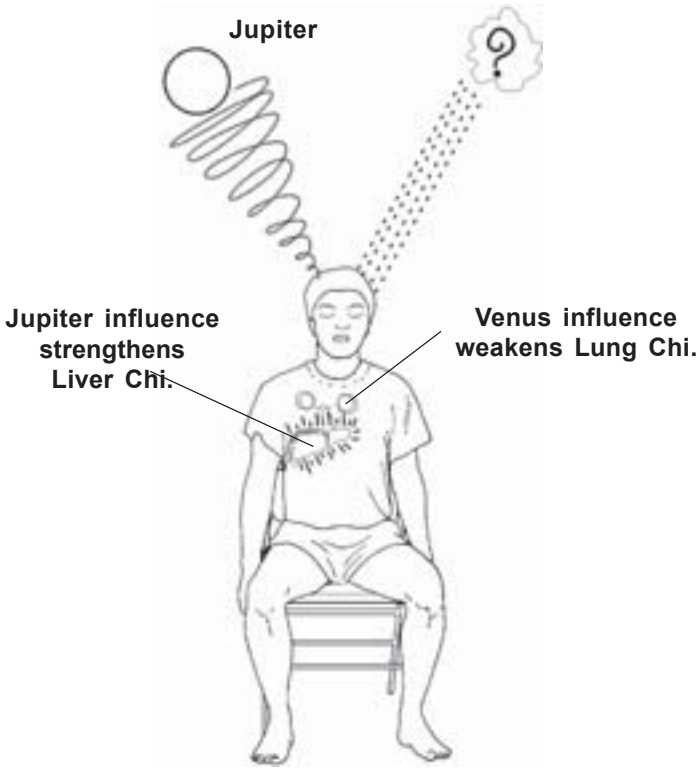

Fig. 11.20 *Balancing the energy.*

Fill the whole body and the aural field with the green light.

Maintain the energy field and bring it into the lungs. Change the color to white, let it radiate into the whole body and the aural field.

Balance the energies of Jupiter and Venus in the organs and aural field (green/white energy).

Look out through the left parietal and picture the planet Venus. At a certain point the light will come down from Venus (white galaxy) and start nurturing the energy field and the lungs.

Fig. 11.21 *Jupiter and Venus Energies*

Meditation 6
Balancing the Yin/Yang Extremes in the Star World

The immensity of the star world is difficult for the undeveloped human mind to grasp, yet is a part of the materialized world and in this way part of the world of polarity and yin and yang.

Although many scientists believe that black holes are built around a point of singularity (infinite density) it is clear that infinite density cannot exist. Infinity cannot be found within our limited thinking of the material world. Black holes are indeed points of extreme density but only to the point that extreme yin turns into its opposite. Extreme darkness starts to produce light again. So, although not yet measurable, light particles are still escaping from black holes.

Also the quasars, the brightest objects in the sky are not infinite light but extreme light, until the point turns to its opposite. Dark holes and quasars are the yin/yang extremes of the star world. In this meditation we will use these two poles to project our awareness beyond the world of phenomena.

It is important that you have taken sufficient time to master the first five meditations; only then can this advanced meditation be of great help in your spiritual development. If you are not prepared, it can be harmful. **We advise that you contact an experienced Cosmic Healing Teacher to introduce you into this level. If you suffer regular headaches, heart problems or mental/emotional problems don't do this Sixth Meditation. Use Meditation 1 and Meditation 7.**

These are the principles of this meditation:

1. Start with good centering/grounding.
2. Expand your awareness in the star world.
3. Connect high above you with the North Star and Big Dipper.
4. Let the light fill your Upper Tan Tien.
5. Connect with two points, placed around the North Star.
6. One extreme light point, quasar (extreme yang).
7. One extreme dark point, dark hole (extreme yin).
8. Let these two points circle around the North Star.
9. Let the process speed up and continue automatically while your attention goes in and through the North Star.
10. At a certain point the process can speed up so much that you start to feel a lifting and the edge between yin and yang start to fade away.
11. Let this process continue naturally, until yin and yang are melting together and the pure yang or ultimate yang energy arises.

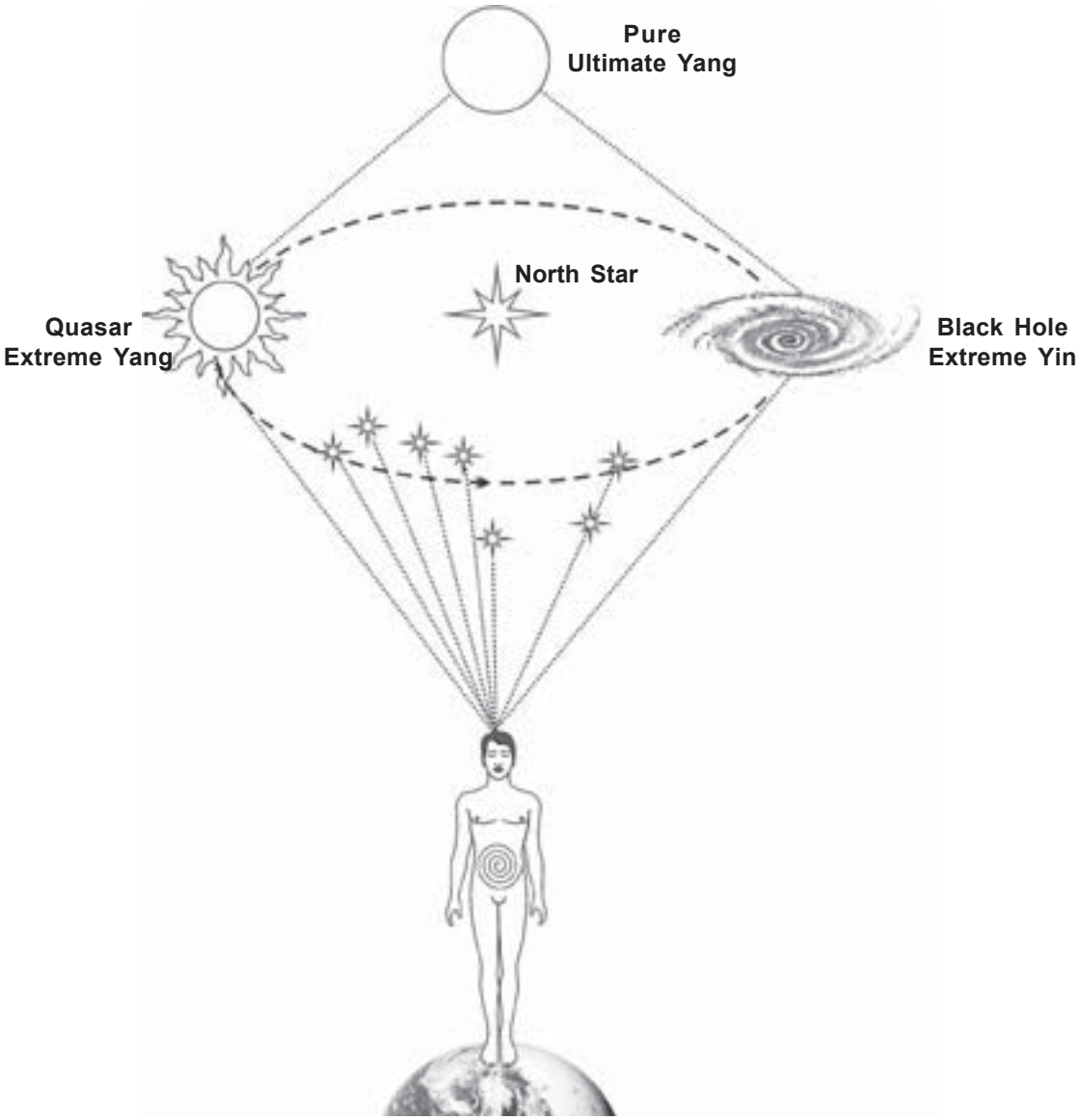

Fig. 11.22 *Connecting with Quasar and Black Hole*

Meditation 7
Yin Stage
Awareness Practice

In this meditation the intention is to let the planetary/galactic forces enter spontaneously. It is important not to use willpower or intention to attract any particular planet, just be open to the planetary/galactic forces, which is an unspecified intention. If you have read the previous parts of this book it will be clear that planetary/galactic forces are influencing us every second of our lives. The only choice we have is to be aware of it or not - the influence is there anyway. For each individual the dominant planetary/galactic influence changes many times in a day. When we sit still and empty the mind we can observe this subtle process of planetary/galaxy energies and shifts in our cranium, our organs and energy field.

During a yin (passive) stage meditation, you can pick up energy from different layers (or combinations) of the universe.

1. Nature Energies: Trees, lakes, Mountains, Thunder, Wind, Lightning, etc.
2. Planets
3. Individual Stars
4. Galaxies, Quasars, Pulsars, Black Holes
5. Connect with elemental qualities in common as Green Galaxy-Star-Jupiter-Tree Energy.

When you learn to observe this process you will be able to feel the direct influence of these planets/stars in that particular moment. It will give you the freedom to understand the specific Universal influence and how it determines your physical/energetic condition and your emotions/thinking process free from any astrological prediction. It also will clarify tensions or growing processes in relationships or with friends. If you and your partner or your friend are both practicing these meditations you can meditate together and see how the energy is naturally working on the two of you. It will definitely give you much insight and information.

This yin stage awareness meditation works very well in groups. Many different processes will be occurring at the same time. The planetary/star energies will:

1. Work on each individual.
2. Work on processes among several individuals.
3. Work on the whole group energy as a unit.

Experience shows us that even in big group meditations 50% to 80% of the people experience the same planets/galaxy entering their energetic fields.

The way to build up this meditation (alone or with more people) consists of:

1. Warming up exercises.
2. Opening the Three Tan Tiens to the Six Directions, integrate the Inner Smile and MCO.
3. Make a firm, condensed Chi ball in the center.
4. Connect to the Mother Earth Force.
5. Bring your attention to the cranium, feel the rhythm, expand the cranial rhythm into the aural field.
6. Connect to the energy field of the people you are meditating with.
7. Just relax and see what happens; if you want, you can softly say to the others what you feel happening in your body or cranium.

Individual and Triangle Awareness Meditation with Saturn Influence

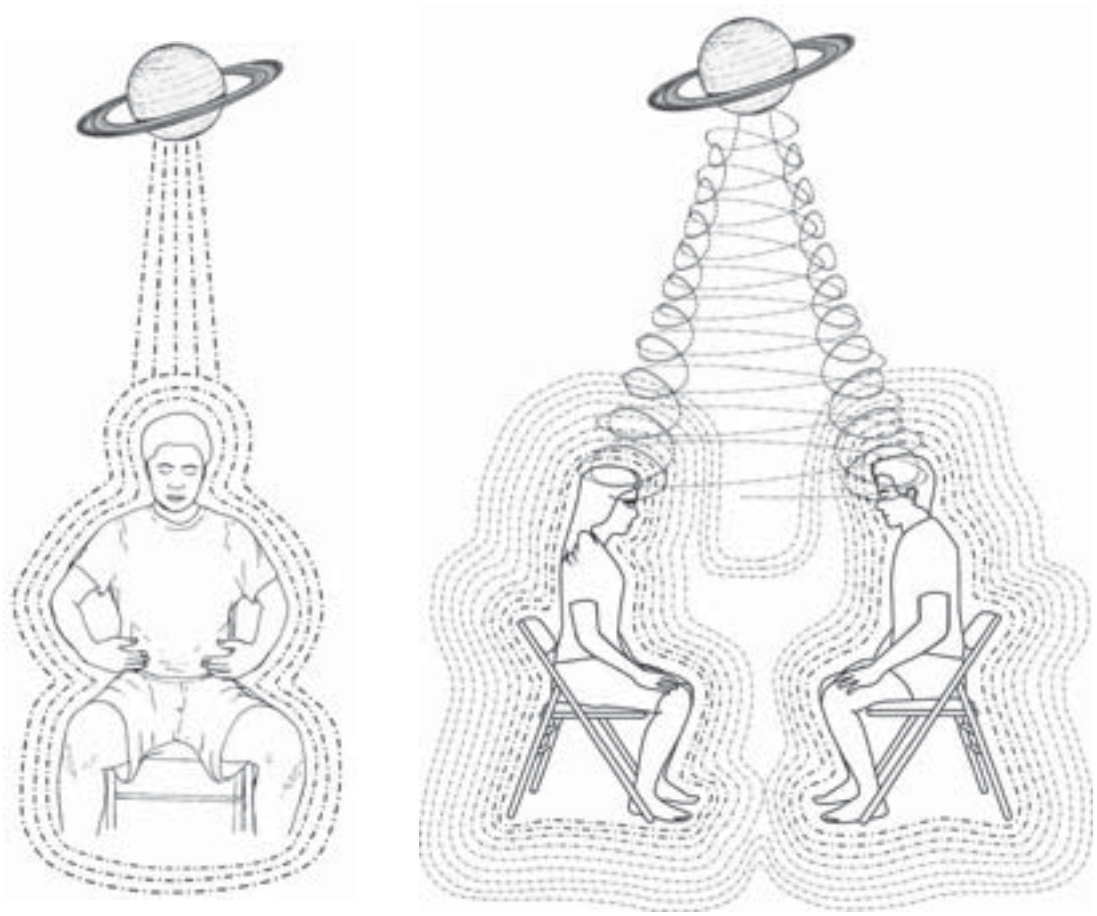

Fig. 11.23 Yin Stage Awareness Meditation - Saturn Influence

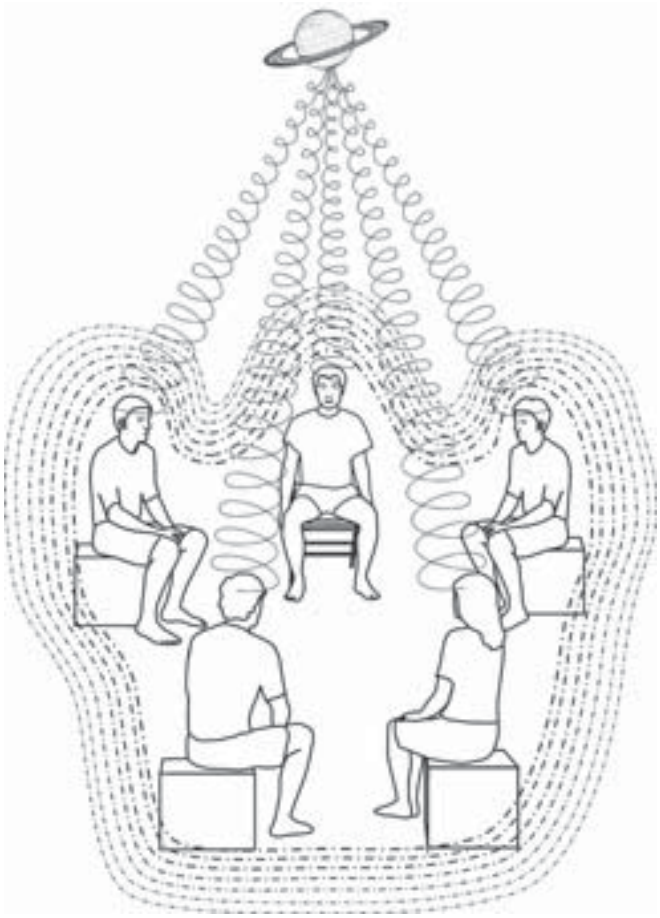

Fig. 11.24 Group Meditation: Yin Stage Meditation - Saturn Influence

8. At the end draw the energy back into your own individual field.
9. Gather into the Lower Tan Tein and make a condensed Chi ball.
10. Circulate throughout the MCO.
11. Then gather it again in the center and rest in the yin stage.
12. End with Chi Self Massage.

First, practice individually or, if you practice in a group, stay with your individual experience. After a while you will be able to distinguish your personal energy field and the shared or group energy field.

If you have difficulty feeling these energies, meditate with someone who has a better connection with the planets, but stay with your own experience.

Be patient, relax. You can be sure that your information/energy source will not run away.

Chapter XII
Use to Help Others

Treatment Expression of your Personal Practice

The therapeutic potential of the previously described practices is unlimited. It can be applied as an individual or self-healing method with great success, but it is also very easy to integrate it into healing and bodywork practices you are using already. This chapter explains some basic techniques on applying Cosmic Healing during a treatment (on one or more students). The complete theoretical and practical procedure on how to help and heal others will be published in the next book of the Cosmic Healing series.

The combination of the Universal Tao practices with Chi Nei Tsang (Internal Organ Chi Massage) is very powerful. Both methods have the same goal in the treatment: to balance the energies in the body and to activate the life force. Chi Nei Tsang uses the Lower Tan Tien as the main area of diagnosis and treatment. Imbalances in energy and tension in the Tan Tien will be treated with a firm physical pressure and with the three forces of the universe (earth, cosmic, universal) as the nurturing source.

In Cosmic Healing the emphasis is on connecting the body with the five elemental forces of nature, the planets and stars, often without touching the body.

We could say that Chi Nei Tsang works mainly from the Lower Tan Tien towards the universe while Cosmic Healing works from the universe towards the Lower Tan Tien.

The combination of these two systems will give you the ability to integrate internal/ external energy in the Lower Tan Tien.

Cosmic Healing: Starting form the universal laws and integrating it into the physical body.

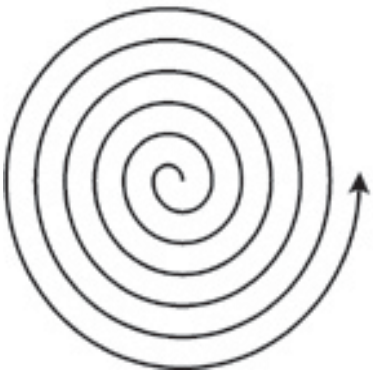

Chi Nei Tsang: Starting from the Lower Tan Tien and connecting with the Universal laws.From matter into subtle energy.

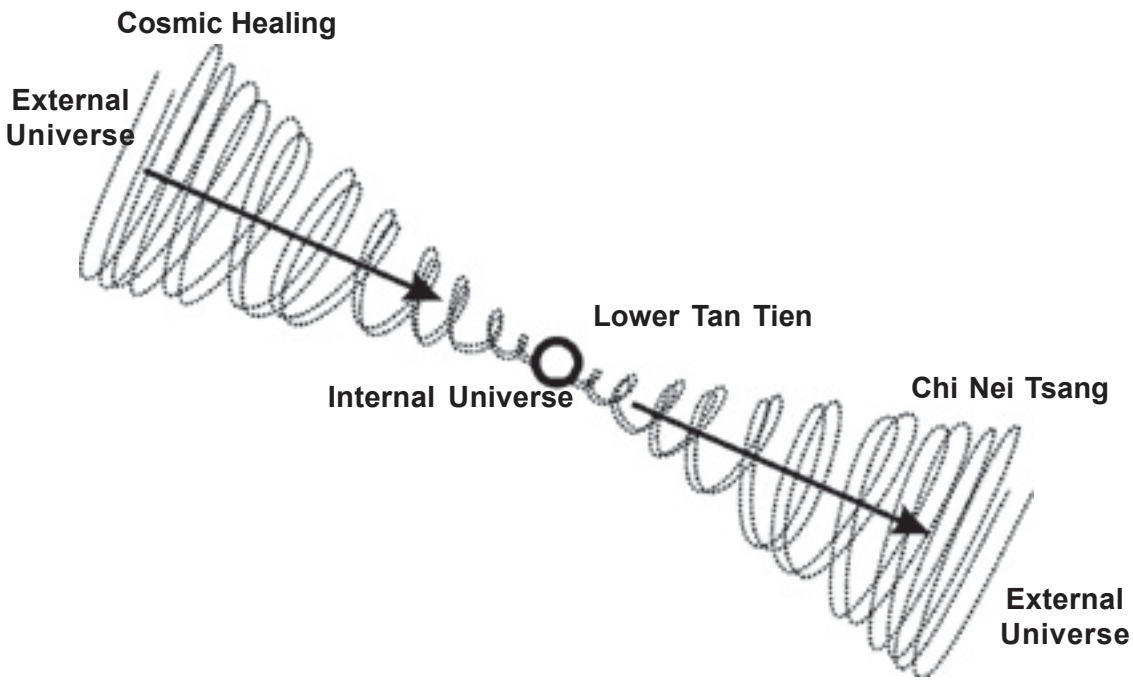

Fig. 12.1 *External and Internal Universes*

These days many healers are working consciously with the Universal connection from subtle energy into matter. Different systems are now in use. Some of them work with initiations to connect the student with the same universal source as the teacher or master.

This is the story of a student who was desperately looking for a teacher who could show him how to reach the state of enlightenment. He visited or followed many teachers, but he did not make much progress. None of them gave him satisfying answers to his main questions and most of them were still in search of enlightenment themselves.

One day he traveled to a master who was known to be fully enlightened. When he asked the master if he could show him how to attain enlightenment, the master said, “Sure,” and smiled at him. After a long silence the student said, “Well, why don’t you tell me?” The master said, “Why confuse you more by telling you something that you surely cannot understand anyway”.

This story shows us how useless it is to give initiations to people who are not ready to integrate and understand. It only creates confusion and illusion. Many students are trying to buy their ‘ticket’ to heaven by paying thousands of dollars for initiations with a master or guru.

Let us stay clear and grounded. There are no shortcuts on the spiritual path. Although spectacular healings occur through this practice it must be clear that the goal of the treatment is mainly one of guidance and teaching.

The purpose of planetary and galactic healing is to reconnect students with the energy of nature, planets, stars and the higher universal frequencies.

This connection:
- Activates the life force in the body which triggers the ability for self-healing.
- Releases and transforms sick/negative energy.
- Creates a strong spiritual connection and higher awareness level.

Although this healing practice is easy to learn for anyone with enough interest and perseverance, the effectiveness of a treatment mainly depends on the level of energy (quantity/quality), the clarity of the connection of the healer with nature and Universal forces and the ability to see what the student really needs at that moment.

This strength and sensitivity can only be cultivated by doing the previously described meditations on a regular basis and fully integrating them into your daily life.

General Healing Session

For reasons of clarity this text only mentions one person or student; this session may however be performed with a group also. Before starting this session do some meditation practice and warm ups with your student(s).
There are two ways of doing this type of healing session:

One way is to focus on the specific location in your own body, using your hands and asking the other person to do the same. Together you go through the complete healing procedure. Another way is to focus on your energy body and do the same step by step meditation. For details refer to the appropriate chapter.

1) Be aware of the Lower Tan Tien and connect to the universe. Let the student sit back on the chair. Sit across from the student. Be aware of your sacrum area and feel the Chi; transfer this feeling up to the crown and to the universe. Spiral the Chi down to the energy body and it will go down to the student's physical body.
2) Draw the green light in with your palm and push it right through the sacrum to spread the sickness through to the other side of the universe. Pull the green light from the universe and push the sick Chi out to the universe. Do this 6 to 9 times until you feel the sacrum is clean. When you pull back, stop the green Chi right at the student's sacrum; there is no need to pull it back to you.

   Yellow light from the ground will help strengthen the sacrum bone. Visualize the sacrum and vitalize the complete bone structure with yellow light.
3) Be aware of the energy body above the crown; extend yourself up from above your crown and channel down the white light from the center of the galaxy and the violet light

from the Polar star. Using your mind power, invite the inside of the bone to open, allowing the white and violet light to flow into the marrow. Focus on the energy body; you can picture the energy body's sacrum and bone structure to guide the energy inside and see the whole body light up from deep inside.

Next, focus on the Door of Life and the navel. First flush them through with green light, to clean them out. Draw the yellow light from the Door of Life through to the navel and then push back through. To cool down the Door of Life (if necessary), draw the blue light and push it through from the navel to the Ming Men connecting with the universe. Then bring the white or violet light down and activate the Lower Tan Tien. Teach people about their Lower Tan Tien. It is like an ocean and the body is like a hollow bamboo. The bamboo can bring the water up. This way energy will never dry up.

4) Concentrate on the solar plexus and T-11. Again, draw the green light in, spiral it, flush with the green light, then energize with white and violet light. As before, always allow the energy to stream through both points fully. When working on the solar plexus, which holds all the emotions, the most important thing to remember is to connect the backside of the solar plexus to the universe. There is literally no end to this connection. Just allow the Chi to come all the way down and pull a little. Simply clean out the path. Allow the information to condense, allow any images to form and be released. Then stabilize the energy. Picture the Chi field encompassing the person as a big protective bubble. Cool down with blue.
5) Proceed to the heart and the Shen Dao (T5/ T6). Draw the green light in and push it through; repeat several times; now scan the heart with your palm, judging its strength; next select the strength of the red color, (never too dark); send the red light through the heart, strengthening it.
6) Cool down any excess heat in the heart, flushing down and out, using blue. Draw in the white Chi; push it through to the Wing Point (T5/T6). Energize the center at the back of the heart using violet and golden Chi. Picture the heart surrounded by a golden aura.
7) Move up to the throat center, flushing through to C-7, using green light first. The throat center responds very well to the blue light; it opens and clears it.
8) Next activate the mideyebrow. Focus on the mideyebrow in your own body. Attract the golden yellow color and use it to flush and stabilize. Flush it all the way through to the back of the head. Energize with violet and golden light.
9) Proceed up to the third eye in the middle of the forehead. Connect to the 'Kun Lun' at the back of the crown. Flush through both points using the light violet light. Energize with electric white golden light.
10) Concentrate on the crown. Invite the violet golden light to enter and flush all the way down through the center channel, leaving the body at the perineum. Cool down the system by showering blue light over the whole body.

Du Mai Information

The co-author of this book Dirk Oellibrandt, together with his wife Katrien Laurens, leads an organization called Du Mai.

This organization is active in Belgium and has side branches in Holland, Sweden and France. The Du Mai philosophy promotes the practice of 4 Dimensional Life and Taoism and uses the Taoist principles in a complete approach of healing and the art of bodywork, called 4 Dimensional Bodywork.

The Du Mai organization offers possibilities in four different fields for deepening and improving the quality of your life and for reaching a higher level of health, happiness and awareness.

In the Du Mai therapeutic clinic many western bodywork techniques are combined with food prescriptions, herbs and other forms of therapy. All this is based on the unique Taoist view of the universe and is structured upon a treatment approach called 4 Dimensional Bodywork.

The Du Mai program is organized into three categories:

1. Personal development
2. Three to five years in therapeutic education
3. Courses of up to three years of training for professional therapists

An Overview of the Du Mai Course and Training Activities

Universal Tao Belgium

Evening, weekend and weekly courses that will teach you to heal yourself, understand your true nature and your task in life discovering vitality, happiness and freedom in daily life.

Basics: Inner Smile
Six Healing Sounds
Iron Shirt Chi Kung I
Chi Self Massage
Microcosmic Orbit
Tao Yin
Taoist Secrets of Love
Advanced Bone Marrow Nei Kung
Fusion I - II - III Inner Alchemy
Tai Chi Chi Kung I - II - III
Pushing Hands
Pakua Palm

Chi Nei Tsang
- Level I, II, III

Cosmic Healing
- Level I, II

4 Dimensional Life Training

1 year/12 weekends training in the art of 4-Dimensional awareness and understanding man, in the world, the universe and the intelligence that connects and governs all these processes called life.

Goals in this training are :

- Spiritual : awakening
- Mental : clearness and presence
- Emotional : understanding, using and transforming emotions
- Physical : building the fundament for a strong/vital/healthy body

Much time is invested in becoming aware through touch and bodywork of the different layers systems and frequencies in your body, so that the deep information and energy potential is awakened.

4 Dimensional Bodywork

A 3 year (500 hours) or 5 year (850 hours) training to became an all round healer/ bodyworker with a strong ground of 4 Dimensional self realization. The Du Mai school offers you a unique training according to quality and variety. Truly understanding life and its play in our manifestation as a human being is the fundament of the school. Within this unique view, a complete circle of all possible bodywork and healing techniques is offered. These techniques come from traditional and modern, eastern and western origin; or from shamanistic traditions, or Taoist cosmology or simply from our own body intelligence. The main guidance into this network of information is the students message and information system, showing us a constant flow in priorities in the treatment approach.

For already professional therapists and bodyworkers (prerequisites are 400 hours of training as a bodyworker/healer/natural therapist). We offer a 3 year training in 4 Dimensional Bodywork that will push your already achieved therapeutic level to a wider and stronger platform. Individual therapeutic limitations are removed and the circle of therapeutic possibilities is enlarged.

Some of the topics are (a specific personal development program for each year) :

- 4 Dimensional life/bodywork
- Natural healing - diagnostics
- Universal Tao: Basics, Iron Shirt I, Healing Love, Tai Chi I, Fusion I
- Chi Nei Tsang I
- Cosmic Healing I
- Chakra + Aura Healing
- Reflexology
- Shiatsu - Thai massage
- Craniosacral Therapy
- Osteopatic Techniques
- Fascia and Visceral Therapy
- Structural Corrections
- Sjamanistic Healing
- Food Prescriptions
- Frequency Healing
- Spiritual Healing
- 4 Dimensional Integration

In the near future, books on 4 Dimensional Life and 4 Dimensional Bodywork will be published. Please contact us for book availability.

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Cosmic Healing II

Taoist Cosmology and Universal Healing Connections

Mantak Chia

and Dirk Oellibrandt

Cosmic Healing II

Cosmic Healing II deepens the knowledge & experience of Cosmic Healing I. In Cosmic Healing II the emphasis is on connecting the body with the five elemental forces of nature, the moon and sun, the planets, the stars, galaxies and other celestial phenomena. This is a continuation of Mantak Chia's Universal Tao System and co-author Dirk Oellibrandt's Du Mai System for personal improvement.

Taoist Astrology and Astronomy

The authors reveal not only the esoteric information, but more significantly they unveil the step-by-step practices both physical and meditative for healing oneself and others. Cosmic Healing II incorporates ancient Taoist knowledge and practices based on Taoist astronomy observations and cosmological research. Modern Taoists Master Mantak Chia and Dirk Oellibrandt expand on this millennia-tested material with their practical experience and expertise. Whether you are interested in building on your base of Chi Kung and meditation or whether you are bodyworker desiring to make giant strides in your treatments you'll find within Cosmic Healing II the substance for growth.

Techniques for Planetary and Galaxy Stellar Meditations

The inner universe & outer universe become even more connected through planetary/galaxy stellar meditations. You'll learn how to integrate Taoist Astrology and Astronomy with your healing practices so as to support others in a deeply rooted cleansing revitalization. Cosmic Healing II teaches people how to take full charge of their health and well-being.

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Smiling Heals the Body

Mantak Chia

Cosmic Inner Smile

Smiling Heals the Body

Mantak Chia

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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Virtues and Transforming Stress

“Heart of the Universal Tao Practices”

The quality of our internal energy is just as important to our health and spiritual development as the quantity. As we increase our internal energy flow and accumulate a surplus of Chi, we must emphasize spiritual development to maintain balance in our daily lives. In essence, our spiritual qualities are our positive attributes, or what the Taoist call “virtues”. Our virtues have the nature of wisdom and love. They are wise because they reflect our interdependence with the Tao, with nature, with all life, and with the different parts of our own body. We cannot exhibit the virtues except in relation to each other. The virtues are also wise since they express love: the attitude that strengthens the positive bonds connecting everything in the universe.

We need food to sustain our lives. Physically, we need material food, but we also must nourish other, subtler bodies within us. They are the soul and spirit bodies. The energy of our virtues, the universe, the stars, and planets provide a source of spiritual food. Although we are trained to depend on our religious beliefs to give us this nourishment, spiritual food is actually all around us. We need to learn how to absorb and digest this. The Universal Tao offers the means by which we can access these energies to cultivate the soul and spirit and to enhance our total being,

Taoism recognizes both the development of the virtues’ energies and the cultivation of life force to create the soul and spirit bodies as important aspects of spiritual growth. These approaches are related, because retaining and recycling internal energy into life force can help to open and still our minds/hearts, bringing forth inner joy, happiness, and love and other virtues.

When combined, these give birth to the subtler bodies of energy and spirit.

Taoists believe that we are born with the virtue qualities of love, gentleness, kindness, respect, honesty, fairness. justice, and righteousness.

When we are abundant with virtues, our life force flows smoothly and efficiently. If we neglect to cultivate the virtues, however, we run the risk of channeling our accumulated energies directly into our negative emotions, amplifying any negative or neurotic tendencies we may have.

Actually, there is nothing wrong with these negative emotions as long as we recognize them and known how to transform them, so they will not block the energy in the organs. It is necessary to find a balance and to learn to acknowledge the totality of ourselves, both the light and the dark sides.

Our society is known for its fast pace, its stressful conditions, and its inability to handle the tons of garbage it produces daily. This includes not only trash from our homes, but also the emotional garbage produced within our bodies. Under the influence of this stressful society, our virtues gradually diminish, and negative emotions such as anger, fear, worry, and impatience will arise. These weaken the virtues, gradually forcing people to survive on low-grade, negative energies. These symptoms manifest, at their extremes, as sickness, disease, social disorders, and violence.

To regain the virtues, we must first become aware of and transform our negative emotions into useful energy. Normally, these emotions are thrown out as garbage, polluting each other and society with useless energy. Like garbage, negative emotions can cause a great deal of damage to both our internal and external environment.

Just as we can transform garbage into compost and use it as fertilizer for our gardens, we can transform negative emotions, which will always come up, into the fertile ground to grow our positive virtues. If we don't compost, these emotions will have harmful effects on the internal organs and glands and may drain our life force, causing our bodies to function on less energy and at a lower vibration. Medical science acknowledges that the presence of negative emotions can wear down the body's resistance before any clinical evidence of disease exists.

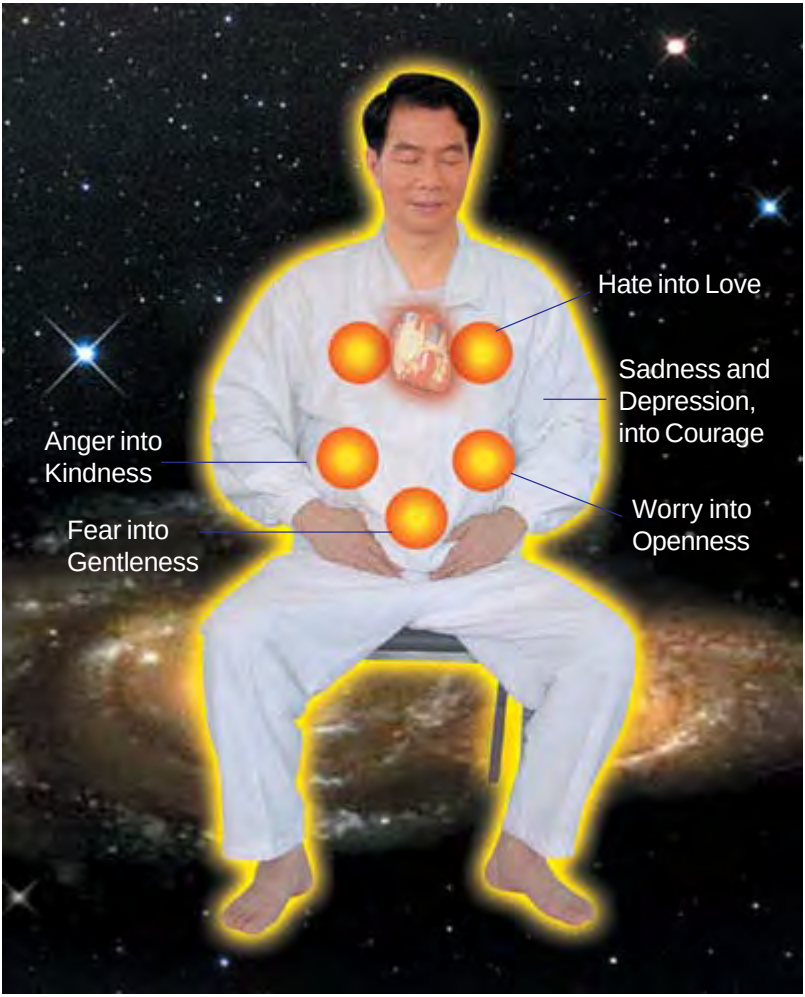

Fig. 1 *Transform Negative Energy into Positive Energy.*

Taoists believe that emotions originate from the organs. Once you can differentiate between and become aware of the different kinds of emotional energy that reside in the organs, you can deal with them more easily. You must observe what outside influences triggers their appearance. This means noticing, for example, how another person's negative emotion triggers anger or sadness in you. Once you have this awareness, you can transfer these emotions into positive life force for yourself. Don't permit them to accumulate in your organs as negative emotional energy to trouble you. By building up a lot of positive life force, you will be able to transform your own "garbage" energy better.

Fig. 2 *Connect the organs and their elements.*

Compassion is the fusion of all other virtues together into their purest expression. It is the highest virtue and the most beneficial energy to share with others. To attain compassion, one must first recycle negative emotional energies to restore and increase the life force. This, in turn, will nourish the positive energies of each organ so that each organ can produce its respective virtue in abundance. Excess virtue energy can be channeled for the benefit of other people. If one tries to practice compassion without transforming the negative emotions and reestablishing the virtue energies, there will be little to offer anyone.

Fig. 3 *Cauldron of the Compassionate Heart*

Compassion is the highest expression of human emotion and virtuous energy. It is a level of development that takes hard work and serious meditation before it can blossom in one's life. It is not a single virtue, but the distillation and culmination of all virtues, expressed at any given moment as a blend of fairness, kindness, gentleness, honesty, respect, courage and love. It is the most beneficial energy to share with others. The power to express any or all of these virtues at the appropriate moment indicates that a person has internally unified him or herself into a state of compassion.

The heart is like a cauldron that can be used to combine all the virtues into the energy of compassion, the ultimate virtue and a necessary attribute for our spiritual being. The basis of compassion is empathy, not sympathy (a weakness people show when the emotions of others easily affect them). It elevates the consciousness beyond human weakness. With compassion, one can love unconditionally and thereby accept the world on its own terms without suffering.

When studying the virtues, we must examine love as a category in itself to better understand its energetic influences. The Taoists view love as an internal energy of the heart rather than as a product of the mind. Although we generally think of love as a positive force, what we commonly call love can actually evoke more negativity in our lives than all the other negative energies combined. For example, we know that extreme love can quickly turn to hate of the most bitter and violent kind.

Fig. 4 *Compassionate Heart*

The misunderstanding of love can also create a vehicle that allows our negative emotions to drain our life force away in the form of self-sacrifice. While our personal supply of energy is limited, the loving energy of the universe is inexhaustible. When we know how to connect to this wellspring, we will always have enough love for ourselves and for others. Yet, if we don't learn how to tap into the higher force to enhance and replenish our supply, we often end up giving away more than we can afford. Eventually this can cause us to drain out our sexual energy and burn out the love in our hearts. We expect love in a personal way from those who are close to us, and in a spiritual way from those who become our role models. Yet the words and actions of others almost never fulfill our needs. The question of what love is, has puzzled men and women for centuries. The answer can only be found within ourselves.

A major problem (in our modern world) is that we always look outside ourselves to fulfill our needs without realizing that others seek fulfillment in the same way. Out of habit, we all seek love externally without nurturing our own source of that energy within us. This leaves us with little to give. Logically, if others are also seeking love, they expect us to have enough loving energy to fulfill them. If we don't cultivate love within ourselves, however, we can drain their energies until the relationship comes to an end. Success in any relationship depends on the ability of all the parties to share in an abundance of love that originates from both sources. Once we are full of love and life force, we can connect to the unlimited loving energy in the universe and share it abundantly with others.

Taoists say we cannot really love others until we can love ourselves. The stress of giving away freely what we don't have enough of can create blockages in the Microcosmic Orbit and can also block the unconditional love from Heaven and Earth.

Because loving energy is accessible from within, we can resolve our primary need for love by using this energy first to replenish the internal organs and glands. Practices such as the Inner Smile help us achieve this.

While learning self-love, one should remember that even the loving energy within us derives from the Original Force of the Wu Chi. This means that the heart's energy (where the loving energy resides) provides a connection to our divine source: Universal Love. The connection between inner and outer sources requires constant attention and alignment. We first have to cultivate love within ourselves to have the power to draw in unconditional love from Heaven, and gentleness and kindness from Mother Earth.

In Taoism, it is believed that each organ has its own soul and spirit energy. By practicing love and respect to cultivate these aspects of the organs, the whole body improves and one learns to love the body as a whole. After learning self-love (which is not to be confused with egoism or narcissism) and connecting with the Universal love, one becomes filled with loving energy to share with others. Practice is the key.

The Universal Tao system emphasizes this recycling, transforming, and refining of internal and external Chi and of our emotional energy in particular.

With the practice of the Inner Smile, we learn to detoxify the organs and let the virtue energy grow again. Transforming our internal energy in this way will also promote a higher vibratory rate and enhance our spiritual growth.

Fig. 5 *Cosmic Inner Smile*

Practice of the Inner Smile Meditation

The Inner Smile is a powerful internal healing and relaxation meditation. Deep relaxation dissolves physical and mental tensions that can cause energy blockages and unhealthy Chi. The Inner Smile enhances the energy of the organs and glands, our life force in general, and stills and focuses the heart/mind (hsien). It makes us more aware of our body and inner being, because we learn to communicate with our organs, glands, spine and other specific parts of our body, as well as our soul. Taoists discovered that consciousness is rooted not only in the brain alone, but also in the vital organs and in the more subtle sense in each of the cells.

By smiling to the organs and thanking them for the work they do, eventually we will reawaken the intelligence of the body. We are often so out of touch with our bodies and emotions that we do not notice inner disharmony developing until it finally manifests itself as a serious illness. Practicing the Inner Smile daily provides a regular scheduled time to look inside, to keep in touch with the state of our inner organs, our Chi, our breath and emotions. We can then spot problems at their inception, making it easier to 'nip them in the bud'.

Low self-esteem is becoming endemic. With the Inner Smile, we start to develop a healthy, loving relationship with ourselves and with others. We start to recognize our own positive qualities. With regular practice, we get to know ourselves as we really are; we will discover our virtues. This will help us form a more authentic and healthier self-image, one that can stay in close contact with reality. The Inner Smile trains our ability to love and relax our own body and soul. If we learn to love and accept ourselves the way we are, it becomes easier and more natural for us to extend this love outward and to love and accept other people as well.

The Inner Smile is indispensable for our rooting practice of Iron Shirt Chi Kung and Tai Chi Chi Kung. If we have a lot of negative emotions, the energy will rise to the upper part of the body and our center of gravity will move up as well and disconnect us from the earth. We will feel unstable, out of balance, and moody. The Inner Smile practice (and the Six Healing Sounds) transforms our negative emotions and relaxes the body and the mind. This deep relaxation will bring the center of gravity back to our Tan Tien, where we can develop our inner power which will keep us centered, rooted, and stable in our practice and in daily life.

Always start the Inner Smile with the rocking exercise. Rock your spine from your sitting bones and sacrum to the sides. Smile into the spine and rock each vertebra, from the base of the spine all the way up to the skull. Feel the spine relaxed and warm, glowing with a golden light.

Next rock your spine back and forth, slightly nodding your head. Picture yourself as a hollow piece of bamboo. (When you nod your head your head has a connection with the lumbar area).

After you finish the rocking, smile down from the top of the spine all the way down to the bottom and then from the bottom all the way up again.

Rocking the spine and smiling into the spine is a very important practice because it relaxes the spine and the nervous system. People who want lo calm down, must first relax the spine. When the spine is tense and stiff, there is no way to calm down.

1. The well-known “Three Lines Inner Smile”, which you will find in the books *Taoist Way to Transform Stress into Vitality* and *in Awaken Universal Light.*

2. The “Energizing Inner Smile”.

3. The Inner Smile that emphasizes relaxation, balancing the emotions and transform them into compassion energy.

The second and third versions of the Inner Smile both use the creation cycle of the five energy phases, corresponding with the five vital organs.

Three Lines Inner Smile

A. Smiling Down to the Organs: the Front Line

1. **Mideyebrow point and eyes**: Relax your forehead, and be aware of smiling energy gathering before your eyes as golden light. Imagine the feelings you would have upon entering a beautiful garden. As you hold that feeling, project an image of your own smiling face in front of you. Feel that smiling energy shining like the sun. Spiral this radiant energy at the point between your eyebrows, drawing it in through that point and through your closed eyes to stimulate the pituitary gland.

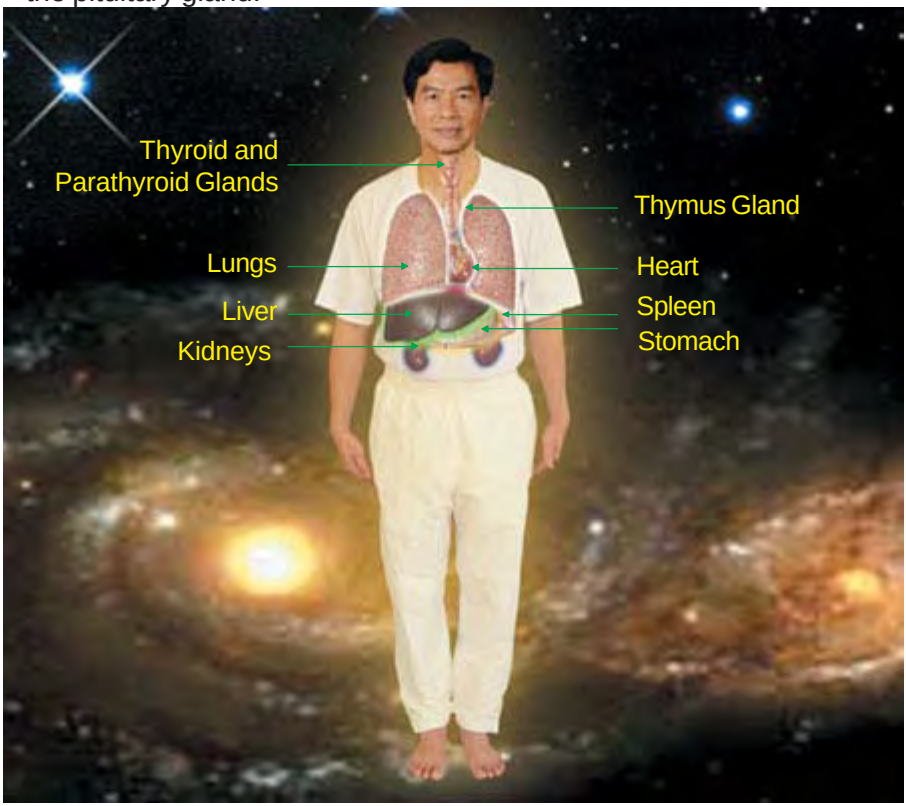

Fig. 6 *Smiling Down the Front Line.*

2. **Face**: Continue to draw smiling energy into the mideyebrow point; feel the mideye expanding. Let the Chi flow into your nose and cheeks. Feel it relaxes your skin and muscles and warms your entire face. Let the smile flow into your mouth, gently lifting its outer corners. Feel the smiling energy flow into the tongue, and move the tongue around to activate the flow of saliva. When you feel the saliva is abundant, swallow it. Touch the tongue to the roof of the mouth, and leave it there for the rest of the practice (this action connects the Governor and Functional channels, which are the two major energy pathways of the body). Swallow the saliva down toward the thymus and the heart, drawing the energy further downwards. Feel the smiling energy flow into the jaws, releasing any tension there. Slightly open your mouth to separate the teeth while pressing the tongue against the palate.

3. **Neck and throat**: Smile down into your neck and throat, allowing your neck to sink down slightly to rest from holding your head. Smile into the thyroid and parathyroid glands, located in the front part of the neck. Feel the throat open like a flower blossoming as the energy releases any tension.

4. **Throat and sternum**: When a lot of saliva is produced, swallow it down toward the organs you are smiling at. Let the smiling energy flow into your thymus gland, located between the throat and sternum. Feel it expand as it radiates the warm, fragrant, smiling energy down into the heart

5. **Heart**: The heart is approximately the size of a fist and is located behind the sternum, slightly left of the center. Smile to your heart and thank it for circulating blood throughout your body. Feel it relax as its workload becomes lighter. Let the smiling energy fill your heart with love as impatience and hastiness are transformed into joy and respect. Love, joy, respect, and ultimately compassion all arise from the heart. Feel these virtues radiate to the organs, glands, and the entire body.

6. **Lungs**: Smile into every cell of your lungs as you thank them for supplying oxygen to the body and releasing carbon dioxide. Feel them soften and become more spongy and moist as they expand

with smiling energy. Feel the virtues of the heart (love and joy) enhance the smiling energy in the lungs as it transforms any sadness and depression into righteousness and courage.

7. **Liver**: Smile into your liver, which is located on the bottom right side of the rib cage. Thank the liver for its role in digesting, processing, storing, and releasing nutrients, and in removing any toxic substances. Feel it soften and increase its moisture. Let the smiling energy, enhanced by the virtues of the heart and lungs (love, joy, righteousness, courage) transform any anger held by the liver into kindness.

8. **Pancreas and spleen**: Smile into your pancreas at the bottom left side of the rib cage. Thank it for producing insulin to regulate your blood sugar level and enzymes for digestion. Smile into your spleen, located behind the pancreas at the same level on the left side. Thank it for producing antibodies to fight diseases. As you smile into your spleen and pancreas, feel any worries they hold become transformed into fairness by the smiling energy enhanced by the virtues of the heart, lungs, and liver.

9. **Kidneys**: Bring the smiling energy into your kidneys, located at the lower back on both sides of the spine, inside the lower part of your rib cage. Thank them for filtering the blood, eliminating waste products, and maintaining the water balance in the body. Feel them grow cooler, fresher, and cleaner. Smile into your adrenal glands, on top of your kidneys; these produce adrenaline and several other hormones. Feel any fears become transformed into the virtue of gentleness by the smiling energy and all of the other virtues collected thus far.

10. **Genitals**: Bring the smiling energy down to the genital area in the lower abdomen. Women: The female genitals are known as the “Ovarian Palace,” and it is located about three inches below the navel, midway between the ovaries. Smile and spiral the accumulated energies into the ovaries, the uterus, and the vagina. Thank the ovaries for making hormones and giving you sexual energy. Bring the combined sexual, smiling, and virtue energies up to the navel, and spiral at that point.

Men: The male genital area is known as the “Sperm Palace.” and it is located one and a half inches above the base of the penis in the area of the prostate gland and seminal vesicles. Smile and spiral the accumulated energies down to the prostate gland and the testicles.

Thank them for making hormones and giving you sexual energy. Bring the combined sexual, smiling, and virtue energies up to the navel, and spiral at that point.

Note: When returning energies to the navel for storage, mentally create a spiraling motion to centralize and keep them there. The vortex created draws in energy like a vacuum.

11. **Eyes**: Return your attention to your eyes. Quickly smile down into the organs in the front line, checking each for any remaining tension. Smile into any tension until it is released.

B. Smiling Down the Digestive Tract: the Middle Line

1. **Stomach**: Once again become aware of the smiling energy in your eyes and the mideyebrow, and allow this energy to flow down into your mouth. Become aware of your tongue, and swish it around to produce saliva. Place your tongue against the roof of your mouth, tighten the neck muscles, and swallow the saliva hard and fast, making a gulping sound. With your Inner Smile, follow the saliva down the esophagus to the stomach, located below the left side of the rib cage.Thank the stomach for digesting your food, and feel it relax as the energy flows into it.

2. **Small intestine**: Smile into the small intestine in the middle of the upper abdomen. Thank it for absorbing nutrients.

3. **Large intestine**: Smile into the large intestine, which encircles the small intestine from above and on both sides, and the rectum. Thank the large intestine for eliminating wastes.

4. **Bladder and urethra**: Bring the smiling energy back up into the bladder, just behind the pubic bone, and into the urethra. Thank these organs for holding and releasing urine.

5. **Eyes**: Return your attention to your eyes. Quickly smile down the middle, checking each area for any remaining tension. Smile into the tension until it melts away.

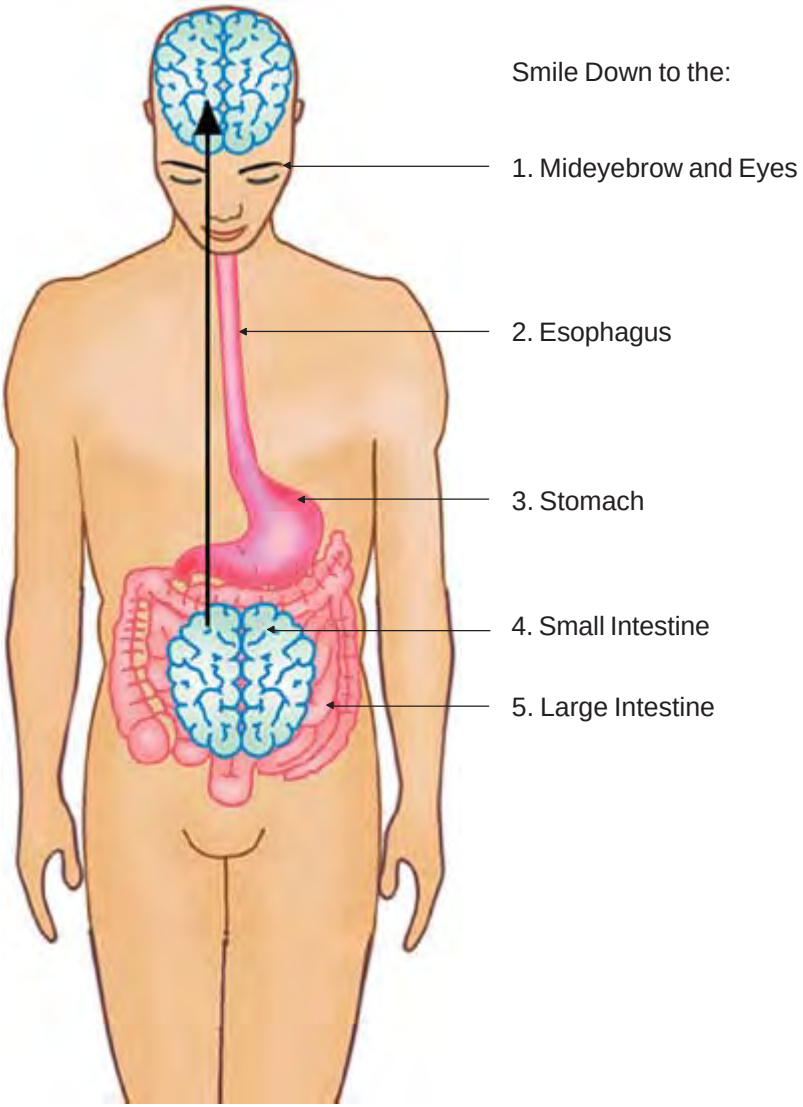

Fig. 7 *Smile Down Middle Line, the Digestive Tract.*

C. Smiling Down the Spine: the Back Line

1. **Eyes**: Bring your attention back to your eyes again and draw more energy into them and the mideyebrow.

2. **Glands in the brain**: Activate the saliva, and swallow as you push the tongue upwards, directing the energy flow into the brain. Draw smiling energy in through the eyes and mideyebrow.

Smile into the pituitary gland, three or four inches behind the mideyebrow. Feel it blossom. Smile into the thalamus gland, which is located directly above the spinal cord, slightly behind and above the pituitary gland and the hypothalamus, which is located in the bottom of the third ventricle room. Smile into the pineal gland under the crown point. Feel these glands swell and grow. Smile into the left and the right hemispheres of the brain to balance and nourish them.

3. **Spinal Column**: Smile into the midbrain and cerebellum and the first cervical vertebra at the base of the skull. Bring the loving energy down through all of the vertebrae to the base of the spine. (Vertebrae: seven cervical, twelve thoracic, five lumbar; base of the spine: sacrum, and coccyx).The disks beneath each vertebra soften as the spine expands and elongates. Your back should feel loose and comfortable.

4. **Back Line**: Return your attention to your eyes, and quickly smile down the entire back line. This exercise greatly increases the flow of spinal fluid and calms the nervous system. Your whole body should feel relaxed.

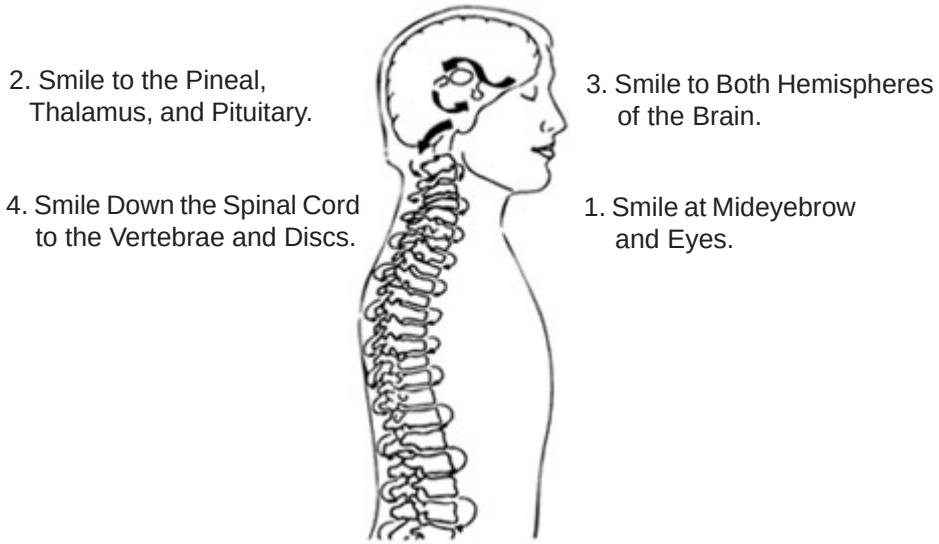

Fig. 8 *Smile Down the Back Line.*

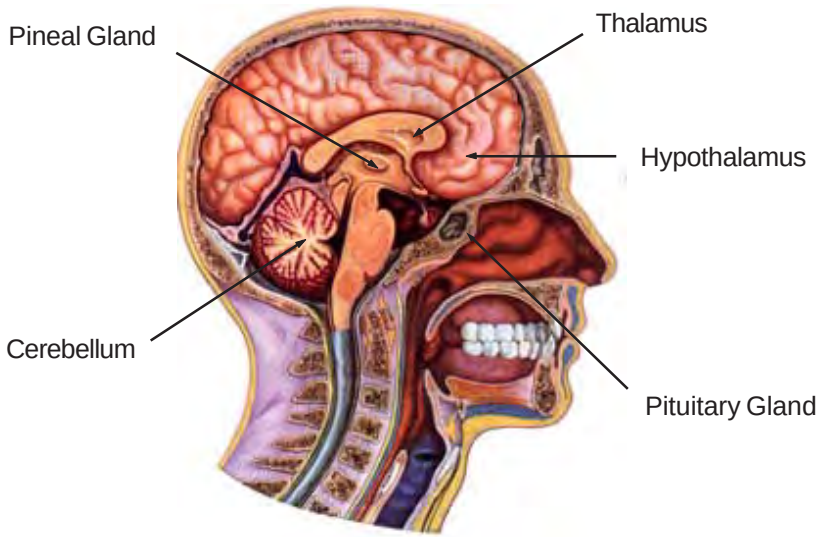

Fig. 9 *Smile into Brain.*

D. Smiling Down the Length of the Entire Body

Entire body: Start at the eyes again, and direct the Inner Smile quickly down the front, middle, and back lines. If you are experienced with this practice, smile down all three lines simultaneously while remaining aware of the organs and spine. Feel the energy descend the entire length of your body like a waterfall of love and peace. Feel the muscles, skin and bones relax as your whole body unwinds.

E. Collecting and Storing Energy at the Navel

To end the practice, it is very important to store the accumulated energies at the navel. Too much Chi remaining in the head or heart causes most of the ill effects of meditation. Drawing this energy into the navel for safe storage can prevent such problems. To collect the energy concentrate on your navel area about one and a half inches inside your body. Then mentally spiral the energy, moving further outwards with each spiral until you complete 36 cycles. Do not go above the diaphragm or below the pubic bone as you expand outward (At first, you may guide the spirals with your forefinger). Finally, spiral back into the navel for 24 cycles.

Men: Cover the navel with both palms left over right. Start spiraling down toward the right side (clockwise) 36 times.

Women: Cover the navel with both palms, right over left. Start spiraling down toward the left side (counterclockwise) 36 times.

Men and Women: Next, reverse directions, and spiral back into the navel 24 times (Men spiral counterclockwise; women spiral clockwise). Move closer to the navel with each cycle. You have now completed the Inner Smile and should feel an increase in your Chi flow.

Energizing Inner Smile

We start to smile into the bladder, the uterus, the ovaries, the testicles and the prostate gland, because it creates a lot of energy.

Slightly rock yourself.

Smile into the bladder, the uterus and the ovaries, the prostate gland and the testicles. Picture these organs and connect with them. Feel they are connected with the brain and that their energy rises up through the spine to nourish the brain. Picture a big blue ocean and a fire under this ocean. See a beautiful blue light evaporate from the ocean.

Smile to the kidneys. Smile this blue light in the bladder, uterus/ovaries, or prostate and testicles, and the kidneys, bringing stillness into the kidneys. Feel these organs expanding with blue light. Let this blue light, with its gentleness and calmness, extend into the whole body, especially into the liver. Feel it energize the liver.

Smile into the liver. Picture your liver and connect with it. See the sun shine in the forest. See the green light. Smile this green Universal light and kindness into the liver. Feel the liver expanding with the green light. Let it radiate out to all the organs, especially to the heart. Feel the green light energizing the heart.

Smile into the heart. Picture the heart and connect with it. Be aware of the red light, a sunset on the ocean producing a red light. Smile this red light into the heart with love, patience, and inner joy. Feel the heart expanding with red light and love. Let it radiate out from the heart into the whole body, especially into the stomach,spleen. and pancreas. Feel the red light energizing these organs.

Smile into the stomach, spleen, and pancreas. Picture and connect with them. See the beautiful filtered rays of sunshine of Indian Summer full of balance and harmony, a golden light. Smile this golden light into the stomach, spleen, and pancreas. Feel calm, serene, and centered. Let this golden light radiate out into the whole body, especially into the lungs. Feel the golden yellow light energizing the lungs.

Fig. 10 *Collect the Energy by Spiraling.*

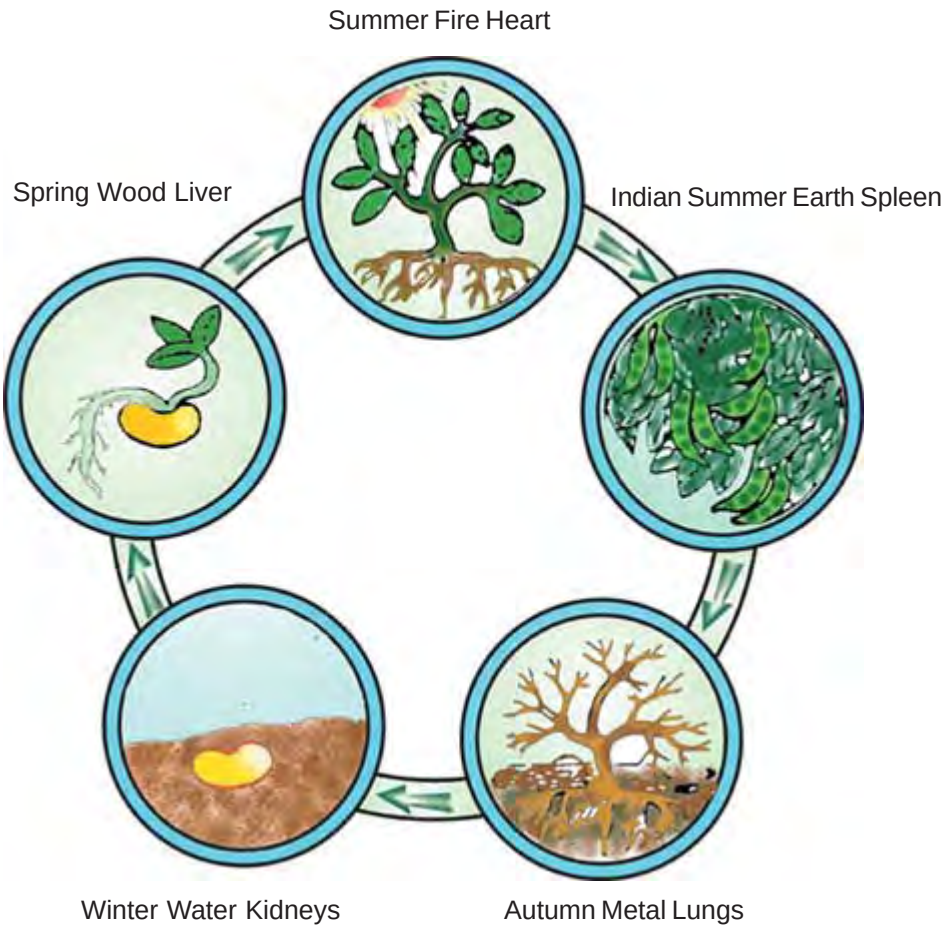

Fig. 11 *Creation Cycle*

Smile into the lungs. Picture and connect with them. See and smell the fresh, pure white light of the high mountains. Smile this light into the lungs, the nose, the skin, and the large intestines. Let it radiate out into the whole body, especially into the kidneys.

Do two more rounds of this cycle of the Inner Smile. Then gather the smiling energy in the bladder, the uterus or the prostate gland and let this energy rise through the spine to the brain. Hold the energy there. Feel how this smiling energy energizes the brain, the spine, the nerves, and all the organs and glands and that the muscles are connected with these nerves. Rest. Concentrate on the energy in the brain and the spine. Feel the energy in the brain and the awareness expanding.

Inner Smile that Relaxes and Balances the Emotions

We generally start with the heart, because the heart creates a lot of strong emotions, especially love and hate. When you start to smile to the heart, sometimes hate or impatience will come up. If you can continue to smile to the heart you will feel that the inner joy, love and happiness will start to grow in your heart very easily. If people cannot feel love, inner joy, and happiness, nothing will be able to make them feel happy.

There is nothing wrong with negative emotions, as long as you recognize them and know how to transform them. This will prevent the energy sticking in the organs. You have to find a balance.

Emotions like hate, anger, impatience, fear will always come up. You have to watch, be aware of them and work with them constantly so that they will not grow too much and start to block the energy in the organs and other parts of the body.

When you continue with the Inner Smile, the Six Healing Sounds and the growth of the virtue energy/pure light in the organs, eventually no more space will be left for these negative energies (emotions) to grow in the organs.

Rock yourself gently, especially your spine.

Practice

Smile into your heart. Feel the love, inner joy, and happiness in your heart and expand this love and happiness into the universe and let it multiply. Continue expanding unconditional love, inner joy, and happiness from the heart into the universe and feel that it is coming back multiplied, into the heart with the red light. Let the light from the heart shine into every single organ of the body like sunshine. If any hate comes up keep on smiling and sending love and happiness to this feeling of hate and eventually it will change into loving, happy energy as well.

Smile down to the stomach, the spleen, and pancreas. See any worry inside them. Inhale the yellow golden light, the feeling of openness, fairness of the earth power, harmony, and centeredness. Accept your worries, balancing them with the virtues of openness, fairness, and centeredness.

Smile to the lungs. See any sadness inside them. Inhale the pure, white light, the courage of the metal power. Accept the sadness, and balance it with courage.

Smile down to the kidneys and the bladder. See any fear inside them. Let the sun shine on the ocean, a blue light. Inhale this blue light and the gentleness and stillness of the water power. Accept the fear. and balance it with this gentleness and stillness.

Smile into the liver. See any anger, resentment, and frustration in the liver. Let the sun shine on the forest producing a green light. Inhale this green light and the kindness and generosity of the wood power. Accept the anger, and balance it with kindness and generosity.

Do two more rounds of this Inner Smile, relaxing and balancing the emotions and eventually transforming the “negative emotions” into virtue energy.

Inner Smile Applications

Here are some examples of how the Inner Smile supports other practices in the Universal Tao System's series of self-healing techniques.

Tao Yin

The Lotus Meditation is wonderfully calming but is complete only with the interior 'posture' or interior attitude cultivated by daily use of the Cosmic Inner Smile.

Fig. 12 *The Inner Smile helps the Dragon Stretch his Tail and Claws in Tao Yin.*

The Lotus Meditation is especially applicable to the Tao Yin movements. Because of the emphasis on working with the whole spine and the powerful psoas muscles the practitioner sends grateful attention from the heart down the spine to the kidneys.

The Lotus meditation can be used during Tao Yin practice, and is especially useful during the rest periods between the movements. You can use the Lotus Meditation in any rest period. Choose the places that best suit you.

This meditation helps to achieve the balance of kidney and heart energy which is a vital part of self-healing. The balanced flow of water and fire energy will greatly help to transform the accumulated stress in the mind and body into a sense of well-being.

Here's the Lotus Meditation for your deep enjoyment.

Lotus Meditation

Imagine the heart as a red lotus flower and the pericardium (the heat-regulating membrane which encloses the heart) as the lotus pads. Visualize the kidneys as being bulbs, similar to the clusters or plexuses where the stems of the pads and the lotus flower join together. In a pond or pool there are usually several lotus plants that join together in a cluster, anchoring in the mud. From the kidneys (kidney bulbs/clusters), visualize roots extending down through the legs into the watery mud of the earth basin.

Through this merging of the body and the lotus in nature, sense these qualities of energy in your body. Feel the supporting connection with the same qualities of red and golden energy coming to us from the sun and the universe above, as well as that of the blue water energy coming from the earth and nature. Feel the warm red energy of the heart and the red and yellow/gold from above. Likewise, sense the cool, blue water energy of the kidneys and the refreshing blue water energy from the earth. Smile even more and relax the mideyebrow.

Fig. 13 *The Inner Smile is like the Sun, Rain and Earth for the Lotus Flower.*

Lotus Energy Meditation

1. **Breathe to the Tan Tien, and consider the lovely blooming lotus:** You can see the open flower, seeing it as red with yellow/gold petals in the center. Smile with appreciation.

2. **Look at the pads, stem and roots:** The leaves float on the water's surface. See the stem as it descends from the bloom to the roots mired in the mud. Feel the roots sinking into the bed of the pond. The roots receive just the correct amount of nutrition from the wet earth.

3. **Sense the harmony of fire and water:** The pads and flower open to the sun and universe to soak up the life-sustaining rays. The sun is the source of fire energy. The earth holds the necessary water. Smile and appreciate this life-giving harmony of the forces of fire and water, yang and yin, male and female.

4. **Connect images with your heart and kidneys:** As you continue with the Tan Tien breath, expanding and contracting, look inside to your heart and kidneys. The kidneys are the roots accessing water. The heart is the open lotus taking in the sun's fiery gift. The spine is the healthy and supple stem connecting the two energies.

5. **Inhale to the heart and exhale to the kidneys:** Coordinate the Tan Tien breathing: Inhale into the heart, drawing the warmth from the sun, feeling it come down through the crown of the head and blend it with the love, joy and happiness in the red heart/lotus. Draw this loving, hot heart energy back to the point opposite the heart center on the spine (the wing point between the scapulas, between T5 & T6) as you slowly inhale. Then exhale the hot energy down the lotus stem/spine to the cool kidneys, warming them with the loving heat from the heart. You may enhance the

emotional balancing effect by subvocally exhaling with the heart sound, Haaaaaw, as you mentally direct the heart energy down the spine.

6. **Alternating, inhale into the kidneys and exhale up to the heart:** See the kidneys as the nourishing bulbs of the lotus with roots that extend down through the legs and soles of the feet into the mud, accessing the soothing blue water energy held by the earth. As you inhale to the kidneys, feel that the roots are drawing the cool, soothing, nourishing blue water energy up through the soles of the feet, up through the legs to the kidneys. In the kidneys, feel the gentle calm, peaceful feeling blending with the cool, soothing blue water energy that has percolated up through the legs. As you exhale, you may subvocally express the kidney sound, Chooooo, and send this soothing boost of gentle, cooling wet blue kidney energy up through the supple stem/spine via the wing point to the grateful, happy heart.

7. **Continue alternating the breath this way for a few times:** Red light from the crown into the heart and down to the kidneys; blue light from the bubbling springs into the kidneys and up to the heart.

8. **Then, just relax and don't bother about the breath:** Simply move the smiling mind back and forth between the heart and kidneys along the connecting spinal stem. The balancing will automatically occur. Smile to the lotus perfection and beauty. Smile with gratitude to your kidneys, spine and heart. The lotus meditation is very calming, and naturally, the more it is used, the easier it is to realize this inner calm.

Chi Nei Tsang

The “secret technique” of Chi Nei Tsang = healing from the heart. The heart guides the Chi Nei Tsang practitioner and student in the CNT healing session. The heart’s respectful and loving power is activated by the Inner Smile and this environment allows healing to flourish.

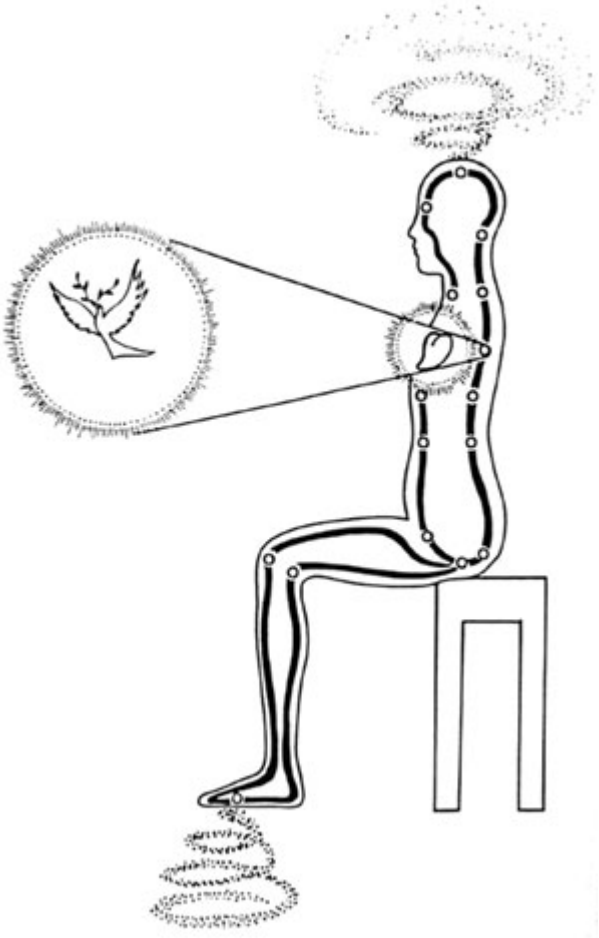

Fig. 14 *Healing with Love from the Heart.*

Inner Alchemy

The Fusions lead to Kan and Li.

Fig. 15 *Inner Alchemy begins and ends with the Inner Smile.*

Iron Shirt Chi Kung

Fig. 16 *The vital Iron Shirt Chi Kung postures and Tan Tien Breath would be empty without the Cosmic Inner Smile.*

Tai Chi Chi Kung

Everyone admires the grace and power of a round of Tai Chi. Integrating the Inner Smile into Tai Chi complements the the inner grace of breath and movement. By smiling into the Tan Tien Chi, the Ying and Yang wholeness of Tai Chi is even more “round”.

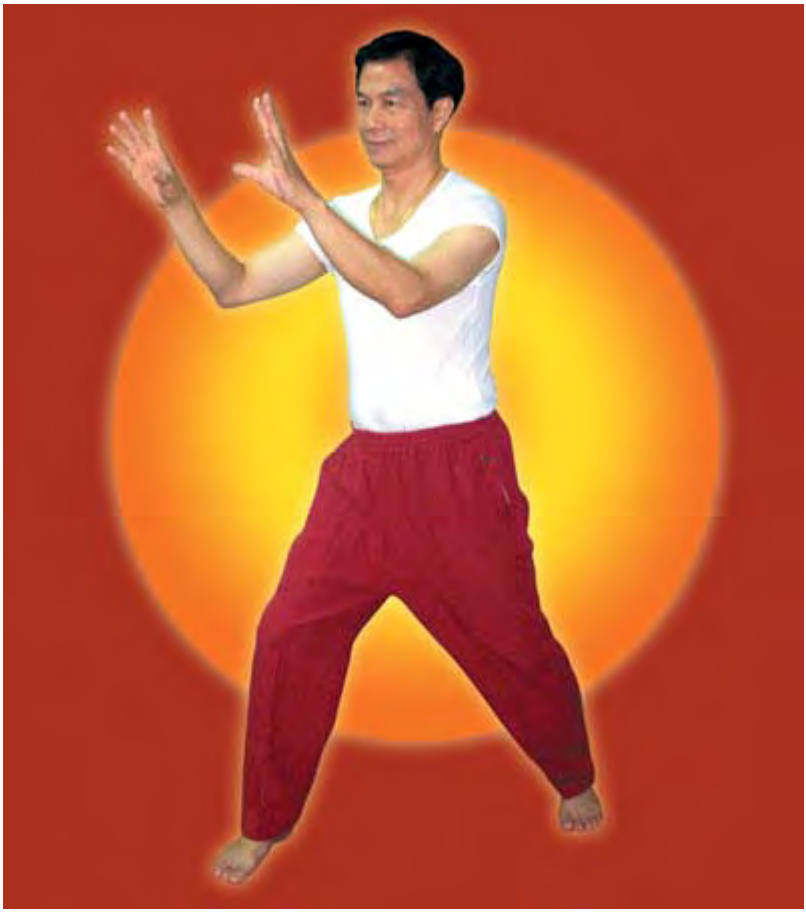

Fig. 17 *The Inner Smile moves the Chi Harmoniously.*

Elixir Chi Kung
Creating the Golden Earth Pill

Fig. 18 *The Alchemy of Creating the Elixir is Enriched with the Cosmic Inner Smile.*

Healing Love

Many practitioners are attracted to the Universal Tao's Healing Love single and dual cultivation. We are sexual beings and must manage sperm and egg energy in a healthy and respectful manner for the growth of our body, mind and spirit.

Fig. 19 *The Center of the Brain connects to the Sexual Organs.*

The pituitary, recognized as the “master gland” and the pineal, known as the “spiritual gland” are profoundly and positively influenced by the Inner Smile. They function in concert with the sexual glands during loving sexual arousal. This glandular cooperation blends what are perhaps the strongest human energies: love and orgasm. The Cosmic Inner Smile fortifies this mixture. When the couple makes love they smile at their own organs and at their partner’s organs with sincere gratitude. The sexual energy multiplies this loving appreciation and in this loving cooperation Healing Love is present.

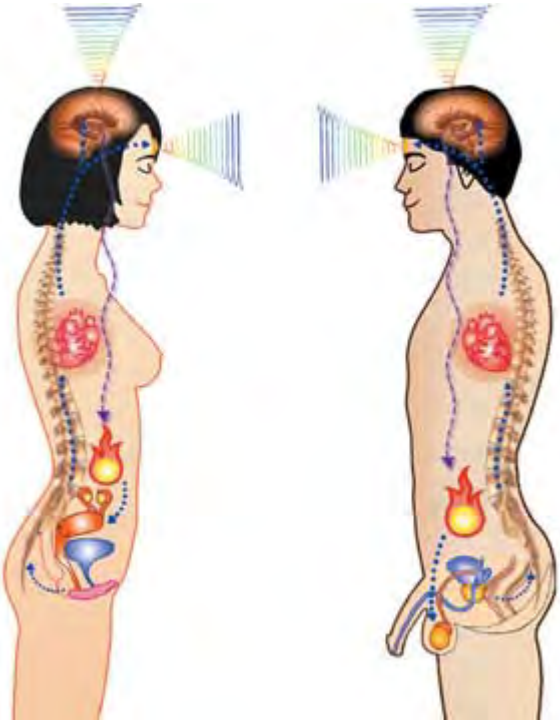

Fig. 20 *Why are this woman and this man “inner smiling”? Because of their loving energy and their orgasmic energy.*

Daily Practice

Practice the Inner Smile when you wake up. It will improve your whole day. If you love your body, you will be more loving to others and more effective in your work. After you have learned the practice, it takes five to ten minutes to smile down your entire body. Try to maintain the sensation of the Inner Smile throughout the day. Keep reminding yourself of the feeling because it is one of the best stress reducers in the world.

Smiling Aura Field: Form of Protection

There are subtle energies or “psychic forces” around us that affect our lives. Although unseen by the majority of people, these forces extend a primary influence on our health and well-being.

Negative psychic energies from others can create stress and cause illness. When a person has strong emotions toward you, the psychological energy associated with those thoughts and feelings can disturb your energies, jeopardizing your health. The “Smiling Aura” is a beautiful emanation of our highest energetic frequencies that protects us from the negative vibrations of others. The Inner Smile Practice enhances this Smiling Aura. By remaining conscious of the smiling energy, especially in the mideyebrow, face, and navel areas, you can intensify the Smiling Aura Field around your body. This will help you to keep out negative vibrations which other people create unknowingly. The Smiling Aura Field can also help you transform your own negative energies into positive life force. For instance, if you feel anger, the smiling energy you maintain gives you the ability to smile into that emotion until it dissipates and transforms into kindness. With practice, you can use this force to transform hatred into love; sadness into courage; and fear into gentleness. After a while, the process becomes automatic.

Fig. 21 *Smiling to the Aura Field.*

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$6.95

Cosmic Inner Smile

Smiling Heals the Body

Mantak Chia

Illustrations by Udon Jandee

Cosmic Inner Smile

The Inner Smile is a powerful internal healing and relaxation meditation. Deep relaxation dissolves physical and mental tensions that can cause energy blockages and unhealthy Chi. The Inner Smile enhances the energy of the organs and glands, our life force in general, and stills and focuses the heart and mind (hsien). It makes us more aware of our body and inner being, because we learn to communicate with our organs, glands, spine and other specific parts of our body, as well as our soul. Taoists discovered that consciousness is rooted not only in the brain, but also in the vital organs and in a more subtle sense, in each of the cells.

Smiling to the organs and thanking them for the work they do will reawaken the intelligence of the body. We are often so out of touch with the body and emotions that we do not notice inner disharmony developing until it finally manifests itself as a serious illness.

Practicing the Inner Smile daily lets us look inside to keep in touch with the state of our inner organs, our Chi, our breath and emotions. We can spot problems at their inception, making it easier to balance the emotions and virtues.

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Darkness Technology

Darkness Techniques for Enlightenment

Mantak Chia

Darkness Technology

All spiritual traditions have used Darkness Techniques in the pursuit of enlightenment. In Europe, the dark room often appeared in underground form as a network of tunnels, in Egypt as the Pyramids, in Rome as the catacombs, and by the Essenes, near the Dead Sea in Israel, as caves. In the Taoist tradition caves have been used throughout the ages for higher level practices. In the Tao, the cave, the Immortal Mountain, the Wu San, represents the Perfect Inner Alchemy Chamber. Meditating and fasting in the cave is the final journey of spiritual work. The caves are the Earth Mother and its energy lines. Like the hollow bones, caves contain the earliest information of life stored inside the Earth. Caves contain the vital essence of the Earth Power. The Tao says: 'When you go into the dark and this becomes total, the Darkness soon turns into light.'

In the Darkness, our mind and soul begin to wander freely in the vast realms of psychic and spiritual experience. When you enter this primordial state or force you are reunited with the true self and divinity within. You literally 'conduct' the universal energy. You may see into the past and future, understand the true meaning of existence, and begin to understand the order of things. You return to the womb, the cocoon of our material structure and Nature's original Darkness.

Complete darkness profoundly changes the sensory sensibilities of the body/brain. We are deprived of all visual reference. Sounds begin to fall away as we lose contact with the external world and turn the senses inward. The effect of darkness is to shut down major cortical centers in the brain, depressing mental and cognitive functions in the higher brain centers. Emotional and feeling states are enhanced, especially the sense of smell and the finer senses of psychic perception. Dreams become more lucid, and the dream state manifests in our conscious awareness. Eventually, we awaken within ourselves the awareness of the Source, the spirit, the soul. We descend into the void, into the darkness of deep, inner space.

Darkness activates the deepest centers within the brain, the glands of the Crystal Palace, establishing a connection with the Original Source, the Wu Chi (Fig. 1). The pineal gland connects us to the Universal Energy. From the hypothalamus gland, we project our soul or spirit upwards, and receive the descending Universal Energy. The pituitary gland receives the Cosmic Force, used to launch the spirit bodies into the earthly or human plane for traveling.

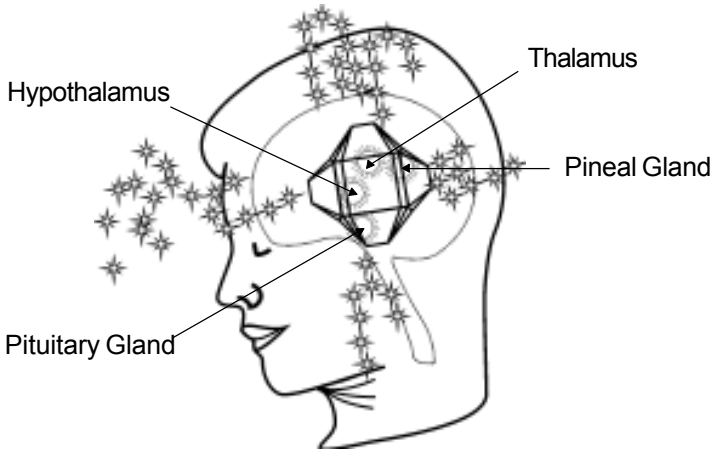

***Fig. 1**.Glands of the Crystal Palace are buried deep within the brain. They include the pineal, hypothalamus, thalamus, and pituitary glands.*

The darkness actualizes successively higher states of divine consciousness, correlating with the synthesis and accumulation of psychedelic chemicals in the brain. Melatonin, a regulatory hormone, quiets the body and mind in preparation for the finer and subtler realities of higher consciousness (Days 1 to 3). Pinoline, affecting the neuro-transmitters of the brain, permits visions and dream-states to emerge in our conscious awareness (Days 3 to 5). Eventually, the brain synthesizes the “spirit molecules” 5-methoxy-dimethyltryptamine (5-MeO-DMT) and dimethyltryptamine (DMT), facilitating the transcendental experiences of universal love and compassion (Days 6 to 12) (Fig. 2).

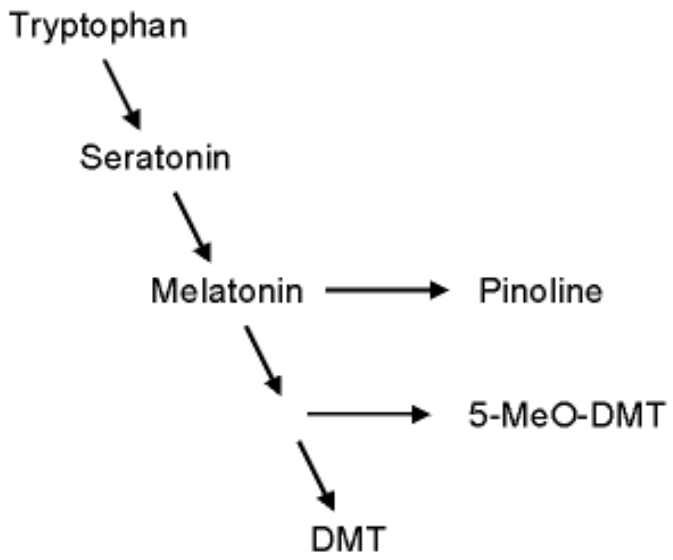

***Fig. 2**. Tryptamine synthesis, simplified: The amino acid tryptophan is the precursor for seratonin, melatonin, pinoline, 5-MeO-DMT, and DMT molecules.*

Universal Tao Darkness

Starting many years ago, Master Chia went in search of natural caves suitable for meditation in absolute darkness, but none were found. Master Chia and Juan Li spent one day in Wu San, the Taoist Immortal Mountain, the most sacred of the Taoist power centers. The cave was not, however, suitable for a dark room retreat. Tourists were ever-present, and the stench of human urine and feces was overpowering. They failed to find the true teaching. Other natural caves were explored, but all suffered some deficiency. The cave environments were dirty and damp, and the air quality poor (dust, fungi, bacteria, insects, snakes, etc.). The caves were dumping grounds, repositories for human waste and garbage. The pristine silence of the darkness was not to be found. Perhaps the perfect cave is still hidden in some deep, high mountain.

Master Chia researched modern Darkness technologies for many years. A pyramid at Tao Garden, northern Thailand, provided the ground for early experiments in darkness retreats. He made visits to darkness retreats in other countries, to gain insights on the best designs for meditation and for comfort. Eventually, the Universal Tao Darkness was constructed, based on all available information and latest technologies. The facility is the perfect Inner Alchemy Chamber, conducive to meditation and providing comforts and necessities for up to 60 people. A large central meeting room is surrounded by two tiers of living quarters. The light and sound proof outer sheath is constructed of bricks made from the red earth of Thailand, preserving the earth elements of the original cave. The Mother Earth power is retained in the modern structure.

The Tao Garden Darkness is enclosed and encased in a light and sound-proof sheath. The building is constructed of bricks made from the red earth of Thailand, containing all of the properties of natural rock in a cave. The earth was mined and hydraulically pressed into bricks, thus preserving the constituent elements and minerals of the parent materials. The Mother Earth power is retained in the modern structure.

The facility consists of a large, central meeting room for meditation and for dining. Two tiers of bedrooms surround the central area, each with private bath. The entire facility is ventilated with fresh air intakes and air conditioning systems. Food is specially prepared to meet the particular requirements of the body, mind, and spirit in attaining the goals of darkness enlightenment. Fresh juices and soups are served for “breakfast” and a light organic meal is served in the “afternoon”. (See: Darkness Nutrition p. 42). Participants are trained and prepared for life in the dark (See: Darkness Preparations p. 39).

The Universal Tao Darkness is currently the largest and most advanced Darkness meditation facility in the world. Aspiring to the Tao, participants remain in utter and complete darkness for one, two, or three weeks, a perfect laboratory for Inner Alchemy. The spiritual knowledge gained by Taoist masters over the ages merges and blends with the insights of 21st century science and technology.

As Above, So Below

There is one point in the sky around which all other constellations revolve, the North Star point. The North Star is fixed, stationary, motionless. Taoists regard it as the Center, the source of the Universe, the Nothingness, or Wu Chi. The North Star is the Gateway to Heaven. In the Tao, the body is a microcosm of the Universe. "As above, so below." Whatever happens "up there" happens "down here." Hence, the physical body is marked with gridlines of energy and meridians of light around a Center. The Center is called the "Tan Tien", or "field of energy" (Fig. 3).

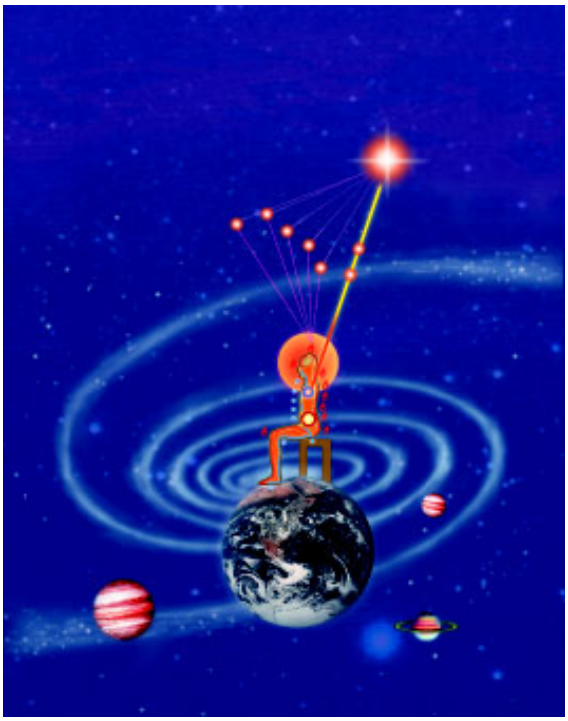

Fig. 3. *Universal connections: We are connected to Mother Earth below, and to the Heavens above. Big Dipper and the North Star are the gateways to immortal life.*

The idea of a Central Axis – the Pole Star in the firmament and a Cauldron in the body – is a central tenet in Taoist philosophy and alchemical practice. To get to the Center of the body, open the Tan Tien; to get to the Center of the Heavens, enter through the North Star. Both are doorways to the heart of the true Tao, the Wu Chi, from which both Heaven and Earth are born. The Inner Alchemy practice of the Universal Tao fuses the body's energies to give birth to a spiritual embryo capable of maturing into a deathless existence and of flight inward, beyond time and space, to the Source.

The Darkness meditation releases us from the bonds of the Earth. No longer controlled by the rotating power of the Earth, the Sun and the Moon, the organs vibrate in unison with the spiritual stars, the Gates of Heaven. The North Star, unmoving and unwavering in space, is the center, the Wu Chi, emanating violet rays throughout the galaxy, affecting every living cell of nature on our planet. The Big Dipper gathers all the violet light from the universe, and emanates the light as infra-red radiant energy. The emanation of infra-red light of the Big Dipper, combined with the violet rays of the North Star, has a positive, nurturing effect upon the bodies and minds of those who know how to access it. Taoists believe that the Violet Stars, the Big Dipper, and other constellations form the "Gates of Heaven." All living things must pass through these gates to return to their source of origin, the Wu Chi, which is the state of oneness with the Tao.

The Darkness environment activates the glands of the Crystal Palace, actualizing their higher powers and providing a "way back" to the Original Source (Fig. 1). When the Crystal Palace is open, it becomes illuminated like millions of shining crystals. It can give and receive light and awaken our inner knowledge and deepest potentials. It receives light and knowledge from the universe and reflects it to the various organs and glands to enhance them.

The pineal gland helps us to overcome death by taking in external forces and combining them with sexual energy and the Original Force to form an "Immortal Body." With this body we can leave the physical body before the final transition (death) occurs. By focusing

on the tip of the Crystal Palace, the pineal gland, and the back of the crown, we can project ourselves to the North Pole or North Star as we attract its violet emanations (Fig. 4).

The pineal, as Yang, is balanced by the Yin of the hypothalamus gland. Taoists regard this point as the main switch for the Universal Force. When the spirit awakens, it resides in the hypothalamus. When the pineal and hypothalamus are connected, they give out a powerful, balanced force. By focusing on this center and picturing the seven stars of the Big Dipper, you can access the constellation's energy, which emanates from the crown as a ray of red light. (Fig. 5).

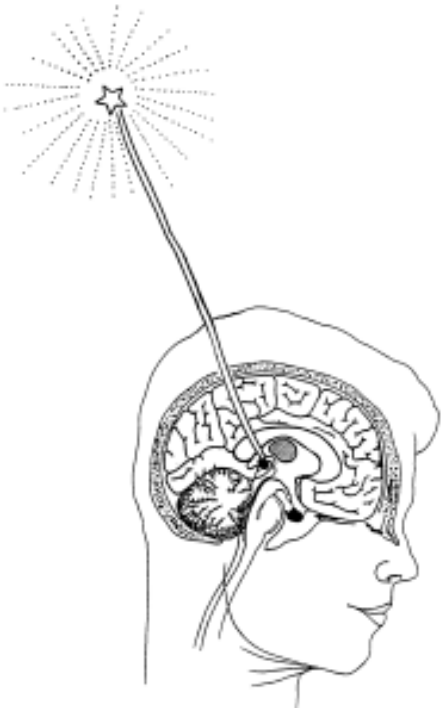

Fig. 4. *Pineal gland has a close connection to the North Star, receiving its violet emanations.*

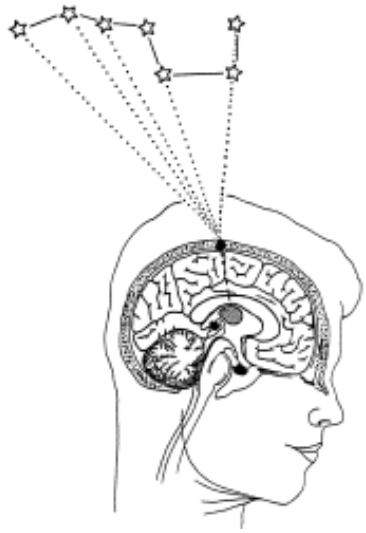

Fig. 5. *Hypothalamus and pineal glands, when connected, allow access to the infra-red emanations of the Big Dipper.*

In the Tao, the sources of longevity and immortality are within the body, not as a physical womb but a spiritual one. Taoists call this spiritual womb the "cauldron". The right method to "cook the cauldron" is not to search outwardly for love from others, but to search within the naked and abandoned self. Self-love, or self-intercourse is the way to give birth to the Immortal Self. The Darkness manifests the bodily processes of "Healing Love."

The human states of true compassion and sexual arousal create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwined in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love.

When the ‘love-vibration’ reaches the pineal gland a new hormone is produced, which in turn creates whole body conductivity (Fig. 6). Only when you feel the waves of orgasmic vibration and unconditional love for the self and others can the process be activated and the essence of the Darkness is magnified.

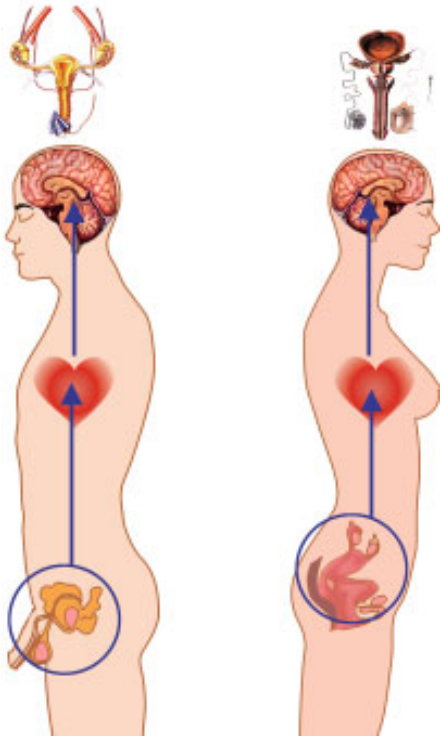

Fig. 6. *Pineal gland connects with the sexual center in the meditation of self-intercourse.*

The essence of the Darkness Practice is giving birth to the soul and spirit. The coupling of Yin and Yang energies of the body in the Kan and Li meditations is aimed at overcoming death. It is the method of going back to the state in which we are all orphans, in the very depth of our body/minds.

Consciousness and the Neuro-Endocrine System

The Darkness environment dramatically alters the chemistry of the brain, manifesting especially in the neuro-endocrine systems, which govern consciousness and regulate body functions. An important neurotransmitter involved in waking consciousness (seratonin) converts into a regulatory hormone (melatonin) that shuts down the organ systems, quieting the body in preparation for the finer and subtler realities of higher consciousness. The pineal gland initiates a cascade of inhibitory reactions, permitting visions and dream-states to emerge in our conscious awareness. Eventually, the brain synthesizes the "spirit molecules" 5-methoxy-dimethyltryptamine (5-MeO-DMT) and dimethyltryptamine (DMT), facilitating the transcendental experiences of universal love and compassion.

Autonomic Functions

The body responds automatically and unconsciously to maintain the integrity and vital functions of the organism. The hypothalamus, located deep within the brain, is the major regulatory gland controlling homeostasis, or body maintenance. Factors such as blood pressure, body temperature, fluid and electrolyte balance, and body weight are maintained in dynamic equilibrium, shifting with the needs of the body. To achieve this task, the hypothalamus receives inputs about the state of the body, and initiates compensatory changes if anything drifts out of whack.

The hypothalamus directs body functions though two main pathways. First, the hypothalamus connects to the brainstem, located at the top of the spinal cord, providing a link to the Autonomic Nervous System, the ANS. The ANS has two parts; the sympathetic nervous system activates the "fight or flight" response; the parasympathetic nervous system activates "rest and digest" activities of the body. The brainstem, through the ANS, controls the essential functions of

pulse, respiration, body temperature, water balance, swallowing, coughing, as well as our stereotyped reactions and movements.

A second pathway is from the hypothalamus to the pituitary gland, the master endocrine gland in the brain. The pituitary gland secretes hormones, which activate major organ systems in the body, for example the adrenal and sexual centers.

The hypothalamus is of particular importance in the Darkness because of its affect on circadian (day-night) rhythms in the body. The suprachiasmatic nucleus of the hypothalamus is one of the body's major biological clocks (Fig. 8). It not only regulates hormones related to the day/night cycle, but it orchestrates the activities of many other internal clocks. In numerous experiments, it has been shown that when the SCN is not innervated, the human body clocks run free; they set their own time[1].

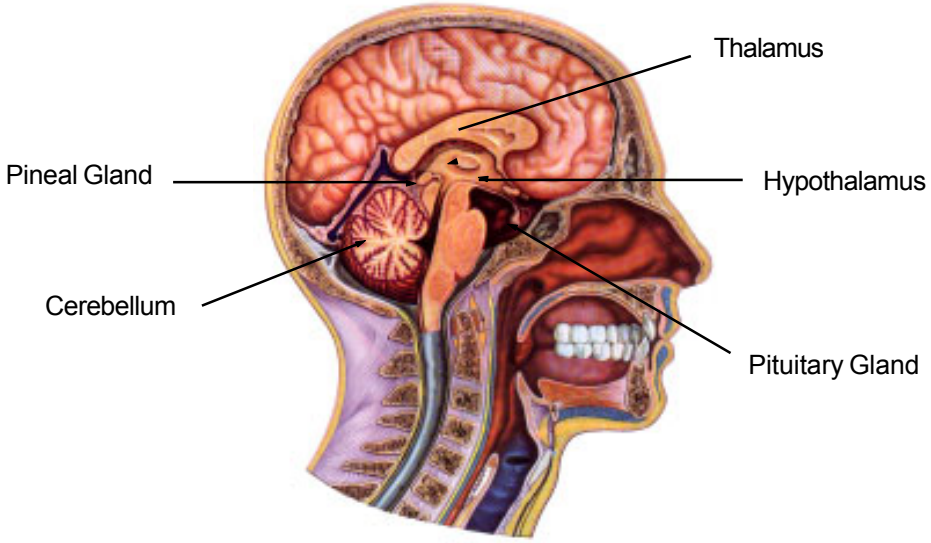

Fig. 7. *Brain Organs*

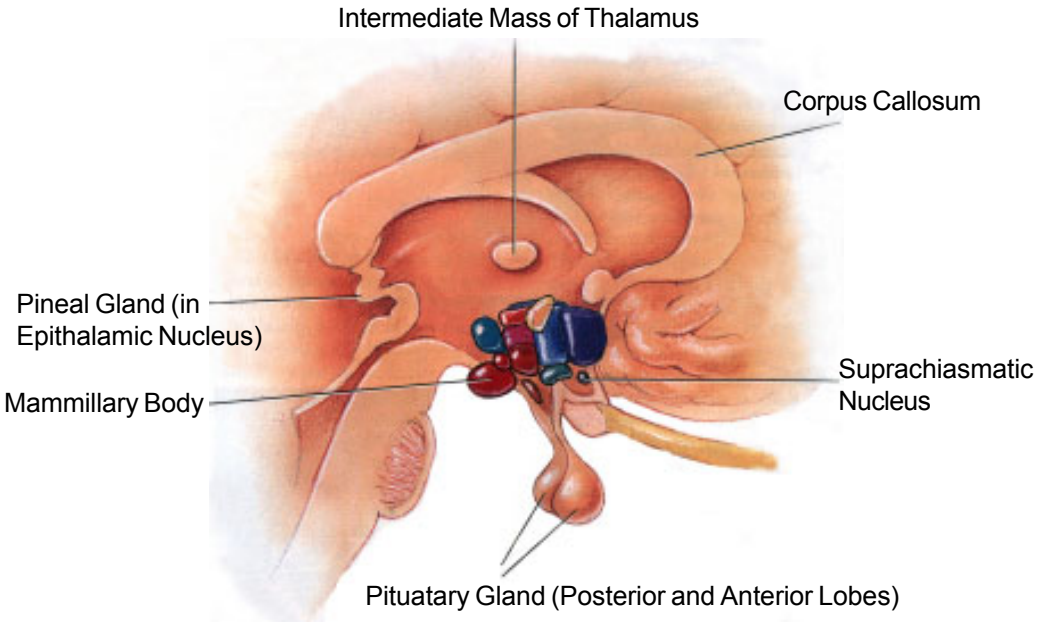

Fig. 8. *Detail of the hypothalamic nuclei. Suprachiasmatic nucleus (SCN) regulates circadian (diurnal) rhythms and activates the pineal gland though sympathetic neurons originating in the brainstem (see Fig. 12)*[2]

Waking Consciousness

An "alarm system" is built into the brainstem, to wake us up and bring us to waking consciousness, called the reticular activating system (RAS) (Fig. 9). Sight and hearing are two major pathways of incoming sensory information, providing cues which maintain our state of alertful wakefulness. The optic and auditory nerves stimulate brainstem centers, which, in turn, activate higher cortical centers in the brain though the RAS.

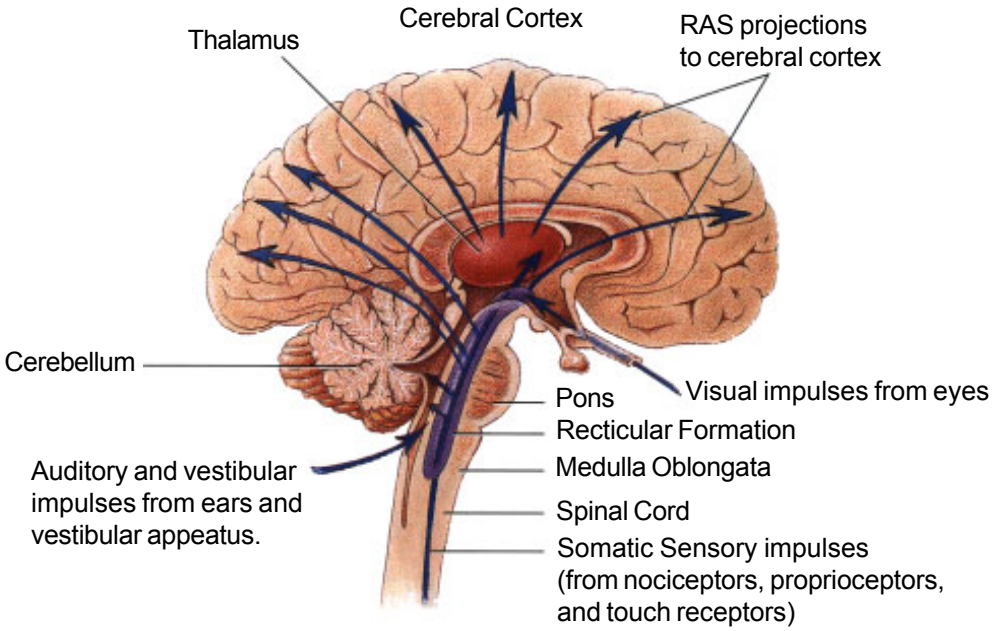

Fig. 9. *Reticular Activating System (RAS): Fibers that project from the reticular formation through the thalamus to the cerebral cortex are responsible for maintaining consciousness, muscle tone, and awakening from sleep, with stimuli from the ears, eyes, and skin, but not the olfactory system, which explains why people die in house fires[3].*

Many of the functions of waking consciousness are maintained by the neurotransmitter seratonin. Seratonin is a chemical messenger, traversing the synapse, or the gap, between two nerve cells (Fig. 10). Some of the important nerve pathways assisted by seratonin begin in a region of the brainstem called the raphe nuclei and extend upwards into the cerebrum (Fig. 11). Seratonin plays an important role in maintaining cortical arousal, concentration, and suppressing distracting stimuli, as well as a role in sleep.

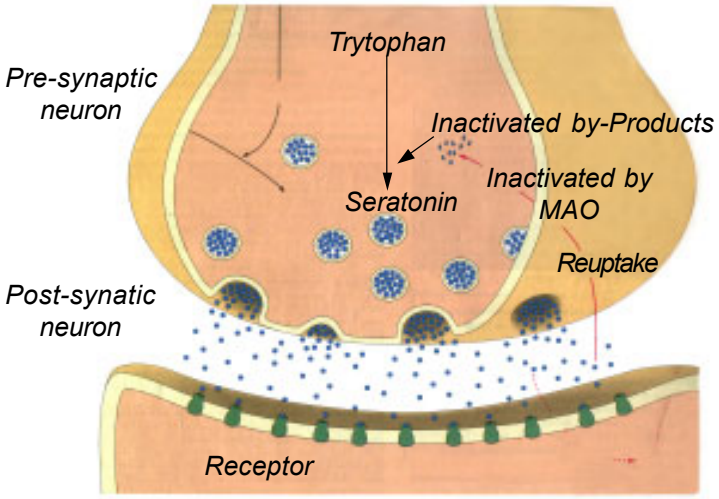

Fig. 10. *Synapse: Neurotransmitter seratonin bridges the gap between nerve cells. After completing its "mission", the seratonin is reabsorbed into the nerve cell and decomposed by MAO into inactive by-products[4].*

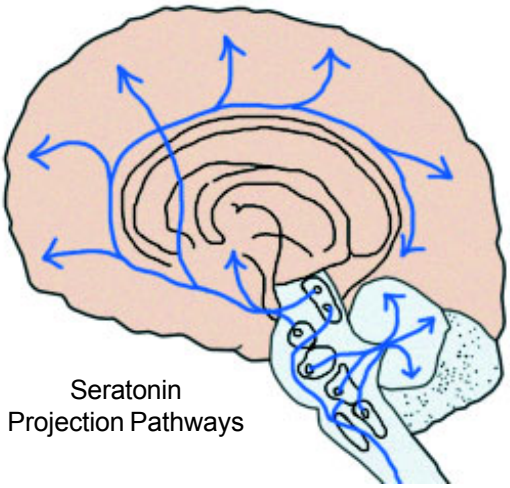

Fig. 11. *Seratonin Pathways. Many of the important nerve pathways assisted by the neurotransmitter seratonin begin in the brainstem and extend upwards into the cerebrum[5] .*

Seratonin is implicated in a wide variety of psychological phenomena, including depression, anxiety, obesity, and LSD hallucinations. The anti-depressant Prozac, for example, elevates seratonin levels in the synaptic cleft by blocking re-uptake of seratonin into pre-synaptic neurons. (Seratonin levels cannot be raised by ingestion, because the molecule is too polar to pass through the blood-brain barrier.) As another example, LSD mimics the shape of the seratonin molecule and redirects nerve impulses down unfamiliar and unstructured neural pathways, giving rise to hallucinatory perceptions and experiences. In short, seratonin is the most important neurotransmitter governing states of waking consciousness.

Sleep and Dream

Each night, our waking consciousness is subdued by chemical messengers that inhibit the activities of the brain. Melatonin, the "sleep molecule", is one of these messengers. Melatonin is produced in the pineal gland, in response to the darkness of night, and to the circadian rhythms of light and dark that are programmed into the hypothalamus, an endocrine gland located deep within the brain (Fig. 12). Melatonin affects major organ systems, quieting the sympathetic nervous system and allowing daily rejuvenation of mind and body. (also see Appendix: Inner Alchemy, A Physical Explanation).

The primary function of sleep is to rest and restore not the body, but the mind. Depriving a person of deep, dreamless sleep (delta stage) results in the seepage of hallucinatory phenomena into the waking state. Sleep deprivation causes severe mental disturbance, attention deficits, visual complaints, hallucinations, and time distortion, and, after a number of days a person may go insane.

In the Darkness, melatonin gradually accumulates in the brain, and we begin to experience the revelations of sleep in our waking consciousness. Sleep and dream states manifest in our awareness, and aspects of our true nature begin to reveal themselves. Sleep consciousness is a profound state of rejuvenation and reconnection to our divine source. It has been said that "…the soul temporarily disengages during sleep to 'visit' other dimensions and have experi-

ences, which are remembered during the waking consciousness as dreams. Each and every soul leaves the body as it rests in sleep. The idea that some aspect of the self dissociates during sleep and transits between dimensions (e.g., astral travel) is a common theme in the traditions of many cultures. Sleep is viewed as an opportunity for the mental being to review previous experiences and plan future actions accordingly, hence the retrospective and precognitive function of dreams."

> "During sleep, connection of the physical, mental and spiritual bodies is maintained by a 'silver cord' … similar to the 'thread' or 'cord' of the pineal system. Death involves the severance of this cord whereas sleep may be viewed as merely a temporary 'stretching' of it. The 'projection' of consciousness out of the body during sleep may be related to the … "kundalini" experience and psychic awakening."[7]

Extended Darkness retreats alter sleep cycles somewhat. Initially, people usually sleep more since most people are busy and often sleep-deprived. After two to three days, however, the need for sleep is diminished and a more restful state of being becomes a pervasive aspect of every day. We have observed that when people are quiet and less active during the beginning of a retreat, the elements settle into their own nature more quickly, and a state of alert relaxation arises. After a couple of weeks, one may need only a few hours of sleep each night, and that sleep is often in continuous consciousness.

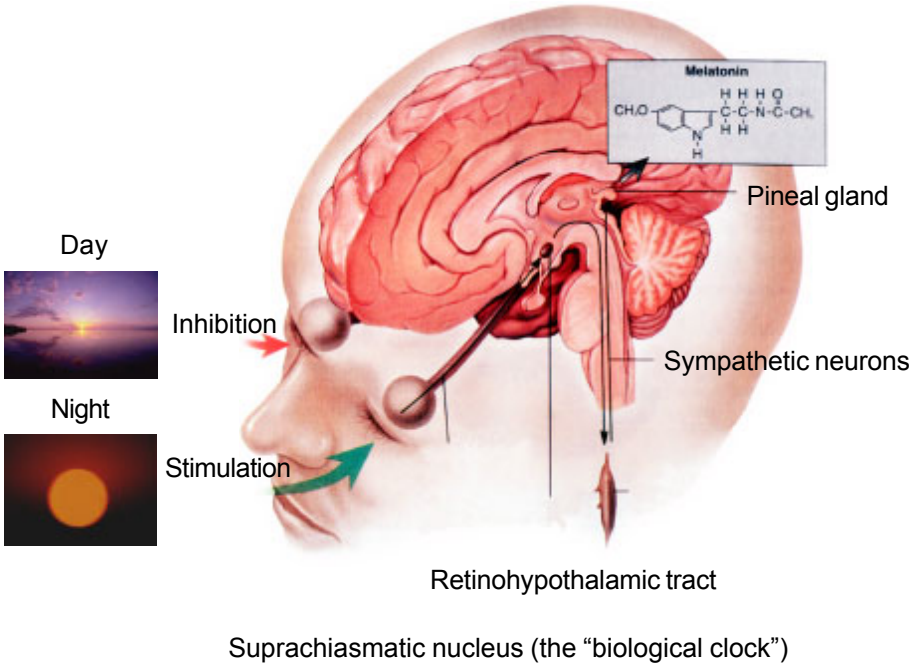

Fig. 12. *Pineal activation: Secretion of melatonin by the pineal gland is stimulated by sympathetic nerve axons originating in the superior cervical ganglion of the brainstem. Activity of these neurons is regulated by the activity of the suprachiasmatic nucleus of the hypothalamus (SCN), which sets a circadian rhythm.*

ineal gland

etic neurons

Descent into Darkness

In the Darkness, our mind and soul begin to wander freely in the vast realms of psychic and spiritual experience. First, sensory receptors that are controlled by the thalamus gland, with the exception of the olfactory, consciously withdraw (Fig. 7). Thus, breathing activity substitutes for the restfulness of visual and auditory function. By keeping the adrenal hormones at their lowest levels the inner peace remains undisturbed. In complete darkness, the visual and auditory abilities become ever more sensitive. The olfactory (smell) and tactile (feeling and touch) organs become the chief senses to supply the little needed energy to the body/mind. Thus the thalamus glands are slowly shut down. The pituitary gland, the master gland for bodily hormones, becomes distilled by the exchange of energy in the body/mind needed for spiritual awakening power.

The hypothalamus gland is in perfect balance and alternates peacefully between wakefulness and sleep. The pineal gland, secreting melatonin to control the subtle bodily rhythms, is sensitized to the vibrations of earth and the scanning light, no longer being driven by the instinctive drive from adrenal power and the waking consciousness of the thalamus glands and the reticular activating system. In this state, wakefulness is a dreaming state and dreaming consciousness is awakening consciousness. They become the functions of spiritual stars and planet earth, rather than the rotating power of the Earth, the Sun and the Moon. This state is the final stage of the returning process on earth.

Limbic System

The primary organ for the emotional activities is coordinated through the function of the amygdala, taken from the Greek word for “almond” because of its fanciful resemblance to almonds. In Taoist tradition, this is the crowning center where both the light and visual frames register, such as the image of sun or of a snake (Fig. 13). As the sexual power engages with the light above the brain to form sweet dew, the light in the pituitary becomes gray-white. When it radiates, the two amygdala glands are activated, allowing the Chi to

circulate within the temporal lobes on either side of the head, above the ears and around the temples. As the light moves forward, the Third Eye, the essential tool for healing diagnosis, is opened.

The temporal lobes govern all auditory, somatic, and motor sensitivities. The breath coming through the nostrils, as well as the light shining upon the amygdala, charges these sensory activities. The adrenal glands, responsible for releasing norepinephrine and epinephrine, become the seat for true inner stillness (Fig. 14). In this state, everything is transformed into the harmless and loving present. By drawing the unconscious light from the adrenal glands, themselves charged by the primordial sexual energy, the mind sees the light and the inner ear hears the cosmic vibration within both the body/mind and the Mother Earth. Mysteriously, the cave of the earth, the cave of the brain (Crystal Palace), and the hollowness within the bones echo with each other, making the cosmic vibration visibly meaningful through the conscious eye.

The meditations of the Inner Smile, Six Healing Sounds, and Fusion Practice are important for quieting and transforming the negative emotions.

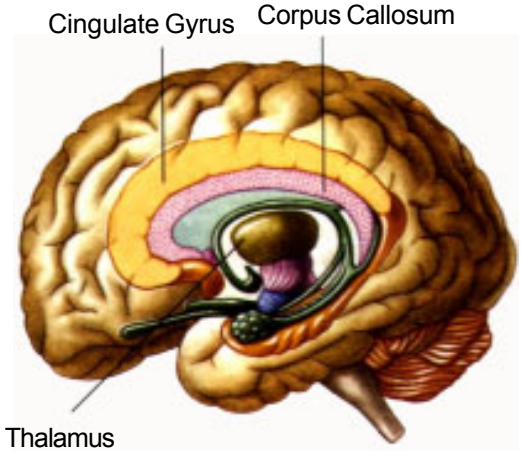

Fig. 13. *Limbic System: The limbic system encircles the top of the brain stem and forms a border (the meaning of "limbic") linking cortical and midbrain areas with lower centers that control automatic, internal body functions.*[8]

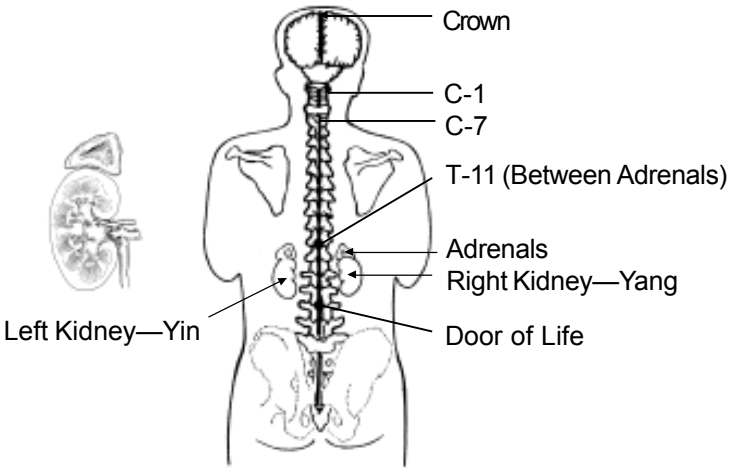

Fig. 14. *Adrenal Glands*

Pineal Gland

The pineal gland is the connection point for the Spirit or Soul. It is the physical center for, and transmitter of, psychic phenomena such as telepathy, clairvoyance in time and space, and the actual influence of thoughts on the physical surroundings[9]. (Fig. 16)

"When activated, the pineal gland becomes the line of communication with the higher planes. The crown chakra reaches down until its vortex touches the pineal gland (Fig. 15). Prana, or pure energy, is received through this energy center in the head. With practice the vibration level of the astral body is raised, allowing it to separate from the physical. …To activate the 'third eye' and perceive higher dimensions, the pineal gland and the pituitary body must vibrate in unison, which is achieved through meditation and/or relaxation. When a correct relationship is established between personality, operating through the pituitary body, and the soul, operating through the pineal gland, a magnetic field is created. The negative and positive forces interact and become strong enough to create the 'light in the head.' With this 'light in the head' activated, astral projectors can withdraw themselves from the body, carrying the light with them".[10]

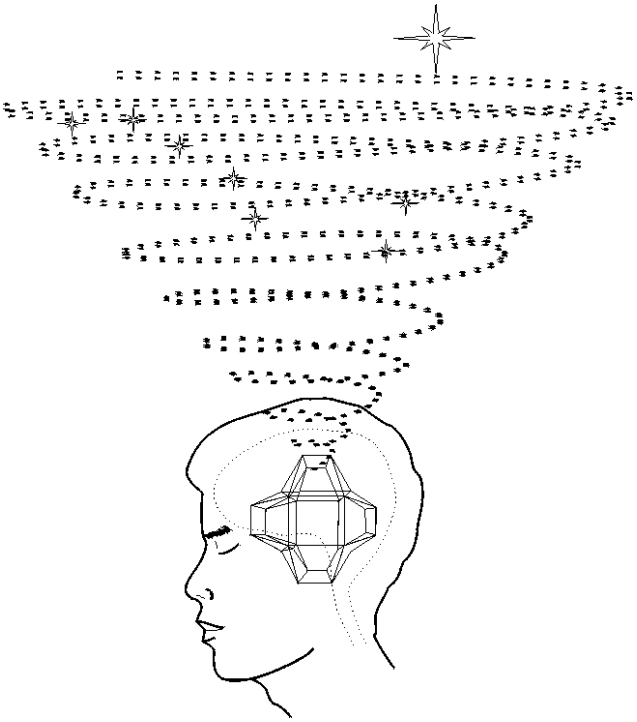

Fig. 15. *Crown Vortex*

Fig. 16. *Third Eye*[11]

"The pineal works primarily by converting the higher dimensional Light, that is constantly streaming into your reality, into usable information for your pituitary. As it gradually activates, the pineal permits the body to move its vibrational patterns into higher and higher levels. This process also allows your Light Body to attach itself even deeper into your physical instrument (Fig. 17). Our process is to reset the focus in the pineal. This chemical 'lens' largely disappears as you grow older. The decrease in its efficacy is one of the major reasons for your body aging as quickly as it does. When the pituitary begins to receive the consciousness energy packets from the Well of Dreams through its interaction with the pineal, it secretes enzymes that permit the chemical 'lens' in the pineal to reappear. As this 'lens' strengthens, it allows the RNA/DNA protein strings in your cells to activate your 'third strand'."[12]

Fig. 17. *Heavenly Mirror*

The pineal gland is located in one of the oldest anatomical regions of the brain. If you draw an imaginary line from the center of your forehead, crossed by a line through the head at the ears, you have its general location. The pineal is cone-shaped, about 8 mm (1/3 inch) in diameter, weighing from 50 to 150 mg. The gland is most active during childhood, and begins to regress at about age 7, becoming a calcified tissue strand in the adult (Fig. 18).

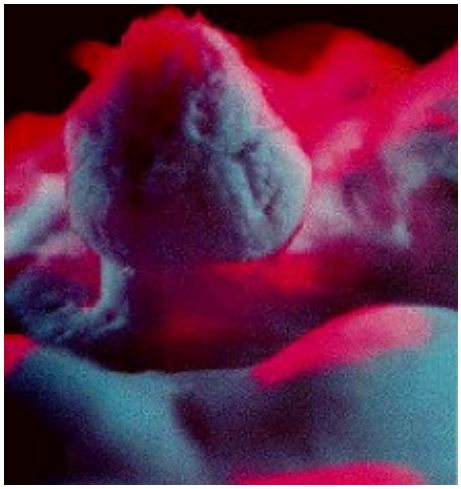

Fig. 18. *Pineal Gland*[13]

There are numerous anatomical and physiological idiosyncrasies associated with the pineal. It is one of the few solitary organs (most organs in the brain are paired, left and right). While small, the blood flow to the gland is quite large. The pineal has been considered as a homologue of the reptilian 'third eye'. Its photosensitivity derives from neural connections with the retina (Fig. 12).

The Taoist practice of Orgasmic Upward Draw is very important to help stimulate the pineal gland. Taoists regard the pineal as the second sexual gland (Fig. 19). In the Kan and Li practice, the steaming process helps to clean out all of the organs and reactivate the thymus and pineal glands.

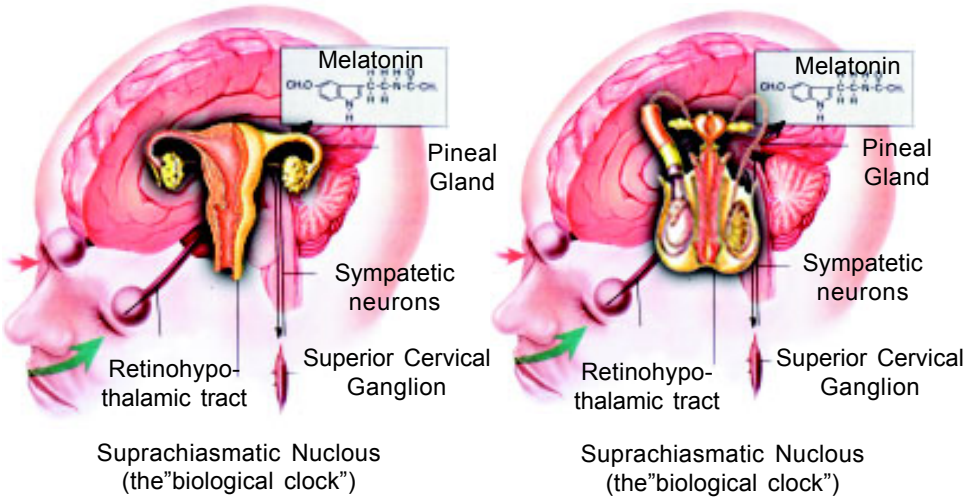

Fig.19 *Pineal as Second Sexual Center*

Fall from Grace

Nothing could be more natural than the state of Wu Chi, nothingness, or divine grace. And yet, the realization of Wu Chi is clouded by obscurations and confusions. Consciousness streams into every body, but only a few can see the light. Why is this so?

An essential function of the "upper brain", the Upper Tan Tien, is to manifest the esoteric and divine realizations of consciousness into our human bodies. Chi spirals through the Crown and the Third Eye into the pineal and pituitary glands, sustaining existence and nourishing the spirit. Infants and children bask in the glow and the power of the Chi Field streaming into, and interacting with, their bodies. The psyche is vibrant and alive and the energy bodies communicate in non-physical dimensions.

As we grow older, however, the internal realities begin to fade and the external world begins to predominate our existence. By puberty, the pineal gland has ossified into a calcified strand of tissue. Our minds project outwardly, and the demands of existence (work, family, daily living, etc.) preoccupy our awareness. Our emotions (fears, angers, resentments and all kinds of distractions to make ends meet) reflect this outward movement of the psyche.

Fear is the oldest negative emotion. It is felt by all animals, and is even stronger among humans since they have so little power to protect themselves, especially the newborn. The longer history required for organic development makes fear the basis of the entire civilization process: to protect ourselves and achieve our highest potential. Fear is closely connected to the kidney Chi (via the adrenal glands), and when the kidney Chi is diminished, the brain slowly begins to pull back and disengage from the fantastic worlds of the Divine. The upper brain becomes the observing brain, dedicated to the worldly tasks of sending, receiving and processing sensory signals related to daily living.

Inhibiting the Divine

The transition from an internally focused awareness of the Divine, the natural state of infancy, to an externally focused awareness of the adult World, requires significant shifts in the chemistry of the brain. The tissues and molecules which normally manifest the consciousness of Wu Chi must be “turned off” or inhibited. Chemically, the inhibitors are enzymes such as MAO (monoamine oxidase) which rapidly convert seratonin into inactive by-products, thus disabling the synthesis of the spirit molecules. The enzyme MAO breaks down seratonin before it can be converted into melatonin, 5-MeO-DMT and DMT (Fig. 20).

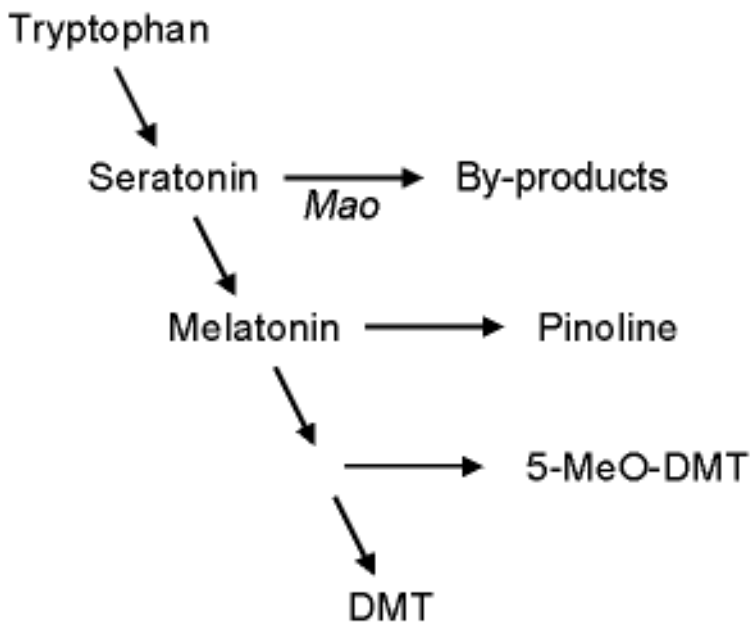

Fig. 20. *Seratonin Deactivation*

Our usual perception of the world in waking consciousness is, in fact, a state of waking ignorance. The brain must inhibit our true nature and divine connections to survive in the physical world. In everyday life, we see everything back to front, as it were. We perceive the primary actions of the brain as providing us with sensibility and cognitive awareness. In fact, the brain's mechanism is to filter and shut off the flow of divine consciousness, making possible survival on Earth, but obscuring all transcendental realities. Darkness meditations remove the obscurations. The inhibitory functions of the brain are lifted, and we revel in the experience of Oneness, Wu Chi, the Original Source.

Reawakening – Spirit Molecules

Waking consciousness satisfies the demands of physical existence, but severs the connection from the Divine. Thus, each night we must disconnect from the outer world and reconnect with our divine source, thereby sustaining life and nourishing the soul. In adult life, the experience of Wu Chi is relegated to the unconscious domains of deep sleep and the supernatural worlds of dream. In Taoist Inner Alchemy, we reawaken the soul to the Immortal Tao, the Wu Chi, the Original Source, and bring back the Divine into our conscious awareness.

Chemically, the reconnection to the Divine occurs by inhibiting the enzymatic actions of MAO and INMT, so that seratonin can convert into melatonin and melatonin into the spirit molecules 5-MeO-DMT (5-methoxy-dimethyltryptamine) and DMT (dimethyltryptamine) (Fig. 21). The enzymes are inhibited by substances secreted in the pineal gland, such as harmaline and pinoline. The "spirit molecules" allow us to reconnect to divine consciousness. They cause color imagery, out of body experiences, lucid dreams, visions of beings and/or animals, mystical states, subjective "other realities" and experiences of "being somewhere else." These states are the language of dreams.

In the Darkness experience, the "spirit molecules" pinoline, 5-MeO-DMT and DMT alter the receiving qualities of the brain. The brain "tunes in" to invisible worlds and parallel universes, like a television tuning in to different channels. Mystical and near-death, out-of-body experiences reflect dynamic equilibria between "channels" in which we experience the essential energy that courses through the receiver[15].

When you reach the 'DMT state' you begin to function consciously from the various psychic centers or chakras. The bodily processes of Healing Love combine the human states of true compassion and sexual arousal to create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwined in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love.

Immortal Body

Rick Strassman, based on several years of intensive medical research, proposes that the release of DMT from the pineal gland at 49 days after conception marks the entrance of the spirit into the fetus. This 49-day prenatal period corresponds to the first signs of fetal pineal tissue, the differentiation of the gonads into male and female, and the time between the death of an individual and its soul's next rebirth according to the Tibetan Buddhist tradition. He suggests that the individual's life-force enters the body through the pineal gland and leaves it through the pineal gland at death (see "DMT, The Spirit Molecule", by Strassman[16]. The infant's brain is flooded with 5-MeO-DMT, secreted from the pineal gland and the brain is 40% more active and open[17].

Chemistry of Consciousness

The chemistry of consciousness is, at first glance, complex. The infant basks in the divine glow of consciousness, manifested in the body/brain by the spirit molecules, 5-MeO-DMT and DMT. However, during development, the brain inhibits the flow of conscious-

ness, utilizing enzymes to deactivate the synthesis of the spirit molecules. Then, to re-realize the divine source, the brain must inhibit the inhibiting enzymes! The chemistry is explained in more detail below.

Seratonin (5-hydroxytryptamine), the neurotransmitter implicated in many of the functions of consciousness, is synthesized in the brain from the amino acid tryptophan, a basic building block of proteins (Fig. 21). After fulfilling its role in the synaptic cleft (the space between nerve cells), the seratonin molecule is decomposed into inactive by-products (5-hydroxyindole acetaldehyde) by the enzyme MAO (monoamine oxidase). The seratonin molecule differs from the tryptophan molecule only by the addition of a hydroxyl group (OH) and removal of a carboxyl group (COO).

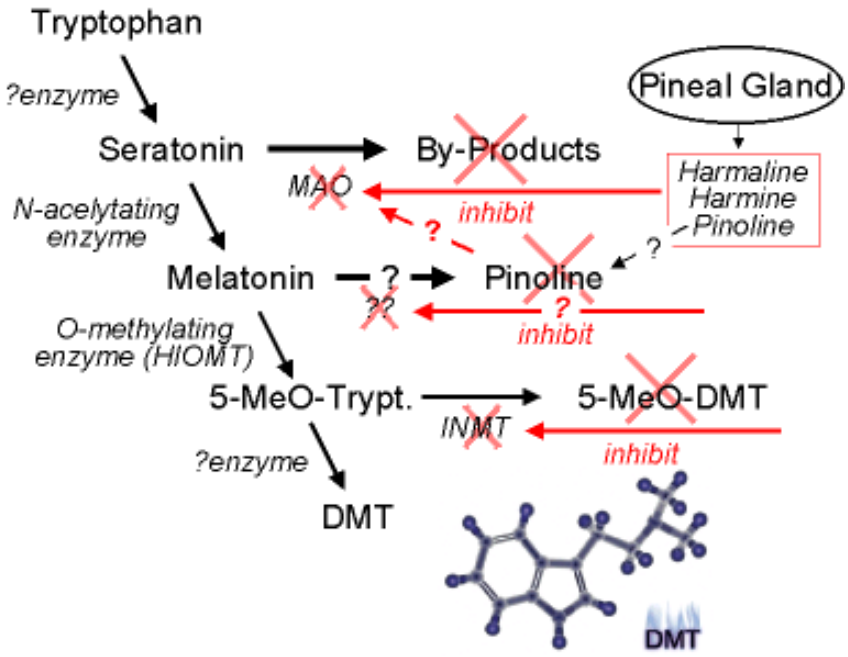

Fig. 21. *Tryptamine Synthesis*[14]

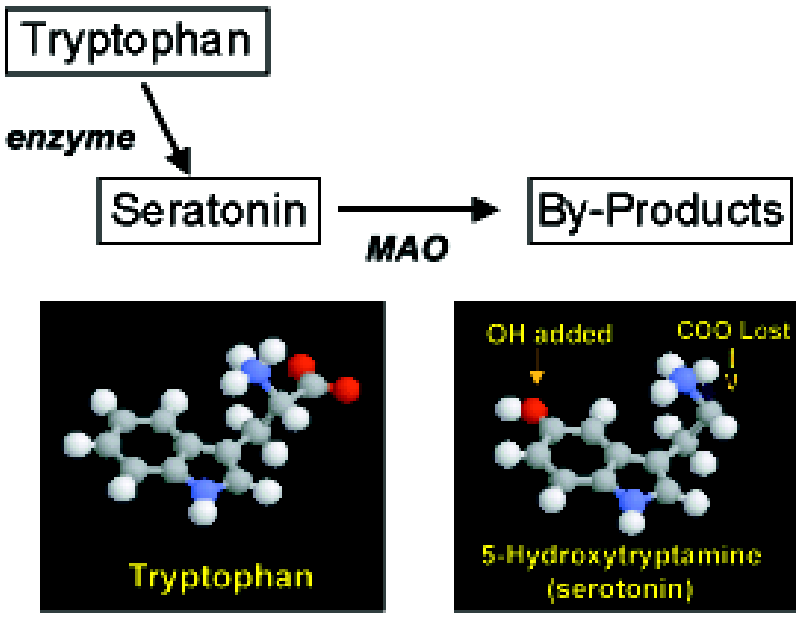

Fig. 22. *Seratonin Synthesis*[18]

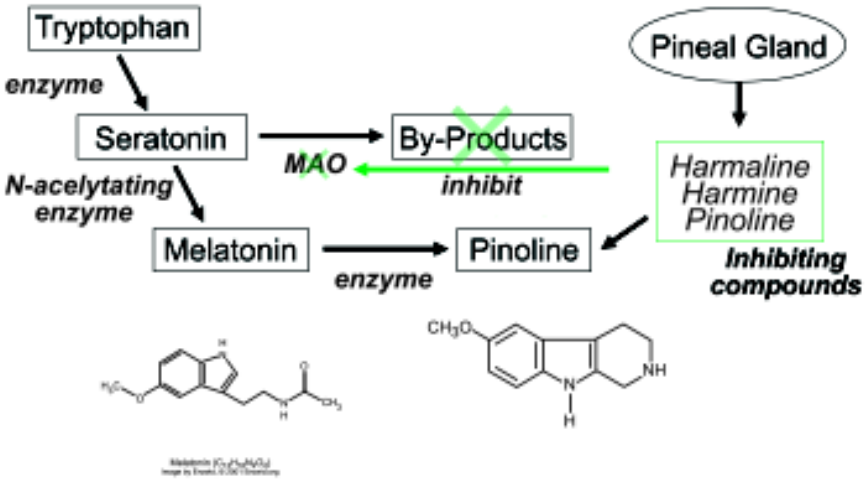

Fig. 23. *Melatonin and Pinoline Synthesis*[19]

indole sub.	aromatic (H_0)	dihydro (H_2)	tetrahydro (H_4)
	with a 1-methyl substituent		
Ar-H	**harman**	harmalan	**tetrahydroharman** (THH)
Ar-6-OH	6-harmol	6-harmalol	**6-tetrahydroharmol**
Ar-6-OMe	6-MeO-harman	**6-MeO-harmalan**	**6-MeO-tetrahydroharman**
Ar-7-OH	harmol	harminol	**tetrahydroharmol**
Ar-7-OMe	harmine (a)	harmaline (a)	tetrahydroharmine (a)
	with a 1-hydrogen substituent		
Ar-H	βC	DHβC	**THβC (tryptoline)**
Ar-6-OH	6-HO-βC	6-HO-DHβC	**6-HO-THβC**
Ar-6-OMe	6-MeO-βC	6-MeO-DHβC	**6-MeO-THβC (pinoline)**
Ar-7-OH	7-HO-βC	7-HO-DHβC	7-HO-THβC
Ar-7 -OH	7-MeO-βC	7-MeO-DHβC	7-MeO-THβC

Fig. 24. *"Harm'" Compounds: Pinoline also goes by the names 6-Methoxytetrahydro beta carboline, and 6MeOTHBC*[20.]

Melatonin (N-acetylseratonin), the neurohormone implicated in sleep, is synthesized directly from seratonin, by deactivating MAO and inhibiting the destruction of the seratonin molecule (Fig. 23). MAO (monoamine oxidase) is deactivated (inhibited) by the beta-carbolene enzymes secreted in the pineal gland: harmine, harmaline, and pinoline. As melatonin levels rise in the brain, the melatonin converts to pinoline (Fig. 23). There is some confusion in the literature regarding pinoline synthesis, perhaps because it has multiple synthesis pathways, as well as close affinities to a variety of related compounds (Fig. 24).

The inhibition of MAO (monoamine oxidase) also allows for the synthesis of the "spirit molecules", 5-MeO-DMT (5-methoxy-dimethyltryptamine) and DMT (dimethyltryptamine) (Fig. 25). In a two-step process, 5-MeO-DMT is synthesized from melatonin with the assistance of the O-methylating enzyme HIOMT (hydroxyindole-O-methyltransferase) and the enzyme INMT. DMT differs from 5-MeO-DMT by the removal of a CH_3 group.

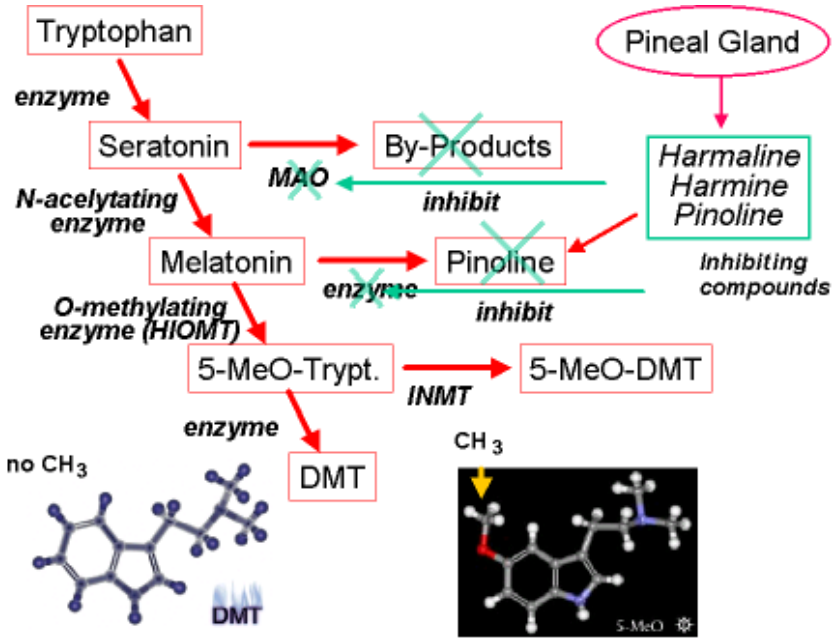

Fig. 25. *5-MeO-DMT Synthesis*[21]

The pineal gland also secretes molecules that inhibit the enzyme INMT, allowing for the synthesis of DMT (Fig. 26). DMT synthesis may require activation by the adrenaline and ephedrine systems.

It should be noted that the tryptamine derivatives are often unstable, volatile substances, and molecules with nearly identical structures may have significantly different functions and effects (Fig. 27). DMT, for example, is metabolized by the brain in a matter of 10's of seconds. The tryptamine molecules may rapidly destabilize and transform into sister compounds, and multiple pathways may exist for the formation of a given tryptamine structure. This probably accounts for some of the considerable confusion in the literature regarding the origin of the various "spirit molecules". Pinoline synthesis, as a prime example, has been variously attributed to both melatonin and 5-MeO-DMT parent compounds. The suggestion that pinoline is a pineal secretion ignores the actual molecular pathways that lead to its synthesis.

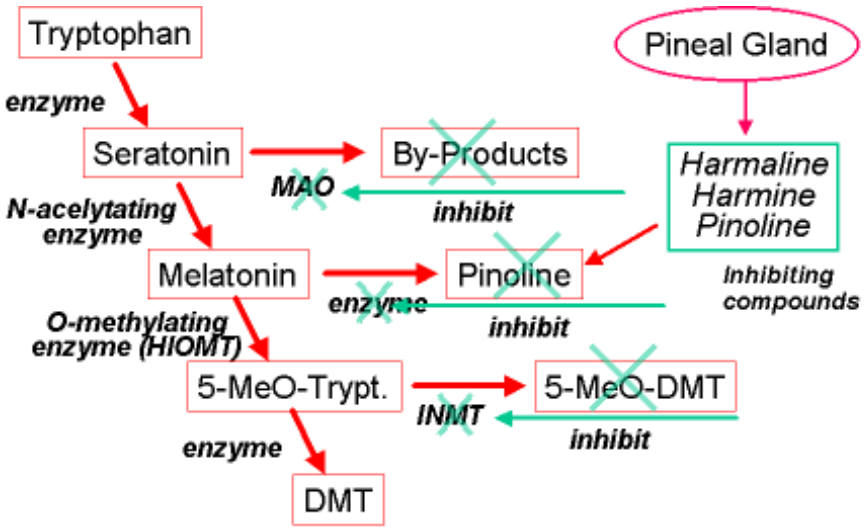

Fig. 26. *DMT Synthesis*[22]

Orally and Parenterally Active Psychotropic Tryptamine Derivatives http://deoxy.org/trypfag.htm
Based on McKenna & Towers 1984

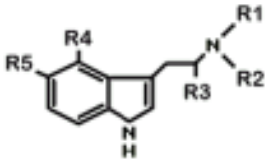

Name of Compound	R1	R2	R3	R4	R5	Dosage (mg)	Route Oral/Par.
tryptamine	H	H	H	H	H	130 *1	par/oral?
DMT (dimethyltryptamine)	CH3	CH3	H	H	H	60	par
5-MeO-DMT	CH3	CH3	H	H	OCH3	8	par
serotonin	H	H	H	H	OH	130 *3	oral
Data compiled from Kantor, et al. 1980; Shulgin 1976, 1982; Shulgin&Carter 1980							

Fig. 27. *Tryptamine Derivatives*[23]

Stages of Darkness Technology

Benefits of Darkness Experience

The Darkness meditations will influence each person uniquely, depending on their maturity and stage of spiritual development. However, most people, even beginners, will receive great benefits, which may include:

1. Relaxation. This is one of the foundations for all other work. During the first days of the retreat, catching up on sleep, allowing the eyes to recuperate from the over-stimulation of our visual world, releasing the grip of mental concerns, plans, and agendas and simply letting the energies settle creates the best vacation you may ever have.
2. Once relaxed and feeling at home in the dark, the Inner Lights may appear as well as possible images of space teachers, deities, colors, and shapes. Imbalances in one's energies can manifest as dull colors.
3. Over time, as one becomes more open, balanced and awake, images clear as day may appear, not inside the mind's eye but outside in the space of the retreat.
4. Advanced practitioners may experience some of the following: Dreams and sleep become more lucid. A state of continuous consciousness arises in which there is no break in conscious awareness; meditation can continue during sleeping and non-sleeping hours.
5. The Taoist Secret of Love and the Healing Love become very active, so that working with sexual energies and engaging in creative work become easier and more powerful.
6. Dreams will often take the form of teachings or participation in great mythological stories.

The Darkness enables the body and mind to undergo a series of profound transformations. The 'states of consciousness' appear correlated with the organic synthesis and accumulation of psychedelic

chemicals in the brain, especially melatonin (Days 1 to 3), pinoline (Days 3 to 5), 5-MeO-DMT (Days 6 to 8), and DMT (Days 9 to 12). The pharmacology of these states is as follows.

'Melatonin Stage' (Day 1 to 3)

Complete isolation from external light causes the pineal gland to flood the brain with the neurotransmitter melatonin (average 2 to 5 mg/day), manifesting initially as the need for sleep and rest. The eyes recuperate from the over-stimulation of the visual world, releasing the grip of mental concerns, plans, agendas, and letting the energies settle. Melatonin is essential for maintaining the hibernation state, which facilitates the emergence of spiritual consciousness. The person retains a child-like biological condition where melatonin is conserved and recycled, not wasted in biological continuation. When this substance works together with the yellow marrow in the bone, the reddish firing reaction will activate a gentle interaction between the sacred water and the light. The sacred waters are the inner fluids that are responsible for producing bone marrow and other bodily fluids. The waters run not only in the center of the bones, but also in the spinal connections between the Crown and Perineum Points.

'Pinoline Stage' (Day 3 to 5)

After about three days, when melatonin concentration reaches sufficient levels (15 to 20 mg) the body then begins to produce the superconductor pinoline, whereby a greater fluidity of thought and healing of the body starts to occur. Pinoline induces cell replication (mitosis) and intercalates with DNA molecules. The 'pinoline stage' is normally activated only in the womb, in lucid dreaming, or in near death experiences. Within this state we can metaprogram the brain to the Unity of Self, heightening awareness of the pathways with which we filter reality. At this stage, the nervous system becomes aware of itself. We become aware of the hologram of the external world that we create constantly in our head[24].

When the pinoline is triggered you activate your clairsentient and clairaudient powers. You may see light and visions, hear music, and gain phenomenal insight. A decoding of the DNA then begins to take place. Cosmic particles are attracted to us and decoded in the form of sound, light, knowledge and realization. The particles, which have the same cell structures as humans (and from which the Tao believes you evolved), are attracted to you magnetically. The body has approximately six trillion cells, which correspond to the universe 'without'. Each of these cells can be seen as a computer with unlimited power and potential. Each cell can become a super conductor, able to receive information from space. You are able to decode this universal information carried from outer space, which may be as old as nothingness itself. When you enter this primordial state or force you are reunited with the true self and divinity within. You literally 'conduct' the universal energy. You may see into the past and future, understand the true meaning of existence, and begin to understand the order of things. You return to the womb, the cocoon of our material structure and Nature's original Darkness.

'5-MeO-DMT Stage' (Day 6 to 8)

At this stage the pineal gland starts to produce the neuro-hormone 5-MeO-DMT (aka 'akashon'). This psychoactive tryptamine is highly luminescent and also extremely phosphorescent due to the amount of phosphene that it transmits onto the visual cortex. 5-MeO-DMT switches on 40% more of the cerebral cortex and awakens the nervous system to become aware of itself; 'beingness' results. Hence, the possibility of metaprogramming the nervous system's bio-computer - activating healing and conflict message assortment of the nervous system. 5-MeO-DMT is the empathogenic neurotransmitter that expands the emotional body between 'infinity and zero'. It gives rise to telepathy in the emotional and intuitive bodies. It engages the awakening of the 'Flower of Life', the spine, which begins to glow in a state of beingness and peace.

5-Meo-DMT discharges the Darkness from the Darkness. A bright light is activated and one experiences a born-again mentality. This Great White Light, the manifestation of the astral body, enables the self to project externally. At this point, some degree of 'N-Methyl-D-Aspartare Inhibition' (NMDA-I) usually occurs. This is a 'soft form' of the slowing of the glutamate input signals into the cells. This makes it easier for the nervous system to cause electrons to stop flowing within the cells, allowing for profound meditative trance states. 5-MeO-DMT intercalates with messenger RNA. One can see in 3 dimensional Holon pictures, as the thoughts behind language.

"Techniques taught in the Darkness enable one to read and go beyond the matrix, by unifying all directions, and externalize the soul computer so that one can start to interact with ones own genetic code of the Tree of Life. In this intensive process 5-MeO-DMT activates the entire spine, the Tree of Life. The spine is activated and reprogrammed and you can start to process the illusion of the dream from its binary code into the unified translated Self: the Unity Self. Through 14 days of total light isolation your consciousness can be expanded to the wider range of wave emanations and transduce the core hologram of reality that is coherently programming ones nervous system to the Unity Self[25]."

Many exercises will be practiced during this period: compacting Chi, consciousness and awareness into the nervous system, working with the Silent Self and anchoring the Immortal Body.

The 5-MeO-DMT prepares the nervous system, through its empathetic state of being and self awareness of the nervous system, for the DMT or dimethyltryptamine production of the pineal gland, in psychoactive milligram doses.

'DMT Stage' (Day 9 to 12)

When DMT levels reach more than 25 mg, one's experience can become very visual. DMT is the visual Third Eye neurotransmitter. It enables the energy body and spirit to journey into hyperspace, beyond third dimensional realms of time and space. It is intensely energizing. "After some 10-12 days one starts to see in infrared, and ultraviolet, one can actually run across the room and touch a person, by seeing their heat patterns. The Holon Images exteriorize and one is walking in a Virtual Reality, which appears to be the DNA language macro uploaded, and interactive."

When you reach the 'DMT state' you begin to function consciously from the various psychic centers or chakras. The bodily processes of Healing Love are then combined with those of the Darkness. The human states of true compassion and sexual arousal create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwining in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love. When this 'love-vibration' reaches the pineal gland a new hormone is produced, which in turn creates whole body conductivity. Only when you feel the waves of orgasmic vibration and unconditional love for the self and others can the process be activated and the essence of the Darkness is magnified.

At this stage of the Darkness retreat, the required amount of sleep tends to diminish dramatically. Although the day may last 24 hours, 3 hours of sleep can seem like 12. During this period we will engage in further practices; psychic games and interactivity, Taoist Dream Yoga (advanced levels) and Imagination Expansion

Darkness Information and Logistics

Preparations for the Darkness Retreat

Our mindset and attitudes upon entering a Darkness retreat will help set the stage for our immersion into darkness. It would be wonderful to enter with a sense of clarity, openness, joy, and of resting in our true nature, but this is more the fruit of the retreat than a prerequisite. Nevertheless, some of the attitudes that can help set the stage include:

1. Looking forward to a wonderful rest and vacation from the pressures of everyday life.
2. Curiosity about what will arise.
3. Longing for the clarity, wisdom and fruits of the practices of the retreat.
4. Dedication to growth.
5. Treating whatever arises as an opportunity to learn.
6. Connecting to your teachers and the teachings.
7. A sense of support from the community.
8. Service to the larger community and the world and wishing to be a beneficial presence.
9. Confidence stemming from the fact that others have successfully navigated through such retreats for thousands of years and have returned with immense treasures through their commitment and efforts.
10. Gratitude for this opportunity to learn, to grow, and to create benefit and beauty for oneself, others, and the World.

Inner Preparations – Practice at Home

1. Each participant should practice the Cosmic Inner Smile, Six Healing Sounds, Fusion of the Five Elements, Microcosmic Orbit, Iron Shirt Chi Kung and Tao Yin, which bring the body into a state of balance and tuning. A physically fit vehicle is the foundation stone from which to launch astral travel into multi-dimensional orbits and higher cortical activity.

2. All participants are encouraged to engage in a healthy preparatory diet and bowel cleansing process, commencing 4 weeks before the retreat. Diet should be rich in Vitamin D, beta-carotene like choleric, calcium (2,000 gm), magnesium (500 mg) and zinc (20 mg/day).
3. We suggest that participants increase their daily intake of seaweed and blue green algae approximately four weeks before the retreat. Bring a sufficient supply of vitamins, seaweed and blue green algae along with you. This will enable essential amino acids and enzymes required by the body and third eye, to produce the all-important neurotransmitters of the 'Internal Alchemical Elixir'.
4. Participants should endeavor to disperse all emotional troubles with friends and family members, prior to the retreat.

Outer Preparations – Practical Advice

1. We recommend that you arrive at Tao Garden several days before the retreat, to settle yourself, continue the purification process, and to become accustomed to the physical environment and retreat layout. This will facilitate your day-to-day life in complete darkness.
2. It is imperative to leave any light-emitting device outside of the Darkness retreat. The eyes and our perception will become extremely sensitive to the least bit of illumination; even the faintest leakages of light, such as a watch dial or LED, will disturb the environment. Therefore, please do not bring: illuminated clocks and watches, flashlights, flash cameras, palm pilots, cell phones, etc.
3. Make sure that all clothing and personal items that you will need for the period of the retreat are in order. Create a way of laying out the different items so that you can easily determine what you are selecting. Organization and order can make everyday functioning much easier.
4. Bring eye-shades with you to Tao Garden, such as the blindfolds that you might wear during travel to help sleep. The

eye-shades will be worn during the retreat to soften the eyes and remind the eyes that they are unnecessary in the Dark ness, breaking their habitual pattern of use.

5. Medications and vitamins require special care. It may be helpful to contain daily doses in separate vials, medication boxes, or plastic zip-lock bags. A multi-vitamin supplement is useful, and special supplements of vitamin D are particularly important to make up for the lack of exposure to sunlight.
6. It is important to take care of any personal business before entering the retreat, such as letters, phone calls, etc., and to plan on total isolation from the outside world for the duration of the retreat.
7. Bring sunglasses and eye-shades with you to Tao Garden. The 7th, 14th and 21st evenings are opportunities to terminate the Darkness Retreat. You will leave through a reflexive tunnel, wearing sunglasses to readjust to the light.

Darkness Nutrition

Food is specially prepared to meet the requirements of the body, mind, and spirit in attaining the goals of darkness enlightenment. Fresh juices and soups are served for “breakfast” and a light organic meal is prepared for the afternoon. The diet consists of simple, often liquid foods. Seaweed and blue green algae meet many of the general dietary requirements, supplying high concentrations of the eight essential amino acids required by the body (see below). Fresh juices, especially from the noni (Morinda) fruit, supply the metabolic enzymes necessary for developing the neuro-endocrine system to its highest potential.

Sufficient levels of tryptophan are especially important for the Darkness experience (See: Chemistry of Consciousness p. 28). Tryptophan is one of 20 amino acids, which are the basic building blocks of proteins. It is one of the eight “essential” amino acids, meaning it cannot be synthesized by the body from other amino acids, and must therefore be ingested in foods. Adults need from 3.5 mg/kg/day to 350-500 mg of tryptophan per day.

As tryptophan crosses the blood-brain barrier, it is converted to serotonin with the assistance of vitamins B6, B12 and folate. Tryptophan is also converted in the body to niacin (vitamin B-3) and picolinic acid. Giving high doses of vitamin B-6 along with tryptophan increases its conversion to niacin and decreases its uptake into the nervous system. Low blood tryptophan levels have been reported in depressed patients and are corrected with tryptophan supplementation. Tryptophan is better absorbed in the brain when consumed as part of a high carbohydrate meal.

Some of the tryptophan-rich foods available at Tao Garden, and recommended for the Darkness retreat, are listed below, along with several other tryptophan-rich foods.

Tryptophan-Rich Foods(Tao Garden[39]) Tryptophan-Rich Foods

- Seaweed, Blue-Green Algae
- Tofu, Soy Milk, Soy Yogurt, Soy Beans
- Brown Rice
- Bananas, Dates, Figs
- Peanuts
- Watermelon Seeds
- Fish and other Seafoods
- Cottage Cheese
- Milk and Milk Products
- Malt
- Legumes
- Almonds, Soy Nuts
- Brewer's Yeast
- Animal Protein: Beef, Turkey, Chicken

Levels of tryptophan in some common foods[40]:

- Fish and other seafoods 800-1,300 mg/lb
- Meats 1,000-1,300 mg/lb
- Poultry 600-1,200 mg/lb
- Peanuts, roasted w skin 800 mg/cup
- Sesame seeds 700 mg/cup
- Dry, whole lentils 450 mg/cup

Accessory Vitamins

B6 (pyridoxene); Sources: Meats, fish, green leafy vegetables, legumes, bananas, whole grains.

B12 (Cobalamin); Found almost exclusively in animal products (meats, fish, poultry, milk, eggs, yeast, cheese).

Blue Green Algae

Algae are the fundamental basis of the entire food chain — the foundational nutrient source for creating and renewing all life on earth. Blue green algae are the crème de la crème of all algae, one of the planet's most powerful foods. This single-celled organism (actually a bacterium) is richly endowed with a vast array of easily assimilated nutrients including essential fatty acids, active enzymes, vitamins, amino acids, minerals, proteins, complex sugars, and phytonutrients.

Blue green algae have an amino acid profile that is nearly in exact proportion to the requirements of the human body. It contains over 60 minerals and trace minerals in naturally chelated form so the body can absorb them into the cells. With the exception of vitamins D and K, all vitamins are present to provide fuel for our cells (Vitamin D and K are produced naturally by our body). Blue green algae contain the Essential Fatty Acids (EFA) Omega-3 and Omega-6, and are one of the highest known natural food sources of beta carotene (a cell regenerator and potent neutralizer of free radicals) and chlorophyll (excellent chelating ability to escort toxins out of the body). The food is also 97% assimilable, digestible and useable by the body.

Spirulina, a spiraled blue green alga, is one of the most common nutritional varieties of blue green algae. A spirulina factory is located in Lampang, southeast of Chiang Mai (see www.spirulina.co.th).

Summary

Complete darkness profoundly changes the sensory sensibilities of the brain. The body is deprived of all visual reference. Sounds begin to fall away as we lose contact with the external world and turn the senses inward. The effect of darkness is to shut down major cortical centers in the brain, depressing mental and cognitive functions in the higher brain centers. Emotional and feeling states are enhanced, especially the sense of smell and the finer senses of psychic perception. Dreams become more lucid, and the dream state manifests in our conscious awareness. Eventually, we awaken within ourselves the awareness of the Source, the spirit, the soul. We descend into the void, into the darkness of deep, inner space. The light appears.

The darkness environment dramatically alters the chemistry of the brain, manifesting especially in neuro-endocrine systems which govern consciousness and regulate body functions. An important neurotransmitter involved in waking consciousness (seratonin) converts into a regulatory hormone (melatonin) that shuts down the organ systems, quieting the body in preparation for the finer and subtler realities of higher consciousness. The pineal gland initiates a cascade of inhibitory reactions, permitting visions and dream-states to emerge in our conscious awareness. Eventually, the brain synthesizes the "spirit molecules" 5-methoxy-dimethyltryptamine (5-MeO-DMT) and dimethyltryptamine (DMT), facilitating the transcendental experiences of universal love and compassion.

The spirit molecules are synthesized from the amino acid tryptophan in a series of biochemical steps, which simplified are: **tryptophan → seratonin → melatonin → pinoline → 5-MeO-DMT DMT**. The spirit molecules enable the nourishment and sustenance of the soul, sought daily in deep sleep and dream.

The direct experience of consciousness is often discordant with the necessities of physical existence on Earth. Thus, in waking consciousness (actually waking ignorance), the body inhibits 5-MeO-DMT and DMT synthesis by producing the compound MAO to deac-

tivate the seratonin – DMT pathway. To maintain its connection to the soul, however, the body must periodically inhibit the action of monoamine oxidase (MAO), allowing for DMT synthesis and a return to the Source. This is accomplished by enzyme inhibitors, such as harmine and harmaline, which are secreted by the pineal gland in response to circadian rhythms and the darkness of night. The pineal gland also produces the hormone melatonin, which helps regulate circadian rhythms in the body.

Daylight is the cue that inhibits our essential connection to the Source, but facilitates physical survival on Earth. The Darkness experience relaxes this constraint, by inhibiting the inhibitor, thereby activating the consciousness connection; for example, the pineal secretion of harmaline inhibits MAO, itself an inhibitor, allowing synthesis of 5-MeO-DMT and DMT. Thus, in the Darkness, our biochemical connections to the Source are re-established. The Dark ness facilitates the synthesis and accumulation of the spirit molecules (5-MeO-DMT and DMT) in the brain, and hence the experience of our true nature, of love and compassion energy, and our **reconnection with the Divine Tao (Wu Chi)**.

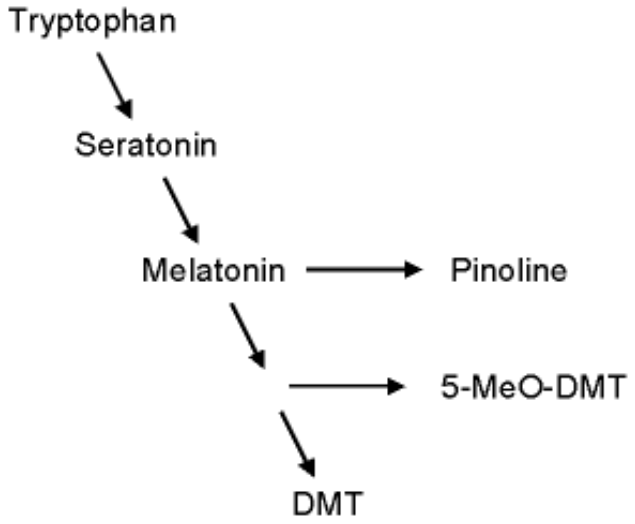

Fig. 28 *Tryptamine Synthesis, Simplified*

Appendices

References of Interest

DMT, The Spirit Molecule, by Rick Strassman, M.D.[26]

TIHKAL, Tryptamines I Have Known and Loved, by Alexander Shulgin and Ann Shulgin[27].

The Vaults of Erowid: Documenting the Complex Relationship Between Humans and Psychoactives[28].

Orally and Parentally Active Tryptamine Derivatives[29].

Notes on the Synthesis of Tryptamine Derivatives

Fig. 21 is based on a variety of rather confusing sources, some of which are reproduced here for further reference and clarification.

"Melatonin is synthesized from serotonin (5-hydroxytryptamine) in the following manner: (1) An N-acetylating enzyme converts serotonin to N-acetylserotonin; (2) the latter compound is O-methylated through the action of hydroxyindole-O-methyltransferase (HIOMT). Serotonin is metabolized to 5-hydroxyindole acetaldehyde by the enzyme monoamine oxidase (MAO). The activity of this enzyme in the destruction of serotonin and that of HIOMT in the O-methylation of N-acetylserotonin provide convenient vehicles for controlling the amount of melatonin present in an organism at any one time.[27]"

1. Melatonin: N-Acetyle-5-Methoxy-Tryptamine, or N-Acetyl-Serotonin.

2. Pinoline: About 212 electrons in weight, it is a tri-cyclic indole nucleus with 3 attached rings, a pyrido, 3,4-indole, known as the beta carboline base) it is: 6-Methoxy-tetra-hyrdo-beta-carboline 6-MeO-THBC. With C13 H12 N2 O.

3. DMT: Is an indole tryptamine made from Tryptamine and Serotonine by several enzyme metabolisations. It has 188 electrons, and is known as: N,N,Dimethyltryptamine, N,N,DMT, more technically as 3-[2-(dimethylamino)ethyl]-indole, with C12 H16 N2.

4. 5-MeO-DMT: 5-Methoxy-Dimethyltryptamine. It has 218 electrons in its molecular weight, it converts to Pinoline, and it is structured as C13 H18 N2 O.

Pinoline and Harmine as well as other beta carbolines, inhibit the Mono Amine Oxidase enzyme. In a process called oxidative deamination, MAO converts as much as 80 percent of the body's serotonin into a physiologically inactive metabolite. As serotonin binds to the enzyme's active sites MAO removes the amine function and renders the molecule harmless and ineffective. … Hence, inhibiting MAO, softly, means that there is a much larger turnover of serotonin which renders a major anti-depresent affect, …. It appears that Pinoline plays an even more important role on depression, and it is produced only in sufficient quantites in darkness.

Pinoline (6-methoxy-1,2,3,4-tetrahydro-beta-carboline) is a naturally occurring compound in the mammalian body which inhibits 5-hydroxytryptamine (5-HT) [seratonin] uptake and exerts antidepressant-like behavioural effects in rats. … pinoline did not have any modulative influence on the activity of 5-HT transporter and it interacts competitively with citalopram on the substrate recognition site of the 5-HT transporter.

Synthesis of DMT Derivatives. Tryptamine derivatives and beta-Carbolines have been detected as endogenous metabolites in mammals, including humans. Methyl transferases that catalyze the synthesis of tryptamines, including DMT, 5-MeO-DMT and bufotenine, are found in human lung, brain, cerebrospinal fluid, liver and heart (McKenna & Towers 1984). In the pineal gland MAO is the primary inactivation pathway of serotonin, a neurotransmitter synthesized from the amino acid tryptophan. If MAO is blocked by harmine, harmaline or other MAO inhibitors serotonin can be converted by the methyltransferase enzymes HIOMT and INMT into psychedelic tryptamines (serotonin —(HIOMT)—> 5-MeO-trypt. —(2*INMT)—>

5-MeO-DMT). …. A potent inhibitor of INMT, which is a necessary enzyme for the synthesis of DMT and 5-MeO-DMT, is found in particularly high concentrations in the pineal gland. A bypassing or inhibition of the synthesis of this inhibitor might be responsible for trances and other psychedelic states achieved “without drugs”.

5-MeO-DMT Drug Trip Account

“I can remember this feeling of building intensity up to a point, and then I was not there in my body or in time. In the 10 to 15 minutes that my body was under the influence of the drug my mind was completely referenceless, there was no way for my consciousness to limit or gauge the stimuli my being was barraged with. I remember switching to a perception where the endless and intricate phosphene was love and the energy of light. I called upon those forces within my being to realign and submit, to let go of all the cogent fears and just exist ... and that innate decision saved me a lot of psychic damage. What is most outstanding about the way it feels is an inability to judge in any way, by any method of the mind ... it is unconquerable, as deep and profound as a totally unconditional love that is life. “What a trip, huh?” …. I beheld every thought that was going on everywhere in the universe and all possible realities while I was wracked out with this horrible ruthless love. It scared the hell out of me. When I could see again (15 minutes later) it was almost as if there was an echo of a thought in my head saying that I was given an extremely rare look at the true consciousness of it all. I’ve never been hit this hard since then. A definite ++++.

“ … it began with a fast-rising sense of excitement and wonder, with an undertone of “Now you’ve done it,” but dominated by a sense of, “WOW, This Is IT!” … The entire universe imploded through my consciousness. It’s as if the mind is capable of experiencing a very large number of objects, situations and feelings, but normally perceives them only one at a time. I felt that my mind was perceiving them all at once. There was no distance, no possibility of examining the experience. This was simply the most intense experience

possible; a singularity, a white-out (as opposed to a black out), I have little memory of the state itself … I had the feeling, a visualization of being part of the universe of beings, all active in our daily, interwoven tasks, still moving at an incredible rate, and with a longing for a single group/organism awareness and transcendence. In a few more minutes it faded to an alert … state with an additional sense of awe and wonder, relief, and a strong feeling of gratitude toward the universe in general, for the experience."

DMT Drug Trip Account

After DMT inhalation: "As I exhaled I became terribly afraid, my heart very rapid and strong, palms sweating. A terrible sense of dread and doom filled me — I knew what was happening, I knew I couldn't stop it, but it was so devastating; I was being destroyed — all that was familiar, all reference points, all identity — all viciously shattered in a few seconds. I couldn't even mourn the loss — there was no one left to do the mourning. Up, up, out, out, eyes closed, I am at the speed of light, expanding, expanding, expanding, faster and faster until I have become so large that I no longer exist — my speed is so great that everything has come to a stop — here I gaze upon the entire universe."

Inner Alchemy: Physical Explanation

Each one of the cells that our body is composed of is directly related to the first original cell located right behind the navel. This cell was born of the meeting of the ovum and sperm of our parents. As long as this cell sends a message of perfection to the DNA of each cell in the body, we are virtually immortal. When we work with inner alchemy, we can recombine the 64 Amino Acids of DNA by following the 64 eternal laws of change (I Ching), and our cells are able to get in better touch with more subtle forces (Higher Energy). We do this until we reach the divine spark in the original cell. This process can change our atomic structure.

Developmental Process of Melatonin

The history of melatonin starts around the pre-Cambrian age, when the anaerobic cells started to evolve into a more efficient form of life, called the aerobic state. Aerobic cells make use of the O_2 (oxygen, Yang, fire), and H_20 (water, Yin). In this way the cells assimilate the organic molecules (mostly composed of $C0_2$, Carbon) much more easily.

In the process of assimilation, oxidation occurs, creating free radicals. Some free radicals deform molecules by penetrating the cellular membrane and "bombing" the DNA, causing a great amount of damage, including mutations. The process of oxidation weakens DNA. When a cell reproduces the new cell's DNA is also weaker. Taoists were aware of this process many thousands of years ago, and said that it was not good to reproduce when one was old, or if one drank, or was in a weak condition, as this would cause the offspring to be weak. To avoid this undesirable process cells started to develop melatonin.

Yin/Yang Harmony in the Body

The first action of melatonin is anti-oxidant, which is a Yang process. Another basic effect of melatonin is a reactive energy we call hormones, and this is Yin. This antioxidant is more efficient and versatile than Vitamin E or Glutathion, and is five hundred times more powerful than DMSO against radiation. They speak as well about Pi Gu, or the nearly complete cessation of food intake. In fact, when you get to the higher level, and not before, you don't want to disperse your refined energy to counteract the oxidation process, especially when eating carbohydrates which are rich in C06. Everything in the universe including our glands have Yin and Yang. We spoke about the Yang aspect of melatonin, and we assert that the Yin side of melatonin is as a hormone. The hormone function of melatonin is related with the whole endocrine system, especially the adrenal glands. The Yin aspect of the adrenal gland is cortisone, while the Yang aspect is adrenaline. To have an ideal situation we

need to balance the Yin hormone melatonin with the Yang adrenaline, and the Yang antioxidant in melatonin with the cortisone that is Yin. The pineal gland that produces melatonin works more during the Yin period of our day, i.e. at night. The adrenal works more during the Yang part of the day, i.e. daytime. If during the daytime we move adrenaline through Tai Chi, meditation, Chi Kung, etc., then at night we will have a stronger production of melatonin and cortisone. From 9 to 11 pm, our bodies produce more cortisone. From 11 pm to 3 am, the sexual energy rises, producing more melatonin, (Yin). This process is connected with the pituitary gland and the thyroid growing process. From 3 to 6 am we produce more melatonin, or Yang antioxidant, and this matches perfectly with what Taoists say - that 3 to 6 am is the best time for meditation. At this time the pineal and sexual glands are connecting, straightening and rejuvenating the DNA, bone, and marrow. From 6 to 12 am, the body produces more adrenaline and it connects with the pancreas in helping the process of the construction of the tendon and muscle fiber. That is why Taoists say that this is the best time for physical practice. The Taoists speak about nine gems that distill essence. In fact, westerners discovered that the process of generating ovum and sperm starts in the pineal gland. A hormonal message, sent to the pituitary and other glands, eventually results in the production of the egg and sperm in the sexual glands. By bringing up this essence, we reconnect the circuit, enhancing and strengthening a more refined production of hormone that slowly starts a transformation, slowing the aging process and enabling the great masters to achieve their remarkable attainments.

Life Style Awareness

Most people do not follow the above mentioned timetable. They use the upper gland energy during the day, getting stressed and emotional, and the lower gland energy at night, by eating late, staying in artificial light, and especially having sexual intercourse at night time. They make the body too fiery and this increases it's tendency to burn out over time. To reverse this aging process through inner transformation, we depend on the ability of our body to produce

melatonin to protect and recreate the stem cells located in the spinal marrow. If we can do this the body is able to reproduce brain cells and other body cells which are free of any of the signs of aging. As a result of the increased and refined flow of melatonin and other hormones in the glands, the immune system is activated 200% more than in the normal state. This especially increases the piastrims, phagocytes and lymphocytes.

Meditation

High dosages of melatonin shut down the conscious processes of the mind and create a space for deep, altered states of consciousness to arise. This means that we can dream and at the same time have Delta waves. We can also have Delta waves while awake, which was considered impossible by western medicine before this experiment. Taoists speak about the ecstatic or inner journey and this refers to the same process that western medicine is now discovering. This is nothing but a deep state of meditation.

Food, Drugs and Melatonin

Ansiolitic medications such as valium, zanax, aspirin and novalgin decrease the production of melatonin. Some mild antidepressant drugs induce relaxation by causing a slight rise in the production of melatonin. Stronger antidepressants, such as prozac, tend to decrease the melatonin production and stimulate the adrenal and other glands. Vitamin B-12, caffeine steroids, tobacco, and in a very special way, refined sugar all tend to decrease melatonin production. Alcohol consumed before 10:30 at night tends to reduce melatonin production, whereas, when it is consumed after 10:30 pm, it tends to increase melatonin production. At 11 pm energy flows into the liver, which is a basic organ in regulating hormonal secretion. Other foods rich in melatonin are: oats, corn, brown rice, ginger, ripe tomatoes, bananas, parsley, algae, dates, oysters, soya, cottage cheese, chicken liver, pumpkin and pumpkin seeds, turkey, tofu, watermelon and apple seeds, almonds, peanuts, yeast, vitamin B-3, (which is

found in dried fruit), parsley, liver, sunflower seeds, salmon and swordfish, vitamin B-6 (found in carrots, lentils, avocado, and prawns). Tryptophan, seratonin, calcium and magnesium, and marijuana increase melatonin production by more than 2000 times, if taken in the right quantities and at the right time of day. However, after such high production of hormone the result can be a down, or feeling of depression. Once a person is practicing we need to be careful. Our bodies become more subtle, precise, refined and more sensitive, so we need to avoid excesses of any kind, especially external stimulation. Such stimulation tends to disharmonize the subtle body mechanics, and this is true for drugs, medicine, food supplements, herbs, etc. If a food or an herb is medically perfect it doesn't necessarily mean that it is good for your body. It could be the opposite. What we are learning is to look for our inner medicine.

Footnotes

[1] http://isd.saginaw.k12.mi.us/~mobility/hypothal.html
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Darkness Technology

Darkness Techniques for Enlightenment

Mantak Chia

Illustrations by Udon Jandee

Darkness Technology

All spiritual traditions have used Darkness Techniques in the pursuit of enlightenment. In Europe, the dark room often appeared in underground form as a network of tunnels, in Egypt as the Pyramids, in Rome as the catacombs, and by the Essenes, near the Dead Sea in Israel, as caves. In the Taoist tradition caves have been used throughout the ages for higher level practices. In the Tao, the cave, the Immortal Mountain, the Wu San, represents the Perfect Inner Alchemy Chamber. Meditating and fasting in the cave is the final journey of spiritual work. The caves are the Earth Mother and its energy lines. Like hollow bones, caves contain the earliest information of life stored inside the Earth. Caves contain the vital essence of the Earth Power. The Tao says: 'When you go into the dark and this becomes total, the darkness soon turns into light.'

Darkness Technology gives our mind and soul the freedom to wander in the vast realms of psychic and spiritual experience. When you enter this primordial state or force you are reunited with the true self and divinity within. You literally 'conduct' the universal energy. With the information in this booklet you may see into the past and future, understand the true meaning of existence, and begin to understand the order of things. You return to the womb, the cocoon of our material structure and our original Dark Room.

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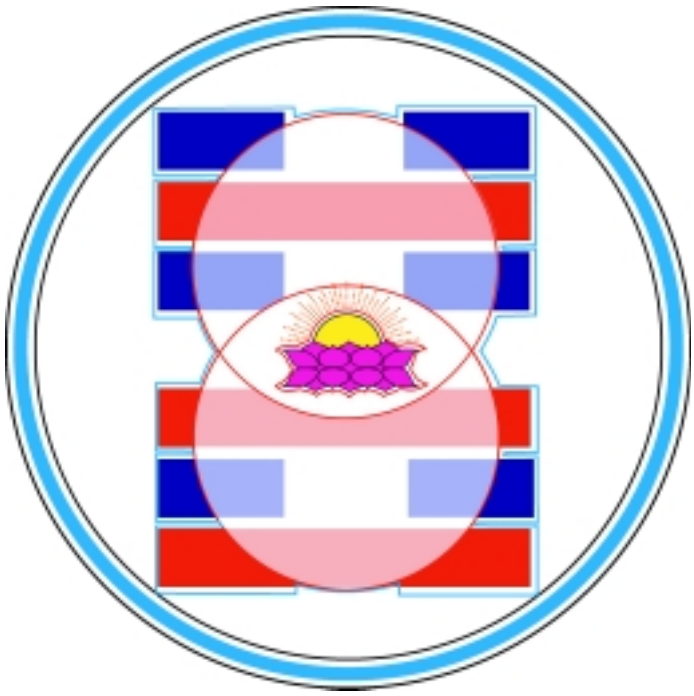

Dark Room Enlightenment

Lesser, Greater, and Greatest Kan & Li

Universal Tao Center, Thailand

18 February 2002

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Dark Room Enlightenment

All spiritual traditions have used Dark Room techniques in the pursuit of enlightenment. In Europe, the dark room often appeared in underground form as a network of tunnels, in Egypt as the Pyramids, in Rome as the catacombs, and by the Essenes, near the Dead Sea in Israel, as caves. In the Taoist tradition caves have been used throughout the ages for higher level practices. In the Tao, the cave, the Immortal Mountain, the Wu San, represents the Perfect Inner Alchemy Chamber. Meditating and fasting in the cave is the final journey of spiritual work. The caves are the Earth Mother and its energy lines. Like the hollowing bones, caves contain the earliest information of life stored inside the Earth. Caves contain the vital essence of the Earth Power. The Tao says: 'When you go into the dark and this becomes total, the darkness soon turns into light.'

In the Dark Room, our mind and soul begin to wander freely in the vast realms of psychic and spiritual experience. When you enter this primordial state or force you are reunited with the true self and divinity within. You literally 'conduct' the universal energy. You may see into the past and future, understand the true meaning of existence, and begin to understand the order of things. You return to the womb, the cocoon of our material structure and Nature's original Dark Room.

Complete darkness profoundly changes the sensory sensibilities of the body/brain. We are deprived of all visual reference. Sounds begin to fall away as we lose contact with the external world and turn the senses inward. The effect of darkness is to shut down major cortical centers in the brain, depressing mental and cognitive functions in the higher brain centers. Emotional and feeling states are enhanced, especially the sense of smell and the finer senses of psychic perception. Dreams become more lucid, and the dream state manifests in our conscious awareness. Eventually, we awaken within ourselves the awareness of the Source, the spirit, the soul. We descend into the void, into the darkness of deep, inner space.

Darkness activates the deepest centers within the brain, the glands of the Crystal Palace, establishing a connection with the Original Source, the Wu Chi (**Fig. 1**). The pineal gland connects us to the Universal Energy. From the hypothalamus gland, we project our soul or spirit upwards, and receive the descending Universal Energy. The pituitary gland receives the Cosmic Force, used to launch the spirit bodies into the earthly or human plane for traveling.

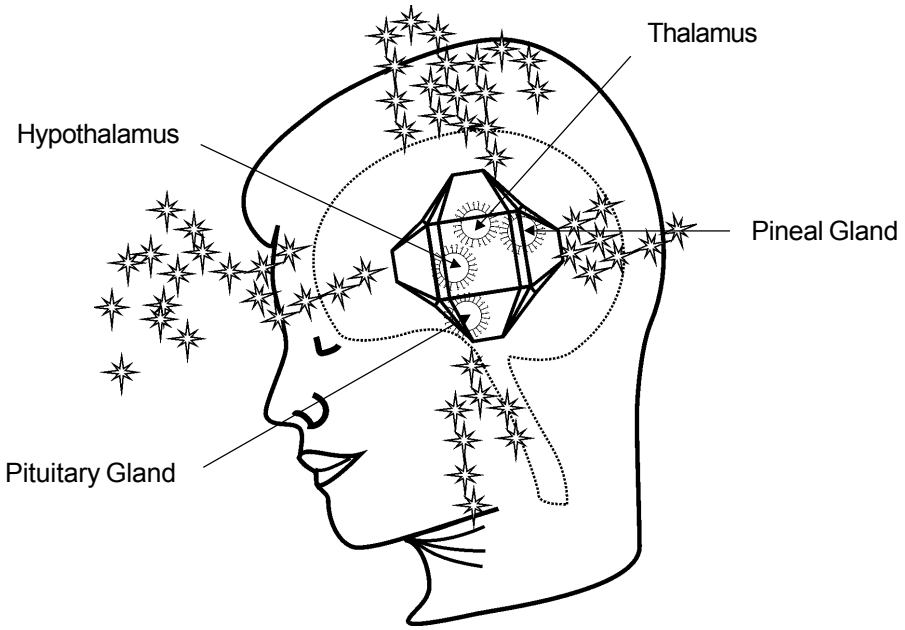

***Fig. 1**.Glands of the Crystal Palace are buried deep within the brain. They include the pineal, hypothalamus, thalamus, and pituitary glands.*

The darkness actualizes successively higher states of divine consciousness, correlating with the synthesis and accumulation of psychedelic chemicals in the brain. Melatonin, a regulatory hormone, quiets the body and mind in preparation for the finer and subtler realities of higher consciousness (Days 1 to 3). Pinoline, affecting the neuro-transmitters of the brain, permits visions and dream-states to emerge in our conscious awareness (Days 3 to 5). Eventually, the brain synthesizes the "spirit molecules" 5-methoxy-dimethyltryptamine (5-MeO-DMT) and dimethyltryptamine (DMT), facilitating the transcendental experiences of universal love and compassion (Days 6 to 12) (**Fig. 2**).

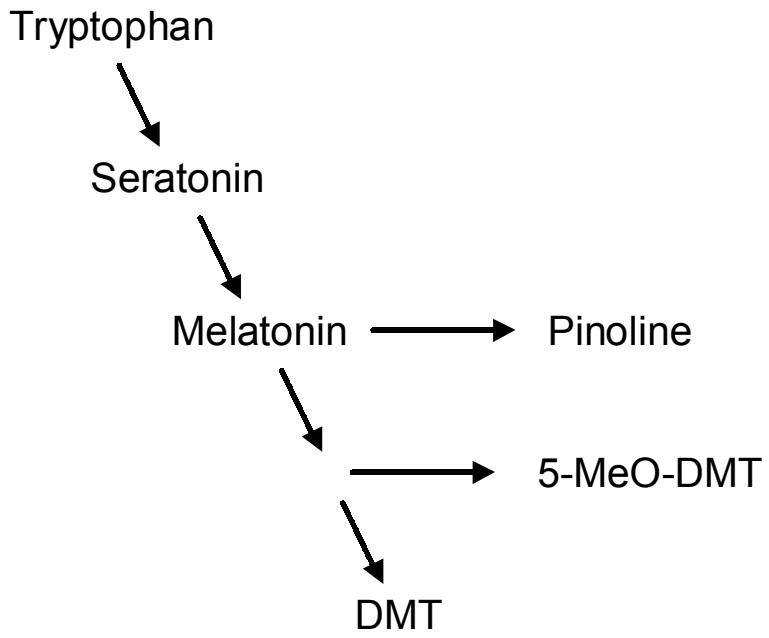

***Fig. 2**. Tryptamine synthesis, simplified: The amino acid tryptophan is the precursor for seratonin, melatonin, pinoline, 5-MeO-DMT, and DMT molecules.*

Universal Tao Dark Room

Starting many years ago, Master Chia went in search of natural caves suitable for meditation in absolute darkness, but none were found. Master Chia and Juan Li spent one day in Wu San, the Taoist Immortal Mountain, the most sacred of the Taoist power centers. The cave was not, however, suitable for dark room retreat. Tourists were ever-present, and the stench of human urine and feces was overpowering. They failed to find the true teaching. Other natural caves were explored, but all suffered some deficiency. The cave environments were dirty and damp, and the air quality poor (dust, fungi, bacteria, insects, snakes …). The caves were dumping grounds, repositories for human waste and garbage. The pristine silence of the darkness was not to be found. Perhaps the perfect cave is still hidden in some deep, high mountain.

Master Chia researched modern Dark Room technologies for many years. A pyramid at Tao Garden, northern Thailand, provided the ground for early experiments in dark room retreat. He made visits to dark room retreats in other countries, to gain insights on the best designs for meditation and for comfort. Eventually, the Universal Tao Dark Room was constructed, based on all available information and latest technologies. The facility is the perfect Inner Alchemy Chamber, conducive to meditation and providing comforts and necessities for up to 60 people. A large central meeting room is surrounded by two tiers of living quarters. The light and sound proof outer sheath is constructed of bricks made from the red earth of Thailand, preserving the earth elements of the original cave. The Mother Earth power is retained in the modern structure.

The Tao Garden Dark Room is enclosed and encased in a light- and sound-proof sheath. The building is constructed of bricks made from the red earth of Thailand, containing all of the properties of natural rock in a cave. The earth was mined and hydraulically pressed into bricks, thus preserving the constituent elements and minerals of the parent materials. The Mother Earth power is retained in the modern structure.

The facility consists of a large, central meeting room for meditation and for dining. Two tiers of bedrooms surround the central area, each with private bath. The entire facility is ventilated with fresh air intakes and air conditioning systems. Food is specially prepared to meet the particular requirements of the body, mind, and spirit in attaining the goals of dark room enlightenment. Fresh juices and soups are served for "breakfast" and a light organic meal are served in the "afternoon". (**See: Dark Room Nutrition**). Participants are trained and prepared for life in the dark (see **See: Dark Room Preparations**).

The Universal Tao Dark Room is currently the largest and most advanced Dark Room meditation facility in the world. Aspiring to the Tao, participants remain in utter and complete darkness for one, two, or three weeks, a perfect laboratory for Inner Alchemy. The spiritual knowledge gained by Taoist masters over the ages merges and blends with the insights of 21st century science and technology.

As Above, So Below

There is one point in the sky around which all other constellations revolve, the North Star point. The North Star is fixed, stationary, motionless. Taoists regard it as the Center, the source of the Universe, the Nothingness, or Wu Chi. The North Star is the Gateway to Heaven. In the Tao, the body is a microcosm of the Universe. "As above, so below." Whatever happens "up there" happens "down here." Hence, the physical body is marked with gridlines of energy and meridians of light around a Center. The Center is called the "Tan Tien", or "field of energy" (**Fig. 3**).

The idea of a Central Axis – the Pole Star in the firmament and a Cauldron in the body – is a central tenet in Taoist philosophy and alchemical practice. To get to the Center of the body, open the Tan Tien; to get to the Center of the Heavens, enter through the North Star. Both are doorways to the heart of the true Tao, the Wu Chi, from which both Heaven and Earth are born. The Inner Alchemy practice of the Universal Tao fuses the body's energies to give birth to a spiritual embryo capable of maturing into a deathless existence and of flight inward, beyond time and space, to the Source.

The Dark Room meditation releases us from the bonds of the Earth. No longer controlled by the rotating power of the Earth, the Sun and the Moon, the organs vibrate in unison with the spiritual stars, the Gates of Heaven. The North Star, unmoving and unwavering in space, is the center, the Wu Chi, emanating violet rays throughout the galaxy, affecting every living cell of nature on our planet. The Big Dipper gathers all the violet light from the universe, and emanates the light as infra-red radiant energy. The emanation of infra-red light of the Big Dipper, combined with the violet rays of the North Star, has a positive, nurturing effect upon the bodies and minds of those who know how to access it. Taoists believe that the Violet Stars, the Big Dipper, and other constellations form the "Gates of Heaven." All living things must pass through these gates to return to their source of origin, the Wu Chi, which is the state of oneness with the Tao.

The dark room environment activates the glouds of the Crystal Palace, actualizing their higher powers and providing a "way back" to the Original Source (**Fig. 1**). When the Crystal Palace is open, it becomes illuminated like millions of shining crystals. It can give and receive light and awaken our inner knowledge and deepest potentials. It receives light and knowledge from the universe and reflects it to the various organs and glands to enhance them.

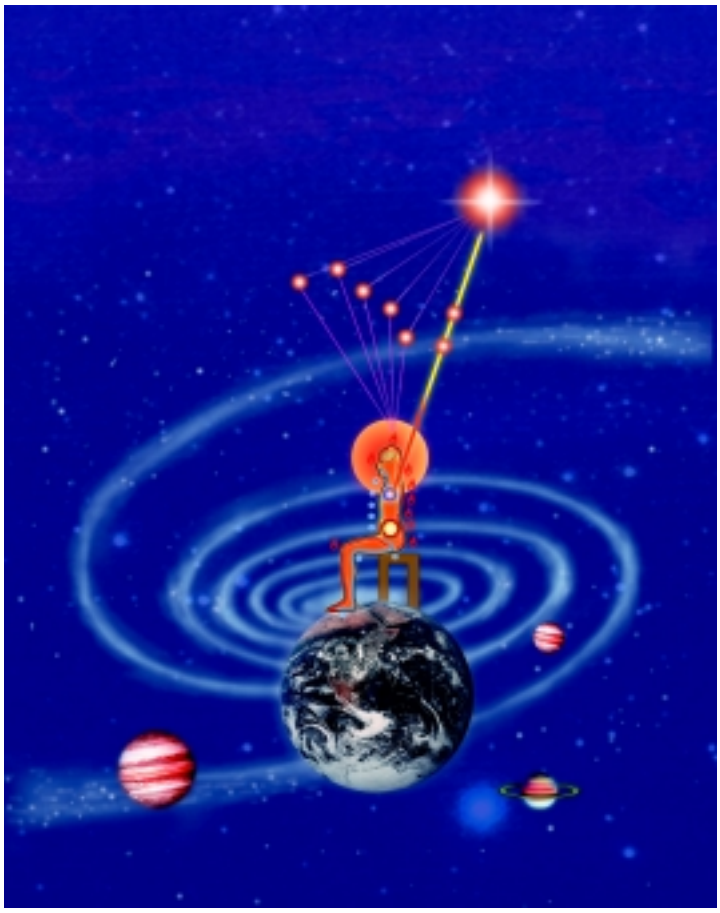

Fig. 3. *Universal connections: We are connected to Mother Earth below, and to the Heavens above. Big Dipper and the North Star are the gateways to immortal life.*

The pineal gland helps us to overcome death by taking in external forces and combining them with sexual energy and the Original Force to form an "Immortal Body." With this body we can leave the physical body before the final transition (death) occurs. By focusing on the tip of the Crystal Palace, the pineal gland, and the back of the crown, we can project ourselves to the North Pole or North Star as we attract its violet emanations (**Fig. 4**).

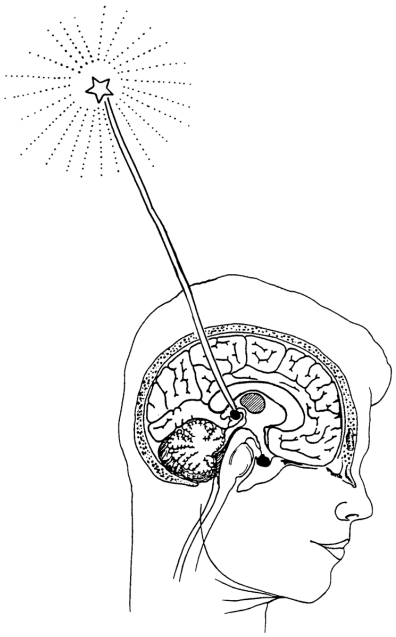

Fig. 4. *Pineal gland has a close connection to the North Star, receiving its violet emanations.*

The pineal, as yang, is balanced by the yin of the hypothalamus gland. Taoists regard this point as the main switch for the Universal Force. When the spirit awakens, it resides in the hypothalamus. When the pineal and hypothalamus are connected, they give out a powerful, balanced force. By focusing on this center and picturing the seven stars of the Big Dipper, you can access the constellation's energy, which emanates from the crown as a ray of red light. (**Fig. 5**).

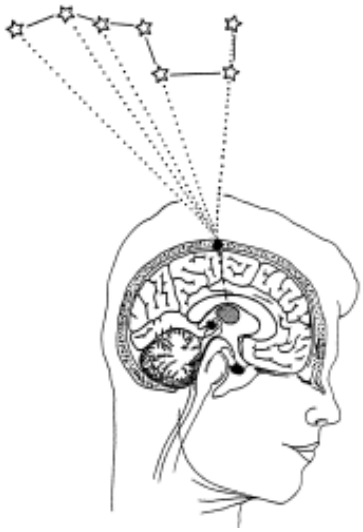

Fig. 5. *Hypothalamus and pineal glands, when connected, allow access to the infra-red emanations of the Big Dipper.*

In the Tao, the sources of longevity and immortality are within the body, not as a physical womb but a spiritual one. Taoists call this spiritual womb the "cauldron". The right method to "cook the cauldron" is not to search outwardly for love from others, but to search within the naked and abandoned self. Self-love, or self-intercourse is the way to give birth to the Immortal Self. The Dark Room manifests the bodily processes of "Healing Love."

The human states of true compassion and sexual arousal create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwined in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love.

When the 'love-vibration' reaches the pineal gland a new hormone is produced, which in turn creates whole body conductivity (**Fig. 6**). Only when you feel the waves of orgasmic vibration and unconditional love for the self and others can the process be activated and the essence of the darkroom is magnified.

The essence of the Dark Room Practice is giving birth to the soul and spirit. The coupling of Yin and Yang energies of the body in the Kan and Li meditations is aimed at overcoming death. It is the method of going back to the state in which we are all orphans, in the very depth of our body/minds.

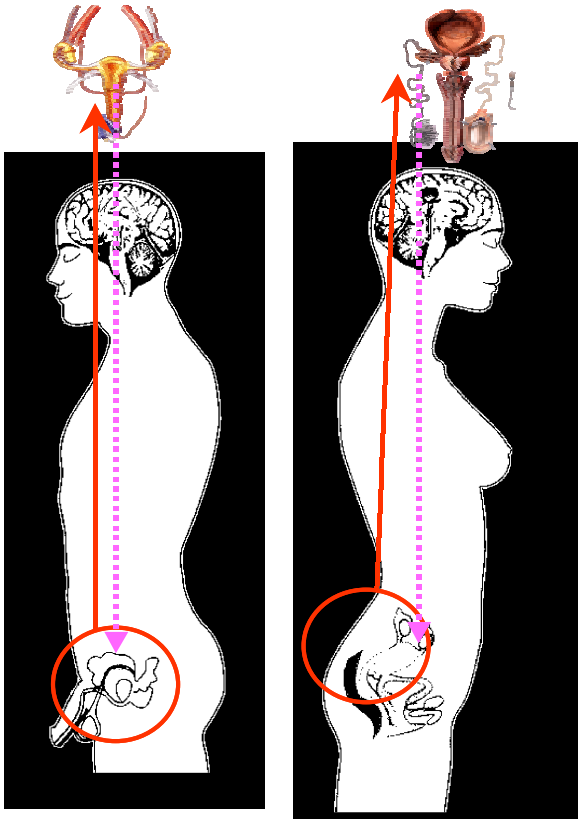

Fig. 6. *Pineal gland connects with the sexual center in the medtation of self-intercourse.*

Consciousness and the Neuro-endocrine System

The dark room environment dramatically alters the chemistry of the brain, manifesting especially in neuro-endocrine systems, which govern consciousness and regulate body functions. An important neurotransmitter involved in waking consciousness (seratonin) converts into a regulatory hormone (melatonin) that shuts down the organ systems, quieting the body in preparation for the finer and subtler realities of higher consciousness. The pineal gland initiates a cascade of inhibitory reactions, permitting visions and dream-states to emerge in our conscious awareness. Eventually, the brain synthesizes the “spirit molecules” 5-methoxy-dimethyltryptamine (5-MeO-DMT) and dimethyltryptamine (DMT), facilitating the transcendental experiences of universal love and compassion.

Autonomic Functions

The body responds automatically and unconsciously to maintain the integrity and vital functions of the organism. The hypothalamus, located deep within the brain, is the major regulatory gland controlling homeostasis, or body maintenance. Factors such as blood pressure, body temperature, fluid and electrolyte balance, and body weight are maintained in dynamic equilibrium, shifting with the needs of the body. To achieve this task, the hypothalamus receives inputs about the state of the body, and initiates compensatory changes if anything drifts out of whack.

The hypothalamus directs body functions though two main pathways. First, the hypothalamus connects to the brainstem, located at the top of the spinal cord, providing a link to the Autonomic Nervous System, the ANS The ANS. has two parts; the sympathetic nervous system activates the “fight or flight” response; the parasympathetic nervous system activates “rest and digest” activities of the body. The brainstem, though the ANS, controls the essential functions of pulse, respiration, body temperature, water balance, swallowing, coughing, as well as our stereotyped reactions and movements.

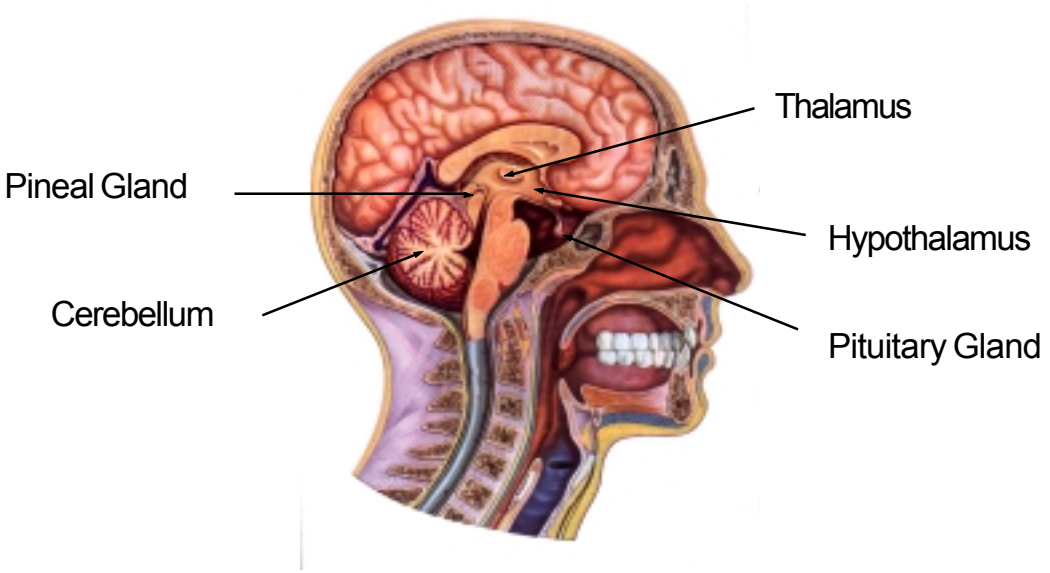

Fig. 7. *Brain Organs*

A second pathway is from the hypothalamus to the pituitary gland, the master endocrine gland in the brain. The pituitary gland secretes hormones, which activate major organ systems in the body, for example the adrenal and sexual centers.

The hypothalamus is of particular importance in the Dark Room because of its affect on circadian (day-night) rhythms in the body. The suprachiasmatic nucleus of the hypothalamus is one of the body's major biological clocks (**Fig. 8**). It not only regulates hormones related to the day/night cycle, but it orchestrates the activities of many other internal clocks. In numerous experiments, it has been shown that when the SCN is not innervated, the human body clocks run free; they set their own time[1].

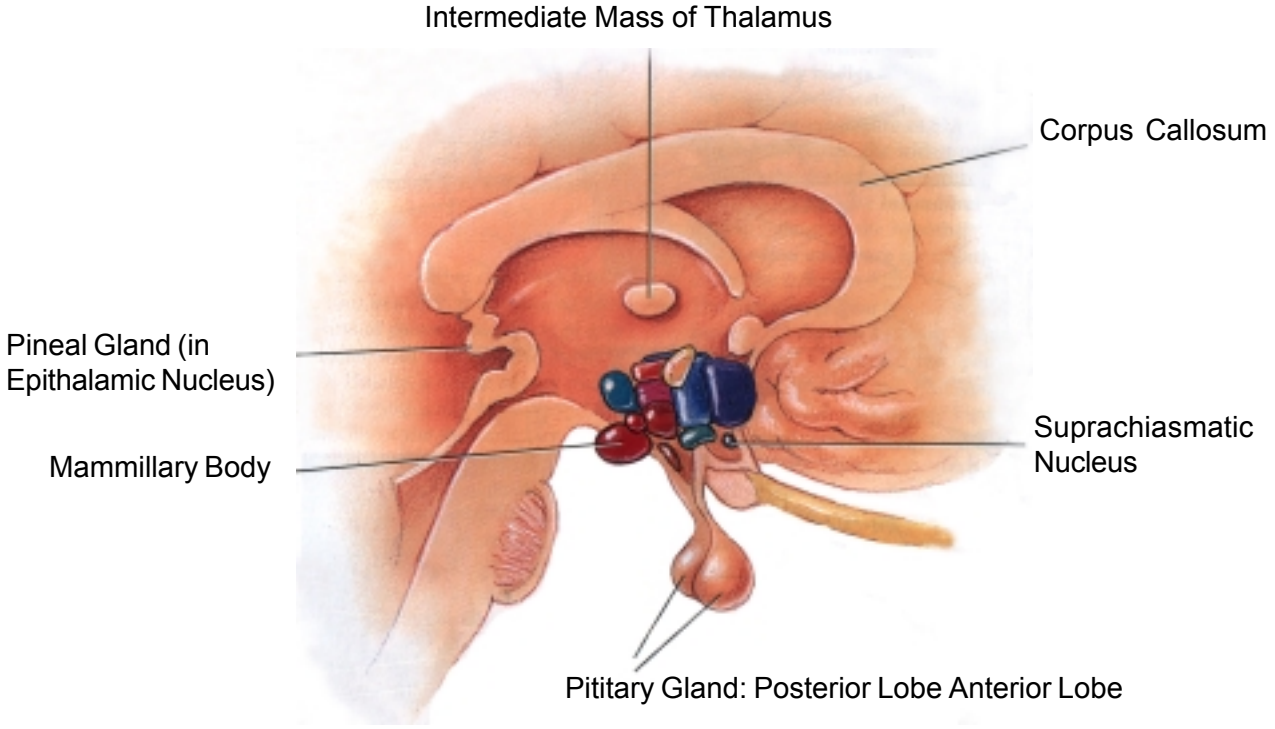

Fig. 8. *Detail of the hypothalamic nuclei. Suprachiasmatic nucleus (SCN) regulates circadian (diurnal) rhythms and activates the pineal gland though sympathetic neurons originating in the brainstem (see Fig. 12)*[2]

Waking Consciousness

An “alarm system” is built into the brainstem, to wake us up and bring us to waking consciousness, called the reticular activating system (RAS) (**Fig. 9**). Sight and hearing are two major pathways of incoming sensory information, providing cues which maintain our state of alertful wakefulness. The optic and auditory nerves stimulate brainstem centers, which, in turn, activate higher cortical centers in the brain though the RAS.

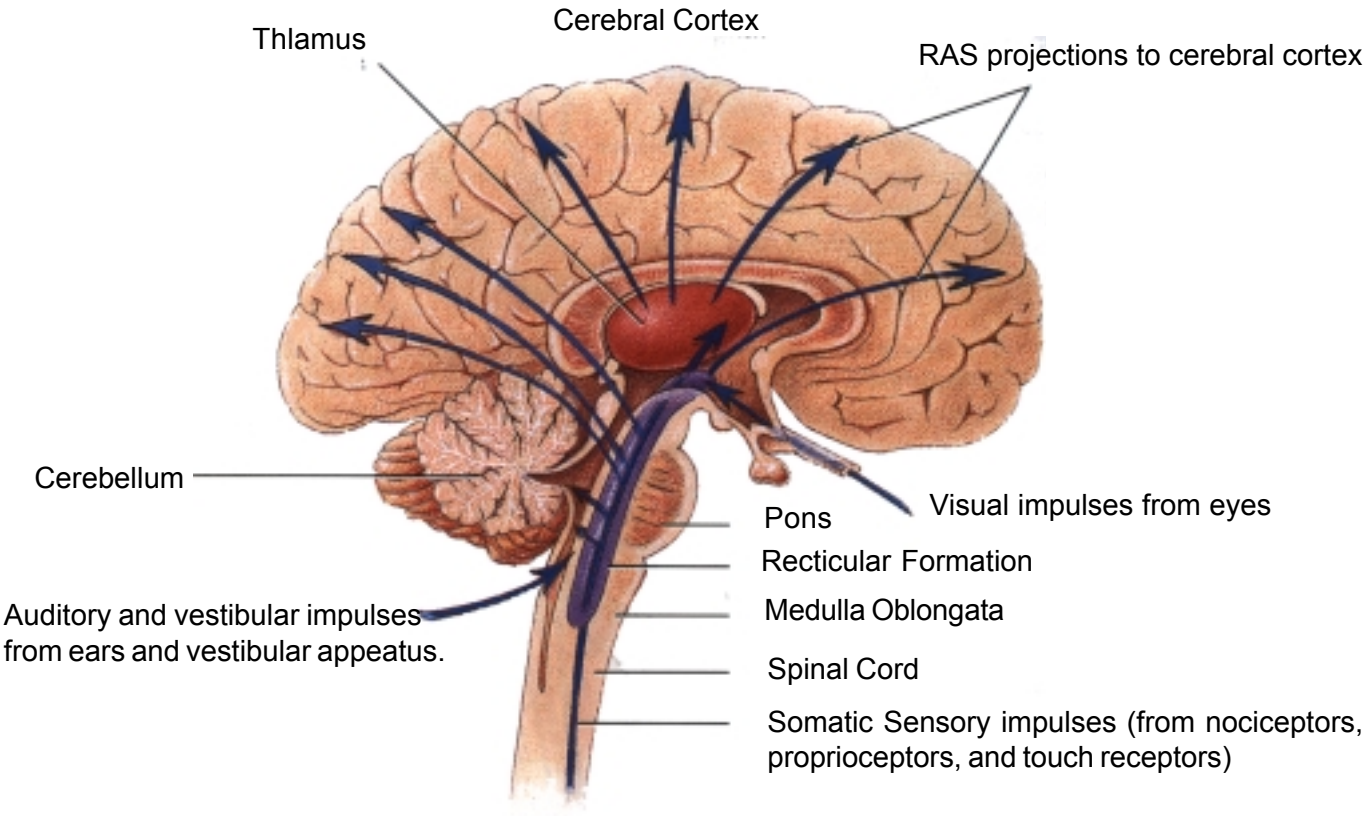

Fig. 9. *Reticular Activating System (RAS): Fibers that project from the reticular formation through the thalamus to the cerebral cortex are responsible for maintaining consciousness, muscle tone, and awakening from sleep, with stimuli from the ears, eyes, and skin, but not the olfactory system, which explains why people die in house fires[3].*

Many of the functions of waking consciousness are maintained by the neurotransmitter seratonin. Seratonin is a chemical messenger, traversing the synapse, or the gap, between two nerve cells (**Fig. 10**). Some of the important nerve pathways assisted by seratonin begin in a region of the brainstem called the raphe nuclei and extend upwards into the cerebrum (**Fig. 11**). Seratonin plays an important role in maintaining cortical arousal, concentration, and suppressing distracting stimuli, as well as a role in sleep.

Seratonin is implicated in a wide variety of psychological phenomena, including depression, anxiety, obesity, and LSD hallucinations. The anti-depressant Prozac, for example, elevates seratonin levels in the synaptic cleft by blocking re-uptake of seratonin into pre-synaptic neurons. (Seratonin levels cannot be raised by ingestion, because the molecule is too polar to pass through the “blood-brain barrier.) As another example, LSD mimics the shape of the seratonin molecule and redirects nerve impulses down unfamiliar and unstructured neural pathways, giving rise to hallucinatory perceptions and experiences. In short, seratonin is the most important neurotransmitter governing states of waking consciousness.

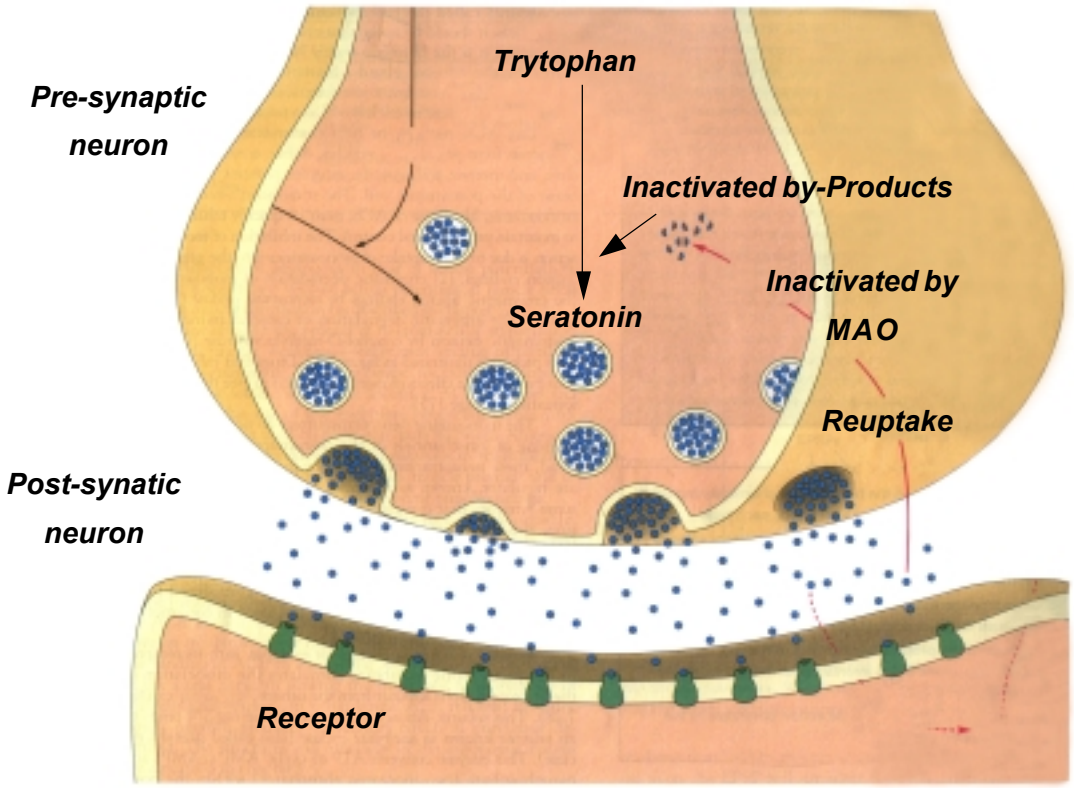

Fig. 10. *Synapse: Neurotransmitter seratonin bridges the gap between nerve cells. After completing its "mission", the seratonin is reabsorbed into the nerve cell and decomposed by MAO into inactive by-products[4].*

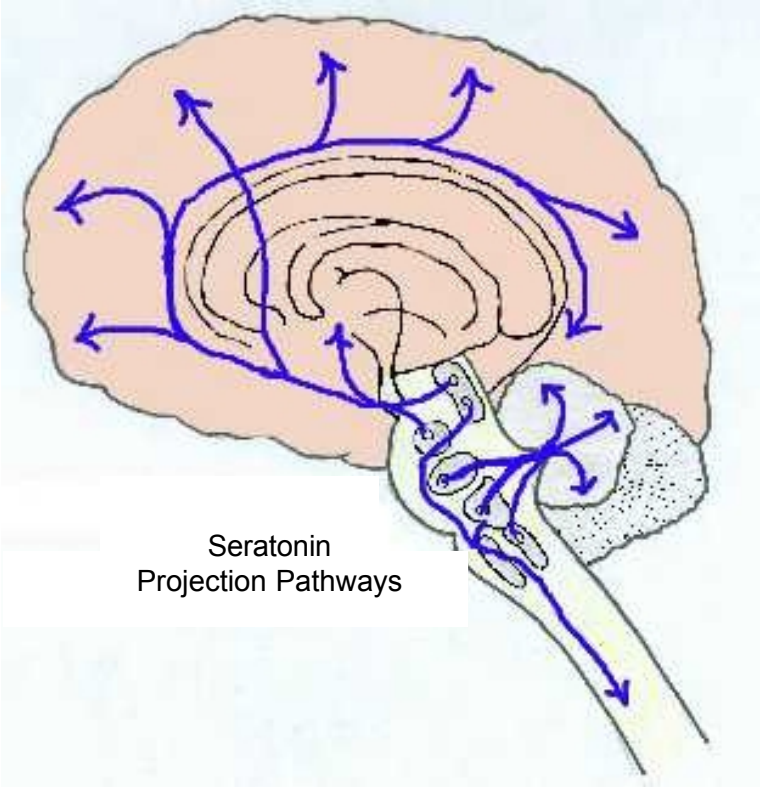

Fig. 11. *Seratonin Pathways. Many of the important nerve pathways assisted by the neurotransmitter seratonin begin in the brainstem and extend upwards into the cerebrum[5] .*

Sleep and Dream

Each night, our waking consciousness is subdued by chemical messengers that inhibit the activities of the brain. Melatonin, the "sleep molecule", is one of these messengers. Melatonin is produced in the pineal gland, in response to the darkness of night, and to the circadian rhythms of light and dark that are programmed into the hypothalamus, an endocrine gland located deep within the brain (**Fig. 12**). Melatonin affects major organ systems, quieting the sympathetic nervous system and allowing daily rejuvenation of mind and body. (also see Appendix: Inner Alchemy, A physical Explanation).

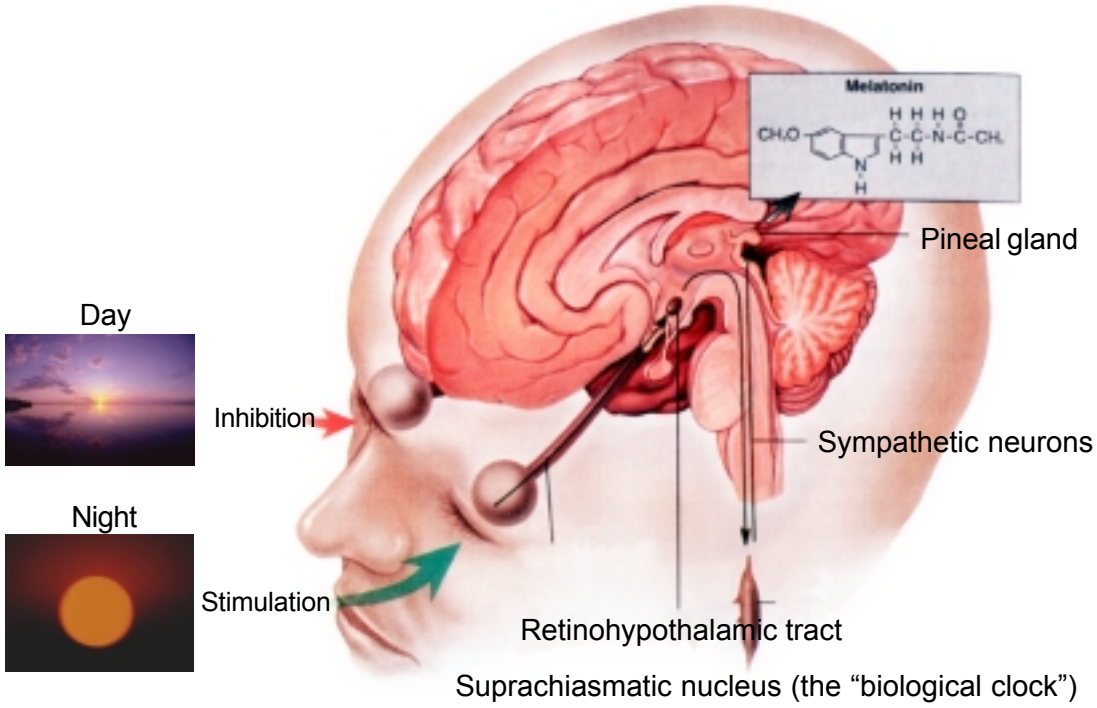

Fig. 12. *Pineal activation: Secretion of melatonin by the pineal gland is stimulated by sympathetic nerve axons originating in the superior cervical ganglion of the brainstem. Activity of these neurons is regulated by the activity of the suprachiasmatic nucleus of the hypothalamus (SCN), which sets a circadian rhythm. This rhythm is entrained to light/dark cycles by neurons in the retina[6].*

The primary function of sleep is to rest and restore not the body, but the mind. Depriving a person of deep, dreamless sleep (delta stage) results in the seepage of hallucinatory phenomena into the waking state. Sleep deprivation causes severe mental disturbance, attention deficits, visual complaints, hallucinations, and time distortion, and, after a number of days a person may go insane.

In the Dark Room, melatonin gradually accumulates in the brain, and we begin to experience the revelations of sleep in our waking consciousness. Sleep and dream states manifest in our awareness, and aspects of our true nature begin to reveal themselves. Sleep consciousness is a profound state of rejuvenation and reconnection to our divine source. It has been said that

> "…the soul temporarily disengages during sleep to 'visit' other dimensions and have experiences, which are remembered during the waking consciousness as dreams. Each and every soul leaves the body as it rests in sleep. The idea that some aspect of the self dissociates during sleep and transits between dimensions (e.g., astral travel) is a common theme in the traditions of many cultures. Sleep is viewed as an opportunity for the mental being to review previous experiences and plan future actions accordingly, hence the retrospective and precognitive function of dreams."

> "During sleep, connection of the physical, mental and spiritual bodies is maintained by a 'silver cord' … similar to the 'thread' or 'cord' of the pineal system. Death involves the severance of this cord whereas sleep may be viewed as merely a temporary 'stretching' of it. The 'projection' of consciousness out of the body during sleep may be related to the … "kundalini" experience and psychic awakening. "[7]

Extended dark room retreats alter sleep cycles somewhat. Initially, people usually sleep more since most people are busy and often sleep-deprived. After two to three days, however, the need for sleep is diminished and a more restful state of being becomes a pervasive aspect of every day. We have observed that when people are quiet and less active during the beginning of a retreat, the elements settle into their own nature more quickly, and a state of alert relaxation arises. After a couple of weeks, one may need only a few hours of sleep each night, and that sleep is often in continuous consciousness.

Descent into Darkness

In the Dark Room, our mind and soul begin to wander freely in the vast realms of psychic and spiritual experience. First, sensory receptors that are controlled by the thalamus gland, with the exception of the olfactory, consciously withdraw (**Fig. 7**). Thus, breathing activity substitutes for the restfulness of visual and auditory function. By keeping the adrenal hormones at their lowest levels the inner peace remains undisturbed. In complete darkness, the visual and auditory abilities become ever more sensitive. The olfactory (smell) and tactile (feeling and touch) organs become the chief senses to supply the little needed energy to the body/mind. Thus the thalamus glands are slowly shut down. The pituitary gland, the master gland for bodily hormones, becomes distilled by the exchange of energy in the body/mind needed for spiritual awakening power.

The hypothalamus gland is in perfect balance and alternates peacefully between wakefulness and sleep. The pineal gland, secreting melatonin to control the subtle bodily rhythms, is sensitized to the vibrations of earth and the scanning light, no longer being driven by the instinctive drive from adrenal power and the waking consciousness of the thalamus glands and the reticular activating system. In this state, wakefulness is a dreaming state and dreaming consciousness is awakening consciousness. They become the functions of spiritual stars and planet earth, rather than the rotating power of the Earth, the Sun and the Moon. This state is the final stage of the returning process on earth.

Limbic System

The primary organ for the emotional activities is coordinated through the function of the amygdala, taken from the Greek word for "almond" because of its fanciful resemblance to almonds. In Taoist tradition, this is the crowning center where both the light and visual frames register, such as the image of sun or of a snake (**Fig. 13**). As the sexual power engages with the light above the brain to form sweet dew, the light in the pituitary becomes gray-white. When it radiates, the two amygdala glands are activated, allowing the Chi to circulate within the temporal lobes on either side of the head, above the ears and around the temples. As the light moves forward, the Third Eye, the essential tool for healing diagnosis, is opened.

The temporal lobes govern all auditory, somatic, and motor sensitivities. The breath coming through the nostrils, as well as the light shining upon the amygdala, charges these sensory activities. The adrenal glands, responsible for releasing norepinephrine and epinephrine, become the seat for true inner stillness (**Fig. 14**). In this state, everything is transformed into the harmless and loving present. By drawing the unconscious light from the adrenal glands, themselves charged by the primordial sexual energy, the mind sees the light and the inner ear hears the cosmic vibration within both the body/mind and the Mother Earth. Mysteriously, the cave of the earth, the cave of the brain (Crystal Palace), and the hollowness within the bones echo with each other, making the cosmic vibration visibly meaningful through the conscious eye.

The meditations of the Inner Smile, Six Healing Sounds, and Fusion Practice are important for quieting and transforming the negative emotions.

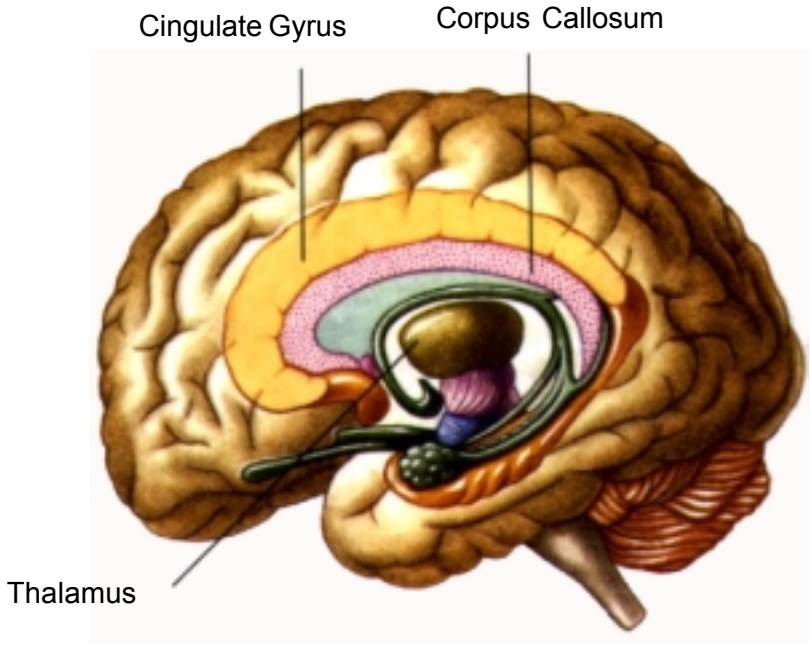

Fig. 13. *Limbic System: The limbic system encircles the top of the brain stem and forms a border (the meaning of "limbic") linking cortical and midbrain areas with lower centers that control automatic, internal body functions.*[8]

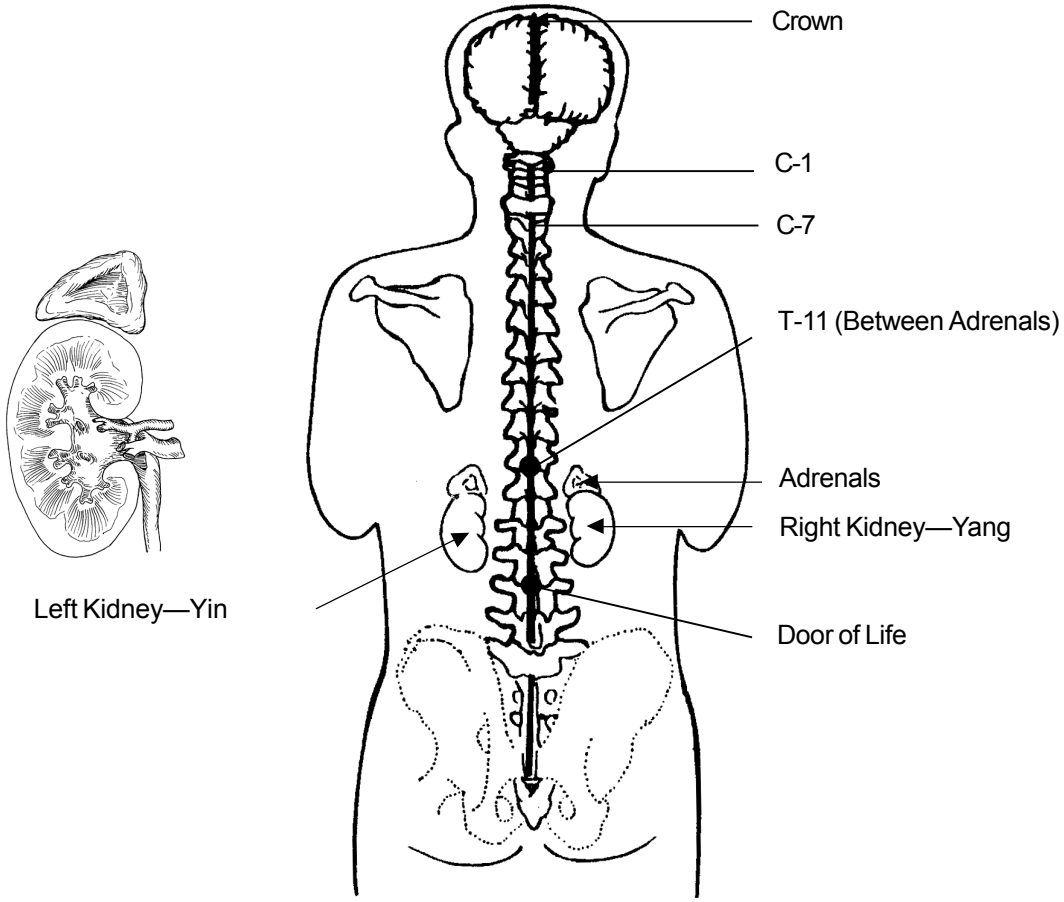

Fig. 14. *Adrenal Glands*

Pineal Gland

The pineal gland is the connection point for the Spirit or Soul. It is the physical center for, and transmitter of, psychic phenomena such as telepathy, clairvoyance in time and space, and the actual influence of thoughts on the physical surroundings[9]. (**Fig. 16**)

"When activated, the pineal gland becomes the line of communication with the higher planes. The crown chakra reaches down until its vortex touches the pineal gland (**Fig. 15**). Prana, or pure energy, is received through this energy center in the head. With practice the vibration level of the astral body is raised, allowing it to separate from the physical. …To activate the 'third eye' and perceive higher dimensions, the pineal gland and the pituitary body must vibrate in unison, which is achieved through meditation and/or relaxation. When a correct relationship is established between personality, operating through the pituitary body, and the soul, operating through the pineal gland, a magnetic field is created. The negative and positive forces interact and become strong enough to create the 'light in the head.' With this 'light in the head' activated, astral projectors can withdraw themselves from the body, carrying the light with them.[10]

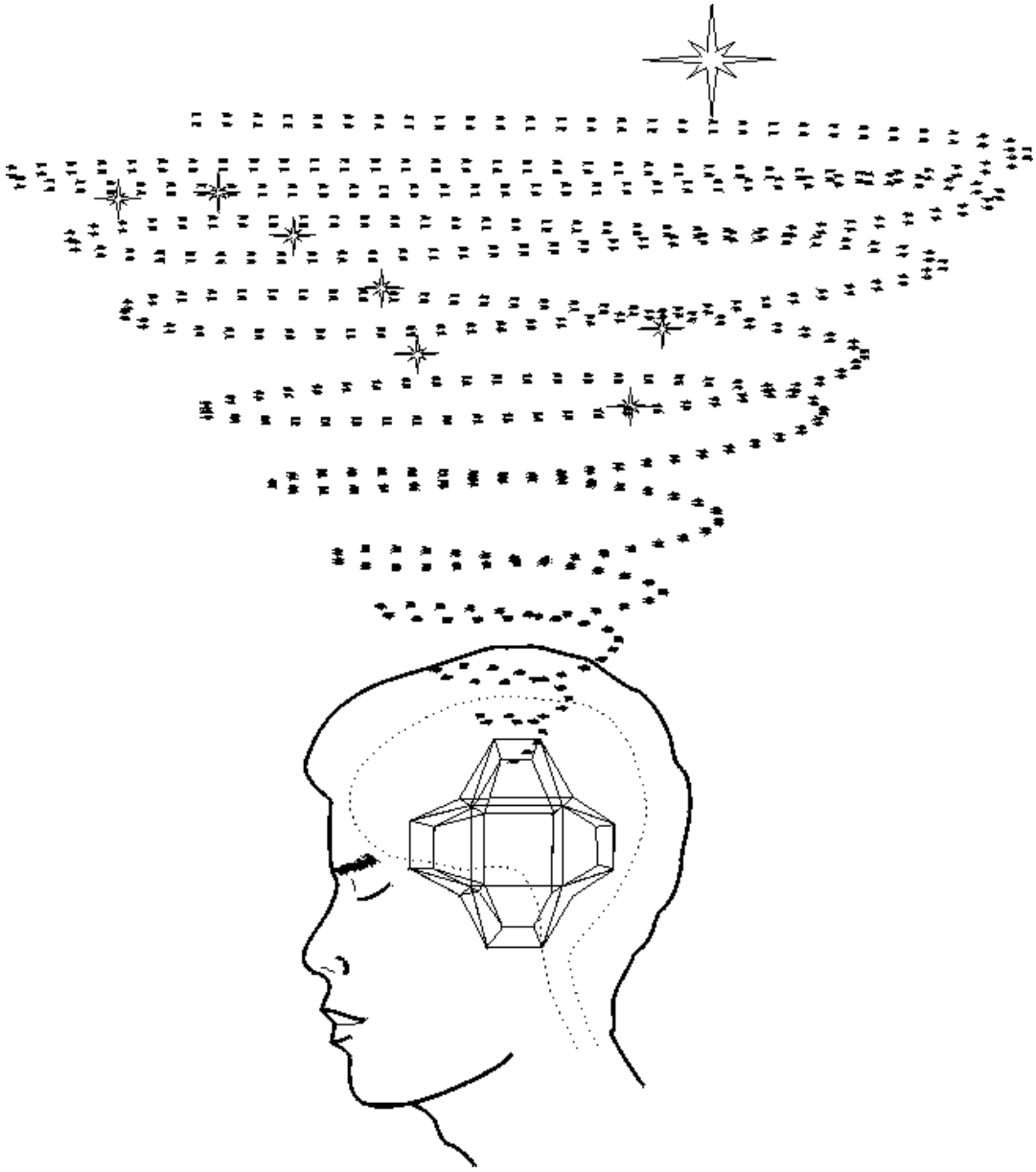

Fig. 15. *Crown Vortex*

Fig. 16. *Third Eye*[11]

"The pineal works primarily by converting the higher dimensional Light, that is constantly streaming into your reality, into usable information for your pituitary. As it gradually activates, the pineal permits the body to move its vibrational patterns into higher and higher levels. This process also allows your Light Body to attach itself even deeper into your physical instrument (**Fig. 17**). Our process is to reset the focus in the pineal. This chemical 'lens' largely disappears as you grow older. The decrease in its efficacy is one of the major reasons for your body aging as quickly as it does. When the pituitary begins to receive the consciousness energy packets from the Well of Dreams through its interaction with the pineal, it secretes enzymes that permit the chemical 'lens' in the pineal to reappear. As this 'lens' strengthens, it allows the RNA/DNA protein strings in your cells to activate your 'third strand'."[12]

Fig. 17. *Heavenly Mirror*

The pineal gland is located in one of the oldest anatomical regions of the brain. If you draw an imaginary line from the center of your forehead, crossed by a line through the head at the ears, you have its general location. The pineal is cone-shaped, about 8 mm (1/3 inch) in diameter, weighing from 50 to 150 mg. The gland is most active during childhood, and begins to regress at about age 7, becoming a calcified tissue strand in the adult (**Fig. 18**).

Fig. 18. *Pineal Gland*[13] *.*

There are numerous anatomical and physiological idiosyncrasies associated with the pineal. It is one of the few solitary organs (most organs in the brain are paired, left and right). While small, the blood flow to the gland is quite large. The pineal has been considered as a homologue of the reptilian 'third eye'. Its photosensitivity derives from neural connections with the retina (**Figs. 12**).

The Taoist practice of Orgasmic Upward Draw is very important to help stimulate the pineal gland. Taoists regard the pineal as the second sexual gland(**Fig. 19**). In the Kan and Li practice, the steaming process helps to clean out all of the organs and reactivate the thymus and pineal glands.

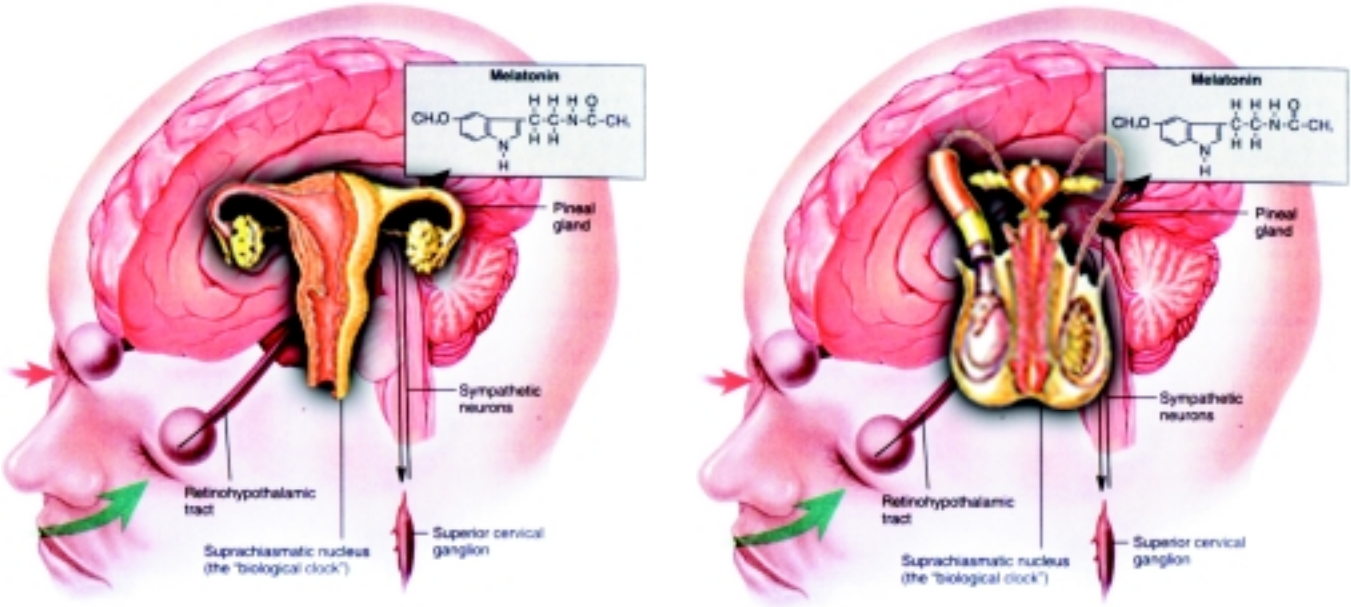

Fig. 19. *Pineal as Second Sexual Center.*

Fall from Grace

Nothing could be more natural than the state of Wu Chi, nothingness, or divine grace. And yet, the realization of Wu Chi is clouded by obscurations and confusions. Consciousness streams into every body, but only a few can see the light. Why is this so?

An essential function of the "upper brain", the Upper Tan Tien, is to manifest the esoteric and divine realizations of consciousness into our humanly bodies. Chi spirals through the Crown and the Third Eye into the pineal and pituitary glands, sustaining existence and nourishing the spirit. Infants and children bask in the glow and the power of the Chi Field streaming into, and interacting with, their bodies. The psyche is vibrant and alive and the energy bodies communicate in non-physical dimensions.

As we grow older, however, the internal realities begin to fade and the external world begins to predominate our existence. By puberty, the pineal gland has ossified into a calcified strand of tissue. Our minds project outwardly, and the demands of existence (work, family, daily living, etc.) preoccupy our awareness. Our emotions (fears, angers, resentments and all kinds of distractions to make ends meet) reflect this outward movement of the psyche.

Fear is the oldest negative emotion. It is felt by all animals, and is even stronger among humans since they have so little power to protect themselves, especially the newborn. The longer history required for organic development makes fear the basis of the entire civilization process: to protect ourselves and achieve our highest potential. Fear is closely connected to the kidney Chi (via the adrenal glands), and when the kidney Chi is diminished, the brain slowly begins to pull back and disengage from the fantastic worlds of the Divine. The upper brain becomes the observing brain, dedicated to the worldly tasks of sending, receiving and processing sensory signals related to daily living.

Inhibiting the Divine

The transition from an internally focused awareness of the Divine, the natural state of infancy, to an externally focused awareness of the adult World, requires significant shifts in the chemistry of the brain. The tissues and molecules which normally manifest the consciousness of Wu Chi must be "turned off" or **inhibited**. Chemically, the inhibitors are enzymes such as MAO (monoamine oxidase) which rapidly convert seratonin into inactive by-products, thus disabling the synthesis of the spirit molecules. The enzyme MAO breaks down seratonin before it can be converted into melatonin, 5-MeO-DMT and DMT (**Fig. 20**).

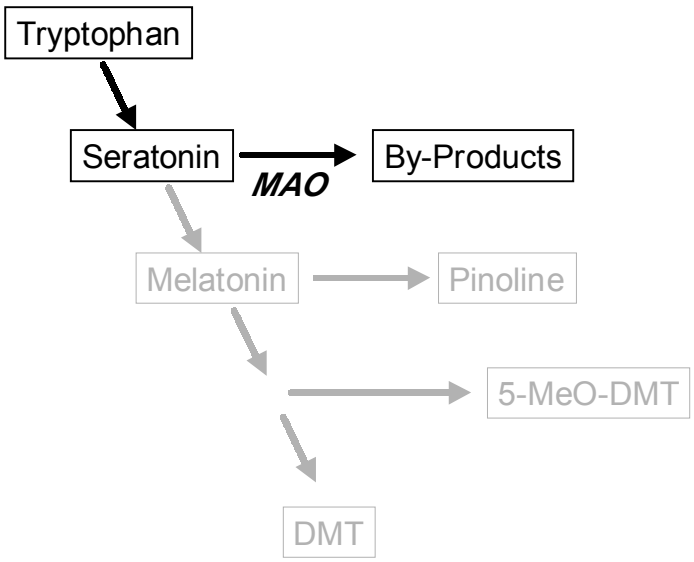

Fig. 20. *Seratonin Deactivaton.*

Our usual perception of the world in waking consciousness is, in fact, a state of waking ignorance. The brain must inhibit our true nature and divine connections to survive in the physical world. In everyday life, we see everything back to front, as it were. We perceive the primary actions of the brain as providing us with sensibility and cognitive awareness. In fact, the brain's mechanism is to filter and shut off the flow of divine consciousness, making possible survival on Earth, but obscuring all transcendental realities. Dark Room meditations remove the obscurations. The inhibitory functions of the brain are lifted, and we revel in the experience of Oneness, Wu Chi, the Original Source.

Reawakening – Spirit Molecules

Waking consciousness satisfies the demands of physical existence, but severs the connection from the Divine. Thus, each night we must disconnect from the outer world and reconnect with our divine source, thereby sustaining life and nourishing the soul. In adult life, the experience of Wu Chi is relegated to the unconscious domains of deep sleep and the supernatural worlds of dream. In Taoist Inner Alchemy, we reawaken the soul to the Immortal Tao, the Wu Chi, the Original Source, and bring back the Divine into our conscious awareness.

Chemically, the reconnection to the Divine occurs by **inhibiting** the enzymatic actions of MAO and INMT, so that seratonin can convert into melatonin and melatonin into the spirit molecules 5-MeO-DMT (5-methoxy-dimethyltryptamine) and DMT (dimethyltryptamine) (**Fig. 21**). The enzymes are inhibited by substances secreted in the pineal gland, such as harmaline and pinoline. The "spirit molecules" allow us to reconnect to divine consciousness. They cause "color imagery, out of body experiences, lucid dreams, visions of beings and/or animals, mystical states, subjective "other realities" and experiences of "being somewhere else." These states are the language of dream.

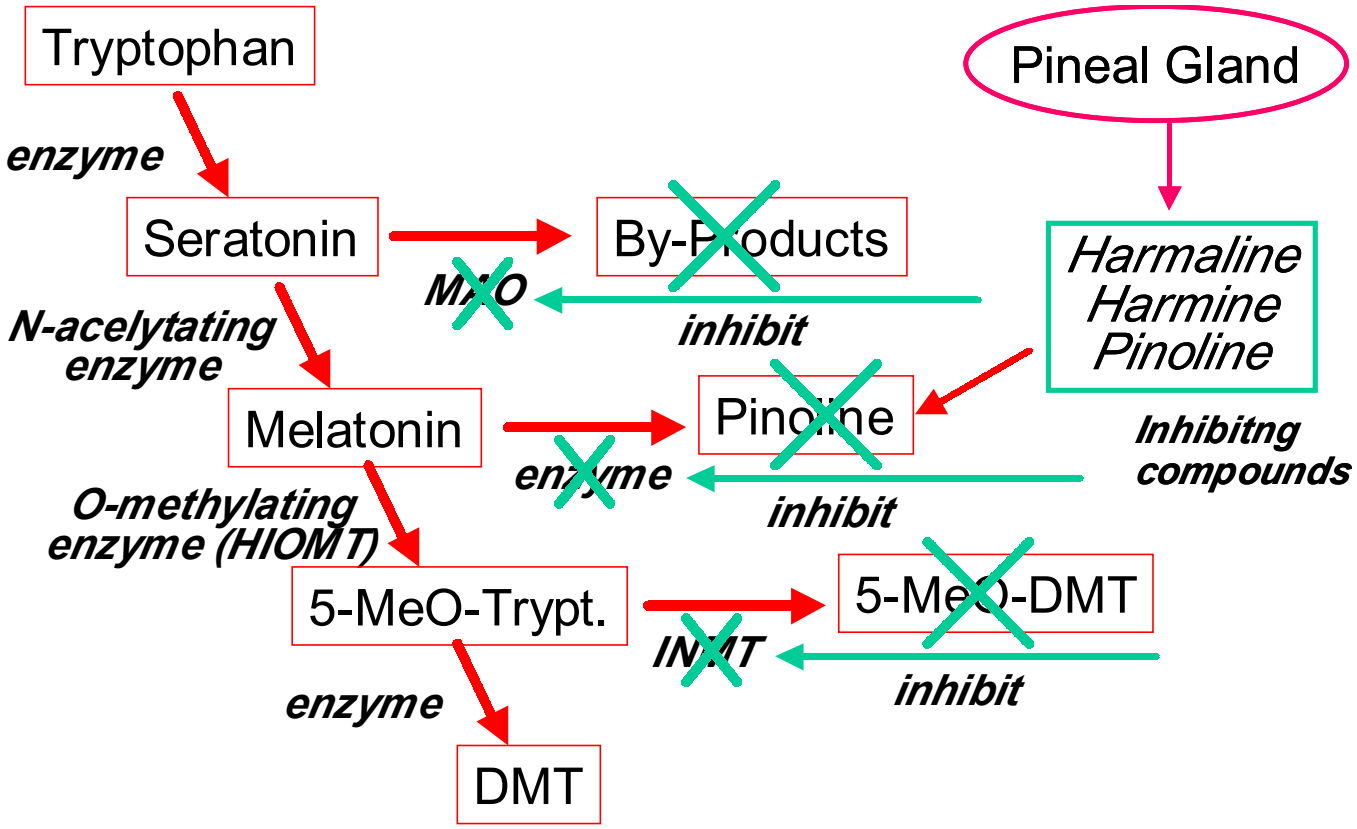

Fig. 21. *Tryptamine Synthesis*[14].

In the Dark Room experience, the "spirit molecules" pinoline, 5-MeO-DMT and DMT alter the receiving qualities of the brain. The brain "tunes in" to invisible worlds and parallel universes, like a television tuning in to different channels. Mystical and near-death, out-of-body experiences reflect dynamic equilibria between "channels" in which we experience the essential energy that courses through the receiver[15].

When you reach the 'DMT state' you begin to function consciously from the various psychic centers or chakras. The bodily processes of 'Healing Love' combine the human states of true compassion and sexual arousal to create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwined in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love.

Immortal Body

Rick Strassman, based on several years of intensive medical research, proposes that the release of DMT from the pineal gland at 49 days after conception marks the entrance of the spirit into the fetus. This 49-day prenatal period corresponds to the first signs of fetal pineal tissue, the differentiation of the gonads into male and female, and the time between the death of an individual and its soul's next rebirth according to the Tibetan Buddhist tradition. He suggests that the individual's life-force enters the body through the pineal gland and leaves it through the pineal gland at death (see "DMT, The Spirit Molecule", by Strassman, and[16]. The infant's brain is flooded with 5-MeO-DMT, secreted from the pineal gland and the brain is 40% more active and open[17].

Chemistry of Consciousness

The chemistry of consciousness is, at first glance, complex. The infant basks in the divine glow of consciousness, manifested in the body/brain by the spirit molecules, 5-MeO-DMT and DMT. However, during development, the brain inhibits the flow of consciousness, utilizing enzymes to deactivate the synthesis of the spirit molecules. Then, to re-realize the divine source, the brain must inhibit the inhibiting enzymes! The chemistry is explained in more detail below.

Seratonin (5-hydroxytryptamine), the neurotransmitter implicated in many of the functions of consciousness, is synthesized in the brain from the amino acid tryptophan, a basic building block of proteins (**Fig. 22**). After fulfilling its role in the synaptic cleft (the space between nerve cells), the seratonin molecule is decomposed into inactive by-products (5-hydroxyindole acetaldehyde) by the enzyme MAO (monoamine oxidase). The seratonin molecule differs from the tryptophan molecule only by the addition of a hydroxyl group (OH) and removal of a carboxyl group (COO).

Melatonin (N-acetylseratonin), the neurohormone implicated in sleep, is synthesized directly from seratonin, by deactivating MAO and inhibiting the destruction of the seratonin molecule (**Fig. 23**). MAO (monoamine oxidase) is deactivated (inhibited) by the beta-carbolene enzymes secreted in the pineal gland: harmine, harmaline, and pinoline. As melatonin levels rise in the brain, the melatonin converts to pinoline (**Fig. 23**). There is some confusion in the literature regarding pinoline synthesis, perhaps because it has multiple synthesis pathways, as well as close affinities to a variety of related compounds (**Fig. 24**).

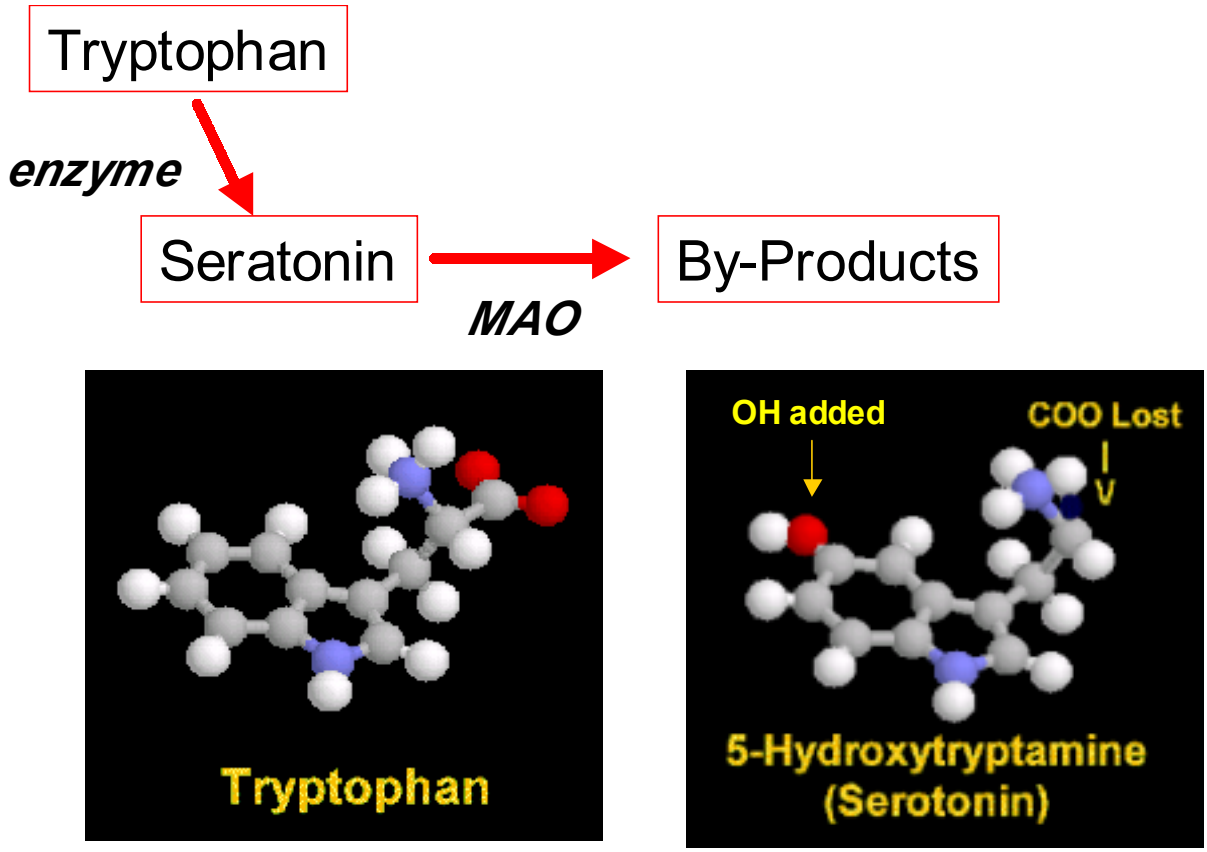

Fig. 22. *Seratonin Synthesis*[18].

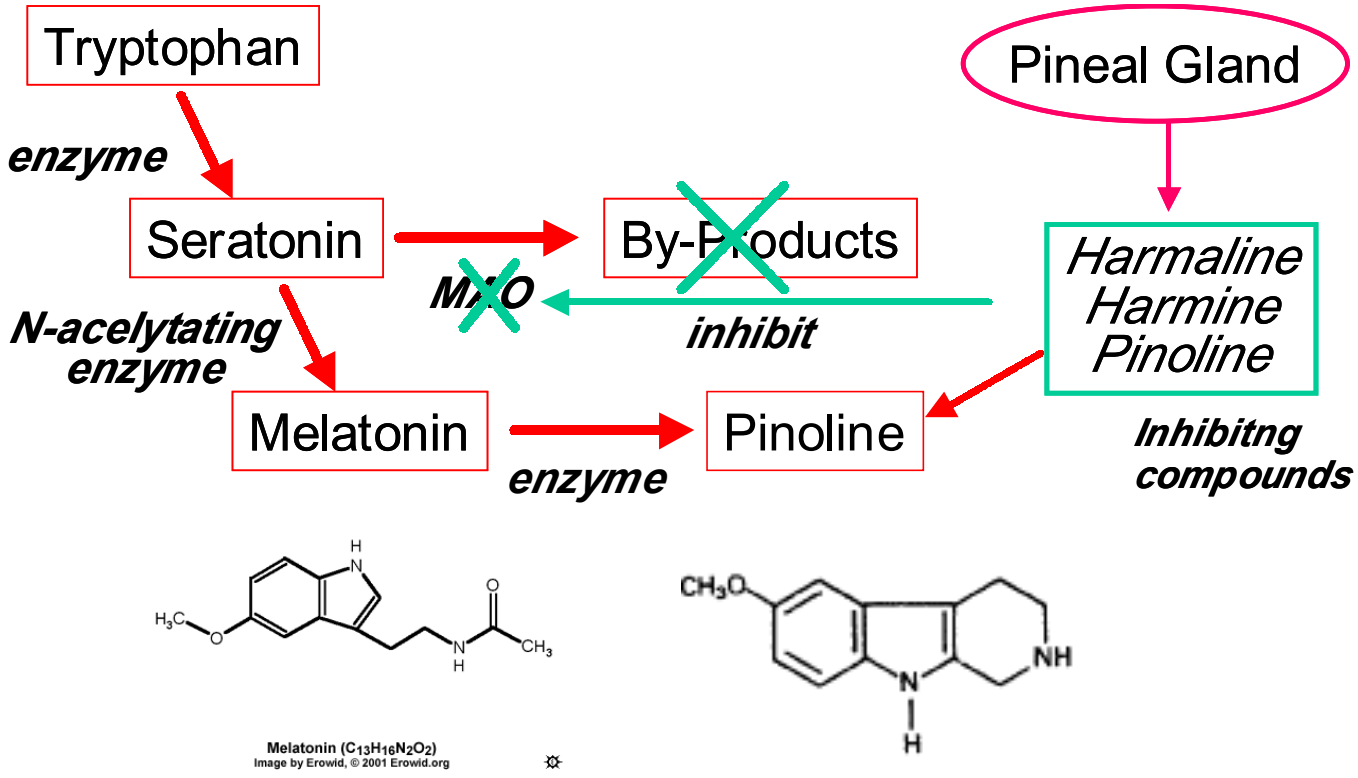

Fig. 23. *Melatonin and Pinoline Synthesis*[19].

indole sub.	aromatic (H_0)	dihydro (H_2)	tetrahydro (H_4)
	with a 1-methyl substituent		
Ar-H	**harman**	harmalan	**tetrahydroharman** (THH)
Ar-6-OH	6-harmol	6-harmalol	**6-tetrahydroharmol**
Ar-6-OMe	6-MeO-harman	**6-MeO-harmalan**	**6-MeO-tetrahydroharman**
Ar-7-OH	harmol	harminol	**tetrahydroharmol**
Ar-7-OMe	**harmine**	**harmaline**	tetrahydroharmine (a)
	with a 1-hydrogen substituent		
Ar-H	βC	DHβC	**THβC (tryptoline)**
Ar-6-OH	6-HO-βC	6-HO-DHβC	**6-HO-THβC**
Ar-6-OMe	6-MeO-βC	6-MeO-DHβC	**6-MeO-THβC (pinoline)**
Ar-7-OH	7-HO-βC	7-HO-DHβC	7-HO-THβC
Ar-7 -OH	7-MeO-βC	7-MeO-DHβC	7-MeO-THβC

Fig. 24. *"Harm'" Compounds. Pinoline also goes by the names 6-Methoxytetrahydro beta carboline, and 6MeOTHBC[20].*

The inhibition of MAO (monoamine oxidase) also allows for the synthesis of the "spirit molecules", 5-MeO-DMT (5-methoxy-dimethyltryptamine) and DMT (dimethyltryptamine) (**Fig. 25**). In a two-step process, 5-MeO-DMT is synthesized from melatonin with the assistance of the O-methylating enzyme HIOMT (hydroxyindole-O-methyltransferase) and the enzyme INMT. Inhibition of INMT results in the formation of DMT.

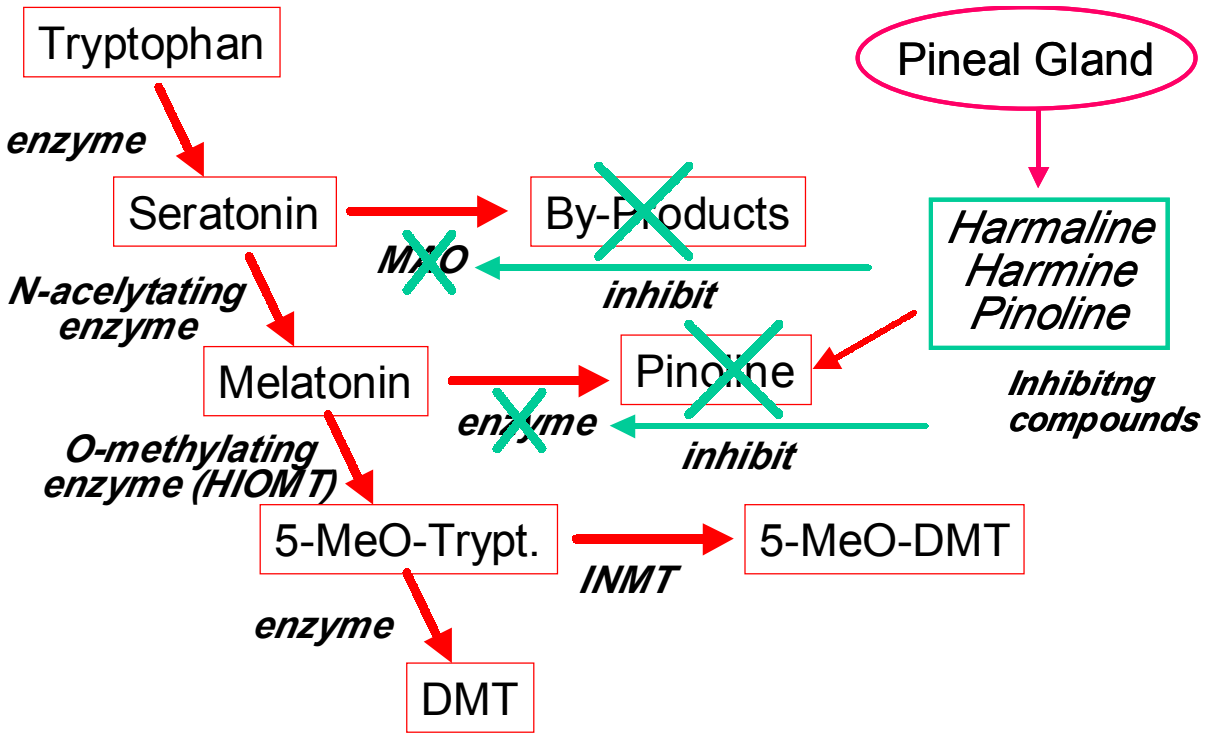

Fig. 25. *5-MeO-DMT Synthesis[21].*

The structures of 5-MeO-DMT and DMT are very similar, differing only by the presence/absence of a CH_3 group (**Fig. 26**).

It should be noted that the tryptamine derivatives are often unstable, volatile substances, and molecules with nearly identical structures may have significantly different functions and effects (**Fig. 27**). DMT, for example, is metabolized by the brain in a matter of 10's of seconds. The tryptamine molecules may rapidly destabilize and transform into sister compounds, and multiple pathways may exist for the formation of a given tryptamine structure. This probably accounts for some of the considerable confusion in the literature regarding the origin of the various "spirit molecules". Pinoline synthesis, as a prime example, has been variously attributed to both melatonin and 5-MeO-DMT parent compounds. The suggestion that pinoline is a pineal secretion ignores the actual molecular pathways that lead to its synthesis.

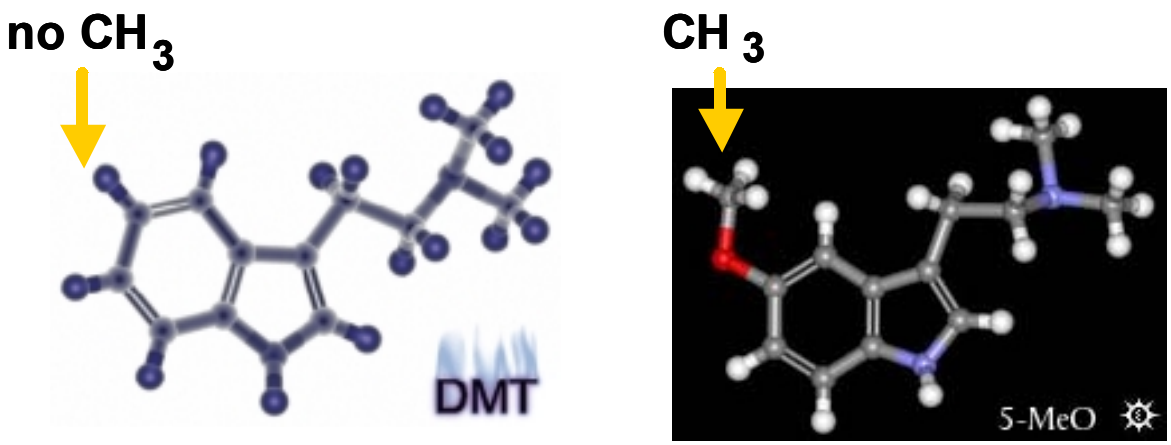

Fig. 26. *Comparison of the DMT and 5-MeO-DMT molecules. They differ by the presence/absence of a CH_3 group*[22].

Orally and Parenterally Active Psychotropic Tryptamine Derivatives http://deoxy.org/trypfaq.htm
Based on McKenna & Towers 1984

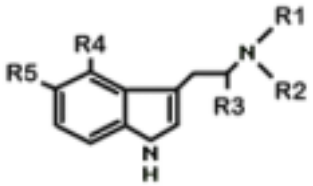

Name of Compound	R1	R2	R3	R4	R5	Dosage (mg)	Route Oral/Par.
tryptamine	H	H	H	H	H	100 *1	par/oral?
DMT (dimethyltryptamine)	CH3	CH3	H	H	H	60	par
5-MeO-DMT	CH3	CH3	H	H	OCH3	6	par
serotonin	H	H	H	H	OH	100 *3	oral
Data compiled from Kantor, et al. 1980; Shulgin 1976, 1982; Shulgin&Carter 1980							

Fig. 27. *Tryptamine Derivatives*[23].

Stages of Dark Room Enlightenment

Benefits of Dark Room Experience

The Dark Room meditations will influence each person uniquely, depending on their maturity and stage of spiritual development. However, most people, even beginners, will receive great benefits, which may include:

1. Relaxation. This is one of the foundations for all other work. During the first days of the retreat, catching up on sleep, allowing the eyes to recuperate from the over-stimulation of our visual world, releasing the grip of mental concerns, plans, and a agendas and simply letting the energies settle creates the best vacation you may ever have.
2. Once relaxed and feeling at home in the dark, the Inner Lights may appear as well as possible images of space teachers, deities, colors, and shapes. Imbalances in one's energies can manifest as dull colors.
3. Over time, as one becomes more open, balanced and awake, images clear as day may appear, not inside the mind's eye but outside in the space of the retreat.
4. Advanced practitioners may experience some of the following: Dreams and sleep become more lucid. A state of continuous consciousness arises in which there is no break in conscious awareness; meditation can continue during sleeping and non-sleeping hours.
5. The Taoist Secret of Love and the Healing Love become very active, so that working with sexual energies and engaging in creative work become easier and more powerful.
6. Dreams will often take the form of teachings or participation in great mythological stories.

The Dark Room enables the body and mind to undergo a series of profound transformations. The 'states of consciousness' appear correlated with the organic synthesis and accumulation of psychedelic chemicals in the brain, especially melatonin (Days 1 to 3), pinoline (Days 3 to 5), 5-MeO-DMT (Days 6 to 8), and DMT (Days 9 to 12). The pharmacology of these states is as follows.

'Melatonin Stage' (Day 1 to 3)

Complete isolation from external light causes the pineal gland to flood the brain with the neurotransmitter melatonin (average 2 to 5 mg/day), manifesting initially as the need for sleep and rest. The eyes recuperate from the over-stimulation of the visual world, releasing the grip of mental concerns, plans agendas, and letting the energies settle. Melatonin is essential for maintaining the hibernation state, which facilitates the emergence of spiritual consciousness. The person retains a child-like biological condition where melatonin is conserved and recycled, not wasted in biological continuation. When this substance works together with the yellow marrow in the bone, the reddish firing reaction will activate a gentle interaction between the sacred water and the light. The sacred waters are the inner fluids that are responsible for producing bone marrow and other bodily fluids. The waters run not only in the in the center of the bones, but also in the spinal connections between the Crown and Perineum Points.

'Pinoline Stage' (Day 3 to 5)

After about three days, when melatonin concentrations reaches sufficient levels (15 to 20 mg) the body then begins to produce the superconductor pinoline, whereby a greater fluidity of thought and healing of the body starts to occur. Pinoline induces cell replication (mitosis) and intercalates with DNA molecules. The 'pinoline stage' is normally activated only in the womb, in lucid dreaming, or in near death experiences. Within this state we can metaprogram the brain to the Unity of Self, heightening awareness of the pathways with which we filter reality. At this stage, the nervous system becomes aware of itself. We become aware of the hologram of the external world that we create constantly in our head[24].

When the pinoline is triggered you activate your clairsentient and clairaudient powers. You may see light and visions, hear music, and gain phenomenal insight. A decoding of the DNA then begins to take place. Cosmic particles are attracted to us and decoded in the form of sound, light, knowledge and realization. The particles, which have the same cell structures as humans (and from which the Tao believes you evolved), are attracted to you magnetically. The body has approximately six trillion cells, which correspond to the universe 'without'. Each of these cells can be seen as a computer with unlimited power and potential. Each cell can become a super conductor, able to receive information from space. You are able to decode this universal information carried from outer space, which may be as old as nothingness itself. When you enter this primordial state or force you are reunited with the true self and divinity within. You literally 'conduct' the universal energy. You may see into the past and future, understand the true meaning of existence, and begin to understand the order of things. You return to the womb, the cocoon of our material structure and Nature's original Dark Room.

'5-MeO-DMT Stage' (Day 6 to 8)

At this stage the pineal gland starts to produce the neuro-hormone 5-MeO-DMT (aka 'akashon'). This psychoactive tryptamine is highly luminescent and also extremely phosphorescent due to the amount of phosphene that it transmits onto the visual cortex. 5-MeO-DMT switches on 40% more of the cerebral cortex and awakens the nervous system to become aware of itself; 'beingness' results. Hence, the possibility of metaprogramming the nervous system's bio-computer - activating healing and conflict message assortment of the nervous system. 5-MeO-DMT is the empathogenic neurotransmitter that expands the emotional body between 'infinity and zero'. It gives rise to telepathy in the emotional and intuitive bodies. It engages the awakening of the 'Flower of Life', the spine, which begins to glow in a state of beingness and peace.

5-Meo-DMT discharges the darkness from the darkroom. A bright light is activated and one experiences a born-again mentality. This Great White Light, the manifestation of the astral body, enables the self to project externally. At this point, some degree of 'N-Methyl-D-Aspartare Inhibition' (NMDA-I) usually occurs. This is a 'soft form' of the slowing of the glutamate input signals into the cells. This makes it easier for the nervous system to cause electrons to stop flowing within the cells, allowing for profound meditative trance states. 5-MeO-DMT intercalates with messenger RNA. One can see in 3 dimensional Holon pictures, as the thoughts behind language.

"Techniques taught in the Dark Room enable one to read and go beyond the matrix, by unifying all directions, and externalize the soul computer so that one can start to interact with ones own genetic code of the Tree of Life. In this intensive process 5-MeO-DMT activates the entire spine, the Tree of Life. The spine is activated and reprogrammed and you can start to process the illusion of the dream from its binary code into the unified translated Self: the Unity Self. Through 14 days of total light isolation your consciousness can be expanded to the wider range of wave emanations and transduce the core hologram of reality that is coherently programming ones nervous system to the Unity Self[25]."

Many exercises will be practiced during this period: compacting Chi, consciousness and awareness into the nervous system, working with the Silent Self and anchoring the Immortal Body.

The 5-MeO-DMT prepares the nervous system, through its empathetic state of being and self awareness of the nervous system, for the DMT or dimethyltryptamine production of the pineal gland, in psychoactive milligram doses.

'DMT Stage' (Day 9 to 12)

When DMT levels reach more than 25 mg, one's experience can become very visual. DMT is the visual third eye neurotransmitter. It enables the energy body and spirit to journey into hyperspace, beyond third dimensional realms of time and space. It is intensely energizing. "After some 10-12 days one starts to see in infra red, and ultra violet, one can actually run across the room and touch a person, by seeing their heat patterns. The Holon Images exteriorize and one is walking in a Virtual Reality, which appears to be the DNA language macro uploaded, and interactive."

When you reach the 'DMT state' you begin to function consciously from the various psychic centers or chakras. The bodily processes of 'Healing Love' are then combined with those of the Dark Room. The human states of true compassion and sexual arousal create a new chemistry and a new vibration within the body. This 'special' vibration occurs at a frequency of 8Hz. 'As in the macrocosm, so it is in the microcosm'; hence if we make love, then all the cells and DNA actually make love as well. The DNA crosses over, like two serpents intertwining in an erotic embrace. You need the orgasmic vibration to arouse this crossover process which leads to the 'two giving birth to three'; the conception of new cells. The two vital states are compassion and arousal leading to orgasm. Both are inextricably linked to love. When this 'love-vibration' reaches the pineal gland a new hormone is produced, which in turn creates whole body conductivity. Only when you feel the waves of orgasmic vibration and unconditional love for the self and others can the process be activated and the essence of the darkroom is magnified.

At this stage of the Dark Room Retreat, the required amount of sleep tends to diminish dramatically. Although the day may last 24 hours, 3 hours of sleep can seem like 12. During this period we will engage in further practices; psychic games and interactivity, Taoist Dream Yoga (advanced levels) and Imagination Expansion.

Taoist Cosmology

North Star and Big Dipper

Taoists regard the three largest known stars – Polaris (the North Star), Thuban, and Vega – as the collective center of our galaxy (**Fig. 28**). The earth's axis shifts toward a different one of these stars every 2,150 years as a result of the gravitational pull from the sun and moon. The axis currently tilts toward the North Star, which is therefore referred to as the Pole Star. In other words, if one were to observe the sky from the North Pole, the entire galaxy would appear to be moving around the North Star. As the earth's axis is influenced by its mass, the North Star controls the earth's energy fields, thereby affecting our health and emotional states.

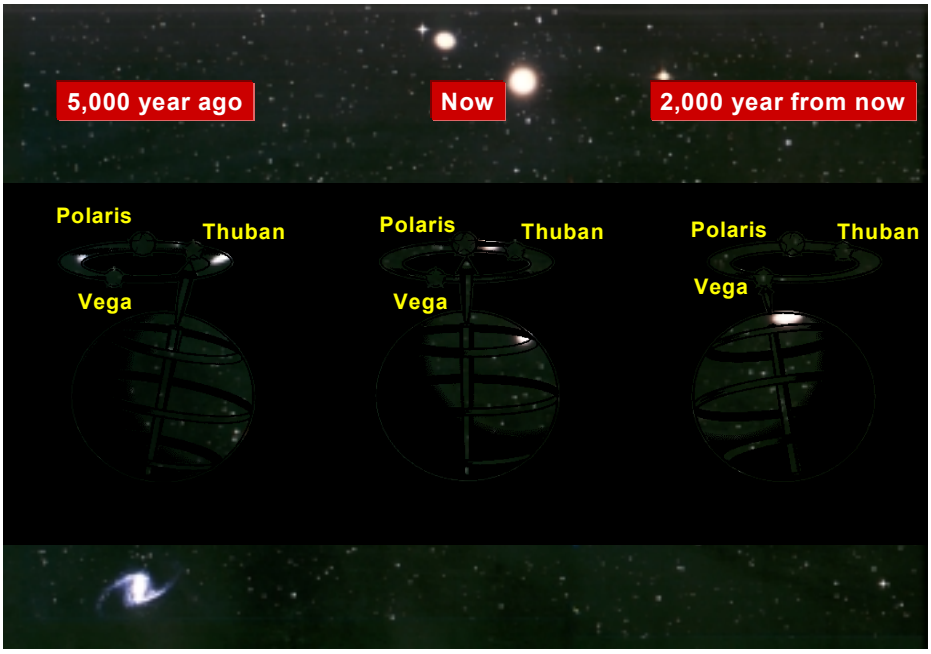

Fig. 28. *Violet Stars.*

The three stars are known as the Violet Stars because they emanate violet rays throughout the galaxy, which affect every living cell of nature on our planet. Taoists believe that a human's heart tilts 45 degrees toward the North Star, just as the earth tilts 23.5 degrees toward it to receive its energy. They also believe that every planet in the galaxy tilts toward these Violet Stars in the same way, and that the North Star is presently controlling them as well (**Fig. 29**).

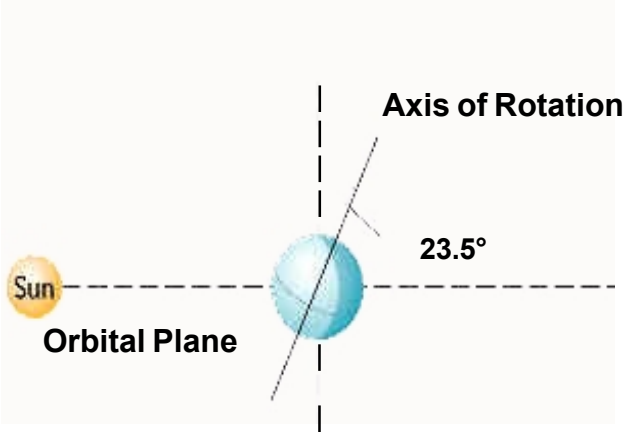

Fig. 29. *Earth tilts 23.5 degrees towards the North Star.*

The Big Dipper revolves around the North Star, as do other constellations, reflecting the earth's seasonal changes. The Big Dipper is a major source of red and infra-red light, or radiant energy (**Fig. 30**). Taoists believe that the cup of the Big Dipper gathers all the violet light from the universe. The emanation of infra-red light of the Big Dipper, combined with the violet rays of the Violet Stars (especially Polaris), has a positive, nurturing effect upon the bodies and minds of those who know how to access it. Taoists believe that the Violet Stars, the Southern Cross constellation, and other constellations form the "Gates of Heaven." All living things must pass through these gates to return to their source of origin, the Wu Chi, which is the state of oneness with the Tao.

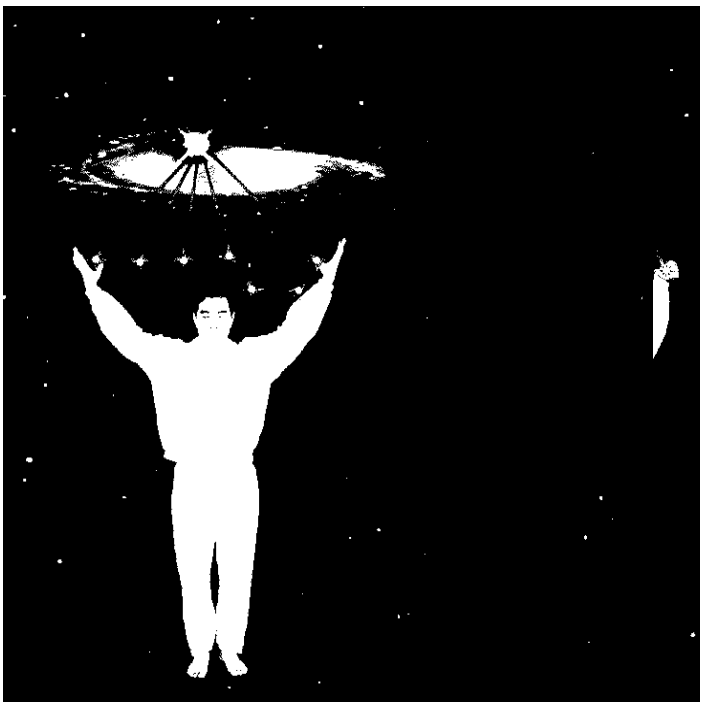

Fig. 30. *Infra-red emanations of the Big Dipper.*

Taoists believe that the soul and spirit come from the stars and ultimately must return to them to find their origins. To do this, one must first gather and refine the energies of soul and spirit until they are as pure as the stars, and eventually as pure as the Original Force. This is the way to achieve oneness with the Tao. The first step is to refine the force internally while practicing detachment from worldly things. This helps to break the bonds that hold us to this world. The second step is to draw in the forces of the planets to enhance our own internal force. This gives us spiritual power in the form of energy to use as fuel for travel to the planets, the constellations (especially the Big Dipper), and finally to the North Star, which points to Heaven. Taoists refer to this process of absorbing, transforming, and combining our soul and spiritual energies as "marrying the force," which means that we purify our energies to merge with the stellar forces.

Nine Sacred Mountains

In the Taoist tradition, the human body is a microcosm of the natural world. Our physical anatomy is an inner landscape with its own rivers, forests, mountains, and lakes that reflect their harmony with the outer landscape of the planet Earth. Figure 31 is an ancient rendering of the inner alchemy practice of the Tao, probably originally drawn by a highly achieved Taoist from China's Tang Dynasty period (7th century C.E.). The numbered areas 16 to 21 are a series of nine sacred mountain peaks. These mountain peaks function as funnels guiding Universal Energy downward. This energy is then concentrated in the mountain caves. Taoist adepts go to these caves for initiation. In the human head there are nine different energy centers (peaks or points), which are able to extend to Heaven to connect to the Cosmos. The brain marrow cavities, as well as the various energy centers of the body, are like caves in a mountain in which you can concentrate, store, and transform energy.

(16) TOP OF THE GREAT PEAK is located at the back of the head. When we tilt our head and push our chin back, our head reaches its highest point. This peak connects the North Star to the Pineal Gland; it is where we receive the descending Universal Energy.

(17) HIGH PLACE OF MANY VEILS lies between the Mud Pill and the Great Peak. It is where the spirit and soul bodies can leave and enter in horizontal flight.

(18) MUDDY PILL is located in the center of the crown (Bai Hui or the hundredth meeting point). When it is open it feel like soft mud. This crown point connects the Big Dipper to the Hypothalamus Gland. It is through this center, which functions as a two-way street, that you can project your energy (soul or spirit) upward or receive the energy flowing downward.

(19) HOUSE OF RISING YANG is the third eye. Located slightly above the middle of the forehead, this center is able to receive the energies of the sun and moon, which it uses to project the soul and spirit bodies into space.

(20) NINE SACRED REALMS are directly connected to the mid-eyebrow and has a close connection to the Pituitary Gland. This center is use to receive the Cosmic Force and to launch the soul and spirit bodies into the earthly or human plane for traveling.

(21) IMMORTAL REALM is located in the center just in front of the crown point. It is here that our energy is able to make a connection with the heavens to draw down even more powerful Universal Energies'.

Nine Palaces

Nine is one of the most commonly use numbers in Taoism being the highest cardinal order in numerical calculation. Lao Tzu once referred to a nine-story-building rising from a clod of earth. A nine-story-building has both architectural significance and spiritual implication. The architectural significance is based upon the order of nine, which implies the highest structure of mental calculation and manipulation. In Chinese architecture, the steps and stories of a building are designed within the function of nine. The nine-story-building refers spiritually to the nine mountain-like palaces crowning the brain (**Fig. 32**). The cortex will gather all the elixir-making fluid needed for crystallizing into mystic elixir. Lao Tzu's statement also refers to the nine-story tower of vocal cord.

In Chinese, nine means literally the change of yang, which depicts the crawling position and extreme end. This nine-yang is the highest order in heaven and on earth, and it is the power representation of all. Beginning from nothing (zero), at nine we reach the peak stage of performance and begin to return to the original state of inactivity, for either a new beginning or a complete change. As life evolves and changes, there will be nine significant crises to be conquered. These can be referred to as the crises of merging within the structural and dynamic trinity. The nine crises determine nine deaths of old conditioning and established habits that one must walk through. Nine deaths bring about the final new birth, or the returning of pure spirit. When a person consciously dies nine times, the last death must be the spiritual birth of self into cosmic void.

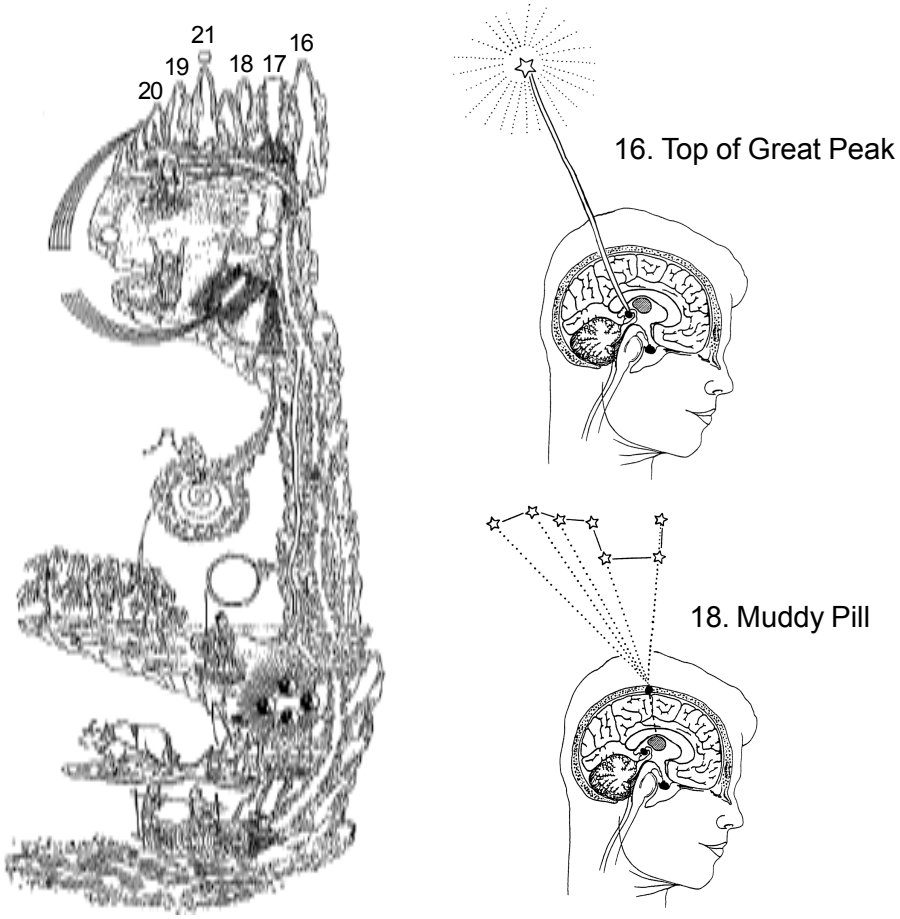

Fig. 31. *On the left, an ancient rendering of the inner alchemy practice of the Tao. On the right, two of the nine mountains (16 and 18) correspond to Nine Palace points in the brain.*

Fig. 32. *In Taoist Inner Alchemy, nine mountain-like palaces crown the brain.*

In the beginning of life, we have nine holes that open and close to life in the body: the life of breath, love, and harmony. Seven of these are charged by seven powers of light. The eighth and ninth discharge the water and concrete wastes externally, or internalize the thrusting power of spirit and its mating partner, the sexual fluid, or the holy water in its earthly matured form. Among these nine holes, two form visual receptors and process the maximum on the information highway. As the receptors collaborate with the visual center in the rear of the brain, the neutralized energy activates the single most powerful interior organ: the pineal gland (**Fig. 33**).

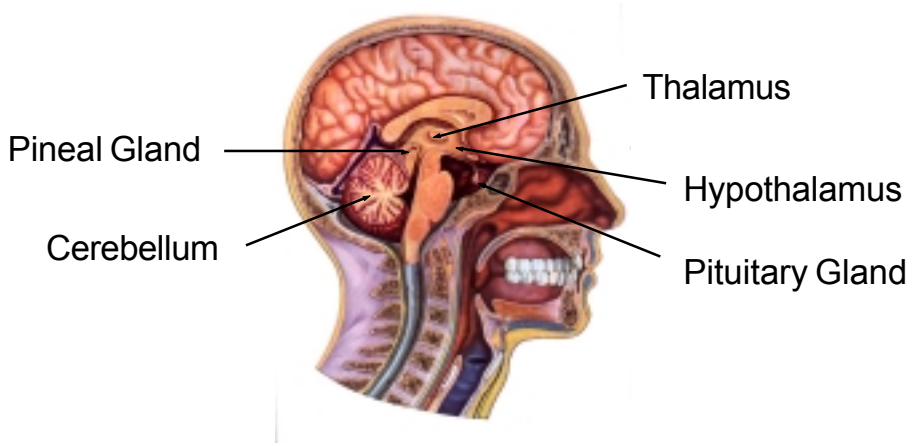

Fig. 33. *Brain includes the organs: cerebellum, thalamus, hypothalamus, pineal gland, pituitary gland.*

The pineal gland stands side by side with the limbic system and helps the cerebral-spinal-abdominal fluid to form the whitish matter by releasing melatonin and other chemicals. Melatonin is the essential substance required to maintain the hibernation state where spiritual consciousness sustains a peaceful, healthy, loving, and long life. The spiritual vitality producing the biological Jing will be preserved. The person then retains a child-like biological condition where no matured melatonin is wasted in biological continuation. When this substance works together with the yellow marrow in the bone, the reddish firing reaction of the biological process will be converted into a gentle cooking interaction between the holy water and light.

The sacred water refers to the inner fluid that is responsible for producing bone marrow and other bodily fluids. When the light activates this sacred water, one experiences a born-again mentality. When sacred water and light merge, the faithful mustard seed is planted, and the true teaching and living begin. The sacred water runs not only in the center of the bones, but also in the midst of the body connecting the Crown and Perineum Points (**Fig. 34**). The Crown Point emits the fire as the Perineum Point secretes the glacial water. The glacial water is the primordial yang Chi that carries the gender-producing substances. The conscious fire in the brain utilizes the unconscious water in the abdomen as elixir or white horse: a completed product.

When the sacral bones again become sacred, they replace the power of the eight incisor teeth. The snake biting returns to fish sprouting. The mouth speaks the truth with integrity. In doing so, the independence toward either masculinity or femininity becomes integrated with the longing partner: sacrificial becomes sacramental.

Under this condition, the nine structural ligaments that form the vocal cord speak with the power of nine kings being guided by the master king, the tenth king of Miphkad. The nine bodily parts and holes are integrated into nine palaces echoing the power of nine teachings. The sacred water and light unify the seven firmaments. The vocal cord no longer resounds with the activation of mouth and teeth, but vibrates directly through the pineal gland and the Crown Point. When the nine vibrations activate the pineal gland, the Crown Point will resonate in the universal and cosmic behavior. The visible biological nine holes in the body will harmonize with the invisible nine holes in the brain. The active nine bodily parts will speak through the inactive nine vocal ligaments. The cerebral cortex becomes the cosmic mud upon which the spiritual elixir can be produced through the activation of the mighty cerebellum. (**Fig. 35**).

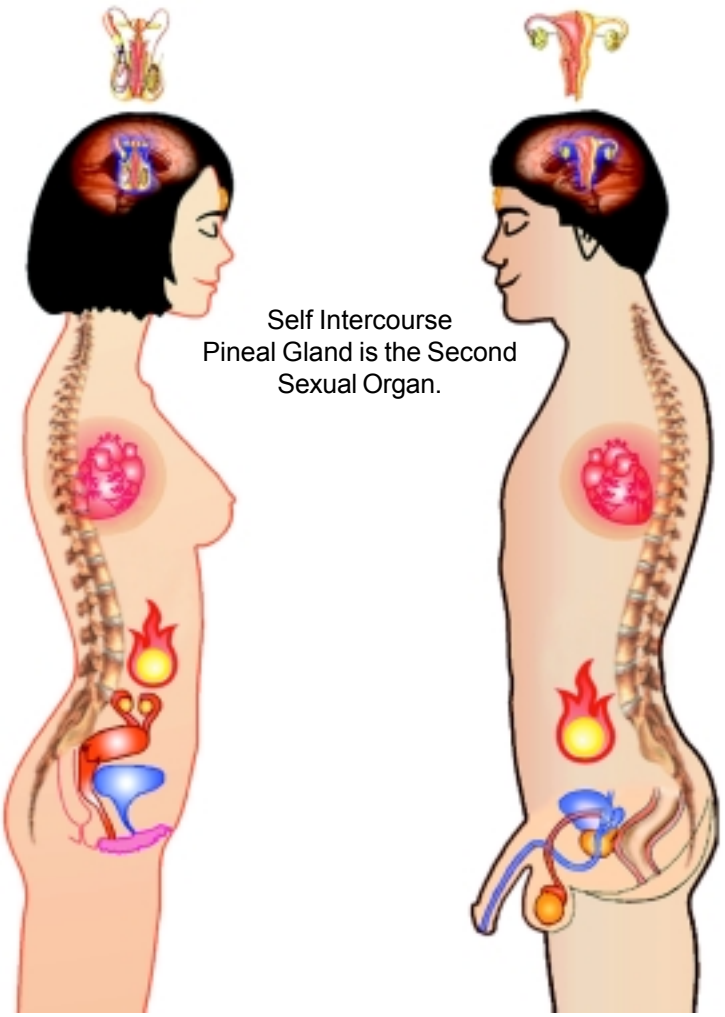

Fig. 34. *Crown Point is connected to the Perineum.*

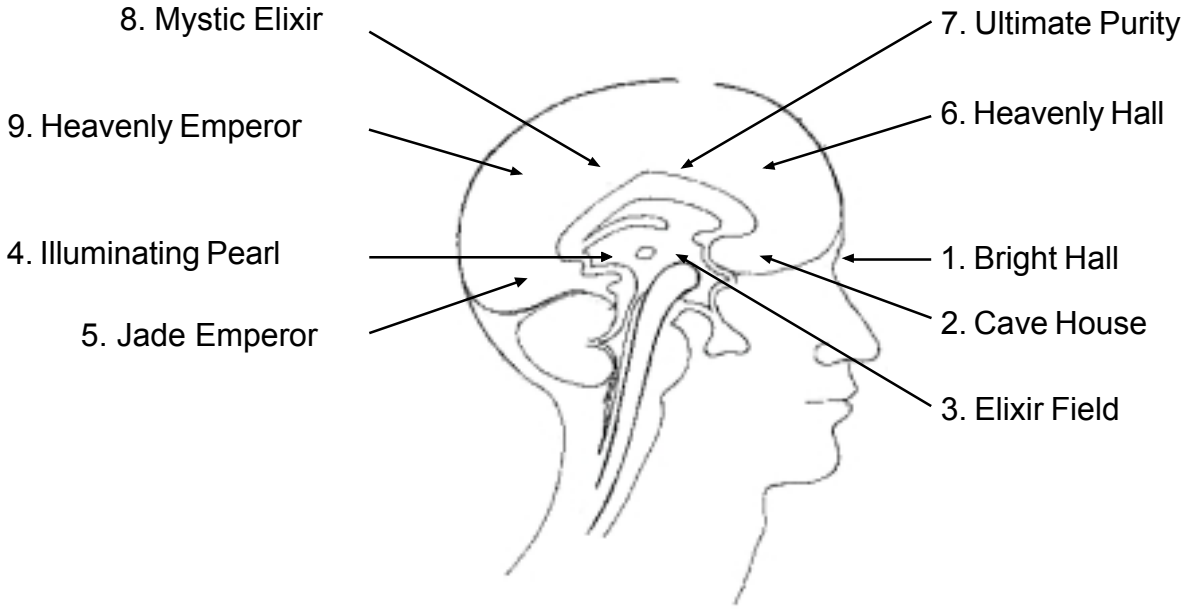

Fig. 35*. Nine Palaces*

When the cerebellum is totally awakened, the instinctive mind behaves through the supervision of eternal peace. Daily activity will unify with nightly rest; the thinking mind will collaborate with the dreaming mind; biological water will balance with sacred water; lustful drive will merge into blissful flow. The inner drumming practice is about to begin. When the glacial thalamus and hypothalamus glands are activated by the holy well of brain fluid under the cave of the corpus collasum, elixir is produced through the interaction of the pituitary and pineal glands. The elixir then travels through the calcarine and parieto-occipital sulcus to nourish the entire cortex and cerebrum (**Fig. 36**). When the time is right, the spirit-elixir will shoot through the central sulcus, the "Crown Point", its heavenly home. Souls are shocked by this drumming power, and spirit is aroused by the drumming frequency of vibration balancing the entire universe. The body is scorched, the souls are sold, and spirit returns to its original home.

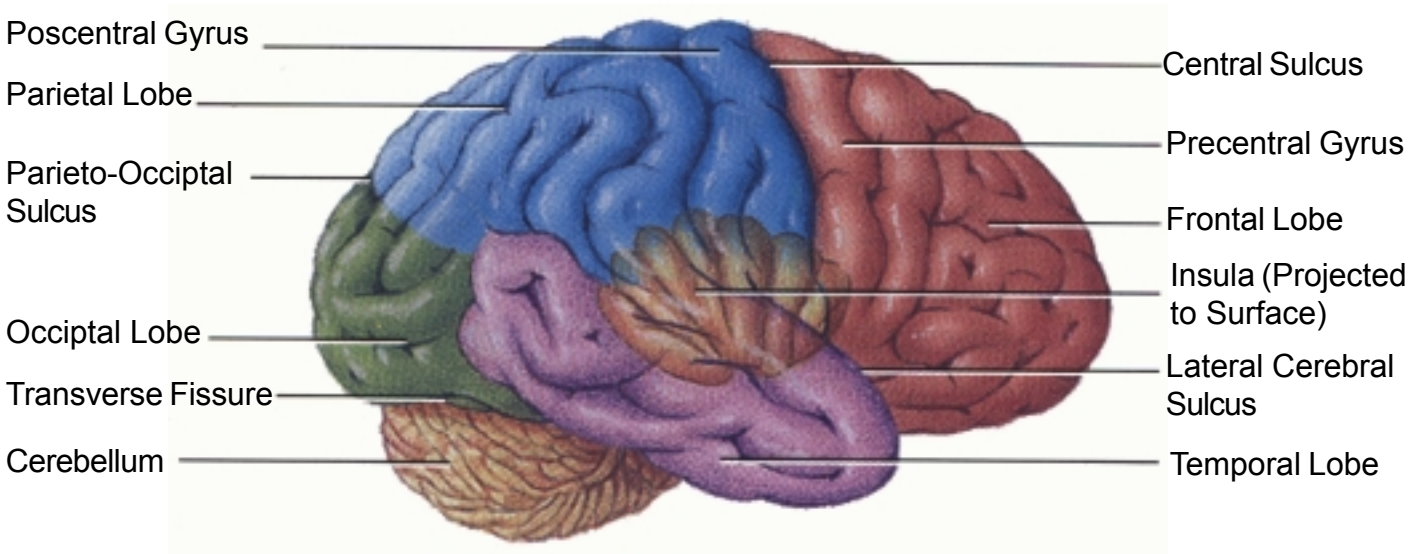

Fig. 36. *Brain Sulci: The parieto-occipital, and central sulci of the skull.*

As the vocal cord produces sound, the nine special areas in the body/mind are opened. Among these nine areas, three represent the Tan Tiens, three the "guans" or passes of fire, and three for "qiao" or knack. The three Tan Tiens are located in the third eye area, the Yellow Court area, and the caldron area respectively (**Fig. 37**). They charge the frontal body by managing the water-Qi circulation. The lower Tan Tien awakens the Kundalini power for the frozen Jing-Qi to become internalized into sweet dew. The middle Tan Tien expresses love through the falling of sweet dew, while upper Tan Tien reviews the cosmic wisdom with its fresh single eye. In Biblical tradition, the lower Tan Tien constructs the Old Gate. The upper Tan Tien forms the Sheep Gate. The middle Tan Tien manifests the Christ Love. These three Tan Tiens belong to the wood element. They possess the power of restoration and charge the power of growth.

Corresponding to these Tan Tiens are the three "guans," the passes of fire. These passes circulate in the back, facing the three Tan Tiens directly. The lower guan opens the life-gate pressure or the Water Gate. The middle guan empowers the spirit-platform or the Horse Gate that fires the hands. The upper guan, called the Jade Pillow, is located in the center of visual cortex. It is the power of the Master Gate, or the Gate of Miphkad. These three guans belong to the golden element. They possess the power of openness and initiate the circulation of change.

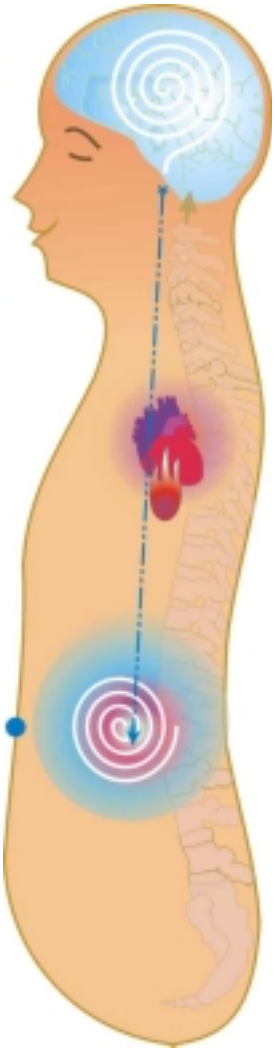

Fig. 37. *Three Tan Tiens*

Circulating between these six special areas are the powers of the three “qiao” or three knacks. Each knack constitutes a “gong” or palace. The yin gong is the perineum point, and the yang gong is the Crown Point. The central gong utilizes the cortex as the cosmic earth. The yin qiao/gong belongs to the water element and possesses the quality of peace. The yang qiao/gong belongs to the fire element and has the quality of action. The central qiao/gong belongs to the earth element and pertains to the quality of harmony.

When these nine special areas are unified in the brain the Nine Palaces are flung open emitting elixir into the cosmos through nine mountain-like openings. Among them, seven connect with star lights of the Big Dipper. The Moon shadows the eighth through the North Star. The ninth is charged by the Sun, which is controlled by the Southern Star. Allowing the Jade Moon and Golden Flower lights to become the basic nutrients, rather than consuming food and water, the meditative mind and fasting body create their own wonder. At a higher level, the eighth is milked by the cosmic holy water and the ninth is clothed by the cosmic white light. The seven teachings are produced through seven sacred body parts, called churches.

Dark Room Practices

The Big Dipper and Nine Palaces are practiced interchangeably: meaning the Big Dipper exercises are done actively as “Wuhuo” or “Military Fire” and the Nine Palaces are exercised passively as “Wenhuo” or “Intellectual Fire.” During the active meditation in the early morning and before midnight, all participants must exercise Big Dipper. During relaxed or sleeping meditation practice, Nine Palaces will be used. Also, practice the Big Dipper first and then the Nine Palaces.

Big Dipper Practice

The names of the seven stars are as followings. 1) Supreme star-Jing, Mystic axis, or Bright Yang; 2) Prime-star, North Platform, Yin Essence; 3) Truth-star, Nine extremity, Pure Person; 4) Network-star, Orbiting Root, Mystic Subtlety; 5) Principle-star, Supreme Peace, Prime Elixir; 6)Disciple-star, Mechanical Spirit, North Pole; 7) Guard-star, Mystic Yang, Heavenly Guard (**Fig. 38**). The names from western Astronomy are in **Fig. 39**.

The first two stars belong to Hun-soul, the third and fourth stars are controlled by po-soul, and fifth and sixth stars generate Spirit-elixir, the seventh star illuminates for all (**Fig. 40**). The others manes are 1) Hungry Wolf, 2) Huge Gate, 3) Prosperity Storage, 4) Intellectual Art, 5)Honest Chastity, 6) Martial Art, 7) Destructive Army.

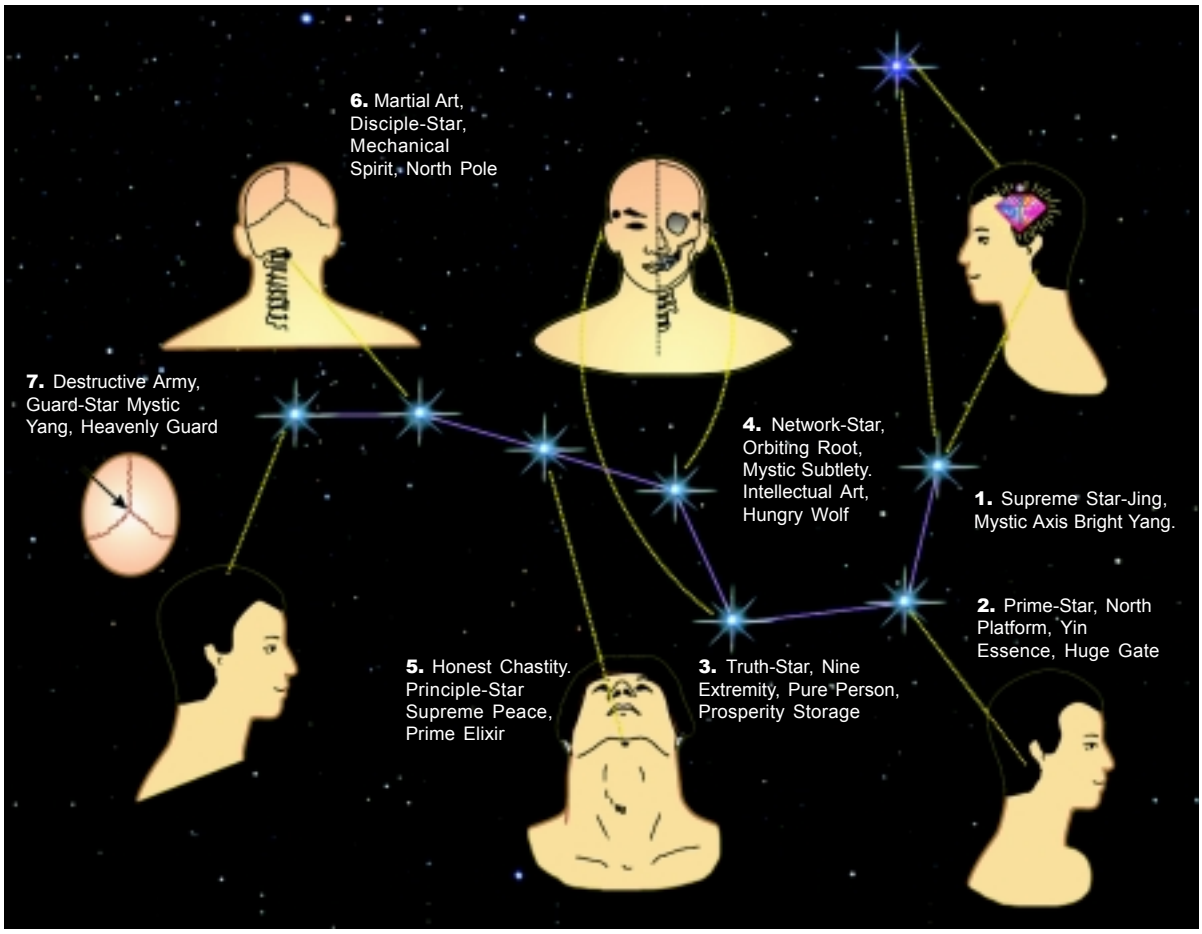

Fig. 38. *Taoist names of the seven stars.*

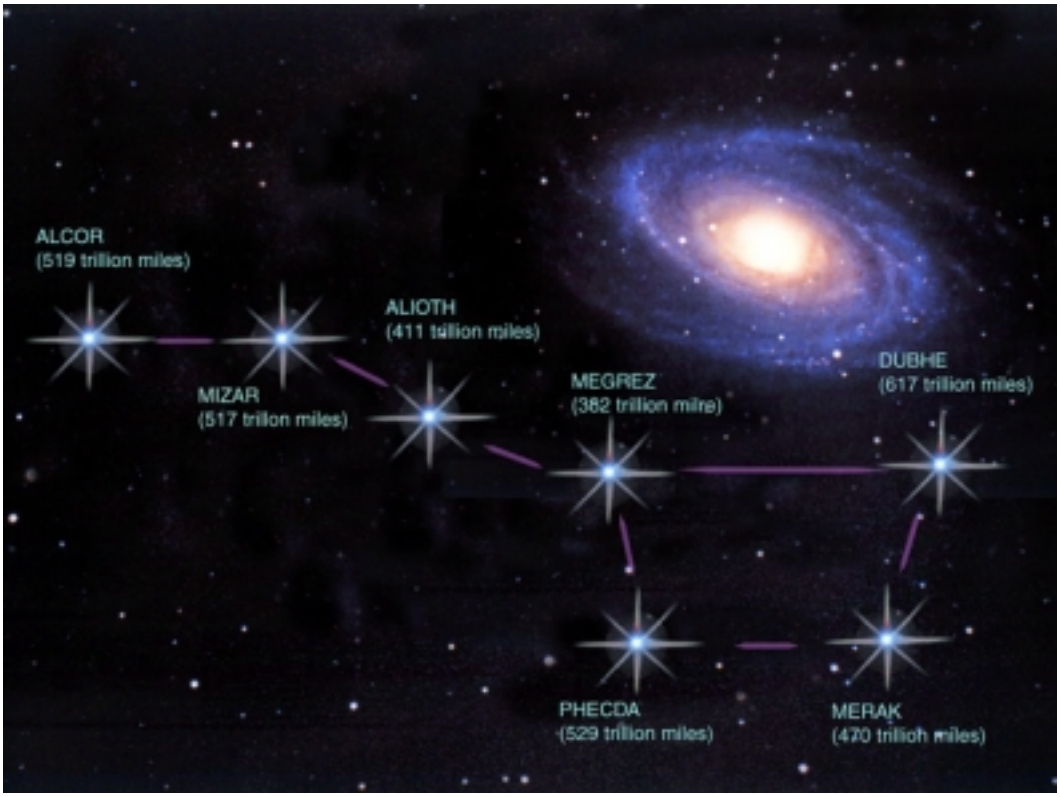

Fig. 39. *Astronomice/stars and their distances from earth.*

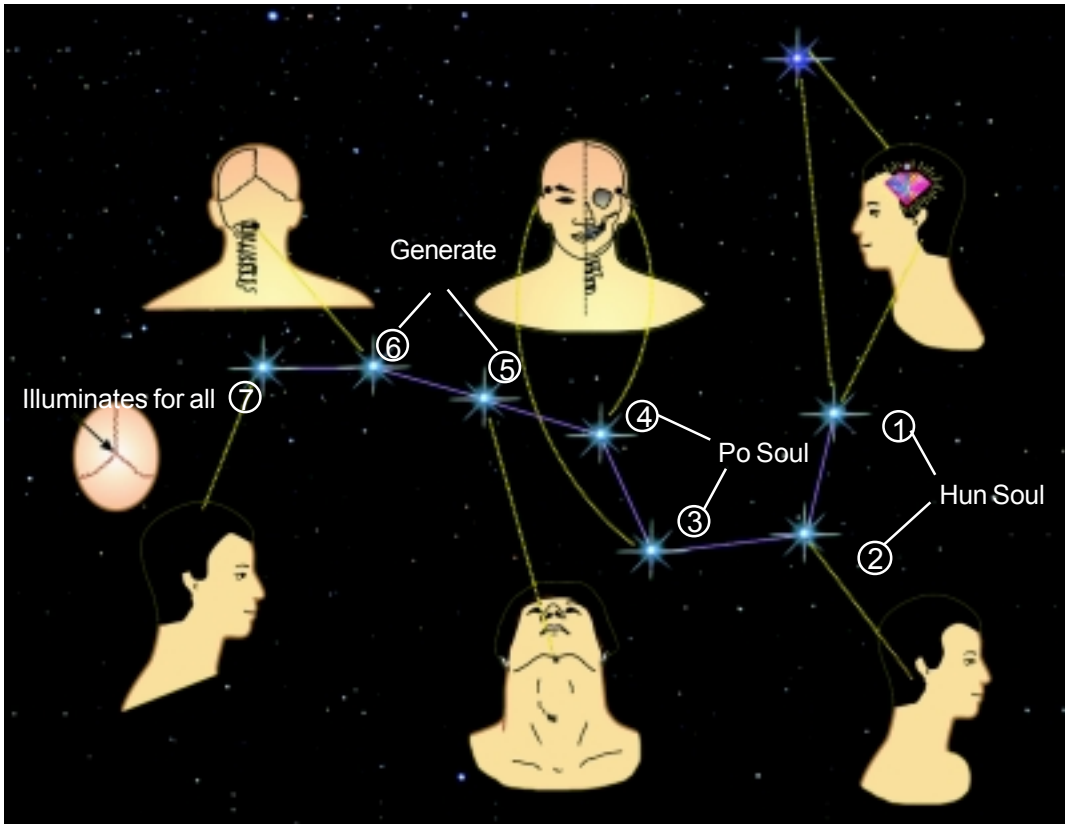

Fig. 40. *Soul names of the stars.*

According to the Chinese Calendar, each two hours is one time period (**Fig. 41**). Each person has a birth star, depending on the specific time period: first star 11:00 pm-1:00 am; second star 1:00-3:00 am/pm; third star 3:00-5:00am/pm; fourth star 5:00-7:00 am/pm; fifth star 7:00-9:00 am/pm; sixth star 9:00-11:00 am/pm; and seventh star 11:00 am-1:00 pm. Before any person goes to the darkroom, he or she must know his or her star. Without connecting to the birth star, Big Dipper practice cannot be practiced successfully. The names are given orally. The normal names that are used are Bright Yang/Hungry Wolf; Yin Essence/Huge Gate; Pure Person/Prosperity Storage; Mystic Subtlety/Intellectual Art; Prime Elixir/Honest Chastity; North Pole/Martial Art; and Heavenly Guard/Destructive Army.

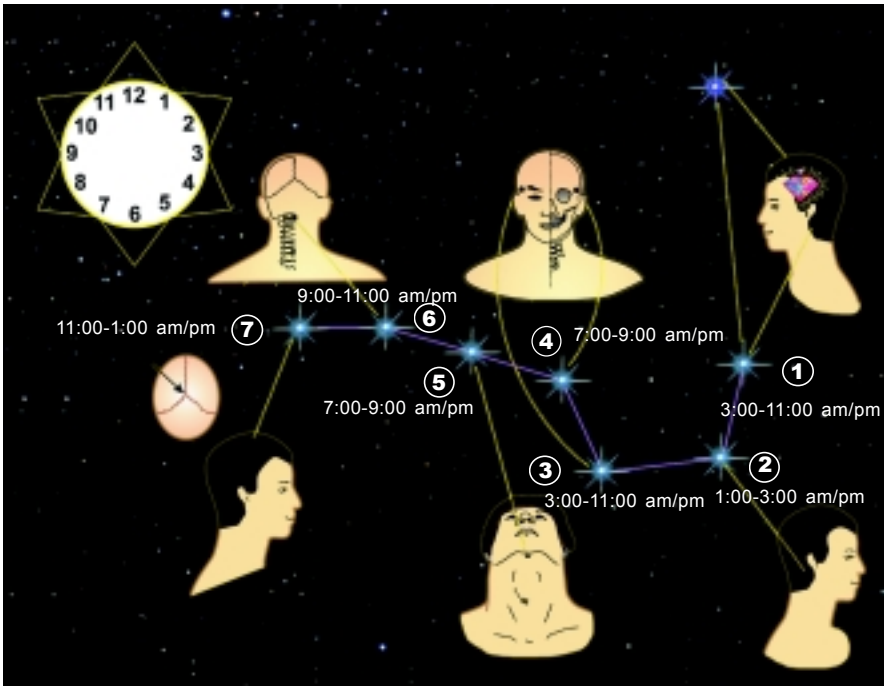

Fig. 41. *Times for each star.*

Exercises

1. The first exercise, the Big Dipper, should be practiced only during nighttime and sleep. Practice the Big Dipper only in the brain. Each star three times with each breath (**Fig. 42**).

a. The first star is located in the Jade Palace, the power of cerebellum. Visualize it as the purple light, inhale gather the purple light into the cerebellum. Hold the breath, condense the light inside the cerebrum, and exhale, relax and observe the energy circulation in the cerebrum.

b. Then concentrate on the memory center in the brain by inviting the second star. Visualizing it with dark-blue light during inhalation. Hold the breath, let the light circulate around the memory center. Exhale, observe the Chi circulation.

c. Then concentrate on the pineal gland by inviting the third star with the light-blue light.

d. Fourthly, concentrate on the thalamus glands by inviting the fourth star and green light. This star is the division between the left-brain and right-brain, or animal brain and human cortex.

e. Then concentrate on the hypothalamus and pituitary glands by inviting the firth star and yellow light. This star connects to human smell and balance.

f. The sixth star connects to the olfactory gland and orange light and temples above the and in front of ears. Hearing-palace and Ear Gate pressure points are located here connecting the Small Intestine and Triple warmer.

g. The seventh star gives ultimately the birth of red fire, the solar light, and passion of sixth sense to mystic awareness. It is located on the yang third eye, or Spirit-hall pressure point.

h. After meditating on each star three times, then visualize all the rainbow colors/lights showing into the brain. Above the rainbow colors the mystic black light, and below is the white (**Fig. 43**).

i. This star exercise connects to the Spleen and planet Saturn, in a sense that the brain becomes the cosmic soil.

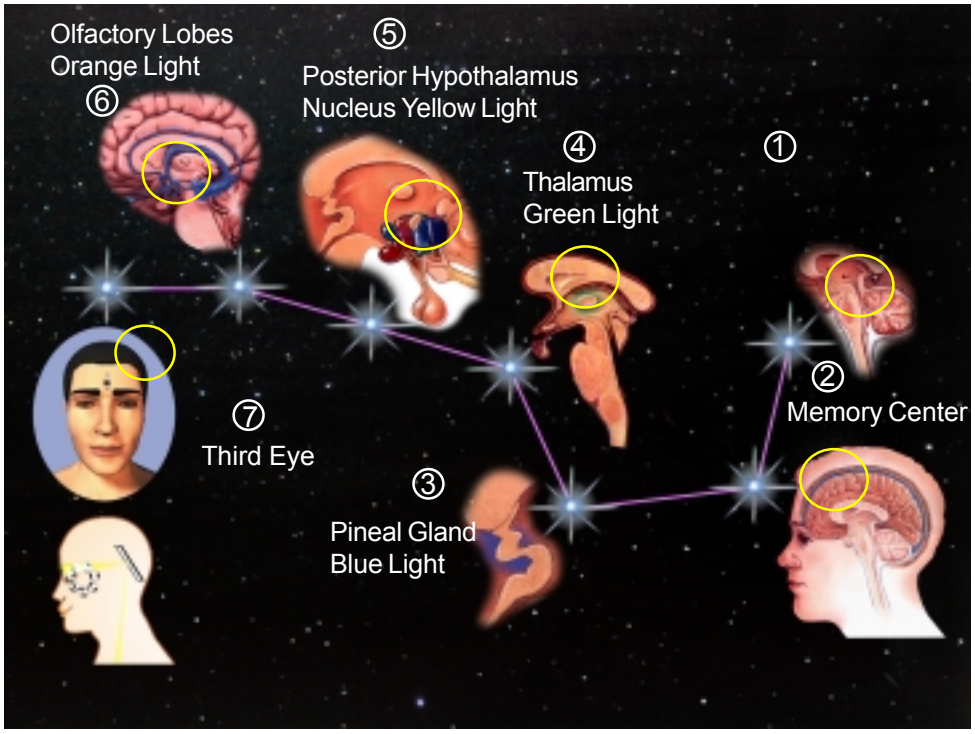

Fig. 42. *Big dipple stars and the brain.*

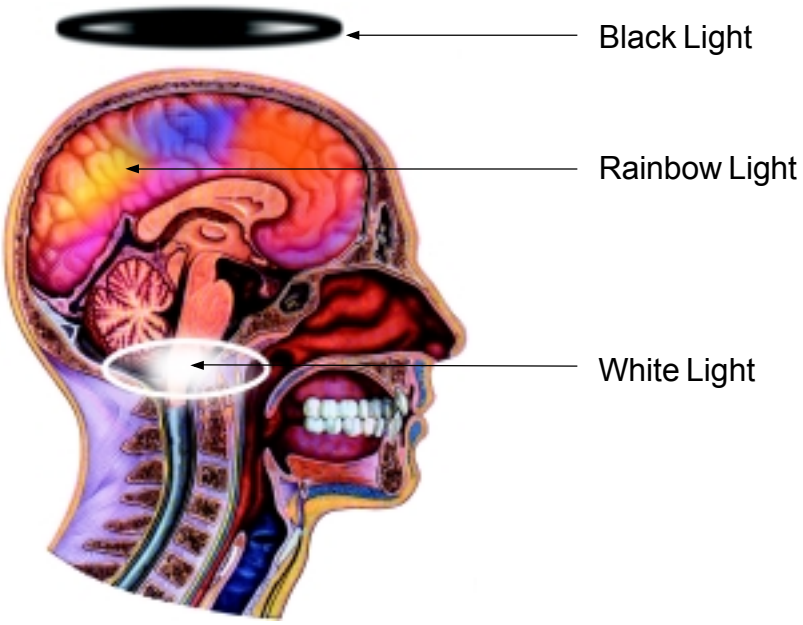

Fig. 43. *Rainbow color lights in the brain.*

2. The second exercise connects to the south and planet Mars (**Fig. 44**). During the night time,1)the practitioner must focus on the brain to gather the star power and solar light. The exercise is: The first star connects to the yang-third-eye; 2) second star/Jade palace;3) third star/C-7; 4) fourth star/thymus gland; 5) Fifth star/Yellow Court;) Sixth Star/umbilical cord; and 7) seven star; lower dantian. Using the same colors and same format as the first exercise.

3. During the daytime, focus on the lower dantian and moon practice (**Fig. 45**). The exercise is: 1) first star/tailbone; 2) second star/pubic bone; 3) third star/umbilical cord; 4) fourth star/life-gate point; 5) fifth star/Yellow Court; 6) sixth star/thymus gland; 7) and seven star/vocal cord. The third exercise relates to the north and planet Mercury.

4. The fourth exercise is about the sleeping practice. Lying down on the right side to avoid the pressure exerting on the heart. The thumb and index fingers of the right hand cover the right ear; with the elbow serving as the pillow. The left big toe touches the right inner ankle, to connect the yinqiao/wei points. The left hand is placed either on the left hip or in between the legs. The seven star arrangements are the same as the fourth exercise.

Exercise four alters between the first star and seventh one, meaning the practitioner can either begin with the brain for descending practice, and gathering the cosmic power; or start with the ascending practice, gathering water-earth-Chi. The standing exercise represents east direction or sunrise, and planet Jupiter. The sleeping exercise represents west direction or sunset, and planet Venus.

After each of these exercises, the practitioner can start with the Nine Palace practice, beginning with the kidney Qi-sound, and observing the vibration in four tones and upper four palaces.

Beginning from using the standing exercise, then the sun, moon, sleeping and ending up with the brain exercise, to finally gather and condense the five Chi between the body/mind and universe.

After the seven-star and nine-palace practices are completed, the seven stars will connect to the North Star via Vega, the Girl Weaver, the eight power. The seven-star practice is completed as Cowherd, the Cowboy, the seventh power.

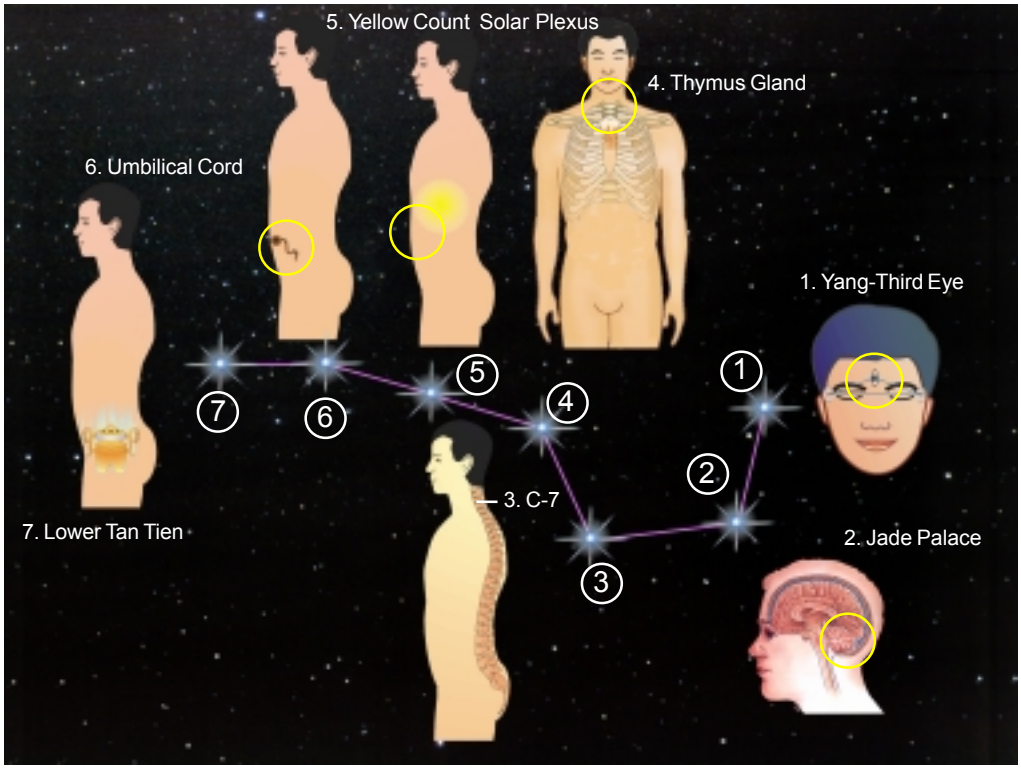

Fig. 44. *Gathering star power and solar light.*

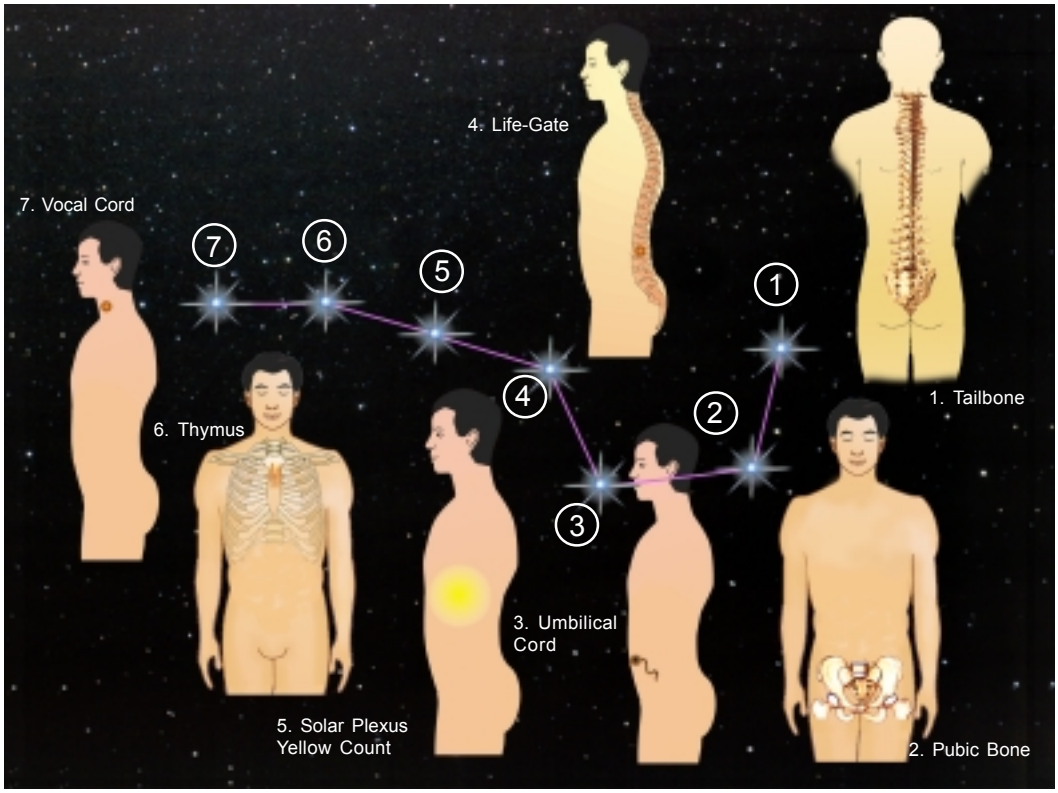

Fig. 45.

Nine Palaces Practice

In Taoist tradition, the Nine Palaces of the brain (**Fig. 46**) connect with nine sacred caves and nine sacred mountains, intersecting the nine sacred power lines of Mother Earth. Each Palace serves as a cosmic antenna, and each mountain transmits the vibration circulating in that region. In order to receive these nine power lines, one must travel across the nine sacred mountains and sit finally on the middle one, the crowning mountain, to practice enlightenment. The caves are the Mother's energy lines. Like the hollowing bones, caves contain the earliest information of life stored inside the Earth. The caves contain the vital essence of the Earth Power. When nine bodily special areas are unified in the brain, the Nine Palaces are flung open, emitting elixir into the cosmos.

1. The first palace is called the Bright Hall and corresponds to the Third Eye (**Fig. 46**). The Bright Hall connects with the power of speech (**Fig. 47**). The Bright Hall vocalizes God's power of the Word. [?Corresponds with Peak 19, House of Rising Yang, **Fig. 31**.]

2. The Cave House, the second palace, is about one inch behind the Bright Hall (**Fig. 48**). It is centered in the optic, auditory and olfactory bulbs, occupied with seeing, hearing, and smelling. The Cave House is the primary sensory power, whether in the cave under the ocean (the fetus stage) or in the cave of darkness (night and advanced spiritual work).

3. The Elixir Field, the third palace, is about one inch behind the Cave House. The Elixir Field generates the crystallized fluid in the brain, making biological and spiritual functioning available. It is the principle field of all bodily glandular functioning as well. This field works directly with the eighth palace of the Mystic Elixir (below). Beneath the cave, the thalamus and hypothalamus glands (**Fig. 48**) can then generate the bluish crystal glacier to form the basic brain fluid. [?Corresponds with Peak 18, Muddy Pill, **Fig. 31**.]

4. The Illuminating Pearl, the fourth palace, is about one inch behind the Elixir Field. The Illuminating Pearl connects with the cerebellum (**Fig. 48**), connecting with ultimate arousal, uplifting bliss, and the precious momentary joy.

5. The Jade Emperor, the fifth palace, is about one inch behind the Illuminating Pearl. The Jade Emperor sees and directs all activities. (**Fig. 47**)

6. The Heavenly Hall, the sixth palace, is about one inch above the Cave House. The Heavenly Hall circulates within the dipole of the forehead.

7. The Ultimate Purity, the seventh palace, is about one inch above the Elixir Field. The Ultimate Purity controls the frontal operculum. Its power connection is the frontal fontanels. It controls the bodily and cosmic movements of touching and tasting (lightning and rain) (**Fig. 47**). The energetic power of touching and tasting also come from the Mystic Elixir, the ground base (below).

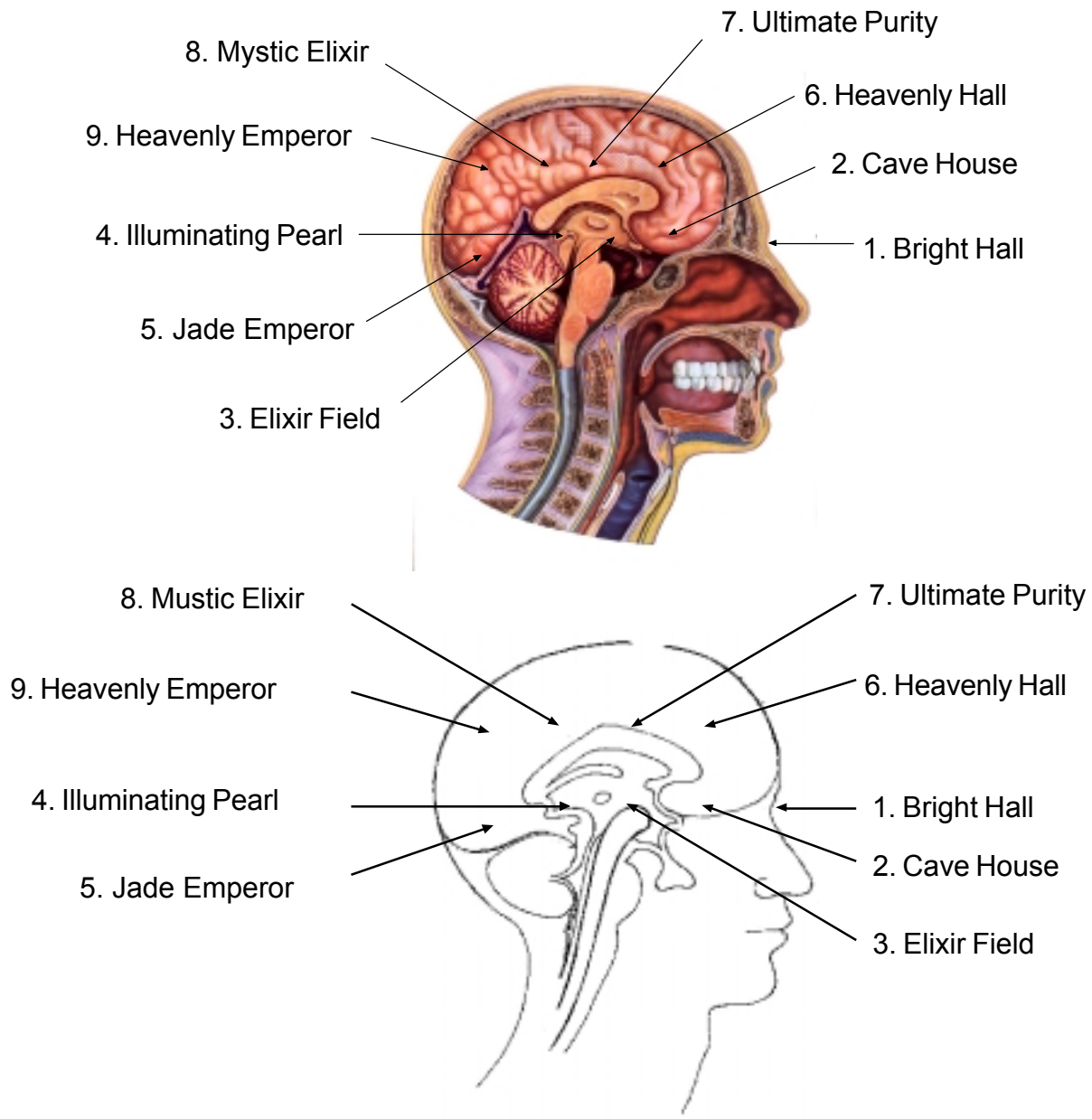

Fig. 46. *The Nine Palaces of the brain connect with the nine sacred mountains.*

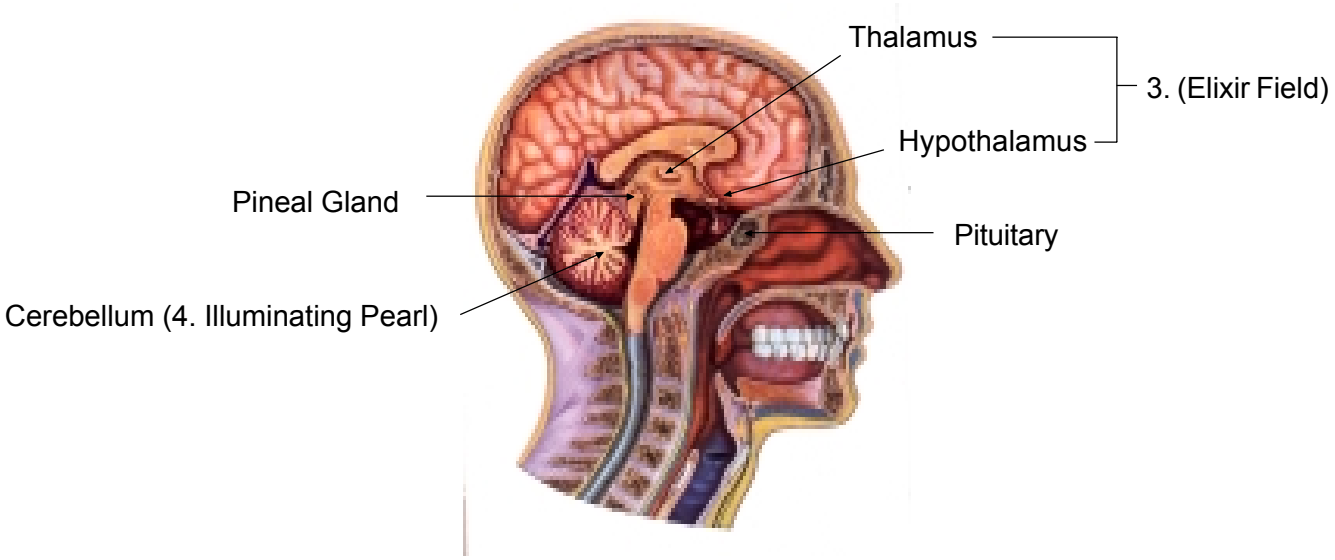

Fig. 47. *Brain areas. Functional areas of the brain and the corresponding nine palace points.*

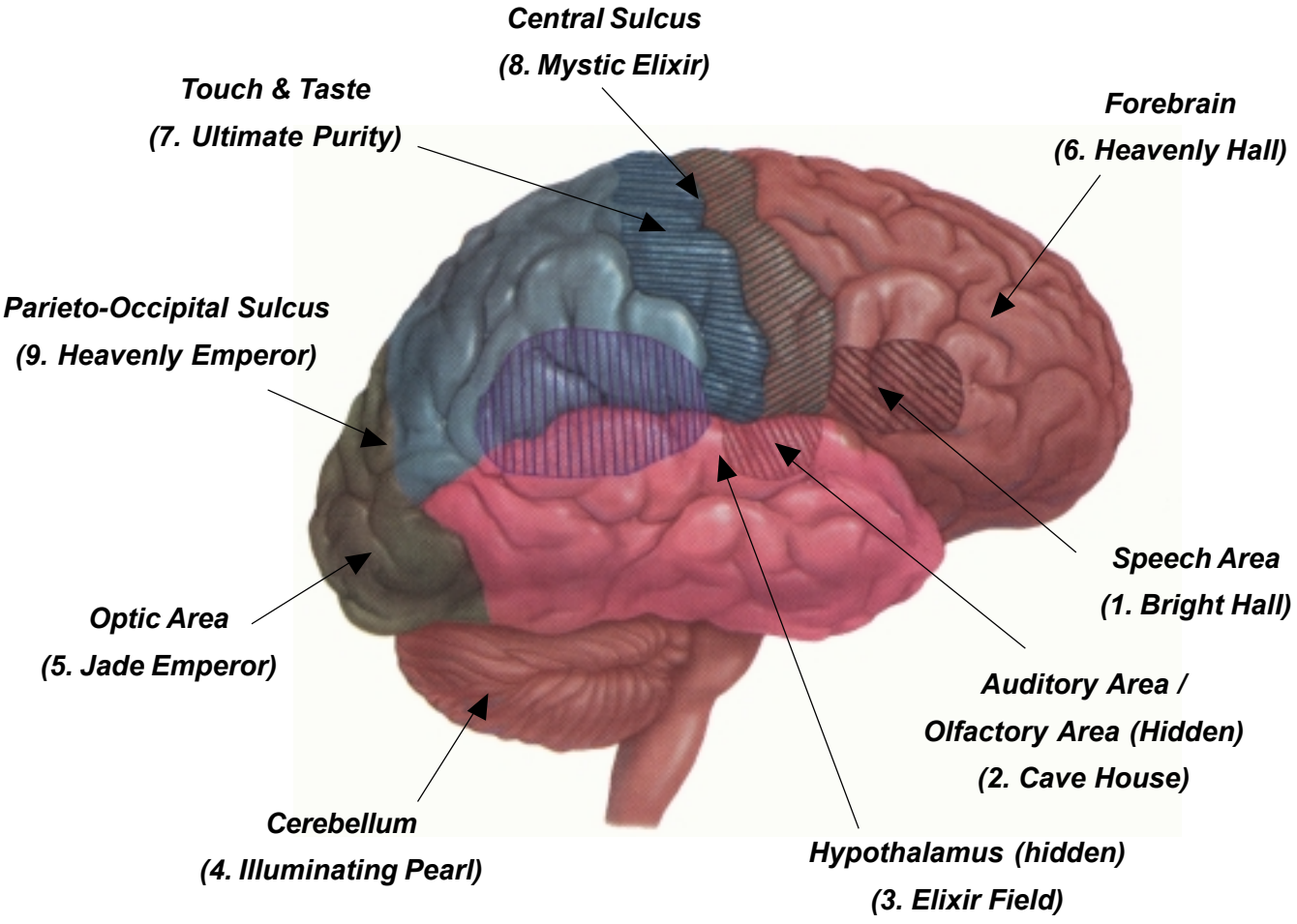

Fig. 48. *Brain areas and associated Palaces.*

8. The Mystic Elixir, the eighth palace, is about one inch above the Illuminating Pearl. The Mystic Elixir gathers the elixir-making fluid from the central sulcus. This is the most refined spiritual fluid in the body, ready to evaporate the spirit into the sky. [?Corresponds with Peak 16, Top of the Great Peak, **Fig. 31**.]

9. The Heavenly Emperor, the ninth palace, is about one inch above the Jade Emperor. The Heavenly Emperor occupies the parietal operculum, behind which, heavenly light shoots into the conscious mind through the parieto-occipital sulcus (**Fig. 39**).

All together, the Jade Emperor supervises all, the Bright Hall sees all, the Cave House hears and smells all, the Elixir Field waters all, the Illuminating Pearl experiences all, the Heavenly Hall idealizes all, the Ultimate Purity balances all, the Mystic Elixir glorifies all, the Heavenly Emperor seals all. Through the cerebral cortex and cerebellum, the Eternal Life and Mystic Elixir give birth to the final end product, Spirit, which is the tenth of all. The cerebral cortex and the cerebellum are the cosmic land in the body / mind.

Exercises

The detailed meditation practice of these nine palaces has to do with the five sonic vibrations purified from the five organs and the four tones within each.

1. To begin with, the yin third eye watches downward to connect the true and false vocal cords as well as the thyroid and parathyroid glands. The distance is about seven inches in between.

2. As the meditator inhales, the true vocal cord generates the green color, while the false vocal cord produces the purple color.

3. While sustaining the breath, the mind gathers the condensed vibration to the corresponding five palaces: the fifth palace connects to the kidney sound, the fourth the liver sound, the third to the heart sound, the second to the spleen and the first to the lungs.

4. Exhale, mentally connecting the sonic vibration from the organs below and the two colors generated by the vocal cords to the four tones of the four upper palaces, then letting the tones vibrate through the left and right brain. The left-brain connects to the blue color, while the right brain to the purple color. Doing so connects the power of the Moon and Sun correspondingly.

Each sound is produced five times. Starting with the kidney sound, the two emotional powers ”will and fear” will be balanced and will resonate at the same time. Next is the liver sound, the power of passion and rage; then heart sound, the power of love and hate; then the spleen sound, the power of worry and giving; and finally the lung sound, the power of happiness and sadness.

It is through these sonic vibrations that the person engaging fasting practice will sustain the power of breath, and the power of mental wakefulness. Even going through the dying process, the spirit mind must be all-time alert. Otherwise, the souls will die into ghost world.

Normally, this set of exercises must be practiced together with the Big Dipper exercise. As the seven emotions are purified through the Big Dipper exercise, the five sonic vibrations will reach to their purest state. The nine palaces will then be fully open.

Cosmic Orbit

Connect to the Universe from Within

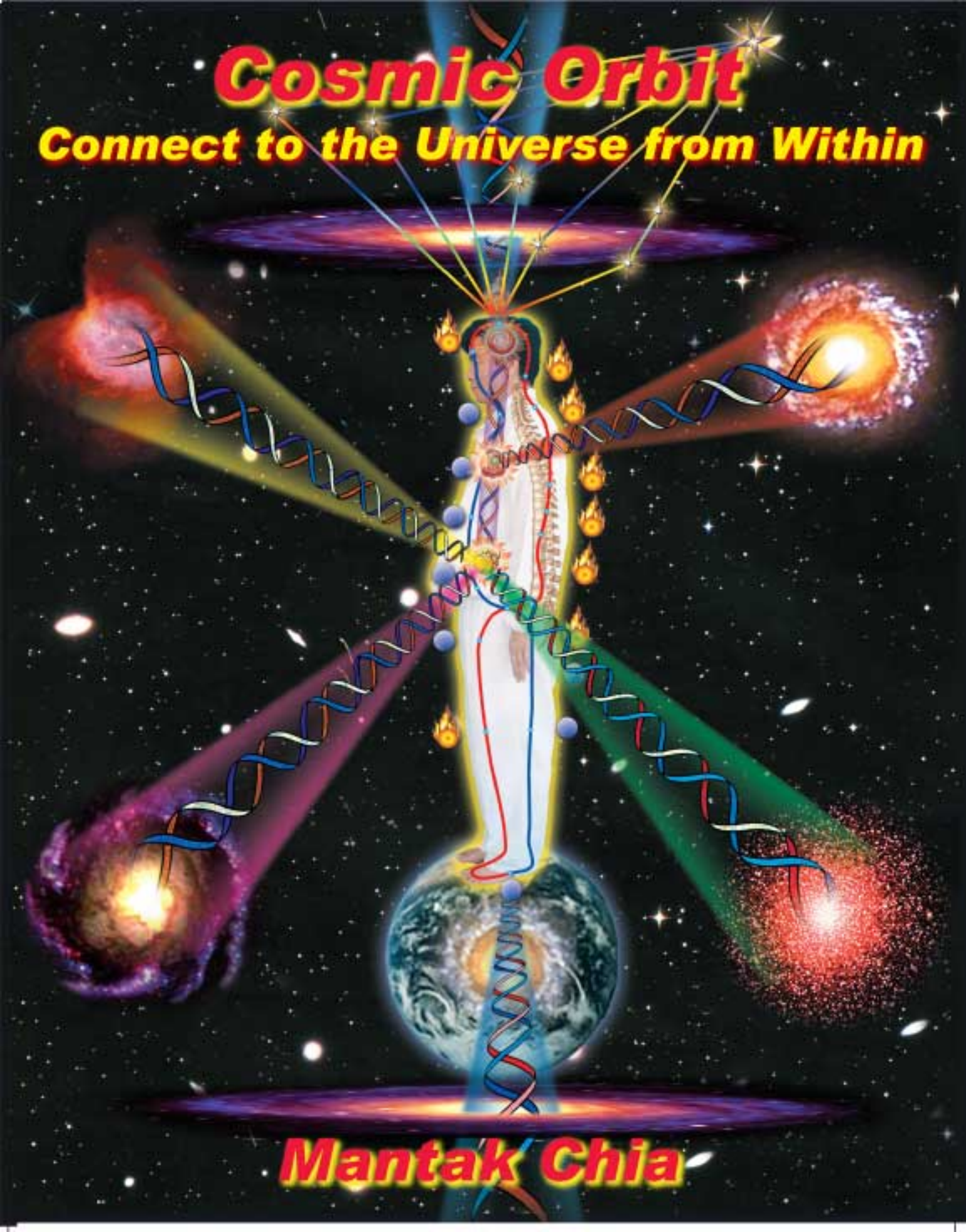

Mantak Chia

Cosmic Orbit

Connect to the Universe from Within

Mantak Chia

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About the Author

Master Mantak Chia

Master Mantak Chia is the creator of the Universal Tao System and is the director of the Universal Tao Center and Tao Garden Health Resort and Training Center in the beautiful northern countryside of Thailand. Since childhood he has been studying the Taoist approach to life. His mastery of this ancient knowledge, enhanced by his study of other disciplines, has resulted in the development of the Universal Tao System which is now being taught throughout the world.

Mantak Chia was born in Thailand to Chinese parents in 1944. When he was six years old, Buddhist monks taught him how to sit and “still the mind.” While still a grammar school student, he learned traditional Thai boxing. He was then taught Tai Chi Chuan by Master Lu, who soon introduced him to Aikido, Yoga and broader levels of Tai Chi.

Years later, when he was a student in Hong Kong excelling in track and field events, a senior classmate named Cheng Sue-Sue introduced him to his first esoteric teacher and Taoist Master, Master Yi Eng (I Yun). At this point, Master Chia began his studies of the Taoist way of life in earnest. He learned how to circulate energy through the Microcosmic Orbit and, through the practice of Fusion of the Five Elements, how to open the other Six Special Channels. As he studied Inner Alchemy further, he learned the Enlightenment of the Kan and Li, Sealing of the Five Senses, Congress of Heaven and Earth and Reunion of Heaven and Man. It was Master Yi Eng who authorized Master Chia to teach and heal.

When Mantak Chia was in his early twenties he studied with Master Meugi in Singapore, who taught him Kundalini, Taoist Yoga and the Buddha Palm. He was soon able to clear blockages to the flow of energy within his own body. He learned to pass the life force energy through his hands also, so that he could heal Master Meugi's patients. He then learned Chi Nei Tsang from Dr. Mui Yimwattana in Thailand.

A while later, he studied with Master Cheng Yao-Lun who taught him the Shao-Lin Method of Internal Power. He learned the closely guarded secret of the organs, glands and bone marrow exercise known as Bone Marrow Nei Kung and the exercise known as Strengthening and Renewal of the Tendons. Master Cheng Yao-Lun's system combined Thai boxing and Kung Fu. Master Chia also studied at this time with Master Pan Yu, whose system combined Taoist, Buddhist and Zen teachings. Master Pan Yu also taught him about the exchange of Yin and Yang power between men and women, and how to develop the Steel Body.

To understand the mechanisms behind healing energy better, Master Chia studied Western anatomy and medical science for two years. While pursuing his studies, he managed the Gestetner Company, a manufacturer of office equipment and became well acquainted with the technology of offset printing and copying machines.

Using his knowledge of Taoism, combined with the other disciplines, Master Chia began teaching the Universal Tao System. He eventually trained other Instructors to communicate this knowledge and he established the Natural Healing Center in Thailand. Five years later, he decided to move to New York, where in 1979, he opened the Universal Tao Center. During his years in America, Master Chia continued his studies in the Wu system of Tai Chi with Edward Yee in New York.

Since then, Master Chia has taught tens of thousands of students throughout the world. He has trained and certified over 2,000 instructors and practitioners from all over the world. Living Tao Centers, Chi Nei Tsang Institutes, Cosmic Healing Forums & Immortal Tao Mountain Sancutaries have opened in many locations in North America, South America, Europe, Asia, Africa and Australia.

In 1994, Master Chia moved back to Thailand, where he had begun construction of Tao Garden and the Universal Tao Training Center fifteen miles outside of Chiang Mai.

Master Chia is a warm, friendly and helpful man who views himself primarily as a teacher. He presents the Universal Tao System in a straightforward and practical manner, while always expanding his knowledge and approach to teaching. He uses a word processor for writing and is totally at ease with the latest computer technology.

Master Chia estimates that it will take thirty-five books to convey the full Universal Tao System. In June, 1990, at a dinner in San Francisco, Master Chia was honored by the International Congress of Chinese Medicine and Qi Gong (Chi Kung), who named him the Qi gong Master of the Year. He is the first recipient of this annual award.

In December, 2000, the Tao Garden Health Resort and Universal Tao Training Center was completed with two Meditation Halls, two open air Simple Chi Kung Pavilions, indoor Tai Chi, Tao Tao Yin and Chi Nei Tsang Hall, Tai Chi Natural Swimming Pool, Pakua Communications Center with a complete Taoist Library, Internal World Class Weight Lifting Hall and complete eight Court Recreational Facilities.

In February, 2002, the Immortal Tao practices were held at Tao Garden for the first time using Darkness Technology, creating a complete environment for the higher level Taoist practices.

Master Mantak Chia has previously written and published these twenty-five Universal Tao books:

Awaken Healing Energy of the Tao - 1983
Taoist Secrets of Love: Cultivating Male Sexual Energy
co-authored with Michael Winn - 1984.
Taoist Ways to Transform Stress into Vitality -1985
Chi Self-Massage: the Tao of Rejuvenation - 1986
Iron Shirt Chi Kung I - 1986
Healing Love through the Tao: Cultivating Female Sexual Energy - 1986
Bone Marrow Nei Kung - 1989
Fusion of the Five Elements I - 1990
Chi Nei Tsang: Internal Organ Chi Massage - 1990
Awaken Healing Light of the Tao - 1993
The Inner Structure of Tai Chi with Juan Li - 1996
Multi-Orgasmic Man co-authored with Douglas Abrams 1996 - published by Harper Collins
Tao Yin - 1999
Chi Nei Tsang II - 2000
Multi-Orgasmic Couple co-authored with Douglas Abrams 2000 - published by Harper Collins
Cosmic Healing I - 2001
Cosmic Healing II co-authored with Dirk Oellibrandt - 2001
Door of All Wonders co-authored with Tao Haung - 2001
Sexual Reflexology co-authored with W. U. Wei - 2002
Elixir Chi Kung - 2002
Tan Tien Chi Kung - 2002
Cosmic Fusion - 2002
Karsai Nei Tsang - 2003
Cosmic Orbit - 2005
Lesser Kan & Li - 2005

Many of the books above are available in the following foreign languages: ***Arabic, Bulgarian, Czech, Danish, Dutch, English, French, German, Greek, Hebrew, Hungarian, Indonesian, Italian, Japanese, Korean, Lithuanian, Malaysian, Polish, Portuguese, Romanian, Russian, Serbo-Croatian, Slovenian, Spanish,*** & ***Turkish*** editions are available from the Foreign Publishers listed in the Universal Tao Center Overview in the back of this book.

Lee Holden has been a Universal Tao Certified Instructor and Chi Nei Tsang Teacher since 1992 and recently has been certified as a Senior Instructor in the Universal Tao. Lee has been the chief editor for Master Mantak Chia for numerous projects such as Tao Yin: Exercises for Health, Revitalization, Longevity, Sexual Reflexology and Cosmic Fusion. Lee has taught workshops throughout the United States, Europe, and South East Asia. Lee has been on staff with Mantak Chia and Deepak Chopra, teaching, writing and facilitating seminars and workshops. Currently, Lee teaches at Five Branches Institute for Chinese Medicine, Twin Lakes College of Massage and is the founder of Pacific Healing Tao in Northern California. Lee's video Tai Chi for Fitness has been featured on two separate television shows and has been the subject of numerous magazine articles. Lee Holden Jr. is a graduate of U.C., Berkeley, with a BA in Psychology and is a Licensed Acupuncturist.

Lee Holden,
Copy Editor

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Thanks to Juan Li for the use of his beautiful and visionary paintings, illustrating Taoist esoteric practices.

We offer our eternal gratitude to our parents and teachers for their many gifts to us. Remembering them brings joy and satisfaction to our continued efforts in presenting the Universal Tao System. For their gifts, we offer our eternal gratitude and love. As always, their contribution has been crucial in presenting the concepts and techniques of the Universal Tao.

We wish to thank the thousands of unknown men and women of the Chinese healing arts who developed many of the methods and ideas presented in this book.

We wish to thank Fiona Jan for her editorial work and writing contributions, as well as her ideas for the cover. We appreciate her research and great labor. We offer thanks for her editorial contributions on the revised edition of this book, as well as thanking our Senior Instructors Dr. Andrew Jan and Wilbert Wils, for their insightful contributions to the revised version. We thank Matt Gluck and Saida Desilets for their technical editing and clear writing throughout the book. We wish to thank Daniel Dubie for his continuing support and valuable contributions towards Master Chia's publications and the Tao Garden.

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Words of Caution

The practices described in this book have been used successfully for thousands of years by Taoists trained by personal instruction. Readers should not undertake the practice without receiving personal transmission and training from a certified instructor of the Universal Tao, since certain of these practices, if done improperly, may cause injury or result in health problems. This book is intended to supplement individual training by the Universal Tao and to serve as a reference guide for these practices. Anyone who undertakes these practices on the basis of this book alone, does so entirely at his or her own risk.

The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training.

Neither the Universal Tao nor its staff and instructors can be responsible for the consequences of any practice or misuse of the information contained in this book. If the reader undertakes any exercise without strictly following the instructions, notes and warnings, the responsibility must lie solely with the reader.

This book does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

The Universal Tao is not and cannot be responsible for the consequences of any practice or misuse of the information in this book. If the reader undertakes any exercise without strictly following the instructions, notes, and warnings, the responsibility must lie solely with the reader.

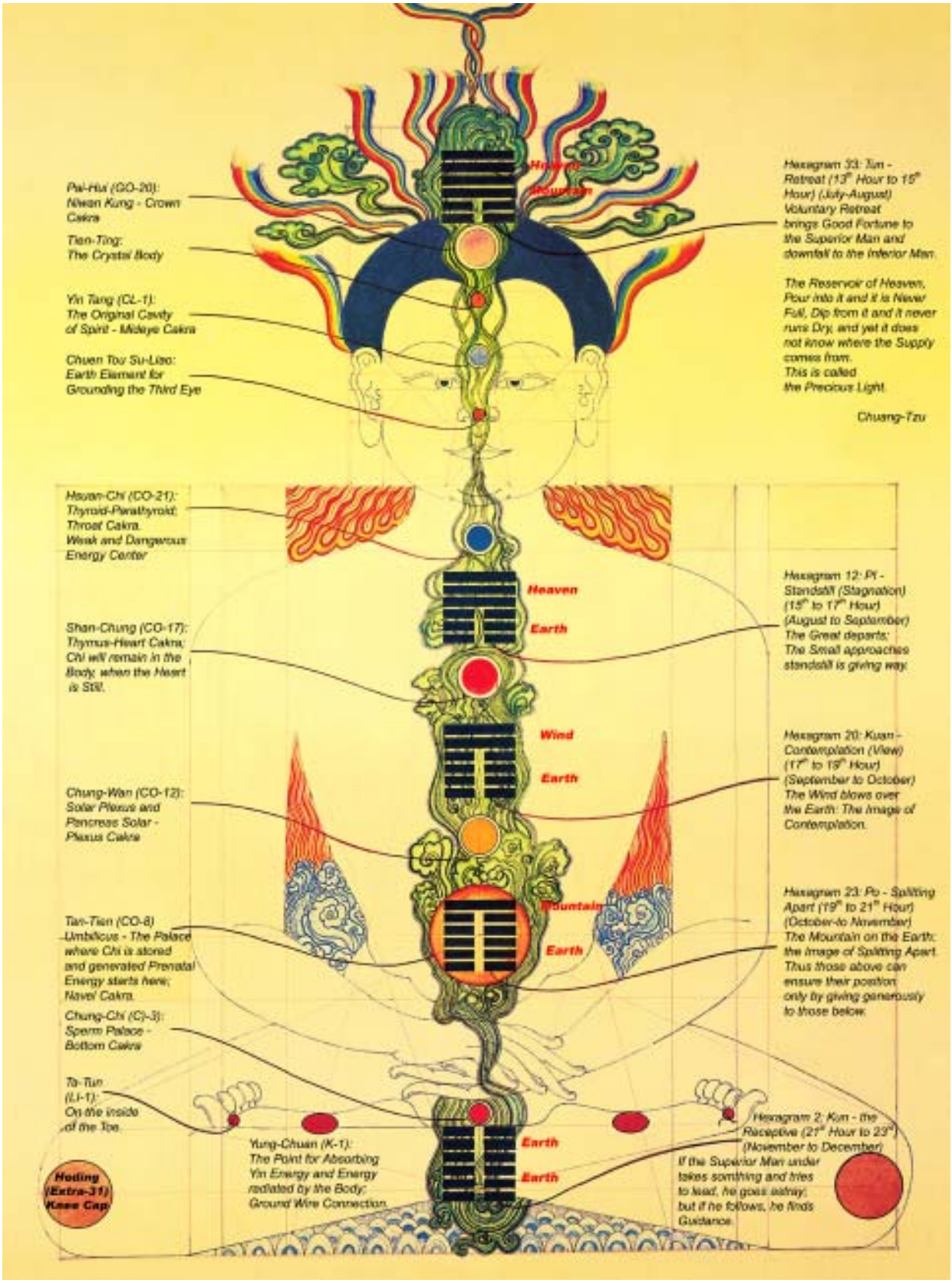
Pai-Hui (GO-20):
Niwan Kung - Crown Cakra
Tien-Ting:
The Crystal Body
Yin Tang (CL-1):
The Original Cavity of Spirit - Midaye Cakra
Chuen Tou Su-Liao:
Earth Element for Grounding the Third Eye
Hexagram 33: Tun - Retreat (13th Hour to 15th Hour) (July-August)
Voluntary Retreat brings Good Fortune to the Superior Man and downfall to the Inferior Man.
The Reservoir of Heaven, Pour into it and it is Never Full. Dip from it and it never runs Dry, and yet it does not know where the Supply comes from.
This is called the Precious Light.
Chuang-Tzu
Hsuan-Chi (CO-21):
Thyroid-Parathyroid; Throat Cakra.
Weak and Dangerous Energy Center
Heaven
Earth
Shan-Chung (CO-17):
Thymus-Heart Cakra; Chi will remain in the Body, when the Heart is Still.
Hexagram 12: Pi - Standstill (Stagnation) (15th to 17th Hour) (August to September)
The Great departs; The Small approaches
standstill is giving way.
Wind
Earth
Chung-Wan (CO-12):
Solar Plexus and Pancreas Solar - Plexus Cakra
Hexagram 20: Kuan - Contemplation (View) (17th to 19th Hour) (September to October)
The Wind blows over the Earth: The Image of Contemplation.
Mountain
Earth
Tan-Tien (CO-8)
Umbilicus - The Palace where Chi is stored and generated Prenatal Energy starts here; Navel Cakra.
Hexagram 23: Po - Splitting Apart (19th to 21th Hour) (October-to November)
The Mountain on the Earth; the Image of Splitting Apart.
Thus those above can ensure their position only by giving generously to those below.
Chung-Chi (C)-3):
Sperm Palace - Bottom Cakra
Ta-Tun (LI-1):
On the inside of the Toe.
Yung-Chuan (K-1):
The Point for Absorbing Yin Energy and Energy radiated by the Body; Ground Wire Connection.
Earth
Earth
Hexagram 2: Kun - the Receptive (21st Hour to 23rd) (November to December)
If the Superior Man undertakes something and tries to lead, he goes astray; but if he follows, he finds Guidance.
Hoding (Extra-31) Knee Cap

Introduction

Tao teaches how to cultivate inner energy and connect this energy with universe.

This is the third book involved with the teachings of the Microcosmic Orbit. In this book there are more details with the most up to date instructions. This book is designed to expand upon the other two and allow practitioners to open their own internal energy and create harmony between themselves and the universe.

The picture below is a 2000-year-old carving in a Tao temple. This carving is a symbolic representation of the Cosmic Orbit. Water is being pumped by the boy and girl through the spine to the top of the head. In the Tao Classics, this is called, “Kidney water reverses its course.” The water passes through the fire at the Lower Tan Tien and the kidney/adrenals transforming it into vapor (Chi or Qi). When the vapor reaches the crown it condenses and drips down like misty water to the heart. This cools the heart fire, so the heart will not dry out and the vapor will nurture all the organs and irrigate the land. This is symbolic for the energy circulation called transforming water into steam. By pumping the watery sexual energy up the spine past the fire from the sexual palace and the kidneys to the top of the head, one is able to understand the symbolic energy circulation called transforming water into steam. Next, it flows down past the fire of the heart and is transformed into Chi, the bio-electromagnetic power of the life force.

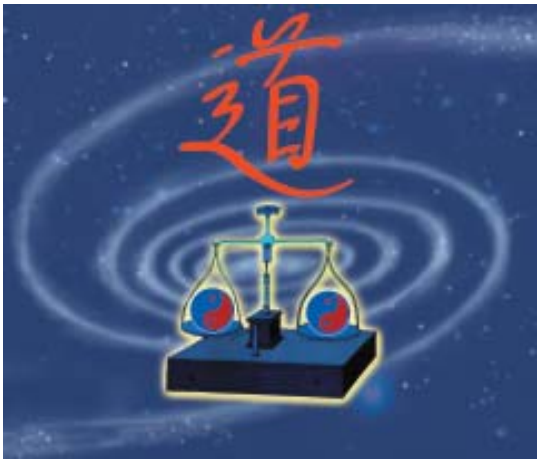

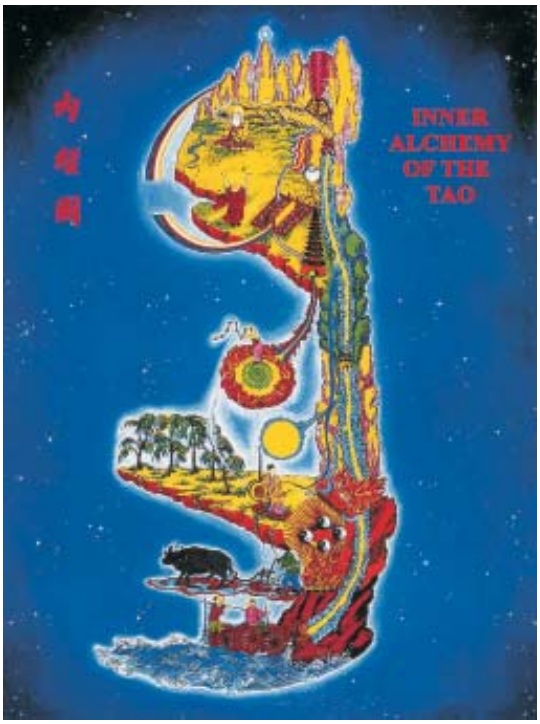

Fig. 1 *2000-year-old Carving in a Tao Temple*

We are directly involved with our solar system: the energies from our body, mind and spirit are constantly affected by the moon, planets, sun, galaxy and the entire universe. The Taoist practices expand our awareness and keep many more elements of the universe in our consciousness.

Fig. 2 *Consciousness of Humanity Field, Awareness Field*

White Magic Practice

丹鼎

The Taoist practices are also called White Magic Practices or Inner Alchemy. With the Inner Smile and the Six Healing Sounds we transform negative emotions into positive energies. Negative emotions are normal. Feelings such as impatience, anger and worry happen everyday. We call them negative because when they stay in us too long they become stagnant and detrimental to our health. This is contrary to what happens with positive emotions such as love, joy, generosity, happiness and trust, which nurture us. What the Taoists discovered is that we can utilize this negative energy to cultivate positive energy through such practices as the Inner Smile and Six Healing Sounds.

Sexual energy or jing chi in the Taoist thinking is the source of all life and creativity. It is the basic resource transformed first into chi and then into shen (spiritual energy). Sexual energy can be cultivated by men learning how to control ejaculation and by women easing the blood flow in the monthly period. Sexual energy can be used for the ultimate creative act of creating a new body. In the Taoist Healing Love practices, learning to circulate the sexual energy, transforming it up along the spine through the cosmic orbit and down the front of the body, recycles and regenerates the body's internal energy.

Inner Alchemy Changes

Transform negative into positive energy. Changing lead into gold.

Alchemical changes happen every day of our life. When our loved ones are sad, angry or depressed, we can send love and gentleness to them and make them feel better. Changing the anger into happiness, is changing the negative into positive, also known in Taoism and alchemy as "Changing Lead into Gold." Western doctors now realize that a lot of sickness is caused by negative emotions. Anger increases blood pressure and puts stress on the heart. We need to learn how to change the negative into positive energy to improve our health and spiritual energy. The basic practices for this are the Inner Smile and Six Healing Sounds.

Recycle the emotions and sexual energy.

When we feel sexual arousal and desire, the sexual hormones are activated. This is the beginning of the inner alchemy of sexual energy. Recycling this energy is the fundamental practice of the Cosmic Orbit. Sexual energy is the creative force that is used to regenerate the body's internal energy as it travels through the orbit.

Returning to the Primordial Force and Born Again Process 重生

Taoists regard the opening of the cosmic orbit as “The Born Again Process”. In the womb we receive nutrients from our mother through the umbilical cord. When we practice the cosmic orbit and touch the tongue to the roof of the mouth, we receive nutrient Chi from the universe and store it in the Tan Tien.

Fig. 3 *Born Again Process and Returning to Primordial Forces*

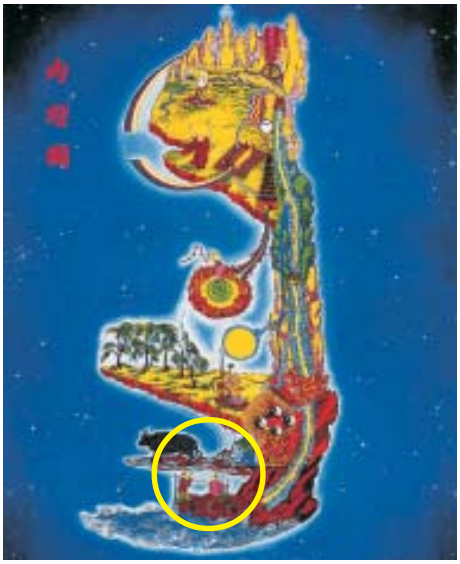

The cosmic orbit practice is sometimes called “Returning to the Primordial Force” or the “Born Again Process.” Turning the water wheel of the cosmic orbit is also referred to as “Spinning the Wheel.”

Fig. 4 *Turning the Water Wheel*

Taoist Universe, Elements and Awareness

The Five Elements play a major role in the way the Taoists see the universe and in the Taoist practices. From the Wu Chi, (in other traditions referred to as the Void or God), or the Ultimate Stillness, creation brings forth yin and yang. These are transformed into each other in an eternal cyclic movement, Tai Chi, which generates the five elements: the stages in the transformation of yin into yang and yang into yin. They are also symbolized as water, wood, fire, earth and metal or air. Of course, Earth, Man and all living things are composed of these elements.

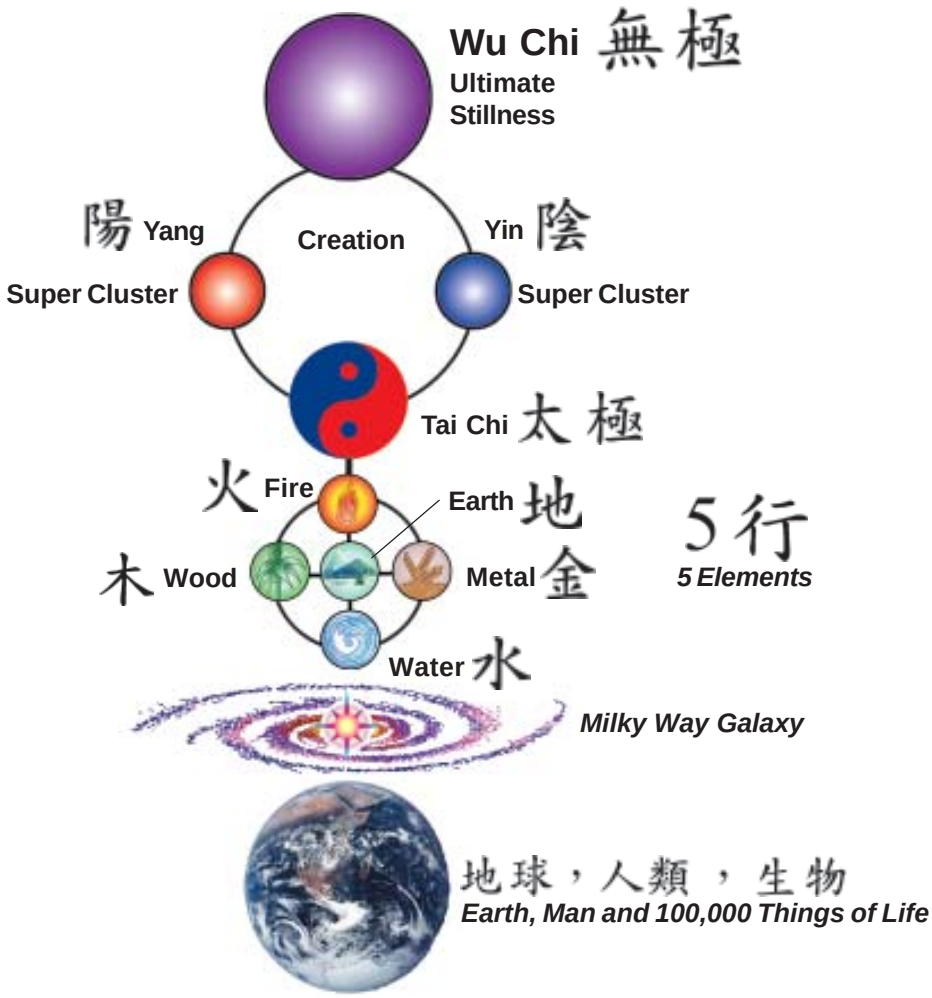

Fig. 5 *Levels of the Cosmic Taoist Universe*

By calming our minds, we can become aware of the many elements in the universe and the major forces that are active around us. When we make contact with these forces and learn to integrate them within our own energy field, we become part of the entire universe. The diversity of the universe is enormous. For example, it has been estimated that there are more than 200 billion galaxies, each containing more than 200 billion stars. So, the Taoists say that the limited energy of the human body can become part of the unlimited energy of the universe.

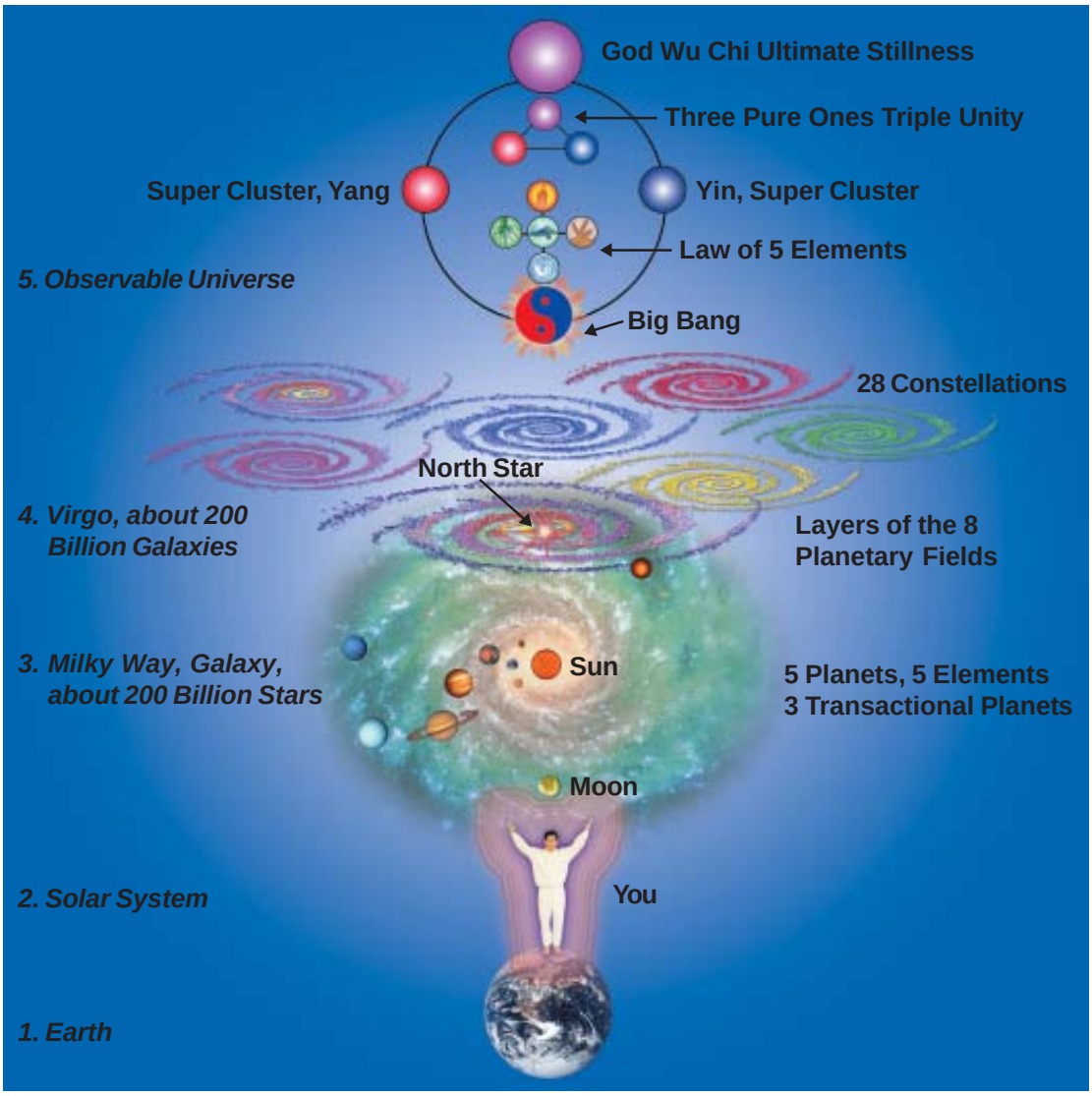

Fig. 6 *Levels of the Cosmic Universe, Field of Human Consciousness, Awareness Field*

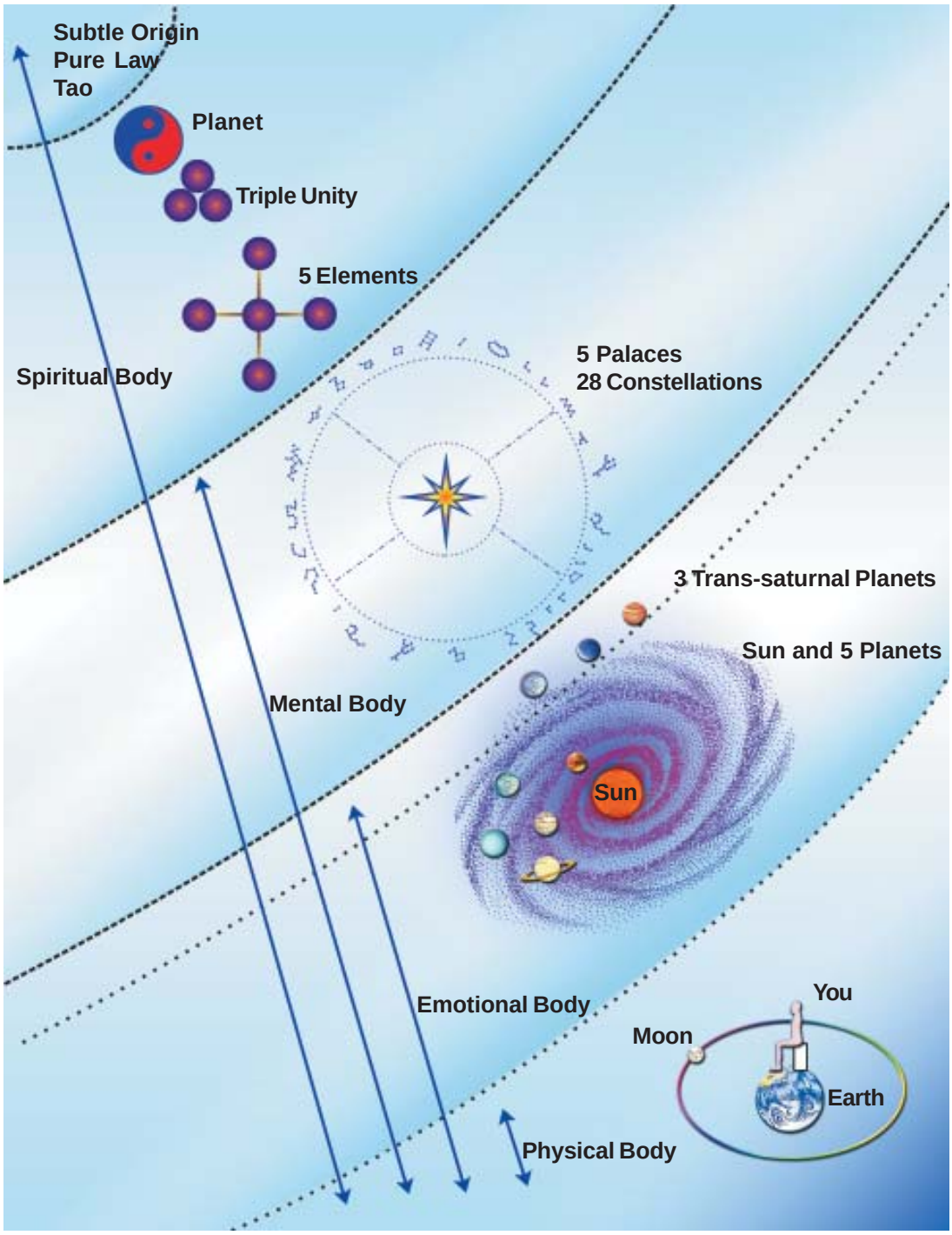

Fig. 7 *A schematic depiction of the various spheres so we can expand our awareness.*

Three Treasures of the Tao 丹 田

Taoist teachings often refer to the Three Treasures.

1. **Treasures of Heaven: Stars, Sun, Moon**

2. **Treasures of Man: Spirit or "Shen" Energy or Chi and Sex/Body or Jing Chi**

3. **Treasures of Earth: Land, Water, Wind**

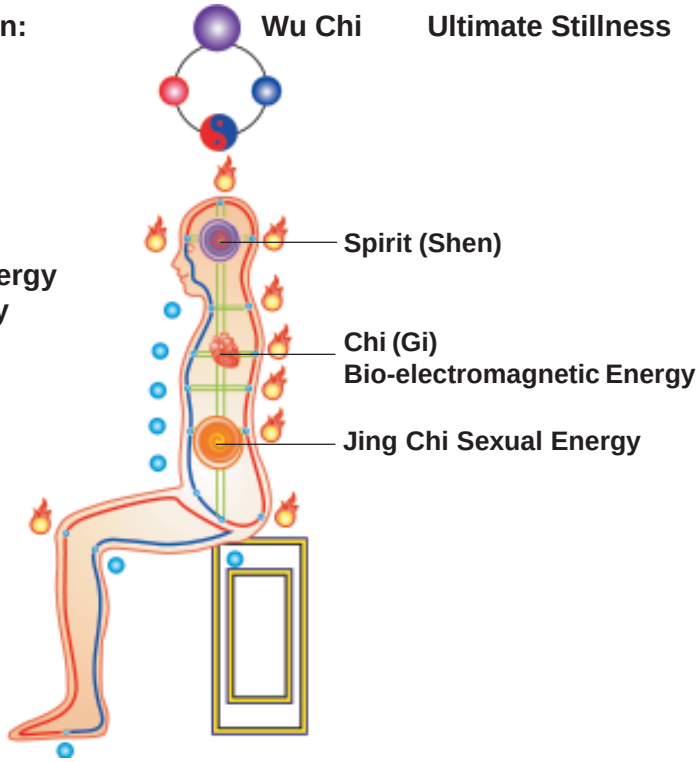

Fig. 8 *Wu Chi*

The Taoist Classics state, "Transform Jing (Sexual Energy) into Qi (Life Force Energy) and Qi into Shen (Spirit Energy)." This is truly the internal alchemical process of returning to the origin, the doorway into the Tao, the primordial void of clear light and inner sound. The Three Treasures practice cultivates self-awareness and develops your personal soul pattern. It is a process of self-transformation, of creating higher forms of vibration, and resonating with the source of life. It is process of self-regeneration using the DNA to divide matter into new cells creating bliss and divine qualities of love and truth.

Chapter 1
Foundation of the Universal Tao System is the Cosmic Orbit Meditation

The Cosmic Orbit Meditation is a refined practice which connects with the earth, cosmic (nature), and universal forces. The first step is to make a connection with the North Star and the Big Dipper's violet/red light ultra violet which is one of the most powerful heavenly lights. Through this practice, learning to feel Chi and using the mind/eye/heart power **(Yi 意)** to guide the Chi flow through the primary energy routes in your body is the foundation of Taoist meditation. This practice is later extended to include the arm and leg routes too; it is then the full Cosmic Orbit flow.

There are hundreds of different Chi Kung forms in China, and many involve different hand movements and gestures. We could spend lifetimes just learning the hand movements. The practice of the Cosmic Orbit meditation will help you feel Chi more easily inside, outside and around the body. It is the core practice of all the Chi Kung forms.

When I was a child I liked to practice Chi Kung so much I had to save my lunch money to learn. After many years of practice, I started to forget the first form, so I learned a new form. One day I tried to practice and review all the forms that I had learned and I realized that I could hardly remember the majority of them. I sat down and thought, "I only have two hands, two legs and one head. Why are there so many forms? And why are there are so many religions and beliefs?" I said to myself that there must be one main thing that they have in common. I started to search and I found out that the most important thing is feeling the Chi within us (God within us). Being able to increase, transform, take in and stay in touch with the universal, the cosmic, nature and the earth forces and letting them all combine within us (oneness with God, oneness with the universe) is what is important. Likewise in religion there is God (a Force in Taoism we call Wu Chi, the nothingness, the supreme power controlling the universe) and, with a good heart and virtuous energy we can connect with this force.

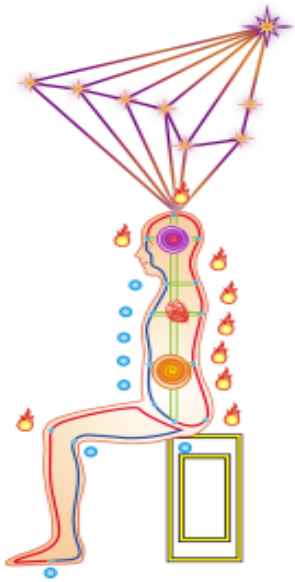

Fig. 1.1 *Cosmic Orbit Meditation*

Cosmic Inner Smile and the Six Healing Sounds

Cosmic Inner Smile and the Six Healing Sounds are very important practices to make the connections between the organs, the colors and the good virtuous energies associated with each organ.

Cosmic Inner Smile
Smile down to the abdomen and warm it up, smile to the heart and feel love with this practice. Energy levels increase, the heart beat remains calm, the body relaxes and, energy charges up the brain.

Fig. 1.2 *Red for the Heart, White for the Lungs, Yellow for the Spleen, Blue for the Kidneys, and Green for the Liver*

Each organ has its own vital color and when this is abundant it will radiate out as an aura for healing and protection. These organ colors and their associated universal connections have great healing power. The power of the 'Six Healing Sounds' will help enhance the connection to the cosmic source. Each sound will bring a different healing energy. The practices also help balance, refine and transform the negative energy into positive energy.

Six Healing Sounds is a Powerful Healing Exercise.

- Six Healing Sounds is a simple, easy and powerful exercise to transform and release negative energies from our body.
- Six Healing Sounds can change our inner energy quality, balance our organ energy and have a calming and healing effect on our body.
- The order of the organs healing sound is: lungs, kidneys, liver, heart, spleen and Triple Warmer.
- It is best practiced before our nightly rest.

Please see more details in the book *Transform Stress into Vitality.* ***Fig. 1.3*** *Six Healing Sounds*

Iron Shirt Chi Kung and Bone Breathing

Iron Shirt Chi Kung and Bone Breathing are systems of standing meditations. These exercises help ground and to root your connection into the earth force, building good structure and absorbing greater force. In turn, this will help draw in the heavenly force, which will combine with the potent healing power of the earth's yellow light. The practice also strengthens the body so you can hold a higher energetic charge. These abilities are essential prerequisites for handling greater amounts of energy.

Iron Shirt Chi Kung also includes the art of "Changing the Sinews and Washing the Marrow." Through these aspects of Iron Shirt, you learn to absorb, store and discharge large amounts of energy through the tendons and bones. *These practices are outlined in detail in the books "Iron Shirt Chi Kung" and "Bone Marrow Nei Kung" by Mantak Chia.*

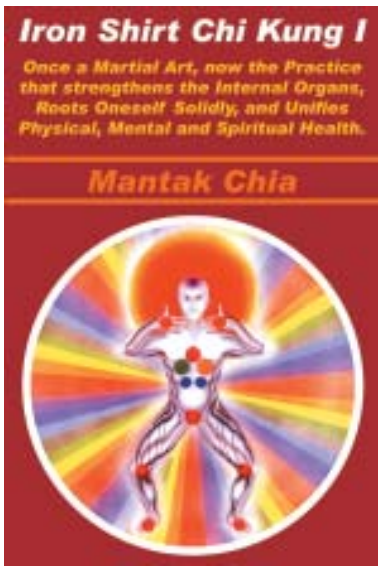

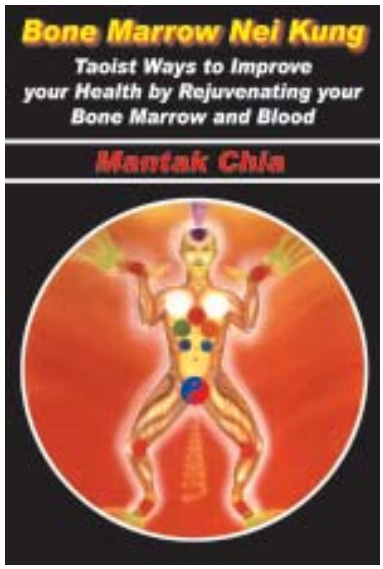

Fig. 1.4 *Iron Shirt Chi Kung and Bone Marrow Nei Kung Books*

To attain skill in Cosmic Chi Kung, it is helpful to practice Iron Shirt, Bone Marrow and meditation as a minimum requirement. Beyond the basic level, the Universal Tao System includes many other intermediate and advanced level Chi Kung practices and meditations. The further one advances, the greater one's mastery of Chi.

Your increasing level of skill in the Universal Tao system will reflect immediately in your Cosmic Healing Chi Kung practice. Furthermore, you will discover that you can incorporate many of your Universal Tao practices directly into your practice of Cosmic Chi Kung. We will give you a simple combined practice of the Cosmic Healing Chi Kung, the Inner Smile, Microcosmic Orbit, Iron Shirt and the Sexual practices.

Stages of Mastering Chi

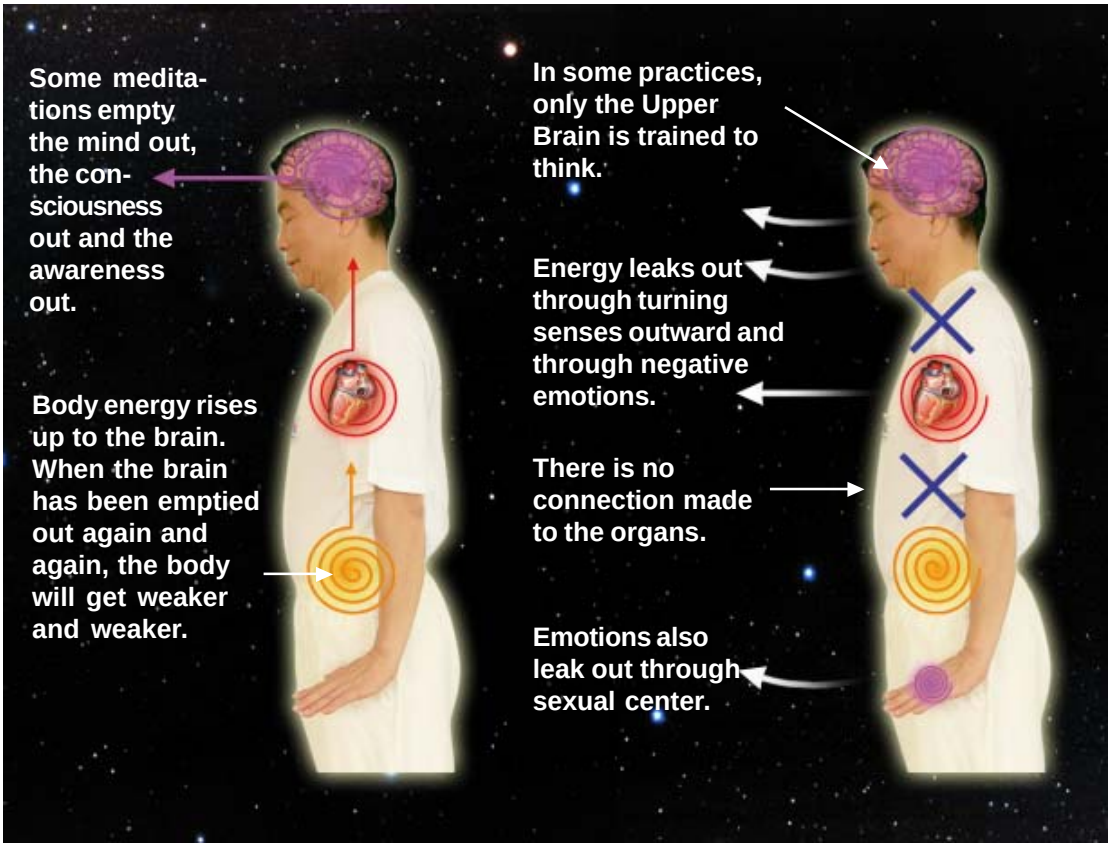

Fig. 1.5 *Some practices attempt to reach enlightenment at the expense of the body. When we lose all energy we lose control of our own mind and spirit.*

1. Conserving Chi. In the Universal Tao System, our *first* goal is to learn to conserve our Chi; when a battery is totally drained, it is harder to charge. Conservation of Chi will help gain more Chi. To have more Chi we first need to maintain control of the gates through which energy normally leaks out and constantly drains our life force. We leak energy:
   - through our reproductive system
   - through negative emotion
   - through constantly turning our senses outward
   - poor diet, eating habits
   - improper or shallow breathing

   Without knowing how to conserve the Chi that we already have, what is the point of acquiring more?

2. Balancing Chi. Learning to balance Chi is the second step to keeping a smooth and harmonious flow of energy moving throughout the whole body. If our energy is imbalanced, we may have too much energy in some places and not enough in others; we may also be too yang or too yin. We may have an excess or deficiency of heat, cold, damp or dryness. This imbalanced energy tends to make us go to extremes.
3. Transforming Qi. Transforming Qi is the third phase and allows practitioners access to more beneficial energies. For example, through the Taoist Sexual Chi Kung practices taught in the Universal Tao (the course known as Healing Love through the Tao), we can transform sexual energy back into basic life force Chi. Through other practices (such as the Inner Smile, the Six Healing Sounds, and Fusion of the Five Elements) we learn to transform negative emotional Chi into positive virtuous Chi. Thus Chi is not only the foundation of our health; it is also the basis of spiritual development in the Tao.
4. Increase Qi. Once we have accomplished the three previous phases of mastering Chi, we then learn to increase it. Chi pervades all of heaven, earth and nature. In Cosmic Healing Chi Kung we learn time-tested ways to tap into these unlimited and transpersonal reservoirs of Chi and greatly expand the amount of energy available to us. It is very important to master first the stages of conservation, balance and transformation before we emphasize increasing our Chi. Otherwise we may waste the energy we bring in, or we may inadvertently amplify the imbalanced or negative energies that we have not yet learned to bring under control.
5. Expanding Qi. Finally, we learn to extend our mind to tap into the vast Chi of nature, the cosmos and the universe to heal our body, mind and spirit and to heal other people. Cosmic Healing Chi Kung practice sensitizes your hands to the feeling and movement of Chi; it uses the mind-eye power to absorb cosmic Chi into the palm and crown and to send it out through the hands and beyond, so that you can help restore balance in others without touching them or draining yourself.

Essence of Tao Practices

"When a man smiles only with his eyes, not with his belly; do not trust him."

Laughing Chi Kung

My wish is for everyone to be spiritually independent and connected personally to the Source, Cosmos, or Primordial Force in our common quest to return to Wu Chi (God). Through this process we can gain inner peace, happiness and compassion for ourselves and others. We can also develop the ability to heal ourselves and to serve as positive energy sources. Naturally, the first step is to be at peace with ourselves. Therefore, I now present this meditation, Laughing Chi Kung as a tool for strengthening the connection we have to ourselves and for opening to the abundant Chi available from the cosmos and for developing the skills of self-healing.

I remember one day practicing the many forms of breathing exercises I had learned. After practicing the whole day I had not finished and I thought to myself, why so many different breathing exercises, after all we have only one nose and two holes? At this point I started to laugh and laugh, and after a few minutes of laughing I felt more relaxed, more open and full of Chi than after a day of complicated breathing exercises. I realized that laughing is a natural and powerful method for calming the nervous system, stimulating circulation and digestion, activating the immune system and generating more energy. This is what this meditation practice and breathing technique is: laughing for our health. Laughing Chi Kung teaches us how to laugh from all the way down in our lower bellies, strengthening the deepest abdominal muscles, the diaphragm and the muscles of the pelvic floor, the urogenital muscles. When our lower abdomen is enlivened through deep belly laughing, we create a good solid home for our awareness and energy.

Fig. 1.6 *Why are there so many breathing exercises when we only have only one nose with two holes?*

Explanation of Benefits

When we laugh from the abdominal area, there is a vibration that moves though the body. This vibration will activates the heart brain and the thymus gland Laughing from our Lower Tan Tien, our second brain, stimulates all the functions of this area and activates the heart brain and the thymus gland. Allowing the laughter to reverberate through the diaphragm, sternum, spine and all the organs feels like a real workout in the beginning. All the tensions we hold on that keep us in a state of contraction are vibrated from the inside and then start to release. You will feel an enormous relaxation in your abdomen and all the related tensions in the rest of your body start to release as well.

1. Increases the minds attention, improves circulation.
2. Activates the diaphragm and the diaphragm activates the abdominal area.
3. Activates the Lymphatic System and improves the Immune System.

Fig. 1.7 *Laughing Chi Kung*

Three Minds into One Mind 意 Yi

In the Tao practice it is important to understand the principle of the three minds. The upper mind, also known as the upper Tan Tien, resides in the brain. The upper mind is good for planning and detailed figuring but it is easily drained by thinking too much. The middle mind, or the middle Tan Tien, is centered in the heart. The heart is the seat of our consciousness. The lower mind, or the lower Tan Tien is in the lower abdomen and this is where our awareness resides. It is also the place to generate Chi. The three minds; the observing brain mind, also known as monkey mind, the conscious heart mind and the aware abdominal mind, can be fused together to form one mind which in Tao we call ***"I"*** . From this one mind we can do all of our thinking and sensing and connect to the cosmos and use a fraction of the energy needed when the upper mind works alone.

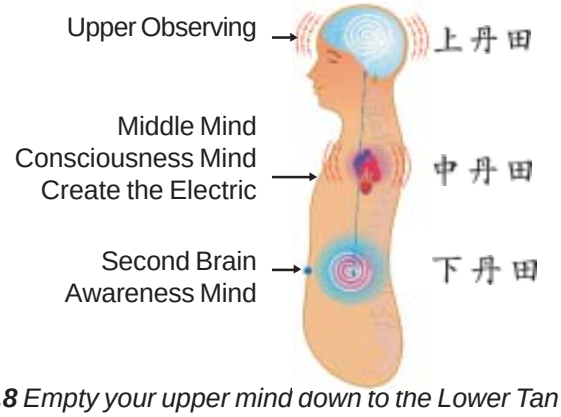

Fig. 1.8 *Empty your upper mind down to the Lower Tan Tien. Let awareness and consciousness combine together.*

Upper Mind, Monkey Mind

The Taoists refer to an over-used upper mind as the monkey mind. The monkey mind is never at rest and consumes an amazing amount of the body's energy, so it is important to train the upper mind to rest in the lower Tan Tien and work together with it. When the upper mind is over-active it will suppress consciousness and awareness, but when we fuse our minds in the lower Tan Tien we become conscious and aware of things we were never conscious or aware of before. When we let our upper mind rest, we conserve energy and improve our health and emotion and spiritual practice. With practice we can learn to charge the lower Tan Tien with more energy and in turn the lower Tan Tien will charge the upper brain. Cultivating Chi in the lower Tan Tien is the key to the whole Tao practice.

Fig. 1.9 *Monkey Mind is known as the Upper Mind*

Second Brain is a Key Concept in Tao Practice.

In the beginning of my practice with my master, I did not understand the Second Brain concept. My master taught me to lower and sink my mind down to the lower Tan Tien. Much later, I understood this when I read that western technology had discovered that the nerve endings in the stomach and intestines, especially those that are related to emotional responses, are the same as those in the upper mind. By just dropping your energy down and smiling to the Lower Tan Tien you can activate your observing mind, conscious mind and awareness mind.

The west has been aware of the second brain for the last one hundred years. It still does not realize exactly how to use it as a conscious element of the human organism. The second brain is located in the regions of the small and large intestines. These carry the same kind of neurons and tissue as the first brain in the head except that they are larger in size and consume less energy. The second brain can perform many of the tasks of the upper brain.

The Taoists call this lower brain, situated in the abdomen, the Lower Tan Tien. This second brain has all the properties of the normal higher brain. In the west we refer to it as our guts. The west has now recognized the existence and importance of this second lower brain and how the higher and lower brain interact.

- The lower brain can be trained to think.
- The lower brain uses much less energy than the upper brain, and it can help us to take care of our daily work.
- Through practice, the lower brain can charge the upper brain with energy.

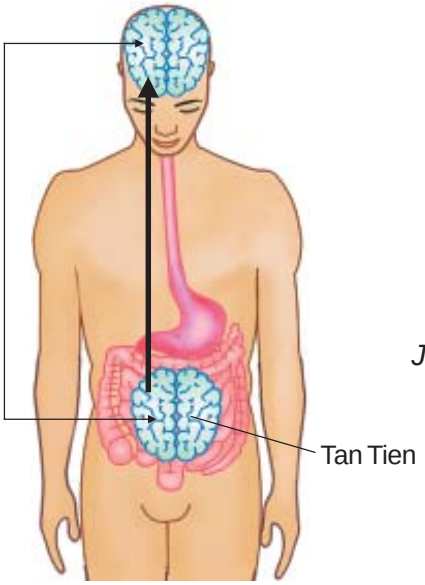

"Complex and Hidden Brain in the Gut"
Makes Stomach Aches and Butterflies

The New York Times
Tuesday, January 23, 1996

The gut has a mind of its own.
Just like the larger brain, this system sends and receives impulses, records experience and responds to emotions.

The gut can upset the brain and the brain can upset the gut.

Fig. 1.10 *Brain Power of the Tan Tien - The Seat of the Awareness Mind*

Studies are also taking place in the West on the Tan Tien Mind.

In his book The Second Brain, Gershon describes how this second brain has been known in the west since for over 100 years, but that people really did not know how to work with it. The Taoists have worked with this brain for 5000 years. The major practice is to "lower" the higher brain into the lower brain. This allows the higher brain to rest and recover. The higher brain uses a relatively larger amount of energy and resting it also saves energy. The lower brain can attract energy from the universe and charge the higher brain or other parts of the body.

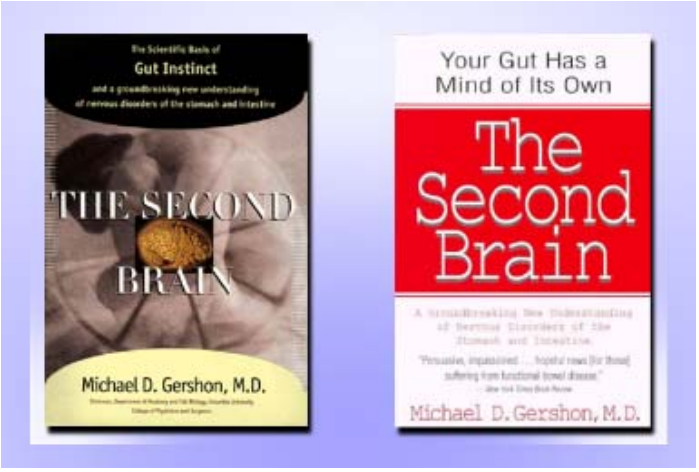

Fig. 1.11 *Books about the Second Brain by Michael D. Gershon, M.D.*

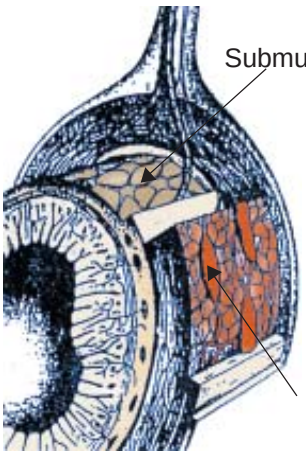

The intestine is loaded with neurons that can learn.

The Taoist practice teaches organs to learn and remember.

Fig. 1.12 *Existence of neurons enables the Second Brain to learn.*

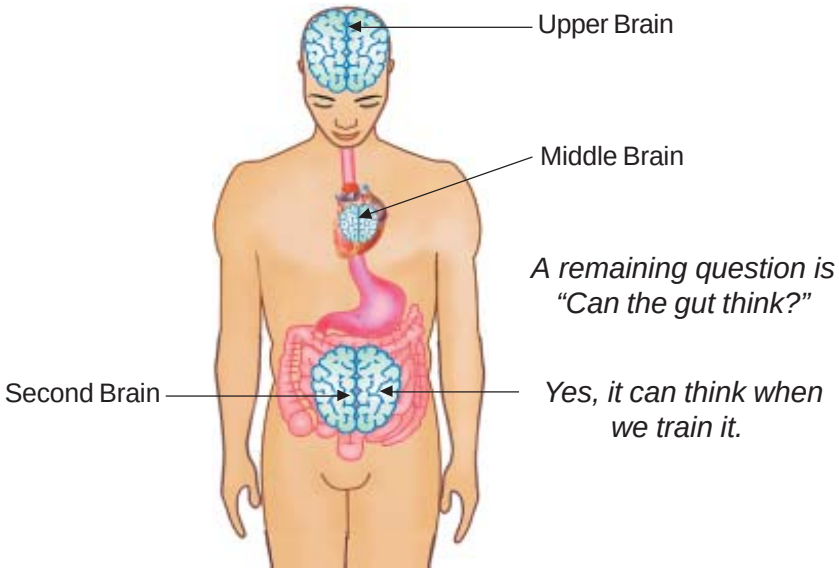

Fig. 1.13 *Taoism believes in the thinking capability of the Second Brain.*

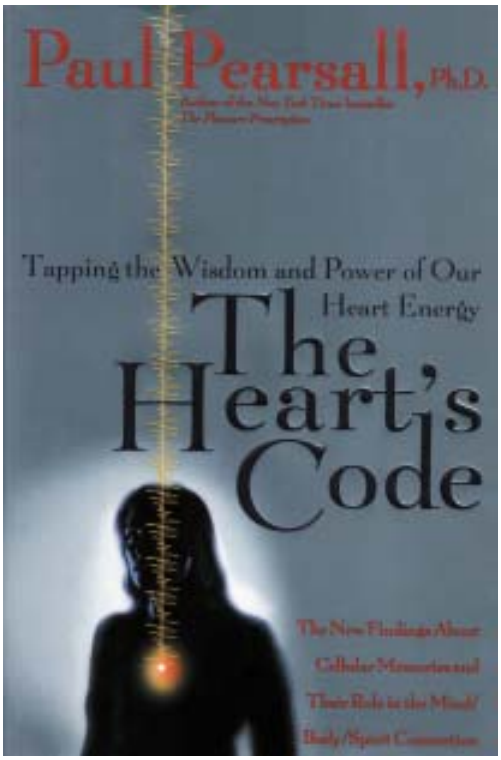

Fig. 1.14 *The heart has its own brain, the conscious mind.*

The Middle Brain, the Conscious Mind

The heart has its own brain, the conscious mind.

The Heart's Code by Paul Pearsall, Ph.D.

Taoism believes that the heart (Middle Tan Tien) is a "Mind", the seat of the conscious mind. The heart refines the spirit and then manifests in radiance of the spirit. The heart is known as radiant and shining heart. The nature of the heart governs and exerts authority on the other organs.

The Heart That Found Its Body Killer
Page 7
Cellular Memories and a Thinking Heart
An eight-year-old little girl received the heart of a murdered ten-year-old girl. This girl started screaming at night about her dreams of the man who murder her donor. Her mother said her daughter knew who it was. Her mother and the psychiatrist finally decided to call the police and, using the descriptions from the little girl, they found the murderer. Everything the little heart transplant recipient reported was accurate e.g. the time, the weapon, the cloth.

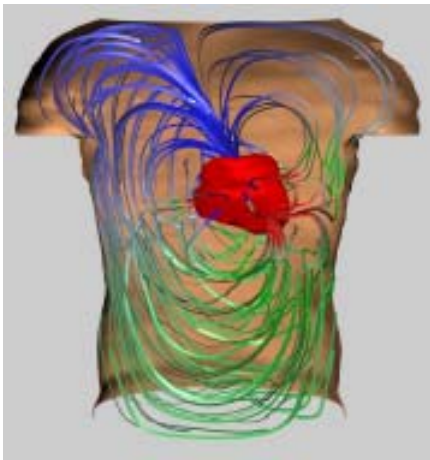

"These images show the use of ribbons to model the current paths inside the thorax. The colors along the ribbons indicate potential (red indicates positive, blue indicates negative)".

picture from:
www.sci.utah.edu/sci_images/pages/track266.html
www.ncsa.uiuc.edu/pubs/access/95.1/mapping.

The electricity manifests as an electrical field within and around the body, subtle but detectable.

Electric Current near the Heart

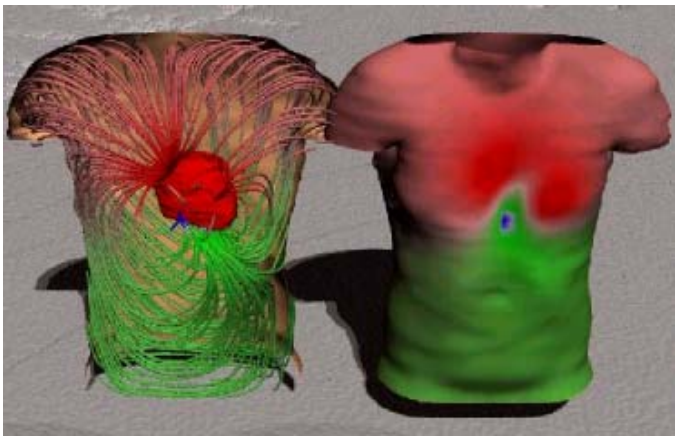

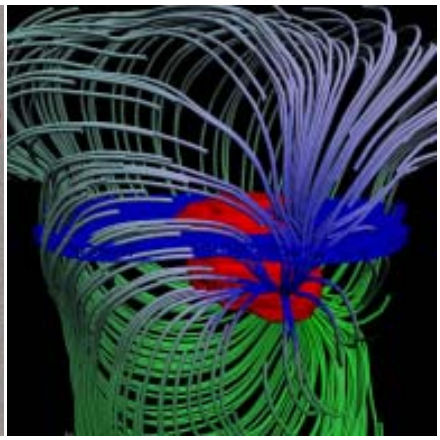

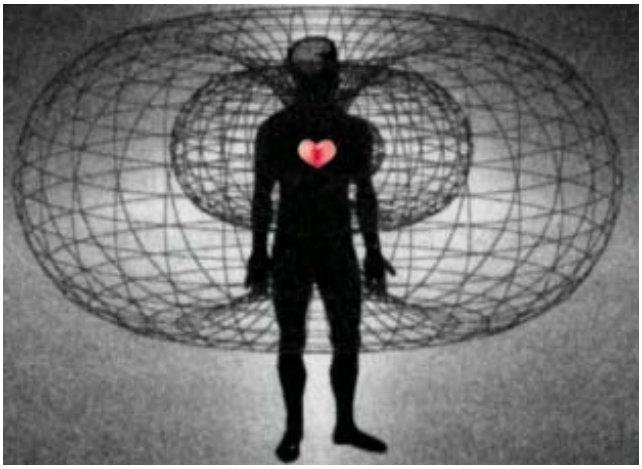

Recent research has revealed that the heart generates a strong electromagnetic field within and around the body. The electrical field is shaped like a donut, or torus, similar to the biomagnetic field of the human aura, and the geomagnetic field of the Earth. When we feel love and compassion, the heart will radiate and shine to all the cells of the body and radiate out to people around us.

Fig. 1.15 *Schematic of the Heart's Magnetic Field, the Radiant Heart*

The axis of the heart's electromagetic field is tilted at an angle to the body axis, similar to the tilt of the Earth's magnetic field. In the Tao, we believe that the heart tilts 45 degrees towards the North Star and that the North Star exerts a strong pull on the heart.

Fig. 1.16 *Axis of the heart's electromagnetic field*

In the Tao, we believe that the heart fibers are bundled into seven layers which generate seven electromagnetic fields and seven states of compassion energy.

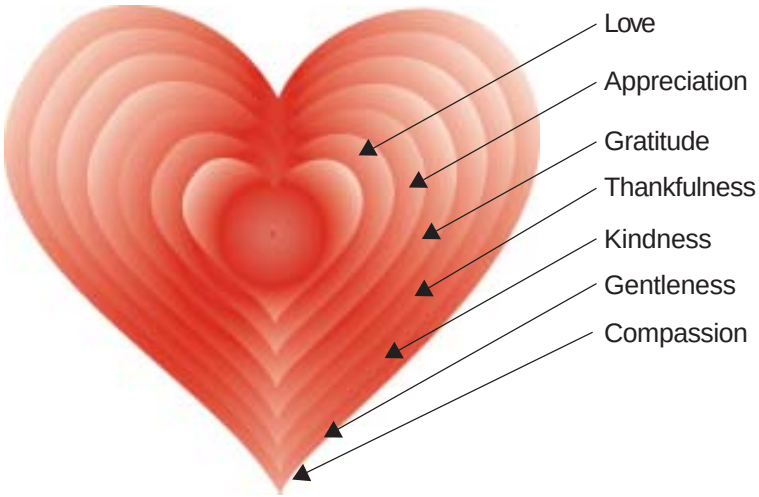

Fig. 1.17 *Generation of seven electromagnetic fields*

Laughing Chi Kung

Six Step of Laughing Chi Kung

1. Generate Chi with laughing
2. Increase the Chi by spiraling
3. Chi rises to the crown and the nostrils open
4. Gather the Chi in the lower Tan Tien
5. Collect the Chi
6. Store the Chi

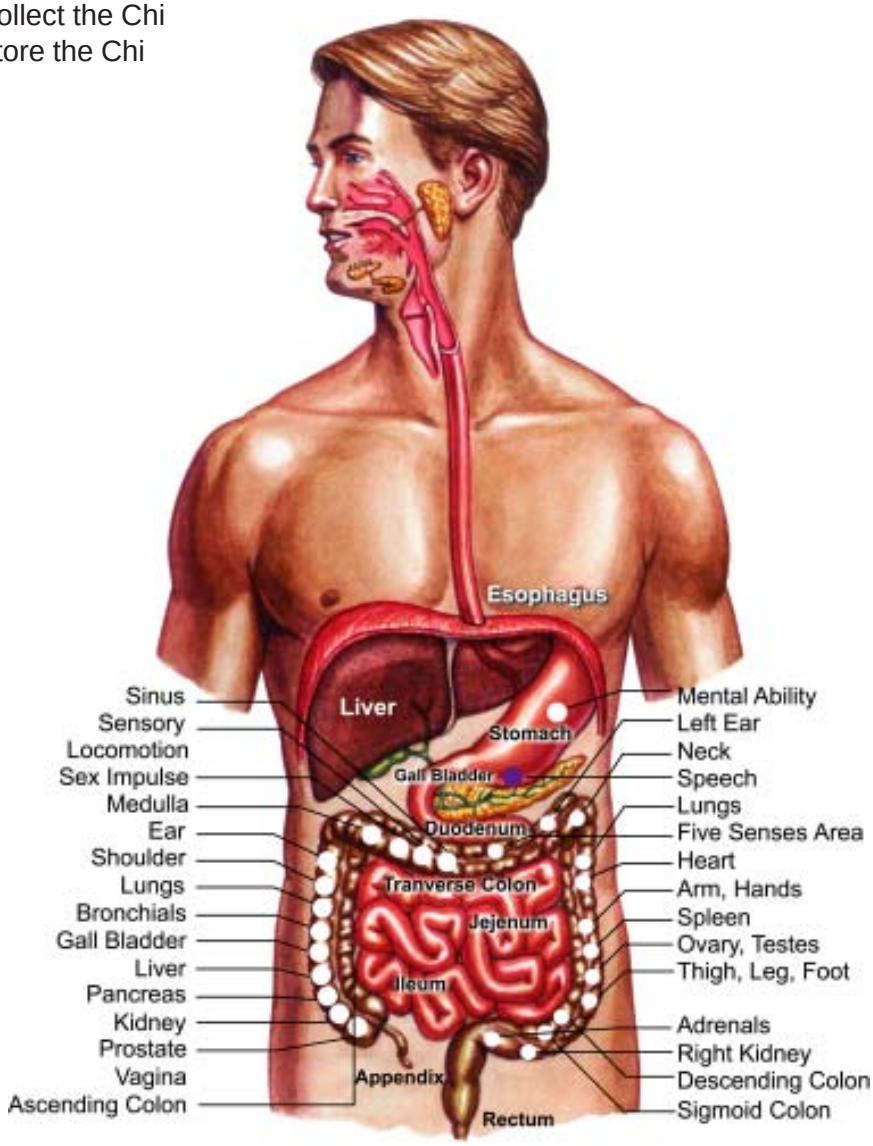

Fig. 1.18 *Reflex Points of the Colon*

Step 1: Generate Chi with Laughing

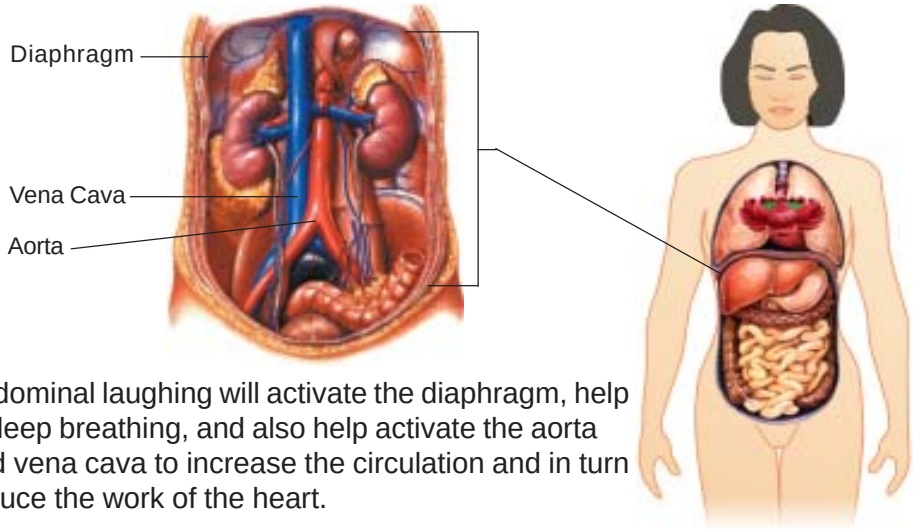

Abdominal laughing will activate the diaphragm, help in deep breathing, and also help activate the aorta and vena cava to increase the circulation and in turn reduce the work of the heart.

Fig. 1.19 *Activate Diaphragm.*

Many reflex points in the large intestine become stimulated with laughter. When the reflex points are stimulated, this has a beneficial effect on the corresponding organ.

Abdominal laughing exercises your diaphragm. When your diaphragm moves more easily this assists the lungs to breathe deeper and more fully. When the muscles in your belly tighten, the pressure in your abdomen increases. This squeezes the arteries and veins and moves the blood. When the muscles release and your belly expands it creates a vaccum for the major veins and arteries, the vena cava and the aorta, which attracts blood. This mechanism acts like a second heart, and lightens the workload for your primary heart.

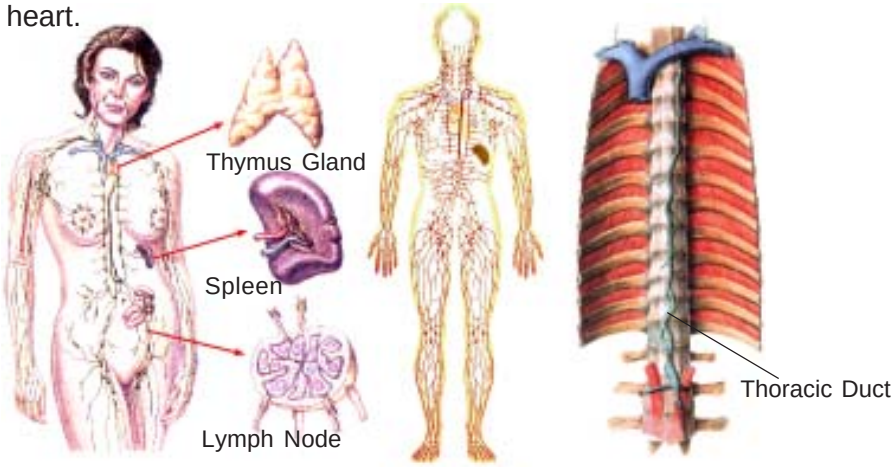

Fig. 1.20 *Activate the Lymphatic System and improve the Immune System.*

Laughing out loud also activates the blood stream, which will affect the thymus.
Thymus: The thymus gland is perhaps the most important organ of the immune system. In it the vital training of the different T-lymphocytes takes place to activate the immune system.

Laughing will activate the blood stream and vibrate the thymus gland let blood flow though the thymus gland, when white blood pass through the gland it will insert the program and white blood cell become T-cells.

Bone Marrow Tissue

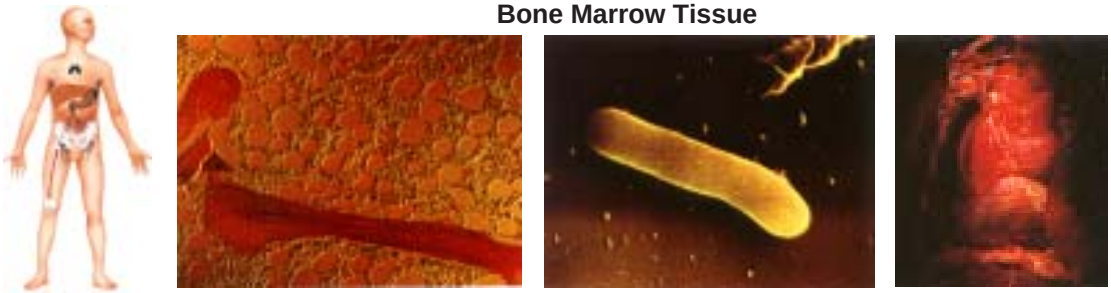

Bone Marrow: A tissue rich in fats, containing plenty of nourishment for the comprehensive production of the different blood cells: red cells for the transport of oxygen, blood platelets for clotting and the various white cells for the immune system.

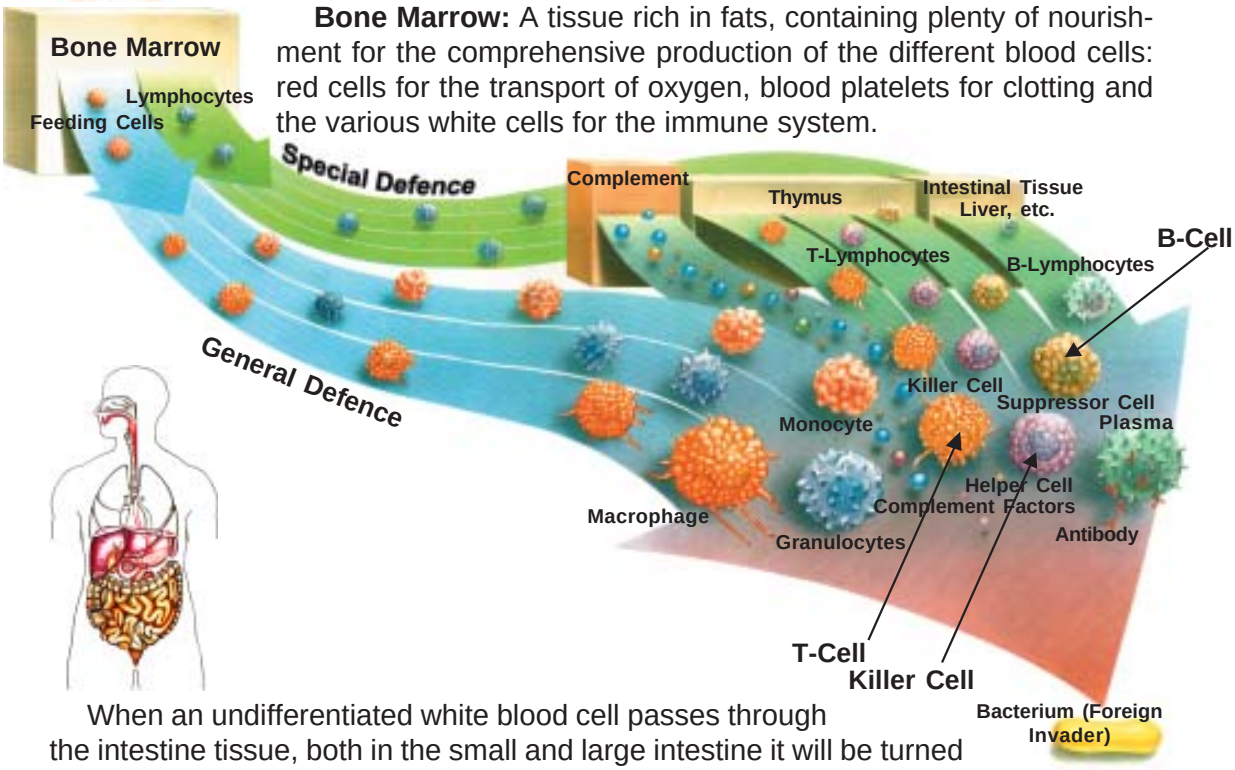

When an undifferentiated white blood cell passes through the intestine tissue, both in the small and large intestine it will be turned into the B-lymphocytes. Every individual B-lymphocyte can make antibodies only against a specific foreign organism. The picture shows a B-lymphocyte, the large round body, with the ability to form antibodies against bacteria. Laughing will help increase more blood flow through the intestinal tissue.

Fig. 1.21 *Bone Marrow, Bacterium and Thymus*

Step 2: Increase the Chi by Spiraling

Spinning the Energy

After each session of laughing we spend time spinning the newly generated energy in the lower Tan Tien. Spinning or spiraling the energy attracts more energy from the cosmos around us. At first we actively spin and spiral ourselves. Later, when we become more aware of the spinning and spiraling deep inside us and in the larger cosmos around us, the spinning and spiraling will happen spontaneously. Just being aware of this enables us to tap into enormous sources of energy.

Even greater speeds are attained through the spiraling of the Milky Way galaxy moving at enormous speeds through the universe. These speeds affect us in some way. Internally at the atomic level, everything spins in similar patterns. These movements influence each other and energy is transferred. The Taoists believe that becoming aware of all these internal and external spins and spirals allows us to constantly attract energy from the universe.

Fig. 1.22 *Spinning Energy*

How fast are you moving?

Spinning is an important concept in Taoist practice. Everything around us spins and often emits strong electromagnetic charged fields. We live in a spinning universe. All energy spins. In Taoist practice we must establish ourselves in the spinning universe, have our own spin to create our own identity and to be able to make contact with it.

For example, every point at the Equator moves at about 1000 miles per hour as the earth turns on its axis in 24 hours. Moreover, the earth moves around the sun in huge annual orbit. As the earth hurtles around the sun it has a speed of 67,000 miles per hour. This creats a spinning force and a force to draw more power from the Cosmos.

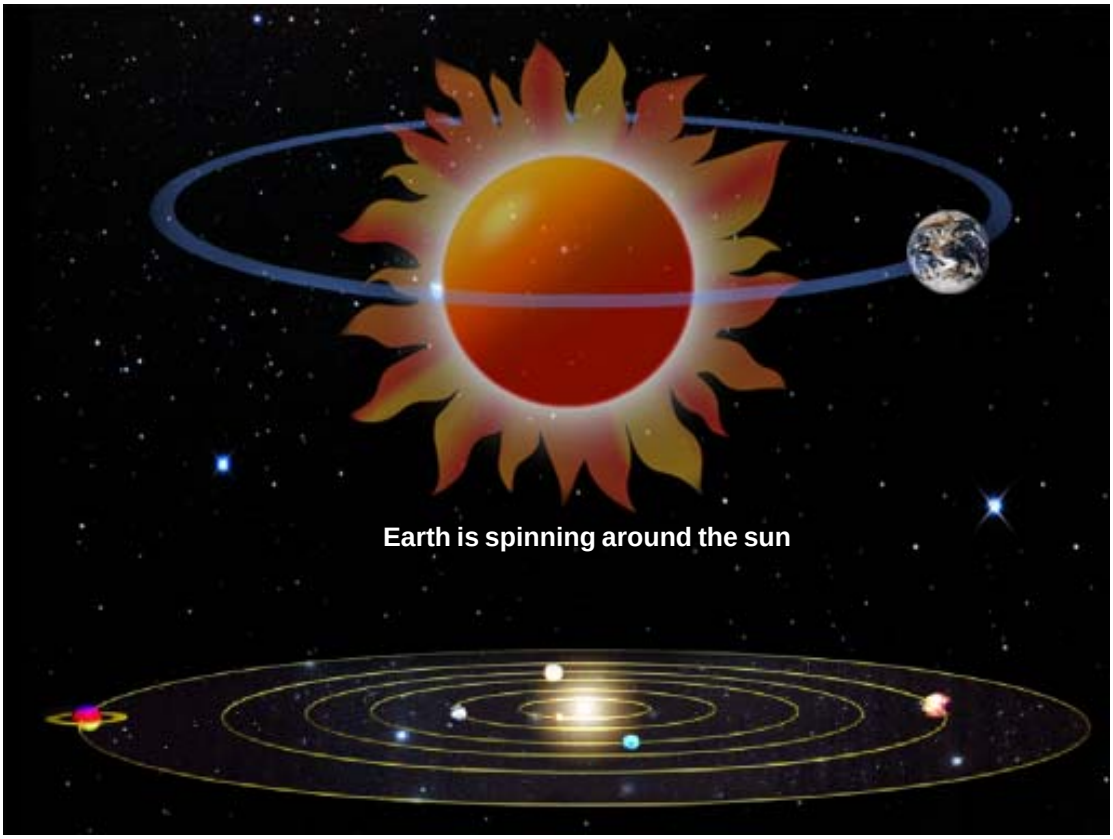

Fig. 1.23 *The Earth and Planets are moving around the Sun at 67,000 miles per hour.*

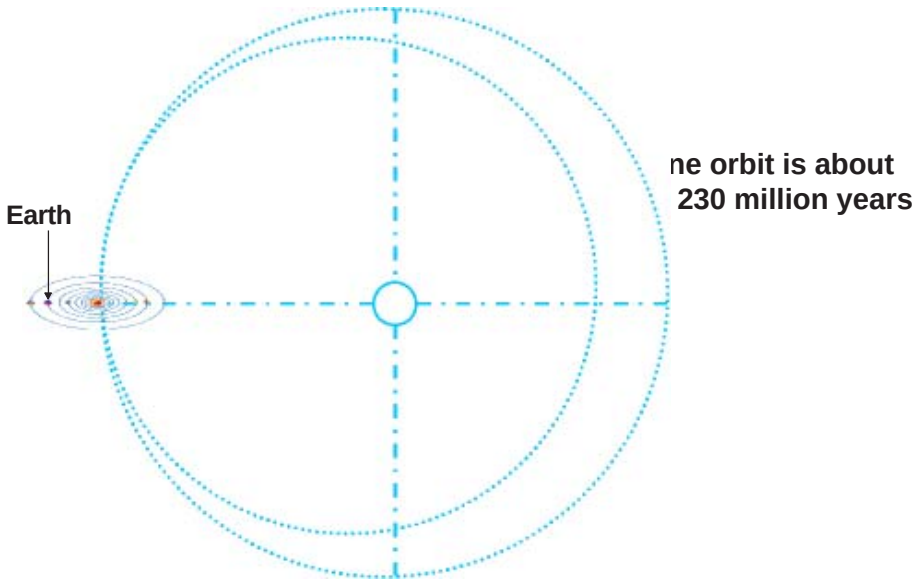

Fig. 1.24 *In addition the sun moves around our galaxy in space taking the whole solar system with it.*

Within the solar system there are many planets all circling around at great speed and influencing each other. It is amazing the planets do not bang into each other.

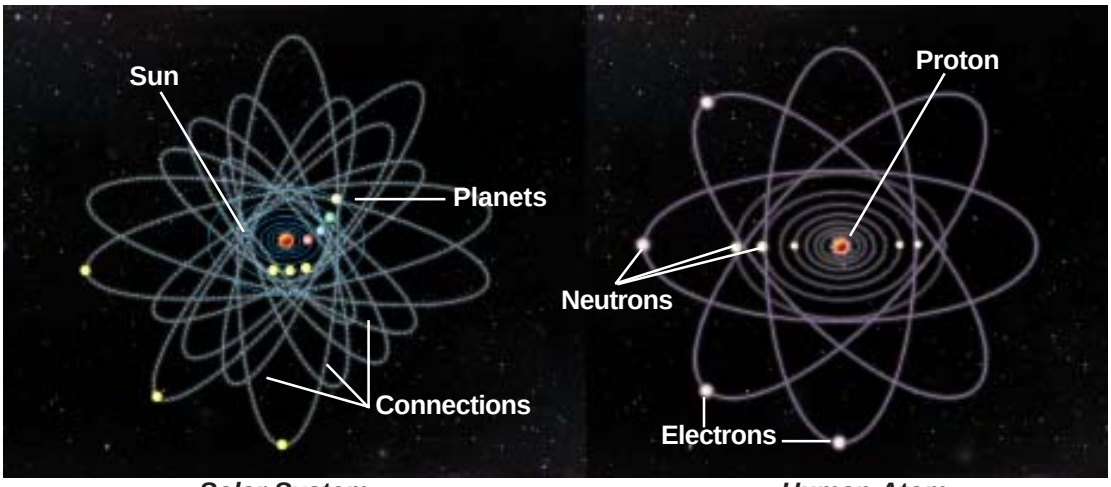

Solar System ***Human Atom***

Fig. 1.25 *Atomic Structure and Solar System Structure look similar.*

There are similarities between the solar system and our atom, with our atom spinning around a central point in an elliptical orbit. We have 6.5 trillion cells and each cell atom is spinning. The combined force of the spinning can generate tremendous power.

When we put these two together they look very similar. This shows how our atoms are continually moving and spinning and are influenced by the solar system.

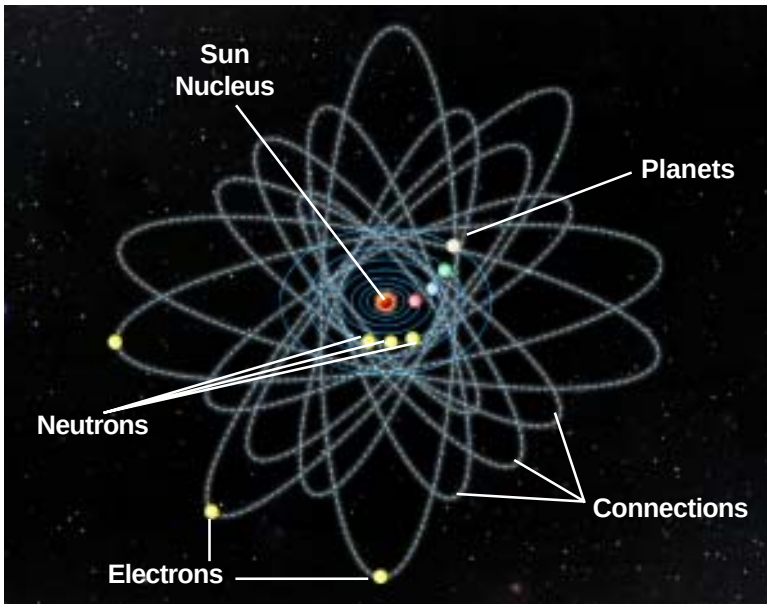

Fig. 1.26 *Human Atom and Planets*

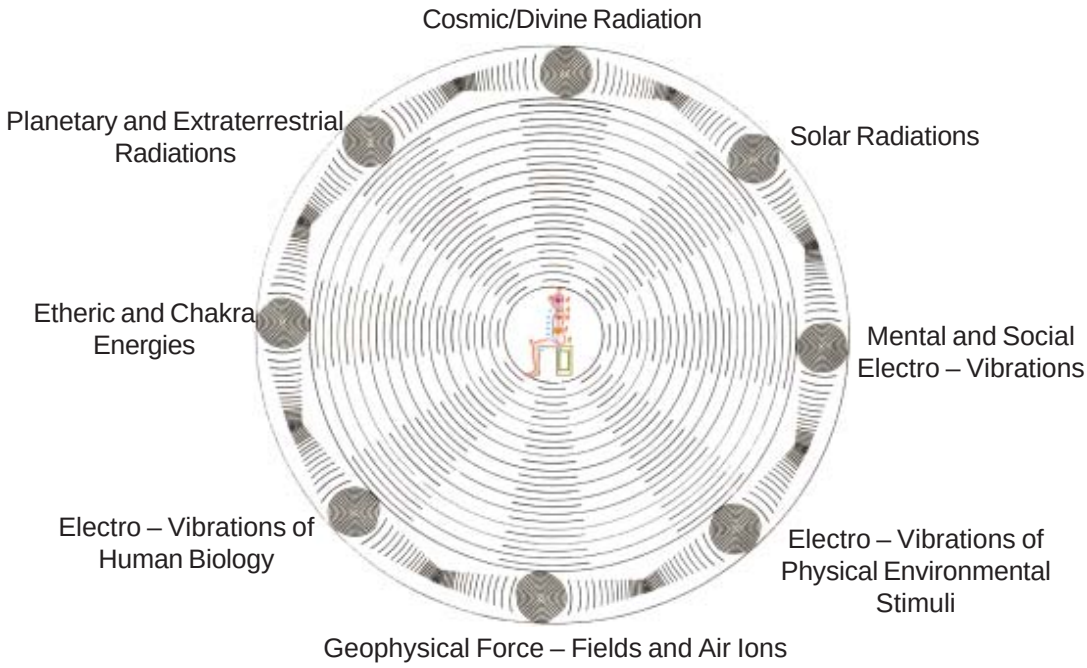

Fig. 1.27 *With the Cosmic/Divine Radiation Fields we are contacting and receiving cosmic energy all around us.*

The earth and many objects in the stars, planets and space emit an electromagnetic field. We are exposed to many such fields. The individual spin and fields enable us to communicate with the rest of the universe and exchange energy with it. We call this the Cosmic Orbit. The cosmic force and our cells are made of the same material which can help enhance the spinnning.

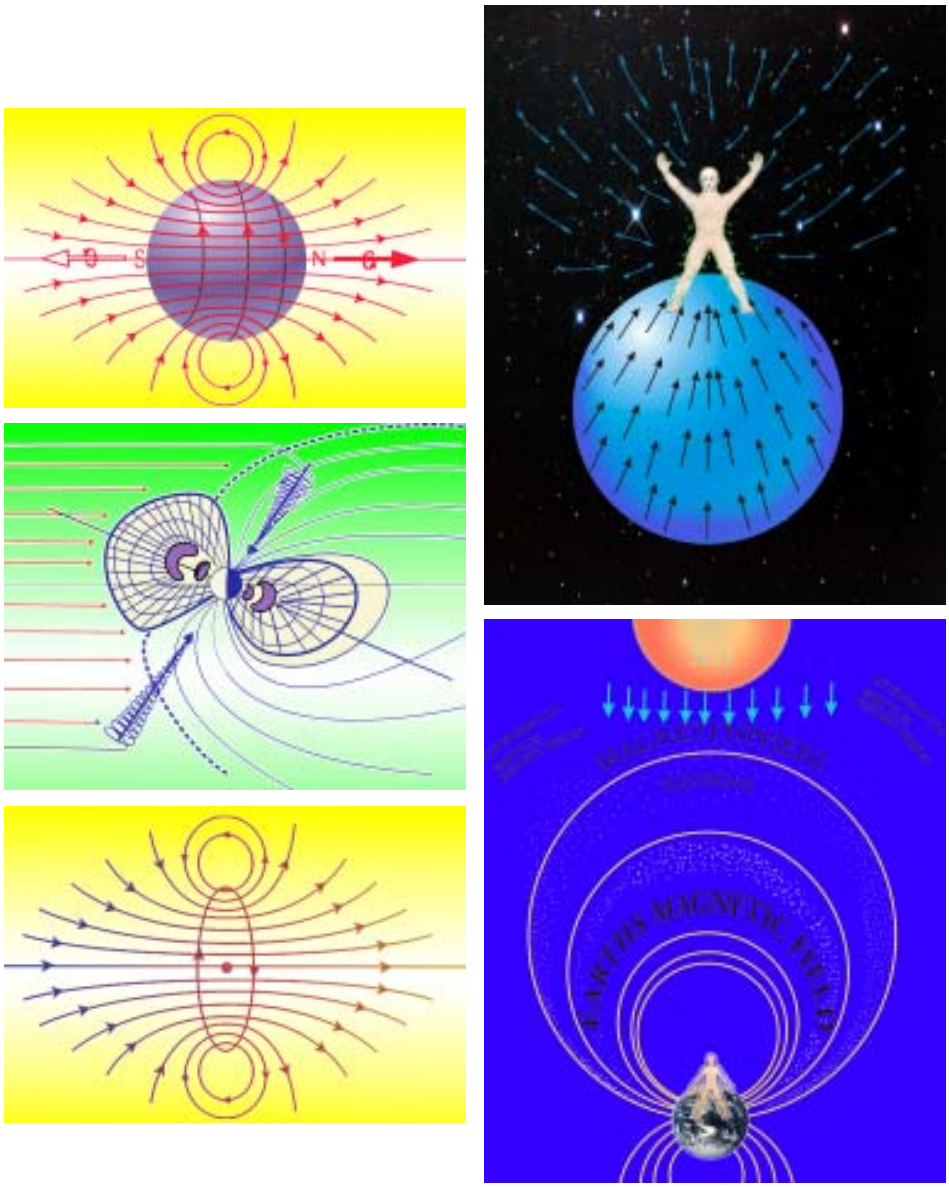

Fig. 1.28 *Cosmic forces flow to us and the world.*

Cosmic Orbit

Turning the Wheel

Moving the Microcosmic Orbit is another spin of energy also known as turning the wheel.

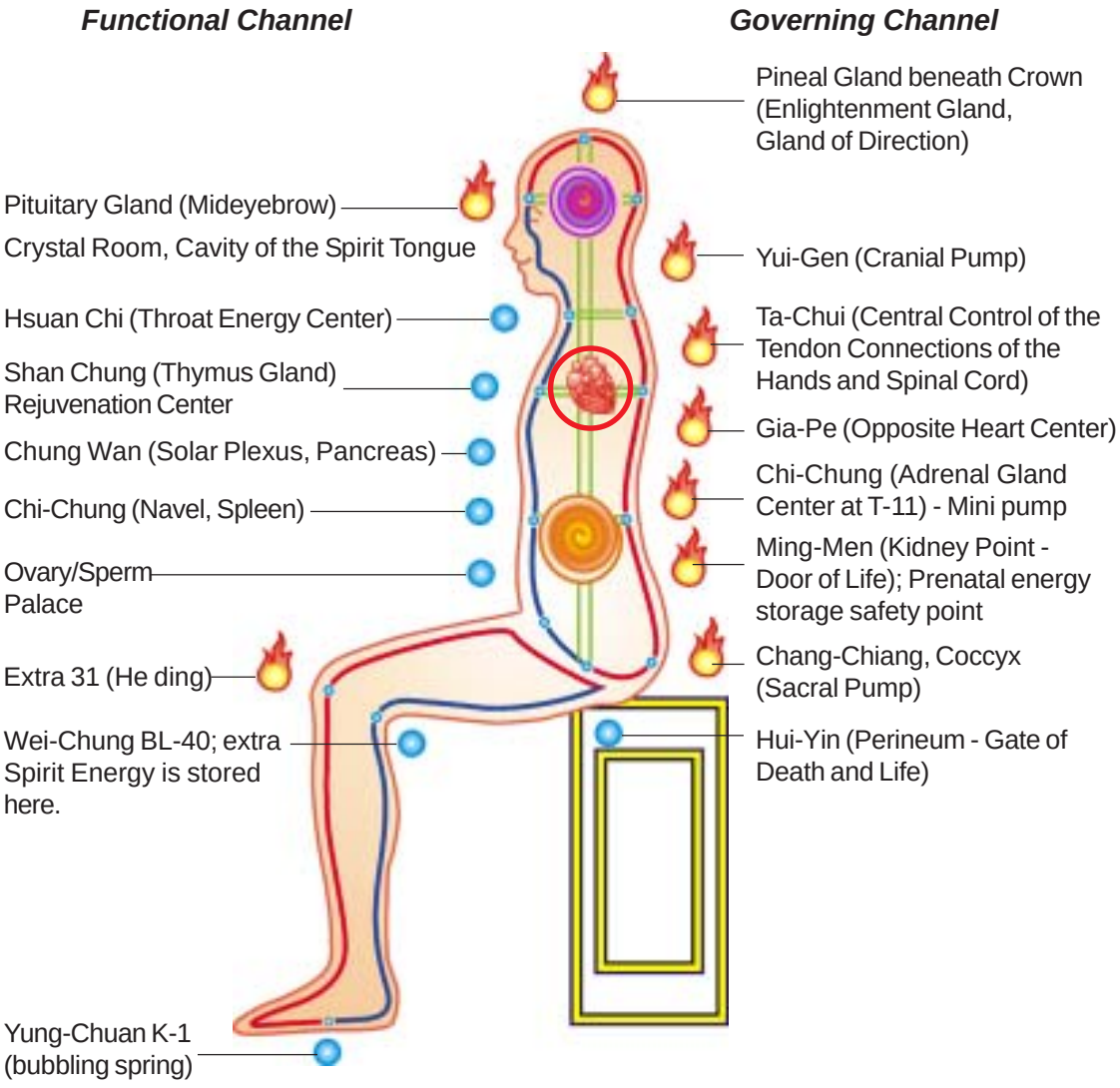

Fig. 1.29 *The Orbit turn in our body. Turning the Wheel*

Step 3: Chi rises to the Crown and the Nostrils Open

Our body with its 6.5 trillion cells is like the universe with its stars, so it is easy to see how the moving of the Cosmic Orbit or Turning the Wheel, is very important to synchronize our body with the movement of the universe. Once we can feel the spin in the lower abdomen the middle mind will spin also. This is similar to three solar system spinning. When this spinning falls in the tan tien it will raise up to the crown and push down to open the nostrils.

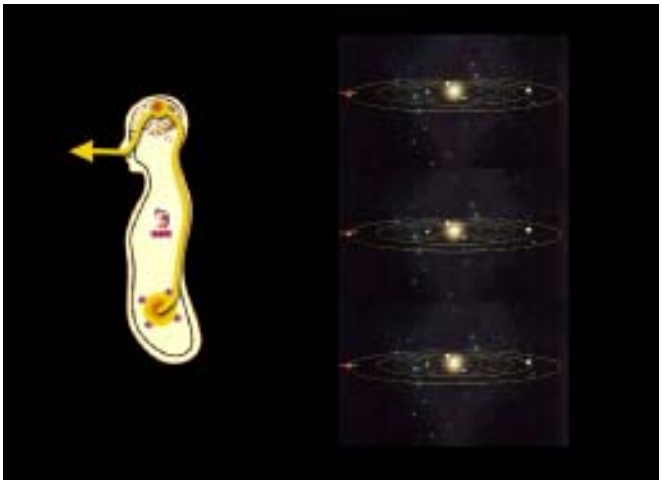

Fig. 1.30 *The Three Tan Tiens are just like the solar system or galaxy turning and spinning inside us.*

Born Again Process

Fig. 1.31 *In many Taoist practices we return to the baby stage and make the connection to the Universe from the umbilical cord.*

Place Tongue to the Root of the Mouth

Before a baby is born, it gets food and oxygen from its mother via the placenta. The baby's blood flows through the umbilical cord to the placenta, where it receives food and oxygen from the mother's blood. This circulation is the same as the microcosmic orbit.

After the baby is born, it breathes in oxygen through its lungs and starts to eat and digest its own food. Its blood circulation changes so that more blood flows to the lungs and gut. The baby no longer needs the placenta, so this is removed by cutting through the umbilical cord. The body starts to move the orbit by itself. When get older, the microcosmic orbit will gradually stop.

Fig. 1.32 *Before the Baby is Born*

Fig. 1.33 *After the Baby is Born*

See how this a one month old child already holds its tongue against the roof of the mouth and so makes it possible for the cosmic orbit to move. It is believed that children do this in the womb.

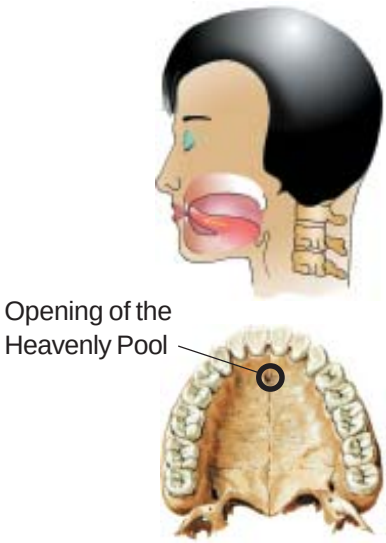

Fig. 1.34 *Babies automatically place their tongues up to the palate, just as they do in the womb. This is the connection of the cosmic orbit, the Chi Bridge.*

Steps 4, 5, 6: Gathering, Collecting and Storing the Energy

Collecting and storing the newly generated energy is an important part of the Laughing Chi Kung practice. After each session of laughing we collect and store the excess energy in the Lower Tan Tien. With continued practice, the Lower Tan Tien becomes very alive, and we feel more centered within ourselves. The Lower Tan Tien conserves and store our energy and when another part of the body needs an energy boost it can draw on this storehouse of energy. Scientists have discovered that the villi in the large and small intestines have properties that are similar to a storage battery. Through hundreds of years of practice the Taoists have discovered that bones and cells can also store energy.

Electrical Polarity is in our Intestines. Villi serve as the Storage Battery of our Energy in the Lower Tan Tien.

The body can store an instant form of energy like “Chi” or “Ki” in the Lower Tan Tien. The only other way we can store energy is in the form of fat. We can activate the energy in fat by fasting. However, often then the body panics and, as soon as we eat again, it tries to store even more energy in the form of fat. There are also other ways to store energy Chi, for example in the bones. But we always have to begin with storing energy in the Tan Tien.

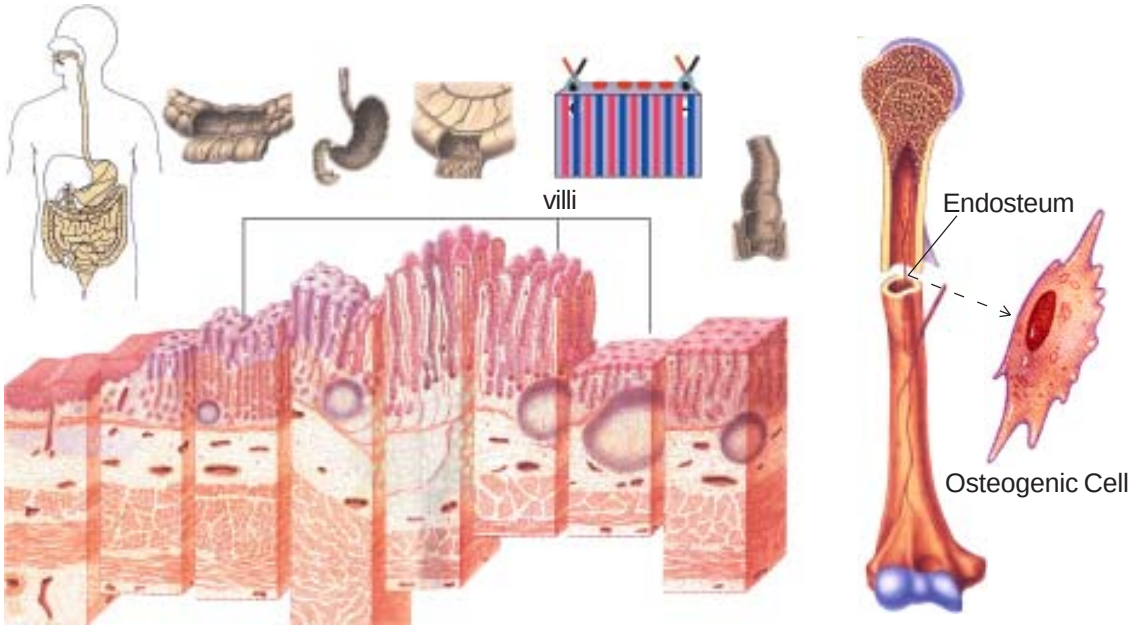

Fig. 1.35 *Energy in Lower Tan Tien and Bone Cells*

Note: The villi in the intestines act like cells in a car battery. Bones and cells also can store energy.

Gather, Collect and Store the Energy

At the end of a laughing meditation or practice, we want to collect the energy in the Lower Tan Tien so we follow a specific procedure. Men follow the energy outward as it spirals clockwise 36 times and next bring in the energy, spiraling counterclockwise 24 times. Women first spiral outward counterclockwise 36 times and then collect the energy, spiraling clockwise 24 times. In Tao practice, the gathering and storing of energy is very important. Energy can be stored for everyday use, for emergencies or used to protect the body from sickness.

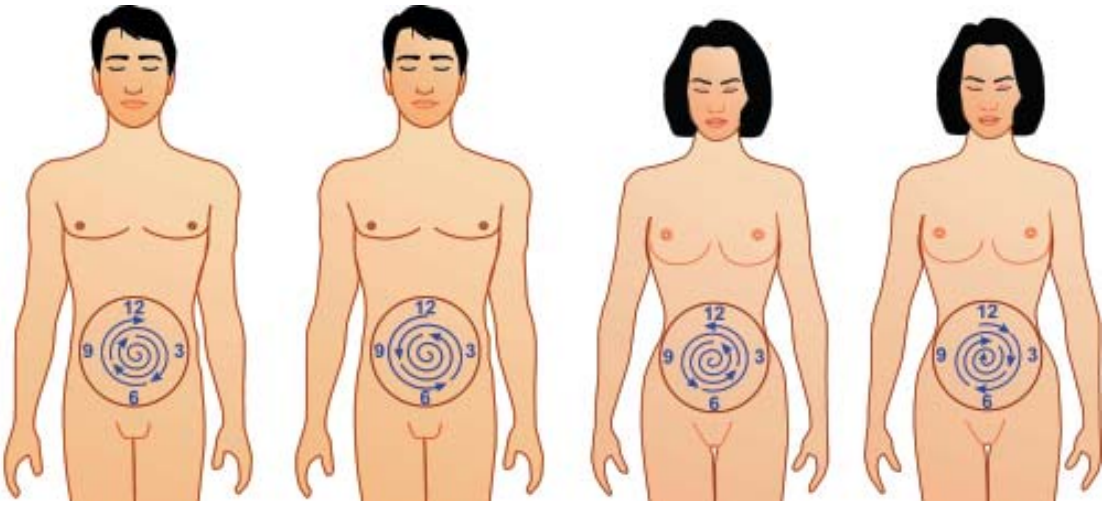

a
Gathering

b
Collecting and Storing

c
Gathering

d
Collecting and Storing

Fig. 1.36 *a. Men collect the energy by spiraling outwardly from the navel 36 times clockwise.*
b. Then they spiral inwardly 24 times counterclockwise, ending at the navel.
c. Women collect the energy by spiraling outwardly from the navel 36 times counterclockwise.
d. Then they spiral inwardly 24 times clockwise, ending at the navel.

Boisterous Laughing

1. Place your hands over your lower Tan Tien and laugh loudly from your belly. Feel your laughter shake the sternum and the lower abdomen and reverberate deep inside your body. Continue laughing for five minutes.
2. Rest and place the tip of your tongue on your upper palate. This allows the energy in your head to drop down to your Tan Tien.
3. Guide any excess Chi in your body to the area behind your navel and in front of the kidneys.
4. Turn the eyes down to the lower abdomnen. Spiral counterclockwise like the earth spiral around the sun. Keep on spiraling until the area becomes warm and fill with Chi, and the Chi starts to move by itself up to the crown, then pushes down to the nose. Feel the nose open and breathe deep as the Chi starts to flow down to the tongue. This will help open the orbit.

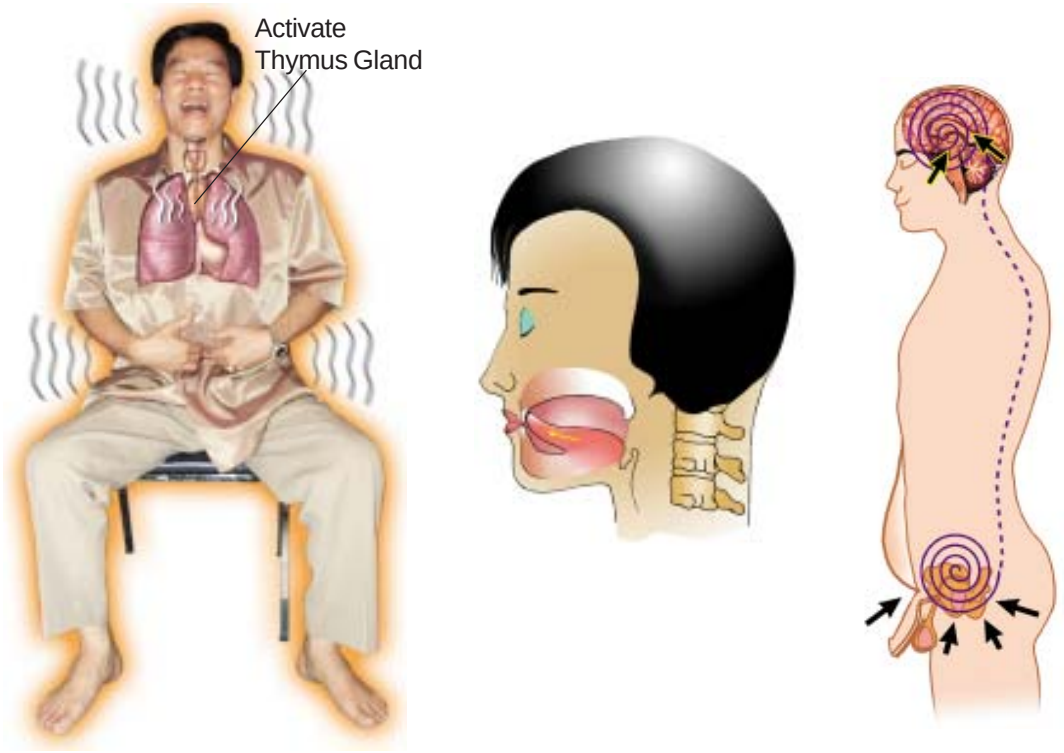

Fig. 1.37 *Laughter Shake*

5. Rest and enjoy the sensations of lightness and peacefulness. Feel the spaciousness inside your body and mind.

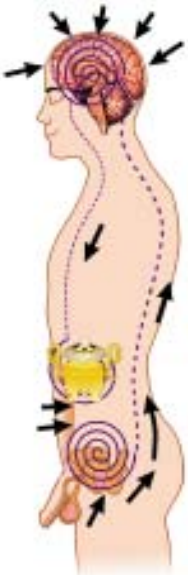

Fig. 1.38 *Turn mind and eyes down to lower abdomen.*

Giggling

Rest at the lower abdomen and start to laugh again.

1. Place your hands over your lower Tan Tien and giggle from your belly. Feel your laughter shake and reverberate throughout your body. Continue laughing for five minutes.
2. Rest and place the tip of your tongue on the upper palate. This allows the energy in your head to drop down to your Tan Tien.
3. Guide any excess Chi in your body to the area behind your navel and in front of the kidneys.
4. Turn the upper mind down.
5. Rest and enjoy the sensations of lightness and peacefulness. Feel the spaciousness inside your body and mind.

Fig. 1.39 *Giggle from your Belly.*

Silent Giggling

Hit the belly drum, feel it vibration inside.

1. Place your hands over your lower Tan Tien and giggle silently from your belly. Feel your laughter shake and reverberate throughout your body. Continue laughing for five minutes. Rest feel energy rises up to the crown.
2. Rest and place the tip of your tongue on the upper palate. This allows the energy in your head to drop down to your Tan Tien.
3. Guide any excess Chi in your body to the area behind your navel and in front of the kidneys.
4. Gather the excess energy in your body by spiraling the energy around the navel 36 times outward and 24 times inward. Men spiral clockwise outward and counterclockwise inward; women spiral counterclockwise outward and clockwise inward. You may use your hands to help you spiral. Feel as though your intestines are physically spiraling.
5. Rest and enjoy the sensations of lightness and peacefulness. Feel the spaciousness inside your body and mind.
6. Hold both hand near your heart and smile to the heart, breathe into the heart, and feel the heart calm. Feel peace, and feel that all three Tan Tien are alight together.

Fig. 1.40 *Silent Giggling*

After the Laughing

Sit comfortably near the edge of your chair with your feet flat on the floor. Relax your body while maintaining the alignment of your spine. Be aware of your star above your crown. Breathe from your lower abdomen. Smile to your heart and feel your heart grow soft. Move the energy from your heart down to your Lower Tan Tien. Feel your three minds rest in your Lower Tan Tien. Be aware of your Tan Tien filling with Chi.

1. Smile and breathe to connect with your personal star. Be aware of your mideyebrow in front of you and be aware of a good feeling (smiling face, a nice place, your favorite thing). Smile at this and breath into the mideyebrow and into the brain for 36 breaths.

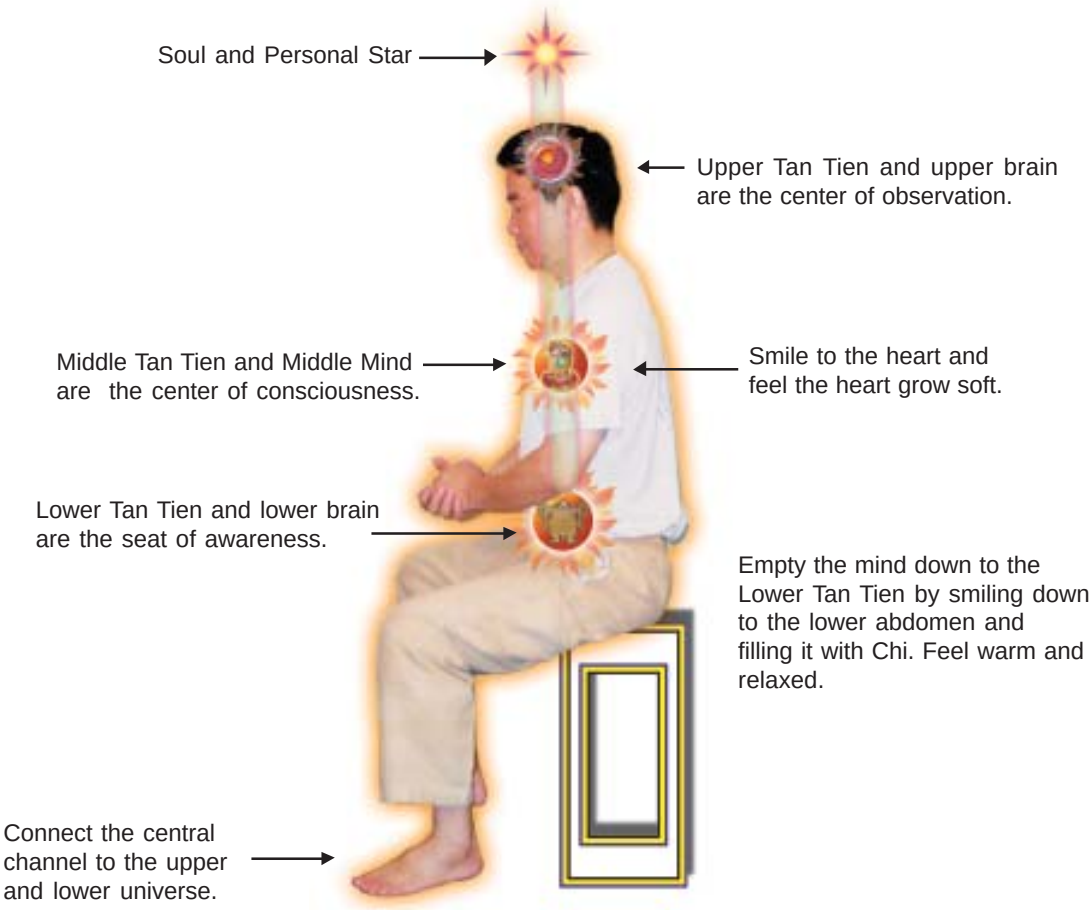

Fig. 1.41 *Empty your mind down to the Lower Tan Tien.*

Fig. 1.42 *Smile and breathe in the good feeling to connect with your personal star.*

2. Be aware of your heart, smile into the heart and make your heart feel soft. Breathe this good feeling into the mideyebrow and down into the heart. Smile and feel good, keep breathing for up to 36 breaths.

Fig. 1.43 *Breath down the good feeling into the brain and smile down to the heart and make your heart feel soft.*

3. Be aware of the Lower Tan Tien, breathe into this good feeling from the mideyebrow and down to the heart and to the Lower Tan Tien. Feel warm and good and again breathe into this feeling 36 times.

Fig. 1.44 *Breathe the good feeling down to Heart and to the Lower Tan Tien.*

Soles of the Feet, Sacrum and Bone Breathing

The sacrum controls all the bones and bone marrow in the body, so, by working on your sacrum, you work on all your bones.

Be aware of the soles of the feet and feel the soles breathing. Keep breathing and feel the center of the earth also pulsing and breathing.

1. Be aware of the soles of the feet breathing.Touch your sacrum and feel your sacral holes breathing and pulsating together with the soles of the feet.
2. Become aware of the bone marrow inside your sacrum.
3. Feel the Chi rise up from the earth to the soles, then up to the sacrum and activate all the vertebrae in your spine and up to the crown, pulsing and breathing.
4. Feel the Chi activate your temporal bones. Feel them pulsing and breathing; the temple bones connect to the third eye when activated.
5. Become aware of your third eye (between your eyes) and feel your third eye open. The third eye is a major opening for receiving cosmic energy.
6. Rest and enjoy the feeling of being both quiet in your body yet energized at the same time.

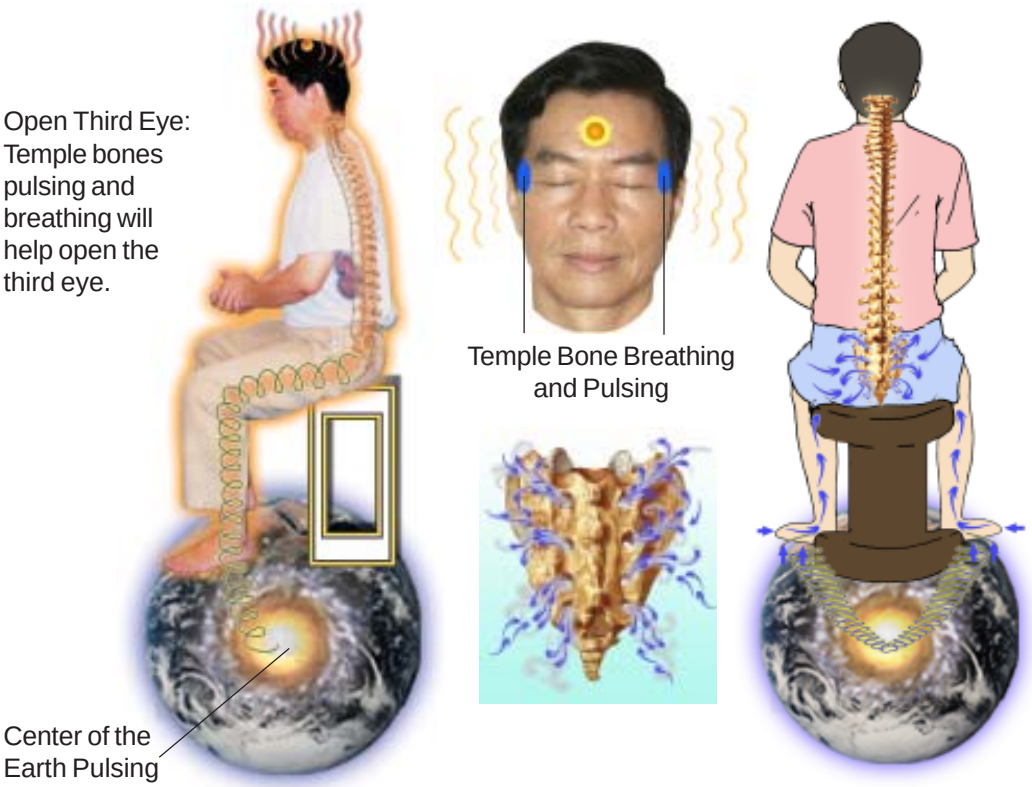

Fig. 1.45 *Soles of the Feet and Sacral Holes Breathing and Pulsating*

Practices of Taoism have three main goals:

1. Learning to heal, love and be kind to ourselves as we develop compassionate hearts and a wholeness of being.
2. Learning to help, heal and love others using the abundance of healing and loving energies we receive from the forces of nature, heaven and earth.
3. Learning about our Original Source and helping it to unfold within us.

Summary

1. Start with 3 ways laughing each 5 minutes. Rest and spin all the Chi. Move it up to the crown and open the nostrils.
2. Tongue up to palate and let Chi down to heart center and down to mind center.
3. Smile to the heart make it soft and calm breathe to the heart and feel the Three Tan Tien spiral.
4. Breathe into the mideyebrow and down to the heart, and finally down to the Lower Tan Tien.
5. Do sole and sacrum breathing, feel the sacrum activated and the energy raising up the spine to temple bones activating the temple bones and opening the third eye.

Chapter 2
Powers of Ten - Universe and the Human

We have included an extract from this wonderful publication due to its relevance to the Cosmic Orbit and the intrinsic and boundless relationship with the Tao. We have made a few adjustments to the annotations, in our attempt to clarify and enhance understanding from a slightly less scientific point of view.

'Powers of Ten' is a true masterpiece, an enlightened work of divine comprehension. It demonstrates natural progressions, transitions and the cyclic nature of things, leading us through the realms of infinity.

The 'outward' explosion merges with the 'inward' implosion, creating the inner eye of a non-vacuous nothingness.

"There is no need to go anywhere or do anything to know the ways of the world".

The macrocosm and the microcosm merge in Heavenly intercourse. ***Our cells and atoms have a very close relationship with that of the cosmos.***

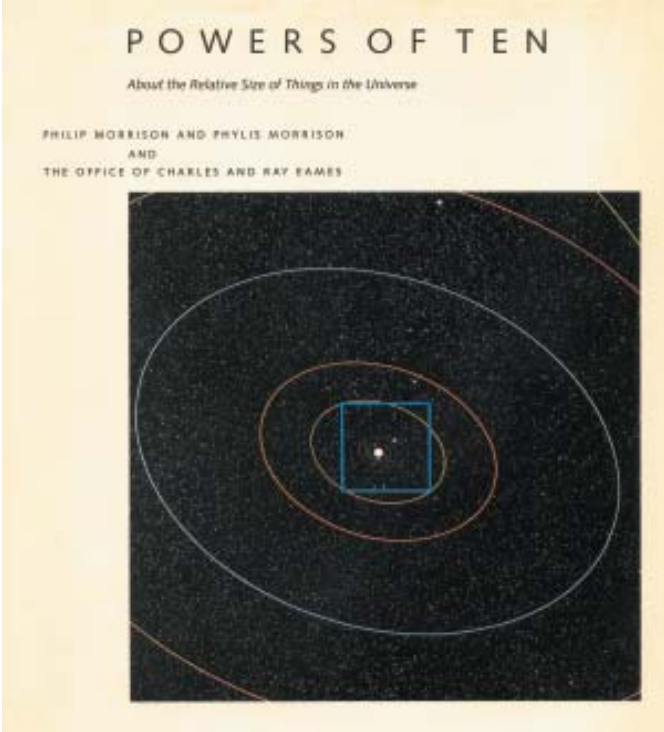

Fig. 2.1 *Book Cover of Powers of Ten*

These next pages are a series of pictures taken from the book called Powers of Ten. By Philip Morrison and Phylis Morrison. First it shows a picture of space very far away, 1 billion light years away and in each consecutive picture the distance is lowered by a factor of 10. Gradually we get to our galaxy, the Milky Way, and to the solar system in it. From there to Earth, to a specific location on Earth (Lake Michigan) and to two people lying on the shore of the beach of this lake. The pictures zoom in on the couple, a hand, the skin and as the zoom is increased, to a cell, the gene chromosomes, etc. We seem to get a remarkably similar picture as we zoom in on the microcosm and as we expand our vision to the macrocosm. At both extremes there is much emptiness or void. This is the ultimate source of things as the book firmly describes, “As above so below.” Our cells connect to the cosmos.

Fig. 2.2 *1 Billion Light-Years 10^{25} Meters*

Most of ‘space’ is empty. At this scale, the distribution of matter is roughly uniform; there is virtually no pattern or structure.

Most of ‘space’ looks as empty as this, the glow of distant Galaxies like clotted dust. This emptiness is normal. A tenfold larger view would show no new structure, no new void; the universe is roughly uniform at such dimensions. This view will dim slowly, for a few billion years at least, as the faint clusters drift farther apart.

Fig. 2.3 *100 Million Light-Years 10^{24} Meters*

We look toward our distant home in the Milky Way. But we see mostly one large intervening cluster of Galaxies, called the Virgo Cluster. Galaxies as a rule associate into orbiting clusters and groups. There is reason to believe that our Milky Way is itself an outpost of the big Virgo Cluster, responsive to its steady gravitational pull: part of a super cluster. Out there beyond the Milky Way is an enormous space volume nearly devoid of noticeable Galaxies.

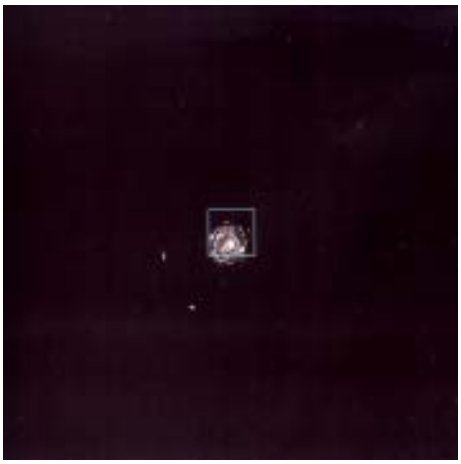

Fig. 2.4 *1 Million Light-Years 10^{22} Meters*

This flat circular disk is our own Galaxy (approximately 200 billion stars) the Milky Way, which adopts the form of a spiral. It travels in space with two satellite Galaxies, the irregular little Clouds of Magellan. We have only observed a few Galaxies that are larger than our own and smaller than Magellan Clouds.

Fig. 2.5 *1 Trillion Kilometers 10^{15} Meters*

Only the Sun is to be seen, against a background of fainter stars beyond. Once that was all we knew of the frontier of the Sun's system. We know now that a great cloud of icy comets orbits here slowly, though invisible in the weak sunlight. We see comets only as each year a few fall into the brighter regions near earth. There we catch sight of them, moving in the sky like temporary planets, the Sun's fires boiling out their long faint tails.

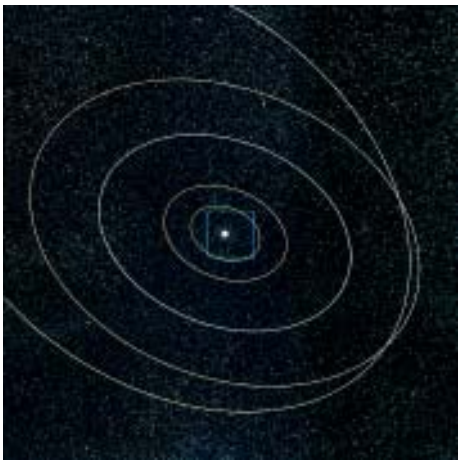

Fig. 2.6 *10 Billion Kilometers 10^{13} Meters*

The paths of the outer planets fill this picture. The strongly tilted orbit belongs to awry little Pluto. The four others are those of Neptune, Uranus, Saturn and Jupiter - with their many satellites. Between Jupiter's path and the Sun run the inner planets in their smaller orbits. The planets circulate counterclockwise here, (which we view at an angle) all nearly on the same plane. The planetary system, apart from Pluto, is as flat as a pancake.

Fig. 2.7 *100 Million Kilometers 10^{11} Meters*

Now we see the inner solar system. The green arc is traversed by planet Earth during some six weeks each September and October.

Fig. 2.8 *100 Thousand Kilometers 10^{8} Meters*

The whole earth appears, isolated, elegant, and fragile. We recognize our globe in open space, a spacecraft in orbit with no Atlas to support it. Its smooth, swift motion around the Sun carries it across such a square at this very hour.

Fig. 2.9 *100 Kilometers 10^5 Meters*

The metropolitan area of Chicago nestles at the south end of the lake. On a day like this, someone walking along the street might have looked up to a blue sky and never known that a camera plane was flying high above them, beyond their eyesight. The lattice visible among so many blurred streets is the mile-square grid of wide Chicago boulevards.

Fig. 2.10 *10 Meters 10^1 Meters*

Along the Chicago riverside, a man and a woman are at a picnic in the park. This picnic is the center of every picture viewed outward among the Galaxies.

Fig. 2.11 *1 Meter 1 Yard 10^0 Meters*

“Of all things, man is the measure,” Protagoras the Sophist proclaimed. His measurements were correct, as this image portrays a life scale of a man and his daily pleasures, including food for the mind, body and soul. The man rests from these activities, as life inside and all around him continues.

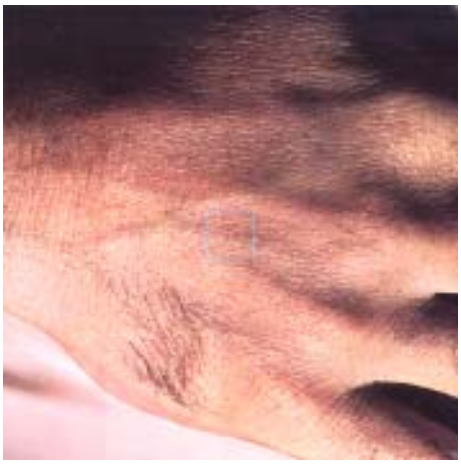

Fig. 2.12 *0.1 Meter 10 Centimeters 10^{-1}Meters*

The scale is now intimate: As you can see, this is an up close look at the back of the mans' hand, a little enlarged. This animate structure, is the creative force of all man's manifestation, making it possible to put thoughts into actions. It is the connecting pull between the mind and body communication. Every cell in this living object continually corresponds with all other cells in the entire being.

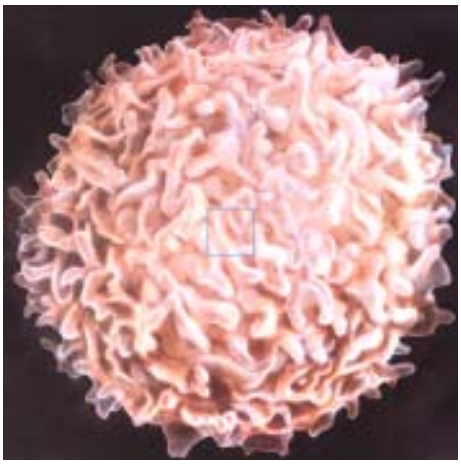

Fig. 2.13 *10 Microns 10^{-5} Meters*

We pass through the living skin to enter a capillary vessel, where blood oozes by. Most blood cells are the small, incomplete, short -lived disks that give red blood its color; this white cell, a lymphocyte, is a long-lived participant in the complex cellular and chemical strategy called the immune system, the body's defense against infection.

Fig. 2.14 *0.1 Micron 1 Thousand Angstroms 10^{-7} Meters*

Held safely inside the cell nucleus are enormously long molecules, the coils of DNA, cunningly spooled and folded within this tiny space. These vital instructions are carefully duplicated at every cell division. One such thread of DNA is stored in each of the forty-six chromosomes within the nucleus of every human cell.

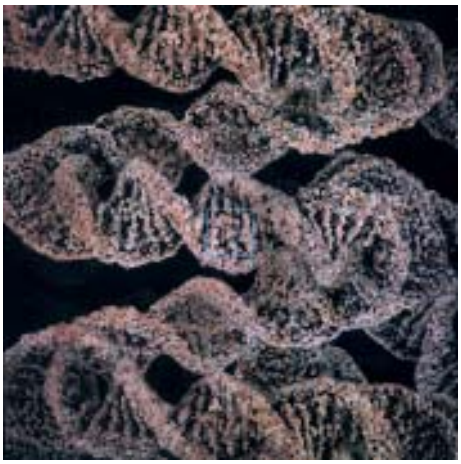

Fig. 2.15 *100 Angstroms 10^{-8} Meters*

In this close-up, the DNA is seen as a long twisted molecular ladder, the double helix. The individuality of the organism is held in the running sequence of the differing rungs. That chemical message is spelled out at great length in a molecular alphabet of four letters. One alphabet serves all life, but the tale retold in every cell of the body differs from individual to individual. The two rails of the ladder come apart during cell duplication, each to act as a template for one complete new copy of the ladder of rungs.

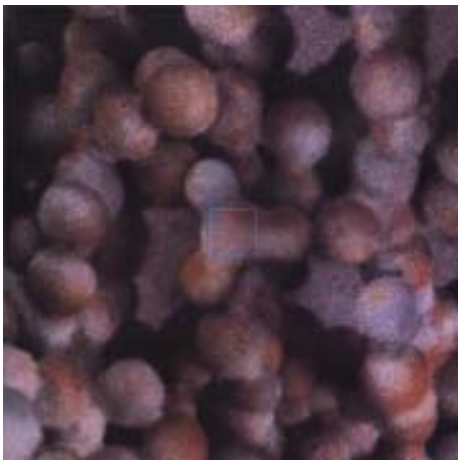

Fig. 2.16 *10 Angstroms 1 Nanometer 10^{-9} Meters*

These building blocks are molecular typography, the letters of the genetic message. It is their particular order that spells out the long text. The forms are chemical patterns, the ordinary stable structures of bound atoms, themselves indifferent to life. The central carbon atom is bonded to three visible hydrogen atoms (and to another atom that lies behind). A similar linkage might well be found abundantly among carbon and hydrogen atoms drifting in the cold thin clouds of our interstellar space.

Fig. 2.17 *1 Angstrom 10^{-10} Meters*

The quantum laws of atomic scale require a description of electron motion that is more subtle and less sequential than for the moving particles of ordinary experience. Accordingly, the dot texture shown does not map individual electrons; instead, it suggests the cloud of electrical charge the electrons paint out during their symmetrical but untraceable quantum pattern of motion. In that cloud the surface electrons are shared by the bonded atoms.

Fig. 2.18 *100 Fermis 10^{-14} Meters*

A transient view of the eternally dancing structure of stable carbon-12. Those neutrons and protons that join to form it are universal nuclear modules. Protons are found free as natural hydrogen; neutrons can be set free by energetic nuclear reaction as in the fission of uranium. Study of these particles as independent objects has revealed one more analogue to chemistry: They too react upon collisions at high enough energy to produce a host of new particles, mostly transient ones.

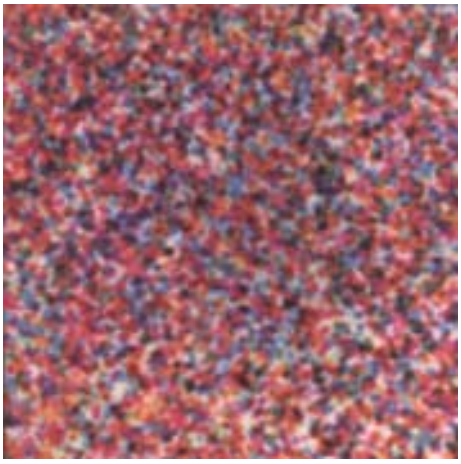

Fig. 2.19 *0.1 Fermi 10^{-16} Meters*

What will we see and what will we come to understand, when we enter into the next levels? When we expand the atom to be very big, we will be closer to understanding the intimate connection to the Universe.

As described in this book, the infinite worlds of the universe are so intimately connected with the finite worlds of the human being. Each universe spirals indefinitely into itself and then out again, creating space and energy. This energy is innumerable, and yet with the ability of man, we are able to measure this mystery with the powers of the mind and technology. With these powers multiplied, we have proven that we can begin to make the connections of our outside world, its properties of nature, to that of our own natural physical body. When it's altered, externally or internally, we affect our perceptions of these worlds and their relationship. It is imperative to understand the relationship of these intertwining universes; for we are the creators of harmony, balance and freedom or agony, destruction and war within these worlds.

It is only because of our continuous research into the unlimited possibilities of the internal and external universe, that we have discovered some of the unknown, intrinsic mystery of this life. We still have so much to unravel, and because of our natural ability to be just and balanced with these pulling forces, we are drawn to discover the ways in which the world turns.

One achieves Expansion of Awareness and Calmness through Observation of Consciousness in and Awareness out to the Universe

Through training, we can become aware of and activate the three minds: The upper brain mind is called the observer mind; the middle heart mind is called the conscious mind and the Lower Tan Tien mind is called the awareness mind. Awareness covers all that influences us, all information that reaches us. That information is filtered and only a tiny part becomes conscious. With the upper brain mind we can direct our consciousness and focus it.

We can expand our awareness very far into the universe. Accomplished Taoist masters were able to just sit in a room and expand their awareness like radar so that they could perceive what happened elsewhere in the universe. Awareness is non-selective. We use consciousness to tune into specific parts, like tuning to a specific radio or TV station. Working with this information happens in the middle brain. All in all, we expand our awareness outward and turn our consciousness inward.

Bring your three minds into one mind, expand your awareness like a radar, and let your conscious mind watch the monitor in your Tan Tien. Greater awareness, consciousness and calmness are achieved. A developed Tan Tien has its own set of senses. These are recognized as the sixth sense.

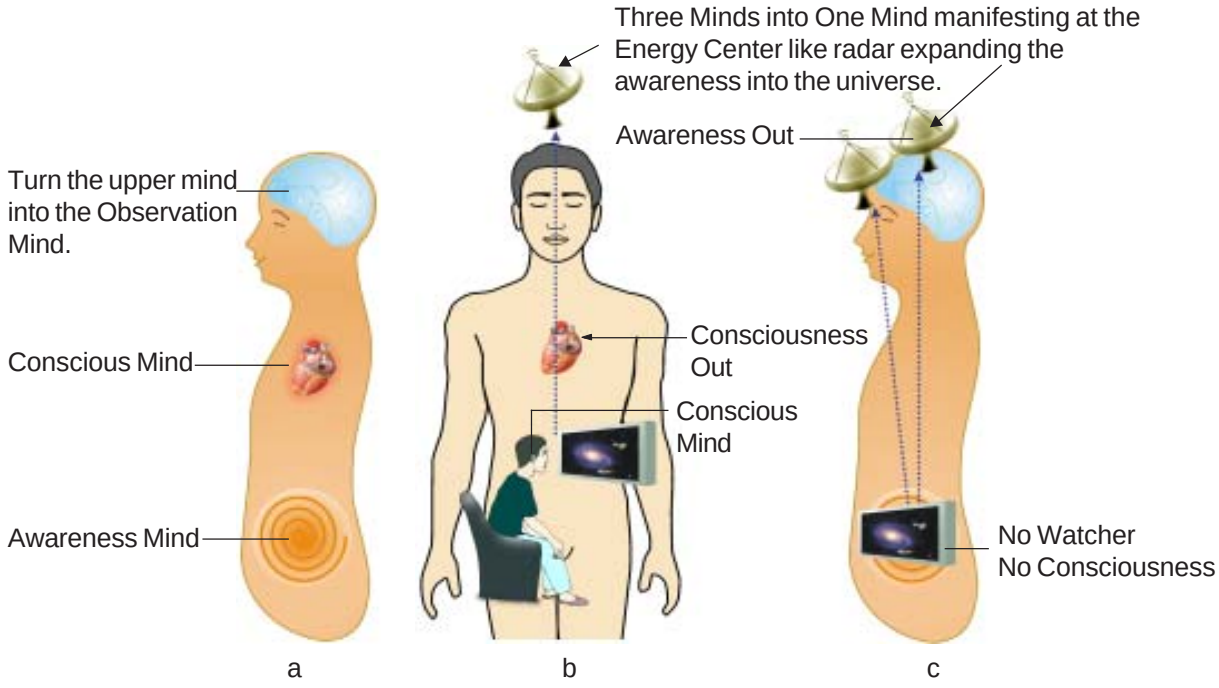

Fig. 2.20 *Consciousness is like a watcher, watching what the awareness picks up.*

When consciousness and awareness are both out, it is like having good radar and a good monitor but no one to watch them. It is better to turn your consciousness in and expand your awareness outwards. If you turn your mind out, and your awareness out, you become a spiritual slave. People can tell such people to do anything and they will do it. They have no inner observation or self-consciousness.

We need to be conscious of what we 'pick up'. We turn our consciousness in and expand our awareness out. If you turn your heart, senses, mind and awareness out, there is nothing left on the inside and you have left yourself unrooted. You will be more inclined to, and influenced by the thoughts and energies of others because you have allowed yourself to be tainted by mass emotion. Roots and anchors exist to keep us from straying too far from home; the self is the center of the heart and center of the body is the Lower Tan Tien. Some believe enlightenment can be purchased from the supermarket, others that it can be hitched onto like a tour bus. Some wait for reincarnations and second comings, divine intervention and alien interception. Whatever your beliefs, the most important thing is to check and know that they are really yours. Imbalance on a small or grand scale may lie ahead if one is not careful. The Tao believes that we can all become immortal, but that we have to work towards this end by way of natural and constant progression. The time it takes to prepare is usually about the same time it takes to live this mortal existence.

Human Energy has the same Quality as the Universal Energy.

We are really children of the universe. We are composed of the same elements as one finds in space and our internal structures can be found externally as well.

The universe has all the components to create life. We have the same structure as the cosmic particles. The universe is filled with nitrogen, protons and electro-magnetic power, which are the same as our energy, bio-electro-magnetic power.

Fig. 2.21 *We are the Universal Children.*

God is Too Big to Fit in One Religion

We have the power to create positive energy patterns in the universe.

The early Taoist masters discovered that they could send specific patterns of energy, for example good or bad emotions, into the universe. These patterns would multiply there and gain in strength before they returned to the sender or to wherever the sender wanted them to go. This process involved first “lowering” the upper and the middle mind into the lower mind; next they would use the lower mind to send the chosen pattern out into the universe. They would spin the Tan Tien and be aware of the spin far in the universe. That is enough to establish the contact and get the process going.

When more people send the same patterns into the universe that pattern will attain some independent existence. An example of this is how religions are formed. Some people think that all of reality comes about this way.

The founders of the Tao system found that when they lowered the upper mind, they awakened the mind of consciousness and awareness. When they calmed down and turned their consciousness in and their awareness out to the universe, they discovered the center of the universe and the spiral force. They also discovered that when energy and the mind’s thinking pattern were sent up to the universe, they would multiply. When more people do the same thing, and have the same thoughts as that of the universe, the energy pattern will multiply.

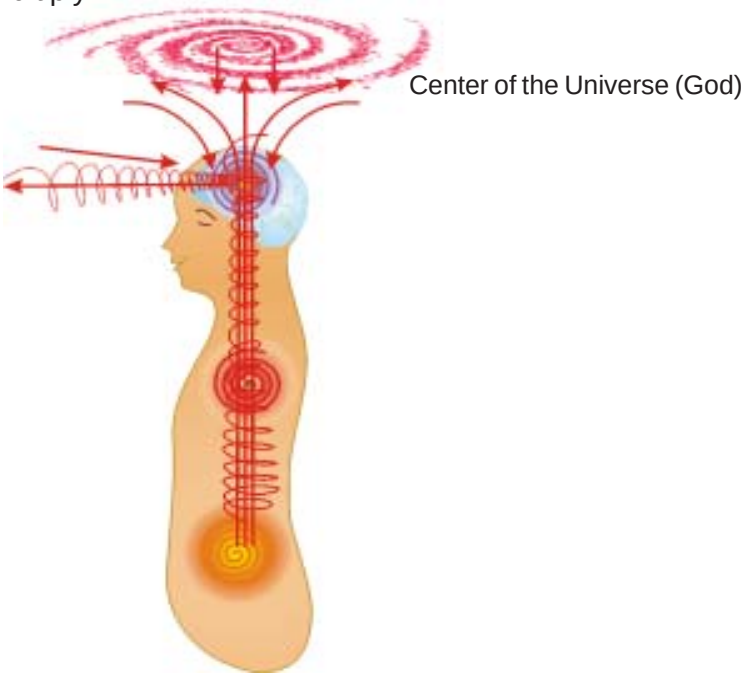

Fig. 2.22 *Spreading positively through the universe by generating a pattern within oneself. God is too big to fit in one religion.*

Primordial Force

Bring your mind down to the Tan Tien and connect to the cosmos.

Like “the Power of Ten” we can bring our attention to the Lower Tan Tien. This can give us another vast universe. So our inner universe can connect with the outside universe. When we are back in the primordial force, similar to being back in the womb, we are fed by the universe.

Bring the senses down to the Tan Tien, sense the dark, deep and vast inner Universe within us. Smile and drop down, let go and sense our inner universe as being very vast, very deep and very dark. Feel the vastness of the outer Universe within us, we are back to our primordial force. Just keep on smiling deeper and deeper down into the body.

Fig.2.23 *Be immersed in the Dark Empty Space of your inner Universe.*

1. Smile into you own vast empty space of the cosmos, the void, fill the space with good feeling.

Fig. 2.24 *1 Billion Light-Years 10^{25} Meters. Most of 'space' is empty. At this scale, the distribution of matter is roughly uniform; there is virtually no pattern or structure, the same as our own universe.*

2. Inhale the void (filled with goodness) into the mideyebrow and down to the heart and the lower Tan Tien. Continue breathing for 36 times.

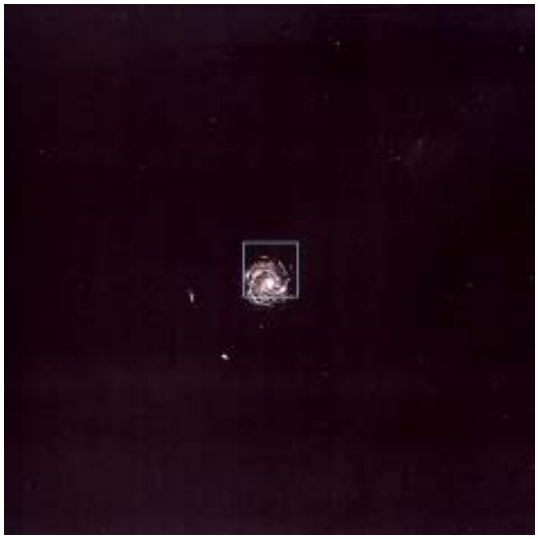

Fig. 2.25 *Sink deep in the your own empty space and look for a dot of light.*

3. Turn the three minds into one mind and down to the lower Tan Tien and sense the dark, deep and vast inner Universe within us.
4. Smile and drop down, let go and sense our inner Universe as being very vast, very deep and very dark. Feel the vastness of the outer Universe within us, we are back to our primordial force. Just keep on smiling deeper and deeper down in the body.
5. Once you sink deep enough to the dark, empty vastness, you can begin to see the dot of light, as you enter into the 'Mystery Gate.' You are actually entering into your own cell and into the outer genes and DNA. The spaces between each cell are very big and when we enlarge DNA to imitate the star, the space between mirrors that of the cosmos.

0.1 Micron 1 Thousand Angstroms 10^{-7} Meters 1 Angstrom 10^{-10} Meters

(In our atom we are entering into our DNA code)

a b

Fig. 2.26 *a. Held safely inside the cell nucleus are enormously long molecules, the coils of DNA. b. Human atom electron motion dot texture shown does not map individual electrons; the cloud of electrical charges the electrons paint out during their symmetrical but untraceable quantum pattern of motion.*

6. Once you get in touch with your own cosmos (Universe), you will then have the ability to connect with the outer cosmos.
7. Keep smiling and sinking down, turning the consciousness inward and expand the awareness outward to connect with the vast cosmos.
8. There are cosmic forces, cosmic wisdom that we have the ability to tune into and connect with. The cosmic force will turn into Chi, and heal and strengthen the body, turning this force into spiritual food.
9. The Pakua has a very similar structure to that of our DNA.

100 Fermis 10^{-14} Meters

Fig. 2.27 *A transient view of the eternally dancing structure of stable carbon-12. Those neutrons and protons that join to form it are universal nuclear modules.*

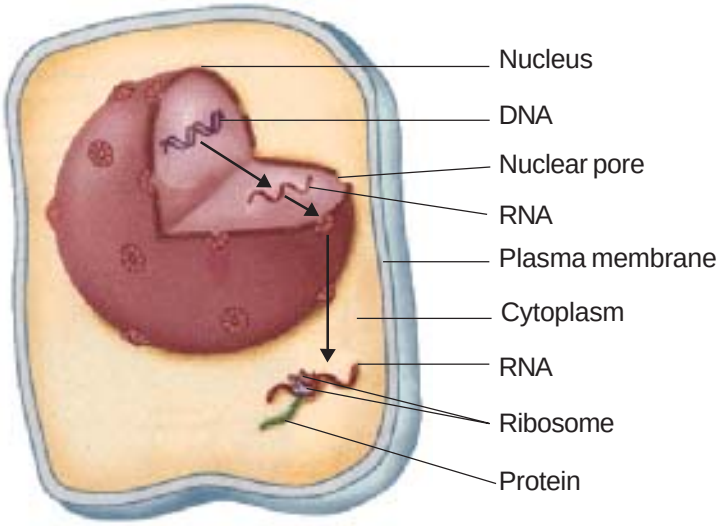

Fig. 2.28 *When the frequency is 8Hz, transcription occurs in the nucleus, which the translation takes place in the cytoplasm.*

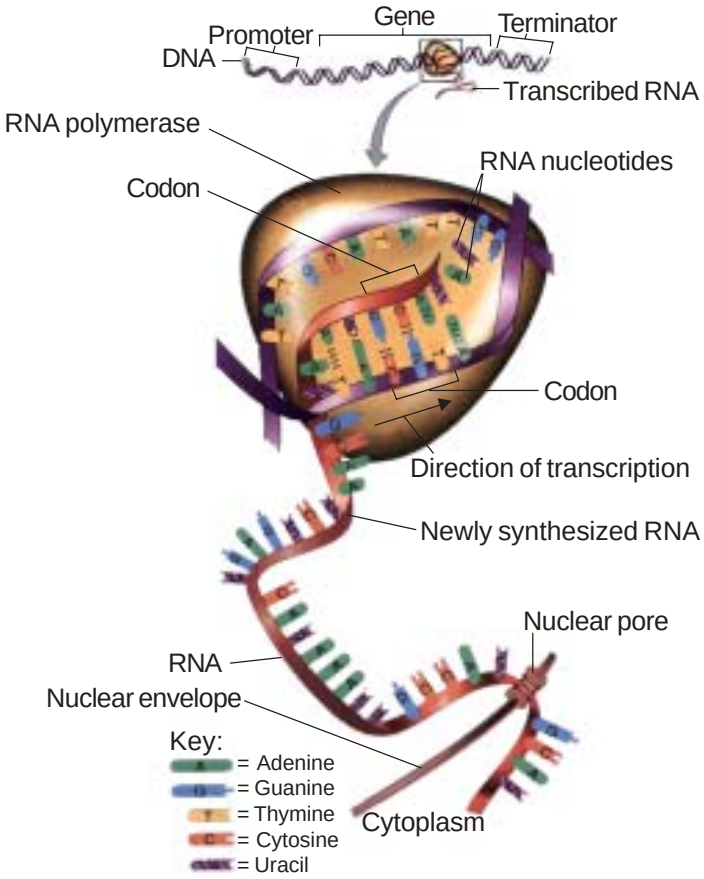

Fig. 2.29 *During transcription, the genetic information in DNA is copied to RNA which in the Tao is known as cupping or self-intercourse.*

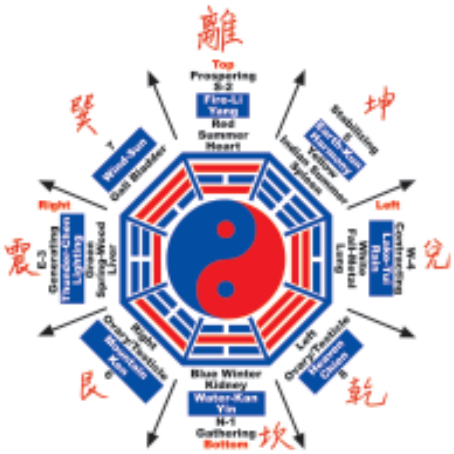

Fig. 2.30 *Pa Kua 64 Hexagrams and Eight Connecting Lines are close connection to the DNA & RNA.*

Chapter 3
Preliminary Practices for Cosmic Orbit

Spinal Cord Breathing

Spinal Cord Breathing enlivens the spine, promoting range of motion and flexibility. It activates the cranial sacral pump, enhancing the flow of cerebral spinal fluid. It also helps relax the back muscles so that meditation is comfortable for long periods of time. Spinal Cord Breathing can be practiced sitting or standing. Find a suitable chair and relax, keeping the spine comfortably straight without allowing it to touch the back of the chair.

1. Begin by exhaling and feeling yourself relax.
2. Inhale, and gently tilt the sacrum back and press the chin toward the neck. Open the chest and expand the rib cage to activate the adrenal and thymus glands. Simultaneously pull back the shoulders and fists (which are held near the shoulders), and pull the scapulae together as you press the neck back and lightly clench the teeth. This activates the cranial pump. Do this spinal cord breathing 36 times.

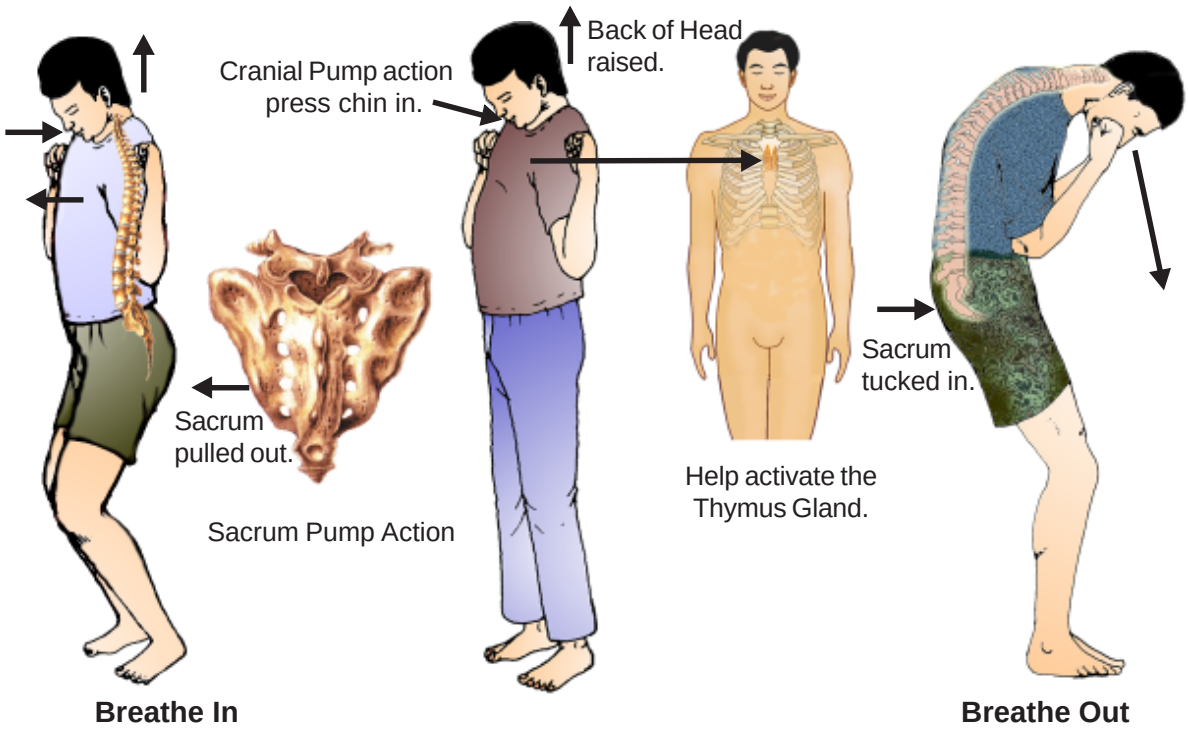

Fig. 3.1 *Movements of Spinal Cord Breathing*

Step 1: Wagging the Tail, Spinal Rock

1. Sit down and smile to the spine. Gently start rocking the spine left and right, like a dog wagging the tail. Feel each vertebra from the lumbar working up through the thoracic and then to the cervical vertebrae. This opens the spine in a lateral direction.

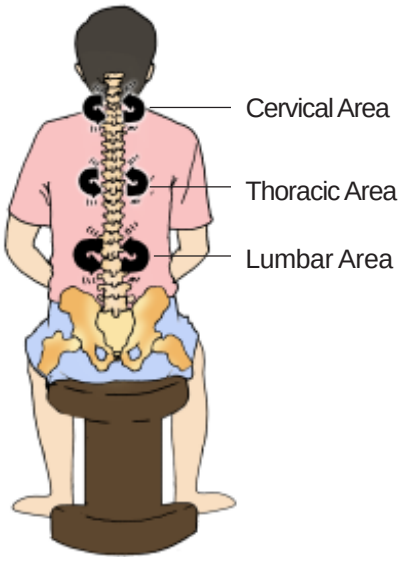

Fig. 3.2 *Begin to rock the spine and smile into organs (lumbar to cervical).*

2. When rocking this way, the whole spine has a vibration and the energy can move throughout the entire back, especially in conjunction with the spinal cord breathing exercise. The spinal cord breathing activates the three pumps: sacrum, Door of Life and the cranial pump. When the lumbar and the Door of Life are open, the fluid can flow and there are sufficient nutrients to feed back to the brain.

Fig. 3.3 *'Riding the Horse' rock lumbar to sacrum, activate pump.*

Step 2: Riding the Horse

3. Rocking the sacrum and the lumbar back and forth on the sitting bones will activate the sacral pump. This will help create good movement of the bones, and openness through the spine. It is an internal movement to enhance the flow of Chi. So when you rock like this throughout the meditation, it creates a vibration rising up the spine from the base of the coccyx through the lower lumbar area and up the cranial base.

Fig. 3.4 *Rock the whole spine and feel energy vibration activate 3 pumps.*

Step 3: Rolling the abdomen helps to eliminate trapped gas.

Hold the breath, roll till the abdomen until it is totally empty. Roll until you feel empty. This creates suction, a vacuum like sensation to energize the internal organs. Start slow until making sure you feel comfortable.

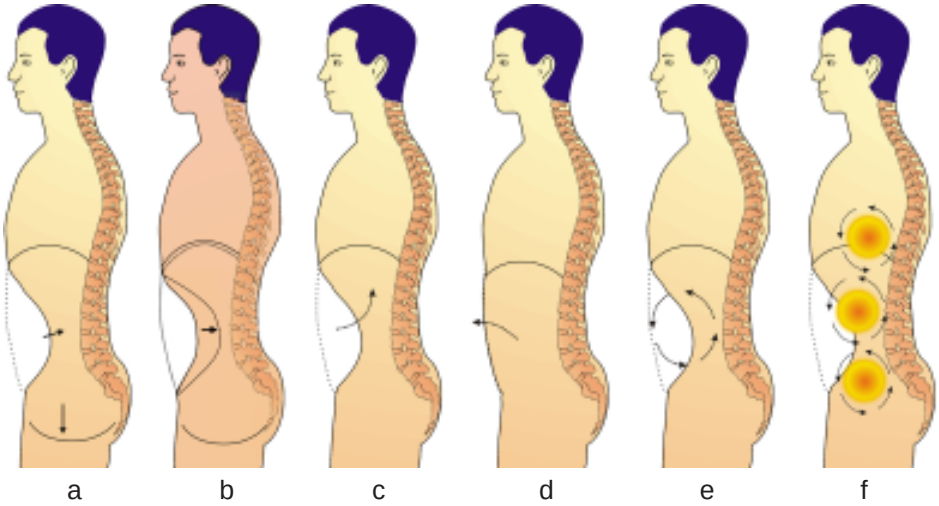

Fig. 3.5 *a. Hold the breath. b. Suck in the abdomen and pull it in more and more. c.d. Pull up the abdominal muscles and roll to the top of the abdomen and push out. e. Push out the abdominal muscles and pull down again. f. Roll the muscles back again.*

Step 4: Use the vacuum within to gasp air into the intestines.

When one is totally out of breath he/she gasps in air. This has a strong cleansing effect on the whole abdominal area. Next, breathe out with the lung sound, while the hands move down in front of the body with the palms facing down.

When out of breath, let the suction from the throat and abdomen within suck the air in, all the way down to the large intestine. This adds Chi into the whole digestive tract. Raise the hands up with palms face down and exhale with the Lungs Sound - SSSSSSSSS. The fresh air will push out the trapped gas and one may even belch.

In the beginning, if you have blockages in the small or large intestine, try to clean the intestine and take more natural fiber. The air will help the composting in the digestive tract and help to eliminate toxins. Do this for 3 to 6 times and the saliva will begin to be produced, then proceed to the next step.

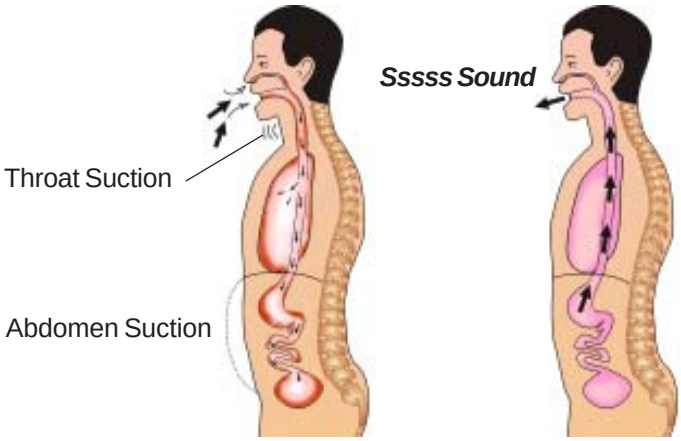

Fig. 3.6 *Gasp air into the intestines.*

Empty Force Practice

Navel Touch the Spine

In Empty Force Breathing one flattens the stomach against the spine and then with the fingers in the stomach one massages in five areas with the abdomen pulled in. The Empty Force helps exercise the organs and is a major rejuvenation practice. The Empty Force breathing will help to increase blood circulation and Chi flow move to the abdominal area.

Create an Abdominal Cavity and Vacuum in the Stomach.

Inhale and exhale. Exhale and flatten the abdomen until you feel as if the navel is touching the spine. Inhale again, and flatten down the abdomen again.

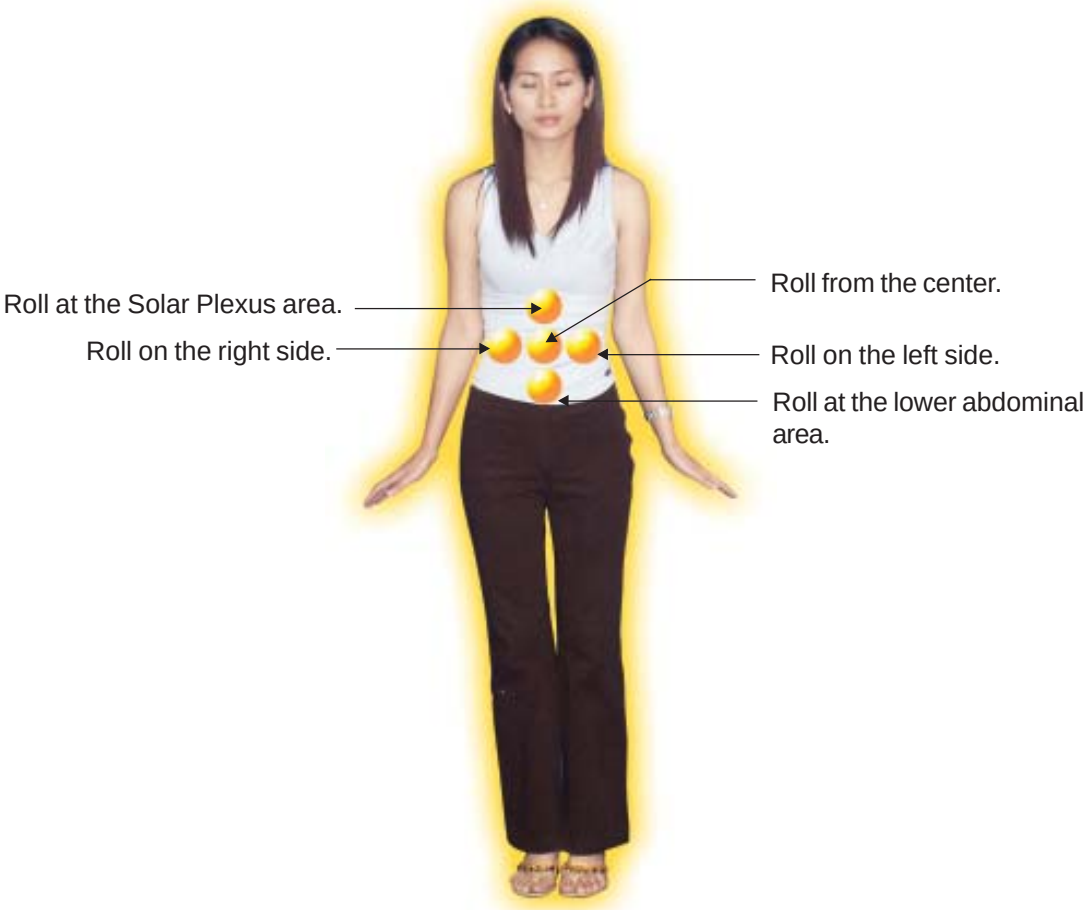

Fig. 3.7 *Empty Force*

Saliva and Chi Mixing

To the Taoists, saliva is the fluid of life. It is the essential fluid for the body, moistening the organs and lubricating all the joints in the body. Saliva will also secrete a major longevity hormone and proper daily chewing will help mix the air with saliva and food. Taoist say, “Eat your liquid and drink your food.” This is because food chewed to liquid will mix well with a lot of saliva and activate enzymes for optimal digestion.

Utilizing the Saliva and Chi

- Mix Saliva with Cosmic Chi
- Mix Chi with Jing (Sexual Chi) as taught in Healing Love

Step 1: Mix saliva and air and with the cosmic chi.

1. Chew the saliva and mix the air and oxygen into it by circling the tongue in the mouth.
   a. Suck the saliva in the mouth to increase the saliva back and forth.
   b. Move the tongue to massage the gums. Knock the teeth to strengthen the bones and activate the saliva gland. Right side 9 times, middle 9 times, left side 9 times.

a. Suck the saliva back and forth

b. Move the tongue to massage the gums.

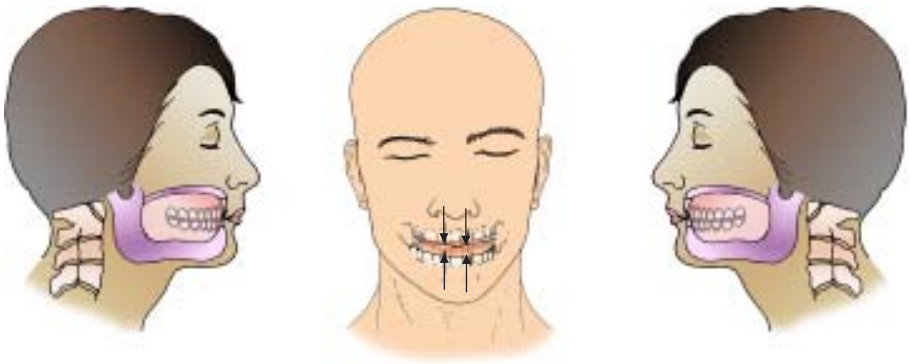

Fig. 3.8 *Knock Right Side 9 times, Middle 9 times and Left Side 9 times.*

2. Open your palms to gather the cosmic Chi and smile to the Cosmos.
3. Activate the throat with your mouth closed and let the abdomen serve as a sucking machine. Draw the Cosmic Chi through the mid-eyebrow to the nose, into the mouth, and mix with the saliva. The saliva is a powerful force mixed with the cosmic energy.

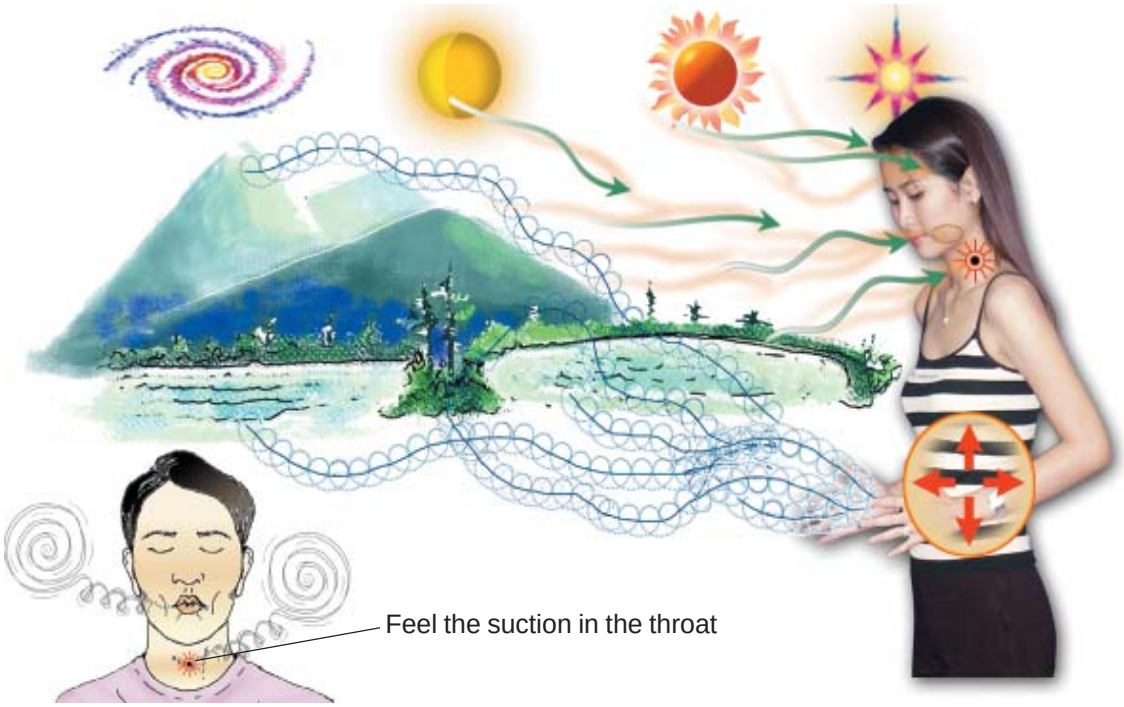

Fig. 3.9 *Close mouth and feel the suction in the throat and abdomen draw the cosmic Chi in.*

Step 2: Swallow with force to push the combined energy to the navel.

Swallow the saliva mixed with Chi forcefully down the throat. The saliva is really sucked into the stomach by moving the flattened stomach out, creating a vacuum and pulling down the saliva.

Exhale and flatten the stomach, lower and tighten the neck and hold the breath as long as you can.

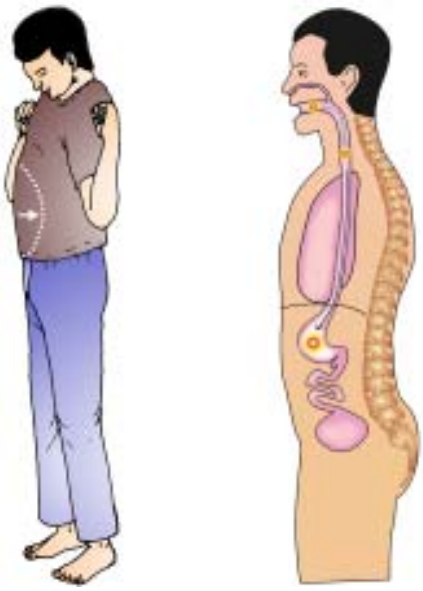

Tighten the neck, swallow the saliva with force 3 times, pushing it down to the navel.

Fig. 3.10 *Saliva Mixed*

Step 3: Let the combined energy help heal your body.

Cover the navel and feel the saliva turn into Chi. Feel the saliva turn into fuel glowing inside your navel. Breathe in, breathe out. Feel the lower abdomen warm.

Use both palms to roll your Chi ball and feel the Chi balls in the Tan Tien rolling and turn the saliva into instance Chi.

Healing Effects of the Practice:

1) Assists in elimination of germs
2) Helps moisturize the internal organs and joints.
3) Increase oxygen available to the body
4) May enhance hormonal balance
5) Helps prevent tooth decay

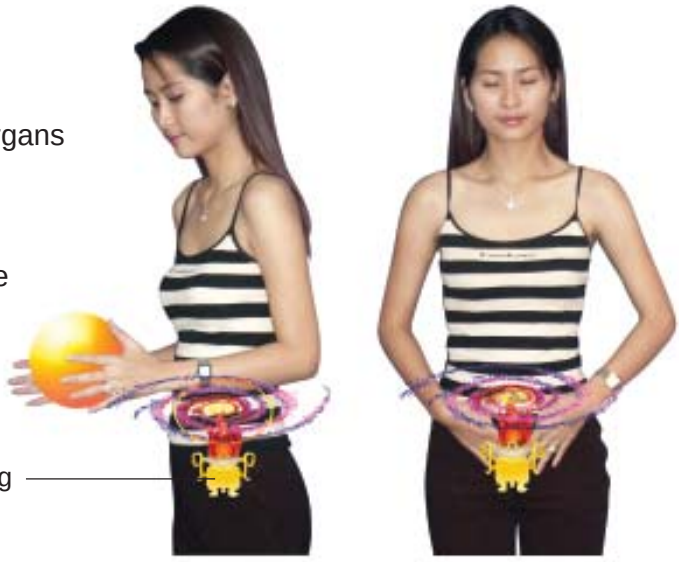

Fig. 3.11 *With the stove burning, saliva turns into Chi.*

Strengthen and Lengthen the Tendons by working with the Tongue and the Sexual Organs.

The tongue is connected to all the tendons and especially to the heart, arteries and veins. Exercising the tongue improves the flexibility of the tendons in the body.

The sexual organs are connected to all the tendons in the back. When the sexual organ becomes shorter, it will cause the tendons in the back to be shorter, and will cause the back to be tight and tense.

Stretching the Tongue

a. Exhale and flatten down the abdomen until it feels like the navel touches the spine. Hold the breath out as long as you can.
b. Exhaling more and spitting the tongue out with the rest of the air.
c. Hold your breath and stretch out your tongue as much as you can to the left, top, right, and bottom for 6 rounds. Reverse the direction. Feel the perineum is moving in connection with the tongue. The eyes also move with the tongue.
When you are out of breath, gasp the air in. The extra oxygen you gasp into the digestive tract will be rushed to the tongue and will strengthen the tongue and the tendons.

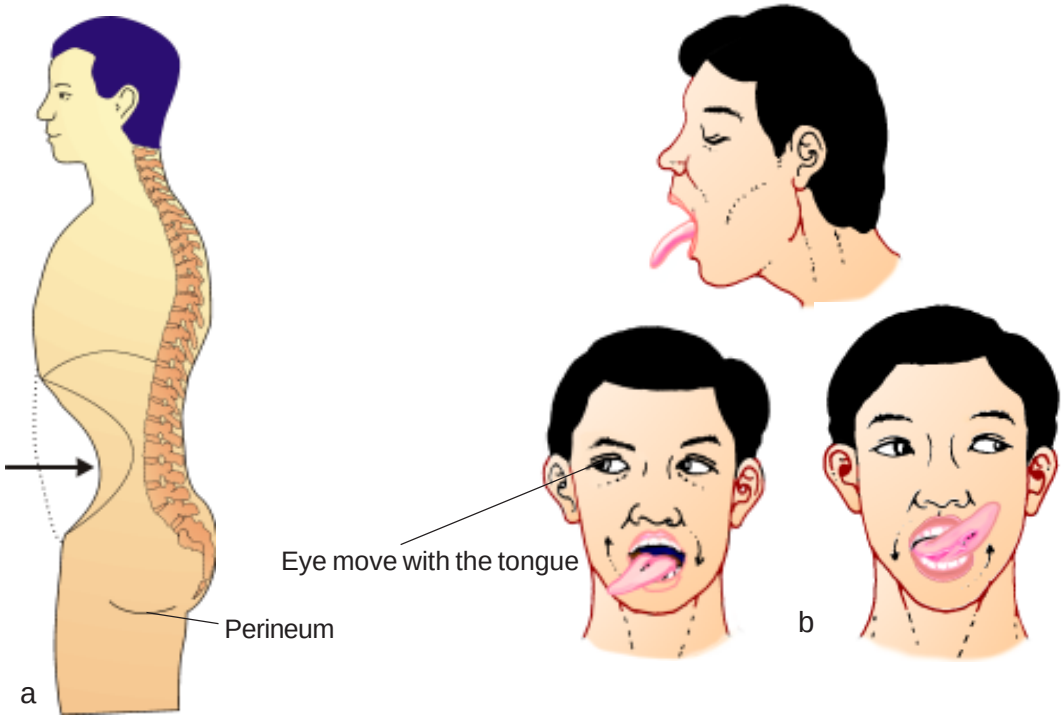

Fig. 3.12 *a. Navel touches the spine. b. Stretching the tongue.*

Stretch the Sexual Organs - Male

Inhale, exhale and flatten down the abdomen. Bring the navel toward the spine.

Flatten the abdomen and stick the tongue out. Men use the thumb and index finger to grip the head of the penis. Pull the penis and thrust the tongue out more at the same time pull to right, left, front, back and middle. With each pull, suck the flattened abdomen up towards the spine and rib cage. Release and repeat. Keep on pulling until you are out of breath. Then gasp air into the intestines. When you exhale again, do the S-s-s sound until you are out of breath. The Chi will rush to strengthen the sexual organ. Do this with 3 to 6 breaths. Use the thumb and index fingers to grip the scrotum and do the same exercise 3 to 6 times.

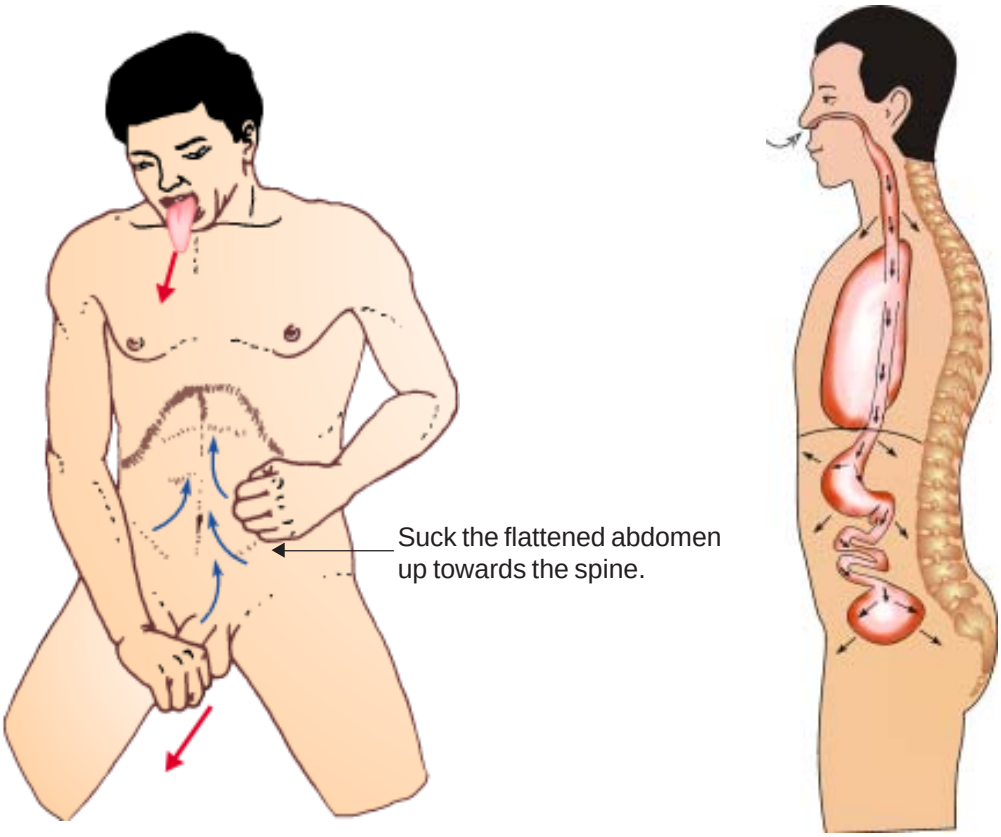

Fig. 3.13 *Stretch the Sexual Organs; Suck in and flatten the abdomen up towards the spine.*

Stretch the Sexual Organs - Female

Exhale and flatten the abdomen. Inhale again.

When you flatten the abdomen, stick the tongue out. Women use the thumb and index finger to grip the thread that is connected to the egg inside while doing the Jade Egg Exercise from the *Bone Marrow Nei Kung* and *Sexual Reflexology* book by Master Chia. Pull the thread and thrust the tongue out more at the same time. With each pull, suck the flattened abdomen up towards the rib cage. Release and repeat.

Keep on pulling until you are out of breath. Then gasp air into the intestines.

When you exhale again, do the S-s-s sound until you are out of breath. The Chi will rush to strengthen the sexual organ.

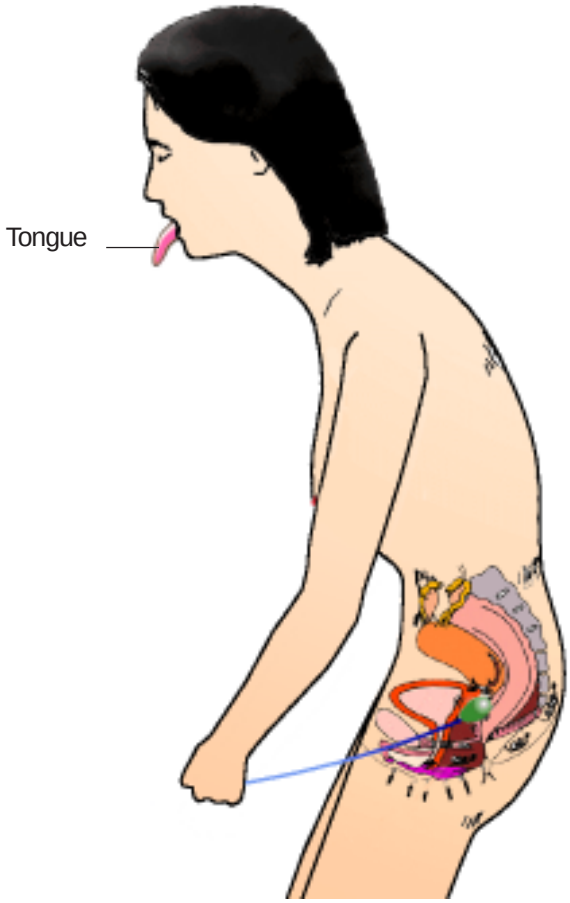

Fig. 3.14 *Contract to the egg inside sexual organs, suck in the abdomen and feel it pull up the sexual organ.*

Chapter 4
Cosmic Healing Chi Kung

Opening the Three Tan Tiens to the Six Directions

Introduction

Opening the Three Tan Tiens is a Chi Kung meditation that strengthens our connection to the universe, opening us up to the primordial force of the Cosmos and the energy within Nature. We are dynamically connected to the infinite. "As above, so below" is an echo of wisdom heard from sages and mystics throughout the ages. When we can connect to and absorb the energy that surrounds us, we are able to tap into the many splendors of the universe.

We exist because of the unique combination of the forces that are around and within us. The two main forces are electricity and magnetism. 'Bio-electro magnetism' is the western term for life force, and what the Tao refers to as Chi. For the last 5000 years, the Taoists have utilized this bio-electromagnetic energy to enhance their way of life and establish a relationship with the universe. Bio signifies life, electro refers to the universal energies (yang) of the stars and planets and the magnetic force refers to the earth force (yin) or gravitational force present on all planets and stars. As we align ourselves with these forces, we become a conduit through which we can absorb and digest these energies through the body, mind and spirit, establishing a direct connection with the universe. The Taoists recognized this connection and created the Chi Kung form of 'Opening the Three Tan Tiens to the Six Directions' to enhance our relationship to and our understanding of this connection.

Humans normally access bio-electromagnetic energy through food and air. Plants take the universal energies of the sun and the magnetic energies of the earth and digest and transform them, thereby making these energies available to all living beings. Taoists believe that the food sources with the purest form of energy are the green leafy vegetables. These have taken sunlight directly into their cells. Rather than waiting until the energy in the universe is processed through plants, the Taoist goes directly to the source of this primordial energy. Through Chi Kung and meditation, the Taoists direct the energy of the universe precisely. Opening the Three Tan Tiens is a meditation Chi Kung exercise that directly taps into the source of energy all around us.

The Tao views human beings as lamps filled with fuel. Many people burn this fuel at very high intensity, without ever taking the time to replenish the oil in the lamp. Alcohol, drugs, tobacco and promiscuity all quicken the depletion of this fuel. The Taoist exercises

strive to continually refuel the energy within. The Taoist recognizes that we are limited in our nature as human beings unless we connect the sources of energy within the universe, thereby becoming infinite. So, within the limitations of our human nature, we constantly fill ourselves with the unlimited abundance of energy around us.

Through their internal quest, the Taoists discovered a doorway to the universe. The more we open our internal energy, the more we are capable of connecting to the forces of energy around us.

Human beings have amazing potential and capabilities. We are unique creatures in the way we use our minds and hands. Look at the world around you, the skyscrapers, the architecture, computers, technology and the myriad creations of man. All have come about through the combination of the mind with the hands. In the Tao practice, we use the mind and the hands, in both Chi Kung and meditation, to connect to the forces of the universe. We use the mind to project a pattern of energy into the universe, to connect to the force, and to bring this energy back into the body.

The mind can travel millions of light years in a few moments. Taoists discovered the unlimited potential of the human mind. If you picture something in your mind; an ocean, a sunset or a mountain, you automatically connect with that image. The mind can take you anywhere you imagine. With the proper training you can connect to the energy of nature and the universe and project your Chi to combine with it, drawing these forces into the body. The hands are called the “touching force,” and like antennae they can transmit the frequencies and vibrations from space. With the mind and the hands, each of us can journey into the boundless energy of the universe.

Relaxation, Letting Go, Surrender and Ego

In some religions and spiritual paths, there is a great emphasis on surrender and letting go. This is actually a form of relaxation. Taoist practices emphasize relaxation, letting go, and emptiness. When a person is relaxed, the muscles are open, the breathing is soft, and the energy can flow through the channels of the body. There is no resistance and no fighting. This allows the creative and higher forces to flow into us.

Most religions have a similar process. To contact the higher self and the higher forces, letting go and surrendering are imperative. Through the surrender of control, touching the forces of nature are more accessible. However, if one continues to surrender and let go, vital energy will be lost. In the long term, this will gradually drain a person. The force will suck the energy out, rather than help to bring the energy into oneself. To avoid this, at the moment that one is in touch with the higher forces, become aware of yourself and your own energy. Then, projecting thoughts, intentions and energy patterns into the creative force will fill rather then deplete the life force energy. This way, energy is grounded and contained within.

Remaining open and empty, using intention, mind and Chi to draw the energy in, rather than focused externally is a vital principle of Taoist practice. What might initially

appear to be a paradox is reformed as one does the practice and learns how to be empty and open and to simultaneously retain enough consciousness to draw the force into oneself.

Mind, Organs and Sexual Organs

When people are disconnected from themselves and from their sexual organs, the mind and organs energy are separate. Taoism believes that the mind, body and spirit must work together. The results depend on a person's practice.

Brain

The brain can access and generate the higher forces, but storing this energy in the brain itself is not easy. We need to train the brain to increase its ability and capacity to store energy. The brain energy, when increased to a certain level, can enable more synapses to grow, and can help turn protein into brain cells. The Tao believes that with training and practice, one can learn to grow more brain and nerve cells, as well as increase the number of synapses in the central nervous system.

Organs of the Body

The organs can also generate energy, but much less than the sexual organs and the brain. They also have a much greater capacity to store and transform energy.

Sexual Organs

The Tao discovered that the sexual organs are the only organs that can generate a significant amount of vital energy (life force). However, the sexual organs cannot store the energy efficiently. When too much energy is generated, considerable amounts have to be dumped out. This is the most refined energy, the 'creative' energy that should be cultivated for self-healing.

Three Tan Tiens

The Three Tan Tiens can also store energy, transform it and supply it to the brain, spinal cord, sexual organs and other organs.

The aim of Taoist basic training is to integrate the brain, sexual organs and other organs into one system. If the brain generates too much energy, it can store the energy in the organs. The excess sexual energy can also be stored in the organs and the three Tan Tiens. If the brain generates too much of the higher forces and we are unable to

store this energy, we have to throw it away. It is like preparing food for one hundred people, when only one person is eating. The rest gets thrown away. In the same way, when too much sexual energy is produced and there is no place for it to be stored, it is wasted. We do not have enough of this energy to be able to waste it. We have a limited amount of energy and time.

Some practices just deal with the spirit and ignore the body and the sexual energy. These practices can generate a lot of energy, but when there is no connection to the organs, it cannot be stored. This is how energy is depleted. Some people practice sitting quietly, emptying the mind, with the whole body relaxed and calm, but very little energy is actually generated. When one gets deep into the practice, some people find it hard to come back to society, because they have no energy and their mind power does not work well. These people have to depend on others to support them.

In the Universal Tao, we are learning to create a sacred and holy temple within ourselves. With the simple practice of smiling to all the organs, we can integrate our bodies, minds and spirits. They are no longer separate. The sexual practice connects the mind with the sexual organs and the brain. The separation between these parts of ourselves is bridged and a synergy is created.

The Taoist practice provides us with the resources to extend beyond the realm of our senses. By tapping into our internal resources and channeling the energy around us, we can perceive much more than the senses normally report to the mind. We want to extend our perception from the limited perspective of the sociologically conditioned senses to the unlimited awareness of the universe. For example, our senses tell us that the earth is flat, that we are stationary, and that heaven is above us. In reality, the earth is a sphere hurtling through space at thousands of miles per hour and the heavens are above, below and beyond the earth in every direction. The goal of the Three Tan Tiens is to connect with the forces from the six directions - above, below, left, right, front and back - and draw all these forces into the body. Eventually, with practice one can draw upon many different energies and use them as needed, thereby giving form to the formless energy that is abundant in nature.

Opening the Three Tan Tiens

Opening the Three Tan Tiens to the Six Directions is just another one of the many resources the Taoist practitioner uses to connect with the universe. The practice combines the power of the mind with the extension of Chi. This combination allows our personal consciousness to directly connect to the patterns and matrices of energy in the universe. When we put our thoughts into the web of the universe, we transform the electromagnetic energy into a force that is accessible to us. The combination of mind power and energy is what allows us to establish a relationship to these creative forces and the high sources of energy.

Three Tan Tiens

Once we make the connection with the forces of energy in the universe, we then want to be able to store this energy in the body. Energy is like money, if you are making a million dollars a year and spend a million dollars, you have nothing left to use in the future. That is the way we live and use our energy in our society. We are spending more energy than we are saving and we are living on borrowed energy, paying very high interest. Our credit will run out very soon.

In the Tao practice, we store energy in the Three Tan Tiens. The Three Tan Tiens are the reservoirs of energy within us; our internal chi savings accounts.

Good Mind

Fig. 4.1 *The* ***Upper Tan Tien*** *is in the brain (the* ***Crystal Room****, third ventricle), and when it is full of energy, the capacity of the brain increases. We store our spiritual intelligence, the mind, here. All the Tan Tiens have both yin and yang within them. In nature, the yin and yang are present in all things. Day (yang) turns into the sunset, which turns to night (yin). It is very important to feel the qualities of yin within yang and yang with yin (sunrise/sunset). One quality does not exist without the other. They are inseparable qualities of the same force.*

Good Heart

Fig. 4.2 *The* ***Heart Center Tan Tien****, between the two nipples, is the* ***Middle Tan Tien****. It is associated with the fire element. Yet, within fire there is always water. The original spirit (Shen) is stored here.*

Good Chi

Fig. 4.3 *The lower abdomen at the* ***Navel*** *is like an empty universe, or ocean. We want to feel a universe of energy in the* ***Lower Tan Tien****. Within this universe or ocean, there is a fire, like a volcano under the ocean; 'fire under water'.*

These reservoirs are places where we can store, transform and collect energy. The reservoirs are the source of energy that flows through the body. The meridians are rivers of energy fed by these reservoirs. The goal of Opening the Three Tan Tiens is to continually fill and replenish the energy of the Three Tan Tiens. When we are connected to the Tao, life ceases to be a struggle. Through the observation of nature, the Taoists learned to flow with the stream of energy and connect to forces in the universe.

In these practices, we use a variety of hand movements and body postures to open to the energy around us. We draw the energy from the six directions into the body, activate the three fires, open the Three Tan Tiens and circulate this energy in the Microcosmic Orbit.

Our Upper Mind consumes a Great Deal of Energy

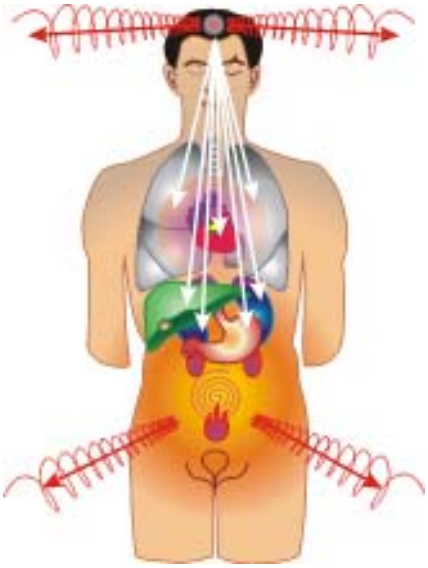

The Upper Mind activates all the senses, organs and emotions, which consume much energy.

When people are very emotional, the Upper Brain can spend up to 80% of the whole body energy.

Fig. 4.4 *Our Upper Mind consumes a Great Deal of Energy*

In Contrast, the Lower Brain uses much Less Energy.

The Lower Brain consumes less energy and can do much daily work, such as send and receive impulses, record experience and respond to emotions.

When you lower down the Upper Mind, it will also lower the blood pressure and anxiety levels.

Fig. 4.5 *In Contrast, the Lower Brain uses much Less Energy.*

Universal Tao Practices utilizes Lower Brain and charges Upper Brain.

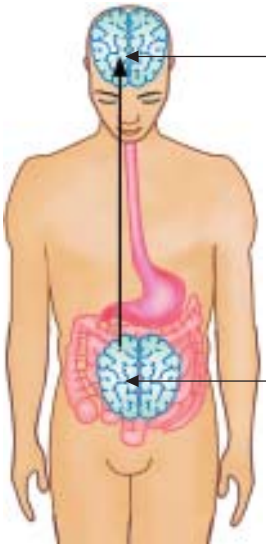

Rest the Upper Brain when you do not use it or are doing routine things.

Empty the Upper Brain down to the Lower Brain, so there will be energy left over. This can charge the Upper Brain during the day. Normally we can only charge our Brain when we have a good, deep sleep.

Fig. 4.6 *Universal Tao practices utilizes the Lower Brain and charges the Upper Brain.*

Our Three Energy Centers have different Generating and Storing Capabilities

Upper mind can generate and receive energy, but it is not good at storing energy.

Organs can store energy very well, but they are not good at generating energy.

Sexual organs can generate energy very quickly and can multiply it, but as soon as it is generated it will go out and not be contained.

Fig. 4.7 *Our Three Energy Centers have different generating and storing capabilities.*

Some Practices attempt to reach Enlightenment at the Expense of the Body.

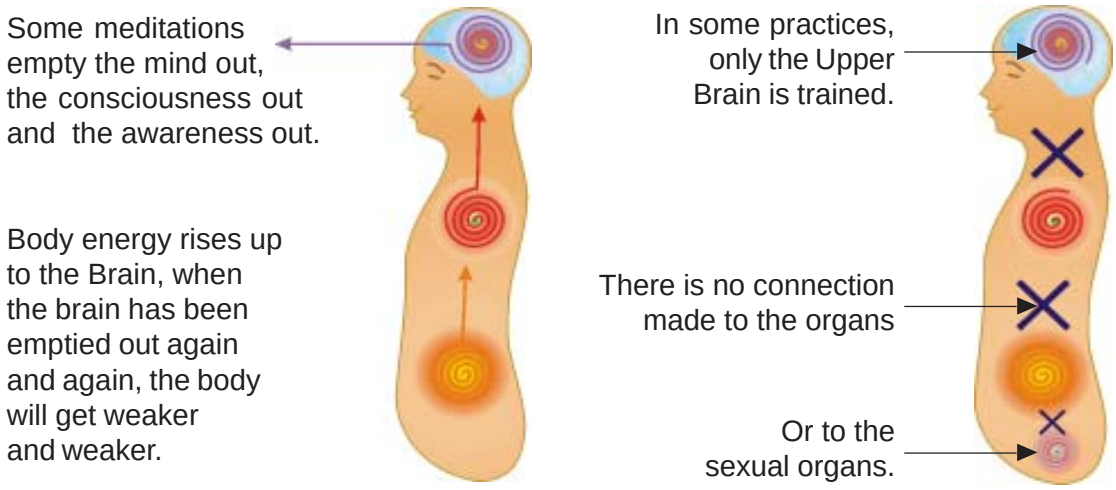

Fig. 4.8 *Some Practices attempt to reach Enlightenment at the expense of the Body.*

Universal Tao Practice Conserves Energy by Connecting to the Lower Tan Tien.

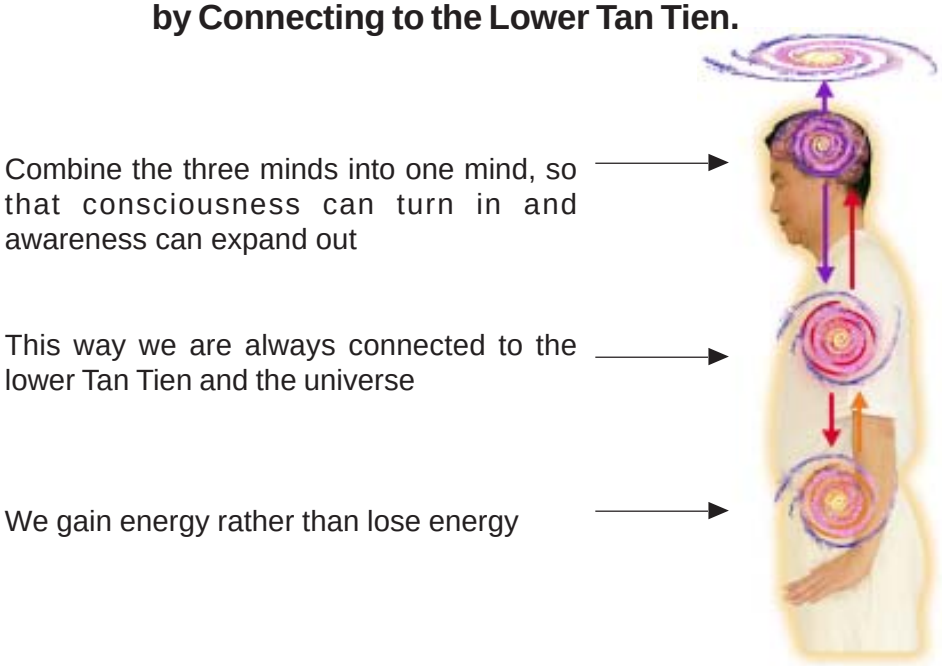

Fig. 4.9 *Universal Tao practice conserves energy by connecting to the Lower Tan Tien.*

Universal Tao Practice balances the Three Energy Centers.

The results of testing showed when we smile down and empty the mind to the navel, the organs can be charged with Chi and store Chi. Gradually, the organs will release Chi to the brain. This effect can last for 10 to 12 hours.

This practice gives a calm release of energy, unlike coffee which studies have shown to create nervous side-effects.

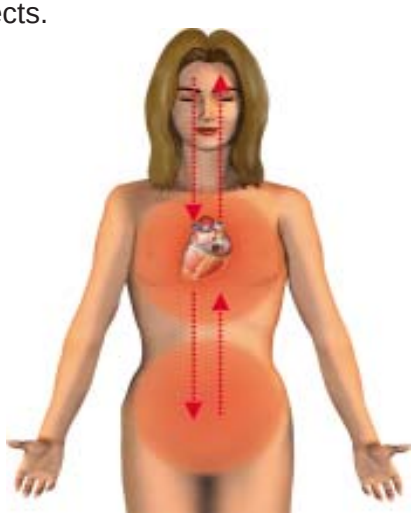

Fig. 4.10 *Universal Tao Practice balances the Three Energy Centers.*

In a Good State of Sleep, the Two Brains interact with Each Other

During sleep, the brain produces 90-minute cycles of slow wave (healing wave) sleep.

During sleep when the stomach has no food to digest, the abdominal brain will also produce 90 minute cycles of slow wave muscle contractions punctuated by short bursts of rapid muscle movement.

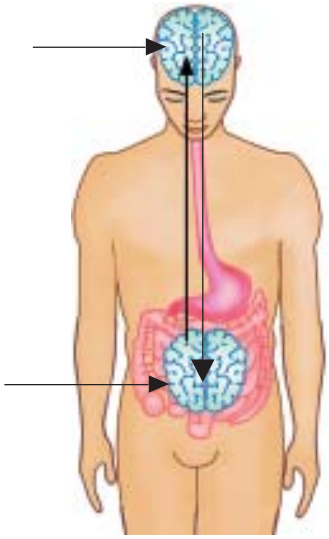

Fig. 4.11 *In a Good State of Sleep, the Two Brains interact with Each Other.*

Good Sleep will charge the Brain, Increase Sexual Hormones and Repair our Body.

1. Sleep early after dark, 9 p.m.—2 a.m., this is the time when Melatonin is produced.
2. Do not have food in the stomach.
3. The room must have no light; it should be completely dark (Neon light will awaken Pineal gland).
4. Couples should use separate beds or have enough space to recharge vital energy.
5. No noise
6. Cool room

Emptying the Mind

There are Five Major Steps in Emptying the Mind.

1. Relax the body and the nervous system.
2. Turn the Upper Mind into an observation mind, and observe inwardly.
3. Spiral at the heart and start to turn the conscious mind down to the Lower Tan Tien. Combine three minds into one mind at the Lower Tan Tien and keep it spiraling.
4. Spiral at the Crown and the mideyebrow.
5. Connect to the Tao.

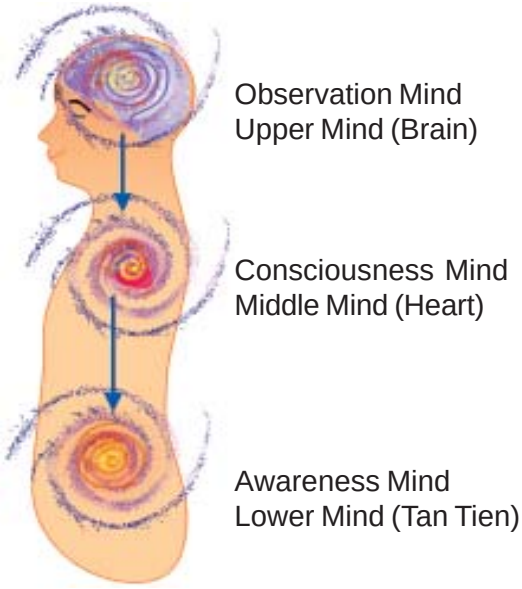

Fig. 4.12 *Combine Three Minds into One Mind at the Lower Tan Tien.*

Daily Practice: Opening, Connecting and Activating Chi Within and Cosmic Charging

Paradoxically, in order to project ourselves out into the immensity of the galaxies and the universe to gather limitless resources of Cosmic Chi for healing, we must take the first steps of the journey within ourselves. In order to 'go out', we must first 'go in'. The vehicle for this magical journey is powered by our ability to relax in mind and body. As we physically relax and let go of muscular and emotional tensions and joint and bone structures we gain access to the inner realms by turning on our very special subtle smile. It opens the pathways of the parasympathetic nervous system. This helps us to reduce the out flowing habits of our senses so that we can be more alert in sensing our inner universe.

This simple process of 'going in' enables us to develop our internal skills so as to safely 'go out' to the universe.

Fig. 4.13 *Focus your attention inside and connect with the outside universe.*

Practice
Relax and Let go

Step 1: Relax and Let go - Smile to Connect with the Universe Within

Smile to mideyebrow, eyebrows, eyes, mouth, jaw, tongue, lips, cheeks, ears, shoulders, ribcage and brain. Let the relaxed sensations and the 'Observer Mind' (Upper Brain) sink down into the Lower Tan Tien.

1. Smile to the mideyebrow. Relax and let go. Smile to the eyebrows and let them grow long to the sides. Lower these relaxed sensations down to the Tan Tien.

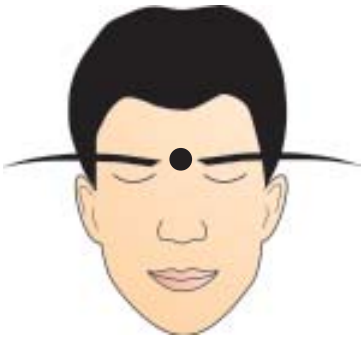

Fig. 4.14 *Smile and relax to the mideyebrow and think of the eyebrows growing very long.*

2. Smile to the eyes: relax the eyes and feel how nice and cool they are. Let the eyes gently draw back in their sockets and start to sink down to the chest and gradually down to the abdomen, the home of your 'feeling and awareness mind'.

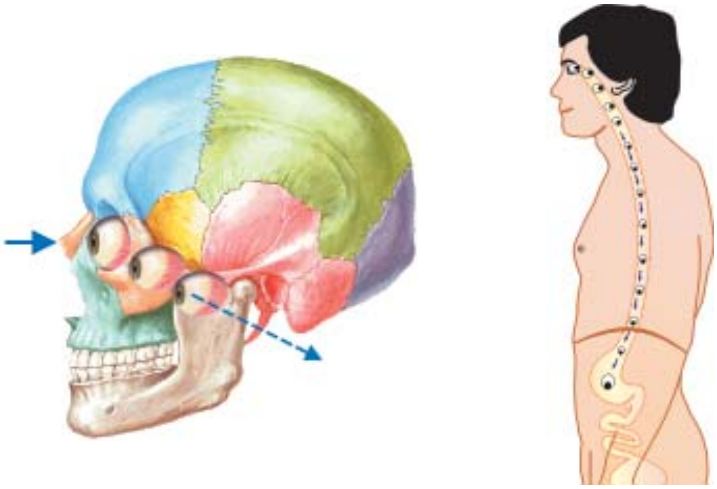

Fig. 4.15 *Smile and relax the eyes, sink into the eye sockets and gradually feel the eyes dropping down into the abdomen.*

3. Relax the two broad muscles extending from the outer portions of the upper lips across the cheekbones, and lightly smile feeling their connection to the upper front of the ears. Gradually feel the ears growing 'long', up and down. Feel the ears grow all the way down and connect to the kidneys.

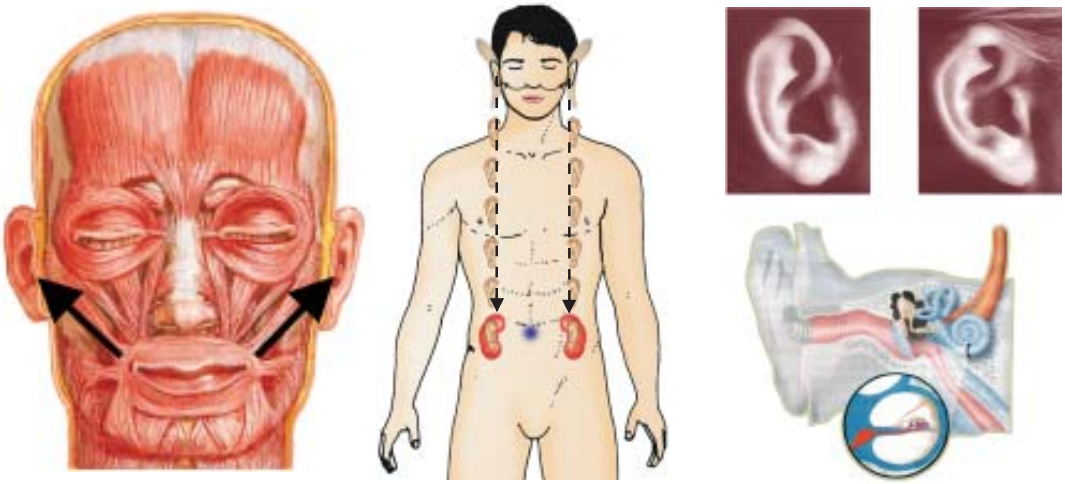

Fig. 4.16 *Smile to the ears and listen to the kidneys.*

4. Open your mouth and relax your jaw, separating the upper and lower teeth. Feel the jaw relax. Once the jaw relaxes the shoulders will relax and drop down. Continue to feel the jaw relax until you feel the saliva start to come out. Relax down to the rib cage. Feel the rib cage drop down, softening all the joints, relaxing down to the Lower Tan Tien. Let the tongue relax back in the mouth. Feel the tongue start to drop down into the throat to the chest and all the way down to the navel sinking the 'floating' sensation down to the Lower Tan Tien.
5. Smile to the shoulders and relax until you feel the shoulders drop and the rib cage relax.

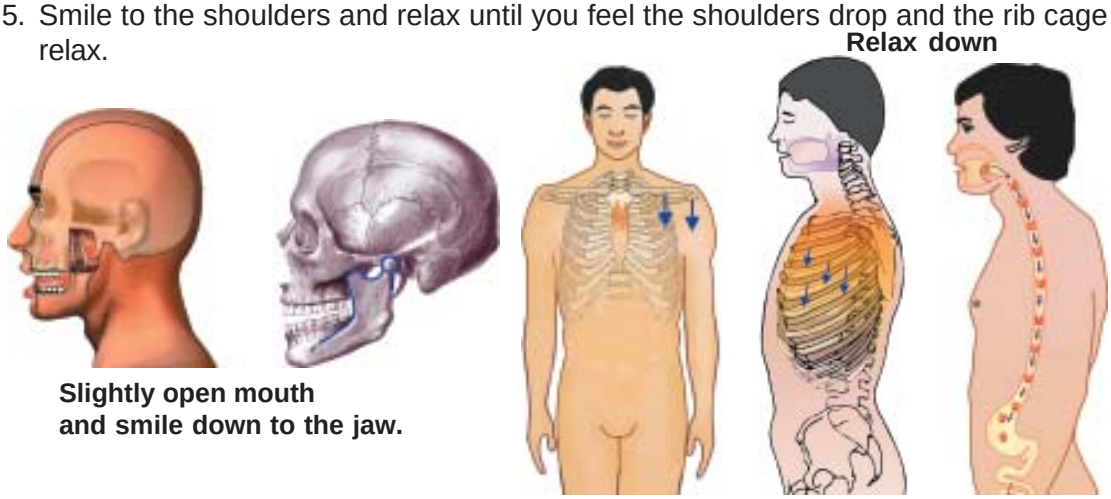

Fig. 4.17 *Relax the jaw, shoulders and tongue. Move the awareness down to the Lower Tan Tien.*

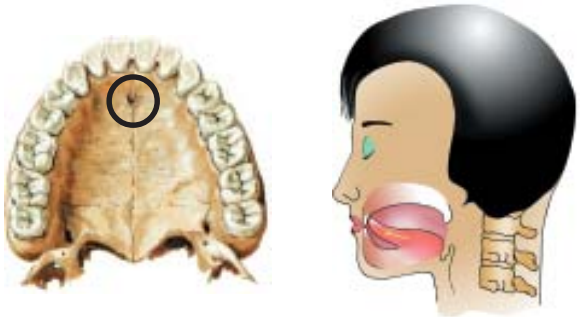

Fig. 4.18 *Place your Tongue to the Roof of the Mouth to make the Connection.*

Step 2: Empty the Mind down to the Tan Tien and Spiral or Turn the Wheel.

Sink deep into the empty space within. Smile down and empty the mind down to the Tan Tien, the Abdominal Brain. Look for a dot of light – the galaxy within. Start to spiral at the Tan Tien. When the abdomen is warm, the Chi is full. It can then charge up to the brain. This will indicate that the Chi is moving.

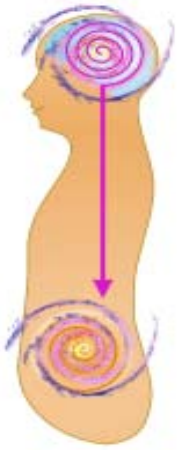

Fig. 4.19 *Empty the mind down to the Tan Tien and spiral or turn the wheel.*

Step 3: Turn Three Minds into One Mind at the Lower Tan Tien, keep on Spiraling, and expand your Awareness to the Universe.

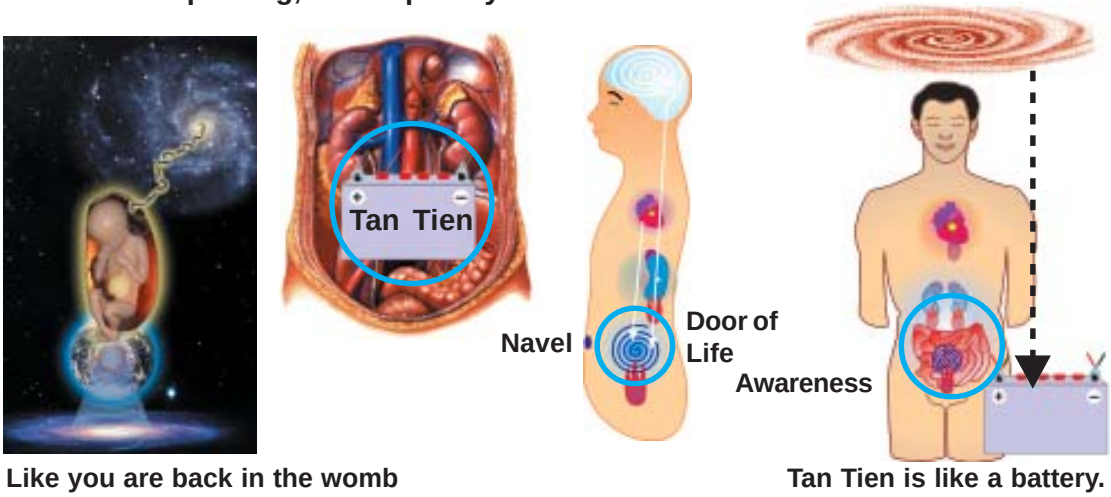

Fig. 4.20 *Universe charges Tan Tien power.*

Tan Tien and the Universe Consciousness In and Awareness Out

The expression, “Tan Tien and the Universe,” is a reminder to feel your Lower Tan Tien, your heart, your mideyebrow/third eye and your crown spiraling while the universe spirals in the six directions around you.

Use your Yi, the three-mind power, repeatedly to recharge your Chi for various purposes. You recharge by connecting to the Chi in the six directions of the universe simultaneously. When you charge a particular area or direct Chi into the body at a particular point, this establishes a connection point for the Chi by placing the hand or fingers on the surface at that location. This is like giving an address for the Chi to go to. Once the address is established and the Chi starts to go there, then move your attention to where you want the Chi to go.

Fig. 4.21 *Tan Tien and the Universe Consciousness, in and awareness out.*

Summary: Turn Consciousness In, Awareness Out

1. Empty the mind by just smiling down.
2. Making the heart soft will activate the Consciousness.
3. Three minds are fused into One Mind at the Lower Tan Tien (the Yi Power).
4. Expand the Yi Power to the mideyebrow, crown and forehead into the universe.
5. Feel yourself being charged by the Universe

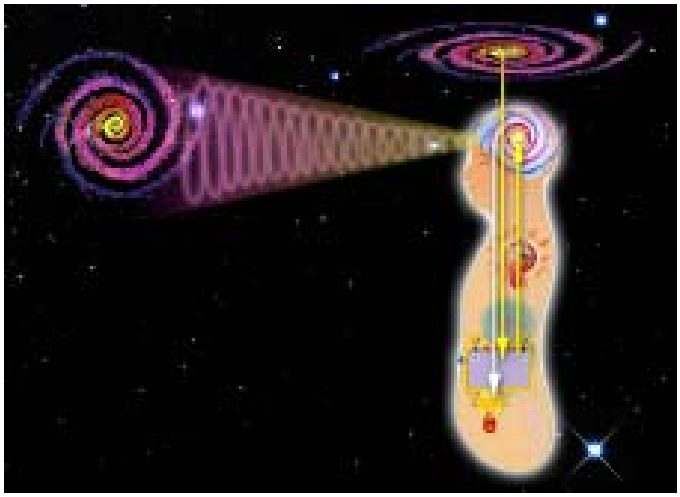

Fig. 4.22 *Lower Tan Tien is the seat of awareness.*

Spiral in the mideyebrow and the crown.
Turn the consciousness in and expand the awareness out to connect to the Universe and the six directions at the mideyebrow and the crown.

Fig. 4.23 *Connect with the Universe and the Six Directions.*

Activating the Six Directions and the Three Fires

This powerful energetic technique allows one to extend the mind, to touch the force in the cosmos, and to draw that energy back into the body.

The Six Directions teaches you how to expand your mind and Chi to receive healing energy. By practicing the Six Directions daily you will increase your healing and cosmic power. Turn your mind and Chi into the cosmos, multiply them and draw them back as energy.

Trust and Believe: Direction Below will turn Visualization into Actualization

When you achieve the three minds into one mind, begin expanding into the six directions. Press your hands down and start with the low direction. Picture yourself standing on the earth and expand yourself far away – deep down into the earth, very, very deep down into the earth, turn the trust and turn the visualization into actualization. Your hands become long; your feet become long, they go all the way down into the earth and out past it into the galaxy below on the other side.

Push. When you push, connect with the galaxy below, pull and think about your Tan Tien filling with Chi. Push and pull. Push and pull. Fill your Tan Tien with Chi.

Practice:

1. Stand, feet together. Put your hands down parallel to the ground. Expand your hands very far away and your mind very far away, smiling into the ground. Continue expanding your hands, feet and your mind far away beyond the earth below. Go down through the galaxy, way beyond to the primordial force. It's just like you are extending all the way to the primordial force 30 million years ago or before.
2. Push, moving the hands forward six inches only.
3. Pull, moving the hands back by the sides. Think about your Tan Tien – Chi coming to the primordial force in your Tan Tien. Smile to your Tan Tien, dark, deep and vast.
4. Push: touch the primordial force in the universe.
5. Pull back the dark primordial forces with your hands to your Tan Tien.
   Push and pull: project your awareness into the vast empty space. Then come back to your Tan Tien – also empty, just like the primordial condition before anything existed. That is where all the forces come from. Push and pull 3 – 9 times.

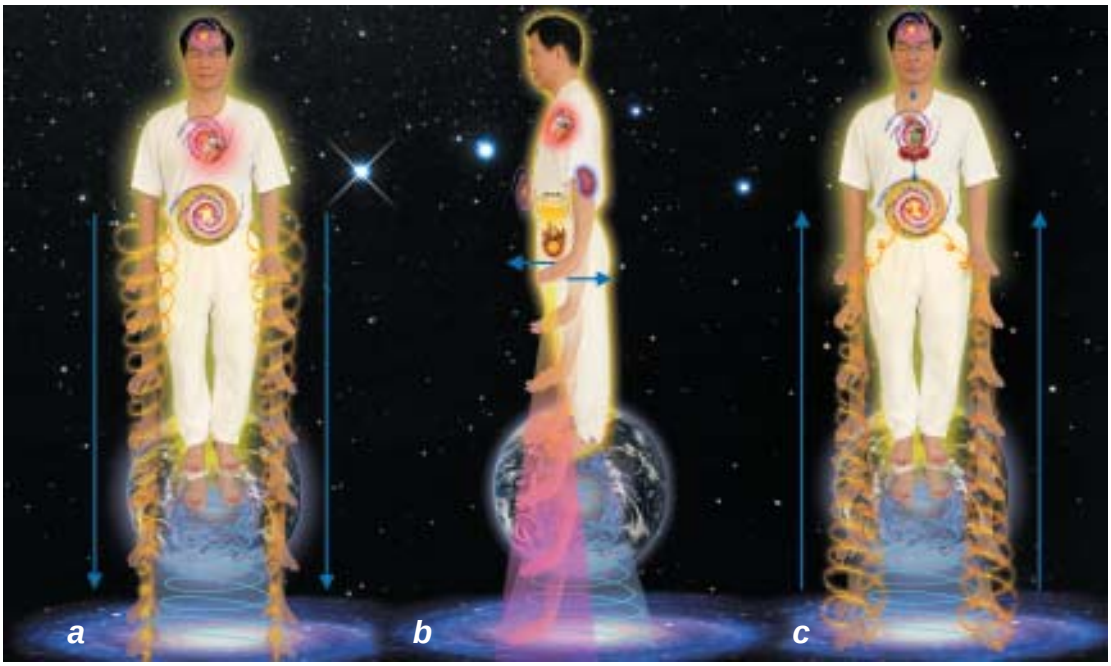

Fig. 4.24 *a. Hands expand through the earth and to the galaxy below. b. Hands push forward and pull back. c. Smile to the primordial Chi from the universe back to the Lower Tan Tien and fill the Tan Tien with Chi.*

Front Direction and Tan Tien Fire

Next, be aware of the front direction; a huge fireball appears in front of you. Open your palms: scoop up the Chi, scoop up the fire. Bring the fire into your Tan Tien. Activate the Tan Tien Fire.

1. Start with a small dot of light inside you. Expand your awareness, smiling to the universe in front of you.
2. Become aware of a big fireball in front of you. Feel your hands becoming bigger and longer. Scoop up the fireball. You may close your eyes to help your inner senses.
3. Use the fireball to light the fire in your Tan Tien. Feel the fire burning in the darkness, the 'fire burning under the sea.'

Fig. 4.25 *a. Be aware of the universe in front. b. Expand your hands very big and long to the universe in front. c. Hold the fireball to activate the Tan Tien Fire.*

Back Direction and Kidney Fire

Be aware of the back of the Tan Tien, the Door of Life and the back or rear direction. Extend your mind very far away to the 'back'. Scoop up the fire and light up your 'Kidney Fire'.

Fig. 4.26 *Be aware of the back direction, move the arms toward the back of the universe and scoop up the universal fire.*

1. Expand your awareness all the way to the back. Move the arms toward the universe behind you.
2. Touch the universe; scoop up the fire. Activate the Kidney Fire. Maintain your awareness in the Tan Tien and expand, smiling out to the universe. The energetic spiral glows in the Tan Tien. Spiral in the heart, spiral in your crown and spiral in the universe.

Heart Fire

Raise your hands up under your armpits, and feel yourself holding two fireballs. Touch the heart by extending the fingers energetically in from the sides; feel your hands extending into your heart and very far away. Activate the Heart Fire.

Fig. 4.27 *Activate the Heart Fire.*

1. Move your hands up under your armpits and extend your fingers deep into your heart. Keep your awareness on the infinite space to the sides.
2. Tan Tien and the Universe: you are connecting to the 'charger,' increasing more fire into yourself.
3. Feel your heart soft in the center of the chest as you smile down. Feel the warmth of the fire, the energy of love, joy and happiness in the heart.
4. Feel the connection with the unconditional love in the universe as you keep your heart consciousness in your Tan Tien and extend your awareness out to the universe.

Sacred Fire *(Chi Fire, Holy Fire)*

Connect the Three Fires to combine into one Fire: *Heart to Kidneys to Navel to Heart*.

Fig. 4.28 *Connect the Three Fires and Sacred Fire.*

1. Move your hands together in front of your heart. Connect the Heart Fire to the Kidney Fire, the Kidney Fire to the Tan Tien Fire and back up to your heart. Connect them all as one triangular Sacred Fire, circulating the Chi between the three centers, first slowly, then getting faster and faster.

Open the Third Eye

Now, extend your hands out to the front, very far away – pushing, pushing, pushing. Turn your palms inward, and extend your middle fingers inward toward your third eye. Picture a crack in the middle of your forehead, and pull the crack open. Feel the light from the heavens opening it and feel the light from the heavens shining into your brain.

1. Open your palms. Open your eyes. Look to the universe. Extend your hands to the front, palms vertical. Extend the arms from the scapulas. Smile and touch the universe.
2. Turn your palms inward and extend your middle fingers inward toward your third eye.

3. Picture a crack in the middle of your forehead and let the heavenly light shine into the brain; pull the crack open and let the light reflect into the organs.
4. Close the third eye. Pull: open-close-open. And, close. With the third eye open, the light from the heavens shines into your brain and reflects down to all your organs. Open and close the third eye 3 - 9 times.

Fig. 4.29 *Look as you smile into the universe in front of you.*

a *b*

Fig. 4.30 *a. The middle finger hooks into the third eye and light reflects down into the organs. b. Pull open the third eye; let heaven open and shine its light into the brain.*

Front Direction: Push/Pull Master Practice

Now, turn your palms, pushing out. Push. Pull. This is the master practice that is imperative for successful completion. When you first start practicing you should do it at least one hundred times and increase up to 200 times. Push and pull. When you push, you feel your hands extended far away – very long – reaching into the sky. Touch the universe. Turn the visualization into the actualization.

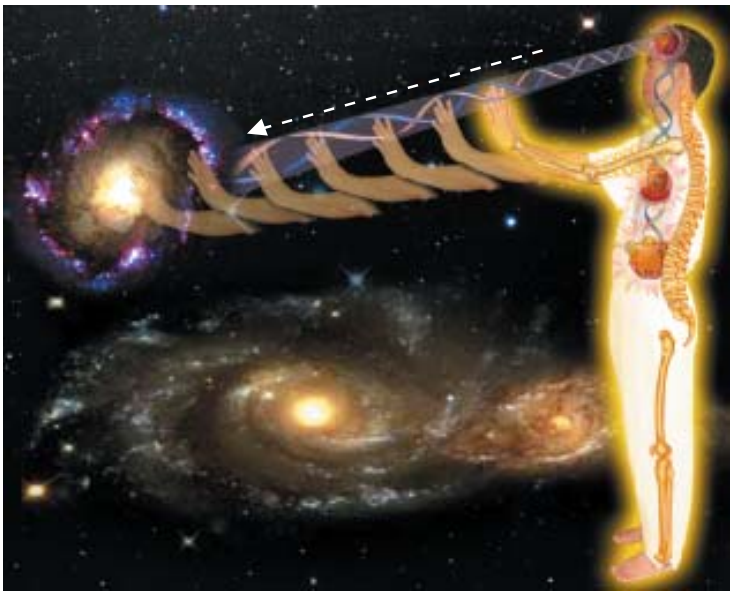

1. Push: Extend your arms and hands to the front, palms vertical. Extend the arms from the scapulas.
   Expand: smiling, smiling, touching the universe – touching the force, touching the Cosmic Chi.

Fig. 4.31
Master practice:
Touch the Universe.

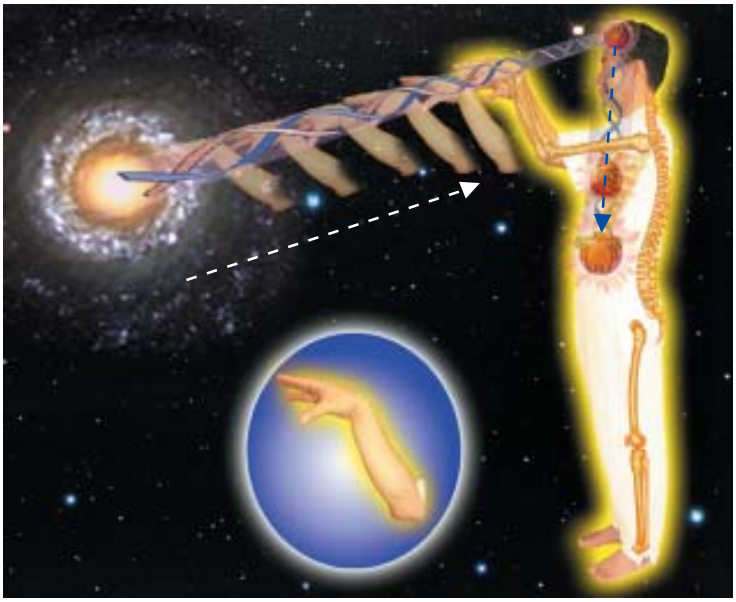

2. Pull: Draw the Chi back to you from the universe. Moving the arms from the scapulas, draw the hands toward your body in a horizontal position, drawing the Chi into the Lower Tan Tien.

Fig. 4.32 *'Drawing' universal Chi - feel your Tan Tien and fill it with Chi.*

Pull. Think and smile to your Tan Tien. Push, very far away to the universe.
Pull. Push: Smile, relax, and let go, touching the sky, touching the universe.

Fig. 4.33
Let go - push and touch the universe 6, 9 or 18 times.

Left and Right Directions

Now, move your hands to the left and right directions. Pull the Universal energy in. Push; touch the universe. Pull; think about your Tan Tien. Push – all the way, touching-touching-touching the universe.

1. Move your extended hands from the front horizon to the left and right sides.

Fig. 4.34 *Touch the universe - left and right.*

2. Pull into the Tan Tien: Smile to your Tan Tien. Keep smiling to your Tan Tien.
3. Push to both sides. Expand all the way, smiling and touching the universe.

Fig. 4.35 *Pull: Just feel your Tan Tien.*

4. Push and Pull: Touching, reaching into the universe drawing in the Chi. Smile energy into you from both sides.
   Do 3—6 times.

Fig. 4.36 *Draw the Chi in from both sides.*

Direction Above

Turn your palms up to the universe. Scoop up the Chi. Pour the Chi over your crown, and then touch the crown. Project the Chi all the way down to the perineum and down through the earth to the universe below. Always feel your Tan Tien spiraling, heart spiraling, crown spiraling and the universe around you spiraling.

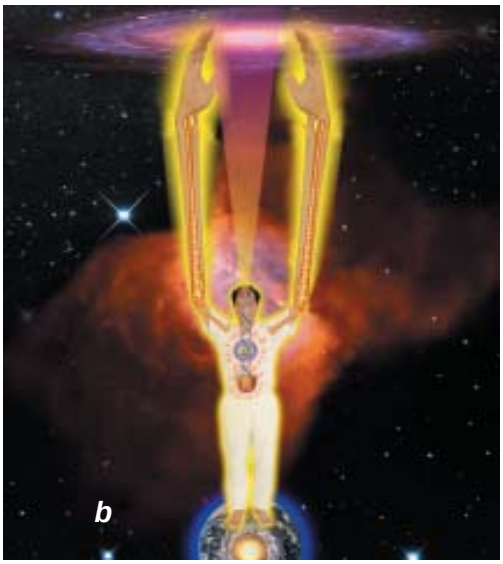

Fig. 4.37 *a. Raise your hands up to the universe. b. Feel that the hands are big and long and that the bones are hollow. Fill and pack the bones with Chi.*

Turn your palms up to the universe. Scoop up the Chi. Pour the Chi over your crown, and touch your crown. Project the Chi all the way down to the perineum and down through the earth to the universe below.

Connecting your Tan Tien and the universe, always feel your Tan Tien, heart and crown spiraling, and the universe around you spiraling.

Fig. 4.38 *Scoop up the universal Chi and pour it over the head.*

Gather the energy and bring it all the way back down to the Tan Tien. Remember, use the mind. Extend it down to the Earth and gather the energy. Go back up and extend up to the universe and gather more energy from the universe. Come back down to the mid-eyebrow and bring in more energy.

Fig. 4.39 *Gather the energy.*

Keep moving the energy. When we move it to a certain level, it gets faster and faster (spiral speed).

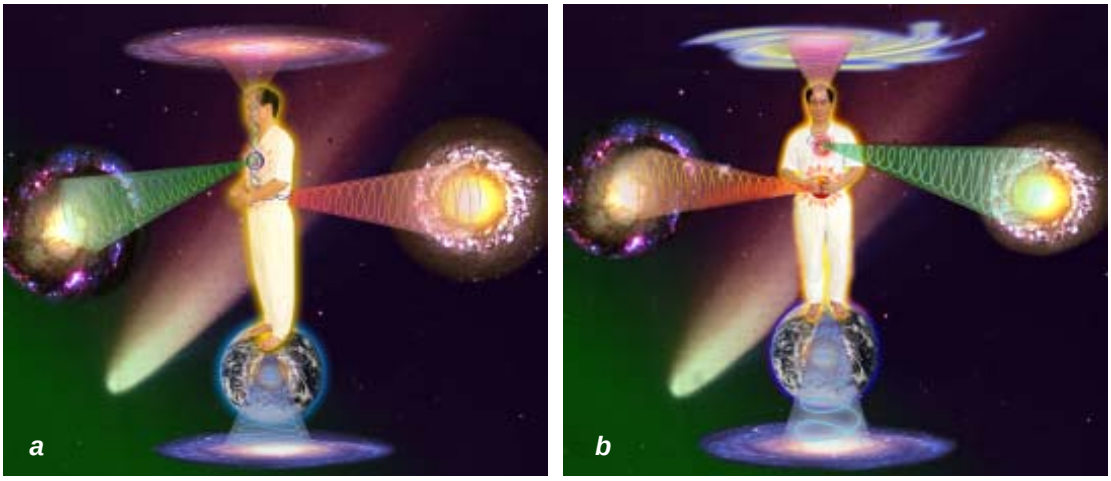

Fig. 4.40 *a: Touch the navel and feel the Chi all sink down to the Lower Tan Tien, start to spiral, faster and faster.*
b: Feel the Tan Tien and the universe all spiraling at a fast speed.

Chapter 5
Protective Circle and Chi Field

It is very importance to create the Chi field as a protection area. Only allow the good intentions enter the space and expel the negative Chi out. Raise your hands up and become aware of the 'Sacred Fire' in the universe. Feel your fingers extend way out into the universe and touch the fire in the sky. Bring the fire down. Make a circle around your community, your house, the meditation hall or where you are and around your body. This creates an energetic field of Chi around the whole room.

Sacred or Chi Fire
Connect and Receive Fire from the Universal Cauldron

1. Activate the Sacred Fire in the Universe

Be aware of yourself. Feel the bones in the arms and fingers grow and expand. Reach into the universe and the Sacred Fire. Let the Sacred Fire fill and condense in your arms and bones.

2. Use Yi Power to Create Sacred Fire Protective Circle

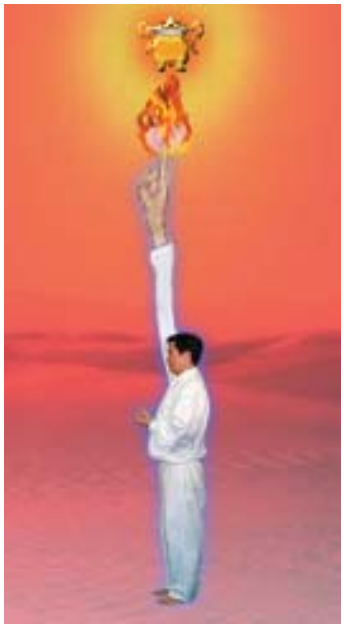

a

Use the Yi Power to draw the Sacred Fire Circle on the ground around your house, office and the room you work in.

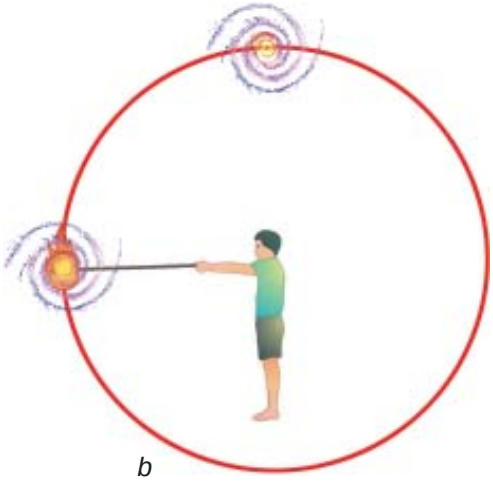

b

Fig. 5.1 *a. Arm bones long; touch the sacred fire.* *b. Make the circle of Chi field.*

3. Create a Chi Field of Sacred Animals Practice

Set up the 'guardian animals', Blue Tortoise in the north, Red Pheasant in the south, Green Dragon in the east, White Tiger in the west, Yellow Phoenix above and Black Tortoise below.

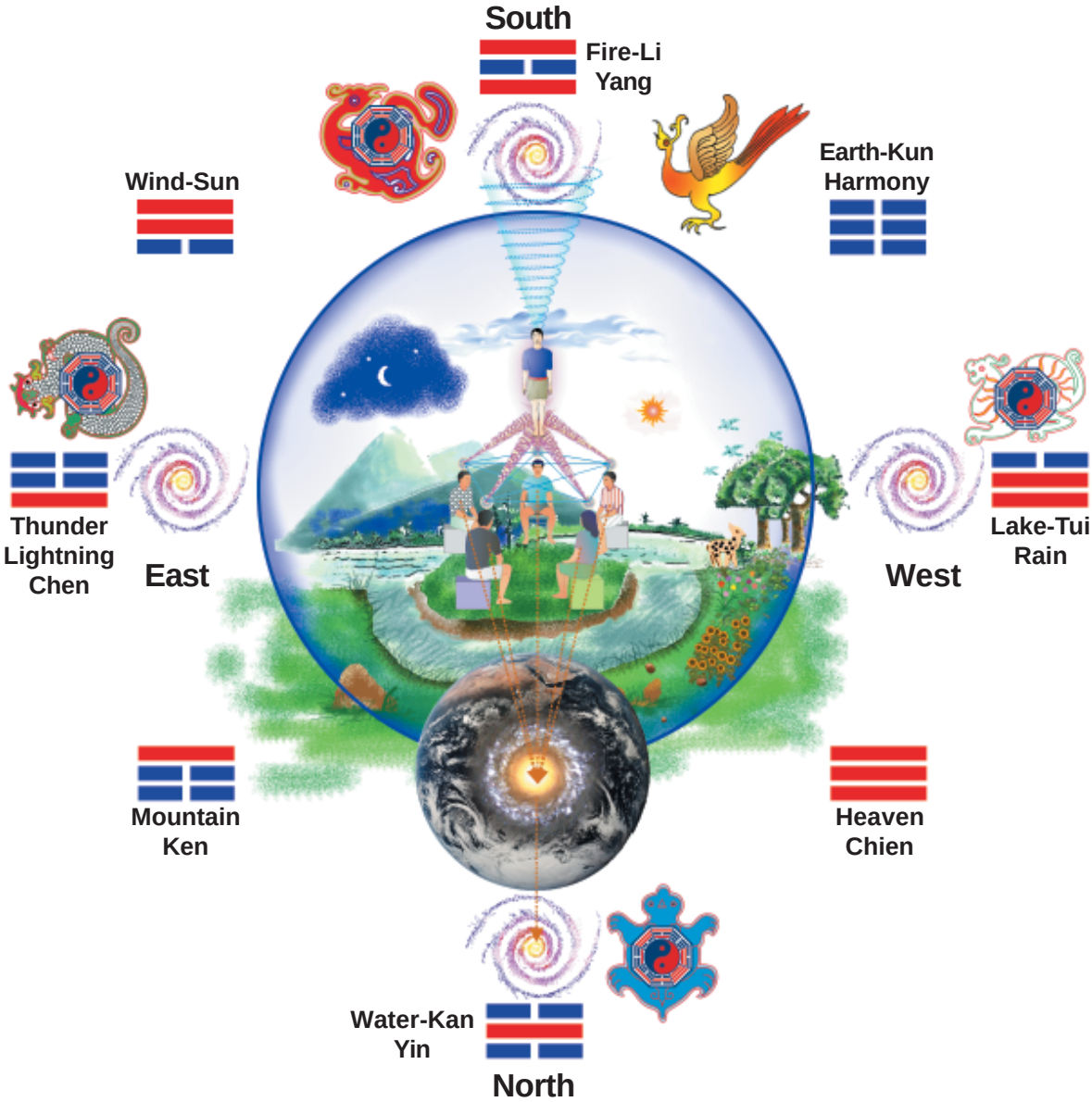

Fig. 5.2 *Create and surround yourself with a Chi Dome and the Guardian Animals.*

4. Activate the Eight Elemental Forces of Nature and the Universe

Activate all eight forces; wind, mountain, fire and thunder on the east. Earth, lake, water and heavenly power on the west. Call the Eight Forces; fire, water (ocean), thunder (lightning), lake (rain), earth, mountain, wind, and heaven.

It is always good to create the Chi field and call upon the eight tri-gram-Pakua power, the eight force, when you want to do the meditation.

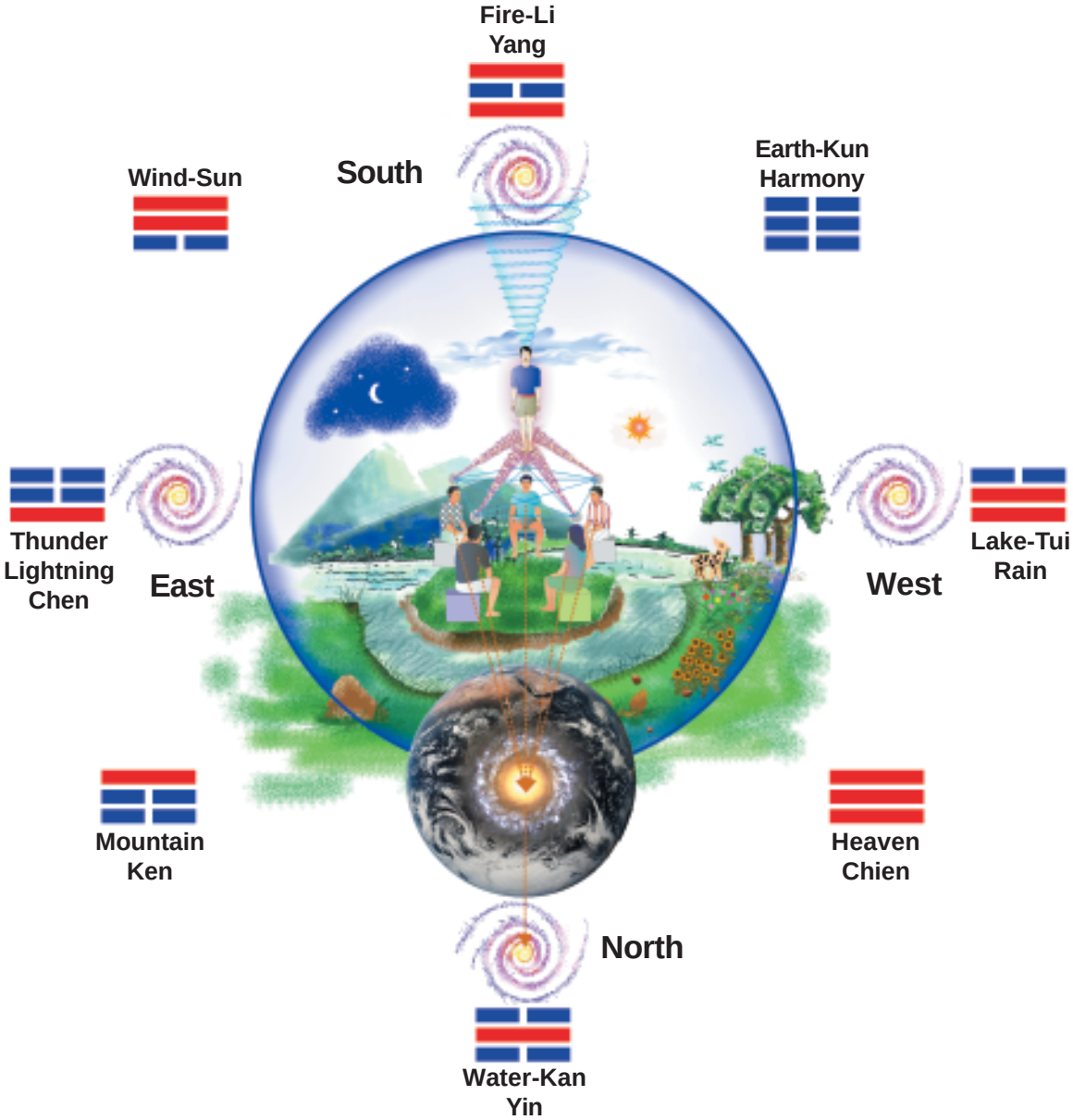

Fig. 5.3 *Activate the Eight Forces.*

We have the Power to create Sacred Water.

The Sacred Water practice is exercising the right of being the children of the cosmos, children of god and asking for the power to give bio-electromagnetic power to the water. The water's power can cleanse the body's cells of sick, toxic or negative energies.

Fig. 5.4 *Sacred Water from the Cosmos*

In the next sections the practices are used for cleaning the cells.
The more you clean the cells the more the Cosmic Healing can take place.
For more detail please read Cosmic Healing I

Chi (Sacred) Water Practice

The Sacred Water practice (also known in the West as Holy Water) is to exercise the right of being the creator of the Cosmos. With strict, regular daily water intake to prevent the stresses and associated damages of dehydration, the chief conductor and supervisor of the body's well being – tryptophan and its neurotransmitter derivatives, serotonin, tryptamine and melatonin will be well positioned to regulate all functions. Regular daily walks will keep muscles well coordinated and correct any physiological processes that are established in the body as a result of anxiety or emotional stress.

Well hydrated and healthy skin needs water to constantly replace that which it loses to the outside environment. This then allows blood vessels in the face and the body to open up and provide necessary nourishment for exposed skin cells.

Science has discovered that even if we clean water through filtration processes, although it may look and taste alright, closer analysis using high powered microscopic technology, indicates that its cell structure is 'unclean'. Water, like humans, maintains the memory of its old 'self'. We store our 'memory' within our DNA; water stores its memory within its cells.

The world is about 70% water

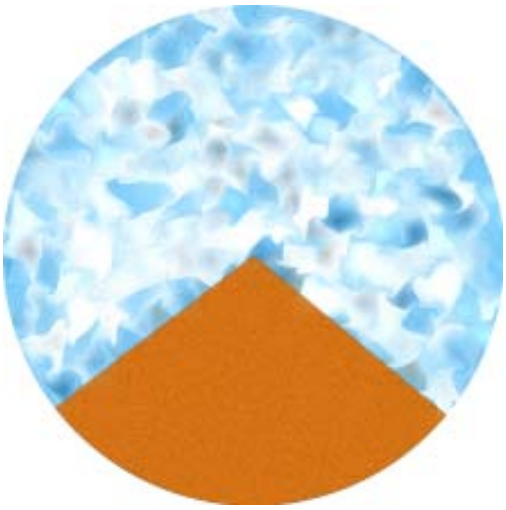

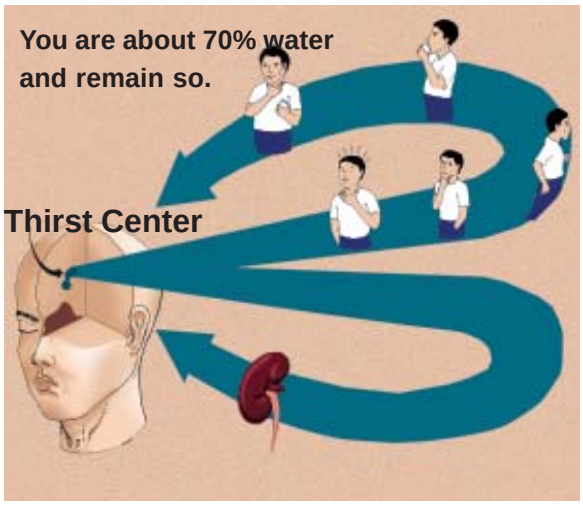

Fig. 5.5 *Water is Life.*

The following three pages contain extracts from the book 'The Message from Water' by Masaru Emoto. He advises us that 'water is telling us to take a closer look at ourselves - water is a mirror reflecting our mind.'

After offering a prayer to the Fujiwara dam the message is reflected in the water.

Chi and Love

Love-Appreciation

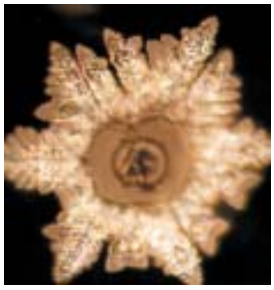

"Let's do it"

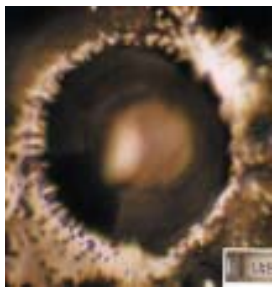

"Do it!"

Fig. 5.6 *The emotions change the water structure.*

When we project Chi and love into water and then freeze it; it will turn into a 'regular' and well structured crystal. If we project negative energy into water, the opposite will apply. Our projections will access the cellular level, clean out the polluted cells and reprogram those remaining with the essence of our affirmation.

When we project a nice, loving instruction or thought into water, like 'let's do it' the water will pick up this vibration and restructure itself. If we project negativity into the water, like a command, 'do it!', the water will acknowledge this accordingly. When we look into a pond we see our image. If we drink a glass of negative image water its destructive energy will enter our system and attempt to multiply.

Outline of Sacred Water Practice

Invoke the power of the Sacred Water practice to cleanse and heal the body's sick, toxic or negative energy.

Step 1: Hold the cup with both hands near your heart. Be aware of your Lower Tan Tien and spiral to feel it warm and feel the Chi radiate to the palms and to the cup of water, filling the water with Chi as done in *Cosmic Healing I* book by Mantak Chia.

Step 2: Command *"This Sacred Water will give me/you health, wealth and longevity."* Project love, joy, thankfulness, gratefulness, appreciation and the energy of compassion into the cup.

Step 3: The Sacred Water will carry the message of the practice to all the cells, where it will remain. If you are practicing in a group, drink the water in unison. If you are working with a student, pass him/her the cup to drink using both hands.

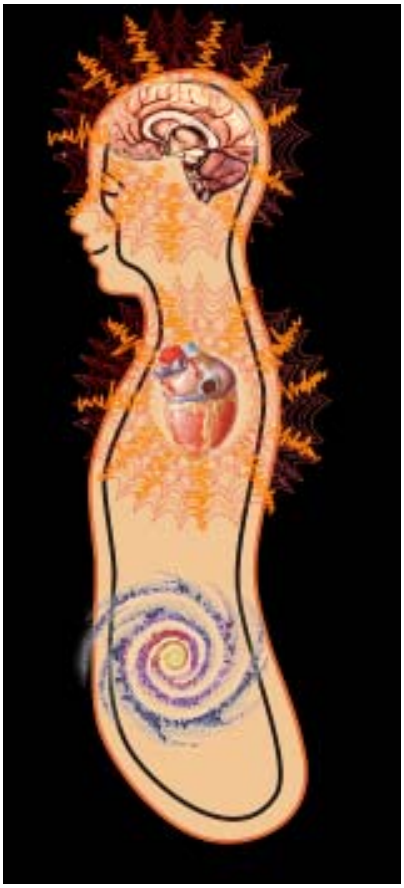

Fig. 5.7 *Feel good, feel love, compassion, joy and happiness.*

The Three Tan Tiens can generate out different waves which can which can change the crystals of the water.

Feel love, compassion, joy and happiness. This will change our body's structure so that it can receive and radiate out good and healing energy.

Before the practice of the Cosmic Orbit it is good to create the Chi field and do the Sacred Water Practice with the green and blue color and filling the body with violet light.

Step 1: Fill the Water with Chi

Hold the cup with both hands near the heart. Be aware the Lower Tan Tien and spiral till is warm in the lower abdominal area.

Fig. 5.8 *Fill the water with Chi.*

Step 2: Fill the Water with Compassion

Hold the cup with both hands near the heart and project goodness into the water. Feel the Chi radiate to the palms and the radiate Chi into the water.

Project love, joy, thankfulness, gratefulness, appreciation and the energy of compassion into the cup.

Fig. 5.9 *Fill the water with Compassion.*

Recent research has revealed that the heart generates a strong electromagnetic field within and around the body. The electrical field is shaped like a donut, or torus, similar to the biomagnetic field of the human aura, and the geomagnetic field of the Earth. The heart can radiate out very powerful healing power.

Each person's palm can generate Chi or healing energy.

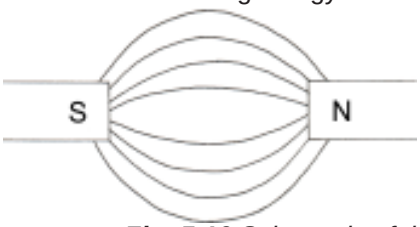

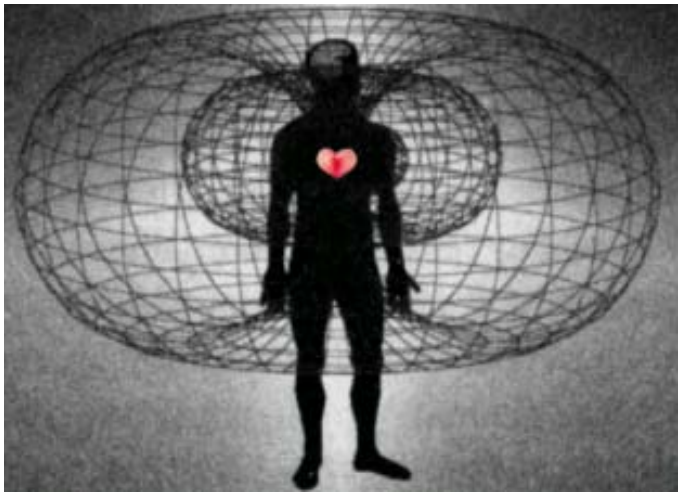

Fig. 5.10 *Schematic of the Heart's Magnetic Field for the Sacred Water Practice*

Step 3: Fill the Water with Good Intention

Hold the cup with both hands near the heart and project goodness through water.

Command: "***This sacred water will give me/ you health, wealth and longevity.***"

Project good intentions and the energy of compassion into the cup.

Fig. 5.11 *Fill the water with good intention.*

Step 4: Drink the Sacred Water

The Sacred Water will carry the message to all the cells. It will keep the message of the Sacred Water practice in all the cells. Use both hands to pass the Sacred Water to the student you are working with, or drink it yourself and/or in unison with your group. **Feel the water go into all the cells of your body. Feel it removing the sick cells and purifying your body.**

You can also sprinkle it on to any area that requires healing.

Clean with Green and Blue Chi

Draw the Green Light from the Universe

The green light and blue light has the power to clean out space, clean out the body and take out toxins, sickness and bad fortune. It is good to clean the space and the body before doing the Cosmic Orbit.

Be aware of the liver, gall bladder, forest while breathing through the throat.

Be aware of the green light in the universe. Let the light come in and blend it in the Tan Tien, up to the heart to blend with the compassionate heart and up to the crown.

Project the light up to the universe. See it spiral and let it multiply.

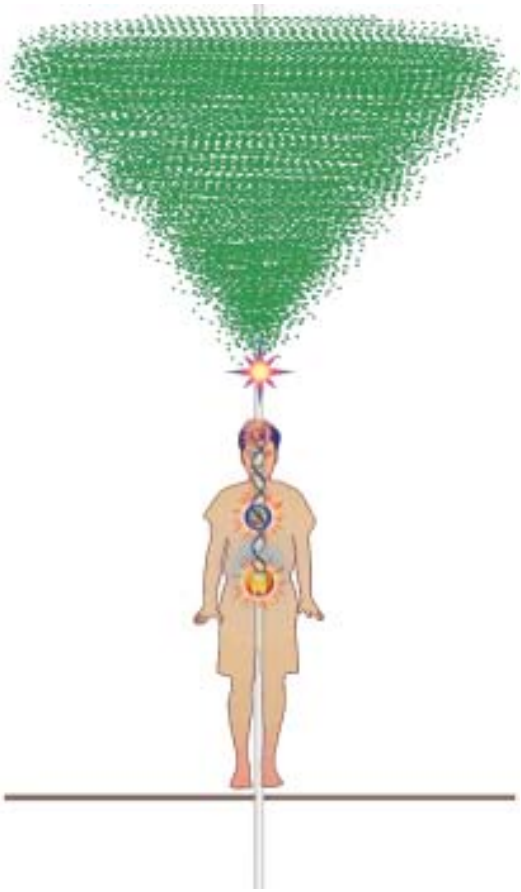

Fig. 5.12 *Draw down the Green Light from the Universe.*

Cleanse Us from Sickness

Extend your arms up, with palms facing the heaven. Use one hand to spiral the green force down. The other hand holds the position and connects to the universe. Let this big pool of green light in the universe spiral down through your community, your home, and then into your crown.

Let the Green light blend into the cells and bond with sickness and toxins. Let the green light bring the sickness out of the cells and flow down to the center of the earth.

Bury the sick energy in an energetic hole. Give the command: “Don’t come back. You will be happy there. You will be transformed into good Chi.”

Repeat it for 6, 9, 18, times. For people who are very sick with cancer or tumors, you can do up to 36, 72, 108 times.

Fig. 5.13 *Green Light bonds with the Sickness and Toxins before returning them to the Earth.*

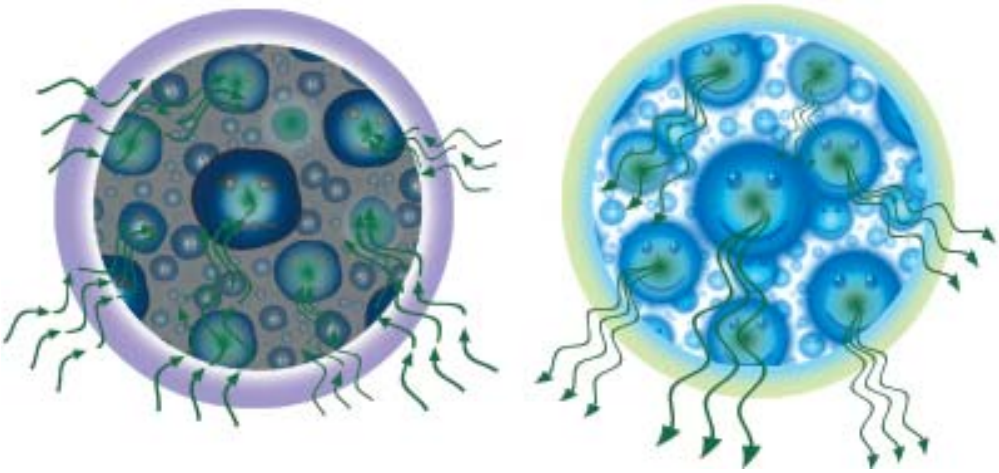

Fig. 5.14 *Green Chi blends in the sick cells and takes out the toxins it flows out and down to the ground. Dig a hole and bury them deep.*

Draw the Blue Light from the Universe

Be aware of the kidneys, the bladder, the oceans and the water energy.

Be aware of the blue light in the universe. Let the light come in and blend in the Tan Tien, up to the heart to blend with the compassion and up to the crown.

Project the light up to the universe. See it spiral and let it multiply.

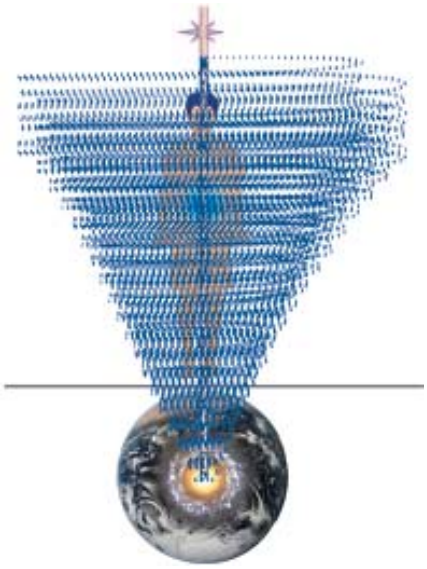

Fig. 5.15 *Draw the Blue Light from the Universe - rinse clean and remove sickness.*

Rinse and Flush

Extend your arms in the air, with palms facing heaven. Use one hand to spiral the green force down. The other hand holds the position and connects to the universe. Let a big pool of green light in the universe spiral down – through your community, your home, and then into your crown.

Then, let the blue light flush into the cells and flush out sickness and toxins towards the center of the earth.

Dig a hole and bury them. Give the command: “Don’t come back. You will be happy down there. You will be transformed into good Chi.”

Repeat it six, nine or eighteen times. For people who are very sick, who have cancer or who may be terminally ill you can do this up to thirty six, seventy two or one hundred and eight times.

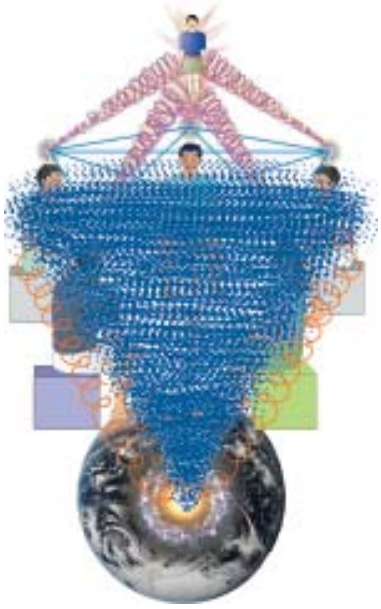

Fig. 5.16 *Blue Light flushes out the sickness and toxins before returning them to the earth.*

Chapter 6
Cosmic Orbit

Preparatory Practices

In the Universal Tao, we teach Cosmic Healing Chi Kung within an entire system of exercise and meditation. As a part of this system, Cosmic Healing Chi Kung comprises the art of healing oneself and others. It focuses on energy work for projecting chi to affect these healings. One can easily learn the simple movements of Cosmic Healing Chi Kung without doing any other Universal Tao practices, but if one truly wishes to master the art of Cosmic Healing Chi Kung, it is important to have a firm foundation in the basic Universal Tao practices. Therefore in this chapter we will introduce you to the basic Universal Tao practices that are used in conjunction with Cosmic Chi Kung.

The preparatory practice consists of a few parts; work through each part at your own pace and eventually join them together as a whole.

Always start with:

1. Warming up the stove.
2. Follow with Laughing Chi Kung at the abdomen.
3. Three Minds into One Mind, direct the fire down to the sexual center to transform the sexual energy.
4. Practice the Cosmic Inner Smile. The Cosmic Inner Smile is a powerful relaxation and self-healing technique that uses the energy of love, happiness, kindness and gentleness as a language to communicate with the internal organs of the body. Each organ corresponds to a specific element and color. For example, the kidneys will consist of the element of water and the color blue. The heart will consist of the element of fire and the color red. This makes it very easy to guide the healing power into each organ by using the appropriate color. The practice also aids the transformation of negative emotions into positive virtuous energy. This transformation is a very powerful Chi Kung practice. A genuine smile transforms negative energy into loving energy that has the power to relax, balance and heal. By learning to smile inwardly to the organs and glands, your whole body will feel loved and appreciated and enjoy more Chi.
5. Activate the Six Directions and the Three Fires.
6. Do the Cosmic Orbit in the standing or sitting position.

Core of the Earth

The earth rotates around itself 1,000 miles per hour caused by its core liquid and movement around sun at 67,000 miles per hour, so this affects every cell in our bodies. The paradox is that the earth appears to be still. The appearance of stillness is created because the earth is moving so fast. This is like the stillness we feel in an airplane because it is so fast it creates this stillness. These incredible speeds greatly influence the liquid in the body. Being are 70 percent water keeps us connected to the forces all around us. This connection is strongest in the Tan Tien, which is linked to the core of the earth.

The earth's spin also create the gravitational and the magnetic forces. This is the yin and yang polarity and the life force within our cells. The North Star is another force that pulls us toward it. This force connects with the axis of the earth tilting toward the North Star (*see pages 26-29).*

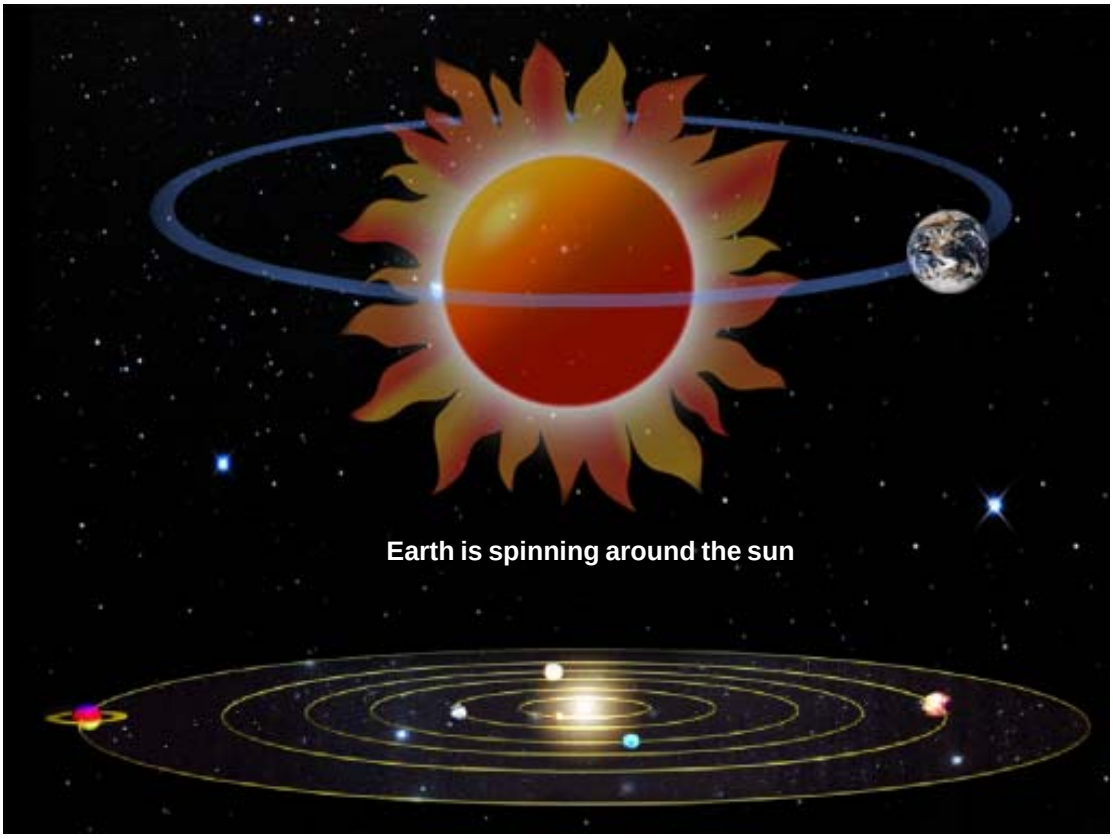

Fig. 6.1 *The Earth and Planets are moving around the Sun at 67,000 miles per hour.*

The North Star, we now know, is actually 100,000 times bigger than our Sun. The Earth's axis 5,000 years ago was aligned with Thuban. Now we are aligned with Polaris – tilted towards the North Star. Perhaps in another 2,000 years it will change again. We are actually influenced by the Sun and the North Star. The space between each star in the Big Dipper is actually very far and no one knows why they stay together as a group. We are aligned to the North Star (North Pole) and the Southern Cross (South Pole).

Taoists regard the North Star as the northern gate to heaven. The North Star is the one object in the sky that does not move and it is easily recognized.

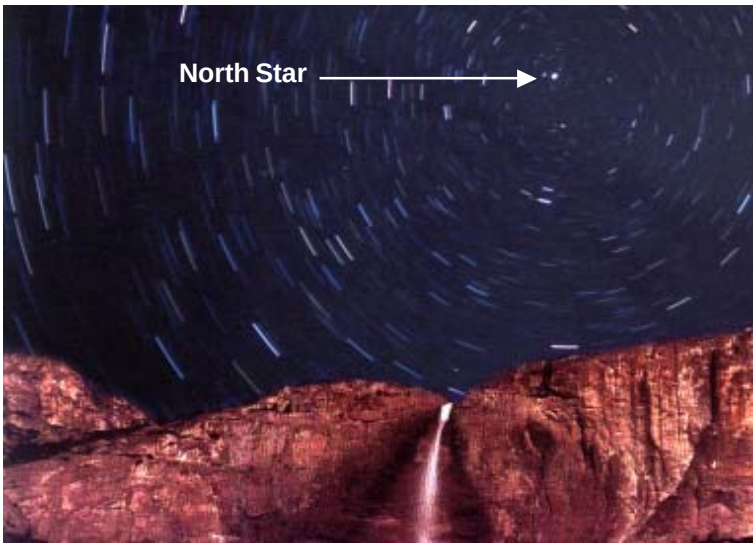

Fig. 6.2 *Gateway to Heaven North Star and Big Dipper*

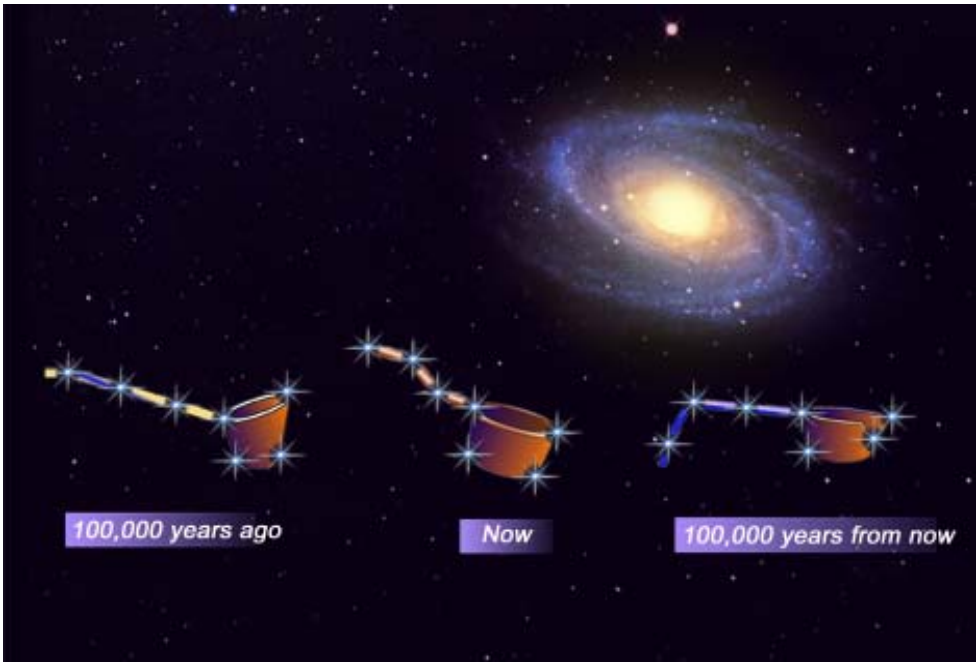

Fig. 6.3 *Big Dipper Movement*

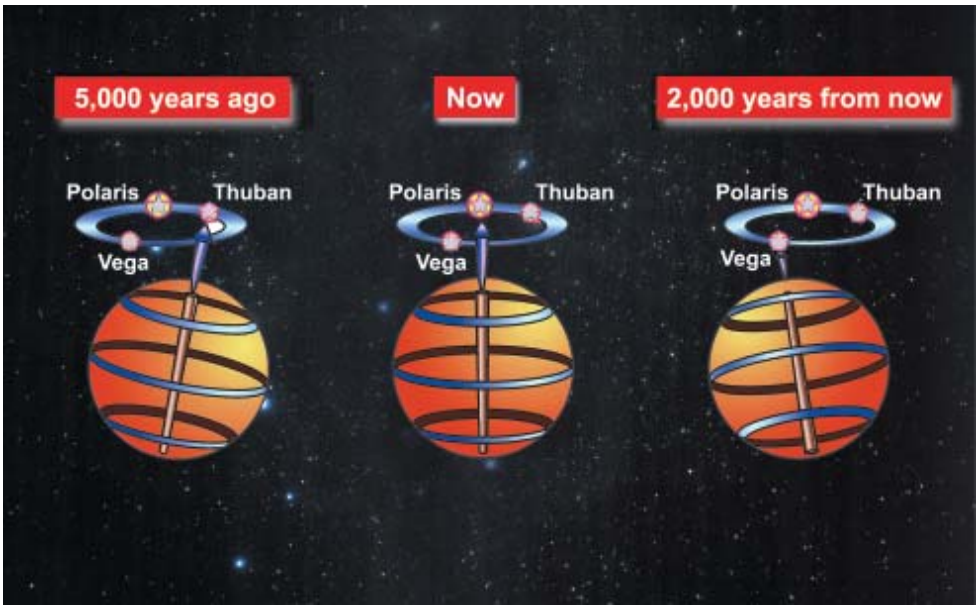

Fig. 6.4 *The Earth axis tilts towards the North Star so all the living things on the earth will connect with the North Star.*

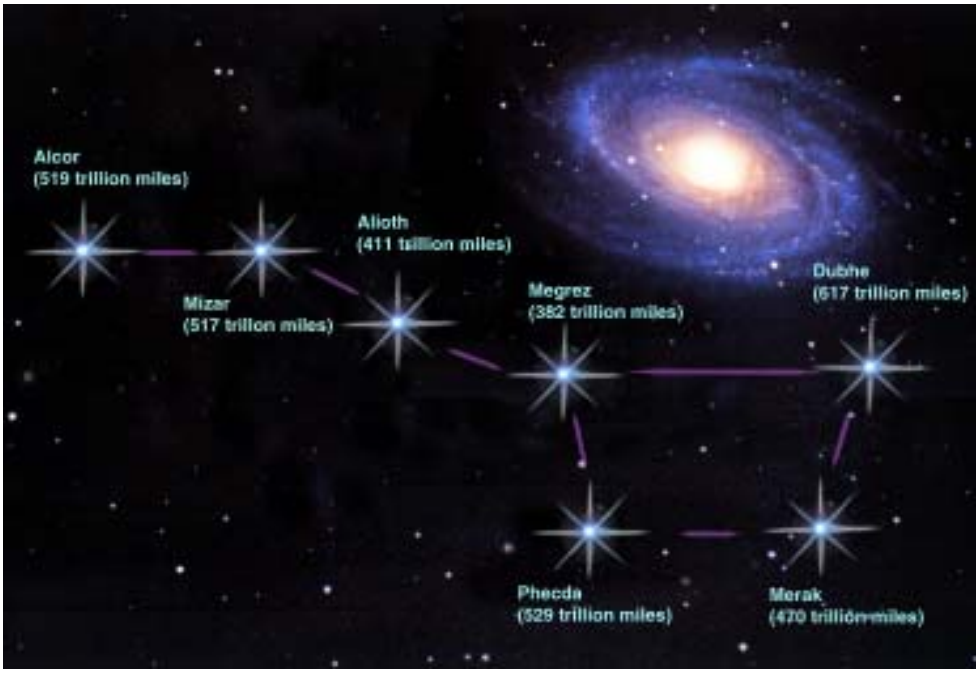

Fig. 6.5 *Space between each star in the Big Dipper*

Fig. 6.6 *North Star (North Pole) and the Southern Cross (South Pole)*

Luminous violet has a unique vibration and can be programmed. The universe is filled with violet light, especially the North Star and the Big Dipper. The color of the star, the higher self, or higher soul, from the crown is also violet light, the Divine or Soul energy.

1. Violet light has all the properties of all of the other colors. It has a rapid regenerating effect on damaged organs and nerves.
2. It develops the crown center, spiritual core center, and it is good for psychological ailments.

Fig. 6.7 *Feel Luminous Violet and the pull of the North Star.*

The North Star is a major source of violet light. The Big Dipper is a major source of red and infra-red light. Taoists believe that the cup of the Big Dipper gathers all the violet light from the universe. Use the left hand to hold the handle of the Big Dipper and pour it down to the crown and let it flow through the whole body.

Fig. 6.8 *Connect with the North Star to receive the violet light.*

The feeling of the Three Forces:

1. Earth force and the sole breathing.
2. North Star pulling you toward it, making you feel you are lighter.
3. Tan Tien Spiral.

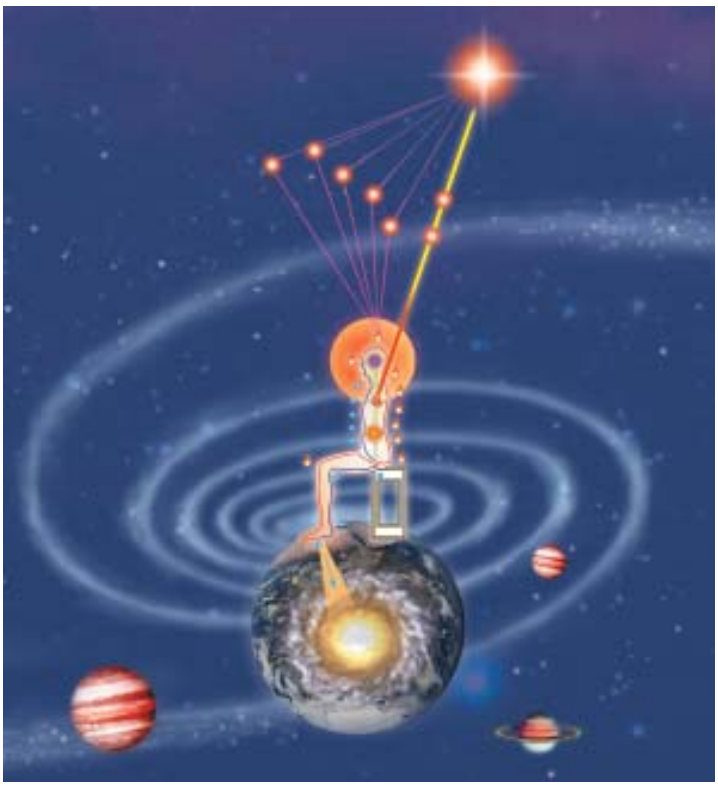

Fig. 6.9 *Connect with Big Dipper and Universe.*

Preparation Practice

Let's start to put the preparation practices together. As you progress, you can be creative with how you prepare. With continued practice, the preparation takes less and less time. Remember, these are just guidelines, you must make the practices and meditations work for you.

1. Start with Warming the Stove, do the Bellows Breathing 36 times. Rest and feel the warmth grow in the abdominal area.
2. Do Laughing Chi Kung, laughing loud for 5 minutes. Spiral the Chi in the lower abdomen. Feel the warm Chi build up and start to rise up to the crown and open the nostrils. Take some deep breaths.
3. Do the Giggling Laughing (not loud) for 3 to 5 minutes. Rest and spiral, allowing the Chi flow up to the crown.
4. Do Inner Laughing and feel the vibration inside for 3 to 5 minutes and rest. Let the energy flow.
5. Three Minds into One Mind.
6. Let the energy flow down to the mideyebrow and breathe through the eyebrow. Breathe this energy into the center of the brain. Do the breathing 9 to 36 times.
7. Breathe the good feeling into the mideyebrow and down to the heart. Hold it in the heart for a moment, allowing it to radiate through the body. Keep on breathing 9 to 36 times.
8. Breathe the good feeling through the mideyebrow, down to the heart and exhale down to the lower Tan Tien. Hold the Chi there, feel centered and balanced. Do this breathing 9 to 36 times. Feel all three minds (Upper Mind, Heart Mind and the Lower Abdominal Mind) merge in the Lower Mind. Feel calm and relaxed.
9. Do the Cosmic Inner Smile.
10. Sit on the edge of the chair and rock from the sacrum up to lumbar then up to the neck. Rest and smile to the spine. Feel the spine warm and open.
11. Smile to the heart and feel joy, happiness and love. Let this good feeling flow down to the spleen, stomach and the pancreas. Breathe in the yellow color of openness and fairness. Do 3 to 6 breaths.
12. Breathe the good feeling into the heart with the red or violet light and let it radiate down to the lungs. Breathe in the good feeling of the white light, courage, and righteous feeling into the lungs. Keep on breathing in 3 to 6 times.
13. Breathe the good feeling into the heart with red or violet light, and let it radiate down to the kidneys. Breathe in the good feeling of the blue light, gentleness and calmness feeling into the kidneys. Keep on breathing in 3 to 6 times.
14. Breathe into the heart the good feeling with red or violet light, and let it radiate down to the liver. Breathe in the good feeling of the green light, kindness and generosity into the liver. Keep on breathing in 3 to 6 times.

15. Feel all the organs surrounded by light. Heart is bright red, spleen is bright yellow, lungs are bright white, kidneys are bright blue, and the liver is bright green.
16. Move your tongue around to activate the saliva, and swallow down to the stomach and down to the small and large intestine. Keep on smiling down and follow the warm feeling of the saliva.
17. Stand up away from the chair, and do the opening of the Six Directions and Three Fires.
18. Follow this with the with the Cosmic Chi Kung practice to help open all the energy centers.
19. Then sit down and do the Cosmic Orbit meditation.

If you start fresh, after doing the Inner Smile, raise the hands to the universe, feel that the hands are big and long and that the bones are hollow. Fill and pack the bones with Chi.

Fig. 6.10 *Raise your hands up to the Universe. Feel that the hands are big and long and that the bones are hollow. Fill and pack the bones with Chi.*

Connect with the North Star to receive the Violet Light

The North Star is a major source of violet light. The Big Dipper is a major source of red and infra-red light. Taoists believe that the cup of the Big Dipper gathers all the violet light from the Universe.

Be aware the North Star and Big Dipper and let them descend down to your hands. Use the left hand to hold the handle of the Big Dipper and pour its light down to your crown and let it flow to all the body.

Fig. 6.11 *Practitioner connects with Universal Violet Light.*

Guide this sensation down into your skull, deep into your brain, cervical vertebrae, sternum, thoracic vertebrae, lumbar vertebrae and down through your legs. Feel it penetrating and enlivening your bones, deep into the bone marrow, washing, cleansing, energizing. This 'liquid-like' Chi spills all the way down to your feet. Feel it connecting with the earth through the soles of your feet; be aware of the bubbling springs in the feet (the K1 point of the kidney meridian) breathing and pulsating.

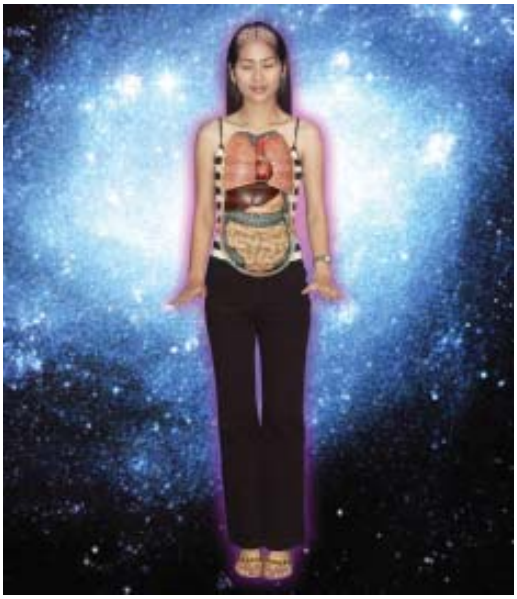

Fig. 6.12 *Let your whole body feel radiant, clean and shining with the healing light.*

Open the Cosmic Orbit

Touch the back-crown point. Pour the Chi all over your crown. Think of your soles so that you feel like there is a waterfall of Chi flowing from your crown all the way down to your soles. Feel your fingers grow long and the Chi penetrate down through your spine to the coccyx. Leave the fingers touching the back of the crown, to maintain the energetic connection with the coccyx.

Fig. 6.13 *Feel your fingers growing long, all the way down to the coccyx.*

Be aware of the Tan Tien and spiral it like universal energy in motion. Feel the heart center spiraling and the crown spiraling. Be aware of the universe spiraling above, below, front, back, left and right. Let all of the sick energy and the negative forces leave the body and go down into the ground for Mother Earth to recycle. Extend the Chi from above, all the way down through the earth and the universe below.

Fig. 6.14 *Be aware of the Lower Tan Tien, Heart Center and Crown spiraling. Feel the universe spiraling and charging the Three Tan Tiens.*

Open the Cosmic Orbit Points

Move to the mid-crown point. Touch the point and project your fingers deep through the middle of your body down to the perineum. Focus on the perineum. Feel the Chi from the universe flow right to your perineum. Look for one dot of light. Look into the darkness, the immense, vast darkness. This is the primordial force.

Fig. 6.15 *Open the Crown Point.*

Be aware of the Tan Tien and spiral it like the galaxy. Feel the heart center spiraling and the crown spiraling.

Be aware of the universe spiraling above, below, front, back, left and right. Let all of the sick energy and the negative forces go out of the body and down into the ground for Mother Earth to recycle. Extend the Chi from above all the way down through the earth and the universe below.

Fig. 6.16 *Tan Tien and the Universe*

Charging the energy - feel your hands and legs very warm when you scoop up the energy. In this part we always want the three Tan Tiens to merge yin and yang energy together. In the Taoist formulas, we involve the Phoenix and Dragon. When Chinese people get married they always have a Phoenix and Dragon, symbolizing the female and male coming together to become one energy. In the three Tan Tiens you can constantly feel this male and female uniting.

Recharge. Be aware of the Tan Tien, heart consciousness in and awareness out. Spiral the Tan Tien, heart, third eye and crown. The Universe and six directions are all spiraling.

Feel the yin and yang, male or female Dragon and Phoenix reunite and make love, spiral into one love and orgasm force in the heart center, and spread out to all the cells in the body.

Fig. 6.17 *Mideyebrow Point*

Scoop the energy and then come down and touch the mideyebrow, focusing on the base of the skull and feel the fingers penetrate straight through to the base of the skull.

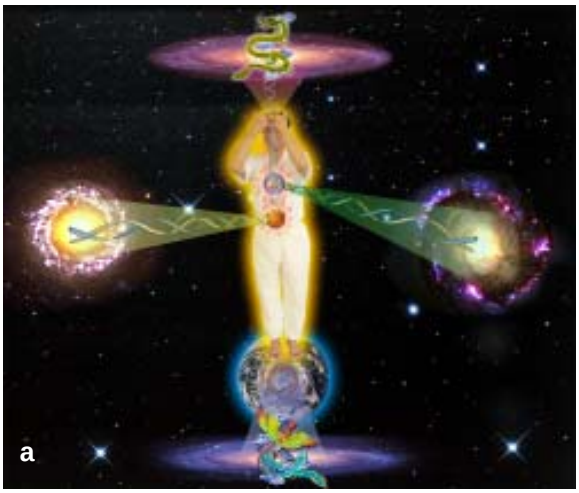

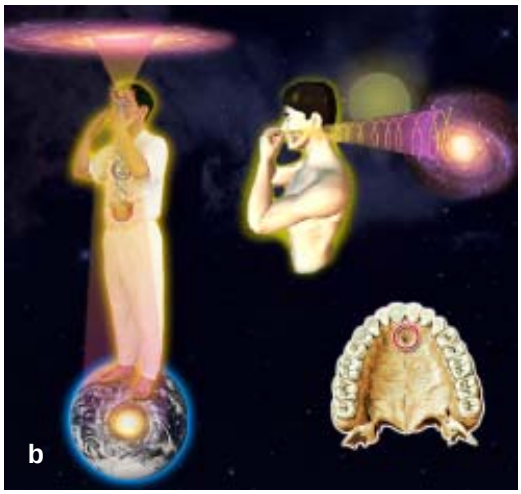

Fig. 6.18 *a. Be aware of Tan Tien and the universe spiraling. With the spiraling, the Chi will become hot in the fingers. It will expand and penetrate out through the back of the head all the way to the universe behind.*
b. Move the fingers down to touch the upper lips. Feel the Chi charge the upper palate.

Come down to the middle or upper lip. This point revives consciousness.

Fig. 6.19 *Feel the universe and galaxies spiral and charge the palate. The circuits are flowing down through the tongue and down to the throat.*

Feel the primordial love and orgasmic energy within; this is the most important energy that we need every day. If you want more energy, just become aware of the universe. The six directions of the universe are below, above, left and right, front and back. Everything is spiraling and moving around us. When you are aware of the universe spiraling, you are charging energy into yourself.

Fig. 6.20 *Feel the Six Directions.*

Touch the left and right ear and feel the fingers grow very long. Make a cross into the brain and open the Upper Tan Tien and the back of the head and the third eye. This opens the whole brain. Chi will go right into it much easier.

Picture your fingers like laser beams of Chi. Feel your Tan Tien and the universe spiral and charge your fingers. Move your fingers out from the mideyebrow around the side of the head to the top of the ears. Your fingers are like lasers, cut-cut-cut-cutting open your skull right in the middle around to the top of the ear. Cut your Upper Tan Tien open, cut and project your fingers long into the middle. Spiral your Tan Tien and the universe. Leave your fingers there. Concentrate on your Tan Tien spiraling your heart, crown, the universe above, below, in front, behind, left and right all spiraling. Your Tan Tien is a big empty space: primordial force, darkness. You can put so much Chi inside there! Chi penetrates into your brain.

Fig. 6.21 *Opening the Jade Pillow*

When you touch the back the energy flows through to the front.

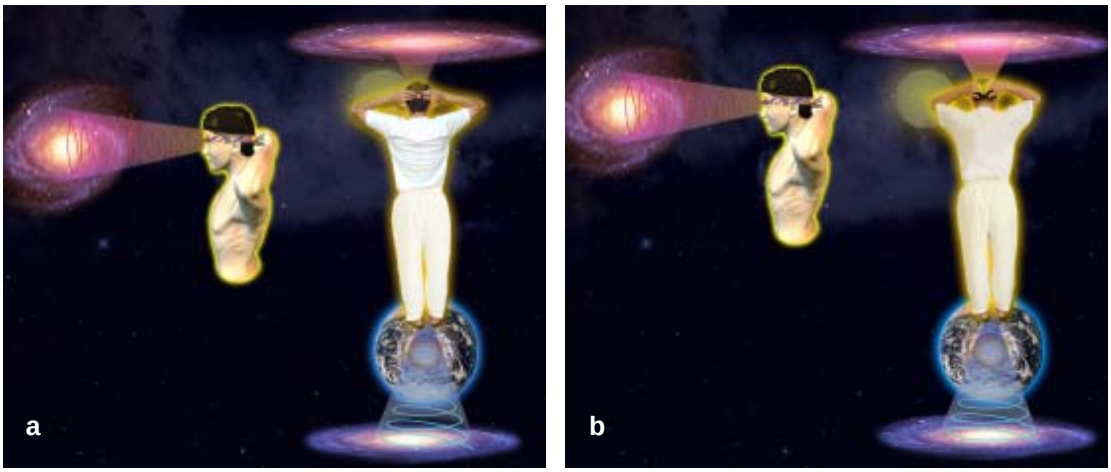

Fig. 6.22 *a. Move your hands all the way to the back, cutting to the back of the skull. Touch, and feel the upper Tan Tien open.*
b. Touch the base of your skull. Focus on the mideyebrow. Feel the Chi flow like a laser beam from back to front and out to the universe in front. Complete the opening process by moving the hands back around to the mideyebrow, cutting as you go.

Anytime you want to recharge the energy (when you feel the hands getting low in energy and to help you open the body), reach into the universe and bring down the energy.

Fig. 6.23 *Recharge from the universe. Feel that your bones and your arms and legs are hollow. Fill and compact them with Chi.*

Feel the constant love and orgasm energy all around us – the creative energy of the universe.

Fig. 6.24 *Scoop the universal Chi and pour it down over your crown and all the way down, down, down to the middle Tan Tien. Feel the Dragon and the Phoenix making love in the heart center. Feel the yin and yang, male or female, Dragon and Phoenix reunite, make love, spiral into one love and orgasm force in the heart center, Lower Tan Tien, the crown, and spread out to all the cells in the body.*

When you are aware of the universe spiraling, you are charging energy into yourself.

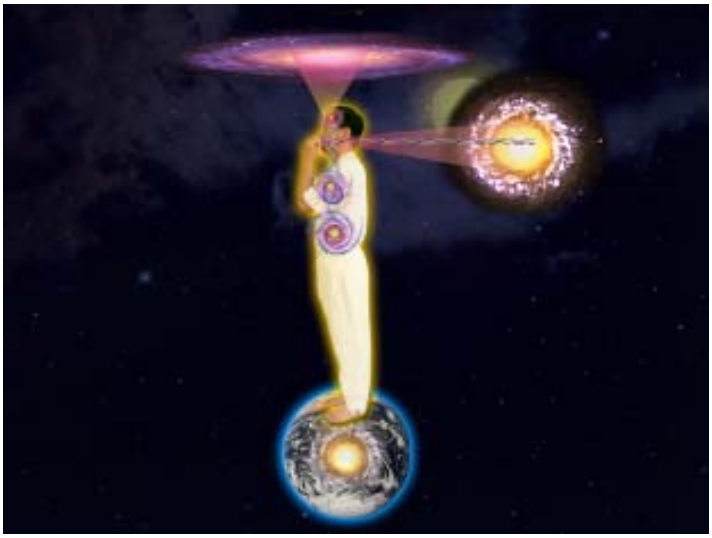

Fig. 6.25 *Touch the upper lips and feel the connection with the tongue and the front palate.*

Move down to the throat center and touch and focus on C-7, on the back of the neck. Focusing on the back of the neck and the throat center will activate the thyroid and parathyroid and thymus glands.

Fig. 6.26 *Move the fingers down to the throat center and feel them penetrate through the C-7 and to the universe behind.*

Every time you need more energy, recharge by reaching into the universe and bring the energy all the way down to the heart center.

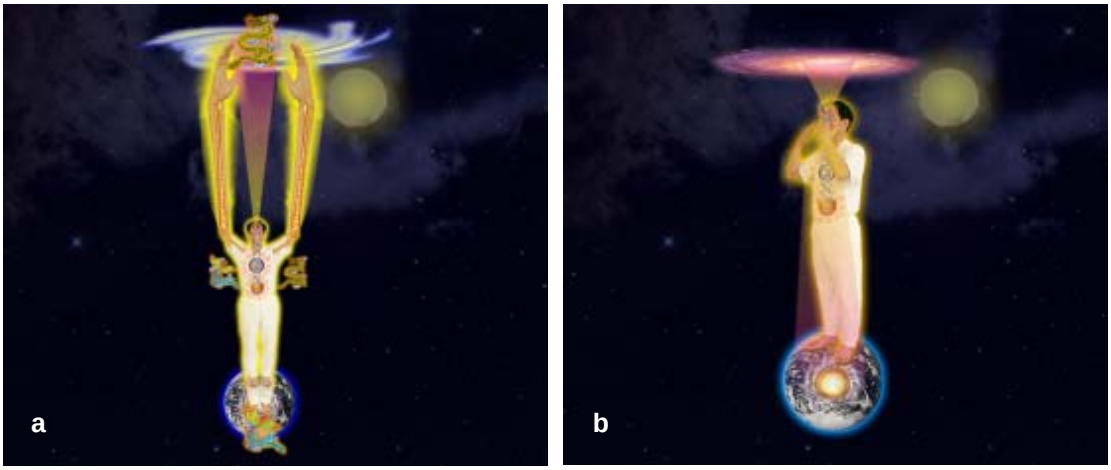

Fig. 6.27 *a. Recharge from the universe. Feel your bones and your arms and legs are hollow. Fill and compact them with Chi.*
b. Recharge and cut around to heart and to the armpits.
Recharge from the universe, pour Chi over the crown down through the body and lower your hands down to the heart center. Touch with the fingertips.

Middle Tan Tien and Heart Point

Touch the heart and focus on the back of the heart to T-5 and T-6. Feel the energy go all the way through to the universe and connect with the galaxy.

Move your hands all the way down to your heart center at the mid-sternum. Touch and focus on the point opposite the heart, T5/T6 on the spine. Imagine the fingers long; the Chi penetrates into your thymus gland. Light golden light penetrates into your thymus. Feel the Chi penetrate through your heart all the way through T5/T6 to the galaxy behind. In the Tan Tien and the universe also feel your fingers penetrate into the bones and bone marrow and spread out into your rib cage.

Fig. 6.28 *Opening Heart Point*

Move to the left and right, opening the heart center (like opening a book) which also activates the thymus gland and all of the lymphatic system, the immune system, the T-cells, B-cells, and the Killer cells. This will immensely help the immune system when you open the heart center.

Fig. 6.29 *The Heart Center is also connected to the thymus gland, which is the most important organ in immune system.*

We open the left and right sides of the heart.

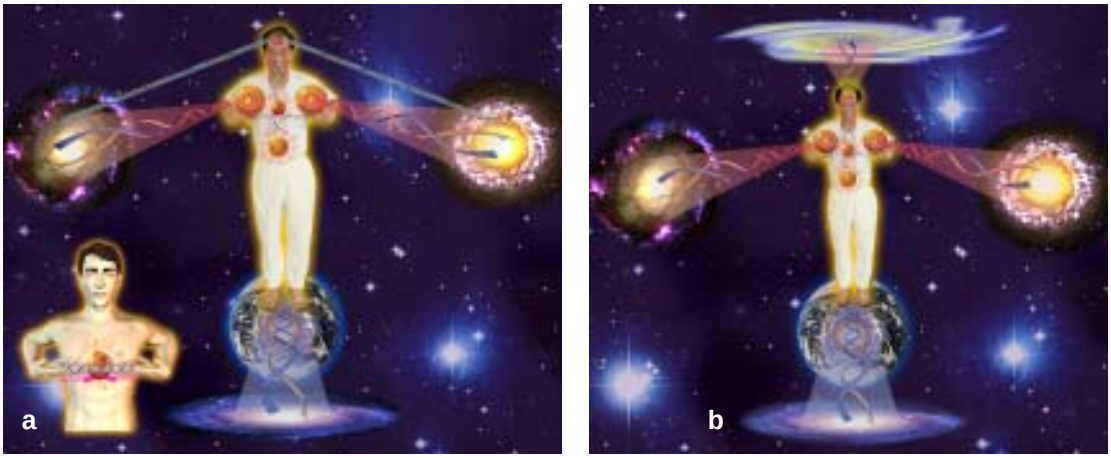

Fig. 6.30
a. Move your hands around under your armpits, extending the Chi like laser beams cutting open the middle Tan Tien. Pause under the armpits as you send the Chi into the center.
b. Be aware of the Tan Tien and the universe spiraling. With the spiraling, the Chi will become hot in the fingers. It will expand and penetrate out through the back of the head all the way to the universe behind.

Open the back, touch the back at T-5/T-6 and feel the energy come to the front.

Fig. 6.31
Continue to move your hands around to your back at T5/T6, touch, and send the Chi from back to front. Let the beam of Chi penetrate out through the heart center to the universe in front of you. Then move the hands back to the front, cutting as you go.

Open Solar Plexus Point

Move down now to the solar plexus, found between the sternum and navel. Touch the solar plexus and focus on the T-11 in the back. Feel your fingers penetrate all the way through. Just hold the Solar Sun here - think that a Sun is shining in your solar plexus and radiating all the light throughout the whole body. Just keep on holding and feel the Sun in the body. The more you can feel and see the Sun shining in the body, the more you can clear the sickness from the body. Sickness doesn't like light/sun energy, it likes darkness, wetness, and dampness.

Fig. 6.32 *a. Move your hands down to your solar plexus center between the sternum and the navel. Touch and focus on the point opposite T-11 on the spine. Make your fingers long; Chi penetrates into your solar plexus.*
b. Tan Tien and the universe: also feel your Chi fingers penetrate into the bone and bone marrow and spread out into your rib cage.

Open Navel Point

Come down now to the navel. Touch the navel and focus on the Door of Life (Ming Men) between L-3 and L-4.

Recharge with universal Chi, Tan Tien and universe. Again, raise your hands and charge with the Chi in the universe. Your hands are very big, very long. The bones are hollow and compacted with compressed universal Chi. Scoop the Chi from above and guide it down. Pour all the way down, down, down, down to the navel. Touch the navel, and focus on the Door of Life opposite, on the spine between L2/L3. Touch and feel the Chi penetrate to the Door of Life. Feel the Chi penetrate through to the back and out to the universe behind.

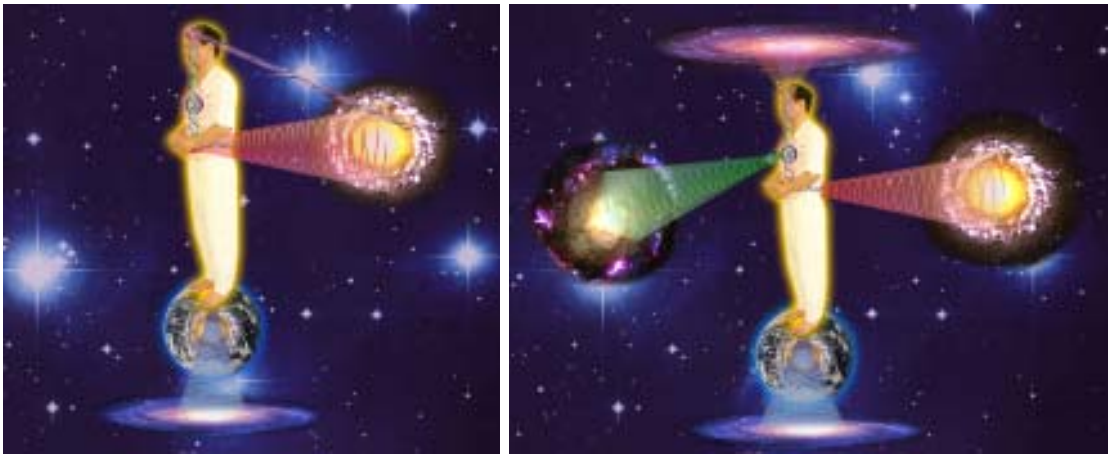

Fig. 6.33 *Tan Tien and Universe*

Feel like there is a laser beam cutting open the left and right sides. Begin at the navel and slowly circle all the way back to the Door of Life; all the while the energy is cutting like a laser and opening this area.

Open this Lower Tan Tien the same way as the Upper and Middle Tan Tiens. Tan Tien and universe - charge more Chi into your hands, and let them be like lasers cutting it open. Cut around to the sides, pause. The fingers of the left and right hand are very long, extended energetically inside. Cut and feel the energy penetrate into the center.

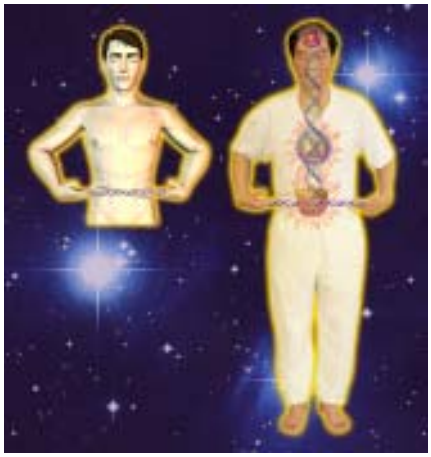

Fig. 6.34 *Open the Lower Tan Tien.*

Wherever you touch, focus on the opposite point and feel the energy flow. As you touch the Door of Life you will feel the energy go right through to the navel and into the universe.

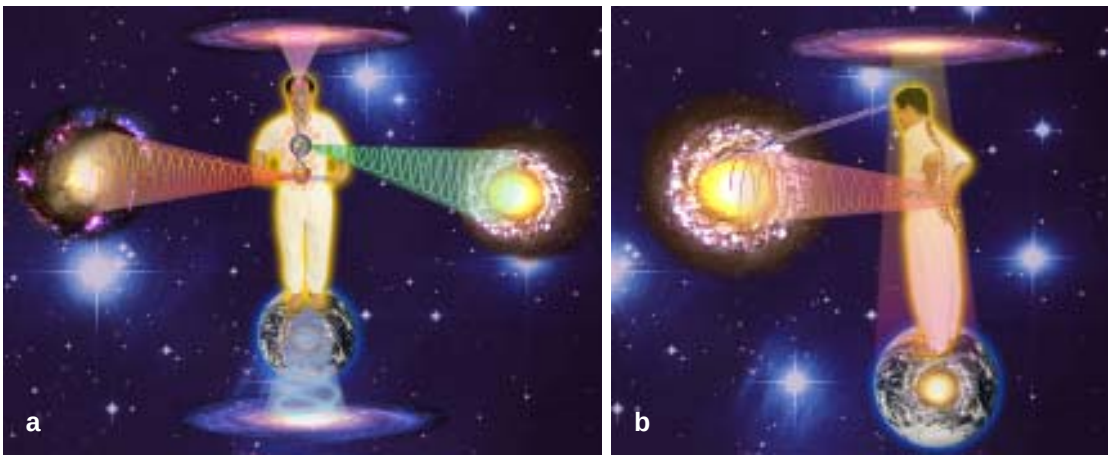

Fig. 6.35 *a.Tan Tien and Universe Feel more Chi.*
b. Continue cutting to the Door of Life. Touch and send the Chi from the Door of Life back to the navel and out to the universe in front.

When you open the orbit and the energy starts to move through it, the body gets penetrated with more and more energy. This process opens the body so that the energy can go through it. The body gets less dense.

When the body is too dense the Chi cannot go through it, light cannot go through it and that's when sickness can start to get into the body. Light and Chi must penetrate through our body. Doing this meditation you will get a lot of energy right through the body.

Fig. 6.36 *Open the Cosmic Orbit and your body gets less dense.*

Open Sexual Palace

Finally, come back down to the navel and go down to the pubic bone and focus on the back. Penetrate right through the sexual organs (ovaries/prostate and bladder area).

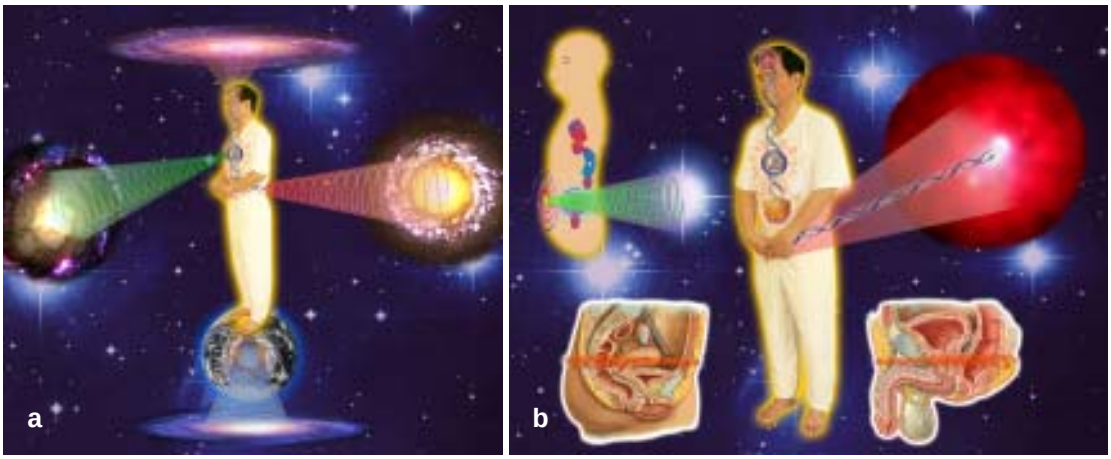

Fig. 6.37 *a. Move the hands back to the navel, extending the fingers and "cutting" the Tan Tien open as you go. Touch the navel, Tan Tien and the universe are spiraling. Feel more Chi, and feel the Tan Tien open.*
b. Touch the sexual center and let the Chi penetrate through to the sacrum. Touch the sacrum and let the Chi penetrate through to the sexual center.

Then we go into our bones. Begin by touching the hipbones and laugh inside the bones. Laugh inwardly and feel the laughing vibration in the bones. Feel your fingers are very long and penetrating right into your bones and bone marrow.

Fig. 6.38 *Receive Chi from the Tan Tien and the universe to the Sexual Center.*

Opening Sacrum

When we are young, this bone produces so many blood cells. The older we get, the more hollow the bones become and they slow diminish their production of blood cells. We lose a very big factory. In the Taoist practice we work to revive this factory. Funny, laughing, happy bones; smile to your bones, feel Chi going into the bones and activating the bone marrow.

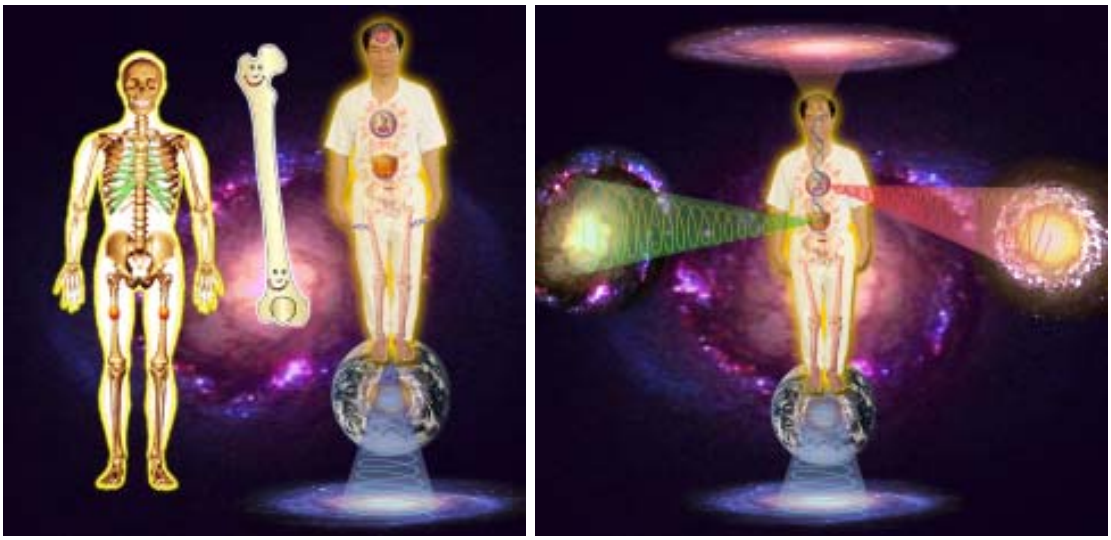

Fig. 6.39
Touch both side of the hipbones. Feel your fingers grow long.
Smile to the bones and feel funny and happy bones.
Touch the femur bones, Tan Tien and universe. Charge the fingers.
Feel the funny, happy, laughing vibration inside the bones and in the bone marrow.

When you have nothing to do, just touch your bones and smile and feel funny, happy, laughing bones.

Touch the sternum and laugh internally sending the vibration into the bones. Funny, happy, laughing bones. The marrow and thymus will activate - this is very important. In inner laughing the Taoists describe it as the sensation of hitting a drum and feeling the inner vibration- BOOMMMM! Inner vibration is the echo of the energy vibrating in the bones.

Squat down and feel the entire body sink down into the ground and gather the Earth energy. Touch your heels and feel the energy go up into the heel and raise your sacrum (straighten your legs). Feel this whole area open, smile to the Tan Tien and wiggle the tailbone side to side. This will open a lot of energy in this area.

Squat down again, collecting more earth Chi and pull it up into your bones, pulling it all the way up to your sacrum.

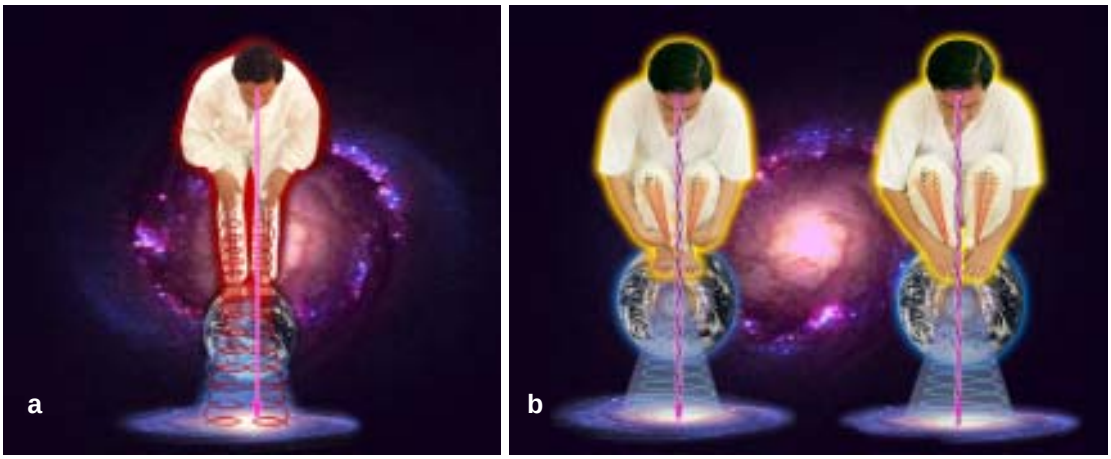

Fig. 6.40 *a. Now we are going to slowly lower the Chi down through the bones to the Earth. Move the hands down the legs as you bend down.*
b. Lower yourself all the way down to the ground and sit on your feet. Move the Chi with your hands down to your toes, down through the Earth and to the universe below.

Fig. 6.41 *Raise your sacrum up, keeping your hands at the toes. Smile to your Tan Tien.*

1. Lower down again. Lower the Chi down to the earth and the galaxy below.

2. Once more, raise your sacrum up, maintaining hand contact with your feet. Smile to your Tan Tien.

3. For the third time, lower down. Open your palms, gathering the Chi from the earth below. Gather and scoop up the Chi.

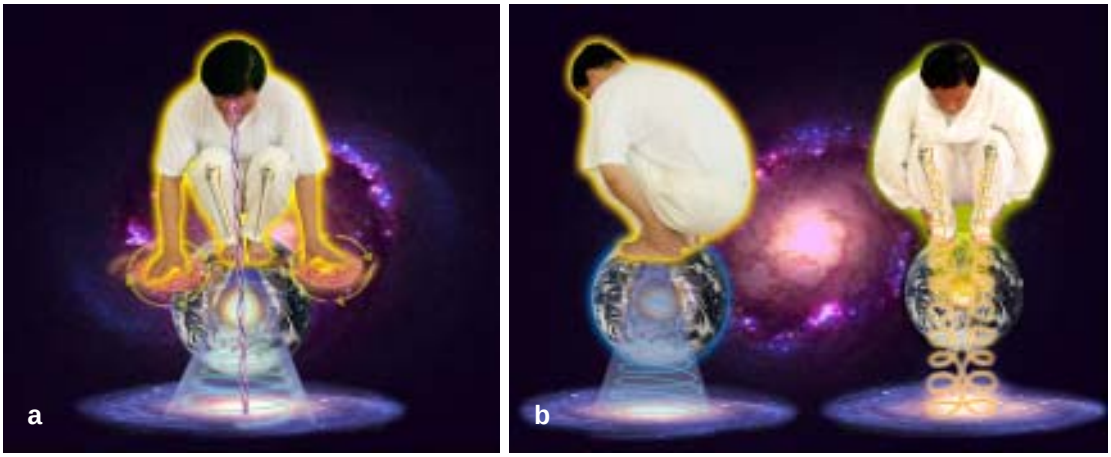

Fig. 6.42
a. Send Chi down to the earth and the galaxy below.
b. Touch your heels and feel your bones as you slowly rise up.
Fill your bones with Chi as you guide it up with your hands.

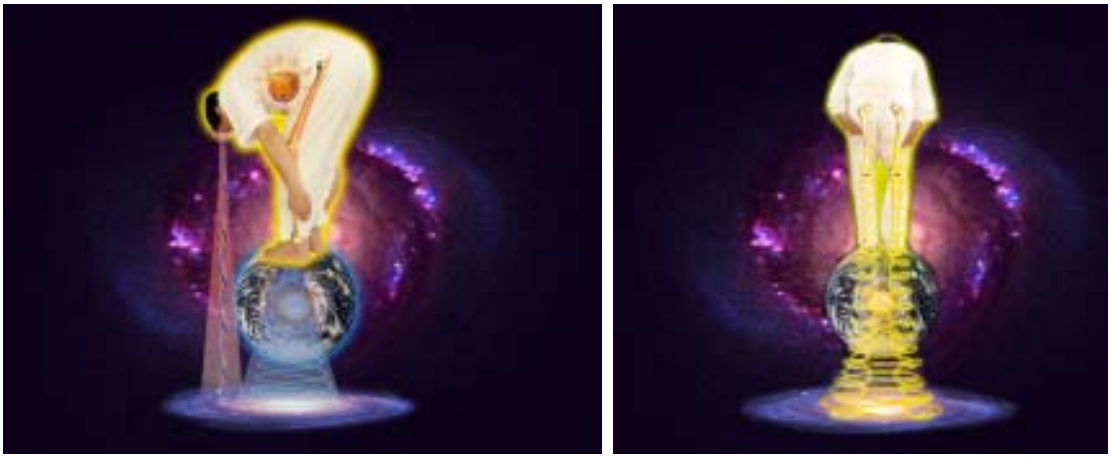

Fig. 6.43 *Fill the bones with Chi as you move your hands up.*

Now reverse. When you touch your coccyx, think about the ground. The energy will go into the bone and spinal cord and reach up to the crown.

Fig. 6.44 *Feel your bones, and fill them with Chi all the way up to your coccyx. Touch your coccyx, Tan Tien and the universe.*

Opening Governing Channel

Touch the sacrum and picture the sacrum grow. Make it bigger and bigger, extending it down to the universe.

Feel the eight holes breathing. The sacrum breathes the energy up into the spine.

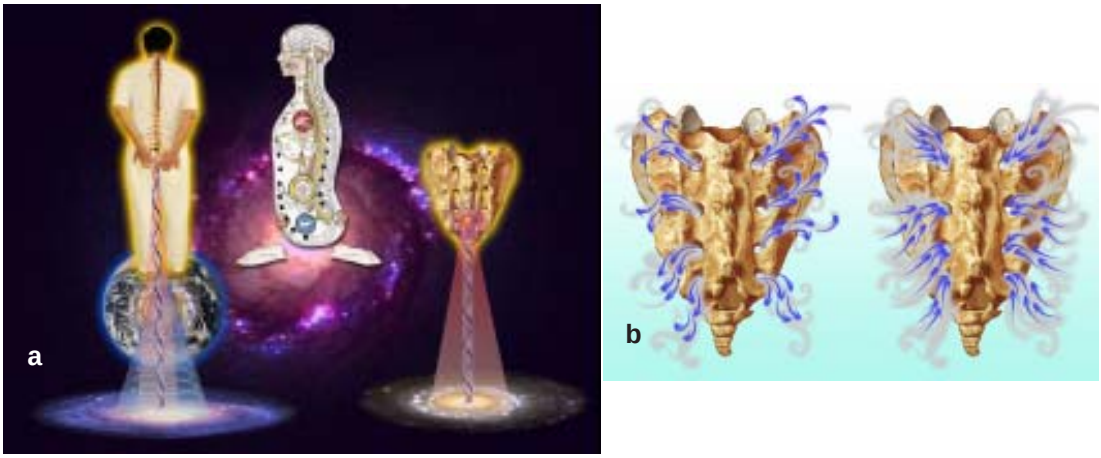

Fig. 6.45
a. Touch your Sacrum. *b. Eight Holes Breathing*

The sacrum bone controls all the bones and bone marrow production. Sometimes when I need to enhance my immune system I touch my sacrum and the sternum. Both of these bones are very important and help to activate the immune system and increase the white and red blood cells.

Feel the sacrum big and breathing. As always, when you need energy, become aware of the universe and Tan Tien.

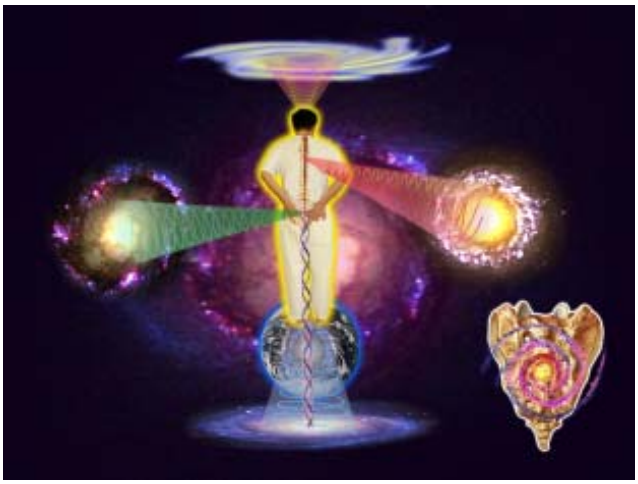

Sacrum Breathing

Fig. 6.46 *Come up to the sacrum, Tan Tien and the universe. Feel the Chi rise up through the spine and spread out to the glands and organs and fill them with Chi.*

Now bring your hands up to the Door of Life (Ming Men) which is opposite the navel.

Fig. 6.47 *a. Come up to the Door of Life and through to the navel. Now you may sit down. b. Connect to the Tan Tien and the universe.*

Move up to C-7, opposite the throat center. Up to the base of the skull (Jade Pillow) which is opposite the mideyebrow.

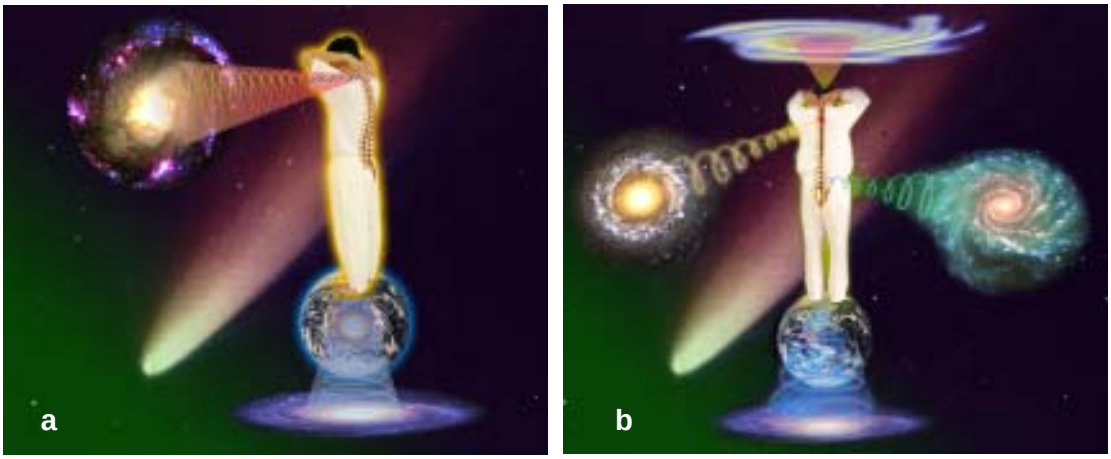

Fig. 6.48 *a. Touch the C-7 and feel the fingers penetrate through to the throat center.*
b. Fingers continue to touch the C-7 point, feel the three Tan Tiens and the universe spiraling.

Finally, go up to the crown. Feel the energy penetrate from the crown all the way down to the perineum. This can take a while.

All you have to do is think that your fingers are ***Long***. It's simple. You practice it, you have it! It's your aura that is extending and penetrating deep within your body all the way to the middle of the perineum.

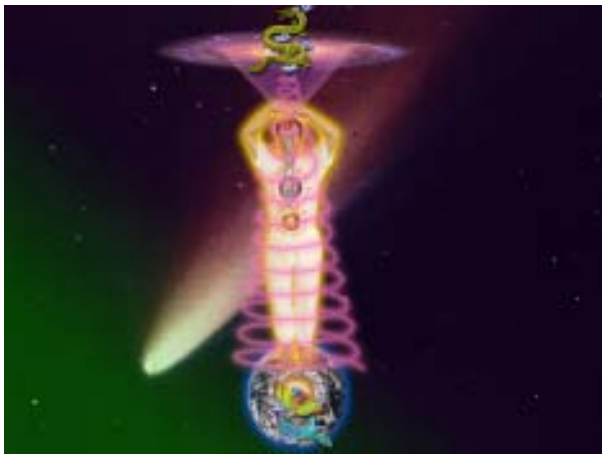

Fig. 6.49 *Move the fingers to touch the crown and feel them penetrate through the body down to the perineum.*

Gather the energy and bring it back down to the Tan Tien. Just use the mind. Extend it down to the Earth and gather the energy. Go back up and extend up to the universe and gather more energy from the universe. Come back down to the mideyebrow and bring more energy into the mideyebrow.

Fig. 6.50 *Gather the Energy.*

Keep on moving the energy. When we move it to a certain level, it gets faster and faster (spiral speed).

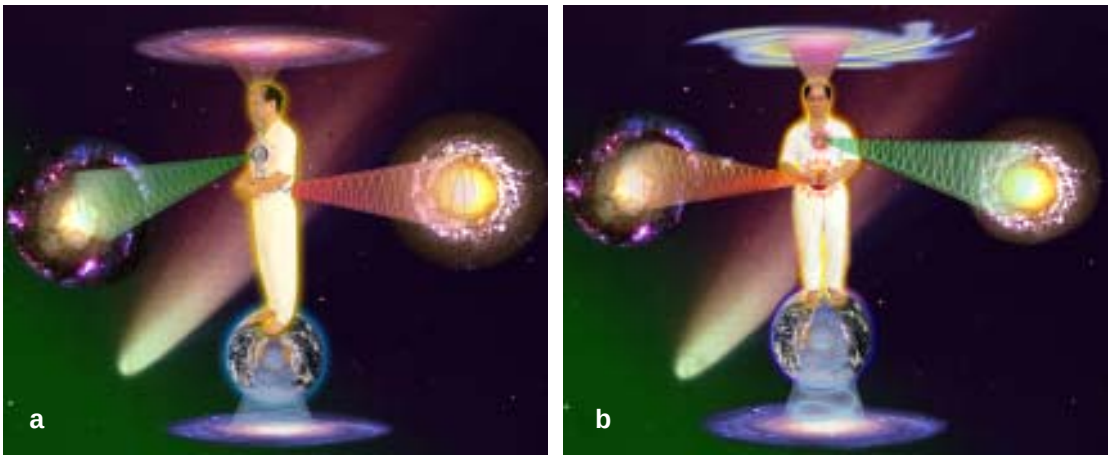

Fig. 6.51 *a. Touch the navel and feel the Chi all sink down to the Lower Tan Tien, start to spiral, faster and faster.*
b. Feel the Tan Tien and the universe all spiraling at a fast speed.

The spiraling is at a rate of 30,000 – 60,000 miles per hour. When you move so fast, you become very still. Just as the Earth is spiraling and spinning so fast, yet it feels still.

Fig. 6.52 *Sit down and start to move the orbit at fast speed, from 1,000 rotations per minute, to 10,000 per minute and up to 30,000 per minute.*

When you move the energy slowly, you will become aware of the spinal cord and all of the nervous system connected to the internal organs.

In the beginning, when we activate the energy, it will spin in this way.

Fig. 6.53 *Become aware of the spinal cord and all of the nervous system connected to the internal organs.*

Microcosmic Orbit

The Microcosmic Orbit Meditation awakens, circulates and directs Chi through the 'Governing Channel', which ascends from the base of the spine up to the head and the 'Functional' or 'Conception Channel', which runs from the tip of the tongue down the middle of the torso to the perineum. Dedicated practice of this ancient esoteric method eliminates stress and nervous tension, energizes the internal organs, restores health to damaged tissue and builds a strong sense of personal well being.

The Microcosmic Orbit is the foundation of Cosmic Healing Chi Kung practice. Each new practice is dependent upon the high quality of your meditations and your ability to perfect the Microcosmic Orbit. In order to master Cosmic Chi Kung, one must practice meditation daily. The meditations in the Microcosmic Orbit also strengthen the 'Original Chi' and teach you the basics of circulating Chi. They allow the palms, the soles of the feet, the mideyebrow point and the crown to open. These specific locations are the major points where energy can be absorbed, condensed and transformed into fresh new life force.

The following steps are a summary of the Basic Microcosmic Orbit Meditation to be utilized in conjunction while doing the Cosmic Orbit Meditation:

1. Be aware of the crown and the North Star; feel the crown and heart being pulled toward North Star.
2. Be aware the soles of the feet and the bones growing down into the ground; feel the soles of the feet breathing. The Chi from earth and galaxy below enter into the soles at the bubbling springs points and travel up into your bones.
3. Be aware the spin in the earth, which affects every cell in the body, spiraling at 1,000 mile rotations per hour and 37,000 mile rotations per hour around the sun, and feel this spiral inside you.
4. Focus on the Lower Tan Tien (the area where the Original Chi is stored, between the navel, kidneys and sexual organs). Feel the pulsing in this area, observe whether this area feels tense or relaxed, cool or warm, expansive or contracting. Notice any sensations of Chi: tingling, heat, expansiveness, pulsing, electric or magnetic sensations. Allow these to grow and expand. Then let this energy flow out to the Navel Center.
5. Use your intention (mind-eye-heart power) to spiral in the navel point, guiding and moving the Chi. Let the energy flow down to the sexual center (Ovarian or Sperm Palace).
6. Move the energy from the sexual center to the perineum and down to the soles of the feet.
7. Draw the energy up from the soles to the perineum and to the sacrum.
8. Draw the energy up from the sacrum to the Door of Life (the point in the spine opposite the navel).
9. Draw the energy up to the mid-spine point (the T-11 vertebrae).
10. Draw the energy up to the base of the skull (Jade Pillow).
11. Draw the energy up to the crown.
12. Move the energy down from the crown to the mideyebrow point.
13. Touch the tip of your tongue to your upper palate, press and release a few times; then lightly touch the palate, sensing the electric or tingling feeling in the tip of the tongue. Move the energy down from the mideyebrow to where the tip of your tongue and palate meet.
14. Move the energy down from the palate through your tongue to the throat center.
15. Move the energy down from the throat to the heart center.
16. Bring the energy down from the heart to the solar plexus and feel a small sun shining out.
17. Bring the energy back down to the navel.
18. Continue to circulate your energy through this entire sequence of points, at least nine times. Once the pathways are open, you can let your energy flow continuously like a river of energy without needing to stop at each point.
19. Conclude when you wish by collecting energy at the navel.

Men: Cover your navel with both palms, left hand over right. Collect and mentally spiral the energy outward from the navel 36 times clockwise, and then inward 24 times counterclockwise.

Women: Cover your navel with both palms, right hand over left. Collect and mentally spiral the energy outward from the navel 36 times counterclockwise, and then inward 24 times clockwise. *For details of this practice see the book, "Awaken Healing Light", by Mantak Chia.*

Heal by using Positive Images and Affirmations.
We can create Positive Images of Ourselves.

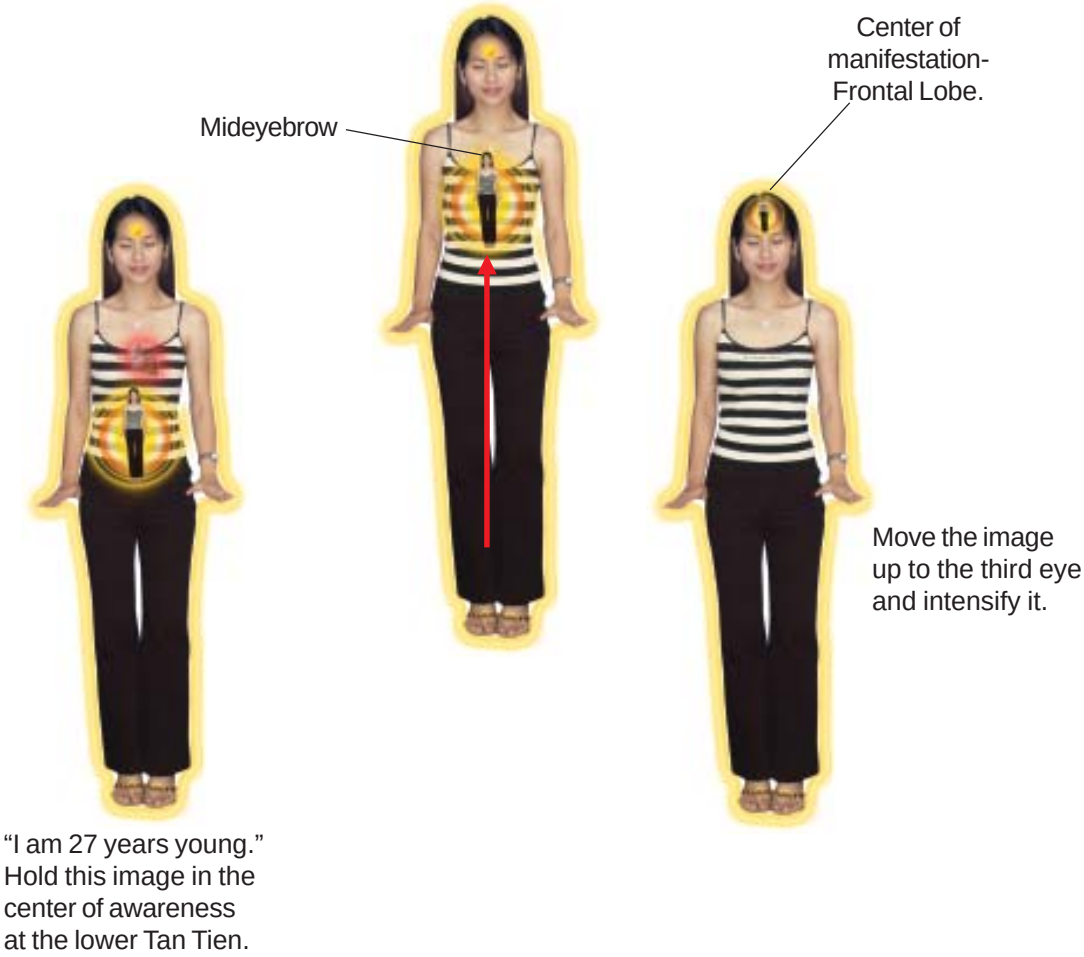

Fig. 6.54 *Positive Images*

Affirm Positive Emotions within us and make Positive Decisions about Ourselves.

Affirm: "I let go of old emotional experiences, seeing them for what they are, and fill myself with radiant joy, love, and compassion."
Affirm: " I make an agreement with myself to enjoy the best of life and to live to my fullest abundant potential."

Fig. 6.55 *Positive Emotions*

I send these Thoughts Out to the Universe to be manifested Here on Earth.

Send the image and question out into the universe and all six directions. The affirmation and answer will multiply and return to be manifested for you.

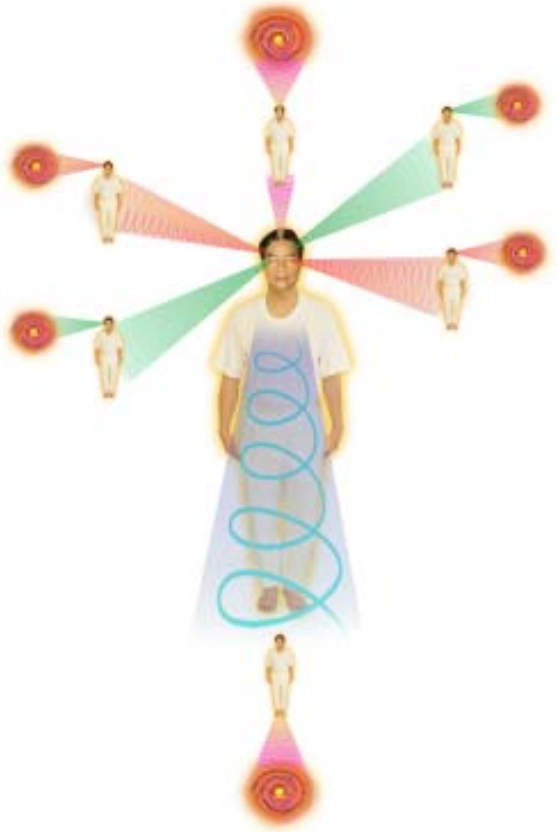

Fig. 6.56 *Sending out manifestations to the Universe.*

Meditation Preparation for Cosmic Inner Smile

Involves Emptying the Mind and Three Minds into One Mind

Cosmic Inner Smile
Heart • Spleen • Lungs • Kidneys • Sexual Organs • Liver • Heart Again

We first need to empty the mind to the Tan Tien, the Second Brain.

During any meditation, we keep emptying the mind down to the Tan Tien and the organs. By emptying the mind, we transfer energy from the mind to the organs.

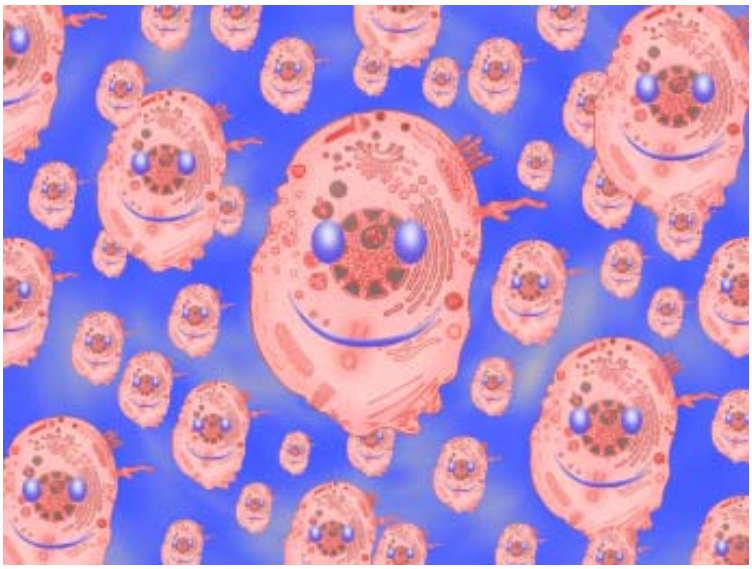

Fig. 6.57 *Charge the organs with Chi through smiling to the organs and the cells.*

Connect with the Heart and the Small Intestine

The heart refines the spirit. It is a natural governor and exerts authority on other organs.

1. Smile, relax, and empty the mind to the heart and the small intestine.
   Put the hands over the heart and smile. Feel the heart filled with love and joyous energy. Feel the radiant heart.

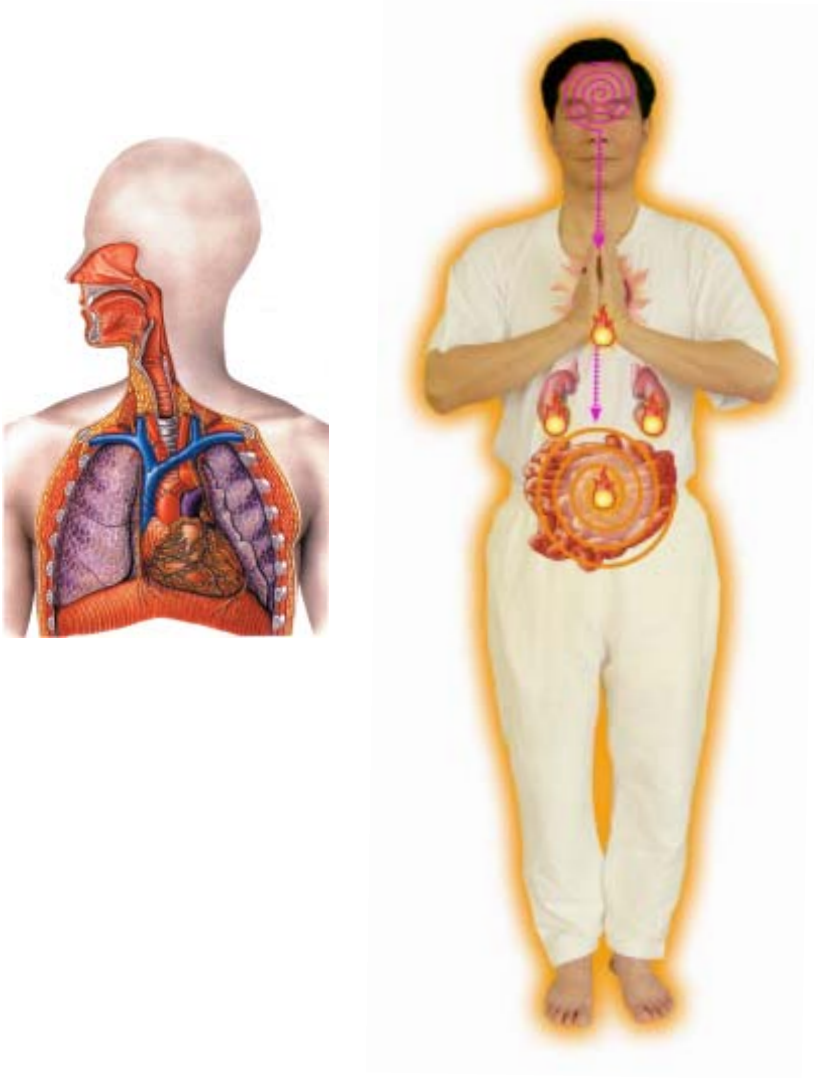

Fig. 6.58 *The heart and the small intestine can store and transform Chi. Keep the Tan Tien spiraling.*

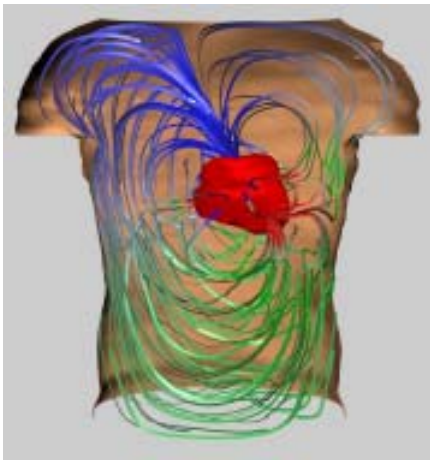

"These images show the use of ribbons to model the current paths inside the thorax. The colors along the ribbons indicate potential (red indicates positive, blue indicates negative)" and are from the web site www.sci.utah.edu/sci_images.

The electricity manifests as an electrical field within and around the body, subtle but detectable.

Electric Current near the Heart

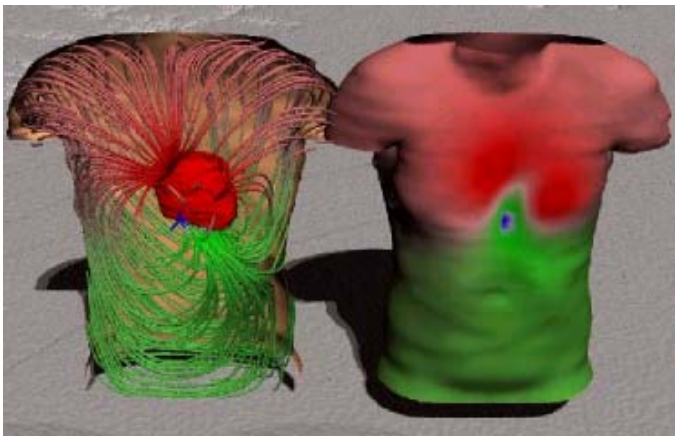

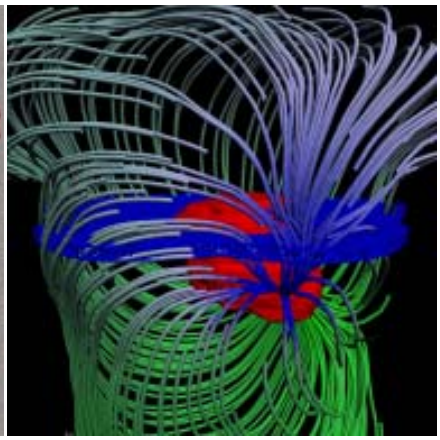

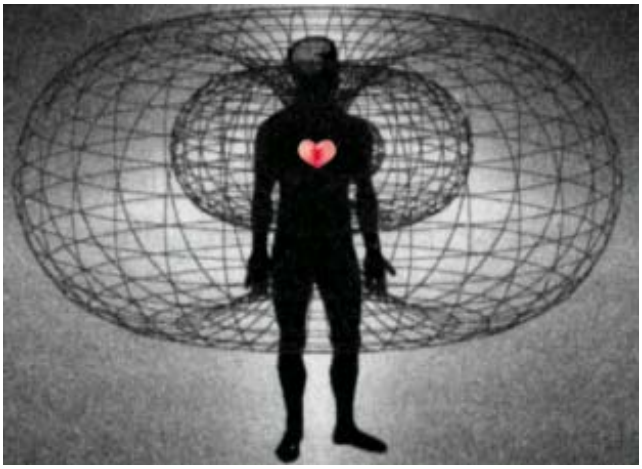

Recent research has revealed that the heart generates a strong electromagnetic field within and around the body. The electrical field is shaped like a donut, or torus, similar to the biomagnetic field of the human aura, and the geomagnetic field of the Earth.

Fig. 6.59 *Schematic of the Heart's Magnetic Field, the Radiant Heart*

2. Smile to the Red and White Blood Cells.

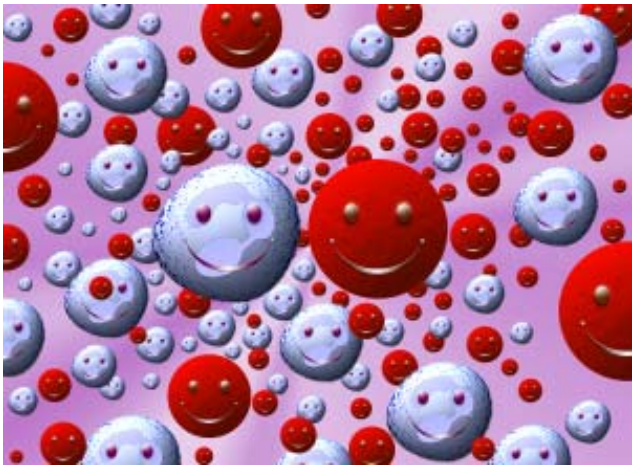

Fig. 6.60 *Red and White Cells*

3. Chi transformed in the heart and the small intestine. Let the Chi raises up to the universe and multiply.

Fig. 6.61 *Charge the Brain with Transformed Chi from the Heart.*

Cosmic Inner Smile Practice

Second Brain - Essence of the Inner Smile

1. Activate the Consciousness (Heart Mind)

Smile to the heart and make it feel soft.
Feel love, joy, happiness and compassion.
Feel the heart spiral and radiate.

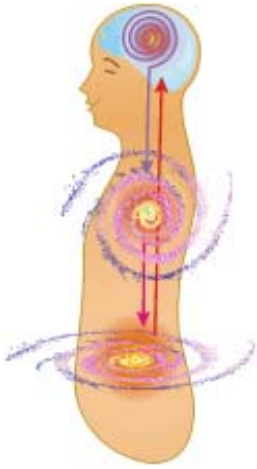

Fig. 6.62 *Feel the heart spiral.*

2. Primordial Force Lowers the Senses to the Tan Tien

Bring the senses down to the Tan Tien, sense the dark, deep and vast inner universe within us. Smile and drop down, let go and sense your inner universe as being vast, deep and dark. Feel the vastness of the outer universe and the primordial force all around us.

Fig. 6.63 *Be Immersed in Dark Empty Space of the Universe.*

3. Inner Smile Originates from Self-love Towards Our Own Body.

The secret of true love is to be lovable.

To be lovable is: To possess a smile that says “I love you with a heart filled with joy and gratitude”.

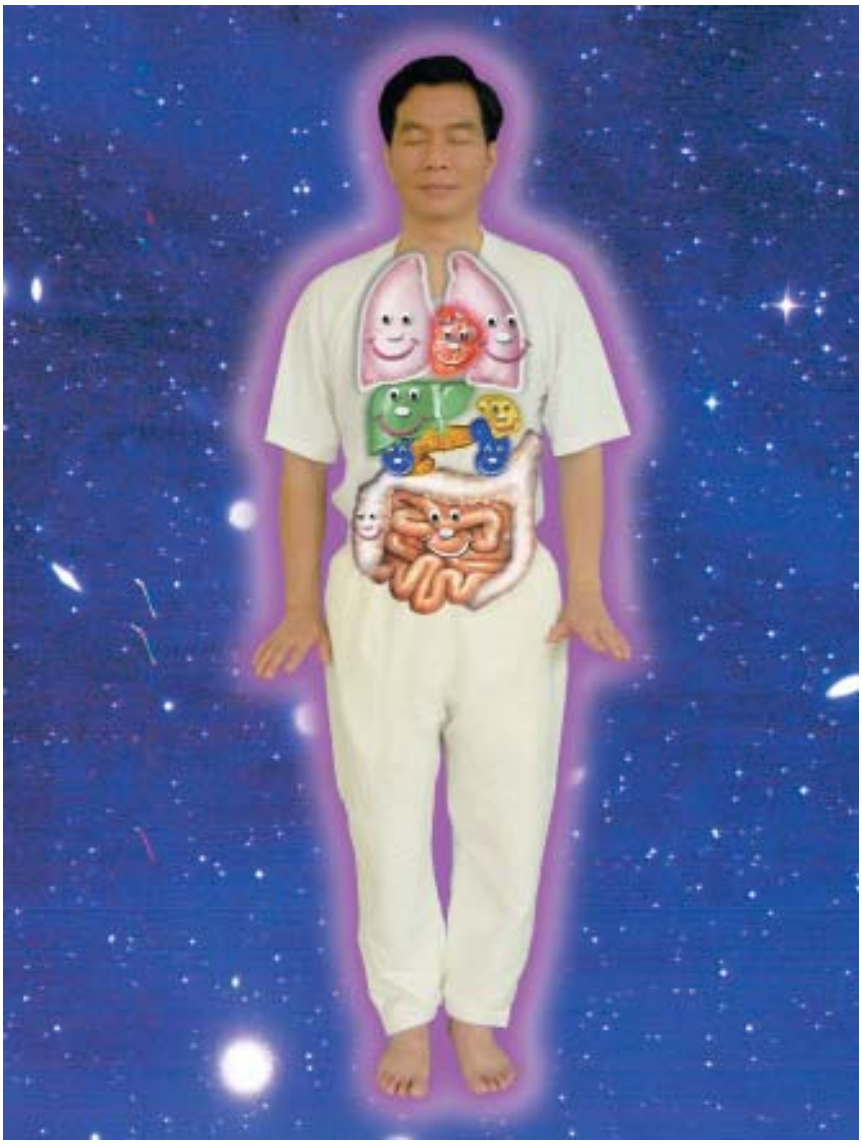

Fig. 6.64 *Self-Love towards our own Body*

Prepare to connect with the Universe

4. Leave the hands over the heart and start to spiral as before. Direct your mind to the Tan Tien and the universe. Start to spiral in the Tan Tien, the heart, the brain and the crown.

Fig. 6.65 *Heart can generate 37 layers of magnetic field.*

Connect with the Universe and charged with the Universal Energy

5. Be aware of the universe above you, below you, in front of and behind you, all of them spiraling. Feel the universe charge your Tan Tien, and the Tan Tien charges your heart and small intestine.

Fig. 6.66 *Connect with the Universe and Become Charged with the Universal Energy.*

Connect with the Spleen, the Stomach and the Pancreas

1. Smile, relax, empty the mind down to the stomach, the spleen and the pancreas. The spleen and stomach are responsible for the storehouses and granaries of the body. The five tastes stem from these organs.

Fig. 6.67 *Connect with the Spleen, the Stomach and the Pancreas.*

Smile Down and charge the Spleen with Loving Energy

2. Cover the spleen with your hands. Smile to the spleen, pancreas and stomach. Feel openness and fairness there, and breathe bright yellow openness and fairness energy into them.

Fig. 6.68 *Smile Down and Charge the Spleen with a Loving Energy.*

Spiraling at the Three Tan Tiens

3. Leave the hands over the spleen and start to spiral as before. Direct your mind to the Tan Tien and the universe. Start to spiral in the Tan Tien until the heart, the brain and the crown all start to spiral.

Fig. 6.69 *Spiraling at the Three Tan Tiens*

Charge with Universal Energy

4. Be aware of the universe above you, below you, in front of and behind you, all of them spiraling and blending with the chi that you sent up.
   Feel the universe charge your Tan Tien, and the Tan Tien charge your spleen, pancreas and stomach.

Fig. 6.70 *Charge with Universal Energy*

Connect with the Lungs and the Large Intestine

The lungs hold the office of minister and chancellor, the regulation of the life-extending network to other organs.

1. Relax, smile, empty the mind down to the lungs and the large intestine.

Fig. 6.71 *Connect with the Lungs and the Large Intestine.*

Transform the Chi in the Lungs with Smile. Let the Chi rise to charge the Brain.

2. With the Mind empty, smile to the lungs allowing the Chi to transform in the lungs and the large intestine transforming the Chi from the lungs and large intestine.

Fig. 6.72 *Transform the Chi in the Lungs with Smiling energy and let the Chi rise to charge the Brain.*

Prepare to connect with the Universe

3. Maintain the hands and lungs connection, and direct your mind to the Tan Tien and the Universe. Start to spiral in the Tan Tien until the heart, brain and the crown start to spiral.

Fig. 6.73 *Prepare to Connect with the Universe.*

Let the Universal Energy charge the Lungs and the Large Intestine

Be aware of the universes above you, below you, in front of and behind you; all of them are spiraling. Feel the universe charge your Tan Tien, and the Tan Tien charge your lungs and large intestine.

Fig. 6.74 *Let the Universal Energy charge the Lungs and the Large Intestine.*

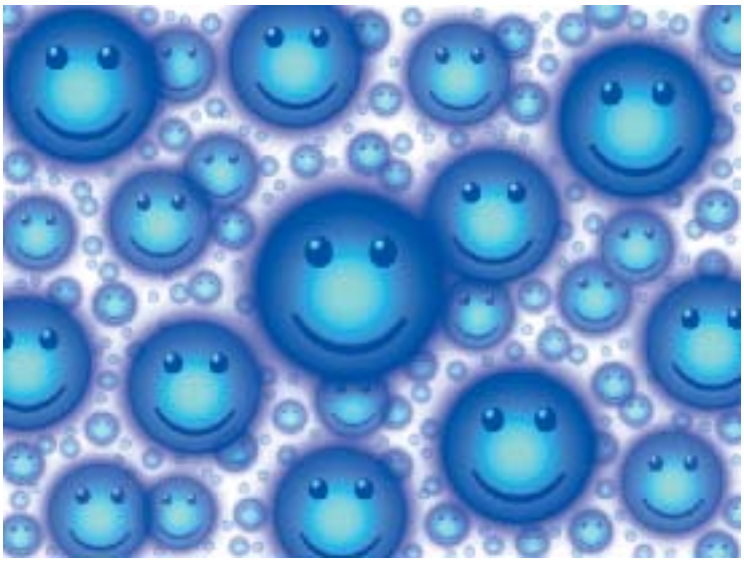

Fig. 6.75 *Let Kidney Cells feel the Loving Smile.*

Maintain Mind Connection with the Tan Tien

The Kidneys represent strong will, strong purpose, clear ideas and good feeling.

1. Smile, relax, and empty the mind down to the kidneys.
2. Put the hands over the kidneys. Fill the organs with love and compassion.
3. Maintain the connection between the hands and the kidneys, and direct your mind to the Tan Tien and the universe. Start to spiral in the Tan Tien until the heart, brain and the crown start to spiral.

Fig. 6.76 *Maintain Mind connection with the Tan Tien.*

Connect with Universal Energy to Charge the Kidneys

4. Be aware of the universe above you, below you, in front of and behind you, all of them are spiraling.
5. Feel the universe charge your Tan Tien, and the Tan Tien charges your kidneys and bladder.

Fig. 6.77 *Connect with Universal Energy to charge the Kidneys.*

Connect with your Sexual Organs

1. Smile, relax, and empty the mind down to the sexual organs.
2. Put hands over the sexual organs. Fill the organs with love and compassion.

Fig. 6.78 *Connect with your Sexual Organs.*

Smile to the Sexual Cells

Let the Sexual Organs be engulfed in the Light Pink. Let the Brain be charged with chi from the Sexual Organs.

Fig. 6.79 *Smile to the Sexual Cells.*

Breathe Gently to the Sexual Organs

3. Maintain the hands cover over the pelvic area the sexual center. Be aware of the Tan Tien. Start to spiral in the Tan Tien till the heart, the brain and the crown start to spiral together.

Fig. 6.80 *Breathe gently to the Sexual Organs.*

Charge the Sexual Organs with the Universal Energy

4. Be aware of the universe above you, below you, in front of and behind you; all of them are spiraling.
5. Feel the universe charging your Tan Tien, and the Tan Tien charging your sexual organs.

Fig. 6.81 *Charge the Sexual Organs with the Universal Energy.*

Connect with the Liver and the Gall Bladder

1. Empty the mind to the liver and the gall bladder.
2. Cover the liver with your hands. Smile to the liver. Feel kindness and generosity, and breathe bright green kindness and generosity energy into the liver and the gall bladder. Let the liver be filled with the green, warm energy of the forest.

Fig. 6.82 *Smile to the Liver Cells.*

Spiraling the Three Tan Tiens

3. Keep the hands over the liver. Be aware of the Tan Tien. Start to spiral in the Tan Tien until the heart, brain and the crown start to spiral together.
   The liver holds the office of general of the armed forces; the liver assess circumstances and draws conception of plans.

Fig. 6.83 *Spiraling the Three Tan Tiens*

Charge the Liver and the Brain with the Universal Energy

4. Send the Chi up to be multiplied. Be aware of the universe above you, below you, in front of and behind you; all of them are spiraling and multiplying with your Chi.
5. Start to feel the universe charge your Tan Tien, and the Tan Tien charging your liver and gall bladder.

Fig. 6.84 *Charge the Liver and the Brain with the Universal Energy.*

Chapter 7
Freedom, Harmony & Balance in the Tao

Goal of the Tao is to achieve Freedom.

Nobody can control our spirit and mind if we do not allow them to. The teachings of the Tao help us to attain inner freedom and mental resiliency.

No one outside ourselves can rule us inwardly and control our soul and spirit. When we know this, we become free.

Certain religious systems try to rule over us inwardly, attempting to control our soul and spirit. Understanding spiritual, emotional and physical independence gives inner freedom and the ability to choose how to direct our own energy.

Freedom is achieved through Internal Harmony.

Freedom is achieved through internal harmony or balance. When we have inner motivation, we have power. But upon losing the motivation, our power is gone as well. If we have internal harmony and balance we have internal power. People will want to listen to us just because they are drawn to us.

Balance is very important in the Tao. Virtue is power. If you are filled with love and kindness, people will respect you. Harmony and balance within will create durable virtuous energy.

Harmony is a power. Harmony is a force. The force is not directly produced by external competitions. Harmony comes from clarity and spiritual achievement. Harmony is generated from the spiritual growth that comes from understanding and balancing our own energy within.

Fig. 7.1 *Internal harmony comes from understanding and balancing our energy within.*

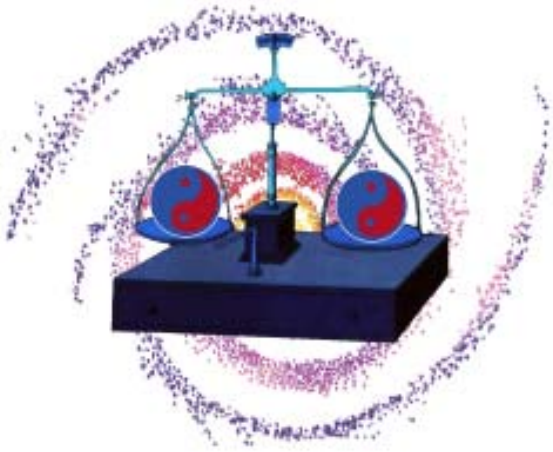

Fig. 7.2 *Harmony is at the core of the universe.*

Harmony is the key element of life for each individual, society and humankind. Harmony in nature is the most nutritious and supportive condition for human life.

Those who are in harmony with themselves will not disturb the harmony existing in nature.

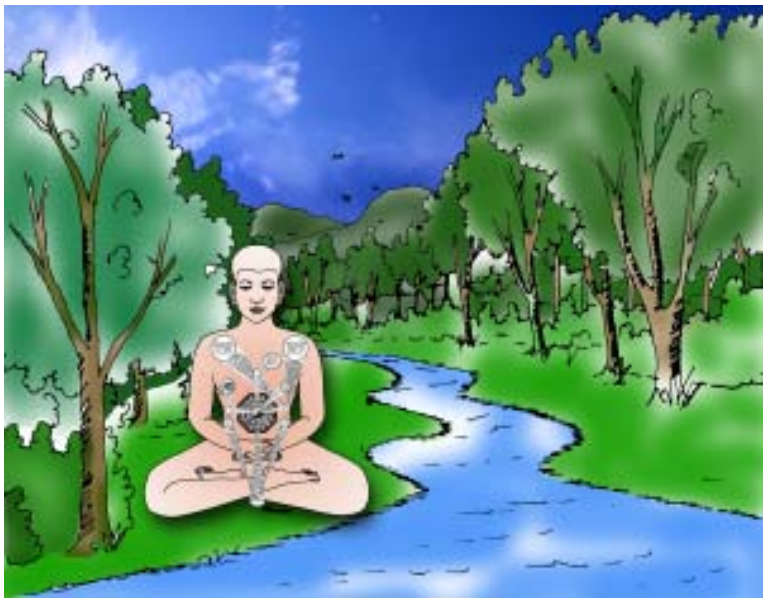

Fig. 7.3 *Harmony in nature nourishes our internal harmony.*

However, when people are not in harmony, they will destroy the harmony in nature as well. If you do not find internal harmony, you not only make trouble for yourself, but anything you create could harm other people.

Fig. 7.4 *Internal disharmony disrupts our environment.*

The people who seek power and build it for themselves take advantage of others by violence or force.

Life itself is a set of conflicts. To diminish conflicts, there is a middle point that can be acceptable to both sides. This is called harmony. Harmony is supportive and helpful.

A Win-Win Attitude

Another important practice to achieve freedom, harmony and balance is to work towards Win - Win situations. In that case there is a balance in yin and yang. Both parties gain (yang) and most likely both parties give in a little (yin). They balance each other. In win - win situations both parties are happy. If one is the winner and the other the loser, the winner is happy, the loser unhappy. That does not create freedom.

Yin pushes yang and yang pushes yin, no one loses and no one wins; this will continue for a billion years. We can practice the win-win attitude everyday of our lives; nobody wins and nobody loses.

Fig. 7.5 *Yin and Yang*

Internal harmony is also based on understanding one's own energy pattern and how to move it. Harmony is based on our understanding the nature of things as they are and not always as we would like them to be. If you want to know the truth, it is essential to forget about right and wrong. The conflict of right and wrong is the sickness of the human mind. Harmony comes from understanding oneself, one's own mind, body and energy within. Words from a Tao Master: "If you want to know the truth, forget about right and wrong. For the conflict between right and wrong is the sickness of the human mind." In other words, find your center in your Lower Tan Tien and the answer will come. Do not rely too heavily on the intellectual mind which always tries to see things as right and wrong.

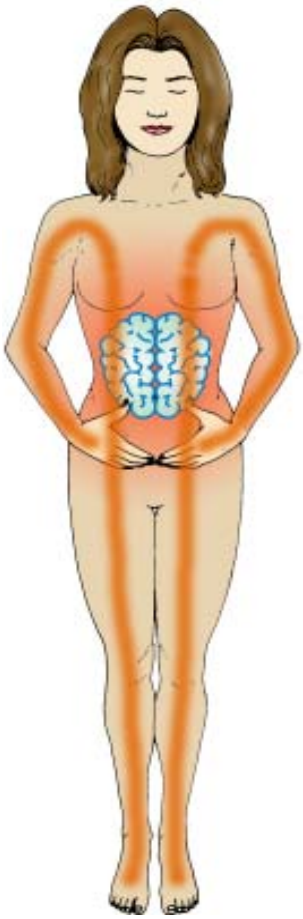

Fig. 7.6 *Harmony is based on our internal understanding.*

We can progress towards harmony within ourselves and in our surroundings through the cosmic inner smile, cosmic healing sounds and cosmic orbit practice.

Fig. 7.7 *Universal Tao practice helps us to achieve inner harmony.*

Tao Teachings

- He who practices the Tao does less and less everyday until the reaches the point where he does nothing. He does nothing, yet there is nothing that is not done!
  —Chuang Tzu

- One who knows when he has enough, is rich.
- Only one who empties himself finds fulfillment and completion.
- What you desire and what you fear are within yourself.

Relationship Is about achieving Harmony between Yin and Yang.

A relationship is just like the Tai Chi diagram, which has two equal sides. Each takes the specific expression of yin or yang according to its nature.

Fig. 7.8 *Yin within Yang and Yang within Yin*

When the energies are in balance with each other, a positive condition will result.

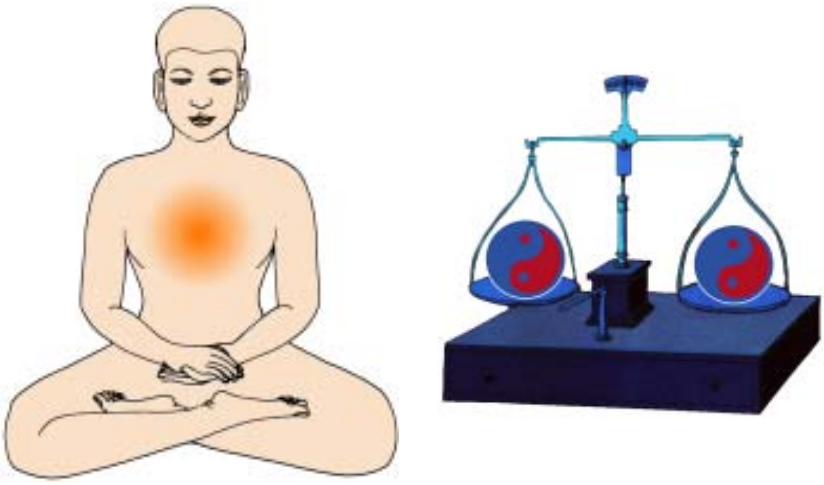

Fig. 7.9 *Balance is the way for a harmonious relationship.*

When there is imbalance in the amount of either yin or yang, usually a negative condition will result.

Fig. 7.10 *Imbalance creates disharmony and discomfort.*

Harmony in groups or in relationships involves creating a healthy point of energy linkage.

When the point of linkage is healthy and helpful, it brings balance and harmony.

The two different forces do not fight against each other. The two different forces, being interdependent, can work together for mutual help.

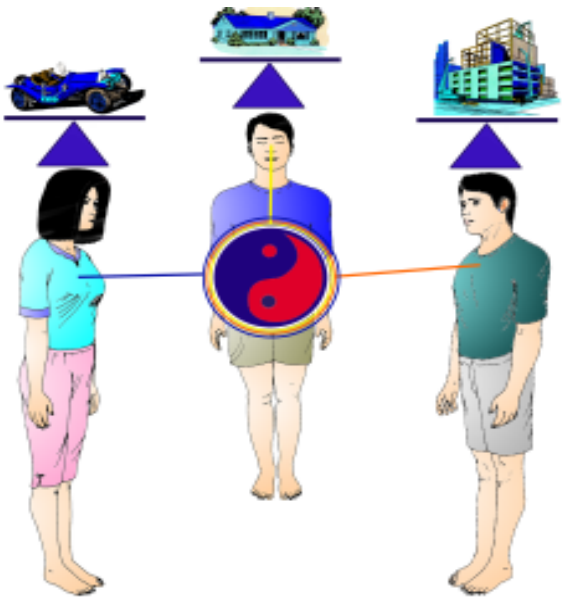

Fig. 7.11 *Balance of healthy energy creates a nurturing linkage in human relationships.*

Scientific Research on Universal Tao Practices

Dr.Jessum's Study focuses on how Universal Tao Practices impact the Brain's Abilities.

EEG, Meditation and Healing Tao by Rhonda Jessum, Ph.D.
Case Study of Master Mantak Chia May 1997

Fig. 7.12 *Dr. Rhonda Jessum presenting her findings.*

Study was done through Measuring the Brainwaves

Beta (15-18 Hertz)

Alpha (8-10 Hertz)

Theta (4-7 Hertz)

There are three levels of Brainwave Frequencies.

Beta (15-18 Hertz)

Beta is the highest activity level of frequency

Associated with external, narrow, focused attention, positive and uplifting emotions, increased physical arousal. When we sustain these too much and for too long, this state will increase stress and high blood pressure.

Fig. 7.13 *Beta (15-18 Hertz)*

Alpha (8-10 Hertz)

Alpha is present in the meditative higher consciousness state of mind. It is associated with meditative states in general and the experience of deep calmness and surrender. Also present when a person is absorbed in imagery, watching TV, a happy comedy, at home relaxing or drinking beer.

Fig. 7.14 *Alpha (8-10 Hertz)*

Theta State (4-7 Hertz)

Theta is a Trance-like State.

State just before falling asleep or waking up. Related to the state of shaman journeying and the trance-like state.

Fig. 7.15 *Theta State (4-7 Hertz)*

Study measures brainwave frequencies during four practices.

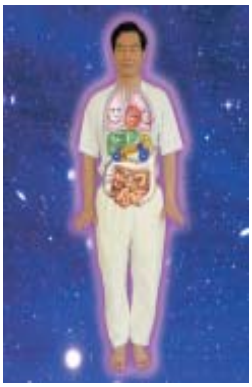

Fig. 7.16
Cosmic Inner Smile

Fig. 7.17
Six Healing Sounds

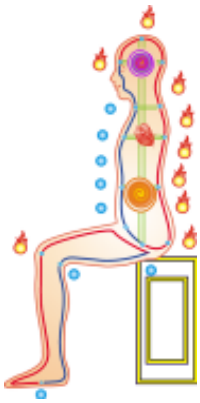

Fig. 7.18
Cosmic Orbit

Fig. 7.19
Orgasmic Upward Draw

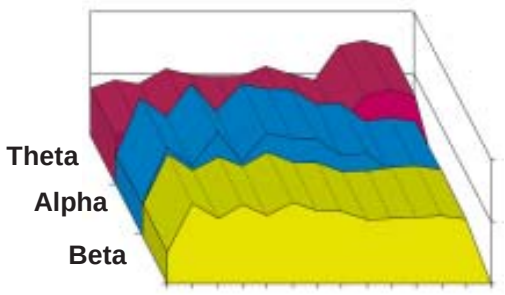

Fig. 7.20 *High Level of Alpha Waves Present during the Cosmic Inner Smile Meditation*

Fig. 7.21 *Ultraslow Brain potentials measurement while in Vienna.*

Master Chia smiles down to his abdomen and warms it up, smiles to his heart and feels love. Energy levels increase, the heartbeat remains calm, the body relaxes, energy charges up the brain.

Fig. 7.22 *First Test: Cosmic Inner Smile*

Through testing done in at the Institute for Applied Biocybernetics Feedback, Vienna, Austria, we found out that when we do the Microcosmic Orbit our body goes through many different kinds of brain waves. When I lower down my mind to the TanTien I get a lot of Theta waves. When I start to move the energy, I get Alpha and Beta waves.

Institute for Applied Biocybernetics Feedback Vienna, Austria October 25th 1996

Research: Measurement of the Ultraslow Brain Potentials

Fig. 7.23 *Mr. Gerhard Eggetsberger, Director of the Institute*

When I move the energy up I get a lot of Beta and Alpha again. Moving back down to the Tan Tien, I get a lot of Theta again. So the Alpha, Beta, and Theta waves are continuously cycling in this manner.

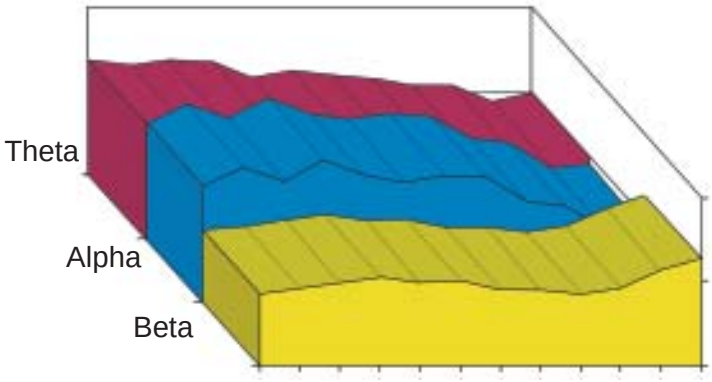

Fig. 7.24 *Altering Dominance of Alpha and Theta Wave during the Cosmic Orbit Meditation.*

This helps a person's body to be strong, healthy and live longer and be happier.

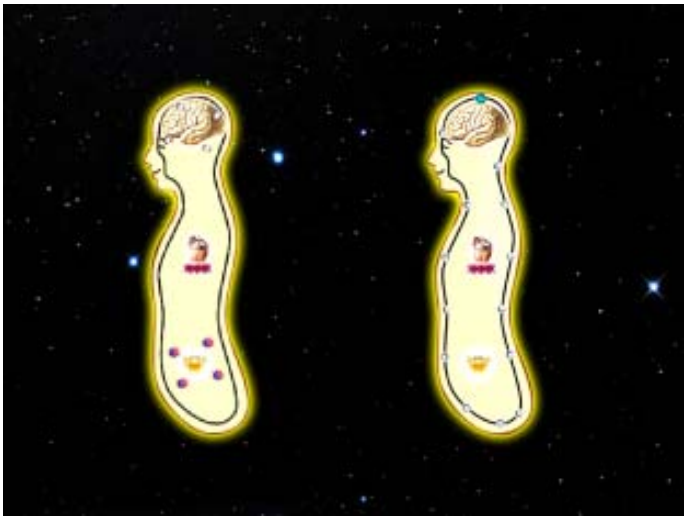

Fig. 7.25 *Movement of the Microcosmic Orbit*

Fig. 7.26 *Doing the Cosmic Orbit*

You will see that if you test the brain waves, it is very easy to get Theta waves when you lower down your mind and feel your navel warm. Your mind will very quickly calm down and there are a lot of Theta waves. When you circulate the energy, there are a lot of Alpha and Beta waves that happen and this is when healing takes place. As long as I keep on holding my attention on my Tan Tien a lot of Theta happens. The whole problem is that the machine only measures the waves of the brain, but it does not measure the Tan Tien waves.

The result of the testing showed that during the Cosmic Orbit Master Chia's brain did not only produce Beta waves, but also produced Alpha and Theta waves. This practice teaches us to use the Lower Brain and rest the Upper Brain. This helps conserve our energy and not drain it out with our emotions.

Fig. 7.27 *Test confirmed the reality of using the lower brain and resting the upper brain.*

I always keep awareness in my Tan Tien and spiral. In the graphs, a lot of Theta waves (on the top) are shown. The brain is not 'working'; it is resting while I use the lower brain (abdominal). So there is not much activity in the top, but there is activity inside. Understand that the upper brain consumes too much energy, the senses activate and this uses up too much energy. When we lower down the upper brain, it will help conserve our energy and not drain it out. Different brain waves are associated with different meditations. When you practice the Universal Tao meditations you see that the brain increases its ability to do many more functions and is flexible between the states of consciousness. When we are in high arousal while maintaining a deep state of consciousness, this also activates the brain. When you feel arousal inside and you move the orgasm into the body you feel a very high and deep state of consciousness.

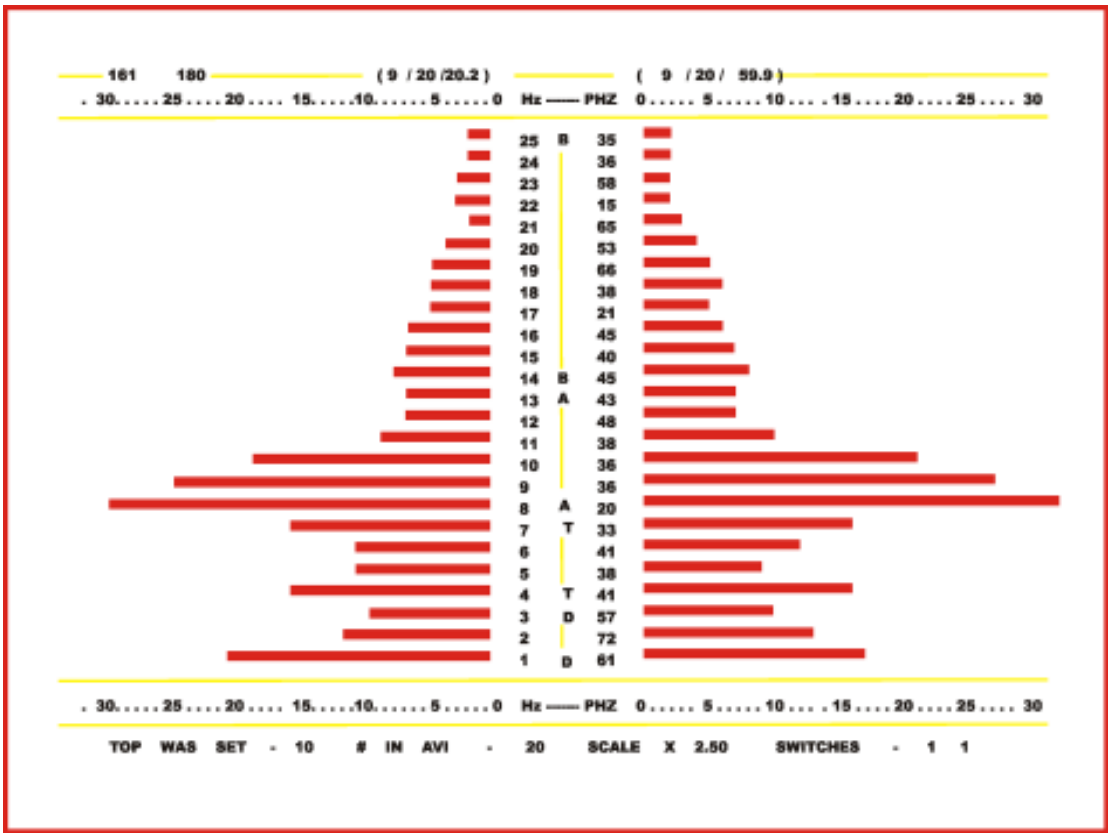

Fig. 7.28 *Summary of Research*

This is the testing done in Vienna. To see the summing up of all the practices, look at the graph starting from the Inner Smile. The left and right brain start to be synchronized from the Inner Smile to the Six Healing Sounds and up to the Microcosmic Orbit then finally to Orgasmic Upper Draw. The left and right brain start to synchronize on all levels and how it applies to the living light Kirlian Technology.

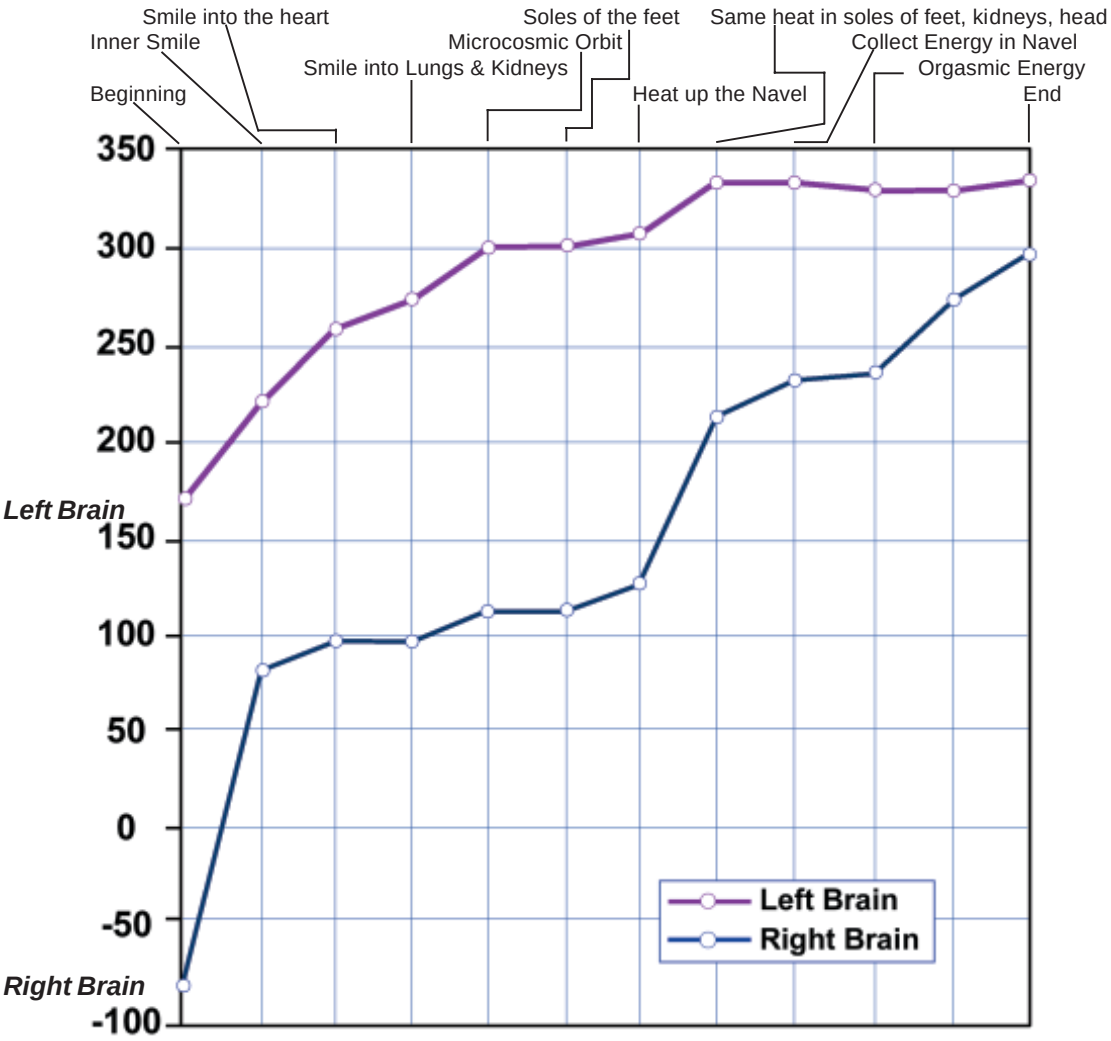

Fig. 7.29 *Left and Right Brain Charts*

Living Light Kirlian Technology

Students doing the Inner Smile practice using Kirlian technology.

Mr.Antonio's aura photographed the night before the practice from front, left and right.

Mr. Antonio's aura after practicing the Inner Smile Meditation.

Mr.Javier's aura the night before doing the practices from front, left and right.

Fig. 7.30 *Mr. Javier's aura after doing the Inner Smile practice from front, left and right.*

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Mantak Chia

Illustrations by Udon Jandee

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After forty-five years of practice and teaching Master Chia gives you here the essentials for running the Microcosmic Orbit. You will learn the preparations correctly: Chi Kung Warm-Ups; Sitting properly and keeping the spine supple and loose; Inner Smiling; Warming the Stove; Activating Sexual Energy; Gathering Tan Tien Chi; Connecting with the Cosmos and Drawing the Cosmic Energy into your Microcosmic Orbit creating the Cosmic Orbit with the Universe.

You will learn to use the recommended techniques for enhancing the sensation of Chi: Mind Eye Power; Hands-on touching of Vital Chi Centers; the Natural Breathing Method. Use them in combination to draw ever more Chi into the Microcosmic Orbit. Use mindeye power to spiral and condense the Chi into each center. Use the hands to focus your awareness and to move the Chi. Utilize slow, deep breath to expand and open the centers. These techniques will support the conscious opening of your Microcosmic Orbit.

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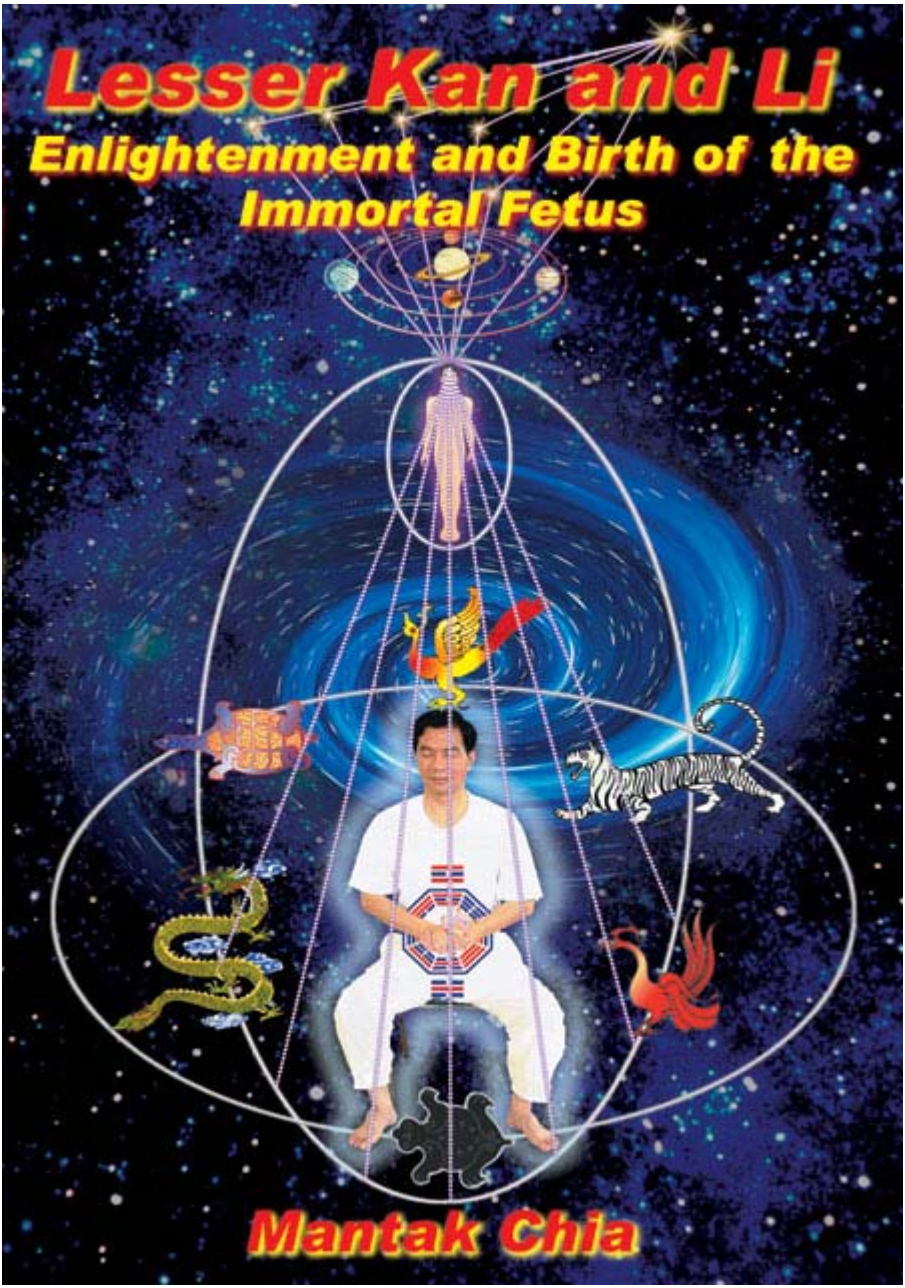
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The meditations, practices and techniques described herein are ***not*** intended to be used as an alternative or substitute for professional medical treatment and care. If any readers are suffering from illnesses based on mental or emotional disorders, an appropriate professional health care practitioner or therapist should be consulted. Such problems should be corrected before you start training. This booklet does not attempt to give any medical diagnosis, treatment, prescription, or remedial recommendation in relation to any human disease, ailment, suffering or physical condition whatsoever.

Taoist Cosmology

North Star and Big Dipper

Taoists regard the three largest known stars – Polaris (the North Star), Thuban, and Vega – as the collective center of our galaxy (Fig. 1). The earth's axis shifts toward a different one of these stars every 2,150 years as a result of the gravitational pull from the sun and moon. The axis currently tilts toward the North Star, which is therefore referred to as the Pole Star. In other words, if one were to observe the sky from the North Pole, the entire galaxy would appear to be moving around the North Star. As the earth's axis is influenced by its mass, the North Star controls the earth's energy fields, thereby affecting our health and emotional states.

The three stars are known as the Violet Stars because they emanate violet rays throughout the galaxy, which affect every living cell of nature on our planet. Taoists believe that a human's heart tilts 45 degrees toward the North Star, just as the earth tilts 23.5 degrees toward it to receive its energy. They also believe that every planet in the galaxy tilts toward these Violet Stars in the same way, and that the North Star is presently controlling them as well (Fig. 2).

Fig. 1. *Violet Stars*

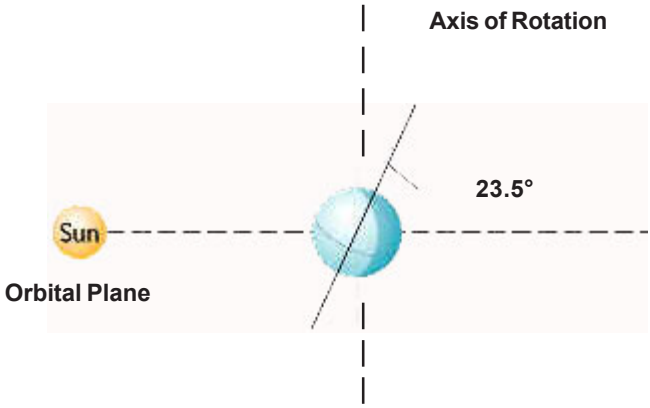

Fig. 2. *Earth tilts 23.5 degrees towards the North Star.*

Fig. 3. *Infra-red emanations of the Big Dipper*

The Big Dipper revolves around the North Star, as do other constellations, reflecting the earth's seasonal changes. The Big Dipper is a major source of red and infra-red light, or radiant energy (Fig. 3). Taoists believe that the cup of the Big Dipper gathers all the violet light from the universe. The emanation of infra-red light of the Big Dipper, combined with the violet rays of the Violet Stars (especially Polaris), has a positive, nurturing effect upon the bodies and minds of those who know how to access it. Taoists believe that the Violet Stars, the Southern Cross constellation, and other constellations form the "Gates of Heaven." All living things must pass through these gates to return to their source of origin, the Wu Chi, which is the state of oneness with the Tao.

Taoists believe that the soul and spirit come from the stars and ultimately must return to them to find their origins. To do this, one must first gather and refine the energies of soul and spirit until they are as pure as the stars, and eventually as pure as the Original Force. This is the way to achieve oneness with the Tao. The first step is to refine the force internally while practicing detachment from worldly things. This helps to break the bonds that hold us to this world. The second step is to draw in the forces of the planets to enhance our own internal force. This gives us spiritual power in the form of energy to use as fuel for travel to the planets, the constellations (especially the Big Dipper), and finally to the North Star, which points to Heaven. Taoists refer to this process of absorbing, transforming, and combining our soul and spiritual energies as "marrying the force," which means that we purify our energies to merge with the stellar forces.

Nine Sacred Mountains

In the Taoist tradition, the human body is a microcosm of the natural world. Our physical anatomy is an inner landscape with its own rivers, forests, mountains, and lakes that reflect their harmony with the outer landscape of the planet Earth. Fig. 4 is an ancient render-

ing of the inner alchemy practice of the Tao, probably originally drawn by a highly achieved Taoist from China's Tang Dynasty period (7th century C.E.). These mountain peaks function as funnels guiding Universal Energy downward. This energy is then concentrated in the mountain caves. Taoist adepts go to these caves for initiation. In the human head there are nine different energy centers (peaks or points), which are able to extend to Heaven to connect to the Cosmos. The brain marrow cavities, as well as the various energy centers of the body, are like caves in a mountain in which you can concentrate, store, and transform energy.

(16) Top of the Great Peak is located at the back of the head. When we tilt our head and push our chin back, our head reaches its highest point. This peak connects the North Star to the Pineal Gland; it is where we receive the descending Universal Energy.

(17) High Place of Many Veils lies between the Muddy Pool and the Great Peak. It is where the spirit and soul bodies can leave and enter in horizontal flight.

(18) Muddy Pool is located in the center of the crown (Bai Hui or the hundredth meeting point). When it is open it feels like soft mud. This crown point connects the Big Dipper to the Hypothalamus Gland. It is through this center, which functions as a two-way street, that you can project your energy (soul or spirit) upward or receive the energy flowing downward.

(19) House of Rising Yang is the third eye. Located slightly above the middle of the forehead, this center is able to receive the energies of the sun and moon, which it uses to project the soul and spirit bodies into space.

(20) Nine Sacred Realms are directly connected to the mid-eyebrow and have a close connection to the Pituitary Gland. This center is used to receive the Cosmic Force and to launch the soul and spirit bodies into the earthly or human plane for traveling.

(21) Immortal Realm is located in the center just in front of the crown point. It is here that our energy is able to make a connection with the heavens to draw down even more powerful Universal Energies.

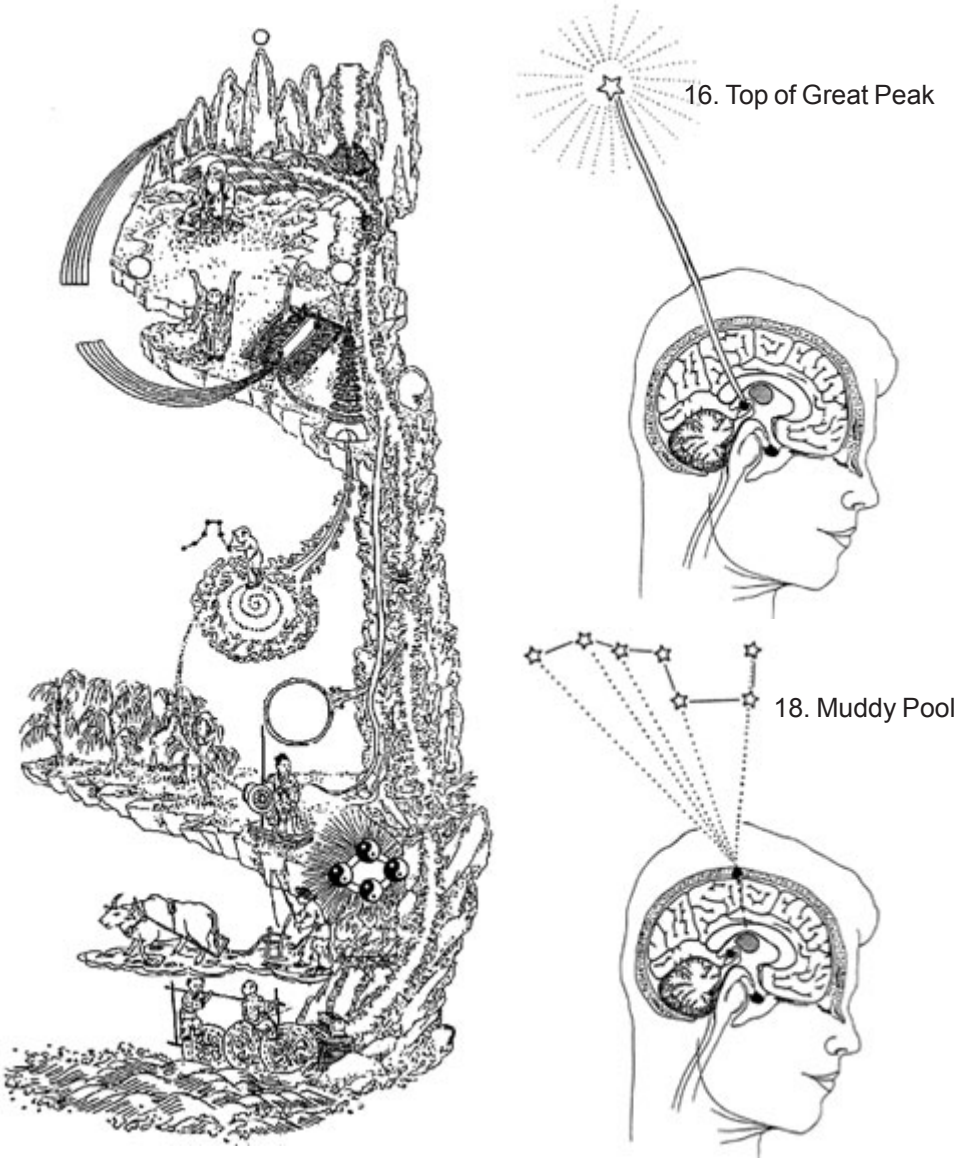

Fig. 4. *On the left, an ancient rendering of the inner alchemy practice of the Tao. On the right, two of the nine mountains (16 and 18) correspond to Nine Palace points in the brain.*

Nine Palaces

Nine is one of the most commonly used numbers in Taoism being the highest cardinal order in numerical calculation. Lao Tzu once referred to a nine-story-building rising from a clod of earth. A nine-story-building has both architectural significance and spiritual implication. The architectural significance is based upon the order of nine, which implies the highest structure of mental calculation and manipulation. In Chinese architecture, the steps and stories of a building are designed within the function of nine. The nine-story-building refers spiritually to the nine mountain-like palaces crowning the brain (Fig. 5). The cortex will gather all the elixir-making fluid needed for crystallizing into mystic elixir. Lao Tzu's statement also refers to the nine-story tower of vocal cords.

In Chinese, nine means literally the change of yang, which depicts the crawling position and extreme end. This nine-yang is the highest order in heaven and on earth, and it is the power representation of all. Beginning from nothing (zero), at nine we reach the peak stage of performance and begin to return to the original state of inactivity, for either a new beginning or a complete change. As life evolves and changes, there will be nine significant crises to be conquered. These can be referred to as the crises of merging within the structural and dynamic trinity. The nine crises determine nine deaths of old conditioning and established habits that one must walk through. Nine deaths bring about the final new birth, or the returning of pure spirit. When a person consciously dies nine times, the last death must be the spiritual birth of self into cosmic void.

In the beginning of life, we have nine holes that open and close to life in the body: the life of breath, love, and harmony. Seven of these are charged by seven powers of light. The eighth and ninth discharge the water and concrete wastes externally, or internalize the thrusting power of spirit and its mating partner, the sexual fluid, or the holy water in its earthly matured form. Among these nine holes, two form visual receptors and process the maximum on the information highway. As the receptors collaborate with the visual center in the rear of the brain, the neutralized energy activates the single most powerful interior organ: the pineal gland (Fig. 6).

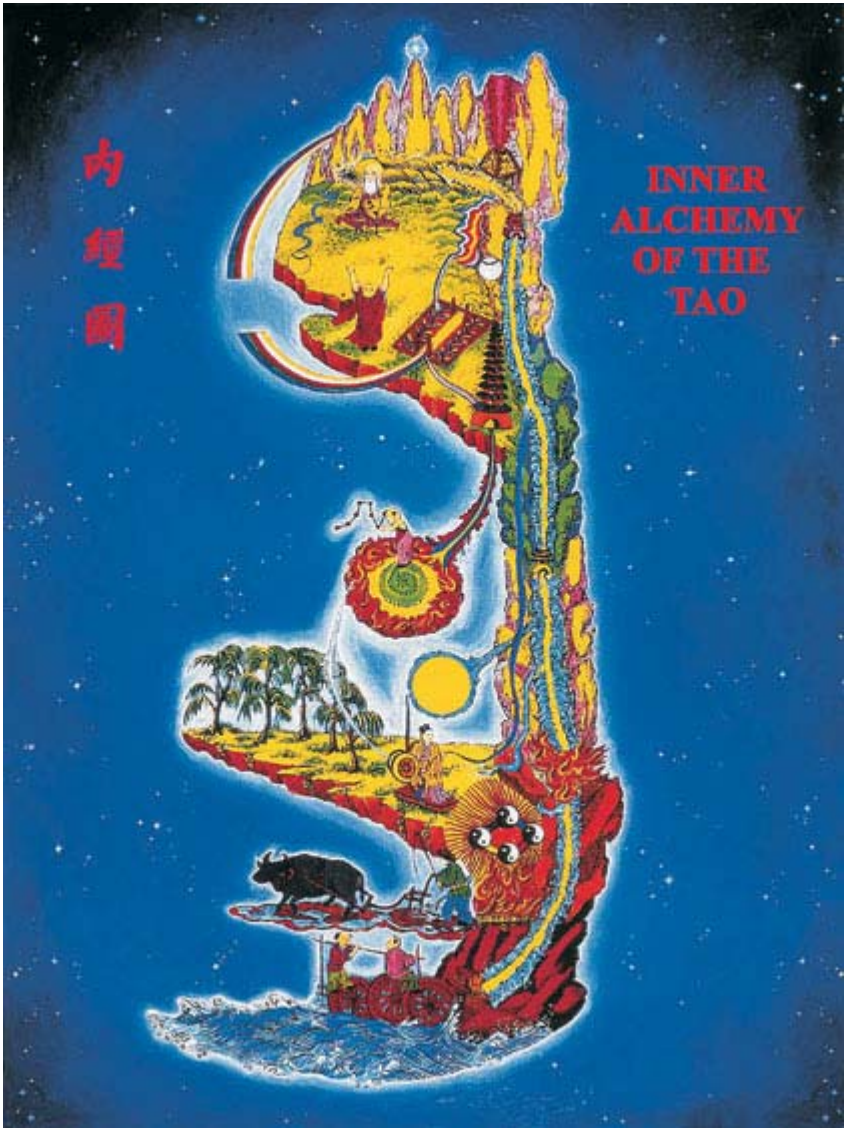

Fig. 5. *In Taoist Inner Alchemy, nine mountain-like palaces crown the brain.*

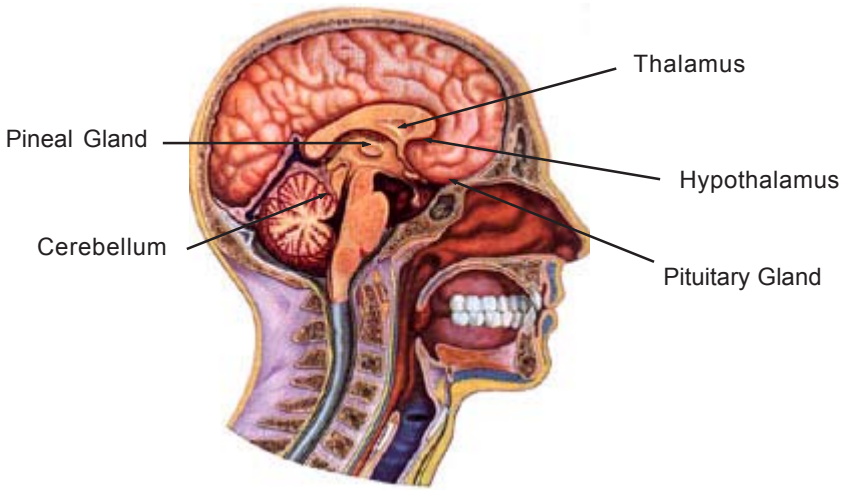

Fig. 6 *Brain includes the organs: cerebellum, thalamus, hypothalamus, pineal gland, pituitary gland.*

The pineal gland stands side by side with the limbic system and helps the cerebral-spinal-abdominal fluid to form the whitish matter by releasing melatonin and other chemicals. Melatonin is the essential substance required to maintain the hibernation state where spiritual consciousness sustains a peaceful, healthy, loving, and long life. The spiritual vitality producing the biological Jing will be preserved. The person then retains a child-like biological condition where no matured melatonin is wasted in biological continuation. When this substance works together with the yellow marrow in the bone, the reddish firing reaction of the biological process will be converted into a gentle cooking interaction between the holy water and light.

The sacred water refers to the inner fluid that is responsible for producing bone marrow and other bodily fluids. When the light activates this sacred water, one experiences a born-again mentality. When sacred water and light merge, the faithful mustard seed is planted, and the true teaching and living begin.

The sacred water runs not only in the center of the bones, but also in the midst of the body connecting the Crown and Perineum Points (Fig. 7). The Crown Point emits the fire as the Perineum Point secretes the glacial water. The glacial water is the primordial yang Chi that carries the gender-producing substances. The conscious fire in the brain utilizes the unconscious water in the abdomen as elixir or white horse: a completed product.

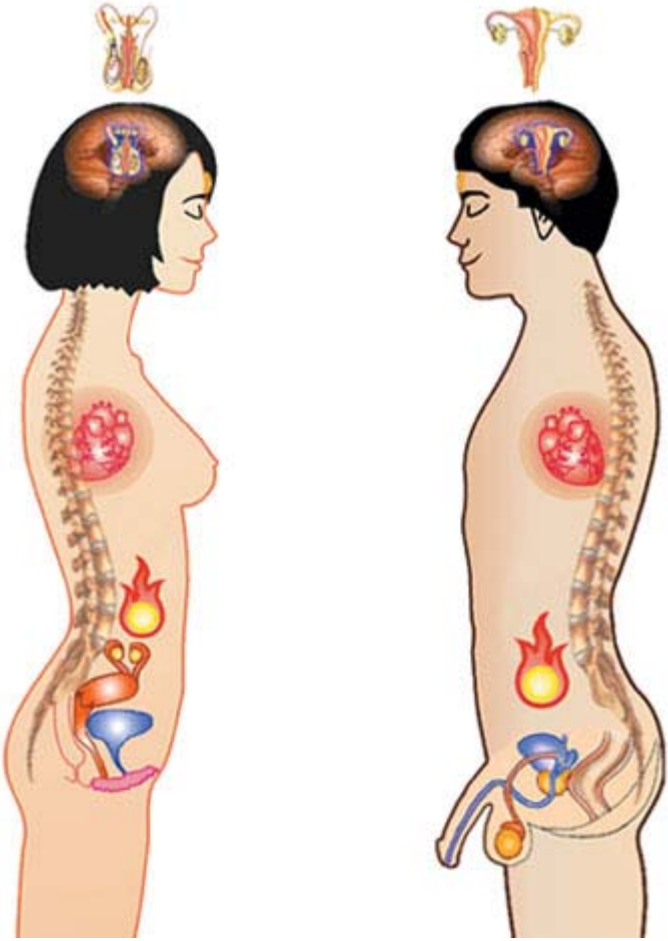

Fig. 7 *Crown Point is connected to the Perineum.*

Under this condition, the nine structural ligaments that form the vocal cords speak with the power of nine kings being guided by the master king, the tenth king of Miphkad. The nine bodily parts and holes are integrated into nine palaces echoing the power of nine teachings. The sacred water and light unify the seven firmaments. The vocal cords no longer resound with the activation of mouth and teeth, but vibrate directly through the pineal gland and the Crown Point. When the nine vibrations activate the pineal gland, the Crown Point will resonate in the universal and cosmic behavior. The visible biological nine holes in the body will harmonize with the invisible nine holes in the brain. The active nine bodily parts will speak through the inactive nine vocal ligaments. The cerebral cortex becomes the cosmic mud upon which the spiritual elixir can be produced through the activation of the mighty cerebellum. (Fig. 8).

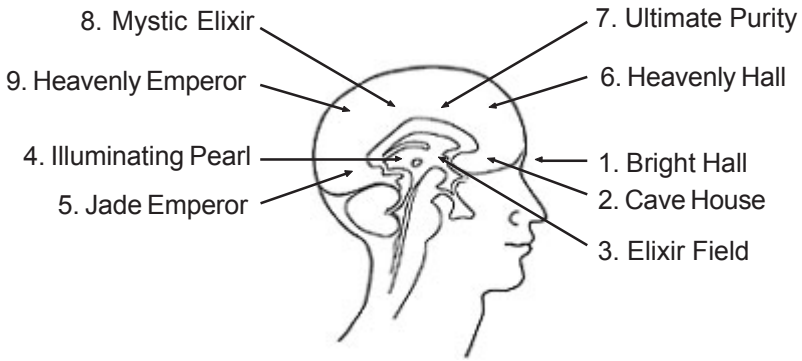

Fig. 8 *Nine Palaces*

When the cerebellum is totally awakened, the instinctive mind behaves through the supervision of eternal peace. Daily activity will unify with nightly rest; the thinking mind will collaborate with the dreaming mind; biological water will balance with sacred water; lustful drive will merge into blissful flow. The inner drumming practice is about to begin. When the glacial thalamus and hypothalamus glands are activated by the holy well of brain fluid under the cave of the corpus collasum, elixir is produced through the interaction of the pituitary and pineal glands. The elixir then travels through the cal-

carine and parieto-occipital sulcus to nourish the entire cortex and cerebrum (Fig. 9). When the time is right, the spirit-elixir will shoot through the central sulcus, the “Crown Point”, its heavenly home. Souls are shocked by this drumming power, and spirit is aroused by the drumming frequency of vibration balancing the entire universe. The body is scorched, the souls are sold, and spirit returns to its original home.

As the vocal cords produce sound, the nine special areas in the body/mind are opened. Among these nine areas, three represent the Tan Tiens, three the “guans” or passes of fire, and three for “qiao”. The three Tan Tiens are located in the third eye area, the Yellow Court area, and the cauldron area respectively (Fig. 10). They charge the frontal body by managing the water-Qi circulation. The lower Tan Tien awakens the Kundalini power for the frozen Jing-Qi to become internalized into sweet dew. The middle Tan Tien expresses love through the falling of sweet dew, while upper Tan Tien reviews the cosmic wisdom with its fresh single eye. In Biblical tradition, the lower Tan Tien constructs the Old Gate. The upper Tan Tien forms the Sheep Gate. The middle Tan Tien manifests the Christ Love. These three Tan Tiens belong to the wood element. They possess the power of restoration and charge the power of growth.

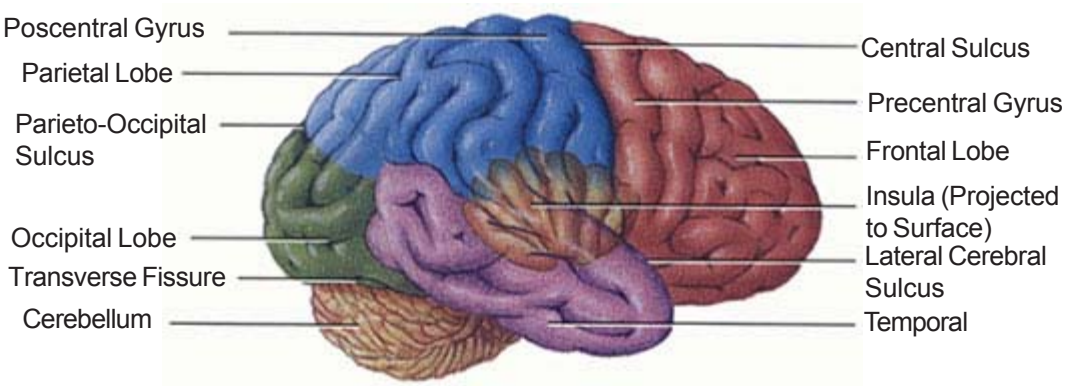

Fig. 9 *Brain Sulci: Parieto-Occipital and Central Sulci of the Skull*

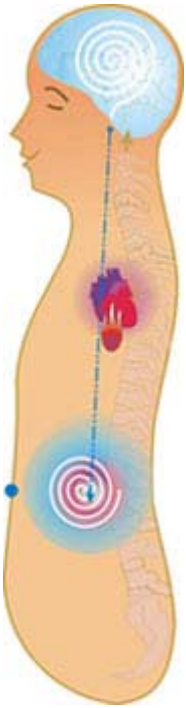

Fig. 10 *Three Tan Tiens*

Corresponding to these Tan Tiens are the three “Guans,” the passes of fire. These passes circulate in the back, facing the three Tan Tiens directly. The Lower Guan opens the life-gate pressure or the Water Gate. The Middle Guan empowers the spirit-platform or the Horse Gate that fires the hands. The Upper Guan, called the Jade Pillow, is located in the center of visual cortex. It is the power of the Master Gate, or the Gate of Miphkad. These three Guans belong to the golden element. They possess the power of openness and initiate the circulation of change.

Circulating between these six special areas are the powers of the three “Qiao” or three Knacks. Each knack constitutes a “gong” or palace. The Yin Gong is the perineum point, and the Yang Gong is the Crown Point. The Central Gong utilizes the cortex as the cosmic earth. The yin qiao/gong belongs to the water element and pos-

sesses the quality of peace. The yang qiao/gong belongs to the fire element and has the quality of action. The Central Qiao/Gong belongs to the earth element and pertains to the quality of harmony.

When these nine special areas are unified in the brain the Nine Palaces are flung open, emitting elixir into the cosmos through nine mountain-like openings. Among them, seven connect with star lights of the Big Dipper. The Moon shadows the eighth through the North Star. The ninth is charged by the Sun, which is controlled by the Southern Star. Allowing the Jade Moon and Golden Flower lights to become the basic nutrients, rather than consuming food and water, the meditative mind and fasting body create their own wonder. At a higher level, the eighth is milked by the cosmic holy water and the ninth is clothed by the cosmic white light. The seven teachings are produced through seven sacred body parts, called churches.

Darkness Practice

The Big Dipper and Nine Palaces are practiced interchangeably: meaning the Big Dipper exercises are done actively as “Wuhuo” or “Military Fire” and the Nine Palaces are exercised passively as “Wenhuo” or “Intellectual Fire.” During the active meditation in the early morning and before midnight while in complete darkness using Darkness Technology (UTS - Booklet), all participants must exercise Big Dipper. During relaxed or sleeping meditation practice, Nine Palaces will be used. Also, practice the Big Dipper first and then the Nine Palaces.

Big Dipper Practice

The names of the seven stars are as followings. 1) Supreme Star-Jing, Mystic axis, or Bright Yang; 2) Prime-star, North Platform, Yin Essence; 3) Truth-Star, Nine extremity, Pure Person; 4) Network-Star, Orbiting Root, Mystic Subtlety; 5) Principal-Star, Supreme Peace, Prime Elixir; 6)Disciple-star, Mechanical Spirit, North Pole; 7) Guard-Star, Mystic Yang, Heavenly Guard (Fig. 11). The names from western Astronomy are in Fig. 12.

The first two stars belong to Hun-Soul, the third and fourth stars are controlled by Po-Soul, and fifth and sixth stars generate Spirit-elixir, the seventh star illuminates for all (Fig. 13). The others names are 1) Hungry Wolf, 2) Huge Gate, 3) Prosperity Storage, 4) Intellectual Art, 5)Honest Chastity, 6) Martial Art, 7) Destructive Army.

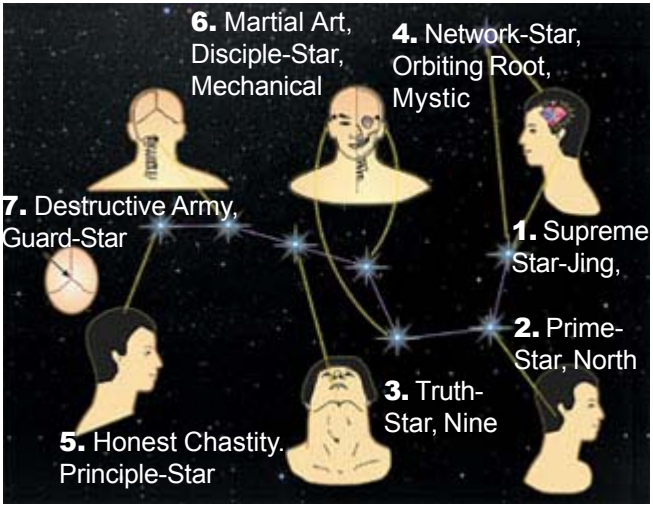

Fig. 11 *Taoist names of the seven stars.*

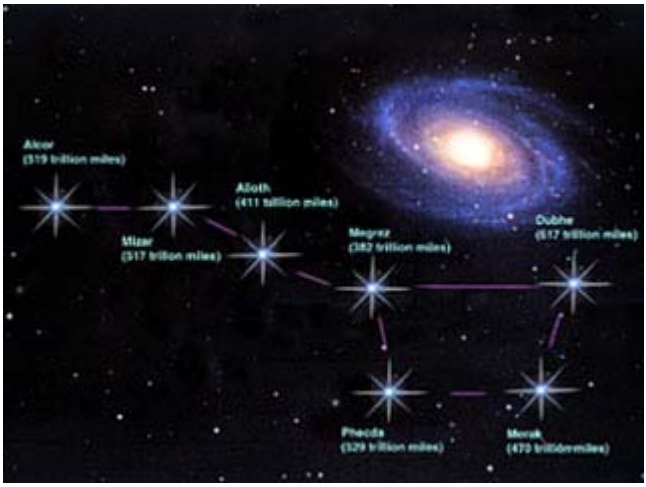

Fig. 12 *Stars and their distances from earth.*

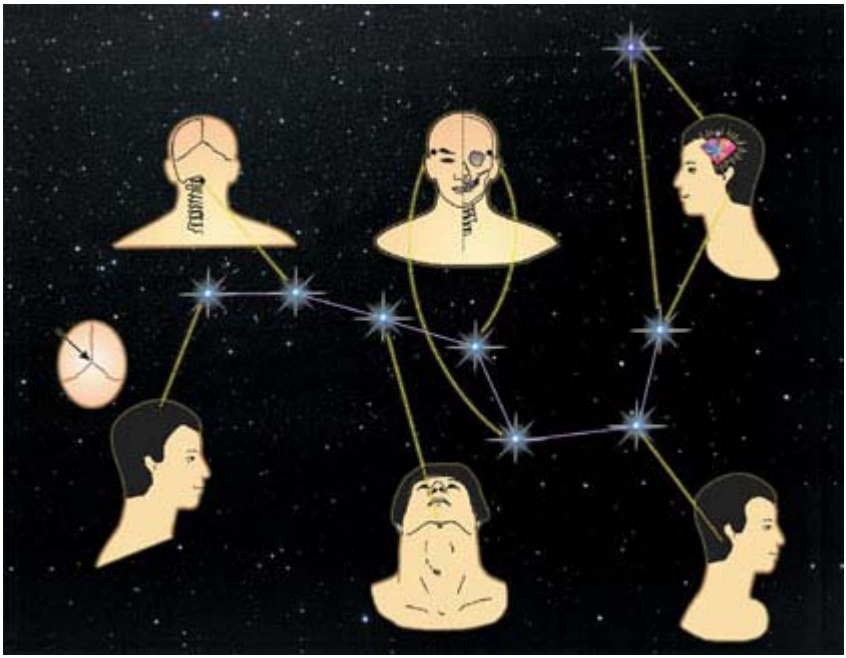

Fig. 13 *Soul names of the stars.*

According to the Chinese Calendar, each two hours is one time period (Fig. 13). Each person has a birth star, depending on the specific time period: first star 11:00 pm-1:00 am; second star 1:00-3:00 am/pm; third star 3:00-5:00am/pm; fourth star 5:00-7:00 am/pm; fifth star 7:00-9:00 am/pm; sixth star 9:00-11:00 am/pm; and seventh star 11:00 am-1:00 pm. Before any person goes to the dark-room, he or she must know his or her star. Without connecting to the birth star, Big Dipper practice cannot be practiced successfully. The names are given orally. The normal names that are used are Bright Yang/Hungry Wolf; Yin Essence/Huge Gate; Pure Person/Prosperity Storage; Mystic Subtlety/Intellectual Art; Prime Elixir/Honest Chastity; North Pole/Martial Art; and Heavenly Guard/Destructive Army.

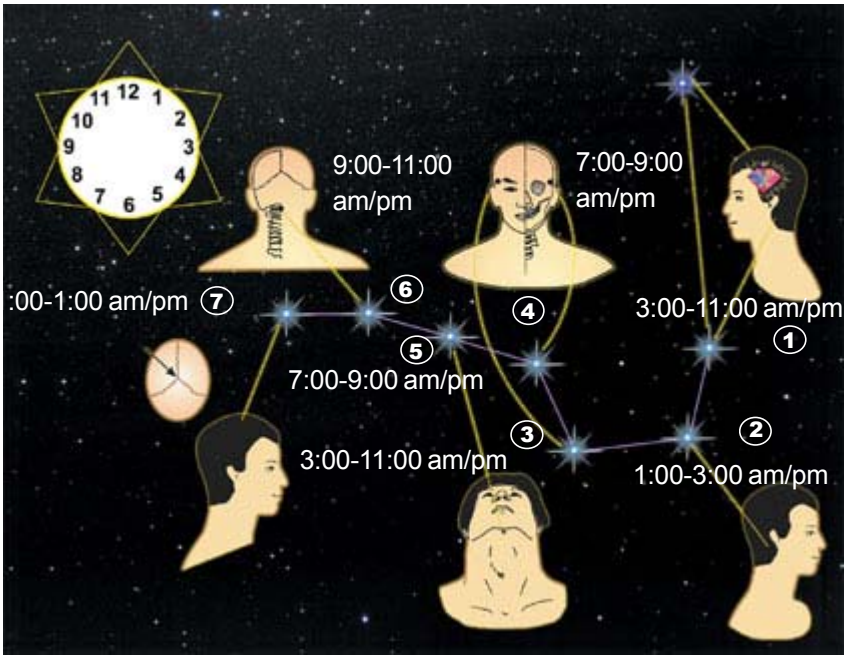

Fig. 14 *Times for each Star*

Exercises

1. The first exercise, the Big Dipper, should be practiced only during nighttime and sleep. Practice the Big Dipper only in the brain. Each star three times with each breath (Fig. 15).

a. The first star is located in the Jade Palace, the power of cerebellum. Visualize it as the purple light, inhale gather the purple light into the cerebellum. Hold the breath, condense the light inside the cerebrum, and exhale, relax and observe the energy circulation in the cerebrum.

b. Then concentrate on the memory center in the brain by inviting the second star. Visualizing it with dark-blue light during inhalation. Hold the breath, let the light circulate around the memory center. Exhale, observe the Chi circulation.

c. Then concentrate on the pineal gland by inviting the third star with the light-blue light.

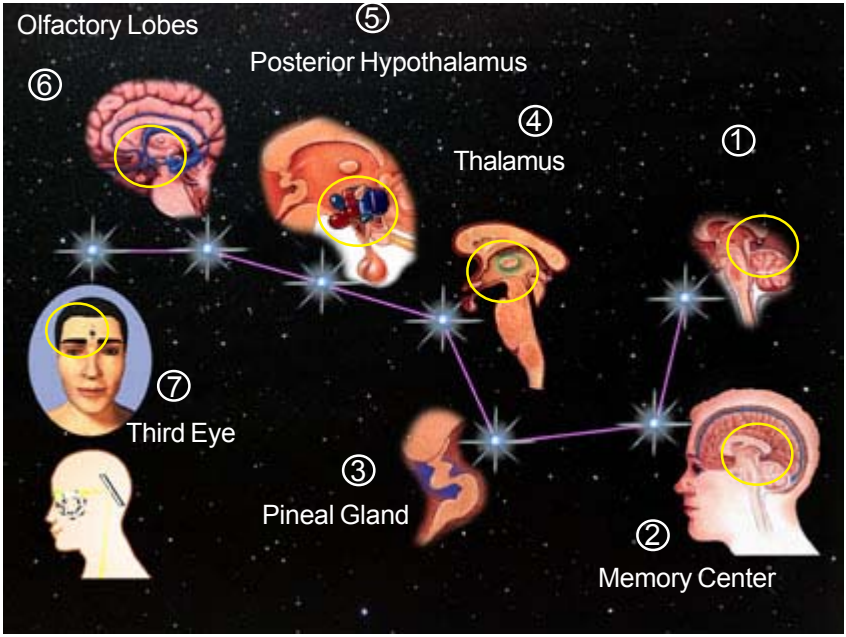

Fig. 15 *Big Dipper Stars and the Brain*

d. Fourthly, concentrate on the thalamus glands by inviting the fourth star and green light. This star is the division between the left-brain and right-brain, or animal brain and human cortex.
e. Then concentrate on the hypothalamus and pituitary glands by inviting the firth star and yellow light. This star connects to human smell and balance.
f. The sixth star connects to the olfactory gland and orange light and temples above the and in front of ears. Hearing-palace and Ear Gate pressure points are located here connecting the Small Intestine and Triple warmer.
g. The seventh star gives ultimately the birth of red fire, the solar light, and passion of sixth sense to mystic awareness. It is located on the yang third eye, or Spirit-hall pressure point.

h. After meditating on each star three times, then visualize all the rainbow colors/lights showing into the brain. Above the rainbow colors the mystic black light, and below is the white (Fig. 16).
i. This star exercise connects to the Spleen and planet Saturn, in the sense that the brain becomes the cosmic soil.

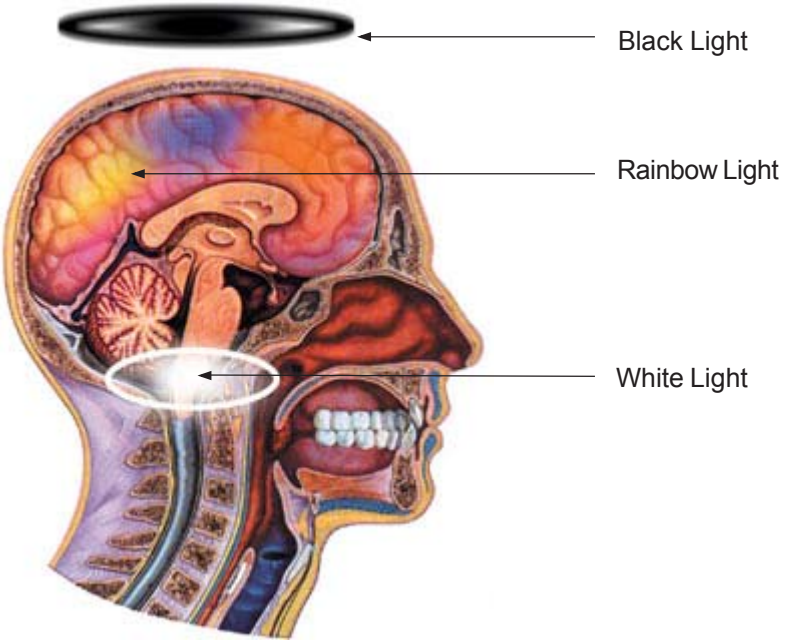

Fig. 16 *Rainbow color lights in the brain.*

2. The second exercise connects to the south and planet Mars (Fig. 17). During the night time the practitioner must focus on the brain to gather the star power and solar light. The exercise is: 1) The first star connects to the yang-third-eye; 2) second star/Jade palace;3) third star/C-7; 4) fourth star/thymus gland; 5) Fifth star/ Yellow Court;) Sixth Star/umbilical cord; and 7) seventh star; Lower Tan Tien. Use the same colors and same format as the first exercise.

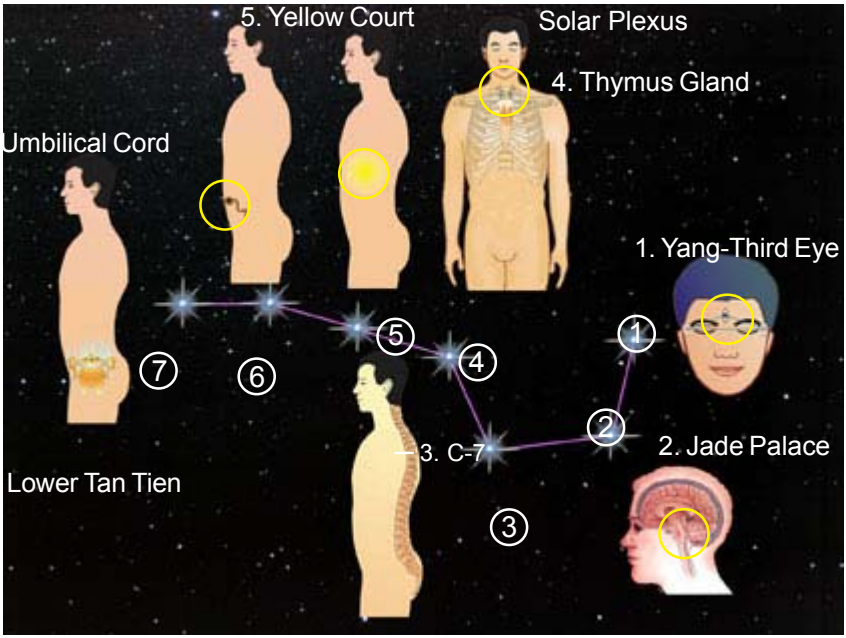

Fig. 17 *Gathering star power and solar light.*

3. During the daytime, focus on the Lower Tan Tien and moon practice (Fig. 17). The exercise is: 1) first star/tailbone; 2) second star/pubic bone; 3) third star/umbilical cord; 4) fourth star/life-gate point; 5) fifth star/Yellow Court; 6) sixth star/thymus gland; 7) and seven star/vocal cords. The third exercise relates to the north and planet Mercury.

4. The fourth exercise is about the sleeping practice. Lie down on the right side to avoid the pressure exerting on the heart. The thumb and index fingers of the right hand cover the right ear; with the elbow serving as the pillow. The left big toe touches the right inner ankle, to connect the yinqiao/wei points. The left hand is placed either on the left hip or in between the legs. The seven star arrangements are the same as the fourth exercise.

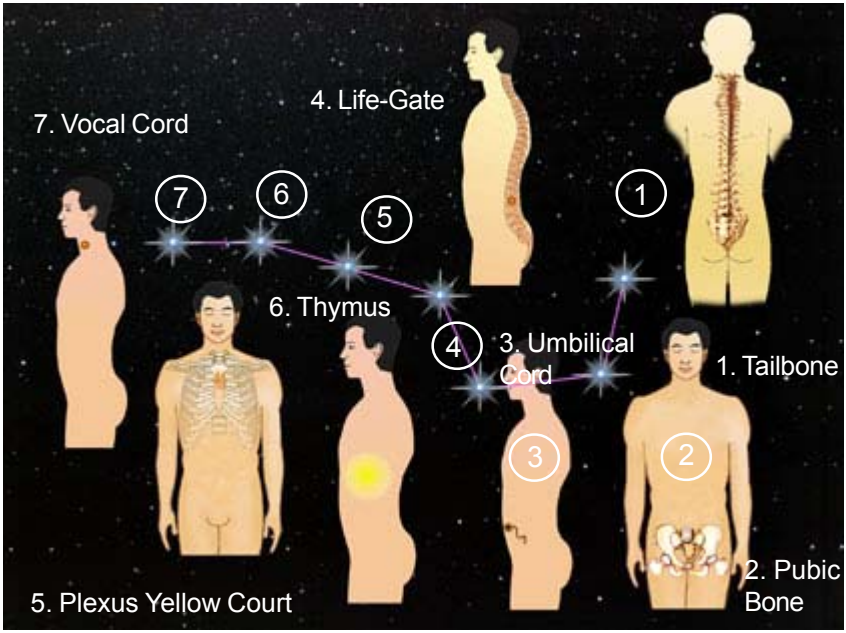

Fig. 18 *Bigger Dipper Stars and Related Body Parts*

Exercise four alternates between the first star and seventh one, meaning the practitioner can either begin with the brain for descending practice, and gathering the cosmic power; or start with the ascending practice, gathering water-earth-Chi. The standing exercise represents east direction or sunrise, and planet Jupiter. The sleeping exercise represents west direction or sunset, and planet Venus.

After each of these exercises, the practitioner can start with the Nine Palace practice, beginning with the kidney Qi-sound, and observing the vibration in four tones and upper four palaces.

Begin from the standing exercise, then the sun, moon, sleeping and ending up with the brain exercise, to finally gather and condense the five Chi between the body/mind and universe.

After the seven-star and nine-palace practices are completed, the seven stars will connect to the North Star via Vega, the Girl Weaver, the eighth power. The seven-star practice is completed as Cowherd, the Cowboy, the seventh power.

Nine Palaces Practice

In Taoist tradition, the Nine Palaces of the brain (Fig. 19) connect with nine sacred caves and nine sacred mountains, intersecting the nine sacred power lines of Mother Earth. Each Palace serves as a cosmic antenna, and each mountain transmits the vibration circulating in that region. In order to receive these nine power lines, one must travel across the nine sacred mountains and sit finally on the middle one, the crowning mountain, to practice enlightenment. The caves are the Mother's energy lines. Like the hollowing bones, caves contain the earliest information of life stored inside the Earth. The caves contain the vital essence of the Earth Power. When nine special bodily areas are unified in the brain, the Nine Palaces are flung open, emitting elixir into the cosmos.

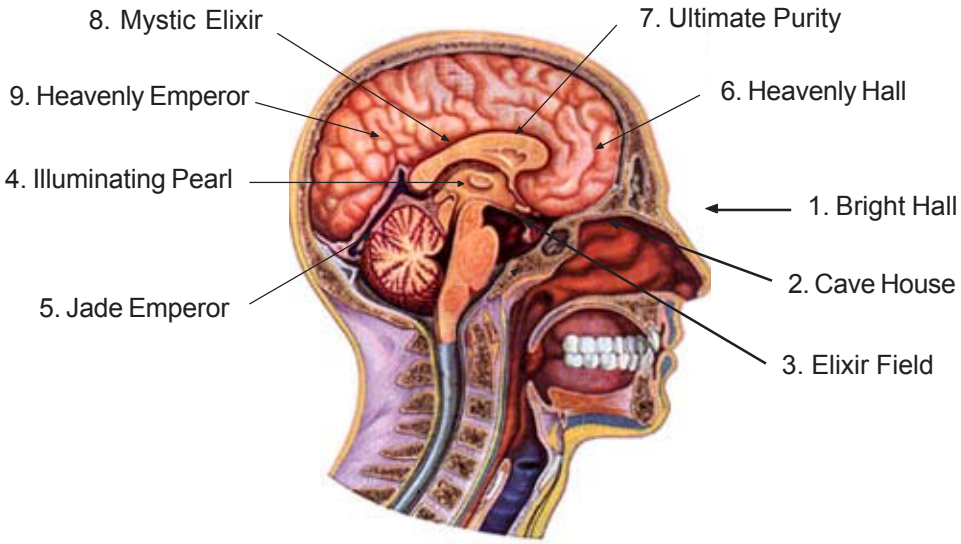

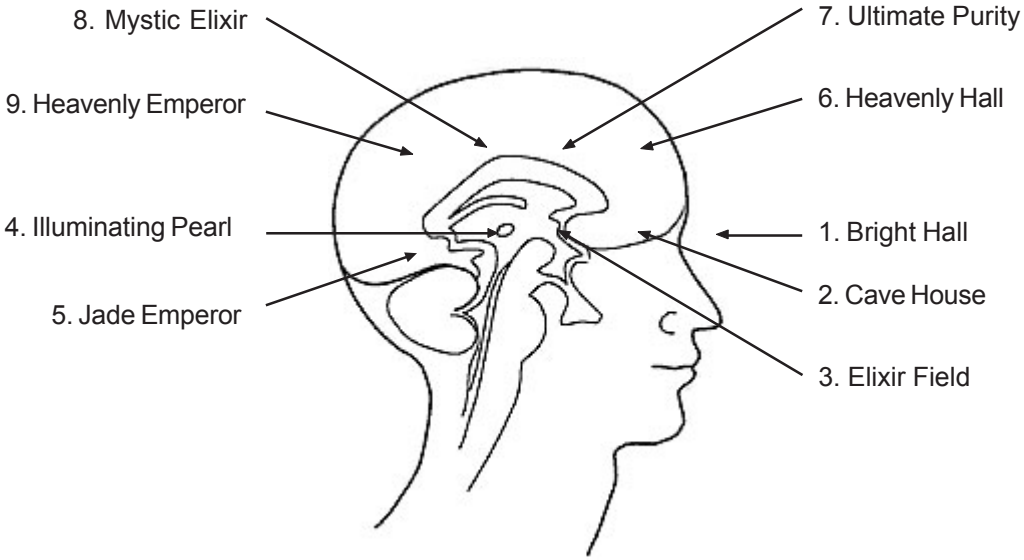

Fig. 19 *Nine Palaces of the brain connect with the nine sacred mountains.*

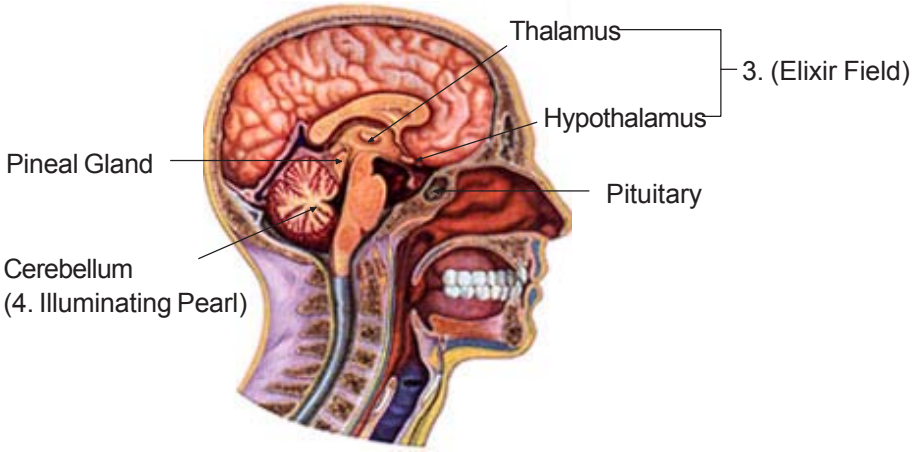

Fig. 20 *Brain areas. Functional areas of the brain and the corresponding nine palace points.*

1. The first palace is called the Bright Hall and corresponds to the Third Eye (Fig. 19). The Bright Hall connects with the power of speech (Fig. 20). The Bright Hall vocalizes God's power of the Word. [Corresponds with Peak 19, House of Rising Yang, Fig. 4.]
2. The Cave House, the second palace, is about one inch behind the Bright Hall (Fig. 21). It is centered in the optic, auditory and olfactory bulbs, occupied with seeing, hearing, and smelling. The Cave House is the primary sensory power, whether in the cave under the ocean (the fetus stage) or in the cave of darkness (night and advanced spiritual work).
3. The Elixir Field, the third palace, is about one inch behind the Cave House. The Elixir Field generates the crystallized fluid in the brain, making biological and spiritual functioning available. It is the principal field of all bodily glandular functioning as well. This field works directly with the eighth palace of the Mystic Elixir (below). Beneath the cave, the thalamus and hypothalamus glands (Fig. 21) can then generate the bluish crystal glacier to form the basic brain fluid. [Corresponds with Peak 18, Muddy Pool, Fig. 4.]

4. The Illuminating Pearl, the fourth palace, is about one inch behind the Elixir Field. The Illuminating Pearl connects with the cerebellum (Fig. 21), connecting with ultimate arousal, uplifting bliss, and the precious momentary joy.

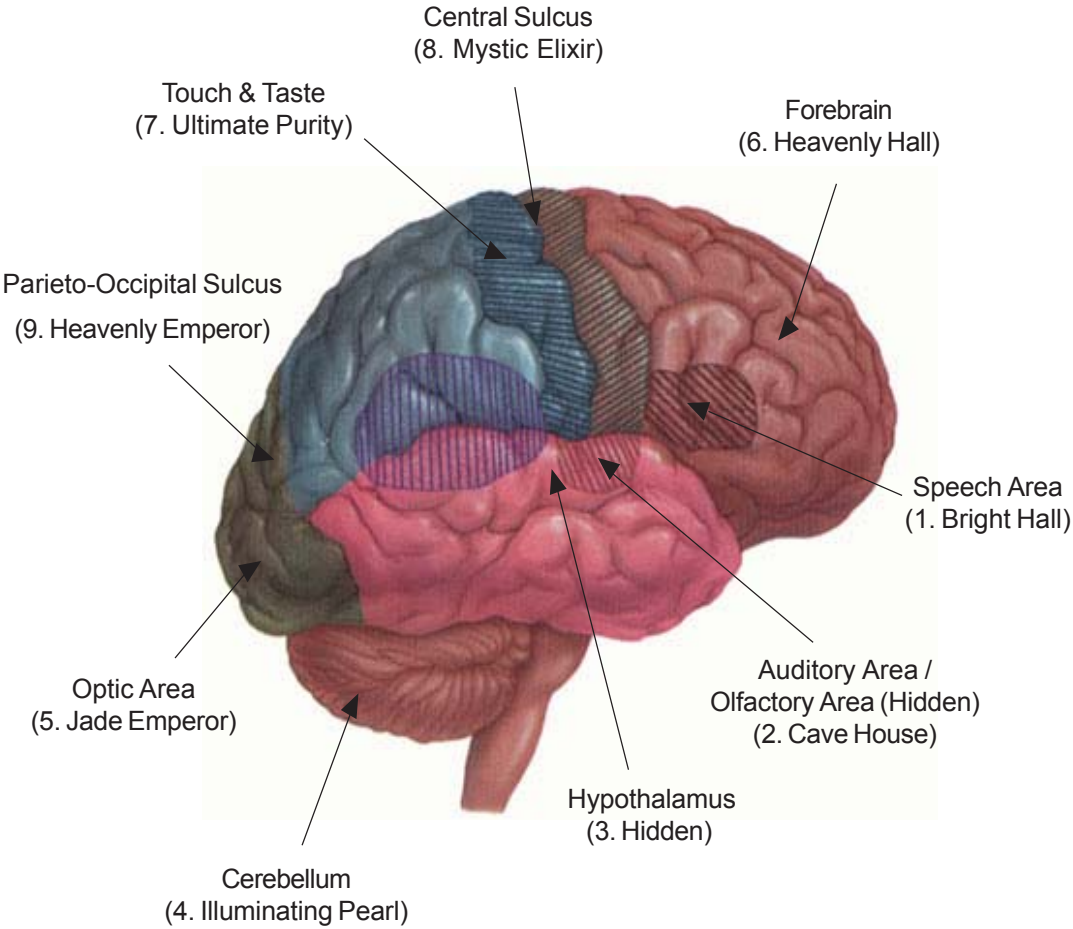

Fig. 21 *Brain areas and associated Palaces*

5. The Jade Emperor, the fifth palace, is about one inch behind the Illuminating Pearl. The Jade Emperor sees and directs all activities. (Fig. 20)
6. The Heavenly Hall, the sixth palace, is about one inch above the Cave House. The Heavenly Hall circulates within the dipole of the forehead.
7. The Ultimate Purity, the seventh palace, is about one inch above the Elixir Field. The Ultimate Purity controls the frontal operculum. Its power connection is the frontal fontanels. It controls the bodily and cosmic movements of touching and tasting (lightning and rain) (Fig. 20). The energetic power of touching and tasting also come from the Mystic Elixir, the ground base (below).
8. The Mystic Elixir, the eighth palace, is about one inch above the Illuminating Pearl. The Mystic Elixir gathers the elixir-making fluid from the central sulcus. This is the most refined spiritual fluid in the body, ready to evaporate the spirit into the sky. Which corresponds with Peak 16, Top of the Great Peak, Fig. 4.]
9. The Heavenly Emperor, the ninth palace, is about one inch above the Jade Emperor. The Heavenly Emperor occupies the parietal operculum, behind which, heavenly light shoots into the conscious mind through the parieto-occipital sulcus (Fig. 11).

All together, the Jade Emperor supervises all, the Bright Hall sees all, the Cave House hears and smells all, the Elixir Field waters all, the Illuminating Pearl experiences all, the Heavenly Hall idealizes all, the Ultimate Purity balances all, the Mystic Elixir glorifies all, the Heavenly Emperor seals all. Through the cerebral cortex and cerebellum, the Eternal Life and Mystic Elixir give birth to the final end product, Spirit, which is the tenth of all. The cerebral cortex and the cerebellum are the cosmic land in the body / mind.

Exercises

The detailed meditation practice of these nine palaces has to do with the five sonic vibrations purified from the five organs and the four tones within each.

1. To begin with, the yin third eye watches downward to connect the true and false vocal cords as well as the thyroid and parathyroid glands. The distance is about seven inches in between.
2. As the meditator inhales, the true vocal cord generates the green color, while the false vocal cord produces the purple color.
3. While sustaining the breath, the mind gathers the condensed vibration to the corresponding five palaces: the fifth palace connects to the kidney sound, the fourth the liver sound, the third to the heart sound, the second to the spleen and the first to the lungs.
4. Exhale, mentally connecting the sonic vibration from the organs below and the two colors generated by the vocal cords to the four tones of the four upper palaces, then letting the tones vibrate through the left and right brain. The left-brain connects to the blue color, while the right brain to the purple color. Doing so connects the power of the Moon and Sun correspondingly.

Each sound is produced five times. Starting with the kidney sound, the two emotional powers ”will and fear” will be balanced and will resonate at the same time. Next is the liver sound, the power of passion and rage; then heart sound, the power of love and hate; then the spleen sound, the power of worry and giving; and finally the lung sound, the power of happiness and sadness.

It is through these sonic vibrations that the person engaging in fasting practice will sustain the power of breath, and the power of mental wakefulness. Even going through the dying process, the spirit mind must be alert all the time. Otherwise, the souls will die into ghost world.

Normally, this set of exercises must be practiced together with the Big Dipper exercise. As the seven emotions are purified through the Big Dipper exercise, the five sonic vibrations will reach to their purest state. The nine palaces will then be fully open.

Preparations for Lesser Kan and Li: Fusion of Five Elements/Creation Cycle

It is important to cleanse the emotions each day so the energies will be pure for the Kan and Li practice. Connect the senses to the organs as you form a pearl and circulate it through the Microcosmic Orbit. Then send the pearl through the organs in the Creation Cycle for at least three rounds. You may use the same pearl or form a new one to send through the thrusting and belt channels (Cosmic Fusion). Finally, if time allows, send the energy through the Bridge and Regulator Channels (Fusion of Eight Psychic Channels).

As you create the pearl, distinguish any negative emotions that may be present within each organ. Look for fear in the kidneys, impatience in the heart, anger in the liver, sadness in the lungs, and worry in the spleen. Transform those negative energies by recycling them in the Creation Cycle, nurturing the virtue energies associated with each organ. Enhance the virtues of gentleness in the kidneys, kindness in the liver, respect in the heart, fairness in the spleen, and righteousness in the lungs.

Foundations of Spiritual Practice

Lesser Enlightenment Kan and Li; Opening of the Twelve Channels; Raising the Soul and Developing the Energy

Lesser Enlightenment of Kan and Li (Yin and Yang Mixed): This formula is called Siaow Kan Li in Chinese and involves a literal steaming of the sexual energy (Ching or creative) into life-force energy (Chi) in order to feed the soul or energy body. One might say that the transfer of the sexual energy power throughout the whole body and brain begins with the practice of Kan and Li. The crucial secret of this formula is to reverse the usual sites of Yin and Yang power, thereby provoking liberation of the sexual energy.

This formula includes the cultivation of the root (the Hui-Yin) and the heart center and the transformation of sexual energy into pure Chi at the navel. This inversion places the heat of the bodily fire beneath the coolness of the bodily water. Unless this inversion takes place, the fire simply moves up and bums the body out. The water (the sexual fluid) has the tendency to flow downward and out. When it dries out, it is the end. This formula reverses normal wasting of energy by the highly advanced method of placing the water in a closed vessel (cauldron) in the body and then cooking the sperm (sexual energy) with the fire beneath. If the water (sexual energy) is not sealed, it will flow directly into the fire and extinguish it or itself be consumed.

This formula preserves the integrity of both elements, thus allowing the steaming to go on for great periods of time. The essential formula is to never let the fire rise without having water to heat above it and to never allow the water to spill into the fire. Thus, a warm, moist steam is produced containing tremendous energy and health benefits, to regrow all the glands, the nervous system and the lymphatic system and to increase pulsation.

Kan and Li Characteristics

Kan (Water): Broken Lines are Yin, Darkness. Solid Line is Yang-Light. The Trigram is Light within Darkness or Fire within Water (Yang within Yin).

Li (Fire): Broken Line is Yin, Darkness. Solid lines are Yang, Light. The Trigram is Darkness within Light or Water within Yin (Yin within Yang).

Kan

Lead, Life Essence,
Sexual Energy, Real Knowledge
True Sense, Real Wisdom
Tama the Tiger

1. The Yang within Yin
2. True Lead, True Sense
3. The Lad of the Kan in the Moon
4. North, Moon
5. Water
6. White Tiger
7. Female
8. Kidney
9. Saliva
10. Semen, Sperm
11. Black
12. Self
13. True Sense mixed with arbitrary Feeling.

Li

Mercury, Spiritual Essence
Temper, Ground the Dragon,
Heart of Compassion

1. The Yin within Yang
2. True Mercury, Spiritual Essence and Virtual
3. The Maiden of the Li in the Sun
4. South, Sun
5. Fire
6. Green Dragon
7. Male
8. Heart
9. Chi
10. Blood, Menstruation
11. Red
12. Other
13. Spiritual Essences become adulterated with Temper.

Kan: Lead, True Sense, Life Essence, Orgasm Energy

1. Lead is dense and heavy

2. True sense of real knowledge; when sexual energy cannot be moved senses will be restored.

3. True sense is outwardly dark but inwardly bright Strong and unbending, able to ward off external afflictions. The Black Tiger's strength and vigor are within.

4. The White Tiger's energy is associated with metal.

5. Iron Man is not constrained by anything.

6. Golden Flower- pivot of creation.

7. North Star-it conceals brightness within darkness and metal within water.

8. Rabbit in the Moon-masculinity within femininity.

9. When sexual energy rises (does not leak out) it gets transformed into bliss.

10. Total Body Orgasm: First: Brain; Second: the Senses; Third: the Kidneys; Fourth: the Liver; Fifth: the Spleen; Sixth: the Lungs; Seventh: the Heart; Eighth: the Soul; Ninth: the Spirit.

11. The Orgasm comes from the material

   a. The material- the sexual organs, the senses, the glands, the organs

   b. When sexually aroused it transforms the aroused sexual energy into immaterial.

   c. When it is aroused to the higher level of force, the orgasm has the power to connect with Universal Force (God) and bring the Earth Energy up to human body.

Li: True Mercury, Spiritual Essence, the Heart of Compassion

1. Mercury: Lively and active, bright and buoyant, soft and yielding. It easily runs oft like the spiritual essence of conscious knowledge in the human body.

2. Spiritual essence is outwardly firm yet inwardly flexible. Call and it responds; touch and it moves. True Mercury goes in and out unpredictably.

3. Green Dragon- when passing through or tempering by fire it changes to the Black Tiger.

4. The Woman: Yang on the outside and Yin on the inside.

5. The Man: Yin on the outside and Yang on the inside.

6. Wood Mother- Soft and Loving.

7. Raven in the Sun- Femininity within Masculinity.

8. Mercury Within Cinnabar- Its reality is hidden within fire.

9. Flowing Pearl- Its light is penetrating.

10 The Firs of heart compassion come from the material into the immaterial.

a. The material- the Organs: Heart, Kidneys, Liver, Spleen, Lungs.
b. Their pure energy transforms into virtue, the immaterial such as love, joy happy, gentleness, kindness, fairness, cour age. Which we can not see, cannot touch, but we can feel its reality.
c. When all these virtues combine at the heart they become the heart of compassion.
d. When it rises up to the mideyebrow it becomes the spiritual essence.

Afternoon or Evening Meditation

Kan and Li Formulas:

Do each formula for two weeks, then combine them if time permits.

A. Reversing the Hot and Cold Energy

These procedures should be done at the beginning of each meditation.

1. Smile down.
2. Listen to the kidneys - feel gentleness and coolness.
3. Distinguish their cold energy from the hot energy of the adrenals, which are located on top of the kidneys.
4. Form a sphere at the perineum in which to collect the cold energy of the kidneys. Collect the hot energy of the adrenal at T-11 on the spine, and send it up the spinal cord to the crown. From there bring it down the middle Thrusting Channel to the heart center, and combine it with the energies of the heart and the thymus.
5. Pull the hot energies from the adrenals, heart, and thymus into the heart collection point and mentally establish the pulse there.
6. Divide your attention between the hot and cold energies at the two collection points. Bring the hot energy down either the front or the left Thrusting Channel to the lower abdomen. Simultaneously bring the cold energy up the back or the right Thrusting Channel to the solar plexus. Do not allow the energies to shift or move as you slowly reposition them. Think of the hot and cold energies as fire and water contained in two separate cups, both of which must not be spilled.
7. Move the hot and cold energies into the middle Thrusting Channel and carefully couple them at the navel. The fire is the stove, and the water is the cauldron. Be careful not to spill the cold energy into the stove.

8. Establish the heartbeat in the cauldron, and allow the kidneys to pulse with the heart as you pull up the sex organs.

9. Seal the senses down into the cauldron as this will help you establish the automatic pulsing there.

10. Stir the cauldron with your inner eye, and feel the steam arise from the cauldron.

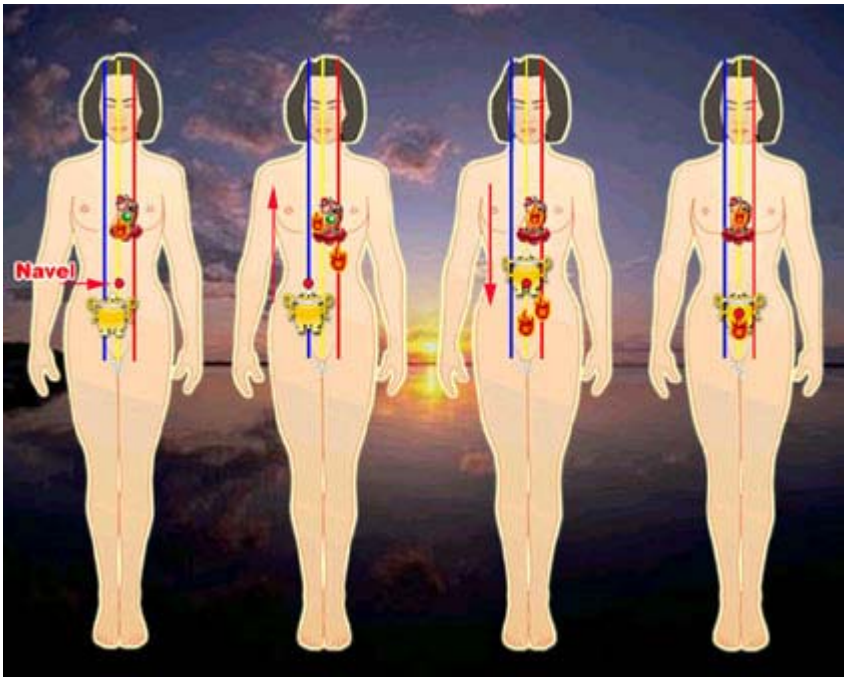

Fig. 22 *Reversing the Hot and Cold Energy*

B. Steaming the Glands and Organs

As the steam comes out of the cauldron, direct the colored steam or vapor to the following glands and organs for a few minutes each. You may feel each organ soften, expand like a flower blossom, and become cool as the steam surrounds it.

1. Kidneys - Bladder - Blue Steam
2. Liver - Gall Bladder - Green Steam
3. Spleen - Pancreas - Yellow Steam
4. Heart - Small Intestine - Red Steam
5. Lungs - Large Intestine - White Steam

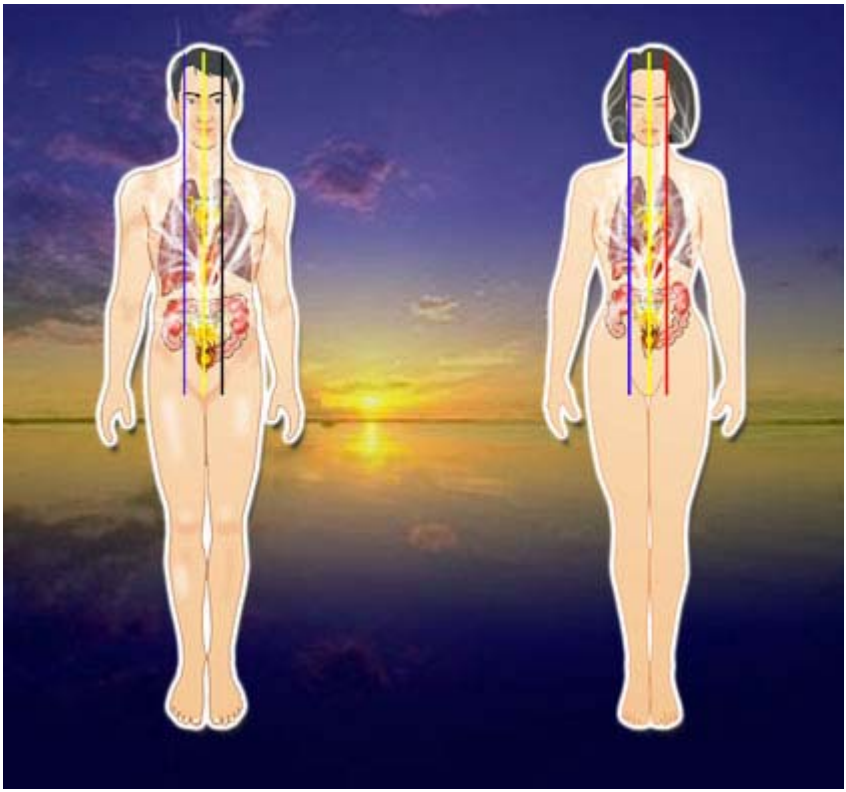

Fig. 23 *Steaming the Glands and Organs*

C. Spinal Cord Steaming

- If starting fresh, complete the steps in A (one to ten).
- If continuing from B, reestablish the automatic beating at the cauldron.

1. As you stir the cauldron with the eyes and pull up the sex organs, move the cauldron and stove back toward the spine.
2. Direct the energy of the steam into the spine. The abdomen may pull in, and the breathing may stop momentarily.
3. As you feel the steam in your back, breathe the energy up and down the spine.

Fig. 24 *Spinal Cord Steaming*

D. Lymphatic System

- If starting fresh, complete the steps in A.
- If continuing, reestablish the pulse in the cauldron.

This exercise requires knowledge of the lymphatic system's locations in the body.

1. Direct the steam into the lymph nodes in the navel area.
2. In time, each node will begin to flower or open one by one.
3. Allow each to open, moving your concentration from the navel area into the chest, neck, armpits, etc., following the pathways of the lymphatic system.

Fig. 25 *Lymphatic System*

E. Nervous System/Spine

- If starting fresh, follow the procedures in A.
- If continuing, reestablish the pulse at the cauldron.

1. Move the stove and cauldron down to the perineum.
2. Move it carefully to the sacrum and steam up the spinal cord.
3. Eventually the steam will flow out of the spinal cord into the nerves throughout the body.

Note: Focus on dry areas and moisten them.

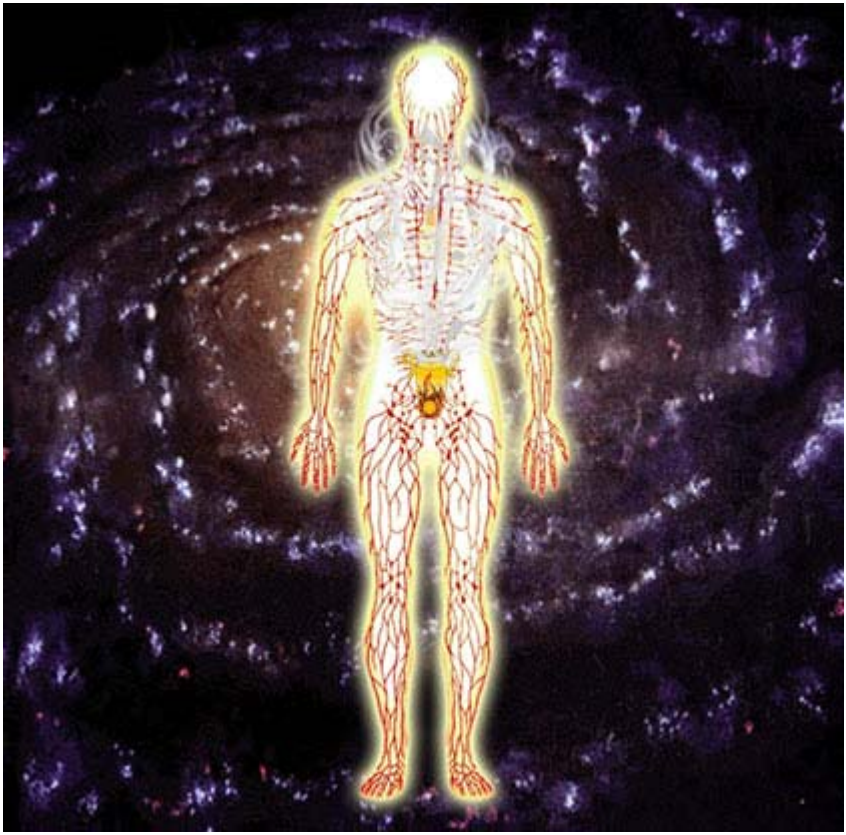

Fig. 26 *Nervous System/Spine*

F. Thymus/Pituitary/Pineal

- If beginning fresh, follow the procedures in A.
- If continuing, reestablish the pulse at the cauldron.

1. Steam the thymus gland located behind the sternum.

Note: Spend less time on the thymus. Calculate before you steam this and the pituitary gland so that the thymus only receives two-thirds as much steam. In other words, if you plan to steam the pituitary for three minutes, steam the thymus for only two.

2. Turn the eyes up to the point between the eyebrows, and direct the steam into the pituitary gland.

3. Turn the eyes up to the top of the head, and steam directly into the pineal gland.

Note: After the pineal gland has been steamed, the energy may spread into any one of a number of routes: eight psychic channels, twelve channels in arms or legs, or any of the routes in *Fusions of the Five Elements, Cosmic Fusion* and *Fusion of Eight Psychic Channels.*

Fig. 27 *Thymus/Pituitary/Pineal*

G. Opening the Twelve Channels

- If starting fresh, follow the procedures in A.
- If continuing, reestablish the pulse at the cauldron.

Note: Be sure to steam each organ before passing the steam through the associated channels. Each channel connects to the next in sequence. After opening each channel the steam will automatically be at the starting point for the next. You may feel a numbness as it passes through each.

1. Lungs: Steam the lungs and their channel as you hold the lung points on the inside edges of your thumbs.

The Lung Channel originates at the middle of the abdomen and travels through the arms to connect with the Large Intestine Channel. From near the cauldron, it runs along the upper orifice of the stomach, passes through the diaphragm, and enters the lungs. At the portion of the lungs nearest the throat, it separates and descends along the inner aspects of the upper arms, through the forearms, and ends at the inside edges of the thumbs. A branch runs directly to the inside tip of each index finger where it links with the Large Intestine Channel.

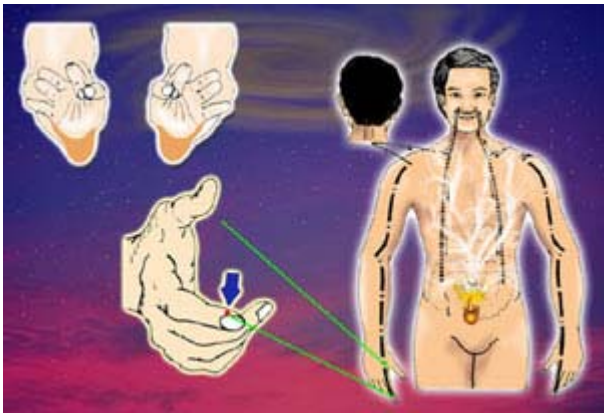

Fig. 28 *Steaming the Lungs Meridian with Holding Point*

Holding Point: Use the index finger of each hand to reach over its respective thumb and press a point on the inside edge facing the centerline of your body where the thumbnail begins.

2. Large Intestine: Steam the large intestine and its channel as you hold the related points on your index fingers.

The Large Intestine Channel starts at the inside tips of the index fingers, running up between the first and second metacarpal bones of each hand. Following the outer length of the forearms, it reaches the outside of the elbows, ascending along the upper arms to the highest point of the shoulders. It travels along the outer border of the acromion and culminates briefly at the C-7 point. From there it descends over the shoulders as it again separates. Each half splits: one part of each route descends to connect with the lungs and diaphragm, entering the large intestine; the other part branches upward through the neck and cheek. The ascending portions travel up the sides of the mouth, partially connecting at the upper lip as they extend upward through both sides of the nose to link with the Stomach Channel.

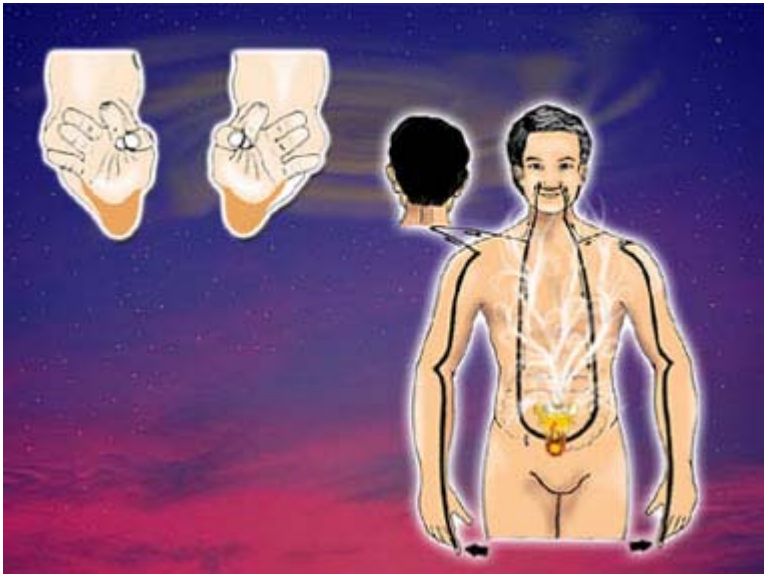

Fig. 29 *Steaming the Large Intestine Channel with Holding Point*

Holding point: Use the tip of each thumb to press a point on inside edge of each index finger facing the thumb where the fingernail begins.

3. Stomach: Steam the stomach and its channel as you mentally hold the related points on the second toes of the feet. (These are the longest toes.)

The Stomach Channel starts on both sides of the nose, extending almost to the inside corner of each eye. From the sides of the nose it descends over the mouth, connecting at the chin. It again separates as two branches run across the lower portion of the jaw on both sides of the head, ascending by the front of each ear along the hairline to the forehead.

Parts of these branches descend along the sides of the throat and split again near the collar bone. Two extensions pass through the diaphragm and the stomach as they travel to the groin. (The left side connects with the spleen.) The other extensions run outside, descending through the nipples and near the umbilicus on the inner sides of the lower abdomen. Four branches connect at the middle of the groin, and then divide into two branches which travel down the front of the legs to the dorsal areas of the feet. These branches again split within each foot. One part extends to the outer tip of the second toe (the holding point), and the other to the inside edge of the big toe as it connects with the Spleen Channel.

Fig. 30 *Steaming the Stomach Channel with Holding Point*

Holding Point: As you hold the lung points with your fingers, focus your attention on points at the outside edges of the second toes facing the middle toes where the toenails begin.

4. Spleen: Steam the spleen and its channel as you mentally hold points located on the inside edges of the big toes facing the centerline where the toenails begin.

The Spleen Channel starts from the tips of the big toes, running along the insides of the feet and ascending up the legs through the inner knees and thighs. The two branches curve around the lower abdomen, combining at the navel before they split into four. One extension connects with the spleen; another flows through the stomach and into the heart to link with the Heart Channel. Two remaining branches ascend through the diaphragm and along the sides of the esophagus until they reach the root of the tongue where they culminate.

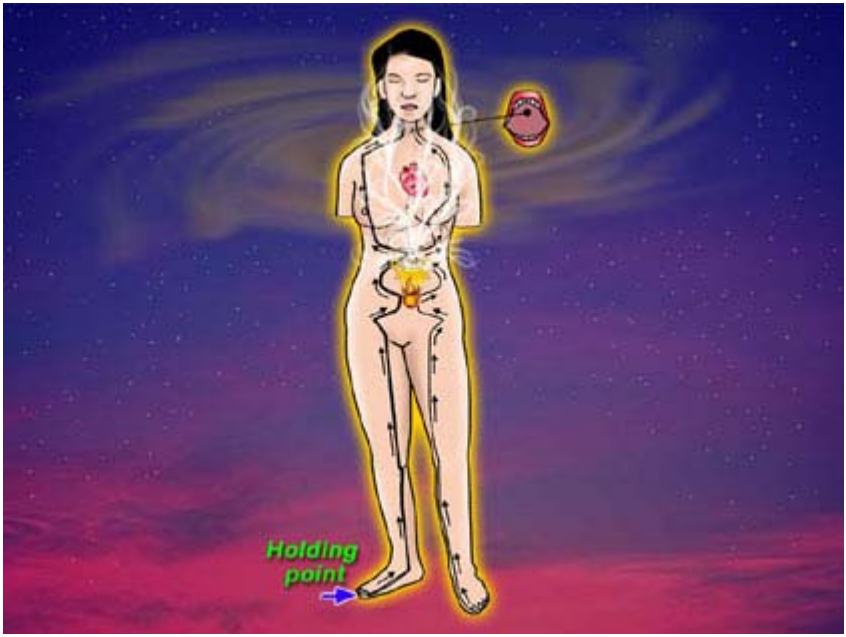

Fig. 31 *Steaming the Spleen Channel with Holding Point*

Holding Point: As you hold the lung points with your fingers, concentrate on the inside edges of the big toes behind the toenails.

5. Heart: Steam the Heart and its channel as you use your thumbs to hold the heart points on the inside edges of the pinky fingers facing the fourth fingers where the fingernails begin.

The Heart Channel originates at the heart and spreads over the surrounding area, flowing down through the diaphragm to connect with the small intestine. One ascending portion of the channel runs along the center of the esophagus to connect with the eye system. Another two branches flow upward to the lungs, curving around to the insides of the forearms and flowing down through the inside edges of the pinky fingers. Here the branches link with the Small Intestine Channel.

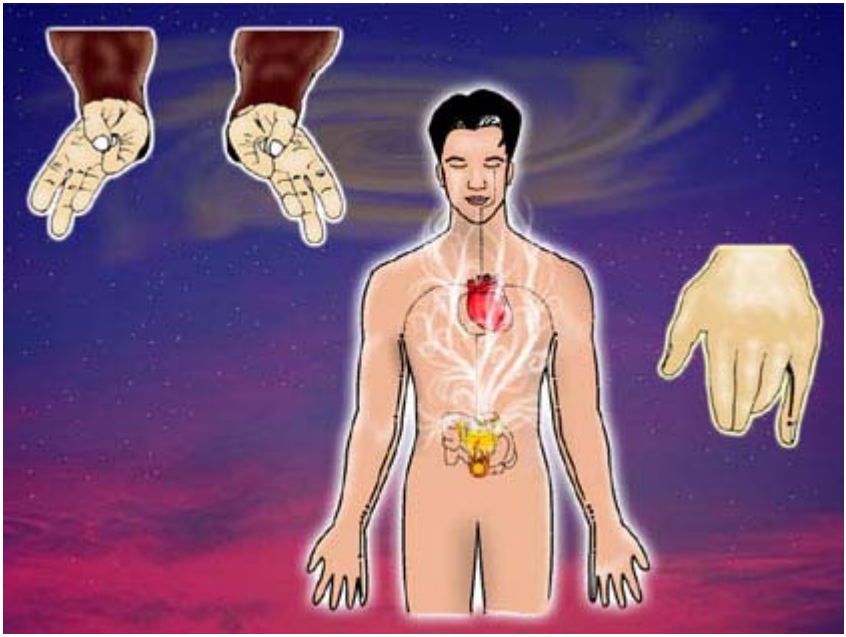

Fig. 32 *Steaming the Heart Channel with Holding Point*

Holding Point: Hold the heart points at the inside edges of the pinky fingers using the tips of the thumbs.

6. Small Intestine: Steam the small intestines and their channel as you use your thumbs to hold the points on the outsides of the pinky fingers where the finger nails begin. (Curl the pinky fingers to access the points.)

The Small Intestine Channel starts at the outer side of the tips of the pinky fingers. Following the edges of the hands, its branches ascend up the outer sides of arms to the shoulder joints. Then they curve through the scapulae and traverse the sides of the lower neck to the front of the body where the two branches split. Their lower extensions connect at the heart and descend as one channel, passing through the diaphragm, the stomach, and finally the small intestines. The ascending branches extend from the collar bone up the sides of the neck to the cheeks where they also split. Two extensions end at the sides of the nose near the inside corners of the eyes where they connect with the Urinary Bladder Channel. The other two extensions split further at the outside corners of the eyes and cross the cheeks to end at the ears.

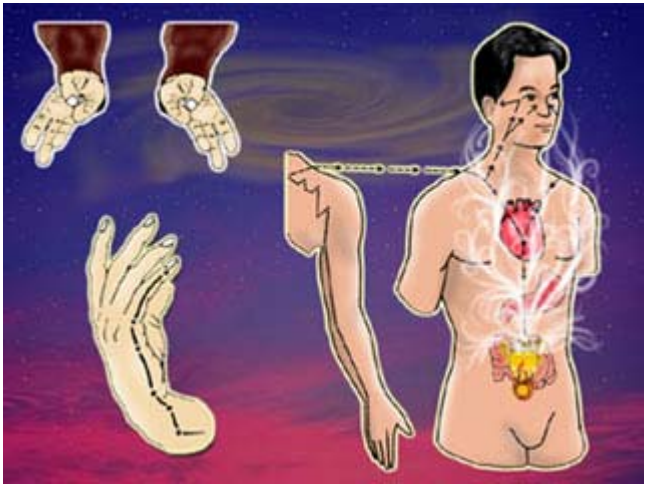

Fig. 33 *Steaming the Small Intestine Meridian with Holding Point*

Holding Points: Use the tips of the thumbs to depress the small intestine points located on the outside edges of the pinky fingers behind the fingernails.

7. Urinary Bladder: Steam the bladder and its channel as you mentally hold points at the outer edges of the pinky toes where the toe nails begin. The Urinary Bladder Channel starts at the nose near the inside corners of the eyes. The two branches ascend to the forehead, joining at its apex, then split and run across the top of the cranium. On the back of the head the branches split again: routes descend behind the ears and converge at the back of the skull, enter the brain, reemerge, and bifurcate into two extensions of each branch. Near the base of the skull, the channel appears as four separate lines. Two of these run vertically down the insides of the scapulae, descending into the lumbar region as they enter the body cavity and connect with the kidneys and the urinary bladder. They swing back to the sacrum and descend down the inner thighs to join two other branches of the Urinary Bladder Channel at the knees. The other two branches descend vertically from the back of the neck along the edges of the scapulae parallel to the inside channels. Passing downward through the buttocks, they cut outward and descend along the backs of the legs. From where these meet with the inside branches at the knees, the recombined lines descend along the lower legs to the outer edges of the feet, ending at the outside edges of the pinky toes. Here the branches link with the Kidney Channel.

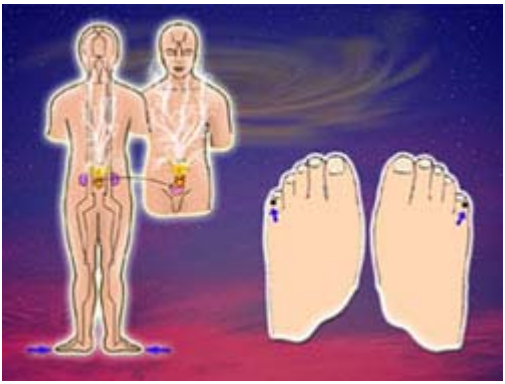

Fig. 34 *Steaming the Urinary BladderChannel with Holding Point*

Holding Point: As you hold the lung points with your fingers, mentally hold the urinary bladder points on the outer edges of the smallest toes.

8. Kidneys: Steam the kidneys and their channel as you mentally hold points located on the undersides of the pinky toes.

The Kidney Channel starts at the underside of the little toes and runs across the soles of the feet. From the soles, the branches emerge and circulate around the protruding inner ankle bones and ascend along the inner legs and thighs toward the coccyx. From the coccyx, the channel follows the spine up to enter the kidneys. From the kidneys, two branches run down to the bladder and up through the liver and diaphragm to enter the lungs. The branches terminate at the root of the tongue. A small branch also joins the heart and links with the Pericardium Channel.

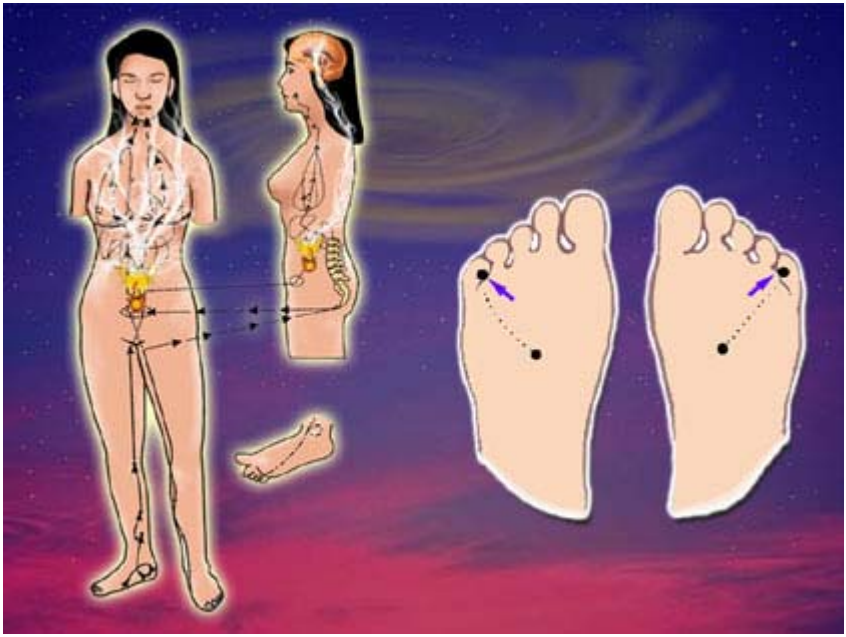

Fig. 35 *Steaming the Kidneys Meridian with Holding Point*

Holding Points: As you hold the lung points with your fingers, concentrate on the bottom of each pinky toe.

9. Pericardium: Steam the area around the heart and its related channel as you hold points on the tips of the middle fingers using the tips of the thumbs. (Curl the middle fingers to access the points with the thumbs.)

The Pericardium Channel originates in the chest around the heart. It enters the pericardium, then it descends through the diaphragm to the abdomen. Other branches run inside the chest toward the nipples, curving up, and then running down the insides of the arms to the palms. The channel ends at the tips of the middle fingers where branches arise from the palms to connect with the Triple Warmer Channel, which begins at the fourth fingers.

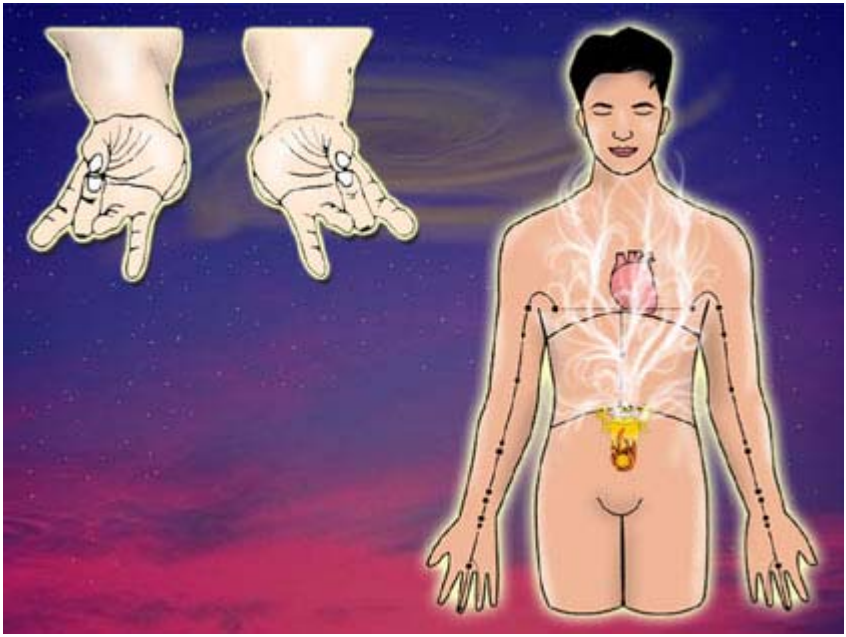

Fig. 36 *Steaming the Pericardium Meridian with Holding Point*

Holding Point: Hold the pericardium points on the middle finger-tips using the tips of your thumbs.

10. Triple Warmer: Steam up the torso upper, middle, and lower abdomen and its channel as you hold points on the tips of your ring fingers with your thumbtips. (Curl the fourth fingers.)

The Triple Warmer Channel originates at the tip of the ring fingers, flowing across the back of each hand and ascending up the outer sides of the arms to the backs of the shoulders. Its branches wind over the shoulders to the supraclavicular fossa where they recombine and split again, spreading in the chest to connect with the pericardium before they descend through the diaphragm to the upper, middle, and lower abdomen.

A branch ascends to the supraclavicular fossa from the chest and continues over the shoulders and up the sides of the neck toward the ears. This channel splits on both sides of the neck. One branch extends around the back of the ear, up to the temple, and down to the cheek, ending at the inside corner of the eye. The other enters the ear, emerges in front of the ear, and crosses to the outer edge of the eyebrow to link with the Gall Bladder Channel.

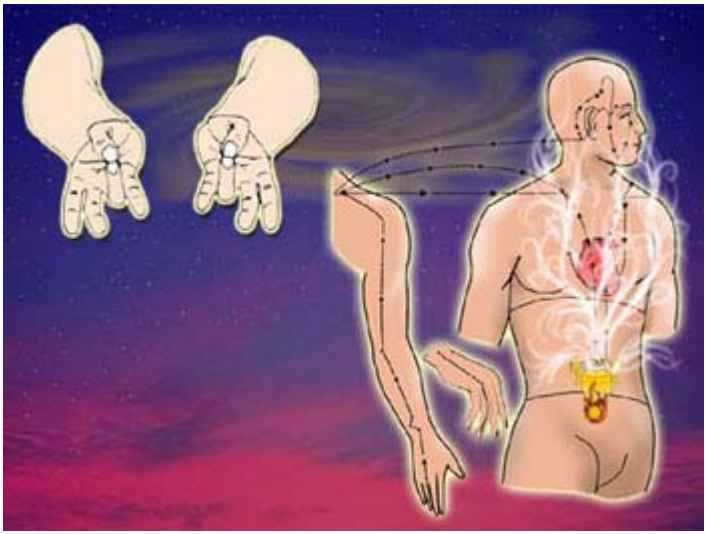

Fig. 37 *Steaming the Triple Warmer Meridian with Holding Point*

Holding Point: Depress the triple warmer points on the tips of the ring fingers of each hand using the tips of the thumbs.

11. Gall Bladder: Steam the gall bladder and its channel as you mentally hold a point on the outside edge of the fourth toe of each foot facing the pinky toe where the toenail begins.

The Gall Bladder Channel originates in the outer canthus, flowing toward the ears, up to the corners of the forehead, and back down to the tips of the ears. Then its branches curve back around the ears, up over the cranium to the forehead, and back down the neck. They traverse the shoulders and join the other branches descending from the infraorbital regions and the cheeks at the supraclavicular fossa region.

From the supraclavicular fossa region, one branch descends into the chest and passes through the diaphragm to connect with the liver and the gall bladder. From there it runs down the abdomen, superficially along the margin of the pubic hair, and then into the hip region. The other branch runs downward along the lateral aspect of the chest and the free ends of the floating ribs to the hip where it joins the other branch. The channel splits again and descends along the lateral aspects of the thighs, knees, and lower legs to the outside tips of the fourth toes. Branches also run to the big toes where they link with the Liver Channel.

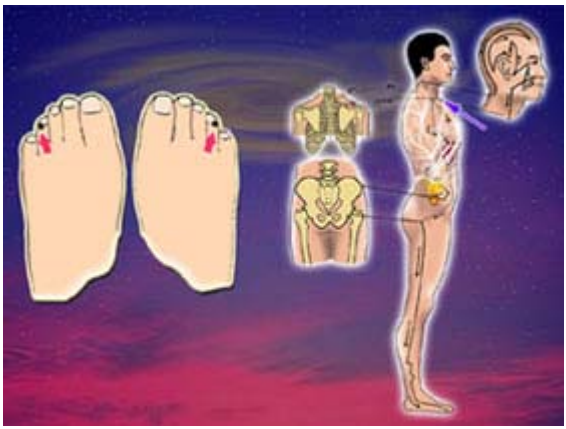

Fig. 38 *Steaming the Gall Bladder Meridian with Holding Point*

Holding Point: As you hold the lung points with fingers, focus your attention on point at the inside edges of the big toes.

12. Liver: Steam the liver and its channel as you mentally hold a point on the outside of the large toe of each foot facing the second toe where the toenails begin.

The Liver Channel starts at the dorsal region of the big toes and ascends up the inner sides of the knees and thighs to the pubic region. It curves around the genitalia and up through the diaphragm to curve around the chest. Then its branches ascend along the posterior aspects of the throat, crossing the cheeks to connect with the eye system. They continue upward, emerging from the forehead above the eyebrow, and pass over the head. A branch comes down from the eye system to curve around the inner surface of the upper and lower lips. Another branch arising from the liver passes through the diaphragm and lungs to link with the Lung Channel.

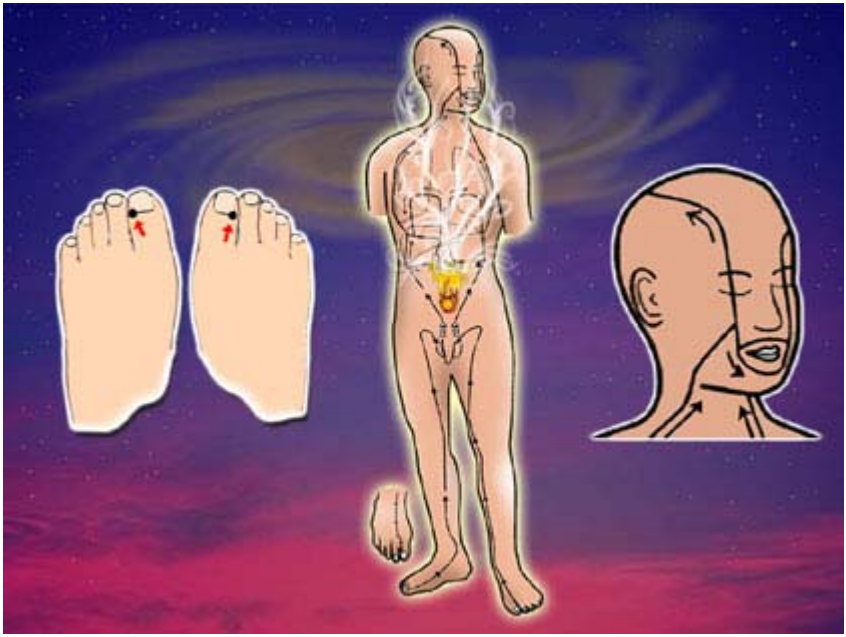

Fig. 39 *Steaming the Liver Meridian with Holding Point*

Holding Point: As you hold the lung points with fingers, focus your attention on point at the inside edges of the big toes.

H. Increasing the Pulses

- If starting fresh, follow the procedures in A.
- If continuing, reestablish the automatic pulsing as you move the stove and cauldron back to the coupling point behind the navel.

1. Mentally allow the heart rate to decrease.
2. Amplify the strength of the pulse at the crown and perineum points. This will assist the heart by moving the blood with Chi energy.
3. Amplify the pulse at the navel, groin, inner ankles, and feet.
4. Amplify the pulse at the neck, temple, back of skull, arm pits, inside elbows, and wrists.
5. As you become familiar with this exercise, begin to synchronize all pulses. By recreating the pulse in other areas, you will eventually be able to transfer the heartbeat up to the energy body.

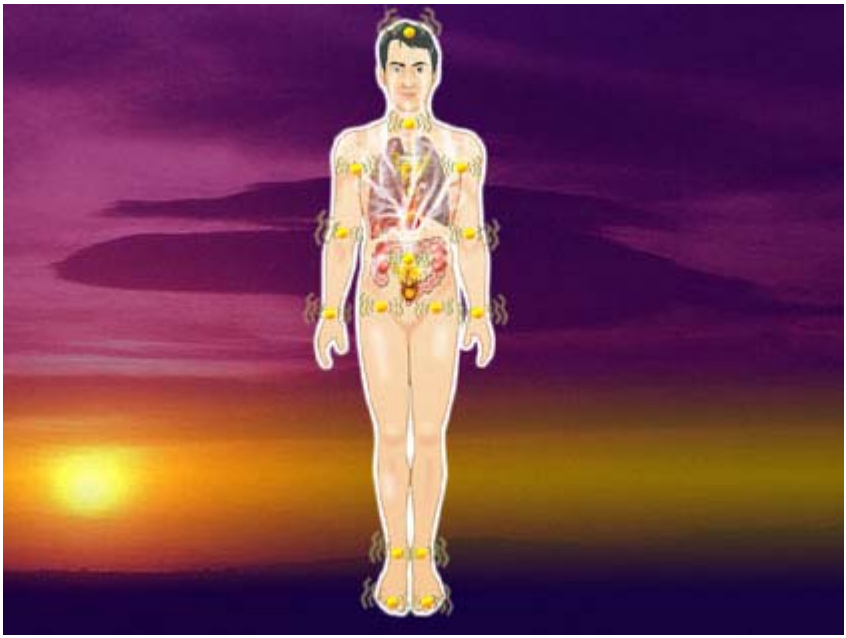

Fig. 40 *Increasing the Pulses*

I. Inner Eye

- If beginning fresh, follow A (one to ten).
- If continuing, return to the stove and cauldron.

1. In the junction point between the stove and cauldron, make the eye. You may begin with it as a point of light.
2. Allow it to grow and strengthen and begin to move it out of the stove/cauldron.
3. Eventually begin to direct the inner eye on exploratory missions throughout the various routes: microcosmic, thrusting, belt, etc.

Fig. 41 *Inner Eye*

J. Self Intercourse

- If starting fresh, follow the procedures in A.
- If continuing, reestablish the pulse at the cauldron.

1. Concentrate on the sexual organs and the pineal gland.
2. Practice the Power Lock for several rounds to draw sexual energy up to the pineal gland.
3. In a separate step, draw sexual energy into the perineum.
4. Using the middle thrusting channel, feel the connection between the genitals through the perineum and the pineal gland.
5. Draw sexual energy up from the perineum as you bring down energy from the pineal gland, compressing them both into the cauldron at the navel. As you establish their connection at the cauldron, an orgasm may occur in the navel area extending out to the organs.
6. When the orgasm reaches what feels to be its peak, seed the cauldron with energy from the liver or the liver collection point.

Note: The cauldron may be seeded either from the top or directly into the coupling point.

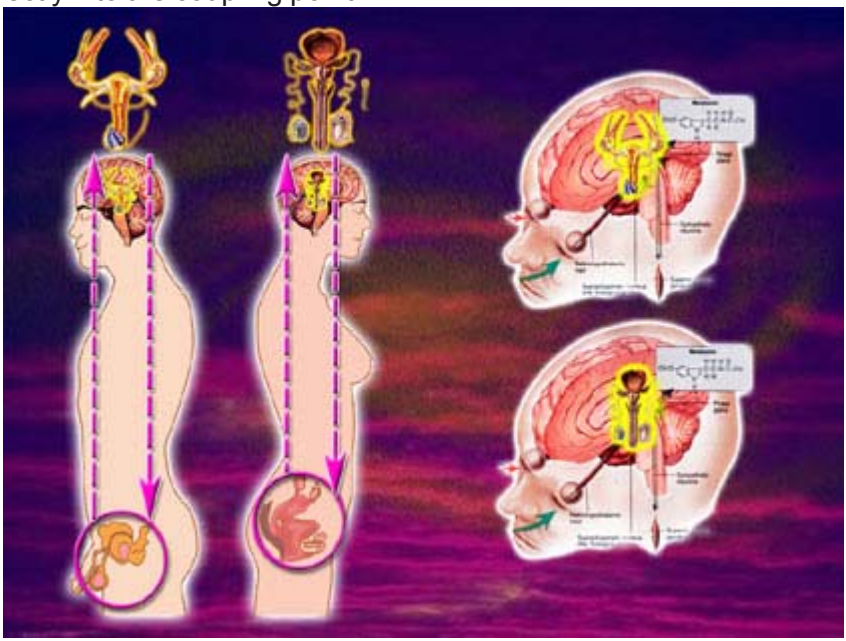

Fig. 42 *Self Intercourse*

K. Virtuous Animal Pure Inner Child and Planet Protection

Spiral Kidney Essence to Kidney Collection Pt.-Feel Blue Light form Virgin Child & Antlered Deer (Earth Force)-Breathe out Blue Light of Gentleness forming Blue Turtle behind(N) connecting above with Mercury. Spiral Heart Essence to Heart Collection Pt.-Feel Red Light form Virgin Child & Pheasant (Earth Force)-Breathe out Red Light of Joy forming Red Pheasant in Front (S) of Body connecting above with Mars. Spiral Liver Essence to Liver Collection Pt.-Feel Green Light form Virgin Child & Dragon (Earth Force) Breathe out Green Light of Kindness forming a Green Dragon Right (E) connecting above with Jupiter. Spiral Lung Essence to Lung Collection Pt. -Feel White Light form Virgin Child & Tiger (Earth Force) Breathe out White Light of Courage forming a White Tiger Left (W) of Body connecting above with Venus. Spiral Spleen Essence to Spleen Collection Pt.-Feel Yellow Light form Virgin Child & Phoenix(Earth Force) Breathe out Yellow Light of Fairness forming a Yellow Phoenix Above (C) of Body connecting with Saturn. Form protective Outer Ring around Organs with Virgin Children & Power Animals then form Protective Ring & Fiery Dome around Physical Body with Earth Force Animals North-South-East-West-Center interconnecting with Planets & Stars (RS).

Fig. 43 *Animal Protection*

L. Gather the Pill

Breathe in through the mideyebrow connecting with an outer light by blinking the eye. Draw and gather the light into a pill and move it down to the Solar Plexus. The pill is the essence and nutriment for the Immortal Fetus. Feel the growth of the Immortal Fetus as you draw in the light.

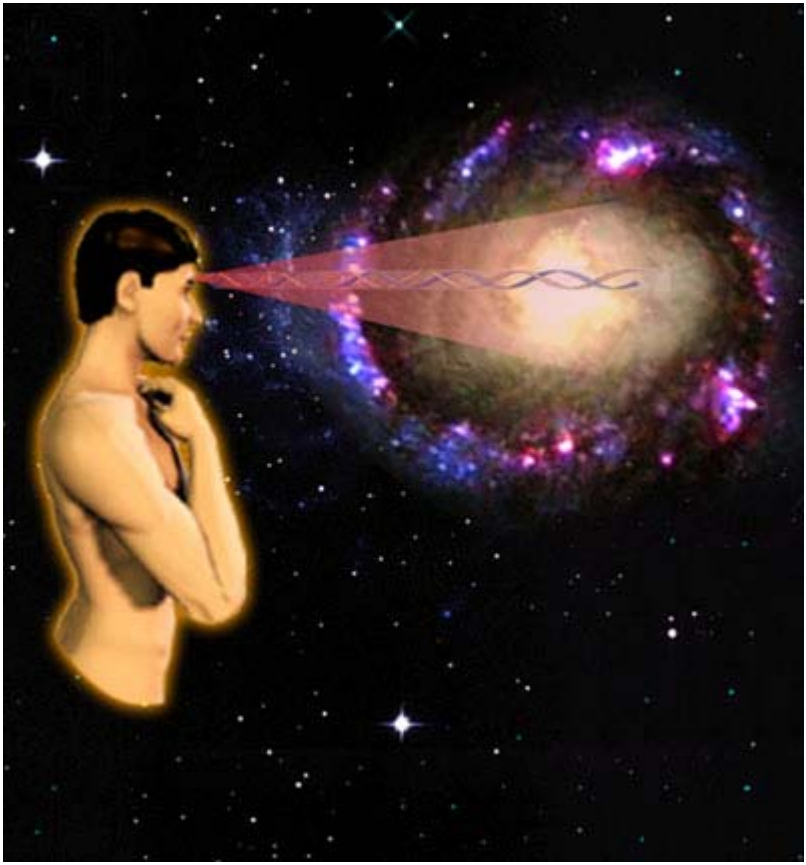

Fig. 44 *Gather the Pill*

M. Transfer of the Organ's Essence

Feel the organ energy and essence and transfer into the organs of the Energy Body with each of the vital organs: Heart Essence into Energy Body's, Lungs Essence into Energy Body's, Spleens Essence into Energy Body's, Liver Essence into Energy Body's, Kidneys Essence into Energy Body's.

Fig. 45 *Transfer of the Organ's Essence*

N. Ending the Meditation: Turning the Wheel

Each Kan and Li meditation should be ended with this formula which is a process of collecting refined energy in the navel cauldron to be used in future meditations, including the higher levels.

- If beginning fresh, follow the procedures in A.
- If continuing from I above, reestablish the cauldron and stove, moving them back to the sacrum.

At this stage, the eyes are used to direct the energy produced by the meditation into the Microcosmic Orbit, guiding it into the cauldron behind the navel.

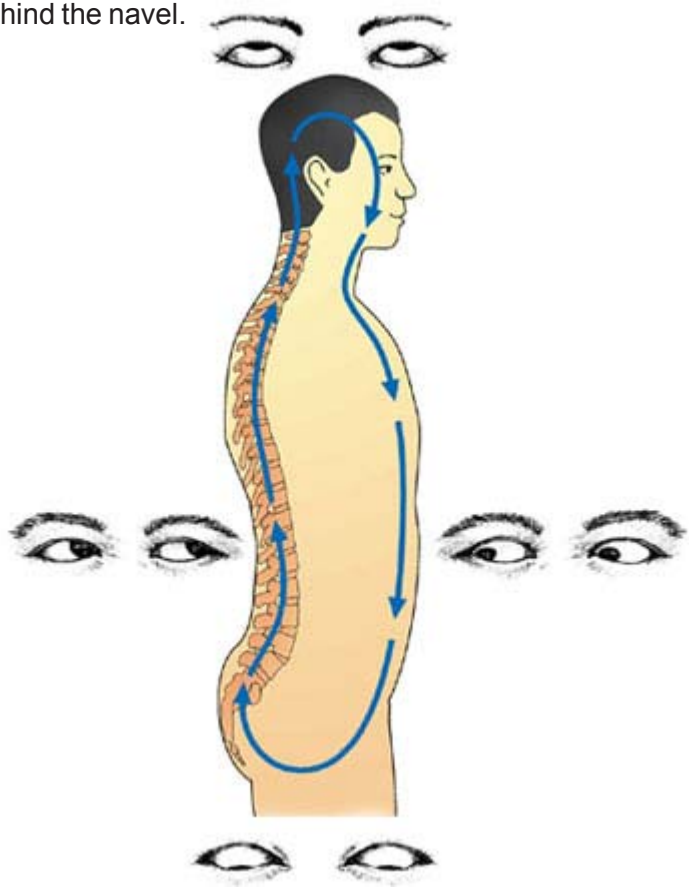

Fig. 46 *Ending the Meditation: Turning the Wheel*

1. Form a pool of sexual energy at the perineum. Looking straight ahead with your eyes closed, form a mental image of a clock with your eyes focused on its center.

2. Look down into the pool (6:00), and draw sexual energy up into the spine. The steam will travel up the spine drawing sexual energy with it.

3. Look from the perineum up to the right (3:00), drawing the energy up to T-11 as it is refined at that point.

4. Look from the right up to the crown (12:00), and draw the energy there to further refine it at the pineal gland.

5. Look from the crown down to the left (9:00), and draw the energy down either through the tongue or the thrusting routes into the cauldron at the navel. The energy is then stored in the cauldron. (These four directions constitute one round.)

6. Follow the above procedures J (two to five) for at least 36 revolutions. You may do them in four rounds of six revolutions with three counts resting in between; or you may do two rounds of twelve revolutions with six counts resting in between. In any sequence, the revolutions and resting counts must add up to 36. The rising steam will eventually flow independently of your counting, but maintain the mental revolutions to be sure it reaches the cauldron.

7. If you have time, do four rounds of 75 revolutions, resting for fifteen counts in between rounds; or do two rounds of 150 revolutions, resting for 30 counts in between rounds; or do 360 revolutions straight through. (All of these methods add up to 360, which is the maximum number of revolutions used to end this practice.)

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$6.95

Lesser Kan and Li

Enlightenment and Birth of the Immortal Fetus

Mantak Chia

Illustrations by Udon Jandee

Lesser Kan and Li

Kan and Li literally means water and fire. The Chinese formula Siaow Kan Li (Yin and Yang Mixed) literally steams the sexual energy (Jing) into life force energy (Chi) in order to feed the soul or energy body.

The Birth of the Soul

The formulas in the lesser Enlightenment help to give birth to the soul body, an awakening of that part of yourself, which is free from environmental and karmic conditioning. The birth of the soul is not metaphor. It is an actual process of converting energy into a subtle body.

Overcoming Reincarnation

The newborn soul matures in relation to your energy skills. If you were to die, the energy gathered in the soul body will not simply dissipate. The Lesser Enlightenment of Kan and Li leads to the first steps of overcoming reincarnation.

Preparing for the Spirit Body

Developing the soul body is the preparation for the growth of the Spirit Body in the Greater Enlightenment of Kan and Li. Come! Experience the mystery. "Begin it now." As Goethe said: "Boldness has genius and magic in it."

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